New Labdane-Type Diterpenoids from *Leonurus heterophyllus*

by **Hai-Qun Gong**[a]), **Rui Wang**[b]), and **Yan-Ping Shi***[a])[b])

[a]) State Key Laboratory of Applied Organic Chemistry, Lanzhou University, Lanzhou 730000,
P. R. China

[b]) Key Laboratory of Chemistry of Northwestern Plant Resources and Key Laboratory for Natural
Medicine of Gansu Province, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences,
Lanzhou 730000, P. R. China (phone: +86-931-4968208; e-mail: shiyp@licp.cas.cn)

Chemical investigation of the aerial part of *Leonurus heterophyllus* led to the isolation and characterization of the seven labdane-type diterpenoids **1**–**7**, including six new ones, **1**–**6**. Compounds **4** and **5** were isolated as a C(15) epimer pair. The determination of the structures and relative configurations of the new compounds were mainly based on 1D- and 2D-NMR spectroscopic methods, and comparison of their NMR data with related compounds. The structure of compound **7** was confirmed by X-ray crystallographic analysis.

Introduction. – The genus *Leonurus* belongs to the Labiatae family, consisting of about 23 species throughout the world, which are distributed predominantly in Europe and Asia [1]. The chemical constituents reported so far from this genus include iridoids, alkaloids, flavonoids, phenylpropanoids, *etc.* [2–4]. Furthermore, it was also reported that some plants of the genus are rich in labdane-type diterpenoids [5–8] (labdane = decahydro-1,1,4a,6-tetramethyl-5-(3-methylpentyl)naphthalene). The aerial parts of *Leonurus heterophyllus* have been used as traditional Chinese medicine (TCM) listed in the Chinese Pharmacopoeia (called Yi-Mu-Cao) for the treatment of cardiovascular diseases, gynecological problems, and nephritis for a long time, and have always produced beneficial treatment effects. To search for biologically active compounds and to clarify the basis of pharmacological activity, we investigated the chemical constituents of the aerial parts of this plant, and seven labdane-type diterpenoids were isolated, including six new ones, namely ($3\alpha,7\beta,9\alpha,15\beta$)-3-(acetyloxy)-9,13:15,16-diepoxy-15-ethoxy-7-hydroxylabdan-6-one[1]) (**1**) (*cf.* [9]), ($3\alpha,7\beta,9\alpha,15\alpha$)-3-(acetyloxy)-$9\alpha$,13:15,16-diepoxy-15-ethoxy-7-hydroxylabdan-6-one[1]) (**2**) (*cf.* [9]), ($3\alpha,7\beta,9\alpha,15\alpha$)-3-(acetyloxy)-9,13:15,16-diepoxy-7-hydroxy-15-methoxylabdan-6-one[1]) (**3**) (*cf.* [9]), ($3\alpha,7\beta,9\alpha,15\beta$)-9,13:15,16-diepoxy-15-ethoxy-3,7-dihydroxylabdan-6-one[1]) (**4**) (*cf.* [9][10]), ($3\alpha,7\beta,9\alpha,15\alpha$)-9,13:15,16-diepoxy-15-ethoxy-3,7-dihydroxylabdan-6-one[1]) (**5**) (*cf.* [9][10]), (6β)-15,16-epoxy-15-ethoxy-6,13-dihydroxylabd-8-en-7-one[1]) (**6**) (*cf.* [11][12]), and a known one, ($3\alpha,6\beta,9\alpha$)-3-(acetyloxy)-15,16-epoxy-6,9-dihydroxylabda-13(16),14-dien-7-one (**7**) [8][13]. To the best of our knowledge, the known compound **7** is reported from *L. heterophyllus* for the first time, and we also determined its structure by X-ray crystallographic analysis. In this article, we report the isolation

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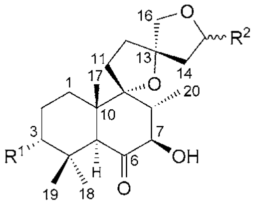
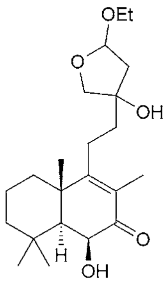
[1]) Trivial atom numbering; for systematic names, see *Exper. Part.*

and structural elucidation of the six new labdane-type diterpenoids **1**–**6** and of the known compound **7** from the EtOH extract of *L. heterophyllus.*



	R^1	R^2
1 1)	AcO	β-EtO
2	AcO	α-EtO
3	AcO	α-MeO
4	OH	β-EtO
5	OH	α-EtO



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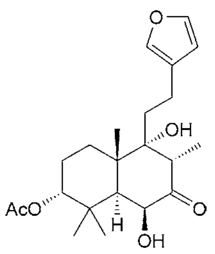

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Results and Discussion. – Compound **1** was obtained as a colorless oil. Its molecular formula, $C_{24}H_{38}O_7$, was deduced by HR-ESI-MS (*m/z* 456.2964, $[M+NH_4]^+$). The IR spectrum exhibited the presence of hydroxy (3469 cm^{-1}) and carbonyl (1709 cm^{-1}) groups. A fragment-ion peak at *m/z* 392 ($[M-EtOH]^+$) in the EI-MS indicated the presence of an EtO group in its structure. The ^1H- and ^{13}C-NMR and DEPT spectra (*Table 1*) exhibited the presence of 24 C-atoms, including three tertiary Me groups (δ(H) 0.87, 0.96, and 1.32 (3 *s*); δ(C) 20.0, 26.6, and 22.0, resp.), one secondary Me group (δ(H) 1.18 (*d*, $J = 5.6$ Hz); δ(C) 13.3), one acetal CH group (δ(H) 5.20 (*dd*, $J =$ 1.0, 5.4 Hz); δ(C) 103.9), one isolated oxygenated CH_2 group (δ(H) 3.88 and 4.03 (2 *d*, $J = 8.4$ Hz); δ(C) 77.5), two oxygenated CH groups (δ(H) 3.85 (*d*, $J = 10.0$ Hz) and 4.53 (br. *s*); δ(C) 77.8 and 77.9, resp.), two oxygenated quaternary C-atoms (δ(C) 90.9 and 92.1), two quaternary C-atoms (δ(C) 35.7 and 47.6), one keto group (δ(C) 211.7), and five CH_2 groups (δ(C) 22.1, 25.8, 29.0, 38.4, and 47.6). Those data, together with six degrees of unsaturation, suggested that compound **1** was a labdane-type diterpenoid, possessing two spiro-connected tetrahydrofuran rings. The simplified proton signal of H–C(5) (δ(H) 3.24 (*s*)) suggested that the keto group was attached to C(6). In the HMBC experiment (*Fig. 1*), the correlations from H–C(5) and H–C(7) to C(6) confirmed this assumption. In addition, the HMBC cross-peaks H–C(3)/C(1), Me(18), Me(19), and Me*C*O, H–C(7)/C(6) and Me(20), and H–C(15)/C(13), C(16), and

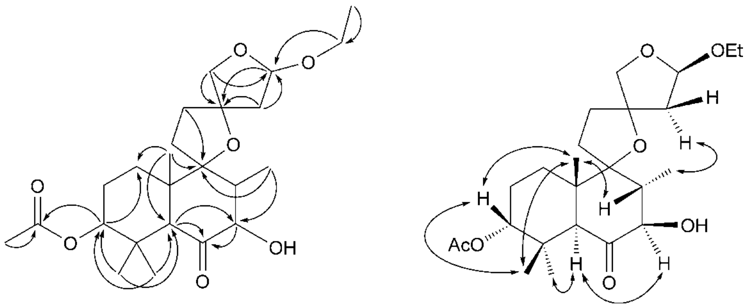

Fig. 1. *Key HMBC* (H → C) *and NOE features* (H ↔ H) *of* **1**

Table 1. *^{1}H- and ^{13}C-NMR Data* (400 and 100 MHz, resp.; $CDCl_3$) *of* **1** *and* **2**. δ in ppm, *J* in Hz.

	1		**2**	
	δ(H)	δ(C) (DEPT)	δ(H)	δ(C) (DEPT)
CH_2(1)	1.17, 1.75 (both overlapped)	25.8 (*t*)	1.17, 1.75 (both overlapped)	25.4 (*t*)
CH_2(2)	1.75, 1.85 (both overlapped)	22.1 (*t*)	1.75, 1.85 (both overlapped)	22.2 (*t*)
H–C(3)	4.53 (br. *s*)	77.9 (*d*)	4.52 (br. *s*)	77.8 (*d*)
C(4)		35.7 (*s*)		35.7 (*s*)
H–C(5)	3.24 (*s*)	51.7 (*d*)	3.24 (*s*)	52.1 (*d*)
C(6)		211.7 (*s*)		211.8 (*s*)
H–C(7)	3.85 (*d*, *J* = 10.0)	77.8 (*d*)	3.87 (*d*, *J* = 10.8)	77.5 (*d*)
H–C(8)	1.85 (overlapped)	46.5 (*d*)	1.85 (overlapped)	47.3 (*d*)
C(9)		92.1 (*s*)		91.7 (*s*)
C(10)		47.6 (*s*)		47.8 (*s*)
CH_2(11)	1.85, 1.90 (both overlapped)	29.0 (*t*)	1.85, 1.90 (both overlapped)	29.1 (*t*)
CH_2(12)	2.14 (overlapped), 2.30–2.36 (*m*)	38.4 (*t*)	1.95, 2.14 (both overlapped)	39.9 (*t*)
C(13)		90.9 (*s*)		90.4 (*s*)
CH_2(14)	2.46 (*dd*, *J* = 5.4, 13.0), 2.01–2.03 (*m*)	47.6 (*t*)	2.36 (*dd*, *J* = 4.0, 13.6), 2.31 (*dd*, *J* = 5.6, 13.6)	47.3 (*t*)
H–C(15)	5.20 (*dd*, *J* = 1.0, 5.4)	103.9 (*d*)	5.11 (*dd*, *J* = 4.0, 5.6)	103.3 (*d*)
CH_2(16)	4.03, 3.88 (2*d*, each *J* = 8.4)	77.5 (*t*)	3.58, 3.90 (2*d*, each *J* = 8.0)	74.9 (*t*)
Me(17)	0.87 (*s*)	20.0 (*q*)	0.86 (*s*)	19.8 (*q*)
Me(18)	0.96 (*s*)	26.6 (*q*)	0.96 (*s*)	26.6 (*q*)
Me(19)	1.32 (*s*)	22.0 (*q*)	1.33 (*s*)	22.0 (*q*)
Me(20)	1.18 (*d*, *J* = 5.6)	13.3 (*q*)	1.19 (*d*, *J* = 6.4)	13.1 (*q*)
Me*CH$_2$*O	3.39–3.46, 3.69–3.74 (2*m*)	62.8 (*t*)	3.45–3.50, 3.70–3.80 (2*m*)	63.2 (*t*)
*Me*CH$_2$O	1.17 (*t*, *J* = 8.4)	15.2 (*q*)	1.20 (*t*, *J* = 6.8)	15.3 (*q*)
*Me*CO	2.08 (*s*)	21.2 (*q*)	2.10 (*s*)	21.2 (*q*)
Me*CO*		170.3 (*s*)		170.3 (*s*)

Me*CH$_2$*O suggested that the AcO, OH, and EtO groups were connected to C(3), C(7), and C(15), respectively. The relative configuration of compound **1** was determined by its NOE experiment (*Fig. 1*) and comparison with related compounds. When Me(17) was irradiated, the intensity of Me(19) and H–C(8) was increased, and when H–C(3) was irradiated, the intensity of Me(17) and Me(19) was increased, which indicated that Me(17), Me(19), H–C(8), and H–C(3) β-oriented. When H–C(5) was irradiated, the intensity of Me(18) and H–C(7) was increased, which indicated that Me(18), H–C(5), and H–C(7) were α-oriented. When H_α–C(14) was irradiated, the intensity of Me(20) was increased, which supported the relative configuration at C(13) as shown in **1** [7][14]. The ethoxy group at C(15) appeared to be β-oriented in **1**, as shown by the comparison of the chemical shift of C(16) with that of the known compound leosibirinone A (=(1″*S*,2′*S*,2″*R*,4″a*S*,5*R*,6″*R*,8″a*S*)-2″,6″-bis(acetyloxy)decahydro-5-methoxy-2″,5″,5″,8″a-tetramethyldispiro[furan-3(2*H*),2′(5′*H*)-furan-5′,1″(2″*H*)-naphthalen]-3″(4″*H*)-one), which was isolated from *L. sibiricus* L. [7]. Therefore, compound **1** was determined as (3α,7β,9α,19β)-3-(acetyloxy)-9,13:15,16-diepoxy-15-ethoxy-7-hydroxylabdan-6-one.

Compound **2** was obtained as a colorless oil. Its HR-ESI-MS showed a peak at *m/z* 456.2947 ($[M+NH_4]^+$) indicating a molecular formula $C_{24}H_{38}O_7$, which was the same as **1**. Comparison of the NMR data of **2** (*Table 1*) with those of **1** indicated that the two compounds are 15-epimers. The NOE experiment of **2** showed the same correlations as those of **1**. Therefore, compound **2** was recognized as an isomer at C(15) of **1**.

Compound **3** was obtained as a colorless oil. Its molecular formula, $C_{23}H_{36}O_7$, was deduced by HR-ESI-MS (*m*/*z* 442.2793, $[M+NH_4]^+$). In the ^{1}H-NMR spectrum (*Table 2*), a MeO group was present at δ(H) 3.38 (*s*), and it showed a HMBC cross-peak with C(15). The NMR data of **3** (*Table 2*) were closely similar to those of **2**, except for the presence of the MeO at C(15) of **3** instead of the EtO group in **2**. The MeO group in **3** was α-oriented, which was deduced by the ^{1}H-NMR chemical-shift difference ($\Delta\delta$) between H_a–C(14) and H_b–C(14). When the MeO group at C(15) is β-oriented, the chemical-shift difference is larger ($\Delta\delta = 0.47-0.74$) than that in the case of α-orientation ($\Delta\delta = 0.02$) [9]. Thus, compound **3** was determined as (3α,7β,9α,15α)-3-(acetyloxy)-9,13:15,16-diepoxy-7-hydroxy-15-methoxylabdan-6-one.

Compounds **4** and **5** were isolated as an epimer mixture (*ca.* 1:1). Their molecular formulas were determined as $C_{22}H_{36}O_6$ by HR-ESI-MS (*m*/*z* 414.2845 ($[M+NH_4]^+$)). The NMR data of **4** and **5** (*Table 3*) were closely similar to those of **1** and **2**, except that the signal of the AcO group at C(3) of **1** and **2** changed into an OH group in **4** and **5**. In the ^{1}H-NMR spectrum, the two chemical shifts at δ(H) 5.20 and 5.10 suggested an

Table 2. *^{1}H- and ^{13}C-NMR Data* (400 and 100 MHz, resp.; $CDCl_3$) *of* **3** *and* **6**. δ in ppm, *J* in Hz.

	3		**6**	
	δ(H)	δ(C) (DEPT)	δ(H)	δ(C) (DEPT)
CH_2(1)	1.17, 1.75 (both overlapped)	25.4 (*t*)	1.20, 1.50 (both overlapped)	37.5 (*t*)
CH_2(2)	1.75, 1.85 (both overlapped)	22.2 (*t*)	1.52, 1.85 (both overlapped)	18.7 (*t*)
H–C(3) or CH_2(3)	4.53–4.54 (*m*)	77.9 (*d*)	1.44, 1.21 (both overlapped)	43.4 (*t*)
C(4)		35.8 (*s*)		34.1 (*s*)
H–C(5)	3.26 (*s*)	52.1 (*d*)	1.53 (*d*, *J* = 4.0)	53.2 (*d*)
C(6) or H–C(6)		211.8 (*s*)	4.30 (*d*, *J* = 2.4)	71.1 (*d*)
H–C(7) or C(7)	3.87 (*d*, *J* = 9.2)	77.5 (*d*)		199.2 (*s*)
H–C(8) or C(8)	1.85–1.95 (*m*)	47.0 (*d*)		170.2 (*s*)
C(9)		91.8 (*s*)		128.3 (*s*)
C(10)		47.8 (*s*)		41.3 (*s*)
CH_2(11)	1.86, 1.90 (both overlapped)	29.1 (*t*)	1.85, 1.92 (both overlapped)	25.1 (*t*)
CH_2(12)	1.95, 2.13 (both overlapped)	40.0 (*t*)	2.44–2.48 (*m*)	36.3 (*t*)
C(13)		90.4 (*s*)		80.1 (*s*)
CH_2(14)	2.32–2.33, 2.33–2.34 (2*m*)	47.4 (*t*)	1.87–1.92, 1.92–1.97 (2*m*)	44.9 (*t*)
H–C(15)	5.01 (*dd*, *J* = 3.6, 5.6)	104.6 (*d*)	5.20 (br. *d*, *J* = 4.8)	104.0 (*d*)
CH_2(16)	3.62, 3.89 (2*d*, each *J* = 8.0)	75.2 (*t*)	4.01, 3.82 (2*d*, each *J* = 9.2)	79.6 (*t*)
Me(17)	0.87 (*s*)	19.8 (*q*)	1.38 (*s*)	22.2 (*q*)
Me(18)	0.97 (*s*)	26.6 (*q*)	1.04 (*s*)	32.4 (*q*)
Me(19)	1.33 (*s*)	22.0 (*q*)	1.30 (*s*)	24.0 (*q*)
Me(20)	1.18 (*d*, *J* = 6.8)	13.2 (*q*)	1.84 (*s*)	11.5 (*q*)
MeO	3.38 (*s*)	55.0 (*q*)		
*Me*CO	2.10 (*s*)	21.2 (*q*)		
Me*C*O		170.3 (*s*)		
Me*CH*$_2$O			3.43–3.50, 3.80–3.83 (2*m*)	63.0 (*t*)
MeCH_2O			1.20 (*t*, *J* = 6.8)	15.2 (*q*)

Table 3. *^{1}H- and ^{13}C-NMR Data* (400 and 100 MHz, resp.; CDCl$_3$) *of* **4** *and* **5**. δ in ppm, J in Hz.

	4/5	
	δ(H)	δ(C) (DEPT)
CH$_2$(1)	1.22, 1.75 (both overlapped, each 2 H)	25.1 (*t*)/25.0 (*t*)
CH$_2$(2)	1.62–1.67 (*m*, 2 H), 1.85 (overlapped, 2 H)	24.6 (*t*)/24.5 (*t*)
H–C(3)	3.31 (*m*)/3.30 (*m*)	75.8 (*d*)/75.8 (*d*)
C(4)		36.6 (*s*)/36.5 (*s*)
H–C(5)	3.27 (2*s*, each 1 H)	51.2 (*d*)/50.8 (*d*)
C(6)		212.3 (*s*)/212.3 (*s*)
H–C(7)	3.86 (br. *s*)/3.84(br. *s*)	77.8 (*d*)/77.6 (*d*)
H–C(8)	1.85 (overlapped, 2 H)	47.1 (*d*)/46.6 (*d*)
C(9)		92.0 (*s*)/91.8 (*s*)
C(10)		48.0 (*s*)/47.8 (*s*)
CH$_2$(11)	1.89, 1.90 (both overlapped, each 2 H)	28.6 (*t*)/29.2 (*t*)
CH$_2$(12)	1.98 (overlapped, 2 H), 2.20–2.40 (*m*, 2 H)	38.9 (*t*)/38.5 (*t*)
C(13)		91.0 (*s*)/90.3 (*s*)
CH$_2$(14)	2.50 (*dd*, $J = 5.6$, 13.2), 2.05/2.29, 2.33 (2*m*)	47.6 (*t*)/46.4 (*t*)
H–C(15)	5.20 (*dd*, $J = 1.0$, 5.2)/5.10 (*dd*, $J = 3.6$, 6.0)	104.1 (*d*)/103.6 (*d*)
CH$_2$(16)	4.11, 3.89 (2*d*, each $J = 8.8$)/4.00, 3.63 (2*d*, each $J = 8.2$)	77.9 (*t*)/75.4 (*t*)
Me(17)	0.85 (*s*)/0.84 (*s*)	19.9 (*q*)/19.7 (*q*)
Me(18)	1.26 (*s*)/1.26 (*s*)	26.8 (*q*)/26.8 (*q*)
Me(19)	1.04 (*s*)/1.04 (*s*)	22.4 (*q*)/22.3 (*q*)
Me(20)	1.11 (*d*, $J = 6.4$, 6 H)	13.1 (*q*)/12.9 (*q*)
Me*CH*$_2$O	3.70–3.74, 3.43–3.50 (2*m*)/3.74–3.78, 3.50–3.56 (2*m*)	63.4 (*t*)/62.8 (*t*)
*Me*CH$_2$O	1.21 (*q*, $J = 7.2$)/1.17 (*q*, $J = 6.8$)	15.2 (*q*)/15.2 (*q*)

opposite configuration at C(15) for **4** and **5**. The other relative configurations in **4** and **5** were the same as those of **1** and **2**, as deduced from the NOE experiment. Therefore, compounds **4** and **5** were determined as (3α,7β,9α,15β)- and (3α,7β,9α,15α)-9,13 : 15,16-diepoxy-15-ethoxy-3,7-dihydroxylabdan-6-one, respectively.

Compound **6** was obtained as a colorless oil. Its molecular formula $C_{22}H_{36}O_5$ was deduced by HR-ESI-MS (*m/z* 381.2622 ($[M+H]^+$)). The NMR data (*Table 2*) together with five degrees of unsaturation showed that **6** should have a tricyclic molecular skeleton with one C=O and one C=C bond. The IR spectrum exhibited the presence of an α,β-unsaturated ketone moiety (1731 and 1651 cm^{-1}), which could be confirmed by its ^{13}C-NMR data (δ(C) 199.2, 170.2, and 128.3 (3*s*)). The HMBC cross-peaks Me(20)/C(7), C(8), and C(9) suggested that the C=C bond had to be put between C(8) and C(9). The NMR spectra of **6** also showed one EtO group and two OH groups. The positions of the EtO and OH groups could be established at C(15), C(6), and C(13) by the HMBC experiment. The relative configuration of **6** was determined by the NOE data. When Me(17) was irradiated, the intensity of Me(19) was increased, which indicated that Me(17) and Me(19) were β-oriented. When Me(18) was irradiated, the intensity of H–C(5) and H–C(6) was increased, which indicated that Me(18), H–C(5), and H–C(6) were α-oriented. Therefore, compound **6** was determined as (6β)-15,16-epoxy-15-ethoxy-6,13-dihydroxylabd-8-en-7-one.

The new compounds **1**, **2**, **4**, and **5** must be artefacts of isolation, produced during the extraction procedure with EtOH from the naturally occurring hemiacetal mixture

(α- or β-$R^2 = OH$ instead of EtO). Indeed, we could not find the above compounds in a CH_2Cl_2 extract of the dried plant material by HPLC analysis.

The known compound **7** was reported from *L. heterophyllus* for the first time, and its structure was established as ($3\alpha,6\beta,9\alpha$)-3-(acetyloxy)-15,16-epoxy-6,9-dihydroxylabda-13(16),14-dien-7-one by comparison of its ^1H- and ^{13}C-NMR data with those reported in [11][14], as well as by X-ray crystallographic analysis (*Fig. 2*).

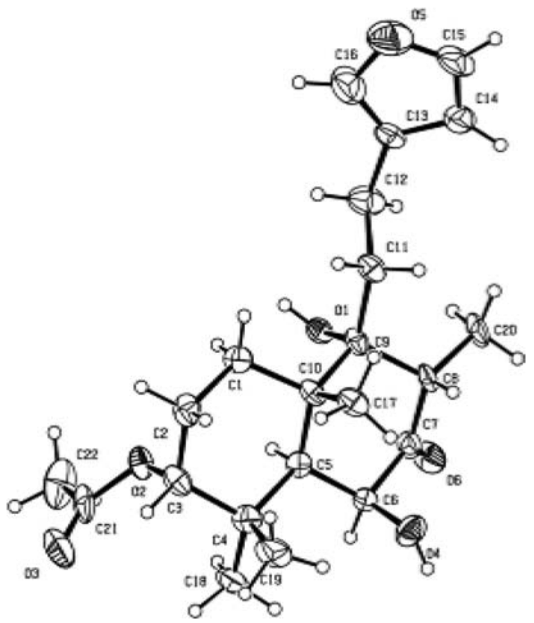

Fig. 2. *X-Ray crystal structure of* **7**1))

This work was supported by the *Important Directional Project of Chinese Academy of Sciences* (No. KSCX2-EW-R-15) and the *National Natural Science Foundation of China* (No. 21075127).

Experimental Part

General. Column chromatography (CC): silica gel (SiO_2; 200–300 mesh; *Qingdao Marine Chemical Factory*, Qingdao, P. R. China). TLC: silica gel *GF_{254}* (*Qingdao Marine Chemical Factory*). HPLC: *Waters-600E-2996* instrument; *Kromasil-C_{18}* column (5 µm, 4.6 mm × 250 mm i.d.; Dalian Institute of Chemical Physics, Chinese Academy of Sciences, Dalian, China). Optical rotations: *Perkin-Elmer 341* polarimeter; in $CHCl_3$ at 20°. UV Spectra: *New-Century-Pgeneral*-T6 spectrophotometer; λ_{max} (log *e*) in nm. IR Spectra: *Nicolet-Nexus-670* FT-IR spectrometer; in cm^{-1}. NMR Spectra: *Bruker-Avance-III-400* NMR spectrometer; chemical shifts δ in ppm rel. to Me_4Si as internal reference, *J* in Hz. HR-ESI-MS: *Bruker-Apex-II* mass spectrometer; in *m*/*z* (LR in *m*/*z* (rel. %)).

Plant Material. The aerial parts of *Leonurus heterophyllus* SWEET were purchased from *Huanghe Medicinal Material Market* in Gansu Province, China, in 2010, and identified by Prof. *Huan-Yang Qi*, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences. A voucher specimen (No. ZY2010l001) was deposited with our laboratory.

Extraction and Isolation. The air-dried plant material (9.5 kg) was extracted with 95% aq. EtOH (6 l) at r.t. The extract was concentrated and the residue (300 g) subjected to CC (SiO_2 (1500 g), petroleum ether/acetone 100:0, 50:1, 30:1, 15:1, 10:1, 4:1, 3:1, 2:1, 1:1, and 100:0): *Fractions 1–10* (TLC monitoring). *Fr. 4* was subjected to CC (SiO_2, $CHCl_3$/AcOEt 30:1): *Frs. 4.1–4.4*. *Fr. 4.2* was further separated by CC (SiO_2, petroleum ether/AcOEt 15:1): *Frs. 4.2.1* and *4.2.2*. *Fr. 4.2.1* then was repeatedly purified by CC (SiO_2, petroleum ether/AcOEt 15:1): **1** (20 mg) and **2** (15 mg). *Fr. 4.2.2* was repeatedly purified by CC (SiO_2, $CHCl_3$/AcOEt 20:1): **3** (2 mg). *Fr. 4.3* was further separated by CC (SiO_2, petroleum ether/AcOEt 15:1): **4/5** (6 mg). *Fr. 4.4* was further separated by CC (SiO_2, petroleum ether/AcOEt 20:1): *Frs. 4.4.1* and *4.4.2*. *Fr. 4.4.1* was repeatedly purified by CC (SiO_2, petroleum ether/AcOEt 12:1): **6** (2 mg). Compound **7** (50 mg) was obtained from *Fr. 5* after CC (SiO_2, $CHCl_3$/AcOEt) and recrystallization from acetone.

(3α,7β,9α,15β)-3-(Acetyloxy)-9,13:15,16-diepoxy-15-ethoxy-7-hydroxylabdan-6-one (= rel-*(1″R,2′S,2″R,3″R,4″aS,5R,6″R,8″aS)-6″-(Acetyloxy)-5-ethoxydodecahydro-3″-hydroxy-2″,5″,5″,8″a-tetramethyldispiro[furan-3(2H),2′(5′H)-furan-5′,1″(4″H)-naphthalen]-4″-one*; **1**): Colorless oil. $[\alpha]_D^{20} = -66.9$ ($c = 1.3$, $CHCl_3$). IR (KBr): 3469, 2978, 2935, 2877, 1733, 1709, 1469, 1443, 1389, 1371, 1243, 1132, 1043, 998, 903, 758. ^1H- and ^{13}C-NMR: *Table 1*. ESI-MS: 438 (M^+), 392 (1), 227 (100), 181 (26), 123 (27), 81 (14), 43 (17), 40 (23). HR-ESI-MS: 456.2964 ($[M + NH_4]^+$; calc. 456.2956).

(3α,7β,9α,15α)-3-(Acetyloxy)-9,13:15,16-diepoxy-15-ethoxy-7-hydroxylabdan-6-one (= rel-*(1″R,2′S,2″R,3″R,4″aS,5S,6″R,8″aS)-6″-(Acetyloxy)-5-ethoxydodecahydro-3″-hydroxy-2″,5″,5″,8″a-tetramethyldispiro[furan-3(2H),2′(5′H)-furan-5′,1″(4″H)-naphthalen]-4″-one*; **2**): Colorless oil. $[\alpha]_D^{20} = +48.5$ ($c = 0.68$, $CHCl_3$). IR (KBr): 3469, 2978, 2935, 2877, 1733, 1709, 1469, 1443, 1389, 1371, 1243, 1132, 1043, 998, 903, 758. ^1H- and ^{13}C-NMR: *Table 1.* HR-ESI-MS: 456.2947 ($[M + NH_4]^+$; calc. 456.2956).

(3α,7β,9α,15α)-3-(Acetyloxy)-9,13:15,16-diepoxy-7-hydroxy-15-methoxylabdan-6-one (= rel-*(1″R,2′S,2″R,3″R,4″aS,5S,6″R,8″aS)-6″-(Acetyloxy)dodecahydro-3″-hydroxy-5-methoxy-2″,5″,5″,8″a-tetramethyldispiro[furan-3(2H),2′(5′H)-furan-5′,1″(4″H)-naphthalen]-4″-one*; **3**): Colorless oil. $[\alpha]_D^{20} = +42.8$ ($c = 0.14$, $CHCl_3$). IR (KBr): 3467, 2980, 2946, 2877, 1732, 1710, 1467, 1371, 1244, 1036, 1101, 1036, 980, 761. ^1H- and ^{13}C-NMR: *Table 2*. HR-ESI-MS: 442.2793 ($[M + NH_4]^+$; calc. 442.2799).

(3α,7β,9α,15β)- and (3α,7β,9α,15α)-9,13:15,16-Diepoxy-15-ethoxy-3,7-dihydroxylabdan-6-one (= rel-*(1′R,2′S,2″R,3″R,4″aS,5R,6″R,8″aS)- and* rel-*(1″R,2′S,2″R,3″R,4″aS,5S,6″R,8″aS)-5-Ethoxy-dodecahydro-3″,6″-dihydroxy-2″,5″,5″,8″a-tetramethyldispiro[furan-3(2H),2′(5′H)-furan-5′,1″(4″H)-naphthalen]-4″-one*; **4** *and* **5**, resp.): Colorless oil. IR (KBr): 3469, 2979, 2928, 2877, 1706, 1470, 1389, 1364, 1323, 1226, 1129, 1112, 1068, 1039, 995, 954,763. ^1H- and ^{13}C-NMR: *Table 3*. HR-ESI-MS: 414.2845 ($[M + NH_4]^+$; calc. 414.2850).

(6β)-15,16-Epoxy-15-ethoxy-6,13-dihydroxylabd-8-en-7-one (= rel-*(1R,4aR,8aR)-4-[2-(5-Ethoxytetrahydro-3-hydroxyfuran-3-yl)ethyl]-4a,5,6,7,8,8a-hexahydro-1-hydroxy-3,4a,8,8-tetramethylnaphthalen-2(1H)-one*; **6**): Colorless oil. $[\alpha]_D^{20} = -23.1$ ($c = 0.13$, $CHCl_3$). UV (CH_3Cl): 218 (4.2). IR (KBr): 3405, 2928, 2859, 1731, 1651, 1603, 1340, 1113, 1040, 990, 924, 804. ^1H- and ^{13}C-NMR: *Table 2*. HR-ESI-MS: 381.2622 ($[M + H]^+$; calc. 381.2636).

X-Ray Crystallography of rel-*(1R,3R,4S,4aR,7S,8aR)-7-(Acetyloxy)-4-[2-(furan-3-yl)ethyl]octahydro-1,4-dihydroxy-3,4a,8,8-tetramethylnaphthalen-2(1H)-one* (**7**). Data were collected with a *Bruker-Apex-II-CCD* diffractometer and graphite-monochromated MoK_α radiation (λ 0.71073 Å). Cell refinement and data reduction were performed by SAINT (*Bruker*). The structure was solved by direct methods with the SHELXS-97 program, and refined on F^2 by full-matrix least squares with the SHELXL-97 package. Molecular graphics was designed with SHELXTL (*Bruker*). Crystallographic Data: $C_{22}H_{32}O_6 \cdot H_2O$, M_r 410.49; crystal size 0.25 × 0.23 × 0.20 mm; space group orthorhombic, $P2_12_12_1$; T 296(2) K; $a = 10.521(6)$ Å, $b = 11.262(7)$ Å, $c = 18.737(11)$ Å, $V = 2220(2)$ Å^3; $F(000) = 888$, $Z = 4$, $D_x = 1.228$ Mg/m^3; 10694 reflections collected with 4056 independent $R_{int} = 0.1249$, data, restraints, and parameters 4056, 3, and 277; goodness-of-fit on $F^2 = 0.970$, final indices $R_1 = 0.0755$, $wR_2 = 0.0879$; largest difference peak and hole 0.184 and -0.163 e · Å^{-3}, resp. CCDC-830659 contains the supplementary crystallographic data for **7** (*Fig. 2*). These data can be obtained free of charge *via* http://www.ccdc.cam.ac.uk/data_request/cif.

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Received October 19, 2011