वार्षिक प्रतिवेदन
Annual Report
2018

Diamond Jubilee Year (1959-2019)

60 Glorious Years of CSIR-CIMAP

CSIR-CIMAP

सीएसआईआर-केन्द्रीय औषधीय एवं सगंध पौधा संस्थान, लखनऊ

CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow

60 Glorious Years of CSIR-CIMAP










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(Council of Scientific and Industrial Research)

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Cover page

Depicts the glorious journey for 60 years of CSIR-CIMAP through some of its most important plants (like Mentha), facilities (like Incubation center) and products (like NBRMAP-DB/BGR-34) which have a proven track record of changing life style and economic status of the people of our country.

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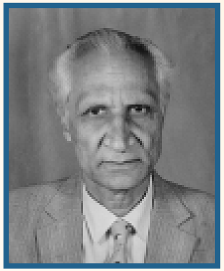


Dr. Akhtar Husain FNA, FNA Sc, FNAAS
Former Director
Central Institute of Medicinal & Aromatic Plants, Lucknow
Ex-Vice Chancellor, Jamia Hamdard, New Delhi

50, Adil Nagar Enclave
Lane No 3, Near Rasphil Academy
Kalyanpur, Lucknow 226 022
Tel: 0522-2752479

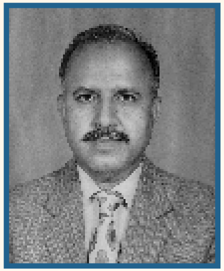
Message

I am pleased to learn that CIMAP is celebrating its Diamond Jubilee. During the last 60 years, the institute has made significant contribution to the economy of the country. It has brought out Japanese Mint Revolution with the result that India is now an exporter of Japanese mint oil and menthol. It has also introduced peppermint and spearmint. The institute has introduced citronella from Indonesia and the country is now self sufficient of citronella oil. The institute has also developed improved agrotechnology of lemongrass oil and palmarosa oil. However, it has still to introduce Ylang-ylang oil and bergamot mint oil which are imported from outside. I hope that the southern centre of the institute will reduce its import.

I wish all the best for your future endeavours.

Dr Akhtar Husain

Dr. R S Thakur, PhD. (Del), PhD. (Cantab)
Ramsay Memorial Fellow,
Research Associate (Stanford)
Former Director (1988-93), CIMAP



Message

It gives me great pleasure to convey my greetings to the Director and other staff on the occasion of diamond jubilee of CSIR-CIMAP. I am proud to be a member of this institution which has attained a world class status. I wish the Institute will prosper in the coming future.

R S Thakur

Sushil Kumar
INSA Honorary Emeritus Scientist,
4/11 Sarvpriya Vihar, New Delhi-110016;
sushil2000_01@yahoo.co.in.

Message

On it's 60th foundation day, I am delighted to wish CIMAP a very productive future. I feel highly privileged to have been associated with CIMAP as it's Director from 1993 to 2000. CIMAP is a great research institute of international importance.

The work of CIMAP has been oriented to provide medicinal and aromatic plant (MAP) materials (alkaloids, phenolics, terpenes etc.) for the preparation of medicines to prevent and cure illnesses and wounds and maintain body health in humans and to provide alternatives of antibiotic growth promoters as livestock food additives, for example Artemisia leaves. CIMAP's work on MAPs is highly inclusive, it concerns botanical, physiological, chemical, genetic and genomic analyses, development of yield and quality improved varieties, production of seeds and propagules, integration of MAP crops in the schedules of food and non-MAP industrial crops prevalent in different agroclimates of India and invention of new medicinal and cosmeticeutical products. On the one hand, CIMAP's work has made India a major resource of several industrial-MAP commodities, especially those having origin in *Artemisia annua, Catharanthus roseus*, mints, *Papaver somniferum* and vetiver. On the other hand, CIMAP's work with farmers has raised the rural income substantially and sustainably. Further, CIMAP has been promoting work on MAPs internationally by conserving the germplasm and publishing the informatics journal JMAPS.

In coming years, with climate change, denser population structure, increase in international travel, and life style disorders such as diabetes, blood pressure, joint pain, allergy and cancer have become common and infectious diseases have chances of becoming more widespread, CIMAP is bound to save crores of lives, like in the past. It's role in increasing rural income and national wealth could be enormous. My best wishes to the staff, scientists and Director of CIMAP for an emminent future.

Sushil Kumar

Message

CIMAP, the diamond to shine green with cutting edge science

The core competence of CIMAP as the leading laboratory of the CSIR has all the components to scientifically harvest the green wealth for enabling the society. Today when we celebrate the diamond jubilee of the institute, the CIMAPians deserve the credit of having relentlessly evolved CIMAP into Centre of Excellence for integrated plant science research leading to world class herbal products, molecules and technologies. The zeal and target oriented scientists and scholars with all member of the team CIMAP appear tuned to innovate and create business opportunities for making India a leading nation in herbals and natural products.

As one of the drivers of this ever evolving hub of plant science and technology during 2001 to 2008and enriched with leads created by my predecessors, I had the privilege to further lead the team of CIMAPians into "Biovillages" from laboratories to set a model of translational research and shaping it as an unmatchable centre of excellence globally in the medicinal and aromatic plants research and technology and pride of the nation. It also attained a status of entrepreneur maker institution of CSIR in rural and urban sectors both by "Reaching the unreached" approach. Since then, I have always cherished watching the success milestones that CIMAP has been achieving under new leadership. Today when we touch the diamond stage from gold and silver in the sleeve, the bigger challenge ahead has also to be added to the vision of interdisciplinary opportunities like artificial intelligence for metabolomics applications and robotics to reach farmers fields as once the distillation units had reached. Simultaneously, frontiers like synthetic biology and engineering need to be applied to create the opportunities for secondary and tertiary agriculture to bring next agri-revolution. This in turn would change the definition of agriculture beyond food creating health products and life aids emerging from farmer fields while industry finds the best enterprising opportunities in it.

If not CIMAP, then who will do this? I wish that CIMAP translates it into reality using the sharpness of focus derived from the cutting edge of diamond of technology that the institute should aim to be.

My best wishes and congratulations to all CIMAPians and CSIR, the mother on the occasion!

Suman Preet Singh Khanuja

काशी हिन्दू विश्वविद्यालय

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Prof. Anil Kumar Tripathi
Director, Institute of Science
FNA, FNASc, FNAAS
Professor, School of Biotechnology
Banaras Hindu University
(Formerly Director, CSIR-CIMAP, Lucknow)

Message

It is a matter of great delight that CSIR-CIMAP is celebrating Diamond Jubilee of its existence on March 26, 2019. Sustaining excellence with relevance for sixty years is a challenging task. But, the team of scientists at CSIR-CIMAP, I have enjoyed being part of the diverse opportunities of creativity and service to the farming community as well as Industry. While deployment of improved varieites of medicinal and aromatic plants, and process technologies developed by CSIR-CIMAP have brought prosperity, better quality of life and smile on the faces of thousands of farmers and their family members, establishemnt of pilot facility and promotion of herbal products by CSIR-CIMAP as friend of farmers, tribals and women by reaching the unreached across length and breadth of our country. The success of Aroma Mission has not only brought hope and happiness to the hoepless farmers; it has opened new vistas of addressing climate change by utilization of unproductive lands. These strides of CSIR-CIMAP have also instilled confidence in aroma industry for sustained availability of essential oils and resurgence of Indian Aroma Industry. By forging links with Research Institute on Fragrant Materials, USA and establishing IORA-RCSTT Coordination centre on Medicinal Plants, CSIR-CIMAP has expanded its domain of influence beyond our national borders. I sincerely feel and hope that the dedicated teamwork by the scientists of CSIR-CIMAP on these initiatives and many more in the service of the national will add meaning and value to its existence as a jewel in the crown of CSIR. It has been a beautiful experience being associated with the beautiful people in the beautiful premises of CSIR-CIMAP.

I convey my heartfelt congratulations and best wishes to all members of CSIR-CIMAP family and hope that CSIR-CIMAP continues to maintain its identify as a friend and well-wisher of farmers in addition to sustaining high quality research in its core areas.

(Anil K Tripathi)

From The Director's Desk....

It is a moment of immense pleasure to present the CSIR-CIMAP Annual Report for another productive year 2018, which also happens to coincide with Diamond Jubilee year celebration of the institute. The pathway to recognition at the highest level during the past 60 years has been made possible due to continuous tireless hard work of our Director, scientists, technical staff, research scholars and other supporting staff.

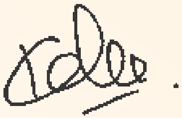
This year we continued our leadership for CSIR-Aroma Mission and contributed immensely as a partner of CSIR-Phytopharma Mission to bring pronounceable progress in these mission programmes. We were also provided an opportunity to play an important role in the newly constituted CSIR-Nutraceutical Mission program.

During this year, we published 74 high quality research articles. Our work identified and characterized important genes encoding OSCs and CYPs that are involved in corsolic acid production in banaba tree and can be utilized for commercial production of few significant pentacyclic triterpenes. We also published metablic engineering studies for increasing scopolamine in *Duboisa leichhardtii* hairy roots and Mono-and dimeric monotorpene indols alkaloids in *Catharanthus roseus*. Stress-responsive and/or spacio-temporal variations in *Artemisia annua* transcriptome, *Withania somnifera* metabolite, transcript and physiological behaviour profile, and *Mucuna purience* L-Dopa pathway regulation were also reported. Genetic and chemical content variation in *Withania somnifera* and *Ocimum basilicum* germplasm, which can be utilized towards selection of better genotypes/chemitypes, were also studied. A Novel method for saving rose-scented geranium mother plants under extreme climatic condition has been developed. In addition, suitability of increasing agricultural income through integration of aromatic crops in crop rotation has been assesed. Chemical composition and antiproliferative and anti-bacterial activity of essential oil from *Zingiber zerumbet* growing in foothills of Northern India was also assessed. We were able to demonstrate the lemongrass essential oil (LgEO)-loaded cellulose nanofibre composites could retain properties of pure LgEO and can be used in application like indoor air quality improvement and food stroage. A novel curcumin mimic 6a was discovered as a safe and efficacious anti-cancer compound. The role of Rutin (A nutritional flavonoid) in restricting the effect of tBHP and H_2O_2 induced oxidative stress in mamalian cells by increasing expression of genes like *nrf2* was also established. Efficacy of withanolide A in increasing life span of cancerous *C. elegans* were also assessed. Our *in vitro* and *in vivo* studied also concluded that ethyl acetate extract of *Rosa damascena* petal could restrain progression and pathogenicity of malarial parasites.

This year we released 'CIM-SFURTI', an advanced breading line of Kewanch having high seeds yield and L-Dopa content, 'CIM-SHISIR' a multicut, lodging resistant cold tolerant high essential oil yielding inter specific hybrid of Ocimum, and 'CIM-Pushti' a withanolide A rich leaf blight tolerant high yielding variety of *W. somnifera*. A natural aromatic floor cleaner was released this year and licensed to Saksham Herbal and Organic Pvt Ltd., New Delhi. One patent was also granted during this year. Our institute was recognized through various awards to our scientists including a 'Certificate of Merit' from CSIR for *Ocimum* based technological interventions.

To celebrate 60 years of our institute, a series of 'Diamond Jubilee' invited lectures was organised, which were delivered by various dignitaries.

On the occasion of Diamond Jubilee Year, I extend my sincere thank and congratulate team CSIR-CIMAP for their immense contribution on scientific, societal and technological fronts. My special thanks to all our former Directors, seniors and peers for their guidance and support towards fulfilling the expectations of the society.



(Alok Kalra)

निदेशक की कलम से......

मुझे सीएसआईआर–सीमैप का 2018 का वार्षिक प्रतिवेदन प्रस्तुत करते हुए अपार हर्ष हो रहा है, जो कि संयोग से सीमैप के हीरक जयंती समारोह का वर्ष भी है। संस्थान के निदेशकों, वैज्ञानिकों, तकनीकी कर्मचारियों व अनुसंधान सहायकों तथा अन्य कर्मचारियों के कठिन एवं सतत् प्रयासों के सामूहिक प्रतिफल के स्वरूप सीमैप इन साठ वर्षों में वैज्ञानिक क्षेत्र में ऊंचाई प्राप्त कर सका है एवं अपनी एक विशेष पहचान बना सका है।

इस वर्ष भी हमने एरोमा मिशन के अन्तर्गत किसानों की आय को बढ़ाने हेतु प्रयास किया और सीएसआईआर फार्मास्यूटिकल मिशन के सहभागी के रूप में कार्य करते हुए इन मिशन के कार्यक्रमों में अपना सघन योगदान दिया। इस वर्ष सीमैप को नवीन परियोजना सीएसआईआर न्यूट्रा स्यूटिकल मिशन में भी महत्वपूर्ण भूमिका निभाने का अवसर प्राप्त हुआ।

इस वर्ष हमने 74 उच्च गुणवत्ता वाले शोध पत्रों का प्रकाशन किया। हमारे अनुसंधान कार्यों के परिणामस्वरूप महत्वपूर्ण जीन्स OSCs और CYPs की पहचान एवं सूचीबद्ध किया गया जिसके माध्यम से बनाबा वृक्ष में कार्सोलिक एसिड के उत्पादन तथा इसके उपयोग से महत्वपूर्ण पेंटा साइक्लिक ट्राईटरपीन्स का व्यावसायिक उत्पादन किया जा सकता है। सीमैप ने चयापचयी प्रौद्योगिकी के अध्ययनों का भी प्रकाशन किया जिसके द्वारा डूबोसिया लैकार्डो हेयरी रूट में स्कोपोलामाईन तथा कैंथरेंथस रोजियस में मोनो एवं डाईमेरिक मोनो टरपीन इंडोल अल्कालायड, विथानिया सोम्नीफेरा में चयापचयी क्रियाएं ट्रांसक्रिप्ट, कार्यकी व्यवहार स्तरों, तथा मुकुना प्यूरियंस में एलडोपा चयापचयी मार्गों के अध्ययनों का भी प्रकाशन किया गया। अश्वगंधा एवं तुलसी के जर्मप्लाज्म में निहित प्रजनिक एवं रसायनिक विभिन्नताओं का उपयोग उच्च गुणवत्ता की प्रजातियों के विकास का अध्ययन किया गया। सीमैप ने रोज सेंटेड जिरेनियम की एक नवीन तकनीक का विकास किया है जिसके माध्यम से वर्षा ऋतु में जिरेनियम के मातृ पौधों का बचाया जा सकता है। इस तकनीक का उपयोग करके किसान अपने खेतों में उच्च मूल्य की जिरेनियम के पौधों को स्वयं बचा सकते है। इसके अतिरिक्त कृषि आय में बढ़ोत्तरी हेतु पारम्परिक फसल चक्र में औस (औषधीय एवं सगंध) फसलों की सहभागिता की संभावनाओं पर परीक्षण किया गया। हमने लेमनग्रास के तेल के नैनोसेलुलोस तकनीक का विकास किया जिसके माध्यम से कमरों के अन्दर की हवा की स्वच्छता एवं भोज्य पदार्थों के भंडारण की गुणवत्ता को बनाये रखा जा सकता है। हमने एक नवीन कैंसर प्रतिरोधी रसायनिक संघटक कुर्कमीन मिमिक 6a का प्रतिपादन किया है। हमारे अध्ययनों ने रूटीन (पोषणिका फ्लेवोनायड्स) के प्रभाव को स्थापित किया है जो कि tBHP एवं H_2O_2 को प्रेरित करने वाले तनाव को सीमित करता है, जब स्तनधारियों की कोशिकाओं की जीन्स जैसे कि nrf2 की अभिव्यक्ति में वृद्धि होती

है। हमारे परीक्षणों द्वारा ज्ञात हुआ है कि विथानोलाइड ए कैंसर ग्रसित सी एलिगन्स के जीवन काल में वृद्धि करता है। हमारी वाह्य एवं आंतरिक अध्ययनों से पता चला है कि रोजा डैमसेना (गुलाब) की पंखुड़ियों के इथाईल एसीटेट के उद्धरण द्वारा मलेरिया परजीवियों के विकास एवं रोगकारक क्षमता को नियंत्रित करने में मदद मिलती है।

इस वर्ष केवॉच की अधिक बीज एवं एलडोपा प्रजाति "सिम स्फूर्ति" तथा तुलसी की प्रजाति "सिम शिशिर" जो कि ठंड रोधी बहु एवं उच्च तेल उत्पादन वाली हाइब्रिड, तथा उच्च उत्पादन एवं विथानोलायड ए युक्त, लीफ ब्लाइट रोधी प्रजाति "सिम पुष्टि" का विकास किया गया है। इस वर्ष नेचुरल एरोमेटिक फ्लोर क्लीनर को विकसित एवं व्यावसायिक उत्पादन के लिए जारी किया गया तथा इस तकनीक को सक्षम हर्बल एवं आर्गेनिक प्राइवेट लिमिटेड, नई दिल्ली को हस्तांतरित किया गया। इस वर्ष एक पेटेंट को भी मंजूरी मिली है। हमारे संस्थान एवं वैज्ञानिकों को विभिन्न संस्थागत पुरस्कारों द्वारा सम्मानित किया गया है जिसमें तुलसी आधारित तकनीक के विकास हेतु सीएसआईआर द्वारा मेरिट प्रमाण पत्र भी शामिल है।

संस्थान के 60 वर्ष पूर्ण होने के उपलक्ष्य में हीरक जयंती व्याख्यान की श्रृंखला भी आयोजित की गयी जिसमें विभिन्न विख्यात सम्मानित बुद्धिजीवियों द्वारा व्याख्यान दिया गया।

हीरक जयंती वर्ष के अवसर पर मैं टीम सीएसआईआर–सीमैप को वैज्ञानिक, सामाजिक एवं तकनीकी क्षेत्रों में उनके योगदान एवं सहयोग के लिए धन्यवाद एवं शुभकामनाएं देता हूँ। मैं पूर्व निदेशकों, वरिष्ठ सदस्यों एवं साथियों को सामाजिक अपेक्षाओं के पूर्ण करने में उनके सहयोग एवं मार्गदर्शन के लिए भी धन्यवाद देना चाहता हूँ।

(आलोक कालरा)

Input: Saudan Singh

Effect of harvesting height and postponement of rainy season harvest under different soil physico – chemical properties on oil yield of citronella

In this study, reduction in oil yield was recorded during peak rainy season harvest i.e. (30.07.2017 to 15.08.2017). Further delay in harvest up to 90 days had positive effect on oil yield irrespective of soil physico-chemical properties and harvesting height. Harvesting of the crop from 20 cm height was always better for getting maximum herbage and oil yield followed by 40 cm and 60 cm. Basic soil fertility had positive correlation with oil yield irrespective of postponement of the harvest and harvesting height.

Field view of the crop before 2nd harvest

Loamy sand with poor fertility

Loamy sand with moderate fertility

Loam soil with good fertility

Field view of the crop after 30 days of IIIrd harvest

Evaluation of productivity of French basil (*Ocimum basilicum* L) grown as intercrop with traditional rainy season crops

Maximum essential oil yield of *Ocimum basilicum* was obtained in sole treatment (85.01 kg/ha) which was at par with Pigeon pea + *Ocimum* (79.71 kg/ha) followed by Okra + *Ocimum* (77.61 kg/ha) , Maize + *Ocimum* (74.93 kg/ha) and Pearlmillet + *Ocimum* (62.57 kg/ha).The reduction in plant population of main crops significantly increased the herb and essential oil yield of *Ocimum basilicum* irrespective of different crops.

Ocimum + Pigeon pea

Ocimum + Okra

Ocimum + Maize

Ocimum + Pearl millet

Input: Rajesh K Verma

Evaluation of essential oil yield and quality of palmarosa (*Cymbopogon martinii*) varieties with arbuscular mycorrhizae species under salinity stress soil

The yield and quality of essential oil of Tripta, PRC-1 and CIMAP-Harsh under the salt stressed soil with intervention of arbuscular mycorrhizal fungi (AMF). The essential oil yield (7.04–12.70 g kg^{-1} fresh biomass) and geraniol yield (5.71–10.56 g kg^{-1} fresh biomass) were significantly affected by the variety, soil type and AMF inoculation. Altogether, twenty-eight constituents, representing 97.32–99.47% of the total oil compositions were identified using GC-FID and GC-MS techniques. Major constituents of the oils of different varieties were geraniol (76.73–83.28%), geranyl acetate (6.59–13.06%), linalool (0.87–3.0%), (2*E*,6*Z*)-farnesol (0.77–2.96%), geranial (0.29–2.03%), myrcene (0.54–1.96%), (*E*)-*β*-ocimene (0.43–1.95%), (*E*)-caryophyllene (0.27–1.28%) and geranyl hexanoate (0.31–1.17%). Significantly, higher essential oil and geraniol yields were observed in var. Tripta due to AMF intervention (*Funneli formismosseae* and *Glomus aggregatum*). Overall, it can be concluded that palmarosa var. Tripta more suited to the SAS than other varieties.

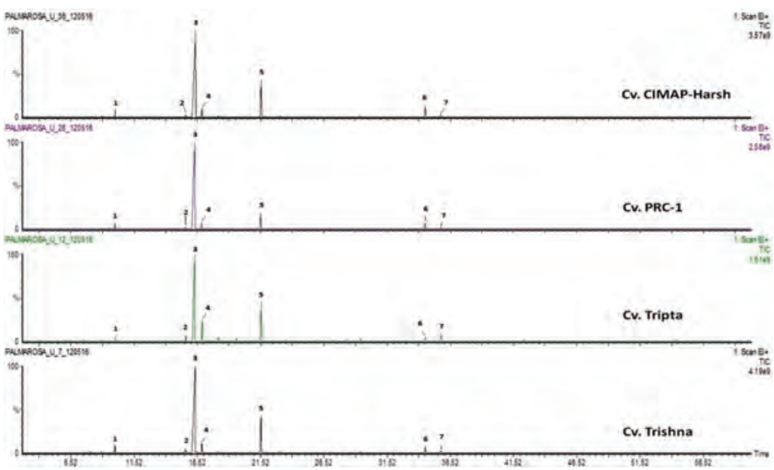


Figure : Comparative chromatographic profiles of different varieties of palmarosa (*Cymbopogon martinii*). Peak **1**: linalool; **2**: neral; **3**: geraniol; **4**: geranial; **5**: geranyl acetate; **6**: (2*E*,6*Z*)-farnesol; **7:** geranyl hexanoate.

Input: Puja Khare

Retention of antibacterial and antioxidant properties of lemongrass oil loaded on cellulose nanofibre-poly ethylene glycol composite

The lemongrass oil (LgEO) exhibits excellent antioxidant and antibacterial properties. However, low aqueous solubility and instability of its major constituents reduced the retention of these properties for the longer time.Hence, LgEo loaded composites of cellulose nanofibres (CNFs)-polyethylene glycol (PEG) were fabricated through melt and mixing process and sustainability of their antioxidant and antibacterial properties was assessed. The interaction of essential oil with composite systems was evaluated using Fourier-transform infrared spectroscopy (FT-IR), *scanning electron microscope* (*SEM*), Transmission electron microscopy (TEM), and X-ray powder diffraction (XRD) and quantification of released major compounds up to 120 days was done by *Solid phase micro extraction/ Gas chromatography-mass spectroscopy* (SPME/GC-MS) methods. Results suggested that composite systems were able to sustained major compounds of lemongrass essential oil (geranial, neral and geranyl acetate) up to 120 days and followed Pseudo Fickian diffusion of aroma molecules. *In vitro* study of total antioxidant capacity, total phenolic, free radical scavenging efficiency and antibacterial properties (against *S. aureus* and *E. coli*) of the composites were suggested that composite system retained the properties of the pure lemongrass oil. These results

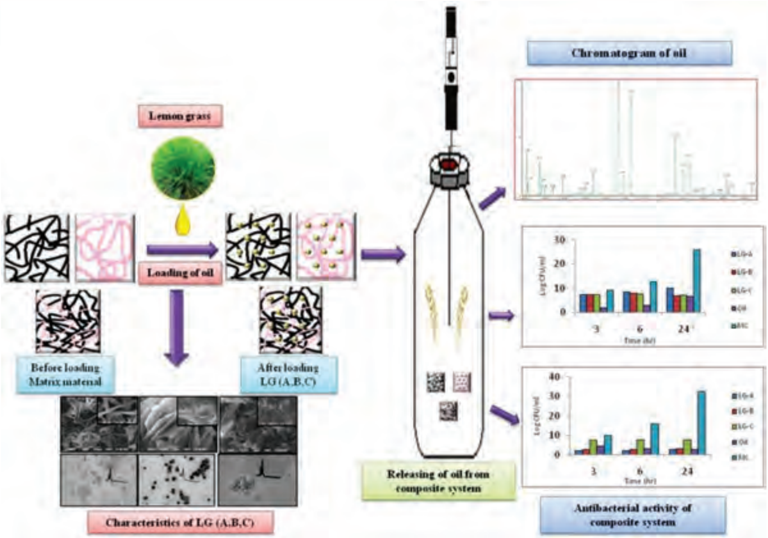
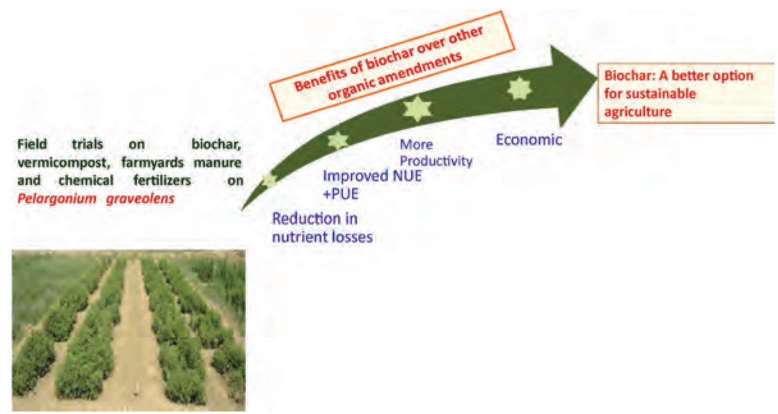


Fig: Lemongrass oil loaded composites of cellulose nanofibres (CNFs)- polyethylene glycol (PEG)

indicate that fabricated scented composites can be used further in various industrial applications such as indoor air quality improvement materials and food storage. [Industrial Crop and Product, 2018, 114, 68-80]

Benefits of biochar over other organic amendments: Responses for plant productivity (*Pelargonium graveolens* L.) and nitrogen and phosphorus losses

Biochar is considered a promising option for soil fertility improvement, little is known about its advantage and profitability over other organic amendments in terms of nutrient losses/harvest and plant productivity for short-term crops. A field trial of geranium *(Pelargonium graveolens L)* was conducted using farmyard manure, vermicompost, and biochar with and without inorganic fertilizers. Nitrification, ammonification, phosphorylation, N_2O emissions, nitrogen, and phosphorus used efficiencies along with crop productivity were examined for each treatment. Results indicated that addition of farmyard manure, vermicompost and biochar reduced nitrogen and phosphorus losses. The improved nutrient efficiencies by organic manure led to increasing the productivity of the geranium crop. Among three organic manures, biochar had the lowest losses to harvest nutrient ratio (0.39-0.69). Vermicompost treatments demonstrated the highest losses to harvest nutrient ratio (1.24 to 3.25). The budget estimates using nutrient loss, damage cost, and plant productivity implied that biochar addition in the sole and in combination with inorganic fertilizers was economics for farmers. However, vermicompost and farmyard manure were also profitable in sole treatments. The combined treatments of farmyard manure and vermicompost were not economic due to higher nutrient losses and their environmental impact. The conversion of organic waste to biochar could be the more promising option for the reduction of nutrient loss, damage cost, and plant productivity in sustainable agriculture. [Industrial Crop and Product, https://doi.org/10.1016/j.indcrop.2019.01.045]



Input : Rakesh Kumar

Performance of different parts of planting materials and plant geometry on oil yield and suckers production of Menthol-mint (Mentha arvensis L.) during winter season

Field experiment was conducted during 2017-18 at the research farm of CSIR-CIMAP Research Centre Pantnagar to evaluate the performance of different sources of planting materials and plant geometry on oil yield and suckers production of menthol mint (*Mentha arvensis* L.) under tarai region of Uttarakhand. The studies involved three source of planting materials (P1-Whole shoot; P2-Upper portion of shoot and P3-Lower portion of shoot) and three plant geometry (S1-50×15 cm; S1-50×30 cm and S1-50×Running) were applied. The study revealed that, planted as whole shoots resulted in higher suckers yields (89.78 q/ha) as evident from higher oil yield (102.76 kg/ha). Among the planting distance, broader spacing showed higher yield of oil (95.31 kg/ha) and suckers (83.52 q/ha) in menthol-mint during experimentation.

Table Performance of different source of planting materials and spacing on oil and suckers production of *Mentha arvensis***.**

Treatments	Plant Height (cm)	Crop Spread (cm)	Herbage yield (kg/m^2)	Herbage yield (q/ha)	Suckers yield (kg/m^2)	Suckers yield (q/ha)	Oil (%)	Oil yield (kg/ha)
Planting Materials								
P_1-Whole shoot	51.89	72.67	1.73	172.74	0.89	89.18	0.60	102.76
P_2-Upper portion of shoot	48.11	68.33	1.59	158.88	0.74	73.54	0.58	92.72
P_3-Lower portion of shoot	42.78	55.11	1.31	131.12	0.42	41.68	0.53	69.36
SEm±	1.13	3.62	0.03	3.46	0.04	4.25	0.02	3.38
LSD (p=0.05)	3.13	10.05	0.10	9.61	0.12	11.80	0.06	9.38
Planting Distance								
S_1-(50×15 cm)	53.33	72.11	1.58	158.01	0.70	69.70	0.58	91.70
S_2-(50×30 cm)	49.00	64.89	1.67	167.07	0.84	83.52	0.57	95.31
S_3-(50×Running)	40.44	59.11	1.38	137.67	0.51	51.18	0.56	77.82
SEm±	2.52	2.56	0.03	2.75	0.04	3.65	0.04	6.53
LSD (p=0.05)	5.50	5.58	0.06	5.99	0.08	7.96	NS	14.24
Interaction	NS	NS	NS	NS	*	*	NS	NS

Input: Alok Kalra & Venkata Rao, D.K.

Production of γ-decalactone, a natural aromatic compound, from castor oil using oleaginous yeast system - Value addition of castor oil

The biological conversion of castor oil into aroma compounds has been known for many years, its practice in India is still rare. The main idea in this project is to develop an engineered strain of yeast to effectively break down ricinoleic acid in castor oil to give a desirable aroma compound. *Yarrowia lipolytica*, a non-conventional yeast, is the organism of choice for accomplishing this, due to its renowned ability to grow on hydrophobic media such as oils and also because of previous reports of *Y. lipolytica* producing aroma compounds from different oil rich substrates. *Yl*MSR-84 strain was cultured on YPD

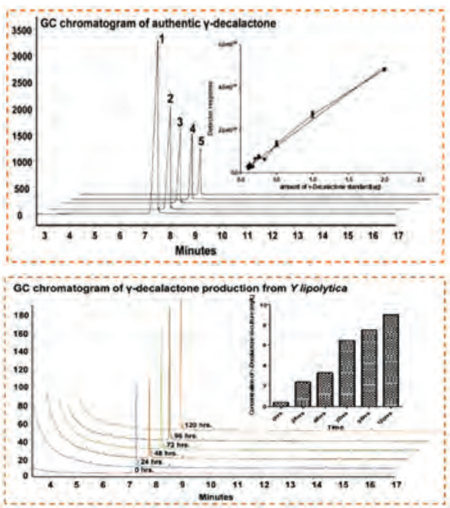


Fig: GC-FID analysis of γ-decalactone production from *Yarrowialipolytica*

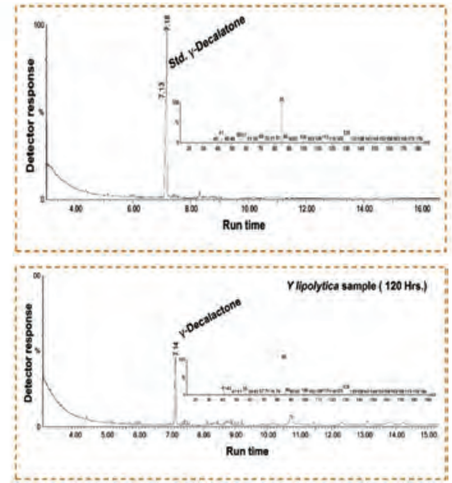


Fig: GC-MS analysis of γ-decalactone production from *Yarrowialipolytica*

medium (1% yeast extract, 2% peptone, 2% dextrose) at 180rpm orbital shaker, at a constant temperature of 30 °C. The growth kinetic studies were performed in YPD by measuring the absorbance of the growth medium at 600nm at various time points. For the biotransformation of castor oil, *Yl*MSR-84 was grown in YPC medium (1% yeast extract, 2% peptone, 3% castor oil, 0.67% yeast nitrogen base with amino acids, 0.3% Tween 80, 0.25% ammonium chloride) where the carbon source dextrose was replaced with castor oil and emulsifying agent. The growth kinetic studies were performed in YPC in a similar manner as in YPD. *Yl*MSR-84 was also grown in YP medium (yeast extract 1g, peptone 2g, water 100ml) as a control. The production of γ-decalactone was analysed in growth medium using GC-FID and GC-MS. The quantitative and qualitative analysis of gamma-decalactone was carried out using GC-FID and GC-MS analyses. Further, strain improvement and fermentation optimization studies are in progress for the maximal yield of gamma-decalactone from castor oil.

Inputs: A. Samad

Acorus calamus Leaf Spot: A New disease Caused by *Curvularia pseudobrachyspora* in India

Acorus calamus (sweet flag), family Acoraceae, is a perennial herb distributed in India, Europe, East Asia, and North America.

It is cultivated globally for β-asarone-rich essential oil that has carminative, antispasmodic, insecticidal, larvicidal, and antihelminthic properties. In July 2016, brown spots 2 to 3 mm in diameter were observed on both sides of leaves in experimental fields of *A. calamus* at CSIR–Central Institute of Medicinal and Aromatic Plants, Lucknow. The spots later turned into dark necrotic lesions with yellow halos. Disease incidence ranged from 25 to 30%. The infected leaves were cut into small pieces, surface sterilized, placed on potato dextrose agar, and incubated at 28 ± 2°C for 7 days. Pure colonies were obtained by single-spore culture. The colonies were gray in color, with hyaline to pale brown mycelia that were septate and branched. Conidiophores were septate, straight, and occasionally branched, pale brown to brown in color. Conidia had 2 to 3 septae, pale brown to brown, mostly curved, ellipsoidal to obovoid, and third cell from the base was usually larger and darker than the other cells. The size of conidia ranged from (15 to) 19.5 to 25 (to 28.5) × (6 to) 8 to 11 (to 13) μm. (Fig. 1) The fungus was identified as *Curvularia*

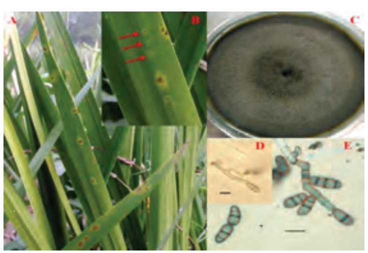


Fig: Leaf spots on *Acorus calamus* caused by *Curvularia pseudobrachyspora*. **A)** Typical leaf spot symptoms with a yellow halo on *A. calamus*; **B)** Initial symptoms showing with an arrow on *A. calamus*; **C)** Fungal culture on PDA; **D)** Conidia attached with conidiophore at 40X (*scale bar* 10 μm); **E)** A single conidia and conidiophores attached with conidia at 100X (*scale bar* 10 μm).

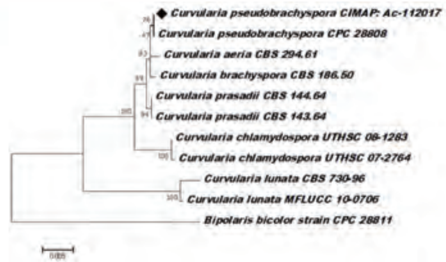


Fig: The phylogenetic tree of combined ITS and GAPDH gene using neighbor-joining MEGA 7 software, and revealed its genetic relatedness with *C. pseudobrachyspora*(CPC 28808). The tree is rooted with *Bipolaris bicolor*.

pseudobrachyspora based on cultural and morphological characteristics. Identity was confirmed by sequence analysis of the internal transcribed spacer and glyceraldehyde-3-phosphate dehydrogenase gene regions of amplified DNA; sequence data were deposited in GenBank (MG645008, MG656404). BLASTn showed 100% identity of both genes to *C. pseudobrachyspora* (MF490819, MF490841). A phylogenetic tree was drawn by MEGA 7 and revealed its genetic relatedness with *C. pseudobrachyspora*. Pathogenicity testing was conducted under a glasshouse by spraying of fungal spore suspension (10^5 spore/ml) on 10 healthy plants. Sterile distilled water was sprayed on three additional plants to serve as a control. All plants were kept in a growth chamber at 27 ± 2°C with 85% relative humidity for 5 days. After that, plants were moved to the glasshouse at 28 ± 2°C for monitoring the development of symptoms. The fungus was isolated from symptoms matching those described above, and *C. pseudobrachyspora* was reisolated, thus confirming Koch's postulates. The disease has affected crop yield in and around Lucknow and is becoming a limiting factor for its cultivation. To the best of our knowledge, this is the first report of Acorus leaf spot disease caused by *C. pseudobrachyspora* in India as well as globally. A similar leaf spotting disease, caused by *Helminthosporium microsorum*, was previously reported on *A. calamus*. These findings support the need to develop diagnostics and effective strategies for managing *C. pseudobrachyspora*.

Input: Rakesh Pandey

Age-induced diminution of free radicals by Boeravinone B in *Caenorhabditis elegans*

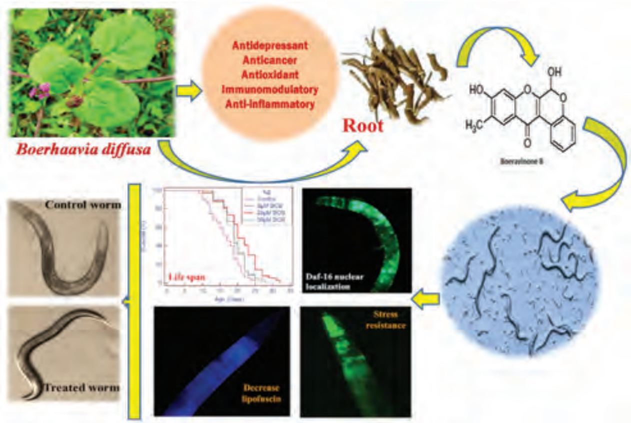
Oxidative damage is accrual of molecular deterioration from reactive oxygen species (ROS) while decrease in generation of ROS is related with free radical scavenging enzymes. *Boerhaavia diffusa* L. (Nyctaginaceae) derived novel molecule Boeravinone B (BOB) possesses a variety of pharmacological activities, yet their anti-aging potential has not been explored. The aim of the present study was to elucidate the mechanism of BOB mediated oxidative stress resistance and lifespan extension in *Caenorhabditis elegans*. The results showed that the BOB significantly extends the lifespan of C. elegans with its anti-oxidative potential via reducing accumulation of reactive oxygen species (ROS). BOB was found to recover the shortened lifespan of oxidative stress prone mutants mev-1 and gas-1 (14.75 and 16.11%, respectively). Additionally, this finding supported by the reduced ROS levels seen in BOB treated worms. Further, the effective concentration of BOB (25 μM) significantly enhanced the expressions of target genes such as superoxide dismutase (SOD-3), glutathione-S-transferase (GST-4) and heat shock protein (HSP-16.2) fused to green fluorescent protein (GFP), and it does so by modulating the stress related signaling pathways (SEK-1) and transcription factors (SKN-1/Nrf and DAF-16/ Foxo). Moreover, BOB exposure (25 μM) caused significant changes of age-dependent biomarkers such as pharyngeal pumping, body bend, locomotor activity and lipofuscin accumulation were also showed that BOB retards the aging. Overall, the findings highlight the antioxidant supplement triggering pharmaceutical potential of BOB which may serve as a new future perspective for healthy aging or delayed onset of oxidative related diseases (Experimental Gerontology 2018, 111:94-106).

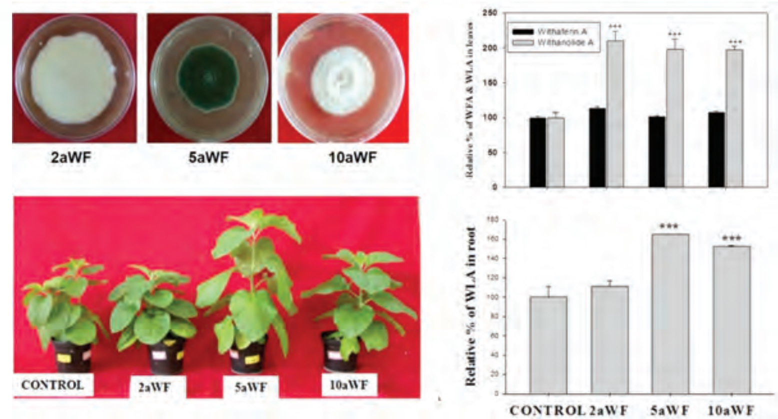
Withanolide A extends the lifespan in human EGFR-driven cancerous *Caenorhabditis elegans*

The conserved EGFR pathway is linked with multiple cancers in humans including breast, ovarian, and lung carcinoma. Withanolide A, one of the major withanolidal active compounds isolated from the Withania somnifera, extends lifespan and ameliorates stress resistance in wild-type C. elegans by targeting the Insulin/IGF-1 signaling pathway. Up-regulation of IGF1 can transactivate EGFR which inturn reduces longevity and promotes tumor development in an organism. We examined the effects of Withanolide A on the lifespan of a human EGFR driven *C. elegans* transgenic model exhibiting the multivulva (Muv) phenotype. The results showed that WA extends the lifespan of both wild human EGFR-driven C. *elegans* model (human wild-type tyrosine kinase) as well as models bearing single (L858R), and double mutations (T790M-L858R). The lifespan extension observed in these transgenic strains was 20.35, 24.21 and 21.27%, respectively. Moreover, the reduced fat levels were noticed in both wild-type N2 worms and transgenic strains. These observations support the heathspan promoting effect of WA as lipid-rich diet has been reported to promote tumor development. In view of the fact that most of the well known FDA approved drugs such as gefitinib fail to inhibit the EGFR-associated cancers because of these mutations, the present findings show the potential of Withanolide A as a foreseen future nutraceutical to improve the average survival of cancer patients (Experimental Gerontology 2018, 104:113-117).

5,7-Dihydroxy-4-methoxyfalvone a bioactive flavonoid delays amyloid beta induced paralysis and attenuates oxidative stress in transgenic *Caenorhabditis elegans*

The various herbal remedies have been used in Aurveda which symbolizes traditional medicine system since ancient times. The increasing popularity in herbal medicine has prompted us towards the





development of natural therapeutics for preventing neurodegenerative disease such as Alzheimer's disease (AD) in living organism. Present study focused on a flavonoid compound 5,7-Dihydroxy-4-methoxyfalvone alsoknow as Acacetin which is major constituent *Premna odorata* (L.) plant. Present findings suggest that 5,7-Dihydroxy-4-methoxyfalvone may provide protection against Aβ toxicity and oxidative stress due to its potential antioxidant activity. Therefore this bioactive compound may provide invaluable medicinal and health benefits which can delay the onset of age related diseases (Pharmacognosy Magazine 2018, 14:S57-64).

Input: CS Vivekbabu

Identification of Three fungal Endophytes in *W. somnifera*

Here we report, three fungal endophytes, *Aspergillus terreus*strain 2aWF, *Penicilliumoxalicum* strain 5aWF and *Sarocladiumkiliense* strain 10aWF from *Withania somnifera*, which could enhance withanolides content in leaf and root. Upon treatment with the above endophytes to 4 weeks old plants in field conditions, *W. somnifera* elicited withanolide A content (97 to 100%) in leaves without considerable changes in withaferin A content. Furthermore, withanolide A content in roots of 5aWF and 10aWF endophyte treated *W. somnifera* plants increased up to 52% and 65% respectively. Incidentally, expression profile of withanolide and sterol biosynthetic pathway genes *HMGR, DXR, FPPS, SQS, SQE, CAS, SMT1, STE1* and *CYP710A1* were significantly upregulated in 2aWF, 5aWF and 10aWFfungal endophyte treated plants. Besides, modulation of withanolide biosynthetic pathway genes, fungal endophytes also induce a host resistant related gene, NPR1 resulting in 2, 4 and 16 fold expression levels in 2aWF, 10aWF and 5aWF endophyte treatments respectively, compared to control plants. Overall, our results illustrate that application of native-fungal endophytes 2aWF (96.60 %), 5aWF (95%) and 10aWF (147%) enhance plant biomass in addition to withanolide content and induce positive stress on secondary metabolite production of *W. somnifera* without causing any deficiencies on plant health.

Input: Anil Kumar Gupta

Genetic and chemotypic variability in basil (*Ocimum basilicum* L.) germplasm

A study was conducted to estimate the genetic diversity in *Ocimum basilicum* germplasm consisting of sixty accessions using Mahalanobis D2 analysis. All the *Ocimum* accessions were grouped into seven diverse clusters and there was no parallelism observed between the genetic divergence and geographical origin. Among the nine economic characters, leaf area was found to be the major contributor towards genetic divergence (16.01%) followed by oil yield (15.12%); however, the lowest contributing character was plant height (4.26%). Chemical characterization of the accessions was also carried out based on the percentage of different components of the essential oils present in them. A six-membered cluster exhibited the maximum content of methyl chavicol in the essential oil. Some accessions were found to be highly rich in linalool and can be used for selection of linalool rich chemotype/lines. Some accessions exhibited linalool along with methyl cinnamate. An accession OB 28 was found to be rich in methyl cinnamate and methyl eugenol.

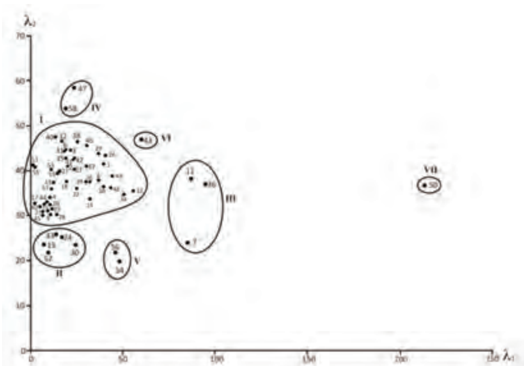


Fig: Spatial distribution of 60 genetic stocks of *Ocimum* in λ_1-λ_2 chart

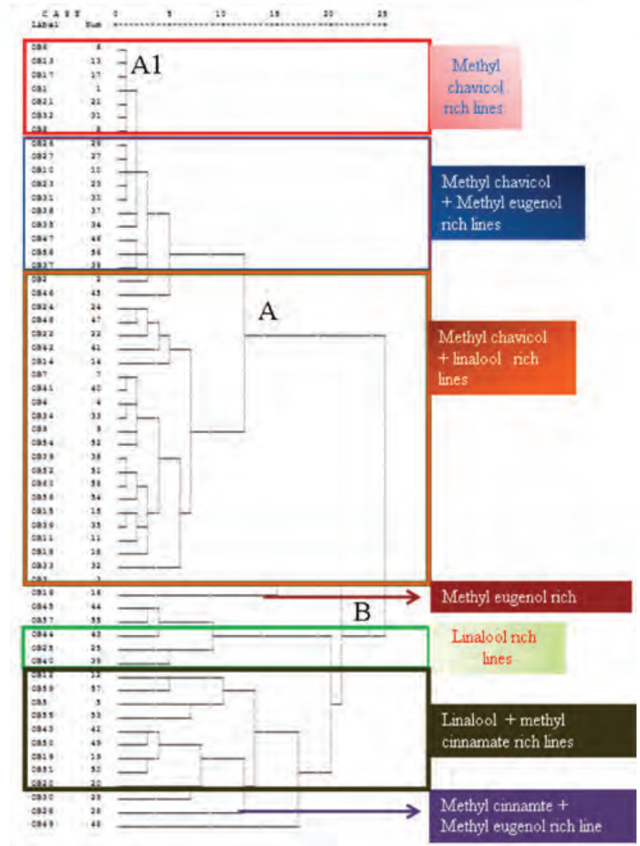


Fig: Bidimensional dendrogram representing the similarity between 60 accessions of *Ocimum basilicum* for the chemical composition of the essential oils.

Therefore, new chemotypes of *Ocimum* can be exploited in the hybridization program possessing different combinations of essential oils. (*Industrial crop and products*, 112: 815-820).

Genetic variability, associations, and path analysis of chemical and morphological traits in Indian ginseng [*Withania somnifera* (L.) Dunal] for selection of higher yielding genotypes

A study on genetic variability and nature of associations of various traits to the root yield of the plant based on data collected on fifty-three diverse genetic stocks of ashwagandha (*Withania somnifera*) for 14 quantitative characteristics revealed that the genotypes differed significantly for all characteristics studied. Presence of high heritability in conjunction with high genetic advance for fresh root weight, 12 deoxywithastramonolide in roots and plant height, indicates that the selection could be effective for these traits. A tight linkage of dry root weight was observed with plant height and fresh root weight. Further, in path coefficient analysis, fresh root weight, total alkaloid (%) in leaves, and 12 deoxywithastramonolide (%) in roots had the highest positive direct effect on dry root weight. Therefore, these characteristics can be exploited to improve dry root weight in ashwagandha genotypes and there is also scope for the selection of promising and specific chemotypes (based on the alkaloid content) from the present germplasm and using them in hybridization program.(*Journal of Ginseng Research* 2018, 42: 158-164)

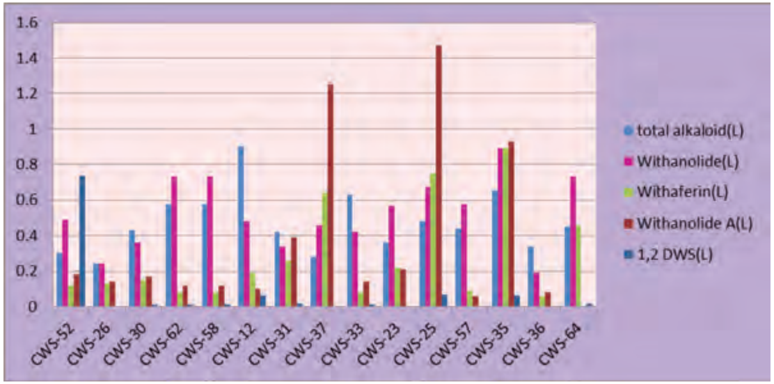


Fig: Graph representing the alkaloid content in leaves of best 15 genotypes in *Withania somnifera* selected based on dry root yield

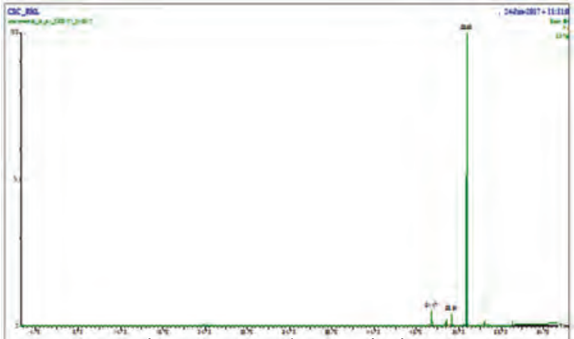
Genetic diversity, essential oil composition, and in vitro antioxidant and antimicrobial activity of *Curcuma longa* L. germplasm collections

Genetic divergence was estimated among sixty-five genotypes of turmeric (*Curcuma longa* L.) using Mahalanobis D2-statistics on thirteen agro-morphological quantitative traits. The genotypes were grouped into nine clusters. The highest inter-cluster distances were observed between cluster IX (1871.46) and cluster VIII (1296.51), suggesting that the genotypes included in these clusters may be used for future breeding programme. Traits like fresh weight of rhizome, dry weight of rhizome were the major contributors to the genetic divergence. The chemical composition of essential oils from eight selected genotypes of *Curcuma longa* L. was studied and identified by gas chromatography–mass spectrometry (GC/MS). The compounds cis-sesquisabinene hydrate (3.4%), curzerenone (0.6%), β-bisabolol (2.2%), and farnesol (1.2%) were found only in CIM Pitamber variety. The total percentage of compounds identified from the essential oil of *Curcuma longa* leaves was maximum in CIM Pitamber (98.1%) followed by Bhagauna (90.9%). The antioxidant activity results demonstrated that *Curcuma* genotypes had marked ferric ions reducing ability and having electron donor properties for neutralising free radicals. All *Curcuma* genotypes exhibited bacteriostatic nature against *Mycobacterium smegmatis* strain, used for the screening of antitubercular activity. (*Journal of Applied Research on Medicinal and Aromatic Plants*, 10: 75-84)

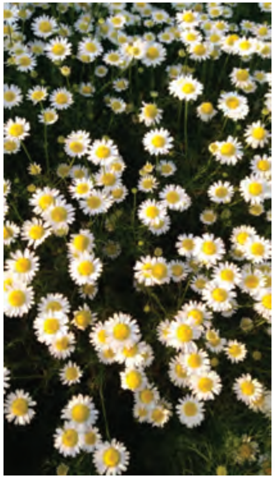
Input: VR Singh

A novel chemotype of chamomile (*Chamomilla recutita* [L.] Rauschert) CIM- Ujjwala: Source of acetylinic compound [(2z, 8z)-matricaria acid methyl ester] for use in cosmetics and pharmaceuticals

The plant *Chamomilla recutita* (family: *Asteraceae*), popularly known as 'Chamo-mile', is a natural source of essential oil containing terpenoides and flavonoids that have value in pharmaceutical and perfumery industries. Its dried flowers are in demand owing to their extensive use in herbal tea, mouth wash and bathing, etc. Although this plant was introduced in India, around three centuries ago, its cultivation could not expand because of volatility in market and lack of improved cultivars. The novel chemotype CIM-Ujjwala is very promising for higher yields of flower and oil, which is rich in acetylinic compound (2z,8z)-matricaria acid methyl ester (76-80%). This improved chemotype has the production potential of 7.0-7.5 q/ha dry flowers and 6.00-6.50kg /ha oil yield. The acetylinic compound [(2z,8z)-matricaria acid methyl ester], effective in reducing pigmentation of human skin, is used in cosmetic and pharmaceutical industries.

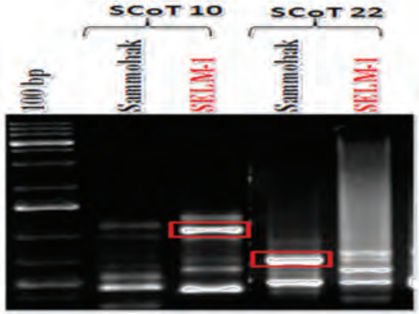


Chromatogram of essential oil



Characteristics of var. 'CIM -Ujjwala'	Crops of Chamomile var. 'CIM Ujjwala'
Characters	CIM- Ujjwala
Plant height (cm)	60
Date of flowering (50%)	100-120 days
Growth habit	Semi close
Primary branches/plant	10
Dry flower yield (q/ha)	7.00-7.50
Oil content (%)	0.88
Oil colour	Light brown
Oil yield (kg/ha)	6.00-6.50
(2Z,8Z)-Matricaria acid methyl ester (%)	76-80.00 %
Other features	Late maturity for harvesting

The chemotype CIM–Ujjwala of Chamomile has been developed by CIMAP through intensive mutation breeding. This chemotype would provide highly remunerative return to the growers and industries.



Molecular profiling by Scot markers

Input: Birendra Kumar

Genetic improvement of MAPs using crop specific breeding strategies : Effect of potassium chloride-induced stress on germination potential of *Artemisia annua* L. varieties

Fig Identified sweet odoured high oil yielding spearmint genotype MSMATS-2

Studied effect of direct exposure of different concentrations of potassium chloride-induced stress on germination potential, enzymatic, non-enzymatic and biochemical changes of two *A. annua* varieties ('CIM- Arogya' and 'JeevanRaksha') under *in vitro* conditions. The results revealed a non- significant decrease in the germination percentage and significant decrease in seedling vigor index while proline and lipid peroxidation increased with a rise in the potassium chloride concentration irrespective to varieties. Comparatively, 'CIM-Arogya' variety showed higher germination percentage, seedling vigor index, carbohydrate, protein, catalase, proline and lipid peroxidation except total phenolic content which was superior in 'JeevanRaksha' at 150 mMKCl. Furthermore, 'CIM-Arogya' showed a better adaptation and tolerance potential (up to 150 mM) to potassium chloride-induced stress than 'JeevanRaksha' (up to 100 mM). The finding also suggest that farmers / cultivators can raise the nursery of *A. annua*in normal conditions of soil and transplant the seedlings with potassium chloride concentration up to 150 mM for 'CIM-Arogya' and 100 mM for 'JeevanRaksha'. [*Journal of Applied Research on Medicinal and Aromatic Plants*. 2018, 9: 110-116 DOI : 10.1016/j.jarmap.2018.03.005]

Genetic improvement of MAPs using crop specific breeding strategies

Genetic enhancement of *Mentha* species Sweet odoured spearmint genotype : MATMS-2 has been developed through interspecific hybridization between M. arvensis x M. spicata having oil yield potential of about 85-100kg/ha with 58-61% carvone, 21-22% limonene, 1.0-2.0% menthol, 1.0-1.6% *iso*-Dihydrocarveol acetate, 1.2% menthone, 1.0% *cis*-carvyl acetate, 0.2% *iso*-pulegol, 0.2% aromadendrene content in its essential oil. The oil content ranged from 0.50-0.60%. Yield evaluation trial is under progress.

Input: Tripta Jhang

Development of Citral rich advance breeding line in *Ocimum basilicum*

There are limited ISO certified sources of citral oil ensuring content minimum of 74%, promising of them of them are Litsea cubeba70-85%, Lemongrass(65-85%). A need for an early growing, short duration, high biomass resource of "citral" can be met from *Ocimum basilicum*in4-5 months. An advance breeding line of Ocimum basilicum rich in citral content 70% and oil content 0.37% fresh herb yield 450-500g per plant na d oil yield167-

Input: Venkatesha K.T

Genetic enhancement of essential oil yield in Menthol mint (*Mentha arvensis* L.).

Fig: Morphologically distinct and agronomically superior half-sib progeny of menthol mint

About 85 half-sib progenies were developed by using genetically different menthol mint varieties *Viz.*,Kalka,Saksham, Himalaya,CIM-Saryu, Gomti,Damroo,Kushal, Kosi,CIM-Kranti, MAS-1 and Sambhav. Individual half-sib progenies were characterized for agro-morphological and chemical constituents of oil. The essential oil yield was varied from 0.3% to 1.3%, menthol was varied from 0.18% to 80.15% and menthone was ranged from 0.12% to 84.76%.

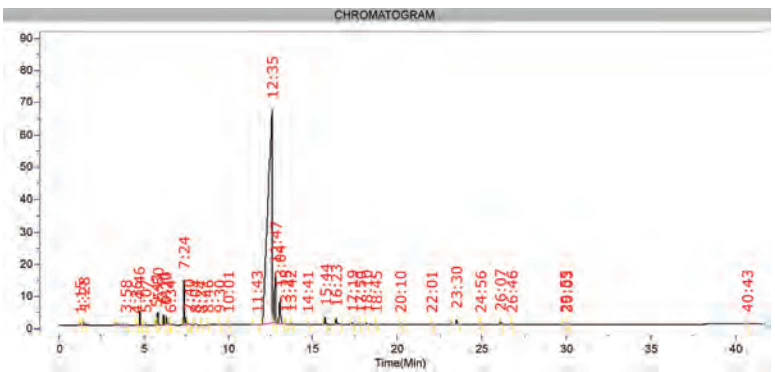


Fig: Gas chromatography profile of menthone rich essential oil of one of the half-sib progeny of menthol mint.

Inputs: Sanjay Kumar, Ramesh Kumar Srivastava, Ram Suresh Sharma, Ram Pravesh and Deepak Kumar Verma.



Study on economics and marketing of Senna (*Cassia angustifolia*)

Senna (*Cassia angustifolia*) is an extremely medicinal plant used in traditional system of medicine from ancient times. The present study of senna is cultivated for leaves and pods, which are used as laxative. Senna is a powerful cathartic used in the treatment of constipation, working through a stimulation of intestinal peristalsis. In India, Senna is cultivated in Gujarat, Rajasthan and dry coastal districts of Tamil Nadu. The data was collected from district Jodhpur, Rajasthan. The data was collected from the 100 farmers of Khidrat area in district Jodhpur, Rajasthan. The area faces extremes of the temperature with very little availability of water. The soil condition of the region is also non-fertile and sandy. The socio-economic profile of the farmers at Khidrat is also not good. In spite of having good average landholding of 6.45 hectares, the farmers are poor in the region. The farmers in the region are preferring the cultivation of medicinal crops rather than the traditional crops because these crops require less resources. Therefore, could survive well in the area. The economics of cultivation of senna per hectare in the study region was calculated using simple mathematical tools. The total cost of cultivation of senna came out Rs. 5,381/ha out of which the maximum contribution of cost were shared by harvesting (36.96%) followed by miscellaneous charges (23.62%). The net return over cost was found Rs. 13,353/ha and B:C ratio hence obtained was 1:2.48 which indicates that on spending a rupee on senna cultivation gave the farmers a return of Rs. 1.48 which is a profitable venture.

Economics of Menthol mint (*Menatha arvensis*)

The present study for performance evaluation newly developed varieties of CIM-Kranti and other varieties of menthol mint cultivation has been carried out at farmers' field of central Uttar Pradesh. Mints are commonly used as the source of fragrance, flavor and pharmaceuticals industry. The study period 100 farmers cultivating CIM-Kranti and other varieties have been selected from the region of central Uttar Pradesh. The primary data were collected from the selected farmer's field on profitability comparison between CIM-Kranti and other varieties under cultivation. The highest area and production has been observed during 2012 and 2013. Simple statistical tools and techniques have been used for data analysis of the cost of cultivation and profitability. It has been observed during the study that CIM-Kranti gives higher returns (Rs.98491/- ha/year) over other varieties (Rs. 70977/-ha/year). However, the input cost of CIM-Kranti is higher than other varieties of the crop but the net return of CIM-Kranti was more profitable than other varieties. The benefit cost ratio has been observed 1.45 and 1.74 of other varieties and CIM-Kranti respectively. The new variety "CIM-Kranti" of menthol mint is cold and frost tolerant and has the potential to produce 10-15% more oil i.e. 145-160 kg/ha in summer season as compared to all other popular commercial cultivars of menthol mint. It is suggested from the study that maximum profit is generated through CIM-Kranti cultivation followed by other varieties crop.

Market Survey:

Major markets of medicinal and aromatic plants were surveyed at different locations in Uttar Pradesh, Madhya Pradesh and Rajasthan. These markets were Varanasi, Rampur, Moradabad, Bareilly, Barabanki, Lucknow, Jodhpur and Neemach. Major commodities traded in these markets were found as ashwagandha, sarpagandha, bramhi, akarkara, satavar, kalmegh, sarpgandha, amla, senna, isabgoal, dry rose flowers and in essential oils menthol mint, lemongrass, palmarosa, vetiver, citronella, chamomile and tulsi.

Inputs : Manoj Semwal

Indian Bioresource Information Network (IBIN) Geoportal Phase III: Enhancing Bio Resource Services, Institutional Linkages and Outreach

The project intends to design a web resource sharing information system/ web portal on MAPs integrating it with advanced information and communication technologies. It will share the idea of user-generated content in applications like conserving economically significant medicinal plant species, policy planning and bio prospecting studies in digitized format. This Web Information System geo-database contains primary information on the taxonomic and biodiversity status on MAPs herbarium holdings especially of Uttarakhand region of CSIR-CIMAP. Presently, 148 records of MAPs have been digitized in the CSIR – CIMAP Medicinal and Aromatic Plants Web Information System, which belong to 22 plant families distributed across 13 districts of Uttarakhand. The embedded information in the database will not only help users to readily obtain desired information on traditional and chemical descriptions of the MAPs exclusively found in various regions of Uttarakhand but also

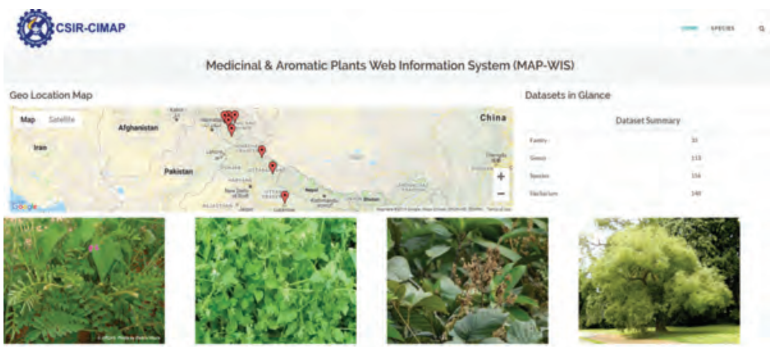


Fig: Screenshot of the web resource sharing information system developed aid in distinguishing the hotspots of MAPs biodiversity to bridge the gap in biodiversity exploration studies. Ecological niche modeling using various available software tools for the rare and endangered MAPs with respect to climate is also being done under the project.

Crop monitoring for Menthol mint based cropping system using unmanned aerial vehicle (UAV/Drones) and date analytics tools.

The study was conducted during the year 2018 in the Barabanki district of Uttar Pradesh. The soil analysis from fields of 42 farmer (7 from each tehsil) was done and soil health card were prepared. The total study was conducted through drone imageries. This helped in providing timely scientifically validated advisory services which not only reduced the input of the resources but also increased the use efficiency of the soil nutrients. The site specific precise recommendations were also provided to reduce the chances of crop failure (due to nutrient deficiency and insect/disease infections as observed by drone data), besides increasing the yield (upto 20%) and profitability of the menthol mint farmers. Spectral libraries were also created for the Kosi, Saryu and CIM-Kranti varieties, nutrient dosages, pests and diseases for development of data analytic models to provide the precise and timely advisories to the menthol mint farmers.

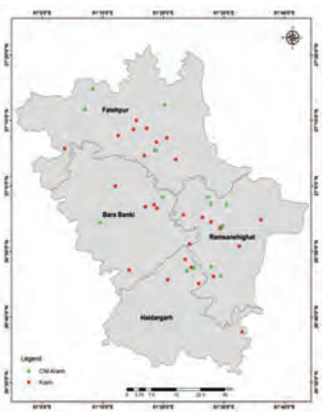
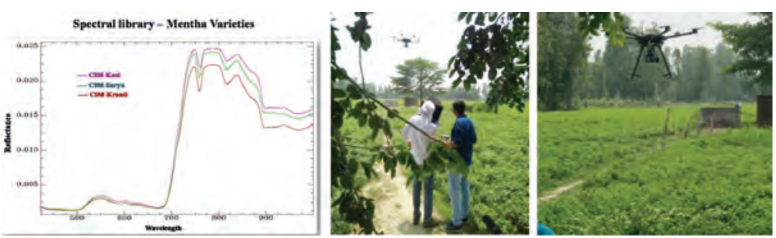


Fig.: Location of farmers



a b c

Fig : (a) Spectral libraries developed (b & c) Drone at farmers field

Mentha crop acreage estimation using Sentinel-2 time series satellite data in Barabanki, Uttar Pradesh

In this work, a method is being developed to estimate crop production at micro scales using high-resolution Sentinel-2 time series (2017 and 2018), GIS and ground data in the Barabanki district up to zone level (Barabanki, Fatehpur, Haidergarh&Ramsanehigha Taluks) for the year 2017-18. This work focused on estimation of agricultural production which relies on supervised, pixel-based crop type classification inside an existing cropland mask. Mentha crop acreage estimation using from Sentinel-2a data had 95% overall accuracy (OA) and 85% Overall Kappa Statistics. An increase of 7.5% in the Mentha crop area was observed in 2018 as compared to 2017.

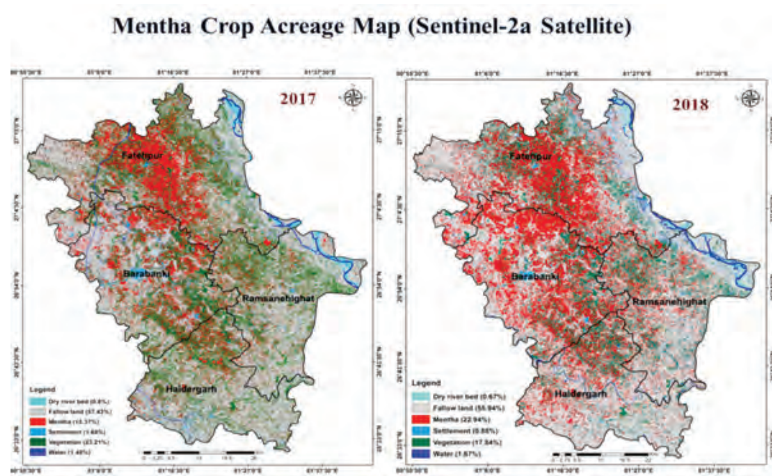
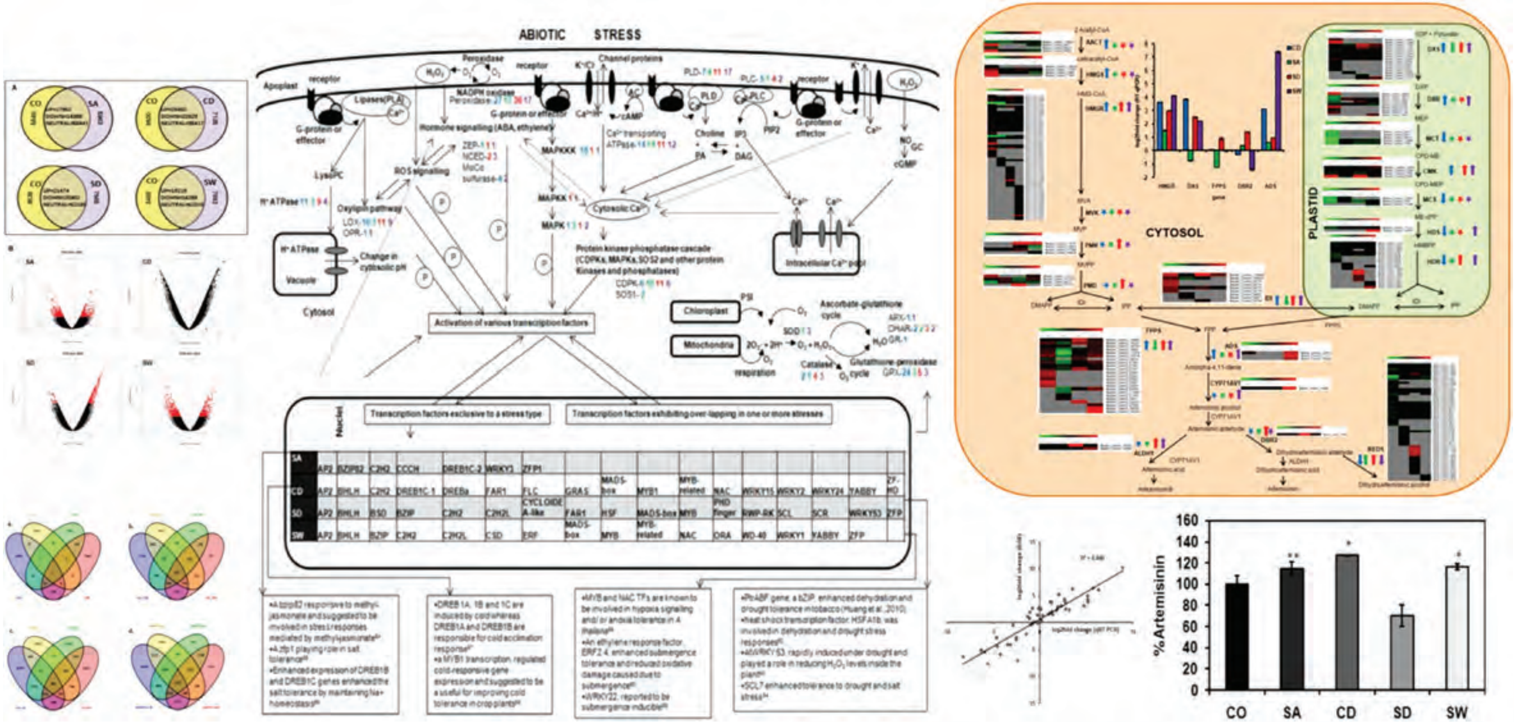


Fig. : Mentha crop acreage maps of Barabanki, Uttar Pradesh

Input: AK Shasany

Transcriptome changes induced by abiotic stresses in *Artemisia annua*

The study was planned in a way that it may simultaneously address two problems encountered by the plant. Firstly, to know the effect on the artemisinin content in the era of climate change because the secondary metabolites tend to increase under stress. Secondly, to identify some of the stress responsive genes that could help in stress tolerance of the plant under abiotic stress. The *A. annua* plants were subjected to four abiotic stresses (salt, cold, drought and water-logging) and it was observed that the artemisinin content increased in all the stress conditions except drought. In order to identify the stress responsive genes, the transcriptome sequencing of the plants under stress was carried out resulting in 89,362 transcripts for control and 81,328, 76,337, 90,470 and 96,493 transcripts for salt, cold, drought, and water logging stresses. This investigation provides new insights for functional studies of genes involved in multiple abiotic stresses and potential candidate genes for multiple stress tolerance in *A. annua* (Sci Rep. 2018 8(1):3423)

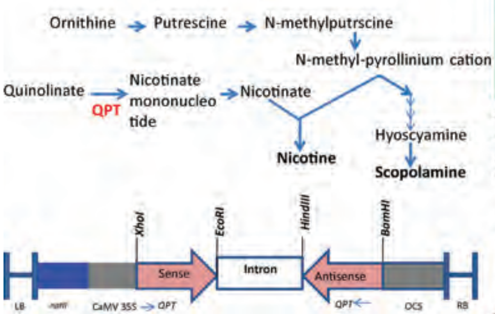


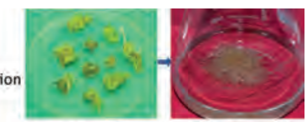
Input : Laiq-ur-Rahman

Silencing of quinolinic acid phosphoribosyl transferase (*QPT*) gene for enhanced Production of Scopolamine in Hairy root culture of *Duboisia leichhardtii*

P7 root line revealed the maximum content of scopolamine (8.84±0.117 mg/gm) which was 2.6 fold higher than the control (1.44±0.12 mg/gm) at 30th days

Maximum content of scopolamine (19.344 ± 0.275 mg/gm) had found at the 96th hour with 150 μM MeJa treatments which gave ~2.2 fold higher amount than the untreated control HR and ~12.24 fold higher than the non transgenic control HR. (Scientific Reports 2018, 8:13939 | DOI:10.1038/s41598-018-32396-0).





Genetic transformation with *A. rhizogene having QPT-RNAi construct* and growth of HR Culture in liquid MS Media

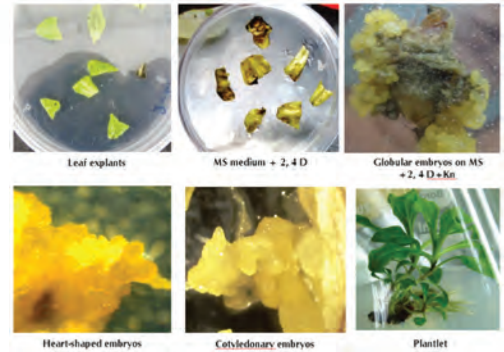
Semi quantitative analysis of *nptII* gene

Direct Somatic embryogenesis of *Swertia chirayita* (Roxb. ex Fleming) Karsten:

Swertia chirayita used as herbal medicine for various health ailments including liver disorder, malaria, diabetes, skin disease and fever.

Its market demand in pharmaceutical industries has been increased considerably.

Leaves were cultured on MS medium supplemented with 2,4-D, NAA, BAP and Kinetin either individually or in combination for direct induction of somatic embryos.



Further maturation of the somatic embryos was achieved on MS medium supplemented with BAP.

Conversion and germination of the mature embryos into plantlets was achieved on half strength MS basal medium.

Input: Vikrant Gupta

Studies on molecular aspects of root biogenesis in *Withania somnifera* for the improvement of root quality and biomass:

Withania somnifera (Ashwagandha), also known as Indian Ginseng and native to India, is one of the most important medicinal plants. In Indian traditional systems of Medicine, Ayurveda and Unani, Ashwagandha is used alone or in combination with other medicinal plants to treat human diseases and health disorders. In Ayurvedic medicine system, Ashwagandha is claimed to have powerful aphrodisiac, rejuvenative and life prolonging properties. Modern-day scientific research have provided strong evidences for a plenty beneficial roles that Ashwagandha may provide to humans such including anti-inflammatory, anti-oxidant, boosting the immune system, suppressing tumor growth, regulating hormones, stabilizing mood, reducing anxiety and regenerating nerve cells. These beneficial roles include. Ashwagandha contains specialized metabolites known as withanolides and withaferins to which most of the pharmacological activities are attributed. Most crucial *W. somnifera* secondary metabolites imparting biological activities are majorly present in the root of plant. The quality and quantity of root produced by the plant of utmost concerns, as the plant material is assessed by root parameters to be used in the medicine system. In order to study the molecular aspects of the root biology of *W. somnifera*, attempts have been initiated to identify the genetic components that are expected to govern the root biosynthesis in this plant. Based on the information available in model plants related to the root biogenesis and growth, putative candidates have been identified including *BIG BROTHER* (an E3 Ubiquitin Ligase and a repressor of plant organ growth), *SHR* (involved in acceleration of plant growth and increased fresh biomass), and *DWARF4* (*DWF4*: over-expression of which yields increased seed yield and higher root biomass and length) in the transcriptome dataset available in NCBI database. Attempts are being done to clone these candidate genes in routine cloning vectors. Once clones, they would be functionally characterized at the molecular level.

Input: Dinesh A. Nagegowda

Metabolic engineering of periwinkle for improved production of anticancer alkaloids

Catharanthus roseus (Periwinkle) is the sole source of two of the most important anticancer monoterpene indole alkaloids (MIAs), vinblastine and vincristine and their precursors, vindoline and catharanthine. The MIAs are produced from the condensation of precursors derived from indole and terpene secoiridoid pathways. Our previous studies demonstrated that the terpene moiety limits MIA biosynthesis in *C. roseus*. To overcome this limitation and to enhance MIAs levels, bifunctional geranyl(geranyl) diphosphate synthase [G(G)PPS] and geraniol synthase (GES) that provide precursors for early steps of terpene moiety (secologanin) formation, were used for metabolic engineering. Agrobacterium-mediated transgenic overexpression of *G(G)PPS* and *G(G)PPS + GES* significantly enhanced the accumulation of secologanin,

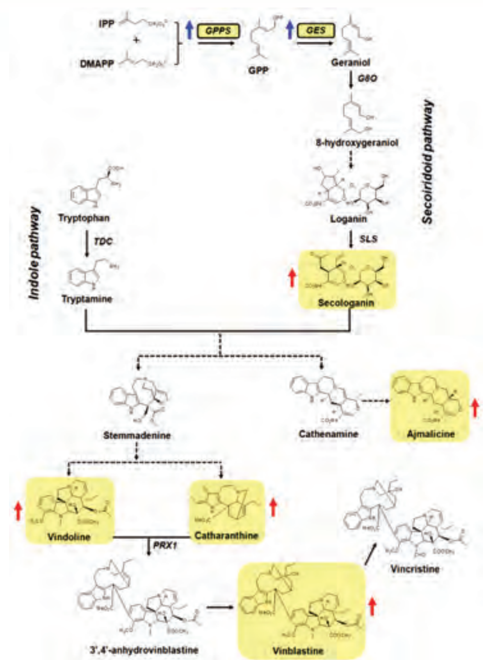


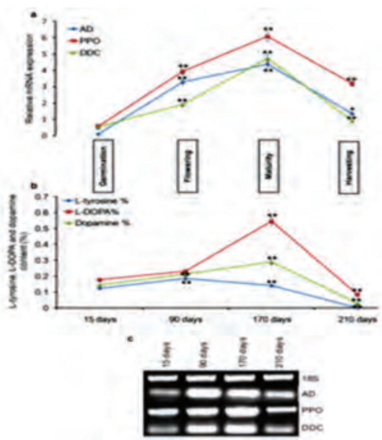
Figure: Simplified version of monoterpene indole alkaloids (MIAs) biosynthetic pathway in *C. roseus*. Full and dashed arrows indicate single and multiple enzymatic steps, respectively. The genes used to generate transgenic plants, geranyl(geranyl) diphosphate synthase [G(G)PPS] and geraniol synthase (GES), are boxed. Structures of analyzed metabolites in this study are shown in yellow highlighted boxes. DMAPP, dimethylallyl diphosphate; G8O, geraniol-10-hydroxylase/ 8-oxidase; GPP, geranyl diphosphate; IPP, isopentenyl diphosphate; PRX1, peroxidase 1; SLS, secologanin synthase; TDC, tryptophan decarboxylase. Blue and red arrows indicate enhanced gene expression and metabolite accumulation, respectively.

which in turn elevated the levels of monomeric MIAs in engineered plants. In addition, transgenic *C. roseus* plants exhibited increased levels of root alkaloid ajmalicine. The dimeric alkaloid vinblastine was enhanced only in *G(G)PPS* but not in *G(G)PPS+GES* transgenic lines that correlated with transcript levels of peroxidase-1 (*PRX1*) involved in coupling of vindoline and catharanthine into 3′,4′-anhydrovinblastine, the immediate precursor of vinblastine. Transgenic plants displayed normal growth in both T_0 and T_1 similar to wild-type plants indicating that the bifunctional G(G)PPS enhanced flux toward both primary and secondary metabolism. (*Frontiers in Plant Science*, 2018, 9: 942)

Input: Sunita Singh Dhawan

Biochemical characterization and spatio-temporal analysis of the putative l-DOPA pathway in *Mucuna pruriens*

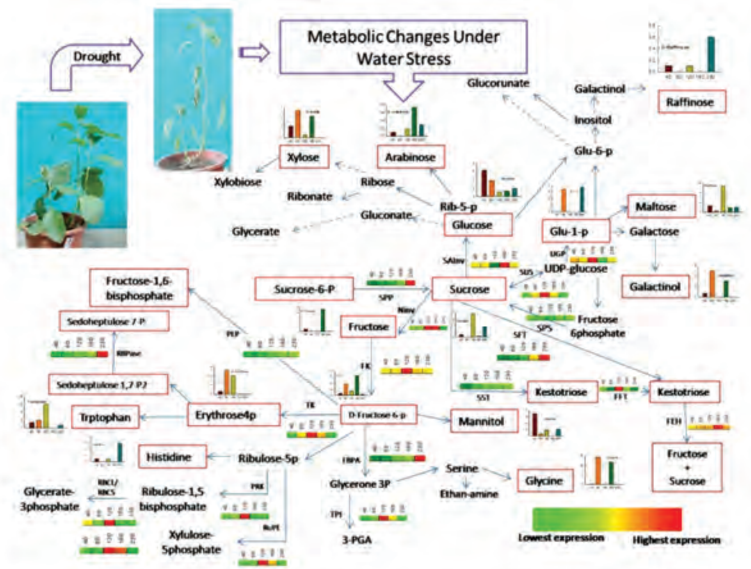
The *de novo* transcriptome analysis was performed using leaves of the selected *M. pruriens mutant T-IV-9* during maturity. The putative l-DOPA pathway and its regulatory genes were retrieved from transcriptome data and the l-DOPA pathway was biochemically characterized. The spatial and temporal gene expression for the l-DOPA pathway was identified with respect to the chemical constituents: l-tyrosine, l-DOPA, and dopamine contents were highest in leaves during maturity (about 170-day-old plants). The



polyphenol oxidase (PPO) was highly expressed in tender stems (230-fold higher as compared to seeds) as well as a high l-DOPA content. The reproductive parts of the plant had a higher amount of l-DOPA content (0.9–5.8%) compared to the vegetative parts (0.2–0.91%). (Planta. 2018, DOI: 10.1007/s00425-018-2978-7).

Modulations in primary and secondary metabolic pathways and adjustment in physiological behaviour of *Withania somnifera* under drought stress

Poshita variety of *W. somnifera* plants were imposed to drought stress. Calvin cycle gene (RBCS, RBCL, RuPE, and TPI) and photosynthesis rate were down regulated under drought stress condition. Differential expression of location and tissue specific genes like SaI, NInv, FBPA and FBPase showed hexokinase mediated sugar signalling under



Metabolic changes under drought stress

drought stress. Downregulation of C2H2 gene responsible for delayed senescence under drought.Upregulation of SQS shows carbon flux diversion towards phystosterol biosynthesis (Plant Science 2018, DOI: 10.1016/j.plantsci.2018.03.029)

Nanoparticles alter the withanolide biosynthesis and carbohydrate metabolism in *Withania somnifera* (Dunal)

Withania somnifera is an important medicinal plant due to the presence of secondary metabolites. Nanoparticles (NPs) have elicitor activity for the enhancement of secondary metabolites biosynthesis in plants. Plants were grown *in-vitro* and *in-vivo* and treated with homologous series of Zn-Ag NPs, Ni, and CdSe. Four NPs having different molar ratio of Zn and Ag have been used for the treatment. NP1, NP2, NP3, and NP4 Exhibit 19:1, 9:1, 3:1 and 1:1 molar ratios between Zn and Ag. Among all the treated NPs NP1 showed maximum enhancement in photosynthesis rate, transpiration rate, withanolide content and increase in some carbohydrates. (Industrial Crops and Products 2018, DOI: 10.1016/j.indcrop.2018.10.049)

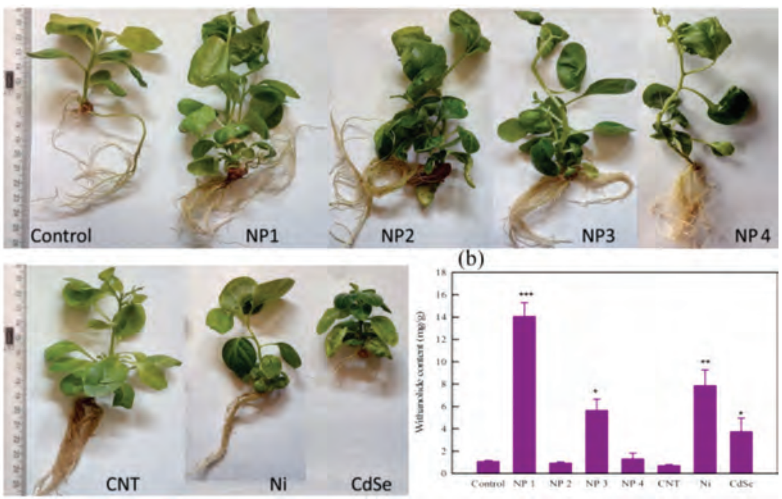


Fig: Plantlets grown in vitro in media containing 20 ppm of NP1, NP2, NP3, NP4, Ni, CdSe, and CNT of Withanolide content of the different NPs treatment and Each bar represents the average and SD of 5 biological samples.

Input: Feroz Khan

- Developed a database of medicinal and aromatic plant's aroma molecules (AromaDb), covered aroma type, essential oil description, phytochemistry and bioactivities.
- Detected genome-wide terpene synthase genes in holy basil (*Ocimum sanctum L.*) using protein motif's weight matrix.
- Developed virtual screening method for screening of anticancer Garcinia caged Xanthone derivatives and explored their mechanism of action by using molecular docking and system pharmacology approaches.
- Identified potential inhibitors against nuclear Dam1 complex subunit Ask1 of *Candida albicans*by using virtual screening and MD simulations methods.
- Developed quantitative structure-activity relationship (QSAR) model for anticancer activity of Tormentic acid derivatives and explored their mechanism of action by using molecular docking and system pharmacology approaches.
- Developed anticancer activity prediction model for Ursolic acid derivatives by using quantitative structure-activity relationship method and human bladder cancer cell line T-24 bioactivity data, targeting NF-kB pathway inhibition.

Input: Ashutosh Shukla (Team: Ajit K. Shasany, Feroz Khan)

Responses of *Artemisia annua* peroxidases to various abiotic stresses

Three *A. annua* class III plant peroxidase gene candidates, Aa547, Aa540 and Aa528, were analyzed for their responsiveness to various abiotic stress factors. Taking cues from previous reports and the regulatory elements observed in the Aa547 promoter, hydration, salinity, temperature, salicylic acid, hydrogen peroxide, and methyl jasmonate (MeJa), were selected to study their effect on the expression of the peroxidase genes through qRT-PCR. The peroxidases were found to be highly sensitive to the various factors but differed in their responses. Broadly, except for responses to high temperature and salicylic acid, the response of Aa547 to various factors was distinct from that of Aa540 and Aa528, which was in line with its distinctness from the other two peroxidases, considering the *in planta* artemisinin content and predicted structural features. (*Plant Molecular Biology Reporter, Year* 36: 295-309)

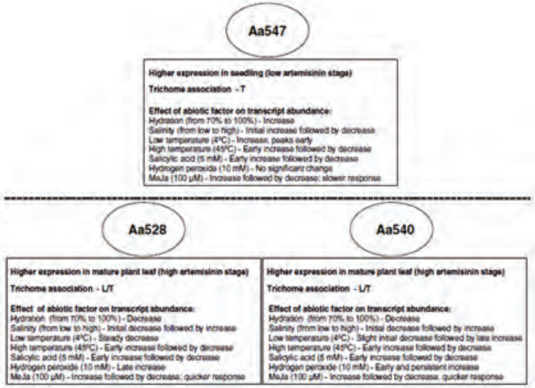


Fig. : A summarized overview of the expression profiles of the three *A. annua* peroxidases in response to various abiotic factors.

Input: Sumit Ghosh

Oxidosqualene cyclase and CYP716 enzymes contribute to triterpene structural diversity in the medicinal tree banaba

Banaba tree [*Lagerstroemia speciosa* (L.) Pers.] leaves are traditionally consumed and used for preparation of herbal medicines to treat diabetes

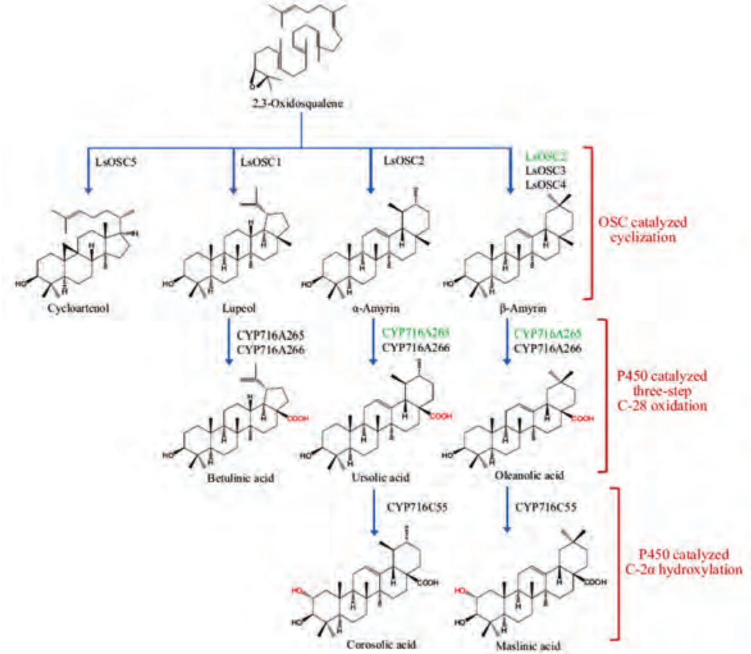


Fig.: The proposed roles of banaba oxidosqualane cyclise (OSCs) and CYP716s in pentacyclic triterpene (PCT) biosynthesis. For multiple enzyme with similar biochemical function, the transcript expression of enzymes highlighted in green showed clear association with temporal accumulation of leaf PCTs, suggesting their major roles in determining PCT profiles in leaf.

and other health problem. The leaves are rich in Ursane (corosolic acid, ursolic acid), oleanane (maslinic acid, oleanolic acid) and lupane (betulinic acid) pentacyclic triterpenes (PCTs) class of bioactive metabolites. However, biosynthetic enzymes and their contributions towards temporal accumulation of PCTs in leaves remained to be studied. We employed an integrated approach involving transcriptomics, metabolomics and gene function analysis to identify oxidosqualene cyclases (OSCs) and cytochrome P450 monooxygenases (P450s) that catalyzed sequential cyclization and oxidative reactions towards PCT scaffold diversification. Four monofunctional OSCs converted triterpene precursor 2,3-oxidosqualene to either lupeol (LsOSC1), β-amyrin (LsOSC3, LsOSC4) and cycloartenol (LsOSC5), and a multifunctional LsOSC2 formed α-amyrin as a major product along with β-amyrin). Two CYP716 family P450s (CYP716A265, CYP716A266) catalyzed C-28 oxidation of α-amyrin, β-amyrin and lupeol to form ursolic acid, oleanolic acid and betulinic acid, respectively. However, CYP716C55 catalyzed C-2α hydroxylation of ursolic acid and oleanolic acid to produce corosolic acid and maslinic acid, respectively. Besides, combined transcript and metabolite analysis suggested major roles for the LsOSC2, CYP716A265 and CYP716C55 in determining leaf ursane and oleanane profiles. Further, combinatorial expression of OSCs and CYP716s in *Saccharomyces cerevisiae* and *Nicotiana benthamiana* led to PCT pathway reconstruction, signifying the utility of banaba enzymes for bioactive PCTs production in alternate plant/microbial hosts that are more easily tractable than the tree species. (Sandeep et al. (2018) *New Phytologist*. doi: 10.1111/nph.15606)

Input: Mukti Nath Mishra

Development of a bacterial platform strain by metabolic engineering for production of sesquiterpene derivatives

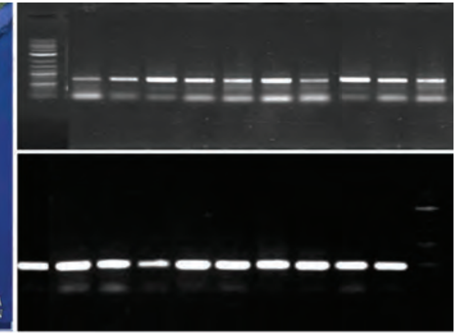
Since higher pool of FPP is a prerequisite for sesquiterpenoid producing platform strains, and since carotenoid overproducing microorganisms have endogenous high-flux isoprenoid pathway, we selected *Azospirillum brasilense*, a carotenoid over-producing bacterium, as a host to develop an improved platform strain for sesquiterpenoid production. Presence of endogenous high-flux isoprenoid pathway and dispensability of carotenoids makes this bacterium a suitable host for sesquiterpenoid production. We have developed a metabolically engineered strain (*A. brasilense*/pAK032-*ads-ispA-rpoE1*), which has the simultaneous facility of RpoE1 expression-mediated induction of a high-flux isoprenoid pathway, IspA expression-mediated accumulation of FPP and ADS expression-mediated conversion of FPP in to amorphadiene. This strain is able to produce 1.5 gm/l amorphadiene in optimized growth condition. Now we are trying to modify this system for the production of other sesquiterpenes.

Input: V. Sundaresan

Captive cultivation of selected high value rare, endangered and threatened (RET) medicinal plant species

Species specific gene bank are made for the selected RET species after the wild collections from different geographical regions of western ghats. The gene bank is with 200 accessions of *Trichopus zeylanicus*, 83 accessions of *Coscinium fenestratum* and 52 accessions of *Aristolochia tagala*. Different propagation methodology is standardized for the multiplication of these selected RET species. Generation of barcode has been initiated for the collected samples. Distribution mapping also initiated with the available field data.

Distribution mapping : *Aristolochia tagala, Coscinium fenestratum, Trichopus zeylanicus, Decalepis hamiltonii*

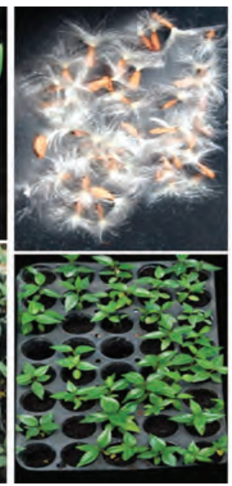


PCR amplification of Coscinium fenestratum using psbA-trnH and ITS 2.

Coscinium fenestratum introduced to the field

Propagation of *Aristolochia tagala* seeds

Trichopus zeylanicus introduced to the gene bank



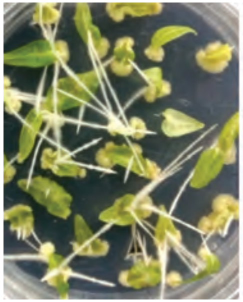
Propagation of *Utleria salicifolia* seeds

Field collection of *Coscinium fenestratum*

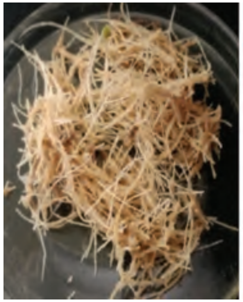
In vitro propagation and 2 - hydroxy – 4 - methoxybenzaldehyde production in root cultures of RET species *Decalepis salicifolia.*

Decalepis salicifolia (Bedd. ex Hook. f.) Venter (Apocynaceae) is critically endangered and endemic to Southern Western Ghats of Tamil Nadu & Kerala. The compound 2-hydroxy-4-methoxybenzaldehyde, an isomer of vanillin is the major constituent in the aromatic tubers of *D. salicifolia.*

An efficient *in vitro* propagation protocol was established for conservation using shoot tip and nodal explants. The plants were successfully established in field with 92.8% survival rate and 99.5% genetic fidelity.


Adventitious root induction

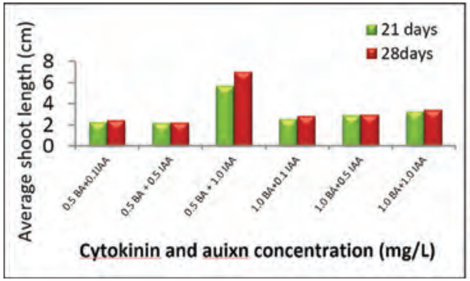

Proliferation of roots in liquid media


Harvested roots


Thin layer chromatogram under 254nm

The use of the plant as a source of the flavor compound is hindered by its endangered nature. Therefore, root cultures for the production of 2-hydroxy-4-methoxybenzaldehyde, combined with appropriate scale up offers a promising alternative to synthetic vanillin.

Adventitious roots were initiated in MS, B5 and WPM along with different hormone combinations. The best responding media was selected for further experiments in liquid media. The roots were harvested at an interval of 10 days. Ethyl acetate extract was used for TLC along with the standard for the preliminary detection of the compound.



Combined effect of Cytokinin with Auxin on shoot induction


Shooting


Rooting


Hardening


UBC 876 profile

Input: Pradipto Mukhopadhyay

Increasing abiotic/Biotic stress tolerance in Rose scented geranium (*P. graveolens*) using CRISPR technique

Our *in silico* search, indicated the presence of 16 negative regulators of biotic/abiotic abiotic stress tolerance in transcript data of *Pelargonium sp* but these were mostly corresponding to small partial contigs. However, two larger contigs were found corresponding to *AtPMR and AtCESA* homologue whose mutation ares known to increase tolerance to fungal stress. *A couple of* sgRNAs were designed against these each of these contigs. Chemically synthesised complementary oligos were annealed to double stranded sgRNA and were cloned in suitable plant CRISPR vectors. These recombinant vectors are being used to generate desired specific CRISPR mutated plants of rose scented geranium.

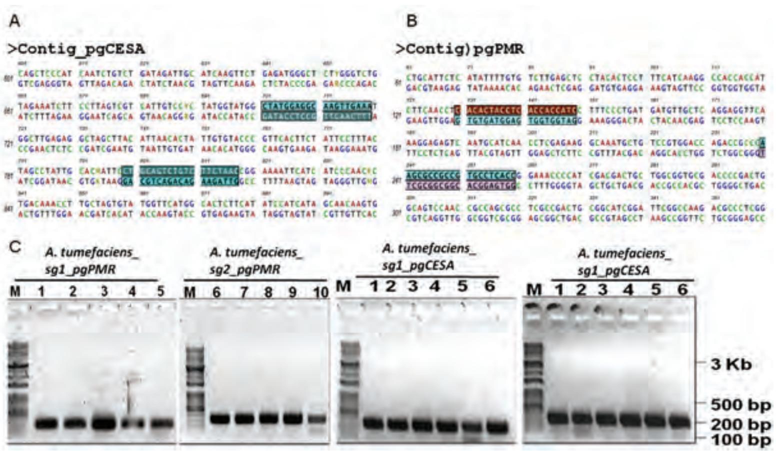


Fig. Desiging and construct preparation of PgPMR and PgCESA genes. A-B show the sgRNA position in a part of the PgPMR and PgCESA contig sequences. C in PCR conformation of *Agrobacterium* starins bearing sgRNA1 and 2 contructs against *PgPMR* and *PgCESA* genes

Improving root biomass/texture in *Withania somnifera*

We earlier identified few putative CLE peptide encoding transcripts in *W. somnifera* transcriptome data. We are analysing its expression profile of four CLE peptide. We have designed and prepared sgRNA construct against three putative but relevant CLE peptide genes which are expected to have strong role in root biomass/textural variations. Additionally we are collecting plant samples from different growth stage of two contarasting varieties viz. Nagori and Poshita to cleary identify genes related to these phenotypes.

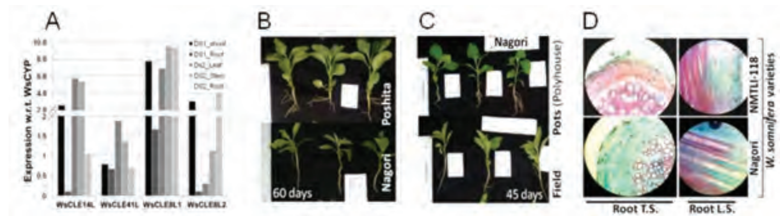


Fig. Differential root formation in contransting varities of *W. somnifera*. (A) Expression analysis of four identified *CLE* genes in shoot and roots of *W. somnifera* plants at two different growth stages. (B) Collection of tissue samples showing differential root formation under pot and field condition. (C) Collection of samples showing differential root formation in nagori and Posita at early growth stages. (D) Differential vascular fibre formation in mature roots of Different *Withania* varieties

Input: Narendra Kumar

Standardization of raw drugs and extracts as per USP and API guidelines

Standardization of pharmacognostical parameters (foreign organic matter, macroscopic and microscopic studies, total ash, acid insoluble ash, water soluble extractive and alcohol soluble extractive) of twelve raw drugs i.e. *Andrographis paniculata* (variety: CIM-Megha), *Phyllanthus amarus* (variety: CIM-Jeevan), *Silybum marianum* (variety: ATG-SM-1), *Curcuma longa* (variety: CIM-Pitambar), *Gymnema sylvestris, Bacopa*

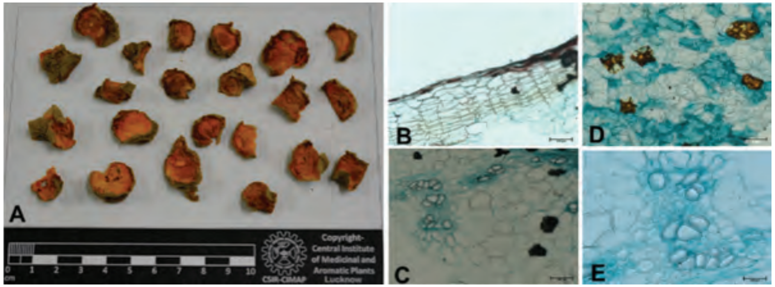


Fig.1: *Curcuma longa* A. crude drug; B-E. T.S. of Rhizome. B- cork layers; C- vascular bundle in cortical region; D-curcuminoids in cells; E- Vascular bundle in ground tissue

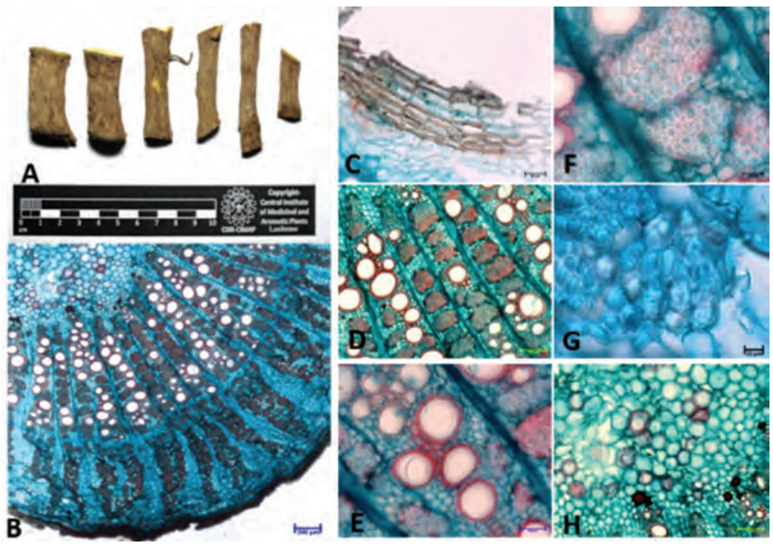


Fig.2: *Glycyrrhiza glabra*. A. raw drug; B. T.S. showing arrangement of tissues; C. periderm showing cork cells; D, T.S. from secondary xylem; E, secondary xylem showing xylem vessels; F, xylem fibre bundles; G, cells filled with prismatic crystals; H, pith region showing parenchymatous region with few lignified cells.

monnieri (variety:CIM-Jagriti), *Withania somnifera* (variety: poshita), *Mucuna pruriens* (variety: CIM-Ajar), *Terminalia chebula*, *Glycyrrhiza glabra* (variety: HM-1),*Terminalia bellerica*, *Embelica officinalis)* were carried out as per the United State Pharmacopeia (USP) and Ayurvedic Pharmacopeia of India (API) guidelines.The Botanical Reference Standard (BRS) of these species has been developed for authentication of raw drugs.

Input: Rakesh Kumar Shukla

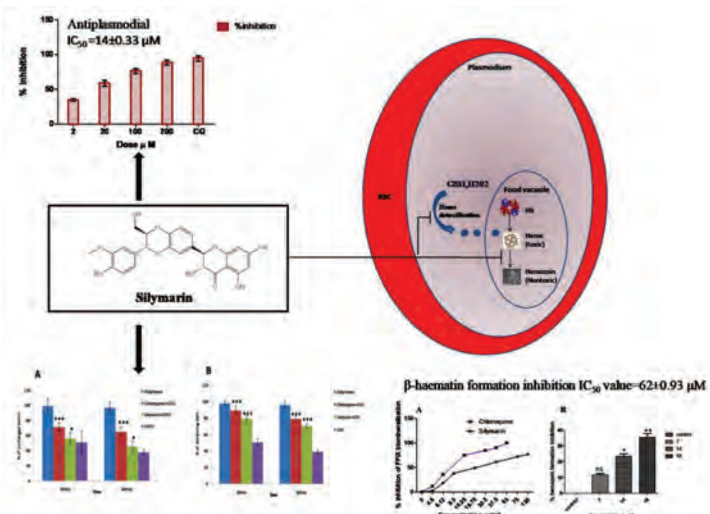
MaRAP2-4, a waterlogging-responsive ERF from Mentha, regulates bidirectional sugar transporter AtSWEET10 to modulate stress response in Arabidopsis.

We attempted to characterize the role of a waterlogging-responsive group I (A-6) ethylene response factor (MaRAP2-4) from *Mentha arvensis*. MaRAP2-4 interacted with multiple *cis*-elements like dehydration response elements (DRE1/2), anoxia/jasmonic acid response element (JARE) and GCC box showing its involvement in multiple responses. Further, MaRAP2-4 specifically targets two positions in *AtSWEEET10 (a sugar transport protein)* promoter carrying DRE and/or GCC box and might regulate carbohydrate availability to different tissues under adverse environmental condition. (Published in Plant Biotechnology Journal).

Input: MP Darokar

Silymarin, a polyphenolic flavonoid impede *Plasmodium falciparum* growth through interaction with heme

A polyphenolic flavonoid, silymarin isolated from *Silybum marianum* is widely known for its hepatoprotective action. In the present study anti-plasmodial activity of Silymarin has been demonstrated for the first time having IC_{50} of 14±0.33 μM against the NF-54 strain of *P. falciparum* with high selectivity index (>100). The parasitostatic action is exerted through inhibition of β-hematin/hemozoin formation which is due to the interaction (*Kd*=3.63±0.9*μ*M) of silymarin with free heme in a Stoichiometry of 1:1 Silymarin: heme complex resulting into heme-induced membrane damage in the parasite. Silymarin could hinder the glutathione and hydrogen peroxide-induced heme detoxification (Natural Product Research. 2018, DOI: 10.1080/14786419.2018.1548449).



Input: Anirban Pal

Ethyl acetate extract of *Rosa damascene* comprising of gallic acid, rutin and other phenols restrains *Plasmodium falciparum* progression *in vitro* and impedes malaria pathogenesis in murine model

Malaria the parasitic disease of tropical countries is seeking newer therapeutic strategies owing to the drug resistance to existing drugs. The

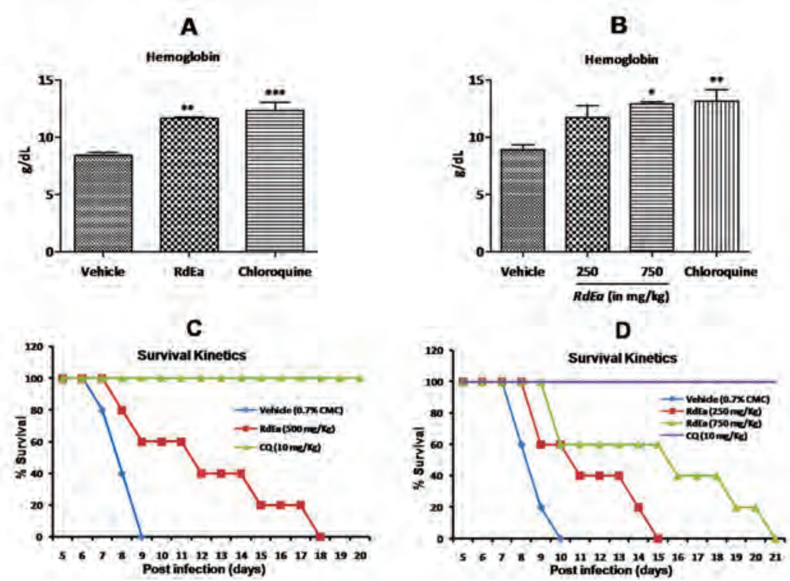


Fig: Consequences of *RdEa* on haemoglobin levels (A) and (B) and on percentage survival (C) and (D) in *P. berghei* infected mice. Data are expressed as Mean ± SEM; $p < 0.05$ *; $p < 0.01$ **, $p < 0.001$***; vehicle vs treatment; (Tukey's multiple comparison test); n=5.

pathogenesis after infection renders the host to oxidative stress resulting in an altered immune status. The present study reports the phenol rich ethyl acetate extract from the petals of *Rosa damascena* (*RdEa)* to be active against *Plasmodium falciparum in-vitro* and *Plasmodium berghei in-vivo*. It restores the haemoglobin level while increasing the mean survival time and chemo-suppression in *P. berghei* infected mice. The HPLC characterised *RdEa* was found to be rich in Gallic acid and Rutin besides other phenols. *RdEa* was capable of scavenging the free radicals and modulating the pro-inflammatory mediators (IL6, TNF, IFN and NO) favourably and also restored the architecture of hepatocytes as evidenced through histopathology. The extract was able to arrest the lipopolysaccharide (LPS) induced damage of J774A.1 cells (murine macrophages) and was found to be safe in mice upto 2000 mg/kg body weight (Biomedicine and Pharmacotherapy. 2018; 97:1654-1662).

Development of a co-infection model in mice harbouring *Plasmodium berghei* and *Salmonella typhimurium*: a mice model study for therapeutic strategy

Impairment of host immune response in malaria favours bacteraemia caused by typhoidal or non-typhoidal serovars of *Salmonella enterica*. The study evaluates the host responses upon treatment with anti-biotic and anti-malarial in a standardized mice model harbouring co-infection.BALB/c mice (18-22 gm) were simultaneously co-infected with *Plasmodium yoelii nigeriensis (Pyn)* and *Salmonella enterica* Serovar Typhimurium (STm) and then treated with Ofloxacin or/and Artesunate from day 4 to day 7. The study concludes that malaria infection aggravates the secondary infection of *Salmonella* serovars and the control of septicaemia is critical in recovery of the co-infected subject (**Shock**. 2018 Jun 13. doi: 10.1097/SHK.0000000000001111).

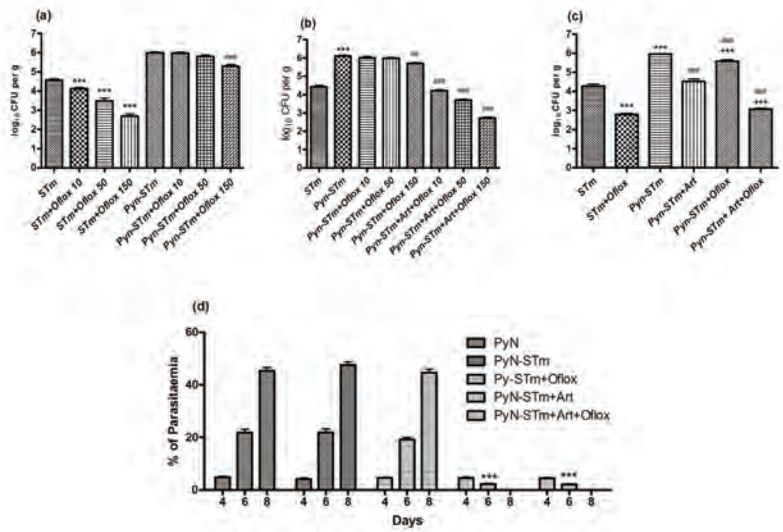


Fig: *Salmonella* Typhimurium (STm) load on spleen in presence and absence of co-infection with *Plasmodium yoelii nigeriensis* (Pyn) and under conditions of treatment with Ofloxacin (antibiotic) and Artesunate (antimalarial) in (a) dose dependent manner for Ofloxacin (Oflox) in mice infected with STm alone and in combination with Pyn, (b) dose dependent manner for Oflox in co-infected mice (Pyn-STm) and treated with curative dose of Artesunate (Art), (c) final model of co-infection with curative doses of Art (80 mg/Kg bd.wt.) and Oflox (100 mg/Kg bd.wt.), (d) progression of parasitemia on days 4,6 and 8 post infection, concluding (a) the in-effectiveness of Ofloxacin to control systemic bacterial infection in presence of malaria (b), restoration of efficacy of Ofloxacin when used in combination with Artesunate (c) and optimization of the dose of Artesunate (80 mg/Kg bd wt.) and Ofloxacin (100 mg/Kg bd.wt.) in mice co-infected with Pyn-STm and (d) STm does not have any effect on progression of parasitaemia in co-infected mice.

Inputs: DN Mani (Team: Karuna Shanker, Ashutosh K. Shukla)

Scientific validation of anti-allergic property of *Euphorbia thymifolia* – Traditional knowledge of Ayurveda leading towards an effective modern therapy

Euphorbia thymifolia L. (Et; family Euphorbiaceae; common name *Laghududhika*) is a very common weed having a pan-Indian distribution. It has been described in Ayurvedic texts for the treatment of allergic cough (*Kash*) as well as asthma. Taking clues from the traditional Ayurvedic knowledge, the anti-allergic effect of Et. extract was evaluated by investigating its effect on mast cell degranulation and allergic inflammation. To evaluate the anti-allergic activity, C48/80-induced systemic anaphylaxis and ova-induced allergic model (small animals, mice) were employed. To assess the preventive effect against C48/80 induced anaphylaxis, Et extract was orally administered in different doses (100, 200 and 400 mg/Kg body weight), an hour before C48/80 challenge. Mortality was monitored for 1 h after the anaphylactic shock and blood was collected for histamine estimation. In ova-induced allergic model, after sensitization with ova on 1st and 14th day, Et extract was administered (200 and 400 mg/Kg bodyweight) till 28th day followed by nebulization with ova for consecutive 3 days. The number of inflammatory cells, anti-ova IgE, Th1, Th2 cytokines levels was estimated along with the lung histopathology. The oral administration of Et extract at different doses (200 mg/Kg, 400 mg/Kg) was found to inhibit the release of histamine and mortality in C48/80-induced anaphylaxis. Et extract at 200 mg/Kg dose was also found to improve the allergic inflammation condition by reducing the accumulation of inflammatory cells, decreasing the secretion of Th2 cytokines (IL-4, IL-5, IL-13) and increasing the secretion of Th1 cytokine (IFN-γ) by regulating their gene expression as analyzed through qRT-PCR. Another effect was the amelioration of the infiltration of inflammatory cells in the lung tissues of ova-challenged mice. Thus the aqueous extract of Et improved the symptoms of anaphylaxis and significantly inhibited degranulation of mast cells as well as reduced the level of allergic mediators. In conclusion, Et extract could lead towards an effective anti-allergic therapy.

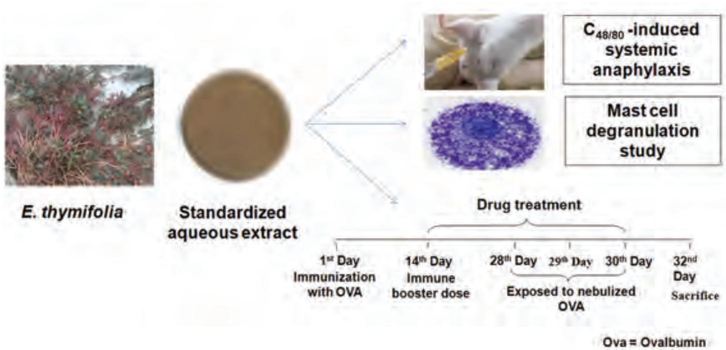


Fig: Validation of Standardized extract of *Euphorbia thymifolia* for anti-allergic activity

Inputs: Dr DU Bawankule

Plumbagin ameliorate severe malaria pathogenesis by inhibiting oxidative stress and inflammation in mice

Plumbagin (PL), a major active constituent in several plants including root of *Plumbago indica* Linn was pharmacological evaluated against severe malaria pathogenesis due to involvement of oxidative stress and inflammatory response. Malaria pathogenesis was induced by intra-peritoneal injection of *P. berghei* infected red blood cells into the Swiss albino mice.

The results of this study revealed that the oral administration of PL @ 3, 10 and 30 mg/kg/day following Peter's 4 day suppression test showed significant reduction of parasitaemia and increase in mean

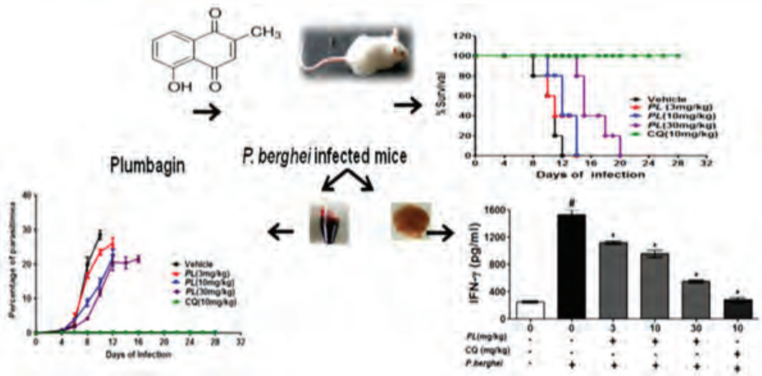


Fig: Effect of Plumbagin on malaria pathogenesis in mice

survival time. PL treatment is also attributed to significant increase in the blood glucose and haemoglobin level when compared with vehicle-treated infected mice. Significant inhibition in level of oxidative stress and pro-inflammation related markers were observed in PL treated group. The trend of inhibition in oxidative stress markers level after oral treatment of PL was MPO>LPO>ROS in organ injury in *P. berghei* infected mice. This study showed that plumbagin is able to ameliorate malaria pathogenesis by augmenting anti-oxidative and anti-inflammatory mechanism apart from its effect on reducing parasitaemia and increasing mean survival time of malaria-induced mice (Inflammopharmacology. 2018, 26(4):983-991).

Inputs: NP Yadav

Polysaccharide Encrusted Multilayered Nano-Colloidal System of Andrographolide for Improved Hepatoprotection

Andrographolide (AP), a phytoconstituent of Andrographis paniculata is reported as a potent hepatoprotective agent. However, utility of this molecule is restricted due to its low aqueous solubility, gastric instability and hence low bioavailability. It was aimed to formulate and characterize AP-loaded, natural biopolymer stabilized, multilayered nanohydrocolloid delivery system. Nanoemulsion (NE) was formulated using layer-by-layer (LbL) technology via electrostatic deposition of chitosan over alginate encrusted o/w NE by ultrasonication. Improved transparency and stability of NE were observed with increasing sonication time. In conclusion, the andrographolide engrained multi-layered NE enhanced the solubility, stability and henceforth assured the increased availability in simulated biological fluids. The in vivo study exhibited the significantly improved hepatoprotection by andrographolide when delivered in stable multilayered NE carrier systems (AAPS PharmSciTech, 18(2):381-392).

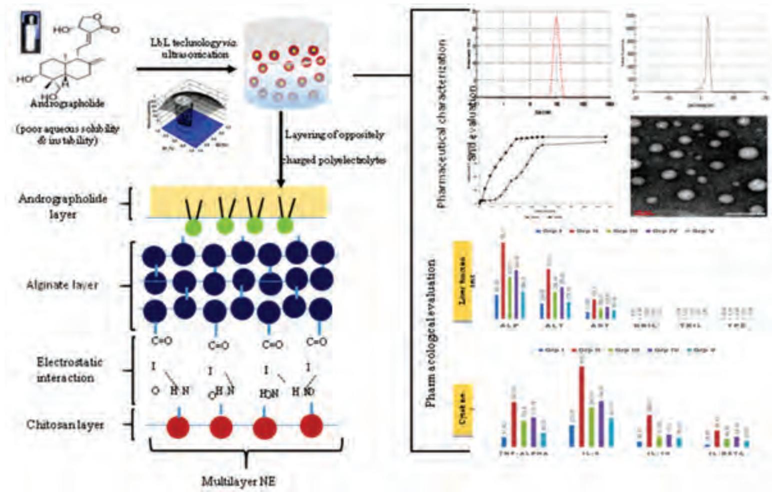


Fig: Multilayered nanoemulsion formulation of Andrographolide for Improved Hepatoprotection

Development of emulgel formulation for vaginal candidiasis: Pharmaceutical characterization, *in vitro* and *in vivo* evaluation

The aim of the investigation was to develop nanoemulsion (NE) based emulgel of Mentha essential oil (MEO: potent antifungal property) to ensure enriched and extended therapeutic effectiveness against various species of *Candida* and vaginal candidiasis. NE was prepared and optimized using central composite design. pH-triggered crosslinking of NE in carbopol 940 matrix (emulgel) was achieved by triethanolamine. Emulgel was evaluated for *in vitro* (against *Candida* spp.) and *in vivo* (efficacy in Swiss albino female mice infected by installing 4×107 cfu/ml of *Candida albicans*) activity against the standard control and simple gel of MEO. *In vivo colony counts of C. albicans in the case of* emulgel were observed to be significantly lesser in number (165 cfu/ml) than simple gel (380 cfu/ml). Encapsulation of MEO in NE followed by crosslinking in cellulosic polymer ensures reduced volatility and improved effectiveness against candidiasis like condition (*Journal of Drug Delivery Science and Technology*, 2018, 48: 490–498).

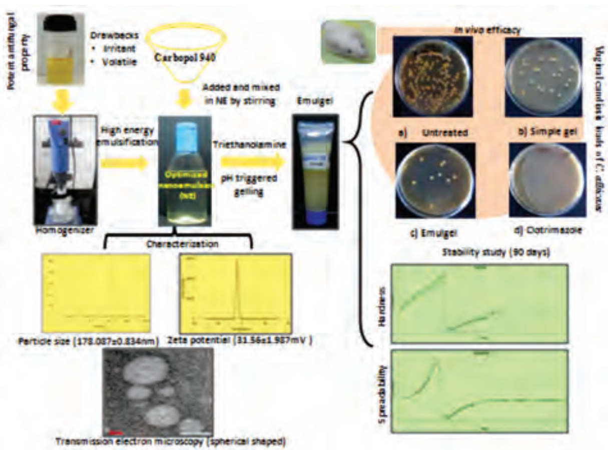
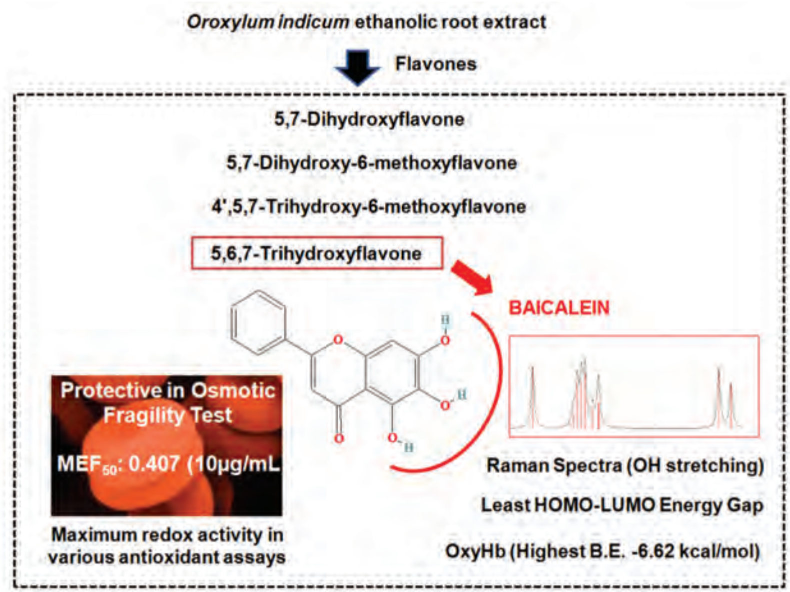


Fig: Development of emulgel formulation for vaginal candidiasis

Inputs: Suaib Luqman

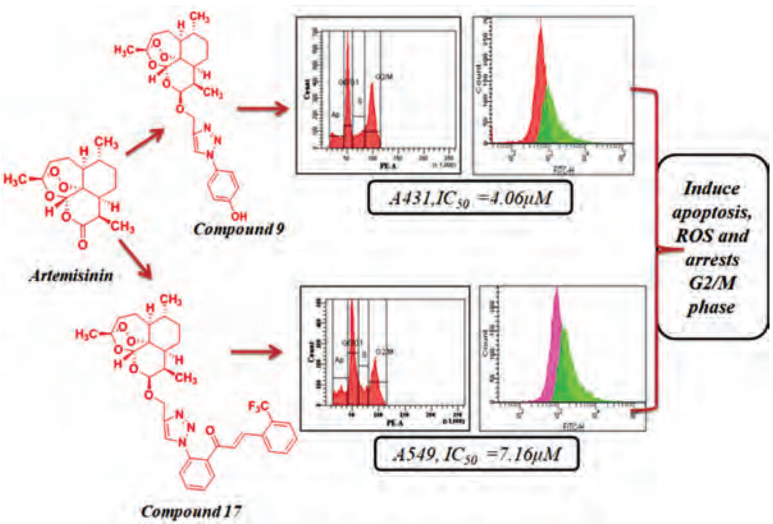
A Density Functional Theory based quantum rationalization of flavones from *Oroxylum indicum* and their correlation with redox effect, molecular interaction investigation and osmotic haemolysis of erythrocytes



(*Current Science* 2018; 115 (11): 2085-2094)

Input: Suaib Luqman and RS Bhakuni

Antiproliferative activity of novel 1,2,3-triazole based artemisinin derivatives



(*New Journal of Chemistry* 2018; 42 (8): 5978-5995).

Input: Debabrata Chanda and Arvind Singh Negi

Safety evaluation of standardized extract of *Curcuma longa*:

Standardized extract of rhizomes of *Curcuma longa* was prepared in Phytopharma mode with four chemical markers and one bioactive marker. The extract was evaluated for biological activity and found to have significant vasorelaxation response in *ex-vivo* system with promise of possible antihypertensive activity *in-vivo*. Hence, for further development of the extract into a phytopharma product, acute and sub acute oral toxicity of the extract was carried out in Swiss albino mice. Our present experiment in Swiss albino mice suggested that the standardized extract of Curcuma longa was well tolerated by the experimental mice upto 5000mg/kg in acute oral toxicity when given as a single oral dose and upto 500 mg/kg in sub acute oral toxicity when given as repeated dose once orally for 28 days. All the haematological, biochemical and observational parameters studied showed non significant changes except significant increase in reduced GSH content of liver tissues indicating the potent antioxidant properties of the extract instead of having any adverse effects.

Table: Effect of *Curcuma longa* rhizome standardized extract as a single acute oral dose at 2000 and 5000 mg/kg on body weight, haematological and biochemical parameters in Swiss albino mice (Mean±SE; n=6 a, P<0.05 compared to control, 2000, 5000 mg/kg).

Parameters	**Dose of *curcuma longa* at mg/kg body weight as a single oral dose**		
	Control	2000 mg/kg	5000 mg/kg
Body weight (gm)	26.11±0.50	21.03±.26	25.17±3.41
Haemoglobin (gm/dL)	13.42±0.28	12.38±0.51	12.98±0.43
RBC (million/mm^3)	7.93±0.25	8.59±0.31	7.87±0.41
WBC (1000*/mm^3)	5.58±0.57	5.51±0.62	7.19±0.84
ALP (U/L)	259.05±14.48	377.11±43.11	332.15±29.81
SGOT (U/L)	63.26±9.03	64.28±5.50	64.67±8.58
SGPT (U/L)	14.29±0.99	9.81±0.94	10.92±3.42
Albumin (g/dL)	1.59±0.22	2.72±.19	0.21±0.15
Creatinine (mg/dL)	1.10±0.23	0.98±0.06	0.53±0.03*
Triglycerides (mg/dL)	144.37±6.09	124.98±5.88	129.91±6.50
Serum Protein (mg/ml)	2.05±0.21	2.93±2.93	2.21±0.15
Cholesterol (mg/dL)	164.13±11.16	155.86±9.72	174.34±10.59
Bilirubin (mg/dL)	0.32±0.13	0.52±0.07	0.72±0.24
Effects on level of GSH and malonaldehyde (MDA) in hepatic tissues of treated animals			
GSH (µM/mg protein)	7.62±0.25	9.30±1.75	14.42±1.55*
MDA (nmole/mg protein)	2.97±0.28	2.45±0.56	2.72±0.28

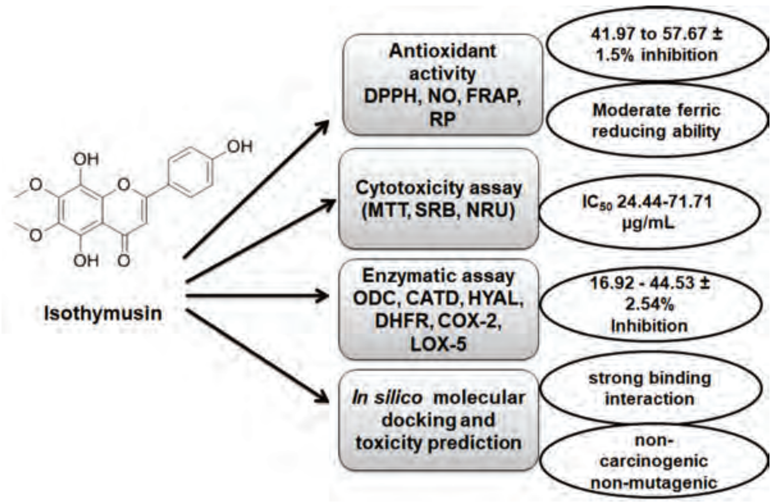
Table: Effect of *Curcuma longa* standardized extract as sub acute oral dose at 62.5 , 125 , 250 and 500 mg/kg body weight once orally for 28 days on body weight, haematological and serum biochemical parameters in Swiss albino mice (Mean ± SE; n = 6).

Parameters	Dose of Curcuma longa standardized extract at mg/kg body weight once orally for 28 days (Mean ± SE; n = 6)				
	Control	62.5 mg/kg	125 mg/kg	250 mg/kg	500 mg/kg
Body weight (gm)	30.57 ± 1.69	31.90 ± 2.37	31.85 ± 1.31	32.95 ± 1.25	31.65 ± 0.60
Haemoglobin (gm/dL)	13.51 ± 0.47	13.17 ± 0.88	12.51 ± 0.83	13.71 ± 0.47	12.84 ± 0.31
RBC (million/mm^3)	8.42 ± 0.83	6.69 ± 0.32	7.39 ± 0.70	9.52 ± 0.84	8.97 ± 0.68
WBC (1000*/mm^3)	4.40 ± 0.39	4.27 ± 0.54	4.29 ± 0.35	4.22 ± 0.63	4.01 ± 0.21
ALP (U/L)	44.68 ± 6.24	43.59 ± 6.58	48.16 ± 3.40	41.01 ± 3.45	41.18 ± 3.32
SGOT (U/L)	35.74 ± 3.81	32.10 ± 1.93	31.55 ± 2.17	37.96 ± 5.12	35.94 ± 5.41
SGPT (U/L)	23.24 ± 1.53	26.41 ± 1.05	25.48 ± 1.49	27.97 ± 2.21	21.59 ± 1.96
Albumin (g/dL)	4.27 ± 0.26	4.40 ± 0.39	4.15 ± 0.27	4.81 ± 0.10	4.85 ± 0.27
Creatinine (mg/dL)	0.38 ± 0.08	0.27 ± 0.04	0.38 ± 0.07	0.41 ± 0.07	0.33 ± 0.03
Triglycerides (mg/dL)	126.92 ± 2.39	123.65 ± 3.16	113.31 ± 9.17	129.41 ± 6.05	110.70 ± 3.11
Total Cholesterol (mg/dL)	142.41 ± 12.23	165.15 ± 8.21	158.48 ± 9.64	134.56 ± 6.99	149.62 ± 13.62
Serum Protein (mg/ml)	6.17 ± 0.26	5.95 ± 0.11	5.92 ± 0.21	6.18 ± 0.44	5.56 ± 0.44
Total Bilirubin (mg/dL)	0.48 ± 0.06	0.48 ± 0.02	0.53 ± 0.06	0.59 ± 0.09	0.52 ± 0.03
Effect on hepatic GSH and malonaldehyde levels					
GSH (μM/mg protein)	9.71 ± 0.79	11.14 ± 0.62	12.37 ± 0.79	10.85 ± 0.55	11.28 ± 0.41
Malonaldehyde (nM/mg protein)	0.89 ± 0.03	0.91 ± 0.03	0.95 ± 0.05	0.53 ± 0.06	0.45 ± 0.05

Inputs: Abha Meena and Suaib Luqman

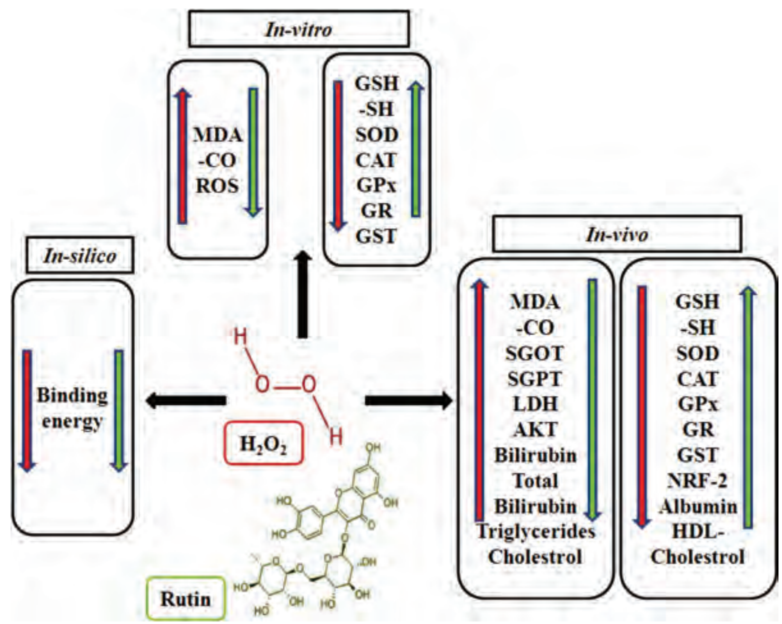
Isothymusin, a natural polyphenolic constituent as a promising inhibitor of cancer cell proliferation

Isothymusin, a polyphenolic constituent present in *Ocimum sanctum*, *Limnophillageoffrayi*, *Becium grandiflorum* showed antiproliferative potential by targeting various enzymes associated with tumorinitiation, promotion, and progression in cancer cell lines. It also showed good binding interaction with the similar targets. Additionally, this molecule showed potential free radical scavenging and antioxidant properties (*Cancer Medicine* 2018. 7 (1): 49-50).



Rutin restricts hydrogen peroxide-induced alterations by up-regulating the redox-system: An *in vitro*, *in vivo* and *in silico* study.

Rutin, a polyphenolic plant flavonoid, ameliorate the effect of hydrogen peroxide (H_2O_2)-mediated deregulation of antioxidant enzyme activity, non-enzymatic biomarkers, reactive oxygen species production (*in vitro* and *in vivo*) and on echinocyte formation *(ex-vivo)*. (*European Journal of Pharmacology* 2018. 835: 115-125).



Input: Arvind Singh Negi

Antiproliferative activity of curcumin mimics against skin cancer

Curcumin mimics have been designed and prepared with an additional bridged phenyl ring in conjugation. Fourteen diverse analogues were evaluated against a panel of human cancer cell lines. Compound DB-6 exhibited potent cytotoxicity against epidermoid carcinoma (A431) cell line ($IC_{50}=1.5$ μM) and DLD1, colorectal adenocarcinoma cell line ($IC_{50}=6.9$ μM). It destabilized tubulin polymerisation process. In cell cycle analysis, compound DB-6 exerted G2/M phase arrest in A431cells and induced apoptosis. Compound DB-6 showed 78.6% tumour reduction at 80 mg/kg dose and 57% solid tumour reduction at 150 mg/kg dose in Ehrlich ascites carcinoma. It was well tolerated and safe up to 300mg/kg dose in acute-oral toxicity experiment in rodent model. The study shows that the novel curcumin mimic DB-6 is a safe and efficacious anticancer compound. However, it needs to be optimized for better efficacy (*European J. Medicinal Chemistry* 2018, 151: 51-61).

Fig: Natural curcuminoids and the most potent designed curcumin mimics **DB-6**

A New synthesis of 2-arylbenzimidazoles and their antitubercular activity

Benzimidazole is a biodynamic pharmacophore present in several natural products and drug candidates, exhibiting various biological activitiessuch as antibacterial, antimalarial,anticancer and anti-HIV etc. An efficient synthesis has been developed for 2-arylbenzimidazoles from *o*-phenylenediamines and aromatic aldehydes in molecular sieves-methanol system. The methodology is straightforward to get 2-arylbenzimidazoles in excellent yields with high chemoselectivity over 2-aryl-1-benzylbenzimidazoles. All these benzimidazole analogues were evaluated against *M. tuberculosis* in BACTEC radiometric assay compounds 4y and 4z exhibited potential antitubercular activity against *M. tuberculosis* $H_{37}R_V$, MIC at 16 μM and 24 μM respectively. The best compound of the series i.e. compound 4y was well tolerated by Swiss-albino mice in acute oral toxicity. Compound 4y possessing a diarylbenzimidazole core, can further be optimized for better activity (*Bioorg. Med. Chem.* 2018, 26: 4551-4559).

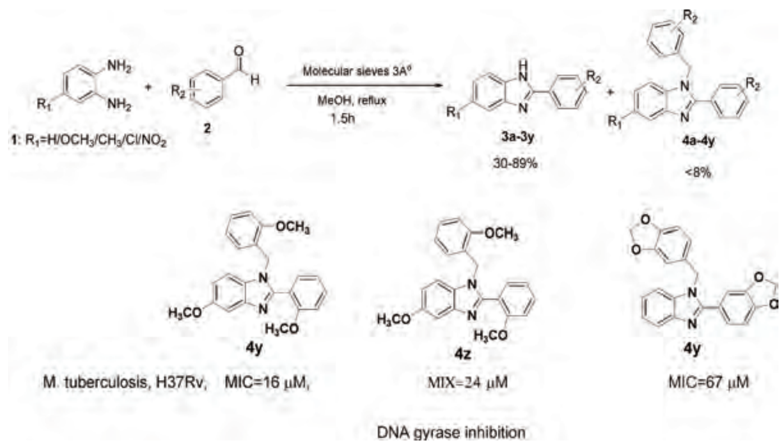


Fig: A new protocol for the synthesis of 2-arylbenzimidazoles and potent antitubercular analogues as DNA gyrase inhibitors

Input: SudeepTandon

Designing and installation of distillation units

Designing, fabrication, installation, commissioning and providing training to farmers for 23 directly fired type, cohobation & boiler operated improved field distillation units of varying capacities & designs under CSIR- Aroma mission project and consultancy projects in farmers field in several states of India have been taken up for distillation of the aromatic crops being cultivated under the aroma mission project. The units have been technical modified with improvements in the design of calandria and condenser tor increase the efficiency. The units have been designed as per the requirements of the crops and farmers.

Mobile SS distillation units installed at ICAR Research Complex for NEH region

Field distillation unit Meghalaya Basin Development Agency-MBDA

Development and validation of Stevia technology

Stevia is one the most promising natural based sweetening plants which mainly contains Steviol glycosides. CSIR-CIMAP has tied up with Startup Company M/s Arboreal Agro Innovations in which collaborative research on development and pilot scale validation of the extraction technology was carried out at CIMAP. The technology has beensuccessfully optimized and scaled up in CIMAP pilot plant.

Input: Karuna Shanker

Development and validation of UPLC–PDA method for quality control of *Dikamali* gum—A natural tablet binder: Fast simultaneous quantitation of six polymethoxyflavones

Dikamali gum (*Gardenia lucida* Roxb., Family—Rubiaceae) is used as tablet binders in the Indian traditional herbal formulations. Recently, its application as a binder in modern drug delivery has also been reported. However, its quality specification is yet to be established. To the best of our knowledge, no validated method is reported so far for the quality assurance of *Dikamali*. A new reverse-phase ultraperformance liquid chromatography–photodiode array (UPLC–PDA) method was developed for the simultaneous quantification of six polymethoxyflavones (PMFs), viz., gardenin E, gardenin D, xanthomicrol, 5-desmethynobiletin, gardenin A, and gardenin B, in *Dikamali* gum using a Waters X-select C_{18} (2.5 μm, 2.1 × 100 mm) column. The influence of acid additive in mobile phase on peak response and column temperature on the peak resolution was also investigated. ICH guideline was followed for method validation of analytical procedures for the compliance of precision, accuracy, linearity, etc. The method is about three times faster than classical HPLC analysis and completed within 15 min. The limits of detection (LOD) and limit of quantitation (LOQ) were in the range 0.02–0.06 and 0.08–0.20 μg mL^{-1}, respectively. Calibration curves were linear from 0.18 to 1.78 μg mL^{-1} with acceptable correlation coefficients ranged 0.9993–0.9999. The percent mean recoveries of the PMFs were ranged from 96.07 to 101.69%. Successful analysis of three *G. lucida* samples from different locations demonstrated the method to be reproducible and convenient. [DOI: 10.1007/s10337-018-3578-1]

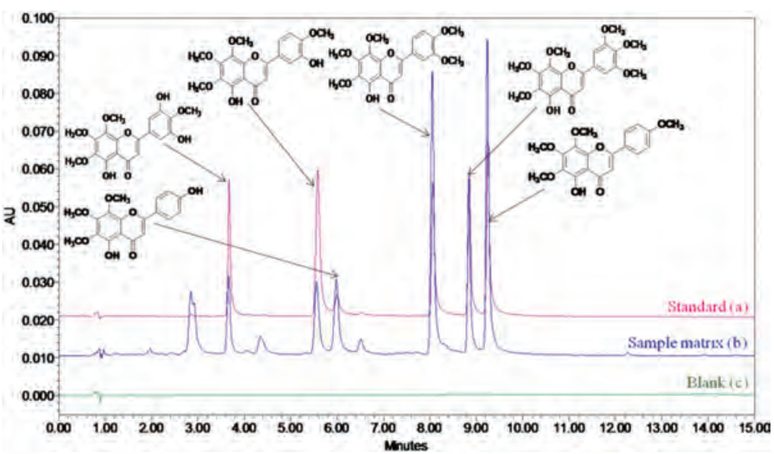
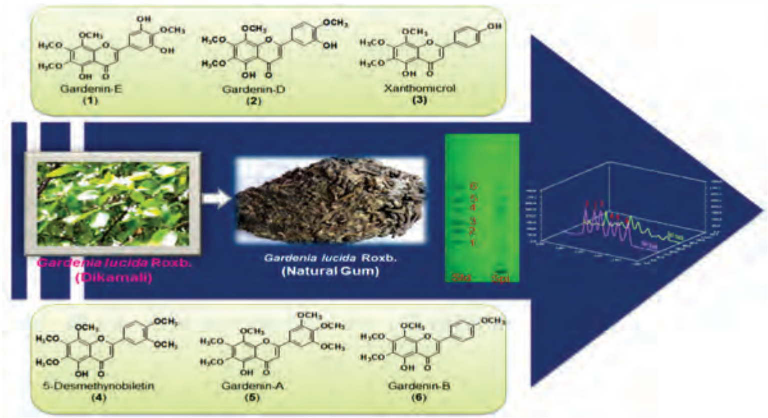


Fig: Chromatograph (UPLC–PDA)of major constituent in *Dikamali* gum

Simultaneous quantification of six polymethoxyflavones in *Gardenia lucida* Roxb. using high-performance thin-layer chromatography

A high-performance thin-layer chromatography (HPTLC) method has been developed for the simultaneous quantification of six polymethoxyflavones (PMFs) in *G. lucida*gum. Chemical markers, e.g., gardenin-E (1), gardenin-D (2), xanthomicrol (3), 5-desmethynobiletin (4), gardenin-A (5), and gardenin-B (6), of *G. lucida* gum were selected for quality assessment. For the quantitative determination of the marker compounds, silica gel 60 F_{254} TLC plates and solvent system n-hexane–diethyl ether–1,4-dioxane (4:6:1, *v/v*) were used for optimum separation and selective evaluation. Densitometric determination was done at 335 nm for the targeted PMFs (1–6). Optimized chromatographic conditions provide well-separated compact bands for the tested polymethoxyflavones. The limit of detectionand limit of quantificationranged from 0.06 to 0.10 µg/band and 0.21 to 0.32 µg/band, respectively. Curves were linear from 0.33 to 1.67 µg/spot with acceptable correlation coefficients ranging from 0.9972 to 0.9988 of all PMFs. The percent mean recoveries of the PMFs ranged from 96.01 to



99.30. The analysis of three *G. lucida* samples from different locations verified the method to be reproducible and convenient. The method was validated as stated by the International Conference on Harmonization (ICH) guidelines. The developed HPTLC method is found to be accurate and precise. The same has successfully been applied for the estimation of the targeted PMFs in *G. lucida* gum samples of different locations. [DOI: 10.1556/1006.2018.31.4.6]

Assessment of postharvest processes on major phenolic chemicals and antioxidant potentials of different *Ocimum* species

Tulsi (*Ocimum sanctum* Linn.) is one of the preferred herbs used as tea blended beverage in India. *Ocimum* is a rich source of antioxidants. The present study demonstrates the effect of post-harvest processes and blanching treatment on antioxidant potential of *O. sanctum* and seven other *Ocimum* species/cultivars. An optimized high performance liquid chromatographic method was applied to study the distribution of caffeic acid (CA) and rosmarinic acid (RA), and rutin (RU) in shed dried and

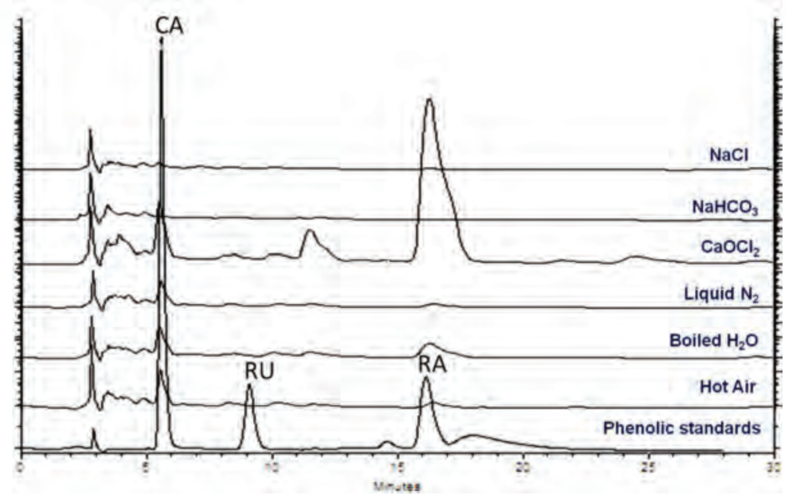


Fig: Effect of post harvest processes on major phenolic of *Ocimum*

blanched *Ocimum* leaves. Blanching treatments included thermal (Deep freeze- liq. N_2, dry-hot air, and wet heat-boil H_2O) and chemical methods (NaCl, $NaHCO_3$, and $CaOCl_2$). In general, blanching treatments have severely degraded the phenolic content of all *Ocimum* species. Only 77% increase in CA content of *O. kilimandscharicum* (OK) when treated with $CaOCl_2$ was observed. Similarly, 14%, 18%, and 19% increase in RA content in the OK leaves were also observed when treated with boiling water, hot air, and $CaOCl_2$, respectively. Shed drying process was found to be most appropriate to hold the antioxidant potential but compromised appearance. Blanching through a quick dip in wet-heat followed by indirect dry-heat drying reduced the loss of green colour. The present findings are useful to adopt the appropriate postharvest handling and pre-treatment of *Ocimum* for optimum retention of green colour appearance and their antioxidant potential. [DOI: 10.1016/j.jarmap.2018.04.002]

Input: CS Chanotiya, RK Lal, Mrs Anju Yadav

Compositional variations, enantiomer distribution and NMR study in essential oils of CIM-Shishir: A hybrid of *Ocimum basilicum* × *O. kilimandscharicum* and CIM-Surabhi varieties

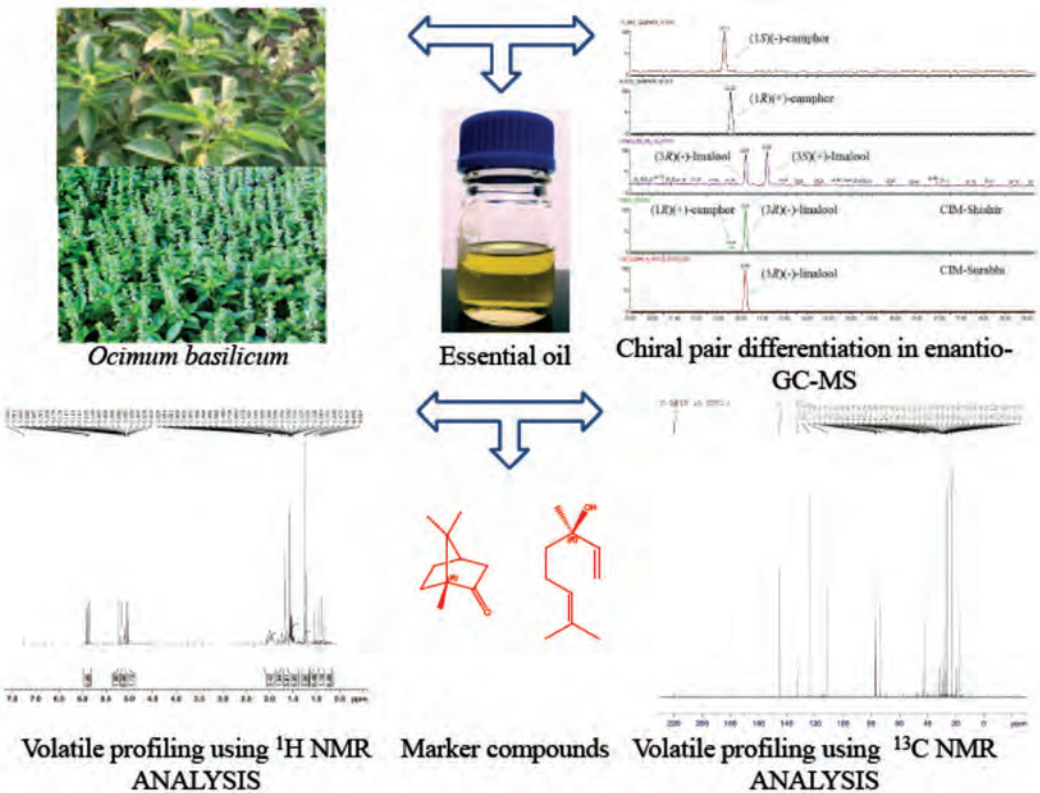


Fig: Enantiomer Separation and NMR characterization of two Ocimum essential oils

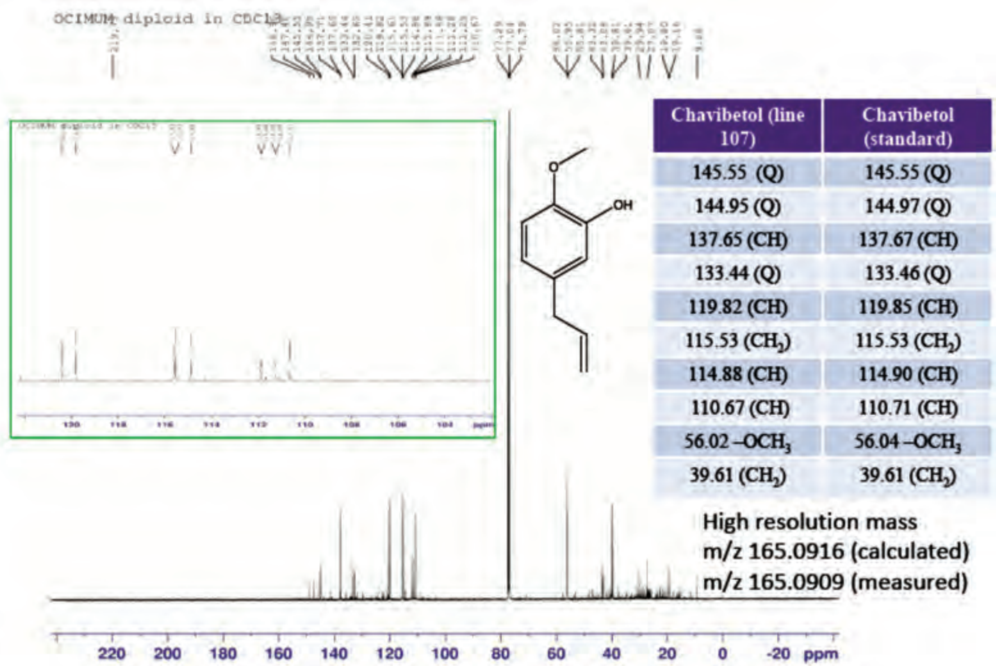
Essential oils from two varieties of Ocimum basilicum christened as CIM-Shishir and CIM-Surabhi were analyzed using GC, enantiomeric analysis on GC, NMR and GC-MS methods. Essential oils of CIM-Shishir contained linalool (68.5%), camphor (8%), 1,8-cineole (4.6%) as characteristic constituents among monoterpenoids, whereas β-caryophyllene (1.9%), germacrene D (1%), and epi-α-cadinol (1.9%) were identified as sesquiterpenoids. CIM-Surabhi possessed linalool (66.1%), 1,8-cineole (5.4%) and geraniol (8.6%). Sesquiterpenoids were identified with very low proportions: β-caryophyllene (0.3%), germacrene D (0.8%), and epi-α-cadinol (2%). An extensive 1D and 2D-NMR experiments were carried out to confirm linalool, geraniol and camphor in both the varieties. When subjected to enantiomer differentiation studies; a high enantiomeric excess for (3R)-(-)-linalool was observed in oils from both the varieties whereas (1R)-(+)-camphor was recorded exclusively in CIM-Shishir (Fig.). In conclusion, the cold tolerant and perennial nature of CIM-Shishir was established by the presence of camphor in its oil. Moreover, camphor has been a unique feature of CIM-Shishir and can be used as marker component in differentiating oil of both *O. basilicum* varieties.

Characterization of a unique phenylpropanoid chavibetol in Inter-specific hybrid of *O. basilicum* and *O. kilimandscharicum*

Chavibetol has been characterized for the first time in essential oils of genus Ocimum. An intensive 1D and 2D NMR experiments were carried out in order to establish the chemical structure (Fig.). Moreover, chavibetol has been a unique feature of this new line and can be used as marker component in differentiating oil.

Cyclodextrin based gas chromatography and GC/MS methods for determination of chiral pair constituents in mint essential oils

The genus Mentha has been known as culinary source of minty note. Besides, the essential oil derived from different species imparts value to several consumer products like confectionary, cosmetics and pharmaceutical preparations. A simple and sensitive enantioselective gas chromatographic method is described for the quantitative analysis of enantiomers in essential oils of two different mint species. The method is based on separation of chiral pairs in different cyclodextrin coated stationary phase capillary columns. Limonene, menthone, menthol and menthyl acetate were identified as pure (-)-enantiomers whereas isomenthone, neomenthol, pulegone and piperitone as pure (+)-enantiomers in menthol mint and peppermint oils, respectively. The selectivity of each enantiomer was also demonstrated using different substituted cyclodextrin phases. A β-cyclodextrin phase with diethyl substitution provides baseline resolution for all target enantiomers with selectivity ranged from 1.004 to 1.050. Moreover, permethylated or diacetylated-β-cyclodextrin showed no selectivity for (+/-)-menthol enantiomers. The communication may facilitate origin authentication studies of mint oils. Investigation of chiral pair compounds involved in menthol biosynthesis pathway has so far shown no indication of the presence of both enantiomers in essential oils. Furthermore, we reported that diethyl substituted β-cyclodextrin as the most versatile



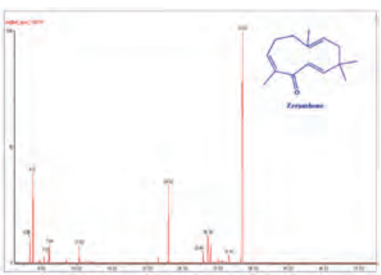
Chavibetol (line 107)	Chavibetol (standard)
145.55 (Q)	145.55 (Q)
144.95 (Q)	144.97 (Q)
137.65 (CH)	137.67 (CH)
133.44 (Q)	133.46 (Q)
119.82 (CH)	119.85 (CH)
115.53 (CH_2)	115.53 (CH_2)
114.88 (CH)	114.90 (CH)
110.67 (CH)	110.71 (CH)
56.02 –OCH_3	56.04 –OCH_3
39.61 (CH_2)	39.61 (CH_2)

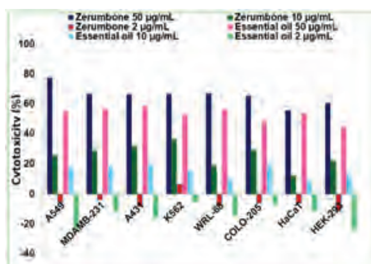
Fig. NMR characterization of chavibetol in essential oil of Ocimum (line 107)

Input : RC Padalia

Zingiber zerumbet (L.) Roscoe ex. Sm.: A Potential source of zerumbone rich essential oil for antiproliferative and antibacterial applications

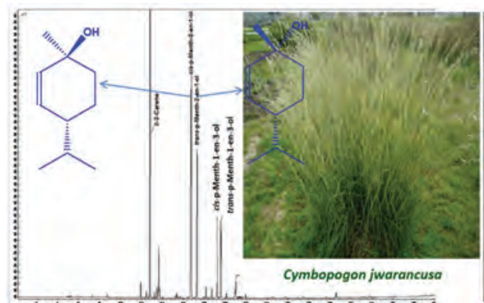
Zingiber zerumbet, commonly known as 'bitter ginger and shampoo ginger', is used extensively in traditional herbal medicine. In present study the rhizome essential oil of *Zingiber zerumbet* was characterized using chromatographic and spectrometric methods (GC-FID, GC-MS, IR and NMR). Zerumbone (72.86%), α-humulene (7.09%), and camphene (5.04%) were characterized as the major constituents. The rhizome essential oil and its major constituents (zerumbone) were found to possess significant antagonist activity against *Staphylococcus aureus* (MIC: 52.0-166.6 μg/mL), *Streptococcus mutans* (MIC: 62.5-208.0 μg/mL), *Escherichia coli* (MIC: 104.1-208.0 μg/mL). The antiproliferative activity of the essential oil and zerumbone was evaluated against various human cancer and normal cell lines (A549, MDAMB-231, A431, K562, WRL-68, COLO-205, HaCaT, and HEK-293). Results showed that, both essential oil and zerumbone possessed antiproliferative activity against tested cell lines, where zerumbone was more competent then essential oil. The diverse reported biological activities of zerumbone make it useful to develop natural derived therapeutics. *Z. zerumbet* grown in foothills of north India with higher essential oil and zerumbone content could be exploited for this bio-active aroma molecule for food-flavor and pharmaceutical products.





Phytochemical study and biological activity of the essential oil of *Cymbopogon jwarancusa* (Jones) Schult.

The essential oil composition of *Cymbopogon jwarancusa* grown at subtropical climatic conditions of Uttarakhand was analysed by chromatographic and spectroscopic methods. The major constituents identified were *cis*-p-menth-2-en-1-ol (25.32-31.80%), *trans*-p-menth-2-en-1-ol (14.03-16.63%), δ-2-carene (11.80-15.76%), *cis*-p-menth-1-en-3-ol (10.50-14.23%), and *trans*-p-menth-1-en-3-ol (8.01-9.22%). The essential oil was tested for antimicrobial activity against eight fungal and nine non-resistant and drug resistant bacterial strains. The essential oil exhibited significant antibacterial activity against *Mycobacterium smegmatis* (MIC: 0.13 μL/mL), methicillin resistant *Staphylococcus aureus* (MIC: 0.13 μL/mL), *Staphylococcus epidermis* (MIC: 0.26 μL/mL), and *Streptococcus mutans* (MIC: 0.52 μL/mL). However, in antifungal assay, *Candida kefyr* (0.06 μL/mL), *Candida*



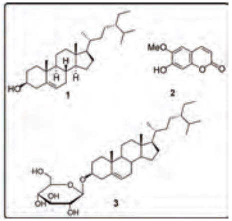
Compounds	Content (%)
δ-2-Carene	11.80±1.81
cis-p-Menth-2-en-1-ol	31.80±1.52
trans-p-Menth-2-en-1-ol	16.25±1.8
cis-p-menth-1-en-3-ol	14.23±1.21
trans-p-menth-1-en-3-ol	8.79±0.66
Essential oil yield (%)	0.53±.0.03

albicans (0.06 μL/mL), *Candida tropicalis* (0.13 μL/mL), and *Candida krusei* (0.26 μL/mL) were found to be more susceptible to essential oil of *C. jwarancusa*. The essential oil displayed moderate antioxidant activity in DDPH, FRAP and NO scavenging assay. Results showed that the p-menthenol rich (71.07%) essential oil of *C. jwarancusa* possessed significant antimicrobial and antioxidant properties for future exploration and exploitation as antimicrobial agents for natural derived herbal formulations.

Input: KVN Satya Srinivas

Isolation of phytomolecules from *Tecomastans* (L)

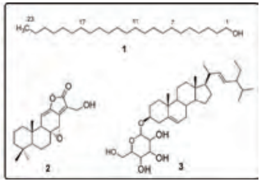
Tecomastans is a flowering perennial shrub belonging to the family Bignoniaceae. The entire plant possess medicinal value, the roots are used as diuretic, anti-syphilitic and vermifuge. The decoction of flowers and bark are used for stomach pains. The plant possessanti-diabetic, anti-spasmodic, anti- microbial, anti-inflammatory, anti-cancer activityetc. The leaves were extracted successively with hexane, ethyl acetate and methanol and the extracts were purified by using silica gel column chromatography and hexane, ethyl acetate solvents as mobile phase in increasing order of polarity yielded nine compounds.



Three compounds were identified on the basis of spectroscopy data. The structure elucidation of remaining compounds is in progress.

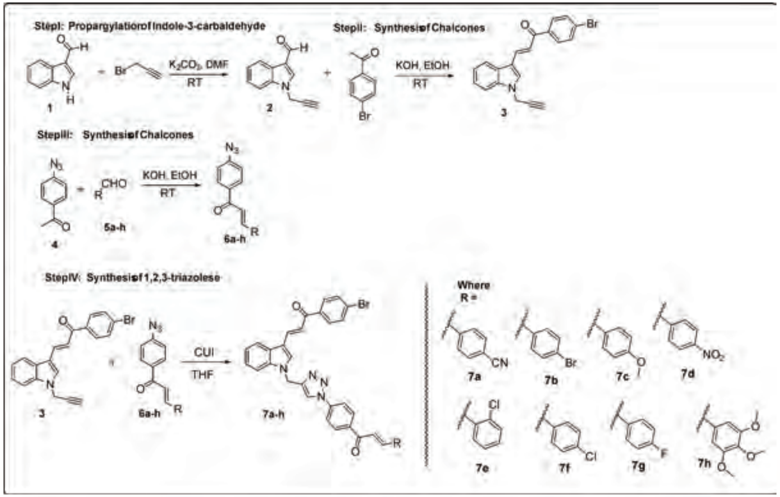
Isolation of phytomolecules from *Indigofera astragalina* (L)

Indigofera astragalina is a weed belonging to the family Fabacea. The ethanol, chloroform and ethyl acetate edxtracts of the plant posseed potent *in vitro* cytotoxic activity and hexane & water extracts showed moderate cytotoxic activity. The leaves and stems were extracted with hexane, ethyl acetate and methanol. The extracts were purified by column chromatography using silica gel and the column was eluted with hexane and ethyl acetate solvents as mobile phase in increasing order of polarity yielded six compounds.Three compounds were identified on the basis of spectroscopy data.The structure elucidation of remaining compounds is in progress.



Synthesis of Indole 3-carbaldehyde di chalconetriazole derivatives.

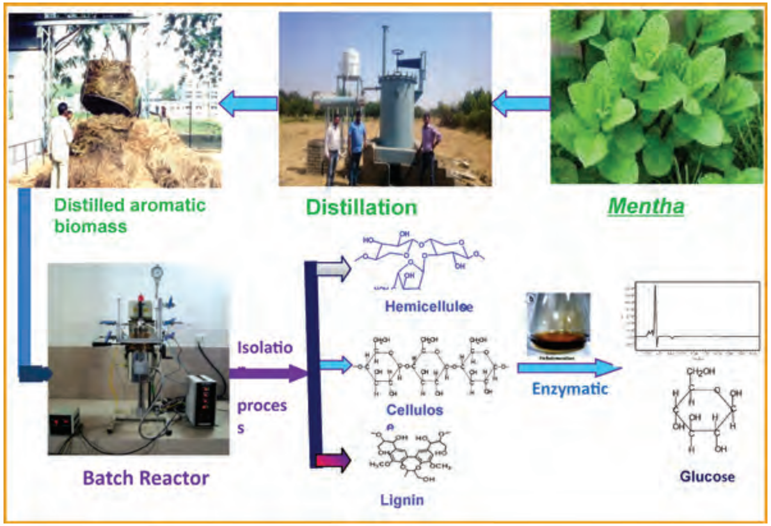
Synthesized a series of Indole 3-carbaldehye-di chalcone-1,2,3-triazole derivatives. In the first step, Indole 3-carbaldehye was propargylated with propargyl bromide and coupled with 4-bromobenzaldehyde in the presence of EtOH and Potassium hydroxide. Later in the second step, the product**3** [(E)-1-(4-bromophenyl)-3-(1-(prop-2-yn-1-yl)-1H-indol-3-yl) prop-2-en-1-one] was coupled with (E)-1-(4-azidophenyl)-3-phenylprop-2-en-1-one under click chemistry reaction conditions (Cu catalyzed 1,3-dipolar cyclo addition) in the presence of Copper (I) iodide as catalyst in dry THF at room temperature for 12-14 hr yielded 7a-hcompounds.



Input: PK Rout and AD Nannaware

Isolation of cellulose from distilled mentha biomass and enzymatic saccharification of isolated cellulose to glucose

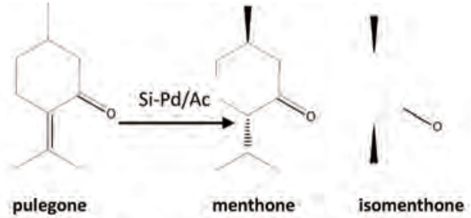
Pre-treatment is the key to unlock renewable lignocellulosic biomass for the production of valuable polysaccharides and biochemicals. *Mentha arvensis* represent an essential oil crop widely cultivated in world for producing high value flavour constituent like menthol (75.8%). After extraction of essential oil, the remaining biomass is generally treated as distilled lignocellulosic biomass. Recently, a novel process has been developed using imidazolium based solvent systems for the isolation of major biopolymers from distilled *M. arvensis* biomass. In this process cellulose (38%), hemicellulose (30%) and lignin (12%) was isolated. Isolated cellulose was further enzymatically hydrolysed using *Cellic CTec2* (114 FPU/ml) and *Trichoderma reesei* enzymes (68 FPU/ml) for the maximum glucose production in shake flask method. Our studies showed that *Cellic CTec2* is more suitable enzyme for the production of glucose from distilled *M. arvensis* biomass with the enzyme loading of 10 FPU/g isolated cellulose in 48 h at 50°C and 4.8 pH. The maximum glucose concentration obtained experimentally was 615 mg/g of isolated cellulose.



Input: PK Rout

Si-Pd/Ac catalyst selectively reduced the pulegone into menthone and isomenthone

Mentha essential oil is one of the most important natural flavoring agents and India produces more than 60% of total global production. The total global production of Mentha essential oil is more than 7000 tons. (-)-Menthol crystal is isolated from *Mentha arvensis* essential oil by freezing. This natural menthol is then physically separated by centrifuging the supernatant liquid away from the menthol crystal. The remaining liquid portion is known as dementholized oil (DMO). DMO contains 30-35% of menthol along with menthone, isomenthone, menthyl acetate, pulegone, etc. In DMO, pulegone is enriched (2-4%) and it is a toxic compound to cause cancer. This compound is not recommended in essential oils and upto 1% might be passed the regulation issue. Moreover, FDAhas removed pulegone from the list of acceptable food additives. Therefore, a heterogeneous catalyst process has been developed for the conversion of pulegone to menthone and isomenthone, where Si-Pd/Ac selectively converts about 99% pulegone into menthone and isomenthone (1:1 ratio approx).



Input: Ram Swaroop Verma

Essential oil composition of wild-mint {*Mentha longifolia* (L.) L.} harvested at different stages of plant growth

Mentha longifolia (L.), popularly known as 'wild-mint' or 'horse-mint' grows wild in many parts of the world. In India, it is distributed in the Garhwal, Kumaon, Kashmir and Punjab regions.The aim of this study was to investigate the changes occurring in the essential oil (EO) content and chemical composition of *M. longifolia* during different stages of plant growth {VS-I: vegetative stage (90 days); VS-II: vegetative stage (120 days); FS-I: flowering stage (150 days); FS-II: flowering stage (180 days) and FS-III: late-flowering stage (210 days)}. The EO content was found to vary from 0.68–1.4 % (v/w; dry weight basis) during different stages, with the maximal during vegetative stages (VS-I, VS-II). The resulting EO was analyzed by gas chromatography-flame ionization detector (GC-FID) and gas chromatography–mass spectrometry (GC–MS). Altogether, forty-two constituents, representing 95.6–98.3 % of total EO composition were identified.Major constituents of the EO were piperitenone oxide (26.5–63.8 %), *trans*-piperitone epoxide (25.3–61.8 %), and germacrene D (0.8–4.1%). Piperitenone oxide was found higher at VS-I (63.8 %) and thereafter it started decreasing with the advancement of plant stage (FS-III: 26.5 %). However, *trans*-piperitone epoxide was recorded minimal at VS-I (25.3 %) and it increased with the advancement of plant stage (FS-III: 61.8 %). The results obtained were of significance for determining the favorable time for harvesting.

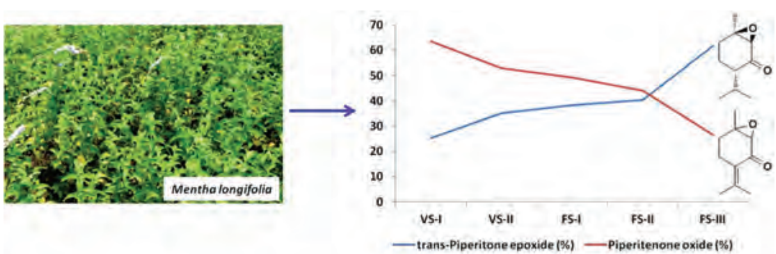
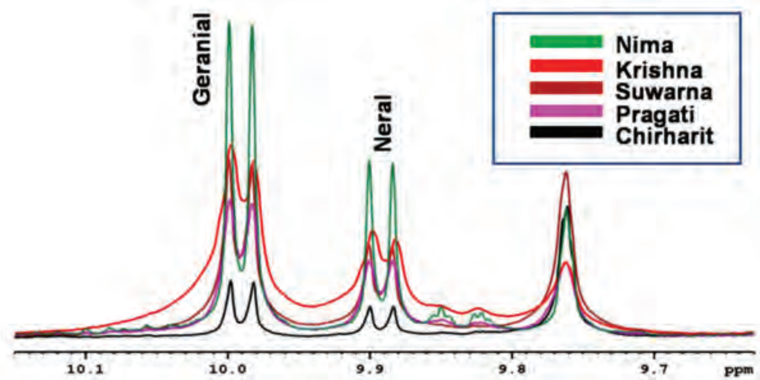


Fig: Essential oil composition of *Mentha longifolia* harvested at different stages of plant growth {VS-I: vegetative stage (90 days); VS-II: vegetative stage (120 days); FS-I: flowering stage (150 days); FS-II: flowering stage (180 days) and FS-III: late-flowering stage (210 days)}.

Input: Hariom Gupta

^{1}H-NMR based metabolic profiling in five chemotypes of *Cymbopogon flexuosus* (lemongrass) and *Mentha arvensis* (Field mint)

Five chemotypes CIMAP-variety of *Cymbopogon flexuosus*(lemongrass) namely, chirharit, pragati, krishna, neema and swarnawhich induces different fragrances and flavors due to compositional variation of constituting molecules which can ultimately affects its medicinal properties. ^{1}H NMR based metabolic profiling in order to distinguish the chemical composition variation in these five chemotypes is studied for mono terpenes mainly Citral (Neral, Geranial), Nerol, Geraniol, Geranyl formate, Citronellyl Propionate, β-Caryophyllene, Geranyl acetate and Linalool. The study demonstrated that the chemotypes showed distinct



cluster groupings in the PCA (Principal Component Analysis) score plot. The detailed analysis suggested that Neemachemotype contains significant higher concentrations of Citral which may impart more effective medicinal properties.

India is one of largest mentha cultivating country and CIMAP has developed number of new improved verities to enhance the menthol content. Twelve verities of this plant developed by our institute namely Sambhav, Khushal, MAS-1, Cim-kranti, Saksham, Kosi, Himalaya, Dmaroo, Kalka, Gomti, Shivalik and Saryu is studied using non invasive NMR technique to evaluate the variation in active constituent of different verities. ^{1}H NMR spectral based metabolic profiling of these twelve varieties is performed to determine the compositional variation in mono terpenes mainlymenthol, menthone, isomenthone, neo-menthone, Piperitone, neo-menthylacetate, limonene and Isopulegol. The detailed analysis shows the significant higher amount of mono terpene in Kosi and Saryu variety of mentha.

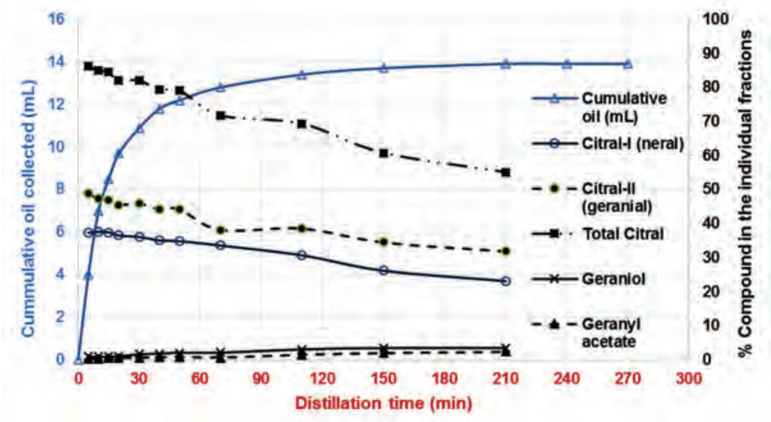
Input: GD Kiran Babu

Optimization of lemongrass oil distillation

The study was aimedatoptimizing the Lemongrass (*Cymbopogon flexuosus* var. Krishna) oil yields through monitoring its quality by gas chromatography. Lemongrass being cultivated in the fields of CRC, Hyderabad was harvested and distilled for 3½ h to recover 13.9 mL oil from 1.2kg fresh foliage with a yield of 1.16% (v/w). The essential oil fractions collected were, then, analyzed on a Varian CP-3800 model gas chromatograph with Galaxy software system equipped with a flameionization detector (FID) and an electronic integrator.

Production kinetics of lemongrass oil

In the first 20min, about 70% of the oil was distilled almost linearly at a rate of 0.5 mL/min. Later, the rate of oil extraction gradually decreased and followed a first order kinetic model. In the first half-an-



hour, about 80% of the oilwas collected; whereas 90% of the oil could be recoveredwithin the first one hour. Complete oil exhaustion could only be achieved after 3½ h. The total citral (neral + geranial) content gradually decreased from 86.3% to 55% during the present experimental condition. A similar decreasing trend was observed in the case of neral (from 37.3% to23.2%) and geranial (from 49% to 32%). Oil fraction collected between 50-70 min of distillation contained about 70% total citral content and thereafter, it reduced drastically. It is also interesting to observe that the oil distillation rate also dropped considerably. On contrary, concentration of geraniol and geranyl acetate increased steadily from 0.95% to 3.5% and 0.3% to 2.4%, respectively. From the foregoing studies, it is recommended that the distillation can be stopped anywhere in between 1 to 1½ h. to get optimum oil yields with improved oil quality.

Process development for extraction of andrographolides

Andrographis paniculata (Burm. F) Nees belongs to the Acanthaceae family commonly known as*Kalmegh* is widely used in traditional medicine in India, Southeast Asia and China.Andrographolides are the

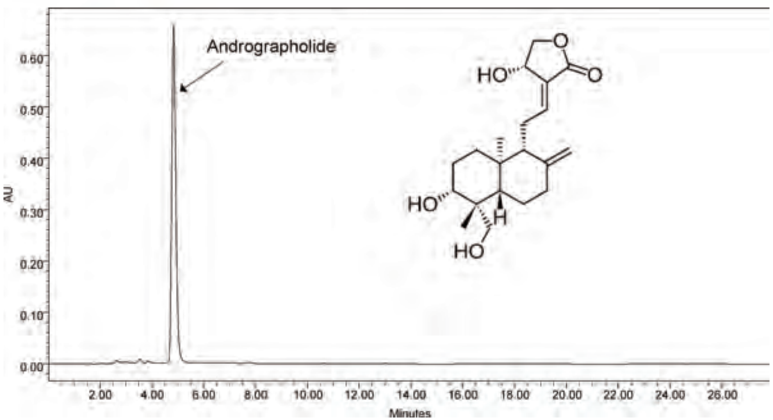


Fig: HPLC chromatogram of andrographolide (95.9%) produced on a laboratory scale

principal bioactive secondary metabolites which have the commercial importance and are largely exported to the USA, France and Japan. Very few conventional methods for production of andrographolide have been reportedand hence there is great scope for developing and standardisation of extraction technology. Therefore, the present preliminary studies on process development at laboratory scale to produce andrographolides from the aerial parts of *A. paniculata*were initiated. Dried aerial parts of *A. paniculata* harvested from CSIR-CIMAP, RC, Hyderabad was extracted with commercial grade alcohol. This crude alcoholic extract was, then, treated with an adsorbent to remove the organic impurities followed by filtration. The extract was concentrated under vacuum andtheandrographolideswere crystalized. These crystals were filtered and further refined to get rid ofimpurities present in smaller quantities. The data from HPLC with PDA detector at 223.8nm UV light revealed that the product contained 95.9% pure andrographolide (Fig). The process upscaling is being carried out at the pilot plant.

Input: Jnanesha AC and Ashish Kumar

Effect of seasonal variation on essential oil and its constituents

An experiment was conducted at CSIR-CIMAP, CRC, Hyderabad to study the effect of seasonal variation on oil yield and chemical constituents of *Ocimumafricanum*Lour. Var. CIM-Jyoti during 2017-18. There was a significant difference about oil yield obtained from different parts of Ocimum *viz*., Whole herb, leaves, stem, and inflorescence was noticed during a different season. Among different season summer season recorded significantly higher oil content compared to winter season. The hydro distilled essential oil content from different parts of the plant obtained from summer and winter season ranges from 0.2 to 0.6. However, the highest essential oil content (0.3 % to 0.6 %) was recorded in summer, and lowest oil content (0.2% to 0.3%) was recorded in the winter season (Fig.). The essential oil consists of Citral II is the most abundant component followed by Citral I. The highest

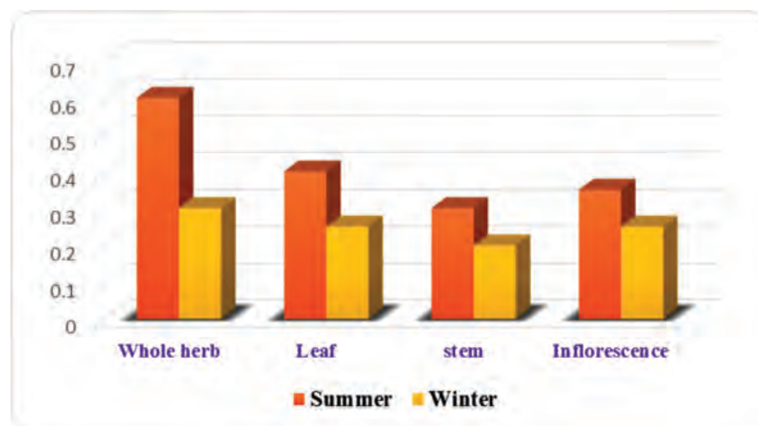


Fig :Percent oil obtained from different parts of *Ocimumafricanum* during summer and winter season amount of Citral I obtained from different parts of *O. africanum*Lour. CIM-Jyoti*viz*., whole herb (42.5 %), leaf (43.5%), stem (44.8%) and inflorescence (39.9 %) collected during summer and was followed by Citral I (33.7 %, 36.2%, 36.2% and 34.6 % respectively). Whereas other essential oil components *viz*., Citronellol, Linalool and geraniol content was higher in different parts of plant obtained during winter season compared to summer season and rest of the essential oil content were higher in summer season compared to the winter season. Similarly, the growth parameters such as plant height, No. of branches, No. of leaves and leaf area were significantly higher during summer season (65.8 cm, 23, 435.8 and 14.68 m^2 respectively) compared to winter season (30.2 cm, 14, 257.4 and 11.18 m^2 respectively). From the experiment, it can be concluded that the growing of *O. africanum*Lour. Var. CIM-Jyoti during summer season gave significantly higher growth parameter in turn herbage yield, oil content and its chemical composition compared to winter season. So, cultivating of this crop instead of lemongrass gave citral in a short duration of 70–80 days and also it fits well in crop rotation/ intercropping between wheat and paddy and with other vegetable crops. Leaves of this variety can also be used in lemon tea gives additional income to the farmer within short time span. Under Rice-fallow system or other traditional cropping system, inclusion this crop gave additional income to the farmer.

Input: AD Nannaware

New design solar distillation apparatus for essential oil extraction

We have designed and developed an innovative solar distillation apparatus for efficiently distilling the volatile fractions from aromatic and medicinal plants. This new design solar distillation unit facilitates the aromatic crops growing farmers with higher oil yield and also allow the farmers to have the complete visibility of essential oil obtained from aromatic plants during distillation operation. Using this new design distillation, farmers can easily see the quality and yield of the essential oil obtained. This technology will help to introduce the agriculture industry about the various uses of solar energy in a very simple and effective way. This solar distillation technology will also curtail the farmer's dependency on fossil resources in modern agriculture practice using renewable source of energy. This will help in assisting the Indian farmers and end beneficiaries with the objective to develop sustainable agribusinesses. The innovative solar distillation work will open a new landmark in rural development of India. This new solar distillation unit was successfully demonstrated to farmers in Kisanmela – 31st January 2018 and to other CSIR/Industrial scientific communities in India International Science Festival 2018. (Patent application no.: 0149NF2017)

CSIR-Aroma Mission

PROGRESS AT A GLANCE

Total Area Covered (ha)	**912**
Total Manpower Trained (number)	**7539**
Total Awareness Programs (number)	**139**
Varieties Developed	**3**

Since the inception of CSIR Aroma Mission, the participating laboratories has been putting considerable efforts to boost the cultivation as well as value-addition of aromatic crops, in their endeavors towards achieving the mission's aim of doubling the farmers' incomes and helping the country to emerge as a global leader in the production and supply of essential oils. Six CSIR laboratories viz., CIMAP, IHBT, IIIM, NBRI, NEIST and URDIP are participating in the mission to develop, disseminate and deploy the aroma related S & T developments to the end users including farmers, industry and society, to enhance farmers' income, improve the quality of their life, business opportunities and rural development.

Keeping with the objective of the development of superior varieties and agro-technologies, three (03) high-yielding varieties of aromatic crops and one (01) agro-technology were developed and released during the year.


CIM-Ujjwala (Chamomile)


CIM-Snigdha (Ocimum)


CIM-Shishir (Ocimum)

During 2017-2018, under CSIR Aroma Mission, a huge amount of planting material of high-yielding varieties of commercially important aromatic crops (most significant being Lemongrass – 50 Lakh slips, Citronella – 10 Lakh slips, Vetiver – 20 Lakh slips, Palmarosa – 660 kg seeds, Menthol Mint – 200 kg suckers, Geranium – 0.25 Lakh slips, Chamomile – 2 kg seeds and Patchouli – 0.08 Lakh slips) was generated at the research farms of CSIR-CIMAP for the distribution to a large number of interested farmers.


Vetiver planting material distribution in Assam


Palmarosa harvesting in Kutch, Gujarat


Lemongrass harvesting in Bastar, Chhattisgarh

Consequently, an additional area of more than 900 hectares was brought under cultivation with aromatic crops (the important ones being Mints ~ 500 ha, Lemongrass ~ 164 ha, Palmarosa ~ 142 ha, Vetiver ~ 73 ha and Citronella ~ 17 ha)

Crop Name	Target for 3 years (in ha)	Achieved during First Year (in ha.)
Lemongrass	450	164

Palmarosa	400	142
Vetiver	200	73
Mints	750	500
Citronella	50	17
Ocimum	70	4
Geranium	40	5
Salvia	40	5
Patchouli	40	-
Rosemary	5	2
	2045	**912**

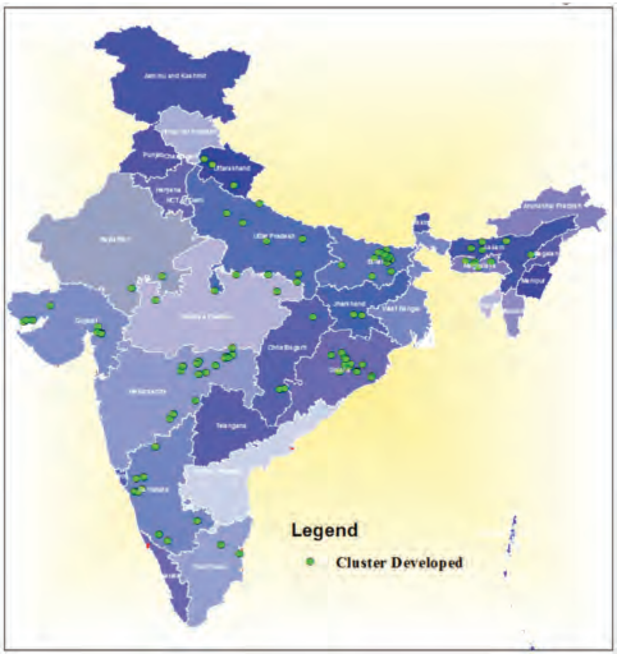


Fig: CSIR Aroma Mission Clusters

Most of the crops selected under the Mission can tolerate high levels of stresses like drought, floods, salinity, shade etc. Many of the drought-tolerant crops like lemongrass and palmarosa were introduced in around 300 ha area in Vidarbha, Bundelkhand, Odisha, Gujarat and Rajasthan which are frequently affected by insufficient rainfall. Crops like vetiver and palmarosa, which are able to tolerate extended periods of flood and salinity respectively, were also introduced in the cyclone- and Tsunami- affected coastal areas of Tamil Nadu and Kutch region of Gujarat. Presently, around 100 ha area is under cultivation of Vetiver in Cuddalore district of Tamil Nadu and of Palmarosa in the Kutch area of Gujarat is providing handsome profits to the farmers. Efforts were also made to introduce high-value aroma crops in the North-Eastern region where high-yielding varieties of Citronella were introduced to revive cultivation of this important crop, the oil of which is in high demand and is imported in huge amounts. Another significant intervention in North-East was the successful cultivation of vetiver in the Brahmaputra basin, which remains saturated with water for a long period.

Different Aromatic Crop Clusters Developed Across the Country

Lemongrass - Anamalai Tiger Reserve (Tribal)

Mentha - Indore, MP

Odisha

Vetiver - Cuddalore, TN

Lemongrass - Bastar, Chattisgarh

Palmarosa - Vidarbha region

Dudhwa Tiger Reserve

Vetiver - Mau, Uttar Pradesh

A total of 24 units were successfully installed by the institute at different farmers' fields resulting in the production of more than 65000 kgs of oil, major contribution being that of mint essential oil (60000 kgs); other contributing essential oils being Lemongrass ~ 2450 kgs, Palmarosa ~ 1495 kgs, Citronella ~ 874 kgs, Ocimum ~ 250 kgs, Vetiver ~ 105 kgs, and Geranium ~ 75 kgs.

To make farmers aware about the benefits of aromatic crops and train them for cultivation and processing of aromatic crops, 139 awareness and skill development programs were organized across the country benefiting around 7539 farmers.




Activity	Target	Achieved
Skill Upgradation	09	19
Awareness programmes organized (Number)	44	106
Advanced Training	12	14
Trained human resource (Number)	2500	7539

In order to enlarge the impact of the proposed activities of the Aroma Mission, efforts were made to bring other stakeholders and line ministries on board which include aroma industries, MSME, MCX, DoNER, DBT, JSPLS, state agriculture/ horticulture/ forest departments/ universities and farmer organizations. Various aroma industries (M/s Ajmal Industries, Ultra International, Synthite, Nishant Aromas, etc.) have shown keen interest and agreed to enter into buy back agreements. The formation of positive collaborations with Research Institute for Fragrant Materials, Inc (RIFM), USA, TNAU Coimbatore, University of Tezpur would further strengthen the activities of aroma mission and its visibility in international market. Efforts are also on to involve the stakeholders such as MSME in providing financial support or any additional resources to install improved primary processing/distillation units in the farmers' fields for efficient on-site processing of raw material and to build mechanisms to link aroma industry with farmers for procuring essential oils at fair price.

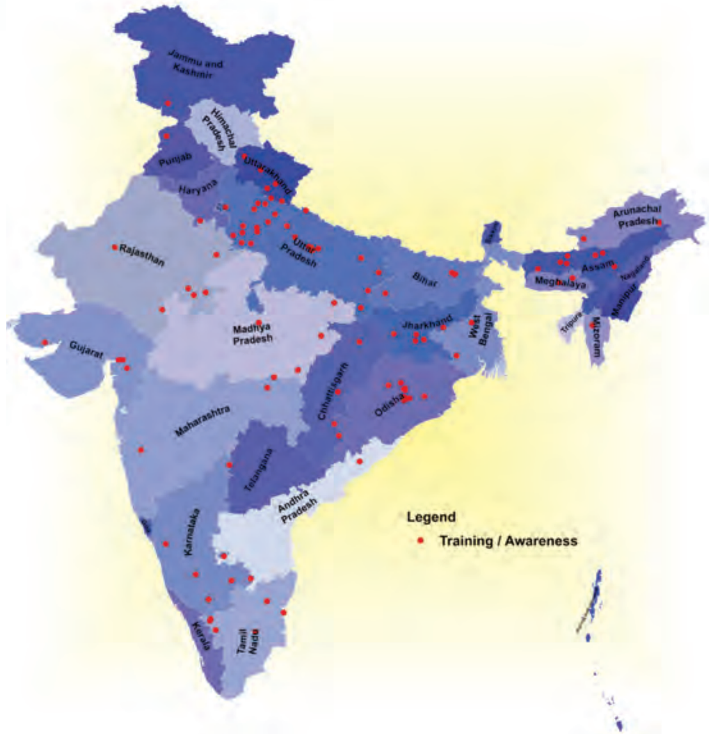


Fig: Training/Awareness program organized at different locations under Aroma Mission

International Collaborations

In order to connect various activities under the CSIR Aroma Mission to various stakeholders, CIMAP developed a web portal (**http://aromamission.cimap.res.in**), which was successfully launched on 4th August 2018 by Dr PK Seth in the august presence of aroma industry, academia and scientific fraternity during the EOAI International Congress and Expo-2018 held at Bangalore. The web portal is a dynamic website which publishes various activities and progress under the mission. The website offers the facility of registration under the Aroma Mission to the beneficiaries, buyers and fabricators. It allows sharing of ideas, thoughts and suggestions with the Mission Director and other participating lab directors in addition to the feedback mechanism. The system has an in-built email and SMS facility as well. Also, during the International Congress, the Team CSIR-CIMAP was awarded with the ULTRA INTERNATIONAL AROMA TEAM AWARD for the innovative and meaningful efforts towards promotion of cultivation and processing of aromatic crops for improving the production of essential oils in India and for enhancing the income of large number of farmers under CSIR Aroma Mission.

Brochures, Pamphlets, Booklets, Short films, Talks, etc
Brochures/pamphlets/booklets printed and distributed : 13
Short films developed: 04
TV Talks on Doordarshan/Local media channels : 10
Radio Talks : 06

Press Coverage of CSIR Aroma Mission

गंगा के किनारे किसान करें खस की खेती

सुगंधित और औषधीय खेती के लिए वैज्ञानिकों ने दिया प्रशिक्षण

कृषि विज्ञान केंद्र में दो दिवसीय कार्यशाला का आयोजन, नौगढ़ के किसानों के लिए लेमन ग्रास की खेती को बताया फायदेमंद

सूखे में सुगंधित फसलों की खेती कर रहे किसान

एरोमा मिशन में मेंथा की 300 प्रोसेसिंग यूनिटें लगाएगी केंद्र सरकार

मिशन में बन रहे सभी 300 क्लस्टर के लिए एक-एक यूनिट की घोषणा, केंद्रीय राज्यमंत्री गिरिराज सिंह ने लखनऊ में बजट से पहले दी जानकारी

किसानों के मुद्दों पर राजनीतिक दल करते हैं नौटंकी

सीएसआईआर की एरोमा मिशन का शुभारंभ

एकल प्रशिक्षण कार्यशाला का शुभारंभ

'एरोमा मिशन किसानों के लिए जीवन परिवर्तन मिशन'

'समाज के हित के लिए कार्य करना वैज्ञानिकों का प्रयास'

CSIR-Phytopharmaceutical Mission

CSIR-CIMAP is participating in the ambitious phytopharmaceutical mission of CSIR, which aims to catalyze phyto-pharmaceutical drug discovery as per global standards for unmet medical needs from indigenous medicinal plants under captive cultivation. CSIR-CIMAP is contributing in the following programme of the mission

- Captive cultivation of selected medicinal plants including high value rare endangered and threatened (RET) ones
- Technology packages for production of GMP grade medicinal plant extracts
- Phyto-pharmaceutical drug development from important medicinal plants as per regulatory guidelines of DCG(I)
- Making public aware of mission activities and achievements using appropriate interface

Captive cultivation of selected medicinal plants like Kalmegh, Ashwagandha etc. is being done:

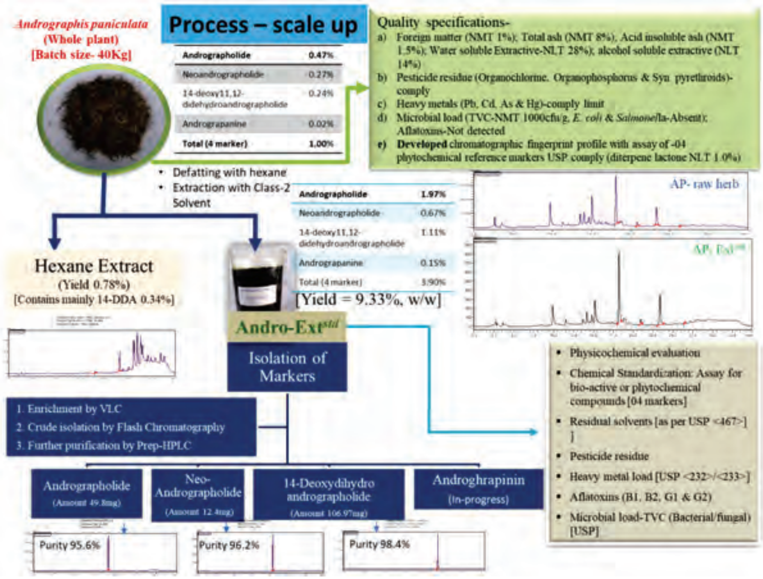


About 9.5 kg seeds of kalmegh produced out of which 7.5 kg has been provided for captive cultivation on farmer,s fields and 2.0 kg is made available for other purpose like development of Agro-technology. Field experiment consisting 17 treatments involving 4 traditional crop (Maize, Bajara, Okra and Pigeon pea) and 3 spacing (60x60, 60x45 and 60x30 cm) + 5 sole crops is being conducted at CSIR-CIMAP , Lucknow. Kalmegh crop is planted on about 1000 M ^{2} area for seed production and about 10 kg seed may be made available by the end of February 2019 for the captive cultivation on farmrsfiels (About 30 ha area).

Phytopharmaceutical project is also focused on development of technology packages for production of GMP grade medicinal plant extracts preparation. There are two major activity- i) Development of improved process for standardized extract with defined CMC (chemistry, manufacturing and controls), and ii) Production of standardized GMP extracts for global markets as per USP standards.Total six plants viz. *Andrographispaniculata, Phyllanthusamarus, Silybummarianum, Curcuma longa, Berberisaristata, and Gymnemasylvestre*have been targetedto generate marker markers compounds for defining the quality and develop the scale-up process for standardized extract. Phytochemicals reference substances from *A.paniculata, S.marianum, C.longa,* and*B.aristata*. Marker chemicals which qualify the criteria of identity and purity were deposited in the repository of CSIR-Indian Institute of Integrated Medicines (IIIM), Jammu along with standard documentation.Comprehensive standard documentation in the form

Identity, Purity and Strength:

Parameter	Value (mean ± Std. dev.)
Foreign matter	0.71±0.11 (Not more than 1%)
Total Ash	6.53± 0.02 (Not more than 7%)
Acid-insoluble ash	1.24±0.08 (Not more than 1.5%)
Water soluble extractive	25.32±0.20 (Not less than 25%)
Alcohol soluble extractive	12.59±0.64 (Not less than 12%)
Value in percent (dry weight basis)	

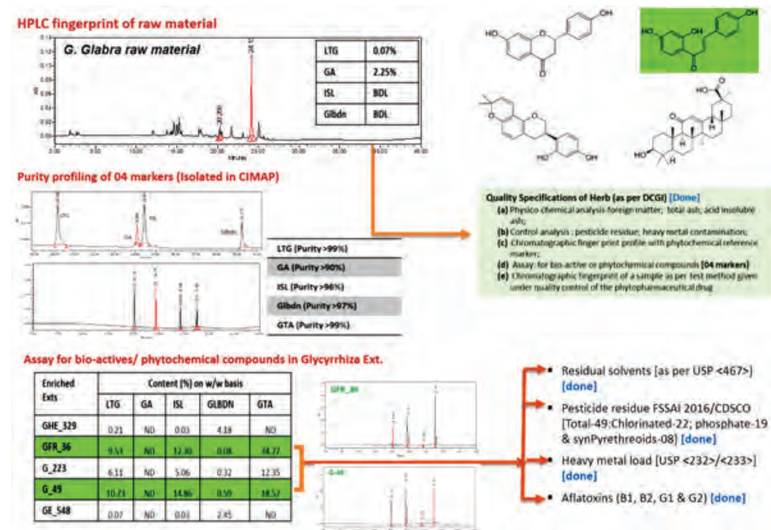


of certificate of analysis of marker chemicals reference substances e.g. andrographolide, silibinin A & B,curcumin, bisdemethoxycurcumin, and berberine have been prepared as proof of quality for the regulatory dossier in compliance with the current guidelines. The certificate of analysis includes raw data from identity using ^{1}H&^{13}C-NMR, mass spectrometry, thin-layer chromatography, and purity analysis by chromatographic methods.

Under drug development objective of the phytopharmaceutical mission project, CSIR-CIMAP is contributing for the development of Isoliquiritigenin enriched formulation of *Glycyrrhiza glabra* for diabetes and following work has been done to achieve this objective:

- Pharmacognostic evaluation of roots of *G. glabra*;
- Preparation of enriched extract of *G. glabra* and standardization with 4 chemical markers;
- OGTT of two standardized extracts of *G. glabra*
- *In-vivo* anti-diabetic activity of standardized enriched extracts in Swiss albino mice at 500mg/kg body weight.
- *In-vivo* anti-diabetic activity of standardized enriched extracts in Swiss albino mice at 250 and 125mg/kg body weight.
- Mutagenicity test (Ame's test)

Chromatographic finger print profile of *G. glabra*



CSIR Nutraceuticals Mission

CSIR-CIMAP is focusing its effort in development of nutraceutical formulations under following categories

A. **Enhancing nutrition**

1. Development of a suitable oral formulation for the increased bioavailability of vitamin B12 using standardized extracts of selected medicinal plants.

2. Development of Nutrifoods for breakfast, a low cost/feasible cost to be met by Govt, which is ready to use in schools and acceptable by children.

B. **Cognition**

1. Alpha linolenic acid (ALA) based Nutraceuticals for cognition and depression management (**Nodal**: Dr. Rakesh Pandey).

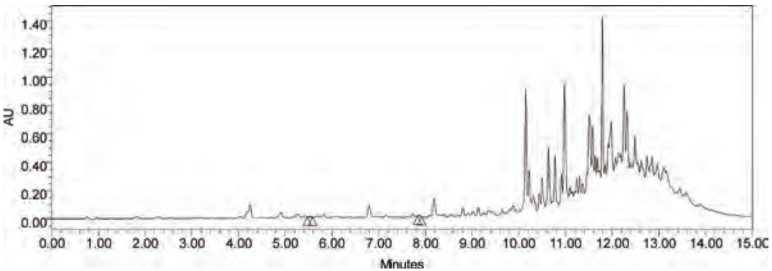
2. Development of nutraceutical for neurodegeneration linked cognitive impairments in elderly population.

C. Immunity

1. Triphala based validated formulation for compromised immunity (**Nodal**: Dr. Anirban Pal).

Progress :

Cognition : Standardized extracts of three selected medicinal plants have been prepared and evaluated in *Caenorhabditis elegans* model wherein they exhibited significant antioxidant and thermal stress tolerance activity with no toxicity upto1000ppm concentration.



Standardization of a plant extract through HPLC analysis

Enhancing nutrition: Standardized extracts of selected plant species have been prepared using the solvents as per FSSAI guidelines. In in vivo assays using mice model, about 2-3 fold enhancement in the bioavailability of Vitamin B-12 has been observed. In case of ready to eat (RTE) nutria-breakfast, Sweet Milk Dalia, Salty Veg Dalia, Namkeen Sattu and Jaggery-Sattu Laddu have prepared. Further, Nutritional analysis and shelf life of the products is being worked out.

Lyophilized Sweet Milk Dalia

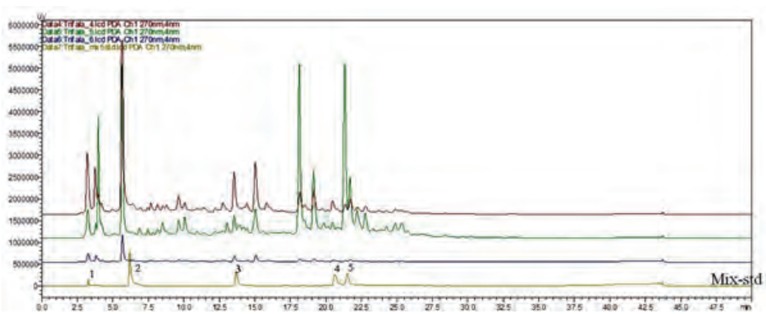
Namkeen Sattu

Jaggery-Sattu laddu

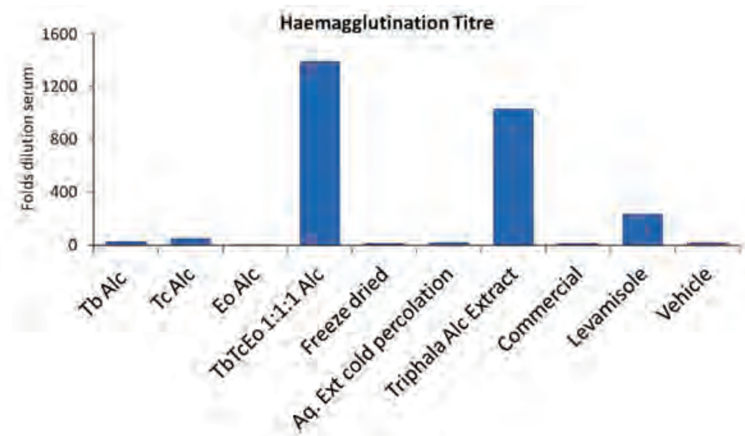
Lyophilized Sweet Milk Dalia

Immunity:

The primary aim of the project is to standardize one of the most common formulations of Ayurveda viz., Triphala which is prepared by mixing equal proportions of the dried fruits three plants, *Terminalia bellerica*, *Terminalia chebula* and *Emblica officinalis*. Though the formulation is one of the most common ones and is being manufactured by almost all the Ayurvedic firms, there aren't any standards available for it. CSIR-CIMAP under its nutraceutical mission has planned to standardize this formulation through step by step quality analysis through pharmacognosy, extraction and biological activity. Besides standardizing the classical formulation, the project also aims to come up with a tablet or a syrup formulation that is easy to standardize based on common phytochemical markers. The immunomodulation results on mice are encouraging and are considerably different than the classical formulation being presently used.



Chromatogram depicting the presence of marker compounds in different extracts of triphala



Haemagglutination titres depicting immunity in mice orally administered with different extracts and preparations of triphala and its constituents

IORA-RCSTT Co-ordination Center

The Indian Ocean Rim defines a distinctive area consisting of coastal states bordering theIndian Ocean. It is a region of much diversity, in culture, race, religion, economic development and strategic interests and consists of 23 member states and 9 dialogue partners.

Subsequent to approval of Ministry of Extenral Affairs for establishing IORA-RCSTT coordination centre at CSIR-CIMAP, Lucknow, the draft of MoU was prepared by CSIR-CIMAP and endorsed by CSIR, headquarter, New Delhi, JS (IOR), MEA, New Delhi and IORA, RCSTT, Tehran. The MOU was signed on 24th February 2018 at Tehran in the presence of Dr Girish Sahni, Director General, CSIR, Prof. AK Tripathi, Director, CSIR-CIMAP and Dr AK Shasany, Head ISCD, CSIR-CIMAP. And Secretary General of IORA H.E. Dr. NomvuyoNokwe.

Following the MOU signing between CSIR-CIMAP and IORA-RCSTT, the IORA-RCSTT Coordination Centre on Medicinal Plants at CSIR-CIMAP was inaugurated by Former-DG, CSIR, Dr Girish Sahni on 07.05.2018.

First Training Program organized by IORA-RCSTT Co-ordination Center at CSIR-CIMAP, Lucknow, India

First training program on diversity, documentation, gene banking, and database for medicinal plantsof Indian Ocean Rim Association (IORA) - Regional Centre for Science and Technology Transfer (RCSTT) was successfully organized on 25 November-1 December, 2018 by the CSIR-Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP), Lucknow, under the guidance of Ministry of External Affairs, Government of India. The meeting was attended by the designated 30 resource persons from the IORA Member States viz. Iran, Sri Lanka, Oman, South Africa, Mozambique, Thailand, Tanzania, Seychelles, Malaysia, Mauritius, Kenya, and Bangladesh. The program has been steered under five major themes- i) Status sharing on Medicinal plants, Experts, Institutes, Market and current quality standards of Medicinal Plants products in IORA member countries, ii) Plant Identification and its significance iii) Documentation of Medicinal Plants and Traditional Practices, iv Current regulatory status of raw drugs and medicinal products, v) Spatial distribution and digitization of Indian medicinal plants, and vi) International Regulatory Measures.

The gathering was addressed by **Chief Guest, Honorable Dr. Dinesh Sharma**, Deputy Chief Minister and Minister for Science & Technology of Uttar Pradesh, India ,**Guest of Honour**, **Mrs Kalpana Awasthi**, Principal Secretary, Environment and Forest, Government of Uttar Pradesh, **Prof Anil Kumar Tripathi**, Director, CSIR-CIMAP and **Dr T Miremadi**, Director, IORA-RCSTT.

Input: Manoj Semwal & Bhaskar Shukla

Major activities carried out by the ICT Department

The major activities undertaken by the Information and Communication Technologies (ICT) department at CSIR-CIMAP during the calendar year 2018 were

- Maintaining and Upgrading Data Center, Network and Desktop, Audio Visual Services of the institute.
- Regular updates of various information on bilingual website of CSIR-CIMAP along with handling facebook page, twitter and uploading short video films on YouTube channel.
- Upgradationof State-of-the-art video conferencing facility(Multiparty) at CSIR-CIMAP HQ along with Installation and configuration of Video conferencing facility set up at Bengaluru, Hyderabad and Pantnagar research center for effective communication.
- Online Portal for Publication of manuscript has been designed so that publication committee would put the summary of the article for one week.
- Online Web Portal of *"National Conference On Mints - Prospects, Challenges and Threats"* for registration and abstract submission has been developed and deployed.
- Web portal of Aroma Mission (http://aromamission.cimap.res.in) has been designed and deployed along with regular updates of various activities carried out under this mission program.
- Finalized script and making of 3 short video film on Mentha, Vetiver and Lemon grass under aroma mission.
- Technical support for implementation of various modules of OneCSIR ERP web portal.
- Development of e-portal for central facility with following features:
    - ➢ Online Registration for Staff and students.
    - ➢ Help Desk for various complaints and its online tracking.
    - ➢ Central facility sample and instrument requisition and tracking for the users registered in the portal.

CIM SFURTI: An advance breeding line of Kewanch with early and high yield of seeds and L-DOPA (Sunita Singh Dhawan and team)

Under the genetic enhancement program of *M. pruriens*, using γ-irradiation (0, 50, 100, 200,300, 400, 500 Gray). 300 variants were primarily screened for elite or improved characteristics viz. high seed and L-DOPA yield as well as gain of traits which could further enhance the overall better traits. The unique charters were compared with the check variety CIM-Ajar in the year of 2012-2013 and selected seven variants namely, T-I-7, T-II-16, T-II-23, T-IV-9, T-VI-1 and T-VI-10. The selected mutant CIM-T-IV-9 –CIM SFURTI is a vigorous and unique chemotype. Small size and thickest inflorescence axis, light brown color of pods and emergence of pod from basal region of mutant are main distinguishing features fulfilling the DUS (distinctiveness, uniformity and stability) criteria also.

Characteristic features	*M. pruriens* CIM – Nirom	*M. pruriens* CIM-AJAR (Check variety)	*M. pruriens* CIM-Sfurti
Growth habit	Climber very fast growing	Climber normal growing	Climber very fast growing
Pod's surface	Non stinging rudimentary trichome	Non stinging rudimentary trichome	Non stinging rudimentary trichome
Flower	Distinctive curved blue petals	Distinctive curved light blue petals	Distinctive curved light blue petals
Seed yield potential (ql / ha)	20.0 (bamboo support)	13.2 (bamboo support)	21.5 (bamboo support)
	-	17.5 (double tier mesh support)	25.0 (double tier mesh support)
	-	-	95.45 (bush support)
Color of ripened pod	Dark black	Light black	Light brown
Color of seed	Dark black	Dull white with black tinged	Light grey
Test weight (g/100 seeds)	174.78	112.84	128.0
Maturity (days)	240-280	270-280	196-240
L-DOPA (%)content	2.99-4.20	3.11 -4.10	4.64-5.16
L-dopa yield (Kg/ha)	72.00	52.80	98.90

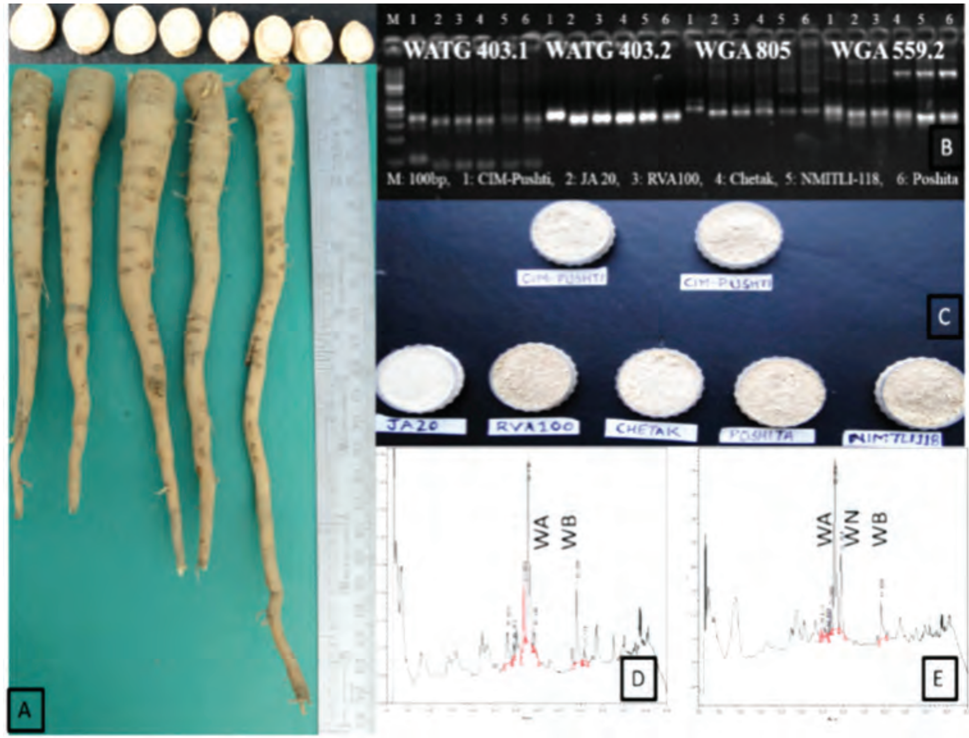
CIM-SHISHIR: A multicut, lodging resistant, cold tolerant, high essential oil yielding with linalool rich variety from inter specific hybrid of *Ocimum* (Sunita Singh Dhawan and team)

In the *Ocimum* genetic stocks and evaluation programme, we have taken *O. basilicum* Ob-1(Female) which has methyl eugenol, linalool and annual crossed with *O. kilimandscharicum* OK - cold tolerant and perennial as male parent for bridging purpose and obtained hybrid (H2) in F1 generation in the year of 2011-12. Then hybrid (H2) using female origin crossed

Description of the strain

Attributes	HYBL-1	Check variety CIM Surabhi
Growth habit	Tall Bushy	Semi spreading
Days to harvest after transplanting	Three cuttings/year with the interval of 90 days	80-85
Days to flower (50 %)	120	70-80
Plant height (cm)	125-130	80-85
Color of leaf (Lower/Upper)	Medium green (137 B/147B)	Light green (138 A/138B)
Leaf surface	Undulated surface	Plain
Length of leaf (cm)	9.30-9.50	6.20-6.30
Width of leaf (cm)	4.50-5.20	3.40-3.50
Fresh herb yield (ql/ha)**	600.00	221.30
Oil content in fresh herb (%) **In clevenger**	0.80	0.75

with *O. basilicum* Ob-2 having desired traits (annual, high essential oil content with high linalool content as male parent) in the year 2012-13. The progeny of this inter specific hybrid named as HYBL1 has the characters -high oil and high linalool content, cold tolerant and perennial/multi cutting. The top highest yielding genotype, HYBL-1, always maintained its superiority and all desired characters as mentioned above over the check and others for high oil and high linalool content**.** The elite strain (HYBL-1) is released as CIM –SHISHIR for commercial cultivation. Strain HYBL-1 is a perennial, tall (128cm), multi cut, cold tolerant, lodging resistant with very broad, long, undulated surface, medium green leaves and yellowish green stem in color of inter specific hybrid. The strain has the following DUS (distinctiveness, uniformity and stability) characteristics.



CIM-Pushti: Withanolide-A rich, leaf blight tolerant high yielding variety of Ashwagandha (*Withania somnifera*) with good root textural quality (Tripta Jhang and team)

A new variety 'CIM-Pushti' have been developed through intra-specific hybridization between 'Nagouri' X 'Kashmiri', the two major ecotypes prevalent in India. It combines the root quality of Nagouri type (cultivated and annual type) and biomass yield of Kashmiri type (wild, perennial type) in one genotype background. The characteristics of the variety are highly wavy, sub-coriaceous, light green leaves with semi erect, strong culm and yellow orangemature berries. Root is whitish cream with non-separable rind, fine pulverisable, brittle roots with high starch to fibre ratio and Withanolide-A content average 0.713mg/g dry weight basis. It is also high in Withanolide-B(0.460mg/g dry weight basis) and negligiblepresence of Withanone. It matures in 168-178 days producing average yield of 9-10 quintal per hectare. It is tolerant to leaf blight. The variety is suitable for cultivation in the Indian agro-climatic zones (VIII,XIII& XIV) i.e. Central Plateau, Western dry region and Gujarat planes regions of India.

Demonstration of Ago-Technology for saving planting material (Input: Dr Saudan Singh)

Low cost field agro-technology for the saving of planting material, developed by CSIR-CIMAP was successfully demonstrated on the farmers' fields of western UP.

Farmer Field View of saved of planted material

Dissemination of Vetiver (*Chrysopogon zizaniodes*) agro-technology in flood prone and contaminated areas of Ganga rivers of Uttar Pradesh (Input: Dr Rajesh Verma)

Awareness and training programme for vetiver plantation at Varansi and Kanpur under NMCG project

Inventorization of medicinal and medicinally important aromatic plants (M&MIAPs) and its conservation in selected Four Ganga Grams [BithoorKhurd, Bithoor Kalan, KatariDodhi and KatariBidhara]of Kanpur Nagar district of Uttar Pradesh (Input: Dr Birendra Kumar)

Developing entrepreneurial skills among the rural youth through on-farm bioconversion methodologies on agricultural waste for producing organic herbs at Barabanki and Lucknow district of Uttar Pradesh. [Input: Dr Rakesh Pandey]

Demonstration of essential oil production technology to the trainees during 25th- 27th June 2018 (Input: Er. G.D. Kiran Babu)

Another skill development-cum-training program on 'cultivation and primary processing of economically important aromatic crops' during 14th to 16thNovember 2018 was conducted under CSIR-Aroma Mission (HCP-0007) at CRC, Research Centre, Hyderabad. About 47 participants including entrepreneurs/farmers attended the said program.A practical demonstration on the production of essential oils on the commercialwas imparted to the trainees during the training program at CRC, Hyderabad on 15th November 2018

Establishment of a primary processing facility for herbal extraction at CRC Hyderabad

Innovation and efficient processing machinery are the keys to successful entrepreneurship. CSIR-CIMAP, RC, Hyderabad has been involved in establishing a herbal processing facility with an objective to foster farmer-institution interaction. Apart from providing state-of-art herbal processing machinery for technology evaluation by the entrepreneurs, the facility would be employed in a demonstration of various herbal extraction technologies for the skill development of unemployed youth, and potential stakeholders in the field. The equipment that was commissioned at CRC, Hyderabad are shown in the following figures.

Production of Aloe vera gel

Aloe vera leaf gel produced after peeling and removing the aloin content

Pulveriser –for making value addition to medicinal plants such as Ashwagandha and turmeric

Awareness & Training Programs

Inputs: Sanjay Kumar, Ramesh Kumar Srivastava, Ram Suresh Sharma, Ram Pravesh and Deepak Kumar Verma.

One Day Awareness on Efficient Price Discovery and Improved Cultivation Practices in Mentha Oil2018

Sr. No.	Date	Place	No. of participants
1	04.01.2018	Lucknow Trg	39
2	04.01.2018	BKT, Lucknow	69
3	05.01.2018	Barabanki (Mohammadpur Chauki)	74
4	06.01.2018	Raebareilly	83
5	07.01.2018	Lakhimpur	47
6	01.02.2018	Barabanki (Harinarayanpur)	66
7	02.02.2018	Lucknow Trg	127
8	07.03.2018	Shahjahanpur	48
9	08.03.2018	Bareilly	54
10	09.03.2018	Rampur	52

11	19.03.2018	Moradabad	57
12	20.03.2018	Shambhal	59
13	21.03.2018	Badaun	65
14	22.03.2018	Kashganj	48
15	23.03.2018	Agra	37
16	24.03.2018	Firozabad	46
17	07.04.2018	Rehra Bazar, Balrampur, UP	90
18	08.04.2018	Shravasti, UP	86
19	10.04.2018	CIMAP Lucknow, UP	94
20	28.05.2018	Fulwari Sharif, Patna , Bihar	54
21	30.05.2018	Lakhisarai, Bihar	65
22	31.05.2018	Hadiyabad, Bhojpur, Bihar	78
23	01.06.2018	Bagar, Ara, Bhojpur, Bihar	80
24	15.10.2018	Tezpur University, Tezpur	95
25	25.10.2018	CIMAP, Lucknow	61
26	26.10.2018	Regional Seminar, Barabanki	94
27	03.12.2018	Dhakhauli, Barabanki	75
28	04.12.2018	Atrauli, Sitapur	73
29	05.12.2018	Kansura, Barabanki	63
30	06.12.2018	Mehmoodabad, Sitapur	85
31	07.12.2018	Lalapurva, Barabanki	68
		Total	**2132**


Awareness programme at Gundala, Kutch, Gujarat


Awareness programme at Rapar, Kutch, Gujarat


Awareness programme at Dudhwa Tiger Reserve, LakhimpurKheri (UP)


Awareness programme at Ranchi, Jharkhand


Awareness programme at Madhepura, Bihar


Awareness programme on cultivation & processing of aromatic plants in Bastar


Awareness Programme at Chhatarpur (MP) under DBT sponsored Bundelkhand


Awareness programme on cultivation & processing of aromatic plants in Bastar

Awareness Programmes under Aroma Mission and other projects 2018)

Sr. No.	Date	Place	Partici-pants
1	13.01.2018	Fingesar, Distt. Gariyaband, Chhattisgarh	29
2	14.01.2018	Maalgaon, Kondagaon, Chhattisgarh	205
3	31.03.2018	Vill. Sera, West Kameng, Arunachal Pradesh	20
4	13.04.2018	Khidrat, Jodhpur, Rajasthan	67
5	14.04.2018	Jhakhadwali, Hanumangarh, Rajasthan	69
6	02.05.2018	Sagar, Madhya Pradesh	92
7	04.05.2018	Dhuskiya, ChandanChauki, LakhimpurKheri	66
8	05.05.2018	Pipraula, ChandanChauki, LakhimpurKheri	108
9	15.05.2018	Maalgaon, Kondagaon, Chhattisgarh	121
10	28.05.2018	Phulwari Sharif, Patna, Bihar	62
11	29.05.2018	Surajpura, Rohtas, Bihar	63
12	30.05.2018	Balihar, Rohtas, Bihar	63
13	31.05.2018	Hadiyabad, Bhojpur, Bihar	80
14	01.06.2018	Bagar, Bhojpur, Bihar	114
15	02.06.2018	KVK Madhepura, Bihar	130
16	05.06.2018	Government Inter College, Mirzapur	115
17	04.06.2018	Ateli, Naunar, Haryana	50
18	10.06.2018	Amritsar, Punjab (with the help of RajendraAgri-clinic)	121
19	11.06.2018	Vill. Devgain Post. Namkum, District Ranchi, Jharkhand	75
20	12.06.2018	Vill. Bhojdeeh, Post. Bundu, District Ranchi, Jharkhand	67
21	14.06.2018	Krishi Gramin Vigyan Kemdra, Ranchi, Jharkhand	54
22	15.06.2018	Vill. Birkham Post. Chandankyari, Distt. Bokaro, Jharkhand	37
23	25.06.2018	Village Abrar Vita, Tehsil Balijana, distt. Goalpara, Assam	41
24	26.06.2018	Vill. Kachukata, Post. Tamulpur, distt. Buxa, Assam	29
25	27.06.2018	Sakomota Tea Estate, distt. Biswanath, Assam	34
26	04.07.2018	Vill. Palli, Tehsil Lohavat (Falodi), Distt. Jodhpur, Rajasthan	38
27	10.07.2018	Vill. Vaghura, Mundra, Kutch, Gujarat	89
28	17.07.2018	Village Kauhara, distt. Banda, UP	23
29	18.07.2018	Village Thakurra, distt. Chhatarpur, MP	87
30	19.07.2018	Village Maudaha, distt. Hamirpur, UP	49
31	20.07.2018	Village Rehuta, distt. Panna, MP	63
32	27.07.2018	Vill. Jhargram, West Bengal	60
33	08.09.2018	Vill. Pipraula, Dudhwa Tiger Reserve, LakhimpurKheri	180
34	13.09.2018	Village Alamchand, Distt. Kaushambi, UP	233
35	01.10.2018	Maalgaon, Kondagaon, Chhattisgarh	20
36	02.10.2018	Vill. Kachla, Jagdalpur, Chhattisgarh	35
37	15.10.2018	Tezpur University, Assam	96
38	23.11.2018	Vill. Dhuskiya, Chandancahuki, Dudhwa, LakhimpurKheri	99
39	24.11.2018	Vill. Pipraula, Bankati Range, LakhimpurKheri	197
40	21.12.2018	Viil. Rapar, Kutch, Gujarat	179
41	22.12.2018	Viil. Gundala, Mundra, Kutch, Gujarat	198
			3558

Training Programmes on Medicinal and Aromatic Plants Production Technology

Sr. No.	Date	Place	No. of participants
1	04-06 January, 2018	Lucknow	26
2	02-04 February, 2018	Lucknow	83
3	19-21 March, 2018	Lucknow	31
4	27-29 March, 2018	Nonstoin, Meghalaya	46
6	10-12 April, 2018	Lucknow	91
7	23-24 April, 2018	Mizoram University, Aizawal	53
8	02-03 May, 2018	Lucknow	08
9	06-08 June, 2018	CPRI, Shimla	39
10	24-26 July, 2018	IINRG, Ranchi	29
11	25-27 September, 2018	Lucknow (For JSLPS)	22
12	23-25 October, 2018	Lucknow	65
13	19-21 November, 2018	Lucknow	75
14	10-21 December, 2018	Lucknow (For Nepal Govt. Officers)	06
		Total	574


Groupphoto of the participants in the training programme at Shimla


View of classroom of Training programme at Lucknow

Preparation of incense sticks using floral bio-resource

A step towards making self-sustainable to unemployed and poor women for making incense sticks using discarded or used flowers for self-employment activity, CSIR-CIMAP organised 7 training programmes attended by 303 women. The dates of such trainings along with number of participants are given in the Table below.

Sr. No.	Date	Place	No. of participants
1	07.04.2018	Balrampur	29
2	24.05.2018	BKT, Lucknow	25
3	04.05.2018	Vindhyachal Temple, Mirzapur	119
4	08.09.2018	WETF, Lucknow	23
5	29.10.2018	Nishatganj, Lucknow	13
6	15.11.2018	District Jail, Barabanki	68
7	15.11.2018	Observation House, Barabanki	26
		Total	**303**


Training Programme at BKT, Lucknow

Survey of cultivation of medicinal plants in and around Lucknow (Input: Alok Kumar Krishna)

A survey has been made in different farmer fields in and around Lucknow city. The area under cultivation and profitability of the crop has been calculated.

Area under cultivation of medicinal plants

Medicinal plants under cultivation	Districts	Villages	Area under cultivation and number of farmers involved	Profitability assured buy back
Centellaasiatica (Mandukparni)	Sitapur	Karona, Gopalpur, Taduajatpur, Tauilapur, Tinakpur, Baragaon	70 acres 40 Farmers	1.5 lakhs per acre
Phyllanthu-sniruirie (BhuiAmla)	Sitapur Unnao	Mundera, Gajrolla, Kaluapur and Samuriya Padrona	85 Acres/60 farmers 80 acres/30 farmers	25-30 quintal in three cuttings. Net income Rs.55000-60000 per acre/year.
Solanunnigrum (Makoy)	Sitapur	Gohnapur	90 acres/62 farmers	Rs.60000 per acre
Moringa-Sahjan	Lucknow Mohanlalganj Bahraich Banda Hardoi	Bauramau, BKT; Hirankhuri, Lucknow Mohanlalganj Prayagpur Sayora,Khurand Mallawa	64 acres/2 farmers 5 acres/3 farmers 40 acre/3 farmers 185 acres/9 farmers 5 acre	3 tonn per acre @ Rs.50 per kg Rs.1.5 lakhs per acre


Centella cultivation at Mahmoodabad


Demonstration of Palmarosa, Lemongrass and Vetiver in the farmers' field of Vadodara, Gujarat


Demonstration of lemongrass in the farmers' field of Jharkhand


A view of Plantation of Lemongrass in district West Kameng, Arunachal Pradesh


A view of Nursery Preparation of Geranium in Nongstoin, Megalaya


One day awareness programme at Nongstoin, Meghalaya

CSIR- CIMAP KISAN MELA – 2018

CSIR-CIMAP organized its annual KisanMela on 31st January, 2018 in its Lucknow campus. Shri Giriraj Singh, Hon'ble, Minister of State (Independent Charge), Ministry of MSME, Govt. of India was the Chief Guest of Kisan Mela, who also inaugurated the CSIR pavilion during the occasion and promise to supply 300 distillation units to support Aroma Mission. Shri Surya Pratap Sahi, Cabinet Minister, Agriculture, Agriculture Education and Agriculture Research, Govt. of Uttar Pradesh was the Guest of Honour. The sale of quality planting materials and publications, demonstration of improved plant varieties, herbal products, distillation/ processing of MAPs early mint technology and soil sample and analysis and training on rose water and agarbatti making and exhibition of CSIR technologies for rural development were some of the the major highlights of Kisan Mela. Two improved varieties of Ashwagandha and Mucuna (Kewanch) developed by CSIR-CIMAP was released by the chief guest. Representatives from various industries such as Jindal Industries, Essential Oil Association of India, Kelkar Group, MCX, Natural Aroma, several buyers of medicinal and aromatic plants also participated in the event.

Kisan Mela at CIMAP Resarch Center Pantnagar

Kisan Mela at CSIR-CIMAP Research Centre, Pant Nagar was organised on 08/02/2018 in presence of over 1000 participants from different states. Prof. A.K. Mishra, Vice-Chancellor, GB Pant University of Agriculture and Technology, Pant Nagar was the Chief Guest. Dr. Alok Kalra welcome the guest and SIC, Dr. VR Singh apprised about the achievements and activities of the Research Centre. Demonstration of Agrotechnologies distillation processing etc. were carried out during the event.

Diamond Jubilee Lecture Series

“Bioresources and Biodiversity towards Bioeconomy and Sustainable Development" by Padma Bhushan **Dr (Mrs) Manju Sharma**, Former Secretary, DBT, Govt. of India on 5th September 2018

"*Food and Nutrition*" by **Dr Trilochan Mohapatra,** Director General-ICAR and Secretary (DARE) on 7th Sep 2018

"*From Incremental to Disruptive Game-Changing Innovation*" by Padma Vibhushan-**Dr RA Mashelkar,** Former Director General-CSIR on 11th Oct 2018

"Recombinant vaccine against anthrax: From clone to clinical trials" by **Prof. Rakesh Bhatnagar**, Vice-Chancellor, Banaras Hindu University, Varanasi, on 22nd Oct 2018

"*Co-evolutionary arms race between bacteria and their viruses: Parallel emergence of revolutionary technologies*" by **Prof. Valakunja Nagaraja**, President, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Dept. of Science and Technology, GOI, Bengaluru, on 31st Oct 2018

"*Building the Bioeconomy Ecosystem: Igniting minds, Spurring Innovations*" by **Dr Renu Swarup**, Secretary, Dept. of Biotechnology, Govt. of India on **10th Jan 2019**

Input: D. Saikia & A. Pal

Republic Day 2018 Celebrations - 26th Jan'18



Mahak Utsav at Sugandh Vihar Colony




An event for the Students , Staff and Family members

CSIR inter-laboratory Rolling Cup tournament - 10th Feb'18



Venue: CDRI grounds; Participants: CDRI, CIMAP, IITR and NBRI

MoU : CIMAP – RIFM at IFRA Annual meet, Paris 8th Nov'18


Mr Jim Romine, President, Research Institute for Fragrant Material (RIFM) USA

INCITE 2018 – 15th Feb'18

Org. By: IITR, CIMAP, Ultra Intl & FFDC for empowering Indian Aroma Industry

Women empowerment Birbhum District, West Bengal 20th Feb'18

Awareness & support for cultivation of aromatic crops

INSA-JIGYASA 2018 : March 9-10'18

CSIR-CIMAP at Rashtrapati Bhawan : March 21, 2018

CIMAP Annual Day : 26th Mar'18

"Chief guest: Prof S Ayyapan, Guest of honour: Prof. Anamik Shah, VC "

Swachchata Pakhwara : May 1-15'18

International Yoga Day : 21st June '18

Staff , Students and family members participated

KVS-JIGYASA: CSIR Scientist-Students Connect Programme : 13th Aug'18

"Students and faculty members of Kendriya Vidyalaya, AFS Mannauri, Allahabad"

Tree Plantation Drive at CIMAP, Lucknow campus : 14th Aug'18



151 saplings of trees on the eve of Independence day

Independence Day Celebrations : 15th Aug'18



Sapling plantation and participation of staff and family members

Interaction of Dr RA Mashelkar with farmers : 12th Oct'18

Release of CSIR-CIMAP Brochure: 31st Oct'18

CSIR-Foundation Day : Vigyan Bhawan, New Delhi : 26th Sep'18

CIMAP's work on Ocimum (Tulasi) wins CSIR Certificate of Merit (CSIR Technology Award)

CSIR-Foundation Day at CSIR-CIMAP, Lucknow : 26th Sep'18

Foundation Day Lecture by Shri JNL Srivastava, Ex Secretary, Govt of India

4th India International Science Festival (IISF 2018), Lucknow

CSIR-CIMAP won in 1^{st} prize in 4^{th} India International Science Festival held on 5^{th}-8^{th} October 5-8, 2018

स्वच्छ भारत मिशन – निराला नगर एवं गोमती नगर विस्तार : 2nd Oct'18

''1500 परिवरों को सीमैप द्वारा विकसित मच्छर प्रतिरोधक लोशन – 'मोसेक्स' का वितरण भी किया गया''

Impact of Aroma Mission on Aroma Industry: 19th Nov'18

Visit of Parliamentary Standing Committee : 4th Dec'18

Parliamentarians expressed their satisfaction on CIMAP's functioning

List of All Agreements/ MoUs executed for contract R&D, Consultancy and Technical Services projects

S.No.	Title of MoU / Agreement Signed	Name of the Institution/Funding agency	Date of Agreement/MoU signing (dd/mm/yyyy)
1	CSIR-CIMAP and Shanta AMP shall work jointly for promoting the MAPs for empowerment and upliftment of farmers involved in the AMP, Pan-India	Shanta AMP Extracts Pvt. Ltd. S1, Anu Castle Apts, Banjara Hills Ra.# 3, Hyderabad-500034	26-03-2018
2	MoU was signed with IGKV, Raipur Chhattisgarh for research and development of medicinal and aromatic plants and extension activities to the farmers/entrepreneurs	Indira Gandhi Krishi Vishwavidyalaya Raipur, Chhattisgarh	04-09-2018
3	Providing technical guidance for cultivation and processing of aromatic crops (Lemongrass, Citronella and Vetiver) in Vidarbha region of Maharashtra	Avantha Agritech Limited,Maharashtra	01-09-2018
4	An agreement was signed for making of Natural Aromatic Floor Cleaner	M/s. Saksham Herbals and Orgnics Pvt. Ltd., 45-B, Ranaji Enclave, Najafgarh, New Delhi-110043	11-10-2018
5	A Memorandum of Understanding (MoU) was signed with Tezpur University, Tezpur, Assam for research and development of medicinal and aromatic plants and extension activities to the farmers/entrepreneurs for Assam, Arunachal Pradesh and other states of North East region	Tezpur University, Tezpur, Assam	15-10-2018
6	Providing consultancy and technical guidance for cultivation and processing medicinal and aromatic plants suitable for Hardoi and Central U.P. region	HCL Foundation, Hardoi, Uttar Pradesh	02-11-2018
7	Providing technical support and services for setting up of distillation facilities for M/s Medroma Pro Extracts Pvt. Ltd, Hyderabad	M/s Medroma Pro Extracts Pvt Ltd, Hyderabad	13-11-2018

Input: Preeti Srivastava

List of the MOU's Signed with Other Institutes

1.	Dr. Ram Manohar Lohia Awadh University, Faizabad	2018
2.	Kumaun University, Nainital	2018
3.	Tejpur University, Assam	2018
4.	Tamil Nadu Agriculture University	2018
5.	Yogi Vemana University, Kadappa, Tamil Nadu	2018

Externally Funded Projects

S. No.	Funding Agency	Project No.	Project title	PI	Start date	Total cost (Rs.)	End date
1	National Medicinal Plants Board	GAP-390	Assessment of hazardous metals (As, Cd, & Pd) translocation and accumulation in Kalmegh (*Andrographis paniculata*): Implication of genotype selection for minimal risk to human health	Dr. Puja Khare	14.02.2018	38,20,600	13.02.2021
2	Arboreal Agro Innovations Private Limited Jabalpur, Madhya Pradesh	CNP-391	Providing technical guidance for Stevia processing technology collaboration with CIMAP	Er. Sudeep Tandon	15.02.2018	10,62,000	14.08.2018
3	DST Indo-Italian Project	GAP-392	Development of nature inspired bivalent antitublins as anticancer agents	Dr. Arvind Singh Negi	17.02.2018	45,90,720	16.02.2021
4	DST- WOS-A	GAP-393	Creation and exploitation of genetic variability for the development of chemotypes and morphogenetic characters through seed propagated progenies of *Curcuma longa* L. genotypes and their hybrids	Ms. Ritu Mishra	08.03.2018	17,50,000	07.03.2021
5	UPCST	GAP-394	Molecular and cell target based approach towards cancer chemoprevention by flavonoids via ROS mediated cascades	Dr. Abha Meena	26.03.2018	10,44,000	25.03.2021
6	SERB, DST	GAP-395	Understanding the systematics, biogeography and phylogenetic relationships of *Garcinia* (Clusiaceae) from Western and Eastern Ghats	Dr. V Sundaresan	17.03.2018	30,95,925	16.03.2021
7	SERB, DST	GAP-396	Screening of plant resources for vitamin D3 and its metabolites	Dr. Narendra Kumar	19.03.2018	35,91,000	18.03.2021
8	SERB, DST	GAP-397	Characterization of squalene epoxidase genes ArSQ1 and ArSQ2 with an aim to enhance the shatavarin IV biosynthesis in Asparagus racemosus cell culture	Dr. Rakesh Kumar Shukla	21.03.2018	38,45,406	20.03.2021

9	DBT	GAP-398	Indian bioresource information network (IBIN) geoportal phase III: Enhancing bioresource services, institutional linkages and outreach	Mr. Manoj Semwal	23.03.2018	30,50,640	22.03.2021
10	DBT	GAP-399	An investigation on high value sesquiterpene(s) biosynthesis and its overproduction in heterologous systems	Dr. AK Shasany	15.03.2018	50,86,000	14.03.2021
11	DBT	GAP-400	Developing entrepreneurial skills among the rural youth through on-farm bioconversion methodologies on agricultural wastes for producing organic herbs	Dr. Rakesh Pandey	16.03.2018	46,44,000	15.03.2021
12	The National Academy Sciences, India (NASI)	GAP-401	Organization of awareness programme on cultivation of medicinal & aromatic plants in scheduled tribes of Dhudwa, Ranchi, Kondagaon & Haridwar region	Dr. RK Srivastava	03.04.2018	5,00,000	02.04.2019
13	JINDAL DRUGS, Mumbai	SSP-402	Promotion of newly developed varieties of Mint and its performance evaluation at farmer's field	Dr. Sanjay Kumar	23.03.2018	10,00,000	22.03.2019
14	M/s BharatRohan Airborne Innovations Pvt Ltd. Delhi	SSP-403	Crop monitoring for Menthol mint based cropping system using unmanned aerial vehicle (UAV/Drones) and date analytics tools	Er. Manoj Semwal	13.04.2018	12,20,000	12.10.2019
15	IOR Division, Ministry of External Affairs	GAP-404	Establishment "IORA Coordinating Centre on Medicinal Plants"	Dr. AK Shasany	03.05.2018	3,05,00,000	02.05.2023
16	National Innovation Foundation- India, Ahmedabad, Gujarat	GAP-405	Validation of a herbal practice for Malaria	Dr. Anirban Pal	01.06.2018	6,00,000	31.05.2019

17	DST	GAP-406	Investigation of traditional *Piper longum L.* milk extract for the management of chronic obstructive pulmonary disease: chemical characterization and in-vitro evaluation	Dr Vijayalakshmi Babu	01.08.2017	9,55,639	31.08.2018
18	DST- WOS-A	GAP-407	Synthesis of podophyllotoxin and related analogues as potential anticancer agents through microtubule and /or DNA topoisomerase inhibition	Ms. Ankita Srivastava	02.07.2018	20,87,000	01.07.2021
19	DBT	GAP-408	Demonstration of cultivation, processing and value addition of selected aromatic crops in Bundelkhand region	Dr. Ramesh Srivastava	22.06.2018	2,46,80,000	21.06.2021
20	SERB, DST	GAP-409	Development of therapeutic formulation of selected medicinal plants and their alkaloids against triple negative breast cancer (TNBC).	Dr. Abhilasha Saxena	09.04.2018	19,20,000	08.04.2020
21	SERB, DST	GAP-410	Catalytic modification of low value essential oils to chiral selective commodity products with enhance bioactivity through green processes	Dr. Prasanta Kumar Rout	07.07.2018	20,36,880	06.07.2021
22	SERB, DST	GAP-411	Enhanced production and gene expression of Camptothecin- potential anti-cancer alkaloid drug in hairy root culture of Miquelia dentate Bedd. using elicitors	Dr. Ganesan Mahendran	12.04.2018	19,20,000	11.04.2020
23	Avantha Agritech Limited	CNP-412	Providing technical guidance for cultivation and processing of aromatic crops (Lemongrass, Citronella and Vetiver) in Vidarbha region of Maharashtra	Dr. Ramesh Srivastava	01.09.2018	5,03,270	31.08.2019
24	DST- WOS-B	GAP-413	Ensuring economic upliftment of rural women and youth through capacity building by recycling medicinal and aromatic plants (MAPs) residue to value added products	Dr. Akanksha Singh	11.09.2018	31,60,000	10.09.2021

25	SERB, DST	GAP-414	Designing of micronutrient doped nutrient nanocarrier for the enhancement of in vitro withanolides production in medicinally important withania spp	Dr. Saheli Pradhan	02.04.2018	19,20,000	01.04.2020
26	SERB, DST	GAP-415	Pre-clinical evaluation of three investigational new drugs (INDs) as cancer chemotherapeutics.	Dr. Arvind Singh Negi	11.10.2018	29,05,000	10.10.2021
27	HCL Foundation	CNP-416	Providing consultancy and technical guidance for cultivation and processing medicinal and aromatic plants suitable for Hardoi and central U.P. region	Dr. Sanjay Kumar	2.112018	45,21,494	01.11.2020
28	UP Govt.	GAP-417	Medicinal plants market intelligence in Uttar Pradesh	Dr. Sanjay Kumar	18.08.2018	2,00,000/-	17.08.2019
29	SERB, DST	GAP-418	Structural investigation of geranyldiphosphate synthase (GPPS) from *Chatharanthus roseus*	Dr. Prema G. Vasudev	19.11.2018	22,10,000	18.11.2021
30	M/s Madroma Pro Extracts Pvt Ltd, Andhra Pradesh	CNP-419	Providing technical support and services for setting up of distillation facilities for M/s Medroma Pro Extracts Pvt Ltd, Hyderabad	Er. Sudeep Tandon	13.11.2018	1,51,335	12.11.2019

DBT-Department of Biotechnology, DST-Department of Science and Technology, UPCST-Council of Science and Technology, UP, NMPB- National Medicinal Plants Board DHR-Department of Health Research, SERB-Science and Engineering Research Board, IORA-Indian Ocean Rim Association

About Superannuated Scientists

Dr. Ashok Sharma

Former Chief Scientist and Head, Biotechnology Division, Central Institute of Medicinal and Aromatic Plants (Council of Scientific and Industrial Research), Lucknow

Co-ordinator, Bioinformatics Centre, CIMAP

Professor (Biological Science) & Co-ordinator (Bioinformatics) in AcSIR (Academy of Scientific and Innovative Research), CSIR

Adjunct Professor, JNU for CIMAP-JNU Ph.D programme.

Working on several positions he became Chief Scientist form February 2010. He assumed the charge of Head, Biotechnology Division in August, 2008 and remained HOD till his superannuation. He was instrumental in the establishment of ICT and Bioinformatics at CIMAP and was the Founder Head of both the groups. He was also instrumental in establishment of Bioinformatics Centre (sponsored by DBT, New Delhi) in 1998 and had steered its activities as Co-ordinator since inception. CIMAP won DBT Award for excellence in Bioinformatics twice under his leadership. He did wide ranging R&D on Bioinformatics of Medicinal and Aromatics Plants which includes – Gene expression study, Analysis of regulatory mechanism of non coding RNA's , Molecular interaction studies of phytomolecules. He published more than 75 research paper in quality National/International Journals. He also contributed more than 15 chapters in books and was co-author in Five Books. He is a member of several professional bodies, Technical committees in CIMAP and other organizations. He has delivered more than 50 invited lectures in Symposium and Conferences.

Dr. R. S. Bhakuni

Presently CSIR-Emeritus Scientist in CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow, he served the organization for more than 36 years and superannuated on 30 April, 2018 as Head, Chemical Sciences Division, CSIR-CIMAP. He has wide experience in basic and applied research of Natural Products /Medicinal Chemistry, developed processing of artemisinin antimalarials, anticancer taxol / taxoids and pharmacopoeal monographs of artemisinin animalarials which are extensively in demand today and important for Industry. Current interest is exploration of novel antidiabetic / antibacterial formulations. He was a Post Doctoral Fellow in the in University of Florida, USA for 2 years (1993 –1995).

As a key team member, he received FICCI Award 2005, First Nina Saxena Excellence in Technology Award – 2007 by IIT, Kharakpur and CSIR Technology Award 2012 on Development and Commercialization of Anti Malarial Drug-Plant *Artemisia Annua* Technology for Industrial Growth, Societal health and Rural prosperity.

He has published 110 research publications including 12 review articles and a book chapter and 27 international/ national patents.

He supervised **7** Ph. D. and 20 graduate/post-graduate students in both basic & applied area of Natural Products Chemistry and delivered 64 Invited /oral lectures and presentations in International/ national symposium and meetings.

Staff Members (as on 31 December 2018)

Prof. Anil Kumar Tripathi
Director

Chief Scientist
Dr. Alok Kalra
Dr. Abdul Samad
Shri PV Ajayakumar
Dr. AK Shasany
Dr. (Mrs) Neelam Singh Sangwan
Dr. Saudan Singh

Senior Principal Scientist
Dr. Alok Kumar Krishna
Dr. Ved Ram Singh
Er. Sudeep Tandon
Dr. MP Darokar
Dr. Arvind Singh Negi
Er. G. D. Kiranbabu
Dr. Birendra Kumar
Dr. AK Gupta
Dr. Laiq-Ur-Rahman
Dr. Dharmendra Saikia

Principal Scientist
Dr. Vikrant Gupta
Dr. Rakesh Pandey
Dr. Anirban Pal
Dr. Dinesh A. Nagegowda
Dr. J Kotesh Kumar
Dr. (Mrs) Sunita Singh Dhawan
Dr. Dayanandan Mani
Dr. Karuna Shanker
Dr. Rajesh Kumar Verma
Dr. Sanjay Kumar
Er. Manoj Semwal
Dr. Dnyaneshwar Umrao Bawankule
Dr. Feroz Khan

Sr. Scientist
Dr. Venkata Rao D.K.
Dr. CS Vivek Babu
Dr. Sumit Ghosh
Dr. (Mrs) Prema G. Vasudev
Dr. Ashutosh Kumar Shukla
Dr. Narayan Prasad Yadav
Shri. KVN. Satya Srinivas
Dr. Suaib Luqman
Dr. Rajendra Chandra Padalia
Dr. V. Sundaresan
Shri. Ram Swaroop Verma
Dr. (Smt) Puja Khare
Dr. Chandan Singh Chanotiya
Dr. Debabrata Chanda
Dr. Prasanta Kumar Rout
Dr. Pradipto Mukhopadhyay
Dr. Kishore Babu Bandamaravuri
Dr. Ramesh Kumar Srivastava
Dr. Mukti Nath Mishra
Dr. Rakesh K. Shukla
Dr. (Ms.) Tripta Jhang
Dr.(Mrs) Abha Meena
Dr. Atul Gupta

Scientist
Dr. Preeti Srivastava
Er. Bhaskar Shukla
Dr. Ram Suresh Sharma
Dr. Rakesh Kumar Upadhyay
Er. Ashween D. Nannaware
Dr. Narendra Kumar
Dr. Rakesh Kumar
Dr. Yogendra N.D.
Dr. Channayya Hiremath
Dr. Venkatesha K.T.
Dr. Jnanesha A.C.
Dr. Hariom Gupta

Group-III

Medical Officer
Dr VK Agarwal

Sr. Superintending Engineer
Shri A M Khan

Principal Technical Officer
Dr. Dinesh Kumar
ShriPrem Singh
Dr DK Rajput
Dr. Sukhmal Chand

Sr. Technical Officer (3)
Dr. Dasha Ram
Shri K Bhaskaran
Dr Ateeque Ahmad

Sr. Technical Officer (2)
Mrs. Sudha Agarwal
Shri Govind Ram
Dr. Neerja Tiwari

Sr. Technical Officer (1)
Smt. Anju Kumari Yadav
Shri Shiv Prakash
Dr. (Mrs.) Manju Singh
Dr. Rajendra Prasad Patel
Dr. Rakshpal Singh
Dr. Anil Kumar Singh
Shri Ram Pravesh

Technical Officer (Gr. III (3))
Dr. Amit Chauhan
Dr. Anil Kumar Maurya
Shri. Amit Mohan

Smt Namita Gupta
Shri A.K. Tiwari
Shri Sanjay Singh
Shri A. Niranjan Kumar
Mrs. Anju Kesarwani
Shri Balakishan Bhukya

Technical Assistant
Shri Amit Kumar Tiwari
Shri Manoj Kumar Yadav
Shri Ashish Kumar
Shri. Prawal Pratap Singh Verma
Shri Ashish Kumar Shukla
Shri Manish Arya
Shri Sanjeet Kumar Verma
Shri Deepak Kumar Verma
Ms Pooja Singh
Dr. Prabhat Kumar
Shri Sonveer Singh

Group-II

Sr. Technician (3)
Shri SK Sharma
Dr. Abdul Khaliq
Shri Raghubind Kumar

Sr. Technician (2)
Shri Shyam Behari
Shri Ram Chandra
Shri Salim Baig
Shri SK Pandey
Shri Gopal Ram
Shri E Bhaskar
Smt S Sharda
Shri PN Gautam
Shri Joseph M Massey
Shri Ram Lakhan
Shri PK Tiwari
Shri Vinod Kumar

Sr. Technician (1)
Smt Raj Kumari
Shri Dharam Pal Singh
Shri V.K. Shukla

Technician (2)
Shri Pankaj Kumar Shukla
Shri Kundan Narayan Wasnik
Shri Yalla VVS Swamy
Shri Basant Kumar Dubey
Shri Vijay Kumar Verma
Shri Harendra Nath Pathak
Shri Hemraj Sharma
Shri Jitendra Kumar Verma
Shri Pramod Kumar

Technician (1)

Group-I

Lab Assistant
Shri Mahesh Prasad
Shri VK Singh
Shri Abdul Mabood
Shri Ram Ujagir
Shri Subhash Kumar
Shri Bharat Singh Bisht
Shri Man Mohan
Shri Mohd. Navi
Shri Munawar Ali
Shri Hari Pal
Shri Nurul Huda
Shri Surendra Nath
Shri Lal Chand Prasad
Smt Pushpa Semwal

Lab Attendant (2)
Shri TP Suresh

Administrative Staff

Group-A

Controller of Administration
Shri. Bhasker Jyoti Deuri

Store & Purchase Officer
Shri. B.L. Meena
Shri Ram Badal

Administrative Officer
Smt. B. Mallikamba

Finance & Account Officer
Shri Bhaskar Kumar Ravi
Shri H. Chongloi

Group-B (Gazetted)

Sec. Officer [Gen.]
Shri Hare Ram Kushwaha

Sec. Officer[F&A]
Shri Ankeshwar Mishra

Sec. Officer [S&P]
Shri Vikash Chand Mishra

Sec. Officer [Gen.]
Shri Sanjay Kumar Ram

Sec. Officer [F&A]
Shri Shailendra Pratap Singh

Private Secretary
Smt Kanchan Lata Thomas

Group-B (Non-Gazetted)

Asstt. Section Officer(Gen)
Smt Sufia Kirmani
Shri Muneshwar Prasad
Shri Sant Lal
Shri Parvez Nasir
Shri P Srinivas
Shri Kaushal Kishore
Shri Siddharth Shukla
Shri Ravi Prakash
Shri KG Thomas
Ms. Sanyogita Sainger
Shri PK Chaturvedi

Asstt.Section Officer(F&A)
Smt Nisha Sharma
Shri Harish Chandra
Shri Shiv Kumar
Shri Suneel Kumar
Shri AL Sahoo
Shri Ayush Singhal
Shri Kanhaiya Lal
Smt KC Nagarathnamma

Asstt.Section Officer (S&P)
Shri Pankaj Kumar
Shri Shamiullah Khan
Shri Anees Ahmad
Shri Ajeet Verma

Senior Stenographer
Ms Gaitry Sharda
Smt P Sabitha
Shri Srikar Ji Sinha
Ms. Suchita Gupta

Isolated Posts (Group-B)
Shri Yograj Singh
Shri Rohit Khanna
Smt Sangeeta Tanwar

Group-C Posts

Sr. Secretariat Asstt(Gen)
Shri Manoj Swaroop Shukla
Mrs. Sheela Yadav
Shri Vijay Kumar Bhartey
Mrs. Preeti Gangwar

Sr. Secretariat Asstt(F&A)
Shri Pradeep Kumar
Smt Farzana Hafeez

Jr. Secretariat Asstt(Gen)
Shri R Algarswamy
Shri. Ravi Prakash Mishra
Ms. Pratibha Maurya

Group C (Non –Tech)

Drivers
Shri Ajay Kumar Verma
Shri Sanjay Kr. Singh
Shri Sarwesh Yadav
Shri Chandrapal Verma
Shri Rajesh Kumar

Canteen Staff
Shri Victor Mukherjee

Group D (NT)
Smt. Nargis Sufia Ansari
Smt Sunita Devi
Shri Santosh Kumar
Shri Sant Ram
Shri Sudhir Kumar Bhattacharya
Shri Harihar
Shri Praveen Kumar
Shri Kishan Ram
Smt. Zarina Bano
Shri Ram Karan
Shri Dharam Pal Balmiki
Shri Abdul Nadir Khan
Shri Arvind Kumar
Smt. Raj Mati
Shri Harpal Valmiki
Shri Kripa Ram

Multi-Tasking Staff/Security Guard
Shri Tula Singh
Shri Ashok Kr. Pathak
Shri Kishan Lal
Shri P Bhikshapathi
Smt Nirmala Verma
Smt Tara Devi
ShriMohd. Shameem
Shri Mohd. Mohsin

CIMAP Welcomes New Staff Members

S.No	Name	Designation	Date of Joining	Posting
1.	Shri. Ram Badal	SPO	21.03.2018	CSIR-CIMAP, Lucknow
2.	Dr. Hari Om Gupta	Scientist	02.04.2018	CSIR-CIMAP, Lucknow
3.	Dr. (Mrs.) Neerja Tiwari	STO (3)	24.07.2018	CSIR-CIMAP, Lucknow
4.	Shri. Bhaskar Kumar Ravi	FAO	24.08.2018	CSIR-CIMAP, Lucknow
5.	Shri. H. Chongloi	FAO	10.09.2018	CSIR-CIMAP, Lucknow

Staff Superannuated

S.No.	Name	Designation	Date of Retirement
1.	Shri. Mata Prasad	JSG	28.02.2018
2.	Shri. Sabhajit	Lab Assistant	31.03.2018
3.	Dr. RS Bhakuni	Sr. Principal Scientist	30.04.2018
4.	Dr. HP Singh	Principal Technical officer	30.04.2018
5.	Shri. S Selveraj	Sr. Technician (2)	30.04.2018
6.	Dr. Ashok Sharma	Chief Scientist	31.05.2018
7.	Shri. M.S Mehra	FAO	30.06.2018
8.	Dr. Mohd Zaim	Principal Technical officer	30.06.2018
9.	Shri. SA Warsi	Assistant (S&P) I	30.06.2018
10.	Shri. Y Shiva Rao	Sr. Technician (2)	31.07.2018
11.	Shri. Rakesh Tiwari	Chief Scientist	30.09.2018
12.	Shri. Kailash Chandra	Safaiwala	30.09.2018
13.	Smt. IV Rautela	Sr. Technician (2)	31.10.2018
14.	Shri. Rajesh Kumar	Assistant (G) I	31.10.2018
15.	Smt. Nisha Sharma	Assistant (F&A) I(MACP)	31.12.2018

Publications (2018)

1. Akhoon BA, Rathor L, Pandey R. 2018. Withanolide A extends the lifespan in human EGFR-driven cancerous *Caenorhabditis elegans*. *Experimental Gerontology* 104:113-117. [IF= 3.224]

2. Alam S, Khan F .2018. Virtual screening, Docking, ADMET and System Pharmacology studies on Garcinia caged Xanthone derivatives for anticancer activity. *Scientific Reports* 81:5524. doi: 10.1038/s41598-018-23768-7. [IF=4.120]

3. Alam S, Khan F. 2018. QSAR, docking, ADMET, and system pharmacology studies on tormentic acid derivatives for anticancer activity. *Journal of Biomolecular Structure and Dynamics* 36:2373-2390 [IF=3.107]

4. Asthana J, Mishra BN, Pandey R. 2018. 5,7-Dihydroxy-4-Methoxyflavone a bioactive flavonoid delays amyloid beta-induced paralysis and attenuates oxidative stress in transgenic *Caenorhabditis elegans*. *Pharmacognosy Magazine* 55: 57-64. [IF= 1.525]

5. Azmi L, Shukla I, Gupta SS, Chaudhary A, Kant P, Yadav NP, Rao Ch V. 2018. Evaluation of chemoprotective effect of quercetin from *Argyreia speciosa* against N-methyl-N-Nitro-N-Nitrosoguanidine and NaCl-induced gastric carcinomas in wistar rats. *Pharmacog J.*, 10(2):215-20.

6. Azmi L, Shukla I, Gupta SS, Yadav NP, Kant P, Rao Ch. V. 2018. *In vitro* and *in vivo* study of *Argyreia speciosa* on chronic gastric ulceration and metabolic studies, *Proc. Natl. Acad. Sci., India, Sect. B Biol. Sci.* https://doi.org/10.1007/s40011-018-1023-8

7. Bora K, Sarkar D, Konwar K, Payeng B, SoodK, Paul RK, Datta R, Das S, Khare P, Karak T. 2018. Disentanglement of the secrets of aluminum in acidophilic tea plant (*Camellia sinensis L.*) influenced by organic and inorganic amendments. *Food Research International*. https://doi.org/10.1016/j.foodres.2018.11.049

8. Chaturvedi AK, Verma AK, Thakur JP, Roy S, BhushanTripathi S, Kumar BS, Khwaja S, Sachan NK, Sharma A, Chanda D, Shanker K, Saikia D, Negi AS.2018. A novel synthesis of 2-arylbenzimidazoles in molecular sieves-MeOH system and their antitubercular activity. *Bioorganic and Medicinal Chemistry* 26: 4551-4559. [IF= 2.793]

9. Chaturvedi T, Kumar A, Kumar A, Verma RS, Padalia RC, Sundaresan V, Chauhan A, Saikia D, Singh VR, Venkatesha KT. 2018. Chemical composition, genetic diversity, antibacterial, antifungal and antioxidant activities of camphor-basil (*Ocimumkilimandscharicum*Guerke). *Industrial Crops and Products* 118:246-258 [IF=3.849]

10. Dutta M, Khare P, Chakravarty S, SaikiaDurlov, Saikia BK. 2018. Physico-chemical and elemental investigation of aqueous leaching of high sulfur coal and mine overburden from Ledo coalfield of Northeast India. *International Journal of Coal Science and Technology* 5:265-281 [IF=0.000]

11. Gehlot PS, Gupta H, KumarA. 2018. Paramagnetic surface active ionic liquids: Interaction with DNA and MRI application. *Colloid and Interface Science Communication* 26:14-23[IF:5.091].

12. Ghosh P, Pradhan RC, Mishra S, Rout PK. 2018. Quantification and concentration of anthocyanidin from Indian blackberry (Jamun) by combination of ultra- and nano-filtrations. *Food and Bioprocess Technology* 11:2194-2203 [IF=2.998]

13. Gupta AC, Mohanty S, Saxena A, Maurya AK, Bawankule DU. 2018. Plumbagin, a vitamin K3 analogue ameliorate malaria pathogenesis by inhibiting oxidative stress and inflammation. *Inflammopharmacology* 26:983-991. [IF=3.304]

14. Gupta AK, Mishra R, Kumar A, Lal RK, Saikia D, Chanotiya CS. 2018. Genetic diversity, essential oil composition and *in vitro* antioxidant and antimicrobial activity of *Curcuma longa*L. germplasm collections. *Journal of Applied Research on Medicinal and Aromatic Plants* 10:75-84 [IF=1.007]

15. Gupta AK, Srivastava A, Shanker K, Gupta MM, Mishra R, Lal RK. 2018. Genetic variability, associations, and path analysis of chemical and morphological traits in Indian ginseng [*Withaniasomnifera* (L.) Dunal] for selection of higher yielding genotypes. *Journal of Ginseng Research* 42:158-164 [IF=4.082]

16. Gupta R, Singh A, Kanaujia R, Kushwaha S, Pandey R. 2018. *Trichoderma harzianum* ThU and its metabolites underscore alteration in essential oils

of *Ocimum basilicum* and *Ocimum sanctum*. *Proc. Natl. Acad. Sci., India, Sect. B Biol. Sci*. 88:219–227. [IF= 0.396]

17. H Saravaia, Gupta H, Popat P, Sodha P, Kulshreshtha V. 2018.Single-step synthesis of magnesium-doped lithium manganese oxide nanosorbent and their polymer composite beads for selective heavy metal removal.*ACS Applied Material and Interfaces* 10:44059–44070.

18. Jhang T, Singh P, Ahmed N, Shukla S, Maurya P, Joshi P, Gupta MM, Shastry KP, KumarSanjay, Tomar VKS, Samad A, Pandey R, Gupta AK, Mishra LN, Lal RK. 2018. Registration of 'CIM-Pushti': Withanolide-A rich, Leaf Blight tolerant high yielding variety of Ashwagandha (*Withaniasomnifera*) with good root textural quality. *Journal of Medicinal and Aromatic Plant Sciences*. 40:58-66.

19. Jnanesha AC, Kumar A, Vanitha TK and Verma DK. 2018. Opportunities and challenges in the cultivation of senna (*Cassia angustifolia*Vahl.). *International Journal of Herbal Medicine* 6: 41-43. [IF=1.685]

20. Jnanesha AC, Kumar A, Vijaya Kumar M. 2018. Effect of seasonal variation on growth and oil yield in *Ocimumafricanum* Lour. *Journal of Pharmacognosy and Phytochemistry* 7: 73-77.

21. Jyotshna, Srivastava N, Yadav AK, Shanker K, Gupta MM, Lal RK. 2018. Impact of postharvest processes on major phenolic constituents and antioxidant potentials of different *Ocimum* species. *Journal of Applied Research on Medicinal and Aromatic Plants* 10:9-15

22. Kapkoti DS, Singh S, Luqman S, Bhakuni RS. 2018. Synthesis of novel 1,2,3-triazole based artemisinin derivatives and their antiproliferative activity. *New Journal of Chemistry* 42:5978-5995 [IF=3.201]

23. Karak T, Abollino O, Paul R, Giacomino A, Khare P, Boruah RK. 2018. Achievability of municipal solid waste compost for tea cultivation with special reference to cadmium. *Clean Soil Air water* 46:1-13 [IF=3.200]

24. Khare S, Gupta M, Cheema HS, Maurya AK, Rout P, Darokar MP, Pal A.2018. *Rosa damascena* restrains *Plasmodium falciparum* progression *in-vitro* and impedes malaria pathogenesis in murine model. *Biomedicine and Pharmacotherapy*. 97:1654-1662.

25. KhushbooK, Verma RK. 2018. Diversifying cropping systems with aromatic crops for better productivity and profitability in subtropical north Indian plains. *Journal of Industrial Crops and Products* 115:104-110.[IF=3.849]

26. Khwaja S, Fatima K, Hassanain[b], Behera C, Kour A, Singh A, Luqman S, Sarkar J, Chanda D, Shanker K, Gupta AK, Mondhe DM, Negi AS. 2018. Antiproliferative efficacy of curcumin mimics through microtubule destabilization. *European Journal of Medicinal Chemistry* Elsevier, USA, 151: 51-61. [IF=4.816]

27. Kumar A, Agarwal K, Singh M, Saxena A, Yadav P, Maurya AK, Yadav A, Tandon S, Chanda D, Bawankule DU. 2018. Essential oil from waste leaves of *Curcuma longa* L. alleviates skin inflammation. *Inflammopharmacology* Springer, USA. doi: 10.1007/s10787-018-0447-3. [IF=3.304]

28. Kumar A, Jnanesha AC. 2018. Effect of different proportion of fly ash and vermicompost on growth and yield of senna in semi-arid region of India. *Journal of Pharmacognosy and Phytochemistry*7:69-72.

29. Kumar A, Rodrigues V, Mishra P, Baskaran K, Shukla AK, Shasany AK, Sundaresan V. 2018. ISSR-derived species-specific SCAR marker for rapid and accurate authentication of *Ocimumtenuiflorum* L. Planta Medica :117-122 [IF=2.342]

30. Kumar B, Prasad P, Mohan R, Goyal N, Luqman S, Khare P. 2018. Effect of potassium chloride-induced stress on germination potential of *Artemisia annua* L. varieties. *Journal of Applied Research on Medicinal and Aromatic Plants* 9:110-116 [IF=1.007]

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19. Singh M, Tiwari N, Khare P and Shanker K. 2018. High-Performance Liquid Chromatography (HPLC)-An overview: instrumentation, principles, procedure, and application in herb quality. in technical manual: practicability, scope and future prospects of Ethno-botanicals in minimizing antibiotic resistance (Eds. Kumar A, Mahajan S, Dubal ZB, Singh TU and Dey S). ICAR-Indian Veterinary Research Institute, Bareilly, India. pp: 32-35.

20. Srivastava RK Kumar S and Sharma RS, 2018. Ocimum as a promissing Commercial Crop; in The Ocimum Genome. Springer Nature, Switzerland AG 2018 pp. 1-7.

Patent Granted

Title	Inventors	Country	Patent number/ grant date
Anticancer and tubulin polymerisation inhibition activity of benzylidene indanones and process of preparing the same. • The invention relates to the potent anticancer and tubulin polymerization inhibition activity of new benzylidene indanones synthesized from gallic acid against several human cancer cell lines. The invention also provides a new process for the preparation of the said molecules and testing these for *in vitro* cytotoxic activity against various human cancer cell lines using Sulphorhodamine B Assay. Compounds were evaluated for acute oral activity in Swiss albino mice and were found to be safe up to 300mg/kg body weight.	AS Negi AP Prakasham AK Saxena S Luqman D Chanda Tandeep Kaur Atul Gupta	**India**	**291668** **12.1.2018**

Input: Preeti Srivastava

Awards & Recognition

- CSIR-CIMAP received the CSIR Certificate of Merit (Technology award for Life Science 2018) for *Ocimum* based technological interventions to facilitate industrial growth, societal health and rural prosperity.
- **ICMR prize 2017** has been conferred to **Dr. N. P. Yadav** for his research work on “Herbal Formulations/Technology Development”. The award is given by Indian Council of Medical Research (ICMR), New Delhi for his significant contribution in the field of biomedical sciences.
- Dr. DA Nagegowda has been awarded “Indo-U.S. Genome Engineering/Editing Technology Initiative (GETin) Overseas Fellowship” of DBT and IUSSTF for 2018-2019 to work for 4 months on CRISPR/Cas9 application in medicinal plants at Purdue University, USA.
- Dr. Birendra Kumar received distinguished Scientist Award for outstanding contribution in the field of Genetics & Crop Improvement during 9-10th September, 2017 given by S&T, SIRI, Warangal, Telangana.
- Dr. Rakesh Pandey has been **a**warded **Dr. M.R. Siddiqi Memorial Award-2018** during National Conference on Bio-intensive approaches in plant protection strategies and their socio-economic impacts and IPS-MEZ annual meeting on 29.10.2018 at AMU Aligarh.
- Dr. Rakesh Pandey has been elected as **Fellow-2018** of **The Horticultural Society of India, IARI New Delhi** for his outstanding research in medicinal and aromatic plants.

International Visits:

- Dr. Anirban Pal attended the Taiwan India Symposium on Traditional Medicine from 5-6 October 2018, at Taipei and delivered talk on “Regulatory landscape for the Clinical Utilization of Traditional Medicine (Ayurveda) in India”. The symposium was organized by the Department of Chinese Medicine and Pharmacy, Ministry of Health and Welfare, R.O.C.(Taiwan).
- Dr. D N Mani felicitated by Prof. Dr. Nguyen Van Hung, Acting Rector & Dean, School of Pharmacy, Hai Phong University of Medicine and Pharmacy (HPMU), Vietnam.
- Dr. Ashutosh K. Shukla delivered an invited talk on “*Medicinal plants – From orphans to models through omics interventions*” on 05 June 2018 at the Institute of Pharmaceutical Sciences, Albert-Ludwigs-University Freiburg, Germany. He also attended the RTG 1976 Retreat Symposium of the University of Freiburg at Falkau, Germany, during 09-10 April, 2018 and Leibniz Plant Biochemistry Symposium at the Leibniz Institute of Plant Biochemistry (IPB), Halle (Saale), Germany, during 28-30 May, 2018.
- Dr. Suaib Luqman and Dr. Debabrata Chanda visited University fo Milan, Italy during 6-19 Oct. 2018 under DST sponsored Indo-Italian bilateral project for collaboration in the area of cancer research.

Research Council

Chairperson

Professor S.S. Handa
Former Director, CSIR-IIIM, Executive Villa, 522-A Block-C, Sushant Lok-1 Gurgaon, Haryana – 122002, Members

Dr. T.R. Sharma
JC Bose National Fellow and Executive Director
National Agri-Food Biotechnology Institute (NABI)
Sector-81, Knowledge City, P.O. Manauli, SAS Nagar Mohali
Punjab – 140306

Prof. Ram Harsh Singh
Life Time Distinguished Professor
Institute of Medical Sciences
Banaras Hindu University
Department of Kayachikitsa
Varanasi, Uttar Pradesh – 221005

Dr. R.R. Hirwani
Former Head, CSIR – URDIP, Pune
A-61, Virndavan Society Pandhavati,
Pashan Road, Pune, Maharastra – 411008

Dr. Ramesh Sonti
Chief Scientist
CSIR-Centre for Cellular and Molecular Biology
Uppal Road, Hyderabad, Telangana – 500007

Dr. Rajesh Kotecha
Special Secretary
Minister of AYUSH
Ayush Bhavan, Block GPO Complex, INA
New Delhi – 110023

Prof. R.B. Singh
Professor, Department of Geography
University of Delhi, School of Economics, New Delhi – 110007

Dr. Ram A. Vishwakarma
Director
CSIR-Indian Institute of Integrative Medicine
Canal Road, Jammu, J&K – 180001

DG's Nominee

Dr. Sanjay Kumar
CSIR-Institute of Himalayan Bioresource Technology, Palampur
Himichal Pradesh – 176061
E-mail: director@ihbt.res.in

Director
Prof. Anil Kumar Tripathi
CSIR-Central Institute of Medicinal & Aromatic Plants
P.O. CIMAP, Near Kukrail Picnic Spot, Lucknow

Permanent Invitee

Head of his Nominee
Planning & Performance Division
Council of Scientific & Industrial Research
Anusandhan Bhawan, 2 Rafi Nagar
New Delhi-110001

Management Council

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Professor Anil Kumar Tripathi
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CSIR-CIMAP, Lucknow

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CSIR-CIMAP, Lucknow

Dr. Sanjay Kumar
Senior Scientist
CSIR-CIMAP, Lucknow

Shri. Manoj Semwal
Senior Scientist
CSIR-CIMAP, Lucknow

Smt. Sudha Agarwal
Senior Technical Officer (2)
CSIR-CIMAP, Lucknow

Controller of Finance and Account
Finance and Accounts Officer

Member Secretary
Controller of Administration /Administrative Officer

Right to Information Act

Following officials have been designated as per the requirement of the act:

Central Public Information Officer

Dr. Dharmendra Saikia
CSIR-CIMAP
E-mail: d.saikia@cimap.res.in
Phone: 91-522 – 2718650

Appellate Authority

Mr. P.V Ajayakumar
CSIR-CIMAP
E-mail: pv.ajayakumar@cimap.res.in
Phone: 91-522 – 2718665

Transparency Officer

Er. Sudeep Tandon
CSIR-CIMAP
E-Mail: s.tandon@cimap.res.in
Phone: 91-522-2718651

Nodal Officer

Er. Bhaskar Shukla
CSIR-CIMAP
E-mail: bhaskar.shukla@cimap.res.in
Phone: 91-522 – 2718616

The summary of the cases during 2018 is:

Year 2018 (01 Jan 2018 - 31 Dec 2018)

Application Received	Rejected	Information provided	1st Appeal	Decision where 1st appeal replied	Referred to CIC, New Delhi
112 including Transfer cases	NIL	98	03	03	NIL

Budget at Glance(As on 31 Dec 2018)

	Allocation (₹ in lakhs)	Expenditure (₹ in lakhs)
Pay and Allowance	2950.000	2269.452
Contingency	397.560	288.382
HRD	0	0
Lab Maintenance	206.310	204.988
Staff Qtr. Maintenance	26.810	10.841
Chemicals / Consumables	405.880	217.968
Works and Services	200.500	15.947
Apparatus and Equipment	125.130	80.194
Office Equipment	0	0
Furniture and Fitting	0	0
Library (Books& Journal) P50	43.400	0
Staff Qtrs. (Construction)	87.587	21.402
CSIR Network Projects	1792.717	720.010
Total		
Pension	2461.000	1551.744
External Budgetary Resources		
Lab Reserve Fund (LRF)		76.991
External Cash Flow (ECF)		522.30

List of the PhD Thesis Awarded

S. No.	Name of the Student	Supervisor	Title of the thesis	Date of Award	University
1.	Abhishek Sharma	Dr. A. K. Mathur	Terpenoid indole alkaloids pathway modulation studies in *Catharanthus roseus* via in vitro cell culture strategies	08-Jan-18	JNU
2.	Umesh Pankaj	Dr. Rajesh Kumar Verma	Study of the mycorrhizal symbiosis with Palmarosa (*Cymbopogon martinii*) under salt affected soil and its influence on growth, yield, quality and soil properties	10-Jan-18	JNU
3.	Subir Kumar Bose	Dr. (Mrs.) Neelam Singh Sangwan	Establishment of novel diterpenoid calliterpenone phytomolecule as a growth enhancer in a comparative manner than gibberellic acid using commercially important *Mentha arvensis* L.	29-Jan-18	AcSIR
4.	Shiv Vardan Singh	Dr. Anirban Pal	Prospecting natural bioactives from medicinal plants for use in adjunctive therapy for the treatment of malaria	13-Apr-18	JNU
5.	Satish Kumar Pandey	Dr. N.P. Yadav	Studies on phytochemical based nanopesticides for management of mosquitoes	16-Apr-18	JNU
6.	Pooja Sharma	Dr. Feroz Khan	Molecular docking and quantitative structure-activity relationship studies on inhibitors of PI3K/Akt/mTOR cancer signaling pathway	27-Apr-18	JNU
7.	Rajesh Chandra Mishra	Dr. Sumit Ghosh	Identification and functional characterization of amyrin synthases from sweet basil *(Ocimum basilicum L.)*	15-May-18	JNU
8.	Deepak Singh Kapkoti	Dr. R. S. Bhakuni	Synthesis of glabridin, psoralen and artemisinin analogues as anticancer agents	04-Jun-18	JNU
9.	Priyanka Gupta	Dr. M.P. Darokar	Pharmacological studies on the fruit juices in combination with antibacterial agents to combat multidrug resistant infections of *Staphylococcus aureus*	08-Jun-18	JNU
10.	Hema Negi	Dr. Rakesh Pandey	Studies on anti-aging activities of ursolic acid in Caenorhabditis elegans	27-Jun-18	JNU
11.	Shubhandra Tripathi	Dr. Ashok Sharma	Molecular interaction studies of targets and drugs of breast cancer through molecular docking and molecular dynamics simulation studies	29-Jun-18	JNU
12.	Bhawana Mishra	Dr. (Mrs)Neelam Singh Sangwan	Biochemical, phytochemical and molecular responses of cadmium stress in *Withania somnifera* (L.) Dunal	02-Jul-18	AcSIR

13.	Noopur Singh	Dr. Ashok Sharma	*In-silico* identification and analysis of microRNAs in important medicinal and aromatic plants.	13-Jul-18	JNU
14.	Arjun Singh	Dr. D. Chanda	Study of antihypertensive potential of medicinal plant based leads using preclinical *ex-vivo* and *in-vivo* studies	20-Jul-18	JNU
15.	Smita Singh	Dr. R.K. Lal	Genetics of quantitative and qualitative economic traits related to essential oil yield in basil (*Ocimum basilicum* L.)	03-Aug-18	AcSIR
16.	Ananad Mishra	Dr.(Mrs.) Sunita Singh Dhawan	Studies on trichome diversity and development in *Mentha arvensis*	06-Aug-18	JNU
17.	Susheel Kumar	Dr. (Mrs.) Sunita Singh Dhawan	Biotechnological investigations for genetic improvement in *Mucuna pruriens* (Kewanch)	06-Aug-18	JNU
18.	Sana Tabanda Saeed	Dr. Abdul Samad	Molecular characterization, diversity of begomovirus infecting mentha spp. and development of diagnostics for the better management	13-Aug-18	AcSIR
19.	Amreen Ali Siddiqui	Dr. R.S. Bhakuni	Phytochemical investigation on Indian medicinal and aromatic plants	29-Aug-18	AcSIR
20.	Sandhya Tripathi	Dr. (Mrs.)Neelam Singh Sangwan	In-depth individual and comparative transcriptome analysis of *Withania somnifera* (L.) Dunal: Insights into global and specialized metabolism	20-Sep-18	AcSIR
21.	Swati Srivastava	Dr. Rakesh Pandey	Investigating neuromodulatory and antiaging potentials of thymol in *Caenorhabditis elegans*	28-Sep-18	AcSIR
22.	Sucheta Singh	Dr. Alok Kalra	Endophytes modulate terpenoid indole alkaloids (TIAs) biosynthesis in *Catharanthus roseus*	03-Oct-18	AcSIR
23.	Maneesha Mall	Dr. Ashutosh Shukla	Molecular studies related to key terpenoid indole alkaloid biosynthesis in *Catharanthus roseus*	23-Oct-18	JNU
24.	Priyanka Mishra	Dr. V. Sundaresan	Genome analysis of *Senna* species for development of sequence characterized amplified region (SCAR) markers to characterize and validate *Senna alexandrina* towards checking rampant substitution in herbal market	29-Oct-18	AcSIR
25.	Akhil Kumar	Dr. Ashok Sharma	Development of selective small multi-target-directed phytomolecules and their derivatives based inhibitors	03-Dec-18	JNU

*AcSIR- Academy of Scientific and Innovative Research, Ghaziabad *JNU-Jawaharlal University, New Delhi

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सिट्रोलेना के तेल के उत्पादन वृद्धि हेतु कृषि प्रौद्योगिकी सिट्रोनेला के तेल के उत्पादन वृद्धि हेतु एक कृषि प्रौद्योगिकी विकसित की गयी। विकसित तकनीकी के अनुसार 20 सेमी. ऊचाई एवं 90 दिनो के उपरांत कटाई से तेल के उत्पादन में वृद्धि पायी गयी।

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वाराणसी जनपद के काशी हिन्दू विश्वविद्यालय के रासायन शास्त्र विभाग में किसानों के लिए आर्थिक रूप से महत्वपूर्ण औषधीय एवं सगंध पौधों पर दो दिवसीय प्रशिक्षण कार्यक्रम का आयोजन दिनॉक 20 से 21 मार्च 2018, को किया गया जिसमें वाराणसी के विभिन्न क्षेत्रों के 96 किसानों ने भाग लिया। इस कार्यक्रम का शुंभारम्भ भारतीय शाक–भाजी अनुसंन्धान संस्थान वाराणसी के निदेशक डा0 विजेन्द्र सिंह द्वारा किया गया, जिसमें निदेशक सीएसआईआर–सीमैप, मुख्य प्रधान वैज्ञानिक डा0 आलोक कालरा, डा0 जितेन्द्र वैश्य (एन.एम. पी.बी.सदस्य) एवं सीएसआईआर–सीमैप के विभिन्न विषय–विशेषज्ञ उपस्थित रहे।

इसी सन्दर्भ में कानपुर गंगा बेसिन के किसानों के लिए सीएसआईआर–सीमैप की टीम द्वारा सुगंध एवं स्वाद विकास केन्द्र कन्नौज (एफ.एफ.डी.सी.सेन्टर) के परिषर में दो दिवसीय प्रशिक्षण कार्यक्रम का आयोजन किया गया। जिसमें कानपुर गंगा बेसिन के 80 किसानों ने भाग लिया। इस कार्यक्रम का शुंभा. रम्भ जिला वन अधिकारी, एवं (एफ.एफ.डी.सी.) श्री शक्ति विनय शुक्ला द्वारा सीएसआईआर–सीमैप के वरिष्ठ संकाय की उपस्थिति में किया गया।

yo.kh; e`nk esa ¼ekbdksjkbth½ **(Arbuscular mycorrhizae)** ds lkFk ikekjkstk dh fofHkUu fdLeksa dh mRiknu] xq.koRrk dk ewY;kadu %&

समस्याग्रस्त लवणीय मृदा में माइकोराइजी के प्रयोग से पौधों की जैवरासायनिक और शारीरिक क्रियाओं में सकारात्मक परिवर्तन पाया गया है। यह द्वितीयक तथा चयाचपयी क्रियाओं एवं जैव संश्लेषण को भी प्रभावित करता है, जैसे कि सुगंधित पौधों में सुगन्धित तेल का बनना।

इस अध्ययन के द्वारा पामारोजा की चार व्यवसायिक किस्मों पी.आर.सी.–1, तृष्णा, तृप्ता एवं सिमैप–हर्ष में आवश्यक तेल की पैदावार और गुणवत्ता का आंकलन किया।

माइकोराइजी के प्रयोग से सुंगन्धित तेल की उपज (7.04–12.70 ग्राम/किग्रा ताजा शाक) एवं मुख्य रासायनिक संघटक जिरेनिओल के उपज (5.71–10.56 ग्राम/किग्रा ताजा शाक) में आसातीत् गुणात्मक वृद्धि देखा गया।

उपरोक्त परीक्षण से यह निष्कर्ष निकाला जा सकता है कि प्रजाति तृप्ता अन्य प्रजातियों की तुलना में लवणीय एवं क्षरीय मृदा के लिए अधिक अनुकूल है।

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पेलार्गोनियम ग्रेवोलेंस एल) का एक खेत परीक्षण अकार्बनिक उर्वरकों के साथ और बिना खेत की खाद, वर्मीकम्पोस्ट और बायोचार का उपयोग करके किया गया था। परिणामों से संकेत मिलता है कि खेत की खाद, वर्मीकम्पोस्ट और बायोचार के अलावा नाइट्रोजन और फास्फोरस की कमी हुई है। जैविक खाद द्वारा उन्नत पोषक तत्वों की क्षमता के कारण जिरेनियम फसल की उत्पादकता में वृद्धि हुई। तीन जैविक खादों में, बायोचार से पोषक तत्वों का नुकसान कम था। बायोचार जैव कृषि में जैविक कचरे का रूपांतरण, पोषक तत्वों की क्षति रोकने हेतु और कृषि में टिकाऊ उत्पादन के लिए अधिक आशाजनक विकल्प हो सकता है।

lSY;wykst uSukQkbcj&ikWyh,fFkyhu Xykbdksy dEiksftV ij ykns x, ,yeuxzkl vk;y ds thok.kqjks/kh vkSj ,UVhvkWDlhMsaV xq.kksa dh vo/kkj.kk

लेमनग्रास ऑयल (LgEo) उत्कृष्ट एंटीऑक्सिडेंट और जीवाणुरोधी गुणों को प्रदर्शित करता है। हालांकि, कम जलीय घुलनशीलता और इसके प्रमुख घटकों

की अस्थिरता ने लंबे समय तक इन गुणों की अवधारण को कम कर दिया। इसलिए, सेल्यूलोज नैनोफाइबर (CNFs) के LgEo– पॉलीइथाइलीन ग्लाइकॉल (पीईजी) के कम्पोजिट को उनकी एंटीऑक्सिडेंट और जीवाणुरोधी गुणों की स्थिरता के लिए आकलन किया गया। परिणामों के अनुसार कम्पोजिट सिस्टम लेमनग्रास आवश्यक तेल (geraniol, neral और geranyl एसीटेट) के प्रमुख यौगिकों को 120 दिनों तक बनाए रखने में सक्षम थीं। इन परिणामों से संकेत मिलता है कि सुगंधित कंपोजिट का उपयोग विभिन्न औद्योगिक अनुप्रयोगों जैसे इनडोर वायु गुणवत्ता सुधार सामग्री और खाद्य भंडारण में आगे किया जा सकता है।

b] flfV';kMksjk] vks- cflfyde vkSj ,e- vkjosfll ds vko';d rsyksa dk rhu vyx&vyx [kjirokjksa vkSj enk ekbØksfc;y xfrfof/k;ksa ij çHkko

इस अध्ययन में Essential oil के निरोधात्मक प्रभावों (*Eucalyptus citriodora* Hook, *Ocimum basilicum* L., और *Mentha arvensis*) *A. arvensis*, *C. rotundus* और *Cynodon dactylon* का मुल्यांकन खरपतवारो पर किया गया था। परिणामों से पता चला है कि अलग–अलग सांद्रता (50,75 और 100 µl/ml) पर EOE के छिड़काव से खरपतवार की वृद्धि रुक जाती है।

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कास्टर आयल, *Ricinus communis*, के बीन्स से उत्पन्न किया जाता है। इसका उपयोग विभिन प्रकार के उद्योगो में होता है जैसे फार्मास्यूटिकल, परफ्यूम, लुब्रिकेंट्स, सोअप्स आदि. भारत की गिनती कास्टर आयल के बड़े एक्सपोर्टर्स मे होती है। 2017 मे इस का उत्पादन लगभग 10.55 lakhs टन आका गया था कास्टर आयल विभिन प्रकार के फैटीएसिड्स से बनता है जैसे की रिसिनोलिक एसिड (80%–90%)। रिसिनोलिक एसिड मे हाइड्रॉक्सिल फंक्शनल ग्रुप C12 मे पाया जाता है जो बहुत रिएक्टिव होता है और इसीका उपयोग करके विभिन प्रकार के फ्लेवर फैटी एसिड्स बनाया जाता है जिनका व्यवसायिक महत्व बहुत जादा है. इन्ही मे से एक है γ-Decalactone, जि. सका उपयोग फूड, फ्लेवर, पर्सनल केयर प्रोडक्ट्स मे होता है। प्राकर्तिकली उत्पादित होने से जनता मे इन जैसे कंपाउंड्स का रुझान जादा है। इस प्रोजेक्ट का मुख्य उदेश एक ऐसा Engineered strain विकसित करना है जो कास्टर आयल केरिसिनोलिक एसिड को विभाजित करके विभिन प्रकार के एरोमा कंपाउंड्स उत्पादित करे. *Y-lipolytica*, इसके लिए उपयोग किया जा सकता है क्यूंकि यह हइड्रोफोबिक मीडिया जैसे तेल मे बड़ सकता है। इस के द्वारा उत्पा. दित lipases हाइड्रोफोबिक कंपाउंड्स जैसे की triglycerides को विभाजित कर सकते है। Yarrowia lipolytica MSR–84 (Hereafter "YlMSR–84") strain को Microbial Type Culture Collection (MTCC), CSIR-Institute of Microbial Technology] Chandigarh] India। YlMSR-84 strain को YPD (1% yeast extract, 2% peptone, 2% dextrose) मे विकसित किया गया. Growth kinetics का अध्ययन करने के लिए विभिन time points is absorbance (600 nm)। Castor oil के biotransformation के लिए YlMSR–84 को YPC medium (1%Yeast extract, 2% peptone, 3% castor oil, 0-67% yeast nitrogen base with amino acids, 0-3% Tween 80, 0-25% ammonium chloride) मे उगाया गया जिसमे carbon source dextrose के बदले कास्टर आयल और emulsifying agent का प्रयोग किया गया। Growth kinetics का अध्ययन YPC मे भी YPD प्रकार किया गया। उत्तपन γ-decalactone का GC–MS द्वारा विश्लेषण किया गया। Strain improvement और fermentation optimization अध्ययन कार्य प्रगति पर है जिससे अधिकतम γ–Decalactone castor oil से उत्पादित किया जा सके।

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एकोरस कैलेमस (वच) एक पौधा है, जो कि भारत, यूरोप, पूर्वी एशिया और उत्तरी अमेरिका में पाया जाता है इस पौधे को संसार में बीटा–अर्सेशेन तेल के प्राप्ति के लिए उगाया जाता हैं जिसमे बहुद्देशीय गुण हैं। सीमैप लखनऊ (जुलाई, 2016) में, इसके कई पौधो में छोटे छोटे दाग देखे गए, जो कुछ दिनो के बाद गहरे परिगलित एवं पीले प्रभामंडल में बदल गए, यह लक्षण कवक से मिलते जुलते थे। कवक की कालोनी संरचना, मॉलिक्यूलर शोध व माइक्रोस्कोप के सघन अध्यन के आधार पर कर्वुलेरिया स्यूडोब्रेचीस्पोरा सिद्ध हुआ। यह कवक इसके पूर्व भी कई महत्वपूर्ण औषधीय एवं सुगंधित पौधो को प्रभावित कर चुका

है। अतः इस कवक पर सघन शोध कार्य होना चाहिए ताकि इस फसल तथा अन्य दूसरी फसलो को भी इसके प्रकोप व क्षति से बचाया जा सके।

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साइट्रल ऑइल के सीमित आईएसओ प्रमाणित स्रोत हैं जो सामग्री को न्यूनतम 74% सुनिश्चित करते हैं, उनमें से होनहार लित्से क्यूबेब 70–85%, लेमनग्रास (65–85%) हैं। "सिट्रल" के शुरुआती बढ़ते, कम समय, उच्च बायोमा ससंसाधन की आवश्यकता को 4–5 महीनों में Ocimum basilicum से पूरा किया जासकता है। उन्नत ऑसिमम बेसिलिकम की अग्रिम प्रजनन लाइन में तेल की उपज 167–175 किग्रा/हेक्टेयर थी। जिसमें सिट्रेल कन्टेन्ट 70% है।

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CSIR-CIMAP में Withanolide लक्षित प्रजनन कार्यक्रम के तहत, भारत में प्रचलित दो प्रमुख पारिस्थितिक क्षेत्रों' नागौरी' x प कश्मीरी' के बीच अंतर–. विशिष्ट संकरण के माध्यम से एक नई किस्म' CIM-Pushti 'विकसित की गई है। यह एक जीनोटाइप पृष्ठ भूमि में नागौरी प्रकार (खेती और वार्षिक प्रकार) और कश्मीरी प्रकार (जंगली, बारहमासी प्रकार) की बायोमास उपज की मूल गुणवत्ता को जोड़ती है। विविधता की विशेषताएं अत्यधिक लहराती, उप–कोरियास, अर्धस्तंभ के साथ हल्के हरे रंग की पत्तियां, मजबूत पुल और पीले नारंगी परिपक्व जामुन हैं। रूटवाइटिश क्रीम है जिसमें गैर–वियोज्य राईड, महीन पल्सवेरीसेबल, भंगुर जड़ों के साथ उच्च स्टार्च के साथ फाइबर अनुपात और विथेनाओलाइड–ए सामग्री औसत 0.713 मिग्रा/ग्राम सूखा वजन आधार है। यह विटेनहाइड–बी (0.460mg / g सूखा वजन आधार) में भी उच्च है और विथानोन की नगण्य उपस्थिति है। यह 168–178 दिनों में परिपक्व होकर 9–10 क्विंटल प्रति हेक्टेयर औसत उपज देता है। यह पत्ती ब्लाइट के लिए सहिष्णु है। यह किस्म भारतीय कृषि–जलवायु क्षेत्रों (VIII, XIII-XIV) यानी सेंट्रल पठार, पश्चिमी शुष्क क्षेत्र और भारत के गुजरात विमानों के क्षेत्रों में खेती के लिए उपयुक्त है।

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डिकमाली गोंद (गार्डेनिया ल्यूसिडा रॉक्सब, फैमिली– रुबिकिया) का उपयोग भारतीय पारंपरिक हर्बल योगों में टैबलेट बाइंडर के रूप में किया जाता है। हाल ही में, आधुनिक दवा बनने में भी उपयोग में लाया गया है। हालाँकि, इसके गुणवत्ता विनिर्देश को स्थापित किया जाना अभी बाकी है। सटीकता, रैखिकता आदि मानकों एवं विश्लेषणात्मक प्रक्रियाओं के सत्यापन के लिए अंतराष्टीय (आईसीएच) दिशा–निर्देशों का पालन करते हुए नवीन विधि प्रतिपादित की गयी। इस यूपीएलसी–पीडीए विधि से कम समय में गोंद की जाँच कर गुणवत्ता निर्धारित की जा सकती है।

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पहली बार छह पॉलीमेथॉक्सीफ्लेवोन–गार्डनिन–ई (1), गार्डिन–डी (2), जेंथोमाइक्रोल (3), 5–डेस्मिथाइलोनोबॉयलेटिन (4), गार्डनिन–ए (5), एवंगार्ड. निन–बी(6) जैसे रासायनिक मार्कर का चयन गार्डेनिया ल्यूसिडा की गुणवत्ता मूल्यांकन के लिए किया गया है। विधि को वैधीकरण अंतर्राष्ट्रीय दिशानिर्देशों (ICH) के अनुरूप किया गया। वर्तमान विधि ल्यूसिडा पर आधारित हर्बल उत्पाद की गुणवत्ता तय करने में उपयोगी है।

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तुलसी (*Ocimum sanctum* Linn.) भारत में चाय मिश्रित पेय के रूप में इस्तेमाल की जाने वाली पसंदीदा जड़ी बूटियों में से एक है। तुलसी एंटी ऑक्सिडेंट का एक समृद्ध स्रोत है। वर्तमान अध्ययन *Ocimum sanctum* और सात अन्य इष्टतम प्रजातियों की एंटीऑक्सीडेंट क्षमता पर कटाई के बाद की

प्रक्रियाओं और उपचार के प्रभाव का आंकलन करता है। एक एच पीएलसी विधि को कैफिक एसिड, रसमार्निक एसिड और रुटिन के वितरण शेड में सूखे और उपचारित ओसिमम पत्ते का अध्ययन करने के लिए लागू किया गया। हरे रंग की उपस्थिति और उनके एंटीऑक्सीडेंट क्षमता के इष्टतम प्रतिधारण के लिए उपयुक्त पोस्ट हार्वेस्ट हैंडलिंग और तुलसी के पूर्व उपचार को अपनाने के लिए वर्तमान निष्कर्ष उपयोगी हो सकते हैं।

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- औषधीय और सुगंधित पौधे के सुगंध अणुओं (अरोमा–डिबी) का एक डेटा बेस विकसित किया। यह सुगंध के प्रकार, आवश्यक तेल विवरण, फाइटो के मिस्ट्री और बायोएक्टिविटीज के बारे में जानकारी प्रदान करता है।
- संरक्षित प्रोटीन अनुक्रमों का उपयोग करते हुए तुलसी में जीनोम विस्तृत टरपिन सिंथेज जीन का पता लगाया गया।
- एंटीकैंसर गार्सिनिया जैंथोन (बंद) डेरिवेटिव की स्क्रीनिंग के लिए इन–. सिलिको स्क्रीनिंग विधि विकसित की और आणविक डॉकिंग और सिस्टम फार्माकोलॉजी दृष्टिकोण का उपयोग करके उनके तंत्र की खोज की।
- इन–सिलिको स्क्रीनिंग और आणविक गतिशीलता सिमुलेशन विधियों का उपयोग करके कैंडिडा अल्बिकन्स के परमाणु डैम 1 जटिल सबयूनिट एस्क 1 के संभावित अवरोधकों की पहचान की गयी।
- टॉरमेनटिक एसिड डेरिवेटिव के एंटीकैंसर गतिविधि के लिए मात्रात्मक संरचना–गतिविधि संबंध भविष्यवाणी मॉडल विकसित किया और आणविक डॉकिंग और सिस्टम फार्माकोलॉजी दृष्टिकोण का उपयोग करके उनके तंत्र की खोज की गयी।
- मात्रात्मक संरचना बायोएक्टिविटी रिलेशनशिप विधि और मानव मूत्राशय कैंसर सेल लाइन टी –24 बायोएक्टिविटी डेटा का उपयोग करके उर्सोलिक एसिड डेरिवेटिव के लिए एंटी–कैंसर बायोएक्टिविटी का भविष्यवाणी मॉडल विकसित किया गया, जो एनएफ–केबी पाथवे निषेध को लक्षित करता है।

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कैथरैनथस रोसिय्स (सदाबहार) दो सबसे महत्वपूर्ण एंटीकैंसर मोनोटेरपीन इंडोल अल्कलॉइड्स (एमआईए, MIA), विन्ब्लास्टाइन और विन्क्रिस्टाइन और उनके अग्रदूतों, विन्डोलिन और कैथेरैथिन का एक मात्र स्रोत है। MIAs का जैव संश्लेषण इंडोल और टरपिन सेकेराइडोइड मार्ग से प्राप्त अग्रदूतों के संघनन से होते हैं। हमारे पिछले अध्ययनों से पता चला है कि टेरपिन मौएटी सदाबहार में डप। जैव संश्लेषण को सीमित करता है। इस कार्य मे, ये सीमा को पार करने के लिए और MIA के स्तर को बढ़ाने के लिए, टरपिन सेकेराइडोइड (secologanin) गठन के शुरुआती चरणों में अग्रदूत जेरनयल (जेरनयल) डिफॉस्फेट सिंथेज geranyl (geranyl) diphospate synthase] G (G) PPS और जेरनीओल सिंथेज (geraniol synthase, GES) को चयापचय इंजीनियरिंग के लिए उपयोग किया गया। जी (जी) पीपीएस और जी (जी) पीपीएस जीईएस के द्वारा इंजीनियर सदाबहार पौधों ने काफी हद तक secologanin के संचय को बढ़ाया, जिससे मोनोमेरिक MIA के स्तर बहुत बढ़ गया। इसके अलावा, इंजीनियर सदाबहार पौधों में जड़ क्षारीय एजमैलिसिन के स्तर में वृद्धि देखी गई। डिमेरिक अल्कलॉइड विनाब्लास्टाइन को केवल G(G) PPS में नहीं बल्कि G(G) PPS+GES ट्रांसजेनिक लाइनों में बढ़ाया गया था, जो कि पेरोक्सीडेस –1 (PRX1) के ट्रांसक्रिप्ट स्तरों से संबंधित था, जो 3′,4′–anhydrovinblastine और कथारनतिन्न के युग्मन में शामिल है। कुल मिलाकर, चयापचय इंजीनियरिंग किए पौधों ने एंटीकैंसर अल्कलॉइड के उन्नत उत्पादन के साथ सामान्य वृद्धि दिखाई।

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मेंथा आरवेंसिस में water logging-responsive समूह एथिलीन प्रतिक्रिया कारक (MaRAP2 Ma4) की भूमिका का पता लगाया गया। MaRAP2–4 ने निर्जलीकरण प्रतिक्रिया तत्वों (DRE1 / 2), एनोक्सिया/

जैस्मोनिक एसिड प्रतिक्रिया तत्व (Jare) और GCC बॉक्स जैसे कई सीआईएस कम तत्वों के साथ कई प्रतिक्रियाओं में अपनी भागीदारी दिखाई। इसके अलावा, MaRAP2.4 विशेष रूप से DRE और/या GCC बॉक्स ले जाने वाले AtSWEEET10 (एक suger परिवहन प्रोटीन (प्रमोटर में दो पदों को लक्षित करता है और प्रतिकूल पर्यावरणीय स्थिति के तहत विभिन्न ऊतकों को कार्बोहाइड्रेट की उपलब्धता को नियंत्रित कर सकता है।

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हमारे इन सिलिको पद्धति द्वारा की गयी खोज में, पेलार्गोनियम स्पीशीज के ट्रांसक्रिप्ट डेटा में जैविक/अजैविक तनाव सहिष्णुता के कम से कम 16 नक. ारात्मक नियामकों की उपस्थिति का संकेत मिलता है, लेकिन ज्यादातर इनके कंटिग के छोटे आंशिक सीक्वेंस का ज्ञान ही हासिल है। हालाँकि, AtPMR और AtCESA समरूपता के अनुरूप दो बड़े कंटिग पाए गए जिनके परिवर्तन–करण से अराबिडोप्सिस में फंगल स्ट्रेस के प्रति सहनशीलता बढ़ने का पता चलता है। SgRNAs के एक जोड़े को इनमें से प्रत्येक कंटिग के खिलाफ डिजाइन किया गया। रासायनिक रूप से संश्लेषित संपूरक DNA ओलिगोस को डबल–स्ट्रैंड sgRNA के रूप में पुनर्संयोजित किया गया और उपयुक्त वनस्पति CRISPR वेक्टर में क्लोन किया गया। इन पुनःसंयोजित वैक्टरों का उपयोग गुलाब की खुशबू से सुगंधित जेरेनियम के CRISPR द्वारा उत्परिवर्तित पौधों को उत्पन्न करने के लिए किया जा रहा है।

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ओक्सिलिलम इंडिकॉम से फ्लेवोन के घनत्व के आधार पर क्वांटम युक्तिकरण और रेडॉक्स प्रभाव, आणविक बातचीत की जांच और एरिथ्रोसाइट्स के आसमाटिक हेमोलिसिस के साथ उनका संबंध नए 1,2,3–ट्राईजोल आधारित आर्टेमिसिनिन डेरिवेटिव की एंटीप्रोलिफेरेटिव गतिविधि

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- *Ocimum sanctum* में मौजूद एक पॉलीफेनोलिक घटक, Isothymusin, Limnophillageoffrayi, Beciumgrandiflorum ने कैंसर सेल लाइनों में tumorinitation संवर्धन, और प्रगति से जुड़े विभिन्न एंजाइमों को लक्षित करके एंटीप्रोलिफेरेटिव क्षमता को देखा गया। इसके अतिरिक्त, इस अणु ने संभावित फ्री रेडिकल एसकेवन्सि और एंटीऑक्सीडेंट गुण दिखाए। इस अणु के एंटिऑक्सिडेंट क्षमता और एंटीकैंसर क्षमता जोड़ने वाले आगे के अध्ययन अभी चल रहे हैं।
- रुटिन, एक पॉलीफेनोलिक फ्लैवोनॉइड, एंटीऑक्सीडेंट गतिविधि, गैर–एंजाइमी बायोमार्कर, प्रतिक्रियाशील ऑक्सीन प्रजातियों के उत्प. ादन (इन विट्रो और विवो में) और इचिनोसाइट गढ़न (एक्स–विवो) में हाइड्रोजन पेरोक्साइड (H_2O_2) के प्रभाव को संशोधित करता है।

buiV% ,u-ih- ;kno

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एंडोग्राफोलाइड (ए.पी.), एक शक्तिशाली हेपेटोप्रोटेक्टिव फाइटोकॉन्स्टिट्यूएंट है जो की एंड्रोग्रैफिस पैनिकुलेटा में पाया जाता है। हालांकि, इस अणु की उपयोगिता इसकी कम जलीय घुलनशीलता, गैस्ट्रिक अस्थिरता और इसलिए कम जैव उपलब्धता के कारण प्रतिबंधित है। इस शोध का उद्देश्य ए.पी. को प्राकृतिक बायोपॉलिमर में संपुटित कर बहुपरतीय स्थानांतरण प्रणाली का निर्माण तथा निर्स्पण करना है। नैनोईमल्शन का वैज्ञानिक सूत्रीकरण/विनिर्माण अल्ट्रासॉनिकेशन विधि/प्रणाली के माध्यम सेध्द्वारा चिटसन के ऊपर एल्जिनेट की परत–दर–परत तकनीक से विकसित किया गया है। वर्तमान शोध में अल्ट्रासॉनिकेशन प्रक्रिया के समय में वृद्धि के साथ बेहतर पारदर्शिता और स्थिरता देखी गई है। निष्कर्षस्वरूप, इस प्रणाली से ए.पी. की घुलनशीलता, स्थिरता और जैव–उपलब्धता में वृद्धि पायी गयी। विकसित नैनो–इमल्शन के

जैविक (इन–वीवो) अध्ययन हुआ और बेहतर हिपैटोप्रोटेक्शन पाया गया। (ए ए पी एस फार्मसाईटेक, 18(2):381–392).

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शोध का उद्देश्य मेंथा तेल (शक्तिशाली एंटिफंगल एजेंट) के लिए नैनोईमल्शन आधारित इमल्जेल विकसित करना था, जिससे कैंडिडा और योनि कैंडिडिआसिस की विभिन्न प्रजातियों के विरुद्ध समृद्ध और विस्तारित चिकित्सीय प्रभावशीलता की पुष्टि की जा सके। नैनोईमल्शन को विकसित और अनुकूलित/ऑप्टिमाइज सेंट्रल कम्पोजिट डिजाइन द्वारा किया गया है। कार्बोपोल 940 मैट्रिक्स (इमल्जेल) में नैनोईमल्शन के पीएच–ट्रिगर क्रॉसलिंकिंग को ट्राईथेनॉलमाइन द्वारा प्राप्त किया गया था। इमल्जेल का मूल्यांकन इन–विट्रो (कैंडिडा प्रजाति के विरुद्ध) और इन–वीवो (4×10^{7} cfu/ml कैंडिडा अल्बिकंस संक्रमित स्विस फिमेल चूहे) में प्रभावकारिता मानक नियंत्रण और साधारण जेल के आधार पर स्थापित किआ गया। इन–वीवो अध्ययन में ये पाया गया की इमल्जेल में सी. एल्बिकैंस कालोनी (380 cfu/ml) साधारण जेल (165 cfu/ml) के मुकाबले में काफी कम पायी गयी। मेंथा तेल को नैनोईमल्शन में संपुटित करने से उदवायी/अस्थिरता कम हुई तथा कैंडिडा प्रजाति के विरुद्ध बेहतर प्रभावशाली पाया गया। (जर्नल ऑफ ड्रग डिलीवरी साइंस एंड टेक्नोलॉजी, 48: 490–498).

çdk'ku ¼2018½

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de|pkjh lnL; ¼31 fnl|cj 2018½

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प्रो. अनिल कुमार त्रिपाठी

e[; oKkfud
डॉ. आलोक कालरा
डॉ. अब्दुल समद
श्री पी.वी अजया कुमार
डॉ. ए.के शासनी
डॉ. (श्रीमती) नीलम सिंह सांगवान
डॉ. सौदान सिंह

ofj"B ç/kku oKkfud
डॉ. आलोक कुमार कृष्णा
डॉ. वेदराम सिंह
इं. सुदीप टंडन
डॉ. एम.पी. दारोकर
डॉ. अरविंद सिंह नेगी
इं. जी.डी. किरण बाबू
डॉ. बीरेंद्र कुमार
डॉ. ए.के. गुप्ता
डॉ. लइक–उर–रहमान
डॉ. धर्मेंद्र सैकिया

ç/kku oKkfud
डॉ. विक्रांत गुप्ता
डॉ. राकेश पांडे
डॉ. अनिर्बन पाल
डॉ. दिनेश ए नागे गोडा
डॉ. जे कोटेश कुमार
डॉ. (श्रीमती) सुनीता सिंह धवन
डॉ. दयानंदन मणि
डॉ. करुणा शंकर
डॉ. राजेश कुमार वर्मा
डॉ. संजय कुमार
इं. मनोज सेमवाल
डॉ. ज्ञानेश्वर उमराव बावनकुले
डॉ. फिरोज खान

ofj"B oKkfud
डॉ. वेंकटराव डी.के.
डॉ. सी.एस विवेक बाबू
डॉ. सुमित घोष
डॉ. (श्रीमती) प्रेमाजी वासुदेव
डॉ. आशुतोष कुमार शुक्ला
डॉ. नारायण प्रसाद यादव
श्री के.वी.एन. सत्य श्रीनिवास
डॉ. शोएब लुकमान
डॉ. राजेंद्र चंद्र पडालिया
डॉ. वी सुंदरेसन
श्री रामस्वरूप वर्मा
डॉ. (श्रीमती) पूजा खरे
डॉ. चंदन सिंह चनोटिया
डॉ. देबब्रत चंदा
डॉ. प्रशांत कुमार राउत
डॉ. प्रदिप्तो मुखोपाध्याय
डॉ. किशोर बाबूबंदमारावुरी
डॉ. रमेश कुमार श्रीवास्तव
डॉ. मुक्तिनाथ मिश्रा
डॉ. राकेश के शुक्ला
डॉ. (सुश्री) तृप्ता झंग
डॉ. (श्रीमती) आभा मीना
डॉ. अतुल गुप्ता

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डॉ. प्रीति श्रीवास्तव
इ. भास्कर शुक्ला
डॉ. राम सुरेश शर्मा
डॉ. राकेश कुमार उपाध्याय
इं. अश्विन डी नन्नावरे
डॉ. नरेंद्र कुमार
डॉ. राकेश कुमार
डॉ. योगेंद्र एन.डी.
डॉ. चन्नेया हिरेमथ
डॉ. वेंकटेश के.टी
डॉ. ज्ञानेश ए.सी.
डॉ. हरिओम गुप्ता

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fpfdRlk vf/kdkjh
डॉ. वी.के अग्रवाल

ofj"B v/kh{k.k vfHk;ark
श्री ए एम खान

ç/kku rduhdh vf/kdkjh
डॉ. दिनेश कुमार
श्री प्रेम सिंह
डॉ. डी.के. राजपूत
डॉ. सुखमल चंद

ofj"B rduhdh vf/kdkjh ¼3½
डॉ. दशाराम
श्री के भास्करन
डॉ. अतीक अहमद

ofj"B rduhdh vf/kdkjh ¼2½
श्रीमती सुधा अग्रवाल
श्री गोविंद राम
डॉ. नीरजा तिवारी

ofj"B rduhdh vf/kdkjh ¼1½
श्रीमती अंजू कुमारी यादव
श्री शिव प्रकाश
डॉ. (श्रीमती) मंजू सिंह
डॉ. राजेंद्र प्रसाद पटेल
डॉ. रक्षपाल सिंह
डॉ. अनिल कुमार सिंह
श्री राम प्रवेश

rduhdh vf/kdkjh ¼thvkj III½ ¼3½
डॉ. अमित चौहान
डॉ. अनिल कुमार मौर्य
श्री अमित मोहन
श्रीमती नमिता गुप्ता
श्री ए.के. तिवारी
श्री संजय सिंह
श्री ए निरंजन कुमार
श्रीमती अंजू केसरवानी
श्री बाला किशन भुक्या

rduhdh lgk;d
श्री अमित कुमार तिवारी
श्री मनोज कुमार यादव
श्री आशीष कुमार
श्री प्रवल प्रताप सिंह वर्मा
श्री आशीष कुमार शुक्ला
श्री मनीष आर्या
श्री संजीत कुमार वर्मा
श्री दीपक कुमार वर्मा
सुश्री पूजा सिंह
श्री प्रभात कुमार
श्री सोनवीर सिंह

leg&II

ofj"B rduhf'k;u ¼3½
श्री एसके शर्मा
डॉ. अब्दुल खालिक
श्री रघुबिन्द कुमार

ofj"B rduhf'k;u ¼2½
श्री श्याम बिहारी
श्री राम चंद्र
श्री सलीम बेग
श्री एस.के. पांडेय
श्री गोपाल राम
श्री इ भास्कर
श्रीमती एस शारदा
श्री पी.एन. गौतम
श्री जोसेफ एम मैसी
श्री राम लखन
श्री पी.के तिवारी
श्री विनोद कुमार

ofj"B rduhf'k;u ¼1½
श्रीमती राज कुमारी
श्री धर्म पाल सिंह
श्री वी.के. शुक्ला

rduhf'k;u ¼2½
श्री पंकज कुमार शुक्ला
श्री कुंदन नारायण वासनिक

श्री यल्ला वी.वी.एस स्वामी
श्री बसंत कुमार दुबे
श्री विजय कुमार वर्मा
श्री हरेंद्र नाथ पाठक
श्री हेमराज शर्मा
श्री जितेन्द्र कुमार वर्मा
श्री प्रमोद कुमार

rduhf'k;u ¼1½

leg&l

ç;kx'kkyk lgk;d

श्री महेश प्रसाद
श्री वी.के सिंह
श्री अब्दुल महमूद असगर
श्री राम उजागिर
श्री सुभाष कुमार
श्री भरत सिंह बिष्ट
श्री मन मोहन
श्री मो. नवी
श्री मुनव्वर अली
श्री हरिपाल
श्री नुरुल हुदा
श्री सुरेन्द्र नाथ
श्री लाल चंद प्रसाद
श्रीमती पुष्पा सेमवाल

ç;kx'kkyk ifjpj ¼2½

श्री टी.पी. सुरेश

ç'kklfud LVkQ

leg ,

ç'kklu fu;=d

श्री भास्कर ज्योति देउरी

HkkMkj ,o Ø; vf/kdkjh

श्री बीएल मीना
श्री राम बादल

ç'kklfud vf/kdkjh

श्रीमती बी मल्लिकम्बा

foÙk ,o ys[kk vf/kdkjh

श्री भास्कर कुमार रवि
श्री एच चोंगलोइ

leg ch ¼jkt if=r½

vuHkkx vf/kdkjh@lkekU;]

श्री हरे राम कुशवाहा

vuHkkx vf/kdkjh@foÙk ,o ys[kk

श्री अंकेश्वर मिश्रा

vuHkkx vf/kdkjh@HkkMkj ,o Ø;

श्री विकास चंद मिश्रा

lqj{kk vf/kdkjh@lkekU;

श्री संजय कुमार राम

vuHkkx vf/kdkjh@foÙk ,o ys[kk

श्री शैलेन्द्र प्रताप सिंह

futh lfpo

श्रीमती कंचनलता थॉमस

xqi&ch ¼vjkt if=r½

lgk;d vuHkkx vf/kdkjh ¼lkekU;½

श्रीमती सूफिया किरमानी
श्री मुनेश्वर प्रसाद
श्री संत लाल
श्री परवेज नासिर
श्री पी श्रीनिवास
श्री कौशल किशोर
श्री सिद्धार्थ शुक्ला
श्री रवि प्रकाश
श्री के.जी थॉमस
सुश्री संयोगिता सैंगर
श्री पी.के. चतुर्वेदी

lgk;d vuHkkx vf/kdkjh ¼foÙk ,o ys[kk½

श्रीमती निशा शर्मा
श्री हरीश चन्द्र
श्री शिव कुमार
श्री सुनील कुमार
श्री ए.एल साहू
श्री आयुश सिंघल
श्री कन्हैया लाल
श्रीमती केसी नागरत्नम्मा

lgk;d vuHkkx vf/kdkjh ¼HkkMkj ,o Ø;½

श्री पंकज कुमार

श्री शमीउल्लाह खान
श्री अनीस अहमद
श्री अजीत वर्मा

ofj"B vk'kfyfid

सुश्री गायत्री शारदा
श्रीमती पी सबिता
श्री श्रीकरजी सिन्हा
सुश्री सुचिता गुप्ता

iFkdikLV ¼leg&ch½

श्री योगराज सिंह
श्री रोहित खन्ना
श्रीमती संगीता तंवर

x|i&lh ikLV

ofj"B lfpoky; lgk;d ¼lkekU;½

श्री मनोज स्वरूप शुक्ला
श्रीमती शीला यादव
श्री विजय कुमार भरतेय
श्रीमती प्रीति गंगवार

ofj"B lfpoky; lgk;d ¼foÙk ,o y[kk½

श्री प्रदीप कुमार
श्रीमती फरजाना हफीज

dfu"B lfpoky; lgk;d ¼lkekU;½

श्री आर अल्गार स्वामी
श्री रवि प्रकाश मिश्रा
सुश्री प्रतिभा मौर्य

x|i lh ¼u,u &Vd½

Mkboj

श्री अजय कुमार वर्मा
श्री संजय कुमार सिंह
श्री सर्वेश यादव
श्री चंद्रपाल वर्मा
श्री राजेश कुमार

dVhu LVkQ

श्री विक्टर मुखर्जी

x|i Mh ¼u,u&Vd½

श्रीमती नरगिस सूफिया अंसारी
श्रीमती सुनीता देवी
श्री संतोष कुमार
श्री संत राम
श्री सुधीर कुमार भट्टाचार्य
श्री हरिहर
श्री प्रवीण कुमार
श्री किशन राम
श्रीमती जरीना बानो
श्री राम करण
श्री धर्मपाल बाल्मीकि
श्री अब्दुल नादिर खान
श्री अरविंद कुमार
श्रीमती राजमती
श्री हरपाल वाल्मीकि
श्री कृपा राम

eYVh VkfLdx LVkQ@lj{kkdeh

श्री तुला सिंह
श्री अशोक कुमार पाठक
श्री किशन लाल
श्री पी भिक्षापति
श्रीमती निर्मला वर्मा
श्रीमती तारादेवी
श्री मोहम्मद शमीम
श्री मोहम्मद मोहसिन

सीमैप नए स्टाफ सदस्यों का स्वागत करता है

क्र.सं.	नाम	पद	पोस्टिंग की तिथि	प्रविष्टि
1.	श्री राम बदल	भंडार एवं क्रय अधिकारी	21.03.2018	सीएसआईआर–सीमैप,लखनऊ
2.	डॉ. हरि ओम गुप्ता	वैज्ञानिक	02.04.2018	सीएसआईआर–सीमैप,लखनऊ
3.	डॉ. (श्रीमती) नीरजा तिवारी	एस.टी.ओ (3)	24.07.2018	सीएसआईआर–सीमैप,लखनऊ
4.	श्री भास्कर कुमार रवि	वित्त एंव लेखा अधिकारी	24.08.2018	सीएसआईआर–सीमैप,लखनऊ
5.	श्री एच चोंगलोई	वित्त एंव लेखा अधिकारी	10.09.2018	सीएसआईआर–सीमैप,लखनऊ

सेवानिवृत्त कर्मचारी

क्र.सं.	नाम	पद	सेवानिवृत्ति की तिथि
1.	श्री माता प्रसाद	जे.एस.जी	28.02.2018
2.	श्री सभाजीत	प्रयोगशाला सहायक	31.03.2018
3.	डॉ. आर.एस. भाकुनी	वरिष्ठ प्रधान वैज्ञानिक	30.04.2018
4.	डॉ. एच.पी. सिंह	प्रधान तकनीकी अधिकारी	30.04.2018
5.	श्री एस. सेल्वरज	वरिष्ठ तकनीशियन (2)	30.04.2018
6.	डॉ. अशोक शर्मा	मुख्य वैज्ञानिक	31.05.2018
7.	श्री एम.एस. मेहरा	वित्त एंव लेखा अधिकारी	30.06.2018
8.	डॉ. मोहम्मद जैम	प्रधान तकनीकी अधिकारी	30.06.2018
9.	श्री एस.ए. वारसी	सहायक (भंडार एवं क्रय) I	30.06.2018
10.	श्री वाई. शिवा राव	वरिष्ठ तकनीशियन (2)	31.07.2018
11.	श्री राकेश तिवारी	मुख्य वैज्ञानिक	30.09.2018
12.	श्री कैलाश चंद्र	सफाईवाला	30.09.2018
13.	श्रीमती आई.वी. रौतेला	वरिष्ठ तकनीशियन (2)	31.10.2018
14.	श्री राजेश कुमार	सहायक (सामान्य) I	31.10.2018
15.	श्रीमती निशा शर्मा	सहायक (वित्त एवं लेखा) I (MACP)	31.12.2018

l|puk dk vfèkdkj vfèkfu;e

fuEufyf[kr vfèkdkfj;k dk vfèkfu;e dh vko';drk d vu|lkj ukfer fd;k x;k g%

dæh; ykd l|puk vfèkdkjh

M, èkeæ lfd;k
सीएसआईआर–सीमैप
ई–मेलः d.saikia@cimap.res.in
फोनः 91–522–2718650

vihyh; çkfèkdj.k

Jh ih-oh- vt;kd|ekj
सीएसआईआर–सीमैप
ई–मेलः pv.ajayakumar@cimap.res.in
फोनः 91–522–2718665

ikjnf'krk vf/kdkjh

b- l|nhi VMu
सीएसआइआर–सीमैप
इ–मेलः s-tandon@cimap-res-in
फोनः 91–522–2718651

ukMy vfèkdkjh

Jh HkkLdj 'kDyk
सीएसआईआर–सीमैप
ई–मेलः bhaskar.shukla@cimap.res.in
फोनः 91–522–2718616

o"k 2018 d nkjku ekeyk dk lkjk'k g%

o"k 2018 ¼01 tuojh 2018 & 31 fnlcj 2018½					
आवेदन प्राप्त हुआ	अस्वीकृत	सुचना प्रदान की गई	पहली अपील	निर्णय जहां पहली अपील का जवाब दिया गया	सीआइसी, नई दिल्ली को संदर्भित किया गया
स्थानांतरण मामलों सहित	NIL	98	03	03	NIL

vu|lèkku ifj"kn

v/;{k

çkQ lj ,l-,l- gkMk
पूर्व निदेशक, सीएसआईआर–आईआईआईएम,
कार्यकारी विला, 522–ए ब्लॉक–सी, सुशांत लोक –1 गुड़गांव, हरियाणा – 122002

lnL;

M,-Vh-vkj- 'kek
राष्ट्रीयकृषि–खाद्य जैव प्रौद्योगिकी संस्थान (एनएबी. आई)
जेसी बोस नेशनल फेलो और एक्जीक्यूटिव डायरेक्टर
राष्ट्रीय कृषि–खाद्य जैव प्रौद्योगिकी संस्थान (एनएबीआई)
सेक्टर –81, नॉलेज सिटी, पीओ–मनौली, एसएएस नगर, मोहाली पंजाब – 140306

çkQ lj jke g"k lg
लाइफ टाइम प्रतिष्ठित प्रोफेसर
चिकित्सा विज्ञान संस्थान, कायचिकित्सा विभाग
वाराणसी, उत्तर प्रदेश – 221005

M,- vkj vkj fgjokuh
पूर्व प्रमुख, सीएसआईआर – यूआरडीआईपी, पुणे
ए –61, वृंदावन सोसाइटी पंढवती,
पाशन रोड, पुणे महाराष्ट्र – 411008

M,- je'k oh- lkVh
मुख्य वैज्ञानिक
सीएसआईआर –कोशिकीय एवं आणविक जीव विज्ञान केन्द्र
उप्पल रोड, हैदराबाद – 500007

M,- jkt'k dkVpk
विशेष सचिव,
आयुष मंत्रालय
आयुष भवन, बी–ब्लॉक जीपीओ कॉम्प्लेक्स, आईएनए, नई दिल्ली – 110023

çkQ lj vkj-ch- flg
प्रोफेसर, भूगोल विभाग
दिल्ली विश्वविद्यालय अर्थशास्त्र विभाग
नई दिल्ली – 110007

M,- jke , fo'odek
निदेशक
सीएसआईआर–भारतीय समवेत औषध संस्थान (आई.आई.आई.एम.) जम्मू
नहर रोड जम्मू,
जम्मू और कश्मीर – 180001

egkfun'kd ukfer

M,- lat ; dekj
निदेशक
सीएसआईआर–हिमालय जैव संपदा प्रौद्योगिकी संस्थान
पोस्ट बॉक्स नंबर 6 भारत
पालमपुर (हि.प्र.) 176061

fun'kd

çk vfuy dekj f=ikBh
सीएसआईआर–केन्द्रीय औषधीय एवं सगंध पौधा संस्थान (सीमैप)
पी. ओ–सीमैप, निकट कुकरैल पिकनिक स्पॉट
लखनऊ – 226015

LFkk;h vkef=r
प्रमुख या उसके नामित
योजना एवं निष्पादन विभाग
वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद
अनुसन्धान भवन, 2 रफीमार्ग
नई दिल्ली–110001

i|c/ku ifj"kn

v/;{k

çkQl j vfuy d|ekj f=ikBh
निदेशक
सीएसआईआर–सीमैप, लखनऊ

l nL;

M,- , l-d|- ckfjd
निदेशक
सीएसआईआर–एनबीआरआई, लखनऊ

M,- vCn|y len
मुख्य वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

M,- , d| 'kkluh
मुख्य वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

M,- ¼Jherh½ l|uhrk fl|g /kou
प्रधान वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

M,- l|t; d|ekj
वरिष्ठ वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

Jh euk|t l|eoky
वरिष्ठ वैज्ञानिक
सीएसआईआर–सीमैप, लखनऊ

Jherh l|/kk vxoky
वरिष्ठ तकनीकी अधिकारी (2)
सीएसआईआर–सीमैप, लखनऊ

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foÙk vk|j [kkrk@foÙk vk|j y|[kk vf/kdkjh

l nL; lfpo
ç'kklu d| fu;|=d@ç'kklfud vfèkdkjh

ctV ,d utj

	vkoVu ¼yk[k e½	0;; ¼yk[k e½
वेतन और भत्ता	2950.000	2269.452
आकस्मिकता	397.560	288.382
मानव संसाधन विकास	0	0
लैब रख–रखाव	206.310	204.988
स्टाफ मकान रख–रखाव	26.810	10.841
रसायन/उपभोग्य	405.880	217.968
काम और सेवाएँ	200.500	15.947
उपकरण	125.130	80.194
दफ्तर के उपकरण	0	0
फर्नीचर और फिटिंग	0	0
लाइब्रेरी (पुस्तकें और जर्नल)	43.400	0
स्टाफ मकान (निर्माण)	87.587	21.402
सी.एस.आई.आर. नेटवर्क परियोजनाएँ	1792.717	720.010
;kx		
पेंशन	2461.000	1551.744
okà; ctVh; lalk/ku		
लैब रिजर्व फंड (एल.आर.एफ)		76.991
okà; udnh çokg ¼bZ-lh-,Q½		522.30

ih,pMh Fkhfll ls lEekfur fd;k x;k

Ø-l-	Nk=k dk uke	i;Zos{kd	Fkhfll dk 'kh"kZd	frfFk	fo'ofo|ky;
1.	अभिषेक शर्मा	डॉ. ए.के. माथुर	टरपेनोइड इन्डोल अल्कॅलॉइड्स पाथवे मॉडुलेशन स्टडीज इन कैथरन्थस रोसेउस वाया इन विट्रोसेल कल्चर स्ट्रेटेजीज	08–जनवरी–18	जेएनयू
2.	उमेश पंकज	डॉ. राजेश कुमार वर्मा	स्टडी ऑफ दी माईकोराइजोल सिम्बिओसिस विथ पामारोसा (सिम्बोपोगोन मार्टिनी) अंडर साल्ट अफेक्टेड सॉइल एंड इट्स इन्फ्लुएंस ऑनग्रोथ, यील्ड, क्वालिटी एंड सॉइल प्रॉपर्टीज	10–जनवरी–18	जेएनयू
3.	सुबीर कुमार बोस	डॉ. (श्रीमती) नीलम सिंह सांगवान	इस्टैब्लिशमेंट ऑफ नावेल डिटरपेनॉयड कॉलिटेरपेनो नेफयटो मोलेक्यूलेएसए ग्रोथ एनहांसर इन एकम्पेरेटिव मैंनेर दैन गिबबेरेल्लिक एसिडयूसिंग कमर्सियली इम्पोर्टेन्ट मेंथा आरवेंसिस एल.	29–जनवरी–18	एसीएसआइआर
4.	शिव वर्धन सिंह	डॉ. अनिर्बान पाल	प्रोस्पेक्टिंग नेचुरल बायोएक्टिवस फ्रॉम मेडिसिनल प्लांट्स फॉर यूज इन एडजंक्टिव थेरेपी फॉरदी ट्रीटमेंट ऑफ मलेरिया	13–अप्रैल–18	जेएनयू
5.	सतीश कुमार पाण्डेय	डॉ. एन.पी. यादव	स्टडीज ऑन फाईटोकेमिकल्स बेस्ड नैनोपेस्टीसाइडस फॉर मैनेजमेंट ऑफ मोसक्वोटोज	16–अप्रैल–18	जेएनयू
6.	पूजा शर्मा	डॉ. फिरोज खान	मॉलिक्यूलर डॉकिंग एंड क्वांटिटेटिव स्ट्रक्चर–एक्टिविटी रिलेशनशिप स्टडीज ऑन इन्हिबिटर्सऑफ PI3K/Akt/mTOR कैंसर सिग्नलिंग पाथवे	27–अप्रैल–18	जेएनयू
7.	राजेश चंद्र मिश्रा	डॉ. सुमित घोष	आइडेंटिफिकेशन एंड फंक्शनल कैरेक्टराइजेशन ऑफ अमीरिन सिंथेसेस फ्रॉम स्वीट बेसिल (ओसीमम बैसिलिकम एल.)	15–मई–18	जेएनयू
8.	दीपक सिंह कपकोटी	डॉ. आर.एस. भाकुनी	सिंथेसिस ऑफ गलैबरिडिन, पसोरलें एंड अर्टेमिसिनीं अनलॉगस एस एंटीकैंसर एजेंट्स	04–जून–18	जेएनयू

9.	प्रियंका गुप्ता	डॉ.एम.पी. दरोकर	फार्माकोलॉजिकल स्टडीज ऑन दी फ्रूट जुसेस इन कॉम्बिनेशन विथ एंटी बैक्टेरियल एजेंट्स टू कॉम्बैट मल्टीड्रगरे सिस्टेंट इन्फेक्शन्स ऑफ स्ताफ्य्लोकॉकस औरुस	08–जून–18	जेएनयू
10.	हेमा नेगी	डॉ. राकेश पांडे	स्टडीज ऑन एंटी– एजिंग एक्टिविटीज ऑफ उर्सोलिक एसिड इन कैनोरहबड़ीटीस एलेगंस	27–जून–18	जेएनयू
11.	शुभंद्र त्रिपाठी	डॉ. अशोक शर्मा	मॉलिक्यूलर इंटरेक्शनस्टडीज ऑफ टार्गेट्स एंड ड्रग्स ऑफ ब्रेस्ट कैंसर थ्रूमॉलिक्यूलर डॉकिंग एंड मॉलिक्यूलर डायनामिक्स सिमुलेशन स्टडीज	29–जून–18	जेएनयू
12.	भावना मिश्रा	डॉ. (श्रीमती) नीलम सिंह सांगवान	बायोकेमिकल, फाईटोकेमिकल्स एंड मॉलिक्यूलर रेस्पॉन्सेस ऑफ कैडमियमस्ट्रेस इन विथानिआ सोम्निफेरा (एल.) दुनाल	02–जुलाई–18	एसीएसआइआर
13.	नूपुर सिंह	डॉ. अशोक शर्मा	इन–सिलिको आइडेंटिफिकेशन एंड एनालिसिस ऑफ माइक्रोRNAs इन इम्पोर्टेन्ट मेडिसिनल एंड एरोमेटिक प्लांट्स.	13–जुलाई–18	जेएनयू
14.	अर्जुनसिंह	डॉ. डी चंदा	स्टडी ऑफ एंटी हाईपरटेंसीव पोटेंशियल ऑफ मेडिसिनल प्लांट बेस्ड लीडस्यूसिंग प्रीक्लीनिकल एक्स–वीवो एंड इन–वीवो स्टडीज	20–जुलाई–18	जेएनयू
15.	स्मिता सिंह	डॉ. आर.के. लाल	जेनेटिक्स ऑफ क्वांटिटेटिव एंड क्वालिटेटिव इकोनॉमिक ट्राइट्स रिलेटेडटू एसेंशियल आयल यील्ड इन बेसिल (ओसीमम बैसिलिकम एल.)	03–अगस्त–18	एसीएसआइआर
16.	आनंद मिश्रा	डॉ. (श्रीमती) सुनीता सिंह धवन	स्टडीज ऑन त्रिकोमे डाइवर्सिटी एंड डेवलपमेंट इन मेंथा आरवेंसिस	06–अगस्त–18	जेएनयू
17.	सुशील कुमार	डॉ. (श्रीमती) सुनीता सिंह धवन	बायोटेक्नोलॉजिकल इंवेस्टीगेशंस फॉर जेनेटिक इम्प्रूवमेंट इन मुकुना प्रुरिएंस (केवांच)	06–अगस्त–18	जेएनयू
18.	सना बांडा सइद	डॉ. अब्दुल समद	मॉलिक्यूलर कैरेक्टराइजेशन, डाइवर्सिटी ऑफ बेगमोवायरस इन्फेक्टिंग मेंथा स्पेसीज एंड डेवलपमेंट ऑफ डायग्नोस्टिक्स फॉर दी बेटर मैनेजमेंट	13–अगस्त–18	एसीएसआइआर

19.	अमरीन अली सिद्दीकी	डॉ. आर एस भाकुनी	फाईटोकेमिकल्स इन्वेस्टीगेशन ऑन इंडियन मेडिसिनल एंड एरोमेटिक प्लांट्स	29–अगस्त–18	एसीएसआइआर
20.	संध्या त्रिपाठी	डॉ. (श्रीमती) नीलम सिंह सांगवान	इन– डेथ इंडिविजुअल एंड कम्पेरेटिव ट्रांस्क्रिप्टोम एनालिसिस ऑफ विथानिआ सोम्निफेरा (एल.) दुनालः इनसाइट्स इंटू ग्लोबल एंड स्पेशलाइज्ड मेटाबोलिज्म	20–सितम्बर –18	एसीएसआइआर
21.	स्वाति श्रीवास्तव	डॉ. राकेश पांडे	इंवेस्टिगेटिंग न्यूरोमॉडुलाटोरी एंड एंटीएजिंग पोटेंशिअल्स ऑफ थाइमोल इन कैनोरहाबड़ीटीस एलेगंस	28–सितम्बर–18	एसीएसआइआर
22.	सुचेता सिंह	डॉ. आलोक कालरा	इंडोफाइट्स मोडूलेट टरपेनोइड इण्डोल अल्कॅलॉइड्स (TIAs) बायोसिंथेसिस इन कैथरन्थस रोसेउस	03–अक्टूबर–18	एसीएसआइआर
23.	मनीषा मॉल	डॉ. आशुतोष शुक्ला	मॉलिक्यूलर स्टडीज रिलेटेड टू की टरपेनोइड इण्डोल अल्कलॉइड बायोसिंथेसिस इन कैथरन्थस रोसेउस	23–अक्टूबर–18	जेएनयू
24.	प्रियंका मिश्रा	डॉ. वी सुंदरेशन	जीनोम एनालिसिस ऑफ सेना स्पीशीज फॉर डेवलपमेंट ऑफ सीक्वेंस करक्टराइज्ड एम्प्लिफाइएड रीजन (SCAR) मार्कर टू करक्टराइज एंड वैलिडेट सेना अलेक्सांद्रीना टुवर्ड्स चेकिंग रामपंत सब्स्टिटूशन इन हर्बल मार्किट	29–अक्टूबर–18	एसीएसआइआर
25.	अखिल कुमार	डॉ. अशोक शर्मा	डेवलपमेंट ऑफ सेलेक्टिव स्माल मल्टी– टारगेट– डायरेक्टेड फाइटोमॉलिक्यूल्स एंड देयर डेरिवेटिव्स बेस्ड इन्हिबिटर्स	03–दिसम्बर–18	जेएनयू

*जेएनयू जवाहर लाल नेहरू विश्वविद्यालय, नई दिल्ली

सीएसआईआर–वैज्ञानिक और नवीकृत अनुसंधान अकादमी, गाजियाबाद

Glimpses from the history*

CSIR-Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP) is a premier multidisciplinary research institute of Council of Scientific and Industrial Research (CSIR), India with its major focus on exploiting the potential of medicinal and aromatic plants (MAPs) by cultivation, bioprospection, chemical characterization, extraction, and formulation of bioactive phytomolecules. With a strength of 100 scientists, 162 technical officers, 129 support staff and nearly 300 doctoral and post-doctoral scholars at its HQ in Lucknow and research centers at Bengaluru, Hyderabad, Pantnagar, and Purara, CSIRCIMAP has played a key role in positioning India as a global leader in production of mints, vetiver and other aromatic grasses, and in ensuring indigenous production of artemisinin - a WHO approved anti-malarial. CSIR-CIMAP houses a National Gene Bank on MAPs, which is one of the three of its kind in India. CSIR-CIMAP has played a key role in successfully commercializing an ayurvedic herbs-based anti-diabetic formulation, which has now benefitted millions. The institute is presently accredited by ICS-UNIDO and Indian-Ocean Rim Association (IORA) as a focal point for research and training on Medicinal Plants among 21 participating member countries.

History at a Glance

- Initially set up as Central Indian Medicinal Plants Organisation (CIMPO) in the year 1957 with a mandate to work and stimulate research on medicinal plants; subsequently aromatic plants also brought under its ambit
- CIMPO started functioning from 26th March 1959 with the appointment of late Shri P.M. Nabar its first Officer Incharge and rechristened as Central Institute of Medicinal and Aromatic Plants (CIMAP) in the year 1978
- The institute shifted to its present campus near Kukrail forest, Lucknow in the year 1980

Our Mandate

- CSIR-CIMAP is engaged in multi-disciplinary high-quality research in agricultural, biological and chemical sciences and extending technologies and services to the growers and entrepreneurs of MAPs with the following mandate:
- Genetic improvement, cultivation, production and chemical processing of economically important MAPs
- Characterization and conservation of genetic resources
- Production of planting material of the improved cultivars
- Bioprospecting plants and their constituents for various biological activities using different in vitro and in vivo techniques
- Metabolic pathway studies for identifying and modulating yield determinants
- Herbal products and formulations for better life
- Knowledge management for the enhancement and dissemination of R&D
- Human resource development for R&D in the basic and applied areas of MAPs

**cited from the 2018 brochure of the CSIR-Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP)*

Salient Contributions of CSIR-CIMAP

- Catalysed transformation of India from menthol importing country to the largest global producer and exporter of menthol mint oil by spreading *Mentha* cultivation in more than 300,000 hectares, developing short-duration and high yielding varieties, and superior agro and processing technologies which enhanced the income of nearly 600,000 farmers.
- Ensured 'Make in India' of the anti-malarial drug artemisinin by developing high yielding varieties of *Artemesia annua,* chemical process for extraction and derivatization of artemisinin and promoting cultivation of improved varieties in farmers field.
- Profitable utilization of salt-affected and flood-prone coastal and river bank areas by developing and deploying short duration and high yielding varieties of Vetiver (Khus).
- Development and deployment of improved varieties of lemon grass, palmarosa, ashwagandha, and tulsi cultivation in under-utilized rain deficit areas like Bundelkhand, Vidharbha, Kutch and Marathwada.
- Developed one of the most successful herbal formulation for the management of diabetes type 2 (With CSIR-NBRI) using medicinal plants mentioned in Ayurveda and ensuring clinical efficacy and safety.
- Leading CSIR Aroma Mission to empower Indian farmers and aroma industries by cultivation, processing, value addition and marketing of aromatic crops.
- Coordinating promotion of exchange of knowledge and trade of medicinal plants among IORA member states of Indian-Ocean Rim Association.

Research Center Bengaluru

Research Center Hyderabad

Research Center Pantnagar

Research Center Purara

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CSIR-Central Institute of Medicinal and Aromatic Plants
(Council of Scientific and Industrial Research)
Kukrail Picninc Spot Road, Lucknow-226015 (INDIA)
Ph: +91-522-2718639, 2718641, 2718505; E-mail: director@cimap.res.in, Website : www.cimap.res.in

army printing press
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