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THE EFFECT OF ALTITUDES ON COMPOSITION AND CONTENT OF ESSENTIAL OILS OF ENDEMIC ORIGANUM SACCATUM P.H. DAVIS

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ABSTRACT

The genus Origanum is represented in Turkey by 22 species or 32 taxa, 21 being endemic to Turkey. The rate of endemism among the Turkish Origanum species is 63%. Out of 52 known taxa of Origanum, 60% are recorded to grow in Turkey. Origanum saccatum is called as "Tahtacı Kekiği" in Alanyaregion around Antalya. It grows on the slopes at limestone rocks and the pine forests. It is endemic for C3 and C4 squares.

In this study, essential oil content and compositions of four O. saccatum plants were collected from Ermenek (Southern part of Turkey). The altitudes of collected places of plants were 1196 m, 1323 m, 1449 m and 1523 m from sea level. The essential oil content of O. saccatum plants was hydro-distilled by Clevenger apparatus, and they were determined between 0.20% and 0.33%. The highest essential oil content (0.33%) was obtained from 1196 m. The composition of essential oils was analyzed by GC/MS. The main components were: p- cymene (37.91-49.21%), carvacrol (6.71–27.58%), γ-terpinene (6.04–16.69%), Isoborneol (6.31–12.56%).

Keywords: Origanum saccatum, Ermenek, essential oil, endemic

1. INTRODUCTION

Turkey, one of the richest countries in terms of plant diversity in temperate climate zone, has more than 3000 endemic plant species. This number is distinctly higher than the number of the endemics of whole European countries. However, the richness of plant diversity in Turkey is under threat and being reduced. The conservation studies in Turkey recently came into prominence. In these studies, conserving small areas instead of large areas has taken over and concept of Important Plant Area has gained importance. Turkey is the first country to apply the criteria defined by Planta Europa Steering Committee and to complete a national inventory of Important Plant Areas (Bilgili and Duman, 2015).

Turkey is regarded as an important gene center for the family *Lamiaceae* (Başer 1993). With their pleasant fragrance, many species of *Lamiaceae* have been used as herbal teas in Turkey. Many of species are used as raw material in cosmetic industry. Some species are traditionally used as medicinal plants (Baytop 1984).

Origanum L. is one of the high-valued medicinal and aromatic plant species used for a variety of purposes such as food, primary medicine and drinks. Many members of the genus *Origanum* are wildly grown in the Mediterranean region and in many areas of Europe, Asia, Africa and America. Several species in this genus are important among the culinary herbs

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in the world trade and local markets as raw materials in herb and spices, pharmaceutical and cosmetic industries (Ince et al. 2014).

Origanum saccatum is called as "Tahtacı Kekiği" in Alanya region around Antalya. It grows on the slopes at limestone rocks and the pine forests. It is endemic for C3 and C4 squares (Demirezer, 1985).No study was carried out on chemical composition of *Origanum saccatum* essential oil.

In this study, the essential oil of four *O. saccatum* plants collected at different altitudes from Ermenek (Southern part of Turkey) and chemical composition of its oil were determined.

2. MATERIAL AND METHODS

Plant

O. saccatum P.H. Davis is usually hairless perennial shrub with 30-80 cm in length. The stem is perpendicular, corners not obvious and young plants are rounded. The branches up to 12 in number are mutual at the stem. Leaves are hairless, simple, top acute, vascularity, arranged in pinnate and decussated manner and the base is markedly shrinked toward the top of the plant (Demirezer, 1985).Plant materials from *O. saccatum* P.H. Davis were collected from four different altitudes 1196, 1323, 1449 and 1523 m) during its flowering stage in July, 2012from Ermenek (Southern part of Turkey). The plants were identified at Department of Agronomy of Agricultural Faculty of Çukurova University.

Essential Oil Isolation

Air- dried plant material (25 g) was hydro distilled for 3 h using a Clevenger type apparatus. The oil was kept in sealed vial at 4 °C until analysis.

GC–MS Analysis

Gas chromatography/mass spectrometry (GC/MS): GC/MS analysis of the oils was carried out on a 7000 Series Triple Quad GC/MS apparatus [Agilent], equipped with split-splitless injector and automatic liquid sampler, attached to HP-5MS capiller column (30 m x 0.25 mm x 0.25 µm film thickness, %5 phenyl methyl poly siloxane). The carrier gas flow rate (He) was 1 ml/min, split ratio 1:30, oven temperature program was started at50°C (held for 3 min.) while column temperature was linearly programmed from 50-240°C (at rate of 3°/min). The essential oil was diluted with dichloromethane, split ratio was 1:25, injected 1 µl. The constituents were identified by comparison of their mass spectra to those from Agilent Flavor libraries.

3. RESULT AND DISCUSSION

The essential oil content of *O. saccatum* plants was hydro-distilled by Clevenger apparatus, and they were determined between 0.20% and 0.33%. The highest essential oil content (0.33 %) was obtained from 1196 m, while 1323 m, 1449 m, and 1523 m were as found (0,15% 0,20 % and 0,30 % respectively).The identified components and their percentages are listed according to their Retention Time (RT) Table 1. For the altitude1196 m of collected *Origanum saccatum* twenty-five components were identified representing 87.85% of total essential oil. The major constituents of the oil were p-Cymene (37.913%), Carvacrol (27.586%), gamma-Terpinene

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(11.054%), Isoborneol (Isomer 2) (6.321%) and Camphene (2.721 %). The altitude of second collected place was 1323 m. The major constituents of the essential oil was p-Cymene (41.083%), Carvacrol (16.928%), gamma-Terpinene (16.696%), Isoborneol (Isomer 2) (6.316%) and Camphene (3.311%). For the altitude 1449 m of collected plant the major constituents of the essential oil was p-Cymene (38.401%), Carvacrol (14.789%), gamma-Terpinene (10.685%), Isoborneol (Isomer 2) (6.591%) and Camphene (2.812%). The altitute of last collected place was 1523 m. The major constituents of the essential oil was p-Cymene (49.217%), Isoborneol (Isomer 2) (12.568%), Carvacrol (6.712%), Camphene (6.654%) and gamma-Terpinene (6.043%). p-Cymene was determined as the main components of the naturally growing all altitudes. The highest p-Cymene rate was recorded 1523 m (49.217%). Carvacrol, gamma-Terpinene, Isoborneol (Isomer 2) and Camphene were recorded as other principle essential oil components. According to results p-Cymene and Carvacrol existed for all collected places with high levels. *O. saccatum* is remarkably a variable species because the essential oil of *O. saccatum* was characterized by its high content of p-cymene.

It was reported that the chemical composition of *Origanum* species essential oils were very variable (Scheffer *et al.* 1986; Barata *et al.* 1998; Baser *et al.* 2003). Our finding is in agreement with Ozcan and Chalchat (2009), who reported that *Origanum saccatum* oil was rich in p-Cymene (82.83%). The other important constituents were g-terpinene (6.23%), *p*-cymene-8-ol (1.5%) and carvacrol (1.2%). Baser *et al.* (2003) reported that *Origanum syriacum* oil was rich in thymol (24–29%), cis-sabinene hydrate (18–20%), g-terpinene (13–15%), *p*-cymene (5–8%) and terpinene-4-ol (4–8%) as the main constituents. *Origanum majorana* is very rich in cis-sabinene hydrate, carvacrol and terpinene-4-ol (Novak *et al.* 2002). Ravid and Putievsky (1986) reported carvacrol (63.1%), g-terpinene (15.8%), *p*-cymene(8.2%), g-pinene (3.1%), myrcene (2.8%) and thymol (2.2%) in the oils from *O. majorana*. As was reported previously (Fleisher and Fleisher 1988), carvacrol (67.3%), g-terpinene (15.0%), *p*-cymene (5.9%), borneol (1.1%), gcaryophyllene (1.0%) and terpinene-4-ol (0.7%) were identified as the major components of *O. vulgare* spp. *hirtum* oil.

Table 1. Constituents of the essential oils from collected different altitudes of *Origanum saccatum* (%).

RT	Compound	1196 m	1323 m	1449 m	1523 m
6.8116	delta-3-carene	-	0.184	-	0.395
7.0283	alpha-phellandrene	0.475	1.387	0.179	0.720
7.2449	alpha-Pinene	0.900	1.536	1.375	1.791
7.6607	alpha,alpha-Dimethylphenethyl alcohol	-	-	-	0.303
7.7661	Camphene	**2.721**	**3.311**	**2.812**	**6.654**
8.7645	sabinene	0.175	0.362	-	0.191
8.8461	beta-Pinene	-	0.235	0.144	0.218
9.0647	1-octen-3-ol	-	0.549	-	0.372

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9.4450	6-Methyl-3,5-heptadien-2-one	-	-	0.500	-
9.5485	Myrcene	0.502	0.901	0.454	0.300
10.5344	alpha-terpinene	**1.055**	**2.176**	**0.999**	0.446
10.9232	p-Cymene	**37.913**	**41.083**	**38.401**	**49.217**
11.0577	Limonene	0.403	0.644	0.822	0.734
11.1243	Eucalyptol	-	-	1.118	0.216
12.3946	gamma-Terpinene	**11.054**	**16.696**	**10.685**	**6.043**
12.7134	Linalyl butyrate	-	-	0.350	-
13.7272	alpha-Dimethyl phenethyl acetate	0.450	0.391	0.429	0.281
14.0951	delta-3-carene	0.156	0.255	0.286	0.310
14.2800	Linalol	1.200	0.571	1.674	0.430
16.0092	Safranal	-	-	0.676	-
16.0911	trans,trans-2,4-Decadienal	-	-	1.144	0.349
17.0946	Isoborneol (Isomer 2)	**6.321**	**6.316**	**6.591**	**12.568**
17.6600	4-Carvomenthenol; terpinene-4-ol	0.3284	0.563	0.422	0.498
18.0593	alpha-Dimethyl phenethyl acetate	0.683	0.627	0.731	1.126
18.2771	alpha-Terpineol	-	-	2.389	-
18.5701	omega-6-Hexadecalactone,	0.237	-	-	0.409
19.0905	Safranal	-	-	0.607	-
20.0953	Citronellal	-	-	-	0.426
20.4473	Cuminaldehyde	0.394	0.300	0.422	0.561
20.5872	Citral	-	-	-	**1.389**
20.9554	Terpinyl acetate	-	0.299	-	-
20.9581	cis-Jasmone	0.323	-	-	-
22.5661	Isoborneol (isomer 1)	0.475	-	-	0.386
22.7889	Cuminaldehyde	0.203	0.161	0.271	0.212
22.9361	Thymol	0.447	0.138	0.176	-
23.3985	Carvacrol	**27.586**	**16.928**	**14.789**	**6.712**
28.0645	beta-Caryophyllene	0.994	0.574	4.104	1.776
31.1884	Bisabolene	-	0.165	0.627	0.438
31.1888	Camphene	0.304	-	-	-
31.7816	Farnesol (Z,E-)	0.690	0.477	0.845	0,831
31.8963	Valencene	-	-	-	0,366
	Total (%)	87.850	89.433	85.082	87.277
	Number of component	25	26	29	32

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