Title: Nanovaccines for animal diseases, the Polyanhydride platform technology.

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Abstract.

The economic success of animal production worldwide hinges on extensive use of vaccines to control bacterial and viral infections. Most of the current antibiotics are not used in food animals to curb the problem of spreading drug-resistant pathogens and anti-viral agents are expensive to use in animals. Despite vaccines are available to combat many of the important pathogens that impact animal health, most of these vaccines do not provide sufficient immunity against emerging infections and are not stable under field conditions. In this project, we are applying synthetic, biodegradable polyanhydride nanoparticles (PAN) to improve efficiency and delivery of protective antigens for prolonged and robust induction of immune responses. We tested this platform technology using two different infection models including bacterial (Johne's disease) and viral (avian influenza) diseases. To start, we examined the fate of PANs in mice and chicken which resulted in no untoward effects on animals, confirming the safety of PAN in two approved models of the target diseases, respectively. We also deciphered the immunogenicity and protective immunity of key antigens encapsulated within PANs in standard immunization and challenge models for testing vaccine efficacy**.** Immunological assays demonstrated a substantial increase in the levels of antigen-specific T cell responses post-vaccination in the PAN-vaccinated groups as indicated by high percentages of triple cytokine (IFN-γ, IL-2, TNF-α) producing $CD8^+$ T cells, a key marker for successful vaccination. More importantly, when animals were immunized with PAN-based vaccines, superior protection as indicated by lower tissue pathogen loads were elicited for both Johne's disease and avian influenza models. Currently, we are trying more approaches to examine the utility of nanovaccines as platform technology for animal vaccination to overcome problems associated with traditional vaccine applications under field conditions.

Keywords—*Nanovaccines, paratuberculosis, avian influenza, polyanhydride nanoparticles.*

Professional Biography (100-150 words)

I am a microbiologist with a long-term interest in better understanding the pathogenesis of emerging infectious diseases. I received my veterinary and master' degrees from Cairo University, Egypt and a Ph.D. from the School of Medicine University of Maryland At Baltimore, USA. Currently, I am a professor of microbiology at the University of Wisconsin-Madison. My research involves developing new technologies and innovative approaches to understand bacterial pathogenesis and to generate useful therapies (drugs and vaccines). Currently, we are working on the functional genomics of *Mycobacterium tuberculosis* and *M. avium subsp. paratuberculosis*. Recently, we started to utilize nanotechnology to develop nano-biosensors and Nanovaccines to control animal infections, including avian viral agents. In 2011, I started a biotechnology company (Pan Genome Systems, INC.) to further develop

intellectual properties generated by our group (vaccine-based patents) into products useful to improve human and animal health. During the past decade, I have mentored 17 undergraduates, 19 graduate students and 10 post-doctoral fellows in my laboratory at the University of Wisconsin-Madison. The results of my career at UW-Madison were shared through more than 50 articles in peer-reviewed journals.



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Any Comments: