Food poisoning is a stomach-churning, miserable condition that sends thousands of Americans to hospital emergency rooms every year. Now scientists report in ACS' journal *Analytical Chemistry* a simple, paper-based test that could help detect pathogens hitchhiking on food before
they reach store shelves, restaurants and, most importantly, our stomachs.

According to one estimate by the U.S. Department of Agriculture, the foodborne bacteria *Salmonella* alone led to nearly 20,000 hospitalizations and almost 400 deaths in 2013. Economists estimate that the treatment of all these patients and the related productivity losses cost more than $3 billion annually. And those numbers account for just one of the 15 pathogens responsible for most of the *food poisoning* cases. Current testing for pathogens in food requires complicated machinery and trained personnel. But these tests don't provide the simple results needed in large-scale food manufacturing. So Je-Kyun Park and colleagues set out to find a more practical way to detect *foodborne pathogens*.

The researchers developed a paper-based test that can handle the multistep reactions necessary for this kind of analysis by controlling the pore size of the paper. When dipped into solutions containing the *E. coli* strain O157:H7, *Salmonella typhimurium* or both, lines appeared on the dipstick indicating a positive result within 15 minutes. Because the method requires dipping the device into a solution once and produces an easy-to-read result, it could be performed by workers without special training, the researchers say.


**Abstract**

This paper presents a pressed paper-based dipstick that enables detection of foodborne pathogens with multistep reactions by exploiting the delayed fluid flow and channel partition formation on nitrocellulose (NC) membrane. Fluid behaviors are easily modified by controlling the amount of pressure and the position of pressed region on the NC
membrane. Detection region of the dipstick is optimized by controlling flow rate and delayed time based on Darcy's law. All the reagents required for assay are dried on the NC membrane and they are sequentially rehydrated at the prepartitioned regions when the device is dipped into sample solution. In this manner, multistep reactions can be facilitated by one-step dipping of the dipstick into the sample solution. As a proof of concept, we performed detection of two fatal foodborne pathogens (e.g., Escherichia coli O157:H7 and Salmonella typhimurium) with signal enhancement. In addition, we expanded the utilization of channel partitions by developing a pressed paper-based dipstick into dual detection format.

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