This research has contributed to a novel, specific, reliable and fast detection for food-borne pathogens and safeguard human health from the contamination.

Highly Specific and Rapid Immuno-fluorescent Visualization and Detection of Pathogenic Bacteria

Who cares and why?

Pathogenic bacteria have a profound impact on the very basic aspects of human beings, such as the food we eat, the water we drink and the environment we live in. Contamination due to bacteria can cause loss of life, debilitating illness, economic and environmental impact. According to Center for Disease Control (CDC), in 2014, there were 35 outbreaks in 12 states in the US related to food contamination with at least 7 deaths with scores hospitalized and many product recalls. The infected food products included apples, ice-cream, soy products, sprouts, cheese etc. The health concerns caused by exposure to pathogenic bacteria include Meningitis and pregnancy-related illnesses due to Listeriosis (disease caused be Listeria), bloody diarrhea (due to E.coli O157:H7) infection etc. The economic cost related to disease outbreak, food recalls and health care cost account for more than 50 billion. To effectively counter the issue related to food contamination, it is imperative that we come up with reliable and fast "detection techniques", because effective detection is the first line of defense for effective containment.

What has the project done so far?

This research has focused on techniques that are capable of detecting "specifically" very small quantities (colony forming units, CFU) of bacteria in very short time. Many currently used methodologies require 2-4 days to confirm the presence of bacteria in a sample. We have fabricated and tested devices that can test "multiple" samples "simultaneously" and can provide results in < 2 hours. Such technique uses a combination of antibody immobilization on a magnetic particles and fluorescent detection of bacteria. As shown in figure 1, it can be seen that the 'fluorescently labeled" bacteria (green hue) is bound to the particles which were immobilized with the antibody (figure 1b) whereas there was no detection when there was no antibody present (figure 1d). This technique proves the binding between the antibody and the bacteria "visually" and also confirms the "specificity" (antigen-antibody binding) and provides the test results in < 2 hours.

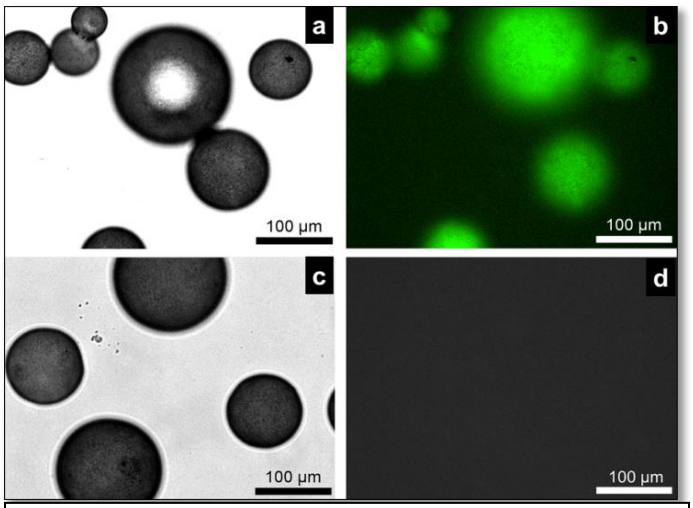

Figure 1: Microscopic images of immune-complex formation: a) Light microscopic image of magnetic particle- antibody-bacteria complex; b) Fluorescent microscopic image of magnetic particle-antibody-bacteria complex; c) Light microscopic image of the test without antibody; d) Fluorescent microscopic image of the test without antibody.

What research is needed?

Results from the study are very positive, and we believe that pursuing this technique further would bring down the testing time to a "few minutes" and a detection limit at extremely small concentrations (1-10 CFU/ml). We have also learnt that the issue of pathogen detection is not just a "microbiological issue" as is a conventional perception. Employing "engineering" technique or a combination of other techniques could also provide faster and reliable alternate.

IMPACT STATEMENT

The impact of this technique could be significant. Faster detection means quicker implementation of "containment" protocols and conversely isolation of contaminated food or other products. This also means less infections and fatalities. This device could detect "multiple" pathogens and provide qualitative and quantitative analysis in hours, rather than days. Development and use of such a device could have a very positive impact on food safety, health screening and the environment.

Want to know more?

Project Director: Dr. Majed Dweik, dweikm@lincolnu.edu; (573)681-5134

This research is supported by an USDA-NIFA's Evens-Allen Research Program through Lincoln University of Missouri. This project addresses the NIFA's priority areas of "Food Safety"

Additional link can be found at http://www.umes.edu/ard/Default.aspx?id=46285