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 hydro distillation in a Clevenger-type apparatus of the aerial parts of *Eremostachys macrophylla* Montbr & Auch, grown wild in Iran, was analyzed by GC/MS. 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%).

**Keywords:** *Eremostachys macrophylla*; 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 include the analysis of the fresh aerial parts of *Eremostachys lacinata* Bunge from Jordan [3], flowers, stems, and roots of *Eremostachys laevigata* from Iran [4], flower, leaf and stem of *Eremostachys macrophylla* and the aerial parts of *Eremostachys labiosa* from Iran [5], the aerial parts of *Eremostachys adenantha* and *Eremostachys macrophylla* from Iran [6], the aerial parts of *Eremostachys macrophylla* from Central Iran [7], the aerial parts of *Eremostachys laevigata* Bge. From Iran [8] and the aerial parts of *Eremostachys lacinata* Bge. from Iran [9].

Phytochemical investigation on a few species of *Eremostachys* revealed the presence of vicar in, a new isoflavone from *Eremostachys vicaryi* [10], eremosides A-C, new iridoid glucosides from *Eremostachys loasifolia* [11], loasiferin, a new flavonoid from *Eremostachys loasifolia* [12], a new acidic iridoid glucoside [13], furanoblaned diterpene glycosides from *Eremostachys lacinata* [14], new iridoid glucosides from *Eremostachys moluccelloides* Bunge [15] and Eremostachin and a new furanoblaned diterpene glycoside from *Eremostachys glabra* [16].

Our study dealt with the analysis of the essential oils of aerial parts of *Eremostachys macrophylla* grown wild in northeastern Iran. We reinvestigate the essential oil of aerial parts of the plant collected in May 2012 while in previous study plant material collected in June 2008.

**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 (No. 218) was identified in Research Institute of Forests and Rangelands (RIFR), Tehran and it has been deposited in the herbarium of Research Center of Natural Resources, Sabzevar, Iran. The aerial parts of plant were dried in the shade (at room temperature).

**Essential oil isolation**

Air-dried aerial parts of *E. macrophylla* (100 g) were subjected to hydro distillation 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/MS analysis**

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

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. The hydro distilled volatile oil from the crushed dry aerial parts of *Eremostachys macrophylla* from Sabzevar (Iran) was studied by GC/MS. The air-dried aerial parts of the plant yielded 0.18% (w/w) of a clear and colorless oil. Forty-four components, accounting for 91.6% of the compounds were identified in the aerial parts oil. (Table 1) lists formulas, percentages, and retention indices of identified compounds in the oil. As is 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/MS analysis method revealed monoterpenoid hydrocarbon (MH), oxygenated monoterpenes (OM), sesquiterpenoid hydrocarbons (SH), oxygenated sesquiterpenes (OS), nonterpenoid hydrocarbons (NH), diterpene hydrocarbons (DH) and oxygenated diterpene (OD) in the oil from the aerial parts of *Eremostachys macrophylla*. One monoterpenoid 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. 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, 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* growing in Sabzevar was investigated. This study showed considerable amounts of hexadecanoic acid (27.5%), ethyl linolate (8.5%), 6-methyl-a-ionone (8.0%), isobutyl phthalate (5.8%), a-cadinenol (4.7%) and germacrene D (4.3%).

Thus the oil consisted mainly of nonterpenes and relatively small fractions of terpenoids. Also, oxygenated nonterpenes (53.2%) predominated over nonterpene hydrocarbons (28%).

However, a previous study [6] on volatile oil from aerial parts of *E. macrophylla* found, among the thirty-five identified compounds comprising 92.9% of the oil, that the major components were pathuleno (23.4%), hexadecanoic acid (13.5%) and carophyllene oxide (9.3%). On the other hand, another study [7] of oil from the aerial parts of this plant reported that, of the sixteen identified compounds comprising 96.4% of the oil, the major ones were germacrene-D (47.1%), germacrene-B (17.8%), a-ene (9.1%), myrcene (6.7%), b-ene (2.7%), and b-phellandrene (2.6%). In addition, we also reported analysis of the essential oils from flowers, leaves and stems of *E. macrophylla* [5]. However this specimen had been collected at different place, time and altitude from that in the 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 a-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 %) [5].

It is evident from the above data that, there are significant differences in the results of the current study with previous ones [5-7] for the aerial parts of *E. macrophylla*. There may 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.

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### References


