

Preface

The book tries to cover the application of biocatalysis in various fields together with appropriate biochemical as well as some chemical fundamentals. The latter does not mean that biochemistry textbooks are dispensable; readers are in fact encouraged to consult the excellent biochemical literature available nowadays. The term "biochemical fundamentals" as related to this book should be understood as first background information in context with the different aspects of biocatalysis put up for discussion here.

The core of this book is chapter 10 about the application of biocatalysts in the synthesis of organic compounds. Preceding are chapters providing additional knowledge useful for understanding some general principles of biocatalysis. Chapter 4 is devoted to non-protein groups, mainly the coenzymes, supplemented by further examples in chapter 7 the main emphasis of which are reaction mechanisms; included here is the discussion of some biocatalysts having particular application potential as e.g. hydrogenases (hydrogen production) or nitrogenases (ammonia synthesis). Enzyme mimics are also considered in this chapter and elsewhere. Chapters 5 and 6 introduce into fundamentals in kinetics, and enzyme kinetics, respectively. A brief discussion about antibiotics, focusing on nonribosomal peptide synthesis is the content of chapter 8, and in chapter 9 the different methods of enzyme immobilization together with the properties of immobilized biocatalysts, including aspects of heterogeneous kinetics, are treated.

Chapter 10 is followed by enzymatic catalysis in unconventional media (chapter 11). Two further chapters deal with the possibility to improve the performance of biocatalysts through evolutionary methods (chapter

12) and by pathway engineering (chapter 13) both being rather new techniques that revolutionized biocatalysis within a rather short period of time. One aim of this book was to address aspects of biocatalysis that are sometimes more or less disregarded in textbooks on biocatalysis. To these belong not only the already mentioned non-ribosomal peptide synthesis but also catalytic antibodies (chapter 14) or RNA-catalysts (chapter 15); all three research areas at the present time are not of higher importance for direct application, however, this may change in the future. Irrespective of that they are part of the substantial arsenal of possibilities symptomatic for biocatalysis.

Within several chapters some aspects are discussed in more detail if they are instructive to students for reasons others than just conveying expert-knowledge, e.g. the scientific debate on the mechanism of the enzyme methyl coenzyme M reductase, catalyzing the formation of methane, the recently detected bi-directional glycosyltransferases, *etc.*; these selected examples may in some cases also deliver some insight into how science functions.

Chapter 10 itself is organized in a way deviating from the EC numbering system (chapter 3) in that it starts with the enzyme class 3, the hydrolases because they are the biocatalysts used most frequently in Organic Synthesis. In connection with epoxide hydrolases it seemed to make sense to also discuss the biological synthesis of epoxides by monooxygenases belonging to the enzyme class 3. Nitrile hydratases, though members of the enzyme class 4 (lyases) are included within the sub-chapter nitrile-hydrolyzing enzymes for similar reasons. A separate and more detailed chapter deals with carbohydrate modifying enzymes comprising hydrolases as well as transferases (enzyme class 2), thus allowing for the great importance of glycobiotechnology. This is followed by a survey of oxidoreductases (chapter 10.3), and lyases (aldolases and hydroxynitrile lyases, chapter 10.4). In the final sections of chapter 10, enzymes are reconsidered that catalyze various other reactions among them the most important racemases and epimerases of the enzyme class 5.

The last two chapters about the application of biocatalysts in industry not only provide an insight into the commercial use of this class of catalysts for the production of fine chemicals, pharmaceuticals, agro-

chemicals, or bulk chemicals including polymers, and for the improvement of various processes. Industrial biotransformations will envisage a promising future as they represent a green technology compared with traditional chemical processes, and it is to be expected that biotechnology becomes more and more competitive with petroleum-based productions. Thus, due to the ecological benefit of biocatalysts, applied biocatalysis is a typical sustainable technology, expressed since some years by the term White Biotechnology.

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