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BOOK REVIEW

Handbook of Glycosyltransferases and Related Genes

(Taniguchi, N., Honke, K., and Fukuda, M., eds., Springer, Tokyo-Berlin-Heidelberg-New York-London, 2002, 670 p., $195)

Glycobiology is an intensively developing area, which together with molecular biology is widely employed in modern medicine and biotechnology. Glycosyltransferases represent a large group of enzymes of various substrate specificity and cellular localization responsible for wide diversity and complexity of glycoconjugates which include glycoproteins, glycolipids, and proteoglycans. The "Handbook of Glycosyltransferases and Related Genes" consists of 89 chapters written by more than 50 internationally distinguished experts in this field.

In chapter 1 Y. Hirabayashi and S. S. Ichikava consider glucosyltransferases and UDP-glucoseceramide glucosyltransferase. The latter is widely distributed in animal and plant tissues. Since glucosylceramide is a precursor for many glycosphingolipids, this enzyme plays a key role in the biosynthesis of these compounds.

Chapters 2-8 deal with various types of galactosyltransferases such as β4-galactosyltransferase I (by N. Shaper and J. Shaper), β4-galactosyltransferases II, III, IV, V, VI, and VII (by K. Furukawa and H. Clausen), β3-galactosyltransferases I, II, and III (T. Hennet and E. Berger), β3-galactosyltransferase IV (GM1-synthase) (K. Furukawa), β3-galactosyltransferase V (H. Narimatsu), α3-galactosyltransferase (D. van den Eijnden and D. Joziasse), and galactosylceramide synthase (W. Stoffel).

Chapters 9-21 consider various types of N-acetylglucosaminyltransferases. Substrate specificity of various N-acetylglucosaminyltransferases is considered by P. Stanley (N-acetylglucosaminyltransferase I), H. Shachter (N-acetylglucosaminyltransferase II), Y. Ikede and N. Taniguchi (N-acetylglucosaminyltransferase III), M. Minova et al. (N-acetylglucosaminyltransferase IV), J. Dennis (N-acetylglucosaminyltransferase V), K. Honke and N. Taniguchi (N-acetylglucosaminyltransferase VI). Several chapters of this section deal with β3-N-acetylglucosaminyltransferases (R. Haltivanger and M. Fukuda), β6-N-acetylglucosaminyltransferases I, II, and III, which attach N-acetylglucosamine to protein cores type 2 (M. Fukuda et al., M. Fukuda, J. Yeh), α4-N-acetylglucosaminyltransferase (J. Nakajama), and O-GlcNAc-transferase (S. Iyer and G. Hart).

Chapter 22-26 also deal with N-acetylglucosaminyltransferases. F. Hagen et al. review polypeptide N-acetylglucosaminyltransferases, K. Furukawa considers β4-N-acetylglucosaminyltransferase. Transferases involved into biosynthesis of substances of A and B blood groups are considered by S. Hakomori. K. Honke considers glycolipid synthase involved into biosynthesis of Forsmann glycolipid.

Chapters 27-34 summarize data on fucosyltransferases. These include α-2-fucosyltransferases (R. Oriol and R. Mollicone), α3/4-fucosyltransferases (H. Narimatsu), α3-fucosyltransferases IV, V, VI, VII, and IX (H. Narimatsu), and also α6-fucosyltransferase VIII (E. Miyoshi and N. Taniguchi).

One of the largest sections (chapters 35-53) of this book was reserved for sialyltransferases, including α2,3-sialyltransferases I, II, III, IV, V (M. Fukuda, J. Marth; T. Hamamoto, S. Tsuji; S. Kitazume-Kawaguchi, S. Tsuji; M. Saito, A. Ishii), α2,6-sialyltransferases, which catalyze addition of N-acetylneuraminic acid to galactose (T. Hamamoto, S. Tsuji) and to N-acetylgalactosamine (N. Kurosava, S. Tsuji; S. Takashima, S. Tsuji). Some chapters of this section deal with α2,8-sialyltransferases catalyzing addition of N-acetylneuraminic acid (NANA) to terminal NANA residues in carbohydrate chains of glycoproteins and glycolipids (Y. Sanai, N. Kojima, S. Tsuji, Y. Yoshida, J. Nakayama et al.). Properties and substrate specificity of α2,8-sialyltransferases, members of this group of enzymes catalyzing biosynthesis of polysialic chains, which may contain up to several tens of sialic acid residues, are analyzed. In a separate chapter, A. Suzuki considers CMP-NANA hydroxylase, which catalyzes conversion of CMP-NANA into CMP-N-glycolylneuraminic acid. Hydroxylation reaction requires the enzymatic complex containing cytochrome b_5, NADH-cytochrome b_5 reductase, CMP-NANA hydroxylase, and also NADH.

Chapters 51-53 summarize data on glucuronyltransferases. One of these enzymes, HNK-1-glucuronyltransferase, is involved in biosynthesis of carbohydrate chains of HNK-1-carbohydrate epitope, which is a sulfated trisaccharide SO_4-3GlcAβ1-3Galβ1-4GlcNAc. The latter is a component of such biologically important molecules as NCAM (nervous cell adhesive molecule), myelin associated glycoprotein, telencephalin, etc. (S. Oka, T. Kawasaki). This section also deals with two glucuronyltransferases

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(GT), glycosaminoglycan-GT1 (H. Kitagawa, K. Sugahara), and UDP-glucose dehydrogenase (A. Spicer). The latter is the key enzyme of biosynthesis of glycosaminoglycans; it also plays an important role during toxin detoxication and metabolism of such endogenous substrates as steroids, heme pigments, and thyroxin.

Glycosyltransferases involved in biosynthesis of glycosaminoglycans are considered in chapters 54-57. These include α4-N-acetylhexosaminyltransferase (H. Kitagawa, K. Sugahara), hyaluronan synthases 1, 2, and 3 (K. Kimata), heparan sulfate GlcA/GlcNAc transferase (M. Kusche-Gullberg, U. Lindahl), and D-glucuronyl-C5-epimerase (J. Li, U. Lindahl).

A big section of the book (chapters 58-73) is devoted to sulfotransferases. Most of these enzymes sulfate carbohydrate chains in proteoglycans, glycolipids, and glycoproteins.

A separate section (chapters 74-76) deals with transporters of UDP-galactose, UDP-N-acetylglucosamine, and CMP-sialic acid.

Chapters 77-82 highlight dolichol derivatives involved in certain processes of biosynthesis of glycoconjugates.

Chapters 83-89 consider enzymes involved into processing of N-glycans: phosphomannose isomerase, α-mannosidase II, GlcNAc-1 phosphotransferase, and others.

Each chapter not only contains a bibliography of the most important papers in each field, but also refers readers to principally important reviews and monographs for further reading. Such recommendations help the readers to get "deeper penetration" into particular problems discussed in each chapter. In each chapter much attention is also paid to biological aspects of glycosyltransferases, their genetic control, and impairments appearing as the result of mutations in corresponding genes.

This book contains an alphabetic index and maps of metabolic reactions of biosynthesis of N- and O-glycans, glycosphingolipids, and proteoglycans.

This book is quite valuable theoretically and methodologically for specialists of various fields of glycobiology, biochemistry, biotechnology, and medicine. I believe that this book will become an important desk book for researchers working with glycosyltransferases.

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