An innovative concept towards standardized method development to separate, characterize and quantify engineered nanoparticles in food and cosmetics

Stephan Wagner, Milica Velimirovic, Fazel Abdolahpur Monikh, Frank von der Kammer, Thilo Hofmann

University of Vienna, Department for Environmental Geosciences

corresponding author: thilo.hofmann@univie.ac.at

Generic schemes to systematically develop methods for detection, characterization, and quantification of engineered nanoparticles (ENPs) in complex matrices are required by the industry, by the scientific community as well as by regulatory bodies. Recently, Wagner et al. (2015) published the first tested generic sample preparation scheme for separation, characterization, and quantification of ENPs in complex food matrices which defines quantitative quality criteria. This novel generic sample preparation scheme and the applied quality criteria are of pivotal relevance for standardized method development for ENPs in food and consumer products. In our experimental study we challenged this generic approach and selected a real food sample and a cosmetic sample: sample 1) a powdered tomato soup which contains SiO_2 particles as anti-caking agent (E551), and sample 2) a sunscreen which contains TiO_2 as UV-filter and Fe-oxides as pigment. The two challenges associated with the samples were: A) there was no reference material available for E551 particles in tomato soup. B) two types of particles (TiO_2 and Fe-oxides) had to be extracted from the sunscreen. Following sample preparation, the extracted particles were analyzed by asymmetric flow field flow fractionation (AF^4) online coupled to multi-angle light scattering (MALS) and inductively coupled plasma mass spectrometry (ICPMS).

As the most prominent result, it was found that an adapted generic sample preparation scheme in combination with the AF^4-MALS-ICPMS analysis is applicable for both matrices. For SiO_2 in tomato soup, complete matrix removal and Si mass recovery > 90% were achieved using acid digestion supported by heat (90°C) and hydrogen peroxide as oxidation agent. The static light scattering signal was used for the first time as a fingerprint to identify the type of particles present in the food matrix. For TiO_2 in sunscreen, ENPs could be isolated by a combination of combustion and solvent washing followed by magnetic separation of TiO_2 and Fe-oxides. Recoveries were sufficiently high to perform FFF-MALS-ICPMS analysis indicating complete separation of TiO_2 and Fe-oxides ENPs. This presentation will demonstrate the application of the generic sample preparation approach in combination with high-end analytical techniques to detect, characterize and quantify ENPs in food and consumer products.

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