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Araştırma Makalesi/Research Article

Essential Oil Composition of Endemic *Sideritis dichotoma* Huter (Lamiaceae) From Turkey

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Abstract- ***Sideritis* L. has a significant place among the other Lamiaceae genera owing to high percentage of endemism. The genus patterns are used as medicinal and herbal plants all over the world and Turkey. The plant is showed a strong antioxidant activities and it has diuretic effect. In this study, chemical composition of essential oil obtained by hydrodistillation of** *Sideritis dichotoma* Huter **was investigated by GC and GC-MS. The essential oils yield is 0.3 (v/w). Thirty nine components were comprised the 96.7% of the total essential oil extracted from the** plant sample**. The predominant compounds of plant were determined as β-pinene (28.5%), α-pinene (22.5%), limonene (4.6%) and α-terpinene (4.5%). The results were discussed with the genus patterns in means of chemotaxonomy and natural products.**

***Key words- Sideritis dichotoma*, GC-MS, essential oil, β-pinene, α-pinene.**

I. INTRODUCTION

In the Flora of Turkey *Sideritis* L. genus represented by 46 species and altogether 55 taxa, 42 taxa being endemic and this genus named ‘‘Dagcayi or Adacayi” in Turkey [1]. *Sideritis* genus is divided into 2 sections in Flora of Turkey according to their habitus, hair, bracts and calyx structures; these sections are *Hesiodia* Bentham and *Empedoclia* (Rafin.) Bentham. *S. dichotoma* is belongs to *Empedoclia* section. *Sideritis* taxa are annual or perennial herbs or small shrubs, aromatic, pilose or tomentose, with or without glands, rarely glabrous and an endemic plant in Flora of Turkey [2]. A large scale examination program is ongoing in Turkey to investigate the taxonomical, morphological, anatomical, caryological, palinological and genetic aspects of the *Sideritis* taxa [3]. The presence of ecotype variation, polymorphism and frequent hybridation between *Sideritis* species, made more difficult to classify for a long time; the classification of *Sideritis* is based on mainly their morphological, caryological, palinological and genetical aspects but in recent years botanical, phytochemical and pharmacological aspects of *Sideritis* taxa have taken place by some researhers [4-5].

The genus *Sideritis* is comprised by medicinal and aromatic plants widely used in folk medicine for their anti-inflammatory, antirheumatic, antimicrobial, digestive, diuretic [6], anti-inflammatory [7], antispasmodic - antibacterial, activities and often used as herbal tea and folk medicine in Turkey [8]. In the literature there have been some studies about essential oils of *Sideritis* taxa [9-10,5]. Most of the *Sideritis* taxa researched to date are richer in monoterpene hydrocarbons than in other terpenoid compounds [9].

In the present study, as a continuation of these studies we contribute to the knowledge of the essential oil compounds of aerial parts of *S. dichotoma* and to examine potential chemotaxonomic significance and potential usefulness of this plant.

II. MATERIALS AND METHODS

A. Plant Material

Plant sample was collected by Bagci (Bagci-3254) and Dogan from Kürşatlar (Baskil/Elazığ/Turkey) locality steppe, on June 2013, an altitude 1300-1350 m. Plant materials were identified with Flora of Turkey and East Aegean Islands [2]. The voucher specimens have been deposited at the Herbarium of department of Biology, Firat University (FUH).

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B. Isolation Of The Essential Oils

The air-dried aerial parts of the plant material were subjected to hydrodistillation using a Clevenger-type apparatus for 3 h.

C. Gas Chromatographic (GC) Analysis

The essential oil was analyzed using HP 6890 GC equipped with and FID detector and an HP- 5 MS column (30 m × 0.25 mm i.d., film tickness 0.25 µm) capillary column was used. The column and analysis conditions were the same as in GC-MS. The percentage composition of the essential oils was computed from GC-FID peak areas without correction factors.

D. Gas Chromatography / Mass Spectrometry (GC-MS) Analysis

The oils were analyzed by GC-MS, using a Hewlett Packard system. HP-Agilent 5973 N GC-MS system with 6890 GC in Plant Products and Biotechnology Research Laboratory (BUBAL) in Firat University. HP-5 MS column (30 m × 0.25 mm i.d., film tickness (0.25 µm) was used with helium as the carrier gas. Injector temperature was 250 ºC, split flow was 1 mL/min. The GC oven temperature was kept at 70 ºC for 2 min. and programmed to 150 ºC at a rate of 10 ºC/min and then kept constant at 150 ºC for 15 min to 240 ºC at a rate of 5 ºC / min. Alkanes were used as reference points in the calculation of relative retention indices (RRI). MS were taken at 70 eV and a mass range of 35-425. Component identification was carried out using spectrometric electronic libraries (WILEY, NIST). The composition of the essential oil of plant sample is reported in Table 1.

Table 1. Constituents of the essential oil of *Sideritis dichotoma*

Compounds	RRI*	*Sideritis dichotoma*
α-thujene	1016	1.5
α-pinene	1021	**22.5**
Camphene	1034	0.2
Sabinene	1052	1.8
β-pinene	1056	**28.5**
β-mrycene	1063	1.5
β-phellandrene	1077	0.8
δ-3-Carene	1084	0.6
α-terpinene	1091	**4.5**
p-cymene	1093	3.5
Limonene	1097	**4.6**
1,3-6-Octatriene	1116	0.1
γ-terpinene	1136	1.5
α-terpinolene	1138	0.4
1,6-Octadien-3-ol,3,7-dimethyl	1149	0.4
Nonanal	1176	0.3
Trans-pinocarveol	1179	0.3
Verbenol	1192	0.6
Pinocarvone	1198	0.4
Borneol	1203	0.4
3-cyclohexan-1-ol	1208	1.4
α-terpineol	1215	1.5
Mrytenol	1229	0.2
Trans-carveol	1231	0.4
α-cubebene	1285	2.5
Thymol	1297	0.3
Caryophyllene	1391	0.7
Epi-bicyclosesquiphellandrene	1416	0.9
Germacrene D	1436	0.2
Naphtalene	1440	0.3
Bicyclogermacrene	1443	1.6
α-amorphene	1456	3.1
δ-cadinene	1459	3.9
1H-3a-Methanoazulene	1466	2.1
Cis-3-Hexenyl benzoate	1489	0.4
Spathulenol	1493	0.5
Muurolol	1498	0.8
Benzyl-Benzoate	1594	1.3
2-Pentadecanone	1629	0.2
	Total	**96.7**

RRI*: Relative Retention Index

III. RESULTS AND DISCUSSION

In this study, essential oil composition of *S. dichotoma* was researched by GC and GC-MS. The essential oil yield is 0.3 (v/w). The predominant compounds of plant were detected as β-pinene (28.5%), α-pinene (22.5%), limonene (4.6%) and α-terpinene (4.5%) (Table 1). *Sideritis* taxa from Turkey classified into six groups by the major essential oil components; these groups were "monoterpene hydrocarbon-rich", "sesquiterpene hydrocarbon-rich", oxygenated monoterpene-rich", "oxygenated sesquiterpene-rich", "diterpene-rich" and "others". 57% of Turkish *Sideritis* taxa include monoterpene hydrocarbons as the main components, among these α-pinene, β-pinene, β-phellandrene, sabinene and myrcene were detected in high amounts [11]. Kirimer *et al.*, (2004) determined a correlation between the oil yield and the major groups of constituents in *Sideritis* essential oil from Turkey; the higher oil yield, the higher the monoterpene hydrocarbon content; the lower the oil yield, the higher the sesquiterpene content is [11]. β-caryophyllene (17.30%), β-pinene (13.29%), sabinene (12.17%) and limonene (5.65%) were the main constituents of *S. erythrantha* Boiss. & Heldr. var. *erythrantha* and the major constituents of *S. erythrantha* var. *cedretorum* were α-bisabolol (7.80%), β-pinene (6.78%), limonene (5.60%) and α-terpinene (5.53%) [12]. Similarly, in this study the essential oil of *S. dichotoma* was characterized by a high content of β-pinene (28.5%), α-pinene (22.5%), limonene (4.6%) and α-terpinene (4.5%) (Table 1). In another study, the main components two varietes of *S. erythrantha* (var. *erythrantha* and var. *cedretorum*) were; myrcene (24.3% - 21.9%), α-pinene (16.3%-19.5%) and sabinene (6.1% - 10.4%) respectively [13]; like this study, α-pinene (22.5%) was found to be one of the main compounds of *S. dichotoma*, whereas β-myrcene (1.5%) and sabinene (1.8%) was detected only low amounts (Table 1). Chalchat & Ozcan (2005) reported that, *S. erythrantha* var. *erythrantha* essential oil included α-pinene (25.13%), eucalyptol (8.83%), linalool (7.88%), α-bisabolol (7.32%) and germacrene-D (5.87%) as the major constitents [14]. In our study, eucalyptol, linalool, α-bisabolol were absent and germacrene D (0.2%) present only in low percentages (Table 1).

According to Kirimer *et al.*, (2004) α-pinene (10.0%) and β-pinene (14.0%) showed the highest percentage in the *S. vulcacina* oil; α-pinene (15.5%) and β-pinene (28.5%) was also characterized by the presence of *S. dichotoma* oil (Table 1). Aligiannis *et al.*, (2001) detected that, α-pinene (20.11%), (3.63%), (24.85%), (35.21%) and β-pinene (7.31%), (9.06%), (17.99%), (8.75%) were determined the main compounds of *S. clandestina* subsp. *clandestina, S. raeseri* Boiss. & Heldr. subsp. *raeseri, S. raeseri* subsp. *attica, S. sipylea* Boiss., respectively [15]; similarly α-pinene (22.5%) and β-pinene (28.5%) were the main components of *S. dichotoma* in this study (Table 1). β-caryophyllene (30.3%), α-cadinol (16.9%), β-pinene (10.6%) were detected the major components *S. montana* L. subsp. *montana*; α pinene (15.5%), 1,8-cineole (13.9%), caryophyllene oxide (9.7 %) were identified the major components of *S. vulcacina* Hub.-Mor. and the oils were complex mixtures of sesquiterpenes, monoterpenes and non-terpenes [5]. In another study, *S. albiflora* Hub.-Mor. included high amounts trans-caryophyllene (17.4%), α-pinene (15.4%), β-pinene (13.5%), cadinene (12.1%), pulegone (9.7%) and myrcene (6.5%) [16]. However, in our study, 1,8-cineole, α-cadinol, β-myrcene, pulegone were absent or present only in low percentages (Table-1).

In conclusion, monoterpene (α-pinene, β-pinene, limonene, α-terpinene) are characteristic for *S. dichotoma* and these components possible chemotaxonomical markers of this plant. The cited results in this text showed that the genus *Sideritis* had a considerable variation in respect to essential oil composition. This study demonstrates the occurrence of the β-pinene, α-pinene chemotype of *S. dichotoma* in the eastern Anatolian region of Turkey and the essential oil results have given some clues on the chemotaxonomy of the genus patterns and usability of this species as natural product. According to the results, *S. dichotoma* was found to be rich in respect to essential oils. Furthermore, the chemical datas of this study with *S. dichotoma* might be helpful in potential usefulness and chemotaxonomy of *Sideritis* taxa.

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