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Engineered enzymes to disrupt and prevent biofilms

Engineered enzymes that inhibit hazardous and infectious biofilms by breaking down bacterial communication molecules.

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Biofilms: pervasive, destructive and difficult to prevent

Bacterial biofilms are significant health challenges. It is estimated that 80% of all microbial infections and 60% of healthcare-associated infections (HAI) in humans are caused by biofilms. The societal costs of HAIs are estimated at between $96 to $147 billion annually. Biofilms are characteristically slimy collections of bacteria surrounded by a matrix of DNA, proteins and polysaccharides that can adhere to and grow on a variety of surfaces. Because of the pervasive nature of bacteria, biofilms are incredibly common and can form on substrates, ranging from structural materials to living tissue. As sources of contamination, infection and biocorrosion, biofilms cause of an astounding array of problems, including: food contamination and rot, contamination of medical devices and a wide variety of human and animal infections. Biofilms are inherently resistant to antimicrobial agents and their physically sticky nature makes them challenging to treat and dislodge. A key step in the formation of many biofilms is bacterial communication through molecules known as quorum signals. Researchers at the University of Minnesota have engineered enzymes to break down quorum sensing molecules as a novel way to inhibit bacterial communication and disrupt or prevent biofilm formation.

Breaking lines of communication

Bacterial communication is vital for the formation of biofilms and interfering with this communication may mitigate against biofilm formation. Bacteria often secrete acyl homoserine lactones (AHLs), a molecule required for quorum sensing and biofilm formation. AHLs are degraded by the enzyme lactonase. University of Minnesota researchers have engineered lactonases in order to maximize enzyme stability and activity against a wide variety of lactones. These enzymes are capable of disrupting bacterial communication and preventing biofilm formation. The improved solubility, stability and longevity profile of these enzymes makes them ideal anti-infectives. Specifically, they can be incorporated in a variety of solvents or coatings, thus rendering them readily deployable on most surfaces. Significant human and veterinary medicine applications are possible where biofilm control is critical, for

example biofilms associated with cystic fibrosis, bacterial endocarditis and urinary tract infections.

To learn more about applications in material and biological sciences, read our complementary postings, 2016027a and 20160278c.

Phase of Development

Proof of concept. Experiments have shown that the enzymes can be added to a coating on steel, retain activity and successfully prevent biofilm-mediated biocorrosion.

Features & Benefits

- **Prevents and disrupts biofilms:** Lactonase breaks down the AHL lactones used for quorum sensing by bacteria, a key step in the formation of biofilms.
- **Non-toxic:** Based on research and animal feeding studies, no environmental or health hazards have been identified, which are commonly associated with biocidal compounds.
- **Robust and useable in diverse environments:** The enzymes are temperature, protease, acid and age resistant, retaining activity even in organic solvents.
- **Conventional production methods:** Scalable enzyme production using fermentation.

Applications

- Disinfecting coating or spray (medical or food surfaces)
- Anti-microbial coating for medical devices/products (pacemakers, bandages, contacts, dentures, bandaids…)
- Prevent post-harvest crop rot
- Prevention of food contamination (spray/coat food products)

Researchers

Mikael H. Elias, PhD
Assistant Professor, Department of Biochemistry, Molecular Biology, and Biophysics
External Link (cbs.umn.edu)
Randall Earl Hicks, PhD
Professor, Swenson College of Science and Engineering
External Link (scse.d.umn.edu)
Eric Chabrière, PhD
Professor, Aix-Marseille University
Siqian “Simon” Huang, PhD
Postdoctoral associate

Publications

Evaluation of biological and enzymatic quorum quencher coating additives to reduce biocorrosion of steel
PLOS ONE, May 16, 2019

Ready for Licensing

This technology is now available for license! The university is excited to partner with industry to see this innovation reach its potential. Please contact us to share your business' needs and your licensing interests in this technology. The license is for the sale, manufacture or use of products claimed by the patents.

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