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DECOLORIZATION OF DIFFERENT DYES BY USING WHITE ROT FUNGUS

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ABSTRACT

The textile industry generates a huge volume of highly polluted effluents. The discharge of such effluents without an appropriate treatment is an issue of serious concern due to their aesthetic and toxic impacts on receiving waters. The traditional technologies for wastewater treatment are inefficient or costly in the treatment of textile effluents. This has impelled the search for new technologies to substitute or complement the existing ones. In this regard, white-rot fungi represent an eco-friendly and less expensive alternative for the treatment of such effluents. Different technologies may be used for decolorization of wastewater containing dyes. Among them, biological processes are the most promising because they seem to be environmentally safe. The aim of this study was to determine the efficiency of decolorization of selected textile dyes. The present work focused on the isolation of white rot fungus, which can efficiently decolorizes the selected textile dyes, i.e, Aniline blue, Brilliant green, Congo red, and Methyl orange. The mushroom was collected from local area Dharwad, Karnataka, India. In this study, the fruiting body of mushroom was used for the isolation of mycelia. It was cultivated on potato dextrose agar (PDA) plate. The isolated fungus was morphologically identified as belong to *Pleurotus ostreatus*. Further dye decolourization was performed with the selected fungus.

KEYWORDS: *Pleurotus ostreatus*, Textil dyes.

INTRODUCTION

Synthetic dyes have a wide application in the food, pharmaceutical, textile, leather, cosmetics and paper industries due to their ease of production, fast pace, and color variation as compared to natural dyes (Adedayo et al., 2004). Most of these compounds such as azo dyes are toxic, mutagenic, carcinogenic and highly resistant to degradation (Brown and De Uito, 1993; Sharma et al., 2004; Neill et al., 2004). It is estimated that from 1 to 15% of the dye is lost during dyeing section of a textile industry process and is released in wastewaters (Neill et al., 1999; Galindo et al., 2001; Sarnaik and Kanekar, 1995). Most of the azo dyes, which are released into the environment originate from textile industry and dyestuff manufacturing industry [MacKey et al., 1980]. The presence of dyes and chemicals in the waste effluent even at low concentrations is harmful to both aquatic and terrestrial life (Barka et al., 2009). Therefore their presence in aquatic systems reduces light penetration which retards the photosynthetic activity and also has a tendency to chelate metal ions producing micro-toxicity to fish and other organisms (Bhatt et al., 2000; Song et al., 2003). A number of physicochemical methods, such as adsorption, coagulation, precipitation, filtration and oxidation, have been used to treat dye stuff effluents, but these methods have many disadvantages and limitation (Robinson et al., 2001) such as being generally expensive and produce large amounts of sludge (Stolz et al., 2001) that requires special disposal techniques a in accordance with law (Neill et al., 1999). In recent years there have been many reports regarding decolourization of various azo dyes to a great extent by the use of various bacterial and fungal cultures (Mielgo et al., 2002; Dave and Dave, 2008; Revankar and Lele, 2007). Most of the previous studies focused on the dye decolorization by white rot fungi (Adiveppa et al., 2017). It was demonstrated in an earlier study by Adiveppa and Kaliwal, (2017) that white rot fungus *Marasmius* sp. and Coprinus sp. have efficiently decolorized synthetic dyes (Adiveppa and Kaliwal, 2017 ; Adiveppa and Kaliwal, 2015). In view of the industrial significance of laccase, in this present study, white rot fungus was isolated and investigation led to the confirmation of fungal isolate which is the effectiveness of the dye decolorisation.

MATERIALS AND METHODS

Collection of Samples and Isolation of fungus

The fungus used in this study was isolated from natural habitat such as mushroom in the forest area of Haliyal, Karnataka, India. The sample was collected in sterile

plastic bags and were sealed and brought to the lab aseptically for further study.

Fruiting body of mushroom used for the isolation. Mycelium was isolated by aseptically moving the upper unexposed part of the basidiocarp on Potato Dextrose Agar (PDA). The plates were incubated at 37 °C for 4 days. Distinct fungal mycelia was isolated and repeatedly subcultured until pure cultures were obtained. The culture was maintained on PDA slants at 5 °C (Adiveppa and Kaliwal, 2015).

Morphological Identification of Selected Fungus

The classical method of identifying fungus is by using light microscopy. Isolated fungus was identified based on colony morphology, cultural characteristics and especially, on the morphology of their sporulaing structures. The morphology of the isolates, stained with lactophenol-cotton blue, was studied using a light microscope.

Dye decolourization experiment

Decolourization experiments were conducted in 250 ml Erlenmeyer flask containing 100 ml of medium. The isolated *Pleurotus ostreatus* was tested for its ability to decolourize selected dyes over a period of 0-48 hours (h). The final concentrations of the dye in the medium without inoculation with *Pleurotus ostreatus* was considered as a control (Adiveppa and Kaliwal, 2017). The extent of decolourization was recorded as residual colour. Various dyes such as Aniline blue, Brilliant green, Congo red and Methyl orange (50 mg l^{-1}) were monitored at their absorbance maxima at 585 nm, 624 nm, 495 nm and 540 nm, respectively (Yongmin, 2013; Ewa et al., 2014 ; Rajesh and Arun Kumar,2011; Maulin et al., 2013).

$$\text{Decolourization (\%)} = \frac{\text{Initial absorbance} - \text{observed absorbance}}{\text{Initial absorbance}} \times 100$$

RESULTS AND DISCUSSION

Isolation and Identification

Fruiting body of mushroom used for the isolation of mycelia, Sathiyavathi and Parvatham, (2011) who suggested the isolation through basidiocarp for selection of mycelia. Isolated fungus was maintained in PDA medium. Isolated fungus was morphologically identified as *Pleurotus ostreatus* (Balaji et al., 2012).

Decolourization of dyes by *Pleurotus ostreatus*

The isolated *Pleurotus ostreatus* was tested for their ability to decolourize the selected dyes namely Aniline blue, Brilliant green, Congo red and Methyl orange by 97.55%, 91.74%, 87.82%, 84.28% and 76.52% within 24 hours respectively (Table 1). The *Pseudomonas putida* was tested for their dye decolourizing ability against synthetic dyes and industrial effluents (Mohammed et al., 2013). The percentage of degradation was achieved against Red HE7B and Yellow FN2R by *Aspergillus niger* (94%) and *Mucor racemosus* (92%) after 5 day of incubation (Balaji et al., 2012). The dye degradation ability of the isolated *Aspergillus* sp. showed maximum dye decolorization of brilliant violet at 78% under optimum condition (Yamini et al., 2012). *Schizophyllum commune* was used for decolorized the congo red and methyl orange (Selvam and Shanmuga Priya, 2012)

The dye degradation or decolorization of this study might be due to the biosorption of the fungal hyphae as previously reported by various researchers (Yamini et al., 2012). Decolorization of various dyes is related to the various processes of extracellular oxidases, such as manganese peroxideases (Gold et al., 1988). Liginin peroxidise (Lip), manganese dependant peroxidase (MnP) and laccase, all of them were involved in lignin degradation (Vyas and Molitores, 1995).

Table 1: Decolourization of dyes by *Pleurotus ostreatus* in liquid culture.

			Decolourization (%)	
Sl. No.	**Dyes**	**Wavelength (λ max)**	**24 h**	**48 h**
1	Congo red	495	48.84	98.82
2	Brilliant green	624	42.65	95.74
3	Methyl orange	540	39.85	89.28
4	Aniline blue	585	38.55	86.55

CONCLUSION

In the present study selected dyes were decolourized to 86-98% when treated with *Pleurotus ostreatus*. Other Worker also reported decolorization of synthetic dyes by laccase but in most of the studies fungi were used (D'Souza et al., 2006; Mechichi et al., 2006). It can also be used efficiently in paper and pulp industries, textile industries and in bioremediation.

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