Adding ECO on aquatic toxicity studies conducted with nanoparticicles. A case study of nanoparticles of TiO2 on Daphnia magna life-history performance across food ratios

Carlos Barata, Bruno Campos

IDAEA-CSIC, Jordi Girona 18 , 08034 Barcelona, Spain.
cbmqam@cid.csic.es

Abstract
Despite the huge amount of studies that have addressed the toxicity of nanoparticles across species and environmental conditions, few of them have truly used ecological relevant exposure scenario. The use of unrealistic exposure scenarios may aggravate the estimated environmental risks of nanoparticles. This is the case for many nanoparticle forms that despite having low toxicity to organisms aggregated in aqueous solutions and as such may facilitated the sedimentation of edible particles and hence may dramatically affect those organisms that feed on those particles. In this talk we present results on the extent to which different forms of nanoparticles of titanium dioxide (nano-TiO2) aggregated with microalgae, decreased food levels and hence impaired growth, reproduction and fitness of *Daphnia magna* individuals [1]. Treatments included three different types of nano-TiO2 differing in their coating or cristalline structure but of similar primary size (20 nm) plus a micron-sized bulk material, two exposure levels (1, 10 mg/l) and two food ration levels of the microalgae *Chlorella vulgaris* that included an non limiting (1.5 µg C/ml) and a limiting one (0.3 µg C/L). Effects were assessed using standardized chronic tests and assays that maximized food depletion in the water column under semi-static and re-suspension conditions. Results indicated that the high ion levels in culture medium lead to the aggregation of nanoparticles followed by particle destabilization. Nanoparticle aggregates interacted with the algae cells, forming clusters. Large TiO2-algae agglomerates settled readily depleting dramatically the concentration of edible food for *D. magna.* At limiting food ratios food depletion by nanoparticle aggregation had dramatic effects on reproduction and fitness of exposed *D. magna* at 1 mg/L irrespectively of the particle form. At high food rations effects were only observed for one of the nano-TiO2, P25, at high exposure levels (10 mg/l) under both semi-static and particle re-suspension conditions, which suggest that P25 effects were mediated by clogging the gut and hence diminishing food acquisition. These results indicate that nano-TiO2 may affect the transfer of energy throughout the planktonic aquatic food webs increasing the settlement of edible particles from the water column..

References

1. Campos, B., C. Rivetti, P. Rosenkranz, J.M. Navas, and C. Barata, *Effects of nanoparticles of TiO2 on food depletion and life-history responses of Daphnia magna.* Aquatic toxicology, 2013. **130**: p. 174-183.

Figures

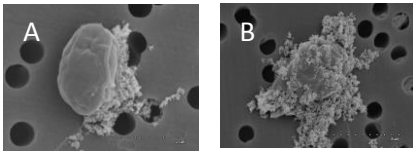

Figure 1: SEM Images of algae cells in the presence of 1 mg/L (A) and 10 mg/L (B) of P25-TiO2 at high food levels.