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*Short Communication*

# Biodecolorization of acid violet 19 by *Alternaria solani*

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**Microorganisms are the nature's tools for cleaning the environment. Bioremediation using bacteria, fungi and algae is becoming an attractive option for the treatment of industrial effluents containing a wide spectrum of pollutants including dyes and heavy metal ions. In the current research work, the potential of a deuteromycete fungus, *Alternaria solani* for the removal of a dye, Acid Violet 19 from aqueous solution was studied. The fungus showed promising potential for the decolorization of the dye (88.6%) at a dye concentration of 30 mg/L within a relatively short period of time (four days). But with increase in the contact time, the % decolorization decreased showing that some of the adsorbed dye was desorbed especially in case of higher dye concentrations. The desorption of the dye from the fungal cells at long contact time and higher dye concentrations was considered to be due to higher molecular mass, structural complexity and the presence of inhibitory groups, $SO_3Na$ in the dye**.

**Key words:** Decolorization, Acid Violet 19, *Alternaria solani*, biosorption, desorption.

## INTRODUCTION

Environmental pollution is one of the major problems of the modern world. On one hand, industrialization is necessary to satisfy the needs of the world's overgrowing population but on the other hand, it threatens life on earth by polluting the environment. The problem of environmental pollution is increasing day by day due to the release of xenobiotic substances into water, soil and air. These substances include organic compounds (pesticides, dyes, polymers etc.) and heavy metal ions. The damage caused by these pollutants to plants, animals and humans cannot be neglected and hence strategies must be developed to solve the problem of environmental pollution on priority basis.

Among the wide spectrum of water pollutants, the synthetic dyes cause a severe problem. Apart from causing other problems, the synthetic dyes produce intense coloration in water when released into natural water bodies. This coloration of the natural water bodies is not only undesirable from aesthetic point of view but is actually affecting the aquatic flora and fauna by reducing the transmission of sunlight through the water surface. It has been estimated that about 10 - 15% of the dyes used in textile processing during the dyeing do not bind to the fibers and are therefore released into the aquatic environment (Vaidya and Datye, 1982). Wastewater from the textile industry is a complex mixture of many polluting substances associated with dyes and associated chemicals in the dyeing process (Correia et al., 1994).

Several methods are available for the removal of dyes from wastewaters. These include methods like adsorption on activated carbon, coagulation, electrolysis, ozonation, etc. Some of these methods are effective but have limitations like high cost and hazardous byproducts (Mohan et al., 1999). Bioremediation is a cost effective and environment friendly alternative for the treatment of industrial wastewaters. Biological processes such as biosorption and biodegradation have been proposed as having potential application in removal of dyes from textile wastewaters (Bustard et al., 1998). Many bacterial, fungal and algal species have the ability to adsorb and/or degrade dyes. Non-viable biomaterials are also investigated extensively for adsorption of dyes and many other pollutants (Low and Lee, 1997, Sanchez et al., 1999, Zouboulis et al., 1999). Knapp and Newby (1995) reported that adsorption of dyes to the microbial cell surface is the primary mechanism of decolorization.

The use of many fungal species for bioremediation of wastewaters containing dyes and heavy metal ions has

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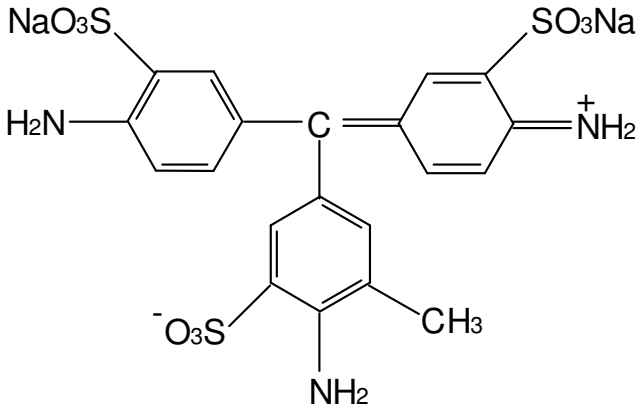


**Figure 1.** Structural formula Acid Violet 19 (Gurr, 1971).

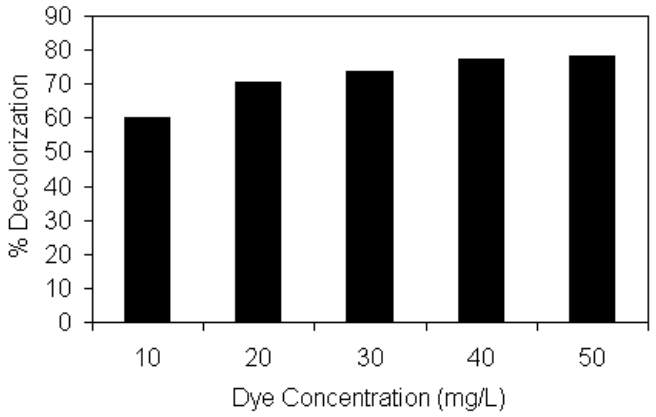


**Figure 2.** Effect of Acid Violet 19 dye concentration on decolorization by Alternaria solani in the initial 48 h.

been studied. The aim of the present study is to investigate the potential of a deuteromycete fungus, *Alternaria solani* for the removal of a dye, Acid Violet 19 from aqueous solution.

## MATERIALS AND METHODS

### Fungal inoculum

The pure spores of *Alternaria solani* were obtained from Microbiology Section, Center of Biotechnology, University of Peshawar, Peshawar, Pakistan. These were grown and maintained in Petri dishes on slightly modified Czapek Dox Agar medium. All the glassware used as well as the medium was sterilized by autoclaving at 121°C for 20 min.

### Dye

The dye, Acid Violet 19 was taken from our own laboratory. The property wise data of the dye is as follows

| | |
|---|---|
| C.I. number | 42685 |
| Class | Triarylmethane |
| $\lambda_{max}$ | 540-546 nm |

Structural formula for Acid Violet 19 is shown in Figure 1 (Gurr, 1971).

### Growth and decolorization medium

Slightly modified Czapek Dox Agar medium was used as growth medium. This medium contained the following ingredients per liter: sucrose 30 g, $NaNO_3$ 3 g, KCl 0.5 g, $MgSO_4$. $7H_2O$ 0.5 g, $FeSO_4$. $7H_2O$ 0.01 g and $KH_2PO_4$ 1 g. The final pH of the medium was 7.2 at 25°C. A volume of 100 mL of this growth medium was taken in five 250 mL Erlenmeyer flasks and stock dye solution was added to each of them to make final dye concentrations of 10, 20, 30, 40 and 50 mg/L. To each of these flasks, 100 mg of the fungal inoculum was added and the flasks were kept in a static incubator at 37.5°C. Non-inoculated culture medium containing dye (50 mg/L) was used as control.

### Decolorization assay

The extent of decolorization was determined by measuring the optical density (Absorbance) of the samples in the start and then at various time intervals at the predetermined wavelength of maximum absorbance, $\lambda_{max}$ (545.5 nm) using a UV-Visible Spectrophotometer (UV-1700, Shimadzu). Medium without dye and inoculum was used as the blank. The $\lambda_{max}$ of all the samples was also determined each time. For each reading, a few mL liquid was taken from the sample, it was filtered using disposable syringe filter (0.45 μ) and then analyzed instrumentally. The experiment was performed in duplicate and mean readings were taken. The % decolorization was calculated by using the following equation.

$$\%\ Decolorization^{\ b} = \frac{A_o - A_t}{A_o} \times 100\ \%$$

Where $A_o$ = initial absorbance and $A_t$ = absorbance after time t (Olukanni et al., 2006).

## RESULTS AND DISCUSSION

The study revealed that the deuteromycete fungus, *Alternaria solani* decolorizes the aqueous solution of Acid Violet 19 to an appreciable extent. The % decolorization increased with increasing dye concentration in the initial two days. This linear increase in % decolorization with increasing dye concentration has been shown in Figure 2.

The linear increase of % decolorization with increasing dye concentration was not observed after four days of the treatment. After the second day, the % decolorization further increased for the lower dye concentrations (10, 20 and 30 mg/L) and decreased in case of the relatively higher concentrations (40 and 50 mg/L). After six days of the treatment, fall in % decolorization was noticed for all of the five dye concentrations. The decrease in % decolorization with increase in contact time is shown in Figure 3.

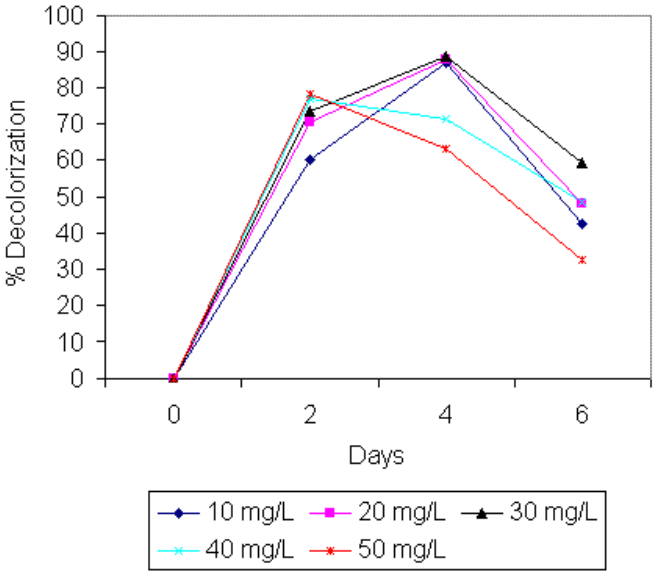


**Figure 3.** Effect of Acid Violet 19 dye concentration on decolorization by Alternaria solani.

There was no decolorization in the control flask (flask containing medium and dye but without inoculum). Since there was no change in the □max of the dye after treatment, therefore it can be inferred that the dye molecules have been adsorbed on the fungal cells i.e., the mechanism of decolorization seems to be biosorption and not biodegradation. Furthermore, since some of the dye is desorbed after long contact with the cells, therefore this further supports the inference that the dye has been adsorbed.

The desorption of the dye from the fungal cells especially at higher dye concentrations may be due to higher molecular mass, structural complexity and the presence of inhibitory groups, $SO_3Na$ in the dye (Hu Tai-lee and Wu, 2001). The extent of % decolorization of this dye by *Alternaria solani* may be increased by treatment under shaking conditions because shaking facilitates the transfer and distribution of materials and oxygen between the medium and the microbial cells. Further studies in this direction will be valuable to know the details of desorption of the dye from the fungal cells in case of higher dye concentrations and long contact time.

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