



Advice note 3 – NanoFATE has demonstrated that NPs and ions have different toxicokinetics in general – differing internal levels of metals. Ionic Ag is more toxic than AgNP based on mass calculations

Advice notes to answer the big five questions

NanoFATE has identified five “Big Questions” important to our understanding of the ecotoxicology of engineered nanoparticles and will help provide key information required to assess the risk that these materials may pose to the environment.

This advice note is in response to the question:

Are there examples of nanoparticles acting through a different mechanism and/or being more toxic than the ion?

Rationale & Methods

We investigated the comparative toxicities of ionic silver (presented as AgNO_3) to *Pseudokirchneriella subcapitata*, *Daphnia magna* and *Danio rerio* as model organisms to investigate the toxicity of AgNP and AgNO_3 by assessing different biological endpoints and exposure periods. Organisms were exposed following specific and standardised protocols for each species/endpoint, with modifications when necessary. AgNP were characterised in each test-media by Transmission Electron Microscopy (TEM) and experiments were performed by Dynamic Light Scattering (DLS) to investigate the aggregation and agglomeration behaviour of AgNP under different media chemical composition and test-period.

Results & Conclusions

TEM images of AgNP in the different test-media showed dissimilar patterns of agglomeration, with some agglomerates inside an organic layer, some loosely associated particles and also the presence of some individual particles. The toxicity of both AgNO_3 and AgNP differ significantly based on the test species: we found no differences in toxicity for algae, a small difference for zebrafish and a major difference in toxicity for *Daphnia magna* (Table 1). These results indicate that on a mass concentration basis AgNO_3 is between eight and 22 times more toxic to *Daphnia magna* than AgNP.

Table 1. Comparative values of 24 h and 48 h LC_{50} of AgNP and AgNO_3 for *Daphnia magna* in the presence and absence of food in the media.

	AgNP		AgNO ₃	
	With food	Without food	With food	Without food
24 h-LC ₅₀	81.84 (2.27)	11.41 (0.98)	3.71 (0.08)	1.36 (0.09)
48 h-LC ₅₀	72.00 (1.85)	11.02 (1.85)	3.38 (0.08)	1.04 (1.84)

More information

For further information about the work discussed here please contact Susana Loureiro (sloureiro (at) ua.pt), leader of the ENP Ecotoxicology work package or request a reprint of our paper in Science of the Total Environment 466–467 (2014) 232–241, doi: <http://dx.doi.org/10.1016/j.scitotenv.2013.06.101>.