# *Salmonella* detection in soil using phage-based magnetoelastic biosensors

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Fresh produce can become contaminated by direct contact with irrigation water, animal waste, insects, and soil during harvest. The identification of the original source of a contamination is necessary to better control and prevent foodborne illnesses caused by consumption of fresh produce. Hence, a previously developed phage-based magnetoelastic (ME) biosensor method was applied to detect *Salmonella* in soil. The ME biosensor method utilizes magnetoelastic resonators coated with genetically engineered E2 filamentous phage to bind with *Salmonella*.

Since soil is composed of a variety of components such as organic matter and minerals, the direct of application of the ME biosensor method did not provide reliable results. Therefore, filtration and cation-exchange resin methods were introduced for maximum recovery of the target pathogen from the soil sample while minimizing the recovery of soil matrix components. In addition, a new blocking method was introduced in order to minimize non-specific binding of soil components to the sensor platform. Figure 1 shows the extraction and application of the ME biosensor method for the detection of *Salmonella* in soil. After extraction of *Salmonella* from the soil, the modified ME biosensor was applied to detect *Salmonella*.

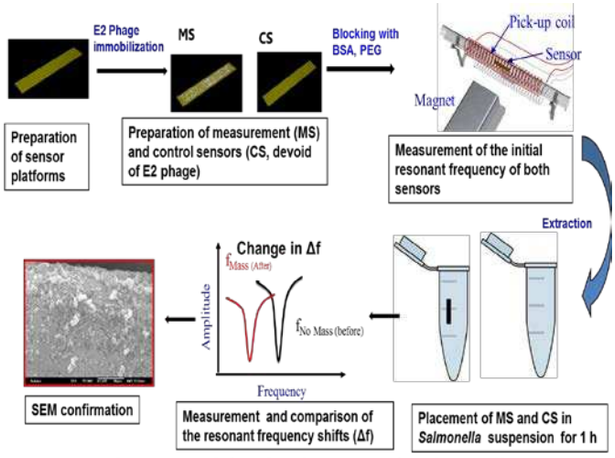


Figure1. Scheme used for the detction of *Salmonella* in soil using extraction and modified phage-based ME biosensor method.

The introduction of filtration during extraction procedures decreased recovery of other components from the soil sample. However, there were no obvious and significant difference between filtration only and a combination of cation-exchange resin and filtration (Figure 2). Despite successful recovery of viable *Salmonella* from the soil sample, the binding of *Salmonella* on the sensor platform was not guaranteed. Therefore, a different blocking agent was applied on the sensor platforms in order to minimize non-specific binding of soil matrix components. Polyethylene glycol (PEG), the new blocking agent showed significant binding of *Salmonella* by decreasing non-specific binding of soil matrix components to the sensor platform. Finally, the modified ME biosensor method was performed to detect *Salmonella* in soil. The resonant frequency shifts of measurement sensors increased with an increase in the concentration of *Salmonella* (Figure 3). In contrast, the control sensors showed a relatively constant and low magnitude frequency shift. Limit of detection was determined to be 3 log CFU/ml. This study demonstrates that the ME biosensor method can successfully detect *Salmonella* in soil with reliability and reproducibility.

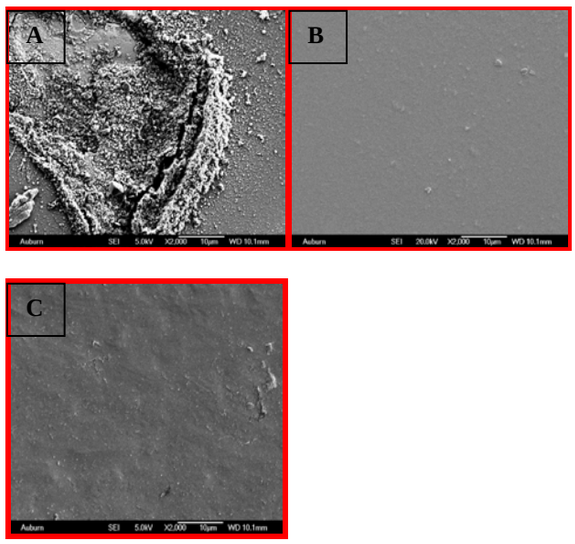


Figure 2. SEM image of measurement sensor without (A) intoudction of filtraion, and (B) with introudciton of filtration and (C) with combination of filtraion and cation-exchange resin method.

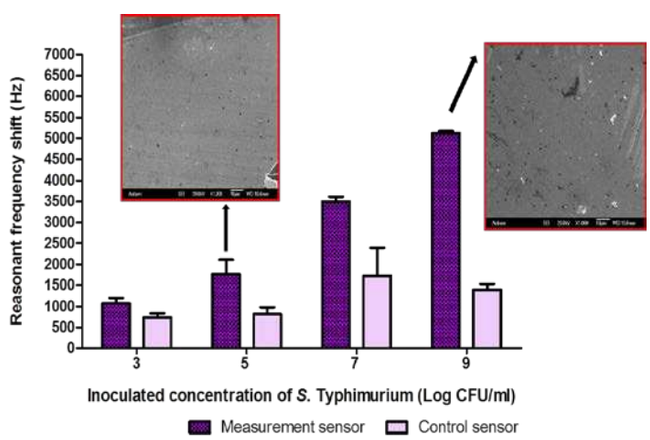


Figure 3. Resonant frequency shifts and SEM images of measurement sensors at various inoculated concentration of *Salmonella* in soil after modified ME biosensor performance.