Optimization of Zinc Oxide Nanoparticles for Vaccine Delivery

Sowrirajan, Hari (School: Animas High School)

Vaccines are the one of greatest health innovations in human history, saving an estimated two million lives annually. They function by exposing the body to an antigen mimicking a pathogen and allowing the body to develop immune protections. The effectiveness of a vaccine is often hindered by incorrect formulation or poor delivery of the antigen. When incorporated in vaccine systems, nanoparticles (NPs) can improve the delivery of the antigen and also function as an adjuvant that further enhances the immune response. This increases the likelihood that the body will develop protection. Properties of NPs such as surface defects can be modified and may influence their ability to function in vaccine systems. This project investigated the impact of three distinct defects on the ability of ZnO NPs to function as a vaccine system. Macrophages play a significant role in the immune system; therefore, evaluating the robustness of their response following NP exposure is indicative of the body's immune response. NPs were coated with ovalbumin protein, which functioned as the antigen, and exposed to macrophages. mRNA expression of immune response genes and the release of inflammatory cytokines were generally higher following NP exposure. The expression of surface receptors and signaling proteins presented during an immune response was elevated with NP exposure. No significant differences could be found between the defective and pristine NPs. Overall, NPs were determined to be an effective vaccine system through the enhancement of the immune response. However, surface defects were not determined to alter their function significantly.

Awards Won:
Third Award of $1,000