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Responses of freshwater microbial decomposers to copper oxide nanoparticles

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Intensive use of nano metals increases the chance of their release into natural watercourses and may pose at risk aquatic biota and their ecological functions. In streams, microbial decomposers, predominantly aquatic fungi, play a crucial role in organic matter turnover. We investigated the impact of nano CuO on stream-dwelling microbial decomposers of leaf litter by examining i) structure and functions of fungal and bacterial communities retrieved from a non-polluted stream, and ii) the physiological and cellular responses of fungal populations isolated from metal-polluted and non-polluted streams. Results were compared to those obtained after exposure to Cu^{2+}. The exposure to nano CuO (≤500 ppm, 4 levels) and Cu^{2+} (≤30 ppm, 4 levels) significantly reduced leaf decomposition, bacterial and fungal biomass, fungal reproduction and diversity. Cluster analysis of DGGE based on DNA fingerprints showed that both forms of copper induced shifts in community structure. However, impacts were stronger for bacteria than fungi. At the cellular level, increased nano CuO concentrations (≤200 ppm, 5 levels) induced activity of laccase by single fungal populations. Fungal populations from non-polluted streams were more affected by nano CuO than those from polluted streams, as shown by stronger inhibition of biomass production, accumulation of reactive oxygen species (ROS), plasma membrane disruption and DNA strand breaks. Results showed that nano forms are less toxic than ionic forms, and further suggest that the toxicity of nano CuO to freshwater microbial decomposers may occur due to induction of oxidative stress.

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