A comparison of the toxicity induced by the exposure to microplastics made of a conventional and a biodegradable polymer on the earthworm Eisenia fetida

Marco Parolini*[1], Beatrice De Felice[1], Stefano Gazzotti[2], Giulia Driussi[1], Michela Sugni[1], and Marco Aldo Ortenzi[2]

[1]University of Milan – Department of Environmental Science and Policy, University of Milan, via Celoria 26, I-20133 Milan, Italy, Italy

[2]University of Milan – Laboratory of Materials and Polymers (LaMPo), Department of Chemistry, University of Milan, via Golgi 19, I-20133, Milan, Italy, Italy

Abstract

Microplastics (MPs) contamination represents a widespread environmental problem that affects both aquatic and terrestrial ecosystems. Although several studies have highlighted the presence of MPs in the soil, the information on their toxicity towards soil organisms is still limited compared to the aquatic counterpart. Therefore, the present study aims at evaluating and comparing the potential negative effects induced by 28-days exposure to MPs made of a conventional polymer, the polyethylene terephthalate (PET), and a biodegradable, the polylactic acid (PLA), administered at two different concentrations (1 g/kg of soil - 0.1% w/w and 10 g/kg of soil - 1% w/w) to the earthworm *Eisenia fetida*. Microplastics of PET (PET-MPs) and PLA (PLA-MPs) of heterogeneous size and irregular shape were mixed in the soil and administered to the earthworms for 28 days under static conditions. A multi-level approach was applied to assess the effects induced by MPs exposure sub-individual and individual level. At sub-individual level, the modulation of antioxidant and detoxifying enzyme activity, as well as lipid peroxidation, was investigated at specific time points (7, 14, 21 and 28 days). At tissue level, cellular and tissue alterations of digestive tract due to mechanical damage or inflammatory situations were investigated, while changes in digging behavior in response to a light stimulus was used as a behavioral endpoint. Although earthworms efficiently ingested MPs of both the polymers, PET-MPs did not induce any adverse effect at sub-individual and individual level, while PLA-MPs caused a modulation of earthworm' oxidative status but no tissue damage or behavioral alteration occurred. PLA-MPs induced effects at sub-individual level could be related to the by-products of PLA degradation that occurred in our experimental systems. Our findings suggest that the exposure to MPs made of a biodegradable polymer may represent a risk for soil organisms.

Keywords: soil organism, polyethylene terephthalate (PET), polylactic acid (PLA)

*Speaker