

**“PLASTIC AS A VECTOR FOR
CONTAMINATION ON MARINE
ECOSYSTEM”**

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE
OF

**MASTER OF
SCIENCE**

IN

BIOTECHNOLOGY

Submitted by:

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Have you registered for the conference (yes/no)? : Yes

Status of the paper (Accepted/published/communicated): Accepted

Date of paper communication: 19/5/2021

Date of paper acceptance: 30/5/2021

Date of paper Publication: 25-27 june 2021

2. **Title of the Paper:** Microplastic as a vector for contamination on aquatic ecosystem.

Author name: Surbhi Kandwal

Name of the journal: Research Journal of Biotechnology

Conference date with Venue (if applicable):

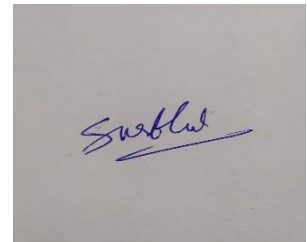
Have you registered for the conference (yes/no)? : no

Status of the paper (Accepted/published/communicated): Communicated

Date of paper communication: 28/5/2021

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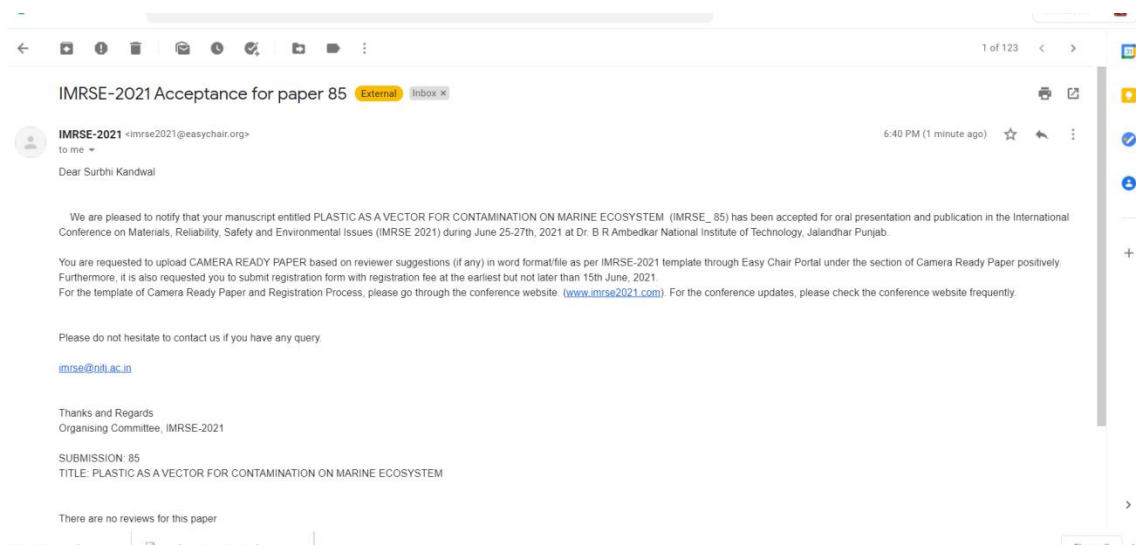
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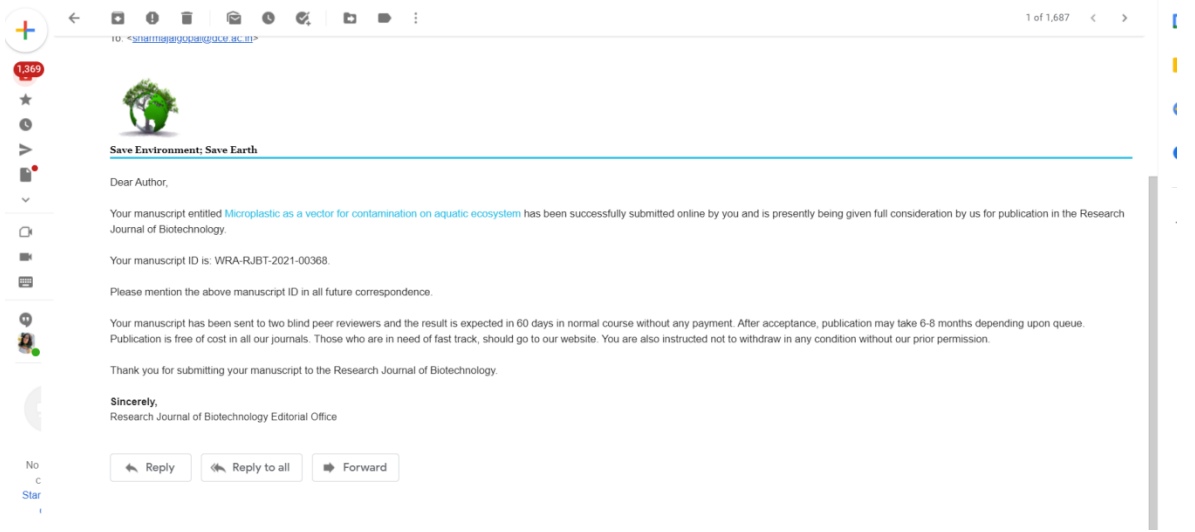
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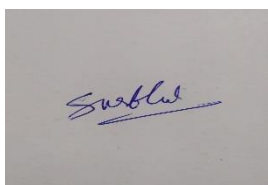
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Acknowledgement

It is my privilege to express my profound sense of gratitude and indebtedness to my mentor **mentor Prof. Jai Gopal Sharma**, Professor in the Department of Biotechnology, Delhi Technological University for his valuable guidance and consistent encouragement during the progress of the project work. The dissertation wouldn't be completed within a short period without his insightful suggestions and support. I am equally grateful and wish to express my wholehearted thanks to respected lab seniors, Ms. Neha Tiwari for their kind support and help in the course of my research work. On a personal note, I wish to express my gratitude and affection to my family for their constant love and support. I would like to thank all my friends for their boundless love and trust which motivated me to complete the project work in the given time.



Surbhi Kandwal

ABSTRACT

The marine ecosystems are inter-connected with the terrestrial ecosystem; thus, any alteration in one system has impacts on another. The impacts of the micro-plastics on marine ecosystem plants and organisms are presently, the subject of intense study. When the plastic debris can enter into the marine ecosystem the debris of the micro-plastics can harm the plants present in the marine but grounded on the novel investigation, micro-plastics has the negligible effects on the plants. Floras can be therefore, symbolize a sustainable pathway for the micro-plastics to arrive in the marine food webs. In spite of this, the strong interfaces of the plastic debris by floras can be used for their phyto-stabilization and then the ultimate elimination from marine ecosystem. The chief purposes of the review here is to deliberate about micro-plastics and sources or transfer of them into the marine ecosystem. We were also discussing the impacts of marine plants and organisms when the micro-plastics enter into the marine ecosystem and what are the outcomes. The small debris of the micro-plastics when enter the marine ecosystem, the marine organisms directly or indirectly consumed the micro-plastic particles

which result in the contamination of the seafood. As micro-plastics are already present in a variety of sea-food matters, there is powerful encouragement for the transfer of micro-plastic particles to the humans. The ingestion can cause skin irritation, digestive problems, cardiovascular disease, respiratory problems, reproductive effects, and cancer in the humans.

CONTENTS

Candidate Declaration

Certificate

Acknowledgement

Abstract

Content

CHAPTER 1 INTRODUCTION

List of figures

Figure 2.1 Marine ecosystem surrounded by microplastics.

Figure 2.2 Plastic pollution near beach and river side.

Figure 3.1 Plants affected by microplastics

Figure 3.2 Fish consumed microplastic particles which lead to death.

Figure 3.3 Transfer of microplastics

CHAPTER 1

INTRODUCTION

The endurance of the plastic that produces such an appealing substance to practice too makes them extremely tough for ruin or degradation, therefore decomposing of micro-plastic waste is challenging. Some of the plastic waste is reused, but the majority come to an end in land-fill wherever it might take many eras for such substance to collapse & then finally decomposed.

Plastic pollution symbolizes one of the most serious risks of the current period. Many of over-all mess unrestricted in the normal atmospheres fit in to the minor size plastic-debris i.e., (micro-plastics) which come after an extensive range of causes, comprising attire, cosmetics, trawling, & manufacturing methods; their is plenty predictable remain to rise, indicating the major fear about marine or human biota. The consumption of tiny micro-plastic by the many aquatic kinds like turtles, mammals, cetaceans, fish, seabirds, is producing worry within the methodical society, administrators, procedure creators or the common civic[1] [2] [3] [4] [5]. Micro-plastics can also effect on the marine plants while causing harm to the physical characteristics and soil biota. But the effect of the micro-plastics on marine organisms is more harmful comparing to the marine plants. Vascular plants are the significantly primary producers of the marine ecosystem and can be characterize as the food for the fish and birds. As micro-plastics already exist in a variety of sea-food matters, there is powerful encouragement for the allocation of micro-plastic elements to the beings. When human consume the plastic debris of the contaminated seafood sources, it can cause direct or indirect health problems on human. Especially because of the micro-plastics tiny size, the particles could be easily consumed or collected in the brain, or nerves, and also in the circulatory system of the creatures which cause the many adverse well-being effects [6].

CHAPTER 2

MICROPLASTICS

The small pieces of plastics present in the marine ecosystem are micro-plastic which is almost 5 mm in length that arise in the environment by the plastic pollution. The micro-plastics present in the aquatic environment are of wide range of shapes, i.e., film, fibre, irregular, shapes. The materials are characteristically collected of the poly-ethylene, a common constituent of the plastics, but they can also be mass-produced from the poly-propylene, poly-ethylene. There are seven types of microplastics present around the marine ecosystem and environment namely, 1) micro-beads 2) scrubbers 3) nurdles 4) plastic powders 5) fibres 6) foam and 7) secondary microplastics.

Microplastics have a low recovery rate as compared to paper, glass, aluminium and iron. And also they are non-biodegradable. They take many years and eras to decompose and destroy. Plastic materials are basically made up of the synthetic chemicals like poly-ethylene terephthalate that biodegradation micro-organisms cannot consume. It is considered that more than 1.1 to 88 MT of the plastics discarded into the land and marine ecosystem almost every year. As an outcome, of which the marine organisms are directly affected by the entanglement of plastics, consumption problems or chemicals that create variations in their tissue organizations.



(Source: Wikipedia) Marine ecosystem surrounded by microplastics

Classification of Micro-plastics

Micro-plastics could be categorized between the two: primary micro-plastics & secondary micro-plastics depend on the particle size. Primary micro-plastic primarily includes plastic microbeads and nanoparticles and is basically used in industrial methods, i.e., industrial detergents and cosmetics. Secondary micro-plastics occurred from the large plastic substances that have broken down in situ i.e., household garbage's, plastic film remains.

Primary micro-plastics	Secondary micro-plastics
• Industrial detergent	• Household garbage
• Cosmetic formulation	• Vehicle emission
• Microplastic particles	• Agricultural plastic films
• Personal care products	• Atmospheric deposition
• Plastic microbeads	• Sewage and sludge



MICROPLASTICS



Aquatic ecosystem
○ Groundwater
○ Aquatic organisms
○ Sediments
○ Microorganisms

CHAPTER 3

SOURCES AND TRANSFER OF MICRO-PLASTICS INTO THE MARINE ECOSYSTEM

The plastic pollution is either directly or indirectly transferred by us in the marine ecosystem. In this review paper, we will discuss about together direct or indirect methods that helps the plastic debris to enter in aquatic ecosystem. Plastic debris within a earthly resource provides ~80% of micro-plastics which are establish in aquatic ecosystem [7]. These types of plastics are the primary micro-plastics that are used in air-blushing and cosmetics. Because of the property of primary micro-plastics they have high potential for entering the marine ecosystem via rivers, seas, oceans and other water bodies. The macro-plastics and many other plastic debris traps into the waste-water treatment plants, a large amount of micro-plastics will pass through such filtration systems[8] [9]. These plastics than enter directly in the marine ecosystem.

- The most of the occurrence of the dangerous plastic materials in the marine ecosystem is because of the anthropogenic actions which may involves industrial and domestic actions or activities.
- Coastal events which involve aqua tourism actions, fishing practices and marine industries are also the sources of micro-plastic pollution create in the marine ecosystem.
- Beach tourism, entertaining and industrial or entertaining trawling, sea ships or aquatic productions are all the resources that belong to the plastics which can enter directly to the marine ecosystem.
- Engaging and tourism activities performed near beaches and coastal are one of the major sources of the plastic pollution in marine ecosystem.



(Source:Wikipedia) plastic pollution in beaches and river side

3.1 Impacts of micro-plastics on the marine ecosystem

The micro-plastics are present everywhere and in large amount in the marine ecosystem [10] [9] [11]. The probability of the plastic debris can cause hazard to the biome is high, because they are minor in the size which marks the plastic debris accessible to enter into the marine organisms [10] [12] [8] [13]. The consumption of these micro-plastics by the marine ecosystem organisms cause adverse effects and contaminated responses.

3.2 Impacts of micro-plastics on marine flora/plants

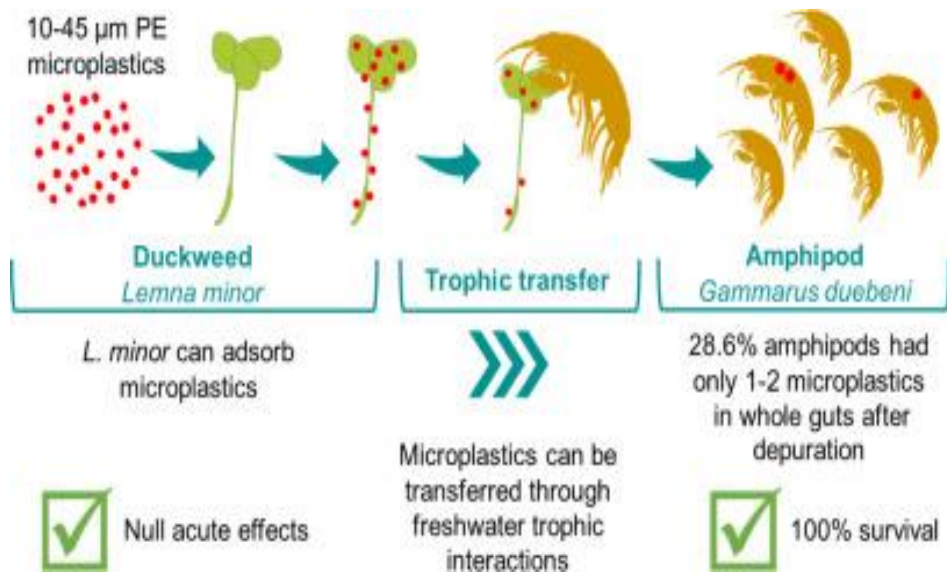
Vascular-plants are significant main creators in the marine ecosystem where they signify diet for the fishes or birds and assist as a better environment for most of the different species. When the micro-plastic enters the marine ecosystem, the maximum number of the plastic debris floats upon the water's surface. Consequently, there is plenty of micro-plastic in the water surface micropayer [14] of unmoving waters like water reservoirs and lakes [15] [16].Here they can main cooperate with the moving-plant for example duck-weeds. When micro-plastic comes in interaction with the duck-weed, then they rapidly involved with the

origins or abaxial-leaf shallow of the duck-weed [17] [18]. Micro-plastic do not suggestively disturb the growth rate of the duckweeds [17] [19] [18], but solid micro-plastic with harsh ends can directly disturb the end length of the duck-weed and also cause influence on the end tissues [19]. So, when the micro-plastic enters in the marine ecology & connect with the floras, at the exact period, they just quickly inhabited through various infective lives which produce a bio-film[20]. The biofilm can help to cover the sharp micro-plastic edges and can also defend the duckweed roots from damage [21]. Therefore, it is believable the marine vascular-plants are not that toughly exaggerated by the micro-plastics present in the marine ecosystem.

Vascular-plants have the potential to be used for the purpose of exclusion of the micro-plastics from the marine ecosystem by the technique phyto-stabilization. It is a bio-remediation technique retaining the floras to calm, de-mobilize, & fixed impurities through the flora's ends and the grasses, thus reduced their bio-availability. That technique is used for dissolving of the impurities [22] and the nanoparticles [23]. It makes us believe that this technique may be considered to the removal of the micro-plastics. Thereby, such as, moving vascular-plants can be used in upcoming for micro-plastics gathering in the fresh-water, particularly near the Dams wherever the high deliberations of the moving micro-plastics are collected [24]. Current investigation believed that also underwater vascular plants are not suggestively affected by accurate environmental absorptions of microplastics.

- As same as the algal cells, the microplastics due to the electrostatic forces can be fascinated to the cellulose constituents of the plant cells. Also there adsorption is improved by the roughness of that plant cellulose surfaces, which deliver several binding sites for the attachment of plastic materials.
- A significant role in microplastic plant interactions as showed for macroalgae was surface morphology; structurally compound thalli can obtain more microplastics.
- A periphyton layer on the marine plants surface can also help them to obtain the microplastics due to the adhesiveness that strongly bind microplastics on a marine plant.

Marine vascular plants consumed by the herbivores may also signify a feasible pathway for the microplastics to enter the marine food webs. The marine vascular plants are the suggestively the primary producers of the marine ecosystem and also be signify as the food for the fish and birds.



(Source: Wikipedia) Plants effected by microplastics

3.3 Impacts of micro-plastics on marine organisms

Ingestion and Entanglement are some of the serious issues combined with the micro-plastic portions. Ingestion and Entanglement of macro-plastic fragments could be dangerous or sub-deadly. As the immediate outcomes of ingestion and entanglement, the marine or seaside biotic-organisms may decrease or sometimes get damaged lethally. Sub-deadly impacts affect dropping the catching and consuming the food elements, damage of the sensitivity, impairing reproduction capability, damage of mobility, reduced the growth and body condition, the lack of ability to escape from the predators. The consumed particles frequently contains the meso or micro debris sized particles that is capable to enter easily into the gut and then body without harming or affecting the beings. In highly situations, though, these tiny particles can stuck inside in the throat, stomach, or gastro-intestinal region and can origin harm or a fake feeling of fullness, which will cause food shortage in the body.

Fishes, sea-birds, sea-turtles, and aquatic organisms can become knotted in or ingest plastic particles, which results in causing suffocation, food shortage, and dying. Humans are not resistant to this warning: As the plastics are expected more than hundreds of years to complete decompose, and some of them break down into the small particles, the outcome of

which is end up in the seafood we eat. Many birds in the marine ecosystem jump in water bodies in search for food, and thereby meet plastic debris. Fishing lines and six-pack rings are the supreme reasons of tangle by sea-birds are whaling-lines & six-pack rings.

Research reveals that half of many sea turtles global have consumed plastic. Because of consumption of plastic, they feel starving mistakenly, supposing their stomachs are already full. Also, plastic pollution causes harm to the reproduction rates of the turtles by changing the temperature of the sand where incubation takes place. In recent research discovered that the sea turtles that consume around 14 plastic pieces have a high risk of death. The offspring are mainly at threat because they are not as careful as their elders about what they eat around them.

3.3.1 Intake by fish

Many reasearchers have found that the occurrence of the micro-plastic in the intestine of numerous fishes. And a investigation group examined that the more than 20 species of fish from the South-China Sea [27] and detected the micro-plastic in the gastrointestinal tracts and having not any problems while consumption of micro-plastic. A recent study by [28] recognized that (91 fish) from the different 4 classes of the KwaZulu-Natal, South Africa. The reading appealed that the plastic debris consumption can be possible because of the misidentification of the prey and the trophic transfer which were recommended by [29]. Marketable fish have its place to diverse trophic level was composed from the Biobio district of the Chile (Pozo et al. 2019) to take out the trophic transfer of the plastic debris. [30] calculated 11 profitable fish from the Malaysia or found that the marine-fish which consumed the micro-plastic by mistake can indirectly or directly cause harm to the culture mammals and individuals as recommended by [31].



(Source: Wikipedia) Fish consumed microplastic particles which lead to death.

3.3.2 Intake by molluscs

The blue mussels was recognized with the acceptance polymers of the dissimilar sizes also huge total of polystyrene was identified in their circulatory system in the body[28]. The two public aquatic-foods ingested in the Europe, particularly in the Belgium are the Bivalves & Mussels. The small particles of the plastics was settle to be surrounded in the mussel nerves and the organs, so there has the probability of the bio-accumulation to the levels of trophic which also embraces the human [29] [27]. Many of the current revisions on molluscs has concentrated on observing occurrence of micro-plastic in their guts *Mytilus edulis* [30] [31].

3.3.3 Intake by crustaceans

Because of the rate of the micro-plastic ingestion of Crustaceans have gathered importance as observed in the number of studies. Micro-plastic consumption through the marine lobster

Nephrops norvegicus was experimentally evidenced through [4] as their learning proved that the 83% of trial mammals had confirmed test positive, while the examining through [32] on the similar species found 262 micro-plastic molecules from the 103 individuals gathered from the field.

3.3.4 Intake by the marine mammals

Marine mammals like dolphins and whales are known to ingest majority amount of the micro-plastic debris [37] projected the postulates on the probable ingestion of the micro-plastic debris by the *Balaenoptera Physalus*. The sieve beneficial for the environment of the whale allows them to swallow huge quantity of the plankton on the way ingesting the substantial amount of the micro-plastic. Nelms et al. examined that the circulation of the stuck aquatic mammals within the sea-side of the Britain [38]. It has been discovered that complete of the 6 kinds of dolphins (21 nos), 2 species of the seals (7 nos), harbor porpoise (21 nos), and 6 species of pygmy sperm whale (1 nos) were discovered stranded throughout their examining. They exposed occurrence of usual of 5.5 molecules per animal amongst the examining 50 stuck organisms. Presence of the micro-plastic was in the gut or intestine which includes PP, PET, LDPE, nylon, rayon, phenoxy resin, polyester, and polyamide resin.

3.4 Intake by Benthic Invertebrates

Naidu-et al. (2018) experiential that the occurrence of the poly-styrene in the benthic invertebrates likes *Magelona cinta* which was a deposit feeder, *Tellina sp.* Or *Sternaspis scutata* which was a suspended feeder though could not describe effects of the micro-plastic [39]. The 3 taxonomic families of the freshwater invertebrates namely, *Hydropsychidae*, *Heptageniidae*, and *Baetidae* were examined, and micro-plastics in the array of the 0.14MP mg tissue⁻¹ were detected [40]. The study recommended that the detritivores and filter

feeders have the inclination to ingest the micro-plastic. Kim with his colleagues examined that spring ends (*Lobella sookamensis*) get confined in the soil because of the gathering of the micro-plastic in the biopores made by the movement of the creatures [41].

3.5 Intake by microbiota

Many scientists have examined the micro-plastic consumption by microbiota like zooplankton [42], marine isopod—*Idotea emarginata* [43], *Calanus helgolandicus* [44]; *Daphnia magna* [45]; Amphipod *Orchestoidea tuberculata* [46]. At this examined, Cole et al. (2015) articulated decrease in nourishing of the *Calanus-helgolandicus* in the ingestion of the micro-plastic [44]. The copepads are massive feeders of the micro-algae; so, once the plastic debris was consumed, then there was the substantial decreasing in their nourishing behaviours. They were also capable of exposing the connection among the serving and imitation as the size and also the sum of the producing eggs was also reduced. Because of the toxicity of the micro-plastic mixture and gold nanoparticles [47] exposed decreasing growth in the marine micro-algae *Tetraselmis chuii*.

3.6 Intake by other organisms

A number of other species like birds and turtles were found to consume the marine debris. This consumption of the micro-plastic can diversely affect the respiratory system and can cause the damage and also is the reason for the suffocation in different organism, it can also harm to the stomach lining which affects the problem in digestive system[42]. The mixroplastics could be originating in all the trophic levels and are unintentionally ingested by different organisms. A common of the researches concentrating on the different species of fish and molluscus as they were reasonable and easy to examine.

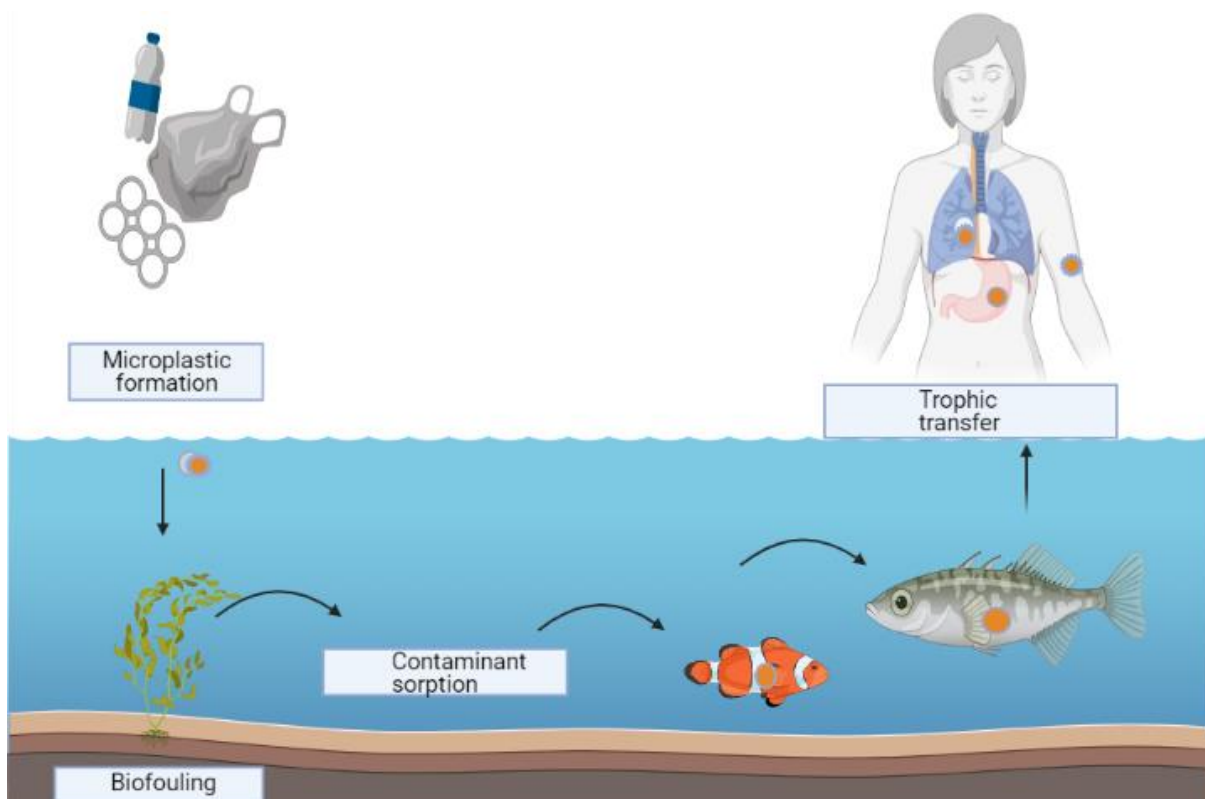
3.7 Impacts of micro-plastics on human

The acceptance of the plastic debris by the individuals can arise complete intake of earthly and marine foodstuffs, or ingestion water and inhalation [50]. Even though seafood being an accepted cause of impurities to the human regimen, existence of the plastic debris in marine food is not measured nor precise [51]. Marine food is a vital component for individual regimen; besides plenty presence of the micro-plastics in the marine food lead to a severe risk to vigour of the individual. Marine food might be polluted by the micro-plastics from the consumption of normal prey, observance of the organisms or throughout handling and marketing period [42] [52]. Several readings have confirmed the existence of the plastics debris in the eatable fishes, prawns, and by consuming these means, the micro-plastics arrive in the human structures as an outcome of the bio-magnifications [53] [54] [55].

As micro-plastics now exist in a variety of sea-food matters, also there is powerful encouragement for allocation of micro-plastic elements to the individuals. Therapeutic trainings on rats & individuals are already established that trans-location of poly-styrene and poly-vinyl-chloride elements < 150 µm from the intestine cavity to lymph & circulatory system [56] [57]. Very few elements are proficient of intersection the cell-membranes, the blood-brain blockade and placenta, with known effects including oxidative stress, cell-injury, swelling and deficiency of vigour provision like that informed for aquatic mammals [50]. When human consume the plastic debris of the contaminated seafood sources, it can cause direct or indirect health problems on human.

Apart from these, many non-marine food i.e. beer and honey are also hold micro-plastic in them. More than a series of 40-660 fiber molecules/kg of the honey was informed by the Liebezeit (2014)[58] where he then demanded that the molecules could be presented throughout the dispensing of the honey. Kosuth et al. (2018) initiate that about the 189 micro-plastic elements from the 12 kinds of the beer or then recommended that elements may have been unintentionally presented while dispensation or wrapping [59]. Koelmans et al. (2019) approved that there is presence of the micro-plastic in drinking water though claimed that main polymers were PVC, PET, PE, PP, and PS [60].

Foodstuffs are not only the one cause of the deliver micro-plastic acquaintance to the human. The plastic exposure can also be arising from the breathing of the air or breathing treatments/tablets [61] [62] [63]. It can straightly inhale and can finish up in the breathing system of the human body [63]. Adversative health special effects can decrease country's efficiency and waged proficiency with harmful influences on public and economic features of the exaggerated zone.



Possible health effects causing from the bio-magnification and the bio-accumulation by the micro-plastics inside the human body. The consumption of the micro-plastics by trophic transfer to human body can affect diversely, the ingestion can cause skin irritation, digestive problems, cardiovascular disease, respiratory problems, reproductive effects, and cancer.

CHAPTER 4

PLASTIC POLLUTION CONTROL AND PREVENTION

- 1) Reduce the use of the plastic materials
 - the decrease in the quantity of the novel plastic manufactured will also decrease the number of harmful outcomes.
- 2) Increase the use of the natural wrapping resources
 - by using the natural wrapping resources like the bamboo utensils, or banyan leaf.
- 3) Trash should be disposed suitably
 - the unsuitable disposition of the trash lead to effect the ecosystem, the proper disposal should be done for avoiding the plastic wastes in road and water.
- 4) Encourage the use of Recyclable plastics materials
 - alternative way of avoiding the contribution of the plastics into the marine ecosystem is to familiarize the recyclable plastic materials. It is made up of the renewable bases and is basically made up of the polymers.
- 5) Encourage the use of Recyclable plastics materials
 - alternative way of avoiding the contribution of the plastics into the marine ecosystem is to familiarize the recyclable plastic materials. It is made up of the renewable bases and is basically made up of the polymers.

New research methodologies must be developed for the conservation management and supporting various educational platforms for the protection of the marine ecosystem against these harmful polymers. The very immediate call in this field is to blowout the awareness among the common people regarding the harmful effects of the micro-plastics. This would arouse different revolutions to decrease the utilization and consumptions of the plastics and its materials. To decrease the plastic input into the marine ecosystem the most significant methodology is to gather and reuse of the plastic materials. To avoid upcoming risk, the best answer is to halt the producing of

plastic further and find out the alternative of the plastic materials. More study is also needed to recognize the possible impact of micro and nano-particles on primary manufacture and food web interactions. Also a main attention should be put on the freshwater organisms as they may be at greatest danger by upcoming future.

CHAPTER 5

CONCLUSION

The paper expected to deliver an impression of the different foundations or transfer of micro-plastic into the marine ecosystem and how it produces damage to marine ecosystem plants and organisms. The pollution caused by plastic have many different biological influences in the assemblage, specific or levels of ecosystem. As the bulk of the micro-plastic is alike as food particles which are ingested by most of the aquatic organisms live in lower trophic levels, these micro-pollutants, are extremely vulnerable to gathering in such biota through consumption with injurious outcomes. The damage would also reach to the humans and many different organisms expressing the advanced trophic levels over the trophic transfer. The small debris of the microplastics when enter the marine ecosystem, the marine organisms directly or indirectly injected the microplastics the outcome of which is that it contaminated the sea food. As microplastics are already present in a variety of sea-food matters, there is a powerful encouragement for the transfer of microplastics to the humans where it causes many problems to the human body. It is undeniable that the maximum number of the organisms is exposed to the micro-plastics and also that exposure may cause a variety of impacts and harm the individuals of the different species. At current, drinking water, table salt and other daily life food items are contaminated by the micro-plastics. For avoiding this contamination, severe actions must compulsory at the level of the National and the International stages against the practice of the plastics use.

To avoid the coming hazard, the finest answer is to halt the developing of the plastics more and discover new substitute of the plastic materials. To reduce the plastic contribution into the marine ecosystem the best significant method is to gather the recycle of the plastic trashes. The acts which are performed by the human are the basically constituent of biosphere; so, it is our concern to deliver the minimum involvement of the use of plastics.

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