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PROGRESS IN DEVELOPING PORPHYRIN DOPED ANTIBACTERIAL POLYMERS

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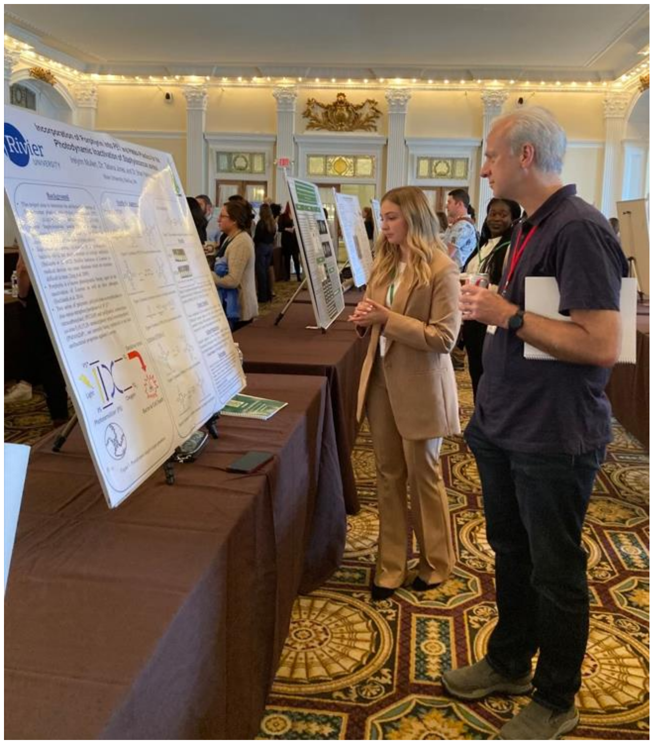

Irelynn Mullen, a junior Biology and Psychology major, presents her research project at the Transformative Learning Conference (TLC) in April 2024.

"… My research journey started by surveying freshwater turtle populations with my ecology professor and other students at Rivier. Doing field research sparked my interest in trying other types of research. So, when I heard there was an open position to work on a research project at Rivier, I jumped at the opportunity to apply for the position. I was luckily chosen for the position and was allowed to work in the lab alongside Dr. Brian Patenaude. For roughly a year, I was able to assist Dr. Patenaude on his research project regarding the incorporation of porphyrin into PET and PMMA plastics for the photodynamic inactivation of Staphylococcus aureus. This lab experience was very challenging to say the least, but it was also the best experience of my life. I accomplished so much within that year that I honestly never thought could have been possible. This project pushed me to become a better student and researcher. If it wasn't for Dr. Patenaude to give me this opportunity, I wouldn't be where I am today. My undergraduate research experience has given me the confidence to pursue graduate school and continue doing research in the future."

Abstract

The opportunistic pathogen *Staphylococcus aureus* (*S. aureus*) poses a significant challenge in healthcare settings due to its association with infections and the rise of antimicrobial resistance. Photodynamic therapy utilizing zinc porphyrin derivatives bonded to polymer surfaces has emerged as a promising alternative route to preventing bacterial infections by replacing materials known to be passive transmission vectors. These porphyrin derivatives generate reactive oxygen species (ROS), particularly singlet oxygen, when exposed to full spectrum light, such as lighting found in clinical settings, effectively inhibiting the growth of *S. aureus* strains, including Methicillin-resistant S. aureus (MRSA). This study investigates the antibacterial properties of consumer plastics, specifically poly(ethylene terephthalate) (PET) and poly(methyl methacrylate) (PMMA), when incorporating zinc porphyrin

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photosensitizers into their structure. Novel polymers, poly[ethylene-co-terephthalate-co-Zinc-meso-Tetraphenyl-porphine-4,4′,4″,4‴-tetracarboxylate] (PETZnP) and poly[methylmethacrylate-co-Zinc-5,10,15,20-tetrakis (phenyl prop-2-enoate)-2,3,21,23-tetrahydroporphyrin] (PMMAZnP) were synthesized with varying concentrations of porphyrin monomers. The synthesis involved incorporating porphyrin monomers at levels ranging from 0% to 1% to assess the dose-dependent effect on bacterial growth inhibition. Characterization of these polymers was conducted using Nuclear Magnetic Resonance (NMR) spectroscopy and Ultraviolet-visible (UV-Vis) spectroscopy. PET's antibacterial properties have begun evaluation through photodynamic inhibition assays, while PMMA's assessment is scheduled for the upcoming weeks. This research sheds light on the potential of photodynamic therapy agents embedded plastics as a viable strategy against *S. aureus* infections, offering insights into the relationship between porphyrin dosage and antibacterial efficacy.

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* **IRELYNN MULLEN**, a junior Biology and Psychology major at Rivier University, was a presenter at the Transformative Learning Conference (TLC) in April 2024.

† **Dr. BRIAN PATENAUDE** has been part of the Division of Arts and Sciences at Rivier University since August 2020. Brian earned his B.S. in Mathematics and B.S. in Physics from the University of New Hampshire in 2009. He then went on to work in industry for five years prior to returning to academia. Brian earned his Ph.D. in Inorganic Chemistry from the University of New Hampshire in May 2020. During his time at the University of New Hampshire, Brian's research focused on generating small molecule and polymeric model systems for hydrogenase enzymes and heme proteins.