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Isolation of Plastic Degrading Microorganisms from Soils Contaminated with Industrial and Municipal Waste

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Abstract

Plastics are the synthetic polymers formed by hydrocarbons. Their versatile properties and usage led to their massive production. This massive production and its improper disposal ultimately resulted in the plastic pollution. In the present study soil samples were collected from multiple dumpsites of Multan. The polymers targeted for degradation studies were PET, PVC and PE. Clear-zone plate assay was performed to isolate the plastic degrading fungi on media supplemented with PEG-6000. On the basis of plastic degradation potential one fungal isolate from each sample was selected for further studies. Liquid culture assay and soil burial simulation test were conducted with selected strains (named as F7 and F8) for the period of 60 days. In weight loss test, F8 showed cumulative better weight loss results as compared to other strains and consortia over a period of 60 days in both setups. Moreover, enzyme plate assays including amylase, protease and lipase were also conducted. The best cumulative activity for esterase with all four polymers was observed for F8 when analyzed by spectrophotometry. Salinity and temperature tolerance were also evaluated, where F8 gave the highest salinity tolerance of 15% while F9 was able to grow at maximum temperature of 50ºC. FTIR results showed that F7 treated PET had formed new C-H and alcoholic O-H bonds while F8 treated polymer had new acidic O-H bonds. F7 treated PVC showed C-O bond breakage while F8 treated PET showed acidic O-H bonds breakage and also C=O and C-O bonds breakage. F7 treated PE film showed CH bonds breakage while F8 treated PE had more intense peaks showing increased number of bonds in treated polymer. Changes in thermal characteristics was observed using TGA-DSC where PET treated with F8 had increased weight loss in comparison to other selected strains. When PVC film was treated with F7, it had lower Tm than other strains. F8 treated PE had more change in Tm as compared to F7. Degradation analysis for liquid cultures were better as compared to the films treated by soil burial test mimicking the natural environment. Among the isolated strains F8 proved to be the efficient degrader of various polymers selected in the study.

Keywords: