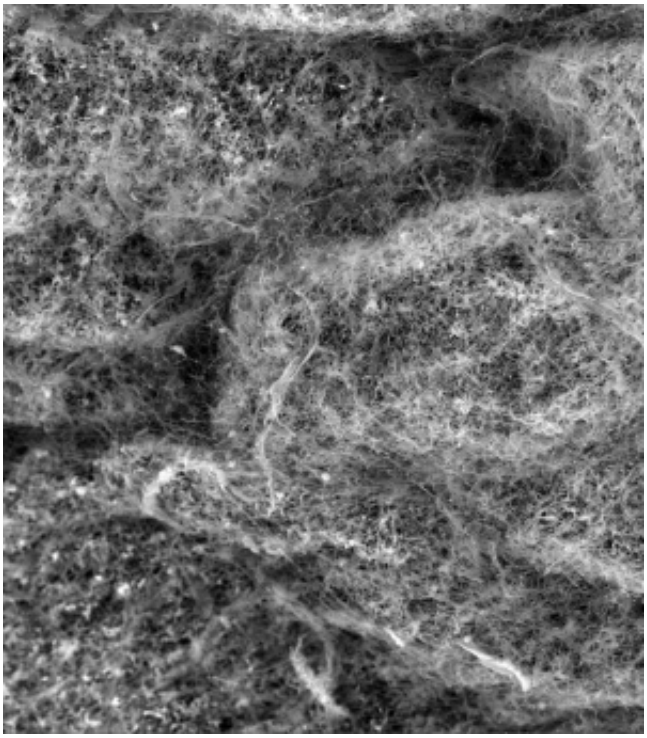
Salivary mucins play active role to fight cavities

November 11 2014



The viscoelastic properties of mucus and saliva are attributed to mucins, large glycoproteins that play a key role in host defense and maintaining a healthy microbiome. Human salivary mucins protect teeth from dental cavities, which are primarily caused by *Streptococcus mutans* colonization. Credit: Photo by Nicole Kavanaugh.

Salivary mucins, key components of mucus, actively protect the teeth from the cariogenic bacterium, *Streptococcus mutans*, according to

research published ahead of print in *Applied and Environmental Microbiology*. The research suggests that bolstering native defenses might be a better way to fight dental caries than relying on exogenous materials, such as sealants and fluoride treatment, says first author Erica Shapiro Frenkel, of Harvard University, Cambridge, MA.

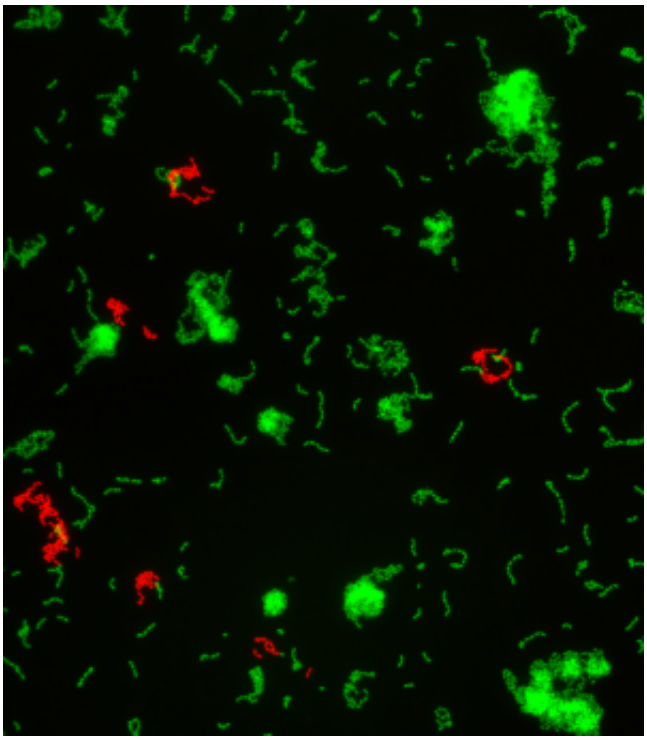
S. mutans attaches to teeth using sticky polymers that it produces, eventually forming a biofilm, a protected surface-associated bacterial community that is encased in secreted materials, says Frenkel. As *S. mutans* grows in the biofilm, it produces organic acids as metabolic byproducts that dissolve tooth enamel, which is the direct cause of cavities. "We focused on the effect of the salivary mucin, MUC5B on *S. mutans* attachment and biofilm formation because these are two key steps necessary for cavities to form," says Frenkel.

"We found that salivary mucins don't alter *S. mutans*' growth or lead to bacterial killing over 24 hours," says Frenkel. "Instead, they limit biofilm formation by keeping *S. mutans* suspended in the liquid medium. This is particularly significant for *S. mutans* because it only causes cavities when it is attached, or in a biofilm on the tooth's surface." She adds that the oral microbiome is better preserved when naturally occurring species aren't killed. "The ideal situation is to simply attenuate bacterial virulence," she says.

The study grew out of previous work in the investigators' laboratory showing that other types of mucins, such as porcine gastric mucins, had protective effects against common lung pathogens, says Frenkel. With this in mind, they suspected that salivary mucins would play a protective role, but they were not sure what that would be.

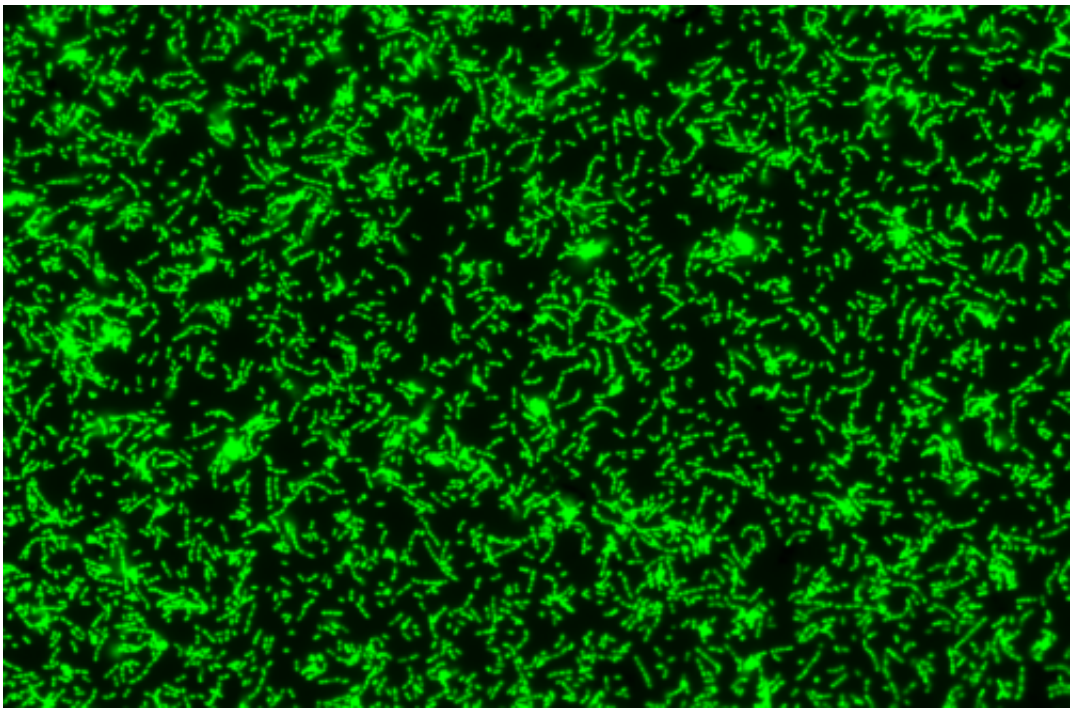
"Defects in mucin production have been linked to common diseases such as asthma, cystic fibrosis, and ulcerative colitis," says Frenkel. "There is increasing evidence that mucins aren't just part of the mucus for

structure or physical protection, but that they play an active role in protecting the host from pathogens and maintaining a healthy microbial environment. We wanted to apply these emerging ideas to a disease model that is a widespread, global public health problem—cavities. We chose to study the interaction of MUC5B with *Streptococcus mutans* because it is the primary cavity-causing bacteria in the oral cavity."



This is two overlayed fluorescent microscopy images of *Streptococcus mutans*, the primary bacteria responsible for dental cavities. When *S. mutans* forms biofilms on the tooth surface, it produces organic acids as metabolic byproducts that dissolve tooth enamel. The green fluorescent image shows *S. mutans* biofilm mass when grown in the presence of sucrose, a substrate necessary for substantial bacterial attachment and biofilm formation. The red fluorescent image overlayed depicts *S. mutans* biofilm mass in the presence of sucrose and purified human salivary mucins. Mucins are key structural components of mucus and saliva that play an important role in host defense. Credit: Nicole Kavanaugh.

The research makes a fundamental contribution to scientific understanding of host-microbe interactions, says principal investigator Katharina Ribbeck, of the Massachusetts Institute of Technology, Cambridge MA. "It is generating a paradigm shift from the textbook view of mucus as a simple catchall filter for particles, towards the understanding that mucus is a sophisticated bioactive material with powerful abilities to manipulate microbial behavior."



A fluorescent microscopy image of a *Streptococcus mutans* biofilm. Credit: Photo by Nicole Kavanaugh

Provided by American Society for Microbiology

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