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Lantana camara berry for the synthesis of silver nanoparticles

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ABSTRACT

Objective: To synthesize the silver nanoparticles (AgNPs) by reduction of silver ions into nano silver, using ripened berry extract of *Lantana camara* and evaluate its antioxidant activity against 1, 1-diphenyl-2- picrylhydrazyl.

Methods: The prepared AgNPs were characterized by visual, UV-visible spectrophotometer, dynamic light scattering and transmission electron microscopy with selected area electron diffraction.

Results: Transmission electron microscopy and dynamic light scattering analysis confirmed the AgNPs are spherical and 75.2 nm average sized. Selected area electron diffraction analysis supports that the obtained nanoparticles were in crystalline form. In addition, the antioxidant efficacy of prepared AgNPs was found to be higher than berry extract against 1, 1-diphenyl-2-picrylhydrazyl.

Conclusions: From the results obtained it is suggested that surface modified AgNPs at lower concentration, showed higher antioxidant activity than berry extract against 1, 1-diphenyl-2-picrylhydrazyl and could be used effectively in future ethno pharmacological concerns.

1. Introduction

The recent interest of nanobiotechnology, is the development of environmentally benign technology for the synthesis of metal nanoparticles with significant applications in the pharmaceutical, cosmetics, food, agriculture, health, environment and defense. Metallic nanoparticles exhibit unusual optical, thermal, chemical, and physical properties due to large surface atom, large surface energy, spatial confinement and reduced imperfections. The reduction of material dimensions has pronounced effects on the physical properties that may be significantly different from the corresponding bulk material[1]. Among all metals, synthesis of functionalized silver nanoparticles (AgNPs) using phytochemicals transformations in test tube play an indispensable role, because the functional groups of various phytochemicals enhance the reduction of silver ions to elemental silver. Hence, plant-based methods for AgNPs synthesis using *Zingiber officinale* root extract[2], soybean[3], sacha inchi oil[4], agricultural wastes[5], leaves[6], *Citrus sinensis* peel extract[7], edible mushroom extract[8], clove extract[9]and extracts from *Passiflora tripartita*[10], are widely growing in popularity. Due to a straightforward synthesis, stability, and ease of incorporating functional groups for targeting capabilities, silver nanoparticles have great application in antifungal[11], antibacterial[12], anti-inflammatory[13], antiviral[14], antiangiogenesis[15], *etc*.

Lantana camara L. (*L. camara*) is a notorious weed and a popular ornamental garden plant, growing at elevations up to 2000 m in tropical, sub-tropical and temperate regions[16]. It has found

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various uses in folk medicine in many parts of the world against fever, influenza, stomachache, chicken pox, measles, rheumatisms, asthma, vermifuge, leprosy, scabies and high blood pressure[17-19]. The ripe blue-black berries (Figure 1) are also eaten in some tropical country, but ingestion of the green berry has led to human fatalities[17,19]. The major phyto constituents of *L. camara* is mono- and sesquiterpenes, triterpenes, iridoid glycosides, flavanoids, *etc*[16]. However, there have been no reports on the preparation of the AgNPs using ripened berry of *L. camara* and its antioxidant activity against 1, 1-diphenyl-2- picrylhydrazyl (DPPH•).

Figure 1. *L. camara* ripened berry.

2. Materials and methods

2.1. Synthesis of silver nanoparticles

All chemicals were of analytical grade and used without any purification. Silver nitrate ($AgNO_3$, 99%) was purchased from Spectrum (USA) and ripened *L. camara* berrys were collected from the local garden of Universidad de las Fuerzas Armadas, Sangolqui, Ecuador. DPPH• (>99.5%) was purchased from Sigma Aldrich, USA. The collected fresh black color *L. camara* fruits (2 g) were washed thoroughly with Milli-Q water and heated (55-60 ℃) in 20 mL of ethanol (95%) for 10 min. After cooled, the light greenish-yellow color extract was filtered using Whatman No.1 paper. For the green synthesis, 2 mL of filtrate was mixed with 18 mL of 1 mmol/L $AgNO_3$ solution at room temperature (22-25 ℃). Reduction occurs slowly by the appearance of a pink color after 6 h.

2.2. Characterization of silver nanoparticles

The *L. camara* berry mediated AgNPs were confirmed by UV-visible, single beam spectrophotometer (Thermo Spectronic, GENESYSTM 8, England, Quartz Cell, path length 10 mm and graph plotted on the Origin 6.1 program). The particle size distributions of nanoparticles were determined using the HORIBA, Dynamic Light Scattering Version LB-550 program. Size and selective area electron diffraction (SAED) pattern of nanoparticles are studied on transmission electron microscopy, TEM (FEI, TECNAI, G2 spirit twin, Holland).

2.3. Evaluation of antioxidant activity

The scavenging activity of AgNPs was measured by using DPPH• as a free radical model based on the method adapted from Kumar *et al.*, 2014[6]. An aliquot (1.0-0.2 mL) of AgNPs or control and (1.0-1.8 mL) of H_2O was mixed with 2.0 mL of 0.2 mmol/L (DPPH•) in 95% ethanol. They were mixed vigorously by vortex mixer and allowed to stand at room temperature for 30 min in the dark. Absorbance of the mixture was measured spectrophotometrically at 517 nm, and the free radical scavenging activity was calculated using equation:

$$\text{Scavenging effect } (\%)=[1-(\text{absorbance}_{\text{sample}}/\text{absorbance}_{\text{control}})]\times 100 \quad (1)$$

The scavenging percentage of all samples were plotted. The final result was expressed as % of DPPH• free radical scavenging activity (mL).

3. Results

3.1. Visual and UV-vis study

The visual signature for the formation of AgNPs using an ethanolic extract of *L. camara* berry is shown in the Figure 2. It presents the color changes with addition of berry extract of *L. camara* to $AgNO_3$ solution during the reaction time. Figure 3 displays the UV-vis spectra of AgNPs as a function of reaction time and the progress of two new absorbance band at 390 nm and 520 nm.

3.2. Dynamic light scattering study

In order to determine the particle size distribution of AgNps in solution, dynamic light scattering measurements were carried out over 120 h of reaction time. The mean particle sizes of AgNps are 75.2 nm shown in Figure 4.

3.3. Ttransmission electron microscopy (TEM) and selected area electron diffraction (SAED) study

Figure 5 shows the TEM images of AgNps recorded after 120 h of reaction time. It can be seen that the average size of the AgNps was around 40-70 nm. With spherical shapes, the bright circular spot in SAED pattern reveals that the synthesized AgNps are crystalline.