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MICROPLASTICS IN DRINKING WATER: A GLOBAL CONCERN

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Abstract

Primary micro plastics are specifically manufactured in the micro plastic size range, for example industrial abrasives used in sandblasting and micro beads used in cosmetics. Secondary micro plastics are formed by the fragmentation and weathering of larger plastic items either from wear or from their release into the environment. Particle concentrations reported in individual samples ranged from 0 to over 104 particles/L and mean values ranged from roughly 10-3 particles/L Micro plastics can enter the food chain, being ingested by small marine animals, which can then be consumed by larger animals, including humans. The presence of micro plastics in drinking water also has implications for aquatic ecosystems. Furthermore, micro plastics can act as a vector for the transport of pollutants, such as heavy metals and pesticides, into aquatic ecosystems.

Introduction

The definition of micro plastics is not completely straightforward. Micro plastics represent a diverse range of material types, shapes, colors and sizes to account for these complexities, researchers have proposed definitions for plastic debris (Hartmann et al., 2019) and micro plastics for example, by describing them according to specific criteria. Because of the different methods used to collect and quantify micro plastics, it was not possible to apply a uniform definition to the results of existing studies. However, the lack of a uniform definition does not impact this assessment, nor the conclusions in this report. Most definitions in the literature focus on composition and size. A widely used definition describes micro plastics as plastic particles smaller than 5 mm in length. However, this is a rather arbitrary definition and is of limited value in the context of drinking-water since particles at the upper end of the size range are unlikely to be found in treated drinking-water. Some groups define a lower bound at about 1 µm. The lower bound is often simply a function of the sampling and analytical technique used in the study. A subset of micro plastics smaller than 1 µm in length are often referred to as nano plastics, but again with an inconsistent upper bound. As for the composition of micro plastics, there is again no standard definition. Many studies focus on particles made from synthetic polymers rather than using the International Organization for

Standardization (ISO) definition, which excludes elastomeric material.

The German Federal Ministry of Education and Research defines plastics as a subgroup of polymers including elastomers and modified natural polymers (Braun et al., 2018). The European Chemicals Agency uses solid polymer-containing particles but excludes natural polymers that have not been modified. Microplastics are sometimes categorized as two types, primary and secondary. Primary microplastics are specifically manufactured in the microplastic size range, for example industrial abrasives used in sandblasting and microbeads used in cosmetics. Secondary microplastics are formed by the fragmentation and weathering of larger plastic items (e.g. bags, bottles, clothing, tyres, etc.) either from wear or from their release into the environment.

Sources of Microplastics

Microplastics can enter drinking water through various sources, including tap water, bottled water, and freshwater sources such as groundwater and surface water. A study analyzing 159 water samples found micro plastics in 83% of the samples, with the highest concentrations in tap water 4. Another study reviewed 55 records from 50 studies, reporting micro plastic concentrations in drinking water and its freshwater sources.

One of the primary sources of microplastics in drinking water is the degradation of larger plastic products, such as plastic bags, bottles, and microbeads. These products break down into smaller pieces, known as microplastics, which can then enter the water supply through wastewater treatment plants, agricultural runoff, and atmospheric deposition (Andrady, 2011)

Microplastics concentration in drinking water

A total of nine studies measured microplastics in drinking-water. Particle concentrations reported in individual samples ranged from 0 to over 104 particles/L and mean values ranged from roughly 10-3 particles/L in a study of drinking-water derived from groundwater to over 103 particles/L. In general, ground waters are well protected from particulate contamination. Similarly, conventional drinking-water treatment is expected to provide an effective barrier for a wide range of particle sizes. Different studies looked at different ranges of particle sizes and had different cut-offs for reporting particle sizes. Studies typically used a filter with a mesh or pore size of less than 10 µm and in some cases characterized particles as small as 1 µm. In the context of drinking-water, an arbitrary cut-off of 100 µm in length was suggested to distinguish large particle from small particles. Where studies looked at both large and small particles, small particles tended to be more numerous. (Amrutha and Warrier, 2020).

Effects on Human health

The effects of microplastics on human health are not yet fully understood, but research suggests that consuming microplastics can have adverse health effects. Microplastics can leach toxic chemicals, such as bisphenol A (BPA), into the water, which can then be ingested by humans. These chemicals have been linked to various health problems, including cancer, reproductive issues, and neurological damage (Atanasova, 2018).

A study estimated that the average American consumes more than 70,000 particles of microplastics per year, with those who drink only bottled water consuming even more. The long-term

effects of consuming microplastics are unknown, but it is clear that reducing exposure to these pollutants is essential for protecting human health (Amaral Zettler et al., 2015)

Environmental Impacts

Microplastics not only affect human health but also have devastating environmental consequences. Plastic pollution has been found on beaches of remote, uninhabited islands and in sea water samples across the planet. Microplastics can enter the food chain, being ingested by small marine animals, which can then be consumed by larger animals, including humans (Arias and Andres, 2018).

The presence of microplastics in drinking water also has implications for aquatic ecosystems. Microplastics can alter the physical and chemical properties of water, affecting the habitats of aquatic organisms. Furthermore, microplastics can act as a vector for the transport of pollutants, such as heavy metals and pesticides, into aquatic ecosystems (Abbasi et al., 2020).

Detection and Removal of Microplastics

Detecting and removing microplastics from drinking water is a complex task. Current methods for detecting microplastics include visual inspection, spectroscopy, and chromatography. However, these methods are often time-consuming and expensive, making it challenging to implement them on a large scale. Removing microplastics from drinking water requires the use of effective filtration systems. Some water treatment plants use filters with pores smaller than 20 µm to remove microplastics, but these systems are not foolproof. Additionally, the removal of microplastics from drinking water is often not a priority, as other contaminants, such as bacteria and viruses, are considered more pressing concerns (Barbosa et al., 2020).

Conclusion

Microplastics in drinking water are a growing concern, with far-reaching implications for human health and the environment. Reducing the amount of microplastics in drinking water requires a multifaceted approach, involving the reduction of plastic waste, improvement of wastewater treatment infrastructure, and development of effective filtration systems. Further research is needed to fully understand the effects of microplastics on human health and the environment. However, it is clear that action must be taken to address this emerging problem. By working together, we can reduce the amount of microplastics in our drinking water and protect the health of our planet.

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