

Study of Antibacterial Activity of Silver Nanoparticles Synthesis from Calotropis Gigantea flower Extract

Ashish Shivaji Sartape

Department of Chemistry,

Balwant College, Vita Dist. Sangli India- 415311

Email: sartape_chem@yahoo.co.in;

ashish.ana.chem@gmail.com

Abstract:

The nanoparticles are fundamental blocks of nanotechnology which rapidly growing science. Synthesized silver nanoparticles have wide applications in biomedical, optical and electrical field etc. due to wide range of applications we have prepared silver nanoparticles with greener way. For this proposes we used green approach Calotropis Gigantea flower extract was used for silver nanoparticles synthesis. Single step synthesized particles were used for application of antibacterial activity. UV-visible spectrophotometer is used to confirm the synthesis. Finally, it may conclude that it is simple, rapid, non-toxic and green one step method.

Keywords: Calotropis Gigantea, flower, silver nanoparticles, antimicrobial activity, UV-visible study

Introduction:

Nanotechnology has gained momentum in the recent years since it has multiple applications starting from space, medical, industrial and allied fields to day-to-day life [1]. Nanotechnology has recently been given much attention as a result of the unique properties of the nanoparticles (1–100 nm). The parameters that give rise to these properties include size, morphology and shape hence a significant number of studies have been conducted to manipulate the shape and size of nanoparticles in during their preparation for different applications [2]. Nanoparticles show unique and significantly modified physical, chemical and biological properties, as compared to their macro scaled counterparts, which make them of particular interest. Day by day increasing incidence of microbial challenges, multiple drug resistance (MDR) micro-organisms, poor dietary intake and serious health hazardous drugs call on new site for researchers to work on prominent antimicrobial active metabolites with good antioxidant activity to boost metabolism of an individual and overcome the problem of clinically significant microorganisms including MDR microorganisms [3]. The most targeted use of Nano Particle (NPs) is their utilization in biomedical field for example, in drug loading, drug delivery, antioxidant, antidiabetic, antimicrobial etc. due to the above cited characteristics. One of the major problems associated with NPs is how to synthesize the desired nanomaterial for desired applications [4]. Silver NPs have been largely used in various electronic and sensing devices, coating materials, data packing, and molecular

switches. Apart from this, they have also been applied in the diagnosis and treatments of various diseases [5].

Plenty of physical, chemical methods, polar solvents, and reducing compounds have been employed for the synthesis of silver nanoparticles. In turn to develop biocompatible, nontoxic, ecofriendly silver nanoparticles, plant extracts have been extensively used [6]. Top-down and bottom-up approaches can be used for the synthesis of Ag NPs. The top-down approach involves breaking down a bulk material into nano-sizes using techniques such as laser ablation and puttering. In contrast, the bottom-up approach refers to building nanoparticles using smaller entities, such as chemical and biological methods [7]. Chemically prepared nanoparticles are not appropriate for medical usages due to hazardous chemicals binding on their surface. Furthermore, by-products produced in chemical routes are toxic for the environment. Physical routes for synthesis of NPs have some drawbacks, too. These methods require high energy and space, and are expensive [8]. This is when biological approaches employing less expensive sources are exploited as Ag NPs precursors. The green synthesis of nanoparticles has gained a lot of attraction since it uses non-toxic phytochemicals and avoids the dangerous ingredients that would otherwise be used in chemical synthesis. Green synthesis methods use extracts from diverse plant parts, microbial cells, and biopolymers, and are so classified as such. The nanoparticles created are biocompatible and have the correct level of efficacy for the purpose for which they were created. Metallic NPs can be synthesized biologically using various plants and their extracts which are easily available in huge quantities. The plants and their extracts are safe to handle, less toxic and eco-friendly [9].

Biogenic synthesis of AgNPs is an easy single-step protocol without generating harsh and toxic chemicals; hence, they are saved, economical and eco-friendly. In recent years, both plant and microbes are extensively investigated for the biosynthesis of AgNPs of varying size, shape, stability, and antimicrobial efficacy [10]. *Eupatorium adenophorum* Spreng. (*E. adenophorum*) [also known as *Ageratina adenophora* (Spreng.)] of Asteraceae family, have been used in traditional medicine for the treatment of wounds, diabetes, inflammation, fever, jaundice and dysentery has been used to synthesis of Ag NPs [11]. Along with this *Capsicum* (*C. annum*, *C. frutescens*, *C. baccatum* and *C. chinense*) [12], *Acalypha wilkesiana* [13], *Ageratum conyzoides* Leaf Extract [14], *Lallemantia royleana* leaf Extract [15], *Adhatoda vasica* leaf extract [16], *Cucumis prophetarum* Aqueous Leaf Extract [17] were used to synthesis the silver nanoparticles. These developed nanoparticles were applied for various antimicrobial activities successfully.

In present work we have synthesized silver nanoparticles with *Calotropis Gigantea* flower extract. This is green synthesis with one of the medicinally used plant. Prepared material also applied for antibacterial application.

Materials and methods:

Chemicals and reagents:

All chemicals and reagents used in this research were >99 % purity.

Plant material:

Calotropis Gigantea plant is one of the medicinally important abundantly available plants in Maharashtra. Their flowers were collected from campus botanical garden of the Balwant College, Vita Dist. Sangli (M.S.).

Green synthesis of AgNPs:

Freshly collected flowers of Calotropis Gigantea plant was washed with distilled water number of times to remove dirt and other matters. Flower of Calotropis Gigantea were taken about 10g and then cut into small pieces. Small pieces of flower boiled for 30 minutes. Extract was cooled at room temperature and then filtrated by whatmann no. 1 filter paper. The process was followed as per Majid Sharifi-Rad et al. [15] reported. After completion of the heating brown colored silver nanoparticles were developed (Fig.1).

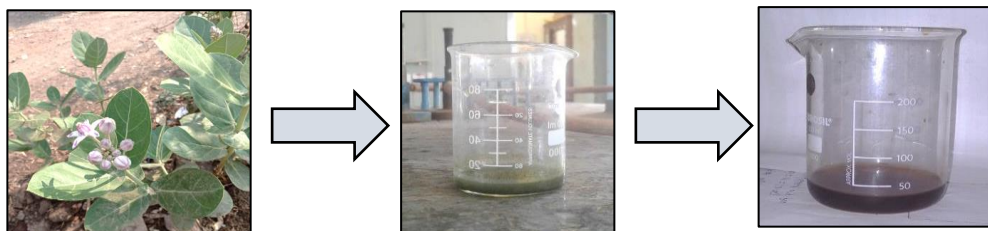


Fig.1 *Calotropis Gigantea* flowers – flower extract- formation of silver nanoparticles

Characterization of synthesized silver nanoparticles:**UV–visible spectroscopy:**

Ecofriendly synthesized silver nanoparticles were characterized with UV-Visible spectrophotometer. Range for the spectrophotometer was 340 to 710nm. As per various previous reports it showed maximum absorption at 450nm. It is confirmation of the formation of Ag NPs as per previous many of the reports [1-8].

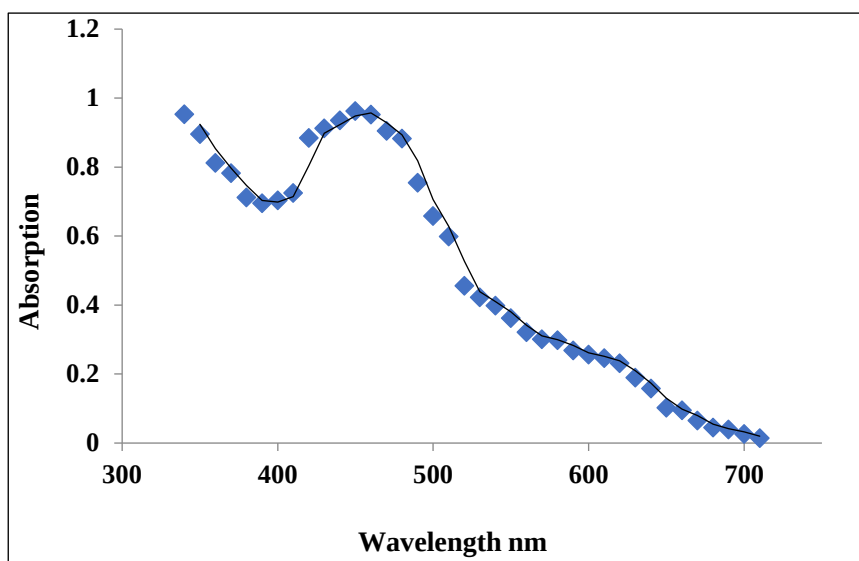
Antimicrobial Activity:

Antimicrobial property of silver owes to the fact that microbes cannot build up resistance against it as they are doing against conventional and narrow-target antibiotics, because the metal attacks a broad range of targets in the organisms, which means that they would have to develop a host of mutations simultaneously to protect themselves [3]. In present work prepared silver nanoparticles were used to determine the antimicrobial activities. We have determined antimicrobial activities against e-coli and bacillus and for these we found good result with Ag NPs.

Result and Discussion:**UV–Visible spectroscopy:**

The prepared AgNPs showed an absorption peak at 450 nm (Fig. 2), which in accordance with a previous report, where AgNPs exhibits maximum absorption between 410 and 460 nm. The colour of green synthesized AgNPs remained stable for 1 week [16]. The UV–V is absorption spectrophotometric analysis was used to follow and

investigate the formation of the green-synthesized Ag NPs, as reported previously [12-14], considering that the small spherical AgNPs give a surface plasmon resonance (SPR) band extended in the range from 350 to 500 nm. The optical response of the green-synthesized AgNPs due to their intense SPR band in the spectral region mentioned above



confirmed the efficient formation [16]. of these NPs [15].

Fig. 2. The UV–V is absorption spectra of the green synthesized Ag NPs

Antimicrobial studies:

The Antimicrobial activity is determined by using the human pathogenic e-coli and bacillus and also using standard disc diffusion method. Macconkey broth medium was used to sub culture bacteria and were incubated at 37°C for 24h fresh overnight cultures were taken and spread on the MacConkey agar plates to cultivate, bacteria. sterile paper discs of 5 nm diameter saturated with flower extract, silver nanoparticle and double distilled water (as control) were place in plate and incubated again at 37°C for 24 h and the antibacterial activity was measured based on the inhibition zone around the disc impregnated with flower extract and synthesized colored silver nanoparticle (Fig.3).



Fig. 3 Antimicrobial activities against *Basillus* and *E-coli* of prepared Ag NPs**Conclusion:**

It is concluded that nanomaterials show fascinating and useful properties; they have variety of applications in diverse fields. Many of the studies were reported that leaves were used to prepare the silver particles while very some of the reports of the flowers. In present study *Calotropis Gigantea* flowers were utilized to prepare silver nanoparticles with greener way. Prepared silver nanoparticles were confirmed with UV-Visible spectrophotometry which showed maximum absorption at 450nm. Prepared materials were applied for the antimicrobial activities for bacillus and e-coli in which for e-coil it showed good results. Finally, it may conclude that its greener and economical way to prepare silver nanoparticles.

Acknowledgment:

Author is thankful to the Principal, Balwant College, Vita, Head Department of Chemistry, Head Department of Microbiology for their support to complete this work.

References:

1. Parvathy Ajith, Aswathy Murali, Sreehari H, Bindhya Vinod, Amrita Anil, Smitha S; 2019 Green Synthesis of Silver Nanoparticles using *Calotropis gigantea* extract and its Applications in Antimicrobial and Larvicidal activity Materials Today: Proceedings 18, 4987–4991.
2. Netai Muchanyereyi, Cecilia Gusha, Munyaradzi Mujuru, Upenyu Guyo, Stephen Nyoni; 2022 Synthesis of silver nanoparticles using plant extracts from *Erythrina abyssinica* aerial parts and assessment of their anti-bacterial and anti-oxidant activities Results in Chemistry 4, 100402, 1-7.
3. Jasmeet Kaur Sohal, Ashish Saraf, Kamlesh Kumar Shukla; 2017 Green Synthesis of Silver Nanoparticles (Ag-NPs) Using Plant Extract for Antimicrobial and Antioxidant Applications: A Review Inter. J Adv Res Sci Eng 6, 10, 766-777.
4. Aroosa Habib, Yamin Bibi, Iqra Qayyum, Muhammad Farooq; 2024 Hierarchical plant extracts in silver nanoparticles preparation: Minuscular survey to achieve enhanced bioactivities Heliyon 10, e24303.
5. MR Shaik, M Khan, M Kuniyil, A Al-Warthan, Hamad Z. Alkhathlan, M Rafiq H. Siddiqui, J P. Shaik, A Ahamed, A Mahmood, M Khan, S FAdil 2018 Plant-Extract-Assisted Green Synthesis of Silver Nanoparticles Using *Origanum vulgare* L. Extract and Their Microbicidal Activities, Sustainability 10, 913.
6. T. Sivaranjani, A. Asha, P. Thirunavukkarasu, S. Asha; 2016 Silver Nanoparticle Synthesis from Plant Extracts and its Application – A Review Inter J Adv Res Physical Sci. 3, 3, 5-8.
7. Njud S. Alharbi, Nehad S. Alsubhi, Afnan I. Felimban 2022 Green synthesis of silver nanoparticles using medicinal plants: Characterization and application J Rad Res Appl Sci, 15,109–124.

8. Saba Pirtarighat, Maryam Ghannadnia, Saeid Baghshahi 2019 Green synthesis of silver nanoparticles using the plant extract of *Salvia spinosa* grown in vitro and their antibacterial activity assessment, *J Nanostructure Chem* 9, 1–9.
9. Alok Giri, Biswajit Jena, Bhagyashree Biswal, Arun Pradhan, Manoranjan Arakha, Saumyaprava Acharya, Laxmikanta Acharya; 2022 Green synthesis and characterization of silver nanoparticles using *Eugenia roxburghii* DC. extract and activity against biofilm-producing bacteria, *Scientific Reports* 12, 8383.
10. Chhangte Vanlalveni, Samuel Lallianrawna, Ayushi Biswas, Manickam Selvaraj, Bishwajit Changmai, Samuel Rokhum, 2021 Green synthesis of silver nanoparticles using plant extracts and their antimicrobial activities: a review of recent literature *RSC Adv.*, 11, 2804–2837.
11. Tarun Kumar Dua, Simran Giri, Gouranga Nandi, Ranabir Sahu, Tapan Kumar Shaw, Paramita Paul 2023 Green synthesis of silver nanoparticles using *Eupatorium adenophorum* leaf extract: characterizations, antioxidant, antibacterial and photocatalytic activities *Chemical Papers* 77, 2947–2956.
12. Diego Rosales, Adalberto Ojeda, Oscar Maldonado, Morelia Reyes, Georgina Padilla, Edgar Naranjo, Víctor Mayo, Gilberto Juárez; 2022 Green Synthesis of Gold and Silver Nanoparticles Using Leaf Extract of *Capsicum chinense* Plant Molecules, 27, 1692, 1–20.
13. Adewumi Dada, Folahan Adekola, Fehintoluwa Dada, Adunola Adelani-Akande, Micheal Bello, Chidiogo Okonkwo, Adejumo Inyinbor, Abimbola Oluyori, Adeniyi Olayanju, Kolawole Ajanaku, Charles Adetunji; 2019 Silver nanoparticle synthesis by *Acalypha wilkesiana* extract: phytochemical screening, characterization, influence of operational parameters, and preliminary antibacterial testing, *Heliyon* 5, e02517.
14. Jimoh Igbalaye, Adesegun Adeyemo, Adetola Adenubia, Oladejo Ahmodua, Basit Shodimua, Faizat Hazeza, Suliat Hassan; 2024 Silver Nanoparticles Synthesized Using *Ageratum conyzoides* Leaf Extract Exhibit Antioxidant, Anti-inflammatory and α -Glucosidase Inhibitory Properties, *Asian J Green Chem* 8, 25–38.
15. Majid Sharifi-Rad, Hazem Elshafie, Pawel Pohl 2024 Green synthesis of silver nanoparticles (AgNPs) by *Lallemantia royleana* leaf Extract: Their Bio-Pharmaceutical and catalytic properties, *J Photochem Photobio A: Chem* 448, 115318.
16. Ronak Chaudhari, Priyanka Shah¹, Pranav Shrivastav; 2023 Green synthesis of silver nanoparticles using *Adhatoda vasica* leaf extract and its application in photocatalytic degradation of dyes, *Discover Nano* 18, 135.
17. Hemlata, Prem Raj Meena, Arvind Pratap Singh, Kiran Kumar Tejavath; 2020 Biosynthesis of Silver Nanoparticles Using *Cucumis prophetarum* Aqueous Leaf Extract and Their Antibacterial and Antiproliferative Activity Against Cancer Cell Lines, *ACS Omega* 5, 5520–5528.