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BOOK REVIEW

Glycochemistry. Principles, Synthesis, and Applications

(Wang, P. G., and Bertozzi, C. R., eds., Marcel Dekker, New York-Basel, 2001, 682 p., $195)

This book recently published by Marcel Dekker continues a series of monographs describing the newest methods of synthetic chemistry of carbohydrates and their application in various fields of biotechnology including design of large number of pharmaceutical preparations.

Some previously issued monographs have already been reviewed in *Biochemistry (Moscow)*: "Carbohydrates in Drug Design" (1999, **64**, No. 7, 847), "Glycopeptides and Related Compounds. Synthesis, Analysis, and Applications" (1999, **64**, No. 9, 1092), "Techniques in Glycobiology" (1999, **64**, No. 10, 1215). Although the other book published by Marcel Dekker in this series in 1997, "Preparative Carbohydrate Chemistry" (Hanessian, S., ed., 648 p.) was not reviewed in this journal, it was highly evaluated by experts of glycobiology and carbohydrate synthesis.

This book consists of 18 chapters written by an international team of authors. Chapter 1 (by P. H. Seeberger) deals with solid-phase synthesis of oligosaccharides. This relative new direction in oligosaccharide synthesis appeared in the 1970s. Now it is one of the promising methods for synthesizing (with high yield) rather large amounts of final products of high purity.

Chapters 2 (by D. Gin) and 3 (by D. Crich) consider approaches of stereoselective formation of glycosylated products. The authors pay special attention to dehydrative glycosylation using 1-hydroxy donors (chapter 2) and glycosyl triflates as highly reactive donors for a wide range of glycosyl acceptors (chapter 3). The latter approach is especially convenient for synthesis of β-mannopyranosides which often appear as components of various biologically important compounds.

Chapter 4 (by M. H. Postema and D. Calimente) deals with methods of synthesis of C-glycosides. Although these compounds are not synthesized in humans they are components of natural products. In contrast to corresponding to O-glycosides, C-glycosides are not subjected to enzymatic hydrolysis and therefore they may be considered as stable compounds imitating sugars. The authors focus much attention on characterization of numerous methods of synthesis of α- or β-C-glycosides.

In chapter 5, T. L. Lowary considers methods and conformational analysis of mycobacterial D-arabinofuranosides. These compounds were found in cell wall of *Mycobacterium tuberculosis* and *M. leprae* which cause such dangerous diseases as tuberculosis and leprosy. About one third of the world population is infected with *M. tuberculosis* and three million people suffering with this disease die every year. Resistance of *M. tuberculosis* and *M. leprae* to antibiotics is largely associated with properties of cell wall compositions, particularly with such polysaccharides as arabinogalactan (AG) and lipoarabinomannan (LAM). Special sections of this chapter deal with structure of AG and LAM, their biosynthesis and chemical synthesis of oligosaccharides containing D-arabinofuranose residues. This chapter also considers conformational properties of oligo- and polysaccharides containing D-arabinofuranose residues.

In chapter 6, B. Yu and Y. Hui describe chemical synthesis of biologically active steroid saponins. Chemical compounds of this class widely distributed in plants are used for preparation of pharmacologically active substances. Special attention is paid to various approaches for glycosylation of steroid saponins.

In chapter 7, R. L. Halcomb and M. D. Chappell analyze recent achievements in technologies of sialic acid glycosylation using chemical synthesis and enzymatic methods.

Chapter 8 (by D. A. Mann and L. L. Kiessling) deals with chemistry and biology of lectin–ligand interactions, which play an important role in numerous biological processes such as binding of bacteria and viruses to host cells, immune system functioning, graft rejection, fertilization, etc.

The authors consider plant lectins (e.g., concanavalin A), mammalian liver lectin known also as asialoglycoprotein receptor involved in heme agglutination of influenza virus. The latter binds to sialic acid residues on the surface of host cells and provides the first stage of viral infection. In this connection the authors consider structure and synthetic approaches described in the literature for the development of inhibitors of such binding by means of sialic acid containing polymers based on, e.g., acrylamides. A

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special section of the chapter was reserved for selectins, C-type lectins localized on the surface of endothelial cells of blood vessels involved in binding of circulating leukocytes in response to inflammatory processes.

In chapter 9, R. Roy considers approaches which allow construction of sialic acid-containing compounds for potential use in studies of the biological role of sialic acids. The author described methodology of synthesis of sialic oligosaccharides, functional sialosides, sialic clusters, N- and O-bound sialoglycopeptides, sialoglycopolymers, and glycodendrimers. This chapter also contains information on methods for preparation of new dendrimer-polymeric glycoclusters characterized by increased affinity to influenza virus agglutinin.

Chapters 10 (J. Haddad et al.) and 11 (J. Haddad et al.) describe structure and action mechanism of aminoglycoside antibiotics (AA) and methods of their chemical synthesis. These antibiotics are also known as aminocyclic antibiotics because their antibiotic activity is mainly determined by the aminocyclic moiety of their structure. AAs are effective against Gram-positive and Gram-negative microorganisms. Streptomycin is one of the best known representatives of the AA. It was the first effective antibiotics with respect to *M. tuberculosis*. Antimicrobial effect of AA against various bacteria involves antibiotic binding to certain site of bacterial ribosomal RNAs. Successful application of AA for treatment of various infectious diseases in man stimulated development of methods for synthesis of AAs highly effective against resistant microorganisms. The authors characterize a large number of AAs, consider known ways for enzymatic modification of AAs (aminoglycosyl acetyl transferases, aminoglycosyl nucleotidyl transferases, and aminoglycosyl acetyl phosphotransferases), and characterize sites of RNA–AA complexes. A special section of chapter 10 was reserved for consideration of AA toxicity. The authors of chapter 11 consider in detail methods of AA synthesis.

In chapter 12, B. Yeung et al. describe methods of chemical syntheses of glycosaminoglycans (GAG) such as hyaluronic acid, chondroitin sulfate, keratan sulfate, dermatan sulfate, heparin, and heparan sulfate. The authors emphasize that chemical synthesis of GAG oligomers is essential for elucidation of biological activity of GAGs and their application for the development of various drugs.

In chapter 13, J. Gervay-Hague and T. Weathers, Jr., consider methods of synthesis of amino acid conjugates with glycopyranosides and their various derivatives. The authors summarize literature data on various syntheses; they begin with synthesis of relatively simple O- and N-glycopeptides with neuraminic acid and end the chapter with description of methods of synthesis of complex oligosaccharides forming secondary conformational structure.

Chapter 14 (by X. Qian et al.) deals with the use of glycosyl transferases in oligosaccharide synthesis. Among the group of these enzymes the authors consider various types of β-1,4-, β-1,3-, and α-1,4-galactosyl transferases, fucosyl transferases, and α-2,3-, α-2,6-sialyl transferases.

In chapter 15, H. Cheng and Q.-M. Gu discuss problems of polysaccharide biotransformation using enzymes and microorganisms. The authors consider various types of polysaccharide modification by means of lipases and β-galactosidases. For acylation of neutral polysaccharides (e.g., galactomannan) into an anionic polymer, various types of microbial lipases were used.

Chapter 16 (P. Andreana et al.) deals with various aspects of studies of α-galactose epitope (its carbohydrate sequence is responsible for tissue rejection during xenotransplantation).

In chapter 17, P. Kowal et al. characterize bacterial glycosyl transferases used in biotechnology for elaboration of polysaccharide components of bacterial wall.

In chapter 18, S. Goon and C. Bertozzi consider approaches for synthesis of metabolic substrates which may be used in various research projects in glycobiology.

All of the materials in the book unquestionably demonstrate progress in synthetic carbohydrate chemistry, which is a most complex field in organic synthesis. Like other books published by Marcel Dekker (and mentioned in this review), this book also demonstrates increased interest of researchers in glycochemistry and glycobiology.

This well illustrated book contains many schemes of chemical syntheses, figures, and tables. The illustrative material helps better understanding of the considered material. A comprehensive bibliography at the end of each chapter and an alphabetical index at the end of the book help to find any information available in this monograph and use it as the reference book.

I do believe that this new book will be useful for specialists working in the fields of carbohydrate chemistry, biochemistry, medical chemistry, glycobiology, and also biotechnology and pharmacology.

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