

Garlic constituent blocks biofilm formation, could benefit CF patients and others

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E Pluribus Unum, the motto of the United States, could just as well apply to biofilm-forming bacteria. Bacterial biofilms are far more resistant than individual bacteria to the armories of antibiotics we have devised to combat them. Now Tim Holm Jakobsen and Michael Givskov of the University of Copenhagen, and their many collaborators have pinpointed a constituent of garlic that attacks a key step in the development of biofilms, in an effort they hope may offer help in particular for patients with cystic fibrosis. The research is published in the May 2012 issue of *Antimicrobial Agents and Chemotherapy*.

In earlier work, Givskov and his colleagues showed that “crude extracts of garlic inhibit the expression of a large number of genes that are controlled by bacterial quorum sensing [communication among bacterial cells involved in biofilm development], and that extracts promote a rapid clearing of pulmonary *Pseudomonas aeruginosa* infection in mice,” he says. “These findings encouraged us to identify and assess the efficacy of the pure active compound.”

That compound turned out to be ajoene, the major constituent of a multitude of sulfur-containing compounds produced when garlic is crushed, says Jakobsen. The team then showed in *P. aeruginosa* that ajoene inhibits expression of 11 genes that are controlled by quorum sensing. “These key genes are regarded as crucial for the ability of *P. aeruginosa* to cause disease,” he says.

“We also found ajoene to reduce the production of rhamnolipid, a

compound that shields the biofilm bacteria from the white blood cells that otherwise would destroy bacteria, and that by combining ajoene with the antibiotic tobramycin, it was possible to kill over 90 percent of bacteria living in a biofilm,” says Jakobsen.

“Our study is part of a series of comprehensive investigations of natural compounds targeting bacterial quorum sensing systems, and it further strengthens previous proof of concept research we conducted on the potential of compounds which block communication among pathogen cells in contrast to simply killing [bacteria](#), as conventional [antibiotics](#) do,” says Jakobsen. Such alternative approaches “may postpone or minimize development of antibiotic resistance,” he adds.

Jakobsen says the garlic project grew out of a major donation from the German [Cystic Fibrosis](#) Association. “In CF patients, *P. aeruginosa* infection leads to bronchiectasis, pulmonary fibrosis, respiratory failure, and death,” he says. “Despite intensive antibiotic treatment, CF patients have a life expectancy of about 40 years, and the main cause of death in CF patients remains complications associated with [this infection].” Jakobsen’s team and the German CF Association have patented the action of ajoene against biofilms, and are seeking a pharmaceutical partner to develop antimicrobial drugs based on ajoene.

Jakobsen notes that garlic has been used medicinally “for thousands of years.” Garlic not only has antibacterial properties; it has anti-viral, anti-fungal, and anti-protozoal properties as well, and it has beneficial effects on the cardiovascular and immune systems, as well, he says.

More information: T.H. Jakobsen, M. van Gennip, M. Givskov, et al. Ajoene, a sulfur-rich molecule from garlic, inhibits genes controlled by quorum sensing. [Antim. Agents Chemother.](#) 56:2314-2325.

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