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STEREOCHEMISTRY OF THE PRODUCTS OF THE HYDROGENATION OF LEUCOMISIN

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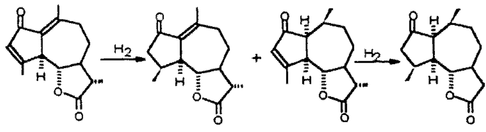
An x-ray structural investigation has been made of tetrahydroleucomisin, and its spatial structure has been established.

We have shown [1] that the catalytic hydrogenation of the biologically active lactone leucomisin (**1**), which has a system of double bonds in cross-conjugation with a carbonyl group in a five-membered ring, takes place stepwise, 1,10-dihydroleucomisin (**3**) and 3,4-dihydroleucomisin (**2**) first being recorded in the reaction mixture, after which these are reduced to tetrahydroleucomisin (**4**). The reaction takes place stereoselectively with the formation of one of the possible geometric isomers of each of the products.



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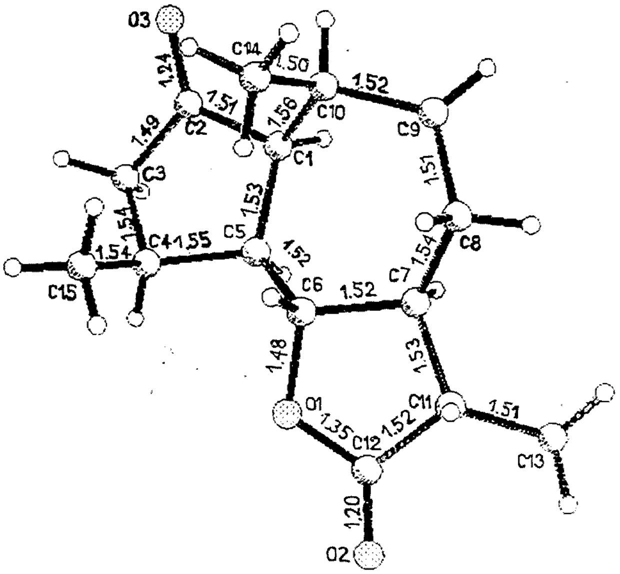

Fig. 1. Spatial structure of tetrahydroleucomisin.

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TABLE 1. Coordinates (× 10^4) of the Nonhydrogen Atoms and Temperature Factors U_{eq} (Å^2) of the Tetrahydroleucomisin Structure

Atom	*x*	*y*	*z*	*U* eq
C1	6021(15)	5289(9)	3690(8)	45(5)
C2	7316(19)	4537(10)	4135(8)	55(5)
C3	6817(18)	4339(10)	5111(9)	68(6)
C4	4742(17)	4489(9)	5106(8)	53(5)
C5	4535(15)	5400(9)	4416(7)	37(4)
C6	2640(15)	5528(8)	4029(7)	36(4)
C7	2421(15)	6441(9)	3374(6)	37(4)
C8	2801(16)	6174(10)	2364(7)	52(5)
C9	4754(16)	5930(10)	2140(8)	56(5)
C10	5665(17)	5052(9)	2659(8)	52(5)
C11	472(16)	6798(10)	3539(8)	52(5)
C12	181(18)	6513(10)	4539(8)	50(5)
C13	20(20)	7920(11)	3335(8)	84(6)
C14	4821(20)	4011(11)	2475(8)	74(6)
C15	3739(19)	3483(10)	4844(9)	79(6)
O1	1438(11)	5814(6)	4798(5)	49(3)
O2	−974(11)	6817(6)	5046(6)	65(4)
O3	8659(13)	4136(8)	3763(6)	82(4)

In order to determine unambiguously the stereochemistry of the products obtained, we have made an x-ray structural investigation of **(4)**, and this has enabled us to establish the orientation of the substituents and the linkage of the rings. The spatial structure of the **(4)** molecule is shown in Fig. 1. No anomalies are observed in the valence distances and angles in comparison with the standard values [2]. The mean square errors in the determination of bond lengths do not exceed 0.01 Å. It can be seen from Fig. 1 that the methyl groups at the C4 and C10 atoms are β-oriented, while that at C-11 has the α-orientation. Rings *A/B* are *cis*-linked (the torsional angle H1C1C5H5 is −11.4°) and rings *B/C trans*-linked (the torsional angle H6C6C7H7 is −156.3°).

Ring *A* has the half-chair conformation with C_2 symmetry. The degree of asymmetry ΔC_2 according to [3] is 5.9°. The seven-membered ring *B* has a conformation close to the chair conformation ($\Delta C_S(8, 1\text{-}5) = 18.3°$), and the lactone ring (ring *C*) an envelope conformation with symmetry C_S ($\Delta C_S(7) = 2.2°$).

Thus, compound **(4)** has the structure of 2-oxo-1,4,5,7,10-αH-6,11-βH-guaian-6,12-olide, and the intermediate hydrogenation products **(2)** and **(3)** the analogous stereochemistries of the asymmetric centers. Consequently, the hydrogenation of double bonds in cross-conjugation with a carbonyl group takes place stereoselectively.

EXPERIMENTAL

Colorless tabular crystals of compound **(4)** were grown from solution in ethanol. The space group, the parameters of the unit cell, and the intensities of the reflections from the crystal were measured on a Syntex-P2_1 automatic four-circle diffractometer at room temperature using CuK_α radiation: $a = 7.383(1)$, $b = 12.884(1)$, $c = 14.599(1)$ Å, $d_{calc} = 1.197$ g/cm^3, crystals rhombic, space group $P2_12_12_1$, $Z = 4$.

A complete set of experimental reflections (1214) with $\theta < 58°$ was obtained on the above-mentioned diffractometer ($\theta/2\theta$ scanning). In the primary treatment of the group, weak reflections with $I < 2\sigma$ (1) were discarded. The calculations made use of 692 reflections with $|F| > 4\,4\sigma(|F|)$ [sic]. The structure was determined by the direct method using the SHELXS-86 program [4] and was refined in the full-matrix isotropic-anisotropic approximation by the SHELX-76 program [5] (both programs in the PC MSDOS versions). The positions of the H atoms, the initial parameters of which were calculated, were refined isotropically. The final value of the divergence factor R was 0.091 ($R_W = 0.083$). The coordinates of the nonhydrogen atoms are given in Table 1.

REFERENCES

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