Regular Articles

Study on the chemical constituents of the essential oil of the leaves of *Eucalyptus globulus* Labill from China

Aihua Song [a], Ying Wang [b*], Yanmei Liu [a]

a. School of Pharmacy, Shenyang Pharmaceutical University, Shenyang 110016, China

b. Tianjin Key Laboratory of Chemistry and Analysis of Chinese Materia Medica, Tianjin University of Traditional Chinese Medicine, Tianjin 300193, China

Abstract

The chemical constituents of the essential oil obtained from the leaves of *Eucalyptus globulus* Labill in the Cangshan mountain region in the Yunnan Province of China were analyzed by GC-MS. Forty-seven compounds were identified in the essential oils and the main constituents of the essential oils were 1, 8-eucalyptol (72.71 %), α-pinene (9.22 %), α-terpineol (2.54 %), (-)-globulol (2.77 %), α-terpineol acetate (3.11 %), and alloaromadendrene (2.47 %).

Key words: *Eucalyptus globulus* Labill; essential oil; gas chromatography; mass spectra; 1, 8-eucalyptol; chemical constituents

Introduction

Eucalyptus globulus Labill belonging to the family Myrtaceae is a fast-growing species native to Australia and widely distributed in southern China, such as Guangdong, Guangxi, Sichuan and Yunnan. The essential oil extracted from the leaves of *Eucalyptus globulus* Labill is known to be a rich source of traditional medicines with a variety of biological activities [1]. It is widely used to treat pulmonary tuberculosis [1], diabetes [2, 3], asthma [4] and also used as disinfectant [5, 6], antioxidant agent [7, 8], and antiseptic agent [1] especially in the treatment of upper respiratory tract infections and certain skin diseases.

Few studies have been reported on the chemical constituents of the essential oil obtained from the leaves of *Eucalyptus globulus* Labill [9], and to remedy this, we choose to investigate one of the major Eucalyptus species-*Eucalyptus globulus Labill* which grows in Cangshan mountain area in the Yunnan Province of China. We report here the isolation of the water-distilled volatile oil from the leaves of *Eucalyptus globulus* Labill, the qualitatively examination of the chemical constituents of this essential oil and their quantitative determination by direct comparison with results from MS databases attached to the GC-MS instruments following GC-MS analysis.

Experimental

Materials

* Author to whom correspondence should be addressed. Address: Tianjin Key Laboratory of Chemistry and Analysis of Chinese Materia Medica, Tianjin University of Traditional Chinese Medicine,Tianjin 300193; Tel: 024-23986263; E-mail: chem2000@163.com

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The leaves of *Eucalyptus globulus* Labill were collected from the Cangshan mountain region in the Yunnan Province of China in May of 2007. The specimen was botanically identified by Professor Jing-ming JIA (School of Traditional Chinese Materia Medica, Shenyang Pharmaceutical University, Shenyang). All solvents and reagents were of analytical grade.

Extraction and isolation of essential oil

The fresh leaves were completely immersed in water overnight, then water-distilled in a full glass Clevenger-type apparatus to giving greenish-yellow oil. The extraction was carried out for 6 h and the essential oil was dried over anhydrous sodium sulphate and stored at 4 ºC before being analyzed. The extraction yield of this essential oil was 0.18 % (*w*/*w*).

GC-MS analysis and identification

A Shimadzu GC-17A gas chromatograph equipped with a GCMS-QP5050 column was used. This was coupled to a Mass spectrometer operated in negative chemical ionization mode. A fused-silica capillarity column (30 m, 0.25 mm I.D., 0.25 mm film thickness) with chemically bonded phases DB-1(J&W Scientific) was used for the GC separation. The initial oven temperature was 60 ºC , this was held for 4 min then raised at the rate of 4 ºC/min to 220 ºC, and then held for 15 min. Other operating conditions were as follows: carrier gas, He (99.999 %), with a flow rate of 1 ml/min; injector temperature, 280 ºC; split ratio, 10:1. Mass spectra were recorded at 70 eV and the mass range was from *m*/*z* 33 to 500 amu.

The constituents were identified by comparison of their mass spectra with those of NIST02 library data for the GC-MS system (Fig. 2-5). The results were further confirmed by comparison of their retention indices of the compounds with literature data [10, 11].

Results and discussion

The total ion chromatogram of the essential oil is displayed in Fig. 1. The amounts of the components from the volatile oil were determinated by the peak area normalization method. This presence of several overlapping peaks shows the complexity of the mixture. The chemical constituents of the essential oil are listed in Table 1. The essential oil consisted mainly of oxygenated monoterpenes, monoterpenes and oxygenated sesquiterpenes. Of these, 1, 8-eucalyptol (72.71 %), α-terpineol (2.54 %), terpinen-4-ol (0.34 %), and linalool (0.24 %) were the main oxygenated monoterpenes, while α-pinene (9.22 %), and β-pinene (0.4 %) were the main monoterpenes and α-eudesmol (0.39 %), (-)-globulol (2.77 %), and epiglobulol (0.44 %) were the main sesquiterpene. Several significant compounds were

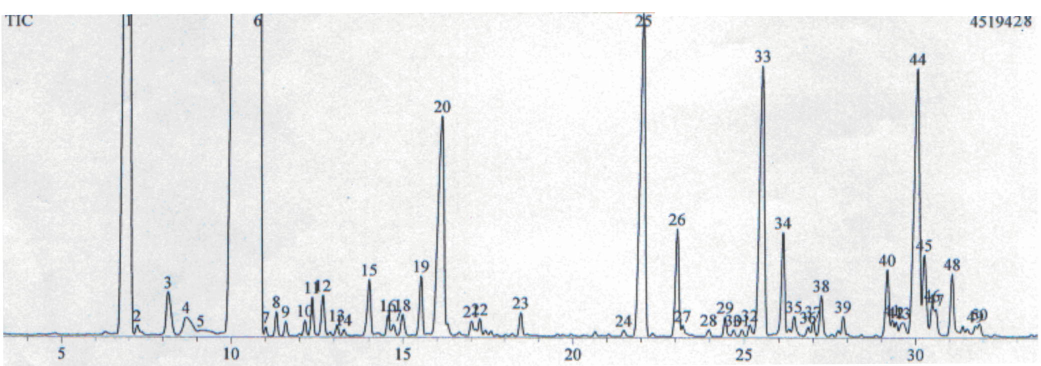

Fig. 1. TIC of essential oil of *Eucalyptus globulus* Labill leaves

Table 1. Chemical constituents of the leaves essential oil of *Eucalyptus globulus* Labill

No.	Retention time	Molecular formula	Compound	Relative content (%)
1	6.993	$C_{10}H_{16}$	α-pinene	9.22
2	7.237	$C_{10}H_{16}$	camphene	0.05
3	8.150	$C_{10}H_{16}$	β-pinene	0.4
4	8.679	$C_{10}H_{16}$	β-sabinene	0.25
5	9.113	$C_{10}H_{16}$	limonene	0.04
6	10.785	$C_{10}H_{18}O$	1, 8-eucalyptol	72.71
7	11.012	$C_{10}H_{16}$	cis-β-ocimene	0.03
8	11.324	$C_{10}H_{16}$	γ-terpinene	0.11
9	11.595	-	unidentified	0.07
10	12.151	-	unidentified	0.07
11	12.362	$C_{10}H_{16}$	terpinolene	0.19
12	12.674	$C_{10}H_{18}O$	linalool	0.24
13	13.084	$C_{10}H_{18}O$	fenchol	0.05
14	13.282	$C_{10}H_{16}O$	1, 7, 7-trimethylbicyclo [2.2.1] hept-5-en-2-ol	0.03
15	14.020	$C_{10}H_{16}O$	pinocarveol	0.36
16	14.563	$C_{10}H_{14}O$	5, 5-dimethylene-3-hylenebicyclo [2.2.1] heptan-2-one	0.11
17	14.727	$C_{10}H_{18}O$	2, 6-dimethyl-1, 5, 7-octatrien-3-ol	0.06
18	14.991	$C_{11}H_{18}O_2$	isobornyl formate	0.14
19	15.533	$C_{10}H_{18}O$	terpien-4-ol	0.34
20	16.156	$C_{10}H_{18}O$	α-terpineol	2.54
21	17.013	$C_{10}H_{16}O$	trans-carveol	0.09
22	17.258	$C_{10}H_{16}O$	2-methylene-5-(1-methylethenyl) cyclohexanol	0.08
23	18.463	$C_{10}H_{18}O$	3, 7-dimethyl-2, 6-octadien-1-ol	0.13
24	21.493	$C_{12}H_{20}O_3$	exo-2-hydroxycineole	0.04
25	22.073	$C_{12}H_{20}O_2$	α-terpineol acetate	3.1
26	23.061	$C_{12}H_{20}O_2$	geranyl acetate	0.71
27	23.210	$C_{15}H_{24}$	isoledene	0.06
28	23.927	$C_{12}H_{20}O_2$	isopulegol acetate	0.04
29	24.443	$C_{15}H_{24}$	α-gurjunene	0.1
30	24.685	$C_{12}H_{18}O_2$	(-)-cis-carvyl acetate	0.03
31	24.925	$C_{15}H_{24}$	β-panasinsene	0.03
32	25.158	$C_{15}H_{24}$	β-gurjunene	0.07
33	25.534	$C_{15}H_{24}$	alloaromadendrene	2.47
34	26.127	$C_{15}H_{24}$	aromadendrene	0.61
35	26.444	$C_{13}H_{18}O_2$	2-phenylethyl isovalerate	0.09
36	26.850	$C_{15}H_{24}$	eudesma-4(14), 11-diene	0.05
37	26.999	$C_{15}H_{24}$	α-guaiene	0.07
38	27.235	$C_{15}H_{24}$	(+)-ledene	0.24
39	27.872	$C_{15}H_{22}$	dehydroaromadendrene	0.09
40	29.171	$C_{15}H_{26}O$	epiglobulol	0.44

Continued table 1

41	29.311	$C_{15}H_{26}O$	cubenol	0.08
42	29.422	$C_{15}H_{26}O$	ledol	0.06
43	29.621	$C_{15}H_{24}O$	spathulenol	0.11
44	30.068	$C_{15}H_{26}O$	(-)-globulol	2.77
45	30.261	$C_{15}H_{26}O$	α-cadinol	0.57
46	30.490	$C_{15}H_{26}O$	γ-eudesmol	0.22
47	30.595	-	unidentified	0.12
48	31.084	$C_{15}H_{26}O$	α-eudesmol	0.39
49	31.766	$C_{15}H_{26}O$	β-eudesmol	0.04
50	31.886	$C_{15}H_{26}O$	1, 2, 3, 3a, 4, 5, 6, 7-octahyfro-α, 3, 8-t-5-azulenemethanol	0.07

α-terpineol acetate (3.1 %), geranyl acetate (0.71 %), *L*-pinocarveol (0.36 %), β-sabinene (0.25 %), and terpinolene (0.19 %). A portion (0.26 %) of the total constituents remains unidentified.

The yield of essential oil and the content of 1, 8-eucalyptol are within the values reported in the literature [12] and the percentage contents of the main constituents are similar to those given in the literature [10, 11]. Some constituents, such as β-sabinene, linalool, isoledene, ledene, epiglobulol, and cubenol had no literature data [10, 11]. This possibly may be due to the fact that the trees grown in different regions may exhibit differences in their chemical constituents.

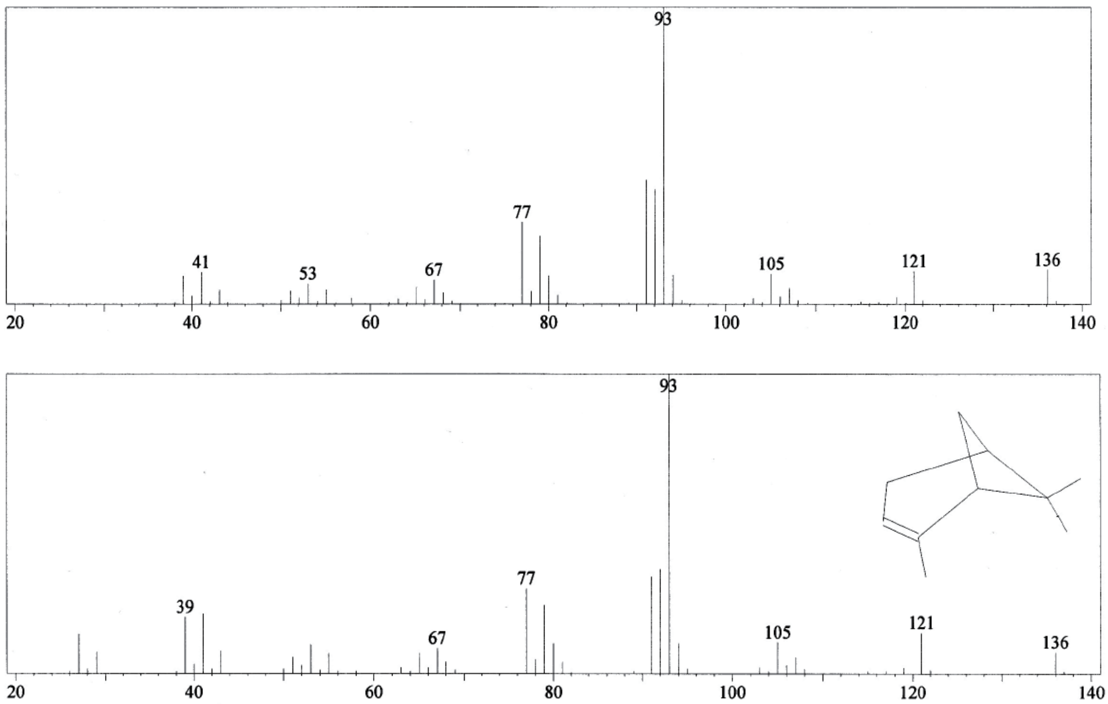

Fig. 2. A. The MS of α-pinene in the essential oil of *Eucalyptus globulus* Labill leave; B. The MS of α-pinene in NIST02 library data of the GC-MS system

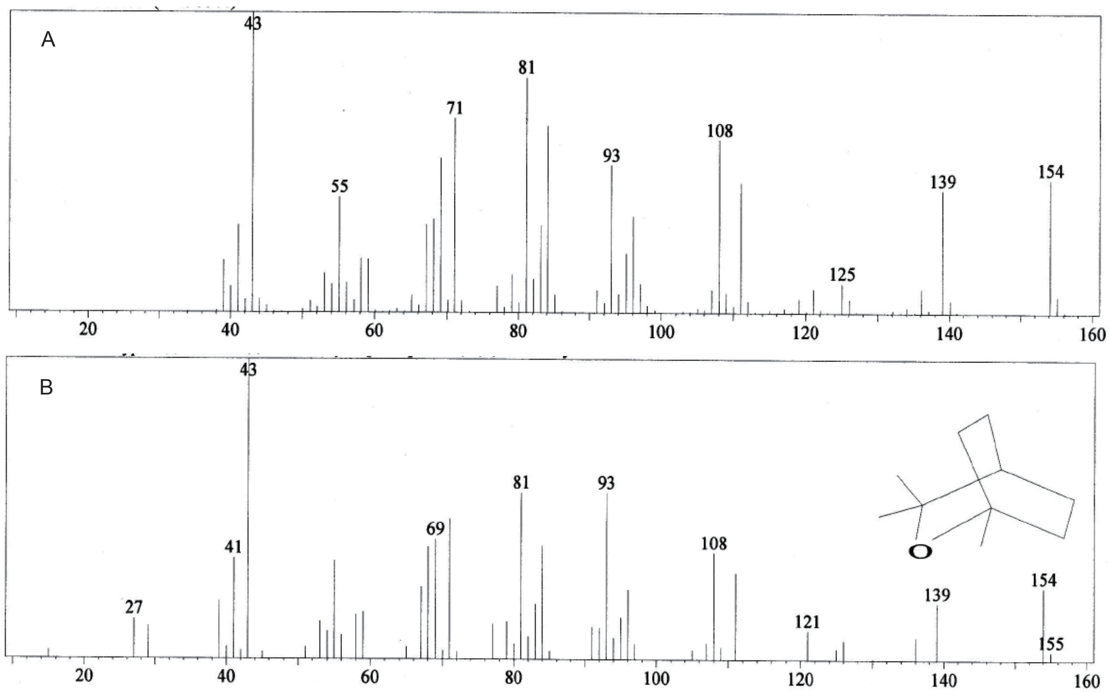

Fig. 3. A. The MS of 1, 8-eucalyptol in the essential oil of *Eucalyptus globulus* Labill leaves; B. The MS of the 1, 8-eucalyptol in NIST02 library data of the GC-MS system

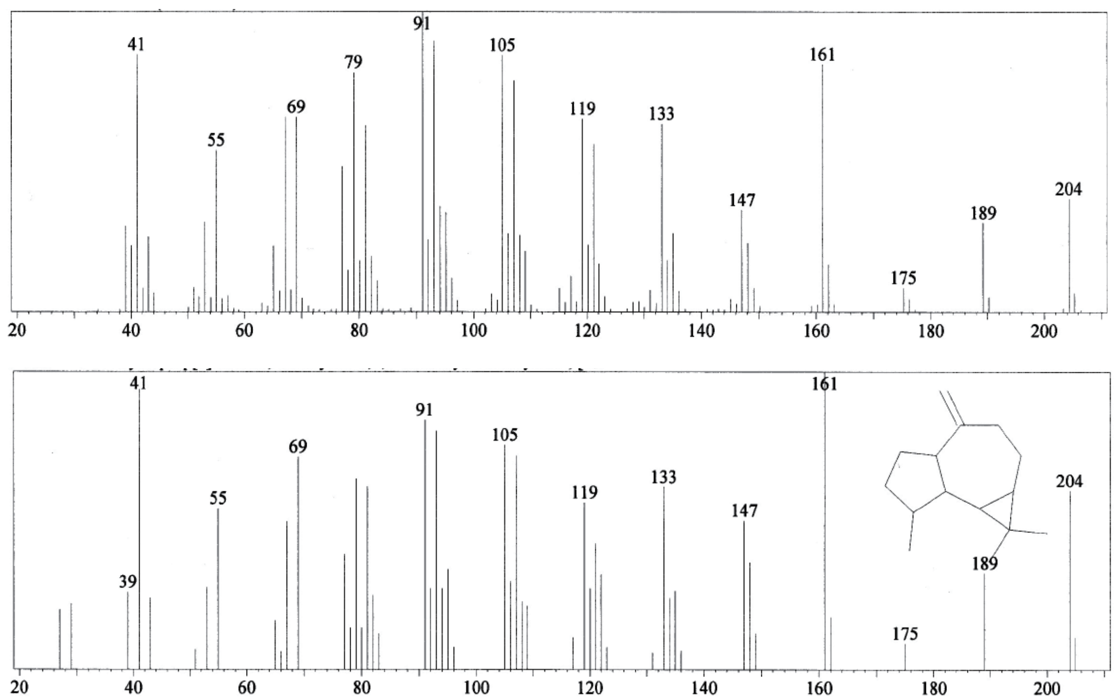

Fig. 4. A. The MS of alloaromadendrene in the essential oil of *Eucalyptus globulus* Labill leaves; B. The MS of the alloaromadendrene in NIST02 library data of the GC-MS system

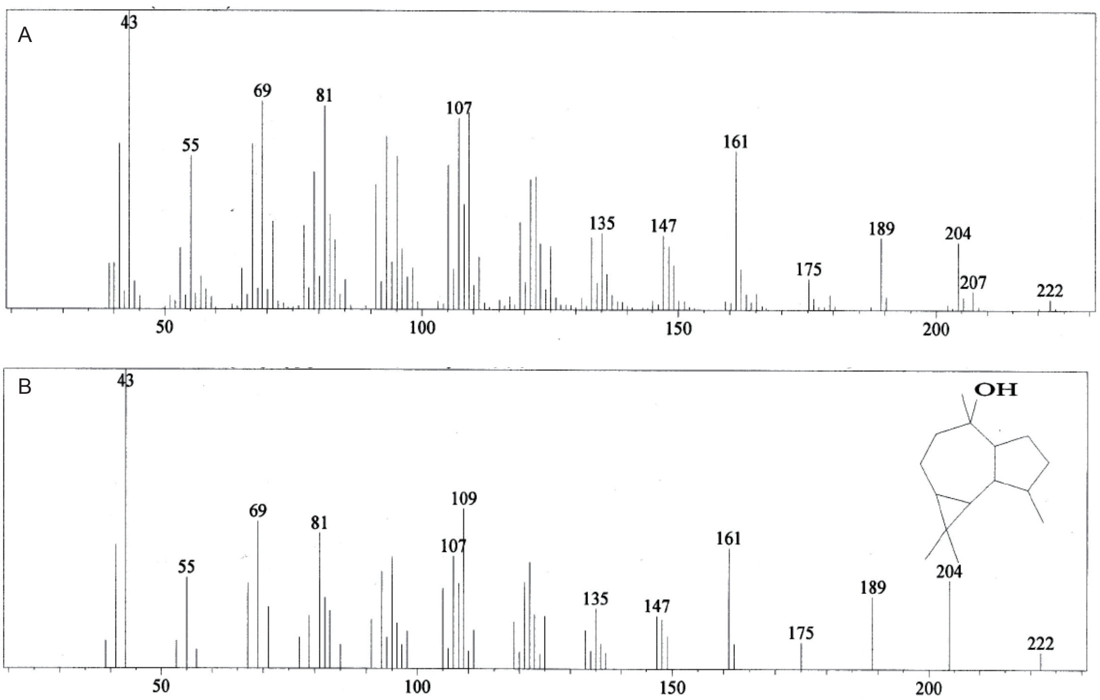

Fig. 5. A. The MS of (-)-globulol in the essential oil of *Eucalyptus globulus* Labill leaves; B. The MS of (-)-globulol in NIST02 library data of the GC-MS system

Conclusion

In the present work, 47 constituents of the essential oil from *Eucalyptus globulus* Labill grown in the Cangshan mountain region in the Yunnan Province of China were successfully identified and determined. A comparison with literature data showed that the major constituents in the essential oil were similar to those reported elsewhere, although there were differences in the percentage composition. Some trace or minor chemical constituents have not reported in the literature.

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