Biochemical and behavioral effects induced by conventional and bio-degradable plastics towards the cladoceran Daphnia magna

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Abstract

The accumulation in the environment of plastics raised a worrisome concern for natural ecosystems, pushing the society to look for sustainable solutions, including the transition from the use of fossil-based to bioplastics (BPs). However, similarly to conventional fossil-based plastics, the inappropriate management of plastic waste can confer to BPs objects the same probability to end up in the environment and to experience weathering processes, which can result in the generation of microplastics (MPs). Thus, this study aimed at investigating the toxicity induced by the exposure to MPs made of a fossil-based polymer, the polyethylene terephthalate (PET-MPs) and a bioplastic, the polylactic acid (PLA-MPs), towards the cladoceran *Daphnia magna*. In detail, organisms were exposed for 21-days exposure to three concentrations (0.125 μg/mL, 1.25 μg/mL, 12.5 μg/mL) of the selected polymers. A multi-level approach was performed to investigate MPs-induced adverse effects at different levels of the biological hierarchy, from sub-individual (i.e., biochemical) to individual (swimming behavior) level. At biochemical level the onset of oxidative stress, in terms of changes in the activity of antioxidant enzymes and lipid peroxidation levels, was explored. Modulations in protein, carbohydrate and lipid content, as well as in the total caloric content, were investigated to assess the potential effects on energy reserves. The effects at individual level were assessed as changes in swimming activity (i.e., distance moved and swimming speed). Our results showed that the exposure to MPs of both the polymers induced slight alterations in the oxidative status and energy reserves of cladocerans, while a significant effect on swimming activity was noted in organisms exposed to PLA-MPs only. These results suggested that MPs made by a biodegradable polymer such as the PLA can affect the health status of a freshwater filter-feeder species in the same way of its fossil-based counterpart, representing a potential threat for freshwater ecosystems.

Keywords: bioplastics, oxidative stress, multi level, ecotoxicology

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