Harnessing Viral Enzymes to Combat Bacterial Infections in Dairy Cows

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When most of us think about viruses and bacteria, we envision germs that make people sick. But, Dr. Daniel Nelson, IBBR Fellow and Associate Professor, Department of Veterinary Medicine at the University of Maryland College Park, studies viruses that may end up making us well -- by killing disease-causing bacteria.

The Nelson Lab studies bacteriophage (or “phage”) – viruses that infect bacteria. In particular, they focus on enzymes produced by the phage that directly destroy bacterial cells. These enzymes, called endolysins, may prove to be alternatives to antibiotics. “Enzybiotics (for ENZYme antiBIOTICS) reflect the old proverb ‘The enemy of my enemy is my friend.’ Essentially, they break chemical ties in the bacterial wall, and the resulting high internal pressure within the bacterial cell causes it to explode and die,” explains Nelson.

Nelson has recently teamed up with Dr. Kasey Moyes, Assistant Professor, Department of Animal and Avian Sciences at the University of Maryland College Park, to test the use of endolysin PlyC in dairy cows. One of the most common infections of dairy cows is bovine mastitis caused by Streptococcus uberis (S. uberis). Economic losses due to antibiotic treatment and consumer concerns about antibiotic resistance make potential alternatives attractive.

Nelson and Moyes were recently awarded $498,500 from the USDA to approach the exploration of PlyC as a new S. uberis treatment both in the laboratory and in the farm environment.

The Nelson group will work on scaling-up production to produce consistent, high-quality PlyC for this study and future applications. In addition, they will perform pre-clinical studies of how PlyC works to kill S. uberis and explore how likely S. uberis populations are to develop resistance to this new treatment.

Moyes will assess the clinical effectiveness of PlyC in lactating dairy cows, both in treating and preventing S. uberis infection. Her group will also address management and regulatory issues necessary for moving forward with PlyC as a new therapeutic.

“Beyond addressing the challenge of antibiotic resistance and reducing the rate of infection
recurrence, PlyC is cleared by the system without any toxicity or chemical residue that may harm the animal as well as humans via consumption,” said Dr. Moyes. “This would allow it to be implemented by both conventional and organic dairy producers.”

Nelson and Moyes will make their findings, tools developed during this project, management strategies, and recommendations based on their results available to stakeholders, producers, veterinarians, and the public.