NOTE

THE CONSTITUENTS OF THE LEAVES OF *CHAMAECYPARIS FORMOSENSIS* MATSUM

JIM-MIN FANG (方俊民), LEE-JEN LAI (賴麗珍)
AND YU-SHIA CHENG (鄭玉瑕)*
Department of Chemistry, National Taiwan University, Taipei, Taiwan, R.O.C.

Key Word Index—*Chamaecyparis formosensis* Matsum; leaves; α-pinene; β-pinene; 3-carene; α-terpineol; γ-muurolene; kaurene.

Forty one terpenoidal compounds were isolated from the essential oil of *Chamaecyparis formosensis* Matsum. The dominant component is α-pinene. Other major components include β-pinene, 3-carene, α-terpineol, γ-muurolene, and kaurene.

Chamaecyparis formosensis Matsum, known as the Taiwan red cypress, is one of the major forest trees indegenous to the high mountain area of Taiwan. The chemical constitution of the bark is reported in the accompanying paper[1], and the constituents of the root and wood have been previously investigated[2]. We here report the constituents of the leaves of *C. formosensis* Matsum.

RESULTS AND DISCUSSION

The essential oil of *C. formosensis* Matsum was found to consist of forty one terpenoidal compounds as shown in Table 1. Peaks 1-18 correspond to monoterpenes, peaks 19-36 are sesquiterpenes, and peaks 37-41 are diterpenes. Thirty five compounds were identified and the percentage of each was determined. The dominant component is α-pinene (57%). Other major components include β-pinene, 3-carene, α-terpineol, γ-muurolene, and kaurene. This study and the related work on the total constitution of *C. formosensis* Matsum provides a chemical basis for the taxonomy of this plant. Taiwan red cypress is known to possess antifeedant activity against squirrels, and strong resistance against wood-decaying fungi[2]. With the collaboration of the Department of Forestry (NTU), we are currently investigating the active compounds of *C. formosensis* Matsum.

EXPERIMENTAL

The fresh leaves of *C. formosensis* Matsum were collected in May 1981 in the high mountain areas (2-3 *km*) of Taiwan (南投縣望鄉). The leaves were subjected to continuous steam distillation and extraction with *n*-hexane for three days. The organic phase was dried over anhydrous Na_2SO_4, and concentrated *in vacuo* (~40 *mmHg*) to give 21 *g* of essential oil. A small amount of the essential oil was kept as an authentic sample. The rest of the essential oil was prefractionated on a column of silica gel (200 *g*) to give fractions A, B and C, by eluting with *n*-hexane, 10% ethyl acetate in *n*-hexane and ethyl acetate, respectively. The components of the three fractions were further chromatographed on columns of silica gel (impregnated with 7% $AgNO_3$ in the case of fraction A), and finally separated on a preparative GC. The components which were isolated in sufficient amounts were identified by spectroscopic methods (IR, MS and ^1H NMR) and the retention times of mixtures of the compounds and authentic samples (peak enrichment techniques). Identifica-

Table 1. Composition of the essential oil of *Chamaecyparis formosensis* Matsum

Peak No.	Compound	RR_t*	Content (%)
1	(−)-α-pinene	0.06	57.32
2	camphene	0.11	0.18
3	(−)-β-pinene	0.14	3.25
4	sabinene	0.16	0.19
5	(+)-3-carene	0.17	5.61
6	α-terpinene	0.21	0.06
7	limonene	0.23	0.61
8	β-phellandrene	0.24	0.97
9	1,8-cineole	0.25	0.01
10	γ-terpinene	0.28	0.04
11	*p*-cymene	0.34	0.20
12	*p*-isopropenyl toluene	0.61	0.02
13	linalool	0.89	0.19
14	linalyl acetate	0.94	0.07
15	thymyl methyl ether	1.04	0.84
16	(−)-α-terpineol	1.27	1.52
17	citronellyl acetate	1.28	1.21
18	geraniol	2.14	0.29
19	β-caryophyllene	1.01	0.84
20	γ-muurolene	1.27	1.54
21	α-guaiene	1.32	trace
22	γ-cadinene	1.43	trace
23	cuparene	1.57	0.01
24	unidentified	1.59	0.09
25	calamenene	1.61	trace
26	unidentified	1.95	0.33
27	unidentified	2.23	0.25
28	elemol	2.34	0.85
29	cedrol	2.36	trace
30	widdrol	2.42	0.16
31	γ-eudesmol	2.43	0.73
32	cadalene	2.48	0.01
33	α-eudesmol	2.52	0.23
34	β-eudesmol	2.53	0.27
35	α-cadinol	2.56	0.60
36	unidentified	2.57	0.23
37	unidentified	2.59	trace
38	sandaracopimaradiene	2.60	0.11
39	isokaurene	2.68	trace
40	(−)-kaurene	2.86	1.80
41	unidentified	2.92	trace

* RR_t is the retention time relative to that of longifolene.

tion of the minor components was based on retention time data and analyses of the mass spectra.

Quantitative GC analyses were carried out on a Hewlett-Packard model 5710A gas chromatograph using a fused silica capillary column (25 *m*×0.2 *mm id*) coated with Carbowax 20 *M*. The column temperature was programmed from 70°C to 210°C at the rate of 4°C/*min*. The column was operated by using nitrogen as carrier gas at a flow rate of 0.2 *ml/min*. A Hewlett-Packard model 3380A reporting integrator was used to determine peak areas without correction for response factors. Preparative GC was carried out on a Shimadzu model 8A chromatograph using a column (2 *m*×3 *mm id*) of 20% Carbowax 20 *M* supported on Chromosorb W (60/80 *mesh*). Infrared spectra were taken on a Jasco Infrared IRA-1 spectrometer. ^1H NMR spectra were recorded on a Varian EM-390 or a Jeol JNM-FX-100 spectrometer. Mass spectra were recorded on a Jeol JMS-300 mass spectrometer operating at an ionizing voltage of 70 *eV*.

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