Bio Decolourization of Textile Dye Red ED3B by Bacterial Cultures

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Abstract- *Water pollution is the major problem of environmental concern due to increasing industrialization. Textile industries are playing prominent role in polluting the environment by disposing its hazards chemical waste in the natural reservoirs. Among all industries the textile industries are generating a large volume of waste water. The dyes are used to a greater extent in textile industries for colouring the fabrics which are harmful, carcinogenic, mutagenic and toxic to all leaving beings. The discharge of these dyes along with waste water causes an obvious aesthetic problem. The decolorization of textile dye Red ED3B was carried out by using bacterial isolated cultures from acclimatized soil samples. The microorganisms from the soil were acclimatized by respective dye and total 5 isolates were having capacity to decolorize 94.35% of the dye in nutrient medium and about 89.51% decolorization in half strength nutrient medium within 24 hours. The effect of various carbon and nitrogen sources was also studied by using 5 isolates. The bacteria could decolorize 98.99 % and 98% of the dye in presence of carbon and nitrogen source in less than 24 hours. The percent decolorization of the dye was determined by spectrophotometer.*

Keywords- Textile dyes, Red ED3B, Decolorization, Bacterial cultures.

I. INTRODUCTION

Pollution due to textile waste water is the major problem of growing environmental concern. The textile effluent contains large amount of various dye stuffs, hazardous chemicals, surfactants and softeners which are non-biodegradable and toxic to environmental flora and fauna. These dyes can produce aromatic amines which are considered as carcinogenic to human being (Banat *et al.*, 1996; Weisburger, 2002). These dyes generally effect on photosynthetic ability of plants, depletion of oxygen, increased BOD, and reduce the soil fertility. Recently it has been studied that near about 12% of synthetic dyes are lost from textile industry per year (Srinivasan*et al.*,2009). Today more than 10,000 colours and pigments are available worldwide in textile industry (Robinson *et al.*, 2001). The reactive dyes are largest group among all dyes which contain different chromophore group such as Azo, Anthraquinone and Triarylmethane. A large amount of disposal of effluent from the textile industries causes a hazardous problem to surrounding environment (Chen *et al.*, 2005). The presence of the dyes (below 1 ppm) is clearly visible and affects the quality of water and environment. Hence it is very essential to remove these colours and toxic compounds from the textile waste water (Ou*et al.*, 2005).

Traditionally these dyes can be removed by physical, chemical and biological methods. The physical and chemical methods such as coagulation with alum, ferric chloride, magnesium carbon, chemical oxidation, electrophotocatalysis, adsorption, filtration and precipitation are available for the treatment of textile effluent. But these methods are having several limitations such as very expensive, produce large amount of secondary sludge. Biological methods using microorganisms are having advantage due to their low cost; require less experimental setup, easy to perform and no production of sludge. The biotransformation by using microorganisms for the decolorization and degradation of textile dyes is an efficient method. The microorganisms are studied which are able to degrade the textile dyes and are very effective and less expensive option for the treatment of textile waste water(Casieri*et al.*,2008). However certain synthetic dyes are structurally difficult to degrade by microorganisms (Kuhad*et al.*, 2004). Generally microorganisms are able to degrade the azo dyes (Syed *et al.*, 2009). Hence for the decolorization of textile dyes it is necessary to screen the microbes and to optimise the decolorization in presence of different parameters such as effect of co-substrate, pH, temperature, inoculums size, dye concentration etc. (Zhang *et al.*, 2009). It has been studied that additional carbon and nitrogen sources are essential for growth of microorganisms and effective degradation of dyes (Jin *et al.*, 2006). It was studied that microorganisms are unable to utilize dyes as co-substrate due to toxic nature of dyes but still very few researchers found that some of bacterial cultures are able to utilize dyes as carbon and nitrogen source (Saranaik*et al.*,1999). The present research work deals with the effect of full strength nutrient and half strength nutrient broth and also effect of different carbon and nitrogen sources on the decolorization of textile dye Red ED3B by using 5 isolated

bacterial cultures and to find out the optimum co-substrate to increase the efficiency of decolorization.

II. MATERIALS AND METHODS

2.1 Collection of samples:

The soil and water samples were collected from the area near by waste disposal site of the textile industry and ETP along with compost. These samples were brought to laboratory in sterile polythene bags and bottles carefully.

2.2 Dye: Textile Azo dyeRed ED3B **(**λmax- 450 nm**).**

2.3 **Acclimatization of samples:**

The collected samples were mixed and homogenized properly. The microflora from the collected samples was acclimatized with increasing concentration of Red ED3B dye for about one month.

2.4 Isolation and screening of dye decolorizing bacterial cultures:

For the isolation of bacterial cultures, dilutions of acclimatized soil samples were prepared and spreaded over nutrient agar plates. The well grown, isolated colonies were further used for screening. The screening of dye decolorizing bacteria was carried out on nutrient media containing the dye Red ED3B (100 ppm). The colonies showing zone of clearance were used for further study.

2.5 Effect of different media on dye decolorization:

2.5.1 Decolorization of dye in nutrient broth:

The screened bacterial isolates were then inoculated in tubes having30 ml nutrient broth containing 100 ppm of the dye Red ED3B. Allthese tubes were then incubated at ambient temperature for 24 hours. After incubation the percent decolorization was determined by using spectrophotometer at itsλmax (450 nm).

2.5.2 Decolorization of dye in half strength nutrient broth:

To study the effect of half strength nutrient broth on dye decolorization,the isolated cultures were inoculated in 30 ml half strength nutrient broth containing 100 ppm of the dye Red ED3B. The tubes were then incubated at ambient temperature for 24 hours. After the incubation the percent decolorization was carried out by using spectrophotometer.

2.5.3 Decolorization of dye in presence of differentCarbon and Nitrogen sources:

The efficiency of dye decolorization in presence of different Carbon and Nitrogen sources was examined by inoculating the promising bacterial isolates in 30 ml sterile Minimal medium having 100 ppm of dye concentration and 1% of different Carbon and Nitrogen sources such as Glucose, Sucrose, Starch, Peptone, Yeast extract and Meat extract. The tubes were kept for incubation at ambient temperature for 24 hours. Decolorization was determined by spectrophotometer.

2.6 Percent decolorization studies:

The decolorization of dye Red ED3B by promising isolates within 24 hours was studied by percent decolorization studies. The decolorized samples were centrifuged at 10000 rpm for 20 minutes using cooling centrifuge to separate the cell mass. Percent decolorization was calculated by using spectrophotometer at max of the dye Red ED3B. The Percent decolorization was calculated by following formula.

$$\text{Percent Decolorization} = \frac{\text{Initial Absorbance - Final Absorbance}}{\text{Initial Absorbance}} \times 100$$

III. RESULTS

3.1 Isolation and screening of dye decolorizing bacterial cultures:

Total 15 bacterialisolates were isolated from acclimatized samples**.** All isolated bacterial cultures were individually screened for their ability of dye decolorization. Among all 5 isolates were showing maximum decolorization of the dye Red ED3B hence selected for further study.

3.2 Effect of different media on dye decolorization:

3.2.1 Percent decolorization of dye in nutrient broth:

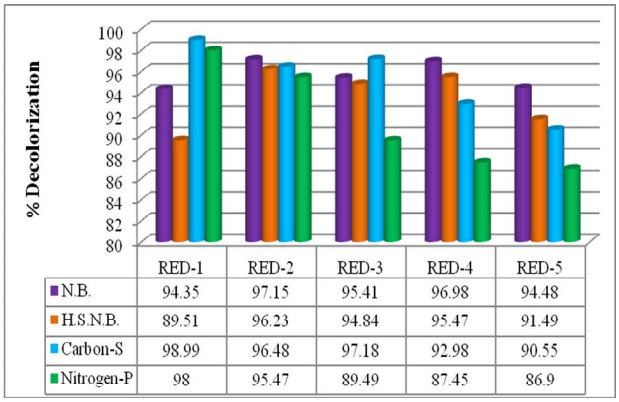
To study the percent decolorization in nutrient medium of dye Red ED3B, all the promising isolates were inoculated in nutrient broth containing one ml of100 ppm concentration of the dye. After incubation of 24 hours at ambient temperature the percent decolorization was studied. The results are shown in **Figure 1.**

3.2.2 Percent decolorization of the dye in half strength nutrient broth:

All the 5 promising isolates were inoculated in half strength nutrient broth containing100 ppm concentration of the dye to study the efficiency of these isolates to decolorize the dye Red ED3B in half strength nutrient medium. After the period of 24 hours incubation at room temperature the percent decolorization was carried out. The results are shown in **Figure 1.**

3.2.3 Decolorization of dye in presence of different Carbon and Nitrogen sources:

Various carbon and Nitrogen sources were added to carry out optimum decolorization of dye. It was observed that all promising isolates were able for highest dye decolorization when medium was added with Starch as Carbon source and Peptone as Nitrogen source. The results are shown in **Figure 1**



	RED-1	RED-2	RED-3	RED-4	RED-5
N.B.	94.35	97.15	95.41	96.98	94.48
H.S.N.B.	89.51	96.23	94.84	95.47	91.49
Carbon-S	98.99	96.48	97.18	92.98	90.55
Nitrogen-P	98	95.47	89.49	87.45	86.9

Figure-1:Effect of different media on decolourization of Red ED3B by promising isolates in 24 hours.

IV. DISCUSSION

It has been proved that microflora from dye contaminated or acclimatized soil is naturally resistant to the toxicity and chemicals (Khehra*et al.*, 2005). The isolation and screening of dye decolorizing bacteria was carried out by using nutrient medium containing 100 ppm concentration of the dye Red ED3B. After the incubation at ambient temperature for 24 hours the 5 isolates were showing maximum decolorization of the dye at pH 7.4, under static condition. Hence these 5 isolates (RED-1, RED-2, RED-3, RED-4and RED-5)were considered as promising isolates and were used for further study. The isolates showed decolorization of the dye in tubes containing nutrient medium. In the control tube there was no growth and no decolorization. It means that the decolorization was due to the growth and metabolism of the organism.

The present study reveals that promising isolates showed upto 94.35% decolorization in nutrient medium and about 89.51% decolorization in half strength nutrient broth. All the promising isolates exhibit the maximum decolorization (98.99%) in presence of the substrate 1% Starch (w/v) as carbon source.These results showed that bacterial isolates were successful in removal of dye in presence of starch substrate as carbon source. Rather few researchers studied that some species of microorganisms could able to utilize the azo dyes as sole carbon source. Azo dyes are deficient in carbon source so the decolorization carried only with metabolite condition (Chang *et al.*, 2004). All the promising isolates exhibit maximum decolorization (98%) when medium is added with 1% Peptone as nitrogen source as compare to Yeast extract and Meat extract. The previous study reveals that Peptone is an ideal source of nitrogen, in presence of which bacteria exhibit maximum decolorization of the dye (Praveen *et al.*,2012).

The present study exhibit that addition of 1% Starch could increases the percent decolorization. This was earlier suggested by Jang *et al.*,(2007). It was studied that addition of 0.1% of starch as carbon source increases the rate of decolorization of Ranocid fast blue dye (Chen *et al.*, 2003). The present research work suggest that the 5 promising bacterial isolates can be used for removal of dye Red ED3B from textile effluent.

V. CONCLUSION

All the 5 promising isolates are able to effectively decolorization of the dye Red ED3B in presence of nutrient medium. The percent decolorization was less in half strength nutrient broth but this method is less expensive. The percent decolorization increases after the addition of carbon and nitrogen sources as co-substrate. These isolates showed maximum decolorization of dye in presence of starch and Peptone as co-substrate. Hence these isolates can be used in bioremediation of textile effluent**.**

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