

Structure of Methyl 14 β ,15-Cyclo-8 β ,16-epoxypimarate*

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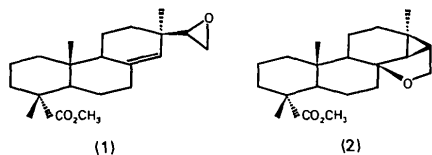
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Abstract. C₂₁H₃₂O₃, $M_r = 332.5$, triclinic, $P1$, $a = 6.435$ (1), $b = 12.749$ (5), $c = 17.351$ (4) Å, $\alpha = 87.60$ (3), $\beta = 100.70$ (2), $\gamma = 92.05$ (3)°, $Z = 3$, $V = 1396.9$ Å³, $D_x = 1.19$ g cm⁻³, $\lambda(\text{Mo } K\alpha) = 0.71069$ Å, $\mu = 0.83$ cm⁻¹, $F(000) = 546$, $T = 293$ K, final $R = 0.042$ for 2807 observed reflections. The structure was solved by Patterson and Fourier recycling methods. The three conformers observed in the structure are very similar. Each molecule contains three *trans*-fused six-membered rings. Two are in slightly distorted chair conformations, the third is in the boat form. For each molecule, the five-membered ring adopts an envelope conformation.

Introduction. The 15,16-epoxide of methyl pimarate (1) on treatment with boron trifluoride–diethyl ether at low temperature (223 K) yielded a mixture of compounds from which an oxygen heterocycle diterpene (2) was obtained (Arreguy-San Miguel, Taran & Delmond, 1987). In order to choose between several structural hypotheses an X-ray analysis was undertaken.



The pentacyclic diterpene observed, having a cyclopropane ring linked to the C nucleus, can be considered as a potential intermediate during the carbocationic rearrangement of pimarane to the strobane skeleton (Herz, Prasad & Mohanraj, 1983).

* Methyl 2a,6,9a-trimethyl-3b,3-epoxymethanoperhydrocyclopropano[*i*]phenanthrene-6-carboxylate.

Experimental. Crystal grown by slow evaporation of an ethanol solution. Colourless crystal of dimensions 0.1 × 0.2 × 0.3 mm; Mo $K\alpha$ radiation; graphite monochromator. Lattice parameters from least-squares adjustment to setting angles of 25 reflections with $11 < 2\theta < 24^\circ$. Correction for Lorentz and polarization effects. ω - 2θ scans, $\theta_{\text{max}} = 24^\circ$; range of hkl : $h -7 \rightarrow 7$; $k -14 \rightarrow 14$; $l 0 \rightarrow 19$. Intensity variation of the three standard reflections $< 3\%$. 4387 unique reflections measured; 2807 with $I > 3\sigma(I)$. Solution by Patterson and Fourier recycling methods (Gilmore, 1984), starting from the hypothesis of a molecule with three regular cyclohexane rings. First, such a molecule with a supposed correct orientation was positioned in the cell. Then, after each of the 13 Fourier recycling steps, allowing localization of all the non-H atoms, the only atoms added in the procedure were those corresponding to classical intermolecular van der Waals interactions and able to form correct intramolecular distances. Refinement on F by block-diagonal least squares; anisotropic non-H atoms, isotropic parameters for H atoms (located geometrically or on ΔF map for the methyl groups). $R = 0.042$, $wR = 0.048$; $w = 1/\sigma^2(F_o)$ based on counting statistics; $S = 0.99$; $\Delta/\sigma_{\text{mean}} = 0.1$. Max. and min. heights in final $\Delta\rho$ map: $+0.2$ and -0.1 e Å⁻³. Atomic scattering factors from *International Tables for X-ray Crystallography* (1974) for non-H atoms and from Stewart, Davidson & Simpson (1965) for H atoms. Local programs *CRISAFFI*, *CRISUTIL*; Mini-6 92 Bull computer.

Table 1 lists atomic positional parameters and B_{eq} values while Table 2 gives interatomic distances and angles.†

† Lists of structure factors, anisotropic thermal parameters and H-atom parameters have been deposited with the British Library Document Supply Centre as Supplementary Publication No. SUP 44321 (32 pp.). Copies may be obtained through The Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

Discussion. Fig. 1 shows the molecular structure of the title compound and the atom labelling of molecule (I). The atom labelling of molecules (II) and (III) is

obtained by adding 30 and 60 respectively. The three independent molecules have the same absolute configuration. They are not exactly identical if the

Table 1. Final fractional coordinates ($\times 10^4$) and equivalent isotropic thermal parameters (\AA^2)

$$B_{\text{eq}} = \frac{1}{3} \sum_i \sum_j \beta_{ij} \mathbf{a}_i \cdot \mathbf{a}_j$$

Molecule (I)	x	y	z	B_{eq}
C1	230 (10)	1918 (5)	50 (4)	4.6 (3)
C2	-1468 (12)	1975 (6)	-695 (4)	5.9 (3)
C3	-1360 (11)	1024 (6)	-1183 (3)	5.5 (3)
C4	-1658 (9)	-17 (5)	-746 (3)	4.6 (3)
C5	23 (8)	-31 (4)	26 (3)	3.5 (2)
C6	69 (10)	-1081 (4)	502 (3)	4.5 (3)
C7	2060 (9)	-1138 (4)	1128 (3)	4.0 (2)
C8	2252 (8)	-226 (4)	1674 (3)	3.3 (2)
C9	2057 (8)	835 (4)	1213 (3)	3.2 (2)
C10	26 (8)	919 (4)	564 (3)	3.5 (2)
C11	2481 (9)	1777 (4)	1762 (4)	4.4 (3)
C12	2824 (9)	1494 (4)	2636 (3)	4.3 (3)
C13	4399 (8)	629 (4)	2860 (3)	3.9 (2)
C14	4263 (9)	-224 (4)	2279 (3)	3.7 (2)
C15	3685 (9)	-477 (5)	3066 (3)	4.3 (3)
C16	1361 (10)	-739 (5)	2903 (3)	4.7 (3)
C17	6582 (10)	986 (5)	3258 (4)	5.4 (3)
C18	-1199 (10)	-898 (5)	-1252 (4)	5.3 (3)
C19	-3970 (9)	-181 (6)	-626 (4)	6.1 (4)
C20	-1949 (9)	990 (5)	939 (4)	4.7 (3)
C21	1319 (15)	-1689 (8)	-1862 (6)	9.5 (6)
O22	754 (8)	-878 (4)	-1369 (3)	7.3 (3)
O23	-2447 (9)	-1561 (5)	-1527 (4)	9.4 (4)
O28	553 (6)	-340 (3)	2127 (2)	4.1 (2)
Molecule (II)				
C31	7555 (11)	-5884 (5)	3165 (4)	5.3 (3)
C32	7009 (13)	-5957 (5)	3990 (4)	6.2 (4)
C33	7553 (11)	-4928 (5)	4403 (4)	5.7 (3)
C34	6477 (9)	-3971 (5)	3929 (4)	4.5 (3)
C35	7049 (8)	-3953 (4)	3094 (3)	3.7 (2)
C36	6297 (9)	-2980 (4)	2594 (3)	4.1 (3)
C37	7329 (9)	-2879 (4)	1873 (3)	4.1 (3)
C38	6893 (9)	-3855 (4)	1388 (3)	3.7 (2)
C39	7530 (9)	-4849 (4)	1891 (3)	3.8 (2)
C40	6478 (9)	-4981 (4)	2635 (3)	3.9 (2)
C41	7359 (10)	-5844 (5)	1382 (4)	5.1 (3)
C42	6323 (10)	-5666 (5)	520 (4)	5.2 (3)
C43	7339 (10)	-4726 (5)	150 (4)	4.6 (3)
C44	7958 (9)	-3806 (5)	674 (3)	4.3 (3)
C45	6251 (11)	-3694 (5)	-40 (4)	5.3 (3)
C46	4228 (11)	-3552 (6)	257 (4)	5.9 (3)
C47	8842 (12)	-5000 (6)	-384 (4)	6.2 (4)
C48	7453 (10)	-2980 (5)	4339 (3)	4.8 (3)
C49	4127 (11)	-3989 (6)	3951 (4)	6.0 (4)
C50	4099 (10)	-5238 (5)	2401 (4)	5.4 (3)
C51	10610 (14)	-1996 (6)	4803 (5)	7.2 (4)
O52	9540 (7)	-2890 (4)	4384 (3)	6.1 (2)
O53	6482 (9)	-2336 (4)	4589 (3)	7.8 (3)
O58	4635 (6)	-3910 (3)	1066 (2)	4.6 (2)
Molecule (III)				
C61	3450 (11)	-7035 (6)	8018 (4)	5.6 (3)
C62	2678 (13)	-6170 (7)	8470 (4)	7.1 (4)
C63	3083 (12)	-5071 (6)	8119 (4)	6.3 (4)
C64	2021 (10)	-4958 (5)	7242 (4)	5.4 (3)
C65	2817 (9)	-5859 (5)	6809 (3)	4.1 (3)
C66	2074 (11)	-5765 (5)	5909 (3)	5.0 (3)
C67	3424 (11)	-6482 (5)	5520 (3)	5.0 (3)
C68	3220 (9)	-7625 (5)	5810 (3)	4.2 (3)
C69	3707 (9)	-7738 (5)	6703 (3)	4.1 (3)
C70	2428 (9)	-6995 (5)	7129 (3)	4.2 (3)
C71	3645 (14)	-8918 (6)	6982 (4)	6.7 (4)
C72	3230 (15)	-9719 (6)	6363 (5)	7.7 (4)
C73	4417 (14)	-9472 (6)	5678 (5)	7.2 (4)
C74	4632 (10)	-8333 (5)	5454 (4)	5.2 (3)
C75	3191 (13)	-9040 (6)	4895 (5)	7.4 (4)
C76	988 (14)	-8652 (8)	4851 (5)	8.6 (5)
C77	6249 (17)	-10166 (7)	5661 (7)	9.8 (6)
C78	2766 (11)	-3932 (5)	6933 (4)	5.8 (3)
C79	-408 (12)	-4917 (7)	7173 (5)	7.5 (4)
C80	80 (10)	-7385 (6)	7023 (4)	5.6 (3)
C81	5669 (14)	-2883 (6)	6624 (6)	8.0 (5)
O82	4845 (8)	-3869 (4)	6918 (3)	7.2 (3)
O83	1668 (9)	-3181 (5)	6722 (4)	8.7 (3)
O88	1062 (6)	-8011 (4)	5517 (2)	5.4 (2)

Table 2. Bond distances (\AA ; $\sigma = 0.006 \text{\AA}$) and angles ($^\circ$; $\sigma = 0.3^\circ$)

	(I)	(II)	(III)
C1-C2	1.531	1.534	1.535
C1-C10	1.542	1.548	1.566
C2-C3	1.524	1.521	1.548
C3-C4	1.521	1.551	1.558
C4-C5	1.563	1.562	1.552
C4-C18	1.524	1.553	1.493
C4-C19	1.543	1.520	1.542
C5-C6	1.543	1.523	1.522
C5-C10	1.559	1.560	1.552
C6-C7	1.519	1.526	1.548
C7-C8	1.516	1.518	1.534
C8-C9	1.539	1.534	1.522
C8-C14	1.507	1.520	1.527
C8-O28	1.461	1.455	1.462
C9-C10	1.564	1.566	1.574
C9-C11	1.548	1.566	1.566
C10-C20	1.539	1.536	1.551
C11-C12	1.522	1.525	1.500
C12-C13	1.514	1.520	1.550
C13-C14	1.505	1.512	1.493
C13-C15	1.516	1.508	1.536
C13-C17	1.509	1.519	1.488
C13-C15	1.502	1.503	1.513
C15-C16	1.499	1.506	1.500
C16-C28	1.430	1.438	1.437
C18-O22	1.313	1.332	1.333
C18-O23	1.196	1.192	1.215
C21-O22	1.462	1.453	1.455
C2-C1-C10			
C1-C2-C3	113.2	114.1	112.2
C2-C3-C4	109.7	110.9	111.8
C3-C4-C5	113.3	113.1	111.4
C3-C4-C18	107.2	107.8	107.2
C3-C4-C19	108.1	107.3	106.8
C3-C4-C18	111.2	110.7	110.0
C5-C4-C19	108.3	108.0	109.1
C5-C4-C19	114.6	115.5	115.5
C18-C4-C19	107.3	107.3	107.9
C4-C5-C6	113.8	113.4	112.2
C4-C5-C10	115.9	115.3	116.2
C6-C5-C10	111.1	111.9	111.5
C5-C6-C7	110.6	110.7	108.1
C6-C7-C8	111.6	111.1	110.8
C7-C8-C9	111.5	111.2	112.1
C7-C8-C14	113.3	113.0	111.1
C8-C9-C10	108.3	107.8	108.4
C9-C8-C14	109.7	109.9	110.3
C9-C8-O28	108.9	109.7	109.9
C14-C8-O28	104.9	104.9	104.8
C8-C9-C10	114.2	113.8	114.2
C8-C9-C11	112.1	111.7	111.2
C10-C9-C11	114.6	114.8	114.3
C1-C10-C5	106.6	106.6	107.3
C1-C10-C9	108.8	108.4	107.1
C1-C10-C20	109.0	109.8	109.6
C5-C10-C9	106.5	106.0	106.4
C5-C10-C20	115.3	115.4	116.1
C9-C10-C20	110.5	110.5	109.9
C9-C11-C12	115.5	115.0	116.8
C11-C12-C13	111.7	111.3	113.2
C12-C13-C14	115.4	115.5	114.9
C12-C13-C15	121.1	122.8	118.3
C12-C13-C17	115.3	114.9	115.7
C14-C13-C15	59.6	59.7	59.8
C14-C13-C17	117.1	117.2	118.7
C15-C13-C17	116.8	115.6	117.9
C8-C14-C13	113.8	112.7	114.3
C8-C14-C15	107.9	107.4	107.5
C13-C14-C15	60.6	60.0	61.4
C13-C15-C14	59.8	60.3	58.8
C13-C15-C16	117.9	117.7	119.6
C14-C15-C16	105.5	106.1	105.8
C15-C16-O28	106.9	105.9	106.9
C4-C18-O22	113.5	113.3	114.5
C4-C18-O23	125.5	124.7	125.0
O22-C18-O23	121.0	122.1	120.5
C18-O22-C21	117.1	116.7	116.9
C8-O28-C16	110.1	110.7	110.9

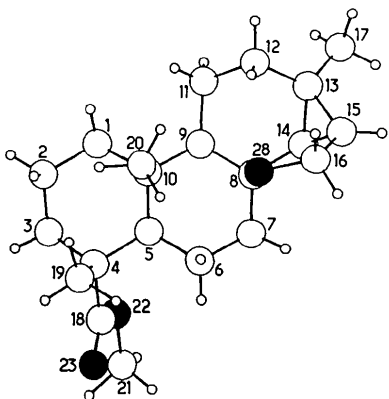


Fig. 1. Molecular structure and numbering of atoms.

orientations of some methyl hydrogens are taken into consideration. They exhibit some rotation of the methyl groups depending on the intermolecular packing environments.

Corresponding bond lengths in the three molecules are comparable. The exception is the C4—C18 bond for molecules (II) and (III) where a difference of 0.040 (6) Å is observed. The largest difference among corresponding valence angles, of the order of 4.5 (3)°, is associated with the C12—C13—C15 angle.

In all the molecules, all the ring junctions are *trans*. Rings *A* and *B* are in the chair form, while the *C* rings are in the boat form (Bucourt, 1974). The 4 α -methoxycarbonyl group of atoms C18—O22—O23—C21, and the corresponding atoms by adding 30 and 60, are coplanar. The torsion angles of type C3—

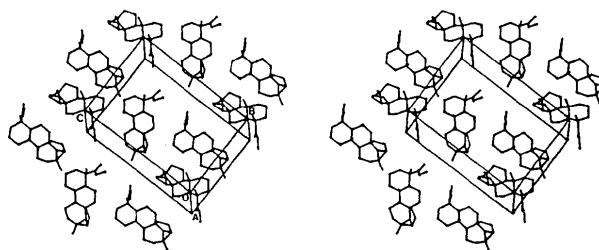


Fig. 2. Stereoview showing molecular packing for the title compound.

C18—O23 with values in the range 122–131° indicate an anticlinical conformation of these groups with respect to the C4—C5 type bonds.

Fig. 2 shows molecular packing in the unit cell. There are no intermolecular contacts shorter than the sum of the van der Waals radii of corresponding atoms.

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[O-(Dioxa-2,5 hexyl) Oxime]-9 de l'Erythromycine A Hydratée

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Abstract. C₄₁H₇₆N₂O₁₅·H₂O, antibiotic CID name roxithromycin, proprietary name Rulid, *M_r* = 854.99, orthorhombic, *P*2₁2₁2₁, *a* = 24.195 (8), *b* = 16.935 (6), *c* = 11.686 (5) Å, *V* = 4788 Å³, *Z* = 4, *D_x* = 1.184 (1) g cm⁻³, λ(Cu *K*α) = 1.5418 Å, μ = 6.4 cm⁻¹, *T* = 293 K, *R* = 0.047 for 5569 unweighted reflections. The erythronolid ring, cladinose and desosamine have the same conformation in this compound and in erythromycin A. This compound and the enantiomer of anhydroerythromycin A cyclic carbonate *N*-methyl

iodide, (9*S*)-9,11-dideoxy-9,11-{imino[2-(2-methoxyethoxy)ethylidene]oxy}erythromycin, also have the same conformation for atoms C(1) to C(6), C(10) to O(14) and for the two sugars. The 9-(*O*-2,5-dioxa-hexyl) oxime chain is directed towards C(8) and bonded by an intramolecular hydrogen bond to O(6*A*) and to the water molecule. Some intermolecular hydrogen bonds occur between the molecules themselves and between the molecule and the water. The van der Waals signature displayed on a graphics system shows strong