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Original Article

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Volatile constituents of the peel and leaf of Citrus aurantium L.cultivated in the north of Iran

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Abstract

The essential oil constituents of the peel and leaf of Citrus aurantiumL. (Rutaceae) grown in the north of Iran, were analyzed by GC and GC/MS. Fourteen components representing 99.6% of the leafoil were identified. The major compounds were linalool (39.4%), linalyl acetate (38.8%) and α-terpineol (7.2%). Twenty constituents consisting 99.4% of the peeloil were identified. The main components were limonene (91.3%), β-myrcene (3.0%) and linalool (1.1%).

Key words: Citrus aurantiumL., Essential oil,Rutaceae, Limonene, Linalool, Linalyl acetate

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1. Introduction

The genus Citrus (Rutaceae) is found in the temperate and semitropical areas of Iran and many species of this genus are cultivated in this area (Ghahreman, 1993)(Salehi, Mohammadi et al. 2008). Citrus aurantiumL. or sour orange is a tree up to 6 m. height with leathery leaves, white and aromatic flowers, globular and orange coloured fruit which first originated in the north Indian areas (Mozaffarian, 2003; Evans, 2006)(Schiff 1980; Mahmoudi, Seyedabadi et al. 2011). It is locally named Narenjand its flowers (BaharNarenj) used as a sedative agent in the folk medicine of Iran (Amin, 2005)(Fazeli, Amin et al. 2007). Because of wide uses of Citrus species, the cultivation of those was extended in whole temperate areas of Iran (Zargari, 1992) (Sahraei, Shams et al. 2007). According to the recent studies on Citrus aurantium L., the peel oil has antimicrobial (Sonbol et al., 1992), antifungal (Ramadan et al., 1996)(Martin and Ernst 2004), insecticide (Mwaiko, 1992) (Kamaraj, Rahuman et al. 2008), antioxidative (Song et al., 2001)(Shahidi and Zhong 2005) and cardiovascular (Occhiuto and Circosta,1996)(Occhiuto and Circosta 1996) effects.

The literature survey revealed that linalool, linalyl acetate and a-terpineol were the major compounds in the leaf oil (Baaliouamen and Meklati, 1986; Calvarano,1968; Di Giacomo and Romeo,1974; Karawya et al.,1970) (Karawya, Hashim et al. 1974; Guenther, Gilbertson et al. 1977; Fishman, Erdmann et al. 1981; Gogorcena and Ortiz 1989) and the main components of the peel oil were limonene and myrcene, in many countries (Boelens and Jimenez, 1989; Dugo and Giacomo, 2002; Lota et al.,2001; Samahy et al.,1982)(Dugo, Mondello et al. 1997; Lin and Rouseff 2001; Lota, de Rocca Serra et al. 2001; Pérez-López, Saura et al. 2006) but there was no report on volatile constituents of Citrus aurantium L. peel and leaf cultivated in the north of Iran.

2. Materials and Methods

Plant material

Citrus aurantiumL. leaves and fruits were collected from Sari in the north of Iran, in April and November 2002, respectively. Samples were authenticated by Prof. Golamreza Amin

Table 1: Chemical composition of Citrus aurantiumL. leaf oil

No.	Compound	RI[a]	Percentage
1	α-Pinene	935	0.3
2	Sabinene	972	0.5
3	β-Pinene	976	3.8
4	Myrcene	988	0.7
5	Limonene	1024	0.3
6	cis-Linalool oxide	1064	0.2
7	Linalool L	1095	39.4
8	α-Terpineol	1173	7.2
9	trans-Geraniol	1203	0.8
10	Linalyl acetate	1228	38.8
11	Geranial	1240	0.4
12	Neryl acetate	1315	2.5
13	Geranyl acetate	1332	4.5
14	trans-Caryophyllene	1368	0.2

a RI: retention indices on DB-5 capillary column

and a voucher specimen (No. 1041-HPAU) has been deposited at the herbarium of the Pharmacognosy Department, Pharmaceutical Sciences Branch, Islamic Azad University, Tehran,Iran.

Oil isolation

The fresh crushed leaves and peels of Citrus aurantium L. were separately subjected to hydrodistillation using a Clevenger-type apparatus for 4 hrs .The obtained essential oils were dried over anhydrous sodium sulphate and stored at 4-6°C.

GC and GC/MS analysis

The leaf essential oil was analyzed by GC and GC/MS using a Hewlett-Packard 6890 gas chromatograph with DB-5 capillary column (30 m x 0.25 mm; film thickness 0.25 mm). The carrier gas was helium with a flow rate of 1 ml/min. The column temperature was programmed from 60oC to 220oC at 6oC/ min. The gas chromatograph was coupled to a Hewlett-Packard 5973 mass selective detector. The MS was operated at 70 eV ionization energy.

The retention indices were calculated by using retention times of n-alkanes that were injected after the essential oil at the same conditions. The components wereidentified by comparison of retention indices with those reported in the literatures and also by comparison of their mass spectra with the published mass spectra or Wiley library (Adams, 2001; Massada, 1976)

Table 2: Chemical composition of Citrus aurantiumL. peel oil

No.	Compound	RI[a]	Percentage
1	Hexanal	773	0.1
2	α-Pinene	923	1.0
3	β-Pinene	960	0.9
4	β-Myrcene	978	3.0
5	Limonene	1024	91.3
6	(E)- β-Ocimene	1053	0.5
7	Octanol	1062	0.2
8	trans-Linalool oxide	1072	trace[b]
9	Nonanal	1082	trace
10	Linalool	1090	1.1
11	4-Terpineol	1152	trace
12	α-Terpineol	1162	0.2
13	Decanal	1181	0.2
14	Nerol	1204	0.1
15	(z)-Citral	1207	0.1
16	trans-Geraniol	1232	0.1
17	Linalyl acetate	1238	0.5
18	Neryl acetate	1336	trace
19	Geranyl acetate	1355	0.1
20	Nerolidol	1536	trace

[a] *RI: retention indices on DB-1 capillary column*

[b] *trace: The values under* 0.05% *were considered as a trace.*

(Baaliouamer, Meklati et al. 1985; Tirillini, Pagiotti et al. 2009). Relative percentage amounts were calculated from peaks total area by apparatus software.

GC and GC/MS analysis of the peel oil was performed on aThermoquest 2000 system with DB-1 capillary column (30 m x 0.25mm; film thickness 0.1mm). The carrier gas was helium with a flow rate of 1.5 ml/min. The column temperature was programmed from 50oC to 265oC at 2.5oC/min. The MS was taken at 70eV. Identifying the compounds was carried out as same as the leaf method.

3. Results and Discussion

The fresh leaves of Citrus aurantiumL. yielded 0.19% V/W of a clear yellowvolatile oil with a fresh sweet and neroli odor.

Fourteen compounds representing 99.6% of the total oil were identified. The detected constituents and their percentage are shown in Table 1.

The major components were linalool (39.4%), linalyl acetate (38.8%) and a-terpineol (7.2%). The leaf essential oil contained 47.6% alcohols and 45.8% esters.

The fresh peels of Citrus aurantiumL. yielded 1.95% V/W of a pale yellow volatile oil with a strong pleasant odor.

Analyzing of the peel oil showed twenty compounds which are given in Table 2.

The identified components were represented 99.4% of the total oil. Citrus aurantium L. peel oil contained 93.2% cyclic monoterpenes with limonene (91.3%) as the principle constituent. Another compound which presented in appreciable amount was b-myrcene (3.0%).

This research on peel and leaf essential oils of Citrus aurantiumL.confirms the previous reports on this species from the other countries. According to the references, the peel oil quality is attributed to limonene content and the presence of 90% limonene is the optimum value (BPC, 1973). This investigation shows that Citrus aurantium L. peel oil cultivated in the north of Iran with 91.3% limonene has a high quality for industrial purpose.

Conflict of interests : None declared.

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