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7-Oxaspiro[5.9]pentadecane-1,8,13-trione

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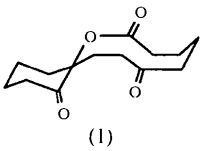
Abstract

The crystal structure of the title compound, $C_{14}H_{20}O_4$, a macrocyclic lactone, is composed of independent molecules with normal molecular dimensions. The average bond distances are C_{sp^3}—C_{sp^3} 1.526 (6), C_{sp^3}—C_{sp^2} 1.514 (14) and C=O 1.210 (3) Å. The six-membered ring adopts a chair conformation, while the ten-membered heterocyclic ring is in a boat–chair–boat (bcb) conformation. There are no unusual interactions between the molecules which are separated by normal van der Waals distances.

Comment

Cyclohexanone, together with its derivatives, are useful building blocks for the construction of organic compounds, especially natural products. There are several macrocyclic lactones derived from fermentation which are used as antibiotics and so have clinical importance, *e.g.* erythromycine, rapamycine and FK-506, *etc.* (Caufield, 1995). Rapamycine and FK-506 became the drugs of choice in the late 1980s as the two new classes of immunosuppressants having the promise of supplementing cyclosporin A for the treatment of transplant rejection, and hopefully, also having use in the treatment of autoimmune disease (Caufield, 1995).

Continuing our studies on the preparation of biologically active compounds derived from Mannich bases (Parvez *et al.*, 1998), we have synthesized the title compound, (1), a macrocyclic lactone.



(1)

The crystal structure of (1) is composed of a ten-membered heterocyclic ring (O1, C1–C9), with two ketonic groups (at C1 and C6), and a six-membered hydrocarbon ring (C9–C14), with a ketonic function at C10; the two rings are linked together at C9. The ten-membered ring has a boat–chair–boat (bcb) conformation, while the six-membered ring adopts a classical chair conformation, with torsion angles in the range ±[53.9 (2)–60.0 (2)°]. The structure contains discrete molecules of (1) separated by normal van der Waals distances. The molecular dimensions are normal and lie within expected values for corresponding bond distances and angles (Orpen *et al.*, 1994), with mean bond distances C_{sp^3}—C_{sp^3} 1.526 (6), C_{sp^3}—C_{sp^2} 1.514 (14) and C=O 1.210 (3) Å, while the C_{sp^3}—O and C_{sp^2}—O distances are 1.471 (2) and 1.349 (2) Å, respectively.

Some of the compounds containing a similar heterocyclic ring which have been studied by crystallographic methods are oxacyclodeca-2,6-dione (Fedeli & Dunitz, 1968), thiobis(cephalosporolide A) (Mabelis *et al.*, 1981), cephalosporolide C and cephalosporolide B 3-*O*-methanesulfonate (Ackland *et al.*, 1985), *endo,endo,exo*-2,6,10-tribromo-*exo*-5-methoxy-13-oxa-*trans*-bicyclo[7.3.1]tridecane (Rissanen & Haufe, 1988), (9*R*,11*R*)-9,11-epoxy-14,15,17-trinor-8,9-secolabdan-8,13-olide (Grant *et al.*, 1991) and nonanolactone (Wiberg *et al.*, 1991).

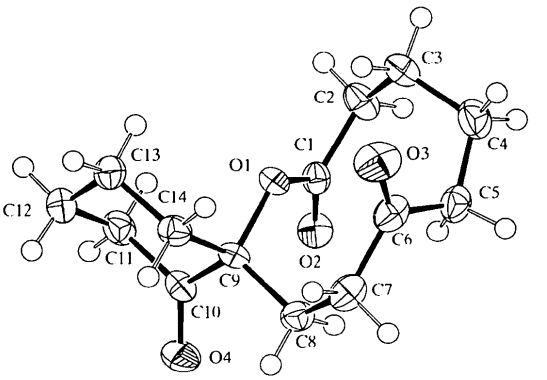


Fig. 1. *ORTEP*II (Johnson, 1976) drawing of (1) with the atomic numbering scheme. Displacement ellipsoids are plotted at the 50% probability level and H atoms have been assigned arbitrary radii.

Experimental

3-Hydroxy-2,16-dioxatetracyclohexadecane (Parvez *et al.*, 1998) (1.2 g, 0.005 mol) in acetic acid (2.0 ml) was treated with CrO_3 (1.0 g, 0.01 mol) dissolved in acetic acid (3.0 ml) and water (1.5 ml). The mixture was shaken vigorously and then allowed to stand for 18 h at room temperature, whereupon it was poured into an ice–sodium bicarbonate mixture and extracted three times with ether. The combined ethereal layers were washed with water and dried over anhydrous sodium sulfate. Removal of the solvent in vacuo and recrystallization from ethyl acetate afforded (1) as large colorless needles, m.p. 402–403 K (0.44 g, 40%).

Crystal data

$C_{14}H_{20}O_4$
M_r = 252.30

Mo $K\alpha$ radiation
λ = 0.71069 Å

Monoclinic
$P2_1/n$
a = 11.667 (3) Å
b = 7.292 (2) Å
c = 15.275 (3) Å
β = 97.02 (2)°
V = 1289.8 (5) Å^3
Z = 4
D_x = 1.299 Mg m^{-3}
D_m not measured

Cell parameters from 25 reflections
θ = 18–25°
μ = 0.094 mm^{-1}
T = 200 (1) K
Block, cut from a large needle
0.45 × 0.38 × 0.30 mm
Colorless

Data collection

Rigaku AFC-6*S* diffractometer
$\omega/2\theta$ scans
Absorption correction: none
2395 measured reflections
2279 independent reflections
1662 reflections with $I > 2\sigma(I)$

R_{int} = 0.046
θ_{max} = 25.0°
$h = 0 \rightarrow 13$
$k = 0 \rightarrow 8$
$l = -18 \rightarrow 18$
3 standard reflections
every 200 reflections
intensity decay: none

Refinement

Refinement on F^2
$R(F)$ = 0.037
$wR(F^2)$ = 0.107
S = 1.171
2273 reflections
165 parameters
H atoms riding
$w = 1/[\sigma^2(F_o^2) + (0.05P)^2 + 0.65P]$
where $P = (F_o^2 + 2F_c^2)/3$

$(\Delta/\sigma)_{max} < 0.001$
$\Delta\rho_{max}$ = 0.222 e Å^{-3}
$\Delta\rho_{min}$ = −0.235 e Å^{-3}
Extinction correction: none
Scattering factors from *International Tables for Crystallography* (Vol. C)

H atoms were included at geometrically idealized positions, with a C—H distance of 0.95 Å.

Data collection: *MSC/AFC Diffractometer Control Software* (Molecular Structure Corporation, 1988). Cell refinement: *MSC/AFC Diffractometer Control Software*. Data reduction: *TEXSAN* (Molecular Structure Corporation, 1994). Program(s) used to solve structure: *SAPI*91 (Fan, 1991). Program(s) used to refine structure: *SHELXL*93 (Sheldrick, 1993). Molecular graphics: *TEXSAN*. Software used to prepare material for publication: *SHELXL*93.

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Supplementary data for this paper are available from the IUCr electronic archives (Reference: FG1408). Services for accessing these data are described at the back of the journal.

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14-*O*-Benzoyl-8-ethoxybikhaconine and 14-*O*-Benzoyl-8-methoxybikhaconine

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Abstract

The molecular structures of two new C_{19} norditerpenoid alkaloids, 14-*O*-benzoyl-8-methoxybikhaconine [(1α,6α,14α,16β)-20-ethyl-13-hydroxy-1,6,8,16-tetramethoxy-4-methoxymethylaconitan-14-yl benzoate, $C_{33}H_{47}NO_8$, (1)] and 14-*O*-benzoyl-8-ethoxybikhaconine [(1α,6α,14α,16β)-8-ethoxy-20-ethyl-13-hydroxy-1,6,16-trimethoxy-4-methoxymethylaconitan-14-yl benzoate, $C_{34}H_{49}NO_8$, (2)], isolated for the first time from the roots of *Aconitum chasmanthum* Stapf ex Holmes of Pakistani origin, have been determined. The two alkaloids differ by one CH_2 moiety in a side chain (8-methoxy *versus* 8-ethoxy), co-crystallize in a 65 (2):35 (2) ratio, *i.e.* $0.65C_{33}H_{47}NO_8.0.35C_{34}H_{49}NO_8$, and are inseparable by thin-layer and column chromatography. The conformations of the rings in the two alkaloids are: *A* and *E*, chairs; *D*, half-chair; *C* and *F*, envelopes; and *B*, boat. The molecular dimensions are normal; the mean bond distances are C_{sp^3}—N 1.463 (6), C_{sp^3}—C_{sp^3} 1.54 (2), C_{sp^3}—O 1.41 (2), C_{sp^2}—O 1.342 (3) and C=O 1.204 (4) Å. There is a short intramolecular