UTTAM CHAND BANERJEE, Ph.D.

Professor and Head
Department of Pharmaceutical Technology
National Institute of Pharmaceutical Education and Research (NIPER)
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RESEARCH INTEREST

Pharmaceutical Biotechnology, Bioprocess engineering, Enzymatic Chiral Drug Synthesis, Fermentation and Downstream processing, Nanobiotechnology

PROFESSIONAL DETAILS

Research Experience	:	37 years
PhD Thesis Guided	:	42 (3 students are enrolled)
M.Tech/M Pharm Thesis	:	145

ACADEMIC QUALIFICATIONS

B.Sc.	*Chemistry Honours*,Visva Bharati University, Shantineketan, *1977*
B.Tech	Food Technology and *Biochemical Engineering*, Jadavpur University, Kolkata, *1980*
M.Tech	*Biochemical Engineering and Biotechnology*, Indian Institute of Technology, Delhi, *1982*
Ph.D.	*Chemical Engineering and Technology*, Panjab University, Chandigarh, *1991*

PROFFESIONAL EXPERIENCE

Dean (2011-2014)	NationalInstitute of Pharmaceutical Education and Research, SAS Nagar
Professor and Head (2003-Till date)	Department of Pharmaceutical Technology, NIPER, SAS Nagar
In Charge, Biotechnology (2011- Till date)	Department of Biotechnology, NIPER, SAS Nagar
Professor and Head (2000-2003)	Department of Biotechnology, NIPER, SAS Nagar
Scientist EII (1997-2000)	Institute of Microbial Technology, Chandigarh
Scientist EI (1990-1997)	Institute of Microbial Technology, Chandigarh
Scientist C (1987-1990)	Institute of Microbial Technology, Chandigarh
Scientist B (1984-1987)	Institute of Microbial Technology, Chandigarh

HONOURS, AWARDS AND FELLOWSHIPS

- **Awarded,** Lupin Visiting Fellowships for Bioprocess Technology, ICT, 2018-19
- **Adjunct Faculty**, Department of Bioscience and Bioengineering, IIT Jodhpur, 2018
- **Selected as Professor, Department of Chemical Engineering, IIT Delhi, 2017,declined**
- **Selected as Director, NIPER Hazipur, Department of Pharmaceuticals, Govt. of India, declined 2016**
- **Awarded Top Cited Author for Journal of Colloidal and Interface Science in 2014 – 2015**
- **Highly Cited Article of 2011 Award from American Chemical Society Publications, USA**
- **Innocentive Challenge award 5589410 - Bitterness in Food Products, 2008.**
- **Punjab Ratan Award the recognition of the distinguished services rendered to the people at large, 2005.**

- **TheShield for Process Technology by Council of Scientific and industrial Research, New Delhi** for developing an innovative environment friendly process technology for production of **natural streptokinase,** a life-saving thrombolytic drug, and its successful commercialization, 2002.
- **CSIR Technology prize for Biological Sciences and Technology**, for developing a high osmotolerant, ethanol tolerant and genetically modified strain of *Saccharomyces cerevisiae* for the production of **alcohol from molasses**, 1994.
- **Long-term** overseas fellowship for one year three months by the **Department of Biotechnology,** Government of India. Research performed with **Prof. M. Moo-Young** at the Department of Chemical Engineering, University of Waterloo, Canada. Specialization **"Biochemical Engineering and DownstreamProcessing"**, June 1992 - August 1993.
- "**National Scholarship of India**", 1977.

PHD STUDENTS GUIDED

1. *Dr. Rajesh Saini,* "Studies on the microbial degradation of triphenylmethane dyes", 1998.
2. *Dr. Wamik Azmi*, "Biological treatment of textile & dye–stuff with a special emphasis on triphenylmethane dyes", 1998.
3. *Dr. T. T. A. A. Ghani*, "Optimization of process parameter for the production of streptokinase by a novel isolate of *Streptococcus* species", 2001. (Joint Guide)
4. *Dr. Navneet Batra*, "Optimization of process parameter for the conversion of lactose using thermostable β-galactosidase", 2002. (Joint Guide)
5. *Dr. Purva Vats*, "Studies on myo-inositolhexakisphosphate degrading enzyme from a hyper-producing strain of *Aspergillus niger* van Teighem," 2003.
6. *Dr. Anirban Banerjee*, "Studies on the arylacetonitrilase from *Psuedomonas putida* and its application in the transformation of mandelonitrile to mandelic acid", 2005.
7. *Dr. Sawraj Singh*, "Studies on the microbial lipase-mediated enantiospecific hydrolysis of methoxyphenyl glycidic acid methyl ester (±) MPGM", 2006.
8. *Dr. Pankaj Soni*, "Studies on the microbial reduction of prochiral ketones to optically active hydroxy compounds", 2006.
9. *Dr. Mani Shankar Bhattacharyya*, "Studies on the optimization of carbonyl reductase production by *Geotrichumcandidum*: application in the synthesis of (S)-(-)-1-(1'-Naphthyl) ethanol from 1-acetonaphthone", 2006.
10. *Dr. Harpreet Singh Rai*, "Treatment of basic dye bath effluent in anaerobic reactor", 2006. (Joint Guide)
11. *Dr. Praveen Kaul*, "Reaction engineering aspects of nitrilase from *Alcaligenes faecalis* MT CC126",2007.
12. *Dr. Vineet Agrawal*,"Cloning and Characterization of *AnigAP* from *Aspergillus niger* van Teighem MTCC F0101", 2009. (Joint Guide)
13. *Dr. HimaniKansal*, "Reaction engineering for improved biocatalytic reduction by *Candida viswanathii",* 2009.
14. *Dr. Utpal Mohan*, "Molecular evolution studies using *Pseudomonas aeruginosa* lipase as a model enzyme", 2009.
15. *Dr. Monu Kumari Goyal*, "Effect of preservatives on the stability of lysozyme", 2010 (Joint Guide)
16. *Dr. Manpreet Singh,* "Lipase mediated kinetic resolution of (RS)-1-chloro-3-(3,4-difluorophenoxy)-2-propanol to enantiomerically pure (S)-alcohol for the synthesis of Lubeluzole a drug", 2010. (Joint Guide)
17. *Dr. Ashwini L. Kamble*, "Studies on the free and immobilized whole cells of *Rhodococcuserythropolis* for the production of pharmaceutically important amides", 2011.
18. *Dr. Amit Agarwal*, "Design, synthesis and biological evaluation of 6-aminopurine analogues as potential xanthine oxidase inhibitors", 2011. (Joint Guide)
19. *Dr. Amit Singh*, "Enzymatic synthesis of 3-[5-(4-flourophenyl)-5(S)-hydroxypentanoyl]-4(S)-4-phenyl-1,3-oxazolidin-2-one: an intermediate for antihyperlipidemic drug ezetimibe".2011.

20. *Dr. Gargi Ghoshal*, "Studies on the isolation, screening and characterization of a novel xylanase producing organism and its application in food processing, June 2012. (Joint Guide)
21. *Dr. Shubangi Kaushik*, "Protein engineering studies on *Pseudomonas putida*nitrilase to gain an insight into sequence-function relationship" 2012.
22. *Dr. Vachan Singh Meena*, "Enzymatic and chemical approaches for the synthesis of racemic and enantio-enriched 3-aryloxy-1, 2-propanediols", 2012.
23. *Dr. Sandip Kumar*, "Development and characterization of nanocarriers as non-viral vector for effective gene delivery", July 2013 (Joint Guide).
24. *Dr. Abhishek Kaler*, "Screening, isolation and characterization of metal producing microorganism and their application and in formulation development", 2013.
25. *Dr. LingaBanoth*, "Lipase-mediated kinetic resolution of racemic alcohols to enantiomerically pure compounds for the synthesis of various β-drugs/drugs intermediates"2013.
26. *Dr. Ashish T. Baviskar* "Synthesis, biological evaluation and pre-formulation studies of n-fused imidazole derivatives as topoisomerase ii inhibitors", 2013 (Joint Guide).
27. *Dr. Amit Kumar Mittal*"Synthesis of silver and selenium nanoparticles using various plant extracts and their therapeutic applications ,2014.
28. *Dr.Benezeridowuolatunbosunajayi* "Modulation of mitochondrial membrane permeability transition in selected organs of type 2 diabetic rats by the leaf extract of manihot esculenta (crantz)" 2015 Joint Guide
29. *Dr. Harish Powar* "Design and development of functionalized nanoparticles for combination therapy in breast cancer", Administrative Guide, 2015
30. *Dr. Charan Singh* "Design and development of antitubercular nano-formulations of rifampicin" Administrative Guide, 2016
31. *Dr.Saptarshi Ghosh* "Studies on the microbial production of shikimic acid" 2016.
32. *Dr. Umesh Bihade,* Development of probiotic co-culture system and studies on the production of therapeutically important compounds, 2017.
33 *Dr. Dharampal*, Approaches for the generation and stabilization of recombinant 4-IFNβ from *E. coli,*2016, Joint Guide
34. *Dr. Mahesh D. Patil*, Production, purification and characterization of Arginine deiminase from *Pseudomonas putida*, 2017.
35 *Dr. Amrutkar Suyog Madhav*, Synthesis, biological evaluation and physicochemical parameter studies of imidazo[1,2-*a*]pyrazinederivatives as potential topoisomerase inhibitors, 2017.
36 *Dr. Kiran Bhilare*, Metabolic engineering approaches for the production of shikimic acid by *Bacillus megaterium*, 2017.
37 *Dr. Neeraj Singh Thakur*, Development of nanoparticle based fluorescent probes for various biomedical applications, 2018.
38 *Dr. Gopal Patel*, Optimization of process parameters for the growth and production of mycophenolic acid by *Penicillium brevicompactum* and its application through nanoformulations, 2018.
39. *Dr. Surbhi Soni*, Harnessing the potentials of biocatalysis for the synthesis of enantiopure drugs and drug intermediates, 2018
40. Dr. *Bharat Prasad Dwivedee*, Biocatalytic approach: A paradigm towards the synthesis of pharmaceutically important enantiopure scaffolds, 2018
41. Dr. *Mahendra Singh*, Development and evaluation of various systems of telmisartan 2019.
42. Dr. *Seema Kirar*, Design and Synthesis of Nano-Photosensitizers for various biomedical applications, 2019

In progress

1. Ms. Preeti Grewal Synthesis, biological evaluation and physicochemical parameter studies of potential topoisomerase inhibitors, continuing, 2020.

2. Sahil Verma, Growth and production of laccase and its use for the enantiomeric synthesis of drugs and drug intermediates, continuing, 2020

3. Akash Kanadje, Growth and production of transaminase and its use for the enantiomeric synthesis of drugs and drug intermediates, continuing, 2020.

RESEARCH VISITS (ABROAD)

- **Visited Volketswill, Switzerland** (1984) for training in "The optimum utilization of Chemap fermenters".
- **Visiting Research Assistant Professor** (June 1992 – August 1993) under Prof. M. Moo Young, at the Industrial Biotechnology Centre, Department of Chemical Engineering, University of Waterloo, Ontario, Canada.
- **Visited University of Warsaw, Poland** (October 1998)Department of Chemical Engineering, Technical University, under a collaborative programme (**Indo-Polish Programme)**.
- **Visited Hague, Netherlands** (September 22 – 26, 2002) for paper presentation "A novel detection technique for determining the nitrile hydrolysing activity using fluorimetry" at the international conference on "High Information Content Screening", organized by **The Society for Bimolecular Screening.**
- **Visited Shanghai, Chinato chair a session** and for paper presentation(October 18, 2005) "Highly efficient stereoselective reduction of heteroaryl ketones by a new yeast strain *Candida viswanathii*' **International Symposium on Biocatalysis and Bioprocess Engineering (ISBBE).**
- **Visited the Department of Chemical Sciences, Cagliari University, Italy for delivering an invited lecture, (**November 12, 2006) **"**Role of Biotechnology in the enantioselective synthesis of bioactive compounds".
- **Visited, Bryant University, Smithfield, Rhodes Island, USA** (July 6-11, 2008) for attending the Gordon Research Conference and presented a paper on "Lipase catalyzed enantioselective resolution of (R,S)-1-chloro-3(3,4-difluorophenoxy)-2-propanol a key intermediate of drug Lubeluzole in ionic liquids"

CONFERENCE ORGANIZED

Sectional President of New Biology (Including Biochemistry, Biophysics & Molecular Biology and Biotechnology) section,**99th Indian Science Congress**, held in Bhubaneswar, January 3 - 7, 2012.

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- **Chairman,** Technical Expert Committee of the Biochemical Kit Laboratory, at the National Institute of Biologicals, Sector 62, Noida, Ministry of Health, (2016-2019)
- **Vice President** Biotech Research Society of India (BRSI) (2002-2005)
- **Life Fellow** Indian Institute of Chemical Engineers (LF-IIChE)
- **Life Fellow** Society of Environmental Sciences (FSESc)
- **Life Fellow** Biotech Research Society of India (BRSI)
- **Life Fellow** Institution of Engineers (LF-IEI)
- **Life Member** National Academy of Sciences, India
- **Life Member** Association of Microbiologist of India (AMI)
- **Life Member** Indian Science Congress Association
- **Life Member** Indian Pharmaceutical Association
- **Life Member** Society of Biological Chemists
- **Life Member** Biological Engineering Society of India (BESI)
- **Member** New York Academy of Science (NYAS)
- **Member** American Chemical Society (ACS)
- **Executive Member** Indian Association of Pharmaceutical Scientists and Technologists
- **Life Member** Microbiologist's Society of India

MEMBERSHIP OF DIFFERENT COMMITTEES

1. **Task Force Member ofHuman Resource Development of Department of Biotechnology**, Govt. of India, New Delhi, 2011-2014
2. **Product Development Monitoring Committee (PDMC) for** Quarterly progress review of the cGMP manufacturing of the clinical grade material of the candidate cholera vaccine for human trials under the project titled "To develop and supply clinical grade material of the live, oral genetically modified cholera vaccine candidate under cGMP conditions for conducting Phase III trials, **Department of Biotechnology**, New Delhi, 2009
3. **Chairman Animal Ethics Committee, Panacea Biotec**Ltd., Lalru, Punjab from 2007- 2009
4. **Member of selection committees** for the selection of faculties in different universities (GNDU, Amritsar, Punjabi University, Patiala, IMTECH Chandigarh, IIT Rookee for many years
5. **Working as a visiting faculty** in the Department of Microbiology, PU from 1985 onwards and in the Department of Biotechnology, PU from 1990, Central University, Hyderabad from 1997 to 1999
6. **Member Board of Studies** in the Department of Biotechnology, Himachal Pradesh University, 2006-2008
7. **Member Board of Studies** in the Department of Biotechnology, GNDU, Punjab, 2008-2010, 2012-2014
8. **Member Board of Studies** in the Department of Microbiology, GNDU, Punjab, 2008-2010
9. **Member Board of Studies** in the Department of Biotechnology, Punjabi University, Patiala, 2010-2012
10. **Member Board of Studies** in the Department of Chemical Engineering, Panjab University, 2012-2014
11. **Member Board of Studies** in Biotechnology Engineering in University Institute of Engineering and Technology, Panjab University, Chandigarh, 2012-2014
12. **Member for the Selection** of SRF/RA in CSIR in the field of Food Technology and Biochemical Engineering, 2012, 2014
13. **Member of the Examination Committee** for DBT-JRF Examination (BET), Department of Biotechnology, Govt. of India, New Delhi, 2004 to 2016
14. **Member of the CSIR SRF/RA Selection Committee**for "Medical and Pharmaceutical Sciences (MEDIC/11)" at "Human Resource Development Group (HRDG), CSIR Complex, Library Avenue, Pusa, New Delhi – 110 012"
15. **Member of the "Expert Committee to review ongoing programmes and examine new proposals received for support under the Star College scheme"**in DBT Conference Room no. 816, **HRD Division Department of Biotechnology** (Ministry of Science & Technology), New Delhi-110003.

EDITORIAL COMMITTEE MEMBERS OF NATIONAL/ INTERNATIONAL JOURNALS

1. **Editorial Board Member,** Open Biotechnology Journal, Benthem Science Publishers Ltd.
2. **Editorial Board Member,**Patents in Biotechnology,Benthem Science Publishers Ltd.
3. **Editorial Board Member,** Indian Association of Pharmaceutical Scientists & Technologists
4. **Editorial Board Member,** International Journal of Biosciences and Technology
5. **Editorial Board Member,** Indian Journal of Biotechnology
6. **Editorial Board Member,** Journal of Engineering
7. **Editorial Board Member,** International Journal of Advanced Biotechnology and Bioinformatics
8. **Editorial Board Member,** Bioresources and Bioprocessing, Springer
9. **Editorial Board Member,**Applied Nanomedicine, Elsevier

PROJECTS HANDLED/ ONGOING PROJECTS

Title	Funding agency	Total cost
Biochemical Engineering Research and Process Development Center, a DBT supported National facility at the Institute of Microbial Technology, Chandigarh	Department of Biotechnology (DBT), Ministry of Science and Technology Government of India, New Delhi, **1984-2000**	Rs. 10 crore
Production of chiral precursor (s)-1-(2-thienyl) ethanol or (s)-n,n-dimethyl–3-hydroxy-3-(2-thienyl)-propanamine through microbial reduction and their use in the synthesis of chiral drug s (+)-duloxetine	Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Govt of India, New Delhi, **2002-2005**	Rs.31 lakhs
Cloning and Expression of an Acid Phosphatse (PHYB) with High Phytase Activity in Yeast	Council of Scientific and Industrial Research (CSIR), Govt. of India, New Delhi, **2002-2005**	Rs. 10 lakhs
Enantioselective synthesis of drugs and drug intermediates for using biotechnological route	Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Govt of India, New Delhi, **2002-2012**	Rs. 1.45 crore
Two years M. Tech. Programme in Pharmaceutical Biotechnology,	DBT, New Delhi, **2004-till date**	Rs 2 crore
Purification and characterization of lipase/s for the synthesis of biologically active and enantiomerically pure isomers obtained through enzymatic kinetic resolution of racemates.	Department of Science and Technology (DST), New Delhi, **2003-2006**	Rs 15 lakhs
Use of nitrile hydratase for the synthesis of nicotinamide, a nutraceuticals, from 3-cyanopyridine: a biotechnological approach	DBT, New Delhi, **2005-2008**	Rs 24 lakhs
Chemoenzymatic synthesis of the new cholesterol-lowering agent ezetimibe (SCH 58235,1-(4-flurophenyl)-3-(*R*)-[3-(4-fluorophenyl)-3-(*S*)-hydroxypropyl]-4-(*S*)-(4-hydroxyphenyl) -2-azetidinone)	DBT, New Delhi, **2006-2009**	Rs 36 lakhs
Cloning and over expression of gene encoding and NADH-dependent carbonyl reductase from *Candida viswanathii* involved in stereoselective synthesis of chiral alcohols	CSIR, New Delhi, **2007-2010**	Rs 14 lakhs
Development of enantiomerically pure anti-stroke and non-steroidal anti-inflammatory (NSAID) drugs through enzymatic kinetic resolution	Indian Council of Medical Research (ICMR), **2007-2010**	Rs 3.5 lakh

Enantioselective enzymatic synthesis of (*S*)-1-bromo-3-chloro- 2-propanol, an intermediate for the chiral drugs	CSIR, New Delhi, **2010-2013**	Rs. 20 Lakhs
Studies on anti-tumor and radioprotective potential of *Potentilafulgens* Wall ex Hook and characterization of its active compounds	DBT, New Delhi, **2011-2014**	Rs. 83 Lakhs
Biochemical Engineering and Bioprocess Technology Center (TDC) at NIPER	Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Govt of India, New Delhi, **2007-2012**	Rs. 1.37 crore
Stereoselective synthesis of chiral alcohols of pharmaceutical importance via microbial oxidoreductases: Process development and scale-up (Multi-Institutional)	DBT, New Delhi, **2013- 2016**	Rs. 80 Lakhs
Stereoselective synthesis of chiral alcohols of pharmaceutical importance via microbial oxidoreductases: Process development and scale-up (Multi-Institutional)	DBT, New Delhi, **2013- 2016**	Rs. 80 Lakhs
Pharmacological studies of recombinant and mutant fibrin(ogen0lytic protrease(s)for the prevention and treatment of hyperfibrinogenemia associated cardiovascular disorder. (Multi-Institutional)	DBT, New Delhi, **2018- 2021**	Rs. 84 Lakhs

ADMINISTRATIVE RESPONSIBILITIES

- **Dean, NIPER, 2011-2014**
- **Chairman, Technology Development Center:** Worked as Chairman in Technology Development Center (TDC) of NIPER, SAS Nagar. Technology Development Center caters the need for the industry. This center is equipped with various reactors, downstream process equipment (centrifuges, dryers, solvent extraction system, etc) and mainly designed for the API production. We have the complete infrastructure and service needed for pilot plant. The main objective of the center is the generation of technology and transfer of technical know-how to the industries and to assist them in solving their problems.
- **Course Coordinator of M.TechProgramme in Pharmaceutical Biotechnology:** Independently running a Master's programme M. Tech (Pharmaceutical Biotechnology) fully funded by Department of Biotechnology, Govt. of India in NIPER from 2004. The current intake strength is ten students per year.
- **Chairman, Guest House and Convention Center, NIPER**
- **Project Coordinator, ITECH/SCAPP Programme(Ministry of External Affairs):** Organizedthree weeks long intensive workshop on "Development, Scale up and Production of Biopharmaceuticals" for three consecutive years (2004-2006) in NIPER. The workshop was sponsored by Ministry of External

Affairs (TC Division) under the Indian Technical and Economic Cooperation (ITEC) and Special Commonwealth African Assistance Plan (SCAAP) Programs, Government of India.

- **Working as acting Director of NIPER as and when required**
- **Chairman, Library Information Center, NIPER (2011-2012)**
- **Senate Member in NIPER**
- **Member Academic Development and Planning Committee (APDC) in NIPER**
- **Member Central Instrumentation Laboratory (CIL) Committee in NIPER (2012-2013)**

PUBLICATIONS

INTERNATIONAL JOURNALS

1. Simultaneous stabilization and by-product generation from distillery waste using different methods of treatment, **U. C. Banerjee**, ***Journal of Microbial Biotechnology***, 3(1), 64-73, 1988.

2. Microbial transformation of rifamycin B: A new extracellular oxidase from *Curvularialunata,* R.M. Vohra, **U. C. Banerjee**, S. Das and S. Dube, ***Biotechnology Letters***, 11(12): 851-854, 1989.

3. Production of β-glycosidase (cellobiase) by *Curvularia*sp., **U. C. Banerjee**, ***Letters in Applied Microbiology***, 10(5): 197-199, 1990.

4. Effect of oral lead acetate administration on mouse brain, M.R. Bansal, N. Kaushal and **U. C. Banerjee**, **Journal *of Trace Elements in Experimental Medicine***, 3: 235-246, 1990.

5. Evaluation of agro-residues and grass as carbon source for cellulase production, **U. C. Banerjee** and S.N. Mukhopadhyay, ***Journal of Microbial Biotechnology***, 5(2): 19-24, 1990.

6. Production of laccase by *Curvularia spp*. **U. C. Banerjee** and R.M. Vohra, ***Folia Microbiologica***, 36(4): 343-346, 1991.

7. Production and properties of carboxymethylcellulase (Endo-1,4, β -D-glucanase) from *Curvularialunata*, **U. C. Banerjee** and S. Chakrabarti, ***World Journal Microbiology & Biotechnology,*** 8: 423-424, 1992.

8. Immobilized β-glucosidase from *Curvularialunata*, **U. C. Banerjee**, ***Folia Microbiologica***, 37(4): 256-260, 1992.

9. Biotransformation of rifamycins: Process possibilities, **U. C. Banerjee**, B. Saxena and Y. Chisti, ***Biotechnology Advances***, 10: 577-595, 1992.

10. Effect of pH and glucose concentration on the production of rifamycin oxidase by *Curvularialunata* in a batch reactor. **U. C. Banerjee** and J.P. Srivastava, ***Journal of Biotechnology***, 28: 229-236, 1993.

11. Transformation of rifamycin B with soluble rifamycin oxidase from *Curvularialunata,* **U. C. Banerjee**. ***Journal of Biotechnology***, 29:137-143, 1993.

12. Effect of glucose and carboxymethylcellulose on growth and rifamycin oxidase production by *Curvularialunata,***U. C. Banerjee**, ***Current Microbiology***, 26: 261-265, 1993.

13. Characterization of soluble rifamycin oxidase from *Curvularialunata*var.*aeria*, **U. C. Banerjee**, ***Letters in Applied Microbiology***, 17: 1-3, 1993.

14. Studies on rifamycin oxidase immobilized on k-carrageenan gel, **U. C. Banerjee**, ***Biomaterials, Artificial Cells and Immobilization Biotechnology,*** 21(5): 665-674, 1993.

15. Spectrophotometric determination of mycelial biomass, **U. C. Banerjee**, Y. Chisti and M. Moo-Young, ***Biotechnology Techniques***, 7 (4): 313-316, 1993.

16. Transformation of rifamycin B with immobilized rifamycin oxidase of *Curvularialunata*, **U. C. Banerjee**, ***Biotechnology Techniques***, 7(5): 339-344, 1993.

17. Transformation of rifamycin B with growing and resting cells of *Curvularialunata*, **U. C. Banerjee**, ***Enzyme and Microbial Technology***, 15: 1037-1041, 1993.

18. Characterization of rifamycin oxidase immobilized in alginate gels, **U. C. Banerjee**, ***Biomaterials, Artificial Cells and Immobilization Biotechnology,***21(5): 675-683, 1993 .

19. Studies of rifamycin oxidase immobilized on agar gel, **U. C. Banerjee**, ***Journal of General and Applied Microbiology***, 39:251-255, 1993.

20. Evaluation of different bio-kinetic parameters of *Curvularialunata* at different environmental conditions, **U. C. Banerjee**, ***Biotechnology Techniques*****.** 7(9): 635-638, 1993.

21. Effect of stirrer speed, aeration rate and cell concentration on volumetric oxygen transfer coefficient (K_La) in the cultivation of *Curvularialunata* in a batch reactor, **U. C. Banerjee**, ***Biotechnology Techniques*** 7(10): 733-738, 1993.

22. Optimization of culture conditions for the production of rifamycin oxidase by *Curvularialunata.***U. C. Banerjee**, ***World Journal of Microbiology and Biotechnology,*** 10: 462-464, 1994.

23. Growth and production of rifamycin oxidase by*Curvularialunata*, **U. C. Banerjee**, ***Folia Microbiologica,*** 39(1): 49-52, 1994

24. Disruption of recombinant yeast for the release of ß-galactosidase, F. Garrido, **U. C. Banerjee**, Y. Chisti and M. Moo-Young, ***Bioseparation***, 4: 319-328, 1994.

25. Effect of substrate particle size and alkaline pretreatment on protein enrichment by *Neurospora sitophila*, **U. C. Banerjee**, Yusuf Chisti and M. Moo-Young, ***Resources Conservation and Recycling***, 13: 139-146, 1995.

26. Characterization of L-asparaginase from *Bacillus* sp. isolated from an intertidal marine alga (*Sargassum* sp.), B.R. Mohapatra, R.K. Sani and **U. C. Banerjee**, ***Letters in Applied Microbiology***, 21: 380-383, 1995.

27. Production of levanase by *Rhodotorula* sp. A. Chaudhary, L.K. Gupta, J.K. Gupta and **U. C. Banerjee**, ***Folia Microbiologica***, 41(3): 353-356 1996.

28. Purification and properties of levanase from *Rhodotorula* sp. A. Chaudhary, L.K. Gupta, J.K. Gupta and **U. C. Banerjee**, ***Journal of Biotechnology,*** 46: 55-61, 1996.

29. Extracellular amylase production by *Saccharomycopsis capsularis*, and its evaluation for starch saccharification, S.K. Soni, I.K. Sandu, K.S. Bath, **U. C. Banerjee** and P.R. Patnaik, ***Folia Microbiologica***, 41(3): 243-248, 1996.

30. Studies on slime forming organisms of a paper mill-slime production and its control, Anita Chaudhary, L.K. Gupta, J.K. Gupta and **U. C. Banerjee,*****Journal of Industrial Microbiology and Biotechnology,*** 18: 348-352, 1997.

31. Production and properties of L-asparaginase from the fungus *Mucor* sp. associated with a marine sponge (*Spirastrella*sp.) B.R. Mohapatra, M. Bapuji and **U. C. Banerjee,*Cytobios***, 92: 165-173, 1997.

32. Biodegradation of Triphenylmethane Dyes, W. Azmi, R. K. Sani and **U. C. Banerjee**, ***Enzyme and Microbial Technology***, 22: 185-191, 1998.

33. Levanases for control of slime in paper manufacture, A. Chaudhary, L.K. Gupta, J.K. Gupta and **U. C. Banerjee**, ***Biotechnology Advances,*** 16(5-6): 899-912, 1998.

34. Comparison of static and shake culture in the decolorization of textile dyes and dye effluent by *Phanerochaetechrysosporium*, R.K.Sani, W. Azmi and **U. C. Banerjee**, ***Folia Microbiologica,*** 43(1): 85-88 1998.

35. Characterization of a fungal amylase from *Mucor* sp. associated with the marine sponge *Spirastrella* sp., B.R. Mohapatra, **U. C. Banerjee** and M. Bapuji, ***Journal Biotechnology***, 60: 113-117, 1998.

36. Decolorization of acid green 20, a textile dyes, by white rot fungus, *Phanerochaetechrysosporium*in low cost medium, Rajesh K. Sani and **U. C. Banerjee,*Advances in Environmental Research***, 2(4): 485-490, 1999.

37. Decolorization of triphenylmethane dyes and textile and dye-stuff effluents by *Kurthia* sp., R.K. Sani and **U. C. Banerjee**, ***Enzyme and Microbial Technology***, 24: 433-437 1999.

38. Thermostable alkaline Protease from *Bacillus brevis* and its Characterization as a Laundry Detergent Additive, **U. C. Banerjee**, Rajesh K. Sani, W. Azmi and R. K. Soni, ***Process Biochemistry,*** 35(1-2): 213-219, 1999.

39. Reduction of gentian violet to leucogentian violet by *Kurthia* sp. and assessment of toxicity, R. K. Sani, R. S. Jolly and **U. C. Banerjee,*Advances in Environmental Research***, 3(3): 368-377, 1999.

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TECHNOLOGIES DEVELOPED

I was heading the **National Facility of Biochemical Engineering Research and ProcessDevelopment Centre** at **Institute of Microbial Technology, Chandigarh**. Four technologies were developed and transferred to the industries,

1. **Development of an innovative environment friendly process technology for production of natural streptokinase, a life-saving thrombolytic drug, and its successful commercialization**. This process was given to M/S Cadila Healthcare, Ahemdabad.
2. **Developing a high osmotolerant, ethanol tolerant and genetically modified strain of Saccharomyces cerevisiae for the production of alcohol from molasses.** This process was licensed to various distilleries in India through VittalMalya Research foundation, Bangalore.
3. **Development of a Biotransformation process for conversion of rifamycin B to rifamycin S.** This process of enzymatic transformation of rifamycin B to rifamycin S was demonstrated and subsequently transferred to M/S Indian Drugs and Pharmaceutical Limited, Rishikesh and to M/S Lupin chemical Ltd. on non-exclusive basis.

In the **National Facility of Biochemical Engineering Research and ProcessDevelopment Center,** the following services were given to the different parties on payment basis.

1. A process was optimized for the concentration of 6-APA from its other liquor in a RO (reverse osmosis) system. The 6-APA concentration (4000 ppm) recovered from the mother liquor was about 90% employing RO system. This work was carried out for **Fermenta Pharma, Kulu.**
2. A filtration process was optimized in a pilot scale filter press (Plate and Frame Filter Press and Horizontal Filter Press) for the filtration of an inorganic catalyst developed by **Thapar Corporate Research and Development Center (Patiala**). Different process parameters such as filter quality (pore size), pressure drop, flow rate etc. were optimized with respect to quantity of material obtained.
3. A process was scaled up in 150 L fermenter for the production of an industrial enzyme. Different parameters were optimized during the growth and production of extracellular enzyme. This work was carried out for the **SPIC Science Foundation, Madras**.
4. A process was scaled up for the production of Hepatitis B-surface antigen (HBsAg) in 150 L fermenter. This work was carried out for the **International Center for Genetic Engineering and Biotechnology, New Delhi**.
5. Laboratory scale fermenter was used for the optimization of process parameters for the production of Butanediol using *Enterobactoer cloacae*. This work carried out for the **Microbiology Department, Panjab University, Chandigarh**.
6. A complete process was optimized for the production of Hepatitis-B surface antigen (HBsAg) in laboratory fermenters. This work was carried for **Transgene Vaccines Ltd., Hyderabad in collaboration with Rhein Biotech, Germany.**
7. A process was optimized for the production of **xylanase** using *Termitomycesclypeatus*in a 20 liter laboratory fermenter. Different fermenter runs were taken with varied agitation and aeration rates and 55-56 IU/mL xylanase activity was obtained in 60-72 h fermentation. This work was done for **Indian Institute of Chemical Biology,** Calcutta.
8. A bio-process was optimized for the production of ethanol using agro-residues as carbon source. Delignified agro-residues were saccharified using cellulase from *T. reesei* and then fermented to alcohol using *S. cerevesiae*. This work was done for the **Biochemistry Department** of **Punjab Agriculture University, Ludhiana**.
9. Demonstrations were given to **Gujarat Themis Biosyn Ltd.** (GTBL) for the biotransformation of rifamycin B to rifamycin S in aerobic reactor with rifamycin B fermentation broth.
10. A downstream process was optimized in **Rotary Vacuum Filter** (RVF) using cephalosporin fermentation broth. This work was done for **Max-GB, Ropar.**
11. A process for the **hairy root culture** cultivation was optimized in modified stirred tank reactor. This work was done for **CIMAP, Lucknow.**
12. A process was optimized for the production of secondary metabolite in 150 L reactor. This work was carried out for **M/S Kopran Drugs Private Limited, Bombay.**
13. A process was optimized for the growth of *Penicillium chrysogenum* in a stirred tank reactor and immobilization of the whole cells using different carriers. This work was carried out for **Atomic Minerals Directorate for Exploration & Research, Hyderabad.**

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