

Impact and Invading Trend of Microplastics in Aquatic Environment

Vignesh V.¹ and Velmurugan P.²

¹P.G. Student, Department of Aquaculture, Kerala University of Fisheries and Ocean Studies (KUFOS), Panangad, Kochi, Kerala

²Assistant Professor, Kanyakumari Parakkai Centre for Sustainable Aquaculture, Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Nagapattinam, Tamil Nadu

SUMMARY

Microplastics are minute fragments of plastic wastes, emerge as very harmful trouble to the entire world. They are copious as they are occupying in the terrestrial surface to biogeographical region surface of the deep sea ocean. Here, the effect of microplastics on the aquatic environment and the organism are discussed. The sources of production of microplastics are from the terrestrial environment. But they are transferred into the aquatic ecosystem by biotic and abiotic factors and vice versa. When dealing with an aquaculture system, the system is polluted with different inputs which are meant to increase the efficiency of production and animals' health. They are settled down in the system and ingested by the organisms. The bio-accumulation of the microplastics is done in their body and transferred to other animals through the food chain. Ultimately, humans are affected due to the consumption of those animals, exposed to the microplastics in the environment.

INTRODUCTION

The water resource has become seriously threatened across the globe by various kind of aquatic pollution. In this line, Microplastics pollution is considered an emerging one and their resource are extensive, which include point source of pollution. Annually 500 million tonnes being produced and 80 million tons end up in the marine ecosystem. Its cause widespread distribution and a huge impact on both aquatic and human life. In human life using plastic is being now an unavoidable one. While manufacturing these industry widely adding polyethene, polyvinyl chloride, polyamide, polystyrene and propylene etc. plastic is also playing a vital role in the aquaculture industry such as fishing gear, bucket, breeding and cultivation device etc. Thus, they can't separate from the aquaculture industry. The commercial fish contained a huge quantity of microplastics. Moreover, river and lakes receiving effluent from industry without going through a terrestrial environment. Despite, microplastics get breakdown through a different physical and biological activity where naturally through these are entering into the food chain and it is ending with our food. In the ocean, several organisms are ingesting microplastics mistakenly because they are too small in size. This causes a severe effect on the aquatic organism; a blockage in the digestive system, the problem of gastrointestinal, loss of buoyancy, reproduction failure etc. there are no standard methods exist for determining the number of microplastics from the ecosystem and organism. There is a need to understand the relation between microplastics and aquaculture and their cause on ecosystem & food safety. So that users can be reduced effectively. The Plastic product industries adopt a treatment system and ensure them to discharge treated water into any aquatic ecosystem. Therefore, need an adherence of enforcement for liable to control invade of microplastics into the aquatic system.

Source of Microplastics

Microplastics are often classified with a size range of 0.1 to 5000 μm . These microplastics are potentially harmful to the environment in various ways and damaging the organisms which are part of the former one. The microplastics are incorporated into the environment from different sources. They are incorporated into the terrestrial and aquatic ecosystem from point sources like industrial waste, sewage run-off, and non-point sources like synthetic fibres emitted from the laundry, usage of a wide range of plastic products, etc. Two types of microplastics pollute the ecosystems are primary microplastics (plastics from engineering materials, plastic pellets from which the plastic are produced, small beads of plastic which are used for the different one, etc) and secondary microplastics which includes the small plastic fragments originate from the synthetic clothing materials, household plastic wastes, etc. These microplastics are not only transferred from the terrestrial ecosystem but they originate from the anthropogenic activities done in the terrestrial ecosystem.

Movement of microplastics

The microplastics migrate from terrestrial to an aquatic ecosystem or vice versa. They are migrated through various routes. The first one is the atmosphere. The atmosphere plays a major role in the transportation of the microplastics, as they are transported by wind or by evaporation. Then the microplastics enter into an ecosystem. Another route of transportation of microplastics is animals. Animals like Earthworm ingest the microplastics and the earthworm was consumed by other bird or animal. The same thing is going with other terrestrial and aquatic animals and so the microplastics are transported through the food chain and accumulate in their body.

The microplastics are easily transported from one place to another, irrespective of their individual physical and chemical nature, since they are very small in size and lower degree of photo-degradability. The utmost destination of the microplastics is to be sediments of the terrestrial or aquatic ecosystem. From an aquaculture point of view, the microplastics have also come from the field activities like usage of plastic materials in aquaculture system as constructive materials (consists of floats, nettings, etc), feed and other accessories for culturing animals. And then the cycle repeats.

Microplastics in Aquatic environment

The pollution made by microplastic is started in 1950 when the industries had begun to produce a large number of polymers. Even though polluting the environment with plastic is ceased, the production of microplastics from the fragmentation of already plastics would remain increase. So, there would be a definite chance of increasing microplastics in the environment in future days. The microplastics entered into the aquatic system would spread among various zones of the ecosystem like surface water as floating microplastics, benthic zone if their density is higher than the water. In recent days, the littoral zone of the aquatic system, nearer to the urban area, is having more plastic pollution. This would affect the aquatic organisms which live in the littoral zone. When dealing with the pollution of microplastics in the aquaculture system, the farmers also become an important part of the pollution of their system. As said before, there are many plastic materials, are being used in the aquaculture system which leads to the direct incorporation of the microplastics into the culture system and the organisms in it.

Routes of incorporation into Aquaculture system

To enhance Aquaculture production, various types of artificial fertilizers are used in the field. The antibiotics and other chemicals used for the disease resistance. All these compounds are the source of microplastics and they are absorbed by the microplastics which are already present in the system. Another major source of microplastics is the usage of artificial feed which contains a minute amount of the microplastics, which may be mixed during their formulation in industries. For harvesting the cultured organisms and preventing them from the escapement, the fishing gears and accessories are used, made of synthetic fibres. As the synthetic fibres are prone to sunlight and other chemical reactions, they are broken down into small fragments of microplastics and settle in the culture system forever.

Microplastics in the marine environment

In the case of Mariculture, plastic pollution is a fearful thing to the culturing organisms. The plastic wastes dumped in the freshwater ecosystem like rivers will reach the ultimate destination, the ocean. Then one part of the plastic wastes aggregates near the shore, whereas another part is fragmented into micro-and nano-plastics and enter into the oceans current and being ubiquitous in the ocean. The microplastics present in the marine ecosystem would be a major threat for the organisms (either finfish or shellfish) raised in the mariculture and enter into their body. The ingested microplastics causes a dangerous effect on the organism and the same thing happens for the aquatic organism cultured in the inland ecosystem too. It is also found that microplastics acts as a carrier for pathogens and cause diseases in cultured organisms.

Microplastics in the food chain

The microplastics are absorbed by the plankton, algae, higher plants and other aquatic organisms. Then they are acting as a carrier of those fragmented microplastics and the transfer of those particles occurs through the food chain. Thus, the microplastics are transferred through the different trophic levels and bio-accumulation is

done across the food web. Irrespective of the feeding habit, both filter-feeding organisms and carnivorous organisms are susceptible to microplastics.

Effect on the human body

The toxic effect of taking finfish which ingested microplastic is considerably low since the ingested microplastic is generally removed during processing. The problem arises in the case of shellfish like bivalves and mussels because they are consumed as the whole part. It is found that the microplastics having the size of 150µm could not be absorbed by the mammalian gut epithelium and so could not enter into the other physiological system. However, the microplastics would further fragment into nano plastics which could cause potential health risks in the human body.

CONCLUSION

There is a lack of study on this area to provide information about the toxic effects on the human body and so more research studies have to be done. But there would be no promise that the finfish or shellfish we consume, do not contain microplastics. The plastic pollution keeps on increasing so that the micro- and nano- plastics fragment would turn into the greater risk. In turn, they would affect the planet Earth and every single organism living in it.

REFERENCES

- Lusher, A., Hollman, P., & Mandoza-Hill, J. (2017). Microplastics in fisheries and aquaculture. In *FAO Fisheries and Aquaculture Technical Paper* (Vol. 615, Issue July). <http://www.fao.org/3/a-i7677e.pdf>
- Simmerman, C. B., & Coleman Wasik, J. K. (2020). The effect of urban point source contamination on microplastic levels in water and organisms in a cold-water stream. *Limnology and Oceanography Letters*, 5(1), 137–146. <https://doi.org/10.1002/lol2.10138>
- Zhou, A., Zhang, Y., Xie, S., Chen, Y., Li, X., Wang, J., & Zou, J. (2021). Microplastics and their potential effects on the aquaculture systems: a critical review. *Reviews in Aquaculture*, 13(1), 719–733. <https://doi.org/10.1111/raq.12496>