Snapshot Report

Lab-on-a-chip system for microbial contamination

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2017-7049

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Project Description

The objective of this project is to develop a method for the rapid detection (within 5 min) of specific microorganisms on carcasses and surfaces in red meat processing facilities. The method will be based on existing techniques already under development at the University of Tasmania that use swabs to sample surfaces coupled to a rapid detection method that uses fluorescent staining of nucleic acids in microbial cells. The method will not require sample preparation nor specific technical skills and with subsequent engineering, will be readily implemented into a processing facility for rapid, on-site analyses.

Project Content

This technology will allow near real-time monitoring of contamination of raw product and equipment, which will enable a much faster response to potential contamination events than is currently possible. This will benefit processing facilities by reducing the financial- and reputation-cost of a recall or rejection of product at the time of delivery and will benefit the Australian red meat industry by increasing export and domestic consumer confidence in the safety and quality of the product.

Project Outcome

The major outcome of the project was the development of suitable chemistry for the capillary electrophoresis detection of cells on meat processing surfaces and carcases. Using two nucleic acid stains and a novel isotachophoretic based injection mechanism, a total viable cell count with a detection limit of 131 CFU/mL was obtained, which collected over a 10 x 10 cm^2 area, translate to a detection limit of 1.3 CFU/cm^2. This is below the limit of 10 CFU/cm^2 for a total viable cell count and can currently be obtained within 30 min using a conventional laboratory-based capillary electrophoresis instrument and manual swab extraction.

Capillary electrophoresis chemistry for the selective detection of bacteria was developed using quantum dot – antibody conjugates. The selective detection of *E. Coli* was demonstrated, with the ability to detect just 2 cells injected within 30 min, however, the concentration limit of detection was not practical as the chemistry has not yet been combined with the novel isotachophoretic based injection mechanism which concentrates the bacteria for detection in the instrument. Once optimised, it is anticipated that similar detection limits to the total viable count will be obtained.

A portable capillary electrophoresis instrument was constructed but was not suitable for out-of-lab measurement due to the inferior performance of the home-made laser-induced fluorescence detector. The in-house detector was 50 times worse than the commercial laboratory instrument, with the expected detection limit for the total viable cell count being approximately 65 CFU/cm^2 which is above regulatory standards. The previously constructed extraction system that was going to be used for this project also had terminal failures during this project and a variant constructed in-house failed to show adequate fluidic performance.

Benefit for Industry

At this stage there is very little direct benefit for the industry. Chemistry for a total viable cell count that could be performed out of the laboratory at a processing facility has been developed, but without a suitable instrument upon which to implement, the chemistry cannot be realised. The team is currently discussing with Grey Scan about the possibility to implement this chemistry on a modified version of their ETD-100 system for trace explosive detection. The developed chemistry and method could be implemented in a laboratory with a commercial instrument as an alternative to a plate count method, demonstrating suitable detection limits, and this would save significant time (~30 min v ~24 hr), but would need full validation to ensure that the analytical requirements for detection were suitable for the industry.