MICROPLASTICS IN THE MARINE ENVIRONMENT AND FOOD

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The packaging that we use in our daily lives, play an important role in the quality of food. They provide permanent protection of food from their surroundings, as well as the chemical and physical contaminants.

In the production of food packaging and food contact materials **only materials** and **objects** shall be used that are **not released** into food ingredients during storage and use in quantities that present danger to human health, and also **do not change** its appearance, smell, taste and composition.

Food contact materials are all materials and articles intended to come into contact with food, such as packaging, containers, kitchen equipment, cutlery and dishes, bottles.

Plastics, which are synthetic polymers, are still one of the most widely used materials in the world. **They are lightweight, highly durable, strong and cheap.** These properties make them suitable to produce a wide range of products, persistent and hazardous in the environment.

Many different types of plastic are produced globally, but the market is dominated by 6 classes of plastics:

- ✓ **polyethylene,**
- ✓ **polypropylene,**
- ✓ **polyvinyl chloride,**
- ✓ **polystyrene,**
- ✓ **polyurethane**
- ✓ **polyethylene terephthalate.**

Table 1 shows their common applications

Table 1 Common applications of plastics

Resin Types	Common Applications
Polyethylene	Plastic bags, storage containers
Polypropylene	Rope, bottle, caps, gear, strapping
Polystyrene (expanded)	Cool boxes, floats, cups
Polystyrene	Utensils, containers
Polyvinyl chloride	Film pipe, containers
Polyamide or Nylon	Fishing nets, rope
Poly(ethylene terephthalate)	Bottles, strapping
Polyester resin + glass fiber	Textiles, boats
Cellulose acetate	Cigarette-fiber

It is known that about 70% of the planet is covered by water. Waste falling in water sources and in particular plastics pose a threat not only to the health of marine ecosystems, but also for the global economy and population.

The majority of the waste in the water systems are generated by the activities on land, namely as a result of human involvement.

Table 2

Material	Degradation rate
Plastic beverage holder	400 years
Plastic bag	Up to 1000 years
Plastic bottle	100-1000 years
Synthetic fabric	500 years
Foam cup	50 years
Fishing line	600 years
Polystyrene case	100 – 1000 years

In recent years, plastic pollution has received an increasing amount of interest from researchers, politicians, and the public.

One major aspect of plastic pollution is the occurrence of **microplastics in the aquatic ecosystems.**

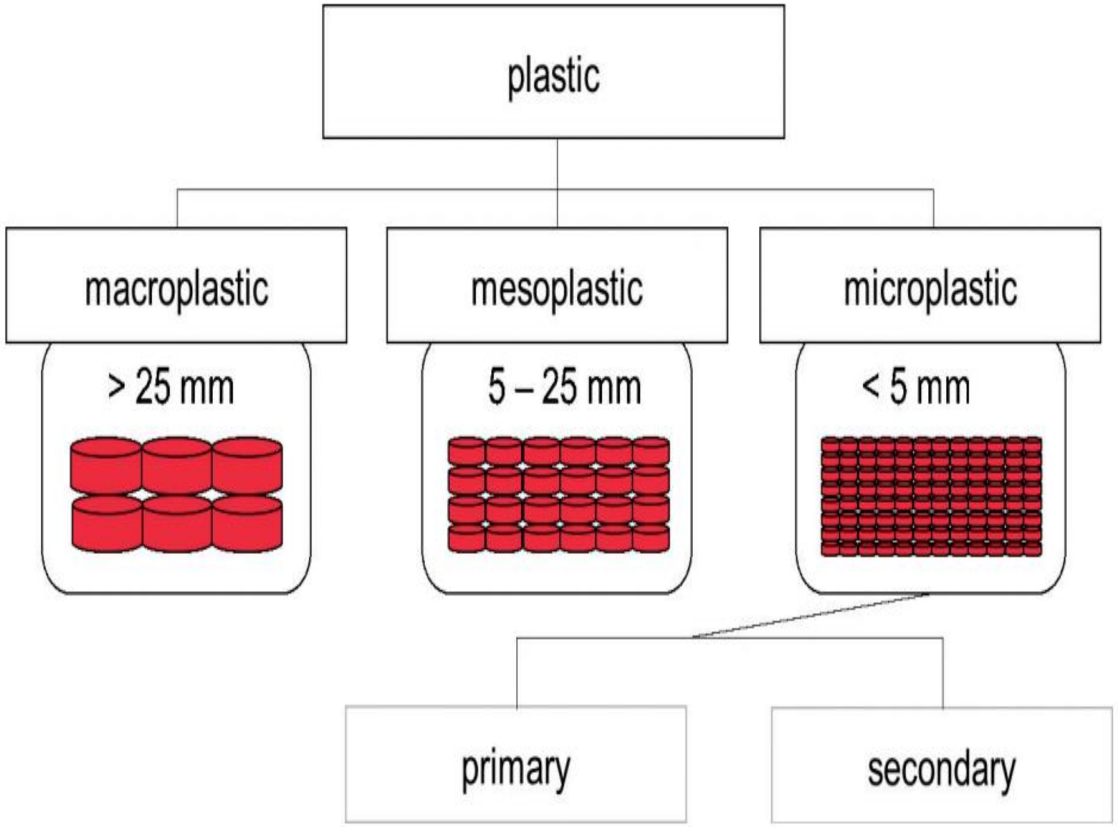


Figure 1 Classification of plastic in the aquatic environment

Daniel Venghaus, Matthias Barjenbruch, Microplastics in urban water management , Environmental engineering DOI: 10.4467/2353737XCT.17.011.6108
Presence of microplastics and nanoplastics in food, withparticular focus on seafood, EFSA Journal 2016;14(6):4501

Microplastics occur in the aquatic environment as **primary** and **secondary** micropastic particles.

Primary microplastic describes industrial defined and produced particles. They include for example pellets, which are used as basic material in the production of plastic products.

Secondary microplastic describes fragments or fibers which rise by biological, chemical or physical degradation of sizeable particles. Consequently, microplastic particles occur in different size, form and colour.

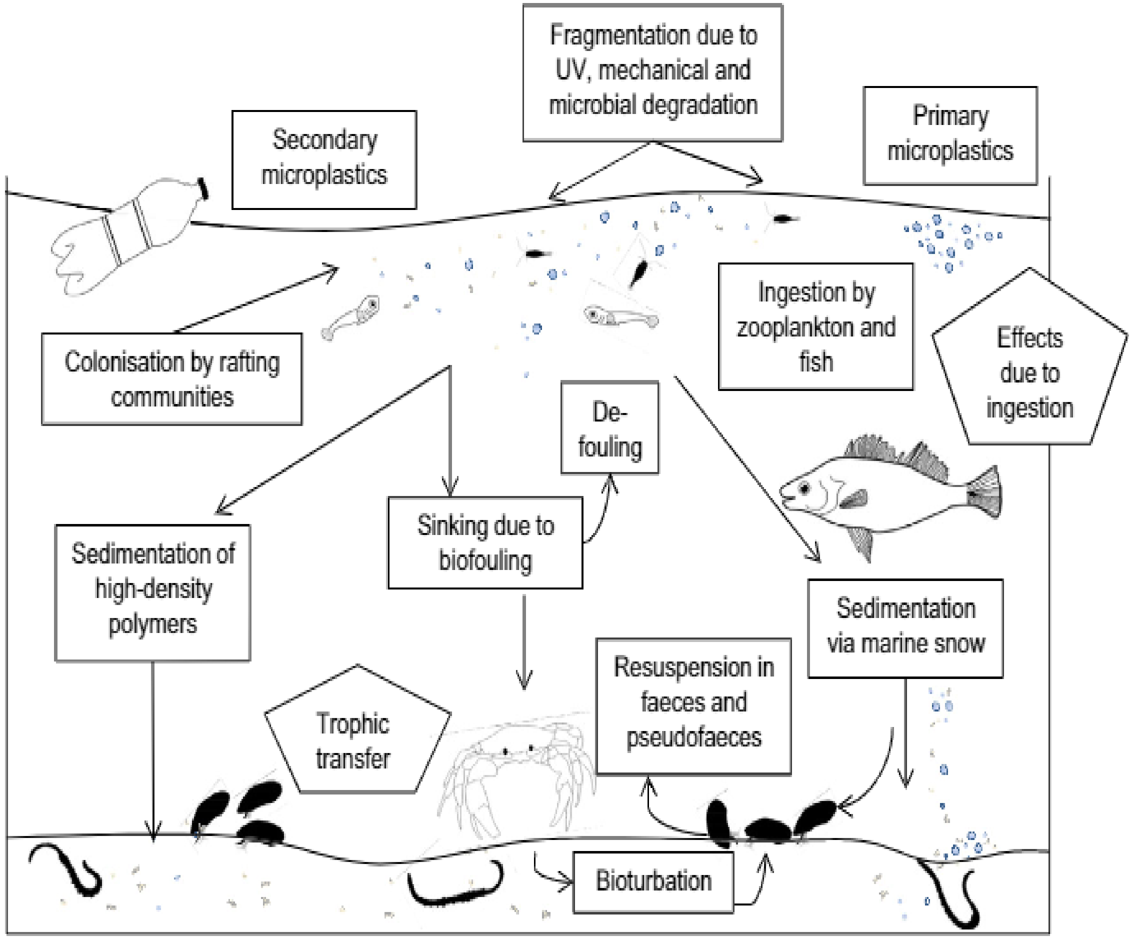
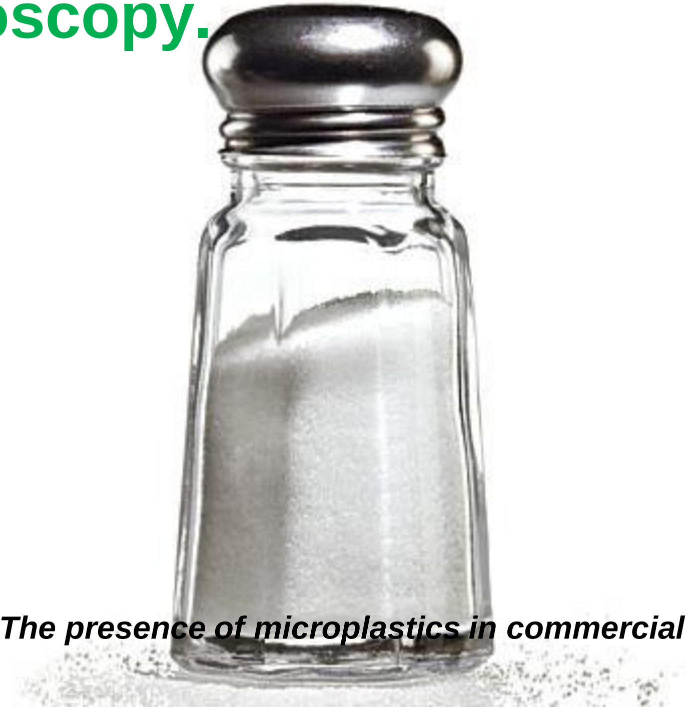


Figure 2 Potential pathways for the transport of microplastics and their biological interactions

The occurrence of microplastics (MPs) in saltwater bodies is relatively well studied, but **nothing is known** about their presence in most of **the commercial salts** that are widely consumed by humans across the globe.

Karami at all extracted MP-like particles larger than 149 μm from **17 salt brands** originating from **8 different countries** followed by the identification of their polymer composition using micro-Raman spectroscopy.



Ali Karami, Abolfazl Golieskardi, Cheng Keong Choo, Vincent Larat, Tamara S. Galloway, Babak Salamatinia, The presence of microplastics in commercial salts from different countries, Scientific RepoRts 7:46173, DOI: 10.1038/srep46173

The results of this study **did not show** a significant load of MPs larger than 149 µm in salts and therefore, negligible health risks associated with the consumption of salts.

The increasing trend of plastic use and disposal, however, might lead to the gradual accumulation of MPs in the oceans and lakes and, therefore, in products from the aquatic environments.

This should necessitate the regular quantification and characterization of MPs in various sea products.

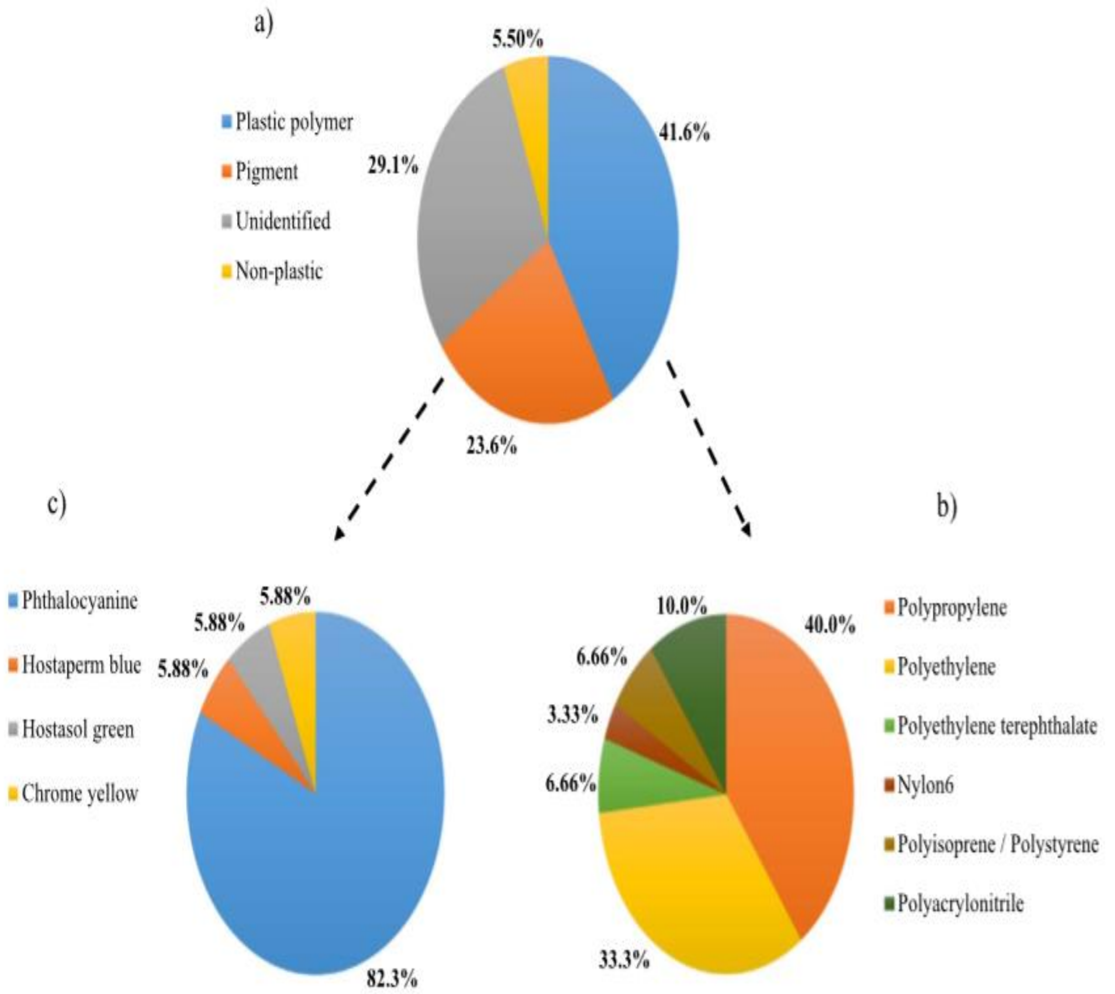


Figure 2 Chemical composition of the isolated particles.
(a) Pie chart of the chemical composition of the isolated particles from all salt samples and the corresponding proportion of different
(b) plastic polymers
(c) pigments

There is study for reliable methods for **microplastic** extraction from **environmental samples.**

Fourier Transformed Infrared (FTIR) Spectroscopic imaging was used to identify and quantify the types of microplastics.

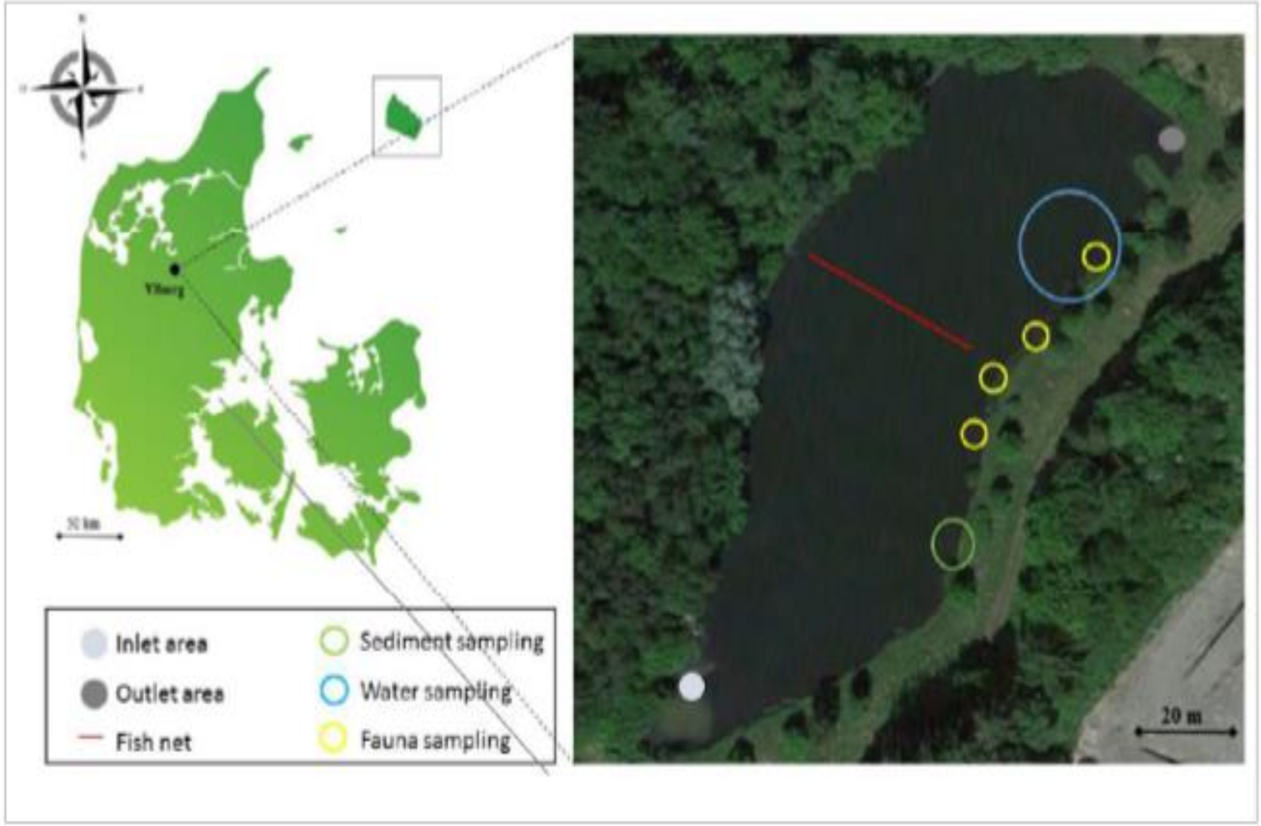


Figure 3 The sampling locations in the wet retention pond in Viborg, Denmark.

The water sampling area is shown as a blue circle, and the sediment sampling area by the green circle. The fauna sampling areas are shown by the yellow circles. The red line shows where a fishing net was located. The light and dark gray dots show the location of the inlet and outlet area respectively

Analysis of Microplastics using FTIR Imaging, Identifying and quantifying microplastics in wastewater, sediment and fauna, (https://www.agilent.com/cs/library/applications/5991-8271EN_microplastics_ftir_application.pdf)

In this study **4.2 million spectra** it becomes a very efficient and accurate method to quantify and chemically identify the particles present.

The percentage by mass and by particle count is presented in Table 3.

Table 3 List of particle ID by % mass and by % particle count

Particle ID	% by mass	% by particle count
PE	0.01%	0.11%
PP	0.30%	1.03%
Polyester	3.11%	3.22%
Polyamide (PA)	0.37%	0.69%
PVC	0.15%	0.23%
Polyurethane	1.21%	1.49%
Polystyrene	0.05%	0.11%
Epoxy	0.02%	0.23%
POM	0.01%	0.11%
Cellulose Acetate	0.15%	0.23%
Protein	1.90%	10.57%
Cellulose	92.98%	82.18%
PU paints	0.10%	0.23%
Alkyd	0.16%	0.46%

The study protocols were validated by spiking samples with a known quantity of **polystyrene particles.** The particles were quantified after the sample preparation and FTIR quantification method was applied.

A high recovery rate was observed for most samples, as shown in Figure 4, with recoveries ranging from 97% in a water sample through to 64% in a sediment sample.

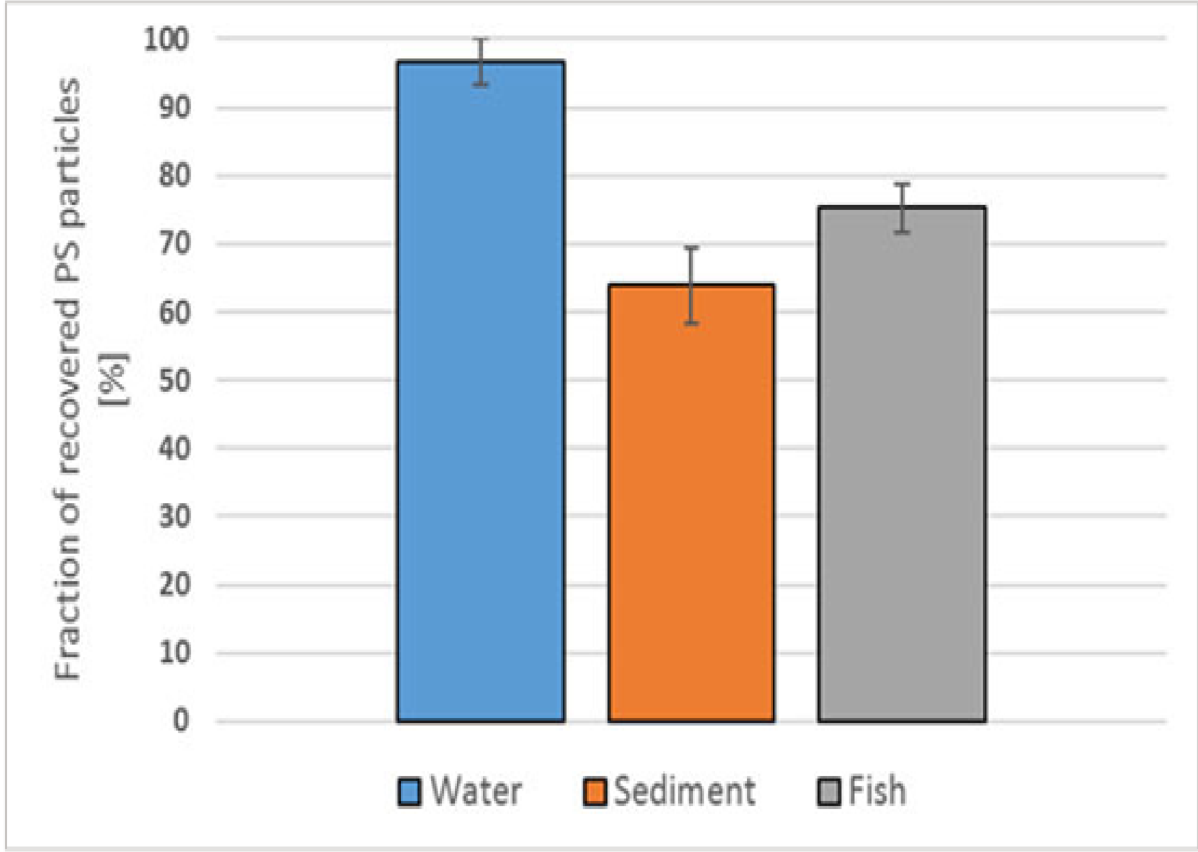


Figure 4 The fraction of recovered polystyrene (PS) beads from spiked samples. The recoveries were: 97% in the water sample, 64% in a sediment sample, and an average of 75% in two fish samples.

New research by Orb Media, a nonprofit journalism organization based in Washington, D.C., shows that a single bottle can hold dozens or possibly even thousands of microscopic plastic particles.

Tests on **more than 250 bottles** from **11 brands** reveal contamination with plastic including polypropylene, nylon, and polyethylene terephthalate.

When contacted by reporters, **two** leading brands confirmed their products **contained microplastic**, but they said Orb's study significantly overstates the amount.

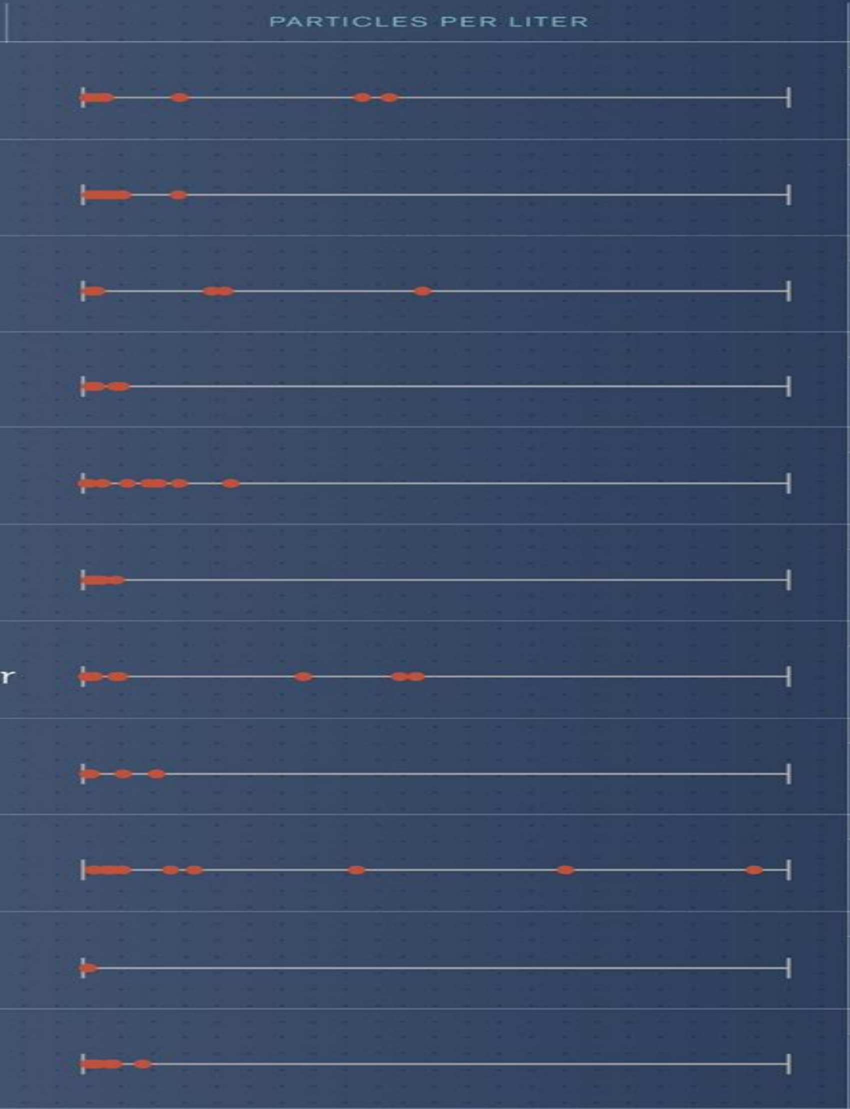
Microplastics found in global bottled water (https://orbmedia.org/stories/plus-plastic/)

TEST RESULTS

BY BOTTLED WATER BRAND

The chart shows the range of particles per liter of bottled water by brand.

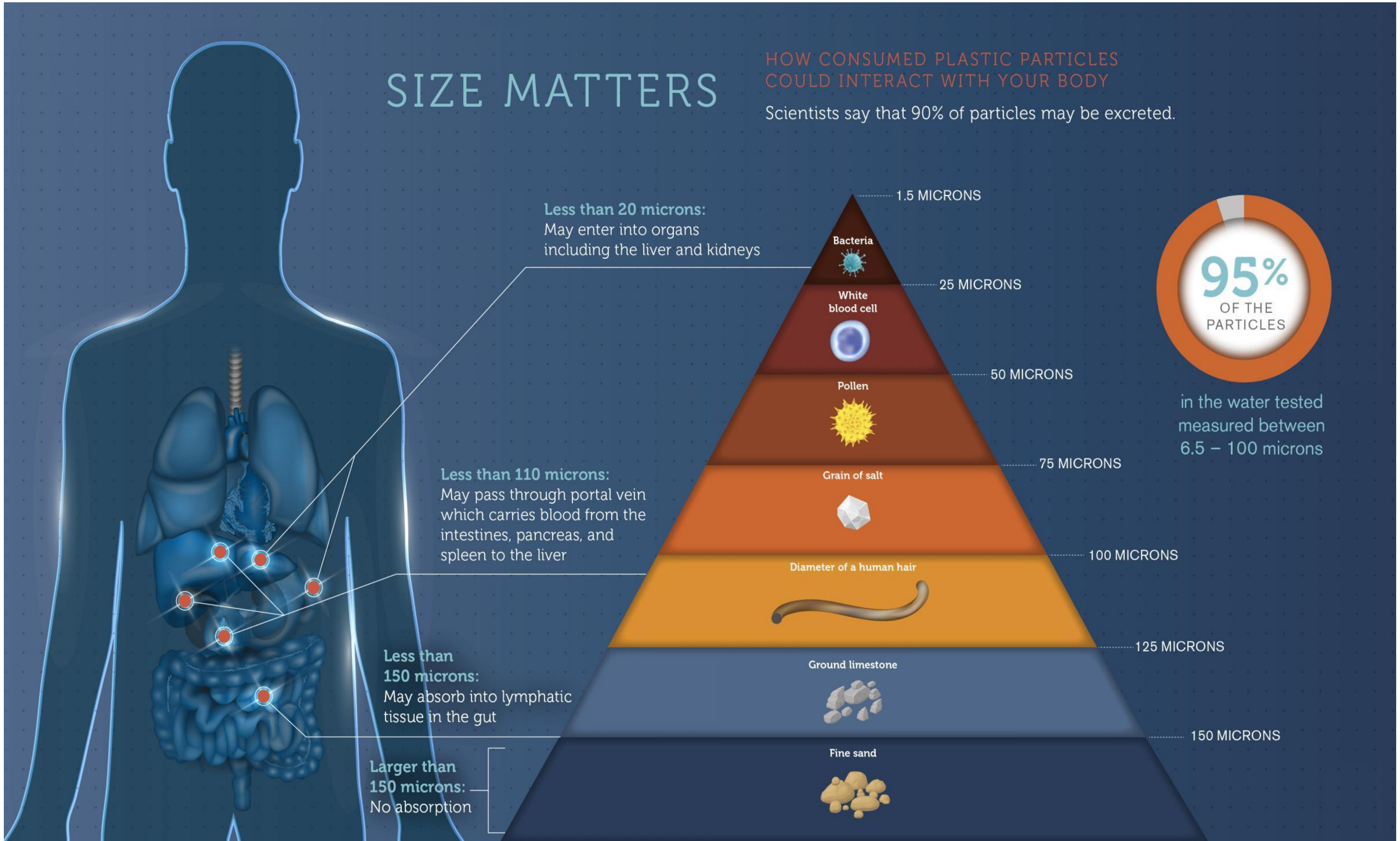
325 average across all brands



BRAND	LOWEST AND HIGHEST NUMBER OF PARTICLES PER LITER: Lowest	Highest
Aqua	0	4,713
Aquafina	2	1,295
Bisleri	0	5,230
Dasani	2	335
Epura	0	2,267
Evian	0	256
Gerolsteiner	9	5,160
Minalba	0	863
Nestle Pure Life	6	10,390
San Pellegrino	0	74
Wahaha	1	731

Note:
Particles rationally expected to be plastic. Bottled water volumes varied from 500 ml to 2 liters. Absolute counts for each bottle were divided by sample volume in order to calculate the density of microplastic (particles per liter). Background contamination amounts have been subtracted from the numbers displayed above.

Sizes ranged from the width of **a human hair** down to the size of **a red blood cell.** **Some bottles had thousands.** A few effectively had **no plastic at all.** One bottle had a concentration of **more than 10,000 particles per liter.**



Polypropylene was found to be the most common polymeric material (54%) with Nylon being the second most abundant (16%) (Figure 5).

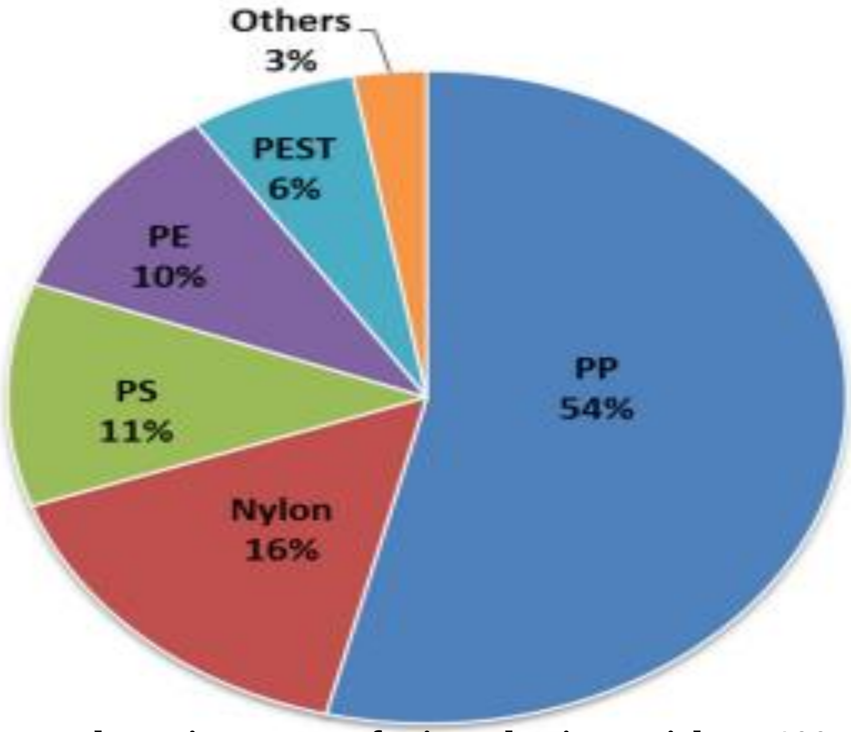


Figure 5 Polymeric content of microplastic particles > 100 um.
PP=polypropylene; PS=polystyrene; PE=polyethylene; PEST=polyester+polyethylene terephthalate; Others includes Azlon, polyacrylates and copolymers

Sherri A. Mason, Victoria Welch, Joseph Neratko, Synthetic polymer contamination in bottled water, State University of New York at Fredonia, Department of Geology & Environmental Sciences, (https://orbmedia.org/sites/default/files/FinalBottledWaterReport.pdf)

Strategies to solve the problem of microplastics pollution should focus on source control and remediation and clean up. Specific issues of concern are addressed below:

1) Removing plastic microbeads from personal care products

2) Use of biodegradable materials

3) Improved reuse, recycle and recovery of plastics

4) Development of clean-up and bioremediation technologies

Wei-Min Wu, Jun Yang, Craig S. Criddle, Microplastics pollution and reduction strategies, Front. Environ. Sci. Eng., 2017, 11(1): 6

IT SHOULD BE KNOWN THAT THE IMPACT OF PLASTIC MICROPARTICLES ON HUMAN HEALTH **HAS NOT YET BEEN FULLY STUDIED.**

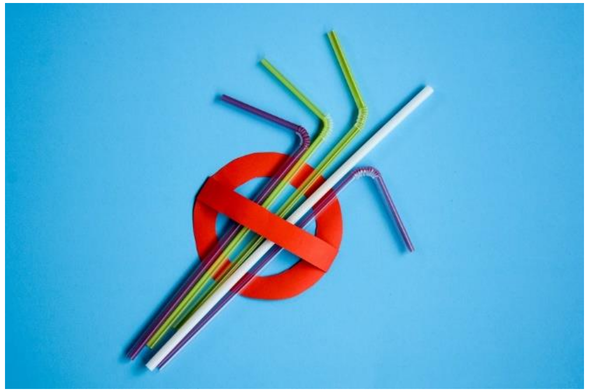
THERE IS **NO LEGISLATION** ON PLASTIC MICROPARTICLES TO TREAT AS CONTAMINANTS IN FOOD.

In total, it is estimated that **between 75 000 and 300 000 tonnes of microplastics** are released into the environment each year in the EU. While a large amount of microplastics result from the fragmentation of larger pieces of plastic waste, significant quantities also enter the environment directly, making it more challenging to track and prevent them.

The European Commission proposes **new a European strategy for plastics** aimed at disposable plastic products, most commonly found on European beaches and seas.

Under the new strategy, the European Union will:

- **Make recycling profitable for business**
- **Curb plastic waste**
- **Stop littering at sea**
- **Drive investment and innovation**
- **Spur change across the world**



Plastic Waste: a European strategy to protect the planet, defend our citizens and empower our industries, (https://ec.europa.eu/ireland/news/plastic-waste-a-european-strategy-to-protect-the-planet-defend-our-citizens-and-empower-our-industries_en)

Recycling, with its respective stages: collection, pre-treatment and reprocessing, provides significant environmental benefits compared to production using primary raw materials on the packaging. This is mostly about the metals, glass and paper that are most common in our everyday life. It saves energy and the emission of harmful emissions in the production of packaging.

Environmental pollution problems from used packaging can be improved by producing biodegradable packaging; waste collection in seas, oceans and rivers.

Thank you for your attention!

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