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Biological Pretreatment of Lignocellulose for Enzymatic Hydrolysis of Cellulose

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ABSTRACT

Pretreatment of lignocellulosic materials is considered as the rate-limiting step in an economically feasible process for enzymatic hydrolysis of cellulose. Biological delignification techniques have not been developed as intensively as physical and chemical methods. However, white-rot fungi are effective degraders of lignin, and some of them even preferentially remove lignin from wood compared with carbohydrates, and therefore might be suitable for biological pretreatment of lignocellulose.

White-rot fungi were cultivated on wheat straw and the residue was hydrolyzed with *Trichoderma reesei* cellulase. Of nineteen fungi examined, *Pleurotus ostreatus*, *Pleurotus* sp. 535, *Pycnoporus cinnabarinus* 115, *Ischnoderma benzoinum* 108, *Phanerochaete sordida* 37, *Phlebia radiata* 79, and two unidentified fungi were found suitable for pretreatment of straw: the yields of reducing sugars and glucose based on original straw were markedly better compared with uninoculated straw, and these fungi also gave better results than *Polyporus versicolor*, a nonselective reference fungus (Cowling, 1961).

In the best cases the efficiency of the biological pretreatment was comparable with that of alkali treatment (2% NaOH, 0.4 g NaOH/g straw, 10 min at 115°C), but the fungal treatment resulted in a higher proportion of glucose in the hydrolyzates. Combined fungal and (strong) alkali treatment did not give better results than alkali or fungal treatment alone.

When culture flasks were periodically flushed with oxygen the treatment time could be reduced by about 1 wk with the two fungi, *P. sordida* 37 and *P. cinnabarinus* 115, tested. The effect of oxygen in pretreatment reflected the effect of oxygen in the degradation of ^{14}C-lignin of poplar wood to $^{14}CO_2$ by these fungi (Hatakka and Uusi-Rauva, 1983).

The economic feasibility of the biological pretreatment process is poor due to the long cultivation times needed. The best results were obtained with the longest treatment time studied, which was 5 wk. However, the rapid progress in

the field of biological lignin degradation may help to accelerate the delignification process, and also find factors that favor lignin degradation, but suppress the utilization of carbohydrates.

REFERENCES

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