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RESEARCH ARTICLE

Chemotaxonomical Study of Some Species Belonging to the Genus Scabiosa l. (Dipsacaceae) in Iraq

Khazal Dh. Wadi Al-Jibouri[1*], Abdullah Shukur Sardar[2], Rafid Ali Abdulsahib Albaldawy[1]

1. *Department of Biology, College of Science, University of Diyala, Iraq.*
2. *Department of Biology, College of Education, University of Salahaddin, Iraq.*

***Corresponding Author: Khazal Dh. Wadi Al-Jibouri**

Abstract

The current study is a comparative chemotaxonomical study of five species species belonging to the genus *Scabiosa* L. from Dipsacaceae (Caprifoliaceae) ,wildly grown in Iraq which are *S.palaestina* L., S. *calocephala* Boiss ,*S. persica* Boiss., *S. leucactis* Patzak. and *S. brachycarpa* Boiss.et Hoh. The study done by using Gas Chromatography Mass Spectrometry (GC-MS), the results helped in isolation species by distinguishing them with their own chemical compounds. All the studied species participated in a single chemical compound Oleic Acid, but the species varied in the number of chemical compounds. *S. brachycarba* contains (18) chemical compounds, *S. leucactis* contained (14) compounds, *S. persica* recorded (21) compounds and *S. calocephala* contained (28) compounds which was the highest among the studied species and the record (6) compounds in the *S. palaestina*, which was the lowest species. The species varied in distinguished compounds of each species, *S. persica* was distinguished by (4) chemical compounds *S. brachycarba* (3) distinct compounds while *S. leucactis* was characterized by (4) compounds, whereas *S. calocephala* (4) compounds and finally *S. palaestina* characterized by a single compound.

Keywords: *Scabiosa, Dipsacacea, Chemotaxonomy.*

Introduction

The modern taxonomical studies based on many evidence like Morphology, Anatomy, Cytology, Palynology, Ecology, Geographical distribution and and Chemotaxonomy (chemical contents) [1]. Chemotaxonomy has various ancient orgins, perhaps foremost comes the search by herbalists and pharmacologists [2]. The first study about the relationship between chemistry and plant taxonomy is the study of Abbot in 1980 on classification of saponin in plants and the study of Reichert in 1916-1919 on carbohydrates in plants [3].

The taste and odor (smell) of plants played important role in distinguished between taxa [4]. Samuel and Luchsinger (1978) confirmed that the flavonoids have important uses in chemotaxonomy, because it almost has existence of absolute in all higher plants and separated and diagnosed whatever the amount of plant materials is mall [5]. Secondary metabolitic compound drivated from primary metabolitic during secondary reactions [6], and they are very important compounds in chemotaxonomy [7].The secondary metabolic compounds were divided into three groups (phenols, alkaloids, terpens) [8,9]. There are many studies in chemotaxonomy on the genus *scabiosa* like the study [10] on the species *S. ochroleuca* L., [11] on the species *S. rotate* Bieb. And [12] on the species *S. columbaria* L. In Iraq there was only one study [13] on the genus *Cephalaria* (L.) Schrad and *Dipsacus* L. belonging to Dipsacacea.

Materials and Methods

Preparation of Extract

The plant extract was preparated from stems and leaves of the species based on dry specimens and by method of [1].

- Leaves and stems of flowering plants of studied species were grinded by electric grinder.

- 40-50 ml of alcohol 70% was added to 3-4 gm. of each specimen, and left at room temperature for 24-48 hrs.
- Infiltration was done by filter paper (ederol medium pore filtering).
- The extract was concentrated to adequate volume in order to get rid of alcohol by using air conditioner.
- In as much as volume of Petroleum Ether (80-100 boiling point) was added to the product, mixture shacked gently, placed in separating funnel and left for sometimes to separate clearly into two layers. Thereby the major part of chlorophyll dissolved in petroleum ether, and float because of its lesser density than water extraction of phenolic compounds that dissolve in water and make the lower layer, which draw from lowers of funnel.
- The extract left to dry at room temperature and dry matter was suspended purity by ethyl alcohol (HPLC).

Chemical Analysis by Gas Chromatography-mass Spectrometry

GC-MS used to diagnose a chemical compound that is found in the extracts of the studied species and the analysis was done as followed:

- Separation column was optime-5 ms (30 X0.25) 30 m length and its internal diameter 259 mm.
- Helium gas was used as carrier in 99.999% purity and the gas flow during the operation constantly which is 1.2ml per min. under pressure 100 Kpa.
- 2 microliter was injected from Ethel extract by using fine needle.
- The machine temperature started at 50 C then gradually raised in average of 10 C per min. until it reached 300 C and it salted for 10 min.
- An electron flowed with 70 volt and the electron source temp. 200 C that leads to separation of the substance to its primary chemical compounds.

Results

The results showed that the species varied in chemical compounds content concentration, retention time and the area,

The results recorded 87 phytochemical compounds in all studied species and they shared in one chemical compound which was Oleic acid.

S. Brachycarba

This species content 18 chemical compounds, the probability ratio range 80-99%, n-Hexadecanoic acid was the highest in probability 99%, and area 12.81, Tetradecane was the lowest in probability 80% and area 0.26.

The species distinguished in three compounds which were:

- Heptadecane,2,6,10,14-tetramethyl
- Methyl 10-trans,12-cis-octadecadienoate
- Hexadecanoic acid,2-hydroxy-1-(hydroxymethyl) ethyl ester

Methyl 10-trans, 12-cis-octadecadienoate was the highest in probability 94% and area 1.06 (table 1).

S. Leucactis

The results found 14 compounds in this species, the probability ratio range 38-99%, 9-Octadecadienoic acid (z)-, methyl ester was the highest in probability 99%, and area 2.15, while maltoz was the lowest in probability 38% and the area 1.68.

The species distinguished with 4 compounds which were:

- Hexacosane
- Maltose
- Lactose
- Cis-13- Octadecadienoic acid

Hexacosane was the highest in probability 86% and area 0.88 (table 2).

S. Persica

this species content 21 chemical compounds, the probability ratio range 46-99%, 9-Octadecanoic acid, methyl ester,(E)- was the highest in probability 99%, and area 9.86, Hexadecanoic acid, ethyl ester was the lowest in probability 46% and area 2.5.

The species distinguished in 4 compounds which were:

- Oxalic acid, allyl hexadecyl ester

- Tetradecanoic acid, 10,13-dimethyl-, methyl ester
- Diisooctyl phthalate
- Tetrapentacontane, 1,54-dibromo-

Diisooctyl phthalate and Tetrapentacontane, 1, 54-dibromo- was the highest in probability 86% and area 10.79 and 0.39 (Table 3).

S. calocephala

This species content 28 chemical compounds, the probability ratio range 44-99%, Oleic acid was the highest in probability 99%, and area 5.82, cis-Vaccenic acid was the lowest in probability 56% and area 0.07.

The species distinguished in 4 compounds which were:

- Nonadecane,9-methyl-
- 10,13-octadecadienoic acid, methylester
- 9,17-octadecadienal,(Z)-
- 10 -octadecadienoic acid, methylester

9, 17-octadecadienal, (Z)-was the highest in probability 98% and area 4.98 (table 4).

S. palaestina

This species content 6 chemical compounds, the probability ratio range 49-99%, 9-octadecenoic acid(z)-,methyl ester was the highest in probability 99%, and area 2.16, tert-Hexadecanethiol was the lowest in probability 49% and area 0.79. The species distinguished in one compound which was tert-Hexadecanethiol with probability 49% and area 0.79 (table 5).

Discussion

The study of the chemical contents of plants is one of the important evidence on which plant taxonomist are based. The phytochemistry is one of the most important challenges faced to the researchers. However, the increasing progress in the fields of technology and the science of plant chemistry has been an innovation for laboratory devices and methods so the chemical compounds was more commonly used as taxonomic evidence [14]. Chemotaxonomy appeared as a systematic study of the chemical differences between the plant categories, which was used as a definitive guide in plant taxonomy in addition to anatomy, heredity and morphology [15].

The results of the chemical study of the genus *Scabiosa*, which was done using GC-MS technique, helped in isolation the species by distinguishing them with different chemical compounds. This is in line with [16], in addition to clarifying their chemical content, which can be used in medical, pharmacological and non-taxonomic research generally.

The results of the analysis of plant extracts showed the abundance of phytochemical compounds, which enhances the taxonomic and medicinal importance of the genus and species studied. All species participated in one chemical compound which was Oleic Acid, which may indicate the convergence of species in terms of their chemical content. In general, the participation of the species with the same chemical compounds can give an indication of a common evolutionary association in terms of chemical characteristics.

The presence of participated compounds in the species indicates the unity of genus and the correct of species belonging to their genus, which confirms the validity of species belonging to their genus and the genus to their families. The species varied in the number of chemical compounds. This may lead to the nature of each species and the effect of environment as well as the extraction method and the solvent effect in each species.

This is agreeing with [17]. The species varied in their distinguished chemical compounds, this is in agreement with what [14] noted in the fact that the presence of distinctive chemical compounds helps to distinguish and isolate species, especially those closely related, which are difficult to separate based on phenotypes. The researchers [18, 20] wrote that the two variety *S. palaestina* var. *calocephala* and *S. palaestina* var. *Persica* are belonging to the same species S. palaestina. But the present study has been able to diagnose these two variety as two species.

This result is agree with [16] study ,because of the species varied in their containing of chemical compound, *S. persica* has 15 chemical compounds and *S. calocephala* containing 4 chemical compounds while *S. Palaestina* contains (2) chemical compounds. The chemistry studies have helped to differentiate between species, especially the closely related species. This is important in taxonomic studies and may help in the future to solve many taxonomic problems at different taxonomic levels.

Table 1: phytochemical compounds of *S. brachycarba*

No.	Phytochemical compounds	Retation time	Area %	Qual
1	Tetradecane	19.281	0.26	80
2	Heptadecane,2,6,10,14-tetramethyl	20.775	0.73	80
3	Hexadecane	24.729	0.55	98
4	Hexadecanoic acid, methyl ester	32.783	0.38	86
5	n-Hexadecanoic acid	34.301	12.81	99
6	n-Hexadecanoic acid	35.268	0.02	92
7	Methyl 10-trans,12-cis-octadecadienoate	36.196	1.06	94
8	Trans-13-octadecenoic acid, methyl ester	36.293	1.02	96
9	Oleic acids	37.531	2.11	95
10	9- Octadecenoic acid, (E)-	37.647	4.66	98
11	6- Octadecenoic acid	38.043	3.43	98
12	Tricosane	39.793	0.41	96
13	Tetracosane	41.456	0.46	96
14	Tricosane	43.051	0.50	94
15	Hexadecanoic acid,2-hydroxy-1-(hydroxymethyl) ethyl ester	43.747	0.81	92
16	Bis(2-ethylhexyl) phthalate	43.893	2.62	96
17	Octadec-9-enoic acid	44.569	0.40	93
18	Nonacosane	48.843	0.32	93

Table 2: phytochemical compounds of *S. leucactis*

No.	Phytochemical compounds	Retation time	Area %	Qual
1	Hexacosane	20.775	0.88	86
2	Hexadecane	24.729	0.34	96
3	maltose	31.400	1.68	38
4	lactose	31.787	2.01	46
5	Hexadecanoic acid, methyl ester	32.802	0.47	83
6	n-Hexadecanoic acid	34.543	0.51	97
7	n-Hexadecanoic acid	34.620	0.05	96
8	n-Hexadecanoic acid	34.649	0.08	98
9	9,12-Octadecadienoic acid(z,z)-,methyl ester	36.206	1.67	98
10	9-Octadecadecenoic acid(z)-,methyl ester	36.293	2.15	99
11	9-Octadecadecenoic acid(z)-,methyl ester	37.530	1.11	86
12	Cis-13- Octadecadienoic acid	37.646	0.29	84
13	Oleic acid	38.033	0.76	93
14	Tricosane	39.783	0.50	95

Table 3: phytochemical compounds of *S. persica*

No.	Phytochemical compounds	Retation time	Area %	Qual
1	Dodecane,2,6,10-trimethyl-	20.775	3.09	72
2	Hexadecane	24.739	1.34	89
3	Oxalic acid, allyl hexadecyl ester	27.669	0.64	49
4	Octadecane	29.921	0.85	80
5	2-pentadecanone, 6,10,14-trimethyl	31.062	5.99	72
6	Hexadecanoic acid, ethyl ester	34.234	2.50	46
7	n-Hexadecanoic acid	34.524	1.02	91
8	n-Hexadecanoic acid	34.611	0.71	99
9	n-Hexadecanoic acid	34.765	0.29	99
10	9,12-Octadecanoic acid (Z,Z)-,methyl ester	36.196	3.74	98
11	9-Octadecanoic acid, methyl ester,(E)-	36.303	9.86	99
12	n-propyl 9-octadecenoate	37.521	5.80	89
13	Trans-13-Octadecanoic acid	38.024	1.62	90
14	Tricosane	39.774	1.21	93
15	Tetracosane	41.437	0.96	95
16	Oleic acid	42.433	1.70	48
17	Octadec-9-enoic acid	43.032	0.83	95
18	Diisooctyl phthalate	43.893	10.79	91
19	Tetrapentacontane, 1,54-dibromo-	44.560	0.39	91
20	Tricosane	46.039	1.68	95

21	Nonacosane	48.833	1.16	96

Table 4: phytochemical compounds of *S. calocephala*

No.	Phytochemical compounds	Retation time	Area %	Qual
1	Nonadecane,9-methyl-	20.775	0.43	81
2	Hexadecane	24.729	0.15	96
3	Octadecane	29.921	0.09	74
4	cis-Vaccenic acid	31.246	0.05	93
5	cis-Vaccenic acid	31.555	0.07	56
6	9-octadecenoic acid,(E)-	32.174	0.27	91
7	Hexadecanoic acid,methyl ester	32.832	0.66	96
8	9-octadecenoic acid,(E)-	34.021	0.02	96
9	n-Hexadecanoic acid	34.881	3.03	93
10	cis-13- octadecenoic acid	35.123	2.13	97
11	9-octadecenoic acid,(E)-	35.181	0.34	94
12	cis-13- octadecenoic acid	35.297	1.10	97
13	cis-13- octadecenoic acid	35.423	1.32	98
14	cis-Vaccenic acid	35.732	3.21	97
15	10,13-octadecadienoic acid,methylester	36.051	5.78	93
16	9,17-octadecadienal,(Z)-	36.216	4.98	98
17	10 -octadecadienoic acid,methylester	36.332	6.17	95
18	cis-Vaccenic acid	37.540	1.84	96
19	cis-Vaccenic acid	37.618	0.38	99
20	Oleic acid	37.676	0.93	99
21	9-octadecenoic acid,(E)-	37.792	2.49	99
22	Oleic acid	38.043	5.82	99
23	9-octadecenoic acid,(E)-	39.793	0.31	97
24	Oleic acid	41.456	0.14	99
25	9-octadecenoic acid,(E)-	43.051	0.11	99
26	Bis(2-ethylhexyl)phthalate	43.922	0.81	98
27	9-octadecenoic acid,(E)-	47.354	0.26	93
28	Octadec-9-enoic acid	48.853	0.14	93

Table 5: phytochemical compounds of *S. palaestina*

No.	Phytochemical compounds	Retation time	Area %	Qual
1	Dodecane,2-methyl-	20.775	0.42	86
2	tert-Hexadecanethiol	34.233	0.79	49
3	9,12-octadecadienoic acid(z,z)-,methyl ester	36.206	0.79	99
4	9-octadecenoic acid(z)-,methyl ester	36.302	2.16	99
5	Oleic acid	37.530	0.20	94
6	Nonacosane	48.843	0.38	97

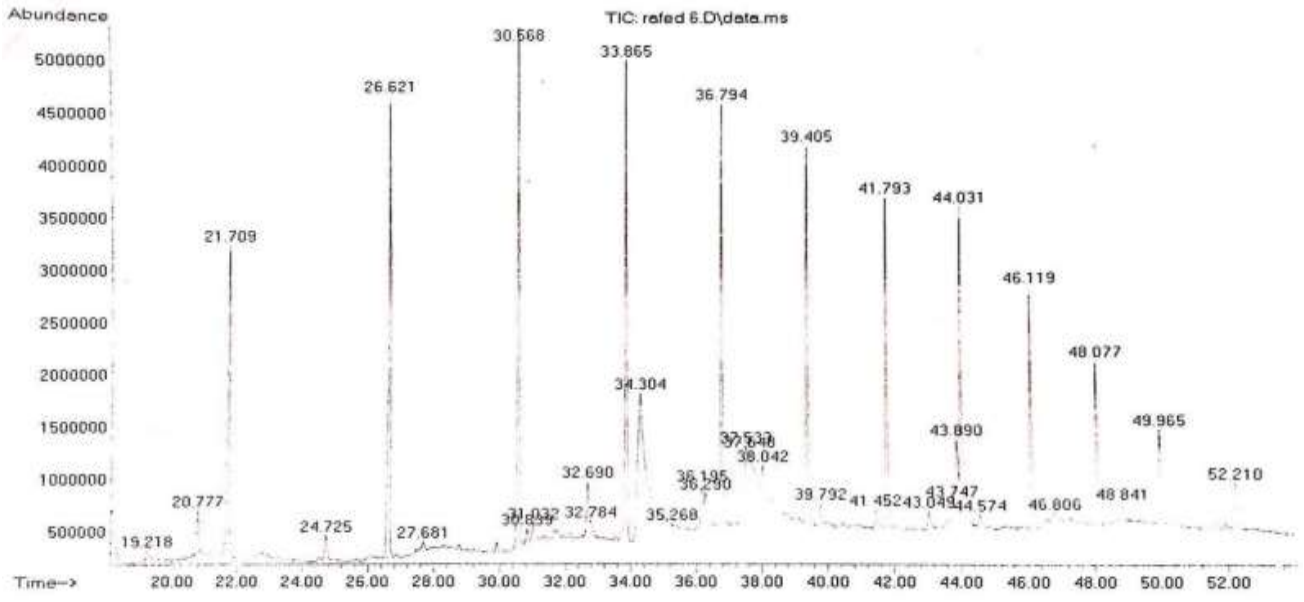

Fig. 1: GC-MS profile of ethanolic extract of S. brachycarba

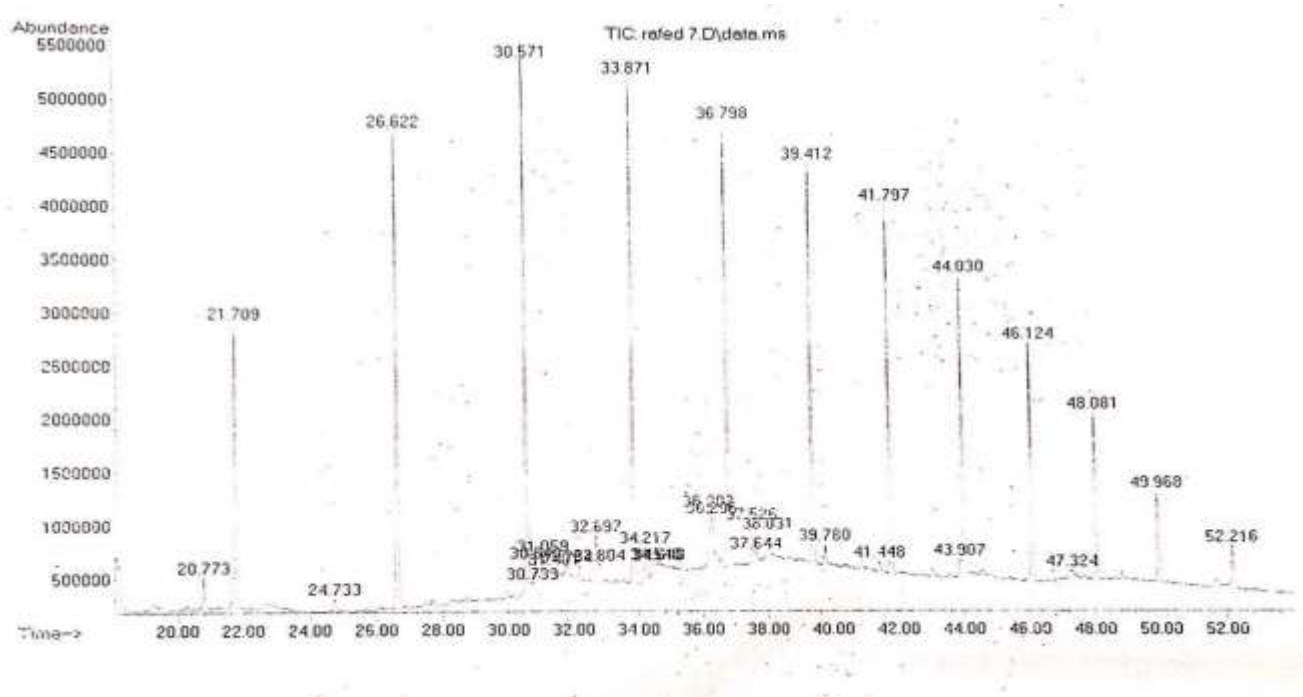

Fig. 2: GC-MS profile of ethanolic extract of S. leucactis

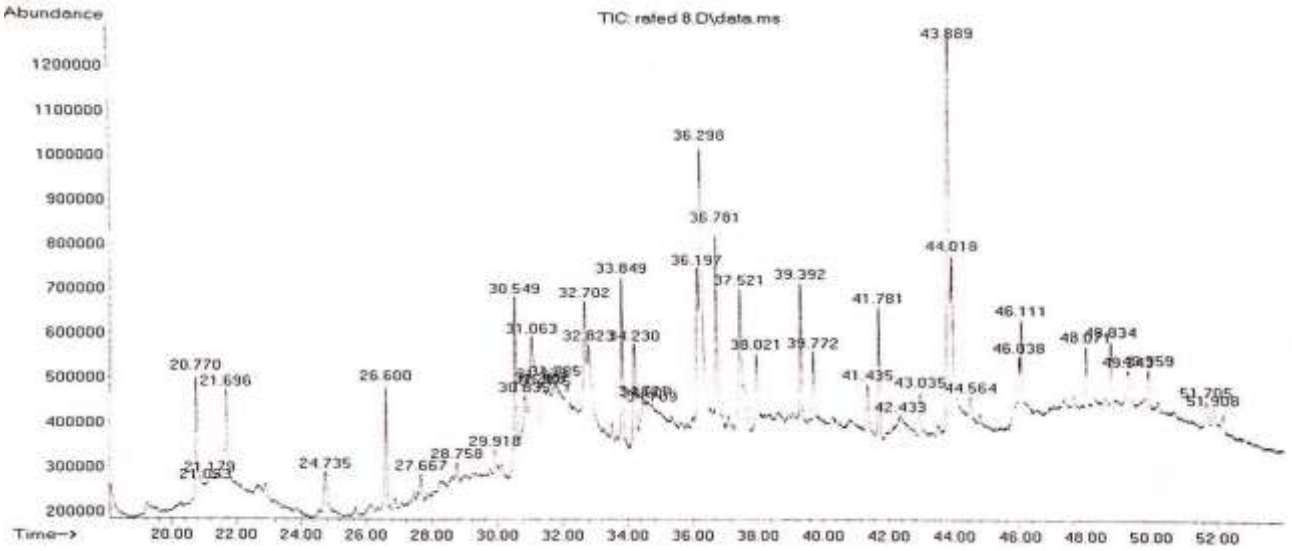

Fig. 3: GC-MS profile of ethanolic extract of S. persica

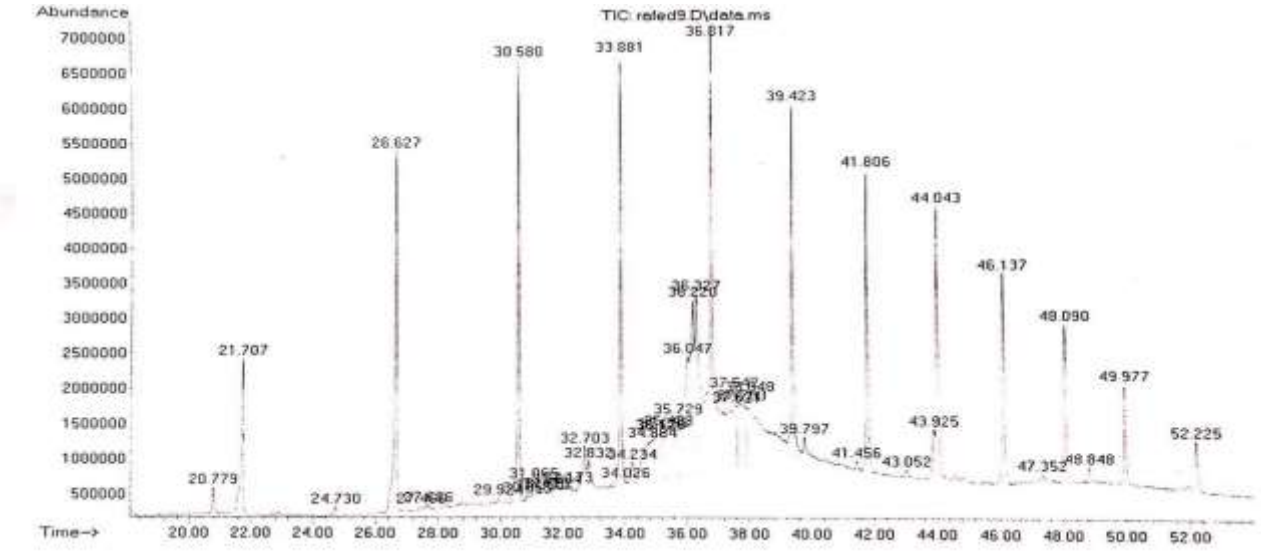

Fig. 4: GC-MS profile of ethanolic extract of S. calocephala

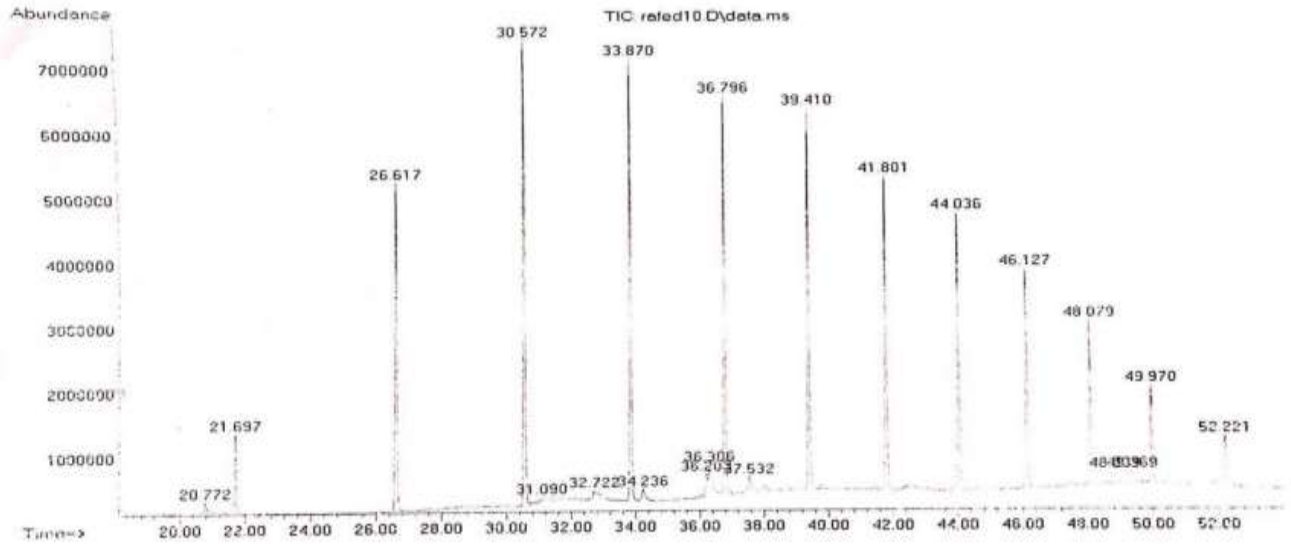

Fig. 5: GC-MS profile of ethanolic extract of S. palaestina

Conclusion

The importance of the results of the study of the chemical content in the distinction and classification of species *Scabiosa* as well as the abundance and diversity of the chemical compounds.

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