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Introduction

Over 250 species of Artemisia (Compositae) are distributed throughout the world and about 34 of these are documented in the flora of Iran, of which two are endemic: A. melanolepis Boiss. and A. kermanensis Podl. [1,2]. Some species are used in folk medicine; A. annua (Oinhaosu) is a traditional medicine herb of China. It is presently being cultivated on a commercial scale in China and Vietnam for its antimalarial sesquiterpene lactone artemisinin [3,4] and its essential oil. A. austriaca and A. spicigera are odorous herbs and used as antiseptics and stomachics in folk medicine [5]. The large genus Artemisia has been investigated chemically in which acetylenic compounds [6] and sesquiterpene lactones [7]. Three eudesmanolides was purified from extract of A. tournefortiana from Iran [8]. Sanz et al. found a new cis-eudesmanolide and three new eudesmane acids in extract of the aerial parts of A. tournefortiana [9]. Tourneforin, a novel eudesmanolide from A. tournefortiana has been reported [10]. A numerous reports appear in the literature on the essential oils of different species of Artemisia [11-34]. Although the volatile constituents of A. tournefortiana from Chinese, previously reported [34], no similarity exist between the major constituents of oils and the present work.

Exprimental

Plant material: The aerial parts of *A*. *tournefortiana* were collected during the flowering stage in Firuzkuh, Hesarbon, province of Tehran, Iran, in October 2007. A voucher specimen (no. 59077) has been deposited at the Herbarium of the Research Institute of Forests and Rangelands (TARI), Tehran, Iran. **Isolation of the oil:** The air-dried aerial parts *A*. *tournefortiana* (153.0 g) of the plant was subjected to separate hydrodistillation using a Clevengertype apparatus for 3 hrs. After decanting and drying over anhydrous sodium sulfate, the corresponding yellowish colored oil was recovered in yields of 0.6 % w/w.

Gas chromatography: GC analysis was performed on a Shimadzu 15A gas chromatograph equipped with a spilt/spiltless (ratio 1:30), injector (250 °C) and a flame ionization detector (250 °C). N_2 was used as carrier gas (1 mL/min) and the capillary column used was DB-5 (50 m x 0.2 mm, film thickness 0.32 pin). The column temperature was kept at 60 °C for 3 min and then heated to 220 °C with a 5°C/min rate and kept constant at 220 °C for 5 min. Relative percentage amounts were calculated from peak area using a CR5 SHIMADSU CR PACK without the use of correction factors.

Gas Chromatography-Mass spectrometry: GC/MS analysis was performed using a Hewlett-Packard 5973 with a HP-5MS column (30 m × 0.25 mm, film thickness 0.25μ m). The column temperature was kept at 60°C for 3 min and programmed to 220°C at a rate of 5°C/min and kept constant at 220 °C for 5 min. The flow rate of Helium as carrier gas was 1 mL/min, final temperature 200 °C and detector temperature 250 °C; MS were taken at 70 eV (E1+ QIMS LMR UP LR mode electron ionization voltage), electron multiplier voltage 1800 eV; mass range, 30 to 350 amu; scan time and 2 scan/ sec.

Identification of components: The components of the oil were identified by comparison of their mass spectra with those of the computer library or with authentic compounds and confirmed by comparison

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of their retention indices either with those of authentic compounds or with data published in the literature [35]. The retention indices were calculated for all volatile constituents using a homologous series of C9 to C19 n-alkanes.

Results and Discussion

The volatile components obtained from *A*. *tournefortiana* are listed in Table I in which the percentage and retention indices of the component are given. Twenty nine compounds were obtained that accounts for 97.3 % of the total constituents in the essential oil. The main components were characterized by (E)-thujone (47.0%), sabinene (16.5%) and β -pinene (8.3%).

Oxygenated monoterpenes constitute the major fraction of the oil (56.0%), while sesquiterpene hydrocarbons accounted to 3.0%. Monoterpene hydrocarbons and oxygenated sesquiterpenes amounted to 32.2% and 6.1% of the oil, respectively. This *Artemisia* is rich in monoterpenes.

In some studies on the essential oils of other *Artemisia* species, thujane derivatives were reported as the main constituents. These compounds were obtained to be major components of the oils of *A. absinthium* [11], *A. fragrans* [12], *A. herba-alba* [13], *A. khorassanica* [14], *A. verlotiorum* [15], *A. adamsii* [16], *A. afra* [17], *A. copa* [18], *A. douglasiana* [19], *A. ferganensis* [20], *A. moorcroftiana* [21], *A. nilagirica* [22], *A. roxburghiana* [23] and *A. vulgaris* [24].

Sabinene, the main component of the oil of *A*. *tournefortiana*, is also characteristic of the oils of *A*. *volgaris* [25], *A. dracunculus* [26], *A. afra* [27] and *A. wallichiana* [28].

Pinane drivatives are found in the oils of some *Artemisia* species, for example, α -pinene was found

A. tournefortiana Compound RI (% w/w)α-thujene 931 0.3 α-pinene 939 2.4 976 sabinene 16.5 β-pinene 980 8.3 991 1.0 myrcene α-phellandrene 1005 1.2 1018 0.3 α-terpinene 1026 0.3 p-cymene 1031 0.9 limonene 1,8-cineole 1033 1.4 1040 (Z)- β -ocimene t (E)- β -ocimene 1050 0.6 1062 0.4 γ-terpinene 1102 (Z)-thujone 3.0 47.0 (E)-thujone 1114 α-campholenal 1125 t 1139 3.1 (E)-pinocarveol 0.2 (E)-sabinol 1140 camphor 1143 0.6 terpinen-4-ol 1177 0.5 a-terpineol 1189 0.1 citronellol 1228 t geraniol 1255 0.1 0.1 α-copaene 1376 β-bourbonene 1384 0.2 (E)- β -farnesene 1458 0.7 germacrene D 1480 0.9 β-selinene 1485 1.0 γ-cadinene 1513 0.1 (E)-nerolidol 1564 5.7 1645 0.2 torreyol α-bisabolol 1683 0.2 Total 97.3 Group components Monoterpene hydrocarbone 32.2 Oxygen-containing monoterpene 56.0

Table 1- Percentage composition of aerial parts of

Oxygen-containing sesquiterpene t = trace < than 0.05%

Sesquiterpene hydrocarbone

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in the oils of *A. annua* [29] and *A. biennis* [30], β -pinene in *A. absinthium* [11], *A. campestris* [31], *A. scoparia* [32] and *A. moorcroftiana* [21] and γ -terpinene in *A. scoparia* [33].

In our research, trans-thujone, sabinene and beta-pinene predominated in the oil *Artemisia* but α -pinene was only found as a minor constituent.

In previous studies on Chinese *A. tournefortiana* [34], the main components were 7,11-dimethyl-1,6,10-12 carbon leukotriene (56.20%) and α -pinene (18.63%), wheras no similarity exist with the present work.

Conclusion

Twenty nine compounds were obtained that accounts for 97.3 % of the total constituents in the essential oil. The main components were characterized by (E)-thujone (47.0%), sabinene (16.5%) and β -pinene (8.3%). This *Artemisia* was rich in monoterpenes. The presence of thujones and terpene alcoholes in the oil can be of great importance in food industry [36] and antimicrobial activity [37] respectively. These results may partly justify the traditional use of this *Artemisia*.

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