Fast, reliable test for microorganism contamination

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Food and water-borne illnesses are a common concern around the world. Every year hundreds of millions of water, beverage and food samples need to be tested to detect harmful bacteria.

Pathogens such as Legionella, Pseudomonas, Giardia/Cryptosporidium,

Salmonella, Campylobacter and pathogenic E. coli are major causes of human disease, which also result in significant economic loss. However, current gold-standard cultivation-based tests can take several days up to two weeks for a result, leading to costly delays in treatment.

The EU-funded Horizon 2020 CellCount project addressed these challenges by developing a revolutionary platform for microbiological testing comprising an instrument and disposable detection kits. It is based on two main principles: immunomagnetic separation (IMS) for isolating and concentrating the pathogenic cells, and flow cytometry (FCM) for detection and counting.

The CellCount instrument is an automated benchtop one-step-operation device, allowing on-site mobile analyses and rapid results leading to effective countermeasures. "CellCount offers a result time of less than one hour, as well as enhanced resolution and accuracy, with lower operator training requirements and easy operation, due to its portability," says project coordinator Dr. Hans-Anton Keserue.

Rapid detection

The IMS method binds magnetic particles to the surface of the target organisms and separates them from the competing flora by applying an external magnetic field. Basic elements of the IMS include the rapid detection assay reagents (antibodies and magnetic nanoparticles) for specific pathogens, the microfluidic cartridges (that contain a lab-on-a-chip) for separation, and the instrument for automating the process.

Antibodies for a specific pathogen are linked to magnetic nanoparticles and contained in the rapid detection assay. The cells are additionally stained with fluorescent markers to indicate their presence and viability. Dr. Keserue claims: "The analysis of the sample at the single cell level and distinguishing viable from dead cells, puts CellCount's test system in

a position to become the new gold standard in pathogen detection and quality control."

A sample of pre-processed water or food and the rapid detection assay reagents are mixed, resulting in the magnetic labelling of the target organisms. "The microfluidic IMS cartridge is designed to be handled like a common well-plate and therefore, the sample is directly pipetted into the corresponding well on the cartridge. The cartridge is then inserted into the instrument where the IMS is conducted by driving the solutions through the microfluidic channels, while applying an external static magnetic field," explains Dr. Keserue.

Easy to use

Microfluidic cartridges are designed to be single-use consumables like standard well-plates, so CellCount includes a fit-for-purpose FCM module that operates with single-use cartridges. "This results in a radical simplification of sample handling, plus the instrument is almost maintenance free. Hence, FCM single cell detection offers fast, reliable and highly resolved data," Dr. Keserue concludes.

CellCount will be invaluable in areas where water safety is critical – hospitals, water purification manufacturers, wastewater treatment plants as well as bottled water manufacturers, hotels, cruise ships and operators of cooling towers. Furthermore, the rapid and cost-efficient CellCount test will help the EU become a leader in technologies for monitoring microbiological contamination in water, beverages and food.

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