Crossian Resonance

A Multidisciplinary Research Journal **ISSN 0976-5417**
(A refereed Biannual Published in June and December)
Vol. 15, No.2, December 2024
https://research.holycrossngl.edu.in/

Green Synthesis of Silver Nanoparticles Using *Sansevieria zeylanica* Leaf Extract

***Delma B.T., M. Anusha, Antilin Princela M., Lizy Roselet S. and Shirly Treasa M.**
Department of Chemistry, Holy Cross College (Autonomous), Nagercoil - 629 004
Affiliated to Manonmaniam Sundaranar University, Tirunelveli - 627 012

ABSTRACT

Interest in the biosynthesis of nanoparticles has significantly increased due to their potential applications in medicine, environmental science, and technology. This study demonstrates an economical, sustainable, and a green synthesis approach for silver nanoparticles (AgNPs) utilizing leaf extract of Sansevieria zeylanica. The biosynthetic process is rapid and straightforward, monitored through visual color changes and ultraviolet-visible (UV-Vis) spectroscopy. The synthesized AgNPs were characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). UV-Vis spectra revealed specific Surface Plasmon Resonance (SPR) absorption peaks at 555 nm, confirming the formation of AgNPs. XRD analysis indicated the crystalline structure of AgNPs, while FTIR spectra showed interactions between plant bioactive compounds and the nanoparticles. SEM analysis revealed spherical nanoparticles with uniform morphology. Phytochemical screening of Sansevieria zeylanica leaf extract indicated the presence of alkaloids, flavonoids, tannins, proteins, saponins, carbohydrates, and phenols, which facilitated the capping and stabilization of AgNPs.
***Keywords**: Silver nanoparticles; Biosynthesis; Sansevieria zeylanica extract*

1. Introduction

In recent years, biological methods for nanoparticle synthesis have attracted considerable interest due to their advantages [1]. Utilizing plant extracts as natural reducing and stabilizing agents for nanoparticle synthesis has emerged as a promising approach [2]. *Sansevieria zeylanica*, commonly known as snake plant or mother-in-law's tongue, is a perennial herbaceous plant with medicinal properties, hardiness and air-purifying properties Somashekara [3]. The phytochemical composition of *Sansevieria zeylanica* includes various secondary metabolites such as flavonoids, phenolics, and alkaloids, which possess reducing and stabilizing properties [4]. This makes *Sansevieria zeylanica* an attractive candidate for the green synthesis of nanoparticles. Have gained considerable attention due to their distinctive physicochemical characteristics, such as a high surface area-to-volume ratio, excellent antimicrobial activity and catalytic properties [5].

Corresponding Author:** **delma.chem5@gmail.com

The fabrication of silver nanoparticles through synthesis using plant extracts offers advantages such as cost-effectiveness, scalability, and biocompatibility [6]. Additionally, Using reducing agents removes the necessity for the need for harsh chemicals, making the process environmentally benign [7]. This study aims to explore the potential of *Sansevieria zeylanica* plant extract for the synthesis of silver nanoparticles. The green synthesis approach offers a sustainable and environmentally friendly alternative to conventional chemical methods [8]. Characterization techniques like UV-Vis spectroscopy, Fourier-transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and X-ray diffraction (XRD) will be utilized to examine the size, morphology, and crystalline structure of the synthesized silver nanoparticles. Furthermore, the catalytic activities of the nanoparticles will be evaluated, highlighting their potential application in biomedical, environmental, and industrial sectors[9]. Overall, the utilization of *Sansevieria zeylanica* plant extract for the green synthesis of silver nanoparticles presents an opportunity to harness the inherent reducing and stabilizing properties of phytochemicals, contributing to the development of sustainable nanotechnology with diverse practical applications [10].

2. Materials and Methods

2.1 Plant Materials and Extract Preparation

Fresh leaves of *Sansevieria zeylanica* were collected, washed thoroughly with distilled water, and air-dried at room temperature. The dried leaves were ground into a fine powder and subjected to solvent extraction using a Soxhlet apparatus with ethanol. The extract was filtered and stored at 4°C for further use.

Fig. 1. Leaf of *Sansevieria zeylanica* used for the synthesis

2.2 Synthesis of Silver Nanoparticles

To synthesize AgNPs, a specific volume of *Sansevieria zeylanica* extract was mixed with an aqueous solution of silver nitrate ($AgNO_3$) in a glass beaker. The reaction mixture was stirred continuously at room temperature. The reduction of silver ions was visually confirmed by a color change from pale yellow to brown, indicating the formation of AgNPs.

3. Results and Discussion

3.1 Phytochemical Analysis

Phytochemical screening of *Sansevieria zeylanica* leaf extract revealed the existence of secondary metabolites, including alkaloids and flavonoids, tannins, proteins, saponins, carbohydrates, and phenols. These bioactive compounds facilitated the reduction of Ag+ ions and stabilized the synthesized AgNPs.

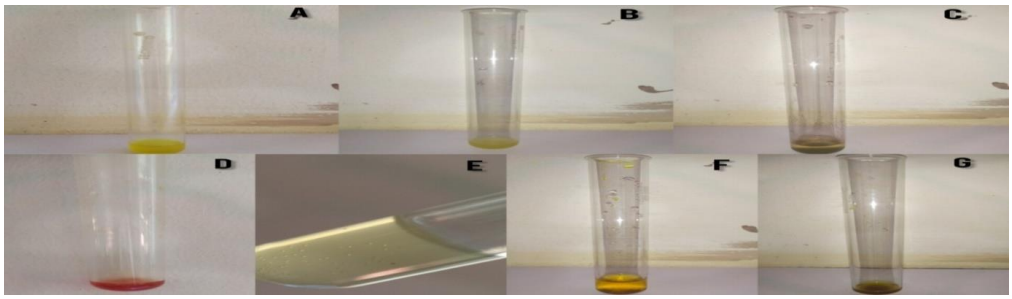

Fig. 2 Photographs of (A) Alkaloids, (B) Flavonoids, (C) Tannins, (D) Proteins, (E) Saponins, (F) Carbohydrates, (G) Phenols.

3.2 UV-Vis Spectroscopy

The UV-Vis spectra of the synthesized AgNPs exhibited a characteristic SPR peak at 555 nm, confirming the formation of silver nanoparticles. The brown coloration of the reaction mixture further indicated successful synthesis.

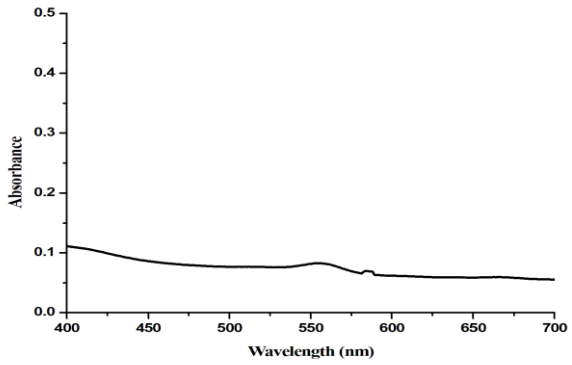

Fig. 3. UV-Vis Spectrum of *S. zeylanica* AgNPs

3.3 FTIR Analysis

FTIR spectra of the synthesized AgNPs revealed functional groups such as hydroxyl and carbonyl, which contributed to the capping and stabilization of nanoparticles. The presence of these groups confirmed interactions between the bioactive compounds of *Sansevieria zeylanica* and the AgNPs.

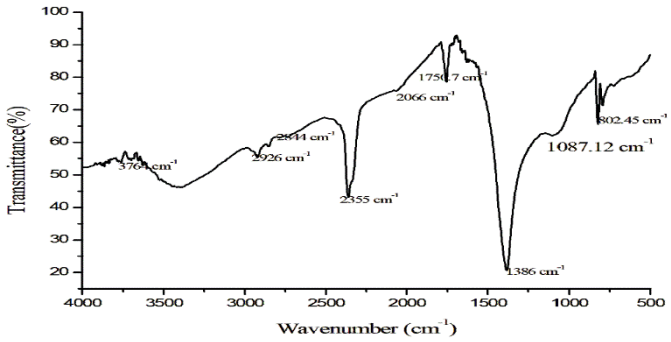

Fig. 4. FTIR spectra of *Sansevieria zeylanica* extract

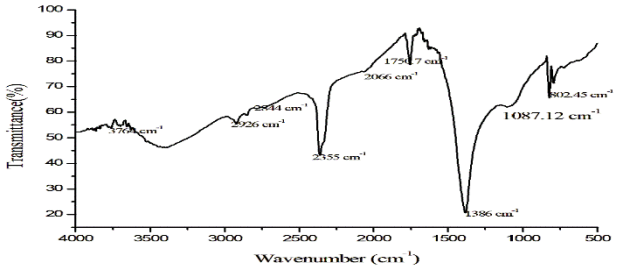

Fig. 5. FTIR spectra of AgNPs synthesized from Sansevieria *zeylanica* extract

3.4 X-ray Diffraction Analysis

XRD analysis showed distinct peaks corresponding to the face-centered cubic (fcc) structure of silver. The average size of the synthesized AgNPs was calculated to be approximately 76.7 nm using Debye-Scherrer's equation.

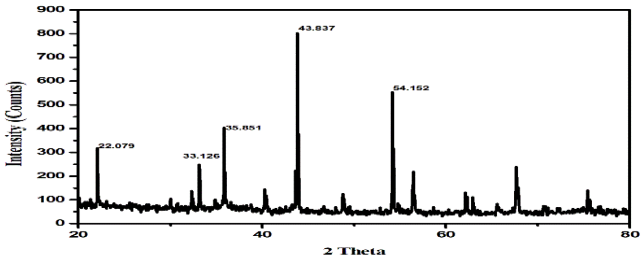

Fig. 6. XRD Spectrum of *S. zeylanica* AgNPs

3.5 SEM Analysis

The synthesized AgNPs were predominantly spherical with a uniform surface, as evidenced by SEM images. The UV-Vis and XRD results were consistent with the uniform morphology and size distribution.

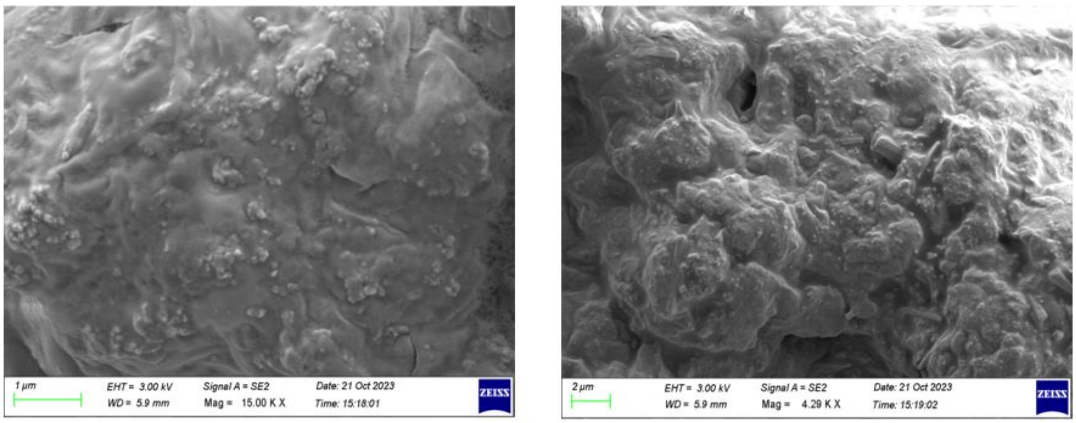

Fig. 7. SEM images of synthesized *Sansevieria zeylanica* based silver nanoparticles

3.6 EDX Studies

The EDAX spectral image displayed the presence of metallic silver at 3KeV. The weight percentage of silver (Ag) and Oxygen (O) in AgNps are 47.81and 30.34 respectively. The other elements found in the spectrum indicate the organic components found in the extract present in the surface of the silver nanoparticles.

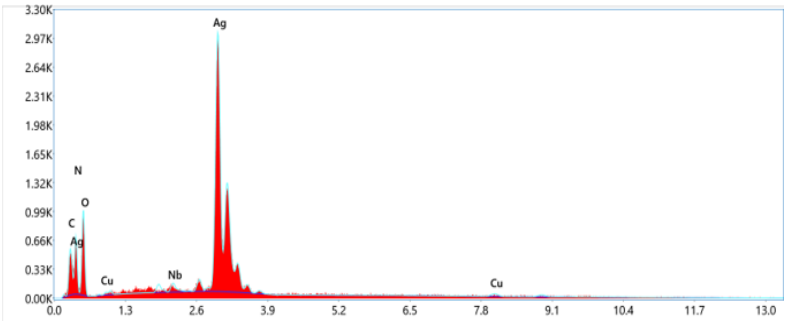

Fig. 8. EDAX Spectrum of AgNPs synthesized from ethanolic leaf extract of *Sansevieria zeylanica*

4. Conclusion

Fast biological production of silver nanoparticles utilizing *Sansevieria zeylanica* ethanolic leaf extract provides an environmental friendly, simple, and efficient route for synthesis of benign nanoparticles. A simple one-pot eco-friendly fabrication of stable silver nanoparticles using *Sansevieria zeylanica* leaf extract at room temperature was reported in this study. The produced silver nanoparticles were analyzed for characterization such as UV, FR-IR, XRD, and SEM. Phytochemical screening of ethanolic leaf extract of *Sansevieria zeylanica* confirmed the presence of Alkaloids, Flavonoids, Tannins, Proteins, Saponins,

Carbohydrates and Phenols. The formation of AgNPs was confirmed through Surface Plasmon Resonance around 555 nm for ethanolic leaf extract. The FTIR spectra are useful in studying the biomolecules responsible for reducing silver nitrate solution to silver nanoparticles in ethanolic leaf extract. XRD study showed the particle size around 7 nm. FESEM studies revealed spherical shaped silver nanoparticles. Hence the presence of phytoconstituents is crucial. to use nanoparticles in the medicinal field.

References

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. Molecular Biology of the Cell 9 - 10. 2015.
2. Atanu, B., Ram, P., Abdul, A.B., Prabha, D., Insha, Y., Umadevi, M., Bindhu, M.R., Marimuthu, G., Abdul, L.K. One-pot fabrication and characterization of silver nanoparticles using *Solanum lycopersicum*: an eco-friendly and potent control tool against rose aphid, *Macrosiphum rosae*. Journal of Nanoscience. 2016.
3. Chen, X., Schluesener, H.J. Nanosilver: A nanoproduct in medical application. Toxicology letters, 2008; 176, 1, 1 - 12.
4. Devendra, J., Kumar, D.H., Sumita, K., Kothari, S.L. Synthesis of plant-mediated silver nanoparticles using papaya fruit extract and evaluation of their antimicrobial activities. Digest Journal of nanomaterials and biostructures. 2009; 4 (3), 557 - 563.
5. Donaldson K., Stone V., Clouter A. Drug delivery and nanoparticles: Applications and hazards – PMC. 2003; 39; 405 - 10.
6. Oberdorster, G., Oberdorster, E., Oberdorster, J. Nanotoxicology: an emerging discipline evolving from studies of ultrafine particles. Environmental Health Perspectives. 2005; Vol. 113, No. 7, 823 - 839, 0091 - 6765.
7. Ratner, M.A., and Ratner, D. Nanotechnology: A gentle introduction to the next big idea. Upper Saddle River, NJ: Pearson Education. 2003.
8. Rayhaneh, A., Mohammad, R.S., Morteza, A. Synthesis, characterization and biocompatibility of silver nanoparticles synthesized from Nigella sativa leaf extract in comparison with chemical silver nanoparticles. Ecotoxicology and environmental safety. 2015; 120, 400 - 408.
9. Seyed, S.M., Sattar, G. Experimental study on effect of different parameters on size and shape of triangular silver nanoparticles prepared by a simple and rapid method in aqueous solution. Arabian Journal of Chemistry. 2009; 2, 47 - 53.
10. TO Egunjobi, D. Ugbomoiko, TO., Erameh, AC., Nwaobi, VN., Mokwenye, EK., Aghatise, I., Osula.. Phytochemical evaluation, total flavonoid assay, and antioxidant

activity of Sansevieria zeylanica growing in Nigeria. Journal of Pharmacognosy and Phytochemistry. 2023; 12(1), 200 - 204.

11. Das, Sandip, Swati B. Debnath, and Sudip K. Ghosh. Green Synthesis of Silver Nanoparticles Using *Sansevieria roxburghiana* Leaf Extract: Characterization and Antibacterial Activity. International Journal of Nanomedicine, 2017; 12, 1957 - 1967.
12. Kumar, S., R. A. P. Patil, S. R. Kolhapure., V. S. Patil. Green Synthesis of Silver Nanoparticles Using *Sansevieria trifasciata* Leaf Extract and Its Antimicrobial Activity. Materials Today: Proceedings, 2019; 15, 123 - 130.
13. Iravani., Siavash., Behzad. Zolfaghari.Green Synthesis of Silver Nanoparticles Using Plant Extracts, Materials Science and Engineering: C, 2011; 31(8), 1245 - 1251.
14. Raut, R. W., J. R. Lakkakula, S. D. Kolekar, and D. P. Gherde. Photocatalytic and Antimicrobial Activity of Synthesized Silver Nanoparticles Using *Sansevieria trifasciata* Leaf Extract. Materials Letters, 2012; 75, 924.
15. Singh, Ranjeet, Shefali S. Dubey, Prashant Mishra. Green Synthesis of Silver Nanoparticles Using Plant Extracts: A Review. Environmental Chemistry Letters, 2018; 16 (1), 315 - 331.
16. Mariselvam, R., M. Ranjitsingh., K. Nanthini., M. Kalirajan., P. Padmalatha. Green Synthesis of Silver Nanoparticles from *Eichhornia crassipes* and Their Characterization. Scientific Reports, 2014; 4(1).
17. Thakkar, Ketan N., Shubhangee S. Mhatre., and Rasesh Y. Parikh. Biological Synthesis of Metallic Nanoparticles. Nanomedicine: Nanotechnology, Biology and Medicine, 2010; 6(2), 257 - 262.