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Green Synthesis of Silver Nanoparticles Using Tulsi (Ocimum Sanctum) and Alo vera Leaf Extract and its Characterization

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Abstract: *Nanotechnology, the exact creation of nanoparticles, has tremendous potential for the health of people due to its abilities to modify particles in terms of size, shape, chemical composition, and dispersity. Nanotechnology utilizes the creation, study, and manipulation of matter at the nano scale, generally between 1-100 nm, generating entities known as nanoparticles. Notably, researchers are concentrating on the burgeoning subject of green nanotechnology, which emphasizes environmentally benign techniques to nanoparticle manufacture. This paradigm shift intends to leverage the potential of natural sources for sustainable nanoparticle production, such as bacteria, fungus, and plants. The advancement of green nanotechnology illustrates the rising dedication of the nanoscience community to ecologically friendly practices. Environmentally sustainable customs, especially in the area of eco-friendly nanoparticle biosynthesis, have drawn the attention of researchers who are drawn to the rapidly evolving field of green nanotechnology. The use of biomolecules comprised of plant extracts for a one-step green manufacturing process that safely reduces metal ions to nanoparticles is one noteworthy method. Tulsi (Ocimum sanctum L.), a fragrant plant in the Lamiaceae family that has been used traditionally in Indian medicine, is the subject of this study's exploration of its potential. Tulsi is a strong option for the green production of nanoparticles because of its extensive range of stabilizing and bio-reduction agents. By highlighting both effectiveness and sustainability, this study advances the larger goal of creating environmentally conscious methods for the manufacture of nanoparticles.*

Keywords: Nanotechnology

I. INTRODUCTION

Development, investigation, and manipulation of materials at the nanoscale, or in the size range of 1-100 nm, which is sometimes referred to as nanoparticles, are the topics of nanotechnology (3). As a cutting-edge technology with an infinite capacity to revolutionizes a wide range of industries, nanotechnology is at the forefront of current studies (1). Because of its flexibility, it has been widely used across a range of scientific fields, signaling breakthroughs that were previously thought to be impossible.(3) The increasing interest in the therapeutic field is especially noteworthy, as nanotechnology is seen as a promising treatment for complicated illnesses including diabetes, cancer, infection, and inflammation.(1) Among the nanomaterials that have been commercialized the most, silver stands out as having an impressive five hundred tons produced annually. This major output demonstrates the demand and broad application of silver nanoparticles in a variety of industries. Because of their exceptional nanoscale properties, which make them highly desirable for a wide range of applications, silver nanoparticles have significant commercial value. (Shakeel Ahmed, 2015). Interestingly, silver nanoparticles' antibacterial abilities have encouraged their use in a wide range of items, especially in the consumer goods and healthcare industries. The volume of silver nanoparticles now produced indicates that they have played a significant role in the development of contemporary technology, and the expectation of more expansion in years to come highlights the versatile nanomaterial's ongoing use and expanding uses. Silver nanoparticles have the potential to maintain their position as a key component of the market for commercialized nanomaterials as long as nanotechnology research and innovation continue. (Shakeel Ahmed, 2015) The biological method of creating nanoparticles is inexpensive, time-, energy-, and safety-efficient. Several techniques are available for the synthesis of silver nanoparticles, each with its unique set of principles and applications. Among these methods, ion sputtering, chemical reduction, and sol-gel processes stand out as prominent approaches.

Ion Sputtering:

By subjecting a target material to a high-energy ion bombardment, atoms are ejected off the target surface using the ion sputtering process. Ion sputtering is a technique that may be used to produce silver nanoparticles from a bulk silver object. It is generally known that this process yields nanoparticles that are reasonably well-defined and uniform.

Chemical Reduction:

One popular technique for creating silver nanoparticles is chemical reduction. It entails employing chemical agents to reduce silver ions to metallic silver. Hydrazine and sodium borohydride are typical reducing agents. This approach is flexible, economical, and gives you control over the shape and size of the nanoparticles. It is widely used in industrial and laboratory settings.

Sol-Gel Process:

A solution-based methodology for creating nanoparticles is the sol-gel process. Controlled chemical reactions translate a sol, or colloidal suspension of nanoparticles, into a gel in the case of silver nanoparticles. To extract the required silver nanoparticles, the gel is subsequently processed. The tunable particle size and complex nanostructure creation possibilities of the sol-gel method are among its benefits. Each of these methods offers advantages and the choice of which to use depends on the particular needs of the intended use. The final silver nanoparticles' size, shape, and dispersity can all be affected by the synthesis procedure used. Scientists and industry professionals frequently select the best approach depending on aspects including cost, scalability, and the required properties of the nanoparticles for a particular use.

Methods of Preparation of Nanoparticle:

A] Polymerization

Emulsion Method

Interfacial Method

B] Polymers

Solvent evaporation method

Solvent displacement method

Saline Out Method

C] Ionic Gelation Method

D] Super Critical Fluid Technique

Advantages of Nanoparticles:

- Nanoparticle drug carriers have higher stabilities.
- Nanoparticles have higher carrier capacity.
- Nanoparticles can be administrated by
- parenteral, oral, nasal(or) ocular routes
- Nanoparticles are biodegradable, Non-toxic and capable of being stored for longer periods
- Ability to sustained & controlled release dosage form
- Site specific delivery of drug

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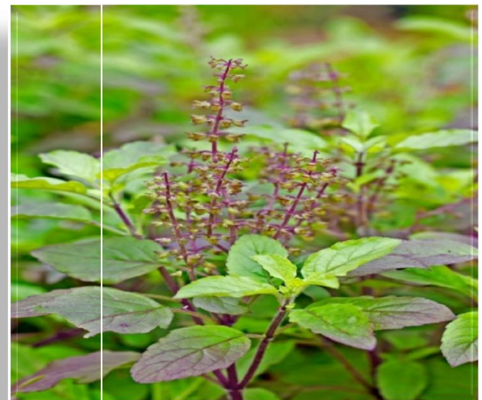
- Nanoparticles reduces dosing frequency
- Nanoparticles helps to achieve maximum therapeutic response with minimum adverse effects

II. PLANT PROFILE

Tulsi



Synonyms: Sacred Basil, Holy Basil, Ocimum sanctum.
Biological source: Tulsi consists of Fresh & dried leaves of plant Ocimum sanctum Linn. (Syn.Ocimumtenuiflorum), belonging to family Lamiaceae.
Chemical constituents: Alkaloid, glycoside, saponin, tannins, vitamin C and tartaric acid. It should contain not less than 0.40% of eugenol calculated on dry basis.
Colour: Fresh & dried leaves are green in colour.
Odour: Aromatic
Taste: Pungent
Height: Herb grows up to the height of 30-75 cm
Uses: Expectorant, Bronchitis, Stomachic Carminative, Stimulant, Flavouring agent, Refrigerant and febrifuge. Antifertility agent. Diaphoretic property Spasmolytic, property, Antibacterial Insecticide, Antiprotozoal.

Alovera

Synonyms: Aloe
Biological source: aloe is obtained from the dried juice of the leaves of aloe barbadensis miller, which belongs to the family: Liliaceae .

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Chemical constituents: alongside A, alongside B, capaloresinotannol with P- coumaric acid, resin of curacao variety barbaloresino- tannol

Organoleptic/Morphological characters:

Colour: dark brown to greenish brown

Odour: characteristic, sour

Taste: bitter and unpleasant.

Uses: Purgative, laxative, used for ulcer and in burns

III. MATERIAL AND METHOD

Extraction Method

Collection and Preparation of Tulsi (Ocimum sanctum) leaf extract and Alo vera Extract:

All the chemical reagents used in this experiment were of analytical grade purchased from Loba chemicals. The Ocimum sanctum leaves were collected from in and around Junnar, Pune Maharashtra, India. Thoroughly washed leaves were cut and boiled with 100 ml of de-ionized water for 15 min in heating mental at temperature 80°C & filtered in Whatman filter paper no.1 and stored in refrigerator at 4°C experiments.

Figure -Boiling of tulsi leaves & Alo Vera in heating metal.

Figure -Filtration of tulsi leaves and Alo Vera extract

Synthesis Of Silver Nanoparticles

For the synthesis of silver nanoparticles (Ag NPs) 25 ml of Ocimum sanctum leaf extract and aloe juice

↓

added in a 1mM Ag ions was prepared by dissolving 0.017g of AgNo3 in 100 ml deionizes water with continuous stirring

↓

After complete addition of leaf extract, the mixture was kept for incubation for 24 hrs

↓

At particular time, the colour of the solution changes from light green to dark green

↓

indicates the formation of silver nanoparticles

↓

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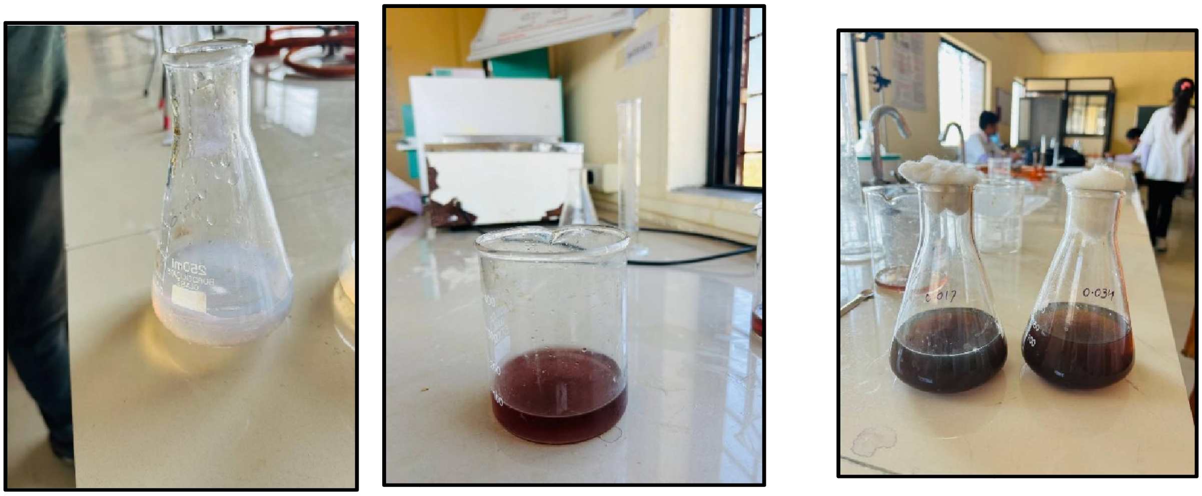
Then the solution was centrifuged at 6000 rpm for 30 min followed by re-dispersion of the pel-let in deionized water to remove any unwanted biological materials

↓

Biosynthesis of nanoparticles



(A) (B) (C)

Figure: Biosynthesis of Silver nanoparticles. (A) Silver Nitrate , (B) Leaf extract (C) Synthesized Silver Nanoparticles.

Table 1: Color change during biosynthesis of Silver nanoparticles

Sr.No.	Solution	Before reduction	After reduction
1.	Ocimum sanctum leaf extract and Alo vera Extract	Brown colour	Green colour
2.	Silver Nitrate	Blue colour	Green colour

IV. EXTRACTION OF THE SYNTHESIZED NANOPARTICLES

The synthesized nano particles are collected by the Process of the centrifugation. In which the synthesized Particles Are filled in the micro centrifuge tubes and spined at the speed of 6000rpm for 3-5 min duration. After that the Silver nano particles get Accumulate at the bottom of the tube that are visible by the naked eye that accumulated particle are dried thoroughly under the IR light or shade dry process. this process can take about the 2-3 days. after this process the collection of the nano particles at one place is done. after that they are converted into nanoparticles.

Fig-Synthesized nanoparticles

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UV- Visible Spectroscopy analysis:

Figure: UV- absorption spectra of –The Mixture of Tulsi and Alo Vera Extract

It is generally recognized that UV- Visible spectroscopy could be used to examine the size and shape-controlled nanoparticles in aqueous suspensions. Absorption spectra of silver nanoparticles formed in the reaction media has absorbance's peak ranges between 300-800 nm. The absorbance peak of silver nanoparticles found to be at 485 nm.

FTIR Of Silver Nanoparticle

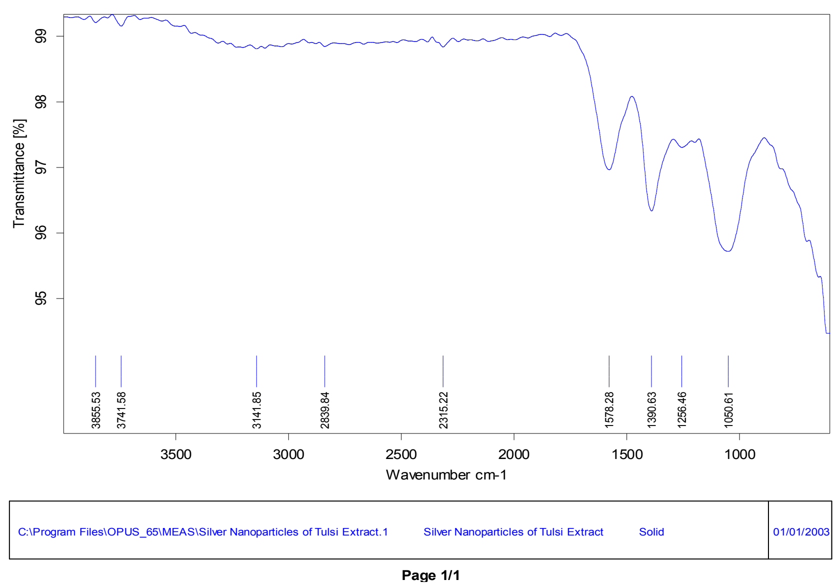

Fig . – FTIR absorption spectra of – Tulsi Extract

Table–- FTIR absorption spectra of – Tulsi Extract

Sr.No.	ReadingPeaks	Bond	FunctionalGroupsPresents
	3855.53 cm^{-1}	O-H	Alcohol
	3741.58cm^{-1}	O-H	Alcohol
	3141.85cm^{-1}	O-H stretch	Alcohol, Carboxylic acid
	2839.84cm^{-1}	C-H stretch	Aldehyde
	2315.22cm^{-1}	C≡N	Nitrile
	1578.28cm^{-1}	C=C	Alkene,Benzene ring
	1390.63cm^{-1}	C-H,No_2	Methine group ,Nitro group
	1256.46cm^{-1}	C-O	Carbonyl group

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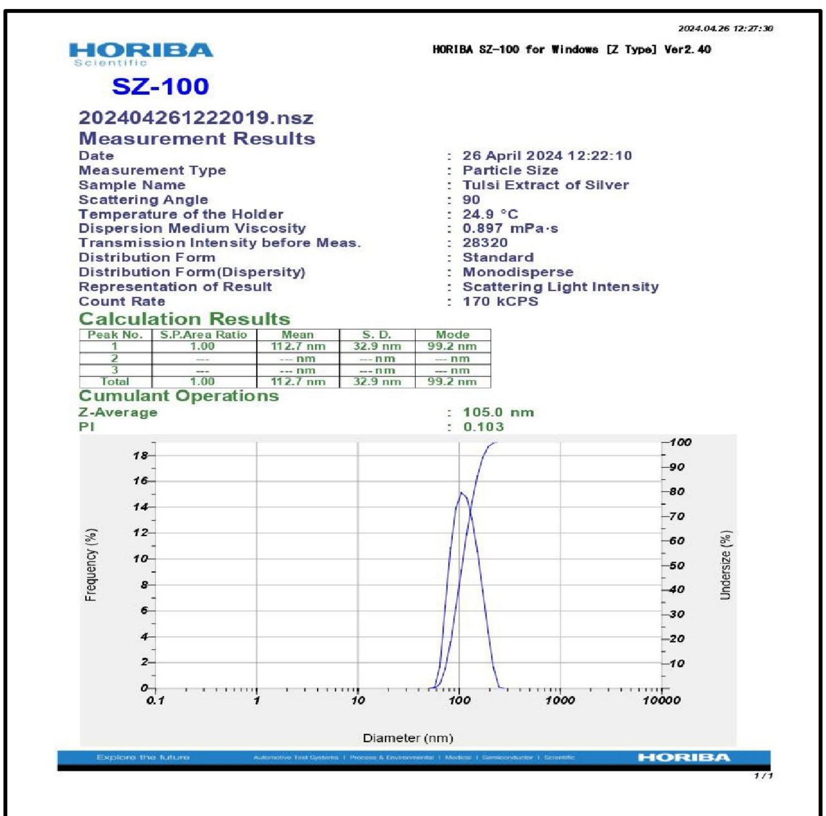
Antimicrobial activity of silver nanoparticle

AgNO3 with larger surface area provide a better contact with microorganisms Thus, these particles are capable to penetrate the cell membrane or attach to the bacterial surface based on their size. In addition, they were reported to be highly toxic to the bacterial strains and their antibacterial efficiency is increased by lowering the particle size. Many arguments have been given to explain the mechanism of growth inhibition of microbes by AgNO3.The free radical generation is quite obvious because in a living system they can attack membrane lipids followed by their dissociation, damage and eventually inhibiting the growth of these microbes.

Fig-Antimicrobial activity

Result-



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Measurement Results

Date : 26 April 2024 12:22:10
Measurement Type : Particle Size
Sample Name : Tulsi Extract of Silver
Scattering Angle : 90
Temperature of the Holder : 24.9 °C
Dispersion Medium Viscosity : 0.897 mPa·s
Transmission Intensity before Meas. : 28320
Distribution Form : Standard
Distribution Form(Dispersity) : Monodisperse
Representation of Result : Scattering Light Intensity
Count Rate : 170 kCPS

Calculation Results

Peak No.	S.P.Area Ratio	Mean	S. D.	Mode
1	1.00	112.7 nm	32.9 nm	99.2 nm
2	---	--- nm	--- nm	--- nm
3	---	--- nm	--- nm	--- nm
Total	1.00	112.7 nm	32.9 nm	99.2 nm

Cumulant Operations

Z-Average : 105.0 nm
PI : 0.103

Particle size Analysis:

V. CONCLUSION

Tulsi leaves + alovera as agricultural waste material was successfully utilized for the consistent and quick synthesis of silver nanoparticles. The biosynthesized silver nanoparticles using Tulsi leaves + alovera were characterized; they are crystalline, uniform, spherical and monodispersed nanoparticles with average particle size of 105. nm. Synthesized silver nanoparticles revealed good antimicrobial activity against the selected pathogenic microorganisms. Moreover, they showed a synergistic effect on the antimicrobial activity of the standard antibiotic levofloxacin against Gram-positive and Gram-negative bacteria under investigation. This green synthesis approach appears to be a cost-effective, non-toxic, ecofriendly alternative to the conventional microbiological, physical and chemical methods, and would be suitable fordeveloping a biological process for large-scale production. These silver nanoparticles maybe used in effluent treatment process for reducing the microbial load. AgNPs acts as Antimicrobial Agent

REFERENCES

[1]. Saranyaadevi, K., Subha, V., Ernest Ravindran, R.S and Renganathan, S (2014) Synthesis and Characterization of silverNanoparticles using Capparis Zeylanica leaf Extract. International Journal of Chemistry, Technology and Research, 6 (10) : 4533 – 4541

[2]. Akpor, O. B and Muchie, M (2010) Remediation of heavy metals in drinking water and water treatment systems: Processes and applications. International Journal of the Physical Sciences, 5 (12) : 1807 - 1817.

[3]. Rajan, M. S., 2004, Nano: The Next Revolution. National Book Trust, India. pp. 15-72.

[4]. Vasudeo Kulkarni, Sampat Suryawanshi and Pramod Kulkarni, (2015) Biosynthesis of silver nanoparticles using aqueous extract of Eucalyptus sp. Plant leaves. Current Science, 109 (2): 255 – 257.

[5]. Monalisa Pattanayak and Nayak,P.L (2013) Green Synthesis and Characterization of Zero Valent Iron Nanoparticles from the Leaf Extract of Azadirachta indica (Neem). World Journal of Nanoscience and Technology, 2 (1) : 06 – 09.

[6]. Javad Karimi and Sasan Mohsenzadeh (2013) Rapid, Green, and Eco-Friendly Biosynthesis of Copper Nanoparticles Using Flower Extract of Aloe Vera. Synthesis and Reactivity in Inorganic, Metal-Organic, and Nano-Metal Chemistry, 45: 895 – 898

[7]. Ipsa Subhankari and Nayak, P.L (2013) Synthesis of copper nanoparticles Using Syzygium aromaticum (Cloves) aqueous extract by using green chemistry. World Journal of Sciences and Technology, 2 (1) : 14 -17

[8]. J. M. Taylor, "New dimensions for manufacturing: a UK strategy for nanotechnology,"Ed., 332 DTIC Document, 2002.

[9]. A.K. Yadav et al.Novel copper resistant and antimicrobial Streptomyces isolated from Bay of Bengal, IndiaJ. Mycol. Med.(2009)