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NEW STEROIDAL ALKALOIDS FROM *Solanum Callium*

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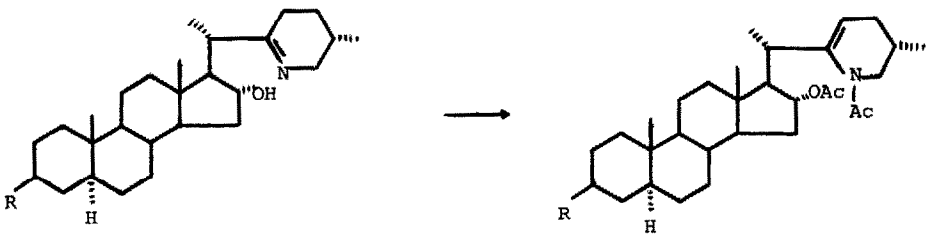
Two new steroidal alkaloids, 25-isosolafloridine (1a) and solacallinidine (1b), have been obtained by hydrolysis of the crude glycoalkaloid extracted from *Solanum callium* C. T. White ex R. J. Henderson (ms), which was collected in south east Queensland in April 1972 (voucher specimen, SN 9033, Queensland Herbarium).



(1a) R = OH
(1b) R = NH_2

(2a) R = OAc
(2b) R = NHAc

25-Isosolafloridine (1a) was readily isolated and purified via its hydrochloride salt, m.p. 325-330° d. (transition 311-312°), which is sparingly soluble in ethanol. The corresponding free base, $C_{27}H_{45}NO_2$, m.p. 164.5-166.5°, $[\alpha]_D^{35}$ + 44.8° (c, 0.85 in $CHCl_3$), showed λ_{max} (EtOH) 239 nm (ε 256), and ν_{max} (Nujol) 1650 cm^{-1}, similar to the corresponding data reported for the >C=N- chromophore of solacongestidine and solafloridine.[1] The i.r. spectrum of (1a) showed hydroxyl absorptions at 3390 and 3240 cm^{-1}. The mass spectrum showed the parent molecular ion at m/e 415 and a prominent peak at m/e 125 for the loss of $C_8H_{15}N$, a fragmentation typical of 22,26-imino-5α-cholest-22(N)-enes.[1-3] This ruled out the possibility of an hydroxyl group being present in the tetrahydropyridine ring. Acetylation of (1a) with acetic anhydride in pyridine gave the triacetyl derivative (2a), m.p. 228-229°, $[\alpha]_D^{35}$ + 87.5° (c, 1.05 in $CHCl_3$), the enamide system of which showed a triplet at δ 5.14 (H23, olefinic) in the 90 MHz p.m.r. spectrum, λ_{max} (EtOH) 236 nm (ε 7444), and ν_{max} (Nujol) 1725 and 1645 cm^{-1} (cf.[1]). The 90 MHz p.m.r. spectrum of (1a) showed singlets at δ 0.69 (18-Me) and 0.80 (19-Me); doublets at 0.91 (27-Me) and 1.10 (21-Me); an apparent doublet at δ 3.03, for one C26-proton, and a broad three-proton multiplet in the region 3-4 for H3α, H16β, and the other C26-proton.

The 22.62 MHz ^{13}C.m.r. spectrum of (1a) confirmed the presence of two secondary hydroxyl groups. The tentative assignment is as follows, with carbon atom number followed by the chemical shift (p.p.m. with respect to $SiMe_4$): 1, 37.0; 2, 31.4; 3, 71.0; 4, 38.2; 5, 44.9; 6, 28.7; 7, 32.0; 8, 35.0*; 9, 54.3; 10, 35.5; 11, 21.1; 12, 40.4; 13, 44.2; 14, 53.3; 15, 35.2*; 16, 76.6; 17, 63.7; 18, 14.0; 19, 12.4; 20, 44.7; 21, 18.9; 22, 177.1; 23, 29.7; 24, 27.4*; 25, 28.0*; 26, 56.1; 27, 19.2. The chemical shifts for the carbon atoms in rings A and B correspond closely to those for 5α-cholestan-3β-ol.[4] With insufficient model compounds available there was uncertainty in the location of the second hydroxyl group, but the p.m.r. and ^{13}C.m.r. spectra together indicated that it was at C15, C16, or less likely, at C12.

The structure of (1a) was determined by X-ray diffraction measurements on the hydrochloride salt. This compound, $C_{27}H_{45}NO_2 \cdot HCl$, crystallizes as large colourless rectangular plates in the monoclinic space group $P2_1$ with unit cell dimensions: $\underline{a}$ = 6.761 (2), $\underline{b}$ = 30.563 (3), $\underline{c}$ = 6.368 (1) Å, β = 94.95 (1)°, $\underline{U}$ = 1311Å^3, $\underline{z}$ = 2, $\underline{D}_m$ = 1.12 (2) g/cc^3, $\underline{D}_c$ = 1.14 g/cc^3.

The structure (Fig. 1) was solved using conventional direct methods.[5] The intensities of 1788 independent reflections with $3° \leqslant \theta \leqslant 54°$ were measured on a Philips PW 1100 diffractometer using Cu-K_α radiation (λ = 1.5418Å). Of the 1616 reflections with $I \geqslant 3\sigma(I)$, four reflections were considered to be extinction-affected, and hence not used in the subsequent least-squares refinement,[6] which at present, with anisotropic thermal parameters on all non-hydrogen atoms, gives R = 0.053. The molecules lie approximately parallel to the y axis and each chlorine atom is linked to three steroid molecules by hydrogen bonding via two oxygen atoms and a nitrogen atom. Further refinement is in progress and full details of the X-ray analysis will be published elsewhere.

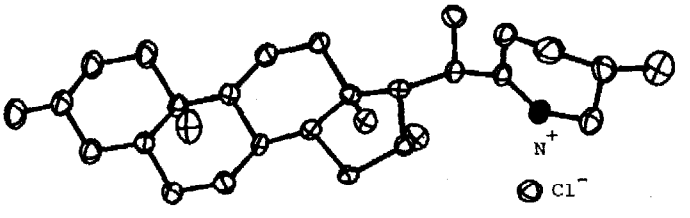


Fig. 1

Countercurrent distribution of the crude aglycone mixture gave a second alkaloid, solacallinidine (1b) $C_{27}H_{46}N_2O$, m.p. 175-178°, $[\alpha]_D^{35}$ + 51.3° (c, 0.90 in $CHCl_3$) which showed λ_{max} (EtOH) 239 nm (ε 247), and ν_{max} (Nujol) 1655 cm^{-1}. The i.r. spectrum showed strong absorption at 3350 cm^{-1} for -OH and $-NH_2$. The mass spectrum showed the parent ion at m/e 414, and a prominent peak at m/e 125. Acetylation of solacallinidine (1b) with acetic anhydride in pyridine gave the triacetyl derivative (2b), m.p. 152-153° $[\alpha]_D^{35}$ + 63.5° (c, 0.92 in $CHCl_3$); λ_{max} (EtOH) 235 nm (ε 7920); ν_{max} (Nujol) 3450, 3210 (NHAc, free and H-bonded), 1720 (OAc), 1660 (NAc of enamide), and 1635, 1550 cm^{-1} (primary amide). The mass spectrum showed a peak (25%) at m/e 541 (M-1), a phenomenon characteristic of primary amides. The 90 MHz p.m.r. spectrum showed a multiplet at δ 3.75 (H3α), an apparent triplet at 4.73 (H16β), a triplet at 5.15 for the olefinic proton at C23, and a doublet at 5.30 for the 3-NHAc. The 90 MHz p.m.r. spectrum of solacallinidine (1b) showed singlets at δ 0.69 (18-Me) and 0.78 (19-Me); doublets at 0.91 (27-Me) and 1.10 (21-Me); an apparent doublet at 3.03 for one of the protons at C26, and a three-proton multiplet at 3.4-3.9 for H3α, H16β, and the other proton at C26. The tentative assignment of the ^{13}C.m.r. spectrum of (1b) is as follows:- 1, 37.7; 2, 32.6; 3, 51.2; 4, 39.5; 5, 45.6; 6, 28.8; 7, 32.1; 8, 35.1*; 9, 54.5; 10, 35.6; 11, 21.0; 12, 40.4; 13, 44.3; 14, 53.4; 15, 35.3*; 16, 76.7; 17, 63.8; 18, 14.0; 19, 12.4; 20, 44.8; 21, 19.0; 22, 176.9; 23, 29.8; 24, 27.5*; 25, 28.0*; 26, 56.2; 27, 19.2. The chemical shifts for all carbon atoms corresponded closely with those for 25-isosolafloridine (1a) except for those in ring A. This indicated that solacallinidine (1b) is the same as 25-isosolafloridine (1a) except that a 3-amino group is substituted for the 3β-hydroxyl group. This was confirmed by measurement of the ^{13}C.m.r. spectrum of 3β-amino-5α-cholestane. The chemical shift differences between 3β-hydroxy- and 3β-amino-5α-cholestane closely parallelled those between (1a) and (1b). All of the spectroscopic evidence is consistent with structure (1b) for solacallinidine. A direct chemical correlation between (1a) and (1b) is in progress. The C.D. of (1a) and (1b), measured in dioxan, showed negative Cotton effects at 242 nm (Δε -2.1), and at 242 nm (Δε -2.3), respectively, consistent with published data[7] for 25-S compounds of this type.

A compound described as 25-isosolafloridine, m.p. 158-159°, $[\alpha]_D^{20}$ + 56.4° (c, 0.58 in $CHCl_3$), was synthesised by Ripperger et al.[8] by hydrogenation of the corresponding 20(21)-dehydro-20-pyridyl derivative. The differences in the physical constants might be due to the presence of a diastereoisomer (C20 and/or C25) in the synthetic compound.

Solacallinidine (1b) is unusual in having two nitrogen atoms. The only other dibasic *Solanum* alkaloid is solanocapsine[9], but a number of 3-aminosolanidanes have been synthesised.[10,11]

All compounds reported gave satisfactory microanalyses.

Acknowledgments

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* Asterisks indicate doubtful assignments.

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