With synthetic mucus, researchers take aim at antibiotic resistance

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Researchers are pursuing an innovative and unexpected new avenue in the quest to fight antibiotic resistance: synthetic mucus. By studying and replicating mucus' natural ability to control pathogenic bacteria, the scientists hope to find new methods for combatting infections.

Katharina Ribbeck, professor of tissue engineering at the Massachusetts Institute of Technology, will present the work at the American Society for Biochemistry and Molecular Biology annual meeting during the Experimental Biology 2017 meeting, to be held April 22–26 in Chicago.

"I am so excited about mucus because I am convinced it can help us find new strategies for protecting us from infections, in particular those that relate to an overgrowth of harmful microbes," said Ribbeck. "My lab and others around the world have begun to engineer mucin-inspired polymers and [synthetic] mucus. We want to use these engineered polymers to control problematic pathogens inside and outside of the body and to stop the growing threat of antibiotic resistant microbes."

You might not think about it until you catch a cold, but mucus is everywhere in the human body. We produce about a gallon of mucus each day to sustain a protective coating on more than 2,000 square feet of internal surface area, including the entire digestive tract as well as the mouth, eyes, lungs, female reproductive tract and, of course, the nose.

Microbes are also incredibly prevalent on and within our bodies, and most of these trillions of microbes live inside the mucus that lines the

digestive tract. Through her research into the functions of mucus, Ribbeck has elucidated how this slimy substance helps maintain a healthy balance between beneficial and potentially harmful microbes.

"Over millions of years, the mucus has evolved the ability to keep a number of these problematic pathogenic microbes in check, preventing them from causing damage," said Ribbeck. "But the mucus does not kill the microbes. Instead, it tames them."

In its new work, her team investigated how mucins, the sugar-coated molecules that form the mucus gel, influence the makeup of our internal microbial communities by constraining the formation of multicellular assemblies (also known as biofilms) by the microbes. As a case study, the scientists looked at the mucins that are found in saliva, called MUC5B. They grew two types of bacteria known to compete in the mouth: Streptococcus mutans, which forms cavities, and Streptococcus sanguinis, a bacterium associated with healthy oral conditions. They found that the harmful Streptococcus mutans bacteria quickly outgrew Streptococcus sanguinis when grown together outside of saliva or mucin-containing media. But grown in the presence of MUC5B (both in real saliva and in MUC5B-containing synthetic mucus), the two species tended to establish a more even balance, suggesting mucin could be instrumental in supporting greater bacterial diversity.

"We conclude from these findings that MUC5B may help prevent diseases such as dental caries [cavities] by reducing the potential that a single harmful species will dominate," said Ribbeck. As a next step, the team plans to continue to investigate the potential role of mucins in maintaining microbial diversity in other mucosal surfaces throughout the body.

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