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Decolorization Potential of *Pleurotus ostreatus*, *Lentinula edodes* and *Ganoderma lucidum* against Solvaderm Brown MF-GO Textile Dye

Fatih Kalyoncu[1]*, Yurdanur Akyol[2]
[1] Manisa Celal Bayar University, Faculty of Science, Biology Department, Manisa, Turkey
[2] Manisa Science High School, Manisa, Turkey
*fatih.kalyoncu@cbu.edu.tr
*Orcid: 0000-0003-3912-9373

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Abstract

Biological decolorization of Solvaderm Brown MF-GO was comparatively studied using three different macrofungi strains (*Pleurotus ostreatus* (Jacq.) P. Kumm., *Lentinula edodes* (Berk.) Pegler and *Ganoderma lucidum* (Curtis) P. Karst.). In the medium, the inceptive concentrations of dye were 250, 500 and 1000 mg/L, respectively. Whole fungi studied decolorized Solvaderm Brown to varying degrees. Fungi strains resulted in the good decolorization at low dye concentration, but mycelia negatively affected from increasing dye concentrations.

Keywords: Decolorization, Macrofungi, Solvaderm Brown, Textile dye

1. Introduction

Synthetic dyes are used in paper and textile industries. Remediation of effluents from these industries is quite difficult. Today, strict regulations about wastewater evacuation have been compulsory in some countries. This strict inspection, in connective with transnational repression has been besetting the very survival of the textile production for instance “eco labels” on products for the US and European [1].

Many applied treatment methods for dyed wastewaters occurring combined processes entailing varied combinations of chemical, physical and biological processes [2-4]. These processes have restricted performance and endured from some disability for example that usage of chemicals and sludge formation, expensive substructure requirements and high operating exes. Conventionally effluent remedy plants reliant prompted sludge systems are not sufficient for the wastewater, since the using bacterial methods for dye wastewaters may result generation of colorless compounds that more toxic than the parents such as aromatic amines [5]. However, the need for an economically and technically convincing remediation method, a bustle of developing technologies are being suggested and tried at several phases of commercialization [6].

By far, white rot fungi is most powerful in overthrow synthetic dyes [7, 8]. Exclusively *Pleurotus* species, are usually more permissive to high levels of dyes than bacteria [9, 10]. White rot fungi are capable of aerobic mineralization and lignin de-polymerization in nature. These fungi to produce extracellular lignin modifying enzymes [8]. Also, *Pleurotus* species are good ligninolytic enzyme producers against some pollutants and textile dye effluents [11, 12]. Nevertheless, no information is existing respecting the use of *Pleurotus ostreatus, Lentinula edodes* and *Ganoderma lucidum* for the decolorization of Solvaderm Brown. The main goal of this research was to in comparison with evaluate the potential of *Pleurotus ostreatus, Lentinula edodes* and *Ganoderma lucidum* to degrade Solvaderm Brown textile dye.

2. Materials and Methods

This research was performed with three strains of white-rot fungi (*Ganoderma lucidum* MCC52, *Lentinula edodes* MCC29, *Pleurotus ostreatus* MCC07). These fungi were stored in the Mushroom Culture Collection (MCC) of the Biology Department, Manisa Celal Bayar University, Turkey and protected on PDA slants at 4^0C until use.

All fungus were transferred on Petri dishes having Kirk’s basal media. This medium were supplemented with Solvaderm Brown dye concentrations of 250, 500 and 1000 mg/L. Agar discs (6 mm) of 7 days old cultures on Kirk’s medium at 27^0C used as inoculum. All plugs cut under aseptic conditions from the agar

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plates and were transferred onto the center of the dye added plates for each replicate. Also, non-inoculated dishes deposited as controls for abiotic decolorization [6]. All fungus were tested in three parallel tests. Petri dishes were stored at 27^0C for 30 days. Mycelial expansion was viewed by gauging radial appendage of the mycelium as explained by literature [13] with a digital caliper on each plate. The average mycelial development was calculated according to three replicates. A colorless zone seen when the fungus degraded the dye.

Also, mycelial discs (6 mm) were used as inoculum for spectrophotometric analyses of decolorization period. 50 ml liquid medium that having Solvaderm Brown (250, 500 and 1000 mg/L) and Kirk's basal media was prepared in Erlenmeyer flasks. Liquid media were autoclaved at 121^0C for 15 min. Each one was inoculated with five agar disc and incubated in shaker incubator at 27^0C, 120 rpm/min [14]. Decolorization of dyes in the liquid medium were monitored at regular intervals during the research.

0.5 ml samples were afflicted from each Erlenmeyer at orderly time spaces, and residuary dye was measured directly by a UV-visible spectrophotometer at the 610 nm maximal wavelength of absorbance. Absorbance rates were used for the computations of decolorization performance. Kirk's medium in distilled water was used as control [6]. The data offered are the means of the results of 3 repeats with a standard error of less than 5%.

3. Results and Discussion

Synthetic dyes are the generally used dyestuffs in the paper and textile industry. Solvaderm Brown is widely preferred synthetic dye was used for the definition of decolorization capacity of three white-rot fungi strains, in this study.

The efficacy of dyestuff levels on the development of fungi studied is indicated in Figure 1. All organisms were unfavorably affected from a spawning level of dye in medium, resulting in remarkably lower mycelial development. Rising levels of Solvaderm Brown in the medium caused up to 2 and 4 times lower mycelial development for all organisms used, respectively (Figure 1). Parallel outcomes have been declared in literature that amaranth dye was used. It has been declared that 100 mg of this dye shows a more toxical effect on the development of *Trametes versicolor* than a lower dye level (33 mg) in the similar medium [15].

As showed in Figure 1; the mycelial development was delayed when the fungi were revealed to rising dye levels, the decolourization performances of the fungi were not retrograded that much for Solvaderm Brown (Figure 2). Figure 2, depict the dye removal performance of each fungus used at 250, 500 and 1000 mg/L levels, respectively. In Figure 2; rising concentration of Solvaderm Brown unfavorably affected the decolorization performance of the fungi to changing degrees. Fungi may be arranged as to their decolourization performances when they were revealed to 250 mg/L dye level in the medium for Solvaderm Brown as follows: *L. edodes* (19%)> *P. ostreatus* (8%)> *G. lucidum* (5%), respectively.

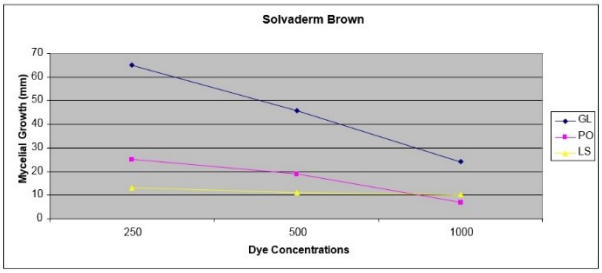

Figure 1. Effect of various Solvaderm Brown concentrations on mycelial growth at 23rd day; GL: *Ganoderma lucidum*; PO: *Pleurotus ostreatus*; LS: *Lentinula edodes*.

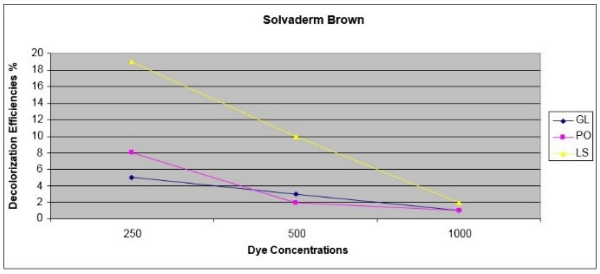

Figure 2. Decolorization efficiencies for each fungus species for Solvaderm Brown at 23rd day; GL: *Ganoderma lucidum*; PO: *Pleurotus ostreatus*; LS: *Lentinula edodes*.

It has been declared in the references that the some white-rot fungi are aerobically biotransformed or mineralized some textile dyes [5, 7, 9, 16]. As crosschecked with some references, we were able to decolourize meaningfully higher levels of dye (250, 500 and 1000 mg/L) in our research. Reife and Freeman [17] remarked that azo dyes, according to their chemical form, are more robust to decolourization than are anthraquinones. Such that wild-type strains of *Pleurotus ostreatus* are the resistant, since the drop in decolourization performance due to the rising dye level was around 4-14%, while the other fungi were meaningfully affected drop in decolourization performance: *P. ostreatus*≥60%, *P. djamor*≥34%, and *P. citrinopileatus*≥19%. These results are in relevance to the other studies related to *Pleurotus sp.* [4, 5, 10, 11]. Yeşilada et al. [18] declared that *Pleurotus ostreatus* showed 97%, 89%, and 84% decolorization efficiency for 264 mg/L azo dyes, called Astrazone Red, Blue and Black, respectively. *Phanerochaete chrysosporium* is also can decolorize textile wastewaters. Different decolourization stages (40%-

73%) are reached in Kirk's medium for eight dyes by this fungus [6].

4. Conclusions

In this research, three white-rot fungi strains were used to show the decolorization capacity of Solvaderm Brown dye. A fungus talented of decolorizing one dye has different abilities for others. There is a need to identify fungi that are capable of decolorizing dye effluent and the inhibitory effects of dyes on fungal development. Results of this research could conduce to a better knowledge of the decolourization capacities of three fungus strains (*Pleurotus ostreatus*, *Lentinula edodes* and *Ganoderma lucidum*) for Solvaderm Brown that has not been researched in detail up to the present. Results appearing from this study supply a background useful to propose new eco-friendly alternatives for the effluent remediation of textile industries. This research shows the decolorization capacity of wild fungi isolated from nature.

Author's Contributions

Fatih KALYONCU: Drafted and wrote the manuscript, performed the experiment and result analysis.
Yurdanur AKYOL: Assisted in analytical analysis on the structure, supervised the experiment's progress, result interpretation and helped in manuscript preparation.

Ethics

There are no ethical issues after the publication of this manuscript.

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