# Antimicrobial activity of Silver nanoparticles from *Swietenia mahagoni*

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## Abstract

**Objective**: To produce natural, non-toxic biologically synthesized silver nanoparticles (Ag NPs) with antimicrobial activity from plant source, *Swietenia mahagoni* as a remedy for multi-resistant drug microbes.
**Methods:** The antimicrobial activity of these Ag NPs from *Swietenia mahagoni* was tested against three bacterial species, *E.coli, S. aureus, P. aeruginosa* and a fungal species, *C. albicans*.
**Results:** The experimental results exhibited satisfactory inhibitions against all tested microorganisms when used at different concentrations viz., 1mM, 3 mM and 5 mM; 3 mM (20 mg/500 µl distilled water) offered the highest sensitivity for *E.coli* and *P. aeruginosa*.
**Conclusion:** Green-synthesized antibacterial agent from *Swietenia mahagoni* showed good antibacterial and antifungal activity.
**Keywords:** E.*coli, C.albicans, P.aeuruginosa, Pithecellobium dulce, S.aureus*

## 1. Introduction

The emerging trend of silver nanoparticle application as drug biosensing [1], their antimicrobial activity [2] and use in biomedical treatments [3] has stunned the world. The current antibacterial agents are chemically modified natural compounds [4], for instance, β-lactams (like penicillins), carbapenems or cephalosporins [5]. Many disease causing microbes that have found to become resistant to drug therapy are an increasing public health problem. For these reasons, there is an urgent need to develop new bactericides. Being antimicrobial, silver nanoparticles take advantages as clean biosynthetic product, cost effective and non-toxic to environmental routes. Recently, green bio-reduction methods for the synthesis of silver nanoparticles were adapted by many researchers using plant extracts such as *Anacardium,* Mushroom extract [6], *Medicago sativa* [7], *Chenopodium murale* [8], *Citrus sinensis* peel [9], *Emblica officinalis* Fruit Extract [10], *Coleus amboinicus* [11], Eucalyptus hybrid [12], *Macrotyloma uniflorum*[13]etc.

*Swietenia mahagoni* belong to Meliaceae family mainly known for its timber. *S mahagoni* is found to have antiulcer activity [14], cytotoxic, thrombolytic and membrane stabilizing activity [15], antidiabetic and antioxidant activity [16], anti-HIV activity [17]. For these reasons special interest was taken in the present study to analyse the antimicrobial activity of Silver nanoparticles synthesized from the medicinal plant *S. mahagoni* against *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeuruginosa* and *Candida albicans*.

## 2. Materials and methods

### 2.1 Preparation of silver nanoparticle from crude extract discs

Sterile Whatman No.1 paper was punched into 5mm diameter disc sizes. The discs were placed in MacCartney bottles and sterilized in an autoclave at 120$^{o}$ C for 15 min. The bottle was transferred

into a hot air oven at 60° C to dry for 30minutes. 500 µl of 3 mM & 5 mM silver nanoparticles were prepared from *S. mahagoni*, i.e. 20mg in 500 microlitres of sterile distilled water, by using a mixer and suspended on the punch prepared discs by applying 10µl inoculation each time followed by air drying and stored in sterile containers.

**2.2 Antimicrobial activity**

The microorganisms used for the study were *E. coli* (ATCC 25922), *S. aureus* (ATCC 25923), *P. aeuruginosa* (ATCC 27853), and *C. albicans* (ATCC 10231). Mueller Hinton agar (HI media) was used for the performance of the antimicrobial assay. Gentamycin (10 µg), Ampicillin (10 µg), Tetracycline (30 µg), and Ciprofloxacin (5 µg) were used as controls. Wells measuring 6 mm diameter were made by using a sterilized metallic borer. Colonies of microorganisms were used to prepare inoculum suspension of 0.5 Standard McFarland Turbidity (which is $1.5 \times 10^8$ CFU/ml); microbes were inoculated and incubated at 37° C for 24 hours. Zone of inhibition were recorded in millimeter after 24 hours. When the antimicrobial activity of the 20 mg/500 µl of the 3 mM and 5 mM concentration of silver nanoparticles were compared, it was significantly proved that the 3mM concentration of the silver nanoparticles were more sensitive towards the microorganisms than that of 5mM concentration of the silver nanoparticles. As the concentration of the nanoparticles increased (i.e. from 50 µl to 100 µl) the sensitivity towards the microorganisms was also increased. It was found out that the concentration of crude extract and the diameter of the inhibition zone were directly proportional. Hence 20mg/500 µl of the 3mM concentration of the silver nanoparticle gave the highest sensitivity. However, when the silver nanoparticles were impregnated on the discs, the sensitivity recorded was poor as compared (see Table 1&2) to that of the ones inserted into the well. This could be due to the proper distribution of the particles throughout the media when inoculated in the medium well. And also, the diameter of the discs was as a 6 mm puncher was not available, now since the diameter of the disc is reduced by 1 mm; it is likely to have affected the results. Additionally, when the effect of the particles against the bacteria's (i.e. *E. coli, S.aureus, P.aeuruginosa*) and the fungus (*C. albicans*), was evaluated, they seem to have a relatively higher zone of inhibition towards the fungus than the bacteria's study revealed that the fungus *C. albicans* was found to be resistant when tested by the leaf of *S. mahagoni* crude extract. The mechanism of the antimicrobial action of silver ions is closely related to their interaction with thiol (sulfhydryl)groups, although other target sites remain a possibility. Cytoplasmic contents and outer cell layers all exhibited structural abnormalities. It was shown in the present study that the antimicrobial activity of the silver nanoparticles synthesized from *S. mahagoni* had sensitivity against the microbial strains *E. coli, S. aureus, P. aeuruginosa* and *C. albicans*. As Soheil [18] has shown the antimicrobial activity of *Swietenia sp,* and it is now been proved with *S. mahagoni* in our study.

Table 1**:** Bioassay of 3 mM and 5 mM concentration of Silver nanoparticles into the Crude Discs

| Name of microbes | 3mM (in disc) 30µl | 5mM (in disc) 30µl |
|---|---|---|
| *E.coli* | 13 | 10 |
| *S. aureus* | 12 | 11 |
| *P. aeuruginosa* | 13 | 12 |
| *Candida albicans* | 15 | 13 |

Table 2: Comparison between the 20 mg/500 µl of 3 mM and 5 mM concentration of Silver nanoparticles in wells.

| Name of microbes | 3mM (in well) | | 5mM (in well) | |
|---|---|---|---|---|
| | 20 mg in 500 µl distilled water | | 20 mg in 500 µl distilled water | |
| | 50 µl | 100 µl | 50 µl | 100 µl |
| *E.coli* | 15 mm | 18 mm | 16 mm | 15 mm |
| *S. aureus* | 15 mm | 18 mm | 16 mm | 15 mm |
| *P. aeuruginosa* | 17 mm | 20 mm | 18 mm | 17 mm |
| *Candida albicans* | 18 mm | 18 mm | 20 mm | 18 mm |

## 3. Conclusion

Biologically synthesized silver nanoparticles from the plant *Swietenia mahagoni* developed sensitivity against the microbial strains *Escherichia coli, Staphylococcus aureus, Pseudomonas aeuruginosa* and *Candida albicans*. The 20 mg/500 µl of the 3mM silver nanoparticle showed the highest sensitivity among the different concentrations used. This antibacterial property of *S. mahagoni* can also be used in textile industry, water disinfection, medicine, and food packaging as suggested earlier[19].

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*The Publication fee is defrayed by Indian Society for Education and Environment (iSee). www.iseeadyar.org*

***Cite this article as:***

Yamini Sudha Lakshmi, D.Mala, S.Gopalakrishnan, Fouzia Banu, V. Brindha and N.Gajendran [2014] Antimicrobial activity of Silver nanoparticles from *Swietenia mahagoni. Indian Journal of Medicine & Healthcare* Vol 3 (1), pp. 310-313