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Chemical Composition of Essential Oil from *Varthemia persica*

Alireza Sardashti[1]*, Samane Khaleghi[1]

[1]Department of chemistry, Faculty of science, University of Sistan and Baluchestan, Zahedan, Iran

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***Correspondence to:**
Alireza Sardashti
asardashti65@gmail.com

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Abstract

Varthemia persica Dc. (Compositae) is an aromatic plant which is used as an anti-spasmodic and anti-emetic for some kidney conditions. In the present study, the chemical composition of the leaf and stem oils of the plant are collected from South Khorasan province (Iran). The essential oils were obtained by hydro distillation method and were analyzed using the GC and GC-MS techniques. The efficiency of extracting (w/w%) are 0.93 and 0.37 on a dry weight basis for the leaf and stem oils respectively. In the leaf oil, fourty-two compounds were identified accounting to 84.63 % of the total oil. The major compounds were, naphtha[2,3-b] oxirene, dehydrate-(22.90%), cysteinyl-acetate (21.36%), isolongifolene,7,8-dehydro-8a-hydroxy (8.73%), and unknown constituents (0.84%). The main components among the thirty constituents characterized in the stem oil representing 45.41% of the total components detected, naphtha[2,3-b] oxirene, decahydrate (10.12%), isolongifolene,7,8-dehydro-8a- hydroxy (9.66%), and bicycle [3.1.1] hept-2-en-4-ol,2,6,6-trimethyl-acetate (8.15%). It seems that the leaf oil is a sesquiterpene-rich essential oil (43.26%). In leaf essential oil, the percentage of oxygenated terpenoids is 68.20 % which is an indicative of the antibacterial properties. Compared to stem oil sample, the leaf sample's essential oil is of the best quality.

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Introduction

The aromatic genus *Varthemia* (*Asteraceae*) has one species, *V. persica* DC, in Iran. This species is also distributed in Afghanistan and Pakistan. *V. persica* has three varieties including *var. persica*, *squarrosula* and *stenocephalas* [1]. There is no report on the pharmacological activity of this species, but antibacterial, antispasmodic and hypoglycemic effect have been reported for other species [2,3].*Varthemia*

persica DC. "Atre-sang" in Persian) belonging to the *Asteraceae* family is an aromatic perennial plant widely distributed throughout the eastern and central parts of Iran [3]. In Iranian folk medicine, the aerial parts of *V. persica* are used as antispasmodic and anti-emetic as well as for the treatment of some kidney conditions [4]. The aromatic aerial parts of this species are also used by indigenous people as a flavor in the preparation of some pickles. Previous photochemical investigations have shown occurrences of flavonoids (lute Olin, quercetin and kaempferol) and chromogenic acid in the aerial parts extracts, together with some sesquiterpene as a major group of constituents in the volatile oils of *V. persica* [3,4,5,6,7]. Plant material was collected in September 1998 from Brijand (South Khorasan province). Monfared et al. (2002) have implemented a research on the same species of the plant that was collected from the province of Kerman, Haraz Mountain. The results of research show that the essential oil of this species, 32 compounds were identified, accounting for 89.3% beta-eudesmol (31.75%), spathulenol (23.50%),(E) trans-caryophyllene(3.90%) and gamma-terpinene(1.11%) were the main components. The oil was characterized by large amounts of oxygenated sesquiterpenes (58.3%) and oxygenated monterpenes (20.2%) with 4-terpineol (8.5%), 1, 8- cineole (2.5%), linalool (2.5%) being the major ones. The total amount of hydrocarbon monoterpenes and sesquiterpenes identified was 8.5%, among them beta-caryophyllene (3.4%) and alpha-pinene (0.9%) were more abundant [8]. Ghasemi et al .(2003) worked on the volatile constituents of the aerial parts from *Varthemia. persica* DC , *Var. persica*, growing wild in Iran (Karkas mountain-Esfahan),were investigated by the GC-MS technique. Sixty-seven constituents were identified. δ-cadinene (9.7%), selin-11-en-4-α-ol (5.30%), germacrene D (4.9%), bicyclogermacrene (4.7%),α-murolene (4.7%), β-eudesmol (4.52%), β-himachalen oxide (3.6%), γ-eudesmol ((3.54%),β-bourbonene (3.21%) were found to be the major constituents of the essential oil respectively[9]. In this study, the essential oil of the aerial parts samples from *V. persica* was analyzed for a qualitative comparison of the leaf oil constituents with those of stem oil constituents reported showed varying compositions.

Materials and Methods

Plant Material

The aerial parts of *Varthemia persica* DC. was collected in August 2010 from the Chardeh village located in 5km from south of Brigand city (south Khorasan province) in the eastern of Iran. A voucher specimen was deposited at the Herbarium of University of Tehran (Iran) and identified by Dr. Farideh Attar [10].

Sampling

The leaves and stems were freeze-dried in the shade at the ambient temperature and stored in double-layer paper bags at the room temperature [1] and protected from the direct light, until the further analysis. They were then sieved to particles with 0.5 mm sizes. All solvents and reagents were of analytical grade.

Essential oil Isolation

50±0.01 g of the prepared plant sample was combined with 450±0.1 mL of twice distilled water in a 2 L - balloon. Subsequently, it was extracted at the temperature of 95 ^{0}C and at normal pressure over a period of 3h by a Clevenger-type apparatus utilizing hydro distillation method and the essential oil was collected in hexane-solvent and was dried over anhydrous sodium sulfate weighed and stored at 4 ^{0}C in dark until use [12].

GC-MS Analysis

The analysis of the essential oil was performed using a Hewlett-Packard 6890 Net work GC System, equipped with a 60m* 0.25mm id, 0.25µm HP-5Ms capillary column, and an HP 5973 mass selective detector. Helium was the carrier gas at 1 mL/min. The injector and MS transfer line temperature were at 250 and 260 ^{0}C respectively. The column temperature was set at 40^{0}C for 1 min, then programmed from 40^{0}C to 250^{0}C at a rate of 3^{0}C./min, and finally, held isothermally for 20 min. For the GC-MS detection an Electron Ionization System was used with ionization energy of 70 eV retention indices were calculated by using the retention times of C_8-C_{26} n- alkenes that were injected with the oil at the same chromatographic conditions according to Van Den Dool method [3].

Identification of Compounds

The linear retention indices for all the compounds were determined by co- injection of the sample with a solution containing the homologous series of C_8-C_{26} n-alkenes. The individual constituents were identified by their identical retention index, referring to known compounds from the literature and also by comparing their mass spectra with either the known compounds or with the Wiley7 mass spectral database [14].

Results

The percent composition of the oils is given in tables 1 and 2 in order of their elution from the HP-5Ms capillary column. It is evident that the essential oils from leaf and stem of *Varthemia persica* Dc differed appreciably. The essential oils content was 0.93 (w/w%) for leaf oil and 0.37 (w/w%) for stem oil, on a dry weight basis of *Varthemia persica* Dc. The difference is mostly qualitatively rather than quantitatively.

Table 1: Chemical composition of the leaf essential oil from *Varthemia Persica* Dc

Compound	RI	%
2-ethyl-3-vinyloxirane	754	0.19
1,6-dimethylhepta-1,3,5-triene	776	0.16
alpha-thujene	784	0.23
alpha-pinene	852	0.98
camphene	859	0.04
sabinene	870	0.15
beta-phellandrene	896	0.13
beta-myrcene	916	0.18
phellandrene	925	0.10
alpha-terpinene	939	1.48
p-cymene	943	3.11
1,8-cineole	949	3.3 1
gamma-terpinene	980	2.22
cis-beta-terpinene	990	0.98
alpha-terpinolene	1004	0.43
1,3-cyclopentadiene, 5,5-dimethyl-2-ethyl-	1010	1.36
naphtha[2,3-b] oxirene, decarhydro-	1032	22.90
pulegone	1037	0.40
1-terpineol	1041	1.71
4-terpineol	1090	6.14
Unknown	1102	0.84
chrysanthenyl acetate	1139	21.36
farnesol	1157	1.1 2
thymol	1208	0.14
citronellyl acetate	1256	0.13
safranal	1300	1.55
methyl eugenol	1303	0.15
trans-Caryophyllene	1324	0.14

aromadendrene	1350	0.29
alpha-amorphene	1362	0.07
calamenene	1367	0.25
alloaromadendrene	1369	0.16
isoledene	1377	0.08
germacrene D	1385	0.09
delta-cadinene	1393	0.59
cis-alpha-copaene-8-ol	1339	0.38
alpha-humulene	1442	0.37
3,5-dimethylethylbenzene	1478	0.59
gamma-cadinene	1511	0.57
isospathulenol	1520	1.21
isolongifolene, 7,8-dehydro-8a-hydroxy	1550	8.73
tetracyclo [3.3.1.1[1,8].0[2,4]] decan	1557	0.23
curcumene	1845	0.17

Retention index relative to n-alkanes C_8-C_{26} on the HP-5Ms capillary column

In the leaf oil, forty-two compounds were identified representing 84.47% of the oil composition. The main compounds were naphth [2,3-b] oxirene, decahydrate (22.90%), chrysanthenyl-acetate (21.36%), isolongifolene ,8-dehydro-8a-hydroxy (8.73%),4-terpineol (6.14%),1,8-cineole (3.31 %), p-cymene (3.11%), gamma-terpinene (2.2 3 %),1-terpineol (1.71 %), safranal (1.55 %),alpha-terpinene (1.48 %), isospathulenol (1.21 %) and Unknown constituents (0.84 %) were the main components among (Table1).

Table 2 : Chemical composition of the stem essential oil from *Varthemia Persica* Dc.

Compound	**RI**	**%**
alpha-thujene	670	0.06
alpha-pinene	840	0.33
sabinene	846	0.07
alpha-fenchene	885	0.07
alpha-terpinene	930	0.61
p-cymene	934	1.75
eucalyptol	939	1.1 2
limonene	942	0.12
gamma-terpinene	971	1.02
cis-sabinene hydrate	978	0.24
alpha-terpinolene	1000	0.20
1,3-cyclopentadiene, 1,2,5,5-tetramethyl-	1004	0.30
cis-beta-terpineol	1009	0.57
naphtha[2,3-b] oxirene, decahydro-	1020	10.12
pulegone	1033	1.19
4-terpineol	1079	2.20

bicyclo[3.1.1]hept-2-en-4-ol, 2,6,6-trimethyl-, acetate	1131	8.15
cis-trans-farnesol	1153	0.56
geranyl acetate	1288	0.58
cis-Jasmone	1323	1.1 2
Alpha-caryophyllene	1345	0.67
nearly acetate	1368	1.10
isoseychellene	1392	0.42
cis-alpha-copaene-8-ol	1398	0.26
alpha-humulene	1442	0.63
cycloisolongifolene, 8-hydroxy-, endo-	1470	0.26
3,5-dimethylethylbenzene	1476	0.55
gamma-cadinene	1509	0.41
isospathulenol	1518	1.07
isolongifolene, 7,8-dehydro-8a-hydroxy-	1546	9.66

Thirty compounds were identified in the stem oil of the plant representing 45.41% of the essential oil composition. The main compounds were naphtha[2,3-b] oxirene, decarhydro (10.12%), isolongifolene, -7,8-dehydro-8a-hydroxy (9.66%), bicyclo [3.1.1] , hept-2-en-4-ol,2,6,6-trimethyl-acetate (8.15%), 4-teroineol (2.20%),p-cymene(1.75 %),pulegone(1.19 %), cis-Jasmone (1.12 %), eucalyptol (1.12 %), isospathulenol (1.07 %) , gamma-terpinene (1.02 %) as the major constituents (Table 2).

Discussion

As presented in table 1, the naphtha[2,3-b] oxirene, decahydro-(22.90%), isolongifolene, chrysanthenyl-acetate (21.36%), 7,8-dehydro-8a- hydroxy (8.73%),4-terpineol (6.14%),1,8-cineole (3.31 %) were found to be the major constituents of the leaf oil. The leaf oil contains mainly terpenoids including total monoterpenes (38.94%), oxygenated monoterpenes (28.32%), total sesquiterpenes (43.26%) and oxygenated sesquiterpenes (39.88%). This may indicate the existence of a correlation between monoterpenes and sesquiterpenes content and the level of oxygenated monoterpenes and oxygenated sesquiterpenes. It seems that the leaf oil is a sesquiterpene-rich essential oil. In the stem oil, total monoterpenes (27.82%), oxygenated monoterpenes (23.59%), total sesquiterpenes (16.64%) and oxygenated sesquiterpenes (14.10%), hydrocarbon terpenoids (6.77%), oxygenated terpenoids (37.69%) (Table 3).

Table 3: Chemical composition of the leaf and stem essential oils from *Varthemia Persica* Dc. by chemical class

Chemical class	**% in stem**	**% in leaf**
Hydrocarbon monoterpenes	4.23	10.62
Oxygenated monoterpenes	23.59	28.32
Total monoterpenes	27.82	38.94
Hydrocarbon sesquiterpenes	2.54	3.38
Oxygenated sesquiterpenes	14.10	39.88
Total sesquiterpenes	16.64	43.26
Other hydrocarbon compounds	0.30	1.71
Other oxygen compounds	-	0.56
Other compounds	0.42	-
Unknown compounds	-	0.84

Hydrocarbon terpenoids	6.77	14
Oxygenated terpenoids	37.69	68.20
Total terpenoids	44.69	82.20
Total without Unknown	45.41	84.63

Conclusion

The leaf essential oil had a better outcome and it has a higher percentage of terpenoid compounds and have 14 similar compounds with high percentage, in the leaf and stem essential oils as tables 1 and 2. Hydro carbons terpenoids' percentage in the stem sample oil is less than leaf sample oil (Table 3). Oxygenated monoterpenes percentage of the leaf sample oil is considerably more than stem sample oil (Figure 1).

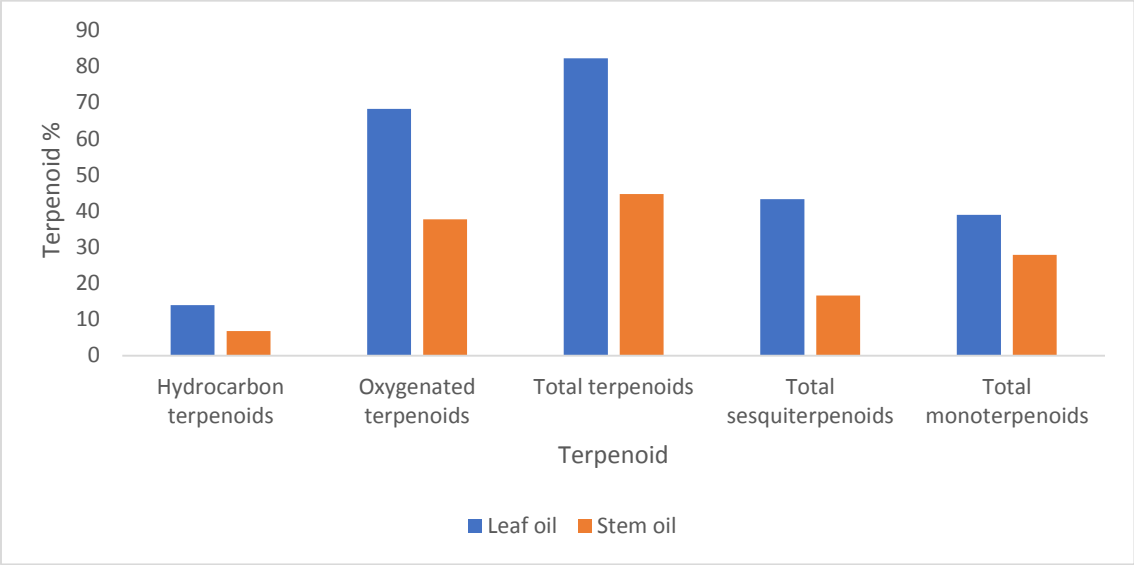

Figure 1. The interpretation of the results in the table 3

In the all samples, the percentage of oxygenated terpenoids surpasses 37% which is an indicative of their antibacterial properties. The leaf sample essential oil is of the best quality (Table 3). Following is the quality order of the samples' essential oil in terms of terpenoids' amount:

Total terpenoids of stem oil=44.69< Total terpenoids of leaf oil=82.20

The leaf essential oil was extracted with a higher efficiency compared to stem sample oil. The higher percent of which: naphtha[2,3-b] oxirene, decahydrate, chrysanthenyl -acetate, is longifolene 7,8-dehydro-8a-hydroxy, p-cymene, gamma-terpinene,1-terpineol, α-pinene, 1,8-cineole,4-terpineol, were the main components in the all samples. However, several studies carried out on aromatic plants have shown that volatile oil composition may vary considerably throughout a year [15,16].

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Conflicts of interest

The authors have declared no conflicts of interest.

Authors' contribution

The manuscript was carried out, written, and approved in collaboration with all authors.

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Department of Biochemistry, College of Natural Sciences, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria

References

1. Afifi F, Saket M, Jaghabir M. and Al-Eisawi D.Effect of Varthemia iphonoides on blood glucose level of normal rats and rats with streptococci- induced diabetes melitus. Curr. Ther. Res,19997; 11:888-892.
2. 2. Aburjai T,Darwish RM ,Al-kalil S ,Mahafzeh A. and Al-Abbadi A.Screening of antibiotic resistant inhibitors from local plant materials againts two different strains of Pseudomonas aerugchosa. J. Ethnopharmacol, 2001; 76:39-44.
3. Ghahreman A,Attar F Biodiversity of plant species in Iran. Tehran University Publication.1999.
4. Mirza M, Navaiee NP and Dini M. Chemical composition of the essential oil of Varthemia persica DC. Pajouhesh & Sazandegi, 2004; 16: 70- 72.
5. Siahpoush A, Ghasemi N,Asghari G, Shams-Ardakani M. Quality and quantity evaluation of flavonoids in the aerial parts, flowers and fruits of varthemia persica (var. persica) DC. J. Mazandar an Univ Med Sci, 2008; 18:28-36.
6. Siahpoush A, Ghasemi N , Shams-Ardakani M, Asghari G.Production of chlorogenic acid in Varthemia persica DC (var. persica) callus cultures.Res Pharm Sci, 2011; 6:63-69.
7. Ghasemi N ,Asghar G , Shams-Ardakani MR. and Siahpoush A. Characterization of volatile constituents from aerial parts of Varthemia persica DC. (var. persica). Iran J . Pharm Res,2012; 2,241-243.
8. Monfared AZ, Nabid ZMR and Rustaiyan AH. Volatile oil of Varthemica Persica DC,from Iran ,Journal of Essential oil Research,2002; 14:124.
9. Ghasemi, N., Asghari, G., Shams Ardakani, M. and Siahpoush, A. Characterization of Volatile Constituents from Aerial Parts of Varthemia persica DC (var. persica), Iranian Journal of Pharmaceutical Research, 2003; 241-243.
10. Mozaffarian V A Dictionary of Iranian Plant Names. Farhang Moaser, Tehran, 2007; 572.
11. Cumhur O, Mahmut S, Hasan S. Freezedrying of turkey breast meat: Mathematical modeling and estimation of transport parameters, Drying Technology, 2016; 34,5: 584-594.
12. Sardashti AR, Sangtarash MH. and Asadi A.Study of the Effect of the Drying Method on Essential oil from Cultivated Lippia citriodora., Journal of essential oil Bearing plants, 2015;18(5) :1275-1281.
13. Van Den Dool H. and Kratz PD. A generalization of the retention index system including linear temperature programmed gas-liquid partition chromatography. J. Chromatogr, 1963; 11:463-471.
14. Adams RP. Identification of Essential Oil Components by Gas Chromatography/ Mass Spectrometry. 4th Ed. Allured Publishing Corporation, Carol Stream, Illinois, USA.2007.
15. Jerkovic I ,Mastelic J , Milos M , Juteau F , Masotti V. and Viano J. Chemical variability of Artemisia vulgaris L. essential oils originated from the Mediterranean area of France and Croatia. Flav.Frag. J, 2003; 8:436-440.
16. Asghari G, Houshfar Gand, Mohamoudi Z . Seasonal Variation of Mono and sesquiterpenes in the Essential Oil of Pycnocycla spinosa Decne. Exboiss. Iran. J. Pharm. Res, 2002; 1: 61-63.