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The OARDC Research Enhancement Competitive Grants Program

Ohio Agricultural Research and Development Center
College of Food, Agricultural, and Environmental Sciences

## Rapid and High Throughput Detection of Pathogenic Bacteria in Food Samples

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■ Detection and prevention of foodborne illnesses are a major challenge for producers and consumers alike, with contaminated foods causing some 5,000 deaths per year in the United States alone.

Despite strict regulations and new technologies in the food industry, foodborne illnesses remain a major challenge for producers and consumers alike. In the United States alone, 5,000 deaths per year result from contaminated foods. People most affected by disease-causing bacteria in foods are infants, those who are pregnant, those who have immuno-compromised systems, and the elderly.

In addition to the detrimental effects on the well-being of people, the economic impact of foodborne illnesses is also quite large. For instance, in a single year, salmonellosis (nausea, diarrhea, vomiting caused by *Salmonella*) resulted in production losses costing more than $500 million. Rapid, easy-to-use, and cost-effective techniques for the food industry and regulatory agencies are needed for effective microbial surveillance to ensure food safety.

Traditional methods for the detection of disease-causing bacteria are accurate and low cost; however, they require several involved procedures, trained personnel, and often take as long as three to six days. This time span is too long, considering that foods are shipped from companies every day, and it may take only hours or a few days to develop a disease from consuming contaminated food.
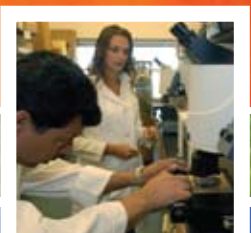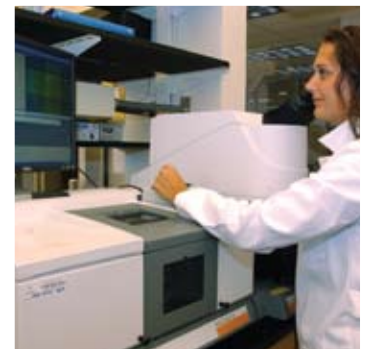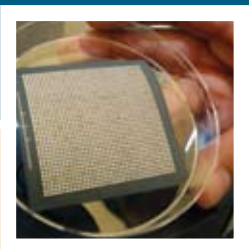
The goal of this project was to develop a tool that would help prevent contaminated food from reaching consumers. To achieve the goal, OARDC scientists developed a protocol to isolate and identify foodborne pathogenic bacteria, specifically *Salmonella enterica serovars*, by using immunomagnetic separation (IMS) and infrared spectroscopy. IMS utilizes micro-sized magnetic beads coated with antibodies against a chosen bacterial species.

The beads are easily dispersed in solution and manipulated under the influence of a magnetic field, which facilitates efficient bacterial retrieval and concentration. The captured bacteria are analyzed by infrared spectroscopy, which provides fingerprint information on the biochemical composition of the samples used to identify and sub-type bacterial species. This procedure takes from 12 to 24 hours, a considerable reduction in testing time.

To accomplish the goal of this study, saline solutions were contaminated with a known level of bacteria. Dynabeads® anti-*Salmonella* were added to the contaminated solution to specifically separate and concentrate the pathogenic *Salmonella* bacteria. The data were analyzed statistically, allowing the generation of classification models that were able not only to predict whether *Salmonella* bacteria were present on the beads but were able to also predict specifically which strain was present.

In order to improve the method further, scientists switched to an infrared microscope having a better detection limit. After only eight to 10 hours, enough bacteria were present to allow for building a model and making predictions, without requiring a removal of the beads from the bacteria.

The next step for this protocol will be testing the presence of foodborne pathogens in actual foods, such as apple, orange, or tomato juice; eggs; meats; and milk. This method has the potential to be used for the detection of other pathogens, since immunomagnetic beads are also available for *Listeria monocytogenes* and *Escherichia coli* O157:H7, the pathogen responsible for the recent outbreak of food-related disease from spinach.

In conclusion, this method is rapid and simple to perform and requires minimal sample preparation. Ultimately, this technique will contribute to more effective and efficient detection techniques for processed foods with regard to contamination by pathogenic microorganisms. This, in turn, minimizes production loss, and therefore cost, while enhancing consumer safety.

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