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Biofilms formation of *Actinomycetes sp*., on UV light exposed Polyethylene Terephthalate (PET-bottle) Surface

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Abstract

Polyethylene terephthalate (PET) water bottles is used mostly worldwide in polymer products and it growth in the environments has become a universal concern. In this work, the ability of *Actinomycetes sp*., biodegrade of PET water bottles. UV exposed PET flakes, resulted in bio-film formation and smoothness of PET flakes surface were evaluated by Scanning Electron Microscopy (SEM). It was interesting to observe the bio film formation on UV exposed PET flake on inoculation with *Actinomycetes sp.,* and it is accelerate biodegradation of PET plastic.

Keywords: PET waste, *Actinomycetes sp.,* UV light treated, SEM

Introduction

Polyethylene Terephthalate (PET) is light weight, colourless and durable but at the same time it is resistant to biodegradation (Muller *et al*., 2001). In outside application of plastic materials UV radiation is accountable for most aging damages, because the quantum energy of UV radiation is high sufficient to cause chain cleavage in molecules of plastic (Scott *et al*., 1990). A number of microbial species associated with degrading plastics have been reported (bacteria: *Pseudomonas sp, Streptococcus sp, Staphylococcus sp, Micrococcus sp* and *Maoraxella sp;* fungi: *Aspergillus*

niger sp, Aspergillus galucus sp, Actinomycetes sp., and *Saccharomonospora genus sp*) (Iring.,1999 and Umamaheswari *et al*., 2014; Umamaheswari and Murali, 2013). The aim of the present study was to isolate *Actinomyceties sp*., species able to colonise and biodegrade of Polyethylene terephthalate waste and to visualise electron microscopic image.

Materials and Method

Isolation of Pet Degrading Microorganisms from Pet Waste

The collected PET wastes collected from soil in different areas were scrapped several times with care to remove the soil and were cut into small pieces. Further, PET waste was washed with distilled water and inoculated into Nutrient Broth medium at room temperature for 24 hour. Identification *Actinomycetes sp*., was performed on the basis of microscopic examination and biochemical test according to Bergey's manual of determinative bacteriology (Sneath *et al*., 1994).

Abiotic and Biotic Treatment of Pet Samples

PET wastes was collected from shop and was cut into small flakes about 0.5×0.5 mm size and were washed with distilled water. Further, they were treated with UV radiation (10 days in UV chamber). Treated PET samples were washed thoroughly with 70% ethanol and finally washed with sterilize distilled Further; they were inoculated into nutrient broth medium along with *Actinomycetes sp.,* for a period of one month.

Scanning Electron Microscopy (SEM)

The scanning electron microscopic analysis of fractured surface of PET film was carried out using Scanning electron microscope (VEGA3 TESCAN). PET flakes were withdrew and generally sputter-coated with gold or some metal ions before SEM examination. Analysis was carried out using low vacuum 0.68 Torr mode, 10 to 30 kv at different magnification 6.13 kx to 500 kx and LFD (large field Detector) (Pinzari *et al.,* 2006).

Results and Discussion

Inoculation of PET flakes in nutrient broth containing *Actinomycetes sp*., colonisation resulted in colonization of *Actinomycetes sp*., after month incubation. On the other hand, *Actinomycetes sp.,*

were successfully able to colonies the UV exposed PET flakes surfaces during the period of month.

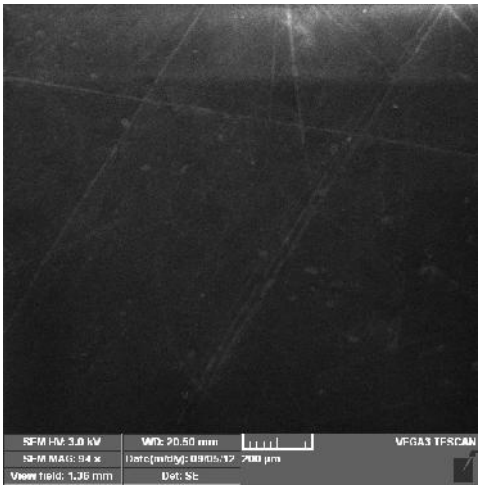
The adherences of selected microorganisms of *Actinomycetes sp* (in both UV unexposed PET flakes and UV exposed PET partially agrees with that of Atefeh Esmaeili *et al.*, (2013) who have also evinced colonisation of mixed culture of fungi (*Lysinibacillus xylanilyticus* and *Aspergillus niger*). On PET flake surface, when incubated in soil inoculated with *Lysinibacillus xylanilyticus* and *Aspergillus niger* for a period of 126 days in the SEM image. The adheren of the microorganisms to the polymeric surface is fundamental for biodegradation to take place (Volke-Sepulveda *et al*., 2002). Raaman *et al.*, (2012) have reported that the control polyethylene strips treated with *Aspergillus niger* and *Aspergillus japonicus* showed appreciable surface corrosion, folding and crakes in the SEM images and have attributed it due to fungal extracellular metabolites and fungal enzymes. Sowmya *et al.*, (2014) have confirmed through Electron microscopic studies that the formation of holes and disappearances of PE structure on inoculation with *Chaetomium globosum* in MSM for a period 3 months.

Barratt *et al.*, (2003) have reported that burial of polyethylene in soil for a period of 44 days resulted in microbial colonization which they observed under light microscopes. They further confirmed through SEM fungal hyphae and spore on all piecures breed at 20-80 % soil – and creak on the surface of polyester PU. In addition, they found neither crakes nor decolonization on samples from 15, 90 and 100 % WHC or control samples – fungal hyphae were present in 15 90 and 100 % WHC results. Umamaheswari *et al*., (2014) have reports that inoculation with *Pseudomonas sp.*, and *Actinomycetes sp*., biofilm formation on pre treated PP surfaces.

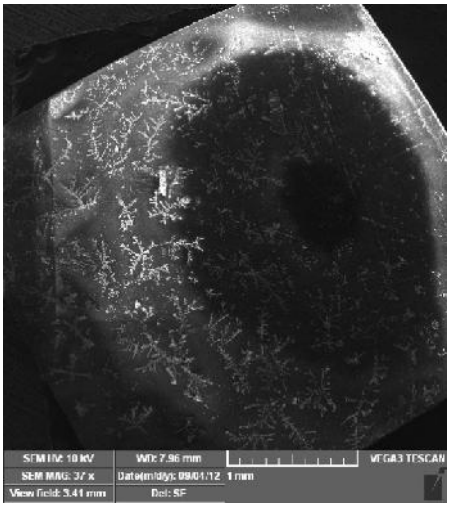
Conclusion

The huge amount of synthetic polymers like Polyethylene Terephthalate, polyethylene and polypropylene waste released into the environment is of global concern. Hence methods to convert these polymers into lower weight intermediates have to be devised. The present study focuses on biotic (*Actinomycetes sp*.,) treatments of abiotically (UV) treated PET flakes resulting in colony formation which is gauged through SEM analysis studies SEM images reveal micromorphological changes likes formation of granules, roughness of the PET surface on exposure to UV light, *Actinomycetes sp*.,. The surface colonisation the inoculated *Pseudomonas sp.* and *Actinomycetes sp*., was evident in the SEM images.

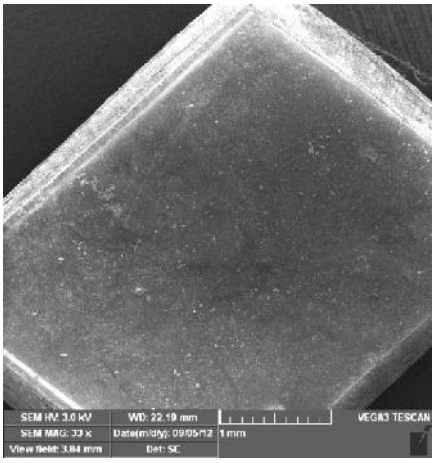
Control PET flakes



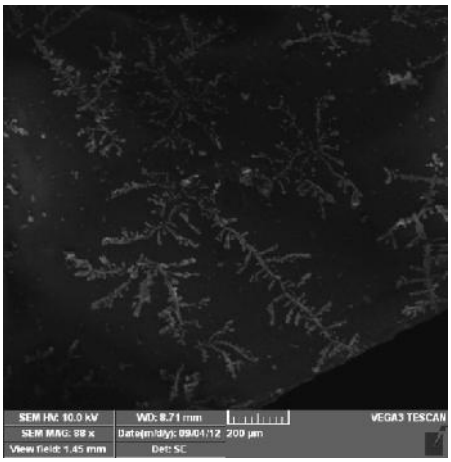
Actinomycetes sp., inoculated + UV exposed PET flakes

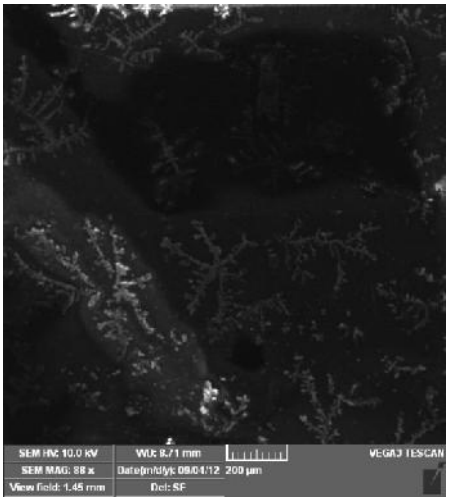


UV exposed PET flakes



Actinomycetes sp., inoculated + UV exposed PET flakes





Actinomycetes sp., inoculated + UV exposed PET flakes

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