BIOMEDICAL & VETERINARY SCIENCES GRADUATE PROGRAM

ANNOUNCES
The Doctor of Philosophy Seminar
and Examination of

Briana Lynn Petruzzi

Pasteurella multocida biofilm formation, and the interrelationship of *P. multocida* with *Histophilus somni* in a polymicrobial biofilm during bovine respiratory disease

Monday, December 11, 2017
11:00 am
Phase II, Classroom 125A

Bio

Briana Petruzzi started her career as a fine art major at The School of the Art Institute of Chicago, but transferred to pursue a degree in biology at the New York Institute of Technology after just one year. She completed her Bachelors of Science in Biology in 2011. Shortly after, she started pursuing her PhD through the interdepartmental microbiology program in 2012, joining Dr. Thomas Inzana's lab in January 2013. Her research has focused on identifying and characterizing biofilm formation and polymicrobial relationships between the Bovine Respiratory disease (BRD) pathogens *Pasteurella multocida* and *Histophilus somni*. Research over the past 4 decades has aided in the reduction of BRD incidence, provided a better understanding of pathogenesis, and has promoted the implementation of preventative techniques. Despite this progress, BRD is still the largest cause of morbidity and mortality in the beef industry, indicating a need for further diagnostic and preventative techniques. Additionally, she studied the importance of biofilm formation by *P. multocida* during avian cholera in chickens. The globalization of avian cholera is the direct result of infected migratory flocks, and has had profound damaging effects on ecological niches such as the arctic, and on poultry farms around the world. Moving forward, Briana hopes to use her deep understanding of infectious diseases to develop and improve novel disease treatments and biotechnology.

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Lay Language Abstract

Pasteurella multocida is a zoonotic pathogen, which means it can be transferred from animals to humans a part of the normal flora of many animals including household pets such as cats and dogs, and agriculture species such as cattle. *P. multocida* is responsible for infected animal bites, especially those resulting from household and large cats. Additionally, *P. multocida* is responsible for several diseases of veterinary importance, including avian cholera and bovine respiratory disease (BRD). Capsule is an essential virulence factor for *P. multocida.* Virulence factors are genetically encoded attributes that aid in the invasion, colonization, and persistence of the bacterium within the host. Capsule allows *P. multocida* to survive within the host and avoid phagocytosis and immune recognition by covering the surface of the bacteria in a non-immunogenic capsular polysaccharide (CPS).

In many similar bacterial species, such as *Histophilus somni*, biofilm formation is a virulence factor. Biofilms are communities of bacteria that survive within a hydrated matrix composed of polysaccharides, proteins, enzymes, antimicrobial compounds, extracellular DNA, and other bacterial and host components. Biofilms can be compared to multicellular organs of eukaryotes. While less complex than multicellular organs, biofilms similarly regulate nutrients, water, cellular composition, remove waste, and perform other processes such as DNA transfer. Biofilms protect bacterial communities by shielding them from the host immune response. Bacteria living in biofilms also grow slowly, and as a result are protected from many antibiotic treatments. While biofilm formation has been suggested for *P. multocida*, the biofilm has not yet been characterized. The work reported here characterizes biofilm formation by *P. multocida* isolates of capsular serogroup A. Biofilm formation was prominent for serogroup A strains of *P. multocida* that were acapsular. However, in the presence of CPS, biofilm formation was inhibited.

H. somni forms a biofilm during BRD that allows the bacterium to persist within the cardiopulmonary tissue of the bovine host. BRD is often caused by several different bacterial, viral, and even parasitic microbes – resulting in a polymicrobial disease. Polymicrobial diseases are more difficult to diagnose and treat, which is a challenge when trying to control this economically important disease. Experimental infections of bovines with *H. somni* have resulted in polymicrobial

infections with *P. multocida*. We confirmed that *H. somni* and *P. multocida* form a polymicrobial biofilm.

Avian cholera can be an acute, chronic, or asymptomatic disease that affects poultry farms and migratory flocks around the world. The spread of *P. multocida* and avian cholera is thought to occur through infected water, infected insects, and through other infected animals surrounding water supplies such as deer, raccoon, and even fish. We hypothesize that *P. multocida* can produce a biofilm and persist within the respiratory tract of birds for extended periods of time, that biofilm formation is important for the establishment of chronic and asymptomatic avian cholera, and that a biofilm assists in the spread of disease between flocks of birds. Chickens were challenged in the respiratory tract with a highly encapsulated, poor biofilm forming strain, or a prominent biofilm forming strain. Biofilm-forming *P. multocida* strains were less virulent and caused less inflammation than non-biofilm forming *P. multocida* strains. Biofilms were visible in the airways of pulmonary tissue by scanning electron microscopy. Biofilm formation by *P. multocida* was observed within the pulmonary tissue of chickens with chronic and acute avian cholera.

Publications

Petruzzi, B., and Inzana, T.J. (2016). "Exopolysaccharide Production and Biofilm Formation by *Histophilus somni*," in *Histophilus somni*: Biology, Molecular Basis of Pathogenesis, and Host Immunity, ed. T.J. Inzana. (Cham: Springer International Publishing), 149-160.

Petruzzi, B., Briggs, R. E., Swords, W. E., De Castro, C., Molinaro A., Inzana, T. J. (2017) " Capsular Polysaccharide Interferes with Biofilm Formation by *Pasteurella multocida* serogroup A" *mBio*, in press

Petruzzi, B., Dalloul, R., Pierson, W., Evans, N., LaRoith, T., Inzana, T. J. "Avian biofilm formation and immune response following experimental acute and chronic avian cholera due to *Pasteurella multocida*" *Veterinary Microbiology*, In Review

Presentations

American Society of Microbiology Virginia Regional Meeting "Characterization of biofilm formation in *Pasteurella multocida*" B. Petruzzi, R. E. Briggs, T. J. Inzana. 2017

Conference of Research Workers in Animal Diseases Annual Meeting "Characterization of Polymicrobial Biofilm Formation by *Pasteurella multocida* and *Histophilus somni* in vitro and during Bovine Respiratory Disease" B. Petruzzi, K. Lahmers, S. Huang, W. K. Scarratt, T. J. Inzana. 2017

Conference of Research Workers in Animal Diseases Annual Meeting "Characterization of Biofilm formation in *Pasteurella multocida*" B. Petruzzi, R. E. Briggs, T. J. Inzana. 2015

Mid Atlantic Microbial Pathogenesis Meeting "Characterization of biofilm formation in *Pasteurella multocidal*" B. Petruzzi, R. E. Briggs, T. J. Inzana. 2015

American Society of Microbiology Annual meeting "Polymicrobial biofilm formation by *Pasteurella multocida* and *Histophilus somni*" B. Petruzzi, I. Sandal, R. E. Briggs, T. J. Inzana. 2014

Awards and Academic Achievements

Microbiology Symposium Graduate Presentation Award, 1st place

CRWAD Respiratory Diseases Graduate Presentation Award, 1st place

Travel Awardee, ASM 2014

Travel Awardee, CRWAD 2015

Travel Awardee, CRWAD 2017

Examination Graduate Committee

Major Advisor/Chair:

Thomas J. Inzana, PhD
Director / Professor, Clinical Microbiology
Tyler J. and Frances F. Young Chair of Bacteriology
Department of Biomedical Sciences & Pathobiology

Graduate Advising Committee Members:

Clayton Caswell, PhD
Assistant Professor, Bacteriology
Department of Biomedical Sciences & Pathobiology

Kevin Edgar, PhD
Professor of Biomaterials and Bioprocessing
Director, ICTAS Bio-Based Materials Center
Department of Sustainable Biomaterials

F. William Pierson, DVM, PhD
Professor, Biosecurity and Infection Control / Avian Medicine
Population Health Sciences
Interim Department Head
Department of Biomedical Sciences & Pathobiology

External Examiner

W. Edward Swords, PhD
Division of Pulmonary, Allergy, and Critical Care Medicine
Gregory Fleming James Center for Cystic Fibrosis Research
University of Alabama at Birmingham

The Tyler J. and Frances F. Young Seminar
in Bacterial Infectious Diseases:
Common themes in dysbioses of the airway

Monday, December 11, 2017
4:00 pm
Classroom 102