

Preface

Isoprenoids, also known as terpenoids, represent the largest class of natural products, comprising more than 40,000 different structures found in all kingdoms of life. Plants, in particular, are well known to harbor an impressive diversity of isoprenoids with a wide range of different ecological, physiological and structural functions, including light-harvesting pigments, hormones, phytoalexins and semiochemicals, among others. The functions of many complex plant isoprenoids, often referred to as secondary or specialized metabolites, in the natural world remain to be discovered. Likewise, the microbial realm is another rich source for isoprenoid molecules. Since ancient times, isoprenoids have been omnipresent in people's every day lives and utilized for their many different properties, for example as medicines, flavors, and fragrances. Isoprenoids define many of the flavor impressions of foods and beverages and may help preserve them during storage. They are key fragrance compounds in perfumes, and beyond their fragrant properties the biological activities of terpenoid-rich essential oils have been used in many traditional medicines. Modern industrial exploitation of isoprenoids range from some high-value pharmaceuticals such as the anticancer drug paclitaxel (Taxol®) to common components of personal hygiene and cosmetic products and inexpensive antimicrobial and organic solvent-like ingredients of household cleaners to commodity materials such as natural rubber. More recently, properties of terpenoids as fuels have been rediscovered and are being explored for the development of advanced biofuels.

Modern biotechnological approaches, including genomics, systems metabolic engineering and synthetic biology, along with biochemistry and chemistry, are bringing along a deeper understanding of isoprenoid biosynthesis in nature and are guiding strategies to harness this knowledge for sustainable production of isoprenoids based on renewable resources.

With the compilation of chapters published in "Biotechnology of Isoprenoids" we set out to cover a rather broad spectrum of research in this field to illustrate both the fascinating diversity and the great industrial potential of these natural products. Given the diversity and manifold applications of isoprenoids, this volume could only cover selected topics while inevitably missing others. Nevertheless, we hope this volume will serve as an introduction for those readers who are new to the field

of isoprenoids and may also give the expert reader an up-to-date overview of recent advances in the field. As the editors, we are grateful to so many of our highly esteemed colleagues who accepted our invitation and generously contributed to their time and expertise to this compilation of sixteen chapters.

The first part of the book focuses on some of the fundamentals of isoprenoid biosynthesis in bacteria, fungi and plants and also offers a deeper insight in one of the key enzyme classes involved in isoprenoid biosynthesis, plant cytochrome P450 monooxygenases. Other important classes of enzymes such as prenyl transferases and terpenoid synthases are covered with different subchapters in several chapters across the book. The second part addresses fundamental techniques for metabolic engineering of microbes, algae and higher plants and also covers the potential of microbial P450s for isoprenoid hydroxylation. It also includes bioprocess engineering of microbial isoprenoid production and analytical methods for volatile isoprenoids. The third part covers a set of examples for the fascinating arena of isoprenoid biotechnology with emphasis on industrially important products. With ascending number of isoprenoid C atoms in mind, the seven chapters of this part are each devoted to a particular isoprenoid product or product class: the hemiterpene isoprene, p-menthane monoterpenoids, sesquiterpenoids such as artemisinic acid, farnesene and nootkatone, diterpenoids such as paclitaxel and ambroxide-related compounds, and carotenoids. The reader will also find a variety of other highly interesting isoprenoid products in the course of the chapters in Parts I and II.

We hope this book will provide all readers with new inspiration for their learning, teaching and research in the field of biotechnology of isoprenoids.

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