Synthesis and physical properties of polysaccharide linear and branched ester derivatives

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Polysaccharides are most important natural resources to obtain biomass-based polymeric materials. Curdlan and paramylon are linear polysaccharides with β-1,3 linked glucose synthesized by Alcaligenes faecalis and photosynthesized by Euglena, respectively. A series of curdlan and paramylon branched ester derivatives with a degree of substitution of three were synthesized and their physical properties and structures were compared with those of linear ester derivatives. Linear ester derivatives with C2-C6 alkyl chains are crystalline polymers with melting temperature (Tm) from 281 °C to 114 °C. Branched ester derivatives had Tms higher than those of the corresponding linear esters. Highly transparent films, injection molding, and melt-spun fibers were prepared from linear and branched ester derivatives and their molecular and crystal structures were investigated by using wide-angle X-ray diffraction.

Furthermore, we succeeded the one-pot synthesis and development of unnatural-type bio-based polysaccharide, α-1,3-glucan. The synthesis can be achieved by in vitro enzymatic polymerization with GtfJ enzyme, one type of glucosyltransferase, cloned from Streptococcus salivarius ATCC 25975 utilizing sucrose, a renewable feedstock, as a glucose monomer source, via environmentally friendly one-pot water-based reaction. More recently, we succeeded to in vitro synthesize graft copolymers with two different kinds of α-1,3 and α-1,6 glycosidic linkages of glucose.

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