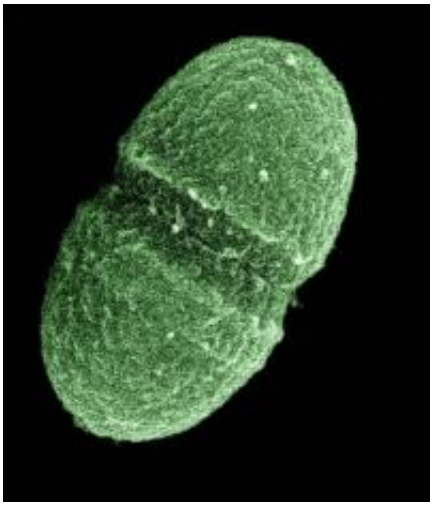
Researchers find intestinal bacteria create phages for use as weapons

October 9 2012, by Bob Yirka



Enterococcus faecalis. Credit: United States Department of Agriculture

(Phys.org)—Researchers at the University of Texas have found that a certain type of bacteria that lives in the mammalian gut creates a virus to kill off competitors. In their paper published in the *Proceedings of the National Academy of Sciences*, the team says their discovery came about purely by accident.

Phages, short for *bacteriophages*, are viruses created by bacteria that target and destroy other bacteria. They are of great interest to scientists because if they could be controlled, they could provide perhaps the ultimate anti-bacterial agent. Unfortunately, despite a lot of research

since their discovery nearly century ago, very little is known about how they function, particularly, in the human gut. In this new research, the team discovered something that had never been seen before, a strain of bacteria that create a phage for the express purpose of killing off other bacteria that are competing for the same resources.

The gut, as most know, is home to trillions of bacteria; some provide benefits to the host, such as helping to digest certain foods, while others are not so good, causing digestive problems. One in particular, the plentiful *Enterococcus faecalis*, appears to live without creating problems in the gut, but causes a lot of problems when it gets in the bloodstream, accounting for many hospital acquired infections. In looking at a particular strain of *E. faecalis* known as V583, the researchers found that when it was introduced alone into a germ-free mouse gut, it began churning out phages, which seemed counter-productive as it takes a lot of energy to do so.

In looking closer, the team discovered that V583 did have a purpose, and that was to kill any other strains of *E. faecalis* that might show up, gobbling resources. Thus, the gut bacteria were creating phages to use as a weapon against closely related bacteria that might consume shared resources. The researchers call it a form of bacterial warfare, but also suggest that the discovery might offer some insight into how bacteria in general might be used to create phages in ways that can be controlled, allowing for the development of targeted anti-bacterial agents that kill offending bacteria without harming those that are beneficial.

More information: A composite bacteriophage alters colonization by an intestinal commensal bacterium, *PNAS*, Published online before print October 8, 2012, doi: 10.1073/pnas.1206136109

Abstract
The mammalian intestine is home to a dense community of bacteria and

its associated bacteriophage (phage). Virtually nothing is known about how phages impact the establishment and maintenance of resident bacterial communities in the intestine. Here, we examine the phages harbored by Enterococcus faecalis, a commensal of the human intestine. We show that E. faecalis strain V583 produces a composite phage (ϕV1/7) derived from two distinct chromosomally encoded prophage elements. One prophage, prophage 1 (ϕV1), encodes the structural genes necessary for phage particle production. Another prophage, prophage 7 (ϕV7), is required for phage infection of susceptible host bacteria. Production of ϕV1/7 is controlled, in part, by nutrient availability, because ϕV1/7 particle numbers are elevated by free amino acids in culture and during growth in the mouse intestine. ϕV1/7 confers an advantage to E. faecalis V583 during competition with other E. faecalis strains in vitro and in vivo. Thus, we propose that E. faecalis V583 uses phage particles to establish and maintain dominance of its intestinal niche in the presence of closely related competing strains. Our findings indicate that bacteriophages can impact the dynamics of bacterial colonization in the mammalian intestinal ecosystem.

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