Advice note 4 – NanoFATE has demonstrated that the protective genes, biochemical pathways and sequestration mechanisms share similarities, but also show unique characteristics for nanoparticles and ions.

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.

In this advice note we give an example of how NanoFATE answers the question:-

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

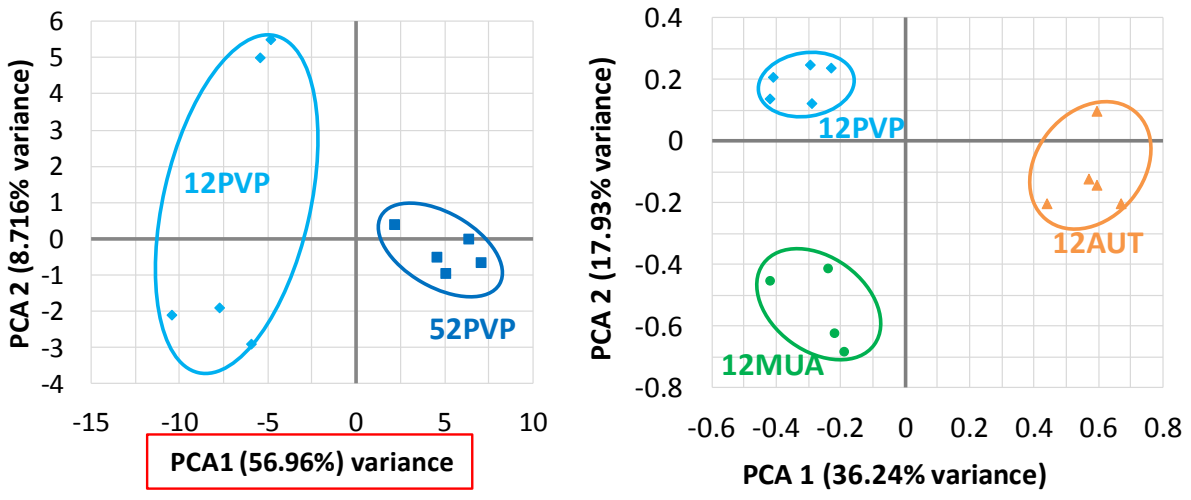
Rationale & Methods

Silver nanoparticles (AgNP) have been shown to cause toxicity and a key question, however, is to which extent the nature of this toxicity varies between particles of similar core composition, but different size and surface chemistry. To investigate the effect of these properties on AgNP toxicity and mode of action in the nematode *C. elegans*, exposures were undertaken using size variant 70 nm and 12 nm neutrally charged Polyvinylpyrrolidon (PVP) coated particles, and coating variant 12 nm negatively charged (Mercapto-undecanoic acid coated) and 12 nm positively charged (11-Aminoundecan-1thiol coated) AgNPs. Exposures to ionic silver were carried out as controls. All exposures were followed by analysis of gene expression to compare mechanisms of effect for the different AgNPs.

Results & Conclusions

These gene expression signatures of exposed nematodes showed distinct clustering with clear separation of patterns for the different AgNP that also differ from those for Ag ions (AgNPs results indicated effects on endocytosis and sensory perception). The differently sized PVP particles induced significant differential expression and the same was also true for differently charged NPs. Difference in expression pattern were most notably associated with the sensory perception of chemicals, membrane functions, neurophysiological processes, signalling pathways and receptor activity. This clearly suggests that there are difference in the pathways of response to different types of AgNP with consequent implication for biological transport, internal fate and toxicity.

Fig 1. PCA plots showing the pattern of gene expression response in nematode exposed to (A) differently sized Ag NPs and (B) differently charged Ag NPs.



More information

For further information about the work discussed here please contact the Francesco Dondero (fdondero@unipmn.it), leader of the ENP toxicokinetics and toxicodynamics work package.

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