Compound from soil microbe inhibits biofilm formation

March 30 2015

Researchers have shown that a known antibiotic and antifungal compound produced by a soil microbe can inhibit another species of microbe from forming biofilms—microbial mats that frequently are medically harmful—without killing that microbe. The findings may apply to other microbial species, and can herald a plethora of scientific and societal benefits. The research is published online ahead of print on March 30, 2015, in the *Journal of Bacteriology*, a publication of the American Society for Microbiology. The study will be printed in a special section of the journal that will comprise of papers from the 5th ASM Conference on Cell-Cell Communication in Bacteria.

Many microbes produce antibiotics and antifungals, presumably to compete with other microbes. "Our working hypothesis was that some of the compounds that bacteria secrete might act more subtly, as signals to alter the behavior of their neighboring microbes rather than to kill them," said corresponding author Elizabeth A. Shank, PhD, assistant professor of biology, the University of North Carolina, Chapel Hill. They found that at low concentrations, the compound, DAPG (the acronym stands for 2,4-diacetylphloroglucinol), produced by the bacterium Pseudomonas protegens, did not kill the experimental target bacterium, Bacillus subtilis, but merely prevented it from forming biofilms. DAPG also blocked spore formation.

For the study, first author Matthew Powers, an undergraduate student in Shank's lab, used a strain of B. subtilis—a species commonly used in lab experiments—that fluoresces when genes for biofilm formation are

being shut off. He grew this "reporter" strain on agar plates, adding a dilute solution of mixed bacterial cells, each of which sprouted a colony on the plate. When one of the B. subtilis colonies fluoresced, he picked a close-lying, non-fluorescing colony off of that plate, regrew it, and then sequenced those cells, determining that the species was P. protegens.

A biofilm is any group of microbes that stick together on a surface. Biofilms are notoriously resistant to antibiotics. They form the plaques that cause tooth decay and gum disease, and can frequently cause complications when they grow on medical implants, such as catheters, and indwelling devices such as joint prostheses. They are frequently implicated in urinary tract infections and middle ear infections, as well as in the rare but oft-permanently damaging heart condition, endocarditis. More than 65 percent of hospital-acquired infections manifest as biofilms.

Biofilms also interfere with industrial processes, for example, by clogging, or corroding pipes, and by instigating corrosion on ships' hulls.

The research may lead to a variety of potential benefits. Both of the bacteria from this study are associated with plant roots, and understanding their interactions using DAPG and other secreted compounds could be important for creating healthy microbial soil communities for plants to grow in, possibly boosting agricultural yields, said Shank. DAPG, or the DAPG-producing P. Protogens as a protobiotic, could be used to inhibit formation of harmful biofilms. Additionally, the experimental approach could be used to discover other, potentially medically important biofilm-inhibiting bacterial, said Shank.

While the more powerful signals produced by many bacteria are well-known, the territory of subtle signals remains poorly mapped, but the results of these early efforts suggest that the importance of such signals may be out of proportion to their relatively subtle modus operandi.

Provided by American Society for Microbiology