

# Facile and ultra-rapid methods for the detection of pathogenic bacteria

Sangmin Jeon

Department of Chemical Engineering, Pohang University of Science and Technology  
(POSTECH), Pohang, Republic of Korea

Facile and ultrarapid analytical methods that use magnetic nanoparticle clusters (MNCs) have been developed for the detection of *Salmonella* bacteria. The facile method utilizes magnetophoretic chromatography for the separation of the MNCs-*Salmonella* complexes from the free MNCs. In brief, antibody-conjugated MNCs (AbMNCs) are used to capture the *Salmonella* bacteria in milk and are then separated from the milk by applying an external magnetic field. The *Salmonella*-containing solution is sucked into a precision pipette tip to which a viscous polymer solution is then added. Once the magnetophoretic chromatography process has been carried out for 10 min, the presence of 100 cfu/mL *Salmonella* bacteria can be detected with the naked eye because the bacteria have become concentrated at the narrow pipette tip.

The ultrarapid method utilizes a novel 3D immunomagnetic flow assay. AbMNCs were magnetically immobilized on the surfaces of a 3D-printed cylindrical microchannel. The injection of a *Salmonella*-spiked sample solution into the microchannel produced instant binding between the AbMNCs and the *Salmonella* bacteria due to their efficient collisions. Nearly perfect capture of the AbMNCs and AbMNCs-*Salmonella* complexes was achieved under a high flow rate by stacking permanent magnets with spacers inside the cylindrical separator to maximize the magnetic force. The concentration of the bacteria in solution was determined using ATP luminescence measurements. The detection limit was better than 10 cfu/mL, and the overall assay time, including the binding, rinsing, and detection steps for a 10 mL sample took less than 3 minutes.