Does particle size affect micro- and nanoplastic quantification by pyrolysis-gas chromatography-mass spectrometry: a study on polystyrene

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To assess the extent and impact of micro- and nanoplastic pollution in the environment and their potential toxicity, robust analytical tools must be employed. Among existing techniques, pyrolysis-gas chromatography-mass spectrometry appears to be a promising tool to identify and quantify micro- and nanoplastics in environmental samples. This technique enables the identification and quantification of numerous polymers after the thermal decomposition of the sample.

The current study aims to determine the impact of particle size on the polymer fragmentation during the pyrolysis process and to highlight the importance of using an internal standard. To address these objectives, different sizes of polystyrene particles, ranging from 30 nm to 5µm in diameter, have been studied. Calibration curves have been built and compared. Even though minor differences in the slopes were observed, they were not correlated with particle size. These calibration curves were also compared with one built using a mixture of 12 different polymers, including polystyrene. Interestingly, in this case differences in slopes were observed, indicating that pyrolysis fragmentation may vary depending on the properties of the calibration mixture. In order to harmonize the calibration, an internal standard, poly(4-fluorostyrene), has been implemented, which reduced the influence of calibration mixture characteristics. As a result, this study highlights the importance of internal standard correction and the need for appropriate standard composition selection when quantifying micro- and nanoplastics in environmental samples.