

All-in-one-bag Detection Platform for Pathogenic *Escherichia coli* O157:H7 in Food Samples during Sample Shipment

Delayed-release phage/antibiotic capsules detect as few as 2 CFU of pathogenic *E. coli* O157 during food sample shipment for faster lab confirmation.

Foodborne pathogens, particularly Shiga toxin-producing *E. coli* (STEC), cause significant illness in the U.S., with over 175,000 cases annually. STEC can cause severe symptoms and lead to life-threatening conditions. The primary reservoir for STEC is cattle, and outbreaks are often linked to contaminated ground beef, though other sources like raw milk and vegetables have also been implicated. The United States Department of Agriculture (USDA) has enforced a strict zero-tolerance policy for STEC in ground beef, expanding this to include additional strains due to their public health threat. The detection of *E. coli* is critical due to its low infectious dose and severe health risks, necessitating rapid and accurate testing methods. Traditional detection methods for detection involve a time-consuming process of culture enrichment, isolation, and biochemical identification, which can take days to weeks. Although rapid methods like polymerase chain reaction (PCR) and antibody-based assays have become popular, the USDA still relies on microbiological methods to ensure accurate detection, involving a detailed multistep process that includes culture enrichment, PCR screening, and various confirmatory tests. The need for a rapid phage-based detection system that can reduce the time needed for pathogen confirmation is clear.

Purdue researchers have developed delayed-release food-grade capsules which contain a specialized bacteriophage and antibiotic for the detection of bacteria, such as *E. coli*. Researchers detected *E. coli* in ground beef samples during the 15–18 hours that these samples spent in transit to testing laboratories. The researchers were able to detect as few as 2–3 colony-forming units (CFU) of *E. coli* O157 within 10 to 12 hours. Furthermore, the researchers were able to detect *E. coli* in both stomacher bags and Nalgene bottles, showing that the developed technology could reliably detect the pathogen even at low concentrations, with increased luminescence correlating to higher pathogen levels. The developed method shows the

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Category

Biotechnology & Life
Sciences/Biomarker Discovery &
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Agriculture, Nutrition, &
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potential to enable faster detection upon arrival at the lab, potentially reducing the time needed for pathogen confirmation.

Technology Validation:

- Luria broth (LB) agar plates to enumerate the number of colony-forming units (CFU)/mL of the overnight culture
- Different concentrations of E. coli (from a strain found in apple cider) were tested for detection, achieving detection of approximately 2 CFU in 40 mL of LB in just over 6 hours, without prior incubation
- Phage concentration of 4.5×10^5 pfu/mL was able to detect approximately 200 cells in roughly 9 h
- E. coli from ground beef was detected, during which 300 CFU were detected at roughly 11 h

Advantages:

- Rapid Detection of E. coli was within hours, significantly reducing the time needed compared to traditional methods
- Low levels of E. coli were detected, demonstrating the high sensitivity of the method
- Integrates with existing USDA sample collection and processing protocols without requiring significant changes

Applications:

- Food Safety Testing: Rapid detection of E. coli O157 and potentially other pathogens in meat products, particularly ground beef.
- Regulatory Compliance: Helps food producers and processors meet stringent safety regulations by providing faster testing results.
- Supply Chain Monitoring: Enables continuous monitoring of food safety during the transportation of meat products from processing facilities to testing laboratories.

TRL: 4

Intellectual Property:

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