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DETERMINATION TO VOLATILE COMPONENTS OF NATURAL *PHLOMIS* L. (LAMIACEAE) TAXA ON DIFFERENT ELEVATIONS OF THE LAKES DISTRICT IN TURKEY

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ABSTRACT

Samples of *Phlomis* taxa were collected from 16 sampling areas in lower and upper altitudes levels and volatile components were determined by SPME analyses. (E)-2-Hexenal (10.07%), β-Caryophyllene (16.55%) and Germacrene-D (27.03%) have been determined in lower elevation level and also (E)-2-Hexenal (9.64%), β-Caryophyllene (15.73%) and Germacrene-D (25.45%) in upper elevation level for *Phlomis armeniaca*; α-Cubebene (16.70%), β-Caryophyllene (13.96%) and Germacrene-D (13.31%) were determined in lower elevation level and also α -Cubebene (13.18%), β-Caryophyllene (12.37%) and Germacrene-D (11.13%) have been determined in upper elevation for *P. bourgei*; Pinene (24.40%), α-Cedrene (31.15%) and α-Curcumene (13.92%) have been determined in lower elevation and also α-Pinene (23.29%), α-Cedrene (25.87%) and α-Curcumene (7.91%) have been determined in upper elevation for *Phlomis grandiflora* var. *grandiflora*; (E)-2-Hexenal (8.74%), Limonene (14.56%) and β-Caryophyllene (22.45%) have been determined in lower elevation and (E)-2-Hexenal (10.81%), Limonene (17.55%) and β-Caryophyllene (24.09%) have been determined in upper elevation level for *Phlomis leucophracta*; Limonene (10.68%), β-Caryophyllene (25.66%) and Germacrene-D (26.88%) have been determined in lower elevation and Limonene (5.75%), β-Caryophyllene (22.50%) and Germacrene-D (25.13%) have been determined in upper elevation for *Phlomis lycia*; Limonene (20.65%), β-Caryophyllene (14.28%) and Germacrene-D (8.27%) have been determined in lower elevation and also Limonene (14.95%), β-Caryophyllene (14.15%) and Germacrene-D (7.71%) have been determined in upper elevation for *P. nissolii*; (E)-2-Hexenal (17.68%), Vinly amyl carbinol (18.60%) and Germacrene-D (8.25%) have been determined in lower elevation and (E)-2-Hexenal (16.87%), Vinly amyl carbinol (12.85%) and Germacrene-D (7.78%) in upper elevation for *Phlomis pungens* var. *pungens* and also α-Copaene (14.71%), β-Caryophyllene (13.75%) and Germacrene-D (17.23%) have been determined in lower elevation and also α-Copaene (8.10%), β-Caryophyllene (8.46%) and Germacrene-D (16.84%) in upper elevation for *P. samia*. As a result, it is determined that reaping the flower and leaves of *Phlomis* taxa on lower altitudes for productivity of volatile components.

Key words:*Phlomis*, elevations, volatile component, the Lakes District, Turkey.

INTRODUCTION

Flora has approximately 11.466 plant taxa in Turkey, whole Europe has approximately 12.000 (Güner, 2012). It is known that 20 thousand of registered 300 thousand flowery or flowering plant of world are suitable for usage of medicinal purposes, about 4000 herbal drug is commonly used especially about 500 species of them are commercially used in all around the word (Baydar, 2009).

Aromatic plants are used for several purposes primarily tea plan, spices, seasoning and volatile oil source. Volatile oils (perfumes, etheric oils) and aromatic extracts are commonly used for perfume production as smell and taste industry, food additives, cleaning products, production of cosmetic and drugs, as source of aroma chemicals or nature identical and semi-synthetic useful aroma chemicals synthesis starting materials (Başer, 2000).

Lamiaceae family is represented by 200 genus and about 3000 species. Family members which are represented by 45 species in Turkey. Approximately 550 species of family are important for pharmacology and perfumery industry due to including volatile and aromatic oils (Güner, 2012).

Etheric oil is obtained and it is used as spices and grown as decoration plant. *Phlomis* taxa which has the most species of Lamiaceae family, has over 100 species all around the world. Taxa of this genus are distributed in Asia, South Europe and North Europe (Mathiesen *et al.,* 2011).It was represented by 39 taxa and 13 hybrids totally 52 taxa in list of Turkish plants (Güner, 2012).

Phlomis has an important place among medical plants and is one of the important species of Lamiaceae family. It has about 100 species all around the world. Heights of *Phlomis* taxa could vary between 30 cm and 2 meters. Sides of leaves are jagged and opposing aligned but not in bulk condition. Feathers covering the surface of plant are stellate. Flowers are purple, pink, white or yellow colored (Huber-Morath, 1982). Leaves and flowers are used as appetizing, anti-allergic, diuretic, diarrhea preventive, getter, against stomach aches, pain seeker, anti-diabetic, herbal tea and tonic. Also, it is known that plant is used for respiratory tract diseases and hemorrhoid problems in colloquially (Harput *et al.,* 2006).

Although it has many usage areas, there are very limited studies on *Phlomis* taxa and volatile component of its leaves in Turkey. In this study, For that reason, effects of lower and upper elevation levels on volatile components of *Phlomis armeniaca* Willd., *P. bourgaei* Boiss., *P. grandiflora* H.S. Thompson var. *grandiflora, P. leucophracta* P.H.Davis & Hub.-Mor., *P. lycia* D. Don., *P. nissolii* L., *P. pungens* Willd., *P. samia* L. taxa were determined.

MATERIALS AND METHODS

Material of study is consist of *Phlomis* samples which were collected from the Lakes District (C2, C3, C4 squares) between the years 2012 and 2015 (Figure 1). For this aim, leaf and flower samples were collected from two different elevation levels as lower and upper altitudes of 16 different sampling areas.

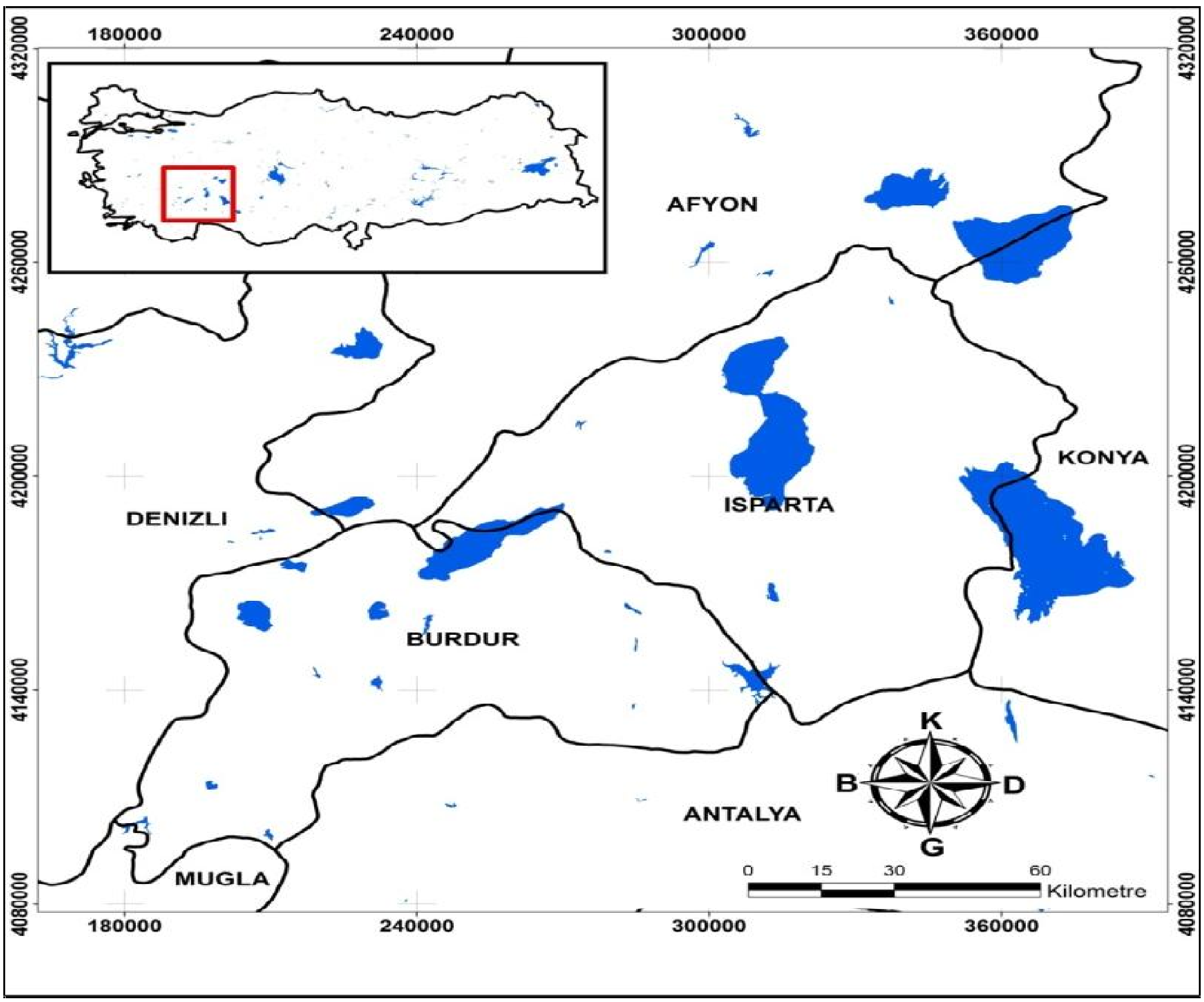

Figure 1.Research area

Method for determination to leaf and flower volatile components: Collected leaves and flower samples have been transported to laboratory by putting in to paper packages and without waiting and exposing to sunlight. After drying the plant materials in room temperature (25 °C), flower and leaf samples were subjected to solid phase microextraction (SPME, Supelco, Germany) with a fibre precoated with a 75 µm-thick layer of

Carboxen/Polydimethylsiloxane (CAR/PDMS). 2.0 g of samples newly hand-picked was put into a 10 mL vial, which was then immediately sealed with a silicone septum and a crimp cap. After incubation for 30 min at 60°C, SPME fibre was pushed through the headspace of a sample vial to adsorbed the volatiles, and then inserted directly into the injection port of the GC-MS (Shimadzu 2010 Plus GC-MS with the capillary column, Restek Rxi®-5Sil MS 30 m x 0.25 mm, 0.25 µm) at a temperature of 250°C for desorption (5 min) of the adsorbed volatile compounds for analysis. Identification of constituents was carried out with the help of retention times of standard substances by composition of mass spectra with the data given in the Wiley, NIST Tutor, FFNSC library.

RESULTS AND DISCUSSION

Leaf and flower volatile components of *Phlomis armeniaca*, *P. bourgaei*, *P. grandiflora* var. *grandiflora, P. leucophracta*, *Phlomis lycia*, *P. nissolii*, *P. pungens* var. *pungens* and *P. samia* have been determined by gas chromatography mass spectroscopy (GC-MS) after solid phase micro extraction (SPME).

By analysis, 54 volatile component of *Phlomis armeniaca*, 62 for *Phlomis bourgaei*, 60 for *Phlomis grandiflora* var. *grandiflora*, 70 for *Phlomis leucophracta*, 62 for *Phlomis lycia*, 53 for *Phlomis nissolii*, 70 for *Phlomis pungens* var. *pungens* and 64 for *Phlomis samia* were determined and all results were given in Table 1.

Sampling areas have been taken as lower and upper elevations from 2 elevation levels and 8 samples of *Phlomis* taxa were collected. Volatile component were determined for this 2 different elevations (Table 1).

Samples of *Phlomis armeniaca* were taken from lower elevation of 830 m and upper elevation of 1762 m. (E)-2-Hexenal (10.07%), β-Caryophyllene (16.55%) and Germacrene-D (27.03%) have been determined in lower elevation level and also (E)-2-Hexenal (% 9.64%), β-Caryophyllene (15.73%) and Germacrene-D (25.45%) in upper elevation level (Table 1). It has been determined that the volatile component rate was higher in lower elevation level.

Component rates of *Phlomis bourgaei* samples taken from lower elevation of 379 m and upper elevation of 1762 m. α-Cubebene (16.70%), β-Caryophyllene (13.96%) and Germacrene-D (13.31%) were determined in lower elevation level and also α-Cubebene (13.18%), β-Caryophyllene (12.37%) and Germacrene-D (11.13%) have been determined in upper elevation (Table 1). It has been determined that the volatile component rate was higher in lower elevation level.

Samples of *Phlomis grandiflora* var. *grandiflora* taken from lower elevation of 783 m and upper elevation of 1580 m. α-Pinene (24.40%), α-Cedrene (31.15%) and α-Curcumene (13.92%) have been determined in lower elevation and also α-Pinene (23.29%), α-Cedrene (25.87%) and α-Curcumene (7.91%) have been determined in upper elevation (Table 1). It has been determined that the volatile component rate was higher in lower elevation.

According to volatile component rates which was determined by gas chromatography mass spectroscopy (GC-MS) after solid phase micro extraction (SPME) results of samples of *Phlomis leucophracta* taken from lower elevation step of 176 m and upper elevation step of 690 m. α (E)-2-Hexenal (8.74%), Limonene (14.56%) and β-Caryophyllene (22.45%) have been determined in lower elevation and (E)-2-Hexenal (10.81%), Limonene (17.55%) and β-Caryophyllene (24.09%) have been determined in upper elevation level. It has been determined that the volatile oil compound rate was higher in upper elevation.

Phlomis lycia samples taken from lower elevation of 783 m and upper elevation of 908 m. Limonene (10.68%), β-Caryophyllene (25.66%) and Germacrene-D (26.88%) have been determined in lower elevation and Limonene (5.75%), β-Caryophyllene (22.50%) and Germacrene-D (25.13%) have been determined in upper elevation. It has been determined that the volatile component rate was higher in lower elevation level.

Samples of *Phlomis nissolii* taken from lower elevation of 830 m and upper elevation of 1312 m. After analyses, Limonene (20.65%), β-Caryophyllene (14.28%) and Germacrene-D (8.27%) have been determined in lower elevation and also Limonene (14.95%), β-Caryophyllene (14.15%) and Germacrene-D (7.71%) have been determined in upper elevation (Table 1). It has been determined that the volatile component rate was higher in lower elevation.

Phlomis pungens var. *pungens* samples were collected from lower elevation of 1488 m and upper elevation of 1649 m. (E)-2-Hexenal (17.68%), Vinly amyl carbinol (18.60%) and Germacrene-D (8.25%) have been determined in lower elevation and (E)-2-Hexenal (16.87%), Vinly amyl carbinol (12.85%) and Germacrene-D (7.78%) in upper elevation (Table 1). It has been determined that the volatile oil compound rate was higher in lower elevation step.

Also, *Phlomis samia* were collected from lower elevation of 942 m and upper elevation of 1529 m. α-Copaene (14.71%), β-Caryophyllene (13.75%) and Germacrene-D (17.23%) have been determined in lower elevation and also α-Copaene (8.10%), β-Caryophyllene (8.46%) and Germacrene-D (16.84%) in upper elevation (Table 1). The volatile component rate was found as higher in lower elevation.

Table 1. Volatile components rates of *Phlomis* samples according to different elevation levels.

			Volatile components rates of *Phlomis* samples															
			P. armeniaca		*P. bourgaei*		*P. grandiflora* var. *grandiflora*		*P. leucophracta*		*P.lycia*		*P. nissolii*		*P. pungens* var. *pungens*		*P. samia*	
	Components	**RT**	**830**	**1762**	**379**	**1312**	**783**	**1580**	**176**	**690**	**783**	**908**	**830**	**1312**	**1488**	**1649**	**942**	**1529**
1.	Dimethyl sulfide	1.326	1.06	0.26	-	-	0.13	-	-	-	-	-	-	-	-	0.82	-	-
2.	Acetic asid, methyl ester	1.368	-	-	-	-	-	0.11	-	-	-	-	-	-	-	-	-	-
3.	2-methyl-Propanal	1.435	0.66	-	-	-	0.26	-	-	-	-	-	-	-	-	0.95	0.47	-
4.	Isobuttyl alcohol	1.442	-	0.30	0.62	0.44	-	0.12	-	-	-	-	-	-	-	-	-	-
5.	2-Thiapropane	1.508	-	-	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	Pentane, 2,4-dimethyl-	1.581	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.60	-
7.	2-Butenal	1.874	-	-	-	-	-	-	1.00	0.15	0.24	0.60	0.14	0.32	0.64	-	-	0.91
8.	3-Methylbutanal	1.920	1.31	0.28	1.06	0.72	0.26	0.12	0.39	-	0.06	0.16	0.23	0.28	0.55	1.29	0.88	0.48
9.	2-Methylbutanal	1.997	1.07	0.33	1.21	0.66	0.24	0.14	0.61	0.12	0.10	0.12	-	0.09	0.25	1.08	-	0.51
10.	Methyl propyl ketone	2.252	0.55	-	-	-	-	-	-	-	-	-	1.06	-	-	-	-	-
11.	n-Pentenal	2.322	-	-	0.30	-	-	-	0.47	0.29	0.15	0.42	-	0.48	0.32	-	-	1.38
12.	Furan, 2-ethyl-	2.344	0.11	0.39	0.77	0.77	0.36	0.33	0.30	0.32	0.23	0.39	0.88	0.60	1.11	1.42	-	1.00
13.	5-methylhexan-1-ol	2.379	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.	Ethyl vinly ketone	2.542	-	-	0.51		-	-	0.12	0.11	-	-	-	0.37	-	-	-	0.33
15.	trans-3-Penten-2-one	2.885	-	-	-	-	-	-	0.18	-	0.04	-	-	-	-	-	-	-
16.	3-Methyl-1-butanol	2.928	-	-	-	-	-	-	-	-	-	-	-	-	-	0.28	-	-
17.	(E)-2-Pentenal	3.166	0.25	-	0.32	0.22	-	-	0.20	0.23	0.12	0.32	0.45	0.55	0.59	0.31	0.34	0.48
18.	(Z)-2-Pentenol	3.459	-	-	-	-	-	-	-	-	-	-	-	-	0.32	-	-	-
19.	3-Methyl-2-butanol	3.808	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.48	0.34
20.	n-Hexanal	4.090	0.95	0.74	2.88	0.88	0.11	0.15	3.54	3.76	1.56	1.87	0.58	3.45	3.73	2.68	6.13	6.36
21.	(E)-2-Hexenal	5.515	10.07	9.64	8.86	8.20	0.51	0.28	8.74	10.81	3.92	5.35	8.57	17.33	17.68	16.87	3.66	9.17
22.	cis-3-Hexene-1-ol	5.576	1.9	0.80	2.43	-	-	0.11	0.44	0.51	0.18	0.18	0.76	-	2.52	2.65	-	0.81
23.	cis-Hex-2-en-1-ol	5.904	0.83	0.27	-	-	-	-	-	0.19	-	-	0.83	-	0.44	0.34	-	0.39
24.	Hexanol <n->	6.015	3.00	0.34	-	-	-	-	0.25	3.07	0.17	0.05	0.81	0.94	2.20	1.30	0.42	2.42
25.	o-Xylene	6.439	-	-	0.54	-	-	-	-	-	-	-	-	-	-	-	-	-
26.	n-Hexyl formate	6.507	-	-	0.81	0.80	-	-	-	-	-	-	-	-	-	-	-	-
27.	Amyl methyl ketone	6.703	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.36	0.70
28.	n-Heptanal	7.015	-	-	0.22	-	-	-	0.85	0.37	0.15	0.36	-	0.35	0.40	-	6.50	6.20
29.	Enanthaldehyde	7.111	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.	2,4-Hexadienal	7.278	-	-	-	-	-	-	0.56	-	0.10	0.11	-	-	-	-	-	0.69
31.	Sorbaldehyde, (E,E)	7.392	-	-	-	-	-	-	-	-	-	-	-	-	-	0.68	2.61	-
32.	α-Thujene	7.835	-	-	0.26	0.69	1.43	1.28	0.51	0.63	0.39	0.13	0.68	0.34	0.66	0.77	-	-
33.	α.-Pinene	8.060	3.44	2.74	1.01	5.13	24.4	23.29	2.72	3.43	2.24	0.74	11.86	3.20	3.85	4.91	3.25	1.15
34.	(E)-2-Heptenal	8.939	-	-	-	-	-	-	1.26	-	0.35	0.58	-	-	0.23	-	-	-
35.	Benzaldehyde	9.042	0.39	2.63	-	0.57	0.30	0.35	1.98	1.02	1.99	2.24	0.58	1.03	5.12	5.42	2.08	3.87
36.	2-Hexenoic acid, methyl ester	9.379	-	-	-	-	-	-	-	0.25	-	-	-	-	-	0.39		
37.	β-Pinene	9.508	-	-	-	-	0.13	0.49	0.22	0.17	-	-	0.34	-	0.33	-	-	-
38.	Sabinene	9.509	-	-	-	-	-	-	-	-	-	-	-	-	0.23	-	-	-

			Volatile components rates of *Phlomis* samples															
			P. armeniaca		*P. bourgaei*		*P. grandiflora* var. *grandiflora*		*P. leucophracta*		*P.lycia*		*P. nissolii*		*P. pungens* var. *pungens*		*P. samia*	
39.	Phenylmethanal	9.555	-	-	1.15	-	-	-	-	-	-	-	-	-	-	-	-	-
40.	β.-Phellandrene	9.610	-	-	-	-	0.41	0.23	-	-	-	-	-	-	-	-	-	-
41.	Amyl vinyl ketone	9.716	-	-	-	-	-	-	0.23	-	0.40	0.30	-	-	-	-	-	-
42.	Vinly amly carbinol	9.869	0.55	2.13	1.90	0.69	0.09	0.10	0.83	0.39	0.40	0.14	8.71	0.34	18.6	12.85	0.73	1.01
43.	4-Pentene-l-yl acetate	10.060	0.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44.	6-Methyl-5-hepten-2-one	10.013	-	-	0.22	0.37	0.31	0.29	0.44	0.57	0.24	0.37	-	5.21	-	-	0.52	1.48
45.	Amyl ethyl ketone	10.130	1.75	0.30	-	-	-	-	-	-	-	-	0.96	-	-	1.79	-	-
46.	(R,S)-2-Propyl-5-Oxohexanal	10.287	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.26	1.05
47.	Fenehone	10.292	-	0.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48.	4-Ethylcyclohexanol	10.303	1.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
49.	n-Octanal	10.708	-	-	-	-	-	-	2.11	0.56	0.32	0.24	0.33	0.29	0.85	-	2.14	2.64
50.	α-Phellandrene	10.760	-	-	0.66	0.30	-	0.14	0.64	0.84	0.58	0.23	0.66	0.67	0.18	-	-	-
51.	2,4-Heptandienal	10.969	0.37	0.18	0.34	0.80	-	-	1.48	0.32	0.39	1.11	0.51	1.51	3.82	2.39	0.65	2.03
52.	p-Dichlorobenzene	11.087	0.57	0.56	-	-	0.11	-	-	-	-	-	0.15	-	-	-	-	-
53.	Hexyl-Ethanoate	11.106	-	-	-	-	-	-	-	-	-	-	-	0.31	-	-	-	0.29
54.	α.-Terpinene	11.176	-	-	0.33	0.44	-	-	1.00	1.14	0.56	0.15	0.41	0.29	-	-	-	-
55.	p-Cymene	11.469	-	-	-	1.62	0.34	0.48	1.29	1.38	0.55	0.32	0.88	1.36	1.51	0.30	-	-
56.	Limonene	11.693	0.69	1.53	5.34	10.88	2.62	3.01	14.56	17.55	10.68	5.75	20.65	14.95	1.83	1.58	1.01	0.71
57.	Cymol	12.006	-	-	2.14	-	-	-	-	-	-	-	-	-	-	-	-	-
58.	(E)-3-Octen-2-one	12.014	-	-	-	-	-	-	0.61	-	0.19	0.15	-	-	-	-	-	1.09
59.	cis-Ocimene	12.084	-	-	1.19	2.38	0.82	3.97	-	-	-	-	-	-	-	-	-	-
60.	Benzeneacetaldehyde	12.224	-	0.58	-	0.58	-	-	-	-	-	-	-	-	-	0.78	-	-
61.	Phenylacetaldehyde	12.134	-	-	-	-	-	-	0.71	0.22	0.10	1.38	-	0.73	0.51	-	-	0.58
62.	β. Ocimene	12.368	-	-	0.73	-	0.15	0.18	0.39	0.99	-	-	0.42	0.12	-	-	-	-
63.	Hyacinthin	12.736	-	-	0.57	-	-	-	-	-	-	-	-	-	-	-	-	-
64.	2 Octenal	12.764	-	-	-	-	-	-	0.98	0.49	0.46	0.24	-	0.26	0.41	-	0.88	0.76
65.	3,5-Octadien-2-one	13.198	-	-	-	-	-	-	0.34	-	0.49	0.31	-	-	0.49	-	-	-
66.	γ-Terpinene	13.336	-	-	0.59	-	-	-	-	-	-	-	-	-	-	-	-	-
67.	Octanol	13.338	-	-	-	-	-	-	0.19	-	-	-	-	-	-	-	-	-
68.	.α.-Terpinolene	13.811	-	-	0.46	0.66	-	-	2.39	1.97	0.89	0.42	0.10	0.96	0.23	-	-	-
69.	Dimethylstyrene <α-para->	13.971	-	-	-	-	-	-	0.21	-	-	-	-	-	-	-	-	-
70.	2-Nonanone	14.064	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.44	0.38
71.	Methyl benzoate	14.102	-	-	-	-	-	-	0.27	-	0.07	0.09	-	-	-	-	-	-
72.	Linalool	14.410	-	0.58	-	-	-	0.19	-	-	-	-	-	-	-	1.17	0.44	0.21
73.	n-Nonanal	14.609	0.42	0.54	0.44	0.50	0.15	-	2.61	1.73	1.03	1.41	1.26	1.33	7.59	1.00	3.17	2.46
74.	Phenethyl alcohol	14.871	-	0.54	-	-	-	-	-	-	-	-	-	-	-	0.52	-	-
75.	.α.-Campholene aldehyde	15.459	-	-	-	-	0.12	0.19	-	-	-	-	-	-	-	-	-	-
76.	trans-Alloocimene	15.609	-	-	-	-	0.08	0.53	-	-	-	-	-	-	-	-	-	-
77.	D-Carvone	16.200	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-
78.	Trans-2-Nonenal	16.674	-	-	-	-	-	-	0.50	-	0.17	0.05	-	-	-	-	0.62	0.46
79.	Pinocarvone	16.786	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-	-	-
80.	Methyl salicylate	17.927	-	0.17	-	-	-	-	-	-	-	-	-	-	-	1.36	-	-

Volatile components rates of *Phlomis* samples																		
			P. armeniaca		*P. bourgaei*		*P. grandiflora* var. *grandiflora*		*P. leucophracta*		*P.lycia*		*P. nissolii*		*P. pungens* var. *pungens*		*P. samia*	
81.	n-Decanal	18.450	-	-	-	-	-	-	0.56	0.61	1.05	0.37	0.17	0.20	0.40	-	0.43	0.34
82.	(E)-2-Decenal	20.477	-	-	-	-	-	-	0.46	-	-	-	-	-	-	-	-	-
83.	Hendecanal	22.141	-	-	-	-	-	-	0.24	-	-	-	-	-	-	-	-	-
84.	Nonyl methyl ketone	21.712	-	0.23	-	2.62	-	-	-	-	-	-	-	-	-	-	-	-
85.	α.-Cubebene	23.507	1.24	1.11	16.7	13.18	-	-	0.20	0.51	0.29	0.45	0.27	0.24	0.30	0.38	0.92	0.37
86.	Ylangene	24.361	-	0.18	-	0.25	-	-	-	-	-	-	-	-	-	-	-	-
87.	α.- Ylangene	24.387	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
88.	α.-Copaene	24.468	1.22	0.80	2.36	2.31	0.16	0.39	0.79	1.51	1.53	1.98	1.84	3.90	0.60	0.50	14.71	8.10
89.	β. Bourbonene	24.734	2.48	0.58	0.51	0.80	1.05	-	0.17	0.17	1.12	1.32	2.86	4.16	3.57	0.75	2.73	2.16
90.	β –Cubebene	24.897	-	-	3.99	-	0.11	-	0.20	0.77	0.60	0.99	0.52	0.37	0.54	-	-	-
91.	(-)-.β.-Elemene	24.960	0.52	0.66	-	-	-	-	0.14	0.41	0.67	0.79	-	0.21	0.34	0.66	0.44	-
92.	Sesquithujene <7-epi->	25.463	-	-	-	-	0.25		-	-	-	-	-	-	-	-	-	-
93.	n-Tetradecane	25.520	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.36	-
94.	α-Gurjunene	25.540	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.33
95.	α.-Cedrene	25.795	-	-	-	-	31.15	25.87	-	-	0.19	0.10	-	-	-	-	-	-
96.	β-Caryophyllene	26.000	16.55	15.73	13.96	12.37	6.40	0.41	22.45	24.09	25.66	22.5	14.28	14.15	0.65	0.74	13.75	8.46
97.	α.-Gurjunene	26.217	-	-	0.97	-	-	-	-	0.23	-	-	-	-	-	-	-	-
98.	β-Cedrene	26.279	-	-	-	-	-	0.22	-	0.28	0.49	1.02	-	0.58	0.65	-	-	0.53
99.	γ.-Elemene	26.403	-	4.17	1.23	0.99	-	-	-	-	-	-	-	-	2.20	4.37	-	-
100.	α.-Bergamotene	26.556	-	-	-	-	1.43	1.62	-	-	0.25	0.44	-	0.21	0.2	-	-	-
101.	α.-Cedrol	26.789	-	-	-	-	0.52	-	-	-	-	-	-	-	-	-	-	-
102.	Alloaromadendrene	26.887	-	-	-	0.64	-	10.87	0.56	0.55	0.43	0.29	1.64	1.29	0.29	-	-	-
103.	(E)-β-Farnesene	27.104	8.87	12.87	0.30	-	-	-	2.96	-	3.71	7.05	2.86	2.86	6.94	11.32	-	0.26
104.	α.-Humulene	27.114	-	-	1.19	1.97	-	-	-	0.02	-	-	-	-	-	-	1.66	1.02
105.	Cyclosativene	27.157	-	-	-	0.36	-	4.2	-	-	-	-	0.66	-	-	-	-	-
106.	Farnesol	27.232	-	-	-	-	1.19	-	-	-	-	-	-	-	-	-	-	-
107.	Cadina-l(6),4-diene<10βH->	27.321	0.37	0.51	-	1.13	-	-	0.21	0.50	0.78	1.62	-	0.33	0.63	-	0.59	0.45
108.	Epi-Bicyclosesquiphellandrene	27.452	2.09	1.09	-	0.61	-	-	-	-	-	-	0.26	-	-	0.29	1.66	1.12
109.	Germacrene-D	27.956	27.03	25.45	13.31	11.13	5.12	10.4	8.32	10.60	26.88	25.13	8.27	7.71	8.25	7.78	17.23	16.84
110.	α-Curcumene	28.131	-	-	-	-	13.92	7.91	-	-	-	-	-	-	-	-	-	-
111.	Bicyclogermacrene	28.464	2.50	0.63	-	-	-	-	-	-	-	2.94	-	1.27	2.00	1.14	-	-
112.	Zingiberene	28.490	-	-	0.37	-	-	0.14	-	-	0.33	-	-	-	-	-	-	-
113.	Valencene	28.548	-	-	-	-	-	0.23	-	-	-	-	-	-	-	-	-	-
114.	α-Muurolene	28.552	0.80	0.53	-	0.33	-	-	-	-	0.54	0.91	0.19	-	-	-	0.58	0.37
115.	Cedr-8-e	28.555	-	-	-	-	1.00	-	-	-	-	-	-	-	-	-	-	-
116.	Sesquithujene <7-epi->	28.556	-	-	-	-	-	0.50	-	-	-	-	-	-	-	-	-	-
117.	Caran-cis-3-ol	28.560	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
118.	p-Menthane, 2,3-dibromo-8-phenyl-	28.825	-	-	-	-	1.21	-	-	-	-	-	-	-	-	-	-	-
119.	β-Bisabolene	28.908	-	-	-	-	-	-	0.22	-	-	-	-	-	-	-	-	-
120.	.γ.-Cadinene	28.975	1.49	2.06	-	11.31	-	-	0.24	0.75	1.09	1.8	0.63	0.40	0.61	0.36	0.91	0.82

			Volatile components rates of *Phlomis* samples															
			P. armeniaca		***P. bourgaei***		***P. grandiflora* var. *grandiflora***		***P. leucophracta***		***P.lycia***		***P. nissolii***		***P. pungens* var. *pungens***		***P. samia***	
121.	δ- Cadinene	29.163	2.46	2.39	1.06	0.25	0.08	-	1.82	1.58	1.35	2.26	0.64	1.72	1.02	0.82	3.55	3.20
122.	β-Sesquiphellandrene	29.362	-	-	-	-	0.21	0.14	-	-	0.37	0.40	-	-	-	-	-	-
123.	α.-Amorphene	29.619	-	-	0.44	-	-	-	-	-	-	-	-	-	-	-	-	-
124.	Androstan-17-one, 3-ethyl-3-hydroxy-, (5.α.)-	30.275	-	-	-	-	0.29	-	-	-	-	-	-	-	-	-	-	-
125.	Germacrene B	30.394	-	4.48	2.80	-	-	-	-	-	-	-	0.55	-	1.28	4.11	-	-
126.	(+)-spathulenol	30.595	-	0.17	1.22	-	-	-	-	-	-	-	-	-	-	-	-	-
127.	Isolongifolene, 4,5,9,10-dehydro-	31.015	-		-	-	0.18	-	-	-	-	-	-	-	-	-	-	-
128.	(-)-Caryophyllene oxide	31.090	-	0.21	-	0.25	1.22	-	0.47	0.36	0.16	0.22	0.37	0.31	-	-	0.50	0.56
129.	(2-Ethylhexyl)Ether	31.342	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34	-
130.	Pentanoic acid, 2,2,4,4-tetramethyl-	31.345	0.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
131.	Ar-tumerone	33.615	-	-	-	-	0.11	-	-	-	-	-	-	-	-	-	-	-
132.	Nonadecane	40.184	-	-	-	-	-	-	0.59	0.50	0.38	0.62	-	0.43	0.71	-	-	0.65
133.	Octadecane	40.618	-	-	0.36	-	-	-	-	-	-	-	-	-	-	-	-	-

Yaşar *et al.* (2010) determined 12 compounds in volatile oil of *P. armeniaca.* They determined that the compounds are Germacrene-D (35.68%), β-Caryophyllene (18.08%), Caryophyllene oxide (13.35%), (E)-β-farnesene (7.24%) and hexahydrofarnesyl aceton (6.99%).

Sarıkürkçü *et al.* (2013) determined the chemical compounds of volatile oils of *P. bourgaei* which has been obtained by hydro distillation and in order to examine the anti-toxicant potentials. Dominant compounds were found as β-Caryophyllene (37.37%), (Z)-β-farnesene (15.88%) and Germacrene-D (10.97%). Başer *et al*. (2008) determined the essential compounds of *P. bourgaei* as Germacrene-D (11.3%) and β-Caryophyllene (11.2%). β-Caryophyllene and Germacrene-D was found as the dominant compounds. These results support our results of research.

Çelik *et al.* (2005) have determined the compounds of *P. grandiflora* var. *grandiflora* as Germacrene-D (45.4%), β-Caryophyllene (22.8%) and bicyclogermacrene (4.9%). Demirci *et al.* (2008) have determined β-eudesmol (42%) and α-eudesmol (16%) which are of oxygenic sesquiterpenes as the most important compounds of *P. grandiflora* var. *grandiflora.* Özcan *et al.* (2009) determined 32 compounds which represents 92.1 % oil obtained from flowers. They determined the essential compounds as β-eudesmol (61.48%), β-curcumene (5.81%), E-β-farnesene (2.35%), α-zingiberene (2.18%) and α-cedrene (1.94%). They determined 39 compounds which represents oil obtained from leaves by 87.7 %. Essential compounds are β-eudesmol (62.04%), β-curcumene (3.43%), α-Curcumene (2.20%) and linalol (2.03%). Especially it has been characterized that it includes high percentage of β-eudesmol in both oils. Results in our research differ from the results of Çelik *et al*. (2005). Özcan *et al.* (2009) determined α-Cedrene and α-Curcumene compounds in their researches. This result supports our study.

Çelik *et al.* (2005), determined β-Caryophyllene (20.2%), α-pinen (19.2%) and limonen (11%) in *P. leucophracta* in Turkey. β-Caryophyllene and limonene were determined as essential compounds. Result of this research supports our study.

Kirimer *et al*. (2006), determined 18 components of *P. nissolii* with the analysis of GC/MS. They determined the essential compounds as Germacrene-D (33.9%), bicyclogermacrene (15.3%) and (Z)-β-farnesene (10.7%). Their results differ from our results. But Germacrene-D was determined as the essential compound in both researches.

Masoudi *et al.* (2006) determined 24 compound of *P. pungens* var. *pungens* in Iran by the analysis of GC/MS. Essential compounds are bicyclogermacrene (14.1%), α-pinen (13.5%) and (E)-β-farnese in the oil which is represented with 91.7 %. Results differ from our results.

Aligiannis *et al.* (2004) determined 72 components of *Phlomis samia* in upper elevations that grows in Greece and the main components were found asα-pinen, limonen, β-Caryophyllene, linalol, (E)-β-farnesene, Germacrene-D, (Z)- γ-bisabolene andcis- β-ocimene. Demirci *et al.* (2008) determined the essential compounds of *P. samia* as Germacrene-D (33.8%) and β-Caryophyllene (6.4%) with GC/MS analysis. Above mentioned results support our results.

Conclusions: It is significantly important to reap the *P. bourgaei*, *P. leucophracta*, *Phlomis lycia* from the lower elevation level. *P. bourgaei* and *Phlomis lycia* in respect to volatile components productivity. It is considered that the locals and traders will become conscious and slapdash plant picking and economic losses will be prevented.

Studies in for encouraging the usage and consume of *Phlomis lycia* should be increased. Anti-microbial, anti-bacterial, anti-septic and deterrent featured detailed studies should be carried out this taxa. These kinds of researches and studies should increase in order to show the plants used for medicine raw material or food and cosmetic products and use them more consciously

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