Steroids are terpenoid lipids with specific structure that occur widely in living systems. Over 250 sterols and related compounds have been reported in plants, insects, vertebrates, and lower eukaryotes such as yeasts. Steroid-based drugs have a wide range of therapeutic purposes, such as anti-inflammatory, immunosuppressive, progestational, diuretic, anabolic, and contraceptive, as well as other applications. As a result, about 300 approved steroid drugs exist to date, and the global market for steroid-containing products is in excess of $10 billion and more than one million tons annually.

Scientific research on steroid chemistry began in the early twentieth century and was encouraged in the 1950s, with the discovery of the pharmacological effects of cortisol and progesterone. Their production is being done by chemical synthesis pathways, but the replacement of some of the chemical steps by bioconversions is allowing, in many cases, fewer stages, higher yields, and new modifications leading to more competitive and robust processes.

One of the major raw materials for steroid industry is the natural steroid sapogenin called diosgenin. The conversion of diosgenin to valuable steroids is done by a well-established chemical route, despite presenting several shortcomings such as higher costs, multistep syntheses, waste of land resources, and exhaustion of wild plant resources. Alternative starting materials for the steroid industry are the natural sterols, e.g., phytosterols, a mixture of sterols industrially obtained as a by-product of the oil refining process or from the cellulose production process.

Microbial bioconversion of phytosterols into steroid intermediates remains a focus of research in the field of steroids. Growing numbers of microbial biotransformations of steroids have been reported, with an emphasis mainly on steroid hydroxylation, Δ1-dehydrogenation, and sterol side-chain cleavage. Many of these biotransformation reactions, in combination with chemical synthesis, enabled the production of large quantities of steroid compounds. Both phytosterol bioconversions and new steroid modifications are two areas of special interest for the industry.

This book is intended to provide practical experimental laboratory procedures for a wide range of steroid bioconversions. Although not an exhaustive treatise, it provides a detailed “step-by-step” description of the most recent developments in these biotechnological processes. The detailed protocols are cross-referenced in the Notes section, providing special details, minor problems, troubleshooting, and safety comments that may not normally appear in journal articles and can be particularly useful for those not familiar with specific techniques.

The two lead chapters of this volume are overviews on microbial bioconversions and chemical synthesis pathways, respectively. The following chapters show comprehensive experimental methods on strain characterization (genomics, transcriptomics, and proteomics) and improvement, bioconversion methods from sterols to androstenedione (AD) and androstadienedione (ADD), steroid hydroxylations, biocatalysis, downstream processes to purify steroid intermediates, and analysis.
This book has been written by outstanding experts in their field and provides a reference source for laboratory and industrial professionals, as well as for graduate students in a number of biological disciplines (biotechnology, microbiology, genetics, molecular biology, etc.).

We are indebted to the authors who, in spite of their professional activities, agreed to participate in this book, to Dr. J. Walker, Series Editor, for his encouragement and advice in reviewing the manuscripts, and to the staff of Springer for their assistance in assembling this volume and their efforts in keeping this project on schedule. Last but not least, we warmly acknowledge our families for their patience and support.

*León, Spain*  
*Boecillo, Valladolid, Spain*

*José-Luis Barredo*  
*Ignacio Herráiz*