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The Presence of Microplastics in Mass Consumption Food

Mishell Arévalo Moyano
Universidad Politécnica Salesiana, Ecuador
Orcid: https://orcid.org/0009-0007-3808-9636

Alexandra Pazmiño Pacheco
Universidad Politécnica Salesiana, Ecuador
Orcid: https://orcid.org/ 0009-0005-5042-1924

At present, the use of plastic has increased disproportionately, since it is considered a material of easy handling, high durability and low production values. However, these characteristics have become one of the main problems of large-scale pollution around the planet, since the environmental factors to which they are exposed during their manufacturing and distribution line generate the fragmentation of the material, causing the start of microplastics. These structures are of synthetic origin and have a diameter of less than five millimeters, a characteristic that makes them imperceptible to the naked eye and difficult to extract. (Bollaín & Vicente, 2019a)

Made up of a number of polymers and chemical substances, microplastics are considered a non-biodegradable organic material, which remains present in the environment for several years, fragmenting due to the influence of environmental factors.

The presence of plastic in the environment is considered one of the biggest problems regarding pollution worldwide, due to the high levels existing in several ecosystems, where approximately 13 million tons of plastic are deposited in the oceans annually, becoming one of the environments most affected by this type of pollutants, Considering that the living organisms that inhabit there, alter their usual development and destabilize the maritime balance (*ONU*, 2018).

The concentration of plastic particles grows on a large scale and its lags are notorious mainly in the sea and soil, where inadequate solid waste management and anthropogenic activities are its main source, resulting in the accumulation and intake of polymers in living organisms (Bollaín & Vicente, 2019).

The plastic industry is one of the most important, because its demand exceeds the level of production, which encourages the increase of it to excessive levels, resulting in the accumulation

of waste that, in general, is not handled correctly and is deposited in landfills and water bodies. Numerous studies have shown the presence of polymers in food, preserves, animals, crops and even neonates, thus marking the importance of the study of microplastics (Silva et al., 2021).

The consumption of food with the presence of microplastics in its structure puts public health and the environment at risk. Research shows the presence of significant amounts in different substances of importance to humans, such as mass consumption foods, in which contaminants accumulate during and after the production line. The use of chemical fertilizers and pesticides, in addition to microparticles absorbed by soil, water and air, increase the variety and concentration of polymers in food supplies (Cort Roig et al., 2021).

Microplastics spread along the food chain, where individuals of the lowest levels, in water, air and land, consume them mistaking them for food, until they reach humans after absorbing the greatest amount of polymers during the process. The control strategies of this contaminant are scarce, because the ignorance of the existence of plastic in the food that is ingested daily, generates high indices of risk for the health and adequate development of living beings (Martínez, s. f.)

The present research seeks to expose the amount of microplastics present in different types of food, through literature review. On the other hand, identify the possible causes of microplastic contamination present in food and beverages. Finally, identify the products with the highest presence of polymers.

This research contains a literature review about the presence of microplastics in food for mass consumption. It describes the methodology used to search for information in databases, the results obtained in the review of 25 articles, statistical graphs of the data comparison, a discussion about the sources of contamination, significant figures of polymer consumption, effects on human health and the final conclusions of the research work.

Methods

Currently, the number of published studies on microplastics has been increasing. The search was carried out in the database, Google Scholar, where an extensive list of results was obtained, including theses, scientific articles and reports, however, the collection of information was carried out based on scientific articles with a maximum publication period of five years, in order to maintain updated data, in addition research from several countries of origin was considered for a broader analysis.

The articles were reviewed in the database, with the use of the word “Microplastics”. Subsequently, the combination of words such as “food”, “drinks”, “fish”, “milk”, “beer”, “salt”, “molluscs” and “crustaceans” was introduced for greater search accuracy.

This review included 25 studies on the presence of microplastics in food and beverages for mass consumption globally. In Table 1, you can find the individual results of the studies, whose year of publication belongs mostly to 2020.

Results

From the compilation of results obtained in various investigations on the presence of microplastics in food and beverages for mass consumption, an analysis was carried out in which different concentrations of polymers are obtained that are shown in the following table.

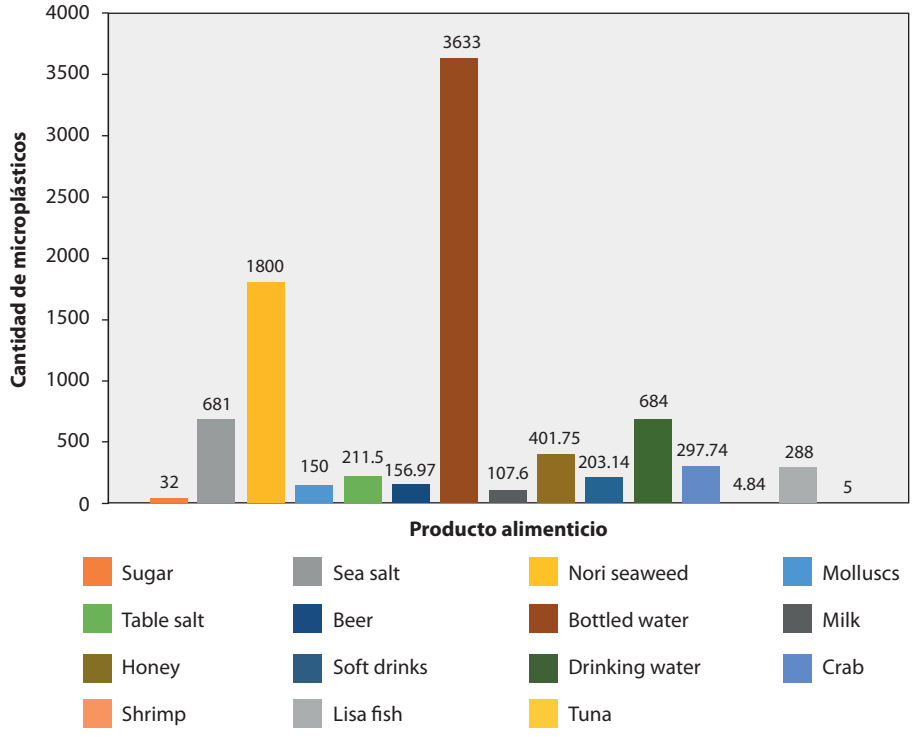
Table 1
Microplastics present in food and beverages for mass consumption

Country	Food/Beverage	Quantity	Unit	Source/Quote
Germany	Sugar	32	particles/kg	(Rubio Armendáriz et al., 2019)
Germany	Beer	33	particles/L	(Rubio Armendáriz et al., 2019)
Germany	Bottled water	3633	particles/L	(Rubio Armendáriz et al., 2019)
Atlantic	Crab	297.74	particles/individual	(Waite et al., 2018)
China	Sea salt	550 - 681	particles/kg	(Rubio Armendáriz et al., 2019)
China	Shrimp	1.55 - 4.84	particles/individuo	Hossain et al., 2020) (Li et al., 2020)
China	Nori seaweed	1800	particles/kg	(Hossain et al., 2020) (Li et al., 2020)
South Korea	Bivalve molluscs	150	particles/kg	(Rubio Armendáriz et al., 2019)
Ecuador	Milk	204.2	particles/L	(Díaz-Basantes et al., 2020)
Ecuador	Artisanal honey	443.5	particles/L	(Díaz-Basantes et al., 2020)
Ecuador	Industrial honey	360	particles/L	(Díaz-Basantes et al., 2020)
Ecuador	Soft drinks	203.14	particles/L	(Díaz-Basantes et al., 2020)
Ecuador	Craft beer	240.25	particles/L	(Díaz-Basantes et al., 2020)
Ecuador	Industrial beer	340.33	particles/L	(Díaz-Basantes et al., 2020)
Spain	Table salt	50-280	particles/kg	(Rubio Armendáriz et al., 2019)
United States	Beer	14.3	particles/L	(Kosuth et al., 2018)
Guatemala	Lisa fish	288	particles/individual	(Ortiz et al., 2021)
India	Table salt	56 -103	particles/kg	(Seth & Shriwastav, 2018)
Easter Island	Fin tuna yellow	5	particles/ individual	(Chagnon et al., 2018)
Italy and Croatia	Table salt	70 - 320	particles/kg	(Renzi et al., 2019)
Mexico, USA, Latin America	Milk	3 - 11	particles/L	(Kutralam-Muniasamy

The research carried out in different countries worldwide, mark the presence of microplastics in all types of food and beverages analyzed, which are usually products of daily consumption. It is noteworthy to note that most studies globally focus on marine species, this is due to the high demand for consumption of them and the rates of polymer pollution recorded in the oceans. The report of the Scientific Committee of the Spanish Agency for Food Safety and Nutrition (AESAN) on the presence of plastics in food, points out that one of the most influential factors for the presence of microplastics in food is the ease of being transferred between trophic levels.

Next, a statistical representation of the products with the presence of microplastics registered in the investigations is made. For this, the most critical data of the values reported in the intervals of Table 1 was taken and an average of the microplastic particles of each type of food was made for its representation.

Figure 1
Particles of microplastics present in different types of food



In the studies carried out in solid foods, described in this research and represented in microplastic particles per kilogram, it is obtained in *Figure 1* that the largest amount of microplastics is found in the *Alga nori*, with 1800 particles per kilogram. Considering that in Asia the consumption of this product is estimated between 4.3 and 5.3 grams per day, so each individual would be ingesting around 7.74 and 9.54 particles of microplastics daily, this is due to the high rate of plastic pollution present in the oceans.

In the studies carried out in beverages, described in this research and represented in microplastic particles per liter, it is obtained in *Figure 1* that the highest amount of microplastics is found in *bottled water*, with 3633 particles per liter. This is due to different variables, such as the packaging and distribution process, and the influence of environmental factors such as temperature and pressure, from the place of production to the point of sale to the public. It is worth mentioning that, in countries such as Germany, the per capita consumption of this product was 147.7 liters in 2018, which means that around 1470 microplastic particles were ingested daily.

In the studies carried out in seafood, described in this research and represented in microplastic particles per individual, it is obtained in *Figure 1* that the largest amount of microplastics is found in *crabs*, with 297.74 particles per individual. It should be considered that this crustacean is omnivorous and the analysis sample was obtained from the Atlantic Ocean, which is characterized by having between 12 and 21 million tons of microplastics on its surface, according to the Nature Communications study. In the United States, one of the largest importers globally, the consumption of this crustacean was 0.58 kg in 2017, indicating an estimated intake of 3453.8 microplastic particles in that year.

Discussion

Microplastics can enter living organisms directly, by being mistaken for food, or indirectly, by consuming contaminated species. To this is added the production of plastic in each of the study locations and the anthropogenic activities that influence pollution levels.

China is characterized by having one of the largest overpopulations globally, a problem that increases waste production. In 2020, it had a population of 1.4 billion people that generated around 63.3 million tons of plastic that, due to the absence of spaces for the proper disposal of this material, were deposited in water bodies, generating high concentrations of polymers in living organisms and aquatic vegetation. It should be noted that plastic particles are mostly deposited at the bottom of rivers and seas accumulating in algae and corals.

Table salt is one of the most demanded products worldwide. According to the WHO, its consumption is recor-

ded at around 5 grams per day, which means that approximately 1.05 particles of microplastics are ingested. It is worth mentioning that salt deposits are mostly found in water bodies, places that, as already mentioned, are the largest accumulators of plastic waste. Senegal is the country that reports the highest amount of particles with respect to the studies carried out in Spain, India, Italy, Croatia, Turkey and Taiwan, due to inadequate management of the extraction, collection, storage and transport of the product. To this is added the extreme temperatures (35°C) that become factors that increase the fragmentation of polymers.

On the other hand, Germany is one of the largest producers and consumers of bottled water globally, generating only in 2017 a consumption per person higher than in the last 5 years. This is due to the culture of consumption, especially of mineral water contained in PET bottles (Polyethylene Terephthalate). Leading the European market and with a population of approximately 83 million inhabitants, this country became the largest daily consumer of microplastics, where variables such as sources of origin and the detachment of particles due to the influence of environmental factors such as temperature and pressure, favor the fragmentation of polymers in the environment.

Beer, one of the most consumed alcoholic beverages globally, is another product with a high amount of microplastics per liter. However, of the studies presented in this research, Ecuador is the country that has the highest presence of microplastics in this drink, despite the fact that its population is significantly lower than that of Germany and the United States. This could be due to variables such as production standards, water quality, packaging process, and the methodologies used for polymer analysis in each study.

Although fish for mass consumption do not present the greatest amount of microplastics in the studies analyzed, their proportion is worrying, since their consumption reaches 20.5 kg per year in each individual, which generates an approximate intake of 1267 polymer particles per year.

Although there are no proven studies on the effects of microplastics on the body, they are considered endocrine disruptors and their accumulation could generate complications in the medium and long term. The global commitment to the control of plastic waste is to reduce, reuse and recycle this type of material, contributing to minimize and mitigate the environmental impact and, therefore, the health of living beings.

Conclusions

The presence of microplastics in food products has become a global problem, due to their high level of contamination, since they are mostly present in food and beverages for mass consumption, such as water, salt, fish, among others, in which a large

amount of microplastic particles has been detected, this problem encouraged scientific communities to conduct research in order to expand existing knowledge and promote the control of production of this type of polymers.

Several researchers agree that the reason why there is the presence of microplastics in food is due to the inadequate management of plastic waste and its overproduction, which generates accumulation in water bodies, air and soil, thus reaching the food that is consumed by humans.

Among the foods with the highest amount of microplastics are those from the sea, which proves that pollution occurs due to the disposal of plastic waste in the oceans, on the other hand, the amount of microplastics existing in bottled water, which although it is true, complies with standardized purification parameters, presents problems in packaging and transport to points of sale, since being exposed to environmental factors that favor the detachment of plastic particles, such as temperature and pressure variation, contaminate the water.

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