Enzymatic Synthesis of Amphoteric Polysaccharide Materials

2015 International Chemical Congress of Pacific Basin Societies (Pacifichem 2015)
Hawaii Convention Center, 15-20 December 2015, Honolulu, Hawaii

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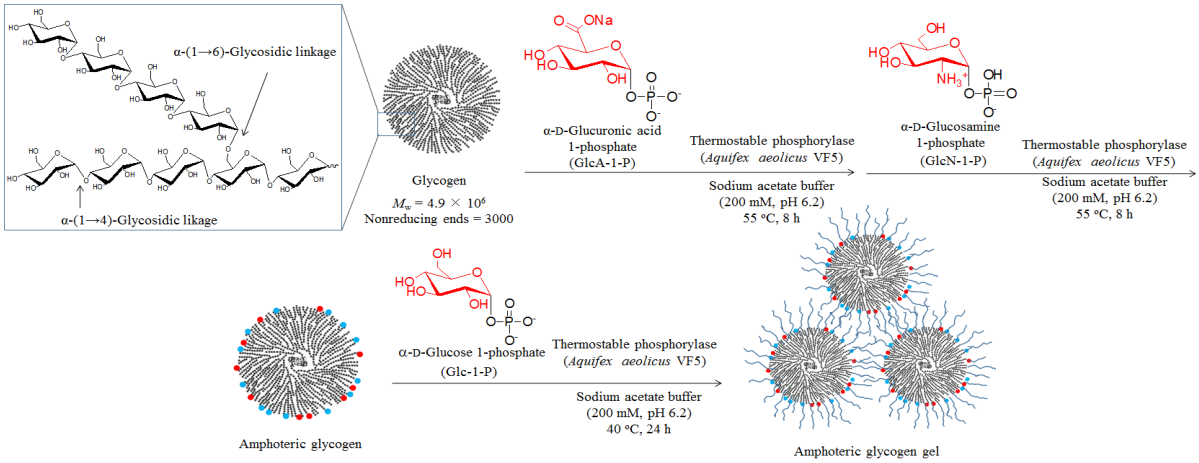
Abstract

Phosphorylase is the enzyme that catalyzes phosphorolysis of α-(1→4)-glucans at the nonreducing ends, such as glycogen and amylose, giving α-D-glucose 1-phosphate (Glc-1-P). By means of the reversibility of the reaction, α-(1→4)-glucans can be prepared by phosphorylase-catalyzed enzymatic polymerization of Glc-1-P as a monomer using a maltooligosaccharide primer according to the manner of successive glucosylations. Because of loose specificity for the recognition of substrates, furthermore, thermostable phosphorylase recognizes α-D-glucuronic acid 1-phosphate (GlcA-1-P) and α-D-glucosamine 1-phosphate (GlcN-1-P) as glycosyl donors, and accordingly, catalyzes glucuronylation and glucosaminylation, respectively, to give oligosaccharides having glucuronic acid (GlcA) and glucosamine (GlcN) residues at the nonreducing ends. On the other hand, glycogen, a natural polysaccharide, acts as a multifunctional glycosyl acceptor for the phosphorylase catalysis because of the presence of a number of nonreducing α-(1→4)-glucan ends interlinked by α-(1→6)-glycosidic bonds. In this study, we performed the thermostable phosphorylase-catalyzed subsequent enzymatic glucuronylation and glucosaminylation of glycogen to give an amphoteric glycogen having GlcA/GlcN residues at nonreducing ends. Furthermore, cross-linking of amylose chains elongated from the product was conducted by the phosphorylase-catalyzed enzymatic polymerization of Glc-1-P to give a hydrogel (Scheme 1) [1].



Scheme 1. Synthesis of amphoteric glycogen gel by thermostable phosphorylase catalysis

Reference

1) Y. Takata, K. Yamamoto, J. Kadokawa, *Macromol. Chem. Phys.*, **2015**, *216*, 1415