Detection of pathogenic E. coli O157:H7 by a hybrid microfluidic SPR and molecular imaging cytometry device

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Abstract: Current methods to screen for bacterial contamination involve using costly reagents such as antibodies or PCR reagents or time-costly growth in cultures. There is need for portable, real-time, multiplex pathogen detection technology that can predict the safety of food. Surface plasmon resonance (SPR) imaging is a sensitive, label-free method that can detect the binding of an analyte to a surface by the changes in refractive index that occur upon binding. We have designed a hybrid microfluidic biochip to perform multiplexed detection of single-celled pathogens using a combination of SPR and fluorescence imaging. The device consists of an array of gold spots, each functionalized with a capture biomolecule targeting a specific pathogen. This biosensor array is enclosed by a polydimethylsiloxane microfluidic flow chamber that delivers a magnetically concentrated sample to be tested. The sample is imaged by SPR on the bottom of the biochip and epi-fluorescence on the top. The prototype instrument was successfully able to image antibody-captured E. coli O157:H7 bacteria by SPR and fluorescence imaging. The efficiency of capture of these bacteria by the magnetic particles was determined using spectrophotometric ferric oxide absorbance measurements. The binding of the E. coli to each spot was quantified by measuring the percent of the gold spot area upon which the bacteria was bound and analyzed using NIH ImageJ software. This hybrid imaging approach of pathogenic E. coli detection coupled with an estimate of relative infectivity is shown to be a working example of a testing device for potential foodborne pathogens.

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