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THE STRUCTURE OF ANHYDROIGNAVINOL.

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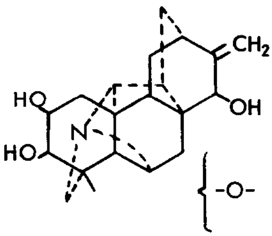
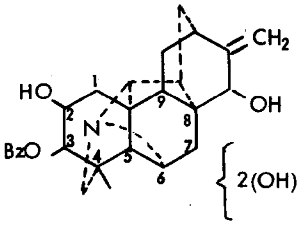
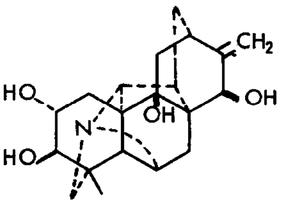
Anhydroignavinol, m.p. 302-304°, the alkaline hydrolysis product of ignavine, a diterpene alkaloid isolated from the roots of Aconitum sanyoense Nakai[1], A. tasiromontanum Nakai[1,2], A. japonicum[3], was reported to have the molecular formula $C_{20}H_{25}NO_4$ (mol. wt. 343).[1] From the spectral and chemical evidence, the tentative structures I and II were assigned to anhydroignavinol and ignavine, respectively[4]. Structure I was assumed to arise from hydrolysis of the benzoate ester at C(3) and the formation of an ether group by dehydration of two hydroxyl groups of ignavine.[4] However, recent high resolution mass spectral studies in our laboratories[5] indicated the molecular ion of anhydroignavinol to be at m/e 345. 1936. The other physical and spectral properties of the sample agreed with those reported for anhydroignavinol.[1,4] This prompted our further investigation of its structure by single-crystal X-ray analysis.



I



II

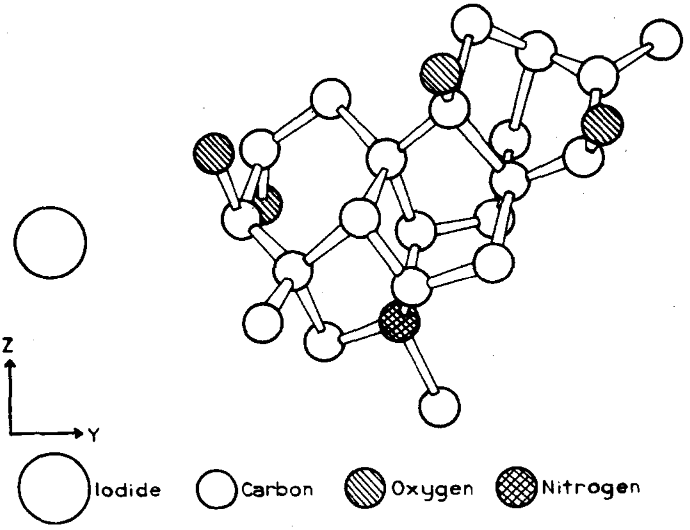


III

Anhydroignavinol methiodide was prepared and recrystallized from absolute methanol, m.p. 285-287°: analysis satisfactory for $C_{21}H_{30}NO_4I$. The crystals were orthorhombic with unit cell dimensions of a=13.28 Å, b=13.87 Å, c=10.58 Å, $\alpha=\beta=\gamma=90°$; Z=4, D_m=1.66g./cm^3., D_c=1.66g./cm^3. (for $C_{21}H_{30}NO_4I$) as determined from precession photographs (Mo-K_α, λ=0.7107 Å). The space group was uniquely determined as $P2_12_12_1$ by systematic absences. Intensity data were collected about the b-axis by the Weissenberg equi-inclination method using mutiple film technique and Cu-K_α radiation (λ=1.5418 Å). The intensities of 1379 unique non-zero reflections used in the analysis were estimated visually with a standard intensity strip.

The structure was solved by the heavy atom method.[6] After refinement to R=0.119, the average estimated standard deviations of bond lengths was 0.04 Å, and the average estimated standard deviation of bond angles was 2°. C-C bond lengths average 1.55 Å, C-N^+ bond lengths average 1.53 Å, and C-OH bond lengths average 1.46 Å.

A view of the structure projected on the bc plane is shown in the Figure. The correct structure of anhydroignavinol is now established as III. The absolute configuration indicated is based on analogy with the other diterpene alkaloids.



Figure

Anhydroignavinol joins the recently reported mijaconitine[7] as an alkaloid of the modified atisine type[8] with an hydroxyl group at C(9). The reported absence of an O-H stretching band in the infrared spectra of the tribenzoyl derivatives of anhydroignavinol, des-N-methylanhydroignavinol, and des-N-methyl-oxo-anhydroignavinol[4] could result from the masking of this band by the C-H stretching band. The hydrogen of the hydroxyl at C(9) would be strongly hydrogen bonded to the carbonyl of the ester function at C(15) in these derivatives, resulting in a bathochromic shift.

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