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Antimicrobial Activity of Vetiveria Zizanioides Mediated Silver Nanoparticles

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ABSTRACT

Introduction: Vetiver roots contain fragrant essential oil, which is a perfume by itself. Aroma chemicals such as vetriverol, vetriverone and vetiveryl acetate are prepared from this volatile oil. In India it is mainly used in perfumes, cosmetics, aromatherapy, food and flavouring industries. Since the plant has extensive finely structured fibrous roots, it is useful in both soil and water conservation and the plant itself is drought tolerant.The aim of this study is to find the antimicrobial activity of *vetiveria zizanoides* mediated silver nanoparticles.

Materials and Method: *Vetiveria zizanoides* was obtained from the local market and was made to dry in a shady region to finalize the moisture content. After this, they were crushed to fine powder using a grinder. Silver nanoparticles are synthesized and characterized.Antimicrobial activity of the nanoparticles have been analyzed by measuring the zone of inhibition for each microbe based on the concentration of nanoparticles.

Results and Discussion: The results obtained in previous study show lesser than the standard values for each bacteria than the antibiotics tested which is similar to the present study.Thus, the compounds with lower antibacterial activity may still have an important role in the development of antibacterial drugs that can be used particularly for children and for the treatment of non-severe infections.For S mutans the zone of inhibition was 13mm for 100µL which is same as the standard antibacterial value.

Conclusion: Based on the results,it can be concluded that the silver nanoparticles extracted from *vetiveria zizanioides* have a moderate level of antibacterial effect.

Keywords: *Vetiveria zizanioides, antibacterial, innovative technique*

1. INTRODUCTION

Vetiver, commonly known as Khus grass, is a perennial grass of Indian origin. *Vetiver* roots contain fragrant essential oil, which is a perfume by itself. Aroma chemicals such as vetriverol, vetriverone and vetiveryl acetate are prepared from this volatile oil. In India it is mainly used in perfumes, cosmetics, aromatherapy, food and flavouring industries. Since the plant has extensive finely structured fibrous roots, it is useful in both soil and water conservation and the plant itself is drought tolerant.(1)Nanotechnology is a field of research and innovation concerned with building 'things' - generally, materials and devices - on the scale of atoms and molecules (2)(3,4). A nanometre is one-billionth of a metre: ten times the diameter of a hydrogen atom (5). Currently, there is a growing need to develop an environmentally benign nanoparticle synthesis that does not use toxic chemicals in the synthesis protocols to avoid adverse effects in medical applications(6,7).The properties of noble metal nanoparticles such as silver and gold have previously been changed with many stabilizing and capping agents for various applications. The biological means of synthesizing nanoparticles provides an edge over chemical means as it is

cost-effective, does not involve physical barriers for lessening agents, and expels the toxic effects of the chemicals used for the synthesis.(8)

Silver has been used in the form of metallic silver, silver nitrate, or silver sulfadiazine to treat burns, wounds, and severe bacterial infections (9).The synthesized silver ions have been used in many kinds of formulations(10,11). Recently, it was shown that hybrids of SNPs with amphiphilic hyperbranched macromolecules display effective antimicrobial surface coatings. The most important applications of SNPs and GNPs are in the medical industry, such as topical ointments to prevent infection in burns and open wounds.(12) Silver nanoparticles (AgNPs) have received tremendous attention due to their significant antimicrobial properties . Large numbers of reports are available on the physical, chemical, and biological syntheses of colloidal AgNPs. Since there is a great need to develop eco-friendly and sustainable methods, biological systems like bacteria, fungi, and plants are being employed to synthesize these nanoparticles. (13) In previous studies the cytotoxicity,antioxidant,antidiabetic and many other characteristics of silver particles extracted from vetiveria zizanioides have been done.Whereas antibacterial studies of the silver nanoparticles is limited.Therefore this study is done to check the antibacterial property of the *Vetiveria zizanioides* mediated silver nanoparticles.

In the present study microbial activity of the *Vetiveria zizanioides* mediated silver nanoparticles was analysed by comparing with the standard antimicrobial agents.This study could have also analyzed various other characteristics such as antioxidant, anti inflammatory activities etc.Our team has extensive knowledge and research experience that has translate into high quality publications (14),(15),(16),(17),(18),(19),(20),(21),(22),(23),(24),(25),(26),(27),(28),(29),(30),(31),(32),(33)

2. MATERIALS AND METHOD

Plant extraction:

Vetiveria zizanoides was obtained from the local market and was made to dry in a shady region to finalize the moisture content. After this, they were crushed to fine powder using a grinder. Then 50 mL of water was added to 0.5 g of *Vetiveria zizanioides* in a conical flask which was then labeled and set for heating. For this heating process, the heating mantle was set to a temperature of 50 to 60 °C and the time taken for this process to complete was 6-8 minutes. After this, the solution was filtered using a filter paper. And finally the plant extract was prepared.

Synthesis of silver nanoparticles:

90 mL of 1 mm silver nitrate prepared and added to 10ml of plant extract that was already prepared before, and found that the solution was light yellow in color. The extract was then further clogged with foil paper. Using an orbital shaker, uniform dispersion was made to initiate the synthesis process and the color change of the solution was observed periodically. After this, the product was dried and heated in a furnace. The annealed product thus obtained was taken as the sample for this study.

Characterisation of synthesized nanoparticles:

The silver nanoparticles synthesized were measured optically using double beam UV– vis spectroscopy. It refers to absorption spectroscopy in visible ranges and directly affects the color of the chemicals present. It is mostly used in analytical chemistry for quantitative determination of different ions, compounds and biological macromolecules at different wavelengths. The synthesized silver nanoparticles were optically measured at different wavelengths ranging from 250 nm to 350 nm.

Antimicrobial test

Antimicrobial activity of respective nanoparticles against the strain *staphylococcus aureus,E.faecalis, S.mutans* and *C.albicans* MHA agar was utilized for this activity to determine the zone of inhibition. Muller hinton agar was prepared and sterilized for 45 minutes at 120lbs. Media poured into the sterilized plates and let them stabilize for solidification. The wells were cut using the well cutter and the test organisms were swabbed.The nanoparticles with different concentrations were loaded and the plates were incubated for 24 hours at 37 ° C. After the incubation time the zone of inhibition was measured.

Figure 1:Nanoparticle preparation

3. RESULTS AND DISCUSSION

Table 1: Shows zone of inhibition of various oral pathogens at different concentrations.

	25µL	50µL	100µL	AB
C albicans	9	9	9	10
E.faecalis	9	14	16	40
S aureus	9	10	14	17
S mutans	9	12	13	13

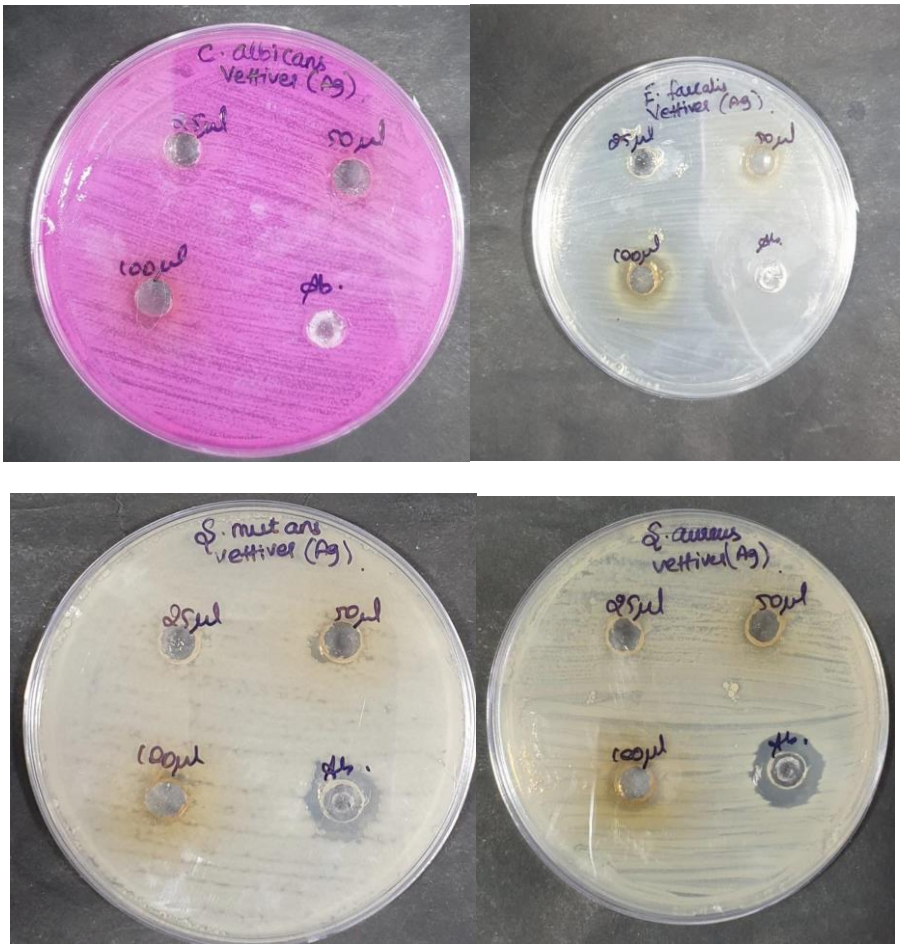
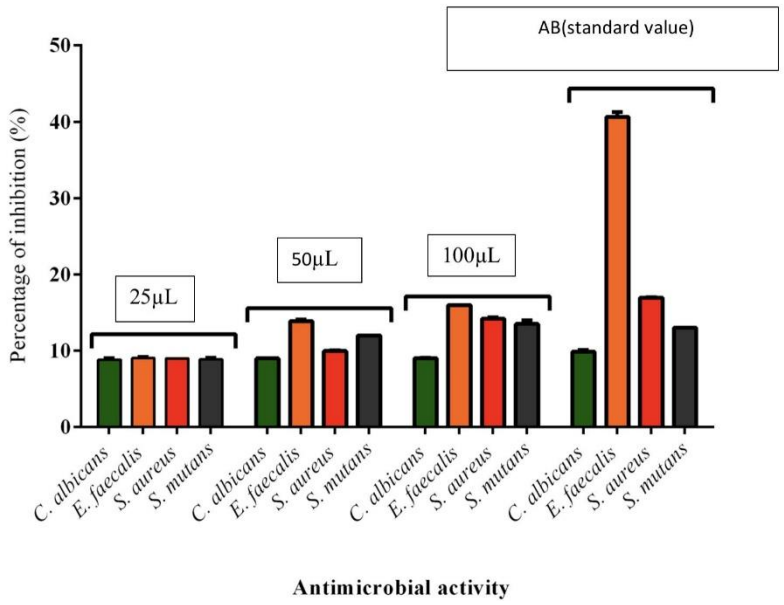


Figure 2:Antimicrobial activity of silver nanoparticles extracted from *Vetiveria zizanioides*.



Graph 1:The graph represents the antimicrobial activity of the silver nanoparticles against C.albicans,E. Faecalis ,S.aureus and S.mutans in different concentrations and is compared with the standard antimicrobial agent.X axis represents the zone of inhibition and Y axis represents the concentration of nanoparticles.Yellow represents S.mutans,Grey represents S.aureus,orange represents E.faecalis and blue represents C.albicans.

Table 1 demonstrates inhibition of bacterial growth at varying concentrations of biosynthesized silver nanoparticles. The antimicrobial activity was evaluated based on their zone of inhibitions and the results were compared with the standard antibacterial agent. The antibacterial activity against S. aureus showed a zone of inhibition of 9mm at the concentration of 25µl.The antibacterial activity against S. aureus showed a zone of inhibition of 10mm at the concentration of 50µL.Antimicrobial activity against S. aureus showed a zone of inhibition of 14mm at the concentration of 100µL.The standard antibacterial agent had 17mm of zone of inhibition.Therefore comparatively the antimicrobial activity of silver nanoparticles is less against S. aureus.The antimicrobial activity of silver nanoparticles based against S. mutans showed a zone of inhibition 9mm at concentrations of 25µL,12mm at 50µl and 13mm at concentration of 100µl.The standard antimicrobial agent has zone of inhibition of 13mm.Therefore when compared to the standard shows moderate antimicrobial activity. The antimicrobial activity of silver nanoparticle against *E. faecalis* showed a zone of inhibition of 9mm at the concentration of 25µl.The antimicrobial activity against E. faecalis showed a zone of inhibition of 14mm at the concentration of 50µl.The antimicrobial activity against *E. faecalis* showed a zone of inhibition of 16mm at the concentration of 100µl.When compared to the standard antimicrobial agent it is observed that this has low level of antimicrobial activity against *E. faecalis*.The antimicrobial activity of nanoparticles against *C. albicans* showed a zone of inhibition of 9mm at the concentration of 5µl.The antimicrobial activity of nanoparticles against *C.albicans* showed a zone of inhibition of 9mm at the concentration of 50µl.The antimicrobial activity against *C.albicans* showed a zone of inhibition of 9mm at the concentration of 100µl.When compared to the standard antimicrobial agent that is 10mm it is observed that this nanoparticles has moderate level of antimicrobial activity against C.albicans.(table 1)Therefore the antimicrobial activity of the *Vetiveria zizanoides* silver nanoparticles was moderate against *C.albicans* and *S.mutans*.(graph 1)

In previous studies,Ethanolic extract of *Vetiveria zizanioides* showed more activity against *Escherichia coli,Pseudomonas aeruginosa* and less antibacterial activity when compared with standard antibacterial agent was shown by aqueous extract similar to the present study.(34)(35) The extract shows increasing inhibitory activity with increase in concentration.(36)The results obtained in previous study show lower antibacterial effects than the antibiotics tested which is similar to the present study.Thus, the compounds with lower antibacterial activity may still have an important role in the development of antibacterial drugs that can be used particularly for children and for the treatment of non-severe infections.(37) Many studies have concluded that extract of *Vetiveria zizanioides* have less antibacterial effect when compared to standard antibacterial agents.(38)(39) The minimum inhibitory effect of *vetiveria* was considered to be high as well as antioxidant activity was also high.(40)

Only antimicrobial activity of the nanoparticles have been analyzed.Further more studies must be done to gain knowledge about the different characteristics of the *Vetiveria zizanioides* mediated silver particles.

4. CONCLUSION

Within the limits of the study,the antimicrobial effect of *Vetiveria zizanioides* mediated silver nanoparticles has been observed.Based on the results it can be concluded that the antibacterial effect of nanoparticles against *C.albicans* and *S.mutans* is moderate when compared to the standard antibacterial agent.Further researches must be done to analyze many more uses and characteristics of the silver nanoparticles extracted from *Vetiveria zizanioides*.

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6. CONFLICT OF INTEREST

The author declares that there is no conflict of interest in the present study.

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