



NIO signs Memorandum of Understanding with IFM-GEOMAR

National Institute of Oceanography (NIO), Goa, has signed a memorandum of understanding with the Leibniz Institute of Marine Sciences (IFM-GEOMAR), Kiel, Germany, for joint research work in marine gas hydrate science, marine substances research and marine aquaculture.

The MoU was signed at NIO on 16 November 2007 by Dr Satish R. Shetye, Director, NIO and Dr Peter M. Herzig, Director, IFM-GEOMAR in the presence of Minister-President of Land Schleswig-Holstein State, Consul General (Germany), Mumbai, and a large number of distinguished Indian and German scientists and officials.

The five-year cooperation agreement envisages joint research projects, exchange of research personnel with core competencies and access to infrastructure within the cooperative projects. The implementation will be monitored by a committee comprising the staff



Exchange of MoU documents

scientists of NIO and IFM-GEOMAR with an intent-schedule to meet alternately in India and Germany.

Patents granted to NAL

The patents granted to National Aerospace Laboratories (NAL), Bangalore's scientists in the recent past include:

Patent No. 197138 granted to Dr P.S. Gopalakrishnan and Shri P.S. Lakshmi Narasimhan for 'An improved process for the preparation of β -sialon powder'.

The invention discloses an improved process for the preparation of β -sialon from naturally occurring aluminosilicates, which are cheap and abundantly available. Sialons are technologically important materials finding application in cutting tools and structural parts of combustion engines and high temperature bearings.

Patent No. 195194 granted to Dr R.M.V.G.K. Rao, Shri Kandasamy Natarajan and Dr Adoni Padma for 'A process for the synthesis of a new

tetraglycidyl para-phenylene diamine (TGPPD) epoxy resin'.

The invention provides a process for synthesis of TGPPD resin having low viscosity, which offers superior processing characteristics to those of commercially available resins.

Patent No. 208812 granted to Dr P. S. Gopalakrishnan and Shri P. S. Lakshmi Narasimhan for 'An improved process for the manufacture of fibrous silicon carbide'.

Silicon carbide has various uses such as refractory material and grinding medium in machine industry. It is also used as high temperature ceramic material in gas turbines, rocket nozzles, etc. Present invention provides

industrially viable process for preparation of fibrous form of silicon carbide since whiskers form causes health problems. Fibrous form is also preferred as it makes a porous perform and infiltrate it with the matrix material in manufacturing composites.

Patent No. 209238 granted to Shri K J. S. Kumar, Shri A. Pourassamy, Shri S.R. Rajagopalan, I. Rajagopal and Dr K.S.Rajam for 'Invention relating to the development of a machine for electrochemically assisted arc machining useful for fast cutting of billets, rods and sheets of metallic materials of various sections which are difficult to cut by conventional methods'.

NEIST: Projects undertaken, completed and technology released

The new projects taken up, projects completed and technology released by the North East Institute of Science and Technology (NEIST), Jorhat, in the recent past, include:

New Projects

Grant-in-aid

- Development of super high strength proppants, Oil Industry Development Board, Ministry of Petroleum & Natural Gas, New Delhi. (Sanctioned Amount – Rs 33.50 lakh, PI- Dr D. K. Dutta, Sc. F). An MoU is proposed to be signed between NEIST- Jorhat and OIIB to this effect shortly.

Consultancy

- Soil investigation for MSQ Improvement Project at Digboi Refinery, Project Department, Indian Oil Corporation Limited (Assam Oil Division), Digboi, Assam. (Total estimated cost Rs 8.90 lakh, PI - Shri A. Biswas, TO(E) and I/c Applied Civil Engineering Division, Duration - 120 days).
- An integrated approach to control biogenic hydrogen sulphide production in oil wells and processing of fluids through chemical and microbial routes, Oil India Limited, Duliajan, Assam (Contract Amount - Rs 6.759 lakh, PI- Dr B. K. Gogoi, Head, Biotechnology Div.)

Projects completed

Grant-in-aid

- Creating awareness and promotion of medicinal plants available in Arunachal Pradesh for production and marketing of medicinal plants towards sustainable development of ST population of Arunachal Pradesh, Department of Biotechnology, Ministry of Science & Technology, Government of India. (PI- Dr B. N. Saha, Scientist, NEIST Branch, Itanagar, Arunachal Pradesh)
- Characterization and upgradation of some limestone deposits of north eastern region of India for value addition and rational utilization, Ministry of Mines, Government of India, New Delhi. (Project Code - GAP 136, Contract Amount - Rs 20 lakh, PI - Dr P. C. Borthakur, Ex-Scientist)
- Assessment and promotion of economic wetland biodiversity of Manipur; a concern for ecological, ethnical and economical dimensions, GB Pant Institute of Himalayan Environment & Development, Ministry of Environment & Forests, Government of India, Almora, UP. (Project Code - GAP 145, Amount received - Rs 4.52 lakh, PI- Dr H. B. Singh, Scientist, NEIST-Manipur Sub-Station)

Consultancy

- Manufacture of coal briquettes for gainful utilization of Nagaland coal, Directorate of Geology & Mining, Government of Nagaland, Dimapur. (Project Code - CNP 420, Contract Amount - Rs 2 lakh, PI - B. P. Baruah, Scientist, Coal Div.)

Technology released

Agropractice for BLI - Arun: An improved strain of lemongrass, released to (i) Herbal Research & Development Institute, Centre for Aromatic Plants (CAP) Government of Uttarakhand, Dehra Dun and (ii) Arunachal Vikash Ebum Shiksha Sangataan, Itanagar, Arunachal Pradesh.



CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, MYSORE

R&D Highlights: 2006-07

THE Central Food Technological Research Institute (CFTRI), Mysore, continues to develop new food products and technologies, with taste, nutrition affordability and eco-friendliness among focal objectives. A brief account of the achievements:

Nutrition and nutraceuticals

A number of new formulations of health-beneficial products were developed with stress on quality and shelf life. These included multi-grain health bars, blended oils with balanced fatty acid composition and protocols for better nutrition from brown rice.

The CFTRI studies showed that rice stored in dark containers at room temperature did not suffer encrustation. Cooking and sensory quality were not affected during five months of storage. Breakage on milling was maximum in pigmented variety of paddy. Waxy varieties suffered the least breakage and parboiling reduced the quantum of broken. Pressure parboiling and milling decreased thiamine and oryzanol content, respectively. Rice of waxy variety had the least content of soluble amylose. Noodles were prepared from raw as well as hydrothermally treated rice. Raw rice noodles exhibited a decrease in water

CFTRI Performance Indicators: 2006-07

Projects	
Grant-in-aid	89
Consultancy	57
Sponsored	20
New Processes Developed	11
Technologies Transferred to Industry	62
Product Samples Analyzed	2398
Technical Counselling	661
Technical Enquiries	6068
Patents	
Filed in India	21
Filed Abroad	28
Publications	
Research Papers	158
Reviews	21
Book Chapters	8
Conference Proceedings	1
Human Resource Development	
M.Sc. students passed out	24
ISMT students passed out	19
Short-term training programmes	59
Ph.D. awarded	14

absorption index and an increase in solubility index. The converse was true in the case of noodles from treated rice. Peak viscosity of processed rice was less than that of raw rice, viscosity of noodles from processed rice was high.

Health bars were prepared using expanded cereals and legumes, such as brown rice, pearl millet, horse gram and moth bean. Brown rice and finger millet (among cereals) were best suited for the product while horsegram and moth bean were better among legumes. *Chikki*, a popular traditional confection was nutraceutically enriched using flax seeds, with good health benefits. A nutraceutically enriched *besan laddu* of acceptable quality was made by replacing *besan* with whey powder. *Chapati* prepared in large scale with certain preservatives and additives could be stored up to 12 days without microbial spoilage. *Chapati* and *paratha* could be stored up to 6 months at - 20°C without loss of quality. Ready mix formulations were prepared for *chapati* and *paratha*. *Chapati* prepared from the ready mix had better quality compared to that made with whole wheat flour. *Chapati* made from dough enriched with xylanase or amylase or a combination of the two

enzymes, retained softness up to four days of storage. High protein crackers stored in metallised polyester pouches, under ambient conditions, were found to be acceptable up to 90 days. Process parameters such as mixing speed, time and temperature were optimised to result in a homogeneous blend of two edible oils. Blended oils, with well-balanced fatty acid compositions, were found to reduce the risk of thrombosis. A nutritionally superior rice bran oil was prepared from crude rice bran oil.

Plantation products and spices

Spices and herbal plants have been the major source of nutraceuticals in various food products. Health beneficial properties of Indian borage, organo, *Ajowan*, marigold, green cardamom, *Allium*, fenugreek, garlic and onion and their use in food formulations have been evaluated through biochemical studies.

Indian borage is found to be an indigenous source of carvacrol, providing a lead for the beneficiation of Indian oregano oil with enhanced carvacrol. *Ajowan*, oregano and borage exhibited potent antimicrobial properties against *Helicobacter pylori*. An isomer of vanillin, 2-hydroxy, 4-methoxy benzaldelyde (HMB), has been successfully incorporated as a flavourant in ice-cream. The level of incorporation has also been optimized to ensure sensory

acceptability of the product. Molecules that are potential nutraceuticals have been identified and extracted from marigold flowers. These molecules have been evaluated for their beneficial properties. Marigold pigment, when incorporated in to a sweet dish, was found to be stable, apart from enhancing sensory as well as organoleptic characteristics of the product. Curcumin has been stabilized by encapsulation. LC-MS analysis of the four peaks, resulting from the separation of oligosaccharides obtained from the digestion of wheat bran water extractable polysaccharides by commercial xylanase in Biogel P-2 column chromatography, has indicated that the peaks correspond to hexa, tetra, tri and mono saccharides, respectively.

Three cultivars of green cardamom were found to be of superior quality with desirable aroma. Bleached cardamom samples were inferior in quality. Principal component analysis of E-nose pattern of cardamom samples pointed to a possible segregation based on aroma quality. Good quality coffee made from optimally roasted beans had high intensity of coffee aroma, optimal level of bitterness and brown colour. *Arabica* coffee had higher intensity of typical coffee like aroma whereas *Robusta* coffee had more body and dark colour. Citric acid exerted positive effect on ginger flavour perception in sugar solutions. Odour and taste threshold values of flavour compounds, such

as linalool and alpha-pinene, were influenced by the nature of food matrices. In all the matrices studied, the odour threshold values were significantly lower than taste threshold values.

The influence of both serotonin and melatonin on the growth of *Coffea canephora* and *Mimosa pudica* cultures were studied *in vitro*. Calcium channel inhibitors reduced the growth of shoots of *Mimosa*, *in vitro*. Soybean genotypes were used to raise seedlings. The methods for analysis of phytoestrogens by HPLC was standardized. Capsaicin, the source of pungency in chilli, was obtained in pure form from the colour free pungent fraction. Antioxidant activities of spent turmeric oleoresin and curcumin enriched colourant powder were evaluated. Viscozyme, a mixture of enzymes, was found to increase the yield of oleoresin and capsaicin, significantly. A biotechnological process with advantages, such as low process cost, complete degradation of caffeine and reduced risk to the eco system, was developed. Free flowing fat powder with maximum fat content could be obtained by encapsulation using casein in combination with sugar or maltodextrin.

A protein concentrate, low in antinutritional factors, was prepared from mustard cake and sesame meals. Ready to use supplementary food formulations with 16-17% protein, capable of providing 370-380 kcal of energy, apart from essential



vitamins and minerals was developed. *Amchur* and citric acid were found to enhance the bio-accessibility of zinc and iron from many food grains. Pressure cooking and stir frying of vegetables were found to enhance the bioavailability of beta-carotene. Corn steep liquor was found to be an alternative source of nitrogen for the growth of *Lactobacillus coryniformis* and *L. salivarius*. Lactose was a good cryoprotectant for the freeze-drying of *L. coryniformis* and *L. salivarius*. A structured lipid that could replace cocoa butter up to a known level in chocolate was identified. Spray dried fat substitutes were prepared from enzymatically hydrolysed corn starch, tapioca starch and rice flour, at pilot scale. Dietary *Allium* spices significantly decreased cholesterol-phospholipid ratio in the bile. Dietary garlic and onion countered hypercholesterolaemia by decreasing LDL cholesterol significantly. Dietary fenugreek was found to considerably lower the incidence of cholesterol gallstone disease in mice.

Fruits and vegetables

Eco-friendly technologies using biotechnological routes in the area of food processing have been the focus of the institute in the recent past. A number of innovative products and processes based on common and underutilized fruits have emerged from various activities pursued in the institute.

Acid lime remained fresh on

storage at suitable conditions for six weeks in corrugated fibre board (CFB) boxes with ventilated polyline. A chitosan based nontoxic bio-emulsion, as surface coating, could enhance the storage life of wood apple up to 14 days, at a temperature of $18 \pm 2^\circ\text{C}$. Irradiation was useful in controlling fungal infection in addition to slowing down ripening of wood apple. Wood apple seeds were found to be rich in mono as well as poly-unsaturated fatty acids. Coating with edible cactus mucilage could extend the storage of nearly ripe, raw custard apple up to 16 days at $18 \pm 2^\circ\text{C}$. Treatment with kinetin and potassium sorbate solutions could help store *amla* fruits at a low temperature up to 16 days in a fresh state. Gunny bags, pigeon pea baskets and fiber cartons are not suitable for packaging of *amla* fruits, as they are prone to mechanical injury during transportation.

Enzyme clarified jackfruit juice and spray dried powder stored at 4°C for 60 days, on reconstitution exhibited high acceptability in terms of overall quality. The spray dried juice powder was hygroscopic in nature. Addition of anticaking agent could afford prolonged storage of the powder. Juice and powder could be stored up to 3 months at ambient temperature in bottles and metallised polyester pouches, respectively. The phenol oxidase activity of pear fruit could be retarded by L-Dopa ferulic acid, syringic acid and cinnamic acid. A process for microfiltered RTS

beverage from pear fruit was developed. Dehydrated guava slices, packed in metallised polyester pouches could be stored at ambient conditions up to six months. A ready-to-serve guava beverage formulation enriched with lycopene from tomato puree, stored at ambient temperature and low temperature, retained acceptability up to six months. Yellow capsicum could be stored for 28 days at 14°C when packed in cellulose pulp trays with PVC film cling wrap. Propionic acid in combination with chlorides of sodium and calcium effectively inhibited enzymatic browning at the stem end of iceberg lettuce. RTS beverages, without carbonation were prepared by blending clarified juice from sour grapes with clarified Bangalore blue grape juice. A few fruits and vegetables were vacuum impregnated with fructooligosaccharide (FOS) in an attempt to develop intermediate moisture products. The retention of beta-carotene in vacuum impregnated fruits and vegetables was quite significant. Texture of fruits and vegetables appeared to have a bearing on FOS intake. Fermentation parameters, such as pH, nutrient limitations and cell density have been optimised at flask level to improve yields of PHA. A native bacteriocinogenic strain of *Ent. faecium* MTCC 5153 was characterized using molecular biology techniques. A native isolate, which can produce very high amount of bacteriocin in anaerobic conditions, was identified.

Breaker stage fruits and young leaf tissues of tomato (var. *Arka Ahuti*) were used for gene expression studies. Relative expression of biosynthetic pathway genes in leaf and fruit tissues, showed a differential gene expression in both the tissues. An efficient transformation protocol was developed for *Nanjangud rasabale* (NR) variety of banana for expressing genes of interest for better agronomic performance using *Agrobacterium tumefaciens*. High amylase content and low stability of mango ginger starch indicated its suitability for use as a nutraceutical in foods for diabetics and pharmaceutical applications. Hydroxyl radical scavenging activity of acetone extract of bark of *Dillenia indica* was assayed through inhibition of deoxyribose damage. The minimum inhibition concentration of the extract for *B. cereus* and *listeria monocytogenes*, was found to be 300 and 400 ppm, respectively.

Traditional foods

CFTRI has been working on various traditional foods for enhancing their quality, including sensory attributes and automation of popular cuisines. The notable work pertains to continuous *poori* fryer, multi-spouted bed roaster for *makhana* seeds and shelf life studies of traditional preparations such as *laddu*, *jahangir* and masala cashew.

The pneumatic extruder and the deep fat fryer were integrated to

complete the automation of *poori* preparation. Trials were conducted with different brands of wheat flour, varying the parameters, thickness of dough sheet, added moisture, mixing time, extension pressure, dipping frequency, frying temperature and time. Normal sensory attributes such as pourability, stickiness, spreadability and slipperiness of the chickpea flour dispersions were investigated to understand their influence on texture and flow properties. Avocado pulp oil was found to be markedly more viscous than watermelon seed oil. A process for the preparation of emulsion gel containing polyunsaturated fatty acids was developed using oil in water emulsion. The emulsion-gel could be used in food products to form a delivery system for health benefits. *Makhana* nut processing was mechanised with a multi-spouted bed roaster, operating on HTST technology and a twin drum roller type of popping unit. HTST treated *makhana* popped better than those subjected to conventional processing.

Laddu prepared with *vanaspati* or ghee stored under normal conditions was acceptable up to 150 days. Under accelerated condition, *vanaspati laddu* retained acceptability up to 90 days while the one made using ghee turned dark with off flavour, after 60 days. Bombay *halwa*, which could retain high overall quality up to 180 days at ambient condition, turned black with significant loss in overall quality within 60 days in

accelerated storage condition. In refrigerated condition, high overall quality was retained up to 180 days. A method of making *Jahangir* base, preservable in a suitable packaging, that can be soaked in syrup just before consumption was developed. This product was found to be more acceptable compared to the ready-to-eat product prepared using hurdle technology. *Masala* cashew was acceptable up to 30 days under ambient as well as accelerated conditions of storage.

Oat flour and carageenan were incorporated in the formulation of meat *kofta* to result in a low fat, fibre-rich product. This product had higher moisture content and better yield on cooking / frying. Incorporation at an optimal level did not affect physico-chemical and sensory attributes of the product. Fried egg albumin cubes were found to have higher moisture, salt and protein content than fried egg yolk cubes, which had higher fat content. Hydrolysed fish oil was high in neutral lipids and low in glycolipids and phospholipids compared to unhydrolysed oil. Hydrolysis decreased FFA and cholesterol content while mono, di and triglycerides increased. Dehydrated fish egg powder was extracted with chloroform:methanol mixture at ambient temperature. Solvent residues were removed from the cake by air drying to prepare a protein concentrate powder. The fat recovered from the solvent was analysed for fatty acid composition. Conditions were optimised for



Pediococcus acidolactici CFR 2182, the best starter culture for fermentation of shrimp biowaste.

Phytonutrients

Basic studies were carried out with respect to antimetastatic, oxidative disturbance related to dietary intake, allergens and anti-aggregating properties.

Allergenic proteins of egg plant, purified by phenyl-sepharose chromatography were found to possess polyphenol oxidase activity. PPO activity of egg plant is predominantly localized in the exocarp of the fruit.

The immunomodulatory activity of *garlic* has been zeroed to its active principles. In addition to the usual sulfur compounds, garlic contains moderate amounts of mannose-specific lectins, which could also be contributing factors. The mitogenic activity of garlic lectins with the identification of new immunomodulatory protein could form the basis for the exceptional immuno-potential of garlic.

The role played by banana flower and banana stem in inhibiting formation of advanced glycation end products was experimentally understood. Dietary fiber and butyric acid treatment was found to be more effective in arresting protein depletion in diabetic rats than dietary fiber alone.

Pectic polysaccharide (PPS) and antioxidant fractions prepared from ginger (GR) and swallow root (SR) were evaluated for their efficacy employing *in vitro* (biochemical) and

in vivo (animal) models. Oxidative damage occurring in ulceration was mitigated as made out by ulcer index, antioxidant enzyme level and thiobarbituric acid reactive substances. GRPP and SRPP inhibited proton-potassium ATPase activity at suitable IC50 values. GRPP inhibited *H. pylori* growth. Galectin levels in invasive cancer conditions had a good correlation with the metastatic stage of the disease. Several dietary sources such as spices, vegetables and fruits were investigated for antimetastatic compounds. *Swallow root* peptic polysaccharide exhibited a very high level of protection against metastasis in the lung.

Administration of iron dextran (ID) in high dose elicited significant elevation in testis cytosol and mitochondria, apart from high oxidative damage in the liver. Oxidative disturbances caused by iron in immature testis clearly suggested the increased vulnerability of the latter to prooxidant. Curcumin is found to inhibit *amyloid-beta* and alpha-synuclein aggregation. The anti-aggregating property of curcumin glucoside was investigated. Under aggregating conditions, *in vitro*, curcumin glucoside not only prevented oligomer formation but also inhibited fibril formation indicating favorable stoichiometry for inhibition.

Enzymes

Enzyme activities, kinetics of esterification, sequencing of rice

bran lipase and anti-nutritional factors in tree-borne oil seeds were studied in the context of food systems.

Various commercially available enzyme, such as carbohydrases, proteases and lipases, were screened for their debranching activity on guar galactomannan. Pancreatic alpha-amylase (PPA) was separated by DEAE-cellulose chromatography into PPA-I and PPA- II. Oxalic and citric acids inhibited PPA and its isoforms in a concentration dependant manner. PPA and its isoforms were found to release, predominantly, maltotriose and maltotetrose, from cereal and millet starches by ESI-MS studies. Blackgram peroxidase, purified by chromatographic technique, was found to be a glycoprotein of single peptide chain, by MALDI-TOF-MS, gel filtration and SDS-PAGE.

Detailed investigation into the esterification kinetics of D-glucose with L-alanine, catalysed by lipase from *Rhizomucor miehei* and *Candida rugosa* showed that both the lipases follow Ping Pong Bi-Bi mechanism, where L-alanine and D-glucose bind in subsequent steps, leading to the formation of dead end lipase-D-glucose complexes. Curve fitting for the best fit of the kinetic model yielded a good approximation to the apparent value of four important kinetic parameters. The cDNA sequence of rice bran lipase (RBL) was elucidated. cDNA of ~ 987bp was amplified using gene specific primers which were designed based on amino terminal sequence of lipase purified from rice

bran. Linker sites, *ECor1* and *BamH1*, were engineered for directional cloning into pRSETC vector with ampicillin gene as a selectable marker. The fragment was cloned into pRSETC vector.

Analysis (2D-PAGE) of the crude extracts indicated that rice bran contains a number of proteins.

A trypsin inhibitor from the unedible seeds of the legume sword bean (*Entada scandens L.*), purified to homogeneity was biochemically characterized to be a Kunitz type inhibitor and a single polypeptide of molecular weight 20 kDa. Phylogenetic analysis of the partially elucidated primary structure showed maximum homology with Kunitz inhibitors of tree legume. Smaller cyclic peptides were designed, based on the inhibitory loop structures of HGI. The peptides were cloned in the pMAL-p2X vector and expressed as fusion proteins.

Studies aimed at identification and quantification of toxic and antinutritional factors in the deoiled meal of tree-borne oil seeds, *Jatropha*, *Karanja* and *Simarouba*, showed presence of phorbol ester, saponins, phytic acid, tannins, trypsin inhibitor, cyanogenic glucoside in *Jatropha*; saponins, alkaloid and tannins in *Simarouba* and saponins, tannins, phytate and trypsin inhibitor in *Karanja*.

Various physicochemical treatments were tried for detoxification of the meals. Detoxification had no effect on the amino acid composition, *in vitro* protein digestibility and available

lysine. Studies on feeding rats with untreated and detoxified *Jatropha* meal indicated the need for further detoxification.

Processes

New and energy efficient processing methods were explored for improved quality products. These include reverse micellar system, direct osmosis, IR & microwave blanching and two-phase extraction methods. Other results include downstream processing of betalin and phycocyanin.

The components of the reverse micellar system, such as surfactants, organic phase and cosolvent, for the extraction of bromelain and papain have been identified. Direct osmosis, a non-thermal process for the concentration of the thermally sensitive liquids (fruit juices and natural colours), offers several advantages such as low energy consumption, better retention of heat labile components and higher concentration without deterioration of the product.

Sodium chloride and sucrose have been employed as osmotic agents in pineapple juice concentration. Direct osmosis has been employed for the concentration of bromelain from pineapple and pineapple wastes. Storage stability of IR and microwave blanched green peas has been compared with that of conventional water blanched sample for quality and other parameters. IR-MW blanched samples have been found to have good storage stability for two

months. Low temperature-low humidity drying of *basil* has resulted in a relatively better retention of volatile oil compared to hot air dried sample.

Processes were developed for the downstream processing of betalin as well as phycocyanin. A simple process was developed for the fractionation of betacyanin, betaxanthin and allophycocyanin, employing aqueous two-phase extraction. A process was developed for the extraction of C-phycocyanin from dry *Spirulina*. Conditions for the preparation of crude bromelain extract from pineapple waste were standardized. The processing conditions for the forward and back extraction of bromelain from the crude extract were so varied as to maximize enzyme activity recovery and purity.

Xylan sources such as birch wood, oat spelt and native corn cob were investigated for their efficacy towards inducing xylanase production using *Aspergillus oryzae* MTCC 5154. The endoxylanase activity of oat spelt xylan was higher compared to that of birch wood xylan. Alkali-pretreated corn cob was used for the production of xylooligosaccharides using xylanase from *Aspergillus oryzae*. SEM photographs of native corncob powder showed the existence of native xylan in the form of xylan-lignin complex, which is greatly altered during alkali treatment. Glucose-yeast extract medium was found to be the best for the cultivation of *Mortierella alpina*. Fermentation conditions were



standardized for maximum biomass, total lipid as well as arachidonic acid content.

Biotechnology

Development of new protocols for the identification of GMOs in processed foods, bioremediation potential of *Decalepis hamiltonii*, downstream processing of carotenoids from *Dunaliella* were the major contributions during this period.

PCR methods are very sensitive for the evaluation of genetically modified foods as they afford detection of up to 1% level. Procedures for the detection of regulatory sequences, taxon specific sequences and transgene sequences have been standardized for insect resistant maize and herbicide tolerant soya powder. Several commercially available, lateral flow strip (LFS) format kits for quick and on the spot testing of grains for herbicide tolerance and insect resistance have been evaluated for their detection limits, stability and easy operation. LFS method of detection of GMOs is suitable for only screening purposes. More specific confirmation by PCR based methods is desirable. Hexane extract of *Decalepis hamiltonii* root was found to be effective in inhibiting the growth of grain borne fungi, fusarium and *A. flavus*. The structural similarities of the partially characterized *Aspergillus carbonarius* during polygalacturonase production with

retinoids gave a clue of its possible therapeutic role against cancer.

Bioremediation potential of *Decalepis hamiltonii* was studied by *in vitro* assay system developed using EAT cells. Cells exposed to insecticides (lindane and endosulfon) showed cytotoxic damage due to oxidative stress. Pretreatment with *D. hamiltonii* extracts was found to inhibit oxidative stress and reduce cytotoxicity of the pesticides. Conditions were standardized for the synthesis of hapten for quinalphos. GC method was standardized for the analysis of quinalphos. The toxicity of DDVP was investigated in *C. elegans* by monitoring ACE inhibition at various concentrations, effect on egg laying, brood size and life span. Lead was obtained to the effect that *Caenorhabditis elegans* could provide an *in vitro* model system for rapid screening for toxicity ameliorative compounds. *Oryzaephilus surinamensis*, *Sitophilus oryzae* and khapra beetle larvae were found to be tolerant to sulfurlyl fluoride, ethyl formate and ethane dinitrile, respectively. Multipesticide analysis (single internal standard) was developed and validated to check its performance using both CPSIL 8CB and CPSIL 19CB column, with formulations such as chlorpyrifos, atrazine, methyl parathion and lindane. Antibodies were raised against the muscle protein of the cigarette beetle (*Lassiderma serricornis*) in rabbits. An assay was

developed that could detect all the stages of development at higher antigen concentration.

The alkaline protease of *Bacillus proteolyticus* CFR 3001 inhibited the growth of several pathogenic organisms, such as *Escherichia coli*, *B. cereus* and *Yersinia enterocolytica*. SEM studies revealed that the protease lyses the cells of these pathogenic bacteria. Red seaweeds exhibited relatively higher antioxidant activity than the brown ones. Aqueous fraction of the red seaweed, *Euचेuma kappaphycus* showed the highest superoxide scavenging activity followed by butanolic fraction of brown seaweed *Turbinaria conoides*. A downstream process for carotenoid from *Dunaliella* was developed. Carotenoids of *D. bardawil* and *D. salina* were identified and characterized by MALDI and LC-MS. A single dose of *Dunaliella* biomass could increase serum retinal significantly. *Botryococcus braunii* biomass exhibited potent antioxidant properties. Seaweeds *Euचेuma* and *Enteromorpha* were used in the preparation of food products such as *chapati*, *pakoda* and puffed rice. The seaweeds exhibited *in vitro* antioxidant activity. They contained carbohydrates, protein and niacin, apart from minerals such as iron. EntB gene was cloned from *Staphylococcus aureus*. The recombinant protein was expressed in *E. coli*. Primers were designed to construct synthetic gene for plant expression.

Indo-Brazil Workshop on Molecular Materials including Nanomaterials

The National Chemical Laboratory (NCL), Pune, organized a three-day Indo-Brazil workshop on Molecular Materials including Nanomaterials during 4-6 October 2007. The workshop was sponsored by the Department of Science and Technology, Government of India and Brazilian Academy of Sciences, Brazil. About

80 participants from various leading institutes such as Indian Institutes of Technology; Indian Institute of Science, Bangalore; Tata Institute of Fundamental Research, Mumbai; Centre for Materials of Electronic Technology, Pune; Indian Institute of Science Education and Research, Pune, besides various universities and colleges from all over India

attended the workshop. Prof. F. Galembeck led the Brazilian team consisting of six distinguished faculties drawn from all over Brazil. The workshop had six sessions.

Prof. Ajay Sood from Indian Institute of Science, Bangalore, delivered the keynote address on 'Carbon in nanodimensions: Nanotubes and graphene'. He



Clockwise from top left: Dr Sivaram delivering his welcome address; Prof. Ajay Sood delivering the keynote address; Dr Jain discussing the role and functions of DST; and Prof. Galembeck giving his remarks during the workshop



introduced the different dimensional forms of carbon such as graphite and diamond in three-dimension, two-dimensional carbon forming graphene sheets, the single walled and multi walled carbon nanotubes in one-dimensional form, and zero-dimensional carbon called fullerenes. Prof. Sood gave detailed description of graphene and the various properties of carbon nanotubes. He explained the importance of one- and two-dimensional carbons, stability of nanotubes under high pressure, new materials based on carbon nanotubes and their properties, flow induced voltage and current in the nanotubes, flow and vibration sensing applications, confinement and state of water inside the single walled carbon nanotubes and the dynamics of confined water, tuning of the Fermi level and electron transport in graphene and carbon nanotubes as well as field effect transistors based on these systems, interaction of nanotubes with biomolecules like DNA, doping of nanotubes and graphene, etc.

Dr S. Sivaram, Director, NCL, in his welcome address noted that India and Brazil were two large countries which shared several interests. The Department of Science and Technology (DST) from India and the Brazilian Academy of Sciences have entered into an agreement to promote greater interaction in science and technology between India and Brazil. The present workshop is first one to be held under this agreement. The agreement would give

opportunity to scientists in both the countries to work together on areas of common interest, write joint proposals that would be funded by DST in India and the Brazilian Academy of Sciences and would allow exchange of young students, post doctoral fellows and principal investigators.

Dr B.K. Jain, Scientist and Adviser, DST, in his talk briefed the audience on the role and functions of DST, which coordinates more than 70 bilateral agreements with different countries. Dr Jain introduced the audience to the Indo-Brazil Science and Technology Cooperation. He said that a large number of workshops in various areas have been planned for the next few years. A call for proposal between Brazil and India will be announced shortly consisting of support for joint workshops, short exploratory visits to establish contacts and joint R & D project of duration of two to three years. Both Brazil and India are emerging economies which placed high value on the importance of S & T as a key tool for economic development and upliftment of its people.

Brazil and India have set up a joint Indo-Brazil Science Council, chaired by Prof. C.N.R. Rao, National Research Professor & Linus Pauling Research Professor, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, from India and Prof. Jacob Palis, President of the Brazilian Academy of Sciences, Rio de Janeiro.

Training Programme at Non-leather Footwear Training-cum- Production Centre at NEIST Manipur Sub-station

With the initiatives of Central Leather Research Institute (CLRI), Chennai and North East Institute of Science and Technology (NEIST), Jorhat, a Non-leather Footwear Training-cum-Production Centre has been established in the NEIST Sub-station at Imphal, Manipur, under a joint project. The objective of this centre is to provide a platform/outlet to the local entrepreneurs of Manipur state enabling them to set up small scale industries in the non-leather sector and also for judicious disposal of the raw materials.

Following the setting up the centre, the first batch of trainees comprising seven participants was recently selected for imparting training at the centre, commencing from the first week of September 2007. The Principal Coordinator of the training being Dr H. B. Singh, Scientist-in-Charge of the NEIST Sub-station.



CSIR Foundation Day Celebrations at Laboratories/Institutes

Highlights of programmes organized on the occasion of CSIR Foundation Day at some of the laboratories/institutes were covered in the 15 December issue of *CSIR News*. The programmes organized at CSIO, NGRI and NIO are highlighted here:

Central Scientific Instruments Organisation (CSIO), Chandigarh

At CSIO, Prof. Manjit S. Kang, Vice-Chancellor, Punjab Agricultural University, Ludhiana, delivered the Foundation Day Lecture on 'R&D Agenda for National Food Security'. He, in his address, traced the rapid strides made by the Indian agriculture sector since independence. Prof Kang discussed various issues related to the agriculture including demographics, food production, agri-land data, food processing, infrastructure, environmental aspects, marketing details, etc. Prof Kang also laid emphasis over the role of agricultural universities,

R&D labs and policy makers with specific mention on the future directions. He stressed upon the need for promotion of excellence in frontier areas of agricultural science. Prof. Kang also said that synergy is very important and thus CSIO and PAU together can play a very important role in some significant areas, e.g. IT Sector, Nano Science, Precision Farming, etc.

Dr Pawan Kapur, Director, CSIO, while welcoming the Chief Guest, highlighted the aims and goals of CSIR and its contribution to the field of Science and Technology. He also talked about

various incentives and award schemes of CSIR for young scientists and school children. Dr Kapur also presented an overview of the on-going projects and future plans of the organisation.

Earlier, two Consultancy Agreements with M/s Recorders & Medicare Systems (P) Ltd, Chandigarh and Bharat Heavy Electricals Ltd, Gurgaon; one technology transfer agreement with to M/s RAMS Automation, Chennai; and one Memorandum of Understanding (MoU) with Bharat Heavy Electricals Ltd, Gurgaon were signed.

National Geophysical Research Institute (NGRI), Hyderabad

At NGRI, Dr Mahtab S. Bamji, FNA, Emeritus Scientist, Dangoria Charitable Trust, Hyderabad, delivered the Foundation Day Lecture on Nutrition for a Strong Nation.

Dr Bamji dwelt at length the effects of marginal malnutrition in major parts of the country. She said that the burden of malnutrition on productivity and medical expenditure is enormous on the society. Malnutrition contributes 60% of around 10 million deaths that occur globally among children under five years. Referring to the ill effects of iron deficiency, she said > 70% of women and children have iron deficiency anemia and this has adverse effect on growth, immunity, mental and motor development. Almost 20% of pregnancy related deaths are caused by iron deficiency.



Dr V.P. Dimri, Director, NGRI, honouring Dr M. S. Bamji with a memento



CSIR Foundation Day Celebrations

Underlining the importance of health, she mentioned health is the most important determinant of development and the various determinants of health are nutrition, environment and genetics. She emphasized the need of political will to make health and nutrition agenda for the country's development.

Dr Bamji remarked that despite substantial increase in production, the per capita availability of vegetables, fruits and animal products is low. Latter are mostly

out of reach for the poor. She further said that since 1996 there has been a decline in yield growth of even wheat and meat.

After the lecture, Dr Bamji presented mementos/awards to NGRI staff members who had retired during the last year and also those who had completed 25 years of service in CSIR. She also gave away cash awards to NGRI staff children who had secured 90% or more marks in three science subjects in intermediate examination. She presented a cash

prize of Rs 5000/- to Shri V.Rajasekhar, Technical Officer, announced by CSIR Sports Promotion Board for winning chess individual competition during XXXVIII SSBMT held at CRRI, New Delhi.

Earlier, Dr V.P. Dimri, Director, NGRI, introduced the speaker to the distinguish gathering and staff members. In his welcome address Dr Dimri summarized the role of NGRI in pollution control studies in groundwater.

Dr S.N. Prasad, Scientist G, proposed a vote of thanks.

National Institute of Oceanography (NIO), Goa

NIO celebrated the CSIR Foundation Day by organizing a public lecture on 'Erosion in River Basins of India: Causes and Consequences' by Prof. S. Krishnaswami, Indian National Science Academy (INSA) Professor at Physical Research Laboratory (PRL), Ahmedabad.

Studies of chemical and physical erosion of river basins have been a topic of research among geochemists since long. Early studies on chemistry of rivers were motivated by the quest to learn about the sources of various elements to water, for example, in terms of atmospheric supply, mineral weathering, and

biogenic inputs and to infer about their distribution and reactivity in the oceans. During the past two decades, the emphasis of investigations on these aspects is more on the role of rivers as an agent of long term global change by regulating the CO₂ budget of the atmosphere. In this context, studies



CSIR Foundation Day Lecture being delivered at NIO

on young orogenic belts (Himalaya) and basaltic terrains (Deccan Traps) with conducive monsoon climate for intense weathering and erosion, has received significant attention among the global river basins. In India, research at PRL has helped understand the importance of rivers as a key component of the Earth System influencing Global Change.

While discussing weathering processes, Prof. Krishnaswami, said, “Weathering breaks down rocks due to their physical and chemical reactions with the atmosphere, hydrosphere and biosphere. Physical weathering results from mechanical fragmentation caused due to stress, whereas chemical weathering is a process by which the rocks are converted to dissolved components and secondary minerals. The chemical weathering is a key pathway in the geochemical cycles of elements and can be explained in three patterns, i.e. carbonate, sulfide and silicate weathering. Out of these the silicate weathering is a sink for CO₂ on land and the weathering rates can be studied using strontium (Sr) isotopes”. The important radiogenic strontium isotope — ⁸⁷Sr/⁸⁶Sr — ratios constraint silicate/ carbonate weathering contributions to rivers. The detailed ⁸⁷Sr/⁸⁶Sr analysis of samples from Himalayan rivers show that silicate weathering contributes significantly high (about 20%) by the silicate rock formations. Studies on young orogenic belts (Himalaya) and basaltic terrains (Deccan Traps) act upon by the monsoon climate, resulting in chemical weathering — quite high compared to the other global rivers.

Prof. S. Krishnaswami concluded that the rapid silicate (chemical) weathering of rocks in the Himalayan region drawing down CO₂ from the atmosphere, which can reduce the temperature, is debated as there is the equally rapid rate of emission of carbon dioxide into the atmosphere resulting in increasing of the temperature.

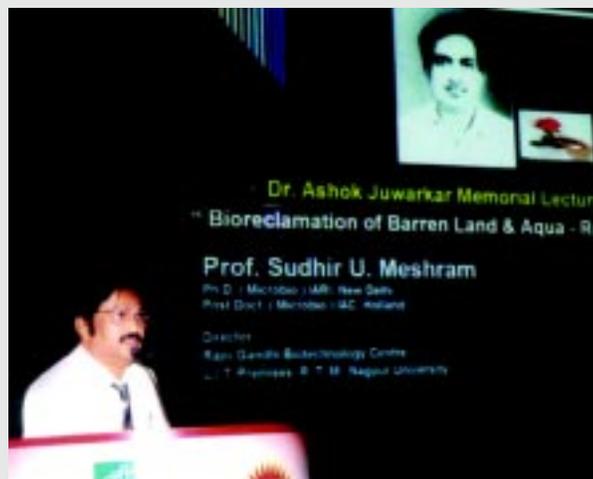
Dr Ashok A. Juwarkar Memorial Lecture

Bio-reclamation of Barren Land and Aqua-reservoirs

Dr Sudhir Meshram, Director, Rajiv Gandhi Biotechnology Centre (RGBC), RTM Nagpur University delivered Dr Ashok Juwarkar Memorial Lecture at the National Environmental Engineering Research Institute, Nagpur, on 13 July 2007. The title of the lecture was ‘Bio-reclamation of barren land and aqua-reservoirs’.

Dr Meshram began his lecture by explaining that it is not proper to term any land as barren or wasteland. In fact, all wastelands can be converted into usable lands and hence it is appropriate to call such lands as reclaimable lands. Dr Meshram informed that the country has about 175 million hectares of such land, of which 44.4 million hectares are in Maharashtra alone and there will be a substantial increase in this by 2035.

Dr Meshram opined that although economic development is essential, but in no case fertile land should be used for Special Economic Zones (SEZ). He stated that indigenous technology should be used to convert wasteland into fertile land. He informed that Rajiv Gandhi Biotechnology Centre at RTM Nagpur University had planted *Subabul* trees in wasteland about ten years ago on experimental basis. The saplings were inoculated with *rhizobium* and now the trees are fully grown. He pointed out that this is a classic example of use of indigenous technology for reclamation of barren land. But much more has to be done in this direction. He informed that various genetic engineering processes are being utilized as a tool to develop barren land. Similarly, even aqua-reservoirs



Dr Sudhir Meshram, Director, Rajiv Gandhi Biotechnology Centre, RTM Nagpur University, delivering the lecture on “Bio-reclamation of barren land and aqua-reservoirs”



can be reclaimed using *Bacillus thuringiensis* by which fish yield can be maintained, he said. Dr Meshram advised the scientists to deliver the outcome of R&D to villages. He informed that his Centre is using biotechnology in tribal and rural areas for benefit of socio-economic welfare.

Earlier, in his welcome address, Dr Sukumar Devotta, Director, NEERI, appreciated the valuable contributions of Late Dr A.S. Juwarkar in the field of Environmental Science and Engineering. He also lauded the efforts being made by the Rajiv Gandhi Biotechnology Centre and desired to collaborate with the Centre to make environment better.

Dr S.P. Pande, Scientist and Head, R&D Planning Unit, NEERI, introduced the Chief Guest and Shri. A. Ghosh., Scientist, R&D Planning Unit, NEERI, proposed the vote of thanks.

Dr Mukul Das elected FNAAS



Dr Mukul Das receiving the award from Dr M.S. Swaminathan, President, National Academy of Agricultural Sciences

Dr Mukul Das, Scientist F and Head, Food Toxicology Division of the Industrial Toxicology Research Centre (ITRC), Lucknow, has been elected Fellow of National Academy of Agricultural Sciences (FNAAS). Dr Das has been working on molecular mechanisms of toxicity and carcinogenicity of compounds found to be present in food as contaminants or adulterants, for example, non-permitted colours, lathyrus, argemone oil, polycyclic aromatic hydrocarbons, mycotoxins, etc. and an approach to prevent their toxicity. His work on biochemical basis of toxicity of argemone oil leading to Epidemic Dropsy and the systematic therapeutic interventions of the disease by bio-antioxidants has been used in the control of recent epidemics at New Delhi, Kannauj and Lucknow. He has contributed to the establishment and characterization of neuronal and cutaneous tissues as a site of xenobiotic and carcinogen metabolism. He has evaluated a series of synthetic and naturally occurring compounds for their anticarcinogenic potential using mouse skin tumor model and demonstrated the mechanism of anticarcinogenicity of these agents. He has also developed new and simple biochemical and chemical assays and has patented two technologies for the detection of Butter yellow and Argemone oil in edible oils.

He has published more than 140 research papers, which are extensively cited. He is a recipient of Burroughs Welcome Fund Award, USA (1985); Schering-Plough Foundation Award Dermatology Foundation, USA (1986); International Union of Biochemistry Fellowship Award, Prague, Czechoslovakia (1988); Institutional Young Scientist Award, (1990); and Fellow of Society of Toxicology, India, (2002). He is a member of several food regulatory bodies of the country, DBT Task Force Committee on Biotechnological Approaches for Food & National Security and WHO Temporary Advisor for Joint Expert Committee on Food Additives, Geneva.