VOLATILE OILS, LIPID CONSTITUENTS AND CHARACTERIZATION OF GREEN SILVER NANOPARTICLES OF SOME PLANTS BELONGING TO FAMILY APIACEAE

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In this study, GC/MS of volatile oils and lipid constituents were explored for four Apiaceae family members: *Deverra tortuosa* (Desf.) DC., *Daucus syrticus* L., *Anethum graveolens* L. and *Petroselinum crispum* (Mill.). The potential of using the ethanolic extracts of these plants in the synthesis of green silver nanoparticles (AgNPs) was investigated. Additionally, the effect of these synthesized nanoparticles on some strains of bacteria and fungi was studied. About the lipoidal matter, the data show that, *D. tortuosa* and *D. syrticus* had 32 and 13 compounds, respectively, while *A. graveolens* and *P. crispum* had 24 ,19 compounds, respectively. The Analysis of volatile oils by GC/MS allowed the identification of 31 compounds in *D. tortuosa* and *D. syrticus* had 23 compounds, while *A. graveolens* had 18 compounds and *P. crispum* had 11 compounds. The data showed that, the size of AgNPs differed according to the plant used in their synthesis as follows: 34.0, 42.7, 37.3, and 41.0 nm for *D. tortuosa*, *D. syrticus*, *A. graveolens* and *P. crispum*, respectively. It was observed that, AgNPs from *P. crispum* had the highest effect against *Bacillus subtilis* (22 mm), while the best activity against *Escherichia coli* was 20 mm from AgNPs of *D. tortuosa* ethanolic extract. AgNPs of *A. graveolens* ethanolic extract had the best effect against *Aspergillus versicolor* with inhibition zone of 40 mm, followed by *D. syrticus* (38 mm).

Keywords: *Anethum graveolens*, *Petroselinum crispum*, *Deverra tortuosa*; *Daucus syrticus*, GC-mass, volatile oils, green silver nanoparticles

INTRODUCTION

Medicinal plants have been assumed to play a key role in the improvement of human society. A significant number of the present-day drugs are produced indirectly from plants. Numerous food crops have therapeutic values, while medicinal plants are resources of new medications. It has been estimated that, there are more than 250,000 blossom plant species, which represent the "spine" of traditional medicine, implying more than 3.3 billion individuals in the less developed nations using medicinal plants on a continuous basis (Panda and Mishra, 2016). The medicinal impacts of plants are because of metabolites, which include primary and secondary metabolites (Jan and Masih, 2012).

Apiaceae is one of the botanical families containing a large variety of plants spread all over the world, but mainly in the temperate areas. Family Apiaceae (syn. Umbelliferae) comprise about 3700 species spread across 434 genera. Many members of this family are used for flavoring of foods, cosmetic, healthy, and medical purposes (Aćimović et al., 2015).

Anethum graveolens (Dill), is an annual aromatic herb originated from Mediterranean and West Asia (Singh et al., 2005). Dill is also known as Shapt or dill weed. Dill has a long history of cultivation and use as culinary and medicinal herb (Gupta and SK, 1995). *Petroselinum crispum* (Soliman et al., 2015) is a bright green plant, which is cultivated widely in the tropic, sub-tropic and temperate regions. It is also used for the treatment of dyspepsia, cystitis, dysmenorrhea, functional amenorrhea and myalgia (Bisset and Wichtl, 1994). *Deverra tortuosa* was used by the Egyptians for preparation of a carminative drink and is occasionally eaten by grazing animals. The plant has been found to treat asthma, hepatitis, fever, rheumatism, diabetes, digestive difficulties and menstruation (Krifa et al., 2015). *Daucus syrticus* (Teubert et al., 1977) are used in the treatment of cough, diarrhea, dysentery, cancer, malaria and tumors, and as an antiseptic, abortifacient, aphrodisiac, carminative, stimulant, stomachic and tonic. The objective of this study was to determine the volatile oils and lipid constituents of the plants under investigation, and to synthesize their green silver nanoparticles (AgNPs).

MATERIALS AND METHODS

1. Plant Materials

The fresh aerial parts (stem and leaves) of the tested plants under investigation were collected during the year 2019. Cultivated plants (*A. graveolens* and *P. crispum*) were collected from Beniseuif and wild plants (*D. tortuosa* and *D. syrticus*) were collected from Mersa Matrouh. Plant specimens were identified by Dr. Omran Ghaly, Head of Plant Taxonomy Unit, Herbarium of Desert Research Center.

All collected samples were transferred quickly to the laboratory, whereas the soil debris and unhealthy parts were discarded, then the plants

were air-dried at lab temperature under shading till constant weight, and finally ground to fine powder and kept to be used for different analyses.

2. Determination of Lipoidal Matter

2.1. Sample preparation

Ten g of the dried plant powder were extracted with petroleum ether for 24 h. The lipids were obtained by distilling off the solvent. The last traces of the solvent were removed by heating the liquid sample in a vacuum oven at 50°C till constant weight.

2.2. GC-MS of lipids

The lipoidal matter of the tested plants were determined using Trace GC-TSQ mass spectrometer (Thermo Scientific, Austin, TX, USA) with a direct capillary column TG–5MS (30 m x 0.25 mm x 0.25 µm film thickness). The column oven temperature was initially held at 50°C and then, increased by 5°C/min to 250°C hold for 2 min, increased to the final temperature of 300°C by 30°C/min and hold for 2 min. The injector and MS transfer line temperatures were kept at 270, 260°C, respectively. Helium was used as a carrier gas at a constant flow rate of 1 mL/min. The solvent delay was 4 min and diluted samples of 1 μL were injected automatically using Autosampler AS1300 coupled with GC in the split mode. EI mass spectra were collected at 70 eV ionization voltages over the range of m/z 50–500 in a full scan mode. The ion source temperature was set at 200°C. The components were identified by comparison of their mass spectra with those of WILEY 09 and NIST 14 mass spectral database.

3. Volatile Oils

3.1. Determination of oil percentages of each plant sample

Fifty g of each fresh plant material were subjected to steam distillation to extract the volatile oils according to Wagner and Bladt (1996).

3.2. GC/MS of Volatile Oils

The volatile oils were determined using Trace GC-TSQ mass spectrometer (Thermo Scientific, Austin, TX, USA) with a direct capillary column TG–5MS (30 m x 0.25 mm x 0.25 µm film thickness). The components of volatile oils were identified by comparison of their mass spectra with those of WILEY 09 and NIST 14 mass spectral database.

4. Biosynthesis and Characterization of Silver Nanoparticles from Plant Extracts

Fifty mL of 0.065 mol of silver nitrate solution was added to 50 mL of 70% ethanol plant extracts separately, whereas the color changes indicate the formation of AgNPs. Then, the pH of each solution was adjusted by using NH_4OH for completing the reaction (pH of *D. tortuosa* was 6.99, *D. syrticus* was 4.27, *A. graveolens* was 6.78 and *P. crispum* was 6.90). The solutions were heated to settle down AgNPs and centrifuged at 4000 rpm for 10 min.

AgNPs were characterized by measuring their particle size, UV-visible spectroscopy and scanning electron microscope (SEM).

5. Antimicrobial Activity of Silver Nanoparticles Susceptibility Test

The susceptibility test was performed according to NCCLS (National committee for clinical laboratory standards) recommendations (Goud et al., 2003). Screening test regarding the inhibition zone was carried out by the well diffusion method (Hindler et al., 1994). The inhibition zone (mm) was measured around each well after 24 h at 37°C. Controls using dimethyl sulfoxide were adequately done. The fungal and bacterial strains were obtained from the Regional Center for Mycology and Biotechnology (RCMB), Al-Azhar University, Cairo, Egypt.

6. Statistical Analyses

Statistical analyses were done using the SPSS package (SPSS Inc., Chicago, IL, USA). One-way Analysis of Variance (ANOVA) was applied to all data. Tukey's Multiple Range Test ($P < 0.05$) was carried out as the post-hoc test for mean separations. Each experiment was done in three replicates (n = 3).

RESULTS AND DISCUSSION

1. GC/MS of Lipoidal Matter

1.1. GC/MS of lipoidal matter of *D. tortuosa*

According to the data recorded in Table (1), *D. tortuosa* had 32 compounds. The highest concentration of the recorded compounds was for mesitylene (9.06%), followed by 7,7 dimethyl-tetracyclo [4.1.0.0(2,4).0(3,3)] heptane (4.77%), it is called beta-carene, followed by 2,3-epoxicaran, trans (1.32%) and 12,15-octadecadiynoic acid, methylester (1.32%).

Mesitylene is an important organic chemical raw material, the use of mesitylene can develop three toluene, trimesic acid, benzoic anhydride and other dye intermediates, it can also be used for the production of trimesic acid and antioxidants, polyester resin curing agent, stabilizer polyester resin, alkyd resins and plasticizers and dyes (https://www.chemicalbook.com/ChemicalProductProperty_EN_CB5852758.htm). In the electronics industry, mesitylene has also been used as a developer for photo patternable silicones due to its solvent properties. It plays a significant role in aerosol and tropospheric ozone formation as well as other reactions in atmospheric chemistry (https://www.worldofchemicals.com/chemicals/chemicalproperties/mesitylene.html). 7, 7 –dimethyl – tetracyclo [4.1.0.0 (2, 4).0 (3, 3)] heptane is called *beta*-carene (monoterpene hydrocarbons). Carene is abundant in nature and is commonly found in allspice, rosemary, basil, cedar, pine and turpentine, as well as cannabis (https://ceresmedvt.com/terpene-of-the-month-carene/).

Table (1). GC/MS of lipoidal matter of *Deverra tortuosa* (Desf.) DC.

Compound	Mol. formula	Class	Mol. wt	Rt	Area%
N-Benzylaniline	$C_{13}H_{13}N$	Azomethines (Nitrogenous compound)	183	4.06	0.80
Bicyclo[2.1.1]hexan-2-ol, 2-ethenyl	$C_8H_{12}O$	Hexyl alcohol	124	4.07	0.44
7,7-Dimethyl-tetracyclo[4.1.0.0(2,4).0(3,3)]heptane	C_9H_{12}	Monoterpene hydrocarbon	120	5.37	4.77
Mesitylene	C_9H_{12}	Aromatic hydrocarbon	120	6.28	9.06
1,3,8-P-menthatriene	$C_{10}H_{14}$	Monoterpene	134	7.99	0.81
2-Cyclohexen-1-ol, 2-methyl-5-(1-methylethen Yl)-, acetate	$C_{12}H_{18}O2$	Hexyl secondary alcohol	194	8.81	0.50
2,3-Epoxicaran, trans-	$C_{10}H_{16}O$	Monoterpene hydrocarbon	152	9.11	1.32
Aminopterin	$C_{19}H_{20}N_8O_5$	Nitrogenous compound	440	10.15	1.32
Tetradecane, 2,6,10-trimethyl-	$C_{17}H_{36}$	Alkane hydrocarbon	240	11.60	0.72
1-Chlorooctadecane	$C_{18}H_{37}Cl$	Alkane hydrocarbon	288	12.64	0.32
1,3,5-Triazine-2,4-diamine, 6-chloro-N-ethyl-	$C_5H_8CLN_5$	Nitrogen-containing heterocycles	173	16.21	0.79
Dotriacontane	$C_{32}H_{66}$	N- Alkane hydrocarbon	450	17.14	0.28
Idebenone	$C_{19}H_{30}O_5$	Quinones	338	17.21	0.38
12,15-Octadecadiynoic acid, methyl ester	$C_{19}H_{30}O_2$	Unsaturated fatty acid methyl ester	290	17.40	1.32
10-Heptadecen-8-ynoic acid, methyl Ester, (E)-	$C_{18}H_{30}O_2$	Saturated fatty acid methyl ester	278	17.77	0.49
2-Aminoethanethiol hydrogen sulfate (ester)	$C_2H_7NO_3S_2$	Organo sulphur compound	157	18.53	0.54
Bicyclo[4.4.0]dec-2-ene-4-ol, 2-methyl-9-(prop-1-en-3-ol-2-yl)-	$C_{15}H_{24}O_2$	Alkene alcohol	236	19.73	1.19
Dotriacontane	$C_{32}H_{66}$	Alkane hydrocarbon	450	20.34	0.79
1,3,5-Triazine-2,4-diamine, 6-chloro-N-ethyl-	$C_5H_8ClN_5$	Nitrogen-containing heterocycles	173	20.49	1.29
12,15-Octadecadiynoic acid, methyl ester	$C_{19}H_{30}O_2$	Conjugated unsaturated fatty acid	290	21.19	0.79
9-Octadecenoic acid (Z)-	$C_{18}H_{34}O_2$	Conjugated fatty acid	282	21.60	0.85
Oleic acid	$C_{18}H_{34}O_2$	Unsaturated fatty acid	282	22.11	0.32
9-Octadecenoic Acid, (2-Phenyl-1,3-Dioxolan-4-Yl) Methyl Ester, Cis-	$C_{28}H_{44}O_4$	Conjugated fatty acid	444	22.33	0.65
Cis-5,8,11,14,17-Eicosapentaenoic Acid	$C_{20}H_{30}O_2$	Polyunsaturated fatty acid	302	22.64	1.03

Table (1). Cont.

Retinal	$C_{20}H_{28}O$	Retinaldehyde	284	22.77	1.14
Alanine, 3-(benzyloxy)-, L-	$C_{10}H_{13}NO_3$	Nitrogenous compound	195	23.00	0.40
Oxiraneoctanoic acid, 3-octyl-, cis-	$C_{18}H_{34}O_3$	Saturated fatty acid	298	23.41	0.82
Estra-1,3,5(10)-trien-17á-ol	$C_{18}H_{24}O$	Alcohol (ester with aromatic ring)	256	24.09	0.87
7,9-Di-tert-butyl-1-oxaspiro(4,5)dec A-6,9-diene-2,8-dione	$C_{17}H_{24}O_3$	Oxaspiro compound	276	24.58	1.97
Benzoic acid, pentachloro-	$C_7HCl_5O_2$	Aromatic halides	292	24.73	1.59
1,2,3,4-Tetrahydro-1,1,4,4,6-pentamethyl-5,7 dinitronaphthalene	$C_{15}H_{20}N_2O_4$	Nitrogenous compound (polycyclic aromatic hydrocarbon)	292	24.75	0.52
9-Octadecenoic acid, (2-phenyl-1,3-dioxolan-4-yl) methyl ester, cis-	$C_{28}H_{44}O_4$	Unsaturated fatty acid (ω-6)	444	37.66	1.00

Mol. wt: Molecular weight RT: Retention time

1.2. GC/MS of lipoidal matter of *D. syrticus* Murb.

D. syrticus had 13 compounds as shown in Table (2). The highest concentration of the detected compounds was for mesitylene (24.93%), followed by bicycle [2.1.1] hexan-2-ol, 2-ethenyl (8.85%), followed by 1,3,8-*p*-menthatriene (8.11%) and 7,7-dimethyl-tetracyclo[4.1.0.0(2,4).0(3,3)] heptane (4.91%). *P*-mentha-1,3,8-triene is a monoterpene that has a role as a plant metabolite, a human xenobiotic metabolite and a volatile oil component (https://foodb.ca/compounds/FDB015991).

1.3. GC/MS of lipoidal matter of *A. graveolens* L.

Anethum graveolens had 24 compounds as indicated in Table (3). The highest concentration of the detected compounds was for 7,9-di-tert-butyl-1-oxaspiro [4.5] deca-6,9-diene-2,8-dione (21.36%) followed by mesitylene (8.07%); tetradecane, 1-chloro (7.62%) and 3,5,9-trioxa-5-phosphaheptacos-18-en-1-aminium,4-hydroxy-n,n,n-trimethyl-10-oxo-7-[(1-oxo-9 octadecenyl)oxy]-,hydroxide, inner salt, 4-oxide,(r)-(2.43%). 7,9-di-tert-butyl-1-oxaspiro[4.5]deca-6,9-diene-2,8-dione is an oxaspiro compound. It can be found in morels (*Morchella* spp.), which are among the most valuable and important mushrooms because of their taste and commercial value (TaŞKin, 2013). Also, it can be identified as one of bioactive compounds in whole plant extract of *Euphorbia pulcherrima*, which are used in folk medicine to treat skin diseases, gonorrhea, migraine, intestinal parasites, and warts (Sharif et al., 2015). It can also be found as phyto-active compound in *Manilkara hexandra* (Roxb.) Dubard stem bark (Monisha and Vimala, 2018).

Tetra-decane, 1-chloro is a straight chain alkane consisting of 14 carbon atoms. It has a role as a plant metabolite and a volatile oil component. It was previously found that capric, lauric, myristic, palmitic,

stearic, oleaic, linoleic, linolenic and arachidoic acids as heterogeneous components from *A. graveolens* oils were separated using gas chromatography (Badar et al., 2008).

Table (2). GC/MS of lipoidal matter of *Daucus syrticus* Murb.

Compound	Mol. formula	Class	Mol. wt.	Rt	Area %
Decane, 1-chloro	$C_{10}H_{21}Cl$	Alkane hydrocarbon	176	4.08	1.22
Bicyclo[2.1.1]hexan-2-Ol, 2-ethenyl-	$C_8H_{12}O$	Hexyl alcohol	124	4.17	8.85
Sec-Butyl fluoroformate	$C_5H_9FO_2$	Organoflurine compound	120	4.69	1.96
7,7-Dimethyl-tetracyclo[4. 1.0.0(2,4).0(3,3)]heptane	C_9H_{12}	Alkane hydrocarbon	120	5.38	4.91
Mesitylene	C_9H_{12}	Aromatic hydrocarbon	120	5.69	24.93
Para tolyl acetaldehyde	$C_9H_{10}O$	Aldehyde	134	6.76	4.17
1,3,8-*p*-Menthatriene	$C_{10}H_{14}$	Monoterpene	134	7.51	8.11
6,7-Dimethyl-3,5,8,8a tetrahydro-1H-2-benzopyran	$C_{11}H_{16}O$	Polyctic isochromene	164	9.12	1.71
1-Chlorooctadecane	$C_{18}H_{37}Cl$	Alkane hydrocarbon	288	11.60	1.12
Aminopterin	$C_{19}H_{20}N_8O_5$	Nitrogenous compound	440	12.11	0.42
1,3,5-Triazine-2,4-diamine, 6-chloro-n-ethyl-	$C_5H_8ClN_5$	Nitrogen-containing heterocycles	173	12.64	0.54
Dotriacontane	$C_{32}H_{66}$	n- alkane hydrocarbon	450	16.20	0.85
9-Octadecenoic acid	$C_{18}H_{34}O_2$	Unsaturated monocarboxylic acid	282	24.74	1.37

Mol. wt: Molecular weight RT: Retention time

Table (3). GC/MS of lipoidal matter of *Anethum graveolens* L.

Compound	Mol. formula	Class	Mol. wt.	Rt	Area %
Tetradecane, 1-chloro	$C_{14}H_{29}Cl$	Alkane hydrocarbon	232	4.18	7.62
7,7-Dimethyl-tetracyclo[4. 1.0.0(2,4).0(3,3)]heptane	C_9H_{12}	Monoterpene hydrocarbon	120	4.35	1.29
Silane, trichlorodocosyl	$C_{22}H_{45}C_{l3}Si$	Organosilicon compound	442	4.41	1.89
Mesitylene	C_9H_{12}	Aromatic hydrocarbon	120	6.26	8.07
4,6-Decadiyne	$C_{10}H_{14}$	Alkadiyne	134	6.79	2.98
10,12-Octadecadiynoic acid	$C_{18}H_{28}O_2$	Unsaturated fatty acid	276	6.88	2.34
1H-2-Indenol, 2,3,4,5,6,7-Hexahydro-1-(2-hydroxy-2-methylpropyl	$C_{13}H_{22}O_2$	Hydroxylated indene	210	9.83	1.68
Aminopterin	$C_{19}H_{20}N_8O_5$	Nitrogenous compound	440	10.14	0.99
5,6-Azulenedicarboxaldehyde, 1,2,3,3a,8,8a-Hexahydro-2,2,8-trimethyl-, (3aà,8à,8aà)-(-)	$C_{15}H_{20}O_2$	Non- bezenoid aromatic hydrocarbon	232	19.31	3.66
Cycloprop[e]indene-1a,2(1h) -Dicarboxaldehyde, 3a,4,5,6,6a,6b-Hexahydro-5,5, 6b-Trimethyl-, (1aà,3aá,6aá,6bà)-(+)-	$C_{15}H_{20}O_2$	Carboxaldehyde	232	19.73	2.20
1-Chlorooctadecane	$C_{18}H_{37}Cl$	Alkane hydrocarbon	288	20.34	2.04
12,15-Octadecadiynoic Acid, Methyl Ester	$C_{19}H_{30}O_2$	Fatty acid, methyl ester	290	21.19	2.12
Oleic acid	$C_{18}H_{34}O_2$	Monounsaturated fatty acid	282	21.60	1.85
Hi-Oleic Safflower Oil	$C_{21}H_{22}O_{11}$	Polyunsaturated fatty acid	450	22.63	3.50
2-Aminoethanethiol Hydrogen Sulfate (Ester)	$C_2H_7NO_3S_2$	Nitrogenous compound	157	22.75	2.90
1,3,5-Triazine-2,4-Diamine, 6-Chloro-n-Ehyl	$C_5H_8ClN_5$	Nitrogenous compound	173	22.99	5.79
9-Octadecenoic Acid, (2-Phenyl-1,3-dioxolan-4-yl) Methyl Ester, Cis-	$C_{28}H_{44}O_4$	Unsaturated fatty acid	444	24.09	2.87
7,9-Di-tert-butyl-1-oxaspiro [4.5]deca-6,9-Diene-2,8-dione	$C_{17}H_{24}O_3$	Oxaspiro compound	276	24.57	21.36

Table (3). Cont.

1,2-Benzene dicarboxylic acid	$C_{24}H_{38}O_4$	Carboxylic acid	390	33.50	6.44
2-Hydroxy-3-[(9e)-9-octadec enoyl oxy]propyl(9e) 9Octadecenoate	$C_{39}H_{72}O_5$	Unsaturated fatty acid	620	36.58	0.32
Glycidyl oleate	$C_{21}H_{38}O_3$	Fatty acid methyl ester	338	36.84	0.80
9-Octadecenoic acid, 1,2,3-propanetriyl ester, (e,e,e)-	$C_{57}H_{104}O_6$	Unsaturated fatty acid methyl ester	884	36.96	0.40
3,5,9-Trioxa-5-phosphaheptacos-18-en-1-aminium, 4-hydroxy-n,n,n-trimethyl-10-oxo-7-[(1-oxo-9-octadecenyl)oxy]-, hydroxide, inner salt, 4-oxide, (r)-	$C_{44}H_{84}NO_8P$	Phosphor-containing compound	785	37.14	2.43
9-Octadecenoic acid, (2-phenyl-1,3-dioxolan-4-Yl) methyl ester, cis-	$C_{28}H_{44}O_4$	Fatty acid methyl ester	444	37.47	1.39

Mol. wt: Molecular weight RT: Retention time

1.4. GC/MS of lipoidal matter of *Petroselinum crispum* (Mill.)

According to the data in Table (4), P. crispum had 19 compounds. The highest concentration of the recorded compounds was for mesitylene (26.43%), followed by *o*-cymene (10.06%); 7,9-di-tert-butyl-1-oxaspiro(4,5) deca-6,9-diene-2,8-dione (6.23%), and 7,7-dimethyl-tetracyclo [4.1.0.0(2,4).0(3,3)] heptane (4.48%).

o-Cymene is an organic compound classified as an aromatic hydrocarbon. Its structure consists of a benzene ring *ortho*-substituted with a methyl group and an isopropyl group. *Petroselinum crispum* leaves were found to contain n-3 omega fatty acids like linolenic and palmitic acids (Vokk et al., 2011 and Punoševac et al., 2021). The main components of parsley fruit, besides furanocoumarins, are fatty oils in the content of 25%. The main fatty acid is petroselinic acid (60-80%) in the form of glycerides.

2. GC/MS of Volatile Oils of the Studied Plants

2.1. Percentages of volatile oils

Steam-distilled plant essential oils have been widely used instead of ordinary culinary herbs not only for food flavouring but also for bactericidal, fungicidal, and medicinal applications and in fragrances (Bakkali et al., 2008). Essential oils usually contain a variety of volatile compounds such as mono- and sesquiterpenes, phenol-derived aromatic and aliphatic components. Table (5) shows the percentages of volatile oils of the studied plants.

2.2. GC/MS of volatile oils of *D. tortuosa* (Desf.) DC.

GC/MS of the volatile oils from *D. tortuosa* are indicated in Table (6) allowed the identification of 31 compounds in *D. tortuosa*. The highest concentration of the detected compounds was for eugenol (32.05%), followed by 1-decanol (13.05%).

Table (4). GC/MS of lipoidal matter of *Petroselinum crispum* (Mill.).

Compound	Mol. formula	Class	Mol. wt.	Rt	Area %
n-Benzylaniline	$C_{13}H_{13}N$	Aromatic amine	183	4.07	0.56
Prostaglandin a1-biotin	$C_{35}H_{58}N_4O_5S$	Cyclopentenane	646	4.16	3.34
Sec-Butyl fluoroformate	$C_5H_9FO_2$	Carbonic acid	120	4.69	1.36
7,7-Dimethyl-tetracyclo[4. 1.0.0(2,4).0(3,3)]heptane	C_9H_{12}	Monoterpene hydrocarbon	120	5.37	4.48
Mesitylene	C_9H_{12}	Aromatic hydrocarbon	120	5.68	26.43
Oxadixyl	$C_{14}H_{18}N_2O_4$	Nitrogenous compound	278	6.52	0.24
***O*-Cymene**	$C_{10}H_{14}$	Aromatic hydrocarbon	134	7.50	10.06
1-Chlorooctadecane	$C_{18}H_{37}Cl$	Alkane hydrocarbon	288	11.59	0.94
1,3,5-Triazine-2,4-diamine, 6-chloro-n-ethyl-	$C_5H_8ClN_5$	Diamine	173	16.20	0.88
Methyl Octadec-6,9-Dien-12-ynoate	$C_{19}H_{30}O_2$	Alkane hydrocarbon	290	19.11	2.93
5,6-Azulenedicarboxaldehyde, 1,2,3,3a,8,8a-hexahydro-2,2,8 -trimethyl-, (3aà,8à,8aà)-(-)	$C_{15}H_{20}O_2$	Dicarboxaldeyde	232	19.32	2.07
Retinal	$C_{20}H_{28}O$	Vitamin a aldehyde	284	19.81	3.82
Hi-Oleic safflower oil	$C_{21}H_{22}O_{11}$	Unsaturated fatty acid	450	20.48	1.77
Oleic Acid	$C_{18}H_{34}O_2$	Unsaturated fatty acid	282	20.88	1.12
2-Aminoethanethiol hydrogen sulfate (ester)	$C_2H_7NO_3S_2$	Organo sulphur compound	157	20.96	1.86
9-Octadecenoic acid	$C_{18}H_{34}O_2$	Unsaturated fatty acid	282	21.59	1.44
9-Octadecenoic acid, (2-phenyl-1,3-dioxolan-4-yl) methyl ester, Cis	$C_{28}H_{44}O_4$	Unsaturated fatty acid methyl ester	444	22.62	1.11
9-Octadecenoic acid (z)-	$C_{18}H_{34}O_2$	Unsaturated fatty acid	282	24.08	2.29
7,9-Di-tert-butyl-1-oxaspiro(4,5)dec A-6,9-diene-2,8-dione	$C_{17}H_{24}O_3$	Oxaspiro compound	276	24.56	6.23

Mol. wt: Molecular weight RT: Retention time

Table (5). Percentages of volatile oils of the studied plants.

Plant Species	Oil %
D. tortuosa	92.28
D. syrticus	93.45
A. graveolens	99.49
P. crispum	81.06

Table (6). GC/MS of volatile oils of *Deverra tortuosa* (Desf.) DC.

Compound	Mol. formula	Class	Mol. wt.	Rt	Area %
2-Ethyl-oxetane	$C_5H_{10}O$	Heterocyclic organic compound (Ketone)	86	4.08	0.38
3-Tert-butyl-5-hydroxymethyl-cyclo hex-2-enyl)-methanol	$C_{12}H_{22}O_2$	Heterocyclo alkane	198	4.32	1.23
Decane, 1-chloro-	$C_{10}H_{21}Cl$	Hydrocarbon	176	5.40	0.80
3-Trifluoroacetoxypentadecane	$C_{17}H_{31}F_3O_2$	Monoterpene alcohol	324	9.10	0.43
Terpinen-4-ol	$C_{10}H_{18}O$	Terpene alcohol	154	9.83	5.25
Isopulegol	$C_{10}H_{18}O$	Monocyclic monoterpene alcohol	154	10.30	1.45
9,12-Octadecadienoyl chloride, (z,z)-	$C_{18}H_{31}ClO$	Fatty acid derivative	298	11.10	0.79
Cis-*p*-Mentha-1(7),8-dien-2-ol	$C_{10}H_{16}O$	Menthan monoterpenoid	152	11.36	0.96
1-Decanol	$C_{10}H_{22}O$	Fatty alcohol	158	12.00	13.05
9-Octadecenoic acid (Z)-	$C_{18}H_{34}O_2$	Unsaturated monocarboxylic acid	282	12.49	0.35
Eugenol	$C_{10}H_{12}O_2$	Allylbenzene	164	14.14	32.70
Bicyclo[7.2.0]undec-4-ene, 4,11,11-trimethyl-8-methyle Ne-, [1r-(1r*,4e,9s*)]-	$C_{15}H_{24}$	Oily liquid (caryophyllone)	204	14.91	8.89
3-Oxabicyclo[4.2.0]oct-5-ene, endo-8-methyl-exo-8-(2-propenyl)-	$C_{11}H_{16}O$	Propenyl compound	164	15.16	0.56
Cis-À-bisabolene	$C_{15}H_{24}$	Sequiterpenoid	204	15.66	1.64
a-Copaene	$C_{15}H_{24}$	Liquid hydrocarbon	204	16.24	0.89
7-Epi-cis-sesquisabinene hydrate	$C_{15}H_{26}O$	Sequiterpenoids	222	16.73	1.04
4,7-Dimethylpyrano[4,3-b]pyran-2,5-dione	$C_{10}H_8O_4$	Pyrone derivative	192	17.46	3.21

Table (6). Cont.

Cyclododecanepentanoic acid, 1-nitro-Á,2-dioxo-, phenylmethyl ester	$C_{24}H_{33}NO_6$	Unsaturated monocarboxylic Acid	431	18.01	0.38
1H-Cycloprop[E]azulen-7-ol, decahydro-1,1,7-trimethyl-4-methyle Ne-, [1ar-(1aà,4aà,7á,7aá,7bà)]-	$C_{15}H_{24}O$	Naphthalene compound	220	18.47	4.84
Aromadendrene oxide-(2)	$C_{15}H_{24}O$	Sequiterpenoid	220	18.92	0.30
Tau.-cadinol	$C_{15}H_{26}O$	Sequiterpenoid	222	19.70	2.24
2-Naphthalenemethanol, decahydro-à,à,4a-trimethyl-8-methylene-, [2r-(2à,4aà,8aá)]	$C_{15}H_{26}O$	Alcohol	222	19.98	2.39
(1R,7S,E)-7-isopropyl-4,10-dimethyl enecyclodec-5-enol	$C_{15}H_{24}O$	Cycloalkene alcohol (alkenols)	220	20.61	1.27
5-Isopropylidene-6-methyldeca- 3,6,9-trien-2-one	$C_{14}H_{20}O$	Alcohol	204	21.79	3.87
Oleic acid	$C_{18}H_{34}O_2$	Omega fatty acid	282	22.80	0.27
9-Octadecenoic acid	$C_{18}H_{34}O_2$	Unsaturated fatty acid	282	23.01	0.66
Trans-13-octadecenoic acid	$C_{18}H_{34}O_2$	Unsaturated fatty acid	282	23.23	0.62
Hexadecanoic acid, 2,3-dihydroxypropyl ester	$C_{19}H_{38}O_4$	Unsaturated fatty acid	330	23.61	0.48
2-Hydroxy-3-[(9e)-9-octadec enoyloxy]propyl (9e)-9-octadecenoate #	$C_{39}H_{72}O_5$	Unsaturated fatty acid	620	24.37	0.35
7-Methyl-Z-tetradecen-1-ol acetate	$C_{17}H_{32}O_2$	Acetate ester	268	28.76	0.63
Glycidyl oleate	$C_{21}H_{38}O_3$	Fatty acid methylester	338	32.72	0.36

Mol. wt: Molecular weight RT: Retention time

The volatile oils of *D. tortuosa* from Southern Sinai have a different composition from other regions in Egypt with camphene (31.0%) as the major constituent (Al-Gaby and Allam, 2000). The essential oils of *D. tortuosa* from Egypt is a mixture of several volatile components. According to Krifa et al. (2015), the essential oil contained sabinene, *α*-pinene, limonene and terpinen-4-ol as major constituents. Sabinene and 4-terpineol were recorded (Abdelgaleil et al., 2012).

The biological activity of essential oils may be due to one of the compounds or due to the entire mixture. Most essential oils have 166 antifungal and antibacterial action. Their mode of action result from the damage to the membrane of the microorganism, that induce material losses

(cytoplasmic), leakage of ions, loss of energy substrate (glucose, ATP), leading directly to the lyses of bacteria (cytolysis) and therefore to its death (Djilani and Dicko, 2012). Another possibility of action is inhibition of production of amylase and protease which stop the toxin production, electron flow and result in coagulation of the cell content (Hammer et al., 2008). Eugenol is an allyl chain-substituted guaiacol, a member of the allylbenzene class of chemical compounds (Bingham and Spooner, 1932). It is present in concentrations of 80–90% in clove bud oil and at 82–88% in clove leaf oil (Cortés Rojas et al., 2014). It is used as a flavor or aroma ingredient in teas, meats, cakes, perfumes, flavorings, and essential oils. It is also used as a local antiseptic and anaesthetic (Tsuchiya, 2017).

2.2. GC/MS of volatile oils of *D. syrticus* Murb.

D. syrticus had 23 compounds as recorded in Table (7). The highest concentration of the detected compounds was for 4-methoxy-6-(2-propenyl)-1,3-benzodioxole (32.09%), followed by (-)-spathulenol (16.65%). Spathulenol is a tricyclic sesquiterpenoid that has a role as a volatile oil component, a plant metabolite, an anaesthetic and a vasodilator agent (Juell, et al., 1976).

The volatile oil of the *D. syrticus* herb collected during January revealed the presence of different classes of terpene and non terpene compounds, among which γ-terpinene, α-terpineol, α-humulene, α-bisabolol, neophytadiene, phytol, heptacosane, nonacosane, n-hexadecanoic acid, 9,12,15-octadecatrienoic acid methyl ester and acetyl-5-methyl-furan were found to be the main compounds, and the data obtained from the GLC analysis of the unsaponifiable fraction showed that, it contains a series of hydrocarbons (80.24%), sterols, (2.28% cholesterol, campasterol, stigmasterol, and β-sitosterol) and triterpenes (0.96% α-amyrine), while the GLC of fatty acid methyl esters revealed the presence of saturated fatty acids (35%) and unsaturated fatty acids (65%), among which plasmatic and linolenic acid are the main compounds, respectively (Abd Alla et al., 2013 and Mansour et al., 2004).

2.3. GC/MS of volatile oils of *A. graveolens* L.

A. graveolens had 18 compounds as shown in Table (8). The highest concentration of the detected compounds was for bicyclo (3.1.1) heptane-2,3-diol 2,6,6-trimethyl (43.72%), followed by dill ether (17.79%).

Anethofuran (dill ether) belongs to the class of organic compounds known as benzofurans. These are organic compounds containing a benzene ring fused to a furan. Furan is a five-membered aromatic ring with four carbon atoms and one oxygen atom (Duke, 2004).

2.4. GC/MS of volatile oils of *P. crispum* (Mill.)

Petroselinum crispum had 11 compounds according to data in Table (9) . The highest concentration of the detected compounds was for (+)-alpha-terpineol (*p*-menth-1-en-8-ol) with a percentage (24.95%), followed by terpinen-4-ol (9.42%).

Table (7). GC/MS of volatile oils of *Daucus syrticus* Murb.

Compound	Mol. formula	Class	Mol. wt.	Rt	Area %
α-Pinene	$C_{10}H_{16}$	Hydrocarbon monoterpene	136	4.32	5.48
a-Myrcene	$C_{10}H_{16}$	Hydrocarbon monoterpene	136	5.46	4.72
4-Isopropenyl-1-methyl-1-cyclohexene(r(+)-limonen)	$C_{10}H_{16}$	Aliphatic hydrocarbon (cyclic monoterpene)	136	6.22	1.89
3-Cyclohexen-1-ol, 4-methyl-1-(1-methylethyl	$C_{10}H_{18}O$	Terpineol	154	9.95	6.30
2-Cyclohexen-1-one, 4-(1-methylethyl)-	$C_9H_{14}O$	Cyclohexanone	138	10.09	1.34
Naphthalene, 1,2,3,4,4a,5,6,7-octahydro-4a-methyl	$C_{11}H_{18}$	Sequiterpenes	150	10.42	1.46
(1R,5S,6R)-2,7,7-trimethylbicyclo[3.1.1]hept-2-en-6-yl acetate	$C_{12}H_{18}O_2$	α -pinene	194	11.50	4.58
Bornyl acetate	$C_{12}H_{20}O_2$	Acetate ester	196	12.01	1.04
Chrysanthenyl acetate	$C_{12}H_{16}O_2$	Monoterpene	192	12.60	2.65
***P*-Cymen-7-ol**	$C_{10}H_{14}O$	Benzyl alcohol	150	12.89	1.14
Thymol	$C_{10}H_{14}O$	Oxygenated monoterpene	150	13.54	2.33
Humulene	$C_{15}H_{24}$	Monocyclic sequiterpenes	204	15.71	2.25
6-[1-(Hydroxymethyl)vinyl]-4,8a-dimethyl1,2,3,5,6,7,8,8aoctahydro-2-naphthalenol	$C_{15}H_{24}O_2$	Alcohol	236	16.46	0.75
4-Methoxy-6-(2-propenyl)-1,3 benzodioxole,	$C_{11}H_{12}O_3$	Benzene derivative	192	17.98	32.09
α -Guaiene	$C_{15}H_{24}$	Sequiterpenes	204	18.39	1.40
(-)-Spathulenol	$C_{15}H_{24}O$	Tricyclic sequiterpenes	220	19.01	16.65
1H-Cycloprop[E]azulen-4 Ol,decahydro-1,1,4,7-tetramethyl-,[1ar-(1aà,4á,4aá,7à,7aá,7bà)]-	$C_{15}H_{26}O$	Alkane alcohol	222	19.13	0.21
(1R,7S,E)-7-isopropyl-4,10-dimethyl enecyclodec-5-enol	$C_{15}H_{24}O$	Cyclo alkene alcohol (alkenol)	220	19.23	1.36
Calarene epoxide	$C_{15}H_{24}O$	Bicyclic monoterpenoid	220	19.32	0.71

Table (7). Cont.

2-((2r,4ar,8as)-4a-methyl-8-methyl enedecahydronaphthalen-2-yl)prop-2-en1-ol	$C_{15}H_{24}O$	Alcohol	220	19.37	0.66
Tau-cadinol acetate	$C_{17}H_{28}O_2$	Sequiterpenoids alcohol	264	19.87	1.15
Aromadendrene oxide-(2	$C_{15}H_{24}O$	Sequiterpenoid	220	20.15	1.50
a-Bisabolol	$C_{15}H_{26}O$	Monocyclic sequiterpene alcohol	222	20.64	1.79

Mol. wt: Molecular weight RT: Retention time

Table (8). GC/MS of volatile oils of *Anethum graveolens* L.

Compound Name	**Mol. formula**	**Class**	**Mol. wt.**	**Rt**	**Area %**
1,3-Propanediol, 2-ethyl-2-(hydroxymethyl)-	$C_6H_{14}O_3$	Primary alcohol	134	4.32	0.45
2-Ethyl-oxetane	$C_5H_{10}O$	Heterocyclic organic compound	86	4.37	0.81
a-Phellandrene	$C_{10}H_{16}$	Cyclic monoterpenes	136	5.69	4.36
Limonen-6-ol, pivalate	$C_{15}H_{24}O_2$	Aliphatic hydrocarbon	236	6.21	1.78
Dill ether	$C_{10}H_{16}O$	Benzofurans	152	9.81	17.79
Isopinocarveol	$C_{10}H_{16}O$	Monoterpenoid	152	10.60	1.04
4,4-Dimethyl-cyclohex-2-en-1-ol	$C_8H_{14}O$	Alkane hydrocarbon	126	10.90	7.48
2,5-Methano-1H-inden-7(4H)-o-Ne, hexahydro-	$C_{10}H_{14}O$	Alcohol	150	11.45	0.81
2-Oxabicyclo[2.2.2]octan-6-ol, 1,3,3-trimethyl-, acetate	$C_{12}H_{20}O_3$	Fatty alcohol	212	13.01	4.21
1-Oxaspiro [2.5]octan-4-one, 2,2,6-trimethyl-, trans-	$C_{10}H_{16}O_2$	Oxaspiro compound	168	13.34	2.34
Bicyclo(3.1.1)heptane-2,3-diol, 2,6,6-trimethyl	$C_{10}H_{18}O_2$	Alkane hydrocarbon	170	13.65	43.72
(2,2,6-Trimethyl-bicyclo[4.1.0]hept-1 -yl)-methanol	$C_{11}H_{20}O$	Alcohol	168	14.49	1.04
Isocaucalol	$C_{15}H_{26}O_3$	Oil	254	15.26	4.22
2-Cyclohexen-1-one,4-hydroxy-3-methyl-6-(1-methylethy L)-, trans-	$C_{10}H_{16}O_2$	Aromatic hydrocarbon	168	16.02	2.29
8,12-Epoxy-13,14,15,16,17-pentanorlabdane	$C_{15}H_{26}O$	Norlabdane compound	222	19.32	4.50
9-Octadecenoic acid (Z)-	$C_{18}H_{34}O_2$	Unsaturated fatty acid	282	28.72	1.41
2-Hydroxy-3-[(9e)-9-octadecenoyloxy]propyl	$C_{39}H_{72}O_5$	Unsaturated fatty acid	620	28.83	1.24

Mol. Wt: Molecular weight RT: Retention time

Table (9). GC/MS of volatile oils of *Petroselinum crispum* (Mill.)

Compound name	Mol. formula	Class	Mol. wt.	Rt	Area %
Dichloromethyl ethyl sulfone	$C_3H_6Cl_2O_2S$	Sulphur containing compound	176	4.14	7.12
Hexanoic acid, 2-methyl-3-oxo-, ethyl ester	$C_9H_{16}O_3$	Unsaturated fatty acid eethyl ester	172	4.97	6.32
Tca;[trichloroacetic acid];(erbitoxt95),(occigram)(cy cocel)(radapon),(basfapon)	$C_2HCL_3O_2$	Carboxylic acid	162	5.66	7.34
1,5-Heptadien-4-ol, 3,3,6-trimethyl	$C_{10}H_{18}O$	Unsaturated aliphatic alcohol	154	6.23	4.25
2-Norpinanol,3,6,6-trimethyl-	$C_{10}H_{18}O$	Pinane monoterpenoid	154	8.05	4.26
Citronellal	$C_{10}H_{18}O$	Monoterpenoid aldehyde	154	9.32	4.48
Terpinen-4-ol	$C_{10}H_{18}O$	Monoterpene alcohol	154	9.83	9.42
(+)-Alpha-terpineol(p-menth-1-en-8-ol)	$C_{10}H_{18}O$	Monoterpenoids	154	10.29	24.95
1,2-15,16-Diepoxyhexadecane	$C_{16}H_{30}O_2$	Alkane hydrocarbon	254	11.08	5.96
6-Octen-1-ol, 3,7-dimethyl-,acetate	$C_{12}H_{22}O_2$	Alcohol	198	11.76	3.17
2-(2s,4ar)-4a,8-dimethyl-1,2,3,4,4a,5,6,7-octahydronaphthalen-2-yl)propan-2-ol	$C_{15}H_{26}O$	Alcohol	222	19.19	3.79

Mol. wt: Molecular weight RT: Retention time

Terpineol is a naturally occurring monoterpene alcohol that has been isolated from a variety of sources such as cajuput oil, pine oil, and petitgrain oil. (https://foodb.ca/compounds/FDB014922). Analysis of volatile oils from *P. crispum*, callus and cell culture showed that monoterpenes were the main constituent. ρ-1,3,8-menthatriene was high abundant compound among monoterpenes followed by β-phellandrene and apiol. Moreover, aldehydes (nonanal and decanal) and also fatty acids (free and bound) were found in the volatile oil (López et al., 1999).

3. Characterization of Green Silver Nanoparticles

3.1. Ultraviolet spectroscopy

The synthesis of AgNPs had been confirmed by measuring the UV-visible spectrum of the reaction media. The UV-visible spectrum of AgNPs synthesized from four plants have absorbance peaks at 450 nm as shown in

Fig. (1). The UV-Vis spectrum of colloidal solutions of AgNPs synthesized from *Boswellia ovaliofoliolata*, *Shorea tumbuggaia* and *Svensonia hyderobadensis* have absorbance peaks at 350 nm, 430 and 300 to 400 nm respectively; and the broadening of peak indicated that, the particles are poly-dispersed (Savithramma et al., 2011).

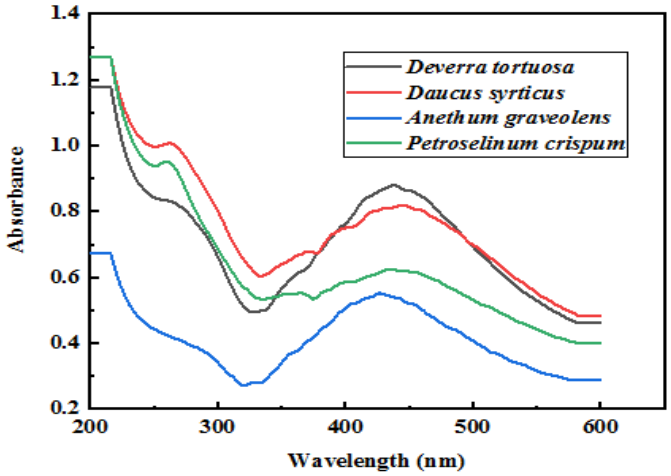

Fig. (1). UV spectrum of SNPs synthesis from the investigated plants.

3.2. Particle size

The particle size is used to determine the size of AgNPs synthesis from *D. tortuosa*, *D. syrticus*, *A. graveolens* and *P. crispum*. The data obtained in Table (10) show that, the size of AgNPs differed according to the plant used in their synthesis as follow: 34.0, 42.7, 37.3, and 41.0 nm for *D. tortuosa*, *D. syrticus*, *A. graveolens* and *P. crispum*, respectively.

Table (10). Particle size of the synthesized AgNPs.

Green silver nanoparticles (AgNPs)	**Particle size (nm)**
AgNPs of *D. tortuosa*	34.0
AgNPs of *D. syrticus*	42.7
AgNPs of *A. graveolens*	37.3
AgNPs of *P. crispum*	41.0

One of the first approaches of using plants as a source for the synthesis of metallic nanoparticles was with alfalfa sprouts (Gardea-Torresdey et al., 2002), which was the first report on the formation of AgNPs using a living plant system. The advantages of using plants for the synthesis of nanoparticles are that the plants are easily available and safe to handle and possess a large variety of active agents that can promote the reduction of silver ions. Most of the plant parts like leaves, roots, latex, bark, stem, and seeds are being used

for nanoparticle synthesis (Kharissova et al., 2013). The most important point is the active agent contained in these parts, which makes the reduction and stabilization possible. Ecofriendly plant extracts contain biomolecules, which act as both reducing and capping agents that form stable and shape-controlled nanoparticles. Main compounds which affect the reduction and the capping of the nanoparticles are biomolecules such as phenolics, terpenoids, polysaccharides, flavones, alkaloids, proteins, enzymes, amino acids, and alcoholic compounds. However, quinol and chlorophyll pigments, linalool, methyl chavicol, eugenol, caffeine, theophylline, ascorbic acid, and other vitamins have also been reported (Bindhu and Umadevi, 2013).

3.3. Scanning electron microscope (SEM)

These studies in TEM have shown that, the presence of a capping layer in plant mediated synthesis of AgNPs, where the plant extract acts as capping layers, shapes the nanoparticle during its growth. It also has an effect on the size distribution of these nanoparticles. In our results, we noticed the irregular shape of AgNPs (Fig. 2, 3, 4 and 5) which synthesized by the extracts of tested plants. These result are in parallel with Kathiravan et al. (2014), who used the fresh leaf extract of *Melia dubia* (Meliaceae) — malai vembu in the syntheses of AgNPs and the shaped result of these nanoparticles is irregular shape and these caused by the phytoconstituents present in plant which is alkaloids, carbohydrates, glycosides, phenolic compounds, tannins, gums, mucilages. Also, Edison and Sethuraman (2013) proved the distorted spherical of AgNPs synthesized by the extract of pod of *Acacia nilotica* (Fabaceae) — babul; this referred to the presence of bioactive compound like gallic acid, ellagic acid, epicatechin, rutin and this agrees with our result which cleared that, the studied extracts contain many bioactive compounds like alkaloids, tannins, phenol, flavonoids, carbohydrates. In our results of the studied plants we noticed the irregular shape of AgNPs (Fig. 2, 3, 4and 5) which synthesized by the plants extract, and these may be caused by the phytoconstituents present in each plant extract (primary andsecondary metabolites).

3.4. Antimicrobial effect of AgNPs

The effect of AgNPs synethized by 70% alcoholic extract of the investigated plants on the inhibition of some strains of bacteria and fungi were studied. The antimicrobial activity was assessed by the presence of inhibition zone (mm) and detecting its diameter. From the obtained data in Table (11) it was observed that, AgNPs from *P.crispum* had the highest effect aginast *Bacillus subtilis* (22 mm), while the best activity against *Escherichia coli* was (20 mm) from AgNPs of *D. tortuosa* ethanolic extract. AgNPs of *A. graveolens* had the best effect against *Aspergillus versicolor* with inhibition zone (40 mm) followed by *D. syrticus* (38 mm). Several studies have confirmed the effectiveness of essential oils against bacteria resistant to numerous antibiotics, and they are also effective in dermatological infections. Parsley essential oil from aerial parts demonstrated a moderate antibacterial

effect and was bactericidal against *Escherichia coli* and *Bacillus spisizeciaela* and bacteriostatic against *Staphylococcus. epidermidis* , *Staphylococcus aureus, Enterococcus faecalis* and *Klebsiella pneumonia* , except against *P. aeruginosa* (Punoševac et al., 2021).

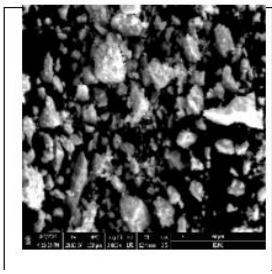

Fig. (2). AgNPs synthesized by *D. tortuosa* using SEM.

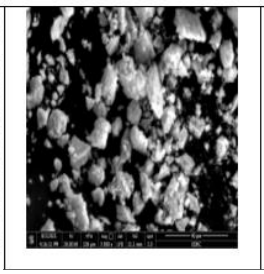

Fig.(3). AgNPs synthesized by *D.syrticus* using SEM.

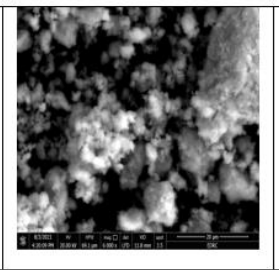

Fig. (4). AgNPs synthesized by *A. graveolens* using SEM.

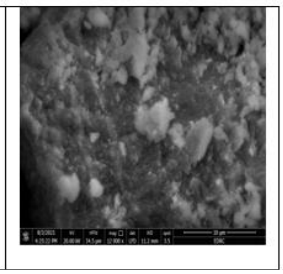

Fig. (5). AgNPs synthesized by *P. crispum* using SEM.

Table (11). Antimicrobial effect of AgNPs.

Bacterial strains	**Inhibition zone (mm)**							
	D. tortuosa		***D. syrticus***		***A. graveolens***		***P. crispum***	
	$AgNO_3$	**AgNPs**	**$AgNO_3$**	**AgNPs**	**$AgNO_3$**	**AgNPs**	**$AgNO_3$**	**AgNPs**
Bacillus subtilis **(+ve) RCMB 015 (1) NRRL B-543**	10	12	10	13	10	17	10	22
Escherichia coli **(-ve) (ATCC 25922)**	15	20	15	12	15	16	15	16
Fungal strains								
Aspergillus versicolor **(ASPEVE)**	18	35	18	38	18	40	18	35

CONCLUSION

In this study, four plants under investigation were riched with lipoidal matter and volatile oils. The identified compounds in the lipoidal matter have been shown to contribute to the culinary and medicinal values of such plants, in addition to their incorporation in pharmaceutical industries. The efficiency of wild and cultivated plants extracts in the rapid synthesis of stable nanoparticles provides a variety of interesting and valuable morphologies due to the collaboration of diverse groups of phytochemicals such as phenolics and flavonoids. The antimicrobial results revealed the efficiency of these nanoparticles for inhibiting the growth of microorganisms.

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الزيوت الطيارة ومكونات الدهون وتوصيف جزيئات الفضة النانوية لبعض النباتات التي تنتمي إلى عائلة الخيمية

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في هذه الدراسة، تم استكشاف GC / MS للزيوت المتطايرة والمواد الدهنية لأربعة نباتات من العائلة الخيمية: *Anethum gravolens, Daucus syrticus, Deverra tortuosa, Petroselinum crispum*. تم دراسة إمكانية استخدام المستخلصات لهذه النباتات في تخليق جزيئات الفضة النانوية (AgNPs). بالإضافة إلى ذلك، قمنا بدراسة تأثير هذه الجسيمات النانوية المركبة على بعض سلالات البكتيريا والفطريات. بالنسبة للمادة الدهنية، أظهرت النتائج أن *Deverra tortuos* و *Daucus syrticu* يحتويان على ٣٢ و١٣ مركبًا، على التوالي، في حين احتوى *Anethum Gravolens* و *Petroselinum crispu* على ٢٤ و١٩ مركب، على التوالي. من خلال تحليل الزيوت المتطايرة بواسطة GC / MS تم تحديد ٣١ مركبًا في *Deverra tortuosa* بينما *Daucus syrticu* احتوى على ٢٣ مركب، واحتوى *Anethum gravolens* على ١٨ مركب، واحتوى *Petroselinum crispus* على ١١ مركب. بالنسبة لتخليق الجسيمات النانوية تشير النتائج إلى أن حجم AgNPs اختلف وفقًا للنبات المستخدم في تركيبها على النحو التالي: ٣٤ و٤٢.٧ و٣٧.٣ و٤١ نانومتر لـ *Anethum gravolen, Daucus syrticus, Deverra tortuos, Petroselinum crispum*. لوحظ أن الجسيمات النانوية من *Petroselinum crispum* كان لها أعلى تأثير ضد *Bacillus subtilis* (٢٢ مم)، بينما كان أفضل نشاط ضد *Escherichia coli* (٢٠ مم) من الجسيمات النانوية لمستخلص *Deverra tortuos* بينما كانت الجسيمات النانوية للمستخلص الإيثانولي لنبات *Anethum gravolens* لها أفضل تأثير ضد *Aspergillus versicolo*r (٤٠ مم) تليها *Daucus syrticus* (٣٨ مم).