Behavior of silver nanoparticles and ions in food simulants and low fat cow milk under migration conditions

Research on the potential migration of nanoparticles (NPs) from nano-based food contact materials (FCMs) has often reached inconsistency in previous studies. Conventional food simulants and traditional migration tests, which are established for small molecules, have been used for studying the potential migration of NPs from nano-based FCMs. The suitability of conventional food simulants and migration tests was investigated by studying the behavior of 40nm polyethylene glycol (PEG) coated AgNPs and silver ions in food simulants (10% ethanol, 20% ethanol, 50% ethanol, 3% acetic acid, olive oil) under migration conditions. Particle mass and number concentrations, ionic concentration and particle size distributions were determined by single particle inductively coupled plasma-mass spectrometry (spICP-MS) before and after incubation for 4h or 10 days at 40°C. In agreement with similar studies, 50% ethanol preserved the AgNPs, while acetic acid induced dissolution of AgNPs. Dissolution of the PEG-AgNPs obeyed pseudo-first-order reaction kinetics. PEG-AgNPs showed similar behavior in low fat cow milk during storage at 4°C for 5 days as in the corresponding food simulant, 50% ethanol. Addition of sodium chloride to ultrapure water led to enhanced dissolution. The potential reduction of silver ions to NPs in food simulants, low fat milk and in alkaline conditions in the presence of reducing agents was studied. Based on the obtained results, it is unlikely that AgNPs are formed from Ag ions at the low concentration which are typically observed for the migration of Ag from polymeric FCMs.

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