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SILVER SPECIATION AND CHARACTERIZATION OF NANOPARTICLES RELEASED FROM PLASTIC FOOD CONTAINERS BY SINGLE PARTICLE ICPMS

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Abstract

Silver migration from a commercial baby feeding bottle and a food box containing AgNPs, as confirmed by SEM-EDX analysis, was evaluated using food simulant solutions [i.e., water, 3% (v/v) acetic acid, and 10% and 90% (v/v) ethanol]. Silver release was investigated at temperatures in the 20-70°C range using contact times of up to 10 days. Migration of silver from the food box was in all cases 2 to 3 orders of magnitude higher than that observed for the baby bottle, although the total silver content in the original box material was half of that found in the baby bottle. As expected, for both food containers, silver migration depended on both the nature of the tested solution and the applied conditions. The highest release was observed for 3% acetic acid at 70°C for 2h, corresponding to 62 ng dm^2 and 1887 ng dm^{-2} of silver for the baby bottle and the food box, respectively.

Single particle-inductively coupled plasma mass spectrometry (SP-ICPMS) was used to characterise and quantify AgNPs in the food simulants extracts. Sample preparation was optimized to preserve AgNPs integrity. The experimental parameters affecting AgNPs detection, sizing and quantification by SP-ICPMS were also optimised. Analyses of water and acidic extracts revealed the presence of both dissolved silver and AgNPs. Small AgNPs (in the 18-30 nm range) and particle number concentrations within the 4-1510 10^6 L^{-1} range were detected, corresponding to only 0.1-8.6% of the total silver released from these materials. The only exception was AgNPs migrated into water at 40°C and 70°C from the food box, which accounted for as much as 34% and 69% of the total silver content, respectively.

Keywords