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About National Medicinal Plant Board

The National Medicinal Plants Board, Ministry of AYUSH, promotes the medicinal plant's sector by developing suitable mechanisms for promotion of the research, cultivation, and export of medicinal plants.

The growing demand for medicinal plants is met by the NMBP's focus on conservation and augmentation of local medicinal plants and species of significance. The NMPB encourages research and development, capacity building through training and promotion of activities such as the creation of herbal gardens in rural as well as urban areas. The board also supports programs for quality assurance, which institute a credible mechanism for the certification of quality raw drugs, seed, and planting material.

This conference is supported to discuss various research avenues, opportunities, and challenges in the medicinal plant sector.

Message from the Principal...✍

Hansraj College, University of Delhi, is one of the largest constituent colleges of University of Delhi, and is governed by D.A.V. ethos and culture, where we believe that a blend of traditional knowledge and modern science and fostering innovations can take the country forward. The Department of Botany, Hansraj College, has a vibrant environment with faculty trained in teaching and research in various branches of Plant Sciences. I am happy that the Department of Botany, Hansraj College in association with the National Medicinal Plant Board, Ministry of AYUSH is organizing a National Conference on Medicinal Plants: Frontier Areas of Research and Development on March 16-17, 2023. The conference is aimed towards sharing recent highlights in the field of medicinal plants. Distinguished academicians and scientists from the field will share their knowledge with students and faculty members across the country. Young researchers and students will get a chance to showcase their research and ideas through oral and poster presentations.

The conference will give an opportunity to our participants to interact and collaborate with the leading academicians and scientists.

I wish all the teachers of the department, organizing committee members of the national conferences and the Botanique, the Botanical Society a huge success.

Prof. (Dr.) Rama
Principal
Hansraj College

Message from the Teacher-in-charge...✍

Greeting from Department of Botany!

Dear conference participants it is my pleasure to welcome you to this exciting and enthralling conference. Your participation in this event is a testament to your dedication and passion for advancing research and innovation in the field of Medicinal Plants. I believe that events like these are crucial in bringing together experts and professionals from various fields to exchange knowledge and ideas. In today's rapidly changing world, it's more important than ever to stay updated on the latest trends and advancements in our respective fields. It's also crucial to collaborate and share our experiences and insights with each other, as it helps us to broaden our perspectives and find innovative solutions to the challenges we face.

I'm confident that this conference will provide a valuable platform for all of us to learn more about Medicinal Plants from each other, network, and build lasting connections. I encourage everyone to actively participate in the discussions and take advantage of the opportunity to gain new insights, build relationships, and explore potential collaborations.

Thank you for your participation, and I wish you all a fruitful and enjoyable conference experience.

With regards

Dr. Anand Sonkar
Teacher-in-charge, Department of Botany

Message from Conference Conveners...✍

Medicinal plants represent the major chunk of herbaceous flora amongst the angiosperms. Besides angiosperms, lower plants (algae, bryophytes, pteridophytes and gymnosperms) and symbiotic associations (lichens) have also been investigated for their medicinal potential. These grow in specialized environments and display niche specialization and in wastelands and open fields. A vast majority of these plants are being used by traditional, local communities across the world, thus wanting to be validated by scientists and deposited in the data banks and knowledge repositories.

The medicinal plant sector is also confronted with various challenges. The availability of quality raw material, the exploration of new areas, the separation and isolation of secondary metabolites, authentication and purity of active pharmaceutical ingredients and standardization of drugs, are areas where scientists, industry and researchers must collaborate.

Through this conference we have tried our best to bring together scientists from national research institutes, universities, industry, and private sector to discuss the latest research happening in the field around the world; to appraise the young minds of the tools and techniques that are being used and areas where there are open ended questions and opportunities.

Understanding the present status and prospects of medicinal plants, how they are documented by means of surveys, tapping their potential for bioprospecting, understanding the threats posed, subsequent conservation strategies, applications of bioinformatic tools to analyse large data sets followed by cultivation marketing and entrepreneurship are some key areas that will be highlighted in the discussions in this two-day conference.

This conference is a consortium of around 200 delegates including eighteen experts of the field representing different states, and UTs of India . It provides an opportunity to all the participants to discuss, deliberate, collaborate, and innovate in various arenas of medicinal plant biology.

We wish to achieve some success in our endeavours and thank NMPB, Ministry of AYUSH, Government of India, expert speakers, our patrons, the principal, the advisory committee members, the faculty, and the students for helping us.

Conveners

Prof. (Dr.) Monika Koul
Dr. Ishwar Singh

Abstracts

Invited Speakers

Name of the Invited Speaker	Designation and Affiliation	Title of the talk
Prof. (Dr). S. R. Yadav	Professor Department of Botany, Shivaji University, Kolhapur-416 004 (MS) India.	Little known plant species of medicinal potential from Western Ghats and their bioprospecting
Dr. A. P. Das	Adjunct Professor (UGC) Department of Botany Rajiv Gandhi University Doimukh 791112, Itanagar, Arunachal Pradesh, India	Recognition and Conservation of medicinal plants –Looking Back to the Ethnic Lifestyle
Dr Avinash Kaur Nagpal	Professor Department of Botanical and Environmental Sciences Guru Nanak Dev University, Amritsar, Punjab	Conservation of Medicinal Plants in GNDU Botanical Garden and their Ethnomedicinal Importance
Dr. Gitanjali Yadav	Scientist at NIPGR New Delhi, as well as Adjunct Professor of Data Science at the IISER Bhopal	Data Science for Deciphering Plant Natural Products
Prof. Milind M. Sardesai	Professor Department of Botany Savitribai Phule Pune University, Pune-411 007 (M.S.) India.	Are wall plasters of Ellora saved by Hemp?
Prof. Veenu Kaul	Professor and Head Department of Botany, University of Jammu, Jammu-180006, J &K, India	Reproductive biology of some lesser-known medicinal plants- why to study?
Dr Rupesh Kariyat	Associate Professor Department of Entomology and Plant Pathology University of Arkansas, Fayetteville	Investigating the physical and chemical anti- herbivore defenses in *Aloe barbadensis*, a medicinal plant species
Dr Sarvepalli Badari Narayan	Advisor-Bioresources Development Group Dabur Research & Development Centre	Exploring Business Avenues through Medicinal Plants Cultivation
Dr Kapudeep Karmakar	Assistant Professor, Regional Research Station,Tarai Zone, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Coochbehar, West Bengal	Plant's arsenal against human pathogens: Antibacterial molecules
Dr Sumit Ghosh	Senior Principal Scientist Plant Biotechnology Division CSIR-Central Institute of Medicinal and Aromatic Plants Lucknow 226015, India	Understanding resin terpene biosynthesis in the medicinal tree *Boswellia*

Prof. Ravinder Raina	Founder and Director, Raina Naturals and Educational Consultants P. Ltd Gurugram, Haryana	Sustainable Livelihood through Himalayan Medicinal Plants-Opportunities for Entrepreneurship
Dr. B.S. Ravikumar	Associate Professor & HOD, Department of Botany & Environmental Studies AVK College for women, Hassan-573201, Karnataka	Medicinal Plants of Western Ghats: Conservation Status
Vandana Mishra	Department of Environmental Studies and Centre for Interdisciplinary Studies on Mountain & Hill Environment University of Delhi, Delhi 110 007, India	Indian Mistletoe from Himalaya and Western Ghats: Potential for Anticancer Drug Development
Dr Archana Prasad	Founder Lambert Labs, Noida, Uttar Pradesh	Formulating Green Hair & Skin care Products
Dr Suphala Gupta	Senior Principal Scientist & Professor Academy for Scientific and Innovative Research	Elucidation of glycyrrhizin Biosynthetic Pathway: Research journey of a medicinal Plant
Prof PL Uniyal	Professor Department of Botany University of Delhi	Search of Novel Compounds in Lower Plants: Challenges and Opportunities
Dr Shashi Kumar	Group leader of Metabolic Engineering ICGEB New Delhi.	Metabolic Engineering of Plant for Antimalaria Drug Biosynthesis

Abstract of Oral and Poster Paper Presentations

S. no	Topic	Authors (Name of presenter is underlined)	
1	Bioprospecting Germplasm of Important Medicinal and Aromatic Plants of India	Archana P Raina	Oral
2	Assessment of Air Pollution Tolerance Index of Some Medicinally Important Plant species of Family Fabaceae Growing in GNDU Campus	Nitika Sharma, Akanksha Bakshi, Inderpreet Kaur and Avinash Kaur Nagpal	Oral
3	Impending threat to plants that heal	Saloni Gulati and Jasleen Kaur	Oral
4	Synthetic Seed Technology: A Potential tool for Germplasm Conservation of Medicinal plants	Richa Upadhyay	Oral
5	Bryophytes - A Neglected Treasure of Plant World	Pratibha Kumari and Devayani Muley and P.L Uniyal	Poster
6	Medicinal value and pharmacognostic evaluation of the aerial parts of *Tylophora indica* (Burm. f.) Merr.	Shikha Laha and Bharti Chaudhry	Oral
7	Medicinal plants in the Indian Himalayan region	Anubha Agarwal	Oral
8	A survey on some commonly used medicinal plants in Manipur.	Leisan Judith, Gladys Muivah, Vera Yurngamla Kapai, Huidrom Helen Devi, Timron Hungyo	Oral
9	Study of local Medicinal plants of Modinagar	Riya Ahlawat	Oral
10	Authentication of Herbal medicines using DNA Barcoding	Utkarsha, Devender Singh Meena, Kiran Bamel and Prabhavathi	Oral
11	Medicinal plants used by Nocte tribe of Tirap district, Arunachal Pradesh, India	Nonya Chimyang, Pherkop Mossang, Vinay Shankar, Heikham Evelin and Prem Lal Uniyal	Oral

12	Seaweed prebiotics – cure for alzheimers?	Inderdeep Kaur	Oral
13	Threatened and Endemic Medicinal Plants of Rajasthan (India)	Amit Kotia, Shikha Gupta and Jai Singh	Oral
14	Potential use of mycorrhizae in cultivation of medicinal plant cultivation	Devayani Muley and Pratibha Kumari	Poster
15	*Clerodendrum glandulosum* Lindl., a medicinal plant in Arunachal Pradesh, North-East India.	Pherkop Mossang, Nonya Chimyang, Vinay Shankar, Heikham Evelin and Prem Lal Uniyal	Oral
16	DNA Barcoding for Identification of Wild Plants in Traditional Medicine	Falguni Patil, Mahek Surti, Suprriya Waghmare, Reshma Bhor, Sanket Tembe	Oral
17	Examining the causes of illegal trade in medicinal plant species any possible impact on conservation efforts	Anfas Muhammed	Oral
18	Effect of Elevated Temperature on the Production of Secondary Metabolites	Palak, Tribeni Sharma,Ankit Kumar, S Gautam, Shaurya, Seema Talwar and *Kiran Bamel	Oral
19	Understanding potential threats to medicinal plants.	Shruti Srivastava	Oral
20	Evolutionary expansion and expression dynamics of profilin (PRF) gene family in the modern amphidiploid mustard (*Brassica juncea* L.)	Vandana Yadav, Anirudhabhai Khmanand Bhupendra Chaudhary	Oral
21	Understanding the ecological challenges of *Cydonia oblonga* (Quince), an underexploited temperate medicinal tree, in Northern India	Romila Rawat Bisht, Tanzeela Nazir and Monika Koul	Oral

22	Ethnobotanical Investigation of the *Muthuvan* tribe's Medicinal Plant Usage In Edavanna Panchayath, Malappuram District, Kerala	Athira	Online oral
23	Seabuck thorn; A traditional medicinal plant demonstrating ecological benefits in the Ladakh region of India	Gaurav Kumar	Online oral
24	Major contributing factors in the decline of the medicinally important Indian Frankincense and plausible conservation interventions	Aditi Tailor	Online oral
25	Potency of Gingerol and EGCG for Targeting Multiple Tumor Markers: An In-Silico Analysis Based Approach	Abhishek Rajesh C P and Rohini Samadarsi	Online oral
26	Conservation of Medicinal Tree Diversity of Central India: Seed Technological Perspectives	Manish Kumar Vijay	Online Oral
27	Agro-morphological characterization of Kalazeera accessions in North-western Himalayan region of Kashmir	Susheel Kumar Raina, Sangita Bansal, Sheikh M Sultan, Suheel Ahmed Dand, Sheeraz Saleem Bhat	Online oral
28	Restoration of degraded lands: Kanha-Pench wildlife corridor	Arpita Singh	Online oral
29	Consumption of *Garcinia* sp. by the indigenous community of Idukki district, Kerala, India	Nirmal Nithula and Lingassamy Arul Pragasan	Online oral
30.	Green synthesis of silver nanoparticles of *Ocimum* and *Zingiber*	Priyanka Pandey	Poster

31	Effect of Organic Extracts on *in vitro* Seed Germination in *Withania coagulans*	Sonali Jandya and Avinash Kaur Nagpal	Poster
32	Ethnomedicinal usage of Plant Species by Population of Verka-Block of Amritsar, against Diabetes	Akanksha Bakshi and Avinash Kaur Nagpal	Poster
33	Coordinated and fine-scale expressions of essential microRNAs regulate flowering-time phenotypes in miR167 target mimic transgenic lines of tobacco (*Nicotiana tabaccum* L.)	Madhu Kumari, Sakshi Arora and Bhupendra Chaudhary	Poster
34	Bioprospection of some important Medicinal Plants	Phalisteen Sultan, Firdous A Mir and Qazi Parvaiz Hassan	Poster
35	*Ephedra* – Bridging Traditional and Modern Medicine	Gagandeep Singh, Khushi, Tanya Singh and Ridhi Khurana	Poster
36	Medicinal plants cultivation marketing and entrepreneurship: Role of rural Youth	Ayush, Vishal Jhakar, Vibha G Checker and Renu Kathpalia	Poster
37	Medicinal plants of Indian Subcontinent: Potential and Threats	Ayushi Tiwari and Kabir Khanna	Poster
	Commiphora wightii: An important medicinal plant species of Indian arid region	Anjali Joshi	Online oral
38	Invasion: A growing threat to the native medicinal plants of the Himalayas	Priya Hansda, Shailendra Kumar, and Satish Chandra Garkoti	Poster
39	Genus *Allium* L. (Amaryllidaceae) in India with emphasis on conservation of rare and threatened species	Damini Sharma, Sandeep Chauhan, and Arun K. Pandey	Oral
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41	Black rice: Health benefits and medicinal properties	Manisha Sharma, Dhananjay Raturi, Suman Sharma, SoomNath Raina and Apekshita Singh	Oral
42	Agro-morphological variation in selected genotypes of black rice with nutritional and medicinal importance	Dhananjay Raturi , Manisha Sharma , Soom Nath Raina and Apekshita Singh	Poster
43	A study on antioxidant activity and isolation of bioactive compounds in the gal leaf and healthy leaf of *Syzygium caryophyllatum* (L) Alston in Western Ghats of Karnataka, India	Manasa CR and K. Krishna Swamy	Poster
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45	Digitising Flora of DAV College Chandigarh through Quick Response (QR) Codes	Ranju Gulati	Poster
46	Study the effects of synthetic cytokinin on micro- propagation of endangered medicinal plant: *Vitex negundo* (L.)	Shweta Chaudhary and Garg G	Poster
47	Conservation of medicinal plants using *in-situ* and *ex-situ* approaches	Ishita Sukhija, Madhu Bajaj, Saloni Bahri and Somdutta Sinha Roy	Poster
48	Medicinal Plants as Bioresources	Vanshika, Saloni Bahri, Madhu Bajaj and Somdutta Sinha Roy	Poster
49	An Exploratory Study of *Remusatia vivipara (*Roxb) Schott Wild Plant.	Bommegowdna A Mauna, Manasa CK and Parmeswar Naik T.	Oral
50	Isolation and identification of *Agrobacterium* species from different natural habitats and evaluation of their potential in atmospheric nitrogen fixation and plant growth	Malavika J and Jayakumar K	Oral

Little Known Plant Species of Medicinal Potential from Western Ghats and their Bioprospecting

S.R. Yadav

Department of Botany, Shivaji University, Kolhapur-416 004 (MS) India.

sryadavdu@rediffmail.com

Man has been studying plants since the time of Theophrastus (330 BC.) for their therapeutic values. Herbalists have made significant contributions to the medicinal plants of the world and their therapeutic values. The world's 80% population depends on herbal medicine in their primary health care. Most of the drugs are of plant origin. There is no plant species which has no medicinal value. India has great treasure on medicinal plants and Ayurveda is gaining credit and respect throughout the world as a science of life. Plants have been the primary basis for drug discoveries and developing new drugs. Plants are of incalculable value to human health. Of the top 10 prescription drugs in the US, nine are based on natural plant products. 80% of the world's population relies on traditional plant medicines. Some examples of plant-derived substances developed into valuable drugs are Codeine from *Papaver somniferum,* Digitalin from *Digitalis purpurea,* Quinine from *Chinchonaledgeriana,* Vincristine and Vinblastine from *Catharanthusroseus,* Taxol from *Taxus brevifolia,* Castanospermine from *Castanospermum australis* and Artemisinin from *Artemisiaannua.*Camtothecin (an anticancerous drug) is obtained from wood of *Mappia nimmoniana.*There are several such plants *viz. Trichopus zeylanicus, Strychnos nux-vomica, Rauvolfia serpentina,Pueraria tuberosa, Coscinium fenestratum, Celastrus paniculata, Embelia ribes, Toddalia asiatica, Chlorophytum borivallianum, Kaempferia galanga, Gloriosa superba, Drimia indica, Asparagus racemosus, Dioscorea sp., Myristica malabarica, Moullava spicata, Tylophora indica, Hydnocarpus pentandra, Ancistrocladus heyneanus* etc in Western Ghats. Western Ghats is the potential hunting ground for medicinal plants and their active biomolecules. India is one of the 12-mega centers of biodiversity supporting more than 21000 species of Angiosperms alone. Angiosperms are the major source of our plant-based drugs. Western Ghats, one of eight hottest hotspots of biodiversity is a gold-mine for medicinal plants, however,

for various reasons no due attention has been paid for phytochemical analysis and discovery of active biomolecules from species of rare occurrence of Western Ghats. Screening of plants for active biomolecules, pharmacognosy, and clinical tests needs well-trained field taxonomists, Phyto chemists, pharmacists, and doctors. Collaborative efforts are a need of time for discovery of new drugs from plant species of Western Ghats.

Extensive literature has been accumulated on medicinal plants and many times writing books on known medicinal plants has become a fashion. Several books are being published adding no new significant data on medicinal plants. Despite modern tools and methods available for analysis of chemicals of plants, not much progress has been made in our knowledge of Ayurveda. Questions are raised about standardization of Ayurvedic drugs by the world; however, no serious attention has been paid to this question. Under the name of ethnobotany, a great deal of literature has been accumulated but the authenticity of the information on medicinal plants is many a times questionable. It has obscured the real specific medicinal uses of plant species creating confusion about species-specific medicinal uses. The uses mentioned in literature have rarely any experimental or practical base and scientific analysis. Several uses are given for every species creating doubt in mind about genuine uses of the species.

Many plant species with proven medicinal value are now threatened because the species is needed for global requirements and in many cases no country can make available global demands of a particular species. Therefore, indeed, in the global scenario every medicinal plant species today is threatened. Several species of established therapeutic value from Western Ghats are of rare occurrence and some of them need investigations on screening of their active molecules, and therapeutic value. Western Ghats is a storehouse for discovery of new drugs to treat ailments.

Some of the rare medicinal plants with traditional uses from Western Ghats include *Ancistrocladus heyneanus, Antiaris toxicaria, Baliospermum montanum, Capparis moonii*, *Cassine paniculata*, *Chlorophytum borivilianum*, *Commiphora mukul, Conscinium fenestratum, Delphinium malabaricum, Embelia ribes, Embelia ribes*, *Eulophia nuda*,

Eulophia ochreata, *Heracleum species, Holigarna arnotiana, Holigarna grahamii, Holostemma annulare*, *lphigenia stellata*, *Morinda citrifolia, Myristica malabarica, Mappia nimmoniana, Operculina turphetum*, *Ophiorrhiza rugosa, Oroxylum indicum*, *Pedalium murex, Peuraria tuberosa*, *Pinda concanense, Piper longum, Pterocarpusmarsupium, Ravoulfia serpentina, Ravoulfia verticilliata, Salacia brunoniana*, *Santalum album*, *Saraca asoca, Smilax zeylanica, Trichopus zeylanicus* and many more.

Plant species of potential medicinal values from Western Ghats which need investigations are *Actinodaphne angustifolia, Adenia hondala, Alseodaphne semecarpifolia, Anamitra cocculus, Ancistrocladus heyneanus, Antiaris toxicaria, Antiaris toxicaria, Argyreia boseana, Bacopa monerii, Bacopa monnieri, Baliospermum montanum, Bidaria khandalense, Bryonia dioica, Bryonia dioica, Cassine glauca, Castanospemum australe, Cinnamomum nitidum, Coix gigantea,Corallocarpus epigaeus, Dendrobium barbatulum, Diospyros species, Diploclisia glaucescens, Diplocyclos palmatus,Drimia polyantha, Entada rheedei, Gardenia gummifera, Gnidia glauca, Hemidesmus indicus, Heracleum species, Heterostemma species, Ipomoea species, Jasminum malbaricum, Kedrostis foetidissima, Leea setuligera, Lobelia nicotianefolia, Macaranga peltata, Moringa cocanensis, Moullava spicata, Myristica species, Naregamia alata, Oroxylum indicum, Pedalium murex, Phyllanthus amarus, Phyllanthus debilis, Pinda concanense, Piper longum, Pittosporum dasycaulon, Radermachera xylocarpa, Rauvolfia verticillata, Rhus sinuta, Salacia brunoniana, Sapium insigne, Saraca asoca, Sauropus quadrangularis, Smilax macrophylla, Solanum species, Spermadictyon suaveolens, Stereopermum chelenoides, Swertia densiflora, Symplocos species, Tabenemontana alternifolia, Toddalia asiatica var. asiatica, Toddalia asiatica, Trichosanthus tricuspidata, Viscum species, Wattakaka volubilis,Withania coagulence, Withania somnifera, Zanthoxylum rhetsa,* etc. It is sure that some of these plant species will yield active biomolecules resulting in discovery of new drugs. Present lecture emphasizes need for multidisciplinary studies on little known plant species of medicinal potential from Western Ghats and their bioprospecting.

Data Science for Deciphering Plant Natural Products

Gitanjali Yadav

Scientist at NIPGR New Delhi
Adjunct Professor of Data Science at the IISER Bhopal

gy@nipgr.ac.in

For thousands of years plant-derived natural products have been harvested for their medicinal properties in an effort that is now called Bioprospecting. The astonishing chemical diversity of biologically active substances in various organisms reflects an equally staggering diversity in function. Despite enormous diversity, most phytochemicals are terpenes, derived from five-carbon isoprene units assembled and modified in thousands of ways, such that the full complement of genes involved in terpene biosynthesis is now called the 'Terpenome'. Understanding the mechanism by which few initial substrates are converted into a tremendous chemical arsenal holds promise for improving agro-biochemical and pharmacological potential of plants.

My talk will be about how we push and merge boundaries of modern and traditional technologies like deep learning and headspace chromatography, to investigate this plant chemical production line. We use supervised and unsupervised machine learning to generate complex networks that enable transcriptional regulatory inferences from large scale gene expression datasets. I also hope to emphasize the role of University Herbaria and their specimen collections from various parts of the world spanning centuries, and how these offer untapped opportunities to expand research investigations by covering very wide taxonomic and spatio-temporal scales.

Recognition and Conservation of medicinal plants – Looking Back to the Ethnic Lifestyle

Abhaya Prasad Das

Department of Botany, Rajiv Gandhi University, Rono Hills, Doimukh 791112, Arunachal Pradesh, India

Formerly: Taxonomy & Environmental Biology Laboratory, Department of Botany, North Bengal University, Darjeeling 734013, Bangla, India

apdas.nbu@gmail.com, apdasrgu@gmail.com

When 'Man' originated and evolved in eastern Africa then at the beginning certainly they received most of the 'Knowledge' for their survival from their primate parents and siblings. For survival, apart from Oxygen and water, early man needed good food and, of-course, some medicines. Even birds and many other animals are known to self-medicate using plants. The life and cultural traditions of traditional communities have remained almost undisturbed and static for thousands of years. These communities in the world over have the wealth of accumulated knowledge and wisdom particularly about the biological resources around them. Man is the 'most important migratory animal'. They migrated out of their 'Cradle' over a million years ago and now live almost in all corners of this planet. While people migrate, they generally accompany seeds and propagules of different plants, pets (dogs, horses, etc.) and obviously their brain-full of 'knowledge'. Eastern Himalaya and Northeastern part of India forms a very important biodiversity zone of the world. The richness of the biological diversity of the East Himalayan region, located within the territory of IUCN demarcated Himalaya Hotspot for biodiversity conservation, is beyond any question. Eastern part of Nepal, whole of Sikkim, major part of the Darjiling district of West Bengal, TAR, Bhutan and Arunachal Pradesh are located within Eastern Himalaya. This zone is contiguous with two other similar Hotspots, - the Indo-Burma Hotspot and Mountains of SE China Hotspot. Biodiversity of this entire region, particularly of plants, has attracted botanists, plant lovers and plant hunters equally from around the world to visit, explore and exploit its vegetation at least during the last three centuries. Terai and Dooars regions in the

northern part of West Bengal are also covered with equally rich vegetation cover having contiguity with the East Himalayan forests. Even with the highly incomplete knowledge on the flora of Northeastern states we know it represents one of top-rated regions in the world for the floristic richness. Innumerable sects of people living there, almost in isolation, without the benefit of advanced civilization but with their traditionally developed knowledge only. Such natural ways of learning also include the recognition of the usefulness of the medicinally beneficial pants. However, the importance of East Himalayan vegetation from the utilitarian points is immense. There are numerous publications related to different types of useful plants native to the region. These include numerous species of medicinal plants. Even today, so many species are regularly but illegally exploited from this entire region and exported to remote places. In addition to the scientifically known medicinal plants, there are many more plants that are used in traditional medicines by different groups of people at different places. Recent publications recorded numerous such plants. Journals like Indian Journal of Traditional Knowledge, Ethnobotany, Pleione etc. are regularly documenting the area's Traditional Knowledge on medicinal plants. There are a large number of in-situ and ex-situ protected areas established in the region, – in all the states. Some ex-situ conservatories like Saramsa Garden of Medicinal Plants, Garden of Medicinal Plants of NBU, small gardens in some colleges and schools, some Forest Department Gardens, etc. are conserving medicinal plants. National and State Medicinal Plants Boards are equally helpful in developing such gardens even at the school level. However, medicinal plants cannot be saved in their habitat unless we stop their exploitation from the wild. Mass scale cultivation along with the development of region-wise propagation and cultural methodology need immediate implementation. And, at the same time, National and State governments should be 'serious' to ensure that farmers are getting proper returns. Our experience from Terai, Duars and Darjeeling Hills, North Bengal, is measurable. Now the farmers are no longer interested in cultivated Medicinal Plants. There are numerous in situ Protected Areas (PAs) in this region. Sikkim is a very small state but there are seven Sanctuaries, one National Park and one Biosphere Reserve within its territory. On the other hand, 'Terai, Duars and Darjeeling Hills',

quite a small area, together have five National Parks, five Sanctuaries and one Tiger Reserve. In addition, there are numerous other reserve forests. Similarly, in different other states of Northeast India numerous such PAs have been recognized. Now, we need to remember, most of these Pas are also heavily marketed in the name of ecotourism. Once one environmentally sensible person visiting the Lataguri area, adjacent to Gorumara National Park, will realize how in the name of ecotourism the openly rampant 'hotel business' is going to destroy the beautiful National Park and the nearby reserve forests. No species can be saved within a boundary wall!! Recent horror of tree felling along the National Highway passing through Lataguri-Surshuti area created a scintillating public agitation in the area. We must remember that I have been shouting for the last 20 years or more that, 'conservation and commercial exploitation can't go hand-in-hand'! Our assessment of the occurrence of medicinal plants in the MPCAs located in Terai and Duars has exposed the existence of rich green wealth that needs to be conserved very carefully. But, these are regularly exploited through the rampant illegal collection. Population explosion, urbanization, extension of Tea Gardens and other plantations with one or few (with some exotics) species are destroying the habitat. The Forest department restarted planting Cryptomeria japonica (Dhupi). This has been aggravated through the implementation of different mega-projects within the Hotspot area, including a large number of Hydroelectric Power Stations on different hill rivers degrading different habitat conditions very fast. Following the suggestion of Dr. Stephen Hawking, we can settle on other planets, but there we have to survive like 'Robots' and not as 'Man'!! We should remember, if we survive, we shall survive along with the neighboring biological diversity and not with only our exploitive attitude.

Conservation of Medicinal Plants in GNDU Botanical Garden and their Ethnomedicinal Importance

Avinash Kaur Nagpal

Department of Botanical and Environmental Sciences
Guru Nanak Dev University, Amritsar, Punjab

avinash.botenv@gndu.ac.in

Plants have been used for the cure of a wide range of diseases across the globe since prehistoric times. Medicinal plants are the most valuable resource for global health care systems as they are being used not only for traditional medicine but also in the development of modern pharmaceutical drugs. This has led to their indiscriminate collection from the wild leading most of them towards extinction. This necessitates their conservation to ensure their availability for future generations. Different conservation strategies like *in situ* and *ex situ* conservation as well as cultivation of medicinal plants are in use globally. Botanical Gardens distributed across the globe are playing a significant role in conservation of a wide range of plant species including medicinal plants. GNDU Botanical Garden spread over an area of 23 acres has a collection of nearly 300 plant species including cacti, medicinal, rare, threatened, and endangered species. Some of the medicinal plant species in the GNDU Botanical Garden include *Azadirachta indica*,*Cassia fistula*,*Cymbopogon citratus*,*Justicia adhatoda*, *Lavandula angustifolia*, *Murrayakoenigii*, *Terminalia arjuna*, *Tinospora cordifolia, Withaniasomnifera*, *W. coagulans* and many more. We have also created an electronic Database of Trees and Shrubs of GNDU Botanical Garden (eDOTS_GNDUBG) which is a sub-database of eDOPS available at GNDU website (http://www.gndu.ac.in/eDOPS/index.aspx).

This presentation is aimed to give an overview of medicinal plants available at GNDU Botanical Garden and discuss their ethnomedicinal importance.

Are wall plasters of Ellora saved by Hemp?

Milind M. Sardesai

Department of Botany, Savitribai Phule Pune University, Pune-411007 (M.S.) INDIA.

sardesaimm@gmail.com. ; mmsardesai@unipune.ac.in

Plants are utilized for the purpose of food, clothing, and medicine from the time unknown. They are also depicted in art, mythology, and literature and thus they have played a major role in civilization. Plants are also symbolized for fertility, growth and purity in art, mythology, religion, and literature. Study of physical or symbolic archaeological samples associated with botanical knowledge is nothing but archaeobotany. Archaeobotanical investigations largely involve the study of actual plant remains or an art from archaeological contexts. It helps to find out how our forefathers utilized plants for different purposes. It provides evidence for the patterns of domestication of plants and throws light on human-plant relationships. Archaeobotanical studies have become systematic in terms of analytical and interpretative methodologies. Most of the studies from India, focus chiefly on seed and fruit remains, and very few include other botanical remains like leaves, bark, roots, etc.

This paper deliberates on the use of raw hemp as an organic additive in the clay plaster in one of the Buddhist Caves of Ellora. The samples investigated from different locations depict different use patterns. The occurrence of hemp in the archaeological sample raised eyebrows. Besides its known fibre, psychoactive, and medicinal properties, this was a different aspect associated with construction. The hemp mixed in clay plaster has been characterized using Scanning Electron Microscope, Fourier Transform Infrared Spectroscopy and stereomicroscopic studies, and the results have been compared with fresh specimens. The study indicates that many valuable properties of hemp were known to the ancient Indians.

Samples were also analysed from various caves in Maharashtra for botanical remains yielding wheat, rice, grasses, and other plants. This tells us about its use and cultivation pattern in ancient times, especially in drought-prone regions of Maharashtra state. These investigations will also help in the conservation or restoration of damaged sites.

Keywords: Archaobotany, Ellora, Hemp, Mud plasters, Plant remains

Biology of Some Lesser-Known Medicinal Plants - Why to Study?

Veenu Kaul

Department of Botany, University of Jammu, Jammu-180006, J &K, India

veenukaul@yahoo.co.in

Since times immemorial man has learned to distinguish plants for their multifarious activities. Most important among them being the ones that could serve to satiate their hunger and relieve them from pain. The latter commonly known as medicinal plants have been utilized since ages in a traditional way using varied procedures. And the role of the traditional healers in providing deliverables to the health care system of people in far flung areas has been explicitly realized. In our scriptures also, we believe that every plant is of some use; that we may not know of now. Many plants can cure one or the other ailment but their potential as medicines is either unexplored or under-explored. As such, these taxa are frequently subject to negligence or ill treatment and/or rampant clearing. The list of such taxa is long, and these plants are fascinating from reproductive and cytogenetic perspectives as well. Few worked out in our lab include *Allium roylei*Stearn, *Anisomeles indica* (L.) Kuntze, *Drimiaindica*Roxb., *Asphodelus tenuifolis* Cavan, *Cleome viscosa* L., *Solanum nigrum* L. complex and so on. Not much attention has been given to these species despite their having numerous medicinal properties. Many among these face reproductive and cytological bottlenecks and are prone to anthropogenic threats also. However, detailed studies conducted on these plants unfolded numerous mechanisms employed by them to overcome these threats. The presentation will discuss the reproductive strategies of one or two of these taxa and elaborate upon the need to undertake such studies.

Keywords: Reproductive biology, Strategy, Cytogenetic, Under-explored, Un-explored, Medicinal, Health care

Investigating the Physical and Chemical Anti- Herbivore Defenses in *Aloe barbadensis*, A Medicinal Plant Species

Rupesh Kariyat

Department of Entomology and Plant Pathology (PTSC 217)
University of Arkansas, Fayetteville, AR 72701

rkariyat@uark.edu

Native to Africa, the genus Aloe has been found to have numerous human health benefits including, but not limited to managing gastrointestinal reflux disease, with antioxidant, anti-inflammatory, and immunoregulatory properties. However, an extensive examination of phytochemicals in *A. barbadensis* and their role in defending against insect herbivores have been seldom investigated. Using a combination of analytical chemistry tools, and behavioral assays with two insect herbivores, we show how *A. barbadensis* mounts an integrated defense phenotype using both structural and chemical defenses. Using *A. barbadensis* rinds, a common waste product but rich in secondary metabolites, we will also discuss potential benefits of other crop waste on human and animal health.

Exploring Business Avenues through Medicinal Plants Cultivation

Sarvepalli Badari Narayan

Advisor-Bioresources Development Group
Dabur Research & Development Centre 22,
Site IV, Sahibabad – 201010, U.P. Dist. Ghaziabad (NCR Delhi)

s.narayan@dabur.com

As a visionary corporate, Dabur was first one to visualise importance of cultivation of Rare, Endangered and Threatened -Medicinal and Aromatic Plants Species (RET-MAPS) and other alternatives for Medicinal Bark trees (Young Roots of Brihatpanchmoola) by conceiving an idea of establishing a state-of-the-art Greenhouse complexes both in India and Nepal for these critical species. It all began with the Himalayan yew and today we have done with more than Three dozen critical plants. Some of them are: *Saussurea lappa* (Kuth) ; *Rheum emodi* (Revandchini) ; *Taxus baccata* / wallichiana.(Tuneer) *Picrorriza kurroo* (Kutki)A*conitum heterophyllum* (Atish) *Zanthoxylum armatum* (Timur) etc. More recently in collaboration with NMPB on young roots of Bael, Syonak, Agnimonth , Gambhari and Padal Eventually we have established a greenhouse complex in Kathmandu (Banepa) Nepal in the year 1998 & 2011 in Pantnagar ,UA for the sole objective mass scale production (over 5 million saplings) and distribution of these critical MAPS through CSR to the farmers with full technical handholding and complete buy back arrangement.

Plant's arsenal against human pathogens: Antibacterial molecules

Kapudeep Karmakar

Regional Research Station, Tarai Zone, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Coochbehar, West Bengal

kapudeep@ubkv.ac.in

Medicines are a drug or other preparation for the treatment or prevention of diseases in humans. A special class of medicine is 'antibiotics' which have the potential to attack the disease-causing microorganism thereby killing them. However, the source of this contaminating microbe can be food, water, soil etc. This implies a free-living life cycle of pathogens exists outside the human host. This life cycle can be in the agricultural fields where the pathogenic microbe enters the food chain via freshly harvested crops. We aim to use the curative approach in medicine to prevent the entry of pathogens into the food chain. In this regard, plants which produce antimicrobials against human pathogens are eco- friendly approaches. We use Salmonella, a foodborne human pathogen, as a model to study this interaction. Controlling the spread of Salmonella in the field is very important to prevent outbreaks of various food-borne diseases. A screening of common salad vegetables for anti- Salmonella activity was performed and *Beta vulgaris* root (beetroot) was found to have very low colonization of Salmonella under in vitro conditions. The active ingredient was found to be water-soluble and thus we hypothesized that beetroot can be used to reclaim the soil contaminated with *Salmonella*. The antimicrobial effects were found to be non-specific. Thus, a co-cultivation system of beet and tomato (a Salmonella susceptible plant) was used. It was concluded that the inclusion of these crops in the crop rotation or as a bio-control crop can be a fruitful tool to reclaim the Salmonella-contaminated soil. Since climate change can alter the concentration of the antimicrobial metabolite in plants, a second approach was studied wherein methylglyoxal (MG), one of the common metabolites (a bi-carbonyl compound) that accumulate in plants during both biotic and abiotic stress, plays a role in regulating the level of Salmonella on plants. Even in the presence of stress factors like salinity, the MG-overproducing plants can kill the disease-causing pathogens. These reports are the first of their kind showing the implication of using medicinal plants in agricultural practices to prevent the entry of disease-causing organisms into the food chain. Moreover, genetic engineering tools can be used to overproduce these metabolites in field crops and prevent the spread of diseases.

Understanding resin terpene biosynthesis in the medicinal tree *Boswellia*

Sumit Ghosh

Council of Scientific and Industrial Research-Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP), Lucknow-226015, India

sumitg80@gmail.com

Boswellia tree bark exudes oleo-gum resins in response to wounding. The terpene-rich resins and extracts have shown various pharmaceutical and aromatic values. The terpenes found in the resins can be partitioned into volatile and non-volatile fractions, which have medicinal and aromatic properties. However, terpene biosynthetic pathways and enzymes were not well understood. Our research group at CSIR-CIMAP employs an integrative approach combining high-throughput transcriptomics, metabolomics, and biochemical and functional genomics tools to understand terpene biosynthesis in various medicinal plants including Boswellia. We have studied metabolite profiles of resins and conducted high-throughput RNA-sequencing to understand spatiotemporal transcript expression in *Boswellia*. We have identified and biochemically characterized a suite of enzymes belonging to the terpene synthases (TPSs) and acetyltransferase families, which catalyzed crucial reactions toward terpene scaffold diversification in *Boswellia*. These enzymes include a scaffold-selective BAHD acetyltransferase (BsAT1), catalyzing C3-O-acetylation of major boswellic acids (αBA, βBA, and 11-keto-βBA) and a group of TPSs that convert prenyl pyrophosphate to the terpene volatiles found in Boswellia resin. Overall, my presentation will cover our group's recent work in Boswellia toward the discovery of key enzymes of the terpene biosynthetic pathways.

Sustainable Livelihood through Himalayan Medicinal Plants- Opportunities for Entrepreneurship

Ravinder Raina

Founder Director, Raina Naturals & Educational Consultants Ltd
Former Professor /Prin. Scientist,

Amity University Uttar Pradesh; Dr. YSP Univ. of Horti. & Forestry, Solan;
Shoolini Univ. of Biotech. & Management, Solan

raviraina57@gmail.com

Medicinal and aromatic plants are extensively used in Indian traditional systems of medicine such as Ayurveda, Siddha, Tribal, Folk medicine and other systems of medicine that have found place in India such as Unani, Homeopathy, Herbo-mineral etc. Due to competition from Allopathy and globalization challenges, these traditional systems have been relegated as alternate therapies and were not receiving the attention they deserved. Tremendous growth of the AYUSH sector in the country in the last 5 to 10 years has increased the demand for medicinal plants both by herbal industries and the export sector. Many R&D organizations in the country are developing innovative technologies like quality planting material production, Good Agricultural and Collection Practices, value addition, extraction technologies etc. Such innovative technologies need to be scaled up to develop enterprises. The increased demand for herbals has renewed interest in the diverse industries to produce herbal health care formulations, herbal cosmetic products, herbal nutritional supplements etc. Thus, medicinal plants in addition to serving medicinal functions have huge economic importance. Significant economic gains are realized through sale of medicinal plant products such as herbal foods, herbal cosmetics, herbal drinks, herbal pesticides, essential oils etc. Thus there is a huge potential in the medicinal plant sector towards startup/entrepreneurship opportunities and creation of extended platforms for strengthening value chain and value addition.

Increasing global demand for chemicals and products derived from medicinal and aromatic plants have opened entrepreneurial opportunities to process these

plants for value added products thereby generating enormous employment avenues. India is gifted with 8000 medicinal and 2500 aromatic plants, many of which can be mined for natural chemicals and processed for commercial products with export value.

Entrepreneurship development in medicinal and aromatic plants is an approach of developing human resources and training the youth for taking risks and managing resources in an efficient way. Entrepreneurship in medicinal and aromatic plants includes production, processing, marketing, trade, and distribution of raw materials, also including supply of inputs and services. Medicinal and aromatic plants are demanded by herbal and pharmaceutical industries. The increasing demand of the pharmaceuticals industry has created problems of supply and one of the major difficulties being experienced by the industry is that of obtaining enough quantities for manufacturing good medicine. Technical guidance and consultancy provided to the farmers by the qualified entrepreneurs and establishing testing facilities and agri-clinics are some of the important areas of emerging opportunities in this sector. The raw material is a very critical component for production and to meet the growing demand of private industry for extensive range of product.

An individual to become successful entre/agripreneurs needs to recognize appropriate market opportunities and manage existing resources for taking risks. In general, entre/agripreneurs should be proactive, determined, persistent, visionary, hardworking, honest, and integrity with strong management and organizational skills. Entre/Agripreneurship is greatly influenced mainly by the economic situation, education, and culture. Educatedyouth especially in broad areas of Botany/ Horticulture/ Agriculture & also from allied fields form the most natural potential entrepreneurs and if provided the right environment with suitable policies, technological support, and timely availability of credit, it can enhance sustainable raw material production to ensure quality natural products.

Recent initiatives of the government hold promise of increased activity in entrepreneurship development in the herbal sector riding on Startup India, Make in India, Ease of doing business, Heal in India etc.

Medicinal Plants of Western Ghats: Conservation Status

Dr. B.S. Ravikumar

Associate Professor & HOD, Dept. of Botany & Environmental Studies
AVK College for women, Hassan-573201, Karnataka

prakum5601@gmail.com

The medicinal plant diversity is the natural biological capital of the earth, and its conservation and sustainable management presents important opportunities for all nations. The Western Ghats of India is known for its biodiversity richness and endemism of different species of medicinal plants. This is considered one of the 20 biodiversity hotspots of the world. It spreads in six states, from Kerala to Gujarat including Karnataka. The entire Western Ghats runs around 1600 km. length and 100 km. width. The hills reach up to a height of 2800 m. It experiences high rainfall, maximum temperature with fertile soil. The Western Ghats is very rich in its medicinal wealth consisting of about 3500 species out of which 35 percent are endemic. It is an ideal ground for the luxurious growth of plants with therapeutic value. The forests and hills of this region is a treasure house of about 800 known medicinal plants species hold a very high value in the folk and herbal health forms for the treatment of different forms of ailments. Many are exploited commercially for their active enzymes and their commercial value.

The plants such as *Rauvolfia serpentina, Saraca asoca, Gymnema sylvestre, Gloriosa superba, Strycnos nux-vomica*, *Nothpodytes nimmoniana* are included in Red list which are very rich in their medicinal strength but are in the verge of extinction. Some important endemic species of medicinal plants in western Ghat are *Artocarpus hirsutus, Tabernamontana heyneana, Diopyros paniculata, Cinnamomum wightii, Garcinia gummi-gutta, Rhododendron arboretum & Ervatamia heyneana.* Appropriate conservation strategies must be implemented immediately to protect the fragile habitats of many such medicinal plants. The efforts must be undertaken to conserve them and to sustain their existence for the future generations. But since the region is being uncontrollably invaded by urban development and human settlements, life of

such valuable medicinal wealth is at risk. Hence, there is an urgent need to conserve the endemic diversity in the medicinal plants before it is wiped out from nature. Therefore, collection and cultivation of such species and the conservation of their genetic traits by genetic engineering and tissue culture techniques is the present-day call for conservationists.

Indian Mistletoe from Himalaya and Western Ghats: Potential for Anticancer Drug Development

Vandana Mishra

Department of Environmental Studies and
Centre for Interdisciplinary Studies on Mountain & Hill Environment
University of Delhi, Delhi 110 007, India

vandanamishra77@gmail.com

The Indian traditional system of medicine has emerged as a key to managing and curing modern diseases that are considered the major threats to sustainable health. Mistletoes (Viscum spp.) have been traditionally used for blood and bone-related diseases in India, in anticancer treatment in Europe, and in the beverage industry to improve immunity in China. Viscum spp., as a storehouse of novel proteins and phytochemicals, serves as the foundation of a multi-billion-dollar industry globally. Mistletoe lectins (MLs), the ribosome inactivating proteins (RIPs), have been recognized as the active principle for mistletoe-based anticancer therapy. Several species of *Viscum* are endemic to Himalaya and Western Ghats region, and some also show variations in host and habitats. Most Viscum species, although in traditional use in India, were not evaluated for their potential to house novel active principle(s). We evaluated the Himalayan population of the *Viscum album* and purified four novel isoforms of RIPs showing unique sugar binding potential, a critical property that determines the pharmaceutical potential of RIPs. Structural basis of novel functional diversity, i.e., sugar binding, of purified Himalayan mistletoe RIP (HmRIP) was determined by elucidating three-dimensional structure using x-ray crystallography. Further, thirteen species of Viscum from the Western Ghats region were evaluated for diversity in RIPs, and novel RIPs with high anticancer potential were reported from *V. articulatum*. Another unique RIP, Articulatin, was purified that showed anticancer potential despite lacking sugar-binding ability. Molecular mechanisms of apoptosis-mediated anticancer activity of mistletoes from the Himalaya and Western Ghats regions were elucidated that will help transfer traditional medicines into the modern system of anticancer treatment. India is rich in the traditional system of medicines, and a hotspot of *Visucm* spp. may serve as a nucleus for revolutionizing and globalizing mistletoe-based pharmaceutical, health care and other industries.

Search of Novel Compounds in Lower Plants: Challenges and Opportunities

P L Uniyal

Department of Botany, University of Delhi North Campus, Delhi 110007

uniyalpl@rediffmail.com

Pteridophytes possess an enormous diversity of alkaloids, flavonoids, glycosides and terpenoids, with many primary and secondary metabolites and these organic constituents can be utilized in preparation of medicine. They have been used in the traditional systems of medicines and play a pivotal role in health care of urban, rural and tribal people for all types of diseases. They are also recognized for having unusually high levels of numerous important amino acids, as well as essential fatty acids as evidenced by the present analysis. The starch extracted from fern rhizomes can be used to make a variety of foods and industrial products. Ferns have several significant functional properties like antimicrobial, cytotoxic, hepatoprotective, antihyperglycemic, antiprotozoal, antinociceptive, and immunomodulatory, and chemopreventive properties are known in ferns. Elements such as calcium, strontium, selenium, cobalt, tin, titanium, vanadium, and palladium are found in higher concentration in some of the fern species. Phosphorus, potassium, copper, zinc, nitrogen, arsenic, nickel, gallium, germanium, silver are found in higher concentration in ferns. Ferns possess various fatty acids such as caproic acid, caprylic acid, myristic acid, palmitic acid, stearic acid, arachidic acid, behenic acid, lignoceric acid, palmitoleic acid, hypogeic acid, margaric acid, oleic acid, erucic acid, nervonic acid, linoleic acid, γ-linolenic acid, eicosadienoic acid, dihomo-gamma-linolenic acid, arachidonic acid, alpha-linolenic acid, and eicosapentaenoic acid are the most prominent ones. Interestingly, the five fatty acids, such as palmitic acid, stearic acid, lignoceric acid, oleic acid, and linoleic acid are found in most ferns. Amino acids such as alanine, arginine, citrulline, glycine, leucine, valine, methionine, ornithine, phenylalanine, tyrosine is reported in many of the fern species. Ferns contain phenols, flavonoids, tannins, polyphenols, alkaloids, terpenoids and steroids. High concentration of phenols is found in most of the ferns.

Due to the presence of these compounds many fern species show good radical scavenging potential and have a good source of antioxidant activity.

The functional groups can be identified in the fern compounds, which are responsible for medicinal properties investigated in this study. Fern species are rich sources of phytoconstituents and that pharmacognostical and phytochemical markers to detect adulterants in ayurvedic medications may be developed. Isolation of phytochemical constituents could lead to the development of unique therapeutic formulation. Improved analytical techniques can be used to create markers that can be used by the public to assess the quality of herbal drugs included in pharmacopeia. Quantitative assessments of these phytochemicals can also be performed easily to determine which bioactive class of molecules should be isolated as a target. Such studies will be useful for future research into pharmacological activities, which could add new knowledge to the information in the traditional medical systems. The proximate composition, fatty acids, amino acids, minerals, secondary metabolites, and antioxidant activity, all of which could be beneficial in nutrition, as well as reducing the progression of oxidative stress and oxidative stress-related disorders. The application of minerals, amino acids, and fatty acids in the nutraceuticals, pharmaceutical and cosmetics industries have fundamental significance, in order to stimulate the production of new herbal products which offer various benefits to their consumers. With wide acceptability, many commercial applications have evolved, and research aimed at treating cardiovascular disorders, inflammatory responses, and enhanced brain functions have achieved favorable results.

In this context, the usage of plants as sources of PUFAs itself not as an economic option, but also as a possible alternative to human health. Research into the isolation and identification of antioxidant compounds in the investigated plants could open new avenues for the pharmaceuticals and nutraceutical sectors to produce innovative health-medicines. It is recommended that the more and more taxa of ferns should be analyzed for identification of the compounds which can lead to the discovery of novel drug, cosmetics, food additives and biopesticides. It could be used for the welfare of human beings and add more diversity in the world food basket for human populations in the changing climate.

Metabolic Engineering of Plant for Antimalaria Drug Biosynthesis

Shashi Kumar
International Centre for Genetic Engineering and Biotechnology,
Aruna Asaf Ali Marg, New Delhi

Antimalaria drug artemisinin is biosynthesized through the isoprenoid pathway. Itisa life-saving drug for treatingmalaria patients. It is not affordable as it incurs a high cost of extraction and purification process from the low-yielding native Chinese plant (*Artemesia annua*). We have successfully biosynthesized artemisinin in an alternative plant using a compartmentalized metabolic engineering approach of 12 heterogeneous genes (yeast mevalonate and artemisinin biosynthetic pathways). The rationalized expression of the biosynthetic pathway's genes via a combined approach of chloroplast and nuclear genome engineering has enabled us to produce the maximum yield at clinically meaningful levels. Extract from the double transgenic has inhibited in vitro growth progression of *Plasmodium falciparum*-infected red blood cells. Oral feeding of whole intact plant cells encapsulating the artemisinin reduced the parasitemia levels in challenged mice compared to the commercial drug. Such novel synergistic approaches should facilitate low-cost production and delivery of artemisinin and other terpenoid drugs through edible plants' chloroplast and nuclear genome engineering.

Elucidation of Glycyrrhizin Biosynthetic Pathway: Research Journey of a Medicinal Plant

Suphla Gupta

Senior Principal Scientist & Professor at Academy for Scientific and Innovative Research.
CSIR-Indian Institute of Integrative Medicine, Canal Road Jammu, Jammu & Kashmir (UT)

sgupta@iiim.res.in

Glycyrrhiza (Fabaceae), commonly known as licorice, is an important source of flavonoids and terpenoids. Roots and stolons of Glycyrrhiza plants (*G. uralensis* Fisch. and *G. glabra* L., Fabaceae) are highly valued commercial products used in oriental medicine. Glycyrrhizin, an oleanane-type triterpenoid saponin, obtained from the dried roots (stolons), is widely recognised as a natural sweetener, flavouring agent and crude drug in Japanese, Chinese and Indian systems of medicine. It is the major bioactive ingredient of several herbals, possessing immuno-modulatory, antiulcer, anti-allergic and antiviral activities. In modern medicine it is considered an important crude drug for its various pharmacological activities including anti-diabetic, anti-inflammatory and hepato-protective. Glycyrrhizin also has HIV and severe acute respiratory syndrome (SARS)-associated coronavirus, selectively block the tumor COX-2 pathway and suppress colon carcinogenesis in mice and humans. Since almost all the licorice root used in mercantile is sourced from plants, therefore its high demand and low supply has invited establishing alternative systems as renewable resources. My lab research focuses on understanding glycyrrhizin biosynthesis pathway and enhancing it through functional genomic approach. We have cloned and characterized the genes along with their promoters committed to glycyrrhizin biosynthesis from *Glycyrrhiza glabra*. Also, the genes-β-amyrin synthase (bAS), β-amyrin-11-oxidase (CYP88D6), 11-oxo-beta-amyrin 30-oxidase (CYP72A154) and UDP-dependent glucosyl transferase (UGT) and their promoters were functionally validated in *Nicotiana benthamiana.* The promoter-GUS fusion construct of the cloned promoters showed enhanced activity as demonstrated by histochemical analysis and MUG based assay. The data revealed transcriptional control of NAA, GA3 and ABA phytohormones which could be

correlated to the cis-responsive elements of the respective genes. The study provided an insight into the intricate interaction between hormone responsive motifs present in the promoter region with the corresponding co-expression of the glycyrrhizin biosynthetic pathway genes.

Formulating Green Hair & Skin care Products

Archana Prasad

Founder Lambent Lab, NOIDA, Uttar Pradesh

archana.prasad@lambentlab.co.in

What "greener" alternatives are then available to the formulator? Green emulsifiers and/or surfactants, Green oils/fats, Green viscosity modifiers and texturizers, Green emollients, Green solvents, Green additives, Green actives.

The efficacy of all the modern products is due to synthetic materials, which are excellent at doing what is required and are often far from green. SLS and SLES dominated the personal care market in the 1960s especially mass-market products and even though there are many surfactants available and the negative effects like irritations. Because of this there is a drive towards milder Ammonium lauryl sulphate and ammonium laurel sulphate. They are made from sulphonation of petroleum products and therefore from sustainable sources. Many companies are trying to win customers by emulating the success of the natural skin care market however they have two major constraints: (1) They should not sacrifice product performance to become greener. (2) The consumer expects to pay less for hair care products so these formulations will not necessarily be able to afford the more expensive green actives. Herbal cosmetics (saundaryaprasadka) allow every individual to feel beautiful & healthy about themselves, besides there are many other tangible and intangible benefits. There is a huge variety of herbal cosmetics that are produced and used for daily purposes like herbal oil, shampoos & conditioners for hair, herbal soaps for skin; herbal face wash and many more. The best thing about herbal cosmetics is that it is made purely from herbs and shrubs. The natural content in the herbs does not have any reactions on the human body; rather enhances the body with supplements and other helpful minerals. The herbal cosmetics industry is an industry that is looking for innovation and marketing and has huge potential in future.

Abstracts

Paper Presentations

Bioprospecting Germplasm of Important Medicinal and Aromatic Plants of India

Archana P Raina

ICAR-National Bureau of Plant Genetic Resources, New Delhi

archana.raina@icar.gov.in

India has been considered as a treasure house of valuable medicinal and aromatic plant species. The agro-climatic condition prevailing in India provides an ideal habitat for the natural growth of a variety of plants and herbs, which provide raw materials for pharmaceutical, phytochemical, food, flavouring and cosmetic industries. Medicinal plants are a rich source of bioactive phytochemicals or bionutrients and have been used as drugs for millennia. The phytochemicals responsible for preventing disease and promoting health have been studied extensively to establish their efficacy and to understand the underlying mechanism of their action. Recently scientific interest has further increased in medicinal plants due to the search for new drugs from plant origin in the herbal industry. In order to harness the potential of the rich heritage of medicinal and aromatic plants available in India, a holistic approach is required to regulate and manage these valuable resources in a scientific manner. In this context, survey, collection, characterization, evaluation, conservation and utilization of these genetic resources along with the documentation of associated Indigenous Knowledge occupies a unique place in the field of PGR management. The thrust area being the plants used in the organized sector of industry as well as in the Indian System of Medicine from the core of collection. After agro-morphological and chemical evaluation the promising germplasm will be harnessed for commercial production of raw material as well as to find out the newer source of drugs and aromatic chemicals. Present study was undertaken for characterization of important medicinal and aromatic plants germplasm collected from different agro-climatic zones of India and being maintained at the gene bank of ICAR-NBPGR, New Delhi which is a nodal organization for management of plant genetic resources in India. Chemical characterization of important medicinal and aromatic plants germplasm by HPTLC

and GC/MS suggested a wide range of variation in active compound across the germplasm of *Andrographis paniculata* (andrographolide; 0.66-2.64%), Mucuna pruriens var. pruriens (L-DOPA; 4.91-7.09%), Ocimum species (essential oil; 0.13-0.45), *Alpinia s*pecies (essential oil; 0.21- 0.96%), and *Kaempferia galanga* (essential oil; 0.8-2.1%). Detailed chemical profiling indicated presence of different chemotypes in germplasm of *Ocimum sanctum* (eugenol and methyl eugenol), *Ocimum basilicum* (methyl chavicol, Linalool, methyl cinnamate) *Alpinia galanga* (1,8-cineole), *Alpinia calcarata* (1,8-cineole and α-fenchyl acetate) and *Kaempferia galangal* (ethyl-p-methoxycinnamate). Promising accessions and chemotypes identified in these crops have potential for use in future breeding programmes for crop improvement for enhancing active compound and pharmaceutical utilization. The variation in active constituents and different chemotypes identified for high medicinal value of these herbs has been highlighted in this paper. A need-based strategy including adoption of improved production packages, planning and proper marketing strategies should be chalked out to meet the market requirements of plant based crude drugs for promoting cultivation of medicinal and aromatic plants.

Keywords: bioactive compound, medicinal plants, chemotypes, herbal drug industry

Assessment of Air pollution Tolerance Index of Some Medicinally Important Plant species of Family Fabaceae Growing in GNDU Campus

Nitika Sharma[1], Akanksha Bakshi[1], Inderpreet Kaur[2] and Avinash Kaur Nagpal[1]*

[1]*Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India-143005*

[2]*Department of Chemistry, Guru Nanak Dev University, Amritsar, Punjab, India-143005*

nitikasharma0094@gmail.com

India is rich in all three levels of biodiversity, as species diversity, genetic diversity and habitat diversity. Traditional medicinal plants are the source of a number of significant medications that are still in use today. Despite several developments in the fields of synthetic drug chemistry and antibiotics, plants remain one of the main sources of raw materials for pharmaceuticals used to treat a variety of human diseases.In addition to their role in medicine, plants also help to curb the problem of air pollution, which is a matter of utmost concern in urban areas. Plants growing in green spaces in urban areas play an important role in decreasing air pollution. Different physiological parameters of leaves like pH, relative water content, chlorophyll content, and ascorbic acid content are known to govern Air Pollution Tolerance Index (APTI) of plants. Another index, Anticipated Performance Index (API) which takes into consideration morphological and socio-economic values of a plant species along with APTI is also being used to determine air pollution tolerance levels of different plant species. The present study was aimed to assess air pollution tolerance of ten plant species growing at GNDU campus viz. *Acacia auriculiformis, Albizia lebbeck, Bauhinia purpurea, B. variegata, Cassia fistula, C. glauca, C. siamea, Dalbergia sissoo, Delonix regia and Pongamia glabra,* belonging to Fabaceae family using the above two indices, APTI and API. Based on APTI score, plant species can be categorized as tolerant (30-100), intermediate (29-17), sensitive (16-1) and very sensitive (<1). Among the ten plant species investigated, highest value of APTI was shown by *C. fistula* (41.83) which is tolerant followed by *D. regia* (25.89), *B. purpurea* (19.52), *A, auriculiformis* (19.41), *C. glauca* (18.99), *B. variegata*

(17.21) which can be considered as intermediary tolerant. Whereas, *A. lebbeck* (16.68), *C. siamea* (16.39), *P. glabra* (16.27) *and D. sissoo* (14.60) are considered as sensitive. However, while considering API values, 2 plant species were very good performers (*C. fistula* and *P. glabra*) while 6 plant species were moderate performers. Two plant species i.e., *C. glauca* and *C. siamea* were poor performers.

Impending Threat to Plants that Heal

Saloni Gulati and Jasleen Kaur

Department of Botany Dayal Singh College, University of Delhi

jasleen@dsc.du.ac.in

Humanity on this Planet is lucky to be gifted enormously by the web of life. Plants having medicinal value are one of the most important treasures of nature being tapped by people since ancient times. Many of the lifesaving drugs such as taxol, alkaloids from periwinkle, novel antibiotics and antiviral drugs, drugs for curing diabetes, HIV, and many more to be counted are obtained from this natural resource. Research towards ethnomedicinal and ethnobotanical investigations on herbal drugs has enhanced due to their low cost and no side effects. However, narrow range of distribution, explosion of human population, climate change, specificity of habitat, heavy grazing by livestock, unchecked commercialization of medicinal plants and many other factors have imposed a lot of extinction risk on them which may result in loss of countless lifesaving cures of diseases. Therefore, there is an urgent need for recognition of the value of medicinal species to be incorporated into our laws, land and resource management policies and to work on their sustainability on priority basis so that no intelligent species should needlessly risk its future.

Synthetic Seed Technology: A Potential Tool for Germplasm Conservation of Medicinal plants

Richa Upadhyay

Mihir Bhoj PG College, Dadri, GB Nagar, UP, India-203207

ru4004@gmail.com

India is a rich heritage of medicinal plants since ancient times. Medicinal plants are used to cure different ailments in traditional systems of medicine such as Ayurveda, Siddha Unani, and Homeopathy. The fast-growing population associated with increasing industrialization, and increasing food and medicine demand has put pressure on plants' biodiversity. However, biotechnology has expanded its horizons to meet public interest and of course their demand. The plant tissue culture is one of the major achievements of the 19th century that enabled the regeneration and conservation of rare and endangered medicinal plant resources. Synthetic seed technology is an ex-situ conservation technique of the plant germplasm. Using this method different plant propagules such as shoot tips, axillary nodes and embryos can be encapsulated in the bead formed by varying concentrations of sodium alginate and calcium chloride. These synthetic seeds can be conserved for several months depending upon the viability of the explant and regenerated when required. In this paper application of synthetic seed technology for the conservation of medicinal plants' germplasm and their achievements and limitations will be discussed in detail.

Keywords: Synthetic Seed Technology; Medicinal Plants;*ex-situ*; Germplasm

Bryophytes – A Neglected Treasure of Plant World

Pratibha Kumari[1], Devayani Muley[2] and P. L. Uniyal

[1] *Department of Botany, Daulat Ram College, University of Delhi*

[2] *Department of Botany, Zakir Husain Delhi College, University of Delhi*

mh.pratibha@gamil.com

Bryophytes have more than 23,000 plant species which consist of three groups namely liverworts, hornworts, and mosses. They are secondary colonizers after lichens and play a very significant role in ecosystem functioning. Bryophytes are closely linked with cultural beliefs, civilization, and ethics of humankind. They have simple morphological and reproductive diversity. They almost lack any developed physical barrier, but they are rarely attacked by any pathogens and herbivores. This is due to the wide range of secondary metabolites produced by them which help bryophytes to survive in unfavourable abiotic conditions and protect them against any pathogenic attack. They contain a variety of diverse phytochemical compounds like carbohydrates, terpenoids, proteins, steroids, hormone lipids, organic acids, polyphenols, fatty acids, sugar alcohols, aromatic compounds and many more. Presence of these different types of secondary metabolites in bryophytes helped them to perform diverse functions as antifungal, antibacterial, phytotoxic, molluscicidal and insect antifeedants. For centuries many tribes and natives have been using bryophytes for treating various kinds of diseases such as eye, skin, heart and reproductive problems. In China Polytrichum sp. and Fissidens sp. used as diuretics and hair growth tonics. North Americans use Mnium sp, Bryum sp, *Polytrichum juniperinum*, Philonotis sp. to heal wounds, burns and bruises. Gaddi tribes of Himachal Pradesh, India use Plagiochasma appendiculatum paste to treat boils, burns, blisters and skin eruptions due to hot sunlight in summers. Recently, rare bioactive ingredients are extracted from bryophytes now being used in various commercial applications. Moss *Physcomitrella patens* used to enhance the resilience of the skin against environmental changes and *Sphagnum magellanicum* used in many skincare products. Bryophytes are relatively underexplored plant species in many

aspects including their medicinal value as well as other commercial importance. Now, the time has arrived when this neglected world of treasure should not to be ignored anymore.

Keywords: bryophytes, medicine, tribes, secondary metabolites

Medicinal Value and Pharmacognostic Evaluation of the Aerial Parts of *Tylophora indica* (Burm. f.) Merr.

Shikha Laha* and Bharti Chaudhry**

Department of Botany, Ramjas College, University of Delhi

bhartichaudhry@gmail.com

Tylophora indica, commonly called Indian Ipecac, Indian ipecacuanha, Emetic swallow-wort, is a perennial, twining herb, of the family Apocynaceae, indigenous to the Indian subcontinent. The plant is known to have potent anti-asthmatic, expectorant, bronchodilator, anti-allergic, antiangiogenic, antitumour, antioxidant, anti-inflammatory, hepatoprotective, anti-convulsant, diuretic, antimicrobial and immunomodulatory properties; and has been traditionally used in Ayurveda for the treatment of bronchial asthma, allergic rhinitis, common cold, fever, whooping cough, anaphylaxis, dermatitis, and rheumatism. The powerful anti-inflammatory and anticancer activity are attributed to the active phenanthroindolizidine alkaloids, Tylophorine, Tylophorinine and Tylophorinidine, that are present in the leaves and roots of the plant. Adulteration and substitution of the crude drugs is a major problem in the herbal industry. Despite its pharmaceutical potential, limited information is available on the pharmacognostic parameters of *Tylophora indica*. The plants of *T. indica* used in the present study were procured from the herbal Garden and Agro-Research Department of Patanjali Yogpeeth, Haridwar, Uttarakhand and established in the herbal garden of Ramjas College, University of Delhi. Organoleptic, macroscopic and microscopic evaluation of the leaves and stems of plants, preliminary phytochemical screening and powder analysis of the drug was done which can provide useful diagnostic characteristics in the identification, standardization and quality control of this invaluable traditional drug.

Medicinal Plants in the Indian Himalayan Region

Anubha Agarwal

DST Women Scientist

agrawal.anubha@gmail.com

Indian Himalayas are divided into three different zones, which are western, eastern, and central Himalayas. The climatic setting of these regions and the response of glaciers to them are different from each other. Eastern Himalayas have summer-accumulation type glaciers, i.e., the region receives maximum precipitation in summers which is accumulating and melting simultaneously. Western Himalayas are winter-accumulation type glaciers, i.e., the region receives maximum precipitation in winters. Central Himalayas act as a transition zone between the two regions. The glaciers located in different climatic settings and different geomorphology react differently to global warming. Different glaciers located in different regions are monitored to study regional climatic changes and their impacts on the local ecosystems. Like glaciers, local biodiversity and medicinal plants also react differently to regional climatic changes. To study the impacts of regional climate changes on medicinal plants it is important to monitor them in their niche.

A Survey on Some Commonly used Medicinal Plants in Manipur

Leisan Judith, Gladys Muivah Vera Yurngamla Kapai, Huidrom Helen Devi, TimronHungyo

Department of Botany, Gargi College, University of Delhi

vera.yurngamla.kapai@gargi.du.ac.in

Manipur is in a biodiversity hotspot and has many endemic medicinal plants. Many such plants have long been used in primary health care as part of the traditional medicine system. Different plant parts such as their leaves, flowers, fruits, roots, tubers, rhizomes, and bulbs are made into various medications. The plants are either employed singly or as polyherbal preparation by different local communities of Manipur. Most of these uses are part of traditional knowledge and are transmitted orally down the generations. This survey was carried out using standard questionnaires and personal interactions across various age groups. It attempts to assess the use of some medicinal plants by different communities and how effectively it is still transmitted in the present generation. Also, efforts are made to document the benefits of these medicinal plants.

Keywords: Manipur, medicinal plants, traditional knowledge, local communities, generation

Study of Local Medicinal Plants of Modinagar

Riya Ahlawat
SRM University, Ghaziabad, Uttar Pradesh
riyahlawat76@gmail.com

According to WHO, 25% of herbal drugs in modern pharmacopoeia are plant based and several synthetic drugs are manufactured by using chemical substances isolated from plants. Studies suggest that approximately 80% of the world population depends on herbal medicines as these medicines are affordable and safe with less or no side effects. Due to the outbreak of pandemic people have become more inclined to the plant-based products and altering their life-style hence the resurgence in the consumption of such products has been noticed that leads to extinction and adulteration of these products which became the major concern. Survey and documentation of these medicinal plants are an important facet of conservation approach and supports in-situ diversity conservation. This poster specifically deals with the study of medicinal flora of Modinagar with plant parts utilisation and their applications in traditional treatments.

Authentication of Herbal Medicines using DNA Barcoding

Utkarsha, Devender Singh Meena, Kiran Bamel and Prabhavathi

Department of Botany, Shivaji College, Raja Garden, New Delhi-110027

prabhavathi@shivaji.du.ac.in

The authentication of herbal medicine is critical for ensuring its quality, safety, and efficacy. The use of DNA barcoding has emerged as a powerful tool for authenticating herbal medicines and detecting adulteration. With the use of the latest sequencing methods and data analysis this technique can be a powerful tool to identify the adulterated formulations and authenticate the genuine ones. This study is an attempt to analyse the available work and identify the strengths and limitations of DNA barcoding to establish best practices for its application. It would guide future workers to identify the most appropriate genetic markers and reference databases for different plant species, as well as the most suitable protocols for DNA extraction and analysis. Additionally, the present investigation will identify the challenges and limitations of DNA barcoding, including issues related to DNA degradation, contamination, and the presence of multiple plant species in a single sample. A thorough review can help to establish standardized protocols and guidelines for DNA barcoding in herbal medicine authentication, which can facilitate its wider adoption by regulators, manufacturers, and consumers. Ultimately, the importance of this review on authentication of herbal medicine using DNA barcoding lies in its potential to recommend solutions to existing issues, promote transparency, accountability, and trust in the herbal medicine industry.

Medicinal Plants used by Nocte Tribe of Tirap district, Arunachal Pradesh, India

Nonya Chimyang[1,3], Pherkop Mossang[1,3], Vinay Shankar[2], Heikham Evelin[1] and Prem Lal Uniyal[3]

[1]*Department of Botany, Rajiv Gandhi University, Rono Hills, Doimukh–791112, Arunachal Pradesh*

[2]*Department of Botany, Gaya College, Magadh University, Gaya -823001, Bihar*

[3]*Department of Botany, University of Delhi, Delhi-110007*

heikham.evelin@rgu.ac.in

The Nocte is an ethnic tribe of Tirap district of Arunachal Pradesh, India. The Tirap district is in the Eastern Himalayan region, which is one of the biodiversity hotspots of the world. The Nocte people are deeply linked with nature, relying on plants for food, medicine, clothing, and shelter. According to an ethnobotanical survey conducted in the area, the Nocte people employ a variety of plants for therapeutic purposes. For example,plants species like *Ageratum conyzoides* (L.) L., *Artemisia dubia Wall*, *Brugmansiasuaveolens* (Humb. &Bonpl. exWilld.) Bercht. &J.Presl, *Chromolaena odorata* (L.) R.M.King&H.Roband *Raphidophora* sp. are used for skin related issues such as cuts, wounds, irritations, rashes, scabies etc. Boiled leaves of *Clerodendrumcolebrookianum*Walp. and *Debregeasia longifolia* (Burm.f.) Wedd., are used in hypertension, bowel troubles, stomachache, and blood dysentery; rhizome of *Houttuynia cordata*Thunb. is used to treatdiarrhoea; *Scoparia dulcis* L. and*Leucas aspera* (Willd.) Link are used for treatment of piles.In this manner, the people of Tirap are very much dependent on plant related medicines. However, as modernization advances quickly, the traditional understanding of plants is fading away with the older generations. Therefore, more documentation of traditional uses of plants and in vitro studies are needed. Moreover, steps need to be taken to spread awareness about the conservation and sustainable management of these bioresources.

Keywords: Eastern Himalaya, medicinal plants,Nocte, Tirap, traditional knowledge

Seaweed Prebiotics – Cure for Alzheimers?

Inderdeep Kaur

Department of Botany, Sri Guru Tegh Bahadur Khalsa College, University of Delhi, Delhi 110 007

inderdeepkaur@sgtbkhalsa.du.ac.in

Alzheimer's disease is a common neurological disease, affecting the brain with plaque and neurofibrillary tangles that disrupt the communication between the neurons. This leads to loss of memory with its severe manifestation in dementia and finally death of the neurons. In the healthy brain, acetylcholine, a neurotransmitter acts at all autonomic ganglia, at several autonomously innervated organs, at the neuromuscular junction, and at synapses in the Central Nervous System. Such cholinergic receptors bring about neuron-neuron communication that help in cognitive functions. The acetylcholine in neurological disease is rapidly degraded by acetylcholinesterase leading to a loss of cholinergic transmission at pre-synaptic endings of the cells. Certain drugs such as donepezil, galantamine and rivastigmine are generally prescribed as inhibitors of cholinesterase. However, patients on this medication show side effects such as nausea, anorexia, and less overall improvement.

Studies on seaweed polysaccharides and oligosaccharides reveal that they can modulate intestinal metabolism and alleviate Alzheimer's disease by targeting the gut instead of brain. Brown seaweeds are neuroprotective via antioxidant activity which is related to phlorotannins. Crude extracts of brown algae such as *Laminaria japonica, Ascophyllum nodosum, Fucus, Sargassum* are reported to inhibit amyloid and plaque production. Several metabolites such as *fucoxanthin, phloroglucinol, dibenzodioxine-2,4,7,9-tetraol, eckol* and *fucosterol* have shown encouraging inhibitory effects on cholinesterses. Administration of the algal oligosaccharide sodium oligomannate (GV-971) is reported to restore homeostasis of the gut environment, thus inhibiting the onset of the neuroinflammatory process. Oligomannates manage the communication system between gut and brain which is called the gut-brain axis. The gut microbiome is kept at a balance which reduces production of excess Th1 cells (T Helper cells) leading to reduced neuroinflammation and slower and less severe manifestation of the disease. Seaweeds as prebiotics change the gut microflora and are acknowledged as a 'new life ticket' for a public health priority.

Threatened and Endemic Medicinal Plants of Rajasthan (India)

Amit Kotia*, Shikha Gupta and Jai Singh

Department of Botany, University of Rajasthan, Jaipur-302004

kotia.amit@gmail.com

Rajasthan is covering an area of 3, 42,239 km², categorized into two biogeography zones *i.e.*, Arid and Semi-arid zPones. The State has a total forest cover of ca. 4.62%, most of which (9%) falls under Semi-arid region and the scrub forest cover is around 4,564 km². India has an immense wealth of rich biodiversity. According to estimates there are about 45000 species of wild plants and out of these 7500 species are of medicinal use in indigenous health practices. In any country, for maintaining biodiversity the forests should be one third of the total land. The real danger for biodiversity is from the urban elite which destroys the forests for industrialization and for their own needs, resulting in serious genetic erosion of biodiversity. Rajasthan state is harbor of around 2000 flowering plants among these many of them are medicinally valuable. These plant species are harvested and traded by several tribes for their livelihoods. Rapid deforestation caused by over-harvesting and exploitative trade of medicinal plants has significantly reduced the availability of the medicinal plants in Rajasthan. According to Conservation Assessment and Management Prioritization (CAMP, 2007) around 39 medicinal plant species are Red-listed among these six plant species are critically endangered, 13 species as endangered and other twenty species are vulnerable. During present investigation attempts were made and around 60 plant species are categorized as rare for the State.

Potential Use of Mycorrhizae in Cultivation of Medicinal Plants

Devayani Muley and Pratibha Kumari

Zakir Husain Delhi College, University of Delhi

devayani.muley@zh.du.ac.in

Arbuscular mycorrhizae (AM) fungi are ubiquitous and reported to be associated with plants growing in arctic, temperate to tropical regions. AM fungi colonize plant roots and have a role in improving plant growth, health, and productivity. The growth improvement is mainly because of enhanced uptake of phosphorus, zinc, copper, and other nutrients. The colonization resulted in increased accumulation of nutrients, chlorophyll, carotenoids, sugars, terpenoids, proteins, polyphenols, and other substances also.AM also benefits in increasing the compound production from primary and secondary metabolism. Some plants can increase antioxidant defence in humans by adding natural antioxidants by use of medicinal plants. Medicinal plants are cultivated worldwide, and useful substances extracted from these plants for medicinal properties. Medicinal plants have clinical and curative benefits without toxic side effects. Hence, there is a need for research for improving the quality and quantity of drugs produced from medicinal plants in relatively shorter periods and at lower expense by using AM fungi. Global research should be more focused on the improvement of active compounds in medicinal plants.AM has a great potential to increase the yield of medicinal plants by more production of metabolites in a sustainable way for the benefits of human society.

Keywords: Arbuscular Mycorrhiza, Medicinal plants, Nutrient uptake, Metabolites.

Clerodendrum Glandulosum Lindl., a Medicinal Plant in Arunachal Pradesh, North-East India

Pherkop Mossang[1,3], Nonya Chimyang[1,3], Vinay Shankar[2], Heikham Evelin[1,3] and Prem Lal Uniyal[3]

[1]*Department of Botany, Rajiv Gandhi University, Rono Hills, Doimukh–791112, Arunachal Pradesh*

[2]*Department of Botany, Gaya College, Magadh University, Gaya-823001, Bihar*

[3]*Department of Botany, University of Delhi, Delhi-110007*

heikham.evelin@rgu.ac.in

Clerodendrum glandulosum Lindl., which has significant ethno-pharmacological value is commonly found in Arunachal Pradesh of Northeast India. The plant has been widely used in the native medical systems of China, India, Japan, Korea, and Thailand for its numerous therapeutic properties. The leaves of *C. glandulosum* have been traditionally used to treat metabolic diseases like diabetes, hypertension, obesity and are known to have other antioxidant properties as well as advantageous effects against non-alcoholic steatohepatitis. Several species of the genus *Clerodendrum* have also been reported to treat a variety of illnesses, including asthma and cancer. The plant leaves are traditionally used as a pain reliever, antiperiodic as well as in treating many forms of skin problems. Recent studies on the crude extract of *C. glandulosum* revealed the presence of a high concentration of flavonoid and phenolic content, which may contribute to the therapeutic actions shown by the plant species. *C. glandulosum* has been used for its various ethnomedicinal purposes by the people of Arunachal Pradesh. Leaves are mainly consumed by the people suffering from hypertension and diabetes. Apart from Arunachal Pradesh, the plant has been reported to be used by different ethnic groups of other North-Eastern states like Assam, Manipur, and Nagaland for its high potential in treating various health conditions. Although, science and clinical advancement showed that *C. glandulosum* have high potential effects against various ailments, the plant has only been used to optimize hypertension and control diabetes by the natives of the state, Arunachal Pradesh which in turn, indicates that the people therein may be unbeknownst of its other important medicinal properties. Therefore, imparting valuable knowledge

among the natives about the plant's other modern usage in medicine may ignite more interest about the plant species as well as other medicinal plants found in the state, Arunachal Pradesh of North-East India.

Keywords: *Clerodendrum glandulosum,* Arunachal Pradesh, Ethnobotany, Flavonoids, hypertension, Therapeutic properties

DNA Barcoding for Identification of Wild Plants in Traditional Medicine

Falguni Patil[1], Mahek Surti[1], Suprriya Waghmare[2], Reshma Bhor[2], Sanket Tembe[1]

[1]Department of Biotechnology, Fergusson College (Autonomous), Shivaji Nagar, Pune.

[2]IMT Technologies Pvt. Ltd., Kondhwa Khurd, Pune.

sankettembe@fergusson.edu

A resurgence of interest in studying wild plants due to their medicinal properties has triggered research on methods for quick identification of these species. DNA barcoding is a proven technique for rapid and accurate identification of organisms across all taxa. In the present study, utility of this molecular technique was tested using rbcl gene as a molecular marker for identification of medicinally important five plant species namely *Ipomoea cairica, Cyperus rotundus, Chenopodium album, Commelina benghalensis* and *Trianthema portulacastrum.* Each specimen was given a unique ID before DNA isolation from its leaf tissue, using established extraction protocols. Amplified PCR products were sequenced bidirectionally. Alignment and analysis of sequences was done using Clustal W and MEGA respectively. A phylogenetic tree was reconstructed using the NJ method and pairwise distances were calculated using the Kimura-2 parameter. Statistical support for all nodes in the tree was estimated by bootstrap replication. The analysis involved twenty-five species across five genera. Results are promising and suggest that species level identification is possible using this DNA barcode.

Keywords: DNA barcoding, Wild plants, Traditional medicine, Neighbour-Joining (NJ)

Examining the Causes of Illegal Trade in Medicinal Plant Species and Possible Impact on Conservation Efforts

Anfas Muhammed

Ramjas College, University of Delhi

anfas.m.salim@gmail.com

The conservation of biodiversity is seriously threatened by the illegal trade in medicinal plant species, which also jeopardises efforts to use natural resources sustainably. This study looks at the factors that contribute to the illegal trade in medicinal plants and how it might affect conservation efforts. To pinpoint the primary causes of illegal trade and its effects on populations of medicinal plants, case studies and statistical data are analysed. Our research suggests that market demand, poverty, and lax law enforcement are the main forces behind the illegal trade in medicinal plants. We also point out how traditional and cultural beliefs, in addition to a lack of understanding of sustainable harvesting methods, contribute to the growth of illegal trade. We go over the possible negative effects of illegal trade on the preservation of medicinal plant species, such as habitat destruction, biodiversity loss, and elevated extinction risk. We emphasise the significance of conservation tactics that incorporate responsible harvesting methods, neighbourhood involvement, and enhanced law enforcement. The scale and complexity of the issue are highlighted by the case studies of the illegal trade in medicinal plants from India, China, and Southeast Asia. The severity of the problem is further highlighted by statistical information from the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). References: anfas.m.salim@gmail.com Cunningham AB, Brinckmann JA. Medicinal plants in trade and conservation. In: Bogers RJ, Craker LE, Lange D, editors. Medicinal and aromatic plants. Springer; 2006. p. 239– 252. • Keywords: Leaman DJ. Medicinal plants: Biodiversity and drugs. In: Levin SA, editor. Encyclopedia of biodiversity. Academic Press; 2001. p. 429–439. • Nijman V. An overview of international wildlife trade from Southeast Asia. Biodivers Conserv. 2010;19

(4):1101–1114. • World Health Organization. Traditional Medicine Strategy 2014–2023. Geneva: World Health Organization; 2013. • Xu J, Zhang Y, Liu W, Yin S, Liu C, Liu S, et al. China's evolving managed nature reserve system: A case study from northwest Yunnan. Environ Manage. 2006;38(6):933–951. • • Medicinal plants, illegal trade, conservation, sustainable harvesting, Biodiversity loss. The conservation of biodiversity is seriously threatened by the illegal trade in medicinal plant species, which also jeopardises efforts to use natural resources sustainably. This study looks at the factors that contribute to the illegal trade in medicinal plants and how it might affect conservation efforts. To pinpoint the primary causes of illegal trade and its effects on populations of medicinal plants, case studies and statistical data are analysed. Our research suggests that market demand, poverty, and lax law enforcement are the main forces behind the illegal trade in medicinal plants. We also point out how traditional and cultural beliefs, in addition to a lack of understanding of sustainable harvesting methods, contribute to the growth of illegal trade. We go over the possible negative effects of illegal trade on the preservation of medicinal plant species, such as habitat destruction, biodiversity loss, and elevated extinction risk. We emphasise the significance of conservation tactics that incorporate responsible harvesting methods, neighbourhood involvement, and enhanced law enforcement. The scale and complexity of the issue are highlighted by the case studies of the illegal trade in medicinal plants from India, China, and Southeast Asia. The severity of the problem is further highlighted by statistical information from the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Effect of Elevated Temperature on the Production of Secondary Metabolites

Palak, Tribeni Sharma, Ankit Kumar, S Gautam,Shaurya, Seema Talwar and Kiran Bamel

Shivaji College, University of Delhi, New Delhi-110027

kbamel@yahoo.in

Plant secondary metabolites (PSMs) are not directly involved in plant growth and development. These are considered as plants defensive compounds as they provide the protection against UV radiations, predators, pathogens, herbivores and nematodes and also known to attract insects/animals for pollination and seed dispersal. Several secondary metabolites possess vital ecological functions in plants. Most of the secondary metabolites are being considered for drug development (medicines, pharmaceuticals and agrochemicals). However, the increase in atmospheric temperature due to the several anthropogenic activities is a matter of concern now. Due to the temperature stress many morphological, physiological and biochemical changes occur within the plant. The temperature stress can modify the concentrations of secondary metabolites and chemical compositions. Several studies have reported that high temperature reduces the enzyme activities or stimulates the active scavenging enzymes thereby affecting the plants defense mechanisms and synthesis of several PSMs. The objective of this study is to understand the impact of elevated temperature on the secondary metabolism, to investigate gaps in published literature and discuss future scenarios to manage the optimal synthesis of these metabolites for the survival of these plants and for therapeutic role. These are highly essential for combating several human diseases as this show anti-fungal, anti-microbial and anti-cancerous. Currently, the demand for these secondary metabolites is increasing day by day to keep the world's growing population healthy and safe with the use of natural products. Therefore, keeping in mind the importance of metabolites, maximum emphasis should be focused on their quantity as well as quality.

Understanding Potential Threats to Medicinal Plants

Shruti Srivastava

Kalindi College, University of Delhi

Shruti28sri@gmail.com

In non-industrialized societies, medicinal plants, also known as medicinal herbs, are widely used because they are accessible and less expensive than modern medications. They have been discovered and used in traditional medicine practices since prehistoric times. The estimated yearly global export value of the tens of thousands of different plant species with therapeutic characteristics is $60 billion and is increasing at a rate of 6% per year. The botanical herbal market has drawn criticism for having lax regulations and for selling placebo items that make medical claims but lack the evidence to back them up. Both broad concerns, including climate change and habitat degradation, and the specific threat of over-collection to satisfy market demand affect medicinal plants. Habitat degradation brought by increased activities, loss of the forest, plant species being destructively collected exotic species encroaching and displacing local species and industrialization being the major threats to these medicinal plants. The main dangers to medicinal plants are overuse of agrochemicals, natural and man-made disasters, genetic degradation, etc. Because we are unsure of what we are losing and what we will need in the future, this is leading to conservation of plant resources, which is a worry for the entire world.

Evolutionary Expansion and Expression Dynamics of Profilin (PRF) Gene Family in the Modern Amphidiploid Mustard (*Brassica juncea* L.)

Vandana Yadav, Anirudhabhai Khma and Bhupendra Chaudhary

School of Biotechnology, Gautam Buddha University, Greater Noida, U.P.

bhupendra@gbu.ac.in

Profilin (PRF) is a ubiquitous, low-molecular weight, actin-binding protein involved in cytoskeletal organization in both prokaryotes and eukaryotes. The PRFs belong to a multi-member gene family involved in regulating different aspects of cell-wall development, and as transducers of key flowering genes regulating apical-to-floral meristem conversion during floral transition in plants. Occurrence of *PRF* genes in viruses, cyanobacteria, animals, and plants demonstrates their ancient origin and evolutionary expansion along with diverse lineages. To understand the evolutionary expansion of *PRF* genes in *Brassica* genomes, we performed a meta-analysis of *PRF* genes in different diploid and amphidiploids mustard genomes in an evolutionary framework. At least 23 *PRF* gene members with a conserved signature domain were identified in amphidiploid *Brassica juncea* genome (AABB; 2n=36). Genetic evolution of paralogous and orthologous genes was essentially accountable for the geneic-expansion of *PRF* homologs in *B. juncea*. Evidently, structural divergences among *PRF* paralogous sequences compared to their orthologs indicated that the progenitor *PRF* sequence had been subjected to substantial structural modifications in plants, perhaps because of the evolutionary split between monocots and eudicots. Further, functional evolutionary characteristics of *PRF* genes present in *Brassica* genomes were identified by analyzing their comparative spatiotemporal expression patterns in diverse tissues and developmental stages of diploid progenitor species *B. rapa* and *B. nigra* along with the descendent amphidiploid species *B. juncea*. Remarkably, the temporal expression evolution of profilin paralogs/homeologs during mustard allopolyploidy provides evolutionary impressions of the selection of *PRF* genes during floral induction. These results provide evolutionary evidence for common ancestry of cytoskeletal *PRF* genes, and highlighted important roles of *PRF* genes in floral development in mustard.

Understanding the Ecological Challenges of *Cydonia oblonga* (Quince), An Underexploited Temperate Medicinal Tree, in Northern India

Romila Rawat Bisht[1], Tanzeela Nazir[2] and Monika Koul[1]

[1] *Department of Botany, Hansraj College, University of Delhi*

[2] *Summer Intern at Hansraj College*

drmkoul@gmail.com

Cydonia oblonga is an important temperate fruit tree growing in many parts of North India especially, in the hilly regions of Kashmir, Uttarakhand and Himachal Pradesh. Despite being a hardy tree, the density of *C. oblonga* is decreasing. The last decade has witnessed a drastic change in horticultural practices (growing new apple hybrids, grafting of varieties that fetch low costs and introduction of new cultivars) across the region. Quince trees have also been eliminated out of the orchards and replaced by cherries and prunes, thus pushing this tree to an edge. Besides, the changes observed in climate, especially the temperature and precipitation, during the flowering period is affecting the quality of the fruits and lowering the yield per tree. In South Kashmir, the trees are now a rare sight, and some few trees can be seen in apple stands where these serve as food to pollinators.

The fruits and leaves store a bouquet of metabolites, nutrients, and minerals. The fruits are a rich source of iron, calcium, and many vitamins. The pharmacological profile of the metabolites has been well-established, and the fruits of quince are recommended for treatment against many diseases.

Therefore, the scientists, farmers, the local landlords, research institutes and agricultural extension workers need to come together to develop a strategic plan to revive this tree and start its plantation in the common lands, orchards, and other community areas. This will not only help in protection and conservation of this horticulturally important plant but boost the economy.

Keywords: Quince, medicinal, climate change, conservation

Ethnobotanical Investigation of the *Muthuvan* Tribe's Medicinal Plant Usage in Edavanna Panchayath, Malappuram District, Kerala

Athira* and Rose de Leema J

Department of Botany, Providence College for Women, Coonnoor

athiranair641@gmail.com

Ethnobotanical studies are always in the forefront in revealing the intimate association between human beings and plants. India is widely known for its immense wealth of medicinal plants and for the fact that this plant wealth has been utilized for healing diseases since ages. Tribal societies possess their own ideologies and belief systems when it comes to the usage and protection of plants. Among many tribal communities in Kerala, *Muthuvans* are known for their knowledge in usage of plants for the preparation of medicine. Documentation of such knowledge is utmost important for the upcoming future. The present study is conducted with an aim to document the medicinal plants used by the *Muthuvan* tribe of Malappuram district, Kerala for the treatment of common ailments. Questionnaire survey, periodic field trips to the tribal area and secondary information collected from KIRTADS has been presented here. A total of 72 plants belonging to 39 families have been recorded along with their vernacular names, parts used and mode of preparation of medicines. The commonly represented family was Fabaceae with 7 species, followed by Lamiaceae with 6 species and Asteraceae comprising 5 species. The current study elaborately reveals that the tribal community depends on plant wealth of Cholar Hills for the treatment of common ailments and their medicinal preparations have been effective over many years. Therefore, documentation of the knowledge possessed by the tribes is extremely important as these can be used for further studies and novel discoveries.

Keywords: Ethnobotany, Kerala, *Muthuvans*, medicinal plants

Seabuckthorn: A Traditional Medicinal Plant Demonstrating Ecological Benefits in the Ladakh Region of India

Gaurav Kumar[1,2]

[1]*Department of Agricultural and Environmental Sciences – Production, Landscape & Agroenergy, Unimont, University of Milan, Italy*

[2]*School of Ecology & Environment Studies, Nalanda University, Rajgir, India*

gauravkumar@student.unimi.it

Seabuckthorn (*Hippophae rhamnoides* L.) belonging to the family Eleagnaceae is an endemic shrub found in Ladakh which is also native to Europe and Asia. It is a medicinal plant traditionally used for the treatment of digestive disorders, tendon & ligament injuries, cardiovascular problems, ulcers and skin diseases. The reported medicinal properties of Seabuckthorn are immune modulatory, anti-tumour, anti-stress, cytoprotective and anti-microbial. In addition to its medicinal properties, Seabuckthorn possesses immense ecological benefits for the Ladakh region. This study assessed the biomass, carbon stock and rhizospheric properties of *Hippophae rhamnoides* (Seabuckthorn) in Spituk village of Leh district in Ladakh. The destructive harvest method was applied to determine biomass and carbon stock. The shrubs at a diameter class of 6.1-7.0 cm comprised the stand-level total biomass of 30.78 mg ha^{-1}. The trends of the total stand-level vegetation carbon stock were analogous to the biomass trends. The stand-level vegetation and soil carbon stocks together stood at 74.15±8.58 Mg C ha^{-1}. The pedological analysis revealed that in the shallow depths from 0 to 0.3 m, the stand level total nitrogen was 9.80 Mg ha^{-1} which dropped to (4.89 Mg ha^{-1}) in the depth range of 0.3-0.6 m. Alkaline pH (8.71±0.24) was observed through the entire depth range of (0-0.9 m). The electrical conductivity in the top layer (0-0.3 m) of soil was higher than in the deeper layers (0.3-0.9m). The order of moisture content of the plant parts was crown (>80%) >root (0 to 60%) >stem (0 to 25%). The study indicated that *Hippophae rhamnoides* holds the potential for creating carbon reserves and soil enhancement leading to ecological benefits in the Ladakh region.

Major Contributing Factors in the Decline of the Medicinally Important Indian Frankincense and Plausible Conservation Interventions

Aditi Tailor

Genetics and Tree Improvement Division, Arid Forest Research Institute, Jodhpur, Rajasthan-342005, India

tailoraditi69@gmail.com

Referred to as Shallaki in the Indian Ayurvedic medicinal system, *Boswellia serrata* Roxb. ex. Colebr. or Indian Frankincense has been used for thousands of years as an integral part of folk medicine and many religious rituals. The species is an important non-timber forest product and owes its medicinal properties to the fragrant oleo gum-resin (Salai) that oozes out of its trunk, more specifically to the pharmacologically important terpenoids known as boswellic acids present in the gum. Since centuries the species has been used for treating various chronic inflammatory diseases, such as asthma and arthritis.Additionally, oil from *Boswellia* is used for making incense and high-end cosmetics and perfumes. Harvesting of *Boswellia* oleo gum-resin is done using the practice of trunk tapping, however, tapping has been identified as a significant factor leading to decline of its population. Tapping negatively impacts the longevity, its reproductive health and seed production ability and poses a threat to survivability and sustenance of its population. An increasing market demand for *Boswellia* gum has promoted unsustainable harvesting of frankincense, which combined with the low germination rates and poor natural regeneration, has caused a continuous population decline and threatened the species to extinction. The consequences of this population decline may have severe socio-economic and ecological implications. Therefore, there is a need to take steps towards conservation of this species and enforce sustainable management practices. There is also a need to evolve the harvesting practices to encourage sustainable harvesting of gum from *Boswellia* trees so as to minimize physiological stress to the tree so that it does not affect the normal growth functions and seed germination.

Potency of Gingerol and EGCG for Targeting Multiple Tumor Markers: An In-Silico Analysis Based Approach

Abhishek Rajesh C P[1], Dr Rohini Samadarsi[2]

[1] *Sree Chitra Thirunal College of Engineering, A.P.J Abdul Kalam Technological University, Trivandrum, Kerala, India. Contact number: 8714925767*

[2] *Sree Chitra Thirunal College of Engineering, A.P.J Abdul Kalam Technological University, Trivandrum, Kerala, India. Contact number: 9495830147.*

rohini@sctce.ac.in

Cancer is one of the leading causes of death worldwide. Many of these compounds also exert anti-carcinogenic effects in animal models of cancer, and much progress has been made in defining their many biological activities at the molecular level. Chemoprevention using pharmacological doses of bioactive compounds such as EGCG and gingerol may prove valuable against cancer treatment as polyphenols exert anti-carcinogenic effects in animal models of cancer. However, such strategies require a full risk-benefit analysis based on a thorough understanding of the long-term biological effects. Hence the potential of Epigallocatechin (EGCG) and 6-Gingerol against multiple tumor markers through various in silico tools were analyzed in the current study.

Materials and methods: Bioactive components EGCG and Gingerol were identified through data mining, and they have excellent anticancer, and antioxidant properties. The binding affinity of EGCG and gingerol with the targeting of multiple tumor markers was carried out using the CB-Dock2 software. The interaction of these bioactive components with the four major signaling pathways as TGF-β signaling pathway, the Hippo Signaling Pathway, the cAMP signaling pathway, and the WNT pathway was studied. Interactions of EGCG and gingerol with proteins involved in the signaling pathway were carried out. Toxicity analysis is done by Toxtree and The Toxicity Estimation Software Tool (TEST).

Results: Docking studies showed a good affinity towards the proteins of tumor markers and signaling pathways. EGCG has a binding energy (kcal/mol) ranging

from -9.3 to -5.4 and 6-Gingerol from –7.7 to –3.8 with the tumor markers. As for the signaling pathways, EGCG showed the highest binding energy of –127.4 kcal/mol and 6-Gingerol –99.7 kcal/mol with Smurf1 of the TGF-β signaling pathway. Toxicity analysis of EGCG & Gingerol using Toxtree and T.E.S.T predicted that both are not toxic to many important factors. In essence, these studies showed the potency of EGCG and 6-Gingerol to produce anticancer drugs. So, soon, it is also optimistic to develop a drug that is safe, efficient, economical, and non-toxic to a cohort of patients.

Keywords: CB-Dock2, Toxtree, T.E.S.T, Tumor marker, Signaling Pathway

Conservation of Medicinal Tree Diversity of Central India: Seed Technological Perspectives

Manish Kumar Vijay

Scientist-B, Tropical Forest Research Institute, Jabalpur

vijaym@icfre.org, manishvijay89@gmail.com

The current "back to nature" attitude, which gained popularity during the corona outbreak, has led to an increase in interest in research on Medicinal and Aromatic Plants (MAPs) worldwide. The bulk of the species still gathered from the wild are used in herbal treatments, bringing them in the Rare, Endangered and Threatened (RET) categories. Hence, measures must be created immediately for domesticating, conserving, and regenerating the species of exploited medicinal plants. For the regeneration and propagation of medicinal plants, seed-based, clonal, and micro-propagation techniques are frequently employed. The most effective and practicable way of reproduction for the vast majority of species is seed-based reproduction. Lack of high-quality MAP germplasm, species-specific seed handling procedures, and poor seed storability are the main issues with seed propagation. The conservation of germplasm in gene/seed banks and the notification of a variety under the Seeds Act rely on seed standards and seed testing procedures for medicinal species. For around 150 of the Indian crops cultivated, minimum seed certification standards are available. Nevertheless, no such MAP seed guidelines have been developed nationwide. As a result, the quality of seeds offered to MAPs growers cannot be regulated as intended by the Seeds Act. To address these issues, a number of projects funded by CAMPA (MoEF&CC) are underway at the ICFRE-Tropical Forest Research Institute in Jabalpur (Madhya Pradesh), including the All India Coordinated Research Projects and the National Programme for the Conservation of Forest Genetic Resources (NPFGR). These involve activities to document, conserve, and propagate more than 70 tree species from central India that have significant medicinal value. For the ex-situ seed germplasm conservation of these valuable timber and non-timber forest species, including medicinal plants, a mid ($5\pm2^{O}C$) and long term ($-20^{O}C$) seed germplasm bank facility was recently developed at the institute. These efforts will be advantageous for the domestication and conservation of these vulnerable MAPs.

Keywords: NTFPs, MAPs, Seed quality, Certification, Conservation

Agro-morphological Characterization of Kalazeera Accessions in North-western Himalayan Region of Kashmir

Susheel Kumar Raina[1], Sangita Bansal[2], Sheikh M Sultan[1], Suheel Ahmed Dand[3], Sheeraz Saleem Bhat[3]

[1]CAR-NBPGR Regional Station Srinagar, KD Farm, Old Air Field, Rangreth, Srinagar-191132, J & K, INDIA

[2]CAR-NBPGR New Delhi, Pusa Campus-190011, INDIA

[3]CAR-IGFRI Regional Research Srinagar KD Farm, Old Air Field, Rangreth, Srinagar-191132, J & K, INDIA

Susheel.Raina@icar.gov.in; Susheelkr76@gmail.com

Black caraway (*Bunium persicum* Boiss.) commonly known as '*kalazeera*' is a perennial aromatic and medicinal herb. In India, the Black Caraway grows wild in subalpine forest slopes including the states/UT's of Jammu and Kashmir, Himachal Pradesh, Garhwal and Kumaon regions of Uttaranchal and some areas of Kargil Ladakh. In Jammu and Kashmir, the crop species grows mostly in the wild, under natural conditions in forests, open hilly grassy slopes, lower alpine and tablelands, as sub – populations, mostly across the hilly areas of Gurez, Tulail, Keran, Machil, Tangdar, Kishtwar Paddar, Khrew and Char-e-sharief. We have also observed plants of black caraway growing occasionally on several *karewa* lands especially in Budgam district of Jammu & Kashmir This condiment has also found place in indigenous system of medicine and has been found useful in curing diarrhoea, dyspepsia, fever, flatulence, stomach-ache, haemorrhoids, and obstinate hiccups. The essential oil in the seeds contains 45-65 per cent carvone, a mixture of ketone, carvone, terpene and traces of carvacrol and cuminaldehyde.

In the present study, we evaluated eight accessions of *Kalazeera* collected from different parts of erstwhile Jammu and Kashmir State for different agro-morphological traits. These accessions were collected from Gurez, Wasturvan, Abhama, KD Farm, NBPGR Farm and Kargil district of Ladakh. Mean values of traits like plant height (cm), umbels/plant, umbel diameter (cm), thousand seed weight (gm) and seed length (mm) among the accessions were 29.2, 18, 6.53, 1.24, 3.5

respectively. Maximum number of umbels/plant was recorded in KD Farm accession while Gurez-2 accession revealed least number of umbels/plant. The Kargil accession exhibited the lowest thousand seed weight while Gurez-2 revealed the highest thousand seed weight of 1.9 gms. The plant height revealed a highly significant ($p<0.01$) positive association with umbel diameter. Thousand seed weight exhibited a significant ($p<0.05$) positive correlation with seed length. An interesting general observation was that accessions collected from Gurez are rich in aroma compared to the other accessions. These studies reveal considerable genetic variability among the *Kalazeera* accessions for agro-morphological traits paving the way for future genetic improvement in this economically important spice crop.

Restoration of Degraded Lands: Kanha-Pench Wildlife Corridor

Arpita Singh

Saurashtra University, under Wildlife Institute of India

arpitasingh1490@yahoo.com

Threat to biodiversity around the world is a major concern for wildlife conservation. Constant decline in biodiversity i.e., species, ecosystem, and genetic diversity is a critical challenge of the 21st century. The current rate of extinction of species is 1000-10,000 times higher compared to fossil records. Around the world there are many factors leading to biodiversity loss, like over exploitation of resources, habitat fragmentation, habitat destruction and invasive alien species. Expansion of altered lands to meet the demands of food production by the growing population has given rise to desertification and fragmentation of forest habitats. There has been an increase of 500% in PAs around the world in last thirty years and India comes under 17 mega diverse countries having high biological diversity and human population having 950 PAs

Consumption of *Garcinia* sp. by the Indigenous Community of Idukki District, Kerala, India

Nirmal Nithula and Lingassamy Arul Pragasan

Environmental Ecology Laboratory, Department of Environmental Sciences, Bharathiar University, Coimbatore, Tamil Nadu -641046, India.

arulpragasan@yahoo.co.in

Garcinia gummi-gutta, also known as Kudampuli or Malabar tamarind is a plant native to the Western Ghats and has been used for centuries to treat various ailments. The indigenous community residing in Idukki district, Kerala State, India uses locally available *Garcinia gummi-gutta* to prepare a spice soup, which they believe "clears the uterus" and provides immunity against infections and post-delivery ailments like back pain and swelling. Data was collected through explorative field trips, informal discussions, and semi-structured face-to-face interviews with the respondents. The protocol for the preparation of the spice soup was noted and the benefits of the ingredients have been discussed through a literature survey. The use of *Garcinia* species in the preparation is a novel feature and its role as a functional food needs further investigation.

Keywords: *Garcinia gummi-gutta*, Indigenous food, Kudampuli, Pregnancy, Spice soup

Green Synthesis of Silver Nanoparticles of *Ocimum* and *Zingiber*

Priyanka Pandey

Gargi College, University of Delhi

priyanka.pandey@gargi.du.ac.in

Medicinal plants like *Ocimum* and *Zingiber* were used for extraction of nanoparticles with bioactive compounds. Nanoparticles can be synthesized with either top down or bottom-up approaches. Reduction in size of a particle (atom or molecule) by using physical and chemical methods is termed as top-down approach and when there is a synthesis of nanoparticles from small entities (atoms or molecules), involving oxidation reduction reactions, it is termed as bottom-up approach. Biological entities including plants have an ability to reduce metal precursors. Green synthesis is a bottom approach. It is a chemical reduction reaction in which there is a replacement of a reducing agent (reductant, an expensive chemical) with an extract of a natural product such as leaves or fruits. The end product is the metal or metal oxide nanoparticle (green Nanoparticle, NPs). Green synthesis is a promising method of generating nanoparticles and it is a multidisciplinary approach in which various streams of sciences (life sciences and physical sciences) contribute with unlimited scope and utility. Preparation of metal nanoparticles is done by using aqueous solutions of metal precursors like Au, Ag, Cu, Fe etc and mixing them with purified bio extracts and the reduction reaction occurs in a specific environment. In this report green synthesis of silver nanoparticles using medicinally important plants, Ocimum and Zingiber has been demonstrated with colour reactions and UV spectra analysis. Green nanoparticles could be synthesized efficiently in both the systems with slight modifications in the experimental protocol. The study easily demonstrates synthesis of silver nanoparticles in medicinally important plants with a bottom down approach.

Effect of Organic Extracts on *in vitro* Seed Germination in *Withania coagulans*

Sonali Jandyal and Avinash Kaur Nagpal

Department of Botanical and Environmental Sciences,
Guru Nanak Dev University, Amritsar, 143005, Punjab, India.

sonalijandyal@gmail.com

The use of organic extracts (compost and vermicompost) is steadily increasing because they are beneficial for plant growth and yield. Compost extracts contain soluble nutrients from compost like humic acid, sugar and amino acids which promote plant growth. Vermicompost leachate and tea contain earthworm secretions, microbial load and soluble nutrients and these have been reported to have positive influence on germination, plant growth and development. *Withania coagulans* Dunal (family Solanaceae) commonly known as Indian cheese maker or punir bundh, is one of the important medicinal plants and is well-documented in Ayurvedic literature for providing health benefits. Presently, this species is listed in the endangered category due to its over exploitation for medicinal purposes and as fodder for animals etc. Considering various medicinal properties of this plant, present study was planned to investigate effect of different extracts of compost and vermicompost on seed germination of *W. coagulans* under *in vitro* conditions. Three types of compost(CT) and two types of vermicompost (VC) were prepared using following composition of kitchen waste, leaf litter, and cattle dung: CT1 (kitchen waste 50% + leaf litter 25%+ cattle dung25%), CT2 (kitchen waste 50%+ leaf litter 35% + cattle dung15%), CT3 (kitchen waste 75% + leaf litter 25%), VC1 (leaf litter 50% + cattle dung 50% + 30 earthworms (*Eisenia foetida*)) and VC2 (Leaf litter 25%+ kitchen waste 25% + cattle dung 50%+ 30 earthworms (*Eisenia foetida*)). Three different concentrations (5%, 10%, 15%) of each type of compost and vermicompost were used for treatment. Prior to any treatment, seeds were surface sterilized with 0.1% $HgCl_2$ solution for 30 seconds and then washed 3-4 times under running tap water followed by 1-2 washings in distilled water. Then seeds were soaked in different concentrations of extracts of CT1, CT2, CT3, VC1 and VC2 for 24 h. Seeds

without any treatments were used as control. After 24 h, seeds were inoculated on Petri plates lined with *Whatman* filter paper No. 1. 15 seeds were placed in each Petri plate. 2-3ml of each extract was poured in each Petri plate daily for 4 weeks. The experiment was set up in a culture room maintained at 25 ±2^{o}C for 16 h light and 8 h dark. Seed germination percentage, root and shoot lengths were recorded after 4 weeks of setting the experiment. Out of different concentrations of vermicompost extracts, VC1 15% showed maximum germination percentage (84.4%) followed by VC2 10% (77.7%). Among different treatments of three compost extracts (CT1, CT2 and CT3), maximum germination percentage (84%) was noticed for CT1-5% followed by 82.2% for CT2 -5%, 81.2% for CT3-5%.

Ethnomedicinal Usage of Plant Species by Population of Verka-Block of Amritsar, Against Diabetes

Akanksha Bakshi and Avinash Kaur Nagpal

Department of Botanical and Environmental Sciences,
Guru Nanak Dev University, Amritsar (Punjab).

prof.avnagpal@gmail.com

Plants have been used extensively for their medicinal benefits across the globe since ages. Traditionally, various plant parts have been used to treat a number of diseases affecting the respiratory, reproductive, urinary, circulatory, neurological, and skeletal systems. Diabetes is a chronic condition (hyperglycaemia) characterised by continuously high levels of sugar in the blood. Untreated diabetes may cause serious damage to vital organs. Knowledge of plants to cure different diseases and disorders has been gained by human beings from generation to generation mainly by verbal means of communication without any proper documentation. Ethnomedicinal studies conducted in various countries, including Saudi Arabia, Bangladesh, Mexico, Sudan, and India, have demonstrated the value of using traditional remedies to treat diabetes. The purpose of the presence research is to investigate and document the tremendous knowledge on ethnomedicinal importance of plants used by the local people of Verka-Block, Amritsar for the treatment of diabetes. Using the snowball sampling method, the current study was conducted to gather ethnomedicinal data on various plant species. An online questionnaire as well as several visits to the study area with a different questionnaire for interviewing various informants were used. The Factor of Informant Consensus (FIC) was calculated to measure the homogeneity of the informants' knowledge regarding medicinal plants. After interviewing more than 100 persons, it was revealed that 19 plant species from 13 families have been used to treat diabetes. This study reveals an intriguing use of medicinal plants by the local population, indicating the continued use of medicinal plants. Unfortunately, due to modernization, traditional knowledge is rapidly disappearing; there is an urgent need to preserve our ancestral knowledge. These plants have the potential to be used in drug discovery to treat diabetes.

Coordinated and Fine-Scale Expression of Essential Micrornas Regulate Flowering-Time Phenotypes in Mir167 Target Mimic Transgenic Lines of Tobacco (*Nicotiana tabaccum* L.)

Madhu Kumari, Sakshi Arora and Bhupendra Chaudhary

School of Biotechnology, Gautam Buddha University, Greater Noida, U.P.

bhupendra@gbu.ac.in

MicroRNAs (miRNAs) are small, non-coding RNAs having vital roles in regulating expression patterns of numerous transcription factors and their target genes. The miRNAs are also necessary for the regulation of a shift from vegetative to reproductive stages as well as floral development. Evidently, miR156, miR159, miR160, miR164, miR165/166, miR167, miR169, and miR319 control floral growth and flowering-time phenotypes in plants. Amongst these miRNAs, auxin signalling regulating miR167 is crucial for the initiation and growth of flowers. Determining flowering-time traits significantly depends on the magnitude of miR167 transcription. Target mimicry-based expression diminution of miR167 genes measuring up to 27% causes an early flowering phenotype in tobacco whereas 45-76% reduction causes a late flowering phenotype. Evidently, other flowering-associated miRNAs and their target genes exhibit altered expression profiles in miR167 silencing mimic lines. Remarkably, the degree of expression alteration of these miRNAs is inversely correlated with the percent miR167 diminution, leading to '*early*' and '*late*' flowering-time phenotypes. Early flowering miR167 mimic lines exhibited >90% transcriptional alteration in associated miR156, miR159, and miR172 compared to smaller transcription changes in late-flowering mimic lines. Altered expression profiles of flowering-associated miRNAs are possibly regulating the varied flowering phenotypes. This information adds to our understanding of the fine-scale expression coordination of flowering-associated miRNAs and their future utilization in translational research.

Bioprospection of Some Important Medicinal Plants

Phalisteen Sultan, Firdous A Mir & Qazi Parvaiz Hassan

CSIR, Indian Institute of Integrative Medicine,
Sanatnagar, Srinagar – 190005, J&K, India

phalisteen@iiim.res.in

India is endowed with huge natural plant resources that have a great pharmaceutical value in modern times and provides great opportunity for meeting the global demand for production of some high value natural products and its valuable bioactive molecules. The advancing and emerging field of phytopharma industry offers great potential to the economic development of this region. The basic scientific techniques for conservation of genetic diversity of these high value plant species are i*n-situ* and *ex-situ* conservations and efforts are required to upscale the production of such herbal products. Understanding of the challenges and opportunities in conservation of some rare and threatened medicinal plants and also to develop new emerging biotechnological approaches for the sustainable supply of such high value herbal products. Medicinally important plants are continuously harvested from the wild for their traditional applications and for the development of novel drugs or supplementary products. More attention is given for discovery of new drugs from medicinal plants and the demand for raw material of these plant species is steadily growing. However, there are not enough meticulous efforts taken in this direction to ensure the availability of targeted medicinal plants in the organized sector to fulfil the industry's demand and fulfil global challenges. Moreover, there are no sustainable approaches developed for harvesting as well as for conservation of in-demand medicinal plants. Due to this awful situation, many medicinal plant species are becoming rare, vulnerable, endangered and or extinct. Unfortunately, very meagre, or no concrete efforts have been undertaken for their conservation and sustainable supply of these products. Therefore, there is a need to intensify the efforts not only for conservation but also to ensure sustainable supply of medicinal plants. Biotechnological tools such as micropropagation, cryopreservation and transgenic approach should be used efficiently for the conservation of medicinal plants for the sustainable growth and development of the industry, people and the planet.

Keywords: medicinal plant, traditional, biodiversity, herbal, pharmacological.

Ephedra – Bridging Traditional and Modern Medicine

Gagandeep Singh, Khushi, Tanya Singh, Ridhi Khurana

Department of Botany, Hansraj College, University of Delhi – 110007

khuranaridhi@gmail.com

Traditional medicine systems such as Ayurveda, Unani, and traditional Chinese medicine have been practiced for centuries. About 40% of the world's approved pharmaceuticals have origins in natural products. As per WHO's estimates for the year 2022, 80% of the world's population was found to use some form of traditional medicine. The sympathomimetic properties of ephedrine alkaloids in *Ephedra* spp. have been used in traditional medicine systems for treating cardiovascular diseases, cold, cough, allergies, asthma, hay fever and metabolic conditions etc. Despite its effectiveness in treating the aforementioned conditions, the FDA banned use of *Ephedra* derivatives as dietary supplements in 1983 owing to health risks arising from a combination of ephedrine with caffeine such as – cardiac arrests, seizures, and strokes etc., and abuse of psychostimulant properties of certain species. Researchers have recently shown new potential avenues for *Ephedra* derivatives in improving human health. Recent studies highlighting the antioxidant, antimicrobial, and anticancerous properties of *Ephedra* extracts will be presented.

Medicinal Plants Cultivation Marketing and Entrepreneurship: Role of Rural Youth

Ayush[1], Vishal Jhakar[1], Vibha G Checker[2] and Renu Kathpalia[3]

Department of Botany, Kirori Mal College, University of Delhi

rkathpalia@kmc.du.ac.in

Medicinal Plants are a major source of biomolecules that play a major role in modern medicine in the treatment of many diseases. India's 'One Nation, One Health System' approaches are providing treatment modalities between contemporary and traditional medicinal plants too. However, the cultivation of these plants is also fraught with the peril of substitutes and adulterants traded freely in the market, thus affecting the quality and efficacy of the final product. The farmers' lack of access to technical knowhow and advisory support for cultivation and management of these plants add to the issues, as they often purchase poor-quality planting materials at a very high price. Different government institutions have taken initiatives to tackle these issues. Central Institute of Medicinal and Aromatic Plants (CIMAP) has released several varieties of Medicinal and Aromatic Plants (MAPs), their complete agro-technology and post-harvest packages which have revolutionised MAPs cultivation and business scenario of the country. On the other hand, the pharmaceutical industry is facing tremendous challenges in acquiring sufficient quantities of raw material derived from MAPs for manufacturing high quality medicines.

Rural youth can be the active partner in the process of learning modern techniques and methods of cultivation of MAPs and can bring innovation among rural people. The youth has a pivotal role in encouraging and creating awareness among farmers and among themselves to enhance the cultivation and making the profit out by growing MAPs. Our study provides a holistic overview about the role of youth in enhancing the cultivation of these medicinal plants and making it a way of their livelihood.

Keywords: Entrepreneurship, cultivation, Medicinal and Aromatic plants (MAPs), rural youth

Medicinal Plants of Indian Subcontinent: Potential and Threats

Ayushi Tiwari and Kabir Khanna

Department of Botany Hansraj College, University of Delhi

ayushitiwari.1912@gmail.com

Our scientific poster explores the traditional ethnobotanical practices of medicinal plants in the Indian subcontinent for skin care. The study and research focuses on the use of medicinal plant-based remedies for various skin conditions, such as acne, eczema, and psoriasis, and examines the cultural significance of these practices. Medicinal plants contain a wide range of bioactive compounds, including antioxidants, anti-inflammatory agents, and antimicrobial agents, which have been found to be effective in treating various skin conditions. We conducted a comprehensive review of the existing literature and various research articles on ethnobotanical practices in the Indian subcontinent, including traditional medicine systems such as Ayurveda, Unani, and Siddha. There is a rich tradition of using plants for skin care in the Indian subcontinent, with many remedies passed down through generations. Some commonly used plants include neem, turmeric, aloe vera, and sandalwood, which have anti-inflammatory, antibacterial, and antioxidant properties. These practices could be integrated into modern dermatological care, offering safe and effective alternatives to conventional treatments. We have also researched potential threats to medicinal plants and included in our poster in brief. Overall, our scientific poster highlights the importance of preserving and promoting traditional knowledge of ethnobotanical practices for skin care in the Indian subcontinent, underscores the need for further research to better understand their potential therapeutic benefits and the need to develop policies in order to safeguard India's treasure to the world. National Conference on Medicinal Plants 2

Commiphora wightii: An Important Medicinal Plant Species of Indian Arid Region

Anjali Joshi

ICFRE-Arid Forest Research Institute, Jodhpur (342005), Rajasthan

ajoshi@icfre.org

Commiphora wightii (Arnott) Bhandari belongs to the family Burseraceae and is an important medicinal plant of Indian arid regions. Popularly known as Guggul, the species is mainly found growing on the rocky tracts of Gujarat, Rajasthan, Karnataka and Madhya Pradesh with the oleo-gum-resin extracted by tapping of the species being the economically important product being used widely in incense, perfumery and ayurvedic medicine industries. Tapping of *C. wightii* is a destructive process with plants drying shortly after being tapped for gum resin which have led to the reduction in area under natural *C. wightii* plantations leading to the extinction of the species from large areas. The reduced availability of the gum resin and widespread demand had led to import of the gum resin from foreign countries at significantly higher prices. The species is also characterised with predominance of female trees in the population while male plants are rare. This ultimately has led to low pollen availability hence poor seed set. Rarity of male trees have also led to evolution of apomictic mode of reproduction in the species, which involves circumventing the process of pollination as well as fertilization and forming seeds identical in genotype to the parent plant. Besides incompatibility reactions and poor seed germination are also evident. All these factors have considerably reduced the genetic variability in the species which ultimately limits the extent of genetic gain as a result of conventional breeding programmes. The species therefore requires the incorporation of novel biotechnological approaches for its genetic improvement and so as to encourage its commercial plantation in order to meet the increasing market demand as well as indirectly conserve the naturally occurring germplasm of the species.

Keywords: *Commiphora wightii*, Guggul, Genetic improvement, Variability

Invasion: A Growing Threat to the Native Medicinal Plants of the Himalayas

Priya Hansda, Shailendra Kumar and Satish Chandra Garkoti

Plant Ecology Laboratory, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi

hansda.priya95@gmail.com

Plant invasion has emerged as one of the most severe environmental and socio-economic problems and has increased drastically over the decades. Invasive alien species (IAS) pose severe threats to the native biodiversity and ecosystem of any area. *Ageratinaadenophora* is one such invasive plant that has affected several ecosystems in the Himalayan region.The Himalayas are a rich repository of medicinal plants that have great use in traditional medicine systems. Our study observed the invasion impacts on three native shrubs – *Berberis asiatica*, *Rubus ellipticus,* and *Pyracantha crenulata* in the Almora district, central Himalaya. These native shrubs are of great importance because of their medicinal value. We observed the phytosociological attributes and soil physicochemical parameters like soil organic carbon, total nitrogen, soil moisture, etc. to understand how the invasive alien plant is successfully spreading and threatening the native shrubs in different forests of the study site. We sampled soils beneath invasive and native shrub species and analyzed a few parameters to understand the belowground mechanisms. Our findings suggest that Invasive *Ageratina adenophora* possesses certain traits that favor its own growth and hampers the distribution of the nearby native species and that the plant invasion has led to a tremendous decrease in the density and abundance of the three medicinal shrubs in different forests of the study area.

Keywords: Plant invasion, medicinal shrubs, native, Himalayas

Genus *Allium* L. (Amaryllidaceae) in India with Emphasis on Conservation of Rare and Threatened Species

Damini Sharma[1,3], Sandeep Chauhan[2] and Arun K. Pandey[3]

[1]*All India Institute of Ayurveda (AIIA), Mathura Road, Sarita Vihar, New Delhi-110076*

[2]*Botanic Garden of Indian Republic, NOIDA-201303*

[3]*Mansarovar Global University, Bhopal-462042, Madhya Pradesh*

daminis861@gmail.com

The genus *Allium* (family Amaryllidaceae) is used across the globe as vegetable, condiment and in traditional medicine for the treatment of various ailments. In India the genus includes approximately 45 species of which three species viz., *Allium gilgiticus, A. humile*, and *A. wallichii* are endemic. In many cases over the years the diversity of *Allium* in India has been defined by phenotypic plasticity and underlying variations which are not morphologically expressed. This has led to a great deal of confusion, drastically different taxonomic interpretations, and a lower chance of global acceptance. As a result, determining conservation priorities of the targeted taxa has become challenging. The present study reviews the morphological, and distributional data on Indian Alliums. The *Allium* species occurring in Himalayan region are facing threat due to anthropogenic activities. Thus, there is a need for developing strategies for conservation of rare and threatened species. In the present work, an attempt has been made to conserve some of the wild species of *Allium* collected from Western Himalayan region.

Keywords: *Allium*, Taxonomy, Threatened taxa, Conservation

Unexplored Medicinal Plants of Potential Therapeutic Importance: A Review

Shehla Adhami[1], Seerat Siraj, Humaira Farooqi[1]*

Department of Biotechnology, School of Chemical and Life Sciences, Jamia Hamdard, New Delhi, India

hfarooqi@jamiahamdard.ac.in

The wisdom of traditional practitioners for tapping the vast pharmacological potential of medicinal plants serves as the basic foundation of scientific research in medicinal plants. Modern research not only validates the ethnopharmacological application of medicinal plants but also showcases the possibility of exploring a plethora of plants that are still hidden yet widely applicable by the traditional practitioners for treatment of health disorders ranging from simple pyrexia to more complex disease like cancer. Thus vast databases of medicinalplants are still unexplored and need attention. The paper would highlight some chosen unexplored medicinal plants of therapeutic importance which could attract the attention of researchers in the field of herbal medicine to investigate and explore their clinical efficacy and medicinal potential as new therapeutic agents in disease prevention.

Black Rice: Health Benefits and Medicinal Properties

Manisha Sharma[1], Dhananjay Raturi[1], Suman Sharma[2], SoomNath Raina[1] and Apekshita Singh[1]*

[1]*Amity Institute of Biotechnology, Amity University, Noida, 201313, U.P., India*

[2]*Department of Botany, Ramjas College, University of Delhi, Delhi 110007, India*

apak28@gmail.com

Colored or pigmented rice such as Black rice is gaining importance and is consumed not as a staple food but as a functional food because of its nutraceutical properties and health benefits. Black rice has its origin traced back in Asian countries Black rice is rich in anthocyanins which imparts black color to the pericarp. These pigments are not only present in rice pericarp but also present in grains, leaves and stems of the plant. Black rice is rich in bioactive compounds like anthocyanins, phenolics, alkaloids, flavonoids, sterols etc. When compared with white rice black rice is loaded with higher amounts of carbohydrates, vitamins (vitamin B1, B2, folic acid), minerals (calcium, zinc, iron, selenium, phosphorus) and proteins (essential amino acids like lysine, tryptophan). Besides all types of rice varieties, black rice contains the highest amounts of proteins, dietary fibers and antioxidants which are the first line of defense against free radical damage. Also, it reduces the risk of chronic disease development. Black rice enhances longevity, improves digestive system, lipid profiles and heart health, reduces risk of various diseases like diabetes, allergies, atherosclerosis, osteoporosis, hypertension, asthma and has anti-cancerous and anti-inflammatory properties. Hence, black rice is an excellent source of dietary supplement with various nutritive and medicinal properties and a potential to protect from various diseases. The objective of the present investigation is based on the extraction of total seed storage proteins and diversity analysis of selected black rice germplasm to screen out the nutritionally rich varieties which will be enriched with higher levels of proteins and thus possessing medicinal properties.

Agro-morphological Variation in Selected Genotypes of Black Rice with Nutritional and Medicinal Importance

Dhananjay Raturi , Manisha Sharma , Soom Nath Raina and Apekshita Singh*

Amity Institute of Biotechnology, Amity University, Noida, 201313, U.P., India

apak28@gamil.com

Rice (*Oryza sativa* L.), a member of Poaceae is the second most important staple crop of the world being the source of nutrition to more than half of the world's population distributed in a range of climatic regions and environmental conditions. Black rice is well known for its high nutritional value due to the presence of anthocyanins. Other names given for this rice are forbidden rice, emperor's rice, royal's rice and Chakhao rice. This rice originated from Asian countries. It also contains numerous nutritional and bioactive components, including essential amino acids, vitamins, minerals, functional lipids, dietary fibre, phenolic compounds, γoryzanols, tocotrienols, phytosterols and phytic acid. Therefore, consumption of black rice in the regular diet helps to prevent many non-communicable diseases (NCD) such as occurrence of cancer cells, atherosclerosis, osteoporosis, asthma hypertension, diabetes, digestive health and reduces stroke risk level. The present study aims to classify Black Rice germplasm containing accessions collected from different countries based on important agro-morpholoogical characters in order to select varied genotypes for crop improvement.

A Study on Antioxidant activity and Isolation of Bioactive Compounds in the Gal Leaf and Healthy Leaf of *Syzygium caryophyllatum* (L) Alston in Western Ghats of Karnataka, India

Manasa C.R and K. Krishna Swamy

Sahyadri Science College, Kuvempu University, Shimogga, Karnataka

shettymanasa07@gmail.com

Syzygium caryophyllatum is an important medicinal plant, family Myrtaceae, commonly known as south Indian plum. It is a small evergreen tree growing up to 3-5 m tall and is found in Central and Western Ghats of Karnataka. Though it is mentioned in the classics as a variety of Jambu, more uses can be traced from the folklore practitioners. The total phenolic content in ethanol, methanol and aqueous solvent extracts revealed that high phenolic content is reported in aqueous and ethanolic extract of all samples like gall leaf and healthy leaf. Reducing power is associated with antioxidant activity and may serve as a significant reflection of the antioxidant activity. In the present investigation, the concentration dependent reducing ability of the extracts of *Syzygium caryophyllatum* was determined. The antioxidant activity of *Syzygium caryophyllatum* healthy and infected leaf extract were determined by 1,1-diphenyl 1-2 picrydrazyl (DPPH) method. In methanol, ethanol and aqueous healthy leaf extracts showed high percentage of radical scavenging activity determined in ethanol (92.66%), methanol (91.98%) and aqueous (82.84%). In present work, LCMS was conducted for the methanol and ethanol leaf extracts of both healthy and infected samples which showed the presence of different bioactive compounds. The antioxidant potential of the extract was measured by DPPH radical scavenging potential. This study may be useful to explore the pharmacological activity of the extract and individual phytochemicals present in this extract. Further investigations are required to study the mechanism of actions of *Syzygium caryophyllatum* and its constituents by which they exert their therapeutic effects.

Keywords: *Syzygium caryophyllatum*, western Ghat, antioxidant, ethanol, methanol and aqueous

Medicinal Aspects of Lentils (*Lens culinaris)*

Sagar Ruhal[1], Suman Sharma[2], Soom Nath Raina[1]and Apekshita Singh[1]

[1]*Amity Institute of Biotechnology, Amity University, Noida, 201313, U.P., India*

[2]*Department of Botany, Ramjas College, University of Delhi, Delhi 110007, India*

asingh20@amity.edu

Lentils (*Lens culinaris*) isan annual plant which belongs to the Fabaceae family. It is widely known for its lens-shaped seeds and contributes a major portion as dietary components due to its large health benefits as well as high nutritional and medicinal value. *Lens culinaris* contains fibers, B-complexes, and ions such as magnesium, iron, calcium, potassium, molybdenum, and selenium etc. Daily consumption of lentils lowers the potential risk associated with cardiovascular diseases (CVD_s). Fibers present in lentils help to reduce cholesterol thereby boosts metabolism and prevents bowel syndrome. It also helps to prevent the risk associated with colon cancer and prostate cancer. The ions present in lentils help to reduce blood pressure and possess anti-tumour and anti-inflammation properties. *Lens culinaris* also contain certain phytochemicals such as phenolic acids, phytic acid and flavanols which in turn provides lentils their antioxidant propertyand lowers the occurrence of developing atherosclerosis. Lentils are a rich source ofmolybdenum thereby acting as a catalyst for enzymes to promote the breakdown of certain amino acids. Also, lentils can be beneficial for diabetic patients as it helps in maintaining balance in blood sugar levels and lowers plasma glucose. The seeds of *Lens culinaris* are mucilaginous and laxative and are beneficial for treatment of constipation and other intestinal problems. Also paste of lentil is applied for cleansing purposes in foul and indolent ulcers. Hence, Lentils (*Lens culinaris*) benefits human beings to large extent due to its potential medicinal values.

The present study reviews the medicinal properties associated with Lentils (*Lens culinaris*).

Digitising Flora of DAV College Chandigarh through Quick Response (QR) Codes

Ranju Gulati

Assistant Professor, DAV College, Sector 10, Chandigarh 160011

ranjugulatidav@gmail.com

The present poster demonstrates a system that uses Quick Response (QR) codes to increase knowledge gain by students and visitors to the DAV College Campus Botanical Gardens. QR codes are two-dimensional barcodes that may contain virtually any kind of electronic data, including links to websites, text, videos, etc. These QR codes were placed on existing botanical signs in the Gardens. The QR codes can be scanned by visitors' smart mobile devices, which link them to an online resource for further information, such as Google or Wikipedia. First, a suitable QR code generator was chosen. The chosen generator is free and creates traceable codes that record which codes are being scanned and how often. Next a database of existing signs and coordinating documents and websites was created. Finally, the QR codes were then printed on heavy-duty, waterproof laminated paper for installation on signs. It has been concluded that QR codes are very flexible, easy to create, simple to track, and therefore could be applied to any demonstration landscape to educate visitors.

Keywords: Quick response Codes, Botanical signs, database

Study the Effects of Synthetic Cytokinin on Micro- Propagation of Endangered Medicinal Plant: *Vitex negundo* (L.)

Shweta Chaudhary and Garg G

School of Biotechnology, Gautam Buddha University, Greater Noida (U.P) India

shwetachaudhary2022@gmail.com

An efficient and improved shoot regeneration technique for the micro-propagation of Vitex negundo, an aromatic and medicinal shrub through in vitro culture of nodal segments with axillary buds is described. The influences of plant growth regulators on shoot regeneration culture on MS medium with 1.0, 1.5, 2.0mg/l benzylaminopurine (BAP), Diphenyl urea (DPU) and thidizuron (TDZ) were resulted to be the greatest percentage of shoot development was hundred percent at 2.0 mg/l BAP in MS medium. The genus *Vitex* is also known as a chaste tree, in which it is a large shrub of native to the tropical and subtropical regions of the world. A diverse range of species is distributed throughout Southern Europe, the Mediterranean and Central Asia. The *Vitex* tree, including its leaves and fruits, has been used for herbal remedies in the form of pastes and decoctions and dried fruits since ancient times. Benzylaminopurine (BAP) used at 2.0mg/l was the most effective in inducing bud break and growth and also in initiating multiple shoot proliferation from nodal explant as compared to other two synthetic cytokinins DPU and TDZ. By repeated subculturing of nodal explants, a high-frequency multiplication rate was established. Optimum shoot multiplication and elongation was achieved when BAP exposed explants were subculture on Murashige and Skoog (MS) media containing a BAP at 2.0mg/l concentration. The greatest average number of shoot multiplication at 2.0mg/l BAP in MS medium compared to other synthetic cytokinins DPU and TDZ in MS medium after seven weeks of culture. The result of MS medium at 2.0mg/l of BAP found the highest multiplication rate of nodes.

Keywords: *Vitex negundo*, subculturing, benzylaminopurine, diphenylurea, thidizuron, cytokinin.

Conservation of Medicinal Plants Using *in-situ* and *ex-situ* Approaches

Ishita Sukhija, Madhu Bajaj, Saloni Bahri and Somdutta Sinha Roy

Department of Botany, Miranda House, University of Delhi, India

madhu.bajaj@mirandahouse.ac.in

Ayurveda that translates the knowledge of life is now considered as traditional medicine of India (WHO). This holistic science of medicine which has been practised and utilized by Indians since centuries is now being globally accepted which has resulted in increased demand for medicinal plants. Medicinal plants such as Aloe, Tulsi, Neem, Turmeric and Ginger are used as herbal home remedies for common ailments in Indian households.

Consumption of allopathic medicines many times results in side effects in humans. Therefore, people prefer herbal medicines. This has increased the demand for medicinal plants leading to overexploitation and irrational cutting of trees ultimately resulting in deforestation. Furthermore, the natural and man-made calamities lead to depletion of medicinal plant diversity which has led to a concern for conservation of medical plants. Conservation of medical plants includes strategies to promote sustainability and protect genetic diversity. Conservation of medicinal plants and their genetic resources can be undertaken by in-situ and ex-situ methods.

In-situ method of conservation deals with the "on-site conservation" of the wild genetic diversity in its own natural habitat. In India, forests are conserved through Protected Areas like National Parks, Wildlife Sanctuaries and Biosphere Reserves. *In-situ* conservation of medicinal plants can be given a great boost if the Government (at national level) prepares some policies related to their judicial use (Kadam and Pawar, 2020).This type of conservation works through two ways, firstly by setting areas as nature reserves and wild nurseries and secondly by ensuring that as many wild species as possible survive in maintained habitats like farms and

plantation forests. Species that are exponentially exploited by over-collection/over-use must be re-introduced into areas where they originally grew.

Ex-situ conservation is used to safeguard them from human destruction, replacement or environment deterioration through techniques such as seed storage, DNA storage, field gene banks and botanical gardens, etc. *Ex-situ* plant conservation is an invaluable resource for plant conservation practitioners at botanic gardens, zoos, and other conservation organizations (Raven, 2004).

Medicinal Plants as Bioresources

Vanshika, Saloni Bahri*, Madhu Bajaj and Somdutta Sinha Roy

Department of Botany, Miranda House, University of Delhi, India

saloni.bahri@mirandahouse.ac.in

Medicinal plants have been used since ancient times as therapeutic agents to cure various diseases. Majority of the drugs used today are derived from over 35,000 plants. The concern that synthetic drugs have side effects has led to search for phytochemicals to be used as safer drugs. The discovery of bicyclol which is used for treating hepatitis, is an example of synthetic derivative of a compound obtained from the fruit of *Schisandra chinensis*, the Chinese magnolia vine that yields several active compounds with anti-steatotic effects in liver cells, thus, creating new alternatives for the treatment of hypercholesterolemia. It also balances hormonesand improves the ability to deal with physical and psychological stresses. Therefore, it helps to treat psychiatric disorders (Pan et al. 2013; Thomas, 2021). Another important medicinal herb is *Nymphaea pubescens* consumed as food and anti-diabetic. Extracts of flowering parts of the plant can be used to reduce the blood glucose level. Further, the leaves, roots and flowers of the plant can be used as antioxidants (Pokhrel et al. 2022; Prodhanet al. 2023). Another study on bioactive compounds from *Piper* species highlights its medicinal importance in drug discovery. *Piper* species are often used to treat rheumatoid arthritis and stomach ache. They possess antibacterial, antifungal, anti-inflammatory, antimalarial, and antioxidant properties. Several alkaloids including chabamide, piperlongumine, piperine, guineensine, and pellitorine have been isolated from *Piper* species. These have been demonstrated to inhibit the growth of cancer cell lines inducing apoptosis and acting as nuclear export inhibitors (Mgbeahuruikeet al. 2017). Brown seaweeds are a source of bioactive compounds fucoxanthin, phloroglucinol, and fucoidan which have shown cytotoxicity against various cancer cell lines. Thus, theycan serve as effective therapeutic agents against breast cancer (Pádua et al. 2015). Some studies have shown that nanotherapycan be developed against cancer using seaweed biomass. Red seaweed derived polysaccharide and silver nanoparticles can be used to make

nanocomposites which are non-toxic to healthy as well as stem cells, destroying only cancer cells (Kholiya et al. 2020). Thus, bioactive compounds obtained from medicinal plants can be used as therapeutics against diseases such as cancer, diabetes and hepatitis.

An Exploratory Study of *Remusatia vivipara* (Roxb) Schott Wild Plant

Bommegowdna A Mauna, Manasa C. K., Dr. Parmeswar Naik T.
muthyashok@gmail.com

Kodagu the Scotland of India is one of the unique area for its food and its traditional culture. Kodagu is a source of medicinal plants with different practices. The *Remusatia vivipara* (Roxb) Schott has traditional values where the leaves and corm are rich in vitamins, calcium, and starch. The plants have slimy property which serves as anti ulcer agent. The present survey includes high nutritional and ethnomedicinal sources. The studied plants have other medicinal properties such as antioxidative property, antimicrobial activity. *Remusatia vivipara* also has anticooling property. The phytochemical screening showed the presence of flavonoids, erpenoids, alkaloids, saponins and reducing sugars. More study is going on to analyse pharmacological activities.

Keywords: Kodagu, Remusatia vivipara, starch, Anticooling property, phytochemicals.

Isolation and Identification of *Agrobacterium* Species from Different Natural Habitats and Evaluation of their Potential in Atmospheric Nitrogen Fixation and Plant Growth

Malavika J and Jayakumar K*

Department of Botany, SVR NSS College, Vazhoor, Kottayam

malavikaj609@gmail.com

In plants, nitrogen is a critical limiting factor required for the proper maintenance of growth and production. Nitrogen forms about 78% of the total atmosphere gases and plants can utilize its reduced forms only. Certain microorganisms in the soil have potential to build up atmospheric nitrogen into its reduced and plant absorbable form, a process called nitrogen fixation. In conventional agricultural methods, farmers rely largely upon chemical fertilizers in nitrogen deficient soils to counter the deficiency and increase the crop yield. Besides the benefit, more often, these chemicals are costly and associated with several ecological problems. Contrary, nitrogen fixing bacteria (NFB) can effectively substitute chemical fertilizers and are eco-friendly too. But research in the development of NFB into bio fertilizers is in its infancy stage and many areas in India are not properly studied for the presence of novel NFB strains. In this context, we can understand the importance of the study I have mentioned above and research works in this particular Agrobacterium species is very rare and it was found that a few species were efficient in nitrogen fixation and it is new information in the field of microbiology. So if we get succeeded in finding a new strain or species which have more capacity to fix atmospheric nitrogen than the existing species through morphological analysis, biochemical screening, molecular methods like DNA extraction, 16 S rRNA sequencing, comparison with the existing species, identification through phylogenetic tools and further proper testing in different plants, it will be a great milestone in the present scenario and in agriculture field. It will open a new pathway to produce more crops within limited land resources in an eco-friendly way.

Keywords: Nitrogen, 16S rRNA, Agrobacterium

Common Medicinal Plants and their relevance in Traditional System of Medicine

Savita[1*] and Avinash Kaur Nagpal[2]

[1]*Department of Botany, Hansraj College, University of Delhi, Delhi, India*

[2]*Department of Botanical and Environmental Sciences, Guru Nanak Dev University, Amritsar, Punjab, India*

avnagpal@rediffmail.com; savita14.du@gmail.com

Traditional medicines obtained mainly from herbs play an important role in rural and tribal areas, as remedies for different diseases. The use of traditional medicines has increased in the recent past which demands strong scientific evidence for effectiveness of these therapies. For primary health care, traditional or indigenous medicines are still popular among 75–80% population of the world, mainly in the developing countries, because they are most affordable and accessible, culturally accepted, more compatible with human body and have lesser side effects. The Indian Himalayan Region (IHR) is considered as a 'store house' of the valuable medicinal plants and is one of the richest reservoirs of biological diversity in the world. Medicinal plants are integral part of traditional medicine systems, providing clues to new areas of research and in biodiversity conservation. However, the information about the medicinal plants from many interior areas of Himalaya are still lacking. The present chapter includes the history, origin and principles of various traditional medicinal systems (Ayurveda, Siddha and Unani medicine) and medicinal plants used in these systems from Himalayan regions.

First Report of *In-vitro* Elicitation of an Anticancerous Biomolecule Berberine in *Linum usitatissimum* L. callus Cultures

Sahil Mehta[1] and Veena Agrawal[2]

[1]Department of Botany, Hansraj College, University of Delhi, Delhi, India

[2]Department of Botany, University of Delhi, Delhi, India

Plants are the world's best combinatorial chemists that provide hidden secrets of healing properties to soothe humankind from fatal diseases like cancer, malaria, typhoid, diarrhea, AIDS, tuberculosis, etc. One of such oldest yet most important cultivated industrial oil and fiber crop plant is linseed or common flax (*Linum usitatissimum* L.; Family Linaceae) grown for fiber, oil, food, and nutrition. Flax plants accumulate multiple biological secondary actives including lignans, linolenic acid, and linoleic acid. However, many other flax compounds have received very little attention to date. One of such least studied bioactive principle is Berberine, a natural, yellow, non-fluorescent isoquinoline alkaloid bestowed with several medicinal effects including anti-microbial, anti-tumoral, anti-obesity, anti-inflammatory, antioxidant, anti-diabetic, anti-adipogenic, and immunomodulatory properties. Considering this point, an attempt was undertaken first to evaluate the berberine content in different plant parts of *L. usitatissimum*. Following this, the berberine content in *L. usitatissimum* callus cultures was enhanced by the novel method of elicitation. Interestingly, the perusal of bibliographical records revealed that this is the first report highlighting the potential of elicitation for enhancing berberine content in flax.

Keywords: *Linum usitatissimum*; Medicinal properties; Berberine; Elicitation; HPLC

Population Level Differences in Active Phytochemical Profile of Selected Medicinal Plants: A Bibliometric Analysis

Aanchal, Aditya Prakash, Anudeepti Bajpai, Ashish Kumar Tiwari, Saurabh Awasthi, Pratibha Pant, Shalini Kaushik Love*

Department of Botany, Hans Raj College, University of Delhi

*shalinikaushiklove@gmail.com

Globally, phytochemicals having medicinal properties are an important source for drug discovery pipelines in the pharmaceutical industry. Phytochemicals are secondary metabolites produced by plants in response to various factors such as environmental factors and genetic structure. In this study, a systematic query-based search for research articles published in last ten years from India on eleven selected medicinal plants was carried out from two publicly available research databases viz. Pubmed and Science Direct. The medicinal plants selected were taken from the prioritized list of medicinal plants developed by National Medicinal Plant Board and also the listing developed by Central Council for Research in Ayurveda and Siddha.

The results of the study show clear trends with respect to research on medicinal plants in the country. Species which are commonly recognized as having high medicinal value cover bulk of the publications, which include *Withania somnifera, Ocimum sanctum and Tinospora cordifolia*. The relative proportion of published research articles on species such as *Rauvolfia serpentina, Picrorhiza kurroa, Gloriosa superba* and *Glycyrrhiza glabra* was low. Amongst the well-known medicinal plants, the major proportion of studies focus upon subject areas of pharmacology, pharmaceutical sciences, medicine followed by studies on biological and agricultural sciences and genetic diversity studies. There were few research publications which reported population-based phytochemical screening of medicinal plants. The research articles on how to bring the medicinal plants under mass cultivation are lacking.

Such studies need to be undertaken particularly for the prioritized list of medicinal plants. This would help in developing strategies so that suitable methods may be developed for bringing identified high yielding populations of medicinal

plants under cultivation, which in turn will help in developing more efficacious treatment remedies. This is of prime importance as only 22 % of medicinal plant production is sourced through cultivation.

KEYWORDS: Databases, Phytochemical profile, Environmental Factors, Medicinal Plants populations, Disease treatment efficacy

Identification of Medicinal Plants Present in Hansraj College Campus and Creating Awareness Among Students about their Medicinal Properties and their Use in Prevention and Treatment of Various Human Diseases

Muskan, Nisha Bharadwaj, Priyanka Kumari, and Shaifali Sethi

Department of Botany, Hans Raj College, University of Delhi

Medicinal plants play an important role in the primary healthcare system of developing countries especially because of their easier availability and abundance. They form the backbone of traditional systems of medicines such as Ayurveda, Unani, and Siddha. The correct identification of medicinal plant is must before it can be utilized for any treatment. The personal communication with many of the undergraduate students revealed that they are unable to identify most of the plant.

In this study, we have carried out survey of all the medicinal plant species present in Hansraj college campus and documented their medicinal properties, nutritional values, part used, digital photographs, generated QR codes for correct identification. Thus, this can help students to know, identify and gain insight about the most common, easily available medicinal plants present in the college.

Message

Amantram akshram naasti, naasti moolanaushadham
Ayogyah purusho naasti yojakastara dulabha

"There is no syllable or letter that cannot be used in mantra. There is no root/herb that cannot be used as medicine. There is no person who is useless. It is just scarce or difficult to find a person who knows how to make use of these."

Provoking inscriptions such as these immortalized in our ancient scriptures have been nudging inspired and motivated human beings committed to human welfare since ages.

The conference being organised by Hansraj College on Medicinal Plants – Frontier Areas of Research and Development during March 16 &17, 2023 is one such noble effort that deserves highest appreciation.

Igniting young minds with the thoughts that have direct application to meet the ever-increasing challenges with respect to human health is the need of the hour and most relevant activity. The scars of the recently faced pandemic have further underlined the fact that any amount of efforts in terms of time, money, research, awareness etc in search of cures for human ailments cannot be considered as overemphasis.

The support provided by National Board of Medicinal Plants in organizing this conference is greatly appreciated. The most important target group of the conference, the bright and energetic students of Hansraj College and other colleges of University of Delhi, will surely bring rich dividends to their financial support as they are the future and hope of our great nation.

I am particularly happy to see the theme areas identified in the conference as they are covering all aspects of medicinal plants comprehensively.

I am confident that the participants as well as the organizers will be greatly benefitted by this useful two- day interaction. I convey my best wishes to the participants and also to the able team of organisers.

"All that man needs for health and healing has been provided by God in nature, the Challenge of science is to find it." ~ Paracelsus.