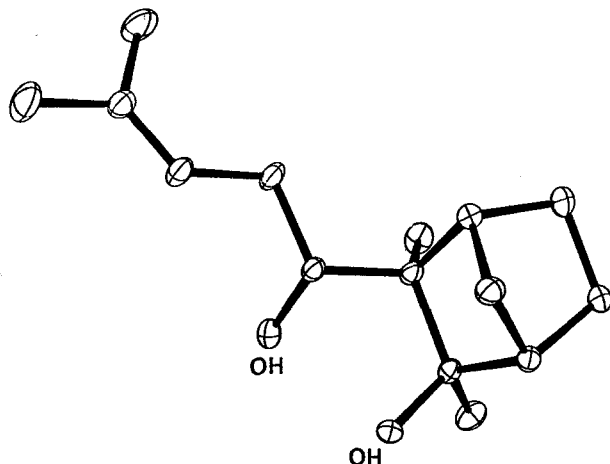


Clausantalene and dihydroclausantalene failed to give an acetyl derivative under mild acetylation conditions. As attempts to correlate the carbocyclic ring system with one of the already known sesquiterpene skeleta failed, and a variety of reactions yielded unsaturated products or intractable mixtures, an X-ray study was undertaken.



Clausantalene ($C_{15}H_{26}O_2$) crystallizes as clear regular rectangular blocks; they are *orthorhombic*, space group $P2_12_12_1$, $a = 8.205$, $b = 8.488$, $c = 20.616$ Å, $Z = 4$ mols/cell. Intensities of 1594 reflections were measured on a Siemens diffractometer with $Cu-K_\alpha$ radiation (to $\theta = 70^\circ$), and of these 45 were reckoned unobserved. The structure was solved by direct methods and is currently refined to $R = 0.11$. The molecular arrangement is given by II, and, by implication, that of dihydroclausantalene by III.

The Figure shows a perspective view of the molecule (or its enantiomorph). The hydroxy groups are linked by both intra-(2.68 Å), and inter-(2.82 Å) molecular hydrogen bonds to form continuous chains running parallel to a .

An attempt will be made to determine the absolute configuration by allowing for anomalous scattering by oxygen, but this cannot be done until the structure is fully refined and may not prove possible in view of the small amount of oxygen in the molecule.

The occurrence of a santalane type sesquiterpene from the Rutacea family may be of some taxonomic interest⁷.

Zusammenfassung. Es wurde ein neues Sesquiterpen $C_{15}H_{26}O_2$ (Clausantalene) aus den Wurzeln von *Clausena indica* Oliv. (Rutaceae) isoliert. Spektralanalytische und röntgenkristallographische Daten ermittelten ein β -Santalane-Derivat.

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The Structure of Quimbeline, a New Bisindole Alkaloid from *Voacanga chaltiana*

The root bark of *Voacanga chaltiana* has been found to contain, beside a number of known indole alkaloids and three new bases¹, considerable quantities of vobtusine (II) and minor amounts of a closely related compound, which we have named quimbeline, $C_{48}H_{48}N_4O_6$, m.p. 270° , $[\alpha]_D^{25} -195^\circ$ (c1, $CHCl_3$). The gross structure of vobtusine has been determined mainly on the basis of spectroscopic considerations², while the location of the hydroxyl function at C-2' and the configuration of the C-7 spiral centre were established by X-ray investigation³. The complete structural proposal I for quimbeline is based almost entirely on a mass spectrometric and ^{13}C -NMR investigation in comparison with vobtusine, the information to be gained from 1H -NMR-spectrum being minimal owing to the complexity of the molecule.

The close relationship between the 2 alkaloids is apparent from the similarity of their IR- and UV-spectra. Quimbeline shows UV-absorption maxima (MeOH) at 221, 263, 301, 327 nm ($\lg \epsilon$ 4.54, 4.05, 4.15, 4.21 respectively) and IR stretching bands ($CDCl_3$) at 3390 (NH), 1675 and 1610 ($-N=C-C-CO_2Me$) cm^{-1} , which agree for the presence of the N-alkyl-methoxy-indoline and β -anilino-acrylic ester groupings². The 1H -NMR-spectrum of quimbeline ($CDCl_3$, 100 MHz) shows a broad singlet at δ 8.95 (NH), an aromatic pattern superimposable to that of vobtusine, 2 singlets at δ 3.80

and 3.74 (CO_2Me and $ArOMe$) and 1 proton at δ 4.95 as a doublet ($J = 14$ Hz). The latter signal is due to one of the C-8 protons, which demonstrates the deshielding effect of the lone pair of the indoline N_a nitrogen atom, and is diagnostic for the configuration at C-7. In vobtusine this signal falls at δ 5.14, whereas the 1H -NMR-spectrum of amataine⁴, an alkaloid possessing the vobtusine skeleton with an opposite configuration at C-7, lacks of such signal.

Quimbeline contains 2 less hydrogens than vobtusine. Owing to the lack of further sp^2 carbon atoms in the ^{13}C -NMR-spectrum and to the presence of only 1 active hydrogen (NH), the additional unsaturation is due to the formation of an ethereal linkage involving the hydroxyl function of vobtusine and 1 of the neighbouring carbon

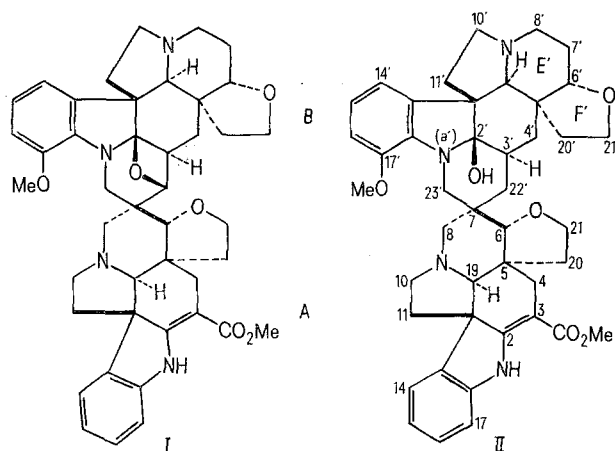
¹ B. GABETTA, E. M. MARTINELLI and G. MUSTICH, *Fitoterapia* 45, 32 (1974).

² J. POISSON, M. PLAT, H. BUDZIKIEWICZ, L. J. DURHAM and C. DJERASSI, *Tetrahedron* 22, 1075 (1966).

³ J. NARANJO, M. HESSE and H. SCHMID, *Helv. chim. Acta* 55, 1849 (1972), footnote.

⁴ N. KUNESCH, B. C. DAS and J. POISSON, *Bull. Soc. Chim. fr.*, 1970, 4370. - V. AGWADA, M. B. PATEL, M. HESSE and H. SCHMID, *Helv. chim. Acta* 53, 1567 (1970).

atoms. The MS-spectrum accounts for an unaltered A portion of the molecule (ions at m/e 305 and 363)⁵, while the fragments at m/e 393 and 504 of the vobtusine spectrum shift at m/e 391 and 502 respectively, showing that the additional ring is present in part B. Furthermore, the MS (ions at m/e 110 and 138)⁶ indicates that the F' and E' rings do not carry substituents.



From these data it is clear that the carbon involved in the ethereal bridge can only be one of the atoms C-22', C-3', C-4' and C-11', the absence of low-field resonating singlets in the ¹H-NMR-spectrum of I automatically excluding C-23' as a possible linkage position.

Comparison of the ¹³C-NMR-spectrum of quimbeline (22.6 MHz, CDCl₃) with that of vobtusine gives support for the location of the ethereal bridge at C-22'. In addition to the signal of the β -anilino-acrylic ester unit (C-2 166.9, C-3 93.9, C-13 137.7^a, C-14 121.5, C-15 120.6, C-16 127.7, C-17 109.3, C-18 143.1, C=O 168.6, OCH₃ 51.0) and the 7-methoxyindoline grouping (C-13' 137.4^a, C-14' 114.8, C-15' 118.3, C-16' 111.0, C-17' 145.2, C-18' 134.5, OCH₃ 55.1), the spectrum of vobtusine exhibits a strongly deshielded singlet at δ 94.4 due to the C-2' atom, which

confirms that the hydroxy function is part of a carbinol-amine system. The chemical shift assignments for the vobtusine carbon atoms derive from shift theory, and partially follow the arguments discussed by WENKERT⁶ in the ¹³C-NMR analysis of *Aspidosperma* alkaloids:

C-6	87.6	C-6'	80.5
C-19	69.0	C-19'	63.7
C-21	64.3 ^b	C-21'	65.3 ^b
C-12	54.9	C-12'	56.0
C-8	53.9	C-8'	48.8
C-10	51.9 ^c	C-10'	51.0 ^c
		C-23'	46.2 ^d
C-5	47.7	C-5'	44.2
C-11	45.0 ^d	C-11'	36.5
C-7	39.7	C-7'	27.4
C-20	34.8	C-20'	33.9
C-4	25.8		

^{a, b, c, d} Assignments may be reversed.

The remaining three carbon atoms (C-22', C-3' and C-4') resonate at δ 31.2, 31.5 and 32.5.

The ¹³C-NMR-spectrum of quimbeline is the same in character as that of vobtusine, the most noteworthy differences being the presence of an additional oxymethyne carbon atom at δ 82.0 and the downfield shift of the C-7 singlet at δ 43.3 and of the C-3' doublet at δ 58.3. These data are only compatible with the allocation of the ethereal bridge at C-22, as represented in formula I.

Since upon hydrogenolytic fissure of the oxetane ring⁷ (MeOH, Pd-C, 5 days) vobtusine is obtained, the 2 alkaloids are assigned the same absolute stereochemistry.

Quimbeline is therefore the first compound belonging to the vobtusine class which surely possesses an oxetane ring. In fact, amataine should contain an analogous ring between C-2' and C-23', though an alternative ethereal bridge between C-2' and C-8 cannot be excluded³.

Résumé. La structure I a été attribuée à la quimbéline, un nouvel alcaloïde indolique extrait de l'écorce des racines du *Voacanga chaltiana*, grâce à des méthodes physiques et notamment à la comparaison de son spectre de résonance magnétique du ¹³C avec le spectre de la vobtusine (II).

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20 June 1974.

⁵ A. A. GORMAN, V. AGWADA, M. HESSE, U. RENNER and H. SCHMID, *Helv. chim. Acta* 49, 2072 (1966).

⁶ E. WENKERT, D. W. COCHRAN, E. W. HAGAMAN, F. M. SCHELL, N. NEUSS, A. S. KATNER, P. POTIER, C. KAN, M. PLAT, M. KOCH, H. MEHRI, J. POISSON, N. KUNESCH and Y. ROLLAND, *J. Am. chem. Soc.* 95, 4990 (1973).

⁷ S. SEARLES, K. A. POLLART and E. S. LUTZ, *J. Am. chem. Soc.* 79, 948 (1957).

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Properties of the Purified Penicillin V-Acylase of *Erwinia aroideae*

The activity of a penicillin V-acylase, (E.C. 3.5.1.11) present in *Erwinia aroideae* was studied. The bacterium was grown in shaking cultures on the following medium: glucose 1.0 g; secondary potassium phosphate 1.0 g; yeast extract 5 g; tryptone 5.0 g; distilled water 1 l (pH 7.0). After 24 h of growth at 28°C, the cells were centrifuged, washed 3 times and suspended in a sterile phosphate

buffer (pH 5.6). To the cell suspensions penicillin V (4 mg/ml final concentration) or other penicillins were added. The degradation products were determined qualitatively by thin layer chromatography¹ and quanti-

¹ E. J. VANDAMME and J. P. VOETS, *J. Chromat.* 71, 141 (1972).