

Preface

The introduction of styrene into the environment by anthropogenic activity initiated numerous studies on its bioavailability and degradation by microorganisms already during the 1970s. Besides several studies with respect to eco-toxicity and environmental fate, also its effect on humans after exposure was investigated. It has been often reported that styrene itself and metabolites have serious impacts on the living world.

The historical time line started with the first description of styrene from a natural resource called *Styrax* in 1831. After heating, the plant material styrene was extracted and identified as the substance causing a distinct odor. Thus, its name was given based on the plant source. Styrene became a major chemical for diverse industries as, for example, in polymer-production. Later, the environmental pollution by styrene was investigated and from a microbiological point of view the degradation potential and pathways were described in detail. Single enzymes were also investigated. Thus, it was possible to solve mechanisms and structures as well as demonstrate biotechnological applications. Cascades of some enzymes or even complete pathways were either applied in bioremediation or production of fine chemicals. Respectively, over the years the field of microbial styrene conversion and related topics became a diverse and large area of research. Furthermore, styrene is one of the most produced and processed chemicals worldwide. Thus, its impact on the environment and ecosystems is still important!

In the group of Prof. Michael Schlömann the bacterial degradation of aromatic compounds and involved enzymes were studied extensively. While doing so also an enzyme possibly participating in styrene degradation was determined by Dirk Eulberg and Silvia Lakner. This monooxygenase, later named StyA2B, was the first self-sufficient one-component styrene monooxygenase that was able to initially activate styrene for microbial breakdown. However, nothing was known about it and its biochemical role or even biotechnological application. That was the initiation of my Ph.D. project which aimed at the extensive characterization of StyA2B and related monooxygenases. During these studies several aspects of microbial styrene mineralization were investigated, enzymes studied,

and biotechnological applications initiated. Respectively, several novelties were uncovered and published in order to contribute to the field of microbial styrene degradation.

The objective of this book is to present an overview of styrene degrading organisms and their repertoire of enzymes involved in metabolization of styrene under anaerobic and aerobic conditions. Therefore, a description of the physicochemical properties of styrene is given. Toxicological aspects are discussed. Microorganisms and their styrene degradation routes are outlined with respect to metabolites, genetic background, and regulatory machinery. Respectively, most important enzymes involved are highlighted. Furthermore, biotechnological applications that were reported or even patented are presented. The overview allows to determine the impact on various fields as microbiology, biochemistry, and biotechnology as well as poses still uncovered questions! Thus the book presents a general view of the current state of microbial styrene metabolism and initiates further work!

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The past years we worked together as friends, students, and colleagues on several aspects of microbial styrene metabolism and respective enzymes. Thus, it was possible to collect and publish novel data as well as compile the literature from many years. Finally, it was possible to generate this book summarizing the state of the art on styrene metabolism by microorganisms including genetic, enzymatic, and technological reports. Herewith I want to say **THANK YOU** and acknowledge Michael Schlömann, Willem van Berkel, George Gassner, Andreas Schmid, Uwe Bornscheuer, Andreas Liese, Hedda Schlegel-Starmann, Stefan Kaschabek, Adrie Westphal, Janosch Gröning, Rene Kermer, Michel Oelschlägel, Anika Riedel, Thomas Heine, Stefania MonTERSINO, Eliot Morrison, Ringo Schwabe, Paula Zwicker, Juliane Zimmerling, Catleen Conrad, and of course all other lab mates! Some of them supported to some extent the development of the book and provided content of chapters and will be therefore mentioned as co-authors in the acknowledgment.

As we all know, to achieve novelty and success depends not just on a good working situation, but to a large extent, also on the family behind. Therefore, I finally thank my parents, sister, wife, and son for never-ending support!

Finally, I thank the Springer publishing team, especially Jutta Lindenborn, for help throughout the writing and editing process. The overall support made it possible to create this overview of microbial styrene degradation and involved enzymes!

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