Volatile oil constituents of alecost [*Tanacetum balsamita* L. ssp. *balsamitoides* (Schultz-Bip.)] growing wild in North-West of Iran

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Summary

The hydrodistilled essential oil of aerial parts of *Tanacetum balsamita* L. ssp. *balsamitoides* (Schultz-Bip.) Asteraceae growing spontaneously in Tabriz (North-West of Iran) was analyzed by GC-MS. Twenty-three components comprising 96.83% of the total essential oil were identified. Oxygenated monoterpens (87.93%) were the major class of identified components. Sesquiterpene hydrocarbons (6.66%) were the second class. Main monoterpene constituents of the aerial parts essential oil were carvone (49.11%), α-thujone (24.6%), β-thujone (2.68%) and 1,8-cineole (2.59%). β-bisabolene (4.44%) a sesquiterpene hydrocarbone was also present in significant amounts. According to the volatile oil profile, *T. balsamita* L. ssp. *balsamitoides* (Schultz-Bip.) plant studied in the present experiment was belong to the carvone/α-thujone chemotype that produces appreciable amounts of β-bisabolene.

Key words: *Tanacetum balsamita L. ssp. balsamitoides (Schultz-Bip.), Asteraceae, essential oil, GC-MS, carvone, α-thujone, β-bisabolene*

Alecost *[Tanacetum balsamita* L. ssp. *balsamitoides* (Schultz-Bip.)] belongs to the *Asteraceae* family and *Anthemideae* tribe [1, 2]. Alecost is a perennial rhizomaceous plant with yellow tubular flowers representing typical appearance of *Asteraceae* flowers [3, 4]. This plant of Asian origin is widely grown in Europe and Asia [5-7]. Alecost is one of the most important traditional medicinal plants used in Iran and has been naturalized and cultivated in North-West of Iran in last two decades [2, 7]. This plant is propagated by rhizome cuttings or division. However, seed propagation is not satisfactory [8, 9]. Alecost is rich in different phytochemicals such as essential oil, phenylpropane derivatives, flavones, sesquiterpene lactones, tannins and oligoelements [10]. Essential oil extracted from aerial parts is the main phytochemical applied in traditional and modern medicine. Alecost has been used to flavor different kinds of food, cakes and drinks as well as in confectionery [2, 9, 11]. For therapeutic purposes alecost and its preparations have been used as hepatoprotective, antimicrobial, antiallergenic, sedative, antiseptic, astringent, digestive, carminative and cardiotonic [7, 9-13]. There are reports that essential oil derived from this plant has been used as an insecticide such as its counterparts *Chrysanthemum cinerariaefolium* L. and *Tanacetum vulgare* L. This activity is due to the presence of pyrethrin1, thujones and levo- carvone in essential oil of this plant [4, 6, 9]. Teixeira da Silva [4] reported that sesquiterpene constituents of this plant have allelophatic effects. According to the dominant terpenes of essential oil four chemotypes have been reported for alecost [4, 10]:

1) carvone type
2) camphor type
3) camphor- thujone type
4) carvone- α-thujone type

Bylaite et al. [9] identified 78 constituents in the essential oil of alecost with carvone – the most abundant component up to 80%. Gallori et al. [11] reported that carvone, camphor and thujone were the predominant components of essential oils studied in Romania, Poland, Germany and Russia. Carvone was the more abundant component of alecost grown in Turkey and Spain (52% and 56%, respectively) [3, 6]. The aim of our study was to identify the volatile constituents of aerial parts essential oil of *T. balsamita* L. ssp. *balsamitoides* (Schultz-Bip.) growing wild in North-West of Iran.

MATERIAL AND METHODS

Plant material

Aerial parts of *T. balsamita* L. ssp. *balsamitoides* (Schultz-Bip.) were collected at flowering stage in late July 2006 from Tabriz, Iran. A voucher specimen was deposited in the herbarium of the Faculty of Agriculture, University of Maragheh, Iran.

Isolation of essential oil

Fresh aerial plant parts were dried for 4 days in the shade at room temperature. 100 grams of chopped material was subjected to for 2 h hydrodistillation using a Clevenger type apparatus for 2h. Hydrodistillation was carried out in triplicate. Essential oils were dried over anhydrous sodium sulphate and refrigerated in sealed vials until analysis.

Gas chromatography–mass spectrometry analysis

The oils were analyzed by GC-MS using a Shimadzu GC/MS – QP 5050A system equipped with an apolar DB-5 (5% phenyl polymethyl siloxane) capillary column (60 m x 0.25 mm i.d. and 0.25 μm film thickness). The carrier gas was helium with a flow rate of 0.7 ml/min. Oven temperature was 80°C for 6 min, programmed at 2°C/min to 200°C with hold time of 2 min in this temperature. Subsequently, 200°C to 290°C with 1°C/min, and finally kept constant at 290°C for 2 min. Injector and detector temperatures were 260°C and 300°C respectively. Injection volume was 1 μL of oil in n-hexane (3% solution of essential oil in n-hexane). Split ratio was 1:60. The MS operating parameters were as follows: ionization potential 70 eV, ion source temperature: 200°C, resolution: 1000, solvent cut time: 3.0 min. The quadrupole mass spectrometer was scanned over the 30–600 amu.

Identification and quantification of constituents

Relative percentage amounts of essential oil constituents were calculated from peak total area by apparatus software. Identification of the essential oil components was based on comparison of mass spectra and retention time with those found in the literature [6, 9, 11, 14] and by computer matching with NIST and NBS54 library as well as by comparison of the fragmentation pattern of the mass spectral data with those had reported in the literature [14].

RESULTS AND DISCUSSION

The hydrodistillation of the aerial parts of *T. balsamita* L. ssp. *balsamitoides* (Schultz-Bip.) gave a pale yellow liquid with a mean yield of 0.58% (V/W) based on dry weight. Table 1 lists the essential oil constituents in order of their elution from the DB-5 column, their percentage and retention indices on DB-5 column. Twenty-three constituents were identified in the volatile oil of alecost, representing 96.83% of the oil. Table 2 shows the main classes of identified constituents of the volatile oil.

Table 1.

Volatile oil constituents of *Tanacetum balsamita* L. ssp. *balsamitoides* (Schultz-Bip.) from Iran

No.	compound	RI	%
1	ρ-cymene	1025	0.57
2	1,8-cineole	1031	2.59
3	α-thujone	1102	24.6
4	β-thujone	1114	2.68
5	trans-ρ-mentha-2,8-dienol	1123	1.4
6	cis-ρ-mentha-2,8-dienol	1138	0.71
7	trans-pinocarveol	1139	0.43
8	cis-verbenol	1141	0.35
9	trans-verbenol	1145	0.3
10	pinocarvone	1165	0.36
11	terpinen-4-ol	1177	0.3
12	trans-ρ-mentha-1(7),8-dien-2-ol	1189	1.44
13	myrtenol	1196	0.83
14	cis-carveol	1229	1.16
15	cis-ρ-mentha-1(7),8-dien-2-ol	1231	1.67
16	carvone	1243	49.11
17	cis-chrysanthenyl acetate	1265	0.32
18	cis-carvyl acetate	1368	0.31
19	γ-muurolene	1480	1.76
20	β-bisabolene	1506	4.44
21	δ-cadinene	1523	0.46
22	α-cadinol	1654	0.64
23	eudesm-7(11)-en-4-ol	1700	0.4

Compounds are reported according to their elution order on DB-5 column.

The major constituents of the oil were: carvone (49.11%), α-thujone (24.6%), β-bisabolene (4.44), β-thujone (2.68%), 1,8-cineole (2.59%), γ-muurolene (1.76%), cis-ρ-mentha-1(7),8-dien-2-ol (1.67%), trans-ρ-mentha-1(7),8-dien-2-ol (1.44%), trans-ρ-mentha-2,8-dienol (1.4%) and cis-carveol (1.16%), (tab. 1). Monoterpene coumpounds (88.5%), mostly consisting of oxygenated monoterpenes (87.93%), were the main class of identified compounds followed by sesquiterpene hydrocarbons (6.66%). Carvone and α-thujone (sum 73.71%) were the predominant oxygenated monoterpene components of volatile oil (tab. 1). The number and amount of monoterpene hydrocarbons were found to be very low with ρ-cymene (0.57%) as only representative of this class (tab. 1, 2). β-bisabolene beside γ-muurolene and δ-cadinene were three sesquiterpene hydrocarbons (6.66%) of volatile components (tab. 1). In contrast oxygenated sesquiterpenes (1.04%) were very low with α-cadinol and eudesm-7(11)-en-4-ol as their representatives (tab. 1, 2).

Table 2.

Main classes of essential oil constituents of *Tanacetum balsamita* L. ssp. *balsamitoides* (Schultz-Bip.) from Iran

groups	%
monoterpene compounds	88.5
monoterpene hydrocarbons	0.57
oxygenated monoterpens	87.93
sesquiterpene compounds	7.7
sesquiterpene hydrocarbons	6.66
oxygenated sesquiterpens	1.04
others	0.63
total identified	96.83

Tanacetum balsamita L. volatile oil was the subject of several studies conducted in the past [3, 6, 9, 11]. Bylaite et al. [9] reported carvone (up to 80%) as major component of volatile oil of alecost grown in Italy. Husnucan et al. [3] studied the enantiomeric distribution of carvone and camphor in *Tanacetum* species and reported carvone as main chemotype of *Tanacetum balsamita* L. cultivated in Turkey. Perez-Alonso et al. [6] studied essential oil of alecost for therapeutic and insecticidal properties and reported that carvone and α-thujone were the predominant components of *T .balsamita* cultivated in Spain. Gallori et al. [11] studied the essential oil and n-hexane extract of alecost and noted that of fifty-two components identified in these materials carvone and α-thujone were the main components. Comparison between our results and findings of other scientists [3, 6, 9, 11] show differences especially in volatile oil profile probably due to the different environmental and genetic factors, nutritional status, different essential oil extraction procedures as well as harvesting time. High amounts of thujone isomers especially α-thujone, which is blamed to cause severe health problems probably on the central nervous system [15] is arguable in this plant. Therefore, regulations and medical considerations in internal use of preparations of alecost volatile oil ought to be considered. In conclusion, the aerial parts volatile oil of *T. balsamita* L. ssp. *balsamitoides* (Schultz-Bip.) was characterized as carvone/α-thujone chemotype that produces significant amounts of β-bisabolene.

REFERENCES

1. Mozaffarian V. Dictionary of Iranian Plant Names. Iran. Farhang Moaaser Publishing Company, 2004.
2. Hassanpouraghdam MB, Tabatabaie SJ, Nazemyieh H, Aflatuni A. N and K nutrition levels affect growth and essential oil content of costmary (*Tanacetum balsamita* L.). J Food Agr Environ 2008; 6(2):150-4.
3. Hüsnücan K, Demirci B, Tabanca N, Özek T, Gören N. Composition of the essential oils of *Tanacetum armenum* (DC.) Schultz Bip., *T. balsamita* L., *T. chiliophyllum* (Fisch. & Mey.) Schultz Bip. var. *chiliophyllum and T. haradjani* (Rech. fil.) Grierson and the enantiomeric distribution of camphor and carvone. Flav Fragr J 2001; 3:195-200.
4. Teixeira da Silva JA. Mining the essential oils of the Anthemideae. Afric J Biotechnol 2004; 3(12): 706-20.

5. Todorova M, Ognyanov I. Sesquiterpene lactones in a population of Balsamita major cultivated in Bulgaria. Phytochemistry 1989; 28(4):1115-17.
6. Pérez-Alonso MJ, Velasco-Negueruela A, Burzaco A. *Tanacetum balsamita* L. A medicinal plant from Guadalajara (Spain). Acta Horticult 1992; 306:188-93.
7. Nickavar B, Amin BG, Mehregan BN. Quercetine, a major flavonol aglycon from *Tanacetum balsamita* L. Iranian J Pharm Res 2003; 2:249-50.
8. Philps R, Foy N. Herbs. UK. Pan Books Ltd, 1992.
9. Bylaite E, Venscutonis R, Roozen JP, Posthumus MA. Composition of essential oil of costmary [*Balsamita major* (L.) desf.] at different growth phases. J Agricult Food Chem 2000; 48(6):2409-14.
10. Marculescu A, Sand C, Barbu CH, Bobit D, Hanganu D. Possibilities of influencing the biosynthesis and accumulation of the active principles in *Chrysanthemum balsamita* L. species. Romanian Biotechnol Lett 2001; 7(1):577-84.
11. Gallori S, Flamini G, Bilia AR, Morelli I, Landini A, Vincieri FF. Chemical composition of some traditional herbal drug preparations: Essential oil and aromatic water of costmary (*Balsamita suaveolens* Pers.). J Agric Food Chem 2001; 49:5907-10.
12. Kubo A, Kubo I. Antimicrobial agents from *Tanacetum balsamita*. J Nat Prod 1995; 58(1):1565-69.
13. Marculescu A, Hanganu D, Kinga ON. Qualitative and quantitative determination of the caffeic acid and chlorogenic acid from three chemovarieties of *Chrysanthemum balsamita* L. Romanian Biotechnol Lett 2001; 6(6):477-84 .
14. Adams RP. Identification of essential oil components by gas chromatography/quadrupole mass spectrosccopy. USA. Allured Publishing Corporation Company, 2004.
15. Emmert J, Sartor G, Sporer F, Gummersbach J. Determination of α-/β- thujone and related terpenes in absinthe using solid phase extraction and gas chromatography. Deutsche Lebensmittel Rundschau 2004; 100(9):352-56.

SKŁADNIKI OLEJKU ETERYCZNEGO ZŁOCIENIA BALSAMICZNEGO [*TANACETUM BALSAMITA* L. SSP. *BALSAMITOIDES* (SCHULTZ-BIP.)] DZIKO ROSNĄCEGO W PÓŁNOCNO-WSCHODNIM IRANIE

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S t r e s z c z e n i e

Olejek eteryczny uzyskany na drodze destylacji wodnej ze złocienia balsamicznego [*Tanacetum balsamita* L. ssp. *balsamitoides* (Schultz-Bip.)] dziko rosnącego w okolicach Tabriz w północno-wschodnim Iranie analizowano za pomocą chromatografii GC/MS. Znaleziono 23 składniki stanowiące 96,83% zawartości olejku eterycznego. Najwięcej znaleziono utlenionych monoterpenów (87,93%), drugą co do wielkości grupą były węglowodory seskwiterpenowe (6,66%). Głównymi składnikami monoterpenowymi olejku eterycznego części nadziemnej były: karwon (49,11%), α-tujon (24,6%), β-tujon (2,68%) i 1,8-cineol (2,59%). Znaleziono również znaczne ilości β-bisabolenu (4,44%), związku seskwiterpenowego. Ze względu na profil olejków eterycznych analizowany tu *T. balsamita* należy do chemotypu karwon/α-tujon, produkującego znaczne ilości β-bisabolenu.

Słowa kluczowe: *Tanacetum balsamita* L., *Asteraceae, olejek eteryczny, GC/MS, α-tujon, β-bisabolen*