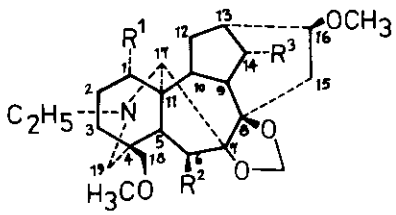
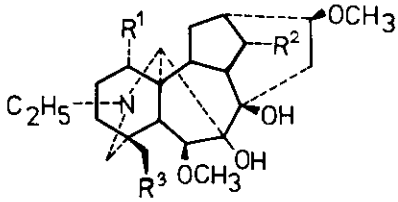
THREE NEW C_{19}-DITERPENOID ALKALOIDS, DELBRUNINE, DELBRULINE AND DELBRUSINE FROM *DELPHINIUM BRUNONIANUM* ROYLE

Wei Deng and Wei Liang Sung*
Institute of Materia Medica, Chinese Academy of Medical Sciences
1 Xiannongtan Street, Beijing, China

Abstract - The structure elucidations of delbrunine (1), delbruline (2) and delbrusine (3) isolated from *Delphinium brunonianum* Royle are presented.

In a previous paper we have reported the structure of brunonine, a C_{20}-diterpenoid alkaloid isolated from *Delphinium brunonianum* Royle[1]. This paper presents the structure elucidations of three unreported C_{19}-diterpenoid alkaloids designated as delbrunine (1), delbruline (2) and delbrusine (3) obtained from the same plant. Four known alkaloids were also isolated and identified as delcosine (4), browniine (5), lycoctonine (6) and septentriodine (7).





1 R^1= R^3= OH, R^2= OCH_3 Delbrunine
2 R^1= R^2= OCH_3, R^3= OH Delbruline
3 R^1= R^2= R^3= OCH_3 Delbrusine
8 R^1= OH, R^2= OCH_3, R^3= OAc
9 R^1= R^3= OCH_3, R^2= OH
10 R^1= R^2= OCH_3, R^3= OAc

4 R^1= R^2= OH, R^3= OCH_3
5 R^1= R^3= OCH_3, R^2= OH
6 R^1= R^2= OCH_3, R^3= OH
7 R^1= R^2= OCH_3, R^3= OAr
Ar = COC_6H_4-o-$HNCOCH_2$
CH_3OOCCH_2

Delbrunine, $C_{25}H_{39}NO_7$ (M^+ 465.2665, calc. 465.2726), mp 178°C, $(\alpha)_D^{17}$ 0°(c 0.085, EtOH). Its ^{1}H-NMR showed the presence of an N-C_2H_5 group (δ1.16, 3H, t, J = 7.2 Hz), three methoxyls (δ3.37, 3.35, 3.33, 3H each, s) and a methylenedioxyl group

(δ5.12, 5.09, 1H each, s), demonstrating that the compound was a lycoctonine-type diterpenoid alkaloid[2]. The signals δ3.72 (1H, s) in ^{1}H-NMR and 88.3 ppm (d) in ^{13}C-NMR spectra indicated that an OCH_3 group was located at C(6) position with β-orientation[3,4]. The existance of C(18)-OCH_3 was evidenced by the ^{13}C-NMR absorption at 77.9 ppm (t)[4]. One methoxyl group was assigned to C(16)-β-position on account of ^{13}C-NMR peak at 81.7 ppm (d)[4] as well as the biogenetic considerations of those known naturally occurring lycoctonines[5]. IR of delbrunine exhibited the absorption of hydroxyls (3388 cm^{-1}, br), one of which would be placed at C(1) position because of the ^{13}C-NMR data: a methine doublet at 71.8 ppm together with the matching methylene triplets at 27.2 and 29.4 ppm assigned to C(2) and C(3), respectively[4]. Another hydroxyl group is situated at C(14)-α-position based on the peak δ4.88 (1H, t, J = 4.8 Hz) in ^{1}H-NMR of delbrunine monoacetate (8)[6]. ^{13}C-NMR spectral data of delbrunine were found to be in agreement with its postulated structure 1 when comparision was made with that of known compounds delcosine (4)[4] and delcorine (9)[7] (Table 1). Thus, structure 1 was assigned to delbrunine. Since the structure of delbrunine (1) differs with that of delcosine (4) only in its C(7), C(8) substituents, cleavage of the methylenedioxyl group of 1 in mineral acid was carried out[2], and the product in quantitative yield was proved to be identical (R_f, IR, MS and mmp) with 4. Consequently, the structure 1 for delbrunine is substantiated.

Delbruline, $C_{26}H_{41}NO_7$ (M^+ 479.2914, calc. 479.2883), mp 129-131°C, $(\alpha)_D^{17}$ 0° (c 0.09, $CHCl_3$). ^{1}H-NMR (δ) indicated it was a lycoctonine-type alkaloid: 1.06 (3H, t, J = 7.2 Hz, $NCH_2\underline{CH_3}$), 3.26, 3.32, 3.36, 3.36 (3H each, s, 4 X OCH_3) and 5.13, 5.16 (1H each, s, OCH_2O). The similarity between ^{1}H-NMR of delbruline and that of delbrunine (1) as well as the fact that the former possessed one more methoxyl group and 14 atomic-mass-unit higher than the latter implied that delbruline may be the C(1)-OH or C(14)-OH methylated derivative of delbrunine (1). Acetylation of delbruline gave a monoacetate (10) (M^+ 521) which showed in its ^{1}H-NMR spectrum (δ) a signal at 2.06 (3H, s, OAc) and a one-proton-triplet centered at 4.82 with J = 4.6 Hz, while the broad singlet at 4.08 found originally in the ^{1}H-NMR of delbruline disappeared. This indicated that there is a hydroxyl group situated at C(14)-α-position[6], the same as in the case of delbrunine (1). Consequently, it is reasoned that it must be the hydroxyl group at C(1) of delbrunine being methylated to become delbruline, and the structure of the latter could be denoted as 2. This was then verified through correlation between delbruline and delbrunine (1). 1

Table 1. The Carbon-13 NMR spectra[a] of delbrunine (1), delbruline (2), delbrusine (3), delcosine (4) and delcorine (9)

Carbons	1	2	3	4	9
1	71.8 (d)	83.2 (d)	82.1 (d)	72.7	83.1
2	27.2 (t)	26.7 (t)	26.7 (t)	27.5	26.4
3	29.4 (t)	31.9 (t)	31.6 (t)	29.4	31.8
4	37.1 (s)	37.9 (s)	39.0 (s)	37.6	38.1
5	42.0 (d)	51.0 (d)	52.3 (d)	44.0	52.6
6	88.3 (d)	88.5 (d)	89.5 (d)	90.1	78.9
7	92.1 (s)	93.7 (s)	92.5 (s)	87.9	92.7
8	83.4 (s)	80.7 (s)	84.0 (s)	78.1	83.9
9	45.7 (d)	48.0 (d)	48.7 (d)	45.3	48.1
10	46.6 (d)	42.1 (d)	40.2 (d)	45.3[b]	40.3
11	50.7 (s)	49.0 (s)	50.7 (s)	48.9	50.2
12	29.0 (t)	25.7 (t)	28.3 (t)	29.4	28.1
13	38.6 (d)	36.0 (d)	37.9 (d)	39.4[b]	37.9
14	74.7 (d)	74.2 (d)	82.1 (d)	75.8	82.5
15	36.5 (t)	32.1 (t)	35.0 (t)	34.5	33.3
16	81.7 (d)	81.8 (d)	81.9 (d)	82.0	81.8
17	65.8 (d)	64.4 (d)	64.3 (d)	66.3	63.9
18	77.9 (t)	78.3 (t)	79.0 (t)	77.4	78.9
19	57.4 (t)	53.4 (t)	53.9 (t)	57.1	53.7
$N-CH_2$	50.1 (t)	50.4 (t)	50.7 (t)	50.4	50.7
CH_3	13.5 (q)	13.9 (q)	13.4 (q)	13.7	14.0
1'	-	55.5 (q)	55.1 (q)	-	55.5
6'	58.1 (q)	58.1 (q)	58.5 (q)	57.4	-
14'	-	-	57.8 (q)	-	57.8
16'	56.2 (q)	56.2 (q)	56.2 (q)	56.4	56.3
18'	59.2 (q)	59.1 (q)	59.5 (q)	59.1	59.6
OCH_2O	94.1 (t)	93.7 (t)	94.0 (t)	-	92.9

a. Chemical shifts in ppm downfield from TMS; solvent $CDCl_3$.

b. These two values have been reversed as suggested by S.W. Pelletier, S.K. Srivastava and B.S. Joshi, Heterocycles, 1985, 23, 331.

was acetylated (Ac_2O/CF_3CO_2H) under controlled condition to yield the 14-acetyl derivative (8)[6], and the monoacetate in turn methylated at C(1) in the usual manner[8] to afford a product which was demonstrated to be identical (R_f, IR and MS) with the acetylated compound of delbruline (10).

Delbrusine, $C_{27}H_{43}NO_7$ (M^+ 493.3032, calc. 493.3039), mp 141 C, $[\alpha]_D^{17}$ +16.8°(c 0.057, $CHCl_3$). ^{1}H-NMR (δ) showed this compound was a lycoctonine-type alkaloid: 1.06 (3H, t, J = 7.0 Hz, NCH_2CH_3), 3.32, 3.33, 3.38, 3.42, 3.43 (3H each, s, 5 X OCH_3) and 5.11, 5.16 (1H each, s, OCH_2O)[2]. Delbrusine exhibited close similarity with delbruline (2) in ^{1}H-NMR and ^{13}C-NMR, IR and MS except that the former showed no hydroxyl absorption in IR and an increment of 14 atomic-mass-unit (CH_2) in MS than that of the latter. Hence, it is reasonable to regard delbrusine as a methylated derivative of delbruline (2). To comfirm this, delbruline (2) was methylated in the usual manner[8], and the crystalline product so obtained was demonstrated to be identical with delbrusine in all respects including R_f, MS and mmp. Therefore the structure of delbrusine was determined as 3.

REFERENCES AND NOTES

* Present address: Institute of Medicinal Plant Development, Chinese Academy of Medical Sciences, Hai Dian District, Dong Bei Wang, Beijing, China.

1. W. Deng and W.L. Sung, the previous paper.
2. S.W. Pelletier and N.V. Mody, "The Alkaloids", Chapter 1, Vol. 17, edited by R.H.F. Manske and R.G.A. Rodrigo, Academic Press, New York, 1979.
3. B.S. Joshi, J.A. Glinski, H.P. Chokshi, S.Y. Chen, S.K. Srivatava and S.W. Pelletier, Heterocycles, 1984, 22, 2037.
4. S.W. Pelletier, N.V. Mody, R.S. Sawhney and J. Bhattacharyya, ibid., 1977, 7, 327.
5. Y. Ichinohe, Kagaku No Ryoiki, 1978, 32, 27.
6. H. Takayama, A. Tokita, M. Ito, S.I. Sakai, F. Kurosaki and T. Okamoto, Yakugaku Zasshi, 1982, 102, 245.
7. S.W. Pelletier, N.V. Mody and O.D. Dailey, Jr., Can. J. Chem., 1980, 58, 1975.
8. V. Skaric and L. Marion, ibid., 1960, 38, 2433.

Received, 28th October, 1985