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# Effect of microplastics in animals and humans

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## *Abstract*

The present article describes about the ill effects of microplastics in animals and humans. During manufacture or usage of plastic, particles ranging from 1-5 microns enter into the environment, water and foods. Plastics will be degraded by hydrolytic, photo, thermo-oxidative and biodegradation processes. The major degradation products are polycyclic aromatic carbon compounds, formaldehyde, formic acid, acetaldehyde acetic acid and other aldehydes and acids which are carcinogens. Phthalates and Bisphenol-A are the major chemicals added to plastic products during their manufacture apart from flame retardants, pigments and antifouling agents. The rate at which these chemicals release depends on permeability, volatility, size, concentration, temperature and pH. Microplastics can absorb pollutants and acts as vector for pollutants and microorganisms, which enter into the water and food, finally reaches animal and human bodies. Various types of pollutants like trace metals, organic compounds like insecticides and antibiotics. Microplastics cause damage to immune system, damage cells, cause inflammation and damage to gut micro-biome. Other effects are cardiovascular diseases, type-2 diabetes, abnormal fetal development, changes in reproductive system and metabolic effects such as insulin resistance and obesity. Microplastics have been found in freshwater animals and invertebrates. Microplastics could pass through gut wall and soft tissues and retained in the body for longer periods. Microplastics can pass through food chains via various trophic levels and the concentration increased as the trophic levels increases.

## Introduction

Microplastics (MPs) are defined as "synthetic solid particles or polymeric matrices, with regular or irregular shape and with size ranging from 1 μm to 5 mm, of either primary or secondary manufacturing origin, which are insoluble in water. "It is estimated that around 8 billion tonnes of plastics were manufactured from 1950 to 2015 in the world. Of this, around 6 billion tonnes have become plastic waste and 79% of these still remains on the planet, either as landfill or in the terrestrial, freshwater or marine environment (Geyer *et al.,* 2017).

Now a days, plastics usage became a part of human life *i.e.,* packing of food items, clothing, cosmetics, water supply pipes, serving plates etc., Plastics will enter into the food through heat degradation,

solubility in acidic/alkaline foods, degradation of fancy or decorative items and eventually enter into the human system. The concentration of plastic residues entering into the human and animal body and their effects on the public health is not fully understood so far. To enlighten about the ill effects of microplastics this article was written. The common varieties of plastics used are polyvinyl chloride (PVC), polyvinylidene chloride (PVDC), polyester, polystyrene and etc. which are used as a primary or secondary material. The various sources of microplastics are waste water from industries, aerosols from industries and open areas, plastic degradation in the soil, plastic residues entering into food systems and residues entered in to the body through consumption of food.

## Degradation of plastics

The major degradation products of plastics under relevant conditions are polycyclic aromatic carbon compounds, formaldehyde, formic acid, acetaldehyde, acetic acid and other aldehydes and acids. Aerosols are formed in significant amounts. Alkoxy radicals have also been detected. All most all plastic deteriorated products are carcinogens/co-carcinogens. Plastics can be degraded in the environment by 4 mechanisms *i.e.*, hydrolytic degradation, photo-degradation, thermo-oxidative degradation and biodegradation (Zeenat *et al.*, 2021).

Hydrolytic degradation can occur within plastic materials as a result of submersion in water, progression through condensation cycles, or by exposure to steam. It can also result from contact with acids (high $H^+$ concentration) or bases (high $OH^-$ concentration), which can dramatically accelerate the process.

Photo-degradation process is a very slow and inefficient process. The 3 steps that occur during photo-degradation are initiation, propagation and termination. In Initiation step polymer structure absorb UV light and breakage of chemical bonds and form free radicals. In Propagation step polymer radical reacts with oxygen to form a per-oxy radical. In termination step, inert products are formed from the combination of two radicals or the formation of oxygen-containing functional groups (Wayman and Niemann 2021).

In thermal oxidation, the polymer chains are cleaved, and the resulting shortened chains are terminated with oxygenated functional groups, including carboxylic acids, esters, ketones, and aldehydes. The process of biodegradation is threefold: first an object undergoes bio-deterioration, which is the mechanical weakening of its structure; then follows bio-fragmentation, which is the breakdown of materials by microorganisms; and finally, assimilation, which is the incorporation of the old material into new cells.

## Microplastics-chemical additives

A number of chemicals are added to plastic products during their manufacture, two of the most common additives are bisphenol A (BPA) and phthalates.BPA is found in many mass-produced plastic

products including medical devices, food packaging and cosmetics (Thompson *et al.,* 2009). Phthalates (or phthalate esters) are the most commonly used in PVC production, which is widely used to make products such as pipes, cables and rubber ducks. Alongside plasticisers, other common additives are flame retardants, pigments and antifouling agents. Plasticisers are not particularly stable molecules when combined into plastic materials and can leach out into the environment with relative ease. Low molecular-weight phthalates used in plastics are likely to leach into the environment. So, it is gradually replaced by high-molecular weight phthalates which increases permanency and durability.

## Microplastics a vector for pathogens

Microplastics act as a vector, transporting chemicals and other pollutants around freshwater, then into soil and then into animals. Both the plastics and some pollutants are hydrophobic (water hating) and are attracted to one another instead of interacting with the surrounding water. Various types of pollutants like trace metals (zinc, mercury), persistent organic pollutants and some of the antibiotics bind to microplastics. The aging and weathering of microplastic particles leads to an increase in their surface area to volume ratio and porosity, and therefore increases the concentration of chemicals possible. Among the plastics polyethylene has greater capacity for binding with pollutants.

## Impact of microplastics on human beings

There are several potential pathways for human exposure to microplastics, however exposure via the diet is the most frequently cited. Microplastics have been detected in seafood, table salt (Rist *et al.,* 2018), sugar, beer, drinking water, canned fish, mussels, and chicken meat. The ingestion of microplastics could cause localised effects on the immune system, damage cells (possibly increasing the risk of cancer), increase gut inflammation and damage the gut micro-biome. Negative reproductive and developmental outcomes have been observed in the general population associated with BPA exposure. It has been reported that BPA linked with cardiovascular disease, type 2 diabetes, and abnormalities in liver enzymes. The phthalates are mostly related to endocrine system of humans. The most significant adverse effects are on foetal development, changes to the reproductive system and metabolic effects such as insulin resistance and obesity. Other speculative effects include abnormal sexual development and birth defects.

## Effects on animal health

Stray ruminant animals may consume varieties of plastics, either through street foods or accidentally which may remain in the rumen for longer periods causing ruminal impaction. Ingested plastics in rumen slowly release chemicals into rumen contents, which may enter the food chain through milk and meat (Priyanka and Dey, 2018). Microplastics have been found in a variety of freshwater

animals. Experimental ingestion of microplastics has resulted findings of remnants of microplastics in different animals.

In the freshwater zebra mussel, microplastics could pass through the gut wall into the soft tissue and remain in an animal's body. The presence of microplastics in freshwater animals can affect their behavior in a range of ways, such as false satiation (feeling full when not), decreased movement, or increased buoyancy, (which affects swimming behaviour). In freshwater animals, nano-plastic and microplastic exposure has resulted in some non-lethal internal damage to the animal, typically in the gut, liver. In one study, 80% of goldfish displayed physical damage to the mouth cavity following the chewing and expelling of microplastic fragments (Jabeen *et al.*, 2018).

Microplastics can pass through trophic levels of food and accumulate in larger animals. Vrije Universities Amsterdam has conducted a study and reported that 80 percent of meat, milk etc., Samples (feeding pellets, shredded feed, blood from cows and pigs, cow milk and meat products) contained detectable amounts of at least one type of plastic, of which 72 percent of the milk samples and 75 percent of the meat samples contained Styrofoam (Lavars, 2022).

Microplastics (MPs), polymer particles capable of accumulating heavy metals from ambient media, have been widely found in agriculture and pasture soils. Through the consumption of MPs in soils, heavy metals adsorbed on MPs can be transported into ruminant digestive guts. (Yu-liang Liao and Jin-yanYang, 2022).

## Conclusion

Now-a-days, plastic usage became a part of human life including packing of food, clothing, cosmetics, water pipes, disposable plates, etc, which enter into the food through heat degradation, solubility in acidic/alkaline foods and eventually enter into human and animal system causing various health problems including cancer. So, it is recommended that all the plastics after usage should not be thrown and they should be collected and recycled.

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