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Short Communication

Effect of laccase from *Hypsizygus ulmarius* in decolorization of different dyes

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ABSTRACT

The objective of the study was to check the laccase (purified from *Hypsizygus ulmarius*) for decolorization of different dyes. The purified laccase from *Hypsizygus ulmarius* was studied for its decolorization of different dyes (Remazol brilliant blue R (RBBR), Alizarin red, Congo red, methyl orange and methyl violet). The results indicated that the percent of decolorization was increased when the time course and enzyme concentration was increased. The purified laccase showed maximum amount of decolorization in RBBR (85%) and followed by Methyl Orange (75%), Alizarin Red (73%), Methyl Violet (72%) and Congo Red (69%) without any additional redox mediator which suggest that this enzyme could be used in industries for effluent treatment.

INTRODUCTION

Laccases (p-diphenol: oxygen oxidoreductase; EC 1.10.3.2) are phenol-oxidases which catalyze the oxidation of a great variety of phenolic compounds and aromatic amines using molecular oxygen as electron acceptor (Baldrian, 2006). The distribution of laccase is widespread among plants and fungi and also in bacteria (Claus, 2003). These enzymes are involved in various physiological functions; in plants, they seem to be involved in lignin synthesis (Palonen *et al*., 2003) whereas in fungi, they are involved in lignin degradation, pigmentation, and pathogenesis (Thurston, 1994). The enzyme has great biotechnological applications because of its wide reaction capabilities. It may be used in drug analysis, clarification of wines, bio-bleaching of kraft pulp (Srebotnik and Hammel, 2000), decolorization of synthetic dyes (Baldrian, 2006), organic synthesis (Pilz, 2000), laundry cleaning (Gouka *et al*., 2001), bioremediation (Mayer and Staples, 2002) and biosensors (Vianello *et al*., 2006).

Laccases are capable of defrading many synthetic dyes including azo, anthraquinone, and tryphenylmethane (Abadulla *et al*., 2000; Nagai *et al*., 2002). The advantage of the enzyme is that they do not require H_2O_2 for substrate oxidation unlike peroxidases (Saito *et al*., 2003). Furthermore, the presence of small molecular weight redox mediator enhances both range of dyes decolorized and decolorization rates. Of late, the demand for removal of synthetic dyes from industrial waste using laccase is being increased tremendously. Therefore, the search for potential laccase to cope with this demand is an important task in the area of dye degradation.

Hypsizygus ulmarius (elm oyster mushroom) is a high yielding mushroom for which commercial cultivation technology has been released and is gaining popularity. Previous reports suggests that the mushroom is rich in antioxidants and proved for its anti-diabetic activity (Meera *et al*., 2011). In our previous study, the production, purification and characterization of a laccase from *Hypsizygus ulmarius* was reported (Ravikumar *et al*., 2012). Hence, the present study was focused on decolorization of different dyes by laccase from *Hypsizygus ulmarius*.

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MATERIALS AND METHODS

Organism and culture conditions

Hypsizygus ulmarius was obtained from the mushroom research centre, TNAU, Coimbatore, India. The culture was maintained on PDA and transferred to liquid medium (Slomczynski *et al*., 1995). The production medium was inoculated with a loop of culture and incubated at 30°C.

Production and purification of the enzyme

The enzyme laccase was produced, purified and further characterized for future applications (Ravikumar *et al*., 2012). Laccase activity was assayed spectrophotometrically by measuring the oxidation of ABTS at 420 nm (Liu *et al*., 2010).

Dyes decolorization by laccase

The decolorization of the dyes Remazol brilliant blue R (RBBR), Alizarin red, Congo red, Methyl orange and Methyl violet was investigated using laccase from *Hypsizygus ulmarius*. Stock solutions of the dyes were prepared and diluted (25 mg/L). The reaction was initiated with laccase (100 g/L) at 37°C. Control samples were done without the enzyme. All measurements were done in triplicate. The absorption spectrum of dye was measured spectrophotometrically between 200 and 800 nm. The effect of dye decolorization was determined by the decrease in absorbance under the maximum wavelength of the dye, respectively. The efficiency of decolorization was expressed in terms of percentage.

RESULTS AND DISCUSSION

Decolorization of different dyes (Remazol brilliant blue R (RBBR), Alizarin red, Congo red, methyl orange and methyl violet was studied with the purified laccase. It was observed that the percent of decolorization was increased when the time course and enzyme concentration was increased. 85% of RBBR dye was removed where as decolorization of other dyes were nearly 70% (Figure 1). The laccase from *Hypsizygus ulmarius* efficiently decolorized different dyes without using any additional redox mediators.

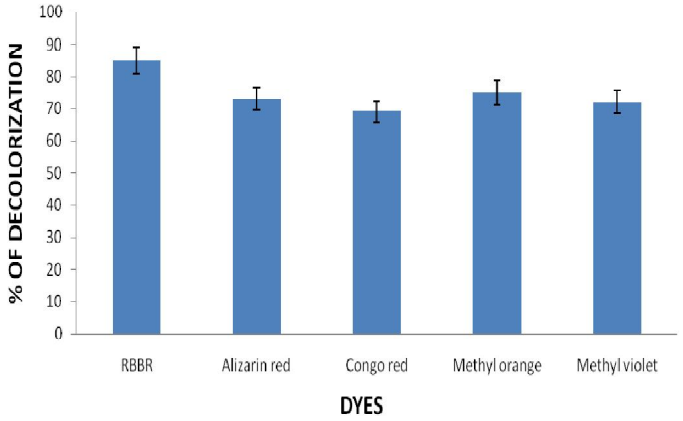

Fig. 1: Effect of laccase from *Hypsizygus ulmarius* in decolorization of different dyes.

In previous reports, higher decolorization rates were obtained for the laccases from a number of fungi (Lu *et al*., 2007). The process of dye decolorization based on laccase was an efficient method and attracted increasing interest. However there has been no study on the decolorization of dye with laccase from this mushroom. Therefore, the present study was chosen to check the effect of purified laccase in decolorization of different dyes.

Enzyme-based decolorization is an efficient method and of current interest in industrial effluent treatment. Anthraquinone-based dyes are difficult to decolorize due to their complicated aromatic ring structures (Fu and Viraraghavan, 2001). In this study, anthraquinone and azo dyes were used for dye decolorization. The purified laccase showed maximum amount of decolorization in RBBR (85%) and followed by Methyl Orange (75%), Alizarin Red (73%), Methyl Violet (72%) and Congo Red (69%) without any additional redox mediator. Our results were supported by (Wang *et al*., 2011) who studied the decolorization of dyes using laccase from *Bacillus subtilis*. This is advantageous to facilitate the benefit of using the enzyme for decolorization of anthraquinone and azo dyes.

CONCLUSION

Thus, the present study confirms the ability of purified laccase from *Hypsizygus ulmarius* in decolorizing different groups of dyes without any additional redox mediator and suggests that this enzyme could be used for the decolorization of different industrial effluents.

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