Use of Bioluminescence to Determine Sub-Lethal Toxicity of Buckminster Fullerenes: Potential for Bacterial Bioaccumulation

Supporting/Contributing Agency: NSF and W. Peters was partially supported by an undergraduate research fellowship (Purdue College of Agriculture)

Carbon-based nanoparticle production has increased dramatically; however, there is limited information on the toxicity of carbon-based nanomaterials on environmental microorganisms. To examine the lethal toxicity of Buckminster fullerenes (C60) on bacteria, a study was conducted using the classic Microtox assay in which a bioluminescent bacteria (*V. fischeri*) was exposed to solutions of Buckminster fullerenes in decreasing concentrations. Results showed no significant loss in luminescence resulting from the C60 solutions indicating a lack of cellular toxicity. It was previously demonstrated that solvents can increase luminescence by damaging the bacterial membrane, causing an increase in a limited reactant required for bioluminescence. This sub-lethal membrane toxicity was termed the "solvent effect." Utilizing a bioluminescent engineered soil microbe, P. fluorescens 5RL (*Figure*), an assay was also performed to examine membrane perturbation by increases in luminescence, exploiting the "solvent effect."

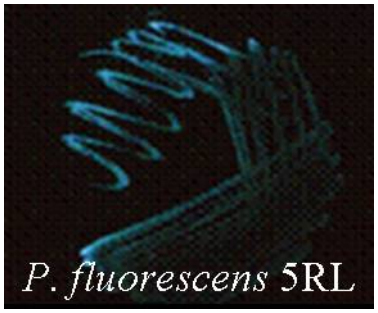

Figure x.6.

The previous C60 solutions used in the microtox assays were added to growing cultures of *P. fluorescens* 5RL and luminescence was monitored. High concentrations of C60 showed a two-fold increase in luminescence after 1 hour of exposure. The results were consistent with the mode of luminescence increase associated with membrane perturbation, suggesting the Buckminster fullerenes are interacting with the membrane similar to solvents. These results are significant because they suggest the C60 is potentially accumulating in the bacterial membrane, which could have significant long-term effects.

Reference/Publication

Peters, W., W. Dominguez, A. Salinas, R. Turco, and B.M. Applegate. 2007. Application of the solvent effect on bioluminescent reporter bacteria as a membrane toxicity assay for carbon nanoparticles. Presentation at the ASM Annual Meeting. Toronto, Canada.