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Book review

Sialic Acids: Chemistry, Metabolism and Function: edited by R. SCHAUER, Springer-Verlag, Wien and New York, 1982, xix + 320 pages + Subject Index, $65.60, DM 164.00.

Since their initial biochemical characterization in the mid-1950's by Blix and Klenk, the sialic (neuraminic) acids have been found by cell biologists to be effectors in such phenomena as receptor recognition, adhesiveness, catabolic protection, aggregation, masking (or unmasking) of antigenicity, metastatic potential, nerve-signal transmission, viral replication, and certain genetic disorders. At the biochemical level, enzymes that are critical to the formation, degradation, transfer, and pathologic contributions of sialyl residues have also been extensively investigated. This family of amino sugars not only appears at the molecular level as a component of glycoproteins and oligosaccharides, and of gangliosides in several differing positional and structural placements, but also reflects a number of intrinsic, substitutional variations on a fundamental, chemical theme. The complexity of dealing with these substances has been further compounded by an as-yet-unresolved, twenty-five-year-old nomenclatural dispute as to whether the parental, nine-carbon amino sugar ought to be designated sialic or neuraminic acid. It is, therefore, not surprising that the foregoing considerations have been the subject of several books and review articles, beginning in 1960.

The latest compilation of the chemistry, metabolism, and function of the sialic acids comes by way of this volume in the Cell Biology Monograph series, edited by R. Schauer. The first chapter, by A. P. Corfield and R. Schauer is an in-depth review of the natural occurrence of sialic acids. It is formulated along phylogenetic and ontogenetic lines, concluding with a discussion of the possible evolutionary appearance of these compounds. Under the section that deals with Mammalia, the authors describe the polymeric structures of classes of sialic-containing oligosaccharides, glycoproteins, and gangliosides. In an organizationally curious constellation, the nature and chemistry of free and of glycosidically linked sialic acids, in terms of their linkage types, branching patterns, and molecular complexities, are next described. The second chapter, also by Schauer and Corfield, covers the isolation and purification of sialic acids, essentially from the laboratory operational point of view.

A following article by J. F. G. Vliegenthart and J.P. Kamerling describes the latest synthesis of sialic acid and of its derivatives, including blocked compounds, disaccharides, isotopically labeled species, lower analogs, and substrates. Methods

for obtaining an unsaturated sialic acid analog that they discuss under the erroneous trivial name "2-deoxy-2,3-dehydro-*N*-acetylneuraminic acid" are also detailed. In at least a dozen citations in this volume, this compound, which is either so designated or as "Neu5Ac2en", should have been correctly named as 5-acetamido-2,6-anhydro-3,5-dideoxy-D-*glycero*-D-*galacto*-non-2-enonic acid, as, strictly speaking, it is *not* a derivative of NeuAc. Interspersed between this chapter and the next two, although logically following them, is a brief account of the colorimetric and fluorimetric determination of sialic acids, as well as their thin-layer chromatographic characteristics, by Schauer and Corfield. Also included here is a brief subsection dealing with the so-called "high-performance" liquid chromatographic separation of members within this family of compounds.

For those whose main concern and interests in sialic acids and its relatives lie in the chemistry of these compounds, two monumental articles by J. P. Kamerling and J. F. G. Vliegenthart and their collaborators follow. The first of these delineates derivatization procedures and attendant gas–liquid chromatographic separations for sialic acids, including quantitation techniques, followed by combined g.l.c.–mass spectrometry, analysis of fragmentation patterns, and finally, their interpretation. This section is extensively documented with electron-impact mass-spectral graphics for a wide variety of trimethylsilylated, acetylated methyl esters of the parental compound. Next, these authors provide an updated review of the high-resolution, n.m.r. spectroscopy of the sialic acids. Presented are extensive examples of ^{1}H- and ^{13}C-n.m.r. spectroscopic features of the sialic acids at 60, 360, and 500 MHz, including many resolution-enhanced, 500-MHz patterns. Tabular interpretations of ^{1}H-n.m.r. chemical-shift data are liberally provided, and applications of ^{13}C-n.m.r. chemical shifts towards the determination of the structures of sialic acid oligomers and polymers are delineated.

The next article, by C. F. A. Culling and P. E. Reid, covers the histochemical methodologies available for the location and identification of sialic acids and their variants in tissue sections. This encompasses dye staining, enzymic visibilizations, and a number of chemical techniques, including a most useful compendium of standardized fixation, control, and processing protocols. However, this reviewer looked in vain for any reference to the work of Brossmer or of Palese and their coworkers on the application of specific chromogenic glycosides for localization of sialidases; especially, for a revelation of the unpublished synthesis by Eschenfelder *et al.* for preparing the 5-bromoindol-3-yl glycoside of α-*N*-acetylneuraminic acid.

The rest of the volume is devoted to intermediary, biochemical aspects of the sialic acids. A keystone chapter by Corfield and Schauer covers the *de novo* synthesis of sialic acids, sialyl-transfer enzymology, the catabolism of sialic acids, their uptake and recycling in cells, and regulatory aspects of sialic acid metabolism. The latter, both in terms of basic and clinical biochemistry, is one of the many strong points in this section. One might cavil here only with the repetitive use of the misnomer "*N*-glycoside", as, according to the IUPAC Rules for Carbohydrate Nomenclature. *all* glycosides are defined as *O*-glycosides. This contribution is im-

mediately followed by a chapter by Reutter *et al.* about the biological significance of sialic acids at a somewhat higher cellular-organizational level. Thus, the several main functions of these compounds are interpreted in terms of such phenomena as adhesiveness, the half-life of blood components, blood clotting, immunology and immunotherapy, and hormonal influences. The final chapter of this monograph, by M. Cantz, concerns itself with the clinically important sialidoses. The manifestations, classification, enzymology, and laboratory diagnostic aspects of these metabolic defects are reviewed and brought up to date.

This account of the current status of knowledge about the sialic acids is essentially definitive, timely, well balanced, and extensively referenced. Aside from the nomenclatural slips noted, it appears to be free from scientific errors. However, the text itself contains a number of foreignisms, and might well have benefitted from an additional English editing. The Figures, formulas, and layout are each of the high quality expected from a Springer-Verlag product. This volume will prove to be a useful addition to the personal collection of many carbohydrate and biological chemists, and should be a mandatory acquisition for scientific libraries. Parenthetically, it should be noted that an excellent summary of the extensive information contained in this book, plus a good deal of complementary data, but minus the errors, is to be found in a parallel chapter by R. Schauer in *Advances in Carbohydrate Chemistry and Biochemistry,* Vol. 40 (1982).

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