Chemical Constituents from the Whole Plant of *Euphorbia altotibetic*

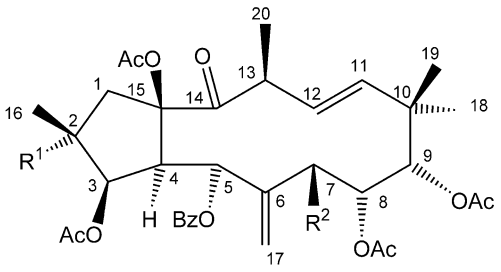
by **Pan Li***[a],[c]), **Zhang Xiao Feng**[a]), **Deng Ye**[c]), **Wang Huan**[a]), **Wu Da Gang**[b]), and **Luo Xiao Dong**[b])

[a]) The Northwest Plateau Institute of Biology, The Chinese Academy of Sciences, Xining 810001, P.R. China
[b]) Kunming Institute of Botany, The Chinese Academy of Sciences, Kunming 650204, P.R. China
[c]) Chengdu Institute of Biology, The Chinese Academy of Sciences, Chengdu, 610041, P.R. China
(phone: 86-28-85229227; fax: 86-28-85223843; e-mail: xnplus@yahoo.com)

Four new jatrophane diterpenoids, altotibetin A (**1**), altotibetin B (**2**), altotibetin C (**3**), altotibetin D (**4**), and nine known compounds, β-sitosterol, cycloart-23-ene-3β,25-diol, cycloart-25-ene-3β,24-diol, lupeol acetate, scopoletin, kaempferol, uracil, uridine, astragalin, and daucosterol have been isolated from the whole plant of *Euphorbia altotibetic* PAULS. Their structures were established by spectral methods, and the configurations of **1** and **2** were confirmed by X-ray analysis.

Introduction. – *Euphorbia altotibetic* PAULS., a perennial plant spreading in northwestern China, mainly in the Qinghai-Tibet Plateau, is an important traditional Tibetan herb, used in folk medicine for curing skin tinea and tumefaction [1]. Some macrocyclic and polycyclic diterpenes with ingenane, tigliane, and daphnane skeletons isolated from some species of *Euphorbia* plants have skin-irritant, tumor-promoting and anti-tumor activities [2–4], while the chemical constituents of this species have not been investigated so far. Herein, we report the isolation and structure elucidation of the compounds from the whole plant of *E. altotibetic*.

Results and Discussion. – The whole-plant extract of *E. altotibetic* afforded four new highly oxygenated jatrophane polyesters **1**–**4** and nine known compounds. Compounds **1**–**4** were very similar to each other based on their ^{1}H- and ^{13}C-NMR spectra (*Tables 1–4*).



1 R^1 = H, R^2 = AcO
2 R^1 = H, R^2 = PrCOO
3 R^1 = OH, R^2 = AcO
4 R^1 = OH, R^2 = PrCOO

Altotibetin A (**1**; colorless crystals), showed a molecular ion peak at *m*/*z* 698 in the FAB mass spectrum; the formula was confirmed as $C_{37}H_{46}O_{13}$ by HR-EI-MS (*m*/*z* 698.2937; calc. 698.2938).

The IR spectrum exhibited absorptions at 1736 (br.), 1660, 1600, 1454, and 717 that are characteristic of ester and Ph groups. In the ^{1}H-NMR spectrum, Me signals (δ 1.74, 1.99, 2.04, 2.06, 2.06) revealed the existence of five AcO groups. The signals of aromatic-ring H-atoms (δ 7.20 (2 H), 7.56 (1 H), 8.07 (2 H)) indicated the presence of a Bz group, which was confirmed with the ^{13}C-NMR data. In addition to these signals, the 20 ^{13}C signals in the ^{13}C-NMR spectrum were attributed to a keto group, a (*E*)-disubstituted CH=CH group, an exocyclic C=CH_2 bond, six oxygenated C-atoms (five secondary and a tertiary), a CH_2, three CH groups, a quaternary C-atom, and four Me groups. These signals indicated that **1** is a bicyclic jatrophane-type of diterpenoid. Comparing the spectral data with those of some jatrophane polyesters [5–7], they were all found to be based on the same framework and shared a common arrangement of functional groups: a (*E*)-configured bond (C(11)=C(12)), an *exo*-CH_2 group at C(6), a keto C=O group at C(14), and OH groups usually at C(2), C(3), C(5), C(7), C(8), and C(9). In the HMBC spectrum, the correlations of H–C(1) with C(2), C(3), C(4), and C(15), of H–C(4) with C(3), C(14), and C(15), of H–C(17) with C(5), C(6), and C(7), of Me(16) with C(1), C(2), and C(3), of Me(18) and Me(19) with C(9), C(10), and C(11), of Me(20) with C(12), C(13), and C(14) confirmed the assumed skeleton. The long-range correlations between oxymethine H-atoms and the corresponding C=O groups (H–C(3)/C=O(Ac), H–C(5)/C=O(Bz), H–C(7)/C=O(Ac), H–C(8)/C=O(Ac), and H–C(9)/C=O(Ac) were clearly observed in HMBC spectrum, leading to the locations of the ester residues.

According to the literature [5–7], the conformational differences of the twelve-membered ring were based on the orientation of the C(6)=CH_2(17) group and the configuration at C(13). The C(6)=CH_2(17) group, being perpendicular or parallel to the main plane of the macrocyclic ring, led to either large (9–11 Hz) or small (0–4 Hz) *J*(4,5) values, respectively. In the ^{1}H-NMR spectrum of **1**, a small coupling value (2.7 Hz) of *J*(4,5) indicated that compound **1** adopted the latter conformation. The configuration at C(13) is a crucial factor effecting the conformation of the northern part of the molecule. The Me group at C(13) of compound **1** is in a quasi-equatorial position. The NOEs between Me(20) and H–C(12), H–C(4) and H–C(13), and the absence of NOE between Me(20) and H–C(11) supported this conclusion. All known jatrophane diterpenes show a *trans* ring junction [5–7]; the β-orientation of the Ac group at C(15) was presumed. The α-orientation of H–C(4) was assumed on a biogenetic basis [8]. We obtained further information by investigating the correlations of NOE effects. On the basis of the cross-peaks H–C(2)/H–C(4), H–C(2)/H–C(3), H–C(4)/H–C(3), H–C(5)/H–C(8), and H–C(8)/H–C(9), the relative positions of the substituents were deduced. The structure was determined as (11*E*)-3β,7β,8α,9α,15β-pentaacetoxy-5α-(benzoyloxy)-14-oxojatropha-6(17),11-diene by ^{1}H- and ^{13}C-NMR (DEPT), and HMQC, HMBC, and ^{1}H,^{1}H-COSY experiments, and by comparison with the literature data [5–7]. The structure was further confirmed by X-ray crystallographic analysis (*Fig. 1*).

The molecular formula of altotibetin B (**2**; colorless crystals), was determined as $C_{39}H_{50}O_{13}$ by HR-EI-MS (*m*/*z* 726.3254; calc. 726.3251). The structure of **2** was very similar to that of **1**, except for the butanoyloxy group at C(7) instead of an AcO group. The butanoyl (But) signals were sorted from the ^{1}H-NMR spectrum (δ 2.24 (2 H–C(2″)), 165 (2 H–C(3″)), and 0.91 (Me(4″)) as well as the ^{13}C-NMR spectrum

Table 1. *^{1}H-NMR Data of Compounds* **1**–**4** (δ in ppm, J in Hz; in $CDCl_3$)

	1[a])	**2**[a])	**3**[b])	**4**[b])
H_α–C(1)	2.80 (*dd*)	2.74 (*dd*)	2.70 (br. *d*)	2.72 (br. *d*)
H_β–C(1)	2.15 (*dd*)	2.12 (*dd*)	2.38 (*d*)	2.45 (*d*)
H–C(2)	2.47 (*m*)	2.45 (*m*)	–	–
H–C(3)	5.70 (*m*)	5.64 (*m*)	5.45 (br. *d*)	5.47 (*d*)
H–C(4)	3.06 (*dd*)	3.02 (*dd*)	3.73 (*dd*)	3.77 (*dd*)
H–C(5)	5.65 (br. *s*)	5.62 (br. *s*)	5.57 (br. *d*)	5.61 (br. *d*)
H–C(7)	5.60 (br. *s*)	5.56 (br. *s*)	5.60 (br. *s*)	5.61 (br. *s*)
H–C(8)	5.10 (br. *s*)	5.06 (br. *s*)	5.04 (br. *s*)	5.08 (br. *s*)
H–C(9)	4.94 (*s*)	4.90 (*s*)	4.89 (*s*)	4.92 (*s*)
H–C(11)	5.84 (*d*)	5.80 (*d*)	5.80 (*d*)	5.84 (*d*)
H–C(12)	5.63 (*dd*)	5.60 (*dd*)	5.63 (*dd*)	5.62 (*dd*)
H–C(13)	3.56 (*dq*)	3.55 (*dq*)	4.08 (*dq*)	4.14 (*dq*)
Me(16)	0.99 (*d*)	0.96 (*d*)	1.29 (*s*)	1.31 (*s*)
CH_2(17)	5.19 (br. *s*)	5.11 (br. *s*)	5.08 (br. *s*)	5.14 (br. *s*)
	5.16 (br. *s*)	5.11 (br. *s*)	5.08 (br. *s*)	5.10 (br. *s*)
Me(18)	0.94 (*s*)	0.90 (*s*)	0.89 (*s*)	0.92 (*s*)
Me(19)	1.29 (*s*)	1.24 (*s*)	1.23 (*s*)	1.26 (*s*)
Me(20)	1.30 (*d*)	1.25 (*d*)	1.22 (*d*)	1.25 (8*d*)
AcO	1.74	1.67	1.60	1.68
	1.99	1.97	1.97	1.99
	2.04	2.00	2.03	2.03
	2.06	2.03	2.07	2.10
	2.06	–	2.13	–
BzO:				
H–C(2′), H–C(6′)	8.07	8.03	8.04	8.07
H–C(4′)	7.56	7.52	7.52	7.53
H–C(3′), H–C(5′)	7.40	7.38	7.37	7.41
BuO:				
CH_2(2″)	–	2.24 (*m*)	–	2.43 (*m*)
CH_2(3″)	–	1.66 (*m*)	–	1.75 (*m*)
Me(4″)	–	0.91 (*t*)	–	0.97 (*t*)

[a]) For compounds **1** and **2**: $J(1\alpha,1\beta) = 15.2$, $J(1\alpha,2) = 8.9$, $J(1\beta,2) = 7.0$, $J(4,5) = 2.7$, $J(11,12) = 15.8$, $J(12,13) = 8.6$, $J(16,2) = J(20,13) = 6.8$. [b]) For compounds **3** and **4**: $J(1\alpha,1\beta) = 16$; $J(3,4) = 3.5$, $J(4,5) = 3.4$; $J(11,12) = 16$, $J(12,13) = 9.3$, $J(20,13) = 6.6$.

(δ 172.7 (C=O(But)), 36.2 (C(2″)), 18.2 (C(3″)), and 13.5 (C(4″))). The correlations of C=O(But) with H–C(7) can be observed in the HMBC spectrum. The structure of **2** was elucidated as (11*E*)-3β,8α,9α,15β-tetraacetoxy-5α-(benzoyloxy)-7β-(butanoyloxy)-14-oxojatropha-6(17),11-diene. X-Ray crystallographic analysis confirmed this structure (*Fig. 2*).

Altotibetin C (**3**) was isolated as tiny colorless crystals, and its molecular formula was determined as $C_{37}H_{46}O_{14}$ by HR-EI-MS (*m*/*z* 714.2891; calc. 714.2876). The characteristic absorption at 3498 cm^{-1} indicated the existence of a OH group. Comparison of the spectral data with those of **1** revealed the most-significant difference on the five-membered ring. An oxygenated tertiary C-atom (δ 79.9) appeared instead of a CH C-atom (δ 38.0), and the downfield shifts of C(1), C(3), and C(16) with δ 6.2, 3.8 and 8.8 ppm, respectively, in the ^{13}C-NMR spectrum indicated that

Table 2. *^{13}C-NMR* (DEPT) *Data of Compounds* **1**–**4** (δ in ppm; in $CDCl_3$)

	1	**2**	**3**	**4**
C(1)	43.1	42.9	49.4	49.7
C(2)	38.0	37.9	79.2	79.4
C(3)	76.1	75.9	79.9	80.2
C(4)	49.9	49.9	46.7	47.1
C(5)	70.0	67.6	68.3	68.9
C(6)	142.1	142.8	143.6	143.6
C(7)	67.9	68.7	68.8	68.5
C(8)	69.1	70.1	69.8	70.4
C(9)	80.4	80.4	80.6	80.9
C(10)	40.4	40.4	40.7	41.0
C(11)	135.5	135.7	135.2	135.6
C(12)	131.1	130.8	131.8	132.2
C(13)	44.8	44.8	43.8	43.8
C(14)	204.4	204.0	204.4	204.7
C(15)	92.3	92.5	92.4	92.9
C(16)	14.3	14.3	23.1	23.5
C(17)	115.4	114.5	113.7	113.7
C(18)	25.7	25.9	26.4	26.4
C(19)	23.3	23.3	23.5	23.5
C(20)	19.8	19.8	19.5	19.8
AcO	169.5	169.5	169.1	169.8
	169.6	169.7	169.2	169.9
	169.7	169.7	169.5	169.9
	169.8	169.8	169.5	170.3
	170.0		170.3	
	20.5	20.6	20.6	20.9
	20.6	21.1	20.6	21.0
	21.0	21.1	21.1	21.5
	21.1	21.1	21.1	21.7
	21.2		21.3	
BzO:				
C=O	164.2	164.2	163.9	164.2
C(1′)	129.9	130.0	129.9	130.6
C(2′), C(6′)	129.8	129.7	129.8	130.1
C(4′)	133.1	133.0	133.0	133.5
C(3′), C(5′)	128.2	128.2	128.2	128.6
BuO:				
C=O	–	172.7	–	173.4
C(2″)	–	36.2	–	36.7
C(3″)	–	18.2	–	18.8
C(4″)	–	13.5	–	14.0

C(2) was hydroxylated. The α-orientation of this OH group at C(2) was deduced from the NOE effect of Me(16) with H_β–C(1). The structure of **3** was elucidated as (11*E*)-3β,7β,8α,9α,5β-pentaacetoxy-5α-(benzoxloxy)-2α-hydroxy-14-oxojatropha-6(17),-11-diene.

Altotibetin D (**4**), was isolated as tiny colorless crystals. Its molecular formula was determined as $C_{39}H_{50}O_{14}$ by HR-EI-MS (m/z) 742.3235; calc. 742.3201). The IR

Table 3. *HMBC Data of Compounds* **1**–**4**

	1	**2**	**3**	**4**
H_α–C(1)	2,3,4,14	2,3,4,14	2,4,14	2,4,14
H_β–C(1)	2,15,16	2,4,14,15,16	15,16	4,14,15,16
H–C(2)	1,16	1,16	–	–
H–C(3)	1,15,CO(Ac)	1,15,CO(Ac)	1,15,CO(Ac)	4,15,CO(Ac)
H–C(4)	3,14,15	3,5,6,14,15	3,14,15	3,14,15
H–C(5)	3,4,6,17,CO(Bz)	3,4,6,7,17,CO(Bz)	3,6,17,CO(Bz)	3,6,17,CO(Bz)
H–C(7)	6,8,17,CO(Ac)	6,8,17,CO(But)[a])	6,8,17,CO(Ac)	6,8,9,17,CO(But)[a])
H–C(8)	6,9,10,CO(Ac)	6,9,10,CO(Ac)	6,7,9,10,CO(Ac)	6,7,9,10,CO(Ac)
H–C(9)	7,8,10,11,18,19,CO(Ac)	7,8,10,11,18,19,CO(Ac)	8,10,11,17,18,19,CO(Ac)	8,10,11,17,18,19,CO(Ac)
H–C(11)	8,10,12,13,19	8,9,10,12,13,19	9,10,12,13,19,20	9,10,12,13,19,20
H–C(12)	10,11,13	10,11,13	11,13	11,13
H–C(13)	11,12,14,20	11,12,14,20	11,12,14,20	11,12,14,20
Me(16)	1,2,3	1,2,3	1,2	1,2
CH_2(17)	5,6,7	4,5,6,7	5,6,7	4,5,6,7
Me(18)	9,10,11,19	9,10,11,19	9,10,11,19	9,10,11,19
Me(19)	9,10,11,13,18	9,10,11,18	9,10,11,18	9,10,11,18
Me(20)	12,13,14	12,13,14	12,13,14	12,13,14

[a]) But: butanoyl.

Table 4. *NOE Data of Compound* **1**–**4**

	1	**2**	**3**	**4**
H_α–C(1)	1β,2,13	1β,2,13	1β,4,13	1β,4,13
H_β–C(1)	1α,16	1α,16	1α,16	1α,16
H–C(2)	1α,3,4,13,16	1α,3,4,13,16	–	–
H–C(3)	2,4,16	2,4	4	4
H–C(4)	1α,2,3,7,13	1α,2,3,7,12	1α,3,7,13	1α,3,7,13
H–C(5)	8	8	8	8
H–C(7)	4	4	4	4
H–C(8)	5,9,19	5,9,19	5,9,19	5,9,19
H–C(9)	8,18,19	8,18,19	8,18,19	8,18,19
H–C(11)	13,18	13,18	13,18	13,18
H–C(12)	20	20	20	20
H–C(13)	1α,2,4,11,20	1α,2,4,11,20	1α,4,11,20	1α,4,11,20
Me(16)	1β	1β	1β	1β
CH_2(17)	17′	17′	17′	17′
	17	17	17	17
Me(18)	9,11	9,11	9,11	9,11
Me(19)	8,9,12	8,9,12	8,9,12	8,9,12
Me(20)	13	13	13	13

spectrum showed absorption of a OH group at 3491 cm^{-1}. Comparison of the NMR data with those of **3** revealed a butanoyloxy instead of an AcO group at C(7). Signals of the butanoyl (But) group could be recognized in the ^{1}H-NMR spectrum (δ 2.43 (2 H–C(2″)), 1.75 (2 H–C(3″)), and 0.97 (Me(4″)) as well as in the ^{13}C-NMR spectrum (δ 173.4 (C=O(But)), 36.7 (C(2″)), 18.8 (C(3″)), and 14.0 (C(4″))). In

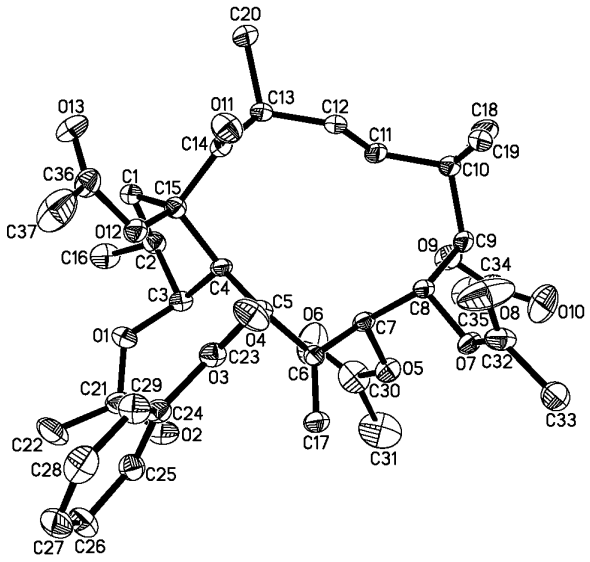


Fig. 1. *X-Ray structure of* **1**

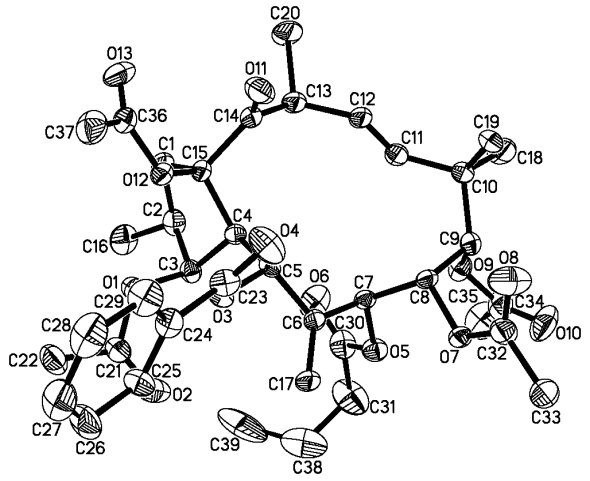


Fig. 2. *X-Ray structure of* **2**

HMBC spectrum, the correlations of C=O(But) with H–C(7), H–C(2″), and of H–C(3″) and H–C(7) with C(6) and C(8) were observed. The structure was accordingly established as (11*E*)-3*β*,8*α*,9*α*,5*β*-tetraacetoxy-5*α*-(benzoyloxy)-7*β*-(butyanoyloxy-2*α*-hydroxy-14-oxojatropha-6(17),11-diene.

Experimental Part

General. Column chromatography (CC): silica gel (200–300 mesh; *Qingdao Marine Chemical Co.*). M.p.: *XRC(1)* apparatus; uncorrected. Optical rotations: *PE-241* polarimeter. IR Spectra: *Nicolet MX-1* spectrometer. NMR Spectra: *Bruker AM-400* spectrometer; TMS as the internal standard. FAB-MS and HR-EI-MS: *VG-AutoSpec-3000* spectrometer.

Plant Material. The whole plants were collected from the Heka Mountain at an altitude 3600–3700 m, Haixin, Qinghai, China, in July 1999 and identified by Prof. *Pan Jing-Tang*. A voucher specimen (XN1999012) was deposited in the Herbarium of the Northwest Plateau Institute of Biology, The Chinese Academy of Sciences.

Extraction and Isolation. The fresh whole plant of *E. altotibetic* (8 kg) was extracted three times (3 × 7 days) with 90% EtOH at r.t. The crude extract was concentrated *in vacuo* to give 400 g extract, which was suspended in H_2O (1500 ml) and extracted successively with petroleum ether, AcOEt, and BuOH. The petroleum ether extract (50 g) was separated by CC on silica gel (elution with petroleum ether/AcOEt 20:1 → AcOEt, then AcOEt/MeOH 1:1) to yield five fractions (*Fr.*). β-Sitosterol (800 mg) was obtained from *Fr. 2* by recrystallization from AcOEt. Cycloart-23-ene-3β,25-diol (15 mg) was isolated from *Fr. 3* by chromatography (silica gel; petroleum ether/AcOEt 4:1) and further purified by recrystallization from AcOEt. *Fr. 3* afforded lupeol acetate (12 mg) after purification on silica-gel columns two times, with a two-gradient system of petroleum ether/AcOEt 3:1 and petroleum ether/Me_2CO 4:1, resp. The AcOEt extract (45 g) was subjected to chromatography (silica gel; petroleum ether/AcOEt 20:1 → AcOEt, then AcOEt/MeOH 1:1 → MeOH) to yield 11 fractions. The intermediate fractions were further purified. *Fr. 2* was separated (silica gel; petroleum ether/Me_2CO 5:1 → 1:1) to yield three fractions, of which *Fr. 2.2* afforded cycloart-25-ene-3β,24-diol (20 mg) and **2** (15 mg) after further chromatography (silica gel; Et_2O/AcOEt 3:1), and then **2** was purified by recrystallization from EtOH. *Fr. 3* was separated by chromatography (silica gel; petroleum ether/Me_2CO 5:1 → Me_2CO) to yield two fractions, the latter fraction afforded **1** (20 mg) after purification on a silica-gel column (Et_2O/Me_2CO 2:1), then **1** was recrystallized from EtOH. *Fr. 4* was separated by CC (silica-gel column; $CHCl_3$/Me_2CO 20:1 → Me_2CO) to yield three fractions, of which *Fr. 4.2* afforded three fractions after further chromatography on silica gel, from the intermediate part of which **4** was purified by crystallization. *Fr. 5* was separated by CC (silica gel; $CHCl_3$/Me_2CO 10:1 → Me_2CO, then Me_2CO/MeOH 1:1) to yield three fraction, of which *Fr. 5.1* afforded scopoletin (30 mg) by crystallization, and *Fr. 3* yielded **3** (7 mg) and kaempferol (12 mg) by further purification on a silica-gel column with $CHCl_3$/MeOH 20:1 → 5:1. Uracil (5 mg) was obtained as white powder from *Fr. 7*. *Fr. 8* was subjected to CC (silica gel; $CHCl_3$/MeOH 20:1 → MeOH) to yield four fractions, of which *Fr. 8.2* and *Fr. 8.4*, afforded uridine (10 mg) and astragalin (14 mg) by CC (silica gel; $CHCl_3$/MeOH 15:1 → MeOH and $CHCl_3$/MeOH 10:1 → MeOH, resp.). Daucosterol (60 mg) was obtained as white deposit from *Fr. 10*.

Altotibetin A (= *(2*S*,3*S*,3a*R*,4*R*,6*S*,7*S*,8*S*,10*E*,12*S*,13a*R*)-3,6,7,8,13a-pentaacetoxy-2,3,3a,4,5,6,7,8,9,12,13,13a-dodecahydro-2,9,9,12-tetramethyl-5-methylidene-13-oxo-1*H*-cyclopentacyclododecen-4-yl Benzoate*; **1**). Colorless crystals. M.p. 192–196° (EtOH). $[\alpha]_D^{20} = +39$ ($c = 0.100$, $CHCl_3$). IR (KBr): 2979, 1736 (br.), 1660, 1600, 1454, 1373, 1279, 1228, 1120, 1041, 995, 717. ^{1}H- and ^{13}C-NMR: see *Tables 1* and *2*. HR-EI-MS: 698.2937 ($C_{37}H_{46}O_{13}^+$; calc. 698.2938). FAB-MS: 699 (17, $[M+H]^+$), 639 (7, $[M-AcO]^+$), 577 (7, $[M-PhCOO]^+$), 105 (100, $[PhCO]^+$).

Altotibetin B (= *(2*S*,3*S*,3a*R*,4*R*,4*R*,6*S*,7*S*,8*S*,10*E*,12*S*,13a*R*)-3,7,8,13a-tetraacetoxy-6-(butanoyloxy)-2,3,3a,4,-5,6,7,8,9,12,13,13a-dodecahydro-2,9,9,12-tetramethyl-5-methylidene-13-oxo-1*H*-cyclopentacyclododecen-4-yl Benzoate*; **2**). Colorless crystals. M.p. 189–191° (EtOH). $[\alpha]_D^{20} = +36.6$ ($c = 0.417$, $CHCl_3$). IR (KBr): 2970, 1739 (br.), 1660, 1600, 1454, 1375, 1278, 1232, 1072, 958, 717. ^{1}H- and ^{13}C-NMR: see *Tables 1* and *2*. HR-EI-MS: 726.3254 ($C_{39}H_{50}O_{13}^+$; calc. 726.3251). FAB-MS: 727 (55, $[M+H]^+$), 667 (16, $[M-AcO]^+$), 639 (5, $[M-BuO]^+$), 605 (19, $[M-PhCOO]^+$), 105 (100, $[PhCO]^+$), 71 (43, Bu^+).

Altotibetin C (= *(2*R*,3*R*,3a*R*,4*R*,6*S*,7*S*,8*S*,10*E*,12*S*,13a*R*)-3,6,7,8,13a-pentaacetoxy-2,3,3a,4,5,6,7,8,9,12,13,13a-dodecahydro-2-hydroxy-2,9,9,12-tetramethyl-5-methylidene-13-oxo-1*H*-cyclopentacyclododecen-4-yl Benzoate*; **3**). Tiny colorless crystals. M.p. 266-268° (EtOH). $[\alpha]_D^{20} = +0$ ($c = 0.117$, $CHCl_3$). IR (KBr): 3498 (br.), 2977, 1743 (br.), 1722, 1660, 1605, 1454, 1373, 1286, 1228, 1076, 1038, 995, 717. ^{1}H- and ^{13}C-NMR: see *Tables 1* and *2*. HR-EI-MS: 714.2891 ($C_{37}H_{46}O_{14}^+$; calc. 714.2888). EI-MS: 715 (69, $[M+H]^+$), 655 (26, $[M-AcO]^+$), 105 (100, $[PhCO]^+$).

Altotibetin D (= *(2*R*,3*R*,3a*R*,4*R*,6*S*,7*S*,8*S*,10*E*,12*S*,13a*R*)-3,7,8,13a-tetraacetoxy-6-(butanoyloxy)-2,3,3a,4,5,6,-7,8,9,12,13,13a-dodecahydro-2-hydroxy-2,9,9,12-tetramethyl-5-methylidene-13-oxo-1*H*-cyclopentacyclododecen-4-yl Benzoate*; **4**). Tiny colorless crystals. M.p. 225–226.5° (EtOH). $[\alpha]_D^{20} = +3$ ($c = 0.167$, $CHCl_3$). IR (KBr):

3491 (br.), 2972, 1743 (br.), 1724 (br.), 1660, 1600, 1452, 1371, 1277, 1232, 1178, 1074, 1032, 958, 716. ^{1}H- and ^{13}C-NMR: *Tables 1* and *2*. HR-EI-MS: 742.3235 ($C_{39}H_{50}O_{14}^+$; calc. 742.3201). EI-MS: 743 (54, $[M+H]^+$), 683 (10, $[M-AcO]^+$), 621 (7, $[M-PhCOO]^+$), 105 (100, $[PhCO]^+$), 71 (7, Bu^+).

X-Ray Crystal Structures. Crystallographic data for **1** and **2** have been deposited with the *Cambridge Crystallographic Data Centre* (CCDC-191295 and -191296). Copies of the data can be obtained, free of charge, on application to CCDC, 12 Union Road, Cambridge CB2 1EZ, UK (fax: +44-(0) 1223-336033; e-mail: deposit@ccdc.cam.ac.uk).

β-Sitosterol: m.p. 138° (AcOEt); identified by comparison of the R_f value with that of the standard sample of β-sitosterol.

Cycloart-23-ene-3β,25-diol: m.p. 200–203° (AcOEt); identified by comparison of the NMR data with those in [9][10].

Cycloart-25-ene-3β,24-diol: m.p. 184–189° (AcOEt); identified by comparison of the NMR data with those in [10].

Lupeol Acetate: m.p. 184–190° (AcOEt); identified by comparison of the NMR data with those in [11].

Scopoletin: m.p. 205–207° (MeOH); identified by comparison of the R_f value with that of the standard sample of scopoletin.

Kaempferol: m.p. 273–275° (MeOH); identified by comparison of the NMR data with those in [12].

Uracil: m.p. >300° (MeOH); identified by comparison of the NMR data with those in [13].

Uridine: m.p. >300° (MeOH); identified by comparison of the NMR data with those in [14].

Astragalin: m.p. 209–211° (MeOH); identified by comparison of the NMR data with those in [15].

Daucosterol: m.p. 302° (MeOH); identified by comparison of the R_f value with that of the standard sample of daucosterol.

The authors gratefully acknowledge Prof. *Pan Jing-Tang* who identified the plant, and Dr. *Liao Zhi-Xing* who recorded the ID and IR data. Thanks are also due to Prof. *HeYi-Neng* for the NMR measurements and Prof. *Yu Kai-Bei* for X-ray analysis.

REFERENCES

[1] Y. C. Yang, 'Handbook of Tibetan Medicnine', Qinghai People's Press, Xining, 1991, pp. 145–146.
[2] S. Öksüz, F. Gürek, R. R. Gil, T. Pengsuparp, J. M. Pezzuto, G. A. Cordell, *Phytochemistry* **1995**, *38*, 1457.
[3] E. H. Seip, E. Hecker, *Phytochemistry* **1983**, *22*, 1791.
[4] Z. H. Mbawambo, S. K. Lee, E. N. Mshiu, J. M. Pezzuto, A. D. Kinghorn, *J. Nat. Prod.* **1996**, *59*, 1051.
[5] J. Jakupovic, F. Jeske, T. Morgenstern, F. Tsichritzis, J. A. Marco, W. Berendsohn, *Phytochemistry* **1998**, *47*, 1583.
[6] J. Jakupovic, T. Morgenstern, M. Bittner, M. Silva, *Phytochemistry* **1998**, *47*, 1601.
[7] J. A. Marco, F. Senz-Cervera, A. Yuster, J. Jakupovic, F. Jeske, *Phytochemistry* **1998**, *47*, 1621.
[8] C. O. Fakunle, J. D. Connolly, D. S. Rycroft, *J. Nat. Prod*. **1989**, *52*, 279.
[9] S. Öksüz, H.-L. Sihieh, J. M. Pezzuto, N. Özhatay, G. A. Cordell, *Planta Medica* **1993**, *59*, 472.
[10] C. Djerassi, R. McCrindel, *J. Chem. Soc. C* **1962**, 4043.
[11] S. B. Mahato, A. B. Kundu, *Phytochemistry* **1994**, *37*, 1571.
[12] K. R. Markham, B. Ternai, R. Stanley, H. Geiger, T. J. Mabry, *Tetrahedron* **1978**, *34*, 1389.
[13] J.-M. Gao, J. Shen, X. Yang, J.-K. Liu, *Acta Botanica Yunnanica* **2001**, *23*, 385.
[14] X.-S. Chen, D.-H. Chen, J.-Y. Si, *Chinese Traditional and Herbal Drugs* **2000**, *31*, 495.
[15] R. M. Rabanal, S. Valverde, M. M. Lomas, B. Rodrigurz, V. M. Chari, *Phytochemistry* **1982**, *21*, 1830.

Received January 25, 2003