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Microplastics: A Potential Threat to Environment and Public Health

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"Plastikos" the Greek word for plastics, means suitable for molding into various forms. They are synthetic or semi-synthetic organics which can be molded into objects of various shapes and sizes and prepared from organic polymers such as PE, PVC, PET, nylon, etc. The global plastic production grew from 348 million in 2017 to 367 million T in 2020. Of all the anthropogenic waste, plastic waste contributes to about 54% by mass. In India, around 25,940 T of plastic waste is generated per day. In 2010, around 0.09–0.24 million Mt of plastic waste entered into the oceans from Indian coastal population. Goa, Gujarat, Karnataka, Lakshadweep, and Andaman are highly affected by the plastic litter than other states.

Microplastics: A more recent definition of Microplastics (MPs) follows standard international unit nomenclature (SI units) of microplastics = 5 mm − 1 µm
Nanoplastics - plastic particles smaller than 1 µm

Causes of Microplastics

1. **Atmospheric**: Synthetic clothing, Abrasion from rubber tires, City dust, house furniture and Industrial emissions
2. **Soil**: Sewage sludge, Rain water and Defecation
3. **Terrestrial**: Packaging, Use of plastic mulches, Sewage-treated sludge, Atmospheric deposition and Tire wear
4. **Aquatic**: Domestic or industrial drainage, Runoff from wastewater treatment plants, Beach littering, road runoff, Illegal dumping activities, By the action of winds, currents and waves

Concerns of Microplastics

The bioaccumulation of microplastics in the digestive tract of fish is not of great concern for humans. More serious is the bioaccumulation in crustaceans, which are filter feeders and their digestive tract is consumed. Mussels and mollusks are a good indicator as they are consumed whole and can be a significant source of microplastics.

A. **Effects on Marine life**: Neurotoxicity, emergency dysregulation, altered immune response, oxidative damage, intestinal blockage, organ damage, inflammation etc.
B. **Effects on Birds**: Entanglement, injury, suffocation, gut ulcer, gut obstruction, delayed ovulation, reduce reproductive output, impair digestive functions etc.
C. **Effects on Farm animals**: Microplastics have been found in the blood of cows and pigs for the first time raising concerns about their movement through food chain. Plastic particles entering bloodstreams risk being deposited in the organs or potentially making their way into milk which can be a public health concern.
D. **Effects on Humans**: Endocrine disruptors, carcinogens, teratogens, allergens, bioaccumulating agents, early puberty in females, breast and ovaries cancer, testicular and prostate cancers, reduced sperm counts, hypothyroidism, type ii diabetes etc. While

microplastics smaller than 20 µm can penetrate few organs such as placenta, brain and liver. Microplastics has been founded in breast milk, lungs, faeces, blood.

Prevention

1. 4R rule of reducing, reuse, recycle and recover can be implemented
2. Removal: monitor and initiatives to clean up the accumulation of the plastic debris
3. Mitigation: Development of regulations for better disposal of litter and discharge
4. Education: Focus on an awareness campaign and behavioural change initiatives.
5. Legislation –Ban single use plastics and restriction in the prodution and use of MPs
6. Engeneering tools –Membrane bioreactors -better removal efficiency of MPs (99.4%) compared to the overall conventional activated sludge-based process (98.3%).
7. Bioplastics -Use of biodegradable materials (low in organic contents) such as cellulose or lignin to produce plastics. The microorganisms that can break down microplastics are present in the environment should further explore.
8. Bioengeneering based solutions -Bacteria and Fungi - enzymatic hydrolysis of plastics. For example, PET (Polyethylene terephthalate) can be breakdown by *Ideonella sakaiensis*; PE (Poly ethylene) by the marine fungus *Zalerion maritimum*.

Conclusion

Microplastics is a serous public health concern and also a potential threat to the environment. Recent findings of MPs in drinking water, blood, lungs have raised concern on human exposure to these particles (with food and air as additional sources of exposure). At present, although there is no reason to be an alarmist about the health effects, more research is needed to establish the hazard of these particles to humans. These legislative actions must be supported by the development of recyclable plastics materials, making recycling processes more efficient by the study and isolation of degrading microorganisms. Suitable combinations of these processes may reduce microplastic pollution in water. Furthermore, continuous press releases and information to the public in general from governments, NGO's, and scientists are needed in order to reduce the use of plastic. These measures together with technologies such as recycling/remediation/removal will help to reduce plastic and litter pollution.