# Revealing the weapons by which bacteria fight each other

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A new study which was performed jointly at Umea University and the University of Washington in Seattle, USA, discovered that bacteria can degrade the cell membrane of bacterial competitors with enzymes that do not harm their own membrane. This exciting finding opens the way for the development of new antibacterial drugs to fight bacteria using their own weapons.

During the infection of a host organism, pathogenic bacteria can excrete toxins that cause damage to host cells and tissue. Interestingly, bacteria also use similar mechanisms in competition with one another. Notably, they can use secretion systems with syringe-like structures to inject the toxins into other cells. Among the different secretion systems that are known in bacteria, the type VI secretion system is of particular importance to interbacterial competition, and is found in many different species of bacteria. The collaborating Swedish-American research teams now found that certain enzymes, phospholipases, are secreted by the type VI system and that they are only effective against the competitor but not the producer's own cell membrane.

Sun Nyunt Wai, professor at the Laboratory for Molecular Infection Medicine Sweden (MIMS) and the department of Molecular Biology in Umeå, Sweden, and Joseph D. Mougous, professor at the University of Washington, Seattle, USA, studied together with their students and post-docs the genes and proteins that are behind this selective defence mechanism. They studied the type VI secretion systems in Pseudomonas aeruginosa, soil bacteria causing severe infections of intestines, blood

and lungs, and in Vibrio cholerae, a pathogen causing the life-threatening cholera diarrhea.

"Bacteria have evolved many strategies for defence against predators and competitors in the environment. In this study we found that the bacteria possess phospholipases, that degrade a major phospholipid component in the cell membranes," Sun Nyunt Wai, said. And we found that the bacteria producing the antibacterial effector at the same time produced an immunity protein that protects them against their own toxin. Her student Krisztina Hathazi and postdoctoral fellow Takahiko Ishikawa participated in the studies and are co-authors of the report in *Nature*.

When the team tested their hypothesis with mutants lacking the genes for immunity, they found that membrane integrity was greatly impaired, as the bacterial cells were now harmed by self-intoxication.

"The finding that bacterial phospholipases, classically considered potent mediators of virulence, can also serve as offensive weapons against competing bacteria was really quite surprising and challenges basic assumptions made concerning these enzymes," commented PhD student Alistair B. Russell, the first author of the report. Both Alistair and the second author, Michele LeRoux, are graduate students in the laboratory of Joseph D. Mougous, the corresponding author of this study. Joseph and his students are members of the Department of Microbiology and Molecular and Cellular Biology Program at the University of Washington in Seattle, and an additional author of the study, professor Paul A. Wiggins, is a member of the Departments of Physics and Bioengineering at the University of Washington in Seattle.

Provided by Umea University