A new abietane diterpenoid from *Clerodendrum kaichianum* Hsu

Mingfeng Xu, Lianqing Shen*, Kuiwu Wang and Qizhen Du

College of Food Science and Biotechnology Engineering, Zhejiang Gongshang University, Hangzhou 310035, P. R. China

A new abietane diterpenoid has been isolated from *Clerodendrum kaichianum* Hsu and characterised as 11-methoxyl-12,14-dihydroxy-13-(2-hydroxypropyl)-3,5,8,11,13-abietapentaen-7-one. Its structure was established by spectroscopic analysis, including 2D NMR.

Keywords: *Clerodendrum kaichianum* Hsu., abietane diterpenoid, NMR, HRESIMS

The genus *Clerodendrum* contains more than 30 species that are found in China. Some of these have been used in traditional Chinese medicine (TCM),[1] such as *C. indicum* for treating rheumatism and malaria[2]. In China, the leaves of *C. kaichianum* Hsu. are used as a traditional medicine for hypertension. There are no reports on chemical constituents of *C. kaichianum* Hsu., but phytochemical investigation of other *Clerodendrum* species have reported the presence of iridoids, as well as diterpenoids, triterpenes, phenylethanoid glycosides and saponins, which have been found to possess beneficial pharmacological effects, such as antimalarial, antitumour, and anti-HIV activity.[3–9]

As part of our ongoing search for bioactive compounds from genus *Clerodendrum*, the stems of *C. kaichianum* Hsu. were investigated. We present here the isolation, structural elucidation of the new abietane diterpenoid (Fig. 1).

Compound **1** gave a positive $FeCl_3$ test on TLC. The HRESIMS of the compound indicated a molecular formula $C_{21}H_{26}O_5$ (*m/z* 357.1705, Calcd: 357.1700) which indicated 8 degrees of unsaturation. It had $[\alpha]^{25}$+75.0 ° (*c*, 0.06, MeOH); UV (nm, MeOH): 226, 280, 231 sh. M.p. 253–255 °C; IR (KBr): ν_{max} 3401 (OH), 1668 (C=O), 1618, 1575, 1460, 1362 and 1221.

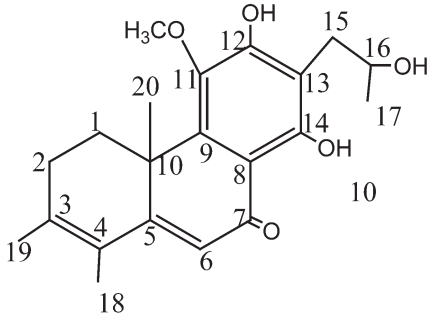

Fig. 1 Structure of compound **1**.

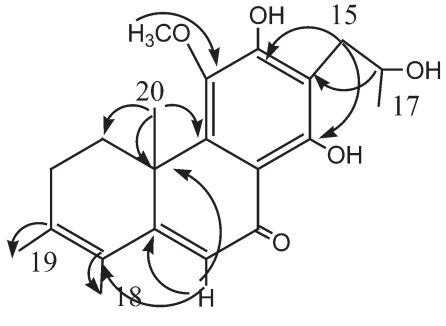

Fig. 2 Key HMBC correlations of compound **1**.

The ^{1}H NMR spectrum (Table 1) showed signals corresponding to four Me signals at δ 1.15 (d, 3H, *J* = 11.2), δ 1.51 (s, 3H), δ 1.91 (s, 3H) and δ 1.93 (s, 3H), a pair of double doublets at δ 1.96, 1.25, 2.54 and 3.41 (m, 1H each) corresponding to two methylene groups, two methine groups at δ 6.22 (s, 1H) and 4.13 (m, 1H) together with one methoxyl group 3.80 (s, 3H, 11-OMe).

A total of 21 C-atom signals were observed in the ^{13}C NMR and DEPT 135 spectra of **1**, which showed a C=O signal at δ 192.2, six aromatic C-atom signals at δ 156.5, 155.0, 141.6, 136.2, 119.7 and 112.2. The upfield region showed four Me signals at δ 15.1, 20.8, 22.4 and 23.2, three methylene signals at δ 30.4, 31.2 and 34.2, two methine signals at δ 119.1 and 68.2, and four quaternary C-atom signals at δ 143.1, 126.4, 168.9 and 41.0, and one methoxyl at δ 61.4 (Table 1).

Based on the analyses of the ^{1}H–^{1}H-COSY and HSQC data, partial structures linking C-1 to C-2, C-16 to C-15 and C-17 were identified. In the HMBC spectrum, the ^{1}H,^{13}C long-range correlations between H-1/C-2, C-3, C-10, and C-20, H-2/C-1, C-3, C-4, and C-10, H-6/C-4, C-5, C-7, and C-10, H-15/C-12, C-13, C-14, C-16, and C-17 (Table 1) also suggested that an abietane diterpenoid framework was present in the molecule. Furthermore, the ^{1}H,^{13}C long-range correlations between H-17/C-15, and C-16, H-18/C-3, C-4, and C-5, H-19/C-2, C-3, and C-4 suggested that C-17 was connected to C-16, C-18 and that C-19 were connected to C-4 and C-3, and that C-20 was

Table 1 NMR spectral date of compound **1**[a]

Position	δ_C	δ_H(*J/Hz*)	^{1}H–^{1}H COSY	HMBC(H→C)
1	30.4	α 2.54 m	H1β, H2α, H2β	C2, C3,C10,C20
		β 1.96 m	H1α, H2α, H2β	
2	31.2	α 3.41 m	H1α, H1β, H2β	C1, C3, C4,C10
		β 2.25 m	H1α, H1β, H2α	
3	143.1			
4	126.4			
5	168.9			
6	119.1	6.22(s)		C4, C5,C7,C10
7	192.2			
8	112.2			
9	141.6			
10	41.0			
11	136.2			
12	155.0			
13	119.7			
14	156.5			
15	34.2	α 2.78 m	H15β,H16	C12,C13,C14, C16,C17
		β 2.88 m	H15α,H16	
16	68.2	4.13 (*m*)	H15α,H15β,H17	C13,C15,C17
Me(17)	23.2	1.15 (*d*,*J* = 11.2)	H16	C15,C16
Me(18)	15.1	1.93 (*s*)		
Me(19)	20.8	1.91 (*s*)		
Me(20)	22.4	1.51 (*s*)		
OMe	61.4	3.80 (*s*)		C9,C11

[a] NMR data were measured in MeOD. The assignments based on DEPT, ^{1}H–^{1}H COSY, HSQC and HMBC experiments.

* Correspondent. E-mail: zjgsu423@yahoo.cn

connected to C-10, respectively. The chemical shifts of C-15, C-16, and C-17, were very similar to those of Incanone[10]. Therefore, compound **1** possesses an abietane-type diterpenoid framework with an OCH_3 group on C-11. Thus, the structure of **1** was elucidated as 11-methoxyl-12,14-dihydroxy-13-(2-hydroxypropyl)-3,5,8,11,13-abietapentaen-7-one.

Experimental

Melting points were determined with a Fischer-Johns micro hot-stage apparatus. IR spectra were determined as KBr pellets on a Nicolet 380 FT-IR spectrophotometer. ^{1}H NMR and ^{13}C NMR spectra were recorded using a Bruker Avance III 500 MHz spectrometer in MeOD with tetramethylsilane as internal standard. Optical rotations were determined on a Perkin-Elmer 241 MC polarimeter. UV spectra were recorded on a Shimadzu UV-2550 spectrophotometer. HRESIMS were carried out using a Agilent 6210 TOF-MS mass spectrometer. Silica gel (200–300 mesh, Qingdao Haiyang Chemical Co. Ltd.), and Sephadex LH-20 gel (Amersham Biosciences) were also used for column chromatography. Preparative HPLC were carried on a JAI-9103 Pre-HPLC. TLC plates were precoated with silica gel GF254 (Merck, 0.25 mm). All solvents used were of analytical grade.

The stems of *C. kaichianum* were collected on the mountains of Lin'an County, Zhejiang Province, P. R. China, in September of 2009, and identified by Dr. Bin Wu (College of Pharmaceutical Sciences Zhejiang University, Hangzhou, China). A voucher specimen (No. 20090913) was deposited in the lab of Zhejiang Gongshang University, Hangzhou, P. R. China.

Extraction and isolation: The air-dried powder of the stems (11.6 kg) of *C. kaichianum* was extracted with 75% aq. EtOH three times to give the crude extract 325.0 g. The crude extract was sequentially partitioned with petroleumether (PE), EtOAc and n-BuOH, respectively.

The PE layer was concentrated under reduced pressure to yield 102.0 g, Part of the EtOAc extract (90 g) was subjected to column chromatography eluted with EtOAc:PE gradient (0:1–1:0) to afford ten fractions (Fr.1–Fr.10) on the basis of TLC analysis. Fr.3 was further subjected column chromatography eluted with EtOAc: PE (9:1–3:1) and sephadex LH-20 (MeOH), later preparative HPLC to give compounds **1** (46 mg).

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