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Microplastics in Food Chain - The Invisible Threat

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Abstract: Microplastics are small particles generated from the degradation of plastics. They can enter water, soil, air, and eventually into the food chain. In recent years, the increasing spread of microplastics in the food chain and environment has become a topic of much research. This article examines the types and sources, composition, their movement through the food chain, possible effects on human health, existing knowledge gaps and strategies for reducing exposure and plastic pollution.

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I. INTRODUCTION

Plastic has been an essential part of our life because it is cheap, durable, lightweight and versatile. But every year large quantities of plastic waste enter landfills, rivers, oceans and soil. This plastic does not simply disappear but, sunlight, heat, waves and physical abrasion gradually break larger plastic objects into smaller particles. These particles are called **microplastics.** Microplastics have become an emerging environmental and food-safety concern because they can move through ecosystems, creating a complex pathway through the food chain finally entering the human bodies. India generates over 3.5 million tonnes of plastic waste every year. But, nearly 40% of it remains uncollected, eventually breaking down into micro plastics that contaminate our ecosystems.

II. WHAT ARE MICROPLASTICS?

Microplastics are the particles measuring less than 5 mm. Particles below 1 micrometre are often referred to as **nanoplastics**. They can be.

- *Primary Microplastics:*

These are manufactured in very small sizes and may originate from Industrial plastic pellets, synthetic textile fibres, abrasive materials, plastic powders.

- *Secondary Microplastics:*

These are formed when larger plastic products gradually break down. These include plastic bottles, containers and bags, food packaging, fishing nets, synthetic clothings, tyres and agricultural plastics.

III. COMPOSITION OF MICROPLASTICS

Their composition depends on the original plastic. Common polymers include polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC) and polyester. Microplastics can occur as fibres, fragments, films, foams or beads.

IV. MICROPLASTICS IN FOOD

Microplastics have been reported in several food categories.

- *Seafood*

Fish and shellfish can ingest microplastics from contaminated water and sediments. A study conducted in India, examining the marine fish from the southern coastal region found fibres and fragments of plastic polymers in the gastrointestinal tract and gills. Another Indian study found microplastics in 21 species of marine dried fish from four locations.

- *River Fish*

Microplastic pollution is also present in freshwater ecosystems. Research on fish from the Ganga River found plastic particles in wild-caught fish, demonstrating that plastic contamination can enter freshwater food webs.

- *Salt*

Salt can become contaminated when seawater or salt-processing environments contain microplastics. Research on edible salt from major salt-producing regions of India detected microplastics in samples from Gujarat and Tamil Nadu.

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➢ *Drinking Water and Other Foods*

Microplastics have also been reported in drinking water and various food products. The contamination can occur through environmental pollution, processing, packaging and handling.

V. MOVEMENT IN THE FOOD CHAIN

The movement of microplastics through the food chain can be represented as:

Plastic waste → Soil/Water → Small organisms → Fish/Animals → Humans

However, the microplastics do not necessarily become increasingly concentrated at every level of the food chain. Their movement depends on particle size, shape, polymer type, feeding behaviour and the ability of organisms to retain or eliminate them.

VI. EFFECTS ON HUMAN HEALTH

The World Health Organization has reviewed available evidence concerning dietary and inhalation exposure and has emphasized that important uncertainties remain regarding the health risks associated with microplastics. But the important ones include:

➢ *Inflammation:*

Microplastics may activate inflammatory responses. Persistent inflammation can potentially contribute to tissue damage.

➢ *Oxidative Stress:*

Some microplastics can increase oxidative stress, which may damage cells when antioxidant defences are overwhelmed.

➢ *Endocrine Effects:*

Plastic particles may contain chemical additives which can interfere with hormonal systems.

➢ *Cardiovascular Concerns:*

A 2024 study published in the New England Journal of Medicine detected microplastics and nanoplastics in carotid artery plaques in a substantial proportion of patients undergoing surgery.

➢ *Microplastics in Human Organs:*

More recent research has reported micro- and nanoplastics in human organs including the liver, kidney and brain. A 2025, Nature Medicine study reported higher concentrations of micro- and nanoplastics in brain samples than in some other tissues examined.

VII. MAJOR GAPS IN CURRENT KNOWLEDGE

Despite rapid growth in microplastic research, several questions remain unanswered.

➢ *Lack of Standardized Testing:*

Different laboratories use different methods to collect, identify and measure microplastics. This makes comparisons between studies difficult.

➢ *Difficulty Detecting Very Small Particles:*

Nanoplastics are particularly difficult to detect. Current techniques may not identify all particles present in food or human tissues.

➢ *Uncertainty About Actual Human Exposure:*

The amount of microplastics that an average person consumes varies according to diet, location, food preparation, water source and environmental exposure.

➢ *Limited Long-Term Human Studies:*

Most evidence about biological effects comes from laboratory experiments, animal studies and observational research. Long-term studies in humans are still limited.

VIII. MANAGEMENT AND PREVENTION

Microplastic pollution cannot be solved by one action alone. It requires changes at individual, industrial and governmental levels. The most effective long-term strategy is to reduce unnecessary plastic production and consumption. Which can be achieved by the reducing use of plastic, using reusable articles and recycling. Plastic waste should be properly collected, segregated, recycled and disposed of. Open dumping and uncontrolled burning should be avoided. Wastewater treatment plants can help remove a significant proportion of microplastic particles and fibres before water enters natural ecosystems. Food safety authorities should develop standardized methods to detect and quantify microplastics in food and drinking water. Microplastic-specific monitoring standards and risk-assessment frameworks would improve food-safety management.

IX. CONCLUSION

Microplastics may be invisible to the naked eye, but their environmental presence is increasingly measurable. Protecting the food chain from plastic pollution means protecting ecosystems, animals and ultimately human health. With over 5,000 studies documenting micro plastic harm, the question is not if we are exposed, but whether we will respond before the damage becomes irreversible. The regulatory frameworks remain inadequate, but at this point inaction is not a neutral choice.

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