Rapid detection of foodborne pathogens

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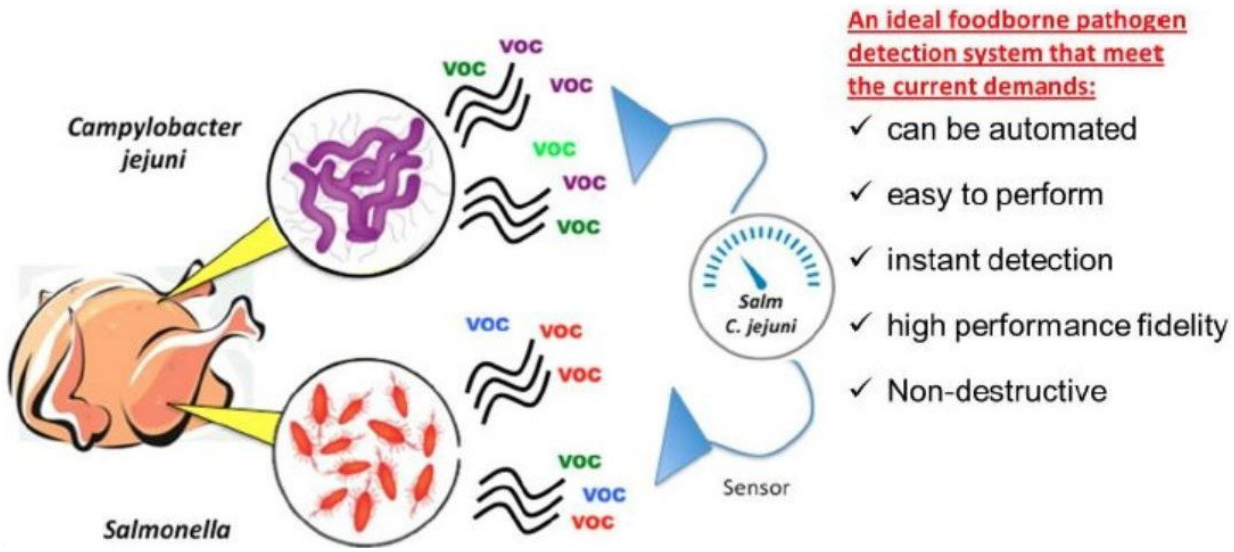

Development of a Volatile Organic Compound (VOC)-based detection system. Credit: Dr Chai Lay Ching

A researcher at University of Malaya, Malaysia, has developed a real-time method based on specific volatile organic compounds (VOCs) to detect dangerous bacteria causing foodborne diseases in raw chicken.

The World Health Organisation reported that there were more than 600 million cases of foodborne diseases globally in 2010, causing more than 155,000 deaths worldwide. Several surveillance studies in Malaysia have shown that as high as 9 out of 10 raw chickens in the market are positive for Salmonella and C. jejuni contamination. It was reported that

approximately 35—88 percent of raw chicken in Malaysia were contaminated with Salmonella; while C. jejuni was detected in 50—90 percent of farmed chickens and 30—45 percent of raw chicken in the market.

The increased scale of food production and global food trading have raised the risk of failures in our food safety monitoring system to detect foodborne pathogens. Unfortunately, the conventional laboratory-based testing approaches of raw chicken are too slow and can no longer meet the demands of today's large-scale food production. It currently takes two to seven days to complete. A major problem in the current approaches to detect foodborne pathogens is that products must be sacrificed when tested, making the process an expensive affair as it reduces profit margins and raises price. Although new molecular approaches have been adopted to speed up the detection time, the widespread use of this technology is hampered by challenges such as high operational cost and dependency of highly-skilled labour. The technology also suffers from low performance fidelity which is caused by biological interference.

Dr. Chai Lay Ching, food microbiologist from Faculty of Science, University of Malaya (UM), proposed a solution to identify pathogenic bacteria in food based on the detection of specific volatile organic compounds (VOCs) produced by bacteria. Microorganisms are known to emit specific VOCs as gases during the process of breaking down food. The VOCs are a diverse group of carbon-based chemicals that are volatile at ambient temperature and can be detected through smell. Different types of bacteria produce their own VOC signatures. These findings have led the researcher to develop a novel and rapid method to detect bacterial spoilage in food products in a real-time fashion and non-destructive manner, and named her as one of the three winners for the Malaysian L'Oréal-UNESCO for Women in Science Award.

VOCs analysis has been used in clinical diagnosis of various bacterial diseases in humans, such as detection of Clostridium difficile, C. jejuni and Vibrio cholerae in patients' stool. Preliminary laboratory results showed a distinctive VOC-profile associated with C. jejuni in specific laboratory conditions, suggesting the potential of VOC-based biosensors or electric noses that can sniff out these highly pathogenic bacteria in food.

"I accidentally found that Campylobacter produces a very specific scent when we grow them on the agar plate. This allowed me to correctly identify samples with Campylobacter from the negatives ones," Dr. Chai explained.

The findings from this study will generate a database of volatilome of foodborne associated Salmonella and C. jejuni-contamination in raw chicken and different carbon substrates. This work is key for future development of a real-time monitoring system that meet the ideal high-throughput detection criteria. It can be automated, is easy to perform and instantly detects contamination. The application will be key in saving lives and reducing morbidities-associated with these bacteria, as well as helping the food industry to save cost. The successful completion of this project will lead to a better understanding of bacterial metabolism and adaption in different types of substrates, which will help us understand the impact of environment on bacterial growth.

Provided by University of Malaya

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