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Green Synthesis of Silver Nanoparticles and Detection of Antimicrobial Activities of Exotic Weeds Like *Parthenium hysterophorus*: A Review

Vinu Kirthika V.* and Rajasulochana P.

Department of Microbiology, Saveetha Medical College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Saveetha Nagar, Thandalam, Kanchipuram, Tamil Nadu 602105, India

**Corresponding Author*

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Abstract: Since ancient times, silver has been employed as a non-toxic, secure inorganic antibacterial and antifungal agent. In a variety of biological applications, silver exhibits a very high potential, especially when it is in the form of nanoparticles. The advantages of green synthesis processes include their reasonable budget and the accessibility of raw materials. This eco-sustainable feature has now emerged as a crucial social concern and plays a crucial role in preventing environmental pollution by lowering or removing hazardous materials. The current review is straightforward, economical, and practical. Exotic weeds are taken as samples for this research. Weeds imported from foreign nations are referred to as exotic weeds or alien weeds. These weeds are arbitrarily characterized as undesirable, problematic, and difficult to control. They may disperse widely and have a huge potential for reproduction e.g. *Croton bonplandianus*, *Argemone mexicana*, *Lantana camara*, *Acanthospermum hispidum*, *Parthenium hysterophorus*, and *Eichhornia crassipes*. Simple annuals cannot grow again after being cut off at the ground level but *Parthenium* and some other species will regrow again when they are cut off at the ground level and appear as perennials. They are also referred to as special problem weeds. Specifically, *Parthenium hysterophorus* is used for this research and is a noxious weed. *Parthenium hysterophorus* is now considered a weed, although new applications are beginning to surface. They have a variety of applications that have only recently been discovered, such as nanomedicine, biopesticide, green manure potential, an agent for bioremediation of toxic metals and dyes, herbicides, an affordable substrate for enzyme production, and a source of biogas. The antibacterial activity against the organism like *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Shigella dysenteries*, *Serratia marcescens*, *Salmonella* sp., and *Enterococcus* sp. is demonstrated by the silver nanoparticle that was isolated from the *Parthenium hysterophorus*.

Keywords: Green synthesis, Nanoparticles, Antimicrobial activity, *Parthenium hysterophorus*

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Introduction

A nanoparticle is a microscopic particle with a size between 1 and 100 nanometers. Most nanoparticles include a few hundred atoms and are too small to be seen with the naked eyes.

Nanoparticles have exceptional potential in developing industries like food, medicine, agriculture, and genetics due to their high surface area-to-volume ratio and magnetic, mechanical, optical, and chemical capabilities.

Silver is widely used in nanosystems and has a variety of biomedical applications. When compared to other metal nanoparticles, silver nanoparticles have superior medical and nonmedical qualities and applications. There have been reports that numerous plants and herbal extracts are used in the green method of synthesizing nanoparticles since it has low to no toxicity. The term "exotic weed" is used to describe marijuana strains that are distinctive in their flavor aroma, look or the region in which they were grown. These strains are typically less well-known and harder to get. Exotic weeds, particularly *Parthenium hysterophorus* in urban areas, have surpassed harmful biological contaminants in India.

Traditional medicine has utilized the decoction of *Parthenium hysterophorus* as an emmenagogue as a treatment for fever, diarrhea, neurological problems, urinary tract infection, dysentery, and malaria. According to ethnobotany, it is used by some tribes as a treatment for gynecological disorders, eczema, skin rashes, herpes, rheumatic pain, colds, and inflammation. *Parthenium hysterophorus* has pharmacological activity as a vermifuge, an analgesic for neuralgia, and a treatment for muscular rheumatism.

Silver nanoparticles are created by employing an extract of *Parthenium hysterophorus* to reduce the silver ions in an aqueous solution of silver nitrate complex. This finding may eventually turn this harmful plant into a useful weed for nanotechnology-based enterprises. This technique has the potential to be significant for the large-scale synthesis of additional nanomaterials because of the uses of such environmentally friendly nanoparticles in antibacterial, wound healing, and other biomedical and electronic applications.

Collected sample of *Parthenium hysterophorus*. Required green synthesis of AgNPs is silver metal ion solution and reducing biological agent. AgNPs are synthesized using *Parthenium hysterophorus* and a centrifugation technique is used for the synthesis of the silver nanoparticles (Fig. 1). Characterized it by SEM, TEM, FTIR, XRD, and EDX. Determined the MIC (Minimum Inhibitory Concentration) by using the silver nanoparticles against the microorganism.

Rautela *et al.* (2019) concluded that when 50 g of AgNPs were employed the well-diffusion method demonstrated the antibacterial impact of AgNPs on several microbes, with the zone of inhibition being 16 mm for *Staphylococcus aureus*, 12 mm for *Bacillus cereus*, and 17 mm for *E. coli*, the minimum inhibitory concentrations were discovered to be 5.2, 2.6, and 2.0 g/ml, respectively. By examining the leakage of reducing sugars and proteins, the method of action of nanoparticle antimicrobial activity was studied, indicating that AgNPs were able to impair membrane permeability.

Naveed *et al*. (2022) reported silver nanoparticles' potent antibacterial and antiproliferative effects on the MCF-7 and HeLa cell lines. The pure nanoparticle has a higher capacity to absorb heat than the mixed nanoparticle, according to the mathematical modeling. This study showed that biosynthesized *Acer oblongifolium* AgNPs have potential applications as antioxidant, antibacterial and anticancer agents.

Yasir *et al.* (2018) used UV-visible spectroscopy to track the production of silver nanoparticles from *S. podophyllum* leaf extract. The silver nanoparticles created from *S. podophyllum* leaf extracts showed peaks maximum at 455 nm. The disc diffusion method was also used to determine the antifungal activity.

Roy *et al.* (2018) showed that AgNPs enter the cell, severely damage the peptidoglycan and respiratory chain dehydrogenases, and eventually kill the cell. Ahmed Shakeel *et al.* (2015) stated

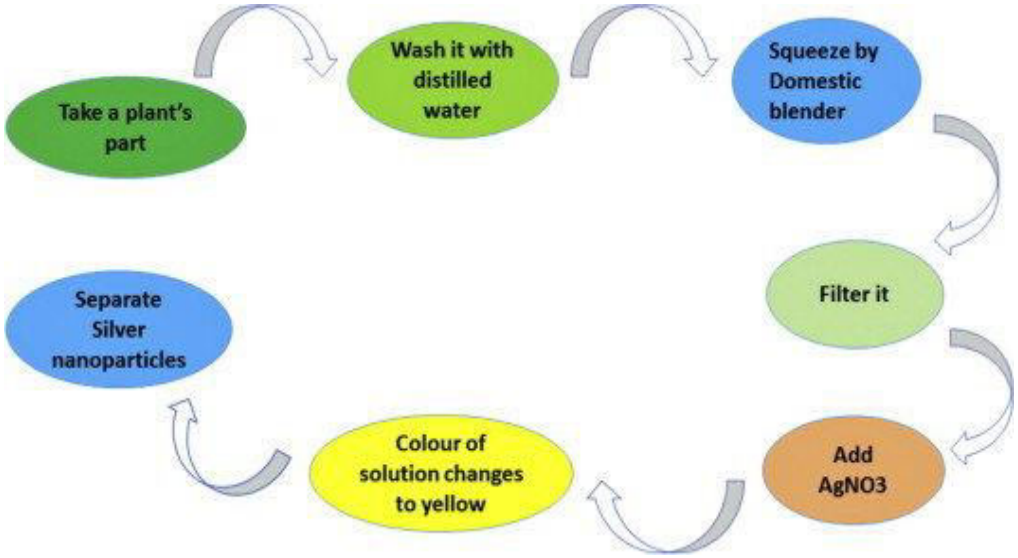

Fig. 1: Preparation of silver nanoparticles.

that both *S. aureus* and *E. coli* were successfully eradicated by the synthesized silver nanoparticles. Using plant extract in synthesis has several advantages, it saves money uses less energy, and protects the environment and human health resulting in less waste and safer products. With the potential to be used in biomedical applications and plays a significant role in optoelectronics and medical devices in the near future, this environmentally friendly method has a chance to be a competitive alternative to the traditional physical/chemical methods used for the synthesis of silver nanoparticles.

Ibrahim (2015) reported that silver nanoparticles made from banana peel extract (BPE) effectively combatted pathogens of bacteria and yeast. Both the minimal inhibitory and bactericidal concentrations were identified. The antibacterial activity of the produced nanoparticles and the antibiotic levofloxacin rose by 1.16 to 1.32 fold.

Femi-Adepoju *et al.* (2019) used FTID, SEM, EDX, TEM, and XRD to characterize the resultant *Gleichenia pectinate* AgNPs (GPAgNPs). Functional biomolecules were proven to be present by FTIR spectroscopy. The TEM finding was supported by the SEM, which showed p\spherical form morphology. GPAgNPs had a mean size of 7.51 2.88 nm and were calculated using TEM. While XRD analysis confirmed the GPAgNPs' crystallinity, EDX analysis confirmed the GPAgNPs' elemental composition with a strong signal of Ag at 3.0 keV. Four opportunistic, drug-resistant bacteria were successfully combated by GPAgNPs' potent antimicrobial activity.

Femi-Adepoju *et al.* (2018) stated that Phymatode AgNPs are effective antimicrobial agents. The synthesis AgNPs showed good antibacterial activity against the bacterial pathogens *Klebsiella pseudomonas*, *Pseudomonas aeruginosa*, *Salmonella typhi*, and *Escherichia coli* but showed the least activity against the fungus *Candida albicans*.

Rauwel *et al.* (2015) reported that for the reduction or elimination of hazardous material, this environmentally friendly component is crucial to fight against the effect of degradation.

Researchers have looked into the usage of silver nanoparticles as delivery systems for a variety of payloads, including tiny medicinal molecules and big macromolecules, to particular targets. Numerous studies and applications have been inspired by the special characteristics of nanomaterials in the fields of electronics, nanomedicine, biomaterials, energy, and food. Silver ions or their associated compounds are not particularly harmful to animal cells, however, bacteria and fungi are highly effective. The plant

also has the best chemical for synthesis, which increases the pace of synthesis.

Conclusion

Even *Parthenium hysterophorus* has negative effects, such as decreased pasture productivity, allergic contact, allergic respiratory symptoms, etc., yet they are useful in a variety of ways. The formation of silver nanoparticles of application in medicine's important anticancer properties are displayed by the zone of inhibition; a large zone of inhibition equaled a lower MIC number and vice versa. These conditions included treating inflammation, eczema, skin rashes, herpes, rheumatic pain, cold heart difficulty, and as a treatment for female diseases.

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