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RESEARCH ARTICLE

BIOSYNTHESIS OF SILVER NANOPARTICLES USING *TYPHA DOMINGENSIS* AND STUDY OF THEIR BIOLOGICAL ACTIVITY

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ABSTRACT

The Green synthesis method of silver nanoparticles by *Typha domingensis* was investigated. The aqueous extract prepared from *Typha domingensis* was evaluated as reducing agent for biosynthesis of silver nanoparticles. The formation of silver nanoparticles was visually monitored with change in colour from yellow to brown and later monitored with UV-Vis spectroscopy. Energy dispersive x-ray spectra (EDS) analysis method shows the qualitative and quantitative analysis of synthesis of silver nanoparticles. The synthesized silver nanoparticles were further characterized by SEM, and were employed in biological study. The results reveal that *typha*, is capable of synthesizing spherical shaped silver nanoparticles with biological activity.

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INTRODUCTION

In the field of biomedicine and chemistry silver nanoparticles play an efficient role because of their antiviral and anti-inflammatory action (Al-Abdullah *et al.,* 2017;Veerasamy *et al.,* 2011). There are varied methods to outcome metallic nanoparticles and many different approaches such as electro chemical (Tarowicz, and Banaś, 2006) the use of microwave (Sreeram and Nair, 2008) thermal decomposition (Navaladian *et al.,* 2007) and green chemistry methods (Begum *et al.,* 2009). Many chemical and physical methods have been used for stabilizing silver nanoparticles (Klaus *et al.,* 1999; Senapati, 2005). The development of a reliable green process for the synthesis of silver nanoparticles is one of the most important factors in the current nanotechnology research. There is a number of benefits in green synthesis it is cost effective, environment friendly and may be easily scaled up for large-scale synthesis these advantages are in contrast with physical and chemical methods. Furthermore, temperature, toxic chemical energy and high pressure are not needed to be used in the process of green synthesis. The use of plant to produce nanoparticles is one of the environmentally friendly green processes. Also this biosynthesis can be considered as an economic process due to the usage of a range of different metabolites by an extensive distribution of the plant and safety. It is a matter of importance to use protective agents to stabilize dispersive nanoparticles during the course of metal nanoparticles preparation, preventing their agglomeration (Oliveira *et al.,* 2005). The following process is economically sustainable, simple, eco-friendly, making it amenable to large-scale industrial production of silver nanoparticles. Silver nanoparticles are of interest because of the unique properties which can be incorporated specially into antimicrobial applications.

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Our approach

Silver nanoparticles synthesized by using silver nitrate as a source of silver ion and reducing sugar (Typha) as reducing agents. *Typha domingensis* was extract which taken from Iraqi marshes. The nanoparticles thus produced were capped with tri sodium citrate. Silver nanoparticles was characterised by different instruments and the bioactivity for nanoparticles was applied. Our research work was concentrated on the wet chemistry (chemical reduction method) and the effect of using green methods for produced bio silver nanoparticles.

Synthesis and stabilizing of silver nanoparticles using *Typha domingensis* powder

Colloidal silver nanoparticles were synthesized by reduction silver nitrate by dissolve (0.1)g from Typha in(100)ml deionised water. Then (0.1)g from trisodium citrate as a stabilizing agent was added into a beaker containing above solution and kept for stirring for about (5) min at 70˚c. After

(2) min the formation of silver nanoparticles is indicated by the appearance of light brown colour as shown in Figure 1.

Figure 1: shows the mixture after (2) min with formation of silver nanoparticles confirmed by laser beam

Characterization

The reduction of Ag^+ ions to Ag^0 was monitored by measuring the UV–Vis spectroscopy of sample aliquots (1.0)ml of silver nanoparticles solution, which was diluted to (3.0)ml with deionised water. UV–Vis spectral analysis was done using UV- Vis spectrophotometer (UV-160 v, Shimadzu, Japan) at the range of (300-500)nm and absorption peaks were observed at (400-460) nm regions due to the excitation of surface plasmon vibrations in the siver nanoparticles solution, which are identical to the characteristics UV- Vis spectrum of metallic silver. Scanning electron microscopy (SEM) of the samples were done using Zeiss instrument operated at an accelerating voltage of (200) kV. The elemental analysis of silver nanoparticles was evaluated by using (EDS). The antibacterial of the silver nanoparticles was carried out against *S. aureus*, and *E coli* using the Agar-well diffusion method.

RESULTS AND DISCUSSION

UV-Vis Spectrometry: Silver nanoparticles solution, which are identical to the characteristics UV- Vis spectrum of metallic silver. The peak intensity (Figure 2) is mention to the coherent oscillation of electrons at the surface of silver nanoparticles. The nanoparticles which are smaller than the wavelength of light can produce a coherent resonance waves at a particular absorbance wavelength which is in the visible range for silver nanoparticles. The appearance of surface plasmon resonance peak (SPR) at (420) nm provides a convenient spectroscopic signature for the formation of silver nanoparticles.

SEM analysis: *Typha domingensis* particle was imaged under SEM., as seen in Figure3 (A). The size and shape of the silver nanoparticles were examined clearly under scanning electron microscope as seen in Figure 3(B). The particle size is between (10) nm to (46) nm this result is best than before when another reducing sugar was used (Al-Abdullah *et al.,* 2017).

EDS Analysis: The present method for silver nanoparticles and their thin films is simple, convenient, and viable which allows nanocrystal-line silver particles of spherical shape and almost narrow size distribution as can be seen in Table 1 and Figure4. The droplets of prepared solution on hot thin layer of Aluminum foil were very good for both imaging and element nalysis of silver nanoparticles in SEM. The figure shows high percentage of silver in the thin film of silver nanoparticles.

Table 1. Shows the analysis of x-ray spectra

Element	Series unn. [wt.%]	C norm. [wt.%]	C Atom. [wt.%]	C Error (3 Sigma) [wt.%]
Aluminium	K-series 42.98	41.41	39.33	5.84
Silver	L-series 27.85	26.83	6.47	3.24
Oxygen	K-series 15.92	15.34	24.94	6.20
Carbon	K-series 10.78	10.38	22.50	4.58
Sodium	K-series 4.49	4.33	4.90	0.88
Chlorine	K-series 1.78	1.71	1.26	0.32
Total	103.79	100.00	100.00	

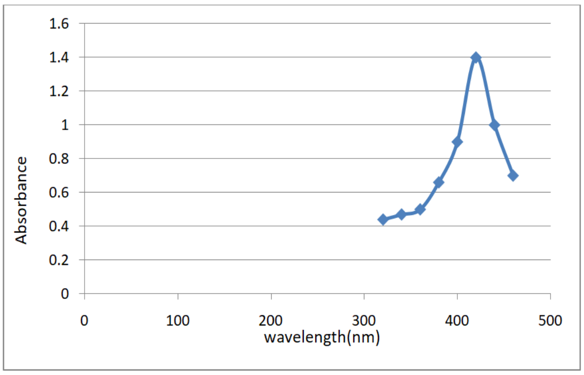

Figure 2. UV-Vis absorption spectrum of silver nanoparticles

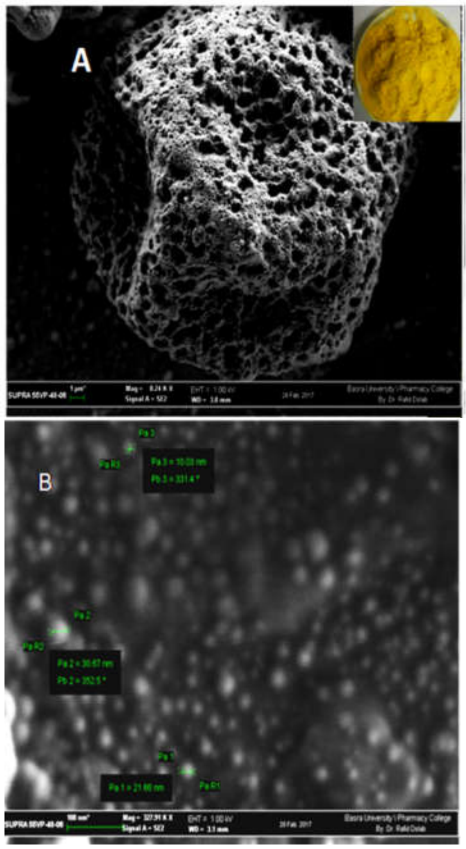

Figure 3. SEM image of (A) *Typha domingensis* particle (B) biosynthesized silver nanoparticles

Biologic activity of silver nanoparticles

Silver nanoparticles have high reactivity and large surface areas per volume ratio. It can damage cell membrane and intracellular components (Kimble *et al.,* 2012).

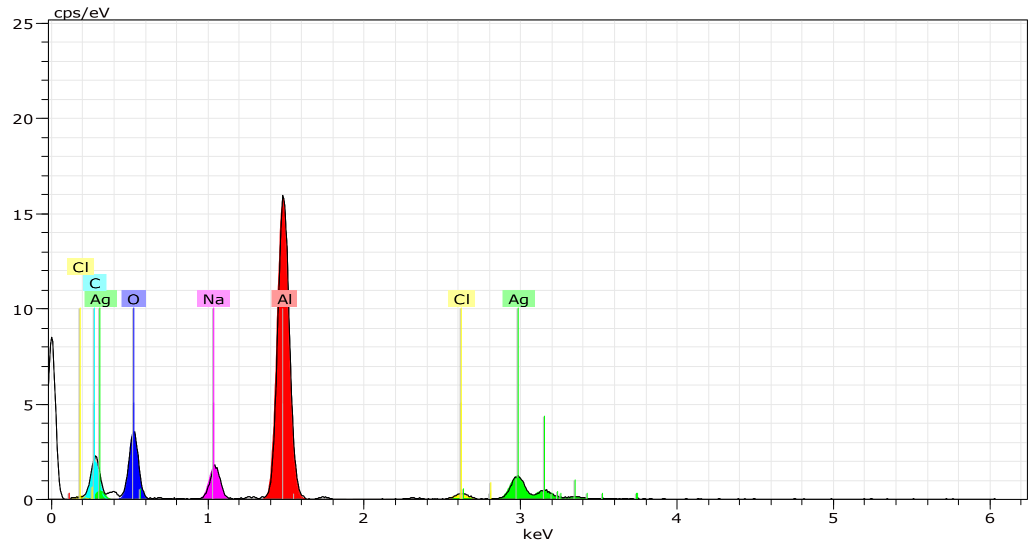

Figure 4. XRD spectra pattern of synthesized silver nanoparticles

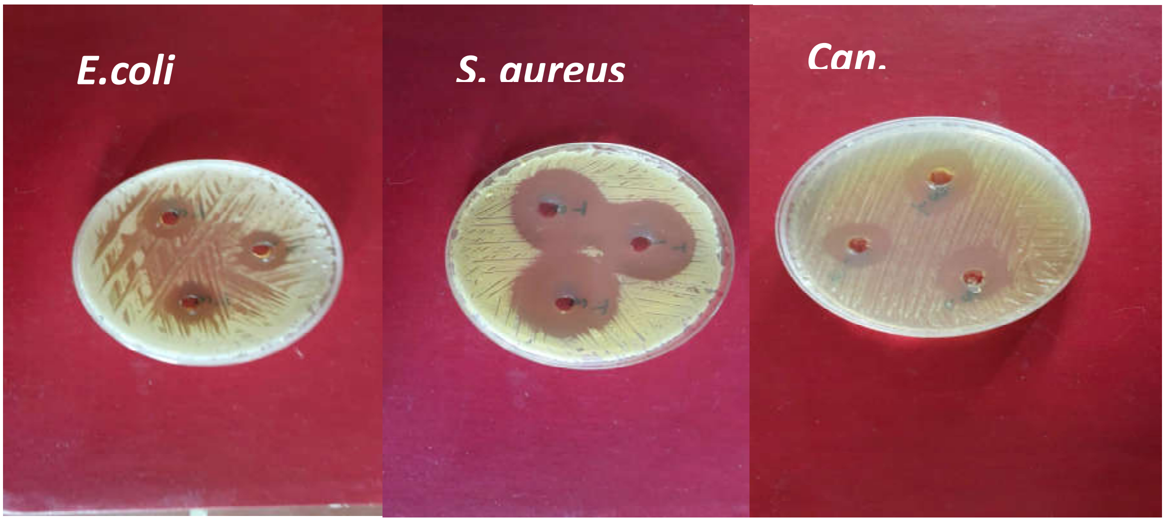

Figure 5. Antibacterial activities of silver nanoparticles against (a) *E. coli* (b) *S. aureus(c)* candida albicans

Silver ions released from silver nanoparticles can be sorbed into the cell wall and cause lysis leading to death (Zhang and Oyanedel-Craver, 2012; Zhang *et al.,* 2012). Moreover, reactive oxygen atoms can be formed (Vigeant *et al.,* 2002; Mullet *et al.,*1999) in silver nanoparticles solution leading to a significant increase in the chemical activity. The activity of the prepared silver nanoparticles was applied on three types of germs *candida albicans, S.aureus and E.coli* the highest activity was against Gram positive bacteria *S. aureus* with inhibition zone (28) mm as seen in table 2.

Table 2. Shows the diameter of inhibition zones against bacterial strains and candida albicans

Sample	candida albicans	S.aureus	E.coli
Sample1 (0.1g silver)	10 mm	27 mm	10 mm
Sample2 (0.5g silver)	15 mm	25 mm	15 mm
Sample3 (0.25g silver)	15 mm	28 mm	10 mm

The main component of the cell walls of Gram-positive bacteria is a rigid network composed of three macromolecular concentric shells making it resistant to mechanical rupture, while Gram-negative bacteria have a network that is only one molecule thick, together with up to 25 % (mass) of lipoprotein. The small size of the silver nanoparticles synthesized in this work enabled the easier penetration into the cell, wall of *S. aureus* thereby affecting the cell membrane and finally death of the cell, Figure 5 shows antibacterial activities of silver nanoparticles against (a) *E. coli*, (b). *S. aureus and (c) candida albicans.*

Conclusion

It has been demonstrated that silver nitrate is capable to producing silver nanoparticles using Typha as reducing agent which it is stable in aqueous solution. The appearance of surface plasmon resonance peak at (420) nm provides a convenient spectroscopic signature for the formation of silver nanoparticles. Moreover silver nanoparticles which are synthesized active towards the bacteria. Analysis from SEM show silver nanoparticles spherical in shape and are well dispersed in their solution. The particle size is in the range from (10) nm to (46) nm. From our knowledge this is the first time of synthesis of silver nanoparticles from *Typha domingensis* from Iraqi marshes. The results encourage of preparations of ointments of silver nanoparticles for medicine with more experiment on it.

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