

ISOLATION AND STRUCTURE OF PACHYTRIOL

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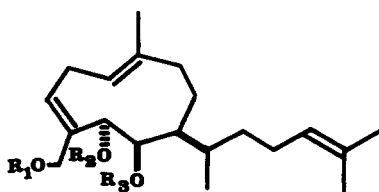
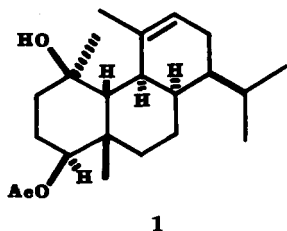
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We have previously reported (1) that α -dictalediol monoacetate [1], a new diterpene possessing a novel carbon skeleton, was the major metabolite of *Dictyota dichotoma* (Huds.) Lamour collected off Güimar, Tenerife, Canary Islands. From the remaining metabolites, we isolated a diterpene triol to which we tentatively assigned the structure 2. Our interest in this compound was rekindled when Ishitsuka *et al.* described a related diterpene monoacetate 3 from *Pachydictyon coriaceum* (2). We have subsequently confirmed the relationship between the two compounds by comparison of spectral data for samples of the triacetate 4.

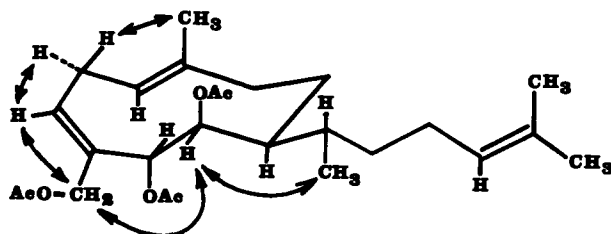
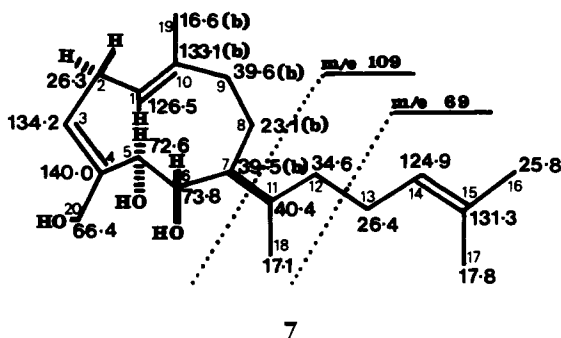
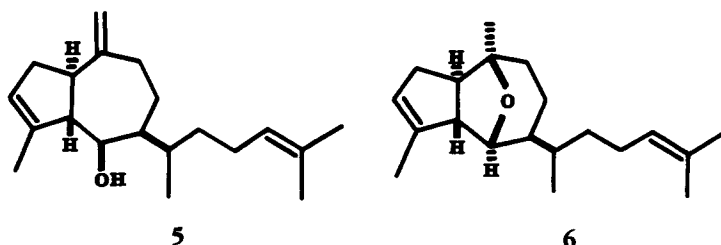
RESULTS AND DISCUSSION

The triol 2 had the molecular formula $C_{20}H_{34}O_3$. The ir spectrum contained bands at 3660, 3600, 3450 (hydroxyl), and 1656 cm^{-1} (vinyl). The ^{13}C -nmr spectrum (CDCl_3) indicated the presence of four methyls at δ 25.8, 17.8, 17.1, and 16.6 (b); three trisubstituted enes at δ 140.0 (s), 133.1 (bs), 131.3 (s), 134.2* (d), 126.5 (d), and 124.9 (d); and three C-O signals at δ 73.8 (d), 72.6 (d), and 66.4 (t). In addition, five CH_2 signals were observed at 39.6 (b), 34.6, 26.4, 26.3, 23.1 (b); and two CH signals at 40.4 and 39.5 (b) ppm. The triol 2 was, therefore, monocyclic. Two

features of the ^{13}C -spectrum were notable, a concentration- and temperature-dependent broadening of certain lines (signals named b above) and one vinylmethine signal with an unusual chemical shift (starred above). The line broadening observed in the ^{13}C -nmr spectrum was also present in the ^1H -nmr spectrum and was thought to be due to conformational isomers present in solution at 25° . This was the first indication of the presence of a medium-sized ring in compound 2. The unusually low chemical shift of the methine carbon at 134.2 ppm and the downfield (δ 6.06) chemical shift of its corresponding olefinic proton in the nmr spectra of 2 indicate a *cis*-relationship between this olefinic proton and the hydroxymethyl group. The mass spectrum shows fragments at m/z 109 and 69 (3), which together with the strong and sharp signals (4) observed in the ^{13}C -nmr spectra at δ 17.1, and 17.8, 25.8, 26.4, 34.6, 40.4, 124.9, and 131.3, were indicative of an eight carbon side-chain on a dienic ten-membered ring. Location of the secondary glycol moiety on C_5 and C_6 of a germacran-type diterpene gave an appropriate skeleton for a complete and unambiguous assignment of the ^1H -nmr spectrum (Table 1). The ^{13}C -nmr spectrum was consistent with the structure proposed, as shown in 7.



- 2 $R_1=R_2=R_3=H$
 3 $R_1=Ac, R_2=R_3=H$
 4 $R_1=R_2=R_3=Ac$



The outcome of nmr COSY experiments and decoupling are summarized in Table 1. A problem encountered was

excessive line broadening due to conformational equilibria where COSY failed to clarify connectivities of protons with

TABLE 1. ^1H -nmr Data for Triol **2** and Triacetate **4**

Ha r C No.	2	Multiplicity	J (Hz)	4
1	5.05	brd	11	5.22
2 α	2.50	dd	13, 9	2.59
2 β	3.00	ddd	13, 11, 5	3.26
3	6.06	dd	9, 5	6.25
5	3.72	d	10.5	5.34
6	4.00	brd	10.5	5.44
14	5.05	t	7	5.05
16	1.65	s		1.67
17	1.57	s		1.59
18	0.92	d	6.5	0.82
19	1.66	s		1.84
20	4.00	d	12	4.52
	4.30	d	12	4.60
-OAc		s		1.97
-OAc		s		2.00
-OAc		s		2.07

broad signals; however, this was overcome by homonuclear decoupling studies.

We recently learned that Kakisawa's group had proposed an identical skeleton (2) for a monoacetate **3** isolated from *P. coriaceum*. Comparison of spectral data showed that the triacetate **4** from the triol **2** was identical in all respects with a sample prepared from monoacetate **3**. Kakisawa has suggested the name acetoxypachydiol for compound **3**; the triol **2** is, therefore, pachytriol. It appears to be related biosynthetically to dictyols (cf pachydictyol-A [**5**] or dictyoxide [**6**]) with which it co-occurs (1).

Additionally, a nOe difference experiment revealed the existence of nuclear Overhauser enhancements, which are shown in structure **8**, upon which the observed through-space interactions are overlain. These findings showed the conformation of the triacetate **4** to be **8**, a stable conformation alternative to that proposed for acetoxypachydiol [**3**] (2).

EXPERIMENTAL

For general procedures, see González *et al.* (5). *D. dichotoma* was collected from shallow water at Güimar, Tenerife, during September 1981 and July 1984. A voucher specimen was deposited in the Departamento de Biología Vegetal, Universidad de La Laguna, Tenerife, Spain. Both samples contained the same array of major metabolites. The fresh alga was homogenized and repeatedly extracted with *i*PrOH-CH₂Cl₂ (1:1). The volume of the filtrate was reduced in vacuo, and the residue was partitioned between Et₂O and H₂O. The Et₂O-soluble extract (65.6 g) was obtained from 8.85 kg of fresh alga. Gravity flow gradient Si gel chromatography using solvents of increasing polarity from hexane through Et₂O and EtOAc to MeOH yielded predominantly (1) a mixture of dictyols and α -dictalediol monoacetate. The fraction eluted with Et₂O-EtOAc (1:1) was rechromatographed by low pressure Si gel

chromatography using Et₂O-EtOAc (4:1) as eluent to obtain the triol **2** (13.7 mg, 0.0015% fresh wt); oil, $[\alpha]_D^{25} -46.7^\circ$ (c, 1.49, CHCl₃); ir (CHCl₃) 3660, 3600, 3450, 1656, 1450, 1380, 1100, 1010, 930 cm⁻¹; ¹H nmr (CDCl₃) see Table 1; ¹³C nmr (CDCl₃) see structure **7**; ms *m/z* 304 (M⁺-H₂O); hrms, observed *m/z* 304.2395, C₂₀H₃₂O₂ requires, 304.2402; further peaks are found at *m/z* (relative intensity) 286 (9), 271 (7), 219 (10), 206 (16), 205 (87), 189 (17), 175 (21), 161 (26), 135 (50), 121 (100), 109 (98), 100 (53), 82 (82), 69 (71).

Acetylation of triol 2.—A solution of the triol **2** (18 mg, 56.0 μ mol) in Ac₂O (0.60 ml) and pyridine (1.0 ml) was allowed to stand at room temperature overnight. The reagents were evaporated under high vacuum and the residue dissolved in Et₂O and passed through a short plug of Si gel to obtain the triacetate **4** (22 mg, 49.1 μ mol), having spectral data identical with those of a sample prepared by Ishitsuka *et al.* (2) from the monoacetate **3**.

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