Pill some day may prevent serious foodborne illness, scientist says

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Modified probiotics, the beneficial bacteria touted for their role in digestive health, could one day decrease the risk of *Listeria* infection in people with susceptible immune systems, according to Purdue University research.

Arun Bhunia, a professor of food science; Mary Anne Amalaradjou, a Purdue postdoctoral researcher; and Ok Kyung Koo, a former Purdue doctoral student, found that the same *Listeria* protein that allows the bacteria to pass through intestinal cells and into bloodstreams can help block those same paths when added to a probiotic.

"Based on the research, it looks very promising that we would get a significant reduction in *Listeria* infections," said Bhunia, whose findings were published this month in the journal PLoS One.

Bhunia's earlier work showed that *Listeria* triggers intestinal cells to express heat shock protein 60 on their surfaces. That allows *Listeria* to bind to the intestinal cells using an adhesion protein and pass into them, acting as a sort of gateway to the bloodstream.

Once in the bloodstream, even small doses of *Listeria* can cause fever, muscle aches, nausea and diarrhea, as well as headaches, stiff neck, confusion, loss of balance and convulsions if it spreads to the nervous system. It can also cause abortion and stillbirth in pregnant women.

According to the U.S. Centers for Disease Control and Prevention, it

sickens about 1,500 and kills 255 people each year in the United States and primarily affects pregnant women, newborns, older adults and those with weakened immune systems.

"We're seeing fewer *Listeria* infections, but the severity of those infections is still high," Amalaradjou said.

The researchers found that probiotics alone were ineffective in combatting *Listeria*, so they stole a trick from the bacteria's own playbook. By adding the *Listeria* adhesion protein to the probiotic *Lactobacillus paracasei*, they were able to decrease the number of *Listeria* cells that passed through intestinal cells by 46 percent, a significant decrease in the amount of the bacteria that could infect a susceptible person.

With the adhesion protein, *Lactobacillus paracasei* interacts with heat shock protein on the surface of intestinal cells just as *Listeria* would. The probiotic then attached to the intestinal cells, crowding out *Listeria*.

"It's creating a competition," Bhunia said. "If *Listeria* comes in, it doesn't find a place to attach or invade."

Bhunia said he could one day foresee the development of a pill or probiotic drink that could be given to at-risk patients to minimize the risk of *Listeria* infection.

The results came from tests on human intestinal cells. The next step would be animal testing. Bhunia said that would allow him to see whether different doses would have a greater effect.

More information: Recombinant Probiotic Expressing Listeria Adhesion Protein Attenuates Listeria monocytogenes Virulence In Vitro, *PLoS One.*

ABSTRACT

Background: Listeria monocytogenes, an intracellular foodborne pathogen, infects immunocompromised hosts. The primary route of transmission is through contaminated food. In the gastrointestinal tract, it traverses the epithelial barrier through intracellular or paracellular routes. Strategies to prevent L. monocytogenes entry can potentially minimize infection in high-risk populations. Listeria adhesion protein (LAP) aids L. monocytogenes in crossing epithelial barriers via the paracellular route. The use of recombinant probiotic bacteria expressing LAP would aid targeted clearance of Listeria from the gut and protect high-risk populations from infection.
Methodology/Principal Findings: The objective was to investigate the ability of probiotic bacteria or LAP-expressing recombinant probiotic Lactobacillus paracasei (LbpLAP) to prevent L. monocytogenes adhesion, invasion, and transwell-based transepithelial translocation in a Caco-2 cell culture model. Several wild type probiotic bacteria showed strong adhesion to Caco-2 cells but none effectively prevented L. monocytogenes infection. Pre-exposure to LbpLAP for 1, 4, 15, or 24 h significantly (P