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ALKALOIDS OF DELPHINIUM VIRESCENS NUTT.: VIRESCENINE AND 14-ACETYLVIRESCENINE

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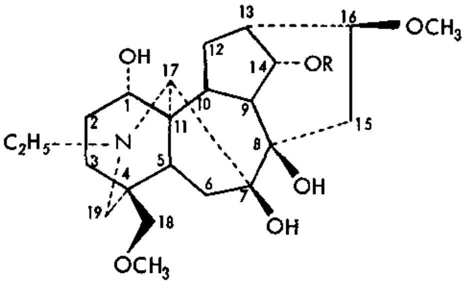
Abstract — Investigation of Delphinium virescens Nutt. has led to the isolation and structure elucidation of two new lycoctonine-type alkaloids, virescenine (1) and 14-acetylvirescenine (2), as well as the known alkaloids, browniine (3) and ajaconine (4).

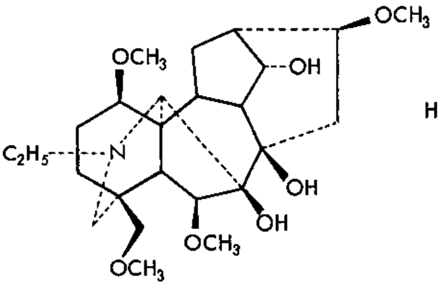
Investigation of the whole plants of Delphinium virescens Nutt.,[1] a rare plant native to the southeastern United States, has led to the isolation and structure determination of two new lycoctonine-type diterpenoid alkaloids, virescenine (1) and 14-acetylvirescenine (2). We also have isolated the known C_{19}-diterpenoid alkaloid, browniine[2] (3) and the known C_{20}-diterpenoid alkaloid, ajaconine[3] (4). These alkaloids were isolated from the 95% ethanol extract by a combination of pH gradient extraction, alumina thick-layer, and column chromatographic methods.



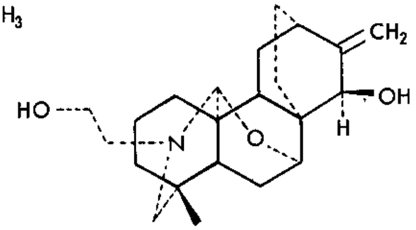
1 R = H Virescenine
2 R = Ac
7 R = CH_3 Umbrosine

Virescenine, $C_{23}H_{37}NO_6$, crystallized from ether-hexane, mp 68-70°C, $[\alpha]_D^{24}$ + 16.9° (c 1.0 95% ethanol), showed IR absorption at 3450 (hydroxyl), 1100 (ether) cm^{-1} and other characteristic peaks of the C_{19}-diterpenoid alkaloid skeleton. The ^1H NMR spectrum of virescenine in deuterochloroform indicates the presence of $N\text{-}CH_2\text{-}\underline{CH_3}$ (3H, triplet) at $\delta 1.10$, two aliphatic methoxyl groups (3H, singlets) at $\delta 3.36$ and $\delta 3.38$, and a broad doublet of doublets centered at $\delta 4.30$ for the C-14 proton.

14-Acetylvirescenine, $C_{25}H_{39}NO_7$, $[\alpha]^{24}_{D}$ + 31.8° (c 0.5 $CHCl_3$), crystallized from ether-hexane, mp 157-159°C, showed IR absorption at 3560 (intramolecularly bonded hydroxyl), 3375 (hydroxyl), 1740 and 1250 (acetate), and 1100 (ether) cm^{-1}. The ^1H NMR spectrum in deuterochloroform showed one triplet for an N-CH_2-$\underline{CH_3}$ group at δ 1.10, one singlet for an acetoxy group at δ 2.07, two sharp singlets for two methoxyl groups at δ 3.29 and δ 3.33, and a broad doublet of doublets centered at δ 4.88 for the C-14 proton. The IR and ^1H NMR spectra of alkaloids 1 and 2 are similar to those of isotalatizidine[4] (5) and condelphine[4] (6), respectively. Treatment of 14-acetylvirescenine (2) with 5% KOH in methanol at room temperature afforded an amino alcohol, which was identical with virescenine (1). The signal at δ 4.88 in alkaloid 2 is shifted upfield to δ 4.30 in alkaloid 1, an indication[4] that the acetate group in 2 must be present at the C-14 position.

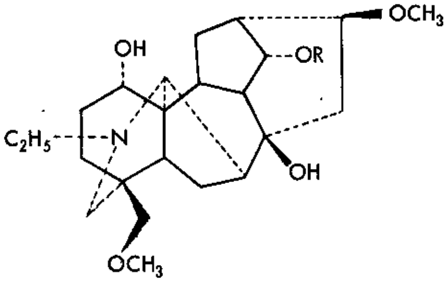


3 Browniine



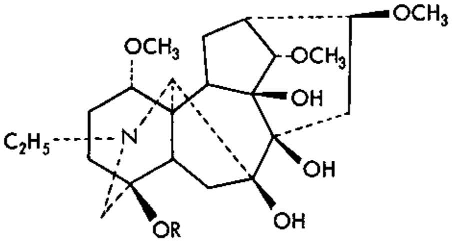
4 Ajaconine

Comparison of the ^{13}C NMR spectra of virescenine and 14-acetylvirescenine was made with the spectra of isotalatizidine,[5] condelphine,[5] and the published ^{13}C NMR data for the lycoctonine-type alkaloids, delcosine, 14-acetyldelcosine, and delsoline.[6,7] The ^{13}C chemical shifts pattern in 1 and 2 is similar to that of the known alkaloids 5 and 6 except for a few changes. The appearance of an extra singlet at 86.1 ppm and disappearance of a doublet in the ^{13}C NMR spectrum of 1 in comparison with that of 5 indicates the presence of a tertiary hydroxyl group at C-7 in virescenine (1). The presence of the C-7 hydroxyl group was confirmed by observing the downfield change in the ^{13}C chemical shifts of C-6, C-8, and C-17 carbons in comparison with isotalatizidine. All other signals are in agreement with the assigned structure 1 for virescenine. The presence of an acetoxy group at the C-14 position in alkaloid 2 was confirmed by basic hydrolysis as well as by comparison with the ^1H and ^{13}C NMR spectra of condelphine and other C-14 acetate-containing diterpenoid alkaloids.



5 R = H Isotalatizidine

6 R = Ac Condelphine



8 R = CO-C_6H_4-o-NHAc

TABLE 1: CARBON-13 CHEMICAL SHIFTS AND ASSIGNMENTS FOR VIRESCENINE (1), 14-ACETYLVIRESCENINE (2), ISOTALATIZIDINE (5), AND CONDELPHINE (6)[a,b]

Carbon	(1)	(2)	(5)	(6)
1	72.4	72.4	72.3	72.1
2	28.5	29.0	29.2	29.1
3	29.3	29.4	29.7	29.7
4	37.7	37.7	37.3	37.3
5	41.9	41.7	41.7	41.4
6	33.5	33.7	25.0	25.1
7	86.1	85.9	45.3	45.8
8	76.2	76.9	74.3	74.5
9	48.0	45.9	46.7	44.6
10	39.7	37.7	40.4	37.0
11	49.4	50.0	48.7	49.0
12	26.9	26.8	26.8	26.7
13	43.6	42.9	44.1	43.5
14	75.5	77.1	75.6	76.9
15	36.0	35.9	42.3	42.4
16	81.9	82.1	82.4	82.2
17	64.9	64.9	63.7	63.5
18	78.7	78.8	79.0	79.0
19	55.8	56.1	56.6	56.6
$N\text{-}CH_2'$	50.5	50.6	48.4	48.4
$\vert$ CH_3	13.9	13.9	13.0	13.0
16-OCH_3	56.4	56.3	56.2	55.9
18-OCH_3	59.4	59.4	59.3	59.3
$14'\text{-}C{=}O$	-	170.9	-	170.3
$\vert$ CH_3	-	21.3	-	21.2

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[a] Chemical shifts in ppm downfield from TMS. The solvent is deutrochloroform.

[b] Carbon-13 NMR spectra were taken at 15.03 MHz in the Fourier mode using a JEOL FX-60 spectrometer.

In addition to the two recently isolated alkaloids, umbrosine[8] (7) and ranaconitine[9] (8), virescenine and 14-acetylvirescenine represent two more examples of lycoctonine-type alkaloids in which the C-6 position is unsubstituted. Ajaconine and browniine were isolated as major and minor alkaloids of D. virescens, respectively. The identity of these alkaloids was established by comparison with authentic samples.

REFERENCES

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