Nanotechnology Perceptions
ISSN 1660-6795
www.nano-ntp.com

Synthesis Of Silver Nanoparticles Using Ecbolium Ligustrinum Leaves: Characterization Through Advanced Analytical Techniques

Durga Pani Kumar Anumolu[1*], Swathi Naraparaju[2], Surya Bhargavi Addada[1], Vani Pagidipally [1], Veera Shakar Pulusu[3] Syed Sara Afreen[1]

[1*,] *Gokaraju Rangaraju College of Pharmacy, Department of Pharmaceutical Analysis, Osmania University, Hyderabad, Telangana-500090, India*
[2] *Gokaraju Rangaraju College of Pharmacy, Department of Pharmaceutical Chemistry, Osmania University, Hyderabad, Telangana-500090, India*
[3] *Ohio University, Department of Chemistry &Biochemistry, Athens, OH, USA-45701*
**Corresponding author: Dr Durga Panikumar Anumolu*
**Associate Professor, HOD, Pharmaceutical Analysis, Gokaraju Rangaraju College of Pharmacy, Hyderabad Telangana-500090, India. panindrapharma05@gmail.com*

Silver nanoparticles are the nanoparticles of silver that are between 1 and 100 nanometers in size, whose numerous applications in the pharmaceutical and UV-blocking textile sectors have recently received prominence. This study's goal is to develop an technique for producing AgNPs by employing leaf extract from the Ecbolium ligustrinum plant. The UV-Vis Spectroscopy, Spectro Fluorimetry, Fourier Transform Infrared Spectroscopy (FTIR), Zeta Potential, and Particle Size Analyzer were used to analyse these silver nanoparticles. The obtained results from the UV-Vis spectra (SPR) at 430nm, indicating the production of nanoparticles. By using FTIR, study revealed that the N ─ H, C ═ O, and =C-Hgroups were responsible for the formation of AgNPs. The zeta potential and particle size of AgNPs is 27.0 mV and 48.2 nm.

Keywords: Green synthesis, silver nanoparticle, Ecbolium ligustrinum, leaf extract

1.INTRODUCTION

Silver nanoparticles are the nanoparticles of silver that are between 1 and 100 nanometers in size.

Plants are a highly appealing system for nanoparticle synthesis because of their incredible ability to synthesize a wide range of bioactive secondary metabolites with significant lowering potential. The green synthetic process, which biosynthesizes nanoparticles using leaf extract, is safe, cost-effective, and environmentally friendly.

Ecbolium ligustrinum, other names include turquoise cross Andra, green shrimp plant, and green ice crossandra. It belongs to the family: Acantharean, a kingdom: Planate, Order: Lamiales, genus: ecbolium, species: E. ligustrinum shown in Figure 1. Green or blue flowers are possible on this plant and grows in the range 5.0-8.0. Orientin, Vitexin, Isoorientin, and Isovitexin are found in the leaves of Ecbolium ligustrinum

Ecbolium ligustrinum has been used to treat a variety of ailments, including gout and dysuria. The leaves are used to alleviate stricture, and the roots are used to treat jaundice, menorrhagia, and rheumatism. AgNPs have antibacterial, antifungal, antiviral, anti-inflammatory, anti-angiogenic, and anti-cancer properties in the biomedical sector.

AgNPs are employed in UV-blocking textiles as well as medical textiles and devices in textiles. AgNPs are employed in food packaging and nanotechnology in the food sector. AgNPs are also used in pharmaceutical applications like antimicrobial and larvicidal properties. Silver nanoparticles offer wound-healing properties, as well as being employed in water purification and having catalytic activity.

It is demonstrated that the extract of Ecbolium ligustrinum, a well-studied plant species, has never been researched as a source of silver nanoparticles. Silver is said to have a one-of-a-kind role in antibacterial, catalytic, and biological systems. UV-Visible spectroscopy, Fourier transforms infrared spectroscopy (FTIR), Spectro fluoro photometer, and other techniques were used to analyze the produced nanoparticles.

FIG 1. Ecbolium ligustrinum leaves

2. Materials

Fresh leaves of Ecbolium ligustrinum have been picked in Uppal, Hyderabad.
Silver nitrate ($AgNO_3$) was procured from Research-lab fine chem industries, Mumbai.

3. METHODS

3.1 Preparation of Plant Extract

Fresh Ecbolium ligustrinum leaves were collected and washed thoroughly in running water to eliminate dirt and dust from the leaves surface. 4 gms of coarsely chopped leaves were added to 40 ml water and simmered for 10 minutes. The extract was chilled, filtered, and kept for future use, and this solution was employed for silver nano particle production (AgNPs).

3.2 Synthesis of Silver nanoparticles solution

Plant leaf extract 1 mL was combined with 100 mL of 1mM $AgNO_3$ solution in a 100 mL flask. The Colour of the solution changes from transparent to reddish brown colour after 2 hrs of heating indicating the formation of silver nanoparticles.

UV-Visible Spectroscopy

In the wavelength range of 200-800 nm, the UV absorbance spectrum of silver nanoparticles solution was obtained. The UV visible spectrum of a plant extract solution, as well as a silver nitrate solution, is obtained. For every 15 minutes, the UV visible spectrum of silver nano particle solutions is obtained.

3.4 Spectro Fluorimetry

The 200-800 nm range was used to measure the excitation and emission spectra of solutions containing silver nanoparticles, plant extracts, and silver nitrate.

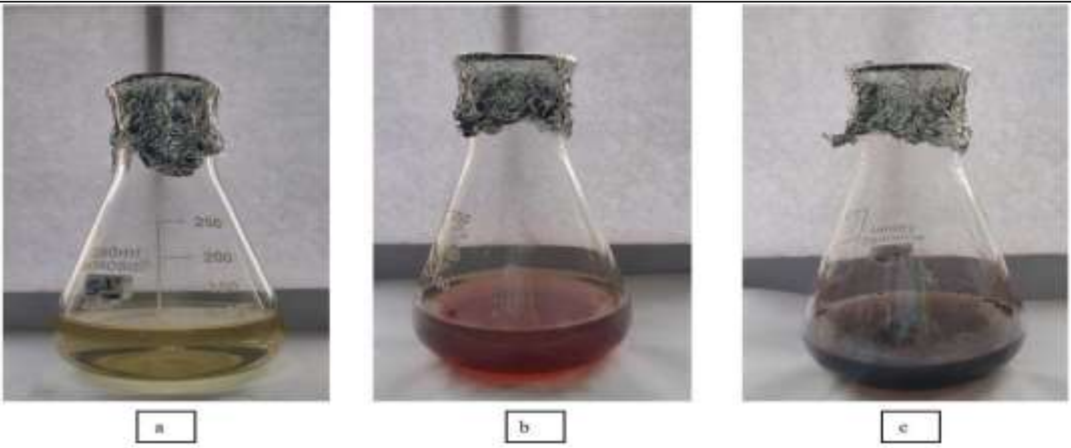
3.5Fourier Transform Infrared Spectroscopy (FTIR) Analysis

The sample of silver nanoparticles of Ecbolium ligustrinum leaves were prepared and analyzed by NISHKA Research Pvt, Ltd., Hyderabad to determine the presence of functional groups. The FTIR spectrums were collected in transmission mode between 4500 and 400 cm^1.

3.6 Partice size Analysis

The samples were prepared and were sent to analyze by NISHKA Research Pvt, Ltd., Hyderabad to determine the size of the silver nano particles of Ecbolium ligustrinum leaves.

Fig.2. Plant extract solution



a) 1ml Plant extract with 100ml 1mM $AgNO_3$ solution (Transparent colour).

b) During heating, colour change is observed.

c) After heating, colour changes to reddish brown colour which concludes formation of silver nanoparticles.

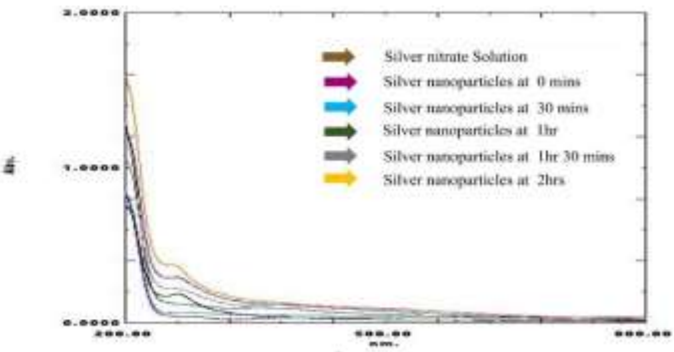
Fig. 3. Synthesis of silver nanoparticles

4. RESULTSANDDISCUSSION

4.1 Characterization of silver nanoparticles by UV-Visible Spectroscopy:

The synthesis of AgNPs was monitored by recording absorption spectra in the 200 nm-800 nm wavelength range. The formation of AgNPs during the process is indicated by a visible change in the colour of the reaction solution from transparent to reddish brown. The surface plasmon resonance of AgNPs in solution characterizes their formation. Surface plasmon resonance (SPR) peaks at 430 nm were observed in the UV-Vis spectrum, confirming the synthesis of AgNPs. Previous research suggested that AgNPs have an SPR peak between 410 and 450 nm.

Fig.4.1 Characterization of silver nanoparticles by UV-Visible spectroscopy at different intervals.



4.2 Characterization of silver nanoparticles by Spectro Fluorimetry:

Using fluorescence emission spectroscopy, the photoluminescence of the AgNPs produced by Ecbolium ligustrinum leaf extract. The photoluminescence emission spectra for the 420 nm excitation wavelength are recorded while the silver nanoparticles are dispersed in water at 425 nm with the Peak pick, at 423 nm it has shown 171, 288 intensity, and at Point pick, at 420 nm it has shown 0.041 intensity, are recorded. Ecbolium ligustrinum plant extract was excited at 420 nm with the Peak pick, showing 63.171 intensity at 482 nm, and with the Point pick, showing 28.867 intensity at 478 nm. Excitation wavelength at 530 nm for silver nitrate solution has exhibited 109.325 intensity and 0.232 intensity with the Peak pick, and 68.422 intensity with the Point pick at 538 nm.

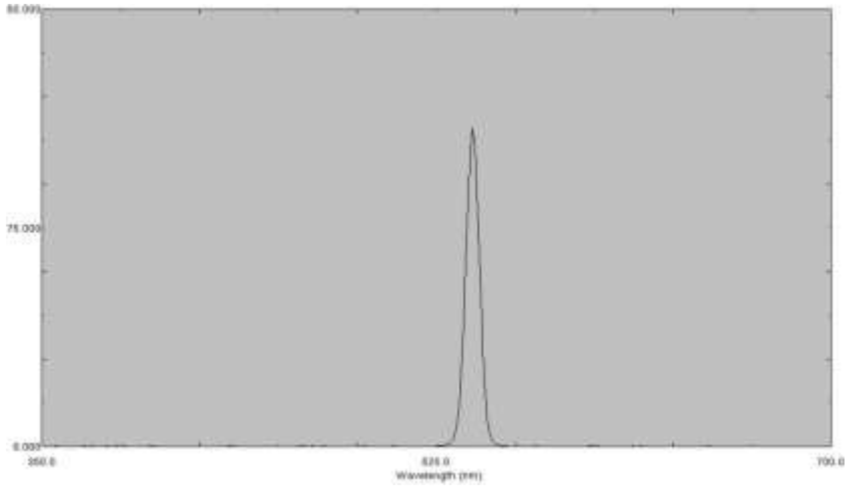


Fig.4.2.1. Spectrum of leaf extract solution

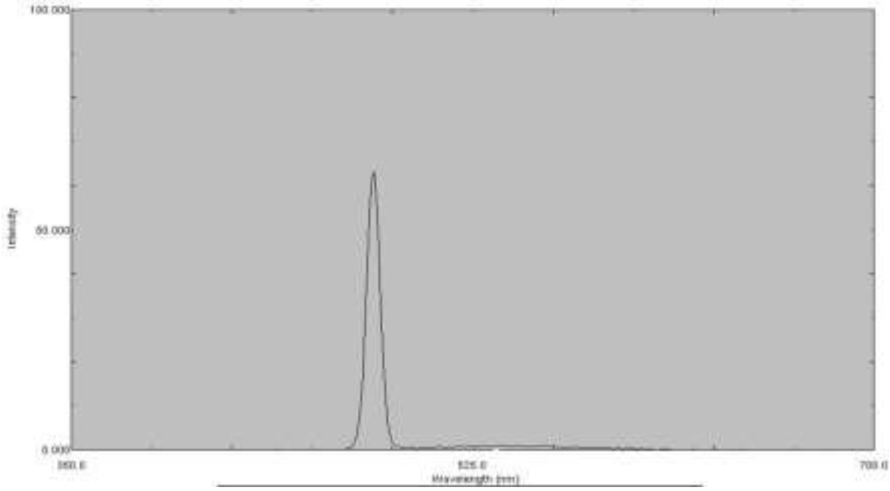


Fig.4.2.2. Spectrum of Silver nitrate solution

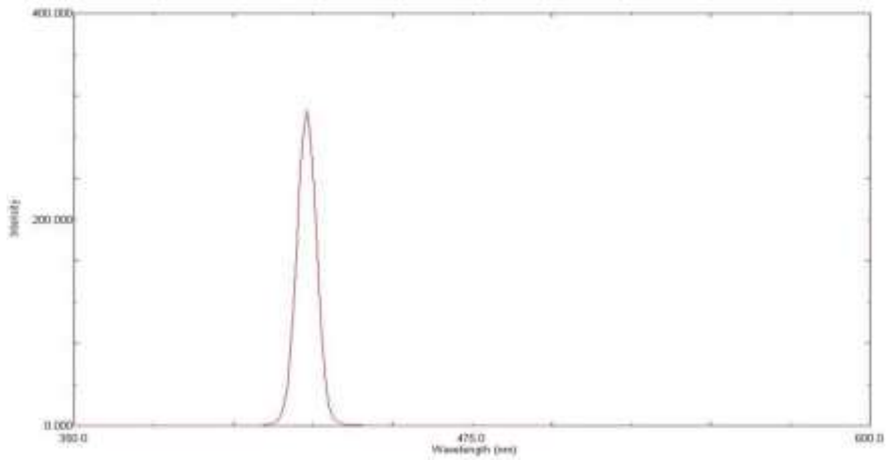


Fig.4.2.3. Spectrum of Silver nanoparticles

4.5 Characterization of silver nanoparticles by FTIR Analysis:

The stretching vibrations of the N-H group of group NH_2 and OH, which overlap with the stretching vibrations assigned to the molecules of water and E. ligustrinum leaf extract, result in a broadband between 3346.96 cm^{-1}. Amide C=O stretching is represented by the band at 1641.61 cm^{-1}.The flavonoids and terpenoids that are overly prevalent in plant extracts are primarily responsible for the observed peaks. On the other hand, the produced extract sample displays a broad and strong peak with a maximum intensity at 562.53cm^{-1}, which is consistent with =C-H bending. The findings and those in the literature are in good accord. The bio-organic components from the E. ligustrinum extract created a potent coating or capping on the nanoparticles, according to the FTIR.

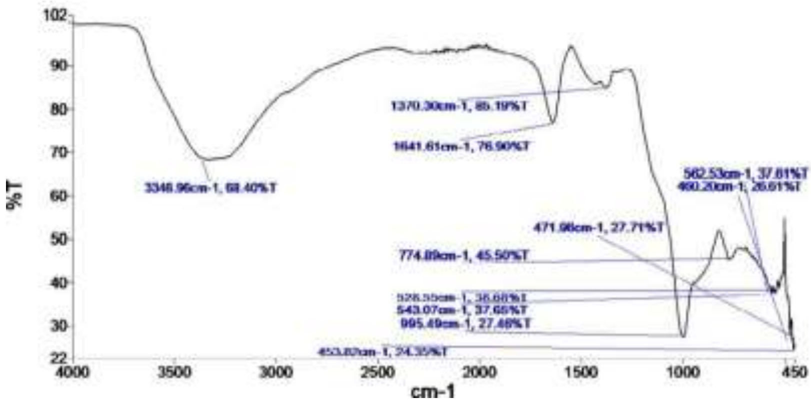


Fig.4.3 Characterization of silver nanoparticles by FTIR

4.6 Characterization of silver nanoparticles by Particle size analysis:

The average particle size and zeta potential of synthesized silver nano particles was identified using Zeta plus particle analyzer, by NISHKA Research Pvt, Ltd., Hyderabad. The particle size of the synthesized silver nano particles was investigated. Viscosity of the dispersion medium: 0. 893mPa.s. Zeta potential is a crucial tool for analyzing the status of a nanoparticle's surface and determining whether the dispersed particles will remain stable over time. The produced nanoparticles with zeta potential values larger than +25Mv or lessthan-25 mV often exhibit a high degree of stability, according to previous research. Incontrast, the zeta potential of AgNPs is substantially influenced by pH, electrical conductivity, and particle concentration. It's interesting to note that according to our data, green AgNPs have a zetapotential value of 27.0mV. Zeta potential measurements show that the biosynthesized AgNPs have a high level of stability.

Peak No.	Zeta Potential	Electrophoretic Mobility
1	27.0MV	0.000209cm2/Vs
2	-----mV	------cm2/Vs
3	-----mV	-------cm2/Vs

4.5.1 Table of zetapotential of silver nanoparticles

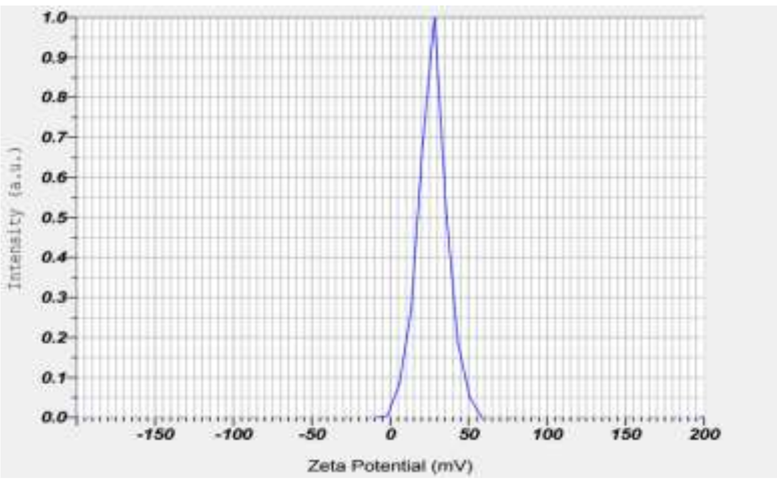


Fig.4.4.1 Zeta potential of silver nanoparticles

PeakNo.	S.P. Area Ratio	Mean	S.D.	Mode
1	1.00	179.5 nm	48.2 nm	162.0 nm
2	---	---nm	---nm	---nm
3	---	---nm	---nm	---nm
Total	1.00	179.5 nm	48.2 nm	162.0 nm

4.4.2 Table of Particle size of silver nanoparticles

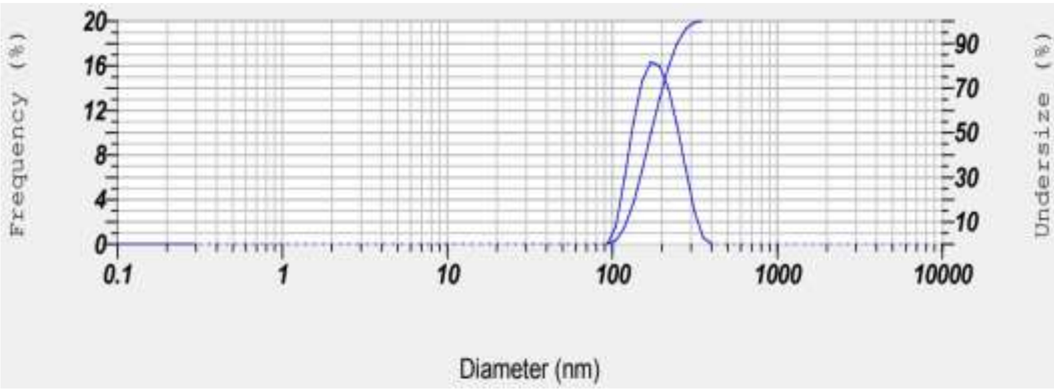


Fig.4.4.2. Particle size of silver nanoparticles

CONCLUSION

In conclusion, it has been shown that the leaf extract of Ecbolium ligustrinum may bio-reduce aqueous Ag+ ions. However, the efficacy of Ecbolium ligustrinum leaf extract as a capping and reducing agent hasn't been thoroughly investigated. Ecbolium ligustrinum can be available source for the synthesis of silver nanoparticle, according to the findings of the current study. This green chemical method for creating silver nanoparticles has various benefits, including the process's simplicity for scaling up and economic viability. This technique has the potential to be interesting for the large-scale synthesis of various inorganic materials because of the uses of such environmentally friendly nanoparticles in antibacterial, wound healing, and other medical and electronic applications (nanoparticles).The reaction was easy to manage and, more crucially, straight forward, and it is thought that this gives it an edge over alternative biological synthesis.

REFERENCES

1. Singh, D. Jain, M. K. Upadhyay, N. Khandelwal, H. N. Verma. DigestJournal of Nanomaterials and Biostructures, Vol. 5, No 2, July-September 2010, p.483-489.GreensynthesisofsilvernanoparticlesusingArgemonemexicanaleafextract and evaluation

of their antimicrobial activities.

2. Erico R. Carmona, Noelia Benito, Tanya Plaza & Gonzalo Recio Sánchez (2017) Green synthesis of silver nanoparticles by using leaf extracts from the endemic Buddle jaglobosa hope, Green Chemistry Letters and Reviews, 10:4,250-256, DOI: 10.1080/17518253.2017.1360400.
3. Kumar V, Singh S, Srivastava B, Bhadouria R, Singh R, Green Synthesis ofSilverNanoparticlesUsingLeafExtractofHolopteleaintegrifoliaandPreliminary Investigation of Its Antioxidant, Anti-inflammatory, Antidiabeticand Antibacterial Activities, Journal of Environmental Chemical Engineering (2019), https://doi.org/10.1016/j.jece.2019.103094.
4. Pragyan Roy, Bhagya Laxmi Das, Abhipsa Mohanty, Sujata Mohapatra. Appl Nano sci (2017) 7:843–850, Springer. Green synthesis of silver nano particles using Azadirachta indica leaf extract and its antimicrobial study.
5. Shakeel Ahmad, Isfahan Tauseef, Kashif Syed Haleem, Khushal Khan, Muhammad Shahzad, Mehboob Ali, Faisal Sultan.AppliedNanoscience,2019. Synthesis of silver nanoparticles using leaves of Catharanthus roseusandtheirantimicrobial activity.
6. Tahir Rasheed, Muhammad Bilal, HafizM. N. Iqbal, ChuanlongLi, Green biosynthesis of silver nanoparticles using leaves extract of Artemisia vulgaris and their potential biomedical applications, Colloids and Surfaces Bio interfaces http://dx.doi.org/10.1016/j.colsurfb.2017.07.020
7. Vyom Parashar, Rashmi Parashar, Bechan Sharma, Avinash c. Pandey. DigestJournal of Nanomaterials and Biostructures Vol. 4, No.1, March 2009, p. 45 -50. Parthenium hysterophorus L leafextract mediated synthesis of silver nanoparticles: A novel approach towards weed utilization.