Toxic effects of leachates from car tire rubber in marine microalgae

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Abstract

Micronized car tire rubber (CTR) particles constitute an important fraction of plastic particles released into the environment. A major consequence is the leaching of chemical additives from CTR to the marine environment, some of which highly toxic to aquatic organisms. Microalgae, at the basis of the aquatic food-web, are particularly vulnerable to chemical mixtures released from plastic particles. As key-stone organisms, any impacts or alterations in microalgae communities can have substantial consequences for the whole aquatic ecosystem. The present study analysed the toxic effects of CTR-associated chemicals released after 7 and 14 days of leaching to 4 different marine microalgal species, namely *Skeletonema pseudocostatum*, *Rhodomonas baltica*, *Isochrysis galbana* and *Tetraselmis suecica*. Flow cytometry and pulse amplitude modulated fluorometry were first used as screening tools, where general toxicity was indicated by effects in growth rate, cell size and complexity, natural pigments content and photosystem II performance. The 14 days leachate was the most toxic for all species, with *S. pseudocostatum* being the most sensitive (EC50=3.26 mg/mL). A high-throughput methodology was then used at sub-lethal levels to further analyse this specific toxicity. The analysed endpoints included metabolic activity, cell viability, cytoplasmatic and mitochondrial membrane potentials, ROS formation, lipid peroxidation, neutral lipids, cellulose and DNA contents. The specific toxic mechanisms of CTR leachates to crucial components of microalgae cells was revealed, with ROS formation and oxidative stress being the most affected, along with a high decrease in cellulose content. This study provides new information on the toxicity mechanisms of CTR leachates to marine microalgae and highlights the importance of comprehensively understanding the potential impacts of plastic-associated chemicals to the marine ecosystem.

Keywords: Car tire rubber, leachates, marine microalgae, ecotoxicological effects.

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