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# Antimicrobial Properties of Green Synthesised Silver Nanoparticles using Azadirachta indica (Neem) and Murraya koenigii (Curry leaves)

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## ABSTRACT

*Nano science and nanotechnology advancements have changed the way we classify, treat, and prevent diseases around the world. Silver nanoparticles (AgNPs) are most widely used and most intriguing amongst others in biomedical applications. In nano science and nanotechnology, nanoparticles, especially silver NPs, play a very critical role. Particularly in the field of Nano medicine, AgNPs have been focused on possible applications in cancer detection and treatment, even though other noble metals have been used for different purposes. We go through the antibacterial, antifungal, drug delivery, immunomodulation, and anticancer capabilities of AgNPs, as well as the mechanism of AgNPs' anti-cancer effect. The antibacterial and antioxidative effects of silver Nps are investigated in this work. The quasi-spherical shape of AgNPs may be seen in the SEM image. MCF-7 and HeLa cells were stopped from proliferating, and inflammation was reduced by AgNPs. Treatment with AgNPs significantly decreased allergic disorder. AgNPs stimulated phagocytosis. AgNPs could be a promising future therapeutic for preventing inflammation, reducing allergy diseases, and preventing bacterial infection by up-regulating phagocytosis, according to the findings. Finally, we'll talk about AgNPs' prospects in the future.*

**Key words:** Green synthesis, Dentistry, Nanotechnology, Silver nanoparticles

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## INTRODUCTION

Medicinal plants have been utilised as cures for human diseases for ages, and old medicine has only recently been recognised as a viable alternative to modern medicine. Due to the increasing resistance of numerous infectious organisms to currently available antibiotics, there is a greater incentive to use therapeutic herbs. Furthermore, the growing usage of plant extracts in the food, cosmetics, and pharmaceutical industries indicates that medicinal plant research is critical for discovering active chemicals. Nanotechnology research and studies have been steadily improving around the world. Despite the field of nanotechnology's potential for development, some people are concerned about the potential risks and effects of nanoparticles on the environment and human health [1].

Nanoparticles have risen to the limelight for years as a result of their applications in fields such as diagnostics, biomarkers, cell labelling, antimicrobial agents, drug delivery, and in this regard, therapy [2]. In this regard, the most practical and efficient were found to be in the 1–100 nm range, all of which were created using chemical methods. To make high-quality nanoparticles, a variety of chemical procedures were predetermined. Carbon nanotubes (CNTs), carbon quantum dots (CQDs), epoxy resin-coated CNTs, polymer-coated Ag, super magnetic iron oxide nanoparticles (SPION), mesoporous silica particles, catalytic metals, metal oxides, quantum dots (QD), dendrimers, Nano films, nano fibers, and reinforced Nano composites were all developed using nanoparticles [3].

Because of their favourable Photocatalytic properties, many of these nanoparticles, such as ZnO, FeO, SiO2, CeO2, and TiO2, are widely used. Elemental metals in nanometric dimensions (such as Ag, Au, Fe, Cu, Pt, Pd, Ni, and Co) are commonly used for antimicrobial, optical catalytic, electronic, and sensing applications, as well as doping agents. Rubber additives, catalytic converters, biomedical imaging, photovoltaic cells, cameras, and environmental remediation (paints, cosmetics, and plastics products) all use metal oxide NPs. Some of the latest fabrication methods for Nanomaterials are addressed from a green perspective, and flaws are highlighted.

In this paper, some examples of recent research outcomes that went beyond routine and old technologies by specifically integrating into their design elements to (l) reduce the use of harmful and depleting material inputs, (2) increase the effectivity of time, space, and energy, and (3) create nanoparticles for eco-effective solutions were presented. Recent developments in nano science and nanotechnology have revolutionised the way we identify, manage, and prevent diseases across the board. Silver nanoparticles (AgNPs) are one of the most common and interesting metallic nanoparticles used in biomedical applications. Silver is one of the most commercialised Nanomaterials with five hundred tons of silver nanoparticles production per year and is estimated to increase in the next few years. Its importance in the fields of high sensitivity biomolecular detection, catalysis, biosensors, and medicine is well documented.

It has proven to have potent inhibitory and bactericidal properties and antifungal, anti-inflammatory, and anti-angiogenesis properties. Silver nanoparticles can be produced using a range of methods, including ion sputtering, chemical reduction, sol-gel, and others. Sadly, many nanoparticle synthesis methods use dangerous chemicals or need a lot of energy, making them harder to do and requiring costly purifications. Techniques for making nanoparticles that use naturally occurring reagents as reductants and capping agents, such as sugars, biodegradable polymers, plant extracts, and microorganisms, may be appealing for nanotechnology.

The analysis aims to see how antimicrobial silver nanoparticles derived from Neem and Curry leaves battle oral pathogens.

## MATERIALS AND METHODS

The synthesis of AgNPs using neem leaves and curry leaves extracts was done using the method as described previously [4].

The antibacterial activity of AgNPs against the selected oral pathogens was carried out using Agar well Diffusion Susceptibility Test method. The bacteria strains were spread on Mueller-Hinton agar (MHA) using sterile cotton (Merck, Germany). The discs were filled separately with neem and curry leaf extracts, silver nitrate solution (1mM), and a solution containing neem and curry leaf controlled synthesised AgNPs. After that, the discs were


**Figure 1: Colour change at nanoparticles synthesis.**

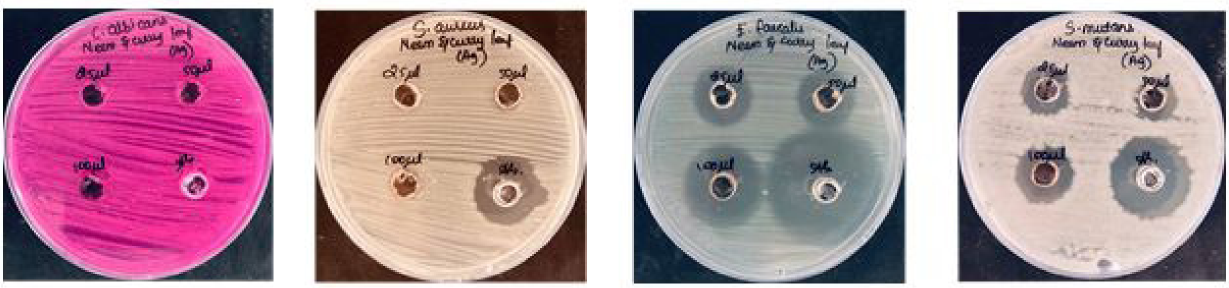

**Figure 2: Antimicrobial activity.**

**Table 1: Shows the zone of inhibition after antimicrobial testing in C. albicans, S. aureus, E. faecalis, S. mutans with concentrations of 25 ml, 50 ml, 100 ml and AB control.**

| | *C. albicans* | *S. aureus* | *E. faecalis* | *S. mutans* |
|---|---|---|---|---|
| 25 ml | 9 | 9 | 20 | 16 |
| 50 ml | 9 | 10 | 21 | 17 |
| 100 ml | 9 | 10 | 27 | 2 |
| Ab | 9 | 23 | 40 | 26 |

mounted on the agar plate and incubated for 24 hours at 37°C. After 24 hours of incubation, the inhibition zone was discovered (Figures 1 and 2).

## RESULTS

The antimicrobial test (Kirby–Bauer Disk Diffusion Susceptibility Test method) is as tabulated in the table on the side. The antibacterial activity of AgNPs was determined against four species of Gram-negative foodborne pathogens (C. albicans, S. aureus, S. mutans, E. fecalis)

The silver Nps showed the best results of the highest zone of inhibition in the oral pathogen E. fecalis followed by S. mutans and S. aureus and showed negligible zone of inhibition against C.albicans (Table 1).

## DISCUSSION

Green chemistry has emerged as a novel term for the production and application of chemical processes to reduce or eliminate the use of dangerous chemicals. Biosynthesis of Ag NPs using microorganisms, as opposed to plant extracts, necessitates a precise method of cultivating and preserving microbial cells, which may be pathogenic to humans in certain instances.

Plant extracts have several advantages, including ease of use, affordability, and broad metabolite viability. Biosynthesis of nanoparticles from plant extracts is gaining popularity due to the widespread availability of plant extracts as well as a diverse range of biodegradable biologically active metabolites. In a recent study, green synthesized nanoparticles were tested and analysed to find a better response to antibacterial and anticancer effects [5,6]. Plant extracts have many benefits, including ease of use, low cost, and metabolite viability. Due to the widespread availability of plant extracts as well as a broad range of biodegradable biologically active metabolites, biosynthesis of nanoparticles from plant extracts is gaining popularity.

They were chosen due to their special effect on antibiotic-resistant drugs, cancer and some other diseases that were mentioned. Several studies have shown that green synthesised nanoparticles from plants and other biological sources are superior to chemical drugs. Due to their potent antimicrobial influence, silver ions and silver compounds have been used as antimicrobial agents in various fields for decades [7]. Due to their powerful biocidal activity against microorganisms, silver nanoparticles are well-known as the most universal antimicrobial agents and have been used to prevent and treat various diseases for decades. AgNPs are also widely used as anti-fungal [8], anti-inflammatory [8,9], and anti-viral properties [10]. A previous study [11,12], reported that AgNPs employed antibacterial activity on Gram-negative bacteria. The visible clear AgNPs created a kill zone against four separate Gram-negative bacteria species. Non-hazardous AgNPs can now be easily synthesised and tested as a new form of the antimicrobial agent using a cost-effective process. Due to their powerful biocidal activity against microorganisms, silver nanoparticles are well-known as the most universal antimicrobial agents and have been used to prevent and treat various diseases for decades [11]. AgNPs are also widely used as anti-fungal [8], anti-inflammatory [13-15], and anti-viral properties [16]. Non-hazardous AgNPs can now be easily synthesised and tested as a new form of antimicrobial agent using a cost-effective process [5]. Plant extract for synthesis has the advantages of being energy-efficient and cost-effective, as well as protecting human health and the environment, resulting in less waste and safer goods.

In the field of nanotechnology, the production of efficient, cost-effective, and environmentally friendly processes for the synthesis of metallic nanoparticles is a critical need. As a reducing and capping agent, we used a natural, biological, low-cost U. fasciata ethyl acetate extract. This procedure does not involve the use of hazardous chemicals or solvents. The biogenic Nano silver showed promise against X. campestris pv. Malvacearum, an economically important cotton plant pathogen that causes substantial yield loss in cotton-growing regions around the world.

## CONCLUSION

Silver nanoparticles and silver ions, in conclusion, have similar effects on the cell membrane. Nanoparticles anchor the cell in different locations and inflict damage at various sites in the membrane, while silver ions induce bacteria into an active but nonculturable - ABNC state. Cell lysis and nanoparticle aggregation in the membrane can result, with some nanoparticles likely to penetrate the cell.

While the results for nanoparticles and silver ions in terms of interaction with the E. fecalis cell membrane were similar, the inhibition results were not.

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