Acta Crystallographica Section C
Crystal Structure Communications
ISSN 0108-2701

2*β*-Hydroxy-4′-demethyldesoxypodophyllotoxin[1]

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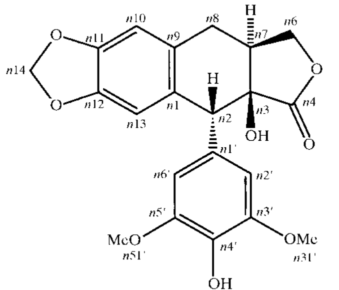
Received 18 May 1999
Accepted 22 October 1999

A room-temperature single-crystal X-ray structure determination of the title compound, $C_{21}H_{20}O_8$, confirms the stereochemical assignment made previously on the basis of spectroscopic studies [Shaari & Waterman (1994). *J. Nat. Prod.* **57**, 720–724].

Comment

Some years ago (Shaari & Waterman, 1994), the title compound, (I), was isolated from *Casearia clarkei* King, a small lowland rainforest tree endemic to Malaysia and Singapore, and an assignment of the structure was made on the basis of spectroscopic and chiroptical evidence. An X-ray structure determination was considered desirable at the time, the better to secure the assignment, but specimens were only available as fine flakes of insufficient substance to be amenable to such a study by our contemporary single-counter diffractometer instrumentation. The advent of area-detector instrumentation has now permitted an effective attack on this problem, yielding a definitive assignment of the structure which confirms that proposed previously.



(I)

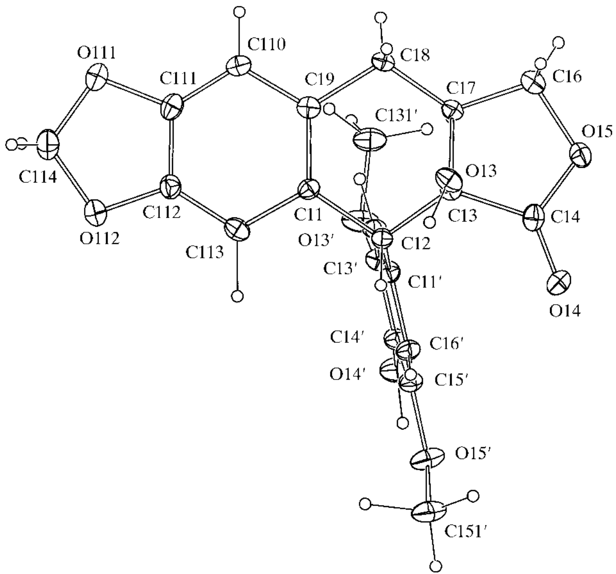


Figure 1
Projection of molecule $n = 1$ (molecule 2 is similar) normal to the fused-ring plane. Displacement ellipsoids are shown at 20% probability levels for the non-H atoms; H atoms are shown with an arbitrary radius of 0.1 Å.

The results of the room-temperature single-crystal X-ray study of (I) are consistent with the stoichiometry, connectivity and stereochemistry proposed previously; two molecules (n = 1, 2), pseudosymmetrically related, comprise the asymmetric unit of the structure and the unit cell in the uncommon triclinic space group *P*1. The skeletal form appears to be previously unrecorded in the Cambridge Structural Database (Allen & Kennard, 1993), but offers no surprises in respect of bond lengths and angles generally and these have been deposited. The absolute configuration was not assignable from the crystallographic work and follows that previously defined in the chemistry. The two molecules of the asymmetric unit are of the same chirality and of similar conformation; only one is shown in Fig. 1. The plane of the pendant ring is quasi-normal to that of the fused system; the unit-cell contents as displayed in Fig. 2

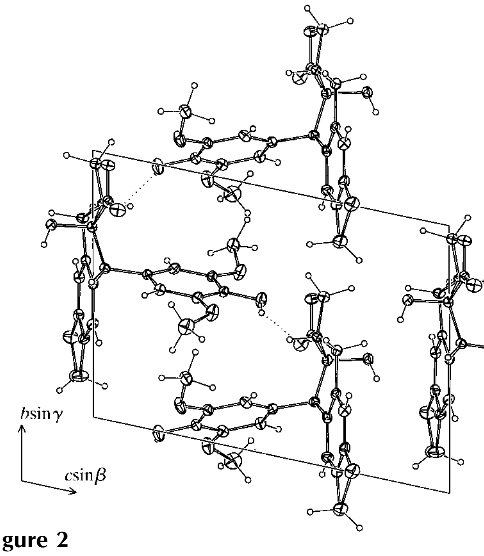


Figure 2
Unit-cell contents projected down **a**, showing intermolecular hydrogen bonds within the cell.

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[1] Systematic name: 5a-hydroxy-5-(4-hydroxy-3,5-dimethoxyphenyl)-5,5a,6,8,8a,9-hexahydrofuro[3′,4′:6,7]naphtho[2,3-*d*]-1,3-dioxol-6-one.

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show the pseudosymmetry, the hydrogen bonding and parallel packing of the major molecular planes. The numbering of the non-H atoms (not systematic) within each molecule ($n = 1,2$ to be prefixed) is as shown in the Scheme above.

Experimental

Material isolated in a previous study (Shaari & Waterman, 1994) was used in the present work.

Crystal data

$C_{21}H_{20}O_8$
$M_r = 400.38$
Triclinic, $P1$
$a = 7.8540\ (10)$ Å
$b = 9.3840\ (10)$ Å
$c = 13.230\ (2)$ Å
$\alpha = 101.563\ (2)^\circ$
$\beta = 103.699\ (2)^\circ$
$\gamma = 90.184\ (2)^\circ$
$V = 926.8\ (2)$ Å^3
$Z = 2$
$D_x = 1.435$ Mg m^{-3}
Mo $K\alpha$ radiation
Cell parameters from 1868 reflections
$\theta = 2$–29°
$\mu = 0.111$ mm^{-1}
$T = 300$ K
Plate, colourless
$0.20 \times 0.10 \times 0.05$ mm

Data collection

Bruker AXS CCD diffractometer
ω scans
10 605 measured reflections
4460 independent reflections
2592 reflections with $F^2 > 2\sigma F^2$
$R_{\rm int} = 0.068$
$\theta_{\rm max} = 28.4^\circ$
$h = -10 \rightarrow 10$
$k = -12 \rightarrow 12$
$l = -18 \rightarrow 18$

Refinement

Refinement on F^2
$R(F) = 0.040$
$wR(F^2) = 0.044$
$S = 1.070$
4460 reflections
681 parameters
All H-atom parameters refined
$(\Delta/\sigma)_{\rm max} = 0.02$
$\Delta\rho_{\rm max} = 0.20$ e Å^{-3}
$\Delta\rho_{\rm min} = -0.18$ e Å^{-3}
Extinction correction: Zachariasen (1967)
Extinction coefficient: 2063.4 (7)

As might be expected from the above, data were limited in scope and intensity, nonetheless permitting solution of the structure, with stable and meaningful refinement of non-H atom anisotropic displacement parameters and $(x, y, z, U_{\rm iso})$H, the latter permitting delineation of any hydrogen-bonding interactions, particularly of the hydroxyl-H atoms (Hn3 and Hn4′); for Hn3, none are discernible but those of Hn4′ are of interest, being directed toward On5′ [H$\cdots$O 2.08 (5) and 2.24 (4) Å (n = 1, 2)], with further interactions being intermolecular [H14′$\cdots$O24($x-1$, y, z) 2.11 (7) and H24′$\cdots$O14($1+x$, $y-1$, z) 2.33 (5) Å] to the lactone carbonyl-O atoms. The usual exocyclic angular distortions are found at the points of fusion of the methoxy and hydroxy substituents to the pendant aromatic ring.

Data collection: *SMART* (Siemens, 1995); cell refinement: *SAINT* (Siemens, 1995); data reduction: *SAINT*; program(s) used to solve structure: *Xtal*3.5 *GENTAN* (Hall *et al.*, 1995); program(s) used to refine structure: *Xtal*3.5 *CRYLSQ*; molecular graphics: *Xtal*3.5 *PIG* and *ORTEP*; software used to prepare material for publication: *Xtal*3.5 *BONDLA* and *CIFIO*.

Supplementary data for this paper are available from the IUCr electronic archives (Reference: JA1004). Services for accessing these data are described at the back of the journal.

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