
What are the toxic components of microplastics? Investigating the overlooked role of particles vs chemical leachates as microplastic toxicity drivers

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Abstract

Knowledge remains limited regarding the effects of plastics and their associated chemicals. Importantly, there is a lack of studies successfully deconvoluting particle and leached chemical effects on organisms. This study aimed to unravel the role of car tire rubber (CTR, used as MP model material) as a pollutant particle and as a carrier of chemicals, and thus distinguish between the effects derived from MPs from those resulting from associated chemicals. Early life stages of Atlantic cod (*Gadus morhua*) were used to study the effects of three different components of CTR were: 1) CTR particles (50-1000 μm) pre-leached for 30 days to allow quantitative desorption of associated chemicals, 2) chemicals leached from the CTR over seven days, and 3) pristine CTR particles (pCTR) not subjected to any pre-treatment and thus including all the associated chemicals. Each treatment was tested at 1, 10 and 100 mg L⁻¹ particles for 4 days, followed by a recovery period of ca. 11 days. Differences in the chemical composition of particles and associated exposures were verified using GC-MS and pyrolysis GC-MS. Investigated effect endpoints included survival and mortality, hatching success, developmental alterations assessed by morphometric measurements and expression of 15 genes. Leachate and pCTR exposures led to significantly lower hatching success and increased mortality compared to the pre-leached particles, which did not have any significant effect. Further, larvae exposed to pCTR showed a smaller eye diameter and an increased yolk/body fraction. Only leachates affected eye-to-front distance in a dose-dependent way. Larvae exposed to leachates and pCTR also showed significant reduction in the myotome length. Results demonstrate that associated chemicals and not the physical particles are the main CTR toxicity drivers for the endpoints studied. Further research should be directed towards understanding if this is extendable also to other types of plastic- and rubber-based materials.

Keywords: particles, leachates, fish, toxicity assessment, toxicity drivers

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