

DEPARTMENT OF BIOTECHNOLOGY
ANNUAL REPORT
2005 - 2006

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 kinds 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, 2005- March 2006 academic session:

B.Tech. : 26

Ph.D. : 15

IV) FACULTY STRENGTH

Faculty strength as on March 31, 2006: 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 Super speed centrifuges, Ultracentrifuge, Inverted Fluorescence Microscopes,

PCR machine, Steady State Fluorimeter, UV-Visible thermostat control spectrophotometer, Ultrasonicator, Fermenters, Gel Documentation system, Water purification unit for deionised water, Fraction collector, Cell disrupter, and so on. Many more equipments are in the pipeline. 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. A Mammalian cell-culture facility has also been developed for screening bioactive compounds with therapeutic applications.

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), Council of Industrial and Scientific Research (CSIR) 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 and development of biosensors; Genetic engineering of grain legumes for biotic and abiotic stress tolerance, marker free transgenic; Identification of plus trees and mass cultivation in biofuel plants; Segregation of abiotic stress genes in mapping population of rice; 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; 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.

Some of the highlights of above research activities are;

- Detection and identification of lactic acid bacteria targeting ribosomal RNA and signature genes
- Assessment of microbial diversity, phylogenetic analysis and construction of bacterial genomic library of soil microbes.
- Established mammalian cell culture and transfection techniques.
- Developed new generation of nonviral gene therapy vectors.
- Synthesis of nanoparticles by biological systems and understanding the mechanism of nanoparticle & cell interaction in fluorescent bacteria.
- Drug resistance of HIV-protease has been investigated. Simulation using dual processor Linux machines has been achieved.
- A detailed study of medicinal plants of Assam used for curing skin diseases and used as cosmetics have been compiled.
- Structural, functional and biochemical analysis of modular cellulases from *Clostridium thermocellum*.
- Purification, characterization and structural analysis of glycoside hydrolases from *Leuconostoc mesenteroides*.
- Fungal redox enzymes with novel molecular and catalytic properties for the development of biosensors.
- Genetic evaluation and transformation studies in entomopathogenic fungi
- Mass production and development of a potent biopesticide using entomopathogenic fungi.

VII) SPONSORED RESEARCH PROJECTS

ONGOING:

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

NEW PROJECTS:

Title : Structural, functional and biochemical analyses of modular cellulases
Investigator : Dr Arun Goyal
Sponsoring Agency : CSIR
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

Title : Evaluation of *Beauveria bassiana* (Bals.) Vuill and *Metarhizium anisopliae* (Metsch.) Sorokin isolates for virulence, development of DNA markers and transformation studies.
Investigator : Dr Gurvinder Kaur Saini
Sponsoring agency : MHRD
Duration : 3.5 years

Title : In vitro morphogenesis and biochemical analysis of neem (*Azadirachta indica* A. Juss).
Investigator : Dr Rakhi Chaturvedi
Sponsoring Agency : DST
Duration : 3 years

Title : Collection of *Pongamia* germplasm from North Guwahati for identification of plus trees and mass cultivation in wasteland
Investigator : Dr Latha Rangan
Sponsoring Agency : DST
Duration : 3 years

Title : Effect of NaCl on expression of translation initiation factor (eIF1) gene in leaf and roots of rice varieties and mapping of the gene in segregating populations.
Investigator : Dr Latha Rangan
Sponsoring Agency : CSIR
Duration : 3 years

Title : Glucose sensor based on evanescent wave induced fluorescence spectroscopy
Investigator : Sunil Khijwania
Co-Investigator : Mr Utpal Bora
Sponsoring Agency : BRNS, DAE,
Duration : 3 years

Title : Engineering nanoscale materials and their applications in nanotechnology
Investigator : Arun Chattopadhyay
Co-Investigator : Dr S. S. Ghosh
Sponsoring Agency : DST

Duration : 3 years

VIII) CONSULTANCY- NIL

IX) PUBLICATIONS

A. JOURNAL

INTERNATIONAL:

1. Mahanty, **K. Pakshirajan** and V. Venkata Dasu. (2006). Production and properties of a biosurfactant applied to PAH solubilization. *Applied Biochemistry and Biotechnology*. To appear in March issue.
2. Lopamudra Homchaudhuri, Satish Kumar and **Rajaram Swaminathan** (2006). Slow aggregation of lysozyme in alkaline pH monitored in real time employing the fluorescence anisotropy of covalently labelled dansyl probe. *FEBS Letters* **580**, 2097-2101.
3. **Siddhartha S. Ghosh**, P. Gopinath and A. Ramesh (2006). Adenoviral vectors: A promising tool for gene therapy. *Applied Biochemistry and Biotechnology* Vol. **133**, No. 1.
4. **K. Pakshirajan** and T. Swaminathan. (2006). Continuous Biosorption of Pb, Cu and Cd by *Phanerochaete chrysosporium* in a packed column reactor. *Soil and Sediment Contamination: an international journal*, **15** (2), 187-197.
5. **Pradipta Bandyopadhyay** and B. R. Meher. (2006). Drug resistance of HIV-1 Protease against JE-2147: I47V mutation investigated by molecular dynamics simulation. *Chemical Biology and Drug Design*. **67**, 155,
6. Kiran Kumar and **Pranab Goswami**. (2006) Functional characterization of alcohol oxidases from *Aspergillus terreus* MTCC 6324 *Appl Microbiol Biotechnol*. DOI 10.1007/s00253-006-0381-y (Online)
7. Abinash Pratim Saikia A, Venkat Kishore Ryakala, Pragya Sharma, Pranab Goswami, **Utpal Bora** (2006) Ethnobotany of medicinal plants used by Assamese people for various skin ailments and cosmetics *Journal of Ethnopharmacology* xxx-xxx doi: 10.1016/j.jep.2005.11.033 (Online).
8. **Arun Goyal**, E. Taylor, C.I.P.D. Guerreiro, J.A.M. Prates, V. Money, N. Ferry. C. Morland, A. Planas, J.A. Macdonald, R.V. Stick, H.J. Gilbert, C.M.G.A. Fontes and G.J. Davies (2005) How family 26 glycoside hydrolases orchestrate catalysis on different polysaccharides? Structure and activity of a *Clostridium thermocellum* licheninase, CtLic26A. *Journal of Biological Chemistry* **280(38)**, 32761-32767.
9. M. Nigam, **Arun Goyal** and S.S. Katiyar (2006) High yield purification of *Leuconostoc mesenteroides* NRRL B-512F dextransucrase by phase-partitioning. *Journal of Food Biochemistry*, **30**, 12-20.
10. Eganathan P, Subramanian H M SR, **Latha R**, Srinivasa Rao C. (2006). Oil analysis in seeds of *Salicornia brachiata*. *Industrial Crops and Products*. **23**: 177-179.

11. **U. Bora**, P. Sharma, S. Kumar, K. Kannan and P. Nahar. (2006) Photochemical activation of polycarbonate surface for covalent immobilization of a protein ligand. *Talanta. (In Press)*

NATIONAL:

1. Ravi K. Purama and **Arun Goyal** (2005) Dextranucrase production from *Leuconostoc mesenteroides*. *Indian Journal of Microbiology* **45(2)**, 89-101.
2. Sangeeta Bharali, Ravi K. Purama, Avishek Mazumder, Carlos M.G.A. Fontes and **Arun Goyal** (2005) Molecular cloning and biochemical properties of family 5 glycoside hydrolase of bi-functional cellulase from *Clostridium thermocellum*. *Indian Journal of Microbiology* (in press).

B. CONFERENCE PROCEEDINGS

INTERNATIONAL: NIL

NATIONAL:

1. **Pradipta Bandyopadhyay**. Computer simulation to study complex biological processes 3rd National conference of the Biotechnology society of India, Dec., 2005.
2. Preety Vatsyayan, A. Kiran Kumar, and **Pranab Goswami**, Characterization of Alkane Oxygenase produced by *Aspergillus terreus*. 46th Annual Conference, *MICROBIOTECH 2005*, Hyderabad 8-10 December 2005 Page no: 103 (Ind 80).
3. A. Kiran Kumar, and **Pranab Goswami**, Subcellular localization and partial characterization of alcohol oxidase produced by *Aspergillus terreus* 46th Annual Conference, *MICROBIOTECH 2005*, Hyderabad 8-10 December 2005 Page no: 23 (Ind 5).

C. OTHER PUBLICATIONS

BOOKS: – NIL

CHAPTERS:

1. Malcolm Elliott, Leila G. Rubia, **Latha R**, Miroslav Kaminek and Anatole Krattiger (2005), Plant Biotechnology in Developing Countries: Opportunities and Constraints. In: Serageldin, I. and Persley, G.J. (eds) *Discovery to Delivery: BioVision Alexandria 2005*. Alexandria: Bibliotheca Alexandrina, 2005, pp. 95-109.

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

INTERNATIONAL:

2. Lopamudra Homchaudhuri, Satish Kumar and **Rajaram Swaminathan** (2006). Slow aggregation of lysozyme in alkaline pH monitored in real time employing the fluorescence anisotropy of covalently labelled probe (**Poster**). 216-Pos/B82, Session: Protein assemblies

- and aggregates. Presented as a poster on 19th Feb 2006 at the 50th Annual Meeting of the Biophysical Society held at Salt Lake City, Utah, USA during Feb 18-22, 2006.
3. A.Kiran Kumar, and **Pranab Goswami**. (2005) Alcohol Oxidases with novel catalytic properties from *A. terreus*. *Catalysis and Biocatalysis in Green Chemistry : Royal Society of Chemistry Conference*, Cambridge UK 11-13 December 2005. P02.
 5. Sangeeta Bharali, Ravi Kiran Purama, Avishek Mazumder and **Arun Goyal** (2006) Hyperexpression, purification and biochemical properties of a clostridial cellulase. International Symposium on Frontiers and Biotechnology-Retrospect and Prospect, January 8-10, 2006, Osmania University, Hyderabad, India .
 6. Ravi Kiran Purama, Avishek Mazumder and **Arun Goyal** (2006) Purification and functional characteristics of family 70 glycoside hydrolase from *Leuconostoc mesenteroides* NRRL B-742. International Symposium on Frontiers and Biotechnology-Retrospect and Prospect, January 8- 10, 2006, Osmania University, Hyderabad, India.
 7. J.A.M. Prates, L.M.A. Ferreira, C.M.G.A. Fontes and **Arun Goyal** (2005) Functional properties of a family 26 Licheninase from *Clostridium thermocellum*. Microbial Diversity-2005, April 16-18, 2005, University of Delhi South Campus, New Delhi, India.
 8. **Arun Goyal**, E. Taylor, J.A.M. Prates, G.J. Davies, H.J. Gilbert, L.M.A. Ferreira and C.M.G.A. Fontes (2005) Insights into the molecular determinants of substrate specificity of Lic26A. 6th Carbohydrate Bioengineering Meeting, April 3-6, 2005, Barcelona, Spain.
 9. **U. Bora**. (2005) Surface functionalization of polymeric carriers using a photoreactive heterobifunctional reagent. BioNANO3: BIONANOTECHNOLOGY 2005 Brighton, United Kingdom

NATIONAL:

1. Mahanty, V.V. Dasu and **K. Pakshirajan**. (2005) Production and Properties of a Biosurfactant from Pyrene utilizing Microbial Culture. 46th Annual conference of Association of Microbiologist of India, Hyderabad, December 2005.
2. Priyanka Srivastava and **Rakhi Chaturvedi** (2006). In vitro morphogenesis and biochemical analysis in neem (*Azadirachta indica* A. Juss.). Second International Symposium on Green/Sustainable Chemistry. January 10-13 at University of Delhi, Delhi.
3. Ravi Kiran Purama, Avishek Mazumder and **Arun Goyal** (2005) Production and purification of family 70, glycoside hydrolase from *Leuconostoc mesenteroides* NRRL B-742. 46th Annual Conference of Association of Microbiologists of India (AMI), December 8-10, 2005, University of Hyderabad, Hyderabad, India.
4. Ravi Kiran Purama and **Arun Goyal** (2005) Structural analysis, comparative modelling and functional properties of family 2, acetyl-xylan esterase from *Clostridium thermocellum*. 2nd Convention of Biotech Research Society of India (BRSI), November 24-26, Anna University, Chennai, India.
5. **Arun Goyal**, L.M.A. Ferreira and C.M.G.A. Fontes (2005) Molecular characterisation of a

- cloned, family 5 glucoside hydrolase (GH5) module of bifunctional cellulase from *Clostridium thermocellum*. Annual Meeting of Society of Biological Chemists of India (SBCI), November 7-10, 2005, Central Drug Research Institute, Lucknow, India.
6. **Gurvinder Kaur Saini**. "Entomopathogenic fungi - potential biocontrol agents". Global conference - II on Plant health - Global wealth, Udaipur, Nov.25-29, 2005.
 7. **Gurvinder Kaur Saini**. "Development of a potent biopesticide using entomopathogenic fungi". National seminar on Current trends in crop disease management for improving productivity, RRL, Jorhat, Jan.19-20, 2006.

B). CONFERENCES/WORKSHOP/SYMPOSIA ATTENDED

INTERNATIONAL:

1. **Rajaram Swaminathan** (2006). 50th Annual Meeting of the Biophysical Society held at Salt Lake City, Utah, USA during Feb 18-22, 2006.
2. **Pranab Goswami**. (2005) *Catalysis and Biocatalysis in Green Chemistry: Royal Society of Chemistry Conference*, Cambridge UK 11-13 December 2005. P02.
3. **Arun Goyal** (2005) 6th Carbohydrate Bioengineering Meeting, April 3-6, 2005, Barcelona, Spain.
4. **U. Bora**. (2005) BioNANO3: BIONANOTECHNOLOGY 2005 Brighton, United Kingdom

NATIONAL:

1. **Gurvinder Kaur Saini**. Global conference - II on Plant health - Global wealth, Udaipur, Nov.25-29, 2005.
2. **Gurvinder Kaur Saini**. National seminar on Current trends in crop disease management for improving productivity, RRL, Jorhat, Jan.19-20, 2006.
3. **Pradipta Bandyopadhyay**. CDAC conference on Current Trends in Computational Biology” Pune, Nov. 2005.
4. **Rakhi Chaturvedi**. National Conference on “Biodiversity Related International Conventions: Role of Indian Scientific Community” organized by Delhi University Botanical Society at Indian National Science Academy, New Delhi from March 8- 10, 2006.
5. **U. Bora**. Molecular Techniques for Gene Characterization and Genome Analysis. NBAGR, Karnal, November 17-26, 2005.
6. **Arun Goyal** (2005) Microbial Diversity- 2005, April 16-18, 2005, University of Delhi South Campus, New Delhi, India.

XI) INVITED LECTURES OF DEPARTMENTAL FACULTY:

1. **Dr. R. Swaminathan.** “Influence of Macromolecular Crowding and Protein Aggregation on the Function and Dynamics of Proteins, respectively” at the School of Chemistry, University of Hyderabad, Hyderabad on 13 December 2005.
2. **Siddharth Sankar Ghosh.** “Nanobiotechnology: the promise and new approaches to molecular recognition”. 15th September 2005, Department of Chemistry, Guwahati University
3. **Siddharth Sankar Ghosh.** “Nanobiotechnology: Application and perspectives”, 28th March 2006, Department of Biotechnology, Guwahati University.
5. **K Pakshirajan.** ‘Technical Writing’ in AICTE sponsored training program on ‘Pedagogy and Teaching Skill’ for the EFIP scholars (Early Faculty Induction Program) held during 23/03/06 to 25/03/06 at IIT Guwahati.
6. **Pradipta Bandyopadhyay.** “ Mathematical modelling and high performance computing. Tezpur University, October, 2005.
7. **Pradipta Bandyopadhyay** “CDAC conference on “Current Trends in Computational Biology” Pune, Nov. 2005
8. **Pradipta Bandyopadhyay** “3rd National conference of the Biotechnology society of India, Structural Biology and Bioinformatics session”, Dec. 2005, Gurgaon.
9. **Pradipta Bandyopadhyay.** Invited speaker and resource person at the Winter School on Catalysis, Tezpur University, February, 2006.
10. **Utpal Bora.** Lectures in QIP-STC on “Semiconductor organics as future generation electro-optical materials” ITTG, June 20-24th, 2005.
11. **Utpal Bora.** Lectures in Short term course on Bioelectronics, approved by AICTE under its SDP scheme. Tezpur University, 30 -06-05.

XII) VISITORS FROM OTHER INSTITUTES/UNIVERSITIES :

Prof. B. Jayaram, IIT Delhi visited on 16th and 17th March, 2006.

XIII) SHORT-TERM COURSES : NIL

XIV) SEMINARS/WORKSHOPS/CONFERENCES ORGANIZED : NIL

XV) INVITED LECTURES/VISITORS:

Prof. B. Jayaram, IIT Delhi gave a talk on Bioinformatics on 16th March, 2006.

XVI) PATENT FILED : NIL

XVII) AWARDS & HONOURS:

1. **Pradipta Bandopadhyaya** Nominated for inclusion in Marquis WHO'S WHO IN SCIENCE and ENGINEERING 2006-2007.
2. **Gurvinder Kaur Saini**. Best Paper Presentation National seminar on Current trends in crop disease management for improving productivity, RRL, Jorhat, Jan.19-20, 2006.

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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Biocatalysis and biotransformation.

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Dr Lingaraj Sahoo

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Dr Siddhartha Sankar Ghosh

Assistant Professor

Development of new generation of gene therapy vectors (Viral and Non-Viral) and tests their therapeutic potential on cell culture based systems, Development of reversible immortalized cell lines for drug and therapeutic gene testing, Targeted delivery of siRNA encapsulated with Nanoparticles into liver cells.

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Assistant Professor

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Dr (Ms.) Gurvinder Kaur Saini

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Mr Utpal Bora

Senior Lecturer

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