Impacts of CuO nanoparticles on aquatic detritus foodwebs

Arunava Pradhan, Sahadevan Seena, Cláudia Pascoal and Fernanda Cássio

Centre of Molecular and Environmental Biology, Department of Biology, University of Minho, Campus of Gualtar, 4710-057 Braga, Portugal

Massive use of nanoparticle based products increases the possibility of their release into freshwaters which may pose biota and ecological services at risk. In streams, aquatic microbes and invertebrate shredders play key roles in detritus foodwebs transferring energy from terrestrial plant litter to higher trophic levels. The effects of nano CuO on plant litter decomposition by aquatic microbes were examined and results were compared with those of its ionic form. Alder leaves were colonized by microbes in a stream and exposed to nano CuO ($\leq$ 500 mg L^{-1}) and ionic copper ($\leq$ 30 mg L^{-1}) in microcosms. In control, 11 fungal sporulating species were identified, among which *Articulospora tetracladia* and *Flagellospora* sp. were dominant. Exposure to nano CuO or Cu^{2+} decreased species number. Also, nano or ionic copper altered the structure of fungal and bacterial communities as observed in DGGE-based DNA fingerprints. Both forms of copper reduced fungal biomass (33.7 – 66.0%), fungal reproduction (98.0 – 99.4%), bacterial biomass (83.5 – 91.3%) and leaf decomposition. The impact of nano form was less pronounced than that of ionic form. The exposure of the shredder *Allogamus ligonifer* (Thricoptera) to nano CuO decreased leaf consumption and animal growth. Exposure via water had stronger effects than via food. Analysis of copper in water, leaves, and larval body and case indicated that leached Cu^{2+} might play a role in nano CuO toxicity. Overall results indicate that nano CuO can have negative effects on microbial decomposers and invertebrate shredders with reduction in litter decomposition in streams.

Keywords: nano CuO; Cu^{2+}; fungi; bacteria; invertebrate shredder; leaf decomposition; streams

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