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## Synthesis of human milk oligosaccharides by trans-glycosidases

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Recently, significant progress has been made within enzymatic synthesis of biomimetic, functional glycans, including, for example, human milk oligosaccharides. These compounds are mainly composed of N-acetylglucosamine, fucose, sialic acid, galactose, and glucose, and their controlled enzymatic synthesis is a novel field of research in advanced food ingredient chemistry, involving the use of rare enzymes, which have until now mainly been studied for their biochemical significance, not for targeted biosynthesis applications. For the enzymatic synthesis of biofunctional glycans, reaction parameter optimization to promote “reverse” catalysis with glycosidases is currently preferred over the use of glycosyl transferases. Numerous methods exist for minimizing the undesirable glycosidase-catalyzed hydrolysis and for improving the trans-glycosylation yields. This presentation will provide an overview of the approaches and data available concerning optimization of enzymatic trans-glycosylation for novel synthesis of complex bioactive carbohydrates using sialidases,  $\alpha$ -L-fucosidases,  $\beta$ -N-acetylhexosaminidases, and  $\beta$ -galactosidases as examples. The use of an adequately high acceptor/donor ratio, reaction time control, continuous product removal, enzyme recycling, and/or the use of co-solvents may significantly improve trans-glycosylation and biocatalytic productivity of the enzymatic reactions. Protein engineering is also a promising technique for obtaining high trans-glycosylation yields, and proof-of-concept for reversing sialidase activity to trans-sialidase action has been established. However, the protein engineering route currently requires significant research efforts in each case because the structure–function relationship of the enzymes is presently poorly understood.

### Biography

Joern Dalgaard Mikkelsen has completed his PhD at Carlsberg Laboratory, before he moved to Danisco, now Danisco/Dupont, where he worked 20 years as Scientist and Research Manager and finally Director of Research in Danisco Biotechnology. He moved to the Technical University in 2008 with a Danisco grant to establish a group working on enzymes, hydrocolloids and prebiotic oligosaccharides. He has published 138 publications and 25 patents.

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