Journal of Medicinal Plants and By-products (2012) 2: 79-82

Original Article

Chemical Composition of the Essential Oil of Three Tanacetum Species from North-West of Iran

Mohammad Bagher Rezaee*, Kamkar Jaimand and Mahmood Naderi

Phytochemistry Group, Department of Medicinal Plants & By-products, Research Institute of Forest and Rangelands, P.O. Box 1318, Tehran, Iran

Article History: Received: 6 January 2013/Accepted in revised form: 2 February 2013

Abstract

The *genus Tanacetum* is one of the most important medicinal plants that contains 26 species in Iran, 12 of them are endemic. This paper reports the essential oil composition of *Tanacetum angulatum* Willd. *Tanacetum canacens* DC. and *Tanacetum pinnatum* Boiss. growing wild in Iran. Plant flowers and leaves were collected from different locations of North- West of Iran. Samples were hydro-distilled to produce the oils in the yields (v/w) of 0.4% for leaves and 0.02% for flowers for both *T. angulatum* Willd and *T. canacens* DC., collected from Azerbaijan province (Tabriz), in of 0.05% for leaves and 0.2% for flowers *T. pinnatum* from Zanjan province (Zanjan) Main oil components of *T. angulatum* Willd. identified by GC/MS for leaves were 1,8-cineole (75.3%), camphor (8.1%) and for flowers were 1,8-cineole (66.0%), camphor (9.0%). For T*anacetum canacens*, main oil components of leaves were 1,8-cineole (25.3%), α- calacorene (7.9%) and for flowers were *n*-eicosane (19.7%), α- calacorene (13.3%). Main oil constituents of *T. pinnatum* leaves were camphor (24.2%), α-calacorene (13.3%), and for flowers were germacrene B (33.0%), *n*-eicosane (10.5%).

Key words: *Tanacetum angulatum* Willd., *Tanacetum canacens* DC., *Tanacetum pinnatum* Boiss., Essential oil, Hydrodistillation, 1,8-cineole, Camphor.

Introduction

The Asteraceae is the largest plant family. The family comprises more than 1600 genera and 23000 species [1,2].

The native flora of Iran comprises about 8000 angiosperm species. The genus *Tanacetum* (L.), formerly *Pyrethrum* (Zinn.), is a large, poorly defined classification group in the Asteraceae (Compositae) containing polymorph species, many of which have applications as herbal medicines [3]. *Tanacetum polycephalum* is used in folk medicine to treat many disorders [4], therefore, it seem interesting to investigate its biological activity and chemical analysis. Essential oils are a complex mixture of natural compounds, mainly monoterpenes, sesquiterpenes and their oxygenated derivatives, Asteraceae is a valuable source of essential oil-containing plants and there are many reports on the volatile constituents of the oils of these plants [5-7]. These oils have been shown to possess antibacterial [8] and antioxidant activity [9].

Materials and Methods

Plant materials

Plant materials were collected from different locations of north west of Iran from Azerbaijan provence (Tabriz) and Zanjan provinces (Zanjan), in Azarbijan province, *T. angulatum* Willd. samples collected on August 2011, from Tabriz 10 Km to Marand, Azerbaijan province, and T*anacetum canacens* DC. samples from Tabriz to Ahar Ghojehbil defile, Azarbijan province, collected on August 2011, and finaly *T. pinnatum* Boiss. were collected on October 2011, old road Zanjan to Tabriz, from Mianeh 3 km fatigued to Ghareh Chaman from Zanjan, Azerbaijan province.

All samples were hydro-distilled produced the oils in the yields of *T. angulatum* Willd leaf were 0.4% and

*Corresponding author: Phytochemistry Group,Department of Medicinal Plants & By-products, Research Institute of Forest and Rangelands, P.O.Box 1318, Tehran, Iran
E-mail Address: mbrezaeei@rifr-ac.ir

flower 0.02% (V/W) from Tabrize and T*anacetum canacens* DC. leaf were 0.4% and flower 0.02% (V/W) from Tabriz and *T. pinnatum* Boiss. leaf were 0.05% and flower 0.2% (V/W) from Zanjan, respectively, and analyzed by GC and GC/MS. Plant materials were identified at the Research Institute of Forests and Rangelands Herbarium.

GC analysis

GC analysis was performed on a Shimadzu 15A gas chromatograph equipped with a split/splitless injector and a flame ionization detector at 250°C. N_2 was used as a carrier gas (1 mL min^{-1}) and a DB-5 type was utilized as the capillary (50 m × 0.2 mm, film thickness 0.32 μm). Temperature within the column for 3 min was retained at 60°C, after that the column was heated at a rate of 5°C min^{-1} until it reached at 220 °C and maintained in this condition for 5 min.

The percentage of relative amounts was calculated from peak area using a Shimadzu C-R4A Chromatopac without applying correction factors.

Table 1 Identification chemical composition of essential oils of *Tanacetum angulatum* Willd., *Tanacetum canescens* DC. and *Tanacetum pinnatum* Boiss.

Compound		*T. angulatum*		*T. canescens*		*T. pinnatum*	
		Tabriz		Tabriz		Zanjan	
	R.T.	Leaf	Flower	Leaf	Flower	Leaf	Flower
2-heptanone	897	1.3	1.5	-	-	-	-
α- pinene	932	0.9	1.3	2.0	-	-	-
Camphene	950	0.8	0.8	0.7	-	-	-
3-octanone	985	-	-	0.8	-	-	-
β-myrcene	992	0.7	0.4	0.7	-	-	-
α-terpinene	1017	1.0	1.4	3.3	-	1.4	-
1,8-cineole	1030	75.3	66.0	25.3	-	12.1	3.5
trans-linalool oxide	1071	0.3	-	-	-	-	-
trans-sabinene hydrate	1099	1.5	2.8	0.6	-	-	2.2
trans- thujone	1113	0.3	0.3		-	0.7	-
Chrysanthenone	1130	1.2	3.6	0.8	-	9.3	3.5
Camphor	1141	8.1	9.0	2.1	-	24.2	6.4
neo-3-thujanol	1154	1.1	0.8	6.1	-	1.3	0.5
δ-terpineol	1165	0.5	0.7	6.2	-	2.8	-
trans-chrysanthenyl acetate	1245	2.0	3.4	-	-	4.2	3.3
cis-ethyl chrysanthemumate	1271	2.5	1.5	-	-	1.4	-
Bornyl acetate	1282	1.2	-	1.6	0.6	2.1	-
Methyl decanoate	1325	-	-	0.7			-
Neryl acetate	1362	-	-	-	0.7	2.2	0.6
Viridiflorene	1496	-	-	-	1.0	0.6	0.6
β-sequiphellandrene	1522	-	-	0.6	-	-	-
trans-calamenene	1531	-	-	-	1.4	-	-
α-calacorene	1546	-	1.1	7.9	13.3	13.3	-
Germacrene B	1560	-	-	1.0	4.8	6.0	33.0
n-tridecanol	1570	-	0.2	2.9	3.9	1.1	2.9
Geranyl isovalerate	1608	-		-	1.2	1.8	-
Humulene epoxide II	1612	-	0.5	3.2	0.6	1.6	-
β-cedrene epoxide	1623	-	-	-	-	0.7	0.9
γ- eudesmol	1630	-	0.4	3.6	3.5	3.4	4.7
α-muurolol	1647	-	-	-	1.9	1.5	1.4
Dihydro-eudesmol	1660	-	0.4	1.6	7.1	-	0.8
Germacrone	1694	-	0.3	1.6	2.6	0.6	0.8
(Z,Z)- farnesol	1718	-	-	2.2	-	0.5	0.8
Curcumenol	1735	-	0.6	7.3	1.4	1.2	1.9
(E,Z)-farnesol	1749	-	-	-	1.7	-	1.9
Cyclopentadecanolide	1834	-	0.8	1.6	10.6	1.4	3.5
n-hexadecanol	1873	-	-	3.5	-	-	2.1
n-nonadecane	1896	-	-	-	-	-	0.6
Methyl hexadecanoate	1923	-	-	-	1.6	-	0.5
Phytol	1943	-	-	-	2.1	-	-
Nootkatin	1960	-	0.9	2.4	-	2.6	-
n-eicosane	2003	-	-	-	19.7	-	10.5
Iso-bergaptene	2034	-	-	-	1.3	0.4	-
n-octadecanol	2084	-	-	0.8	1.2	0.8	-
n-heneicosane	2106	-	-	0.7	5.8	-	0.9
Grandiflorene	2177	-	-	-	3.5	-	2.3
n-tricosane	2288	-	-	-	7.0	-	1.5
-	-	98.7	98.3	88.2	98.5	99.2	94.2

Gas Chromatography - Mass Spectrometry

The GC/MS unit consisted of a Varian Model 3400 gas chromatograph coupled to a Saturn II ion trap detector was used . The column was same as GC, and the GC conditions were as above. Mass spectrometer conditions were: ionization potential 70 eV; electron multiplier energy 2000 V.

The identity of the oil components was established from their GC retention indices, relative to C_7- C_{25} n-alkanes, by comparison of their MS spectra with those reported in the literature [10-12], and by computer matching with the Wiley 5 mass spectra library, whenever possible, by co-injection with standards available in the laboratories.

Results and Discussion

The yield of essential oil obtained by hydro-distillation from flower and leaves of the dried plant in full flowering stage is between 0.02 up to 0.4%. The composition of the essential oil of three tanacetum speices was listed in Table 1. For *T. angulatum* Willd. Azerbaijan province (Tabriz), were hydro-distilled to produce the oils yields in leaf were 0.4% and flower 0.02% (V/W), from leaf sixteen compounds were identified main compounds were 1,8-cineole (75.3%), camphor (8.1%) and in flowers twenty three compounds were identified main compounds were 1,8-cineole (66.0%), camphor (9.0%), and seconds samples *T. canacens* DC. from Azerbaijan province (Tabriz), were to produce the oils yields in leaf were 0.4% and flower 0.02% (V/W), from leaf twenty eight compounds were identified main compounds were camphor (25.3%), α-calacorene (7.9%) and in flowers twenty four compounds were identified main compounds were n-eicosane (19.7%), α-calacorene (13.3%), and the last samples *T. pinnatum* Boiss. from Zanjan province (Zanjan), with yield in leaf were 0.05% and flower 0.2% (V/W), from leaf twenty seven compounds were identified main compounds were camphor (24.2%), α-calacorene (13.3%), and for flower twenty eight compounds were identified majore compounds were germacrene B (33%), *n*-eicosane (10.5%).

With Comparing of our study two samples *T. angulatum* Willd. and *T. canacens* DC. from Azerbaijan provence (Tabriz), identified for first time but for last samples *T. pinnatum* Boiss. from Zanjan proveince (Zanjan), we have refrences from Esmaeili and Amiri, 2011, the samples of *T. pinnatum* Boiss. were collected during the flowering stage from Khoramabad, Province of Lorestan, Iran, in June 2008, have a paper on "the *in vitro* antioxidant and antibacterial activities of *T. pinnatum* Boiss. grown in Iran" identification of 25 compounds, representing 98.7% of the oil content. The main components in the oils were camphor (23.2%), *α*-pinene (8.5%), camphene (7.7%), 1,8-cineole (7.3%), *β*-eudesmol (5.8%) and caryophyllene oxide (5.6%). The possible antioxidant and antibacterial activity of the samples was studied using the DPPH and the *β*-carotene-linoleic acid assays and the disc agar diffusion test, respectively. In general, the nonpolar extract of *T. pinnatum* Boiss. exhibited the greatest antioxidant activity in the DPPH test system. The essential oil displayed the highest antioxidant activity in the *β*-carotene-linoleic acid assay; it showed the best antibacterial activity against *Staphylococcus aureus* [13]. Comparing the results of different studies on essential oil composition of *T. pinnatum* Boiss. reveals that their constituents are variable according to their habitat that may be regarded to different chemotyps.

References

1. Kadereit JW, Jeffrey C (eds.). Flowering plants vol. VIII. Eudicots. Asterales. Springer. Verlag Press. Berlin Heid elberg. 2007.
2. Funk VA, Susanna A, Stuessy T, Bayer R. (eds.). *Systematics, Evolution and Biogeography of the Compositae.* International Association for Plant Taxonomy, Washington D.C. 2009.
3. Brown AMG, Edwards CM, Hartman TVP, Marshal JA, Smith RM, Davey MR, Power JB, Lowe KC. Sexual hybrids of *Tanacetum*: biochemical, cytological and pharmacological characterization. J Exp Bot. 1999;50:435-444.
4. Zargari A. Medicinal Plants. Vol. 3, Tehran University Press, Tehran, Iran. 1996; 321-322.
5. Nori-Shargh D, Norouzi-Arasi H, Mirza M, Jaimand K, Mohammadi S. Chemical composition of the essential oil of *Tanacetum polycephalum* (Schultz Bip. ssp. *heterophyllum*), Flavour Fragr J. 1999;14:105–106.
6. Javidnia K, Miri R, Soltani M, Khosravi AR. Composition of the essential oil of *Tanacetum polycephalum* Schultz Bip. subsp. *farsicum* Podl. from Iran. 2008;20:209-211.
7. Najafi Gh, Sefidkon F, Mozaffarian V, Zare-Maivan H. The Essential Oil of *Tanacetum polycephalum* Schultz-Bip. subsp. *argyrophyllum* (K. Koch.) Podlech from Iran. J Essent Oil Res. 2007;19:460-462.
8. Polatoglu K, Demirci F, Demirci B, Gören N, Can Baser KH. Antimicrobial activity and essential oil composition of a new *T. argyrophyllum* (C. Koch)

Tvzel var. *argyrophyllum* chemotype. J Oleo Sci. 2010;59:307-313

9. Amiri H. Chemical Composition, Antibacterial and antioxidant activity of the essential oil of *Tanacetum polycephalum* Schutz. Bip. Int J Bot. 2007;3:321-324.
10. Shibamoto T. Retention indices in essential oil analysis. In: capillary gas chromatography in essential oil analysis. Edits., P. Sandra and C. Bicchi, 259-274. Dr. Alfred Huethig Verlag, Heidelberg, 1987.
11. Davies NW. Gas chromatographic retention index of monoterpenes and sesquiterpenes on methyl silicone and carbowax 20 M phases. J. Chromatogr.1990;503:1-24.
12. Adams RP. Identification of essential oils by Ion trap Mass Spectroscopy. Academic Press, San Diego, CA. 1989.
13. Esmaeili A, Amiri H. The *in vitro* antioxidant and antibacterial activities of *Tanacetum pinnatum* boiss. grown in Iran. Bulgarian Chem Commun. 2011;43:532–537.