TROPHIC TRANSFER OF ZnO NANOPARTICLE FROM ARTEMIA TO GOLDFISH IN A SIMPLIFIED FRESH WATER FOOD CHAIN

Mehmet Ates, James Daniels and Zikri Arslan

Department of Chemistry, College of Science and Technology, Jackson State University, Jackson, MS 39217, USA

Abstract: The increased use of nano-sized materials is likely to result in the release of these particles to environment. Distribution and accumulation in the environmental systems may pose risk to human and aquatic resources. In this study, short term chronic exposure (21 days) was conducted on goldfish to determine the effects of zinc oxide nanoparticles (ZnO NPs 10-30 nm). Accumulation limits were measured along with toxicity measures including lipid peroxidation and changes in red and white blood cell counts. First group of fish were exposed to 1 and 10 mg/L directly by adding ZnO NPs into water. A second group fish were exposed to ZnO NPs by feeding with Artemia salina nauplii that had been pre-exposed to 10 and 100 mg/L of ZnO NPs for 24 h. The results indicated that ZnO NPs can transfer from A. salina to goldfish by dietary exposure. However, no significant mortality was observed under short term chronic for regardless of direct exposure or by dietary uptake. It was found that NPs accumulate significantly in intestine, gills and liver of the fish. Higher body burden to NPs were found under direct exposure, though dietary exposure also led to significant accumulation of NPs in the body. Average ZnO NPs content was about 3.35, 0.151 and 0.111 µg/g in the intestine, gill s the liver, respectively. No significant accumulation was detected in the heart, brain and muscle tissue of any treatments compared with the controls. Oxidative stress was measured through malondialdehyde assay (MDA) in the liver and gills. MDA levels increased at high dose of ZnO NPs and were 65.0 and 14.3 nmol/g for the liver and gills, respectively, indicating toxic effects under waterborne exposure. This result was also confirmed with increasing number in white blood cell counts, ranging between 12.6 and 24.6x10⁶. Red blood cell counts (2.7-4.3 x10³) did not show any significant changes. These results suggest that though ZnO NPs impede the food uptake and growth, but do not exhibit lethal effects at environmentally feasible concentrations.

Key words: ZnO nanoparticle, Accumulation, Oxidative stress, Blood Cell, Goldfish

Acknowledgements: This research is supported by a grant from NIH-RCMI Program (Grant No G12RR013459) to Jackson State University.