Vigyan Samachar/DBT News
13/02/2020

Valuable agricultural waste-based technologies and products developed at the Center of Innovative and Applied Bioprocessing (CIAB), Punjab

By Dr. Bilqeesa Bhat

Agricultural wastes have been the focus of investigations during the last decades, being considered the most effective source for the production of second-generation bioethanol at the world level. Agricultural waste is considered as a major source of easily available, low cost, abundant and renewable source of lignocellulosic biomass.

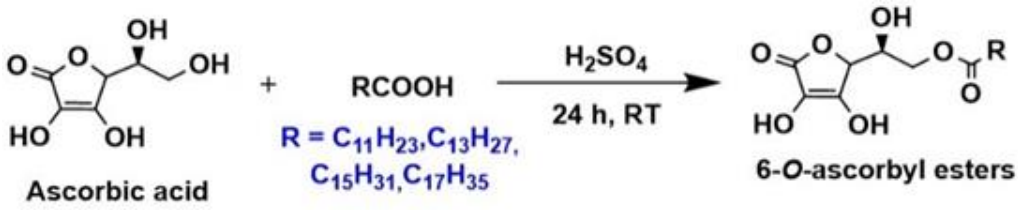
Globally productions of agricultural waste such as rice, wheat- and corn straw and sugarcane bagasse has increased at tremendous rate. As the society is getting environmental conscious, it has necessitated the need to recycle, reuse and develop fuel, food products, valuable industrial chemicals, essential oils, edible and pharmacological, and other environment friendly products.

Thus, in order to address the agri-waste challenge, and to convert it into valuable products, different technologies have been developed at the Department of Biotechnology, Government of India's national institute, the Center of Innovative and Applied Bioprocessing (CIAB), Punjab. Most of the technologies developed at CIAB, Punjab aims at exploring the valorization potential of agricultural waste biomass into valuable compound. Besides, the institute has tried to develop various process of digestion, and composting of agricultural waste. Some of the important technologies developed at institute are discussed in detail.

1. **Levulinic acid from agri-residue wastes**: A process for production of levulinic acid from rice straw agri-residue wastes has been done in a single-pot reactor setup. The levulinic acid compound is recognized as valuable product which can be used for synthesis of variety of value-added chemicals including liquid energy fuel and/or drop in biofuels after proper processing.
2. **Citronella essential oil with improved fragrance**: Institute has developed a process that can be used for fragrance improvement of low value citronella (*Cymbopogon winterianus*) essential oil by enriching it with rose oxide. Furthermore, a process of

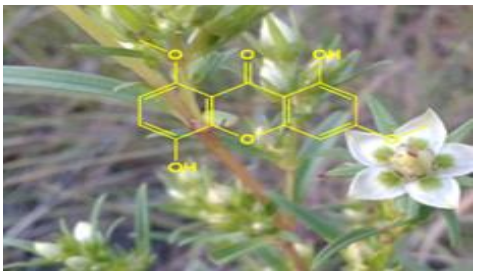
production of rose oxide has been developed and thereby, improving commercial value, utility, and use range etc. of the essential oil.

3. **Fragrance enrichment of Citronella essential oil suing iodine:** The inventions includes process for fragrance improvement of low value citronella (Cymbopogon winterianus) essential oil with rose oxide using hypervalent iodine reagents and improving commercial value, utility, and use range of the oil.
4. **Food grade ester production**: An improved process for production of food grade 6-*O*-ascorbyl esters by chemical esterification of L-ascorbic acid with various fatty acids and their simple purification.



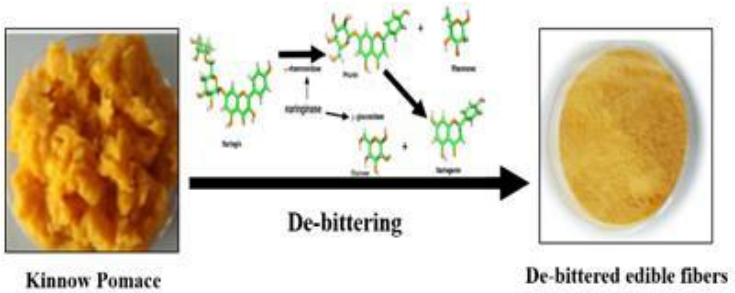
5. **Xylose, levulinic acid and lignin production**: The CIAB, Punjab has developed a process for production of xylose, levulinic acid (22%) and lignin from spent aromatic biomass in high yield. The aromatic oil was obtained from aromatic crops, and then the spent aromatic waste and citrus waste was used to produce xylose sugar. the biomass obtained was treated to form levulinic acid and the leftover biomass was used to form the final product lignin in good yield.

6. **A secondary metabolite from *Swertia paniculata***: the institute has developed an improved process for isolation of a xanthone 1, 5-dihydroxy-3, 8-dimethoxyxanthone, a secondary metabolite from *Swertia paniculata*. The chemical compound has got huge medicinal uses.

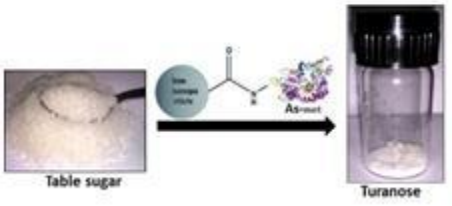


Swertia paniculata, commonly known as Charaita in India

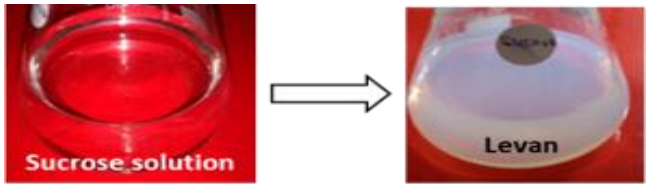
7. **Edible fibres from kinnow waste:** A green strategy was developed by institute to make dietary edible rich fibres from kinnow waste which is often bitter. The fibers developed from waste obtained from kinnow juice extraction were not bitter.



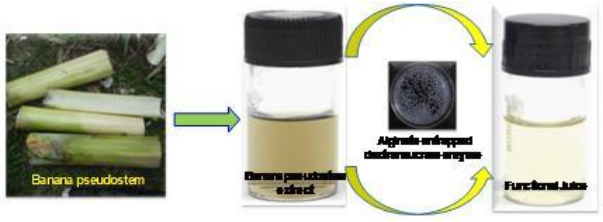
8. **Valuable products from maize gluten meal**: The scientist at CIAB, Punjab has developed a novel process for the production of off odour/off flavour free protein hydrolysate from maize gluten meal. The product has been used for multiple purposes.
9. **Biosynthesis of turanose**: A method was developed to synthesize turanose, the next generation functional sugar, from sucrose biomass.



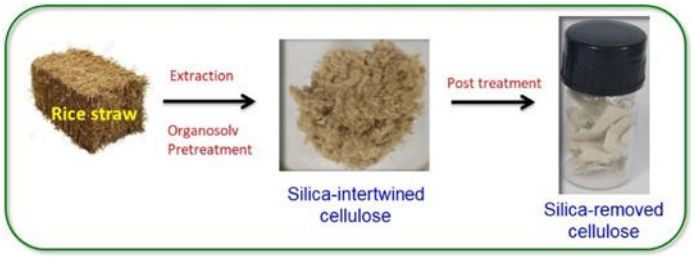
10. **Prebiotic development**: Prebiotics are indigestible carbohydrates which are of immense importance for growth of gut microbiota. A method for catalytic production of prebiotic fructooligosacchrides and levan from sucrose containing feedstocks.



11. **Banana pseudo-stem**: A process was developed functional juice from banana pseudo-stem. The juice was enriched with indigestible prebiotic oligosaccharides, and nearly calorie free functional sugar, D-allulose.



12. **The 4-galactosyl-kojibiose and kojibiose:** A method was developed to convert raw and by-products from dairy and sugarcane industries into functional biomolecule, 4galactosyl-kojibiose and kojibiose.
13. **Silica-removed cellulose**: A two-step process was developed for production of silica-removed cellulose from rice straw, an agri-waste of paddy crop.

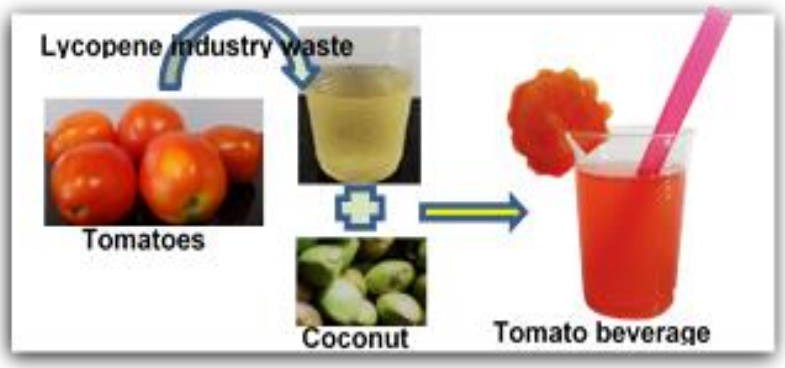


14. **Process for production of Silica-removed cellulose:** A one-pot process was developed by institute to selectively removal of silica from rice straw, an agri-waste of paddy crop.

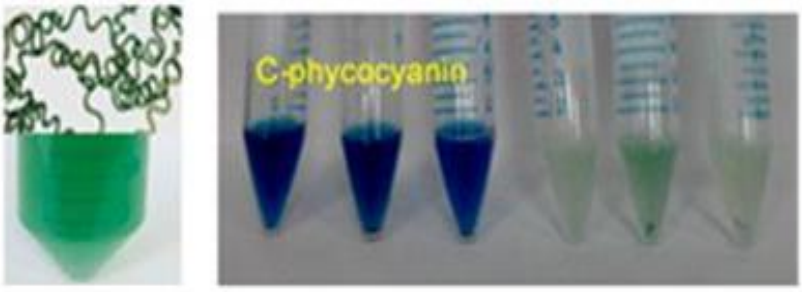
15. **Xylooligosaccharides (XOS) production**: A xylanase and magnetic-xylanase-CLEA based process was developed for xylooligosaccharides (XOS) production from physically treated agro-biomass.

16. **Novel bakery products**: The tomato and tomato by-products were used to develop fiber, minerals and antioxidant rich novel bakery products.

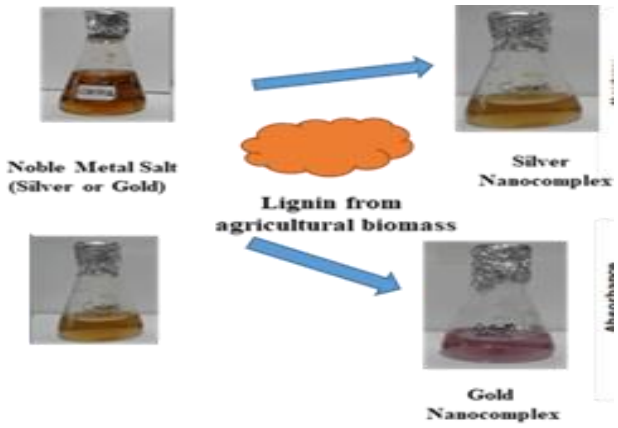
17. **Beverage production:** A special beverage based on tomato fruit juice, coconut water and other additive was produced at institute.



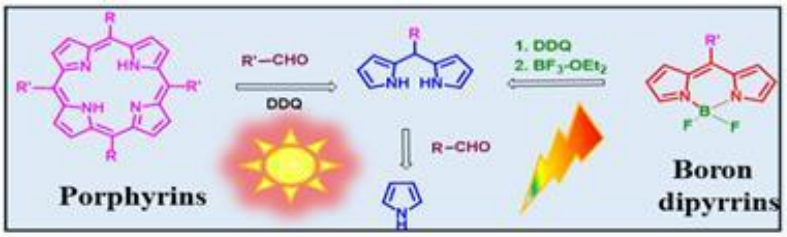
18. **Whey products**: An efficient process was developed for production of whey proteins, bacterial cellulose, calcium citrate and D-tagatose from liquid whey.
19. **C-phycocyanin production:** A simple method was developed for production of high purity C-phycocyanin from *Spirulina platensis.*



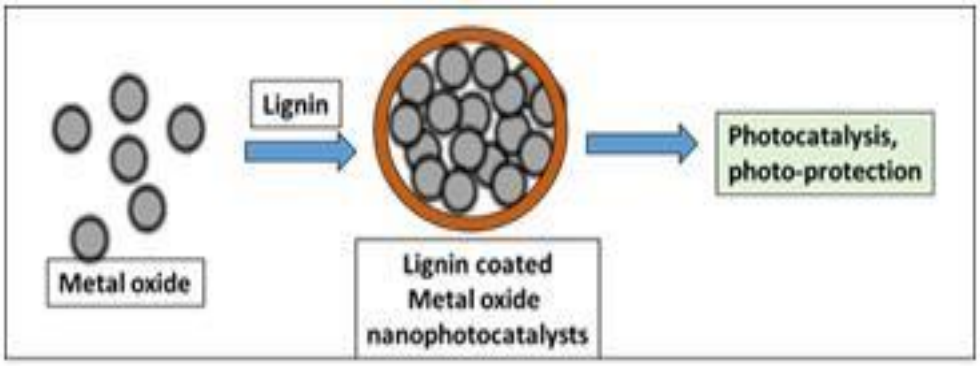
20. **Rice straw nanofibers:** An up scaled process was developed for production of rice straw derived nanocellulose or cellulose nanofibers with improved delignification and better crystallinity index.
21. **Nano-therapeutic and nano-diagnostic agents:** At CIAB institute, a process was developed for synthesis of lignin coated metal (silver and gold) nanocomplexes. Such nanocomplexes was used to make several nano-therapeutics and nano-diagnostic agents.



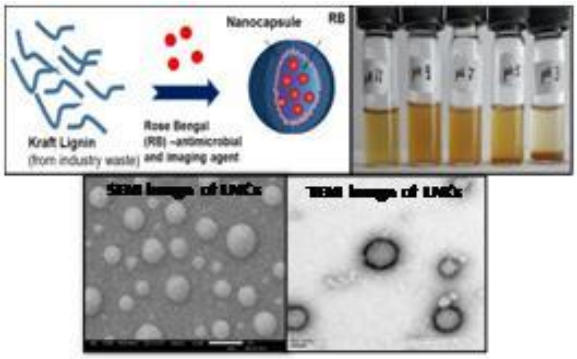
22. **Polypyrrolic compounds:** a simple, one-pot method was developed for making light activatable polypyrrolic compounds and their nanoformulation.



23. **Nano-composite products:** A processes was developed to make lignin based metal oxide nano-composites for UV protective, antimicrobial and photocatalytic applications.



24. L**ignin nano-carriers:** A processes was developed to make lignin nano-carriers in facile, green and high yielding manner.



25. **Novel D-allulose 3-epimerse biocatalyst**: A processes was developed to make novel D-allulose 3-epimerse biocatalyst system for biosynthesis of nearly zero calorie functional sugar, D-allulose

Contact Person:

Chief Executive Officer (attn. Dr. Jayeeta Bhaumik)

Center of Innovative and Applied Bioprocessing (CIAB-DBT)

Mohali, Punjab

E-mail: ceo@ciab.res.in, jayeeta@ciab.res.in

Phone: 01725221539, 904142372