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ISOLATION AND STRUCTURES OF CITROPONE-A AND -B FROM CITRUS PLANTS, FIRST EXAMPLES OF NATURALLY-OCCURRING HOMOACRIDONE ALKALOIDS CONTAINING A TROPONE RING SYSTEM

Andrew T. McPhail,[a] Motoharu Ju-ichi,[b] Yukari Fujitani,[b] Mami Inoue[b], Tian-Shung Wu[c], and Hiroshi Furukawa[d]

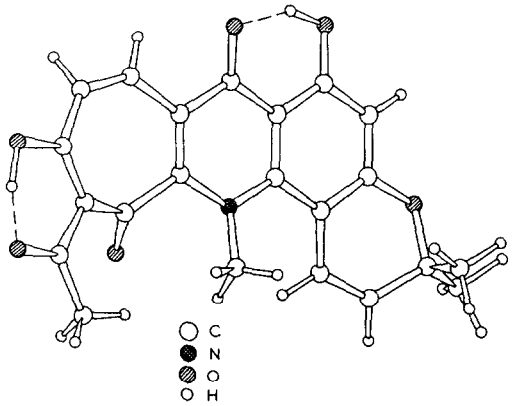
a) Paul M. Gross Chemical Laboratory, Duke University, Durham, North Carolina 27706, U. S. A.; b) Faculty of Pharmaceutical Sciences, Mukogawa Women's University, Nishinomiya, Hyogo 663, Japan; c) Department of Applied Chemistry, Providence College of Arts and Science, Taichung 400, Taiwan, R. O. C.; d) Faculty of Pharmacy, Meijo University, Tempaku, Nagoya 468, Japan

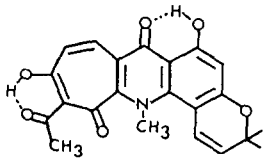
Abstract The first isolation of homoacridone alkaloids, citropone-A (1) and -B (2), from the root bark of Citrus grandis Osbeck f. buntan Hayata and C. natsudaidai Hayata is described.

The isolation of acridone alkaloids from plants of the genus Citrus (Rutaceae) has been reported elsewhere.[1] In continuation of our studies on chemical constituents from this source, we here describe the first isolation of two homoacridone alkaloids having a tropone ring system, citropone-A and -B, from Citrus grandis Osbeck f. buntan Hayata collected in Taiwan. Citropone-A was also obtained from C. natsudaidai Hayata collected in Japan.

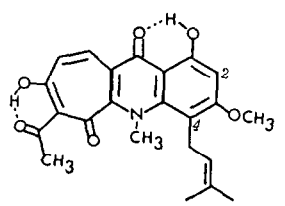
Citropone-A (1), $C_{22}H_{19}NO_6$ [m/z 393.1203 (M^+, found); 393.1210 (calcd.)], m.p. 280-282°C (red needles from acetone); δ_C (100MHz, $^{12}CDCl_3$) 203.6, 185.7, 180.1, 176.8, 164.4, 162.0, 153.9, 144.0, 117.6, 117.5, 108.7, 102.0, and 76.8 (13×s), 133.5, 124.8, 124.1, 120.6, and 100.4 (5×d), 47.1, 28.5, and 27.0(×2) (4×q). The u.v. absorption bands [λ_{max} (MeOH): 215 (log ε 4.26), 230inf. (4.25), 272 (4.39), 287inf. (4.38), 330sh. (4.09), and 410 nm (3.84)] revealed shifts typical for 1-hydroxy-9-acridones upon addition of $AlCl_3$ or NaOMe.[2] The ^{1}Hn.m.r. (100MHz, $CDCl_3$) spectrum showed signals assignable to two oxygen-linked tertiary methyl [δ 1.57 (6H, s)], one acetyl [δ 2.56 (3H, s)], one N-methyl [δ 3.76 (3H, s)], and two intramolecularly hydrogen-bonded hydroxyl [δ 14.11 and 16.58 (1H each, s)] groups, as well as two pairs of AB-type signals [δ 5.56 (1H, d, J=10 Hz) and 6.61 (1H, dd, J=1 & 10 Hz); 6.65 (1H, d, J= 12 Hz) and 7.95 (1H, d, J=12 Hz)], and a long-range coupled one-proton signal [δ 6.34 (1H, d, J=1 Hz)].

A single-crystal X-ray analysis established the complete structure of citropone-A (1).[3] A view of the structure is provided in the Figure.





(1)



(2)

Citropone-B (2), $C_{23}H_{23}NO_6$ [m/z 409.1538 (M^+, found); 409.1524 (calcd.)], m.p. 192-194°C (orange needles from acetone); δ_C (25MHz, $^{12}CDCl_3$) 203.6, 185.8, 180.7, 176.5, 165.5, 162.9, 154.9, 146.1, 132.5, 117.3, 116.4, 108.3, and 108.0 (13×s), 133.4, 123.4(×2), and 95.4 (4×d), 26.7 (t), 56.2, 46.9, 28.4, 25.6, and 18.1 (5×q); λ_{max} (MeOH): 217 (log ε 4.46), 230sh. (4.41), 265 (4.41), 309 (4.29), 330sh. (4.22), and 407 nm (3.99). Close resemblance between the u.v. and ^{13}C-n.m.r. spectra of (1) and (2) suggested that both alkaloids possessed the same basic skeleton. The ^{1}H-n.m.r. (100MHz, $CDCl_3$) spectrum of (2) differs from that of (1) only by the presence of signals for a methoxyl (δ 3.92) and a prenyl [δ 1.74 (3H, s), 1.76 (3H, s), 3.42 (2H, d, J=6 Hz), and 5.23 (1H, br. t, J=6 Hz)] group instead of signals ascribed to the dimethylpyran ring system in (1); other signals were observed at δ 2.56 (3H, s, OAc), 3.66 (3H, s, N-CH_3), 14.04 and 16.42 (1H each, s, H-bonded OH), 6.42 (1H, s), 6.58 (1H, d, J=13 Hz), and 7.86 (1H, d, J=13 Hz). The appearance of mass-fragment peaks at m/z 366 and 354, assignable to [M^+- $CH{=}C(CH_3)_2$] and [M^+- $CH_2CH{=}C(CH_3)_2$], respectively, also pointed to the presence of a prenyl moiety in the molecule. The chemical shift values of the aryl carbon C(2) [δ 95.4 (d)] and a methylene carbon [δ 26.7 (t)] of the prenyl moiety in the ^{13}C-n.m.r. spectrum of (2) suggested that the prenyl moiety was located at C(4).[4] On the basis of the foregoing spectral data, structure (2) was assigned for citropone-B.

References and Notes

1. M. Ju-ichi, M. Inoue, Y. Fujitani, and H. Furukawa, Heterocycles, 23, 1131 (1985) and references cited therein.
2. J. Reisch, K. Szendrei, E. Minker, and I. Novak, Pharmazie, 27, 208 (1972).
3. The crystal structure was solved by direct methods (MULTAN11/82). Full-matrix least-squares refinement of atomic positional and thermal (anisotropic C, N, O; isotropic H) parameters converged to R = 0.043 over 2170 reflections [$I > 3.0\sigma(I)$] recorded on an Enraf-Nonius CAD-4 automated diffractometer (Cu-Kα radiation, incident beam graphite monochromator, λ=1.5418 Å; ω-2θscans, θ_{max}=67°). Crystal data: $C_{22}H_{19}NO_6$, M=393.40, Triclinic, space group $P\bar{1}$(C_i^1), a=9.052(1), b=11.292(1), c=8.965(1)Å, α=98.10(1), β=92.32(1), γ=102.87(1)°, V=882.0 Å^3, Z =2, $D_{calc.}$=1.481 g cm^{-3}.
4. H. Furukawa, M. Yogo, and T.-S. Wu, Chem. Pharm. Bull., 31, 3084 (1983).

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