



BIOLOGICAL SYNTHESIS OF SILVER NANOPARTICLES BY USING APPLE (*MALUS PUMILA*) PEEL AND ITS CHARACTERIZATION

Dipali Markam* and Dr. M. K. Gupta

*Department of Microbiology, Barkatullah University, Bhopal, India.

***Corresponding Author: Dipali Markam**

Department of Microbiology, Barkatullah University, Bhopal, India.

Article Received on 19/02/2018

Article Revised on 11/03/2018

Article Accepted on 31/03/2018

ABSTRACT

In this study, synthesis of silver nanoparticles has done using extract of apple peels. Nanoparticles can be synthesized by various physical and chemical methods. In this study, an environment friendly biogenic technique has used to produce silver-nanoparticles. Nano particles have synthesized by adding 1mM silver nitrate solution into the plant extract and characterized by UV-Visible absorption spectroscopy. The UV-Visible spectrum showed strong absorption peak at 300 to 340 nm. Role of apple peel extract as a reducing and capping agent of silver ion has identified by Fourier transform infrared (FTIR) spectroscopy. The result of Zeta potential showed that silver nanoparticles were 381.3 nm in size. Biogenic synthesis of silver nanoparticle is a rapid and simple method which can be used in place of hazardous chemicals. Eco-friendly plant material is used as reducing or stabilizing agent which is economic and cost effective. Synthesis of nano-particles was confirmed by UV-Spectroscopy, FTIR spectroscopy and Zeta potential. This study also promotes the green technology to produce silver-nanoparticles.

KEYWORDS: In this study, synthesis nano-particles produce silver-nanoparticles.

INTRODUCTION

In present world, where many tools and techniques are present, nanotechnology has become more popular and rapidly accepted by many field of Science. With the help of nanotechnology, materials with nanometer size are produced. Many research shows that nanoparticles have special optical, chemical, physical, magnetic and antimicrobial properties in it. Nano particles can be produced by physical, chemical and biological method.^[4,7,20] As name impels Physical methods include ultra-sonication, irradiation, microwave, electrochemical technique, whereas chemical methods utilize chemicals as reducing agent. These two methods involve use of toxic and hazardous chemicals which are expensive and have potential to harm environment, as

a result, responsible to increase various biological risks.^[11] Biological methods utilize the potential of microbes and plant material as a reducing or stabilizing agent. Biological method is being adopted by many researchers because it is an environment friendly method, and it is cost effective and rapid method to synthesize silver nanoparticle.^[12,13,19]

Metal ion, like silver, gold, cadmium sulphide etc. is reduced into metallic nano particles during the process of nanoparticle synthesis. Silver nanoparticles gained attention of many researchers, as silver is known as very beneficial element and being used as an antimicrobial

agent since a long time ago. Because of its high antimicrobial properties, chemical stability and catalytic activity, silver is considered as an ideal metal to produce nanoparticle.

Apple is well known for very rich source of nutrient and many researchers have already proved that apple peel contains more nutrients than apple flash. Apple skin has flavonoid like quercetin glycosides and cyanidin glycosides which is not found in apple pulp.^[20] Apple belongs to the Kingdom:- Plantae, Division- Angiosperms Class – Eudicots, Sub-class- Rosids, Order:-Rosales, Family- Rosaceae Genus:-Malus and species:-*M.pumila* and its Binomial name is *Malus pumila*.

METHOD AND MATERIAL

Collection of material

Fresh apple peels were obtained by peeling fresh apples and some were collected from local juice shop where they use apple pulp for fruit custard and peels were of no use for them. The apple peels were washed well by using distilled water.

Extraction method

Boiling Method

To obtain aqueous extract, fresh apple peels were used. 20 gm. of apple peels were soaked in 200 ml of distilled water and boiled for 30 minutes. Extract was first filtered

by muslin cloth then by whatman no.1 filter paper. This mixture was kept at 66°C in a water bath and cooled to room temperature. Extract was transferred to glass vials and kept at low temperature in refrigerator.

Biosynthesis of nanoparticles

Preparation of Silver nitrate solution

Silver nitrate solution was prepared. To prepare 1mM AgNO₃ solution 16.9 mg AgNO₃ was dissolved in 100 ml deionized water.

Silver nanoparticle biosynthesis by using aqueous extract of apple peel:- For silver nanoparticles synthesis, one ml of fresh apple peel extract was added to 9 ml of 1mM AgNO₃ in 50 ml flask. Then flask was incubated for a desired time (commonly 24hr) at room temperature. After definite time interval a change in color of reaction mixture from light brown to dark brown was observed.

Characterization of silver nanoparticles

UV-Spectroscopy

The primary characterization of silver nanoparticle is done by UV-Spectroscopy.

This technique is very reliable, easy, simple, and need short period of time for measurement. Due to some unique optical properties silver nanoparticle interact strongly with specific wavelengths of light. In the visible region of electromagnetic radiation, vibration of free electrons of silver nanoparticle, in resonance with light wave give rise to a surface plasmon resonance (SPR) absorption band.^[21] During synthesis of silver nanoparticle, Color development is characteristic of the surface plasmon resonance (SPR) of silver nanoparticles.

FTIR Spectroscopy

To find out presence of bio reducing agent in the reaction mixture FT-IR spectroscopy was carried out. For this freshly synthesized nanoparticles were centrifuged at 5000 -6000 rpm for 10 minutes to remove any uncapped ligand from the reaction mixture, after centrifugation suspension were again subjected to centrifuge in 10 ml sterile distilled water. This process was repeated for 2 to 3 times to collect silver nanoparticles. To obtain dried powder of silver nanoparticle the purified suspension was freeze dried. These dried nanoparticles were analyzed later with the help of FT-IR spectrophotometer. The functional groups present in the sample were identified by comparing the obtained spectral data with reference chart.

Particle Size Analysis

Zeta potential

With the help of Zeta potential analysis technique the surface charge of silver nanoparticles can be determined. A property of zeta potential gives the net surface charge to the silver nanoparticle. The state of silver nanoparticle surface and its stability can be understood with the help of zeta potential.^[9]

RESULT AND DISCUSSION

UV-Vis spectroscopy analysis

Initially the synthesis of silver Nano particle were confirmed by observing the color change of reaction mixture from light brown to dark brown (Image No.1). UV-Visible absorption spectrum of the solution showed the surface Plasmon resonance derived from the silver nanoparticles at around 400 nm. (Image No.2).

The high OD of the solution suggests a high conversion of Ag⁺ to Ag⁰ as nanoparticle.

FTIR Spectroscopy

Image no. 3 showed the IR spectrum of silver nano particles, the peaks were observed very weak at O-H stretch at 3853 & 3740 nm, very broad O-H stretch (hydrogen bonded) shifted to lower frequency at 3339 nm, C=C stretch broad less intense at 1641 nm, C=C aromatic ring stretch at 1526 nm, Methylene C-H stretch at 1418 nm, O-C-O stretch very weak alkene out of plane deformation at 1092 nm, at 920-867 peak disappeared. As per above observation major functional groups in reaction mixture are hydroxyl, alkene, Carbonyl indicated by Infra-Red absorption spectrum.

Zeta Potential

The size of silver nanoparticle and its charge were determined with the help of Zeta Potential. Image -4 reveals the average particle size of 381.3 nm and these particles carries negative charge on it.

Graph and gallery



Image 1: Silver nanoparticle reaction mixture.

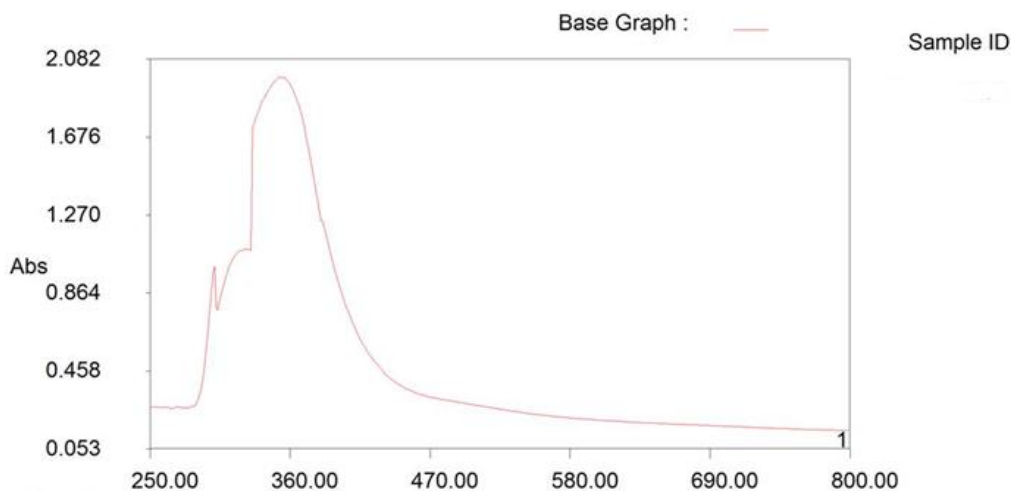
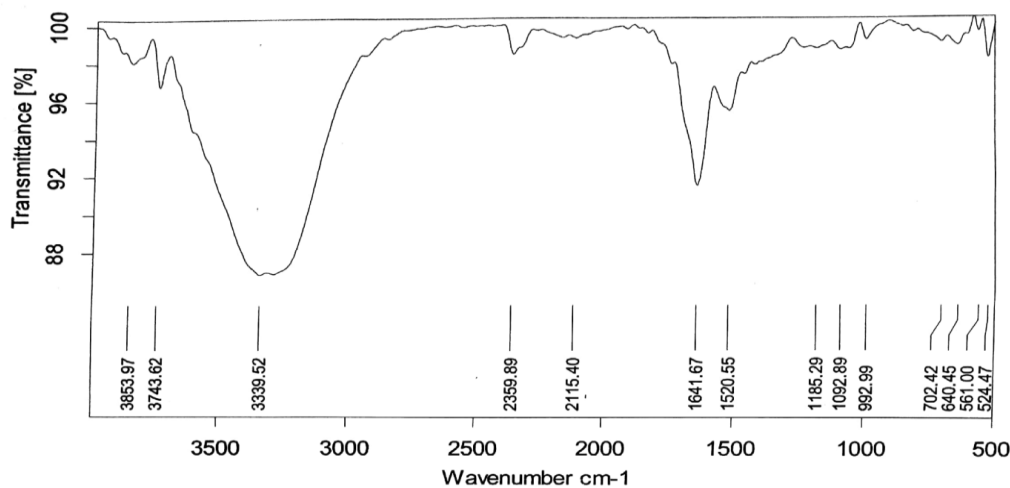


Image 2: UV-Visible spectroscopy of Silver nanoparticle.



Wavenumber	Abs. intensity	Rel. intensity	Width	Found if threshold <	Shoulder
3853.9647	0.981	0.015	107.9661	9.865757	0
3743.6223	0.968	0.019	30.6699	12.559769	0
3339.5238	0.869	0.132	474.0575	97.337814	0
2359.8905	0.984	0.015	67.5524	11.399440	0
2115.3967	0.993	0.006	173.8526	3.371946	0
1641.6696	0.915	0.086	109.5262	62.736301	0
1520.5511	0.965	0.015	64.2641	9.234586	0
1185.2938	0.987	0.004	111.8202	2.735604	0
1092.8945	0.987	0.009	12789.1231	4.504252	0
992.9896	0.992	0.009	35.7795	6.357455	0
702.4198	0.991	0.004	30.6650	2.125693	0
640.4474	0.989	0.014	192.0255	9.601531	0
560.9965	0.996	0.007	17.2800	4.368339	0
524.4673	0.982	0.017	24.5911	11.598294	0

Image 3: IR spectroscopy of Silver nanoparticle.

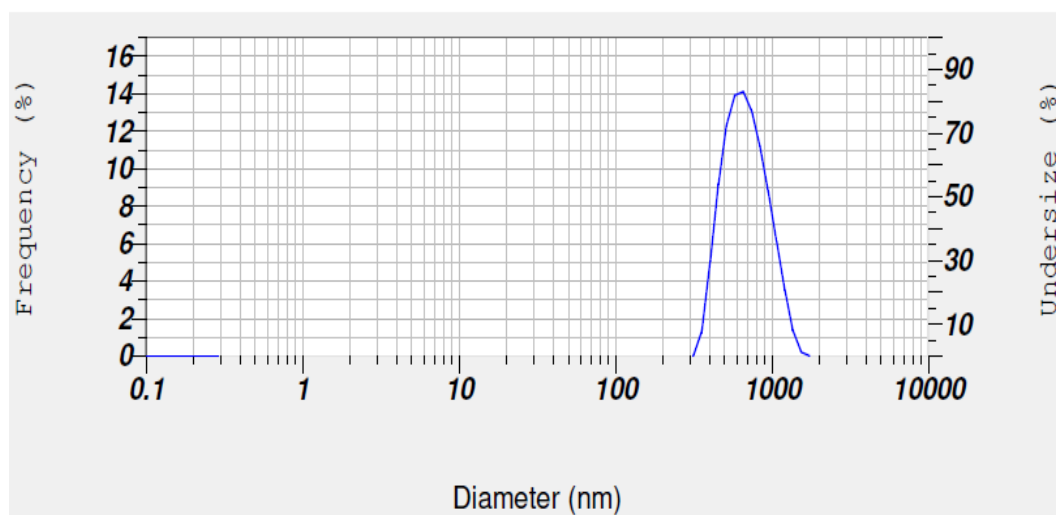


Image 4: Zeta Potential of Silver nanoparticles.

CONCLUSION

This study concludes that the peel of apple can be used effectively for the synthesis of silver nanoparticles. UV-Spectrophotometer absorption spectrum has shown particular band and FTIR spectroscopy spectra has given confirmation of presence of capping ligand and synthesis of stabilized silver nanoparticles. It is well documented and many research has confirmed that silver nanoparticle is able to show antimicrobial activities.^[1,3,5,6] This biogenic synthesized silver nanoparticles can be used to control pathogenic microbes as an effective antimicrobial agent. As green synthesized nanoparticles are ecofriendly, it must be promoted to utilize in place of chemical method of SNPs synthesis, besides that it is also cost effective.

REFERENCE

1. Awad M Akl et al(2013) Green synthesis of silver nanoparticles using carob leaf extract and its antibacterial activity. International Journal of Industrial Chemistry., 4: 29.
2. Ahmed Shakeel, Ikram Saiqa(2015) Silver nanoparticle: One Pot Green Synthesis Using *Terminaliaarjuna* Extract for Biological Application. J Nanomed Nanotechnol, 6: 4.
3. Bhakya s., Muthukrishnan S., Sukumaran M.(2015) Biogenic synthesis of silver nanoparticles and their antioxidant and antibacterial activity. Appl Nanosci., 6: 766.
4. Begam Nasrin J.(2016) Biosynthesis and characterization of silver nanoparticles(AgNPs) using marine bacteria against certain human pathogens. International Journal of Advances in scientific Research, 2: 7.
5. Bosel Debadin, Chatterjee Someswar(2015) Biogenic synthesis of silver nanoparticles using guava(*Psidiumguajava*) leaf extract and its antibacterial activity against *Pseudomonas aeruginosa*. Appl Nanosci., 6: 895-901.
6. Dhanapal Antony Tanislaus Cordelia Anto et al.(2015) Synthesis and Characterization of Silver Nanoparticle from *MangiferaIndica* and its Antimicrobial Activity. International Journal of food and Nutrition Sciences, 4: 4.
7. Eraee Hoda, Rajaian Hamid, Nazifsaeed(2017) Synthesis and characterization of novel silver nanoparticles using Chamaemelumnobile extract for antibacterial application. Adv. Nat. Sci.: Nanosci. Nanotechnol, 8: 025004.
8. Halawani Mohamed Eman(2017) Rapid Biosynthesis Method and Characterization of Silver Nanoparticles Using *Zizyphusspinachristi* Leaf Extract and Their Antibacterial Efficacy in Therapeutic Application. Journal of Biomaterials and Nanobiotechnology, 8: 22-35.
9. Haider J.Mohammed, Mehdi S.Mohammed(2014) Study of morphology and Zeta Potential analyzer for the silver Nanoparticles. International Journal of Scientific & Engineering Research, 5: 7.
10. Kalainila P, SubhaV, Ravindran Ernest S.R., Renganathan Sahadevan(2014) Synthesis and characterization of silver Nanoparticle from *Erthrinaindica*. Asian J Pharm Clin Res., 7: 39-43.
11. K.Anandalakshmi, J Venugobal(2017) Green synthesis and characterization of Silver Nanoparticles Using Vitexnegundo (Karu Nochchi) Leaf Extract and its antibacterial activity. Medchem (Los Angeles), 7(7): 218-225.
12. Khatami M., Nejadsoftani M., Poursevdi Sh.(2015) Biogenic synthesis of silver Nanoparticles Using Mustard and its Characterization. Int. J Nanotechnol, 11(4): 281-288.
13. Mathur Abhishek et al.(2014) Green synthesis of silver nanoparticles using medicinal plant and its characterization. Der Pharmacia sinica., 5(5): 118-122.
14. M.Prabakaran.(2012) Biosynthesis of silver nanoparticles using *Sphaerulinaalbispiculata* and evaluation of antibacterial activity. European Journal of Experimental Biology., 2(2): 297-303.
15. Pannerelvam, Balashanmugam, Thangavelu Pudupalayam, kalaichelvan(2015) Biosynthesis

- characterization of silver nanoparticles using *Cassia roxburghii* DC. Aqueous extract and coated on cotton cloth for effective antibacterial activity. *International Journal of Nanomedicine*, 10.
16. Premasudha Paramasivam et al.(2015) biological synthesis and characterization of silver nanoparticles using *Eclipta alba* leaf extract and evaluation of its cytotoxic and antimicrobial potential. *Indian Academy of science*, 38: 965-973.
 17. Prusty Kumar Amiya, Patro Kumar Saroja.(2017) Study of invitro antimicrobial activity of biogenicallysynthesised silver nanoparticle using leaf extract of *aponogetonnatans*. *International Journal of Comprehensive and Advance Pharmacology*, 2(2): 60-64.
 18. Roy Swarup, Das Kumar Tapan.(2015). Plant Mediated Green Synthesis of silver Nanoparticles-A Review. *International Journal of Plant Biology & Research*, 3(3): 1044.
 19. Sware Kantrao et al(2014) Biosynthesisand characterization of silver nanoparticles using *Ficus Benghalensis* Leafextract. *International Journal of research in Engineering and Technology*, 3: 5.
 20. Umoren A. S., Obot B.I., Gasem M. Z., (2014) Green Synthesis and Characterization of Silver Nanoparticles Using Red Apple (*Malusedomestica*) fruit Extract at Room Temperatuer. *J. Mater. Environ. Sci.*, 5(3): 907-914.
 21. Zhang Xi-Fenget al.(2016) Silver Nanoparticles: Synthesis, Characterization, Properties, Applications, and Therapeutic Approaches. *International journal of molecular science*, 17: 1534.