Automated detection and identification of microplastics in biota using Nile red and machine learning: validation of an innovative, cost-effective approach.

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Abstract

Plastic pollution has become one of the most ubiquitous threats the oceans are facing nowadays. Microplastics (MPs) are of special concern as it has been shown these are ingested by a wide range of marine species from different trophic levels. However, the environmental implications of MPs ingestion, coupled to the toxicological relevance of different MP polymers and their chemical composition, remains poorly understood. This highlights the need for standardised, cost- and time-effective monitoring procedures to accurately and routinely determine the abundance, composition and distribution of MPs in the marine environment, to allow for effective management strategies.
We developed an innovative approach for MP analysis in biota, thereby combining the advantages of both high-throughput screening and automation. MP detection and identification of the polymer types is done using two machine learning decision models. The first model predicts with high accuracy whether a particle is plastic or of natural origin, while the second model allows to identify plastic polymer types. The model classification is based on RGB colour data, extracted from Nile red-stained particles photographed under a fluorescence stereomicroscope.

We evaluated the method in mussels and different fish gastrointestinal tracts (GIT) samples, and validated the efficiency and suitability of our approach by spiking six MP types into mussels and fish GITs, each one varying in the combination of polymer type (PAN, PE, PET, PP, PS and PVC), size (250-1000 μm) and shape (particle/fibre). Recovery per polymer type was determined visually combined with μFTIR-based polymer identification as well as by using the developed ML models. Obtained results of both techniques were compared.

Based on our findings, the unique method proves to be promising for a cost- and time-effective routine analysis of MPs in mussels and fish GITs in a simple, yet reliable way.

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