

Foreword

“Living organisms cannot colonize environmental territories on our planet that were thought to be extreme from an anthropogenic point of view.” Such a statement was well accepted in the scientific community for a long time. However, the last century taught us that microorganisms are even capable of thriving in the harshest places on earth including the deep sea, hot springs, glaciers, deserts, and solfataric fields. Microorganisms belonging to the domains of *Bacteria* and *Archaea* exclusively populate such extremely demanding environments, and we now start to understand that the so-called extremophiles must be adequately adapted with regard to metabolic processes, biological functions, genomes, and transcriptomes to overcome the challenges of life. Nowadays, fantastic new species have been discovered in both natural and artificial extreme environments. Moreover, these kinds of microorganisms are characterized by their unique and highly adapted enzymes, the so-called extremozymes, which can be applied in various industrial processes.

The purpose of the book *Biotechnology of Extremophiles: Advances and Challenges* is to give an extensive overview about several contemporary fields of research on extremophilic microbes and their potential application in industry. Well-renowned scientists have contributed outstanding book chapters covering their respective fields of expertise. The topics of these chapters illustrate recent and remarkable progress and feature the best of the latest in academic and industrial research on extremophiles.

The first part of the book is focused on basic aspects on different types of extremophilic microbes, environmental conditions, and the potential for biotechnological applications. A comprehensive overview on growth and metabolism of extremophiles with a special focus on carbohydrates and amino acids is provided (Chap. 1). Other authors explore cold environments including Antarctica, Arctic, and Himalayan glaciers to discuss the biodiversity and biotechnological potential of psychrophiles (Chaps. 2 and 3). Thermophilic species are presented as valuable sources to produce bioactive exopolysaccharides (Chap. 4). Three chapters focus on the lifestyle of acidophilic microbes including acidophilic sulfur reducers and biofilm-forming acidophilic metal oxidizers (Chaps. 5–7), while alkaliphilic prokaryotes are described as producers of highly relevant enzymes for versatile

industrial applications (Chap. 8). Finally, the nitrogen metabolism in halophiles is the topic of another interesting article (Chap. 9).

All these organisms represent a “treasure chest” of biocatalysts with a tremendous potential for versatile industrial applications (especially in “white industrial biotechnology”), which is the major topic of the second part of this book dealing with novel screening techniques including proteomics, biochemical characterization, and supply of important groups of extremozymes (Chaps. 10 and 11). Extensive efforts have been undertaken to understand their roles in metabolism, biochemical functionality, and evolution. These biocatalysts are well known to cope with extremes of temperatures, pressure, and high concentrations of toxic metal ions or organic solvents. In this book, experts in the field illustrate the potential of lipolytic enzymes and proteases to be used in different industrial applications (Chaps. 12–14) and demonstrate the great potential of cold-active beta-galactosidases that are relevant in cosmetics, pharmaceutical, and food industry (Chap. 15). Further authors shed light on the evolution and biotechnological application of pesticide-hydrolyzing lactonases and alpha-amylases (Chaps. 16 and 17), while additional chapters report on enzymes from thermophiles, including DNA-replication proteins (Chap. 18) and lignocellulolytic hydrolases for the degradation of plant waste materials (Chap. 19).

In the third part, a bioinformatics approach to reconstruct ancestral protein sequences that can be used for the creation of heat-stable proteins (Chap. 20) and a systems biology framework that uses high-throughput “omics” technologies to investigate cell function in response to temperature shifts are presented (Chap. 21). Moreover, the potential of experimental microbial evolution is critically evaluated using state-of-the-art methodologies (Chap. 22), and immobilization strategies to isolate, purify, and reuse thermozymes based on the utilization of solid-binding peptides are described (Chap. 23). Molecular dynamics simulations are portrayed as an efficient tool to investigate structure-function relationships in extremozymes from psychrophiles (Chap. 24), and finally, the establishment of an expression system to produce malaria vaccines in a halophilic heterologous host is discussed (Chap. 25).

In summary, this book sheds light on various aspects of extremophilic microorganisms and their enzymes. It is a unique read and greatly covers some of the most exciting and innovative areas in the wide research field of “biotechnology of extremophiles.” My congratulations to the authors and the editor!

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