

REDOX-MEDIATED DECOLORIZATION OF SYNTHETIC DYES BY LACCASE *T. VERSICOLOR*

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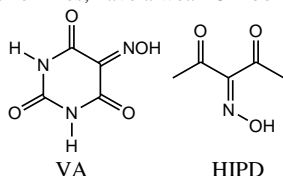
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Synthetic dyes are widely used in different fields including textile, paper industry, printing, cosmetics and pharmaceuticals. Many synthetic dyes are difficult to decolorize due to their complex structure. In recent years, much attention has been paid to the enzymatic oxidation of the dyes using fungal oxidoreductases, such as laccases due to the effective decolorization of wastewater. The addition of low molecular weight redox mediators to enzymes expands the range of substrates and increases the rate of oxidation of compounds. The aim of this study was to develop an effective method for increasing the productivity of laccase to discolor many synthetic dyes in the presence of mediator.

We have used mediators for *Trametes versicolor* laccase – 3-(hydroxyimino)pentane-2,4-dione (HIPD) and violuric acid (VA). These are organic compounds belonging to the class of oximes, have a weak OH bond and easily form iminoxyl radicals, which are quite stable.



The following dyes were selected: azodyes – methylene orange (MO), allura red AC (AR), mordant blue 13 (MB 13); triphenylmethane dyes – methylene green (MG), methylene violet (MV); anthraquinone dye – reactive blue 4 (RB4); thiazine dye – methylene blue (MB) and indigo dye – indigo carmine (IC).

Decolorization of dyes was studied by monitoring the decrease in absorbance of solutions at the maximum wavelength of dyes using a UV-visible spectrophotometry in citrate-phosphate buffer at optimal pH for each dye. The reaction proceeds very slowly in the presence of only the *Trametes versicolor* laccase reaction system. Decolorization of synthetic dyes is much faster when using the biocatalytic laccase-mediator systems. The solutions become transparent, and the absorption bands completely disappear. The decolorization system included a 20 μM synthetic dye in the presence of 0.497 mg/ml laccase and 5 mM HIPD or VA in citrate-phosphate buffer pH (3–6) at T = 308 K. The Table shows the decolorization rates of synthetic dyes by the laccase-mediator system.

Table. The initial rates of synthetic dyes decolorization by the laccase-mediator system

| Dye | MO | AR | MB13 | MG | MV | RB 4 | MB | IC |
|----------|----------------------------------|-----|------|-----|------|------|-----|-----|
| Mediator | $R \times 10^6, M \times s^{-1}$ | | | | | | | |
| VA | 3.1 | 3.6 | 11.5 | 0.7 | 0.8 | 0.4 | 0.5 | 7.0 |
| HIPD | 0.3 | 0.5 | 9.8 | 0.1 | 0.08 | 2.6 | 1.3 | 0.7 |

The data in the Table show that the decolorization rates of synthetic dyes were different depending on the mediator used. VA is the best mediator compared with HIPD, but HIPD is non-toxic, easy to synthesize, and inexpensive.