FOOD AND NUTRACEUTICALS FOR EFFICIENT POST HARVEST MANAGEMENT OF AGRO PRODUCTS

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Food Engineering provides technological knowledge transfer for cost-effective production and commercialization of food products. Over the last few years, CSIR-NEIST has initiated efforts to build an R&D centre to explore the resources of NE India in the line of health food. This endeavour will help to generate jobs for rural people, reduce post-harvest losses and efficient by-products utilization by developing newer and safe technologies in the field of cereal and fruit processing by-products. This would bring a two-fold benefit for the global food industry, viz., sustainable disposal of highly impacting wastes, and generation of value added products. Considering these, an Indo-EU collaborative work was started under the joint call of Department of Biotechnology India– European Commission.

Food processing involves combination of procedures and processes intended to change the raw materials into foodstuffs. The procedures and processes are conveniently called unit operations. Food engineering is a multidisciplinary field of applied physical sciences which combines science, microbiology, and engineering education for food. It provides the technological knowledge transfer essential to the cost-effective production and commercialization of food products and services. The domain of knowledge and action are

- Research and development of new foods, which fulfil consumer expectations as far as price, diet, habit, appropriate nutritional quality and safety and other likes are concerned.
- Development and operation of manufacturing, packaging and distributing systems for food products
- Design and installation of food production processes
- Food safety
- Design and operation of environmentally responsible waste treatment systems
- Marketing and technical support for manufacturing plant.

Over the last few years, North East Institute of Science & Technology (NEIST), one of the constituent of Council of Scientific and Industrial Research (CSIR), India, has initiated an effort to build a research and development centre considering the vast potential of exploring the knowledge and resources in this area of mega bio diversity especially in the line of health food.

Agro- food processing Technology is the area which has been selected as one of the area of interest because nearly 74 per cent of the country's population lives in the rural areas and a little over 60 per cent of the labour force is still engaged in the agricultural sector. The rural economy has so far been unable to absorb the increasing rural labour force in production activities and this has been a big constraint for reducing the incidence of rural poverty. This employment will be in rural areas where these industries have to be located near the source of raw materials, especially perishable agricultural products. These industries

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would help in reducing post-harvest losses and wastes as well as in using by-products more efficiently. This can increase farmers' income by getting them better prices and also consumer welfare by increasing the availability of agricultural consumer goods.

Due to the wide range of activities, there is a lot of diversity in the nature of problems and issues relating to different agro-food processing industries. NEIST has chosen to concentrate on development of newer and safe technologies in the field of cereal grain and fruit processing and by-products of cereal and fruit processing industries.

Asia is the biggest rice producer, accounting for 90 per cent of the world's production and consumption of rice. China and India, which account for more than one-third of global population supply over half of the world's rice. The rank of India in production of rice stands at second, approaching towards 100million tonnes per year. Indian rice cultivars include long-grained and aromatic Basmati, long and medium grained Patna rice and short grained Sona Masoori rice in East. In South India the most prized cultivar is 'ponni' which is primarily grown in delta regions of Kaveri River. In the western Indian state of Maharashtra, a short grain variety called Ambemohar is very popular which has the characteristic fragrance of Mango blossom.

One of the most abundantly available natural resource of North Eastern India is pigmented rice, otherwise called as medicinal rice. The use of these varieties of rice with different colour e.g. black, purple and red, has no direct commercial value because of its coarse grain with high or medium amylopectin. The pigmented rice variety is a good source of nutraceutical where the major nutrients are concentrated in the bran portion of the grain including highly stable natural food colour with very high antioxidative properties[1]. The mega diversity of this part of the country gives tremendous natural resources for development of health/ functional food and natural food colours with same pace as with organic foods of the millennium. The work will have direct impact on uplift of socio-economic conditions of the people of the North eastern region by using this fresh waste materials which otherwise has got very little market potential as such in the region.

The Indian and European food industries generate millions of tons of plant by-products and waste each year. Such waste streams are liable to putrefy and become a nuisance or health hazard. So the International Landfill Directive has placed limits on the amounts of them to be allocated into landfill sites. They are potential sources of valuable food ingredients and can also be used to generate new foods and feeds. There are only few cases of commercial feeds obtained from plant by-products and waste, whereas very little is known about new food generated from the same matrices. The development of economically viable ways to turn such matrices into new foods and feeds would bring a twofold benefit for the Indian and European food industry, i.e. (a) the sustainable disposal of highly impacting wastes and (b) the generation of new value added products, with remarkable improvements of both sustainability and competitiveness of the sector. The Republic of India and European Community efforts on this common priority might provide relevant mutual benefits in terms of Research and Technology Development (RTD) and new market opportunity for the food sector of both countries.

Considering the above two aspects an Indo-EU collaborative work was slated under the joint call of Department of Bio Technology(DBT) - New delhi – European Commision (EC) under scientific collaboration programme FP -7. The granted project is " *N*ew *A*dvances in the integrated *M*anagement of food processing w*A*ste in India and Europe: use of *S*ustainable *T*echnologies for the *E*xploitation of by-products into new foods and feeds'' (NAMASTE) with an objective to develop and asses laboratory-scale experimental protocols relying on economical and environmental sustainable process for efficiently turning by-products and waste of the cereal and fruit processing industries (rice bran and mango pomegranate processing by-products in India and wheat bran and citrus processing by-products in Europe) into new foods with improved nutritional properties, such as functional beverages, mono-dose fruit paste, fruit enriched breakfast cereals, filler for bakery products and a new feed for aquaculture. CSIR-NEIST is the coordinating Institute of the consortium. The other four partners are: University of Agricultural Sciences (UAS), Bangalore, Euro India Research centre (EIRC), Bangalore, Nature Fresh logistics, Pune and Vaighai Agro Products, Madurai.

The important aspect of EU-India effort is to develop common protocols for the selection, integrated characterization and stabilization of above mentioned food processing by-products and waste, obtain natural ingredients with antioxidant and antimicrobial properties, formulation of new beverages, fruit paste, fruit based snacks, fruit enriched breakfast cereals[2], shelf stable fillers for bakery products and new feed are highlighted below. Further work to optimize and assess interdisciplinary Indian –European integrated innovative protocols for the assessment of quality, chemicals and microbial safety of the new food and feeds

and of the environmental and economic sustainability of the processes selected and employed in the project, evaluate new market opportunity with close cooperation of Indian European food industries and jointly train scientists and engineers of the consortium.

NEIST is dealing with activities related to characterization and extraction of natural ingredient from rice bran using laboratory protocol after stabilization[3-6]. The stabilized rice bran was tested in the normal atmospheric condition for 3-4 months and evaluated their stability towards lipase activity. It was found that no rancidity was developed during the prolonged stay of the stabilized bran. The stabilised bran used for extraction of natural colour was found to have similar stability as in bran with excellent colour intensity. Exploitation of this colour in different food matrices and their characterization will be done very soon. Laboratory protocols were developed for other valuable ingredients like rice bran protein concentrate[7] and dietary fibre using both chemical and enzymatic approach. Optimization of process parameters and economic evaluation is being done. Generally protein and amino acid that present in deoiled bran can be extracted by chemical method which is alkali or acid hydrolysis, followed by acid precipitation. However this method obtain low protein yield due to degradation at extreme pH condition. Alternatively, enzymatic process has been studied which takes long time and cost of enzyme is very high.

The high level of antioxidant in rice bran: γ-oryzanol[8], tocopherol[9] and tocotrienol as reflected in high 3-7% unsaponifiable matter in bran oil contributes to the hypocholesterolemic effects and other health benefits of the full fat bran. γ- Oryzanol are a group of ferulic acid esters of sterols and triterpenoid alcohols (4-4-dimethyl sterols). Separation of γ-oryzanol from rice bran oil soapstock have been investigated for many decades. In the development of these processes into commercial scale, several factors such as productivity, environmental and health problems, process investment, and separation efficiency have been considered. Rice bran is also rich in water soluble antioxidant, phytic acid. These are the important considerations in the formulation of new rice products.

The extraction processes used for the preparation of these phytochemicals extracts have to meet some requirements. Firstly, to explore a suitable low cost drying method which allow the raw material for prolong storage. It is also necessary to use compatable solvents as is the case of water, ethanol or mixture of them. Thermal treatments are generally necessary to inactivate enzymes that can degrade the phytochemicals during extraction process[10]. The extract obtained need to be concentrated and spray drying or freeze drying is the technologies that could be applied depending on the price of the obtained product in the market. The extract in some cases purified with adsorption in stationary resin bed and later are eluted by suitable solvent and dried. These extract can be used for the preparation of pill or to prepare functional juices[11] or other new foods such as soups, sauces, etc.

The use of these products, however, required to evaluate the potential market and price for which in the team two industrial partners are already supporting in the job. The safety aspects also seriously looked into by doing routine analysis of pesticides residue, heavy metal content and microbial contamination and other environmental aspects.

The byproducts and residues of the food processing industries, constitute an interesting source of phytochemicals that can be readily extracted by simple methods and can then be used for the preparation of different products. The biological activity of these extracts needs further research. ❐

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