
International Journal Of

**Recent Scientific Research**

**ISSN: 0976-3031**

**Volume: 7(2) February -2016**


# BIOLOGICAL AND GREEN SYNTHESIS OF GOLD NANOPARTICLES USING CYMBOPOGAN CITRATUS EXTRACT


**Jeyalalitha T., Murugan K and Umayavalli M**



THE OFFICIAL PUBLICATION OF
INTERNATIONAL JOURNAL OF RECENT SCIENTIFIC RESEARCH (IJRSR)
http://www.recentscientific.com/ recentscientific@gmail.com

ISSN: 0976-3031

Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 7, Issue, 2, pp. 8688-8693, February, 2016

International Journal of Recent Scientific Research

RESEARCH ARTICLE

# BIOLOGICAL AND GREEN SYNTHESIS OF GOLD NANOPARTICLES USING CYMBOPOGAN CITRATUS EXTRACT

**Jeyalalitha T[1]*., Murugan K[2] and Umayavalli M[3]**

[1]Department of Zoology, Arulmigupalaniandavar College of Arts and Culture, Palani
[2]Division of Entomology, Department of Zoology, School of Life Sciences, Bharathiyar University, Coimbatore
[3]Department of Chemistry, Arulmigupalaniandavar College of Arts and Culture, Palani

**ARTICLE INFO**

***Article History:***

Received 06th November, 2015
Received in revised form 14th December, 2015
Accepted 23rd January, 2016
Published online 28th February, 2016

***Key words:***

Biosynthesis, Goldnanoparticle, transmission electron microscopy, Cymbopogancitratus.

**ABSTRACT**

The bio molecules present in the plant induced the reduction of $Au^{3+}$ ions from $HAuCL_4$, resulted in the formation of Gold nanoparticles. The growth of nanoparticles was monitored by Uv-Vis spectrophotometer that demonstrated a peak at 540nm. Particle size Analyser and Transmission electron microscopy (TEM) were used to find the size and shape of the Gold nanoparticles. Gold nanoparticles were 20-30nm in size and their shape varied from spherical to triangular and hexagonal poly shaped. X-ray Diffraction analysis (XRD) studies corroborated that the biosynthesized nanoparticles were crystalline gold. Energy dispersive spectroscopy (EDAX) confirmed the presence of an elemental gold signal. Fourier transform-infrared (FTIR) spectroscopy analysis revealed that biomolecules were involved in the synthesis and capping of gold nanoparticles.



## INTRODUCTION

In recent years a rapid advancement in various technologies for the fabrications of nanoparticles . Metal nanoparticles are witnessing extreme attention due to their inverse properties and uses, like magnetic and optical polarizability, electrical conductivity[1]catalysis and antibacterial and antimicrobial activities[2,3], DNA sequencing [4] and surface enhanced Raman scattering (SERS )[5]. Many chemical based methods are available for synthesis of silver and Gold nanoparticles, but there is a growing concern towards use of these chemicals as they are reported to be very toxic for the environment and cost effective at the industrial scale.

Due to these problems, various ecofriendly approaches for the synthesis of Gold nanoparticles are being adopted. Among them, plant mediated synthesis is being widely explored. Number of plants have been successfully used for the synthesis of gold nanoparticles. The gold nanoparticle are synthesized within live alfalfa plants[6]. There have been recent reports on biosynthesis of gold nanoparticles by employing coriander leaves,[7]sundried *Cinnamomum camphora* leaves[8] phyllanthin extract[9] and purified compound extracted from henna leaves [10].Research on biosynthesized nanoparticles and insect control should be geared towards introduction of faster and ecofriendly pesticides in future [11] *Cymbopogon* (lemongrass) is a genus of about 55 species of grasses, (of which the type species is *Cymbopogon citratus*) native to warm temperate and tropical regions. Lemongrass oil is used as a pesticide and a preservative. Research shows that lemongrass oil has anti-fungal properties. It is native to cambodia, India, sri lanka, burma, and thailand.

Lemongrass is usually ingested as an infusion made by pouring boiling water on fresh dried leaves and is one of the most widely used traditional plants in folk medicine. It is used as an antispasmodic, antiemetic, and analgesic, as well as for the management of nervous and GI disorders and the treatment of fevers. In India it is commonly used as an antitussive, antirheumatic, and antiseptic. In Chinese medicine, lemongrass is used in the treatment of headaches, stomach aches, abdominal pain, and rheumatic pain. Lemongrass is an important part of Southeast Asian cuisine, especially as

**Corresponding author:* **Jeyalalitha T**
Department of Zoology, Arulmigupalaniandavar College of Arts and Culture, Palani

flavoring in Thai food. Other uses include as an astringent and a fragrance in beauty products. [12,13,14] . It is also used as an insect repellent in insect sprays.

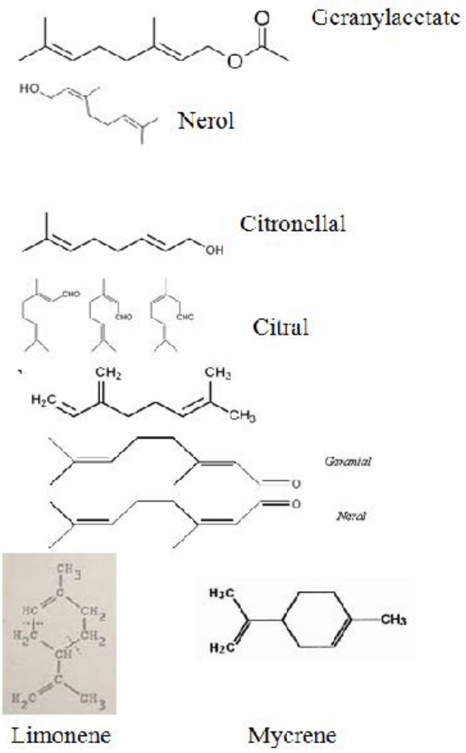
### *Chemical composition*

The main chemical components of lemongrass oil are myrcene, citronellal, geranyl acetate, nerol, geraniol, neral and traces of limonene and citral. Fresh C. citratus grass contains approximately 0.4% volatile oil. The oil contains 65% to 85% citral, a mixture of 2 geometric isomers, geraniol and neral. Related compounds geraniol, geranic acid, and nerolic acid have also been identified [15,16,17,18]. Other compounds found in the oil include myrcene (12% to 25%), diterpenes, methylheptenone, citronellol, linalol, farnesol, other alcohols, aldehydes, linalool, terpineol, and more than a dozen other minor fragrant components. [19,20,21]. Several reports describe antimicrobial effects of lemongrass, including activity against both gram-positive and gram-negative bacterial pathogens, and fungi.[22,23,24,25,26,27,28,29,30]

### *Chemical Structures of Important Constituents In Green Leaves of Cymbopogan Citratus*

The effects are attributed in part to the geraniol (alpha-citral) and neral (beta-citral) constituents. [31,32] In our work , We present a simple and green method for the preparation of gold nanoparticles from naturally occurring plant extract as both the reducing and stabilizing agent. No other chemical reducing agent is added. The reaction is carried out in an aqueous solution in a process that is benign to the environment.

***Chemical Structures of Important Constituents In Green Leaves of Cymbopogan Citratus***




## MATERIALS AND METHOD

### *Synthesis of gold nanoparticles*

The collected fresh leaves of plant *Cymbopogan citratus* was washed three or four times with distilled water. 25 gm of leaves were chopped into fine small pieces and added to 100 ml of deionized water and boiled for 5 minutes and at known temperature (55$^{o}$C) using a water bath. This was filtered to get a clear aqueous extract.

Chloroauric acid ($HAuCl_4$), were purchased from Sigma Aldrich Chemicals was used in typical synthesis of gold nanoparticles using Cymbopogan Citratus and the leaf extract was added to lmM concentration of aqueous Chloroauric acid($HAuCl_4$),solution in 100 ml of conical flask stored at room temperature under dark condition.

### *Characterization of the synthesized nanoparticles*
### *UV –Vis absorbance spectroscopy*

The bioreduction of the AUCL4 ions in solution was monitored by periodic sampling of aliquots (2ml) and measuring the UV-VIS spectra of the solution in 10-mm –optical –path- length quartz cuvettes with a systronics. UV –VIS spectrophotometer at a resolution of 1nm between 500 and 680 nm with a scanning speed of 1856 nm/min. After the OD values were taken upto 3 days at regular intervals. The sample was then centrifuged at 42,000 rpm for 10 minutes and pellet was dried and the nanopowder obtained was used for further analysis. The optical properties of AOT and SDS-capped gold nanoparticle solutions (samples 1–4) were monitored on a Hewlett-Packard diode array spectrophotometer (model HP-8452) operated at a resolution of 2 nm.

### *Transmission electron microscopy (TEM) measurements*

TEM measurements were performed on a JEOL model 1200 EX instrument operated at an accelerating voltage of 120 kV. Samples for TEM studies were prepared by placing drops of the silver nanoparticle solutions in samples 1–4 on carbon-coated TEM grids. The films on the TEM grids were allowed to dry in air for 2 min following which the extra solution was removed using a blotting paper.

### *X-ray diffraction measurements*

X-ray diffraction (XRD) analysis of drop-coated films on glass substrates from the AOT-capped silver nanoparticles in sample 1 was carried out on a Phillips PW1830 instrument operating at 40 kV and a current of 30 mA with CuKa radiation.

### *Particle size analyser*

The particle size of range of the nanoparticles was determined by using particles analyser (Malveern Zetasizer nanosizer). Particle size was arrived based on measuring the dependent fluctuation of scattering of laser light by the nanoparticles.

***Fourier Transform infrared (FTIR) spectroscopy measurements***

Samples were measured by shimadzu 8400s and using spectral range of 4000-400cm$^{-1}$ with resolution of 4cm$^{-1}$ power samples for the FTIR was prepared similarly as for powder diffraction measurements. The FTIR spectra of leaf extracts taken before and after synthesis of AuNPs were analyzed. This analysis shows the presence of functional groups in this extract, which helps in the formation of AuNPs.

## RESULTS AND DISCUSSION

Absorption spectra of gold nanoparticles of *Cymbopogan citratus* is shown in fig. 1. Reduction of gold iron into Au particles during exposure to the plant extracts could be followed by colour change. Au nanoparticle exhibit pinkish Red colour in aqueous solution due to the surface plasmon resource. The result obtained in this investigation is very interesting in terms of identification of lemon grass is *Cymbopogan citratus* for synthesizing the Au Nanoparticles. UV-vis spectrograph of the colloidal solution of gold nanoparticles has been recorded. Absorption spectra of Au nanoparticles formed in the reaction media has absorbance peak at 540.

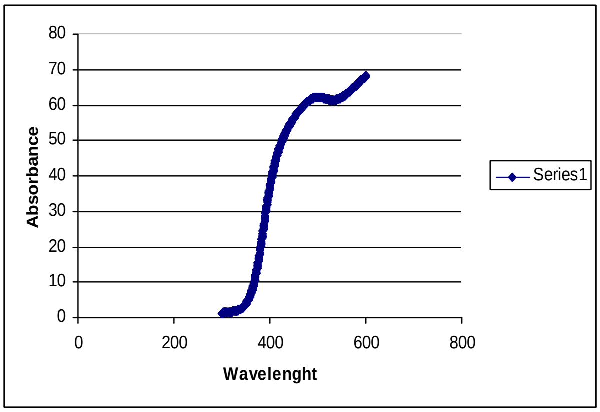



**Fig. 1**Absorption spectra of gold nanoparticles of *Cymbopogan citratus*

In figure, 2a&b. From Tem Analysis it is possible to identify large population of poly dispersed gold NPS Consisted of Spherical, triangular, hexagonal and rod shapes. The resultant histograms representing the size distribution of the particles were obtained by digital analysis of images containing at least 243 particles. The distribution of the particle diameters showed as main peak located between 1 and 40 nm and the sizes ranging with an average particles size of 20nm. A percentage distribution for each different shape and size of particles is shown in the fig.3 & 4. From this figure, it can be seen that the spherical particles are more than that of hexogen, triangle & rod shapes. The Stability of the resultant solution was confirmed by UV-visible and Tem Analysis. This figure also shows the Tem images of the biogenic gold nanoparticles and the corresponding electron diffraction patterns of the particles obtained using *Cymbopogan citratus*. The SAED pattern was obtained by aligning the electron beam perpendicular to the triangular facet of the nanoplate. The hexagonal symmetry of the diffracted spots suggests the single crystalline nature of gold nanotriangle lying flat on the TEM grid (Germain *et al*-2003).

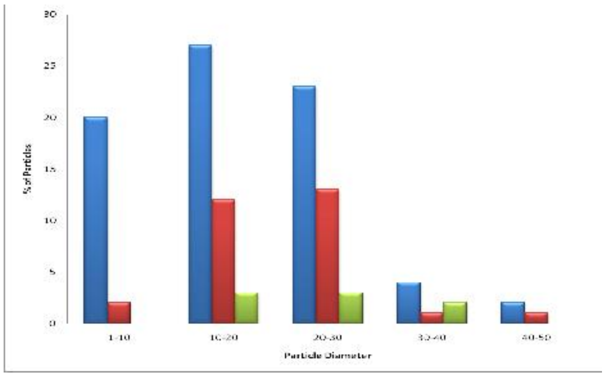


**Fig. 2a** Percentage of gold nanoparticles of *Cymbopogan citratus* with different particle size

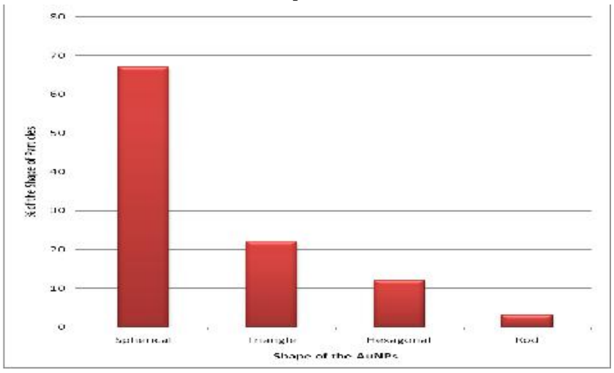


**Fig. 2b** Percentage of gold nanoparticles of *Cymbopogan citratus* with different particle shape

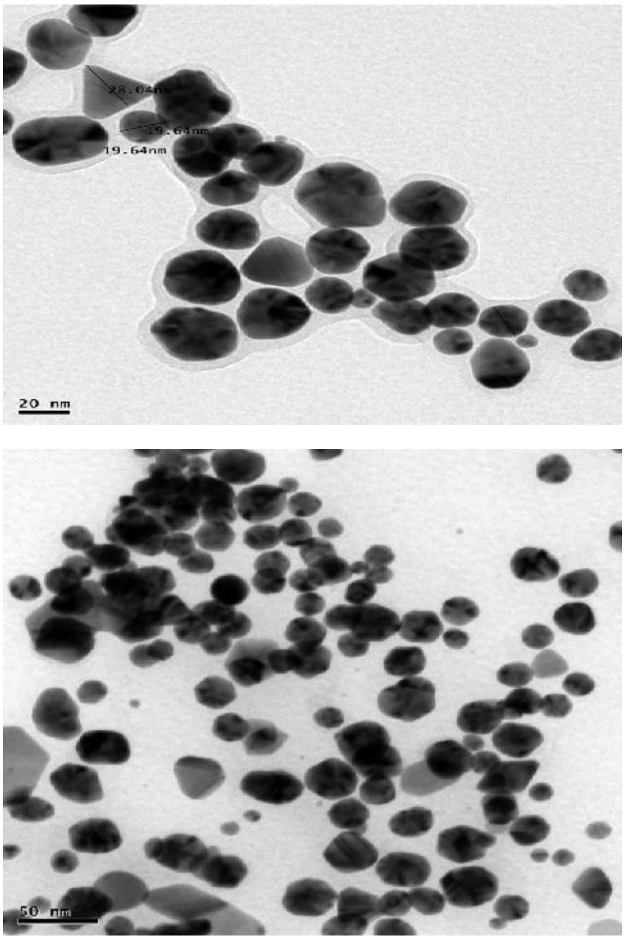



**Fig 3&4** TEM images and corresponding size distribution of gold nanopartcles obtained by reduction of $HAuCL_4$ with *Cymbopogan citratus.*

The fig 5 i.e Particle size Analyzer shows the nanoparticle sizes ranging from 10 to 110 nm.

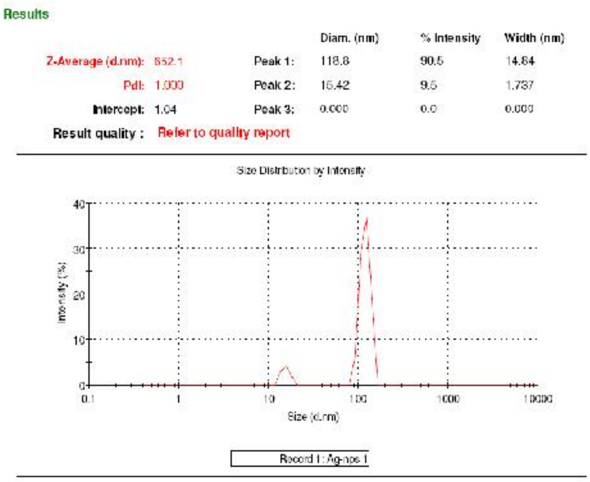



**Fig.5** Size of gold nanoparticles in Particle size analyser

The presence of the elemental gold can be seen in the graph presented by the EDX analysis, which indicated the reduction of gold ions to goldnanoparticles (Fig.6). The EDX profile shows a strong gold signal along with weak oxygen, which may have originated from the biomolecules bound to the surface of the gold nanoparticles. It has been reported that nanoparticles synthesized using plant extracts are surrounded by a thin layer of some capping organic material from the plant leaf broth and stable in solution after synthesis.

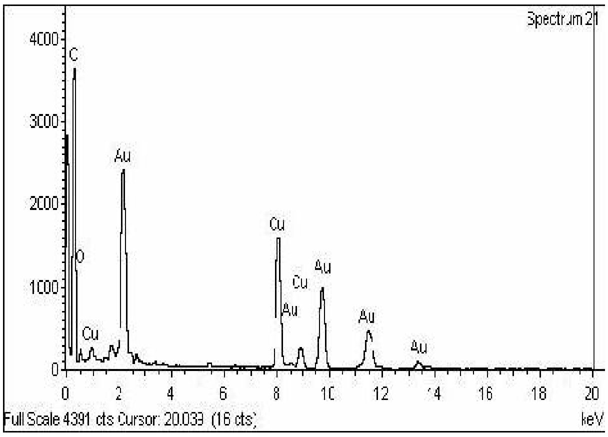



**Fig.6** EDX spectrum of gold nanoparticles of *Cymbopogan citratus*

XRD patterns obtained for gold nanoparticles synthesized using lemon grass is shown in fig.7. The experimental data obtained from X-ray diffraction (XRD) of very small particle is quite difficult to analyse.

Nanoparticles in XRD patterns exhibit several different size dependent features leading to anomalous peak position height and width. XRD analysis is mainly taken to study the crystalline nature of the gold nanoparticles. A number of Bragg reflections corresponding to the (111), (200), (220), (311) and (222) sets of lattice planes are observed. The XRD pattern thus clearly shows that the gold nanoparticles formed by the reduction of HAUCl4 by lemon grass leaves extract are crystalline in nature.

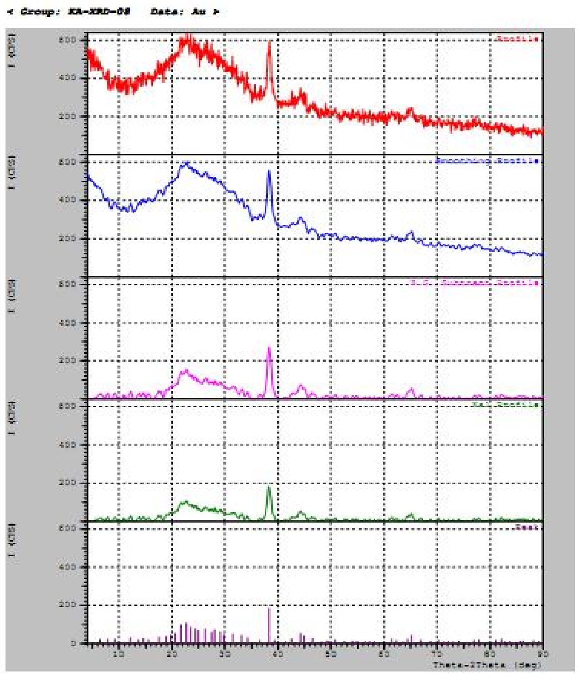
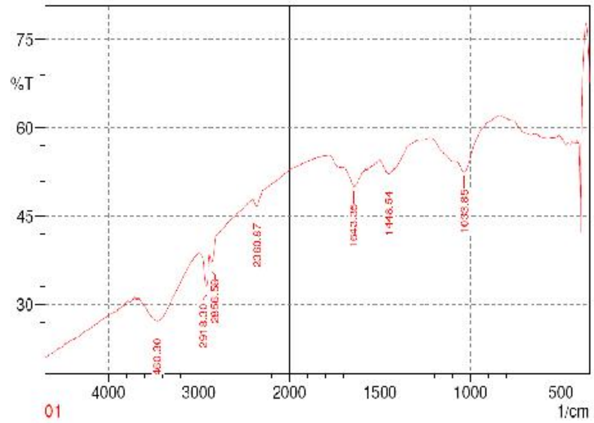



**Fig.7** X-ray diffraction measurements of gold nanoparticles of *Cymbopogan citratus*




| | Peak | Intensity | Corr. Intensity | Base (H) | Base (L) | Area | Corr. Area |
|---|---|---|---|---|---|---|---|
| 1 | 1033.85 | 52.5 | 3.42 | 1085.92 | 837.11 | 59.69 | 0.95 |
| 2 | 1448.54 | 52.09 | 0.55 | 1463.97 | 1419.61 | 12.42 | 0.09 |
| 3 | 1643.35 | 50 | 0.45 | 1691.57 | 1637.56 | 15.83 | 0.12 |
| 4 | 2360.87 | 46.73 | 0.77 | 2384.02 | 1955.82 | 126.98 | -1.12 |
| 5 | 2856.58 | 37.2 | 2.48 | 2881.65 | 2810.28 | 20.53 | 1.23 |
| 6 | 2918.3 | 33.07 | 5.56 | 2995.45 | 2881.65 | 50.18 | 3.26 |
| 7 | 3460.3 | 27.17 | 0.04 | 3583.74 | 3458.37 | 69.36 | 0.57 |

**Fig.8** FTIR analysis of gold nanoparticles

FTIR analysis was used for the characterization of the extract and the synthesized nanoparticles and shown in fig 8. The FTIR spectra of (Lemon grass) *Cymbopogan citratus* extract before and after bioreduction did not show any significant changes. The FTIR spectrum of the leaf extract showed bands at 3460.3 and 1033.85 cm-1 is the characteristic of the hydroxyl functional group in alcohols and phenolic compounds. The band at 1033.85 cm-1 can be assigned to the amide 1 band of the proteins released by the *Cymbopogan citratus* or to alkyl halide C-f stretch. The FTIR spectrum of gold Nanoparticles showed bands at 1448.54, 1643.35, 2360.87, 2856.58 cm-1. the band at 1448.54 cm-1 corresponds to the c=c stretching vibration of Nitro groups of aromatics. The bands at 1643.35 and 2360.87 cm-1 corresponds to the amides of c=o stretching and P-H stretch of phosphines. The bands at 2856.58 and 2918.30 cm-1 can be assigned to the carloxylic acids. The observed peaks are more characteristic of flavanones and terpenoids that are very abundant in lemon grass leaves extract.

## CONCLUSION

Biocompatible and rapid synthesis of gold nanoparticles using the leaf extract of cymbopogan citrates is demonstrated with possible role of different phytochemicals as reducing and stabilizing agents. The present investigation provides a new possibility for synthesis gold nanoparticles using natural products. These nanoparticles shows special geometrical structures such as triangles and hexagons are obtained having absorption coefficient in the NIR region, which makes it very attractive in photonic devices such as optical sensors and NIR absorbers. These rapid time scaled methods for the synthesis of Gold nanoparticles using environment friendly natural resources are need to be Explored and focused on.

**Acknowledgements**

The authors are grateful to Dr.K. Sasikala, Professor and Head, department of Zoology, Bharathiar University for the laboratory facilities provided. Funding contributed by the University grant commission, Delhi.

## References

1. Chang, L.T. and YEN, C.C (1995), “Studies on the Preparation and Properties of Conductive Polymers. VIII. Use of Heat Treatment to prepare Metalized Films from Silver chelate of PVA and PAN”, Appl. Polym. Sci., 55, 371-374.
2. Baker, C., Pradhan, A., pakstis, L., Pochan, D.J. and Shah, S.I.(2005) “Synthesis and Antibacterial properties of Silver Nanoparticles” 224-249,
3. Shahwerdi, A.R., Mianaeian, a S., Shahverdi, H.R., Jamalifar, H. and Nohi, A.A. (2007), “Rapid Synthesis of Silver Nanoparticles using Culture Supernatants of Enterobacteria: Anoval biological Approach”, Process Biochem., 42,919-923.
4. Cao, Y.W., Jin, R and Mirkin C.A. (2001) “DNA-Modified Core – shellAg/AU Nanoparticles”, J.Am. Chem. Soc, 123, 7961-62.
5. Matejka, P., Vickova, B., Vohlidal, J., Pancoska, P and Baumuruk, V.,(1992)”The role of TritonX-100 as an Adsorbate and a molecular spacer on the surface of silver Colloid: A surface –Enhanced Raman scattering Study”, J.Phys.Chem.,96,1361- 1366,
6. Gardea Torresdey, J.L., Gomez, E., Peralta Videa, J., Parsons, J.G., Troiani, H., Jose Yacaman, M., (2003). Alfalfa Sprouts: a natural source for the synthesis of silver nanoparticles. *Langmuir*., 19: 1357-1361.
7. Narayanan, K.B., Sakthivel, V., (2008) Coriander leaf mediated biosynthesis of goldnanoparticles. *Materials Letters*., 62: 4588.
8. Huang, J., Zhu, Z., Zhuang, (2008). Spectrochim. *Acta Part A*., 69: 566-571.
9. Kasthuri, J., Kathiravan, K., Rajendiran, N., (2009). Phyllanthin-assisted biosynthesis of silver and gold nanoparticles a novel biological approach. *J. Nanopart.Res.*, 11: 75-85.
10. Kasthuri, J., Veerapandian, S., Rajendrian, N., (2009). Biological synthesis of silver and gold nanoparticles using apiin as reducing agent. *Colloids Surf B Biointerf*., 68: 55-60.
11. Bhattacharya,d.,(2005).Nanotechnology and potential of microorganism Rev.Biotechnol.,25;199-204
12. Blumenthal, M, ed. (1998) the Complete German Commission E Monographs. Austin X: American Botanical Council; 341-342.
13. Leung AY. (1980) Encyclopedia of Common Natural Ingredients Used in Food, Drugs, and Cosmetics. New York, NY: Wiley.
14. Leite JR, Seabra Mde L, Maluf E, *et al*.(1986) Pharmacology of lemongrass (Cymbopogon citratus Strapf.) III. Assessment of eventual toxic, hypnotic and anxiolytic effects on humans. J Ethnopharmacol. 17(1):75-83.
15. Ming L, *et al*. (1996) Yield of essential oil of citral content in different parts of lemongrass leaves (Cymbopogon citratus [DC.] Stapf.) Poaceae. Acta Hortic. 426
16. Torres R.(1993)Citral from Cymbopogon citratus (DC) Stapf (lemongrass) oil.Philipp J Sci .;122:269-287.
17. Sargenti S, *et al*. (1997) Supercritical fluid extraction of Cymbopogon citratus . Chromatographia; 46:285-290.
18. Masuda T, Odaka Y, Ogawa N, Nakamoto K, Kuninaga H.(2008) Identification of geranic acid, a tyrosinase inhibitor in lemongrass (Cymbopogon citratus). J Agric Food Chem .56(2):597-601.
19. Kasumov F, *et al*. (1983) Components of the essential oil of Cymbopogon citratus Stapf. Khim Pnr Soedin.1:108-109
20. Ansan S, etal (1986) al. Thin layer gas liquid chromatographic analysis of lemongrass oil. Indian J Nat Prod. ;2:37-43
21. Viturro C, *et al*. (1998) Composition of the essential oil of Cymbopogon citratus . An Asoc Quim Argent .86:45-48.
22. Ogunlana EO, Höglund S, Onawunmi G, Sköld O. (1987) Effects of lemongrass oil on the morphological characteristics and peptidoglycan synthesis of Escherichia coli cells. Microbios; 50(202):43-59.
23. Onawunmi GO, Yisak WA, Ogunlana EO. (1984) Antibacterial constituents in the essential oil of Cymbopogon citratus (DC.) Stapf. J Ethnopharmacol. 12(3):279-286.
24. Hammer KA, Carson CF, Riley TV. (1999) Antimicrobial activity of essential oils and other plant extracts. J Appl Microbiol. 86(6):985-990.
25. Chalcat J, *et al*. (1997) Correlation between chemical composition and antimicrobial activity. VI. Activity of some African essential oils. J Essent Oil Res. 9:67-75. wannissorn B, *et al*. (1996) Antifungal activity of lemon grass and lemon grass oil cream. Phytother Res. 10:551-554.
26. Wannissorn B, *et al*. (1996) Antifungal activity of lemon grass and lemon grass oil cream. Phytother Res. 10:551-554.
27. Lima EO, Gompertz OF, Giesbrecht AM, Paulo MQ.

(1993)In vitro antifungal activity of essential oils obtained from officinal plants against dermatophytes. Mycoses. 36(9-10):333-336.
28. Qureshi S, Rai MK, Agrawal SC.(1997) In vitro evaluation of inhibitory nature of extracts of 18–plant species of Chhindwara against 3-keratinophilic fungi. Hindustan Antibiot Bull .39(1-4):56-60.
29. Yadav P, *et al*. (1994) Screening some essential oils against ringworm fungi. Indian J Pharm Sci.; 56:227-230.
30. Kishore N, Mishra AK, Chansouria JP. (1993) Fungitoxicity of essential oils against dermatophytes. Mycoses.36 (5-6):211-215.
31. Onawunmi GO, Yisak WA, Ogunlana EO. (1984) Antibacterial constituents in the essential oil of Cymbopogon citratus (DC.) Stapf. J Ethnopharmacol. 12(3):279-286.
32. Syed M, *et al*. (1995) Essential oils of the family Gramineae with antibacterial activity. Part 2. The antibacterial activity of a local variety of Cymbopogon citratus oil and its dependence on the duration of storage. Pak J Sci Ind Res. 38:146-148.

*******

**How to cite this article:**

Jeyalalitha T., Murugan K and Umayavalli M.2016, Biological And Green Synthesis of Gold Nanoparticles Using Cymbopogan Citratus Extract. *Int J Recent Sci Res.* 7(2), pp. 8688-8693.

ISSN 0976-3031

9 770976 303009 >