

BIODEGRADATION OF TANNERY EFFLUENT AND ITS IMPACT ON SEED GERMINATION OF *ORYZA SATIVA*

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ABSTRACT

Environmental pollution, especially of water bodies, is one of the major problems and it is increased day by day. The contamination of environment with various toxic metals is a serious threat for ecosystem and human health. Industrial effluents may contain toxic metals, harmful volatile compounds and several organic and inorganic compounds such as chromium, cadmium, mercury, arsenic and lead which are directly or indirectly discharged into the environment without adequate treatment. However, tannery industries are the major source of chromium contamination into the environment. Tanneries are typically characterized as pollution intensive industrial complexes which generate widely varying, high-strength wastewaters. The discharge of these toxic effluents has been a major loss from the ecological, social and economic perspective. There are many conventional physiochemical methods available for the removal of heavy metals from the tannery effluents that are highly expensive and require skilled techniques. However, microbial reduction of toxic chromium to non-toxic chromium by chromium resistance microorganism is the most pragmatic approach that offers an economical as well as eco-friendly process. Hence, this study examines the biodegradation of tannery effluent and its impacts on the germination of *Oryza sativa* seeds.

Keywords: *tannery effluent, heavy metals, pollution, biodegradation, seed germination*

INTRODUCTION

Disposal of waste water from industries is one of the major problems and almost all surrounding area is polluted by these industries [1]. Industries discharge a variety of pollutants in their wastewater including heavy metals, resin pellets, organic toxins, oils, nutrient and solids. Many of the tanneries have poor

environmental controls and pose a threat to the environment [2]. Discharge of tannery wastewater into water bodies is not safe because it creates harmful effects to aquatic ecosystems and also the people residing in these industries [3]. Most of the industries pollute different water bodies such as lakes, rivers, oceans and ground water [4]. Therefore, these effluents can be properly treated using

bacterial consortium that can be suitable for irrigation purposes because the physicochemical parameters were found to be relatively high in untreated tannery effluent that severely affect the plant health [5]. Generally, the effects of tannery effluent on germination and growth performance showed that effluent was not fit for irrigation due to higher concentration of organic and inorganic matter and heavy metal contents. The tannery effluent cannot be used for irrigation purposes without proper treatment [6]. Hence, this study aimed to treat tannery effluent by biological methods and to study its impact on seed germination of *Oryza sativa*.

EXPERIMENTAL

Sample collection

The effluent sample was collected from the tannery industry, near Dindugal district, Tamil Nadu, India. The sample was collected in a sterile container and stored in a refrigerator for further studies.

Analysis of physicochemical parameters

The physicochemical parameters of the tannery effluent such as colour, pH, total solids (TS), total suspended solids (TSS), total dissolved solids (TDS), biological oxygen demand (BOD), chemical oxygen demand (COD), calcium and magnesium were estimated using the standard methods [7].

Bacterial isolation

The nutrient agar medium was used for the isolation of heavy metals resistant bacteria and the tannery effluent sample directly streaked on nutrient media and incubated at 37 °C for 24 hours. After the incubation period, the plates were observed for growth on the media and the isolated colonies were selected for the further studies. Microscopic and biochemical tests were applied to this isolates and

identified according to Bergey's manual of systematic bacteriology. The genera to which the isolates belong were determined. The selected isolates were stored on the nutrient agar medium at 4 °C for further studies.

Biodegradation of tannery effluent

Biodegradation process was done by using selected strains. A loop full of bacterial culture was transferred to test tube containing 10 mL nutrient broth and incubated at 37 °C for 24 hours. After incubation, 10 mL culture was transferred to conical flask containing 100 mL broth. For biodegradation process, the bacterial culture was inoculated in the sterile and controlled (unsterile) tannery effluent. Then, the tubes were incubated at 37 °C for 24 hours.

Seed germination study

In this study, the tannery filtrate was used for *Oryza sativa* L. seed germination by Whatman filter paper method. 10 paddy seeds were placed on the each Petri dish and incubated at room temperature for seed germination. Radical length, hypocotyl length and germination percentage were measured from first day till 10th day.

RESULTS AND DISCUSSION

The physicochemical characteristics of tannery effluent were analysed before and after treatment and it was showed in Table 1. The raw effluent was brown in colour and after treatment there was a decrease in pH, TDS, BOD, COD, calcium and magnesium contents. This was mainly due to higher concentration of bacterial biomass in the effluent. The bacterial isolates from the tannery effluent were identified as *Enterobacter* sp. (Figure 1 and 2) according to Bergey's manual of systemic bacteriology.

Table 1. Physicochemical properties of tannery effluent before and after treatment

Parameters (mg/L)	Untreated effluent	Treated effluent
Colour	Brown	Light yellow
Temperature	34 °C	36 °C
pH	8.5	7.0
TDS	37.95	36.9
TSS	1.28	1.15
BOD	2000	250
COD	1100	150
Calcium	250	200
Magnesium	316.55	255.67

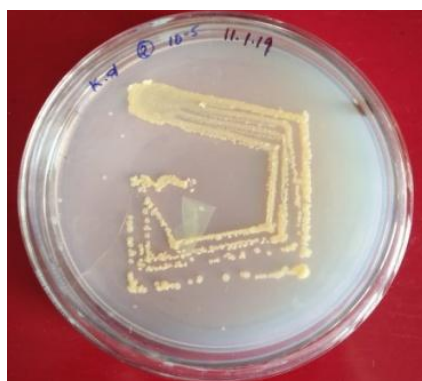


Figure 1. *Enterobacter* sp.

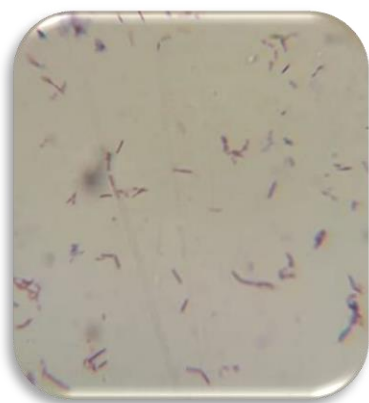


Figure 2. Microscopic view of *Enterobacter* sp. (40X)

After 72 hours, the physicochemical properties were found decreased in the effluent [5]. The industrial sample colour changed from blackish to light brown after degradation using native *E. coli* and in non-native *Bacillus* sp. [8]. The physiochemical parameters were found to be reduced in all the treatments but

significant reduction was observed only with the combined treatment [9]. The reduction of biological oxygen demand in tannery effluents was reduced after inoculation of *Rhodospseudomonas blastica*. *Aspergillus* sp. was used at various concentrations to treat the effluent [10]. Reduction of COD in tannery effluents was also noticed after inoculation of *Enterococcus casseliflavous* [11]. The COD level was reduced by *Botryosphaeria rhodina* after five days under agitation [12].

Seed germination was done by using sterile and unsterile treated filtrate and the parameters were measured (Figure 3). The treated tannery effluent containing *Enterobacter* sp. was used to promote plant growth and suppress the plant disease. The percentage of seed germination, radical length, and hypocotyl length in tannery with bacteria is higher than other treatments (Figure 4) on 10th day.

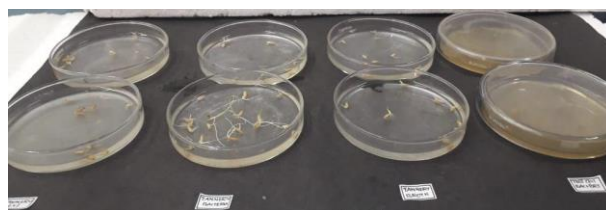


Figure 3. Seed germination using sterile and unsterile treated tannery effluent on 10th day



Figure 4. Analysis of morphological parameters on *Oryza sativa* L.

The tannery effluent showed a significant effect on seed germination and morphological parameters [13]. The percentage of seed germination, seedling growth and fresh weight of green gram were increased with different

concentration of tannery effluent [14]. The application of treated tannery effluent promoted the seed germination of *Vigna radiata* L. when compared to chemical treatment [15].

CONCLUSION

The physicochemical parameters of tannery effluent were reduced after treatment with *Enterobacter* sp. The results indicated that bacterial treatment method is a feasible technique for bioremediation of tannery effluent. Therefore, it was found that the remediation using *Enterobacter* sp. provides an effective and environmentally acceptable option for wastewater treatment. This study concluded that the *Enterobacter* sp. have the capacity to degrade the tannery effluent and promote the seed germination of *Oryza sativa* L.

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