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Enzymes Involved in Cellulose and Lignin Degradation

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ABSTRACT

A detailed presentation was given of the discovered and studied enzymes involved in degradation of cellulose and lignin by the white-rot fungus, *Sporotrichum pulverulentum (Phanerochaete chrysosporium)*. The fungus utilizes, for the degradation of cellulose:

(a) Five different endo-1,4-β-glucanases
(b) One exo-1,4-β-glucanase (acting synergistically with the endo-glucanases)
(c) Two 1,4-β-glucosidases

The regulation, induction, and catabolite repression of the endoglucanases have been studied in depth and the results of these studies were also presented.

In addition to the hydrolytic enzymes, *S. pulverulentum* also produces the oxidative enzyme cellobiose oxidase that is of importance for cellulose degradation. Another unconventional enzyme is cellobiose:quinone oxidoreductase, which is of importance for both cellulose and lignin degradation. It reduces quinones from the lignin under oxidation of cellobiose from the cellulose.

It has recently been discovered that *S. pulverulentum* produces two acidic proteases of importance for cellulose degradation since they enhance the endoglucanase activity, particularly in young cultures of the fungus grown on cellulose.

The enzymes involved in lignin degradation are not known nearly as well as these involved in cellulose degradation. However, extracellular phenol oxidases, laccase, and peroxidase have been shown to be involved in and necessary for lignin degradation to take place. A phenol oxidase-less mutant of *S. pulverulentum* cannot degrade lignin unless a phenol oxidase is added to the medium.

Recently, an enzyme splitting the α—β bond in the propane side chain has been discovered by Kirk and coworkers.

Several enzymes involved in the metabolism of vanillic acid, always a metabolite in lignin degradation, have been discovered and studied in our laboratory. Presentations of the enzymes for decarboxylation, demethoxylation, methanol oxidation, ring cleavage, and intracellular quinone reduction by NAD(P)H:quinone oxidoreductase were given.

A discussion of possibilities for a specific enzymic primary attack on the native lignin, as well as of the likeliness for an unspecific radical nature of this attack, was also given.