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ORIGINAL PAPER

Lignin biodegradation and ligninolytic enzyme studies during biopulping of *Acacia mangium* wood chips by tropical white rot fungi

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Abstract White rot fungi are good lignin degraders and have the potential to be used in industry. In the present work, *Phellinus* sp., *Daedalea* sp., *Trametes versicolor* and *Pycnoporus coccineus* were selected due to their relatively high ligninolytic enzyme activity, and grown on *Acacia mangium* wood chips under solid state fermentation. Results obtained showed that manganese peroxidase produced is far more compared to lignin peroxidase, suggesting that MnP might be the predominating enzymes causing lignin degradation in *Acacia mangium* wood chips. Cellulase enzyme assays showed that no significant cellulase activity was detected in the enzyme preparation of *T. versicolor* and *Phellinus* sp. This low cellulolytic activity further suggests that these two white rot strains are of more interest in lignin degradation. The results on lignin losses showed 20–30% of lignin breakdown at 60 days of biodegradation. The highest lignin loss was found in *Acacia mangium* biotreated with *T. versicolor* after 60 days and recorded 26.9%, corresponding to the percentage of their wood weight loss recorded followed by *P. coccineus*. In general, lignin degradation was only significant from 20 days onwards. The overall percentage of lignin weight loss was within the range of 1.02–26.90% over the biodegradation periods. Microscopic observations conducted using scanning electron microscope showed that *T. versicolor*, *P. coccineus*, *Daedalea* sp. and *Phellinus* sp. had caused lignin degradation in *Acacia mangium* wood chips.

Keywords Lignin peroxidase · Manganese peroxidase · Laccase · Cellulase · Ligninolytic · Biopulping

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Introduction

Chemical pulping processes, such as the kraft process, separate wood into its constituent fibres by dissolving the lignin and producing wood pulp, which is the raw material for paper production (Wainwright 1992; Singh et al. 2010). In the kraft process, wood is cooked in sodium sulphide and sodium hydroxide, which dissolves most of the lignin, but produces a characteristic dark-brown material. This brown color is usually removed by chemical bleaching using chlorine. Although chlorination followed by alkaline extraction effectively removes most of the residual lignin from unbleached kraft pulp, some of the chlorine becomes bound to the lignin leading to the formation of chlorinated organic compounds (Wainwright 1992; Ali and Sreekrishnan 2001). The pulp and paper industrial effluent water is heavily polluted with lignin, inorganic salts and foul smelling hydrogen sulphite that arise from the pulping processes. The removal of lignin from the wood is a key operation in the manufacturing of high value paper products. The lignin discharged into the effluent water