Food Safety Biosensor Detects Pathogens In Foods

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perform laboratory tests, but they are costly and slow – sometimes not even yielding results for 48 to 72 hours. That delay requires that food products remain stored in warehouses for longer periods.

The biosensor will help in overall quality control in food processing plants, said collaborator Dr. Paul Edmonds, a professor of biology at Georgia Tech. It would minimize the chance of the final product being contaminated.

Georgia Tech researchers – in collaboration with Dr. Robert Brackett, a professor at the University of Georgia's Center for Food Safety and Quality Enhancement in Griffin – have been developing and testing the biosensor in their laboratories for about four years. Now they are ready for a field test expected to start in November at Gold Kist in Carrollton, Ga., just west of Atlanta.

Laboratory tests have proven the biosensor is extremely sensitive, meaning it can detect pathogens at minute levels of 500 cells per milliliter. Researchers believe they can improve that sensitivity to 100 cells per milliliter. Current laboratory methods only achieve sensitivity levels of 5,000 cells per milliliter, and they usually take from eight to 24 hours to yield results.

In addition, lab equipment costs $12,000 to $20,000 per instrument compared to an estimated $1,000 to $5,000 for a biosensor.

But before the biosensor gains market acceptance, it must prove its effectiveness in the upcoming field test. The first phase will last three to six months, and researchers will be comparing their biosensor test results with the company's lab findings.

One of the things we will be looking at is reproducibility of results, Hartman said. We will split a sample for testing with both of the technologies (the biosensor and lab tests). For every 1,000 tests we do, we will look for the variation between results of the two methods.

The biosensor can simultaneously detect 12 different pathogens, but researchers are concentrating on six bacterial species for now. They are Salmonella, E. coli 0157:H7, generic E. coli, Listeria monocytogenes, Campylobacter jejuni and Yersenia enterocolitica (found primarily in red meat). All of these pathogens are associated with stomach illness in humans. When detected, they are usually found in meat, but sometimes they occur in produce.

The biosensor operates with three primary components – integrated optics, immunoassay techniques and surface chemistry tests. It indirectly detects pathogens by combining immunoassays with a chemical sensing scheme. In the immunoassay, a series of antibodies selectively recognize target bacteria. The "capture" antibody is bound to the biosensor and captures the target bacteria as it passes nearby. A set of "reporter" antibodies, which bind with the same target pathogen, contain the enzyme urease, which breaks down urea that is then added and produces ammonia. The chemical sensor detects the ammonia, affecting the optical properties of the sensor and signaling changes in transmitted laser light. These changes reveal both the presence and concentration of specific pathogens in a sample at extremely minute levels.

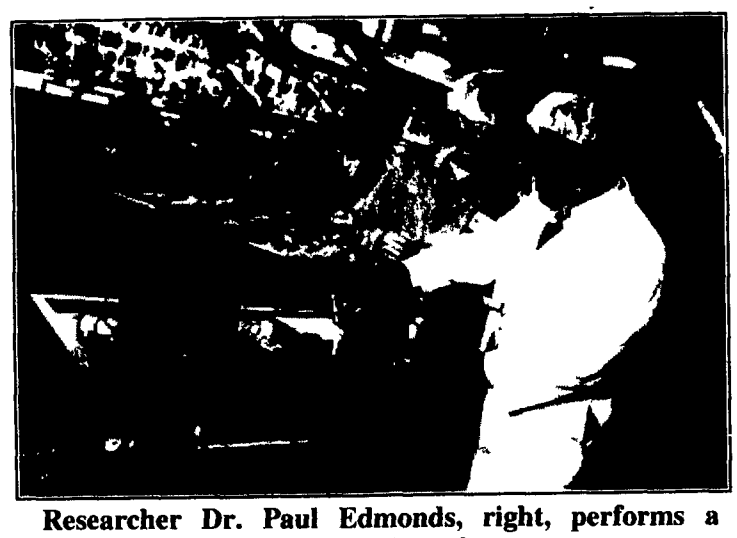
If pathogens are found with the biosensor, then food processors can make decisions more quickly about applying treatments, such as antiseptics, Edmonds said. Or they might divert those products to cooking operations, which would kill the pathogens. And companies could modify their sanitation plans.

The field test is expected to demonstrate the biosensor's ability to improve food processors' operations, but it has some competition from other techniques. One that is under development is an electrochemical scheme that can reportedly detect pathogens at 100 to 1,000 cells per milliliter.

Another technique already in use is a DNA-based method called PCR. While extremely sensitive, it is very time-intensive in terms of sample preparation.

Meanwhile, the integrated optic interferometric sensor technology upon which the biosensor is based has already been patented by Hartman and the Georgia Tech Research Corporation. It is also the basis for a chemical contaminant sensing system called E-SMART. That system is also undergoing field tests. The chemical sensor was licensed commercially by the Atlanta-based company Photonic Sensor.

Commercialization for the biosensor is still some time away, researchers said. After the field test at Gold Kist is completed, researchers plan to return to their laboratories to further refine the technology. "We would like to extend the biosensor's capabilities to detect other pathogens, and we will need to optimize the chemistry for that," Hartman said. "Also, we would like to use the biosensor to address other food safety issues, such as those associated with insecticides, pesticides and growth hormones."



Researcher Dr. Paul Edmonds, right, performs a biosensor test at a Georgia poultry plant.

In addition to its application in the poultry and beef industries, Edmonds believes there is a need for the biosensor in the seafood industry. It contends with a variety of waterborne pathogens, particularly in shellfish. And the dairy industry could benefit from biosensor use, as well, he said. An outbreak of Listeria was found in Brie cheese several years ago.

While biosensor development continues, the state-funded Agricultural Technology Research Program at Georgia Tech is sponsoring the project.

New Members Welcome In 4-H

LANCASTER (Lancaster Co.) — Interested Lancaster County youth are welcome to attend the next meeting of the Red Rose 4-H Beef Club at 7:30 p.m., Wednesday, Oct. 13, at the Lancaster Farm and Home Center.

This special meeting for new members will include official sign-up, explanation of project goals, introduction of leaders, and a program on "Beef Breed Identification."

The club holds seven meetings each year, a round-up in August, and a recognition banquet. Members of the club will have the opportunity to participate in livestock and meats judging programs, community fair beef shows, and the Pennsylvania Farm Show.

For additional information, contact Chet Hughes, Penn State Cooperative Extension livestock agent, at (717) 394-6851.