Screening of Wood Rotting Basidiomycetes Fungi for Bioremediation Ability of Textile Dye Effluents

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Introduction

Sri Lanka is considered to be one of the world's leading apparel producers. The textile industry utilizes large volumes of water in its processing operations and generates substantial quantities of dye containing waste water which is usually discarded into water bodies mostly without further treatments. About 10-15% of all dyes are directly lost to wastewater in the dying process and removal of color from effluent is one of the major problems that the textile industry faces. The presence of color in water hinders the absorption of solar radiation, thus reducing the natural photosynthetic activity, causing changes in aquatic biota. Furthermore, textile dyes pose serious health threats to humans due to their carcinogenicity and lead to mutagenic and toxic effects on organisms. Amongst many classes of synthetic dyes, triphenyl methane group of dyes such as crystal violet and malachite green are the most used in the textile and dyeing industries (Bumpus and Brock, 1988). The decolonization and degradation of textile dye effluent does not occur when treated with conventional effluent treatment systems (Murugesan *et al.*, 2007). Use of microorganisms to remove dyes from industrial effluents or bioremediation is inexpensive and the end products of complete mineralization are nontoxic. Basidiomycete fungi produce an array of extracellular enzymes helpful in removing synthetic dyes from industrial effluents (Asamudo *et al.*, 2005). This study investigates the ability of some selected Basidiomycete fungi to decolonize malachite green.

Methodology

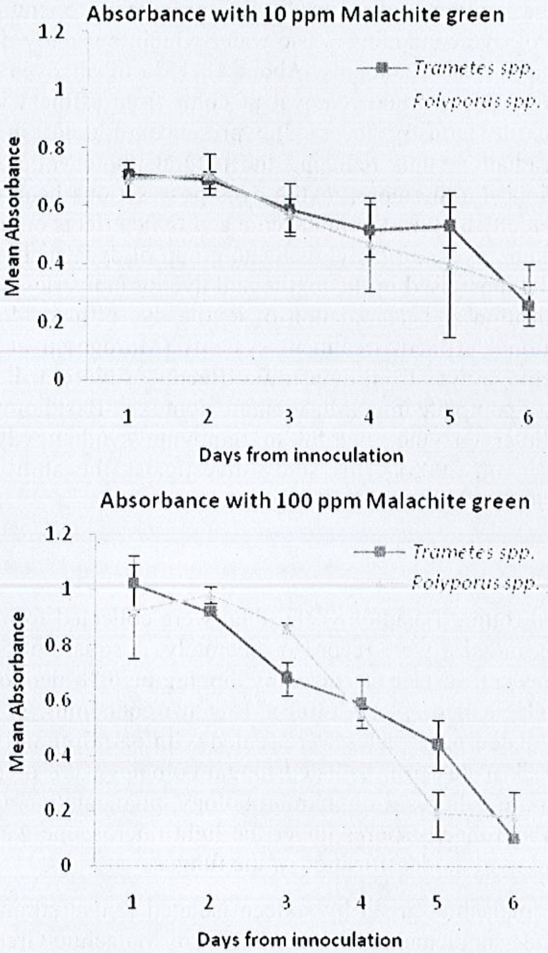
Basediocarps of wood rotting Basidiomycete fungi were collected from different localities and their shape, color and size were recorded separately. A square of 5 x 5 mm from each of the Basediocarp was cut, surface sterilized by dipping in 70% alcohol solution for 1 min and cultured separately in petri plates (100 x 15 mm) containing Potato Dextrose Agar (PDA) medium. Inoculated petri plates were sealed with parafilm and incubated at 30^0 C. After two weeks, streak plates from isolated fungal colonies were prepared in fresh PDA medium to establish pure cultures. Colony morphology, pigmentation and ultra structure of the fungal mycelium and macro spores under the light microscope was recorded for each pure stain isolated and used in identification of the fungus.

Ability to decolorize malachite green by sixteen isolated fungal strains was evaluated by culturing in PDA plates supplemented with 100 ppm of Malachite Green. A disc of fungal mycelia 5 mm in diameter was cut separately from fungal strains and placed in the center of petri plate. PDA plate containing either 10 ppm or 100 ppm of Malachite Green but no mycelium served as the control. All the plates were then incubated at 30^0C and after for 10 days, ability of the fungi to decolorize the dye was established visually using a three scale scoring system (poor, average and good).

Two fungal strains *Trametes* spp. and *Polyporus* spp. with proven decolonization abilities were used for liquid phase assessments. Selected fungal strains were grown separately in 200 mL of Potato Dextrose Broth (PDB) medium in 500 mL Erlenmeyer flask containing 10 ppm or 100 ppm Malachite green and incubated at 30 ^{0}C for 10 days. An aliquot of 15 mL was removed from cultures daily (up to six days) and centrifuged separately at 4000 rpm for 2 min. The maximum absorbance at 617 nm was measured using UV spectrophotometer and de-colorization of the dyes was calculated using Beer-Lambert law.

Experiments were arranged in a Complete Randomized Block Design. Data were analyzed using one way ANOVA and pair wise comparison was done by Tukey comparison test using MINITAB statistical package version 14.0.

Results and discussion



(Each data point represent mean of three readings. Vertical bars represent SD.)

Figure 01: Mean Absorbance of *Trametes* spp. and *Polyporus* spp. grown in PDB medium with 10 ppm and 100 ppm Malachite green.

The two fungus types *Trametes* spp. and *Polyporus* spp. showed significant ($p<0.05$) de-coloration effects when cultured in 10 ppm and 100 ppm Malachite green concentrations. *Trametes* spp. showed the lowest absorbance hence highest decoloration compared to *Polyporus* spp. Rate of de-coloration was low in the first two days of culture and thereafter de-coloration was steadily accelerated (Fig.01). This could be attributed to the elevated level of exogenous enzyme production when fungal strains colonize the growth medium.

Lignin degrading enzymes produced by white rot fungi is capable of de-coloration of organic compound such as Malachite green. De-coloration ability of *Trametes* spp. has been well demonstrated by previous works (Wesenberg *et al.*, 2003) whiles to our knowledge no such records available for *Polyporus* spp. This study was conducted under stimulated conditions in the laboratory using only one dye type. It is important to extend the study to check the de-coloration ability of other dyes associated with textile dye effluents. Identification of fungal stains remains a difficult task and this study identified strains only up to genus level. Species level identification could even necessitate molecular approaches and could be an important future perspective.

Conclusion

This study identified two fungal stains belonging to wood decaying white rots with dye de-coloration abilities. The two fungi have the potential to be used in treating textile dye effluents. However, further studies are needed before industrial level applications to determine complete mineralization of dyes leading to the production of nontoxic compounds.

References

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