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THE STRUCTURE OF TECOMANINE

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The presence of alkaloids in Tecoma stans Juss. was first noted by Boorsma in 1899[1]. In 1959 Hammouda and Motawi[2] reported the existence of a liquid alkaloid, tecomine, in the same plant. Their product, $[\alpha]_D^{23}$ -20°, exhibited a carbonyl group in the infrared, formed a picrate, m.p. 154°, a methiodide, m.p. 265° and a 2,4-dinitrophenylhydrazone, m.p. 260°. The methiodide suggested $C_{11}H_{17}NO$ as the empirical formula of the free base.

We have reinvestigated this species and have found a similar alkaloid which we have named tecomanine and for which we propose structure III.

Tecomanine is a colorless, unstable liquid, b.p. 125° (0.1 mm.) $[\alpha]_D^{24}$ -175° (c 1.17, chloroform), $\lambda_{max}^{ethanol}$ 226 mμ (log ε 4.10, $\lambda_{max}^{acidic\ ethanol}$ 223 mμ (log ε 4.13), $\eta_{max}^{chloroform}$ 1700, 1620 cm.$^{-1}$ (α,β-unsaturated cyclopentenone, see below) (Found: C, 73.24; H, 10.02; N, 7.72; neut. equiv., 184. $C_{11}H_{17}NO$ requires: C, 73.70; H, 9.56; N, 7.81; neut. equiv., 179). The base forms a picrate, m.p. 179.5-180.5° (Found: C, 50.00, 50.23;

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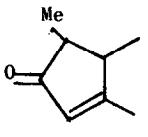
[1] Boorsma, G. E., Meded. Lands' Plantent 18, 39 (1897); ibid. 31, 136 (1899). See C. Wehmer, Die Pflanzenstoffe 2, 1136, J. W. Edwards, Edwards Brothers, Inc., Ann Arbor, Michigan (1950).

[2] Hammouda, Y. and Motawi, M. M., Egypt. Pharm. Bull. 41, 73 (1959); cf. Chem. Abstr. 54, 21646c (1960).

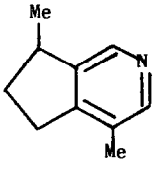
H, 5.25, 5.16; N, 13.73, 13.79. $C_{17}H_{20}N_4O_8$ requires: C, 50.00; H, 4.94; N, 13.72) and a methiodide, m.p. 240-2° dec. (Found: C, 44.79; H, 6.81; N, 4.48. $C_{12}H_{20}ONI$ requires: C, 44.88; H, 6.28; N, 4.36).

The NMR spectrum of tecomanine in a mixture of deuterochloroform and perdeuteroacetic acid showed the presence of an olefinic proton at δ= 5.95, an N-methyl group at δ= 2.75 and two C-methyl groups as doublets centered at δ= 1.12 (A) and δ= 1.07 (B). After heating the sample at 100° for 3 hours the C-methyl doublet (A) converged to a singlet indicating the presence of the grouping $-\overset{O}{\overset{\|}{C}}-CH(CH_3)$.

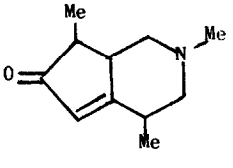
Reduction of tecomanine in ethanol with palladium-on-charcoal gave predominantly one dihydrotecomanine which was purified via the picrate, m.p. 189.5-191.5° (Found: C, 49.75, 49.56; H, 4.43, 5.62; N, 13.42, 13.69. $C_{17}H_{22}N_4O_8$ requires: C, 49.75; H, 5.41; N, 13.65).



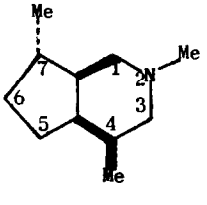
I



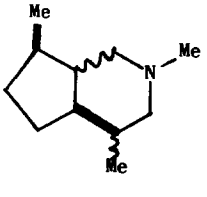
II



III



IV



V

The free base, recovered from the picrate, was an oil, transparent above 220 mμ, η_D^{34} 1.4763, $\lambda_{max}^{chloroform}$ 1740 cm.$^{-1}$ (cyclopentanone) (Found: C, 72.63, 72.81; H, 10.66, 10.57; N, 7.62; neut.equiv., 180, 181. $C_{11}H_{19}ON$ requires: C, 72.88; H, 10.57; N, 7.73; neut. equiv., 181). The NMR spectrum in deuterochloroform showed no olefinic protons, an N-methyl group at δ= 2.35 and two C-methyl groups as doublets centered at δ= 1.07 and δ= 0.90. Hence tecomanine contains the system shown in I.

When tecomanine was reduced with platinum oxide in acetic acid a mixture of saturated ketones was obtained. Huang-Minlon reduction of the mixture afforded a mixture of three bases, which was dehydrogenated over palladium-on-charcoal at 270°. A pyridine was isolated and identified as dl-actinidine (II)[3,4] by comparison of the melting point of the picrate (138-140°) with that recorded (139-140°). The product was identical in ultraviolet and infrared spectra as well as vapor phase retention time with a sample of l-actinidine kindly supplied by Professor Djerassi. Thus the structure of tecomanine may be expanded to III.

Pure dihydrotecomanine, recovered from the picrate, m.p. 189.5-191.5°, was subjected to Huang-Minlon reduction and a single oxygen-free base was obtained, $[\alpha]_D^{24}$ -13 (c 0.68 chloroform) which formed a picrate, m.p. 152-3° (Found: C, 51.77, 51.65; H, 6.28, 6.19; N, 13.98. $C_{17}H_{24}O_7N_4$ requires: C, 51.51; H, 6.10; N, 14.14. Although this is presumably one of the eight possible isomers of skytanthine (IV),[4] it differs in melting point and

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[3] Sakan, T., Fujino, A., Murai, F., Butsugan, Y and Suzui, A., Bull. Chem. Soc. Japan 32, 315, 1155 (1959).

[4] Djerassi, C., Kutney, J. P., Shamma, M. Shoolery, J. N. and Johnson, L. F., Chem. & Ind. 210 (1961); Tetrahedron 18, 183 (1962); Casinovi, C. G., Gargarino, J. A. and Marini-Bettòlo, G. B., Chem. & Ind. 253 (1961).

rotation from the four isomers recently synthesized.[5] Authentic specimens of these isomers, kindly supplied by Dr. E. J. Eisenbraun, showed depressions on admixture with our sample as well as differences in infrared spectra (KBr). Retention times (on SE-30) of the β, γ and δ isomers were also different while that of the α-isomer was nearly the same as our sample.

The known isomers of skytanthine all possess the same absolute configuration of the 7-methyl group and contain the 4^a-4 linkage trans to it relative to the cyclopentane ring.[5] Thus, we may assign our product the partial structure V or its antipode.

Unfortunately, none of these facts shed light on the stereochemistry of tecomanine itself because of possible isomer formation during hydrogenation and Huang-Minlon reduction.

The basic skeleton of tecomanine is isoprenoid and it may therefore be added to the growing list of monoterpenoid alkaloids.[5] The location of the carbonyl function at C_6 is more difficult to explain since it would seem to be derived from the methyl instead of the carbonyl carbon of acetic acid.

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[5] Eisenbraun, E. J., Bright, A. and Appel, H. H., Chem. & Ind. 1242 (1962); Casinovi, C. G., Delle Monache, F., Marini-Bettòlo, G. B., Bianchi, E. and Garbarino, J. A., Sci. Rpts. 1st Super Sanità I 588 (1961); Casinovi, C. G., Delle Monache, F., Marini-Bettòlo, G. B., Bianchi, E. and Garbarino, J. A., Gazz. chim. Ital. 92, 479 (1962).