

Preface

Glycobiology can be said to be sweet biology. The full appreciation of the role of sugars, glycomolecules and glycosylated structures and their biological functions has been a more recent one compared to that of nucleic acids and proteins, particularly in the specialization of microbiology and related fields. Understanding has grown that monosaccharides represent an alphabet of biological information similar to amino acids and nucleic acids, but with a greater, and potentially unsurpassed, coding capacity. Though it has been predicted that microorganisms can synthesize more sugar building blocks than their eukaryotic counterparts, e.g. for bacteria it is considered to be six-fold greater, this extensive coding capacity impacts the biological functioning of microbial molecules and also influences the interaction of microbes with their environment, including host structures.

The concept behind this book is to present, in an easy-to-read format, reviews of the important central aspects of microbial glycobiology, i.e. the study of carbohydrates as related to the biology of microorganisms. The importance of substitution of proteins by sugars (glycosylation) and the role played by glycosylated structures (glycoproteins, glycopeptides, glycolipids, lipoglycans, glycoconjugates, etc.) in disease development, immune recognition, and environmental processes have become well-established. Moreover, from the viewpoint of biotechnology industry, glycobiology, microbial glycobiology and microbial glycomics are important components. Microbial, especially bacterial, glycomes represent an excellent toolbox for glycobiologists

to understand the fundamentals of glycosylation pathways, to develop new techniques for glycobiology, and to exploit glycosylation pathways for development of novel diagnostics and therapeutics. Despite the relevance of glycobiology in medical and environmental microbiology, and the potential to exploit this knowledge for industrial and medical processes, this field has only begun to be fully appreciated. In particular, glycomics – the applied biology and chemistry of the structures and functions of carbohydrates – and microbial glycomics – glycomics as related to microbial components – have become recognized as areas of emerging technological development. For instance, this area has been highlighted in the Massachusetts Institute of Technology Review as one of ten emerging technologies that will have a significant influence in the near future. Furthermore, it has been commented that the field of microbial glycobiology could fuel a revolution in biology and industry and aid biomedical development and drug discovery.

Indeed, the number of publications in this field has risen dramatically in recent years, making it extremely difficult for even the most diligent reader to stay abreast of progress. Additionally, in many areas of microbial glycobiology well-based and extensive reviews are lacking. Thus, we considered there was a major need to provide a book reviewing the range of topics relevant to microbial glycobiology since no such book has previously been available. It is our hope that this text distills the most important cutting-edge findings in the field to

produce a timely and definitive overview, providing a useful introduction to the subject for new researchers, as well as an invaluable reference for experienced ones. Our goal has been to create a state-of-the-art compendium and to delineate the knowns and unknowns in the field.

Since microbial glycobiology represents a multidisciplinary and emerging area with implications for a range of basic and applied research fields, as well as having industrial, medical and biotechnological implications, care has been taken in the choice of topics to be covered. This volume cannot attempt to be completely comprehensive, but we believe, the central concepts and areas of intensive investigation have been covered as have aspects of the glycobiology of bacteria, viruses, fungi and protozoa. The approach has been to cover and link knowledge among microbiologists, synthetic and analytical chemists, biomedical and biopharmaceutical scientists and biotechnologists. The first section of the book introduces readers to the nature, structures and functions of glycomolecules and glycosylated components of microorganisms and infectious agents. This includes not only such components of bacteria but also those from viruses, fungi and protozoa. In the next section, the genetics and biosynthesis of these components, as well as the ability to chemically synthesize a number of these molecules are reviewed.

The interaction with and recognition by the host of these molecules is considered subsequently, as are both the environmental and medical relevance of microbial glycosylated structures and glycomolecules. Finally, the biotechnological and medical applications of microbial glycosylation and glycosylated molecules is explored. Collectively, the chapters present basic science understanding of these molecules through to the applied science of exploitation and applications of microbial glycosylation, both industrially and biomedically.

We have been fortunate to have been joined by our colleagues, leaders in the field, who have contributed their ideas, experiences and insights in a free and open manner to yield what we believe are insightful, concise and stimulating chapters in a review format. The editors sincerely thank the numerous contributors of these chapters. Furthermore, special thanks is deserved by Mari Moran and Sharon Ackerman for their expert secretarial assistance during manuscript preparation at different stages of this project. Finally, and by no means least, we thank Lisa Tickner and Christine Minihane for their unwavering support in making this text a reality, Kristi Anderson for her editorial skills, and Claire Hutchins, Caroline Jones and their team for their efforts during the production phase.

On behalf of the editors,
Anthony P. Moran