Microplastics in the marine environment and the assessment of potential adverse effects of associated chemicals

av

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Abstract

During the last decade plastics have gained interest by scientists as emerging pollutants particularly in the marine environment due to their ubiquity and persistence. While several studies report the occurrence of microplastics in surface waters globally, there are no harmonized methods to sample and measure microplastics, and the knowledge of toxicological effects in the marine ecosystem is scarce. One of the concerns is that microplastics could transfer hazardous chemicals into organism upon ingestion.

In this thesis chemical and bioanalytical methods were combined to address the hypothesis that plastic pollution poses a risk for marine ecosystems by exposure to plastic associated chemicals such as sorbed environmental pollutants, additives, and monomers. Six different pristine plastic polymers were studied which have been deployed in the marine and freshwater system for up to 12 months. Potential adverse effects of plastic associated chemicals were investigated with in vitro reporter gene assays which can be activated by several chemical classes. The main focus was on the aryl hydrocarbon receptor-mediated activity for the assessment of dioxin-like chemicals. Different groups of persistent environmental pollutants, which are present in the aquatic environment, were analyzed by gas chromatographic mass spectrometric methods. The contribution of the targeted chemicals to the measured biological activities was examined by conducting potency balance calculations. A better knowledge about the occurrence of microplastics in the waters surrounding Sweden was gained by sampling surface waters comparing two different sampling techniques, trawl and in-situ pump.

The plastic pellets induced bioactivities in most tested reporter gene assays and the activities varied by type of polymer. In the majority of samples the contribution of the targeted environmental pollutants to the observed bioactivities was low. Concentrations of microplastics > 0.3 mm in surface waters around Sweden were observed to be low and the findings of this thesis suggest that the tested polymers with sizes 2-4 mm will not lead to an increased risk for marine ecosystems in terms of exposure to chemicals.

Keywords: Microplastics, reporter gene bioassays, sorption, HOCs, polyethylene, polypropylene, polystyrene.

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