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Glyco-Forum section

Letter to the Glyco-Forum

Regarding galactofuranose-containing glycoconjugates

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We have with interest read the mini review in the recent issue of *Glycobiology* about galactofuranose-containing glycoconjugates by de Lederkremer and Colli, (*Glycobiology* 5:6 (1995) 547–552). For some time we have also been interested in galactofuranose containing glycoconjugates, particularly from fungi. Therefore, we find it quite surprising to find lack of referencing to the appropriate literature in such a review, where the reader expects to have up-to-date expert advice in a new area without his own special expertise.

We have tried to use the latest version of the complex carbohydrate database (CCSD version 14) available from NCBI[1] or on the internet[2]. Although the coverage of release CCSD14 is not 100% it contains more than 37,000 entries covering therefore to a large extent published carbohydrate structures. Searches for the structural unit Galf performed in the Database (see Table I) revealed that the occurrence of Galf is not restricted to fungi, protozoa and bacteria as suggested by de Lederkremer. This can easily be seen from a simple search for 'Galf' and 'Animalia'. Furthermore, important articles[3–7] in this field which to our minds deserve to be cited can easily be extracted from the CCSD.

Table I. Results from searches for Galactofuranose in the Complex Carbohydrate Structure Database (release 14) using different search strategies

Search strategy	Number matches in CCSD 14
{RS ≈ Galf}	1117
{RS ≈ D-Galf}	291*
{RS = α-D-Galf}	72
{RS = β-D-Galf}	253
{RL = ?-?-Galf?-linked}	102
{RL = ?-?-Galf?-linked} and {MT = N-linked Glycoprotein}	18
{RS = ?-?-Galf} and {(K) = Animalia}	6

*The sum of α-D-Galf and β-D-Galf exceeds this number because in 34 oligosaccharides α-D-Galf and β-D-Galf occur simultaneously in the same structure which is not counted twice in the respective selective searches.

We hope that this example in the future can encourage the use of CarbBank and its associated database to ensure optimal literature citing in both scientific papers and particularly in reviews.

References

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Book Review

Acid sweeteners

Biology of the Sialic Acids, edited by Abraham Rosenberg, Plenum Press, New York, 1995. ISBN 0-306-44974-9

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It is well over a decade since the last major monograph on the sialic acids, edited by Roland Schauer, was published. In that time the science of glycobiology has certainly matured, and the importance of glycan moieties as functional players in cell biology finally has become appreciated. The present volume brings the field of sialobiology, as the editor chooses to call this speciality, well up to date. Indeed the need for such a revision is provided in the first full chapter by the fact that twelve new sialic acid structures have been discovered since 1982, fully a third of the total number of these saccharides described since the initial chemical structures were determined in the mid 1950's.

The survey of sialic acid biology provided by Schauer and colleagues in chapter two is extremely well done although it is a shame about the quality of the micrographs in Figure 5. Analysis, enzymatic modification and roles as viral, bacterial, parasitic and ligands in cell–cell adhesion are all covered in sufficient detail to equip the reader with a good overview and sufficient knowledge for the later more specialised chapters. The biosynthesis of sialic acids and the molecular structures of sialidases are also considered, with some updates to evolutionary perspectives provided by new sequence data. Particularly interesting is the observation that the 'small' sialidases of *Clostridium* and *Salmonella*, both enteric pathogens, share unexpectedly close homology having probably arisen through bacteriophage-mediated horizontal transfer.

In chapter three the current status of molecular cloning and genetic studies of sialyltransferases is reviewed. There has been a huge amount of interest in these enzymes recently, due to their importance in creation of the sialyl-Le^x epitope and to alterations in sialylation patterns in transformed cells. Much of the information is presented both in the text and in tables and figures, some of which are not that easy on the eye, but the review is certainly up to date, as exemplified by discussion of the role of the transmembrane versus the lumenal domain in Golgi retention of sialyltransferase. When dealing with the cloning of these enzymes I found the detailed descriptions of the screening strategies somewhat tedious and pointless. This seems to be at the expense of discussion of the developmental and oncogenic aspects of the biology of these enzymes, which is dealt with rather briefly; for example, we are told about the presence of polysialic acid on embryonic NCAM, but there is no indication of why this is important. Next Troy provides a comprehensive review of polysialic acids, ranging from functions and structures in bacteria, teleost fish eggs, and the mammalian CNS. A list on pages 106–107 of the possible functions of this glycotope (jargon: why are carbohydrate moieties singled out for special and ugly nomenclature treatment?) is impressive, but a number of the entries remain speculative. Biosynthesis of the polysialic acid structures of neuroinvasive bacteria are dealt with in some detail, and a number of new techniques for the identification of these structures are also discussed. Chapter five deals with the biosynthesis and oncobiology of sialic acid carrying proteins. A thorough review of N and O glycan biosynthesis drawing on specific protein examples follows, and the rest of the chapter deals with alterations in the oncogenic state. This is again well done, with a wealth of detail.

Turning to glycolipids, chapter six purports to deal with cell biological aspects of gangliosides. This chapter is rather weak, and focuses almost exclusively on the nervous system. A brief excursion into leukocyte development and roles as viral and bacterial receptors is also included, but no mention of the emerging recognition of the importance of these molecules in trafficking and sorting is made, although the rather confused area of gangliosides in high doses having neuritogenic properties is given substantial (and in my opinion too much) airtime. The section on biosynthesis is accurate but misleading in that the reader could be forgiven for believing that all ganglioside biosynthesis is microsomal and lumenal, despite the fact that a significant fraction of glycolipids are synthesised by the plasma membrane and on the cytosolic face of other cell membranes. It was also somewhat alarming to discover that sialylgangliosides were only recognised as microorganism receptors by solid phase overlay methods in 1989, especially when in Table IV we are told that GM1 was identified as the receptor for *Vibrio cholerae* in 1973. Ganglioside storage diseases are not dealt with at all. The second article on glycolipids, by Hakomori, is a concise review of the potential roles that these molecules have in signalling and cell adhesion events. The chapter focuses on GM3 and sialosylparagloboside (SPG). Both of these lipids have been strongly implicated as modulators of various transmembrane receptors, specifically the EGF and PDGF receptors, for GM3, and the insulin receptor for SPG. The importance of GM3 as a potential adjunct to integrin mediated cell-substratum adhesion is well dealt with, and the direct role of this ganglioside in cell–cell adhesion, with asialo-GM2 as the ligand is described, albeit rather too briefly for so interesting a story. Hakomori is also non-committal with regards to possible roles for sialyl-Le^x-bearing gangliosides in E and P selectin-mediated adhesion. This chapter is rather weakened by referral to earlier reviews and does not fully stand alone, which is unfortunate.

The chapter on sialidases by Saito and Yu is a superb description of this important class of enzymes. With admirable clarity in both the text and display items the authors take us through the viral, bacterial, protozoan and mammalian sialidases, documenting their occurrence and properties. The biological importance of these activities in various organisms is highlighted in some detail. In chapter nine the importance of sialic acid for myxoviruses is considered. The different strategies used by the myxoviruses, combining different activities into one or more polypeptide, are described; then the receptor-binding proteins are dealt with in detail, followed by the sialidases and finally the target proteins on the host themselves. The structural description of the viral capsid molecules is well done, but the figures, in poor quality 100dpi greyscale, neither do justice to the data nor really aid the reader in forming an impression of the glycoproteins under consideration.

The final two chapters deal with pathological aspects of sialic acid biology. In chapter ten all the classic gangliosidoses are discussed, along with sialidosis, a rare inability to remove sialic acids in the lysosome, and Salla disease, a deficiency in export of sialic acid from the lysosome following release. Chapter eleven deals with the phenomenon of neurite loss due to decreased ganglioside sialylation which may be mechanistically related to fetal alcohol syndrome. The article is rather brief and is left somewhat open-ended. I would have liked to have learnt more.

Overall, *Biology of the Sialic Acids* is a worthy summary of a field very much at a stage of progression. There are a number of flaws, the balance is somewhat idiosyncratic in some of the chapters and there is a great range in the quality of the contributions. However, the best are very good indeed, and the wealth of information that the contributors have amassed makes this a valuable volume to have in the laboratory or library.