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ISODELECTINE: A NEW NORDITERPENOID ALKALOID FROM *DELPHINIUM VESTITUM*

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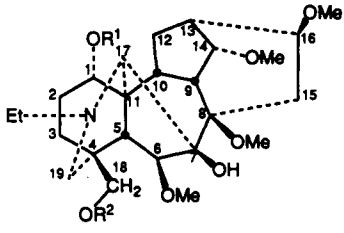
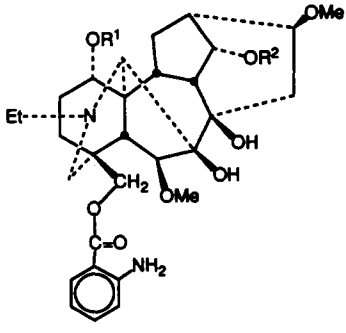
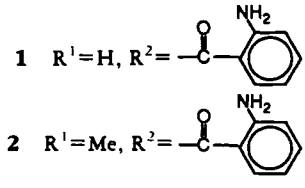
ABSTRACT.—Isodelectine [**3**], a new norditerpenoid alkaloid, has been isolated from *Delphinium vestitum*. Its structure has been deduced from spectroscopic data and a chemical correlation with delvestine [**1**]. Anthranoyllycoctonine [**4**] was also isolated from this plant.

Delphinium vestitum Wall. (Ranunculaceae) grows in the Western Himalayas and inner Tibetan valleys at elevations of 10,000–12,000 ft. and is reported to be poisonous to goats (1). In our previous investigation (2) of the aerial parts of *D. vestitum*, we reported isolation of two new norditerpenoid alkaloids, delvestine [**1**] and delvestidine [**2**]. In continuation of our interest in the diterpenoid alkaloids of the genus *Delphinium* (3) we now report the isolation and structure determination of a new norditerpenoid alkaloid, isodelectine [**3**], from the aerial parts of *D. vestitum*. The known alkaloid anthranoyllycoctonine [**4**], which has not been previously reported from this plant, was also isolated.

Isodelectine [**3**] was isolated from the fractions containing anthranoyllycoctonine [**4**] by a combination of vacuum liquid chromatography (vlc) (4) and centrifugally accelerated radial tlc (Chromatotron) (5). Compound **3** was amorphous, $[\alpha]_D$ +54° (c = 0.345, $CHCl_3$). Its ir spectrum showed the presence of hydroxyl (3460 cm^{-1}), amino (3323 cm^{-1}), aromatic ester carbonyl (1695 cm^{-1}), aromatic (1620 cm^{-1}), and ether (1100 cm^{-1}) groups. The ^{1}H-nmr spectrum indicated the presence of a $-NCH_2CH_3$ group (δ 1.13, 3H, t), three methoxyl groups (3.29, 3.36, 3.41 each 3H, s), a 14β proton (3.63, t), a primary amino group (5.76, 2H, brs, disappearing with D_2O), and aromatic protons (6.63–7.80). These resonances are typical of a C-18 ester residue such as is found in anthranoyllycoctonine [**4**] and is sup-







1 R^1=H, R^2=

2 R^1=Me, R^2=

3 R^1=H, R^2=Me
4 R^1=R^2=Me
5 R^1=Me, R^2=H

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ported by its eims *m/z* 572 ($[M]^+$ for $C_{31}H_{44}N_2O_8$). The ^{13}C-nmr spectrum, which showed signals characteristic of the above functional groups, compares well with those of anthranoyllycoctonine [**4**] (6), except for the absence of one methoxyl group. This fact was consistent with its mass spectrum which showed the molecular ion (*m/z* 572) 14 mass units less than that of anthranoyllycoctonine (*m/z* 586). That the hydroxyl group is at C-1 is evident from the presence of a methine chemical shift at δ 72.5 ppm and a distinct 1H triplet for the H-14β at 3.63 ppm in the ^{13}C- and the ^1H-nmr spectra, respectively. A one-proton broad singlet at 3.73 ppm also suggested the presence of a 1α-OH group. The ^1H-nmr spectrum of delectine [**5**][2] shows a one-proton multiplet at 4.01 ppm for H-14β which changes to a triplet on the addition of D_2O. The tlc R_f values, ms, ir, and ^1H- and ^{13}C-nmr spectra of compounds **3** and **5** are not identical.

Structure **3** for isodelectine was confirmed by demethylation of delvestine [**1**] with 3 M H_2SO_4. The product showed tlc behavior, ir, and ^1H-nmr spectra that were identical with those of **3**.

EXPERIMENTAL

GENERAL EXPERIMENTAL PROCEDURES.—Spectra were recorded on the following instruments: ir, Perkin-Elmer model 1420 spectrophotometer; ^1H nmr, Bruker WM 300 spectrometer; ^{13}C nmr, JEOL FT models FX 60 and FX 270 (DEPT) spectrometers; and ms, Finnegan Quadrupole 4023 spectrometer. Optical rotations were measured on a Perkin-Elmer model 141 polarimeter. Chromatographic separations were carried out on a Chromatotron (5) with rotors of 1 mm thickness coated with Al_2O_3 (EM 1104-3).

ISOLATION OF DELVESTINE [**1**], DELVESTIDINE [**2**], AND ANTHRANOYLLYCOCTONINE [**4**].—The 85% EtOH extract (15 liters) of the dried and powdered aerial parts (5 lb) of *D. vestitum* (supplied by Himalaya-Range Drug Fields, H.P., India, UGA Herbarium, Specimen No. 163859) was passed over a column of cation exchange resin (DOWEX 50W X8, H^+, 500 g), and all the basic material was retained on the column. The alkaloids were liberated by washing the column with 5% NH_4OH solution until the eluted solution was found to be basic. The Dowex resin was exhaustively extracted with CH_2Cl_2 in a Soxhlet apparatus, and the extract was taken to dryness. The crude basic residue (1.8 g) was subjected to chromatographic separation techniques of vlc (4) and centrifugally accelerated radial tlc (Chromatotron) (5).

Vlc separation of the crude base (750.0 mg) on an Al_2O_3 column with a gradient of hexane, Et_2O, and MeOH gave the following compounds (200-ml fractions were collected): Fraction 2 eluted with hexane gave delvestidine [**2**] (53.0 mg). Fraction 3 eluted with hexane gave delvestine [**1**] (35.1 mg). Fractions 14–16 eluted with hexane-Et_2O (1:1) were homogeneous on tlc and were combined (142.0 mg). This combined fraction was purified on an Al_2O_3 rotor of a Chromatotron with a gradient of hexane and Et_2O (fractions of 15 ml each were collected). Fractions 61–66 eluted with Et_2O/20% hexane were found to be homogeneous on tlc and were combined (56.2 mg) to give anthranoyllycoctonine [**4**] (mp, tlc behavior, ir, and ^1H- and ^{13}C-nmr spectra were identical with those of an authentic sample).

ISOLATION OF ISODELECTINE [**3**].—The crude basic product (285.0 mg from 1.8 g above) was fractionated on an Al_2O_3 rotor of a Chromatotron with a gradient of hexane and Et_2O. Elution with hexane/25% Et_2O gave fractions 3–26 (56.2 mg) which were homogeneous on tlc (3 spots). Preparative tlc on an Al_2O_3 plate (Et_2O) gave three compounds. The major (most polar) amorphous compound (24.1 mg) was named isodelectine [**3**]: $[\alpha]_D$ 54° ($c = 0.345$, $CHCl_3$); eims *m/z* (%) $[M]^+$ ($C_{31}H_{44}N_2O_8$), 572 (8.11), $[M-15]^+$ 557 (21.6), $[M-31]^+$ 541 (15.5); ir (KBr) ν max 3460, 3323, 1695, 1620, 1590, 1100, 750 cm^{-1}; ^1H nmr ($CDCl_3$) δ 1.13 (3H, t, $J = 7$ Hz, NCH_2CH_3), 3.29, 3.36, 3.41 (erch 3H, s, 3 × OMe), 3.63 (1H, t, $J = 4.5$ Hz, H-14β), 3.73 (1H, brs, H-1β), 3.97 (1H, s, H-6α), 5.76 (2H, brs, exchanges with D_2O, $-NH_2$), 6.63–7.80 (aromatic protons); ^{13}C nmr ($CDCl_3$) 72.5 d (C-1), 27.1 t (C-2), 30.4 t (C-3), 36.8 s (C-4), 43.3 d (C-5), 90.8 d (C-6), 87.8 s (C-7), 78.5 s (C-8), 43.9 d (C-9), 45.3 d (C-10), 49.5 s (C-11), 29.2 t (C-12), 37.7 d (C-13), 84.5 d (C-14), 33.5 t (C-15), 82.9 d (C-16), 65.8 d (C-17), 68.2 t (C-18), 57.0 t (C-19), 50.2 t and 13.5 q (NCH_2CH_3), 57.7 q (C-6′), 57.7 q (C-14′), 56.3 q (C-16′), 168.0 s, 110.1 s, 150.9 s, 116.8 d, 134.4 d, 116.3 d, 130.6 d (anthranoyl ester carbons).

[2]X. Liang, H.K. Desai, and S.W. Pelletier, unpublished work.

CORRELATION OF ISODELECTINE [3] WITH DELVESTINE [1].—A solution of delvestine [1] (30.1 mg) in 3 M H_2SO_4 (1.5 ml) was heated on a steam bath for 17 h. Usual workup gave a mixture of three compounds (tlc). The major compound (14.5 mg) isolated from this mixture proved to be identical with **3** (tlc behavior, ir, and ^{1}H-nmr spectra).

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