

Chemical composition of oil from *eremostachys macrophylla*



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Chemical composition of the essential oil from aerial parts of *Eremostachys macrophylla* Montbr. & Auch. from Northeast of Iran

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Abstract

The essential oil obtained by hydrodistillation of the aerial parts of *Eremostachys macrophylla* Montbr. & Auch., grown wild in Iran, was analyzed by GC and GC/MS. The colorless oils were obtained by hydrodistillation, using a Clevenger-type apparatus for three hours, from aerial parts in 0.18% yield (w/w). Forty-four compounds representing 91.6% of aerial parts oil of *Eremostachys macrophylla* were identified. The main components of the oil were hexadecanoic acid (27.5%), ethyl linoleate (8.5%), 6-methyl- α -ionone (8.0%), isobutyl phthalate (5.8%), α -cadinol (4.7%) and germacrene D (4.3%). The oil was rich in nonterpenoids (56.0%) and among them, oxygenated nonterpenes (53.2%) predominated over nonterpene hydrocarbons (2.8%).

Key Word Index

Eremostachys macrophylla Montbr. & Auch., Lamiaceae, essential oil composition, hexadecanoic acid

Introduction

The genus *Eremostachys* of the family Lamiaceae (*alt.* Labiatae) contains 15 species of perennial in Iran, and five of them are endemic (1, 2). During the past decade, seven investigations have been carried out on the chemical composition of the essential oils of the genus *Eremostachys*. These studies <https://assignbuster.com/chemical-composition-of-oil-from-eremostachys-macrophylla/>

analyze the fresh aerial parts of *Eremostachys laciniata* Bunge from Jordan (3), flowers, stems, and roots of *Eremostachys laevigata* from Iran (4), flower, leaf and stem of *Eremostachys macrophylla* Montbr. & Auch., and aerial part and stem of *Eremostachys labiosa* from Iran (5), aerial parts of *Eremostachys adenantha* and *Eremostachys macrophylla* from Iran (6), aerial parts of *Eremostachys macrophylla* from Central Iran (7), aerial parts of *Eremostachys laevigata* Bge. From Iran (8) and aerial parts of *Eremostachys laciniata* Bge. from Iran (9).

Phytochemical investigation on a few species of *Eremostachys* revealed the presence of vicarin, a new isoflavone from *Eremostachys vicaryi* (10), eremosides A-C, New Iridoid Glucosides from *Eremostachys loasifolia* (11), loasifolin, a new flavonoid from *Eremostachys loasifolia* (12), a new acidic iridoid glucoside (13), furanolabdane diterpene glycosides from *Eremostachys laciniata* (14), new iridoid glucosides from *Eremostachys moluccelloides* Bunge (15) and Eremostachiin: a new furanolabdane diterpene glycoside from *Eremostachys glabra* (16).

Our study dealt with the analysis of the essential oils of aerial parts of *Eremostachys macrophylla* Montbr. & Auch grown wild in northeastern Iran.

Experimental

Plant material: The plant material was collected during the flowering stage in May 2012 from northern Sabzevar in Khorasan Province, Iran, at an altitude of 1580 meters. A voucher specimen has been deposited in the herbarium of Research Center of Natural Resources, Sabzevar, Iran.

Essential oil isolation. Air-dried aerial parts of *E. macrophylla* (100 g) were subjected to hydrodistillation in a Clevenger-type apparatus for three hours to produce colorless oils. The yield of total volatiles was 0.18% (w/w). The oils were dried over anhydrous sodium sulfate and stored in sealed vials at 4 °C before analysis.

GC analysis. GC analysis was performed using a Shimadzu GC-9A gas chromatograph, equipped with a HP-5MS fused silica column (30 m×0.25 mm i. d., film thickness 0.25 µm). The oven temperature was held at 50 °C for five minutes and then programmed to 250 °C at a rate of 3 °C/min. The injector and detector (FID) temperatures were 290 °C. Helium was used as carrier gas with a linear velocity of 32 cm/s.

GC/MS analysis. GC/MS analysis was carried out on a Hewlett-packard 6890 gas chromatograph fitted with a fused silica HP-5MS capillary column (30m×0.25 mm ; film thickness 0.32 µm) . The oven temperature was programmed from 60 °C to 220 °C at 6 °C/min . Helium was used as carrier gas at a flow rate of 1 mL/min. The chromatograph was coupled to a Hewlett-Packard 5973 mass selective detector with an ionization voltage of 70 eV.

Qualitative and quantitative analyses. Constituents of the volatile oils were identified by comparison of their retention indices relative to C9-C21 n-alkanes and of their mass spectral fragmentation pattern with those reported in the literature (17) and stored in a MS library (Wiley 275). The quantification of the components was performed on the basis of their GC peak area data from the HP-5MS column separation.

Results and discussion

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Because of the variable results obtained in previous studies and as a part of on-going work on the chemical analysis of oils obtained from the wild plants of Iran, we decided to re-investigate the oils of this specific plant.

Hydrodistilled volatile oils from the crushed dry aerial parts of *Eremostachys macrophylla* Montbr. & Auch. (Lamiaceae) from Sabzevar (Iran) was studied by GC and GC/MS. The air-dried aerial parts of the plant yielded 0.18% (w/w) oil. The oil was clear and colorless. Forty-four components were identified in the aerial parts oil that contained 91.6% of the compounds. Table 1 lists formulas, percentages, and retention indices of identified compounds in the oil. As evident from the table, the main components are hexadecanoic acid (27.5%), ethyl linoleate (8.5%), 6-methyl- α -ionone (8.0%), isobutyl phthalate (5.8%), α -cadinol (4.7%) and germacrene D (4.3%).

In this study, GC and GC/MS analysis method revealed monoterpenoid hydrocarbon (MH), oxygenated monoterpenes (OM), sesquiterpenoid hydrocarbons (SH), oxygenated sesquiterpenes (OS), nonterpenoid hydrocarbons (NH), diterpene hydrocarbon (DH) and oxygenated diterpene (OD) in the oil from the aerial parts of *Eremostachys macrophylla*. One monoterpene hydrocarbon (0.1%), five oxygenated monoterpenes (8.8%), thirteen sesquiterpene hydrocarbons (13.4%), six oxygenated sesquiterpenes (10.4%), seventeen nonterpene hydrocarbons (56.0%), one diterpene hydrocarbon (2.5%) and one oxygenated diterpene (0.4%) were detected in this oil. The data lead to a rank order of constituent groups: NH > SH > OS > OM > DH > OD > MH for the aerial parts oil. The main components in this oil were hexadecanoic acid (27.5%), ethyl linoleate (8.5%), 6-methyl-

α -ionone (8.0%), isobutyl phthalate (5.8%), α -cadinol (4.7%) and germacrene D (4.3%).

The oil consisted mainly of nonterpenes and relatively small fractions of other terpenoids. Also, oxygenated nonterpenes (53.2%) predominated over nonterpene hydrocarbons (2.8%).

However, in a previous study on volatile oil from aerial parts of *Eremostachys macrophylla*, among the thirty-five identified compounds that have been compromised to 92.9% of the oil, spathulenol (23.4%), hexadecanoic acid (13.5%) and caryophyllene oxide (9.3%) were the major ones (6), while in other report on the aerial parts of this plant, among the sixteen identified compounds that have been compromised to 96.4% of the oil; germacrene-D (47.1%), germacrene-B (17.8%), γ -elemene (9.1%), myrcene (6.7%), β -elemene (2.7%), and β -phellandrene (2.6%) have been the major ones (7). Also, we reported analysis of the essential oils from flowers, leaves and stems of *Eremostachys macrophylla* (5). The specimen had been collected at different place, time and altitude from current study. The major compounds in the flower oil of *E. macrophylla* were 1, 8-cineol (19.0%) and germacrene D-4-ol (10.6%), whereas the leaf oil contained α -pinene (30.0%), 1, 10-di-epi cubenol (22.7%), elemol (13.3%) and bornyl acetate (11.0%). The stem oil of the plant consisted mainly of 1, 10-di-epi cubenol (34.4%) and elemol (24.0%).

Evident from the above data, there are significant differences in the results of the current study with previous studies (6, 7) for the aerial parts of *E. macrophylla*. These discrepancies are not entirely unexpected since

hydrodistillation relates to the interactions of the oil constituents with water vapor. Of course, there may also be differences related to environmental conditions such as climate, altitude, collection time, ground composition of the sampling area and different growth stages such as pre-flowering, fresh flowering and air-dried-flowering stages.

Conclusion

The chemical composition of the essential oil of aerial parts from *Eremostachys macrophylla* Montbr. & Auch. (Lamiaceae) growing in Sabzevar was investigated. This study showed considerable amounts of hexadecanoic acid (27.5%), ethyl linoleate (8.5%), 6-methyl- α -ionone (8.0%). These major constituents were different from previous studies on the same species⁵⁻⁷. These results demonstrated that the chemical composition of the essential oil of the same species can change depending on a variety of conditions, including climate, time of collection, and the ground composition of the sampling area besides of growth stages of plant.

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Table 1. Constituents of the essential oils from aerial parts of *Eremostachys macrophylla* obtained by hydrodistillation a

No. compound	Formula	Percentage	RRI ^b	Class
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1	Limonene	$C_{10}H_{16}$	0.1	1031 MH ^c
2	4-Terpineol	$C_{10}H_{18}O$	0.1	1179 OM ^d
3	Fenchyl acetate	$C_{12}H_{20}O_2$	0.4	1223 OM
4	Anethole	$C_{10}H_{12}O$	0.1	1285 OM
5	α -Copaene	$C_{15}H_{24}$	0.2	1364 SH ^e
6	β - Bourbonene	$C_{15}H_{24}$	0.8	1385 SH
7	β -Cubebene	$C_{15}H_{24}$	0.1	1390 SH
8	Tetradecane	$C_{14}H_{30}$	0.1	1400 NH ^f
9	β -Caryophyllene	$C_{15}H_{24}$	0.3	1418 SH
10	α -Guaiene	$C_{15}H_{24}$	0.1	1439 SH
11	Aromadendrene	$C_{15}H_{24}$	0.6	1442 SH
12	α -Humulene	$C_{15}H_{24}$	2.0	1452 SH
13	(E)- β -Farnesene	$C_{15}H_{24}$	0.1	1457 SH
14	Germacrene D	$C_{15}H_{24}$	4.3	1480 SH
15	β -Ionone	$C_{13}H_{20}O$	0.2	1488 OM

16	Bicyclogermacrene	C ₁₅ H ₂₄	0.7	1500 SH
17	γ-Cadinene	C ₁₅ H ₂₄	0.6	1515 SH
18	6-Methyl-α-ionone	C ₁₄ H ₂₂ O	8.0	1518 OM
19	δ-Cadinene	C ₁₅ H ₂₄	3.5	1522 SH
20	Cadina-1, 4-diene	C ₁₅ H ₂₄	0.1	1533 SH
21	Germacrene D-4-ol	C ₁₅ H ₂₆ O	0.6	1574 OS ⁹
22	Spathulenol	C ₁₅ H ₂₄ O	1.5	1578 OS
23	Caryophyllene oxide	C ₁₅ H ₂₄ O	0.5	1583 OS
24	Humulene epoxide II	C ₁₅ H ₂₄ O	1.7	1608 OS
25	τ-Muurolol	C ₁₅ H ₂₆ O	1.4	1643 OS
26	α-Cadinol	C ₁₅ H ₂₆ O	4.7	1656 OS
27	Tetradecanoic acid	C ₁₄ H ₂₈ O ₂	1.8	1760 NH
28	Octadecane	C ₁₈ H ₃₈	0.4	1800 NH
29	6, 10, 14-Trimethyl-2-Pentadecanone,	C ₁₈ H ₃₆ O	1.7	1848 NH
30	2-Hydroxy-	C ₁₅ H ₂₈ O	0.4	1853 NH

	Cyclopentadecanone	2		
31	Pentadecanoic acid	$C_{15}H_{30}O_2$	0.3	1867 NH
32	Isobutyl phthalate	$C_{16}H_{22}O_4$	5.8	1877 NH
33	Cyclohexadecane	$C_{16}H_{32}$	0.3	1883 NH
34	16-methyl-Oxacyclohexadecan-2-one,	$C_{16}H_{30}O_2$	0.3	1943 NH
35	Sandaracopimara-8(14), 15-diene	$C_{20}H_{32}$	2.5	1969 DH ^h
36	di-Butylphthalate	$C_{16}H_{22}O_4$	0.9	1973 NH
37	Hexadecanoic acid	$C_{16}H_{32}O_2$	27.5	1977 NH
38	Eicosane	$C_{20}H_{42}$	2.0	2000 NH
39	Heptadecanoic acid	$C_{17}H_{34}O_2$	0.4	2065 NH
40	Methyl linoleate	$C_{19}H_{34}O_2$	0.6	2084 NH

41	Phytol	$C_{20}H_{40}O$	0.4	2111	OD ⁱ
42	(Z, Z)-9, 12-Octadecadienoic acid	$C_{18}H_{32}O_2$	2.7	2136	NH
43	Ethyl linoleate	$C_{20}H_{36}O_2$	8.5	2164	NH
44	Octadecanoic acid	$C_{18}H_{36}O_2$	2.3	2172	NH
	Total identified		91.6		

^a The compounds have been arranged according to their retention indices on an HP-5 MS capillary column

^b Kovatz retention indices given in the literature

^c Monoterpene hydrocarbons

^d Oxygenated monoterpene

^e Sesquiterpene hydrocarbons

^f Nonterpene hydrocarbons

^g Oxygenated sesquiterpene

^h Diterpene hydrocarbon

ⁱ Oxygenated diterpene

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