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Rapid synthesis and characterization of silver nanoparticles using aqueous extract *of Conyza Canadensis*

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Abstract: In this study, describes a rapid and eco-friendly method for green synthesis of silver nanoparticles (AgNPs) from aqueous solution of silver nitrate using *Conyza Canadensis* leaf extract in a single-step process. Formation of silver nanoparticles was confirmed with different techniques such as UV-visible spectroscopy, X-ray diffraction (XRD), Transmission electron microscopy (TEM) and Fourier transform infrared spectroscopy (FT-IR). The surface plasmon resonance (SPR) peak of synthesized NPs was observed at 460 nm. XRD and TEM analysis revealed that AgNPs are face-centered, cubic structure being spherical in shape with an average particle size of 20 nm.

Keywords: Eco-friendly, Silver nanoparticles, *Conyza Canadensis*,Green synthesis

Introduction

*Conyza Canadensis*is an annual medicinal plant belonging to the Asteraceae family. This species is widely distributed and is found in Europe, Turkey, Iran, and North America. The essential oil and extract of *Conyza Canadensis* has been in Iranian traditional medicine for many purposes [1, 2].*Conyza Canadensis* contains a wide range of biologically active compounds such as being rich in terpenes, acetylene derivatives, flavonoids, polyphenols, benzoic acid derivatives, alkaloids, essential oils, sphingolipids, fatty acids and sterols [3].*Conyza Canadensis* was chosen because of its functional properties like anti-inflammatory, antitumor, antioxidant, antiviral, antibacterial, cytotoxic and antiagregant [4].

The chemicals present in the plant with anti-oxidant property are the basis for the preparation of the metal nanoparticles (MNPs). The metal nanoparticles (MNPs) have been synthesized by using various methods, including chemical [5], electrochemical [6], photochemical [7], and biological techniques [8-10]. Although most of the methods are successful in producing pure and well defined nanoparticles, they are quite expensive or potentially dangerous to the environment. Among the various methods of synthesis of silver nanoparticles the biological approach proved to be cost-effective, environmentally friendly are can be easily scaled up for large-scale synthesis. Between the biological methods, the use of plant extracts for the synthesis of AgNPs is not only simple and cost-effective but also the synthesized particles are stable. A number of bio-molecules act as reducing and protecting agents in the green synthesis of silver nanoparticles.

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In the recent years, different types of plant extracts have been reported to be used as reducing or capping agents in the synthesis of NPs. Some of the examples include the eco-friendly synthesis of AgNPs uses leaf extract of Pongamia pinnata [11], green tea [12], Aloe Vera [13],Vitex negundo [14], Artemisia nilagirica [15], Ocimum sanctum [16], beet-root [17], Convolvulus arvensis [18], Withania somnifera [19] and Rosmarinus officinalis [20].
In the present paper, for the first time, we report the rapid and Green' method for the synthesis of silver nanoparticles using important medicinal plant *Conyza Canadensis* and possible mechanism on the basis of the role played by the phytochemical constituents present in the plant extract. The silver nanoparticles synthesized are characterized by instrumental methods (UV-vis absorption, FT-IR, XRD and TEM).

Results and discussion

UV-visible spectral studies of AgNPs

A reduction of silver nanoparticles was clearly observed when the *Conyza Canadensis* leaf extract was added with $AgNO_3$ solution within 30 min. The color of the reaction mixture was gradually changed from light yellow to dark brown, indicating the formation of silver nanoparticles [21] (see Figure **1**).

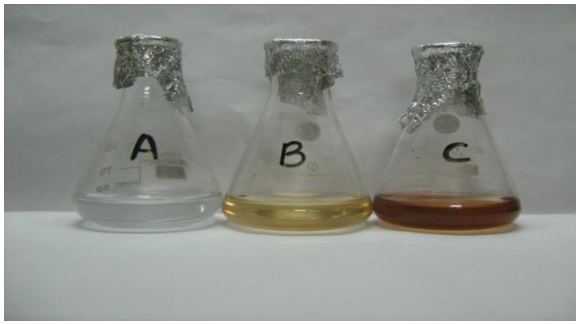

Figure 1: Photographs of (A) Ag $NO_{3(aq)}$ 3mM, (B) aqueous extract and (C) AgNPs

UV–vis absorption spectroscopy is an important method to detect the formation and stability of metal NPs in the reaction mixture. The spectra recorded at different time intervals (Figure **2**) exhibited an increase in the intensity of peak around 450 nm indicating an increase in the concentration of silver nanoparticles with time. No change in absorbance was observed after 72h, indicating the complete conversion of Ag+ ions to Ag^o (NPs). This peak corresponded to the surface plasmon resonance of the synthesized AgNPs [22].

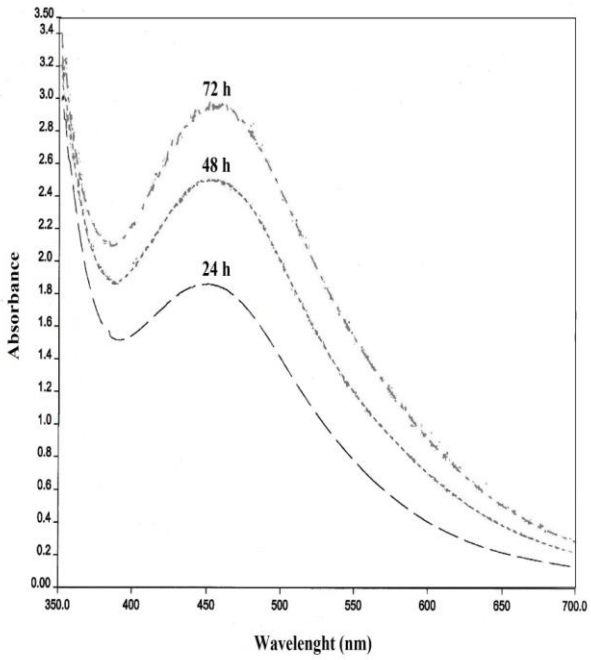

Figure 2: Optical absorption spectra of AgNPs at different reaction time

Structural studies

The X-ray diffraction analyses were carried out to determine the known phase of the silver nanoparticles.The XRD patterns of AgNPs indicated that the structure of silver nanoparticles is face centered cubic (FCC)[23].In (Figure **3**), the main XRD peaks of crystalline AgNPs were observed at 2θ of 38.14 (111), 44.27(200), 64.50 (220) and77.44 (311), which was in agreement with the standard diffraction spectrum (JCPDS Card No.87-0717). Broadening of the peaks in the XRD pattern can be the sign of the small size of silver nanoparticles. The crystal size of AgNPs was calculated using the characteristic peaks of XRD patterns by Scherer equation as follows:

$D=K\lambda/(\beta_{1/2}\,Cos\,\theta)$

Where D is the average crystal size; K is a constant (here chosen as 0.9); λ is the wavelength

of X-ray radiation (1.542 Å); $\beta_{1/2}$ is the half width of the diffraction peak (rad); and θ (°) is Bragg angle. The result of D value using 311 planes is about 20 nm. A small number of unassigned peaks (marked with stars) were also recorded that might be due to the crystallization of bioorganic phases present in *Conyza Canadensis* extract on the surface of the silver nanoparticles. These results are consistent with previous studies that reported similar diffraction peaks for Ag NPs [24,25].

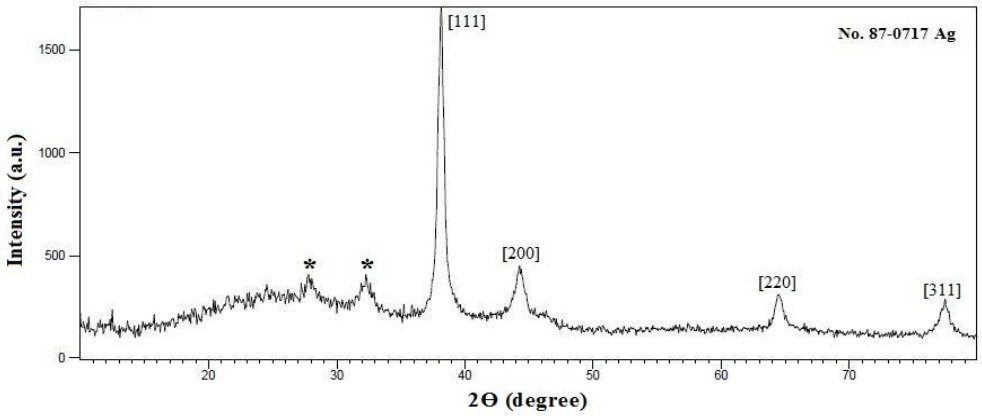

Figure 3: X–ray diffraction patterns of synthesized AgNPs using *Conyza Canadensis* leaf extract

TEM analysis

The shape and size of the biosynthesized AgNPs were further analyzed by transmission electron microscopy. The TEM image confirms that the agglomerated materials consist of small crystals with an average size of 20 nm (Figure **4**).The obtained results from a TEM image we´re in a good agreement with the XRD result.

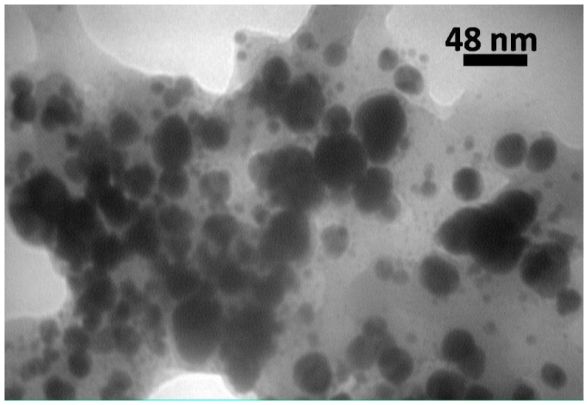

Figure 4: TEM images of AgNPs

Analysis of Fourier Transform Infrared Spectroscopy

To determine the possible biomolecules and functional groups involved in the reduction, capping and efficient stabilization of newly synthesized AgNPs, FTIR spectroscopy was employed. The FTIR spectrum of stabilized silver nanoparticles is depicted in Figure **5**. The spectra showed absorption bands at 3414, 2942, 2854, 1636, 1395 and 1033 cm^{-1}.The highest functional, peak is observed in the region 3414 cm^{-1}, indicating the presence of phenolic hydroxyl groups in the structure [26], which essentially substantiates the presence of lupeol, friedelin and β-sitosterol groups. The band at 2927 and 2854 $cm^{-1}$was attributed to alkane C–H stretching vibration. The sharp peak in the region 1636 cm^{-1} indicates the C=C stretching vibration of aromatic rings or carbonyl group (C=O), associated with the phenolic ring structure.

The peak at 1395 cm^{-1} was corresponded to C–H bending. Further, peak assigned at 1033 cm^{-1} were attributed to C–N stretching possibly due to the presence of amine group and –C–O is stretching frequency of biocomponents. Hence,the main components such as, saponin, phenols, flavonoids, anthraquinone glycosides, terpenoids, proteins,

anthocyanins, sterols and carbohydrates, alkaloids, oils, and fats were present in the leaf extract of *C. Canadensis* and responsible for the reduction and capping during the synthesis of AgNPs [4]. The spectrum reveals that the carbonyl group and phenolic hydroxyl groups are involved in the reduction of Ag+ to Agº.

Therefore, it may be concluded that flavonoids, alkaloids and anthraquinones are responsible for capping and efficient stabilization.

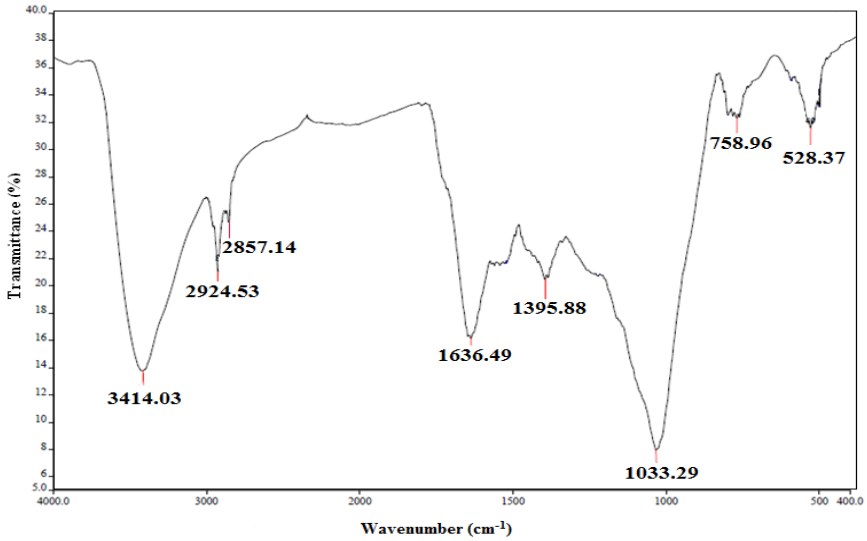

Figure 5: FT-IR spectrum of AgNPs stabilized by the *Conyza Canadensis* leaf extract

Experimental

Materials

The dried leaves of the *Conyza Canadensis* were collected from Poldokhtar, Lorestan Province, Southwest of Iran.Silver nitrate ($AgNO_3$)with ≥ 99.5% purity, was obtained from the Merck Company for this study.

Preparation of silver nanoparticles(AgNPs)

The fresh leaves of *Conyza Canadensis* were washed several times with distilled water, to remove dust particles and any dirt. The leaves of the plants were dried in the shade and at room temperature. The leaf powder (10 g) was weighted and added to 100 ml of distilled water and heated at 60ºC for 10 min. After completion of the reaction, extracts were filtered through Whatman No.1 filter paper and filtered extract was stored in refrigerator at 4ºC until it was used as the reducing and stabilizing agent.

For the synthesis of AgNPs, 90 ml of 0.003 M $AgNO_3$ was added to 10 ml of aqueous extract of *Conyza Canadensis* and mixed on a magnetic stirrer. The reaction mixture was then shaken to ensure thorough mixing and allowed settle at room temperature. The appearance of signatory yellowish brown color confirms the AgNPs formation. This happens due to the time factor and reaction rate of the chemicals between the leaf extract with the aqueous solution of $AgNO_3$. To separate unreacted components of reaction mixture from the synthesized AgNPs, the mixture was centrifuged at 6000 rpm for 30 min and washed for three using distilled water. Dried powder of the silver nanoparticles was obtained by freeze-drying.

Characterization of of silver nanoparticles

The optical properties of the silver nanoparticles were studied using UV–visible absorption (UV–1700 Spectrometer of SHIMADZU) spectrometer with sample in quartz cuvette. FT–IR spectra of silver nanoparticles were performed using a JASCO FT-IR (680 plus, Japan) spectrometer with KBr pellet in the range of 4000–400 cm^{-1}. The crystalline nature of silver nanoparticles was investigated by XRD analysis. X–ray diffraction data of AgNPs were obtained using a Philips–X'Pert Pro MPD with Cu ka radiation (k = 1.54 Aº) 2θ range of 20º to 80º, and with a step size of 0.02º at 40 Kvand 30 mA. The morphology and size of the prepared silver nanoparticles were done using of the AgNPs was examined by TEM (CM120 Philphs,

Netherlands).

Conclusion

Silver nanoparticles were synthesized using *Conyza Canadensis* leaf extract at room temperature through green route. The bio-reduction of aqueous Ag+ ions by the leaf extract of *C. Canadensis* has been demonstrated. The major compounds (flavonoids, terpenoids and alkaloids) present in the *C. Canadensis* leaf extract was responsible for the reduction and stabilization of AgNPs.

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References

[1] Khare, C.P.; *Indian Medicinal Plants-An Illustrated Dictionary*. Springer, Berlin., **2007**.

[2] Zhu, L-F.; Li,Y-H.; Lu, B-Y.; Zhang, W-L.; *Aromatic Plants and Essential Constituents*. Supplement. South China Institute Botany, Chinese Acad. Sciences, Hai Feng Publ. Co., Peace Book Co., Hong Kong,**1995**.

[3] Csupor-Löffler, B.; Hajdú, Z.; Zupkó, I.; Kele, Z.; Hohmann, J.; *Planta Med*., **2011**, *77(11)*, 1183.

[4]Shah, N.Z.; Khan, M.A.; Muhammad, N.; Azeem, S.; *Middle-East J. Med. Pl. Res*., **2012**, *1(3)*, 63.

[5] Hu, R.; Yong, K.T.; Roy, I.; Ding, H.; He, S.; Prasad, P.N.;*J. Phys. Chem. C Nanomater Interfaces*.,**2009**, *113*,2676.

[6]Yin, B.; Ma, H.; Wang, S.; Chen, S.;*J. Phys. Chem. B*.,**2003**, *107*, 8898.

[7] Callegari, A.; Tonti, D.; Chergui, M.; *Nano Lett*., **2003**, *3*, 1565.

[8] Pandey, S.; Goswami, G.K.; Nanda, K.K.; *Int. J. Biol*., **2012**, *51*, 583.

[9] Gopinathan, P.; Ashok, A.M.; Selvakumar, R.;*Appl. Surf. Sci.*, **2013**, 276, 717.

[10] Marimuthu, S.; Abdul Rahuman, A.; Rajakumar, G.; Santhoshkumar, T.; Vishnu Kirthi, A.; Jayaseelan, C.; Bagavan, A.;Abduz Zahir, A.; Elango, G.; Kamaraj, C.;*Parasitol. Res.*, **2011**,*108*, 1541.

[11]Sundrarajan, M.; Ambika, S.; Bharathi, K.; *Adv. Powder Technol*., **2015**, *26*, 1294.

[12]Vilchis-Nestor,A.R.; Sánchez-Mendieta, V.; Camacho-López, M. A.; *Mater. Lett.*, **2008**,*62*,3103.

[13]Chandran, S. P.; Chaudhary, M.; Pasricha, R.; Ahmad, A.; *Biotechnol.*, **2006**, *22*, 577.

[14] Prabhu, N.; Raj, D.T.; Yamuna, G.K.; Siddiqua, S.A.; *Dig. J. Nanomater*., **2010**, *5* ,185.

[15] Vijayakumar, M.; Priya, K.; Nancy, F.T.; Noorlidah, A.; *Ind. Crop. Prod*., **2013**, *41*,235.

[16] Rout,Y.; Behera,S.; Ojha,A.K.; Nayak,P.L.; *J. Microbiol. Antimicrobial*., **2012**,*4*,103.

[17] Bindhu, M.R.; Umadevi, M.;*SpectrochimActa A.*,**2015**, *135*, 373.

[18] Hamedi, S.; Shojaosadati, S. A.; Mohammadi, A.; *J. Photoch. Photobio. B.*, **2017, Online.**

[19] Warluji Raut, R.; Damodhar Mendhulkar, V. Balaso Kashid, S.; *J.Photoch. Photobio. B.*, **2014**, *132*, 44.

[20] Ghaedi, M.; Yousefinejad, M.; Safarpoor, M.; Zare Khafri, H.; Purkait, M.K.;*J. Ind. Eng. Chem.***2015**, *31*, 167.

[21] Roopan, S.M.; Madhumitha, G.; Rahuman, A.A.; Kamaraj, C.; Bharathi, A.; Surendra, T.;*Ind. Crops Product*., **2013**, *43*, 631.

[22] Shameli, K.; Bin Ahmad, M.; Jaffar, E.A.; Mulla,A.; Ibrahim,N.A.; *Molecules*, **2012**,*17*,8506.

[23] Shameli, K.; Ahmad, M.B.; Jazayeri, P.; Sangpour, P.; Gharayebi,Y.; *Chem. Cent. J*., **2012**, *6*(1*)*,1.

[24]Bindhu, M.; Umadevi, M.; *Spectrochim. Acta A*., **2014**, *128*, 37.

[25]Karuppiah, M.; Rajmohan, R. *Mater. Lett*., **2013**, *97*, 141.

[26] Kumar, K.M.; Mandal, B.K.; Sinha, M.; Krishnakumar,V.;*Spectrochim. Acta. A.*, ***2012***, *86*, 490.