3D-Printed Microfluidic Device for the Detection of Bacteria Using Size-based Separation in Helical Channel

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A facile method has been developed to detect pathogenic bacteria using magnetic nanoparticle clusters (MNCs) and a 3D-printed helical microchannel. Antibody-functionalized MNCs were used to capture E. coli (EC) bacteria in milk, and the free MNCs and MNC-EC complexes were separated from the milk using a permanent magnet. The free MNCs and MNC-EC complexes were dispersed in a buffer solution, then the solution was injected into a helical microchannel device with or without a sheath flow. The MNC-EC complexes were separated from the free MNCs via the Dean drag force and lift force, and the separation was facilitated in the presence of a sheath flow. The concentration of the E. coli bacteria was determined using a light absorption spectrometer, and the limit of detection was found to be 10 cfu/mL in buffer solution and 100 cfu/mL in milk.