

# Application of chitin and chitosan to functional materials; Organo- and water-soluble chitosan derivatives and N-acetyl-D-glucosamine

Sei-ichi Aiba\* and Hitoshi Sashiwa\*\*

Bio-based Polymers Group, Research Institute for Innovation in Sustainable Chemistry, National Institute of Advanced Industrial Science and Technology (AIST), Ikeda, Osaka 563-8577, JAPAN

\* CA, aiba-seiichi@aist.go.jp

\*\* Present address, Kaneka Corporation

Studies on chitin and chitosan have been enhanced in these three decades because these showed excellent biological properties. Therefore, chitin and chitosan have been expected as new functional materials. However commercial or practical use of chitin and chitosan has been limited. To make a breakthrough for the utilization of them, chemical and enzymatic modification will be a key point. In this poster, we present the recent research results on chemical and enzymatic modification of chitin and chitosan.

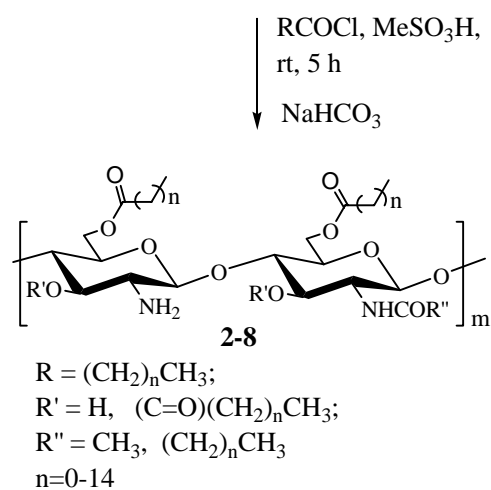
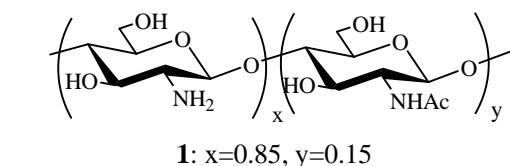
Chitosan is insoluble in ordinal organic solvent and water because of its rigid crystalline structure. Conversion of chitosan to organo- or water-soluble derivatives is an important study. We studied synthetic procedure for obtaining organo-soluble derivatives (1-3). Many kinds of acyl chlorides were successfully reacted with OH groups (DS= ca.1 for O-acyl group) as can be seen in Scheme 1 and hexanoyl and benzoyl derivatives were soluble in THF, MEK, toluene, and CHCl<sub>3</sub>.

Water-soluble derivatives are useful for biomedical materials such as hydrogel. We studied the Michael type reaction of chitosan with acrylic acid and esters (1, 4-6) as can be seen in Scheme 2. We obtained a variety of water-soluble derivatives.

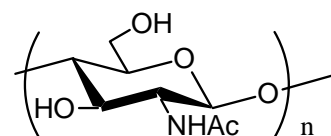
We studied enzymatic production of N-acetyl-D-glucosamine [GlcNAc] from chitin because they have some biological effects. We tried to use commercially available enzyme preparations such as cellulose (Scheme 3). Cellulase preparations from *Trichoderma viride* and *Acremonium cellulolyticus* were very active for  $\beta$ -chitin (7, 8). In addition GlcNAc was prepared from  $\alpha$ -chitin by the action of crude enzyme preparation from *Aeromonas hydrophila* H-2330 culture broth in high yield (9).

1. H. Sashiwa, S. Aiba, *Prog. Polym. Sci.* , **29** , 887-908 (2004)
2. H. Sashiwa, S. Aiba , et al, *Biomacromolecules*, **3**, 1120-1125 (2002)
3. H. Sashiwa, S. Aiba, et al, *Biomacromolecules* , **3** , 1126-1128 (2002)

4. H. Sashiwa, S. Aiba, et al, *Biomacromolecules*, **4**, 1250-1254 (2003)
5. H. Sashiwa, S. Aiba, et al, *Macromol. Biosci.*, **3**, 231-233 (2003)
6. H. Sashiwa, S. Aiba, et al, *Carbohydr. Res.*, **338**, 557-561 (2003)
7. H. Sashiwa, S. Aiba, et al, *Chem. Lett.*, 308-309 (2001)
8. H. Sashiwa, S. Aiba, et al, *Carbohydr. Polym.*, **51**, 391-395 (2003)
9. H. Sashiwa, S. Aiba, et al, *Carbohydr. Res.*, **337**, 761-763 (2002)



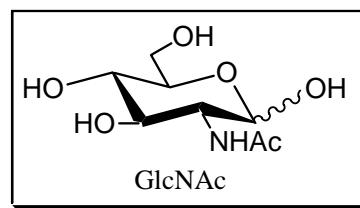
**Scheme 1.**



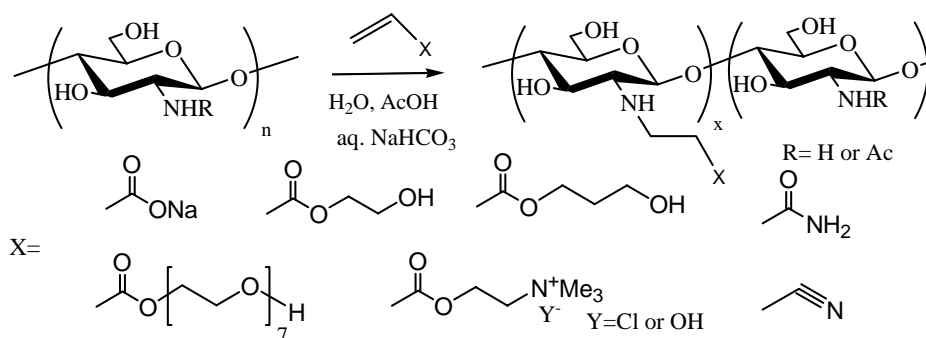
$\alpha$ -Chitin or  $\beta$ -chitin

$\downarrow$  Endo-type  
 Oligosaccharides  
 $\downarrow$  Exo-type

} Crude enzymes



**Scheme 3**



**Scheme 2**