New Salmonella Finding—

Inter-Bacterial Communication!

Cells of *Salmonella enteritidis* change shape as they grow. This scanning electron micrograph shows a mixture of small cells with filaments and very large cells that lack filaments. Small cells arise only during certain growth stages and efficiently contaminate eggs when the time is right. Magnified about 18,000x.

JEAN GUARD-PETTER (K8732-2)

Talking bacteria may sound bizarre, but microorganisms do have a primitive form of communication—much as some insects use pheromones to lure a mate or signal an attack. An Agricultural Research Service scientist found this happens with *Salmonella* bacteria, and her discovery could have big implications for food safety.

Veterinarian Jean Guard-Petter, who is in ARS' Southeast Poultry Research Unit at Athens, Georgia, found that the food pathogen *Salmonella enteritidis* uses acyl-homoserine lactone, or AHL, as its chemical "call to arms."

"This chemical tells cells to rewrite their genetic programming," says Petter. "It enhances their ability to grow as much as a hundred-fold and signals cells to produce molecules that increase virulence—the ability to invade living things and cause disease."

Over the last 15 years, occurrences of *S. enteritidis* food poisoning have increased fourfold in the United States and fortyfold in Europe.

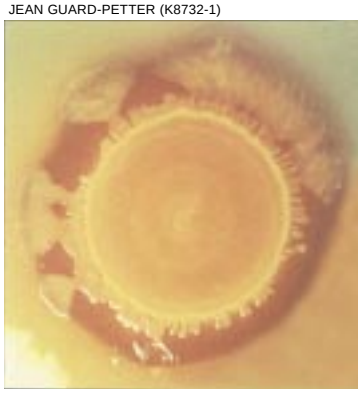
Petter's findings are a first look at how a major foodborne pathogen couples heightened growth potential with virulence factors to maintain itself as a food-safety threat.

In an animal host, the bacteria swim along, putting out low levels of AHL, Petter explains. But once there are a lot of bacteria concentrated in a confined space—like the spleen of a chicken—the chemical builds up and signals an aggressive attack, so the next battlefront—usually a hen's eggs—can be occupied.

Salmonella enteritidis in eggs can be a big problem. The infected hens don't appear sick, so farmers won't know anything is wrong. The contaminated eggs, however, can make people seriously ill.

Fortunately, the new USDA Hazard Analysis and Critical Control Points (HACCP) inspection system uses sensitive detection techniques to keep pathogen numbers as low as possible.

JEAN GUARD-PETTER (K8732-1)



This large bacterial colony of *Salmonella enteritidis* grew rapidly (62 millimeters in diameter in 16 hours) and readily contaminated eggs when given to chickens by injection but not when given by mouth.

Petter was the first to see that AHL is a factor in this bacterium's rapid growth and spread. It was J. Woodland (Woody) Hastings at Harvard University who, in the late 1960s, discovered that microorganisms can communicate chemically. Scientists call the phenomenon quorum-sensing.

Petter made her discovery by using a special plasmid reporter system developed at the University of Nottingham in England. This reporting system puts genes in *S. enteritidis* bacteria that cause them to emit light if they are producing AHL. The theory was that as the light came on and got brighter, growth to a high cell density would happen at the same time.

The samples showed this was happening. Now, Petter is working with ARS microbiologist Amy Charkowski in Albany, California, to understand the chemical structure of AHL.

Petter theorizes that egg contamination is a cooperative effort by two forms of *S. enteritidis* produced by certain strains. The first are "scout cells" that are ingested by hens and move from the gut to the spleen. Scout cells can't infect eggs any better than common *Salmonella* strains. But they blaze a trail for a second type of the bacterium that is very good at producing AHL and growing to unexpectedly high levels within the body of the bird.—By **Jill Lee,** formerly with ARS.

This research is part of Food Safety, an ARS National Program (#108) described on the World Wide Web at http://www.nps.ars.usda.gov/programs/appvs.htm.

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