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Antimicrobial Activity of Silver Nanoparticle Synthesized by Using *Costeus igneus*

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ABSTRACT

The field of Nanotechnology is the most active area of research in modern material science. Though there are many chemical as well as physical methods, green synthesis of nonmaterial is the most emerging method of synthesis. We report the synthesis of antibacterial silver nanoparticles using leaf broth of medicinal herb *Costus igenus*. The synthesised AgNPs have been characterised by UV-Vis spectroscopy. The silver nanoparticles stabilized by *Costus igenus* leaf extract were found to have enhanced antimicrobial activity against well-known pathogenic strains *Streptococcus sp, Pseudomonas aeruginosa sp , staphylococcus sp, Proteus sp* as well as fungi *Penicillium sp, Mucor sp, Candida albicans sp, Aspergillus sp.*

Keywords: *Costeus igneus,* Soxhelet, Silver nanoparticles, Antimicrobial activity

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INTRODUCTION

Nanotechnology is e merging as a rapidly growing field with its application in science and technology for the purpose of manufacturing new materials at the nanoscale level. In the present scenario, nanoscale materials have emerged up as novel antimicrobial agents owing to their high surface area to volume ratio and the unique chemical and physical properties [1,2]. Silver have come up but silver nanoparticles have proved to be most effective as it has good antimicrobial efficacy against bacteria, viruses and other eukaryotic microorganisms [3].The current investigation supports that use of silver ion or metallic silver as well as silver nanoparticles can be exploited in medicine for burn treatment, dental materials, coating stainless steel materials, textile fabrics, water treatment, sunscreen lotions, etc. and posses low toxicity to human cells, high thermal stability and low volatility [4]. Nanotechnology is now creating a growing sense of excitement in the life sciences especially biomedical devices and Biotechnology [5]. Nanoparticles exhibit completely new or improved properties based on specific characteristics such as size, distribution and morphology. The silver nanoparticles have various and important applications. Historically, silver has been known to have a disinfecting effect and has been found in applications ranging from traditional medicines to culinary items. It has been reported that silver nanoparticles (SNPs) are non-toxic to humans and most effective against bacteria, virus and other eukaryotic micro-organism at low concentrations and without any side effects [6]. Antimicrobial capability of SNPs allows them to be suitably employed in numerous household products such as textiles, food storage containers, home appliances and in medical devices [7].

MATERIALS AND METHODS

Collection and Drying of Plant Materials

Mature leaves of *Costus igenus* were collected from Theni at Vathalakundu, Tamil Nadu. The leaves of *Costus igenus* were washed thoroughly three times with water and once with distilled water. The plant materials were air dried and powdered. The powdered samples were hermetically sealed in separate polythene bags until the time of extraction.

Preparation of Plant Extract

10 g of powdered leaves were extracted successively with 100 ml of methanol at 40-50°C in Soxhelet extractor until the extract was clear. The extracts were evaporated to dryness and the resulting pasty form extracts were stored in a refrigerator at 4°C for future use [8, 9].

Synthesis of *Costus igneus* Silver Nanoparticles

1mM silver nitrate was added to the plant extracts separately make up a final solution of 100ml. After incubation, the plant extract will turn to brown color, it indicates the synthesis of nanoparticles. After dilute the plant extract and detect its absorbance values and peaks on UV- visible spectrophotometer range between 400-450nm.

Test Microorganisms

Nine pathogenic bacteria, *viz*., *Staphylococcus aureus*, *Bacillus cereus*, *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhi*, *Shigella flexneri*, *Klebsiella pneumonia*, *Vibrio cholera* and *Pseudomonas aeruginosa species of bacteria and Penicillium, Mucor, Candida albicans* and *Aspergillus nige*r were used during the present study and were obtained from PSG Hospital, Coimbatore. The cultures were sub-cultured and maintained on Nutrient agar slants and stored at 4°C.

Antibacterial Activity

Muller Hinton Agar plates were prepared, sterilized and solidified. After solidification, the bacterial cultures was swabbed on these plates. Then the well of the suitable size (6mm in diameter) was cut in each plate. The synthesised nanoparticles were concentrated by centrifugation and the pellets at different concentrations (50,75,100µl) were added an each well. It was then incubated at 37°C.for 24hrs.The plates were examined for inhibitory zones.

Antifungal Activity

It was done by well diffusion method.Potato dextrose agar plates were prepared, sterilized and solidified, after solidification fungal cultures were swabbed on these plates. The sterile discs were dipped in silver nanoparticles solution (50,75,100 µl) and placed in the agar plate and kept for incubation for 7 days. After 7 days zone of inhibition was measured.

RESULTS AND DISCUSSION

The green synthesis of silver nanoparticles through plant extracts were carried out. It is well known that silver nanoparticles exhibit yellowish - brown colour in aqueous solution due to excitation of surface plasmon vibrations in silver nanoparticles [10]. The appearances of yellowish-brown colour in the reaction vessels suggest the formation of silver nanoparticles (SNPs) [11**].** Silver nitrate is used as reducing agent as silver has distinctive properties such as good conductivity, catalytic and chemical stability.

The aqueous silver ions when exposed to herbal extracts were reduced in solution, there by leading to the formation of silver hydrosol. The time duration of change in colour varies from plant to plant. The synthesis of SNPs had been confirmed by measuring the UV-Vis spectrum of the reaction media. The UV-Vis spectrum of colloidal solutions of SNPs synthesized from, *Costus igneus* have absorbance peaks at 400 to 450 nm at 24 hrs and 48 hrs. Toxicity studies on pathogen opens a door for nanotechnology applications in medicine. Biological synthesis of metal NPs is a traditional method and the use of plant extracts has a new awareness for the control of disease, besides being safe and no phytotoxic effects [12]. The biologically synthesized silver nanoparticles using medicinal plants were found to be highly toxic against different pathogenic bacteria and fungi of selected species. The SNPs of *Costus igneus*

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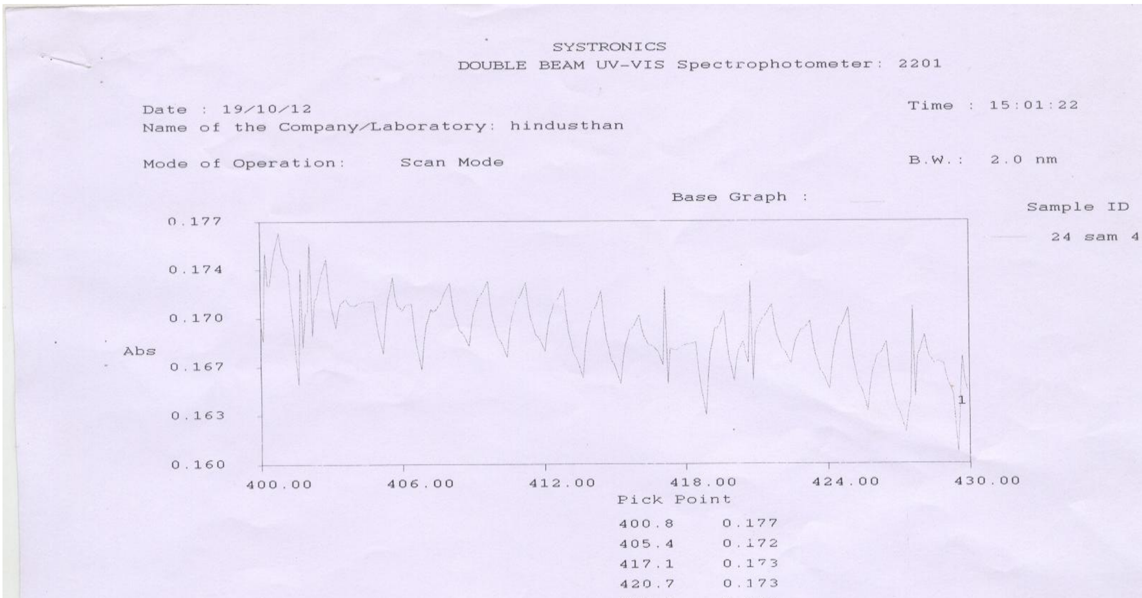
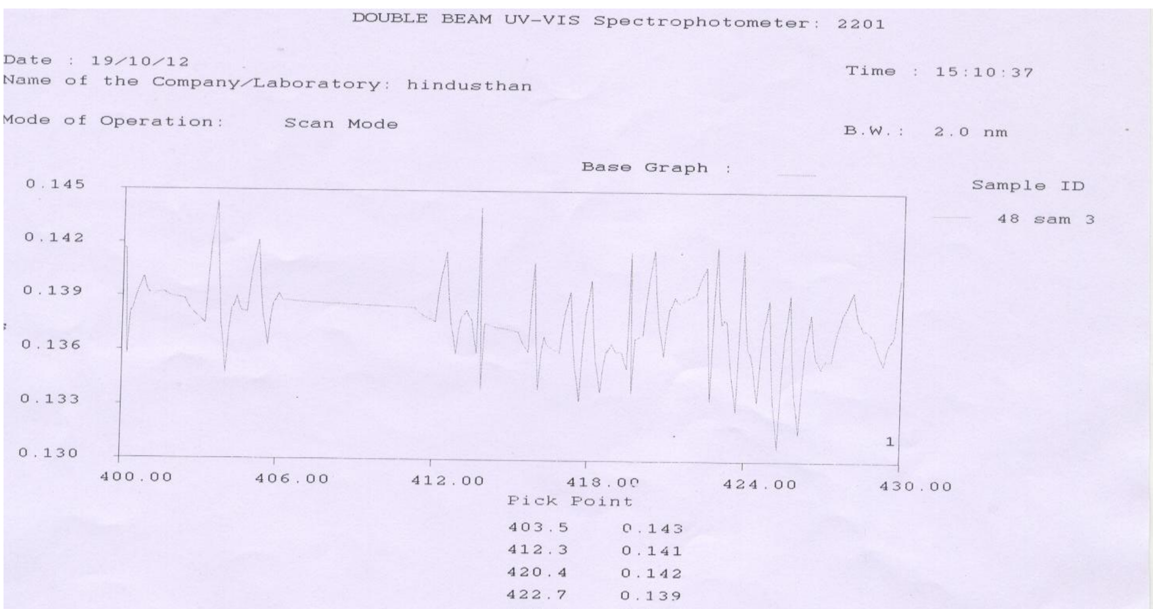
Fig 1: UV-Vis absorption spectroscopy analysis of silver nanoparticles synthesized from c*ostus igneus* at 24hrs and 48hrs





shows highest antibacterial activity against *Streptococcus sp* (12mm) followed by St*aphylococcus sp* and *Proteus sp* (10mm); and antifungal activity was observed against *Penicillum sp* (10mm)and *Mucor sp* (9mm). The molecular basis for the biosynthesis of these silver crystals is speculated that the organic matrix contain silver binding proteins that provide amino acid moieties that serve as the nucleation sites (Prabhu *et al.*, 2010). The efficiency of various silver based antimicrobial fillers in polyamide toward their silver ion release characteristics in an aqueous medium was also investigated and discussed in number of plants including algae, yeast and fungi [13, 14]. The present work supports the medicinal values of this plants was confirmed and also revealed that a simple, rapid and economical route to synthesis of silver nanoparticles; and their capability of rendering the antimicrobial efficacy. Moreover the synthesized SNPs enhance the therapeutic efficacy and strengthen the medicinal values of this plant.

Table 1: Antibacterial activity of *Costus igenus* methanol extract against bacterial pathogens:

S.No	Organism	Concentration of extract and zone of inhibition(mm)		
		50mg	75mg	100mg
1	*Streptococcus sp*	4mm	9mm	12mm
2	*Pseudomonas aeruginosa sp*	5mm	10mm	5mm
3	*Staphylococcus sp*	4mm	7mm	10mm
4	*Bacillus subtilis sp*	3mm	7mm	9mm
5	*Proteus sp*	5mm	8mm	10mm

Table 2: Antifungal activity of *Costus igenus* methanol extract against pathogenic fungi:

S.No	Organism	Concentration of extract and zone of inhibition(mm)		
		50mg	75mg	100mg
1	*Penicillium sp*	4mm	9mm	12mm
2	*Mucor sp*	5mm	10mm	5mm
3	*Candida albicans sp*	4mm	7mm	10mm
4	*Aspergillus sp*	3mm	7mm	9mm

CONCLUSION

The present study included the bio-reduction of silver ions through medicinal plants extracts and testing for their antimicrobial activity. The aqueous silver ions exposed to the extracts, the synthesis of silver nanoparticles were confirmed by the change of colour of plant extracts. These environmentally benign silver nanoparticles were further confirmed by using UV-Vis spectroscopy. The results indicated that silver nanoparticles have good antimicrobial activity against different microorganisms. It is confirmed that silver nanoparticles are capable of rendering high antifungal efficacy and hence has a great potential in the preparation of drugs used against fungal diseases.

REFERENCES

[1] Morones JR and Elechiguerra JL, Alejandra Camacho, Katherine Holt, Juan B Kouri, Jose Tapia Ramírez and Miguel Jose Yacaman. Nanotechnology 2005; 16: 23-46 .
[2] Kim JS, Kuk E, Yu KN, Kim JH, Park SJ, Lee HJ, Kim SH and Park YK. Nanomed Nanotechnol Biol Med 2007;3(1):95–101
[3] Gong, P, Li, H, He, X, Wang, K, Hu, J, Zhang S and Yang X. Nanotechnol 2007; 18(28): 604-611.

[4] Duran N, Marcarto, PD, De Souza, GIH., Alves, OL and Esposito E. J Biomed Nanotechnol 2007; 3(2), 203-208.
[5] Prabhu N, Divya TR, Yamuna G. Digest J Nanomater Biostruct 2010; 5: 185-189.
[6] Jeong SH, Yeo SY, Yi SC. J Mat Sci 2005; 40: 5407-5411.
[7] Marambio-Jones C, Hoek EMV. J Nanopart Res 2010; 12:1531-1551.
[8] Chessbrough M. Medical laboratory manual for Tropical countries, Linacre House, Jordan Hill, Oxford 2000.
[9] Evans WC. Trease and Evan's Pharmacognosy. 5th edition, Haarcourt Brace and Company: 2002; 336.
[10] Thirumurgan A, Tomy NA, Jai Ganesh R and Gobikrishnan S. De Phar Chem 2010; 2: 279-284.
[11] Shankar SS, Rai A, Ahmad A and Sastry MJ. J Collid Interface Sci 2004; 275: 496-502.
[12] Gardea-Torresdey JL, Gomez E, Peralta- Videa J, Parsons JG, Troiani HE and Jose-Yacaman. Langmuir 2003; 13: 1357.
[13] Arya V. Digest J Nanomater Biostruct 2010; 5: 9-21.
[14] Jeong SH, Yeo SY, Yi SC. J Mat Sci 2005; 40: 5407-5411.