INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 4, No. 7, p. 95-99, 2014

SHORT COMMUNICATION OPEN ACCESS

Aroma profile of summer savory cultivated under greenhouse conditions in Kavar, Iran

Mohammad Kazemimiraki, Shahram Sharafzadeh*

Department of Agriculture, Firoozabad Branch, Islamic Azad University, Firoozabad, Iran

Key words: *Satureja hortensis*, essential oil, carvacrol, γ-terpinene, GC-MS.

http://dx.doi.org/10.12692/ijb/4.7.95-99 Article published on April 01, 2014

Abstract

Summer savory is an annual plant belonging to Lamiaceae family. Medicinal activities of this plant can be due to their essential oils that include different amounts of active substances. The shoots of this plant cultivated under greenhouse conditions in Akbarabad, Kavar, Fars province, Iran were subjected to hydrodistillation at full bloom stage. Isolated essential oil was analyzed by GC-MS. Major oil components were carvacrol (50.90%), γ-terpinene (31.73%), α-terpinene (5.02%), p-cymene (3.66%), myrcene (1.80%) and α-thujene (1.21%).

* **Corresponding Author:** Shahram Sharafzadeh ✉ shahramsharafzadeh@hotmail.com

Introduction

The genus *Satureja* from Lamiaceae (Labiatae) family indicates approximately 200 species with wide distribution in the Mediterranean area, Asia and Northern America (Senatore *et al.*, 1998). It presents 14 aromatic species in Iran which eight of them are endemic (Sefidkon and Jamzad, 2006). Medicinal properties of these species can be due to their essential oils that include different amounts of active substances such as carvacrol and thymol (Hadian *et al.*, 2011). Active substances of *Satureja* plants result in antifungal and antibacterial activities (Behravan *et al.*, 2004; Vagionas *et al.*, 2007) and antioxidant property (Eminagaoglu *et al.*, 2007). Literatures reveal that the volatile oils are natural larvicidal substances (Michaelakis *et al.*, 2007). Essential oil of *Satureja* has antiviral activity against HIV (Yamasaki *et al.*, 1998) and improves fertility (Haeri *et al.*, 2006).

Summer savory (*Satureja hortensis* L.) is an annual plant. It is native to southern Europe and central and south-west of Asia (Boskabady *et al.*, 2007; Gontaru *et al.*, 2008). This plant can use as additives for many foods and is also used in the traditional medicine to treat muscle pains, indigestion and infection diseases (Gontaru *et al.*, 2008).

Environmental and geographical conditions can influence on volatile oils significantly. Researchers identified thirty seven components when *S. hortensis* grown under greenhouse conditions in Firoozabad, Iran (Sharafzadeh *et al.*, 2013) and identified twenty one constituents when plants were from Khorasan Province, Iran (Hassanzadeh-Khayyat *et al.*, 2012) and the main components were γ-terpinene and carvacrol, respectively. The aim of this study was identification of essential oil components of summer savory cultivated under greenhouse conditions in Akbarabad, Kavar, Fars province, Iran.

Materials and methods

Plant materials and experimental conditions

This study was conducted under greenhouse conditions in Akbarabad, Kavar, Fars province, Iran. The seeds of summer savory were sown in the pots containing about 3 Kg soil mixtures and thinned at 4-6 leaves stage to one plant per each pot. The pot mixture was tested before sowing and showed PH=7.59, organic C=0.19%, total N=0.02%, available P=77 mg/kg, available K=453.33 mg/kg, TNV=40.75% and EC=2.35 ds/m. The experiment was carried out using three replications. Each replicate contained 6 pots. The Plants were kept at 22±3/14±3°C day/night temperatures. The shoots were collected at full bloom and dried at room temperature.

Essential oil isolation

Isolation of essential oils was performed using hydrodistillation of dried sample of shoots using a Clevenger-type apparatus over 3 hours. The oils were dried over sodium sulphate.

Identification of oil components

Isolated essential oils from three replications were mixed and analyzed by GC-MS (Agilent Technologies-5975C-MS, 7890A-GC) equipped with a HP-5MS column (30 m × 0.25 mm, 0.25 µm film thickness). GC condition was as follows: The oven temperature increased from 60 to 210°C at a rate of 3°C/min then 210 to 240°C at a rate of 20°C/min and the final temperature kept for 8.5 min. The electron ionization energy was 70eV in the electronic ionization (EI) mode, ion-source: 230°C, Detector: MS, Interface line temperature: 280°C, Injector: 280°C, Split ratio: 1:50, Carrier Gas: He (1 ml/min), mass range: 50-480. The software was Chemstation. The retention indices for all the components were determined according to the Van Den Doll method using n-alkanes as standard. The compounds were identified by comparison of retention indices with those reported in the literature and by comparison of their mass spectra with the Wiley.

Results and discussion

Chromatogram of the GC-MS analysis of volatile oils (Figure 1) indicated six major peaks at times of 5.41, 7.12, 7.98, 8.24, 9.61 and 19.68 minutes for α-thujene, myrcene, α-terpinene, p-cymene, γ-terpinene and

carvacrol, respectively. Analysis of the essential oils has been shown in Table 1. Forty two components were identified in summer savory oil. The major components were carvacrol (50.90%), γ-terpinene (31.73%), α-terpinene (5.02%), p-cymene (3.66%), myrcene (1.80%) and α-thujene (1.21%). Tricyclene, octanol, 1,8-cineole, (Z)-β-ocimene, cis-dihydro carvone, trans-dihydro carvone, δ-elemene, eugenol, aromadendrene, α-humulene, β-sesquiphellandrene and caryophyllene oxide were less than 0.05%. Other components were in the range of 0.05-1.00%.

Table 1. Aroma profile of summer savory cultivated under greenhouse conditions.

No	RI	Compound name	%
1	920	Tricyclene	t
2	923	α-Thujene	1.21
3	930	α-Pinene	0.90
4	944	Camphene	0.07
5	969	Sabinene	0.09
6	973	β-Pinene	0.58
7	987	Myrcene	1.80
8	991	3-Octanol	t
9	1002	α-Phellandrene	0.43
10	1008	δ-3-Carene	0.08
11	1014	α-Terpinene	5.02
12	1021	p-Cymene	3.66
13	1024	Limonene	0.32
14	1025	β-Phellandrene	0.28
15	1028	1,8-Cineole	t
16	1033	(Z)-β-Ocimene	t
17	1043	(E)-β-Ocimene	0.11
18	1060	γ-Terpinene	31.73
19	1064	cis-Sabinene hydrate	0.09
20	1084	Terpinolene	0.06
21	1091	Methyl benzoate	0.06
22	1095	trans-Sabinene hydrate	0.11
23	1161	Borneol	0.10
24	1173	Terpinene-4-ol	0.22
25	1190	α-Terpineol	0.06
26	1198	cis-Dihydro carvone	t
27	1206	trans-Dihydro carvone	t
28	1239	Carvacrol methyl ether	0.16
29	1289	Thymol	0.18
30	1297	Carvacrol	50.90
31	1333	δ-Elemene	t
32	1353	Eugenol	t
33	1369	Carvacrol acetate	0.18
34	1414	(E)-Caryophyllene	0.27
35	1433	Aromadendrene	t
36	1448	α-Humulene	t
37	1491	Bicyclogermacrene	0.18
38	1504	β-Bisabolene	0.73
39	1519	β-Sesquiphellandrene	t
40	1538	(E)-γ-Bisabolene	0.08
41	1572	Spathulenol	0.07
42	1578	Caryophyllene oxide	t

Literatures show that γ-terpinene is converted to p-cymene by aromatization and p-cymene can convert to thymol by hydroxylation, on the other hand, thymol and carvacrol are isomer (Nhu Trang *et al.*, 2006; Michaelakis *et al.*, 2007). Therefore, under present experimental conditions, most of p-cymene has been converted to carvacrol (50.90%) instead of thymol (0.18%).

According to analysis of the pot soil (section of materials and methods), available phosphorus was at high level (77 mg/Kg). Phosphorus has important role in essential oil biosynthesis. Besides production of pyruvate, it is present in ATP, NADP and CoA structure which terpenoids biosynthesis depend on such coenzymes (Sell, 2003; Kapoor *et al.*, 2004).

Sharafzadeh *et al.* (2013) showed thirty seven compounds in the essential oils of *S. hortensis* grown under greenhouse conditions. γ-terpinene (45.3-49.4%) and carvacrol (37.0-41.3%) were the major components.

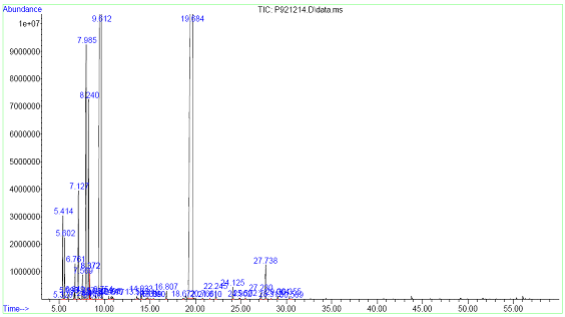

Fig. 1. GC-MS chromatogram of volatile oils of summer savory.

Essential oil of the aerial parts of *S. hortensis*, from the Khorasan province, Northeast of Iran revealed twenty-one compounds that the main oil constituents were carvacrol (55.69 %), γ-terpinene (24.93 %) and p-cymene (4.07 %) (Hassanzadeh-Khayyat *et al.*, 2012).

Another investigation (Karimi *et al.*, 2012) with aerial parts of *S. hortensis* cultivated in growth chamber indicated that the main components before flowering were carvacrol (47.77%), γ-terpinene (17.99%), cymene (5.04%) and after full flowering were carvacrol (49.96%), n-hexadecanoic acid (2.60%), Cymene (2.54%), β- bisabolene (2.53%), and α-terpinene (2.40%).

In conclusion, volatile oil constituents and their quantities could be markedly affected by geographical environment, plant age, physical and chemical characteristics of soil, oil isolation method, etc.

References

Behravan J, Ramezani M, Kasaian J, Sabeti Z. 2004. Antimycotic activity of the essential oil of *Satureja mutica* Fisch & C.A. Mey from Iran. Flavour and Fragrance Journal **19,** 421-423. http://dx.doi.org/10.1002/ffj.1328

Boskabady MH, Aslani MR, Mansuri F, Amery S. 2007. Relaxant effect of *Satureja hortensis* on guinea pig tracheal chains and its possible mechanism(s). DARU **15,** 199-204.

Eminagaoglu O, Tepe B, Yumrutas O, Akpulat HA, Daferera D, Polissiou M, Sokmen A. 2007. The in vitro antioxidative properties of the essential oils and methanol extracts of *Satureja spicigera* (K. Koch.) Boiss. and *Satureja cuneifolia* ten. Food Chemistry **100,** 339-343. http://dx.doi.org/10.1016/j.foodchem.2005.09.054

Gontaru L, Plander S, Simandi B. 2008. Investigation of *Satureja hortensis* L. as a possible source of natural antioxidants. Hungarian Journal of Industrial Chemistry **36,** 39-42.

Hadian J, Mirjalili MH, Kanani MR, Salehnia A, Ganjipoor P. 2011. Phytochemical and morphological characterization of *Satureja khuzistanica* Jamzad populations from Iran. Chemistry and Biodiversity **8,** 902-915. http://dx.doi.org/10.1002/cbdv.201000249

Haeri S, Minaie B, Amin G, Nikfar S, Khorasani R, Esmaily H, Abdollahi M. 2006. Effect of *Satureja khuzistanica* essential oil on male rat fertility. Fitoterapia **77,** 495-499.

Hassanzadeh-Khayyat M, Rahimizadeh M, Azadi M, Sahebkar A. 2012. Phytochemical analysis of *Satureja hortensis* L. essential oil from Iran. Analytical Chemistry Letters **2,** 192-197. http://dx.doi.org/10.1080/22297928.2000.10648269

Kapoor R, Giri B, Mukerji KG. 2004. Improved growth and essential oil yield and quality in *Foeniculum vulgare* mill on mycorrhizal inoculation supplemented with P-fertilizer. Bioresource Technology **93,** 307-311.

Karimi N, Yari M, Ghasmpour HR. 2012. Identification and comparison of essential oil composition and mineral changes in different

phenological stages of *Satureja hortensis* L. Iranian Journal of Plant Physiology **3,** 577-582.

Michaelakis A, Theotokatos SA, Koliopoulos G, Chorianopoulos NG. 2007. Essential Oils of *Satureja* species: Insecticidal effect on *Culex pipiens* larvae (Diptera: Culicidae). Molecules **12,** 2567-2578. http://dx.doi.org/10.3390/12122567

Nhu Trang TT, Casabianca H, Grenier Loustalot MF. 2006. Deuterium/hydrogen ratio analysis of thymol, carvacrol, γ-terpinene and *p*-cymene in thyme, savory and oregano essential oils by gas chromatography-pyrolysis-isotope ratio mass spectrometry. Journal of Chromatography **1132,** 219-227.

Sefidkon F, Jamzad Z. 2006. Essential oil analysis of Iranian *Satureja edmondi* and *S. isophylla*. Flavour and Fragrance Journal **21,** 230-233. http://dx.doi.org/10.1002/ffj.1562

Sell CS. 2003. A Fragrant Introduction to Terpenoid Chemistry. The Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, UK. 410 p.

Senatore F, Urrunaga Soria E, Urrunaga Soria R, Della Porta G, De Feo V. 1998. Essential oils from two peruvian *Satureja* species. Flavour and Fragrance Journal **13,** 1-4. http://dx.doi.org/10.1002/(SICI)10991026(199801/02)13:1<1::AID-FFJ672>3.0.CO;2-4

Sharafzadeh SH, Sabahi A, Ordookhani K, Zare M. 2013. Growth and active substances of summer savory as affected by PGPR. Journal of Novel Applied Sciences **2,** 997-1000.

Vagionas K, Graikou K, Ngassapa O, Runyoro D, Chinou I. 2007. Composition and antimicrobial activity of the essential oils of three *Satureja* species growing in Tanzania. Food Chemistry **103,** 319-324. http://dx.doi.org/10.1016/j.foodchem.2006.07.051

Yamasaki K, Nakano M, Kawahata T, Mori H, Otake T, Ueba N, Oishi I, Inami R, Yamane M, Nakamura M, Murata H, Nakanishi T. 1998. Anti-HIV-1 activity of herbs in Labiatae. Biological and Pharmaceutical Bulletin **21,** 829-833.