Chapter

Effect of Microplastic on the Human Health

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Abstract

Microplastics are defined as a tiny plastic particle with length less than 5 mm that result from commercial product development and the breakdown of larger plastics can be considered as harmful to our environment. The surfaces of plastic tiny fragments can be carrying disease-causing organisms and acts as a vector for diseases. The microplastics can found in water and soil carrying different types of contaminants. The small particles of microplastics serve as carriers for bacteria and persistent organic pollutants, which are considered as biodegradable material that remains active for years. The main definition of microplastics and their source as well as the effect of microplastic waste on the human health with the main solution that helps to eliminate this kind of waste will be explained in this chapter. It was found that the human person eats high quantity of microplastic particles every year through breath air, drinking water, and eating plant crops and animals. On the other hand, sea fish can contain microplastic parts due to drinking and eating sea water with microplastics. Therefore, it is very important to reduce throwing of plastic waste on the ocean and landfill to avoid the effect of microplastic on the human health.

Keywords: microplastic, human health, environment, waste, soil

1. Introduction

Due to increasing the number of populations worldwide, the consumption of plastic was increased too and led to produce and generate microplastic waste. The plastics were entered into all parts of our life from clothing to cleaning products because it is a cheaper, durable, and lightweight material. Large quantities of plastics are released into rivers and oceans, which can be classified into large plastic wastes and small plastic particulates named microplastics [1].

Microplastics are defined as tiny plastic particles that form as a result of the plastic content in consumer products and the breakdown of large plastics. Once they have entered the environment become pollutants, causing harm to the environment and animal health.

Microplastics prove much more challenging to remove due to their small sizes, which are often too small to spot or grab in moving water and can remain active marine contaminants for up to 450 years. The small particles of microplastics serve as carriers for bacteria and persistent organic pollutants, which are toxic organic compounds that take years to degrade. Moreover, they consist of chemical materials that are hazardous to human and animal health in high concentrations. The humans ingest

microplastics by eating marine animals that have consumed the material or through drinking water or breathing air. Therefore, it is very important to have idea and information about microplastics and how to avoid or eliminate their effect on our life.

This chapter will explain the main source and effect of microplastic on the human health.

2. Microplastic

Increasing consumption of plastic products in modern society has caused microplastic contamination in nearly all environmental media. Microplastics are tiny plastic particles that result from both commercial product development and the breakdown of larger plastics. As a pollutant, microplastics can be harmful to the environment and animal health. Microplastics are fragments of any type of plastic less than 5 mm in length, according to the U.S. National Oceanic and Atmospheric Administration and the European Chemicals Agency. Moreover, microplastics can be defined as heterogeneously mixed plastics that include plastic fibers, granules, and fragments with diameters less than 5 mm. They are considered to be emerging contaminants of concern [2].

3. Source of microplastic

The main source of microplastics can be defined as tires, synthetic textiles, marine coatings, road markings, personal care products, plastic pellets, and city dust. Moreover, the majority of microplastics come from household activity with a percentage of 77% and 23% from industrials application [1].

4. Effect of microplastic waste on the human health

Based on the latest global estimate of microplastics, there are 93–236 thousand tons of microplastics floating on the ocean surface, which corresponds to 51 trillion particles. 79% of global plastic waste is stacked in landfills, which makes soil a large microplastic sink. For example, 90% of Swiss floodplain soils have microplastics at depths between 0 and 5 cm [1].

Plastic products are usually manufactured by using new resources basically petroleum-based materials. However, they lost their value during their life cycles due to leakage along the entire value chain such as pellet loss, loss during transportation, and storage of plastic waste and littering as well as combined sewage overflow and poorly designed products, which lead to loss into our environment easily and difficult to recover as shown in **Figure 1**. This leads to contamination of the environment, affecting wildlife and human well-being. A small proportion is recycled for remanufacturing with remainder utilized for energy recovery [3].

The sources of microplastics are mainly classified as either primary or secondary microplastics. Primary microplastics are purposefully manufactured for specific applications, which include cosmetic abrasives, drug vectors, and industrial and engineering applications such as air blasting. These microplastics are usually difficult to remove using sewage disposal technologies and once they enter wastewater, they will ultimately accumulate in the environment. Secondary microplastics originate from larger

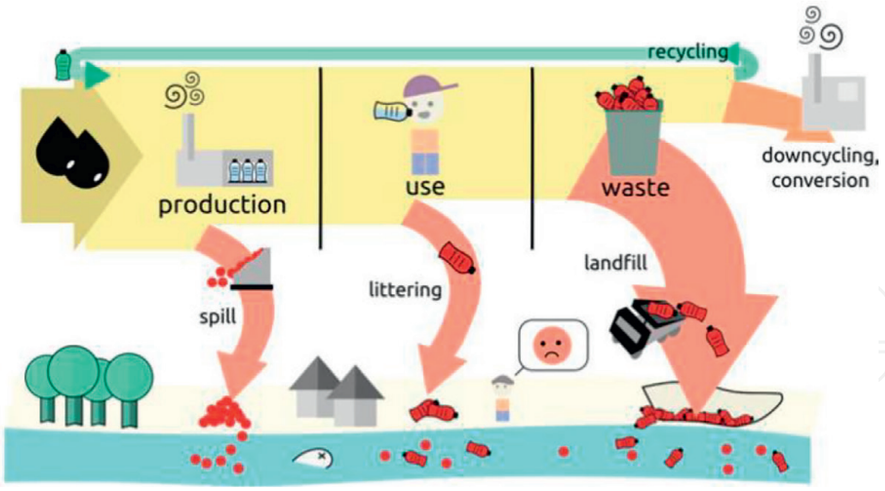

Figure 1.
Life cycle of microplastic and plastic products.

plastics as they are progressively fragmented into smaller pieces by multiple, complex environmental conditions such as wind, waves, temperature, and UV light [2].

The sources of microplastics in the ocean mainly include land-based sources with a percentage of 80% caused by coastal tourism, recreational, commercial fishing, or plastic fishing gear applications and 18% caused by marine vessels and marine industries such as aquaculture and oil rigs. The microplastics enter soil via multiple sources that include landfills, soil amendments, land application of sewage sludge, wastewater irrigation, compost and organic fertilizer, residues of agricultural mulching films, tire wear and tear, and atmospheric deposition. **Figure 2** shows source of microplastic waste in soil [2, 4].

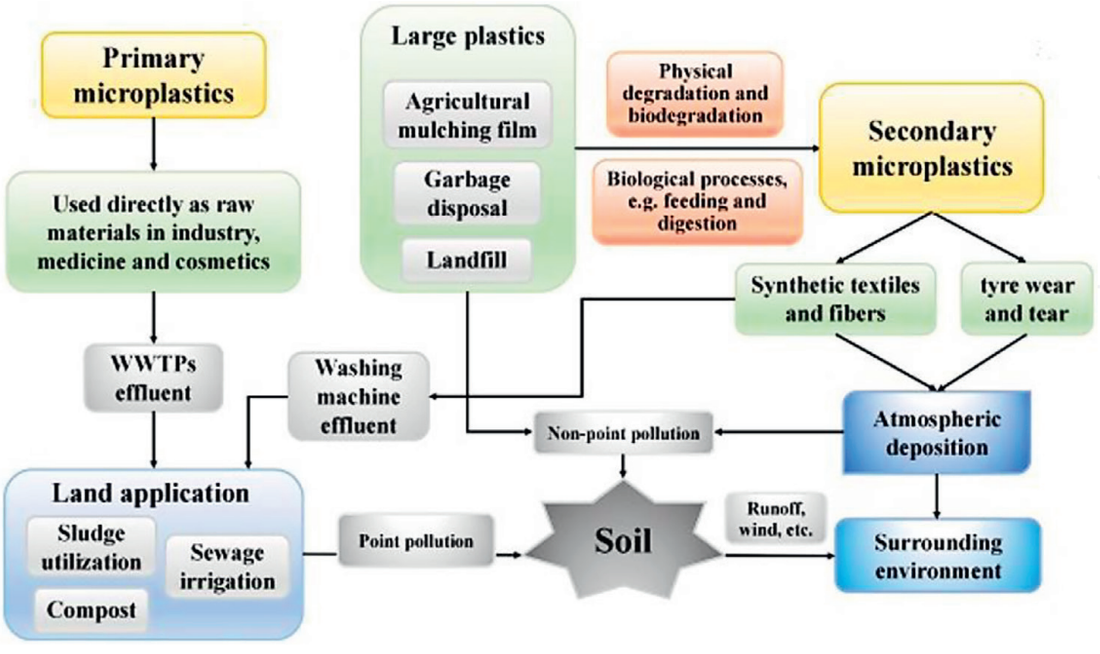

Figure 2.
Source of microplastics in soil [2].

Microplastic waste can be affecting soil by making soil cracking, pores, agronomic practices by plowing and harvesting, root elongation of plants, the activities of ingestion, and egestion of geophagies soil fauna. Moreover, the excavating activities of other soil animals contribute likely to the most vertical transport of microplastics in soil; however, the activities of hunting and life activities of epigenic earthworms, as well as agronomical practices can be facilitating the horizontal distribution of microplastics in soil. Additionally, plastic types can also influence the migration, because those microbeads and microfibers have been proved to show different interactions with soil aggregation, which may exert potentially blocking effects on the transport of microplastics in soil. Furthermore, transport may be influenced by plastic surface properties and eco-corona altered by the process of degradation. Soil nature influences the migration of microplastics, which lies to change the properties of soil such as soil structure and function as well as microbial diversity. This microbial may translate to plant and animal consequences and present potential concerns for food quality and safety, ultimately threatening human health as shown in **Figure 3**.

Salt is mostly produced by the distillation of seawater, which will contained microplastic materials. It is difficult to avoid microplastics in final sea salt products without further purification steps. Thermoplastics such as polyethylene, polypropylene, and polystyrene comprised the majority of microplastics that can be found in the food, which account for more than 50%. Fibers are critical because they are thought to cause toxic effects at lower doses than spherical particles. Fibers including particles classified as "filaments" were dominant in many food items. For example, the fraction of fibers reached almost 100% of microplastics in sea salts and edible tissues of fish and shellfish [5–11].

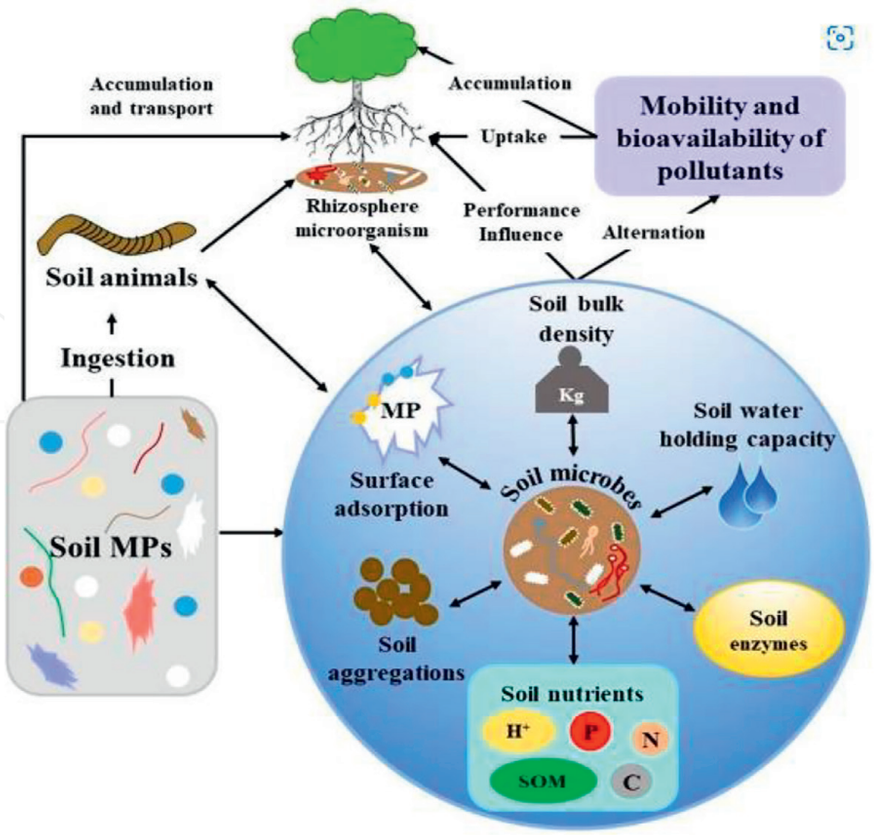

Figure 3.
Impact of microplastics on soil function and properties [2].

Microplastics have been found in different foods such as fish and seafood, table salt, beer, honey and sugar, and tap water. On the other hand, it is found in soil as a result of contamination from items such as discarded packaging or plastic agricultural equipment [12–16].

The studies show that the human person eats at least 50,000 microplastic particles every year because of the infiltrated food chain, drinking water, and breathing air. There are seven types of sources can be considered as food sources of microplastics that includes bottled water, beer, sea food (Shellfish and fish), salt, tee Bag, canned Food, and ready meals. Water in plastic bottles that is used for drinking is one of the worst sources of microplastic, which results in ingesting around 130,000 fragments of microplastic in the human body yearly. The infiltration only gets worse when the bottle is exposed to direct sunlight. The tap water contains tiny plastic bits but the level in bottled water is double than tap water. On the other hand, 1 liter of beer contains 4.05 plastic fibers. Moreover, shellfish is the second major source of microplastic after water because many marine species mistakenly eat plastic debris floating in the ocean. Tiny plastic fibers are present in their entire body including bivalves, which are consumed by humans. In addition, 1 kilogram of sea salt contains 212 particles of microplastic. Furthermore, plastic teabags when dipped in hot water leach microplastics in the cup, therefore, most brands use paper teabags. The biggest health threat with canned foods is the chemical BPA because it is used to harden the plastic, which seeps into the food inside and contaminates it. Finally, the quick meals are usually served in plastic containers, which add a secret ingredient to your diet along with other nutrients microplastic [17].

There is a different source of plastic waste that can be collected from any wildlife in or around rivers, which is exposed to the threats of microplastic pollution. Microplastics can block the gastrointestinal tracts of organisms, or trick them into thinking they do not need to eat, leading to starvation as shown in **Figures 4–6** [18].

Microplastic materials can be carried a range of contaminants such as trace metals and some potentially harmful organic chemicals. The chemical materials can be leaching from the plastic surface into the body, which leads to an increase in the

Figure 4.
Plastic and microplastic waste collected around rivers [18].

Figure 5.
Municipal workers cleaning plastic wastes from river [18].

Figure 6.
Different types of plastic wastes covering the top surface of rivers [18].

potential of toxic effects. Moreover, microplastics can cause cancer because they have carcinogenic properties.

Microplastics were found in tap water, which can be carried on their surfaces disease-causing organisms, and act as a vector for diseases in the environment. It is interacted with soil fauna, affecting their health and soil functions. Moreover,

microplastics can be blocked the gastrointestinal tract of small birds and fish as well as they can be caused internally physical damage such as lacerations or irritation to sensitive gastrointestinal tissues.

Researchers show that human exposure to microplastics could lead to oxidative stress, DNA damage, and inflammation, among other health problems. Particularly, when inflammation becomes chronic, this can pave the way to very serious health problems.

The fruit and vegetables have contamination that transpires when the plants suck water that contains microplastic up through their roots. The majority of crops have microplastics such as pears, potatoes, radishes, and lettuce. However, apples and carrots have the highest levels of microplastic particles.

A recent study has found that people eat 5 grams of micro and nano plastics every week. From the most remote depths of the ocean to the deepest section of the lung, microplastics appear to have invaded every bit of our lives, including the human gastrointestinal tract. In laboratory tests, microplastics have been shown to cause damage to human cells, including both allergic reactions, cell death, damaging cells, and inducing inflammatory and immune reactions.

Regarding the microplastic contamination of soil, the ecological and health risk resulting from microplastic exposure was of significant concern. Microplastics may concentrate in human body through various exposure pathways as shown in **Figure** 7 such as inhalation of dust, consumption of food, or direct drinking water contaminated by microplastics [19].

According to European Food Safety Authority (EFSA), still, we do not have enough information and data that explain how microplastics are present in food and how to affect human health and their behavior in our bodies. Therefore, it is very important to make more research to develop new standardization methods to analyze microplastics and determine their effect and risk on the human body. At the moment there is no advice from official authorities indicating that we need to change our eating behavior or avoid certain foods to steer clear of microplastics [13, 14].

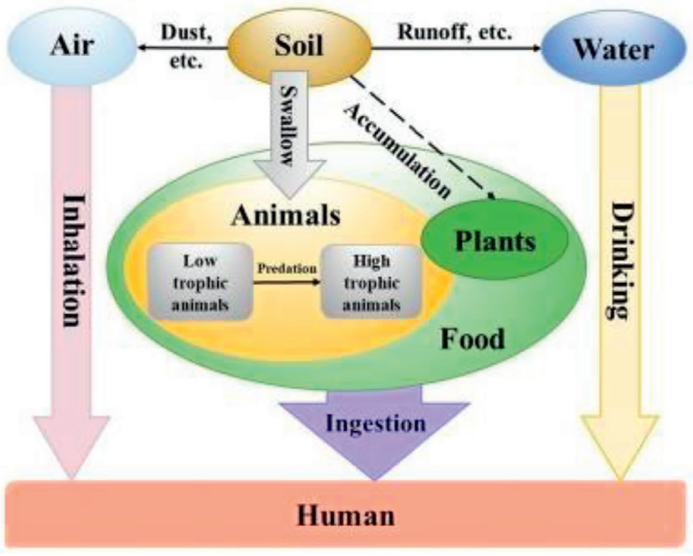

Figure 7.
Various contact pathways of concentration microplastics in human body [19].

5. Solution to eliminate microplastic waste

The ocean cleanup has developed the first scalable solution to efficiently intercept plastic in rivers before it reaches the oceans. By tackling 1000 rivers around the world. To eliminate the microplastic waste effect there are seven things that can be done, which include [20]:

1. Reduce your use of single-use plastics.

2. Support legislation to curb plastic production and waste.

3. Recycle properly.

4. Participate in a beach or river cleanup.

5. Avoid products containing microbeads.

6. Spread the word.

7. Buy a water filter, and stop using bottled water.

8. Buy non-synthetic eco-friendly clothes.

9. Get a laundry ball.

10. Air dry, do not use the dryer.

11. Use public transport, and favor rail infrastructure.

12. Reduce your meat and fish consumption.

13. Use active carbon filter on your tap water

14. Using paper bag instead of plastic bag.

6. Conclusions

Microplastics demonstrate much more challenging to remove due to their small size and huge quantity, which can be remain active for years. The small particles of microplastics serve as carriers for bacteria and persistent organic pollutants, which are considered as biodegradable materials. Moreover, they consist of chemical materials that are hazardous to human and animal health in high concentrations. Many sources of food and landfill have microplastic waste that goes directly or indirectly to the human body by eating food or breathing air, which affect human health. It was found that the human person eats at least 50,000 microplastic particles every year. Still, there is not enough data that help to know how microplastics affect humans. However, there are some solutions to eliminate the effect of microplastics on the

humans and animals. Therefore, it is very important to make more researches to develop new standardization methods to analyze microplastics and determine their effect and risk on the human body.

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