Iranian Journal of Pharmaceutical Research (2006) 1: 73-75
Received: December 2004
Accepted: October 2005

Original Article

Volatile Oil Constituents of Leaves of the *Eucalyptus gillii* Maiden and *E. microcarpa* Subsp. *macrocarpa* Hook from Iran

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Abstract

The essential oils isolated by hydrodistillation from the leaves of two Eucalyptus *gillii* Maiden and *E. microcarpa* Subsp. *macrocarpa* Hook were analysed by GC and GC/MS. The main components identified in *E. gillii* oil were 1, 8-cineole (79.5%), trans-pinocarveol (8%) and α-pinene (2.7%), and in *E. microcarpa* were 1, 8-cineole (77.3%), α-pinene (5.6%) and terpin-1-ol (5.1%). Oils with high content of 1, 8-cineole are classified as a "eucalyptol or medicinal" type.

Keyword: *Eucalyptus gillii* Maiden; *Eucalyptus microcarpa* subsp. *macrocarpa* Hook; Essential oil compostion; 1, 8-Cineole; α-Pinene.

Introduction

The genus *Eucalyptus* (family Myrtaceae) comprises well-known plants of over 600 species of trees (1). Although most of the plants are native to Australia, numerous species have been introduced to other parts of the world, including Iran, as economic and ornamental trees in forest trial provenances (2), where the plants have become source of important fast-growing hardwood trees (3) and *Eucalyptus* oils (4). The *Eucalyptus* essential oils could be grouped into three types (medicinal, industrial and perfumery) on the basis of their chemical constituents (5, 6, 7). Consequently, *Eucalyptus* essential oils compositions from various countries have been extensively investigated due to their numerous uses in the pharmaceutical and cosmetics industries. The eucalyptus essential oils are valued because of their main component, 1, 8-cineole, which is an antiseptic used in the treatment of respiratory tract infection. Thus, its major use is in the pharmaceutical industry. French and English pharmacopoeias require the 1, 8-cineole content to be at least 70%. However, the yield and chemical composition of the leaf oil vary widely among species, individual trees as well as with the growing environment (6, 7, 8). Previous studies of the leaf oil compositions of *Eucalyptus* species used commercially as a natural source of 1, 8- cineole have been reported (9, 10). Much research has been done on the oil composition of different *Eucalyptus* species. The essential oils of some of these *Eucalyptus* species and their chemical constituents have not been investigated in Iran. Practically nothing whatsoever is known about the constituents of the Iran-grown *Eucalyptus* species, in spite of their important industrial uses. It was therefore necessary to investigate the chemical composition of the essential oils of these plants and correlate the economic potential of the essential oils with the volatile oil constituents. This paper now reports for

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the first time the results of the analyses of leaves essential oil of *Eucalyptus gillii* and *E. microcarpa* growing in Iran.

The seeds of *Eucalyptus gillii* Maiden and *E. microcarpa* subsp. *macrocarpa* Hook were purchased from the trial plots established at the propagated from seed supplied by the Kimberly Seed Co. Perth, Australia in 1993. The plants were cultivaed on 1994 in south-west of Iran in Dezful city in Fadak Reasearch Station with ecological conditions of latitude 16º 32′, longitude 25º 48′, elevation 80 m, precipitation 250 mm, Maximum temperature of 52ºC and Minimum temperature of -2ºC , soli texture clay and sandy loam.

Experimental

Plant sample

Fresh leaves were collected on April 2004 from Dezful city (Province Khuzistan) in Fadak Research Station which is in south-west of Iran. The plants were cultivaed on 1994.

Isolation of volatile leaf oil

About 35 g leaves from trees of the two *Eucalyptus* species collected on April 2004, were air-dried and subjected to hydrodistillation for 20 min. using a Clevenger-type apparatus (11). The oils were separated from the water by decantation and were dried by filtration over anhydrous sodium sulfate. Oil yields were 2.45% for *E. gillii* and 1.40%, for *E. microcarpa*.

GC analyses

GC analyses were performed using a Shimadzu-9A gas chromatograph equipped with a flame ionization detector, and quantitation was carried out on Euro Chrom 2000 from Knauer by the area normalization method neglecting response factors. The analysis was carried out using a DB-5 fused-silica column (30m x 0.25 mm, film thickness 0.25 µm, J & W Scientific Inc., Rancho Cordova, CA, USA). The operating conditions were as follows: injector and detector temperatures, 250°C and 265 °C respectively; carrier gas, helium. Oven temperature programme was 40°- 250°C at the rate of 4°C/min.

GC/MS analyses

The GC/MS unit consisted of a Varian Model 3400 gas chromatograph coupled to a Saturn II ion trap detector. The column was same as GC, and the GC conditions were as above. Mass spectrometer conditions were: ionization potential 70 eV; electron multiplier energy 2000 V.

Identification of constituents

The identity of the oil components was determined from their GC retention indices, relative to C_7- C_{25} n-alkanes, by comparison of their MS spectra with those reported in the literature (12, 13, 14) and by computer matching with the Wiley 5 mass spectra library, whenever possible, by co-injection with standards available in the laboratories.

Table 1. Percentage composition of the oil of *E. gillii* and *E. microcarpa*

Compound name	R.I.	*E. gillii*	*E. microcarpa*
α-pinene	935	2.7	5.6
sabinene	975	0.7	---
α-phellandrene	1004	---	0.1
1,8-cineole	1027	79.5	77.3
terpinolene	1085	---	1.0
myrcenol	1111	0.2	0.1
α-campholenal	1126	0.1	0.3
terpin-1 ol	1133	---	5.1
trans-pinocarveol	1138	8.0	---
δ- terpineol	1158	2.6	1.8
pinocarvone	1161	0.3	---
terpin-4-ol	1175	---	0.8
α-terpineol	1185	0.7	1.3
dihydro carveol	1193	0.6	0.7
cis-dihydro carvone	1195	0.3	---
verbenone	1206	---	0.4
trans-carveol	1216	---	0.5
neoisodihydro carveole	1227	0.6	1.0
isobornyl formate	1233	0.3	---
aromadendrene	1436	0.6	0.8
bicyclogermacrene	1492	---	0.3
caryophyllene oxide	1577	0.8	1.3
globulol	1587	---	0.1
β-eudesmol	1643	---	0.2
α-eudesmol	1649	0.7	0.1

a R.I. = retention indices on DB-5 column.

Results and Discussion

Results obtained for the qualitative and quantitative analysis of two eucalyptus oils are shown in table 1. The highest value was found in *E. microcarpa* subsp. *macrocarpa* Hook (77.3%) and *E. gillii* Maiden (79.5%). The chemical composition of the oil was determined by GC and GC/MS (Table I). Because of the high content of 1, 8-cineole (77.3 - 79.5%) the oil was classified as a "eucalyptol or medicinal "type (5, 6, 7, 8). The main oxygenated monoterpenes detected were trans- pinocarveol (8%) in *E. gillii*. Twenty minor compounds were also identified in this species. Aproximately 98.8% of the oil compositions were characterized. The study on essential oil of the two Eucalyptus species has shown that there is potential for commercial exploition of medicinal Eucalyptus oil in Iran for both the domestic and export markets. Much will depend on how these species perform in different regions of the country.

Acknowledgments

The author wishes to thank directory of Research Institute of Forests and Rangelands for support of this investigation.

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