Czech Chemical Society Lecture

Thursday, April 3, 2025, 14:00

University Campus Bohunice, Kamenice 5, Building B11 / room 132

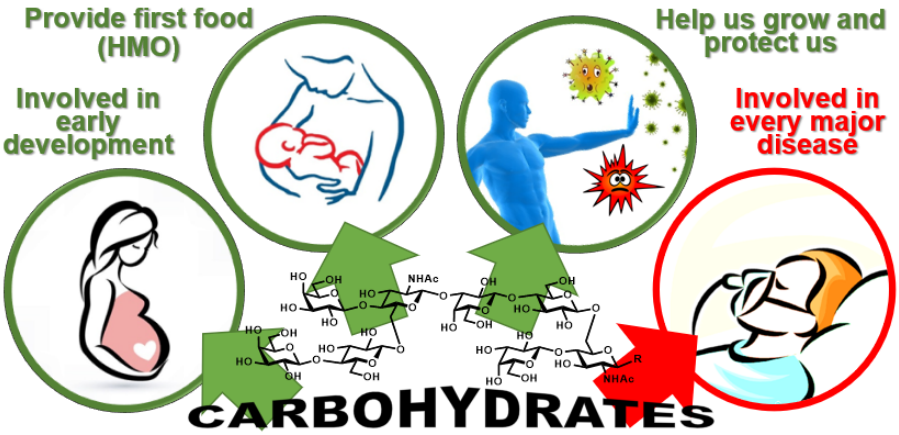
New methods and technologies for the synthesis of glycopharmaceuticals

Alexei V. Demchenko, PhD

Department of Chemistry, Saint Louis University
3501 Laclede Ave, St. Louis, Missouri 63103, USA
E-mail: alexei.demchenko@slu.edu; www.glyco-world.com; @glycoworld

Complex carbohydrates (glycoconjugates, oligosaccharides, or glycans) are involved in many processes and are referred to as the “essential molecules of life.” Our life begins with fertilization, which takes place via carbohydrate-protein recognition. Our journey with sugars continues with human milk that becomes the ideal first food. Glycans present in human milk called HMO can provide prebiotic effects, function as antimicrobial agents, and supply nutrients for the development of cognition. Throughout our lifetime, sugars are involved in many upkeeping processes and defensive mechanisms including joint lubrication, cell growth, antigenic determination, anti-inflammation, immune response. The explosive growth of glycobiology has increased our understanding of the roles of sugars also as “molecules of death” due to their involvement in pathogenesis of every major disease including cancer, AIDS, pneumonia, septicemia, diabetes, malaria.

With improved understanding of functions of glycans, the demand for robust methods to produce both natural glycans and their mimetics has increased. Glycans can be obtained by isolation from natural sources, prepared enzymatically, and/or chemically to study their composition, conformation, interaction with other molecules, and functional roles. Manufacturers are also interested in glycans due to their prebiotic, therapeutic, and diagnostic potential. The discovery of glycans is accelerating aided by advances in separation, analysis, and array technologies. Still, the availability of glycans remains low. The discovery of new methods[1-3] and accessible technologies[4-6] that offer new capabilities for obtaining pharmaceutically relevant glycans is at the heart of this presentation.



References

(1) Singh, Y.; Demchenko, A. V. *Chem. Eur. J.* **2019**, *25*, 1461-1465.
(2) Mannino, M. P.; Demchenko, A. V. *Chem. Eur. J.* **2020**, *26*, 2927-2937.
(3) Dent, A.; Escopy, S.; Demchenko, A. V. *Chem. Eur. J.* **2023**, *29*, e202300873.
(4) Panza, M.; Stine, K. J.; Demchenko, A. V. *Chem. Commun.* **2020**, *56*, 1333-1336.
(5) Escopy, S.; Singh, Y.; Stine, K. J.; Demchenko, A. V. *Chem. Eur. J.* **2022**, *28*, e202201180.
(6) Kashiwagi, G. A.; Petrosilli, L.; Escopy, S.; Lay, L.; Stine, K. J.; De Meo, C.; Demchenko, A. V. *Chem. Eur. J.* **2024**, *30*, e202401214.

BIOGRAPHICAL SKETCH

Alexei Demchenko was born (1965), raised, and educated in Moscow, Russia. He graduated from the Mendeleev University of Chemical Technology of Russia with a Diploma (M.S.) in Chemical Engineering (1988) before joining the laboratory of the late Professor Kochetkov at the Zelinsky Institute of Organic Chemistry in Moscow. In 1993, he was awarded a Ph.D. in organic chemistry by the Russian Academy of Sciences for his work on the development of thiocyanate methodology for glycosylation. After two post-doctoral years under Kochetkov, he joined Professor Boons' group at the University of Birmingham (UK) as a BBSRC post-doctoral research fellow. In 1998, he moved to the Complex Carbohydrate Research Center, University of Georgia (USA) as a research associate. In 2001, he joined the faculty at the University of Missouri - St. Louis (UMSL) as an Assistant Professor where he was promoted to the rank of Associate Professor with tenure (2007) and Professor (2011). In 2014, Demchenko was appointed Curators' Distinguished Professor of Chemistry and Biochemistry. In 2021, Demchenko joined the faculty at Saint Louis University as Professor and Department Chair.

Professor Demchenko received a number of professional recognitions and awards including a CAREER award by the National Science Foundation (2005), the New Investigator Award by the Division of Carbohydrate Chemistry of the American Chemical Society (ACS, 2007), the UMSL Chancellor's Award for Excellence in Research and Creativity (2013), the ACS St. Louis Award (2014), the UMSL Senior Investigator of the Year Award (2017), Fellows Award by the Academy of Science – St. Louis (2020), the UMSL Co-Investigators of the Year Award (with Keith Stine, 2020), the Melville L. Wolfrom Award by the Division of Carbohydrate Chemistry and Chemical Glycobiology of the ACS (2024), and the ACS Midwest Award (2024).

With participation of 175 trainees, Professor Demchenko has co-authored more than 235 articles (Scopus *H*-index 50, Scholar *H*-index 54) and has given 190 invited lectures and seminars. His research interests are in the area of synthetic carbohydrate chemistry that include: streamlined synthesis of carbohydrate building blocks; novel glycosylation reactions; methods for stereocontrolling the glycosidic bond formation; strategies for expeditious assembly of complex glycans and glycoconjugates; synthetic vaccines and glycopharmaceuticals; human milk oligosaccharides and other food additives and ingredients; solid phase and automated synthesis; modification and conjugation of glycans to protein carriers, surfaces, and nanoparticles. His research program has been funded by grants from a variety of sources totaling $13.3M.

Professor Demchenko has served in many editorial roles and organized several international conferences including the 2015 Gordon Research Conference on Carbohydrates. From 2019, he has served as President of the U.S. Advisory Committee for the International Carbohydrate Symposia. Professor Demchenko was the 2020-2021 Chair of the Division of Carbohydrate Chemistry and Chemical Glycobiology of the ACS. Demchenko is the National Representative of the USA for the International Carbohydrate Organization.