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Assessment of Microbial Load from the Polyamide Netting Materials kept in Soil, Water and Atmosphere

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A B S T R A C T

Polyamides are the most commonly used polymers for routine applications as well as in the fisheries sector for the construction of fishing gear due to its high resistancey. The accumulation of polyamide after thrown in environment or the effect of ghost fishing is a threat to environment as it causes pollution, creating an imbalance in the ecosystem, thus proving to be hazardous. As polyamide is highly resistant to the environment, the natural degradation of polyamide is too time consuming and at the same time the ways to degrade polyamide have not been successful. The main objective of the present study is to assess the microbial load of the polyamide netting materials exposed in soil, water and atmosphere using standard microbial procedures.

Introduction

The use of polyamide materials have been increased in food clothing, shelter, transportation, construction, medical, and recreation industries.

They are most widely used worldwide as they are having certain advantages like they are strong, light-weighted, durable and having the highest elastic recovery than any other polymer. However, they are disadvantageous as they are resistant to biodegradation, leading to pollution, harmful to the natural environment. Increasing environmental pollution and waste that cannot be renewed and degrade it encourages research and studies in the field of biosynthetic and biodegradation material. One of the waste that cannot be destroyed is polyamide waste, which is a type of a plastic waste.

Materials and Methods

The test material comprised samples of: (i) PA monofilament yarn of specification viz. of diameter 0.23 mm diameter and (ii) PA multifilament twine of specification, viz. 210 d × 1 × 2.

Samples were kept in three environmental conditions i.e., water, atmosphere and soil.

Sub-samples from the test material were removed for the assessment of microbial load after 8, 15, 30, 45, 60, 90 days of exposure. The test exposure was done from February, 2018 to May, 2018.

Soil

Polyamide samples were buried in soil at 20 cm depth sewn with vinyl-coated polypropylene (PP) rope 2 cm apart on a frame. Samples were buried in the experimental tank outside the Department of Fishery Engineering & Technology, Kerala University of Fisheries and Ocean Studies at a latitude of 9°54'44.92"N and longitude of 76°19'2.67"E.

Marine condition

Experiment was conducted by keeping the samples in a glass aquarium of the size 180 cm × 80 cm × 80 cm; length, width, height having a total capacity of 1000 L. Seawater was collected from Chellanam, Kochi (Kerala) in plastic drums. Samples were sewn into a rope made with plastic to prevent eventually forming fragments from falling apart. The rope was with non-biodegradable vinyl-coated polypropylene having a diameter of about 280 mm.

The rope along with the nylon samples were suspended in the aquarium, the distance between the samples was approximately 5 cm. To avoid large temperature fluctuations the tank was kept inside lab and covered with a sheet.

Atmospheric condition

The samples were exposed to atmospheric conditions on the roof top of the Department of Fisheries Engineering Kerala University of Fisheries and Ocean Studies (9°54'44.92"N and 76°19'2.67"E) for a period of 3 months from February to May 2018. The two ends of the samples were tied to Polypropylene ropes with a 2 cm gap in between and taking care that there is no tension in the material and then mounted on a frame of 1m x 0.7m.

Microbial load and colony morphology was assessed after each sampling by taking Total Plate Count and visual observation. Assessment of total plate count (TPC) was done as per the standard procedure given below and colonies were serially numbered based on their morphological characters such as color, shape, transparency etc. 10 grams of exposed sample was collected using a sterile scissor and transferred into a sterile mortar.

No. of bacteria/g = (No. of colonies per ml x reciprocal of dilution x 100) / weight of the sample

Results and Discussion

Colony morphology and microbial load during each sampling time of each sample was observed. Microbial load of the sample during each sampling time is shown in Table 1. In soil the microbial load after 90th day for mono and multifilament were 2.3 x 10^5 cfu/g and 1.7 x 10^6cfu/g respectively.

In water the loads were 2.1 x 10^7 cfu/g and 2.3 x 10^6cfu/g respectively. In atmosphere for mono and multifilament samples upto3rd and 2nd sampling, there were no colonies found in petri plates. However, at the end of 90 the day microbial load on mono and multifilament were 3.3 X 10^4 cfu/g and 3.9 X 10^4cfu/g.

Table 2 showed the morphological characteristics of the colonies with color, margin and shape. Among the all colonies, yellow and pale yellow color colonies were found from samples of all three environments and were most abundant.

Table.1 Microbial load of mono and multifilament samples in different environments

	MONOFILAMENT SAMPLES			MULTIFILAMENT SAMPLES		
DAY	**SOIL (CFU/g)**	**WATER (CFU/g)**	**ATMOSPHERE (CFU/g)**	**SOIL (CFU/g)**	**WATER (CFU/g)**	**ATMOSPHERE (CFU/g)**
8	3.1 x 10^4	3.5 x 10^5	No colony	4.0 x 10^4	2.5 x 10^5	No colony
15	3.7 x 10^4	1.7 x 10^6	No colony	2.5 x 10^5	2.8 x 10^5	No colony
30	4.2 x 10^4	2.2 x 10^6	No colony	3.0 x 10^5	3.0 x 10^5	3.4 x 10^4
45	4.6 x 10^4	2.3 x 10^6	2.8 x 10^4	3.3 x 10^5	1.6 x 10^6	3.5 x 10^4
60	2.0 x 10^5	8.7 x 10^6	3.1 x 10^4	1.3 x 10^6	1.7 x 10^6	3.6 x 10^4
90	2.3 x 10^5	2.1 x 10^7	3.3 x 10^4	1.7 x 10^6	2.3 x 10^6	3.9 x 10^4

Table.2 Assessment of microbial load of mono and multifilament samples in difference conditions on agar medium

SOIL	**Colony no.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
	Color	Yellow	Transparent	White	Green	Creamish white	Red	Pale yellow
	Shape	Round	Round	Round	Irregular	Oval	Oval	Rod
	Margin	Circular	Circular	Circular	Weavy	Circular	Circular	Cylindrical
WATER	**Colony no.**	1	2	3	4	5	6	
	Color	White	Pale yellow	Creamish white	yellow	Red	Orange	
	Shape	Rod	Rod	Oval	Round	Round	Oval	
	Margin	Circular	Circular	Circular	Circular	Circular	Circular	
ATMOSPHERE	**Colony no.**	1	2					
	Color	Yellow	Pale yellow					
	Shape	Round	Irregular					
	Margin	Circular	Weavy					

A gradual increase in the microbial load was observed for both samples in all three environments. At the end of the 90 days the microbial load was maximum for the samples kept in water for both mono and multifilament and minimum for the samples kept in atmosphere. Types of microbes found more in the samples kept in soil and minimum was found in the samples kept in atmosphere.

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