Doctoral in Biomedical Sciences Dissertation Defense

Presents a Defense Titled:

“Study of Silver Ions and Silver Nanoparticles on Embryonic Development”

Presented by:

Ms. Martha Johnson
Biomedical Sciences
Doctoral Student
Advisor, Dr. Nancy Xu
Old Dominion University

This dissertation focuses on the study of toxicity of metal nanoparticles (NPs) and their ions on the development of zebrafish embryos, aiming to understand unique biological effects of NPs and ions, and design in vivo assays to characterize the toxicity of these metal NPs and metal ions. We investigate the effects of our silver NPs (Ag NPs) and silver ions (Ag⁺ ions) on the embryonic development of zebrafish and compare their biocompatibility and toxicity. We found that the Ag⁺ ions caused deformities and death of the developing embryos in a concentration dependent manner, where critical concentration of the Ag⁺ ions was 0.20 µM for chronic exposure of the ions and varied in a stage-dependent manner in acute exposure during specific developmental stages. Exposure of Ag⁺ ions influences specific types of defects in development, which are far less drastic than those caused by the purified Ag NPs with the same amount of Ag atom. Thus, we can conclude that toxicity of Ag NPs on embryonic development is not due to the release of its ions, but rather their own unique physicochemical properties. We also synthesized and purified spherical Ag NPs (41.5 nm in diameter) that are stable (non-aggregated) in egg water media. We examined the biocompatibility and toxicity of single Ag NPs in vivo at specific stages of development and the defects associated with treatment at those specific developmental stages. We then developed new imaging approaches to characterize single Ag NPs as they interact with key brain biomarkers that were significant for neurological development in zebrafish embryos. More specifically, we exposed Tg(pax2a:GFP) zebrafish embryos to various concentrations of the Ag NPs, and studied the effects of Ag NPs on the expression of the pax2a gene during treatment using fluorescent microscopy. Sublethal concentrations of the Ag NPs (0.00, 0.50, 1.00, 2.00, and 5.00 pM) resulted in a phenotypical dependent morphological effect on embryonic development and a decrease in heart-rate of both normal and deformed zebrafish, as the developing embryos were exposed to the Ag NPs. Furthermore, we found that each embryo accumulated a significant amount of Ag NPs in a dose dependent manner, which explains why some embryos developed normally, abnormally or resulted in embryonic death during treatment.

Monday, April 8, 2019 @ 12:00 p.m. in KAUF 224