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ABSTRACTS OF THE 53rd ANNUAL MEETING OF THE JAPAN WOOD RESEARCH SOCIETY

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Q231045 **Removal of copper, chromium, and arsenic from CCA-treated wood by bioremediation with brown-rot fungi**

Wood Research Institute, Kyoto University ○ S. Nami Kartal, Erman Munir, Yuji Imamura

Introduction

Considerable attention has been focused on remediation of treated wood in recent years due to public and scientific awareness about release of chromium, copper, and arsenic from chromated copper arsenate (CCA)-treated waste wood and environmental concerns about such waste wood. As a result, substantial progress has been made in remediation of CCA-treated waste wood by chemical extraction with several mineral and organic acids and biodegradation using bacteria and fungi in recent years. Previous studies suggested that oxalic acid plays an important role in partial solubilization of the insoluble metal compounds of CCA wood preservative fixed in the wood. This work reports that the detection of oxalic acid produced by brown-rot decay fungi *Fomitopsis palustris*, *Coniophora puteana*, and *Laetiporus sulphureus* and bioremediation of CCA-treated wood using liquid cultures of these fungi.

Materials and Methods

Mycelia of *F. palustris*, *C. puteana*, and *L. sulphureus* from stock cultures were transferred to 500 ml Erlenmeyer flasks containing 100 ml of fermentation broth. Cultivation of fungi was carried out on a rotary shaker at 120 rpm. A known volume of fermentation broth was removed with 1, 2, 5, and 10 day-intervals from the flasks inoculated with the fungi. The amount of oxalic acid formed during fermentation was enzymatically determined using an oxalate kit and the amount of oxalate was determined spectrophotometrically using a double-beam spectrophotometer.

For bioremediation process, CCA-treated sawdust was placed into teabags made from polyester fibers. Each bag containing sawdust of 3 g was placed in the flasks containing 100 ml of fermentation broth inoculated with *F. palustris*, *C. puteana* or *L. sulphureus* for 10 days as described above. The flasks were agitated for 1, 2, 5, and 10 days at 120 rpm on a rotary shaker at 27°C. Uninoculated fermentation broth (UFB) and deionized (DI) water extraction served as control. Two replicates of 3 g sawdust were removed at each time interval and rinsed three times with 300 ml of DI water at 20°C. Bioremediated sawdust was oven-dried at 60°C for 24 h and conditioned at 23°C and 65% RH for two weeks. Bioremediated sawdust was then analyzed for remaining copper, chromium, and arsenic content using an X-ray fluorescence analyzer. The percent reduction of copper, chromium, and arsenic in the sawdust samples was calculated based on the initial amount of elements in the samples.

Results and Discussion

Higher amounts of oxalic acid were produced by *F. palustris* and *L. sulphureus* compared to *C. puteana*. After 10-day fermentation, oxalic acid accumulation reached 4.2 g/L and 3.2 g/L for these fungi, respectively. *F. palustris* (Figure 1A) and *L. sulphureus* exposed to CCA-treated sawdust for 10 days showed a decrease in arsenic of 100% and 85%, respectively; however *C. puteana* fermentation removed 18% arsenic from CCA-treated sawdust. Likewise, copper and chromium removal rates in *F. palustris* and *L. sulphureus* fermentations were higher than those in *C. puteana* depending on less oxalic acid accumulation compared to *F. palustris* and *L. sulphureus* (Figure 1B and Figure 1C). These results suggest that *F. palustris* and *L. sulphureus* fermentation can remove inorganic metal compounds via oxalic acid production increasing the acidity of the substrate and increasing the solubility of the metals.

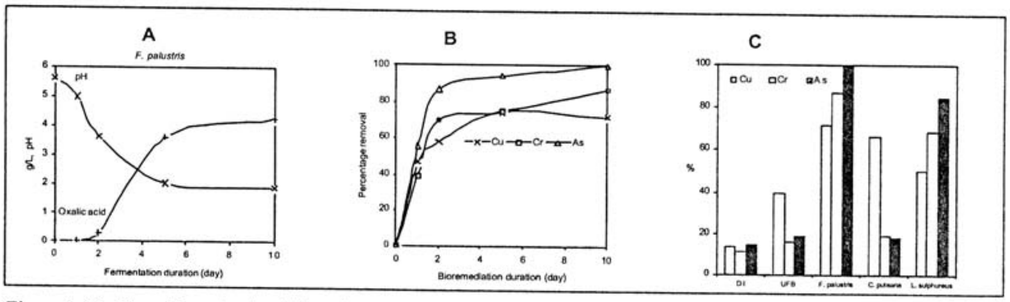

Figure 1. Oxalic acid production (A) and percentage removal of elements by *F. palustris* (B) and percentage of elements removed from sawdust after 10-day fermentation by the fungi used in the study (C).