IMPACTS OF PFAS AND MICROPLASTICS IN AQUATIC SYSTEMS: A CRITICAL REVIEW

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Human and aquatic system health is currently compromised by the persistence of widespread per- and polyfluoroalkyl substances (PFAS) introductions into the environment. Occurrence of these enduring chemicals result from both direct and indirect emissions from industrial production. They are introduced into aquatic systems through runoff, PFAS product breakdown or wastewater discharge. Despite their useful properties such as high chemical resistance, heat resistance, and hydrophobicity their chemical composition and structure of strong carbon-fluorine bonds and charged hydrophilic functional groups promote bioaccumulation and can cause physiological damage to living organisms.

Previous research concerning toxicity pathways has shown PFAS exposure as a participant of physiological damage to aquatic fish, influencing tissue interactions, which vary by species, sex, and stage of pregnancy. For instance, PFOA exposure to *Danio rerio*, exhibited lipid buildup in the liver in males, increased antioxidant activity, and apoptosis in larvae. Subsequently, PFAS have also been found to concentrate in microplastics, another type of an abundant anthropogenic contaminant within aquatic systems. These microplastics negatively impact the metabolic and physiological functions of aquatic biota through ingestion. They provide a surface for biofilms to form, facilitating the establishment of diverse microbial communities with distinct ecological functions. Interactions between microplastics and biofilms can serve as carriers for pathogenic bacteria, contribute to antibiotic resistance genes, and act as sorption sites for heavy metals and co-existing PFAS, presenting a risk through trophic transfer.

Microbial composition and ecological functions of biofilms may also be adversely affected by PFAS exposure. Co-existence of these contaminants may have additive ecotoxicological effects, causing significant damage through the ingestion of contaminated food sources. Further understanding of these complex interactions between PFAS – microplastics – biofilms is essential for revealing impacts on essential ecological processes, human health risks and acquire novel knowledge regarding fate, transport, and behavior of associated contaminants, thus addressing co-contamination research gaps.

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