

Sustainable Synthesis of Silver Nanoparticles via Aloe Barbadensis Extract with Antioxidant Potential

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ABSTRACT

Introduction: The environmentally beneficial and sustainable nature of biological entity-based nanoparticle synthesis has attracted a lot of attention (Ahuja *et al.*, 2024). Aloe Barbadensis Miller, a common succulent plant is widely known for its healing properties, has demonstrated potential as a source for the fabrication of nanoparticles (Habib *et al.*, 2024). The present study evaluates silver nanoparticles synthesized by green synthesis with aqueous and ethanolic extracts of well-known Aloe Barbadensis Miller. The method depicted plant's natural constituents and ecofriendly sustainable alternative approach for nanoparticle production.

Aim and Objective: The aims of this study were to investigate the ability of phytoconstituents present in Aloe vera plant extract to catalyze the reaction of silver nanoparticle (AgNPs) synthesis by optimization of the key reaction parameters, including the silver nitrate concentration, the ratio of plant extract to the silver nitrate, reaction time, temperature, and pH.

Additionally, the study focused on characterization of the synthesized nanoparticles via techniques like UV-Vis spectroscopy and scanning electron microscopy (SEM) and also aim to investigate the antioxidant potential of plant extract derived nanoparticles in comparison with plant extracts.

Materials and Methods: Fresh Aloe Barbadensis Miller leaves were collected and washed under tap water. The aqueous and ethanolic extract was prepared according to previously described method and phytochemical screening was executed (Nagime *et al.*, 2024). The various factors were optimized comprising the silver nitrate and plant extract ratio, reaction duration, temperature, and pH. The reaction progress was examined by UV-visible spectroscopy and antioxidant activity was evaluated by DPPH (2, 2-diphenyl-1-picrylhydrazyl) scavenging assay (Narde *et al.*, 2023) (Taqveem *et al.*, 2024). SEM were performed to visualize the AgNPs.

Result and Discussion: The results of phytochemical profiling indicated the presence of a different plant phytochemicals, including polyphenols, carbohydrates, flavonoids, Terpenoids, saponins, and tannins in both extracts. The DPPH free radicals activity revealed the potential of plant extract as well as plant mediated AgNPs, in comparison the free radical scavenging power of plant extract mediated AgNPs is more than plant extract (Figure 2). The generation of AgNPs was confirmed by the visible scrutiny of colour transformation and UV-visible absorption spectrum with Plasmon peak at 400 nm of aqueous plant extract and 440 nm of ethanolic plant extract (Figure 1). Size and shape of AgNPs were observed by SEM which shown promising results.

Conclusion: Aloe Barbadensis Miller-mediated synthesis deals with a green and sustainable route for fabricating silver nanoparticles with meticulous characteristics. The produced nanoparticle have strong antioxidant prospective. The biocompatible and environmentally friendly nature of the synthesis process enhances the applicability of these nanoparticles in various fields of science and technology.

Keywords: Aloe Barbadensis Miller, Antioxidant, Green Synthesis, Phytochemicals, Silver Nanoparticles.



Figure 1. Left; synthesized AgNP by ethanolic extract of Aloe Vera plant, Right: synthesized AgNP by aqueous extract of Aloe Vera plant.

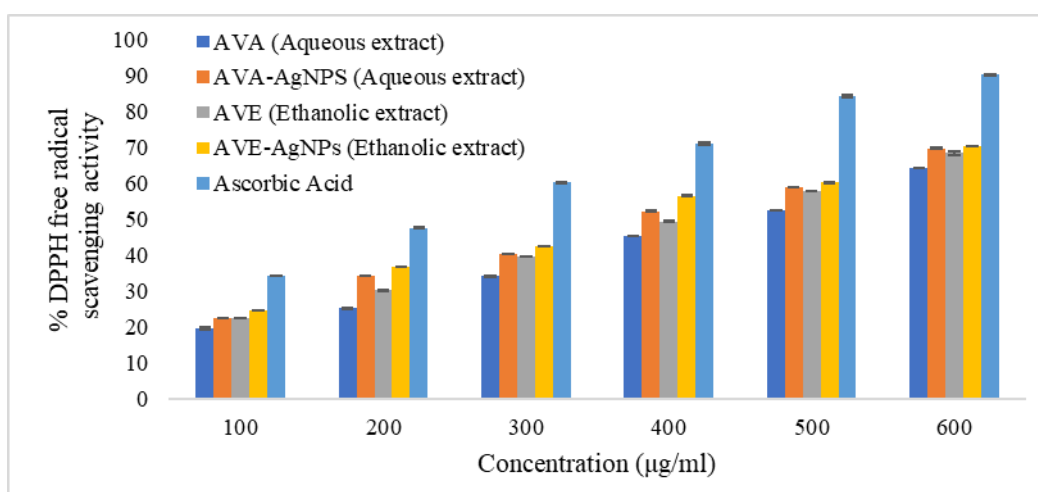


Figure 2. DPPH free Radicals Scavenging Activity of Aloe Vera (Aqueous and ethanolic) extract and AV-AgNPs.

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