The effect of PVP coatings on internalization and toxicological mechanisms of cerium oxide nanoparticles

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Abstract

Cerium oxide nanoparticles (CNPs, nanoceria) are increasingly used in industrial applications and may be released to the aquatic environment, where the exposure of aquatic organisms becomes likely. There are contradictory reports on whether nanoceria may act as an oxidant causing toxicity [1] or as an antioxidant being able to scavenge free radicals [2], given that the toxicological behaviour of these nanoparticles is still poorly understood. Moreover, little is known about the internalization process of CNPs in algae. There is evidence of CNP-internalization by *Chlamydomonas reinhardtii* (*C. reinhardtii*), but the internalization mechanism and route of uptake are still unknown [3]. In this study, we used an uncoated and different polyvinylpyrrolidone-coated CNPs (the purpose of the coating being to improve their stability, by inhibiting aggregation) with the aim of identifying their internalization and toxicological mechanisms. Monodispersed nanoparticles were synthesized and physicochemically characterized both in distilled water and the exposure media. Nanoparticles coated with PVP, irrespective of PVP molecular weight, provoked higher growth inhibition of *C. reinhardtii* than bare CNP. PVP-CNPs significantly increased ROS formation in exposed cells, indicating that oxidative stress might be an important toxicity mechanism. Interestingly, there was evidence of membrane integrity alterations which might facilitate further internalization of the nanoparticles. At present, the mechanisms of CNP-internalization are under thorough study.

References

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