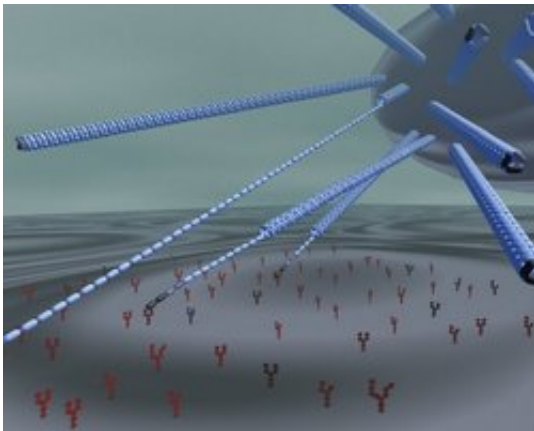


# Tiny shock absorbers help bacteria stick around inside the body

August 29 2006

---



This illustration shows an *E. coli* bacterium with hair-like fimbriae that bind to molecules on a surface. Some of the fimbriae have uncoiled from one end as fluid flow pulls on the bacterium. The uncoiling and recoiling of the fimbriae, like a nanoscopic Slinky toy, ensures that each fimbria keeps the right amount of force for the finger-trap-like molecules at the tip to stick firmly to the surface even in high and unstable fluid flow. (Sheila Luna, ETH Zurich)

Bacteria have hair-like protrusions with a sticky protein on the tip that lets them cling to surfaces. The coiled, bungee cord-like structure of the protrusions helps the bacteria hang on tightly, even under rough fluid flow inside the body, researchers report in the journal *PLoS Biology*.

A group of researchers at the University of Washington in Seattle and ETH Zurich in Switzerland have been studying how the bacterium *E.*

coli attaches to mucous membranes in the body. In their previous research, they explained how the protrusions, known as fimbriae, have an adhesive protein called FimH at their tip that binds in an unusual way to a sugar molecule on a surface.

The FimH-sugar combination makes a "catch bond" that acts like a finger trap, and actually gets stronger as drag force is exerted on a bacterium. Rather than being swept away by fluids moving through the human body, the bacterium grips even more tightly, helping it stick around and form an infection, like those seen in the urinary tract, for instance. The catch bonds release their grip when there is little or no force on the bacteria.

In new research, the scientists have learned that the mechanical properties of the bungee-like fimbriae also play a key role in the tenacity of *E. coli* clinging to mucousal surfaces. The tiny fiber-like protrusions are made up of interlocking protein segments in a tightly coiled helix shape, like a seven-nanometer-wide Slinky toy. The researchers found that under force, the fimbriae stretch to many times their original length as the protein segments uncoil one by one. If the force on them drops, the fimbriae coils are compressed, keeping tension on the bond between the bacterium and the mucous membrane.

"The fimbriae uncoil and recoil to dampen sudden changes in forces caused by rough and rapidly changing flow conditions," explained study co-author Dr. Viola Vogel, professor in the Department of Materials at ETH Zurich. This process maintains an optimal force required to keep the finger trap-like FimH anchor from breaking loose.

"This system is similar to a set of shock absorbers on your car that dampen turbulent forces caused by bumpy road conditions," added study co-author Dr. Wendy Thomas, assistant professor of bioengineering at the UW.

The researchers found that fimbrial uncoiling and recoiling events balance each other at an intermediate force level that corresponds to the force at which the sticky protein tip forms the most stable bond with the surface. Thus, the mechanical and adhesive features of the system evolved together to help the bacteria persist in tough environments inside a host animal or person.

"Research on these fimbriae uncovers something that's essentially a mechanical nanotechnological device created by nature, and gives us the opportunity to adapt such a system for biotechnological and even other technical uses," said study co-author Dr. Evgeni Sokurenko, associate professor of microbiology at the UW and a principal investigator at the NIH Bioengineering Research Partnership that primarily funded the project. "It also improves our understanding of how to fight bacteria that persist in turbulent environments, like the human urinary tract or intestines."

Source: University of Washington

Citation: Tiny shock absorbers help bacteria stick around inside the body (2006, August 29)  
retrieved 25 April 2024 from <https://phys.org/news/2006-08-tiny-absorbers-bacteria-body.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.