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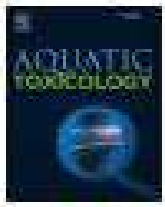

Bioaccumulation of polystyrene microplastics and changes in antioxidant and AChE pattern in a freshwater snail (*Filopaludina bengalensis*) from river Ganga

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ABSTRACT

Microplastic pollution is a leading global problem affecting terrestrial and marine aquatic ecosystems. Due to the stagnant nature of microplastics, the toxic effect of microplastics is more pronounced to benthic organisms than the surface feeder. Hence, the present study effort was to study the microplastic bioaccumulation pattern and changes in the enzymatic and nonenzymatic antioxidant and AChE pattern of freshwater snail *Filopaludina bengalensis*, which were subjected to 0.5 ppm to 5 ppm levels of polystyrene microsphere (~ 30 μm) for 27 days. The study showed that microplastics were easily accumulated in the test organism in a dose and time-dependent manner, amounting to 52 ± 6.02 particles /individuals at a 5 ppm dose on the 27th day. However, no mortality was observed at the test microplastic dosages. The enzymatic antioxidant profile (SOD and catalase) showed limited variability and remained stable with increased duration and microplastic dose. However, the nonenzymatic antioxidant profile showed distinct variability with the complete setting of the DPPH activity on the 27th day at 5 ppm microplastic dose and a gradual decrease of ABTS and FRAP activity at all the dose ranges. Here the AChE activity decreased with higher exposure concentrations. The present study for the first time shows the direct impact of microplastics on a freshwater snail widely available in the Indian subcontinent, indicating the role of microplastic pollution will create havoc in the Ganga river eco-ecosystem in the long run.

1. Introduction

Microplastic (MPs) pollution is recently considered the leading environmental problem due to its omnipresent nature and potentially harmful effect on aquatic biota. MP pollution has been studied well in marine ecosystems for more than 50 years (Sobhani et al., 2020; Bergmann et al., 2015), while recently, researchers are focusing on the impact of microplastics pollution in the freshwater aquatic ecosystems and their effect on different biotic components (Wagner and Lambert, 2018; Sarkar et al., 2021a). MPs pollution is caused by synthetic polymers of different size ranges (< 5 mm) with varied morphology (fibres, pellets, beads, foam fragments or small fragments), which are being introduced into the environment through various anthropogenic activities (Sarkar et al., 2019, 2022). Due to their small size, MPs accumulate easily in aquatic organisms through ingestion (Tanaka et al., 2013; Besseling et al., 2017). MPs contamination through trophic transfer was reported to invoke physiological changes in higher vertebrates like fish (Carbery et al., 2018). Neurotoxicity, reproduction and endocrine disruption, histopathological alterations, reduction of body weight and oxidative stress were all highly evident in fish species (Santos et al., 2020). Aquatic vertebrates and invertebrates are highly prone to the toxins leached from the plastic materials absorbed by the marine environment (Nakashima et al., 2016). Toxic compounds originating from MPs eventually migrate through the biological species into humans, creating a chemical hazard in the food chain (Wright and Kelly, 2017).

Not only in fish but MPs contaminations are also reported to occur in macrobenthic organisms through trophic transfer or direct ingestion (Carbery et al., 2018). MPs tend to accumulate in the soft tissues of the macroinvertebrates and are transferred to the next trophic level through the food chain (Farrell and Nelson, 2013). Hence, the bioaccumulation pattern of MPs was extensively studied in various strata of the trophic pyramid, including plankton, benthos, macrobenthic organisms and

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