Direct and trophic exposure of polystyrene and environmental nanoplastics on *Corbicula fluminea*

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Objective

Nanoplastics (NPs) are major ecotoxicological concerns in aquatic environments. Among aquatic organisms, filter feeders are particularly exposed to the ingestion of NPs, filtering large quantities of water for food and having an unselective feeding strategy. As part of the TROPHIPLAST project*, the present study investigates the effect of environmental nanoplastics (ENV NPs) generated from macro-sized plastic debris collected in the Garonne River (France), and polystyrene NPs (PS NPs) on the freshwater bivalve *Corbicula fluminea* (Müller 1774) by direct and trophic exposure.

Methodology

PS NPs (200 nm) and ENV NPs (235 ± 70 nm) were exposed to the bivalve *Corbicula fluminea* at a concentration of 10 μg L⁻¹ for 21 days. The GENE EXPRESSION MEASUREMENTS IN THE GILLS

Results and discussion

**DIRECT EXPOSURE**

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<th>PS NPs</th>
<th>ENV NPs</th>
<th>TROPHIC TRANSFER</th>
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<td>PS NPs 0.008</td>
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<td>PS NPs 10</td>
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**TROPHIC TRANSFER**

| PS NPs 0.008 | ENV NPs 0.008 | ENV NPs 0.10 |
| PS NPs 10 | ENV NPs 10 | ENV NPs 100 |
| PS NPs 100 |

**Results**

Results are presented as fold-change factors between gene expression in controls and gene expression in exposed organisms (>1: induction; <1: repression, in red). Only significant differences are represented (p-values ≤ 0.05) and only factors <0.5 and >1.5 are considered as significant.

**Direct exposure:**

PS NPs: an up-regulation of genes, mainly involved in immunity, apoptosis, neurotoxicity, oxidative stress and detoxification was measured. Important immune system activity was observed even at low concentrations of NPs. Such a shift in the immune response has already been reported for bivalves exposed to MPs and NPs [1,2].

ENV NPs: an up-regulation of gst and mdr genes was measured, representing essential chemical detoxification route. It suggests the presence of additives and/or some chemical compounds adsorbed on the surface of the ENV NPs. This is consistent with the high metal concentrations measured in the ENV NPs used in our study.

**Trophic transfer:**

Different expression pattern compared to direct exposure. Intense repression of gene expression involved in almost all functions studied for both type of plastic particles could lead to strong adverse effects in a long-term. Possible surface biocorona could impact the transportation, uptake, distribution, biotransformation and toxicity of NPs [3].

PS NPs: effects on gene expression at concentrations of 0.008 and 10 μg L⁻¹. ENV NPs: effects observed for all tested concentrations.

Conclusion

This study highlighted the need to use NPs sampled in the environment for future ecotoxicological studies, compared to manufactured PS NPs as their properties (composition, size distribution, surface charge, additive and adsorbed contaminants) influence different effects at the molecular level to living organisms. In addition, exposures led to changes in gene expression patterns at environmentally relevant concentrations, whether the plastic source, manufactured plastics beads (PS) or environmental particles (ENV).

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*TROPHIPLAST project*: Micro- and nanoplastic particles toxicity on aquatic organisms along a freshwater-marine continuum: evaluation of a trophic transfer. *supported by ANSES 2018-2022*