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Bioaccumulation and effect of sediment-associated silver in different forms in two marine deposit feeders

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Introduction
• Different behaviour and effects of metal-bearing nanoparticles (NPs) have been found compared to their corresponding metallic ions [1,2].
• Toxicity of metal-bearing NPs isn’t easily predicted when comparing to corresponding ionic form
• It is unclear whether toxicity of metal-bearing NPs is dependent on particle size.

The aim of our study is to exam effects at the individual level by measuring size:

Corresponding ionic form/Particle size
• 
No significant effects were detected on mortality, condition index or growth of exposed organisms.

Result

Introduction

Bioaccumulation

Hypothesis:
Toxicity and biota is metal form/particle size dependent?
(Here are their relative differences in size)

Experiment design

Capitella teleta exposure (for 14 d):
Age+
30nmNPs(Sigma)
100nmNPs(JRC)
Micron-Ag(Sigma)

Macoma balthica exposure (for 35 d):
Age+
20nmNPs(Sigma)
50nmNPs(Sigma)
Micron-Ag(Sigma)

Endpoints
• Mortality
• Growth
• Health condition
• Body burden

Result – Capitella teleta

Toxicity
No significant effects on either mortality or specific growth rate were detected for any Ag form or nominal concentration (data not shown).

Bioaccumulation
There was no significant effect of Ag form on Ag accumulation in C. teleta, although body burden increased significantly as a function of nominal concentration (One-way ANOVA, p = 0.001) (Figure 2).

Figure 2. Silver concentration measured in Capitella teleta exposed to nominal concentration of 10, 50 and 100 µg/g dw sed. Error bars indicated 1 standard deviation (n=6). 20 nm-nanoparticle at 100µg/g dw sed nominal concentration was removed due to a significant difference in initial measured Ag concentration from the other treatments with the same nominal concentration at day 0.

Conclusions
• No significant effects on mortality and growth of C. teleta and M. balthica.
• All Ag forms are bioavailable to both organisms.
• Metal form/particle size dependence of bioavailability is species specific, possibly due to differences in:
  • gut structure, thus
  • particle sorting mechanisms

Such differences in the bioavailability of metal-bearing particles warrant further investigation and consideration in terms of the impact of them in sediment environments.

References

Figure 1. Silver concentration measured in M. balthica exposed to a nominal conc. of 200µg/g dw sed. *** refers to a significant difference from ionic Ag. Error bars indicated 1 standard deviation (n=5).

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