



**GREEN BIOSYNTHESIS AND PHYTOFABRICATION OF SILVER NANOPARTICLES
USING CORCHORUS AESTUANS LEAF EXTRACT AND ANALYSIS OF
ANTIMICROBIAL ACTIVITIES**

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ABSTRACT

In recent years nanoparticles have obtained great importance and remains remarkable for its unique properties. Silver nanoparticles have wide medicinal usage as it exhibits antimicrobial, antifungal and anti-inflammatory properties. The Agnp synthesis via bioentities have more advantages over other methods. In the present study, Agnp nanoparticles were synthesized by incubating the leaves of *Corchorus aestuans* with silver nitrate solution, making them to react in dark. The synthesized silver nanoparticles of the leaf extract is then tested for antibacterial property with both gram positive and gram negative bacteria. With the synthesized silver nanoparticles phytofabrication was done with *C.aestuans* leaf extract which is applicable in medical field as it has antibacterial property.

KEYWORDS: *Corchorus aestuans*, silver, nanoparticles, phytofabrication, antibacterial.

INTRODUCTION

Silver nanoparticles are an arch commodity from the field of nanotechnology that has attracted a lot of attention due to their specific properties such as chemical stability, strong conductivity, catalytic, and most notably antibacterial, antiviral, antifungal, and antiinflammatory activities.^[1] Due to the availability of more biological components for their formation, the synthesis of nanoparticles using bioentities has more advantages than other traditional processes. The wide variety of such entities should be investigated for the purposes of synthesis.^[2]

Microbial resistance to currently available antimicrobial agents has played a significant role in the development of novel microbe-inhibitory agents. Silver has been shown to have antimicrobial properties.^[3] It is used as a topical bactericide in medicine. Silver is used to avoid food spoilage and manage pathogenic infections. And is also used to treat ulcers and as a wound healing agent.^[4]

Besides these methods, plant-mediated AgNP synthesis appears to be fast, simple, dependable, non-toxic, and environmentally sustainable. Silver nanoparticles have been synthesized using plant parts such as bark, root, stem, fruit, seed, callus, peel, leaves, and flower.^[5] Plant extracts are used to synthesize metal nanoparticles, which has advantages over other biological synthesis methods that require extremely challenging procedures

such as maintaining microbial cultures.^[6] Plant-mediated AgNP synthesis outperforms chemical and physical approaches and can be quickly scaled up for large-scale synthesis.^[7]

Secondary metabolites found in plant crude extract include phenolic acid, flavonoids, alkaloids, and terpenoids. These compounds are primarily responsible for the formation of bulk metallic nanoparticles from ionic compounds.^[8] These primary and secondary metabolites are continuously involved in the redox reaction that results in the formation of environmentally friendly nanosized particles.^[9]

Corchorus aestuans is a medicinal plant that has broad uses e.g. as a diuretic, anti inflammatory, antimicrobial and cardiogenic etc like other *Corchorus* species.^[10] The genus comprises about 40-100 plants which comes under Tiliaceae family. Despite its long history of therapeutic and prophylactic uses, little is known about the active concepts derived from *Corchorus* leaves, their biological functions, and toxicological limits. Such information is vital for realizing the future commercialization of *Corchorus* leaves. To some degree, the market prospects of *Corchorus* leaves have been illustrated by the production of a skin rejuvenating cream formulation.^[11]

Corchorus aestuans was used as a low-cost fibre plant (known as jute). Extracts of the roots or leaves were used

in traditional African medicine to treat gonorrhoea, and an extract of the whole plant, including the roots, was used to make injections for the treatment of urethral discharges. The leaves were used to treat headaches in the Philippines, and the seeds were used as a tonic, carminative, and febrifuge in the form of powder or decoction.^[12]

C.aestuans is a potential source of natural antioxidants, which act as free radical scavengers and chain breakers, complexes of prooxidant metal ions, and singlet-oxygen quenchers. Analgesics are commonly used to treat pain, which is a common symptom of many diseases. *Corchorus* leaves are well-known analgesics in several parts of the world.^[13]

Yet, this research work was made an attempt to synthesis silver nanoparticles and to know the antibacterial potential and healing property of *Corchorus aestuans* leaves.

MATERIALS AND METHODS

Materials and chemicals: Whatmann filter paper, sterile cotton swab, bacterial inoculums, inoculation loop, antibiotic disc, Conical flasks, Beakers, Petri dish, Test tubes, Test tube stand, mortar and pestle, measuring cylinder, volumetric flask, Silver nitrate, citric acid, nutrient solution, Mc farland's standard, Distilled water was used throughout the reaction.

Instruments: Refrigerator, Weighing balance, Waterbath, Bunsen burner, autoclave, incubator. Pneumatic padding mangle, spectrophotometer.

Plant collection: The leaves of *Corchorus aestuans* was collected from the garden in Bharathiyar University, Coimbatore. The leaves were harvested from the young plants and used for this study.

Green Synthesis of Silver Nanoparticles

Preparation of the plant extract: 10 g of freshly collected leaves were used to make an aqueous extract of *C. aestuans*. The leaves were surface washed with running tap water, then distilled water, and then boiled for 5 minutes at 80°C with 100 mL distilled water. Due to the gradual loss of plant extract viability, the extract was filtered via Whatman paper No. 1 and processed at 4°C for further use, being usable for 1 week.

Silver nanoparticles synthesis: For the synthesis of the silver nanoparticles, a 5ml of aqueous plant extract was added to 45 ml of aqueous AgNO₃ solution. It is incubated at room temperature in the dark to minimise the photo activation of silver nitrate under static conditions. After the bio reduction process at 30°C in dark, the colour change in the solution was observed.

Determination of Antibacterial Finishes on textile materials

Microorganisms used: The microorganisms used in all assays were *Staphylococcus aureus* (ATCC 6538) and *Klebsiella pneumoniae* (ATCC 4352), selected according to the standards.

Quantitative method: The quantitative determination of antimicrobial activity was based on the Absorption method from AATCC Test Method 100 protocols.

For the AATCC 100 method, a circular sample of 4.8 ± 0.1 cm in diameter was used.

The growth of cultures was checked visually after 24 hours. If turbidity is present (i.e. bacteria), checking was done with the concentration of 24 h broth culture using McFarland's standard at 625 nm and diluted to the concentration of 1-2 x 10⁵ CFU/mL with NB (OD value = 0.08 ± 0.02 in UV via spectrophotometer). The determined no of cut/sterilized treated and untreated swatches were placed separately in a petridishes and evenly distribute 1.0 ± 0.1 ml of diluted S.a and K.p inoculums separately. The 24 h bottle was inoculated for 24 hour duration at 37 °C ± 2 °C. Immediately, in 0 h bottle, 100 ± 1 mL of neutralizing solution was added to each of the bottles of inoculated treated, inoculated untreated and un inoculated treated and the bottles are vigorously shaken in shaker for 1 min. Serial dilution (10⁰, 10¹, 10² and 10³) of above neutralizing solution were made and plated in duplicates with L rod. The plates were kept in the incubator (37 °C ± 2 °C) and incubated for 24 to 48 h. The 0 h plates were examined for the growth, the colonies were counted and the values are noted. In case of 24 h incubation, 100 ± 1 mL of neutralizing solution was added and the steps are repeated as it is done for 0 th hour All assays were performed in duplicate and repeated three times.

Pad – Dry – Cure Method of fabric

Liquor ratio taken for the material in dyeing the fabric was 1:40 .The antimicrobial solution which is used here is the reduced silver nitrate solution. The cross linking agent used here is 6% of citric acid with respect to weight of fabric. hen it is passed through pneumatic padding mangle at speed of 100 RPM with pressure of 1 KG/Cm² to remove excess solution ensuring the wet pick up of 70%. Later, the fabric was shade dried and cured for 3 minutes at 1400C.

RESULTS AND DISCUSSION

Silver nanoparticles were synthesized using an aqueous leaf extract of *Corchorus aestuans*. The antibacterial resistance of the synthesized silver nanoparticles on the fabric is tested using the AATCC 100 method against gram positive and gram negative bacteria such as *Staphylococcus aureus* and *Klebsiella pneumoniae*.

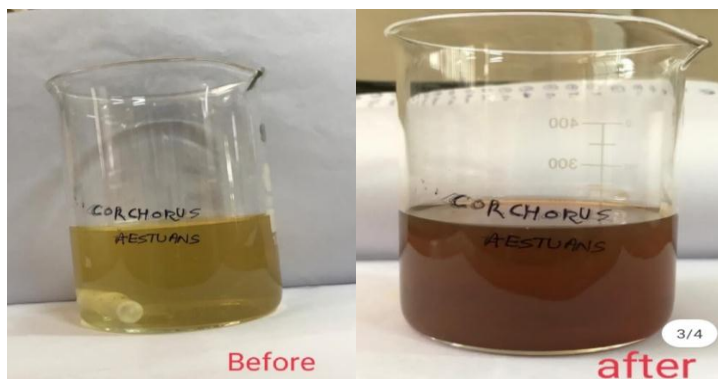


Figure 1: Synthesized Silver Nanoparticles (AgNPs).

Estimation of Antibacterial activity

Antibacterial activity was done for the leaves of *Corchorus aestuans*. Various methods have been described to determine the efficacy of antimicrobial fabrics. Here quantitative tests are used in this study.

The quantitative method allows the determination of the exact value of the antimicrobial activity obtained by the calculation of the reduction of bacterial growth against a control. The percentage of microbial growth inhibition

could be accurately determined using the quantitative methods. The reduction percentage of both *Staphylococcus aureus* and *Klebsiella pneumoniae* caused in the reduced silver nitrate solution after the four swatches was 99.99% which is obtained by the AATCC 100 method. The bacterial growth in serial dilution of neutralizing solution was noted for both the bacteria on 0th hour and 24th hour respectively and shown in Table 1.

Table 1: Estimation of bacterial growth on 0thhour and 24 thhour.

Plant extract	Gram positive bacteria	Gram negative bacteria	Bacterial Growth count				
			Serial dilution	0 th hour <i>S.aureus</i>	24 th hour <i>S.aureus</i>	0 th hour <i>K.pneumoniae</i>	24 th hour <i>K.pnuemoniae</i>
<i>Corchorous aestuans</i>	<i>Staphylococcus aureus</i>	<i>Klebsiella pneumonia</i>	10 ²	106	0	174	0
			10 ³	17	0	19	0
			10 ⁴	0	0	1	0

Staphylococcus aureus on 10² of serial dilution had the bacterial count of 106 was shown in figure 7, where it gradually decreases to 17 on 10³ and then at 10⁴ the bacterial count was 3. And this reduction in the bacterial colony was illustrated in figure 2. Similarly *Klebsiella pneumoniae* on the 0th hour showed the bacterial count of 174 in figure6 and decreased on every dilution to 19 and then 1 was shown in figure 3. On their 24th hour both the bacteria showed no growth in their inoculums which

clearly shows the antibacterial potential of the nanoparticles coated fabric on figure4 and figure5.

Thus the bacterial growth decreases to nil. Regarding the results obtained with the quantitative method illustrates that the silver nanoparticles synthesized fabric of *C.aestuans* had the same rate of antibacterial activity on both bacterial species.

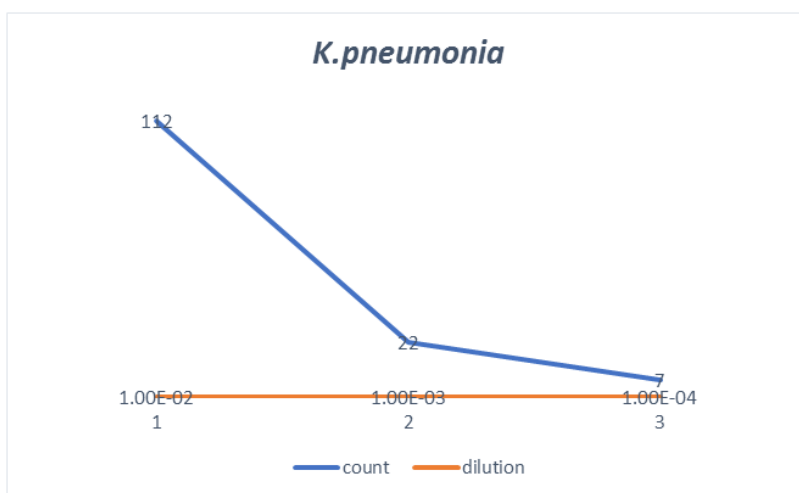


Figure 2: Reduction in the growth counts of *K.pneumoniae*.

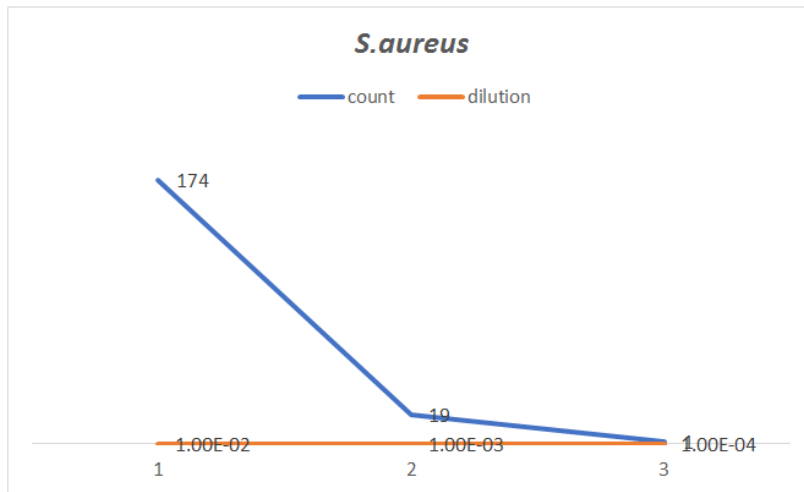


Figure 3: Reduction in the bacterial count of *S.aureus*.

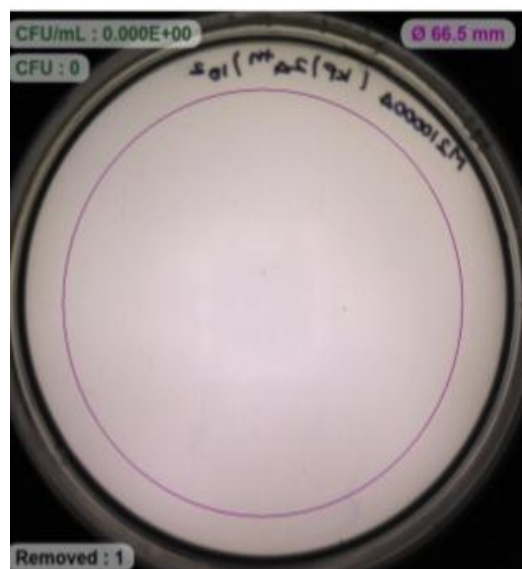


Figure 4: Validation of no growth of *K.pneumoniae* on 24th hour.



Figure 5: Validation of no growth of *S.aureus* on 24th hour.



Figure 6: Validation of 174 *K.pneumoniae* bacterial colonies on 0th hour.

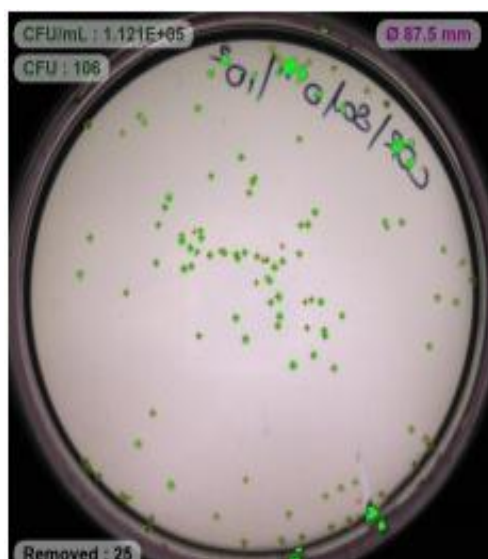


Figure7. Validation Of 106 *S.aureus* bacterial colonies on 0th hour.

Production of antibacterial fabric from silver nanoparticles

Antimicrobial textiles may prevent microorganisms from spoiling cloth and can be used as medical devices to prevent dermal infections or microbial development, which is particularly useful in hospitals. The fabric was treated with the antimicrobial solution shown in figure 8, which is the reduced silver nitrate solution and with the cross linking agent. After that the textile fabric coated with the silver nanoparticles synthesized from leaf extract of *C.aestuans* which shows potential antibacterial activity against both the Gram positive bacteria *Staphylococcus aureus* and Gram negative bacteria *Klebsiella pneumoniae* was obtained.

The antibacterial fabric was shown in figure 9 and figure 10 shows the processing of the fabric through pneumatic padding mangle where it gets softens.



Figure 8: Antibacterial stock solution.



Figure 9: Antibacterial fabric.



Figure 10: Fabric passed through pneumatic padding mangle.

CONCLUSION

The use of plants for green synthesis of nanoparticles is gaining more popularity over years. The synthesis is cost effective, eco friendly, efficient and rapid. In the

Corchorus aestuans leaves, the silver nanoparticles are synthesized using the aqueous extract. The synthesized silver nanoparticles of *C.aestuans* leaves which were coated on the textile fabric had equal amount of

antibacterial activity against gram positive bacteria like *Staphylococcus aureus* and gram negative bacteria like *Klebisella pneumoniae*. Hereby, we conclude that *Corchorus aestuans* leaves have high antibacterial activity against both gram positive as well as gram negative bacteria. Thus the antimicrobial fabric can be used in wound healing as it has antibacterial potential. This finds to be useful in medicinal industries. Till now there is no reference related to this research work. This is a new attempt of preparing antibacterial fabric or bandage from the green synthesized silver nanoparticles of *Corchorus aestuans* leaves.

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