

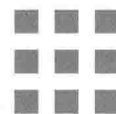
Current Developments in Biotechnology and Bioengineering



Bioprocesses, Bioreactors and Controls

Editors

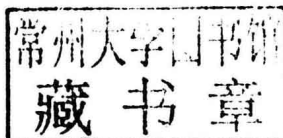
Christian Larroche • Maria Ángeles Sanromán
Guocheng Du • Ashok Pandey



Current Developments in Biotechnology and Bioengineering

Bioprocesses, Bioreactors
and Controls

Edited by
Christian Larroche, Maria Ángeles Sanromán,
Guocheng Du, Ashok Pandey



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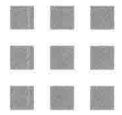
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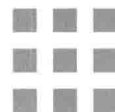
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Current Developments in Biotechnology and Bioengineering



List of Contributors

J.A. Baeza Autonomous University of Barcelona, Bellaterra (Barcelona), Spain

M.F. Barroso REQUIMTE/LAQV, Instituto Superior de Engenharia do Instituto Politécnico do Porto, Porto, Portugal

E.S. Bayrak Illinois Institute of Technology, Chicago, IL, United States

L. Bazinet University of Laval, INAF, STELA, LTAPEM, Québec, QC, Canada

C. Bhattacharjee Jadavpur University, West Bengal, India

P. Binod CSIR–National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram, Kerala, India

A. Brucato University of Palermo, Palermo, Italy

J. Büchs RWTH Aachen University, Aachen, Germany

A. Busciglio University of Bologna, Bologna, Italy

C. Cabassud University of Toulouse, LISBP, CNRS, INRA, INSA, Toulouse, France

J.-S. Chang National Cheng Kung University, Tainan, Taiwan

C.-Y. Chen National Cheng Kung University, Tainan, Taiwan

A. Cinar Illinois Institute of Technology, Chicago, IL, United States

F. Costa University of Minho, Braga, Portugal

F. Coutte University of Lille, EA-7394-ICV - Institut Charles Viollette, Lille, France

F.J. Deive University of Vigo, Vigo, Spain

C. Delerue-Matos REQUIMTE/LAQV, Instituto Superior de Engenharia do Instituto Politécnico do Porto, Porto, Portugal

- F. Delvigne University of Liège, Gembloux Agro-Bio Tech, Gembloux, Belgium
- P. Dhulster University of Lille, EA-7394-ICV - Institut Charles Viollette, Lille, France
- G.C. Du Jiangnan University, Wuxi, China
- D. Eibl Zurich University of Applied Sciences, School of Life Sciences and Facility Management, Institute of Biotechnology, Wädenswil, Switzerland
- R. Eibl Zurich University of Applied Sciences, School of Life Sciences and Facility Management, Institute of Biotechnology, Wädenswil, Switzerland
- E. Favela-Torres Universidad Autónoma Metropolitana, México, DF, México
- A. Ferreira Universidade do Porto, Rua Dr. Roberto Frias s/n, Porto, Portugal
- E.C. Ferreira University of Minho, Braga, Portugal
- L. Firdaous University of Lille, EA-7394-ICV - Institut Charles Viollette, Lille, France
- B. Frahm Ostwestfalen-Lippe University of Applied Sciences, Lemgo, Germany
- X. Ge The Ohio State University, Wooster, OH, United States
- M. Georgiev Laboratory of Applied Biotechnologies, The Stephan Angeloff Institute of Microbiology, Bulgarian Academy of Sciences, Plovdiv, Bulgaria
- A. Grünberger Forschungszentrum Jülich GmbH, IBG-1: Biotechnology, Jülich, Germany
- V.C. Hass Furtwangen University, Furtwangen, Germany
- R. Hausmann University of Hohenheim, Stuttgart, Germany
- F. Hecker University of Hohenheim, Stuttgart, Germany
- M. Henkel University of Hohenheim, Stuttgart, Germany
- B. Hitzmann University of Hohenheim, Stuttgart, Germany
- S.-H. Ho Harbin Institute of Technology, Harbin, China

G.S. Hossain Jiangnan University, Wuxi, China

V. Jossen Zurich University of Applied Sciences, School of Life Sciences and Facility Management, Institute of Biotechnology, Wädenswil, Switzerland

R. Kapel University of Lorraine, LRGP, CNRS-UMR-7274, Plateforme SVS, Vandoeuvre-Lès-Nancy, France

C. Kistler Merck Research Labs, Merck & Co. Inc., Kenilworth, NJ, United States

D. Kohlheyer Forschungszentrum Jülich GmbH, IBG-1: Biotechnology, Jülich, Germany

M. Kraume Berlin University of Technology (TU Berlin), Institute of Process Engineering, Berlin, Germany

T. Ladner RWTH Aachen University, Aachen, Germany

D. Lecouturier University of Lille, EA-7394-ICV - Institut Charles Viollette, Lille, France

Y. Li The Ohio State University, Wooster, OH, United States

T.-C. Ling Institute of Biological Sciences, University of Malaya, Kuala Lumpur, Malaysia

L. Liu Jiangnan University, Wuxi, China

J. López-Santín Universitat Autònoma de Barcelona, Bellaterra, Spain

A. Lübbert Martin Luther University, Halle-Wittenberg, Germany

A. Marchev Laboratory of Applied Biotechnologies, The Stephan Angeloff Institute of Microbiology, Bulgarian Academy of Sciences, Plovdiv, Bulgaria

S. Morais REQUIMTE/LAQV, Instituto Superior de Engenharia do Instituto Politécnico do Porto, Porto, Portugal

J. Morchain LISBP, Université de Toulouse, CNRS, INRA, INSA, Toulouse, France

A. Mota University of Minho, Braga, Portugal

D. Nagarajan National Cheng Kung University, Tainan, Taiwan

A. Nath Jadavpur University, West Bengal, India

H.P.A. Nouws REQUIMTE/LAQV, Instituto Superior de Engenharia do Instituto Politécnico do Porto, Porto, Portugal

J.G. Pacheco REQUIMTE/LAQV, Instituto Superior de Engenharia do Instituto Politécnico do Porto, Porto, Portugal

A. Pandey Center of Innovative and Applied Bioprocessing, (a national institute under Dept of Biotechnology, Ministry of S&T, Govt of India), Mohali, Punjab, India

M. Papagianni Aristotle University of Thessaloniki, Thessaloniki, Greece

W.-N. Phong Institute of Biological Sciences, University of Malaya, Kuala Lumpur, Malaysia

O. Platas Barradas Hamburg University of Technology (TUHH), Hamburg, Germany

D. Pollard Merck Research Labs, Merck & Co. Inc., Kenilworth, NJ, United States

R. Pörtner Hamburg University of Technology (TUHH), Hamburg, Germany

C. Probst Forschungszentrum Jülich GmbH, IBG-1: Biotechnology, Jülich, Germany

F. Rocha Universidade do Porto, Rua Dr. Roberto Frias s/n, Porto, Portugal

L.V. Rodríguez-Duran Universidad Autónoma Metropolitana, México, DF, México

M.Á. Sanromán University of Vigo, Vigo, Spain

G. Saucedo-Castañeda Universidad Autónoma Metropolitana, México, DF, México

F. Scargiali University of Palermo, Palermo, Italy

P. Sen Jadavpur University, West Bengal, India

P.-L. Show University of Nottingham Malaysia Campus, Semenyih, Selangor Darul Ehsan, Malaysia

B. Silva University of Minho, Braga, Portugal

R. Sindhu CSIR—National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram, Kerala, India

C.-H. Tan University of Nottingham Malaysia Campus, Semenyih, Selangor Darul Ehsan, Malaysia

T. Tavares University of Minho, Braga, Portugal

J.A. Teixeira University of Minho, Braga, Portugal

M.T. Torres-Mancera Tecnológico de Estudios Superiores de Coacalco, México, México

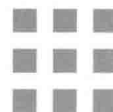
M.A. Trujillo-Roldán Universidad Nacional Autónoma de México, México, DF, México

N.A. Valdez-Cruz Universidad Nacional Autónoma de México, México, DF, México

F. Valero Universitat Autònoma de Barcelona, Bellaterra, Spain

J. Vasco-Correa The Ohio State University, Wooster, OH, United States

A.C. Veloso University of Minho, Braga, Portugal; Polytechnic Institute of Coimbra, ISEC, DEQB, Coimbra, Portugal



About the Editors

Christian Larroche

Professor Christian Larroché is a graduate in biochemical engineering from the Institut National des Sciences Appliquées de Toulouse, Toulouse (1979); Docteur-Ingénieur in organic chemistry from Paul Sabatier Toulouse 3 University (1982); and Docteur ès Sciences (PhD) in biochemical engineering from Blaise Pascal University (1990). He has strong research interests in the areas of applied microbiology and biochemical engineering. His skills are related to biochemical engineering, especially the study and development of special processes for the use of microorganisms. This includes fungal spore production by solid-state cultivation and their use as protein (enzyme) reservoirs in biotransformations. A special interest in phase transfer phenomena coupled with metabolic engineering has to be noticed. It is applied to the design and optimization of biotransformations involving hydrophobic compounds and carried out in biphasic liquid–liquid media. These processes are related to both the food and environment (bioremediation) areas. His interests have been extended to bioenergy, and he is currently the coordinator of two French research programs in biohydrogen production by nonphotosynthetic anaerobic microorganisms grown on complex media.



He is author of about 200 documents, including 90 articles, three patents, 13 book chapters, and 21 co-editions of books or journal special issues. He has supervised 13 PhD students and 20 MSc laboratory works. He is a member of SFGP (the French Society for Process Engineering) and administrator of IFIBiop, an international network entitled “International Forum on Industrial Bioprocesses.” He belongs to the team GePEB (Process Engineering, Energetics and Biosystems) of Institut Pascal in the same university. He has been vice president of the university in charge of research valorization and technology transfer (2008–12) and is currently Dean of Polytech Clermont-Ferrand, a graduate school of engineering of Blaise Pascal University.

Maria Ángeles Sanromán

Professor M. Ángeles Sanromán is a graduate in chemical engineering from the University of Santiago de Compostela, Spain (1987). She completed her PhD degree in Biotechnology (1991), focusing on the development of bioreactor and cell immobilization techniques. She joined the staff at the University of Vigo in the Department of Chemical Engineering. She is head of the Bioengineering and Sustainable Processes Group at the University of Vigo. This is a multidisciplinary research group that joins knowledge and efforts in the development of technologies to be applied in several industrial sectors. Currently, main research lines carried out are the biodegradation of recalcitrant organic compounds, solid-state fermentation, enzymatic technology, bioreactor design, and advanced oxidation technologies. The results of these research works have been published in more than 220 papers, 5 patents, 18 book chapters, and more than 350 research communications. She has collaborated in more than 50 research and innovation projects at national and international calls and various contracts and actions in relation to the transference of technology to business administration and companies. In this context, her activity as researcher is remarkable, because she was director of the Research Results Transfer Office of the University of Vigo and member of ANEP-Spanish Ministry of Economy and Competitiveness in the Chemical Technology Area (2007–11) and Technology Transfer Area (2015–present), and regular evaluator of research projects in competitive calls for various national and international programs and member of the editorial board of several journals, including *Bioresource Technology* as associate editor.

**Guocheng Du**

Professor Guocheng Du works at the School of Biotechnology, Jiangnan University, China. He is a distinguished professor of Changjiang Scholars, Ministry of Education, China. His current main research focus is in bioprocess engineering and metabolic engineering. He has about 230 publications and communications, including 60 patents, 8 books, and 210 original and review papers. He won two Second Prizes of State Science and Technology Award in 2006 and 2012, respectively. He has been conferred an Honorary Doctorate degree from Jiangnan University, China. Professor Guocheng Du is deputy director on the Committee of Biochemical Engineering Modeling and Control, Chinese Society for Microbiology, and deputy director of the Beer Branch, China Alcoholic Drinks Industry Association. He is an



associate editor of the *Journal of the Science of Food and Agriculture* and *Microbial cell Factories*, and an editorial board member of *Bioresource Technology*.

Ashok Pandey

Professor Ashok Pandey is Eminent Scientist at the Center of Innovative and Applied Bioprocessing, Mohali (a national institute under the Department of Biotechnology, Ministry of Science and Technology, Government of India), and former chief scientist and head of the Biotechnology Division at the CSIR's National Institute for Interdisciplinary Science and Technology at Trivandrum. He is an adjunct professor at Mar Athanasios College for Advanced Studies Thiruvalla, Kerala, and at Kalasalingam University, Krishnan Koil, Tamil Nadu. His major research interests are in the areas of microbial, enzyme, and bioprocess technology, which span various programs, including biomass to fuels and chemicals, probiotics and nutraceuticals, industrial enzymes, solid-state fermentation, etc. He has more than 1100 publications and communications, which include 16 patents, 50+ books, 125 book chapters, and 425 original and review papers, with an h index of 75 and more than 23,500 citations (Google Scholar). He has transferred several technologies to industries and has been an industrial consultant for about a dozen projects for Indian and international industries.



Professor Pandey is the recipient of many national and international awards and fellowships, which include Elected Member of the European Academy of Sciences and Arts, Germany; Fellow of the International Society for Energy, Environment and Sustainability; Fellow of the National Academy of Science (India); Fellow of the Biotech Research Society, India; Fellow of the International Organization of Biotechnology and Bioengineering; Fellow of the Association of Microbiologists of India; honorary doctorate degree from the Université Blaise Pascal, France; Thomson Scientific India Citation Laureate Award, United States; Lupin Visiting Fellowship; Visiting Professor at the Université Blaise Pascal, France, the Federal University of Parana, Brazil, and the École Polytechnique Fédérale de Lausanne, Switzerland; Best Scientific Work Achievement Award, Government of Cuba; UNESCO Professor; Raman Research Fellowship Award, CSIR; GBF, Germany, and CNRS, France fellowships; Young Scientist Award; and others. He was chairman of the International Society of Food, Agriculture and Environment, Finland (Food & Health) during 2003–04. He is the Founder President of the Biotech Research Society, India (www.brsi.in); International Coordinator of the International Forum on Industrial Bioprocesses, France (www.ifibiop.org); chairman of the International Society for Energy, Environment & Sustainability (www.isees.org); and vice

president of the All India Biotech Association (www.aibaonline.com). Professor Pandey is editor-in-chief of *Bioresource Technology*, Honorary Executive Advisor of the *Journal of Water Sustainability* and *Journal of Energy and Environmental Sustainability*, subject editor of the *Proceedings of the National Academy of Sciences (India)*, and editorial board member of several international and Indian journals, and also a member of several national and international committees.



Preface

This book is a part of the comprehensive series, *Current Developments in Biotechnology and Bioengineering* (Editor-in-chief: Ashok Pandey), composed of nine volumes. To this series, the current volume brings extensive and thorough state-of-art information and perspectives on bioprocesses, bioreactors, and controls. In past decades, biotechnological knowledge has been boosted by the rapid expansion of biochemistry and genetic engineering, reaching high levels of excellence and competitiveness. Moreover, the discovery of novel microorganisms and genetically engineered strains has contributed to yield new products or substances in a more efficient and environmentally sustainable manner than their counterparts synthesized by conventional chemical routes. These changes have paralleled great academic effort in the development of new bioreactor designs and control systems that have drastically improved the effectiveness of these processes. The integration of these topics has favored synergic and collaborative exchanges among microbiologists, biochemists, molecular biologists, bioengineers, chemical engineers, and food and pharmaceutical chemists, thus allowing new bioprocesses to rapidly surpass the walls of academic laboratories and become implemented on an industrial scale.

The practical significance of these aspects has encouraged us to include this volume in this book series to bring together the knowledge and expertise of researchers. All are applying and developing engineering principles of cultivation performance and control in bioreactors to different bioprocesses. This volume intends to cover current trends and perspectives in the field to serve as a wide-ranging reference. It has been organized into three main sections: Industrial Bioprocesses, Bioreactors for Industrial Bioprocesses, and Controls of Industrial Bioprocesses.

The first six chapters consider different bioprocesses of industrial relevance, including examples using genetically engineered microorganisms and animal and plant cells. The next 11 chapters are devoted to bioreactor design (including unconventional designs). Careful selection of bioreactors and operating conditions is crucial for the proper development of many bioprocesses, because they must provide a suitable environment to house optimum microbial or cell growth and product formation. This section addresses the current state of the art on the development, design, control, and mode of operation of different configurations such as stirred tank, membrane, packed-bed, photobioreactor, and disposable bioreactors, as well as their application to several industries, and special conditions such as solid-state fermentation or extremophilic cultures. Moreover, a guide to the modeling of bioreactors is provided, stressing the need to define a set of numerical tools to enable quantitative prediction of the behavior of biological systems at various scales. The third and last section of this volume is devoted to bioprocess control, including common instrumentation such as online sensors and analyzers easing process monitoring, and control loops available to improve the response of bioprocesses against disturbances and variations in the operational set point. These strategies aim to ensure the robust control and stability of biological processes, and examples of their application are presented.

All in all, this volume is the result of the joint efforts of more than 40 engineers and scientists who represent the expertise of professionals from all parts of the world, including

China, India, Greece, Bulgaria, Italy, Portugal, Switzerland, France, Taiwan, the United States, Spain, Belgium, Germany, and Mexico. It has been a long journey from initial contact with our contributors and their rapid answer to starting this volume. They have contributed not only their knowledge and expertise but also their diligence, drive, time, patience, effort, and enthusiasm, making it possible for this volume to come true, for which we are most grateful. We would like to acknowledge the reviewers for their valuable comments to improve the final quality of different chapters included in this volume. In addition, we would like to thank Dr. Kostas Marinakis, book acquisition editor, Ms Anneka Hess, and the entire production team at Elsevier for their help and support in bringing out this volume. Without their commitment, efficiency, and dedicated work, this volume never could have been accomplished.

Editors

Christian Larroche
Maria Ángeles Sanromán
Guocheng Du
Ashok Pandey



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