Microplastics and warming: Metabolic disorders in Pacific oysters (Crassostrea gigas) from the intertidal zone

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Abstract

Microplastics (MP; < 5 mm) have been identified as an emergent environmental threat, especially for filter-feeding organisms such as bivalves. Most laboratory studies however used unrealistic MP concentrations, experimental setups mimicking just the subtidal habitat, or neglected the potential synergistic risk of MP under climate warming. This study therefore focused on potential effects of environmentally realistic MP concentrations on the metabolism of intertidal living Pacific oysters (*Crassostrea gigas*, Thunberg 1793). Based on their natural habitat, the oysters experienced a simulated semidiurnal tidal cycle following a 9 h immersion : 3 h emersion rhythm. In order to analyse dose- and time-dependent effects of MP, oysters were exposed to different concentrations (0 μg/L, 0.025 μg/L, 25 μg/L) of a mixture of different-sized polystyrene MP beads (4 μm, 7 μm, and 10 μm), and tissue samples were taken along the exposure period (0d, 3d, 12d). At the end of the incubation, a sub-group of the remaining oysters experienced rising air temperature during the final low tide simulation, mimicking realistic warming during a midday low tide (3 ∘C/h). These oysters were used for investigating potential effects of MP on their susceptibility to warming. Gills and digestive glands were analysed using untargeted metabolic profiling based on 1H-nuclear magnetic resonance (NMR) spectroscopy. First results revealed that neither MP nor short-term warming has any effect on the metabolome of the digestive gland. On the contrary, the gill metabolome showed dose-dependent disorders compared to control, with oysters exposed to high MP concentrations sharing a very similar gill metabolome to those exposed to short-term warming during simulated midday low tide. These findings may suggest potential synergistic or antagonistic effects of combined MP exposure and warming. Further research is therefore needed to clarify the physiological impact of MP for oysters in coastal intertidal zones.

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Keywords: Metabolomics, Oyster, Intertidal, Microplastics, Warming