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Contaminants of Microplastics in the Marine Environment

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Abstract:

Pollution of microplastics is increasing internationally day by day, it is need to know the behaviour of pollution in marine context which is still developing and affecting the marine biota. The plastic debris called microplastics in marine environment as a pollutant has long been the area of environmental research. Microplastics are universally spread in marine environment and causing harm to the marine ecosystem. Microplastics are found in their highest concentration to the coastlines and within mid ocean gyres and it is found abundantly in the marine environment. This review is conducted for the discussion of routes of entrance of microplastic to the marine ecosystem, methods of evaluation of microplastics entering in the marine ecosystem and to discuss environmental impact of microplastics.

Keywords: *Microplastics, Marine Biota, Marine litter, Plastic Ingestion*

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Introduction

Plastics are produced by the polymerization of monomers extracted from oil or gas and are synthetic organic polymers. In 1940s, the amount of plastic being manufactured has increased rapidly with 230 million tonnes of plastic because of the mass production of the plastics. Plastic is an attractive material and its durability make it highly resistant to degradation thatswhy, it is problematic to dispose the plastic material. Plastics are internationally recognized pollutants and its debris entering the marine environment upto 10% and accumulated and persist there (Barnes *et al*., 2009). Microplastics, an small plastic fragments produced by the breakdown of the macroplastics, are tiny and used as scrubbers in cosmetics and air blasting are increasing environmental concern day by day. In 1970s, it is first highlighted the microplastics fragments scattered over the ocean and later it was revealed that these microplastic fragments are omnipresent and have tendency to harm the marine biota.

Microplastics

Macroplastic debris focused on the environmental concern for some time, at turn of century, these fragments are collectively termed as microplastics which is universal pollutant. Andrady (2011) has suggested the term "mesoplastics" to scientific nomenclature, to differentiate between small plastics visible to the human eye and that only visible through microscope.

1. Primary microplastics

Plastic that are produced in microscopic size are defined as primary microplastics and are used in facial cleansers and cosmetics or as air blasting media. Microplastic scrubbers are used as exfoliating hand cleansers and facial scrubs. These plastics are different in shape, size and composition which is depending on the product. Air blasting technology involves the primary microplastics and this process includes blasting acrylic, melamine or polyester microplastic scrubbers at machinery, engines and boat hulls for the removal of rust and paint.

2. Secondry microplastics

These are produced on breakdown of the larger plastic debris on both sea and land. The structural integrity of plastic debris can be reduced by the result of physical, biological and chemical processes. Photodegradation of the plastics, ultraviolet radiation in sunlight causes oxidation of the polymer matrix leading to bond cleavage is caused by the prolong periods of sunlight exposure and these degradation is just because of the additives added to increase the durability and corrosion resistance of the plastic. The smallest microparticles reportedly found in the ocean is 1.6 µm, still is is considered that microplastics can be futher breakdown into nano particles size. These nano plastics in the marine environment will be more significant in the field of researches in upcoming years.

Sources and Transfer of Microplastics into the Marine Environment

Marine litter results from the unselective direct or indirect disposal of waste items transferred to our seas and oceans. Source of approximately 80% of the plastic found in the marine litter is terrestrial. These plastics includes primary microplastics which is used in cosmetics and air blasting, improperly disposed user plastics and plastic lechates from refused sites. The plastic used in cosmetics and air blasting media can enter into the water body via domestic or industrial drainage system whereas, macroplastics and some small plastic debris is trapped by the waste water treatment plants within oxidation ponds or sewage sludge. A numbe of microplastics are paases through this filteration systems (Browne *et al.*, 2007). The transfer of the terrestrial debris from land to sea can be exacerbated by the extreme weather such as flash flooding or hurricans. The other source of plastic debris is plastic products that use granules and small resin pellets which are known as nibs as their raw materials. During transport, accidental spillage of the raw material may enter into the sea and ocean and may contaminate and cause harm to the aquatic biota (Cole *et al.*, 2011).

Impact of Microplastics on the Marine Environment

Microplastics are the omnipresent pollutant and makes a biological impact on the organisms of marine environment. Because of their small size, it is found worldwide and making threat to biota and increasing scientific concerns. Toxi responses can also result from inherent contaminants leaching from the microplastics and extraneous pollutants which are stuck on the microplastics along with the ingesting the microplastics. Microplastics have tendency to be ingested by the marine biota just because of their small size and it is present in both pelagic and benthic ecosystems. It is challenging to observe microplastic ingestion in the wild, but it is reported the microplastics ingestion throughout the food chain (Cole *et al.*, 2011). There is list of laboratory experiments which demonstrate that

marine biota such as zooplanktons, invertebrates and echinoderm larvae, ingest microplastics.

Table 1: List of Laboratory Experiments Demostrating the Ingest Microplastics by Marine Biota.

Organism(s)	Microplastic (µm)	Identification technique
Copepods (Acartia tonsa)	7–70	Microscopy
Echinoderm larvae	10–20	Video observation
Trochophore larvae (Galeolaria caespitosa)	3–10	Microscopy
Scallop (Placopecten magellanicus)	16–18	Detection of 51Cr labelled particles
Amphipod (Orchestia gammarellus), Lugworm (Arenicola marina) & Barnacle (Semibalanus balanoides)	20–2000	Dissection and wormcast examination
Mussel (Mytilus edulis)	2–16	Dissection and fluorescence microscopy
Sea cucumbers	Various	Excrement analysis

(Source: Bolton and Havenhand, 1998)

Review of Literature

Andrady, (2011) discussed the generation mechanism and impact of the microplastics on the ocean environment and said microplastics concentrate persistent organic pollutants (POPs) by partition. Microplastics loaded by the concentrate level of POPs can be ingested by the marine biota. There is an urgent need to quantify the magnitude of these potential outcomes and assess the future impact of increasing microplastics.

Franeker and Law, (2015) worked on seabirds, gyres and global trends in plastic pollution. An effective biological indicators of the abundance of floating plastic marine debris are fulmars. Sinks of the floating plastic debris in the marine environment is still undetermined which rapidly lost from the ocean surface.

Wang *et al.*, (2015) reviewed the behaviours of microplastics in the marine environment and classified the behaviours of microplastics as physical behaviours, chemical behaviours and bio behaviours and said with increasing production poor npolicy enforcement and in feasible removal of substantial plastic debris, the plastic pollution in the marine environment would deteriorate.

Anderson, Park and Palace, (2016) summarized the current state of knowledge of microplastics in Canadian aquatic environments. They suggested that, efforts to determine aquatic receptors at greatest risk of detrimental effects due to microplastic exposure, and their associated contaminants, are particularly warranted.

Avio, Gorbi and Regoli, (2016) noted that plastic pollution in the marine environment is now recognized as a real threat with large scale distribution and making adverse effects on the physiological perfoirmance and health of organisms and suggested that the futher studies should be carried out to better lucdate factors influencing the occurrence of microplastics in marine organisms and modulations of biological effects.

Law, (2017) represent the evaluation of the current understanding of the sources, distribution fate and impacts of the marine plastics and recognized that standardized sampling methodology and reporting are critically lacking in the detection, quantification and characterization of plastic debris in the marine environment.

Mrowiec, (2017) presented a review on some of the physicochemical propertiesof plastic materials for the determination of their toxic effect on the aquatic environment and discussed the issue of plastic pollutants in the water can determined the socio economic system.

Conclusion

It is clear by the previous studies that microplastics have become a major problem for the marine life as

it is consumpted by the marine biota that gives an adverse effect on their health (e.g. mortality, morbidity and reproductive success) which remains unclear and these contaminants passes upto the food chain. It is the topic of significant concern about the microplastic ingestion along with the toxic chemicals to biota. Further studies should be done to fill the gaps in this field of research and there is need to reduce the use of microplastic that endangers the life of marine biota.

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