

# **DEPARTMENT OF BIOTECHNOLOGY**

## **ANNUAL REPORT**

2004 - 2005

### **I) INTRODUCTION**

The Department of Biotechnology at the Indian Institute of Technology - Guwahati, started in November 2002, has both Undergraduate (B.Tech) and doctoral (Ph.D.) academic programmes. It is one of its kind in the whole North-Eastern India providing an excellent research environment and imparting quality education through its B.Tech. and Ph.D. programmes. The department has faculty from diverse streams and specializations.

The department is developing state-of-art research facilities to promote safe, sustainable and beneficial use of natural resources for producing market-driven biomolecules as well as therapeutics.

### **II) ACADEMIC ACTIVITIES**

The department is currently offering two programmes – B.Tech. and Ph.D. The B.Tech. degree offers comprehensive education in biotechnology focusing on basic concepts and techniques in biotechnology and allied engineering sciences. The programme consists of core and elective courses, seminars, summer training and a final year research project. The department also offers a Modern Biology course as a core subject to first year B.Tech. students of all disciplines.

The department has initiated research leading to the award of the Ph.D. degree in the following areas: Protein Folding and Aggregation; Computer Simulation to study Drug-Resistance of HIV-protease, Enzyme and Microbial Technology; Plant Genetic Engineering; Gene Therapy for Viral and Metabolic Diseases; Molecular Fingerprinting and Expression Systems in Food Grade bacteria; Biochemistry and Molecular Biology of Carbohydrate Enzymes; Fungal Biotechnology and Bio-pesticides, Biological Control of Insect Pests; Environmental bioremediation, Bioprocess development (upstream to downstream), Metabolic Engineering, Computational molecular biophysics, structural biology, protein function, In silico drug design.

### **III) STUDENT UPTAKE**

Student intake in the year April, 2004- March, 2005 academic session:

B.Tech. : 23

Ph.D. : 04

#### **IV) FACULTY STRENGTH**

Faculty strength as on March 31, 2005: **13 (Thirteen)**

Assistant Professor: **9 (Nine)**

Associate Professor: **3 (Three)**

Senior Lecturer: **1 (One)**

#### **V) MAJOR EQUIPMENTS AND FACILITIES**

The department has developed fully equipped B.Tech. Laboratories for Biochemistry, Microbiology, Molecular Biology and Plant Biotechnology. The department has procured major equipments like High speed centrifuges including one Ultracentrifuge, Inverted Fluorescence Microscopes, Water purification unit for deionised water, Steady State Fluorimeter, Gel Documentation system, Photoperiodic racks, CO<sub>2</sub> Incubators and so on. Many more equipments are in the pipeline. At present, the department is developing the Biochemical Engineering and Computational Biology Laboratories. The department is developing a cell-culture facility for screening bioactive compounds with therapeutic applications. A well-equipped Computational Biology and Biochemical Engineering Labs are also being developed to undertake projects of industrial relevance. The department is equipped with up-to-date computers and software, such as SYBYL, AMBER 8.0 etc. to provide a thorough knowledge of computational biology techniques.

#### **VI) RESEARCH & DEVELOPMENT ACTIVITIES**

The department is committed to research in all aspects of biotechnology. Research projects sponsored by Department of Science and Technology (DST), Ministry of Human Resource and Development (MHRD) and Department of Biotechnology (DBT) are currently in progress. Several Ph.D. students are pursuing research for their doctoral degree. The research in the department is carried out in diverse areas:

Protein aggregation with emphasis on structural characteristics of aggregates and detection of protein aggregates in solution, Protein folding with focus on residual structures; Development of redox and lipolytic enzymes for regio and enantio-selective synthesis of pharmaceutical compounds; Genetic engineering of grain legumes for biotic and abiotic stress tolerance, marker free transgenics; Phylogenetic analysis of emerging infectious viruses, Gene-therapy approaches for viral and metabolic diseases; Molecular fingerprinting of industrial food grade microorganisms, Identification of bioactive compounds from metagenomic library, Molecular analysis of carbohydrate enzymes; Functional genomics, Biological control of insect pests, Plant tissue culture and biochemical analysis; Environmental bioremediation, Biohydrometallurgy; Bioprocess development (upstream to downstream), Bioreactor design and control, Metabolic engineering, Bioenergy; Computational Biology, In silico drug design; Biomolecule Immobilization, Biosensors, Analytical Biochemistry and Bioassays.

#### **VII) SPONSORED RESEARCH PROJECTS**

**Title:** Protein Folding: Looking for residual structures in denatured proteins.

**Investigator:** Dr. R.Swaminathan

**Sponsoring Agency:** Ministry of Human Resource Development (MHRD)

**Duration:** 3.5 years

**Title:** Studies on the metabolic machinery involved in the assimilation of alkane by filamentous fungi.

**Investigator:** Dr. P.Goswami

**Sponsoring Agency:** Department of Science and Technology (DST)

**Duration:** 3 years

**Title:** Genetic engineering of cowpea (*Vigna unguiculata* L. Walp) for storage pest resistance.

**Investigator:**Dr. L.Sahoo

**Sponsoring Agency:**DST

**Duration:** 3 years

**Title:** Construction of a hybrid pro-drug-suicide gene transduction system.

**Investigator:** Dr. S.S.Ghosh

**Co-Investigator:** Dr. A.Ramesh

**Sponsoring Agency:** MHRD

**Duration:** 3 years

**Title:**Construction of environmental library to access microbial diversity for identification of bioactive compounds.

**Investigator:** Dr. A.Ramesh

**Co-Investigator:** Dr. S.S.Ghosh & Dr. R.Swaminathan

**Sponsoring Agency:** DBT

**Duration:** 2 years

**Title:** Signature gene mediated specific identification and molecular fingerprinting of industrial strains of lactic acid bacteria.

**Investigator:** Dr. A.Ramesh

**Co-Investigator:** Dr. S.S.Ghosh

**Sponsoring Agency:** MHRD

**Duration:** 2 years

**Title:** Computer simulation to study drug resistance of HIV-Protease.

**Investigator:** Dr. Pradipta Bandyopadhyay

**Sponsoring Agency:** DST

**Duration:** 3 years

**Title:** Genetic evaluation and mass production of entomopathogenic fungi for development as a potent biopesticide.

**Investigator:** Dr Gurvinder Kaur Saini

**Sponsoring Agency:** DST

**Duration:** 3 years

## **VII) CONSULTANCY**

**Title:** Sustainable management of forest resources of Nagaland State.

**Investigator:** Dr. L.Sahoo

**Co-Investigator:** Dr. S.Dutta (Dept of Civil Engineering)

**Duration:** 2004-2005

## IX) PUBLICATIONS

### A) JOURNAL

#### INTERNATIONAL:

- 1) **Arun Goyal**, A.L. Carvalho, J.A.M. Prates, D.N. Bolam, H.J. Gilbert, V.M.R. Pires, L.M.A. Ferreira, A. Planas, M.J. Romao and C. M.G.A. Fontes, 2004. The family 11 Carbohydrate-Binding Module of *Clostridium thermocellum* Lic26ACel5E accommodates  $\beta$ -1,4 and  $\beta$ -1,3-1,4-mixed linked glucans at a single binding site. *Journal of Biological Chemistry* **279**(33): 34785-34793.
- 2) N.D. Singh, **L. Sahoo**, R. Saini, N.B. Sarin and P.K. Jaiwal, 2004. *In Vitro* regeneration and recovery of primary transformants from shoot apices of pigeonpea using *Agrobacterium tumefaciens*. *Physiol. Mol. Biol. Plants* **10**(1): 65-74.
- 3) L. Homchaudhuri and **R. Swaminathan**, 2004. Near ultraviolet absorption arising from lysine residues in close proximity: A probe to monitor unfolding and aggregation in lysine-rich proteins. *Bull. Chem. Soc. Japan* **77**: 765-769.
- 4) **P. Bandyopadhyay**, 2005. Accelerating QM/MM sampling using pure MM potential: the case of effective fragment potential. *Journal of Chemical Physics* **122**: 091102. (The article has also been selected in *virtual journal of biological physics research*, March 1 issue, 2005).
- 5) K. Ravikumar, **K. Pakshirajan**, T. Swaminathan and K. Balu, 2005. Optimization of batch process parameters using response surface methodology for dye removal by a novel adsorbent. *Chemical Engineering Journal* **105**: 131-138.

NATIONAL: NIL

### B) CONFERENCE PROCEEDINGS

#### INTERNATIONAL:

- 1) T. Swaminathan, E. R. Rene, K. Jagannathan and **K. Pakshirajan**. Treatment of effluents containing hazardous pollutants using rotating biological contactor. Proceedings of the second international symposium on 'Southeast Asian Water Environment', Hanoi, Vietnam. December 1-3, 2004. pp16.
- 2) R. Saisheela, N. Bhaskar, **K. Pakshirajan**, E. R. Rene and T. Swaminathan. Biotransformation of Cr (VI) by mixed culture – Studies on inhibition kinetics of microbial growth. Proceedings of the international conference on 'Advances in Industrial Wastewater Treatment', Chennai, India. February 9-11, 2005. pp65.

NATIONAL: NIL

## X) A) PAPER PRESENTED IN CONFERENCES/WORKSHOP/SYMPOSIA

### INTERNATIONAL:

- 1) **Arun Goyal**, A.L. Carvalho, V.M.R. Pires, J.A.M. Prates, L.M.A Ferreira, D.N. Bolam, H.J. Gilbert, M.J. Romão and C.M.G.A. Fontes, 2004. Structural and functional analysis of a family 11 carbohydrate binding module of *Clostridium thermocellum* bi-functional cellulosomal cellulase Lic26A-Cel5E. The 2<sup>nd</sup> Symposium of Protein Society-Protein Structure and Function, October 28-30, 2004 at Indian Institute of Technology Bombay, Mumbai, India.
- 1) L. Homchaudhuri, M. Agrawal, N. Sarma, S.B. Santra and **R. Swaminathan**, 2004. Effect of macromolecular crowding on the rate of alkaline phosphatase catalysed hydrolysis reaction. The 2<sup>nd</sup> Symposium of Protein Society-Protein Structure and Function, October 28-30, 2004 at Indian Institute of Technology Bombay, Mumbai, India.
- 3) **Arun Goyal**, M. Nigam and S.S. Katiyar, 2004. *Leuconostoc mesenteroides* NRRL B-512F dextransucrase purification by phase partitioning. Bioconvergence, November 18-20, 2004 at Thapar Institute of Engineering and Technology, Patiala, India.

### NATIONAL:

- 1) **Gurvinder Kaur** and V. Padmaja, 2004. Evaluation of *Beauveria bassiana* (Balsamo) Vuillemin isolates for pathogenicity against *Spodoptera litura* (Fabricius) and *Helicoverpa armigera* (Hubner). 26th Annual conference and symposium of Indian Society of Mycology and Plant Pathology. October 7– 9, 2004 at Goa University, Goa.
- 2) **Gurvinder Kaur** and V. Padmaja, 2004. Evaluation of *Beauveria bassiana* (Hyphomycetes) isolates against *Spodoptera litura* (Lepidoptera:Noctuidae) larval stages and detection of RAPD-PCR based molecular markers for virulence. 45th Annual conference of Association of Microbiologists of India, November 23–25, 2004 at National Dairy Research Institute, Karnal, Haryana.
- 3) **Arun Goyal**, D.P. Tyagi and S.S. Katiyar, 2004. Identification of a single cysteine residue in dextransucrase of *Leuconostoc mesenteroides* NRRL B-512F by amino acid analysis. 45<sup>th</sup> Annual Conference of Association of Microbiologists of India, November 23-25, 2004 at National Dairy Research Institute, Karnal, India.
- 4) A.L. Carvalho, V.M.R. Pires, J.A.M. Prates, L.M.A Ferreira, M.J. Romão, C.M.G.A. Fontes and **Arun Goyal**, 2005. Crystal structure and functional properties of carbohydrate binding module of a cellulase from *Clostridium thermocellum*. 34<sup>th</sup> National Seminar on Crystallography (NSC-34), January 10-12, 2005 at Gauhati University, Guwahati, India.

## B) CONFERENCES/WORKSHOP/SYMPOSIA ATTENDED

### INTERNATIONAL:

- 1) Interaction meeting with Members of the Bamboo Thematic Network of European Union at Guwahati held on October 25-26, 2004. **By Dr L. Sahoo.**

NATIONAL:

- 1) National Workshop on Conservation and Sustainable Utilization of Medicinal Plants of North-East India, May 27-28, 2004 held at NEHU, Shillong. **By Dr L.Sahoo.**
- 2) National Consultation on biosafety aspects related to Genetically Modified Organisms for members and nominees of DBT on Institutional Biosafety Committees (IBSCs) held on October 27, 2004 at National Institute of Immunology, New Delhi. **By Dr L. Sahoo.**
- 3) Indian Academy of Sciences Refresher Course on "Plant Genetic Engineering" held at Department of Plant Biotechnology, School of Biotechnology, MKU, Madurai from December 7-21, 2004. **By Dr L. Sahoo.**
- 4) National Seminar on Genetically Modified Organisms- Biosafety Aspects organized by Delhi University Botanical Society at Indian National Science Academy, New Delhi from March 10-11, 2005. **By Dr R. Chaturvedi.**
- 5) Workshop on Biodiesel, Development of Resources & Processes for Commercial Applications, organized by Indian Oil Corporation Limited at Guwahati Refinery on March 12, 2005. **By Dr L. Sahoo.**

**XI) INVITED LECTURES OF DEPARTMENTAL FACULTY:**

- 1) **R. Swaminathan.** Application of fluorescence technique in biology. 50<sup>th</sup> Technical session of Assam Science Society and national conference on current trends of research in science and technology at Gauhati University, Guwahati, India. January 28-29, 2005.

**XII) VISITORS FROM OTHER INSTITUTES/UNIVERSITIES:**

- 1) Prof. Pradip Sinha, Head, Department of Biosciences and Bioengineering, IIT-Kanpur. (March 15-16, 2005).
- 2) Prof. T.K.Ghose, Professor (Retd.), Department of Biochemical Engineering and Biotechnology, IIT Delhi (April 7-11, 2004).

**XIII) SHORT-TERM COURSES: NIL**

**XIV) SEMINARS/WORKSHOPS/CONFERENCES ORGANIZED:NIL**

**XV) INVITED LECTURES/VISITORS:NIL**

**XVI) PATENT FILED: NIL**

**XVII) AWARDS & HONOURS: NIL**

**XVIII) ANY OTHERS (SPECIAL MENTION): NIL**

**XIX) FACULTY MEMBERS ALONG WITH E-MAIL I/DS AND AREAS OF INTEREST:**

**Dr Rajaram Swaminathan**

Associate Prof. and Head  
Protein Structure, Folding and Aggregation, Effects of Macromolecular crowding on physiological media.  
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**Dr Siddhartha Sankar Ghosh**

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**Dr Aiyagari Ramesh**

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