

plant–gall midge interaction and their implication in the development of durable resistance in rice employing DNA marker-based diagnostic tests to estimate virulence structure of the pest population.

It is a pity that this report cannot cover the rest of the oral and the complete set of 33 poster presentations, all of which portrayed diverse yet interesting topics. Out of a total of 104 participants, 50 were students, who were often seen engaged in

querying the experts in whatever little time they could manage in an otherwise packed schedule. A brief final session was dedicated to develop a roadmap for insect genetics and genomics research around the world. The organizers' attempt to facilitate fruitful interactions among researchers seemed to have met with reasonable success.

A web link was created at <http://www.cdfd.org.in/insectgenomics> to access par-

ticipant list, a downloadable abstract book and some sample photographs of the symposium.

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**Sunil Archak**, Laboratory of Molecular Genetics, Centre for DNA Fingerprinting and Diagnostics, Hyderabad 500 076, India. e-mail: archak@cdfd.org.in

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## MEETING REPORT

### Bioprocesses in the food industry\*

About 200 participants from 31 countries participated in the Second International Congress on 'Bioprocesses in Food Industries'. The congress was convened by A. Koutinas and P. Costas (University of Patras), P. M. Emmanuel (University of Ionnina) from Greece, and Ashok Pandey (RRL, Thiruvananthapuram) from India. The proceedings of the congress included an opening lecture on 'Indigenous enzymes in milk' by P. F. Fox (Ireland), two plenary lectures ('Lactic acid bacteria in food biotechnology' by W. H. Holzapfel, Germany, and 'The impact of bacterial genomics on the food industry' by Roger Merchant, Northern Ireland), three keynote addresses ('Engineering aspects of biotransformation processes' by Christian Larroche, France; 'Biotechnology of flavours' by R. G. Berger, Germany and 'Health-promoting food processing' by S. Pandiella, UK), over 40 invited lectures, 50 short lectures and 200 poster presentations.

Research carried out since 1881 has revealed the presence of about 60 different enzymes in milk. Some of them are of interest for their beneficial activity (e.g. lactoperoxidase, lysozyme), some as indices of processing (e.g. alkaline phosphatase) and some for their positive/negative effects on the quality of dairy products (e.g. xanthine oxidase, lipoprotein lipase). This information is based on human and cow milk. Fox emphasized on the need of research on the enzymology of milk from other animals. Traditional

food fermentation involving lactic acid bacteria serves functions such as preservation by the products such as lactic acid, acetic acid, alcohol and antimicrobial peptides (bacteriocins), enrichment/improvement of the diet, biological enrichment by the production of proteins, essential amino acids, fatty acids and vitamins, detoxification and degradation of anti-nutritional factors, improvement in digestibility and favourable effects on gastrointestinal tract by probiotic activities. Holzapfel stressed on the need to select lactic acid bacteria as multifunctional strains to address food and human gastrointestinal environments. Many areas of genomics have a great potential for the food industry, but have not yet been exploited. Merchant felt that metagenomics could be used to examine the effects of various functional foods on the gut flora, as a tool to evaluate new and existing products.

A. C. Noe (Mexico) reported that pomegranate peels and bush leaves (*Larrea tridentata*) are excellent supports for solid-state fermentation and are sources of antioxidants. Rintu Banerjee (IIT Kharagpur) has isolated a novel polysaccharide from pomegranate rind that inhibited tyrosinase activity, and therefore, may find application as a potential skin whitener. Bioengineering provides a number of technical solutions to improve flavour yields. The poor water solubility of terpene substrates was compensated by the use of stable enzymes, and cofactor dependency was overcome by cofactor-coupled enzymes. Berger (Hannover, Germany) informed that a lipase-catalysed synthesis was found to be economically superior to chemosynthesis. Such examples will help in establishing

biotechnology as a viable and sustainable alternative for flavour production.

A new-born infant is devoid of bacteria, and prone to infection during the first few days due to inadequately developed defence mechanisms and exposure to a variety of microbes. In breast-fed infants, the intestinal flora is dominated by Bifidobacteria. According to Bezirtzoglou (Greece), Bifidobacteria may play a probiotic role in preventing establishment of pathogens in the new-born infants. Nutraceuticals are physiologically active molecules/preparations which have the ability to provide specific medical/health benefits, and therefore, are used as food supplements. These have been claimed to reduce the risk of cancer and heart disease, control hypertension, high cholesterol, excessive weight, osteoporosis, diabetes, arthritis, cataract, insomnia, diminished memory and concentration, digestive disorders, constipation and headache. There are peptide-based nutraceuticals, oligosaccharides, and lipid-based nutraceuticals. Subhash Chand (IIT Delhi) described lipid-related nutraceuticals generated involving lipase catalysis. C. Drainas (Ionnina, Greece) reported a novel mechanism of glucose tolerance in *Zymomonas mobilis*. This involves a cluster of four genes.

S. Ferreira-Dias (Lisbon, Portugal) presented work done by his group on the production of mono- and di-acylglycerols (emulsifiers), flavouring esters and fats rich in omega-3 PUFA for the margarine industry employing immobilized lipase in organic solvents. P. Gunasekaran (Madurai) reported construction of a recombinant of *Z. mobilis* (with multiple copies of levan sucrose gene) that produced enhanced

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level of levan ( $10.7 \text{ g l}^{-1}$ ) in a medium containing sucrose. S. Vikineswari (Malaysia) demonstrated that *Auricularia auricula-judae* contains high fibre, low protein and fat, and therefore, is suitable for a healthy diet. This mushroom contained high antioxidant value.

S. Papanikolaou and coworkers (Greece) demonstrated the possibility of producing citric acid ( $57.5 \text{ g l}^{-1}$ ) from the waste discharged from biodiesel plant that contained glycerol. Saroj Mishra and coworkers (IIT Delhi) have developed a process for enhanced production of xylanase by a mutant of *Melanocarpus albomyces* using soluble alkaline lignocellulosic extract in submerged fermentation. V. Nedovic (Serbia) reported development of an immobilized yeast cell system for the production of beer with flavour-active compounds such as alcohols, esters and vicinal diketones.

G. J. E. Nychas (Athens, Greece) has developed a method employing chemometrics for reliable evaluation of meat spoilage and prediction of its shelf life. I. S. Thakur (JNU, New Delhi) reported that his group has developed a consortium of microbes involving *Serratia marcescens* and others that efficiently detoxified highly carcinogenic and mutagenic dioxin-like compounds.

Omar Ibrahim and coworkers (Malaysia) have developed several solid-state fermentation processes for the production of value-added products such as enzymes, flavour compounds, biofuels, antibiotics and bioplastics using agro-residues.

S. D. Pillai (Texas, USA) informed that auto-inducer molecules have been implicated in controlling the regulatory pathways of organisms that play a critical role in the food industry, such as *Lactobacillus* spp. and *Saccharomyces* spp. He further discussed the potential applications of quorum-sensing and cell-signalling pathways in bioprocesses. T. Satyanarayana (UDSC, New Delhi) reported development of processes for the production of maltogenic and thermostable  $\alpha$ -amylase and amylopullulanase, and phytase using *Geobacillus thermoleovorans* and *Sporotrichum thermophile* respectively. These enzymes showed antistaling properties in bread and reduced antinutrient phytic acid in the dough.

Xylitol is widely used in chewing gum, soft drinks and oral hygiene products to reduce tooth decay and as a sweetener for diabetics. L. V. Rao (Hyderabad) reported

that his group is developing a mutant strain of *Candida tropicalis* and a recombinant *Saccharomyces cerevisiae* for the production of xylitol from corn fibre and sugar cane bagasse hydrolysates. P. Strehaiano and coworkers (Toulouse, France) developed immobilized mixed cultures of *Oenococcus oeni* and *S. cerevisiae* for producing good-quality wine from acidic grape musts. The immobilized microbial system is being used in the production of sparkling wines.

S. Roussos and coworkers (Marseille, France) have isolated several mycotoxigenic fungi from spoiled olives and olive cake, and detected mycotoxins. K. Sankaran (Chennai) reported development of sensitive, simple colorimetric identification method for the detection of food-borne *Escherichia coli*. Sudheer Chincholkar (Jalgaon) reported efforts in increasing available iron in wheat and groundnut using siderophorogenic bacteria. E. Tsakalidou (Greece) isolated a novel *Streptococcus macedonicus* that produces a bacteriocin macedocin. This bacteriocin is a lantibiotic that is active against *Clostridium tyrobutyricum*.

The following conclusions can be drawn from the short presentations:

(i) Osmodehydrofrozen, sliced cucumber showed improved quality and functional properties such as colour retention, pleasant and organoleptic characteristics, firmness and crispness.

(ii) Organic tomato fruits contained more dry matter, total and reducing sugars, vitamin C, total flavones and  $\beta$ -carotene, but less lycopene in comparison with the conventional ones.

(iii) Anthocyanin pigments of grape skin extracts and wines made from such grapes differed considerably.

(iv) With the increase in starch nanocrystals in nanocomposites, the crystallinity of the composite polymer increased, which resulted in enhancement of tensile strength.

(v) A correlation was found between polyphenols and antioxidant activity and reducing power of Greek white wines.

(vi) Treatment of soya food products with  $\gamma$ -radiation caused decline in bacterial contamination and Crustacean allergenic protein.

(vii) The polyelectrolyte complex membrane of alginate-chitosan reduced leakage of entrapped yeast cells into the medium.

(viii) Toluene monooxygenases exhibit enantioselective sulphoxidation activity.

(ix) Osmotic stress and high concentration of sodium chloride influence both yeast cell viability and its fermenting ability.

(x) Soybean oil exhibited stronger positive effect on carotenoid yield by *Blakeslea trispora* in submerged fermentation.

(xi) Yoghurt prepared using starter cultures with transglutaminase had better physical properties (viscosity and whey separation) and sensory characteristics than that prepared with starter devoid of transglutaminase.

(xii) Extracellular  $\beta$ -galactosidase of *Thermomyces lanuginosus* exhibited optimum pH and thermostability needed for its application in dairy processing.

(xiii) Immobilized lipase of *Candida antarctica* was found useful in supercritical fluid extraction of borage seed oil. A two-fold enhancement in oil yield was recorded when extraction pressure was increased from 150 to 250 bar.

(xiv) Using proteolytic enzyme actinidin from *Actinidia chinensis* as milk-clotting agent, a variety of dairy products such as yoghurt and cheese can be produced.

(xv) Cloud point extraction using food-grade surfactants can be used to extract natural antioxidants such as polyphenols, carotenes and tocopherols.

Posters were presented on microflora of raw materials used in producing various food products, microbes used in food processing, quality of food products, production of food enzymes by various fermentation processes, improving existing food products using microbes and enzymes, development of new processes for producing conventional food products, natural antioxidants and antibiotic compounds, and bioinformatics in food processing.

The congress came to an end with a declaration that the Third International Congress on 'Bioprocesses in Food Industries' will be convened by L. V. Rao at Osmania University, Hyderabad in December 2008.

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**T. Satyanarayana**, Department of Microbiology, University of Delhi South Campus, New Delhi 110 021, India.  
e-mail: tsnarayana@gmail.com