Humans not the major target of Shiga toxin

December 3 2007

If you've survived Shiga toxin and the after-effects of food poisoning, you may have been the innocent victim of a battle for survival between predator and prey.

Bacteria that carry a virus (a bacteriophage) that packs the Shiga toxin gene (Stx) may depend on it for protection from bacterial predators like the ciliated protozoan Tetrahymena. This is small comfort if you've just consumed that.

Food poisoning victims -- as a result, for example, of consuming Shiga-packing E.coli in a contaminated bag of spinach -- have always had the cold comfort of being told that not all common bacteria make humans extremely sick, only the strains that have integrated the Shiga gene into their DNA. These bacteria can produce large amounts of the Shiga toxin and release it into the surrounding environment.

Leaving sick humans aside for a moment, Gerald Koudelka, Todd Hennessey, and colleagues from the University at Buffalo in Amherst, New York, wondered what evolutionary advantage the bacteria would derive from carrying around such a prickly viral hitchhiker. They hypothesized that the Stx gene might give the bacterial host an equalizer against bacterial predators.

"Humans may not be the major target of this toxin," explains Koudelka. "Instead, they might be simply caught in the cross-fire in this ancient battle between prey and predators."

To test their hypothesis, the researchers grew Tetrahymena with an E. coli strain (EDL933) that carries the Stx gene. It worked, at least, for the EDL933 that grew successfully in co-cultures with Tetrahymena. In this hostile environment, it was the predator, Tetrahymena, that was killed by the bacteria's Shiga toxin. An E. coli strain (W3110) lacking Stx did poorly with Tetrahymena as roommates. The Tetrahymena had them for lunch.

The Shiga toxin kills by binding to a receptor on the surface of Tetrahymena. Adding protein subunits that block toxin binding to the protozoan predator prevented killing by Shiga toxin. Humans have the same surface receptor for Shiga toxin as do Tetrahymena, which gives biologists and produce packers a close interest in the deadly duel between Tetrahymena and Shiga-packing E. coli.

The Koudelka and Hennessey labs are continuing to characterize the route of Shiga toxin entry into the cytoplasm of Tetrahymena, its mode of killing, and the ability of Tetrahymena to develop resistance to Shiga toxin. The protozoan might make a model cellular system for Shiga detoxification, which one day might relieve some of the stress around the salad bar, say Koudelka and Hennessey.

Source: American Society for Cell Biology