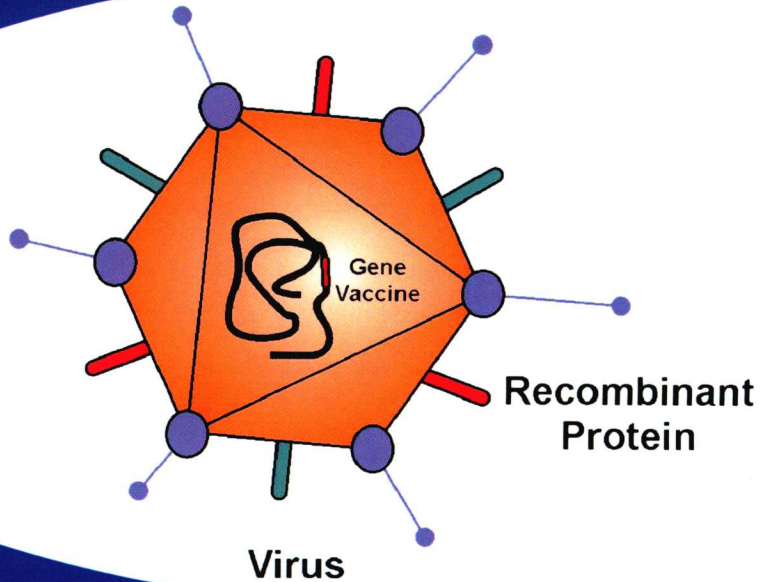
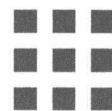


# Current Developments in Biotechnology and Bioengineering



Human and Animal Health Applications

*Editors*  
Vanete Thomaz-Soccol • Ashok Pandey • Rodrigo Resende



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*Edited by*  
Vanete Thomaz-Soccol, Ashok Pandey,  
Rodrigo R. Resende



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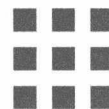
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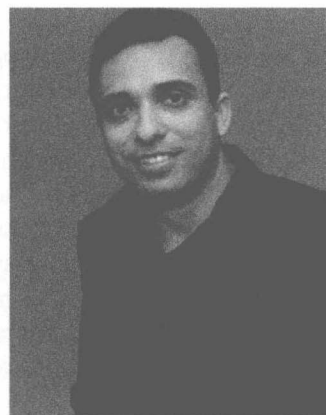


enzymes, solid-state fermentation, etc. He has more than 1100 publications and communications, which include 16 patents, 50+ books, 125 book chapters, and 425 original and review papers, with an h index of 75 and more than 23,500 citations (Google Scholar). He has transferred several technologies to industries and has been an industrial consultant for about a dozen projects for Indian and international industries.

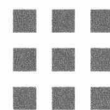
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# Preface

This book is a part of the comprehensive series, *Current Developments in Biotechnology and Bioengineering* (Editor-in-Chief: Ashok Pandey), composed of nine volumes. Within this series, the current volume is dedicated to human and animal health applications in biotechnology. In the 1970s, researchers developed DNA recombinant technology, which facilitated the production of recombinant proteins. One of the first molecules produced by this technology was somatostatin. Through genetic engineering techniques, the gene coding for somatostatin was inserted into *Escherichia coli* cells, which expressed a recombinant protein with activity similar to the human hormone. Over the ensuing years, other heterologous systems were introduced for producing recombinant human molecules, including yeast, insect, and mammalian cells. The new class of biologically derived therapeutic molecules was called *biopharmaceuticals*.

Actually, 60% of the new drugs approved by the Food and Drug Administration are biopharmaceuticals that were developed for the treatment of cancer and infectious, cardiovascular, and inflammatory diseases. Biopharmaceuticals now comprise a diverse number of molecules, such as coagulation factors, hormones, enzymes, monoclonal antibodies, and vaccines. Owing to their complexity in three-dimensional structure and size, each process applied to produce a molecule will result in a biopharmaceutical with specific physicochemical properties and biological activity. The biotechnological industrial sector has made outstanding contributions to medical progress resulting in improvements to life.

This book is composed of nine parts. In the first part, Chapters 1 and 2 present the global market and perspectives on biotechnology health, in which different classes of biopharmaceutical products are described and the manufacturing technologies used to obtain these products are discussed. Part 2 is devoted to research and development in immunotechnology, such as interferon production by the biotechnology industry for viral infections and cancer treatments, and monoclonal antibodies that have revolutionized the fields of research and medicine. Chapter 5 introduces and explores new perspectives in recombinant antibody production, a unique source of biomolecules that are used as pharmacologic tools and which also should contribute to a revival of immunodiagnostic and biomedical applications as yet unimagined.

In the third part, combinatorial libraries are described, which include the impacts of the aptamer technology on diagnostics, biotechnology, and therapy; combinatorial preparation; and high-throughput screening of arrays of compounds that are the basis of numerous platforms of pharmaceutical drug discovery processes. Finally the concept, innovations, applications, and future of phage display technology are presented.

The fourth part is on gene and cell therapy. Chapter 9 discusses the power of mathematical networks and modeling for the identification of key components related to rheumatoid arthritis and how to predict the response of different individuals to infections. Chapter 10 reviews the biogenesis pathways and general functions of microRNAs, PIWI RNAs, and long noncoding RNAs. It presents current knowledge concerning the use of noncoding RNAs in diagnosis, prognosis, and therapeutics and discusses their role in the development of

the immune system and the regulatory functions of  $H_2O_2$  during the course of metazoan evolution.

Part 5 deals with tissue engineering. Chapter 11 presents biomaterials, which are derived from naturally occurring molecules and those that recapitulate key motifs of biomolecules within biologically active synthetic materials. The most significant biological features of the extracellular matrix are discussed and several engineering methods currently being implemented to design and tune synthetic scaffolds to mimic these features are presented. Chapter 12 presents protocols to isolate adipose-derived stem cells, strategies to characterize these cells, an example of stem cell differentiation into bone cells (generating material to perform bone repair *in vivo*) and some techniques that can be applied to verify the structure of the newly generated bone tissue. In Chapter 13, the current state of bioengineering and regenerative medicine is discussed with respect to each abdominal organ. Chapter 14 offers new approaches to reprogramming mesenchymal stem cells for tissue engineering on a biofunctionalized scaffold for tissue repair and for restoring its function.

The next part is about biofilms and biosurfactants in health, which describes the most promising technology using microbial surfactants, which have attracted attention as potential substitutes for, additions to, currently employed antimicrobial compounds, mainly for biofilm infection control. Chapter 15 discusses the potential use of these biomolecules in formulating drug delivery nanocarrier systems, including liposomes and polymer-based carriers. Chapter 16 highlights the use of bacteriocins as a new strategy for planktonic cells and biofilm control.

The field of vaccinology has yielded several effective vaccines that have significantly reduced the impact of a number of important diseases. Biotechnology has made the development of new vaccines safer and less costly. Chapter 17 reviews technologies that are currently available for the development of recombinant veterinary vaccines. Chapter 18 describes new technologies related to the production of acellular pertussis vaccine against whooping cough; Chapter 19 presents a case description about the biotechnological development of a diphtheria subunit vaccine using diphtheria toxin subunit B as the immunogenic protein. Chapter 20 discusses serum-free rabies vaccine production and Chapter 21 discusses the lyophilization process.

Biotechnological strategies needed to develop better pharmaceuticals against leishmaniasis are presented in Chapter 22. Finally, Chapter 23 focuses on maternal recognition of pregnancy and genes controlling maternal recognition of pregnancy events that facilitate the development of optimal reproductive management strategies and paradigms to augment embryo survival.

We hope that this book will be of special interest to academicians, researchers, graduate students, and industry scientists working in the field. We would like to thank the authors and reviewers of the chapters for their cooperation and for their preparedness in revising the articles on a scheduled timeline. We 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 could not have been accomplished.

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