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BIODEGRADATION OF TEXTILE DYES, MALACHITE GREEN AND CONGO RED BY FUNGI AND BACTERIA

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Abstract:
In the present study, there is estimation of extent of biodegradation of textile dyes viz. malachite green and congo red by using fungi and bacteria. Pure cultures of bacteria and fungi were maintained by subsequent sub culturing. It has long been reported that bacteria inhabits in industrial effluents utilizing its constituents as their source of energy. These bacteria are of indigenous type and the dye effluent serves as their source of nutrients. Textile dye effluent harbor a wide range of bacterial species that may even degrade the dyes to obtain their essential elements.Screening of the bacterial isolates was performed to figure out the isolate capable of degrading textile dyes namely Congo red and malachite green in media containing respective dye. Notably, only 2 bacterial strains capable of decolorizing the majority of dyes up to 60% were screened and considered as potential candidates.
Keywords: Biodegradation, textile dyes, malachite green, congo red, elements screening.

Introduction

Rapidity of industrialization and urbanization around the world has lead to the recognition and understanding of relationship between environmental pollution and public health. While, the pollution triggered by the human activities becomes the top most challenge for modern civilization. Among the most concerned environmental pollutions that threatening our biodiversity, water pollution are a major one where effluents from dye-based industries serve as principal source.The structures of azo dyes consists coupling of diazotized amine with either an amine or a phenol and also contain azo Linkage. Most of these dyes are potentially toxic to aquatic life and some are even carcinogenic and mutagenic to humans. Furthermore, color of the dyestuff interrupts the aquatic environment by reducing light penetration, gas solubility and Interference of phytoplankton's photosynthesis.

Methods like chemical precipitation, adsorption and flocculation have substantial disadvantages, which include complex structural set-up, huge chemical and power consumption and formation of a large volume of Sludge. Apparently, the development of novel biological decolourization system consisting This study attempts to isolate and identify bacterial strains possessing strong dye-decolorizing capacity, which can be potential candidate agent for the remediation of textile dye effluent.The purpose of this work is to review the chemical engineering principles, which should be applied during the research and transfer of dye bioremediation technologies to a large scale

Bacterial degradation of these dyes was carried out by their intracellular uptake while the fungi degrade these by extra cellular enzymes. The organisms used in most of the study were *Staphylococcus* sp., *E.coli*, *Bacillus* sp., *Clostridium* sp., *and Pseudomonas* Sp.

Materials and methods:

Materials:

Dyes used:

Dyes were purchased from Himedia laboratories (Mumbai)

Congo red and malachite green

Organisms used:

Proteus vulgaris, Staphylococcus aureus, Klebsiella pneumoniae,
Aspergillus niger, Candida albicans.

Medium:

Nutrient Agar, Nutrient Broth, Potato Dextrose Agar ,Potato dextrose broth

Apparatus (Borosil)

Petri plates,Conical flasks,Testubes,Testubes stand,Beakers,Pipettes,Ph paper
Volumetric flask,Inoculating needle.

Methods

1.Collection of effluent samples.

2. Maintenance of pure cultures: Maintenance of pure cultures was done by frequent sub culturing with respective time period in nutrient broth and nutrient agar.

3. Screening of Dye-Decolorizing Bacteria and fungi in solid media: Nutrient agar and PDA containing respective dyes at different concentrations were prepared as per the composition Effluent samples were enriched by co-incubating in nutrient agar containing different concentration of each dye . A minute

volume (0.01 ml) of each enrichment culture was plated onto nutrient agar medium supplemented respective dye.

After incubation ,the resulting bacterial colonies and fungi exhibiting clear zone round them .

4. Screening of Dye-Decolorizing Bacteria and fungi in liquid media:

Nutrient broth and potato dextrose broth Containing respective dyes at different concentrations were prepared as per the composition

5. Dye Decolourization Assay: Following incubation,Centrifuge at about 2000 rpm for 15 min is carried. The optical density of supernatant was then estimated colorimetrically at 520-540 nm for Congo red and at 616 nm for malachite green and % of dye degradation was then estimated by following formula:

Decolorisation (%) = (Ai-At)/ Ai*100,

Where, Ai = O.D of control

At = O.D of test

Results:

Table no.1. % decolorization of Malachite green and Congo red at *0.01 %* concentration.

Organisms	%decolorization of Malachite green.	%decolorization of Congo red.
P. vulgaris	63.66	3.79
S.aureus	30.33	1.26
K.pneumonia	97.0	62.02
A. niger	70.37	90.16
C.albicans	1.56	3.27

Table no.2: %decolorization of Malachite green and Congo red at *0.05 %* concentration

Organisms	%decolorization of Malachite green.	%decolorization of Congo red.
P. vulgaris	3.0	1.56
S.aureus	11.0	3.12
K.pneumonia	3.0	4.68
A. niger	91.3	50.81
C.albicans	0.0	1.56

Table no.3 %decolorization of Malachite green and Congo red at *0.1 %* concentration

Organisms	%decolorization of Malachite green.	%decolorization of Congo red.
P. vulgaris	25.0	4.76
S.aureus	50.0	1.58
K.pneumonia	6.33	0.00
A. niger	63.63	82.0
C.albicans	4.54	4.0

Table no.4 %decolorization of Malachite green and Congo red at unknown concentration (industrial effluent)

Organisms	%decolorization of Malachite green.	%decolorization of Congo red.
P. vulgaris	50	6.06
S.aureus	0.0	3.03
K.pneumonia	66.66	13.63
A. niger	52.94	0.78
C.albicans	1.13	0.0

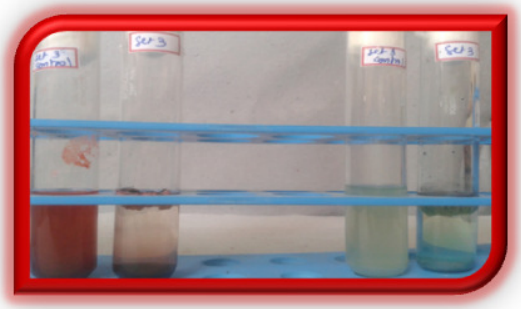

Figure 1. Dye degradation by *A. niger* at 1% concentration indicating in the fig. (left showing Congo red and right malachite green)

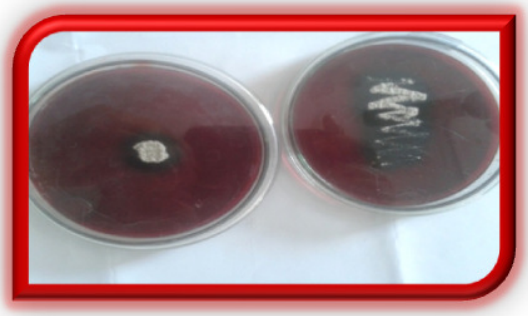

Figure 2. Dye degradation by *A. niger* at 1% concentration in Congo red.

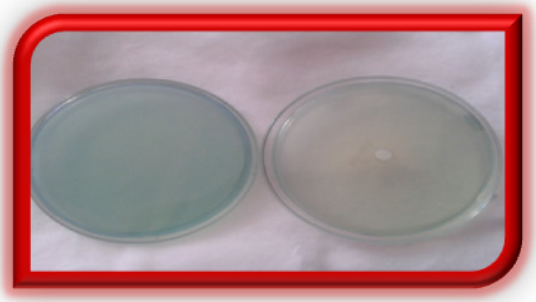

Figure 3. Degradation of malachite green by *P.vulgaris*

Discussion:

Screening of the bacterial isolates was performed to figure out the isolate capable of degrading textile dyes namely Congo red and malachite green in media containing respective dye. Notably, only 3 bacterial strains capable of decolorizing the majority of dyes up to 60% were screened and considered as potential candidates. In the present study, results for dyes degradation/decolorization/precipitation by *A.niger* were observed.

Adsorption of dyes to the microbial cell surface is the primary mechanism of decolourization (Knapp *et al.*, 1995). In our study, the adsorption of dyes by the fungal Mycelium was also observed, as it was confirmed by the change in the color of fungal mycelium in tested dyes. Extracellular enzymes, such as Laccase, are produced by fungal strain, like *Aspergillus* .Breakdown of most of organo-pollutants by fungi is closely linked with ligninolytic metabolism.

Decolourization of dye is related to the process of extracellular oxidases, particularly manganese peroxidases (Gold *et al.*, 1988). Liginin peroxidase (Lip), manganese dependant peroxidase (Mnp) and Laccase, all of which are involved in lignin degradation, have been reported to decolorize dyes. In the present study, the degradation and decolourization of tested dyes by *A. niger* appeared to be due to the production of extracellular enzymes by this fungus in the dye-containing medium. It is quite clear that the change in color might be due to the biochemical (metabolic) reactions of fungal strain.

The fungal strain used in the present study was responsible for biodegradation/decolourization of textile dyes, and it was also responsible for change in dye color from reddish to a light color ring around the mycelium.

Conclusion:

Result showed the textile effluents containing Congo red and Malachite green are very effectively decolorized by *A.niger* within 24hours. Moreover, the strains which are pathogenic in nature, their gene of interest can be used for dye degradation by **recombination DNA technology**.

K.pneumonia and *A.niger* can be used as excellent bioagents for bioremediation of textile dyes containing Congo red and Malachite green after reducing their pathogenicity.

Other bacteria which are pathogenic in nature can be treated first for reducing pathogenicity and can be used as dye decoloring agents.

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