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GC-MS and FTIR analysis Phytocomponents on different parts of *Capparis spinosa* L. (Capparidaceae) in Iraq

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ABSTRACT

Twenty and twenty five phytoconstituents compounds were distinguished in methanolic extract of roots and leaves *Capparis spinosa* L. respectively. GC-MS analysis in extract of root revealed the existence of Spiro[2.4] heptan-4-one; Oxacyclododecan-2-one Oxacyclododecan-2-one; D-glucose, 6-O-α-D-galactopyranosyl; Dimethyl fumarate; 2-Pyridineacetic acid, hexahydro; DL-Leucine, N-glycyl; 6-Acetyl-β-d-mannose; 4-Amino-1,5-pentandioic acid; 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl; 2H-Benzotriazole, 2-methyl; Acetate, [3-(acetyloxy)-4,5-dihydro-5-isoxazolyl]methyl; α-D-Glucopyranoside, O-α-D-glucopyranosyl-(1.fwdarw.3)-β; Thieno [2,3-d] pyrimidine-6-carboxylic acid, 5-methyl-4-oxo-3-;1H-Benzotriazole, 1-methyl-; Benzoic acid, 4-methyl, [4-(methoxycarbonyl)phenyl]methyl; 2,5-Octadecadiynoic acid, methyl ester; 2-(2-Azepan-1-yl-2-oxoethyl) -1-hydroxy-1-phenyl-octahydro; 9-Hexadecenoic acid; Propanoic acid, 2-(3-acetoxy-4,4,14-trimethylandrost-8-en-; 2,7-Diphenyl-1,6-dioxopyridazino[4,5:2',3']pyrrolo[4',5'—d]pyrico. GC-MS test in extract of leaves confirmed the existence of be3-Azabutyl-1-ol, 4-cyclopropyl-3,3-dimethyl-, bromide; Methyl 6-oxoheptanoate; 5-Oxohexanethioic acid, S-t-butyl ester; 1-Methyl-2-pyrrolidineethanol; DL-Leucine, N-glycyl-; 4-Hexenal, 6-hydroxy-4-methyl-, dimethyl acetal, acetate, (Z); Octanoic acid, 6-hydroxy-8-methoxy-, ε-lactone; Dithiocarbamate, S-methyl, N-(2-methyl-3-oxobutyl); 1-Methyl-pyrrolidine-2-carboxylic acid; Pyrrolizin-1,7-dione-6-carboxylic acid, methyl (ester); 2-Cyclohexylpiperidine; α-L-Galactopyranose, 6-deoxy, cyclic 1,2,3,4-bis (methylboro); N-(1Hydroxy-4-oxo-1-phenylperhydroquinolizin-3-yl)carbamic; dl-1,6-Diaminoheptanedioic acid; Cholestan-3-ol , 2-methylene, (3β,5α)-; 3,6-Diazahomoadamantan-9-one Hydrazone; 17-Octadecynoic acid; n-Hexadecanoic acid; D-Streptamine, O-6-amino-6-deoxy-α-D-glucopyranosyl; 9,12,15-Octadecatrienoic acid, (Z,Z,Z)-; 5,8,11-Heptadecatriynoic acid, methyl ester; 18-Nonadecenoic acid; 3',8,8'-Trimethoxy-3-piperidyl-2,2'-binaphthalene-1,1',4,4'-tetr and (+)-γ-Tocopherol, O-methyl. FTIR analysis implemented on five parts of capers and showed entity of variations when compared to the methanol extract of each part with the rest of the parts add to variation in original and methanolic extract for each parts in plant and manifested the appearance of alkenes, alkanes, esters, ethers and carboxylic acids

KEY WORDS: *Capparis spinosa*, caper, GC-MS analysis, FTIR analysis, Chemical study.

1. INTRODUCTION

Capparis L. (caper) belongs to the subfamily Capparoideae (Capparidaceae) (Linnaeus, 1753,1754), contained around 250 species dispersed in tropical and subtropical areas of the globe such as southern America, Europe and Africa (Willis,1988; Inocencio, 2006). Only two species are found in Iraq, *C. spinosa* L. *and C. cartilaginea* Decne (Blakelock and Townsend, 1980). A first species is a common perennial shrub, had many prostrate-branched extended to 2 meters. Stem had tiny spines, green or yellowish green, almost straight and glabrous. Leaves had alternative arrangement, orbicular to elliptic, Flowers solitary, Sepals broadly oblong or ovate, Petals white, widely ovate to suborbicular, Stamens numerous and pink or purplish, Gynoecium green or purplish, Fruit oblong-ovoid caberberry were splitting open at ripe to reveal a pale or reddish pulp were embedded a purplish achene. *Capparis spinosa* was known by various names, KABAR, SHAFALLAH, MAR GIR, MARA GIRA and KABARUK (in Arab) and Caper (in English) (Hewood, 1964). Additionally, caper is a standout amongst the most broadly recognized aromatic plants which established have highly various economic and medicinal importance in Iran, Egypt, Greece and China Tlili, 2011, pointed. Ancient Egyptians and Arabs used the roots to treat liver and kidney disease, also using Leaves to treat skin diseases, Buds to treat spleen disease, but Romanians use it to treat paralysis. Ancient Greek used the fruits to treat convulsions and flowers as a stimulant to excess erection and relive the pain. In traditional economically, the pickled flower buds, immature fruits and shoots, are stocked in salt, vinegar or brine and utilized as a canapé with olives, cheddar, and other edible vegetables (Sher, 2010). Caper has an assortment of pharmacological action and it utilized as a part of phyto-medicine around the globe for its Antibacterial, antifungal, anti-parasite activity, Anti-sclerosis activity, Antioxidant activity, Anti-sclerosis activity, anti-hepatotoxic, Immuno-stimulant and anti-tumor activity, anti-diabetic activity (Tlili, 2011) and anti-inflammatory (Al-Said, 1988), Anti-arthritic (Feng, 2011). In this study we seek to recognize the chemical and bioactive components from the different parts of caper (roots, leaves, Flowers, fruits and seeds) were scanned and quantified by several researches.

2. MATERIALS AND METHODS

Preparation of plant and extraction: Roots, leaves, flowers, fruits, and seeds of caper were gathered from the natural habitat in Hillah city during the period March to June, 2016 (Fig.1). According to Hameed, 2015, all parts

were air dried and powdered. Then 10 gram of each powder was weighted and soaked with 100 ml of methanol for 3 days, so that major chemical constituents such as alkaloids and flavonoids will get dissolved (Jasim, 2015; Hameed, 2016). Then filtration the extract and removed the residue.

Phytochemical Screening by GC-MS Analysis: 2µl of the methanolic extract of root and leaf caper was employed for GC-MS analysis by Clarus 500 Perkin–elmer (Auto system XL), connected with Turbo mass gold–Perkin Elmer Turbomass 5.1 spectrometer. The GC/MS system was been supplied with an Elite–1 fused silica capillary column (30m length x 0.25mm diameter, 1µm film thickness) consist of 100% dimethyl poly siloxane. Helium was the carrier gas a flow rate at 1.0 mL.min^{-1} and a split ratio of 1:10, the temperature program: 110 ºC for 2min; going up at 5 ºC min^{-1} to 200 ºC and held for 9min; rising at 5C°.min^{-1} to 280C° and held for 9 minutes. The injector and detector temperatures were detained at 280 ºC. Mass spectra were taken at 70 eV, using a spectral range of m/z 45-450. The mass detector applied as a part of the examination was Turbo-Mass Gold-Perkin Elmer and the software depended on handle mass spectra and chromatograms was a Turbo-Mass ver 5.2 (Hussein, 2015). The majority of the components were identified using mass spectra (authentic chemicals, Wiley spectral library collection and NIST library) (Jasim, 2015).

Phytochemical Screening by FTIR analysis: Shimadzu, IR Affinity, Japan is an instrument that used to obtain FTIR examination of powdered sample of caper's parts under study .The specimen was keep running at infrared area between 400-4000 nm.

Figure.1.*Cappris spinosa* plant (1- whole plant; 2- leaf; 3-fruit; 4- flower; 5- cross section of mature fruit; 6- longitudinal section of mature fruit and 7- seed)

3. RESULTS AND DISCUSSION

GC-MS profile of methanolic extract roots and leaves *C.spinosa* were represented differences in number of chemical compounds. Root extract was explained in table 1. Chromatogram profile determined the existence of twenty main peaks and related components were known as follows. The first peak was recognized to be Oxacyclododecan-2-one. Secondly peak indicated to Spiro [2.4] heptan-4-one. The third peak identified to be D-Glucose, 6-O-α-D-galactopyranosyl-; Dimethyl fumarate; 2-Pyridineacetic acid, hexahydro-; DL-Leucine, N-glycyl; 6-Acetyl-β-d-mannose; 4-Amino-1,5-pentandioic acid; 4H-Pyran-4- one , 2,3-dihydro-3,5-dihydroxy-6- methyl-; 2H-Benzotriazole, 2-methyl-; Acetate, [3-(acetyloxy)- 4,5-dihydro-5-isoxazolyl]methyl; α-D-Glucopyranoside ,O-α-D-glucopyranosyl-(1.fwdarw.3)-β; Thieno [2,3-d]pyrimidine-6-carboxylic acid, 5-methyl-4-oxo-3-; 1H-Benzotriazole,1-methyl-; Benzoic acid, 4-methyl-,[4-(methoxycarbonyl) phenyl] methyl; 2,5-Octadecadiynoic acid, methyl ester;2-(2-Azepan-1-yl-2-oxoethyl)-1-hydroxy-1-phenyl-octahydro;9-Hexadecenoic acid; Propanoic acid, 2-(3-acetoxy-4,4,14-trimethylandrost-8-en-; 2,7-Diphenyl-1,6-dioxopyridazino [4,5:2',3'] pyrrolo [4',5'—d] pyrico. The result of GC-MS approved the companionship of twenty-five major peaks determined as follows. The peak was firstly resolved to be3-Azabutyl-1-ol, 4-cyclopropyl-3,3-dimethyl-, bromide. Secondly peak was appeared to be Methyl 6-oxoheptanoate. The other peaks considered to be 5-Oxohexanethioic acid ,S-t-butyl ester; 1-Methyl-2-pyrrolidineethanol; DL-Leucine, N-glycyl-; 4-Hexenal,6-hydroxy-4-methyl, dimethyl acetal, acetate, (Z); Octanoic acid, 6-hydroxy-8-methoxy-, ε-lactone; Dithiocarbamate , S-methyl-,N-(2-methyl-3-oxobutyl)-; 1-Methyl-pyrrolidine-2-carboxylic acid; Pyrrolizin-1,7-dione-6-carboxylic acid, methyl (ester); 2-Cyclohexylpiperidine; α-L-Galactopyranose, 6-deoxy, cyclic 1,2,3,4-bis (methylboro); N-(1Hydroxy-4-oxo-1-phenylperhydroquinolizin-3-yl)carbamic; dl-1,6-Diaminoheptanedioic acid; Cholestan-3-ol, 2-methylene-,(3β,5α)-; 3,6-Diazahomoadamantan-9-one Hydrazone; 17-Octadecynoic acid; n-Hexadecanoic acid; D-Streptamine,O-6-amino-6-deoxy-α-D-glucopyranosyl-(1-4); 9,12,15-Octadecatrienoic acid, (Z,Z,Z)-;5,8,11-Heptadecatriynoic acid, methyl ester; 18-Nonadecenoic acid; 3',8,8'-Trimethoxy-3-piperidyl-2,2'-binaphthalene-1,1',4,4'-tetr; (+)-γ-Tocopherol.

In addition, the FTIR analysis achieved on five parts of caper and confirmed the existence of variations when compared with methanolic extract of each part of plant and a presence of variation in original and methanolic extract. All results showed possibility of identifying effective function groups in the chemical constituents of each part of caper and possible whereby identify the different compounds, since each compound has own fingerprint, add to can distinguished between aromatic and non-aromatic compounds and alkenes, alkanes, esters, ethers and carboxylic

acids and unknown compounds. Also, it became possible to understand chemical and physical properties of each compound through knowledge of chemical bonds such as CH, CO, OH, CF stretch or others, and measuring the intensity (Altameme, 2015) per summit curved peak and determine the group frequency to confirm biological activity of each compound. On the other side, one of the things to consider is the type of solution which can used in the extraction and so for being affects the chemical compounds in analysis, because in another study by Manikandaselvi and Brindha, 2014, appeared the existence of fifty three compounds like Heptadecanoic acid, ethylester, 1,2-Benzenedicarboxylic acid, mono acid (2-ethylhexyl ester,9,12-octadecadienoic acid, ethyl ester, octadecanoic acid, ethylester, Eicosanioc acid, ethyl esterby in hexane extract compared with chloroform extract which contain twenty nine compounds such as n-Hexadecanoic acid, Tetratiracontane, nananoic acid 3,7,11,15-Tetramethyl-2-hexadecen-1-ol and 13-Tetradece-11-yn-1-01.

Through these results it became clear that the roots, fruits and seeds of caper have a great significance and a large number of available chemical compounds which, compared with other parts which confirmed using caper in traditional medicine (Sher and Alyemeni, 2010). Likewise it has been recorded that caper possess some therapeutic properties and antioxidant activities (Tlili, 2011) and aromatic plants in Mediterranean cooking by investigation of the flavor profile (Romeo, 2007). However these findings are still in early stages and future experimental and clinical studies are needed Subsequently this kind of GC-MS investigation is an initial move towards recognition the way of dynamic standards in this medicinal plant and this sort of project will be useful for further point by point study.

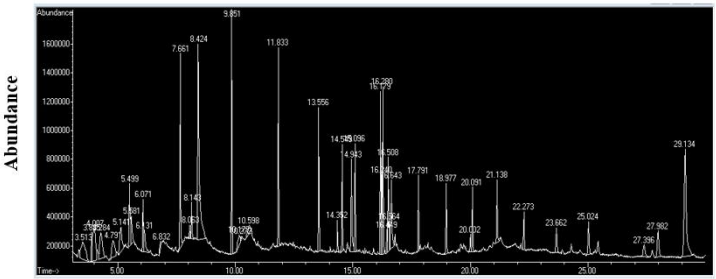

Figure.2. Chromotogram of *C.spinosa* roots extract by GC-MS

Table.1. Main bioactive chemical composition distinguished in extract roots of *C.spinosa*

Name of chemical compound	Retention time (min)	Exact Mass	Molecular weight	Molecular formula
Oxacyclododecan-2-one	3.201	184.14633	184	$C_{11}H_{20}O_2$
Spiro[2.4]heptan-4-one	3.339	110.073165	110	$C_7H_{10}O$
D-Glucose , 6-O-α-D-galactopyranosyl-	3.556	342.11621	342	$C_{12}H_{22}O_{11}$
Dimethyl fumarate	3.997	144.042258	144	$C_6H_8O_4$
2-Pyridineacetic acid ,hexahydro-	4.352	143.094628	143	$C_7H_{13}NO_2$
DL-Leucine , N-glycyl-	4.546	188.116093	188	$C_8H_{16}N_2O_3$
6-Acetyl-β-d-mannose	4.792	222.073953	222	$C_8H_{14}O_7$
4-Amino-1,5-pentandioic acid	5.176	175.084458	175	$C_5H_9NO_4$
4H-Pyran-4-one , 2,3-dihydro-3,5-dihydroxy-6-methyl-	5.507	144.042258	144	$C_6H_8O_4$
2H-Benzotriazole , 2-methyl-	6.108	133.063997	133	$C_7H_7N_3$
Acetate , [3-(acetyloxy)-4,5-dihydro-5-isoxazolyl]methyl	6.354	201.063723	201	$C_8H_{11}NO_5$
α-D-Glucopyranoside ,O-α-D-glucopyranosyl-(1.fwdarw.3)-β	7.481	504.169035	504	$C_{18}H_{32}O_{16}$
Thieno[2,3-d]pyrimidine-6-carboxylic acid , 5-methyl-4-oxo-3-	7.945	353.086784	353	$C_{15}H_{19}N_3O_3S_2$
1H-Benzotriazole , 1-methyl-	8.494	133.063997	133	$C_7H_7N_3$
Benzoic acid , 4-methyl-,[4-(methoxycarbonyl)phenyl]methyl	10.222	284.104858	284	$C_{17}H_{16}O_4$
2,5-Octadecadiynoic acid , methyl ester	11.098	290.22458	290	$C_{19}H_{30}O_2$
2-(2-Azepan-1-yl-2-oxoethyl)-1-hydroxy-1-phenyl-octahydro	13.209	398.256943	398	$C_{24}H_{34}N_2O_3$
9-Hexadecenoic acid	14.359	254.22458	254	$C_{16}H_{30}O_2$
Propanoic acid , 2-(3-acetoxy-4,4,14-trimethylandrost-8-en-	16.528	430.30831	430	$C_{27}H_{42}O_4$

2,7-Diphenyl-1,6-dioxopyridazino [4,5:2',3']pyrrolo[4',5'—d]pyrico	17.077	355.106924	355	$C_{20}H_{13}N_5O_2$

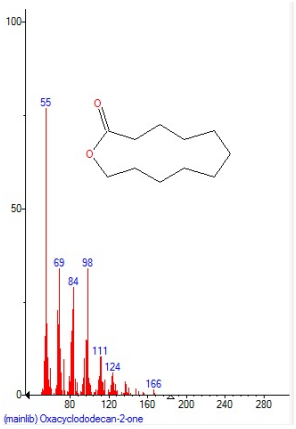

Fig.3. Oxacyclododecan-2-one structure in the root extract of *C. spinosa*

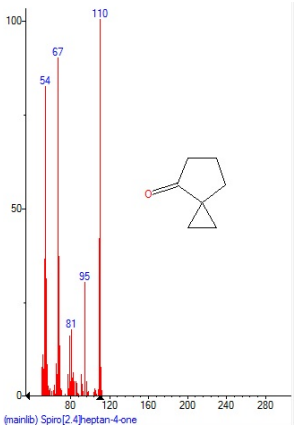

Fig.4. Spiro [2.4] heptan-4-one structure in the root extract of *C.spinosa*

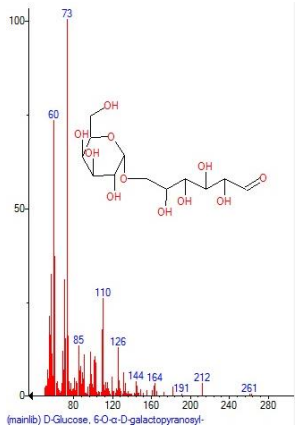

Fig.5. D-Glucose, 6-O-α-D-galactopyranosyl- structure in the root extract of *C.spinosa*

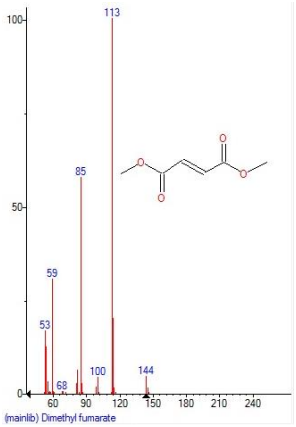

Fig.6. Dimethyl fumarate structure in the root extract of *C.spinosa*

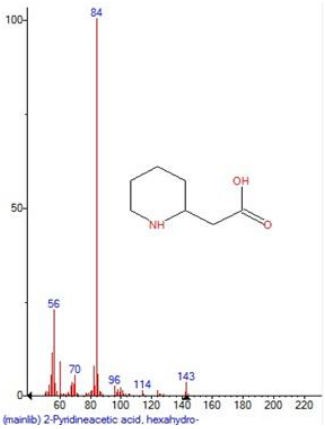

Fig.7. 2-Pyridineacetic acid, hexahydro- structure in the root extract of *C.spinosa*

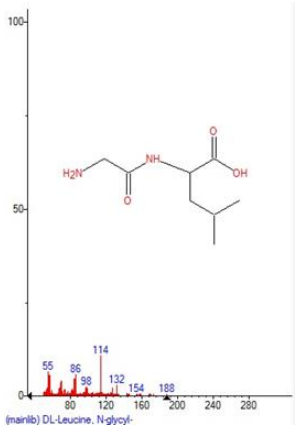

Fig.8. DL-Leucine, N-glycyl- structure in the root extract of *C.spinosa*

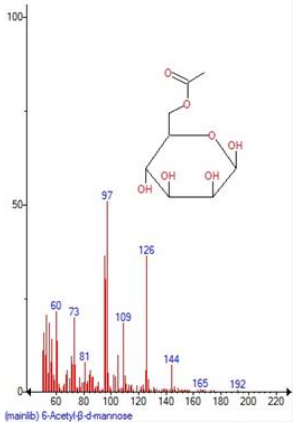

Fig.9. 6-Acetyl-β-d-mannose structure in the root extract of *C.spinosa*

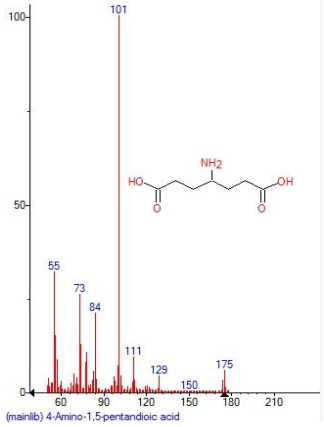

Fig.10. 4-Amino-1,5-pentandioic acid structure in the root extract of *C.spinosa*

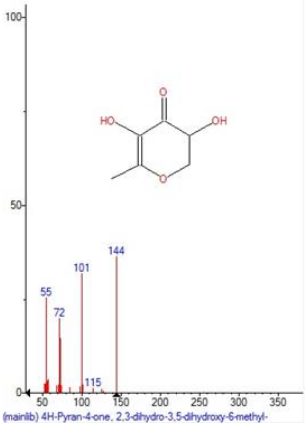

Fig.11. 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- structure in the root extract of *C.spinosa*

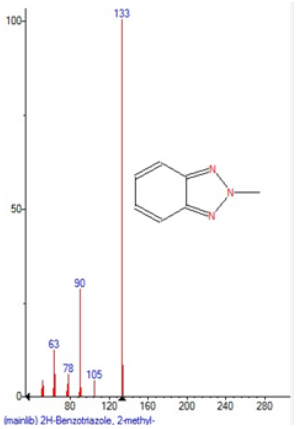

Fig.12. 2H-Benzotriazole, 2-methyl- structure in the root extract of *C.spinosa*

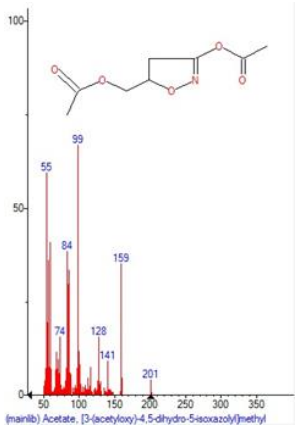

Fig.13. Acetate, [3-(acetyloxy)-4,5-dihydro-5-isoxazolyl] methyl structure in the root extract of *C.spinosa*

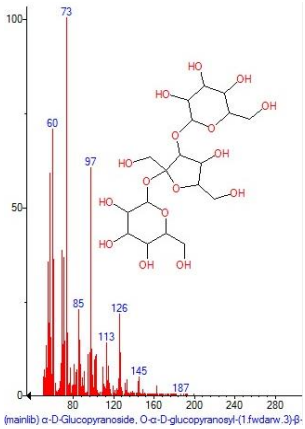

Fig.14. α-D-Glucopyranoside, O-α-D-glucopyranosyl-(1. fwdarw.3)-β structure in the root extract of *C.spinosa*

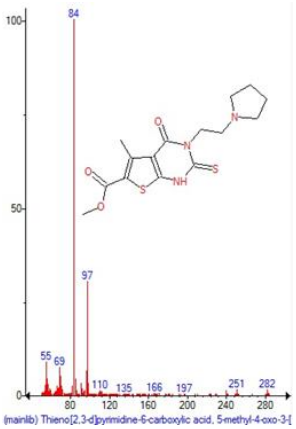

Fig.15. Thieno[2,3-d] pyrimidine-6-carboxylic acid, 5-methyl-4-oxo-3- structure in the root extract of *C.spinosa*

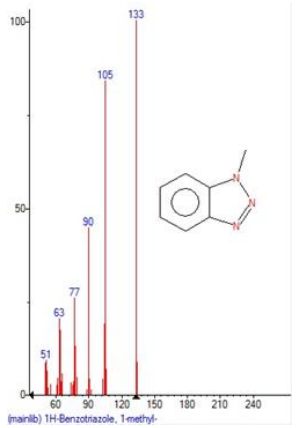

Fig.16. 1H-Benzotriazole, 1-methyl- structure in the root extract of *C.spinosa*

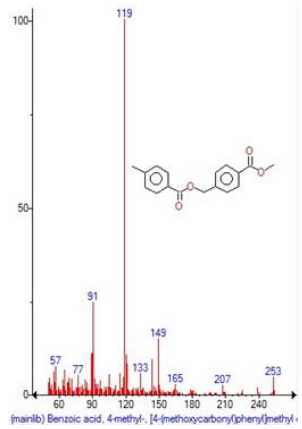

Fig.17. Benzoic acid, 4-methyl-, [4-(methoxycarbonyl)phenyl] methyl structure in the root extract of *C. spinosa*

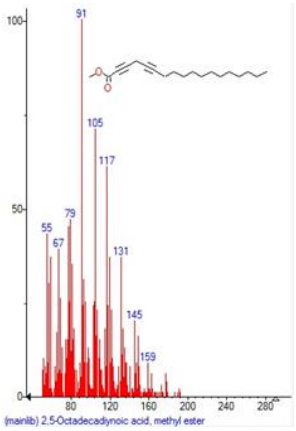

Fig.18. 2,5-Octadecadiynoic acid, methyl ester - structure in the root extract of *C.spinosa*

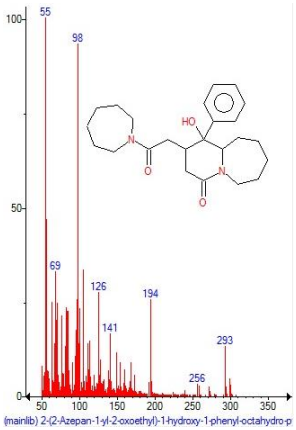

Fig.19. 2-(2-Azepan-1-yl-2-oxoethyl)-1-hydroxy-1-phenyl-octahydro structure in the root extract of *C.spinosa*

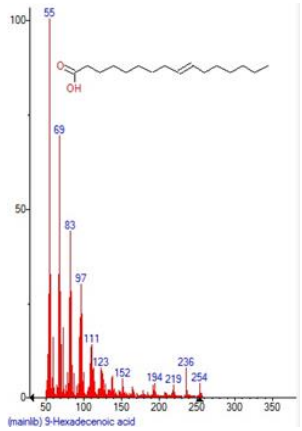

Fig.20. 9-Hexadecenoic acid structure in the root extract of *C.spinosa*

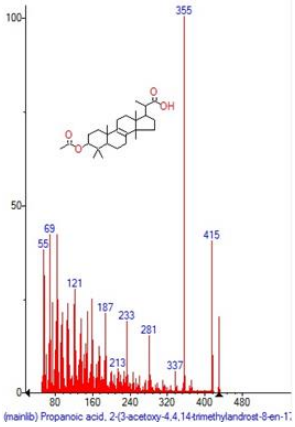

Fig.21. Propanoic acid, 2-(3-acetoxy-4,4,14-trimethylandrost-8-en- structure in the root extract of *C.spinosa*

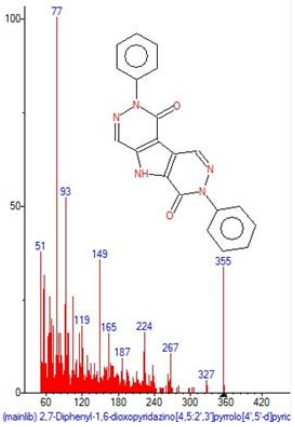

Fig.22. 2,7-Diphenyl-1,6-dioxopyridazino [4,5:2',3'] pyrrolo[4',5'—d] pyrico structure in the root extract of *C. spinosa*

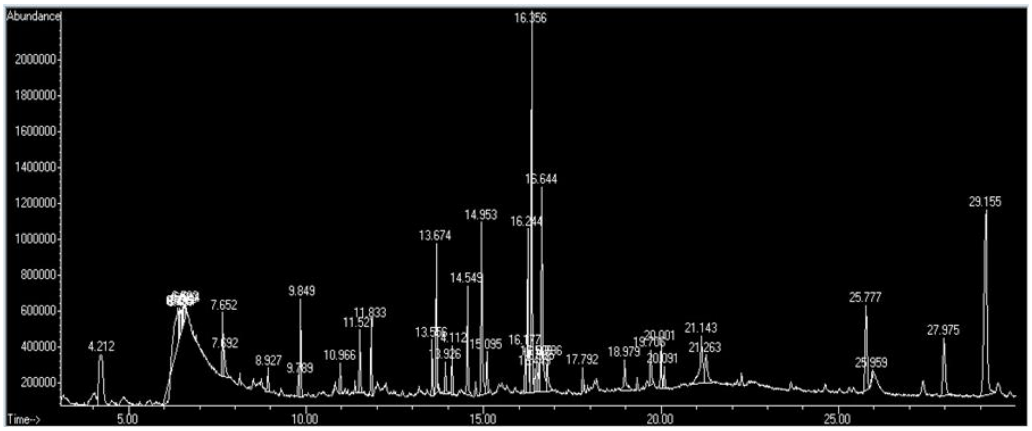

Fig.23. Chromotogram of *C.spinosa* leaves extract by GC-MS

Table.2. Main bioactive chemical composition distinguished in extract leaves of *C.spinosa*

Name of chemical compound	Retention time (min)	Exact Mass	Molecular weight	Molecular formula
3-Azabutyl-1-ol, 4-cyclopropyl-3,3-dimethyl bromide	3.230	144.138819	144	$C_8H_{18}NO^+$
Methyl 6-oxoheptanoate	3.556	158.094295	158	$C_8H_{14}O_3$
Paromomycin	3.571	615.296303	615	$C_{23}H_{47}N_5O_{18}S$
5-Oxohexanethioic acid ,S-t-butyl ester	4.077	202.102751	202	$C_{10}H_{18}O_2S$
1-Methyl-2-pyrrolidineethanol	4.243	129.1153	129	$C_7H_{15}NO$
DL-Leucine , N-glycyl-	4.517	188.116093	188	$C_8H_{16}N_2O_3$
4-Hexenal,6-hydroxy-4-methyl-,dimethyl acetal , acetate , (Z)	4.849	216.136159	216	$C_{11}H_{20}O_4$
Octanoic acid , 6-hydroxy-8-methoxy-, ε-lactone	5.645	172.109944	172	
Dithiocarbamate , S-methyl- , N-(2-methyl-3-oxobutyl)-	5.891	191.043856	191	$C_7H_{13}NOS_2$
1-Methyl-pyrrolidine-2-carboxylic acid	6.411	129.078979	129	$C_6H_{11}NO_2$
Pyrrolizin-1,7-dione-6-carboxylic acid , methyl (ester)	8.168	197.068808	197	$C_9H_{11}NO_4$
2-Cyclohexylpiperidine	8.523	167.167399	167	$C_{11}H_{21}N$
α-L-Galactopyranose, 6-deoxy-, cyclic 1,2,3,4-bis (methylboro)	8.906	212.102735	212	
N-(1Hydroxy-4-oxo-1-phenylperhydroquinolizin-3-yl)carbamic	9.261	394.189257	394	$C_{23}H_{26}N_2O_4$
dl-1,6-Diaminoheptanedioic acid	9.318	190.095357	190	$C_7H_{14}N_2O_4$
Cholestan-3-ol , 2-methylene - , (3β,5α)-	10.058	400.370516	400	$C_{28}H_{48}O$
3,6-Diazahomoadamantan-9-one Hydrazone	10.852	180.137497	180	$C_9H_{16}N_4$
17-Octadecynoic acid	13.924	280.24023	280	$C_{18}H_{32}O_2$
n-Hexadecanoic acid	14.937	256.24023	256	$C_{16}H_{32}O_2$

D-Streptamine , O-6-amino-6-deoxy-α-D-glucopyranosyl-(1-4)	16.202	482.258793	482	$C_{36}H_{65}F_3N_4O_{13}$
9,12,15-Octadecatrienoic acid ,(Z,Z,Z)-	16.636	278.22458	278	$C_{18}H_{30}O_2$
5,8,11-Heptadecatriynoic acid , methyl ester	17.380	272.17763	272	$C_{18}H_{24}O_2$
18-Nonadecenoic acid	18.176	296.27153	296	$C_{19}H_{36}O_2$
3',8,8'-Trimethoxy-3-piperidyl-2,2'-binaphthalene-1,1',4,4'-tetr	20.012	487.163101	487	$C_{28}H_{25}NO_7$
(+)-γ-Tocopherol , O-methyl-	25.797	430.38108	430	$C_{29}H_{50}O_2$

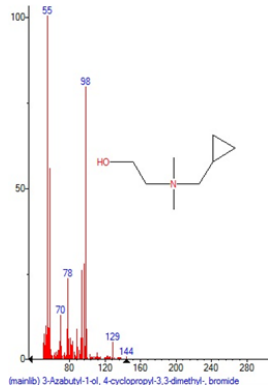

Fig.24. 3-Azabutyl-1-ol, 4-cyclopropyl-3,3-dimethyl-, bromide structure in the leaves extract of *C.spinosa*

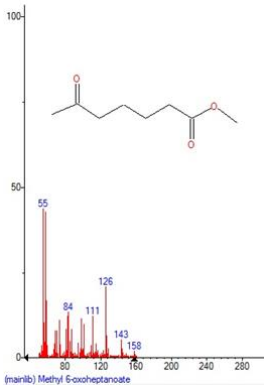

Fig.25. Methyl 6-oxoheptanoate structure in the leaves extract of *C.spinosa*

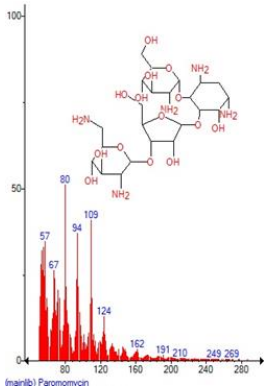

Fig.26. Paromomycin structure in the leaves extract of *C.spinosa*

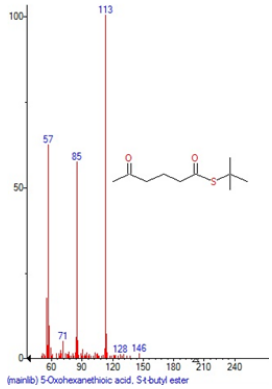

Fig.27. 5-Oxohexanethioic acid, S-t-butyl ester structure in the leaves extract of *C.spinosa*

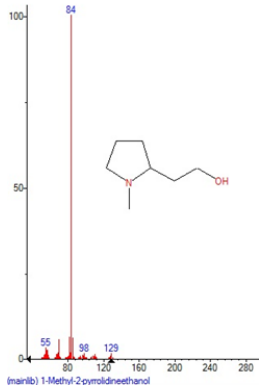

Fig.28. 1-Methyl-2-pyrrolidineethanol structure in the leaves extract of *C.spinosa*

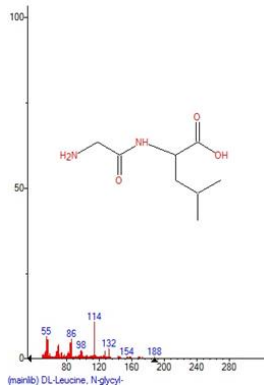

Fig.29. DL-Leucine, N-glycyl- structure in the leaves extract of *C.spinosa*

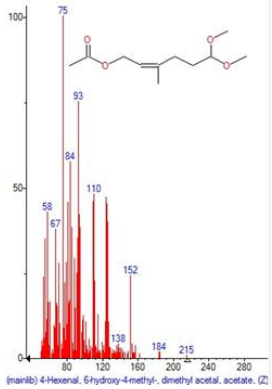

Fig.30. 4-Hexenal,6-hydroxy-4-methyl-, dimethyl acetal, acetate, (Z) structure in the leaves extract of *C.spinosa*

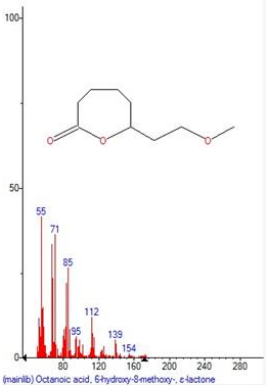

Fig.31. Octanoic acid, 6-hydroxy-8-methoxy-, ε-lactone structure in the leaves extract of *C.spinosa*

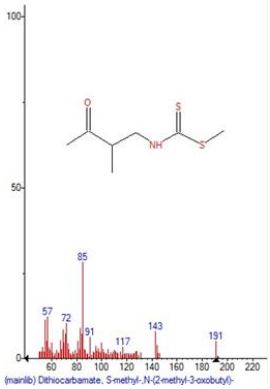

Fig.32. Dithiocarbamate, S-methyl-, N-(2-methyl-3-oxobutyl)- structure in the leaves extract of *C.spinosa*

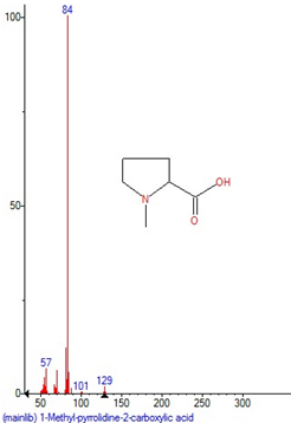

Fig.33. 1-Methyl-pyrrolidine-2-carboxylic acid structure in the leaves extract of *C.spinosa*

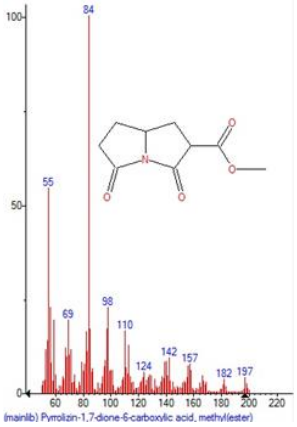

Fig.34. Pyrrolizin-1,7-dione-6-carboxylic acid, methyl (ester) structure in the leaves extract of *C.spinosa*

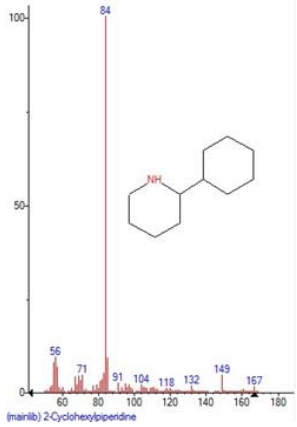

Fig.35. 2-Cyclohexylpiperidine structure in the leaves extract of *C.spinosa*

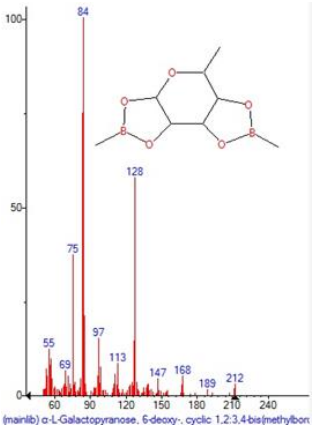

Fig.36. α-L-Galactopyranose, 6-deoxy-, cyclic 1,2,3,4-bis (methylboro structure in the leaves extract of *C. spinosa*

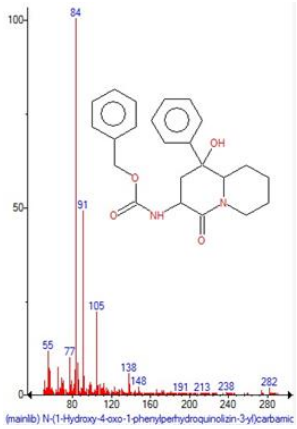

Fig.37. N-(1Hydroxy-4-oxo-1-phenylperhydroquinolizin-3-yl) carbamic structure in the leaves extract of *C.spinosa*

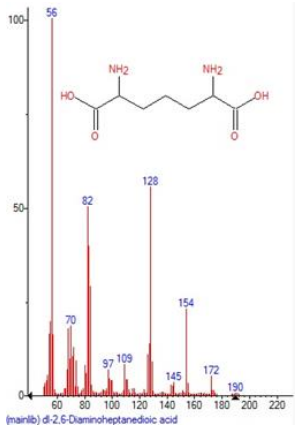

Fig.38. dl-1,6-Diaminoheptanedioic acid structure in the leaves extract of *C.spinosa*

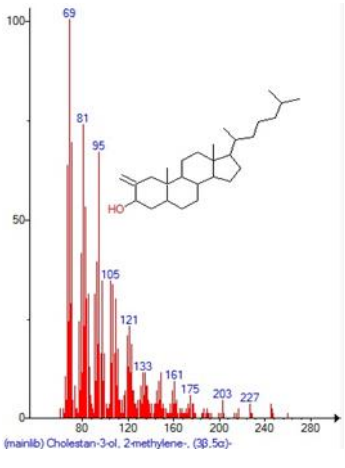

Fig.39. Cholestan-3-ol, 2-methylene, (3β,5α)- structure in the leaves extract of *C.spinosa*

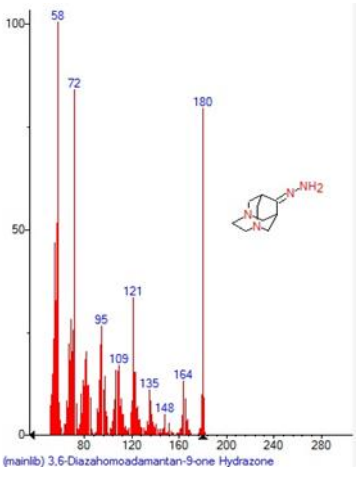

Fig.40. 3,6-Diazahomoadamantan-9-one Hydrazone structure in the leaves extract of *C.spinosa*

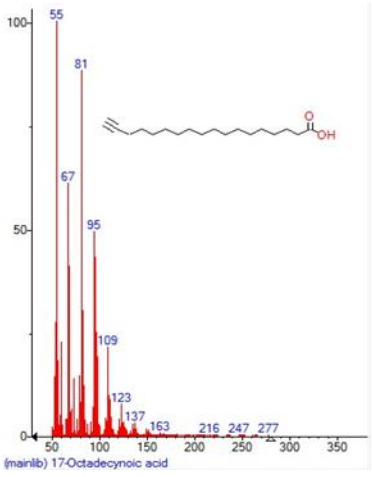

Fig.41. 17-Octadecynoic acid structure in the leaves extract of *C.spinosa*

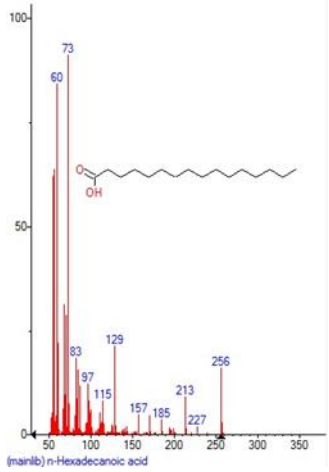

Fig.42. n-Hexadecanoic acid structure in the leaves extract of *C. spinosa*

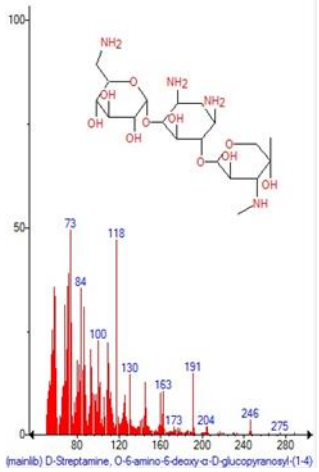

Fig.43. D-Streptamine, O-6-amino-6-deoxy-α-D-glucopyranosyl-(1-4) structure in the leaves extract of *C.spinosa*

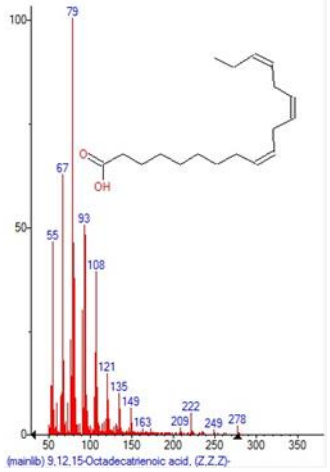

Fig.44. 9,12,15-Octadecatrienoic acid, (Z, Z, Z)- structure in the leaves extract of *C.spinosa*

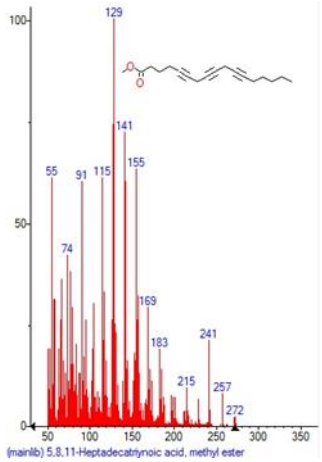

Fig.45. 5,8,11-Heptadecatriynoic acid, methyl ester structure in the leaves extract of *C.spinosa*

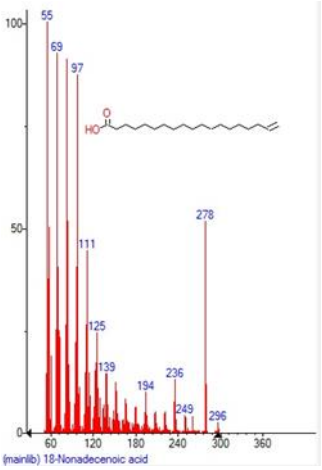

Fig.46. 18-Nonadecenoic acid structure in the leaves extract of *C.spinosa*

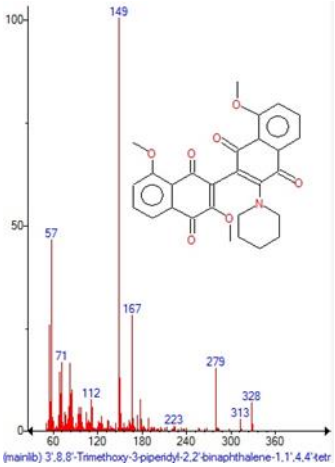

Fig.47. 3',8,8'-Trimethoxy-3-piperidyl-2,2'-binaphthalene-1,1',4,4'-tetr structure in the leaves extract of *C. spinosa*

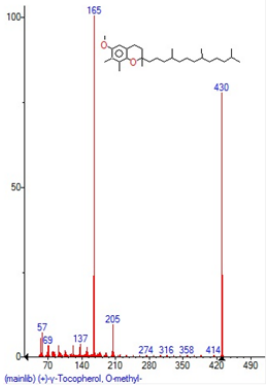

Fig.48. (+)-γ-Tocopherol, O-methyl- structure in the leaves extract of *C.spinosa*

Table.3. FTIR peak levels of solid analysis of *C.spinosa* root (original)

Peak value (Wave number cm-^{l})	Intensity	Stretching	Functional group	Group frequency
669.30	64.122	-	Unknown	-
702.09	66.387	C-H	Alkenes	675-995
769.60	69.414	C-H	Alkenes	675-995

995.27	53.575	C-F	Aliphatic fluoro compounds	1000-1050
1012.63	52.768	C-F	Aliphatic fluoro compounds	1000-1050
1236.37	77.946	C-O	Alcohols, Ethers, Carboxylic acids, Esters	1050-1300
1259.52	78.400	C-O	Alcohols, Ethers, Carboxylic acids, Esters	1050-1300
1404.18	76.765	C-H	Alkanes	1340-1470
1604.77	74.473	-	Unknown	-
3157.47	80.334	H-O	H-bonded H-X group	2500-3500

Table.4. FTIR peak levels of *C.spinosa* root methanolic extract

Peak value (Wave number cm-1)	Intensity	Stretching	Functional group	Group frequency
667.37	64.8914	-	Unknown	-
867.97	77.680	C-H	Alkenes	675-995
908.47	75.674	C-H	Alkenes	675-995
991.41	51.950	C-H	Alkenes	675-995
1012.06	46.440	C-F	Aliphatic fluoro compounds	1000-1050
1103.2	73.466	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
1234.4	58.100	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
1269.1	86.237	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
1319.3	85.268	NO2	Nitro Compounds	1300-1370
1408.0	81.746	-	Unknown	-
1616.3	83.249	-	Unknown	-
2835.3	88.484	C-H	alkanes	2850-3000
3091.8	86.430	O-H	carboxylic acids	2500–3300
3143.9	82.733	O-H	carboxylic acids	2500–3300
3236.5	76.343	O-H	Hydrogen bonded Alcohols, Phenols	3200-3600

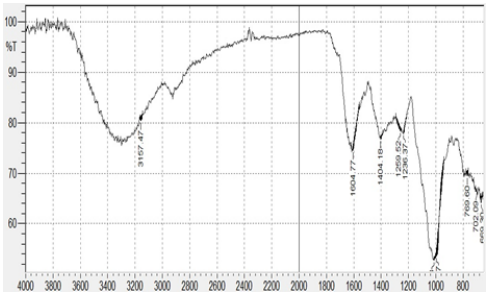

Fig.49. FTIR profile of *C.spinosa* root extract (original)

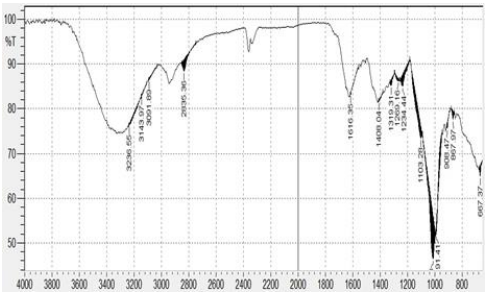

Fig.50. FTIR profile of *C.spinosa* root methanolic extract

Table.5. FTIR peak levels of *C.spinosa* leaf extract (original)

Peak value (Wave number cm-1)	Intensity	Stretching	Functional group	Group frequency
661.58	59.914	-	Unknown	-
675.09	60.822	C-H	Alkenes	675-995
804.32	70.875	C-H	Alkenes	675-995
871.82	75.011	C-H	Alkenes	675-995
914.26	74.894	C-H	Alkenes	675-995
999.13	56.300	-	Unknown	-

1012.63	53.681	C-F	Aliphatic fluoro compounds	1000-1050
1234.44	76.690	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
1305.81	76.811	NO2	Nitro Compounds	1300-1370
1369.46	73.080	NO2	Nitro Compounds	1300-1370
1398.39	70.282	C-H	Alkanes	1340-1470
1516.05	77.938	-	Unknown	-
1606.70	66.524	-	Unknown	-
3251.98	73.969	O-H	Alcohols, Phenols	3200-3600
3294.42	73.493	O-H	Alcohols, Phenols	3200-3600

Table.6. FTIR peak levels of *C.spinosa* leaf methanolic extract

Peak value (Wave number cm-ˡ)	Intensity	Stretching	Functional group	Group frequency
1012.63	65.222	C-F	Aliphatic fluoro compounds	1000-1050
1238.30	85.613	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
1396.46	82.757	C-H	Alkanes	1340-1470
1529.91	85.697	-	Unknown	-
1608.63	80.238	-	Unknown	-
2920.23	88.005	C-H	alkanes	2850-3000

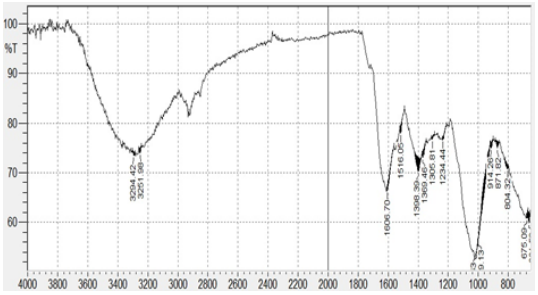

Fig.51. FTIR profile of *C.spinosa* leaf extract (original).

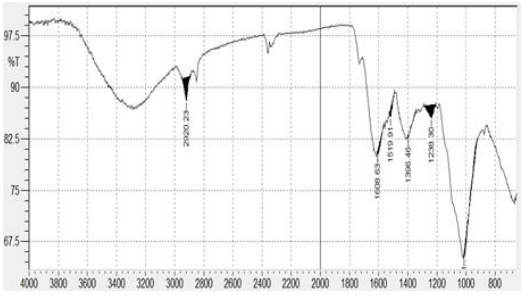

Fig.52. FTIR profile of *C.spinosa* leaf methanolic extract

Table.7. FTIR peak levels of *C.spinosa* flower extract (original)

Peak value (Wave number cm-ˡ)	Intensity	Stretching	Functional group	Group frequency
657.73	63.311	-	Unknown	-
804.32	71.196	C-H	Alkenes	675-995
869.90	74.187	C-H	Alkenes	675-995
962.48	69.068	C-H	Alkenes	675-995
1010.70	56.538	C-F	Aliphatic fluoro compounds	1000-1050
1022.27	55.538	C-F	Aliphatic fluoro compounds	1000-1050
1041.56	55.309	C-F	Aliphatic fluoro compounds	1000-1050
1232.51	77.107	C-O	Esters, Ethers, Alcohols, carboxylic acids	1050-1300
1325.10	76.143	NO2	Nitro Compounds	1300-1370
1365.60	73.181	NO2	Nitro Compounds	1300-1370
1398.39	71.558	C-H	Alkanes	1340-1470
1610.56	68.843	-	Unknown	-
3199.91	77.217	O-H	Phenols, Hydrogen bonded Alcohols	3200-3600
3226.91	75.822	O-H	Phenols, Hydrogen bonded Alcohols	3200-3600

Table.8. FTIR peak levels of *C.spinosa* flower methanolic extract

Peak value (Wave number cm-^{l})	Intensity	Stretching	Functional group	Group frequency
983.70	77.153	C-H	Alkenes	675-995
1014.56	72.920	C-F	Aliphatic fluoro compounds	1000-1050
1037.70	74.134	C-F	Aliphatic fluoro compounds	1000-1050
1101.35	79.176	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300

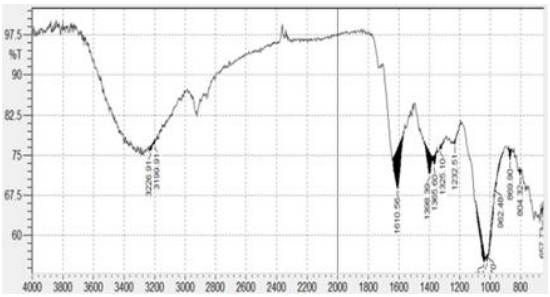

Fig.53. FTIR profile of C.spinosa flower extract (original).

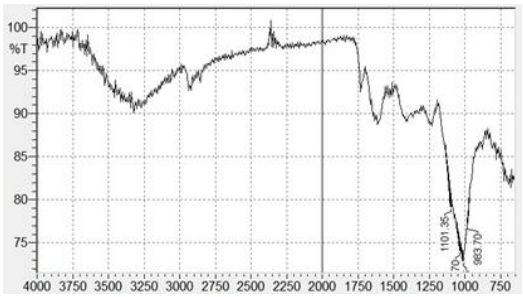

Fig.54. FTIR profile of C.spinosa flower methanolic extract

Table.9. FTIR peak levels of *C.spinosa* fruit methanolic extract

Peak value (Wave number cm-^{l})	Intensity	Stretching	Functional group	Group frequency
65	68.697	-	Unknown	-
88	82.326	C-H	Alkenes	675-995
96	80.399	C-H	Alkenes	675-995
10	67.786	C-H	Alkenes	675-995
10	67.111	C-F	Aliphatic fluoro compounds	1000-1050
12	79.627	C-F	Aliphatic fluoro compounds	1000-1050
13	81.043	C-F	Aliphatic fluoro compounds	1000-1050
13	78.499	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
13	76.128	NO2	Nitro Compounds	1300-1370
15	78.775	NO2	Nitro Compounds	1300-1370
16	73.831	C-H	Alkanes	1340-1470
28	84.732	-	Unknown	-
29	79.968	O-H	Hydrogen bonded Alcohols, Phenols	3200-3600

Table.10. FTIR peak levels of *C.spinosa* seed methanolic extract

Peak (Wave number cm-^{l})	Intensity	Stretching	Functional group	Group frequency
667.73	64.772	-	Unknown	-
786.96	71.322	C-H	Alkenes	675-995
885.33	81.879	C-H	Alkenes	675-995
948.98	82.433	C-H	Alkenes	675-995
991.41	76.790	C-H	Alkenes	675-995
1055.06	67.186	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
1099.43	75.627	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
1240.23	75.104	C-O	Esters, Ethers, Alcohols carboxylic acids	1050-1300
1396.46	78.485	C-H	Alkanes	1340-1470
1456.26	81.476	C-H	Alkanes	1340-1470
1539.20	72.207	-	Unknown	-
1633.71	67.192	-	Unknown	-

1708.93	86.755	-	Unknown	-
2341.58	88.334	-	Unknown	-
2854.65	84.119	C-H	alkanes	2850-3000
2924.09	78.822	C-H	alkanes	2850-3000
3196.05	81.020	O-H	carboxylic acids	2500–3300

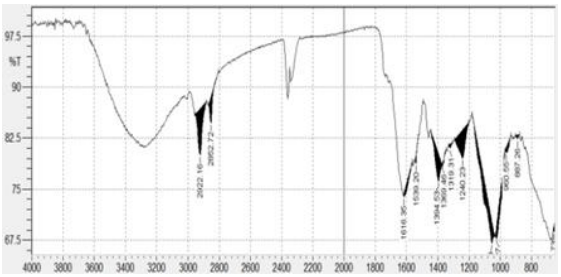

Fig.55. FTIR profile of *C.spinosa* fruit methanolic extract

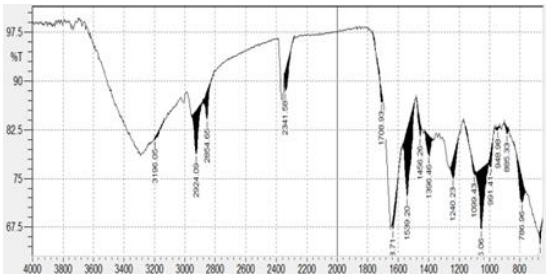

Fig.56. FTIR profile of *C.spinosa* seed methanolic extract

4. CONCLUSION

GC-MS investigation of methanolic extract of roots and leaves of *Capparis spinosa* which is a native plant of Iraq, showed a distinctly complex profile containing around twenty and twenty-five components respectively. Caper contains phytoconstituents which might be valuable for different herbal detailing as antipyretic, analgesic, antiasthamatic and antiphlogistic and have an extensive variety of applications in the folkloric treatment and used in cooking.

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