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# GC / MS analysis of *Echinophora platyloba* DC. essential oil from Northwest Iran: a potential source of (Z)-β-ocimene and α-phellandrene

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The hydrodistilled essential oil composition of air-dried aerial parts of *Echinophora platyloba* DC. from Northwest Iran was analysed by GC / MS. Thirty-three components were identified, comprising 91.9% of the volatile oil. Monoterpenes (89.6%) were the major class of identified components. Monoterpene hydrocarbons (84.8%) were the main subclass of volatiles, followed by oxygenated monoterpenes (4.8%). (Z)-β-ocimene (38.9%) and α-phellandrene (24.2%) were the principle monoterpene hydrocarbon constituents (sum 63.1%) of essential oil. Other monoterpene hydrocarbon components with amounts ≥ than 1% were p-cymene (7.4%), β-phellandrene (6.3%), α-pinene (3.4%) and myrcene (1.6%); γ-decalactone (1.7%) and linalool (1.2%) were the highlighted oxygenated monoterpene components of essential oil. Sesquiterpenes were the minor class of essential oil components, with spathulenol (0.5%) as their main representative. In total, *E. platyloba* DC. analysed essential oil was characterized as a monoterpene-rich oil and could be serve a potential source of (Z)-β-ocimene and α-phellandrene.

**Key words:** GC / MS, *Echinophora platyloba* DC., essential oil composition, (Z)-β-ocimene, α-phellandrene, p-cymene, β-phellandrene

## INTRODUCTION

The genus *Echinophora* (family: Apiaceae or Umbelliferae) is represented in the flora of Iran by four species: *E. cinerea*, *E. platyloba*, *E. orientalis* and *E. sibthorpiana*. Two former species are exclusive of Iran [1]. *E. platyloba* DC. is a perennial aromatic herb with alternate compound leaves whose divided blades lead to thorns characteristic of the genus *Echinophora*. *Echinophora platyloba* DC. has epigynous, regular, bisexual yellow colored flowers in umbels and dry two mericarpous fruits [2]. *E. platyloba* DC. is commonly widespread in high latitudes (1400–2000 m above sea level) of Northwest Iran. This plant is locally known as Tologh-Oti [2, 3]. For successful growth, *E. platyloba* DC. prefers partially sandy soils with long growing seasons [4]. For therapeutic purposes, this plant and its essential oil have been used as antiseptic, antimicrobial and antifungal [5–7]. Recently, essential oil of this plant has been used as a natural preservative in dairy products industries [5, 6]. This application is inspired by the long-term traditional uses of *E. platyloba* DC. aerial parts in yoghourt and cheese flavourings. Essential oil of *E. platyloba* DC. has been the subject of some studies conducted in the past [5, 6]. Asghari et al. [6] reported that (E)-β-ocimene (67.9%), 2-furanone (6.2%) and myrcene (6%) were the main components of *E. platyloba* essential oil from Isfahan province in central parts of Iran. (E)-β-ocimene (49.9%), γ-decalactone (8.4%), α-pinene (6%) and linalool (5.6%) were reported as the principle constituents of *E. platyloba* essential oil from Tehran province in Iran as well [5].

To the best of our knowledge, there is no previous report about the essential oil composition of *E. platyloba* DC. from Northwest Iran. The objective of the present work was to identify the volatile oil components of *E. platyloba* DC. from Maragheh district in Northwest Iran for the first time.

## EXPERIMENTAL

**Plant material.** The flowering aerial parts of *Echinophora platyloba* DC. plants spontaneously growing in Northwest Iran (Maragheh district) were harvested in July 2008.

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A voucher specimen was deposited in the herbarium of the Faculty of Agriculture, University of Maragheh. The harvested materials from about ten individual plants were air-dried in a shaded place at ambient temperature (about 25 °C) and air circulation. The air- dried material was mixed and grounded to obtain a homogeneous fine-grade powder.

**Essential oil extraction.** 25 grams of air-dried and ground plant material was subjected to hydrodistillation by an all-glass Clevenger type apparatus for 3 h. The extracted pale-yellow-coloured essential oil was trapped with n-hexane as an organic collecting solvent. The oil was dried over anhydrous sodium sulphate and kept in refrigerator in sealed glass vials until analysis. Essential oil content was expressed as volume per weight (V / W) based on the dry weight of plant material.

**GC / MS analysis.** The analysis of the oil was carried out using a GC (Agilent Technologies 6890N) interfaced with a mass selective detector (MSD, Agilent 5973B) equipped with an apolar Agilent HP-5 ms (5%-phenyl methyl poly siloxane) capillary column (30 m × 0.25 mm i. d. and 0.25 μm film thickness). The carrier gas was helium with a constant flow rate of 1 ml/min. The oven temperature was set at 50 ºC for 2 min, then programmed until 70 ºC at a rate of 5 ºC/min, once more heated to 100 ºC at a 20 ºC/min rate and finally increased, at the rate 10 ºC/min, to 290 ºC, isothermal at this temperature for 2 min. Injector and detector temperatures were 300 ºC and 200 ºC, respectively. Injection mode, split; split ratio 1 : 100, volume injected, 4 μl of the oil. The MS operating parameters were as follows: Ionization potential, 70 eV; interface temperature, 200 ºC; and acquisition mass range, 50–800.

**Identification and quantification of constituents.** Relative percentage amounts of the volatile oil components were evaluated from the total peak area (TIC) by apparatus software. Identification of components in the volatile oil was based on a comparison of their mass spectra and retention time with those of the authentic compounds and by computer matching with NIST and WILEY library as well as by comparison of the fragmentation pattern of the mass spectral data with those reported in the literature [5, 6, 8].

## RESULTS AND DISCUSSION

Hydrodistillation of the flowering aerial parts of *E. platyloba* DC. gave a pale yellow liquid with a yield of 0.55 ± 0.1% (V / W) based on dry weight. The results obtained from the analysis of the essential oil of *E. platyloba* DC., i. e. the chemical constituents of the analysed oil, the percentage composition of the individual constituents, and the major classes and subclasses of the identified components are presented in Table and Figs. 1 and 2, respectively. In total, 33 components were identified in the essential oil of *E. platyloba* DC. from Maragheh district in Northwest Iran, comprising 91.9% of the total oil (Table). Monoterpenes (89.6%) were found to be the most abundant components and the major class of essential oil, followed by minor proportions of some $C_9$ to $C_{17}$ compounds (1.1%) and sesquiterpenes (0.9%) (Figs. 1, 2). Monoterpene hydrocarbons were the main subclass of essential oil constituents with (Z)-β-ocimene (38.9%), α-phellandrene (24.2%), p-cymene (7.4%), β-phellandrene (6.3%), α-pinene (3.4%) and myrcene (1.6%) as the main ones (Table and Fig. 2). In particular, (Z)-β-ocimene and α-phellandrene (Sum 63.1%) comprised about 70% of the total essential oil identified components (Table).

Oxygenated monoterpenes (4.8%) were the second subclass of monoterpenoidal compounds, with γ-decalactone (1.7%) and linalool (1.2%) as their representatives (Fig. 2). In total, 11 alcohol monoterpenes were identified in the essential oil of *E. platyloba* DC., from which carvacrol (0.4%) and

Table. **Essential oil constituents of *Echinophora platyloba* DC. from Iran**

| No | Compound | RI | % |
|---|---|---|---|
| 1 | n-Nonane | 0900 | 0.3 |
| 2 | α-Thujene | 0930 | 0.3 |
| 3 | **α-Pinene** | 0939 | **3.4** |
| 4 | Sabinene | 0975 | 0.7 |
| 5 | β-Pinene | 0979 | 0.3 |
| 6 | **Myrcene** | 0991 | **1.6** |
| 7 | **α-Phellandrene** | 1003 | **24.2** |
| 8 | α-Terpinene | 1017 | 0.5 |
| 9 | **p-Cymene** | 1025 | **7.4** |
| 10 | **β-Phellandrene** | 1030 | **6.3** |
| 11 | **(Z)-β-ocimene** | 1037 | **38.9** |
| 12 | γ-Terpinene | 1060 | 0.1 |
| 13 | Terpinolene | 1089 | 0.5 |
| 14 | **Linalool** | 1097 | **1.2** |
| 15 | Allo-ocimene | 1132 | 0.8 |
| 16 | Cis-β-Terpineole | 1144 | 0.1 |
| 17 | Terpinene-4-ol | 1177 | 0.2 |
| 18 | p-Cymene-8-ol | 1183 | 0.1 |
| 19 | α-Terpineole | 1189 | 0.5 |
| 20 | Myrtenol | 1196 | 0.4 |
| 21 | Cis-piperitol | 1196 | 0.1 |
| 22 | Thymol | 1290 | 0.1 |
| 23 | Carvacrol | 1299 | 0.4 |
| 24 | α-Terpinyl acetate | 1349 | 0.2 |
| 25 | Methyl eugenol | 1404 | 0.2 |
| 26 | trans-caryophyllene | 1419 | 0.1 |
| 27 | **γ-Decalactone** | 1467 | **1.7** |
| 28 | Cis-Nerolidol | 1533 | 0.2 |
| 29 | Cis-3-Hexenyl benzoate | 1567 | 0.4 |
| 30 | Spathulenol | 1578 | 0.5 |
| 31 | Caryophyllene oxide | 1583 | 0.1 |
| 32 | γ-Dodecalactone | 1678 | 0.2 |
| 33 | (E)-Nerolidol acetate | 1717 | 0.1 |
| 34 | Total | | 91.9 |

Note. RI – retention index on nonpolar column.

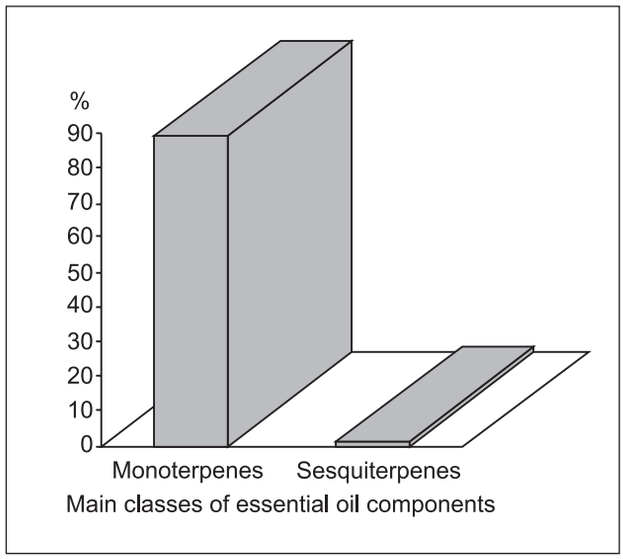


**Fig. 1.** Main classes of *Echnophora platyloba* DC. essential oil components from Iran

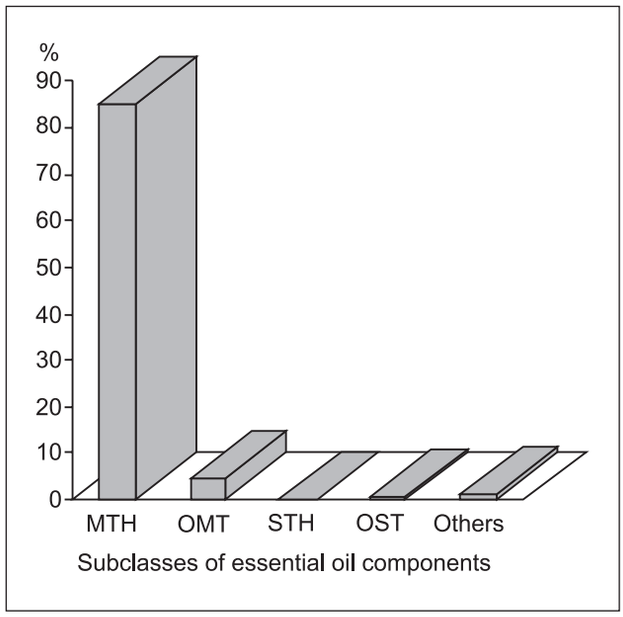


**Fig. 2.** Major subclasses of *Echinophora platyloba* DC. essential oil components from Iran (MTH – monoterpene hydrocarbons, OMT – oxygenated monoterpenes, STH – sesquiterpene hydrocarbones, OST – oxygenated sesquiterpenes).

thymol (0.1%) were the characteristic compounds showing the possible chemotaxonomic similarities of *E. platyloba* DC. with *Thymus* species plants (Table). Considering the monoterpenoidal profile of the studied volatile oil, there was a significant difference between the present study and reports of the other scientists from elsewhere [5,6]. Sesquiterpenoidal compounds (0.9%) with four components – trans-caryophyllene (0.1%), cis-nerolidol (0.2%), spathulenol (0.5%) and caryophyllene oxide (0.1%) – were the minor class of essential oil components (Table, Fig. 1). Taking into account the chemical profile (main classes and subclasses) of the essential oil of wild-growing *E. platyloba* DC. plants from Maragheh district in Northwest Iran and reports of other scientists, it seems that there are significant qualitative and quantitative differences between the chemical profile of the essential oils [5, 6]. It is likely that these chemical variations are due to the diverse climatic and geographic differences of *E. platyloba* DC. plant wild habitats as well as divergent harvesting times and volatile oil extraction procedures. Furthermore, it is likely that *E. platyloba* DC. plants studied in this experiment might be a distinct chemotype of this plant owing to it's unique volatile oil profile. However, this claim needs further studies based on phytochemical surveys.

## CONCLUSIONS

The chemical composition of the essential oil of *E. platyloba* DC. plant spontaneously growing in Northwest Iran was characterized by the presence of appreciable amounts of (Z)-β-ocimene and α-phellandrene. The data obtained in this experiment showed drastic qualitative and quantitative differences in volatile oil constituents compared with former reports. Ultimately, it can be postulated that *E. platyloba* DC. plants studied in this experiment can be a promising source of (Z)-β-ocimene and α-phellandrene either for substituting other sources of these commercial monoterpenes or for meeting the high demands of pharmaceutical industries for these monoterpenes.

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### References

1. V. Mozaffarian, *A Dictionary of Iranian Plant Names* (Persian), Farhang Moaaser Publishing Company, Iran (2004).
2. A. Ghahreman, *Flora of Iran* (Persian), Research Institute of Forest and Rangeland, Tehran, Iran (1988).
3. A. Ghahreman, *Plant Systematics: Cormophytes of Iran* (Persian), Iran University Press, Tehran, Iran (1993).
4. S. Akhondzadeh, *Encyclopedia of Iranian Medicinal Plants* (Persian), Arjmand Publication, Tehran, Iran (2002).
5. H. Mazloomifar, S. Tehrani, A. Rustaiyan, S. Masoudi, *J. Essent. Oil Res.*, **16(4)**, 284 (2004).
6. G. R. Asghari, S. E. Sajjadi, H Sadarei, K. Yaghobi, *Iran J. Pharm. Res.*, 185 (2003).
7. M. Avijgan, M. Hafizi, M. Saadat, M. A. Nilforoushzadeh, *Iran J. Pharm. Res.*, **4**, 285 (2006).
8. R. P. Adams, *Identification of Essential Oil Components by Gas Chromatography / Quadrupole Mass Spectroscopy,* Allured Publishing Corporation, USA (2004).

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## ŠIAURĖS VAKARŲ IRANO *ECHINOPHORA PLATYLOBA* DC. ETERINIO ALIEJAUS TYRIMAS DUJŲ CHROMATOGRAFIJOS–MASIŲ SPEKTROMETRIJOS BŪDU: POTENCIALUS (Z)-β-OCIMENO IR α-FELANDRENO ŠALTINIS

*S a n t r a u k a*

Dujų chromatografijos–masių spektrometrijos būdu buvo tirta šiaurės vakarų Irano *Echinophora platyloba* DC. antžeminės dalies eterinių aliejų, gautų hidrodistiliacijos būdu, sudėtis. Identifikuoti 33 komponentai, sudarantys iš viso 91,9 % lakiųjų aliejų. Didžiausią jų dalį (89,6 %) sudaro monoterpenai. Tarp jų didžiausią dalį sudaro monoterpeniniai angliavandeniliai (84,8 %) ir deguonies turintys monoterpenai (4,8 %). Pagrindiniai monoterpeniniai angliavandeniliai yra (Z)-β-ocimenas (38,9 %) ir α-felandrenas (24,2 %), kurie sudaro iš viso 63,1 % eterinio aliejaus. Kiti monoterpeniniai angliavandeniliai, kurių kiekis didesnis kaip 1 %, yra p-cimenas (7,4 %), β-felandrenas (6,3 %), α-pinenas (3,4 %) ir mircenas (1,6 %). Pagrindiniai eterinio aliejaus deguonies turintys monoterpenai yra γ-dekalaktonas (1,7 %) ir linaloolis (1,2 %). Nedidelę dalį eterinio aliejaus sudaro seskviterpenai, kurių pagrindinis yra spatulenolis (0,5 %). Apskritai *E. platyloba* DC. eteriniai aliejai turi daug monoterpenų ir potencialiai gali būti (Z)-β-ocimeno ir α-felandreno šaltinis.