RESEARCH PAPER

FREE RADICAL SCAVENGING ACTIVITY OF SILVER NANOPARTICLES SYNTHESISED USING LAVENDER ANGUSTIFOLIA AND CLITORIA TERNATEA

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ABSTRACT

INTRODUCTION

Nanotechnology is a vigorous research area in the current science field. Silver nanoparticles are used to treat infections in open wounds, chronic ulcers and in textiles, home water purification systems, medical devices, cosmetics, electronics and in medicine. Antioxidants act as radical scavengers, hinder lipid peroxidation and free radical umpired procedure, and they protect the human body from various diseases accredited to the reaction of radicals. Lavender angustifolia, classified in the mint family, is an evergreen shrub native to southern Europe, primarily the Mediterranean region. Lavender essential oil, when diluted with a carrier oil, is commonly used as a relaxant with massage therapy. The flower Clitoria ternatea belongs to family Fabaceae and subfamily Papilionaceae is an herbaceous perennial, is a connective enhancer used in Ayurveda that is also known as Shanka Pushi.

AIM

The aim of the study is to evaluate the free radical scavenging activity of silver nanoparticles synthesised using Lavender angustifolia and Clitoria ternatea.

MATERIALS AND METHODS

DPPH assay was used to test the free radical scavenging activity of biogenic synthesised silver nanoparticles. The percentage of inhibition was determined from the following equation, % inhibition = (Absorbance of control - Absorbance of test sample) / Absorbance of control × 100. Hydroxyl radical scavenging assay and FRAP assay was also done.

RESULTS AND DISCUSSION

The study has resulted that activity of DPPH assay is significantly inhibited by the silver nanoparticle synthesis using Lavender angustifolia and Clitoria ternatea. Further, the synthesised nanoparticles also significantly inhibited H_2O_2 assay.

CONCLUSION

In conclusion, our results demonstrate that the synthesised silver nanoparticles using Lavender Angustifolia and Clitoria ternatea effectively inhibited the DPPH assay and H_2O_2 assay thereby exhibiting as a free radical scavenging agent.

KEYWORDS: Nanotechnology, free radical scavenging, Lavender angustifolia, Clitoria ternatea, Antioxidants, peroxidation.

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INTRODUCTION:

Nanotechnology is a vigorous research area in the current science field. Nanoparticles have dimensions up to 100 nm and revelations of dissimilar properties constructed on their size and morphology(Kannan et al. 2014) . The maximum considered nanoparticles are those made from metal

such as Copper, Gold, Silver and Platinum is the metal of excellence for biological systems and medicine. The metal is synthesised by various biological techniques using plants and fungi (Shukla and Iravani 2018). Nanoparticles can be chemical or biological reduction(Jain et al. 2019). Nanoparticles have considerable application in the field of medicine, mechanical, chemical, electronic, optical, food, agriculture, environment, etc. A number of nanoparticles based therapeutics have been approved clinically for infection, vaccine and renal disease.(Krithiga et al. 2015). Silver nanoparticles are used to treat infections in open wounds, chronic ulcers and in textiles, home water purification systems, medical devices, cosmetics, electronics, household appliances, catalysis, biosensing, imaging, drug delivery, nanodevice fabrication and in medicine(Ingle et al. 2020).

Lavender (*Lavandula angustifolia*), classified in the mint family (Lamiaceae), is an evergreen shrub native to southern Europe, primarily the Mediterranean region. It is commercially cultivated in, among other places, France, Portugal, Poland, Spain, Hungary, the UK, Bulgaria, Australia, China, and the USA](Cavanagh and Wilkinson 2005).The species name angustifolia is Latin for "narrow leaf". Previously, it was known as Lavandula officinalis, referring to its medicinal properties.It is a strongly aromatic shrub growing as high as 1 to 2 metres (3 ft 3 in to 6 ft 7 in) tall. The leaves are evergreen, 2–6 cm (1–2+1⁄2 in) long, and 4–6 mm (3⁄16–1⁄4 in) broad. The flowers are pinkish-purple (lavender-coloured), produced on spikes 2–8 cm (1–3 in) long at the top of slender, leafless stems 10–30 cm (4–12 in) long(Yegorova et al. 2019).lavender is commonly grown as an ornamental plant. It is popular for its colourful flowers, its fragrance, and its ability to survive with low water consumption(Madan et al. 2026). It does not grow well in continuously damp soil and may benefit from increased drainage provided by inorganic mulches such as gravel. It does best in Mediterranean climates similar to its native habitat, characterised by wet winters and dry summers. It is fairly tolerant of low temperatures and is generally considered hardy to USDA zone 5.It tolerates acid soils but favours neutral to alkaline soils, and in some conditions it may be short-lived.The flowers and leaves are used as a herbal medicine in the form of lavender oil or as a herbal tea(de Oliveira et al. 2020).Lavender essential oil, when diluted with a carrier oil, is commonly used as a source relaxant with massage therapy(Brailko et al. 2017).

The flower *Clitoria ternatea* L. (Butterfly pea) belongs to family Fabaceae and subfamily Papilionaceae is an herbaceous perennial, is a connective enhancer used in Ayurveda that is also known as Shanka Pushi. It is native to South - east Asia and broadly dispersed throughout the world, mainly in tropical countries. Almost all the parts have medicinal importance and are used traditionally for the treatment of various ailments(K et al. 2020). It is currently grown as a mixed ornamental, fodder and medicinal plant. The roots, leaves, and stems are all frequently used in Ayurveda, but for slightly different purposes. *Clitoria ternatea* L. is commonly used as a brain tonic in Ayurveda system of traditional Indian herbal medicine to ameliorate intelligence and intensity the memory function(Ponnusamy et al. 2010)

Antioxidants act as radical scavengers, hinder lipid peroxidation and free radical umpired procedure, and they protect the human body from various diseases accredited to the reaction of radicals(Duraisamy et al. 2024). In healthy individuals, the production of free radicals is balanced by the antioxidative defence system(Radwan et al. 2019) . Major sources of naturally stirring antioxidants are whole grains, fruits and vegetables. Plant source food antioxidants like vitamin C, vitamin E, carotenes, phenolic acids, phytate and phytoestrogens have been documented as having the potential to reduce disease risk, Antioxidant based drug(Sharma et al. 2025) preparation are used for the anticipation and treatment of multifaceted diseases like diabetes, Alzheimer's disease, atherosclerosis, stroke and cancer(Jamil and Pa'ee 2018). The study is to estimate the free radical scavenging activity of silver nanoparticles synthesised using lavender angustifolia and clitoria ternatea.

MATERIALS AND METHODS:

1.DPPH METHOD

Antioxidant activity

DPPH assay was used to test the antioxidant activity of biogenic synthesised silver nanoparticles. Diverse concentrations (10µL,20µL,30µL,40µL,50µL) of Lavandula angustifolia and clitoria ternatea extract was mixed with 1 ml of 0.1 mM DPPH in methanol and 450 µl of 50 mM Tris HCl buffer (pH 7.4) and incubated for 30 minutes. Later, the reduction in the quantity of DPPH free radicals was assessed dependent on the absorbance at 517 nm. Ascorbic acid was used as standard. The percentage of inhibition was determined from the following equation,

% inhibition= Absorbance of control- Absorbance of test sample/Absorbance of control × 100

HYDROXYL RADICAL SCAVENGING ASSAY:

All solutions were prepared freshly.1.0mL of the reaction mixture contained 100µL of 28mM of 2-deoxy-2-ribose (dissolved in phosphate buffer,pH 7.4), 500µL solution of various concentrations of the Lavandula angustifolia and clitoria ternatea extract (10µL,20µL,30µL,40µL,50µL) 200µL of 200µM Fecl3 and 1.04mM EDTA (1:1 v/v),100µL H2O2(1.0mM) and 100µL ascorbic

acid(1.0mM).After an incubation period of 1 hour at 37°C the extent of deoxyribose degradation at about 532nm against the blank solution . Vitamin E was used as a positive control.

FRAP ASSAY :

REAGENTS FOR FRAP ASSAY:

a) Acetate buffer 300 mM pH 3.6: Weigh 3.1g sodium acetate trihydrate and add 16 ml of glacial acetic acid and make the volume to 1 L with distilled water. b) TPTZ (2, 4, 6-tripyridyl-s- triazine): (M.W. 312.34), 10 mM in 40 mM HCl (M.W. 36.46). c) FeCl3. 6 H2O: (M.W. 270.30), 20 mM. The working FRAP reagent was prepared by mixing a, b and c in the ratio of 10:1:1 just before testing. Standard was FeSO4. 7 H2O: 0.1 - 1.5 mM in methanol. All the regents were prepared from Merck (Germany) company.

b) FRAP solution (3.6 mL) is added to distilled water (0.4 mL) and incubated at 37˚C for 5 min. Then this solution mixed with a certain concentration of the Lavandula angustifolia and clitoria ternatea extract (10µL,20µL,30µL,40µL,50µL)and incubated at 37˚C for 10 min. The absorbance of the reaction mixture was measured at 593 nm. For construction of the calibration curve, five concentrations of FeSO4, 7H2O (0.1, 0.4, 0.8, 1, 1.12, 1.5 mM) were used and the absorbance values were measured as for sample solutions.

RESULTS:

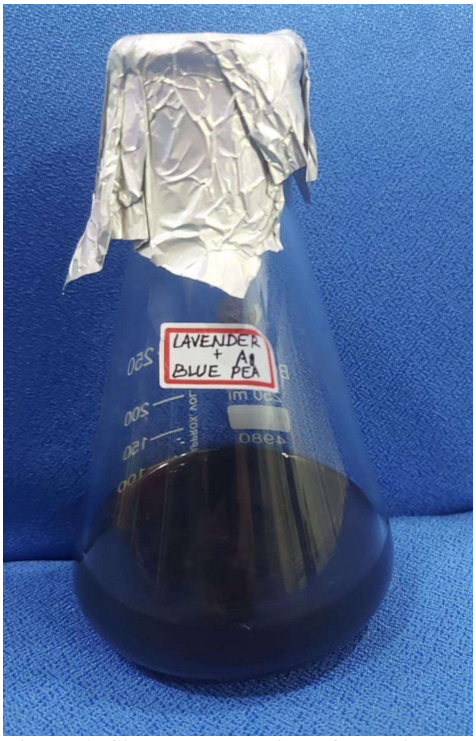

Figure 1: Silver nanoparticles formation.

Effect of silver nanoparticles synthesised using *Lavender angustifolia* and *Clitoria ternatea* on DPPH assay:

In the present study, the activity of DPPH assay was significantly inhibited by silver nanoparticles synthesised using *Lavender angustifolia* and *Clitoria ternatea.*

Effect of silver nanoparticles synthesised using *Lavender angustifolia* and *Clitoria ternatea* on H2O2 assay:

In the present study, the activity of H2O2 assay was significantly inhibited by silver nanoparticles synthesised using *Lavender angustifolia* and *Clitoria ternatea.*

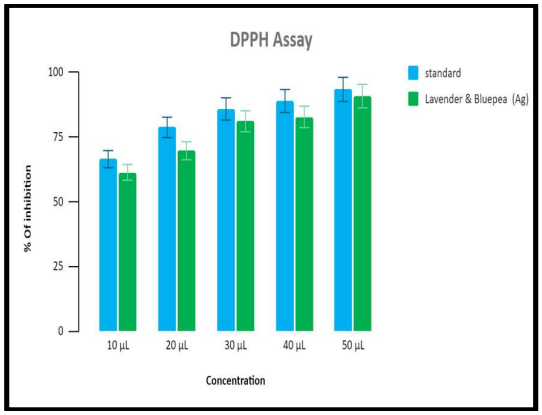

Figure 2: Effect of silver nanoparticles synthesised using *Lavender angustifolia* and *Clitoria ternatea* on DPPH assay.

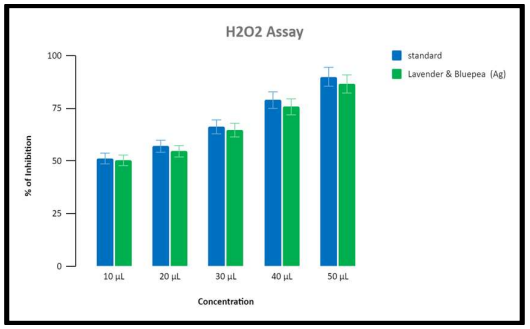

Figure 3: Effect of silver nanoparticles synthesised using *Lavender angustifolia* and *Clitoria ternatea* on H2O2 assay.

DISCUSSION:

Silver nanoparticles are the most often used nanoparticles among the others. It was used in personal care products, sensors, antimicrobial creams, and biomedical applications. Their potential toxicity is a concern given their diverse variety of uses. The two anti-inflammatory drugs that are used most frequently are ibuprofen and diclofenac sodium, both of which are NSAIDs(Swathy et al. 2020). Materials known as nanoparticles (NPs) have properties that set them apart from their bulk and molecular counterparts. Using a physical approach,

nanoparticles have been used to alter and enhance the pharmacokinetic and pharmacodynamic characteristics of a number of pharmaceutical drugs. To increase treatment efficiency while lowering side effects, several polymers have been used to create nanoparticles for drug delivery research(Banfield and Navrotsky 2018).

Although the prognosis for these drugs is good, they typically have gastrointestinal side effects that can include gastric ulcers and cardiovascular problems. Due to their safety characteristics and wide range of applications, notably in the biological sciences, silver nanoparticles produced through biosynthesis are preferred to those produced through other methods of synthesis. Biosynthesized AgNPs are used in pharmaceutical research(Kumar et al. 2021). The synthetic Lavender and Clotoria extract may have antioxidant capabilities without the usage of nanoparticles, according to research contradicting Chaudhary's direction(Chaudhary et al. 2013).

By lessening the cellular oxidative damage brought on by free radicals, antioxidants serve as a defence mechanism to stop the body from developing serious chronic diseases. To assess the scavenging abilities of the silver nanoparticles synthesised from Lavender angustifolia and Clitoria ternatea, the DPPH assay was carried out(Rajeshkumar et al. 2021). The potential of silver nanoparticles to significantly reduce cell viability in lung cancer cell lines (HepG2) and liver cancer cell lines (A59). According to Rajeshkumar's research, the free radical scavenging activity was concentration-dependent as well. Due to the presence of antioxidative compounds in its tissues, *Lavandula angustifolia* and *Clitoria ternatea* is well known for its health-promoting qualities(Zulfiqar et al. 2022). The i.a. cultivation method, growth environment, climatic circumstances, and plant genotype all have an impact on the chemical makeup of plant metabolites and their antioxidative characteristics(Imtiaz et al. 2021). The present study concluded that *Lavender angustifolia* and *Clitoria ternatea* showed significant free radical scavenging activity by DPPH assay and H2O2 assay.

CONCLUSION:

The *Lavender angustifolia* and *Clitoria ternatea* mediated Silver nanoparticles showed remarkable and considerable free radical scavenging activity when compared with the standard values. The antioxidant property of the extract mediated Silver nanoparticles, was applicable in nanomedicine through the help of advanced technologies to support the medical voided fields. The properties of the synthesised nanoparticles were further implied in nanotechnology which may be useful for other sourcing fields. More research is needed to fully assess the potential of plant-mediated nanoparticles. More scientific study must be done to develop our understanding on free radical scavenging activity of silver nanoparticles synthesised using *Lavender angustifolia* and *Clitoria ternatea.*

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CONFLICT OF INTEREST:

The authors would like to declare no conflict of interest in the present study.

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REFERENCES:

Banfield, Jillian F., and Alexandra Navrotsky. 2018. *Nanoparticles and the Environment*. Walter de Gruyter GmbH & Co KG.

Brailko, Valentine, Olga Mitrofanova, Nina Lesnikova-Sedoshenko, Svetlana Chelombit, and Irina Mitrofanova. 2017. “ANATOMY FEATURES OF LAVANDULA ANGUSTIFOLIA MILL. AND LAVANDULA HYBRIDA REV. PLANTS IN VITRO.” In *The Journal “Agriculture and Forestry,”* vol. 63, 63. no. 1. Preprint. https://doi.org/10.17707/agricultforest.63.1.13.

Cavanagh, Heather M. A., and Jenny M. Wilkinson. 2005. “Lavender Essential Oil: A Review.” In *Australian Infection Control*, vol. 10, 10. no. 1. Preprint. https://doi.org/10.1071/hi05035.

Chaudhary, S. K., N. K. Nema, N. Maity, S. Bahadur, and P. K. Mukherjee. 2013. “Angiotensin Converting Enzyme (ACE) Inhibition Activity of Standardized Extract of the Ocimum Sanctum L. Leaves and Its Fractions.” In *Planta Medica*, vol. 79, 79. no. 05. Preprint. https://doi.org/10.1055/s-0033-1336513.

Duraisamy, Revathi, Dhanraj Ganapathy, Rajeshkumar Shanmugam, Ezhilarasan Devaraj, and Amrutha Shenoy. 2024. “Assessment of Antimicrobial Activity of Nanocomposites Based on Nano-Hydroxyapatite (HAP), Chitosan, and Vitamin K2.” *Cureus* 16 (1): e53339.

Imtiaz, Taanya, R. Priyadharshini, S. Rajeshkumar, and Palati Sinduja. 2021. “Green Synthesis and Characterization of Silver Nanoparticles Synthesized Using Piper Longum and Its Antioxidant Activity.” In *Journal of Pharmaceutical Research International*. Preprint.

https://doi.org/10.9734/jpri/2021/v33i51a33501.

Ingle, Avinash P., Aayushi Biswas, Chhangte Vanlalveni, et al. 2020. "Biogenic Synthesis of Nanoparticles and Their Role in the Management of Plant Pathogenic Fungi." In *Microbial Nanotechnology*. Preprint. https://doi.org/10.4324/9780429276330-8.

Jain, Aditya, Roy Anitha, and S. Rajeshkumar. 2019. "Anti Inflammatory Activity of Silver Nanoparticles Synthesised Using Cumin Oil." In *Research Journal of Pharmacy and Technology*, vol. 12, 12. no. 6. Preprint. https://doi.org/10.5958/0974-360x.2019.00469.4.

Jamil, Nadzirah, and Furzani Pa'ee. 2018. "Antimicrobial Activity from Leaf, Flower, Stem, and Root of Clitoria Ternatea – A Review." In *AIP Conference Proceedings*. Preprint. https://doi.org/10.1063/1.5050140.

Kannan, N., Biotechnology Unit, Department of Botany, et al. 2014. "Preparation of Silver Nanoparticles Using Leaf and Fruit Extracts of Morinda Coreia Buck., Ham. –A Green Approach." In *Journal of Scientific and Innovative Research*, vol. 3, 3. no. 3. Preprint. https://doi.org/10.31254/jsir.2014.3307.

K, Jayanthi M., M. K. Jayanthi, K. Aswathi, K. L. Krishna, and Ramu Ramith. 2020. "Evaluation of Antioxidant and Diuretic Activities of Clitoria Ternatea Leaf Extracts in Wistar Albino Rats." In *Journal of Applied Pharmaceutical Science*. Preprint. https://doi.org/10.7324/japs.2021.110118.

Krithiga, Narayanaswamy, Athimoolam Rajalakshmi, and Ayyavoo Jayachitra. 2015. "Green Synthesis of Silver Nanoparticles Using Leaf Extracts of *Clitoria Ternatea* and *Solanum Nigrum* and Study of Its Antibacterial Effect against Common Nosocomial Pathogens." In *Journal of Nanoscience*, vol. 2015, 2015. Preprint. https://doi.org/10.1155/2015/928204.

Kumar, Samir, Prabhat Kumar, and Chandra Shakher Pathak. 2021. *Silver Micro-Nanoparticles: Properties, Synthesis, Characterization, and Applications*. BoD – Books on Demand.

Madan, Shivam, Ganapathy Dhanraj, and Ramasamy Ramasubburayan. 2026. "Antibacterial and Antibiofilm Activities of Streptomyces Rochei-Mediated Zinc Oxide Nanoparticles against Dental Caries-Causing Streptococcus Mutans - An In Vitro Study." *Indian Journal of Dental Research : Official Publication of Indian Society for Dental Research*, ahead of print, April 15. https://doi.org/10.4103/ijdr.ijdr_467_24.

Oliveira, Mozaniel Santana de, Sebastião Silva, and Wanessa Almeida Da Costa. 2020. *Essential Oils: Bioactive Compounds, New Perspectives and Applications*. BoD – Books on Demand.

Ponnusamy, Selvamaleeswaran, Wesely Ebenezer Gnanaraj, Johnson Marimuthu @Antonisamy, Velusamy Selvakumar, and Jeyakumar Nelson. 2010. "The Effect of Leaves Extracts of Clitoria Ternatea Linn against the Fish Pathogens." In *Asian Pacific Journal of Tropical Medicine*, vol. 3, 3. no. 9. Preprint. https://doi.org/10.1016/s1995-7645(10)60173-3.

Radwan, D. E. M., A. Essa, S. Ghozwany, K. Hamzy, and M. Hefzy. 2019. "Bioactive Compounds, Antioxidant and Antimicrobial Properties of Wild Plants Seed Extracts Used in Traditional Medicine." In *Research Journal of Medicinal Plants*, vol. 14, 14. no. 1. Preprint. https://doi.org/10.3923/rjmp.2020.15.23.

Rajeshkumar, S., M. Vanaja, and Arunachalam Kalirajan. 2021. "Degradation of Toxic Dye Using Phytomediated Copper Nanoparticles and Its Free-Radical Scavenging Potential and Antimicrobial Activity against Environmental Pathogens." In *Bioinorganic Chemistry and Applications*, vol. 2021, 2021. Preprint. https://doi.org/10.1155/2021/1222908.

Sharma, Vipra, Annathai Pitchai, Revathi Duraisamy, Dhanraj Ganapathy, and Pasiyappazham Ramasamy. 2025. "Synthesis, Partial Characterization of Nanochitosan from Cuttlebone Waste of and Its in Vitro Anticancer Potentials." *3 Biotech* 15 (10): 342.

Shukla, Ashutosh Kumar, and Siavash Iravani. 2018. *Green Synthesis, Characterization and Applications of Nanoparticles*. Elsevier.

Swathy, S., Anitha Roy, and S. Rajeshkumar. 2020. "Anti-Inflammatory Activity of Ginger Oleoresin Mediated Silver Nanoparticles." In *Research Journal of Pharmacy and Technology*, vol. 13, 13. no. 10. Preprint. https://doi.org/10.5958/0974-360x.2020.00808.2.

Yegorova, N. A., I. V. Mitrofanova, V. A. Brailko, O. A. Grebennikova, A. E. Paliy, and I. V. Stavtseva. 2019. "Morphogenetic, Physiological, and Biochemical Features of Lavandula Angustifolia at Long-Term Micropropagation In Vitro." In *Russian Journal of Plant Physiology*, vol. 66, 66. no. 2. Preprint. https://doi.org/10.1134/s1021443719010060.

Zulfiqar, Hafsa, Muhammad Shoaib Amjad, Ansar Mehmood, et al. 2022. "Antibacterial, Antioxidant, and Phytotoxic Potential of Phytosynthesized Silver Nanoparticles Using Elaeagnus Umbellata Fruit Extract." In *Molecules*, vol. 27, 27. no. 18. Preprint. https://doi.org/10.3390/molecules27185847.