Researchers discover new, abundant enzyme that helps bacteria infect animals

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Researchers have discovered a new class of enzymes in hundreds of bacterial species, including some that cause disease in humans and animals. The discovery provides new insights into how bacteria invade their hosts. The research appears this week in *Nature Communications*.

Andrew Doxey, a professor of biology at the University of Waterloo, led the team that found it in a new type of flagella, a whip-like appendage found on the outside of a bacterial cell that propels it. This new type of flagella is capable of digesting proteins in the bacteria's environment. This discovery updates the long-held view that bacteria use their flagella mostly for movement, and demonstrates that flagella can also function as enzymes, like what happens with the spread of infection.

Doxey made the discovery through the use of bioinformatics, a growing scientific field that combines biology and computer science to study large biological datasets, such as genomes.

"It is an exciting time for bioinformatics right now. We have thousands of genomes available to us and most of them are unexplored. It's amazing that we can discover new biology by using a computer alone," said Doxey, who is also cross-appointed to the Cheriton School of Computer Science at Waterloo. "What we found in this case is that many bacteria have repurposed their flagella to function as protein-degrading enzymes. There are thousands of these enzymes, making this potentially one of the largest enzyme structures known."

Bacterial flagella are filaments composed of around 20,000 proteins that link up together and form structures about 10 micrometers long - roughly one-tenth the width of a human hair. While they can differ structurally, most flagella help with propulsion, and in some cases, they can attach bacteria to host cells. The discovery of flagella as enzymes means that some of them can also break down tough bonds in cells and tissues.

"We think that these enzymatic flagella may help some bacteria degrade and move through viscous environments. Interestingly, scientists have tried engineering flagella with this functionality before, but until now, we didn't know that nature already did this," said Doxey, a member of the Centre for Bioengineering and Biotechnology at Waterloo.

To test whether these new enzymatic flagella are active, scientists examined Clostridium haemolyticum, a pathogen that's highly fatal in cows and sheep, and isolated the flagella. This pathogen has numerous flagella on one cell. They found that the flagella are capable of breaking down proteins found in cow liver—precisely where the organism infects.

The researchers also found the enzymes in bacteria that inhabit the human gut. Further research is needed to determine whether they play a beneficial or harmful role in humans.

The enzyme may improve understanding of how this organism and related pathogens cause disease. There may be ways of using these enzymes in biotechnology to degrade things we want to break down, including biofilms, sticky colonies of harmful bacteria. They are associated with more than 80 per cent of infections.

Provided by University of Waterloo

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