Structure of Prieurianin, a Complex Tetranortriterpenoid; Nuclear Magnetic Resonance Analysis at Nonambient Temperatures and *X*-Ray Structure Determination

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Summary Prieurianin, a complex tetranortriterpenoid from *Trichilia prieuriana* (Meliaceae), is assigned structure (**1**) on the basis of n.m.r. analysis at nonambient temperatures and *X*-ray structure determination of prieurianin-*p*-bromobenzenesulphonate.

The structure of prieurianin isolated from the timber of *Trichilia prieuriana* (Meliaceae) in 1965[1] has remained obscured owing to the unresolved nature of its ^1H n.m.r. peaks. We have found that the broadness is caused by the presence of multiple conformational isomers at ambient temperature, and that the ^1H and ^{13}C n.m.r. spectra are sharpened at higher temperatures. We assign structure (**1**) to prieurianin; $C_{38}H_{50}O_{16}$ (high resolution m.s.), m.p. 213—214 °C, λ_{max} (MeOH) 210 nm (ϵ 5980); c.d. (MeOH) 306 nm ($\Delta\epsilon$ −1·4, ketone); ν_{max} (dil. CCl_4) 3560 (free OH), 3370 (intramol. H-bonded OH), 1760—1710br (CO) cm^{-1}. The ^1H n.m.r. peaks at 33 °C, including the two tertiary methyls around δ 1·7, are broad and poorly resolved (Figure 1); however, they develop into a well defined spectrum at 67 °C, the detailed analysis of which clarified the proton assignments given in Figure 1. The remaining skeletal signals (2-H, 5-H and 6-H) became apparent upon addition of Eu(dpm)$_3$ to a $CDCl_3$ solution at *ca.* 65°C.

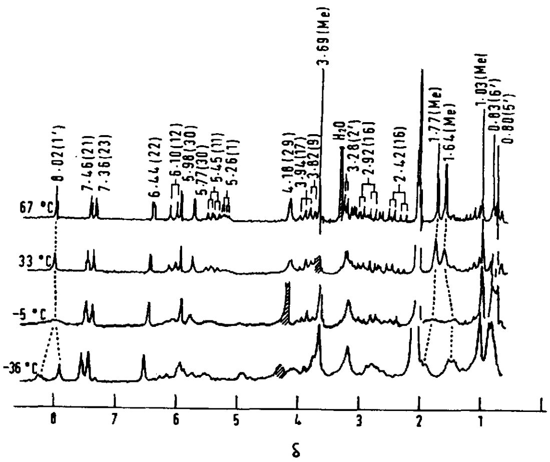
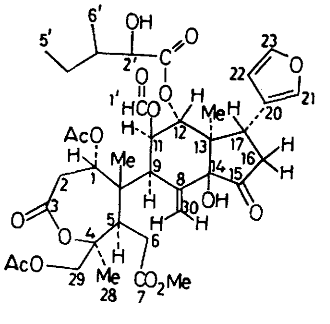
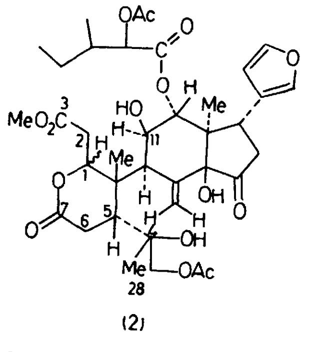


Figure 1. Variable temperature 100 MHz ^1H n.m.r. spectrum of prieurianin (**1**) in [$^2H_6$]-acetone.

The ^{13}C n.m.r. spectrum was measured at 50 °C (in [$^2H_6$]-acetone) since some peaks were broad or missing at 33 °C. Proton-noise and continuous-wave decoupling clarified the multiplicities of all 38 carbon atoms, including the formate C-1′ at 161·8 p.p.m., five esters or lactones at 168·8, 170·3, 170·4, 174·7, and 177·5 p.p.m., one ketone at 206·3 p.p.m., and two ethylenic carbons at 125·7 (C-30) and 139·3 (C-8) p.p.m. Two hydroxy-groups (δ 5·10 H-bonded OH, and 2·65), a furan and the above carbonyl groups account for all 16 oxygen atoms.



(1)



(2)

Ring a. Alcoholysis of (**1**) with 5% KOH–MeOH and acetylation yielded two C-1 epimeric diacetates. The ^1H and ^{13}C n.m.r. spectra at 33 °C of the major diacetate led to structure (**2**) derived from (**1**) by methanolysis of the lactone,† β-elimination of the C-1 acetate, and Michael addition of the 7-CO_2H to C-1.

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† The corresponding ethyl esters were formed with 5% KOH–EtOH.

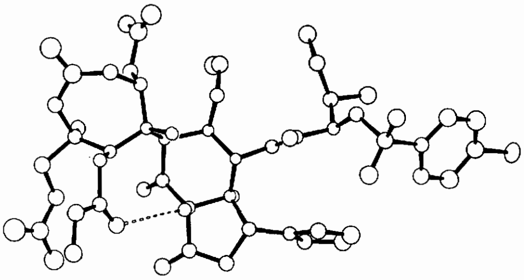

FIGURE 2. Structure of prieurianin 2′-*p*-bromobenzenesulphonate

Rings C/D. The ^1H n.m.r. data indicated the arrangement of the 9-H, 11-H, 12-H (including stereochemistry) and 16-H, 17-H proton systems, and the large J_{gem} (20 Hz) for 16-CH_2 (Figure 1) was consistent with its being adjacent to a ketone. The formate is at C-11 because there is weak coupling (*ca.* 0·5 Hz) between 1′-H and 11-H; the 2′-hydroxy-3′-methylpentanoate is at C-12 since 23-H shifts from 7·36 to 7·44 on acetylation of 2′-OH. The same arrangement of ester groups is present in heudelottin E from *T. heudelotti*.[2] The α-configuration for the 13-Me and 17-furan is common to all limonoids.[3]

A three-dimensional *X*-ray analysis of the crystal structure of prieurianin 2′-*p*-bromobenzenesulphonate confirmed structure (**1**) and resolved the stereochemical ambiguities remaining for C-1, C-4 and C-14.

Crystal data: $C_{44}H_{53}BrO_{18}S$, $M = 981{\cdot}8$, orthorhombic, $a = 11{\cdot}339$, $b = 16{\cdot}371$, $c = 26.737$ Å; $U = 4963.2$ Å; $D_m = 1{\cdot}262$ g cm^{-3} (by flotation), $Z = 4$, $D_c = 1{\cdot}314$ g cm^{-3}, $F(000) = 2048$; space group $P2_12_12_1$. $\mu = 10{\cdot}1$ cm^{-1} (for Mo-K_α, $\lambda = 0{\cdot}7107$ Å).

The structure was solved by a combination of the heavy atom technique and non-centrosymmetric direct methods, and has been refined by least squares calculations to a final *R* of 0·098. A perspective view of the molecule is shown in Figure 2. The O . . . O distance for the intra-hydrogen bond is 2·72(4) Å.

^1H n.m.r. spectra of (**1**) recorded at different temperatures are shown in Figure 1. The multiplicities of some peaks at −36 °C, *e.g.* peaks due to the two methyls at δ *ca.* 1·7 p.p.m. and the formate, show that prieurianin exists as a mixture of several conformers, presumably differing in the rotation around the C-9, C-10 bond and/or the conformation of the lactone ring.[4]

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[1] C. W. L. Bevan, D. E. U. Ekong, and D. A. H. Taylor, *Nature*, 1965, **206**, 1323.

[2] D. A. Okorie and D. A. H. Taylor, *J.C.S. Perkin I*, 1972, 1488.

[3] D. L. Dreyer in 'Fortschritte der Chemie Organischer Naturstoffe,' Vol. XXVI, ed., L. Zechmeister, Springer-Verlag, New York, 1968; J. D. Connolly, K. H. Overton, and J. Polonsky in 'Progress in Phytochemistry,' Vol. II, ed., L. Reinhold and Y. Liwschitz, Interscience, 1970.

[4] See following for examples in germacranolides: H. Yoshioka, T. J. Mabry, and H. E. Miller, *Chem. Comm.*, 1968, 1679; H. Yoshioka and T. J. Mabry, *Tetrahedron*, 1969, **25**, 4767; R. K. Bentley, J. G. St. C. Buchanan, T. G. Halsall, and V. Thaller, *Chem. Comm.*, 1970, 435; K. Tori, I. Horibe, K. Kuriyama, H. Tada, and K. Takeda, *ibid.*, 1971, 1393; K. Tori, I. Horibe, H. Minato, and K. Takeda, *Tetrahedron Letters*, 1971, 4355; I. Horibe, K. Tori, K. Takeda, and T. Ogino, *ibid.*, 1973, 735.