Device speeds concentration step in food-pathogen detection

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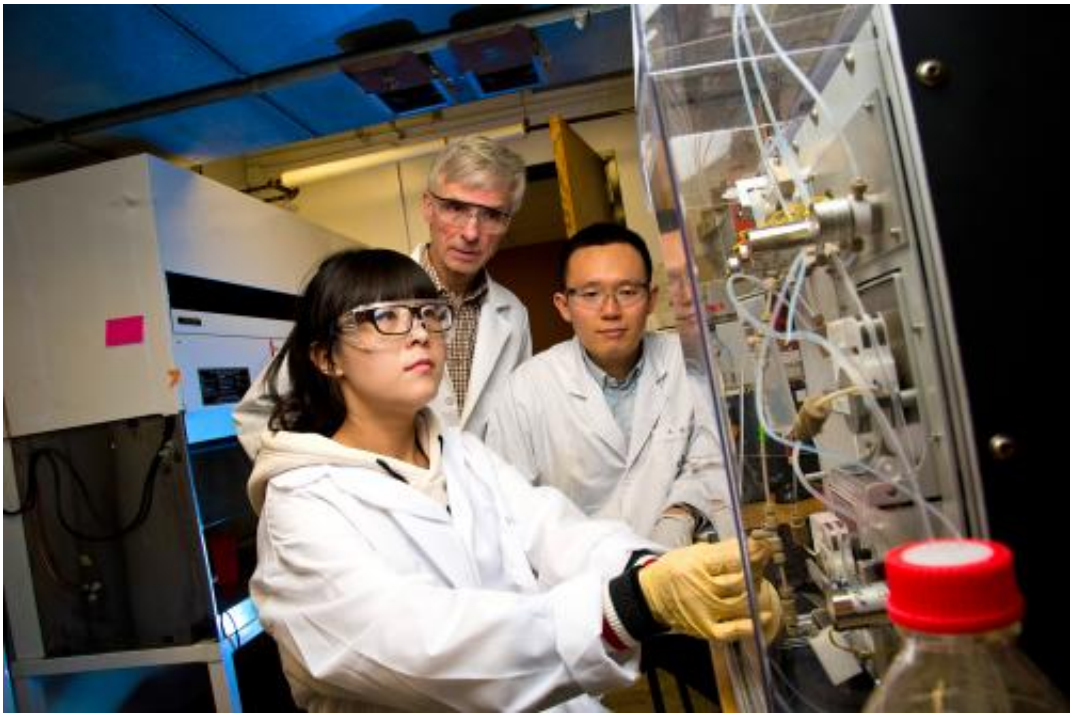

Purdue University doctoral students, from left, Xuan Li and Seockmo Ku operate a new system that concentrates foodborne salmonella and other pathogens faster than conventional methods, representing a potential new tool for speedier detection. The research is led by Michael Ladisch, center, a distinguished professor of agricultural and biological engineering. Credit: Purdue University photo/Steven Yang

(Phys.org) —Researchers have developed a system that concentrates foodborne salmonella and other pathogens faster than conventional

methods by using hollow thread-like fibers that filter out the cells, representing a potential new tool for speedier detection.

The machine, called a continuous cell concentration device, could make it possible to routinely analyze food or water samples to screen for pathogens within a single work shift at food processing plants.

"This approach begins to address the critical need for the food industry for detecting food pathogens within six hours or less," said Michael Ladisch, a distinguished professor of agricultural and biological engineering at Purdue University. "Ideally, you want to detect foodborne pathogens in one work shift, from start to finish, which means extracting the sample, concentrating the cells and detection."

A report from the Centers for Disease Control and Prevention (CDC) indicates a lack of recent progress in reducing foodborne infections and highlights the need for improved prevention. Although many foodborne illnesses have declined in the past 15 years, the number of laboratory-confirmed salmonella cases did not change significantly in 2012 compared with 2006 to 2008.

The first step in detecting foodborne pathogens is concentrating the number of cells in test samples. The new system enables researchers to carry out the concentration step within one hour, compared to a day for the standard method now in commercial use, said Ladisch, also a professor of biomedical engineering and director of Purdue's Laboratory of Renewable Resources Engineering (LORRE)

Findings are detailed in a research paper to appear in November in the journal *Applied and Environmental Microbiology*.

The paper was authored by doctoral student Xuan Li; LORRE research scientist Eduardo Ximenes; postdoctoral research associate Mary Anne

Roshni Amalaradjou; undergraduate student Hunter B. Vibbert; senior research engineer Kirk Foster; engineering resources manager Jim Jones; microbiologist Xingya Liu; Arun K. Bhunia, a professor of food microbiology; and Ladisch.

Findings showed the system was able to concentrate inoculated salmonella by 500 to 1,000 times the original concentration in test samples. This level of concentration is required for accurate detection. Another finding showed the system recovered 70 percent of the living pathogen cells in samples, Ladisch said.

"This is important because if you filter microorganisms and kill them in the process that's self-defeating," he said. "The goal is to find out how many living microorganisms are present."

The machine was used to concentrate cells in a sample of chicken meat. The sample is first broken down into the consistency of a milkshake and chemically pretreated to prevent the filtering membranes from clogging. The fluid is then passed through 12 hollow-fiber filters about 300 microns in diameter that are contained in a tube about the size of a cocktail straw. The filtering process continues until pathogens if present are concentrated enough to be detected.

The technique, developed by researchers from Purdue's colleges of Engineering and Agriculture, could be performed during food processing or vegetable washing before the products are shipped.

The U.S. Department of Agriculture will test the system, which is not yet ready for commercialization.

One feature that could make the machine practical for commercial application is that it can be quickly cleaned between uses. The tubes are flushed with sodium hydroxide and alcohol.

Purdue has filed a patent application for the concept.

More information: Rapid Sample Processing for Detection of Food-Borne Pathogens via Cross-Flow Microfiltration, *Applied and Environmental Microbiology*, 2013.

ABSTRACT

This paper reports an approach to enable rapid concentration and recovery of bacterial cells from aqueous chicken homogenates as a preanalytical step of detection. This approach includes biochemical pretreatment and prefiltration of food samples and development of an automated cell concentration instrument based on cross-flow microfiltration. A polysulfone hollow-fiber membrane module having a nominal pore size of 0.2 um constitutes the core of the cell concentration instrument. The aqueous chicken homogenate samples were circulated within the cross-flow system achieving 500- to 1,000-fold concentration of inoculated Salmonella enterica serovar Enteritidis and naturally occurring microbiota with 70% recovery of viable cells as determined by plate counting and quantitative PCR (qPCR) within 35 to 45 min. These steps enabled 10 CFU/ml microorganisms in chicken homogenates or 102 CFU/g chicken to be quantified. Cleaning and sterilizing the instrument and membrane module by stepwise hydraulic and chemical cleaning (sodium hydroxide and ethanol) enabled reuse of the membrane 15 times before replacement. This approach begins to address the critical need for the food industry for detecting food pathogens within 6 h or less.

Provided by Purdue University