

Preface

The term biotechnology was only coined in 1919 by the Hungarian engineer Karl Ereky. He used it as an umbrella term for methods by which microorganisms helped to produce valuable products. Humankind has been using biotechnological methods for thousands of years – think of the use of yeast or bacteria in the production of beer, wine, vinegar, or cheese.

Biotechnology is one of the key technologies of the twenty-first century. It includes established traditional industries such as the production of milk and dairy products, beer, wine, and other alcoholic drinks, as well as the production and bio-transformation of enzymes, amino acids, vitamins, antibiotics, and other fine chemicals. This area, including the associated process engineering, is referred to as **white or industrial biotechnology**. As it is well established, it will only be treated in passing in Chapter 34. Many good books have been written to cover the field.

Breathtaking progress has been made in molecular and cell biology in the past 50 years, particularly in the last 20–30 years. This opens up new exciting perspectives for industrial applications. This area of applied biology is clearly distinguished from the traditional biotechnological fields and is known as **molecular biotechnology**. In a few years' time, however, it may well be regarded as another established branch of traditional biotechnology.

Molecular biology and cell biology have revolutionized our knowledge about the function and structure of macromolecules in the cell and the role of the cell itself. Major progress has been made in genomics and proteomics. A historic milestone was the sequencing of the human genome in 2001. At present, more than 1200 genomes of diverse organismal groups (including more than 100 genomes of eukaryotes) have been completely sequenced (<http://www.ebi.ac.uk/genomes>). As a next milestone it has been proposed to sequence 10 000 genomes from species covering the tree of life (<http://www.genome10k.org>). With the new generation of DNA sequencers it is now possible to sequence the human genome in a matter of weeks. This new knowledge has had direct repercussions on medical science and therapy, as it is now possible for the first time to study the genetic causes of diseases. It should thus be possible in due course to treat the causes rather than the symptoms. High-throughput sequencing will probably become a routine diagnostic, which will allow personalized medical treatment. Opportunities open up for the biotech industry (**red biotechnology**) to develop new diagnostics and therapeutics such as recombinant hormones, enzymes, antigens, vaccines, and antibodies that were not available before the genetic revolution. In the field of **green biotechnology**, targeted modification of crop cultivars can improve their properties, such as resistance to pests or the synthesis of new products (including recombinant human proteins). In **microbial biotechnology**, production processes can be improved and new products can be created through combinatorial biosynthesis.

The term **molecular biotechnology** also covers state-of-the-art research in genomics, functional genomics, proteomics, transcriptomics, systems biology, gene therapy, or molecular diagnostics. The concepts and methods are derived from cell and molecular biology, structural biology, bioinformatics, and biophysics.

The success of molecular biotechnology has been considerable, if you look at the scientific and economic prowess of companies like Genentech, Biogen, and

others. Already today total annual revenues from recombinant drugs exceeds US \$ 20 billion. Over 100 recombinant proteins have been approved by the US Food and Drug Administration and several hundred others are in the developmental pipeline.

As textbooks covering this extensive subject are few, a group of experts and university teachers decided to write an introductory textbook that looks at a wide variety of aspects. This is the English language version of the second edition of *An Introduction to Molecular Biotechnology*, which has been thoroughly updated, a new chapter on systems biology has been added (Chapter 23), and many illustrations are now in color.

The comprehensive introductory chapters (*Part I*) provide a brief compendium of the essential building blocks and processes in a cell, their structure, and functions. This information is crucial for the understanding of the following chapters, and while it cannot be a substitute for the profound study of more substantial and extensive textbooks on cell and molecular biology (Alberts *et al.*, 2008; Campbell and Reece, 2006), it gives a quick overview and recapitulation.

Part II contains short chapters discussing the most important methods used in biotechnology. Again, for a more thorough approach to the subject, consult the relevant textbooks.

Part III explores the different fields of molecular biotechnology, such as genome research, functional genomics, proteomics, transcriptomics, bioinformatics, systems biology, gene therapy, and molecular diagnostics. It not only gives a summary of current knowledge, but also highlights future applications and developments.

Part IV discusses the industrial environment of molecular biotechnology, including the business environment and difficulties young biotech firms have to cope with and their chances of success.

To give a snapshot of state-of-the-art research in an area where things move faster than anywhere else is next to impossible. Thus, it is inevitable that by the time this book goes into print, some developments will have superseded those described here. Although we have tried to include most relevant issues, the choice of topics must naturally be limited in a such a textbook.

Forty-two coauthors worked on this project, and although we tried to find a more or less uniform style, the authors with their different views and values are still recognizable.

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Michael Wink