Detection of Molecular Vibrations of Shigella Pathogenic Gram-negative Bacterium with Surface Enhanced Raman Spectroscopy (SERS) Biosensors and Investigation of its Antibacterial Activity with Silver Nanoparticles Prepared by the Tollens Method in a Laboratory Environment

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Abstract

Common gram-negative bacteria called Shigella may be found in a variety of food products and are very capable of thriving in harsh environmental circumstances. One of the potentially fatal causes of dysentery is the Shigella bacterium, which may cause infections and even death in young patients. Controlling and accurately detecting minute concentrations of Shigella bacteria are thus crucial. In order to identify Shigella bacteria, a prevalent cause of diarrhea, the researchers in this work used filter paper substrates coated with silver nanoparticles (AgNPs) as sensitive and quick surface-enhanced Raman scattering (SERS) platforms. With an experimentally measured enhancement factor of 4.626×10^6, the SERS substrates demonstrated an extremely low limit of detection for Shigella bacteria, with 10^1 CFU. They also demonstrated remarkable repeatability. Furthermore, the suspension of AgNPs had potent antibacterial action against Shigella, demonstrating bactericidal activity for 90 min at a minimum inhibitory concentration of 1300 μg/ml. As a result of the excellent recyclability, repeatability, and chemical stability of the developed SERS-active plasmonic substrates, the results point to their great potential for use in the identification of Shigella bacteria, as well as for the development of sophisticated nanoscale sensors.