



Preface

This book is a part of the comprehensive series *Current Developments in Biotechnology and Bioengineering* (Editor-in-chief: Ashok Pandey), comprising nine volumes, and presents a collection of chapters dealing with the foundations of biotechnology and bioengineering. Biotechnology has been part of human activities for more than 10,000 years and its importance has been increasing with human development. Nowadays, biotechnology has an enormous impact on our everyday life and is a key technology for industry, health, environment, food, and other areas of activity. Biotechnology, according to the Organization of Economic Co-operation and Development, is defined as “the application of scientific and engineering principles to the processing of materials by biological agents.” In biotechnology, intact organisms, such as yeast, bacteria, or microalgae, or their components, such as enzymes, are used to manufacture useful products and provide services. This makes clear the multidisciplinary character of biotechnology and the importance of professionals from different areas of knowledge interacting and understanding one another so that the full potential of biotechnology can be exploited.

This book comprises eight chapters: the first and second chapters are dedicated to the fundamentals of microbiology and biochemistry; from the third to the fifth, topics addressed are focused on genetics, molecular biology, and genetic and metabolic engineering; Chapters 6 and 7 deal with the most important engineering operations in biotechnology; and, finally, Chapter 8 reviews methods and tools in synthetic biology.

Chapter 1 gives an overview of the basic aspects of microbiology, including microbial metabolism, and its role in various industrial bioprocesses; in Chapter 2 the main biological molecules are introduced, such as proteins, carbohydrates, lipids, and nucleic acids, including their chemical structures, properties, and importance in biotechnological and bioengineering developments such as genetic engineering and bioprocesses. This chapter also points out advances in areas such as proteomics and genetic engineering, and their relevance to advances in the discovery of new drugs and treatment of diseases is discussed.

The basic concepts of the fundamental units of life, encompassing DNA replication, transcription, and gene regulation, are discussed in Chapter 3. Other vital biological phenomena such as transformation, conjugation, transduction, recombination, and horizontal gene transfer are also presented in this chapter. The major techniques in molecular biology, such as blotting, polymerase chain reaction, and sequencing technologies, are also described. Chapter 4 compiles information on the principles of genetic engineering, describing not only the basic techniques used in molecular biology and the basics of recombinant DNA technology, but also presenting more recent developments on these techniques, as well as up-to-date *in silico* tools. In Chapter 5, metabolic engineering is the topic considered, and the major steps involved in metabolic engineering—analysis and synthesis—are described. Metabolic flux analysis and its importance to bioprocess development are also addressed.

Chapters 6 and 7 deal with the most relevant engineering topics in biotechnology—bio-reaction engineering and downstream processing. Chapter 6 presents the basic concepts of biocatalyst (cell and enzymes) kinetics and the main bioreactor types and operation modes, as well as a comprehensive approach regarding the monitoring of various

bio-reactions and control strategies. In Chapter 7, the most commonly used unit operations in the downstream processing of biotechnology products are described, and relevant considerations in designing a purification strategy are discussed.

Finally, in Chapter 8, the relevance of synthetic biology in the improvement of biotechnology is presented together with a review of the tools and methods used.

We hope that this book will be of great value to engineers, microbiologists, geneticists, and others in providing key life science and engineering aspects of the development of biotechnology and bioengineering. We would like to acknowledge the reviewers for their valuable comments to improve the final quality of the chapters included in this volume. 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 ever been accomplished.

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