Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6740

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (3):** 502-508 (2018)

International Journal of Pure & Applied Bioscience

Research Article

OPEN ACCESS

Green Synthesis of Silver Oxide Nanoparticles Prepared from Waste Part of Mango Peels

Mohd. Jalees[1*], Reena Shirley Lawrence[2], Amit Chhattree[3], Mrinalini Yadav[1], Neha Sailus[1]

[1]Research Scholar, [2]Associate professor, [3]Associate Professor and Head,

Department of Chemistry, Sam Higginbottom University of Agriculture, Technology & Sciences (SHUATS)

Rewa road Allahabad 211007 U.P. India

*Corresponding Author E-mail: jaleessiddiqui@gmail.com

Received: 25.05.2018 | Revised: 22.06.2018 | Accepted: 28.06.2018

ABSTRACT

The synthesis of nanoparticles is in the spot light in modern nanotechnology. In recent years, the development of competent green chemistry methods for synthesis of metal nanoparticles (NPs) has become a main lime light of researchers. Biological synthesis of nanoparticles using waste part of fruite is currently under exploitation. The first time in this paper we have reported the green synthesis of silver nanoparticles (AgNPs) by reduction of silver nitrate, using fruit peel extracts of mango ; commonly found plant in india . The reaction process for the synthesis of silver nanoparticles is simple, cost-effective, novel, rapid and ecofriendly route using fruit peel extract of mango plant, which acted as a reducing and stabilizing agent simultaneously at room temperature. Formation of the nano silver was confirmed by surface Plasmon spectra using UV-Vis spectrophotometer and absorbance peak at 410 nm. Different silver ion concentration and contact times were experimenting in the synthesis of silver nanoparticles. The prepared nanoparticles properties were characterized by UV-Vis.

***Key world** -Mango peel Uv-Vis silver nitrate.*

INTRODUCTION

Full of beans of nanotechnology in each and every field of science and technology has been successful at a tremendous rate now a day. Started its journey from organic chemistry, this field has now even reached to aeronautical research, and a special attention has been drawn in the medical and allied branches for exploitation of the nanotech for attending the limitations of the present time. Carrying foreword the success of nanotechnology in field of physical, chemical and medical sciences, it has now started revolutionizing the drug delivery sciences. The term nanoparticle is used to describe a particle with size in the range of 1–100 nm. They tend to react differently than larger particles of the same composition because of their large surface area, thus allowing them to be used in novel applications[2]. Moreover, they serve as the fundamental building block of nanotechnology. Nowadays there is a wide application of nanoparticles in diverse fields including catalysis, energy, chemistry and medicine.

Cite this article: Jalees, M., Lawrence, R. S., Chhattree, A., Yadav, M., Sailus, N., Green Synthesis of Silver Oxide Nanoparticles Prepared from Waste Part of Mango Peels, *Int. J. Pure App. Biosci.* **6(3):** 502-508 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6740

Nanotechnology approaches to control disease in human and plants have recently been increasing greatly and the unique physicochemical properties of nano-sized metal particles make them successful in biology and medicine[8]. The current understanding of potential risks associated with the release of these materials in the environment for human and animal health is still insufficient[28]. However, very recently Verano-Braga *et al*.[27] reported that the toxicity of AgNPs depends upon both dosage and particle size. Metal nanoparticles show large surface to volume ratio and exhibit antimicrobial properties due to their ability to interact with cellular membranes through disruption of cell wall structure[3,25]. Especially silver has long been known for its strong toxicity against a wide range of micro organisms including bacteria and fungi[16]. There are numerous methods for synthesis of silver nanoparticles, but, mostly used chemical methods.

MATERIAL AND METHODS

Materials

The fresh fruit peels of Mango was collected from local garden. The fruit peels was kept 0˚C until further analyses. Silver nitrate (AgNO3) was purchased from Sigma Aldrich Chemicals, lucknow. Chemicals were of analytical reagent grade and were used without further purification. All solutions were freshly prepared using deionised distilled water and were kept in the dark to keep away from any photochemical reaction. Glass wares have been properly washed with distilled water and dried in oven before use.

Methods

Preparation of fruit peel extract The fresh fruits peels of mango shown were washed several times with distilled water to remove the dust. The fruits peels were cut into small pieces.35 g of properly washed fruits peels were added in 175mL ultrapure water in a 500mL Erlenmeyer flaskand boiled for 10-15 min. Then Whatman filter paper (No. 40) was used for the filtration of boiledmaterial to prepare the aqueous fruit extract, which was used as such for metal nanoparticles synthesis

Synthesis of silver nanoparticles Aqueous solution (1mM) of silver nitrate was prepared. For the green synthesis of silver nanoparticles (AgNPs), 1.8ml of fruit peels extract was mixed to 50mL of prepared silver metal ion solution and stirring continued for 4 min at room temperature. The reduction takes place rapidly as indicated by brown-yellow colour solution was formed after 30min which indicating the formation of silver nanoparticles. The effects of reaction conditions such as the silver ion concentration and reaction time were also studied.

UV-Vis spectral analysis

Synthesized silver nanoparticles was confirmed by sampling the aqueous component of different time intervals and the absorption maxima was scanned by UV-Vis spectrophotometer at the wavelength of 300 – 800 nm on Perkin-Elmer Lambda 25 spectrophotometer.

X-ray diffraction studies

The formation and quality of compounds were checked by X-ray diffraction (XRD) spectrum. The XRD pattern was measured by drop coated films of AgNO3 on glass plate and employed with X-ray diffractometer (INEL X-ray diffractometer) of characteristic Co-kα1 radiation (λ = 1.78 A°) in the range of 20° to 90° at a scan rate of 0.05°/min with the time constant of 2 sec.

TEM analysis of silver nanoparticles

Morphology and size of the silver nanoparticles were investigated by TEM images using Phillips, TECHNAI FE 12 instrument. Thin film of the sample was prepared on a carbon coated copper grid by just dropping a very small amount of the sample on the grid and drying under lamp.

FTIR spectral analysis

The bioreduced silver nitrate solution was centrifuged at 10,000 rpm for 15 min and the dried samples were grinded with KBr pellets used for FTIR measurements. The spectrum was recorded in the range of 4000 - 400 cm-1 using Thermo Nicolet Nexus 670 spectrometer in the diffuse reflectance mode operating at resolution of 4 cm-1.

RESULTS AND DISCUSSION

Fig. 1 represents the UV-Vis spectra of aqueous component as a function of time variation of leaf broth with 1 mM aqueous $AgNO_3$ solution. Metal nanoparticles have free electrons, which gives surface plasmon resonance (SPR) absorption band, due to the combined vibration of electrons of metal nanoparticles in resonance with light wave. The sharp bands of silver colloids were observed at 436 nm. The intensity of absorption band increases with increasing time period of aqueous component and consequent color changes were observed from without color to reddish yellow, shown in Fig. 2. These characteristic color variation is due to the excitation of the of the surface plasmon resonance in the metal nanoparticles.

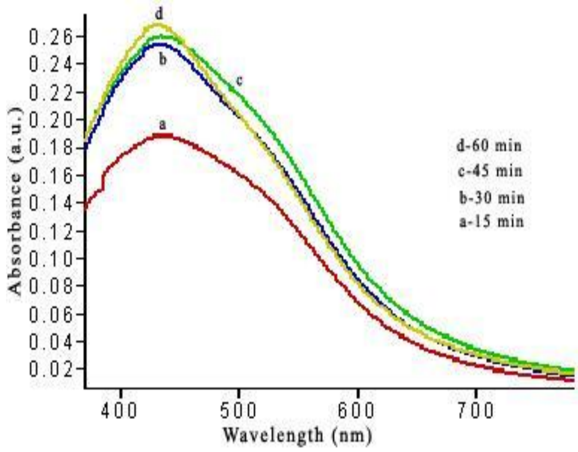

Fig. 1: UV-Vis spectra of silver nanoparticle

Fig. 2: Picture of aqueous solution of 1mM $AgNO_3$ with mango peel extracts before adding the leaf extract and after addition of mango peel broth.

The XRD spectrum

The XRD spectrum (Fig.3) showed three distinct diffraction peaks at 37.6°, 44.7° and76.3°, which are indexed the (111), (200) and (311) of the cubic face-centered silver. The obtained data was matched with the Joint Committee on Powder Diffraction Standards (JCPDS) file No.03-0921. The average grain size of the silver nanoparticles formed in the process was estimated fromthe Debye Scherrer equation ($d = (k\lambda\times180) / \beta Cos\ \theta_{\beta}\Pi$) by determining the width of the (111)Bragg's reflection[24], where k is Scherrer constant, λis the wavelength of the X-rays, βand $\theta_{\beta}$are full width half maximum of the Bragg angle, the estimated mean size oftheparticlewas6.2nm.

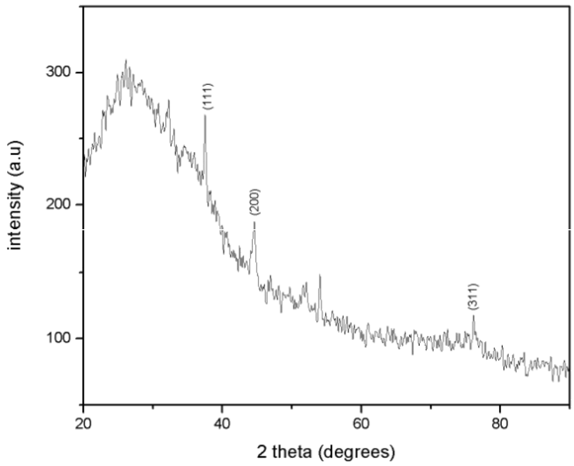

Fig. 3: XRD pattern from drop-coated films of synthesized silver nanoparticles.

Transmission electron microscope image of silver nanoparticles derived from *Mango peel* extract was shown in Fig. 4. The morphology of the nanoparticles was spherical in nature. Under careful observation, it is evident that the silver nanoparticles surrounded by a faint thin layer of other materials, which we suppose are capping organic material from mango fruite peel broth. The obtained nanoparticles are in the range of sizes 3–20 nm and few particles are agglomerated. Fig. 5 shows the histogram of silver nanoparticles, it is evident that there is variation in particle sizes and the average size estimated 9.5 nm. It may be noted that the size of the silver nanoparticle obtained from TEM is good agreement with the size obtained from the XRD measurements.

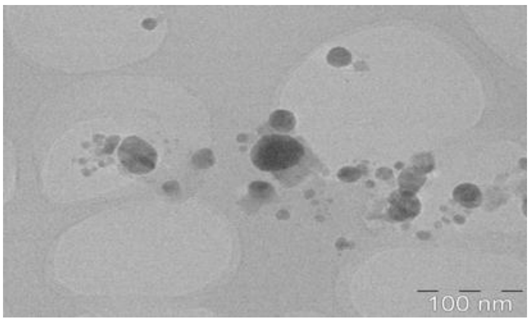

Fig. 4: TEM image of silver nanoparticles

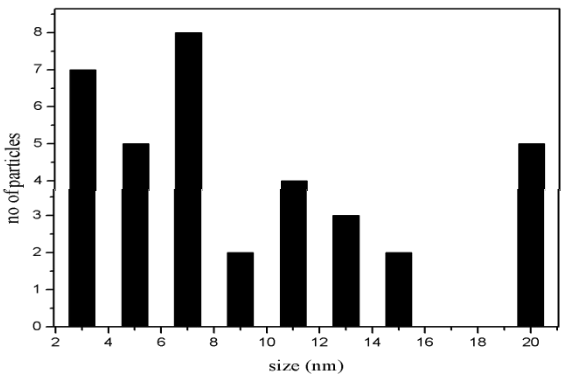

Fig. 5: Histogram of synthesized silver nanoparticles

FTIR measurements were carried out to identify the biomolecules for capping and efficient stabilization of the metal nanoparticles synthesized by *Mango peel* broth. The FTIR spectrum of silver nanoparticles is shown in Fig. 6. The band at 3419 cm^{-1} corresponds to O-H stretching H-bonded alcohols and phenols. The peak at 2923 cm^{-1} corresponds to O- H stretch carboxylic acids. The assignment at 1648 cm^{-1} corresponds to N- H bend primary amines. The peak at 1376 cm^{-1} corresponds to C-N stretching of aromatic amine group and the bands observed at 1163, 1113, 1059 cm^{-1} corresponds to C-N stretching alcohols, carboxylic acids, ethers and esters. Therefore the synthesized nanoparticles were surrounded by proteins and metabolites such as terpenoids having functional groups of alcohols, ketons, aldehydes and carboxylic acids. From the analysis of FTIR studies we confirmed that the carbonyl group from the amino acid residues and proteins has the stronger ability to bind metal indicating that the proteins could possibly from the metal nanoparticles (i.e., capping of silver nanoparticles) to prevent agglomeration and thereby stabilize the medium. This suggests that the biological molecules could possibly perform dual functions of formation and stabilization of silver nanoparticles in the aqueous medium[12].

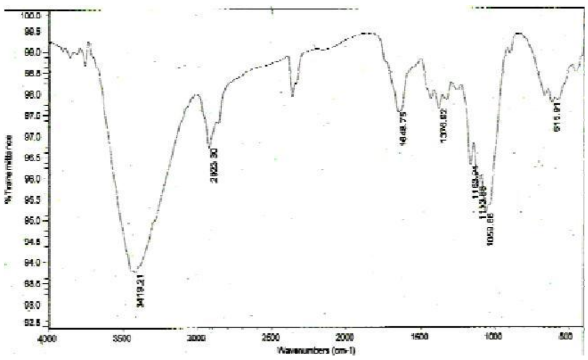

Fig. 6: FTIR spectrum of silver nanoparticles synthesized using mango peel broth.

FTIR measurements were carried out to identify the biomolecules for capping and efficient stabilization of the metal nanoparticles synthesized by *Ocimum* leaf broth. The FTIR spectrum of silver nanoparticles is shown in Fig. 6. The band at 3419 cm^{-1} corresponds to O-H.

CONCLUSIONS

The rapid biological synthesis of silver nanoparticles using leaf broth of *Mango peel* provides an environmental friendly, simple and efficient route for synthesis of benign nanoparticles. The size of the silver nanoparticles was estimated as 3-20 nm. The bioreduced silver nanoparticles were characterized using UV-Vis, XRD, TEM and FTIR spectroscopic techniques. These reduced silver nanoparticles were surrounded by a faint thin layer of proteins and metabolites such as terpenoids having functional groups of amines, alcohols, ketones, aldehydes and carboxylic acids. From a technological point of view, these obtained silver nanoparticles have potential applications in the biomedical field and this simple procedure has several advantages such as cost-effectiveness, compatibility for medical and pharmaceutical applications as well as large scale commercial production.

REFERENCES

1. Abdeen, S., Geo, S., Sukanya Praseetha, P. K., Dhanya, R. P., Biosynthesis of silver nanoparticles from actinomycetes for therapeutic applications. *Int J Nano Dimens* **5(2):** 155–162 (2014).
2. Abou El-N, M. M., Eftaiha, A., Al-Warthan, A., Ammar, R. A. A., Synthesis and application of silver nanoparticles. *Arab J Chem* **3:** 135–140 (2010).

3. Ahmad, T., Wani, I. A., Manzoor, N., Ahmed, J., Asiri, A. M., Biosynthesis, structural characterization and antimicrobial activity of gold and silver nanoparticles. *Collo Surf B*: Biointerfaces **107:** 227–234 (2013).
4. Bansal, V., Ramanathan, R., Bhargava, S. K., Fungus-mediated biological approaches towards ‘‘green’’ synthesis of oxide nanomaterials. *Aust J Chem* **64:** 279–293 (2011).
5. Baun, A., Hartmann, N. B., Grieger, K., Kusk, K. O., Ecotoxicity ofengineered nanoparticles to aquatic invertebrates: a brief review and recommendations for future toxicity testing. *Ecotoxicology* **17:** 387–395 (2008).
6. Garg, S., Rapid biogenic synthesis of silver nano particles using black pepper (piper nigrum) corn extract. *Int J Inno Biol Chem Sci* **3:** 5–10 (2012).
7. Huang, J. L., Li, Q. B., Sun, D. H., Lu, Y. H., Su, Y. B., Yang, X., Wang, H. X., Wang, Y. P., Shao, W. Y., He, N., Hong, J. Q., Chen, C. X., Biosynthesis of silver and gold nanoparticles by novel sundried Cinnamomum camphora leaf. *Nanotechnol* **18:** 1–11 (2007).
8. Jo, H. J., Choi, J. W., Lee, S. H., Hong, S. W., Acute toxicity of Ag and CuO nanoparticle suspensions against Daphnia magna: the importance of their dissolved fraction varying with preparation methods. *J Hazard Mater* **227:** 301–308 (2012).
9. Kasthuri, J., Kathiravan, K., Rajendiran, N., Phyllanthin-assisted biosynthesis of silver and gold nanoparticles: a novel biological approach. *J Nanopart Res* **11:** 1075–1085 (2009).
10. Kim, S.W., Kim, K. S., Lamsal, K., Kim, Y. J., Kim, *et al.* An in vitro study of the antifungal effect of silver nanoparticles on oak wilt pathogen *Raffaelea sp. J Microbiol Biotechnol* **19:** 760–764 (2009a).
11. Kim, K. J., Sung, W. S., Suh, B. K., Moon, S. K., Choi, J. S., Kim, J. G., Lee, D. G., Antifungal activity and mode of action of silver nanoparticles on Candida albicans. *Biometals* **22:** 235–242 (2009b).
12. Lamsal, K., Kim, S. W., Jung, J. H., Kim, Y. S., Kim, K. S., Lee, Y. S., Application of silver nanoparticles for the control of Colletotrichum species in vitro and pepper anthranose disease in field. *Mycobiology* **39:** 194–199 (2011).
13. Mano, P. M., Karunai, S. B., John, P. J. A., Green synthesis of silver nanoparticles from the leaf extracts of Euphorbia Hirta and Nerium Indicum. *Dig J Nanomater Biostruct* **6(2):** 869–877 (2011).
14. Mondal, N. K., Chowdhury, A., Dey, U., Mukhopadhya, P., Chatterjee, S., Das, K., Datta, J. K., Green synthesis of silver nanoparticles and its application for mosquito control. *Asian Pac J Trop Dis* **4(1):** S204–S210 (2014).
15. Mulvaney, P., Surface plasmon spectroscopy of nanosized metal particles. *Langmuir* **12:** 788–800 (1996).
16. Narayanan, K. B., Park, H. H., Antifungal activity of silver nanoparticles synthesized using turnip leaf extract (Brassica rapa L.) against wood rotting pathogens. *Eur J Plant Pathol doi*: 10.1007/s10658-014-0399-4 (2014).
17. Narayanan, K. B., Sakthivel, N., Coriander leaf mediated biosynthesis of gold nanoparticles. *Mater Lett* **62:** 4588–4590 (2008).
18. Narayanan, K. B., Sakthivel, N., Biological synthesis of metal nanoparticles by microbes. *Adv Colloid Interface* Sci **156:** 1–13 (2010).
19. Nethra, D. C., Sivakumar, P., Renganathan, S., Green synthesis of silver nanoparticles using Datura metel flower extract and evaluation of their antimicrobial activity. *Int J Nanomater Biostruct* **2(2):** 16–21 (2012).
20. Ouda, S. M., Antifungal activity of silver and copper nanoparticles on two plant pathogens, Alternaria alternate and Botrytis cinerea. *Res J Microbiol* **9(1):** 34–42. doi:10.3923/jm.2014.34.42 (2014).
21. Shafaghat, A., Synthesis and characterization of silver nanoparticles by phytosynthesis method and their biological activity. *Synth React Inorg Metal-Org Nano-Metal Chem* **45:** 381–387 (2015).

22. Sukirtha, R., Priyanka, K. M., Antony, J. J., Kamalakkannan, S., Thangam, R., Gunasekaran, P., Krishnan, M., Achiraman, S., Cytotoxic effect of green synthesized silver nanoparticles using Melia azedarach against in vitro HeLa cell lines and lymphoma mice model. *Process Biochem* **47:** 273–279 (2012).
23. Surjushe, A., Vasani, R., Saple, D. G., Aloe Vera: a Short Review. *Ind J Dermatol* **53(4):** 163–166 (2008).
24. Tripathu, S., Pradhan, D., Anjan, M., Anti-inflammatory and antiarthritic potential of Ammania baccifera Linn. *Int J Pharma Biol Sci* **1:** 1–7 (2010).
25. Trop, M., Novak, M., Rodl, S., Hellbom, B., Kroell, W., Goessler, W., Silver-coated dressing acticoat caused raised liver enzymes and argyria-like symptoms in burn patient. *J Trauma Injury*, Infect (2006).
26. Crit Care 60:648–652. doi:10.1097/01.ta.0000208126.22089.b6 Vahabi, K., Mansoori, G., Karimi, V., Biosynthesis of silver nanoparticles by fungus Trichoderma reesei. *Insci J* **1(1):** 65–79 (2011).
27. Verano-Braga, T., Miethling-Graff, R., Wojdyla, K., Rogowska-Wrzesinska, A., Brewer, J. R., Erdmann, H., Kjeldsen, F., Insights into the cellular response triggered by silver nanoparticles using quantitative proteomics. *ACS Nano* **8(3):** 2161–2175 (2014).
28. Wang, H., Wu, L., Reinhard, B. M., scavenger receptor mediated endocytosis of silver nanoparticles into J774A.1 macrophages is heterogeneous. *ACS Nano* **6(8):** 7122-7132 (2012).