Available online at **www.joac.info**

ISSN: 2278-1862

Journal of Applicable Chemistry

2018, 7 (4): 835-842
(International Peer Reviewed Journal)

Green Synthesis of Silver Nanoparticle from Leaves of *Artemeisia roxburghiana L*

S.C. Sati P K Tripathi[1] and Manisha D Sati[2]*

1. Department of Chemistry (A Central University), HNB Garhwal University, Srinagar, Uttarakhand, **INDIA**
2. Department of Chemistry Govt PG College Devprayag, Tehri Garhwal, **INDIA**
Email: sati_2009@rediffmail.com

Accepted on 8th July, 2018

ABSTRACT

In this paper we have reported the green synthesis of silver nanoparticles (AgNPs) by using the leaves extract of Artemeisia roxburghiana as capping and reducing agents. The synthesized nanoparticles were characterized by the spectral techniques such as UV–Vis, Powder XRD, HR-SEM and HR-TEM which confirm the average size of nanoparticles about 42 to 47 nm. In the EDX data it has been found that the synthesized nanoparticles are 46 percent silver and it is nearly spherical in shape. After characterization it has been screened for antioxidant activity by DPPH method which shows that its IC50 value of 63 further in order to check the materials applicability the photocatalytic degradation of natural dyes such as alizarin red and methyl orange, were monitored in the presence of synthesized nanoparticles.

Graphical Abstract

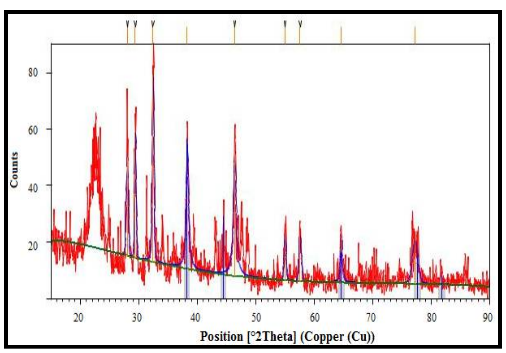


Figure 2. XRD peaks of AgNPs

Keywords: Green chemistry, *Artemisia roxburghiana*, DPPH, photocatalytic activity.

INTRODUCTION

Since green chemistry [1-4] in association with nanotechnology [5-6] can have a wide range of applications for the betterment of mankind. The synthesis of silver nanoparticles [7-10] by using plant material as capping as well as reducing materials minimize the use of hazardous materials not only in laboratory but it also prevents its leaching into the environment. The silver is antimicrobial in its own, on conversion into nanoscale materials by reduction it behaves differently whether it is matter of biological application or catalytic application. The basic concept of nanotechnology and green chemistry provide the base for these experiments. The advantages of using green method for the synthesis of nanomaterials over physical or chemical methods are that it is not only cost effective but also has lesser adverse effect on the environment.

The isolation work has been performed on the plant *Artemisia Roxburghiana* [11, 12]. Many biologically active compounds i.e. 1,8-cineole (16.6%), camphor (15.2%) and a-thujone (10.0%) have been isolated from leaves of this plant. Artimicine is a compound, isolated from *Artemisia annua* plant has antimalarial activity.

The nanoparticles are small assembly of molecules in the range 1 to 100 nm with wide range of application and also a proper approach to the synthesis provide a way to design the morphology of the nanoparticles to be synthesized by monitoring the condition of the synthesis via various routes of synthesis like chemical, mechanical and biological route, every route for the synthesis of metal nanoparticles has its own merits and demerits. The green synthesis route is the route with minimum demerits because any human activity which affects our environment is never be fruitful in long run. The main objective behind the development of green chemistry was the environmental cleanup. There are numerous materials in the environment in the nano-range (i.e.1 to 100 nm) but these are not engineered [13] i.e., they formed by the natural process such as volcanic eruption and burst fire etc, these nanoparticles have adverse effect on the human health or living organism. The engineered nanoparticles synthesized by green root are free from such kinds of flaws. Human and the various segments of environment contains free radicals or prone to be free radical type compounds in different proportion generated from various sources which has carcinogenic effect to the human health. Many solvent used in chemical industries for synthetic purpose has been proven that it is carcinogenic [14] i.e. Benzene so regarding this concern an antioxidant is needed to cope up with these radical scavengers. The antioxidant activity through DPPH method provides a mechanistic tool to estimate the potency of a particular material against the radical scavengers.

Dyes [15-19] are used to colour the various objects of the daily use whether it is cloth or paint on our doors but problems arises when these dyes releases into the water stream or in the atmosphere in any form which could be injurious. Nanoparticles due to its higher surface to volume ratio are found to have a catalytic effect in the photocatalytic degradation of natural or artificial dyes.

In present investigation we have reported the synthesis of silver nanoparticles by an ecofriendly method using *Artemisia roxburghiana* leaves extract. , The synthesized nanoparticles was characterized by the spectral techniques such as UV–Vis, Powder XRD, HR-SEM and HR-TEM. After characterization it has been screened for antioxidant activity by DPPH method which shows that its IC50 value of 63 further in order to check the materials applicability the photocatalytic degradation of natural dyes such as alizarin red and methyl orange were monitored in the presence of synthesized nanoparticles.

MATERIALS AND METHODS

Preparation of the plant extracts and synthesis of plan AgNPs: The plant *Artemisia roxburghiana*, collected from Srinagar, Pauri Garhwal Uttarakhand in the month of September. The extract was prepared by dissolving the 5 g dried leaves in the 100 mL double distilled water 250 mL Erlenmeyer flask, after that it was placed in the heating mental for 30 min at 60°C. The extract was then filtered twice with Wattman filter paper no. 44. The plant extract was then mixed with the 5 mmol silver nitrate solution in the ratio 1:9 of plant extract to silver nitrate solution. The synthesis of AgNPs at 1mM, The resulting solution give absorption near 470 nm in UV-Vis spectrometer due to the surface plasma resonance (SPR) which confirms the formation of silver nanoparticles further the solution give a visible change in color after 12 h which also confirm the formation of silver nanoparticles. The solution which contain AgNPs was centrifuged at 5000 Round per minute (RPM) for 20 min. After the collection of nanoparticles, they were washed twice to remove the agglomeration if present in the nanostructure. The synthesized material was then characterized by UV-Vis spectroscopy, Powder-XRD, SEM-EDX and HR-TEM.

RESULTS AND DISCUSSION

Characterization:

UV-Vis spectroscopy: UV-Visible spectroscopy was used during and after the synthesis of nanoparticles for the study of kinetics of formation of nanoparticles. Also the formation of AgNP gives a clear visual change but it was also monitored by UV-Vis spectroscope. At early stage of synthesis, the characteristic band for AgNP appears at 400 nm which show a hyperchromic and blue shift as duration of synthesis increases (Fig 1).

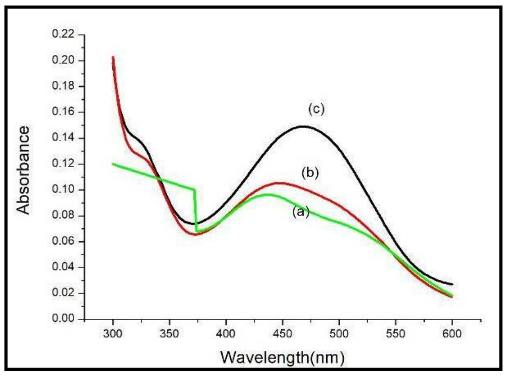


Figure 1. UV-Vis spectroscopy of (a)AgNP At 30 min, (b) At 60 min, (c) At 90 min

Powder XRD: Powder-XRD of synthesized nanoparticles was done by using Diffractometer. The scanning of the sample was done from 15.02 (2θ value) to 90.00. The major peak at 38.212 correspond to the plane 1 1 1 which give cubic structure of nanoparticles other peaks are also there but can be considered as noise as some elements can come from plant materials during synthesis. On analysis the XRD data shows that the AgNPs are in crystalline for with the volume of unit cell 67.73 Å (fig. 2).

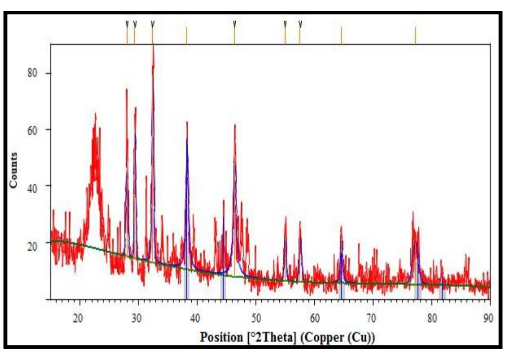


Figure 2. XRD peaks of AgNPs

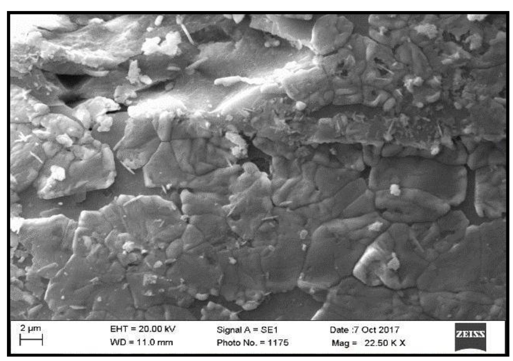


Figure 3. SEM image of synthesized AgNPs

Scanning Electron Microscopy (SEM): Scanning electron microscopy was carried with EDX which give surface morphology and percentages elemental composition (Fig 3).

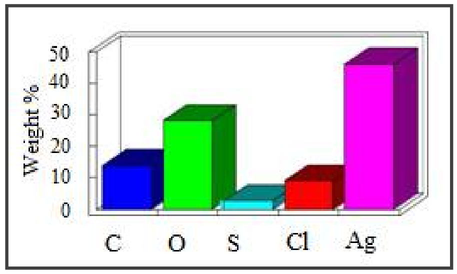


Figure 4. Showing the percentage composition of AgNPs

Transmission Electron Microscopy (TEM): Transmission electron microscopy is used for the study of surface morphology and to calculate grain size of particles. The grain size was calculated by using Emage J software which gives the average grain size of the synthesized nanoparticles about 17.6 nm which is in nanometre range (Fig 5 and 6).

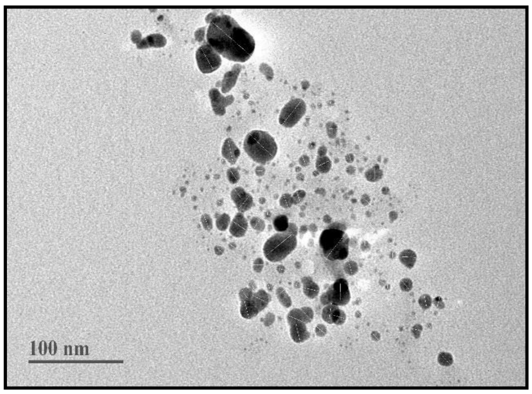


Figure 5. HR-TEM at100 nm magnification

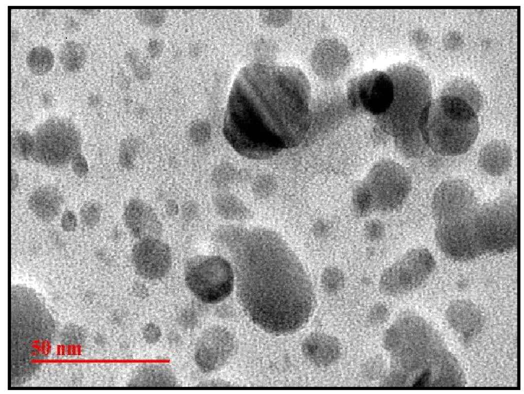


Figure 6. HR-TEM at 50 nm magnification

The EDX data clearly shows that the synthesized nanoparticles has adequate percentage of Ag (silver) which was being encapsulated by secondary metabolites of plant materials.

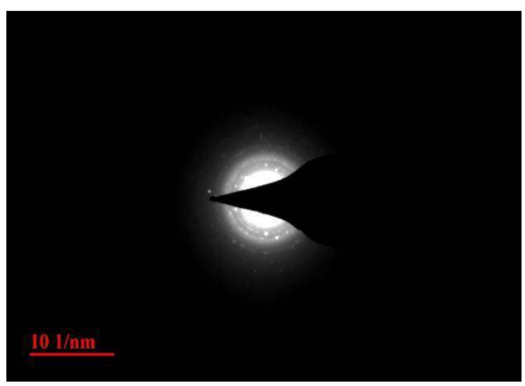


Figure 7. HR-TEM at 101 nm

Antioxidant activity: Antioxidant activity was performed through DPPH method [20-25] using ascorbic acid as standard which gives 66.53% reduction on concentration of 100 µg mL^{-}1 (fig. 8), DPPH free radical scavenging activity of sample soluble in DMSO. The antioxidant activity was monitored at increasing concentration of AgNPs against the constant concentration of DPPH redial scavengers. At 90 µg mL^{-1} concentration of AgNPs the % reduction was 63.87compartive to ascorbic acid (Table 1).

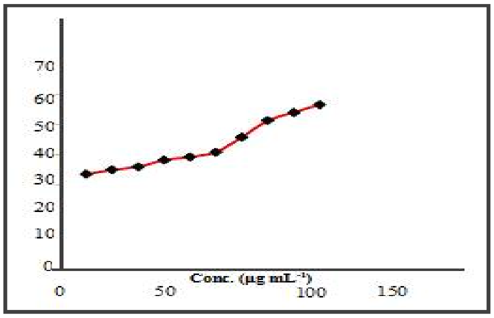


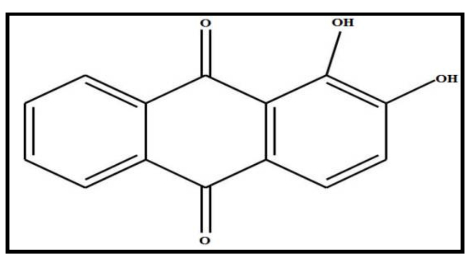
Figure 8. Antioxidant activity

Table 1. Antioxidant activity

S. No.	Conc. (µg mL^{-1}	absorbance	% Reduction	IC_{50} Value
1.	10	0.277	43.46	
2.	20	0.270	44.89	
3.	30	0.265	45.91	
4.	40	0.254	48.16	
5.	50	0.249	49.18	51
6.	60	0.241	50.81	
7.	70	0.217	55.71	
8.	80	0.190	61.00	
9.	90	0.177	63.87	

Photocatalytic Degradation: The photocatalytic degradation of natural dye alizarin red S and malachite green was screened in the absence and presence of nanoparticles which has shown that the nanoparticle has accelerating effect on photocatalytic degradation. The photocatalytic degradation was performed by making 5 ppm solution of Malachite Green and Alizarin Red separately. The absorbance without and with the catalyst was monitored at the interval of 15 min. It was found that the synthesized nanoparticles have accelerating effect on the photocatalytic degradation of dyes.

Alizarine Red S: Alizarin or 1,2-dihydroxyanthraquinone is a prominent red dye isolated from roots of plants of maddar genus. It has molecular formula $C_{14}H_8O_4$. It was also first natural pigments synthesized chemically.



1, 2-dihydroxyanthracene-9,10-dione

The photocatalytic degradation of Alizarin was performed by using 5 mM solution of Alizarin in double distilled water. The solution was kept in sunlight and the degradation of alizarin was monitored by using UV-Vis spectroscopy in the absence of AgNP at the interval of 15 min. The above process was also repeated with alizarin in the presence of catalytic amount of AgNP. The AgNP catalysis was heterogenous catalysis hence the quantity of nanoparticles was not compromised. The results were compared and were found that the accelerating effect of AgNP on photocatalytic degradation of alizarin was good.

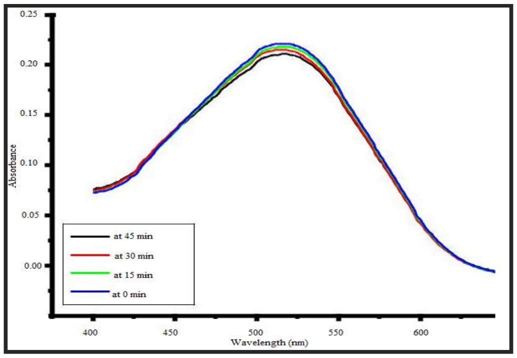


Figure 9. Photocatalytic degradation of alizarin in the absence of nanocatalyst

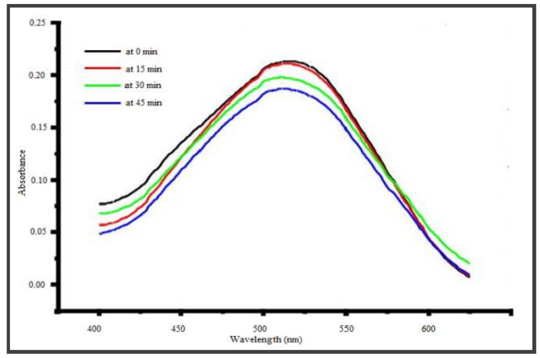
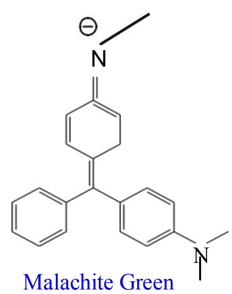


Figure 10. Photocatalytic degradation of alizarin in the presence of nanocatalyst

On comparison of above two graphs it is evident that the synthesized nanoparticles have good catalytic effect due to maximum surface to volume ratio.

Malachite Green: Malachite green is an organic compound used as coloring reagent in dye industries and it has been proven that it too has toxicity to marine life and mankind. The photocatalytic degradation was performed of alizarin and following results was found.



Malachite Green

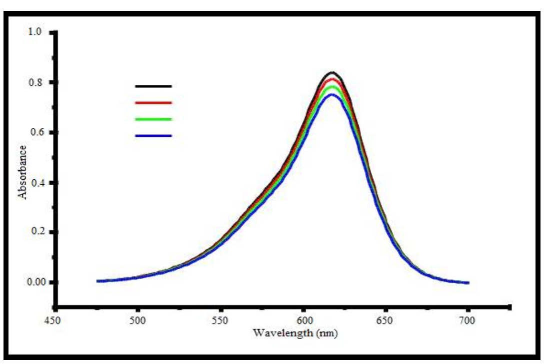


Figure 11. Photochemical degradation of malachite green in the absence of AgNP.

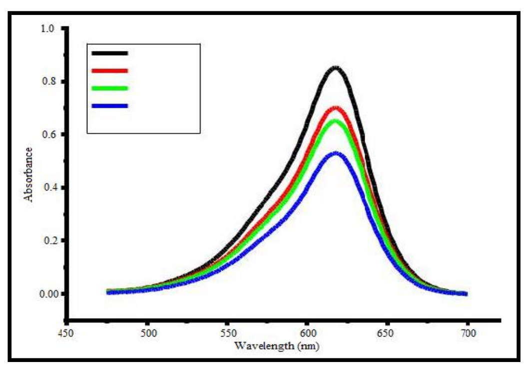


Figure 12. Photochemical degradation of malachite green catalyzed by AgNP

The above two graphs clearly depicts that the AgNP has catalytic effect on the degradation of malachite green.

APPLICATON

The applications of synthesized AgNPs was appreciable in both of its mentioned application further it's utilization can be extended to other application such as Anti-microbial agent and as biosensor and many more.

CONCLUSIONS

The synthesis of AgNPs was efficient as plant material is available in abundance in the garhwal Himalaya. The applications of synthesized AgNPs was appreciable in both of its mentioned application further it's the utilization can be extended to other application such as Anti-microbial agent and as biosensor and many more.

REFERENCES

[1]. T. Anastas, Paul, John Charles Warner. *Green chemistry: theory and practice*. Vol. 30. Oxford: Oxford university press, **2000**.
[2]. Clark, James H. Green chemistry: challenges and opportunities, *Green Chemistry,* **1999**, 1(1) 1-8.
[3]. Constable, J. C. David, Key green chemistry research areas-a perspective from pharmaceutical manufacturers." *Green Chemistry*, **2007**, 9(5) 411-420.
[4]. L. Y. Tang, Samantha, L. Richard. Smith, Martyn Poliak off. "Principles of green chemistry: Productively." *Green Chemistry,* **2005**, 7(11), 761-762.
[5]. Leszczynski, Jerzy, Principles of Nanotechnology, *Stem Cell Nanoengineering*. Wiley-Blackwell, **2015**. 67-85.
[6]. E. Marchant, Gary, J. Douglas Sylvester, Kenneth W. Abbott. Risk management principles for nanotechnology. *Nanoethics*, **2008**, 2(1), 43-60.
[7]. Bar, Harekrishna, et al., Green synthesis of silver nanoparticles using latex of Jatropha curcas, *Colloids and surfaces A: Physicochemical and engineering aspects,* 2009, 1-3, 134-139.
[8]. Sharma, Virender K., Ria A. Yngard, and Yekaterina Lin. Silver nanoparticles: green synthesis and their antimicrobial activities, *Advances in colloid and interface science* 145.1-2 (2009): 83-96.
[9]. Li, Shikuo, et al., Green synthesis of silver nanoparticles using Capsicum annuum L. extract, *Green Chemistry,* **2007**, 9(8), 852-858.
[10]. Saxena, Antariksh, et al., Green synthesis of silver nanoparticles using aqueous solution of Ficus benghalensis leaf extract and characterization of their antibacterial activity, *Materials letters,* 2012, 67(1), 91-94.
[11]. Bicchi, Carlo, et al., Constituents of Artemisia roxburghiana Besser essential oil, *Flavour and fragrance journal,* **1998**, 13(10 40-46.
[12]. Haider, Flora, et al., Effect of altitude on the essential oil constituents of Artemisia roxburghiana Besser var. purpurascens (Jacq.) Hook, *Journal of Essential Oil Research,* **2009**, 21(4), 303-304.
[13]. Mueller, C. Nicole, Bernd Nowack, Exposure modeling of engineered nanoparticles in the environment., *Environmental science and technology,* **2008**, 42(12), 4447-4453.
[14]. Lutz, K. Werner, C. H. Schlatter, Mechanism of the carcinogenic action of benzene: irreversible binding to rat liver DNA, **2012**.
[15]. Lachheb, Hinda, et al., Photocatalytic degradation of various types of dyes (Alizarin S, Crocein Orange G, Methyl Red, Congo Red, Methylene Blue) in water by UV-irradiated titania, *Applied Catalysis B: Environmental,* **2002**, 39(1) 75-90.
[16]. Carter, G. Stephen, Daniel W. Karl, Inorganic phosphate assay with malachite green: an improvement and evaluation, *Journal of biochemical and biophysical methods,* **1982**, 7(1) 7-13.
[17]. Stock, L. Naomi., et al., Combinative sonolysis and photocatalysis for textile dye degradation, *Environmental science & technology,* **2000**, 34(9) 1747-1750.

[18]. M. Ramya, M. Sylvia Subapriya, Green synthesis of silver nanoparticles, *Int J Pharm Med Biol Sci.,* **2012**, 1(1), 54-61.
[19]. Kaler, Abhishek, Navin Patel, Uttam Chand Banerjee, Green synthesis of silver nanoparticles, *Curr Res Inf Pharm Sci.,* **2010**, 11(4), 68-71.
[20]. Bar, Harekrishna, et al., Green synthesis of silver nanoparticles using latex of Jatropha curcas, *Colloids and surfaces A: Physicochemical and engineering aspects,* **2009***,* 1(3) 134-139.
[21]. Sharma, Virender K., Ria A. Yngard, and Yekaterina Lin, Silver nanoparticles: green synthesis and their antimicrobial activities, *Advances in colloid and interface science* 1-2, **2009**, 1(8), 3-96.
[22]. Saxena, Antariksh, et al., Green synthesis of silver nanoparticles using aqueous solution of Ficus benghalensis leaf extract and characterization of their antibacterial activity, *Materials letters*, **2012**, 67(1), 91-94.
[23]. Brand-Williams, Wendy, Marie-Elisabeth Cuvelier, C. L. W. T. Berset. Use of a free radical method to evaluate antioxidant activity, *LWT-Food science and Technology*, **1995**, 28(1), 25-30.
[24]. Molyneux, Philip. The use of the stable free radical diphenylpicrylhydrazyl (DPPH) for estimating antioxidant activity, *Songklanakarin, J. Sci. Technol* , **2004,** 26(2), 211-219.
[25]. Bondet, V., W. Brand-Williams, C. Berset. Kinetics and mechanisms of antioxidant activity using the DPPH. free radical method. *LWT-Food Science and Technology,* **1997**, 30(6), 609-615.