Zinc oxide nanoparticles toxicity to *Daphnia magna*: size-dependent effects and dissolution

Sílvia Lopes[1], Fabianne Ribeiro[1], Jacek Wojnarowicz[2], Witold Łojkowski[2], Kerstin Jurkschat3, Alison Crossley[3], Amadeu M. V. M. Soares[1] & Susana Loureiro[1]

[1] Department of Biology & CESAM, University of Aveiro; [2] Institute of High Pressure Physics, Polish Academy of Sciences; [3] Department of Materials, Oxford University.

Abstract

As the production of zinc oxide nanoparticles (ZnO-NPs) and other metal oxides is exponentially increasing, it is important to investigate potential environmental and health impacts of such nanoparticles. Nanoparticles' properties (e.g., size, dissolution rate) may change in different water media, and their characterization is essential to derive conclusions about toxicity results. Therefore, an aquatic model organism, *Daphnia magna*, was used to investigate the effect of ZnO-NPs with 2 different particle sizes (30 nm and 80- 100 nm) and then compare these effects with ZnO microsized particles (>200 nm) and the ionic counterpart (in the form of $ZnCl_2$) on immobilization, feeding inhibition, and reproduction endpoints. The 48-h median lethal concentration (LC50) for immobilization ranged between 0.76 mg Zn L^{-1} for the ionic zinc and 1.32mg Zn L^{-1} for ZnO-NPs of 80 nm to 100 nm. For the chronic exposures, the reproduction output was impaired similarly among zinc exposures and possibly driven mainly by the ionic form. The concentrations used showed a total dissolution after 48h. On the other hand, feeding activity was more affected by the 30 nm ZnO-NPs than by the ionic zinc, showing that the particulate form was also playing an important role in the feeding inhibition of *D. Magna*. Dissolution and particle size in the daphnia test media were found to be essential to derive conclusions on toxicity. Therefore, they can possibly be considered critical for evaluating nanoparticles' toxicity and fate.

Reference

Lopes, S., Ribeiro, F., Wojnarowicz, J., Łojkowski, W., Jurkschat, K., Crossley, A., Soares, A.M.V.M. & Loureiro, S. (2014). Zinc oxide nanoparticles toxicity to *Daphnia magna*: size-dependent effects and dissolution. *Environmental Toxicology and Chemistry*, **33**, 190 – 198. Doi: http://dx.doi.org/10.1002/etc.2413.

For more information you can contact:

Project office: NanoFATE@ceh.ac.uk ; Project Coordinator: Claus Svendsen (csv@ceh.ac.uk)

ENP ecotoxicology work package leader: Susana Loureiro (sloureiro@ua.pt)

Project Website: www.nanofate.eu

This project is supported by the European Commission under the Seventh Framework Programme. Theme 4: NMP – Nanosciences, Nanotechnologies, Material and new Production Technologies and Theme 6 – Environment (including Climate Change). Gant Agreement no. CP-FP 247739 NanoFATE