Joey Pryor
Determining the Toxicity and Ecotoxicity of Nanomaterials for Biomedical Application
Dr. Stacey Harper
Environmental and Molecular Toxicology
URISC Grant
Fall 2012-Spring 2013
$1100

The URISC funds were used primarily for equipment necessary for determining the toxicity nanomaterials, specifically, dendrimers. The use of polymeric nanomaterials in the development and delivery of novel therapeutic compounds has emerged as a promising field of biomedical development. Polymeric dendrimers have a well-defined branched architecture consisting of an initiator core, a radiating interior structural layer composed of repeating generations and terminal functional groups attached to the outer generation.

Zebrafish were the model organism for the experiment because of their rapid development, clear embryo, and shared pathways. Embryos naturally develop in a chorion which is a protective barrier. In order to test ecological toxicity, the zebrafish were exposed with the chorion on. The chorion acts as a protective barrier separating the chemicals from directly interacting with the embryo which is similar to environmental exposure. In order to assess the biological toxicity, the chorion was removed to ensure direct interaction with the embryo. Once exposed, the embryos were observed at 24 hours post fertilization (hpf) and 120 (hpf). Some of the endpoints assessed included but not limited to the brain, heart, eye, yolk sac, and jaw development. The method for analysis was the Embryonic Zebrafish Metric (EZ Metric) system that weights endpoints based on effect that endpoint has on the organism. For example heart malformations hold more weight than pigmentation endpoints. The idea is that heart malformations are more detrimental to the organism, therefore, more toxic to an organism. After exposure of the dendrimers to zebrafish, statistical analysis showed that there was no significant difference between a concentration and the control. These results were seen both in both ecolological and biological toxicity. The original hypothesis looked at the size in relation to toxicity, however, once no toxicity was seen among all sizes and in both chorion on and off, we began to shift towards surface chemistry. The longstanding hypothesis is that cationic nanoparticles are more toxic to biological systems because they are attracted to the negative charge of a cell, thus, increasing the effective dose.

Two projects have arisen out of my original one. The first being a comparison paper looking at previously studied dendrimers and the dendrimers I studied. The trend we found fits the widely accepted hypothesis that cationic nanoparticles cause toxicity. The second would be to test and see if it is the strictly the surface group. In order to do so, I would have to change the surface chemistry on my dendrimers from neutral to positive-aldehyde to amine. If it is solely the surface chemistry that dictates toxicity, then one would expect there to be toxicity only after the dendrimers have been manipulated.

Currently I am working on a manuscript for publication regarding the comparison of several dendrimers. For the second project, I am currently working on synthesizing the particles to then test throughout the next year. These projects however have not received my full attention because I have been offered several opportunities to help on other projects that will result in publications.

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Overall, the URISC scholarship has helped fund my research and provide me with laboratory experience which has led to several other awards for my research. Since the URSIC grant, I have received the Honors Promising Finishing scholarship, Summer Undergraduate Research Experience Scholarship (SURE), and the Honors Experience Scholarship. These have and continue to help me towards my future goal of attending medical school.

Thanks,

Joey Pryor