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Microplastic Contamination and Its Impact on Aquatic Life

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Fish is an essential dietary protein source for humans, crucial for promoting bodily growth. Microplastics are considered a worldwide problem because of their destructive effects on fish. The contamination of fish by microplastics is a significant risk that necessitates specific attention. Fish may suffer from various health problems after exposure to microplastics, either by themselves or with other contaminants. Microplastics have the potential to induce tissue damage, oxidative stress, alterations in immune-related gene expression, and changes in antioxidant status in fish. Microplastics exhibit variations in color and density, which are determined by the specific polymers they comprise. They are typically categorized based on their sources, namely primary and secondary microplastics.

Keywords Microplastic, Pollution, Fish Health, Aquatic Environment.

Introduction

Plastic particles that are smaller than five millimeters are known as microplastics. The persistence, capacity to build up in ecosystems, and possible harm to aquatic and human health of microplastics make their detection in micro and macro ecosystems a major environmental issue. According to Yu et al. (2018) and Alimba and Faggio (2019), microplastics enter the environment worldwide, making them a global problem. A study conducted by Marn et al. in 2020 revealed that introducing microplastics has a detrimental impact on about 700 aquatic species worldwide, including sea turtles, penguins, and various crustaceans. In 2018, worldwide plastics output climbed to approximately 359 million tonnes (Mt), up from 348Mt in 2017. Since the 1950s, when plastic items became widely available, global plastic manufacture has risen dramatically, from 0.5 Mt/year in 1960 to 348 Mt/year in 2017. With 107.7 million tons produced in 2018, China accounted for thirty percent of the world's plastic production, making it the world's top producer.

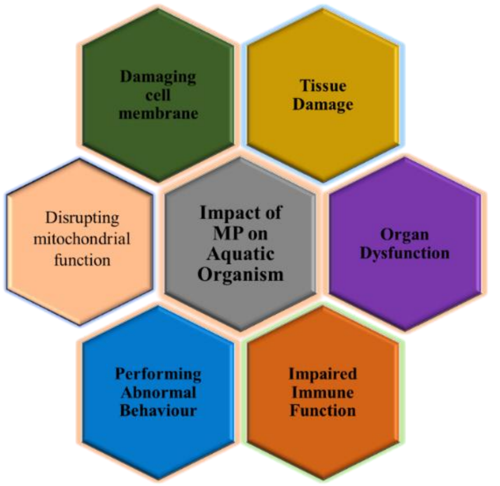
Sources of Microplastic Contamination

Ingression of plastics into the ecosystem is usually due to erroneous human behaviours or unregulated wastes from water or sewage treatment facilities and textile manufacturers. The terrestrial plastic accretion ultimately spills into the water systems due to insufficient landfill burial procedures. Because of their small size and range of impacts, microplastics serve as a home for microorganisms in growth. Microplastics can quickly accumulate and release dangerous organic pollutants into water, such as DDT, polybrominated diphenyl ethers, and other additives incorporated during manufacturing. Microplastics have the potential to cause harm to marine species, but the precise impacts are yet unknown when it comes to particle size reduction. Microplastics are categorized into two types based on their size: primary and secondary microplastics.

1. **Primary Microplastics**: Microbeads are small-sized artificial beads used in personal care, cosmetic goods, and industrial abrasives.
2. **Secondary Microplastics**: Particles reach the ocean by littering, incorrect disposal of plastic debris, wear and tear of plastic objects, discharge of sewage from households, industries, water treatment facilities, and unintentional leaks during transportation and handling in industry.

Impact on Aquatic Life

Microplastics infiltrate aquatic ecosystems and inflict diverse damage to many marine life. In fish, oxidative stress can be generated by several sources, such as exposure to toxins, infections, and environmental stressors. Excessive ROS (Reactive Oxygen Species) generation or inadequate antioxidant defences can produce oxidative stress, connected to many physiological impacts in fish, including tissue damage, organ malfunction, and decreased immunological function (Padmini and Udayakumar, 2021).



Different fish species and life stages have varying levels of antioxidants, which could contribute to the precise mechanism by which microplastics cause oxidative stress. Other factors could be the plastic's type, size, and form. The exposure of the Crucian carp to nylon microplastic disrupts mitochondrial function, resulting in oxidative stress on the gills.

The polyethylene microplastics generated oxidative stress in the liver of tilapia by disrupting cell membranes and increasing lipid peroxidation. Microplastic contamination in three economically valuable species, namely sea dace (*Dicentrachus labrax*), Atlantic horse mackerel (*Trachurus trachurus*) and Atlantic chub mackerel (*Scomber colias*), was examined by Barboza *et al*. (2020). As per previous research, exposure to polypropylene microplastics exacerbated oxidative stress in the grass carp intestines by generating inflammation and immunological activation.

In addition to producing organ damage and oxidative stress, microplastic intake can alter behavioural patterns in fish. Several studies indicated that exposure to polyethylene terephthalate microplastics changed juvenile perch behaviour. Researchers observed that compared to control fish, fish exposed to microplastics were likelier to engage in dangerous behaviours like swimming in open water. In addition to feeding and swimming habits, microplastics can also impact the activity patterns of fish.

Mitigation Strategies

1. **Reducing Plastic Production and Use**: Implementing policies and practices to reduce plastic consumption, promote alternatives, and enhance recycling can significantly reduce microplastic generation.
2. **Improving Waste Management**: Enhancing waste collection, recycling, and treatment facilities can prevent plastics from entering aquatic environments.
3. **Public Awareness and Education**: Increasing awareness about the sources and impacts of microplastics can encourage more sustainable behavior among consumers and industries.

4. **Regulatory Measures**: Governments can implement regulations to limit the use of primary microplastics, such as microbeads in cosmetics, and enforce stricter controls on plastic waste disposal and treatment.

Conclusion

Microplastic contamination harms aquatic life, significantly affecting ecosystem wellness and human well-being. Addressing this issue involves a multi-faceted approach comprising prevention, mitigation, and education to limit the formation and effect of microplastics in the environment.

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