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Biodegradation of Congo red Dye by the Mushroom *Tricholoma* Species

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Abstract: **The increasing use of synthetic dyes is alarming and their discharge as textile waste may cause substantial ecological damage. Biological decolorization of dye using microorganisms is an environmental friendly, cost-competitive and an alternate to chemical methods. This study involves in decolorization and biodegradation of Congo red dye using *Tricholoma* sp. a common fungus. This azo dye is a major constituent present in most of the textile mill. The fungal mycelia grown in nutrient-rich and poor liquid mediums were used to biodegrade Congo red dye. The results indicate the capacity of the mushroom, *Tricholoma* sp. to biodegrade Congo red dye in nutrient rich medium, in a dye concentration of 1.10-5 Mol.dm-3, with the best results obtained at pH of 6.5.**

***Keywords: Tricholoma*, Congo red, Biodegradation, Dye decolonization.**

1. INTRODUTION

Tricholoma sp. (Tricholomaceae) are white rot, edible fungus industrially cultivated for food production due to its nutritional qualities and immune – stimulating medicinal properties. Since they have efficient enzymatic machinery, they are used in bio-pulping and pulp bleaching, recycling of agricultural wastes and bioremediation. *Tricholoma* sp. is used in biotechnological processes of bioconversion and bioremediation, such as the fungal degradation of chlorinated monoaromatics and BTEX compounds (Buswell, J. A 2001), xenobiotic compounds (Morgan *et al.*, 1991), in the purification of air, water and soil (Miles *et al.*, 1997, Reid *et al.*, 2002).

Another application is the biodegradation of industrial effluents such as dyes. A large number of dyes are released for consumption, including red 40. Although the risks posed by red 40 are unknown and its use is forbidden in some countries, this dye is widely utilized. The possible risk to humans that ingest food containing dyes can be extended to the environment, for factories discharge their residues into nearby rivers and streams (Bontempo, 1985). This work involved an investigation of the use of the mushroom *Tricholoma* sp. in the degradation of Congo red dye, a possible alternative in the treatment of industrial effluents.

2. MATERIALS AND METHODS

Culture collection:

The culture of *Tricholoma* species were obtained from S.D.N.B. Vaishnav College for Women, Chrompet-44 (Plate 1). The cultures were grown under aseptic condition in Potato dextrose agar (PDA) and incubated at 25±1ºC for optimal mycelial growth. This mycelium was used for further studies.

PLATE-1

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a. Habit of *Tricholoma* sp.

b. culture of Tricoloma sp.

Congo red dye:

Congo red is the sodium salt of benzidinediazo-bis-1-naphthylamine-4-sulfonic acid (formula: $C_{32}H_{22}N_6Na_2O_6S_2$; molecular weight: 696.66 g/mol). It is a secondary diazo dye. Congo red is water soluble, yielding a red colloidal solution, its solubility is better in organic solvents such as ethanol. It has a strong non-covalent affinity to cellulose fibres. However, the use of Congo red in the cellulose industries (cotton textile, wood pulp & paper) has long been abandoned, primarily because of its tendency to change colour and its toxicity.

Degradation of the dye was investigated both in nutrient rich Mushroom Complete Medium liquid medium (20g of Glucose) and Nutrient-poor Mushroom Complete Medium (10g of Glucose) according to the method of Heinfling *et al.,* (1998). The mycelium was grown in a rotary shaker at 120 rpm for eight days at 28°C, with an average of 1.58 grams (wet weight) of mycelium inoculated for every 100 ml of culture medium, to which 1.10-5 Mol.dm-3 of Congo red dye was added. An evaluation was also made by the degradation of mycelium cultivated in a nutrient poor liquid medium, to which 1.10-5 Mol.dm-3 of Congo red dye was likewise added. The only control used here was culture medium (pH 4.5). The degradation experiment with the nutrient-poor medium and nutrient rich medium (10g and 20g of Glucose) was noted during the third, fifth, and seventh days of incubation the dye degradation was analysed using a spectrophotometer at 330 nm wavelength.

3. RESULTS AND DISCUSSION

In this experiment, nutrient rich medium and nutrient poor medium, the mycelium was found to degrade the Congo red dye. The mycelium grown in Nutrient rich medium showed more degradation of dye on fourth day this was followed by third and second day (Fig. 2). The mycelium grown in Nutrient poor medium showed more degradation of dye on fourth day this was followed by third and second day (Plate 2, 3 & 4) (Fig. 1). When compared to Nutrient poor medium, the Nutrient rich medium showed more degradation on second, third and fourth day. An identical result was observed in *P. Florida* to biodegrade gossypol (Rajarathnam *et al.,2001*) and the cultivation of mushrooms in liquid medium has also been found to increase biodegradation, for it favours hexosamine and laccase activity. The experiment conducted to assess the mycelium's efficiency in nutrient-poor medium showed satisfactory result (Fig.2).

Therefore, the present study focused to prove the ability of *Tricholoma* sp. to degrade Cong red dye, probably as a result of the activity of the mushroom's enzymatic complex. *Aspergillus niger* (C28B25), pectinase hyper producing mutants were used for solid state fermentation on coffee pulp (Antier et al., 1993). Degradation of environmental pollutants by *Phanerochaete chrysosporium* was reported by Aust S. D**. (**1990). Screening for ligninolytic fungi which is applicable to the biodegradation of xenobiotics was carried out by Field *et al.,* (1993).

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PLATE-2

a **b**

A. Mycelium of *Tricholoma* sp. after 8 days in Mushroom Complete Medium with a. 10g of glucose and b. 20g of glucose

a **b**

B. Mycelium of *Tricholoma* sp. after 8 days with Congo red dye in Mushroom Complete Medium with a. 10g of glucose and b. 20g of glucose

PLATE-3

a **b**

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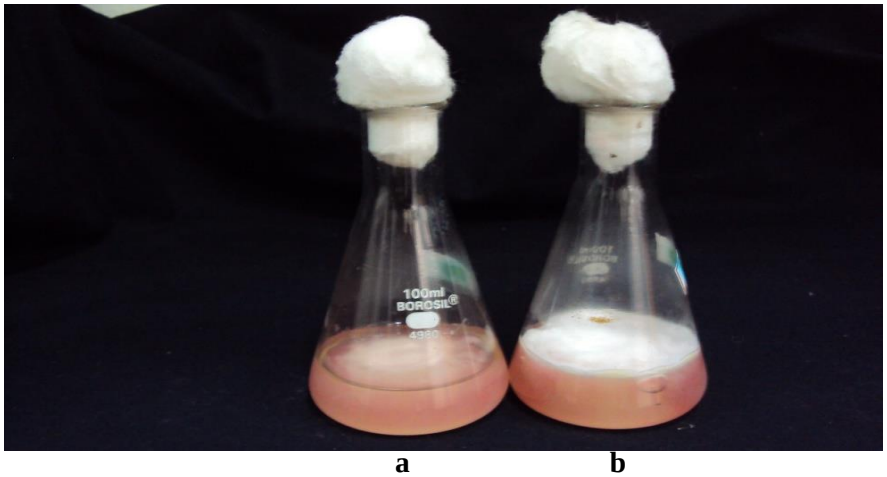
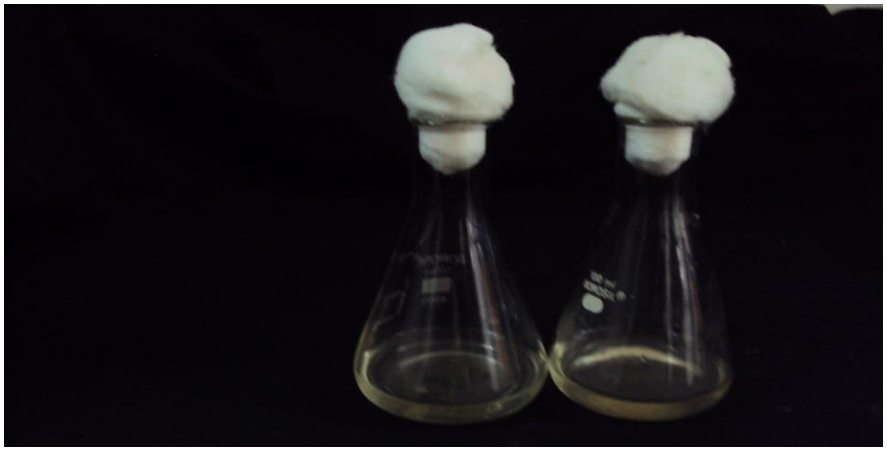
A. Mycelium of *Tricholoma* sp. after 2 days Incubation with Congo red dye in Mushroom Complete Medium with a. 10g of glucose and b. 20g of glucose

PLATE-4



a **b**

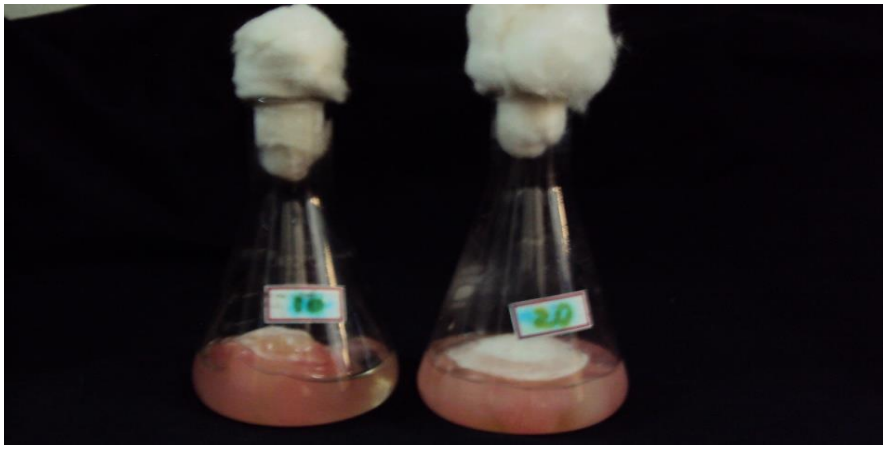
A. Mycelium of *Tricholoma* sp. after 3 days of Incubation with Congo red dye in Mushroom Complete Medium with a. 10g of glucose and b. 20g of gluco**se**



a **b**

B. Congo red dye added mycelial filtrate of *Tricholoma* sp. after 3 days in Mushroom Complete Medium with a. 10g of Glucose and b. 20g of glucose

PLATE-5



a **b**

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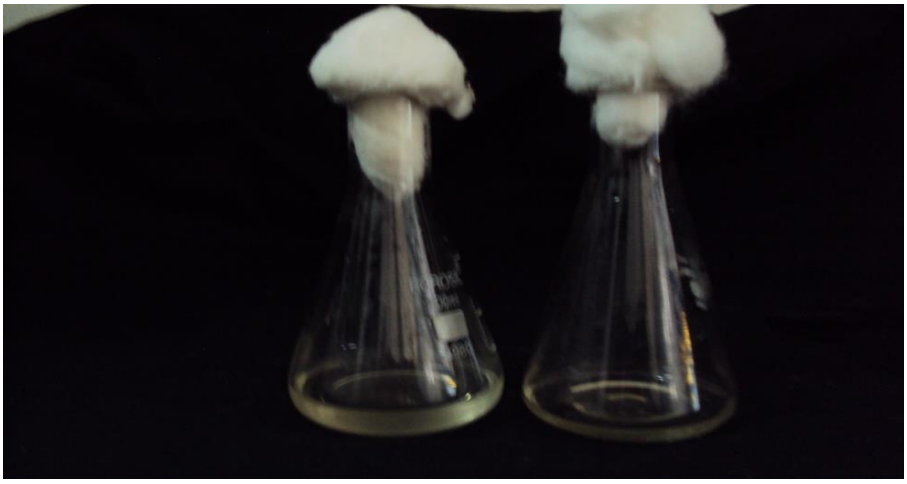
A. Mycelium of *Tricholoma* sp. after 4 days of Incubation with Congo red dye in Mushroom Complete Medium with a. 10g of glucose and b. 20g of glucose



a **b**

B.Congo red dye added mycelial filtrate of *Tricholoma* sp. after 4 days of Incubation in Mushroom Complete Medium with a. 10g of Glucose and b. 20g of glucose

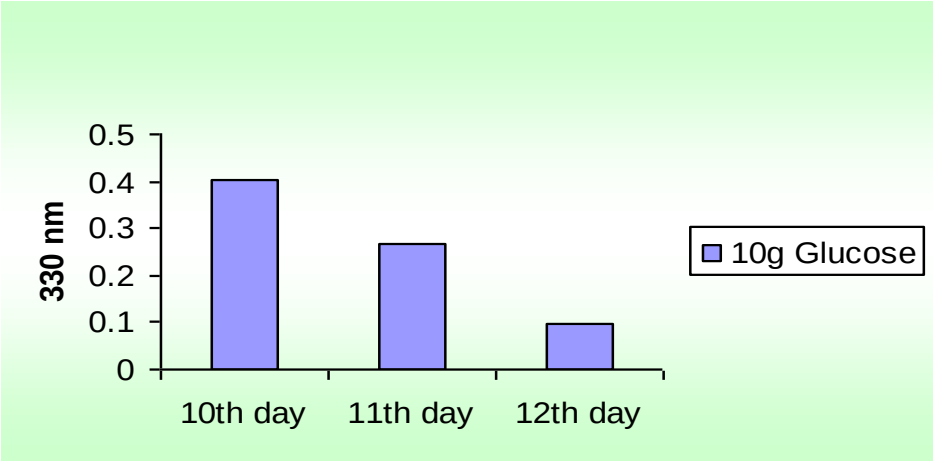


Figure 1. Degradation measured in absorbance (nm) of dye in a Mushroom complete medium containing 10g of Glucose

Figure 2. Degradation measured in absorbance (nm) of dye in a Mushroom complete medium containing 20g of Glucose

In summary, the results reported here indicate the capacity of the mushroom, *Tricholoma* sp. to biodegrade Congo red dye in nutrient rich medium, in a dye concentration of 1.10-5 Mol.dm-3, with the best results obtained at a pH of 6.5.

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REFERENCES

[1] P. Antier, A. Minjares , S. Roussos , M. Raimbault, and G. Viniegra-Gonzáles. Pectinase hyper producing mutants of AspergillusnigerC28B25 for solid state fermentation on coffee pulp. Enzyme and Microbial Technology Vol.15, p. 254-260, 1993.

[2] S. Aust. Degradation of environmental pollutants by Phanerochaetechrysosporium. Microbial Ecology Vol. 20, p.197-209, 1990.

[3] M. Bontempo. InRelató.rio Orion, L & PM Editores. Lt da, São Paulo, p. 35-42, 1985.

[4] J.A. Buswell. Fungal degradation of chlorinated monoaromatics and BTEX compounds. In Fungi in Bioremediation, ed. G. M. Gadd. Cambridge: Cambridge University Press, p. 113-135, 2001.

[5] J.A. Field, E. De Jog, G. F. Feijoo-Costa, and J. A. M. De Bont,. Screening for ligninolytic fungi applicable to the biodegradation of xenobiotics. TIBTECH, Vol.11, p. 44-49, 1993.

[6] A. Heinfling, M. J. Martínez, A. T. Martínez, M. Bergbauer, and U. Szewzyk. Transformation of Industrial Dyes by Manganese Peroxidases from Jerkanderaa dusta and Pleurotus eryngi iin a Manganes e-Independent Reaction. Applied and Environmental Microbiology Vol. 64, p. 2788-2793, 1998.

[7] P. G. Miles, and S. T. Chang. Mushroom biology: concise basics and current developments. Singapore: World Scientific, p.194, 1997.

[8] P. Morgan, S. T. Lewis and R.J. Watkinson. Comparison of abilities of white-rot fungi to mineralize selected xenobiotic compounds. Applied Environmental Microbiology Vol. 34,p. 693-696, 1991.

[9] S .Rajarathnam, M. N. Shashirekha and Z. Bano. Biodegradation of gossypol by the white oyster mushroom, Pleurotus florida, during culturing on rice straw growth substrate, supplemented with cotton seed powder. World Journal of Microbiology and Biotechnology Vol. 17, p. 221-227, 2001.

[10] B. J. Reid, T. R. Fermor, and K. T. Semple.Induction of PAH-catabolism in mushroom compost and its use in the biodegradation of soil-associated phenanthrene. Environmental Pollution Vol. 118, p. 65-73, 2002.