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# 1,6-Anhydro-2,3-di-*O*-benzyl-5*C*-[(*R*)-ethoxycarbonyl(hydroxy)methyl]-β-L-altrofuranose

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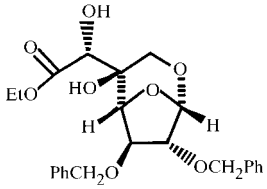
The crystal structure of the title compound, $C_{24}H_{28}O_8$, has been determined. The conformation of the furanose ring can be described as 58% ideal envelope ${}^{O}E$ conformer and 42% ideal twisted ${}^{O}T_1$ conformer. The 1,3-dioxane ring adopts a chair conformation with the anhydro-O atom pointing upwards. Both phenyl rings are quasi-perpendicular to the mean plane of the furanose ring. The hydrogen bonding is intermolecular and consists of infinite chains parallel to the *a* axis.

## Comment

The zaragozic acids (squalestatins) have attracted intense interest since their isolation in 1992 (Dawson *et al.*, 1992; Bergstrom *et al.*, 1993; Hasumi *et al.* 1993), due to their biological activity, as they are potent inhibitors of squalene synthase, and to their intriguing structures (Nadin & Nicolaou, 1996). The title compound, (I), is a key intermediate in the synthesis of simplified analogues of zaragozic acids. The present crystal structure determination was carried out in order to confirm the 2,8-dioxabicyclo[3.2.1]octane core and to elucidate the configuration of the diol moiety.




(I)

The molecular structure of compound (I) is shown in Fig. 1. The expected 2,8-dioxabicyclo[3.2.1]octane core presents a similar conformation to that observed in 1,6-anhydro-β-L-altrofuranose (Köll *et al.*, 1988).

The conformation of the furanose ring [puckering parameters (Cremer & Pople, 1975) $Q$ = 0.452 (4) Å and $\varphi$ = 9.2 (5)°] can be described as 58% ideal envelope ${}^{O}E$ conformer ($\varphi$ = 0°) and 42% ideal twisted ${}^{O}T_1$ conformer ($\varphi$ = 18°). The 1,3-dioxane ring adopts a chair conformation, with O1 pointing upwards [puckering parameters $Q$ = 0.636 (4) Å, $\varphi_2$ = 137.7 (3) and $\theta$ = 16.7 (4)°]. The angle between the two planar phenyl rings is 74.0 (2)°. The C12–C17 and the C19–C24 phenyl rings are quasi-perpendicular to the mean plane of the furanose ring, at angles of 84.5 (2) and 85.5 (2)°, respectively. Atom C5 presents the expected *R* configuration.

In the crystal of (I), the molecules form infinite chains parallel to the *a* axis. Each is stabilized by weak hydrogen bonds involving the two diol groups (see Table 1 for details). The chains are stabilized by van der Waals interactions between the phenyl groups.

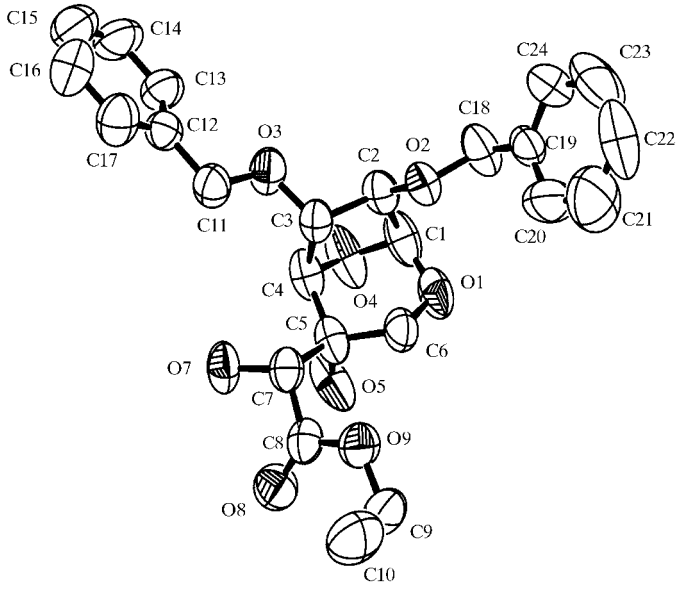



**Figure 1**
The molecular structure of (I) with the atom-numbering scheme and 25% probability displacement ellipsoids. H atoms have been omitted for clarity.

## Experimental

Compound (I) was synthesized in two steps from 1,6-anhydro-2,3-di-*O*-benzyl-β-L-*arabino*-hexofuranos-5-ulose (Taillefumier *et al.*, 1999) by Wittig homologation of the keto group to the corresponding α,β-unsaturated methyl ester and subsequent flash dihydroxylation of the olefinic bond under Shing conditions ($RuCl_3$, $NaIO_4$; Shing *et al.*, 1996). Single crystals of (I) were grown from a solution in $CH_2Cl_2$/hexane by slow evaporation. Analytical data: $R_f$ = 0.23 (hexane: EtOAc 3:2); IR spectroscopy (KBr, $\eta$, $cm^{-1}$): 3462, 1747; $^1H$ NMR (250 MHz, $CDCl_3$, p.p.m.): 1.31 (*t*, 3H, $CO_2CH_2CH_3$), 3.19 (*d*, 1H, $J_{7,OH}$ 8.5 Hz, OH), 3.53 (*d*, 1H, $J_{7,OH}$ 2.0 Hz, OH), 3.83 (*dd*, 1H, $J_{gem}$ 12.0, $J_{4,6e}$ 2.0 Hz, H6*e*), 3.91 (*dd*, 1H, H7), 3.98 (*m*, 1H, H3), 4.07 (*d*, 1H, H6*a*), 4.30 (*q*, 2H, $CO_2CH_2CH_3$), 4.47 (*br s*, 1H, H4), 4.50 (*d*, 1H, $CH_2Ph$), 4.52 (*d*, 1H, $CH_2Ph$), 4.63 (*d*, 1H, $CH_2Ph$), 4.70 (*d*, 1H, $CH_2Ph$), 7.25–7.48 (*m*, 10H, Ph)

**Table 1**
Hydrogen-bonding geometry (Å, °).

| $D$—H···$A$ | $D$—H | H···$A$ | $D$···$A$ | $D$—H···$A$ |
|---|---|---|---|---|
| O5—H5···O7$^{i}$ | 0.82 | 2.14 | 2.879 (3) | 151 |
| O7—H7···O8$^{ii}$ | 0.82 | 2.34 | 3.136 (5) | 164 |

Symmetry codes: (i) $\frac{1}{2}+x, \frac{3}{2}-y, -z$; (ii) $x-\frac{1}{2}, \frac{3}{2}-y, -z$.

*Crystal data*

$C_{24}H_{28}O_8$
$M_r = 444.46$
Orthorhombic, $P2_12_12_1$
$a = 5.6740$ (14) Å
$b = 11.699$ (6) Å
$c = 33.5340$ (15) Å
$V = 2226.0$ (13) Å$^3$
$Z = 4$
$D_x = 1.326$ Mg m$^{-3}$
Cu $K\alpha$ radiation
Cell parameters from 25 reflections
$\theta = 9.5$–$32.9°$
$\mu = 0.828$ mm$^{-1}$
$T = 293$ (2) K
Prismatic, colourless
0.40 × 0.25 × 0.25 mm

*Data collection*

Enraf–Nonius MACH3 diffractometer
$\omega/2\theta$ scans
2447 measured reflections
2447 independent reflections
1942 reflections with $I > 2\sigma(I)$
$\theta_{max} = 69.97°$
$h = 0 \rightarrow 6$
$k = 0 \rightarrow 14$
$l = 0 \rightarrow 40$
3 standard reflections
frequency: 60 min
intensity decay: 0.18%

*Refinement*

Refinement on $F^2$
$R[F^2 > 2\sigma(F^2)] = 0.051$
$wR(F^2) = 0.148$
$S = 1.047$
2447 reflections
289 parameters
H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.0816P)^2 + 0.5716P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max} < 0.001$
$\Delta\rho_{max} = 0.22$ e Å$^{-3}$
$\Delta\rho_{min} = -0.21$ e Å$^{-3}$

The absolute stereochemistry of (I) was assumed from 1,6-anhydro-2,3-di-*O*-benzyl-β-L-*arabino*-hexofuranos-5-ulose (Taillefumier *et al.*, 1999). All H atoms connected to C were placed at calculated positions using a riding model and had their isotropic displacement parameters fixed at 1.3 times that of the parent atom.

Data collection: *CAD*-4 *Software* (Enraf–Nonius, 1989); cell refinement: *CAD*-4 *Software*; data reduction: *MAXUS* (Mackay *et al.*, 1999); program(s) used to solve structure: *SIR*92 (Altomare *et al.*, 1994); program(s) used to refine structure: *SHELXL*97 (Sheldrick, 1997); molecular graphics: *MAXUS*.

Supplementary data for this paper are available from the IUCr electronic archives (Reference: GS1095). Services for accessing these data are described at the back of the journal.

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