JAP&T
TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2019, *25* (2), 106-110

Journal of Agroalimentary Processes and Technologies

Chemical constituents of essential oils of *Salvia heldreichiana* Boiss. Ex Bentham and *Salvia tomentosa* Mill.

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Abstract

Essential oils from dried aerial parts of *Salvia heldreichiana* Boiss. Ex Bentham and *Salvia tomentosa* Mill. were analysed using gas chromatography-mass spectrometry (GC-MS). The air dried plant materials were subjected to hydrodistillation for 4 h using a Clevenger type apparatus to give yellow oils in 0.5% (*S. heldreichiana*) and 1.3% (*S. tomentosa*), respectively. Seventy and fifty-four constituents were identified in the oils of both plants, representing 95.2 and 96.9% of the total oil. While α-Pinene (8.19%), β-pinene (14.89%), linalool (5.06%) and α-terpineol (6.19%) were established as major constituents of *S.heldreichiana*, α-pinene (5.24%), β-pinene (44.78%), myrcene (7.41%), eucalyptol (12.11%) were found as major constituents of *S.tomentosa* oil.

Keywords: *S. heldreichiana*, *S. tomentosa*, essential oil, constituents, β-pinene

1.Introduction

Salvia L. is the largest genus of the family Labiatae, including over 900 species in the world and represented in Turkey by 94 taxa belonging to 89 species with 50% endemism [1,2]. *Salvia* species are commonly used in Anatolia for colds, stomach aches, and sore throats. A solution of *Salvia tomentosa* is also used by pouring onto the open cuts and called "Tenturdiyot otu (Iodine tincture herb), "Moşabla" or "Boş yaprak". Many species and varieties of this family are cultivated in many parts of the world [3,4]. *Salvia* oil is used as a flavour and food condiment, and in cosmetics, perfumes and medicine [4,5]. An infusion of aerial parts of *Salvia* spp. is used as a tonic, carminative, antiseptic, spasmolytic, astringent, haemostatic and diuretic [6,7]. Many of wild growing *Salvia* species are sometimes used in traditional medicine of different nations instead of sage or as an adulteration, because of very similar surface and shape of leaves [8].

Some of the essential oils and phenolic compounds of plants belonging to this genus have also shown excellent antimicrobial activity as well as antioxidant capacity [9,10].

In this report, we present an analysis of essential oils in the *Salvia heldreichiana* Boiss. Ex Bentham and *Salvia tomentosa* Mill. growing wild in Turkey. The differences in essential oil content and composition are compared with results of literature.

2. Materials and Methods

2.1. Materials

Plant materials were collected from Taurus mountains in Turkey. *Salvia heldreichiana* Boiss. Ex Bentham and *Salvia tomentosa* Mill.from Bozkır-Konya and *Osmaniye* provinces. Herbarium speciments [*Salvia heldreichiana* Boiss. Ex Bentham (O Tugay 7110) and *Salvia tomentosa* Mill. (O. Tugay 7200.] were deposited at the Department of Biology, Faculty of Science, Selçuk University, Turkey.

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2.2. Recovery of the essential oils

Dried aerial parts of the plants (200 g) were ground and submitted to hydrodistillation for 4 h using a Clevenger-type apparatus and the oils obtained were dried over anhydrous sodium sulfate. The essential oils were light yellow with yield of 0.5% and 1.3 %, v/w, on dry basis, respectively.

2.3. Idendification of components

For identification of components, analytical HP 5890 gas chromatograph equipped with FID (GC) was performed a DELSI 121 C apparatus fitted with a flame ionization detector and a CP WAX 51 fused silica column (25 m x 0.3 mm; 0.25 µm film thickness). Temperature was programmed from 50°C for 5 min and to reach 220°C at the rate of 3°C per min. ACP WAX 51 fused silica WCOT column (60 m x 0.3 mm) for GC/ MS was used with helium as carrier gas (flow rate 1 ml/min) and coupled to a HP mass spectrometer: ionization energy 70 eV. Temperature programming was from 50-240°C at the rate 3°C/min. The samples were injected at injector temperature 240°C. The components were identified by comparing linear Kovats indices (KI), their retention times (RT) and mass spectra with those obtained from the authentic samples and/or the MS library. Qualitative analysis was based on a comparison of retention times and mass spectra with corresponding data in the literature [11].

3.Results and Discussion

Chemical composition of essential oils of *Salvia heldreichiana* Boiss. Ex Bentham and *Salvia tomentosa* Mill. are give n in Table 1. The air dried plant materials were subjected to hydrodistillation for 4 h using a Clevenger type apparatus to give yellow oils in 0.5% (*S. heldreichiana*) and 1.3% (*S.tomentosa*), respectively. Essential oils from dried aerial parts of *S. heldreichiana* and *S. tomentosa* were analysed using gas chromatography-mass spectrometry (GC-MS). Seventy and fifty –four constituents were identified in the oils of both plants, representing 95.2 and 96.9% of the total oil. α-Pinene (8.19%), β-pinene (14.89%), β-phellandrene (4.27%), linalool (5.06%), borneol (4.41%), terpinene-4-ol (4.14%), cryptone (4.54%), α-terpineol (6.19%) and caryophyllene oxide (3.13%) were established as major constituents of *S.heldreichiana* .

In addition, α-pinene (5.24%), β-pinene (44.78%), myrcene (7.41%), eucalyptol (12.11%), camphre (2.68%) were found to be the major constituents of *S.tomentosa* oil. As seen Table 1, β-pinene, myrcene and eucalyptol contents of *S.tomentosa* were found higher than that of *S.heldreichiana*. In addition, α-pinene, β-phellandrene, linalool, borneol, terpinene-4-ol, cryptone, α-terpineol and caryophyllene oxide contents of *S.heldreichiana* were found partly high compared with *S.tomentosa* oil. The obtained results show that there are clear differences in the quantity of essential oil (0.073% for *S. pratensis* and 0.0016% for *S. berolonii*). The aerial parts of *Salvia palaestina* and *S. tomentosa* were hydro-distilled to produce the oils and it is determined as 0.4% (v/w) and 0.3% (v/w) oil yields respectively [12]. The major compound in the essential oil of *S. pratensis* was *E*-caryophyllene (26.4%) while in *S. berolonii* essential oil caryophyllene oxide was the major component (35.1%) [13]. Başer [2] reported that some Turkish *Salvia* species (*S. recognita, S. aytachii, S.aucheri, S. multicaulis, S. fruticosa, S. cryptantha, S. cyanescens, S. cadmica and S. myrnaea*) contain camphor and 1.8-cineole as major constituents. Baser *et al*., [14] reported that *S. crypthanta* includes 1-8 cineole (15.69-37.12%) and *S. aytachii* includes camphor (30.78%) and 1,8-cineole (27.28%) as main component from Turkey. There are also some results about spathulenol as a main component in the *Salvia* spp. Water distilled essential oils from the aerial parts of *Salvia* species from Turkey were analysed by GC and GC/MS. *Salvia aucheri* var. *aucheri*, *Salvia aramiensis*, and *Salvia fruticosa* oils have te same main constituent: 1,8-cineole (39.2%, 55.6%, and 52.8% respectively). α-Pinene (25.1%), camphor (14.9%), and borneol (13.2%) were identified as the major components of *Salvia tomentosa*. The main constituents, β-pinene (21.4%) and 1,8-cineole (16.1%), were also the major constituents in the oil of *Salvia verticillata* subsp. *amasiaca*. *S. verticillata* subsp. *amasiaca*, *S. aucheri* [15].

In a previous study, the essential oils of *S. aucheri* subsp. *aucheri* from a different locality in Turkey were shown to contain α-pinene (7.6% to 4.3%), *β*-pinene (6.1% to 4.0%), and 1,8-cineole (39.2% to 20.3%) [16]. The major constituents of *S. tomentosa* were α-pinene (33.7%), germacrene D (7.5%), β-pinene (6.8%), α-humulene (6.0%), veridiflorol (3.8%) and limonene (3.1%) [12]

Table 1. Chemical composition of *Salvia heldreichiana* and *Salvia tomentosa* (%)[a].

RT	Constituents	*Salvia heldreichiana*	*Salvia tomentosa*
9.77	tricyclene	0.028[b]	0.060
9.92	α- thujene	1.177	0.546
10.19	α- pinene	8.189	5.239
10.77	Camphene	0.792	1.279
11.61	Sabinene	2.066	1.842
11.78	β- pinene	14.89	44.778
11.91	1-Octene-3-ol	0.493	0.653
12.09	3-Octanone	0.198	0.061
12.2	Myrcene	1.840	7.409
12.51	3-Octanol	0.316	0.061
12.69	Mentha-1(7),8-diene(origan)	0.591	-[c]
12.77	α-phellandrene	0.122	-
13.14	α-terpinene	0.480	-
13.41	p-Cymene	1.786	0.141
13.56	Limonene	1.838	0.857
13.62	β-phellandrene (origan)	4.272	0.611
13.69	Eucalyptol	2.435	12.101
13.79	(Z)-β-ocimene	0.195	0.099
14.14	(E)-β-ocimene	0.409	-
14.53	γ- terpinene	1.190	0.142
14.97	Cis oxyde de linalol	1.459	
15.41	Terpinolene	0.275	0.080
15.49	Trans-Oxyde de linalool	0.701	0.142
15.91	Linalool	5.055	0.924
16.01	Hotrienol	0.063	-
16.68	Menthe-2-ene-1-ol cis para	0.540	-
16.75	α-Campholenal	0.303	-
17.15	Nopinone	0.402	0.056
17.2	Trans -pinocarveol	1.357	0.584
17.23	Menthe-2-ene-1-ol trans para	0.280	-
17.4	Camphre	1.490	2.682
17.9	Cis pinocamphone	-	0.277
17.63	Sabina-Cetione	0.365	-
17.85	Pinocarvone	0.601	0.192
18.17	Borneol	4.408	0.475
18.37	pinocamphone	-	0.195
18.4	Terpinene-4-ol	4.131	0.431
18.61	Cryptone	4.540	
18.85	α-terpineol	6.190	2.137
19.22	Verbenone	0.401	-
19.51	Trans-Carveol	0.400	-
19.64	m-Isopropylphenol	0.360	-
19.79	Formate de bornyle	0.086	-
20.19	Cuminaldehyde+carvone peut etre	1.560	-
20.32	Formate de linalyle	0.272	
20.36	Piperitone	0.303	-
21.18	Phellandral	0.734	-
21.43	Acetate de bornyle	0.164	-
21.54	p-cymen-8-ol	0.713	-
21.71	Carvacrol	0.126	-
22.97	Acetate d'alpha terpenyl	0.312	-
23.03	α-cubebene	-	0.722
23.25	Acetate de neryle	0.133	-
23.76	Acetate de geranyle	2.210	-
23.79	α-copaene	-	0.187
23.97	β bourbonnene	0.373	0.093

Table 1. *(continue)*

RT	Constituents	*Salvia heldreichiana*	*Salvia tomentosa*
24.09	β-cubebene	-	0.062
24.89	B-caryophyllene	0.610	1.077
25.13	β-copaene	0.091	-
25.51	Geranyle acetone	0.121	-
25.78	α- humulene	0.412	0.457
25.88	Allo-aromadandrene	0.210	-
26.24	Gamma-muurolene	-	0.090
26.35	Ar curcumene	0.120	-
26.41	Germacrene D	-	0.776
26.61	β-selinene	-	0.138
27.23	γ-cadinene	-	1.256
27.33	ô-cadinene	-	0.152
28.52	ledol	-	0.119
28.66	Spathulenol	0.540	0.494
28.8	Oxyde de caryophyllene	3.133	0.242
29.03	Salvial-4(14)-en-1-one(origan)wiley	0.052	0.068
29.31	Epi-globulol	-	0.122
29.42	Humulene-1,2-epoxyde	1.735	0.311
30.4	β-Eudesmol	0.935	
30.84	valeranone	-	0.417
33.02	Myristate de methyle	0.249	0.160
34.56	Diethylphtalate	0.021	-
35.85	Palmitate de methyle	1.085	-
35.86	Hexadecanoic acid	-	0.949
38.33	Abietatriene	0.104	-
38.95	Linoleate de methyle	0.440	1.052
39.08	Oleate de methyle	1.264	1.932
39.56	Stearate de methyle	0.422	0.362
Total (%)		**95.2**	**96.9**

[a]Compound listed in the order of elution from a HP-5MS column.
[b]Each compound is mean of two values
[c]unidentified

The water-distilled essential oils from dried aerial parts of *Salvia blepharochlaena*, *S. caespitosa*, *S. divaricata*, *S. hypargeia*, *S. longipedicellata* and *S. pilifera* (Lamiaceae) were analysed by GC–MS, and α-pinene, β-pinene, 1,8-cineole, thymol, caryophyllene oxide, α-thujone respectively, were the major constituenst of the oils [17]. According to our survey of the available literature on the composition of *Salvia* species, our data partially agrees with previous studies. As a result, it can be said that plant derivatives are good phenol resources. Also, several derivatives such as essential and extracts of medicinal and aromatic plants can be used as preservatives for food. Further studies should be carried out on biofunctional properties of these plant derivatives *in vitro*.

4.Conclusions

- All plants were very rich in essential oils, yielding 0.5% and 1.35% v/dry weight.
- These results show that these plants are remarkably variable species.
- The high quantities of α-Pinene, β-pinene, α-terpineol, myrcene, eucalyptol.
- Especially, *Salvia heldreichiana* Boiss. Ex Bentham and *Salvia tomentosa* Mill contained monoterpene hydrocarbons constituents.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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