Indian Journal of Chemistry
Vol. 37B, June 1998, pp. 612 - 614

Note

Tongolenine C and tongolenine D, two new diterpenoid alkaloids from *Delphinium tongolense F.*

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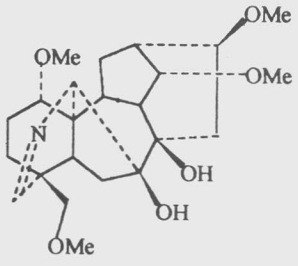
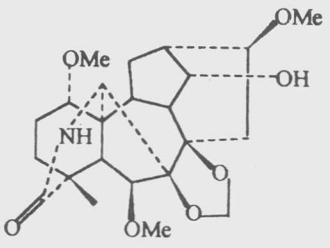
Received 17 June 1997; accepted (revised) 2 February 1998



Tongolenine C (1)



Tongolenine D (2)

The phytochemical investigation of *Delphinium tongolense F.* yields two new diterpenoid alkaloids tongolenine C and tongolenine D. Their structures have been elucidated by spectroscopical methods.

Delphinium tongolense F., distributing in the North of Yunnan Province and the West of Sichuan Province of China, is antipyretic[1]. In the previous study two new diterpenoid alkaloids tongolenine and tongolenine have been isolated[2]. In continuation to the above studies another two new diterpenoid alkaloids were obtained from the whole plants. Their structures were established as 1α, 14α, 16β-trimethoxy-7,8-diol-4-methoxy-methylene-$\Delta^{19(N)}$lycoctonate (tongolenine C, **1**) and 1α, 6β, 16β-trimethoxy-14α-ol-4-methyl-19-one-7,8-methylenedioxylycoctonate (tongolenine D, **2**) by means of spectroscopic method.

Results and Discussion

Tongolenine C (**1**) was isolated as white powder. The molecular ion peak at m/z 421.2503 in its HREIMS revealed the molecular formula $C_{23}H_{35}NO_6$. The ^{1}HNMR spectrum exhibited four signals for the protons of four methoxy groups at δ 3.12, 3.34, 3.42 and 3.51 (each 3H, s), besides C_{18}-Ome, other three methoxy groups should be located to C–1, C–14 and C–16[3]. All of which indicated tongolenine C is a C_{19}-diterpenoid alkaloids. According to the HREIMS (m/z 421.2503, M^+, $C_{23}H_{35}NO_6$), ^{13}CNMR (DEPT, Table I) signals at δ 77.2 (s) and 86.6 (s) as well as the absorptions at 3450 and 3446 cm^{-1} in IR indicated the presence of two hydroxy groups which could be assigned to C–8 and C–7[4]. There are no evidences for the existences of NCH_2CH_3 and C_4–Me (C_{18}), but a methine (C–19) with a chemical shift of 180.1 ppm (d) and a methane at δ 80.4 ppm (t), thus the moieties –N=CH– (absorption at 1645 cm^{-1} in IR) and $-CH_2$–OMe rather than 4–Me (C–18) could be postulated. The above mentioned spectral data enabled us to elucidate the structure is 1α, 14α, 16β-trimethoxy-7,8-diol-4-methoxymethylene-$\Delta^{19(N)}$lycoctonate.

Tongolenine D (**2**) was obtained as colorless needles. The molecular ion peak at m/z 435.2262 (M^+, $C_{23}H_{33}NO_7$) in HREIMS was observed. Twenty three signals in ^{13}CNMR (DEPT, Table I) were recognized as (9×CH, 5×CH_2, 4×CH_3 and 5×C. The signals at δ 5.23 and 5.15 (each 1H, s) in ^{1}HNMR along with signal at δ 93.9 (t) in ^{13}CNMR indicated the existence of 7,8-OCH_2O. The ^{1}HNMR spectrum exhibited a signal for the protons of three methoxy groups at δ 3.28, 3.39, 3.41. These evidences showed that tongolenine D is belonging tolycoctonine type diterpenoid alkaloid with 7,8-methylenedioxy. The signal at δ 176.1C and the lack of a signal at about δ 57.0 (CH_2) for C-19 in ^{13}CNMR, the ion peak at m/z 404 $[M–CO–H\bullet]^+$ in EIMS as well as the absorption at 1720 cm^{-1} in IR suggested the presence of a carbonyl group (C–19), which is something like that in thaliesessine[5]. C_{19}=O causes downfield shift of C_4–Me (18–H), which resonate at δ 1.29 (3H, s). In view of the fragment at m/z 418 (M^+–·OH), the molecular ion peak in EIMS and the twenty three signals in ^{13}CNMR (DEPT) one hydroxy group could be resumed. By comparing the NMR data of tongolenine D with those of delelatine[6] and del-

Table I—^{13}CNMR data of tongolenine C (1) and tongolenine D (2)

C-atom	Tongolenine C#	Tongolenine DΔ	C-atom	Tongolenine C#	Tongolenine DΔ
1	82.5, d	81.8, d	14	84.0, d	74.1, d
2	28.8, t	26.3, t	15	33.0, t	34.1, t
3	33.1, t	29.7, t	16	83.6, d	81.7, d
4	38.5, s	34.1, s	17	66.3, d	59.4, d
5	53.0, d	45.9, d	18	80.4, t	22.0, q
6	31.3, t	91.5, d	19	180.1, d	176.1, s
7	86.6, d	91.0, s	$-OCH_2-$		94.4, t
8	77.2, s	79.9, s	1–OMe	57.6, q	55.7, q
9	42.2, d	47.8, d	6–OMe		58.9, q
10	46.0, d	42.2, d	14–OMe	56.3, q	
11	49.0, s	47.2, s	16–OMe	56.2, q	56.7, q
12	24.7, d	26.7, t	18–OMe	58.9, q	
13	37.7, d	35.2, d			

*s, d, t and q refer to C, CH, CH_2 and CH_3, respectively.
and Δ recorded at 100 MHz and 75 MHz, respectively.

brunine[7], two signals for quaternary carbons at δ 91.0 and 79.9 ppm could be tentatively assigned to C–7 and C–8, respectively. Because of the signals at δ 91.6 (C–6), 81.8 (C–1) and 81.7 (C–16) ppm in ^{13}CNMR (DEPT), the three methoxy groups should be located to C–1, C–6 and C–16[6]. The hydroxy group was determined as C_{14}–OH due to the resonance at δ 74.1 (d) in ^{13}CNMR and at δ 4.03 in ^{1}HNMR[6]. Consequently, the structure of tongolenine D was elucidated as 1α, 6β, 16β-trimethoxy-14α-ol-4-methyl-19-one-7,8-methylenedioxy-lycoctonate.

Experimental Section

General. Mps are uncorrected; ^{1}HNMR were taken in $CDCl_3$ using TMS as internal standard and HREIMS were taken at 70 eV.

Plant material. *Delphium tongolense F.* was collected in Sept. 1994, in Luding County, Sichuan Province, P.R. China, and identified by Professor S.-C. Xiao (Chengdu Institute of Biology, Academia Sinica, P.R. China), where a specimen is deposited.

Extraction and isolation. The whole plant (1.3 kg) of *D. tongloense* were powdered and soaked three times with 95% EtOH at r.t. After removing solvent *in vacuo* the extract was suspended in 2% H_2SO_4 and filtrated. The acidic solution was basified to about *p*H 10 with ammonia (25%) and exhaustively extracted with $CHCl_3$ to get 16 g of alkaloidal extract after removing $CHCl_3$. The extract was subjected to CC (550 g, Al_2O_3) and eluted with Et_2O to give fractions 1→IV. From fraction 3, **1** (2 mg) was obtained by CC on silica gel eluting with cyclohexane : acetone : diethylamine=20 : 1 : 1 drop → 1 : 1 : 1 drop, and then HPLC wotj C_{18}-reverse phase, methanol:water. From fraction IV **2** (5.3 mg) was isolated by CC on silica gel eluting with cyclo-hexane:acetone (10:1), and further purification by recrystallization from acetone.

Tongolenine C (1). White powder m.p.>350°C; $[\alpha]_D^{24}$ +44.4° (c=0.5, $CHCl_3$) IR(KBr): 3450 and 3446 (OH) 1645 cm^{-1} (–N=C⟨); HREIMS: m/z 421.2503 (M^+, Calc. for: $C_{23}H_{35}NO_6$, 421.2464); EIMS: m/z 421 (M^+), 420 (M^+–H), 358 (M^+–CH_3OH–CH_3O·), 404 (M–HO)$^+$, 390 (M^+–OMe), 376 (M^+–CH_2OMe), 403 (M^+–H_2O), 402 (M^+–H_2O–H), 374 (M^+–CH_3OH–CH_3); ^{1}HNMR (400 MHz): δ 3.66 (1H, br), 3.61 (1H, t, *J*=4.7 Hz, 14β-H), 3.12, 3.34, 3.42 and 3.51 (each 3H, s, 4×OCH_3); ^{13}CNMR (100 MHz) data, see Table I.

Tongolenine D (2). Colorless needles, m.p. 310~311°C (acetone); $[\alpha]_D^{24}$ +5.66 (c=0.27, $CHCl_3$); IR(KBr): 3350 (OH), 1720 (C=O); HREIMS: m/z 435. 2262 (M^+, Calc. for $C_{23}H_{33}NO_7$: 435.2257). EIMS: m/z 435 (M^+), 420 (M^+–OMe), 404 (M^+–CO–H), 388 (M^+–CO–H_2O–H); ^{1}HNMR (300 MHz); δ 5.23 and 5.15 (each 1H, s, $-OCH_2O-$), 4.03 (1H, br, 14β–H), 3.96 (1H, d, *J*=6.2, 6α–H), 3.78 (1H, t, *J*=3.7 Hz), 3.24 (1H, d, *J*=2.5 Hz, 1β-H), 3.28, 3.39 and 3.41 (each 3H, s, 3×OMe), 1.40 (3H, t, *J*=7 Hz, NCH_2CH_3), 1.29 (3H, s, 18-H).

Acknowledgement

This work was supported by the Di-ao Foundation from the Di-ao Pharmaceutical Company of the Chinese Academy of Sciences.

References

1 Delectis Florae Repupubaris Sinicae Agendae Academiae Sinicae Edita Flora Republica Popularis Sinicae, Science Publisher, Beijing, 27, **1979**, p. 405.

2 He L, Chen L-S, Li B-G & Chen Y-Z, *Chinese Chemical Letters*, 7, **1996**, 556.

3 Wada K, Yamamoto T, Bando H & Kawahara N, *Phytochemistry*, 31, **1992**, 2135.

4 Sakai S-I, Shinma N, Hasegawa S & Okamoto T, *Yakugaku Zashi*, 98, **1978**, 1376.

5 Wu Y –C. Wu T –S, Niwa M, Lu S –T & Hirata Y, *Phytochemistry*, 27, **1988**, 3949.

6 Ross S –A, Desai H –K, Joshi B –S, Srivastave S –K, Glinski J –A, Chem S –Y & Pelletier S –W, *Phytochemistry*, 27, **1988**, 3719.

7 Deng W & Sung W –L, *Heterocycles*, 24, **1986**, 873.