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RESEARCH ARTICLE

PLASTIC DEGRADING ACTINOMYCETES ISOLATED FROM MANGROVE SEDIMENTS

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ABSTRACT

Totally 34 different kinds of marine Actinomycetes isolates were obtained from marine soil. Among them five predominant Actinomycetes cultures were used for plastic degradation such as *Streptomyces* sp (2), *Pseudonocardia* sp, *Actinoplanes* sp, *Sporichthya* sp. Ten - days heat treated plastic films were inoculated in to the yeast extract broth with Actinomycetes cultures were incubated with shaking condition for different time interval at 37^{O}C. After completion of incubation time the plastic film weight was measured and find out the degradation capacity. The weight of the plastic film was gradually reduced by the action of *Streptomyces.*

INTRODUCTION

Plastic accumulate in the environment at a rate of 25 million tons per year. The fact of these organic polymers in the environment and the time required for the total mineralization to CO_2 have yet to be fully understood. Actinomycetes play an important role in the recycling of organic carbon and are able to degrade complex polymers [5]. Plastic is a common term used to include all sorts of polythene (polyethylene) and polyvinyl chloride materials. The main effects of land pollution caused by plastics is the blockage of rain water from getting underground, thus reducing ground water level. These plastic wastes can be disposed off by either recycling or incineration. Recycling is not widely used now because of economics. Even incineration causes air pollution, as combustion of plastic in mass will release highly toxic organic compounds in to the air. Vinyl chloride and acrylonirrile are classified as environmental carcinogens [3]. Actinomycetes are gram positive bacteria having high G+C content in their DNA, and were generally considered to be an intermediate between bacteria and fungi. Actinomyetes dominate the microbial life in soil. Most of the antibiotic are obtained from this group of organisms. Where they play a major role in dead organic matter. Actinomyetes present in the marine and coastal ecosystem must be rich in gene pool possibly containing isolates capable of producing useful metabolites. However, work on biodiversity of actinomycetes especially in the mangrove ecosystems is largely non-existing. Plastic can cover many synthetic or semi synthetic polymerization products. Some plastics are partially crystalline and partially amorphous in molecular structure, giving then both a melting point. Recent research found that most of the constituents of plastics can be microbial degraded and the plastic can be treated by microbial systems. Efficiency of the microbes in degradation of polyethylene and plastics were analyzed in liquid culture method [23]. Recently Poly l-lactic acid (PLA) degrading enzyme producing *Actinomadura* sp.was reported [17]. Unculturable microorganisms were identified from the compost consisting of PLA by using metagenomic method including *Paecilomyces, Thermomonospora* and *thermopolyspora* [15]. A novel poly (L. lactide) degrading thermophilic Actinomycetes*, Actinomadura keratinilytica* strain T16-1 and pla sequencing [18][2]. There is a growing interest in the development of degradable plastics to enhance biodegradability of plastic products in landfills and composts. Many plastic degrading *Actinomycetes* strains were already identified. The ability of lignocellulose degrading *Streptomyces badius* 252, *Streptomyces setoni* 75 vi2, and *Streptomyces viridisporus* T7A strains [11].

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MATERIALS AND METHODS

Isolation of Actinomycetess

Sediment samples were collected from Muthupet mangrove forest,located in south east coast of india. Soil sample were made at a depth within 10 -15 cm from the surface of the soil. The texture of the samples was sandy with brown to blackish in colour. Then, 10 fold serial dilution of the samples were prepared, using filtered and sterilized 50% sea water. serially diluted 1ml sample was plated in the starch casein agar medium and incubating at 28ºc for 2-3 weeks. After incubation, actinomycetes colonies were identified on the

plates as coloured, dried, rough, with regular or irregular margin was observed. All the colonies that were growing on the petriplates, sub cultured, ensured for their axenicity and maintained in slants.

Identification of Actinomycetes Isolates

Cultural characteristics of the isolates grown on starch casein agar media were identified using standard procedure [16]. Micromorphology and sporulation were observed under light microscope by coverslip culture technique [25].The actinomycetes group isolates were observed under the microscope,the colony morphology was noted with respect colour, aerial mycelium, size and nature of colony, reverse side colour and pigmentation. Physiological characteristics were examined according to the methods described in the Standard International *Streptomyces* projects.

Plastic degradation

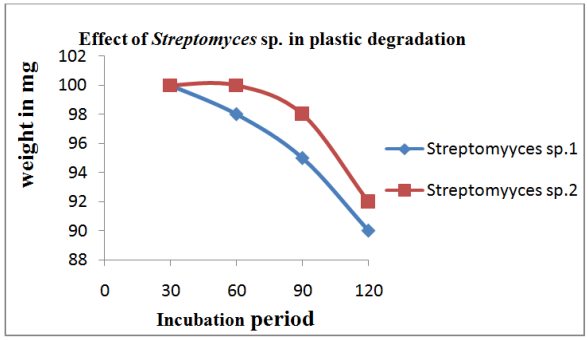
The fresh polyethylene coated plastics were collected. Then the plastic sheet was heat treated at (40ºC) in a forced Hot air oven for 14 days and then cut in to small strips (100 mg). Plastic degradation process was carried out by using the standard procedure [11]. The isolated *actinomyectes* culture concentrates were added into each conical flask aseptically. Sterility checks were conducted by aseptically adding each plastic film to 50ml of sterile 0.3% yeast extract containing broth and then incubating with shaking condition at 37ºC for 24 hours. After 30, 60, 90 and 120 days incubation, the films were washed with 70% ethanol, dried over night at 45ºC and then measured the evaluated changes of plastic film.

RESULTS AND DISCUSSION

Totally 34 different kinds of marine Actinomycetes isolates were obtained from mangrove soil. Among them five predominant Actinomycetes cultures such as *Streptomyces* species (1) and (2), *Pseudonocardia*, *Actinoplanes*, *Sporichthya* were selected for plastic degradation. Plastic degradation work was conducted at different time interval. From the initial incubation up to 120 days the plastic film weight was measured with 30 days time interval. The gradual reduction of weight was observed in *streptomyces* inoculated strips. The reduction rate was observed 20% and 14% of *streptomyces* (1) and *streptomyces* (2) respectively. *Streptomyces* sp. showed significant reduction when compared with other tested organisms. The previous literature cited that an extracellular polyethylene degrading enzyme produced by *Streptomyces* sp [13]. The present study also similar to the previous one. A wide variety of *Streptomyces* grow and degrade plastics and their polymers,but they had to be upgrade. The present results showed the level of reducing capacity itself for *Streptomyces sp*. Both of the *Streptomyces* species have a special potentiality for plastic degradation process. Among them *Streptomyces* sp(1) showed the best degradation activity.

Biodegradation of plastic as well as the production of major extracellular enzymes during lignocellulose degradation was observed in *Streptomyces badicus* 252, *Streptomyces setoni* 75 vi2 in agitated submerged culture [1]. The various

thermophilic Actinomycetes and found their ability to degrade a high melting point [8]. Polyster degrading Actinomycetes



strains such as *Streptomyces sp.* and *Micromonospora sp* was studied [7]. The present study showed two different kinds of *Streptomyces* species provide ultimate result (Figure.1). A wide variety of Actinomycets species can be degrades plastic and their polymers such as the production of an extracellular polyethylene degrading enzymes by *Streptomyces sp.* [6][9][13], biodegradation of plastics was tested in the compost stored at−20 °C, 4 °C and 20 °C for different periods[19] ,polyethylene degradation by a novel actinomycetes *Pseudonocordia dioxanivoran*s [12] and potent poly(cis-1,4-isoprene)-degrading bacterium [24]. Polylactide or poly(l-lactic acid) (PLA) is a commercially promising material for use as a renewable and biodegradable plastic. Three novel PLA-degrading enzymes, named PLAase I, II and III, were purified to homogeneity from the culture supernatant of an effective PLA-degrading bacterium*, Amycolatopsis orientalis* sp. [10] [14]. Thermophilic Actinomycetes strains were isolated from various environment in Taiwan and screened for degradation of Poly(ethylene Succinate) (PES), poly(epsilon-caprolactone) (PCL) and/or poly(beta-hydroxybutyrate) (PHB) by the clear-zone method [4][20][21]. The biodegradation of poly (L-lactide) (PLA) [22]. The important role of Actinomycetes in PLA degradation is emphasized. The present study clearly reveals that the marine Actinomycetes play a vital role in the degradation of plastics. Different kinds of novel secondary metabolites can be produced from actinomycetes. Hence, actinomycetes is one of the eco-friendly microorganism.

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