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Original Article

Chemical Composition of the Essential Oil of Two *Tanacetum* Species from Iran

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Abstract

The genus *Tanacetum* L. is one of the most important medicinal plant that contains 28 species in Iran, 12 of them are endemics. This paper reports the essential oil composition of *Tanacetum hololeucum* (Bornm.) Podlech; *Tanacetum kotschyi* (Boiss.) Grierson, growing wild in Iran. Plant flowers were collected from different zones of Dizin in north of Iran. All samples were hydro-distilled (Clevenger apparatus), to produce the oils in *T. hololeucum* from three zones with yields of (0.35%, 0.35% and 0.16%), and also *T. kotschyi*, from three zones with yields of (0.57%, 0.41% and 0.10%), respectively. All samples were injected to GC and GC/MS. Main components for *T.hololeucum* from Dizin of three places from zone 1 were borneol 39.4%, trans-sabinene hydrate 8.4%, 1,8-cineole 8.1%, and from zone 2 were n-hexadecane 14%, elemol acetate 13.6%, trans-thujone 13.4%, and from zone 3 were terpinolene 35.7%, α- phellandrene 23%, γ- eudesmol 7.1% , and in *T. kotschyi* also from Dizin of three places from zone 1 were 1,8-cineole 27.8%, terpinolene 13%, trans-thujone 7.2%, and from zone 2 were n-undecane 27.9%, n-hexadecane 14.7%, n-nonadecane 8.7% , and from zone 3 were n-tridecane 55.1%, terpinolene 13.4%, myrcene 7%, respectively.

Key word: *Tanacetum hololeucum* (Bronm.) Podlech, *Tanacetum kotschyi* (Boiss.) Grierson, Essential oil, Hydrodistallation, Borneol, n-tridecane

Introduction

The genus *Tanacetum* L. which is an important member of the Asteraceae or Compositae family is spreaded in Europe and West Asia throughout the northern temperate areas. The family comprises more than 1600 genera and 23000 species [1,2]. Its many genera and species, its worldwide distribution and the fact that it comprises many useful plants have made it the subject of many karyological studies [3]. Many karyological and cytological studies have been performed in the Asteraceae [4-7]. 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 [8]. *Tanacetum* is one of the largest genera of the family Asteraceae, containing 250-500 taxa depending on the opinions of the authors who have studied the genus [9-17]. It is distributed throughout the northern hemisphere, with very few representatives (not more than 10 species) in the southern hemisphere. It seems that the genus is a polyphyletic complex and should be revised carefully regarding its species and subgenus [18, 19,20]. The genus *Tanacetum* belongs to the tribe Anthemideae of the compositae and comprises only one species of herbaceous plant, *Tanacetum hololeucum* (Bronm.) Podl; *Tanacetum kotschyi* (Boiss.) Nab., [21]. The genus *Tanacetum* (compositae) is represented by 28 species in the flora of Iran, 12 of them are endemic [22]. *Tanacetum* species are rich in essential oils,

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sesquiterpene lactones and bitter substances and they have anti-inflammatory, antibacterial and antihistaminic activities; in moderate doses, tansy essential oils are stomachic, cordial effect and used as a food additive [23].

Various extracts of plants materials and essential oil of plants have agitated interest as sources of natural products. The essential oils and seconder metabolites of plant samples have been investigated for their potential uses as alternative remedies for the treatment of many diseases. Especially antioxidant, antimicrobial and antibacterial activities of plants essential oils and various extracts of plant samples have formed the basis of many applications, including pharmaceuticals, alternative medicine, natural and aroma therapies [24].

Some members of *Tanacetum* have also been used as anti-helmintic for migraine, neuralgia, rheumatism, loss of appetite [25], antiinflammatory [26], antibacterial and antifungal [27] activities.

Material and Methods

Plant Material

The plants of *Tanacetum hololeucum, T.kotschyi*, growing wild in Iran, were collected from different zones, time and high of Dizin in north of Iran. and *T.hololeucum,* collected from three zones, time(11 July, 23 July and 6 August 2013) and high (3143 m, 2500 m, 2500 m) of Dizin, respectively, and *T.kotschyi*, collected from three zones, time(11 July, 23 July and 6 August 2013) and high (3143 m, 2500 m, 2500 m) of Dizin, respectively. All samples were collected by M. Golipour and identity of the plant was determined by V. Mozaffarian in Iranian Botanical Garden (IBG). All samples flower were hydro-distilled (Clevenger apparatus), to produce the oils in *T.hololeucum* from three zones with yields of (0.35%, 0.35% and 0.16%), and also *T. kotschyi*, from three zones with yields of (0.57%, 0.41% and 0.10%), respectively, and analyzed by GC and GC/MS.

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 mx0.2 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.

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 [28-30] 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 essential oil composition of *Tanacetum hololeucum*; *Tanacetum kotschyi*, growing wild in Iran. Plant flowers were collected from different zones of Dizin in north of Iran. All samples were hydro-distilled (Clevenger apparatus), to produce the oils in *T.hololeucum* from three zones with yields of (0.35%, 0.35% and 0.16%), and also *T. kotschyi*, from three zones with yields of (0.57%, 0.41% and 0.10%), respectively. All samples were injected to GC and GC/MS. Main components for *T.hololeucum* from Dizin of three places from zone 1 were borneol 39.4%, trans- sabinene hydrate 8.4%, 1,8-cineole 8.1%, and from zone 2 were n-hexadecane 14%, elemol acetate 13.6%, trans-thujone 13.4%, and from zone 3 were terpinolene 35.7%, α- phellandrene 23%, γ- eudesmol 7.1% , and in *T. kotschyi* also from Dizin of three places from zone 1 were 1,8-cineole 27.8%, terpinolene 13%, trans-thujone 7.2%, and from zone 2 were n-undecane 27.9%, n-hexadecane 14.7%, n-nonadecane 8.7% , and from zone 3 were n-tridecane 55.1%, terpinolene 13.4%, myrcene 7%, respectively.

Table 1 Percentage composition of essential oil of the flower of *Tanacetum hololeucum, T.kotschyi*,

Compound name	RI	*T. kotschyi*			*T. hololeucum*		
		flower	flower	flower	flower	flower	flower
Tricyclene	920	-	-	0.5	-	-	1.8
α- Pinene	940	-	2.1	-	-	-	-
n-Heptanol	963	-	-	-	-	2.3	-
Myrcene	997	-	-	7.0	-	-	-
α- Phellandrene	1010	-	-	-	1.7	-	23.0
α- Terpinene	1016	-	2.8	-	-	-	-
1,8-Cineole	1030	27.8	-	-	8.1	7.6	-
(Z) –β- Ocimene	1040	2.5	-	-	3.6	-	-
(E) –β- Ocimene	1055	0.5	-	-	-	-	0.4
γ - Terpinene	1060	0.5	-	-	-	-	-
Terpinolene	1080	13.0	-	13.4	0.6	-	35.7
Trans- Sabinene hydrate	1098	-	-	-	8.4	-	-
n-Undecane	1105	-	27.9	0.3	-	-	0.3
Trans-Thujone	1115	7.2	-	-	-	13.4	0.4
Cis-p-Menth-2-en-1-ol	1121	5.2	-	0.6	-	-	-
Chrysanthenone	1126	1.8	0.7	-	2.6	-	0.9
Cis-β- Terpineol	1145	1.5	-	0.8	0.9	1.3	6.1
Isoborneol	1154	3.7	2.1	0.7	-	-	2.6
Borneol	1165	4.3	4.2	1.2	39.4	1.0	-
Terpin-4-ol	1176	-	-	-	0.4	9.4	0.6
n-Dodecane	1200	-	-	-	0.4	-	-
Cis-p-Mentha-1(7),8-dien-2-ol	1232	-	-	-	1.9	-	-
Carvone	1242	4.5	-	4.5	1.5	-	-
Methyl ether, carvacrol	1248	-	-	-	6.4	-	4.2
Cis-Carvone oxide	1265	-	-	-	1.4	-	-
Cis-Chrysanthenyl acetate	1268	-	-	-	0.7	-	-
n-Decanol	1271	-	-	-	2.7	13.1	-
p-Menth-1-en-9-ol	1296	-	-	-	0.6	-	
n-Tridecane	1304	-	0.4	55.1	-	0.5	1.1
n-Nonanyl acetate	1318	-	-	0.9	-	-	-
Trans-Carvyl acetate	1342	0.8	-	-	6.0	1.0	-
Cis-Carvyl acetate	1368	5.1	-	-	0.4	-	-
α- Copaene	1375	2.7	1.0	-	0.8	-	-
Z-β- Farnesen	1447	-	0.4	2.2	-	-	0.4
Allo-Aromadendrene	1464	-	-	-	-	1.0	-
γ- Muurolene	1479	0.6	-	-	-	-	-
β- Himachalene	1494	-	-	-	-	1.7	-
(E,E)- α- Farnesene	1509	-	1.0	0.4	-	0.7	-
Geranyl isobutanoate	1517	-	0.4	-	-	-	-
Z- Nerolidol	1534	-	0.6	-		1.7	-
α- Calacorene	1545	-	-	2.1	0.4	-	-
E- Nerolidol	1563	-	1.1	2.3	-	-	5.6
n-Tridecanol	1570	-	3.9	0.4	-	-	2.2
Spathulenol	1577	0.5	-	-	-	0.4	0.7
n-Hexadecane	1606	-	14.7	-	0.5	14.0	0.4
β- Himachalene oxide	1614	2.6	0.6	-	-	0.4	-
10-epi- γ- Eudesmol	1623	-	1.0	-	-	-	-
γ- Eudesmol	1638	-	1.4	2.7	0.7	4.8	7.1
β- Eudesmol	1654	0.5	1.1	1.2	-	0.4	0.4
Ar-Turmerone	1669	-	8.8	0.7	2.3	0.4	1.5
Cadalene	1679	1.1	-	-	-	-	0.8
Elemol acetate	1681	0.8	3.3	0.6	0.7	13.6	1.1

Compound name	RI	*T. kotschyi*			*T. hololeucum*		
		flower	flower	flower	flower	flower	flower
Longiborneol	1689	3.7	-	-	0.7	-	-
Germacrone	1692	-	2.6	0.5	-	1.0	-
n-Heptadecane	1708	-	0.6	-	0.6	2.6	-
(E,E)- Farnesol	1726	-	-	-	-	0.6	-
Curcumenol	1732	-	-	-	3.0	2.5	-
(E,Z)- Farnesol	1746	-	-	-	0.8	-	-
Benzyl benzoate	1758	-	1.6	-	-	-	-
n-Pentadecanol	1773	-	-	-	0.5	-	-
n-Octadecane	1810	-	-	-	-	0.7	-
n-Hexadecanol	1871	-	-	-	-	-	1.2
Cubitene	1877	-	0.9	0.6	-	-	0.5
n-Nonadecane	1904	-	8.7	-	-	-	-
Cyclohexadecanolide	1931	-	0.5	-	-	-	-
Phytol	1946	-	-	-	-	1.2	-
Bifloratriene	1977	-	-	-	-	0.9	-
Not identified	2245	-	0.4	-	-	-	-
(E)-Methyl communate	2257	-	0.9	-	-	-	-
Dehydro abietal	2279	-	0.7	-	-	-	-

The main chemical constituents reported in the essential oils of *Tanacetum* were camphor, bornyl acetate, α–phellandrene, chrysanthenyl acetate, α –terpinene, p-cymene, terpinene-4-ol, α–terpineol, verbenone, *α*-phellandrene, *α*-terpinene, tetradecane, caryophyllene oxide. *α*-tujene, *α*-pinene, camphene, *β*-pinene, *p*-cymene, limonene, *γ*-terpinene, benzaldehyde, sabinene, pinocarvone, borneol myrtenal, *β*-caryophylene, (e)-*β*-farnesene, valencene, *β*-bisabolene thymol, and carvacrol **[**32, 33].

In *T.hololeucum* with borneol (34.9%) has been reported to have significant analgesic, treat and prevents bronchitis, anti-inflammatory, reduces fever, protects hepatic system. Can be toxic to central nervous system and cause spasms activity [34]. And also terpinolene (35.7%) has been reported to have significant deodorant activity [34]. 1,8-cineole has been reported to have significant anesthetic, kills worms, antiallergic, antiseptic, bactericide, expectorant, sedative, lowes blood pressure, treat and prevents throat inflammation, laryngitis, coughing and bronchitis. Stimulates central nervous system and the production of bile by liver. May cause reddening of the skin, allergenic [34]. α- phellandrene (23%) has been reported to have significant irritant activity [34].

With Comparing of our study two samples *Tanacetum hololeucum*; *Tanacetum kotschyi*, identified for first time. The influence of environmental and ecological conditions on plants is huge; so that similar plant species may show quite different pharmaceutical properties when grown in various ecological conditions. Difference between the populations of a single plant species grown in various ecological regions is a natural phenomenon [31].

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