

Silver nanoparticles (AgNPs) have distinctive physiochemical characteristics, used in waste water treatment as an antibacterial agent. In this study, polyvinyl pyrrolidone (PVP) used as a stabilizer in chemical reduction and green synthesis of AgNPs utilizing sodium borohydride and green tea extract as a reducing agents respectively. In addition to comparing the two approaches effects on particle size, shape, crytallinity and stability. This study clarifies how PVP influences nucleation and growth. UV-Visible spectroscopy, X-ray diffraction (XRD), Particle size analyzer (PSA), and Zeta potential were among the characterization methods employed to examine the nanoparticles. The green synthesis approach offers a sustainable option with lower toxicity, but with less accuracy in size control. Chemical reduction ensures controlled morphology. This aims to close the gap between sustainability and efficiency by fusing the morphology controlling capabilities of PVP with environmentally friendly synthesis, providing a more sustainable method of creating stable and useful AgNPs. UV-Visible spectroscopy gave peak at 430nm, which confirms the formation of AgNPs. PSA results confirmed that chemical reduction using PVP yield small size AgNPs (45nm) as compared to green synthesis method using PVP which yield moderately sized AgNPs (73.62nm). When SDS is used as stabilizer, stabilization was poor, leading to the largest AgNPs (102.7nm). PSA also confirmed the good stabilizing effect of PVP. XRD results showed that PVP capped-AgNPs have face centered cubic (FCC) structure and good crystallinity. Average crystallite size is 52.4 nm and a minimal micro strain value is 0.012. Strong antibacterial action demonstrated by PVP-capped AgNPs, with notable inhibition zones seen against *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*. Because of their improved stability and regulated size brought about by PVP capping, they showed good interaction with bacterial membrane due to increased surface area, which affectively inhibited growth.