

## Microplastic Pollution - Nature fed the thrown away plastics to humans which disposed to the environment by us

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From our childhood, we have heard and learned about how plastic pollutes the environment. We must have written essays about plastic pollution for various competitions and sometimes we might have won from those. All that we have talked about are plastic waste which we can see from our naked eye. Its accounts only for 15%. Therefore where and what is the rest of the 85%? It's call microplastics and nano plastics. According to the estimated amounts by the year 2017,

approximately 6300 million tons of plastic waste had been generated throughout the world. From this huge amount, nearly 20% was recycled or incinerated. In contrast, the remaining 80% was either used in landfills or released without control of natural environments. Microplastics(MPs) and Nanoplastics (NPs) refer to the fraction of plastic that is released into the environment, either properly or otherwise, through various environmental or human processes. These MPs particles range from 1 micrometer ( $10^{-6m}$ )

to 5 millimeters and those that are smaller than that ( $< 1 \mu m$  scale) are called Nanoplastics.

How do these micro and nano plastics join the environment? There are many ways that micro and nano plastics enter the environment. For studying purposes, we can divide it into primary and secondary microplastics.

### Primary Microplastics

Primary MPs are plastics that are manufactured in sizes less than 5mm and released to the market. For example, plastic nurdles washed to the Sri Lankan beach by recent marine disaster - MV X-Press Pearl, small plastic beads used in textiles, tiny plastic beads found in face washes/toothpaste/shower gels, belong to this category. Do you know that per one wash of face scrub it is estimated that 94,000-100,000 microplastics are released to the environment?

### Secondary Microplastics

Secondary MPs include plastics that are released to the environment after being used once (plastic drink



Figure 01 : Plastic nurdles washed to the Sri Lankan beach by recent marine disaster - MV X-Press Pearl



**Figure 02 : Microplastics in the face wash /scrubs**

bottles, straws) or several times (plastic pans). These plastics get continuously broken down into very small pieces by sunlight, rain, crushed by vehicle tires, burning, etc...

Furthermore, nylon clothing also releases these secondary micro-plastics as fibers into the environment. According to scientific studies most fibers are coming from acrylic-based clothing.

How do these microplastics and nano plastics enter the human body and how it affects human health? These microplastics enter humans in many pathways. Main pathways are described below.

**Via the food we eat**

One pathway is via the marine environment. The microplastic that joins the environment gets washed away by rivers and streams and eventually ends up in the ocean. When it enters the marine environment these MPs/NPs are ingested by the animals. The microscopic animals see these small MPs/NPs as their food. These tiny zooplankton are the basic steps of a food chain. When these zooplankton are eaten by bigger



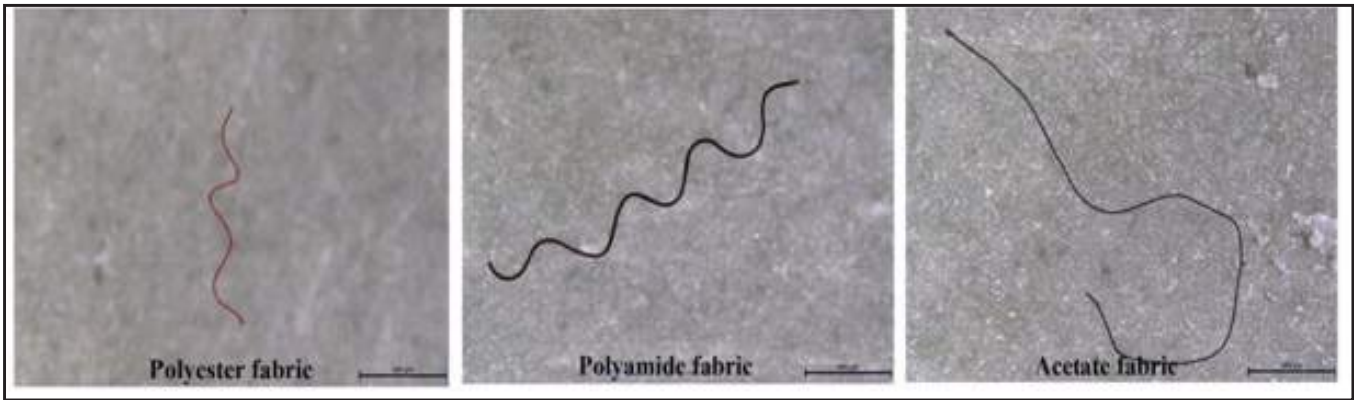
**Figure 03 : Microplastics in toothpaste**

fish and as it ascends in the food chain these MPs/NPs will gradually undergo bioaccumulation. As humans being the end stage of the food chain, tend to consume these fish/ mussels belong to various stages of the food chains. Therefore humans are at risk of end-stage bioaccumulation.

The diagram shown below shows a simple food chain. Number 01 in fig.06 represents the basic step in the food chain(zooplankton). The zooplankton are eaten by the bigger fish represent by the number 02 and hose fish are eaten by even bigger fish represented by the number 03 (Fig.06). Finally,



**Figure 04 : Methods of production of secondary microplastics**



**Figure 05 : secondary microplastics fibers released to the environment by washing nylon or acrylic cloths**

below web link.

humans take the marine products that belong to different stages of the food chain. Since these microplastics are bioaccumulated in the food chain, as the final recipient humans ingest quite a number of these microplastics.

Not only seafood, but microplastics can also enter the human body via other meat products as well.

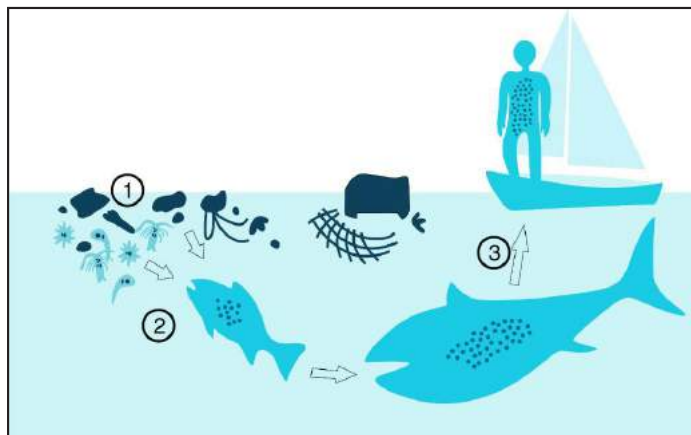
**Via water we drink**

According to available literature in addition to the microplastic contaminated food that we eat, MPs/NPs have been shown that it can be found in table salt, drinking water bottles, tap water, and bottled water. Research done in the USA using branded bottled water has shown 93% of

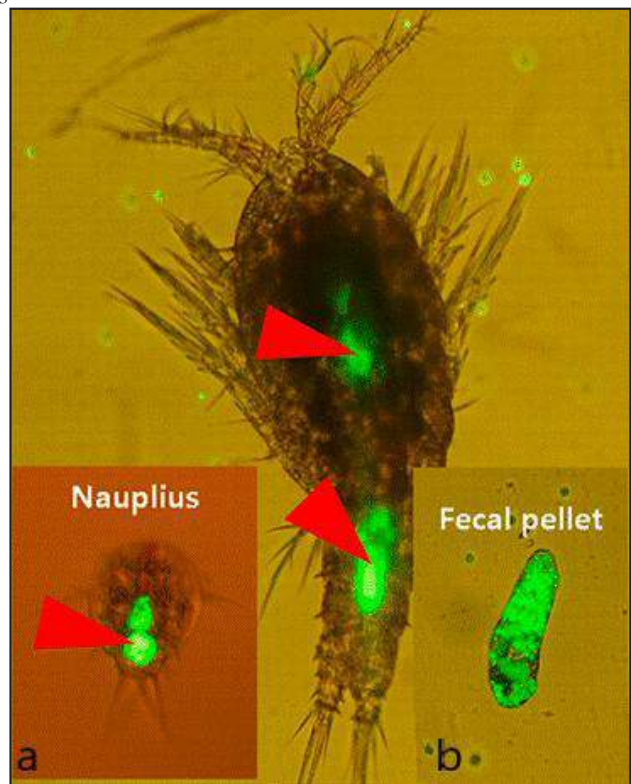
the total 259 water bottles are contaminated with MPs. According to the calculations, an average of 325MPP/L(microplastic particles per liter) MP particles were found. Furthermore, the concentration of MPs size more than 100 μm were 10.4MPP/L and MPs size between 6.5-100μm were 315MPP/L. It was interesting to know that water stored in glass bottles had fewer MPs than plastic bottles. The World Health Organization(WHO) in 2019 has issued a report about “Microplastics in Drinking water” (ISBN: 978-92-4-151619-8). The report can be downloaded by the

Whatever the way these plastic particles enter the human gastrointestinal tract can pass through the intestinal epithelium and enter the blood circulation via inhalation

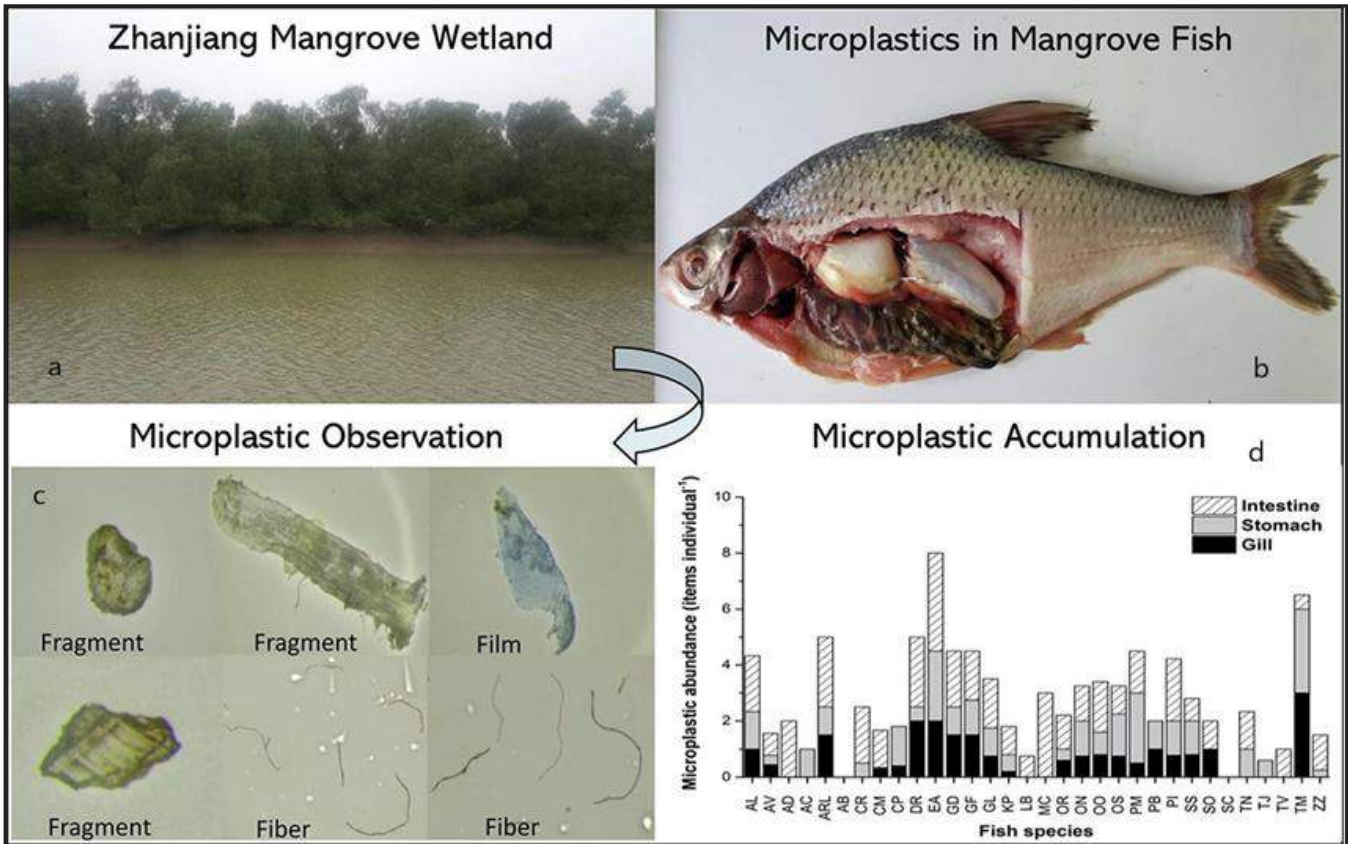
These MPs/NPs are also present in the air, so they enter our bodies through inhalations. Artificial



**Figure 06 : Microplastics in the simple food chain**

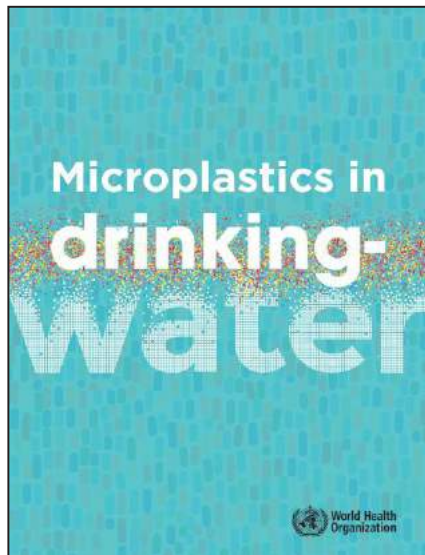


**Figure 07 : microscopic marine animals ingested microplastics. (a) microplastics in the intestine of the animal, (b) microplastic particle – Luminas green**



**Figure 08 : Microplastic in (a) Zhanjiang mangrove wetland (b) fish (c) different plastic particles (d) type of fish and microplastic content in different body parts**

cloths, tire dust, burning of plastics, packing material, constructing site waste, 3D printing, etc could release MPs/NPs to the environment.



**Figure 09 : WHO report on Microplastics in drinking water**

Scientists have found out the commonest size of the atmospheric MP is 5 µm and the microfibers with 3 µm diameter. The apparel industry use microfibers of 1-5 µm are one of the reasons to increase the atmospheric microfibers.

These MPs/NPs and Microfibers inter into the human body via the lungs. Inhaled particles and fibers cross the respiratory epithelium and enter the pulmonary circulation. After that, the particles are carried away via blood to different organs/ locations in the body.

Therefore scientists at the University of Newcastle estimate that an average adult could consume about 5 g of plastic (74,000-121,000 particles)

(approximate equivalent to a credit/debit card which is 5g in weight) weekly from a variety of commonly eaten foods, beverages, and air. This has been confirmed by examination of stool samples obtained from 7 countries including the USA, United Kingdom, and Japan.

The consequences of ingested plastic particles can be divided into two main categories. One is due to the physical properties of the particle and the other one is due to the chemicals in the particle.

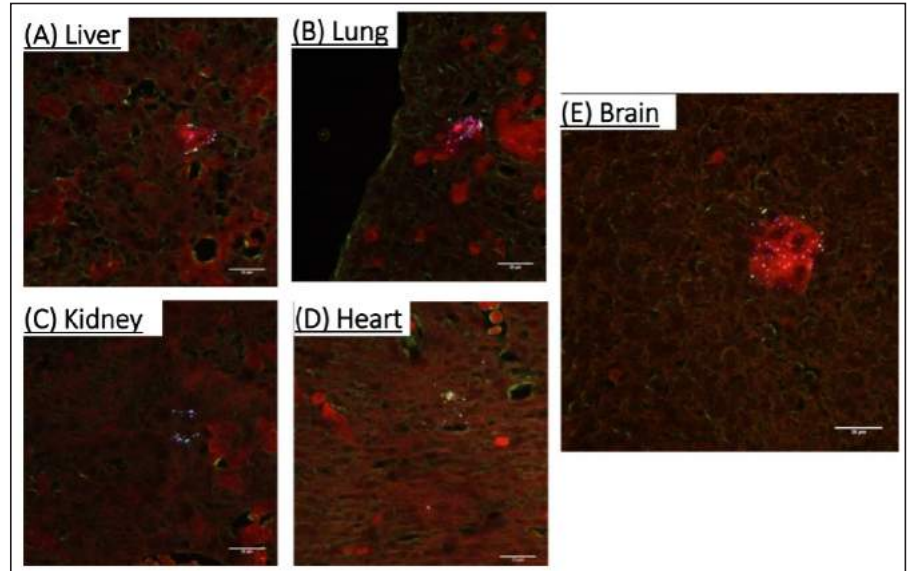
During the plastic manufacturing process, various chemicals are added to obtain different colours, properties, thermal resistance, bending properties and to prevent

oxidation, etc. These chemicals include heavy metals and chemicals already proven to cause cancers. The ultimate plastic product we see or use is a cocktail of various chemicals.

These MPs/NPs are fond of adsorbing and absorbing various heavy metals and carcinogenic chemicals when in the environment.

As shown above, in figure 06, there are known bioaccumulation when climbing the food chain ladders. Therefore these chemicals are entered into the human body in higher concentrations. After entering into the blood circulation these particles will be deposited in various organs and start releasing the absorbed chemicals in simple diffusions. This chemical could lead to genetic changes in the surrounding cells and ultimately cause cancers. This chemical not only can cause cancers but also can mimic certain endocrine hormones and affect the endocrine system of the human body. This could lead to various non-communicable diseases and reproductive system health problems.

One such harmful chemical is



**Figure 11 : Laboratory test results of fetal rat specimen where microplastics were inhaled by the mother rat. (MPs particles are shown as white dots)**

Bisphenol A (BPA). These BPH can mimic estrogen hormone and react on estrogen receptors  $\alpha$  and  $\beta$ . These stimulations can cause program cell deaths, cell mortality changes. Therefore these BPA can affect the development of the ovaries, breast, and prostate gland and their function.

Finally, the scientist has shown that these NPs can cross the placenta and enter to the unborn fetus. This means the future generations are born with various plastics inside

their bodies and could have inborn chemical toxins which could lead to various diseases.

Think now. How much damage have we done to ourselves? Think twice. Save the planet from plastic for future generations.



**Figure 10 : Average of 5 g of plastics are consumed per week**



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