

BIOREMEDIATION OF SELLA-RICE PLANT EFFLUENT

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ABSTRACT

The disposal of Sella-rice plant effluent has become a serious problem. It is a major environmental pollutant. The samples of effluent were collected from three Sella-rice plants located in Haryana. Using three different types of media, 130 isolates were isolated and characterized. Only 4 bacterial isolates were found to show high efficiency for utilization of starch in presence of peptone and yeast extract. The bioremediation of Sella-rice effluent by using selected bacterial isolates under laboratory conditions. These bacterial isolates were reduced the amount of starch, COD and BOD after 12 days of incubation.

INTRODUCTION

Paddy one of the most important crops of the world is the prime cereal crop that is cultivated in India in an area of 42 million hectares. Annual production of paddy is 76 million tones and it constitutes approximately 42% of India's food grain production (Rao, 2003). A major part of total paddy produced is converted into 'Sella' or parboiled rice. Parboiling is a premilling process for paddy that originated in India (Subrahmanyam, 1971). It involves hot water treatment of paddy at 60-70°C for 3-3.5 h (Paspia and Desikachar, 1980). After soaking, the water is drained that has high BOD, COD and organic contents. The effluent is generated @ 900-1000 litres for each tones of paddy processed. According to water pollution control and Prevention Act, 1974, the Sella-rice plant effluent can not be disposed without treatment. However, in general most of the Sella producing units dispose effluent in water bodies at cultivated lands after 5 to 10 times diluted with water, which involves a high quality of water and costly transport facilities.

Because industrial effluents have an adverse impact on soil health and agriculture they need to be treated by physical, chemical or microbiological techniques. Among these methods microbiological treatment is not only cheap and easy but also ecofriendly. Effluents from distillery, tannery, textile and paper industries have been treated with bacteria and fungi (Hernandez *et al.* 1994; Singh *et al.* 1995; Srivastava and Thakur, 2003 and Kuhad *et al.* 2004) prior to disposal. However, no such information is available with regard to treatment of Sella-rice plant effluent. A study thus was conducted to determine the conditions required for growth of microorganism on Sella-rice effluent for its bioremediation.

MATERIALS AND METHODS

Collection of samples - The samples of Sella-rice effluents were collected from 3 different locations in Haryana i.e. Jind, Fatehabad and Yamunanagar in presterilized glass bottles for microbiological analysis.

Isolation of starch utilizing bacteria - Microorganisms were isolated from effluent on 3 different types of media viz. LB, YEPDA and PDA by enrichment culture technique. Further all the selected isolates were studied in starch both (1.0% supplemented with peptone (0.2%) and yeast extract (0.2%) for determination of starch (Malik and Singh, 1980) and growth at different time intervals under shaker conditions. The inoculated flasks were incubated at 30°C on rotary shaker for 48 h. The samples (10 mL) were withdrawn at different time intervals up to 48 h, centrifuged the samples of each isolate was taken for estimation of starch and pellets were resuspended in sterile distilled water and absorbance was measured at 600 nm.

Bioremediation process - The bioremediation of Sella-rice effluent was examined under laboratory conditions by using selected bacterial isolates under shaker as well as stationary condition at temperature 30°C.

RESULTS AND DISCUSSION

Microorganisms were isolated from Sella-rice effluents by enrichment culture technique. A total number of 130 isolates were obtained from effluent samples collected from 3 locations on 3 different media. These isolates were further characterized for cultural and morphological characteristics. Out of 130 isolates only 8 were able to utilize starch as a source of carbon in presence of peptone (0.2%) and yeast extract (0.2%) (Fig. 1 depicts the growth and utilization of starch by 4 isolates). However, none of the isolates showed slow growth as utilization of starch. Addition of nutrients such as peptone and yeast extract improved the utilization of starch (Fig. 2) by isolates. The concentration of starch decreased from 9900 mg/mL to 3500 mg/mL when isolates LB-9S, LB-18 F and Y-11 M were used; growth was also fast.

The experiment was conducted for bioremediation of effluent using sterilized as well as unsterilized Sella-rice effluent in presence of bacterial isolates (individually as well as mixed culture) under stationary and shaker condition (Fig. 3a to 5b). It was found that with the inoculation of different

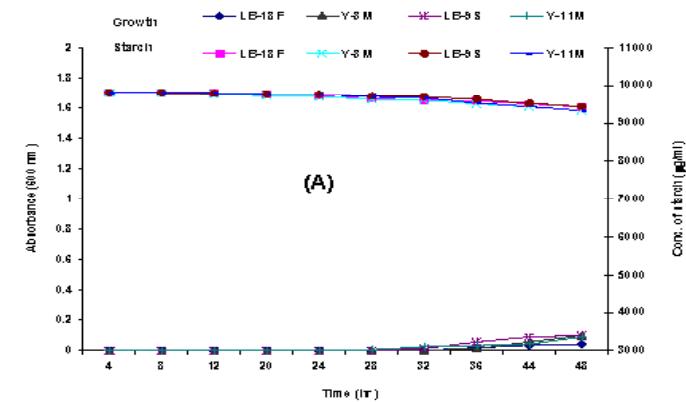


Fig. 1 Utilization of starch by different bacterial isolates in starch (1.0%)

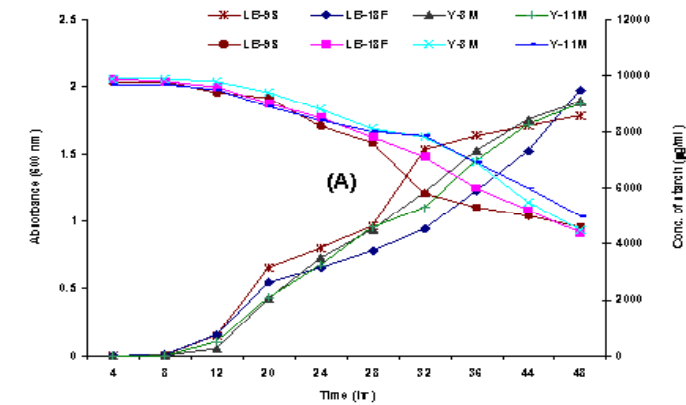


Fig. 2 Utilization of starch by different bacterial isolates in media containing starch (1.0%) + peptone (0.2%) + yeast extract (0.2%)

isolates not only amount of starch decreased but BOD and COD also decreased within 12 days at incubation. The amount of starch was reduced (Fig. 3a) from 650 to 140 mg/mL after 12 days of incubation in sterilized effluent on rotary shaker in comparison to unsterilized effluent. Likewise, COD (Fig. 4a) was also reduced from 2500 to 1200 mg/L and BOD (Fig. 5a) from 650 to 160 mg/L by using selected bacterial isolates inoculated in sterilized effluent on shaker condition. The odour and colour of the treated effluent were found to be pleasant and light yellow colour in comparison to control that possessed foul smell and dark colour. Thus, these cultures can be efficiently used for bioremediation of Sella-rice effluent.

CONCLUSION

The samples of effluent were collected from 3 Sella-rice plants located in Haryana. Total numbers of 13 isolates were characterized. Only 4 isolates showed maximum utilization of starch in presence of peptone (0.1%) and yeast extract (0.1%). The effluent was treated under laboratory conditions

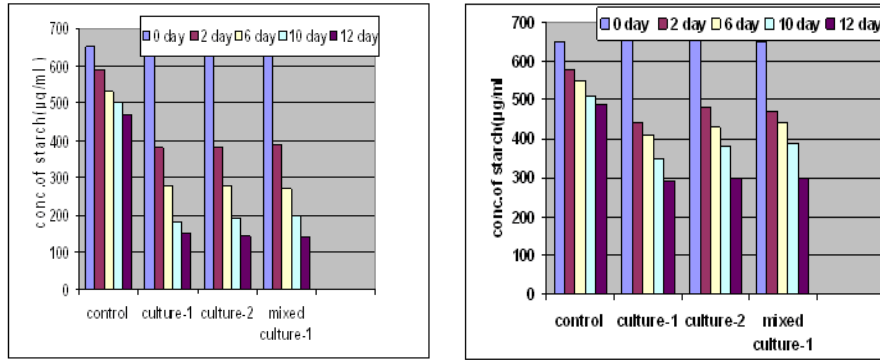


Fig. 3 (a) Reduction of starch by using selected bacterial isolates in sterilized effluent (A) shake culture (B) stationary

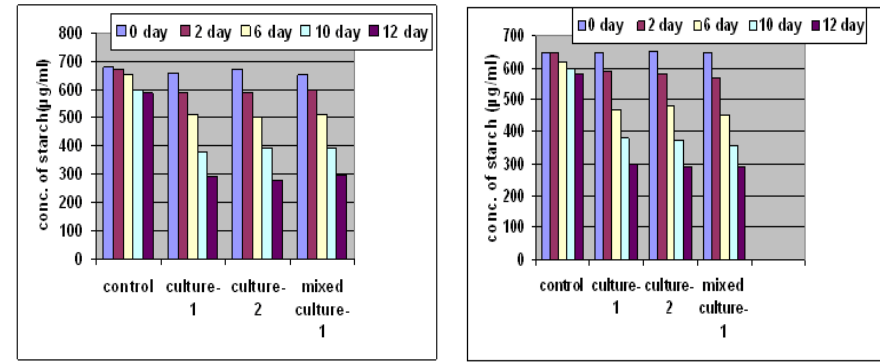


Fig. 3 (b) Reduction of starch by using selected bacterial isolates in unsterilized effluent (A) shake culture (B) stationary

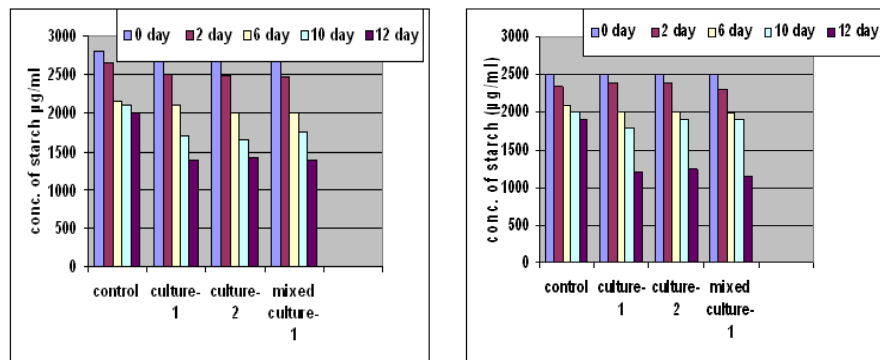


Fig.4 (a) Reduction of COD by using selected bacterial isolates in sterilized effluent (A) shake culture (B) stationary

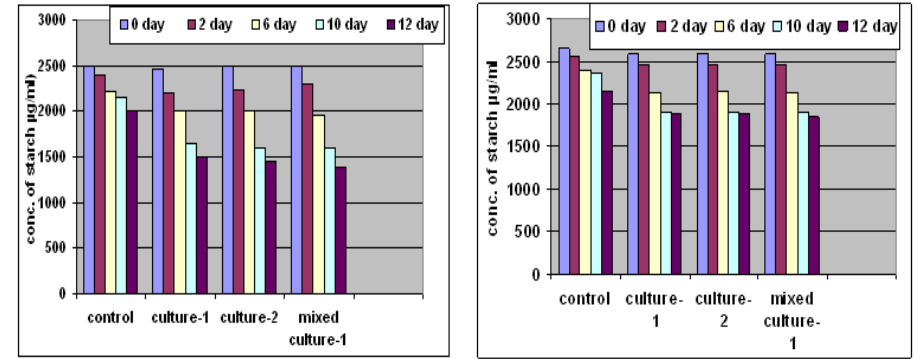


Fig.4(b) Reduction of COD by using selected bacterial isolates in unsterilized effluent (A) shake culture (B) stationary

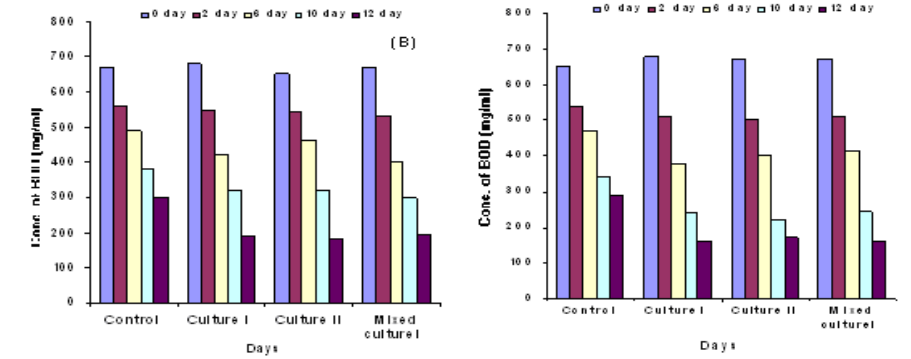


Fig. 5 (a) Reduction of BOD by using selected bacterial isolates in sterilized effluent (A) shake culture (B) stationary

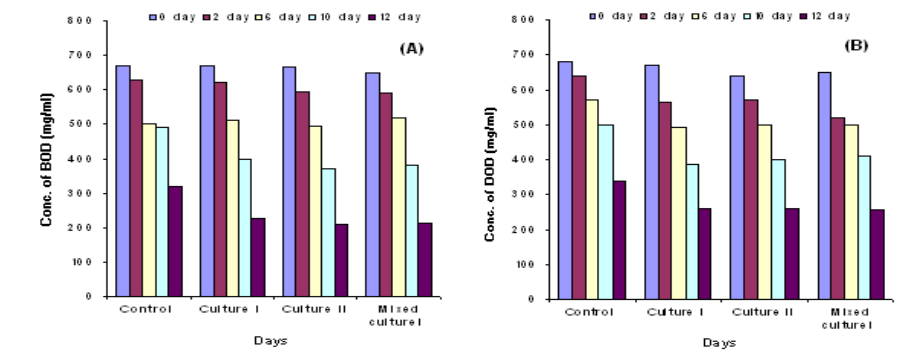


Fig. 5 (b) Reduction of BOD by using selected bacterial isolates in unsterilized effluent (A) shake culture (B) stationary

using selected bacterial isolates (individual as well as mixed culture) for rapid bioremediation. These bacterial isolates can be exploited to develop a bioremediation process to reduce starch, BOD and COD of Sella-rice effluent.

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