

A Novel Enzyme for the Dispersal of Bacterial Biofilms

Background

Biofilms are composed of communities of bacteria that adhere to natural, clinical, and industrial environments and impact human health and industrial productivity. Microbial biofilms can form on any moisture rich surface such as teeth, solid surfaces such as rocks, and liquid air interfaces. Biofilms are medically important and account for over 80% of microbial infections in human beings including oral, dental implants, gastrointestinal tract, urogenital tract, and airway and lung tissues. Medical implants such as indwelling catheters, cardiac implants, prosthetic heart valves, and ventricular assist devices accumulate biofilms on their artificial surfaces. Because biofilms are embedded in a matrix of polysaccharides, they are extremely resistant to antimicrobials and are completely shielded from host immunological and other defense mechanisms.

The development of strategies for the prevention and treatment of biofilm related diseases have been hampered by the inability to study gene expression and metabolism of the biofilm microbes at the single cell level without destroying the bacteria. In order to colonize surfaces, biofilm bacteria must be able to disperse cells into the environment. Erosion and sloughing resulting from enzyme production, chemical signal production, abrasion or shear forces, and predator grazing have been proposed as mechanisms for the detachment of cells from biofilms.

UMDNJ investigators have discovered a novel enzyme that enables the detachment of bacteria from clusters of *A.actinomycetemcomitans* and other closely related bacteria that compose biofilms. **This novel enzyme represents a useful tool for studying biofilm dispersal in the oral cavity.**

Description of the Technology

A.actinomycetemcomitans, the causative agent of juvenile periodontitis affecting adolescents, has also been implicated in infective endocarditis and other non-oral diseases. Biofilm colonies comprising of clinical isolates of *A.actinomycetemcomitans* release cells into the liquid medium which then colonize the surface of the vessel enabling the bacteria to spread. UMDNJ researchers have created a mutant *A.actinomycetemcomitans* via insertional mutagenesis utilizing the IS903 ϕ kan transposon. These mutants are unable to release cells into the medium or spread over the surface of the culture vessel. Additionally, a novel gene, designated dspB gene, was identified to be associated this phenotype and is predicted to encode a secretory β -N-acetylglucosaminidase protein. When added to culture medium, the dspB protein restored the ability of *A.actinomycetemcomitans* mutants to release cells and colonize the culture vessel. The purified dspB protein could also induce the detachment of biofilm colonies of diverse strains of *A.actinomycetemcomitans* and closely related *Haemophilus aphrophilus* bacteria but not biofilm colonies of distantly related bacteria. Thus, this novel gene represents a useful tool in the study of biofilm dispersal.

Applications

- Modulating the detachment and/or release and dispersion of bacterial cells from biofilms in natural, clinical, and industrial environments
- To identify agents that can modulate the detachment and/or release and dispersion of bacterial cells from biofilms
- In the treatment of bacterial infections, including infections of the oral cavity

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- . •To coat medical devices:
- . ⑩ Intravascular catheters (especially central venous catheters)
- . ⑩ Prosthetic joints
- . ⑩ Cardiac pacemaker leads
- . ⑩ Prosthetic heart valves
- . ⑩ Cerebrospinal fluid shunts
- . ⑩ Vascular grafts (including aortofemoral grafts)
- . ⑩ Peritoneal dialysis catheters
- . ⑩ Intraocular lenses

Deliverables

- . •Vectors containing nucleic acid sequences of DspB protein
- . •Mutants of *A.actinomycescomitans*

Patent Status

PCT application filed.

Licensing Opportunity

This technology is available for licensing non-exclusively for research purposes and exclusively for clinical or industrial use.

Contact

Peter Golikov, MS, MBA
Director, Ventures and Licensing
University of Medicine and Dentistry of New Jersey
335 George Street
New Brunswick, NJ 08901
Direct Phone: (732)-235-9355
Main Office Phone: (732)-235-9350
Facsimile: (732)-235-9358
golikope@umdnj.edu

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