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Rapid, Label-Free, Direct Detection and Quantification of Escherichia coli Bacteria Using Nonlinear Acoustic Aptasensor

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Abstract : Rapid, label-free and direct detection of pathogenic bacteria is critical for the prevention of disease outbreaks. This paper for the first time attempts to probe the nonlinear acoustic response of quartz crystal resonator (QCR) functionalized with specific DNA aptamers for direct detection and quantification of viable E. coli KCTC 2571 bacteria. DNA aptamers were immobilized through biotin and streptavidin conjugation, onto the gold surface of QCR to capture the target bacteria and the detection was accomplished by shift in amplitude of the peak 3f signal (3 times the drive frequency) upon binding, when driven near fundamental resonance frequency. The developed nonlinear acoustic aptasensor system demonstrated better reliability than conventional resonance frequency shift and energy dissipation monitoring that were recorded simultaneously. This sensing system could directly detect $10^{(5)}$ cells/mL target bacteria within 30 min or less and had high specificity towards E. coli KCTC 2571 bacteria as compared to the same concentration of S.typhi bacteria. Aptasensor response was observed for the bacterial suspensions ranging from $10^{(5)}$-$10^{(8)}$ cells/mL. Conclusively, this nonlinear acoustic aptasensor is simple to use, gives real-time output, cost-effective and has the potential for rapid, specific, label-free direction detection of bacteria.

Keywords : acoustic, aptasensor, detection, nonlinear
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