IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 4, June 2014.

www.ijiset.com

ISSN 2348 - 7968

Eco-friendly synthesis of Silver Nanoparticles Using Fruit extract of Averrhoa carambola

Mandar Medhi

Department of Chemistry, R. Jhunjhunwala College, Ghatkopar-400086

mandarmedhi@yahoo.com

Abstract

Plant extracts are eco-friendly and can be an economic and efficient option for the large-scale synthesis of nanoparticles. The current study deals with the synthesis of silver nanoparticles (AgNPs) using Starfruit (*Averrhoa carambola*) extract. The aqueous fruit extract and aqueous $AgNO_3$ (5mM) solution changed from yellowish to reddish brown, the final color appeared gradually with time. Formation of AgNPs was confirmed by UV-visble spectroscopy, Fourier transform infrared spectroscopy (FTIR) and Scanning electron microscopy (SEM). These AgNPs were used to study their antimicrobial activity. Biological methods which are environment friendly and convenient are good competitors for the chemical procedures.

Keywords : *eco-friendly biosynthesis, silver nanoparticles, starfruit extract, microorganisms.*

Introduction

The importance and benefits of nanotechnology in biology and medicine are now well-recognized by scientists, technologists, as well as various governmental and private research funding agencies. Nanotechnology has exploded onto the scientific scene in the last 20 years or so after the discovery, followed by Nobel Prize recognition, of novel forms of carbon as the fullerenes molecules or buckyballs Kroto et al.1985, the rediscovery of carbon nanotubes (CNTs) by Iijima1991and Graphene synthesis 2007. The subsequent development has impacted nearly every field of scientific research. The early life of nanotechnology began in materials science laboratories and has now grown at the front of several other disciplines, including chemistry, physics, biology and biomedical engineering. Nanotechnology is now rapidly being expanded for improved biotechnology to the extent that it can now be called as a subfield of "nanobiotechnology."

There are number of approaches are available for the synthesis of silver nanoparticles for example, reduction in solutions [2], chemical and photochemical reactions in reverse micelles [3], thermal decomposition of silver compounds [4], radiation assisted [5], electrochemical [6], sonochemical [7], microwave assisted process [8] and recently via green chemistry route [9, 10, 11,].

The biosynthetic method employing plant extracts have drawn attention as a simple and viable alternative to chemical procedures and physical methods. Bioreduction of silver ions to yield metal nano particles using living plants, geranium leaf, Neem leaf. Very recently, they have demonstrated synthesis of gold nanotriangles and silver NP using *Aloevera* plant extracts , *Emblica officinalis* (amla, Indian Gooseberry). Nevertheless, the bioreduction of silver ions proceeded merely in the presence of ammonia. Most of the above research on the synthesis of silver or gold NP utilizing plant extracts employed broths resulting from boiling fresh 122 plant leaves. The green synthesis of silver NP using *Capsicum annuum* L. extract has been reported. According to previous reports, the polyol components and the water-soluble heterocyclic components are mainly responsible for the reduction of silver ions and the stabilization of the NP, respectively.

Silver has long been recognized as having inhibitory effect on microbes present in medical and industrial process. The most important application of silver and silver NPs is in medical

industry such as topical ointments to prevent infection against burn and open wounds.
Carambola, also known as Starfruit, is the fruit of *Averrhoa carambola*, a species of tree native to the Philippines, Indonesia, Malaysia, India, Bangladesh, and Sri Lanka. The fruit is a popular food throughout Southeast Asia, the South Pacific and parts of East Asia.

Carambola fruit is a fairly complex with many benefits, but, as with strawberries a small percentage of the human population should be Cautious of the fruit for Health Reasons.

2. Experimental

2.1 Plant material and preparation of extract and silver nanoparticles

Averrhoa carambola fruits were collected from Raigad, Maharashtra, India. The fruits were air dried and then were kept in the hot air oven at 100°c for 24- 48 h. The fruits were ground to a fine powder. 5 mM silver nitrate (AR grade $AgNO_3$ was purchased from HIMEDIA) was added to fruit extract and heated at 60-80°c. A change in the color of solution was observed during the heating process.

Fig.1 Photograph of Leaf and fruit of *Averrhoa carambola*

2.2 Characterizations

The Ag NPs obtained using silver nitrate and ***Averrhoa carambola*** fruit extract was characterized by using UV-VIS spectra and SEM

3. Antimicrobial activity study

Antibacterial activity of the synthesized Ag NPs was determined using the agar well diffusion assay method. Approximately 20ml of molten and cooled media (Nutrient agar) was poured in 3 sterilized Petri dishes. The plates were left overnight at room temperature to check for any contamination to appear. The bacterial test organisms were grown in Nutrient Broth for 24h. A 100ml nutrient broth culture of *S. aurous* bacterial organism was used to prepare bacterial lawns. Agar wells of 5mm diameter were prepared with the help of a stainless steel cork borer. Two wells were prepared in the agar plates. The wells were labeled as A, B. A well was loaded with 20µl of Ag NPs and B was loaded with 20µl of control (plant extract).

4. Results and discussion

Five different fruit extracts were screened for biological synthesis of silver nanoparticles and among them *Averrhoa carambola* fruit extract was found to be capable of synthesizing Ag NPs with maximum stability. For the screened fruit extract filtrate colour has changed from pale yellow to dark brown after reduction. The formation of silver nanoparticles was preliminary confirmed by the colour changes from pale yellow to dark brown. Development of dark brown color is due to the Surface Plasmon Resonance property of silver nanoparticles.
The reduction of pure Ag+ ions was monitored by measuring the UV-Vis spectrum of the reaction medium at 5 hours after diluting a small aliquot of the sample into distilled water. UV-Vis spectral analysis was done by using UV-VIS spectrophotometer (Cary 4000 UV/ Vis spectrophotometer). The absorption maxima for the biosynthesized nanoparticles were noted in the visible range of 400-700nm. The typical absorption maxima for Ag NPs synthesized was obtained at around 440 to 460 nm which is shown in the Fig. 2.

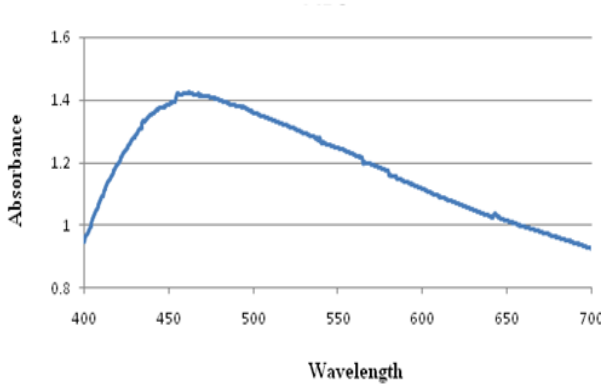

Fig. 2 UV-Visible Spectrum of Ag NPs obtained by using *Silver nitrate and Averrhoa carambola* fruit extract.

SEM analysis was done using Hitachi S-3500SEM machine. Thin films of the sample were prepared on a carbon coated copper grid by just dropping a very small amount of the sample on the grid, extra solution was removed using a blotting paper and then the film on the SEM grid were allowed to dry by putting it under a mercury lamp for 5 min. SEM analysis shows the Ag NPs obtained by using *Averrhoa carambola* fruit extract of size 40-50 nm having uniform shape shown in Fig.3.

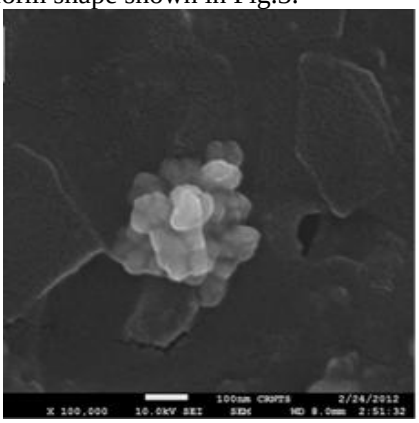

Fig. 3 SEM image of Ag NPs obtained by using *Silver nitrate and Averrhoa carambola* fruit extract

The plates containing the *S. aurous*, plant extract and Ag NPs after incubation at 35ºC for 24hours the plate was examined for evidence of zones of inhibition which appear as a clear area around the wells. The diameter of zones inhibition with AgNPs was 1cm Fig. 4 (A) and 0.5cm Fig.4 (B) for *Averrhoa carambola* fruit extract. This confirms the anti microbial activity of the fruit extract is approximately doubled because of Ag NPs.

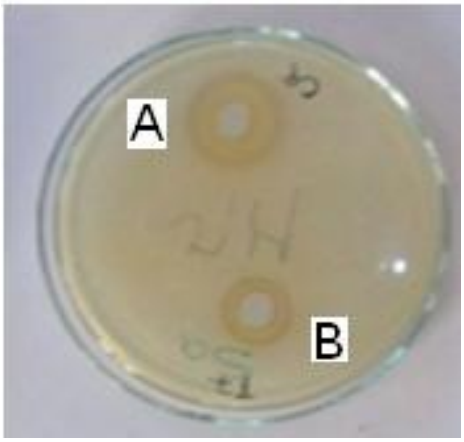

Fig. 4 A) Antimicrobial activity of AgNps with S. aurous, B) with *Averrhoa carambola* fruit extract

4. Conclusion

In this current work nanoparticles were synthesized biologically using the ***Averrhoa carambola*** fruit Extract. This method is purely as per the green chemistry as well as completely toxic free compared to chemical synthesis methods. The AgNPs are characterized by UV-Vis spectrophotometer and SEM. development of simple and eco-friendly synthetic route would help promoting further interest in the synthesis and application of metallic nanoparticles. In this respect, nature has provided exciting possibilities of utilizing biological systems for this purpose. This comes from the fact that microorganisms while interacting with metal ions have shown to reduce the ions into metallic particles. Thus, fungi have shown ability to reduce metal ions to form metallic nanoparticles.

References

[1] P.Mukherjee, A. Ahmad, D.Mandal, S. Senapati, S.R. Sainkar, M.I. Khan, R. Parishcha, P.V. Ajaykumar, M.Alam, R.Kumar, M.sastry, Nano Lett.**1**, 515(2001).
[2] D.V. Goia, E. Matijevic N. J. Chem. **22,** 1203 (1998)
[3] C. Taleb, M. Petit, P. Pileni Chem. Mater. **9,** 950 (1997)
[4] K. Esumi, T. Tano, K. Torigoe, K. Meguro Chem. Mater. **2,** 564 (1990)
[5] A. Henglein Langmuir **17,** 2329 (2001)
[6] L. Rodriguez-Sanchez, M. C. Blanco, M. A. Lopez-Quintela J. Phys. Chem. B **104,** 9683 (2000)
[7] J. J. Zhu, S. W. Liu, O. Palchik, Y. Koltypin, A. Gedanken Langmuir. **16,** 6396 (2000)
[8] Pastoriza-Santos, L. M. Liz-Marzan Langmuir **18,** 2888 (2002)
[9] N. A. Begum, S. Mondal, S. Basu, R. A. Laskar, D. Mandal Colloids and Surfaces B: Biointerfaces **71,** 113-118 (2009)
[10] H. Bar, D. K. Bhui, G. P. Sahoo, P. Sarkar, S. P. De, A. Misra. Colloids and Surfaces A: Physicochem. Eng. Asp. **339,** 134 (2009)
[11] J. Y. Song, B. S. Kim. Bioprocess Biosyst. Eng. **32,** 79–84 (2009). 133