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THE REVISED STRUCTURE OF DAPHNODORIN C, A NOVEL SPIRO BIFLAVONOID

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Previously, the structure of the novel flavan, daphnodorin C (3), isolated from the root and bark of Daphne odora THUNB., was identified as 3a. Now, we redefine its structure as 3b after further spectral and chemical investigations. The absolute configuration of 3 is determined to be 2S, 2"S, 3"S.

KEYWORDS ——— Daphne odora; Thymelaeaceae; daphnodorin C; flavan; biflavonoid; ruixianggen; biflavonoid X-ray analysis

In the course of our studies of the phenolic components of Tymelaeaceous plants, we investigated the constituents of the root and bark of Daphne odora THUNB. Previously, we had isolated three new flavans, daphnodorin A (1), daphnodorin B (2) and daphnodorin C (3), and elucidated the structures of 1 and 2.[1,3) The structure of 3 [$C_{30}H_{22}O_9$, mp 233 - 235°C(dec.), $[\alpha]^{22}$-262.9°(dioxane)] was assumed to be formula 3a (Fig. 1), from the NMR data (Table I and II) and from the evidence that 3 and 3-pentamethyl ether (4) afforded 1 and 1-pentamethyl ether (5), respectively, upon heating with H_2SO_4 in EtOH.[1)

After that, it was thought that formula 3b (Fig. 1) possessing the spiro ring was preferred to 3a as the structure of 3, considering the chemical shift of the quaternary sp^3 carbon ($-\overset{|}{\underset{|}{C}}-$) of the condensed part of the biflavonoid at 93.91 ppm in the ^{13}C-NMR spectrum of 3. This communication is concerned with a correction of the structural formula, and with the stereostructure of 3.

A ^{13}C-NMR long-range selective proton decoupling study of 3 was undertaken. The irradiation of the H-2" proton at 5.47 ppm reduced the doublet signal at 172.42 ppm(C-7) to a singlet, the doublet signal at 93.91 ppm(C-3") to a singlet, the broad singlet signal at 193.30 ppm(C-4") to a singlet, the doublet doublet (dd) signal at 168.00 ppm(C-8a") to a doublet, the doublet doublet doublet signal at 123.42 ppm(C-9") to a dd, and the dd signal at 129.00 ppm(C-10", 14") to a doublet. These findings indicated that the partial structure of 3 is 3c (Fig.2).[2)]

Daphnodorin C pentamethyl ether (4) was treated with $NaBH_4$ in EtOH/THF to afford an alcohol (6), $C_{35}H_{34}O_9$, M^+:598.2219, mp 127-129° C, whose ^{1}H-NMR spectrum (δ, $CDCl_3+D_2O$) showed a sharp singlet signal due to a proton of a $-\overset{|}{C}H-O$ newly formed from the reduction of the carbonyl group at C-4" at 5.37 ppm (Tables I and II).

From the above results, the structure of 3 was established as 3b. The absolute configuration of 3 has been determined to be 2S, 2"S, 3"S on the basis of X-ray analysis[4)] of 3 and the evidence that daphnodorin A (1) (2S configuration)[3)] was prepared from 3 on treatment with H_2SO_4 in EtOH. The ORTEP drawing of the molecule structure of 3 is shown in Fig. 3.

Table I. ^{1}H-NMR Data for Daphnodorin C and Their Derivatives

	3		4		6	
	δ	J	δ	J	δ	J
2	4.78d	10.4	4.80dd	10.7,1.8	4.85dd	10.1,1.6
3	1.55m		1.81m		2.05m	
	2.27m		2.16m		2.32m	
4	2.55m		2.56ddd	16.9,11.7,5.8	2.62ddd	16.9,11.4,6.1
			2.74ddd	16.9, 5.3,2.3	2.83ddd	16.9, 5.9,2.4
6	6.10s		6.20s		6.24s	
2', 6'	6.85m	8.8	6.99m	8.8	6.94m	8.5
3', 5'	6.59m	8.8	6.72m	8.8	6.74m	8.5
2"	5.47s		5.81s		5.51s	
6"	5.83d	1.7	5.79d	1.8	5.86d	2.0
8"	5.52d	1.7	5.76d	1.8	5.69d	2.0
10",14"	7.04m	8.8	7.27m	8.8	7.31m	9.0
11",15"	6.68m	8.8	6.80m	8.8	6.80m	9.0

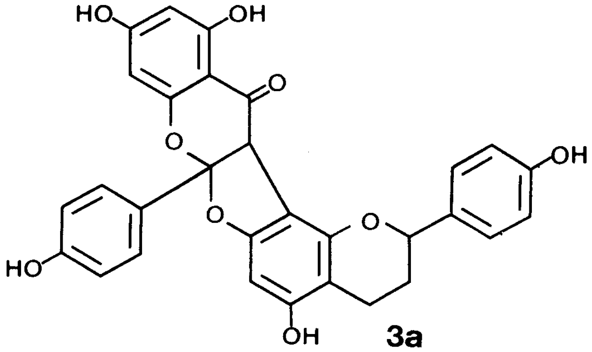
5		10.63s	5		3.84s	5		3.84s	
4'		10.42s	4'		3.83s	4'		3.77s	
5"	-OH	9.88s	5"	-OMe	3.77s	5"	-OMe	3.76s	
7"		9.50s	7"		3.77s	7"		3.68s	
12"		9.25s	12"		3.69s	12"		3.65s	
						4"-OH		3.91d	12.0
						4"		5.37d	12.0

3 was measured in DMSO-d_6, and 4 and 6 were measured in $CDCl_3$.

Table II. ^{13}C-NMR Data for 3, 4 and 6

	3	4	6
2	75.89d	77.02d	77.70d
3	19.29t	19.64t	19.58t
4	28.25t	28.85t	26.68t
4a	102.57s$^{a)}$	103.69s$^{a)}$	104.36s$^{a)}$
5	160.80s$^{b)}$	161.86s$^{b)}$	161.10s$^{b)}$
6	89.42d	86.40d	87.25d
7	172.42s	173.77s	162.98s
8	102.66s$^{a)}$	104.02s$^{a)}$	104.65s$^{a)}$
8a	152.40s	152.21s	152.21s
1'	131.14s	133.31s	131.82s
2',6'	126.06d	126.62d	127.43d
3',5'	114.84d	113.27d$^{d)}$	113.78d
4'	157.65s$^{c)}$	158.59s$^{c)}$	159.19s$^{c)}$
2"	90.87d	91.07d	92.98d
3"	93.91s	95.21s	99.75s
4"	193.30s	194.63s	77.70d
4a"	102.78s$^{a)}$	104.87s$^{a)}$	107.34s$^{a)}$
5"	159.10s$^{b)}$	161.41s$^{b)}$	160.39s$^{b)}$
6"	96.10d	92.51d	91.47d
7"	157.71s$^{c)}$	159.66s$^{c)}$	159.77s$^{c)}$
8"	89.37d	88.17d	87.59d
8a"	168.00s	169.75s	160.92s$^{b)}$
9"	123.42s	125.47s	125.47s
10",14"	129.00d	128.78d	129.51d
11",13"	114.84d	113.42d$^{d)}$	113.33d
12"	156.26s$^{c)}$	158.45s$^{c)}$	157.48s$^{c)}$
5	-OMe	55.89q	55.78q
4'		55.79q	55.42q
5"		55.79q	55.28q
7"		55.20q	55.19q
12"		55.20q	55.08q

a-d) Assignments may be reversed in each column.
3 was measured in DMSO-d_6, and 4 and 6 in $CDCl_3$ at room temperature.
Assignments based on C/H two-dimensional correlations.



3a

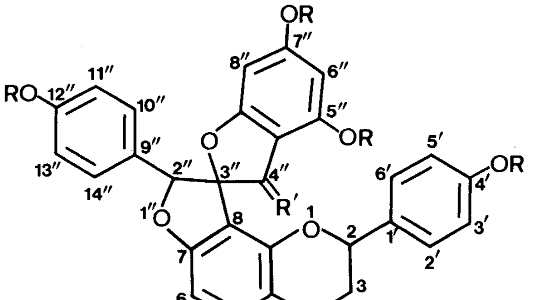
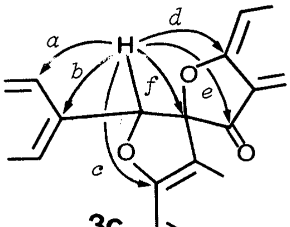


Fig. 1

3b: R=H, R'=O
4: R=CH$_3$, R'=O
6: R=CH$_3$, R'=<$^{OH}_{H}$



3c

Fig. 2

J(Hz)
a= 4.4
b= 3.7
c= 2.9
d= 2.9
e= 0.18→0.09*
f= 1.5
*half-width

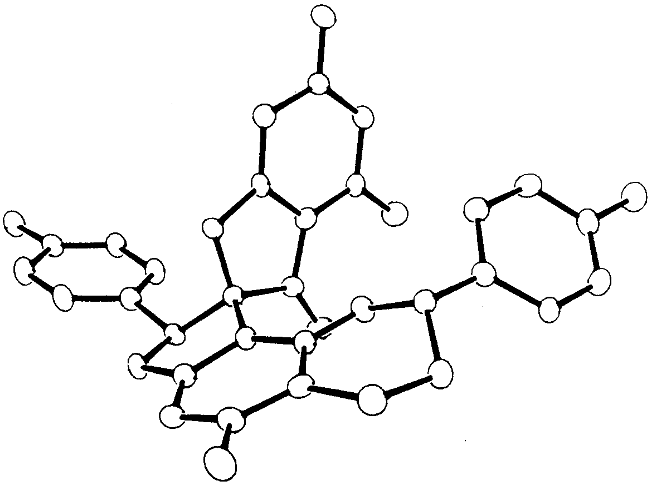


Fig. 3

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REFERENCES AND NOTES

1) K. Baba, K. Takeuchi, F. Hamasaki and M. Kozawa, Chem. Pharm. Bull., **33**, 416 (1985).
2) The large long range coupling constant ($^4J_{CH}$=2.9 Hz) between H-2" and C-8a" may be attributable to the W type conformation between them, as been reported by H. Seto *et al*. in 26 th the Symposium on the Chemistry of Natural Products, Symposium Papers, p. 197 (1983).
3) a) K. Baba, K. Takeuchi, F. Hamasaki and M. Kozawa, Chem. Pharm. Bull., **34**, 595 (1986); b) K. Baba, K. Takeuchi, M. Doi, M. Inoue and M. Kozawa, Chem. Pharm. Bull., **34**, 1540 (1986).
4) The X-ray diffraction intensities from a pale yellow crystal (0.3 x 0.4 x 0.6 mm of daphnodorin C were measured on a Rigaku AFC-5 diffractometer equipped with a graphite-monochrometer. A total of 2125 independent reflections with $2\theta<120°$ were collected by θ - 2θ scanning mode, no absorption effects being corrected. Crystal data were: $C_{30}H_{22}O_9$, monoclinic, C2, a=20.622(7), b=7.723(1), c=17.927(7), β=126.13(4), Z=4, dm=1.496(1) g/cm^3. The crystal structure was solved by a direct method. All heavy atoms were refined with anisotropic temperature factors by block-diagonal least-squares and hydrogen atoms were calculated in their stereochemically expected positions with isotropic temperature factors. The R factor was reduced to 0.067 including hydrogen atoms. Calculations for structure determinations and refinements were carried out using mostly the UNICS and AUTO library of crystallographic programs (Crystallographic Research Center, Institute for Protein Research of Osaka University).

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