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Evaluation and Formulation of Silver Nanoparticles by using Cathoranthus Roseus Plants

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Abstract: *Silver nanoparticles (AgNPs) have gained significant attention in the field of nanotechnology due to their remarkable biological and pharmaceutical applications. The present study focuses on the green synthesis, formulation, and evaluation of silver nanoparticles using leaf extract of Catharanthus roseus as a reducing and stabilizing agent. Plant-mediated synthesis of nanoparticles is considered eco-friendly, cost-effective, and safer compared to conventional chemical methods. In this study, aqueous leaf extract of Catharanthus roseus was mixed with silver nitrate solution for the synthesis of silver nanoparticles, which was confirmed by a visible color change from pale yellow to dark brown. The synthesized nanoparticles were evaluated using various characterization techniques such as UV-Visible spectroscopy, particle size analysis, zeta potential, and morphological examination. The formulation showed satisfactory stability, uniform particle size distribution, and good physicochemical properties. Furthermore, the synthesized silver nanoparticles demonstrated promising antimicrobial and antioxidant activities, indicating their potential application in pharmaceutical and wound-healing formulations. The study concludes that Catharanthus roseus-mediated silver nanoparticles can serve as an effective and sustainable approach for developing novel therapeutic formulations*

Keywords: Silver nanoparticles (AgNPs) Green synthesis, Catharanthus roseus Herbal nanoparticles Plant-mediated synthesis, Nanotechnology, Characterization, etc

I. INTRODUCTION

Nanotechnology is an emerging field of science that involves the synthesis and application of materials at the nanoscale level, typically ranging from 1 to 100 nm. Among various nanomaterials, silver nanoparticles (AgNPs) have gained significant attention due to their remarkable physicochemical and biological properties such as antimicrobial, antioxidant, anti-inflammatory, anticancer, and wound healing activities. Because of these unique properties, silver nanoparticles are widely used in biomedical, pharmaceutical, cosmetic, and environmental applications [1].

Conventional methods for the synthesis of silver nanoparticles mainly involve physical and chemical techniques. However, these methods are often expensive, energy-consuming, and may produce toxic by-products that can harm the environment and human health. Therefore, green synthesis of silver nanoparticles using plant extracts has emerged as an eco-friendly, cost-effective, and sustainable alternative. Plant-mediated synthesis utilizes naturally occurring phytochemicals such as flavonoids, alkaloids, terpenoids, phenolic compounds, and proteins, which act as reducing and stabilizing agents during nanoparticle formation [2].

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Fig 1: Silver Nanoparticles

Catharanthus roseus, commonly known as Madagascar periwinkle, is an important medicinal plant belonging to the family Apocynaceae. The plant is rich in bioactive constituents including alkaloids such as vincristine and vinblastine, flavonoids, tannins, and phenolic compounds. It possesses several pharmacological activities including antimicrobial, antioxidant, antidiabetic, anticancer, and wound healing properties. Due to the presence of these phytochemicals, Catharanthus roseus is considered a suitable candidate for the green synthesis of silver nanoparticles.[3].

Catharanthus vinca, a member of the Apocynaceae family, is a medicinal herb that is grown in many tropical nations like Vietnam, India, Indonesia, Philippines, Africa, Australia, Brazil, etc. In Europe and America in hot regions, it is also grown year-round, but plants are grown seasonally in cold areas because they do not tolerate cold. [1]

The present research focuses on the formulation and evaluation of silver nanoparticles synthesized using Catharanthus roseus plant extract. The synthesized nanoparticles are evaluated for their physicochemical characteristics such as color change, particle size, shape, surface morphology, UV-visible spectroscopy, and stability. The study aims to develop an environmentally friendly method for nanoparticle synthesis and to explore the potential biomedical applications of the prepared silver nanoparticles [4]..

The leaves are used traditionally in various regions of the world including India, West Indies as well as Nigeria to control diabetes [5]. The leaves have been knowntocontain 150 useful alkaloids among other pharma cologically active compounds. Significant antihyperglycemic and hypotensive activity of the leaf extracts (hydroalcoholic or dichloromethane-methanol) have been reported in lab oratory animals [6].

Many popular names for Catharanthus roseus include vinca roseus, rose periwinkle myrtle, sparkling eyes, cape periwinkle, graveyard plant, old maid, pink periwinkle, and rose periwinkle. It has various colours, including pink, purple, and white, and is utilized as a decorative as well as a therapeutic plant [7].

PLANT PROFILE:

Catharanthus is a perennial tropical medicinal plant belonging to the Family Apocynaceae which comprises eight species, seven endemic to Madagascar (C. coriaceus, C. lanceus, C. longifolius, C. ovalis, C. roseus, C. scitulus, C. trichophyllus), and one, C. pusillus, from India. Specifically, C. roseus is a decorative and curing plant of enormous pharmaceutical interest because it is nothing less than a chemical factory, producing more than 130 different terpenoid indole alkaloids (TIAs), some of which exhibit strong and important pharmacological activities . Vinca alkaloids are a subset of drugs obtained from the Madagascar periwinkle plant.[8]

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Fig 2: Catharanthus roseus

SCIENTIFIC CLASSIFICATION OF VINCA PLANT

- Botanical Name(s): Vinca Rosea (Catharanthus roseus)
- Family Name: Apocynaceae
- Kingdom: Plantae
- Division: Magnoliophyta (Flowering plants)
- Class: Magnoliopsida (Dicotyledons)
- Order: Gentianales
- Family: Apocynaceae

MATERIAL & METHODS:

Collection of Plant:

Plant Material The basic plant material of V. rosea Linn whole plant used for the investigation The plant can be identified, authenticated by department of Botanical Survey of India.

The whole plants were collected and kept for shadow dry. The shade-dried whole plants were subjected to pulverization to get coarse powder. The coarsely powder whole plant (500mg) of V. rosea

Fig 3: Catharanthus roseus leaves

Preparation Of Crude Extract:- Using Maceration Process:

Take 250 gm of dried leaves powdered was introduced into a beaker containing 500 ml water

And stand for 7 days with twice a day stirring. To calculate the amount of dry matter in the aqueous extract, the C. roseus aqueous extract earlier prepared as above (100ml) of the filtrate was evaporated on water bath (30ºC) over 24 hours, and 22.67g of dry extract was Zobtained.

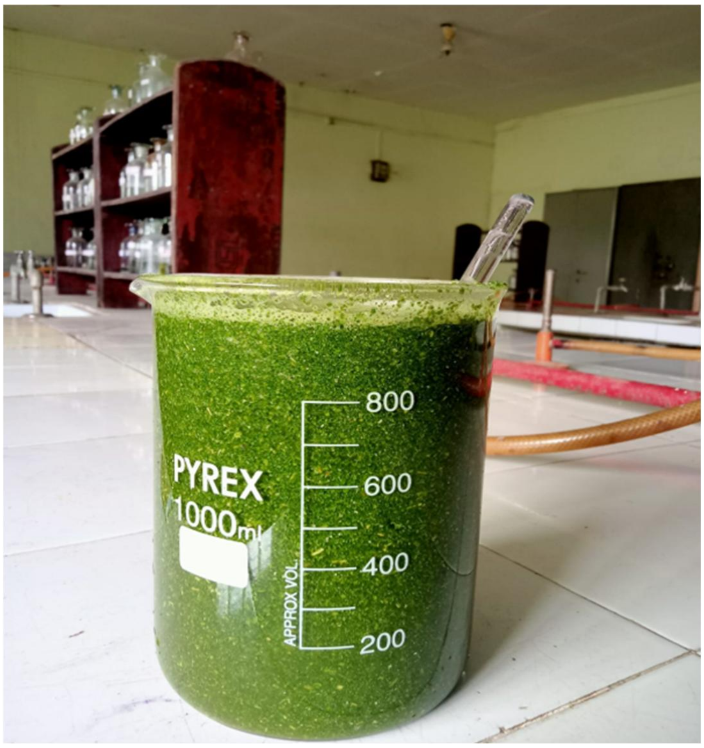

Fig 4: Maceration Process

Screening method-

Test for Saponin:

A drop of Na_2CO_3 solution was added to 5ml of extract in a test tube. After vigorous shaking, it was left to rest for five minutes. Foam formation indicated the presence of saponin.

Test for Alkaloids:

Mayer's Tests:

Mayer's reagent is an alkaloidal precipitating reagent used for the detection of alkaloids in natural products. Mayer's reagent is freshly prepared by dissolving a mixture of mercuric chloride (1.36g) and of potassium iodide (5.00g) in water (100ml). 3ml of extract was taken in a test tube. Few drops of Mayers reagent were added along sides of test tube. Gives creamy precipitate.

Picric acid Test:

Picric acid test is carried out by using Hager's reagent. Hager's reagent is prepared by adding 1g of picric acid in 100ml of distilled water. 3ml of extract was taken in a test tube. Few drops of Hager's reagent were added along sides of test tube. It gives yellow precipitate.

Wagner Test:

Alkaloid sample reacts with Wagner reagent (Iodine – Potassium – Iodine Solution) which gives brown colour precipitate which indicates the presence of alkaloids. Iodine 1.3g, potassium iodide 2.0g and water to make 100ml

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Preparation of Nanoparticles-

Synthesis of silver nano particle: 5 mg of 278atharanthus roseus aqueous extract was taken in a beaker and paced on a magnetic stirrer with hot plate. Then this 50 ml of 1 mM silver nitrate solution was added drop wise with constant stirring at 120 rpm. The colour change of the solution was checked periodically.

Separation of silver nano particle:

The nano particle were separated by centrifugation using REMI centrifuge at 500 rpm for 15 minute. Then pellets were collected and store.

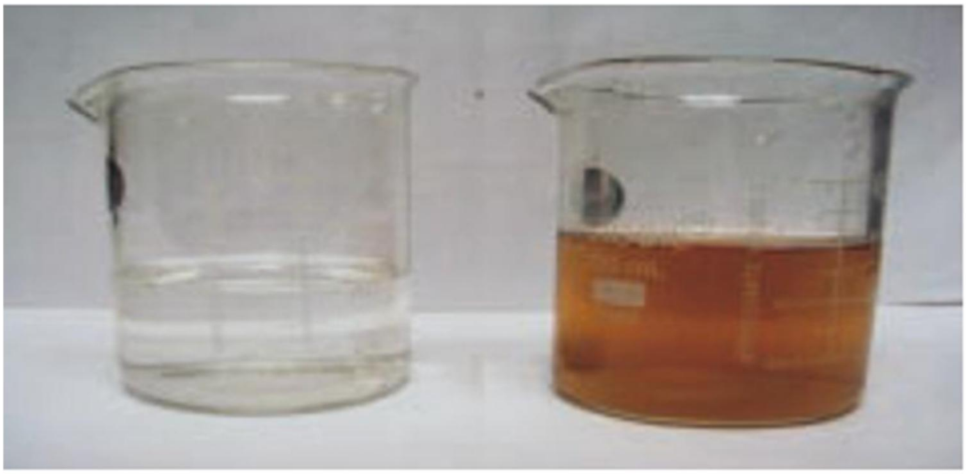

Fig 5: Preparation of silver nano particle

Evaluation test for nanoparticles-

Visualization analysis:

Visualization test means observing the size, shape, and structure of nanoparticles using advanced microscopes. It confirms that silver nanoparticles (AgNPs) are properly formed. which are usually spherical and 10-100 nm in size. Visualization analysis in the green synthesis of nanoparticles refers to the systematic interpretation of the images and graphical spectra gathered during characterization. Researchers look at specific visual cues, peaks, and shapes on these charts to evaluate if the process worked and to measure the properties of the resulting materials.[11]

UV-visible spectroscopy analysis:

The change in color of the reaction mixture was recorded by visual observation. The reduction of silver nitrate to silver nanoparticles was analyzed by measuring UV-vis spectra of the solution. The absorption spectrum of the sample was taken in the range of 300-500 nm using Thermo scientific UV-vis spectrophotometer UV-Visible Spectroscopy (UV-Vis) is the most critical visual tool used in the green synthesis of nanoparticles. It serves as the primary "optical fingerprint" to prove that metal ions have successfully transformed into solid nanomaterials. [12]

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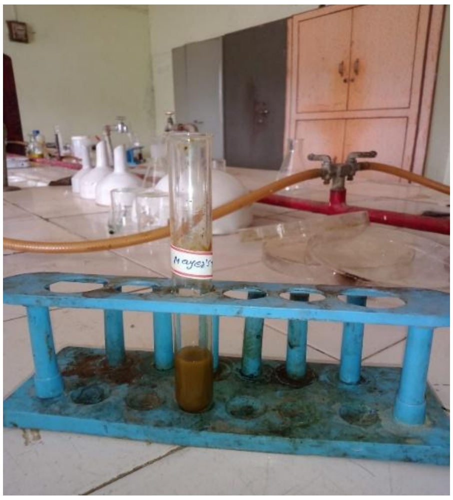
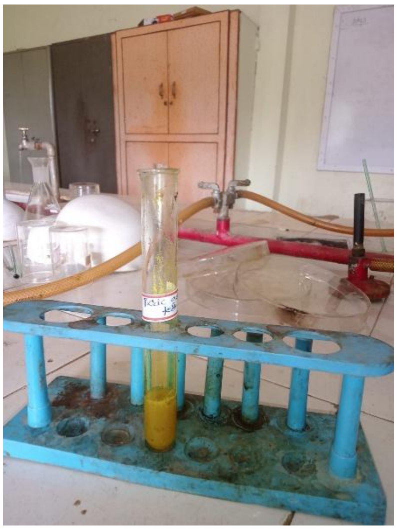
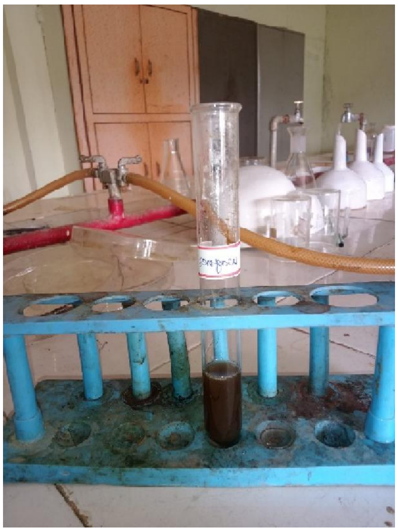
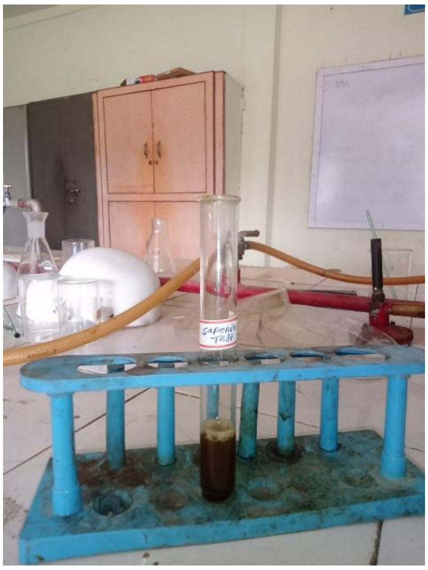
II. RESULTS

Sr. No	Identification test	observation	Inference
1. (a)	Test for alkaloids Mayer's test	 it gives creamy precipitate	It shows the presence of alkaloids
(b)	Picric acid test	 it gives yellow precipitate	Slight amount of alkaloid is present

(c)	Wagner test	 it gives your brown colour precipitate	Alkaloids is present
2.	Test of saponin	 foam formation	Slight amount of alkaloid is present

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2) Result of nanoparticles

Visualization analysis-

PARAMETERS	RESULT
Particle size	1nm
Shape of nanoparticles	Spherical
Visual Inspection	Dark brown colored particles
PH	8

UV-visible spectrophotometric analysis -

By employing UV-visible spectrophotometer analysis, the stability of CELFeNPs iron oxide nanoparticles produced in an aqueous solution were verified and characterized. The size, shape, and chemical makeup of the generated FeNPs determine the formation of absorption bands and is caused by stimulation of surface plasmon vibration, which leads to aggregation. The wavelength range for the greatest UV Vis absorption spectra was 10–100 nm and CELFeNPs showed a characteristic absorbance at a spectral range of 336nm.[13]

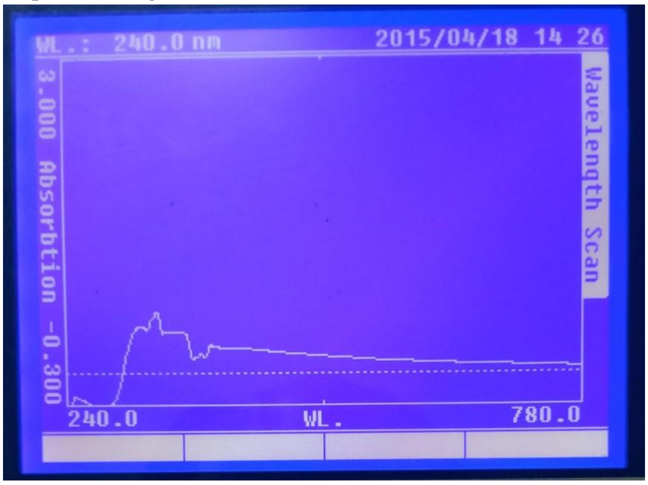

Fig 6: UV-Vis spectra of CELFeNPs

DISCUSSION

The present study successfully demonstrates the green synthesis of silver nanoparticles using Catharanthus roseus leaf extract. The observed color change from pale yellow to dark brown confirms the reduction of silver ions (Ag^+) into silver nanoparticles (Ag^0), which is a typical indication of nanoparticle formation due to surface plasmon resonance.

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The UV–Visible spectroscopy results showing an absorption peak around 336.0 nm are consistent with earlier findings reported by Shamsuddin Ahmed et al. (2016), confirming the formation and stability of silver nanoparticles. The peak sharpness suggests that the nanoparticles are well-dispersed and stable in solution.

Additionally, the antioxidant activity observed in this study indicates that the nanoparticles possess free radical scavenging ability, which may be due to the presence of bioactive compounds from the plant extract. This enhances their potential use in therapeutic and pharmaceutical applications.

Overall, the results confirm that Catharanthus roseus is an effective biological source for the synthesis of stable and biologically active silver nanoparticles. The green synthesis approach used in this study is simple, cost-effective, and environmentally friendly, making it suitable for future large-scale production and applications in medicine and environmental fields.

III. CONCLUSION

The present study concludes that Catharanthus roseus is an effective and reliable source for the green synthesis of silver nanoparticles. The successful formation of nanoparticles was confirmed through visual observation, UV–Visible spectroscopy, and other characterization techniques, indicating stable and crystalline nanoparticles within the nanoscale range.

This study demonstrates that green synthesis is a simple, cost-effective, and environmentally friendly method compared to conventional techniques. Therefore, plant-mediated silver nanoparticles can be considered a promising alternative for future research and large-scale applications in medicine, drug delivery, and environmental protection.

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