

ABSTRACTS (MASTER THESIS)

The characteristic of enzymatic saccharification on Cellulosic Biomass by ethylenediamine swelling treatment

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As sustainable resources for bioethanol production, cellulosic biomass has been receiving increasing interests. However, the effective pretreatment that allows stable and rigid structure of cellulose to be digested is still a major key target of intensive studies.

In this work, we studied the effect of ethylenediamine (EDA) treatment on the enzymatic hydrolysis of cellulosic biomass. This treatment induced intracrystalline swelling of cellulose I into III_I and morphological change such as fibrillation. The effect of EDA treatment on highly crystalline cellulose microfibril as well as woody biomass was investigated.

Experiment

(1) The treatment on *Valonia ventricosa*

V. ventricosa film known as highly crystalline cellulose, was used as a standard sample. Purified cellulose was swollen into 100% EDA solution for 15min, successively washed by 100% methanol baths for 15 min. Repeating the whole procedures at ten times (EDA treatment), cellulose I_α was almost completely transformed into cellulose III_I. In addition, the transformation of cellulose I into cellulose III_I has been known to be a reversible reaction. Therefore, reproduced cellulose I_β was prepared by hydrothermal treatment (150°C). The crystalline polymorphs were confirmed by FT-IR ATR, then, these samples were incubated with a commercial cocktail named Accellerase 1500 (Genencor, Danisco US, Inc. Rochester, NY) for enzymatic saccharification.

(2) The treatment on Sugi

Thin longitudinal slices from wood block were treated Schultze solution at 60 °C for 2 h under continuous stirring. The products were then thoroughly washed with distilled water until neutrality. The EDA treatment for Sugi was performed as mentioned above. In order to investigate the morphological change, Sugi was delignified by Schulze solution and its tracheid was isolated. After EDA treatment, the sample was observed by optical microscopy.

Results

(1) The effect of EDA treatment on *V. ventricosa*

The enzymatic hydrolysis of cellulose III_I (the sample treated by EDA treatment) proceeded much faster than that of cellulose I_α (the sample untreated by EDA treatment). As a result, saccharification ratio of cellulose III_I was reached 95% at 24h and increased 45% compared with cellulose I_α. Moreover, the saccharification ratio of regenerated cellulose I_β increased 16%, compared with cellulose I_α. This improvement is probably due to the effect of fibrillation of cellulose microfibril. The results obtained demonstrated that crystalline conversion from I into III_I clearly contributed to higher enzymatic saccharification than fibrillation.

(2) The effect of EDA treatment on sugi

Although the crystal transformation by EDA treatment did not take place, the enzymatic saccharification ratio was improved. EDA treatment after maceration induce, the ballooning of tracheid observable under optical microscopy, which increased the internal surface area resulting in higher susceptibility to the saccharification.

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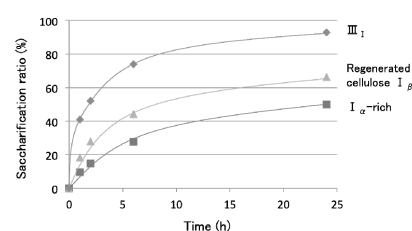


Figure 1 Saccharification ratio of cellulose crystalline forms using *V. ventricosa*.