Chemical and ecotoxicological characterization of additives leaching from a plastics-polluted island, Lisla Lyngøyna - Norway

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Abstract

In the last decade, the presence and environmental effects of plastic pollution in the aquatic and terrestrial ecosystems have gained special attention from the society and scientific community. Once stranded and buried, plastic waste undergoes a different type of transformations turning large plastic items into small pieces, classified as microplastics. Currently, the plastics fragmentation processes are well documented, however, little is known about plastics-associated chemicals and additive leaching phenomena, their composition, ecological effects, and environmental fate. The Lisla Lyngøyna island, West Coast of Norway, represents a unique "open lab" where a large amount of stranded marine litter has been buried over time and several ecological processes are still occurring. In the present study, the occurrence and environmental effects of the leachates generated from buried plastic waste have been investigated. Three soil layers (top, medium, and deep; ≈20 cm each) have been collected at three different sampling sites containing high, medium, and low plastic pollution levels. The chemical composition of the chemicals leaching from collected soil samples was analyzed using a gas chromatography system coupled with tandem mass spectrometry. For that purpose, *target analysis* was performed in selected ion monitoring mode for quantification of selected plastic additives as well as using isotopic internal standards. The toxicity of the leachate samples was characterized using standardized methods applied to selected testing species of key ecological value such as the crustacean *D. magna*, the algae *R. subcapitata,* and higher plants such as *S. saccaratum, L. sativum,* and *S. alba.* This study provides an overview of the presence and effects of plastic additives in the environment with a special focus on freshwater and terrestrial environments. Through chemical and biological studies, we evaluated the consequences of plastic as a threatening agent to the environment and the benefits of reducing plastic pollution.

Keywords: Soil, leachates, plastic additives, biological effects

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