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Decolourising Efficiency of *Oscillatoria Subuliformis* With Coir Pith in Textile Dye Effluent

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ABSTRACT

Environmental pollution is one of the major problems of the world and its increasing day by day due to urbanization and industrialization. A study was carried out using marine cynobacterium Oscillatoria subuliformis with coir pith for the reduction of physiochemical parameters such as BOD, COD and simultaneous removal of heavy metals such as zinc, nickel, mercury , copper , chromium, iron, nitrogen, phosphorous , potassium, manganese in textile dye effluent. Improved results were obtained in combined treatment using O. subuliformis along with coir pith compared to control and other treatments. The treated effluent was used as foliar spray on the plant Tagetes erecta and various morphological parameters were studied.

KEYWORDS : Textile effluent, Cyanobacteria, heavy metals, decolourisation.

1. INTRODUCTION

Dyes are widely used in textile industries. The effluent which is released from the industries are mostly affect the environment and cause severe problem to the plants, animals and aquatic habitats and human beings. As synthetic dyes are relatively resistant to biodegradation, the elimination of colored effluents in waste water is based mainly on physical and chemical methods. Although these methods are effective, they suffer from short-comings such as high cost, formation of hazards by products and intensive energy requirements (Walker and Weatherly, 1997)

Microorganisms can act as the bioremediation agent to treat the waste water containing textile dyes (Chung et al., 1993, Ramalho et al 2002, 2004). Coir pith is one of the important wastes which are highly exposed into the environment due to the activation of coconut tree. It has a high lignin (31%) and cellulose (27%) content. The application of cyanobacteria have immerse potential in waste water, industrial effluent treatment, bioremediation of aquatic and terrestrial habitats, chemical industries, bio fertilizers (Malliga 1996; Malliga et al., 2012). This study presents use of cyanobacterium Oscillatoria subuliformis along with coir pith for bioremediation of textile wastewater and application in the growth of plant.

2. MATERIALS AND METHODS

2.1.Effluent collection:

The textile dye effluent used for this study was obtained from textile industry located at Karur district, Tamil Nadu, India.

2.2.Coir pith:

Coir pith was collected from coir pith industry in Sri rangam, Tiruchirapalli, Tamil Nadu, India.

2.3.Organism and source:

The marine cyanobacterium O. subuliformis was obtained from germplasm of National Facility for Marine Cyanobacteria (NFMC), Department of marine biotechnology, BDU, Tiruchirappalli, India and maintained in ASNIII medium with alternative illumination of 1500 lux with light/dark cycle of 14/10 hrs.

2.4.Experimental set up:

For individual treatments 0.6g dry weight of coir pith and 0.3g of wet weight O. subuliformis in 100 ml of textile dye effluent separately and in combined treatment both O. subuliformis and coir pith were inoculated together. These were incubated for 25 days. Physiochemical parameters, colour reduction and heavy metals were carried out during the study and culture filterate was applied on plant to compare morphological parameters.

2.5.Colour reduction:

Decolourization of textile dye effluent was determined by using the colorimeter at the absorbance of 580 nm.

2.6.Physio – chemical parameters:

The physico-chemical parameters were determined using analytical methods (APHA, 1998). The parameters such as OD, pH, Nitrate, Alkalinity, Calcium, Magnesium, Ammonia, chloride, sulphate, BOD and COD were estimated to analyze bioremediation efficiency of O. subuliformis with coir pith.

2.7.Estimation of heavy metals:

Heavy metals like Zinc, Cadmium, Nickel, Mercury, Copper and Chromium, iron and manganese were determined in the treated textile effluent supernatant (culture filtrate) obtained from the degradation process by AOAC, (2000).

2.8. Statistical analysis:

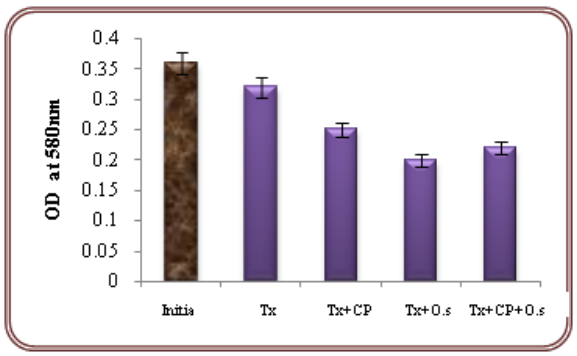
The effect on each parameter were studied in triplicate and the data are graphically presented as the mean ± S.D. of triplicates (n = 3) and all the graphs have been prepared using Microsoft Excel 2007.

3. RESULTS AND DISCUSSIONS

3.1. Estimation on colour reduction

Decolourising efficiency based on optical density reading was determined at the end of the 25th day treatment. Textile effluent control showed slight reduction in the colour change, whereas, it was decolourised more with cyanobacterium when compared with coir pith and combined treatment **(Fig. 1).**

Fig. 1. Effect on Color reduction in treated textile dye effluent using coir pith and Oscillatoria subuliformis on 25th day



TX= Textile effluent, CP= Coir pith, O.s = *Oscillatoria subuliformis*

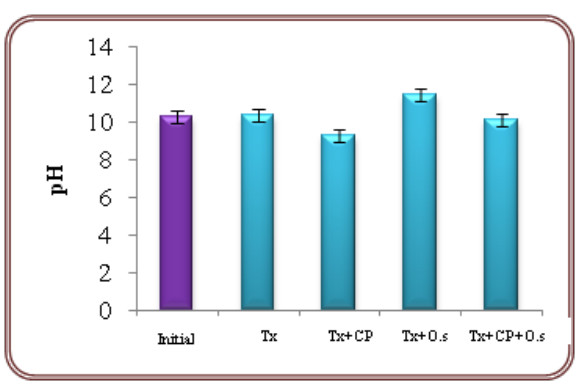
The adsorption of colored particles may involve different mechanisms like active metabolism, passive transport or diffusion of adsorbed solute to the surface of the microbial cell (O' Mahong et al., 2002; Asku and Tezer 2000; Veglio and Beolchini, 1997).

Marine cyanobacterium Lyngbya sp. along with coir pith renders the properties such as adsorption of particles present in the dye, decolourisation of dye and degradation of coir pith (Jenny and Malliga, 2013).

3.2. Effect on pH

The initial pH of the textile dye effluent was alkaline which was slightly reduced with coir pith treatment followed by combined treatment but increased with all cyanobacterial treatments **(Fig. 2).**

Fig. 2. Effect on pH in treated textile dye effluent using coir pith and Oscillatoria subuliformis on 25th day



Safia Moosvi, (2005) reported that the coir pith has an ability to reduce the pH was decreased from alkaline to acidic level. Supporting evidence showed that the adsorbent of congo red by coir pith carbon was carried out under acidic pH and the adsorption capacity was found to be 6.7 mg dye per g of the adsorbent. Decolourization of acidic blue 113 at various pH values by Bacillus subtilis showed that increase in pH from 5 to 7 while the decolourization rate value decreased as pH was increased, further, from 7 to 8. Supporting evidence showed that the Phromidium could remove more than 90% textile dyes acid red 119 and direct black 115 from the solution in the pH range higher than pH 11 (Shah et al., 2001).

3.3. Estimation of physio chemical parameters in treated effluent

There were not much transformation in physio chemical parameters in textile effluent control on 25th day, while coir pith treated effluent showed minor reduction in parameters such as Sulphate, Nitrate, Calcium, Magnesium, BOD and COD followed by cyanobacterial and combined treatment, whereas, major increase in parameters like Alkalinity, chloride and ammonia were noticed with all other treatment **(Fig. 3-8).** Some physiochemical parameters exhibited reduction on 25th day significantly with the Oscillatoria sp., as well as O. Subuliformis with coir pith treatment when compared to coir pith treatment alone. This can be mainly due to the intake of nutrients present in the textile by the cyanobacterium and the adsorption capacity of coir pith.

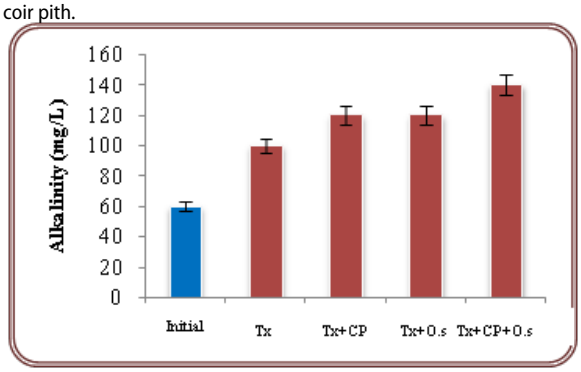


Fig. 3. Effect on Alkalinity in treated textile dye effluent using coir pith and Oscillatoria subuliformis on 25th day

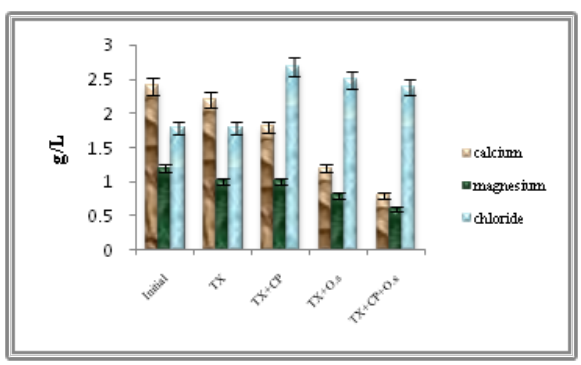


Fig. 4. Effect on biochemical parametres in treated textile dye effluent using coir pith dye and Oscillatoria subuliformis on 25th day

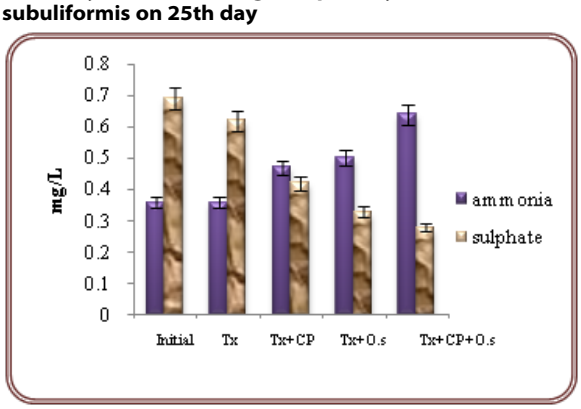


Fig. 5. Effect on ammonia and sulphate in treated textile dye effluent using coir pith and Oscillatoria subuliformis on 25th day

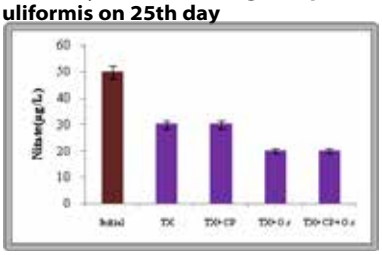
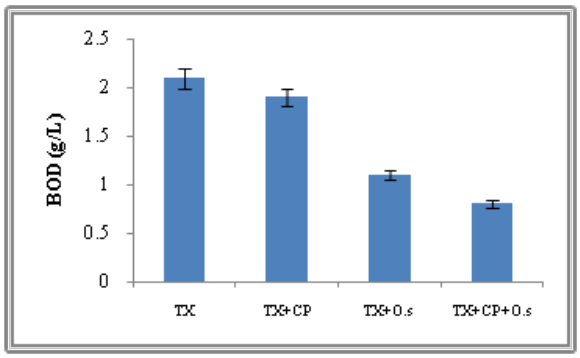


Fig. 6. Effect on Nitrate in treated textile dye effluent using coir pith and Oscillatoria subuliformis



on 25th day

Fig.7. Effect on Biological oxygen demand in treated textile dye effluent using coir pith and Oscillatoria subuliformis on 25th day

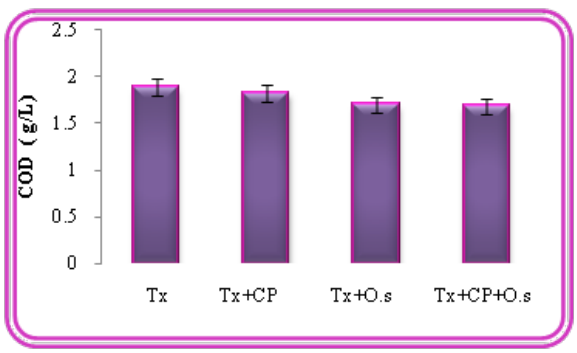


Fig. 8. Effect of Chemical oxygen demand in treated textile dye effluent using coir pith and *Oscillatoria subuliformis* on 25th day

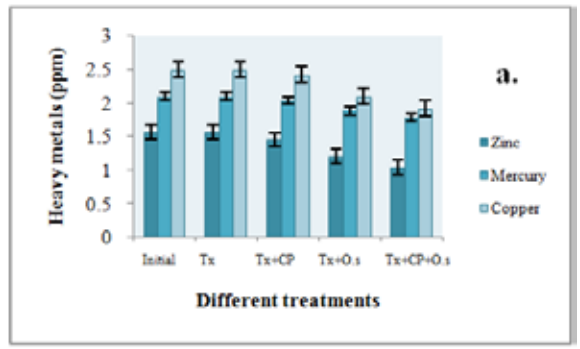
Evidence given by Sonil et al, (2010) also states that the calcium content was decreased when employed for the bioremediation of paper mill effluent. Similarly, magnesium content was found to be low in the physio chemical analysis of textile dye (Henciya et al., 2013). The coagulation/flocculation treatment of coir pith using sulphate was evaluated for the removal of organic compounds and colour from synthetic effluents stimulating the cotton, acrylic and polyster dyeing wastewater (Garg and Kaushik, 2007). Thus, the alkaline content was reduced when the textile efflent was treated with cyanobacterium. In high rate algal ponds treating rubber effluent with Chlorella the reduction of COD ranged from 78% to 96% (Phang et al., 2001).

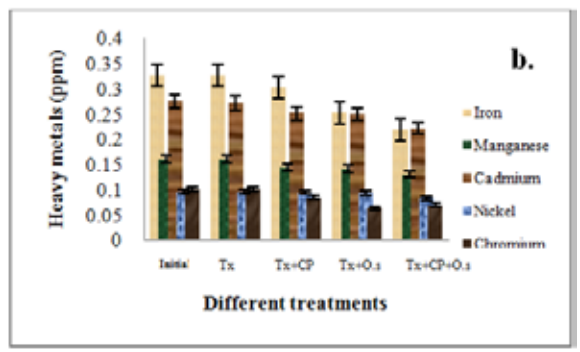
3.4. Estimation of heavy metals

Heavy metals such as Zinc, Mercury, Copper, Iron, Manganese, Cadmium, Nickel and Cadmium (Fig. 9.a and 9.b) were estimated from treated culture filtrate obtained after treatment. Maximum removal was found to be with the combined treatment of textile with Oscillatoria subuliformis and coir pith when compared to all other treatment. This accentuates the effectiveness of combined treatment concentrating heavy metals from wastewater. Also, O. subuliformis provides binding site for the compression of the heavy metals facilitating adsorption proceed and similar result was obtained by Gong et al, (2005). Parallel results were obtained by Nandhini et al, (2014) which emphasizes the role of Lyngbya sp. along with ground nut shell in removal of heavy metals from the textile effluent.

Addition of coir pith stimulates the redox reaction and improves the adsorption of particles at the surface (Shanmugapriya et al., 2013). The mechanism of up-taking heavy metal ions can take place by metabolism-independent metal-binding to the cell walls and external surfaces (Deliyanni et al., 2007).

Fig. 9. Effect on heavy metals in treated textile dye effluent using coir pith and Oscillatoria subuliformis on 25th day

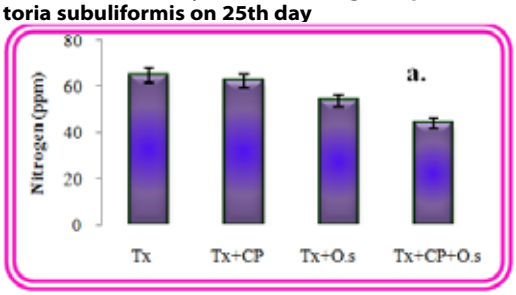


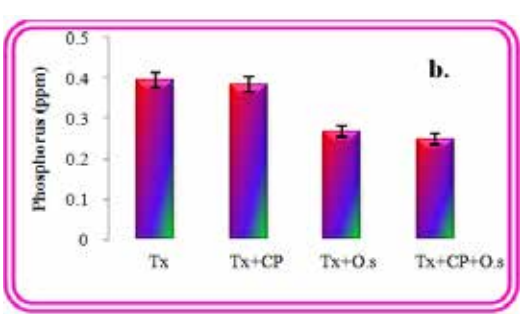


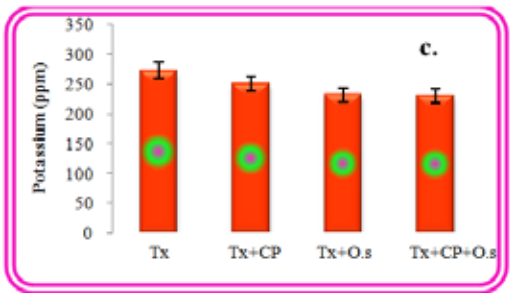
3.5. Estimation of NPK (Nitrogen, Phosphorus, Potassium)

NPK are very important sources for agricultural purpose. A typical NPK fertilizers have a composition of 8% Nitrogen, 8% Phosphorous, 8% potassium. It may be difficult to achieve those levels of nutrients. From the results of NPK it was observed that the textile effluent definitely had certain fertilizer values (Asia et al, 2006). In the current study the level of dissolved nitrogen, phosphorus and potassium were analyzed in the treated effluent. The level of nitrogen, phosphorus and potassium contents were found to be decreased in the combined treatment (Fig 10.a, 10.b, 10.c). This can be explained as intake of these nutrients present in textile by the cyanobacterium for their growth and also adsorption of some particles by coir pith.

Fig. 10. Effect on Nitrogen, Phosphorus and Potassium in treated textile dye effluent using coir pith and Oscillatoria subuliformis on 25th day



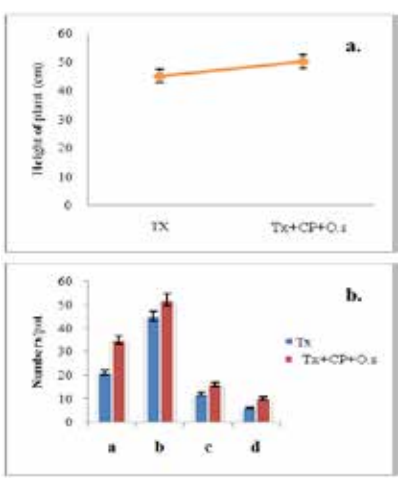




3.6. Plant morphological analysis

Plant growth parameters such as height of the plant, number of leaves, branches, buds and flowers were analyzed with untreated and treated textile effluent on Tagetes erecta. The results demonstrated that treated textile effluent with coir pith and cyanobacterium showed promotive effect on all morphological parameters. However, untreated textile effluent too did not illustrate much inhibitory effect **(Fig. 11a, 11.b).** Nevertheless, the difference can be explained as the presence of heavy metals in untreated effluent which directly influenced the morphology of the plant when compared to treated effluent where the concentration of heavy metals were reduced and nutrient status was uplifted.

Fig. 11. Effect on morphological parametres of plant with untreated and treated effluent



a-number of leaves, b- number of branches, c- number of buds, d- number of flowers

Literature reveals that micronutrients found in waste water may be beneficial for plant growth but several micronutrients which are heavy metals may produce undesirable effects on plants at higher concentration. (Kocak *et al*, 2005).

CONCLUSION

In this study, three treatments were carried out to reduce the pollutant in the effluent. The treatment methods are cyanobacterium, coir pith as individual treatments and combination of cyanobacterium with coir pith as combined treatment. Coir pith is an important and economically useful in decolorization of effluent and it also acts as a good adsorbent. Cyanobacterium, otherwise called as blue-green algae and it has an ability to reduce pollution load in textile industry waste water. The above study confirmed that the combined application of coir pith and cyanobacterium showed the better result compare to coir pith and cyanobacterium in individual treatment. Physiochemical parameters and heavy metals were also reduced in combined treatment.

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