PC 5 - Chemical Synthesis of Chitooligosaccharides with Controlled Sizes and Architectures

A. Pernet-Poil-Chevrier, N. Barroca, S.Trombotto and A. Domard

Laboratoire des Matériaux Polymères et des Biomatériaux, UMR CNRS 5627, ISTIL, Domaine Scientifique de la Doua, 15 Bd. Latarjet, 69622 Villeurbanne Cedex-France

Fairly recently, chitooligosaccharides have attracted considerable attention as functional biomaterials in the field of medicine, food industry, cosmetics and pharmaceutics, thanks to their interesting biological properties, including anti-tumor, anti-fungal, anti-microbial and elicitor activities.
The biological activities of chitooligosaccharides are known to depend on their structure parameters as the degree of N-acetylation (DA), the degree of polymerization (DP), but also on the sequence of the glucosamine (GlcN) and N-acetylglucosamine (GlcNAc) units along the oligomer chain. However, the usual methods to obtain chitooligosaccharides, i.e. the chemical or enzymatic hydrolysis of chitin or chitosan, do not allow a perfect control of the sizes and the architectures of structures, leading to mixtures of oligomers with average DPs and different sequences.
In order to propose an alternative route, we have developed a new chemical method based on the total chemical synthesis of oligosaccharides. This method can be described in three stages. The first stage concerns the preparation, from the commercial D-glucosamine, of four monosaccharides playing the role of donor and acceptor of both GlcN and GlcNAc. The formation of protected oligosaccharides occurs in the second stage by the coupling reactions of one GlcN/GlcNAc donor with one GlcN/GlcNAc acceptor. And finally, in the third stage, the removal of protecting groups by means of specific reactions allow to generate expected oligomers. An important advantage of this strategy is based on its convergence. Thus, each protected oligosaccharide structure can be easily converted into a new glycosyl donor or acceptor, thanks to simple chemical modifications, and then leads more easily to higher DP chitooligosaccharides.
These oligomers could be very useful models to analyse structure-function relationships of chitosans. Moreover, they will also constitute some decoys of biological media and their biological activities will be studied by means of collaborations within the EC project NanoBioSaccharides.