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GREEN SYNTHESIS OF SILVER NANOPARTICLES USING PLANT LEAF EXTRACTION OF *TRADESCANTIA ZEBRINA*: SYNTHESIS AND CHARACTERIZATION

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ABSTRACT: Nanoparticles are primary to nanoscience and nanotechnology, presenting powerful process over different fields. However conventionally synthesized by using physical and chemical methods, these strategies always suffer from harmful issues. To highlight these approach, eco-friendly and less toxic green synthesis methods have been established. These methods involve natural sources such as medicinal plant *Tradescantia zebrina*, the use of these medicinal plantsknown for the specially assuring path due to its significant to overcome toxicity and microbial resistance problems found in current therapeutic practices. Eco-friendly green synthesis of silver nanoparticles (AgNPs) from silver nitrate (AgNO3) using *Tradescantia zebrina* leaves extract as reducing agent by a simple method at room temperature. The biosynthesized nanoparticles (NPs) were characterized by scanning electron microscopy (SEM) coupled with (EDAX) and Fourier transform infrared spectroscopy (FTIR). The AgNPs synthesized were spherical, block shaped, and irregularin shapes. The XRD spectrum confirmed the presence of silver ions and crystalline nature of synthesized AgNPs. FTIR showed the functional groups such as C-O, N–H and C–N groups involved in the reduction of Ag^+ to Ag.

INTRODUCTION: Nanotechnology is rapidly growing with nanoparticles produced and employ in a wide range of commercial products throughout the world. For example, silver nanoparticles (Ag NP) are employ in electronics, bio-sensing, clothing, food industry, paints, sunscreens, cosmetics and medical devices. These broad applications, however, increase human revelation and thus the potential risk related to their short- and long-term toxicity.

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A huge number of in vitro studies clamour that Ag NPs are toxic to the mammalian cells extract from skin, liver, lung, brain, vascular system and reproductive organs [1]. The recent development and execution of new technologies have led to new era, the nano-revolution which flatten role of plants in bio and green synthesis of nanoparticles which seem to have drawn quite an unambiguous attention with a view of synthesizing stable nanoparticles.

Conventionally silver nanoparticles are synthesized by chemical method using chemicals as reducing agents which later on become responsible for numerous biological risks due to their general toxicity; engendering the major concern to develop environment friendly processes.

Biological methods using plant extracts have emerged as an alternative to conventional methods of synthesis of silver nanoparticles. Crude extracts of plants contain novel secondary metabolites such as tannins and phenolic substances, flavonoids, terpenoids etc. which are responsible for the reduction of metallic ions into nanoparticles [2].

AgNPs play acrucial role in nanoscience and nanotechnology, especially in nanomedicine. To assess the incorporate nanomaterials, many analytical techniques have been used, including Fourier transform infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), Scanning electron microscopy (SEM), transmission electron microscopy (TEM) and so on Green Chemistry Approach for the Synthesis of AgNPs. Biotically-contained synthesis of nanoparticles have been revealed to be simple, cost effective, reliable, and environmentally friendly perspective and much attention has been given to the high yield production of AgNPs of defined size using various biological systems [3]. Previous studies have reported that the proteins, phenolic compounds and flavonoids found in plants also play an important role in capping of the nanoparticles and thus plays key role in the stabilization of silver nanoparticles.

Tradescantia zebrine Heynh. (Family Commelinaceae), commonly known as 'Wandering Jew' is a herbaceous perennial plant with creeping shoots and fleshy leaves. The plant is traditionally used for the treatment of common cold, tuberculosis, uterine diseases, urinary infection, hemorrhoids and influenza. *Tradescantia zebrine* plant is also used to purify the blood, the leaves applied to shrink swellings, haemorrhoids, blood in the stools and taken orally to treat kidney infections., The plant leaves are used as a source of tea for blood cleansing and treatment of influenza [4]. In the present investigation, we report the green synthesis of silver nanoparticles (AgNPs) by an eco-friendly method including the in-situ reduction of silver ions by the leaf extract of *T. zebrina*. AgNPs were synthesized according to an efficient protocol using *T. zebrina* leaf extract. Scanning electron microscopy (SEM) EDAX revealed the morphology of the AgNPs and Fourier transform infrared spectroscopy (FTIR) measurements were performed to determine their crystalline nature and functional groups, respectively.

MATERIAL AND METHODOLOGY:

Collection of Plant Material: Healthy *Tradescantia zebrine* plant leaves were collected from MGM University Campus, Chh. Sambhajinagar, Maharashtra, India. The selected plant leaves were collected by scrapping using neat and clean knife during the month of April 2024, and collected materials were carefully washed and dried at 45°C to constant weight. To get rid of all dust and undesirable particles, the process was repeated for 2–3 three times.

Biosynthesis of Silver Nanoparticles: The collected *Tradescantia zebrine* plant leaves were allowed to shade dried for 72 h. After that, 30 g of *Tradescantia zebrina* leaves were boiled in 100ml of distilled water contained in the conical flask or beaker, the extract was filtered by using Whatman No. 1 filter paper and the resulting filtrate (12ml) was taken and treated with 88ml of aqueous 1 mM AgNO3 solution and incubated in dark condition, at room temperature. Appearance of brownish yellow coloured solution shows the formation of AgNPs. The synthesized nanoparticles centrifuged at 10,000 rpm for 10 min so that the nanoparticles were collected after eliminating the supernatant. The synthesized nanoparticles were isolated and kept in an aluminium foil containing volumetric glass flask.

Characterization of Synthesized Silver Nanoparticles:

Scanning Electron Microscopy (SEM) EDAX: The shape and morphology properties of silver nanoparticles (AgNPs) are measured by implementing a SEM. After centrifuging silver nanoparticles at 15,000 rpm for 10 min, the pellets are collected and deposited in a dehydration oven at 50 C to remove any remaining water SEM study was performed to study shape, size and surface area of the silver nanoparticles (AgNPs). The AgNPs solutions were ultra- sonicated at room temperature for 15 min and one drop of the sample was placed on a glass slide. After drying, the glass slide was coated with silver and visualized under SEM.

FTIR Analysis: FTIR spectrometer was used to study the chemical composition of the synthesized silver nanoparticles. The solutions containing silver nanoparticles (AgNPs) were centrifuged at 10,000 rpm for 15 min.

The supernatant was discarded, and the pellets were resuspended in sterile double distilled water and centrifuged at 10,000 rpm for 10 minutes. The purified pellets were dried at 60°C and the dried powders were subjected to FTIR spectroscopy measurement in the range 4000–400 cm^{-1} using KBr pellet method.

RESULTS AND DISCUSSION:

AgNPs Synthesis: Green synthesis of nanoscale materials by biological materials was favoured to harmful substances production. Attempts were made to synthesis AgNPs from *Tradescantia zebrine* and its molecular characterization. Silver nanoparticles (AgNPs) appear purplish in colour in aqueous medium as a result of surface Plasmon vibrations [5]. Silver nitrate added to aqueous solution, the colour of the solution changed from dark purple to yellowish brown to reddish brown and lastly to colloidal brown revealing AgNP synthesis. Similar changes in colour have also been observed in earliest studies and hence verified the finalization of reaction in leaf extract and$AgNO_3$ [6].

FT-IR Analysis: FT-IR spectroscopy was employed to elucidate the primary biomolecules within the aqueous extract of *T. zebrina* leaves, which facilitated the reduction of Ag+ ions to elemental silver (Ag0), culminating in the formation of silver nanoparticles (AgNPs). The Ag. NPs, FT-IR spectrum is presented in Fig.9. Showed peaks at 575 cm^{-1} and 2890 cm^{-1}: Attributed to N-H stretching vibrations indicative of aliphatic primary amines. The prominent peaks in FTIR spectrum were observed 2345 cm^{-1} shown with O-H stretching vibrations, typical of alcohols (phenolic compounds) in the aqueous extract. The peak of 2924.09 cm^{-1} potentially corresponds to O-H stretching vibrations from carboxylic acids or alcohols, N-H stretching from amine salts, or C-H stretching from alkanes. Peaks observed 1601 cm^{-1} ascribed to C=O stretching vibrations from aldehydes, esters, aliphatic ketones, or carboxylic acids may also represent C-H bending vibrations from aromatic compounds, C=C stretching in conjugated or cyclic alkenes, and N-H bending from amines. The range of pic in 1384.89 cm^{-1} characterized by C-H bending vibrations from alkanes or aldehydes, O-H bending from alcohols or phenols, and C-F stretching vibrations from fluoro compounds. Peak obtained in 1216 cm^{-1}: Indicative of C-N stretching vibrations from amines or C-O stretching from primary alcohols. Formation of peak at 1138 cm^{-1} C-N stretching vibrations from amines. The obtained pic in range of 891, 759, 683 cm^{-1}: attributed to C-Cl, C-Br, and C-I stretching vibrations from halo compounds, as well as C=C bending vibrations from alkenes and C-H bending from substituted compounds. After synthesis of Ag. NPs showing the contribution of these groups (OH−, C=O, and C-H, respectively) in the synthesis of Ag. NPs[7].Our findings are similar with previous study of green synthesis of silver nanoparticles in *Argyria nervosa* [8] and *Zingiber officinale* [9].

Scanning Electron Microscopy (SEM) EDAX: Silver nanoparticle was synthesized from a leaf extract using such as *Tradescantia zebrina*. The colour transformed from dark purple to darker brown when *Tradescantia zebrina* leaf extract was introduced droplet manner to the silver nitrate mixture, indicating Ag NPs formation. The morphological nature of AgNPs is examined by employing SEM, it shows rod-like structure, spherical with some agglomeration where an average particle shape was 24, 41 and 49nm respectively. The particle size, morphological, and crystalline were examined by employing SEM and Particle size analyser [10]. SEM was revealed to describe the morphology of the synthesized AgNPs.SEM analysis showed the spherical shape and average size range 41nm, though the size of few particles was either large or very small **Fig. 7**. Morphology of AgNPs depend upon the association of organic compounds.

The EDAX spectra obtained from the silver nanoparticles are revealed inset (Fig8).The EDAX profile shows a strong silver NPs signal along with weak oxygen, chlorine, zinc and copper peaks, which might be developed from the biomolecules bound to the surface of the silver nanoparticles. The formation of copper peaks may bedue to the same being present in the grids. It has been showed that nanoparticles synthesized using plant extracts are encompassed by a thin layer of some cappingorganic material from the plant leaf broth and are, thus, stable in solution up to 4 weeks after synthesis [11]. This is significance of nanoparticles extracted using plant extracts instead of synthesized using chemical methods.

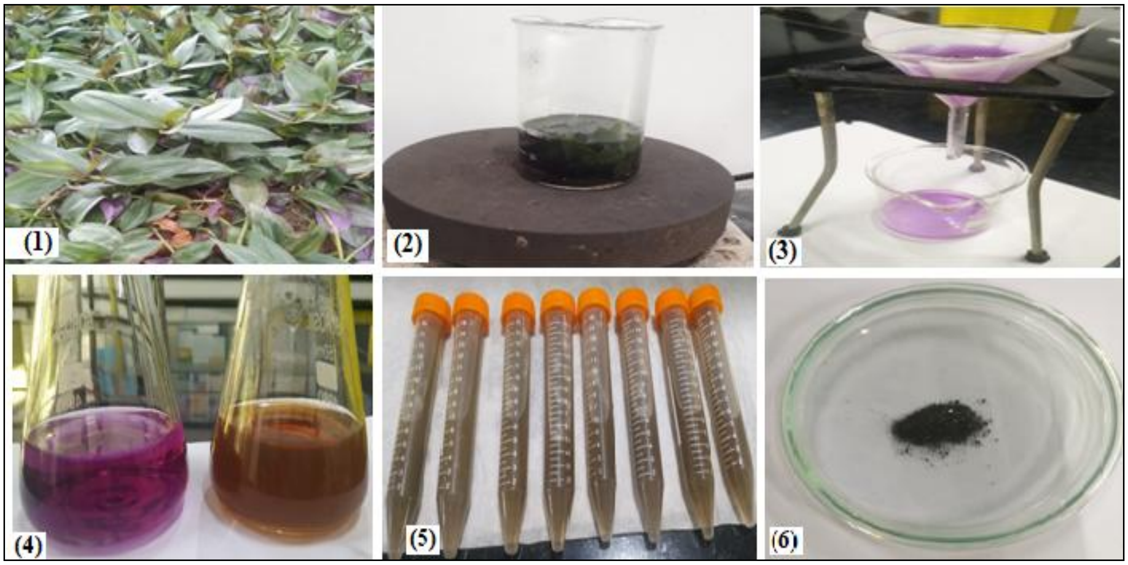

FIG. 1-6: REPRESENTATIVE IMAGES OF 1) *TRADESCANTIA ZEBRINE* PLANT 2) PLANT AQUEOUS EXTRACT 3) AQUEOUS EXTRACT FILTERED BY WHATMAN FILTER PAPER NO.1. 4) *T. ZEBRINA* AQUEOUS EXTRACT BEFORE (PURPLE COLOR) AND AFTER (BROWN COLOR) DILUTION OF AGNPS. 5) CENTRIFUGATION OF FILTERED EXTRACT. 6) FORMATION OF AGNPS.

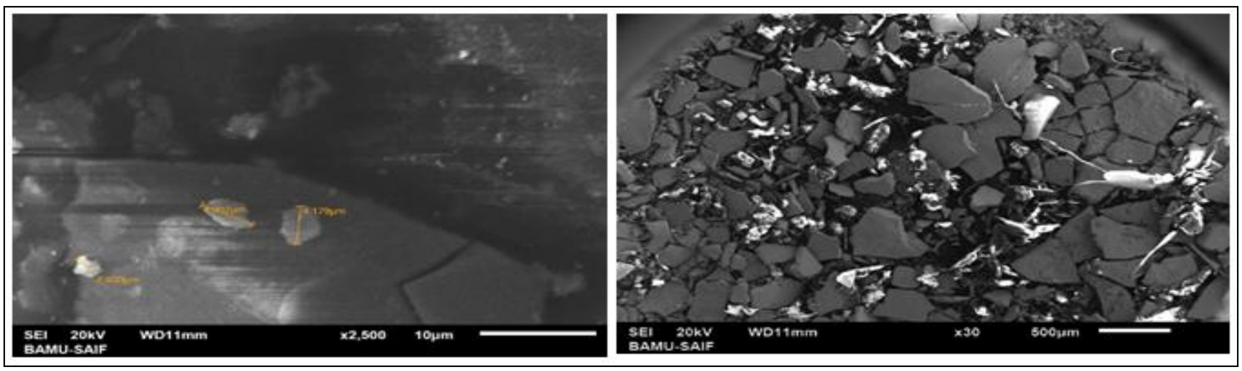

FIG. 7: FIELD EMISSION SCANNING ELECTRON MICROSCOPY (SEM) OF AGNPS AT MAGNIFICATION OF 2,500 X

TABLE 1: EDAX SPECTRA OF SYNTHESIZED AGNPS

Element	Weight%	Atomic%
O K	23.07	59.30
Cl K	13.91	16.13
Cu K	1.00	0.65
Zn K	1.13	0.71
Ag L	60.89	
Total		100.00

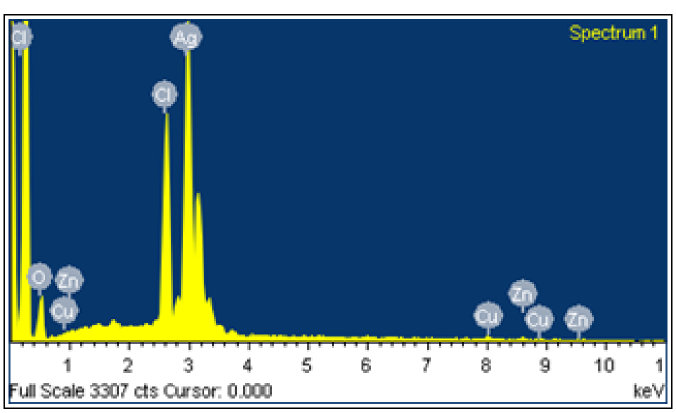

FIG. 8: EDAX SPECTRA OF SYNTHESIZED AGNPS

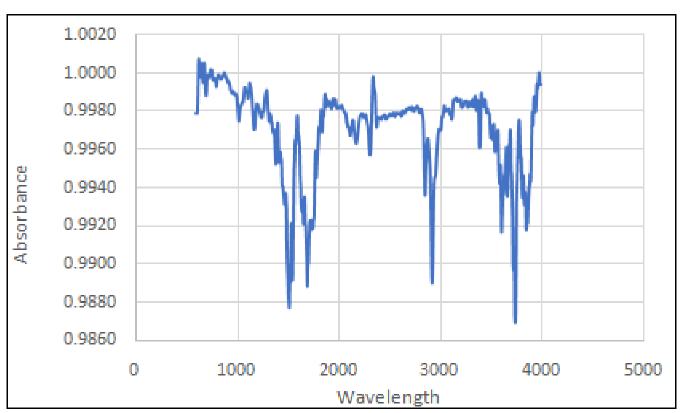

FIG. 9: FTIR SPECTRUM OF AG NPS FROM TRADESCANTIAZEBRINA EXTRACT

CONCLUSION: The AgNPs are successfully biosynthesized in a simple, efficient, rapid, and eco-friendly manner. The ornamental *T. zebrina*. were used as a stabilizing and reducing agent in the synthesis of AgNPs, instead of the usage of hazardous wastes and toxic solvents. The synthesized nanoparticles are spherical within range of particle size of 24 nm to49 nm as shown by SEM analysis. The EDAX pattern confirmed the crystalline nature of AgNPs. No chemical reagent is required in the process, which consequently established the bioprocess with the advantage of being environmentally friendly since, plant based natural substances is a source of non-toxic reducing and stabilizing agents, green synthesis of silver nanoparticles could be considered as a safe and most significant method.

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CONFLICTS OF INTERESTS: The authors declare that there is no conflict of interests regarding the publication of this paper.

REFERENCES:

1. Sarwer Q, Amjad MS, Mehmood A, Binish Z, Mustafa G, Farooq A & Pérez de la Lastra JM: Green synthesis and characterization of silver nanoparticles using Myrsine africana leaf extract for their antibacterial, antioxidant and phytotoxic activities. Molecules 2022; 27(21): 7612.
2. Vishwanath R & Negi B: Conventional and green methods of synthesis of silver nanoparticles and their antimicrobial properties. Current Research in Green and Sustainable Chemistry 2021; 4: 100205.
3. Bamal D, Singh A, Chaudhary G, Kumar M, Singh M, Rani N & Sehrawat AR: Silver nanoparticles biosynthesis, characterization, antimicrobial activities, applications, cytotoxicity and safety issues: An updated review. Nanomaterials 2021; 11(8): 2086.
4. Ramos-Arcos SA, López-Martínez S, Velázquez-Martínez JR, Gómez-Aguirre YA, Cabañas-García E, Morales-Bautista CM & Hernandez-Gallegos MA: Phytochemicals and Bioactivities of *Tradescantia zebrina* Bosse: A Southern Mexican Species with Medicinal Properties. J of Food and Nutrition Research 2021; 11(9): 564-572.
5. Alharbi NS & Alsubhi NS: Green synthesis and anticancer activity of silver nanoparticles prepared using fruit extract of *Azadirachta indica*. Journal of Radiation Research and Applied Sciences 2022; 15(3): 335-345.
6. Naaz R, Siddiqui VU, Ahmad A, Qadir SU & Siddiqi WA: Study of antibacterial and antioxidant activities of silver nanoparticles synthesized from *Tradescantia pallida* (purpurea) leaves extract. Journal of Dispersion Science and Technology 2023; 45(5): 990–1000.
7. Nikaeen G, Yousefinejad S, Rahmdel S, Samari F & Mahdavinia S: Central composite design for optimizing the biosynthesis of silver nanoparticles using Plantago major extract and investigating antibacterial, antifungal and antioxidant activity. Sci Rep 2020; 10: 1–16.
8. Sapkal KR, Patil VS and RR: Green synthesis of silvernanoparticles using the leaf extract of *Argyria nervosa* and antimicrobial studies. IJPSR 2024; 15(5): 1400-1404.
9. Chondhe AB, Sapkal KR and Taur RR: Ginger (*Zingiber officinale*) extract mediated green synthesis of silver nanoparticles and evaluation of their antimicrobial activity. Int J Pharm Sci Rev Res 2024; 84(6): 5-10.
10. Naaz R, Siddiqui VU, Ahmad A, Qadir SU & Siddiqi WA: Study of antibacterial and antioxidant activities of silver nanoparticles synthesized from *Tradescantia pallida* (purpurea) leaves extract. Journal of Dispersion Science and Technology 2024; 45(5): 990-1000.
11. Vinodhini S, Vithiya BSM & Prasad TAA: Green synthesis of silver nanoparticles by employing the *Allium fistulosum, Taberna montana* divaricates and *Basella alba* leaf extracts for antimicrobial applications. Journal of King Saud University-Science 2022; 34(4): 101939.

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