TESSA

2020

A Virtual International Conference on

Technologies for Environmental Sustainability and Smart Agriculture

Centre of Excellence in Sustainable Technologies for Rural Development [CESTRD]
Department of Biotechnology & Bioinformatics
Jaypee University of Information Technology
Waknaghat, Solan - INDIA (173234)

TESSA – CESTRD-2020

TESSA-CESTRD

BY

CESTRD Team

A Virtual International Conference on

Technologies for Environmental Sustainability and Smart Agriculture

On 18th and 19th September 2020

Organised By

CENTRE OF EXCELLENCE IN SUSTAINABLE TECHNOLOGIES FOR RURAL DEVELOPMENT [CESTRD]

DEPARTMENT OF BIOTECHNOLOGY AND BIOINFORMATICS

At

Jaypee University of Information Technology

Waknaghat, Solan - INDIA (173234)

Mission: The mission of CESTRD is the upliftment of lifestyle and living status of rural people through intervention of JUIT scientists. The sustainable technologies in the area of renewable energy (Solar energy, Hydro-wind energy), landscape designing, crop harvesting technologies, Biogas production, Biofertilizers, plastic waste management and economic activities such as approach to market and government bodies for financial assistance will be made easily understandable for rural people.

Eminent Speakers

Dr. Rajesh Jalota
Brisbane, Australia

Dr. RK Sani
SDSMT, USA

Prof. SS Kanwar
HPU, Shimla

Dr. Hesam Kamyab
UTM, Malaysia

Dr. Gaurav Zinta
IHBT, Palampur

Dr. Prasun Kumar
South Korea

Dr Abuzar Ansari
South Korea

Dr Gajanan Ghodke
South Korea

Dr. Swati Tyagi
IRRI, Varanasi

Dr. Vivek Dogra
IHBT, Palampur

Thematic Areas

The thematic areas of this event includes environmental sustainability, interrelationship between economic progress and environmental management, new techniques to increase the productivity of crops and smart agriculture.
The emission of greenhouse gases and pollutants in the environment is affecting nutritional balance in plants, quality of product and individual wellbeing. This event will provide the researchers, academicians, environmentalists, and scholars, to get interconnected and share their ideas and knowledge to minimize ecological damage, new techniques for smart agriculture and to mitigate the climate change.

Chief Patron
Prof Vinod Kumar, Vice Chancellor, JUIT

Patrons

Prof Samir Dev Gupta
Dean (Academics), JUIT

Maj Gen Rakesh Bassi (Retd.)
Registrar and Dean of Students, JUIT

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Dr. Geetanjali
Member, Department of CSE

Dr Raj Kumar
Member, Department of BT & BI

Dr. Ragini Raj Singh
Member, Department of PMS

Student Coordinators

Ms. Reva Bhardwaj

Mr. Umang Maheshwari

The Registration is Free Of Cost!

Register here: https://forms.gle/7nVXshzYrQY4aM357

Technologies for Environmental Sustainability and Smart Agriculture Centre of Excellence in Sustainable Technologies for Rural Development (CESTRD) Jaypee University of Information Technology, Waknaghat, Distt. Solan, (H.P.) INDIA CONFERENCE PROGRAM SCHEDULE					
	Date	**Timing**	**Speaker**	**Topic**	**Session Chair**
Day1	**18/09/2020**	**SESSION-1**			
		9:00am to 09:30am	Inaugural Address by Vice Chancellor, Dean Academics, Registrar JUIT Waknaghat Thematic Address by Prof. Sudhir Kumar, HOD BT/BI, JUIT Waknaghat	Opening Ceremony	Dr. Ashok Nadda (Convener)
		09:30 am-10:30 am	Prof. R. K. Sani, South Dakota School of Mines and Technology, USA	Microbial technologies in sustainable development of energy, environment, agriculture and health	Dr. Ragini Raj Singh & Dr. Raj Kumar
		10:30 am-11:15am	Dr. Gajanan Ghodke, Donguk University, South Korea	Recent advances in phytoremediation for soil reclamation and water purification	
		11:15 am-12:15 pm	Dr. Hasam Kamyab, University of Technology, Malaysia	Production of bioenergy and recovery of nutrient by microalgae produced from agro wastewater Palm Oil mill effluent POME	
		12:15 pm- 02:00 pm	e-Poster Discussion/ Lunch		Dr. Anil Kant Thakur Dr. Jata Shankar
		SESSION-2			
		02:00 pm-02:45 pm	Dr. Sunita Varjani, Gujarat Pollution Control Board, Gujarat, India	Microbial processes for remediation of petroleum hydrocarbons	Dr. Harish Changotra & Dr. Tirath Raj Singh
		02:45 pm-03:30 pm	Dr. Vivek Dogra, Senior Scientist, CSIR IHBT, Palampur, India	Plant-Environment and Interactions: The emerging role of chloroplast	
		03:30 pm-04:15 pm	Dr. Prasun Kumar, Yungnam University, South Korea	Renewable substrates in the aid of microbial polyesters	
		04:15 pm-05:00 pm	Open Forum and Discussion Session for Participants		
Day2	**19/09/2020**	**SESSION-3**			
		09:00 am-10:00 am	Dr. Rajesh Jalota, Senior Environmental Officer, Department of Environment and Science Brisbane, Australia	Environmental sustainability and land restoration	Prof. Dr. Sudhir Kumar & Dr. Saurabh Bansal
		10:00 am-11:00 am	Dr Abuzar Ansari, Donguk University, South Korea	Environment and human metabolic disease: Management with herbal and omics-technology	Dr. Rahul Shrivastava Dr. Hemant Sood Dr. Poonam Sharma
		11:00 am-12:00 pm	Dr. Gaurav Zinta, Senior Scientist, CSIR IHBT, Palampur, India	Mechanistic insights into plant response to global climate change	
		12:00 pm-02:00 pm	e-Poster Discussion/ Lunch		Dr Anil Kant Thakur Dr. Geetanjali Dr. Harsh Sohal
		SESSION-4			
		02:00 pm-03:00 pm	Prof. S. S. Kanwar, H.P. University Shimla, Himachal Pradesh, India	Lipopeptides: Peptide-antibiotics with diverse biological activities	Dr. Narendra Kumar & Dr. Abhishek Chaudhary
		03:00 pm-04:00 pm	Dr. Swati Tyagi, International Rice Research Institute, Varanasi, Uttar Pradesh, India	Microbial volatile organic compounds: Invisible players for sustainable agriculture	Prof. Dr. Ashish Kumar & Prof. Dr. Sudhir Kumar
		04:00 pm-05:00 pm	**Closing ceremony**		**CESTRD Team**

Technical Support Committee:
Mr. Shambhoo Nath, Ms. Somlata Sharma, Mr. Baleshwar Prasad, Ms. Mamta Mishra, Ms. Sonika Gupta

CESTRD and its Activities

Vision: The vision of CESTRD established at Jaypee University of Information Technology (JUIT) is to focus on the development of rural personnel and to benefit the people of all age groups irrespective of gender, race and financial category in Himachal Pradesh (H.P). The aim of the centre is to impart awareness about the recent sustainable technologies and Government aided scheme available for their convenient livelihood in H.P. The CESTRD will focus on the transfer the technologies to the rural people through their scientific taskforce and spread agricultural and environmental awareness. CESTRD is also determined to train the rural youth about use of upcoming technologies for skill development and to upgrade their acquaintance about self-employment and entrepreneurship. The centre will target the rural youth, women groups and rural development committees through continuous consultancy, training and workshop sessions.

Mission: The mission of CESTRD is to uplift the lifestyle and living status of rural people through intervention of JUIT scientists. The sustainable technologies in the area of renewable energy (Solar energy, Hydro-wind energy), landscape designing, crop harvest technologies, Biogas production, Biofertilizers, plastic waste management and economic activities such as approach to market and government bodies for financial assistance will be made easily understandable for rural people.

CESTRD - Chair-person & Coordinator

Prof. Sudhir Kumar (HOD)

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JUIT, Waknaghat
Solan, H.P.
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  All HODs, JUIT

- **Organizing Committee Chairperson and Coordinator**

  Prof. (Dr.) Sudhir Kumar, JUIT

- **Convener**

  Dr. Ashok Kumar

- **Organizing Committee, Members**
  - Dr. Ashish Kumar
  - Dr. Abhishek Chaudhary
  - Dr. Raj Kumar
  - Dr. Ragini Raj Singh
  - Dr. Geetanjali
  - Dr. Harsh Sohal

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Speakers Profiles

1. Dr. Rajesh Sani

Dr. Rajesh Sani is a Professor in the Department of Chemical and Biological Engineering at South Dakota Mines, South Dakota, USA. His research expertise includes Rules of Life in Biofilms, Extremophilic Bioprocessing, Biocatalysis, Biomaterials, Gas to Liquid Fuels, Genome Editing of Extremophiles and Space Biology. Over the past 14 years, he has been the PI or co-PI on over $44.39 million in funded research. He has one patent, seven invention disclosures, and published over 93 peer-reviewed articles in high impact factor journals and have contributed to over 24 book chapters. In addition, he has edited eight books and one Proceedings for Springer International Publishing AG, Wiley, and ACS publications. Dr Sani has also been leading a research consortium funded by the NSF with the aid of 84 scientists and engineers.

Abstract: This keynote talk will discuss roles of unexplored microorganisms present in the deep biosphere (300 to 5,000 ft. deep levels) of Sanford Underground Research Facility (SURF) at Homestake Gold Mine (SD, USA) in developing sustainable technologies for energy, environment, agriculture, and health. More specifically, I will discuss our group's ongoing research (Extremophilic/Thermophilic Bioprocessing), and provide several examples including i) STEMBnB – Biofuel and Value-Added Products; ii) Power systems for NASA missions; iii) Biopolymers (Polyhydroxyalkanoates and Exopolysaccharides); and iv) Thermophilic Exopolysaccharide Films: A Potential Device for Local Antibiotic Delivery. Recent activities of i) BuGReMeDEE consortium (Building Genome-to-Phenome Infrastructure for Regulating Methane in Deep and Extreme Environments) and ii)"Rules of Life" in biofilms grown on 2D materials will also be presented.

2. Dr. Hesam Kamyab

Dr. Hesam Kamyab is a Senior Researcher at Universiti Teknologi Malaysia (UTM) in 2020. Dr. Kamyab was a Postdoctoral Research Fellow for 3 years in the Department of Engineering at UTM in 2017. He was appointed as a visiting researcher from University of Illinois Chicago (UIC) in 2016. He obtained Master of Bioscience and Bioengineering (Biotechnology) at Universiti Teknologi Malaysia (UTM). He earned PhD in Civil Engineering in the field of Environmental Engineering at Universiti Teknologi Malaysia (UTM). He was awarded the Young Water Professional Awards by International Water Association (IWA-YWP) in 2014 at Taipei, Taiwan. Moreover, He received outstanding Reviewer Award in Journal of Cleaner Production (Elsevier) and Clean Technologies

Environmental Policy (Springer) in 2017. He was appointed as the Junior Board Member in Journal of Cleaner Production, Elsevier (IF: 7.246) following his active paper review role. Also, he was appointed as managing guest editor in Energy Journal, Elsevier (IF: 6.082). He has a chair in IWA Emerging Water Leader (EWL). He has published more than 80 papers in reputed journals and has been serving as an editorial board member of repute.

3. Dr. Prasun Kumar

Dr. Prasun Kumar is presently working as an Assistant Professor at the Department of Chemical Engineering, Yeungnam University, Republic of Korea. He holds a Ph.D. in Biotechnology from CSIR-Institute of Genomics and Integrative Biology, Delhi, India. His main areas of research are Biopolymers, Bioenergy, and Biofilms. He has over seven years of experience in applied microbiological research including over 3 years of post-doctoral research experience as BK-21 plus fellow. He made a significant contribution while working on valorizing lignocellulosic biowastes or cheap raw materials into value-added products. To his credits, there are over 30 papers in various peer-reviewed SCI journals including Trends in Microbiology; Biotechnology Advances; Bioresource Technology, etc. In addition, he has edited four books and 10 book chapters. He has been contributing to scientific society by actively reviewing articles for more than 32 SCI journals and as an editorial board member of two international journals.

4. Dr. Rajesh Jalota

For the last 17 years Dr. Rajesh Jalota has been working with Queensland Government in different capacities and roles. Currently, Dr. Jalota is serving as Senior Environmental Officer, Department of Environment and Science, Queensland Govt. Brisbane, Australia. While working on different projects, Dr. Jalota have successfully transferred his already developed technical and research skills to deliver sustainable management and protection of Queensland's Natural Resources and Environment, in addition to acquiring new skills (technical, project management and legislation).

Dr. Jalota has extensive experience in range of fields, soils science, soil surveying, database management, carbon sequestration, environmental management roles including compliance and licensing of mines (level 1 and level 2), Thermal Energy (coal, gas and kerosene fired plants), Coal Seam Gas, Sewage Treatment Plants, Waste Collection and Recycling, Quarries, Heavy industry, Coastal, Chemical Storage and Handling, Land

Rehabilitation (mine sites) and Community Engagement (education and extension). Dr. Jalota is involved in environmental assessment of energy production *viz*, thermal power, biofuels, petroleum and gas (including coal seam gas (CSG), liquefied natural gas and conventional oil and gas, Geothermal, CO_2 storage), extractive and chemical industries. Carry out duties consistent with contemporary Administrative Decision Making Principles Till June 2018 Dr. Jalota was working as a law enforcement and compliance officer DES.

5. Dr. Shamsher S. Kanwar

Dr. Shamsher S. Kanwar, a Senior Professor at the Department of Biotechnology, Himachal Pradesh University, Shimla (India) does research in nanotechnology, medicinal chemistry, therapeutics and biocatalysis. One of his current projects is 'Improvement of activities of industrially important enzyme by protein engineering, rational design and enzyme immobilization'. Dr. Kanwar has guided more than 175 students for their Post Graduate degrees in Biotechnology with dissertation(s), 26 candidates for the Master of Philosophy Degree in Biotechnology and 18 candidates for Ph.D. Degree in Biotechnology. He pursues his research activities by developing bio-products and bio-processes for a variety of extracellular microbial enzymes such as lipase, cholesterol oxidase, ribonucleases, L-methionase, alkaline proteases & dye-degrading peroxidases. To assess the antitumor & anticancer activities of purified microbial enzymes [asparagine, glutaminase, L-methionase and ribonucleases] as well as some of the phyto-molecules is one of the dominant fields of research activities of Dr. Kanwar. Dr. Kanwar has published 190 articles including chapters in the books (Published by Elsevier, Springer, In Tech, CRC Press, Francis & Taylor etc.) over a career spanned over 26 years. He has filed six (06) patents and five of these have been published. Dr. Kanwar is a certified reviewer of 58 international and national peer-reviewed journals. He is also editor of Current Biotechnology, Journal of Advanced Microbiology, Insight in Enzyme Research and Current Research in Virology & Retrovirology. He has a Research Gate Score (RG) of 61.61, 3011 citations and H-index of 26.

6. Dr. Sunita Varjani

Dr. Sunita Varjani is Scientific Officer at Gujarat Pollution Control Board, Gandhinagar, Gujarat, India. Her major areas of research are Microbial Bioprocesses, Agricultural and Environmental Microbiology/Biotechnology, Waste Biorefineries. She has worked as visiting scientist at EPFL, Lausanne, Switzerland. Dr. Varjani has authored more than 200

publications, including research and review papers, books, book chapters and conference communications. She has won several awards, including Young Scientist Awards from Biotech Research Society, India (2018), Microbiologist's Society India (2018-19), Association of Microbiologists of India (2018), International Society for Energy, Environment and Sustainability (2018) and AFRO-ASIAN Congress on Microbes for Human and Environmental Health, New Delhi (2014); Highly Cited and Highly downloaded papers, Bioresource Technology, Elsevier; Top Reviewer Award - 2018, Bioresource Technology, Elsevier; Top Reviewer Award - 2017, Bioresource Technology, Elsevier and Best Paper Awards in national and international conferences in 2008, 2012, 2013, 2018 and 2019. She is member of editorial board of Journal of Energy and Environmental Sustainability and has served as guest editor of special issues of Bioresource Technology, Environmental Science and Pollution Research, ASCE- Journal of Environmental Engineering, Bioengineered, Industrial Crops and Products Journal, Energy and Environment, Journal of Experimental Biology, and others. She is Management Council Member of the BRSI (www.brsi.in).

7. Dr. Vivek Dogra

Dr. Vivek Dogra is presently working as Senior Scientist at CSIR-IHBT- Palampur. We are interested to understand the role of the Chloroplast for sensing and managing various environmental/developmental cues and the cognate responses. We are trying to unveil the readjustments in the chloroplast homeostasis and to delineate various retrograde signaling cascades initiated from the Chloroplast using the model plant Arabidopsis thaliana and High Altitude Extremophiles of western Himalayas. Publications: in journals including Cell, Nature Communications, the Plant Cell, PNAS, Plant Physiology etc.

8. Dr. Abuzar Ansari

Dr. Abuzar Asnari completed his Masters of Science in Zoology from Allahabad University (India)I and his Master of Philosophy in Zoology from Aligarh Muslim University (India). Then he worked as a senior researcher at the Department of Neurosurgery, All India Institute of Medical Sciences (New Delhi, India) for 4 years. After receiving Ph.D. Scholarship in 2014 at Dongguk University International Hospital, Republic of Korea, and received the Ph.D. degree in 2018 in Korean Medicine. Currently, Dr. Ansari working as a Researcher at Ewha Women University. Research interest: Metabolic (Obesity, Diabetes), and Neurodegenerative (Epilepsy, Alzheimer's) disorder mechanism. Gut-microbiota in

diseases, especially in connection with gut-brain-axis. Natural medicine therapeutic response to diseases and their metabolic activity. Research citation (Google scholar): Total citations: 184; h-index: 8; i10 Index: 7. Dr. Ansari is a growing researcher and published research articles in National and International renowned journals.

9. Dr. Gaurav Zinta

Dr. Gaurav Zinta is working as a Scientist at Biotechnology Division, CSIR-Institute of Himalayan Bioresource Technology, Palampur, HP, India. He works on various aspects of plant responses to climate change.

10. Dr. Swati Tyagi

Ph.D. in Plant biotechnology from Jeonbuk National University, South Korea and presently working as Scientist at International Rice Research Institute, South Asia regional Centre, India. She worked as Post-doctoral research fellow at Genomics division, National Institute of Agriculture Science, Rural Development Administration, Republic of Korea. Her research interests are plant microbe interactions, microbial volatiles, next generation sequencing, and plant genomics including genome engineering tools. She has published several research articles, book chapters, conference articles in national and international peer reviewed journal.

11. Dr. Gajanan Ghodke

Dr. Gajanan is working is associate professor in Dongguk University Seoul South Korea. He is working in the field of environmental chemistry, nanotechnology and application of nanomaterial in various fields of environment. He also works on phyto remediation and environment pollution.

Keynote Speaker Abstracts

Microbial technologies in sustainable development of energy, environment, agriculture, and health

Rajesh Sani*

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This keynote talk discussed the roles of unexplored microorganisms present in the deep biosphere (300 to 5,000 ft. deep levels) of Sanford Underground Research Facility (SURF) at Homestake Gold Mine (SD, USA) in developing sustainable technologies for energy, environment, agriculture, and health. More specifically, Dr. Rajesh Sani group's ongoing research (Extremophilic/Thermophilic Bioprocessing), and provided several examples including i) STEMBnB – Biofuel and Value-Added Products; ii) Power systems for NASA missions; iii) Biopolymers (Polyhydroxyalkanoates and Exopolysaccharides); and iv) Thermophilic Exopolysaccharide Films: A Potential Device for Local Antibiotic Delivery. Recent activities of i) BuG ReMeDEE consortium (Building Genome-to-Phenome Infrastructure for Regulating Methane in Deep and Extreme Environments) and ii) "Rules of Life" in biofilms grown on 2D materials were also be presented.

Keywords: Sustainable technologies, Mining, Bioprocessing, Polyhydroxyalkanoates, Exopolysaccharides, 2D materials

Recent advances in phytoremediation for soil reclamation and water purification

Gajanan Ghodake*

Dongguk University-Seoul, College of Life Sciences and Biotechnology, Department of Biological and Environmental Sciences, Ilsan, Siksadong, Goyang, South Korea

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Massive industrialization and rapid population growth resulted in environmental pollution with toxic metals, metalloids, and organic compounds. These pollutant's presence in soil and water is a major environmental concern and most of the conventional remediation approaches like land excavation, landfilling, and coagulations are not effective in providing acceptable ultimate solutions. Phytoremediation, which involves plants depending upon contamination sites employs either terrestrial and aquatic plants for environmental cleanup. In India, aquatic plants like *Spirodela polyrrhiza*, *Hydrilla verticillata*, *Phragmites karka*, *Scirpus lacustris*, and *Bacopa monnierii* have been had found potential candidates to treat heavy metal contaminated wastewater effluent from textile and leather industries. Four major strategies that have to be executed for maximum performance include phytoextraction, Rhizofiltration, Phytostabilization, and Phytovolatilization. Thus phytoremediation, generally recognized as 'green technology' for the removal of toxic contaminants can be increasingly adopted as an environment-friendly and cost-effective alternative to the traditional remediation methods.

Keywords: Green technology, phytoremediation, soil reclamation, wastewater

Production of bioenergy and recovery of nutrients by microalgae produced from the agro-wastewater palm oil mill effluent (POME)

Hesam Kamyab

Engineering Department, Razak Faculty of Technology and Informatics, UniversitiTeknologi Malaysia, Jln Sultan Yahya Petra, 54100, Kuala Lumpur, Malaysia

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Wastewater and environmental pollution is gaining interest in developing and developed countries. Malaysia is known as one of the world's biggest palm oil producers. Hence, it is important to develop an environmentally friendly and economical method for treating effluent from palm oil mills (POME).Wastewater can serve as an economical source or substrate of nutrients which can sustain microalgae cultivation. This can be a fantastic nutrient at the same time as remediating effluent and producing biomass for algal cultivation. Many microalgae species are currently being investigated to determine their potential and effectiveness for application of phytoremediation, in particular high growth rates. However it is expensive to use synthetic media to produce microalgae on a large scale. It is recognised that POME (as enriched media of nutrients) assisted enhanced growth of microalgae under certain conditions will considerably reduce the presence of organic and inorganic compounds. In this context, the ability of wide range of predominant microalgae species with an emphasis on green microalgae (high efficiency of removal) has been investigated. In addition, we thoroughly explored the past, methods and potential prospects of nutrient removal by green microalgae. This context addresses several possible strategies to resolve the environmental problem created by POME agro-waste water with an increase in the productivity of biomass that can be used as an alternative for energy production.

Keywords: Palm oil mill effluent; microalgae; wastewater treatment

Microbial processes for remediation of petroleum hydrocarbons in agri fields: Challenges and research needs

Sunita Varjani*

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Safe removal and treatment of oily sludge produced by businesses from petroleum segment is very important concern around the world. During raw petroleum investigations, stockpiling and transportation spillage may happen which cause damage of soil. It might contaminate close by water bodies as well. Hence oily sludge generated from petroleum industries activities pose an alarming threat to environment. In recent many years expanded pace of oil spill occurrences has been accounted for because of expanded investigation exercises for raw petroleum. Additionally, tremendous amount of risky oily sludge has been accounted for from petroleum industrial segment exercises. All around the world oily sludge has been accounted for as risky because of severe guidelines oily garbage removal as environmentally helpful manner is a significant issue for organizations of petroleum explorations. Oily sludge contaminated environment can be re-established by utilizing various innovations. Constituents of oily sludge are poisonous for people and living beings and furthermore compromise the environment. This necessitates to develop 'green' processes to remediate them, for which current emphasis is on developing biological methods as they offer potential sustainability. Soil remediation by employing microorganisms provides noteworthy technology when compared with physico-chemical methods for the same. Remediation of petroleum hydrocarbons contaminated agricultural soil using microbial processes will be discussed.

Keywords: Agricultural sustainability; Green processes; Microbial activities, Oily sludge; Petroleum explorations

Plant-environmental interactions: The emerging role of chloroplasts

Vivek Dogra*

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Plants being sessile face a series of environmental perturbations together with the internal developmental events. Cellular organelles play a vital role in sensing those stimuli and also primes the cognate response. In the plant cells, mitochondria and chloroplasts are organelles of prokaryotic origin, which during evolution, undergone endosymbiosis and transferred the majority of their genomes to the host nuclear genome. Due to which these organelles are mostly dependent upon the nucleus and therefore maintain harmony with it. Among these endosymbionts, the chloroplast is essential not only for photosynthesis, but it also provides a site for the synthesis of fatty acids, phytohormones, and several vital metabolites. Besides, emerging evidence shows that chloroplast also acts as a sensor that, upon perceiving the internal (developmental) and external (environmental) cues, instigate retrograde signaling to change the nuclear gene expression for activating cognate responses, including growth inhibition, programmed cell death, and acclimation. These cues primarily target the vital processes in the chloroplast, especially the photosynthetic machinery, leading to the generation of reactive oxygen species (ROS). The antioxidant system normally scavenges these ROS; however, upon adverse conditions, they damage various biomolecules, including proteins, lipids, and nucleic acids. Upon accumulation of the damaged products of these biomolecules, chloroplast triggers various retrograde signaling cascades, which underline the plant's response towards the developmental/environmental cues.

Keywords: Chloroplasts, plant signalling, ROS, plant development

Renewable substrates in the aid of microbial polyesters

Prasun Kumar*

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Petroleum-based plastics have become an integral part of our everyday life. Due to their non-biodegradable nature, the indiscriminate usage of synthetic plastics causes a risk to all the living organisms of the planet besides causing environmental pollution. In this context, biodegradable polymers of microbial origin have dragged significant attention. Polyhydroxyalkanoates (PHAs) are polyesters that can be accumulated intracellularly by microbes under particular environmental conditions and store these polymers as a reservoir of energy and reducing equivalents. A plethora of hydroxy acid monomers can be incorporated with the PHA enabling it to exhibit a wide range of Physico-chemical properties and consequently broad range applications similar to synthetic plastics. However, the production cost of PHAs is still high, limiting its common use or application. Since microbes are known to degrade and utilize renewable substrates including agro-industrial wastes, it is imperative to use such cheap raw materials for PHA production. Therefore, the major focus of this presentation would be towards the production of PHA from agricultural wastes and biodiesel industry waste (i.e. crude glycerol) using bacterial isolates belonging to the genus *Bacillus* and *Paracoccus*. Our work has demonstrated that cost-effective PHA production is possible using biowastes. However, further integration of other biochemical production is desirable in order to realize this wonder polymer in the market. This talk will also cover the biosynthetic pathway of PHA, extraction method, characterization technique, applications of PHA in various sectors, and its future perspective.

Keywords: Synthetic plastics, PHAs, polymers, biodiesel, biowastes

Land rehabilitation - Using common sense and bit of science

Rajesh Jalota*

Senior Environmental Officer, Department of Environment and Science, Queensland Govt. Brisbane, Australia

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A request from a community group to help them in growing trees on a bare slop (20%) turned out to be an ongoing project that has achieved soil stabilisation, establish ground cover and stop pollution of the head waters of the Opossum creek, in Springfield Lakes in South East Queensland. Because of paucity of funds we are using locally available material from the nearby bushland, so called "waste" and any other organic materials to stop soil erosion, establish soil cover and to improve the soil quality. After the success of rehabilitation of ~ 2 acres of cleared land we are now targeting to control erosion in nearby bushland and eradicating weeds in the area.

Keywords: Land rehabilitation, bushland, soil erosion, environment

Environment and human metabolic disease: Management with herbal and omics-technology

AbuZar Ansari*

Department of Obstetrics and Gynecology and Ewha Medical Research Institute, College of Medicine, Ewha Womans University, Seoul 07984, Republic of Korea

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The environment directly affects human systems and has a great impact on genomic, transcriptomic, proteomic, epigenomic, and metabolic mechanism. A busy lifestyle and western-style diet also dysregulate the normal metabolic mechanism which leads to metabolic diseases like Cardivascular, Obesity, Diabetes, or Alzheimer's disease. At the genomic level, a single SNP of any gene might dysregulate the next omic metabolic process which induces the metabolic dysregulation, and a single metabolic dysregulation may influence the multi-dysregulation and results in multi-metabolic disease. In humans, only 10% is the human genome while the resting 90% genome belongs to microbes, which means that the microbes control 90% of human metabolic mechanisms. Herbal technology opens the door to multiple ways of utilizing the multifarious potentialities of herb with their promising therapeutics. The Ayurveda, Chinese, and Oriental, doctors have perfected the ancient art of herbal technology professional formulas have set the standard with advanced omic-technologies in clinical practice for the management of metabolic diseases. Using herbal traditional medicine can modulate the gut microbes through several metabolic axes, like the gut-brain axis, gut-liver-axis, or gut-adipose tissue axis. An herbal formula like *Chowiseungcheng-tang* exerts the anti-obesity effect through modulation of the brain-gut-adipose tissue axis. A combination of herbal formula with western medicine is expected to show synergetic effects such as the combination of *Scutellaria baicalensis* and Metformin for co-treatment of ameliorates diet-induced metabolic dysregulation via the gut-liver-brain axis. A fermented herbal remedy is expected to show enhanced efficiency with the potential effect on metabolic diseases like fermented *Samjunghwan* ameliorates hepatic metabolic disease through the relative abundance of beneficial microbes profile in a fermented herbal formula. Treatment with beneficial microbes might work as probiotics like *Lactobacillus* strains of fermented food like *L. sakei*, *L. plantarum*, *L. brevis*, *L. lactis* treatment work as immunobiotics and modulate the metabolic dysregulation via microbiota-metabolites. In conclusion, using the herbal formula and implication of omics-technology will give new dimensions to better understand the mechanism and management of environmental, genetic, or diet induce metabolic diseases.

Keywords: Environment, Herbal-medicine, Metabolic-disease, Microbes, Omics-technology

Mechanistic insights on plant responses to climate change

Gaurav Zinta*

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Ongoing climate change involves co-occurring changes in various environmental factors, such as atmospheric CO_2, temperature and precipitation. Extreme heat and drought limit plant growth and yield, whereas elevated CO_2 alone is beneficial, at least for C3 species. Here, insights on the interactive effects of climate change factors *viz*. heat, drought and high CO_2 in the model plant *Arabidopsis thaliana* and C3 grassland species are discussed. Key findings include 1) elevated CO_2 mitigates the impact of combined heat and drought stress on growth and photosynthesis, 2) temporal metabolic profiling revealed that short- and long-term exposure to combined heat and drought altered primary metabolism differentially, 3) repeated heat stress exposure of Arabidopsis for multiple generations induce transgenerational effects, 4) nutrient quality losses are less prominent in grasses than legumes under climate change conditions, 5) grasses and legumes utilize unique proline accumulation strategies during the stress period. At the end, the role of CRISPR/Cas9 genome editing technology to improve plant traits by manipulating genetic and epigenetic components is also discussed.

Keywords: Climate change, C3 plants, Arabidopsis, CRISPR/Cas9, genome editing

Lipopeptides: Peptide antibiotics with diverse biological activities

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The animal and human diseases because of drug resistance of pathogenic microbes both bacteria and fungi have been increasing over the last few decades in spite of availability of traditional and broad spectrum antibiotics. The increasing cases of multi drug resistance (MDR) or extreme drug resistance (XDR) of pathogens have further limited the use of currently available front-line antibiotics. Many of the existing antibiotics such as rifampin, isoniazid etc when administered on long-term basis cause hepatotoxicity and the penicillin's or its derivatives often cause irritating digestive problems. There is an urgent need to explore and produce new antibiotics with higher yield to combat the fungal phyto-pathogens possessing distinct modes of action. Lipopeptides (LPs) are low molecular weight (~1.0 kDa) bio-surfactants that emulsify and decrease the surface tension of water. Among anti-microbial peptides, cyclic LPs (CLPs) Surfactin, Iturin, Fengycin (or plipastatin), Bacillomycin, Daptomycin, Caspofungin & Mycosubtilin have well-recognized potential uses in biotechnology & bio-pharmaceutical applications because of their surfactant properties. While exploring the history, the first isolation of a lipopeptide antibiotic occurred in 1953 with the discovery of Amphomycin (Toxicity!). Interestingly, the members of the genus *'Bacillus'* are often considered microbial factories for the production of a vast array of biologically active molecules. One of the most commonly used and well-studies organism, the *B. subtilis*, 4–5% of its genome is devoted to antibiotic synthesis and has the potential to produce more than two dozen structurally diverse antimicrobial compounds. Daptomycin, a lipopeptide has become increasingly important to combat infections caused by Gram +ive bacteria because of the presence of MRD in these organisms, particularly in methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE). Daptomycin, a lipopeptide antibiotic with *in vitro* bactericidal activity against Gram-+ive bacteria; approved by the FDA, USA in 2003 for soft-tissue infections and in 2006 for *Staphylococcus aureus* bacteremia and right-sided endocarditis. Mammalian innate immune system molecules known as cationic antimicrobial peptides (CAMPs), specifically the human cathelicidin LL-37 have antiviral-enveloped, antibacterial and antifungal activities. In the developing countries the crop losses are common due to insufficient storage and transportation facilities for the plant produces. Therefore, the development of eco-friendly

alternatives to reduce the chemical pesticides for sequestering the crop diseases has attracted the attention of researcher's world-over. A common bacterium also considered a probiotic i.e. *B. subtilis* produces mainly three types of LPs with potential for biotechnological and biopharmaceutical applications. These LPs include surfactin, iturin, fengycin, mycosubtilin etc which exhibit surfactant and antimicrobial activities. Methodology: To achieve optimal production of LP from a *Bacillus subtilis* strain, physico-chemical parameters of fermentation process were manipulated, the LP was purified, characterized and its biological activities including anti-obesity potential were validated *in vitro*. Findings: The yield of LPs in the fermentation broth of *B. subtilis* improved from 176.9 mg/L to 926 mg/L by a traditional approach while a statistical (CCD) approach further enhanced it to 985.0 mg/L.

Conclusion: The purified lipopeptide of *B. subtilis* primarily appeared to be a surfactin possessing potent antifungal and anti-obesity activities.

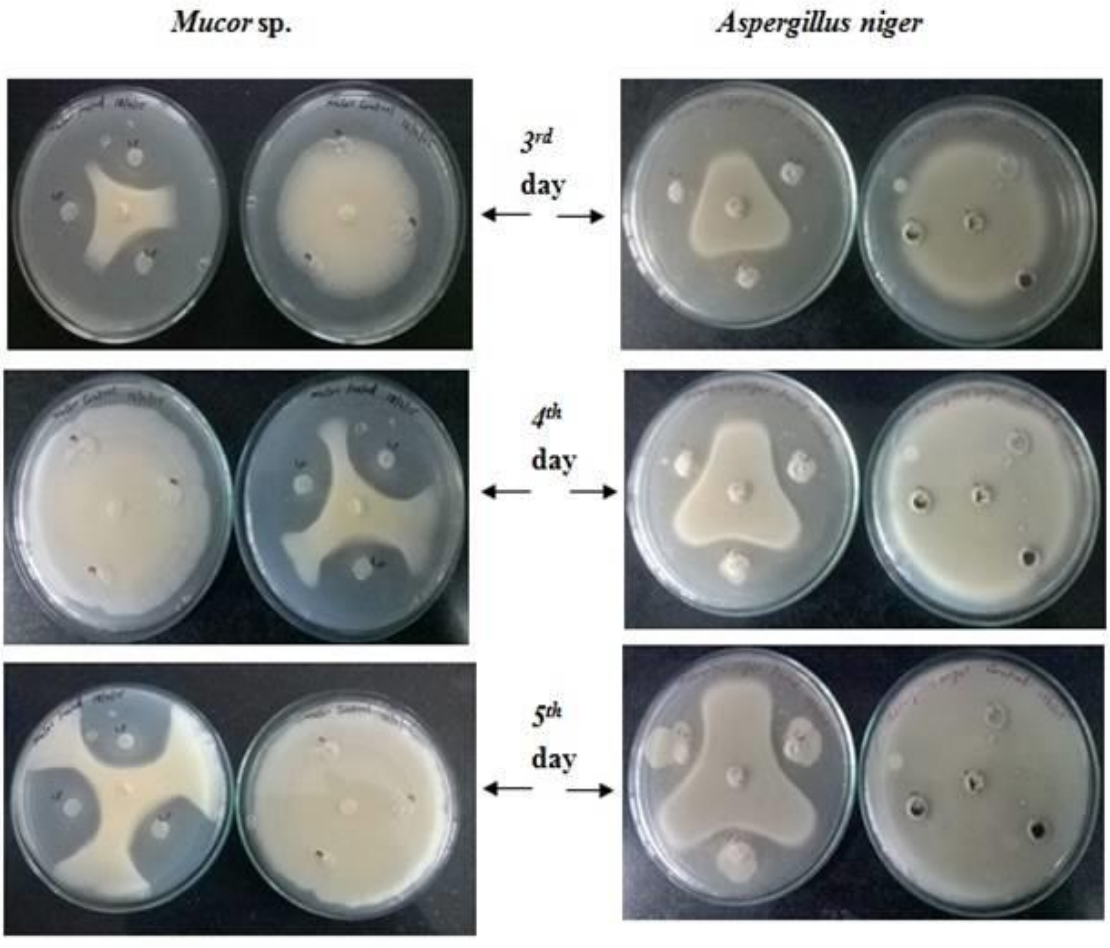

Figure 1: Potent antifungal activity of purified LP of *Bacillus subtilis* KLP2015. Growth inhibition of *Mucor sp.* and *Aspergillus niger* was 77.8% and 52.4%, respectively after 5 days of treatment with LP at 30°C.

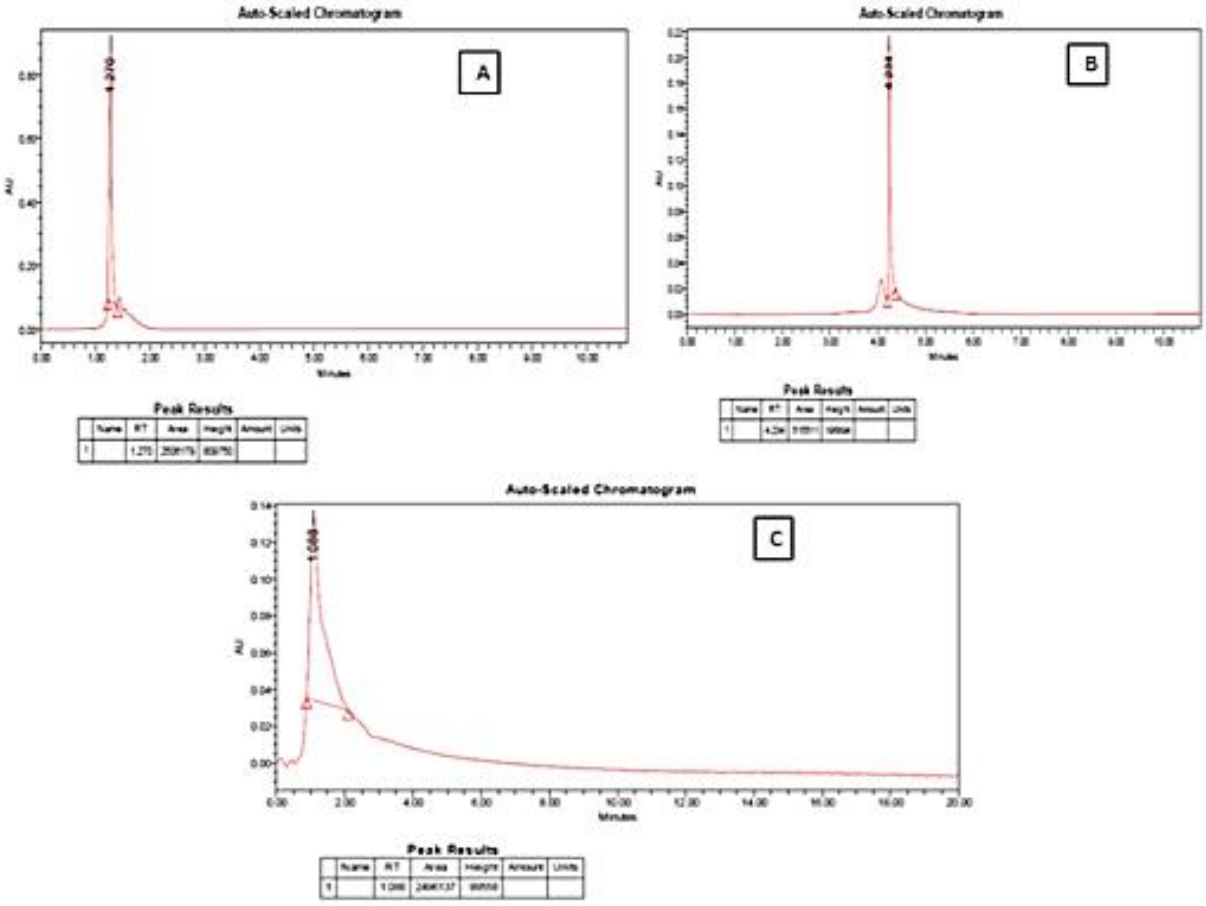

Figure 2: (A) Surfactin, (B) Iturin A and (C) purified lipopeptide of *B. subtilis* KLP2015. HPLC [C-18 column] analysis showed 9.95 mg yield of the lipopeptide from 500 mL of optimized fermentation broth of *B. subtilis* KLP2015.

Keywords: Lipopeptides, bio-surfactants, toxicity, MDR, XDR

Effect of volatile dimethyl disulfide on plant development and plant pathogens

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Microbial volatile compounds abbreviated as MVCs are the compounds secreted by several organisms as a bioproduct of their primary and secondary metabolite and play important role in interactions among plants and microorganisms. MVCs can travel to long distance in air, soil, water and can influence genetic and physiological processes in plant and associated microorganisms. Substantial evidence indicates that MVCs can serve as an indirect plant promoting agent by controlling the phytopathogens and improving the growth of plants. However, a thorough understanding of the function and mechanism of action of MVCs requires detailed knowledge that influences the trait. Although the study carried out in last two decades only focused with the use of MVC blend and their effects on the receivers, but underlying mechanism remained unexplored. Apart from it, MVCs are mixture of several complex compounds those as a mixture or alone can regulate differential mechanisms. To fill this gap, we investigated the impact of Dimethyl disulfide – microbial volatile compound analogue on plant, phytopathogens (fungi/bacteria), their interactions and the downstream signaling network involved in the pathogen virulence and plant defense. It was noticed that DMDs have dose dependent effect on the growth of plant (*Arabidopsis thaliana*, tomato), and pathogens and 50 µM concentration of DMDS is enough to promote the plant growth and induce the systemic resistance in the tomato plants. In plants, DMDS affect the plant growth positively by influencing the canonical auxin signaling pathway while fungal (phytopathogen; *Sclerotinia minor*,) growth was retarded by a membrane damage mechanism. This dose is not only effective against the soil borne pathogen but also sublethal to foliar pathogens such as *Pseudomonas syringae* pv. DC3000. The subtoxic concentration of DMDS altered the global transcriptome expression of DC3000 and restricted the bacterial motility reducing the bacterial virulence. Collectively, it can be said that DMDS can influence growth, development in plants by altering the expression of growth-related genes and increasing the resistance of the plants to infection by pathogens. The results of our study identified the tripartite interaction of DMDS with plant and phytopathogens (bacterial/fungal). However, further in-depth analysis to find the receptors that receive the

volatile compounds like DMDS, and their action spectra analysis must be performed to better understand the link between perception of DMDS by plant and pathogens.

Keywords: Dimethyl disulfide (DMDS), *Arabidopsis thaliana*, root system architecture, *Sclerotinia minor*, membrane damage mechanism, Ergosterol, *Pseudomonas syringae* pv.DC3000, Transcriptomics, RNA seq, Virulence, and motility.

Abstracts

Isolation of plant growth-promoting rhizobacteria from the plants grown on house buildings

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The human population is increasing day by day and is expected to reach 9.8 billion (approx.) by 2050. Increasing population often drive up demand for food, which is fulfilled by using excess of chemical fertilizers. Excessive use of chemical fertilizers is harmful/unsafe to both humans as well as to environment. The use of plant growth promoting rhizobacteria (PGPR) is a promising approach for sustainable agriculture. PGPRs are the soil bacteria inhabiting root surface that promotes plant growth and development either by direct mechanism of nutrient uptake or indirect mechanisms of biocontrol. Therefore, present study was aimed to investigate plant growth promoting potential of bacteria growing on walls/houses/building under stressed nutrient environment. The rhizospheric samples were collected from District Kapurthala, Punjab. A total of 22 bacterial strains were isolated, out of which 5isolates (L1, IL1, W1, S1 and Y1) have shown phosphate solubilizing potential. All the five bacterial isolates were tested positive for siderophore production, nitrogen fixation, and IAA production. None of the isolate were tested positive for HCN production. Among the five bacterial isolates W1 exhibited maximum phosphate solubilisation (109.3 microgram /ml and solubilization index6.5), siderophore production (solubilization index 10), whereas, IAA production was maximumin case of IL1 (40.8 microgram/ml). The bacterial isolates seems promising and needs to be explored under *in vivo* conditions to further strengthen their role/potential as PGPR.

Keywords: PGPR, Biofertilizer, Phosphate solubilization, Agriculture.

Isolation of metal tolerant microorganisms from natural environment and to analyze their metal bioleaching capabilities

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E-waste is taken into consideration due to presence of feasible amount of metal content in it which could be extracted by using bacterial strains with bioleaching capabilities. It is a matter of great concern because the crude and unscientific methods can cause a huge damage to not only our environment but also to the human beings as well. The spectacular development in the technology has undoubtedly enhanced our lives but at the same time it has led to manifold problems which include the generation of massive amount of hazardous waste which we now call e-waste. This work is mainly concerned with the objective of isolating bacteria from the natural environment which can tolerate high e-waste toxicity and also concerned with the detrmination of the cyanide lixiviate and optimization of different parameters like pH, temperature and pulp density. Bacterial strains were isolated from natural environment and tested for e-waste toxicity tolerance. Isolation was done using the enrichment strategy in which e-waste toxicity tolerance of bacteria was analyzed using powdered printed circuit boards (PCBs) of particle size $\leq$15mm, which was procured from Exigo Recycling Pvt. Ltd., India. The EC_{50} value of the two isolates was calculated which was 250 g/l of e-waste pulp density. Aqua regia digestion was also carried out to determine the composition of e-waste and showed a significant variation when compared with the previous studies due to heterogeneity. Further, two step bioleaching was carried out under different parameters for maximum metal mobilization and to estimate leaching capabilities of the isolates.

Keywords: E-waste; Heterogeneity; Bioleaching; Aqua Regia; Pulp density

Biodegradation of pyridinecarbonitrile using nitrilase activity of *Gordonia terrae*

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Nitrilases catalyse the biotransformation of various nitriles to their corresponding acids and ammonia. Nitriles are the cyanide containing compounds, wide spread in the nature and produced by anthropogenic and biological activities. Nitriles are toxic in nature and are known to cause environmental pollution. Microbial nitrilases have potential applications in the bioremediation of environmental pollution as these are specific in action and ecofriendly in use. Microbial degradation of nitriles for the production of compounds of commercial interests has been considered as a proficient way of eliminating extremely toxic nitriles from the environment. In the present study, the whole cell nitrilase of *Gordonia terrae* MTCC8139 induced by isobutylronitrile hydrolyzed 3-pyridinecarbonitrileto nicotinic acid. The reaction conditions were optimized for the assay of enzyme activity. The optimum nitrilase activity was observed in 0.1 M phosphate buffer of pH 8.0 using 50 mM substrate at 40 °C. Thermal stability profile of nitrilase revealed the half-life ($t_{½}$) of enzyme to be 14 h and 3 h at 45 °C and 50°C, respectively. 0.1 M 3-pyridinecarbonitrile was completely converted to nicotinic acid at 40 °C in 0.1 M K_2HPO_4/KH_2PO_4 buffer (pH 8.0) using 10 U/ml whole cell nitrilase in 15 min. A fed batch process was developed at 1l scale resulted in 1.6 M product formation.

Keywords: Nitrilase, Biotransformation, Bioremediation, 3-pyridinecarbonitrile, nicotinic acid

Valorization of agricultural residues for sustainable production of thermo-alkali-stable xylanase

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Xylanases are one of the lignocellulases that have emerged as the green catalyst of great importance to various industries. Specifically, the xylanases active at high temperature and high alkaline conditions have significant contribution in biomass conversion and paper pulp bleaching processes. That is why, the search for more and more efficient thermo-alkali-stable xylanases is still going on. In this context, we carried out production of xylanase using *Geobacillus thermodenitrificans* X1 (GTX1); isolated from Tattapani hot spring soil. For sustainable production the expensive pure substrate i.e. birchwoodxylan was replaced with agricultural residues (wheat straw, rice straw, corn cob and wheat bran). All the agricultural substrates were observed to be an excellent carbon source and inducer for xylanase production. However, wheat straw gave the best output; comparable to birchwoodxylan. Under optimized conditions the final xylanase activity of GTX1 xylanase was 24±2 U/mL. For optimization, One-factor-at-a-time (OFAT) and Response Surface Methodology (RSM) were explored. GTX1 xylanase had temperature and pH optima of 70°C and 8, respectively. This study not only minimized the production cost of xylanase but also supports agricultural waste management. The tons of heaps of agricultural residues are usually burnt open in the fields every year, which create a menace to environment by polluting the air around. Valorizing such wastes is a great alternative to earn profit out of waste with sustainable development.

Keywords: Valorization, xylanase, lignocellulases, birchwoodxylan, sustainable energy

Conversion of CO_2 into calcium carbonate by employing keratin microparticles immobilized *Corynebacterium flavescens*

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Conversion of CO_2 into calcium carbonate using CO_2 utilizing bacteria is one of the promising methods to reduce the increased level of CO_2 into the atmosphere. In the present study, keratin particles were successfully synthesized from chicken feathers and then *C. flavescens* cells were immobilized onto highly porous keratin microparticles to enhance the CO_2 conversion efficiency. The keratin immobilized cells showed maximum cell immobilization yield when glutaraldehyde concentration was 0.6% (v/v) and the temperature was 4^oC under shaking conditions. Furthermore, the same trend was observed for relative $CaCO_3$ production by immobilized cells under similar conditions. The results suggested that immobilized *C. flavescens* cells showed a significant increase in $CaCO_3$ production compared to free cells. Under the repeated batch conditions, relative $CaCO_3$ production for immobilized and free cells was 53.46 and 22.15% respectively after 10 cycles. The synthesized $CaCO_3$ was analysed using scanning electron microscopy, FTIR and X-ray diffraction techniques for particle size, morphology and elemental structure. Here, we determine that keratin particles immobilized cells are a green biocatalyst for the conversion of CO_2 into calcium carbonates. Calcium carbonates precipitation by bacterial cells makes it a potential candidate to be effectively employed in biomimetic CO_2 sequestration.

Keywords: *C. flavescens*, CO_2, keratin particles, immobilization, $CaCO_3$

Sustainable production of silver nanoparticles from waste onion (*Allium cepa*) peel and their application to enhance α-amylase activity

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Production of silver nanoparticles on the principles of green chemistry is a strategically cost-effective and environment friendly approach. Silver nanoparticles produced by means of biological approaches provide them certain unique characteristics beneficial for their applications. The invaluable physico-chemical properties of silver nanoparticles have led them to find applications in fields of nanobiotechnology, diagnostics, bio-sensing, cosmetics, and material science. In the present study we have investigated the potential of onion peel waste extract for green synthesis of silver nanoparticles. The synthesis was confirmed by using UV-vis spectrophotometrically, waste onion peel produced nanoparticles exhibited surface plasmon absorption band at 410nm. The particles are 10.0 nm in size and having spherical as revealed by XRD and SEM analysis. The antioxidants of onion peel serve as potential reducing and capping moieties. Furthermore, generated nanoparticles successfully enhanced the α-amylase activity by 2.1-folds.

Keywords: nanoparticles, sustainable development, surface plasmon absorption, surface plasmon absorption

Phytotoxic and bactericidal effect of LiP treated and untreated azo dyes

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Textile industries release hazardous effluents in the environment which mainly constituted of synthetic dyes. These harmful dyes affects flora and fauna of the local area when discharged without any proper treatment and needed to be detoxified before their release to the environment. Various chemical and biological strategies has been used for this purpose. Biological method being ecofriendly and cost effective are preferred over chemical methods. Various enzymes like LiP has been used for this purpose. In present study lignin peroxidase from *Pseudomonas fluorescence* LiPRL5 was used to detoxifying the textile dyes and its enzymatic activity was optimized by RSM. Phytotoxicity& microbial toxicity of synthetic dye was also investigated with three plant (*Vigna radiate*, *Cicerarietinum* and *Phaseolus vulgaris*) and four microbial species (*Escherichia coli*, *Bacillus* sp., *Pseudomonas* sp. and *Lactobacillus* sp.). Statistical optimization resulted in the enzyme activity i.e. 54.87 U/ml increased 19.26 fold. Crude enzyme was applied for degradation of textile dyes. Malachite green was decolorized faster and more efficiently than and coomassie brilliant blue and the rate of decolourizationwas78± 1.27 %, and 54.89± 0.74%respectively of their initial value. Finding of this research showed that phytotoxicity and microbial toxicity of pure dyes can be reduced by the use of microbial enzymes to promote the plant as well as microbial growth in the niche environment. These findings suggested that LiP will not only help to detoxify the hazardous dyes but also help to remove the toxic effect of dyes on the native flora and fauna and promote the sustainable development.

Keywords: Lignin peroxidase, Response surface methodology, Textile dyes, Decolourization, Phytotoxicity, Microbial toxicity.

Optimization of culture conditions for the production and germination of artificial seed in an important medicinal plant, *Swertiachirayita*

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Swertiachirayita, commonly called as chiretta, is a critically endangered medicinal herb of Himalayas belongs to the family of Gentianaceae. *Swertiachirayita* is found in the sub temperate region of Himalyas distributed in India, Nepal and Bhutan. It is known for its beneficial effect on treatment of various ailments and also known to play important role in biological activities like being as hepatoprotective, digestive, astringent, laxative, anti-inflammatory and anti-malarial. In this study we have optimized the culture conditions for the production and germination of artificial seed in *Swertiachirayita* for its mass propagation. This study utilized somatic embryogenesis as a source for the artificial seed production of *Swertiachirayita*. Morphogenetic capabilities of leaf explants have been optimized on Murashige and Skoog (MS) media. The study revealed that2,4D (1 mg/L) 6BAP (0.5 mg/L) TDZ (0.5 mg/L) are most appropriate for callus initiation and its proliferation. The artificial seeds were successfully produced with 3% sodium alginate in 100ml of water and 100 mM calcium chloride solution. The 90-95% germination of artificial seeds was achieved in 7-10 days on MS media supplemented with IBA (1 mg/L) +KN (2 mg/L) +GA3 (3 mg/L). Artificial seed production has led to increase in the viability rates and germination potential of *Swertiachirayita* seeds, thereby providing efficient means of germplasm conservation, easy transportation, and large scale propagation of endangered species.

Keywords: Medicinal herb, culture, germination, germplasm

Parthenium hysterophorus as an alternate energy source

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The weed menace is viewed with respect to prevention and prevention is the most essential aspect of weed management program. In India, *Parthenium hysterophorus* weed was first cited in the year 1956. Once this noxious weed has entrenched, control measure has become increasingly intractable and in turn exorbitant. As a basic principle of the weed management program, *Parthenium hysterophorus* has undergone a process of suppression, prevention, eradication and management. Weed biomass contains a varying amount of nutrients, preferably used by microorganisms, to potentially convert it into an energy resource. This study has efficiently utilized *Parthenium* biomass in the production of alternative energy fuel-biogas. *Parthenium hysterophorus* was subjected to physical, biological, chemical treatment followed by additive treatment subjected to anaerobic digestion in the pilot plant. PT1, PT2, PT3, PT4 were the test samples which were inoculated at a I/S ratio of a,b,c. Co-additives CD, GD were added at three different ratios to improvise the biogas production from biomass substrate. The experimental GC result of PT4cCDIII PT43GDI, showed the maximum biogas production at the 30 days of HRT.

Keywords: *Parthenium hysterophorus*, Weed Management, Biomass, Biogas

Mutational analysis of microbial carbonic anhydrase for enhanced catalysis

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The gamma-class carbonic anhydrase from thermophilic archaeon *Methanosarcina thermophile* (Cam) provides a cost effective and eco-friendly solution for mitigation of global warming through carbon sequestration from environment. Several attempts to increase the efficiency of Cam through site-directed mutagenesis have been reported earlier. Mutational analysis of highly conserved active site Arg 59 (centroid distance from catalytic zinc centre of 6 Å, PDB: 1THJ) and another internal active site residue, Glu 62 (6 Å) had a negative impact on the enzyme efficiency in terms of decrease in k(cat). Arg 59 and Glu 62 form the first shell of the catalytic site. A loss in activity was also observed after mutation in Trp 19 and alanine substitution of an external loop residue, Glu 84 (9 Å) that form the second shell. Mutations in the third shell residues Glu 88 (18 Å) and Glu 89 (21 Å) had negligible changes in enzyme activity rendering them as less important for enzyme function. Interestingly, a mutation in the Tyr 200 (12 Å, second shell) of third monomer of the Cam has a positive impact on catalysis by a 5-fold increase in k(cat) and increased rate constants for proton transfer. These results emphasised on the positive impacts of mutational analysis of second shell residues which are positioned distant from the catalytic centre.

Keywords: Carbonic anhydrase, global warming, mutation, carbon sequestration

Mitigation of green house gases by bioeconomy to make world prosperous

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The temperature of the earth's atmosphere is rising due to continuous emission of greenhouse gases (GHGs) which results in serous outbreaks like melting of glaciers, irregular rainfall patterns and intense weather actions. The accelerating swiftness of climate transformation, with global population causes depletion of agricultural resources which finally threatens food security globally. Development of individual nation's bioeconomy is now embedded in the strategic activities of almost all countries in order to mitigate increase rate of GHGs and to overcome food security problems**.** In bioeconomy, the growth of active forestry and impact of biotechnology is meant to address the grand challenges which are being faced by society especially climate change. Biotechnology also offers a solution to overcome these serious issues *via* biotech crops or microbial enzymatic technologies. Several studies outline the potential of industrial biotechnology and bio-based products to lower the impact of industry on the environment, with particular regard to lowering GHGs emissions. Thus, considering the impact of suitable bioeconomy, extensive investigation will be carry out to widen our knowledge towards the role of bioeconomy to mitigate GHGs to make world prosperous.

Keywords: Bioeconomy, Greenhouse Gases, Climate, Biotechnology

Biodegradation of nicotine: An ecofriendly approach for environmental detoxification

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Nicotine, the main component of tobacco and risky neurotoxin, has negative impact in our life. If it is ingested, it will be poisonous and it also one of the most harmful than all poisons. It makes soil contamination and unthoughtful disposal of cigarette butts by farmers in the field can enhance this contamination rate. As a result various herbal plants, spice plants, and food crops can take-up this alkaloid. This nicotine contamination is widely spread in case of plant derived products also. Sometimes we use plant extract or plant derived materials direct and then human being may be affected by this. In human direct application of nicotine may cause an irritation as well as burning sensation in the throat and mouth also. Abdominal pain, vomiting, diarrhea is also the reason of nicotine. It increases in plasma free fatty acid and hyperglycemia and also the chance of cancer. Thus, nicotine via soil contamination and by natural oxygen supplier, may harm non-smokers also. As nicotine has all of these adverse effects, so need of hour is the degradation of nicotine by biological process. The microorganisms which degrade nicotine may use this as the only source of nitrogen and carbon for their development. Few strains have a large spectrum in pH stability, adaptability and shows the persistency in repeatedly use. So, if we use biological breakdown system by microbes then we can degrade nicotine which can help to save us as well as our environment.

Keywords: Cigarette butts, Nicotine, Soil contamination, Adverse effect, Biodegradation

E-waste: Core of "Urban Mining" and Its Eating Microbes

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Nowadays, technology revolution has unveiled or updated many electronic products with generation of new kind of solid waste stream which is known as E-waste or WEEEs. This solid waste stream is accelerating globally with 2 million metric ton production per year and till date, about 52.6 million metric ton has been dumped worldwide, containing the raw material of the $16 billion worth, more than the GDP of various developing countries. Moreover, UNU has been estimated that e-waste contains a high amount of precious metals 40 to 50 times more in comparison to natural resources. Approximately, 320 ton of gold worth $ 16 billion and more than 7500 ton of silver worth $5 billion is used every year for the production of the electronic product all over the world. Due to the presence of such valuable metals, e-waste is considered as the core of "urban mining" or "sleeping mines" and motivate to address this fast-growing solid waste stream. At present biohydrometallurgy is a new emerging technique which has been exploring microbial diversity for recovery of many valuable metals from the heap of WEEEs. *Chromobacterium violaceum, Acidithiobacillus ferrooxidans, Pseudomonas sp.*, *Bacillus megaterium, Leptosprillium ferrooxidans* are some of the e-waste eating microbes which have been explored for the recovery of Au, Ag, Cu etc. Thus, these microbes are providing both economic and ecological benefits by recovering the $21 billion worth precious metals and have drawn the interest of various scientific hub for the e-waste treatment.

Keywords: E-waste, biodegradation, microbial leaching, sustainable development

Organic farming: An eco-friendly way to sustainable agriculture

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In the post independence period, the most important challenge in India has been to produce enough food for the growing population. Hence, high-yielding varieties are being used together with irrigation water, fertilizers, or pesticides. This combination of high-yielding production technology has helped the country to develop a food surplus. Exhaustion of the natural potential, destruction of the agrosphere and environmental pollution resulting from increased manmade environmental modification expressed as climate change, has posed threat to existence of humankind. As time went by, extensive dependence on chemical farming has shown its darker side. The land is losing its fertility and is demanding larger quantities of fertilizers. Therefore need for a new philosophy of sustainable development aroused. To reverse this trend, one of the possible means is to go to organic agriculture. A critical appraisal reveals that organic farming systems offer some solutions to the problems, currently besetting the agricultural sector of industrialized or green revolution countries. Organic farming can provide quality food without adversely affecting the environment; however, a concern is whether large-scale organic farming will produce enough food for India's large population. Organic farming unites all agricultural systems that maintain ecologically, socially and economically advisable agricultural production. Organic farming has potential to overcome drawbacks of conventional farming. There is urgent need to adopt the organic farming practices to improve the health and environment and we should take it as potential option to mitigate climate change.

Keywords: Organic farming, sustainable agriculture, pollution, economy

Environment pollution and method of sustainability

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The acceleration of globalisation, urbanisation and industrialization in developing countries has contributed to serious environmental issues. Economic and social shifts such as rapid population growth, migration from rural to urban areas, accelerated mechanization and increased deforestation have changed the country's natural resource base. General factors such as over exploitation of fertile soil, water and air contamination, over use of chemicals, uncontrolled drainage, slums, etc. typically decreased environmental standards. Usually, three main causes, i.e. water, dirt, and noise pollute the urban atmosphere. The causes of air pollution are increase in population and traffic, thermal and nuclear generation, gas emission from industries, hydrocarbons from automobile exhausts and particulate matter from power generation plants, roadways dust etc. water become contaminated from drainage of dirty water from homes, runoff from pesticide spray fields, leakage of oil spills in the oceans and drainage from the industries left off water which contains large amount of poisonous elements like lead, arsenic etc. The present rate of environment degradation is threat and an obstacle for sustainability for human development and lots of living beings. Sustainability can only be achieved through voluntary and involuntary measures. Voluntary measures include public awareness, effective waste management techniques, relying on the non convention sources of energy, etc. Involuntary measures include regulations for imposing restrictions on waste and pollutant emission, maintaining pollution standards and progressive taxation on emission and waste.

Keywords: Pollution, economy, sustainable development, energy, waste

Sustainable Traditional Medicine: Challenges and opportunities in the advancement of herbal medicine

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Medicinal plants play significant role in primary healthcare. Reliance on natural medicinal resources can be attributed to cultural preferences as well as to the high cost and inaccessibility of western medicine. Traditional medicine is sustainable medicine in its true sense as it takes care of the environment from where it has originated. The widespread and long-term use of antibiotics has led to emergence of resistant strains and other side effects that can be overcome using traditional or herbal formulations which are safe, efficacious and multifunctional. Even today, several medicinal plant species are being used in traditional medicinal systems by Vaidyas/ Hakims especially in rural areas. This conventional knowledge is being passed verbally from generation to generation since ages and is mainly restricted to Vaidyas/ Hakims. Also loss of biodiversity, over-exploitation and unscientific use of medicinal plants, are the obstacles in the growth of herbal medicine. Therefore conservation, proper research on traditional knowledge and proper documentation are essential for the growth of herbal medicine usage as no particular measures have been taken to store this information permanently. Hence keeping in view the above mentioned facts the present study was planned to document and enlist the common herbs, herbal formulations used by the local practitioners of one of the culturally rich district of Himachal Pradesh i.e. Kangra. Further the herbs mainly used in herbal formulations will be explored under laboratory conditions for comparative analysis. This traditional knowledge can be further combined with modern techniques to yield more medicinal resources for the benefit of mankind.

Keywords: Medicinal plants, Traditional medicine, Antibiotics and Herbal formulations.

Utilizing traditional herbal wealth for rural health improvement and socioeconomic development

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In India, about 65.5% of our population resides in rural areas and agriculture is the primary source of livelihood for about 58% of country's population. Agricultural practices majorly revolve around cultivation of grains/pulses/cash crops and people mostly hesitate to adopt medicinal/herbal cultivation using newer scientific technologies despite the country reserves highly nutritional herbal treasure. As a result, rural income and community health remains below satisfactory levels. The NHFS-4 (2015-16) survey reveals that 35.8% of children under 5 years of age are underweight. Also about 58.6% of children under 5 years and 53.1% women of reproductive ages (15-49 years) are registered as anaemic.

In order to uplift the nutritional status and socio economic aspects of rural population, Government of India as well as state governments has taken various measures and initiatives like Mid-Day Meals, Integrated Child Development Scheme (ICDS) and many more. The National Medicinal Plants Board is working to promote herbal and medicinal cultivation through schemes like National Mission on Medicinal Plants (NMMP) and National AYUSH Mission (NAM). It will not only empower farmers economically but will also raise community health and nutrition standards.

Proper utilization of nutritional plants to prepare high quality nutritious formulations which fulfil the basic nutritional requirements at low cost is needed. Commercialization of these products will have great impact on income of farmers and health aspects of society.

Keywords: Development; health; herbal; nutrition; rural; socioeconomic.

Polymeric membrane for water treatment

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Today's world is suffering with major problems, one with the supply of clean water or scarcity of the freshwater. 90% of the world's water is salty remaining 10% is also contaminated due to industrial emission, farming. To solve these problems the new technique is discovered to purify the water with the use of polymeric membrane. These polymers give porous support during process of water purification such as reverse osmosis, ultra filtration, and microfiltration. These polymers too have limitations membrane fouling. Continuous movement of water leads to accumulation of the material and it reduce water flux. So, there is a requirement for improving membrane that has higher flux and antifouling properties. The biggest advantage it is affordable to use and have proven to be reliable over longer period of time.

Keywords: Water purification; polymeric membrane; fouling

Biomedical applications of micro and nanocellulose based polymeric composites

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Polymer with Micro and Nano cellulose are having the striking properties and highly reactive on the surface of cellulose which result in the formation of high density of hydroxyl group on large scale. Polymer Composites are the widely spread composites, characterized by low cost, simplistic processing methods, and various applications. Composites material are the required part of our daily routine because of their magnificent properties and there varying applications. Biomedical applications are highlighted such as tissue engineering (including bone, blood vessels, oral tissues, and skin) dental resin-based composites and wound dressings, drug delivery. A brief representation of the biomedicine application, terms and there method of obtaining cellulose nanostructure used in functionalization of the cellulose surface to improve the hydrophilic character and there compatibility with polymer pattern. Originality arises from the damage skin which tends to utilize the microorganism injuries and surgical explosion to embed site and inner organs.

Keywords: Micro-nano cellulose, Polymer Composites, Characterization, Compatibility, polymer pattern, hydrophilic.

Biorefinery: An underrated treasure

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The rapid increase in energy demand and shortcoming of fossil fuels has placed immense pressure to look for alternative sustainable energy resources. Bio-waste is one such renewable and eco-friendly alternate from which fuels and useful chemicals can be produced. Biorefinery, equivalent to petroleum based refinery, is an effective waste management setup to convert high quantities of bio-waste to useful materials, feedstock, heat and energy. The goal of a biorefinery is to produce low-value high volume product to meet global demand and high-value low volume product to meet overall cost. India generates estimated 300 million tons of agricultural waste every year which could be used to generate value-added fuels. Other than this, waste generated from food processing industry and beverage industry is a good feedstock for biorefinery. Both solid and liquid waste had proven cost effective generating valuable products. The biorefinery can be utilized by communities to convert bio-waste into value-added biofuels, fertilizers and biochemical compounds. Numerous biorefineries have been developed but their commercial implementation is still underrated. Further, high investment cost and risks, expected yield and profits and little or no trust are the barrier which need to be addressed for development and successful industrial implementation of this technology.

Keywords: Biorefinery, bio-waste, feedstock, energy

Apple pomace: A potential source of energy and its management

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India has around 500 apple processing industries which are responsible for production of variety of juices and 1.3 million tons of apple pomace annually. A rapid increase in the production of juices and ciders has generated a large amount of apple pomace and now its disposal is a huge problem. Apple pomace is about 25% of its original mass and is a rich source of pectin, carbohydrates, crude fibre and also contains small fractions of minerals, proteins and vitamins. Therefore, it is often utilized as animal feed or as fertilizer. The production of apple pomace as a by-product offers a wide range of alternative substrates. Generally, it is used as animal feedstock or thrown away but several attempts has shown its big potential in renewable energy i.e. in production of bio ethanol (by solid state fermentation), biogas (by process of anaerobic digestion) and other value added by- products such as organic acids (by solid state fermentation), biopolymers (by submerged and solid state fermentation), hetero polysachharides, aroma compounds etc. Bio ethanol production at 30ºC for 96 hrs shows fermentation efficiency of 89%. 80% of pomace organics are converted into biogas with Rs. 734 to Rs. 2000/- per metric ton. Addition of different food wastes, alkali addition, feed interruption and mixing with nitrogen rich substrate is used to overcome unbalanced biogas production. The organic acids produced with *Aspergillus niger* when incubated for 30ºC for 5 days has applications in rust removal, buffer solutions etc. The production of fungal chitosan which is a biopolymer can be done with apple pomace which has huge applications in tissue engineering, medical devices, pharmaceutical industries etc. All these techniques further helps to promote a more systematic and non- expendable conduction of this under- utilized and overgrowing waste. All of which will finally contribute to integrated apple pomace waste management and food economy.

Keywords: Renewable energy; Bio fuels; Bio products; Biomass

Smart agriculture technologies for environmental management

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Agriculture synchronizes with the lifestyles of humanity, joining demands from the human population, meals protection, weather extrade mitigation, and variation, agricultural resources, biofuel and oil costs, meal prices, which have engendered a new transformative, resilient, and clever agricultural method entitled “Climate Smart Agriculture”. Fast alteration with the help of using human beings on agricultural panorama pushed with the aid of using aspirations to maximize manufacturing, productiveness, and earnings with scant respect to environmental worries brought about the degradation of agricultural lands, alteration in worldwide carbon and element cycles, lack of soil fertility and multifariousness, pesterer and disease outbreaks. underneath such circumstances, agriculture manufacturing gadget ought to be insured towards the forthcoming risk of weather extrade; increased with a range of organic resources; more desirable with adaptive ability and resilience; supplied with site-unique sustainable control practices like incorporated crop control, conservation agriculture, agriculture diversification, and panorama control. Climate sensible Agriculture (CSA) is construed as a “complete agricultural method that goals at sustainable productiveness enhancement, mitigation of and variation to weather extrade, and attaining worldwide meal protection and different related sustainable improvement goals”. CSA includes the virtues of “weather-clever meals gadget”, “weather-evidence farms”, and “weather-clever soils”.

Keywords: Environmental stewardship, Climate smart agriculture, Resilience, Food security, Sustainable development goals

Bio-fuel: a sustainable approach of bio-energy production and mitigate climate change

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Energy security and climate change are the two major driving forces for worldwide bio-fuel development which also have the potential to stimulate the agro-industry. Depletion of petroleum derived fuel and environmental concern has promoted to look over the bio-fuel as an alternative fuel sources. Sustainable bio-energy has tremendous potential to prevent carbon emissions from entering the atmosphere simply by switching from fossil-based petroleum to bio-based fuels as our primary transportation fuel. There are several technology that can convert biomass feed-stocks to bio-based fuels such as bio-ethanol and biodiesel. Lignocelluloses may prove to be one of the most useful alternatives to renewable energy sources. Sugar substances like molasses, sugarcane juice and starch based materials like corn, rice and wheat have proved to be promising raw materials for the bio ethanol production. Various agricultural wastes are rich sources of sugars that can be efficiently fermented to ethanol with the help of appropriate fermenting organisms. The first criteria in selecting a feed-stock is that its production must not consume more fossil fuel carbon than it can displace to meet sustainability standards. The second criteria is that the feedstock conversion to bio-fuel will be done with advanced (bio)chemical processing technologies that meet rigorous fuel test standards. Hence, there should be advance research and government policies should be made and implemented to provide a multi-disciplinary, comprehensive, and insightful analysis of the issues that need to be considered in selecting and transforming biomass feed-stocks into sustainable bio-fuels.

Key words: Bio-fuel, Sustainable bio-energy, Feed-stocks, Lignocelluloses, Advance research and government policies etc.

Media & culture conditions for accumulation of high value metabolites in marine microalgae majorly on lipids

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Microalgae are suggested to be a promising and sustainable feedstock for various food and non-food products. They are fast growing, rich in oils, proteins and carbohydrates, and can be cultivated in seawater and on non-arable land, and may therefore be grown in regions unsuitable for agriculture. Microalgae compounds of particular interest are the omega-3 long-chained polyunsaturated fatty acids (LCPUFAs), eicosapentaenoic acid (EPA, 20:5) and docosahexaenoic acid(DHA, 22:6).This paper aims to give a brief insight about the detained of cultural conditions for microalgae growth and accumulation of high value metabolites , lipid being the major focus. As we know increase of CO_2 in the atmosphere leading to climate change & global warming. So, it is essential to switch from unsustainable bio resources to sustainable renewable and safe alternative. As part of endeavours to tackle the energy crises and global warming oleaginous microalgae are promising sustainable resource which have many applications. The growth rate, cell density and the lipid content are the main factors of lipid production. Various environmental parameters like light, pH, nutrients, salinity, etc. in the medium affects those factors and it leads to different variations. Several researches are going on modulating those parameters to enhance the accumulation of lipid productivity and increase in cell biomass.

Keywords: Microalgae, metabolites, sustainable renewable source, environmental parameters.

Biomining from fly ash

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Biomining has lot of advantages over the conventional method. Different types of biomining techniques are used to extract various metals which involves different reaction mechanisms. Substrate from various sources can be used for biomining, one source is the coal fly ash (CFA) from thermal power plant. CFA is harmful to the environment as well as to the living organisms. Release of fine particles of CFA into the atmosphere should be restricted and can be used as a substrate to extract metals. CFA contains various valuable metals (Au, Cu, Zn, Pb, Ni, Ur, etc) that could be extracted through biomining. CFA contains both trace metals and rare earth elements (REE). Biomining uses microorganisms which are either bacteria or fungi, however for biomining from CFA mostly fungi are used. The common species used are *Aspergillus niger*, *Candida* sp., *Acidithiobacillus ferrooxidans*, *Acidithiobacillus thiooxidans*, *Penicillium* sp., *Pseudomonas* sp., *Leptospililum ferrooxidans*, etc. These microorganisms either produce extracellular polymeric substances (EPS) forming a biofilm over the substrate or produce acids (citric acid, gluconic acid, etc.) to leach the metals from the substrate. This paper gives a brief review on biomining and its use in valuable metal extraction from fly ash, the microorganisms involved, along with few case studies providing evidences.

Key words: Biomining, coal fly ash, metals, microorganisms, extracellular polymeric substrate, acids.

Integrated Catalytic approaches for the conversion of CO_2 into polymers

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Carbon dioxide (CO_2) is one of the major reasons of global warming which is still increasing rapidly. CO_2 capture and its conversion into valued added products has gained much attention of researchers in last decade. Conversion of CO_2 into polymers such as Polyhydroxyalkanoates (PHA), Polyhydroxybutyrate (PHB), Polyurethane (PUR) and many other polycarbonates which are of industrial use. Various nano-porous materials such as nanotubes, nanosheets, nanoparticles , metal organic frames (MOFs) and porous organic polymers (POPs) have been used as absorbent for CO_2 capture. By using ring opening co-polymerization, this captured CO_2 can be converted into sustainable polymers and hydrocarbon based fuels. CO_2 can also be converted by photocatalytic reduction which is also known as artificial photosynthesis. Normally, this method is utilized to convert captured CO_2 to value-added products by utilizing sun-based vitality, for example, light or laser. Polyesters like poly lactic acid, poly glycolic acid and polyhydroxyalkanoates are produced by using CO_2 as a raw material. PHAs have also been used in the biomedical applications because of their low toxicity, biocompatibility and biodegradability. These methods can be used in the industrial scale and hence can lower the CO_2 levels in the atmosphere.

Keywords: CO_2, polymer, MOFs, POPs, Artificial photosynthesis, Nanosheets, Nanotubes

E-waste: a treasure warrants special attention

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The burden of e-waste is rising on this blue planet. According to UN's Global E-waste Monitor 2020, 53.6 million metric tons (Mt) of e-waste was generated in 2019. E-waste is known as "Urban mine" as it contains several precious, critical and non-critical metals which on recycling can be used as secondary material. Surprisingly, only 17.5 percent of 2019 e-waste was collected and recycled. This may be because of increased involvement of informal sector, limited number of formal recycling units, lack of collection centers, lack of good recycling technologies, lack of awareness among people, negligence of governing bodies, and poor enforcement of the regulations. To increase the safe recycling of e-waste in informal sectors, these units need to be strengthen with scientifically trained persons, equipped with latest technologies and should be coupled with formal sector. Other than Urban mines; e-waste is also known as toxic due to the presence of hazardous substances which may cause negative impacts if managed improperly. Currently used methods are Hydrometallurgical and Pyrometallurgical both are not safe for health and environment. Biohydrometallurgical methods are low cost and ecofriendly alternative to recover valuable metal resources from e-waste. The microorganisms including bacteria (*A. ferrooxidans, A. thiooxidans, Chromobacterium violaceum, Bacillus megaterium, and Pseudomonas* sp.) and some fungi (*A. fumigatus, A. flavipes, A. japonicas* etc.*)* are employed in biological recovery. However, process is slow, time consuming and operates at low e-waste concentrations; obstructing its way to industrial success. Therefore, innovative microbial interventions coupled with interdisciplinary involvement are required to fully utilize e-waste treasure and that too in an eco-friendly and sustainable manner.

Keywords: Bioleaching, e-waste, metals, microorganisms, urban mines

Environmental and Social Impacts of Poor Waste Management and its Mitigation

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Uncollected waste is usually dumped on land or in waterways; they are often burned or buried, causing an increase in air pollution, diseases, and ground/water contamination and have cascading negative impacts on public health, economic development and the environment. These impacts include unavailability of land for development, impacts on the tourism sector, clean-up costs for the future, increasing collection of plastics that will not degrade and deterioration of the environment. The economic costs of uncollected waste can be up to 2% of GPD/annum. Moreover, costs for Southeast Asia (McKinsey) is estimated at $375/ton for uncollected waste, compared to $50-100/ton costs for integrated waste management at international good practice service levels. Waste management is integral to development priorities. A significant amount of waste can be reduced through proper management, starting from generation to final disposal in what we call waste management chain. It includes segregation of waste at the source into organic and inorganic, classifying the type of waste to be recycled or sent to composting facilities, anaerobic digesters, waste to energy facilities and ultimately landfills.

Keywords: Environment, Impact of waste, Waste management

Conversion of CO_2 to methanol by enzymatic, catalytic and chemical methods

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With the increasing atmospheric CO_2 concentration, the major risk and concern of the hour, is its impact on the radiation balance of the atmosphere, which is the "greenhouse" effect. Hence to reduce this greenhouse gas effect, there is an exclusive need for the reduction of CO_2that can be achieved by converting it into renewable fuels and important chemicals. An enzymatic method for this conversion has gained mass popularity through consecutive reduction reactions catalysed by three different dehydrogenases, wherein CO_2 is dehydrogenized into formate, then formaldehyde and at last to methanol. Henceforth, not just a single product but there can be a number of chemical variants that can be processed out of this greenhouse gas. Another method used is compilation of photocatalytic and electrocatalytic methods for the photo-electrocatalytic CO_2 reduction process. Other novel technologies and approaches that have come to light for the conversion of CO_2 to methanol are through homogenous catalysis, heterogeneous catalysis, photochemical and electrochemical conversion, which if processed with utmost precision can contribute to the economic growth and mitigate the hazardous emissions for a cleaner environment. Hereby, another significance of this generated methanol is that it can be replaced as a substitute for the fossil fuels, thus reducing the dependence on fossil fuel and contribute in the market growth of CO_2 utilization, marking the gas as a significant industrial growth-boosting input element.

Keywords: CO_2, enzyme, chemicals, methanol, utilization

Advanced methods of enzyme immobilization and its applications

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The current demands of sustainable green methodologies have increased the use of enzymatic technology in industrial processes. Employment of enzyme as biocatalysts offers the benefits of mild reaction conditions, biodegradability, and catalytic efficiency. The harsh conditions of industrial processes, however, increase the propensity of enzyme destabilization, shortening their industrial lifespan. Some of its applications can be in industrial production, food industries, biomedical applications, production of biodiesel, wastewater management, textile industries and in research. Consequently, the technology of enzyme immobilization provides an effective means to circumvent these concerns by enhancing enzyme catalytic properties and also simplify downstream processing and improve operational stability. There are several techniques used to immobilize the enzymes onto supports which range from reversible physical adsorption and ionic linkages to the irreversible stable covalent bonds. Such techniques produce immobilized enzymes of varying stability due to changes in the surface microenvironment and degree of multipoint attachment. Hence, it is mandatory to obtain information about the structure of the enzyme protein following interaction with the support surface as well as interactions of the enzymes with other proteins. Characterization technologies at the nanoscale level to study enzymes immobilized on surfaces are crucial to obtain valuable qualitative and quantitative information, including morphological visualization of the immobilized enzymes. These technologies are pertinent to assess the efficacy of an immobilization technique and the development of future enzyme immobilization strategies.

Keywords: Enzymes, immobilization, biodegradability, microenvironment

Biodiesel: Clean fuel of future

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World energy requirement is increasing day by day due to ever increasing population and rapid industrialization. High energy prices, and environment security, concerns about petroleum supplies are drawing considerable attention to find a renewable biofuel. Biodiesel, a mixture of fatty acid methyl esters (FAMEs) derived from animal fats or vegetable oils, is rapidly moving towards the mainstream as an alternative source of energy. However, biodiesel derived from oilseeds or animal fat cannot meet realistic need, and can only be used for a small fraction of existing demand for transport fuels. Therefore, fat stored in oleaginous microorganisms can be used as substitute for the conventional oil in biodiesel production. Keeping in view present research work has been designed with an aim to produce biodiesel using oleaginous microorganisms for development of new and renewable source of energy. A total of 50 microorganisms were screened for their ability to accumulate fat that can be used for biodiesel production after trans-esterification. Since maximum biodiesel production was observed in LPS-A i.e. 146 µg/ml. After optimizing the reaction parameters, there was increase in productivity. Further approaches combining the techniques of genomics, transcriptomics, metabolomics and lipidomics will undoubtedly provide support in increasing the yield of fat and improve the use of low-cost raw material as a viable substitute for biodiesel production that suitably environmentally superior, economically competitive. If successful at large scale, the process can be taken up for large scale production, which will solve the fuel crisis to a greater extent.

Keywords: Fatty acid methyl ester, oleaginous microorganisms, transesterification.

Antimicrobial peptides: potential application in agriculture

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Increase in use of antibiotics and pesticides have led to development of resistance among pests and pathogens as well as increase of environmental problems and health risks. Antimicrobial peptides have captured the debate in recent year because of their ability in fighting against pathogens. Several drugs and pesticides have been produced based on these peptide molecules and numbers of plants have been manipulated with antimicrobial peptide encoding genes. For small peptides, they can be achieved by chemoenzymatic procedure, but, in many cases, production can be operated by biotechnological protocols using transgenic crops or genetically modified organisms. Peptide affects root, shoot, seed and flower development as well as regulate plant's immune system and other responses to environmental changes. Antimicrobial peptides occur naturally and showed high antimicrobial activity to generate disease resistance transgenic plants. Additionally, AMPs have proven to be a natural biopreservatives since they have distinct mechanism of action and probably represents low toxicity comparing to other preservatives. Recent development of antimicrobial peptides indicates a promising future in various agricultural activities.

Keywords: Antimicrobial peptides, resistance, pathogens.

Molecular techniques for enhancing polyhydroxyalkanoate (PHA) production

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The awareness about environmental hazard caused by conventional plastic has risen the demand of bioplastics and the current production of bioplasticis not upto the mark as per the demand. Polyhydroxyalkanoate (PHA) based bioplastic has been into focus because of its complete biodegradability and non-toxicity. PHAs are the polyesters of hydroxyalkanoates which are produced by microorganisms as carbon and energy store under nutrient limiting and carbon rich conditions. They have been applied in many fields like packaging, agriculture, cosmetic industries, tissue engineering and pharmaceuticals. Despite their great significance with regard to the environmental issues, PHA bioplastic is still not common because of its higher production cost than conventional plastic. Therefore, different methods have been applied like using cheaper carbon sources and molecular engineering of PHA synthesizing enzymes and metabolic pathways. The approach of engineering metabolic genes can be applied in many ways like overexpression of PHA synthase operon, inhibiting PHA utilizing enzyme of the cell, providing sufficient amount of NADH/NADPH for synthesis, inhibiting beta oxidation pathways to favor the PHA synthesis, enhancing cell size by modifying cell morphology and deleting pathways competing with PHA synthesis. The combinations of two or three ways can be used in a single recombinant strain in order to maximize the production.

Keywords: Bioplastics, polyhydroxyalkanoates (PHA), environment friendly, molecular techniques.

Zero Budget Natural Farming: A novel approach for sustainable agriculture

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India became surplus in food grain production due to intensive chemical agriculture. India's food grain production has reached from 50.82 to 277.49 million tonnes from1950-51 to 2017-18 with the increasing use of fertilizers (39773 to 57000 metric tonnes) from 2005-06 to 2016-17.But now productivity and growth rates of food grains have started stagnating and even declining. Uncontrolled and unscientific use of chemical fertilizers has resulted in deterioration of soil health and decline in crop productivity and quality. In search for ecological sound and farmer friendly alternative systems of farming, Subhash Palekar's Zero Budget Natural Farming (ZBNF) is increasingly becoming popular among the farming community. ZBNF is a holistic alternative to the high cost chemical inputs based agriculture and is very effective in addressing the uncertainties of climate change. ZBNF as the name implies, is a method of farming where the cost of cultivation of crops is almost zero. This means farmers need not to purchase costly fertilizers and pesticides for obtaining higher yield. In this system, soil is supplemented with the microbial inoculums like *Beejamrit* and *Jeevamrit* etc. which enhances microbial activity in soil and ultimately ensure the availability and uptake of nutrients by the crops. In ZBNF, crops require only 10% water and 10% of electricity as compared to the intensive agriculture and organic farming. Thus ZBNF has potential to grow more food with less cost under adverse conditions which approaches to food sustainability.

Keywords: Natural Farming, ZBNF, sustainable agriculture, economy

Pine oil biofuel blends: An upcoming strategy to develop sustainable biofuels

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Today's world is facing a threat of climate change and global warming due to extensive use of fossil fuels in the past century leading to decreased sources of these conventional forms of energy. In order to counter these issues, we have to come up with new sources of energy and develop environment friendly sources of energy. Biofuels can be obtained from agricultural products, oleaginous plants, biomass available in forests and similar sources of organic matter, making them an easily renewable option for energy. They can be used either as isolated forms or as blends with conventional sources and one of the latest developments in this step is the use of pine oil in diesel engines as blends with other biofuels to curb the emission of smoke, carbon monoxide, carbon dioxide and NO_X from the engines Pine oil is obtained from the resin of pine tree (*Pinus spp.)*, from the wood chips and pine cones and contains terpinol and pinene. This oil is found to have higher calorific value, making it an appropriate substitute of diesel for diesel engine. Pine oil has lower viscosity, boiling point, flash point and cetane number as compared to the conventional petroleum and diesel. This review gives an insight on the chemical aspects of pine oil and its role in biofuel blends in developing an environment friendly fuel.

Keywords: Sustainable; Biofuel; Pine oil; Biofuel blends; Environment friendly

Advances in the methanol production from CO_2: Circular economy and climate change

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A continuous increase in greenhouse gases is causing serious threats to the environment. In this context, CO_2 is one of the major candidates among them. Reducing the excess CO_2 by converting it into industrial products is beneficial for the environment and to boost industrial growth. Conversion of CO_2 into methanol is very beneficial as it is cheaper to produce, less inflammable, and is advantageous in many industries. Thus, it will reduce the usage of fossil fuels. Various plants, algae, and the use of microbial enzymes to reduce CO_2 is sustainable key to reduce global carbon footprint. Furthermore, materials like MOFs, biochar, porphyrins, and nanomaterials are used for CO_2 absorption and conversion into methanol. Homogeneous and heterogeneous catalysts was studied for the electrocatalytic conversion of CO_2 to methanol. A combination of enzyme and material which jointly capture and convert the CO_2 into methanol plausibly energize the CO_2 utilization. The CO_2 to methanol conversion utilizes carbon better than the conventional syngas and the reaction yields fewer by-products, the methanol produced can further be used as a clean-burning fuel, in pharmaceuticals, as a general solvent, etc. This makes methanol an ideal fuel in comparison to the conventional petroleum-based ones and it is advantageous for a safer and cleaner environment. The various aspects of circular economy with present scenario of environment crisis will also be considered for large scale sustainable biorefinery of methanol production from atmospheric CO_2.

Keywords: CO_2, microbial enzyme, materials, chemicals, methanol

Carbon dioxide for fuels and energy: Climate crisis and need

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Greenhouse gases (GHGs) mitigation is the most severe challenges that we are facing in 21st century. Therefore, the way to reduce GHGs emissions becomes important, that do not generate extra CO_2 to the atmosphere. In this context the reduction of CO_2 and its conversion into renewable fuels such as methanol, ethanol, formic acid, electricity, are the promising way to reduce the GHG concentration in atmosphere. Various novel technologies, for the conversion of CO_2 to methanol through heterogeneous catalysis, homogenous catalysis, electrochemical, photochemical, and photo-electrochemical conversion, are available. A review of various state of-the-art technologies for CO_2 conversion to methanol was carried out aiming to establish the advances in this area and present an overview of the recent research trends for future development. Conversion of CO_2 into methanol is advantageous to automobiles, power plants and other industries including pharmaceuticals, fine chemicals and food production units. Methanol is a sustainable power source that can be delivered from any crude material containing carbon (fundamentally CO_2), that can be utilized as transportation fuel. Living organisms can also be exploited for CO_2 digestions which are not limited to photosynthetic living beings but microorganisms and biomolecules. Here we sum up the CO_2-using microorganisms, enzymes that are most widely used in modern scale bioprocesses for bioeenrgy production.

Keywords: Green house gas, CO_2 utilization, heterogeneous catalysis, methanol

Microbial carbonic anhydrase in CO_2 conversion for mitigating global warming

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Emission of greenhouse gases (GHGs) into the atmosphere by human activities leads to global warming. Various methods to reduce the level of CO_2 concentration in the atmosphere are replacing the fossils fuels by clean fuels, chemical fixation and utilization of biomass etc. Whereas, using microbes and their enzymes to reduce CO_2 is a sustainable key to reduce global carbon footprint. Thus, CO_2 conversion using microbial carbonic anhydrase (CA) may prove eco-friendly and cost-effective. To reduce the CO_2 level, the conversion of CO_2 into calcium carbonate using carbonic anhydrase enzyme may prove eco-friendly and cost-effective. This method of CO_2 conversion is an alternative as well as a complementary process to CO_2 capture and as an environmentally friendly approach, demanding no energy input based on the effective action of the stabilized enzyme system. In the present study, bacterial and fungal strains were isolated from ash samples using the enrichment culture technique. After thorough screening for CA activity in the bacterial and fungal cultures, ten isolates were selected. These strains have been identified based on physiological and molecular characteristics. The study presented here is one of the efforts of using an enzyme as a means for CO_2 conversion and to reveal new possibilities to encourage applying them as efficient innovative pathways of technologies.

Keywords: CO_2, global warming, carbonic anhydrase, calcium carbonate

Recovery of valuable products from wastewater: Chemo-biological approaches

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Wastewater treatment and water-activated sludge present a major challenge worldwide. Wastewater generated from industries, laundries, human residential areas, and other small scale industries is emerging as one of the major challenges in sanitation and maintenance of smart/green cities. During the last decade, various technologies and processes have been developed to recycle and purify wastewater. The recycled water can be utilized in gardening agriculture, land conditioning. Nevertheless, the presence of small fractions of heavy metal impurities and pharmaceutical molecules or toxic compounds may develop the threat of health disease issues in human beings and animals. Therefore, identification of existing technologies that allow resource recovery from polluted water to produce biofuels like bio hydrogen (fermentation [light &dark] processes), biogas and biodiesel. Other value-added products such as bio-plastics, short-chain fatty acids, organic acids, bio-pesticides, bio-surfactants, bio-flocculants can be obtained simultaneously in wastewater treatment (WWT) processes. Various membrane processes like refining or distillation, liquid-fluid extraction, adsorption, precipitation and pyrolysis are broadly utilized for natural organic acid recovery and MFC (microbial fuel cell) for bioelectricity generation. This helps further to promote more systematic and non-expendable conduction of this under-utilized and over-growing waste. Overall these strategies will contribute to integrated wastewater based bio-refinery and circular bio economy.

Keywords: Bioenergy; biofuels; biofibers; biobased products; biowastes, biomethane, microbial fuel cells

Application of domestic waste water in construction practices

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Portable water is very precious for the developed countries. It is to note that in different construction practices, normal drinking water is supposed to utilize as per our Indian standards. But after looking at the past and the present scenario in respect of availability of drinking water it is our prime duty to propose some methodology to preserve the same for our next generation. Therefore, in order to preserve our natural resources it is the need of the study to utilize domestic waste water for the construction and curing purposes. For the same purpose, domestic waste samples were collected from the Sewage Treatment Plant (STP) Waknaghat, Solan. Different concrete cubes (150 mm x 150 mm x 150 mm) were casted by utilizing waste water in various proportions (i.e. 20%, 30%,40%,50%)to show the effect of the waste water on concrete strength. M30 grade concrete with 0.45 water-cement ratio was designed for the present study. Compressive strengths of all the cubes were tested for different time period i.e. 3, 7, and 28 days. After several trials, it was observed that the 20% of waste water can be used as the replacement of normal drinking water for curing and mixing purposes. The implementation of the methodology presented in the current study will be an aid to our society as well as for our country.

Keywords: OPC, Compressive strength, Water-cement ratio, curing, waste water

Sustainable bioenergy production from municipal waste

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Industrialization and urbanization demand continuous supply of energy resources. The energy reserves are at the sake of the depletion mode. Ever-increasing population has led to the continuous waste production. The conventional waste management procedures like incineration, landfill and pyrolysis, generally release greenhouse gases which leads to global warming. The sustainable methods for management of solid waste can be achieved by uncapping the potential of generated waste for the formation of by-products like energy, heat and electricity. The fossil fuel dependent tradition has now transited to bio-based routes referred as waste to energy technologies (WtE). The green remediation of waste and reliable bioenergy production methods are gaining more importance and are in demand now. Waste management sector has made progress which is now focusing on energy recovery from waste rather concentrating only on waste management. This plausible option for the effective management of trash and its conversion to environmental friendly treasure provides solution for two challenges i.e. effective waste management and energy supply. The proficient waste management and bioenergy production methods like anaerobic fermentation, mechanical biological treatments and microbial fuel cells are emerging WtE technologies. Improved pollution control methods, technological advancements and strict government regulations have paced these WtE technologies and many countries have already implemented them. Globally, these cutting-edge technologies are considered as silver lining and have paved the way for the sustainable future for all living creatures.

Keywords: Sustainable energy, Waste to energy (WtE) technology, Green remediation, Microbial fuel cell.

Comparison of phenolic, flavanoid contents and antioxidant activities of various extracts of selected plants of Genus *Cucumis* L. and *Momordica* L. of family Cucurbitaceae

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This study was undertaken to evaluate the correlation between total phenolic content and antioxidant activity of methanol and aqueous extracts of 6 species of two genera *Cucumis* L. and *Momordica* L. using radical scavenging assay (DPPH), hydrogen peroxide assay and reducing power assay. The extracts of different fractions were found to have different levels of antioxidant activity in the systems tested. Of all the plants tested *Cucumis melo* L. showed high antioxidant activity in methanol extract in DPPH free radical scavenging assay. Preliminary phytochemical screening shows the presence of phenols, flavanoids, saponins etc. in all the species of genus *Cucumis* L. and *Momordica* L. Total phenolic content and total flavanoid content was estimated by spectrophotometric methods of methanol and aqueous crude extracts and showed a high content of flavanoid and phenols in methanol extracts and followed by aqueous ones.

Keywords: Antioxidant activities, flavonoid, *Cucumis*, *Momordica*

Microplastics an emerging concern to environment

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For the economic growth of any country increased industrialisation, urbanisation and mechanisation is required leading to increased environmental pollutions distorting our ecosystem. Stratospheric ozone depletion due to increased levels of pollutants in environment is causing increase in UV-B levels in terrestrial sunlight causing damage to synthetic and biopolymer plastic materials when exposed to. Photo-radiations are leading to conversion of larger and smaller plastic particles into micro and nanoplastics. With the advancement in analytical techniques such as Pyrolysis-GC/MS, Raman Spectroscopy and Fourier-transform infrared (FTIR) spectroscopy presence of microplastics in water and food products have been discovered. Similarly effective use of dyes like Rose Bengal and Nile Red has allowed their detection via fluorescence. Increased investigation on microplastics are revealing presence of microplastics in marine water, rivers, drinking tap water, bottled water, beer, table salt and other food such as honey, sugar etc. Microplastics entering into food chain and their impacts on health is a key issue for sustainable environment. For attaining sustainability in ecosystem and sustainable development balance between the competing needs and the advanced technology for better economy are to be maintained protecting the ecosystem in which we all live.

Keywords: Microplastics, Analytical techniques, Sustainability

Restoring degraded lands for biomass production and biodiversity enhancement

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Rapidly increasing global population and exploitation of natural resources including the land systems has resulted in the loss of carbon from soil, reduced food production, and diminished other ecosystem services and lastly the land degradation. Therefore, it is the need of the hour to restore the marginal and degraded lands immediately and obstruct the ongoing process of land degradation via sustainable approaches like biomass plantations. Present study aims to explore the indigenous, fast growing, perennial mixed plantation approach according to the type of degradation in the land systems. Saline land was targeted to restore via aforesaid approaches and concepts and after the four years of plantations the soil salinity has been reduced significantly with the considerable increment in the biomass content. A strong correlation exhibited between plant growth attributes and soil quality ($p < .01$). Soil porosity, texture, pH balance, electrical conductivity (EC), available potassium (AK) and available nitrogen (AN) levels are found to be the key indicators regulating the plant growth. The EC, AK and AN levels were seen to change significantly during the initial stage (2014) from 25 dS m^{-1}, 10 mg kg^{-1} and 23 mg kg^{-1} to 1 dS m^{-1}, 24 mg kg^{-1} and 39 mg kg^{-1}, respectively, towards the end of the study period (2018). This approach has supported the biodiversity perspectives, enriched diversity of pollinators, enhanced belowground processes, aesthetic beauty of the landscape and offers various enriched ecosystem services in the associated regions. Promoting these type of studies could further help in meeting the global targets of Bonn Challenge and the United Nations-Sustainable Development Goals.

Keywords: Land degradation, Sustainable restoration, Soil salinity, Biomass, Biodiversity

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