Volatile Constituents of the Fruit and Leaf Oils of *Thuja orientalis* L. Grown in Iran

Bahman Nickavar[a,*], Gholamreza Amin[b], and Sara Parhami[b]

[a] Pharmacognosy Department, School of Pharmacy, Shaheed Beheshti University of Medical Sciences, Tehran, Iran. Fax: +98-21-8795008. E-mail: bnickavar@yahoo.com
[b] Pharmacognosy Department, School of Pharmacy, Tehran University of Medical Sciences, Tehran, Iran

* Author for correspondence and reprint requests

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The composition of the hydrodistilled essential oils from the fruits and leaves of *Thuja orientalis* L. grown in Iran was analyzed by GC/MS. Nineteen and twenty-eight compounds have been identified in the volatile oils of the fruit and leaf, respectively. While the fruit oil contained α-pinene (52.4%), Δ-3-carene (14.2%), α-cedrol (6.5%) and β-phellandrene (5.1%), the leaf oil contained α-pinene (21.9%), α-cedrol (20.3%), Δ-3-carene (10.5%) and limonen (7.2%) as the main components.

Key words: Thuja orientalis L., Cupressaceae, Essential Oil Composition

Introduction

Thuja orientalis L. (Cupressaceae), locally named Sarv-e Khomreii or Nosh, is an evergreen species, which grows naturally in China, Korea, Japan and Iran. Also, this species is widely cultivated as a common ornamental plant in Iran and other countries (Assadi, 1998).

The chemical composition of the oil of *T. orientalis* has not been the subject of much study except for those of Chen *et al.* and Li *et al.* where they have reported α-pinene and α-cedrol as the major constituents of the leaf and fruit oils, respectively (Chen *et al.*, 1984; Li and Liu, 1997). However, these studies refer to the chemical composition of the oils from Chinese origin and not to the oil of Iranian origin.

The aim of this study was to identify the volatile constituents of the fruit and leaf oils of *T. orientalis* grown in Iran.

Method and Materials

Plant material

Fresh leaves and fruits of *T. orientalis* were collected in May 2001 from Karaj, near Tehran. Voucher specimens have been deposited in the Herbarium of the Pharmacognosy Department, School of Pharmacy, Tehran University of Medical Sciences.

Isolation of the volatile oils

Fresh leaves and fruits of the plant (100 g) were separately hydrodistilled in a Clevenger type apparatus for 4 h. The oils were dried over anhydrous sodium sulfate and stored under N_2 in a sealed vial until required.

Gas chromatography-mass spectrometry analysis

The oils were analyzed by GC/MS using a Hewlett-Packard 6890/5972 system with a HP-5MS capillary column (30 m × 0.25 mm; 0.25 μm film thickness). The carrier gas was helium with flow 1 ml/min. The oven temperature was held at 60 °C for 3 min, programmed at 6 °C/min to 220 °C and then held at this temperature for 3 min. Mass spectra were taken at 70 ev. Mass range was from *m/z* 35–350 amu. The injector temperature was 240 °C. Relative percentage amounts were calculated from peaks total area by apparatus software.

Identification of the compounds

The compounds were identified by comparing mass spectra and retention indices with those in literature (Adams, 1995) and by computer searching followed by matching the mass spectra data with those held in a computer library (Wiley 275.L).

Table I. Chemical composition of the fruit oil of *T. orientalis*.

Compound	RT [min]	RI	Percentage
Tricyclene	5.25	921	0.4
α-Pinene	5.61	936	52.4
β-Pinene	6.58	977	3.3
Myrcene	6.93	992	3.6
Δ-3-Carene	7.44	1013	14.2
β-Phellandrene	7.91	1031	5.1
γ-Terpinene	8.67	1061	0.2
α-Terpinolene	9.43	1091	4.0
Terpinene-4-ol	11.69	1182	0.3
α-Terpineol	12.03	1196	0.1
Bornyl acetate	14.25	1289	1.2
α-Terpinyl acetate	15.67	1354	0.5
β-Elemene	16.63	1397	0.3
β-Caryophyllene	17.26	1427	2.6
Thujopsene	17.50	1439	0.6
α-Humulene	17.97	1462	1.2
Germacrene-D	18.54	1489	1.0
Elemol	19.90	1557	0.5
α-Cedrol	21.02	1615	6.5

RT = retention time; RI = retention index.

Table II. Chemical composition of the leaf oil of *T. orientalis*.

Compound	RT [min]	RI	Percentage
α-Thujene	5.40	928	0.7
α-Pinene	5.66	939	21.9
α-Fenchene	5.89	948	2.6
Sabinene	6.53	975	0.8
β-Pinene	6.61	978	1.6
Myrcene	6.96	993	2.6
α-Phellandrene	7.31	1007	1.3
Δ-3-Carene	7.50	1015	10.5
ϱ-Cymene	7.83	1023	2.2
Limonene	7.97	1033	7.2
γ-Terpinene	8.68	1061	0.2
α-Terpinolene	9.46	1092	3.2
Linalool	9.73	1102	0.2
Terpinene-4-ol	11.69	1182	0.2
Thymoquinone	13.43	1255	0.2
Bornyl acetate	14.25	1290	1.0
Geranyl acetate	16.40	1387	0.4
β-Elemene	16.64	1398	0.3
β-Cedrene	17.13	1421	1.2
β-Caryophyllene	17.29	1429	3.0
Thujopsene	17.53	1441	2.2
α-Humulene	17.99	1463	1.7
Germacrene-D	18.55	1490	0.8
β-Himachalene	18.94	1509	0.3
Δ-Cadinene	19.37	1531	0.4
Elemol	19.94	1559	1.6
α-Cedrol	21.16	1622	20.3
α-Cadinol	21.98	1666	0.9

RT = retention time; RI = retention index.

Results and Discussion

The hydrodistillation of the fruits and the leaves of *T. orientalis* gave yellowish oils with a yield of 0.97% and 0.25%, respectively, based on fresh weights. Nineteen compounds (98.0%) and twenty-eight constituents (89.5%) were identified in the fruit and the leaf oils, respectively. The identified compounds and their percentages in both oils are given in Tables I and II. From the Tables, it is evident that the compositions of the oils are different qualitatively and quantitatively. As indicated in the Tables, mono- and sesquiterpenoids (especially hydrocarbon types) were the main components of the oils. In the fruit oil, the monoterpenoids (85.3%) were the main compounds and the sesquiterpenoids (12.7%) had a low percent but in the leaf oil, both the monoterpenoids (56.8%) and the sesquiterpenoids (32.7%) were the major constituents. α-pinene (52.4%), Δ-3-carene (14.2%), α-cedrol (6.5%) and β-phellandrene (5.1%) were the major components in the fruit oil, while α-pinene (21.9%), α-cedrol (20.3%), Δ-3-carene (10.5%) and limonen (7.2%) were the main constituents in the leaf oil.

In conclusion, the fruit oil of *T. orientalis* was characterized by the very high contents of α-pinene, the low contents of α-cedrol and the presence of β-phellandrene, whereas the leaf oil of *T. orientalis* was characterized by the high contents of α-pinene and α-cedrol and the presence of limonen.

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