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15 August 2024

SESSION 4.20 – Risks and Hazards of Plastics and Plastic Sorbed Chemicals: Knowledge and Future

Session chairs and colleagues: Eric Carmona Martinez, Elisa Rojo-Nieto, Bethanie Carney Almroth

Weathered Nanoplastics Cause Zebrafish Developmental Stress and Augment Bisphenol A-driven Estrogenicity

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Plastic pollution has become a critical issue at the global level during the last decades. Plastics can fragment into smaller pieces, to which all living organisms are continuously exposed, through different routes. Plastic fragments in the environment are classified based on their dimension, the smallest being micro- (diameter < 5 mm) and nano-plastics (NPs) (diameter <100 nm). Most laboratory studies in this field use commercial virgin micro/nanospheres when assessing the impact of exposure to these particles on model organisms. However, fragmented plastics in the environment are not perfectly spherical, and vary in their physicochemical characteristics compared to pristine (non-weathered) plastic particles due to exposure to solar, mechanical, thermal, and biological degradation. In this study, we first compared the response of zebrafish embryos to two physical models of polystyrene (PS) NPs, including commercial virgin nanobeads and laboratory-weathered NPs. The laboratory-weathered NPs are originating from single-use plastic products that, after fragmentation, undergo an accelerated weathering protocol. Through morphological, behavioral, and molecular techniques, we observed that weathered NPs more deleteriously affect embryo development, glucocorticoid-dependent stress response, and locomotor activity than commercial beads. As a second step, we investigated if the weathered NPs may operate as a vector to co-existing pollutats, using Bisphenol A (BPA) as a chemical model substance. After assessing BPA sorption capacity on weathered NPs, we exposed the zebrafish embryos to the particles with and without BPA, and we performed a gene expression analysis, which revealed that zebrafish embryos exposed to BPA-sorbed NPs had increased stress and estrogenic responses. Our findings suggest that exposure to PS NPs can impact the development of living organisms, thereby intensifying their stress response. Additionally, using weathered NPs combined with coexisting contaminants could be an effective tool to evaluate the risks associated with exposure to nanoplastics and related pollutants and to simulate human and wildlife exposure scenarios relevant to the environment.

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