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Original Article

Green Synthesis and Characterization of Silver Nanoparticles using *Piper Betle* Leaf Extract

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Abstract

Green synthesis of nanoparticles by biological reduction method using plant extract is recent development in synthetic chemistry. The green method of nanoparticles is easy, efficient and eco-friendly on comparison with other methods. Silver nanoparticles are synthesized by biological reduction of silver nitrate. Betle leaf extract was used to reduce the silver salt in to its silver nanoparticles. As prepared silver nanoparticles sample was characterized for its structure by employing powder X-ray diffraction (XRD) tool. The morphology of said metal nanoparticle was studied by Scanning Electron Micrograph (SEM) tool. Fourier Transform infrared (FTIR) spectral study was undertaken to know the bonding in the prepared silver sample. Formation of Ag particles was confirmed by energy dispersive X-ray analysis (EDX) study.

1. Introduction

Nanotechnology is emerging field of science which involves synthesis and development of various nanomaterials [1]. Technology at nano level involves tailoring of materials at the atomic level to attain unique properties, which can be suitably manipulated for the desired application [2]. Currently, there is a growing need to develop environmentally benevolent nanoparticles synthesis processes that do not use toxic chemicals in the synthesis protocol [3]. Silver nanoparticle has attracted considerable interest due to their extensive applicability in various areas such as electronics, catalysis, chemistry, energy and medicine [4]. The rapidly developing field of nanotechnology will result in exposure of nanoparticles to humans via several routes (e.g., inhalation, ingestion, skin, etc.). Nanoparticles can translocate from the route of exposure to other vital organs and penetrate cells. Toxicity studies to determine the deleterious effects of nanoparticles on living cells are required. Many techniques of synthesizing silver nanoparticles, such as chemical reduction of silver ions in aqueous solutions with or without stabilizing agents are in literature [5]. Sometimes the synthesis of nanoparticles using plants or parts of plants can prove advantageous over other biological processes by eliminating the elaborate processes of maintaining microbial cultures [6].

Piper betle leaves are widely used as a post meal mouth freshener and the crop is extensively grown in India. Due to strong pungent aromatic flavor, betle leaves are used as masticators by the Asian people.[7-8]. Production of nanoparticles can be achieved mainly through three methods such as, chemical, physical and biological. Since noble metal such as gold, silver and platinum nanoparticles are widely applied to human contacting areas, a large variety of possible biomedical applications have been examined [9-10]

Silver nanoparticles are synthesized by reduction of silver nitrate by reduction using *piper betle* leaf extract is reported in the present work. Green synthesis method was employed for synthesis of silver nanoparticles. The prepared sample is well characterized for its structure by X-ray diffraction (XRD), morphology by Scanning Electron Microscope (SEM) and bonding by Fourier Transform Infrared study (FT-IR) techniques. EDX analysis is carried out for the prepared sample to know the formation of Ag particles.

2. Experimental

2.1 Materials and methods

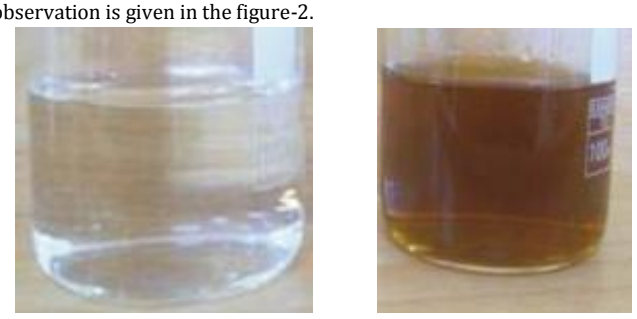
The reagents used were of analytical grade obtained from Merck (Mumbai, India). Double distilled water is used in the preparation of *piper betle* leaf extract and silver nitrate solution. All glass wares are properly rinsed with chromic acid followed by double distilled water and dried. Biological reduction of silver nitrate in to its silver nanoparticles by *piper betle* leaf extract is carried out.

2.2. Preparation of *piper betle* leaf extract

Piper betle leaves were collected freshly from the *piper betle* leaf field (shown in figure-1) and washed thoroughly with distilled water. 10 grams of *piper betle* leaves were cut in to small pieces and put it into conical flask containing 100ml double distilled water, the content is boiled for about 15 minutes and is filtered through Whatmann filter paper no 40 to gel the aqueous leaf extract.

2.3. Synthesis of Silver nanoparticles

10 ml of above prepared *piper betle* leaf extract was added to 100ml of 1mM aqueous silver nitrate solution taken in 250ml round bottom flask. The reaction mixture was boiled for about ten minutes and is kept at room temperature for 24 hours for complete reduction. Silver nanoparticles thus were centrifuged at 500rpm for five minutes followed by re-dispersion in 10ml of distilled water. The colour change observation is given in the figure-2.



(a) (b)

Figure 1: Colour of (a) Pure silver nitrate solution and (b) Ag nanoparticle solution

2.1.3. Characterization

The structures of as prepared zinc oxide were studied by X – ray diffraction using X' Pert Pro X – ray diffractometer with Cu Kα as source of radiation in a θ-2θ configuration. Morphology and bonding of the above oxide was studied by Phillips XL 30 ESEM and Perkin–Elmer 1600 spectrophotometer in KBr medium tools respectively.

3. Results and Discussion

3.1. X-ray diffraction

Silver nanoparticles solution was repeatedly centrifused at 5000rpm for about 15 minutes, re-dispersed with distilled water and lyophilised to obtain pure Ag nanoparticles. Figure-2 shows XRD pattern of as prepared Ag nanoparticles. The pattern shows the presence of d-spacing values of the sample matches well with standard 87-0720 JCPDS file. Unit cell parameters ware obtained by least–square refinement of the XRD data. This study reveals that the sample is monophasic Ag particles with face centered cubic structure having nanosized particles.

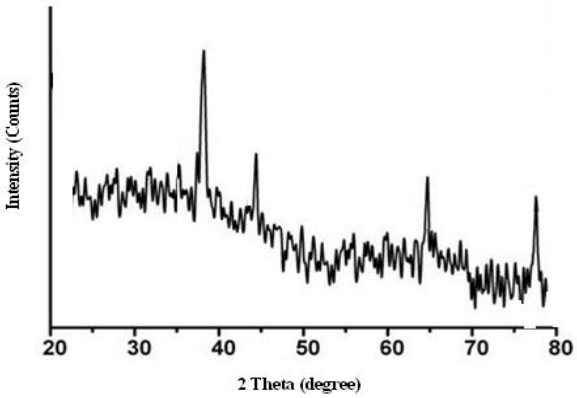


Figure-2: XRD pattern of Ag nanoparticles

3.2. Scanning Electron Microscopy (SEM)

The morphology of the as prepared Ag nanoparticles was studied by scanning electron micrograph image tool. Figure-3 shows SEM image of as prepared Ag nanoparticle sample. This image shows, the most of the particles are spherical in nature with close compact arrangement, In addition to this particle agglomaration with semicrystalline nature.

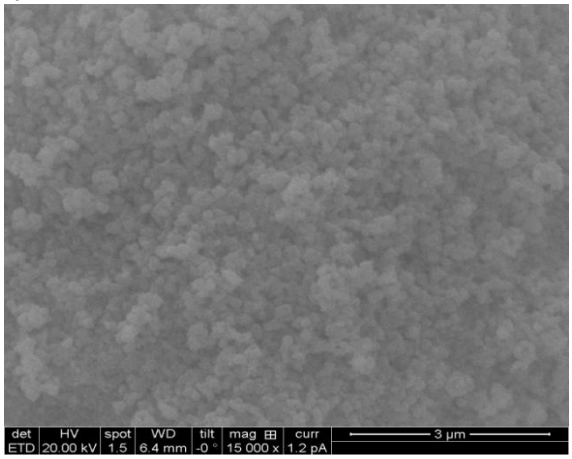


Figure-3: SEM image of Ag nanoparticles

3.3. Infrared Study

Infrared study is undertaken to know the bonding nature in the prepared Ag nanoparticle. The centrifused and redispersed Ag nanoparticles obtained have removed any free residual biomass. Subsequently, the dried powder was obtained by lyophilizing the purified suspension. The resulting lyophilized powder was examined by Infrared tool. Figure-4 shows FT-IR spectra of Ag nanoparticle. The spectrum shows that, the peak at around 1520cm-1 due to carbonyl stretching and N-H stretch vibrations from amide linkage. Vibrational band at around 1350cm-1 is due to C-N stretching vibrations from the aromatic amine compounds. IR bands at 1020cm-1 corresponds to C-O stretching frequency. The shoulders around the band can be specified as overtones and the frequency of the O-H band.

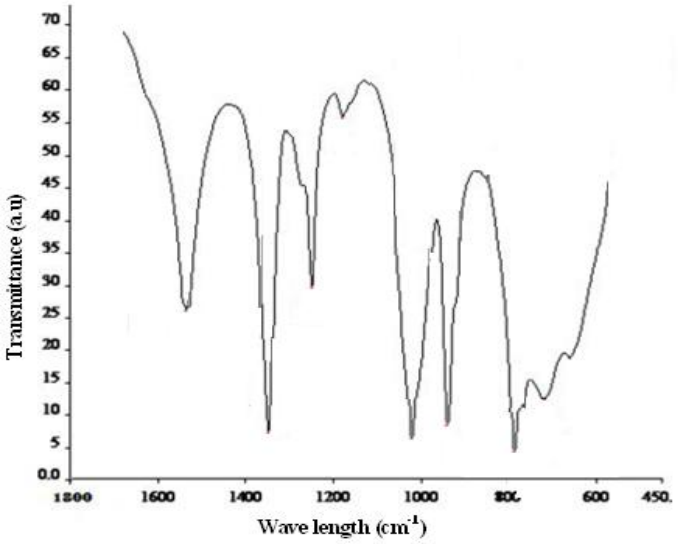


Figure-4: FT-IR spectra of Ag nanoparticles

3.4. EDX Analysis

To know the presence of silver in the synthesized silver nanoparticle, the analysis of the sample was performed by EDX technique. The figure-5 shows EDX spectrum of as synthesized silver nanoparticles. This spectrum shows the presence of strong silver atom signal and a characteristic absorption peak of silver confirms the formation of silver nanoparticles

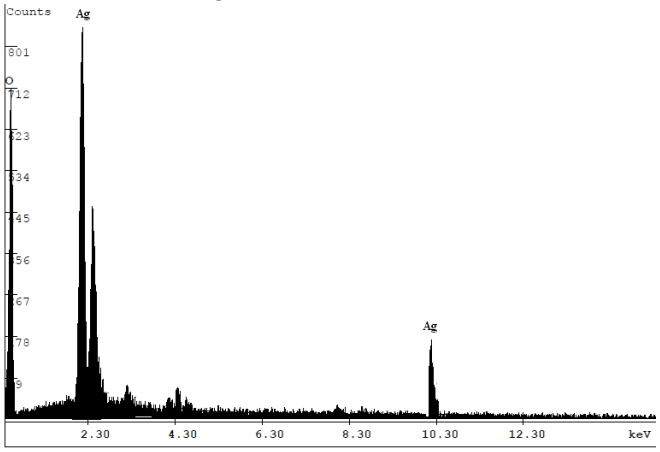


Figure-5: EDX pattern of as synthesized Ag nanoparticles

4. Conclusions

Green synthesis of Ag nanoparticles using betle leaf extract is simple, efficient, ecofriendly method and can be used for the synthesis of other metal nanoparticle. This method is one of the economic viability methods for synthesis of nanoparticles. Reduction of silver ions into silver nanoparticles is carried out by biological procedure. Further detailed characterisation, properties and applications of Ag nanoparticles is our future direction of our work.

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References

[1] Rai M. , Yadav. A, Gade. A. Silver nanoparticles as a new generation of antimicrobials. *Biotechnology Advances*. 2009; 27: 76.

[2] Leiter H., Nanostructured materials: Basic concepts and microstructures, *Act Mater*., 2001; 48: 1.

[3] Whitesides G.M, The 'right' size in nanobiotechnology *Nat. Biotechnol.* 2003; 21:1161.

[4] S. J. P. Jacob, P.R. A. Narayanan and J.S Finub, Green synthesis of silver nanoparticle using Piper nigramleaf extracts and its cytotoxic activity against hep-2 cell line *World. J. Pharm. Res*. 2013; 2(5):1607.

[5] M. Forough, K. Farhadi, Biological and green synthesis of silver nanoparticles, *Turkish J. Eng. Env. Sci.* 2010; 34: 281.

[6] M. Sastry, V. Patil, and S.R. Sainkar, Electrostatically controlled diffusion of carboxylic acid derivatized silver colloidal particles in thermally evaporated fatty amine films, *J. Phys. Chem.* B, 1998; 102: 1404.

[7] N. Dasgupta, B. De, Antioxidant activity of *Piper betle* L. leaf extract *in vitro*, *Food Chem* 2004; 88: 219.

[8] D. Choudhury.., Kale. R.K.,Antioxidant and non-toxic properties of *piper betle* leaf extract: *in vitro* and *in vivo* studies, *Phytother Res.* 2002; 16: 461.

[9] A. Annamalai, S.T Babu, N.A Jose, D. Sudha, C.V Lyza. Biosynthesis and characterization of silver and gold nanoparticles using aqueous leaf extraction of *Phyllanthus amarus* Schum. and Thonn. *World Appl Sci J.* 2011; 13:1833–1840.

[10] A. Kumar, X. Zhang, X. J. Liang**,** Gold nanoparticles: emerging paradigm for targeted drug delivery system, *Biotechnol Adv.* 2013; 31(5): 593.