

Overall activity report of the conference on “Innovations in Bioprocess Technology (IBT-2019)

A conference on “Innovations in Bioprocess Technology (IBT-2019)” was organized by Center of Innovative and Applied Bioprocessing (CIAB), Mohali and National Agri-Food Biotechnology Institute (NABI), Mohali from 11-13 December, 2019.

Inaugural Session: Welcome address was given by Dr T R Sharma, CEO, CIAB and Executive Director, NABI. Chief Guest of the inaugural session was Dr V. Prakash, Former Director CSIR-CFTRI, Mysore. He delivered an inaugural talk on ‘The science of biotechnology in India’s food chain-farm to folk to gut’

Technical Session I on Industrial Bioprocessing: Technology and Business was chaired by Dr. V. Prakash, Former Director, CFTRI and Prof. Satya Dev Tiwari, CEO, Voll Sante Functional Foods & Nutraceuticals Pvt. Ltd., Mumbai. There were six talks in this session.

- Prof. Satya Dev Tiwari delivered talk on “Application driven innovation in bioprocess technology & proposed roadmap for effective commercialization”. He quoted “If food & nutrition is wrong, then medicine is of no use, and if food & nutrition is right, then medicine is not required.” According to him five fundamental panchtatvas for useful product are tasty, nutritious, convenient, natural and preventive. In last, he demonstrated a drink named as “protein water” with its tagline “Refresh, Rehydrate, Reenergize”.
- Mr. Jyoti Saroop, CEO, Unati Cooperative Marketing cum Processing Society Ltd., Talwara delivered talk on “Developing and serving natural products from local Himalayan herbs”. He suggested that every business may not be outcome from big ideas but it needs the combination of ideas & nature that surrounds you. He showed the remarkable journey of Unati. From his own enterprise, he documented Unati a self-sustainable project. Unati is producing several products based on natural resources and particularly envisaged to use jaggery to make high value nutraceuticals for malnutrition.
- Col. K.K. Kakkar, Managing Director, AamztoFaamz Technosolutions Pvt. Ltd., Mohali delivered talk on “Start-up ecosystem in India”. India is the third largest start up ecosystem and creating many employment opportunities around this. He demonstrated various stages of start-ups such as ideation, conceptualization, test bed validation, scaling up and establishment. The segments of activity in food processing industry are food products & packaging, food processing technology, supply chain distribution & logistics, food safety and food processing equipment. His start-up idea formulated upon question “Can ex-servicemen & farmer unite together?”
- Dr. Ashustosh Pastor, IIT Delhi delivered talk on “Lab to Market: Role of technology transfer & Technology Business Incubation”. He explained the benefits of translating research to practice such as community development, standard of living, exports, GDP & per capita income. He discussed about various stage-wise support for start-ups with an example of FITT-IIT Delhi. He reflected upon the numerous roles of technology transfer office. Start-up involves finance, market, support, monitoring and culture.
- Mr. Ramesh Kumar Nibhoria, CMD, Nishant Bioenergy Pvt Ltd Mohali delivered talk on “Post-Harvest Agro Residue Usage as Fuel”. He presented that rice straw is burnt as zero disposal solution which creates huge environmental problem in North India. Solution is to establish decentralised processing plants to perform high temperature drying, chopping and pulverising thus enhancing bulk density as well as energy. He showed the journey of his own enterprise Nishant Bioenergy Pvt Ltd. He practiced “Sanjha Chullah” in JNV Kalan. He brought several products such as Biomass Fuel Pellet Plant, Pellet Fuelled Cook Stove and Pellet Burners in the market.
- Dr. Saswata Goswami, CIAB, Mohali delivered talk on “Waste to Weath: The new trend in Global Bioeconomy”. He talked about biomass feed stock and bioeconomy. His presentation was focused on nano-cellulose derived from plants. He presented the process of nanocellulose preparation and its economics.

Technical Session II on Microbial Bioprocesses was chaired by Dr. Sanjay Nene, CEO, Innovation Biologicals Pvt. Ltd., Pune and Dr. Ajit Dua, CEO, PBTI, Mohali. Five talks delivered in this session were as follow:

- Dr. Anirban Roy Choudhary, IMTech, Mohali delivered talk on “Technology development for microbial production of Pullulan, an industrially important exopolysaccharide creating wealth from waste”. He presented about microbial exopolysaccharide Pullulan, a water soluble exopolysaccharide and its distribution, market size, significance and presented it as a superfood. Interesting physico-chemical properties of Pullulan has been presented. Pullulan has industrial applications in food, cosmetic, pharmaceutical and biomedical industry. He suggested that Pullulan can be used as veg capsules and replacement of gelatin.
- Dr. Anil Kumar Sarma, SSS-NIRE, Kapurthala made his presentation on “Application of different biofuels and blends in CI engines for emission reductions”. The key highlight of his talk was biofuel-an alternative of traditional non-renewable and gaseous fuels that can be used directly in blending or simultaneously with liquid & gaseous fuels. He presented on the engine efficiency parameters in CI engines. He discussed about the impact of petroleum based fuel on environment and human health.
- Prof. Neeraj K. Aggarwal, Kurukshetra University, Kurukshetra delivered his talk on “Bioethanol 2025”. He described bioethanol as one of the attractive ecofuel due to its environmental sustainability and renewability over fossil fuels and is the major contributor in the transport sector. It can be either used directly replacing existing transport fuels completely or blended with petrol or diesel. The ongoing research efforts in the development of appropriate technology for bioethanol production may replace the need of fossil based petroleum in coming times.
- Dr. Sachin Kumar, SSS-NIRE, Kapurthala delivered his talk on “Bioprocessing of Sugarcane Bagasse for bioethanol production via SSCF using Thermotolerant Yeast *Kluyveromyces marxianus* NIRE-K3.2”. He briefed about the exploration of alternative, cheaper and renewable energy carriers for example second generation fuels obtained from lignocellulosic biomass by fermenting its structural sugars arranged in polymeric form. He explained about optimization of pretreatment of sugarcane bagasse using different techniques and subsequent utilization of pretreated biomass to bioethanol.
- Dr. Ravindra Pal Singh, NABI, Mohali made presentation on “Human milk Glycans: Fueling to infant health”. He presented that human milk exhibits several benefits like modulating factors for human gut microbiome, and immune systems, and glycan decoys for avoiding infections caused by pathogenic microbes. His finding suggested that a glycoside phosphorylase could efficiently transfer several different glycans in preparative scales using distinct donors and acceptors.

Technical Session-III on Protein Engineering and Enzyme Technology was chaired by Dr. Sanjay Kumar, Director, CSIR-IHBT, Palampur and Dr. PKS Sarma, Head Technical Division, BIRAC, New Delhi.

- Dr. Shashank Deep, IIT, Delhi presented about the importance of TGF $\beta 3$ in various metabolic activities. He further detailed their low expression in eukaryotic systems. Finally, the strategies to enhance yield by co-expressing with chaperone molecules in presence of osmolytes and polyphenols was discussed.
- Dr. Dharam Singh, CSIR-IHBT, Palampur talked about the global problem of plastic waste and alternatives for reducing the plastic accumulation. Later, he detailed his studies on generation of bioplastics i.e. PHA from stress induced bacteria isolated from Himalayan niches and bioprocess development for scalable synthesis of PHA.
- Dr. Alka Rao, CSIR-IMTECH, Chandigarh introduced Glycobiology to the audience. She presented her work on synthesis of glycosylated bacteriocins through S-glycosylation. She demonstrated the improved synthesis of glycosins through minimal synthetic pathway and presented their possible applications in bio-preservation.
- Dr. Amit Kumar Rai, IBSD, Sikkim Mohali described various fermented foods of north east and the developed bioprocess technique for their in-vitro production with high value nutraceuticals. He talked about his experimental work on milk and soya based fermented products like chhurpi and various bioactive compounds screened during the biotransformation.
- Dr. Nitin Kumar Singhal, NABI, Mohali made presentation on development of thermostable and recyclable magnetic nanobiocatalysts. He detailed on the synthesis of silica coated magnetic nanoparticles for immobilization of enzymes and reported good enzyme activity even at high temperatures and wide range of pH.

Technical Session-IV on Biotech Products and Process was chaired by Prof. Saroj Mishra, IIT, Delhi and Dr. Syed Shams Yazdani, ICGEB, New Delhi. In this session, following presentation were made.

- Prof. Sanjay Mandal, IISER, Mohali described how Six Sigma could be beneficial in delivering the product to the end customer. He also emphasized on various chemistry inventions and their contribution in shaping the modern world. Lastly, he elaborated the contribution of chemical industry in GDP of the world.
- Prof. S. Ramalingam, Anna University presented a possible solution of higher consumption of glucose in conventional 1,3-propanediol (1,3-PD) fermentation through engineered *L. reuteri*. He suggested that the conversion of glycerol to 1,3-PD is possible by minimal glucose consumption.
- Prof. Sanjay M. Jachak, NIPER, Mohali presented the development and importance of Nutraceuticals and Phytopharmaceuticals and their benefits in tackling the common health problems. He also presented the shift towards preventions rather than cure of diseases.
- Dr. J. Bhaumik, CIAB, Mohali described the use of nanotechnology in the valorisation of Agri biomass derived lignin in valuable products. She presented the work on lignin in the development of various nanomaterials for antimicrobials, UV protectants, films, photocatalysis etc.

Technical Session V on Biomass & Chemo-Bioprocessing was chaired by Prof. Shashank Deep, IIT Delhi and Prof. M. V. Shankar, Yogi Vemana University, Andhra Pradesh. In this session, four speakers delivered their talks.

- Prof. D. K. Sharma, IIT Delhi delivered talk on “Bio-sequestration of Carbon Dioxide for Halting Climate Change”. He presented on the effect of CO₂ on global warming and different ways of CO₂ fixations. Utilization of ubiquitous bacteria or micro-organisms such as Euryarchaeota, Aquificae, etc., and promoting the plantation of fast growing trees and biotechnological approaches such as biodiesel, bioethanol productions, growing algae in ponds etc. could be possible ways for CO₂ fixations.
- Prof. Sushil Kumar Kansal, Panjab University, Chandigarh discussed his work on the topic “Potential of Heterogeneous Photocatalysis Process to remove Non-Biodegradable pollutants from Industrial Wastewater”. He presented the problems related to water pollution due to various pollutants from industrial effluents. The advanced oxidation process (AOP) through photocatalysis, catalyzed by semiconductor based photocatalysts such as TiO₂, ZnO, WO₃, SnO₂, CdS, ZnS etc., could be one of the most efficient and environment friendly method for waste water treatment.
- Prof. M.V. Shankar, Yogi Vemana University, Andhra Pradesh made presentation on “Reforming of Biomass Derived Crude Glycerol into Hydrogen Fuel Using Nanocomposite Photocatalysis”. He discussed about production of H₂ fuel from biomass derived crude glycerol as substrate, catalyzed by photocatalyst made up of TiO₂ nanotubes coated with NiOH under the illumination of UV- light. The utilization of biomass derived crude glycerol for fuel production could be one of the beneficial and economical process as compared to the existing process where pure glycerol is utilized.
- Dr Saravanamurugan Shunmugavel, CIAB, Mohali discussed on the topic “Renewable Platform Chemicals from Sugars with Solid catalysts: Role of Acid Sites”. His talk was mainly on the designing of beta-zeolite based solid catalysts having Lewis or Bronsted acid sites by replacing the central metal Al in framework by Sn. He explained how these sites in the catalyst help in the selective conversion of C3-C6 sugars to specific desired products such as methyl lactate, pyruvaldehyde dimethyl acetal, alkyl levulinic acid etc.

Technical Session VI on Natural Products Chemistry was chaired by Dr Suresh Walia IARI, New Delhi and Dr D K Sharma, IIT Delhi.

- First invited speaker for this session was Dr U C Banerjee from NIPER, Mohali. Title of his talk was “Process development for the production of microbial metabolites and enantiomeric synthesis of chiral drugs and drug intermediates”. He gave a very nice and informative presentation on growth and production of various metabolites by a series of microorganisms. One of the soil microorganism *Curvularia lunata*, was found to have rifamycin oxidase activity. The production parameters for this particular organism were fully optimized in shake flask & fermenter. Another isolate, *Pseudomonas putida* was found to produce ADI with higher specific activity. Dr Banerjee explained the growth and production of mycophenolic acid by *Penicillium brevicompactum*, growth and production of shikimic acid by *Bacillus megaterium*, and tachrolimus by *Pseudomonas* sp. He also gave brief

information for synthesis of various nano particles synthesized using microbial - hydro extracts and organic extracts of various medicinal plants.

- Dr. K.K. Cheralathan, Vellore Institute of Technology, Vellore, Tamil Nadu delivered talk on “Development of hierarchical zeolites using biomass derived from agricultural waste” and explained about hierarchically structured zeolites (HSZs), their preparation, secondary porosity (meso and macropores), intrinsic micropores as well as applications in catalysis. He showed the use of biomass such as agricultural wastes; sorghum and corn stem pith to prepare a series of zeolites.
- Dr. Upendra Sharma, CSIR-IHBT, Palampur made presentation on “Don't forget Past: Traditional Knowledge Derived Discovery of Novel Bioactive Molecules”. He explained the immunomodulatory effect of various medicinal plants. He has characterized various immunomodulatory molecules from *T. cordifolia* and *A. racemosus*. He further explained the purification of these immunomodulatory molecules from active fractions of various medicinal plants to explore their biological potential.
- Dr. Govindasamy Jayamurugan, Institute of Nanoscience & Technology (INST), Mohali made presentation on “Nanotechnology: A perfect Companion to the Chemo-Processing of Biomass for the Controlled Delivery of Pesticides/Drugs and Green Catalysis”. He presented the utilization of carbohydrates to convert them into the functionalized carbohydrates using chemo-processing as a tool. Moreover, he had explained that by modifying functional groups and anchoring appropriate metal-nanoparticles, a very active, recoverable catalyst for the selective organic transformation reactions under greener conditions can be developed.
- Dr. Bhuwan Bushan Mishra, CIAB, Mohali made presentation on “Natural product prioritization for commercial implications”. His talk was mainly focused upon the role of natural products, their utilization for flavor & fragrance, pharmaceutical and other industrial applications. He also presented on specific ionic liquids/surface active ionic liquids and processing of biomass for the recovery of value added materials.

Technical Session VII on Food Processing and Nutraceuticals was chaired by Dr. S.K. Sharma, Chairman of the Scientific Panel of Nutraceuticals, & Functional Foods, FSSAI and Dr. Ajay Kumar Pandey, Scientist-E, NABI. There were 5 speakers in this session.

- Dr. Komal Chauhan, NIFTEM, Sonepat presented a talk on “Extraction of Anthocyanins from *Prunus nepalensis* and its Application in Food as Biocolourant”. She concluded that anthocyanins extracted from Sohiong (*Prunus nepalensis L.*), an indigenous crop in Meghalaya, India, using conventional solvent extraction (CSE) and enzyme assisted extraction (EAE) showed immense potential for food applications as natural colourant. The food products developed (yoghurt, syrup and hard-boiled candies) by using such colour showed pigment stability during storage period.
- Dr. S.K. Sharma, Chairman of the Scientific Panel of Nutraceuticals, & Functional Foods, FSSAI presented a talk on “Ayurceuticals Approach in Food Supplement(s) & Natural Products”. He briefed about interconnecting links between Ayurveda and Food for life. He gave a brief description of the origin of Ayurveda and its importance or role played in longevity and curative human health. He concluded that Rasayana drugs can play as adjuvant therapy in many difficult disorders or ailments.
- Dr. Neeraj, NIFTEM, Sonepat, presented a talk on “Sustainability in Agro-Food Processing Sector and Postharvest Supply Chain Systems in Fresh Horticultural Produce”. He explained about food regimes, salient issues in sustainability of agri-food systems, carbon emission profiles from food production to consumption and challenges of creating sustainable agri-retail supply chains. He suggested solutions to achieve greening for sustainability in food processing sector.
- Dr. Manoj K. Tripathi, ICAR-CIAE, Bhopal presented a talk on “Utilization of By-Products and Waste Materials from Food Processing Industries for Food Applications”. He briefed about the utilization of by-products (tofu, whey and okara) from soy food industries. He explained about the physical and microbiological methods for transformation of waste to edible food products such as sauerkraut, microalgae culture, fermented beverages, fermented soy milk powder and probiotic cheese spread.
- Dr. Koushik Mazumder, NABI, Mohali presented a talk on “Carbohydrate based edible coatings to enhance post-harvest shelf life of horticultural produce”. He concluded that agri-crop residues such as wheat straw possess potential to be utilized for arabinoxylans extraction and their further

utilization as edible films and coatings for post-harvest shelf life extension of fruits. He concluded that edible films and coatings were structurally stable and significantly extended the shelf life of Golden delicious apples, pears and bananas.

Technical Session VIII on Young Bioprocess Innovators was chaired by Dr. Anil Kumar Puniya, NDRI, Karnal and Dr. Vipin Parkash, FRI, Dehradun. Young researchers from different Institutions across the country presented their research work.

- In the first talk, Dr. Vipin Parkash, FRI, Dehradun presented on isolation of *Rhizobium* sp. from nodules of wild leguminous plants (*Mimosa rubicaulis*, *Lathyrus sativus* and *Desmodium triflorum*). He concluded that the isolated cultures could be used for trans bio-inoculation experiments. The next speaker was Dr. Pradeep Sharma, FRI, Dehradun who delivered a talk on the value addition of *Cassia. tora* seed gum viz. quaternization, carboxymethylation and purification of galactomannans by adopting the Taguchi's approach. This can be further utilized as a raw material for diverse industrial applications.
- Another speaker, Dr. Swati Sethi, ICAR-CIPHET discussed the process optimization for the processing of grass pea (Khesari dhal) in order to utilize its potential as protein source. Dr. Sonal Datta, CSIR-IMTECH delivered a talk on development of process for N-terminal PEGylation of G-CSF. The method employed was site-specific PEGylation wherein, cysteine insertions/ substitutions were introduced at strategically defined sites such that the activity of the G-CSF was not affected at all or was minimally affected.
- The next speaker was Jagdish Singh, Mata Gujri College Fatehgarh Sahib and talked about the synthesis of cross linked cellulase enzyme aggregates (CLEA). The effect of pH, time, Ca^{2+} concentration and incubation time was studied on the CLEA synthesis. A young researcher Mr. Gaurav Kumar rose, Panjab University presented his work on biological synthesis of silver nanoparticles and analysed against *Salmonella infection* in murine model. He used a cellular extract of fungus *Penicillium oxalicum* GRS1 for the cost effective synthesis of silver nanoparticles. His study suggested that the administration of silver nanoparticles could exert a protective efficacy against the generated oxidative stress by reducing lipid peroxidation and increasing the levels of hepatic superoxide dismutase and reduced glutathione.
- Mr. Jananee Jaishankar, IIT Delhi presented the discovery of novel bidirectional promoter for the dual gene expression in *Gordonia* sp. IITR100. The promoter showed higher expression in the actinomycete *Rhodococcus erythropolis* PR4. The session was continued by talk of another speaker Mr. V. Navakoteswara Rao, Yogi Vemana University, Andhra Pradesh. He delivered a presentation on the $\text{Bi}_2\text{S}_3@\text{NiO}$, $\text{Bi}_2\text{S}_3@\text{In}_2\text{S}_3$, $\text{Bi}_2\text{S}_3@\text{TiO}_2$ core-shell nanostructures for enhanced hydrogen generation. The photocatalytic activity of $\text{Bi}_2\text{S}_3@\text{TiO}_2$ showed high rate of H_2 evolution under UV-visible light irradiation. Mr. Ramesh Reddy, Yogi Vemana Univ., Andhra Pradesh presented his work on highly efficient solar light-driven Cu/FCNTs-titania quantum dot photocatalyst for hydrogen production in glycerol aqueous solution. According to him, this is the safest and most efficient route for hydrogen generation using solar light receptive functionalized carbon nanotubes-titania quantum dots (FCNT-TQDs) as photocatalysts under the influence of solar light irradiation.
- The next speaker Mr. Narashans Alok Sagar, NIFTEM, Haryana delivered his presentation on a process for the extraction of flavonoids from onion skin waste beneficial for Nutraceutical and Food Sector industries. After following the simple extraction process he found the two onion varieties i.e. 'Hissar-2' and 'NHRDF Red' were the best source of flavonoids and natural antioxidants. Further the session was finished by talk of Ms. Manisha Sharma and Ms. Anjali Purohit from CIAB, Mohali. Ms. Manisha presented his research work on application of enzyme for the bioprocessing of agro-industrial bioresource to prebiotic biomolecule. She developed a novel strategy for the bioprocessing of cane molasses, banana pseudo stem extract and sweet sorghum stalk juice to transform the remaining high caloric sugars into low caloric prebiotic oligosaccharides based on the alginic-pectin immobilized enzyme from *Leuconostoc mesenteroides* MTCC 10508. Ms. Anjali Purohit presented her research on the process for oligosaccharide production from the agro-derived biomass using magnetic xylanase CLEA and synthetic enzymes. The engineered enzymes produced significantly higher xylooligosaccharides from the powdered rice straw and corn cob than the wild type enzyme.

Valedictory session: Chief Guest of the valedictory session was Dr Chindi Vasudevappa, Vice Chancellor, NIFTEM, Sonepat. He addressed the participants of the conference and highlighted the need and importance of such conferences. The area of the conference was highly relevant to the institutions and topics covered in the conference would be very useful to the participants particularly young researchers. This conference has created the opportunity for collaborations with institutions and industries. One of the immediate outcome of this conference was that M/s Baijnath Pharmaceutical Pvt. Ltd. (BPPL), Kangra, HP has singed MoU for license and sale of processes or technologies for products being developed by CIAB. CIAB and BPPL also agreed to collaborate on research projects of mutual interest.