OC 1 - Hydrolysis of Chitin Oligomers in Concentrated Hydrochloric Acid

A. Einbu, K.M. Vårum

Norwegian Biopolymer Laboratory (NOBIPOL), Dept. Biotechnology, Norwegian University of Science and Technology (NTNU), 7491 Trondheim, Norway

The monosaccharide 2-amino-2-deoxy-D-glucose (glucosamine, GlcN) has recently drawn much attention in relation to its use for treating osteoarthritis. Glucosamine is prepared from chitin, a process that is performed in concentrated acid. This process involves two acid-catalysed reactions, i.e. the hydrolysis of the glycosidic linkages (depolymerisation) and the N-acetyl linkages (deacetylation). The depolymerisation reaction is much faster compared to the deacetylation, with the consequence that the chitin chain will first be hydrolysed to the monomer 2-acetamido-2-deoxy-D-glucose (N-acetyl-glucosamine, GlcNAc) which are subsequently deacetylated.
The chitin disaccharide GlcNAc-GlcNAc was used to study the depolymerisation reaction and the monosaccharide GlcNAc to study the deacetylation reaction as a function of acid concentration and temperature, and the reactions were monitored by following the change in their proton-NMR spectra. The rate of the acid-catalysed cleavage of the glycosidic linkage of the chitin dimer increased strongly by increasing the concentration of hydrochloric acid from 3 to 12 M, while the rate of the acid-catalysed cleavage of the N-acetyl linkage changed only moderately upon increasing the hydrochloric acid concentration from 3 to 12 M. The activation energies of the depolymerisation and deacetylation reaction was determined to approximately 110 kJ/mol, and neither reaction changed significantly as a function of hydrochloric acid concentration. The results are discussed in relation to reaction mechanisms and relevance to the process of preparing glucosamine from chitin.