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Short Communication

# Accumulation of Acid Orange 7, Acid Red 18 and Reactive Black 5 by growing *Schizophyllum commune*

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**Abstract**

The effect of Acid Orange 7, Acid Red 18 and Reactive Black 5 on the growth and decolorization properties of *Schizophyllum commune* was studied with respect to the initial pH varying from 1 to 6 and initial dye concentration (10–100 mg/L). The optimum pH value was found to be 2 for both growth and color removal of these azo dyes. Increasing the concentration of azo dyes inhibited the growth of *S. commune*. It was observed that *S. commune* was capable of removing Acid Orange 7, Acid Red 18 and Reactive Black 5 with a maximum specific uptake capacity of 44.23, 127.53 and 180.17 (mg/g) respectively for an initial concentration of 100 mg/L of the dye. Higher decolorization was observed at lower concentrations for all the dyes. Finally it was found that the percentage decolorization was more in the case of Reactive Black 5 dye compared to the other two dyes used in the present investigation.


*Keywords:* *Schizophyllum commune*; Decolorization; Reactive Black 5; Acid Red 18; Acid Orange 7

## 1. Introduction

Dyes are generally used in textile, paper, cosmetic, food, pharmaceutical and leather industries. The colored effluents produced by these industries are not found to be eco-friendly. So the removal of these dyes from the effluent is of great importance (Banat et al., 1996). Decolorization of these dyes is possible by using several methods such as adsorption, oxidation, coagulation, flocculation, chemical degradation and photo degradation which fall under the broad classification of physical or chemical methods (Lin and Peng, 1996). However activated carbon is the most widely used adsorbent for the removal of color (EI-Geundi, 1991; Al-Degs et al., 2000). Most of the above methods are not found to be economical and hence biological methods are restored to reduce costs. A wide variety of bacteria and fungi are found to accumulate large quantities of dye (Moreira et al., 1997; Coughlin et al., 1997).

Decolorization of dyes using the fungal strains of *Phanerochaete chrysosphorium* (Kirk et al., 1978), *Trametes versicolor* (Swamy and Ramsay, 1999), *Geotrichum candidum* (Lee et al., 2000) and *Rhizopus arrihizus* (Akzu and Tezer, 2000) with ligninolytic activity has been already well established. Currently, most of the research work deals with the biosorption and bioaccumulation of azo dyes using dead and living fungal biomass (Fu and Viraraghavan, 2002; Donmez, 2002; Walker and Weatherley, 2000; Akzu and Dönmez, 2003; Mou et al., 1991). The main advantage of viable culture in the decolorization process is the fact that separate biomass production for instant activation, harvesting, drying, processing and storage compared to the non-viable microbial biomass process can be avoided.

Among the various fungal strains, *Schizophyllum commune* is a white rot fungus which has been used for the decolorization of lignin (Belsare and Prasad, 1988; Fang et al., 1999). In the present investigation, *S. commune*

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**Nomenclature**

| | |
|---|---|
| $C_0$ | initial Acid Orange 7, Acid Red 18 and Reactive Black 5 dye concentration (mg/L) |
| $C$ | residual Acid Orange 7, Acid Red 18 and Reactive Black 5 dye concentration in the bioaccumulation medium at any time (mg/L) |
| $C_{acc}$ | bioaccumulated Acid Orange 7, Acid Red 18 and Reactive Black 5 dye concentration at any time (mg/L) |
| $C_{accm}$ | bioaccumulated Acid Orange 7, Acid Red 18 and Reactive Black 5 dye concentration at the end of microbial growth (mg/L) |
| $q_m$ | bioaccumulated Acid Orange 7, Acid Red 18 and Reactive Black 5 dye quantity per gram of dried *S. commune* at the end of microbial growth (g/L) |
| $X$ | dried *S. commune* concentration in the bioaccumulation medium at any time (g/L) |
| $X_m$ | maximum dried *S. commune* concentration (g/L) |
| $\mu$ | specific growth rate of *S. commune* (1/h) |

fungal biomass has been used for textile dye decolorization. The main advantage of the *S. commune* is that it is readily available waste fungal biomass. Decolorization using this fungi *S. commune* was observed to occur in two stages (1) physically adsorbed to cell peripheries in a non specific manner and then (2) followed by the specific accumulation into the biomass (Donmez, 2002).

The objective of the present work was to investigate the influence of textile azo dyes such as Acid Orange 7, Acid Red 18 and Reactive Black 5 on the growth and bioaccumulation properties of *S. commune* as a function of the initial pH and initial dye concentration.

## 2. Methods

### 2.1. Microorganisms and growth conditions

The *S. commune* (white rot fungus) was isolated from the bark of *Tamarindus indica* (Tamarind tree). The strain was characterized at the Centre for Advanced Studies in Botany, University of Madras and Chennai, India. This strain was grown aerobically in potato dextrose broth medium in a temperature-controlled shaker maintained at 30 °C and at 180 rpm. After 72 h, the culture was transferred into the azo dye solution.

### 2.2. Bioaccumulation experiments

The effect of Acid Orange 7, Acid Red 18 and Reactive Black 5 on the growth and dye uptake by *S. commune* was carried out in a 250 ml Erlenmeyer flask containing 100 ml of the dye solution. A concentration of 30 mg/L of Acid Orange 7, Acid Red 18 and Reactive Black 5 dye solution was prepared and the pH of the individual dye solution was adjusted to 1, 2, 3, 4, 5 and 6 using tartaric acid for the pH studies. Dye solutions of different concentration (10, 20, 30, 50, 70 and 100 mg/L) were prepared and the solution pH was maintained at 2 for the initial dye concentration studies. All the solutions were sterilized. The pure culture of *S. commune* (15% (v/v)) was inoculated into the dye solutions and the experiment repeated (same as that used for the growth of the fungus).

During the growth, samples were with drawn for every 12 h interval. It was then centrifuged at 12,000 rpm for 10 min and the absorbance of the supernatant liquid was determined using U–V spectrophotometer (Hitachi U3210, Japan). Decolorization values were calculated as the ratio between the bio-accumulated concentrations of dye on the fungal biomass to the initial dye concentration. The dry weight of the biomass was determined by drying the cell pellet at 70 °C for 24 h. At every 12 h interval, pH of the dye solutions was measured and it was observed that the deviation from the fixed value was marginal. Hence, change in pH values was not accounted for during the decolorization process. All experiments were carried out with suitable control and the values used in the calculations were the arithmetical average of at least two experimental values.

### 2.3. Statistical analysis

The initial dye concentrations were employed with six replicate equilibrium uptake tests, which have been used in the batch decolorization studies. Standard deviation was calculated for the six final dye concentration values using the statistical analysis and the values were observed to be less than 6% of the mean value. The correlation coefficients from the dye concentration determination obtained were not less than 0.9704. The experimental results obtained from the present investigation were analyzed using randomized block design on the SPSS by analysis of variance (ANOVA) (Waranusantigual et al., 2003).

## 3. Results and discussion

The influence of Acid Orange 7, Acid Red 18 and Reactive Black 5 dyes on growth and bioaccumulation properties of *S. commune* was investigated as a function of initial pH and initial dye concentration. The dried cell biomass ($X$), specific growth rate of the microorganisms ($\mu$),