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Biosynthesis of silver nanoparticles from leaf tissue of *Martynia annua* Linn.

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Abstract

Owing to environmental issue, biomediated synthesis of metal and metal oxide NPs are now days gaining an immense attention in research. This green synthesis depends upon role of active biomolecules in reduction of metal ion and capping the biosynthesized nanoparticles. The present work was undertaken to synthesize silver nanoparticles using leaf tissue of *Martynia annua* Linn. The size, shape of resultant biosynthesized AgNPs were investigated by using UV-Spectroscopy, FT-IR and XRD. *Martynia annua* Linn. is a monotypic genus of family Martyniaceae used as medicinal herb in ancient period. A phytochemical test detects presence of biological reducing agents like flavonoids, terpenoides, Glycosides, Coumarins and saponins. The present study demonstrates the ability of *M. annua* Linn leaf extract to synthesize AgNPs by characteristic surface plasma resonance peak at 430 nm. FT-IR spectrum confirms presence of amine and phenol groups as capping and reducing agents of silver nanocrystals. The average crystalline size of biosynthesized AgNPs is 17.57 nm. Further mechanism and mode of action of synthesized silver nanoparticles is under study.

Keywords: *Martynia annua* Linn. Green synthesis, AgNPs.

Introduction

In recent era plants and microbes are used for nanoparticle synthesis. Wherein synthesis of green nanoparticles by plant extract is ecofriendly rapid, low cost, single-step method using reducing and capping agents [1]. Many reports are available on the biogenesis of silver nanoparticles using several plant extracts, particularly *Acer oblongifolium,*

Catharanthus roseus Azadirachta indica, *Pelargonium graveolens*, *Medicago sativa*, *Aloe barbadens*, *Emblica officinalis, Ocimum sanctum* etc [2-4]. *Matynia annua* L. (Martyniaceae), is native of Mexico and found throughout India, in waste places along road sides commonly known as Devil's claw. The leaves of *the M. annuna* L. are edible and used as antiepileptic and antiseptic, applied locally to tuberculous glands of the neck, the juice of the leaves as a gargle for sore throat and the leaf paste for wounds of domestic animals [5]. The fruit is useful in inflammations, ash of fruit mixed with coconut oil applied on burns and seeds found to be effective for arresting of graying of hair [6](Babu, *et.al.,* 2010).

The nanoparticles (NPs) have a high surface to volume ratio that increases their reactivity and possible biochemical activity [7]. The nanoparticles appear as point of scattering light under high resolution under Brownian motion and their speed varies strongly with the particle size. Number of plants now a day's explored for their medical importance extensively, but it has yet to be explored for its possible use in stabilizing and reducing the effects of green chemistry [8]. In the present study an effort has been made to synthesize and characterize silver nanoparticles using the leaves of *Martynia annua* L.

Methodology

Collection and identification of plant material

The fresh and mature plants of *Martynia annua* L. were collected from open fields of Baramati (Maharashtra) and identification was carried out using standard taxonomic references.

Preparations of leaf extract

Fresh leaves of plants were collected and washed with distilled water thoroughly and were shade dried for about 4 days, followed by oven drying to remove its moisture content. The dried samples were ground into a fine powder. 10g of plant powder was dispensed in 100 ml of distilled water and boiled for 15 min. at 75°C on water bath. The extract was filtered through Whatman no. 1 filter paper and the obtained filtrate stored at 4°C under dark condition for further analysis.

After addition of 100 ml aqueous leaf extract into 900ml of 1M $AgNO_3$, the solution kept in dark condition at room temperature for 24 hours to monitor the color change. The yield of silver nanoparticles was purified by centrifugation at 15000 rpm for 15 min followed by repeated water wash to remove any impurities. Furthermore, nanoparticles were dried in oven at 60^0C and stored at 4^0 C in amber colored bottles for further analysis.

Phytochemical screening

Aqueous leaf extract of *M. annua* L. were qualitatively tested as per standard procedure for the presence of Alkaloids, Flavonoids, Phenols, Saponins, Glycosides, Coumarins, Tannins, Terpenoids, Xanthoproteins and Polobatannins [9] .

Characterization of Silver Nanoparticles

The characterization of silver nanoparticles is carried out by visual inspection for color change, UV-Vis., IR and XRD analysis.

UV-Visible spectral analysis

Synthesized silver nanoparticles was scanned at different time intervals in absorption maxima of 300-700 nm on UV-Visible spectrophotometer (Perkin Elmer Lambda 25 spectrophotometer), using deionized water as the reference.

Fourier transforms infrared spectroscopy (FT-IR)

FT-IR spectra were recorded on Perkin Elmer, Spectrum GX at a resolution of 4 cm^{-1} in the range 400-4000 cm^{-1} on KBr pellets.

X-ray Diffraction (XRD)

Structural properties of synthesized nanoparticles were studied by analyzing the X-ray diffraction patterns obtained using Philips X-ray diffractometer Model PW-3710 for λ = 1.5406 and 2.2897 A^0 for Cu- K_α and Cr-K_α radiation respectively. The 2θ, d value and intensity were compared from the available literature. Average crystallite particle sizes of synthesized Ag nanoparticles,

the most intense peaks of AgNO3 were preferred. It was calculated by Scherrer equation d = Kλ / βCos θ. The measured intensity as a function of the angel is compared with a standard d value using computer software (JCPDS-International centre for diffraction data, USA (1977) on X-ray diffraction, which completes the identification of the crystal structure.

Result and Discussion

Phytochemical screening

Phytochemical screening in leaf extract of *M. annua* L. is represented in the Table 1. It is clear from table that aqueous leaf extract showed presence of flavonoids, phenols, Glycosides, Coumarins wherein methanolic leaf extract showed presence of Alkaloids, flavonoids, phenols and saponins. This justifies that leaf is good source of antioxidants and plays an important role in capping agents for biosynthesis of silver nanoparticles.

UV-Vis spectra analysis:

UV-Vis spectra analysis of biosynthesized silver nanoparticles from *Martynia annua* leaves is depicted in Figure 1. The biosynthesized silver nanoparticles showed characteristic surface plasma resonance peak at 430nm confirms synthesis of silver nanoparticles. Shankar *et al*, [10] proposed that synthesis of silver nanoparticles is result of excitation of dark brown color silver ion complex due to surface plasmon vibrations. The combined variation of free electrons of nanoparticles in resonance with the light wave gives rise to surface plasma resonance absorption band [11].

Table 1: Phytochemical screening in leaf tissue of *Martynia annua* Linn.

Sr. No	Test	Water	Methanol
1	Alkaloids	-	+
2	Flavonoids	+	+
3	Phenol	+	+
4	Saponins	-	+
5	Glycosides	+	-
6	Coumarins	+	-

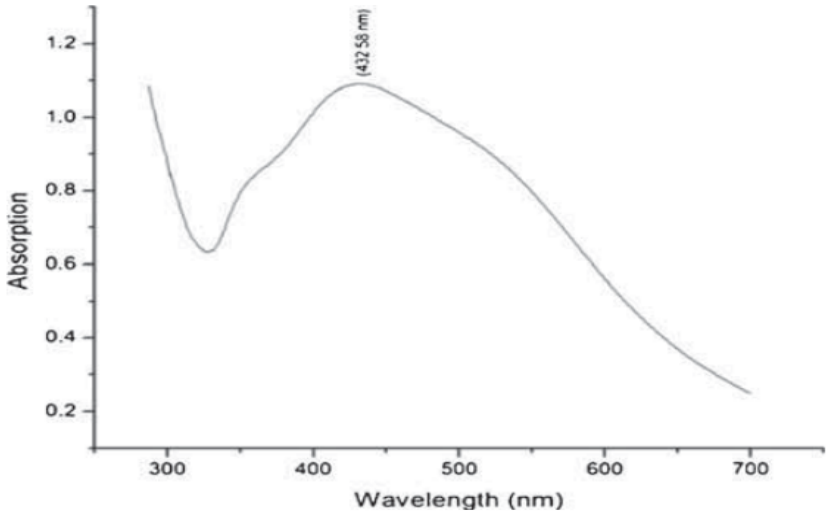

Figure 1 : UV-spectra of Biosynthesized silver nanoparticles from leaf powder of *Martynia annua* Linn.

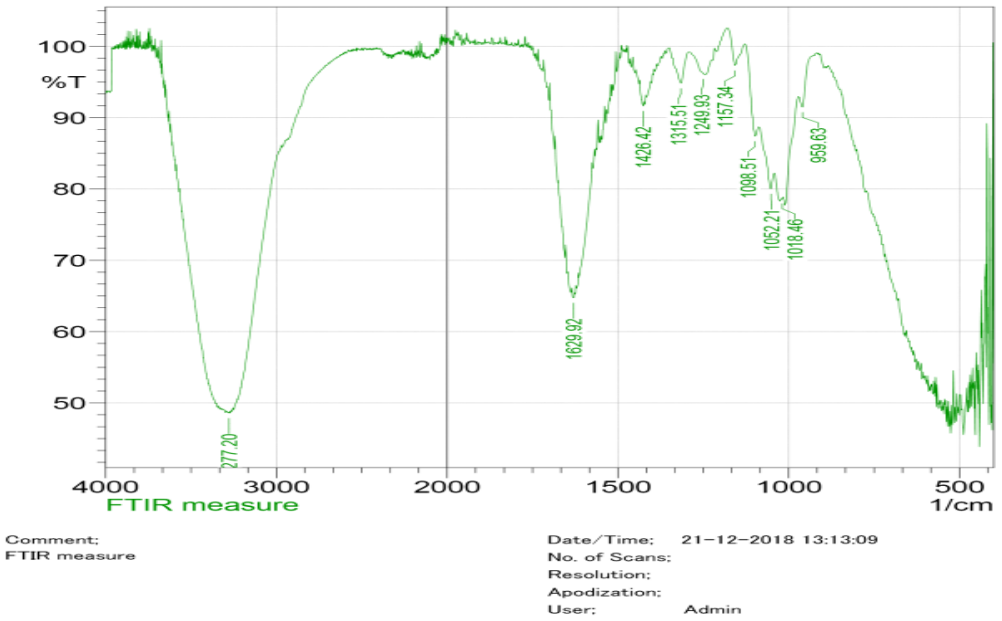

Fig.2 : FT-IR spectra of Biosynthesized silver nanoparticles from leaf powder of *Martynia annua* Linn.

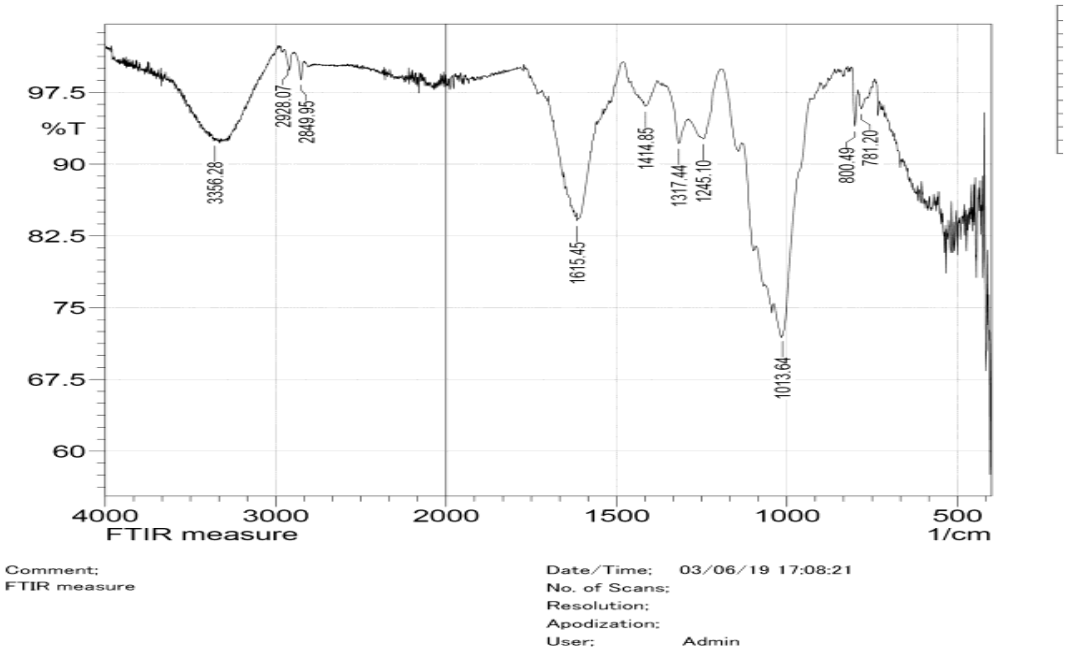

Fig. 3: FT-IR spectra of leaf powder of *Martynia annua* Linn.

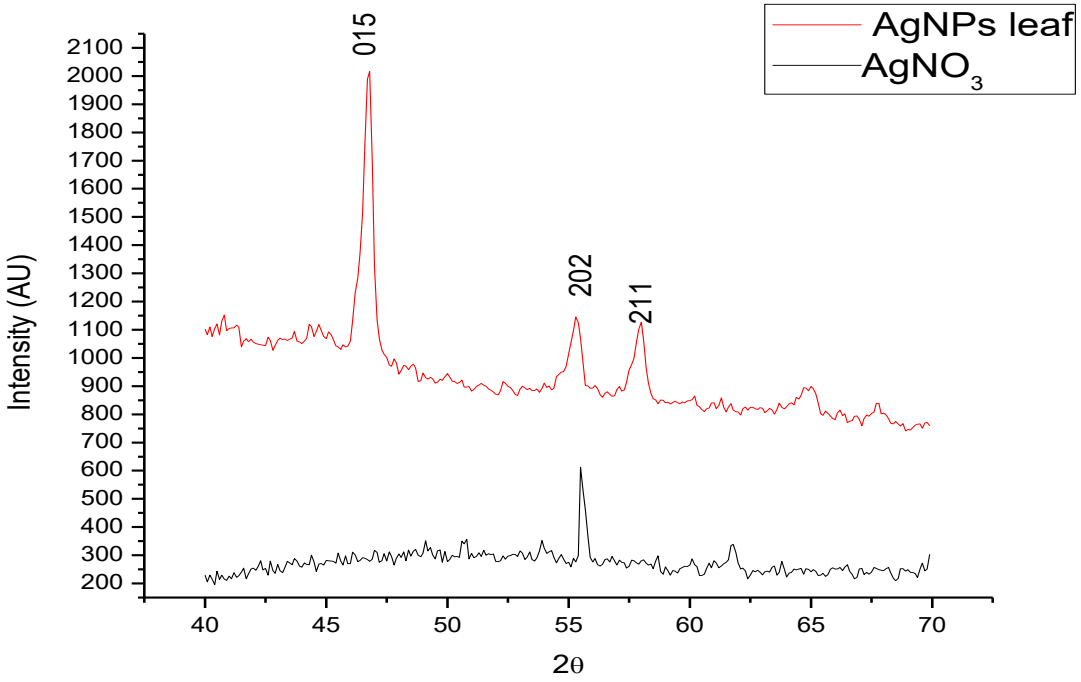

Fig. 4: XRD analysis of Standard $AgNO_3$ and Biosynthesized silver nanoparticles from leaf powder of *Martynia annua* Linn.

There is an active role of biomolecules like phenolics, terpenoids, polysaccharides, flavonoids, alkaloids, proteins, enzymes, amino acids and alcoholic compounds in the reaction of biosynthesis of silver nanoparticles [12]). Flavonoids and phenols have the unique chemical power to effectively wrap the nanoparticles preventing their agglomeration [8].

Sharma et al.,[13] observed that absorption peaks shifted towards higher wavelength with higher concentration of $AgNO_3$was observed in *Azadirachta indica* [13]. Different workers have concluded that not only silver nitrate concentration but also time duration, pH, temperature also affect synthesis of silver nanoparticles

FT-IR Spectroscopy

FT-IR spectrum clearly illustrates the biofabrication of silver nanoparticles mediated by the leaf extracts. Fig 2 and 3 shows the FT-IR spectrum of leaf extract mediated synthesized AgNPs.

M. annua leaf extract showed broad peak at 1615 cm^{-1} which indicate the presence of N-H bending and after the synthesis of AgNPs there is shift to broad peak to the right at 1629 cm^{-1} indicating the formation of silver nitrogen bond. Whereas broad peak at 3356 cm^{-1} indicate presence of N-H stretching and in AgNPs from leaf tissue of *M. annua* shifts to lower frequency 3277cm^{-1} gives additional proof for the metal nitrogen bond. The bond formation between silver ion and amino group of amino acids is confirmed by additional peak at 1157 in AgNPs of *M. annua* leaf.

FT-IR spectra confirms that functional groups present in the synthesized silver nanoparticles of *M. annua* leaf powder for understanding their transformation from simple inorganic $AgNO_3$ to elemental silver by the action of the proteins and amino acid alongwith phytochemicals like steroid, alkaloid, saponin, glycosides, tannins, phenols, flavonoides, terpenoides as analysis of leaf extract specifies presence of such

compounds which may acts as reducing, stabilizing and capping agent.

XRD-analysis:

Analysis of AgNPs by XRD in leaf tissue of *M. annua* L. confirmed synthesis of crystalline nature silver nanoparticles (Fig. 4). The Braggs reflection were observed in the XRD pattern at 2θ = 45.73, 55.21, 58.14. These Braggs reflections clearly indicated the presence of (015), (202), (211) sets of lattice planes. The highly intense and narrow diffusion peaks revealed the crystalline nature of the synthesized nanoparticles. Further the XRD pattern confirmed the formation of silver nanoparticles. The average crystalline size of biosynthesized AgNPs is 17.57 nm. Due to capping agents in plant extracts there are sharp peaks and smaller peaks due to impurities in biological macromolecule [14].

Conclusion

M. annua L. showed good capacity to synthesize AgNPs. The UV absorption peak at 430 nm clearly indicates the synthesis of AgNPs. FTIR studies confirmed the biofabrication of the AgNPs by the action of different phytochemicals with its different functional groups present in the extract solution. The XRD patterns confirmed the purity, phase composition and nature of the synthesized nanoparticles. The size was bigger as the nanoparticles were surrounded by a thin layer of metabolites. All the above analyses proved that the concentration of leaf extract to metal iron ratio plays an important role into the shape determination of the nanoparticles. Bioreduction of aqueous silver ions by *Martynia annua* L. leaves extract provides bioprospecting potential of underutilized plant in efficient and ecofriendly way.

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Conflicts of interest: The authors stated that no conflicts of interest.

References

1. Huang J, Li Q, Sun D, Lu Y, Su Y, Yang X., **2007,** Biosynthesis of silver and gold nanoparticles by novel sundried *Cinnamomum camphora* leaf. Nanotechnology.;18:105104.
2. Ponarulselvam S, Panneerselvam C, Murugan K, Aarthi N, Kalimuthu K, Thangamani S. **2012,** Synthesis of silver nanoparticles using leaves of *Catharanthus roseus* Linn. G. Don and their antiplasmodial activities. Asian Pac J Trop Biomed. 2 (7) : 574-80. doi: 10.1016/S2221-1691(12)60100-2. PMID: 23569974; PMCID: PMC3609350.
3. Jain, S., Mehata, M.S., **2017**, Medicinal Plant Leaf Extract and Pure Flavonoid Mediated Green Synthesis of Silver Nanoparticles and their Enhanced Antibacterial Property. *Sci Rep* **7**, 15867 https://doi.org/10.1038/s41598-017-15724-8.
4. Naveed, M.; Bukhari, B.; Aziz, T.; Zaib, S.; Mansoor, M.A.; Khan, A.A.; Shahzad, M.; Dablool, A.S.; Alruways, M.W.; Almalki, A.A. **2022**,Green Synthesis of Silver Nanoparticles Using the Plant Extract of *Acer oblongifolium* and Study of its Antibacterial and Antiproliferative Activity via Mathematical Approaches. Molecules 27: 4226. https://doi.org/10.3390 molecules27134226.
5. Anonymous**.** The wealth of India. **2004,** Vol. IV, CSIR, New Delhi, 110.
6. Babu H B**,** Mohana L S**,** Saravana A K., **2010**, Studies on phytochemical and anticonvulsant property of *Martynia annua Linn.* International Journal of Phytopharmacology; 1(2): 82-86.
7. Dubchak, S., A. Ogar, J.W. Mietelski and K. Turnau, **2010**, Influence of silver and titanium nanoparticles on arbuscular mycorrhiza colonization accumulation of radiocaesium in *Helianthus annuus*. Spanish J.Agric.Res.,8: 103-108.
8. Ahmed, S.; Saifullah Ahmad, M.; Swami, B.L.; Ikram, S., **2016**, Green synthesis of silver nanoparticles using *Azadirachta indica* aqueous leaf extract. J. Radiat. Res. Appl. Sci. 9, 1–7. [CrossRef]
9. Evans, William Charles., Daphne Evans, and George Edward Trease. **2009**,Trease and Evans Pharmacognosy. 16th ed. Edinburgh ; New York: Saunders/Elsevier.
10. Shankar SS, Ahmed A, Akkamwar B, Sastry M, Rai A, Singh A., **2004**, Biological synthesis of triangular gold nanoprism, Nature, 3:482.

11. Selvi Barnabas, Clara G., Jayaraman Theerthagiri, and Amutha Santhanam, **2018,** "Comparative photocatalytic degradation of organic dyes using silver nanoparticles synthesized from *Padina tetrastromatica*." Current Nanoscience 14(1): 71-75.

12. Anand A C., **2000**, The pharmaceutical industry: 'silent' partner in the practice of medicine. Nata/Med J India, 13:319-21.

13. Sharma, N C, Sahi S V, Nath S, Parsons J G, Gardea-Torresdey JL and Pal T, **2017**, Synthesis of plant-mediated gold nanoparticles and catalytic role of biomatrix-embedded nanomaterials. Environ Sci Technol. 41:5137-5142.

14. Krishnaraj C, Jagan E G, Rajasekar S, Selvakumar P, Kalaichelvan P T and Mohan N, **2010,** Synthesis of silver nanoparticles using *Acalypha indica* leaf extracts and its antibacterial activity against water borne pathogens. Coll surf B: Biointer 76, 50-56.

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