RECENT RESEARCH ACTIVITIES

The structural changes in cellulose microfibril and their susceptibilities to cellulase

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Lignocellulosic biomass is promising materials because of non-competition with food and it contains large amount of cellulose as a fermentable sugars. However, Cellulose is an insoluble crystalline polymer, which decreases the enzymatic hydrolysis from lignocellulose to monosaccharide. The efficient pretreatment, therefore, is required to enhance the susceptibility of cellulose by removing the matrix component as well as modification of cellulose structural property, which leading the reduction of enzyme dosage.

Therefore, we prepared well-dispersed microfibriller cellulose from *Eucalyptus globulus* by mechanical grinding and used as starting substrate [1]. The digestibility of this cellulose I achieves almost complete digestion when sufficient commercial cellulase loading as much as 20mg/g-substrate is applied. However, when the enzyme dosage is decreased to 2mg/g-substrate, the yield of digestion reaches the limit. Therefore, we have performed three pretreatment such as mercerization, dissolution into phosphoric acid and ethylenediamine (EDA) treatment. Transformation into cellulose II hydrate by mercerization and dissolution into phosphoric acid were not sufficient because substrate changed to highly crystalline structure during saccharification. On the other hand, in the case of crystalline conversion of cellulose I to III_I by EDA, almost perfect hydrolysis was achieved even in enzyme loading as small as 0.5 mg/g-substrate, furthermore, hydrolyzed residue was changed to typical cellulose I (Figure), which clearly demonstrated cellulose I is more recalcitrant substrate compared to cellulose III_I. The structural analysis of substrate after digestion gives an insight into interaction of cellulose crystalline property and cellulase for better enzymatic digestion.

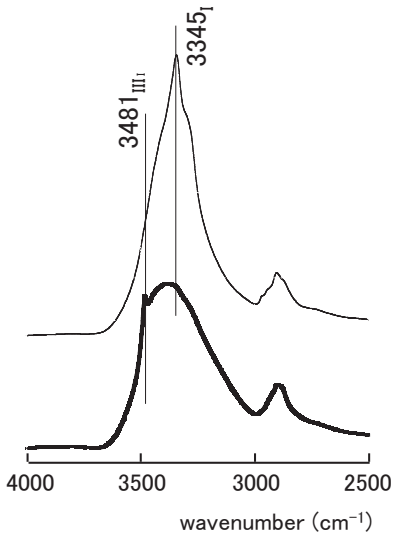

Figure FTIR spectra of cellulose III_I before (bold line) and after enzymatic hydrolysis (hair line). The bands at 3345 and 3481 cm^{-1} are specific to cellulose I and III_I, respectively.

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Reference

[1] Horikawa, Y., Konakahara, N., Imai, T., Abe, K., Kobayashi, Y., Sugiyama, J. (2013) The structural changes in crystalline cellulose and effects on enzymatic digestibility. Polym. Degrad. Stabil., 98 (11), 2351-2356.