ASSESSING NANOPARTICLES-INDUCED ACUTE CYTOTOXICITY WITH E. COLI AND PSEUDOMONAS SP.

Xiaoke Hu, Peng Wang, Sean Cook, Xucheng Zhao, and Huey-min Hwang

Department of Biology, College of Science, Engineering and Technology, Jackson State University, 1400 Lynch Street, P.O. box 18540 Jackson, Mississippi, USA

Abstract: Nanoscience and nanotechnology offer new opportunities for making superior materials for use in industrial and health applications. Because of the size and unique chemical and physical properties, nanoparticles are speculated to cause environmental and human health problems. Despite these concerns, very few studies were actually conducted to assess the health effect of the nanoparticles. Metal oxide nanoparticles with a primary size of <40 nm have not been studied previously with bacterium models for assessing their cytotoxicity. We hypothesized that nanoparticles-induced cytotoxicity can be evaluated with bacterium models. To test this hypothesis, we used the E. coli and Pseudomonas sp. strains as the test organisms. The bacteria culture was prepared at 37°C overnight using LB nutrient broth. Then, the culture was centrifuged at 4000 rpm for 10 min and resuspended in a water solution of NaCl (0.8%) previously sterilized at 121.1°C and 1 bar for 20 min. Ten metal oxide nanoparticles were selected in this study. Nanoparticles stock solutions were prepared with the concentration of 1.2 g/L and consequently were diluted to the final concentrations of 200 mg/L, 400 mg/L, and 600mg/L. One hundred µL of freshly washed bacteria suspensions were added to the diluted solutions. The nanoparticle with bacteria samples were forcefully stirred for 2 h. After 2h of exposure time, the bacteria growth and viability were determined by measuring colony forming unit (CFU) on LB Petri dishes. Results showed that MgO, Fe₂NiO₃Zn, and CuO completely inhibited E. coli. at concentrations of 200 mg/L, 400 mg/L, and 600 mg/L; SnO₂, TiO₂ and Sb₃O₄SnO₂ showed no cytotoxicity at any of the concentrations; Fe₂O₃ and Al₂O₃ demonstrated slight cytotoxicity on E. Coli.; La₂O₃ and ZnO illustrated significant cytotoxicity at the higher concentrations of nanoparticles. According to the test with Pseudomonas sp., MgO, La₂O₃, ZnO, CuO, Sb₂O₃SnO₂ and Fe₂NiO₃Zn almost completely inhibited all the bacteria; Fe₂O₃, SnO₂ and Al₂O₃ showed significant cytotoxicity at the concentrations of 400 mg/L and/or 600 mg/L. These results indicated that metal oxide nanoparticles could inhibit or reduce the viability of the test bacteria. Moreover, Pseudomonas sp. is more sensitive than E. coli in detecting cytotoxicity of the metal oxide nanoparticles. Further experiments and calculation are underway based on this primary data.

Keywords: nanoparticles, cytotoxicity, E. coli, Pseudomonas sp.

Acknowledgements: This research was supported by the following grants: (1) NIH-SCORE S06GM08047 (to JSU), (2) U.S. Department of the Army # W911NF-04-1-0327 to JSU, and (3) U.S. Department of the Army Research and Development grant # W912H2-04-2-0002 to JSU.