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RESEARCH ARTICLE

Compare between Two Methods for Green Synthesis of Silver Nanoparticles

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Abstract

In this study, compared between two biological methods were used for synthesize Ag nanoparticles , the first used the extract of the conocarpus and the second used *Aspergillus niger* .Characterized of these nanoparticles was study by UV–vis spectrum(UV), X-Ray diffraction (XRD), scanning electron microscopy (SEM)analysis .Also antimicrobial activity of synthesis nanoparticles were investigation .Results show, used of plant extract can be considered as the best formulation for the preparation of silver nanoparticles Because of its small particle size, good stability and purity.

Keywords: *Ag nanoparticles, Green synthesis, Conocarpus extract, A. Niger.*

Introduction

Silver nanoparticles are very thin particles of silver metal that have at least one dimension less than 100 nanometers [1]. Nanoparticles are not currently discovered but were discovered about 100 years ago .It was used in the treatment of infections and diseases before the discovery of penicillin 1928.Silver nanoparticles are produced from the conversion of silver metal to silver of Nano scale size, which is very effective against bacterial, fungal and viral infections. These unique properties of nanoparticles because they have a large surface area compared to volume [2].Physical and chemical methods were used to synthesize nanoparticles [3, 6].

In essence, physical methods have a low yield and chemical methods have adverse effects on the environment because of the use of toxic solvents and the generations of dangerous by-products [7].Scientists are currently focusing on the bio-synthesis of nanoparticles using bacteria [8]. Fungi [9].And plants [10]. These biochemical processes are low cost and highly productive, safe and environmentally friendly compared to physical and chemical processes.

In the present study, we have compare between two methods from biogenic synthesis methods of silver nanoparticles using plant extract (conocarpus) and fungus (*Aspergillus Niger*) in present of silver nitrate and we have analyzed the relationship between the quality and quantity of biosynthesized sliver nanoparticles between these methods.

Materials and Methods

Materials

AgNO3 was purchased from nanoshe l company .leaves of conocarpus (*Conocarpus erectus*)were obtained from the garden of Medicine college, University of AL-Qadisiyah .strain of fungus (*Aspergillus niger*), *Trychophyton rubrum Staphylococcus aureus* and *E.coli* were obtain from laboratory of microbiology /college of science / University of AL-Qadisiyah.

Preparation of Extract

10 g of leaves conocarpus .Cleaned with tap water for removing dust and dirt then washed with distilled water three times. Leaves were cut into fine pieces then transferred into 50 mL distilled water and heated for 15 min at boiling. The extract was filtrated triple to get a clear yellow color [11].

Biomass Preparation

A. *niger* was grown in potato dextrose broth (PDB) at 28°C on a rotary shaker (120 rpm) for 96 h. The biomass was harvested by filtration using Whatman filter paper No. 1, followed by washing with distilled water to remove any components of the medium. The biomass (25 g) wet weight was placed in individual flasks containing 100 mL D. water and incubated 24 h. The biomass was filtered, and the cell filtrate was collected and used for biosynthesis of Ag NPs [12].

Green Synthesis of Silver Nanoparticles

By Leaves Extract

100 mL of 1 mM of silver nitrate solution was heated to 80 °C with continuous stirring . After that 5 mL of fresh Conocarpus leaves extract was added to the hot solution of silver nitrate .Change in color from yellow to brownish color [11].

By Fungus (*A. Niger*)

50 ml of cell filtrate was mixed with 10 ml AgNO3 solution (10 mM), cell filtrate without AgNO3 was used as control. The solutions were incubated at 28 °C for 24 h. And kept in dark conditions to avoid any photochemical reactions during the experiment .Color change from yellow to brown was indicated to formed AgNPs .The AgNPs were purified by centrifugation at 10,000 rpm for 10 min twice[12]. Percentage yield of two methods was calculated according to the formula given below [13].

$$\% \text{ Yield} = \frac{\text{Weight of lyophilized silver nanoparticles}}{\text{Weight of silver nitrate used}} * (100)$$

Characterization of SNPs

The techniques used for characterizing nanoparticles are UV–visible spectrophotometry, Scanning electron microscopy (SEM), and X-ray diffraction (X-RD) ,were used in this work .

Antimicrobial Activity

Antimicrobial activities of the Ag nanoparticles synthesis by both methods were tested using well diffusion method. It was performed by Mueller Hinton agar media .After agar solidification, wells were making on the medium by cork borer. The test bacterial pathogens were striking onto the surface of agar plates. Wells were impregnated with 25 µl of the test nanoparticles .plates were left for 30 min. to allow the solution diffuse into the medium. The plates were incubated at 30oC for 24 hours, and then the diameters of the zone of inhibition were measured.

Results and Discussion

Synthesis of Nanoparticles

The change in color from yellow to brown to the mixture indicates the formation of silver nanoparticles Fig (1, 2). This change occurs due to the stimulation of surface Plasmon vibrations with Nanoparticles [14].

Fig.1: Ag nanoparticles synthesis by plant extract, (1) plant extract (2) extract with $AgNO_3$ (Ag nanoparticles

Fig.2: Ag nanoparticles synthesis by plant Extract, (1) filter of fungus (2) filter with $AgNO_3$ (Ag nanoparticles)

Yield%

The percentage of the yield of the methods used was calculated. by applying the above equation, we found that the percentage of yield of method which used plant extract was 52% while method which used fungus was 32%.This results shown that using of plant extract for synthesis nanoparticles is better than used fungi in synthesis of these particles, this may be plants especially conocarpus have many active compounds [15] .May act as reduction agent to reduce $AgNO_3$ to Ag^0.

Characterization of SNPs

UV Visible analysis: The absorption spectrum of ultraviolet radiation is the most widely used method for characterizing the optical properties and the electronic structure of nanoparticles, where the absorption ranges of diameter and the aspect ratio of nanoparticles [16]. Figure (3,4) shows the visible ultraviolet spectra of Ag nanoparticles, The absorption spectra of the reaction medium at the 420nm fig 3 and 450nm fig.4 confirmed the formation of Nano silver [17,18].

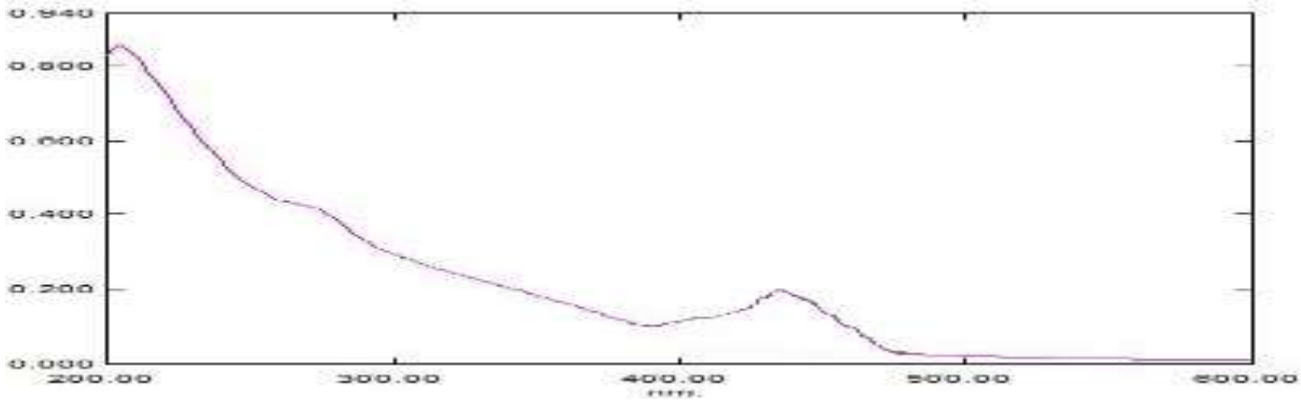

Fig.3: UV spectroscopy of Ag nanoparticles synthesis by plant extract

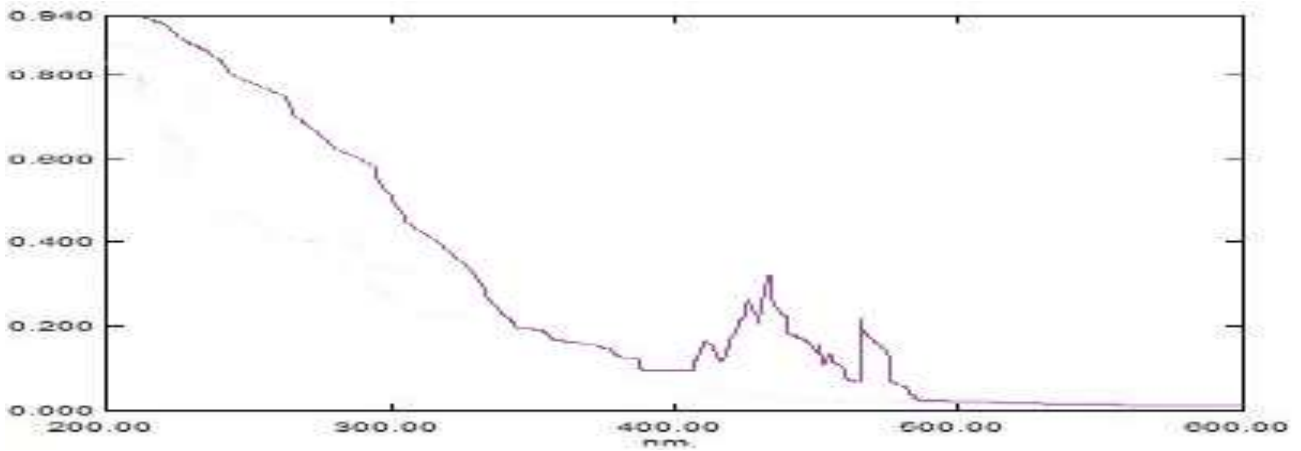

Fig.4: UV spectroscopy of Ag nanoparticles synthesis by fungus (*A.niger*)

XRD Analysis

XRD Analysis in order to confirm the presence of Ag NPs. Relative intensities and Peak positions ,four peaks at 2θ values of 38, 43, 64 and 77 degrees corresponding to (111), (200), (220) and (311) for green synthesized Ag NPs by plant extract (Fig. 5). The average crystalline size was 5.2 nm. This result coordinated with [19]. While in Fig.(6), high XRD peaks (111), (220), (311) planes were observed in 2θfrom 38 degrees, 64 and 77.1 degrees respectively This was in good condition with the unit cell of the faceted focal plane (FCC) structure . Some intensive diffraction peaks at the angles of 31, 35.1, 47.5, 56.6 °, and 68 °, may be associated with Ag for each $AgNO_3$ which might have not been reduced. Because of biomass residues, other crystalline impurities were observed in the XRD profile. The size of the AgNPs according to the XRD was about 13.2 nm. Results of XRD show ,that synthesis of nanoparticles by using plant extract was more active than synthesis by used fungus.

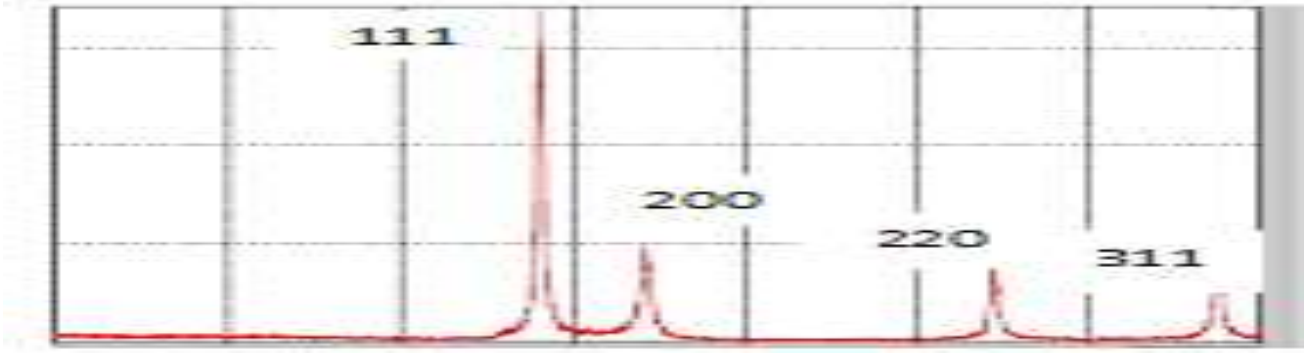

Fig.5: XRD of silver nanoparticles synthesis by plant extract

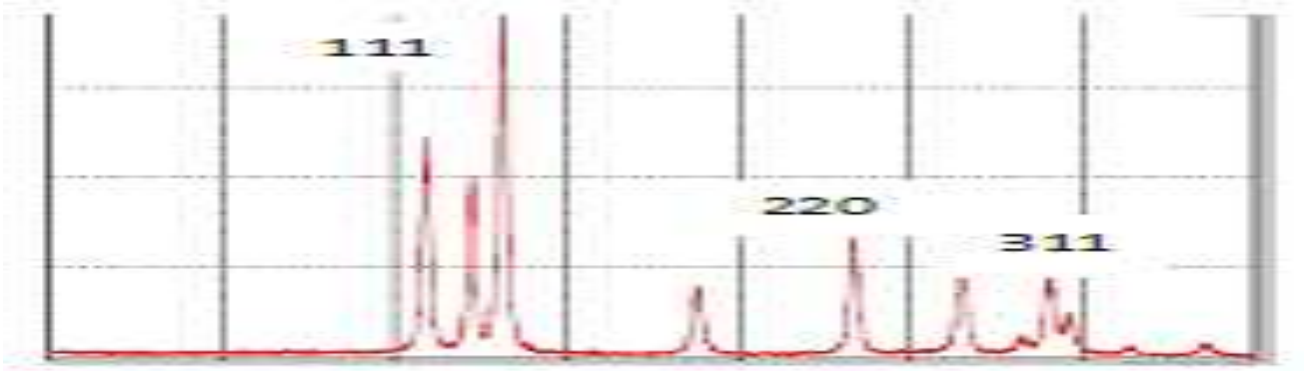

Fig.6: XRD of silver nanoparticles synthesis by fungus

SEM analysis: SEM analysis is useful in determining the structure of nanoparticles The SEM image (Fig.7) revealed a number of separate nanoparticles as well as larger groups. The SEM image of Ag NPs revealed that the nanoparticles were irregular and to some extent the spherical shape. This reported by various researchers [20, 21].

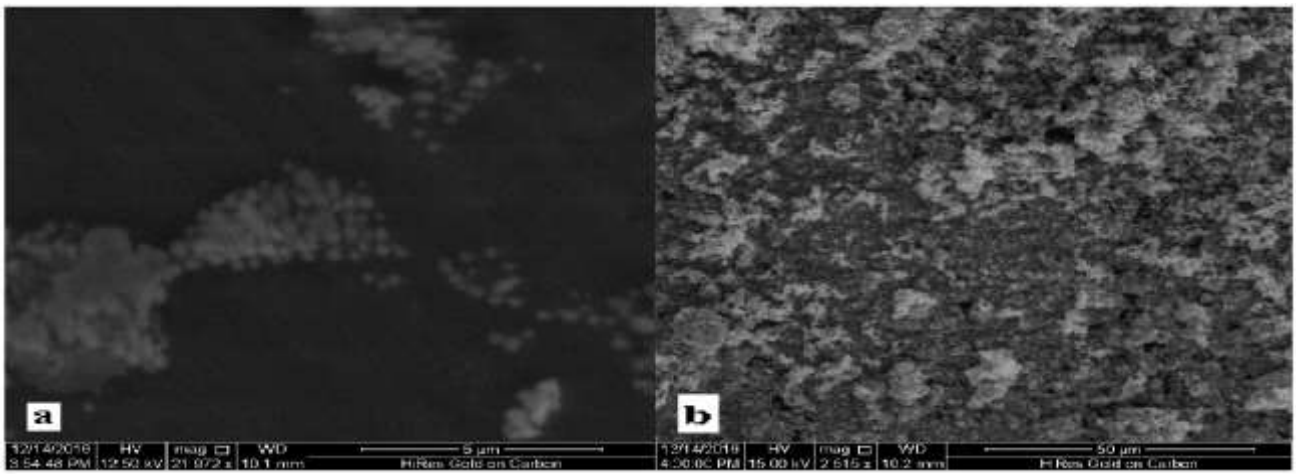

Fig.7: SEM pattern of AgNPs produced by fungus (a), plant extract (b)

Antimicrobial Activity

The antimicrobial activity of synthesis Ag NPs by two method against various pathogenic organisms which tested in this study including bacteria and fungi was clear compared with control treatment , the diameters of inhibition zones increased for all the test pathogens (Fig .8).But nano particles that synthesis by used plant extract more active than these were synthesis by used fungus .This may be because it have smaller size than these synthesis by fungus, the particle size-dependent antimicrobial effect of Ag nanoparticles.

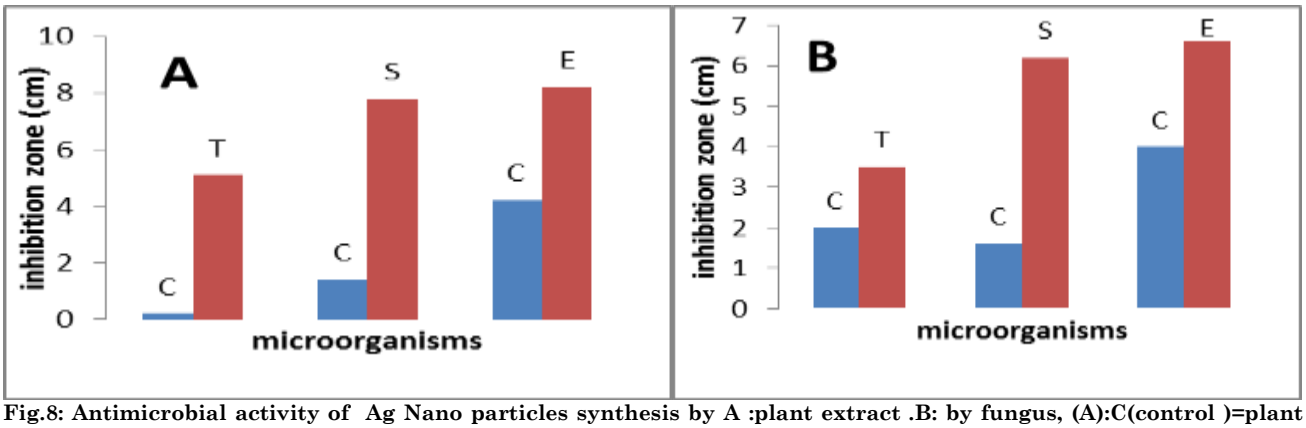

Fig.8: Antimicrobial activity of Ag Nano particles synthesis by A :plant extract .B: by fungus, (A):C(control)=plant extract only ,(B):C (control)= fungus filter only ,T =*T. rubrum* ,S=*S. aureus* ,E=*E. coli*

Conclusions

Green synthesis of silver nanoparticles was successfully carried in this work. synthesis of silver nanoparticles was confirmed by several techniques like UV Visible spectra, XRD, and SEM, in both methods .Also ,antimicrobial activity was investigation .From the results it can be conclude that used of plant extract can be considered as the best formulation for the preparation of silver nanoparticles Because of its small particle size, good stability and purity .Also yield of method which used plant extract was 52% .Applications of silver nanoparticles is mainly dependent on the sizes, shapes and yields of silver nanoparticles.

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