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Original Article

Chemical Constituents of the Flower Essential Oil of *Lavandula officinalis* Chaix. from Isfahan (Iran)

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Abstract

Chemical constituents of the essential oil of flowers of Lavandula officinalis Chaix. growing in Isfahan, Iran, were studied by TLC and gas chromatography-mass specrtometery (GC-MS) methods. Twelve components which constitute 94.8% of the examined oil were identified. The main constituents were linalool (34.1%), 1,8-cineole (18.5%), borneol (14.5%), camphor (10.2%), terpinen-4-ol (4.5%), linalyl acetate (3.7%), α-bisabolol (3%), α-terpineol (2.2%) and (Z)-β-farnesene (2.2%).

*Keywords:*1,8-Cineole; Essential oil; *Lavandula officinalis*; Linalool.
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1. Introduction

Lavandula officinalis Chaix. (synonyms: *L. angustifolia* Mill.; *L. vera* DC.){family: Labiatae} is an evergreen bushy shrub with straight, woody branches, the lower of which are leafless, putting out numerous herbaceous stems to a height of about 1 meter [1-3]. The leaves are opposite, long, narrow, lanceolate and light grayish-green with a downy appearance. There is an inflorescence at the end of each slender stem where the densely packed layers of flowers seem to be in whorls [1].

The plant is indigenous to Southern Europe and is sometimes found growing wild in the Mediterranean area between the coast and the lower mountain slopes [1, 2]. It is cultivated throughout Europe [1] as well as in different parts of Iran.

Flowers of the plant have carminative, antispasmodic, antidepressant, antirheumatic, antiseptic and tonic properties [1, 2] and are indicated in flatulent dyspepsia, colic and depressive headache. Essential oil of the flowers is rubefacient and is used topically in rheumatic pain [2].

The composition of the essential oil of the plant growing in Italy [4], Russia [5] and other parts of the world has been reported, but, as the volatile oil of the plant is well established to be the major active constituent and also is well known to be available in larger quantities in the flowers, and since, in recent years the plant is widely cultivated in Isfahan and the climate as well as the soil conditions in Isfahan are different from those of the original habitat, and on the other hand, as no previous investigation of flower essential oil constituents of the cultivated plant in Isfahan, Iran, has been carried out, therefore,

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in the present study the quantity as well as the quality of the volatile oil obtained from flowers of the cultivated plant in Isfahan is determined.

2. Materials and methods

2.1. Plant material

Flowers of the plant cultivated in standard conditions were obtained from the "Medicinal Plants Section" of the Research Center of Natural Resources-Jihad Sazandeghee of Isfahan, Iran. The plant was identified by the Botany Department of the Faculty of Sciences at the Isfahan University, Isfahan, Iran. Voucher specimens of the flowering plant (No.1484) were deposited in the Herbarium of the Pharmacognosy Department, Faculty of Pharmacy and Pharmaceutical Sciences, Isfahan University of Medical Sciences Isfahan, Iran.

2.2. Essential oil preparation

The air-dried flowers were grossly pulverized and the essential oil fraction was isolated after hydro-distillation for 4 h using the apparatus according to the British Pharmacopoeia [6].

2.3. TLC analysis

The components were tentatively identified on silica gel 60 GF thin layer plates using some authentic samples for comparison. The mobile phase was toluene-ethyl acetate (93:7) and characterization of the separated components was by vanillin-sulfuric acid reagent and Rf values [7]. The above stationary phase was also used for the identification of camphor; the mobile phase was dichloromethane. After development, the plates were treated with phosphomolybdic acid reagent and heated for 5 min. at 100 °C, sprayed with a solution of 0.5 g potassium permanganate in 5 ml concentrated sulfuric acid, and heated again for 5 min. at 100 °C, camphor appeared as a dark blue spot [8].

2.4. GC-MS analysis

A Finnigan-Mat Incos 50 mass spectrometer equipped with a Data General computer, coupled directly with a Varian 3400 gas chromatograph, was used for the identification and structure elucidation of the

Table 1. Composition of the essential oil of *Lavandula officinalis* flowers.

Name of constituents	RI*	Percentage	Identification methods
1,8-Cineole	1029	18.5	GC-MS, RI*, TLC
Linalool	1099	34.1	GC-MS, RI, TLC
Camphor	1142	10.2	GC-MS, RI, TLC
Borneol	1166	14.5	GC-MS, RI, TLC
Terpinen-4-ol	1175	4.5	GC-MS, RI
α-Terpineol	1185	2.2	GC-MS, RI
Linalyl acetate	1253	3.7	GC-MS, RI, TLC
Thymol	1287	0.9	GC-MS, RI
(Z)-β-Farnesene	1442	2.2	GC-MS, RI
α-Chamigrene	1505	0.5	GC-MS, RI
Caryophyllene oxide	1579	0.5	GC-MS, RI
α-Bisabolol	1682	3.0	GC-MS, RI, TLC
Grouped constituents:			
Oxygen containing monoterpenoids		88.6	
Sesquiterpene hydrocarbons		2.7	
Oxygen containing sesquiterpenoids		3.5	
Total		94.8	

* RI=Retention index

components. The column was a 25 m x 0.25 mm i.d capillary DB-1, film thickness: 0.25 μm; carrier gas He, flow rate 1.5 ml/min, temperature program: 60-280 °C at 5 °C/min; mass spectra: electronic impact, ionization potential 70 eV, ion source temperature 180 °C, resolution 1000, and mass range 35-450.

Identification of the constituents was based on computer matching of the mass spectra against the library spectra built up from pure substances and components of known essential oils, comparison of their mass spectra with the literature data [9, 10], comparison of their calculated retention indices with those of the authentic reference compounds on non polar capillary columns [11], interpreting their fragmentation pattern and chromatography on silica gel plates along with some authentic samples.

Dried flowers of *L.* officinalis afforded on hydro-distillation a limpid, yellow-greenish essential oil (1.97 ml/100 g), lighter than water and having the following physical properties: d^{25}: 0.86, η^{25}: 1.461. Twelve components, representing 94.8 % of the essential oil, were identified (Table 1). The monoterpenoid fraction constitutes 88.6% of the oil with the main components linalool (34.1%), 1,8-cineole (18.5%), borneole (14.5%) and camphor (10.2%). Percentage of the identified sesquiterpenes and sesquiterpenoid components was relatively low (6.2%). The main components of this fraction in the examined flowers are α-bisabolol (3%) and (Z)-β-farnesene (2.2%). Other identified components of this fraction are α-chamigrene and caryophyllene oxide. Occurrence of caryophyllene oxide in the flowers of the same plant growing elsewhere has been reported [3]. Flowers of the same plant are reported to produce 1 to 3% essential oil, containing mainly monoterpenes, the most important component of which is linalyl acetate (30-55%), linalool (20-35%), β-ocimene, cineole (1,8-cineole), camphor, and also the sesquitepene caryophyllene oxide [3]. On the other hand, samples of essential oils of the same plant grown in the General Botanic Garden in Russia were mentioned to contain linalool (4.7-22%), linalyl acetate (15-22%), and terpinen-4-ol (7-21%) as the major components [5]. Comparing our results with the above mentioned reports, it can be concluded that the amount of linalyl acetate in our analyzed oil is relatively lower. This difference may be attributed to the different soils and especially climatic conditions. Soils in Europe are enriched with humus [12] but soils in Isfahan are light or heavy and are not enriched with humus. Temperature, rainfall, and day-length (including the quality of light) are among the important climatic factors which affect the plant growth and development and often the nature and quantity of secondary metabolites [12].

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