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PHYTOSYNTHESIS OF SILVER NANOPARTICLES FROM *LAUNAEA NUDICAULIS* LEAVES AND CAPITULA AQUEOUS EXTRACT

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Abstract

Green synthesis of nanoparticles is getting more attention among other techniques because it is simple, coast-effective and more stable. The Current investigation aims to test the ability of *Launaea nudicaulis* (L.) Hook. f. (Asteraceae) to synthesis silver nanoparticle. The study is conducted for the first time in Iraq. Fresh materials of leaves and capitula of *Launaea nudicaulis* were washed, cut into small pieces, and then boiled in 100ml of distill water for 5minutes. The solution was then left to cool then filtered through the filter paper.

About 40ml of leaves or capitula extract was added to 60ml of 10M $AgNO_3$ solution and the reaction was left to take place at room temperature.

The results showed that the plant aqueous solution of the leaves and capitulum has the ability to rapidly form silver nanoparticles. UV-Vis spectroscopy, FTIR, XRD and SEM analysis were conducted to describe the developed silver nanoparticles.

Key words: lactuceae, Phytosynthesis, capitula, silver nanoparticle.

Introduction

The species *Launaea nudicaulis* (Hook) L. is a perennial or biennial herb belongs to the tribe lactuceae from the family (Asteraceae). It is a weedy plants known as Murreyr , Huwwh (Isa, 1981). Its widely distributed in different countries including Iraq, common as wild plant in different regions of Iraq especially the desert and semi desert (Rechinger, 1964). Phytochemical studies revealed that the plant have numerous bioactive compounds mainly fatty acids, Terpenoids (AL-Mawla, 2019), phenolic compounds (Susa, 2000), some of these compounds have medical importance such as Tetradeconoic acids isolated from leaves exhibited anticancer, antioxidant activity (Krashnaveni, 2016) Diterpene (phytol) which act as antimicrobial, anti-inflammatory and anticancer (Anthani and Kumari, 2013), Octadecanoic acid as anticancer (Bashkrani *et al*., 2016).

Nanotechnology is a branch of science deals with the synthesis of small particles with a size of 10-1000 nm (El-Sherbiny *et al*., 2015). Different methods have been used for the synthesis of nanoparticles includes physical, chemical and biochemical (Amin *et al*., 2012), green synthesis of nanoparticles best than the other techniques because it is simple, coast-effective and more stable (Mittal *et al*., 2014).

There are several studies deals with the biosynthesis of silver nanoparticles from the leaves and capitula in few members of Lactuceae such as (Kanchana *et al*., 2011) from the leaves of *Lactuca sativa*, (El-Sherbiny *et al*., 2015) (Zarch *et al*., 2018) from the capitula of six species of *Launaea*.

In this research, synthesis of silver nanoparticles from the leaves and capitula of the species *Launaea nudicaulis* was investigated and described.

Materials and Methods

The leaves and capitula of *Launaea nudicaulis* were collected from their original habitats at University of Babylon, the plant identified and authenticated according to (Davis, 1975) and (Rechinger and Lack, 1977).

Preparation of the aqueous extract

Fresh materials of leaves and capitula of *Launaea nudicaulis* were washed for several times with distill water, the sample of leaves or capitula were washed, cut into small pieces, then added to 100 ml of distill water

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Table 1: FTIR peak values of solid analysis of *Launaea nudicaulis* leaf.

	Peak	Absorption (cm^{-1})	Appearance	Group	Compound Class
.1	1026.13	1250-1020	Medium	C-N stretching	Amine
.2	1095.57	1150-1085	Strong	C-O stretching	aliphatic ether
.3		1124-1087	Strong	C-O stretching	secondary alcohol
.4	1261.45	1310-1250	Strong	C-O stretching	aromatic ester
.5	1315.45	1390-1310	Medium	O-H bending	Phenol
.6	1373.32	1390-1310	Medium	O-H bending	Phenol
.7	1458.18				
.8	1523.76	1550-1500	Strong	N-O stretching	nitro compound
.9	1616.35	1620-1610	Strong	C=C stretching	α, β-unsaturated ketone
.10	1701.22	1710-1680	Strong	C=O stretching	conjugated acid
.11		1710-1685	Strong	C=O stretching	conjugated aldehyde
.12	1716.65	1720-1706	Strong	C=O stretching	carboxylic acid
.13		1725-1705	Strong	C=O stretching	aliphatic ketone
.14	1732.08	1740-1720	Strong	C=O stretching	Aldehyde
.15	2850.79	3000-2840	Medium	C-H stretching	Alkane
.16	2920.23	3000-2840	Medium	C-H stretching	Alkane
.17	2958.80	3000-2840	Medium	C-H stretching	Alkane
.18	3236.55	3300-2500	strong, broad	O-H stretching	carboxylic acid
.19	3278.99	3300-2500	strong, broad	O-H stretching	carboxylic acid
.20	3417.86	3550-3200	strong, broad	O-H stretching	Alcohol
.21	3468.01	3550-3200	strong, broad	O-H stretching	Alcohol

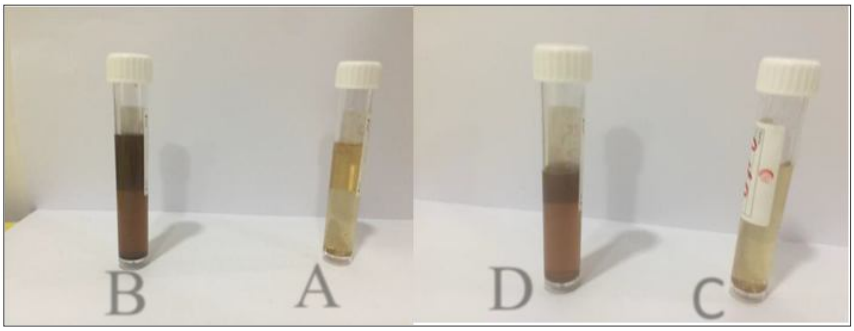

Fig. 1: Phytosynthesis of silver nanoparticles A- Aqueous *Launaea nudicaulis* leaf extract. B- Mix between solution silver nitrate and aqueous leaf extract. C- Aqueous *Launaea nudicaulis* capitulum extract. D- Mix between solution silver nitrate and aqueous capitulum extract. Gradually turn with time into brown color

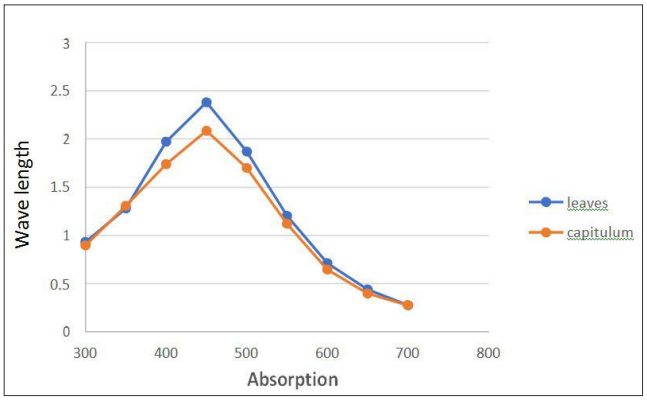

Fig. 2: UV-Visible spectra of silver nitrate and broth of leaf and capitulum.

and then boil for 5 minutes. The solution was then left to cool to normal temperature approximately (25ºC), the extract was then filtered through the filter paper.

Synthesis of silver nanoparticles

The silver nitrate ($AgNO_3$) used in this study was obtained from (Reagent World Company).

About 40ml of leaves or capitula extract was added to 60ml of 10M. $AgNO_3$ solution and the reaction was left to take place at room temperature.

Detection and characterization of silver nanoparticles

• **Visual observation:** The color change of the solution from the mixed of the leaf or capitulum extract with silver nitrate aqueous solution was visually observed, the time taken for the reaction mixture to Change color was observed.

• **Characterization of the synthesized nanoparticles:** The synthesized AgNPs were characterized by FTIR (IR affinity, shimadzu, X-ray diffraction (XRD .6000 As Shimazu) and scanning electron Microscope (SEM (MIRA3 from TESCAN).

Results and Discussion

In this paper, an aqueous extract of the leaves and capitula of the species *Launaea nudicaulis* was used in the extracellular synthesis of silver nanoparticles when treating aqueous silver nitrate solution with leaf or capitulum aqueous extract, rapid reduction of the silver ions is appeared by change the color, which indicates the formation of silver nanoparticles.

Change the color of solution is from yellowish Green to the golden brown, due to cohesive vibration of electron at the surface of nanoparticles resulting in surface plasmon resonance (SPR.) (EL-Sherbiny *et al*., 2015) (Fig. 1).

Changing in color vary with time and part of the plant used, this result was confirmed by (Mittal *et al.,* 2014; Verma *et al*., 2013). In general, reduction with aqueous extract of the leaf is more faster (40min) then those of capitulum (240min) as mentioned by (Zarch *et al*., 2018).

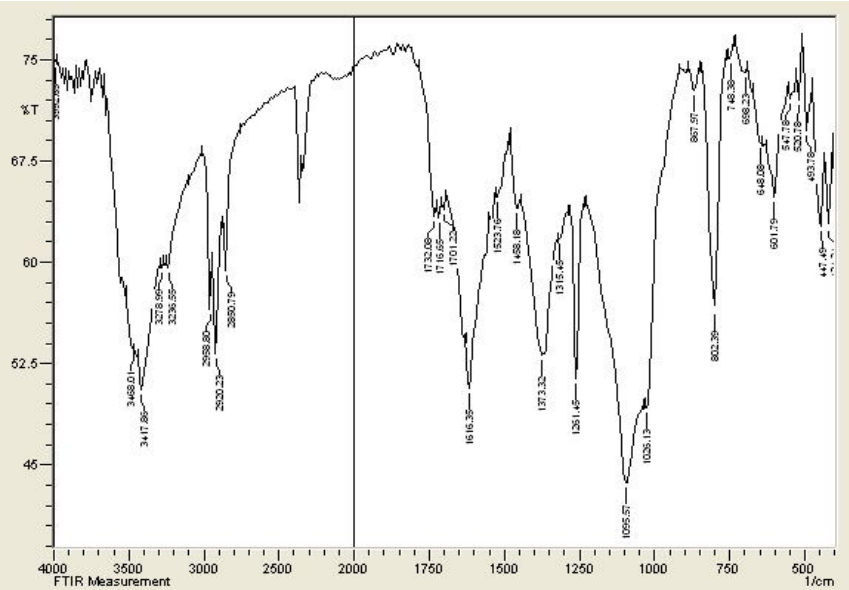

Fig. 3a: FTIR spectra pattern of dried powder of *Launaea nudicaulis* leaf.

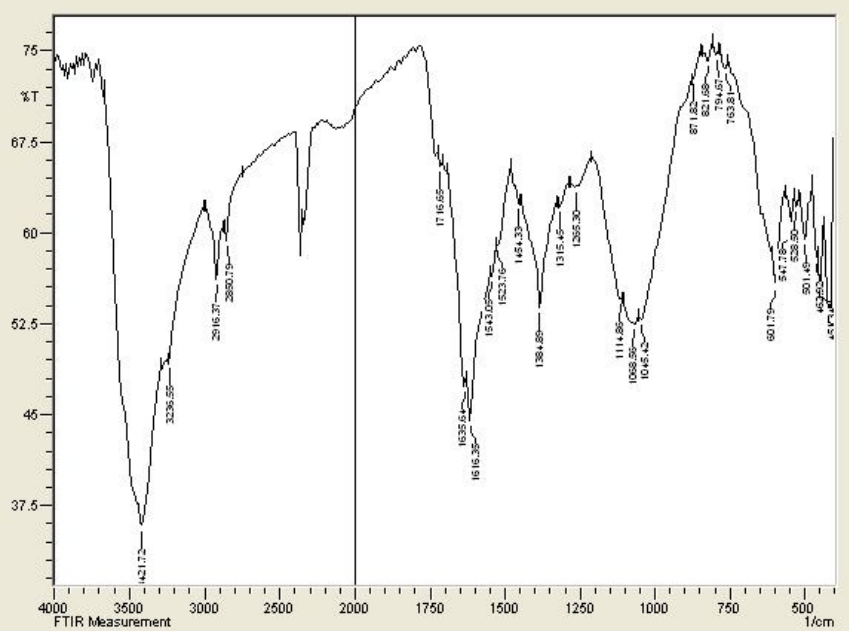

Fig. 3b: FTIR spectra pattern of dried powder of *Launaea nudicaulis* capitulum.

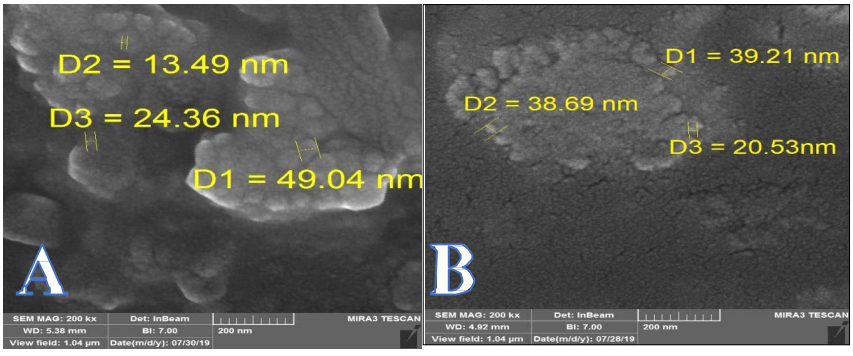

Fig. 5: Scanning electron microscope image of silver nanoparticles using *Launaea nudicaulis* A- Leaf extract at different magnification. B- Capitulum extract at different magnification.

As apparent from fig. 2 the absorption peak in the species *Launaea nudicaulis* was high, this due to the increased in concentration of silver nanoparticles formed.

This result confirmed by (Verma *et al.,* 2013), (Zarch *et al.,* 2018). also reported rapid . Synthesis of stable AgNPs from capitula extract of some *launaea* species.

FTIR

FTIR analysis was done, in order to identify different biomolecules responsible for reducing and stabilizing of Ag+ ions in the aqueous extract of leaves and capitula of species *Launaea nudicaulis* (Fig. 3a).

The representative spectra of stabilized silver nanoparticles obtained from *Launaea nudicaulis* leaf broth showed bands around 3468.01, 3417.86, 3278.99, 3236.55, 2958.80, 2920.23, 2850.79, 1732.08, 1716.65, 1710.22, 1618.35, 1532.76, 1458.18, 1373.32, 1315.45, 1261.45, 1095.57, 1026.13 cm^{-1}.

The peaks at 3468.01cm^{-1}, 3417.86cm^{-1}, 3278.99cm^{-1}, 3236.55, of (Fig. 3) correspond to an alcohol of strong broad O-H stretching and carboxylic acid respectively.

The peaks at 2958.8 cm^{-1}, 2920.23 cm^{-1}, 2850.79cm^{-1} correspond to alkane C-H stretching .The peak at 1732.08 cm^{-1} represent aldehyde, the peak at 1716.65 represent aliphatic ketone or carboxylic acid of strong C=O stretching, the peaks at 1701.22 represent either conjugated aldehyde or conjugated acid.

The band at 1616.35 cm^{-1} represent α, β unsaturated ketone (Natural berry ketone) and the peak at 1523.76 cm^{-1} represent nitro compound, the peak at 1458.8cm^{-1} was unknown. The medium bands appearing at 1373.32 cm^{-1} and 1315.45 cm^{-1} can be assigned to the O-H bending present in phenol.

Absorbance band which are observed in the region of 1095.57cm^{-1}, 1261.45cm^{-1}, 1026.13cm^{-1} are known to be associated with the stretching

Table 2: FTIR peak values of solid analysis of *Launaea nudicaulis* capitulum.

Peak	Absorption (cm^{-1})	Appearance	Group	Compound Class
1045.42	1070-1030	Strong	S=O stretching	Sulfoxide
1068.56	1070-1030	Strong	S=O stretching	Sulfoxide
1114.86	1150-1085	Strong	C-O stretching	aliphatic ether
	1124-1087	Strong	C-O stretching	secondary alcohol
1265.30	1275-1200	Strong	C-O stretching	alkyl aryl ether
1315.45	1390-1310	Medium	O-H bending	Phenol
1384.89	1390-1310	Medium	O-H bending	Phenol
1454.33				
1523.76	1550-1500	Strong	N-O stretching	nitro compound
1543.05	1550-1500	Strong	N-O stretching	nitro compound
1616.35	1620-1610	Strong	C=C stretching	α, β-unsaturated ketone
1635.64	1650-1600	Medium	C=C stretching	conjugated alkene
1716.65	1720-1706	Strong	C=O stretching	carboxylic acid
2850.79	3000-2840	Medium	C-H stretching	Alkane
2916.37	3000-2840	Medium	C-H stretching	Alkane
3236.55	3550-3200	strong, broad	O-H stretching	Alcohol
3421.72	3550-3200	strong, broad	O-H stretching	Alcohol

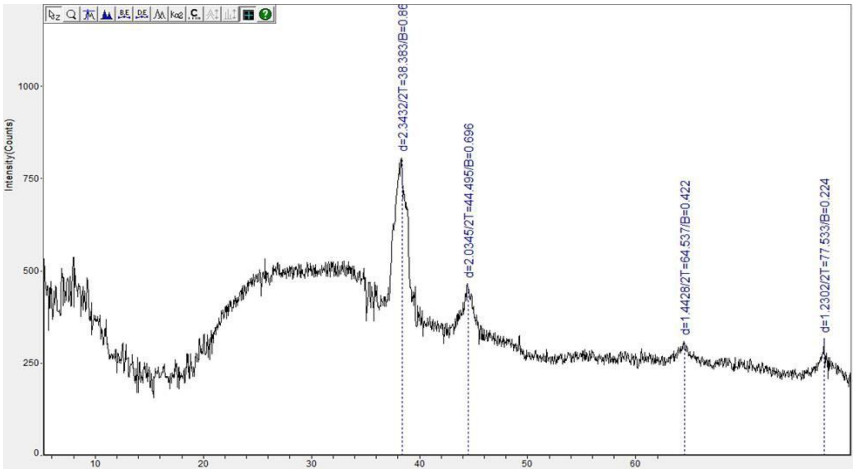

Fig. 6: X-ray diffraction patterns of silver nanoparticles synthesized using *Launaea nudicaulis* leaf extract.

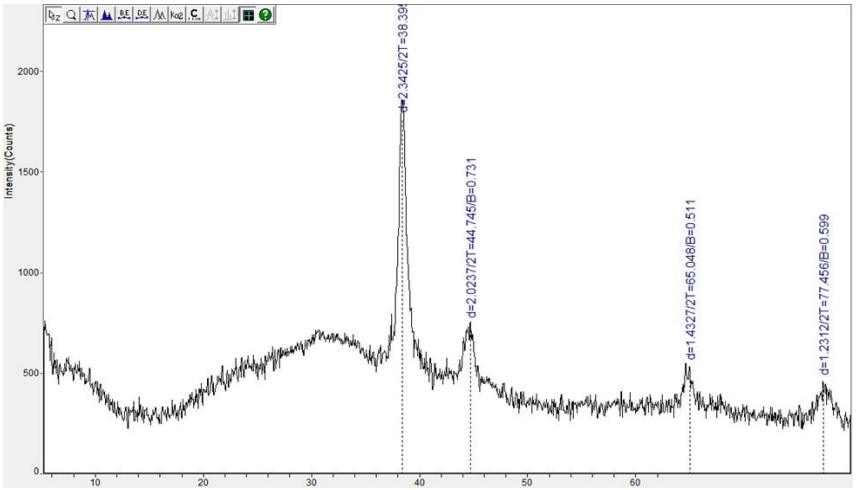

Fig. 7: X-ray diffraction patterns of silver nanoparticles synthesized using *Launaea nudicaulis* capitulum extract.

vibration for C-O. Stretching of aromatic ester, secondary alcohol, aliphatic ether, medium C-N stretching amine.

This result confirmed the experimental evidence which have been reported that *Launaea nudicaulis* contains different group of chemical compounds as alkaloids, sesquiterpene, diterpene, fatty acids, alcohols, phenols (Al-Mawla, 2019). That possess free radical scavenging activities (Bergman *et al*., 2003), which is related to reduction of silver and synthesis of nanoparticles through the biosynthesis.

The absorption spectra of the aqueous extract of capitulum and $AgNO_3$ are show in fig. 3b, which gave (17) peaks. The peaks at 3421.72cm^{-1} 3236.55 cm^{-1} represent alcohol. 2916.37 cm^{-1} and 2850.79 cm^{-1} represent alkane, 1716.65 cm^{-1} carboxylic acid, 1635.64 conjugated alkane, 1616.35 cm^{-1} represent α, β unsaturated ketone (natural berry ketone).

Band of 1543.05cm^{-1} and 1523.76 cm^{-1} of strong N-O stretching represent nitro compound, 1454.33cm^{-1} was unknown. Peaks at 1384.89cm^{-1} and 1315.45 of medium O-H bending represent phenol, 1265.30cm^{-1} represent alkyl aryl ether of strong C-O stretching, 1114.86cm^{-1} secondary alcohol and aliphatic ether, peaks at 1068.56 cm^{-1} and 1045.42cm^{-1} represent sulfoxide. This result was corresponding to (Zarch *et al.,* 2018).

SEM

Scanning electron microscope micrographs (Fig. 5) showed that silver nanoparticles were spherical or semi-spherical in shape, with aggregation, the range of size is between (13-50)nm in the leaf and in the capitulum is (20-40) nm.

Aggregation of particles may be due to the absence or few capping agent (Zarch *et al*., 2018).

XRD

The XRD patterns of synthesis silver nanoparticles showed various bragg peak angles 2Theta (38.38, 44.49,

64.53, 77.25) in the leaf and (38.44, 44.58, 46.74, 77.45) in the capitulum which may be indexed to the (111), (200), (220) and (311) (Fig. 6-7). Confirmed the crystal structure of the synthesized $AgNO_3$ (Vigneshwaran *et al*., 2007).

Conclusion

The plant aqueous solution of the leaves and capitulum has the ability to rapidly form silver nanoparticles.

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