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Green synthesis of silver nanoparticles using a mangrove *Excoecaria agallocha*

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ABSTRACT : *Nanoscience is a field that is making a score in research day by day and making an impact in all spheres of human life. In this paper, we report a novel biological protocol for the synthesis of silver nanoparticles using aqueous extract of Excoecaria agallocha . The newly synthesized silver nanoparticles were characterized using physico-chemical techniques UV, XRD and TEM analysis. UV spectrum exhibited an absorption peak at 434 nm. X-ray diffraction pattern displayed typical peak of crystalline silver at (111), (200), and (220). The transmission electron microscopy result indicates that the most of the formed silver nanoparticles were spherical in nature.*

KEYWORDS : *Excoecaria agallocha, silver nanoparticles, TEM, UV Spectroscopy, X-ray diffraction.*

I. INTRODUCTION

Nanoscience, an emerging field of research, utilizes nanobased- systems for various biomedical applications. This rapidly developing field has raised the possibility of using therapeutic nano particles in the diagnosis and treatment of human diseases [1]. The biological effectiveness of nanoparticles can increase proportionately with an increase in the surface area due to the increase in their surface energy and catalytic reactivity. Although there are many routes available for the synthesis of nanoparticles, there is an increasing need to develop high-yield, low cost, non-toxic, biocompatible and environmentally benign procedures. Hence, the biological approach for the synthesis of nanoparticles become imperative. Biological molecules have qualities by which they can undergo highly controlled and hierarchical assembly, which makes them suitable for the development of a reliable and eco – friendly process for metal nanoparticle synthesis. In order to obtain nanoparticles in large quantities within a short period, physical and chemical procedures are used [2]. At present, there exists a need to develop eco-friendly processes for the synthesis of nanoparticles. Therefore the attention of the researcher is shifted from physical and chemical processes towards 'green' chemistry and bioprocesses [3]. The results addressed herein discloses the synthesis of silver nanoparticles by the reduction of aqueous Au^{3+} ions with the aqueous extract of *Excoecaria agallocha* .The approach established appears to be cost efficient alternative to conventional methods and completely biogenic method of synthesis of silver nanoparticles.

II. MATERIALS AND METHODS

Chemicals and plant material : The leaves of *Excoecaria agallocha* have collected from Pichavaram, Tamilnadu, India. *Excoecaria agallocha* leaves were washed with deionized water and then shade dried, powdered using electronic blender. The dried coarse powder of *Excoecaria agallocha* was extracted using deionized water. Silver nitrate ($AgNO_3$) was obtained from Loba Chem.

Synthesis of silver nanoparticles : 1mM solution of 100ml silver nitrate at concentration of 10^{-3}M prepared by dissolving double distilled water. Different reaction concentration of *Excoecaria agallocha* extract and $AgNO_3$ solution (49:1, 48:2, 47:3, 46:4, and 45:5) was subjected respectively. The reduction of silver ions to silver nanoparticles was completed within 35 min. The formation of the brownish yellow coloured solution indicates the formation of silver nanoparticles.

Characterization of silver nanoparticles : Aliquots of the reaction solution were measured using UV-2300 TECHCOMP spectrophotometer containing double beam in identified compartments each for reference and test solution fitted with 1 cm path length quartz cuvettes. X-ray diffraction of bioreduced silver nanoparticles was carried out using Siefert X-ray diffractometer, operated at a voltage of 40Kv and tube current of 30 mA with Cu – Kα, radiation. For TEM studies newly synthesized silver nanoparticles were prepared by placing a drop of

nanoparticle solution on carbon coated copper grids and allowing water to evaporate. The observations of TEM were performed on JEOL 3010 operated on accelerating voltage of 120 KV.

III. RESULTS

Formation ofsilver nanoparticles by the reduction metal ions during exposure to *Excoecaria agallocha* leaf extract may be easily followed by UV-vis spectroscopy. It is well known that silver nanoparticles exhibit brownish yellow in water, this colour was due to the excitation of SPR vibrations in the metal nanoparticles. It was observed that the SPR of the newly formed AgNps occurs at ca 434 nm.

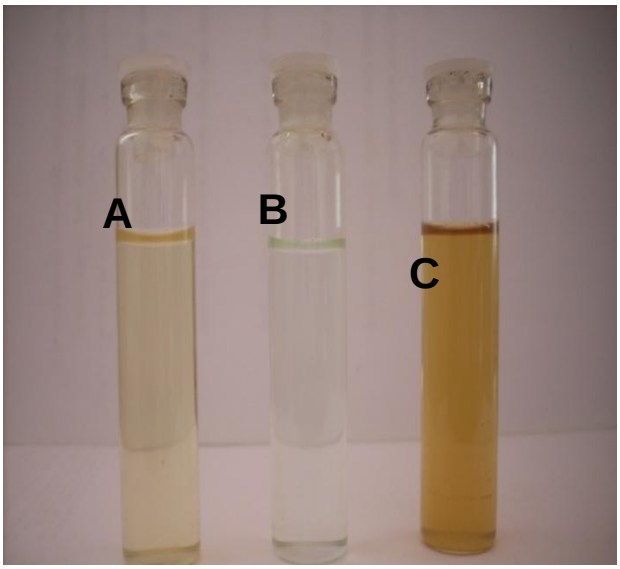

Fig.1. Photograph of vials containing
(A) Aqueous extract of *Excoecaria agallocha*
(B) 1 mM $AgNO_3$ solution
(C) Silver nanoparticles synthesized using *Excoecaria agallocha*

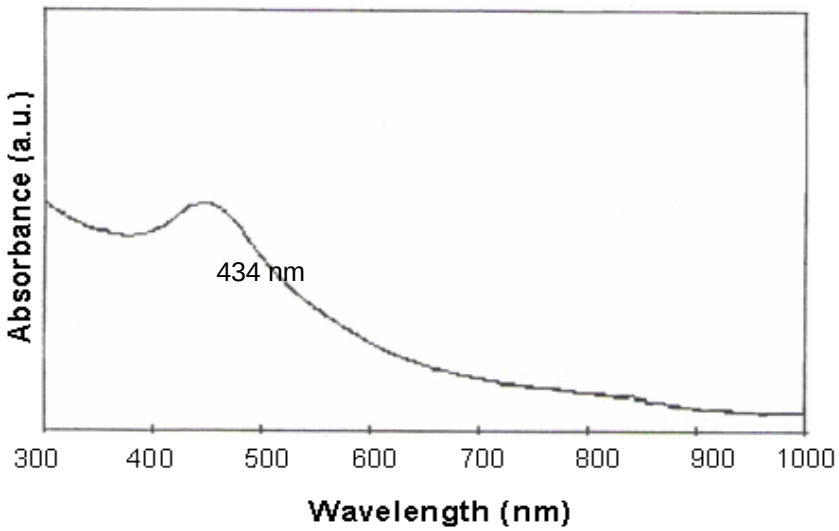

Fig. 2. UV-Visible optical absorption spectrum of *Excoecaria agallocha* synthesized silver nanoparticles.
The XRD patterns obtained for silver nanoparticles using *Excoecaria agallocha* extract. A number of Braggs reflection corresponding to (111), (200), (220) and (311) sets lattice planes were observed which may be indexed based on the fcc structures of the silver metal. Thus, the XRD pattern clearly demonstrates that the nanoparticles are crystalline in nature.

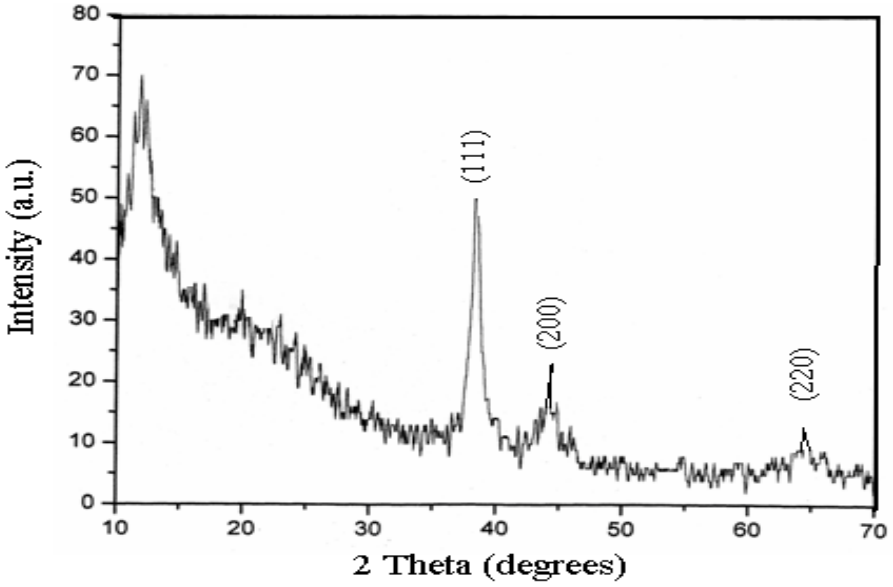

Fig.3 XRD patterns of silver nanoparticles synthesized using *Excoecaria agallocha*.

The silver nanoparticles synthesized by treating silver nitrate solution with *Excoecaria agallocha* extract for 24 hours. It is known that the shape of metal nanoparticles considerably changes their optical and electronic properties. The newly synthesized silver nanoparticles are predominantly spherical in shape and size of from 15 to 43 nm. The average size of nanoparticles was found to be 27nm.

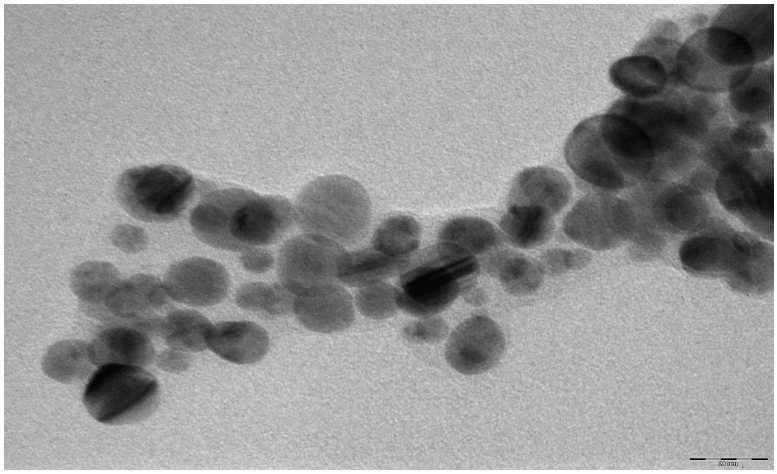

Fig.4. Transmission Electron Microscopy image of the silver nanoparticles formed by the reaction of silver nitrate with *Excoecaria agallocha* extract.

IV. DISCUSSION

Nanobiotechnology is highly interdisciplinary by nature and requires close collaboration between biologists, physical scientists and engineers. Nanotechnology is mainly concerned with synthesis of nanoparticles for human benefits of varying sizes, shapes and chemical compositions. Synthesisi of nanoparticles can be achieved through chemical and physical methods which are expensive and potentially dangerous to the environment. Hence metal nanoparticles are synthesised by using gold, silver and platinum are widely used as they are envirоinment friendly. Biological methods of nanoparticles synthesis using micro organisms, enzyme and plant or plant extract have been suggested as possible eco-friendly alternatives to chemical and physical methods. Use of plant for nanoparticles synthesis can be advantageous over other biological processes by eliminating the elaborate process of maintaining cell culture. Silver nanoparticles receive enormous scientific, technological, and commercial attention due to their unique size and shape dependent properties [4,5]. Extensive research has been devoted to explore the applications of silver

nanoparticles in diversified fields including healthcare/biomedical applications[6].Recently, plant (leaf, flower, seed, tuber, and bark) extract mediated biological process for the synthesis of silver nanoparticles has been extensively explored and compared to other bio-inspired processes [7-14]. Babu and Prabhu have reported the synthesis of silver nanoparticles using *Calotropis procera* flower extract at room temperature [12]. In addition, synthesis of silver nanoparticles using soy (*Glycine max*) and curry (*Murraya Koengii*) leaf extracts [13,14] similarly, neem (*Azadirachta indica*) and mango (*Mangifera indica*) leaf extracts were effectively utilized for the synthesis of silver nanoparticles [15,16]. In addition to silver nanoparticles, plant extract mediated synthesis of gold and palladium nanoparticles has been explored [17,18]. Recent accomplishments in the plant leaf extract mediated biological process include the impregnation of silver nanoparticles into carbon nanotubes, which indicates new opportunities for the process in the development of novel multifunctional materials [19,20].

V. CONCLUSION

The presence study demonstrated the bio-reduction of silver ions by *Excoecaria agallocha*. The synthesised silver nanoparticles were characterised by UV visible spectra which showed a broad peak at 340 nm. The TEM image showed the spherical shape of silver nanoparticles and the size of the synthesized silver nanoparticles was 27nm.

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REFERENCE

[1] MV. Yezhelyev, X. Gao , Y. Xing ,AA. Hajj, S. Nie and RMO. Regan,Emerging use of nanoparticles in diagnosis and treatment of breast cancer, *Lancet Oncol*,2006, 7 , 657– 667.

[2] NC. Bigall and A. Eychmuller,Synthesis of noble metal nanoparticles and their non-ordered superstructures, *Philosophical Transactions of the Royal Societ.*,2010,368,1385-1404.

[3] P, Mohanpuria, NK. Rana and SK. Yadav, Biosynthesis of nanoparticles: technological concepts and future applications, *J. Nanopart. Res*,2008, 10 (3), 507- 517.

[4] BJ. Wiley, SH. Im, J. McLellan, A. Siekkinen, and Y. Xia ,Maneuvering the Surface Plasmon Resonance of Silver Nanostructures through Shape-Controlled Synthesis,*J. Phys. Chem. B* ,2006,110, 15666-15675.

[5] IM, Ramirez, S. Bashir, Z. Luo, and JL. Liu,Green synthesis and characterization of polymer-stabilized silver nanoparticles,*Colloids and Surfaces B: Biointerf*,2009,73,185-191.

[6] K. Govindraju, V. Kiruthiga, V. Ganesh Kumar and G. Singaravelu, Extracellular Synthesis of Silver Nanoparticles by a Marine Alga, *Sargassum wightii* Grevilli and Their Antibacterial Effects,*J. Nanosci. Nanotechnol*,*2009*, 9, 5497-5501.

[7] G. Singaravelu, J. Arockiyamari, V. Ganesh Kumar, and K. Govindaraju,A novel extracellular synthesis of monodisperse gold nanoparticles using marine alga, *Sargassum wightii* Greville *Colloids and Surfaces B: Biointerf*,2007,57,97-101.

[8] K. Govindraju, S. Khaleel Basha, V. Ganesh Kumar, and G. Singaravelu ,Silver, gold and bimetallic nanoparticles production using single-cell protein (*Spirulina platensis*) Geitler,*J. Mater. Sci*,2008, 43,5115-5123.

[9] SS. Shankar, A. Rai, A. Ahmad, and M. Sastry, Rapid synthesis of Au, Ag, and bimetallic Au core–Ag shell nanoparticles using Neem (*Azadirachta indica*) leaf broth, *J. Colloid Interface Sci*,2004, 275,496-502.

[10] S. Li, Y. Shen, A. Xie, X. Yu, L. Qui, L. Zhang, and Q. Zhang,Green synthesis of silver nanoparticles using *Capsicum annum* L. extract, *Green Chem*,2007, 9, 852-858.

[11] NHH. Abu Bakar, J. Ismail, and M. Abu Bakar, Synthesis and characterization of silver nanoparticles in natural rubber, *Mat. Chem. Phys*,2007, 104, 276-283.

[12] S. Anand Babu, and H.Gurumallesh Prabu, Synthesis of Silver Nanoparticles using the extract of *Calotropis proceraflower* at room temperature, *MaterLett*,2011, 65, 1675–1677.

[13] H. Bar, DKR. Bhui, GP. Sahoo, P. Sarkar, SP. De, and A. Misra, Green synthesis of silver nanoparticles using latex of *Jatropha curcas*,*Colloids and Surfaces A: Phys. Eng. Asp*,2009, 339,134-139.

[14] W. Raut Rajesh, R. Lakkakula Jaya, S. Kolekar Niranjan, D. Mendhulkar Vijay, and B. Kashid Sahebrao, Phytosynthesis of Silver Nanoparticle Using Gliricidia sepium (Jacq.), *Curr.Nanosci*,2009, 5,117-122.

[15] D. Raghunandan, B.D. Mahesh, S. Basavaraja, S.D. Balaji, S.Y. Manjunath, and A. Venkataraman, Microwave-assisted rapid extracellular synthesis of stable bio-functionalized silver nanoparticles from guava (*Psidium guajava*) leaf extract, *J. Nanoparticle Res*,2011,13,2021-2028.

[16] G. Singhal, R. Bhavesh, K. Kasariya, A. Ranjan Sharma, and R. Pal Singh ,Biosynthesis of silver nanoparticles using *Ocimum sanctum* (Tulsi) leaf extract and screening its antimicrobial activity,*J. Nanoparticle Res*..2011,13,2981-2988

[17] Sathyavathi,M.BalamuraliKrishna,S.VenugopalRao,R.Saritha, and D. Narayana Rao, Biosynthesis of Silver nanoparticles using *Coriandrum Sativum* Leaf Extract and Their Application in Nonlinear Optics. *Adv. Sci. Lett*,2010,3,138-143.

[18] D. Philip,Green synthesis of gold and silver nanoparticles using *Hibiscus rosa sinensis*. *Physica E: Low-dimen. Sys. Nanostruc*. 2010,42,1417-1424.

[19] A. Bankar, B. Joshi, A. R. Kumar, and S. Zinjarde, Banana peel extract mediated novel route for the synthesis of silver nanoparticles, *Colloids and Surfaces A: Phys. Eng. Asp*,2010,368,58-63.

[20] AJ. Kora, R.B. Sashidhar, and J. Arunachalam, Gum kondagogu (*Cochlospermum gossypium*): A template for the green synthesis and stabilization of silver nanoparticles with antibacterial application, *Carbohydrate Poly*,2010, 82,670-679.