Plasmonic filter paper substrates coated with antibacterial silver nanoparticles for the identification of trace *Salmonella*

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Abstract

Salmonella is a common type of Gram-negative bacteria that is found in many food sources and can not only survive but also easily grow under unfavorable environmental conditions. Therefore, controlling *Salmonella* bacteria in agriculture, food, and processing industries is always a challenging issue, and the identification and detection of very small amounts of it are of great importance. Surface-enhanced Raman spectroscopy (SERS) has emerged as a reliable and accurate method for rapidly detecting small quantities of biological and chemical substances. In this study, a SERS biosensor was developed by utilizing a filter paper (FP) substrate that was coated with silver nanoparticles (AgNPs). The AgNPs were synthesized through a chemical reduction process and underwent characterization using DLS, UV–Vis, TEM, and FE-SEM. By coating the FP substrate with AgNPs, active plasmonic sites were created, enabling the detection of *Salmonella* molecular vibrations (MVs). When the FP substrate was exposed to *Salmonella*, an interaction occurred between the bacteria and the AgNPs, facilitating the identification of extremely low amounts of *Salmonella*. Additionally, the antibacterial properties of the AgNPs were observed. The SERS FP substrate exhibited the capability to detect *Salmonella* at concentrations as low as 10^1 CFU. Experimental measurements were conducted to obtain the Raman spectra and peak signals, and the reproducibility of the substrates was confirmed. The empirically calculated enhancement factor for identifying the *Salmonella* MVs was determined to be 1.448×10^5; while, a numerical estimation yielded a value of 3.740×10^5.