

## **Preparation, Characterization of Silver Nanoparticles and Their Potential Pharmaceutical Applications**

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**Abstract:** The synthesis of nanometer-sized nanoparticles with antibacterial properties is of significant interest for the development of new pharmaceutical products. A key aspect of nanotechnology is the development of rapid and reliable experimental protocols for the synthesis of nanomaterials with controlled chemical composition, size, low polydispersity, and scalability. In this study, a one-step green synthesis route for stable silver nanoparticles (AgNPs) with a narrow size distribution is reported. Silver nitrate was used as the metal precursor, while biocompatible chondroitin sulfate (ChS) served both as a reducing and stabilizing agent. The reaction was carried out in an aqueous medium under continuous stirring at temperatures ranging from 25°C to 80°C. The formation of AgNPs was indicated by a color change from a transparent solution to light red and subsequently to dark reddish-brown. The synthesized nanoparticles were characterized by UV–VIS spectroscopy, transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FTIR), and dynamic light scattering (DLS). The results confirmed the formation of ChS-coated AgNPs. TEM analysis revealed well-dispersed, spherical nanoparticles with an average size below 20 nm, significantly smaller than the hydrodynamic diameter (~80 nm) obtained by DLS measurements. A characteristic surface plasmon resonance (SPR) peak at approximately 417–420 nm further confirmed nanoparticle formation. Increasing the reaction time from 3 to 24 hours resulted in higher absorption intensity and a slight blue shift of the SPR peak, indicating an increase in nanoparticle concentration and a slight decrease in particle size. The antibacterial activity of the AgNPs was evaluated using the Kirby–Bauer method, demonstrating effective bactericidal activity against *Escherichia coli* and *Staphylococcus aureus*. Determination of the minimum inhibitory concentration (MIC) is currently in progress, with preliminary results obtained

**Keywords:** AgNPs, UV-VIS Spectroscopy, FTIR, TEM, DLS measurements.

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