COMPARATIVE EVALUATION OF TOXICITY OF ZINC AND ZINC OXIDE NANOPARTICLES ON BRINE SHRIMP (*ARTEMIA SALINA*) LARVAE

Zikri Arslan¹, Mehmet Ates¹, James Daniels¹ and Ibrahim O. Farah²

¹Department of Chemistry and Biochemistry, Jackson State University, Jackson, Mississippi 39217, USA
²Department of Biology, Jackson State University, Jackson, Mississippi 39217, USA

Abstract: Zinc oxide (ZnO) nanoparticles (NP) are among the most popular nanomaterials manufactured in industrial scale as they are widely used as additives in food, sunscreens and cosmetic products and manufacture of textiles, paint pigments, semiconductors, catalysts, polishers. These NPs also exhibit selective toxicity to bacteria and cancer cell lines. Nanoparticles of Zn are assumed to exhibit similar properties, yet the ecological safety of these NPs has not been understood fully. In this study, brine shrimp (*Artemia salina*) larvae were exposed to different sizes of zinc (Zn) and zinc oxide (ZnO) nanoparticles (NPs) to evaluate their toxicity in marine aquatic ecosystems. Acute exposure was conducted in seawater with 10, 50 and 100 mg/L concentrations of the NPs for 24 h and 96 h. Phase contrast microscope images confirmed the accumulation of the NPs inside the guts. *Artemia* were unable to eliminate the ingested particles, which was thought to occur due to the formation of massive particles in the guts. Although the suspensions of the NPs did not exhibit any significant acute toxicity within 24 h, mortalities increased remarkably in 96 h and escalated with increasing concentration of NP suspension to 42% for Zn NPs (40-60 nm) (LC₅₀ ~100 mg/L) and to about 34% for ZnO NPs (10-30 nm) (LC₅₀ >100 mg/L). The suspensions of Zn NPs were more toxic to *Artemia* than those of ZnO NPs under comparable regimes. This effect was attributed to higher Zn²⁺ levels (ca. up to 8.9 mg L⁻¹) released to the medium from Zn NPs in comparison to that measured in the suspensions of ZnO NPs (ca. 5.5 mg L⁻¹). In addition, the size of the nanopowders appeared to contribute to the observed toxicities. Although the suspensions possessed aggregates of comparable sizes, smaller Zn NPs (40-60 nm) were relatively more toxic than larger Zn NPs (80-100 nm). Likewise, the suspensions of 10-30 nm ZnO NPs caused higher than those of 200 nm ZnO NPs. Lipid peroxidation levels were substantially higher in 96 h (p<0.05) indicating that the toxic effects were due to the oxidative stress.

Keywords: *Artemia salina*, Zn and ZnO nanoparticles, Toxicity, Solubility, Bioaccumulation

Acknowledgements: This project was supported by grants from the National Center for Research Resources (5 G12 RR013459-15) and the National Institute on Minority Health and Health Disparities (8 G12 MD007581-15) from the National Institutes of Health.