A NEW NORTRITERPENOID FROM *Phlomis umbrosa*

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*A new nortriterpenoid (**1**), together with five known compounds, was isolated from* Phlomis umbrosa. *The structure of **1** was elucidated by spectroscopic evidence.*

Keywords: *Phlomis umbrosa,* nortriterpenoid, triterpenoids.

Phlomis umbrosa Turcz, one of the plants of the genus *Phlomis* (Lamiaceae), is a perennial herbaceous plant growing in northern China. Its rhizome has been used in Chinese traditional medicine to reduce swelling and stanch bleeding, and has anti-inflammatory and detoxification properties [1, 2]. Some iridoids, phenylethanoids, and triterpenes were isolated from the plant previously [3–8]. As reported previously [9], we isolated four new nortriterpenoids from the plant. Further studies on the chemical constituents of the rhizome of this plant afforded another novel nortriterpenoid (**1**) with the rare skeleton [10], and five known compounds, corosolic acid (**2**), hederagenin (**3**), arjunolic acid (**4**), belleric acid (**5**), and 3β-hydroxy-29-al-12-en-28-oleanoic acid (**6**). In this paper, we describe the isolation and structure elucidation of compound **1**.

Compound 1 was obtained as a white powder. It has the molecular formula of $C_{29}H_{46}O_6$, established by positive HR-FT-MS: *m/z* 513.3208 $[M + Na]^+$ calcd for $C_{29}H_{46}O_6Na$, 513.3186. The IR absorption indicated the presence of hydroxyl (3412 cm^{-1}) and double bonds (1630 cm^{-1}). Its ^1H NMR spectrum showed four methyl groups [δ 1.17, 1.03, 1.01, 1.24 (each 3H, s)]; four oxygenated methine proton signals [δ 4.42 (1H, d, J = 9.6 Hz), 4.51 (1H, m), 4.68 (1H, br.s), 5.20 (1H, s)]; two oxygenated methylene groups [δ 4.45, 4.64 (each 1H, d, J = 11.1 Hz), 4.11, 4.26 (each 1H, d, J = 11.0 Hz)]; and an olefinic proton [δ 6.31 (1H, br.s)]. The ^{13}C NMR spectral data of **1** revealed 29 carbon groups, including a carbon-carbon double bond and an acetal carbon. These data together with 2D NMR suggested **1** was a nortriterpenoid with the same structure as the compound notohamosin [10]. The ^{13}C NMR signals at δ 75.3 could be assigned to oxygenated C-16 in view of the HSQC correlation at δ 4.68 (1H, br.s)/75.3 (C-16). The HSQC signals at δ 5.20 (1H, br.s)/100.5 (C-30) and the HMBC correlations between H-30 and C-16 suggested that C-30 should be an acetal carbon atom, and the unsaturated degrees of **1** obtained from HR-MS indicated there was another ring in **1**, indicating that C-16 and C-30 are joined by an ether bond. The relative configurations of C-2, C-3, and C-16 were determined based on the NOESY experiments (Fig. 1). Thus, the structure of **1** was assigned as (2α,3β,16β,17*R*)-19(18→17)-abeo-16,30-epoxy-28-norolean-12-ene-2,3,23,24,30-pentaol (**1**).

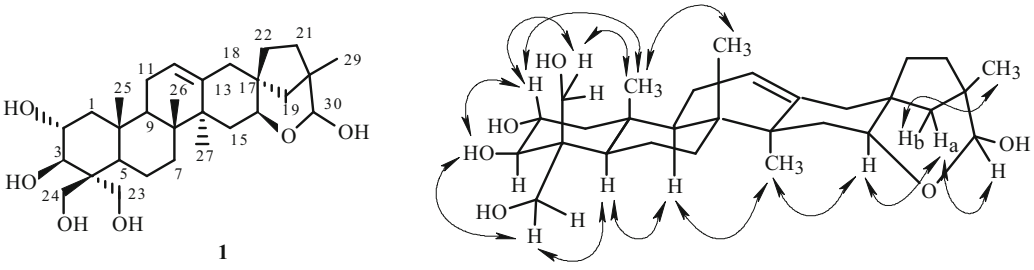

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Fig. 1. The structure and key NOESY of compound **1**.

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TABLE 1. ^{1}H and ^{13}C NMR Data and HMBC Correlations of Compound **1** (C_5D_5N, δ, ppm, J/Hz)

C atom	δ_H	δ_C	HMBC
1	1.45, 2.34 m	48.1	C-3, 5, 25
2	4.51 m	69.2	C-1, 4, 10, 25
3	4.42 (d, J = 9.6)	79.8	C-1, 5, 23, 24
4		48.5	
5	2.07 m	49.1	C-3, 4, 6, 7
6	1.65, 1.87 m	19.7	C-4, 10
7	1.51, 1.73 m	34.3	C-6, 9
8		40.2	
9	1.87 m	48.6	C-8, 11, 12, 14
10		38.8	
11	2.06 m	24.2	C-10, 12, 13
12	6.31 br.s	119.4	C-10, 13
13		139.7	
14		44.5	
15	2.07 (m)	28.2	C-8, 13, 17
16	4.68 (br.s)	75.3	C-14, 15, 18, 19
17		47.1	
18	1.01, 1.83 (each m)	29.2	C-12, 14, 17
19	2.28, 1.21 (each d, J = 12.7)	45.1	C-16, 18, 21, 29
20		44.8	
21	1.56, 2.27 (each m)	36.7	C-19, 29, 30
22	1.22, 1.63 (each m)	31.4	C-19, 18, 20
23	4.45, 4.64 (each d, 11.1)	69.6	C-3, 4, 5, 24
24	4.11, 4.26 (each d, 11.1)	64.5	C-3, 4, 5, 23
25	1.17 (s)	17.7	C-1, 5, 9, 10
26	1.03 (s)	18.2	C-7, 8, 9, 14
27	1.01 (s)	23.4	C-8, 13, 14, 15
29	1.24 (s)	23.1	C-19, 20, 21, 30
30	5.20 (s)	100.5	C-16, 20, 29

All signals of ^{1}H and ^{13}C NMR were assigned by DEPT, HMQC, and ^{1}H–^{1}H COSY experiments.

EXPERIMENTAL

General. Optical rotation was measured with an MC 241 digital polarimeter (Perkin–Elmer). IR spectra were recorded on a NICOLET 380 FT-IR spectrophotometer (Thermo Electron Corporation). NMR spectra were run on a Bruker AVANCE 300 instrument (^{1}H NMR 300 MHz, ^{13}C NMR 75 MHz), both with tetramethylsilane as an internal standard. MS data were obtained on an IonSpec 4.7 Tesla FT-MS. Column chromatography was performed on silica gel (Qingdao Haiyang chemical Co., Ltd.) and Toyopearl HW-40 (TOSOH). Flash chromatography was carried out on a column (C18 HS 40M 1621-1, Biotage, Inc., USA). HPLC was performed on a JASCO Gulliver Series with PU-2089 (pump), RI-2031, and UV-2075 (detector). Preparative HPLC column was used as below: ODS (YMC-Pack ODS-A, SH-343-5).

Plant Material. The plant *Phlomis umbrosa* Turcz was collected from Jianshi country, Hubei Province, China, in December 2005. The plant specimen was identified by Prof. D. R. Wan (School of Life Sciences, South-Central University for Nationalities). A voucher specimen (D20050110) was deposited at the School of Pharmaceutical Sciences, Tianjin Medical University, China.

Extraction and Isolation. The powered and dried rhizomes of *Phlomis umbrosa* (3400 g) were extracted with 95% ethanol (20 L × 3, 6 h each time) under reflux. The extract was concentrated in *vacuo* to give a residue (500 g), which was suspended in water and then partitioned with petroleum ether (60–90°C), EtOAc, and *n*-BuOH, successively. The petroleum ether – partitioned extract (18 g) was chromatographed on a silica gel column and eluted with a petroleum ether–acetone gradient system to give compounds **1** (13.4 mg), **2** (12.9 mg), **3** (21.1 mg), **4** (11.4 mg), **5** (16.7 mg), and **6** (34.6 mg).

Compound 1. White powder; $[\alpha]_D^{25}$ +27.4° (*c* 1.12, C_5H_5N). IR (KBr, ν_{max}): 3412, 2923, 1630, 1455, 1384, 1260, 1044. ^{1}H and ^{13}C NMR data, see Table 1. Positive HR-FT-MS *m/z*: 513.3208 $[M + Na]^+$ calcd for $C_{29}H_{46}O_6Na$, 513.3186.

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