Research Article

Treatment of Textile Industry Effluents and Red CE Dye by *Amorphophallus paeonifolius* Crude Enzyme Extract

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ABSTRACT

Indian Population is involved in textile industries, it releases 3500 different dyes. These dyes directly or indirectly are discharged into the environment, which infects the groundwater posing a hazard to the health and socio-economic life of the people. Therefore, the treatment of textile effluents is essential. Enzymes from plants have been stated to play a significant role in textile wastewater treatment applications.The present study deals with the extraction of crude enzyme extracts from *A. paeoniifolius* corm and treatment of textile industry effluents and textile red dye with the help of extracted enzyme. The extracted crude enyme from *A. paeoniifolius* found to help in reducing the various textile water parameters like pH, BOD, DO, TDS, turbidity etc. After 24 hr of treatment by crude enzyme on textile wastewater BOD decreased 82.4%, DO (35.1%), TDS (17.80%), pH (32.70%) and turbidity by 12.24% whereas BOD (50%), DO (14.2%) pH (4.15%) and turbidity by 10% decreased of Red CE textile dye with same duration of treatment. The crude enzyme extract of *A. paeoniifolius* may offer an economical alternative to replace or supplement the treatment processes for the removal of dyes from wastewater effluents.

Keywords: Textile waste water, *A. paeoniifolius*, Crude Enzyme, BOD, DO.

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INTRODUCTION

Waste water treatment is a process which convert waste water into clean water that can be return to the environment for directly reuse. Three methods of waste water treatment are generally used i.e. physical, chemical and biological. Textile industry usually uses physiochemical process for waste water treatment. Physiochemical processes are adsorption, chemical oxidation, photodegradation, filtration, coagulation, but the uses of these process for treatment are limited because of its high cost.[1] The textile industries are very small in all developing country, these textile industry partially treat water and release to river, pond and lakes.[2]

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Textile industries nearly discharge10-15% of total waste to the environment.[3] The water release from textile industries are vastly poisonous for animals and plants.[4] The occurrence of dyes in the water body enhances the Chemical and Biological Oxygen Demand (COD and BOD).[5]

Therefore, there is a crucial requirement to develop a unique, effective, eco-friendly and efficient system in textile waste water treatment.Textile industries are facing all these problems like removal of coloring matter from effluent, hence an alternative method like to design modern biological treatment can be helpful.[6] Various biological method like phytoremediation, co-plantation, enzymatic treatment from plant source can be used as alternative for chemical methods. In last two periods, several enzymes have been explored for the handling of various textile industry effluent. Different kind of Plants can be effective alternative for waste water treatment. Plant material are useful in the polluted water with phenolic compound. Due to their ease in

application, the use of plant source is a viable option for treatment of contaminated water.[7] Studies showed that there are some useful plants like *Phyllanthus ninuri,*[8] *Typha angustifolia, Paspalum scrobiculatum, Salvinia molesta*[9] which also contains some enzyme which help in waste water treatment from the textile industries.

The enzymes such as peroxidases, secreted by the roots of the plant carry about the degeneration of dyes like malachite green, methyl orange and brilliant blue R.[5] Enzymes need not be adapted for the microbial cultures of the wastewater and also do not need a supply of nutrients for their development.[10] Waste water released from dye industry is highly colored and encompass organic compound, metals, salts that affects COD, BOD, TDS, TSS and pH. The textile dyes have been treated from different kinds of plants. Recycling of textile wastewater is necessary for restricting the amount of wastewater and expenses of production and advised for the protection of environment.[11]

The objective of our study is to assess the parameters of untreated effluents of textile water and dye Red CE and treatment of untreated effluent and Red dye CE with the help of *A. paeoniifolius* crude enzyme extract. *A. paeoniifolius* is commonly an underutilized crop also known as Jimikand and has several medicinal benefits.[12] This study will help in treatment of textile effluents by enzymes from new plant source and help to solve the environmental problems.

MATERIALS AND METHODS

Sample Collection

Sample was collected from Sky Lark, industry Surajpur, Greater Noida, India. Three sample i.e. untreated water, treated water and Red CE dye were collected. Parameters of textile water like BOD, DO, turbidity, pH, TDS were determined separately.

BOD Analysis

The Biochemical oxygen Demand of contaminated water is the measurement of amount of oxygen required for the decomposition of dissolved waste organic matter to occur under aerobic condition at standardized time and temperature.[13] For analysis of BOD water samples were collected without bubbling in 75ml glass bottles. 0.6 ml manganous sulphate and Alkali iodide solution were added at the bottom of the bottle with distinct pipettes and bottles were shake in the upside-down direction for at least six times. After shaking the bottles formation of brown precipitates were reported. After the settlement of precipitate, 1.2 ml of concentrated Sulphuric acid was added in all the stoppered bottle and all were mixed properly to dissolved the brown precipitates. Titration with thiosulphate solution was carried out with 5 ml solution till the color change to pale yellow. Drop of starch solution was added which resulted change the color of the contents from pale to blue. Again the titration with thiosulphate solution was carried out utill the disappearance of blue color. All the analysis was performed in triplicate (D1). Incubate the BOD Bottles at 27°C in BOD incubator for 3 days. Estimate the oxygen concentration in all the three incubated samples. Mean of the 3 reading (D2) were taken. D2 was calculated by applying the same formula after 3 days of incubation.

BOD = D1-D2 (mg/l)

D1 = Initial BOD of sample (mg/l)

D2 = BOD after 3 days incubation (mg/l)[13]

DO Analysis

The amount of dissolved oxygen is directly proportional to the titration of Iodine by thiosulphate solution.[13] DO of the water (mg/l) was calculate the by the formula:

D1 = (8*1000*N*v)/V

v = Volume of sample taken (ml), V=Volume of titrant,

N = Normality of titrant

8 = Constant

Turbidity Analysis

This examination was carried out with turbidity meter of Textile effluent and red CE dye.

pH Analysis

Textile effluent and dye Red CE measured by pH meter. 5ml sample of water was taken in glass tube for measurement of pH.

TDS Analysis

For TDS analysis 25 ml of sample was filtered through filter paper and shifted to the evaportaing dish on a water bath for proper evaporation. The total dissolved solids was determined as the residue left after evaporation of the filtered sample.[13] Calculation of TDS done by:

$$\text{mg total dissolved solids/L}((B-A)*1000)/\text{Sample Volume, mL}$$

B = weight of dried residue + weight of dish

A = weight of empty dish

Plant material and chemicals

Corms of *A. paeoniifolius* were procured from local vegetable market at Ghaziabad, Uttar Pradesh, India. Sodium thiosulphate, Manganous sulphate, Alkali iodide solution, Starch indicator, Sulfuric acid, Distilled water, filter paper, Sodium phosphate, Monosodium

phosphate were procured from CODON biotech Ltd., Noida.

Preparation of the crude enzyme extract

Amorphallus paeoniifolius corms were rinsed under running water, peeled and diced into small cubes of 4 mm, rinsed with distilled water and then stored at -20°C till further processing.[14] Corm were homogenized in 50 mM potassium phosphate buffer (pH 7) for 20 min at 8481 and 4°C. The supernatant was filtered through Whatman No.1 and kept at -20°C until required.

Treatment of untreated effluent and Red CE dye from crude enzyme extract (*A. paeoniifolius*)

For pH and turbidity analysis took 5ml of textile effluent and .5ml of crude enzyme and kept for 24 hr at room temperature, For TDS and TSS analysis untreated water effluent collected 22.5ml and crude enzyme 2.5ml kept for 24hr at room temperature. For BOD analysis untreated water collected 67.5ml and crude enzyme 7.5 ml kept for 24 hr. in room temperature. For pH and turbidity analysis took 5ml of textile Red CE .5ml of crude enzyme and kept for 24hr at room temperature, For TDS and TSS analysis of Red CE collected, 22.5ml and crude enzyme 2.5ml kept for 24hr. in room temperature. For BOD analysis untreated water collected 67.5ml and crude enzyme 7.5 ml kept for 24 hr at room temperature.

Decolorization studies of Untreated effluent and Red CE with *A. paeoniifolius* crude enzyme

Decolorization experiments were initially carried out in the crude enzyme extract with Textile effluent and Red CE before and after treatment for various parametrs like biochemical oxygen demand (BOD),Total Dissolved solid (TDS), Dissolved Oxygen (DO), Turbidity and pH before and after treatment with crude enzyme extract. All test were carried out in triplicate and average mean standards were determined.

RESULTS

All the samples were treated with crude enzyme extract and various waste water treatment parameters (pH, Turbidity, TDS, BOD, DO) were checked. The study carried out for 24 hr. For BOD taken 67.5 ml of untreated textile effluent treated with 7.5 ml of crude enzyme showed that biological oxygen demand decreases after 24 hr, For TDS, Dissolved oxygen, Turbidity and pH crude enzyme treatment for 24 hr decreases the toxicity level of untreated effluent and dye Red CE. Application of *A. paeoniifolius* crude enzyme extract on textile effluent and the red dye found to be effective in reducing the various textile water parameters such as pH, BOD, DO, TDS, turbidity etc. After 24 Hr of treatment by enzyme on textile wastewater BOD decreased 82.4%, DO (35.1%), TDS BY (17.80%), pH (32.70%) and turbidity by 12.24% whereas BOD by 50%, DO by 14.2% pH by 4.15% and turbidity by 10% decreased of Red CE textile dye with same duration of treatment. Results of Untreated textile effluent and Red CE before and after treatment with enzyme extract are shown in Table 1 and Table 2.

Visual color changes were also reported in the samples as shown in Figure 1 and 2, further these color changes need to be monitored with the help of spectrophotometer in terms in percent decolorization study.

DISCUSSION

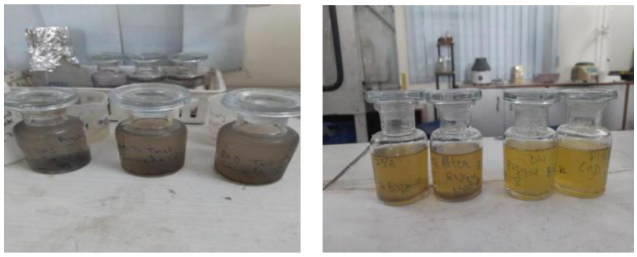
Plant sources contains enzymes these enzymes have potential to decolorize and degrade various pollutants.

Table 1: Parameters of Untreated effluent before and after treatment at lab scale.

Sl. No.	Parameters	Untreated water (Before treatment)	Untreated water (After treatment)
1	pH	10.55	7.1
2	Turbidity	0.49 NTU	0.43 NTU
3	TDS	1.46 mg/l	1.2mg/l
4	BOD	226.8mg/l	40mg/l
5	DO	Day 1 st-493 mg/l	Day 1 st-320mg/l

Table 2: Parameters of Red CE dye before and after treatment at lab scale.

Sl. No.	Parameters	Dye Red CE (Before treatment)	Dye Red CE (After treatment)
1	pH	6.26	6
2	Turbidity	0.07 NTU	0.05 NTU
3	TDS	4mg/l	3mg/l
4	BOD	80mg/l	40mg/l
5	DO	Day 1st-280 mg/l	Day 1 -240 mg/l



(a) (b)

Figure 1: a) Untreated effluent before treatment (b) Untreated effluent after treatment.

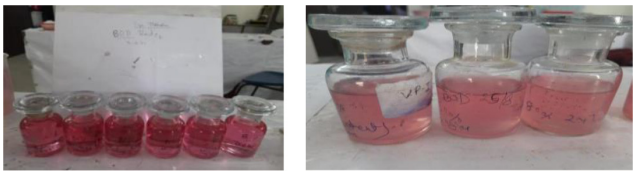


Figure 2: (a) Untreated Red CE dye before treatment (b) Untreated Red CE dye after treatment.

Enzymes like oxidoreductase, transferase, Hydrolases, Lignin mineralizing enzyme are used for waste water treatment.[15] The activity of peroxidase enzyme was also noted in *I.palmate*, *Saccharum spontaneum and P.australis* as an alternative method for dye removal.[16-17] In earlier study, *I. hederifolia* was also able to effectively treat a dye mixture and textile effluent redusing BOD up to 65 and 63% and COD up to 62 and 68%, with in 60 to 96 hr, respectively.[2] Within 96hr it was observed that *Typha angustifolia*, *Paspalum scrobiculatum* and their co-plantation (consortium-TP) reduced COD by 65, 63 and 70%, BOD by 68, 63 and 75%, TDS by 45, 39 and 57%, and TSS by 35, 31 and 47%, respectively.[5]

Plants such as *Typhonium flagelliforme, Blumea malcolmii* and *Phargmites australis* have been utilized for the treatment of textile industry effluent and have proven siginificant in BOD, TDS, COD, TSS removal.[18-19] Using 60±2 g of root biomass, *Salvinia molesta*, an aquatic fern was observed to have the ability of degrading azo dye Rubine GFL up to 97% at a concentration of 100 mg/L within 72 hr.[20] A lab-scale phytoreactor containing *P. grandiflora* was also found to be effective in reducing the levels of COD, BOD, TOC, turbidity, TDS, and TSS in textile effluents by 59, 38, 37, 41, 71, and 60%, respectively.[21] Crude enzyme extracts are preferred over pure enzymes because they are less expensive. In addition, crude enzyme extracts can effectively remove contaminants from trash.[22] Enzymes can convert a particularly obstinate pollutant into less hazardous compounds. It can be used to design cleanup methods that are less dangerous to the environment than traditional methods.[23] Plant-based techniques have traditionally demonstrated actual colour removal as well as significant reductions in environmentally important parameters such as COD and BOD.[24] Therefore plants and enzymes from plant shows significant reduction in the textile effluent treatment.

CONCLUSION

It is a well known fact that the dye and textile industries are one of the biggest industrial polluters along with a variety of other industrial categories. Treatment of textile effluent and dye from plant sources can be more effective. The crude enzyme extract showed the decolorization of textile effluent and Red CE dye. Use of *A. peoniifolius* source could be an extensive approach for advanced textile waste water clean –up program. The enzyme extracted from the corm decolorizes and degrade textile effluents at a laboratory scale. A crude enzyme from *A. paeoniifolius* will find application in the textile industry. Their adaptability and proficiency even in minor reaction conditions give them an improvement over the traditional physio-chemical treatment methods.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

TDS: Total Dissolved solid; **BOD:** Biochemical oxygen Demand; **COD:** Chemical Oxygen Demand; **DO:** Dissolved oxygen; **TSS:** Total suspended solids; **mg:** Milligram; **ml:** Milliliter; **hr:** Hours.

SUMMARY

Enzymes have been used in a variety of industries because of their enormous catalytic potential. Enzyme extract from *A. paeoniifolius* corm can be used in wastewater treatment to provide ecologically friendly remediation processes that are less aggressive than other chemical methods. So far no study is reported from *A. paeoniifolius* crude ezyme extract on treatment of waste water and textile dyes.

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