

## Preparation and study of the structural and optical properties of silver nanoparticles prepared from extracts of some plants

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### Abstract

The study included the preparation of silver nanoparticles using *Punica granatum* extract . as silver nanoparticles were prepared by biological method . which is one of the best ways for its cheapness and the fact that it does not require time and does not leave toxic substance .in the study , the active compounds of the extract were detected and some physical properties of AgNps were studied . the optical and structural properties of the prepared nanoparticles were studied by Uv-Visible spectrophotometer measurement. perform an infrared spectrophotometric test (FTIR ) a field – emitting scanning electron microscope was also performed , ( EDX ) , ( X-RAY ) and the results of ( FESEM ) measurement showed that silver nanoparticles are of oval shape , and of different sizes ranging from ( 32.55 -70.55 ) nm . with a rate of (45.98) nm .

**Keywords:** *Punica granatum* plant , silver nitrate , ethanol alcohol .

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### INTRODUCTION

This study aims to synthesize nanoparticles in the green way using the leaves of the *Punica granatum* plant . nanoparticles are great importance at the present time and are used in many fields [ 1 ] . the interest in preparing nanoparticles has increased a lot especially in the recent period, especially in biosynthesis because these particles have distinct chemical , electronic and optical properties , and they can be changed depending on the size and shape of the particles , which allows them to be used in various applications . the particles prepared by biological methods are characterized by high purity , good electrical conductivity , chemical stability , and high catalytic activity , which depends on the size of the particles , size distribution , the shape of the particles , the degree of crystallization, the composition and proportions of the components [2]. the biological method does not require high pressure , and high temperature , and the quantity produced is high in a short period [ 3 ] . in general there are two types of methods for preparing nanoparticles , which are top - down and bottom-up methods [ 4 ] . A bottom – up technique means building nanoparticles from atoms and molecules , and a top - down technique means dismantling the large- sized materials into smaller particles , which ultimately leads to nanoparticles [ 5 ] . these nanoparticles (NPS) are of great importance as they are an inorganic nano materials , which makes them enter the composition of medicines for the treatment of bacterial diseases , as they are one of the factors used for the effective treatment of microbes , and are used in drug delivery , optical industries , coatings industry and many other fields [ 6 ] .

### Materials and methods

In this study the silver nanoparticles were prepared . the alcohol plant extract was prepared by drying the leaves of the plant and grinding it well weighing about ( 150 ) gm of the plant , then Adding to it ( 100 ) ml of ethanol alcohol , leaving it at room temperature until the next day then filtering the mixture and adding ( 600 ) ml of a ( 3 molar ) solution of silver nitrate to it . then it was noticed that the color of the solution changed from light color to dark ,which indicates the formation of silver nanoparticles it is shown in figure (1 , 2) . then the physical properties of AgNps were studied using ( x-ray ) , ( F T I R ) , ( F E S E M ) ,( E D X ) and Uv – measurements . as these measurements proved the presence of silver nanoparticles and showed that their shapes are spherical .

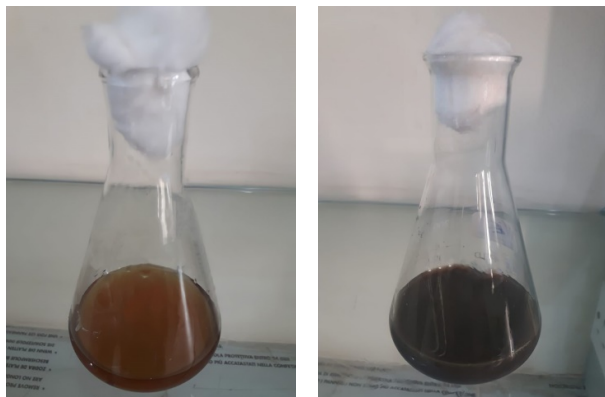


figure (1)

figure (2)

Figure(1) shows solutions represent the plant extract and (2) represent the silver nitrate in the presence of optimized amounts *Punica granatum* extract solutions after completion of the reaction

Previous studies  
Researchers have been interested in silver nanoparticles, and dealt with them in many studies because of the effective role of these particles in the field nanotechnology. As the research (Krishna raj) prepared silver particles from the aqueous extract of the neem tree by placing (100) ml of (1) m M silver nitrate with (12) ml of the aqueous extract of the plant

[7]. The research (Shamili) also prepared nanoparticles from the extract of the *Callicarpa maingayi* plant, and he measured the UV-visible of the extract, and the UV showed the appearance of an absorption peak at (450) nm [8]. The researcher (Kaushik) also prepared silver nanoparticles from grape fruit as he noticed the change in the color of the solution from light yellow to dark after added (10) ml of aqueous silver nitrate solution to the plant extract, using transmission electron microscope TEM, he noticed that the silver nanoparticles were spherical in shape with weak crystal structure with an average size of (20-80) nm [9].

## Results and discussion

### 1-Field Emission Scanning Electron Microscopy (FESEM)

The results of scanning field-emitting electron microscopy examination showed that silver nanoparticles are of oval shape, they are scattered on the surface of the pomegranate leaf extract as shown in figure (3) as this examination shows the membrane surfaces of the alcoholic extract of the plant and AgNps after being deposited on a piece of silicon, as this examination depicts very small details on the surface, and the size of the particles was determined through this examination, as figure (3) shows that the size of AgNps ranges between (23.55-70.55) nm and a rate of (45.98) nm.

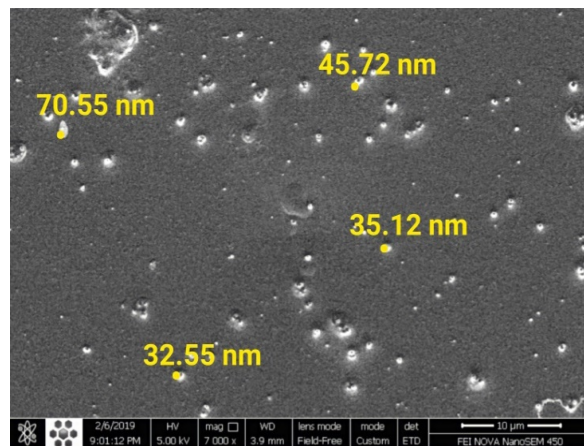


Fig 3 : Shows FESEM of silver nanoparticles

### Uv-Visible spectroscopy ( UV)

The formation of nanoparticles in the plant extract was confirmed by measuring the wavelength of the plant extract .UV- visible spectroscopy refers to the absorption or analysis of spectral reflection in the spectral region of UV rays . Uv - visible showed the ability of pomegranate peel extract to produce nanoparticles , as figure ( 4) shows the production of nanoparticles at the peak of spectral emission ( 400 ) nm .

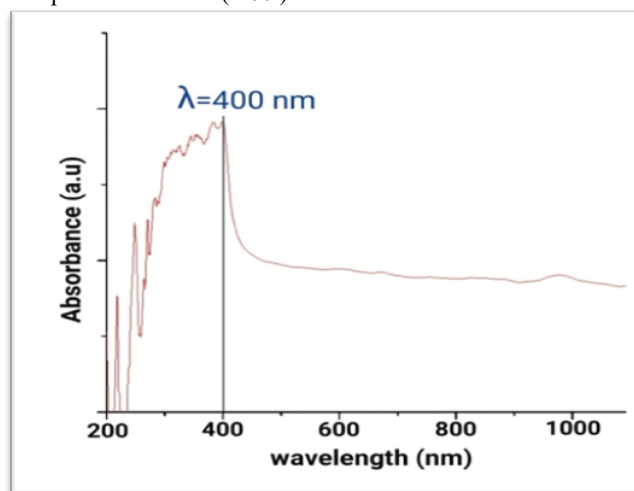


Fig (4) : Shows UV-Vis spectra of the *Callicarpa maingayi* extract

### Energy-Dispersive X-ray Spectroscopy (EDX)

EDX measurement is used in order to know the type of chemical elements present in the sample to be examined , as each elements has it down distinctive atomic structure that gives it asset of distinct peaks in the x-ray spectrum [10] . figure ( 5) shows that silver nanocrystals shows atypical absorption peak at energy (0.25) Kev , and a high peak for silver and then apeak for O2 at energy ( 0.50) Kev , and apeak for AL at energy ( 1.50) Kev , table ( 1) shows the percentage of elements in the nano-extract of pomegranate peels

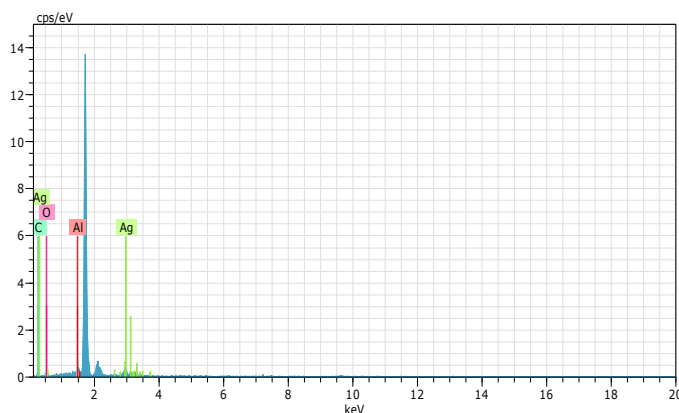


Fig (5): shows EDX analysis spectrum of silver nanoparticles

Table1: EDX results shows percentage of elements in resulting suspension

	[wt. %]	[wt. %]	[at. %]	[wt. %]
O 8 K-series	5.98	36.50	48.18	3.39
Ag 47 L-series	5.37	32.78	6.42	0.43
C 6 K-series	3.59	21.89	38.49	2.24
Al 13 K-series	1.45	8.83	6.91	0.20
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Total: 16.38 100.00 100.00				

#### Fourier Transform Infrared (FTIR)

We notice from figure (6) the appearance of several clear infrared peaks at ( 6346 ) , ( 3444.63 )  $\text{cm}^{-1}$  spectrum bundle ( 3467.77 ) is attributed to (O-H) , spectrum bundle ( 1635.52 )  $\text{cm}^{-1}$  is attributed to (C=O) , and spectrum bundle (1384.79)  $\text{cm}^{-1}$  is attributed to (CH<sub>3</sub>) as shown in figure (6) and table (2).

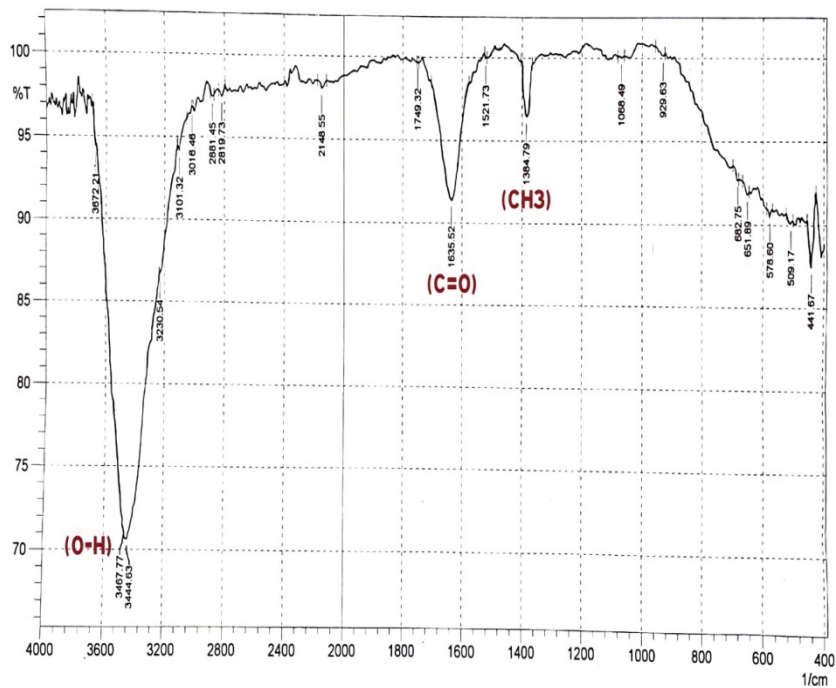


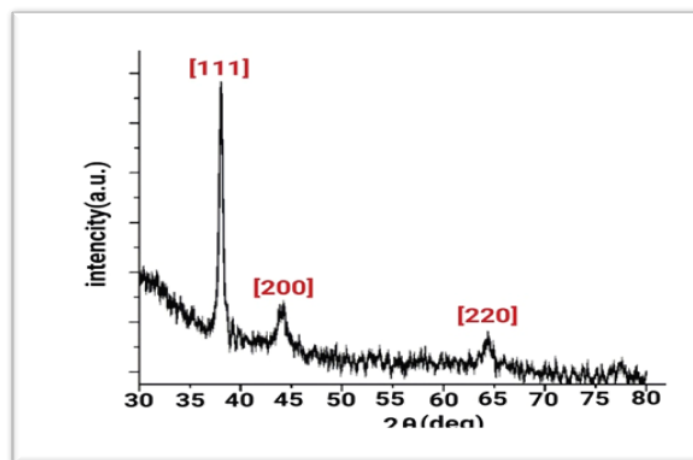
Fig (6): FTIR spectrum of extract *Callicarpa maingayi*

**Table2: The FTIR analysis information of *Callicarpa maingayi* extract**

Plant name	Functional groups	Absorbance peak (cm <sup>-1</sup> )
<i>Callicarpa maingayi</i>	O-H	3467.77 cm <sup>-1</sup>
	C=O	1635.52 cm <sup>-1</sup>
	CH3	1384.79 cm <sup>-1</sup>

### X-ray diffraction

x-ray diffraction spectrum of silver nanoparticles prepared using alcohol pomegranate peel extract . as we notice from the figure the appearance of diffraction peaks for silver due to the cubic crystal structural [11] . and the appearance of distinctive diffraction peaks in (111),(200) and (220) at the angles ( 38.5 ) , ( 43.9 ) and ( 64.5 ) . and the width of these peaks is related to the size of the crystals as shown in fig (7) .



**Fig (7): Shows the X-Ray diffraction of silver nanoparticles**

### Conclusion

Silver nanoparticles can be prepared in several ways , including chemical , physical and biological , but the biological method is one of the best methods because it does not leave toxic chemicals , and is cheap . in the biological method , nanoparticles can be prepared in three sources : bacteria , fungi and plant extracts . the biological method is the best in terms of safety and ease . In this research , the alcoholic extract of the peels of the pomegranate plant was used . the peels were collected dired and finely ground (150 ) gm of the plant was Taken ( 100 ) ml of ethanol alcohol was added to it and left for The next day. then ( 600 ) ml of silver nitrate solution was added to it then it was observed that the color of the solution changed from light yellow to dark ,which indicates the formation of AgNps . the formation of nanoparticles was confirmed by measuring the wave length of the plant extract using UV device . also the spectral infrared transmission spectra of the prepared AgNps extract were recorded using an infrared spectrophotometer ( FTIR ) .The nanoparticles were observed , their properties were studied their shapes were known and their size was determined through ( FESEM ) . Cell shape and size were also determined using x-ray diffraction .

### Further work

Using different other plants and studying their optical properties as well as studying the optical properties of AgNps by using transmission electron microscopy ( TEM ), Gismos measurement and Raman measurement for the prepared nanoparticles

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