Journal of Conventional Knowledge and Holistic Health
(Contents available at www.globalscitechocean.com)

Conference proceedings

International conference on conservation, cultivation and sustainable use of high altitude medicinal and aromatic plants for the socio-economic development

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Article history

Received : May 09, 2022
Accepted : June 02, 2022

DOI: 10.53517/JCKHH.2581-3331.612022223

ABSTRACT

The Faculty of Biomedical Sciences, Uttarakhand Ayurved University, Dehradun (India) has organised the International Conference on conservation, cultivation and sustainable use of high altitude medicinal and aromatic plants for the socio-economic development. The conference was held on 7th and 8th May 2022 at Rishikul, Haridwar, Uttarakhand (India). The conference was mainly focused on the conservation, cultivation of medicinal plants to fulfil market demand and socio-economic developments, novel techniques, approaches, innovations for the farming of medicinal and aromatic plants, phytochemistry and pharmacology of medicinal plants, and standardisation of herbal products for quality control. More than 200 participants presented their papers during the conference. The present conference proceedings covered the abstracts of invited talks, oral and e-poster presentations of the conference.

EDITORIAL

Medicinal plants sector in India: challenges and opportunities

Since the emergence of human civilization, plants have been the main source to cure, heal and alleviate various diseases. Medicinal plants belong to a big plant group with great interest due to their pharmaceutical, cosmetic and nutritional values. India is sitting on a treasure of 8000 medicinal and 2500 aromatic plants. The synthesised compounds of these plants are useful to preserve the health of humans and animals. Plants have an almost limitless ability to synthesize aromatic substances mainly secondary metabolites, of which at least 12,000 have been isolated, a number estimated to be less than 10% of the total. These compounds are usually served as the molecules of plant defence against predation by microorganisms, insects, and herbivores. Many modern medicines include Codeine, Morphine, Atropine, Hyoscyamine, Ephedrine, Quinine, Colchicine, Digoxin, Strychnine, Reserpine, Artemisinin, Taxol, Ergot, etc. are of herbal origin. Medicinal and aromatic plants (MAP) are extensively used in Indian traditional systems of medicine such as Ayurveda, Siddha, Tribal and Folk medicine and other systems of medicine that found a place in India such as Unani, Homeopathy, Herbo-mineral etc. Even in the western countries, about one-quarter of the prescription drugs dispensed in community pharmacies in the USA contain at least one active ingredient derived from plant materials. The export of medicinal plants has grown 33.2 per cent during the year 2020-21, with the growing awareness among people towards natural herbs and traditional medicines.

High altitude regions are characterized by the cold and arid climate, scanty rainfall, high wind velocity, snowstorms and blizzards and high ultraviolet (UV) radiation. Vegetation in these regions exhibits a characteristic adaptation to extreme environmental conditions. The information on medicinal plants (MPs) of high-altitude regions in the Indian Himalayan Region (IHR) is fragmentary, though out of 700 MPs used by the entire Indian drug industry, Himalayan medicinal plants contribute roughly 350 species.

Despite the increasing demand for MAP in National and International markets after the COVID-19 pandemic, the challenges like lack of market, absence of market networks, unethical means adopted by market forces, absence of minimum purchase prices, absence of market yards for trading and godowns for safe storing of produce, absence of growers' organizations etc. are still continued. Moreover, in recent times increased demands for available resources, a number of important plants species have become scarce in areas where they were previously abundant. Still, forests are the main source for the collection of a large number of MP resulting in their dwindling supplies and making some of the species rare and endangered or even extinct (about 75 species became extinct between 1600-1900 and the same number between 1900-1970). If the same trend continues, it is feared that about 60,000 species will become extinct in the current century. The dearth of the scientific validity of claimed medicinal properties, quality inconsistencies, high prices of the products, adulteration, unethical means adopted by some companies, contaminants exceeding prescribed levels, not adhering to time schedules etc. are some more challenges.

In spite of many challenges over the centuries, the use of MAP has become an important part of daily life. They are now being progressively cosmetics, foods and teas, as well as alternative medicines. The amount and variety of chemical

constituents present in high-altitude plants differ from plants growing in the lower region, and this attracts researchers to investigate and explore their medicinal applications for human health care. Generally, the high-altitude ecosystems are considered to be hotspots of medicinal plant diversity and are the most neglected/virgin areas for research because of their inaccessibility and harsh climatic conditions. Hence give opportunities to explore as valuable sources of drugs and lead compounds.

As per an estimate, only 20% high altitude MPs are used in the Indian drug trade and all are being collected from wild sources. Most of the medicinal plants are growing in a wild environment therefore their gradual shift from wild to domestic cultivation needs to be encouraged for livelihood. Further in accordance with a high dependence on wild harvesting, local forest management systems such as informal rules and management practices are required to sustainably harvest MP. This will add value to MP products which will be beneficial for the economy. The chain for commercialization of MPs and people involved in plants production should prioritize law enforcement, benefit and knowledge sharing, and research and development. Therefore, the domestication of wild MP on their ecological behaviour through scientific planning is a huge opportunity for their cultivation.

Medicinal and aromatic plants are generally regarded as industrial crops as their products are used either in pharmaceutical or in flavour and fragrance industries. Despite the abundance of innumerable flora and fauna, most of the people high altitude areas are marginalized and still live on a subsistence level. Due to the low point of agricultural production, lack of industrial development, poverty, and unemployment, peoples migrate to exploit biodiversity to improve their socio-economy. However, they need to adopt sustainable harvesting can provide an extra source of income, which compensates for low agricultural production.

The increasing demand for MAPs increases opportunities to solve the unemployment problem in rural areas, improve rural living standards and enable India to become an important exporter of these plants and their products. Small and medium enterprises can give many entrepreneurs opportunities for new enterprises in this field. Similarly, industries, business opportunities in medicinal and aromatic plants, cultivation, processing, bye-products based industries, product development, marketing, consultancy, quality control, packaging, storing and transport can generate more employment.

Considering the economic importance of medicinal plants, there is also an urgent need to systematically cultivate them to exploit their full economic potential and to save them from extinction. However, traditional knowledge plays an important role in the conservation of floral diversity and it is often used for the treatment of numerous diseases in local medicinal systems. Diverse cultural groups in the high-altitude regions have their own local indigenous healthcare systems, with medicinal plant applications that differ depending on geography and ecology. Therefore, it is important to understand plant ecological behaviour for prioritizing conservation efforts and comprehending the impact of climate change on plant phenological traits. Medicinal plants have a promising future because there are about half a million plants around the world, among them, most of their pharmaceutical capabilities have not been investigated yet. Hence, it is an opportunity to explore them in the future.

About the Uttarakhand Ayurved University

The Uttarakhand Ayurved University (UAU) was established by the Government of Uttarakhand vide Uttarakhand Ayurved University Act, 2009 as a dream project of Devbhumi Uttarakhand to promote education and research on Ayurved and herbal medicine. The University is spread in 25 acres of land at Harrawala, Dehradun. Besides already established faculties (Faculty of Ayurved and Faculty of Biomedical Sciences), the University is in progress to establish faculty of Yoga and Naturopathy, Pharmaceutical sciences, Homeopathy, Unani and Siddha System of medicine. University has three Campuses; the main campus is situated at Harrawala, Dehradun and centaury old historical campuses Rishikual and Gurukul are at Haridwar Uttarakhand. The university is recognized by UGC, New Delhi and CCIM, New Delhi, and currently running almost all courses of AYUSH Education at UG, PG and PhD level including BAMS, BUMB, BHMS, MD/MS, PhD, etc.. Nineteen 19 Ayurvedic, Homoeopathic and Unani Colleges are affiliated to the University. The University has centre of excellence in Panchakarma and Marma Chikitisa. A herbal garden is being established at Charak International Institute of Ayurvedic Research, Charekh, Kotdwar.

Vision and Mission

To seek not merely to turn out men as Doctors, Scientists, Merchants, Theologians but also as men of high character, probity and honour, whose conduct through life will show that they bear the hallmark of a great University. University is to bring the socio-economic change in difficult geographical conditions. Despite its economic backwardness state is enriched with its vivid flora and fauna and is well-known specifically for the vast potential of high altitude medicinal plants and herbs. The economic and scientific usage of such diversified resources is to prove the primary source of overall economic viability and sustainable growth culminating into radical economic growth of local people.

About the faculty of Biomedical Sciences

The main objective of the Faculty is to promote the application of basic sciences in the investigation of Ayurvedic concepts, procedures, products and nurture in the discipline of Ayurved biology and evidence-based medicine. Faculty is validating the time tested Ayurvedic concepts on the platform of modern sciences with a plan to develop personalized medicine and search for new ways to treat disease in the modern world with the help of Ayurved. Research in the faculty is

being carried out in basic science to ensure that University produces documented scientific evidence on Ayurvedic concepts which are the need of the hour and growing demand of the scientific community world over. Faculty is running various research and herbal garden project from different funding agencies to serve humankind in a better way and spread awareness among students and society for medicinal and aromatic plants.

The Faculty of Biomedical Sciences has five departments, Ayurved Biology, Biotechnology, Clinical Pharmacology, Molecular and cellular biology and Phytochemistry. The Faculty started functioning with two faculty members in 2015 at the main campus. In a short time, the faculty has attracted almost one crore rupees from different funding agencies to conduct research and other activities at the University. More than 15 MD/MS/ PhD scholars have done their dissertations/ theses work in the Biomedical Laboratories. More than 50 research papers have been published in various journals of International repute. In addition, 7 books and 6 book chapters have been published by the faculty members in past 6 years. Besides, three Indian patents have been filed based on herbal products.

Operational guidelines for the central sector scheme for conservation, development and sustainable management of medicinal plants

National Medicinal Plants Board, Ministry of AYUSH, Government of India
Source: https://nmpb.nic.in

1. Preamble

India is home to a diverse range of medicinal plants which have been used for centuries by the local people to meet not only their own primary health care needs but also to address ailments of domesticated animals (*Pashuayurveda*) & crops (*Vrikshayurveda*). Medicinal Plants form the major resource base of our indigenous healthcare traditions. Although in recent years cultivation of medicinal plants has started gaining momentum, still a significant part of our requirements continue to be met from wild sources. In order to meet the increasing demand for medicinal plants both domestic and from overseas markets we need to focus on both *ex-situ* cultivation of medicinal plants as well as *in-situ* conservation efforts through systematic surveys, augmenting local medicinal plants and aromatic species of medicinal significance through afforestation as per silvicultural principles and management prescriptions. With this in mind, the Central Sector Scheme for conservation, development and sustainable management of medicinal plants was initially approved by the cabinet vide no. CCEA/21/2008 dated 26.06.2008.

The scheme also focuses on quality R&D, capacity building through trainings, raising awareness through promotional activities like the creation of Home/School Herbal Gardens. The scheme also seeks to support programs for quality assurance and standardization through the development of Good Agriculture and Collection Practices (GACPs); development of monographs laying down standards of quality, safety and efficacy; development of agro-techniques and a credible institution a mechanism for certification of quality of raw drugs, seeds and planting material. Apart from this, medicinal plants collection and trade account for as much as 40 to 50% of the household income in certain forest-rich regions, hence, the scheme also aims at livelihood improvement of local communities, especially in forest fringe areas. The Scheme has been continuing since the XI Plan and on the basis of experience gained, reports furnished by the third party monitoring agency and feedback from the stakeholders, it is clearly felt that the scheme needs to continue during the XII Plan period with appropriate modifications based on the experience gained.

The activities proposed to be undertaken in the scheme will also help the country to meet its international obligations in the field of medicinal plant biodiversity and promote bilateral/international cooperation which is not only critical for future growth of the sector but also for establishing India as a global leader in the sector.

2. Objectives of the Scheme

The efforts of the National Medicinal Plants Board (NMPB) need to be considerably upscaled to tackle the whole range of issues impacting the sustained availability of quality herbs. The strategy needs to focus on both cultivation and collection, together with R&D, promotion and information dissemination through IT dedicated mechanisms for the procurement of MAPs, ensuring Minimum Support Price, setting up networked Agri-Mandis for MAPs, drawing up a database of cultivators and growers/cooperatives. Speciality warehousing & strengthening of the supply chain is another priority area. In order to cater to the domestic market needs of ASU industry, the promotion of primary producer companies (PPCs) should be taken-up in a focused manner. These organizations would then be brought into the foreground for marketing of their produce (either cultivated or collected from the wild). The most important aspect is of course capacity building of all the stakeholders especially the collectors who constitute the poorest of the poor in society. The main objectives of the scheme are as follows:

- Promote in-situ conservation of medicinal plants which are important to the AYUSH and Folk systems of medicine. In situ conservation measures would involve survey, incentivisation and documentation of important medicinal plants in their native/natural habitat coupled with resource augmentation in eco-systems where they form part of the naturally occurring biotic community, holistically preventing degradation of such eco-systems and reversing the onslaught of invasive alien weeds;

- Promote ex-situ conservation by supporting such programs in rural/ degraded forest/public/non-public/institutional lands/urban & peri-urban lands and waste lands.
- Engage the Eco-Task Force mechanism for reversing habitat degradation of medicinal plants. Conservation & Development of eco-systems with medicinal plants bio-diversity.
- Promote R&D in all aspects of medicinal plants, development of agrotechniques, post-harvest management, storage and processing, developing molecular characterization tools etc. and promotion of IT.
- Enhance community mobilization and facilitate sustainable livelihood systems based on medicinal plants for farmers, collectors and other stakeholders, especially in forest fringe areas.
- Ensure Quality Assurance - Maintain Good Quality Gene Pool Sources of medicinal plants and aromatic plants having medicinal applications. Mapping, upgrading, modernizing of Medicinal Plants supply chain and creating/ optimizing market linkages and value addition.
- Quality standardization, Good Collection Practices and Good Agricultural Practices for Medicinal Plants.
- Information, Education and Communication - through seminars, trainings and exposure visits promote capacity building and human resource development through appropriate inter-state and international exposure. Promote the publication of documents, monographs, technical bulletins, documentaries, brochures, posters, other publicity materials, etc.
- Strengthen NMPB to more efficiently co-ordinate all matters related to medicinal plants and function as a clearinghouse of information on medicinal plants including their occurrence, usage, ethnobotanical uses, cultivation practices, Post - harvest practices, markets etc. Institutional Strengthening of SMPBs and creating regional/facilitation centres/Centres of Excellence to optimize the strategic reach of the AYUSH systems.
- Promote mainstreaming of medicinal plants in climate change mitigation strategies & promote regeneration/afforestation of medicinal plant tree species towards carbon sequestration.
- Take steps to meet India's international obligations in the context of medicinal plant biodiversity and promote bilateral/international cooperation.

3. STRATEGY

The scheme is proposed to be implemented during XII Plan period from 2014-15 onwards to facilitate the conservation and maintenance of wild populations of Medicinal Plants for long term sustainability by adopting the following strategy:-

a. Strengthen the Medicinal Plant Conservation Areas (MPCAs) by systematic survey, geo-referencing of the existing natural population of medicinal and native aromatic species having medicinal use.
b. Enhance conservation through *in-situ* and *ex-situ* resource augmentation and artificial re-generation of local populations of medicinal and aromatic plant species.
c. Expand area under medicinal and aromatic plants species of medicinal values linked with the creation of nurseries to maintain good quality propagation material.
d. Promote R&D to address the technology gaps, particularly with respect to quality, documentation, identification of substitutes for important medicinal plants including RET listed plants and species with high demand in trade and bio-activity guided phytochemical studies, etc.
e. Improve production, post-harvest technologies, and certification mechanisms for quality standards, Good Agricultural Practices (GAP), Good Field Collection Practices (GFCP) and Good Storage Practices (GSP) value addition and marketing infrastructure.
f. Stay abreast of International Developments impacting conservation, availability, trade, and quality assurance of medicinal plants.
g. Provide livelihoods and economic benefit to forest dwellers, cultivators, local healers and other stakeholders.

3.1. National Medicinal Plants Board

The Medicinal Plants Board was setup under a Government Resolution notified on 24th November 2000 under the Chairmanship of the Union Health & Family Welfare Minister. The objective of establishing a Board was to establish an agency which would be responsible for the coordination of all matters relating to medicinal plants. The Board has the function of coordinating with Ministries/Department/Organizations/State/UT Governments for the development of medicinal plants in general and specifically in the following fields:-

- Assessment of demand/supply position relating to medicinal plants both within the country & abroad.
- Advise the concerned Ministries/Department/Organizations/States/ UTs Governments on policy matters relating to schemes and programs for development of medicinal plants.
- Provide guidance in the formulation of proposals, schemes and programs etc. to be taken by agencies having access to land for cultivation and infrastructure for collection, storage transportation of medicinal plants.
- Identification, inventorization and quantification of medicinal plants.
- Promotion of *ex-situ* and *in-situ* cultivation and conservation of medicinal plants.
- Promotion of co-operative effort among collectors and growers and assisting them to store, transport and market their products respectively.

- Setting up of database on medicinal plants, dissemination of information and facilitating prevention of patents on plants used in traditional systems.
- The matter relating to import/export of raw material, as well as, value-added products either as medicine, food supplements or herbal cosmetics including the adoption of better techniques for marketing of products to increase their reputation for quality and reliability in the country and abroad.
- Undertaking and awarding Scientific, Technological research and cost-effectiveness studies.
- Development of protocols for cultivation and control.
- Encouraging the protection of Patent Rights and IPR.

4. Components of the Scheme

4.1. Conservation of Medicinal Plants through multi-pronged strategy

4.1.1. *In-situ* conservation

A) Medicinal Plants Conservation and Development Areas (MPCDAs)

Objectives

In-situ conservation of important medicinal plants in their natural habitats by setting up MPCDAs, as well as strengthening/up-gradation of existing Medicinal Plants Conservation Areas (MPCAs) through survey inventory, documentation, protection, and main streaming medicinal plants in habitat management approaches.

Activities

a. Setting up Medicinal Plants Conservation and Development Areas (MPCDAs) through survey, documentation of existing natural population of medicinal and aromatic plants, geo-referencing. This would include:

- Ascertaining threat status of various medicinal plant species traditionally obtained from the wild.
- Identifying major causes of threat to the populations of threatened species and possible remedies.
- Drawing up of action plan for conservation and sustainable utilization of important medicinal plant species.
- Stakeholders capacity building, documentation (including a good quality pictorial directory), hosting on the website, conducting pilot research studies etc. for sustainable utilization, engaging services of qualified taxonomists and other necessary professionals for the purpose by the concerned State Agency/SMPB, preparation of case studies, promoting conservation values/ sustainability.

b. Revisiting/ Reviewing/ documentation in respect of previously designated MPCAs (established more than three years back under different schemes) for further development like up-gradation, improving protection, documentation, communication/dissemination linking with the area management plan, georeferencing, engaging professionals on a short term basis, Capacity Building, Community mobilization, hosting on the website, piloting studies on utilization/sustainability issues etc.

c. Mainstreaming medicinal plant conservation in management approaches based on sound silvicultural/management principles, conducting a systematic survey of local medicinal and aromatics plants with medicinal value, and incorporating sound scientific principles for their management in the Working/Management Plans and its effective communication to Stakeholders. These management plans should also include details of MPCDAs, and where they are constituted.

Eligibility

State Forest/Wildlife Department/Forest Development Corporation/Federations/National and State level Research Organization/ Universities. Non-Government/ Voluntary Organizations with expertise in the field (subject to the recommendation of the concerned forest department.).

Coverage

On average an MPCDA should extend over an area of 200 ha., though smaller areas of important medicinal plant bio-diversity including sacred groves can also be considered for MPCDAs.

Norms of Assistance

- To set up MPCDAs, 100% central assistance @ 20,000/- per hectare will be provided.
- For up-gradation/reviewing/ strengthening of previously designated Medicinal Plants Conservation Area (MPCA) which were established more than three years ago under NMPB or other schemes in various states, assistance @ 5,000/- per ha. will be provided.
- For main streaming medicinal plant conservation in management approaches based on sound management/silvicultural principles, a lump sum support of up to Rs.1.5 Lakhs will be provided per Forest Division to the concerned Forest/ Wildlife Division.

Submission of Proposals

The proposals from the State Forest/Wild Life Department in this respect will be submitted to NMPB in the relevant proforma. In case a proposal is submitted by Forest Division/Circle a copy of the same should invariably be marked to PCCF/Chief Wild Life Warden as well which will help in the implementation and monitoring of the project.

Management support

One project management Consultant and one Data Entry Operator will be permitted to be engaged for providing support at the NMPB level for activities relating to scrutiny, implementation, monitoring and technical support to the state for the component.

B) In-situ resource augmentation

Objectives

Assisted natural regeneration or artificial re-generation of local populations of medicinal and aromatic plant species for conservation of genetic diversity of medicinal plants, thereby complementing the other biodiversity preservation and climate change mitigation interventions being implemented by the country as part of its international obligations.

Activities

In-situ resource augmentation of medicinal species through assisted natural regeneration. Artificial re-generation of local populations of medicinal and aromatic plant species in particularly important in case of species where wild populations have dwindled on account of habitat degradation, and unsustainable harvest. Active interest and engagement of rural communities in such a conservation program is instrumental to address the sustainability of the medicinal plant sector as a whole, hence financial support will also be provided for community mobilization through entry point activities.

Eligibility

- State Forest/Wild Life Departments/Forest Development Corporation.
- Public Sector Corporations/Federations having the mandate to carry out such activities, Voluntary agencies/Non-Government Organisations with experience in the field (only for technical support and capacity building)
- National and State level Research organisations/Universities with the agreement of Forest Department.

Norms of assistance

Cost norms for *in-situ* resource augmentation and plantation of medicinal trees, shrubs, herbs, climbers and perennials can be found at the NMPB website.

Submission of proposals

The proposal from the State Forest/Wild Life Department will be submitted to NMPB in the relevant proforma. In case a proposal is submitted by Forest Division/Circle a copy of the same should invariably be marked to PCCF/Chief Wild Life Warden which will help in monitoring the project during its implementation.

Management support

One project management Consultant along with one Data Entry Operator will be engaged in providing support at the NMPB level for activities relating to scrutiny, implementation, monitoring etc.

4.1.2. *Ex-situ* Conservation

Objective

Ex-situ conservation of medicinal plant species is a complementary action to conserve the genetic diversity of medicinal plant species, thereby reducing pressure on wild habitats and augmenting raw material availability. For many species, wild population shaved dwindled to critical levels and viable populations of these species are not available for initiating in situ conservation action. *Ex-situ* conservation/plantation of medicinal plants will be a reliable seed source and also serve as field gene banks. This will also help in engaging a larger number of stakeholders in the production and regeneration of important medicinal plants and aromatic species of medicinal value.

Activities

For expanding area under medicinal plants and aromatic species of medicinal value. Plantations of medicinal plants would be raised in lands outside designated forests. These plantations may be in blocks, strips, boundaries, marginal lands, agro-forestry models etc., in the countryside as well as urban/periurban locations. Such plantations would be raised by organisations having ownership / long term lease of lands and requisite technical competence either in-house or hired/outsourced.

Eligibility

- State Forest Departments/Social Forestry Divisions/State Wild Life Departments.
- Forest Development Corporations/Federations/SMPBs/Integrated Tribal Development Corporations/SC/ST Corporations (in the SC/ST lands)/Municipal bodies/ Housing Societies/PSUs/Voluntary Organisations with experience in the field provided they have the required technical competence.

- Scientific Organizations and AYUSH Institutes and other Government Agencies have the mandate/ capacity and interest in the field of medicinal plants.
- Corporate Sector (including reputed AYUSH manufacturers) in partnership with land owners and Panchayats Van Panchayats/ BMCs/ JFMCs will be considered for project-based support subject to forming an SPV and demonstrating commitment by contributing at least ` 5.00 lakh rupees to an initial corpus to be dedicated for this purpose out of which at least ` 3.75 lakhs will be contributed by the corporate partner.

Norms of assistance

The cost norms for ex-situ plantation of medicinal trees, shrubs, herbs, climbers and perennials can be found on the NMPB website. The Corporate Sector (including AYUSH manufacturers of repute) can also be supported for raising ex-situ plantations, including as components in boundary plantations, strip plantations, agro forestry, etc., with the adoption of GAP & GFCP. For this purpose, a Special Purpose Vehicle (SPV) involving the reputed AYUSH manufacturer and Panchayats or land owners will be formed. Rs.5 Lakh will be provided as an initial corpus fund out of which at least 75% will be contributed by the concerned Corporate Sector. Financial support from NMPB will be considered in project mode and transferred to a separate bank account to be opened in the name of the SPV. Such proposals will be supported in project mode.

Submission of proposals

The proposal from the State Forest/Wild Life Department will be submitted to NMPB in the relevant proforma. In case a proposal is submitted by Forest Division/Circle, a copy of the same should invariably be marked to PCCF/Chief Wild Life Warden which will help in monitoring the project during its implementation. The proposals by the corporate sector will be submitted to NMPB as well as to SMPB concerned concurrently. The SMPB will render its inputs, if any, within a period of three weeks of receipt of the proposals to the NMPB as well as to the organization concerned, failing which the proposal will be put up for consideration by the PSC/ SFC.

Management support

One project management Consultant along with one Data Entry Operator will be engaged in providing support at the NMPB level for activities relating to scrutiny, implementation, monitoring and technical support to the state.

4.1.3. Engaging Eco Task Force for rehabilitation of critical Medicinal Plant Habitats

Objective

To secure reverse/acute degradation of natural habitats in various parts of the country along with eco-restoration through the plantation of medicinal and aromatic plants.

Activities

The natural habitats of various important medicinal plants are facing high degradation threats. In order to mitigate such threats, Eco-Task Forces have been successfully engaged to secure reverse/acute degradation of natural habitats in various parts of the country. It is, therefore, proposed to commission services of Eco-Task forces involving Ex-servicemen/Territorial Army. This effort is to be initiated in a project mode to be approved by the SFC. The concerned State Forest Department, Ministry of Defence and Ministry of Environment and Forests will be consulted for taking up any such initiative. Proposals under this component should have a plantation of at least 60% of the area with native species of medicinal plants.

Eligibility

Eco Task Forces are set up in different parts of the country.

Coverage

At least 400 hectares per Eco Task Force per annum will be taken up.

Norms of Assistance

The cost norm for this activity will be project-based.

Submission of proposal

The proposals from States will be received by NMPB which will organize a tripartite initial consultation with MoEF and Army/ Headquarters before duly considering the project.

Management support

The project management Consultant along with one Data Entry Operator will be permitted to be engaged in providing support at the NMPB level for activities relating to scrutiny, implementation, monitoring and rendering technical support.

4.2. Support to Joint Forest Management Committees (JFMCs)/Panchayats/Van Panchayats/SHGs/BMCs for setting of local cluster for value addition, drying, warehousing and augmenting marketing infrastructure, etc.

Objectives

There is a need to channelize production and promote a sustainable supply of medicinal plants, through capacity building of JFMCs/Van Panchayat/ Panchayats/local SHGs/BMCs about the medicinal plants & aromatic species of medicinal value that are locally available for encouraging sustainable harvest, adoption of good collection practices, proper post-harvest handling, marketing and regeneration of NTFPs, etc. This activity will provide livelihood augmentation to local and forest fringe communities.

Activities

- Support will be provided for the creation of facilities (including equipments for value addition through drying, de-stoning, cleaning, grading, pulverizing, processing, powdering, billeting and packaging, extracting, warehousing, etc. Capacity building through training programs and exposure visits on Good Collection Practices, Cultivation Practices and Organic Certification.
- Marketing support will be provided for organizations of stakeholders/ buyer-seller meets at Forest Development Agency (FDA) District/ Division level, Entrepreneurship development for micro and small enterprises (training).
- Packaging/handling equipment, testing facilities created in individual JFMC/BMC or pooled facilities catering to more than one JFMC/ BMC/village/Panchayats will be supported.
- Support will be provided for limited resource augmentation and production of seedlings of medicinal plants & aromatic species of medicinal value, if not supported under any other components of the Scheme.
- Capacity building of primary collectors, women Self Help group (SHG), Public Sector Corporations dealing with NTFC, Tribal Welfare Department and frontline Forestry Personnel duly recommended by Local Forest Department/SMPB.
- Generation of livelihoods through the collection of medicinal plants needs to necessarily be linked with the marketing of the product so collected. In order to facilitate the collector's livelihood, support needs to be provided in the interregnum between collection and actual marketing which will be recoverable from the final payment made for the product by the organisation like the Forest Development Corporation or any other agency implementing the scheme. For this, it is desirable that working capital should be earmarked by the state government for the implementing agency. NMPB would contribute 50% of the amount so provided by the state government as working capital.
- The JFMCs/ Panchayats/Village Institution's resources can be pooled for collective activities/interventions at common strategic nodal locations involving a number of such local institutions of various villages. Thus the concerned Departments/Agencies in their proposals can consider a cluster approach (where feasible) so that investment made in a unit can actually have a ripple beneficial effect on adjoining JFMCs/Panchayats/Hamlets, etc. and the project resource can be pooled to create strategically located collective processing or other common facilities.

Eligibility

- Joint Forest Management Committees through FDAs/Forest Departments.
- Panchayat/Van Panchayats/BMCs/ Eco development committees.
- Other state co-operative/corporate bodies in-charge of medicinal Plants collections and trade.
- Reputed NGOs/ Academic organisations with a demonstrable track record (only for activities like community mobilization, hand holding, capacity building, exposure visits, market linkages etc.)

Norms of assistance

The assistance will be based on proposals received from the eligible agencies through the Forest Development Agencies (FDAs)/BMCs and will be limited to a maximum of Rs.15.00 lakhs per JFMC/Van Panchayats/BMCs. The project proposal should be consolidated at the level of FDA/District and forwarded to the State Government/SMPB. The proposal should be formulated keeping in view the following details:-

- The size of area to which JFMCs/Van Panchayat has access for the collection of medicinal plants.
- The species details of medicinal plants being traditionally traded in local/village hatts/mandies and weekly markets in various seasons of the year.
- Local stakeholders involved in collection of medicinal plants and likely to benefit from the project.
- Dependence of community on local traditional Vaidya's, medicinal plants for their healthcare needs.
- Availability of good NGO partners for community capacity building and hand holding.
- Details of the infrastructure of trade centres, and processing units, if any present in the area.
- Availability of other alternative livelihood opportunities to the members of the JFMCs/BMCs/SHGs etc.
- Potential for Resource augmentation Sustainable Collection and Market Linkage.

Submission of Proposals

The proposal from the eligible agencies in the relevant proforma will be submitted through State Forest/Wild Life Department to NMPB. In case proposal is submitted by Forest Division/Circle a copy of the same should invariably be marked to PCCF/Chief Wild Life Warden which will help in monitoring the project during its implementation.

Management support

One project management Consultant along with one Data Entry Operator will be engaged in providing support at the NMPB level for activities relating to scrutiny, implementation, monitoring and technical support to the state.

4.3. Research, Technology Development and Quality Assurance

4.3.1. Research & Development

Objectives

The development of the medicinal plant sector in the country is suffering from scattered and inadequate research on various crucial aspects. The research results need to be consolidated, gaps identified and new initiatives taken to address such research needs.

Activities

(a) Research and Technology Development in the following areas can be supported in project mode:

- Traceability of raw drugs from harvest to consumption level.
- Germination and seed treatment protocols and certification.
- Bio-prospecting, population assessments and conservation biology of Medicinal Plants and Medicinal Aromatic Species (MASs).
- Collection, compilation, documentation, validation and digitization of published scientific information on various aspects of selected Medicinal Plants and their ASU & H formulations and preparations of comprehensive monographs thereof.
- Identification of substitutes/adulterants for traded medicinal plants using pharmacognostic, pharmacological and molecular parameters for their inclusion in Pharmacopoeia.
- Finding substitutes for RET listed medicinal plants and finding use of sustainable alternative plant parts.
- Research aimed at lowering cost of cultivation and production of extracts, phytochemicals, natural colours, flavours and fragrances by using latest R&D technologies.
- Bio-activity Guided Fractionation.
- Development of DNA barcoding, spectrometry HPLC methods etc. for phyto-constituents (preferably the bio-actives/marker compounds) and validation of these methods.
- Study of phyto-chemical variations within available genotypes, chemotypes, ecotypes etc., development of post-harvest treatment, search for elite quality germplasm and development of quality planting material for mass scale propagation.
- Establishment of quality standards in respect of norms related to toxicity and heavy metal content to increase acceptability of botanicals in the International market.
- The impact of invasive species on habitats of native medicinal plants and foreign matter on the safety and efficacy of medicinal plants including MASs in their habitat.
- Development of Biotechnological Techniques (BT) & Information Technology (IT) based tools applications related to Medicinal plants.
- Ethno-medicinal documentation and exploration.
- Marketing, econometrics policies/ regulatory issues related to Medicinal Plants.
- Establishing National and regional raw drug repositories for references.
- Study the impact of environmental changes like global warming and topographical variations in medicinal plants.
- Setting up of national and regional Botanical Reference Standards (BRS).
- Development of improved planting materials, germplasm bank, development of improved cultivars etc.
- Any other emerging issues or suggestions rendered by SFC.

(b) M.Phil/ Ph.D/ Post-Doctoral Fellowship programme on subjects related to medicinal plants through various Educational/ Research Institutions in the country, will be supported. Applications will be screened by the Project Screening Committee of NMPB, which will also finalise the emoluments based on prevailing arrangements in other similar Institutions. NMPB will also engage directly a limited number of JRF/SRF/Research Assistants, etc. (upto five) as per UGC/DST norms for specific projects while allowing them to enroll in academic institutions to pursue doctoral/other studies. The engagement and emoluments will be finalised by Project Screening Committee on research and bring this to the notice of SFC.

Eligibility

- R&D Institutions under CSIR, ICAR, ICFRE, ICMR, DBT, DST, Councils of Department of AYUSH etc.
- Universities recognised by the UGC.
- Industry both in public as well as private sector with R&D facilities.
- Non-government Organisations/Voluntary Organisations, with demonstrated expertise and infrastructure.
- Government-funded institutes/colleges with demonstrable track record infrastructure and expertise.

Norms of Assistance

R&D Institutions/Universities in the public sector/Government Aided colleges etc. will be eligible for 100% assistance. However, organizations/labs/Institutions in private sector will be eligible for 50% assistance.

Submission of proposals

The proposals for R&D will be invited so that strategic research in critical areas is assigned to competent organizations/ scientific professionals. The eligible organization can apply directly to NMPB in the relevant proforma where the proposal will go through scrutiny by the Project Screening Committee (PSC) before being considered for approval by SFC. Prior to placing before the PSC, wherever appropriate the research proposal can first be referred to subject expert by NMPB for taking expert's opinion on quality of the proposals. For such scrutiny a fee of Rs. 1500/- per proposal will be paid to the domain expert by the NMPB for examination and comments.

Management Support

One project management Consultant along with one Data Entry Operator will be engaged for providing support at NMPB level for activities relating to scrutiny, implementation, monitoring and technical support to the state.

4.3.2. Quality Assurance

Objectives

Today globally companies are looking for traceability of raw materials to their source, as it is obvious that the quality of the end product can only be as good as the quality of the components that go into that product. Hence the importance of maintaining good standards while collecting, cultivating and post-harvest handling of the raw material cannot be over emphasized.

4.3.2.1. Promotion of Good Practices

- For India to become a global hub in medicinal plants processing, we need to list out the challenges faced by the sector. One of the most important stakeholders is the group of intermediaries who are a very important part of the supply chain from collectors/cultivators to the end users of the raw material. These intermediaries are largely in the private sector and deal with bulk handling of raw material from procurement to storage and sale in the mandies. This is the stage at which there are maximum chances of contamination of the raw material, due to lack of general hygiene. Elimination of such sources of contamination is imperative for tackling the issues of microbial overload in herbal products. In order to do so, extensive capacity-building of the intermediaries is required. There is a need to create awareness about the maintenance of high standards of hygiene amongst collectors, cultivators, other raw material handlers and traders. This capacity building should be an on-going process through a series of stakeholder meetings, workshops, seminars etc. A strategy will be initiated for registration/devising regulation of important intermediaries in the Market Supply Chain of medicinal plants. This will be done by providing support in a project mode, to appropriate agencies.
- In addition to this, we need to evolve norms for proper handling of raw materials i.e. what constitutes good practice as far as raw drug handling is concerned. Also, there needs to be in place a system of self-regulation through peer groups in mandies. Consultancies studies will be commissioned for this purpose. This will also be addressed through focused projects through SFC approval.
- Presently testing is by and large limited to the finished products. The industry has always held that in the absence of a supply of contamination-free raw material, it is not fair to expect the products to stand up to rigorous testing. Hence, maintaining a chain of practices to ensure good quality of raw material will create a win-win situation for the producers/traders on the one hand by ensuring better prices and the manufacturers on the other by ensuring greater market access. This will also be supported in a consultancy/project mode. In order, to more effectively address the above challenges the following measures will also be taken in project/consultancy mode:

a. Development of agro-techniques of selected medicinal plants.
b. Protection of Good agricultural practices (GAP), Good Field Collection Practices (GFCP), Good Harvesting Practices (GHP) & Post Harvesting Practices, Good Storage Practices (GSP). The work done by QCI for GAP & GFCP in the 11th Plan will be taken forward towards actual field implementation in project mode.
c. Support to testing laboratories, reimbursement of testing charges to stakeholders.
d. Development of certification protocols for sustainable harvesting of seeds, planting materials and raw drugs from the wild in project mode.
e. Other measures for Quality certification programmes as necessary.

4.3.2.2. Raw Drug Repositories

Another important aspect of quality is the true botanical identity of the herb. To ensure proper identity, there is a need to establish multiple Raw Drug Repositories (RDR), which can supply certified samples of Indian medicinal plants on cost basis, to act as Reference Standards. Phytochemical reference standards (PRS) are required for assay purposes. There is a need to create a mechanism in India for consistent supply/sale of PRS required by various Pharmacopoeias for quality assessment of Indian medicinal plants. For this purpose, it is essential to establish multiple Raw Drug Repositories, in different areas of the country. Each RDR could be encouraged to develop proficiency/core competence, in a few of the

above listed scientific areas. The RDR's should ideally work on the development of "Key Distinguishing Characters" (KDC) for Indian medicinal plants so that they can be distinguished from their look alike / adulterants. Some of the techniques are:

- Pharmacognosy parameters like Macroscopy (organoleptic characters)
- Microscopy (Anatomy and powder microscopy), TLC, HPLC etc.
- DNA barcoding and fingerprinting
- Detection of characteristic/marker compounds
- Fingerprinting using new techniques like LC-MS-MS and NMR profile etc.

Norms of Assistance

For national repository of raw drugs /BRS total assistance admissible is Rs. 10 crores, while for regional raw drug repositories it is Rs. 5 crores each to Govt. Organizations.

4.4. Awareness Building, Exposure Visits, Education and Capacity Building of Stakeholders through Information Education and Communication (IEC) strategy

The medicinal plant sector involves an array of stakeholders varying from resource managers, cultivators, gatherers, supply chain intermediaries, traders, local healers, and researchers to manufacturers and exporters. It is necessary to disseminate information on different aspects of medicinal plants like harvesting from wild, cultivation technologies, manufacturing, proper handling of raw material, trade, etc. among various target groups about the importance of development and management through an appropriate outreach strategy, Capacity building, appropriate recognition, incentivisation etc.

Activities

- Publicity through regular participation in Exhibitions/Fairs
- Aushadi Vanaspati Mitra Program (AVM)
- Organizing Workshops/Seminars/Conferences/ Arogya Fair etc.
- Setting up of Facilitation Centres
- Medicinal Plant Species-specific/Campaigns
- Systematic use of Multimedia and other appropriate communication tools.
- To meet liabilities/obligations of contractual farming cases from the previous Scheme
- Publication of Periodicals/Magazines and Newsletters
- Setting up and operation of Web Portal.
- Training and Capacity Building initiatives.

4.4.1. Participation in Exhibition/Fairs and Publicity Materials

To promote the message of Indian Medicinal Plants it is essential to participate in International/National/State Level Exhibitions/Fairs associating all important stakeholder groups in the country. Besides, Trade fairs or Medicinal Plants Expo, etc. may also be supported or organized by NMPB, to raise awareness of the importance of medicinal plants among the stakeholders and general public.

Activities

- Participation in Exhibitions/Fairs with a focus on botanicals at State, National and International levels. Industry and other stakeholders will be encouraged to participate in such expos. NMPB would also participate in such events.
- Developing Souvenirs, Pamphlets, Booklets for display and distribution. Organizing quiz shows for children and students, setting up of interactive kiosks and touch screens and development of role plays.
- Development of different types of herbal kits for distribution to visitors, farmers and other stakeholders.
- Launching mobile exhibitions or Aushadi Chetna Yatra for spreading the message of medicinal plants through role plays, audio visuals, expert advice on conservation, cultivation, uses etc. of medicinal plants.

Eligibility

NMPB, SMPB, Industry, R&D Institutions/Universities, Government Organizations including Govt. aided Institutions, Non-government Organizations/Voluntary organizations etc.

Pattern of Assistance

Expenditure incurred by the organizations for participation in fairs etc. would be reimbursed subject to prior permission being obtained from NMPB for participation by the concerned organization. Reimbursable items of expenditure would include, hire charges, stall fabrication, developing publicity material, travel and accommodation. The total financial implication for such participation per event will be Rs.1.00 Lakh for state level, Rs.2.00 Lakhs for National level and Rs.3.00 Lakhs for the international level. For private organizations including Industry, the cost would be limited to 50% of the above or the actual expenditure whichever is less (which includes Travel, Accommodation, hire charges, stall fabrication, publicity, etc.) will be reimbursed. The other activities will be in project mode.

Submission of proposals

Participation in fairs/ exhibitions being time bound need to be examined as and when the proposals are received. Often, by the time the proposals go through the process of screening by PSC and approval by SFC the dates for the events are over. Hence, the CEO NMPB will be authorized to approve expenditure on such activities subject to a limit of Rs 30 lakhs per annum. All those proposals will be put up to PSC post-facto. Eligible Organizations can apply to NMPB in the relevant proformas.

4.4.2. Aushadhi Vanaspati Mitra Program (AVM)

This aims at recognizing initiatives of individuals /community/institutions involved in conservation/cultivation, post-harvest management, R&D, marketing etc. of MAPs. These should be exemplary and successful initiatives which are creative, sustainable and have helped in improving medicinal plant raw material availability.

Eligibility

SMPB or any other appropriate state level organization recommended by the concerned SMPB will organize such program of Aushadhi Vanaspati Mitra Program of the concerned state.

Norms of Assistance

A total of Rs. 2.00 lakhs will be provided to each state per year, towards meeting the expenditure for three cash awards (not exceeding Rs. 65,000/- put together) and for organization of the event and other logistics. The States may, if they so desire vary the amounts and number of awards depending on the ground realities.

Submission of Proposals

SMPBs can apply to NMPB in project mode where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

4.3. Organization of Work Shops/Seminars/Conferences and participation in AROGYA Fairs

The department of AYUSH organizes Arogya fairs from time to time in different states of the country. NMPB is required to set up stalls and display material in such fairs for which there is a need of a dedicated agency who would not only install Arogya stall but also engage in similar work in other such fairs, buyer/seller meets etc. The agency will be selected as per GFR. Participation in fairs workshops/ Seminars is also a time-bound activity and will be considered by the CEO subject to the overall limit of Rs 30 lakhs.

Objectives

Provide a platform for dissemination of the latest information on Medicinal plants to various stakeholders.

Activities

Organizing Seminar/Workshop/Conferences/Exhibition/Arogya Fairs at district, regional, state, national and international levels for promotion and awareness of medicinal plants.

Eligibility

- Central and State Government organizations.
- Recognized academic/Research/Educational institutions including Government Aided Colleges.
- Registered professional and other philanthropic organizations working on non-profit basis.
- Registered Non-Government Organizations (NGO)/Voluntary Organizations/ Trusts with infrastructure and experience in the field of medicinal plants.

Norms of Assistance

The financial assistance would be limited to Rs.1.00 Lakh for organizing district level event, Rs. 2.00 lakh for State, Rs. 3.00 Lakhs for regional level, Rs. 5.00 Lakhs for National level and Rs.10.00 Lakhs for international level event.

Submission of proposals

Eligible Organization can apply to NMPB in the relevant proforma where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

4.4.4. Financial Obligations of Contractual Farming Activities of Previous Plan

During the previous plan Contractual Farming of medicinal plants was carried out by farmers in different States of country and there are some obligations in respect of these activities/projects. To meet such obligations a corpus of Rupee 10.00 Lakh or the actual payable amount to eligible farmer(s) in a state (whichever is less) will be released to concerned SMPB at a time for further disbursement to eligible farmer(s). The payable amount to eligible farmer(s) will be released by SMPB after satisfying the terms and conditions of the guidelines at their end and NMPB's direction in this regard. The concerned SMPB will in turn submit the utilization certificates to NMPB for the amount utilized. In states where these obligations are of more than Rs. 10 Lakh, the subsequent grant-in-aid will be released to concerned SMPB as soon as the

UCs for the released grant-in-aid are liquidated and in this way the necessary grant-in-aid to such SMPB will be released till the settlement of these obligations.

4.4.5. Publication of Periodicals/Magazines and Newsletters

NMPB can undertake publication of books, periodicals etc. through credible organizations which have proven competence in the field.

Activities

- Publication of books on different aspects of medicinal plants.
- Publication of newsletters through outsourcing.
- Subscription/purchase of national and international magazines/ journal/ periodicals on the importance of medicinal and aromatic plants with medicinal value.
- Newspaper/media advertisements on medicinal plants as and when required.

Eligibility

Proposals will be considered from organizations which have proven competence in the field concerned.

Norms of Assistance

100% assistance will be provided in project mode.

Submission of Proposals

Eligible Organizations can apply to NMPB where the proposal will go through scrutiny by the Project Screening Committee (PSC) before being considered for approval by Standing Finance Committee (SFC).

4.4.6. Setting up & Operation of Web Portal

This is a felt need as NMPB is time and again called upon by various stakeholders including Ministries of GOI for advice on issues for which in-house competence is lacking and also to create a transparent, open-access information source for all stakeholders. Interactive portals on medicinal plants accessible to various Stakeholders will be supported. This could include query-based platforms covering important aspects like Database, documentation, geographical distribution, clusters, products and other related technical and scientific information. The Portal would be supported by a panel of experts on various aspects of medicinal plants from an array of areas ranging from, cultivation, conservation, IPR issues, emerging national and international trends, etc. Existing well-established portals developed by other organizations can also be taken over, upscaled and maintained.

Eligibility

Proposals will be considered from organizations which have proven competence in the field concerned.

Norms of Assistance

Experts will be provided a fixed remuneration in consultation with the PSC. Other cost relating to the development, hosting and maintenance of the portal would be project-based.

Submission of proposals

Organizations can apply to NMPB where the proposal will go through scrutiny by the Project Screening Committee (PSC) before being considered for approval by Standing Finance Committee (SFC).

4.4.7. Training and Capacity Building

Training plays an important role in spreading best practices on conservation, cultivation, good agricultural practices, good field collection practices, post-harvest management, marketing etc. Trainings will be provided to various stakeholders like cultivators, conservationists, traders, supply chain intermediaries, policy makers and end users.

Activities

To organise training programmes for capacity building of stakeholders on medicinal plants (including cultivation, conservation, GAPs, GFCPs, GMPs, Storage, PHM and Market Information). Demonstration of technologies developed by Institutions at farmers' field/conservation areas and natural habitats.

Eligibility

- Central and State Government organizations.
- Recognized Research/Academic/Educational institutions
- Registered professional and other philanthropic organizations working on non- profit basis.
- Registered Non-Government Organizations (NGO)/Voluntary Organizations/Trusts with infrastructure and specific experience in the field of medicinal plants

Norms of Assistance

- Rs. 2,000/- per trainee for a minimum of two days with in the state and Rs. 5,000/- per trainee outside the state will be provided which will include exposure visits.
- For officers training/exposure visit within the State Rs. 5,000/- per trainee and outside their state the cost will be limited to Rs. 10,000 per trainee.
- Travel cost will be additional to the above cost.

Submission of proposals

Eligible Organizations can apply to NMPB in the relevant proforma where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

4.4.8. Facilitation Centers

Development of medicinal plants requires an effective institutional mechanism for technology transfer on crops and varieties that can be grown in an agro climatic zone, the soil suitability for a particular crop, the cultivation practices, sources of seed and quality planting material. Farmers/ growers have felt need for hand holding support so that medicinal plants as a crop diversification option may pick up to the desired level.

Activities

- The Facilitation Centres (FCs) will provide a service window for growers of Medicinal Plants for supporting cultivation, provide handholding support to stakeholders in terms of technology dissemination, trainings, data compilation and maintenance etc,. The Facilitation Centers will work in close co-ordination with the concerned State Medicinal Plants Boards (SMPB) and also provide Training in the formulation of projects of Medicinal Plants Cultivation and Development.
- Authentication of quality raw materials on the basis of Taxonomic identification and chemical parameters.
- Organisation of Stakeholders Meets
- Publication and dissemination of scheme guidelines, information on Agrotechniques, markets, prices etc. especially in local languages.
- To help in production of quality planting material by various agencies including Forest Department, NGOs and the private nurseries.
- Making available testing facilities for the material produced under NMPB schemes, where such facilities exist within the facilitation centres. In the districts where Agriculture Technology Management Agency (ATMA) have a presence, they should also be involved in the technology dissemination and capacity building exercises.

Pattern of Assistance

The cost per Facilitation Center will be Rs.50.00 Lakhs for a period of three years.

Eligibility

Departments of State Agriculture Universities, National and State Level Research Institutions, Non-profit making/philanthropic organizations doing considerable work on medicinal plants or related activities, with sound track record will be eligible. Coordination with SMPB/Regional Centers The Facilitation Center will work in close coordination with the SMPBs/Regional Centers. Maintaining Germ Plasm banks or the raising of QPM through the FC or appropriate scientific partners identified by FCs, if considered necessary, will be demand based and will be proposed as a separate project, for consideration of PSC and SFC. The project proposal covering the above key parameters/ costing with minor variations depending upon local situations are permissible.

Performance Monitoring

The institution will also put in place an internal monitoring mechanism to review the progress.

Submission of proposals

Eligible Organizations can apply to NMPB in the relevant proformas where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

Management Support

One project management Consultant along with one Data Entry Operator will be engaged for providing support at NMPB level for activities relating to scrutiny, implementation, monitoring and technical support to the state.

4.5. Promotion of Herbal Gardens

Herbal Gardens of various kind will be promoted under the scheme to create awareness about traditional usage of medicinal plants. This would include Herbal Gardens of National and State importance as well as at the level of Institutions, Schools, Universities, Colleges and Homes.

Eligibility

- Government Organizations, Universities, Research Institutes, Government Aided Colleges and Schools.

- Non-government Organizations (NGOs), Public Sector Undertakings, Federations, Co-operatives, and Societies including Housing Societies etc.

4.5.1. Home Herbal Gardens

Encouraging herbal gardens in the homes is a good way to promote use of medicinal plants for primary health care at the household level.

Activities

- Around 20 Medicinal and Aromatic species of which around 10 species (which in addition to medicinal plants could also include a few aromatic/food plants), based on locality specific need and demand will be distributed to interested households. A note on each species, usage and benefit of each species will be provided to the beneficiary by the implementing agency.
- A Database of all such households, including photographic documentation at various stages of implementation will be submitted to NMPB along with a writeup on the process/approach adopted, benefit accrued and the sustainability mechanism.
- The implementing agency will take steps for raising awareness in the identified locality.
- In case of dense urban localities potted plants and terrace rearing of medicinal plants should be encouraged.
- These initiatives should be dovetailed with activities like Swach Bharat, use of bio fertilizers, vermicompost etc.

Norms of Assistance

Financial assistance of Rs. 2500/- per Home Herbal Garden including cost of raising seedling, transportation, awareness raising, documentation, development, dissemination and use of publicity material, folk theatre, special campaigns, etc.

Submission of Proposals

Eligible Organizations can apply to NMPB in the relevant proformas where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

4.5.2. School Herbal Garden

Setting up of herbal gardens in schools is a good way of reaching the minds of children and make them acquainted with the commonly available and frequently used medicinal plants.

Activities

- Schools will be encouraged to set up herbal gardens with in their school complex. Schools can have separate plots to make up a total of 500 sq.m. for 10-15 species of medicinal plants including tree species.
- Schools will be responsible for maintenance of the Herbal Gardens including irrigation with the active involvement of the students and parent-teacher associations/ NGOs and also make special arrangements during school vacation period. Students will be involved in labelling the plants, watering, weeding etc. which will enhance the knowledge of the students about the benefits and uses of the species nurtured by them.
- The material from School Herbal Gardens could be utilized for further propagation.

Norms of Assistance

Assistance will be given @ Rs.25,000/- per school for an area of 500 sq. m. first year for establishment and up to Rs.7,000/- per annum per school as maintenance cost for the next four years. In case, the schools are proposing area for the School Herbal Garden, which is more or lesser than 500 sq.m., assistance can be considered on pro rata basis based on the justification provided.

Submission of proposals

Eligible Organizations can apply to NMPB through SMPB in the relevant proforma where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

4.5.3. Institutional/Public Herbal Gardens

To sensitize the AYUSH Professional College students/public at large about the usage of medicinal plants based on indigenous knowledge in colleges, universities, hospitals, other places of educational/ recreation/ public importance, assistance will be provided for planning and establishing larger herbal gardens.

Activities

- Establishment of herbal garden with medicinal plants and aromatic plants with medicinal value considering the importance of species/varieties of concerned areas.
- Use of proper cultivation practices
- Walking trails, signages etc. to be established in the garden.
- Proper documentation, data collection, harvest and post-harvest management operations to be a part of the herbal garden.
- Material harvested could be used for value addition or further propagation.

Norms of Assistance

- The activities supported would include land development, site protection, setting up irrigation facilities and procurement of basic planting material, laying of beds, planting, initial maintenance, signages, walking trails etc.@ Rs.3 lakhs per ha. for establishment.
- Thereafter annual maintenance of the Herbal Garden @ Rs. 60,000/- per year per ha. for a maximum of four years.

Submission of Proposals

Eligible Organizations can apply to NMPB in the relevant proforma where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

4.5.4 Herbal Gardens of State and National Importance

A few Herbal Gardens of National Importance will be supported in various Eco-regions of the country in project mode. Similarly, Herbal Gardens of State importance can be established to promote and popularize medicinal plants in an organized manner on a bigger scale. These type of gardens will be established at important or prominent places like the Herbal Gardens at President's/Governor's Estates in the past and will be supported for maintenance for a longer period. Similarly, Herbal Gardens can be created in State Secretariats, Institutions of National importance, prominent tourism spots. Defense establishments, Railways, Corporations and Municipalities, etc. in project mode. 2-4 such Herbal Gardens will be supported in each state at sites notified by the state government specifically for this purpose in consultation with NMPB.

Activities

Establishment and maintenance of herbal gardens, keeping in view all the required modalities like walking trails, signages, landscaping, planting in beds and proper documentation, etc. Use of herbal gardens in supplying propagation/raw material will also be explored.

Norms of Assistance

The proposal received in a project mode will be examined at PSC level and financial assistance will be provided as per the actual requirement with the approval of SFC, NMPB.

Submission of Proposals

Eligible Organizations can apply to NMPB where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

Management Support

One project management Consultant along with one Data Entry Operator will be engaged for providing support at NMPB level for activities relating to scrutiny, implementation, monitoring and technical support to the state.

4.6. Other Promotional Activities

Support for establishing nursery and development of Quality Planting Material/ Germplasm Banks.

Activities

Support for establishing nursery as a part of any project proposal will be provided Norms of Assistance for creation of nursery covering an area of 1 ha Rs. 6.25 Lakhs per unit to be given in two installments. The assistance will be to the extent of 100% to public sector/SHGs and 50% of the cost subject to a ceiling of Rs.3.125 Lakhs in private sector. The nursery will have appropriate infrastructure facility (net house, beds, vermicompost, signage, irrigation system) to hold 50,000 to 70,000 plants. The organization must have a sustainability plan.

Submission of Proposals

Eligible Organizations can apply to NMPB where the proposal will go through scrutiny by the Project Screening Committee (PSC) before approval by Standing Finance Committee (SFC).

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KEYNOTE/ INVITED LECTURES

Current challenges in the medicinal plants sector and initiatives of National Medicinal Plants Board (NMPB)

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India is one of the richest countries in the world in terms of biodiversity and has 15 agro-climatic zones. Medicinal plants are the major resource base for Indian traditional medicine systems viz., Ayurveda, Siddha, Unani & Homoeopathy (ASU&H) and also provide livelihood with health security to a large segment of Indian population. About 1178 species of medicinal plants are estimated to be in trade, of which 242 species have annual consumption levels in excess of 100 metric tons/year. The market for medicinal plants in India stood at Rs. 4.2 billion (US$ 56.6 million) in 2019 and current market size of AYUSH industry is 18 billion US$.

Recently, particularly after COVID-19 pandemic the demand of medicinal and aromatic plants has gone up, therefore ensuring the availability of quality raw material is one of the major concern in this sector. To meet increasing demand for medicinal plants, the NMPB focuses on in-situ & ex-situ conservation and augmenting local medicinal plants and aromatic species of medical significance through support for Quality Planting Material (QPM).

Main goal of NMPB is to develop medicinal plants sector through developing a strong coordination between various ministries/ departments/ organizations for implementation of policies / programs on medicinal plants. Hence, Board encourages the conservation of endangered species, training personnel, encourage development of herbal garden, encourage and facilitate marketing, trade and international cooperation and research and development. In the years ahead, high quality original medicinal plant materials, quality control of medicine and sustainable harvesting of plants will be real challenges to meet the demand of medicinal plants sector. In the recent years, NMPB has taken various initiatives to improve the medicinal plants sector and also the livelihood of the concerned stakeholders.

NMPB supports *in-situ* conservation of important / endangered medicinal plants in their natural habitats carried out by way of establishment of Medicinal Plants Conservation and Development Area's (MPCDA's). It also supports Joint Forest Management Committees (JFMCs) etc. for livelihood generation by involving forest dwellers and forest department to improve their livelihood and reducing the dependency on forest which ultimately leads sustainable way to protect forest areas.

NMPB has recently taken an important initiative to increase awareness about medicinal plants among children. A comic book series with 'Professor Ayushman' as the central character conceived by the National Medicinal Plants Board (NMPB), was unveiled to make children aware of the importance of medicinal plants and their use in home remedies. With a vision to ensure availability of quality raw material, NMPB in collaboration with the Quality Council of India (QCI), has launched a Voluntary Certification Scheme for Medicinal Plant Produce (VCSMPP) to encourage Good Agricultural Practices (GAP) and Good Field Collection Practices (GFCP) in medicinal plants and enhance quality and safety.

For post-harvest management and marketing of medicinal plants, NMPB has launched "*e-CHARAK"*- a virtual market place for collectors, farmers, traders and manufacturers facilitating trade of medicinal plants. It is a multilingual platform available as Web & Mobile (IOS and Android) in 7 languages hosting agrotechniques of 104 MAP crops, GAP, GFC, post-harvest management techniques, schemes, etc.

NMPB has also developed a helpline in collaboration with CDAC Hyderabad, to address specific issues faced by various stakeholders across Medicinal Plants supply chain viz, QPM Nursery, Cultivation, Plant Protection, Post-Harvest Management, Marketing etc. Medicinal Plants Stakeholders can access the helpline through web based application by registering at- https://echarak.in/nmpbhelpline/register. The Helpline Toll-free no. is 1800-120-5778. Recently, with the launch of the WHO Global Centre for Traditional Medicine (GCTM) medicinal plants sector may be expected to grow significantly to cater the health demand of Global population.

Challenges in medicinal plants sector in Himalayan region

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Since the establishment of the National Medicinal Plants Board in 2000, it has taken a lead in promoting the medicinal plants sector in the country. With the continuous efforts of the Board, medicinal plants activity has been identified as one of the potential economic generation source to the farmers along with the other Agricultural related activities. Board has able to provide a common platform to the different stake holders working in this sector where they can address the issues and concerns for the solution. One of the major achievements of the Board is that it has been proven a vital instrument to popularise and to generate awareness in the medicinal plants sector in terms of inventorization, utilisation, marketing, processing, cultivation and conservation aspects. Previously the medicinal plants sector remained unorganised and very little attention was given to this component. Before the inception of NMPB, the main focus was on aromatic plants than

medicinal plant many of which are also considered as medicinal plants. The institutions like CIMAP, CSIR Labs and other such institutions were mainly taking up the promotion of Aromatic plants and very few non-aromatic medicinal plants. Line departments were not usually undertaking this activity as a major programme in their mandate and therefore this sector remained a *"No Man Babby*". But now the situation has changed and these departments are associating in the various works and the schemes launched by National Medicinal Plants Board of India for undertaking the promotion of the medicinal plants. By the periodic studies conducted time to time by the Board on the demand and supply of the raw herbs for the last twenty years, it has been able to generate a database for the potential marketing, export of the produce/products and prioritisation of the region based medicinal plants throughout the country. Now a picture has been emerged to draw a roadmap to the future programms for strengthening the activities in the matter.

To the farmers, the cultivation of medicinal plants is a new activity and therefore, NMPB came up with the various incentives for providing subsidies for the cultivation of selected medicinal time to time to encourage them. For the skill development of the farmers, training programms are being organised on the different aspects of medicinal plants like identification, agro techniques, post-harvest handling, processing and marketing of the target species of Medicinal Plants. For this purpose the necessary GAP guidelines have been drawn by the Board. Still major volume of the crude drugs is derived from the wild and very little come from cultivated source. Therefore, for the judicious sustainable extraction of the produce from wild, the GFPC guidelines have been designed. R&D Institutions are being supported for under taking the research to develop protocols on the Agro techniques for the cultivation of the medicinal plants species and to develop QPM to make these available to the farmers.

Medicinal Plants activity is not only a source of income to the farmers by undertaking the cultivation but it is a base line for the delivery of health care to the larger section of the society. AYUSH department is not only providing effective and low cost health care services across the country but in abroad also. Throughout the world people are realising the side effects of chemical synthetic drugs and shifting to natural herbal based preparations. It is a great opportunity to tap the situation to us and AYUSH department particularly. In spite of the considerable efforts made by the NMPB in a short spell of the time, there are some concerns and challenges which must be addressed for the better out come in this sector.

Constrains in high altitude habitats

Crude drugs form

In the temperate region of the country a large number of high valued medicinal plants species occur in the natural habitats. In sub-alpine and alpine meadows the herbs which grow here are perennial in nature and very few are shrubs or tree. The crude drugs harvested from the plants are mostly the underground parts like root, rhizome, corm, bulbs, tuber etc. To harvest the crude drug, the mother plants have to be dug out and during this process they die off from the habitat forever. In the absence of the any systematic regeneration process and repeated large scale extraction of such crude drugs make many such species to be endangered in the existing habitats. On the contrary in the case of tropical medicinal plants, the crude drugs mostly are derived from the aerial part of the mother plants such as leaves, flowers, fruits, etc. By harvesting these parts the plants do not die off and hence once planted may go yielding the crude drugs for many years. Whereas in high altitude areas, the new plantation has to be done after the extraction of the crude drugs every time for sustained supply. This involves high recurring expenditure and therefore farmers hesitate to take up the cultivation of medicinal plants in temperate region.

Gestation period

The gestation period of temperate medicinal plants is quite prolonged**.** It takes 3-5 years to develop a sizeable crude drug of accepted grade in the market. More over after extraction it involves many steps such as washing, chopping, drying, packaging etc. of the harvested crude drugs for which large man power is required and thus cost of cultivation increases many folds as compare to the other agricultural and vegetable crops which are of short gestation period starting from 3-4 month to one year. It does not involve drying or washing etc and some time the produce is directly lifted from the fields. In this case the cost of cultivation is less than the perennial crops. This is one of the reasons that the farmers of these areas prefer to take up the crops of short duration. Intervention of R & D institutions is required to cut short the duration of prolonged gestation period of the temperate medicinal plants crops.

Land holding

In the Temperate Himalayan region per capita cultivatable land holding is very less. Geographically the mountain terrene here is either covered with forests or with cliffs and deep gorges unfit for cultivation. Most of the high altitude medicinal plants grow in the forest areas, the ownership of which lies with the forest department. Beyond about six thousands ft. msl., the private land holding is negligible. Forest department does not allow any private activity in their vicinity. The working plans of Forest Department are designed to enhance and conserve the forest cover where their main focus remains to raise the trees vegetation than medicinal herbs. They only have the regulations for the extraction of crude drugs under NTFP component which grow naturally as under vegetation in wild habitat or in open pastures. Without the active participation of Forest Department the cultivation activity of High Altitude Medicinal plants cannot pick up. Although the department come forward to take up this activity with the local people participation with the working models like VFC, Van Samridhi-Jan Samridhi Yojna, formation of SHG etc. to allow cultivation of MAPs in forest areas but practically these have not been a success.

Lack of agro-techniques

Uniform standardised cultivation practices packages are not available to the farmers to take up the cultivation of High altitude medicinal plants. Many Research Institutions, Universities and other agencies claim that they have developed the agro techniques of some selected medicinal plants species suitable for this zone but that have many drawback and lacuna. If we go through the detail and the statics of these documents, it is found that the parameters and other components involved for the development of these techniques are mostly designed as per the existing guidelines adopted for the conventional agriculture crops where the statics are calculated on the basis of per acre or per hetc. unit of the land fit for cultivation to flat fields or farms. Whereas in the High Altitude areas where the land is not available in shape of flat fields of big stretches for cultivation but it may be available in form of patched of different sizes in between the gaps of the forests or in shape of bunds or sloppy pastures. In high altitude areas mostly the weather remain moist with the prolonged rainy season, cultivating the species to yield underground part as crude drug there remain chances of decaying of the drug part resulting the poor quality of the produce. To get better yield of quality produce, the cultivation in sloppy lands should be preferred and accordingly the cultivation techniques may be developed in larger interest of farmers and drug efficacy.

Quality planting material (QPM)

The main aim of cultivation of Medicinal Plants is to provide the quality efficacious raw material in voluminous quantity on sustained basis to the Pharmaceutical and other industry houses. The raw material thus produced should be of good quality fitting to fulfil all the basic parameters set for the quality herbal produce. As the produce is ultimately utilised for the manufacturing of drugs, it must contain the optimum or reasonable Phytochemicals contents, the base of which is the mother seed or planting material. For the commercial cultivation, it requires the germplasm in large quantity also. Before to take up the cultivation of a particular species, it is necessary to ensure that the germ plasm to be provided to the farmers must be of good quality in terms of phtochemical ingredients and disease free. Therefore, the characterization of the basic germ plasm for secondary metabolise contents must be analysed before to produce it. But these aspects are not being taken care of in generating the planting material in most of the cases. Generally It has also noticed that the Institutions engaged in the production of germ plasm have not sufficient germ plasm/planting material available with them to meet out the demand for commercial cultivation.In this respect the role of R&D institutions is very vital.

Post-harvest handling of the crude drugs

As stated above, the cultivation activity of Temperate medicinal could not pick up and most of the raw material is derived as a NTFP from the wild habitat. Forest Department issues licences/permits for the extraction of the crude drug of a particular species or forest range within the frame work of the departmental rules and regulations time to time. Harvesting time of the crude drugs in high altitude areas is in-between mid of August to the end of October depending upon the altitude variation and ripening period of the medicinal plants. Theoretically this time is the end of the south-west monsoon but practically the high reaches of Himalayas still face mild to heavy rains till the mid of October. Therefore the local conditions remain wet and humid here. In the absence of any proper drying and storage facilities, the extracted material is thus put directly in the open space or in moist & humid sheds for drying/storage till the time it does not become viable for further transportation. Under these conditions the raw material may get infected by microbes and undergo decaying resulting into the deterioration in respect to the quality and efficacy. The road connectivity is poor in these areas, the fragile ecosystem is prone to landslides due to which road blockage is a common phenomenon here and sometimes the loaded material in transport may undergo for further decaying. It is therefore, necessary to setup some local herbal collection centres and to create the basic infrastructure for the drying of crude drugs and storage nearby by the identified *hot spots* herbal collection locations which may be further linked to the district level or regional level collection centres/mandis.

Herbal marketing centres (Mandis)

To sell the agriculture produce there is marketing systems developed in the country in form of Agricultural Marketing Centres in each state but such facilities are not available in case of Medicinal Plants. To abolish the role of middle man in this trade, multi located herbs collection centres should be established where the small farmers/collectors may sell his produce in the reasonable rates directly. In this direction some states has declared some selected species of medicinal plants as Agriculture produce to facilitate the farmers to sell their produce in the Agriculture Marketing Centres. Himachal Pradesh has taken a lead in this direction where 37 species of selected medicinal plants have been notified as Agriculture produce. Similar steps may also be taken by other states till the establishment of Herbal mandis. In the interest of the farmers, the introduction of Minimum Support Price (MSP) system for some selection Medicinal Plants crops may further boost the activity.

Legal implications

Trade of herbal sector involves many rules and regulations at local level, national level and at international level. At local level every state has its own policy to regulate this trade. Extraction of crude drugs from wild, Forest departments has a set of rules which are notified or amended time to time to facilitate the grower, collectors or on the issues of *in situ* conservation of the species of medicinal plants. At national level, GOI come with certain Acts time to time for the conservation and sustained utilisation of bio resources including medicinal plants by enforcing these in the states. Similarly at international level this trade is regulated by some conventions and treaties enforced by UNO or its supplementary organisation. These rules and regulations as stated above are mostly concerned with the restricted trade of the endangered and rare species. As a matter of fact most of the medicinal plants which occur in the Himalayan region fall in the

Threatened or Endangered categories of the IUCN list and therefore for the promotion of medicinal plants sector in Temperate Himalayas, these must be addressed to make these farmers and industry friendly. Some of the important are:

Convention on international Trade in Endangered Species of Wild Fauna and Flora (CITIES)

It is a multilateral treaty to protect endangered plants and animals drafted as a result of resolution adopted in 1963 at a meeting members of the International Union for Conservation of Nature (IUCN) which was opened for signature in 1973 and CITES entered into force 1975. On the basis of assesses the conservation status of species worldwide, CITES has notified the lists of the species which under the nomenclature of "CITES Appendices" in form of "Appendix I", "Appendix II" and "Appendix III". Appendix I Lists species that are most endangered among CITES listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose is not commercial. Appendix II Lists species that are not necessarily now threatened with extinction but they may become so unless closely controlled. It also includes so called "look-like species". Appendix III is a list of species included at the request of a party that already regulates trade in the species and that needs the cooperation of other countries to prevent or illegal exploitation. Many of the temperate medicinal plants species falls in the list of Appendix II. The farmers, growers and collectors working in medicinal plants sector are not aware about this. Not following the necessary rules as mentioned above may create a hurdle in the trade of medicinal plants.

Biodiversity Act

Biodiversity Act, 2002 is an Act of GoI adopted and passed by the Parliament of India which provides a mechanism for equitable sharing of benefits arising out of the use traditional biological resources and knowledge. It was enacted to meet the obligations under Convention on Biological Diversity (CBD), to which India is a party. Since the medicinal plants is a part of Plants resources, their extraction and trade is regulated under the provisions of Biodiversity Act. Under one of the provision the user agency of the raw material derived from an area as to compensate of BMC under Assess Benefit Sharing (ABS) mechanism. Each of the Biodiversity Management Committee (BMC) has to maintain the Public Biodiversity Register (PBR) dually documented all the biodiversity of their jurisdiction. The various element so floristic and fauna diversity exists in a particular MBC, medicinal plants occurrence is of significance importance as it is related to the delivery of healthcare at the village level and also one of the livelihood earning source. Normally the benefit of this is only taken by a very few people who are directly involved in the trade whereas, as per the provision of Biodiversity act it should be right of the BMC to get the benefit share under ABS mechanism. Similarly some Pharmaceutical or other Industrial houses procure the raw mater directly from the traders or local collector ignoring the ABS system which is against the letter and spirit of Biodiversity Act. On this issue the Industry is reluctant to follow the provision of Biodiversity Act. This issue is required to be settled at GOI level so that the native of the herbal collection locations may to boost the promotion of medicinal plants sector in High Altitude areas.

Biography: Prof. D. R. Nag presently working as member of expert committee of HP Biodiversity Board, HP Govt. for publishing PBRs and as Consultant with Regional Cum Facilitation Centre NR 1, NMPB, at Jogindernagar. He worked for more than 30 years in teaching, exploration, identification and for creating Herbal Gardens, Nurseries and field cultivation of Medicinal Plants. He conducted the survey of Potential Medicinal Plants in the Central Western Himalayas in temperate and extreme cold region of Himachal Pradesh. He played a key role in establishing Herbal Gardens in the different location in Temperate Himalayas in Himachal Pradesh. He established Herbarium of Medicinal plants displaying the different Medicinal plants specifically of Himalayan Region at Research Institute in ISM, Jogindernagr.

Phytochemicals as potential therapeutics in inflammatory bowel disease

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Inflammatory bowel diseases such as Crohn's disease and ulcerative colitis are multifactorial inflammatory disorders of the intestine characterized by abdominal cramps, bloody diarrhea and anemia. Standard treatments including corticosteroids and biologicals (e.g. Tumor necrosis factor (TNF)-α inhibitors) induce severe side effects. Moreover, patients often develop resistance to those therapies. Thus, novel therapeutic options that are well tolerated are urgently needed. Using a translationally relevant mouse model of chronic dextran sulfate sodium (DSS) colitis we have studied three different phytochemicals, i.e., quercetin (Q), indol-3-carbinol (I3C) and a combined sage and bitter apple extract (SBA), for their therapeutic efficacy and potential adverse effects. Oral administration of all three phytopharmaceuticals led to amelioration of clinical symptoms in wild-type mice which was in coincidence with a significantly reduced histopathological score. The treatment prevented in part the DSS-induced loss of epithelial integrity and reduced significantly the inflammatory response in the colon as observed by colonoscopy. In addition, the therapeutic effect of SBA was characterized by a reduction of the number of neutrophils as well as the expression of the neutrophil-recruiting chemokine CXCL-1/KC in the colon tissue, whereas the recruitment of macrophages was induced. Also, the expression of inflammatory markers and the number of transcription factor RORγt expressing cells, i.e., Th17 cells, Th17.1 cells, was significantly decreased, while the number of cells expressing the anti-inflammatory cytokine interleukin10 or the transcription factor FoxP3, i.e., regulatory T cells, were found to be increased in the colon tissue. None of the three phytochemicals revealed adverse effects in the

mouse colitis model. Hence, based on these results, phytopharmaceutical drugs containing I3C, Q or SBA are considered as promising alternatives or complementary options for IBD therapy.

Biography: Lehmann Jörg Lehmann studied Biology at the University of Leipzig, Germany, from 1984-1989. Subsequently, he performed his PhD thesis at the Fraunhofer Institute for Toxicology and Aerosol Research, Hannover, Germany. In 1994 he received his PhD from the University of Leipzig, German. Between 1994 and 2001 he did postdoctoral work at the Medical Faculty, Institute of Clinical Immunology and the Veterinary Faculty, Institute of Immunology of the University of Leipzig. During this period, in 1995 and 2000, he was a visiting fellow at the University of Texas, Southwestern Medical School of Dallas, Cancer Immunobiology Center, TX, U.S.A. and the University of Cambridge, UK. In 2001 Jörg Lehmann switched from academia to the Biotech industry. He headed the R&D department of the Labor Diagnostik GmbH Leipzig. In this function he was responsible for the development and authorization of several immunoassays for veterinary diagnostics. Moreover, he has generated a range of monoclonal antibodies against prion proteins for BSE diagnostics and hyperphosphorylated Tau protein for diagnostics of Alzheimer's disease. In 2006 he became a group leader at the Fraunhofer Institute for Cell Therapy and Immunology (IZI), Leipzig. Between 2009 and 2015 he was the deputy head of the department Cell Engineering, between 2016 and 2021 he headed the department Therapy Validation and since 2021 he is the head of the department Preclinical Development and Validation at the Fraunhofer IZI. In 2008 he has established the GLP test facility at Fraunhofer IZI which is headed by him. 2014-2016 he was responsible for the establishment of a GMP facility for therapeutic antibodies at Fraunhofer IZI that was opened in March 2016. Jörg Lehmann is assistant lecturer for translational medicine, immunology and immunotoxicology at the Medical Faculty of the University of Leipzig. His research interests are focused on the role of T helper cell subsets, macrophages and cytokines in infection and chronic-inflammatory diseases as well as on the identification of new tumour targets and the development of human therapeutic antibodies. He has published more the 80 articles and holds 5 patents.

Development of agrotechnology and cultivation of medicinal plants: A Tool for Sustainable Development & Conservation of High-Altitude Medicinal Plants

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High altitudes of the Himalaya are source of various indigenous drugs used in Indian System of Medicine, modern pharmaceutical industries and in traditional systems of medicine all over the world. In the Indian Himalayan region, there are over 1748 plant species (1685 – angiosperms, 12 – gymnosperms, and 51 – Pteridophytes) including 1020 herbs, 335 shrubs, and 330 trees of medicinal value with 33.5% endemism. In view of the side effects of modern medicine, a revival of interest in herbal medicines has led to their high global demands and consequently exploitation pressures on their populations have increased. Thus many of the high altitude plants are now believed to be under serious threat of existence and conservation strategies are needed to be addressed urgently. In India, the annual trade of medicinal plants is around the US $ 1 billion. About 90% of medicinal plants used and traded in India are harvested from the wild and the majority of the portion of this comes from the high altitude/alpine regions of the Himalayas. Many high altitude medicinal plants viz; *Aconitum heterophyllum, A. atrox, Picrorhiza kurrooa, Nardostachys jatamansi, Podophyllum hexandrum, Rheum emodi, Angelica glauca, Dactylorhiza hatagirea, Lilium polyphyllum, Paris polyphylla* etc. are now endangered or rare and banned for harvesting from natural habitat. Further, Botanical Survey of India has published Red data book for Indian plants which are under serious exploitation pressure and their entity in nature is in peril and recommended ban on their exploitation from nature. Cultivation is an effective tool for conservation and ensures sustained utilization and continuous supply of raw materials without disturbing natural habitat of these plants. For cultivation and to yield higher production and quality of raw material effective agrotechnology is needed to be developed. For the development of appropriate agrotechniques, we should have the knowledge of habit and habitat, climatic and soil requirements, potency of germination, vegetative multiplication, nursery techniques, harvesting and post harvesting techniques of the concerned species. Cultivation trials in different regions of Garhwal Himalaya showed that all these species can be cultivated in suitable agroclimatic regions of Upper Himalaya by the farmers of the region. The large scale cultivation of these species will ease the pressure on their natural populations by meeting the demand of the suppliers and thus will help in the conservation of these species in their natural habitat. Cultivation of these high value medicinal plants by local people / farmers can also augment the economy of the people as well as of the region. The prospects of cultivation of these species is discussed here.

Biography: Prof. Nautiyal is working as a Director, High Altitude Plant Physiology Research Centre, HNB Garhwal University (HNBGU) Srinagar. He did his PhD in Plant Physiology. He has more than 30 years of teaching & research experience. He is Chairman of project screening and evaluation committee, SMPB (since 2014), Coordinator of Research & Consultancy Cell, HNBGU and member of Research Advisory Committee, HRDI (Since 2013). He worked as a Director, HAPPRC, HNBGU (2012–2015) and Dean, School of Agriculture, HNBGU (2010-11 & 2017-20), Member of Expert Panel on Herbal NRDC, DSIR, DST (2014), Member of Executive Council, HNBGU (since 2019-20) and Member of Academic Committee, HNBGU (since 2017-20). His research interest areas are physiology of reproduction in economically important alpine medicinal plants (MPs); Seed biology and multiplication of endangered alpine MPs; studies on growth forms of alpine vegetation and vegetation analysis; cultivation of high-altitude MPs at relatively lower altitudes; Impact of climate change on alpine vegetation and biochemical evaluation of high-altitude MPs. He is Member of National Academy of Sciences (Allahabad), Indian Society for Plant Physiology (New Delhi) and Alpine Garden Society (Pershore, UK). He supervised 16 PhDs and completed 14 R&D projects funded by SAC-ISRO, HRDI, MoEF, GBPIHED, NMPB, DBT, MHFW and GBP-IERP. He published more than 150 research papers in various journals of international repute.

Talented natural molecules as leads discovered in drug and cosmetic R&D studies

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Many examples of natural molecules have entered in clinical application for the treatment of various diseases that even threaten human health. In fact, some of these molecules brought Nobel Prize as well as fame to their inventors. Among them, penicillin, aspirin, captopril, acyclovir, and more recently artemisinin could be counted as bright examples, used as the modern medicines. Relevantly, not only plants, microorganisms or marine organisms, but also animals can produce many bioactive molecules. For instance; exenatide, another star molecule with potent antidiabetic activity obtained from the saliva of the venomous lizard, *i.e. Heloderma suspectum* (Gila monster), has become a licensed drug (Byetta®) in many countries. Consequently, these outcomes explain well why natural products/molecules have been a field of great interest to researchers since many decades. Enzyme inhibition is one of the most-studied mechanisms for the treatment strategies towards lots of diseases along with cosmetic use. During our ongoing extensive studies on finding novel inhibitors against a number of enzymes (collagenase, elastase, xanthine oxidase, HMG-CoA reductase, tyrosinase, cholinesterase, phosphodiesterase, etc), we have been conducting a large screening among natural molecules, which afforded many new/known compounds with promising inhibitions. For example; we have recently reported yuccalechins A–C,[1] semisynthetic *O*-alkylcoumarin derivatives as well as some isoquinoline alkaloids with encouraging cholinesterase inhibition, whereas newly discovered saponins from *Herniaria glabra* were inactive against cholinesterases and tyrosinase when we tested.[3] More recently, we identified quercetin in *Erodium birandianum* as the active inhibitory substance against xanthine oxidase, while the same compound from *Geranium glaberrimum* was also active against tyrosinase, confirmed by molecular docking experiments. On the other hand, several terpenic metabolites from *Salvia* species were shown to possess inhibitory effect against HMG-CoA reductase. In this lecture, our updated data will be mentioned in terms of mostly enzyme inhibitory capacity of favorable examples of natural molecules identified by our group.

Biography: Prof. Orhan holds a Pharmacist degree (1993) from Gazi University (Ankara, Turkey), 1st M.Sc. degree (Pharmacognosy) at the same Faculty in 1996. She was awarded second M.Sc. degree in Marine Natural Product Chemistry in 1998 at the University of the Ryukyus, Japan. She earned Ph.D. degree (Pharmacognosy) at Gazi University in 2002 and visited University of Winnipeg (Canada) in 2003 as post-doc under NATO-TUBITAK fellowship program. She became full professor in 2009. Dr. Orhan was appointed as Dean, Faculty of Pharmacy at Eastern Mediterranean University in the Northern Cyprus for the period of 2011-14. She is Dean of Faculty of Pharmacy, Gazi University since 2016. She is the president of Pharmacy Academy attached to Turkish Association of Pharmacists also Chair of Deans Council of Pharmacy Faculties in Turkey. Dr. Orhan received several awards such as *Young Woman Scientist Award* by OWSD & *Elsevier*, *Science Award* by COMSTECH in 2010, *Young Woman Scientist Award* by L'Oreal & Turkish Academy of Sciences in 2011, *Innovation Award for Women in Turkey* in 2015, *Science Award* by Turkish Association of Pharmacists in 2016, *Golden Mortar Science Award* in Pharmacy in 2017, *Silver Medal for Patent in International Invention Fair* by Turkish Ministry of Science and Technology in 2017 as well as *Best Academic Invention Medal* by International Federation of Invention Associations in 2018. She was selected as the principal member of *Turkish Academy of Sciences* as well as the *Representative of Southeast Europe & Turkey Region for Phytochemical Society of Europe* in 2019. She is member of Analysis and Pharmacopeia Consulting Commission of Turkish Drug & Medical Device Agency, Dietary Supplements Consulting Committee of Turkish Ministry of Agriculture and Forest, Drug Technical Committee of Turkish Ministry of Industry, and Board of Specialty in Pharmacy, and Aromatherapy Working Party of Turkish Ministry of Health. She is author of more than 350 scientific papers and book chapters, 3 patents (Turkish, US, & EP), 5 patent applications, and 3 scientific books. She has supervised 6 PhD and 14 M.Sc. theses. Her research interests are novel enzyme inhibitory compounds from natural sources by *in vitro* and *in silico* methods, phytocosmetics, phytotherapy, aromatherapy, and natural product chemistry. She is currently Associate Editor of Phytomedicine.

Need of conservation and reproduction of Himalayan herbs

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Himalayan region always has been the treasure of herb from ancient time. Maharshi Charak has mentioned in his text that Himalayan herbs are highest in quality and potency.

'' हिमवान् औषध-भमिनां श्रेष्ठम्।।'' (चरक)

In the true sense the basis of medical system is medicinal plants. For the last some decade over exploitation of Himalayan forest leads these valuable herbs in endangered category. Unfortunately the unscientific exploitation of medicinal and aromatic plants of the Jammu and Kashmir, Uttarakhand, Himachal Pradesh, Sikkim, Arunachal Pradesh and Manipur are still going on whole Himalaya region. Though, their planned restoration and reproduction were paid least attention. As a result *Aconitum heterophyllum, Picrorhiza kurroa, Gentiana kurroo, Dactylorhiza hatagirea, Nardostachys jatamansi,* Ashtavarga and many more are becoming endangered. Some of the reasons of their losses from wild habitat are unscientific harvesting of unripen seeds of Annuals, Biennials and Perennials herbs with their roots, storage of more than

required, trampling of the meadows by buffalos, horses, sheep/goat and illegal cutting of forests. These days due to scarcity of genuine plants the prices and adulteration of plants based medicine are increasing. Still, we have chance to pay attention towards the conservation, cultivation of these herbs otherwise these species will be extinct for forever. Therefore, it is hour of need to make a scientific planning to plant these herbs as per their geographical and environment condition to throughout country. This will not only save these endangered herbs but also, manage the balance in environment, reduce the cost of medicine and will generate employment.

Biography: Dr. Uniyal is one of the most experienced and prominently known experts of Ayurvedic Herbs in India. He earned A.M.B.S. (Ayurvedacharya); Ayurved Bhaskar Charak Samhita and Netra Vigyan with a specialty in Dravyaguna. He served as Director, CCRAS, Ministry of AYUSH, Govt. of India as well as a Senior Consultant, Medicinal and Aromatic Plants of Govt. of Uttarakhand. Besides, he is a member of Ayurvedic Pharmacopeia and Fellow of National Ayurveda Vidhyapeeth, AYUSH Ministry, Govt. of India. Formerly, he served as Technical Consultant, Ayurveda in Govt. of Himachal Pradesh and Member of National Medicinal Plants Board, Indian System of Medicine and Homeopathy, etc. Dr. Uniyal is an author of more than 50 useful and informative books of Medicinal and Aromatic Plants. Among them, few books are *Medicinal flora of Garhwal Himalaya; Ashtang Samgrahki Vanoshadiyan evam Vargikaran; Laddakh ki Sanskriti evam Paramparagat Tibeti Chikitsa Pranali; Bihar ki Adivashi Jadibootiyan; Sanskriti Sahitya me Paryavaran evam Kalidaski Vanaspatiyan; Prayogatmak Abhinav Dravyaguna Vigyan; Bharat ki Jadibootiyon ka Krishikaran; Uttarakhand Himalaya ki Vanoshadhiyan evam Khanij; Ayurved Anusandhan Darshika; Uttarakhand him shikharon par divyasanjeevani aushadhiyan; Uttarakhand vanoshadhi darshika; Himalaya luptprayah vanyajantu kastoori mrig evam mahoshadi kastoori*, etc.

Exploration of folklore medicinal plants – documentation and pharmacology

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The Himalayan regions are the richest hot spots of biodiversity and also known for rich heritage of knowledge on plant based treatment. Uttarakhand state in Himalayan region is popularly known as 'Herbal State', is one of the repository of indigenous traditional knowledge with respect to age-old practice and perceptions in the treatment and prevention of various ailments by local communities. Unfortunately, the aforementioned indigenous knowledge of local communities has been disappeared in many places of Uttarakhand due to variations in traditional cultures and advancement in modern technologies. In Uttarakhand, various medicinal plant databases are poorly documented currently. The present study recommends documentation of extensive information such as botanical name, common name, taxonomy, habitat, location, climate and threats to a particular medicinal plant in Uttarakhand along with used part, medicinal use, detailed genomic information, and chemical information. The documented traditional knowledge can be recorded and detailed phytochemical and pharmacological studies can be conducted for developing new drugs for the treatment of many diseases.

Biography: Prof. P. P. Badoni is currently serving as Director, HNB Garhwal University, BGR Campus Pauri. He is also serving as Head of Chemistry Department, HNB Garhwal University. He has a rich experience of teaching and research, and already supervised more than 10 PhDs. He has been a principal investigator of many research projects and published more than 45 papers in various journals. He has been Incharge Officer for Sparsh Ganga, and Uttarakhand Govt. initiative. In addition, he served as a coordinator for NSS at state level. He is member of many academic and scientific societies. His current research areas are natural products, synthesis and natural dyes, etc.

Anti-osteoporotic and anti-osteoclastogenic effect of medical plants with special reference to *Piper betle* leaf extract and its main active constituent hydroxychavicol: A mechanistic analysis

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The human skeletal system is a multifunctional complex organ system that undergoes the process of renewal through a continuous cycle of resorption and formation by osteoclasts and osteoblasts respectively. While bone loss is inevitably observed with progressing age, several other factors like gender, low calcium and vitamin D in the diet, alcohol/tobacco consumption, long-term use of corticosteroid-medications, several malignancies, certain genetic factors and hormonal imbalances can also adversely affect the bone mass. The current need for skeletal healthcare research is focused on the discovery of novel osteo- anabolic agents that can restore the bone mass as well as maintain the physiological balance between bone formation and resorption in osteoporotic conditions. Several investigations have suggested that phytoconstituents from various fruits, leaves, roots or other plant parts can influence the process of bone formation and its resorption. In the current study, we explored the effects of certain phytochemicals including betel leaf extract (BLE) and its major phytoconstituent, hydroxychavicol (HCV), in the promotion of osteogenesis (bone cell formation) and inhibition of osteoclastogenesis (bone cell resorption) in *in vitro* and *in vivo* models. During inflammation, inflammatory cytokines are released from the cells of the immune system and stimulate osteoclastogenesis by increasing the production of TNF-α and RANKL as a result of which osteoporosis is triggered. It is known that NF-κB and MAPK pathways play a major role in

osteoclastic bone resorption thus leading to osteoporosis. Our results exhibited that both BLE and HCV exert an osteogenic effect through promotion of β-catenin/pGSK3β signalling and inhibit osteoclastogenesis through NF-κB, MAPK: P38 and JNK signalling pathway. Moreover, betel leaf extract and hydroxychavicol ameliorate glucocorticoid- induced osteoporosis in rats via inhibition of NF-κB, MAPKs namely p38 and JNK signalling pathways. The improved bone microarchitecture and tissue morphology in response to BLE and HCV in osteoporotic rats further substantiated their role as bone- anabolic agents. Thus, the nutraceutical potential of betel leaf extract and hydroxychavicol can be explored further to mitigate several skeletal complications in future.

Biography: Dr. Partha Roy completed his Bachelors and Masters in Zoology from the University of Kalyani, West Bengal. He obtained his PhD from Visva Bharati University, India and then he moved for Postdoctoral studies at Institute of Reproductive & Developmental Biology, Imperial College London, UK. Currently he is a Professor in the Department of Biotechnology, Indian Institute of Technology (IIT) Roorkee, India. Prior to joining at IIT Roorkee he served as Research Scientist at Glenmark Pharmaceuticals Ltd., Mumbai, India. His current research interest is development and validation of nutraceuticals for the cure and management of various diseases with special emphasis on diseases like cancer, diabetes and bone related disorders. He has published more than 120 research papers in peer reviewed journals and with high number of citations and authored several book chapters. He is the recipient of Outstanding Teacher Awards at IIT Roorkee in 2014 and 2019. He is also the receipt of Ramkumar Award for Outstanding Teaching and Research 2016 at IIT Roorkee. Professionally he is serving various scientific and academic bodies in India as panel members. He has visited various universities/institutes across the world as Visiting Faculty.

Drug discovery from medicinal plants in the Indian context: An introspection

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The last few decades have witnessed a renewed interest in herbal medicines globally. Further, plants continue to provide basic lead moieties virtually in every pharmacological class during drug discovery programs due to the distinctive chemical diversity of natural products present therein. In our quest for isolation of interesting compounds, a series of natural products viz. tiliroside [kaempferol-3-*O*-*β*-D-(6″-*E*-*p*-coumaryl) glucopyranoside], quercetrin (quercetin-3-*O*-*α*-*L*-rhamnopyranoside), biflavanoids GB-1, GB-2, flavones-chromone moiety, etc. have been isolated from medicinal plants based on comprehensive NMR, IR and mass spectral analyses. Further, polysaccharides of forestry species from *Tinospora sinensis*, *Dalbergia sissoo*, *Acacia tortilis*, *Hippophae salicifolia*, *Malvastrumn coromandelianum, Cassia tora* have been thoroughly investigated by isolation, purification, chromatographic separation, degradative and spectroscopic analyses to understand their chemical composition and therapeutic effects thereof. Further, India is the seventh-largest country in the world and Asia's second-largest nation. Ayurveda is one of the most ancient systems being practiced for the last thousands of years. Two of the eighteen hotspots (Eastern Himalayas and the Western Ghats) of the world are in India. However, not many New Chemical Entities (NCEs) have been reported from India. The paper will introspect the challenges and future perspectives for better outputs.

Biography: Dr. Vineet Kumar is presently Scientist-G and Head, Chemistry and Bioprospecting Division, Forest Research Institute, Dehradun. He has ~26 years research experience in the area of natural products chemistry in India, Germany and USA. He has published 80 research papers in prestigious journals with high impact factor including RSC Advances, Planta Medica, Carbohydrate Polymers, International J. Biological Macromolecules, Phytochemical Analysis, Food Hydrocolloids, Industrial Crops and Products, Arabian J. Chem., Journal of Applied Polymer Science, Starch/Starke, Indian J. Chemistry, etc. The current approach of his research work at Chemistry and Bioprospecting Division, Forest Research Institute, Dehradun is directed towards Structural analysis and functionalisation of natural products including polysaccharides for value addition. Besides significant publications, he has transferred technologies from laboratory to four industries so that these can be multiplied on large scale. He earned several awards including Dr. H.C. Srivastava Young Scientist Award by Association of Carbohydrate Chemists and Technologists (ACCTI), India; National Award for Excellence by Indian Council of Forestry Research and Education (ICFRE), Dehradun under the category 'Young Scientist Award; C.G Merchant Award-2018 by ACCTI and National Award for Excellence -2018 by ICFRE under the category 'ICFRE Best Research Paper Award'. He is Editorial Board Member of the journal 'Trends in Carbohydrate Research' and 'Journal of Medicines Development Sciences'. He implemented a series of projects sponsored by DST, DBT, ICAR, NMPB, ICFRE and industries and guided twelve students for Ph.D. degree. He is also an expert reviewer of leading journals viz. Biomacromolecules, RSC Advances, Beilstein J. Organic Chemistry, Carbohydrate Polymers, Int. J. Biological Macromolecules, J. Advanced Research, Carbohydrate Research, J. Molecular Structure, etc.

Policy reorientations for promoting medicinal plants industry in northern Karnataka – A field investigation of NMPB research project

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Field demonstrations were conducted in selected northern Karnataka districts during 2017-2020 to study the techno-economic feasibility of NMPB developed agro-technologies in promoting selected medicinal plants cultivation as part of NMPB ad-hoc research project. The opinion survey of 364 farmers trained under the NMPB educational programme during 2003-2005 revealed that only 9.34 per cent of them shown interest to cultivate medicinal plants. Further, the trained farmers pointed the need of market support/buyback assurance, project mode approach from the development departments,

small scale implements for harvesting and post-harvest operations, and strengthening producers groups to take up post-harvest operations. The field demonstrations in *Ocimum sanctum* (Krishna Tulsi) with the intervention of improved variety CIM-Ayu along with recommended technologies shown 21.71 per cent increased yields with 3.46 benefit cost ratio (B:C) over farmers practice (2.23). In *Centella asiatica* (Brahmi / Vandelaga/ Mandukaparni), introduction of Arka Divya and Arka Prabhavi varieties given 26.15 per cent increased yield with 2.18 B:C over farmers practice (1.79). Further, the introduction of improved variety in *Phylanthus amarus* (Bhumiamalaki/ Nela nelli) shown 31.25 per cent increased yield and 2.18 B:C over farmers practice (1:98). Lastly, the demonstration of CIM Megha and DMAPR AK varieties in *Andrographis paniculata* (Kalmegh) given 64.28 and 25.00 per cent increased yields (with the respective B:C of 2.78 and 2.20) over farmers practice (2.44). Besides, the workshops conducted on Research-Extension-Farmers-Traders (R-E-F-T) linkage pointed out establishment of centralised nursery for ensured availability of medicinal crops seeds and planting materials, enforcing strict legislative measures in implementing contract farming to protect the interests of both the medicinal growers and the companies/industries, encouraging certified and registered local contracting agencies to act as a bridge between medicinal crops growers and industries, announcing the requirement of quantity of medicinal plants well in advance, mobilising medicinal growers to form common interest groups, cooperatives and Producer Organistions, establishment of medicinal plants mandi. The facility of medicinal plants testing laboratory in the vicinity with subsidized / nominal rates of testing, encouraging semi processing clusters and infrastructural facilities for value addition at farmers level, strengthening Research-Extension-Farmer-Traders linkage activities, ensured availability of subsidies and support services through schemes and programmes for promoting organic cultivation of medicinal plants and strengthening the roles and activities of Karnataka Medicinal Plants Authority strategies were identified as the backward and forward linkages for promoting medicinal plants industry.

Biography: Dr. A. Bheemappa is working as Professor in Agricultural Extension Education, College of Agriculture, University of Agricultural Sciences, Dharwad (Karnataka). His Field of Specializations are Entrepreneurship development, ICT applications in agriculture, Diffusion and adoption of agricultural technologies and Impact evaluation of Agricultural programmes. He Completed research projects funded by NABARD, NMPB, DST and ICMR etc. He also completed UAS funded staff research projects. He has published 69 Research papers in National and International Journal. He has published 65 abstracts in National & International seminar/conferences/workshops. He also published 14 chapters and article in books and magazine. He is Member of International Society of Extension Education, Nagpur, Indian Society of Extension Education, IARI, New Delhi, Society of Extension Education, Tamil Nadu Agricultural University, Karnataka Journal of Agricultural Sciences, UAS, Dharwad, Karnataka and Indian Society of Agricultural Information Technology (INSAIT).He received Young Scientists Award from Indian Society of Extension Education New Delhi, Appreciation certificate from Indian Society of Extension Education New Delhi, and ISEE Fellow award from Indian Society of Extension Education New Delhi.

Need of collection, cultivation, storage of medicinal plants in present scenario

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Nature has provided us better surrounding for expansion and development of medicinal plants for thousands of years. Medicinal values of plants date back to ancient times on belief of its safety and economic values. Drugs may be collected from wild or cultivated plants and the assignment may be undertaken by casual, unskilled workers or by skilled workers. The preliminary idea for better survival of those plants is by removing their competitors and later by increasing the fertility of soil by use of fertilizers followed by propagation of larger, high yielding or superior plants. Plant growth and development as well as the nature and quality of secondary metabolites are affected by the temperature, rainfall, aspect, length of day and altitude. The important effects of rainfall on vegetation can be considered as continuous rain can lead to loss of water-soluble substances from leaves and roots by leaching which is responsible for low yield of some active constituents such as alkaloids, glycosides and volatile oil. The plants very much in both the amount and intensity of light which they necessitate. The better development of plant occurs in improved condition of soil, pruning and control of insects, pests etc. Different plant species vary enormously in their soil and nutritive requirements. Variation in particle sizes result in different soils ranging from clay, sand, gravel. Particle size is one factor influencing water holding capacity, moisture content, microbial growth. The age of the plant is also of considerable importance and governs not only the total quantity of active constituents produced but also the relative proportion of the components of the active mixture. To ensure maximum quality in crude drugs it is essential to collect drug plants at proper time, proper part of the plant and at proper stage of development. The season at which drug is collected is variable in case of roots, leaves, bark, stem, rhizomes, gums, resins etc. Better storage of drugs is required to protect them from moisture, air, heat, light, micro-organism etc. In order to reduce undesirable microbial contamination and to prevent the development of other living organisms, some plant materials may require sterilization before storage. Well processed curative plant material should be wrapped properly to avoid deterioration of crude drug and to protect from exposure of microbial contamination. The aim of this work is to ensure high yield of crude drugs and quality control of medicinal plants. Good cultivation practices with knowledge of suitable environmental factors such as temperature, rainfall, length of day, altitude result in yield of active constituents, secondary metabolites. Proper cultivation, collection techniques results in good quality products and is helpful in propagation of rare medicinal plant species. Crude drugs are subject to many hazards at all stages of cultivation, collection and preservation. Knowledge of minute cultivation and collection skills is helpful in propagation of rare medicinal plants.

Biography: Prof. A.K. Singh is presently working as a Professor in the department of Dravyaguna at Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University. He received his MD(Ayurveda) degree in Dravyaguna in 1994 and Ph.D. degree in Dravyaguna from Banaras Hindu University in 2002. He has 10 years of teaching experience in Yashwant Medical College, Kolhapur then he left and joined Sampurnanand Sanskrit University as Assistant Professor. Later, he got selected in the post of Reader at Department of Dravyaguna, Faculty of Ayurveda, Banaras Hindu University and subsequently promoted as Professor in 2011. He had been the Head of Department for three years. He has more than 28 years of teaching experience. His area of expertise includes treatment of various diseases such as Diabetes, Hypertension, GIT disorders, Respiratory disorders, Joint disorders etc. He has published more than 70 research articles as well as 10 books under various National and International publications. He served at post of course coordinator in B.Pharm(Ay.), M.Pharm(Ay), BNYS in Rajiv Gandhi South Campus, Barkachha. He was chairman in boxing, USB, BHU. He is program co-ordinator in University Mountaineering Centre.

Shelf-life and safety of Ayurvedic formulations

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When it comes to herbal medicine safety and standardization are highly discussed issues. It is common belief that ASU (Ayurvedic, Siddha and Unani) formulation can be stored up to three years, which is not true. On February 6, 2004, FDA issued a rule stating that supplements containing "ephedra" present risk of illness putting ban on manufacture and distribution of ephedra containing dietary supplements with effect from April 12, 2004. This was the first time in US that a supplement was been removed from the market under DSHEA (Dietary Supplement Health Education Act).
Schedule T is defined as the schedule of drugs and cosmetic act & rules which represents the good manufacturing practice of ASU (Ayurvedic, Siddha and Unani) medicines along with area required for premises, specification required, qualification required, recommended machinery and equipment etc. The center for disease control received 12 reports of lead poisoning linked to ayurvedic medicine in 2004. Patients suffer from seizure and liver malfunction due to high levels of arsenic, lead and mercury poisoning. Currently the herbal raw material which forms the basis of Ayurvrdic formulation is available in market as crude herbs and processed herbs. Unlike synthetic medicine ensuring the quality of raw material is a challenging task in this case. Though ayurvdic formulation must be prepared in traditional method there is a need to modernize the manufacturing units to meet increasing demand and maintain quality as per the standard ancient text. Manufacturing of ASU medicines is regulated under schedule T of Drugs and Cosmetic Act & Rules which regulates the good manufacturing practice of ayurvedic formulations along with area required for premises, specification required, qualification required, recommended machinery and equipment etc. The Good Manufacturing Practices (GMP) and more data on shelf life are required to ensure safety and standardization of Ayurvedic formulation for consumer benefit.

Biography: Dr. Kumud Upadhyaya (M. Pharm. Ph.D. DSM, Ayurvedratan) is son of Late Sri Gopal Upadhyaya, a renowned writer of Uttarakhand. He has more than 23 years of University and professional experience. He has held many posts of responsibility in Kumaun University, Uttarakhand Technical University and Uttarakhand Ayurved University, Dehradun. He is involved in active teaching in Uttarakhand since 1996 Dr. Upadhyaya is credited with establishing pharmacy education in Uttarakhand. He presently holds the post of State Coordinator, Indian Society of Pharmacognosy. He is pioneer in establishing Pharma education in Uttarakhand and has the distinction of organizing States first National and International Seminar in Pharmaceutical Sciences. He is working as Pharmacy faculty in this region since 1996. He is serving as Associate Professor, Department of Pharmaceutical Sciences, Kumaun University, Nainital. He *has* published extensively N*ational and International journals.* He has organised/actively participated in national and intrnational conferences by means of lectures, poster evaluator, Chair session and invited speaker. Presently he is guiding students for Ph.D. enrolled at UTU, Dehradun and Kumaun University. Beside this he has also guided M. Pharm students for project work working in Institute of repute like FRI Dehradun, NBRI, and CIMAP Lucknow. He has served for four years as Professor at UTU, Dehradun. Under his leadership two UCOST Young scientist awards were won by students.

Identification of Indian medicinal plant with acaracidal properties

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Tick and Tick-borne diseases (TTBDs) affect 80% of the world cattle population, mostly in tropical and sub-tropical countries. The annual global economic losses due to TTBDs are estimated to be $13.9-18.7 billions. Ticks are the most important vectors after mosquitoes in transmitting diseases. Ticks are at the top in transmitting diseases in the livestock. *Rhipicephalus microplus* is the most prevalent among various species of ticks in tropical and sub-tropical areas. Ticks transmit diseases such as theileriosis, *babesiosis* and anaplasmosis in livestock. *They are also involved in transmitting diseases in human. The most common method for controlling tick population is the use of s*ynthetic acaricides. Because *of the* frequent application of synthetic acaricides, there are reports of development of resistance to these commonly used acaricides in *Rhipicephalus microplus*. Hence, there is huge demand for the identification of novel natural acaricides. Plants are known to possess various secondary metabolites like terpenes, phenols, acids, steroids, aldehydes and

essential oils. Some of the metabolites are known to possess insecticidal properties also. Thus, we attempted to identify plants extracts with anti-tick properties in this work. Twenty Indian medicinal plants were selected for screening their acaracidal properties. The soxlate for all these plants was prepared using selected polar organic solvents with low to high polarity (hexane, chloroform and methanol). We tested all these extracts for their ability act as an adulticidal, larvicidal and/or inhibitor of oviposition. We found four out of these twenty plants with either adulticidal activity, larvicidal activity or inhibitor for oviposition. The skin test preformed upon rabbit showed no adverse reaction suggesting that these plant extracts are safe to use. The HPLC and HPTLC profiles of all these plants were further examined. However, the sub-fractionation of the extracts from these plants did not yield better inhibitory effect. Presently, we are in the process of making formulations with these plant extracts.

Biography: Dr. Anand Srivastava is working as Scientist D, in National Institute of Animal Biotechnology (NIAB), Hyderabad, Telangana, India. His area of specialization is Parasitology, Biochemistry, Molecular Biology and Entomology. He was Junior Research Fellow, Senior Research Fellow at CSIR from 2002-2007. He did his PhD from Malaria Research Group, ICGEB, New Delhi, India (2008). He was Post-Doctoral fellow at Institut National de Transfusion Sanguine, Paris and Institute Pasteur, Paris in a European Commission project. He worked as principal investigator in of research project funded by NMPB, Science and Engineering Research Board (Delhi, India) and DBT. He attended several National and International workshop and Training. He has published more than 25 research and review article in National and International journals. He also published a book chapter.

Way towards the development of phytopharmaceuticals from medicinal and aromatic plants

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Plants are remarkable source for therapeutic agents and abundantly exploited from centuries. The lead discovery from plants has been reported due to great interest on natural products for health benefits. Less numbers of drug products have been reported due to ethical clearance issues and long drug discovery programmes. Most of the medicinal and aromatic plant based research in the master and degree programmes were closed in the dark boxes. Even these research works are convertible or can be converted into some valuable products. Thus, to cater these kinds of halted research works, an intermediate regulation has been evolved and known as phytopharmaceutical regulation. This regulation provides the simple scientific way to develop and register a drug product in short duration. Therefore, the current talk will provide the insights on detailed process and methods for development of phytopharmaceutical product and their registration. The current topic will help young minds and innovators to develop and register new drug like products for health and wealth benefits.

Biography: Dr. Dinesh Kumar is presently holding a post of Pricipal Scientist of NMR, Metabolomics & Natural Product Chemistry in the Natural Product Chemistry and Process Development Division at CSIR-Institute of Himalayan Bioresource Technology, Palampur. In addition, he is Nodal Scientist for the Technical Services available in the institute. He has awarded PhD in Pharmaceutical sciences in 2012 from University of Kashmir, Srinagar, India. He worked as lecturer at Punjab college of Pharmacy, Ferozpur in 2006-07 and as Asst. professor at Rayat Institute of Pharmacy-Railmajara, Punjab, India in 2009-10. He had worked as Research associate (SMPF) in 2012-2013 at Department of Pharmaceutical Sciences, University of Kashmir, Srinagar, India. He has been a Postdoctoral fellow in Department of Pharmaceutical Sciences, Tshwane University of Technology, South Africa. He is consultant for various herbal and Biotech industries in India and abroad. He has published more than 100 International papers and received many prestigious awards including INSA, CSIR, KU, etc. He is editorial board member and reviewer of various internationally reputed journals. His major areas of research are metabolomics, herbal drug development and standardization

Rare and important medicinal flora of high altitude of Uttarakhand Himalaya: Search for new herbal and nutraceutical products

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Owing to peculiarity of climatic regimes in the high altitude of Himalaya, this wonder land is gifted with unique and valuable diversity of medicinal and aromatic plants. Most of the species are being used in medicinal forms and had been the part of various social and cultural rites since the beginning of Ayurveda e.g., Atis (*Aconitum heterophyllum*), Meetha (*Aconitum ferox*), Kutki (*Picrorhiza kurrooa*), Jatamansi (*Nardostachys grandiflora*), Van-kakdi (*Podophyllum hexandrum*), Jamboo/Faran (*Allium stracheyi*), Bill/Pama/Bhitaru (*Juniperus* spp.) Kuth (*Saussurea costus*), Kala Jeera (*Carum carvi*), Gandrayni/Cheepi (*Pleurospermum angelicoides*), Choru (*Angelica glauca*), Dolu (*Rheum emodi*), Hattajadi (*Dactylorhiza hatagirea*), Kedda Jadi (*Ophiocordyceps sinensis*) etc. These species have tremendous national and international demand and well established in the trade. Their cultivation should be enhanced for the sustainable supply of the quality raw material. However, there are species which have well place in ethno botanical science and opens new possibilities of research in the field of high altitude medicinal plants. Some paramount flora are Mewal (*Allium prattii*),

Khawal (*Polygonatum graminifolium*), Ya/Bank (*Arisaema jacquemontii*), Yaksan/Nakdun (*Typhonium diversifolium*), Jark/Jarro (*phytolacca acinosa*), Dum (*Fritillaria roylei*), Be-Patto (*Bergenia stracheyi*), Sattu (*Trillidium govanianum*), Kuppu-kutti (*Gagea elegans*), Meed-Chuku (*Hippophae tibetana*), many wild mushrooms etc. These are used locally as medicinal and nutraceutical supplements and are also traded. We need to support research and development projects based on these species and should make effective regulatory policies for sustainable utilization of wild resources of the Himalaya. Detail will be discussed during the Conference.

Biography: Dr. Vijay Prasad Bhatt started his career in Herbal Research & Development Institute as a founder scientist and worked with tribal and ethnic communities of high altitude of Uttarakhand Himalaya. He has participated in more than 100 national and international conferences, workshops and seminars. He also had been member in policy making on medicinal plants in the state of Uttarakhand. He has published more than 100 research articles and papers in national and international Journals and published two books from HRDI. He has coordinated many national and international organizations for the research purposes in the high altitude of Himalaya.

Anticancer activity of methanolic extract of roots of *Rumex obtusifolius* and bark of *Prunus cornuta*

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Talking of the application of plants in the field of medicine, it has been shown that almost all plant parts like leaves, stem, bark, flowers, fruit and roots find use in curing and treating ailments of various kinds. Use of plant material in prevention and therapy of the fatal disease cancer is a major research area in the present day scenario. Extracts from these plant materials may be used to obtain compounds which have potent biological activity and may be utilized in targeting cancer cells. In this paper, the methanolic crude extract of *Rumex obtusifolius* (sample R 2) and *Prunus cornuta* (sample P 1) were subjected to anti-cancer assay using sulphorodamine B. The potent anticancer properties of both the plant parts were observed positive against the liver and colon cells of human being using the suitable standard drug/control. The cytotoxicity properties of the extracts/compounds were determined against liver (hep-2) and colon (502713 HT-29) cell lines. Viable cells were counted in a hemocytometer using trypan blue.

Biography: Dr. M. C. Purohit is presently working as Associate Professor in the Department of Chemistry, H.N.B. Garhwal University, BGR Campus Pauri UK. He is the life members of many scientific bodies like: Indian Science Congress Associations, Indian Council of Chemist, American Chemical Society, Royal Society of Chemistry UK, Chromatographic Society of India, Rajasthan Academy of Science, BOS Chemistry HNB Garhwal University and fellow of Indian Chemical Society. Dr. Purohit has been published more than 60 research paper in reputed national and international journals. He has also been presented research paper in national and international conferences/seminars/workshop as a resource person. He has supervised 8 PhDs and 2 scholars are working for PhDs at present. He has been participated in Science popularization programme of Indian Science Congress Association Haridwar Chapter. His area of research interest is chemistry of natural product, natural dyes and nanosciences.

Natural antitubulins: Structural learning for designing microtubule destabilizers as anticancer agents

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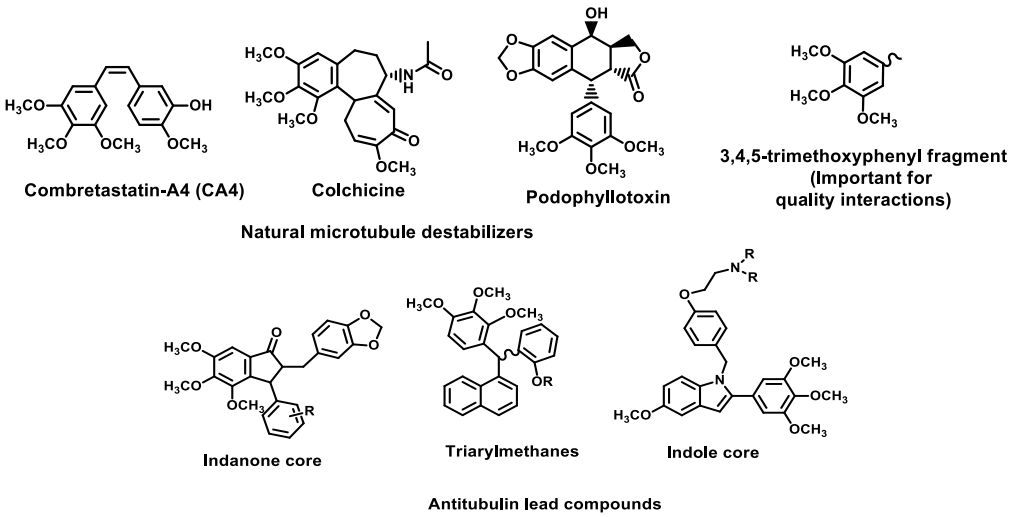
Tubulin, a globular protein has a crucial role in cell growth and division. Tubulin assembly and disassembly is essential for the process of chromosomal segregation. It polymerises to microtubules fibres with which it is in dynamic equilibrium. Any disturbance in tubulin-microtubule dynamic equilibrium leads to cell cycle arrest at mitosis. Thus, modulation of tubulin-microtubule dynamics has become an attractive target for the development of anticancer drugs. Antitubulin is the most successful class of antimitotic agents in cancer chemotherapeutics. There are microtubule destabilizers like colchicines, podophyllotoxin, combretastatins etc. and microtubule stabilizers like paclitaxel, laulimalide, epothilones etc. All these are tubulin-microtubule dynamics modulators which disturb mitosis phase of cell division cycle and subsequently, induce cell cycle arrest. Many of them are successful clinical drug to treat various types of cancer. In our approach, we took structural learnings from some of the naturally occurring antitubulin agents like podophyllotoxin, combretastatin A4 and colchicine to design some basic pharmacophores. A 3,4,5-trimethoxyphenyl fragment is common to all these ligands to interact with beta-tubulin and interrupt cell cycle at mitosis phase by inducing microtubule destabilization effect. In the recent years, Fragment Based Drug Discovery approach (FBDD) has emerged as potential tool to design new drug candidates. We incorporated the 3,4,5-trimethoxyphenyl fragment at an appropriate position in our pharmacophores and achieved some potential antitubulin anticancer agents. Their designing, synthesis and pharmacology will be discussed with some successful examples.



Biography: Dr. Arvind Singh Negi is presently working as Chief Scientist & Head, Phytochemistry Division, CSIR-CIMAP, Lucknow, India. He did Ph.D. in Chemistry (Medicinal chemistry) from CSIR-CDRI Lucknow. He got CSIR-JRF & Lectureship ()1992) and ICAR-JRF & Assistant Professorship (1994). He also worked as Scientist, ICAR-Indian Grassland and Fodder Research Institute, Jhansi. He received ICS-UNIDO fellowship in 2008 (Italy), Raman Research Fellowship in 2010, (University of Illinois, USA), DHR Overseas fellowship in 2017 (University of California, Santa Barbara, USA) and Most cited paper award (Bioorganic Medicinal Chemistry) 2004-2007, 2005-2008 and 2004-2010. He is Associate member-Royal Society of Chemistry. Research Specialization in Medicinal Chemistry, Development of Cancer Chemotherapeutics by modulation of tubulin dynamics. He published 102 research papers in SCI journals (H index=35; I10 index=75; Total citations >4200). He has 11 Indian, PCT & USA Patent.

Chemical and biological exploration of Indian medicinal plants for human healthcare

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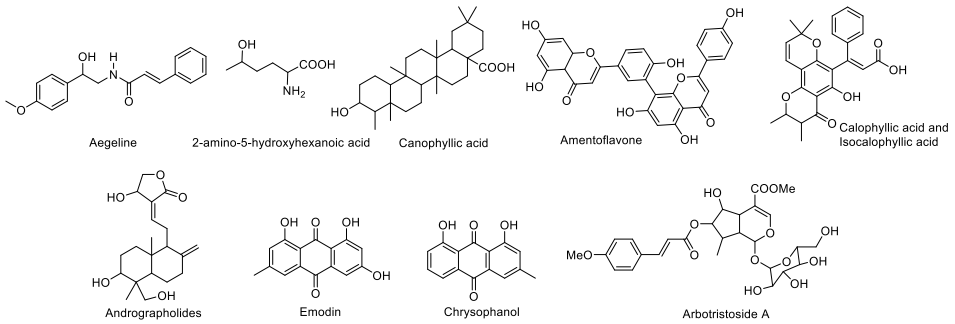
In continuation of drug discovery program on the Indian Medicinal Plants we identified several bioactive molecules for diseases such as diabetes, dyslipidemia, cancer etc. From *Aegle marmelos* we identified an alkaloidal amide (aegeline), which exhibits *in vivo* antihyperglycemic activity and lipid lowering activity. A series of synthetic compounds related to aegeline have been synthesized and evaluated for their antidyslipidemic and antioxidant activity. We isolated an unusual amino acid, i.e. 2-amino-5-hydroxyhexanoic acid from the seeds of *Crotalaria juncea*, and canophyllic acid, amentoflavone and calophyllic acid and isocalophyllic acid from the leaves of *Calophyllum inophyllum*, which showed lipid lowering activity in the in vivo experiments. Andrographolide has been identified as one of the active constituents against atherosclerosis from *Andrographis paniculata*. We synthesized few novel derivatives of andrographolide to improve their antidyslipidemic, LDL-oxidation and antioxidant activity. We also isolated few anticancer compounds such as anthraquinones (emodin and chrysophanol) from *Rheum emodi* and iridoids (arbotristoside A) from *Nyctanthes arbortristis* and a large number of derivatives were synthesized and studied their activity. The structure activity relationships, mechanistic aspects and improvement in their therapeutic activity will be discussed.



Biography: Prof. T. Narender was born in a remote village, Vilasagar, which is located in the Karimnagar district of Telangana State, India. He obtained the Ph.D. degree in the area of natural products (phytochemistry) from the University of Kakatiya, Warangal, Telangana, India in 1999. After obtaining his Ph.D. degree, he joined as a Scientist in the ICAR-Central Marine Fisheries Research Institute (CMFRI) Cochin, which is one of the constituents of ICAR, New Delhi, India in November 1999, and continued there until July 2002, where he worked on the bioactive substances from the marine organisms. In July 2002, he moved to the CSIR-Central Drug Research Institute, Lucknow, India, on a higher position, and July 2016 onwards he holds a Senior Principal Scientist position. He has been awarded the BOYSCAST Fellowship by the Department of Science and Technology, New Delhi, India, in 2007. As a part of this program he visited University of California, San Diego (UCSD), USA, where he worked in Prof. William Fenical's lab on marine

bacteria and fungus from April 2007 to March 2008. He published 125 research articles in various national and international journals, three book chapters, a US patent and delivered 37 invited lectures in national and international conferences. Under his supervision 19 students have been awarded their Ph.D. One of the thesis guided by him has been chosen for Eli Lilly and Company Asia Outstanding Thesis Award for 2014. He is an elected fellow of Telangana Academy of Sciences and received Dr. Mridula Kamboj Award for Drugs, Diagnostics, Vaccines and Related Basic Research-2020 and ISCB 2020 Award for Excellence in Drug Research by Indian Society for Chemists and Biologists. He has been honored with the CSIR-CDRI Incentive Award for the best publication during the year 2008, 2012, 2014, 2017 and 2022 and best technologies during the year 2020 and 2021. Currently, his research group is engaged in natural products and medicinal chemistry work towards developing leads for various diseases such as malaria, leishmania, cancer, diabetes, and lipid lowering from the Indian medicinal plants, marine organisms, chemical transformation and synthesis of natural products of biological importance.

Assessment of polymorphism among the progenies and parent genotype of *Gymnema sylvestre* through genomic SSR markers

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Gymnema sylvestre R. Br. is commonly called gudmar or madhunashini. It belongs to the family Apocynaceae. It is an herbaceous woody perennial widely used in the traditional system of medicine. Its leaves are used for the extraction of gymnemagenin and it is used in the treatment of diabetes since 2000 BC. In the present study, we have investigated the level of polymorphism through genomic SSR markers in 28 seed progenies derived from mother genotype DGS-1 and which were maintained in the field gene bank at ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand (Gujarat). The genomic SSR markers were developed by using Illumina Hiseq 2500 NGS platform. The 28 SSR primers pairs produced a total of 61 bands out of which 55 polymorphic bands and 4 unique bands to a particular genotype. The number of polymorphic bands ranges from 1 to 4. The maximum number of bands generated by the primer Xdagsm SSR71 (4) followed by Xdagsm 34, Xdagsm 60, Xdagsm 69, and Xdagsm 76 and showed 100% polymorphism. These primers are most valuable for the detection of polymorphism among the progenies of *Gymnema sylvestre* because these primers produced a unique band by each primer except Xdagsm 34. The similarity coefficient value ranged between 0.56 and 0.92. A high similarity was found between seed progenies of S12 and S15 (92%) and also S14 and S15 (92%) and high divergent progeny was found between parent (DGS-1) and seed progeny S17. Among the seed progenies tested S12, S14 and S15 are the most similar to the parent genotype DGS-1 and S17 (56%) was the most distinct type it can be used for selection and further crop improvement programs. The cluster analysis based on the UPGMA dendrogram showed that seed progeny S6 and S25 had together shared 100% fragments. The S20 formed as a separate cluster as compared to other seed progenies. The progenies S6, S10, S15, S20, S21, and S25 each formed a separate sub-cluster. This study indicated that considerable genetic variability among the progenies and some of the progenies were unique over the parent DGS-1 and also the remaining progenies due to diversity at the DNA level. Polymorphic markers identified as Xdagsm 34, Xdagsm 60, Xdagsm 69, and Xdagsm 71 are highly useful in the assessment of polymorphism among the progenies and parent genotype of *Gymnema sylvestre* and can be useful in the future molecular breeding program.

Biography: Dr. Akula China Polaiah completed his B.Sc. (Hort.) in ANGRAU Hyderabad, M.Sc. (Hort.) in Medicinal and Aromatic Plants at UAS Dharwad. He was a recipient of departmental merit scholarship for the M.Sc. programme. His Ph.D. (Horticulture) in Plantation, Spices, Medicinal and Aromatic Plants at Dr. YSRHU, Venkataramannagudem (Andhra Pradesh). He has published 28 research papers and 11 popular articles in the national and international Journals. He also served as subject matter specialist to disseminate technology to the farming community. He has worked in different aspects of medicinal and aromatic plants including agrotechiques, conservation, and characterization of medicinal and aromatic plants through molecular markers and breeding of M&APs. He was an active member in various professional societies in M&APs and also Horticulture. He was served as a resource person to various training programmes. He was recognised as external referee of research papers published in national journals and also those published by Elsevier. He was also recognised as external examiner for PG studies in medicinal and aromatic crops. Presently he was working as scientist (senior scale) at ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand (Gujarat).

Medicinal plants: an answer to multidrug resistance in post-antibiotic era

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Alexander Fleming's discovery of antibiotic "Penicillin" and the many more he inspired after have saved millions of lives and spared immeasurable suffering worldwide. However, he also warned about the consequences of abuse of antibiotics that could lead to the expiry of the golden age of antibiotics. Current decreasing effectiveness of antibiotics in general and antifungals in particular, evolution of new drug resistant forms and species and lack of commercial interests to develop new antifungals is a clear indication of post-antibiotic era. In the last two decades, there has been less or no innovation in

the field of antifungal drug discovery with a marginal dip in the number of new licensed antifungal drugs for human use. There is an amplified warning for the pharmaceutical industries, academic and research institutions and the governments to invest the necessary resources to produce next generation of newer, safe and effective antifungal drugs. From the centuries, medicinal plants have already proven a lot of potential to be utilised in developing new therapeutic agents as well as to be utilised as novel strategies to combat multidrug resistance. We used semi-synthetic compounds with an origin from phytochemicals to develop novel agents which can act in combination therapies with known antifungals, target virulence factors, biofilms and quorum sensing. These semi-synthetic chemicals and new strategies are plausible to inspire the formulation of new generation of antimicrobial agents to control multidrug resistant infectious pathogens.

Biography: Dr Aijaz Ahmad is a Senior Medical Scientist in the Division of Infection Control of National Health Laboratory Service at Charlotte Maxeke Johannesburg Academic Hospital and a Lecturer in the Department of Clinical Microbiology and Infectious Diseases, School of Pathology, University of the Witwatersrand. His core research interest is understanding fungal pathogenesis and development of antifungal vaccines and novel antifungal drugs. He has obtained his Ph.D. in Medical Mycology. During his trainings as a Postdoctoral Scientist from the Wits Oral Biological Sciences, Tshwane University of Technology Pharmaceutical Sciences, All India Institute of Medical Sciences and International Clinical Epidemiology Network, he gained lot of experience to be a medical microbiologist. He is HPCSA registered Medical Scientist in Microbiology and is also National Research Foundation (NRF) Y-rated researcher. With an extensive research experience in infectious diseases, microbial pathogenesis and drug development, he has authored/co-authored over 80 peer-reviewed publications with more than 3700 citations. He is also a recipient of several research grants and awards including NRF Grant for rated researchers, Wits University – Friedel Sellschop Award, South African Medical Research Council (SAMRC) Self-initiated Research Grant, and NHLS Research Trust Grant. With his academic citizenship role, he is a member of several international and national societies and committees such as Irish Fungal Society, South African Society for Microbiology, South African Society of Biochemistry and Molecular Biology, Scientific Society of Advanced Research & Social Change, NHLS Research and Development Committee, PathRed Innovation Summit Committee, Wits School of Pathology Transformation Committee, and Biosafety and Biosecurity Standing Committee of Academy of Science of South Africa. He has been elected on to the editorial board of many reputed journals such as PlosOne and Current Pharmaceutical Design. More than 13 post-graduate students have graduated under his supervision since 2015 and has also hosted 6 Postdoctoral fellows for their research projects. He is currently supervising 13 postgraduate students (5 PhDs, 6 Masters, 2 Honours).

Role of dietary flavonoids in the management of metabolic syndrome

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Metabolic syndrome (MetS), also known as insulin resistance syndrome, is a major public health issue that includes complications such as obesity, hyperglycemia, hyperinsulinemia, hypertension, and dyslipidemia. It is a vital and continuously increasing public-health challenge worldwide in the wake of urbanization, unsuitable nutrition, surplus energy intake, increasing obesity and sedentary life habits. Because MetS is a complex disorder, it is difficult to treat with a single drug, so increasing the use of fruits and vegetables and optimising the diet is the preferred MetS management strategy. Nutritional science research has indicated the cardiometabolic effects of flavonoids with complex mechanisms and multiple pathways, and thus suggests their use in the management of MetS. Flavonoids consist of the most abundant group of polyphenolic compounds found in nature and offer a large spectrum of health benefits. Flavonoids are abundantly distributed in our diet, such as apples, tea, broccoli, strawberries, grapes, wine, grains, and citrus fruits conjugated with sugar (e.g., O-glycoside), though few of them are also found as aglycone. Consumption of flavonoids is associated with various beneficial effects on the body. Since ancient times, the health benefits of flavonoids have remained a topic of great interest, owing to their antibacterial, antioxidant, anticancer, antiaging, anti-inflammatory, immunomodulatory, and antidiabetic effects, as well as their role in mitigating metabolic and cardiovascular diseases. Owing to their anti-oxidant, anti-diabetic, anti-obesity and hypolipidemic activities, dietary flavonoids are highly effective in the management of MetS. Intake of flavonoids modulates various signaling pathways involved in MetS like increased AMPK, PPARα and IR/IRS1 activity, upregulation of AKT/AS160/GLUT4 pathways, thereby decreasing insulin resistance. By inhibiting the NF-B pathway and inactivation of Toll Like Receptor 4, flavonoids decrease inflammation in patients with MetS. Flavonoids consumption is also linked to increased expression of antioxidant enzymes in the body, lowering oxidative stress, a major etiological factor for MetS. Therefore, prolonged consumption of dietary polyphenols and flavonoids, as a part of daily dietary intake may prove to be a potential cure for metabolic syndrome and other related health conditions.

Biography: Dr. Mamta F Singh is presently working as Professor and Head, Department of Pharmacology, School of Pharmaceutical Sciences and Technology, SBS University, Dehradun. She is having total work and research experience of 18 years. She has qualified GATE in 2001 and 2002 with 80 and 98.4 percentile and received AICTE scholarship in her Masters. She has guided more than 35 M. Pharm students and more than 45 B. Pharm students. She has guided 02 PhD students and presently guiding 4 PhD students. She has more than 50 research papers in reputed National and International Journals. She is life member of Association of Pharmaceutical Teachers of India and Indian Pharmacological Society. She is recipient of many awards including Young Scientist Award. She has expertise in developing animal models of various diseases. Her area of interest is ethnopharmacology, metabolic diseases and Alzheimer's disease research.

Status of Indian medicinal plants on the IUCN red list and their conservation

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Medicinal plants have been used in traditional medicinal systems to serve mankind for ages. The market demand for medicinal plants is increasing day by day. The present market of herbal drugs is about 40 billion rupees which is expected to increase by 20% in the next 5 years. To date, several important medicinal plants are in their extinct state and already enlisted on the IUCN red list. Because of the high demand for these plants in the market, as well as, less cultivation or availability, the herbal products are being adulterated and hence compromised with their efficacy. The main concern of the present day is the future of Ayurvedic drugs because the collection of source herbs from their natural habitat is mostly prohibited and their cultivation is not enough to fulfil market demand. Many of these plants such as *Taxus baccata* and *T. wallichiana* are endangered and only grown in their natural habitat. Their cultivation in other areas is practically not feasible. This is only todays' status, the situation will be more critical when the demand will increase with increasing population and increasing adoption of Ayurveda. It can be possible that in the coming years, most of the Ayurvedic drugs will be adulterated and these will cause only side effects rather than therapeutic effects. Hence, the conservation, cultivation and sustainable use of medicinal plants are need of the hour.

Biography: Dr. Ruchi Semwal is presently working as Assistant Professor at Govt. Postgraduate College, Dakpathar, Dehradun, India. She earned her PhD in the area of Natural Products having medicinal and dyeing properties. She screened more than 50 plants of medicinal use in various laboratories in India and overseas for their scientific authentication. She developed various methods to isolate bioactive molecules from the plants. Besides, she optimized some traditional dyeing methods in the laboratories for industrial use. Around 70 research papers and 5 books are already in her credit. She has been a recipient of many prestigious awards including NRF Postdoctoral Fellowship, UGC-Dr DS Kothari Postdoctoral Fellowship and UGC-Research Fellowship for PhD. Her research interests are natural products chemistry and bioactivity of natural molecules.

Vascular endothelial dysfunction – Cardorium Plus – Evidence-based Ayurvedic solution

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The power point presentation deals with management of vascular endothelial dysfunction with proprietary Ayurvedic poly herbal formulation Cardorium Plus having high altitude Himalayan medicinal plants as ingredients. Vascular Endothelial Dysfunction came in to clinical practice in the year 2010 only in western countries but Ayurvedic formulation Cardorium Plus was ready by the year 2007 itself. Cardorium plus pre-clinical studies conducted under ethical committee approvals in Vishnu Pharmacy College and paper presented in 79th European Atherosclerotic Society in the year 2011. Clinical Studies jointly conducted by Dr BRKR Govt Ayurvedic College and Nizam's Institute of Medical Sciences under ethical committee aproval in the year 2016 and poster presented in 7th World Ayurveda Conference, Kolkata in the year 2016 and Mata Amritanandamai Medical College in the year 2020. Both animal studies and clinical studies show the results that the Cardorium Plus can address Vascular Endothelial Dysfunction correction of Nitric Oxide Bioavailability, Anti-oxidant Activity, Anti Inflammatory activity, Anti Lipid activity and improvement of insulin sensitivity. Apart from this reproducible result are observed in the improvement of LVEF function in heart failure subjects. Cardorium Plus a poly herbal Ayurvedic formulation can be included in the management protocol of Hypertension, Diabetes, Autoimmune Diseases, Cancer, Ageing and also Covid 19.

Biography: Dr. K.V.G.S. Murty having MBBS degree is formulator and manufacturer of cardorium plus®. He is in the market of manufacturing since 2007. He is Director of Kalaga Herbal Research Labs, Alakananda Herbals Pvt Ltd, Kalaga Integrated Health Care Pvt Ltd. and Paratpara Integrated Health Care Pvt Ltd.

Enhanced biosynthesis of 'Withaferin A' using metabolically engineered cells of Withania somnifera and non-invasive detection of withaferin from plant sources through SMART Sensor

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Quality assurance has been an important concern in the production and utilization of medicinal plants. Identification of quality associated biomarker metabolites (QABMs) plays a crucial role in quality control. The volatilomics-based sensor is emerging as a technology for non-invasive and rapid qualitative analyses of plant natural products. *Withania somnifera* (Aswagandha) extracts have long been used in Ayurveda and traditional Indian medicine system to cure several human ailments. These bioactivities are attributed to the presence of special classes of metabolites, the withanolides. Among these

withanolides, 'withaferin A' is mainly credited for their acclaimed curative properties. In this work, we have developed genetically engineered cell suspension culture of *W. somnifera*, which is capable of producing around 8-fold higher level of withaferin A, as compared to field grown plants. Further, we have performed high-throughput metabolomics of *W. somnifera* to identify novel QABMs to be used in quality control. Those QABMs were used to develop a low-cost smart-phone-based sensor system capable of easy quality monitoring through non-invasive and real-time detection and quantification of QABM at the field. Medicinal plant farmers and pharma companies in the current mobile phone generation can easily accept the proposed sensor technology for non-destructive quality analyses of medicinal plants in the field without the usage of difficult analytical technologies.

Biography: Dr. Debabrata Sircar is currently serving as an Associate Professor in the Biosciences and Bioengineering Department of Indian institute of Technology Roorkee (IIT Roorkee). He has completed his doctoral degree (PhD) in plant natural product biology from Indian Institute of Technology Kharagpur, in 2010. He has obtained his Post-doctoral research training from Institute for Pharmaceutical Biology, Technical University Braunschweig Germany. His major research interest is plant metabolomics, development of SMART cells for high-value and low-cost production of value-added plant natural products and development of metabolomics-driven non-invasive sensors for quality assurance of plants and plant-based products. He has published more than 70 research papers in reputed journals and has been serving as a number of scientific bodies in India.

Bioprospection and conservation of high altitude medicinal plants of Indian Himalayan region

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The Indian Himalayan Region (IHR), among the 36 biodiversity hotspots of the world, harbours plethora of high value medicinal plants. From the region, over 1740 species of medicinal plants are reported that are used in traditional and modern medicine. But with the impact of urbanization, industrialization, overexploitation, rapid loss of natural habitats, climate change and changes in life style, the wealth of medicinal plants from the IHR are gradually diminishing. Moreover, so far, scientific validation of many ethnomedicinal plants has not been done for phytochemical compounds and pharmacological properties. To meet the increasing demand of quality medicinal plants and to identify potential medicinal plants for drug development, scientific efforts are required. To address this, my research group is working on bioprospection of ethnomedicinal plants of Indian Himalaya for pharmaceutical compounds. So far, ten ethnomedicinal plants of Sikkim have been investigated in my lab for antimicrobial and anticancer activities, and we are striving to purify and characterize bioactive compounds from lead extracts. Additionally, large scale propagation protocols for high altitude medicinal plants viz. *Aconitum ferox*, *Bergenia ciliata*, *Betula utilis* were developed through direct and indirect organogenesis employing seedlings and mature explants on a variety of culture media supplemented with different growth regulators such as cytokinin and auxin either alone or in combination. Microbial endophytes from medicinal plants having plant growth promoting properties and host specific secondary metabolite (taxol, betulin) production potential have also been isolated and identified.

Biography: Dr. Mithilesh Singh has done post-graduation in Botany from Banaras Hindu University and PhD in Biotechnology from IIT Guwahati Assam. She is currently working as Scientist D at G.B. Pant National Institute of Himalayan Environment, Almora, Uttarakhand. Since 2013, after joining GBPNIHE as scientist, she has implemented many national and international projects and organized training and demonstration programmes in Indian Himalayan Region (IHR). During 2017-18, she was the head of the Sikkim Regional Centre of the Institute and coordinated centre all the research and development related activities. Dr Singh has received DBT Biocare Women Scientist Award in 2014 and made contributions to diverse fields of work, including biodiversity assessment and conservation, transboundary landscape conservation and development; medicinal and threatened plant propagation through biotechnological interventions; and bioprospecting of ethnomedicinal and wild edible plants of IHR for nutraceutical and pharmaceutical compounds, respectively.

Synthesis and characterization of 6-gingerol gold nanoparticle conjugates for improving bioavailability

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In this study, an optimized conjugated gold nanoparticles were developed and investigated for improving the solubility and bioavailability of 6-Gingerol (Au-6G-PVP-NPs), an active and abundant component of *Zingiber officinale* with limited applications due to its poor water solubility plus lower oral bioavailability. 6-Gingerol is act as a cardiotonic & also used in the treatment of Cancer disease is help to suppress proliferation, transformation, and metastasis of tumor cells and also act on the various stages of cancer cell development but its less solubility makes it very challenging in therapeutic applications. In the current work, we had prepared polymeric PVP- 6 Gingerol conjugated and Metallic *cum* polymeric AuNP-PVP-6-Gingerol (Au-6G-NPs) conjugated nanoparticles. Thus, the developed formulations overcome the drawback and limitation of the conventional drug delivery systems and also subsides critical solubility issues. In our study we have synthesized metallic *cum.* polymeric nanoparticle in which gold nanoparticle adsorbed on the surface of PVP nanosphere.

In second step deposition of AuNPs on PVP nanosphere can be utilized as a promising novel drug delivery system as well as diagnosis of cancer cell & used as cardiotonic. The advantages of improving bioavailability of 6-gingerol is to reduce the systemic side effects, Nanoparticles were successfully prepared by chemical reduction method. Polyvinylpyrrolidone is a biocompatible and biodegradable polymer used for preparing nanoparticles. FTIR was carried out to find out the possible interaction between the drug and polymer. The particle size analysis in HR-TEM and DLS were found in the range of 10-50 nm for gold nanoparticles and >200 nm forPVP-6-gingerol nanoparticles and 200nm for Au-PVP-6G Nanoparticle. The surface charge or zeta potential of plain gold nanoparticles were found to be -4.06, PVP and after PVP conjugation charge increased to -36.40mV and AuNPsPVP-6-Gingerol conjugates have shown -50.1mV. The high surface charge of final conjugates causes the greater stabilization of the nanoparticles. and thus, the nanoparticles show the excellent stability for long time after conjugation. The polydispersity index (PDI) of nanoparticles were found to be 0.622 for plain gold nanoparticles and 0.152 for PVP-6-Gingerol nanoparticles and 0.191 for Au-PVP-6-gingerol nanoparticle. Moreover, after conjugation with 6-Gingerol and PVP makes the nanoparticles mono dispersed and thus the nanoparticles show the excellent stability after conjugation. From *in-vitro* studies, it was concluded that increase in pH of the solution, it releases the drug very fast after that system was unstable, because 6-Gingerol is unstable in higher pH. So, it is showing excellent drug release in lower pH i.e. pH 4 and 5 and morphology of NPs system was also changed after the release of 6-Gingerol. Stability testing of 6-Gingerol was carried out from prepared 6-Gingerol conjugated nanoparticle and it revealed that conjugated 6-Gingerol shows excellent stability as compared to free 6-Gingerol because free 6-Gingerol is unstable in water.

Biography: Prof. Ganesh Kumar working as Professor & Principal in College of Pharmacy, Shivalik Campus Dehradun He did PhD from H.N.B. Garhwal Central University, Uttarakhand (2011). He did his M. Pharm in Pharmaceutics from Bhupal Nobal College of Pharmacy, Udaipur, Rajasthan (2005). He Qualified GATE Conducted by IIT Kanpur in 2001 (AIR-930). He has Professional Diploma in Clinical Research (PDCR). He has 19 years Research and Academic experience. His research Interest in design of Novel Drug Delivery System, Target Oriented Nanoparticle, Liver targeting Delivery system and Compartment Modelling. He has published 76 Research and review article in reputed National and International journals. He also published 2 Books. He guided 6 PhD Scholars (4 ongoing) and more than 30 PG students. He has delivered more than 20 presentation in National and International conference, workshop and seminar. He has organised 6 workshop, symposium and conference. He is Member of APTI and IPA. He is president of Association of Pharmacy Professional's, Uttarakhand State Branch.

Cultivation of Damask rose (*Rosa damascena*) in high altitude area for the socio-economic development

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Uttarakhand is bestowed with various types of vegetation ranging from sub-tropical to Alpine zone, due to its unique geographical condition. The Uttarakhand is considered a rich source valuable Himalayan medicinal and aromatic plants.Aromatic plants are receiving due attention due to their utilization not only in health system but in other sector i.e., Cosmetics, Perfumery, Food flavouring and Aromatherapy also. Although in earlier years these plants are mostly collected from wild source, but now due to Government efforts local inhabitants are cultivating these high value plants. In Uttarakhand, wide range of aromatic plants viz., Damask rose, Lavender, Rosemary, Rose geranium, Chamomile etc can be cultivated in high altitude area. These aromatic plants have vast potential to improve the socio-economic life of farmers engaged in the cultivation, processing and marketing of the essential oils and its produce. Keeping in view CAP has started cultivation of Damask rose in high altitude area of district Chamoli, Uttarakashi, Rudraprayag, Tehri, Dehradun, Nainital, Almora and Pithoragarh. For the socio-economic development CAP has linked damask rose cultivation with MGNREGA from the year 2017.In 2021-22, damask rose cultivation in 53.8 hagenerated 37660 employment days for local inhabitants of value Rs.76.82 lakhs. Toencourage the cultivation of Damask rose, incentive schemes are also being run for the farmers. The cultivation of aromatic plants carried out in cluster approach. In between 25-30 farmers there is one master farmer who is buying the rose flowers and making rose water. The master farmer either directly selling to buyers or local peoples who are selling rose water in local market. From 0.02 ha. (01 nali) plantation farmer get around 50kg fresh flower of value Rs.5000 and by processing 75 kg rose water of Rs.18750is obtained. The uniqueness of the Damask rose,can be raised as intercrop, ability to grow in sloppy areas, long economic life span, regular oil demand and higher returns can play an important role for the strengthening of socio-economic life of farmers of high altitude area. Therefore, the cultivation, processing, packaging and marketing of a high value crop Damask rose could become highly remunerative in both financial and social terms for the local inhabitants.

Biography: Dr. Sunil Sah is working as Scientist-D, Centre for Aromatic Plants (CAP), Selaqui, Dehradun, 248001, Uttarakhand. He did his Ph.D. (Botany) from Kumaun University, Nainital. His career begins from Pharmaceutical Expert Office, Ranikhet, Almora as Assistant Research Officer in the year 1988. The activities included survey, identification, pharmacognostical studies of medicinal and aromatic plants. In the year 2003 he was deputed to Centre for Aromatic Plants, Selaqui, Dehradun. Presently he is working as Scientist-D in the Centre and associated with extension of aromatic crops especially in hilly districts of Uttarakhand. He has been associated in planning & development and execution of government policy and programs for the awareness and extension of aromatic crops commercially. He has published and presented more than 20 research papers in National and International journals and seminars. He is a co-inventor in one patent awarded to CAP.

Phytochemical composition of some medicinal herbs and their biological potential

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The temperate and subtropical region of Uttarakhand is a big repository of medicinal and aromatic plants and witnessed by its rich biodiversity. Family Lamiaceae with common examples like *Salvia, Mentha, Ajuga, Mosla, Ocimum* etc, Family Zingiberaceae like *Zingiber, Curcuma, Alpinia, Hedychium, Roscoea, Glaba* etc and Araceae like sweat flag (*Acorus calamus*) and other many angiosperm and gymnosperm families gives an ample opportunity to explore the flora of this region for their nutraceutical, pharmaceuticals, bio pesticidal applications, *in situ* conservations and judicious exploitation. In recent years there has been increasing attention in the search of natural based products in order to boost up the natural immunity and minimize the resistant developed by synthetic chemicals. In spite of the advent of modern techniques of drug discovery and screening, traditional knowledge systems have given clues to the discovery of valuable drugs. Traditional medicinal plants are easily available, easily consumable and low costing for simple medicinal preparations. In present scenario, traditional medicinal practices form an integral part of complementary or alternative medicine. In present deliberation phytochemical composition of some medicinally important herbs like *Ajuga parviflora, A. baracteosa, Zingiber roseum, Alpinia calcarata, Mosla dienthra, Acorus calamus* etc. with their biological potential studied will be presented. Besides socioeconomic important Through cultivation of aromatic and medicinal plants.

Biography: Dr. Om Prakash is working as Professor in the department of Chemistry since November, 2014 at College of Basic Sciences and Humanities, G. B. pant University of Agriculture & Technology, Pantnagr, the first Agriculture University blended with Technology. Dr. Prakash obtained his Ph.D. Degree from Department of Chemistry, D.S.B., Campus, Kumaun University, Nainital in the field of Natural Product Chemistry under the supervision of Prof. C.S. Mathela in 2006. Dr. Prakash, has teaching and research experience of over 22 years, which can be evidenced by his more than 140 research papers in national and international journals of reputes with more than 900 citations. He has guided 9 PhD, over 23 M.Sc, students and handled six externally funded projects from UGC, DST, UCOST, and Uttarakhand Biodiversity Board, Dehradun as PI and Co-PI. Dr. Prakash is a recipient of Young Scientist Award 2006 by UCOST, IASc – NASI-INSA Summer Research Teacher Fellowship 2007 at IISc- Bangalore and UGC, Post-Doctoral Research Fellowship 2009-2011. He is member of Indian Science Congress Association, Indian Chemical Society, National Magnetic Resonance Society (NMRS) and Indian red cross society. As administrator he has been associated in University administration as associate and additional director of administration and monitoring. He delivered many invited talks in National & International seminars.

Conservation and cultivation prospects of medicinal & aromatic plants (MAPs) of Askote conservation landscape, Pithoragarh, Kumaun Himalaya

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The Askote conservation landscape, located in eastern Kumaun, Uttarakhand, represents an enlarged version of the Askote Wildlife Sanctuary, encompassing within, a minor landscape, which is part of the adjoining Nanda Devi Biosphere Reserve. Of a total land area of 4,463 km^2, about 103 km^2 or just 2.31% of the area is cultivated land. The broad landscape reportedly harbours 2359 species, constituted by Angiosperms- 2258 species, 891 genera, and 170 families; Gymnosperms- 7 species, 7 genera, and 4 families, and pteridophytes- 94 species, 38 genera, and 25 families. Furthermore, over 40 percent of the representative floristic elements present are endemic, or of Himalayan origin. Altogether, 234 species are near-endemics, and 24 endemic species are reported from the landscape. But what is the precise status of the species? Hence, to ascertain the same, a phytosociological study was carried out covering 40 study sites, across the sub-alpine and alpine habitat sites within the broad landscape. Altogether, 236 species, belonging to 131 genera and 45 families were incorporated into the study. The list is exclusive of additional 47 species, 26 genera, and 9 families, which though were sighted at the different sites of study, but did not feature within the quadrates laid out. All in all, a total of 285 species belonging to 158 genera and 54 families were identified, and their precise distribution and density were ascertained. The salient outcome of the study is the following- (i) we are now in possession of the data about the distribution and status of the 285 species, restricted in distribution to sub-alpine and alpine habitat sites, and accordingly, we have identified 28 species, which would be regarded endangered in the landscape; and (ii) the habitat sites harbouring a significant number of species diversity, or those harbouring rare, endangered, or even endemic species; both which can be, or rather should now be targeted for conservation efforts. Additionally, the paper attempts to offer a mechanism whereby the current unsustainable harvesting of some of the RET species can be replaced by a sound mechanism, which includes not just imparting know-how on the sustainable harvesting practices, but also how best the cultivation of the MAPs can be institutionalized in the landscape, not just helping in the conservation of the species in the wild, but at the same time raising the socio-economic condition of the stakeholders, too.

Biography: Chandra S. Negi is currently serving as Professor, Dept. of Zoology, M B Government Postgraduate College, Haldwani (Nainital), did his M. Phil from School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, and Ph. D from Kumaun

University, Nainital. Along with teaching both undergraduate and postgraduates for the last 24 years, he has to his credit more than 50 research papers in International journals of repute, six books: (i) *Introduction to Endocrinology*, PHI Learning Private Limited, New Delhi (ii) *Askote Conservation Landscape- Culture, Biodiversity and Economy*, Bishen Singh Mahendra Pal Singh, Connaught circus, Dehradun (iii) *Earthworm Diversity and Nutrient Cycling*, Lambert Academic Publishing, Deutschland, Germany, (iv) *In the garb of Nanda Devi Raj Jaat-A cultural treatise of Western Himalaya*, Winsar Publishing Co., Dehradun, (v) *The Sacred Uttarakhand- Ethno-biological study surrounding sacred natural sites in Uttarakhand*, Bishen Singh Mahendra Pal Singh, Connaught circus, Dehradun, and (vi) *Uttarakhand- Nature, Culture, Biodiversity* (edited), Winsar Publishing Co., Dehradun; and additionally sixteen popular articles. He has completed 13 major and minor research projects, primarily focused on the field of conservation biology, culture, and traditional knowledge-based system. His expertise has been sought by a number of national as well as international institutions, like Biodiversity Conservation and Rural Livelihood Programme (BCRLIP) Project, an International Project being financed by GEF (IUCN), (ii) G B Pant National Institute of Himalayan Environment, Kosi-Katarmal, and (iii) ICIMOD, under Kailash Sacred Landscape Conservation Initiative-Conservation Initiative: Indian Part. He has also served as Member, monitoring committee constituted for River Bhagirathi watershed Eco-sensitive Zone, Uttarkashi by MoEF&CC, Government of India.

Repurposes of classical Ayurvedic formulation

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The Indian Traditional health system is one of the eldest systems of medical practice in the world having six Indian systems of medicine prevalent and practiced in India named Ayurveda, Yoga, Unani, Siddha, Sowa Rigpa and Homoeopathy (AYUSH) among which Ayurveda is oldest. Ayurveda means 'Science of life' and it provides a complete system to have a long and healthy life. It represents a way of achieving a healthy lifestyle with conventional and established concepts for prevention of communicable and non-communicable diseases. The pharmacological modalities using in Ayurveda are of natural products of plants, animals, or mineral origin. In the past, Ayurveda health system has shown its potential in the treatment of various diseases. Hence, by repurposing the classical ayurvedic drugs and formulation and identification of biologically active natural products along with their mechanistic studies can open a new treatment option to combat the deadly diseases. In the present task we will discuss some formulation and herbs having potential in the treatment of SARS-CoV2, neuro inflammation, non- healing ulcer in diabetic patients etc.

Biography: Dr Rajni Kant Sharma presently working as Research Scientist-II in Research & Innovation Department, Shri Krishna AYUSH University Kurukshetra, Haryana. He is Master in Pharma sciences, from Guru Nanak Dev University, Punjab and got PhD in Natural Product chemistry from HNB Garhwal Central University Uttarakhand. He has got postdoctoral fellowship in medicinal chemistry in H3D Drug Design Centre, University of Cape Town South Africa 2009 to 2014. His area of research is structure and ligand based drug discovery, Natural product based drug discovery, medicinal chemistry, Antimalarial, Anti TB and ACE inhibitor design etc. He has published more than 25 research papers, 5 patents and given 18 lectures in national and international conferences.

Healing impact of vital energy of *Tinospora cordifolia* [Giloy] on the biofield of T2DM patient face by using Biofield Reader (BFR) and Selected Objective Criteria (SOC).

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Tinospora cordifolia, commonly known as Giloy is a traditional ayurvedic herb commonly used for lifestyle disorders to balance and maintain the functions of vital organs/tissues of human body. The vital energy of an herb (virya) is the non-local potential energy which heals the tissues through the morphogenetic field of vital body of a person. Vital body of a person drafts the blueprint and represents in biological form at physical level. The Biofield Reader (BFR) a software, which reads the colour patterns (energy flow interference) of the biofield of a person. This study aims to record the face imaging of a person and to study the biofield energy patterns before and after taking the fresh juice(swaras) of Giloy and selective objective criteria i.e. fasting and post prandial blood sugar.

Biography: Dr. Sangeeta Nehra is Director in AYUSH Department, Government of Haryana. He received his PG degree in Traditional Pharmacology and also has Postgraduate Degrees in Dietetics; Yogic Sciences, Preksha Meditation and Philosophy. He also has LLB degree, Certificate Course in Panchkarma. She pursuing his PhD (2020) in Quantum Science of Health, Happiness and Prosperity. Currently she is serving best of her potentialities as Director in AYUSH Department, Government of Haryana for last 19 years. She is also working as a Teaching Faculty member Sri Krishna Ayurveda College, Kurukshetra; along with OPD and clinical work. Presently she is facilitating the research work on developing Quantum Integrative Wellness Model for AYUSH practitioners, with special reference of type 2 diabetes mellitus [T2DM]; is providing last 19 years of service [admirative and clinical] in AYUSH Department. She is providing free counselling sessions, organizes yoga and meditation sessions, disseminates education on Ayurveda nutrition and diet schedules for a healthy person as well as for a disease specific disease. She has prepared the quantum integrative wellness self-healing card [QIW-SHC]. She is an animal lover and also an avid lover of friends from the plant kingdom. Her speciality is to heal a person with first preference of quantum creative principles – Yoga; Do -Be- Do; Energy Food; Massage Therapy; then the second preference is to treat with single herb (vital) preparations; follows quantum integrated and tangled hierarchy approach.

Endangered species of Uttarakhand and their cultivation & conservation

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Himalayan range has a rich heritage of knowledge on plant based therapy. Medicinal plants play major role in the livelihood from all over the world.
Uttarakhand, a Himalayan state of India also depends on the medicinal plants for medicine and traditional therapy. The people from this state use plants for their primary health care system mainly depend on traditional knowledge of medical practices and medicinal herbs. The current version of UMPDB (Uttarakhand Medicinal Plants Database) contains the 1127 records of medicinal plants which belong to 153 plant families distributed across 13 districts of Uttarakhand. Out of which 93 species are endemic in Uttarakhand. Endangered species are those plants and animals that have become so rare that they are in danger of becoming extinct due to Habitat loss and habitat degradation, Climate change considered as primary causes of species endangerment and spread of introduced species . The International Union for Conservation of Nature (IUCN) is the world's main authority on the conservation status of species. A series of regional red lists are produced by countries or organizations, which assess the risk of extinction to species within a political management unit. To conserve the important medicinal plants various cultivation programme was established. And some important medicinal plants such as *Ativisha, Kushtha, Pushkarmoola, Vatsnabha* are described under this topic.

Biography: Prof. Dinesh Chandra Singh completed his Doctoral degree (PhD) and Post-Graduation from Banaras Hindu University, Varanasi, India in 1993. Currently he is professor and head of Department of Dravyaguna, Rishikul Campus, Haridwar, Uttarakhand Ayurveda University since 2014. His major research interest in identification and theraupeutic actions of original drugs and their subsitutes. He has published more than 60 research papers in national and international journals and has been serving as a number of scientific bodies in India.

Phytochemical analysis, *in-vitro* antifungal evaluation and mechanistic studies of *Paeonia emodi* extracts against *Candida* species

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The rise in the incidence of multidrug resistant fungal pathogens has increases globally in recent decades due to wide spread and prolong uses of antifungal agents. Among the fungal pathogens, *Candida* species are major cause of morbidity and mortality in immunocompromised patients such as organ transplant, AIDS, cancer chemotherapy and burn patients worldwide. The currently available antifungal drugs have several undesirable side effects and are ineffective against drug resistant fungal pathogens. Therefore, the search for new antifungal agents with low host toxicity, broad spectrum and multimode of action demands for identification of novel compounds with potent antifungal activity. In this regards the high altitude medicinal plants of Himalayan region are increasingly seen as an attractive alternative to prevent the multidrug resistant *Candida* species infection in future. The present study aimed to evaluated the antifungal activity, cytotoxicity, mode of action and phytochemical analysis of *Paeonia emodi* (*P. emodi*) against *Candida* species. The antifungal evaluation was done by broth microdiluation assay according to CLSI guideline. The synergistic activity of plant extract was performed with known antifungal drugs (amphotericin B, fluconazole and nistatin). The mechanistic activity of plant extract was done by confocal microscopy, flow cytometry and scanning electron microscopy. The bioactive methanolic seed extract (MSE) was fractionated by thin layer chromatography (TLC) and TLC-bioautography was used to determine the bioactive compounds present in the MSE. Furthermore, Gas chromatography-mass spectrometry (GC-MS) and Fourier-transformed infrared spectroscopy (FTIR) were used to identify the phytoconstituents of the MSE. The toxicity profile of MSE was evaluated against human cell lines (HeLa cells and HEK293). The MSE showed promising antifungal activity against *Candida albicans* (6.25 mg/mL), *Candida glabrata* (3.12 mg/mL) and *Candida parapsilosis* (12.50 mg/mL) among all tested fungal strains. Combination of the MSE with the well-known antifungal drugs (Amp B, NYS and FLC resulted in the killing of *C. glabrata* at non-inhibitory concentrationsi.e. 0.35 µg/mL for Amp B, 0.55µg/mL for NYS and 1.19 µg/mL for FLC. Notably, MSE caused cell wall damage of *C. glabrata* cells, as confirmed by confocal microscopy, flowcytometry and Scanning electron microscopy (SEM). The Gas chromatography-mass spectrometry (GC-MS) and Fourier-transformed infrared spectroscopy (FTIR) revealed 13-docosenamide/9-octadecenamide/*trans*-13-docosenamide (89.70%) as being the predominant compound using a chloroform/methanol solvent system for the separation. Interestingly, the MSE also exhibited less significant cytotoxicity at the minimum inhibitory concentration (MIC) against mammalian cells (HeLa and HEK293 cells). *P. emodi* methanolic extract offer an attractive alternative approach to treat fungal infection caused by *C. glabrata*.

Biography: Dr. Indresh Kumar Maurya is an eminent scientist in the field of drug discovery and infectious biology. He is presently working as CSIR-Senior Research Associate (CSIR-Scientist Pool Scheme) at the Centre of Infectious Diseases, National Institute of Pharmaceutical Education and Research (NIPER), S.A.S. Nagar, Punjab, India. His research contributions largely concern the antimicrobial activity of synthetic molecules, natural compounds from medicinal plants, nanoparticles and their mechanistic studies against bacterial and fungal strains. He has received awards and grants from various scientific organizations, e.g., DST-Inspire Faculty award, CSIR-Young Scientist Travel grant and FEBS Trans-Youth Travel Fund etc. He is author of more than 30 scientific articles, two book chapters and filed two Indian patents.

Tools and techniques to ascertain botanical identity & Standardization of herbs

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To ensure efficacy and safety of botanicals, proper authentication is mandatary. In fact it is the need of hour to do standardization of crude herbs before preparation of dosages for global acceptance. Various techniques used in herb standardization are reviewed and critically analysed. Further their advantages and limitations are discussed in detail. Various methods and tools are in use for quality control and standardization of medicinal plants. Morphological identification such as shape, size, colour, texture, fracture characteristics, odour and taste are used for discrimination of botanicals. Microscopic evaluation includes microscopic inspection of the crude herbs. Chemical profiling establishes a characteristics chemical pattern for a plant material. Chromatographic tools like Thin Layer Chromatography (TLC), High Performance Thin Layer Chromatography (HPTLC), Gas Chromatography (GC) and High-Performance Liquid Chromatography (HPLC) are used for qualitative and quantitative determination of impurities. Further DNA fingerprinting is the new technique for ascertain identification of herbs on the basis of DNA. Every tool and techniques have advantages and limitations. Rational utilization of these tools in combination is beneficial for authentication of herbs.

Biography: Dr. Ghildiyal is Assistant professor, Department of Dravyaguna, All India Institute of Ayurveda, New Delhi, India. She worked as senior resident (2010-2013), Assistant Professor (2013-2015) Department of Dravyaguna, Institute of Medical Sciences, BHU, Varanasi. She got master degree (2009) and PhD (2014) from Department of Dravyaguna, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India. He did diploma course in French and in Yoga. She has expertise and specialization in Pharmacognostical studies of classical Ayurvedic drugs, Qualitative and quantitative estimation of phytoconstituents, Pharmacological screening of classical Ayurvedic drugs, Biochemical analysis and Data analysis & data interpretation. Her area of Interest are Natural product research, Molecular pharmacology and Drug development (Pre-clinical & Clinical study). She has more than 20 research and review publication. She delivered more than 25 presentations in National & International Conferences and other than these attended more than 15 National & International Workshop, CME, Symposium. She is Editorial Board Member of SM Journal of Pharmacology & Therapeutics, Journal of Ayurveda and Journal of Ayurveda case reports. She received Best Paper Award, BHU Medal, Jivaka Award (Himalaya Drug Company) and Saraswati Sammana.

Application of advanced scientific techniques for the quality control and standardization of Ayurvedic products

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Acceptability of Ayurvedic formulations, especially herbal products is increasing globally. Quality testing of polyherbal products has always remained a challenge despite of research works carried out in Ayurvedic and allied departments. Advancement on molecular biology and nanotechnology has helped immensely in understanding the complexity of Ayurvedic products and a number of new tools have been successfully employed for the quality testing and standardization of Ayurvedic formulations. Hence, an attempt is made to review such advanced techniques with their applicability in the field of Ayurveda pharmaceutics. An overview covering various techniques employed in extraction and characterization of Ayurvedic herbal medicines as well as herbomineral nanomedicines for standardization is analysed. In addition, phytosomes increased bioavailability, bhasma as a metal nanocarrier drug delivery system, potential of metabolomics in the development of improved phytotherapeutic agents, DNA based molecular markers in distinguishing adulterants, and SCAR markers for authentication and discrimination of herbs from their adulterants are reported. Utilization of microwave–assisted extraction and supercritical phase extraction technology followed by the standardization utilizing various spectroscopic, chromatographic and thermogravimetric techniques individually and/or in combination has been discussed in relation to herbal drugs. Capillary electrophoresis and polarographic techniques contributions towards standardization of herbal drugs is also reported. Application of instrumental methods of analysis like XRD, XRF, SEM-EDAX, ICP-OES, AFM etc for herbomineral drugs. It has been observed that utilization of metabolomics and other molecular biology techniques opened the door for most reliable methods for the standardization of herbal raw drugs and polyherbal products. Advanced instrumental methods, characterization techniques for nanoparticles aided the quality assurance of Herbomineral products. It has been observed that utilization of metabolomics and other molecular biology techniques opened the door for most reliable methods for the standardization of herbal raw drugs and polyherbal products.

Advanced instrumental methods, characterization techniques for nanoparticles aided the quality assurance of Herbomineral products.

Biography: Dr. Sathyanarayana B is Principal and Director, Muniyal Institute of Ayurveda Medical Sciences, Manipal. His qualification is M.D.(Ayurveda). He has more than 21 years professional experience. He has guided 14 PG dissertations of Ayurveda and one M. Pharm dissertation. He was also Co-guide of 15 PG students. He has more than 20 research and review article in National and International Journals. He has attended and presented more than 80 papers in Seminar and conference as a resource person. His research interest is in Quality control and Biological standardization of medicinal plants, Ayurvedic and herbo-mineral formulations

Tulsi (*Ocimum Sanctum*): A herb for all the reasons

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Ocimum sanctum L. (Tulsi) has been used for thousands of years in Ayurveda for its diverse healing properties. Tulsi, the Queen of herbs, the legendary 'Incomparable one' of India, is one of the holiest and most cherished of the many healing and health giving herbs. The sacred basil, Tulsi, is renowned for its religious and spiritual sanctity, as well as for its important role in the traditional Ayurvedic and Unani system of holistic health and herbal medicine of the East. It has mention in the Charaka Samhita; an Ayurvedic text. Tulsi is considered to be an adaptogen, balancing different processes in the body, and helpful for adapting to stress. Marked by its strong aroma and astringent taste, it is regarded in Ayurveda as a kind of 'elixir of life' and believed to promote longevity. Tulsi extracts are used in Ayurvedic remedies for common colds, headaches, stomach disorders, inflammation, heart disease, various forms of poisoning and malaria. Traditionally, O. sanctum L. is taken in many forms, as herbal tea, dried power or fresh leaf. Taking into consideration the strong antioxidant nature of Tulsi, the ameliorative potential of its leaf extract was evaluated in a mouse model of smokers. Histoarchitectural alterations and enhanced tissue lactate dehydrogenase (LDH) activity in pulmonary tissue was distinctly indicative of damage in smoke exposed mice. Enhanced mucin production was also observed through mucicarmine and Alcian Blue-Periodic Acid Schiff (PAS) staining. Increased expression of MUC5AC was also observed. Alterations in the lung were also evident through FTIR studies. Considerable amelioration in the histoarchitecture of lungs was observed when tulsi treatment was given to smoke exposed mice. Activities of various enzymes were also reported to improve post tulsi treatment. These findings are suggestive of the fact that *Ocimum sanctum* leaf extract effectively modulated CS-induced deleterious effects on pulmonary tissue. Plants are a rich source of biologically active phytochemicals. Studies carried out during the past few decades have shown that these phytochemicals have an imperative part in avoiding serious illnesses like cancer, diabetes and cardiac ailments. The major classes of phytochemicals with disease-preventing functions are antioxidants and immunomodulators. In the context of male reproduction, however; these phytochemicals have dose dependent roles. If ingested at low doses, they work as antioxidants and maintain fertility in various pathological states. On the other hand, if ingested at high doses, they could lead to various side effects, including infertility, a property that can be exploited for the development of male contraceptive. However, much scope for further systematic research is need of the hour in screening medicinal plants for these phytochemicals, assessing their potential in protecting male fertility in diseased conditions and to look out for their potential towards the development of a male contraceptive with minimal side effects.

Biography: Dr Ranawat is currently working as assistant professor in Panjab University Chandigarh. She obtained her PhD in Biophysics in 2009. She has been a recipient of various fellowships and awards. She guided 2 PhDs and 10 MSc students. She is already published more than 25 research papers and presented her work in many national and international conferences. Her research areas are cell biology, microscopy, molecular biology, biochemistry and pharmacology.

Habenaria edgeworthii Hook. f. ex Collett and *Habenaria intermedia* D. Don: the Important Astavarg Species from northwest Himalaya, India

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Habenaria intermedia (Ridhi) and *H. edgeworthii* (Vriddhi) are two important 'Astavarga' species that are known to provide protection against degenerative diseases and to maintain youthfulness, vigour and vitality. Owing to their great medicinal values, they are used in different forms in a wide range of Ayurvedic formulations thus claiming an important place in traditional medicine systems. Demand for these Ashtawarga plants is rising day by day but the accessibility of genuine drugs is not in tune with the market requirements. Presently their total supply is met out from the wild harvest, thus are severely prone to destructive harvest for their tubers being the officinal part. The combined effect of habitat destruction and irrational (destructive) harvesting has resulted in a reduced natural population of these valuable herbal orchids. A study was conducted to evaluate and analyse both targeted species for their morphological and phytochemical attributes. Morphological data such as fresh and dry weight of root (tuber) and shoot, length, height; diameter and moisture

content on shoot and root of target species and substitute was recorded. Both the species were investigated for their physicochemical characteristics, qualitative and quantitative phytochemical composition. There was significant variation in the morphological traits and phytochemical constituents among different accessions collected from various locations and different stages of maturity. The studied aspect provides imperative information about the morphological characteristics, physicochemical traits, phytochemical composition in terms of the presence and/or absence of different phytochemical groups, and the concentration of certain key phytochemical components. It was observed that sometimes plant collectors collect the raw drugs (tubers) at an early stage of maturity and the plant may not have desired active chemical constituents. This also leads to the depletion of valuable resources.

Biography: Dr. Pandey was Assistant Director General (Media and Extension), Indian Council of Forestry Research and Education and Scientist G in Chemistry and Bioprospecting Division, Forest Research Institute. He is renowned Scientist researching in the area of Non-Timber Forest Products, Chemistry of Forest Products, Medicinal and Aromatic plants, Sustainable harvest of NTFPs, Cultivation of medicinal and aromatic plants, documentation of traditional knowledge, livelihood generation and biofuel. He has published more than 100 research papers in International and national journals of repute, 50 popular articles, three books, 15 book chapters; participated in about 150 scientific events.

Economics of cultivation of important medicinal plants grown at farmers' field

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India is considered to be the ancient home of medicinal herbs because it is blessed with a wide variety of soil and climatic conditions which support the enormous plant growth. The cultivation of medicinal plants have been provided traditional health care needs of rural peoples and excellent base of livelihood for farmers especially for tribal community and agricultural labors engaged in its cultivation and allied activities viz. transportation, processing, trade, storage, etc. The present study has been carried out the economic importance of medicinal plants. The study conducted in different state of India. In which 983 farmer's cultivated different medicinal plants in states like Andhra Pradesh, Telangana, Madhya Pradesh, Jharkhand, Rajasthan, Uttar Pradesh, Uttarakhand West Bengal, were selected through the purposive cum random sampling techniques. The majority of farmers cultivated medicinal plants like Senna, Artemisia, Tulsi, Satavari and Sarpgandha in the states of Uttar Pradesh, Rajasthan and Uttarakhand. In Southern region, the states like Andhra Pradesh and Telangana farmers are mainly cultivated Ashwagandha. In Madhya Pradesh and Rajasthan farmers have been cultivated Isabgol, Kalmegh. However in Jharkhand and West Bengal farmers are cultivating Kalmegh, Brahmi and Bhui-amla. The primary information was obtained through the pre-structured interview schedule in order to estimate the socio-economic status of farmers, resource use structure and marketing. The socio-economic profile of the farmers, the overall average land holding size 3.21 hectares and their main occupation is agriculture. The population in the study area comprises of maximum other backward category (56.27%), followed by the schedule caste/schedule tribal (27.27%) and unreserved category (16.45%). The selected respondents having the moderate family size where 87.09% of the population is literate. The value of working assets of the medicinal plants growers is directly correlated with the adoption of production technology. Per hectare cost of cultivation of selected medicinal plants was found highest for Satavar (Rs.349997), followed by the Sarpgandha (Rs.168040), Brahmi (Rs.44393), Bhui-amla (Rs.36880), Artemisia (Rs.35690), Ashwagandha (Rs.31991), Tulsi (Rs.25591), Isabgol (Rs. 24998), Kalmegh (Rs.22431) and minimum for the Senna cultivation (Rs.8854) respectively. In respective of per hectare net return of medicinal plants was found highest for Sarpgandha (Rs.286960), Brahmi (Rs.76519), Artemisia (Rs.62298), Ashwagandha (Rs.66776), Isabgol (Rs.56812), Bhui-amla (Rs.50268), Tulsi (Rs.48938), Satavar (Rs.471703), Kalmegh (Rs.22249) and Senna (Rs.9880) respectively. Disposal of medicinal plants exhibited through two main marketing channels. Despite of this, there are problems faced by growers in production and marketing like management practices, bulkiness and perishability, lack of necessary processing and market infrastructure. These problems are making the cultivation of medicinal plants is tedious business. The study also provides some suggestion for smooth business of medicinal plants cultivation in the country. Improvement of technology, verities and management practices under the medicinal crop for cultivation at farmers' field and need promotion of the online marketing in medicinal crops for selling the product and fetching the remunerative price by the producers are needed. To establish proper marketing system, processing infrastructure and develop the pack houses near to major production hub. The processing and storage infrastructure need to be designed in such a manner so that they can facilitate the year-year-round operation. To regulated market and should be Government determines the MSP of main medicinal plants.

Biography: Dr. Kumar is Sr. Principal Scientist at CSIR-CIMAP, Lucknow. He received PhD in Agriculture Economics. His area of Specialization is Agricultural Economics and Extension. His team made contribution in technology transfer of institute different herbal products, process etc. and 28 technologies transfer has been made to different industries based at Delhi, Mumbai, Chennai, Kolkata, etc. He received FICCI (2005) & CSIR (2008, 2014) award for Rural Development, Certificate of Merit CSIR Technology Award (2018), Certificate of Excellence on CIMAP Annual Day and Certificate of Appreciation from CSIR-CIMAP. He got Prestigious Khorana Technology Transfer Course-2013 Fellowship by Indo-US Science and Technology Forum, DBT (GoI) and University of Wisconsin (2013). He completed several projects as PI/ Coordinator (27) and Co-PI/ Member (13). He guided 10 students and published more than 30 research papers in National and International Journals.

Relevance of ancient Indian health traditions in current scenario

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India is known for its rich health traditions, whether Ayurveda or Yoga. Medical systems are found mentioned even in the ancient Vedas and other scriptures. The Ayurvedic concept appeared and developed between 2500 and 500 BC in India. Recent outbreak of viral disease wherein the World Health Organization declared the outbreak as a Public Health Emergency of International Concern. herbal and traditional medicine played an important role as preventive medicine for public at large. Herbal medicine has been used for thousands of years. It is estimated that 80% of world population rely on traditional herbal medicine for primary health care. In recent years, herbal remedies have been considered as dietary supplement for disease prevention and as alternative/complementary medicine. The Indian subcontinent use of plants as a source of medicine has been an ancient practice and is an important component of the traditional health care system. The ministry of AYUSH issued an advisory for immunity boosting measures for self-care during the crisis. Certain other herbs and compound formulations are found to be useful and helpful in restoring the health. This interest in traditional medicines is growing rapidly due to the attention being given to it by the governmental agencies and different NGOs comprising of general public and researchers as well as the increased side effects, adverse drug reactions, and cost factor of the modern medicines. Textual knowledge and practice both are of utmost importance whether patient care or drug manufacturing. So more avenues and opportunities should be created to ensure proper training and teaching, instead of mushrooming of sub-standard private colleges. As it will become popular demand of raw material will also increase. So there is need to promotion of cultivation of medicinal plants. Last few years the govt initiatives to push ayurveda is commendable, but still it lack the professionalism and consistency in medicines. furthermore the generation gap between old school of experienced Vaidyas and newly passed out Ayurveda Doctors has widened, so there is strong need to improve quality education (updated with modern advancements), quality medicine (scientifically validated) and quality services (improved system) to make it readily available for the common people. The relevance of ancient Indian health traditions in current scenario will be discussed in details.

Biography: Dr. Ojha is currently working Senior Principal Scientist in Pharmacognosy Division, CSIR-National Botanical Research Institute Lucknow. He is an Ayurvedic scholar and fellow of "Society of Ethnobotany", working primarily on herbal / ayurvedic formulations, validation of traditional Knowledge, developing novel compositions / formulations for better health care as well as income generation through plant wealth since 2001. Worked on The Ayurvedic Pharmacopoeia of India, Part-II Vol-I, II & III First Edition (Formualtions). Published by Govt. of India. Ministry of Health & Family Welfare. He recently developed antidiabetic formulation NBRMAP/BGR-34 marketed by M/s Aimil Pharmaceutical, Conceptual designing of formulation & development of composition of NBIRASOF Herbal soft drink the technology transferred to M/s 3D Nutrients, Ratlam (MP) in 2019. Recipient of Technology award for Life Sciences- 2016 by Ministry of Science & Technology (Gov of India) New Delhi for development of antidiabetic formulation and Aryabhatt Award- 2016 and Shri Dhanwantari Sammaan- 2018 Winner of B.N. Mehrotra Medal- 2020. He having more than 40 research publications, 4 chapters in the book, guided one PhD, 8 MD (Ayu)/ MPharma, having several patents on herbal formulations. Also served as consulting Ayurveda physician in CSIR/CSIR-NBRI Dispensary.

CSIR-Aroma Mission: Catalyzing rural empowerment through cultivation, processing, value addition, and marketing of aromatic plants

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The Council of Scientific and Industrial Research (CSIR) has contributed significantly in creating an essential oil-based aroma industry in India. CSIR-Indian Institute of Integrative Medicine (CSIR-IIIM) has a rich history of working on the Research & Development of high-value aromatic crops for the last many decades. Many such high-value industrial aromatic crops and their elite varieties have been developed by CSIR-IIIM, providing higher economic returns than conventional crops, as most of these crops can also be cultivated on degraded, waste, saline, rainfed, or low irrigated lands without affecting the area for cultivation of traditional food crops. To bring a decisive and transformative change in the rural economy, market dynamics, and growth opportunity, the CSIR-Aroma Mission project was conceptualized in 2017 to provide end-to-end technology and value-addition solutions. The project has brought a transformative change in the aroma sector through scientific interventions in agriculture, processing, and product development by fuelling the growth of the aroma industry and rural employment. CSIR-IIIM has provided farmers with free quality planting material of selected aromatic crops and technical knowledge. Awareness programs are being conducted in different parts of the country to popularize these high-value aromatic crops among farmers. Under CSIR-Aroma Mission, CSIR-IIIM has brought about 8000 acres of the additional area under captive cultivation of fourteen high-value aromatic cash crops in 18 states, particularly targeting rain-fed /degraded land. These crops are Lemongrass, Rosagrass/ Himrosa, Lavender, Damask Rose, Dracocephalum, Artemisia, Rosemary, Jammu Monarda, Clary sage, Chamomile, wild Marigold, *Mentha* spp., *Ocimum* spp. and Rose scented geranium. End-to-end technology, including technical and infrastructural support for distillation and value-addition to farmers/growers, has been provided. One prominent example of the success of the CSIR-Aroma Mission

is Lavender cultivation in J&K. Due to the intervention of CSIR-IIIM, a new industry around Lavender cultivation has developed in J&K. More than 1000 farming families in the J&K are currently cultivating Lavender on more than 300 acres in different parts of J&K. The net annual income of Lavender farmers in J&K has increased from around Rs. 40,000/- to Rs. 60,000/- per hectare to between Rs. 3,50,000/- and Rs. 6,00,000/- per hectare. The successful end-to-end technology transfer on the cultivation of Lavender to the farmers of J&K by CSIR-IIIM, Jammu under Aroma Mission has been widely covered nationally and internationally by print and electronic media. The media has recognized this initiative of CSIR-IIIM, Jammu, as the "*Purple Revolution in J&K*." Recently, CSIR-IIIM, Jammu, received the CSIR award for S&T innovations for rural development (CAIRD- 2020) for "*Purple Revolution in Jammu & Kashmir: Rural Development Through Lavender Cultivation in J&K*."

Biography: Dr. Gairola is a plant scientist having 15 years of research experience in the taxonomy and ecology of Western Himalayan flora. His work is focused on understanding the effects of altitude, slope aspects, and anthropogenic disturbances on the flora, species composition, regeneration, biomass, and carbon stocks of different forest types of Western Himalayas. He has worked on the region's RET medicinal and aromatic plants and ethnomedicinal plants used by various indigenous communities of the Western Himalayas. He has published more than 75 research papers in various national and international journals. He has handled many projects from various funding agencies viz., UGC, CSIR, and DST. He is a nodal scientist of CSIR-Aroma Mission and co-nodal scientist of CSIR-Phytopharmaceutical Mission from CSIR-IIIM, Jammu. He has managed the extension of some high-value aromatic crops in 3000 ha area, benefiting more than 2500 farmers at various locations throughout the country. He received the National Environmental Sciences Academy "Scientist of the Year Award 2016". He received the "Ultra International Team Award" for the innovative & meaningful efforts towards promoting the cultivation and processing of aromatic crops for improving the production of essential oils in India and enhancing the income of large numbers of farmers under CSIR-Aroma Mission. His team received the CSIR award for S&T innovations for rural development (CAIRD-2020) for Purple Revolution in J&K Rural Development Through Lavender Cultivation.

Biotechnological interventions in propagating and conserving endangered medicinal plants of the Himalayan region

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Because of high market demand in pharmaceutical industries, uprooting of whole plant before seed setting, flaws in conventional propagation (less seed viability and low seed germination), illegal trading, unawareness and illiteracy of localities/inhabitants, the medicinal plants are striving with numerous threats for their existence. The biotechnological intrusions have been well documented and proved to be as one of the hopeful tools towards mass propagation, conservation and better understanding about various accumulates present in such plants using various classical and emerging approaches. Major tools under plant biotechnology can be categorized as - Plant tissue culture (Micropropagation, Somatic embryogenesis, Meristem culture, Somaclonal variation, Haploid production, Embryo culture, Protoplast culture and fusion and Secondary Metabolite Production, etc.), *In vitro* germplasm conservation (Slow growth, Cryopreservation, etc.), Genetic transformation (through *Agrobacterium* mediation, Electroporation, Biolistic Gun and Microprojectile, etc.)}, Molecular markers (RFLP, RAPD, ISSR, SSR, AFLP and SNP, etc.) and Omics platforms (Genomics, Transcriptomics & Proteomics, etc.). The conservation through seed and germplasm storage has been recognized as a good *ex situ* conservation option that allows orthodox, desiccation-tolerant seeds to be stored at a low temperature is providing an effective and economically viable option for maintaining plant genetic diversity. Moreover, conventional seed propagation and external environment regulates the synthesis and accumulation of secondary metabolites (qualitatively and quantitatively) that usually takes more time period. With a better understanding of the economic importance and threats to the medicinal plants, a few attempts have been made using biotechnological interventions for the past two or three decades on its mass propagation under controlled conditions. However, reports on the biotechnological intervention of medicinal plant have been inadequate so far and a number of strategies have yet to be explored in order to increase the bioactive compounds production. Similarly, *omics* platforms are also being explored for understanding molecular networks underlying biogenesis of industrially valuable secondary metabolites. Thus, these interventions represent the most promising areas of application at present time and giving an out look into the future by it increasing agricultural production and generating rural employment. The areas range from true to type healthy uniform plants in a very short span as well as the production of pharmaceutically and medicinally stimulating compounds, etc. Therefore, it is a potential tool towards conservation and mass propagation of endangered medicinal plants to meet out their demand and supply in sustainable manner.

Biography: Presently, Dr Sharma is working as an Associate Professor and heading the Department of Biotechnology at Dr YS Parmar University of Horticulture & Forestry, Solan (HP). He has been honoured with the Gold medal (Year 2007) in Doctoral Programme for topping the University (UHF, Solan HP). He is a recipient of the Young Scientist Fellowship (Year 2009) of the Department of Science & Technology (DST), Govt. of India, New Delhi as well as an international travel grant from the Department of Science & Technology (DST), Govt. of India, New Delhi to Italy (Year 2013). He has been guided/ guiding M.Sc. & Ph.D. students in Plant Biotechnology & Molecular Biology. He is involved in various national and international collaborated externally funded research projects from DST, DBT, CSIR, NMPB and MoEnv. Forest & Climate Change, New Delhi. His research work is widely published in rated referred journals of national and international repute. He is a member of various professional societies and editorial boards. He has been delivered lectures/presentations in various conferences/symposia/workshops held at the national and international levels.

Antioxidants against Neurotoxic induced Animal Models of Huntington's Disease

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Huntington's disease (HD) is a hyperkinetic, autosomal neurodegenerative disease characterized by chorea, gait abnormalities, resting tremors, and developed due to abnormal repeat of Cytosine Adenine Guanine (CAG) trinucleotide in the huntingtin (Htt) gene. Besides this, oxidative stress, excitotoxicity, mitochondrial dysfunction, and neuroinflammation play an important role in HD's pathogenesis. Despite multiple experimental efforts, no treatment is available yet to completely halt or delay the disease progression. Hence, pathophysiological understanding of the mechanism involved in disease progression is the key to develop potent therapeutic intervention. Animal models are the most reliable tool to understand the disease's pathophysiological features and allow rigorous hypothesis testing. The animal model is ideal if it mimics all the pathophysiological features of the disease; excitotoxicity, mitochondrial dysfunction, and oxidative stress are the pathological features of HD. Chemical models offer more authentic and highly reliable results with the least mortality rate. Chemical models mimic human HD by closely reflecting most of the pathophysiological features, such as 3-nitropropionic acid-induced mitochondrial dysfunction, quinolinic acid induced excitotoxicity, etc., show good predictive validity. But every model has its advantages and disadvantages based on the pathological features that the model mimics. So, the selection of an accurate model gives the best results for any therapeutic intervention. Here we are going to discuss the chemical induces models of HD along with important factors for selection.

Biography: Dr. Puneet Kumar currently working as Associate Professor & Head, Department of Pharmacology, School of Basic and Applied Sciences, Central University of Punjab. He has more than 12 years of teaching and research experience. Dr. Bansal did his Master of Pharmacy and Ph.D. from the University Institute of Pharmaceutical Sciences, Panjab University, Chandigarh. His research interests encompass the pharmacological screening of herbal and semisynthetic and synthetic drugs in animal models of various diseases like movement disorders (Huntington's disease, Parkinson's disease, and Tardive dyskinesia), Traumatic brain injury (TBI), epilepsy, depression, and cognitive impairment related disorders. Dr. Bansal one ongoing project from SERB-DST (32 Lacs) and completed two major research projects from AICTE- RPS (20 lacs) and DST-SERB young scientist award (24 lacs). He has published more than 110 research and review papers in most prestigious, peer-reviewed, and high impact value national and International Journals. His research work globally recognized and published in peer-reviewed journals. He has also published 6 Books and 22 book chapters. Dr. Bansal also filed one patent from his research work. As per Scopus, his research work has 3100 citations with h-index 30, and Google scholar citations are 4200, and h-index is 32. He is a reviewer of all major publishers. Dr. Bansal got international travel awards/grants to attend and to presented his research work at various international conferences held in various countries like USA, Canada, France, Scotland, Australia, Hong Kong, Malaysia, Taiwan, Singapore, Germany. Recently Dr. Bansal is selected as a member of The National Academy of Science, India (NASc) oldest Science Academy of India, National Academy of Medical Sciences (NAMSc) and Fellow of The Linnean Society of London is the world's oldest active biological society. Dr. Bansal has been a recipient of various prestigious national and international recognitions. Dr. Puneet guided more than 50 M. Pharma and 02+03 (ongoing) Ph. D research students. Dr. Bansal is a member of various highly recognized professional national and international societies like NAMSc, APTI, IPS, IAN, IPGA, IBRO, MDS, SFN, EBPS, ISN. He is on the editorial board of several national and international journals. Dr. Bansal also delivered various invited talks and resource persons in various national and state-level conferences.

Cucurbita pepo seeds improve the neuronal dysfunction in STZ-induced diabetic neuropathy *via* targeting cytokine

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Cucurbita pepo is cultivated worldwide as vegetable as well as medicine and it has been used traditionally in several countries such as India, China, Yugoslavia, Argentina, Mexico, Brazil and America as medicine. Most countries utilize *C. pepo* in the management of diabetes. The present study is to investigate the attenuating potential of *C. pepo* diabetic neuropathy in streptozotocin-induced rat model. Diabetic neuropathy was induced by Streptozotocin (STZ; 65 mg/kg, *i.p.*) and Nicotinamide (NAD; 230 mg/kg). Diabetic neuropathy markers i.e thermal hyperalgesia, mechanical hyperalgesia and motor nerve conduction velocity were found to be significantly altered on 60th day of STZ/NAD administration. Treatment with different doses of (100, 200 and 400 mg/kg, *p.o.*) petroleum ether extract of C. pepo (CPE) and hydroethanolic extract of C. pepo (CHE) was started from the 60th day of STZ/NAD administration and continued upto 90th day. CPE and CHE significantly attenuated the markers of diabetic neuropathy and biochemical changes associated with diabetic neuropathy. Moreover, the oxidative-nitrostative stress was found to be significantly attenuated. Present study suggested that CPE and CHE attenuated diabetic neuropathic pain *via* modulation of oxidative-nitrosative stress as well as hyperglycemia in the diabetic rats. Our results evidence the ethnopharmacological relevance of use of *C. pepo* extract in the management of diabetic neuropathy.

Biography: Dr. Randhir Singh is working as Associate Professor in Dept. of Pharmacology in Central University of Punjab, Bhatinda, India and has an experience of more than 15 years of teaching and research. He has published 121 research and review articles in peer reviewed International Journal and his work is cited in highly reputed journals. He received 23 lacs from DST, SERB under Fast Track

Scheme for Young Scientists and 19 lacs from CCRH, Dept of Ayush for research on diabetes and diabetic complications. He received Prof Saroj V.N Sharma award, Best Faculty Award from APP 2017, South Africa and Eminent Researcher Award from DCM Edutech 2018. He has authored 12 books with reputed publishers of national and international level. His name is included in the Top 2% Researchers in the WORLD, Data published by Stanford University, USA in 2021. He is editorial board member in several journals. He has supervised 10 Ph.D. Scholars, 12 M. Pharmacy students and12 Pharm D students.

Extension of saffron (*Crocus sativus* L.) cultivation to non-traditional areas

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Saffron, the stigmas of *Crocus sativus* L. is the costliest spice in the world and is cultivated in the different parts of world such as in Iran, India, Greece, Morocco, Italy and Spain. Due to its use in cosmetic, food and pharmaceutical industry, 1 kg of saffron costs around 2.25 lakh INR. There is a huge gap in demand and production of saffron and as a result it is highly adulterated. The alternatives to bridge this gap in cultivation of saffron is to increase production by using various modern cultivation techniques such as aeroponics, hydroponics, green house cultivation , using genetic and biotechnological tools , better farming practices, tissue culture and introduction of saffron cultivation in non-traditional areas where the pedoclimatic conditions are suitable for saffron production. Introduction of saffron cultivation in non - traditional areas is one of the good alternatives as India has vast geographical locations that apparently seem to be conducive for saffron cultivation. This will not only bridge the gap in demand and supply but also provide alternative income to the farmers. In one such study saffron cultivation was introduced to different non-traditional areas of Jammu and Kashmir. In total seven locations namely Mandi, Dagwar, Gursai, Assar, Kanthi, RS Pura and Mantalai were selected in north-western Himalayas. Different morphological parameters such as flowering, and overall yield were estimated. Physioclimatic properties along with soil nutritional composition were also estimated with an aim to understand the relationship between plants parameters, climatic conditions, and soil properties. The whole experiment was conducted in complete randomized block design (CRBD). Out of seven locations the best results were obtained at Mandi followed by Assar, Gursai, Kanthi, Dagwar, Mantalai and no flowering was seen in Jammu, which was taken as negative control. Yield attributes, viz., flower number, stigma fresh and dry weight were significantly higher at Mandi (Poonch) during second and third year of cultivation compared to other selected non-traditional geographical locations. Other plant morphological parameters viz., shoot, root, leaves and daughter corm number and shoot, root length were also higher at Mandi as compared to other locations for second and third year of cultivation. Mandi was characterized by high altitude (1580m), annual rainfall (>1000 mm), sandy soil texture and high N, P, K content in soil. Though Mandi had high yield among the non-traditional areas selected i.e 3.24 kg/ha but was less than Kashmir the traditional areas i.e 4.92 kg/ha. Principal component analysis (PCA) concluded that environmental factors viz., rainfall and altitude has positive correlation with soil N, P, K content and overall yield. Soils sand and electrical conductance (EC) has negative correlation. Based on this studies, it is being proposed that saffron cultivation can be introduced in non-traditional areas whose altitude is more than 600 amsl, annual rainfall > 100mm, seasonal temperature -1 – 30ºC, in September to November 14-17ºC, in November to March 25-30ºC, in April till August 30-37ºC and soil texture Sandy or Clay with high soil NPK. Additionally, temperature ranging from 14-17 ºC for flowering phase (Oct-Nov).

Biography: For about last 23 years, Prof Jyoti Vakhlu has been teaching to Masters, M.Phil and Doctoral students in the School of Biotechnology. She has also served as a Director School of Biotechnology, 2017-2020 and has been one of the founder members of the School of Biotechnology at University of Jammu. Her group is involved in unraveling the cultivation dependent and cultivation independent microbial diversity in extreme environment soil from north-western Himalayas, healing clay of Chamlyal and rhizosphere of Saffron, *Crocus sativus* using molecular tools. Her group has established the microbiome of the corm of *Crocus sativus* by meta-genomics and culture dependent approach. Her group has isolated & characterized plant growth promoting bacterium that has shown promising growth enhancement of saffron plant in the pot and field trials. Besides, the three way interaction has been unraveled among the saffron corm, pathogenic fungus and biocontrol bacteria (isolated from native cormosphere) at molecular level. The transcriptomic data analysis has led to identification of few genes that have role in resistance to pathogenic fungi. Her aim to use the information generated to develop a disease resistant variety by genome editing. She has also conducted trials for introduction of saffron in non-traditional areas. She has many publications in international journals. She has supervised Ph.D & M.Phil students in addition to masters' dissertations. She has been received national and international awards and research projects.

Biotechnological approaches for conservation of endangered forest plants of Western Ghats

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The forest tree plants conservation of endangered, rare and threatened plants is a international apprehension and augmented concentration is unfocused towards this ambition. A forest is a piece of land with many trees, many animals need forests to live and survive, and forests are very important and grow in many places around the world. The global forest area is slightly under 4 billion hectares, or less than 31 per cent of the total land area. Indian forests types include tropical evergreens, tropical deciduous, swamps, mangroves, sub-tropical, montane, scrub, sub-alpine and alpine forests. The

protected areas of India cover 156,700 km², roughly 4.95% of the total surface area. The use of biotechnology based techniques for the endemic plant species conservation. Unconventional and conventional biotechnological methods for conservation, unconventional methods are organogesis, somatic embryogenesis, protoplast fusion cultures, cryopreservation, phytochemical markers. The conservation of plants are *ex situ, in vitro* techniques has gained, developments in biotechnology and molecular biology are modern, advanced methods have enabled the use of *in vitro* techniques for the identifications, collection, conservations and plant genetic resources. Biotechnological approaches are DNA markers, Random Amplified Polymorphic DNA analysis, plant DNA bank, bar coding, Simple sequence repeat, Sequence characterized amplified regions. There are different funding sources available for conservation of endangered plants, DST, UGC, DBT, SERB, MoEF, IIFM, etc., both method of plant conservations are the modern techniques will act as complementary machinery which to carry out supplementary molecular studies on the endangered species as well as already extinct species.

Biography: Dr. Arjun Pandian currently working as an Assistant Professor, Department of Biotechnology, PRIST Deemed University, Thanjavur, Tamil Nadu, India. Currently running DBT – Forest Conservation Biotechnology - three years major project, is a two Institute mode project (PRIST Deemed University & Gandhigram Rural Institute, Dindigul, Tamil Nadu, India), He worked as a Post-Doctoral Fellow for three years at Tshwane University of Technology, South Africa, in Pharmaceutical Science (Natural Product Research) two years and in Crop Science (Natural Product Research) one year. Has received awards; National Research Foundation (NRF) Freestanding Post-Doctoral Fellowship for three years at South Africa, is a prestigious grand and UGC -JRF Science for Meritorious Fellowship for two years at Centre for Advance Studies in Botany, University of Madras, Guindy Campus, Chennai, Tamil Nadu, file three patents, one granted, published 51 articles in well reputed journals (International and national) Journal of Materials Chemistry, Phytotherapy Research, Tetrahydron, Carbohydrate Research, Regulatory Toxicology and Pharmacology, South African Journal of Botany, Springer, Current Science, Bentham Science Publishers, Taylor & Francis Group etc., Published books 2, book chapters 11, full length proceedings 3, presented papers in national (8) and international (3), conference/symposium/seminars. Have membership in Scientific/Professional Societies like Society for Ethnopharmacology (SFE), Editor in Chief (Golbal SciTech Ocean, Journal of conventional knowledge and holistic health), Reviewer in different journals (Journal of Ethnopharmacology, Industrial Crops and Products, Phytochemistry Letters, Journal of Polymers and the Environment, Journal of Threatened Taxa etc.,), he has Supervising Ph.D 4, Supervised: 16 students (M.Phil-1, M.Tech-2, B.Tech-14), Co-supervisor: Ph.D 4 awarded, 23 (M.Tech-2, D.Tech-2, Ph.D Scholars-2, M.Sc., & M.Phil-17), Mentor: 14 (D.Tech-1, M.Tech-3, M.Pharm-5, B.Pharm-4, B.Tech-1). His area of specialization in the fields of Plant Biotechnology (broad specialization of plant tissue culture), Natural Product Research (isolation, identification and characterization of bioactive compounds from plants and mushrooms), Micro & Molecular Biology (Microbial activities, isolation of proteins and DNA gene sequencing), Anticancer activity (Handling, maintaining *in vitro* cells and *in vivo* animals), Pesticide residue analysis, Sudan dye residue analysis, Food & Fruits Technology.

Spirulina: The superfood

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Spirulina is a filamentous, spiral blue-green alga that grows both in salt and freshwaters. It is typically found in warm lakes with 7.0 above pH. Its best growth has been observed in waters with pH between 8-10 where many other organisms can't survive. Just like plants, cyanobacteria also produce energy from sunlight via photosynthesis but are different from the land plants because it grows in water. Cultivation of *Spirulina* is very easy because it can be grown in all seasons, that too, without soil or outdoor space. *Spirulina* is one of the most nutrient-dense foods on the earth. It had been consumed by the ancient Aztecs but became popular again when NASA proposed that it could be grown in space for use by astronauts. *Spirulina* is considered a superfood because it has high protein and vitamin contents, which makes it an excellent dietary supplement for people on vegetarian diets. It promotes healthy aging, and strengthens the immune system. Its powder contains protein, vitamin B1 (thiamine), Vitamin B2 (riboflavin), vitamin B3 (niacin), copper, iron and a decent amount of magnesium, potassium and manganese. The quality of the protein in *Spirulina* is considered excellent and comparable to eggs. It provides all the essential amino acids needed for human diet. *Spirulina* is a fantastic source of antioxidants, which can protect humans against oxidative damage. Its main active component is phycocyanin which fights free radicals and inhibits the production of inflammatory signalling molecules, providing impressive antioxidant and anti-inflammatory effects. Some evidence suggests that *Spirulina* has anti-cancer properties. It lowers down the blood sugar, blood pressure and cholesterol level in the blood. More studies are still necessary to unfold the miracles folded in the body of this tiny cyanobacterium.

Biography: Dr. Mukesh Kumar is presently working as Professor of Botany & Microbiology at Gurukula Kangri University, Haridwar. He has 32 years of teaching and research experience. He published 46 research papers, 13 books and 41 book chapters. He completed 04 R&D research projects and guided 7 PhDs. He is recipient of Shikshak Shree Samman- 2013, Govt. of U.P., Birbal Sahney Award- 2018, U.P. Hindi Sansthan, Govt of U.P., Paryavaran Bhushan Samman- 2019, Akhand Bharat Bharti Seva Sansthan, Life Time Achievement Award- 2019.

ORAL PRESENTATIONS

Cultivation of *Swertia chirayita*, a high value endangered medicinal herb in Himalaya

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The demand for medicinal plants of Uttarakhand is quite inflated, and many of these plants grow only in the Himalayan region. Uttarakhand is blessed with a variety of soils and agro-climatic conditions, ranging from Sub-Tropical to Alpine, which is a mega biodiversity hotspot for a wide range of wild and cultivated Medicinal plants. *Swertia chirayta* is one of selected few Himalayan medicinal plant species with high market value and easy cultivation technique. *Swertia chirayta* (Gentianaceae), commonly known as *Chirayta* in india, can be found throughout the temperate Himalyas from Kashmir to Bhutan (1200-3000 m a.s.l.). It is an age-old, safe, ethnomedical herb that is listed in the Indian Pharmaceutical Codex and American Pharmacopoeias. Its safe and effective use as important medicinal plant can also be traced back to several traditional and indigenous systems of medicines, such as Ayurveda,Unani and Siddha. The National Medicinal Plant Board, Government of India, has declared *Swertia chirayta* to be a prioritized plant species. The crude extract of the whole plant is used as a hepatoprotective, anthelmintic and even anticancerous agent. The hypoglycemic and antimalarial activities of this medicinal plant are well known. However, due to excessive human exploitation, both in terms of over-harvesting and loss of habitat, and unresolved inherent problems of seed viability and seed germination, this priority plant has now been designated as critically endangered. Annual demand of *Chirayta* group in India is reported to be 60,000-100,000 Kg and is imported mainly from Nepal. Therefore, cultivation of this species to meet ever increasing demand is the solution which will provide high economic returns to the farmers and help in conservation of related species in nature.

In situ conservation of rare and endangered herb *Euphorbia fusiformis* Buch.-Ham. Ex D.Don

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Nature has gifted widest range of plant diversity to India for the welfare of mankind. Plants have been utilized for various purposes by the human being since the time immemorial. Plants have been the basic source for therapeutic preparation in the indigenous system of medicine, the *Ayurveda.* With the recent changes in the life style of human being, over exploitation of natural resources has put a large number of plant species to the verge of extinction. *Euphorbia fusiformis* Buch.-Ham. ex D.Don, botanical source for the classical drug *Adhoguda* is one among plant species threatened with the extinction (endangered). It is a plant having potential pharmacological properties and actions. Traditionally, tribal people of India have been using this plant to treat headache, arthritis, gout, paralysis, diarrhoea, abdominal diseases, abdominal tumour, liver disorders, urinary stones, chronic wound cracks, skin disease, eczema and poor lactation, in scorpion and snake bites, plant latex as an antidote. *E. fusiformis* is reported to possess variety of pharmacological activities like antioxidant, antifungal, diuretic, anti-inflammatory, antibacterial, hepatoprotective, antinociceptive, and galactagogue. Also, the plant is being evaluated for its use in female infertility. If not conserved, it will become extinct. Present paper is an attempt to review therapeutic potential of the drug and measures towards its conservation.

Cultivation of endangered medicinal herb Ativisha (*Aconitum heterophyllum*)

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Medicinal plants are a source of biomolecules with therapeutic potential and as a lead to develop new drugs. Herbal medicines are considered as safer, better physiological compatibility and cost-effective. India is a gold mine of medicinal plants and a rich repository of traditional medicinal knowledge. Demand for the medicinal plant is increasing with expansion in human needs, numbers and trade purpose. Plants are mostly collected from wild sources that may pose a serious situation, along with this loss of biodiversity and forest is another major concern for sustainable supply of medicinal plants in the future. With the increased realization that many species are collected from wild sources and being over-exploited, agencies (private/public) are recommending bringing the important medicinal plants into cultivation systems. Cultivation of medicinal plant can decrease the amount to which wild populations are harvested, it will also help to preserve plant species from extinction and will promote socio-economic growth. *Aconitum heterophyllum* Wall (*Ranunculaceae*) is a critically endangered medicinal herb of the northwestern Himalayas and has enormous pharmacological potential. It is the only nonpoisonous member of the genus *Aconitum*, and has been used as a medicinal herb since ancient times. *A. heterophyllum* is an important ingredient in many traditional systems of medicine. Its nontoxic tuberous roots are commonly used as therapeutic ingredient in the Traditional Indian and Chinese Medicinal System for curing dyspepsia, abdominal pain, diabetes, and diarrhea. Mostly, it is harvested for its roots, and its medicinal properties are due to the presence of diverse bioactive secondary metabolites, commonly known as aconites. Multiple *in vitro*

experimental investigations of *A. heterophyllum* have reported analgesic, anti-inflammatory, antiarrhythmic, anti-helminthic, antipyretic, antiparasitic and anticancer properties, as well as its effects on the central nervous system.Cultivation of *A.heterophyllum* is recommended to meet the large demand of the herbal market and to promote conservation in wild habitats. Currently, it is marketed under the trade name of Ativisha.

Impact of climate change on medicinal and aromatic plants: A threat to Ayurvedic system of medicine

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One of the most serious challenges to biodiversity and ecological functioning is climate change. Climate change and global warming are well-known issues that have had an impact on the world's biodiversity. According to a review of the research, regions at higher elevations are more exposed to the negative effects of climate change. Climate change has an impact on the essential secondary metabolites of medicinal plants. The Indian Himalayan region, one of the world's biodiversity hotspots, is also home to a wealth of Ayurvedic medicinal herbs. The medicinal plant diversity of this region is under threat from climate change and may go extinct in the future. Abiotic variables such as CO2, ozone, drought, and cold are key abiotic factors that influence the alpine environment, habitat fragmentation, shifting distribution ranges, phenology pattern changes, secondary metabolite alterations, and the invasion of new species, all of which have a negative impact on the current medicinal plant resources, directly or indirectly. In comparison to the adverse effects and multidrug resistance situations of allopathic treatment, secondary metabolites of medicinal plants are being used as a safe alternative. Since ancient times, herbal plants and their products have been widely utilised in the treatment of common ailments such as diabetes, cancer, cholera, diarrhoea, asthma, and pyrexia**.** Climate change has resulted in changes to Ayurveda, an ancient system of medicine that relies primarily on plant resources to treat illness, will be severely impacted in the future as a result of climate change. Plants are particularly sensitive to climate changes and do not adapt to them at random. Some climatic conditions promote secondary metabolite production, while other abiotic factors reduce plant development to some extent. The aim of the present work is to study the Impact of climate change on Medicinal and Aromatic Plants. Reviews have been collected from different sources related to medicinal plants. The following headings have been used to discuss the impact of climate change on medicinal plants. Increased CO2 levels have an impact on productivity and quality, Threats to medicinal plant species are affected. Climate change and global warming adaptation measures, Mitigation strategies to reduce CO2/GHG emissions, Research strategies in the future. Climate change has a substantial impact on medicinal plants, both cultivated and wild. A concentrated study approach, particularly on the buildup of secondary metabolites with health implications, is urgently needed. In comparison to other commercial crops, research on medicinal plants in relation to climate change is sporadic and insignificant. It is high time for these plants to be recognised as potential sources of biomolecules and neutraceuticals.

Cultivation of medicinal plants to fulfil market demands

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Many health experts have recommended increasing the body's immune system in the current scenario, where the entire world is scrambling to find a treatment for the Covid-19 epidemic. This can assist to lessen the disease's effect and expedite recovery. Medicinal herbs have emerged as a lifeline in this desperate situation. The aim of present study is “commercial cultivation of medicinal plants is one of the most profitable agribusinesses for farmers”. If someone has enough land and knows how to market herbs, they can make a lot of money in India with a small investment. The Nationwide Medicinal Plant Board made the first real attempt at a national level to survey the demand and supply of therapeutic plants in the country in 2001-02, when it appointed an examination through CERPA to appreciate yearly trade levels of selected 162 medicinal plant species. Following this, the NMPB commissioned a nationwide report in 2006-07 to assess the demand and availability of medicinal plants in India. The FRLHT review brought several complications in the herbal domain to the surface and added to the understanding of the subject related to the various types of raw medicines substances in commerce, their botanical relationships, annual trade volume, and supply sources. To promote cultivation of medicinal plants, Central Institute of Medicinal and Aromatic Plants (CIMAP) has developed a number of high yielding varieties, worked out agro-technologies and processing technologies for them. Profitable cultivation of medicinal plants can be practiced by farmers/ companies/ entrepreneurs along with traditional agricultural horticultural crops as sole crops, intercrops, sequential crops etc. They can be profitably intercropped in plantations/ orchards. The production and cultivation of medicinal herbs in India is largely unorganised. The production and sale of medicinal plants in the country would be improved with better supply chain management and the development of farmer associations. Recent start-ups have entered the market, bringing with them technological advancements. These start-ups use precise farming techniques, such as crop profiling and seed analysis for better germination, by combining artificial intelligence (AI) and data analytics.

Cultivation of medicinal plants to fulfil market demand and socio-economic developments

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The purposeful cultivation of medicinal and aromatic plants is absolutely necessary for the production of medicines in high quality. Medicinal and aromatic plants are extensively used in Indian traditional systems of medicines. The demand for medicinal plants and chemicals derived from them is increasing globally**.** The aim of present work is "a short study on cultivation of medicinal plants". Altitude affects the amount of sunlight and water that plant receives but there are few plants that do not need too much sunlight and water and thus High altitudes are the best place to survive but for cultivation of these plants man power is needed which is quite difficult at higher altitudes. At high altitude, Oxygen availability is very low and this condition makes survival a challenge. But many species have successfully adapted via considerable physiological changes. So, new techniques have been invented to maintain same temperature and climatic conditions on lower altitudes also. Such Methods include constructing Greenhouse so that favourable climatic conditions and regulated temperatures can be maintained according to the need of high-altitude plants. Cultivation ensures the quality and purity of medicinal plants. Because of the availability of agrotechnologies cultivation of medicinal plants have become easier and economically available. The cultivation of medicinal and aromatic plants leads to industrialization to a greater extent. If in the process of cultivation, all the operations are uniformly maintained, a drug with highest purity can be achieved. However, it requires skill along with some professional excellence. Systemic cultivation can yield crops with higher purity.

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Medicinal plant cultivation: Opportunities & threats

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Cultivation of Medicinal plants will provide an additional source of income for the state's poor rural population. Medicinal plants are a source of biomolecules with therapeutic potential and lead to developing new drugs. Medicinal plants occupy an important position in the sociocultural, health care and spiritual arena of rural people of India. Medicinal plants contributed significantly to the rural livelihoods. Globally, medicinal plants constitute one of the integral parts of the biodiversity, ecosystem and biological heritage. Medicinal and aromatic plants are being used since ancient time for the treatment of many diseases in traditional and recognized systems of healthcare and for therapeutic, fragrance and flavouring products in pharmaceutical and cosmetic industries besides as sources of natural dye, fat, essential oil, bio-pesticide, resin, protein, vitamin, condiment, spice, timber, fiber and other useful substances. Ayurveda community is facing many challenges related to raw materials like, Shortage of quality raw materials, A rise in raw materials price, lowering of standards in the products, Adulteration in the raw materials which lead to big question mark for quality, efficacy and safety of the medicinal plants**.** So, there is need to safeguard the medicinal plants and adopting a good agricultural practices and good cultivation practices. Herbal medicines are considered as safer and better physiological compatibility and cost-effective. And, India is a gold mine of Medicinal plants and a rich repository of traditional Medicinal knowledge. Medicinal plants demand is increasing with expansion in human needs, numbers and trade purposes. Plants are mostly collected from wild sources that could pose a serious situation, along with this loss of biodiversity and forest is another main concern for the sustainable supply of Medicinal plants in the future. Opportunities for Medicinal

plants cultivation are like, Widespread use of alternative medicine, Preference for natural products and chemicals from botanicals herbs, Availability of markets (global or national), Availability of high yielding varieties, Availability of agro-technologies, Availability of processing technologies, Profitable returns on a sustainable basis. Need to Promote cultivation of medicinal plants, Training of farmers for cultivation of herbal drugs, implement good agricultural practice, good pre and post harvesting practices and good storage practices, Promote single point sourcing of raw materials.

Need of conservation and cultivation of ativisha (*Aconitum heterophyllum*): A review

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Ativisha (*Aconitum heterophyllum*) is one of the oldest aconite drugs used in India. It is the perennial herb of Himalayan origin ranging about 6000- 15000 ft above sea level. It is highly valuable plant of Indian, Chinese, Bhutanese, Tibetan traditional medicine. In *Ayurveda* its description is found from *Atharveda* to *Nighantus.* The synonyms *Shuklakanda, Shringi, Ghunavallabha, Shishubhaishajya, Kashmira* briefly describes the morphological characterstic, utility and habitat of the drug. The actions include *Deepana, Pachana, Kasaghna, Jwaraghna, Krmighna, Vishaghna* etc. Due to its therapeutic utility it is main content of many formulations like *Balachaturbhadra Churna, Sudarshana Churna, Lakshminarayana Rasa* etc. The drug has large demand in pharmaceutical industry but due to depletion of the species from its natural habitat the plant has become endangered. Moreover, the supply of crude drug is facing the issues of adulteration and substitution and this is further affecting the quality of the formulations. Aim of the article is to explore the cause of depletion of the species and spread awareness regarding conservation and cultivation of the plant for better future of the species and to increase the availability of the crude drug. This document is a review of classical *Ayurvedic* texts, peer reviewed journals and related data available on internet. As the drug has become endangered hence it is not possible to meet the demand of pharmaceutical industry. Adulteration and substitution of the drug is also worsening the situation. To encourage the cultivation subsidy is also provided by the Government. Hence for the sustainable supply to meet the demands of pharmaceutical industries, conservation and cultivation of Aconitum heterophyllum is the need of today for the betterment of the plant species as well as for the whole mankind.

Illegal harvesting, cultivation and conservation status of medicinal plants wealth in Mountain areas: An overview

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For past couple of decades, medicinal plants have been increasingly recognized for their role as not only for health care but also for improving the economic status. In the present time the demand of medicinal and aromatic plants in pharmaceutical industry has grown rapidly because of accelerated local, national and international interest on herbal drugs. But at the same time to fulfil demand of pharmaceutical industries, over exploitation of MAPs in unscientific and irregular manner by the smugglers, pilferers and peoples residing nearby areas is resulting declining natural regeneration of MAPs in their habitat. India is one of the largest countries in Asia, which has the richest arrays of well-known medicinal plants and alternative medical systems including Ayurveda. Though, to promote the cultivation and conservation of MAPs, Govt. of India is launching various projects and schemes, but again regrettably there is no any strong monitoring system for Govt. funded projects one hand and on the other there is no legal and open market for selling of farmers cultivated MAPs produce to earn the monetarily gain. Due to ignorance of Govt. towards the monitoring of progress of work under different projects and schemes, lacking in proper market for farmers, high risk in cultivation, unavailability of quality planting material, long period of crop rotation and low gain after long wait, peoples are forced to go for shortcuts as illegal collection from the natural populations of valuable MAPs. Owing to above facts, it seems that the MAPs opted the level of threatened and are at the verge of vanishing from their natural habitat. Certainly time is very near when people will read the name of these valuable plants in books only. For scientific and regulated harvesting, certifications of local communities either individual or group through strict governmental control measures are necessary for collection procedures. Govt. should also provide an open, easy and legal market for the farmers where they can do their business at their own bid. On the basis of above mentioned facts, the observations and results of this study suggested that to gearing up cultivation of MAPs protection of naturally developed pockets are must for more production of seeds, development of efficient propagation protocols, establishment of model nurseries for availability of quality planting materials to be significantly prioritized. The study also suggested that the illegal and unscientific manner of harvesting can be check through certification of mountain communities and individual people, training on harvesting procedure, etc. which will help on sustainable collection of MAPs germplasm from natural pockets and ultimately in conservation.

Significance of proper processing of high altitude plants namely wild Seabuckthorn Berries to preserve and obtain nutrients of the Berries

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Biosash through its Director, Arjun Khanna has been engaged in the harvesting and processing of Wild Seabuckthorn Berries in the high altitude regions of Ladakh in J & K since 2004. The methods followed have been developed practically since 2004 with a view to obtain quality fit for export to USA and following the various norms required in the processing and harvesting procedures. The unique process we developed also inspired us to apply for a process patent for the same and we are only the second person in the world to have done so in case of Seabuckthorn. We obtained high quality raw materials and this enabled us to obtain high quality of finished product with nutrients intact. Its of utmost importance that raw materials are properly processed and harvested to ensure high quality raw material and consequently high quality finished product. We developed a unique process for the harvesting and process to ensure we obtain seabuckthorn pulp and dry berries and seeds which have retained their nutritive properties. In order to do this – for Seabuckthorn Juice we developed techniques to ensure the following; i.e. proper selection of the wild seabuckthorn berries which are adequately ripe and NOT over ripe, cleaning and sorting of berries so that only berries which are not over ripe and not damaged are selected – we have a rejection rate of approx. 50 percent here, triple washing of Seabuckthorn berries to remove dirt and impurities and further rejected berries which float on top of the washing containers, processing into pulp within time and NOT leaving the berries overnight or more than 6 hours to avoid fermentation of berries making them again unfit, filtration of pulp obtained to remove impurities further so as to obtain a raw clean juice, further process into finished product. In order to do this – for Seabuckthorn Dry Seeds we developed techniques to ensure the following; i.e. thorough drying of residue after pulping and then separation of seeds and sending of seeds for oil extraction as per need. In order to do this – for Seabuckthorn Dry Berries we developed techniques to ensure the following; i.e. berries are picked , sorted and cleaned, washed, dried thoroughly and sent for Oil extraction as per need.

Control dehydration process for better efficacy of aromatic herb

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Plants from historical times are applied for maintain health in addition to the supply of drug treatments; regarding the fact that 80–85% of the world-wide population depends on ancient medicines. In the last few years, the interest of consumers towards aromatic and medicinal herbs has registered a growing trend both in terms of product types and consumption. In the past, these plants mainly concerned the derivatives and ingredients industries, while today we are witnessing a growing use in different sectors, such as functional food (nutraceutics) or infusion drinks (herbal teas) and bio-ecological cosmetics. Drying is a process aimed at reducing the water content in plant materials below a limit where the activity of microbes and decomposing enzymes deteriorate the quality of medicinal and aromatic plants. In addition to traditional methods, plants can be dried by automated methods with stoves or dryers. Today, the interest of consumers towards medicinal and aromatic herbs has registered a growing trend. Aim of the present study is the process of drying of aromatic herbs and evaluating drying efficacy on the microbial community associated with the studied herbs. Temperature control during the drying process is of fundamental importance for the quality of the final product**.** The data is collected from various journals, articles, text, pubmed. During the drying process, the aromatic herbs are subjected to chemical and physical changes that influence the quality of the finished product. The extent of these changes mainly depends on the drying conditions and the biological characteristics of the herbs**.** The microbial load of the aromatic herbs after drying was influenced by the different leaf structures of the species; in particular, with laurel leaves, microbial survival increased with increasing biomass density. Finally, with the drying method adopted, the different species under consideration showed a different microbial stability and, consequently, will have a different shelf life.

Cultivation of medicinal plants

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Medicinal plants, since times immemorial, have been used in virtually all cultures as a source of medicine. The widespread use of herbal remedies and healthcare preparations, as those described in ancient texts such as the Vedas , are obtained from commonly used traditional herbs and medicinal plants, has been traced to the occurrence of natural products with medicinal properties. Herbal medicine is still the mainstay of about 75 - 80% of the world population, mainly in the developing countries, for primary health care. The present paper discusses the development of a participatory approach to promote medicinal plant cultivation as a tool for biodiversity conservation and livelihood enhancement in Jammu district

of J & K state in India. Cultivation of medicinal herbs like Shankhapushpi, Atis, kuth, kutki, kapikachhu, karanja, are changing the Indian agrarian Ayurvedic scenes along with the extraordinary opportunities for the farmers to increase their income. According to the Traditional Treatment Health Center, 25 significant medicinal plants are always in full demand. They are; Indian Barbery, Licorice, bhumyaamlaki, Isabgol, Atis, Guggal, Amla, Chandan, Senna, Baiberang, Long Pepper, Brahmi, Jatamansi, and Madhunashini, Kalmegh, Satavari, Ashwagandha, Chirayta, Kutki, Shankhpushpi, Ashoka, Giloye, tulsi, Safed Musli.

Jeevak of Ashtavarga: three sites of natural occurrence at Himachal Pradesh & Uttarakhand; Geotagged

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Jeevak is first herb of first *Mahakshaya (Jeevaniya)* described by *Maharishi Charak*. Further, it is described in *Snehopaga Mahakshaya* and constituent of many important *Rasayana* drugs. And many Ayurveda texts describe it in in and important group i.e., "Ashtavarga". Although, this drug is accepted and identified as *Microstylis musifera*, most common people and even professionals have not even seen this plant and spotting it at the site of natural occurrence is even rarer. Here in this study geotagging with photograph documentation of three sites of naturally occurring *Jeevak (Microstylis musifera)* found during the work has been noted and documented. The sample 1- *Jeevak (Microstylis musifera)* Photo ID- *IMG_20200112_161736-165638.jpg*, dated-12 January 2020; 16:17pm, at Site: - *Dhanaulti, Tehri Garhwal, Uttarakhand*; GPS location; *Latitude - 30;25;27.6008000000001.., Longitude- 78;10;28;6376000000164..* at an *altitude - 1846 Meter (Camera) (2286m* https://wikitravel.org/en/Dhanaulti*)*; has been seen. The sample 2- *Jeevak (Microstylis musifera)* Photo ID - *IMG_20200808_152300.jpg*, dated -08 August, 2020; 15:22pm, at Site *Kasauli, Solan, Himachal Pradesh*; GPS location; *Latitude - 30;53;46.3481000000027.., Longitude- 76;58;11;7846000000136..* at an *altitude-1927 meters (*https://wikitravel.org/en/Kasauli*)* has been noted and sample 3- *Jeevak (Microstylis musifera)* Photo ID - *IMG_20200813_175623.jpg*, dated -13 August 2020; 17:56pm, at Site *Bir-Billing, Kangra, Himachal Pradesh*; GPS location; *Latitude - 32;3;9.73380000000179.., Longitude - 76;42;23;9116999999968..*at an *altitude- 1444 Meter (Camera) (1525 m https://en.wikipedia.org/wiki/Bir,_Himachal_Pradesh)* has been reported. In this study the altitude range from 1444 meters to 2286 meters for natural occurrence of *Jeevak (Microstylis musifera)* has been reported. This work will be helpful researchers, academicians and other interested people in the field to reach and locate the natural occurrence sites of *Jeevak (Microstylis musifera).*

Cultivation of *Aconitum heterophyllum,* a high altitude medicinal and aromatic plant: A key for sustainable development and bioresource conservation in higher Himalayan region (HHR) of Uttarakhand, India

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Biodiversity is not distributed evenly on Earth, as richest in Tropics, but it's amazing that in temperate regions the great Himalayas are the Center of Plant Diversity with elevations exceeding up to 8000 m which provides the best hot spot for plant biodiversity. Higher plants play an important key role in the lives of tribal peoples living on the edge of the Himalaya and one of them is medicinal plants which are rich in secondary metabolites and are the potential sources of drugs and form the main source of the Indian System of Medicine (ISM). India is a hub of the wild-collected plant medicine industry in Asia, but key species have declined due to over-collection to supply domestic and foreign medicinal markets. Medicinal and aromatic plants (MAPs) are receiving considerable attention all over the world because of their vast untapped economic potential, To find out the current cultivation of high altitude medicinal plants a vast survey was done in more than 8 districts of Uttarakhand during 2016-2021.where different survey questionarire were searched and cultivation area was carried for more than 12 high altitude Medicinal and Aromatic Plants where in this abstract we are focussing on *Aconitum heterophyllum* present Cultivation. Where more than 3353 various stakeholders, farmers were directly benifitted.Cultivation and conservation of medicinal plants is important for a number of reasons, firstly they are an important source of natural ingredients used by the manufacturers of homeopathy, traditional and modern pharmaceuticals. Secondly, the collection and marketing of medicinal plants from forest is an important source of livelihood and employment for a large number of poor people who lived in or nearby forest areas. The cultivation and conservation of medicinal plants, therefore, is a vital component of efforts to conserve biodiversity. It is common in mountain region the farming is carried out on small terraced fields and most of the villagers are small landholdings. Most of the time the traditional crops faced severe problems of timely rainfall which has resulted low production. Now-a- days mountain farming is also facing severe problems of wild animals' e. g. Pig, Monkey (*Macaca mulatta*), Langoor (Semnopithecus entellus), Dear (*Odocoileus virginianus*), Bear (*Ursus thibetanus*), Barhsingha (*Rucervus duvaucelii*), etc., those are

profoundly destroying their crops. In addition to this naturally frozen rain is commonly destroying the highly income crop, particularly Chaulaii (*Amaranthus spinosus*), in high mountain villages.

Outlook of plant conservation: significant for sustaining future world

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Plant conservation is the need of hour. Living beings will survive only if there is presence of plants on Earth. There are lots of researches going on in past for plant conservation due to awareness about population explosion. The first embryo culture was done by Hanning in 1904. In 1925 Laibach recovered hybrid progeny. In 1964, haploid plants were produced from pollen grains of Dhatura plant, which is called Upavisha in *Rasa Shastra*, by Maheshwari and Guha. Protoplast was isolated for culturing by Cocking and in 1972, first somatic hybrid plant was produced by Carlson and coworkers. This study aims to conserve vegetation for future generations of living beings. Plant conservation by different techniques is the neccessity to avoid extinction of that vegetation. For this purpose Ex-situ reproduction of plants or developing improved quality of vegetation so as to cope up with the changing environmental, social and economical conditions of populations along with threats of viability for survival due to increasing Earth's temperature. Seed banking is another option for endangered plant species. Awareness regarding ethnobotany can be adopted. Continuous research for discovering new wonder drugs and for creating new Gene Banks should be encouraged. An agronomic improvement is essential for cultivation. Another method is Cryopreservation. Data Bases should maintain Data Books. Educating industrial sector should be the key point to regulate laws about terrestrial, air and water pollution. Plants are life. Life cannot be dreamt of without presence of plants. So research is the only field which can help us to sustain ecosystem in equilibrium. Endangered species of plants and plants which are going to extinct can be revived only through continuous research for the survival of plants on variable temperatures. So this article can benefit the experts and scientists for reproduction of plants and can bring back the plants from the brink of extinction.

A review on phytochemistry and pharmacology of high-altitude medicinal plants

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Plants are the primary source of the therapeutic needs for mankind since ancient times and capable of growing under extreme conditions. The diversity in ecological growing conditions and also variability in altitude that ranges from 100 to 7500 m above the sea level introduce diverse kinds of medicinal plants in the higher altitude. This paper is a review on the pharmacology and phytochemistry of some selected high altitude medicinal plants. The adverse conditions in higher altitude are due to the presence of ultraviolet (UV) filters, potent antioxidants, and the plants growing in such habitat adapt themselves to different mechanisms of metabolite synthesis. This may account for the availability of diverse and unique chemical properties in the high-altitude plants. Their biochemical machinery has been able to bear the aggressive climatic conditions by the way of new biosynthetic twists leading to new molecular skeletal, which are absent in the lower region plants. High altitude plants under diverse conditions show remarkable properties in healing and various ailments but at the same time are quite difficult to cultivate and thus too expensive too. The amount and variety of chemical constituents present in high-altitude plants differ from plants growing in lower region. This review shows how even on growing on such high altitudes drugs have unique chemical constituents that do wonders on the pharmacological front.

Daruharidra (*Barbesris aristata* DC): A solution to ailments in present and future

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Berberis aristata, commonly known as Daruharidra because of having yellow colour wood, belongs to the family Berberidaceae. The genus Berberis (Berberidaceae) includes about 500 species worldwide, Out of 55 species of Berberis reported in India, 21 species of Berberis are found in Himachal Pradesh in which Berberis aristata, Berberis asiatica and Berberis lycium are more common. B. aristata DC has been accepted as official source for classical drug Daruharidra. It is deciduous, thorny shrub attaining a height of about 6-12 feet found in Himalayan range at the height of about 6000 to 10,000 feet, in Neelgiri hills, Sri Lanka, South Africa, Afganistan, Iran etc. Medicinally used part of the plant is wood. The major chemical constituents present in B. aristata are alkaloids and Berberine is one of the important alkaloids present. Berberine-containing plants are used as food supplements subject to certain restrictive conditions of use. It is a red listed endemic medicinal plant species of conservation concern and has become very important in recent years due to its rarity and huge demand in the medicinal plant sector. Species, such as B. lycium Royle. and B. chitria Lindl. are also generally used in Ayurveda formulations for therapeutic purposes and for the preparation of rasanjana, crude concentrated extract

prepared from the roots and stem bark. It is use to cure several ailments, including conjunctivitis, bleeding piles, ulcers, jaundice, enlarged liver and enlarged spleen. However, many other plants belonging to different genera like Cosinium fenestratum (Gaertn.) Coleb and Morinda umbellate have been recommended as substitutes of Daruharidra and traded in the market in its name. Present paper is an effort towards establishment of therapeutic potential of Daruharidra through reverse pharmacology and measures for its in-situ conservation.

In vivo efficacy study (anti-tussive) of *Kantakari* on SO_2 oxide induced rat model

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Kantakari is well known drug of Ayurvedic materia medica, widely used since ancient times on various respiratory disorders. Anti-asthmatic, anti-tussive and antispasmodic activities are its major therapeutic claims. Its root has been recommended by *Acharyas*. In present study, the drug *Kantakari* has tested for its anti-tussive effect for pre-clinical studies. After ethical clearance, raw drug *Kantakari* was collected, authenticated and analysed for standardization. After this animal experimentation was done on so_2 induced rat model. Group I contains antitussive cough syrup as standard drug. Group II contains *Kantakari* root decoction. Orally medication was given to both groups as per required doses before one hour of so_2 exposure. Cough bouts were induced by sulphur dioxide. Number of cough bouts were counted for 5 minutes, after 30 minutes and after one hour of so_2 exposure. Collected data treated with the Student's t test and inference was drawn accordingly. On observing tabulated analytical data, number of cough bouts of test drug *Kantakari* when compared with the standard drug, the p-value is greater than 0.05 ($p > 0.05$). Results suggested equal efficacy of both groups i.e *Kantakari* root decoction provides equally effective anti-tussive activity as compared to standard drug. Ayurvedic Materia Medica, Anti-tussive, *Kantakarii, Solanum surattense* Burm., so_2 induced rat model.

Brahma Kamal (*Saussurea obvallata* (DC.) Edgew.), an endangered potential herb for therapeutic application: An ethano-pharmacological review

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Plants play an integral part in traditional medicinal system. *Saussurea obvallata* (DC.) Edgew. is an 'endangered' medicinal plant of Uttarakhand, found at high altitude range of about 3000-4800 mt. of Himalayan region, with rich cultural and medicinal significance. The aim of present study is to extend the current knowledge, cultural importance and medicinal applications of *S. Obvallata* in humans for safeguarding health hazards. Under method, review a list of published original articles and secondary data from various databases including PubMed, PubMed Central, Shodhganga, DHARA, Ayush Research Portal, Google Scholar, Medline, Embase, etc. were taken into consideration for review. The literature analysis revealed multiple uses of different plant parts of *S. Obvallata* against dysentery, rheumatism, leprosy, bone fractures, nervine debilities, cerebral palsy, paralysis, sexual disorders, lung infection, urinary tract infections, leucoderma, rhinitis and hyperthermia. In-vivo studies of hydralcoholic extracts of leaves and flowers of *S. obvallata* showed significant results in anti-bacterial and anti-fungal activities. Anti-bacterial studies of methanolic and aqueous extracts of *S. obvallata* showed highest zone of inhibition against the *Staphylococcus aureas* and lowest zone of inhibition against *Pseudomonas aeruginosa*. In cell line study against MCF-7 Breast cancer cell line, considerable activity of extracts of *S. obvallata* was recorded. The experimental study of aqueous extract of S. obvallata also revealed its radio-protective effects and its ability to cure damaged haemopoetic system. In vivo studies also prove its anti-hypoxic and anti-cancerous activities. The major constituents found through GC-MS in *S. obvallata extracts* are Linoleic acid, Palmitic acid, Methyl palmitate, Stearic acid, Henicosanoic acid, α –Terpineol, γ-Curcumene and Piperine. The information in review confirms the traditional claims and contributes in providing promising baseline information for the pharmacological use of *S. obvallata.* The information presented here maybe beneficial for researchers, healthcare professional and pharmaceutical companies to design and develop effective medicines against microorganisms, help in promoting and popularizing this rich herb having promising potentials to prevent and treat various ailments. Additionally, highly developed research is essential for isolation and identification of specific active components which are responsible for pharmacological properties of the plant.

An assesment of herbs of *Shaka varga* as an antacid action

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Ayurveda, the ancient Indian system of medicine deals not only with prevention and cure of diseases but also aims to relish the lifestyle through attaining physical and mental prosperity. Besides, drugs and therapies narrated, *Ayurveda* attaches a lot of importance to the herbs which are to be included in diet for living healthy. Now-a-days, sedentary lifestyle plays an

important role in aggravating the root cause like constipation, indigestion, acidity which in-turn reflects into major health hazards like diabetes, obesity and high blood pressure etc. To get rid of these health problems, society is now attracted and started consuming various herbs and their products to remain healthy. In *Ayurveda, Nighantu* (a traditional herbal pharmacopeia) are the treatise of herbs and their usage. *Bhavaprakash Nighantu* (16th century), which stands in medieval period and makes a bridge in between classical and modern herbs and their usage. Among various *varga* (classification) narrated in *Bhavapraksh Nighantu* like *haritkyadi varga, karpooradi varga, guduchyadi varga* etc, *Shaka Varga* is the most important *varga* (classification) wherein various useful parts of seasonal herbs like *pushpa* (flowers), *patra* (leaves), *phala* (fruits), *kanda* (stem) etc. are to be used to live and remain healthy. As acidity is the main the main root cause in various lifestyle disorders, the usage of useful parts of herbs mentioned in *Shaka Varga* not only neutralizes the acid but also regulates the digestive fire. An assessment will be done of some important herbs mentioned in *Shaka Varga* of *Bhavapraksh Nighnatu* by determining their pH values and re-establish them for their antacid action. This study aimed to determine pH of herbs of *shaak varga* for their acid neutralizing action, to analyze herbs with respect to their *Rasapanchaka* i.e. *ras, guna, virya, vipaka and t*o review these herbs with respect to their chemical constituents. Under methodology, pH of herbs will be determined, assessment of chemical constituents of herbs will be done, herbs will be analyzed w.r.t. their *Rasapanchaka* i.e *ras, guna, virya, vipaka* and data related to pH and antacid action will be reviewed.

Chemical composition and antimicrobial activity of *Ocimum sanctum* i.e. Tulsi

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Due to increasing development of resistance by microorganism, scientists have been realized that the effective life span of any antimicrobial agent is limited. Therefore, several studies have been done to find out the new alternative source of antimicrobial agents i.e. mainly from plants. Ocimum sanctum in English Holy Basil, Tulsi (in Urdu) belongs to plant family Lamiaceae. It has made important contribution to the field of science from ancient times as also to modern research due to its large number of medicinal properties which are antispasmodic, anabolic, immune stimulant, cardio protective, neuroprotective, anti-inflammatory etc. As per Ayurveda literatures tulsi is mentioned under Helminthiasis because it is an anti-microbial agent. The uses of this plant on a daily basis are a witness to Ayurveda intelligence and provide an pattern of earliest information contribution solutions to present trouble. It have also be exposed to respond to metabolic-stress by homogenize of blood sugar, blood pressure, Cholesterol, and mental state through encouraging result on remembrance and perception act and by its anxiolytic and edronax effect. This drug is a famous for house hold medication for many diseases such as injury, respiratory disorders, hepatic disease, viral infection, earache, back pain, hiccup, inflammation of the conjunctiva in new-born's, stomach diseases, urinary disorders, seborrhoea disease, a variety of toxicity and mental stress. The proximate, minerals and preliminary phytochemical analysis of Ocimum sanctum leaves were studied. The nutritional analysis of Ocimum sanctum shown high level of ascorbic acid and total carbohydrate i.e., 65.41 mg/100g and 39.58% in their leaves, Whereas the total phenol was found to be maximum (1.88 mg/g) in leaves. Leaves contain major nutrient like N (3.30%), P (1.10%), K (6.62 %), S (1.55 %) and Na (0.74%). The oil of leaves also contains comparable amount of antioxidant as ascorbic acid, flavonoid and total phenol as well as linolenic acid, polyunsaturated fatty acid which was very good for health. The purpose of the study is to examine the antimicrobial properties of essential oils of Ocimum Sanctum, to quantify the volatile components which are present in leaf, flower and essential oil to investigate the compound which is responsible for any activity. The results of this study shows that the possibility of using the leave extract of Tulsi (*Ocimum sanctum*) as a source of antibacterial compounds for treatment of infections caused by multi-drug resistant bacterial pathogens.

Semecarpus anacardium Linn. leaf extract exhibits activities against breast cancer and prolongs the survival of tumor bearing mice

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Semecarpus anacardium Linn. is a commonly used Ayurvedic medicinal plant which nuts have been described in Ayurveda and Sidda system of medicine to treat clinical ailments such as vitiligo, inflamation, microbial infection, geriatric problem, baldness and neuro related problems. In this study, anti-cancer activity of the leaves of *Semecarpus anacardium* Linn was evaluated for future drug development. The phytochemical screening was done by GC-MS analysis, cytotoxicity was examined using MTT assay, mode of cell death was evaluated by fluorescence microscopy and finally antitumor activity was determined in Ehrlich Ascites Carcinoma (EAC) cell induced tumor bearing mice. The ethyl acetate extract from the leaves of the plant induced cytotoxicity in cancer cells in a dose dependent manner (IC_{50}: 0.57 µg/ml in

MCF-7 cells) in different cancer cell lines. The non-malignant cells were relatively insensitive to the extract. The staining with acridine orange, ethidium bromide and 4′,6-diamidino-2-phenylindole (DAPI) confirmed that the extract induced apoptosis in cancer cells. Furthermore, the extract induced cell cycle arrest at G1 phase and suppressed cancer cell migration. An oral administration of the extract suppressed the tumor growth in mice model bearing ehrlich ascites carcinoma cells. The ethyl acetate extract was also found to prolong the survival of tumor bearing mice. Overall, these observations suggest the anticancer activities of the ethyl acetate extract of the leaves of *S. anacardium.* The study opens a new window to examine the phytochemical constituents from the leaves of the plant responsible for the anticancer activities.

Role of Ayurvedic herbs in blood purifier

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The blood is called 'fluid of health' because it protects the body against the diseases and get of the waste products and unwanted substances by transporting them to the excretory organ like kidney. The kidney, liver and lymphatic system work together to get rid the unwanted toxins and impurities from the body system. Whenever Liver does not perform its unction properly then the process of digestion become poor and the blood making procedure becomes impaired. In Ayurvedic texts, Rakta refers directly to the blood, specifically the red blood cells and indirectly to the tendons and the bile. The Rakta dhatu, being made up primarily of the elements fire. The quality and quantity of Rakta dhatu depends upon the intake of the fire elements. Food (shadrasa ahara) is first digested by the main digestive fire (jathragni). This produces ahara rasa which is digested by rasagni to produce rasa dhatu. In liver ranjan of this rasa dhatu takes place and its results in the formation of blood (rakta dhatu). According to acharya Charaka and acharya Sushruta liver is also a site of origin of the raktavaha srotas.Herbal extracts in amycordial are enriched sources of several, micronutrients, bioflavonoid, glycosides, tannins, and phytoconstituents. That help restore hormonal balance, relief from various infections even prevent from recurrent. These herbs also help maintain to normal physiology of kidney and liver. The aim of present study is to understands the role of the Ayurvedic herbal medicines for blood purification. Literature search- Review of literature regarding *shatatkriyakala* is collected from *Brihatrayi*, *Laghutrayi* and available commentaries on it and research articles are also searched from various websites. Blood purifier is helpful in increased the bowel movement at the beginning which is a temporary phase. It takes three to four days, which is recommended because it is very supportive to the blood cleaning process. It activates the sluggish liver and kidney to make it healthy and more active. Herbal blood purifiers have note single activity they have multiple activity due to poly herbal formulation with lesser side effects. With purification of our system our skin gets healthier.

Phytochemical & pharmacological study of *Pushkaramoola*

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The plant *Pushkaramoola,* or *Inula racemosa* Hook. F., belongs to the Asteraceae family and can be found in practically all sections of India, primarily in the western *Himalayan* region between 5000 and 14000 feet above sea level. In Indian system of medicine (*Ayurveda*), *Pushkaramoola* is an important medicinal herb. *Kasari* (anticough), *Sulahara* (pain reliever) *Sughandhika* (fragrance) and so on are some of its synonyms. It is classified as *Hikkanigrahana* (stops hiccups) and *Svasahara* (relieves dyspnoea and asthma). *Pushkaramoola* is often regarded as the best treatment for pleurisy (*Parshvasula*). Sesquiterpene lactones are major phytochemical substances found in the roots of *Pushkaramoola* and they have a wide spectrum of biological activity. Anti-inflammatory, analgesic, antifungal, antibacterial, hepatoprotective, anti-allergic, antioxidant, hypoglycaemic and cardioprotective effects have been documented for the plant *Pushkaramoola*. This medicine was chosen because of its clinical significance in medical fields such as respiratory disorders and hepatobiliary diseases as well as its value to the phytopharmaceutical sector.

Some economically important medicinal plants of Himalayan region, India

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The economic importance of medicinal plants is much more to countries such as India than to rest of the world. These countries provide two third of the plants used in modern system of medicine and the health care system of rural population depend on indigenous systems of medicine. The international trade of medicinal plants and their products was estimated to be USD 60 billion in 2010, and by 2050, it is expected to reach USD 5 trillion. Asian countries are very rich in medicinal plant species and are the major exporters of these plants and their products. Medicinal plants contribute to the local and national economy and become the source of the cash for the rural livelihood at the hard time. The financial contribution

made by Non-Timber Forest Products, especially medicinal plants, is significantly higher as compared to the timber products. The following plants are medicinally and economically important found in Uttarakhand State such as *Aconitum balfourii* Stapf., *A. heterophyllum* Wall.ex Royle, *Ajuga parviflora* Benth., *Allium cepa* L., *A. sativum* L., *A. wallichii* Kunth., *Angelica glauca* Edgew, *Artemisia nilagirica* (C.B Clarke) Pamp., *Asparagus filicinus* Buch.-Ham. ex. D.Don, *Berberis aristata* DC., *B. lycium* Royle Berberidaceae, *Bergenia ciliata* (Haw.) Sternb., *B. stracheyi* (Hook.f.& Thomson) Engl, *Centella asiatica* (L.) Urb., *Cinnamomum tamala* (Buch.-Ham.) T.Nees & Eberm., *Cirsium wallichii* DC., *Cucumis sativus* L., *Curcuma longa* L., *Dactylorhiza hatagirea* (D.Don) Soo, *Dioscorea bulbifera* L., *Eupatorium adenophorum* Sprengel, *Girardinia diversifolia* (Link) Friis, *Hippophae salicifolia* D.Don, *Juglans regia* L., *Jurinea macrocephala* DC., *Macrotyloma uniflorum* (Lam.) Verdc., *Megacarpaea polyandra* Benth ex Madden, *Mentha piperita* L., *Mirabilis jalapa* L., *Nardostachys jatamansi* (D.Don) DC., *Ocimum tenuiflorum* L., *Oxalis corniculate, Paeonia emodi* Royle, *Picrorhiza kurrooa* Royle ex Benth., *Polygonatum verticillatum* (L.), *Potentilla lineata* Trevir., *Prunus persica* (L.) Batsch, *Punica granatum* L., *Rheum moorcroftianum* Royle, *Rhododendron campanulatum* D. Don, *Rumex nepalensis* Spreng., *Saussurea costus* (Falc.) Lipsch., *Saussurea obvallata* (DC) Edgew., *Selinum vaginatum* (Edgew.) C.B. Clarke., *Swertia chirayita* (Roxb.) Buch.-Ham. ex C.B.Clarke., *S. ciliata* (D.Don ex G.Don) B.L.Burtt., *Tagetes erecta* L., *Taxus wallichiana* Zucc., *Tinospora sinensis* (Lour.) Merr., *Urtica dioica* L. and *Zanthoxylum armatum* DC. This article is presented the economical and medicinal importance of above mentioned plants in the Uttarakhand state (India).

Phytosomes as a promising nano-carrier: A developing platform for herbal extract and bioactives phytochemicals

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The emergence of phytosome nanotechnology has a potential impact in the field of drug delivery and could revolutionize a developing platform for Herbal extract and bioactive phytochemicals delivery. Phytomedicines, complex chemical mixtures prepared from plants, have been used for health maintenance since ancient times. The term "phyto" means plant while "some" means cell-like. Herbal drugs comprises of a vast array of active contents which furnishes us with a number of Applications**.** Phytosome is novel encouraging technique applied to phyto-pharmaceutical which contains phyto-constituents to herbal extract surrounds and bound by lipids and improves bioavailability of herbal extracts for medicinal applications. Most of the bioactive constituents of phyto-medicines are water-soluble compounds like flavonoids, glycosides, terpenoids in which flavonoids are a major class of bioactive compounds possesses broad therapeutic activities. But due to high polarity and poor lipophilicity the active contents are poorly absorbed resulting in poor bioavailability. These problem can be overcome by formulating a suitable novel preparation of the herbal extract and water soluble herbal extract and lipophilic outer layer phytosomes shows better absorption and as a result produce better bioavailability and actions than the conventional herbal extract containing dosage form. The present review describes a complete overview of phytosomes advancement in phytosomes technology, various herbal drugs for which phytosomes have been used as a carrier and benefit of the researchers interested in this field.

Pharmacological and physiochemical study of *Gloriosa superb*: A highly medicinal value plant

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Gloriosa superba L. is a perennial climber and is used as an ayurvedic medicinal herb to cure diseases in various parts of Africa and Southeast Asia. The plant was under threatened category due to its imprudent harvesting from wild as it is extensively used by medicinal industries for its colchicine content. It also faces a low seed set problem, but due to its industrial demand it is now under cultivation. G. superba (Liliaceae) is a semi-woody herbaceous climber found throughout India up to an altitude of 6000 ft. It is a native of tropical Africa and is now growing in many parts of tropical Asia including India, Burma, Malaysia and Srilanka. It is now widely distributed throughout the tropics, and worldwide as a pot plant. In Africa, its distribution is from Senegal east to Ethopia and Somalia, and to South Africa. Gloriosa is national flower emblem of Zambia. The altitudinal range of species is up to 2100 m above mean sea level and in India it is spread from hotter southern parts to the milder mid hill zones of Himachal Pradesh, Jammu Kashmir and Uttar Pradesh. It is known as 'Malabar glory lily' in English, in Hindi as 'Kalihari', in Sanskrit as 'Agnisikha' and its trade name is 'Glory lily'. Glory lily is an industrial medicinal crop in South India, for its high colchicine content, which is still collected from wild. The plant is used to cure arthritis, gout, rheumatism, inflammation, ulcers, bleeding piles, skin diseases, leprosy, impotency, snakebites, etc. Various compounds have been isolated from the plant parts mainly tubers and seeds, via colchicine, colchicoside (its semi-synthetic derivative — thiocolchicoside), superbine, gloriosine, lumicolchicine, 3-demethyl-N-deformyl-N-deacetylcolchicine, 3-demethylcolchicine, N-formyl deacetylcolchicine. Glory lily has been traditionally claimed for a large number of pharmacological actions and ayurvedic medicinal uses. Indiscriminate and imprudent exploitation of the natural resources by mankind is accountable for the current status of this plant. Emphasis should be given to increase productivity and enhancement of colchicine of Kalihari to meet the industrial demand. It is thus

a matter of utmost concern to human life that urgent action is to be taken to prevent further diminution in availability of medicinal plants. Transgenic plants may be eventually developed in which the entire pathway for medicinally active secondary metabolites has been enhanced and introduced. Due to over-exploitation of this important species, this plant has been entered in Red Data Book. Various measures have been taken to conserve this plant using biotechnological applications, through in vitro mass multiplication. Many reports are available on in vitro regeneration of this plant through shoot cuttings and nodal explants, shoot tip explants in vitro corm development , embryoids from leaf tissue , from apical and axillary buds , enhanced in vitro colchicine production. In the present study, I have summarized the information concerning the occurrence, botanical description, ethanopharmacology, medicinal uses, biological activities and toxicological studies on this plant. It is believed that its phytoconstituents and biological activities mentioned in this study can help researchers to explore this plant to further extent. Its use in various other diseases can be tested and toxicity can be studied in detail with clinical trials. Its medicinal properties can be further exploited in future by pharmaceutical industries to treat intractable diseases.

Ethnomedicinal uses, phytochemistry and pharmacological aspects of a genus *Bulnesia*

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The genus *Bulnesia* is in the family *Zygophyllaceae* (26 plant genera), is the major group of *Angiosperms* (Flowering plants). This review is the demonstrated the ethnomedicinal uses, phytochemistry and pharmacological activity of plants species of *Bulnesia* genus such as *Bulnesia* arborea (Jacq.) Engl., *B. bonariensis* Griseb., *B. carrapo* Killip & Dugand, *B. chilensis* Gay, *B. foliosa* Griseb., *B. gancedoi* Rojas Acosta, *B. loraniensis* Griseb. *B. retamo* (Gillies ex Hook. & Arn.) Griseb., *B. rivas-martinezii* G.Navarro, *B. sarmientoi* Lorentz ex Griseb., *B. schichendanzii* Hieron. ex Griseb. and *B. schickendantzii* Hieron. The plants of the genus are useful in gastritis bone tuberculosis, rheumatoid arthritis, inflammation, liver problem, nervous system disorders, as diuretic and cardiac stimulant. Several constituents are reported in to fund in this genus named as guaiene, guaioside, guaioxiole, guanoxide, αpatchoulene, hedycaryol, carotol, Eudesmol, bulnesene and hanamyol etc. The anti-mycobacterial, anti-microbial and anticancer potential of pants of the *Bulnesia* has been studies. This review concludes that more pharmacological studies are needed in future to validate the medicinal use of the plant of *Bulnesia*.

A third-dimensional validation strategy for plant metabolomics using ion mobility mass spectrometry

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Ion mobility-mass spectrometry (IM-MS) has a recent approach used for multi-dimensional characterization and profiling of metabolites. IM-MS is a technique for increasing throughput, and improving isomeric separation, with reduced chemical noise. The aim of the present study is isomeric separation and validation of chiral metabolites in medicinal plants using IM-MS. An ultra high performance liquid chromatograph (UHPLC, Agilent Technologies, USA) coupled with a photo diode array detector (PDA) was used for liquid chromatography. Analytes were separated on a C18 column (2.1 mm x 150 mm, 1.8 µm). In the sustained gradient elution system, mobile phase comprised of water (A) and acetonitrile (B) containing 0.1 percent formic acid. Samples were run in positive and ion-mobility modes (IM-MS). Data was acquired with Mass Hunter software for mass spectrometry. IM-MS processor for ion mobility data. The 3-dimensional maps containing the IMMS frames were captured and saved consecutively by IM-MS processor software. These frames are histogrammed on top of the mass spectrum in a pre-determined number (usually from 100-1000). For a more detailed visualization and understanding of the data, drift time can be plotted against retention time or m/z of the metabolite. IM-MS will significantly accelerate our understanding of the immense chemical diversity seen not only in plants but also in animals, humans, and other tissues.IM-MS willmake an impact on novel isomeric metabolitesin medicinal plants which are difficult to separate in traditional UPLC or HPLC methods.

Phytochemical & pharmacological study of *Ativisha*

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Thousands of years ago, nature provided a diverse assortment of medicinal herbs. As a result, medicinal plants form the backbone of traditional medicine. They have a large number of components that can be used in drug research and

synthesis. In a vast range of land areas, our Indian subcontinent contains a highly rich diversity of plant species. *Ativisha* is a threatened species that can only be found in the *Himalayan* region. since ancient times, *Ativisha* has been employed in several formulations in India's traditional medical method i.e. *Ayurveda*. *Ativisha* is a *Kapha-Pittahara* drug that contains *Katu-Tikta Rasa, Laghu-Ruksha Guna, Ushna Veerya, and Katu Vipaka. Ativisha* (Aconitum Heterophyllum) is a popular herbal remedy for fever, diarrhoea, urinary infections and inflammation. Chemical studies of the plant have revealed that various parts of the plant contain alkaloids such as diterpene, which are the main components and have anti-inflammatory and analgesic pharmacological activities as well as carbohydrates, proteins and amino acids, saponins, glycosides, quinones, flavonoids, terpenoids and other. This is the author's humble attempt to shed light on *Ativisha*'s phytochemicals and pharmacological qualities.

Some common medicinal plants of Uttarakhand

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The state Uttarakhand is rich with floral and faunal diversity including plants used by local inhabitance to cure health problems. There are numbers of side effects are noted using allopathic medicines which lead towards reuse of medicinal plants available locally. Keeping this in view an attempt has been made to enumerate the common medicinal plants used in traditional therapeutic system of Uttarakhand, India. Result revealed that about 50 plant species are used for primary healthcare. The most common enumerate medicinal plants are *Aconitum heterophyllum*, *Saussurea obvallata*, *Swertia chirayita*, *Picrorhiza kurroa*, *Potentilla lineata* etc. The present study highlights the importance of locally available plants in curing different diseases and disorder and also suggests to make ex- situ, in – situ for the sustainable uses.

Phytochemistry & pharmacological aspects of endangered medicinal plants in *Astavarga*

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A group of eight medicinal plants *Jeevak*, *Rishbhak*, *Meda*, *Mahameda*, *Ridhi*, *Vridhi*, *Kakoli*, *Kshirkakoli* considered *Astavarga* having *Rasayana* property, strengthen immune system, increase sexual potency, anti-aging, fever, effective in *vata*, *pitta*, *rakta doshas* etc. ered as a boon to pharmaco-therapeutic aspects. *Astavarga* group of *Ayurvedic* medicine grown in a limited pocket of Himalayan regions distributed mainly in Uttarakhand, Himachal Pradesh and Jammu & Kashmir upto an elevation of 1200-4000 m. The first *Ayurvedic* text which use the word *Astavarga* and provide a sufficient limelight to highlight its herbal description is *Paryayratanamala*. Later, it is mentioned in *Jeevaniya gana*, *Brahmaniya gana*, *Snehopagagana*, *Angamarda Prasamanagana*, *Balya varg*, *Shukrajanana* and *Vayasthapana.* Due to its good medicinal properties, Astavarga is important ingredient of various *Ayurvedic* formulations like *Chyavanprasha, Mahapaisaachik ghritam, Sudarshan churna, Bala tailam, Balarishtha* etc are in *Ayurvedic* text. *Astavarga* having *Rasayana* property, strengthen immune system, increase sexual potency, anti-aging, fever, effective in *vata, pitta, rakta doshas* etc. After independence and restoration of interest in *Ayurveda* provided a necessary eagerness and also the modern taxonomic system about the plant species. The confusion about the exact identification of plant, having not properly sufficient awareness about its phytochemical and pharmacological uses and lack of transfer of knowledge to the next generation are major reasons of its scarcity in natural habitat. As the non-availability of the *Astavarga* has been alarmingly increasing, substitutes made their way into clinical practices. But substitute can't be able to make that much of clinically effect as compared to original plants due to slightly variation in their phytochemical constituents. Therefore, it is hour of need to gather knowledge about phytochemical and pharmacological uses of *Astavarga*. This presentation is an attempt to highlight the information regarding its hytochemical and pharmacological aspects so that further clinical researches will have been done in *Astavarga*.

Purnagiri hills: Medicinal plants reservoir

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Purnagiri hills located in Champawat district of Uttrakhand is a reservoir for a large number of medicinal herbs. During the field survey large number of medicinal plants like *Asparagus adscendence* Roxb.(Liliaceae), *Elephantopus scaber* L. (Asteraceae), *Sida cordata* (Burm.f.) Borss. Waalk. (Malvaceae) and many more with their use in Local Health Traditions by local habitants were recorded. Some of the plants recorded are endangered and rare. Present paper is an attempt to put foreword some specific findings of the survey study.

Herbal crude extract of *Adiantum lunulatum* burm for developing male contraceptive 'pill' for sustainable socio-economic development

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The search for agents of plants origin capable of regulating the female and male fertility is as old as the human civilization and reference to them could be found in the ancient texts of Ayurveda and other Indian system of Medicine. The ever-increasing population of the world at an alarming rate has led to intensification of the research efforts to discover novel compounds from the plant kingdom to control the fertility. The folklore medicine of primitive people frequently included a large number of plants said to be potent contraceptives and abortifacients. Some these plants might have been included, among folklore. Medicines as a result of trial and error observations while for other there may be no reasonable basis. There is a need to verify these claims. A large number of plants have been tested throughout the world for their possible fertility regulating properties, very few plants however, have been studied for their possible male antifertility efficacy. Therefore, there exists a tremendous scope for carrying out research in the area of male fertility regulation to develop a cheaper and safer herbal oral contraceptive pill. In the present work *Adiantum lunulatum* have been selected for exploring their possible male antifertility activity using male albino rats. Effects of crude extract, both alcoholic and decoction of whole plant of *Adiantum lunulatum* Burm was observed on the reproductive structures of male albino rat after the oral administration of 100 mg/kg, 250 mg/kg; and 500mg/kg b.w. for 30, 60, 90 days respectively. A dose and duration dependent effects on testis, epididymis, vas deferens and accessory reproductive organs of the rats were observed. The treatment resulted in deformation in the germ cells of testis leydig's cell were atrophied. No spermatozoa could be seen in the seminiferous tubules and were filled either with edematous fluid or degenerated cellular debris. This experiments can further be continued to higher vertebrates to develop herbal contraceptive 'pill' for sustainable control of human population and socio-economic development growing population.

Extraction techniques of Aromatic plants

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Aromatic plants are a source of fragrances, flavour, cosmeceuticals, health beverages and chemical terpenes. Bioactive compounds from plants are currently the subject of much interest, but their extraction as part of phytochemical/ biological investigations present specific challenges. Extraction process forms the first basic step in medicinal plant research because the preparation of crude extracts from plants is the starting point for the isolation and purification of chemical constituents present in plants. The purpose of standardized extraction procedures for crude drugs is to attain the therapeutically desired portions and to eliminate unwanted material. More efficient and environmentally friendly extraction techniques must be developed in order to prevent pollution and reduce costs in order to pursue further studies. The aim of the present study is to compile about the extraction techniques of Aromatic Plants. Data related to extraction techniques of Aromatic plants have been collected from PubMed, Google Scholar etc. with searching key word of extraction techniques of Aromatic Plants. Various extraction techniques like High performance thin layer chromatography, flash chromatography, counter current chromatography etc will be discussed. Aromatic plants, their extract and essential oils contains a variety of functional bioactive compounds, which have applications in industries, for example in cosmetics, flavoring and fragrance, spices, pesticides, repellents and herbal beverages. These bioactive compounds are isolated from extraction techniques and hence extraction techniques of aromatic plants are important

Wild edible food supplements of uttarakhand (Garhwal Himalaya) with anti-diabetic, anticancer and nephrolithiasis activities

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The sources of drugs is mainly depends on these natural products from plant, animal and minerals. Which is treatment of human and animal disease? The less availability and high cost of new generation antibiotics necessitates looking for the substances from alternative medicines with claimed different activities. Healthy food helps in preventing high cholesterol, diabetes, cancer, high blood pressure & stones in our body & helps prevent many chronic diseases like heart disease, cancer, diabetes & reduce their risk of development. Diabetes mellitus is one of the chronic, worldwide heterogeneous and life-threatening diseases. India is the second highest affected with maximum global burden of the disease and by the year 2025, there will be nearly 80 million diabetics in our country. Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body. Cancer is the second most common disease

in India responsible for maximum mortality with about 0.3 million deaths per year. In India, the six most common cancer types were breast cancer, oral, cervical, lung, stomach and colorectal cancer. The present study is the first report on wild edible food supplements that are endowed with various medicinal properties and significant antidiabetic, anticancer and anti-nephrolithiasis properties. The study was performed to determine the nutritional, mineral profile and phytochemical analysis of seven medicinal plants viz. *Cajanus indicus, Dolichos biflorus, Glycine soja, Benincasa cerifera, Setaria italica, Cleome viscosa* and *Hordeum vulgare* for exploring and development of new, safe and potent drugs.

Phytochemical investigation of *Aconitum heterophyllum* Wall. Ex Royle to validate its traditionally claimed antiplasmodial potential and its UHPLC-DAD based quality control method development

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Phytochemical investigation, commercially important Himalayan medicinal plant, scientific validation of traditional knowledge, quality assurance method development. *Aconitum heterophyllum* Wall. ex Royle is a traditionally used Himalayan therapeutic herb having numerous medicinal potentials. According to *National Medicinal Plant Database* (NMPD), *A. heterophyllum* is highly traded (annual trade of 100-200 metric tons) medicinal plant for medicinal purposes and Indian government is even providing subsidy for its cultivation, hence making it highly prioritized medicinal plant. There are different anti-malarial formulations having roots of this plant as one of ingredient however there is no report on anti-plasmodial potential of this plant. The objective of this study is to perform phytochemical study by implementing chromatographic, analytical and spectroscopic tools starting with preparation of extract, fractions followed by isolation of pure molecules and subsequent assessment of anti-plasmodial activity. Further aim is to develop UHPLC-DAD based quantification method for its quality assurance. Shade dried powdered roots of *A. heterophyllum* were extracted using ethanol: water (1:1 v/v) to prepare hydroalcoholic extract. Extract was undergone fractionation to prepare *n*-hexane, chloroform, ethyl acetate, *n*-butanol and water fraction. Finally, isolation of molecules was done using silica gel-based column chromatography. All extract, fractions and isolated metabolites were assessed for anti-plasmodial activity using the chloroquine resistant *Pf* INDO and chloroquine sensitive *Pf*3D7 strains. Finally, UHPLC-DAD based quantification method was made as there were reports on adulteration and there was no quantification method available for quality assurance of this plant. Chromatographic analysis of fraction led to isolation of six secondary metabolites from roots of *A. heterophyllum*. Among these six molecules, compound 2-*O*-cinnamoyl hetisine is a new diterpenoid alkaloid while compound 4 and 6 i.e., atisinium cinnamate & atisinium formate are new counterionic forms of atisinium. Compound 4-oxabicyclo [3.2.2] nona-1(7),5,8-triene is new compound from this genus while remaining compounds atisinium and aconitic acid are previously reported from this plant. Antiplasmodial activity evaluation of extract, fractions and pure molecules revealed that chloroform fraction if most promising with IC_{50} of 1.01 µg/mL against *Pf* INDO and 1.32 µg/mL against *Pf*3D7 while among pure molecules 2-*O*-cinnamoyl hetisine showed potent antiplasmodial activities with IC_{50} (µM) of 1.92 (*Pf* INDO) and 10.8 (*Pf* 3D7). UHPLC-DAD based quantification method further validated the bioactivity of chloroform fraction having high concentration of 2-*O*-cinnamoyl hetisine than in other fractions. Further quantification data indicate that Atisinium is abundantly present in most of the fractions hence it can be termed as the chief marker compound of this plant. Similarly based on bioactivity 2-*O*-cinnamoyl hetisine can be termed as the biomarker compound based on antiplasmodial potential. Current study scientifically validates the tradition use of the roots of this plant for combating malaria. Diterpenoid alkaloids which are major constituent of this plant could be responsible for antiplasmodial activity of this plant. Hence this study concludes that further phytochemical investigation on this plant can provide us structurally complex bioactive molecules which are required in current scenario. Also developed quality control method can be used to differentiate this herb with its cheap adulterants.

A review on the conservation status of *Katuki* (*Picrorhiza kurroa Royle ex Benth.*): An endangered Himalayan medicinal plant

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Since time immemorial, people have used plant-based formulations for their well-being. Around 60% of recently approved drugs are prepared using various natural sources. The various traditional medicinal systems like Ayurveda, Unani and Traditional Chinese Medicines etc., make use of various plant species and their extracts for treatment of numerous human disorders. *Picrorhiza kurroa Royle ex Benth.* is one of the most employed plant species in traditional medicinal practices of the Himalayan region, specifically, for treatment of various immune related disorders. Furthermore, *P. kurroa* is widely known for its diverse pharmacological properties: anticancer, hepatoprotective, immunomodulatory, antimicrobial, antioxidant, antiallergic, anti-asthmatic, etc. However, recent overexploitation of this plant, owing to its wide range of therapeutic potential places it among the list of the endangered medicinal herbs of the Himalayas. Consequently, this

review presents up to date data on conservation, agro-techniques, biotechnological interventions and sustainable harvesting of *P. kurroa*, an important medicinal herb of the western Himalayas. The aim of the present study is to review the recent status on conservation, agro-techniques, biotechnological interventions and sustainable harvesting of *P.kurroa*. All the relevant data and information on *P. kurroa* were assembled from the following sources: Science Direct, Springer, PubMed, Taylor and Francis imprints, Google scholar, review and research articles from peer-reviewed journals. It was found that owing to the overutilization and collection of *P. kurroa* from the wild habitat, the plant is now becoming endangered plant species, therefore the conservation of the plant species is urgent and it is also the need of the hour. The better and advance agrotechnological and biotechnological techniques plays an important role in the conservation of plant species. Besides the technological advancements for establishment of in-vitro cultures of *P.kurroa*, there is a strong need of framing and implementation of collection (from the wild) related laws. The main source of collection of this plant is still the wild habitats. As a result of over-exploitation, loss of natural habitat, poor harvesting practices, under-developed cultivation techniques and lack of awareness among local people, the biodiversity of this remarkable medicinal plant is facing danger of extinction. Therefore, there is a strong need for the development of efficient cultivation techniques. To date, most of the research is restricted to the roots and rhizomes and only a few studies examined the biological potency of the leaves. So more studies should be conducted to explore the promising biological potential of leaves of *P.kurroa* for improved harvesting and the maximum potential of this plant.

Validation of substitution of Bakuchi Beej with Chakramard phal

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Chakramard and Bakuchi are two important classical drugs, indicated mainly for the management of skin disorders. Classical texts have advocated use of substitutes for scarce drugs and have established criteria for substitute and substituted. Chakramard phal has been accepted as substitute for classical drug Bakuchi Beej by Acharya Bhav Mishra. As per the criteria of substitution, the substitute must have similar pharmacological properties and therapeutical potential to that of the drug to be substituted. Present paper is an attempt to validate the concept of substitution of Bakuchi Beej with Chakramard phal.

Sustainable use of medicinal plants in present scenario

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Medicinal plants are globally valuable sources of herbal products and they are disappearing at a high speed so emphasis on both conservation strategy i.e. in situ and ex situ conservation, cultivation practices and resource management such as good agricultural practices and sustainable use solutions should be taken. Species rarity is used to access the extinction risk of medicinal plants and to identify those species which are most at risk of extinction, prior to commencement of conservation effort. Not all medicinal plants are affected in the same way by overexploitation, indiscriminate collection, uncontrolled deforestation and habitat destruction. Medicinal plant resources are harvested in increasing volumes, largely from wild populations. Indeed, demand for wild resources has increased by 8–15% per year in recent decades. There is a threshold below which species reproductive capacity becomes irreversibly reduced. Natural reserves and wild nurseries are typical examples to retain the medical efficacy of plants in their natural habitats, while botanical gardens and seed banks are important paradigms for ex situ conservation and future replanting. Ex-situ conservation is an effective complement for overexploited and endangered medicinal plants with slow growth, low abundance and high susceptibility to diseases. Botanical gardens can maintain the ecosystem to enhance the survival of rare and endangered plant species. Botanical gardens have multiple unique features. They involve a wide variety of plant species grown together under common conditions, and often contain taxonomically and ecologically diverse flora. Botanical gardens can play a further role in medicinal plant conservation through the development of propagation and cultivation protocols, as well as undertaking programs of domestication and variety breeding. Seed banks over a better way of storing the genetic diversity of many medicinal plants ex situ than through botanical gardens and are recommended to help preserve the biological and genetic diversity of wild plant species. Good agricultural practices (GAP) for medicinal plants have been formulated to regulate production, ensure quality and facilitate the standardization of herbal drugs. The aim of the present study is to cultivate threatened species as well as to ensure their continued survival. Natural reserves and wild nurseries are typical examples to retain the medical efficacy of plants in their natural habitats, while botanical gardens and seed banks are important paradigms for ex situ conservation and future replanting. Cultivation under controlled growth conditions can improve the yields of active compounds, secondary metabolites and ensures production stability. Increased cultivation contributes to recovery of their wild resources and decreases their prices to a more reasonable range. For medicinal plants with limited abundance and slow growth, destructive harvesting generally results in resource exhaustion and even species extinction. Root and whole-plant harvesting is more destructive to medicinal plants than collecting their leaves, flowers or buds. For herbal drugs made of whole plants or roots, using their leaves as a remedy can be a good alternative.

Antioxidant activity of polyherbal combination

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The source of naturally occurring antioxidant materials we got from the parts of the plants, fruits, grains etc. Herbal medicines are play a vital role in curing various diseases because they contain compounds having antioxidant property. Validation of herbal drugs is the requirement of time through the experimental study Therefore, herbal suspension was formulated, evaluated. It was prepared from fruits of *Tribulus terrestris* (Zygophyllaceae), roots of *Boerhavia diffusa* (Nyctaginaceae) and roots of *Crateva religiosa* (Capparacea), fruits of *Piper longum* (Piperaceae). All plants parts of having antimicrobial and antifungal activity but the activity of fruits was the best one. Its diuretic activity is due to high concentration of potassium salts present in it and is reported to inhibit stone formation. It has immunomodulatory, analgesic and anti-inflammatory activities. It also relaxes spasm of smooth muscle. The present study evaluates antioxidant activitiy of the aqueous extracts of the fruits, roots of gokshru, punarnawa and varun, pippali in combination. Antioxidant activity of the samples was determined using the 2,2-diphenil-1picrylhydrazyl radical (DPPH), ferric reducing antioxidant power (FRAP), hydrogen peroxide assay. The IC50 values (97.7mg/ml, 142.4mg/ml, 156.3mg/ml) respectively. The antioxidant activity of herbal medicines gokshru, punarnawa and varun, pippali were undertaken and determined the value by using U.V. spectrophotometer. From this investigation it is found that the combination of these plants has good to moderate antioxidant properties.

Degradation behavior of novel plastic synthesized using mandua starch ester

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As synthetic or petroleum-based plastics create a severe environmental impact, it is very necessary to produce eco-friendly bioplastics materials that have low toxicity to living organism. Further, poor properties of native starches film such as low mechanical properties and high water uptake are the limitations of biodegradable starch films. Considering these points, an attempt is made to extract starch from mandua grains and chemically modified the extracted starch using acetic anhydride. Further, the extracted starch and modified starch were utilized to develop sustainable bioplastics. The prepared bioplastics were studied for biodegradation behaviour. The starch-PVA based bio-plastics were produced by casting and characterized for biodegradation behaviour. Water and glycerol were used as plasticizers. Compost test was carried out to assess biodegradability of bioplastic films. We found that the weight loss rate of alkali isolated mandua starch and acetylated starch based films tested was slower than the weight loss rate of the control film prepared using polyvinyl alcohol and glycerol. The mandua starch-based bio-plastics were biodegraded in 5 days. The test results reveal that the proposed starch-PVA based bioplastics would be a better alternative material to be used in packaging industries. Further, the usage of mandua would also reduce the environmental impact significantly.

Preliminiary phytochemical and analytical study of the traditional herb *Leucas cephalotes* Roth. Spreng. *(Dronapushpi)* & its pharmacological activities

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Leucas cephalotes Roth. Spreng *(Lamiaceae)* plant is a well known herb in the *Ayurvedic*, *Siddha* and Modern systems of medicine, to cure various disorders. Commonly known as *Dronapushpi* or *Guma* is mainly a rainy season weed and is adapted to diverse ecological zones particularly the temperate areas of India, Bangladesh, South-east Asian countries, Mauritius, Malaysia, Pakistan, Nepal & Western China. In India, it is found as a weed in cultivated ground, roadsides or waste lands and through out the greater parts of India ascending upto 1800 m ht. in Himalayas. The present study was carried out to evaluate the profile of phytochemical constituents and extractive values in petroleum ether, ethanolic, aqueous & hydro-alcoholic solvents, estimation of volatile oil, fibre, tannins, sugar and phenolic content in whole herb. To determine anti - oxidant activity of different extracts, FRAP, Peroxidase, lipid peroxidase and ABTS radical scavenging assay was done & total phenolic and flavonoid content was determined. Higher analytical studies include HPTLC of ethanolic extracts and NMR study of hydro-alcoholic extracts have been conducted. In addition, the pharmacological properties of the chemical compounds of this plant shall also be discussed. The extracts of whole plant are rich in diversity of antioxidants, organic acids, phenols, flavonoids, terpenoids, sitosterols, and many different phytochemicals that bear strong antioxidant, anti-pyretic, hepato-protective, anti-helminthic, antifilarial, antiviral, antibacterial , anti-inflammatory anti-scabies, anticoagulant, antispasmodic, antihyperlipidemic, cardiac depressant, hypotensive, antihyperglycemic and

broncho-dilator properties & also have good therapeutic effect in curing symptoms of snake bite, migraine, skin diseases, abdominal colic, etc. Preliminiary phytochemical and analytical study of the traditional herb *Leucas cephalotes* Roth. Spreng. *(Dronapushpi)* & its pharmacological activities is the aim of present study. Estimation of volatile oil, fibre, tannins and sugar content of powder of whole herb were calculated. For hot extraction, Soxhlet extraction method, Cold extraction method using mechanical shaker. For standardization, phytochemical analysis were carried and the data is compared with the standard book (API) and research papers. HPTLC of ethanolic extract and NMR analysis of hydro-alcoholic extract were performed in standard labs. Different anti-oxidant assays, total phenolic and flavonoid content were estimated. Reviews of scientific databases such as ScienceDirect, PubMed, Research Gate and Google scholar. Value of volatile oil, fibre, tannins and sugar content of powder were noted. Out of all different extracts, Hydro-alcoholic extract shows presence of maximum phytochemicals. Also its extractive value is maximum and petroleum ether is minimum. Result of Phytochemical analysis confirm the herb taken is genuine. HPTLC shows 9 spots and 13 spots at short and long UV wavelength The value of different anti-oxidant assay, total phenolic and flavonoid content is high. 1H NMR spectrum varied between 0.736 to 5.378 ppm. 13C NMR varied between 140.943 to 1211.321 ppm. The extracts of whole plant are rich in diversity of antioxidants, organic acids, phenols, flavonoids, terpenoids, sitosterols, tannins, volatile oils, and many different phytochemicals that bear strong antioxidant, antihyperlipidemic, hypotensive, antihyperglycemic properties, etc. & also have good therapeutic effect in curing symptoms of many other ailments.

Asparagus adscendens: Phytochemistry and pharmacology

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Asparagus adscendens is also known as Sweta Musali in Ayurveda or Samoi and Ghirun in locally in Uttarakhand. It is a straggling or scrambling, spinous undershrub, with woody terete, branched stem and fasciculate, tuberous roots. Its flowers are small, white, and fruit is a berry with one seed. It is found from 1000-2200 m above mean sea level and common in scrub forests, on forest edges, forest clearings and in Sal forests; chiefly in Satpuli, Srinagar and Chamoli (Uttarakhand). Medicinally, plant paste is used in fever. India traditional medicine, it is used as an aphrodisiac, appetizer, astringent, coolant, diuretic, diaphoretic, galactagogue, and tonic. It is useful in bodyache, cough, diarrhoea, dysentery, dyspepsia, infertility, leucorrhoea, obesity, scorpion sting, throat complaints, urinary stones and urinary tract inflammation. Asparagins and asparagamine are reported in the plant. The plant has anti-microbial, antifungal, anti-cancer, anti-oxidant, anti-fertility, nootropic, anti-amnesic, anti-convulsant, anti-inflammatory and anti-diabetic potential.

Phytochemistry and pharmacological potential of *Nerium indicum* Mill. for treatment of various skin diseases

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There have been several plants which served as models in the drug development industry historically. Nerium indicum Mill. is one of them which is used in India and China for various health problems including skin diseases. Nerium indicum(family- Apocynaceae) is a wild plant commonly known as " Kaner".The leaves and roots of Nerium indicum Mill contain several active constituents including glycosides, terpenoids, sterols and other compounds. Cardiac steroids, isolated from the leaf, include oleandrin, gentiobiosyl oleandrin, and odoroside. The ayurvedic system of medicine was developed in 'Susruta Samhita' and 'Charak Samhita'. Nerium indicum (Linn.) is one of the thousands of plants mentioned in the Ayurvedic system of India as an important medicine for the treatment of various ailments including skin diseases. The flowers, roots and leaves of Nerium indicum Mill are used for medicinal purposes. These are used in very precise dosages. The dried roots powder in dosage of 30-125 mg, is used for headaches, parasites, inflammation, itching and diseases of the skin. The plant which has been reputed as a therapeutic agent has varieties of biological activities including heart failure, cancer, anti-neoplastic, anti-inflammatory, sedation, anti-bacterial and anti-helminthic effects. The present study aims to explore the phytochemistry and pharmacological potential of Nerium indicum Mill. for treatment of various Skin Diseases.

A medicinal profile of ativisha (*Aconitum heterophyllum* wall): A review

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Ativisha (Aconitum heteropyllum wall) Family Ranunculaceae is a critically endangered medicinal perennial herb native of north-western Himalayas and found in Garhwal, Kuman and Kashmir at altitude between 2500-4000m and has enormous pharmacological potential. It can be cultivated in summer mines in organic and sandy soils. It needs plenty of air, moisture and sunlight. Its planting material is seed, tuber and stem. It is the only Non poisonous member of the genus

Aconitum. Mostly it is harvested for its roots, and its medicinal properties are due to the presence of diverse bioactive secondary metabolites, commonly known as aconites.. It is popular drug used in children diseases hence named "Shishu bhaishajya". In terms of its actions it is kaphapittahar, Dipana, Pachana, sothahar, vishaghana and krimihara. Balachaturbhadra churna, Panchtiktak guggul ghrita and Ativisha churna and kwath are some of its important formulations. Ativisha is a drug of high demands. Because of its increasing demand in pharmaceutical industry, the availability of authentic drug is decreased due to adulteration and substitution. Due to these reasons, there is a huge demand for this plant in the market. It is difficult to cultivate it in areas having different climatic conditions than its native place. Hence for promoting its cultivation In situ type of cultivation must be carried out. Indian government promote the cultivation of many medicinal plants under the scheme of national AYUSH mission. In view of this, 75 percent grant is being given by the National Medicinal Plants Board (NMPB) on the cultivation of Ativisha.

A systemic review on ethnopharmacology, phytochemistry and medicinal uses of *Shati (Hedychium spicatum)*

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H. spicatum is being used in different parts of the Indian subcontinent since ancient time and having different names in different parts of world. The use of indigenous drug industry in India has been widely expanded in recent years. The drug *Shati*-Hedychium spicatum belonging to family Zingiberaceae has a wide array of bioactive principles in exploring nutraceuticals from plant materials. It is a versatile resource for all forms of life and can be an alternative for synthetic drugs considering their adverse effects and also for economic purposes from short duration of cultivation. H. spicatum is considered as an important herbal drug of Indian System of Medicines (ISM).The ayurveda literature has mentioned the utmost properties of *shati* such as *kasaghna, shwasghna, vranaghna, shulaghna, jwaraghna, sothaghna*, *hridya* etc. The herb is known for its therapeutic efficacy and used in treatment of Respiratory diseases such as Asthma, Allergic Rhinitis, chronic obstructive pulmonary disease (COPD), pulmonary fibrosis,Pneumonia, Tuberculosis and lung carcinoma. It is used to treat Cardiac disorders, Wound, Ulcers, colic pain, helmenthiasis, diabetes, fever,skin disease through various preparations. Present review highlights the classical phytochemical and their validation through existing literature and future prospectus. The current study is undertaken to explore and establish the phytochemistry and pharmacological activity of H. spicatum. There is huge traditional use of rhizomes in the hills of uttarakhand by the local inhabitants as a medicine. As the effectiveness of medicinal plant species is higher, the uniform cultivation can be rise with agriculture industry commercialization with future prospectus. The aim of the present review is to extend the current knowledge, importance and beneficial phytochemistry and pharmacology and medical applications of shati in humans for safeguarding various health issues. I have reviewed, analyzed and compiled salient information extensively from the published literature available in scientific databases. The present review describes medicinal applications of *H. spicatum* in countering various disorders and usages. It is a major component of therapeutics for as well as aiding in the betterment of human life expectancy. The information presented would be beneficial for researchers, medical professionals and pharmaceutical companies to design and develop effective medicines, drugs and healthical products exploiting the multiple as well as specific modes of actions of *H. spicatum* , and also help in promoting and popularizing this rich herb having promising potentials to prevent and treat various ailments.

An alternative in-vitro approach for the enhanced production of medicinally essential bacosides in *Bacopa monnieri*

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Bacopa monnieri, also known as "Brahmi", is a perennial, creeping medicinal herb belonging to the family Scrophulariaceae is cultivated in wetlands of southern and Eastern India, Australia, Europe, Africa, Asia, and North and South America. Brahmi is used in Ayurveda for its memory-enhancing properties and treatment of several disorders, particularly those illnesses involving anxiety and stress, nervous disorders like Parkinson's and Alzheimer's, respiratory problems, leprosy (Hansen's disease), epilepsy, splenomegaly, skin disease, cancer, irritable bowel syndrome, and ADHD (Attention deficit-hyperactivity disorder). The medicinally importance of brahmi is due to presence of bacosides (bacoside A3, bacopaside II, bacopaside I, bacopaside X, bacopasaponin C, bacopaside N2), luteolin, apigenin, brahmine, herpestine, hersaponin and betulic acid etc. The whole plant has medicinal significance. Herbal products of Brahmi have increased significantly in the western world and developing countries. A meagre amount and seasonal variation of bacosides production led to plants scarifying rapidly. High market demand for herbal products promoted over-exploitation of Brahmi plants and enlisted endangered species. So, there is an urgent need to develop an alternative method to enhance and extract these metabolites without sacrificing the plants. This study aims to use leaves tissue from a *B. monnieri* plant and produce callus culture. The callus is treated with LED lights of different wavelengths (blue, red and white). Then bacosides and the

other metabolites are directly extracted from the callus tissue without sacrificing the plant and analysed through HPLC (High-Performance Liquid Chromatography). This work has been carried out to decipher the callus development of Brahmi in different hormone combinations and bacoside detection. The combination of 2,4-D and BAP (6-Benzylaminopurine) hormones provided the best callus growth. The quantity of bacosides produced in blue light treated callus was 1.5 times more than in white light treated callus. The maximum amount of bacosides were produced in blue light, followed by red and white light. It is also observed that the squalene synthase gene, an essential gene of bacosides biosynthesis, expresses the maximum under blue light. Thus, we conclude that blue light is preferred for enhanced bacoside production in callus culture.

Phytochemical composition and biological activities of *Hedychium coccineum* Buch.-Ham. ex Sm. essential oils

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Hedychium coccineum Buch.-Ham. ex Sm. a perennial rhizomatous herb belonging to the family Zingiberaceae. The aim of the present study was to compare the chemical composition and biological activities of *H. coccineum* rhizome part essential oil (HCCRO) and *H. coccineum* aerial part essential oil (HCCAO). The comparative study of the rhizome and aerial part essential oils of *H.coccineum* displayed that (*E)*-nerolidol (15.9%), bornyl acetate (13.95%), davanone B (10.9%), spathulenol (8.9%) and 1, 8-cineol (8.5%) contributed majorly to the rhizome essential oil, while 7-hydroxyfarnesen (15.5%), *α*-farnesene (11.1%), *α*-pinene (10.9%), spathulenol (7.7%) and *β*-pinene (6.8%) were present in the aerial part essential oil. Both the essential oils were studied for their nematicidal, antifungal and antibacterial activities.

Nimb: A solution to present day problems

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Nimb (Azadirachta indica), also known as Margosa tree has been used for the welfare of mankind since Vedic Period. It has not only been used for therapeutic purposes to combat health problems but also as a solution for various other day to day problems. It is said to be *tikta-rasa, laghu, ruksha in Guna; virya- sheeta, vipaka-katu* having *kaphpittahar, vamanhara, daha prashman, grahi, ahrdya* actions indicated for the treatment of *kandu, kushtha, trsna prameha, jwara, krimi, siroroga, kamala, aruchi.* Its twigs are used as tooth brush, burning of leaves and other parts to repel insects, oil as contraceptive and mosquito repellent, oil and residual part after oil extraction for pest control in agriculture. The plant has potential to be used for pest control in cultivation of medicinal plants. Present paper is an attempt towards a comprehensive review of Nimba with focus on its use as a herbal pest control measure in cultivation of medicinal plants.

Cultivation techniques of Agnimantha (*Premna integrifolia* Linn.) to meet its indispensable supply

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Dashmoola is one of the best-known health care products of *Ayurveda,* which is a combination of ten medicinal plants. In *Dashmoola,* roots are employed in the compounding of Ayurvedic formulations. These medicinal plants are highly demanded for the preparation of ayurvedic medicines. *Agnimantha* (*Premna intergrifolia* Linn.) is one of the plant species used in the preparation of *Dashmoola*. The tree with which fire was lighted in the sacrificial ceremonies by rubbing the sticks or wood together. This is the literal meaning of the word *agnimantha*. The controversy about *Agnimantha* is basically due to its variety. This is of two types. (1) *Laghu* (small) (2) *Brahat* (large). Charaka Samhita, both are given as separate trees. Laghu agnimantha is *Clerodendrum phlomidis* Linn., while *Brahat agnimantha* is *Premna intergrifolia* Linn. Both belong to the same family, more or less height. In the south, Premna has been used by vaidyas. *Agnimantha* seeds germinate at a very low rate, resulting in decreased production in relation to demand for the plant. Moreover, three-year matured roots of plant have been used for therapeutic purposes, which means they are not able to fulfil market demand. For this reason, *agnimantha* is not available in different parts of India, and *Laghu agnimantha* is sold under the name of *Brahat Agnimantha*. Due to indiscriminate collection, over exploitation, and habit destruction, this valuable plant has become vulnerable in various parts of India. *Agnimantha* is not available in many parts of India. The present review deals with the finding of better cultivation, propagation, and harvesting techniques for *Premna integrifolia* Linn. Its

conservation, which aims to support sustainable development in ways that don't deplete the world's variety of species. Review of scientific databases such as ScienceDirect, PubMed, Research Gate, and Google scholar to find out better cultivation, propagation, harvesting, and conservation techniques. Propagation of *Agnimantha* using hardwood cuttings treated with growth regulators showed significantly higher values of root and shoot parameters. In Vitro morphogenesis is achieved from callus tissue derived from leaf explants to make their cultivation economical and help in the conservation of *Agnimantha.* The present information will be useful for setting up better cultivation and propagation techniques for *Agnimantha*. This will result in sufficient production of the plant, and a genuine sample of the plant will be used in different formulations. This review helps in building research protocols on the year-wise mature roots of *Agnimantha* for their application in therapeutics. This will help in fulfilling the market demand for the plant.

Novel techniques, approaches, innovations for the farming of medicinal and aromatic plants

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The alteration in the soil pH due to improper agricultural practices, injudicious use of synthetic fertilizers and pesticides, and the burning problem of adulteration and substitution made a quench for the new alternative techniques for obtaining the medicinal and aromatic plants of better quality and yield. With the increased realization that such medicinal and aromatic plant (MAP) species are being over-exploited and sustainable harvesting is the need of the hour, a number of agencies like NMPB, National Horticulture Board, Khadi and Village industries board are encouraging and recommending their cultivation through novel techniques. Various novel techniques are being developed now a days for better yield of medicinal and aromatic plants so the aim is to conduct a literature review to know the novel techniques currently employed for cultivation of medicinal and aromatic plants to meet the increasing commercial demands for better yield, efficacy and profitability. An in-depth literature review was conducted regarding different novel cultivational techniques through electronic media, research articles and various text books. Apart from Ex-situ and In-situ conservation various other cultivation techniques such as Hydroponics has also been mentioned as a better alternative for barren areas devoid of fertile soil. Aeroponics, aquaponics, monoculture, agricultural drone technologies and hybrid seed technologies are some of the new modern technologies. Various start-ups, venture and innovations are establishing novel techniques of farming. Technologies like Genome editing, tissue culture, new plant breeding techniques, novel laser techniques for increasing medicinal plant products are now practised to a larger extent. Alternatively, In-Vitro low-cost culture medium for regermination of endangered plants are also effectively employed. Smart farming supported by Central Government of India includes indoor vertical farming, farm automation, livestock farming technologies, modern greenhouse, precision agriculture, and artificial intelligence are increasing the quality of production with reducing environmental footprints. To regulate over harvesting of natural populations and exploitation of local communities by traders and exporters these communities need to be trained in scientific methods of cultivation, collection and marketing. Conservation of biodiversity and protection of indigenous knowledge is an important aspect that needs to be addressed to prevent biopiracy. Cultivation of Medicinal Plants is emerging as an economic opportunity which needs to be utilized judiciously to meet the requirements and aspirations of future generations as well.

Plants regeneration from encapsulated hairy roots of the *Picrorhiza kurrooa* Royle ex Benth.: Genetic fidelity and active ingredient analysis

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Five hairy root lines (H1, H2, H3, H7, H9) of *Picrorhiza kurrooa* were established through *Agrobacterium rhizogenes* (strain A4) mediated transformation. On the basis of maximum picrotin and picrotoxinin accumulation (8.32 µg/g DW and 47.56 µg/g DW, respectively) hairy root line H7 was selected as source of material to encapsulate for production of synthetic seeds. Regrowth of encapsulated hairy roots reached 73.33% following 6 months of storage at 25°C. Plantlets showed root formation following two weeks of their transfer to half-strength Murashige and Skoog medium. These plants were subsequently transferred to pots containing a mixture of soil, sand and farmyard manure (2:2:1, v/v), and same were then shifted in the greenhouse and the overall survival was found to be 85% after 2 months. Transformed plants showed bigger leaf size, higher number of leaves with increased leaf area and highly branched root system compared to non-transformed plants. PCR and southern blot analysis revealed that plants derived from hairy roots retained the Ri TL-DNA. Genetic fidelity of transformed plants was assessed by 45 random amplified polymorphic DNA (RAPD) and 35 inter simple sequence repeats (ISSR) markers. RAPD primers showed 5.19% polymorphism whereas, ISSR primers showed 3.57% polymorphism. Phytochemical analysis of transformed plants showed that metabolite content was almost similar in hairy root line and its regenerants. Development of transformed plants of *P. kurrooa* with in vitro secondary metabolite production potential may offer an important alternative to the exploitation of this endangered plant species and will open new frontiers in metabolic engineering.

Conservation of the high altitude aromatic medicinal plants in the Himalayan region

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The nature of every human is to find solution of daily life problem by the natural way. Diseases are one of the major problems which needs best natural solution. Aromatic medicinal plants are one of the best natural solutions to get rid of this problem. These plants are found in very low amount on the earth so these have very high value and multiple properties of the medicines. In Rig Veda the herbal healthcare preparation is described The demand of these aromatic medicinal plants is increasing day by day so that it is very big challenge to conserve and preserve these high value medicinal aromatic plants without affecting their internal properties. These plants play an important role in the Indian economy. To conserve these high altitude aromatic medicinal plants is to boost the health and the economy both. In this paper I tried to suggest an alternative method to conserve these aromatic medicinal plants.

Comparison of two bioinformatic pipelines used for studying microbiome associated with cormosphere of *Crocus sativus* L.

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Microbiome associated with plants are of great importance for plant health, nutrition, and quality. Study of microbial communities interaction, behaviour and function present in particular niche is very important. Microbiome study is either culture dependent or culture independent i.e. Metagenomics. As all microbes are not cultivable, so uncultivable one can be studied through metagenome by using Next generation sequencing (NGS) techniques. DNA sequencing technology has become cheaper but it have resulted in the production of massive datasets that are difficult to analyse. Different bioinformatics tools, softwares, pipelines, databases used for analysis of different type of data like 16S rRNA /18S rRNA, whole metagenome, metatranscriptomes. There are various softwares, pipelines and databases available for metagenomic data analysis like MG-RAST, MEGAN6, QIIME, MOTHUR, GAIA2, Galaxy, Kraken2 etc. Bioinformatics pipeline is the integration of various softwares algorithm to process raw sequencing data to generate taxonomy and functional profile. For present study two pipelines, MG-RAST and MEGAN6 were used as both are open access pipelines, user friendly and have relatively less time and memory requirement. These tools are used for comparing the microbial diversity, abundance and functional analysis. Functional analysis comparison by using different databases/software available in these tools (COG, NOG, KO, InterPro2go, eggNOG, SEED. Present results highlight the differences in taxonomic and functional composition of samples obtained from the two separate pipelines because of different algorithm and databases used. The outcome of current study is MG-RAST is better for taxonomy analysis whereas MEGAN6 is better for functional analysis. Therefore depending about the question asked, specific pipeline should be used.

Studying the impact of enhanced UV-B exposure on the growth of *Ricinus communis* L.

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Depleting stratospheric ozone layer has resulted in increased penetration of harmful solar UV radiation. UV-B radiation (280-320 nm) is an important environmental stress to plants which poses detrimental impact on their growth and development in general. Plants have learned to cope up with such stresses and various studies of enhanced UV-B exposure on plants showed both, positive and negative, results. The impact of this stress has also shown to increase the medicinal properties of certain plants. *Ricinus communis* L. is one of the important oil-seed plant species with high medicinal properties, which belongs to the family of spurges *i.e.* Family Euphorbiaceae. It is commonly found in the tropical and sub-tropical regions around the world. The present investigation studied the impact of enhanced UV-B on castor oil plant (*Ricinus communis* L.). The vegetative phase of the plant was examined under ambient solar UV-B radiation and enhanced UV-B exposure. The present study was carried out for a time period of 20 weeks in the premises of H.N.B. Garhwal University (S.R.T. campus), Tehri Garhwal, located in the temperate zone at an elevational height of approx. 1700 m a.s.l. The plant samples were grown in two different set -ups, *i.e.* ambient solar UV-B and enhanced UV-B. Plants in enhanced UV-B set -up were irradiated with elevated UV-B exposure 3 hrs. a day daily around noon-time. In the present study, authors have examined 9 different plant growth parameters, *viz.* shoot length, stem base circumference, no. of branches, no. of nodes, internodal length, no. of leaves, no. of veins, leaf mid-vein length and inflorescence development in 5 random samples in both experiments. Germination rate was 86.66 % after 20 days of sowing. Compared to the natural solar UV-B set-up, plants exposed to elevated UV-B showed decrease in shoot length and internodal length, whereas increase in no. of nodes, no. of branches, no. of leaves, leaf mid-vein length and stem base circumference. The inflorescence development was delayed but the development of veins was seen earlier in the enhanced UV-B experiment. *Ricinus* communis L.

seemed to be sensitive towards UV-B irradiation. Increased UV-B dose have resulted in lateral development of plant, while suppressing the apical growth. To cope up with the situation and to increase photosynthesis, no. of leaves increased, which ultimately led to increased no. of branches. Most of the energy is lost in enhancing the photosynthetic factors and repair mechanisms, leading to delayed inflorescence development. Further investigations on physiological and biochemical effects of enhanced UV-B are needed for the complete profile of the impact of elevated UV-B on *Ricinus communis* L.

An explorative study for the determination of ideal post-harvest handling techniques for *Asparagus adscendens* (*Shwet Mushali*)

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The fulfillment of the two primary goals of *Ayurveda*, solely depends on the proper use of *Dravya* (Drug). When it comes to a drug of plant origin, it should be harvested and handled in proper way to maintain its potency and efficacy. *Asparagus adscendens* (*Shwet Mushali*) is a rare herb and has found a critical role to be used as food and medicine. The drug contain saponins, which are heat labile and precipitate when soaked (surfactant action). These form the mainstay of the therapeutic efficacy of the drug. The conventional method used for Post-Harvest Handling of the drug includes soaking and boiling. This may damage/alter the saponins and lead to potency loss of the drug. We propose a method for Post Harvest Handling of the drug that does not include soaking or boiling, with a view to preserve its potency and therapeutic efficacy. Comparative pharmacognostical (qualitative and quantitative) analysis of the crude and processed samples (by conventional and proposed methods) of the drug, to observe the loss of active primary and secondary constituents, which is expected to occur. If we observe potency loss with the conventional but not with the proposed method, we can educate Farmers and Post Harvest Handlers and advocate to adopt the proposed method. This will help to use the drug with its maximum therapeutic potential.

Bacillus aryabhattai D5 a potential plant growth promoting bacteria in *Crocus sativus* L.

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Native Bacillus aryabhattai strain D5 (Bar D5) isolated from the saffron cormosphere (corm sheath) has shown plant growth promotion (PGP) properties and also inhibits the growth of corm rot causing Fusarium oxysporum R1 (Fox R1) in-vitro. Pot assays and field evaluation of Bar D5 confirmed its in-vivo efficacy for PGP traits and biocontrol activity as well. Pot trials were followed by field trials at traditional and non-traditional saffron cultivation areas in Jammu and Kashmir. At both places, Bar D5 bio-formulation has increase the root number & length, shoot number & length, flower number and number & weight of daughter corms. Additionally, it also decreased the corm rot disease incidence significantly in both the areas. Priming of corms with bio-formulation resulted in the reduction of pathogenic fungal load by 3 fold at the depth of corm sowing from ground level. The shelf life/viability of Bar D5 based bio-formulation was found to be 52% (viable spores) for one year at room temperature. Further, the effect of Bar D5 was evaluated on garlic plant and it has shown positive results in garlic also. Draft genome sequence of Bar D5 revealed the presence of genes necessary for PGP and further confirmed by amplification of these genes. Bar D5 based bio-formulation can be provided to companies/researchers interested in saffron cultivation or bio-formulation production for commercial exploitation, since saffron is grown as revenue crop across continents. The present study bridges the gap between genomics and its field application.

Characterization of population variation for germination and seedling traits in *Myrica esculenta* Buch.-Ham.Ex D.Don

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Seedling growth is a prerequisite for the conservation and sustainable use of genetic resources which is dependent on a thorough understanding of the breeding system, genetic inconsistency, and evolutionary forces in forest tree improvement. Any tree improvement programme must begin with a study of variability. The magnitude of variability within and between populations suggests that proper domestication and improvement tools are needed to boost the species productivity. In the current study, eleven populations of *Myrica esculenta* Buch.-Ham.Ex D.Don were chosen from its distribution zone in H.P., India. Seedling growth characteristics of five trees from each population were studied to reveal population variations.

Result showed that there was highly significant variation for all the germination and seedling growth parameters studied ($p \leq 0.001$). Germination percent was higher in Shogi *i.e*. 31.60%. Chakala had the greatest seedling length, total biomass, and sturdiness quotient. The Dickson quality index was found to be highest in the Dabara-Baranji (0.25). Variation in all seedling parameters could be attributed to the natural population than family except number of nodes, number of leaves, leaf length, leaf breadth, root length and root thickness. Leaf length had the highest family heritability (0.91). Population genetic gain was found to be greater than family genetic gain. Seventy-nine percent of variation in nursery traits was explained by six principle components, according to principal component analysis. Cluster II was significant for total seedling length, secondary root number, and shoot biomass. Because none of the populations showed consistent variation for all germination and seedling-related parameters, population/provenance selection for improvement programmes requires multiple criteria.

Biomimetics temperature sensing layers for artificial skin using pectin as herbal product

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Biomimetics is a new field of science emerging nowadays, and will shoot to its peak in coming years. It involves probe of both structure as well as physical component of herbal product with goal of designing novel and enhanced material. Biomimicry in which man-made process, substances, devices, equipment imitate natural response. When we discuss biomimetic temperature sensing layer for artificial skin made from pectin (found in cell wall of plants) capable of sensing temperature changes using mechanism similar to pit vipers which they use for sensing their prey. Pit viper has an evolved heat sensing system to navigate their prey in dark. This field is successfully paying its way amongst researchers and scientist in nanotechnology, robotics, medical industries as well as artificial intelligence. The concept of developing skin is highly sensitive method applied prosthetic- limbs for amputees and robotic arms. This concept can be proven as boon to mankind as the produced materials can be integrated as a layer in artificial skin platforms and boost their temperature sensitivity to reach their best biological performances.

Development of LAMP assay based on specific barcode for the in-field diagnosis of *Fusarium oxysporum* in saffron fields

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Plant disease early detection, prevention and management are better strategy than using eradication methods. The yield of saffron is declining year after year in India and the major causes are fungal infection in saffron fields and plants. Fungal species of the genera *Stromatinia, Cochliobolus*, *Rhizoctonia*, *Penicillium*, *Aspergillus*, *Rhizopus*, *Fusarium*, *Sclerotium* and *Phoma*, have been reported to cause diseases in saffron plant. Though these fungal species are reported to be pathogenic to saffron but corm rot caused by *Fusarium oxysporum* is the most destructive disease in saffron plant that is causing severe yield loss to saffron. Pathogenic *Fusarium oxysporum* (Fox) is considered among one of the 5 most devastating crop pathogens. Diagnostic methods for *Fusarium oxysporum*, based on culturing and morphological properties are available but time consuming and laborious. Moreover, neither differentiation between pathogenic and non-pathogenic species of Fox nor different forma species could be identified by morphological and microscopic techniques. DNA based molecular techniques, including PCR, qPCR and DNA hybridization, have also been used for the detection of Fox; however, these methods, often depend on thermal cyclers that are highly precise but require purified DNA from plant tissue samples. Thus, user-friendly economic methods, that facilitate early disease detection in fields, would be very useful, for controlling this dreadful disease. Therefore diagnostic techniques that are sensitive, easy, specific and economical are need of the hour. Most important attribute should be that it could be used by farmers in field. Therefore current study is to develop an isothermal amplification LAMP method based on specific barcode for the infield diagnosis of pathogenic *Fusarium oxysporum* causing corm rot in saffron.

Is traditional knowledge of plants beneficial for their conservation?

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The word oshedhi literally means heat producer. It is common knowledge that the source of all energy on the globe is the sun, and that the plant know the secret of capturing the solar energy. Therefore, man looked to nature for the treatment of different diseases. In fact, plants remain the main source of medicines for a large proportion of the world's population, The medicinal plants as used in the treatment of diseases because it roost out the disease without causing side effect. In the ancient time the person knowing definite curative action of the plant are known as Vaidya, and are the blessing hands to

the people. The main drawback of these vaidya was that the knowledge possessed by them has became less popular to the world due to thie ignorance of the art of writing .Few vaidya who thought about the future generation, transmitted this to other in the verbal form. The result is, there are no any authentic records (literature) of medicinal plant used by them. The Plants used by vaidya are however phytochemically rich plant species and conservation of these plant species can contribute to the development of various formulations of herbal therapies. So due to lack of knowledge of medicinal value of these plants these plants are not conserved by the society, and so overexploitation of these plant species has caused a decline in the frequency of these species in the past few years. Planned cultivation, proper exploitation, and the commercialization of the medicinal plants can serve as a primary source of income to the people of the downtrodden community, particularly farmers and landless poor people.

An explorative study for the determination of Ideal Post-Harvest Handling techniques for Asparagus adscendens (*Shwet Mushali*)

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The fulfillment of the two primary goals of *Ayurveda*, solely depends on the proper use of *Dravya* (Drug). When it comes to a drug of plant origin, it should be harvested and handled in proper way to maintain its potency and efficacy. *Asparagus adscendens* (*Shwet Mushali*) is a rare herb and has found a critical role to be used as food and medicine. The drug contain saponins, which are heat labile and precipitate when soaked (surfactant action). These form the mainstay of the therapeutic efficacy of the drug. The conventional method used for Post-Harvest Handling of the drug includes soaking and boiling. This may damage/alter the saponins and lead to potency loss of the drug. We propose a method for Post Harvest Handling of the drug that does not include soaking or boiling, with a view to preserve its potency and therapeutic efficacy. Comparative pharmacognostical (qualitative and quantitative) analysis of the crude and processed samples (by conventional and proposed methods) of the drug, to observe the loss of active primary and secondary constituents, which is expected to occur. If we observe potency loss with the conventional but not with the proposed method, we can educate Farmers and Post Harvest Handlers and advocate adopting the proposed method. This will help to use the drug with its maximum therapeutic potential.

Standardization of herbal drugs for quality control

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Herbal medicine has been utilized in many diseases since ancient times by saints and munis. In global perspective , there is a shift towards the use of medicine of herbal origin, as the dangers and the shortcoming of modern medicine are getting more apparent. standardization of herbal medicines is the process of prescribing a set of standards or inherent characteristics, constant parameters ,definitive qualitative and quantitative values that carry an assurance of quality ,efficacy, safety, and reproducibility. Herbal medicine has many active constituents for many diseases, but the proper knowledge must be necessary for the preparation of herbal formulation otherwise active constituent will be damaged. In order to have a good coordination between the quality of raw materials, in process materials and the final products, it has become essential to develop reliable, specific and sensitive quality control methods using a combination of classical and modern instrumental method of analysis. According to WHO, standardization and quality control of herbals is the process involved in the physicochemical evaluation of crude drug covering aspects, such as selection and handling of crude material, safety, efficacy and stability assessment of finished product, documentation of safety and risk based on experience, provision of product information to consumer and product promotion. hence standardization is a tool in the quality control process. In recent years there is a spurt in the interest regarding survival of ayurvedic forms of medication. It is the cardinal responsibility of the regulatory authorities to ensure that the consumer get the medication, which guarantee, purity, safety, potency and efficacy. Procedures for standardization of herbal drugs- in order to assure a consistent and acceptable herbal product, care should be taken right from the identification and authentication of herbal raw materials to the verification process of final products. The following parameters are recommended-Authentication, Physical parameters, Quantitative and qualitative analysis, Microbiological contamination, Pesticide residue and Heavy metal analysis. Plant materials are used throughout the developed and developing world as home remedies, in over-the-counter drug products, and as raw material for the pharmaceutical industry, and they represent a substantial proportion of the global drug market. Therefore, it is essential to establish a standard guideline for assessing their quality. In order to establish a standard guideline, it is recommended that various government agencies should follow a more universal approach to herbal quality and also developing monographs using the various quality parameters outlined above. This will strengthen the regulatory process and minimize quality breach. The subject of herbal drug standardization is massively wide and deep. There is so much to know and so much seemingly contradictory theories on the subject of herbal medicines and its relationship with human physiology and mental function. For the purpose of research work on standardization of herbal formulations, a profound knowledge of the important herbs found in India and widely used in ayurvedic formulation

is of utmost importance. Even when the chemical composition of a plant extract is known, the pharmacologically active moiety may not be. Environment, climate and growth conditions influence composition, as does the specific part of the plant and its maturity.

Modern methodology towards the standardization of herbal drugs

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Standardization of herbal medicines deals with the establishment of quality control methods for Ayurvedic drugs. It is a necessity to maintain the standardization of all the herbal medicines to ensure its quality, safety and efficacy by applying recent standardization techniques. Ayurvedic herbs are being used as medicines since long time for the treatment purpose of humankind and that's the reason herbal medicines are gaining plenty of popularity around the globe. The abundance in production of herbal drugs is more in order to fulfill the demand and supply. Thus chances of adulteration and substitution are more in order to meet the demand and supply of herbal medicines. The lack of quality standards has resulted in inefficacy of herbal products along with various adverse effects. Hence, standardization of herbal medicines has become an important tool to assess the safety, efficacy and quality of the drugs. Aim of the study is to ensure quality control of herbal medicines by bringing the various traditional and modern techniques together at one platform in the field of standardization. Scrupulous consideration of Ayurvedic texts were done and recent guidelines given by WHO on Standardization of Herbal Drugs. Recent standardization procedures were explored through latest research publications on internet. For the proper standardization of Herbal Drugs recent techniques like Advanced Chromatography, Spectrophotometry, Electrophoresis, Chemomatrics, Polarography and biomarkers in fingerprints are required. The utility of herbal medicines has increased worldwide. But due to the involvement of adulteration and substitution, therapeutic efficacy of herbal medicines has become a prestigious issue, thus standardization to nourish the efficacy and safety of herbal medicines is a big challenge. The vision is to gather various references of classical texts related to Standardization of herbal drugs along with the latest scientific methods incorporated for the Standardization of herbal drugs. World Health Organization has instituted specifications for the analysis of safety, quality, therapeutic efficacy and shelf life of herbal medicines. Requirement for the standardization of herbal drugs is very essential to make it act as a successful remedy for the various diseases and its ailments. The advanced techniques of standardization are helpful in the manufacturing sector of herbal industry to assure its safety, efficacy, quality and acceptability of various herbal formulations.

Inclusion of exotic plants into *Ayurvedic* Pharmacopoeia: Need of the day

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Ayurveda is the oldest scientific system of medicine being practiced in Indian subcontinent since the Vedic period. Observation of the textual references reveals gradual increases in the number of plant species utilized for the therapeutic purposes. This fact establishes on-going process of research in the field. *Bhatt Narhari* in *Raj Nighantu* has provided clear cut guidelines for the screening of new medicinal plants and their inclusion to the *Ayurvedic* Pharmacopoeia. Screening and inclusion of new plant drugs into pharmacopoeia is a continuous process. A large number of exotic plants have been screened for their therapeutic potential by scholars of *Āyurvedā*. In recent past, a large number of exotic plant species have entered Indian subcontinent which have potential to be used for therapeutic purposes and are being used for the same by traditional healers. The complete description of such medicinal plants in terms of their pharmacognostical and pharmacological properties i.e. Name, morphology, *Rasa, Guna, Veerya, Vipaka* are not available in the *Āyurvedic* texts. Therefore, there is an urgent need to identify, name these plants and standardize them scientifically. Present paper is in attempt to formulate screening process for exotic plant species on the basis of established principles of *Āyurvedā* with the help of modern technology and their inclusion into *Ayurvedic* Pharmacopoeia.

A review article on *Trimada* WSR to cultivation technique and standardization of *Mustaka* (*Cyperus rotundus*)

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Trimada is a well known polyherbal traditional formulation described in classical texts and is used since ancient times for various purposes. It mainly acts on the digestive system by enhancing the metabolic fire i.e. it is a potent *deepaniya pachaniya dravya.* Additionally, the *Trimada* formulation reduces obstruction by stimulating or deobstruently property, opening the natural channels. It has been used to treat "*Krimi"* (worm infestation), "*Atisara"* (Diarrhoea), "*Pandu"* (anaemia). *Trimada* is constituted of three major herbs - *Chitraka* (*Plumbago zeylanica Linn.), vidanga* (*Embelia ribes Burm.*) and *mustaka* (*Cyperus rotundus Linn.*). The chief chemical constituents of *trimada* are Plumbagin, embelin,

cyperin and other secondary metabolites like flavonoids, alkaloids, glycosides, saponin, tannins etc. Antiobesity, Antimicrobial, Antioxidant, Anti-Inflammatory, Hepatoprotective, Antihyperlipidaemic and Cardioprotective properties are some of the basic pharmacological actions of *trimada*. Not only this, according to the previous researches, one can use this formulation in CAD (coronary artery disease because of its lipid lowering action). Among the three drugs of *trimada*, *mustaka* (also known as *nagarmotha*) is a controversial drug in *ayurveda*, found in many regions of the world. There are so many varieties of *mustaka* currently available in the Indian market. Hence, the need of standardization and cultivation of *nagarmotha* is there to make a proper formulation or being used as a authentic ingredient in other *ayurvedic* medicines. The aim of present study is "phytochemical and pharmacological review of trimada with the standardization of controversial drug "mustaka". Data collection is done from Research papers, Articles, Books, Internet, classical and modern text books, API, Monographs etc. Make a result on species or varieties which is most acceptable as the name of mustaka. This may be helpful to researchers, practitioners and pharmaceuticals. It will also reduce the chances of its adulteration and improve the potency of formulation.

Botanical sources of classical drugs Asan and Beejak: A comprehensive review

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In Ayurveda, controversial and unidentified drugs are major topics. The issue of inappropriation of synonyms in nighantu texts continues to be a major challenge for Ayurvedic academic. A large section of Ayurvedic scholars consider Asan and Bijaka to be synonymous, and Pteocarpus marsupium Roxb. (Fabaceae) has been considered the official source for classical drugs Asan and Bijaka. In various regions of the country, Bijaka is known as Vijayasal. Asana (Terminalia alata Heyne ex. Roth, Combretaceae) and Vijayasal (Terminalia alata Heyne ex. Roth, Combretaceae) are two completely different plants found in the forested areas of Uttar Pradesh's Kheri district (Pterocarpus marsupium Roxb.). The purpose of this research is to answer the debate over the botanical origins of these two classics.

An analytical study for the determination of Bilva (*Aegle marmelos* (L.) Correa) fruit pulp as potential substitute for its root bark

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Nature has gifted the diverse flora as a boon for mankind. This flora, in the form of food and medicine has indispensible role for the existence of life. Ayurveda, advocates discriminate use of these resources for their conservation and sustainable utilization. *Bilva* (Aegle marmelos) is a decidous tree and has been used since ancient times for edible (fruits), medicinal (mainly root bark and stem bark) and spiritual purposes. IUCN (2019) has listed *A. marmelos* in near endangered species in the Red List. Collection of root bark and stem bark is quite an invasive process and causes potential harm to the tree. This puts a big threat for its life and sustainability. We have to look for a potential substitute that can be used in place of the root and stem bark. Fruits of *Bilva* are available abundantly almost all the time and are easy to collect without damaging the tree. We propose these to be used as a substitute for stem and root bark in various medicinal preparations. Observation of properties mentioned in the *Ayurvedic* literature and comparative Pharmacognostical analysis of the stem bark, root bark and fruits of the tree will be done. Based on the observations, we may come to a conclusion, whether we can advocate the use of *Bilva* Fruit as substitute for its stem and root bark. With the positive expected outcome, this study may help to support the theme of conservation and sustainable utilization of our natural resources. We will also get consideration of a potential substitute, which is abundant, can be collected more easily and supports the solution of the research problem.

Pharmacognostical and phytochemical standardisation of new anti-hypertensive ayurvedic formulations [NIA/DG/2020/01 & NIA/DG/2015/01]

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NIA/DG/2020/01 is a new ayurvedic formulation, containing *Arjuna (Terminalia arjuna* Roxb.), *Ashwagandha (Withania somnifera* Linn.), *Jatamansi (Nordostachys jatamansi* DC.), *Shankhpushpi (Convolvulus pluricaulis* Chois.), *Punarnava (Boerhavia diffusa* Linn.), *Gojihwa (Onosma Bracteatum Wall.), Guduchi (Tinospora cordifolia Willd.), Mukta Shukti (Margarita) and Praval Pisti (Corrallium Rubrum)* & NIA/DG/2015/01 is a new ayurvedic formulation, containing *Arjuna (Terminalia arjuna* Roxb.), *Ashwagandha (Withania somnifera* Linn.), *Jatamansi (Nordostachys jatamansi* DC.), *Shankhpushpi (Convolvulus pluricaulis* Chois.), *Punarnava (Boerhavia diffusa* Linn.),,which are used in stage -01 primary hypertension. All these components are very well known for *Hridya, Mootral, Rasayana, pitta shamak* effect and pharmacological actions like cardioprotective, Anti-Hypertensive, Antioxidant, Antimicrobial, Antifungal, Antidepressant or Anxiolytic, Anti- Inflammatory, Psycho-Immunomodulatory Effect and Acetyl-Cholinesterase Inhibitory Activity etc.

All medicinal plants contain phytochemicals or bioactive compounds which plays the key role in its therapeutic action. Most of the drugs show variations in these phytochemicals which results in severe variations of its quality and efficacy. Also, the globalization and increasing demand for Ayurveda drugs resulted in unavailability of authentic and quality drugs in market which meets the quality standards. The aim of the present study is to perform pharmacognostical and phytochemical standardisation of new anti-hypertensive ayurvedic formulations [NIA/DG/2020/01 & NIA/DG/2015/01]. This study involves pharmacognostical and phytochemical analysis of both new anti-hypertensive ayurvedic formulations [NIA/DG/2020/01 & NIA/DG/2015/01] by organoleptic evaluation, microscopic evaluation, physical evaluation, chemical evaluation and chromatographic evaluation which may serve as an important tool to ensure their purity, safety and quality. All the findings of the phytochemical and pharmacognostical study were noted, presented and found within normal limits. The present samples of new anti-hypertensive ayurvedic formulations [NIA/DG/2020/01 & NIA/DG/2015/01] were found to be rich in Quality and was safe, pure and authentic.

A scientific approach to understand the need of standardization of herbal drugs along with traditional methods mentioned in Ayurvedic classics

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Standardization is an essential measurement for ensuring the quality control of herbal drugs. It guarantees the content of one or more active constituents and marker compounds. In recent years, the belief of people from all over the world towards Ayurvedic medicine has been increased rapidly. There is great demand for use of herbal products for healthcare system globally because of their wide range of action, effectiveness, less side-effects and low cost. So, it is necessary for standardization of herbal products with proper integration of modern scientific techniques and traditional knowledge. Three attributes are desirable for standardization (a) Authenticity (which prove the material is true), (b) Purity (which clarify the material is contaminated or not), (c) Assay (which assess the chemical effects and curative values). The aim of this study is to understand the concepts of standardization of herbal drugs by modern as well as traditional methods. Ayurvedic pharmacopeia and other Ayurvedic texts, text book of pharmacognosy. Conceptual review of standardization of herbal drugs. In this work various techniques and methods is explained which will be helpful for differentiation of genuine and adulterated drugs. By using various standard parameters chemical constituents of drugs can be determined which will give a way for substitution of endangered and less abundant species of plants. Along with modern techniques, classical techniques and methods mentioned by Ayurvedic scholars will also be explained in this work. The present work will be helpful for identification of adulteration in the drugs, the use of appropriate medicinal substitute and to decide the appropriate dosage of the drugs.

Standardisation techniques for medicinal plants with special reference to *abhava pratinidhi dravyas* (substitute drugs)

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According to W.H.O, 80% of world's population rely on non-conventional medicines for the treatment. Medicinal plants have been used for a very long time to treat various ailments. They are used globally as complementary and alternative medicine, food supplements, cosmetics, etc. The world today is facing an increasingly disturbing trend of depletion of its natural resources. With the increasing demand of medicinal plant products, the burning issues like adulterations, substitutions, contaminants, inadequate market supply is also increasing which has led to loss in quality health care. The references regarding *abhava pratinidhi dravya* are available in *bhava Prakash* wherein an unavailable drug (*abhava dravya*) is replaced by a substituent (*pratinidhi dravya*). The process of substitute identification is not clearly mentioned in classical texts thereby arises the need of standardization of these medicinal plants. This analysis is an effort in the direction to study the concept of various standardization techniques meticulously in the light of phytochemical studies for its better understanding and application by taking example of *Abies webbiana* and *Taxus baccata* which are grown in high altitudes. As a preliminary step, an in-depth literary analysis was done to compare phytochemical differences in *Abies webbiana* and *Taxus baccata* in order to prevent quality breach. The study was conducted using both print and electronic media to analyse the various standardisation techniques. There were considerable differences found in moisture content, total ash value, extractive values in different solvents, proteins and saponins were found absent in *Taxus Baccata*. By using International Union for Conservation of Nature (IUCN) criteria, about 121 species have been recorded in red data book of Indian plants from *Himalayan* region. The substitutes are of immense value when it comes to reducing the stress on available and rare medicinal plant wealth of the Nation. More such researches should be conducted on the substitutes available in the classical literature focusing on their qualitative and quantitative standardisation methods. This can serve as potential leads for the development of cost-effective medicines and also help to validate the existing *classical* literature.

Evaluation of stem bark of *Grewia optiva*: Pharmacognostical and phytochemical

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Grewia belongs to family Tiliaceae, comprises approximately 150 species, small trees or shrubs is distributed in subtropical and tropical regions, represented in Pakistan by ten species. It is one of the most important ingredients of many medical prescriptions in traditional medicine and has been successfully developed into a medicine to treat cough and sore throats. The root and stem bark of these plant have been used in a folk medicine for the treatment of malaria, diarrhoea, dysentery, typhoid, fever, small pox, cough, irritable condition of intestine and bladder, eczema and rheumatism. In-vitro studies indicate that they anti-oxidant, anti-bacterial, hepatoprotective and antimalarial activities. In the course of studying compounds from plants of genus *Grewia,* steroids, glycosides, flavones, triterpenes have been isolated and characterized. In the present we aimed to obtain the pharmacognostical analysis like Microscopy of *Grewia optiva* stem bark and physiochemical parameters like ash value, extractive value were performed. The microscopical study of plant showed presence of xylem, phloem, phallogen, medullary rays ring, cork cambium. Powder microscopic examination of the stem bark sample represents the presence of epidermis, stomata, starch grains, trichomes, and calcium oxalate crystals. In physiochemical analysis total ash value was found to be 7.65%, water soluble ash 3.66%, acid insoluble ash 4.32%, alcohol soluble extractive and water soluble extractive were 10% and 15%. The phytochemical screening of the stem bark of the plant showed the presence of Alkaloids tannin, flavonoids, glycosides, steroids, amino acids and Saponins etc. The quantitive determination of pharmacognostic parameters will help for setting standards for crude drug. The total ash is particularly important in evaluating the purity of drugs.

Assessment of status of RET species of ayurvedic medicinal plants of Indian Himalayas and concept of pratinidhi dravyas for their conservation

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These days medicinal plants receive increased scientific and commercial attention due the rise of interest in Ayurvedic medicines and cosmetics, which leads to unsustainable harvesting of medicinal and aromatic plants. The Himalayan range in the Northern part of India harbours vast diversity of medicinal plants, however about 70% of Indian Himalayan medicinal plants are destructively harvested. Although the GOI has made extensive efforts on priority basis, these are not enough to meet the growing demand of the pharmaceutical industry. Furthermore, scientists cannot investigate habitats quickly enough as they are being destroyed rapidly. To support the conservation and sustainability of medicinal plants usage of Pratinidhi Dravyas can be an answer to the scarcity of extinct medicinal plants. Pratinidhi Dravyas appear to be the rational substitution of rare/unavailable drug. One of the Laghutrayi, Bhavprakash Samihita first brought out and popularised this idea. Pratindihi dravyas are selected on the basis of Rasa (Taste), Guna (Property), Virya (Potency), Vipaka (digestive effects), and the most important factor, Karma (Action) and not merely on morphological similarities. This paper attempts to identify the availability status of Ayurvedic medicinal plants of Indian Himalayas and to study the role of rational substitutes (Pratinidhi Davyas) as the effective alternatives to non-availability of Rare Endangered Threatened (RET) species of Ayurvedic Medicinal plants of Indian Himalayas. Secondary data like Ayurvedic pharmacopeia of India, IUCN red list of plants, scientific publications, reports and articles about the project area were used to create a dataset of status of Ayurvedic medicinal plants of Indian Himalaya. Ayurvedic literature was reviewed for Pratinidhi dravyas. This article provides a dataset of rare, endangered, threatened, extinct and vulnerable Ayurvedic Medicinal plants. It also throws light on the concept of rational Substitution of medicinal plants. Information about status of Ayurvedic medicinal plants and understanding the concept of Pratinidhi Dravyas (rational substitute) provides a key to conservation of extinct medicinal plants while serving the need of population. As baseline information on medicinal plants and concept of Pratinidhi dravyas, this study could contribute to further strengthening the conversation of Ayurvedic Medicinal plants by implementation of the novel ayurvedic concept of Pratinidhi Dravyas.

Preparation, quality control analytical studies of inhouse prepared polyherbal formulations for treatment of liver disease

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In standardization process, quality and purity of crude drugs are evaluated by various parameters. For herbal formulations, along with the chemical, physical, phytochemical, in- vivo and in- vitro parameters, it is significant to determine its quality

standards. In traditional system of medicine, the developments of analytical parameters are an important step in establishing quality of products, presence of phytoconstituents and its therapeutic efficacy. In this study, the inhouse prepared polyherbal formulations having fifteen herbs with similar effect with different method of administration are used. This polyherbal formulation is targeted mainly to achieve pitta balance whereas specified in ayurvedic system of medicine. This study provides data on quality control parameters and analytical studies such as Liquid chromatography coupled with mass spectrometry (LC-MS), high performance thin layer chromatography (HPTLC). The analytical study shows the presence of various marker compounds. This helps to draw new conclusions from existing data to identify research areas. They assure the quality, purity and safety of herbal formulations.

Pharmacognostical study on Bicchu Ghas (*Urtica dioica*) for determination of its ras

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Urtica dioica commonly known as stinging nettle and bicchoo ghas in local dialect is widely distributed over south Asian countries, Indian subcontinent, Africa etc. Its ethnomedicinal indications in ailments like gout, hematuria, diabetes etc had already been documented .This micronutrient rich plant herb is commonly eaten as vegetable in local culinary culture. Recently it is being marketed as green tea in global herbal markets. Present study aims at reviewing all the contemporary literature published with respect to Urtica dioica and determining RAS of the herb for its inclusion in ayurvedic pharmacopeia of India. This research will pave way for pharmaceutical industries to include this plant in various relevant formulations.

Stringent quality controls on ayurveda products - need of hour: A review

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Ayurveda is our well known Indian traditional system of Medicine. From last 5years decade mainly during& after Corona , Ayurveda & its formulation has increased significantly in both India and different countries and with the increase in the need , it is very much important to maintain the quality of these formulations .We always have focus on the Quality of Ayurvedic Medicines because these will be used by both healthy person & patients for preventing & curing /treatment of the disease & maintaining the Health . Even our ancient Ayurveda texts are familiar & speak about quality, toxicity& safety aspects of the herbs & its Formulations. These are considered as Drugs but unfortunately the regulation norms for the Ayurvedic drugs are not as strict when compared to the drugs. We should give focus from selection of herb from its seedling to final product reaching to end consumer. So quality control & its standards is ultimate vital in Ayurveda. It is, therefore, essential to establish internationally recognized guidelines for assessing their quality. We can do Quality control by meeting the following requirements like choosing the right plant with DNA & other botanical identity, doing good collection practices, good agricultural practices, good& new analytical practices, Good Manufacturing practices, good Storage practices, Good Labelling practices & good Consumer practices. These above-mentioned practices are strictly followed, we may able to control the Quality of our ayurvedic drugs & get the desired benefits & safety of the consumers.

The methods of analysis, their significance, and applications in quality control of herbal medications and preparations

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Medicinal plants have been utilised to promote human health for a long time, and they are expanding in popularity as pharmaceuticals, complementary and alternative therapies, food supplements, cosmetics, and, more shockingly, medical gadgets around the world. The complexity of herbs and extracts supplied to such a diverse range of markets and regulatory environments raises significant quality concerns, necessitating the development of appropriate analytical methods for their identification and standardisation, as well as the detection of adulterants and contaminants. Herbal samples frequently arrive in Customs laboratories, posing a variety of obstacles ranging from quality concerns to safety concerns and even legal concerns. Selecting an appropriate analytical method from the various options (microscopy, spectrometry, spectroscopy, chromatography, etc.) is a critical step that is mostly determined by the analytical objectives. This review seeks to describe such analytical goals and their complexities in order to provide a set of analytical procedures that are likely to be appropriate for each purpose. Major limiting variables are also highlighted, such as herbal product name, sampling, and sample processing. The methods of analysis, their significance, and applications in quality control of herbal medications and preparations. Reviews have been collected from different sources related to herbal medicines. When

dealing with herbal products, intricate mixtures of compounds embedded in complex matrices, customs laboratories are faced with many different questions, that may involve multifarious and sometimes cumbersome analytical work. This paper aims at summarising the different challenges that can be encountered and the various analytical methods appropriate to answer a given question. In an ideal world, a plant or an herbal product should always be unambiguously identified, with all possible adulterants, contaminants and impurities controlled for. This is hardly possible, technically and economically. And so, a trade-off is often necessary, challenging the whole concept of "proof of quality"; in fact, the intended use of a given material (combined with an accepted level of risk) will condition its more or less enacting quality requirements: registration as a drug, marketing as a food, a cosmetic or a medical device, use as a raw material for traditional medicine in a developed country and use as a raw material for traditional medicine in a developing country. This means a delicate analytical balance between what is needed for safety and efficacy, what is desirable and what is locally feasible, the all depending on available technology, local regulations and acceptable costs. This balance can be determined in part from traditional knowledge (plausibility of safety) or by identification of known toxic markers (e.g. pyrrolizidine alkaloids,…), but also by serendipity, in deciphering causes of accidents (e.g. Illicium, Aristolochia,…). And the "proof of quality" certainly evolves with such knowledges.

Evaluation of pharmacognostical parameters and anti-diabetic potential of *Artemisia roxburghiana*

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Artemisia roxburghiana is used for the management of diabetes mellitus in the Indian subcontinent. The present work aimed to evaluate the pharmacognostical parameter of the plant such as organoleptic, microscopic, physical and chemical characteristics with including the anti-diabetic potential of aqueous-ethanol extracts of aerial part by using in-vitro and in-vivo methods. The pharmacological activity was performed to validate the traditional claim of the plant in diabetes mellitus. *In- vitro* studies were conducted using alpha-glucosidase and alpha-amylase assays whereas streptozotocin-nicotinamide-induced diabetic Wistar rats were used for *in vivo* study. The aqueous-ethanol extract from the aerial parts was found to exhibit alpha-glucosidase and alpha-amylase inhibitory activities with the IC_{50} values of 31.0 and 17.2 mg/mL, respectively when compared with acarbose (IC_{50} 8.6 and 16.25 mg/mL, respectively). The extract showed a significant glucose-lowering effect in diabetic rats at the doses of 200 and 400 mg/kg in a dose-dependent manner, while acarbose (10 mg/kg) was used as a standard. The results revealed that *A. roxburghiana* aerial parts showed antidiabetic activity via inhibiting alpha-glucosidase and alpha-amylase enzymes. The present study validated the ethnomedicinal claim of the plant in diabetes mellitus and pharmacognostical parameters will be helpful in the right identification of the plant *A. roxburghiana*.

Pharmaceutico analytical evaluation of nishadi churna

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Ayurveda pharmaceutics are mainly based on herbal drugs which are either used as single drugs or as combination of more than one drug as poly herbal formulations. Standardization of ayurvedic formulations are essential to assess the quality, purity, safety, and efficacy of the drug based on the concentration of their principles. Day by day new approaches and techniques are introduced to accelerate the standardization of *Ayurveda* drugs which in turn enhance the global acceptance of Ayurveda. *Nishadi churna* is a formulation in powder form which consists of *Haridra* (*Curcuma longa* L) and *Amalaki* (*Emblica officinalis* Gaertn.) which is widely practiced and clinically proven in (*madhumeha*) diabetes mellitus. The current study focuses on the standardization of *Nishadi churna* as per the protocol for standardization of *churna* formulations prescribed in the Ayurveda Pharmacoepia. Aim of the study was to formulate *Nishadi churna* and to carry out its analytical study for standardization. Nishadi churna was prepared by triturating powdered *Haridra* (*Curcuma longa* L) for 7 times with juice of *Amalaki* (Emblica officinalis). For standardization of the above formulation various parameters prescribed for standardization of *churna* (powder) as per Ayurveda Pharmacopeia were carried out .The test included macroscopic and microscopic evaluation, moisture content, extractive values, ash values, pH etc. The analytical study showed that the formulation had a moisture content of 6.4%, water soluble extractive value 30.40%, alcohol soluble extractive value 3.6%, ash value 18.33%, pH 2.8, bulk density 0.806 g/ml and tapped density 1g/ml. Even though *Nishadi churna* is a clinically acclaimed formulation for treating diabetes mellitus no standards were available for the formulation so far. The present study was an attempt to standardize the formulation and the analytical values obtained from this study can be considered as its standard parameters and can be used as reference values in further studies.

Standardisation of herbal product for quality control

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Standardization is an essential step in the development and production of herbal medicines in order to assure the quality, efficacy and safety. The quality of raw materials plays an important role on the successful manufacture of phytopharmaceuticals. However, the herbal materials in quantity and quality remains a challenge, due to the influence of several factors such as: biological variability, source of starting herbal materials (cultivation/wildness) and drug processing (drying/grinding/storage). In India, the plant materials are susceptible to adulterations, contaminations and deterioration. Thus, the herbal drugs purity and content preferably established from clinical studies. The quantitative determination of markers plays a major role on the clinical properties of herbal drug, and it is closely linked to the standardization of herbal medicines. The chemical homogeneity of herbal materials is also dependent on their intrinsic variability and becomes more critical due to the chemical complexity of such matrices. Thus, crude extracts manufactured directly from herbal materials show qualitative and quantitative data in accordance to the quality of the respective starting raw material. Chemical standardization also play a major step in the producibility of the efficacy and safety of Phytopharmaceuticals.

Comparative metabolite profiling of *Plumbago zeylanica* Linn., and assessment of bioavailability and anticancer efficacy of plumbagin

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Plumbago zeylanica commonly known as Ceylon leadwort or Chitrak belongs to family plumbaginaceae and order caryophyllales is an important therapeutic herb of this order. Different plant parts such as leaf, stem and root have different therapeutically use in Indian medicine system. *P. zeyalanica* used to treat helminth infection, liver disorders, various gastric disorders, rheumatoid disease, skin diseases etc. Previous studies showed the presence of various phenolics and flavonoid compounds in its plant parts extract but its root is the reservoir of yellow coloredhydroxynaphthoquinone plumbagin(5-hydroxy-2-methyl-1,4-naphthoquinone). Aim of study is metabolite profiling of *P. zeylanica* by using GC-MS identified several primary and secondary metabolites.Methanolic extract of leaf, stem and root (maximum anticancer activity) were studied for anticancer property on different cancer linesthrough MTT assay. Real time analysis for mechanism of plumbagin triggers apoptosis. FACS detected cells were in late apoptosis treated with root extract. Bioavailability of the plumbagin was studiedusing absorption assay on intestinal cell lines. Cancer is one of the fatal diseases worldwide and increasing population needs to meet the demand of the anti-cancer drug. Plant based drugs could be one of the possible ways to sort this out and *P. zeylanica* can be used as potent anti-cancer plant.

Himalayan onion - A review on medicinal uses, phytochemistry and pharmacology

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According to the Botanical Survey of India (BSI), India is home to more than 8,000 species of medicinal plants. About 1127 medicinal plants species are reported on the current version of Uttarakhand Medicinal Plants Database (UMPB) which are widely distributed in different regions of Uttarakhand state. This study aimed to present an exhaustive review about the description, local availability, medicinal uses, phytochemistry and pharmacological effect of *A. wallichii*. For this drive all relevant data and information (review and research articles from peer-reviewed journals) about the *A. wallichii* was collected from the Science Direct, Springer, PubMed, Taylor and Francis imprints and Google scholar. Some books on local flora of Uttrakhand was also preferred. *Allium wallichii* Kunth is commonly known as Himalayan Onion and Ban lahsun or Ladum in In the state Uttarakhand. *A. wallichii* Kunth is a member of *Amaryllidaceae*. Species of *Amaryllidaceae* belong to 80 plant genera, the genus *Allium* contain about 918 are accepted species. In Ayurveda in is named as *Ksirapalandu.* It is a fleshy, aromatic and perennial herb having numerous purple flowers. The plant is in flowering and fruiting between June-August. It is sporadic in alpine zone in grassy slopes between 2700-3600 m altitudes. It is commonly found in Ralam, Martoli, Dronagiiri, Gidara, Kush, Kalyan and Changshil at Uttarakhand State. Its leaves and bulbs are used for medicinal purpose. In traditional medicine, decoction of leaves is also used for body massage by local people. Its bulbs are boiled, fried in clarified butter, and then eaten in cases of cholera and diarrhea. They are also

chewed to treat cough, colds and altitude sickness. The plant has diosgenin, tigogenin and volatile constituents such as 1,2-bis(methylthio)ethene, 2,4-di-methiophene, di-methyl disulfide and di-methyl trisulfide. This plant is reported to have anti-microbial, anti-oxidant and anti-cancer, etc.

E-POSTER PRESENTATIONS

Cultivation of medicinal plants to fulfill market demand and socioeconomic developments

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India is a country with a wealth of medicinal plants. Now India got a global centre for traditional medicine which will again increase the demand of herbs world wide. So over exploitation of plants leads to its extinction. Hence novel methods should be find out to enhance cultivation of medicinal plants. Medicinal plantsfrom wild habitats are collected on a large bases, this will leads to their destruction and lack of availability of original drugs leads to substitution and adulteration. Also the use of chemical fertilizers and pesticides also leads to the increase of heavy metals in plants which reduces its potency and produce certain side effects. So we must think of what all are things that we can do to enhance the cultivation of medicinal plants. List out the medicinal plants which are coming under the red list and endangered species list. According to that either in situ or ex situ cultivation and conservation practices must be think of. In classics also cultivation of different plant are mentioned by acharya Surapala in textbook of Vrikshayurveda. Before we start cultivating, we need to know about the propagation method, plantation techniques, germination methods, adequate soil, and climatic conditions for plantation. A plant will express the original character when the right temperature, soil conditions and climatic conditions are available. Application of modern techniques of selection, cytogenetical modification, mutation, TLC, GLC, Mass spectroscopy can make use of to select good cultivating plant species. Techniques to improve productivity are species selection, genetic improvement, propagation, and nursey techniques, biofertilizers, biopesticides, pathology etc should be properly done. Use of Panchagavya, Kunapa jala and various preparations which can be used as pesticides and fertilizers. Various classics like Krishiparasara, Vrikshayurveda, Brhatsamhita, Upavanavinoda etc are explaining different method of cultivation of plants. It's ideal to space trees 20 cubits apart, 16 cubits apart after that, and 12 cubits apart after that. If the gardening is not done like this which results in mingling, the roots will interfere with each other's function, become poorly at work, and yield no fruits. We can make use of the knowledge of classics and incorporating with modern techniques will help us to improve the cultivation and conservation of medicinal plants.

Usefulness of cultivation of medicinal plants for socio-economic development

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Medicinal Plants are important for us not only in terms of nature but also in terms of medicine. There are numerous plant species in the world having medicinal values. Some of the medicinal plant species, we use them regularly for their medicinal and therapeutic importance. Plant species like *Aloe vera, Catharanthus roseus, Ficus religiosa, Terminalia bellirica* etc., we see them regularly in our surroundings. These plant species have medicinal and therapeutic benefits. These all-plant species also have great impact in building social development and economic development. Even some neighbors sometime ask for *Aloe vera* plant, if you have in your garden. Many can start their business setup based on aloe vera gel. *Ficus religiosa* has their religious cause along with other therapeutic benefits. *Catharanthus roseus* possesses anticancer activity identified by the researchers. So, cultivation of medicinal plants has been useful for socio-economic development. Now-a-days, scenario is shifting more and more towards cultivation of medicinal plants.

Economics of medicinal plant based agroforestry system of South Gujarat, India

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South Gujarat region is the northernmost extension of Western Ghats and observed higher rainfall. the topography and climatic conditions of the region are suitable for orchard plantations and South Gujarat was leading during the year 2016-17, with maximum 13.31 ('000 Ha) area under Sapota cultivation from three districts namely Navsari, Surat and Valsad. Monoculture of fruit trees being risk-prone, broad spacing provided to this crop provides an opportunity to an intercrop in

the first few years, which generate additional income and improve productivity per unit area/volume as a result of efficient utilization of natural resources and improved ecological conditions. Larger inspacement between the trees can be utilized to intercrop shade bearing medicinal plants. *Coleus aromaticus* L. and *Coleus forskohlii* (Poir.) Briq. are two important medicinal plants belonging to Lamiaceae family. Locally *C. aromaticus* is known as "Ajmapan", while *C. forskohlii* as "Pathhar chur" or "Galbel". Fresh leaves of *C. aroamticus* contain 0.055 % volatile oil, largely carvacrol, which is aromatic, carminative, diaphoretic, tonic, stimulant and roots of *C. forskohlii* contain forskolin (syn. coleonol) as an active component, useful in the treatment of congestive heart failure, glaucoma, asthma and a certain type of cancers and also reported to have an anti-inflammatory property. These two plants were cultivated under different Agroforestry with Jatropha to geometry i.e., Sapota+Jatropha, medicinal crop under sole sapota, medicinal crop under sole Jatropha and compared with a sole crop of *C. aromaticus* and *C. forskohlii*. Compare to all respective treatments among different agroforestry system as per species of coleus studied, treatments with *C. froskohlii* recorded a higher benefit-cost ratio (highest when *C. froskohlii* was cultivated under Sapota + Jatropha system, i.e. T2 (1: 7.08) as compared to treatments with *C. aromaticus* under Sapota + Jatropha system followed by intercropped under sole Sapota.

Conservation, cultivation and sustainable use of high altitude medicinal & aromatic plants for the socio-economic development

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Human beings use plants for a multitude of purposes, of which a prominent one across the globe is for their medicinal values. Medicinal plants serve as a major source of income for high altitude inhabitants in the Himalaya, particularly in countries like India , Nepal, and Bhutan. People here harvest huge volumes of medicinal plants indiscriminately, risking their sustainability. The market demand for Uttarakhand's medicinal and aromatic plants is high, and several of these plants are exclusively found in Himalayan states. Himalayan state has a variety of agro-geoclimatic conditions that are ideal for medicinal and aromatic plants. Uttarakhand, being a home to a diverse range of wildlife as well as fragrant plants, has subtropical to tropical soils and agro-climatic conditions. Alpine is a biodiversity hotspot with a diverse assortment of wild animals. As a result of the low point of agricultural production, there is a lack of industrial growth leading to under-development and poverty in such areas. Consequently, Himalayan inhabitants travel to plains to take advantage of biodiversity in order to improve their lifestyle and socioeconomic status. There is a social and economic incentive to migrate for increased livelihood chances in the plain districts.

A comprehensive review of *Nigella sativa*: phytochemicals, pharmacology and its biological application

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Medicinal plants are the local heritage with global importance; the world is endowed with an affluent wealth of medicinal plants. Medicinal plants are utilized in many diseases for many centuries in different indigenous systems of medicine as well as folk medicines. These have a pharmacological activity that is beneficial for various kinds of diseases. Currently, more than 70% of the medicine or drug source is medicinal plants. The medicinal substance produced by the plant is found in nature as primary and secondary metabolites. Keeping in view of the importance of natural product *Nigella sativa* has got the place among the top ranked evidence based herbal medicines. One of the most widely researched plants, both phytochemically and pharmacologically, is *N. sativa.* This is also revealed that most of the therapeutic properties of this plant are due to the presence of thymoquinone which is major bioactive component of the essential oil in antibacterial and anticancer activity in drug discovery, we have grown this plant in himalayan region and aimed at isolation of active compound thymoquinone with applications. PubMed-Medline, Scopus, and Web of Science databases were searched to identify randomized control trials (RCTs) investigating the therapeutic effects of N. sativa and/or TQ. In this review, we investigated the clinical uses of N. sativa and TQ in the prevention and the treatment of different diseases and morbidity conditions in humans. *N. sativa* has long been used for medicinal purposes and is still widely used today; however, elucidation of its therapeutic propensity and mechanisms of action has only recently begun. Its major bioactive constituent, TQ, has demonstrated considerable efficacy for the alleviation of signs and symptoms of many ailments. TQ exhibits a wide range of bioactivities including antioxidant, anti-cancer, anti-inflammatory, cardioprotective, hepatoprotective, anti-asthmatic, antidiabetic, neuroprotective, antianxiety, anti-depressant, lung-protective, gastroprotective, autophagy- and apoptosis inducing, anti-nociceptive and anti-inflammatory, anti-diarrheal, antimicrobial, and antimalarial effects. In addition, TQ is a dietary component which is considered safe for human consumption. TQ has clearly established it as a multi-target inhibitor that exerts its chemopreventive and anticancer activities by inhibiting multiple pathways involved in tumorigenesis, tumor progression, and metastasis. Numerous pathways and mechanisms are governing TQ antiproliferative

and apoptotic effects such as; generation of ROS, P53 pathway, STAT3 pathway, MAPK pathway and Wnt pathway beside inhibition of angiogenesis and metastasis pathways. The safety, efficacy, and low toxicity of TQ highlight the importance of this compound around the world in pharmacological research, pharmaceutical development, and therapeutic benefits for humans.

Herbal medicines: status, challenges and future prospect

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Herbal drugs constitute a major share of all the officially recognized systems of health in India viz. Ayurveda, Yoga, Unani, Siddha, Homeopathy, and Naturopathy, except Allopathy. These non-allopathic medical systems are still used by more than 70% of India's 1.1 billion people. India is recognized as the land of herbs, and Ayurveda. Indian ancient medical system, is focused on herbs and medicinal plants. India is a well-known source of well-documented herbal plants having medical use. With approximately 1.5 million practitioners of the traditional medical system, India possesses roughly 25,000 effective plant-based medicines. In India, there are 7800 medical medicine production plants that use roughly 2000 tons of herbs each year. Botanical medicine or phytomedicine are other terms for herbal medicine. According to the World Health Organization (WHO), roughly 65-80 percent of the world's population lives in developing countries and relies mostly on plants for basic health care due to poverty and a lack of access to modern medication. Herbs are now used to treat chronic and acute diseases, as well as a variety of maladies and difficulties, including cardiovascular disease, prostate problems, depression, and inflammation, as well as to enhance the immune system, to name a few. In reality, conventional medicine is gaining popularity in developed countries and is growing day by day. But it is critical that the quality of herbal medications be monitored in the same way that chemically manufactured pharmaceuticals are. Unfortunately, the regulatory norms for herbals are not as strict as compared to manufactured drugs. Controlling the quality standards of herbal medications and products is therefore critical for the improvement of mankind. Herbal pharmaceuticals require scientific validation and documentation in order to be evaluated for quality and accepted globally. As a result, the current study attempts to emphasize the current structure, obstacles, and future aspects that should be considered in order to promote and grow herbal medication.

Medicinal and nutritional use of *Rhododendron arboreum* and *Myrica esculenta* to fulfil market demand and socioeconomic development of rural people of Tehsil Chachiot and Tehsil Thunag of District Mandi, Himachal Pradesh, North Western Himalyan region

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Inhabitants of the hilly regions largely depend on wild herbs for medicine and food supplements. The indigenous knowledge and traditional use of these wild herbs are vanishing fast. Chachiot Tehsil and Thunag Tehsil of Mandi District are rich repository of wild medicinal herbs. Among them includes *Rhododendron arboreum* and *Myrica esculenta* They have been long used as a medicinal plants,edible and their flowers ,fruits and other value added products are sold in domestic market by the local people . The aim of this study was to investigate nutritional, medicinal and to accesss market demand for socioeconomic development of rural people of *study area.* Local inhabitants of Tehsil chachiot and Tehsil thunag used to collect its flower and fruits seasonally during March to May from the study area. These are good source of food, medicine and income for local people in the study area. But recent upsurge in their use and demand has led to illicit harvesting for trade and habitat loss pushing these to the verge of extinction.

A review of literature on socio-economic and medicinal importance of agro-forestry species- *Grewia optiva*

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In this study, an attempt was made to review the literature on socio-economic as well as medicinal importance of small multipurpose tree *Grewia Optiva* of Thalisain , Pauri Garhwal District , locally named as Beul. Besides these, it is commonly known as Bihul, Bhimal , Bhiunal , dhaman and common in moist deciduous and evergreen forests of Jammu&Kashmir , Himachal Pradesh, Punjab, Uttar Pradesh and Sikkim, Pakistan, Nepal and Bhutan. The tree is strong demander of the Light reaching a height of 13-15 and belongs to Tiliaceae family. It's seedlings are generally suppressed

by weeds ; the trees shows hardness in frost conditions ; prefers a moist , sandy loam and seeds is best sown as soon as it is ripe. Germination and early growth are usually quite quick. The Himalayan *Grewia Optiva* is natural fibre that is extracted by processings "Shoots of *Grewia Optiva"*. It is considered as good forage , particularly valuable during winter, when no other green Fodder is available. The economic importance of this tree is that its woods obtained can be used for making axe-handles , oar-shifts , bows, shoulder poles also up to the places where resultant product requires elasticity and strength . The wood is also suitable for paper making. Baskets can be made from the elastic branches. The bark yields as a fibre of inferior quality and used for cordage making. It is widely used for the treatment of many disease like dysentery, fever, typhoid, diarrhea, eczema, small pox, malaria and fungi. Its bark used as shampoo i.e.washing hair. The metal and metal oxide nanoparticles synthesized from the various parts of this tree used for wastewater treatment. Thus from this thorough study it is concluded that the properties of this agro forestry species have promising and significant use and demand in market. Metal nanoparticles synthesized using the phytochemicals of this tree for wastewater treatment may attract the researchers to explore more applicability of this tree in various fields of science and technology.

Anti fertility effect of ethanolic extract of *Bambusa arundinacea, Trichosanthes diocio, Punica granatum* and isolated quercetin

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The anti-implantation activity was determined according to the method of Stella O. Olagbende- Dada (2009). Twenty four mature females colony bred Wistar albino rats were divided into Four groups (6 female rats per group). One group was used as a control and the other two groups are used as a test group. Female rat of proestrous phase were kept with males with proven fertility in ratio of 2:1. The female rats were examined in the following morning for evidence of copulation the vaginal smear was examined for thick clumps of spermatozoa. The day on which the spermatozoa were found in the smear was considered the first day of pregnancy (Day 1). In group B, C and D, 200 mg/kg of body weight ethanolic extract of Bambusa arundinaceae, Trichosanthes diocio and Punica granatum was administrated intragastrically for 10 days from day 1 to day 10 of pregnancy for the test group and same volume of vehicle for the control group A. On day 11, all groups of rats were laparotomized under light ether anesthesia. The uterus was excised from each animal, cleaned from adhering fat and washed with normal saline. Appropriately weighed uterus was used for estimation of lipid peroxidation (LPO) and assay of superoxide dismutase (SOD) activity. A second set of animals (n=6) from each group were injected intravenously 0.1 ml of 1% Chicago blue 6B dye through a tail vein on day 6 of pregnancy. All the animals were sacrificed, and the uterus was exposed to count the number of sites of implantation.

Curcuma longa Linn*:* A miraculous medicinal herb for multiple health benefits

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Since antiquity to modern era, curcuma has been recognized for its numerous medicinal benefits towards the maintenance of good health. In which the species; *Curcuma longa* Linn (Zingiberaceae) has received worldwide attention for its multiple health beneficial pharmacological activities. This poster is designed to make a short summary on pharmacognosy and pharmacological activities of *Curcuma longa* Linn. The studies elaborate various data findings from several literatures illustrating anti-inflammatory, anti-oxidant, antimicrobial, antiviral, gastrointestinal, hepatoprotective, antispasmodic, cardiovascular, hypolipidemic, antidiabetic, anticancer, antiprotozal, nematocidal, anti-HIV activity etc. To date, more than two hundred compounds have been isolated from the species, in which curcuminoids and essential oils are mainly responsible for different pharmacological actions in *in vitro* and *in vivo* bioassays. The research findings extracted from numerous articles may be categorized as a reference study material for researchers and strengthen the knowledge for the scientific study of *Curcuma longa* Linn.

Exploring the antiplasmodial potential of isoquinoline alkaloids from *Cissampelos pareira* L.

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Cissampelos pareira L. is the medicinal plant utilized traditionally as a remedy to treat several diseases like asthma, diarrhoea, fever, heart disorders, snakebite, vomiting, malaria, pneumonia, dog bite, inflammation and abdominal pain. In India, the roots and leaves are used by traditional healers to treat malaria but the chemical constituents contributing to its

antiplasmodial activity were not investigated. Identification, quantification and pharmacological evaluation of compounds contributing to antiplasmodial activity in different parts (root, stem & leaves) of *C. pareira*. The hydroethanolic extracts and fractions of different parts (root, stem and leaves) of *C. pareira* were prepared for antiplasmodial activity evaluation against chloroquine-sensitive (*Pf*3D7) and chloroquine-resistant (*Pf*INDO) strains of *Plasmodium falciparum* to obtain IC_{50} for all prepared extracts and fractions. The potent fractions were then subjected to phytochemical investigation using silica gel chromatography to afford pure compounds. The structural elucidation of compounds was carried out using NMR, ESI-MS, UV and IR spectroscopy. The isolated compounds were then tested for their antiplasmodial potential against *Pf*INDO and *Pf*3D7 strains. Finally, isolated bioactive compounds were utilized as analytical standards for developing a UPLC-DAD method, which was used for the identification and quantification of pharmacologically important compounds of *C. pareira*. The phytochemical investigation by column chromatography led to the isolation of six compounds namely pareirarine, magnoflorine, magnocurarine, salutaridine, cissamine and hayatinine. Pareirarine is the new isoquinoline alkaloid and salutaridine being reported for first time from this plant. Then isolated compounds were quantified in all extracts and fractions by the developed UPLC-DAD based analytical method. Analysis of the antiplasmodial activity of extracts of different parts (root, stem and leaves) of *C. pareira* found root extract to be the most potent with IC_{50} values (µg/ml) of 1.15 and 1.42 against *Pf*INDO and *Pf*3D7, respectively. Among fractions, the root ethyl acetate fraction was found potent with IC_{50} (µg/ml) 4.0 (*Pf*3D7) and 4.5 (*Pf*INDO) followed by water fraction of stem [IC_{50} (µg/ml) 4.4 (*Pf*3D7) and 4.5 (*Pf*INDO)] and water fraction of root [IC_{50} (µg/ml) 8.5 (*Pf*3D7) and 5.0 (*Pf*INDO)]. Antiplasmodial activity evaluation of compounds revealed that hayatinine isolated from ethyl acetate fraction of root was the most potent compound with IC_{50} (µM) 0.509 (*Pf*3D7) and 0.41 (*Pf*INDO). Then, comparison of activity data with quantification data revealed that the most potent compound hayatinine (~68 mg/g) was found in higher quantity in root ethyl acetate fraction which might be responsible for its antiplasmodial potential. In conclusion, current study revealed that the isoquinoline alkaloids present in *C. pareira* might be responsible for its antiplasmodial potential. Further, this study provides scientific validation for the traditional use of this plant in the treatment of malaria.

Uses of psychomedicinal plants in Udhampur District, Jammu and Kashmir

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In Udhampur district, psychomedicinal plants have been enormously used for traditional and commercial necessities. The distinct household remedies were made and used for the treatment of neurological disorders and mental ailments, such as anxiety, dementia, depression, epilepsy, headache, insomnia, improve cognition power and intelligence, migraine, snakebite etc. Since ancient times, these plants are being used in worshipping supernatural powers, marriages, prayers, exorcism, rituals and funerals. Sorcery practices, like necromancy and voodoo, use some selected psychomedicinal plants for expelling out the ghost influence from the person's body and get rid thoroughly from negative energies by chanting the 'mantra'. In this communication, authors had collected information on different psychomedicinal plants used traditionally by the local people in Udhampur district, Jammu and Kashmir. Extensive and intensive field survey was carried out during the period of 2021-2022 investigating such psychomedicinal plants. The information was gathered from local inhabitants of the study area, like old folk, tribal people, shepherds, *Vaidyas* or medicinal practitioners etc. The collected plant species are properly identified with the help of local floras and authenticated from regional Herbaria. The study enlists 43 plant species from 40 different genera belonging to 32 different families. The botanical name along with the local name, plant parts used and their uses are included for each plant species. The percentage of herbs is 60%, shrubs is 14% and trees is 26%. Poaceae is the dominant family with 5 plant species. All natural resources and related traditional knowledge are very important and should be protected for the local people of this region where they don't have modern facilities for healthcare. Community knowledge should be raised through various awareness programme about the mental health issues. Further, phytochemical and pharmacological analyses needed to be done to examine the bioactive compounds responsible for treating neuro-disorders.

Ethnomedicinal uses, phytochemistry and pharmacological aspects of a Himalayan medicinal plant- *Asparagus curillus* Buch.-Ham. ex Roxb

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Asparagus Curillus is an ornamental plant known Satavari in Hindi. It is a much branched, subscandent, under*Asparagaceae* family. It has various vernacular names like Ghigini, Jhiran, Karua, Karu etc. The plant is met in open Oak Rhodendron forests of the State. The objective of this poster is to discuss the on the ethnomedicinal uses, phytochemistry and Pharmacological aspects of a *Asparagus Curillus.*. The roots and fruits of the plant are used for medicinal purpose. The roots bitter tonic (Agarwal), aphrodisiac, appetizer, stimulant and anti-inflammatory, galactogogue and diuretic. Its ripe fruits used to cause abortion and tuberous roots with honey are taken dysuria, diabetes and dysentery.

Ethnomedicinally, roots are used in Gonorrhoea, piles, cough, as rejuvenating tonic, stomachache agent, in urinary disorder, dysentery and diabetes mellitus in Uttaranchal and Himalaya. In ethnoveterinary practice, roots are used for lactation, indigestion and gastric troubles. The plant contains saponins employed as medicine. Steroidal glycosides, curillins, curillosides, sarsasapogenin and Asparanin are reported in the plant. The plant has been reported to show anticancer effect. This review concluded that the further researches are required related to its pharmacological action to validated the folk use of this plant.

Futuristic scope of agents related to plants-based sources in type 2 antidiabetic therapies

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Based on the current scenario type-2 diabetes has been labelled as one of the major health issues, approaching exponentially towards mind boggling stage of epidemic globally. Considering to its lifelong latency from early to old ages, less awareness to its particular genotype and phenotype and hefty cost involved in its management & treatment; there is substantial need for more advance, personalised and economical therapeutic approaches for its effective therapy and treatment. The current review here discusses peculiar agents obtained from rarely explored distinctive plant sources with potential to be a viable therapeutic option for type-2 diabetes, therefore, could be devised into effective future treatment strategy to it and also to its related microvascular and macrovascular complications. Based on the literature search the therapeutic scope of agents from selected plants sources are delineated, sighting their activities and prospects as to be future revolutionary remedy to type-2 diabetes and associated hitches such as their insulin releasing ability in pancreatic beta cell lines and primary islets cells, effects on glucose level & on other metabolic parameters such as obesity, lipid profile & pancreatic beta cell function etc.

Therapeutic role of *Allium stracheyi* (Pharan) and their active constituents in the prevention and treatment of disease

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Plants belonging to genus *Allium* have been used from the time of ayurveda in the medical practice to treat various disease and disorders. *Allium* is one of the largest genera of monocotyledons comprises approximately 2685 species globally, out of which about 30-40% of species are grown in India. Traditionally, different species of *Allium* have been used as spices by Bhotia tribal communities and indigenous people since ancient times. Amomg them, *Allium straychei* is a small, perennial Himalayan seasoning herb belonging to the family Alliaceae/ Amaryllidaceae and has been widely used from century as a spices, flavouring agents and folk medicine for various physiological and pathological disorders in Himalayan states of India (especially in Uttarakhand). The objective of present study is to highlight the recent advancement in the potential ethnomedicinal uses and active phytochemicals found in *Allium stracheyi*. *Allium straychei* (family *Amaryllidaceae*) commonly known as pharan has great culinary value besides being used as ethnomedicine. *Allium stracheyi* have lots of bioactive principles due to which plant has been proven as the therapeutically important plant. Interestingly, all the parts of plant are used by the local people of uttarakhand as a traditional medicine for the treatment of various conditions, including alleviation of painful and inflammatory conditions, generally in the treatment of jaundice, cough, cold, digestion, and wound healing. Scientific evaluation of *Allium stracheyi* validates its traditional claims and demonstrates diverse pharmacological potential including an anti-inflammatory, antioxidant, anxiolytic, antimicrobial, hypoglycaemic and hypolipidemic. Phytochemical studies revealed the presence of sulphur and phenolic compounds, flavonoids, saponin, steroidal glycosides and essential oil. Carbohydrates, protein, lipids, fiber, vitamin E and C, calcium, phosphorous, magnesium and potassium are also present in appropriate quantity. Published data reported that therapeutic activity of *Allium stracheyi* is due to presence of several bioactive components particularly, organo-sulfur compounds, polyphenols and flavonoids, saponins, alkaloids, tannins, steroidal glycosides. Moreover, both extracts and volatile compound of plant have been evaluated for various biological activities. From the study it can be concluded that *Allium straychei* possess wide spectrum of biological activities making it as a potential therapeutically active medicinal plant. Present study confirms the medicinal importance of plant and suggests *Allium stracheyi* still needs to investigate further on its unexplored elements, such as isolation of bioactive compounds and related mechanism as well as its safety profile in order to increase its cultivation and develop it as a medicine.

Curative properties of *Inula racemosa* Hook. F (Pushkaramula) - A drug with potential medicinal properties

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Inula racemosa Hook. F (Asteraceae) commonly known as Pushkaramula is a well-documented Indian medicinal plant. Pushkaramula is one of the herbs mentioned in all Ayurvedic scriptures. It possesses various synonyms like kasari- an enemy of cough, sulahara - pain killer, sughandhika - fragrant etc. The great sage Charaka has categorized it as hikkanigrahana – stops hiccup and svasahara – alleviates the breathlessness, asthma. It is also best medicament for pleurisy along with cough and asthma. The plant, Inula racemosa is abundantly found in India, China and Europe. The plant grows in temperate and alpine Western Himalayas from 1300 to 4500 meters elevation. The plant is distributed in temperate alpine Himalayas at an altitude of 1,500-4,200m from Kashmir to Kumaon, Afghanistan to Central Nepal. Inula racemosa is known to be used in traditional medicine throughout the world, especially East Asia and Europe. It occurs wild among strong alpine scrub vegetation in the cold arid habitat of NW Himalayas between 2,700-3,500 m in the eastern Ladakh (Leh) region of Kashmir. Domesticated forms of this incipient cultigens are cultivated on borders of agricultural fields of wheat, barley and buckwheat both in Kashmir and Lahaul valley of Himachal Pradesh. Apart from being used for other ailments, the plant extract and its isolated active constituents show promising activity against abdominal pain, acute enteritis, bacillary dysentery, expectorant and tonic. *Inula racemosa* is also used in combination with other plant extracts and used for various conditions including hyperlipidemia, angina and patients with Ischemic Heart Disease. Many of the local and traditional claims for the use of In addition, these compounds exert their allelopathic effects on other flora and vertebrate poisoning different parts of Inula racemosa have been scientifically established by in vivo and in vitro techniques. The plant is used in Ayurveda as an expectorant and resolvent in indurations. Considered a rejuvenator and immunomodulator by Ayurvedic physicians, the drug according to Bhavaprakasha is bitter pungent in taste. When administered it mitigates Vatakapha Jwara (fever caused by vata pitta imbalance), sotha (swelling), aruchi (anorexia), swasa (breathlessness) and parswasoola (pain in the sides of the chest). The root of Inula racemosa is an important ingredient of several polyherbal formulations those are for cardiac disease and inflammatory conditions of spleen and liver. The root is medicinal and considered a specific for cough, dyspnoea, asthma, pleurisy, tuberculosis and myocardial ischemia and chest pain especially pre cordial pain. Root powder is reportedly hypoglycaemic and hypocholesterolemic in human subjects. Externally a paste or liniment is used for relieving pain. The root is also used in veterinary medicine as a tonic. The root forms an important ingredient of several polyherbal formulations for heart diseases and inflammatory conditions of spleen and liver. Various active constituents have been isolated from the plant, most important being sesquiterpene lactones-Alantolactone (ALT) and isoalantolactone (IALT) that show anti-inflammatory and decreased proteolytic activity. Many of these ethno medicinal properties have been experimentally proven in different animal models. Inula racemosa is a medicinal plant of immense importance with a diverse pharmacological spectrum. There is a great scope for further screening of the plant against various diseases.

Ethnopharmacological investigation of phytochemical constituents isolated from *Amaranthus tricolor*: A medicinal plant

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Amaranthus tricolor is an ornamental plant known as Lal Marsa in Hindi. It is a purple red colour leafy vegetable belongs to *Amaranthaceae* family. It has various vernacular names like Lal Marsa, Maarisha-rakta, Lal Shak, Tandalja Bhaji, Chinese spinach, Garden Amaranth etc. It is consumed as nutraceutical herb in Bihar, Jharkhand and West Bengal. It has wide distribution in India as well as South Africa also used as pseudo-cereals in Europe and America. The objective of this poster is to discuss the Ethnopharmacological investigation of phytochemical constituents isolated from *Amaranthus tricolor*: A medicinal plant. Amaranthus tricolor plant is popular not only for their nutraceutical's potentials but also for their colour and flavour. Different parts of *Amaranthus tricolor* plant like leaves, stem, roots are used in Ayurveda. In traditional system of medicine this plant reported as astringent in menorrhagia, leucorrhea, dysentery, diarrhea, hemorrhagic colitis, also used in cough, bronchitis, externally used as emollient and in treatment of piles, blood disorders, bladder distress, tooth ache etc. It has wide range of pharmacological activities like anti-tumor, anti- diarrheal, anti-ulcer activity, hepatoprotective activity, anti-microbial activity, antioxidant activity, anti-bacterial activity, anti-viral activity, anti-nociceptive and anti-inflammatory activity, it also has hematological, Hypoglycemic and Hypolipidemic properties. As per Ayurvedic Pharmacopoeia the plant contains amaranthin, isoamaranthin, betains, Amino Acid, sterols, fatty oils, sitosterol, calcium and magnesium. The nutrients in the leaves are carbohydrates, protein, Vit A (Retinol), Vit C (Ascorbic Acid), Vit B_2 (Riboflavin), Vit B_1 (thiamine), Vit B3 (niacin) and minerals. Flavonoids (Betacyanins A & B, Amaranthin, isoamaranthin and quercetin). In forthcoming time Amaranthus tricolor provide nutritional as well as pharmacological advantages to humans. This poster will provide an overview on its traditional and modern uses in medicines together with the comprehensive profile of phytochemicals, and health promoting bioactive of this valuable plant. In addition, the new

prospective and future challenges in the research on *Amaranthus tricolor* are also outlined. *Amaranthus tricolor* herb have wide spectrum of pharmacological potentials and significant natural compounds that paves the ways toward advanced herbal drug discovery and herbal drug formulation.

A comprehensive review on therapeutically wonder molecule: berberine

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Berberine is an alkaloidal quaternary ammonium reported to be present in various medicinal plant parts, especially in the genus Berberis. Berberine is the key constituent used traditionally in Ayurveda and Chinese medicines for the management of various disease conditions. However, at present several scientific reports claim that Berberine could be used as antibacterial, antioxidant, antidiabetic, antidepressant, antidiarrheal, antiviral etc. Now a days, there are several dietary supplements of berberine are marketed and are being used in various physiological conditions and as health promoters. Berberine is reported to have both antidiabetic and antihyperlipidaemic effect which helps in preventing diabetic associated cardiovascular complications. Moreover, Berberine accounts for the relief of diabetic nephropathy by inhibiting aldose reductase and antioxidant property. This data concludes that Berberine possesses an array of therapeutic benefits that are noteworthy and well proven. Its hydrophilic nature, however, limits its absorption. Therefore, various approaches have been used to enhance the bioavailability of Berberine which includes development of liposomes, dendrimers, nanoemulsions, carbon dots, gold and silver nanoparticles, and magnetic mesoporous nanoparticles. Thus, in view of this, there is a vast scope of developinga novel formulation to overcome the permeability barrier of Berberine in a cost-effective manner.

Medicinal plants as propitious nephroprotective agents

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Nephropathy is a highly lethal physiological condition mainly caused due to hypoxia, ischemia and drug-induced nephrotoxicity. Nephropathy is characterized as disparity of various parameters such as oxidative stress, biochemical, protein kinase C pathways and hemodynamic pathways etc. This results in impaired circulation to the nephrons and increased energy requirements due to oxidative stress. Thus, the concept of using antioxidants to prevent nephropathy is always interesting to be thoroughly discussed. There are many well recognized medicinal plants such as *Solanum xanthocarpum, Sonchus oleraceus, Ceiba pentandra, Eurycoma longifolia, Combretum micranthum, Homonoia riparia, Abelmoschus moschatus, Asparagus falcatus, Barleria prionitis, Macrothelypteris oligophlebia, Dendropanax morbifera, Carica papaya, Pongamia pinnata* and *Boesenbergia rotunda* that are reported to have promising nephroprotective activity. These medicinal plants contain several phytoconstituents having an antioxidant property which provides protection against nephrotoxicity. These scientific claims confirm that medicinal plants are potential candidates to be developed as nephroprotective agents.

A review on phytochemicals, ethno-medicinal uses, pharmacological activities and health promoting activities on *Nelumbo nucifera* (Sacred Lotus): A medicinal plant

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Nelumbo nucifera is a National flower of India. *Nelumbo nucifera* belongs to the Nelumbonaceae family and has several vernacular names including Indian lotus, sacred lotus, Chinese water lily, and so on. It is an aquatic as well as perennial plant which is used as a medicinal herb in India and China. The objective of this poster is to discuss the Phytochemicals, Ethno-medicinal uses, Pharmacological activities and Health promoting activities on *Nelumbo nucifera* (Sacred lotus): a medicinal plant. *Nelumbo nucifera* has a vast geographical range and a high level of biological diversity. It is grown all over the world as a valuable nutrient-dense vegetable. It is grown in many parts of the globe including India for its medicinal, curative and nutritional value. For over 2,000 years, we have regarded it as a vegetable, functional food and herbal medicine. In traditional system of medicine, many parts of the plant (leaves, seeds, flower, fruits and rhizome) are utilized. In traditional system of medicine, the different parts of plant are reported to possess beneficial effects as in for the treatment of pharyngopathy, pectoralgia, spermatorrhoea, leucoderma, smallpox, dysentery, cough, haematemesis, epistaxis, haemoptysis, haematuria, metrorrhagia, hyperlipidaemia, fever, cholera, hepatopathy and hyperdipsia. Phytochemical investigations on different parts of *Nelumbo nucifera* have indicated a wide spectrum of at least 255 constituents belonging to different chemical groups including proteins, amino acids, polysaccharides, starch, flavonoids, alkaloids, essential oils, triterpenoids, steroids and glycosides and they have been isolated which have their own therapeutic

importance. The pharmacological studies have shown that *Nelumbo nucifera* possesses various notable pharmacological activities such as anti-obesity, anti-oxidant, anti-inflammatory, cardiovascular, hepatoprotective, hypoglycaemic, hypolipidemic, anti-tumour, immunomodulatory, memory-improving, anti-viral, anti-fungal, anti-pyretic, anti-dermatophytic and anti-Parkinson's activities etc. In forthcoming times it can be used as a low cost protein and energy supplement. This poster highlights several traditional usage, pharmacological activities and phytochemical studies that have demonstrated the therapeutic potential of *Nelumbo nucifera*. *Nelumbo nucifera* needs to be explored further through clinical studies on human volunteers to provide evidence-based therapeutics. In addition, the new perspectives and future challenges in the research on lotus are also outlined.

A comparative study to investigate the antioxidant potential of ethanolic and methanolic extracts of *Cineraria maritima*

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Cataract is one of the major reasons of reversible blindness worldwide. Till date surgery is the only effective treatment available for cataract throughout the globe. However, modern surgical techniques are effective but severe post operative complications associated with all currently available techniques cannot be neglected. Studies done so far clearly revealed that oxidative stress plays significant role in the development of cataract due to oxidation of natural lens protein. Therefore, strategies dealing with the use of antioxidant therapy may prove beneficial. *Cineraria maritima* is one of the highly prescribed medicines in Homeopathy for the treatment of cataract and other ocular problems since time immemorial. This plant possesses great anti-cataract potential but from research point of view it has not been explored much. The present study deals with the comparison of antioxidant potential of ethanolic and methanolic extracts of *Cineraria maritima* by using three different techniques. Aerial parts (leaves and stem) of *Cineraria maritima* were powdered thoroughly and subjected separately to the Soxhlet extraction by using ethanol and methanol as solvents. Preliminary phytochemical investigations were done according to standard procedures. Three different techniques such as 2,2-Diphenyl-1-picrylhydrazyl (DPPH), hydrogen peroxide and nitrous oxide were employed for the investigation of antioxidant profile of plant extracts. Phytochemical screening of plant extracts clearly revealed the presence of different constituents such as flavonoids, alkaloids, carbohydrates, proteins, phenols etc. Results of all the studies conducted to investigate the antioxidant profile of plant extracts showed that ethanolic plant extract possesses more antioxidant potential than methanolic extract. The obtained results of the study conducted by using three different assay techniques clearly showed high antioxidant potential of ethanolic extract of *Cineraria maritima* as compared to its methanolic ectract. The antioxidant potential of this plant is due to its high phenolic and flavonoid content. Thus, present study endorse well prescribed and extensive use of *Cineraria maritima* in the treatment of cataract in one of the most efficient Homeopatic system of medicines.

Medicinal importance of *Myrica esculenta* (Kaphal)- state fruit of Uttarakhand

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Myrica esculenta (family *Myricaceae*) commonly known as Kaphal tree in Uttarakhand State. Its fruits are very attractive with a distinct flavour. It is found between 900– 2100 m in India, Malaya, Singapore, China, and Japan. Kaphal is a rich source of myrecetin (flavanoids) that is reported for to have effect of cns related and metabolic disorders. the powder of bark in traditional medicine is used in dental ache, epilepsy, chronic gonorrhoea, cough, bronchitis, dysentery, diarrhoea and diuresis. The fruits are useful in piles, Body ache, Toothache and Ulcer healing. This review is a collection of medicinal importance and reports available on the scientific validation of the Kaphal tree such as pharmacological and clinical studies. The literature for this purpose was collected from the research and review article including books also. The reports and data available related to traditional and folk medicinal uses, phytochemistry and pharmacological of the plant are summarized in this review.

Anti-venom activity of selected traditional medicinal plants of Uttarakhand

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Achyranthes aspera Linn. [Amaranthaceae], commonly known as kumoor gass, chirachina, markatha, and Prickly chaff. Different constituents are found in different part of *Achyranthes aspera* (eg. Saponins, amino acid, hentriacontane,

hormones ecdysterone, achyranthiene, betaine, pentatriaontane, 6-pentatriacontanone, hexatriacontane and tritriacontane). Achyranthes aspera is an important medicinal herb found as a grass throught India on the road side and waste place. Though almost all of its part are used in traditional system of medicine specially roots used for snake bite , seed and shoots are most important parts which are used medicinally . Present research give an account of on its which different constituents are responsible for neutralize the snake venom, in Vitro enzyme studies assays indirect hemolysis , procoagulant and lytic assays, Invitro enzyme inhibition assays will be used while In vivo studies Snake venom antiserum , acute toxicity studies ,neutralization of lethal venom effect, neutralization of hemorrhagic activity , neutralization of necrotizing activity, neutralization of coagulant activity , coagulant activity, minimum defibrinogenating dose (MDD), rat paw edema , neutralization of cardiotoxic activity, neutralization of neurotoxic activity.

Fruits consumption and its impact on cardiovascular disease prevention and treatment

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Cardiovascular diseases (CVDs) are one of the world's most serious health issues. Consumption of fruits was found to be i nversely associated to the risk of cardiovascular disease in a growing number of epidemiological researches. Furthermore, numerous experimental investigatons have supported the protective role of fruits against CVDs, and a number of fruits (gra pe, blueberry, pomegranate, apple, hawthorn, and avocado) have been extensively researched and found to have powerful c ardiovascular protective effects. Fruits can help prevent cardiovascular disease and aid in the recovery of the morphology a nd functions of the heart and arteries after an injury. Protection of vascular endothelial function, regulation of lipid metabol ism, modulation of blood pressure, inhibition of platelet function, alleviation of ischemia/reperfusion injury, suppression of thrombosis, reduction of oxidative stress, and attenuation of inflammation were among the mechanisms involved. The present study highlights recent findings on the impact of fruits on cardiovascular disease (CVD) and examines possible mechanisms of action based on evidence from epidemiological, experimental, and clinical investigations.

Formulation and evaluation of in-situ gel of *Achyranthes aspera* for its wound healing activity

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Achyranthes aspera Linn have been used traditionally by rural people for prevention of disease and ailments. This plant has also been used for the treatment of cuts and wounds. The study aimed at evaluating wound healing activity of ethanolic extract of *Achyranthes aspera* L. The wound healing activity will be evaluated using excision wound model on albino rats. Animals will be divided into 4 groups each including disease control, Standard, and Test group. Present study will provide a scientific rationale for traditional use of *Achyranthes aspera***.** L for its wound healing efficacy and will give a positive effect and will confirm in treatment of wounds.

Physiochemical properties of newly synthesized derivatives as anti-proliferative agents

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The term 'cancer' is used for the disease in which uncontrolled growth of cells occur and it can invade around the tissues. The cells of the cancer can spread around the tissue by the blood and lymph system to another part of the body. Hence, it is the need of the hour for research of anticancer drugs. In present work, the quinazoline derivatives were synthesized and their physicochemical properties were studied. The derivatives of quinazoline were developed and their screening was performed on the basis of their physicochemical properties. As these pre-formulation studies are very much helpful for developing formulation and to assess the drug polymer compatibility, the physiochemical analysis of synthesized quinazoline derivatives was carried out for solubility, melting point and FTIR. The solubility of new quinazoline derivatives (RDPP-01-12) was investigated in methanol, water and methanol-water system. The melting point of new quinazoline derivatives (RDPP-01-12) was also investigated in the range of 90-250^0 by capillary tube method. UV-Visible scanning and calibration of synthesized compounds were also studied in different media such as 0.1N HCl (pH 1.2), phosphate buffer (pH 6.8) and phosphate buffer (pH 7.4). The compounds were also studied for the presence of various functional groups by FTIR analysis. The results of the study revealed the presence of different functional groups. The derivatives were found soluble in aqueous and hydro-alcoholic media. The present study reflected the effective synthesis of novel quinazoline derivatives (RDPP-01-12) as anti-proliferative agents. These preparations should be helpful in controlling the cancer worldwide in human being.

Expectorant activity of *Nyctanthes arbortristis.*Linn by phenol red secretion model

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*Nycthanthes arbortristis.*Linn has been used as traditional medicine for numerous of diseases. This plant has also been used for the treatment of cough and has been traditionally used a expectorant. The study aimed at evaluating expectorant activity of ethanolic extract of *Nythanthes arbortristis* L. The expectorant assay has been evaluated with phenol red secretion model in rats tracheas. Rats were randomly divided into groups of 5 each including normal control, standard and test . After gastric administration of test extract in rats 5%(500 mg /kg) was intraperitoneally injected. Trachea was dissected and optical density of tracheal secretion was measured. After 7 days treatment with ethanolic extract (80%v/v) of *Nycthanthes arbortristis.*L at dose of 500 mg /kg significantly increased tracheal secretion of phenol red as compared to normal control group and decrease in tracheal secretion of phenol red as compared to standard. This study provides evidence for expectorant effect of ethanolic extract (80% v/v) extract of *Nycthanthes arbortristis.*L .This may be useful therapeutic option for respiratory disease.

Assessment of anti-aging potential of herbal NLC gel containing coenzyme Q_{10} & *Zehnaria umbillata* leaves extract, using UVA induced photo-toxicity model

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The present study focuses on the development of nano-structured lipid carriers (NLCs), using Coenzyme Q10 & *Zehnaria umbillata* methonolic extract (ZUME*)* of leaves. The 2^3 factorial design is used to statistically optimize the formulation variables, utilizing Design expert software version 11. The selected formulation were further incorporated into Carbapol 934P gel base to develop final ZU nano-structured gel and tested for anti-aging potential. The finally developed gel formulations were characterized for physicochemical & pharmaco-technical parameters. The *in-vivo* photo-protective study was carried out using UVA induced phototoxicity model to access the antiaging potential of the final best gel formulation. Moreover the skin irritation test was also performed as per OECD guidelines, using albino wistar rat. The results revealed that Coenzyme Q10 ZU-NLCs showed good physical stability at 90 days after formulation development. The best optimized formulation F5 (G3) of Coenzyme Q10 ZU-NLCs containing gel had exhibited best release with no any sign of skin irritation in albino wistar rat. The antiaging parameters evaluated by UVA induced photo-protective potential were found to be significant ($p<0.05$) with statistically optimized best formulation F5 (G3) Q10-ZU NLC gel. From the present research it was proved that the developed nano-structured topical gel of Q10 ZU extract could be regarded as the safe & effective anti-aging formulation and may be explored for the future research trials.

Comparative volatile components profiling and antioxidant activity of different *Allium* species

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Allium cepa (onion), *A. sativum* (garlic) and *A. semenovii* (semenov onion) belongs to the Amaryllidaceae/Liliaceae family. Since ancient times, *Allium* species are used globally for their traditional flavours and medicinal properties. This study was focused to determine volatile components, polyphenolic and antioxidant activity of *Allium* species. Total phenolics contents (TPC) and total flavonoids content (TFC) were estimated in different *Allium* species (water, ethanol and hydroalcoholic). Volatile components were analysed by Gas chromatography- mass spectrometry (GC-MS) technique. In addition, antioxidant activities were evaluated in all samples by using 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) ($ABTS^{\bullet+}$) assay. *A. semenovii* contain higher amount of TPC (23.32±0.08 mg gallic acid equivalent/g) in hydroalcoholic extract and TFC (68.78±4.52 mg quercetin equivalent/g) in ethanolic extract as compared to other species. It was found that the highest antioxidant activity of *A. cepa* hydro alcoholic extracts (IC_{50}=0.63±043 mg/ mL DPPH) and *A. semenovii* of ethanolic extract ($ABTS^{\bullet+}$, IC_{50}=0.13±0.01 mg/mL $ABTS^{\bullet+}$). Major volatile compound Bis(1,3-Benzothiazol-2-ylsulfanyl) ethanol (41.0%) was identified in *A. semenovii*. Similarly, palmitic acid (22.8%), 3-Vinyl-1,2-dithiacyclohex-5-ene (45.6%) were identified in *A. cepa* and *A. Sativum* by GC-MS based analysis. The current finding suggest that polyphenolic compounds of *Allium* species are responsible for these antioxidant activity (DPPH and $ABTS^{\bullet+}$ assay). It has been found that the highest antioxidant activity of ethanolic extract ($ABTS^{\bullet+}$) of *A semenovii*. The current study illustrates the chemical variation of *Allium* species including *A. semenovii*, *A.cepa* and *A. sativum.* The current finding suggested that phenolic, flavonoids and sulphur containing compounds in *Allium* species can provided beneficial effects. Further the study of volatile components and antioxidant activity of *A. semenovii* may be utilized in the field of food and nutraceuticals.

Molecular docking approach to identify potential anticancer compounds from plant-derived natural products

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A variety of plant-derived compounds have been reported to have significant anticancer properties; however, their modes of action have not been clearly defined. Docking studies of selected plant-derived compounds with anticancer activity were performed using Schrodinger suit. We used a molecular docking approach to identify natural product compounds that is responsible for antitumor activity with a specific receptor protein and selective inhibition mechanism from selected plant derived compounds. Our goal is to find potential anticancer compounds. Using virtual screening on the protein Vacular Endothelium Growth Factor Receptor VEGFR-2 as a model, selected compound evaluated as cytotoxic agents against MCF7 and HCT 116 cell lines. The objective of this study is the compilation of anticancer activity of different plant derived compounds on MCF7 and HCT 116 cell lines by using PDB ID (**4ASD**). The docking results revealed that alkaloid, steroidal glycoside, triterpenoid glycoside, and flavonoid glycoside (polyphenol) compounds have a higher docking score than other compounds. The compounds were docked with the 4ASD protein to identify suitable inhibitors against the protein function.

Two-Dimensional Gas Chromatography (GCxGC): A multi-dimensional technique hyphenated to mass spectrophotometer for high-resolution separation of biomarkers in essential oils

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Essential oils are a class of secondary metabolites, present on the surface or in the secretory ducts of the plants. Essential oils are multicomponent mixtures of aromatic and volatile chemical compounds extracted from plant tissues, mainly by steam distillation, hydro-distillation and hydro-steam distillation. Several separation and identification techniques for individual components of essential oils are being done by sophisticated instruments like GC-FID, GC-MS, and LC-MS. However, despite the use of these instruments, co-elutions of target peaks with matrix peaks can still be present. GC×GC is thus a new revolutionary tool for the characterization of complex volatile and semi-volatile mixtures. The high peak resolution results due to an extra GC dimension. Chromatograms resulting from a GC×GC analysis can be represented as a three-dimensional figure and contour plots. On one side of the axis, it indicates the chromatogram that would be observed in a mono-dimensional GC. The other side of the axis shows a brief two-dimensional chromatogram after modulation. This technique leads to an improved chemical profiling and provides easy detection of some peaks that coeluted with other peaks in the first-dimension column. A GCxGC technique hyphenated to a quadrupole (GCxGC-MS) or time-of-flight (GCxGC-TOF) mass spectrophotometer can be a powerful and useful tool for detection, identification and quantification of valuable biomarkers as well as toxic compounds present in traces in essential oils.

Challenges in clinical trials for dermatological herbal formulation

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Skin problem contribute approximately 34% of all health disease. Skin diseases cut crosses all the ages and are major health problem worldwide. Skin is outmost covering of body and protects body from external environment and pathogens. Maintaining skin care is essential for healthy body. There are potential use of medicinal plants and their parts from many decades in skin care products. Ethanodermatological herbal preparations are mainly based on plant and plant products. The plants have different chemical constituents which can vary in plant of same species due to climatic conditions, properties of soil, age of plant and geographical location. The pharmacological activities of standard extract may vary with their variation in chemical constituent. An herbal skincare formulation contains different active ingredients. So, it is difficult to perform toxicity, assay response relationship and clinical trial with more accuracy and efficacy. Although, Ayush department has issued some guidelines regarding quality control, standardization, preclinical and clinical trial of herbal drug, but still there is some loophole in clinical and preclinical studies. Lack of proper regulatory guideline, quality control and standardization create a question mark on utilization of herbal product. Hence there is deep insight into the challenges related to clinical trial of herbal formulation so that it can be introduced in National health care system and also an urgent call to protect and preserve our heritage. This can be achieved by Proper Corporation of academician, regulatory bodies and hospitals.

Antioxidant, COX inhibition activity of various extracts of Lantana camara and molecular docking study of phytochemicals against COX-1 and COX-2

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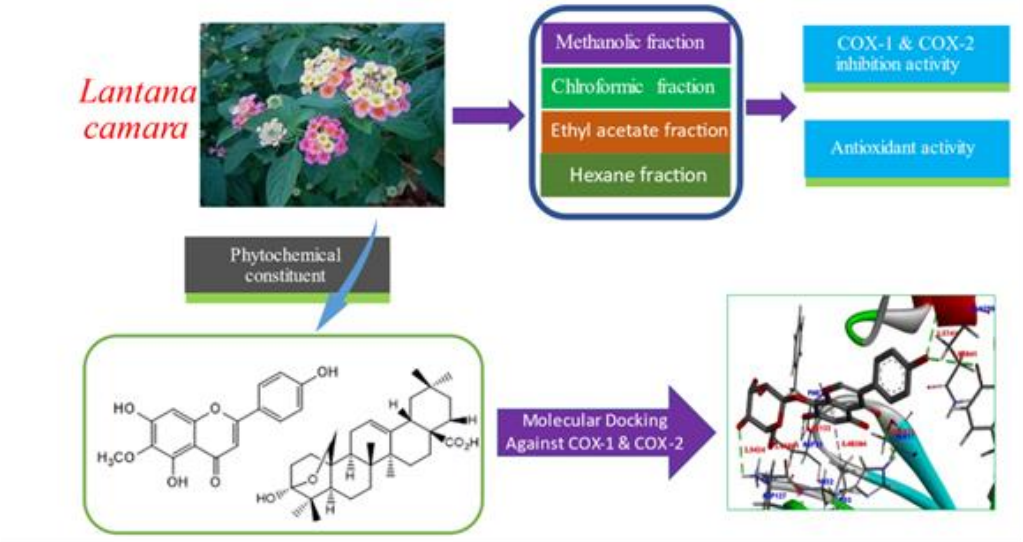
The plant Lantana camara belongs to the genus Lantana (Vervenaceae family) which is used is used in the treatment of many diseases like diabetes, cancer, inflammation, intestinal problem and tuberculosis in many countries of Asia while some important medicinal activity of plants is in pending for new findings. In this analysis, we have tried to find the anti-inflammatory activity of various extracts of tuber of Lantana camara by the in-vitro method as the cyclooxygenase inhibitory potential. The isolated phytochemical constituent of the plant was in-silco screened to find the cyclooxygenase inhibitory potential by molecular docking method. The molecular docking study of pre-isolated phytochemicals from the leaves of plant shows that compounds possess a great inhibition potential against COX-1 and COX-2 therefore, an in-vitro comparative study is required for compounds against COX-1 and COX-2 to conclude the selective and potential COX-2 inhibitor for the development of new anti-inflammatory drug without causing any gastrointestinal ulcer. In the other part of the paper, the anti-oxidant activity of the various extract was also evaluated by DPPH radicle scavenging method.



Arnika of Ayurveda *Ricinus communis* (Palm of wonder)

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Ricinus communis (Castor plant) is a traditional medicinal plant which has been utilized for centuries for the various kinds of treatment. The purpose of this study was to explore the collective biological properties of Ricinus communis leaf extract. The present investigation deals with the pharmacognostical studies on R.communis (castor) leaves. For Pharmacognostical evaluation macroscopy, microscopy, powder study and histochemical analysis of leaves were performed. Physicochemical constants such as ash, GC-MS analysis of R.communis methanolic leaf extract and extractive values were determined. The Physicochemical analysis showed ash values, acid insoluble ash and water soluble ash. Quantification of bio-active compounds (total phenolics content and total flavonoids content) qualitative as well as quantitative analysis (alkaloids, flavonoids, saponin, terpenoids, anthraquinone and cardiac glycosides).

Metabolic and nutritional changes in apples during post-harvest storage at room temperature

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Worldwide consumption of apples and apple products are now growing and their benefits as rich in phytochemicals indicate them as a chief to exert influence on consumers health. Apple peels are a waste product from the production of applesauce and canned apples. In New York state, according to the National Agriculture Statistics Service, 216 million

pounds of apples were processed in this manner in 2000. A total of 16 million pounds of peels were produced, according to expert calculations. Apples usually stays on shelf for 2-4-week postharvest storage, so nutritional changes and metabolite altercations will be intriguing to understand. The aim of study is to decipher the nutritional role of apple peel at room temperature through metabolite profiling and biochemical assays. Nutritional and commercially important 'Red Delicious' apples kept at room temperature postharvest storage for different time course durations. Post-harvest storage from day 0 to day 30 showed a certain increase in flavonoid and phenolics content measured using biochemical assays TPC and TFC. HPLC shows concentration of different secondary metabolites (10) especially antioxidants like epicatechin, catechin and syringic acid significantly surge with the increasing days. Decrease in the concentration of different sugars detected in GC-MS indicates that peels are enriched in phenolics and low in sugars which are highly beneficial for consumers. Nutritional changes and metabolite profiling data enlighten the intriguing nutrition level of apple peel till 30 days post-harvest storage which is of special interest to the consumers and apple industry.

A comprehensive review on plant tissue culture

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Plant tissue culture is in vitro cultivation. It is a new technique used to grow the plant cell, tissue and organ which is especially cultivated on the artificial or nutrient culture medium under suitable container, aseptic and environmental conditions. For example: devil's ivy from the family Araceae. Plant tissue culture procedure: Firstly, in the initiation stage take a leave or any part of the plant which has divided in its section cutting. Then in multiplication stage undifferentiated callus formed which help to grow the root in root formation. At the fourth stage of shoot formation the plant is grown fully. At last, acclimation the plant has been transferred into a greenhouse because of maintained and controlled all condition in that particular area. There are many advantages for this technique because it takes less time to grow any plant; plants can be disease free and desired products; more availability of raw material; crop improvement and also when there are less or no quantity of seeds. It also includes the screening programmers of cells, rather than plants and removal of viruses by propagation from meristematic tissue (growing cells- virus free).

Strategies for delivery of bioinoculants for yield enhancement in fields

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Plant growth promoting bacteria (PGPB) are the plant beneficial bacteria found in association with plants. These PGPB promotes the plant growth directly by increasing nutrient cycling such as biological nitrogen fixation, production of siderophore, phosphate solubilisation and phytohormones synthesis where as indirectly they act as biocontrol agents to inhibit the growth of pathogens by secreting secondary metabolites, hydrolytic enzymes and inducing resistance in plants. The PGPB that act as biocontrol agents protect plants from disease causing pathogens. For sustainable agricultural development they are used as an alternative to pesticides, chemical fertilizers and herbicides. The continuous use of chemical fertilizers and fungicides cause soil pollution and deplete nutrients in the soil and adversely affect environment. Because of the beneficial impact of PGPB in plants, they are used as bio-inoculants to improve crop growth and yield. Bioinoculants such as *Bacillus aryabhattai* D5 have shown antagonism against *Fusarium oxysporum* R1 in *Crocus sativus* L. by secreting various metabolites such as siderophores and antibiotics. As many bio-inoculants have shown promising results in laboratory conditions so there is need to deliver them in field conditions using efficient delivery method to increase plant yield. The foremost step leading to success of biocontrol is choosing correct bio-inoculants and another challenging step is a suitable delivery method to establish it in the fields according to microbial inoculants specific court of action. Correct delivery system improves vigor, plant efficiency, seed germination, increase seed tolerance to environmental stress, early DNA transcription. Different delivery methods such as seed coating, soil drenching, seed bio-priming, foliar application, root dipping, seed encapsulation and consortia application have been used.

Non-targeted metabolomics to identify novel bioactive metabolites from different plant parts of *Tinospora cordifolia*

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Tinospora cordifolia, commonly known as Giloy or Heart-leaved moonseed is a dioecious, deciduous, extensively spreading climbing shrub and a popular medicinal plant belonging to the family *Menispermaceae*. It is extensively used in Ayurveda and Indian folk medicine because of the several bioactive compounds such as alkaloids, sesquiterpenoids,

glycosides, diterpenoid lactones, steroids, phenolics, chalcones, polysaccharides and aliphatic compounds. Studies have reported various medicinal applications of the plant, such as anti-arthritic, hyperlipidemia, antioxidant, immunomodulatory, hypoglycemia, hepatoprotective, anti-tumour, anti-malaria and anti-allergic. All parts of this plant contain important bioactive molecules having significant medicinal properties. However, there is less information available on the comparative analysis of the plant parts with respect to their bioactive metabolite profile and antioxidant potential. In this study, we suggest a new screening strategy using gas chromatography and liquid-chromatography based metabolomics techniques to explore the bioactive metabolites in various plant parts (root, stem, leaf and flower) of *T. cordifolia*. Plant extracts were also subjected to antioxidant and anticancer assays. We identified significantly different metabolite profile from different plant parts. The outcome of this work suggests that metabolomics strategy could be more beneficial in the identification of bioactive metabolite from plants as well as that of their corresponding bioactivity index.

An integrated approach for *ex-situ* conservation of a critically endangered medicinal plant *Swertia chirayita* Buch. Hams. ex wall of Himalayan region

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Swertia chirayita is a highly important medicinal plant indigenous to temperate Himalaya. From Kashmir to Bhutan it is found at an altitude of 1200-3000 m amsl and in the Khasi hills at 1200-1500 m amsl. In general, 2000 m altitude is most preferable range. As the ferocity of the plant is gradually decreasing by the time so a more efficient, affordable and reproducible technique or method needs to be developed for its germplasm conservation. To solve the problem *ex situ* conservation by means of short-term in vitro storage is effective alternate. In our research, experiments were conducted to study and analyze the effect of various growth regulating parameters and effectiveness of different methods that ensured the availability of plant genetic material for pharmaceutical or medicinal purpose in future; moreover, to preserve the rare and endangered plants of *Swertia* species. A result with maximum per cent survival of shoots and hundred per cent homogeneity in morphological parameters was obtained. The results obtained depicts that the *ex situ* conservation of this species under *in vitro* seems to be the best alternate to solve the problem.

Enhanced production of withaferin A through metabolically engineered cell cultures of *Withania somnifera*

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Withania somnifera (L.) Dunal, (Ashwagandha) also known as Indian ginseng, is one of the most important medicinal plants, belonging to the family Solanaceae. This plant exhibits a number of medicinally important metabolites such as phenolics, flavonoids, and alkaloids. It is widely used in the treatment of anti-inflammatory, anti-stress, and anti-tumor diseases, due to the presence of the Withanolides compound, especially Withaferin A. In this work, first we have cloned and functionally characterize *the squalene synthase (WsSQS)* gene from *W. somnifera* plants. Thereafter, young leaves of *W. somnifera* were transformed using a cisgenic strategy to express an extra copy of native *WsSQS* 1 gene to increase the expression of *WsSQS* and subsequent higher SQS enzyme activity. *WsSQS* overexpressing cell lines exhibited 2.4-fold-higher 'withaferin A' yields than wild type cell suspension cultures. In conclusion, we can say that an increase in *WsSQS* activity obtained through cisgenic overexpression of *WsSQS* can improve withaferin production metabolically engineered cell suspension culture of *W. somnifera*.

In vitro propagation and screening of antioxidant potential of *Valeriana jatamansi* - a high value medicinal herb

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Valeriana jatamansi is an important medicinal plant belonging to the family Caprifoliaceae, used for insomnia, leprosy, ulcers, convulsions, jaundice, cardiac debility, dry cough, asthma, seminal weakness, chronic fever etc. due to presence of various metabolites and having sedative and anxiolytic property. Being highly medicinal, the species is constantly uprooted from nature for trade. As a result, availability of the species in its natural habitat is decreasing. In first experiment, surface

sterilization protocol was standardized using Sodium hypochlorite and mercuric chloride as sterilant. The callus was induced using various plant growth regulators and the shooting and rooting was induced in a suitable medium. Among all surface sterilization treatment, combination of Sodium hypochlorite and Mercuric chloride gave maximum survival rate in leaf (80.33 ±0.33) and nodal segment (77.00 ±0.57) explants. Maximum callus induction frequency (88.33± 0.33) was achieved on MS medium with 10.0 mg/l BAP and 2.0 mg/l NAA from leaf explants. MS medium fortified with BAP 4.0 (mg/l) + TDZ (1.0 mg/l)+ NAA (0.5 mg/l) showed highest frequency (74.33 ± 0.66) of shoot induction from callus in 17 days with 15 ± 0.57 number of shoots per explant. Maximum direct shoot induction frequency from nodal explant was achieved on MS medium enriched with BAP (5.0 mg/l) + TDZ (3.0 mg/l) + NAA (1.0 mg/l) in 18 days. Microshoots inoculated on MS media supplemented with 4.0 mg/l BAP, 2.0 mg/l TDZ, 1.0 mg/l NAA and 0.5 mg/l GA3) showed maximum frequency of shoot multiplication with average shoot length (4.36 ± 0.08 cm) and average shoot number (14.00 ± 0.57). A 75.00 ± 1.15 % rooting with significantly high mean root number (8.00 ± 0.57) and root length was achieved in full strength MS medium, supplemented with same concentration i.e. 4.0 mg/l BAP, 2.0 mg/l TDZ, 1.0 mg/l NAA and 0.5 mg/l GA3) combination. A separate medium for root initiation was not required. Maximum plantlets survive after 1 year of acclimatization. High multiplication rate associated with genetic stability ensure the efficacy of the present *in vitro* clonal propagation protocol of this important medicinal plant. There is lack of information on antioxidant activity of *in vitro* raised plants of *V. jatamansi* leaf part extract. In second experiment, aim was to measure antioxidant activity of mother plant and *in vitro* raised plants of *V. jatamansi* in methanol and diethyl ether extract. The methanol (63.07 ± 0.92) and diethyl ether (41.35 ± 1.88) extract showed highest antioxidant activity in mother plant in comparison to *in vitro* raised plants of *V. jatamansi*. The study has practical implications as it will be helpful to meet out industrial as well as domestic demand. In addition, it will ensure conservation of the species by providing the uniform quality planting material.

Preliminary phytochemical analysis of the genus *Ficus* L. from Dangs Forest-South Gujarat

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The genus *Ficus* is represented by more than 750 spp. in World, well distributed in the Tropical and Sub Tropical regions. India, being one of the major distribution areas of *Ficus* with 112 species, represents not only morphological variations, but also enormous diversity in chemical constituents. It is one of the most valuable medicinal tree genera not only used in Ayurveda, but also in other systems of Indian Medicines. With the aim to explore the chemical diversity amongst fruits of different *Ficus* species present in Dangs Forests, an attempt is made to analysis total phenolics and flavonoids content in 10 species of *Ficus.* Total phenolic content was estimated using Folin Ciocalteu method and Flavonoids was measured using Aluminium chloride colorimetry method respectively. Extracts were further subjected to the UV Vis Spectrophotometry using Gallic acid and Quercetin as standard. It was observed that maximum Phenolics are present in *Ficus virens*, followed by *Ficus arnottiana* and *Ficus religiosa.* Similarly maximum flavonoids content was also found in *Ficus rumphii*, followed by *Ficus arnottiana* and *Ficus virens*. Fruits were collected from lateral branches as well as Cauliflory in all the 10 species. Since, data on antioxidant activities are very scanty from *Ficus* species of Dangs Forests, this paper is aimed to provide insight into the Phenolics and Flavonoids in Fruits, as few of the species of *Ficus* in Dangs are edible. Also, both the Phenolics and Flavonoids do play a significant role in anti-oxidant activities, thereby providing first-hand information on further utility and value addition in different *Ficus* species based on the data obtained. This information can also be further utilized to select appropriate chemotype of genus *Ficus.*

Essential oil variations among selected breeding lines of aromatic marigold (*Tagetes minuta* L.)

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Aromatic marigold is an important essential oil bearing plant having high demand in flavour and perfumery industry. In the present study, 14 breeding lines (BTM-1 to BTM- 14) of aromatic marigold which are being maintained through repeated selfing have been evaluated for the variations in essential oil content and quality. Our results showed high variability for essential oil content (0.36 – 0.46 %). Analysis of essential oil (from inflorescence) through GC and GCMS revealed significant variability of chemical constituents. There are greater variations of major essential oil metabolites in the selected breeding lines *i.e.* Dihydrotagetone (7.47- 64.20 %) followed by trans-β-Ocimene (40.55-43.94%), (Z)-Tagetone (3.38-18.80%), (Z)- ocimenone (1.77 -8.36 %) and (E)-ocimenone (zero – 23.98%). The variations observed in the present study can be utilized for the genetic improvement and further breeding programs of aromatic marigold.

Standardisation of herbal product for quality control

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The use of herbs as medicine is the oldest form of healthcare known to humanity and has been used in all cultures throughout history. The knowledge of plant based drugs developed gradually and was passed on, thus, laying the foundation for many systems of traditional medicine all over the world. Herbal medicinal material and product need is increasing, and with this increase in the need, it is very much an essential requirement to maintain the quality of them. The quality of the herbals is altered by various physical, chemical, and geographical aspects which contribute to the quality of these materials. Adulteration, substitution, and lack of skilled personnel are the main reasons for unavailability of genuine herbal drugs. By use of advanced quality control technique and suitable standards, there is need to assure the quality of the medicinal herbal products. Identification, quality, and purity of herbs and herbal product confirmation are done by the means of standardization. Preliminary identification, physical properties, chemical properties, and biological properties together contribute to the purity of herbs. This purity defines the freshness as well as the quality of the herbal products. Based on the different important evaluation parameters like organoleptic properties, ash values, moisture content, microbial contamination, and chromatographic and spectroscopic evaluations, the WHO for the standardization of herbal drugs with current and future trends has set guidelines for standardization methods and procedures. Modern analytical techniques for the analysis of the herbal drugs are very much essential for global acceptance of *Ayurveda* and traditional herbs. These techniques can be used as quality control tool in assessing the quality of herbal materials and herbal pharmaceuticals. It is required that the various techniques are used for the quality control examination of the herbs, which can be regulated to gain the required quality products by setting proper norms. And this in turn will provide the safer use and effective treatment and required potency of the products which will benefit mankind and society by providing means of wellbeing.

Comparative quality analysis of wild *Artemisia maritima* oils from Lahaul Region of North-Western Himalaya and commercially available essential oil

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A. maritima is a perennial species from the Asteraceae family. The species has been reported from North-western India, including J&K (Kishtwar&Gurez), Himachal Pradesh (Lahaul & Spiti and Kinnaur regions) and Garhwal areas of Uttarakhand. Different parts of this plant contain essential oil in varying amounts, which can be influenced by environmental factors, most notably altitudes. The aim of this study was to comparethe quality of *Artemisia maritima* oils extracted from wild locations of North-Western Himalaya and commercially available Artemisia oil. Essential oils of four different locations of Distt-Lahaul & Spiti (Darcha, Jispa, Gemur & Tandi), Himachal Pradesh, (India) were extracted from fresh aerial part of *A. maritima* using Clevenger apparatus and one commercial oil sample was purchased from the essential oil traders. All collected samples were subjected for physiochemical properties and GC-MS/GC-FID based chemical profiling. The oil yield of Artemisia from (Darcha and Jispa) was recorded higher than other two locations (0.54% and 0.48% respectively). The physicochemical parameters were found comparable with all the samples which revealed the preliminary quality of oils. Thereafter, comprehensively 39 constituents were characterized in EOs of all accessions and market samples using GC-MS and quantified by GC-FID. These molecules comprise 87.3-95.1% of the total composition of oils. Extracted EOs was dominated by monoterpenes (3.0-68.5%) and oxygenated monoterpene hydrocarbons (26.6-85.4%) with *β*-myrcene (9.8-20.6%), *α*-terpinene (0.7-17.3%), *β*-phellandrene (1.5-22.4%), 1,8-cineole (3.0-50.8%), terpinen-4-ol (2.5-7.2%), ascaridole (11.5%), bornyl acetate (5.1-14.2%), *trans*-sabinyl acetate (0.8-49.6) and *trans*-ascaridole (7.9%). The metabolites of the market samples and our collected samples showed significant difference in terms of 1,8-cineole, *α*-terpinene, *β*-myrcene and *β*-phellandrene. The 1,8-cineole was a major constituent in the commercially available *Artemisia* essential oil while the wild samples were enriched in *α*-terpinene, *β*-myrcene and *β*-phellandrene. These finding revealed that the commercially available sample was from different species of Artemisia or its location was environmentally different. The study will help to define a suitable season and accession for growers in the region with desired metabolites.

Metabolome analysis of *Ajuga parviflora* along its anti-obesity and anti-diabetic activity

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Ajuga parviflora (Benth.) has widely been used in Ayurvedic, Unani, and Chinese systems of medicines for various ailments such as fever, dysentery, insect's bites, diabetes, and malaria. Due to the huge application of *Ajuga parviflora* in folk medicines, it got attention for chemical exploration but its metabolomics and anti-obesity, anti-diabetic potentials are

not still comprehensively validated. The aim of this study is to profile the metabolites of different parts of *A. parviflora* along with its anti-diabetic and anti-obesity activity. Chemical diversity of *A. parviflora* was explored using Ultra-Performance Liquid Chromatography coupled to Electrospray Ionisation and Time-of-Flight (UPLC-ESI-TOF) and multivariate statistical analysis. The polyphenols and free amino acids were quantified by UPLC-PDA. Anti-obesity effect of extracts was evaluated cellular model. To analyses the all extracts on lipid accumulation, Oil Red O staining was performed. For anti- diabetic activity, glucose uptake assay was performed to assess insulin sensitivity. A total of 786 metabolites were tentatively identified by UPLC-ESI- MS and UHPLC-QTOF-IMS search against METLIN database. The UPLC-PDA based quantification showed presence of vanillic acid, caffeic acid and ferulic acid in extracts of A. parviflora. Further the inhibitory effect of various Ajuga extracts in lipid accumulation significantly decreases in comparison to differentiated control (***P<0.0001). A. parviflora leaves extracts enhanced the insulin sensitivity and protected cellular health in hydrogen peroxide stressed differentiated adipocytes. The study suggested that ethanolic extract exhibited a good anti-obesity activity by modulating oxidative stress, enhancing Glucose uptake. It also enhanced the insulin sensitivity in differentiated adipocytes cells exposed to H2O2- induced oxidative damage.

Chemical exploration including nutritional and antioxidant potentials of *Dactylorhiza hatagirea*

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Dactylorhiza hatagirea (Salam Panja) is high valued orchid used to treat dysentery, general weakness and sexual dysfunction. The current research was focused on chemical profiling including nutritional and antioxidant potential of *D. hatagirea* tubers. Chemical profiling of *D. hatagirea* tubers were performed using UHPLC-QTOF-IMS while amino acids, dactylorhins, and polyphenols were quantified by UPLC and ion chromatography. Further, Total phenolics, flavonoids, antioxidants and micro and microelements were determined by assay methods and atomic absorption spectroscopy. UHPLC-QTOF-IMS had identified 100 metabolites such as sugars, terpenoids, steroids, amino acids, polyphenols, nucleosides, saponins, organic and fatty acids out of which thirty-eight molecules based on mass fragmentation, UV and retention time and 62 molecules were identified through search against METLIN database. UPLC-DAD analysis reveals that various essential (threonine, tryptophan) and nonessential (alanine, proline) amino acids were found promisingly, while in polyphenols only vanillic acid (0.05± 0.73 mg/g) present. Marker compound dactylorhin A (0.819 ± 0.02 mg/g) and B (0.886 ± 0.10 mg/g) both present in good amount in tubers extract. Further, the total phenolics and flavonoids content (73.61 ± 0.92 and 48.59 ± 0.71 mg/g) were observed in tubers extract. The extract showed antioxidant potentials with IC50 1.58± 0.17 and 4.25 ± 0.08 mg/mL in DPPH and ABTS assays. The environmental toxins (Cd, Hg, Pd, As) were absent while micro (Mn, Na, Zn, Cu) and macro (Ca, Fe, Mg, K) elements were found in tubers. The current finding unleashed the chemical information including neutraceutical and medicinal values of dietary orchid. Further, this research will help in agricultural and biotechnological interventions to higher quality produce without overexploitation of natural habitat.

Metabolomics based discrimination of different parts of *Trillium govanianum*

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Trillium govanianum (Melanthiaceae) is commonly known as "Nag Chhatri", distributed in Himalayas of Afghanistan, Pakistan, China, India, Nepal, and Bhutan. In India, it is widely grown in Kashmir, Himachal Pradesh, Uttarakhand, and Sikkim (altitude of 2400-3500m amsl). T. govanianum is enriched in steroidal saponins, terpenoids, and glycosides. It also contains phenolics and nucleobases etc. Traditionally and scientifically, it is used for the treatment of sexual disorder, cancer, pain, inflammation, dysentery etc. Mostly, rhizomes of the plants are explored and other parts are still in deed to explore. The current study was focused to assess the similarities and discrimination in Trillium govanianum tissues based on metabolomics approaches. Total phenolics, flavonoids, and total saponins were determined by using spectrophotometric methods. Polyphenolics determination and antioxidant activity were determined using UPLC-PDA and DPPH/ABTS assay, respectively, in all the tissues. Further, multivariate statistical analysis of quantified parameters was performed to discriminate the different tissues. The results showed variability in total phenolics and flavonoids content in all the parts. Stems (26.17 mg/g), Leaves (30.35 mg/g) and fruits (14.34 mg/g) were enriched with total phenolics, while buds (247.41 mg/g), stems (109.63 mg/g), and leaves (134.44 mg/g) enriched with total flavonoids content. Total saponins content were also found significant in the leaves, fruits, and stems. Due to these variations in the metabolites, a targeted polyphenolic (gallic acid, procatechuic acid, vanillic acid, epicatechin, p-coumaric acid, ferulic acid, rutin, luteolin) estimation was performed using UPLC-PDA and quantified in the various tissues of the plant. Further, stems and leaves were the good inhibitors of DPPH and ABTS free radicals, which indicates that this plant have great potential to scavenge free radicals. PCA and HCA showed the clear discrimination among the different tissues. *Trillium govanianum* is widely used as a traditional medicine, have diverse chemical constituents with biological activities. But, due to the limited knowledge of other parts only rhizomes of this plant are used, which cause excessive uprooting and bring this plant at endangered

condition. Since other parts also showed the presence of valuable metabolites, that can be used as alternative for the medicinal purpose, which will also play significant role for the conservation of the plant.

Variability based on morphological and EO traits in breeding lines of *Valeriana jatamansi*

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Valeriana jatamansi is an essential perennial rhizomatous plant belonging to family Valerianaceae which is used mainly in the flavor and pharmaceutical industry. In the pharmaceutical industry it is used for the formation of medicine against leprosy and anxiety. It is also used in the formulation of tranquilizers. In the Ayurvedic medicine system it has vital role in the treatment of various disorders and diseases like asthma, epilepsy, scorpion sting and snake bite. It is mainly found in the moist shady areas. Rhizome is the main economic part of *Valeriana jatamansi*. The rhizome is used for the extraction of essential oil and valepotriates. The essential oil quality depends upon the age and quality of planting material. Patchouli alcohol is the main component that determines the quality of essential oil. Various populations from the wild were collected and evaluated at CSIR-IHBT, Palampur, Himachal Pradesh at 1250 amsl. The potential plants from different populations were selected and multiplied clonally to establish them as breeding lines. The lines were evaluated in completely randomized block design with 29 treatments and 3 replications. The essential oil was extracted using Clevenger type apparatus for 6 hrs at 50˚C and oil was dried over anhydrous sodium sulfate to remove the water drops from oil. Morphological traits have shown vast diversity among the different breeding lines. Plant height ranged from 7.4 cm to 27.5 cm. Fresh rhizome biomass ranged from 30 gm to 480 gm. Essential oil quantity ranged from 0.03% to 0.37%. Breeding lines VJ-20-12 have 64.68%, VJ-20-11 have 65.1%, VJ-20-04 have 65.01% and VJ-20-02 have 62.92% patchouli alcohol content respectively. These breeding lines can further be used for hybridization of *Valeriana jatamansi*.

Quality control parameters study of endangered species *Swertia chirata* of western Himalaya

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The present study based on Identity, Purity and Assay based analysis of *Swertia chirata* whole plant of western Himalaya, one of the oldest bitter plant mentioned in traditional literature used to heal various body disorders. Emphasizes authentication of Species (*Swertia chirayita* (Roxb.) H. Karst. with issued accession no. 177), Physicochemical parameters includes Foreign matter (1.65±0.159%), Ash values (Total ash (4.28±0.737%), Acid insoluble ash (0.71±0.092%), Water soluble ash (0.266±0.194%), Soluble extractives (Water soluble extractives (14.003±0.4%), Alcohol (60%) soluble extractives (15.442±0.24%)), Moisture content (8.692±0.095%) by K.F., Loss on drying (5.538±0.191%), pH (1%solution 5.41±0.01), (10% 5.053±0.006), Heavy metals (As (0.11ppm), Cd (0.15ppm), Hg (0.04ppm), Pb 1.0ppm) analysis by ICPMS, HPTLC fingerprinting analysis (at 254nm and 365nm), Assay as mention in pharmacopoeial standard showed 1.407±0.021% total bitter content in raw material. A significant quality outcome was found showed suitable for its traditional claim.

Recapture of concept of methods of drug standardisation and evaluation

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In recent time, a large growth in natural product market and interest in traditional system of medicine is seen for which lead to proper integration of modern scientific techniques and traditional knowledge is important. This lead to development of Systematic approach and well-designed methodologies for the standardization of herbal raw materials and herbal formulations, which become an essential for all the ayurvedic practitioners, companies and even ayurvedic product consumers. Many explorations have been conducted regarding its importance and methods, but no one has covered all aspects comprehensively thus this poster aim to collect and comprehense review information available regarding the standardization parameters with the standards value of some herbal drugs along with ayurvedic references of same. This review is in a narrative format and is done from literature and publications relevant to Drug Standardization and Evaluation that were identified through a systematic search of major computerized medical databases. The safety and efficacy of herbal products depends upon the standardization of them. The evaluation of a drug is drug done by studying its various properties. The various properties are: Organoleptic evaluation, Microscopic evaluation, Physical evaluation, Chemical evaluation, Analytical evaluation and Biological evaluation. Methods of standardization may serve as an important tool for confirmation of its identity, Quality and purity. With tremendously growing herbal industry and a greater number of herbal products arriving in the market, the traditional approach towards standardization along with advanced techniques for standardization is needed for current herbal market.

Quantitative estimation of secondary metabolites of Shadanga Paneya classical Ayurvedic formulation and constituent herbs

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Ayurvedic drugs and formulations need standardization for the understanding of their pharmacokinetics and to prevent any safety issues. There are very limited reports available on the standardization of herbal formulations. Shadanga paneya (SP) is an antipyretic ayurvedic formulation composed of six herbs and most of the constituent herbs have shown the presence of alkaloids, flavonoids and Total phenloic contents (TPC). This is the first report of phytochemical estimation of SP formulation. Preliminary estimations of alkaloids, flavonoids and TPC in SP formulation and constituent herbs were done by using Dragendroff's method, sodium hydroxide solution and ferric chloride solution. Then quantitative estimations of alkaloids, flavonoids and TPC in SP formulation and constituent herbs were done by using Bromocresol Green, aluminium chloride colorimetric method and Folin-Ciocalteu's phenol reagent method. All the determinations were replicated in three independent assays, and the results were reported as a mean±standard deviation. The results revealed that all the constituent herbs contained flavonoids and TPC but alkaloids were only present in *Vetiveria zizanioides.* Alkaloids, total flavonoids and TPC of SP formulation were determined as 86.105±6.4, 87.8±4.0 and 105.8±3.8 mgGAE/g, respectively.

A brief pharmacognostical standardization of rhizome of popular healing herb - *Curcuma longa* Linn.

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Healing via herbs is as ancient as human being itself. Many of herbs have been so far recognised for their medicinal purposes, in which rhizome of *Curcuma longa* Linn showing its unique importance. Adulteration, substitution and lack of knowledge relate to herbal drug material may influence the quality control and research studies. The main objective of current investigation aimed to standardize *Curcuma longa* Linn rhizome on the basis of pharmacognostical study and phytochemical tests. Numerous parameters such as morphology, microscopy, preliminary phytochemical screening and physicochemical parameters were studied and their salient observational findings are documented. Macroscopic study helps in identification and preventing adulteration to genuine drug sample. Powder microscopy revealed the presence of xylem vessels with numerous starch grains. The studies of physicochemical standards are found within the limit as shown in authentic reference book. Preliminary phytochemical screening of rhizome extracts marked the presence of alkaloids, glycosides, tannins, steroids and flavanoids. Pharmacognostical and preliminary phytochemical evaluation may serves as a requisite source of information for confirming the identity of *Curcuma longa* Linn rhizome.

Evaluation of the *in-vitro* performance of different explants of Safed Musli for its efficient micropropagation

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Chlorophytum borivilianium is an eminent medicinal plant that has been listed as an endangered plant species. Choice of the most favorable explant which gives the best morphogenetic response with less contamination is very important for the successful micropropagation of the plant. Root Tuber is used as an explant in the conventional method of propagation but its poor germination rate restricted its usage. Tissue culturing of Safed Musli uses explants such as stem disc, leaf base, shoot base, tuber, and nodal explants but evaluation of the performance of each explant is very important in terms of germination, contamination, and survival percentage. The aim of the present study is to evaluate the *in-vitro* performance of different explants of Safed Musli for its efficient Micropropagation. Explants were generated from the plants grown in the nursery of Maharishi Dayanand University, Rohtak. All the explants were washed for 30 min with tap water, then washed for 5 min with liquid detergent teepol followed by washing with 70% ethanol for the 40s. Afterward, the explants were treated with 0.2% $HgCl_2$ for 2-3 minutes. Explants were cultured on an MS medium containing 3% sucrose and 0.8% agar supplemented with BAP (2.22uM) and pH 5.8. All cultures were maintained under 16h light/8h dark photoperiod at 25±2°C. After the experiment, it was observed that leaf base, stem disc, and tubers have poor germination rates with a visibly less percentage of contamination. The germination rate was higher for nodal explant (90%) than the germination rate for shoot base (80%) but the contamination rate was higher in shoot base culture compared to the nodal explant

culture. The nodal explants of Safed Musli can be used for its micropropagation with a higher germination rate, survival percentage, and fewer chances of contamination**.**

Standardization of herbal products for quality control

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Ayurveda is offering a world of possibilities with abundant innovation, investment, and growth opportunities. The need for herbal medicinal products is increasing and with an increase in need, the quality of herbal medicines is the call of the hour. Various physical, chemical, and geographical aspects contribute to the quality of these products. There are various techniques to determine the quality of herbal products. The aim of present study is to compile information on the need, significance, and techniques for quality control of herbal products. Published research articles from various search engines were reviewed mentioning QC of herbal products. Various techniques like HPLC, HPTLC, SFC, GC-MS are used for the quality control of herbs and products. However, each technique has its own benefits and limitations. Therefore, mindful use is necessary to ensure the quality of herbal products. Standardization techniques and parameters are the need of the hour to promote safe usage of herbal products. Therefore, judicial use of these techniques is required to establish safety, efficacy and global acceptance of herbs for the benefit of mankind and society.

Cultivation of medicinal plants to fulfill market demand and socio-economic developments

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Medicinal plants have been used as an essential part of wellbeing of all societies. Beside adding flavor to food, they are used to treat illnesses especially during pandemics. Their cultivation to fulfill the market demands and socio-economic development should be taken under consideration, so that in the coming era, more human population gets benefit. Ayurveda has been utilizing these properties, to enhance and wellbeing of human society since thousands of years. Many phytochemicals with established or potential biological activities have been identified in plants. For ayurvedic medicines, raw materials such as herbs and shrubs can be grown and harvested in a period of one year, while medicinal trees take >10 years to get ready for harvesting. Therefore, it is important to engage in conservation, cultivation, and research & development of medicinal plants. Cultivation of medicinal plants in a commercial mode is one of the most profitable agrobusinessfor farmers in India. If anyone has sufficient land and knowledge of herb marketing, then they can earn a high income with moderate investments. Cultivation of medicinal herbs such as *shankhapushpi, atis, kuth, kutki, kapikachhu* and *karanja* are changing the Indian agrarian ayurvedic scenes and providing extraordinary opportunities for farmers to increase their incomes. According to the traditional treatment health centre, there are 25 significant medicinal plants that are always in full demand. These plants include the Indian Barberry, Liquorice, *Bael, Isabgol, Atis, Guggal, Kerth, Aonla, Chandan, Senna, Baiberang*, Long Pepper, *Brahmi, Jatamansi, and Madhunashini, Kalmegh, Satavari, Ashwagandha, Chirata, Katki, Shankhpushpi, Ashoka, Giloe, Kokum* and *Safed Musli*.

Two-Dimensional Gas Chromatography (GCxGC): A multi-dimensional technique hyphenated to mass spectrophotometer for high-resolution separation of biomarkers in essential oils

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Essential oils are a class of secondary metabolites, present on the surface or in the secretory ducts of the plants. Essential oils are multicomponent mixtures of aromatic and volatile chemical compounds extracted from plant tissues, mainly by steam distillation, hydro-distillation and hydro-steam distillation. Several separation and identification techniques for individual components of essential oils are being done by sophisticated instruments like GC-FID, GC-MS, and LC-MS. However, despite the use of these instruments, co-elutions of target peaks with matrix peaks can still be present. GC×GC is thus a new revolutionary tool for the characterization of complex volatile and semi-volatile mixtures. The high peak resolution results due to an extra GC dimension. Chromatograms resulting from a GC×GC analysis can be represented as a three-dimensional figure and contour plots. On one side of the axis, it indicates the chromatogram that would be observed in a mono-dimensional GC. The other side of the axis shows a brief two-dimensional chromatogram after modulation. This technique leads to an improved chemical profiling and provides easy detection of some peaks that coeluted with other peaks in the first-dimension column. A GCxGC technique hyphenated to a quadrupole (GCxGC-MS) or time-of-flight

(GCxGC-TOF) mass spectrophotometer can be a powerful and useful tool for detection, identification and quantification of valuable biomarkers as well as toxic compounds present in traces in an essential oil.

Phytochemical constituents of some Indian medicinal plants

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Alkaloids, tannins, saponins, steroid, terpenoid, flavonoids, phlobatannin and cardie glycoside distribution in seven medicinal plants belonging to different families were assessed and compared. The medicinal plants investigated were *Aegle marmelos*, *Cynodon dactylon*, *Eclipta prostrata*, *Moringa pterygosperma*, *Pongamia pinnata*, *Sida acuta* and *Tridax procumbens*. The significance of the plants in traditional medicine and the importance of the distribution of these chemical constituents were discussed with respect to the role of these plants in ethnomedicine in India.

How to cite this article?
Proceedings of the International Conference on Conservation, Cultivation and Sustainable Use of High Altitude Medicinal and Aromatic Plants for the Socio-Economic Development, organised by Uttarakhand Ayurved University at Haridwar, Uttarakhand (India) on 07 and 08 May 2022. Journal of Conventional Knowledge and Holistic Health, 6 (1), Article ID 223.

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