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Synthesis and enzymatic degradation of randomly substituted 2,3,6-*O*-cellulose acetate and regioselectively substituted 2,3-*O*-cellulose acetate

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Abstract

To investigate the effect of substitution site on enzymatic degradation property of cellulose acetate (CA), randomly substituted 2,3,6-*O*-CA (DS = 0.4, 1.2, and 2.1) and regioselectively substituted 2,3-*O*-CA (DS = 0.4, 1.3, and 2.0) were synthesized without or with using trytyl group for C6 protection process. Both 2,3,6-*O*-CA and 2,3-*O*-CA were submitted to enzymatic degradation test using cellulase from *Toricoderma reesei*. The concentration of hydrolytic products was analyzed by the reducing sugar analyses using glucose standards. CAs with lower DS (0.4) were more hydrolyzed compared to CAs with higher DS (1.2 or 1.3) and CAs with DS over 2 were not hydrolyzed regardless of substitution site. The degradability of 2,3-*O*-CAs (DS = 0.4 and 1.3) turned out to be higher than that of 2,3,6-*O*-CAs (DS = 0.4 and 1.2). The hydrolytic products of 2,3,6-*O*-CA and 2,3-*O*-CA were analyzed by HPLC and the relationship between their substitution site and the enzymatic degradation behavior was discussed in detail.

Keywords: Cellulose acetate, regioselective substitution, enzymatic degradation, cellulase

Introduction

Cellulose is one of the most abundant polysaccharides produced by nature, such as plants or microorganisms. It has been recognized as renewable resource and expected to be important bio-based material as alternative of petroleum-based plastics. Cellulose is also considered as environmentely friendly material because it is biodegradable and kown to be degraded by cellulase enzymes, which cleave glycosyl bonds *via* hydrolysis. From the point of view of application, cellulose is consisting of β(1→4) anhydro glucose units, and has no plasticity itself due to inter- and intra- molecular hydrogen bondings and esterification of hydroxyl groups of cellulose chains are effective way to alter its property to thermoplastic.

Cellulose acetate (CA) is well known as the most important cellulose ester, which is