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Biodegradation of pre treated polythene by different species of *Aspergillus* isolated from garbage soil

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ABSTRACT

Polythene is most problematic plastic waste which is an increasing ecological threat, as it is a polyethylene are stable polymers and can not easily degraded. In the present investigation an attempt has been made to study the biodegradation of polythene in control laboratory conditions. Different species of fungi were isolated from soil of Municipal Garbage. During the time of investigation microorganisms associated with polythene were identified. They were found to utilize the polythene as source of carbon resulting into its degradation. The microbial species found associated with the degrading materials were identified after staining them with cotton blue. Efficacy of the microbial species in degradation of polythene was analyzed in shaker cultures in the laboratory. Biodegradation comparative studies were done between pretreated and untreated polythene. Polythene discs were irradiated by UV at 254 nm wavelength and then incubated with 99.0% of nitric acid. This pretreated discs were then treated with microbial culture and untreated discs were also given microbial treatment to observe microbial biodegradation. *Aspergillus niger* and *Aspergillus flavus* started the degrading of polythene in 2-4 months by 19-24%.

KEY WORDS: ASPERGILLUS, BIODEGRADATION, POLYTHENE, GARBAGE, SOIL

INTRODUCTION

Polythene being xenobiotic is greatly resistant to degradation. This is recognized as a major threat to land and aquatic life both. Degradation of polythene is a great challenge for researchers. Biodegradation is the natural way to resolve this threat. The ability of microorganisms to degrade extracellular polymer depends on the secretion of specific depolymeras-es that hydrolyze the polymer to water soluble products (Sharma and Sharma, 2003; Hasan *et al*., 2007; Tokiwa *et al*., 2009).

The coastal mangroves have historically been favored dumping sites for the solid waste disposal (Kathiresan and Bingham, 2001). Microorganisms such as bacteria and fungi are involved in the degradation of both natural and synthetic plastic (Gu *et al*., 2000, *Lee et al*., 1991) have reported the biodegradation of degradable plastic polyethylene by phanerochaete and *Streptomyces* species.

During degradation process exo-enzymes from microorganisms breakdown complex polymers yielding small molecules of short chain e.g. oligomers, dimers and monomers and then to be utilized as carbon and energy source. The process is called De-polymerization. When the end products are CO_2, H_2O or Ch_4, the degradation is called mineralization (Frazer,1994). Biodegradation of plastic by microorgan-ism and enzyme seems to be the most effective process (Tokiwa *et al*., 2009).

The initial breakdown of a polymers can result from a variety of physical and biological forces (Swift, 1997). Physical forces such as heating and drying can cause mechanical damage such as the cracking of polymeric materials (Kamal and Huang, 1992).

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The growth of many fungi can also cause small scale swelling and bursting as the fungi penetrate the polymer solids (Griffin, 1980). UV radiation reduces the polymeric chain size of polythene and form oxidizing groups such as hydro peroxides, peroxides, alcohol, ketone and perhaps some aldehyde resulted from partial oxidation of polythene (Hasan, 2007). Degradation by fungal strains were fast in pretreated polythene disc than in case of untreated polythene. Polythene needs to undergo some non-biotic degradation before microbial attack because of its hydrophobicity and its large molecular dimensions. Albertson *et al.* (1994) concluded that UV light or oxidizing agent such as UV sensitizer are needed at the beginning of biodegradation without them it takes more than ten years.

The purpose of the present study was to isolate microorganisms from garbage soil and screen out polyethylene degrading microorganisms and identify the high potential microorganisms. The main objective of the present study was to determine the degradation of polythene under liquid culture in the laboratory conditions.

MATERIAL AND METHODS

Polythene bags buried in garbage soil were taken out and were allowed to be isolate from these samples. They were was maintained in Rose Bengal Medium. Pour plate method was adopted using Rose Bengal Medium for culture. For each dilution three replicates were made. Plates were then incubated at 30°C for two to six days. Fungal counts were taken and then purified for further observation. The fungi was identified by differential and selective morphological, cultural and biochemical tests by following the key of Raper and Fenell, (1987).

The pre weighed discs of 1cm diameter prepared from polythene bags were aseptically irradiated by UV at 254 nm wavelength and then incubated with 99.0% of nitric acid. The pretreated polythene disc were transferred to the conical flask containing 50 ml of culture broth medium and are inoculated with different fungal species separately. Rose Bengal broth medium was used for fungi. Controls were maintained with plastic discs in the microbe-free medium. Three flasks were maintained for each treatment and left in a shaker. After two months of shaking, the plastic discs were collected, washed thoroughly using distilled water, shade-dried and then weighed for final weight. The weight loss of the polythene disc was calculated and compared with controls.

The fungal counts on polythene disc were observed and recorded. Statistically it was analyzed from 2 to 8 months in the meantime sub-culturing was done. The fungal count varied from two to eight months for polythene degradation.

RESULTS AND DISCUSSION

From the data collected, weight loss of polythene bags, was calculated and is shown in Table 1. This reveals that among microbes two fungi *A. flavus* and *A. niger* are efficient in biodegradation. Degradation seen ranged between 24.82 to 40.10% for polythene by *Aspergillus niger*. Among the species, *Aspergillus niger* was more active than *Aspergillus flavus* in degrading polythene within two months. Kathireson, (2003) has reported fungi from the mangrove soil which has the potential to degrade polyethylene. In most studies fungi were considered for the degradation of LDPE due to their ability to form hydrophobic proteins that can attach to the polymer surface (Kershaw and Talbot, 1998; Seneniratne *et al.*, 2006).

The generation of degrading enzymes is well matched with the insoluble LDPE (Shah *et al.*, 2008) and the faster growth of fungal biomass is compared to bacteria (Kim and Rhee, 2003) along with the growth intension and penetration into other location through the distribution of hyphae. Also fungi survive in the environment with low nutrient, low pH and low moisture as well. From the present study it can be concluded that fungi isolated from Municipal garbage soil were found attached to the surface of the polythene bags buried in the soil. After the degradability test it was found that there is change in weight of the pretreated polythene discs. The studies have increased our knowledge of polythene degrading fungi and by viewing the environmental responsibility, this is the ideal time to work on the degrading enzymes and their activities under laboratory condition. Looking forward for better solution of degrading such environmental threats for better future.

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REFERENCES

Albertson AC, Barenstedt C and Karlsson S, (1994). Abiotic degradation productsfrom enhanced environmentally degradable polyethylene . Acta. polymer 45; 97-103.

Amir Ali Shah, Fariha Hasan, Abdul Hameed, Safia Ahmed (2008). Biological degradation of plastics: A comprehensive view Biotechnology Advances 26; 246-265.

Frazer AC, (1994). O-Methylation and other transformation of aromatic compound by acetogenic bacteria. In : Drake HL (Ed.). Acetogenic Chapman and Hall, New York, pp 445-483.

Griffin GJ L, (1980). Synthetic polymers and the living environment. Pure and Applied Chemistry 52;399-407.

Gu JD, Ford TE, Mitton DB and Mitchell R, (2000). Microbial degradation and deterioration of polymeric material In: Review, W. (Ed.). The Uhling corrosion handbook. 2nd Edition. Wiley, New York, USA, pp: 439-460.

Hasan F, Shah AA, Hameed A, Ahmed S, (2007). Synergistic effect of photo and chemical treatmenton the rate of biodegradation of low density polythene by *Fusarium* sp. Af4. J. Appl. Polym. Sci. 105(3); 1466-1470.

Kamal MR and Huang B, (1992). Natural and artificial weathering of polymers. In Hamid, S.H., M. B. Ami, and A.G. Maadhan. Eds., Handbook of Polymer Degradation. Marcel Dekker, New York, NY, 127-168.

Kathiresan K (2003). Polythene and plastic degrading microbes in an Indian mangrove soil Rev. Biol. Trop., 51; 629-633.

Kathiresan, K. & B.L. Bingham. (2001). Biology of mangroves and mangrove ecosystems. Advances Mar. Biol. 40: 81-251.

Kershaw ML, Talbot NJ (1998). Hydrophobias and repellents: proteins with fundamental roles in fungal morphogenesis. Fungal. Genet. Biol., 23: 18-33.

Kim DY and Rhee YH (2003). Biodegradation of microbial and synthetic polyestere by fungi. Appl. Micro. Biotech. 61; 300-308.

Lee B, Pometto AL, Fratzke A, Bailey TB (1991). Appl. Environ Microbiol. 57;678-85.

Raper KB and Fennell DI, (1987). The genus *Aspergillus*. R.E. Krieger (ed.) Huntington, New York. 686.

Seneuriatne G, Tenakoon NS, Weerasekara MLMAW and Nanadasena KA (2006). LDPE Biodegradation by developed *Penicillium-bacillus* biofilm. Curr. Sci. 90; 22-21.

Sharma A and Sharma A (2004). Degradation assessment of LDP and PP by an indigenous isolate of Peudomanan stutzeri. JSIR Vol. 63. 293-296.

Swift, G. (1997). Non medical biodegradable polymer environmentally degradable polymers. Handbook of Biodegradable polymers. Hardwood Academic, Amsterdan.pp 473-511.

Yutaka Tokiwa, Bueenaventurada P.Calabia, Charles U.Ugwer and Seiichi Aiba (2009). Biodegradability of Plastics. International Journal of Molecular Sciences 10; 3722-3742.