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Uptake and depuration of gold nanoparticles in *Daphnia magna* – influence of size, coating and feeding

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Abstract

In recent years the use of nanoparticles in commercially available consumer goods has increased. Studies have indicated that size could influence the uptake and depuration behavior. Furthermore, the influence of feeding on uptake and depuration is not yet characterized. In this study, experiments with crustacean *Daphnia magna* was carried out to test if size, coating and feeding would influence the uptake and depuration of gold nanoparticles (Au NP). Au NP was chosen as a study particle due to a number of reasons: I) Exhibits a low toxicity thus minimizing toxicity effects even in long term studies, II) minimal dissolution effects even at nano-scale, III) Well controlled synthesis with different sizes, shapes and functionalizations, IV) Low background concentrations thus limited interference from matrices. The experiments were based on ISO 6341 Daphnia immobilization test and bioaccumulation studies with *Daphnia magna* including a 24h uptake and 24h depuration phase. To study the influence of feeding green algae (*Pseudokirchnerielle subcapitata*) was added during uptake and depuration phase in separate tests. The tested Au NP had a primary size of 10 nm and 30 nm and with different coating, citrate (CIT) and mercaptoundecanoic acid (MUDA). Characterization included ICP-OES, DLS and TEM. Results show a fast uptake of Au NP within 8 hours of uptake for all tested Au NP independent on size or coating. However, the steady state concentrations varied depending on coating. Preliminary tests showed steady state concentrations for MUDA 10 nm 338±43 ng Au/daphnia, MUDA 30 nm 22±13 ng Au/daphnia, CIT 10 nm 217±21 ng Au/daphnia. Thus, smaller particles yielding higher steady state concentrations than larger particles. With feeding during uptake lower body burden was observed at steady state (8h of uptake) reaching 38±14 ng Au/daphnia. In the study for influence of feeding a fast depuration was observed with and without feeding. However, with feeding the residual body burden was found to be statistical different from the control after 2 hours of depuration. Contrary, the residual body burden after depuration without feeding did not show a statistical difference from control after 24 hours of depuration. Consequently, this study shows the influence of size and coating on the steady state concentration in organisms after uptake and the importance of considering the addition of food when testing nanoparticles.