Microbial Deccolourisation Of Texttile Dyes

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Abstract- *Two different fungal isolates of belonging toTrichoderma were isolated from textile industrial effluent and were tested for their efficiency of decolourisation of textile dyes of three different colours which are commonly used in the textile industry. The efficiency of each fungi was tested for different parameters like pH and concentration of dye. The results showed that both the species were capable of decolorizing the dyes however Trichoderma herzianum Rifai showed more potential of decolurisation at the pH of5 and at 0.1 g/litconcentration of dye.*

Keywords- ungi, dyes, enzymes, decolourisation, Trichoderma, etc.

I. INTRODUCTION

The textile industry is one of the largest industries in India and also among the largest usage of water. As a result it also creates a large amount of waste water. The effluent from the textile industry contains dyes as the major constituent. Most of the dyes are synthetic in nature and hence are difficult to breakdown.(Stolz 2000) Moreover these dyes are also strong to resist action of sunlight and water.

These dyes are used in majority of industries like printing, textile, paper, leather,etc (Garg et al., 2004) these results in large quantities of dyes in the industrial waste water. The textile effluent containing dyes is difficult to treat owing to their synthetic and aromatic nature. (Stolz 2000) these dyes even in small quantities are visible. These dyes reduce the penetration of sunlight and photosynthesis thus adversely affecting the aquatic ecosystem.(Ali et al. 2010). In addition some dyes are also toxic or mutagenic and carcinogenic. (Gong et al., 2005; Nigam et al., 2000; Birhanli and Ozen, 2005; Degon et al., 2005)

II. EXPERIMENTAL METHODS

A. Materials

The dyes used in this study were BROWN 3BS,YELLOW GG and YELLOW BROWN found in abundance in the effluent water. Stock solutions of these dyes were prepared of different concentrations and the cultures were added to these solutions. Decolourisation was measured at peak absorbance wavelength of each dye using UV-VIS Spectrometer.

B. Preparation of Stock solution

Stock solutions of the three dyes were prepared by dissolving accurately measured dyes in distilled water at concentration of 500 mg/ lit. Different concentrations were prepared from this solution. (0.02 g/lit- 0.1 g/lit)

C. Fungal cultures:

Two fungal isolates belonging to Trichoderma viz. Trichoderma *aureoviride* Rifai and Trichoderma *herzianum* Rifai were used for the study. These fungi were isolated from the industrial effluent based on the earlier studies and literature survey.

III. EXPERIMENTAL PROCEDURE

The effluent waste of a textile industry in Surat, Gujrat was obtained and tested for its physical parameters. 1ml of the effluent was transferred into 9 ml of distilled water in sterile test tubes. Serial dilution was done up to10-7 by thorough mixing. 0.1 ml of sample from each dilution was spread on saboraraud dextrose agar plates. The petri dishes were incubated at room temperature (28°C) for 5 days. (Ponraj.M et al.) The predominant isolates were isolated and grown separately. These isolates were identified at the Agarkar research institute, Pune, India. These fungal isolates were further used for the decolourisation experiments.

These were then transferred to the stock solutions in sterile conditions to avoid any kind of contamination. About 5 mm disc of the cultures were inoculated in the dye solutions and incubated for three days at 25^0C.

A. Dye Decolourisation:

The experiments were performed in 250 ml flasks containing stock solutions of different concentrations (0.02-0.1 g/lit). After inoculation of fungi the flasks were incubated and were observed for decolourisation after 3, 6, and 9 days. After each period of time about 20ml sample was used and centrifuged at 7500 rpm for 20 min. then the absorbance for

each concentration was measured at the wavelength of peak absorbance. The stock solutions without culture were used as control. The absorbance was taken after 3, 6 and 9 days and the percentage decolourisation was calculated. % decolurisation was determined by the formula-

$$\% \text{ Decolourization} = 100*(C_0-C_t)/ C_t$$

Where C0 is the initial concentration of the dye (control) and Ct is the concentration at time t.

IV. RESULTS AND DISSCUSSIONS

The fungi are able to decolorize the dyes because of their ability of producing lignin modifying enzymes. Mostly the lacase enzymes are capable of decolurisation. The fungi used in this study were capable lacase activity which was studied in various literatures.(N.F.Ali et al.,) Both the species of fungi were capable of decolorizing the dyes used on a similar amount however the Trichoderma *aureoviride* Rifai was found to be slightly more capable of decoluring both the dyes

A. Effect of initial time of incubation on decolourisation % of dyes:

The results obtained indicated that the decolourisation efficiency of the dyes used for 3, 6, and 9 days intervals using 5 mm approx. disc of fungi culture shown in the tables 1,2, and 3 respectively, both the fungal isolates were capable of removing approximately the highest % of dyes after 9 days of incubation.The nature of the substituent on the aromatic ring has been shown to influence enzymatic oxidation. Electron donating substituents as methyl and methoxy and amino groups enhance enzymatic degradation of azo phenols while electron withdrawing substituents as chloro, nitro and hydroxyl inhibited oxidation (Zheng et al., 1999). Hydroxyl and amino groups enhance decolourization. The presence of Lip in addition to Laccase in the Trichoderma had positive effect on the degree of decolourization for the tested dyes. Figures 9 and 10 shows the photographs of before and after 9 days of incubation of both the dyes used.

B. Effect of initial dye concentration on % decolourisation of dyes:

The effect of initial dye concentration of dye in solution on removal of dyes was studied. We used different concentration of dyes (0.02, 0.04, 0.08 and 0.1 g/l). The removal of dyes was clearly dependent on the initial dye concentration of the solution. The highest concentration of 0.1 g/lit showed slightly greater decolurisation than the other concentrations hence as a result the same concentration was further used for evaluating the effect of pH on the % decolourisation.

C. Effect of the pH on decolourization % dyes:

Figures 5,6,7,8 show the effect of pH of the dye solution on the decolourization % of microorganisms within the range of (3–7).The results showed that the decolourization reached maximum at pH 7 for Brown color while it reached maximum at pH 5 for yellow dyes for all isolates used. Many authors stated that pH is very important for fungal growth.

Table 1- Decolourisation potential of Trichoderma aureoviride Rifai Against different concentrations of dyes for BROWN3 BS

Concentration	3 days	6 days	9 days
0.02 g/L	3.14	6.28	26.7
0.04 g/L	18.91	25.94	27.56
0.06 g/L	21.46	27.45	31.44
0.08 g/L	26.37	28.43	35.71
0.1 g/L	23.44	33.43	56.16

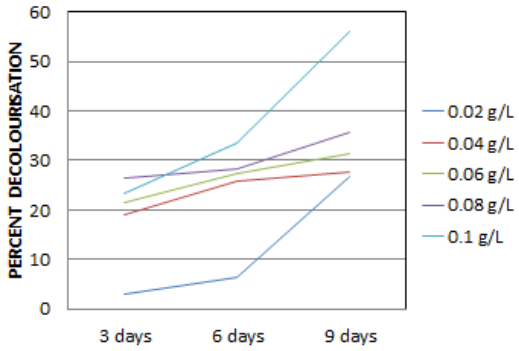


Figure1- Decolourisation potential of Trichoderma aureoviride Rifai Against different concentrations of dyes for BROWN3 BS

Table2: Decolourisation potential of Trichoderma herzianum Rifai Against different concentrations of dyes For BROWN 3BS

Concentration	3 days	6 days	9 days
0.02 g/L	12.56	26.70	36.64
0.04 g/L	19.18	25.94	30.81
0.06 g/L	23.29	28.28	31.44
0.08 g/L	25.96	28.02	31.45
0.1 g/L	26.09	30.37	46.48

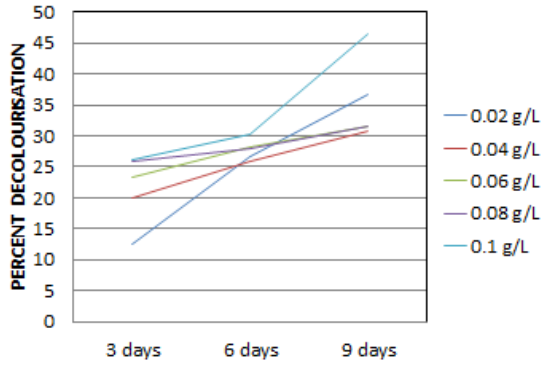


Figure2: Decolourisation potential of Trichoderma herzianum Rifai Against different concentrations of dyes for BROWN3 BS

Table 3: Decolourisation potential of Trichoderma aureoviride Rifai Against different concentrations of dyes for YELLOW GG

Concentration	3 days	6 days	9 days
0.02 g/L	15.07	18.89	26.51
0.04 g/L	9.27	12.79	19.68
0.06 g/L	16.71	9.87	23.46
0.08 g/L	17	27.75	33
0.1 g/L	21.5	23.5	27

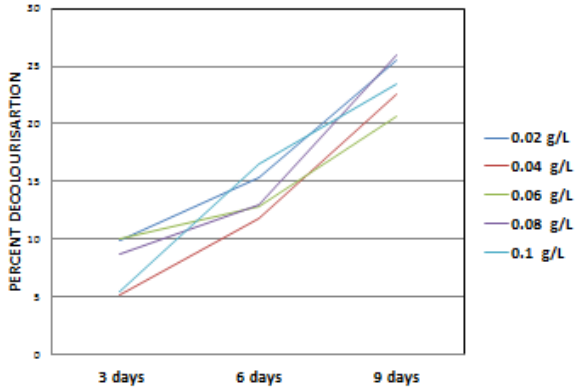


Figure 3: Decolourisation potential of Trichoderma aureoviride Rifai Against different concentrations of dyes for YELLOW GG

Table 4: Decolourisation potential of Trichoderma herzianum Rifai Against different concentrations of dyes for YELLOWG

Concentration	3 days	6 days	9 days
0.02 g/L	9.87	15.42	25.47
0.04 g/L	5.16	11.84	22.64
0.06 g/L	10.07	12.91	20.67
0.08 g/L	8.75	13	26
0.1 g/L	5.5	16.5	23.5

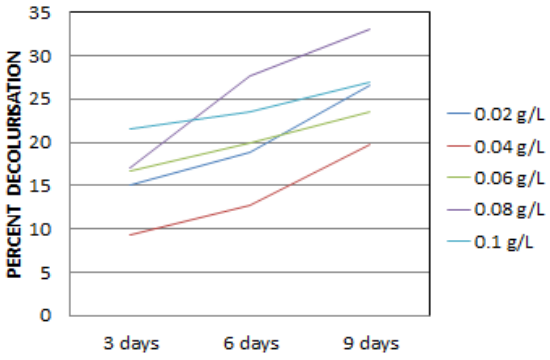


Figure 4: Decolourisation potential of Trichoderma herzianum Rifai Against different concentrations of dyes for YELLOWGG.

Table 5: Decolourisation potential of Trichoderma aureoviride Rifai Against different pH values of dyes for BROWN 3BS

Ph	3 days	6 days	9 days
3	18.31	27.90	40.84
4	19.70	27.94	36.02
5	9.51	21.13	35.93
6	10.74	18.96	23.26
7	20.96	35.83	44.37

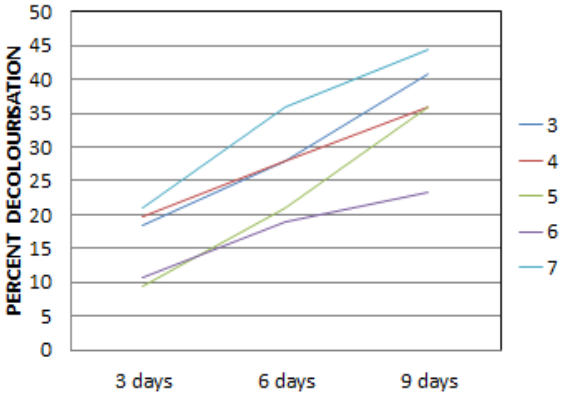


Figure 5: Decolourisation potential of Trichoderma aureoviride Rifai Against different pH values of dyes for BROWN 3BS

Table 6: Decolourisation potential of Trichoderma herzianum Rifai Against different pH values of dyes for BROWN 3BS

pH	3 days	6 days	9 days
3	54.22	69.28	82.24
4	44.83	47.79	65.94
5	51.15	57.47	60.91
6	53.12	56.21	59.30
7	43.92	53.76	55.53

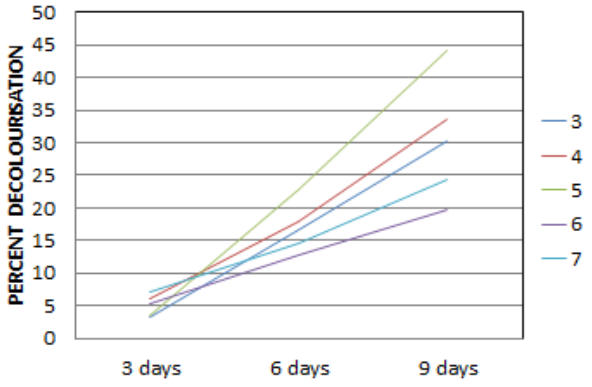


Figure 6: Decolourisation potential of Trichoderma herzianum Rifai Against different pH values of dyes for BROWN 3BS

Table 7: Decolourisation potential of Trichoderma aureoviride Rifai Against different pH values of dyes for YELLOW GG

pH	3 days	6 days	9 days
3	3.25	16.67	30.27
4	5.92	17.85	33.7
5	3.575	22.7	44.22
6	5.28	12.69	19.66
7	7.05	14.65	24.4

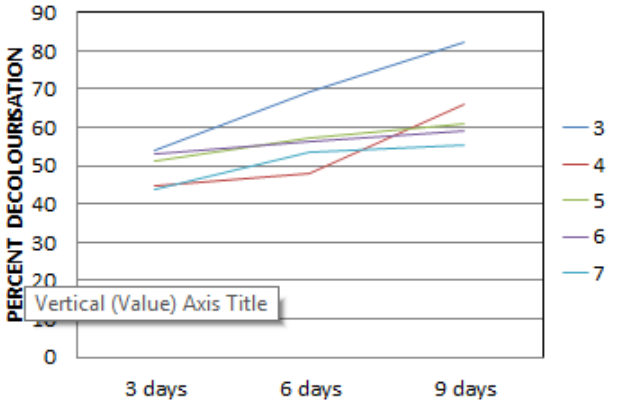


Figure7: Decolourisation potential of Trichoderma aureoviride Rifai Against different pH values of dyes for YELLOW GG

Table 8: Decolourisation potential of Trichoderma herzianum Rifai Against different pH values of dyes for YELLOW GG

pH	3 days	6 days	9 days
3	18.31	27.90	40.84
4	19.70	27.94	36.02
5	9.51	21.13	35.93
6	10.74	18.96	23.26
7	20.96	35.83	44.37

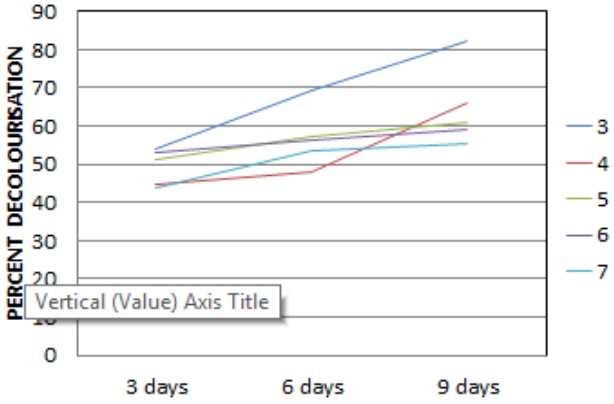
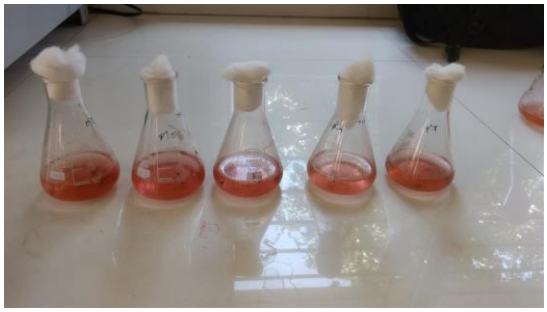


Figure 8: Decolourisation potential of Trichoderma herzianum Rifai Against different pH values of dyes for YELLOW GG.

IV. CONCLUSION

Fungi decolourization of dyes can be achieved by treating with Trichoderma sp. It can be stated that both fungal isolates were capable of removing the highest percent of dye colour after 9 days incubation. The isolate of Trichoderma herzianum Rifai produced the highest biomass accumulation after 9 days and it is the most efficient one in the removal of the reactive and acid dyes at low concentrations. The results showed that the decolourization reached maximum at pH 7 for Brown dye while it reached a maximum at pH 5 for Yellow dye for all isolates used. The results indicate that these fungal isolates can be used in conventional treatment of textile effluent to remove the dyes.

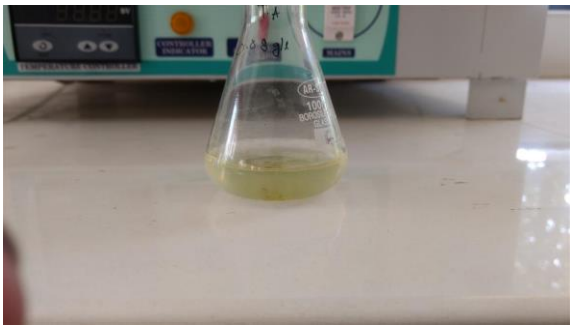


(A)

(B)

Fig 9: photographs of before and after 9 days of incubation of Brown 3BS dye.

(A)



(B)

Fig 10: photographs of before and after 9 days of incubation of Yellow GG dye.

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