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Symbol nomenclature for glycan representation

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Abstract

The glycan symbol nomenclature proposed by Harvey *et al.* in these pages has relative advantages and disadvantages. The use of symbols to depict glycans originated from Kornfeld in 1978, was systematized in the First Edition of “Essentials of Glycobiology” and updated for the second edition, with input from relevant organizations such as the Consortium for Functional Glycomics. We also note that >200 illustrations in the second edition have already been published using our nomenclature and are available for download at PubMed.

Keywords

Glycans; Glycomics; Glycoproteomics; Monosaccharides; Nomenclature; Symbols

It has long been recognized that having a simple way to depict glycan structures is a useful starting point for scientific communication, especially for the many non-expert scientists who are now venturing into the field of glycosciences. The glycan symbol nomenclature that is attributed by Harvey *et al.* [1] to the Consortium for Functional Glycomics (CFG) actually had its origins in 1978, in a paper by Kornfeld *et al.* [2], who realized that standard carbohydrate nomenclature was too complex to convey simple concepts. Variations of the Kornfeld symbol system were subsequently used by numerous authors until 1999, when it was systematized and colorized in the First Edition of “Essentials of Glycobiology” [3]. Given the reasonably wide usage of this codified system, the Editors of “Essentials” decided to update it for the proposed second edition (see http://grtc.ucsd.edu/symbol.html and Supporting Information). Before finalizing the plan, we consulted other relevant organizations, such as the CFG and NLM/NCBI, to ensure compatibility and agreement, realizing of course that there would be no way to please everyone in the field. After further consultations with some others in the community,

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the CFG adopted the modified Essentials symbol nomenclature (http://www.functionalglycomics.org/static/consortium/Nomenclature.shtml) and began to use and publicize it well before the eventual publication of the second edition of Essentials [4], which was recently reviewed by Dwek [5].

With regard to the alternate system proposed by Harvey *et al.*, we can see some relative advantages and disadvantages. For example, while the system gives more information regarding linkages, it might be difficult to use for some vertical representations of glycans. On the other hand, with regard to concerns about use of color in the "Essentials" system, there is actually no problem with discriminating shading in black and white reproductions, if the details of the originally recommended color scheme (http://grtc.ucsd.edu/symbol.html, http://www.functionalglycomics.org/static/consortium/Nomenclature.shtml and Supporting Information) are followed. Both systems do have the limitation that the designated symbols are restricted to monosaccharides found in vertebrate systems, and discussions are under way in various fora to define symbol designations for other monosaccharides found in non-vertebrate taxa. We prefer not to comment further on other specifics regarding the different systems, as many represent matters of opinion and taste. Moreover, >200 illustrations in the second edition of "Essentials" have recently been published using our nomenclature, and they are now freely available for downloading as teaching slides from NCBI/PubMed (http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=glyco2).

The original purpose of the "Essentials" symbol nomenclature was to describe glycan composition and biosynthesis, whereas the emphasis of the alternate system proposed by Harvey *et al.* [1], is to provide further information about primary structure, *i.e.* linkages. Of course, no symbol system will ever convey a full appreciation of the three-dimensional structure of glycans, which is needed to truly understand how glycans and proteins interact. Moreover, such issues regarding scientific nomenclature generally tend to be more controversial than the underlying science, as there is never one final correct answer, and some aspects are indeed matters of opinion and taste. Only time will tell if one or both systems mentioned here eventually find wide usage, or if some other system or a hybrid version replaces them. In any event, what matters much more is the fact that we now know so much about glycan biology that there is a clear need for such representations for the larger scientific community.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Abbreviation

CFG	Consortium for Functional Glycomics

References

1. Harvey DJ, Merry AH, Royle LP, Campbell M, et al. Proposal for a standard system for drawing structural diagrams of N- and O-linked carbohydrates and related compounds. Proteomics 2009;9:3796–3801.
2. Kornfeld S, Li E, Tabas I. The synthesis of complex-type oligosaccharides II characterization of the processing intermediates in the synthesis of the complex oligosaccharide units of the vesicular stomatitis virus G protein. J Biol Chem 1978;253:7771–7778.
3. Varki, A.; Cummings, RD.; Esko, JD.; Freeze, HH., et al., editors. Essentials of Glycobiology. 1. Cold Spring Harbor Laboratory Press; Plainview, NY: 1999.
4. Varki, A.; Cummings, RD.; Esko, JD.; Freeze, HH., et al., editors. Essentials of Glycobiology. 2. Cold Spring Harbor Laboratory Press; Plainview, NY: 2009.

5. Dwek RA. Glycobiology: Moving into the mainstream. Cell 2009;137:1175–1176.