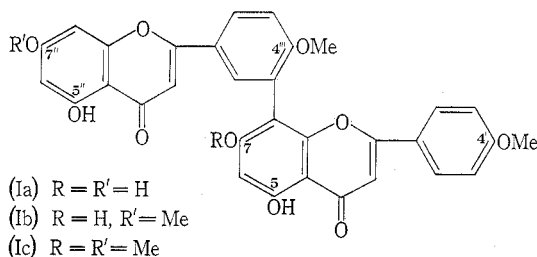


5,5'-DIHYDROXY-7,4',7'',4'''-TETRAMETHOXY-8,3'''-BIFLAVONE
FROM *DACRYDIUM CUPRESSINUM* LAMB.*

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When the leaves of *Dacrydium cupressinum* Lamb. were extracted with hexane in a Soxhlet, a yellow-green powder separated in the receiver. Crystallization of this powder gave yellow prisms of a biflavone, $C_{34}H_{26}O_{10}$. Methylation of the biflavone yielded 5,7,4',5'',7'',4'''-hexamethoxy-8,3'''-biflavone, while alkaline degradation gave 4-methoxyacetophenone and 5-methoxyresorcinol. Oxidation with potassium permanganate produced *p*-anisic acid and 4-methoxyisophthalic acid. Hence the biflavone must be a dimethylether of isoginkgetin (Ia). Its spectra in ethanol and ethanolic sodium ethoxide are similar to those of sciadopitysin (Ib), from which it



might be inferred¹ that one of the two hydroxyl groups in the biflavone was at the 7-position. However, a comparison of its spectrum in the presence of an excess of aluminium chloride with those of isoginkgetin and sciadopitysin (Table 1) would suggest that it contained hydroxyl groups at both the 5 and 5''-positions.

This was confirmed by partial methylation of sciadopitysin, giving 5,5''-dihydroxy-7,4',7'',4'''-tetramethoxy-8,3'''-biflavone (Ic), identical with the biflavone from *Dacrydium cupressinum*.

Experimental

Melting points were determined on a Koffler block. The identities of unknown compounds were established by comparison of i.r. spectra and mixed melting points with authentic specimens.

Isolation of 5,5''-Dihydroxy-7,4',7'',4'''-tetramethoxy-8,3'''-biflavone

Dried, ground leaves of *Dacrydium cupressinum* (3 kg) were extracted with hexane in a soxhlet for 24 hr. The extract was cooled, filtered, and the solid residue dissolved in chloroform. The chloroform solution was washed with sodium bicarbonate, then with 2*N* sodium hydroxide. The sodium salts which separated at the interface were collected, washed with hot aqueous methanolic sodium hydroxide (10%, 0.5*N*), then converted to the free phenols by acidification, recrystallized from isopropanol/methylene chloride and finally sublimed at 280°/10⁻³ mm, giving 5,5''-dihydroxy-7,4',7'',4'''-tetramethoxy-8,3'''-biflavone as prisms (2.7 g), m.p. 292–294°

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¹ Baker, W., Finch, A. C. M., Ollis, W. D., and Robinson, K. W., *J. Chem. Soc.*, 1963, 1477.

(Found: C, 68.3; H, 4.75; O, 27.25. Calc. for $C_{34}H_{26}O_{10}$: C, 68.7; H, 4.4; O, 26.9%), mol. wt. (mass spectrometric), 594. $\lambda_{\max}$ in ethanol at 270, 328 $m\mu$ (ϵ 44,300, 39,600); in $N/5000$ ethanolic NaOEt at 271, 326 $m\mu$ (ϵ 45,000, 39,100); in $N/500$ NaOEt at 290, 360 $m\mu$ (ϵ 54,900, 15,800); in $N/50$ NaOEt at 290, 380 $m\mu$ (ϵ 64,000, 15,800).

Alkaline Degradation of the Biflavone (Ic)

The biflavone (Ic) (640 mg), ethylene glycol (15 ml), and potassium hydroxide (3 g) were refluxed under nitrogen for 3 hr. Steam distillation of the products gave 4-methoxyacetophenone, isolated as its 2,4-dinitrophenylhydrazone (235 mg), m.p. 227–228°. The phenolic products were treated with 2,4-dinitrophenylhydrazine, giving 4-hydroxyacetophenone 2,4-dinitrophenylhydrazone (19 mg), m.p. 259–261°, and the non-ketonic residue acetylated with acetic anhydride and distilled. Recrystallization of the distillate from hexane/isopropanol gave 3,5-diacetoxyanisole (28 mg), m.p. 75–77°.

TABLE 1
SPECTRA OF ALUMINIUM COMPLEXES IN ETHANOL
Points of inflexion are indicated by *italics*

Sciadopitysin		Isoginkgetin		<i>Dacrydium</i> Biflavone	
$\lambda_{\max}$	ϵ	$\lambda_{\max}$	ϵ	$\lambda_{\max}$	ϵ
225	54,000	225	54,400	225	61,200
281	43,000	282	43,200	282	49,400
302	37,300	302	38,300	302	42,000
345	40,100	346	39,800	346	46,000
382	26,900	382	27,100	382	30,600

Oxidation of the Biflavone (Ic)

The biflavone (Ic) (220 mg), potassium carbonate (100 mg), and water (50 ml) were heated together at 90° and potassium permanganate was added in 100-mg portions over 3 hr until no further reaction took place. The manganese dioxide was removed by filtration, the solution extracted with ether, and the aqueous phase evaporated to dryness. Acidification and ether extraction followed by fractional sublimation gave *p*-anisic acid (28 mg), m.p. 181–183° and 4-methoxyisophthalic acid (7 mg), m.p. 278–279°.

Methylation of the Biflavone (Ic) and Sciadopitysin (Ib)

Methylation of (Ic) (75 mg) using the method of Baker *et al.*¹ gave 5,7,4',5'',7'',4'''-hexamethoxy-8,3'''-biflavone (52 mg), m.p. (hydrate) 226–228°, identical with an authentic specimen.

Sciadopitysin (6 mg) was methylated by shaking in acetone (3 ml) with anhydrous potassium carbonate (100 mg) and methyl iodide (50 mg) for 1 hr. The solvent was removed under vacuum, the residue heated with water (1 ml) and filtered. The insoluble potassium salts, on acidification, gave 5,5''-dihydroxy-7,4',7'',4'''-tetramethoxy-8,3'''-biflavone (3.6 mg), m.p. 292–294° (lit.² m.p. 282°), identical with (Ic).

Acknowledgments

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² Nakazawa, K., *Chem. Pharm. Bull. Tokyo*, 1962, **10**, 1032.