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RESEARCH ARTICLE

DECOLOURIZATION STUDIES OF SYNTHETIC TEXTILE DYE USING *ASPERGILLUS SPECIES* UNDER STATIC AND SHAKING CONDITIONS

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ABSTRACT

Different fungi have the potentials to decolourize complex and recalcitrant organic compounds into simpler fragments achieving complete mineralization. Optilan red dye and Indosol yellow dye belong to an important group of synthetic dye used in textile industries. They are considered as recalcitrant compound for decolourisation. In this work a batch experiment was conducted for the decolorization of optilan red dye and indosol yellow dye using *Aspergillus niger* and *Aspergillus flavus* under static and shaking conditions. At 200mg/L of optilan red dye, 77% and 84 % decolorization was achieved with *Aspergillus niger* in 8 days interval at static and shaking condition. In case of *A. flavus* the percentage of decolourization of indosol yellow dye at 200mg/L was found to be 70% and 75%, in 8 days interval at static and shaking condition respectively.This study brings out the ability of *Aspergillus* species to degrade optilan red dyes and direct yellow dye and reinforces the potential of this group of fungi for the decolorization of textile effluents.

Key words: Synthetic dye, Decolorization, *Aspergillus niger, Aspergillus flavus.*

INTRODUCTION

Textile dyes enhances the quality of human lifestyle on an extent[1]. Nowadays, there are more than 100,000 commercially available dyes with over 7.105 tons of dyestuff produced annually [2]. Textile industries are found in most countries and their number had been increased. Dyes include a broad spectrum of different chemical structures, primarily based on substituted aromatic and hetrocyclic groups such as aromatic amine (C6 H5-NH2), which is a suspected carcinogenic, phenyl (C6 H5-CH2) and naphthyle (NO2-OH), the only thing in common is their ability to absorb light in the visible region. A large number of dyes are azo compounds (-N-N-), which are lincked by an azo bridge[3]. In the last two decades the EPA (Environmental Protection Agency) and other national and international agencies imposed increasingly strict regulations on the manufacture and use of synthetic colorants. The pigment and dye industry had to develop the necessary technology to analyze and remediate pollutants in wastewater [4]. Many physical and chemical processes for colour removal have been applied including coagulation and flocculation, biosorption, photo-decomposition and ultrafiltration, oxidizing agents, membrane and electrochemical.

Several industries used dyes and pigments for the coloration of their products, such as textiles, rubber, paper, plastics, leather, cosmetics, food and mineral processing industries [5] . A special problem is encountered in the application of synthetic dyes which have a complex aromatic molecular structure and are designed to be resistant to physical, chemical and microbial fading. The textile industries operate with pure cotton fibers or cotton fibers mixed with polyester. Many dyes and other substances present in textile effluents are polluting the environment[6]. Further disposal of the dyes from the industries into the environment causes a very serious damage, since they may significantly affect the photosynthetic activity of hydrophytes by reducing light penetration and also they may be toxic to some aquatic organisms due to their recalcitrant nature[7]. Therefore, industrial effluents containing dyes must be treated before their discharge into the environment. Consequently, large quantities of dye-containing effluents are released in the environment. Such effluents discolor water bodies and increase biochemical oxygen demand of the contaminated water. In addition, anaerobic degradation products of some dyes may be carcinogenic or mutagenic [8].

Recently, microbial decolourisation involving suitable bacteria or fungi has attracted increasing interest. In contrast to the anaerobic treatment with bacteria, the decolourisation by fungi using an oxidative mechanism has the advantage of giving products that are less toxic than the initial dye. A number of biotechnological approaches have been suggested by recent research as of potential interest towards combating this pollution source in an eco –efficient manner, including the use of bacteria or fungi, often in combination with physicochemical processes [9]. Biotreatment depicts a cheaper and environmentally friendlier alternative for colour removal in textile effluents. The ecofriendly microbial decolourization and detoxification is alternative to the physical and chemical methods[10]. A wide variety of microorganisms are capable of decolourization of a wide range of dyes some of them are as bacteria*: Escherichia coli NO3, Pseudomonas*

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luteola, Aeromonas hydrophila; Fungi: *Aspergillus niger, Aspergillus flavus, Phanerochaete chrysosporium, Aspergillus terricola, P.chrysosporium* ; yeasts: *Saccharomyces cerevisiae, Candida tropicalis, C. lipolytica ; algae: Spirogyra species , Chlorella vulgaris , C. sorokiniana, Lemna minuscula, Scenedesmus obliquus, C. pyrenoidosa and Closterium lunula[11].* The present study was an attempt to develop a cost effective method for dye decolourization using fungal species under static and shaking condition with respect to various parameters.

MATERIALS AND METHODS

Preparation of The Medium

The Potato Dextrose Broth and the Czapekdox Broth was prepared for each 100ml in 12 conical flask,The six prepared conical flask medium is for the dye treatment analysis by *Aspergillus niger* and remaining six prepared conical flask medium is for the dye treatment analysis by *Aspergillus flavus*, the medium prepared were autoclaved for sterilization and then cooled.

Inoculation of Micro-Organism

Aspergillus niger and *Aspergillus flavus* were subcultured from mother culture(obtained from PRIST UNIVERSITY, East Campus,Thanjavur) using sterilized inoculating loop and were then cultured into Potato Dextrose agar and Czapek Dox agar and incubated at 28°C for three days in a incubated shaker. After three days, the growth of the fungal species was observed and was used for further studies.

Synthetic Dye Preparation and Decolorization Analysis

Synthetic dye solutions were prepared for decolorization studies, the Optilan red dyes and Direct yellow dyes were mixed in 100 ml of each prepared conical flask medium different concentrations (50 mg/L, 100 mg/L and 200 mg/L respectively) and the prepared *Aspergillus niger* and *Aspergillus flavus* are inoculated into the culture in conical flasks. The conical flasks were incubated under two different sets of conditions. One set of each was incubated at static condition, 37ºC and pH 7.Other set of conical flasks were incubated in shaker with 150 rpm, 37 ºC and pH7. The absorbance values were taken for analyzing the % of decolorization. The OD values was taken using calorimeter at regular interval of days as the time period.

RESULT AND DISCUSSION

Effect of Different Dye Concentrations on Decolourization

The decolourization performance of optilan red and indosol yellow by *A. niger* and *A. flavus* was studied at various increasing dye concentration (50, 100, 250mg/L). From Fig 4.1-4.4 it was observed that the rate of decolourization varies at different increasing concentration. At 200mg/L of optilan red dye concentration, showed 77% and 84% decolourization with *Aspergillus niger* at static and shaking condition. In case of *A. flavus* showed that percentage of decolourization was observed only 70% and 73% in static and shaking condition respectively. The time required for decolourization varied from 1-8days. Thus it was revealed out that *Aspergillus niger* showed an increased percentage of decolourization of about 84% in shaking condition on optilan red dye and it also proved that *Aspergillus* species are most suitable for the decolourization of harmful synthetic dyes.

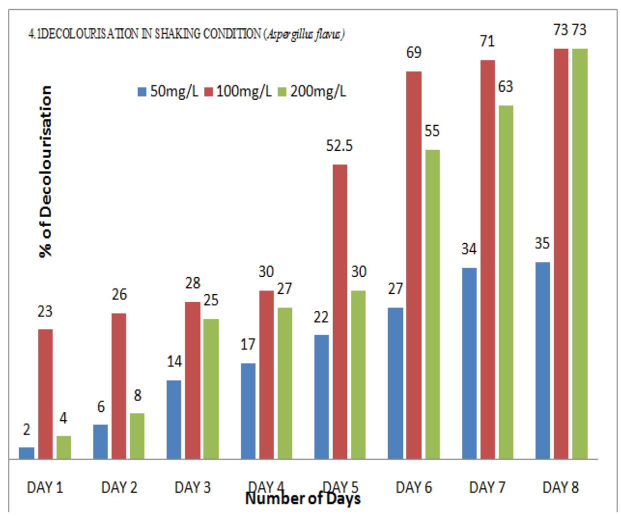
Table 3.1- Od values of optilan red dye decolourisation under static and shaking condition of *Aspergillus niger*

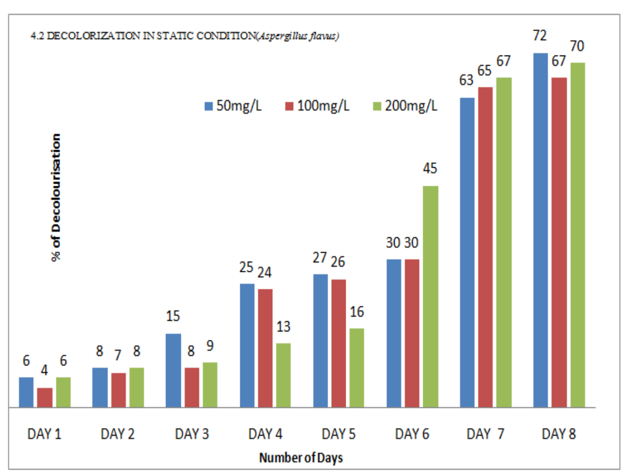
	50 mg/L		100mg/L		200 mg/L	
DAYS	Static 1	Shaking 1	Static 2	Shaking 2	Static 3	Shaking 3
1	1.16	0.81	1.10	1.78	1.08	1.97
2	1.06	0.73	0.59	1.67	0.69	1.94
3	0.64	0.69	0.57	1.55	0.56	1.81
4	0.54	0.59	0.46	1.58	0.50	1.77
5	0.49	0.58	0.41	1.50	0.62	1.67
6	0.35	0.52	0.48	1.44	0.57	1.53
7	0.28	0.41	0.43	1.43	0.48	1.36
8	0.26	0.36	0.53	0.57	0.39	0.63

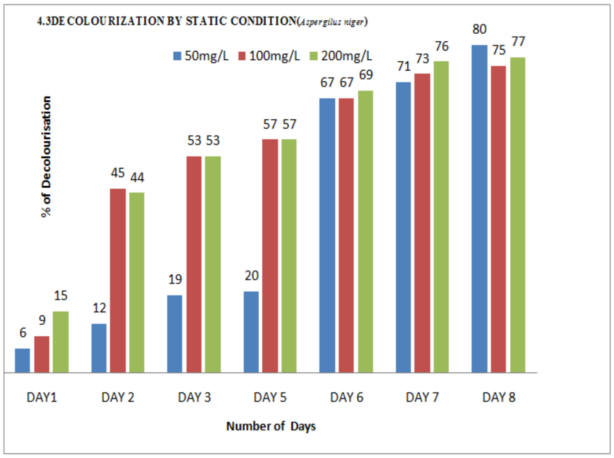
Table 3.2 - Od values of indosol yellow dye decolourisation under static and shaking condition of *Aspergillus flavus*

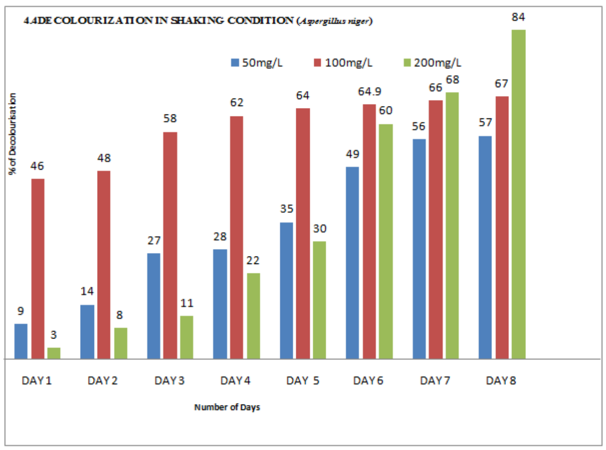
	50mg/L		100mg/L		200mg/L	
DAYS	Static 1	Shaking 2	Static 2	Shaking 2	Static 3	Shaking 3
1	1.94	1.23	1.88	1.86	1.71	1.84
2	1.84	0.93	1.79	1.78	1.61	1.79
3	1.79	0.90	1.64	1.70	1.56	1.72
4	1.75	0.88	1.75	1.68	1.58	1.57
5	1.67	0.85	1.58	1.39	1.52	1.50
6	1.62	0.57	1.50	1.35	1.48	1.43
7	0.09	0.37	0.06	1.29	1.35	1.34
8	0.08	0.47	0.03	0.67	0.66	1.20

Decolorization activity was calculated using following formula
% of Decolorization = [(Initial OD-Final OD)/Initial OD] x 100









Conclusion

Coloured-dye-wastewater treatment and decolourization presents an arduous task. Wide ranges of pH, salt concentrations and chemical structures often add to the complication. Among the most economically viable choices available for effluent treatment/decolourization, and the most practical in terms of manpower requirements and running expences to adopt and develop, appear to be the biological systems. Thus from the experimental study it reveals that the fungal species are more suitable for the decolourization purpose and also seems to have a great significance for future development in bio-removal or bio-recovery of dye.

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