Department of Biomedical Engineering
Graduate Seminar

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**Subject: Food Additive metal oxide nanoparticle exposure alters intestinal function**

**Abstract**:
Overall well-being is related to gut health and function. The gastrointestinal (GI) tract serves as a significant interface between the body and the external environment and has hundreds of square meters that are needed for nutrient absorption,but must also be defended from external threats. Microorganisms that form a largely symbiotic relationship with host cells colonize the GI tract and comprise the resident human microbiota. A healthy gut microbiome is critical to regulating metabolism, promoting immune function, and eliminating xenobiotics, and changes in the number or composition of microbes may lead to pathophysiologic conditions. The average American consumes 1012 - 1014 engineered nanoparticles (NP) per day, primarily as metal oxide NP used in processed foods and food packaging. The effects of NP on GI function are not well understood. We have developed a cell culture model of the GI tract that includes digestion, a mucus layer, multiple physiologically relevant human cell types, and microorganisms, and a panel of functional assays for investigating gut function. Our data shows that dietary doses of metal oxide NP decrease mineral, glucose, and lipid absorption, increase gut permeability, and alter brush border membrane (BBM) enzyme activity in this model system. The decreases in absorption are due to NP-induced alterations in microvilli structure. Under inflamed conditions, NP in a food matrix induce a greater increase gut permeability than inflammation or NP alone in our in vitro model. The presence of of beneficial bacteria in the in vitro model remediates the functional effects of NP. Data with our animal model of nutrient absorption and microbiome composition shows that chick embryos exposed to metal oxide NP in ovo had a significant increase

in cecum to body weight ratio at hatching. Furthermore, an analysis of the cecum contents showed a significant increase in beneficial bacteria in chicks fed metal oxide NP, suggesting a potential protective mechanism. In adult birds, however, NP ingestion results in **significant** increases in opportunistic bacterial species and a decrease in nutrient absorption. Overall, these results suggest that the GI tract is affected at a functional level by exposure to NP.

**Bio:**

In 2002, Dr. Gretchen earned her BS in Chemical Engineering from the University of Massachusetts Amherst. She completed her honors thesis with Dr. Susan Roberts. Dr. Mahler completed her PhD in Chemical and Biomolecular Engineering with Dr. Michael Shuler at Cornell University in 2008. In 2011, Gretchen completed a postdoctoral fellowship at Cornell University in the Biomedical Engineering Department with Dr. Jonathan Butcher. Dr. Mahler joined the Biomedical Engineering Department at Binghamton University in 2011. She was promoted to Associate Professor in 2017 and became the Associate Dean of the Graduate School in 2018. Gretchen has broad training in chemical and biomedical engineering and specialized training in the development, characterization and validation of cell cultureorgan and tissue microfluidic models. Her current research includes the development of body-on-a-chip and barrier tissue models, including the GI tract, liver, kidney, and vascular and valvular endothelium, for mechanobiological and toxicity testing.

**Date and time: Friday Feb 26th, 2021**

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