Toxicity of biosynthesized silver nanoparticles to aquatic organisms of different trophic levels

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Abstract

Although biosynthesized nanoparticles are regarded as green products, research on their toxicity to aquatic food chains is scarce. Herein, biosynthesized silver nanoparticles (Alcea rosea-silver nanoparticles, AR-AgNPs) were produced by the reaction of Ag ions with leaf extract of herbal plant Alcea rosea. Then, the toxic effects of AR-AgNPs and their precursors such as Ag⁺ ions and coating agent (A. rosea leaf extract) on organisms of different trophic levels of a freshwater food chain were investigated. To the three studied aquatic organisms including phytoplankton (*Chlorella vulgaris*), zooplankton (*Daphnia magna*) and fish (*Danio rerio*), the coating agents of AR-AgNPs showed no toxic effects, and Ag⁺ ions were more toxic in comparison to AR-AgNPs. Further investigations revealed that the release of Ag⁺ ions from AR-AgNPs to the test media were not considerable due to the high stability of AR-AgNPs, thus the toxicity stemmed mainly from the particles of AR-AgNPs in all the three trophic levels. Based on values of 72-h EC₅₀ for *C. vulgaris*, 48-h LC₅₀ for *D. magna* and 96-h LC₅₀ for *D. rerio*, the most sensitive organism to AR-AgNPs exposure was *D. magna* (the second trophic level).

Keywords: Toxicity, Silver nanoparticles, Biosynthesized nanoparticles, Aquatic organisms, Trophic level.