GREEN SYNTHESIS OF GOLD NANOPARTICLES FROM COSTUS IGNEUS

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ABSTRACT

Nanotechnology refers broadly to a field of applied science and technology whose unifying theme is the control of matter on the atomic and molecular scale. The use of chemically synthesized nanopaticles leave out the residue and it will be toxic, biological synthesis of nanoparticles are user friendly and synthesized with in an hours of time. In this Study we have synthesized the Gold nanoparticles from the plant Costus igneus by reduction of Auric chloride. The Surface Plasmon resonance was found at 536nm confirmed the gold nanoparticle synthesis. The spherical size nanoparicles in the size range of 54-62 were confirmed by Scanning Electron Microscopy (SEM). The synthesized Nanoparticles Showed higher antibacterial activity against gram positive and gram negative bacteria. It also showed good anti-diabetic activity.

Keywords—*SEM; anti-diabetic; antibacterial; Costus igneus; nanoparticles.*

1.INTRODUCTION

Nanotechnology is mainly concerned with the synthesis of nanoparticles of variable sizes, shapes, chemical compositions and controlled dispersity and their potential use for biomedical applications.With the advancement of technologies and superior scientific understanding paved a way for research and development in the field of plant biology towards intersection of nanotechnology. One such interference is employing plants or plant parts in the synthesis of nanoparticles **[1-3]**. Nanoparticles are of numerous scientific interests as they are effectively a bridge between bulk materials and atomic or molecular structures. Chemical synthesis of metal nanoparticles leads to the production of toxic compounds, which remains adsorbed on the surface that have adverse effects on human health **[4]**. The usage of eco-friendly materials like plant extracts, microbes and enzymes not only eliminate the hazards of toxic material but also many constraints **[5-8]**. Utilization of plants becomes the most voted choice for generating metal nanoparticles for being easily available, environmentally benign, a hoard of metabolites, complex metabolic pathways, ability to tolerate heavy metals, cost effective and less tedious purification steps **[9-11]**. Plant system also requires small incubation period than microbial systems and can be easily scaled up for commercial production **[12]**. They have advantage over other metal nanoparticles for being biocompatible and non-toxic nature **[13-15].** To the

best of our knowledge, gold nanoparticle synthesis from *Costus igneus* is reported for the first time by reducing a solution of Gold (III) chloride.

2. MATERIALS AND METHODS

2.1. Materials

Auric Chloride: Brought from Sigma Aldrich Pvt. Ltd
Silver Nitrate: Himedia
Bacterial Culture : Chettinad University
Fungal Culture: Chettinad University

2.2.Sample collection

Plant sample Costus igneus was collected from Pollachi

2.3Preparation of extracts

The plant leaves was washed well with distilled water, dried in the shade for about one week and powdered .1g of the plants was taken and mixed with 10ml of ethanol. It was kept in an orbital shaker at 100 rpm for 16 hours. It was then centrifuged and the extract was collected

2.4 Synthesis of Gold Nanoparticles

1ml of ethanolic extract was taken and to that 9 ml of 1mMAuric chloride solution was added & mixed well. Then it was kept for incubation.

2.5 Characterisation of gold nanoparticles

2.5.1 UV –Spectroscopy

The synthesized nanoparticles were analyzed by UV-Spectroscopy at Avanz Bio Pvt Ltd, Tambaram
The 10^{-3}M Auric chloride was used as a blank.
It was analyzed between 200-680 nm

2.5.2 SEM

The synthesized gold nanoparticles were characterized by using SEM, done in Department of Nanosciences, Anna University.

2.6 Antibacterial activity of gold nanoparticles

The antibacterial activity of the synthesized nanoparticles were found by Kirby Bauer Disc diffusion method

2.7Antifungal activity of gold nanoparticles

The antifungal activity of the synthesized nanoparticles were found by Kirby Bauer Disc diffusion method.

2.8 Antidiabetic activity of gold nanoparticles

Yeast model:
1% bakers yeast was taken
5mM and 10mM Glucose solution was prepared
checking the antidiabetic activity of the synthesized gold nanoparticles, crude extract ,control and tests were maintained

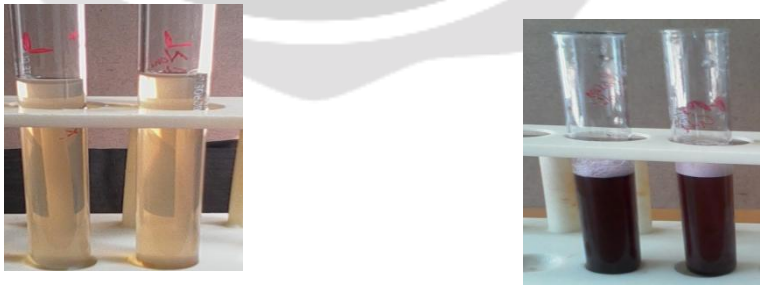
Table -1: Antidiabetic activity of Gold Nanoparticles

Reaction Mixture	**Control**		**Test 1**		**Test 2**	
Glucose	5mM (500 µl)	10mM (500 µl)	5mM (500 µl)	10Mm (500 µl)	5mM (500 µl)	10mM (500 µl)
Distilled water	500µl	500µl	-	-	-	-
Crude Extract	-	-	500 µl	500 µl	-	-
Gold Nanoparticles	-	-	-	-	500µl	500µl
It was kept for 10min Incubation						
Yeast	100µl	100µl	100µl	100µl	100µl	100µl
It was kept for 1 hour Incubation						
Optical density was measured at 600nm						

3. RESULTS AND DISCUSSION

In medicine, gold nanoparticles are used for different proposes. For example, after cellular uptake, they can act as tiny, precise and powerful heaters (thermal scalpels) to kill cancer (El-Sayed I.H. Huang, X. et al., 2006, Salata, O.V. et al., 2004) and they are capable of inducing apoptosis in B-chronic lymphocytic leukemia (Mukherjee, P. et al., 2007). Many reports have been published in the literature on the biogenesis of gold nanoparticles using several plant extracts, particularly Neem leaf broth (Azadirachta indica), alfa alfa (Medicago sativa), Eucalyptus camaldulensis, Pelargonium roseum.

In the present study Costus igneus have chosen for the synthesis of Gold and silver nanoparticles. 1mM Auric chloride is used to synthesis the gold. The ethanolic extracts of the plants was mixed with Auric chloride, it becomes yellow to ruby after 15mins The colour change indicates the formation gold nanoparticles (fig.1).



Before synthesis After Synthesis

Fig. 1: Synthesis of Gold Nanoparticles

In the present study nanoparticle synthesis is confirmed initially by the colour change and later synthesized nanoparticles were characterized by UV-Vis Spectroscopy and Scanning electron microscopy. The nanoparticles

were primarily characterized by UV-Vis spectroscopy, which was proved to be a very useful technique for the analysis of nanoparticles. Reduction of Au ions in the aqueous solution of gold complex during the reaction with the ingredients present in the plant extracts observed by the UV-Vis spectroscopy revealed that gold nanoparticles in the solution may be correlated with the UV-Vis spectra. As the plant extracts were mixed with the aqueous solution of the gold ion complex, it was changed into ruby red color due to excitation of surface plasmon vibrations, which indicated that the formation of gold nanoparticles (Shankar. S.S. et al., 2004). UV-Vis spectrograph of the colloid of gold nanoparticles has been recorded as a function of time by using a quartz cuvette with chloro auric acid as the reference. In the UV-Vis spectrum, the broadening of peak indicated that the particles are poly dispersed. The reduction of gold ions and the formation of stable nanoparticles occurred rapidly within 15mins of reaction making it one of the fastest bioreducing methods to produce gold nanoparticles. In the present study synthesized Gold Nanoparticles showed the maximum absorption at 536nm . The same was reported in the case of synthesis of gold nanoparticles from Momordica charantia fruit (Sunil Pandey, et al., 2012)

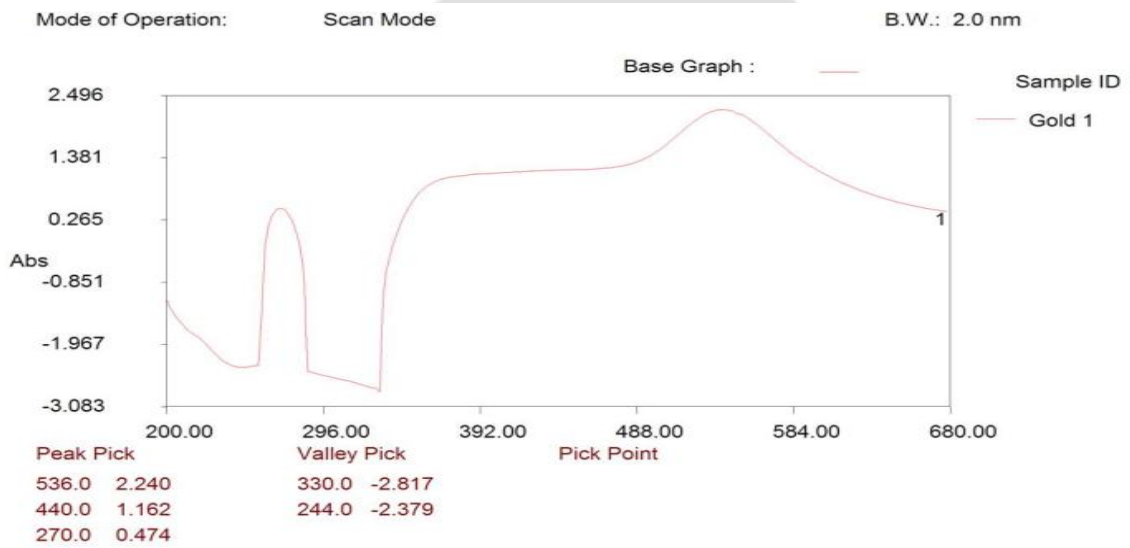


Chart. 1: UV- Vis Spectrum for Synthesized Gold Nanoparticles maximum absorption was at 536nm.

Scanning electron microscopy studies reveals the shape and size of the nanoparticles. The size of the synthesized nanoparticles was found to be 54-62nm; the shape is spherical (Nanospheres) . The important parameter which controls the shape and size of gold nanoparticle was pH value (Shiying He, et al, (2007). If we change the pH of the solution there is a chance for getting small sized nanoparticles.

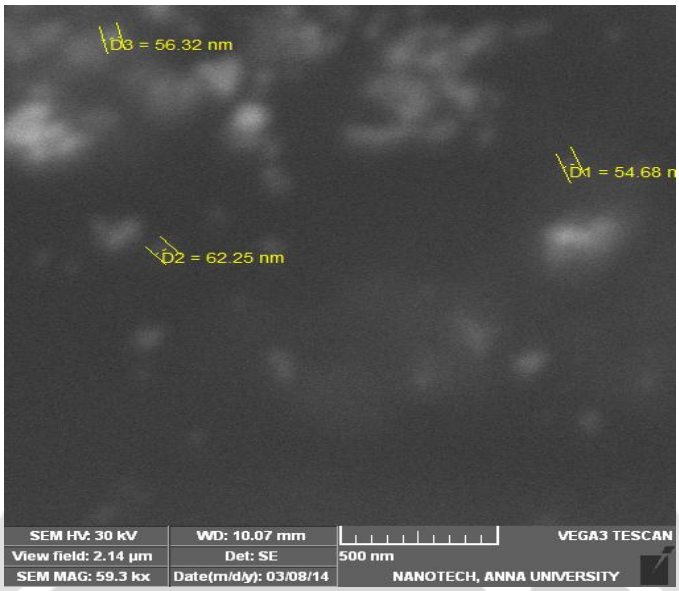


Fig. 2: SEM ANALYSIS - The nanoparticle formed was found to be spherical in shape and size of the nanoparticle was found to be 54-62nm

Antibacterial activity of the synthesized nanoparticles was analyzed against the gram positive and gram negative human pathogens using Kirby bauer disc diffusion method. The activity was found to be more in the case of gold nanoparticles than the ethanolic extracts. Gold nanoparticles showed activity against all the microbes (*Staphylococcus aureus, Proteus mirabilis, Pseudomonas aeuroginosa, Klebsiella pneumonieae, Staphylococcus aureus, E.coli)* and it also showed activity against the fungal species.

Table -2: Antibacterial and antifungal activity of Gold Nanoparticles

Organism	***Water (Negative Control) (mm)***	***Antibiotic (Positive Control) (mm)***	***Crude Extract (mm)***	***Gold Np (mm)***
Staphylococcus aureus	0	24	4	12
Klebsiella pneumonieae	0	12	8	10
E.coli	0	24	4	10
Proteus mirabilis	0	20	2	10
Pseudomonas aeruginosa	0	8	8	8
Salmonella typhi	0	24	4	10
Shigella flexneri	0	8	2	8
Penicillium	0	12	0	4
Aspergillus	0	6	0	2

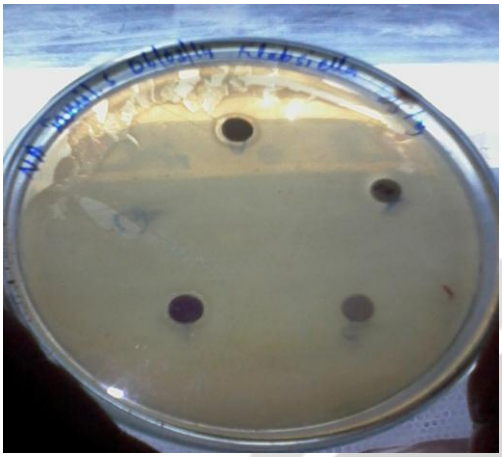


Fig. 3: Activity of AuNps in Klebsiella

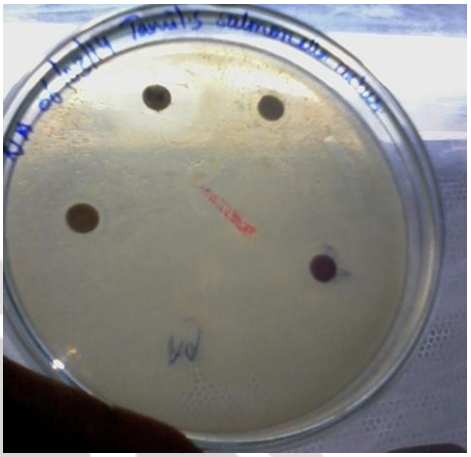


Fig. 4: Activity of AuNps in Salmonella

The number of bacterial colonies grown on agar plates as a function of the different concentration of silver nanoparticles when gradually declined when the concentration of nanoparticles increased, 50µl of silver nanoparticles showed good inhibitory activity against the microorganisms. (K.Govindaraju, et al., 2010). In the present study only 10ul of the nanoparticles were added. If we increase the concentration of the nanoparticles the zone of inhibition will be more.

Gold nanoparticles synthesized using PAT was administered to alloxan (150 mg/kg body weight) induced diabetic male albino rats at different levels for 28 days. Plasma glucose level, cholesterol and triglyceride were significantly ($p<0.001$) reduced in experimental animals treated with gold nanoparticles at dosage of 0.5mg/kg body weight and plasma insulin increased significantly. (_Ali Alkaladi_, et al., 2014) reported that zinc oxide and silver nanoparticles were evaluated for their antidiabetic activity. Zinc oxide and silver nanoparticles induce a significant reduced blood glucose, higher serum insulin, higher glucokinase activity higher expression level of insulin, insulin receptor, GLUT-2 and glucokinase genes in diabetic rats treated with zinc oxide, silver nanoparticles and insulin. In conclusion, zinc oxide and sliver nanoparticles act as potent antidiabetic agents.

In the present approach we used yeast model to study the antidiabetic activity of the synthesized gold nanoparticles. The optical density of the sample got reduced considerably in the case of crude and Gold Nanoparticles. Good antidiabetic activity was shown in Gold Nanoparticle when compared to crude extract

Table -3: Antidiabetic activity of AuNps

SAMPLE	*5mM*	*10mM*
Control	*0.46*	*0.53*
Crude	*0.14*	*0.2*
Gold Np	*0.09*	*0.11*

The synthesized Gold nanoparticles showed good Antibacterial, antifungal and antidiabetic activity.

4.CONCLUSION

In conclusion, we developed a eco-friendly, simple and efficient method for the synthesis of gold nanoparticles using leaf extract of *Costus igneus.* The shape and size of the AuNPs were confirmed by SEM with spherical shape nanoparticle with an average size of 50 and 60nm. The outcome of the experiments was positive concluding that the AuNPs synthesized shows good antimicrobial and antidiabetic properties. The rate of reduction of metal ions using plant agents is found to be much faster and also at ambient temperature and pressure conditions. Future work should implement systematic experiments, which include development of gold nanoparticles of well-defined shape and size. Better understanding of the mechanism of gold nanoparticle biosynthesis will enable us to achieve better control over the size, shape and monodispersity which will lead to the development of high precision production and application of them for commercial use.

5. REFERENCES

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