Antimicrobial activity of *Aegle marmelos* (Correa) Linn. Silver nanoparticles

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Abstract

Objective: The present study was carried out for investigating the antibacterial activity of sliver nanoparticles (Ag NPs) biologically synthesized from the medicinal plant *Aegle marmelos.*

Methods: The silver nanoparticles from *Aegle marmelos* was impregnated onto a blank disks with different concentrations viz., 1mM, 3 mM and 5 mM and tested for its antimicrobial activity against *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeuruginosa* (ATCC 27853), and *Candida albicans* (ATCC 10231).

Results: The results indicated highest antimicrobial activity against *E.coli* and *P. aeruginosa* as a solution for finding.

Conclusion: The ability of *Aegle marmelos* silver nanoparticle to inhibit bacterial and fungi is an indication of its broad spectrum antimicrobial activity which could be a potential source of antibiotic which is cost effective and eco-friendly against drug resistant organisms.

Keywords**:** *E. coli C. albicans P. aeuruginosa S. aureus, Aegle marmelos,* silver nanoparticles.

1. Introduction

In the latest era of biotechnology nanomaterials have received much attention because of their structure and properties differ significantly from those of atoms, molecules, and bulk materials [1] and their application in the field of medicine. The silver nanoparticles can “inactivate proteins, blocking respiration electron transfer and subsequently inactivate the bacteria” [2]. In current trend biological synthesis of metallic nanoparticles is gaining importance because it is reliable and eco-friendly. *Aegle marmelos* (L.) Corr. is a native to Indian belonging to the family Rutaceae. Traditionally it is used for treating diarrhea and dysentery, peptic ulcer and respiratory infections [3]. Several studies on different parts of *Agele marmelos* showed that the plant possesses antidiarrhoeal [4], antidiabetic [5], anti-inflammatory, antipyretic, analgesic [6], anticancer [7] and radioprotective [8]. In this present study the silver nanoparticles are synthesized from *Aegle marmelos* and tested for its antimicrobial activity against: bacteria like *E.coli, P.aeuruginosa, S.aureus* and fungi like *C.albicans.*

2. Materials and methods

2.1. Preparation of silver nanoparticle crude extract discs [9]

Sterile Whatman No.1 paper punched into 5mm diameter disc size were placed in MacCartney bottles and dried in hot air oven. About 20 mg/500 µl of 3 mM & 5 mM AgNPs prepared from *Aegle marmelos* is suspended on the sterilised discs and stored in sterile containers.

2.2. Antimicrobial activity

The antibacterial activity of the biologically synthesized *A. marmelos* Ag NPs were tested against *Escherichia coli* (ATCC 25922), *Staphylococcus aureus* (ATCC 25923), *Pseudomonas aeuruginosa* (ATCC 27853), and *Candida albicans* (ATCC 10231). This experiment was performed in Mueller Hinton agar (HI media), Gentamycin (10 µg), Ampicillin (10 µg), Tetracycline (30 µg), and Ciprofloxacin (5 µg) were used as control. Stock cultures of all microorganisms were grown in nutrient agar broth at 37ºC for 24 hours. A few colonies of single bacteria were transferred into a test tube containing sterilized distilled water. The mixture was homogenized using a centrifuge. The turbidity of the solution was compared to 0.5 M McFarland standard and adjusted until the turbidity of both solutions were the same, which is, corresponding to the concentration of 1 x 108 CFU/mL [10]. The zone of inhibition was recorded in millimetre after 24hrs.

3. Results

The study shows that a relatively higher zone of inhibition was observed with the fungus than on bacteria (*E. coli, S. aureus, P.aeuruginosa*). Thus the fungus *C. albicans* was found to be relatively sensitive when tested by the Ag NPs from *Aegle marmelos* 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 [11]. The antimicrobial activity of *A. marmelos* Ag NPs showed 3mM concentration used showed more sensitivity against the microorganisms than 5mM concentrated disc proving the sensitivity of the nanoparticles increased as the microorganisms was also increased revealing that the diameter of zone of inhibition was directly proportional to the concentration of *A. marmelos* Ag NPs. The 3mM concentration of the *A. marmelos* Ag NPs demonstrated more sensitivity. The impregnated disc with *A. marmelos* Ag NPs exhibited lesser inhibition compared (See Table 1 and Table 2) to that of the direct addition into the well.

The antimicrobial activity of the silver nanoparticles synthesized from *A. marmelos* had sensitivity against the microbial strains *E. coli, S. aureus, P. aeuruginosa* and *C. albicans*. Poonkothai [12] reported the antimicrobial activity of *A.marmelos* of leaf, bark and fruit extracts.

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	10	8
S. aureus	10	9
P. aeuruginosa	11	10
C. albicans	13	11

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

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	12 mm	16 mm	14 mm	13 mm
S. aureus	13 mm	15 mm	14 mm	15 mm
P. aeuruginosa	16 mm	19 mm	13 mm	15 mm
C. albicans	13 mm	15 mm	13 mm	16 mm

3. Conclusion

Green synthesise of silver nanoparticles from the plant *Aegle marmelos* interpreted sensitivity against the microbial strains *Escherichia coli, Staphylococcus aureus, Pseudomonas aeuruginosa* and *Candida albicans*. The 20 mg/500 µl of the 3 mM silver nanoparticle was found as optimum concentration. This phyto-based silver nanoparticles can be used in hospitals (eg. surgical apparel, bedclothes, dressings, catheters), food industry (e.g., food containers), cosmetic, textiles (eg., sportswear, towels, carpets), mobile phones, household goods, water disinfection etc [13].

4. References

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