Three Terpenoids and a Tocopherol-Related Compound from *Ricinus communis*

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Four new compounds named (3*E*,7*Z*,11*E*)-19-hydroxycasba-3,7,11-trien-5-one (**1**), 6α-hydroxy-10β-methoxy-7α,8α-epoxy-5-oxocasbane-20,10-olide (**2**), 15α-hydroxylup-20(29)-en-3-one (**3**), and (2*R*,4a*R*,8a*R*)-3,4,4a,8a-tetrahydro-4a-hydroxy-2,6,7,8a-tetramethyl-2-(4,8,12-trimethyltridecyl)-2*H*-chromene-5,8-dione (**4**) were isolated from the MeOH extracts of the aerial parts of *Ricinus communis* L. by chromatographic methods. Their structures were elucidated by extensive spectroscopic experiments.

Introduction. – *Ricinus communis* L. (Euphorbiaceae), a herb or herbaceous shrub, is widely distributed in tropical regions and cultivated from tropical to extra tropical regions in the world [1]. This plant, which is called 'mahongliang' by the local *Dai* people in Yunnan province, P. R. China, is mainly used for the treatment of icteric hepatitis, arthritis, and constipation [2]. Recent researches have revealed the antifertility [3] and the inhibitory activity to HIV-1 reverse transcriptase [4] of the constituents from this plant. Previous chemical investigation on *Ricinus communis* L. led to the isolation of sterols [3], alkaloids [5][6], diterpenoids [7][8], coumarin, and flavonoids [5][9]. In order to find out the chemical basis of the favorable therapeutic effects, we have chemically investigated the aerial parts of *Ricinus communis* L., which led to the isolation of four new compounds named (3*E*,7*Z*,11*E*)-19-hydroxycasba-3,7,11-trien-5-one (**1**)[1]), 6α-hydroxy-10β-methoxy-7α,8α-epoxy-5-oxocasbane-20,10-olide (**2**[1])), 15α-hydroxylup-20(29)-en-3-one (**3**[1])), and (2*R*,4a*R*,8a*R*)-3,4,4a,8a-tetrahydro-4a-hydroxy-2,6,7,8a-tetramethyl-2-(4,8,12-trimethyltridecyl)-2*H*-chromene-5,8-dione (**4**) (*Fig. 1*). In this article, we report the isolation and structure elucidation of these new compounds.

Results and Discussion. – Compound **1** possesses a molecular formula of $C_{20}H_{30}O_2$, as evidenced by the HR-ESI-MS (*m*/*z* 325.2147, calc. 325.2143 for $C_{20}H_{30}NaO_2^+$, $[M+Na]^+$), indicating six degrees of unsaturation. The IR spectrum showed absorption for OH (3426 cm^{-1}) and conjugated CO groups (1652 cm^{-1}), respectively. The presence of a conjugated CO group was supported by the UV absorption at 270 nm ($\log \varepsilon = 4.74$) [10]. The ^{1}H-NMR spectrum of **1** (*Table 1*) displayed signals of three trisubstituted C=C bonds and four Me groups, two of them attached to sp^2-C-atoms (δ(H) 1.85 (*s*,

[1]) Arbitrary numbering. For systematic names, see *Exper. Part.*

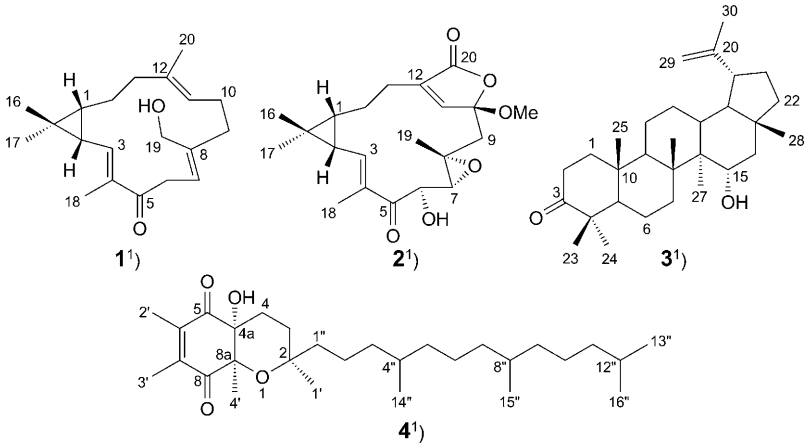

Fig. 1. *Structures of the new compounds* **1**–**4** *from* Ricinus communis *L.*

Me(18)[1])) and δ(H) 1.56 (*s*, Me(20))). With these functionalities, the two remaining degrees of unsaturation were ascribed to two ring systems. The chemical shifts at δ(C) 35.2, 27.6, 25.3, 15.8, and 28.8 in the ^{13}C-NMR spectrum (*Table 1*) together with gem-dimethyl at δ(H) 1.08 (*s*), 1.15 (*s*) in the ^{1}H-NMR spectrum indicated the presence of a cyclopropyl ring. These signals were typical for a casbane-type diterpenoid containing a 14-membered macrocyclic ring. By comparison the spectra data of **1** with those of (2*E*,6*E*,12*E*)-4-hydroxycasba-2,6,12-trien-5-one [11] and those of casbane diterpenoid [12], the differences consisted in that one of the Me groups in the latter two compounds was a CH_2 group in **1**. Considering that δ(H) 4.04 (*d*, $J = 11.9$) and 4.16 (*d*, $J = 11.9$) showed correlations with δ(C) 128.6 (*d*, C(7)), 139.3 (*s*, C(8)), and 35.4 (*t*, C(9)) in the HMBC spectrum (*Fig. 2*) of **1**, the OH substitution was at C(19). The β-orientation of H–C(1) and H–C(2) was assigned on the basis of the close similarity of the coupling constant data with those of agrostistachin [13], of which the relative configurations were established by X-ray crystallographic analysis. This deduction was supported by the correlations of δ(H) 1.08 (*s*, Me(16)) with δ(H) 1.16–1.18 (*m*, H–C(1)) and 1.49 (*t*, $J = 9.0$, H–C(2)) in the ROESY spectrum (*Fig. 3*) of **1**. Thus, compound **1** was indentified as (3*E*,7*Z*,11*E*)-19-hydroxycasba-3,7,11-trien-5-one[1]).

The molecular formula of compound **2** was determined to be $C_{21}H_{28}O_6$ based on the HR-ESI-MS (*m*/*z* 399.1788, calc. 399.1783 for $C_{21}H_{28}NaO_6^+$) and the DEPT data, suggesting eight degrees of unsaturation. The IR spectrum showed absorption for OH (3432 cm^{-1}) and conjugated CO groups (1649 cm^{-1}), respectively. The ^{1}H-NMR spectrum data of **2**[1]) (*Table 1*) revealed the presence of five Me groups including one MeO group, two olefinic H-atoms, and two H-atoms attached to an O-bearing C-atom. The ^{13}C-NMR and DEPT spectra data (*Table 1*) showed signals of two trisubstituted C=C bonds and two CO groups. The presence of a trisubstituted epoxide was deduced from the signals at δ(H) 2.70 (*d*, $J = 6.1$) and δ(C) 63.5 (*d*) and 58.4 (*s*) [14]. Considering the disappearance of a C=C bond in the DEPT spectrum of **2** compared with that of **1**, the epoxidation occurred at C(7) and C(8). The ^{1}H- and ^{13}C-NMR spectra of **2** were similar to those of hookerianolide A [15], except for the presence of

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

	1[1])		**2**[1])	
	δ(H)	δ(C)	δ(H)	δ(C)
H–C(1)	1.16–1.18 (*m*)	35.2 (*d*)	1.20–1.25 (*m*)	33.4 (*d*)
H–C(2)	1.49 (*t*, *J* = 9.0)	27.6 (*d*)	1.48 (*d*, *J* = 8.4)	26.7 (*d*)
H–C(3)	6.37 (*d*, *J* = 10.0)	143.2 (*d*)	6.56 (*d*, *J* = 7.7)	143.6 (*d*)
C(4)		136.6 (*s*)		136.8 (*s*)
C(5)		199.6 (*s*)		199.4 (*s*)
CH_2(6) or H–C(6)	2.12–2.15, 1.96–2.00 (2*m*)	39.4 (*t*)	4.48 (*t*, *J* = 6.6)	72.4 (*d*)
H–C(7)	5.08 (*t*, *J* = 8.0)	128.6 (*d*)	2.70 (*t*, *J* = 6.1)	63.5 (*d*)
C(8)		139.3 (*s*)		58.4 (*s*)
CH_2(9)	2.41–2.44, 1.78–1.81 (2*m*)	35.4 (*t*)	2.78 (*d*, *J* = 15.0), 1.85 (*d*, *J* = 15.0)	45.7 (*t*)
CH_2(10) or C(10)	2.20–2.23, 2.06–2.09 (2*m*)	23.7 (*t*)		106.8 (*s*)
H–C(11)	5.02 (*t*, *J* = 8.0)	119.7 (*d*)	6.50 (*s*)	143.0 (*d*)
C(12)		136.9 (*s*)		139.6 (*s*)
CH_2(13)	2.98–3.03, 3.49–3.53 (2*m*)	39.3 (*t*)	2.62–2.67, 2.14–2.19 (2*m*)	24.6 (*t*)
CH_2(14)	0.84–0.91, 2.10–2.15 (2*m*)	26.6 (*t*)	2.12–2.16, 0.97–1.02 (2*m*)	22.5 (*t*)
C(15)		25.3 (*s*)		24.2 (*s*)
Me(16)	1.08 (*s*)	15.8 (*q*)	1.16 (*s*)	15.7 (*q*)
Me(17)	1.15 (*s*)	28.8 (*q*)	1.19 (*s*)	28.2 (*q*)
Me(18)	1.85 (*s*)	11.6 (*q*)	1.95 (*s*)	13.0 (*q*)
CH_2(19) or Me(19)	4.04 (*d*, *J* = 11.9), 4.16 (*d*, *J* = 11.9)	59.7 (*t*)	1.45 (*s*)	19.5 (*q*)
Me(20) or C(20)	1.56 (*s*)	15.9 (*q*)		170.0 (*s*)
MeO			3.14 (*s*)	50.4 (*q*)

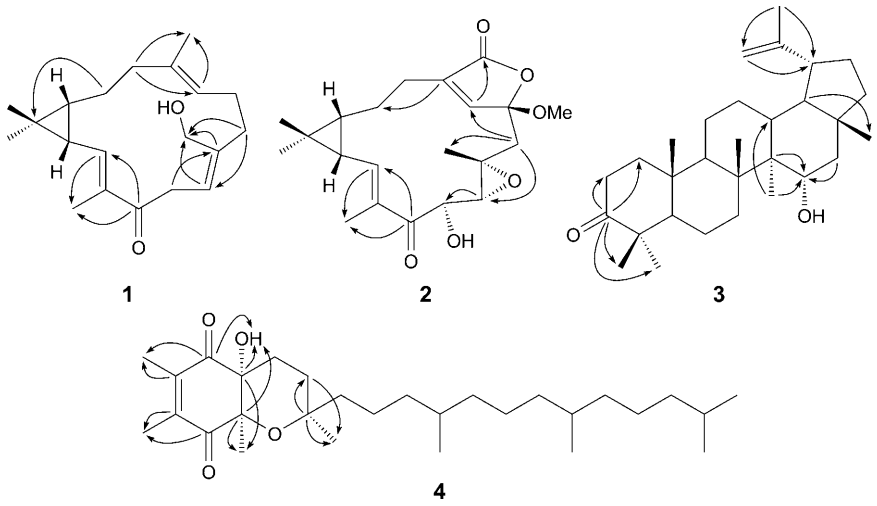

Fig. 2. *Key HMBCs for compounds* **1**–**4**

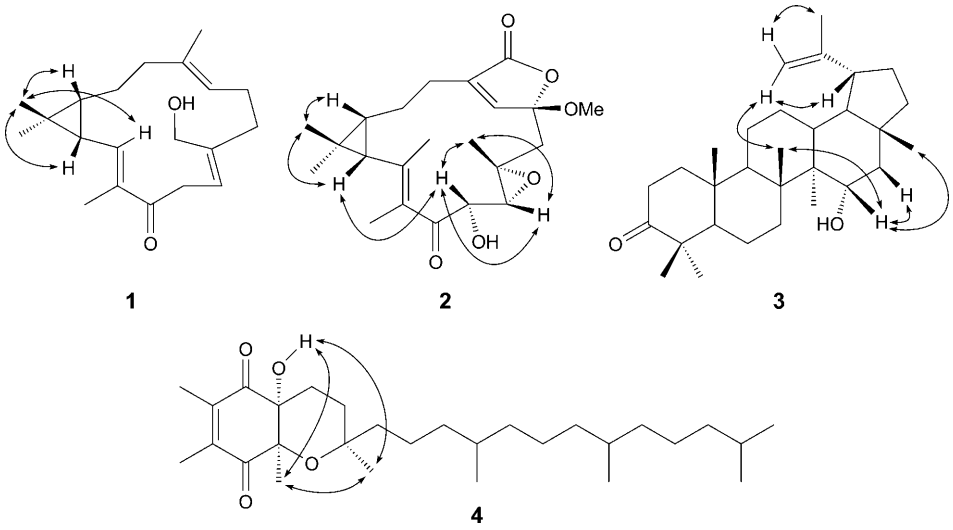

Fig. 3. *Key ROESY correlations for compounds* **1**–**4**

the ketone and the MeO groups, and the absence of an O-bearing CH group and the downfielded chemical shifts of the two olefinic C-atoms (C(3) and C(4)) in **2**. All these data suggested that the OH group in hookerianolide A at C(5) was replaced by an oxo group in **2**. From the correlations of δ(H) 6.50 (*s*, H–C(11)), 3.14 (*s*, MeO), 2.78 and 1.85 (2*d*, $J = 15.0$, CH_2(9)) with δ(C) 106.8 (*s*) in the HMBC spectrum (*Fig. 2*) of **2**, we assigned the MeO group to be placed at C(10). The β-orientations of H–C(6), H–C(7), and Me(19) were deduced from the ROESY spectrum (*Fig. 3*), in which the signal of δ(H) 1.48 (*d*, $J = 8.4$, H–C(2)) was correlated with δ(H) 1.20–1.25 (*m*, H–C(1)) and 4.48 (*t*, $J = 6.6$, H–C(6)), the signal of δ(H) 4.48 (*t*, $J = 6.6$, H–C(6)) with δ(H) 2.70 (*t*, $J = 6.1$, H–C(7)) and 1.45 (*s*, Me(19)). Therefore, compound **2** was identified as 6α-hydroxy-10β-methoxy-7α,8α-epoxy-5-oxocasbane-20,10-olide.

Compound **3** has the molecular formula of $C_{30}H_{48}O_2$ as evidenced by the HR-ESI-MS (*m*/*z* 463.3545, calc. 463.3552 for $C_{30}H_{48}NaO_2^+$), indicating seven degrees of unsaturation. The IR spectrum showed absorptions for OH (3434 cm^{-1}) and CO groups (1697 cm^{-1}), respectively. Analysis based on the combination of ^{1}H-, ^{13}C-NMR and DEPT data (*Table 2*) revealed the presence of seven Me groups, a terminal C=C bond (δ(H) 4.58, 4.67 and δ(C) 109.7, 150.2), and an O-bearing CH group (δ(H) 4.15 (*dd*, $J = 4.9$, 11.0) and δ(C) 69.6). The characteristic chemical shifts of the terminal C=C bond and five rings revealed that **3** was a lupane-type triterpenoid. The spectra data of **3** were similar to those of lup-20(29)-en-3β,15α-diol [16], except that one of the OH groups was replaced by a ketone group. The downfielded shifts of C(2)[1]) and C(4) in **3** indicated the location of the oxo group at the usual C(3) position. The only OH group was located at C(15), which was deduced from the correlations of δ(H) 4.15 (*dd*, $J =$ 4.9, 11.0) with δ(C) 47.9 (*s*, C(14)), 46.5 (*t*, C(16)), and 7.8 (*q*, C(27)) in the HMBC spectrum of **3** (*Fig. 2*). The α-orientation of the OH group was deduced from the observation of the correlations of δ(H) 4.15 (*dd*, $J = 4.9$, 11.0, H–C(15)) with δ(H) 0.83

Table 2. *^{1}H-NMR* (400 MHz) *and ^{13}C-NMR* (100 MHz) *Data of* **3** *and* **4** *in $CDCl_3$.* δ in ppm, J in Hz.

	3[1])			**4**[1])	
	δ(H)	δ(C)		δ(H)	δ(C)
CH_2(1)	1.37–1.41, 1.22–1.25 (2*m*)	39.8 (*t*)	C(2)		87.0 (*s*)
CH_2(2)	2.41–2.44 (*m*)	34.1 (*t*)	CH_2(3)	1.87–1.92, 1.59–1.64 (2*m*)	36.4 (*t*)
C(3)		218.2 (*s*)	CH_2(4)	2.02–2.06, 1.68–1.73 (2*m*)	32.0 (*t*)
C(4)		47.1 (*s*)	C(5)		201.7 (*s*)
H–C(5)	1.28–1.31 (*m*)	54.5 (*d*)	C(6)		141.9 (*s*)
CH_2(6)	1.51–1.53 (*m*)	19.8 (*t*)	C(7)		146.9 (*s*)
CH_2(7)	1.86–1.89, 1.33–1.37 (2*m*)	36.9 (*t*)	C(8)		198.8 (*s*)
C(8)		42.2 (*s*)	C(4a)		93.3 (*s*)
H–C(9)	1.40–1.43 (*m*)	50.2 (*d*)	C(8a)		81.2 (*s*)
C(10)		37.0 (*s*)	Me(1′)	1.36 (*s*)	24.2 (*q*)
CH_2(11)	1.48–1.51, 1.27–1.32 (2*m*)	21.5 (*t*)	Me(2′)	2.09 (*s*)	13.4 (*q*)
CH_2(12)	1.63–1.67 (*m*)	25.1 (*t*)	Me(3′)	2.10 (*s*)	13.0 (*q*)
H–C(13)	1.61–1.65 (*m*)	37.7 (*d*)	Me(4′)	1.39 (*s*)	25.8 (*q*)
C(14)		47.9 (*s*)	CH_2(1″)	1.55–1.63, 1.67–1.72 (2*m*)	41.4 (*t*)
H–C(15)	4.15 (*dd*, J = 11.0, 4.9)	69.6 (*d*)	CH_2(2″)	1.40–1.43, 1.23–1.28 (2*m*)	22.3 (*t*)
CH_2(16)	1.75–1.80, 1.28–1.34 (2*m*)	46.5 (*t*)	CH_2(3″)	1.05–1.24 (*m*)	37.3 (*t*)
C(17)		42.9 (*s*)	H–C(4″)	1.35–1.40 (*m*)	32.7 (*d*)
H–C(18)	1.38–1.44 (*m*)	47.9 (*d*)	CH_2(5″)	1.05–1.24 (*m*)	37.4 (*t*)
H–C(19)	2.37–2.43 (*m*)	47.3 (*d*)	CH_2(6″)	1.20–1.35 (*m*)	24.4 (*t*)
C(20)		150.2 (*s*)	CH_2(7″)	1.05–1.24 (*m*)	37.5 (*t*)
CH_2(21)	1.93–1.97, 1.31–1.36 (2*m*)	30.0 (*t*)	H–C(8″)	1.35–1.39 (*m*)	32.8 (*d*)
CH_2(22)	1.43–1.47, 1.17–1.23 (2*m*)	39.6 (*t*)	CH_2(9″)	1.05–1.24 (*m*)	37.5 (*t*)
Me(23)	1.05 (*s*)	26.5 (*q*)	CH_2(10″)	1.20–1.35 (*m*)	24.8 (*t*)
Me(24)	1.01 (*s*)	20.9 (*q*)	CH_2(11″)	1.10–1.15 (*m*)	39.3 (*t*)
Me(25)	0.93 (*s*)	16.0 (*q*)	H–C(12″)	1.48–1.54 (*m*)	27.9 (*d*)
Me(26)	1.15 (*s*)	16.2 (*q*)	Me(13″)	0.85–0.87[a])	22.6 (*q*)
Me(27)	0.96 (*s*)	7.8 (*q*)	Me(14″)	0.87–0.90[a])	19.7 (*q*)
Me(28)	0.83 (*s*)	19.0 (*q*)	Me(15″)	0.87–0.90[a])	19.8 (*q*)
CH_2(29)	4.67 (*s*), 4.58 (*s*)	109.7(*t*)	Me(16″)	0.85–0.87[a])	22.7 (*q*)
Me(30)	1.67 (*s*)	19.3 (*q*)	OH	3.86 (*s*)	

[a]) Overlapped.

(*s*, Me(28)) and 1.15 (*s*, Me(26)) in the ROESY spectrum (*Fig. 3*). Therefore, **3** was deduced as 15α-hydroxylup-20(29)-en-3-one.

Compound **4** was deduced as $C_{29}H_{50}O_4$ by HR-ESI-MS analysis (*m*/*z* 485.3606, calc. 485.3606 for $C_{29}H_{50}NaO_4^+$). The DEPT spectrum data of **4** (*Table 2*) showed the signals of eight Me and eleven CH_2 groups, indicating the existence of a long aliphatic chain. Comprising the ^{1}H- and ^{13}C-NMR data with those of VE-FPL (= 7a-acetyl-3,4,4a,7-tetrahydro-4a-hydroxy-2,6,7-trimethyl-2-(4,8,12-trimethyltridecyl)cyclopenta[*b*]pyran-5(2*H*)-one) [17], together with the degrees of unsaturation, **4** was found to be a tocopherol-related compound. The ^{13}C-NMR and DEPT spectra data of **4** (*Table 2*) showed the presence of two conjugated CO groups and one tetrasubstituted C=C bond, which was supported by the strong absorption at 1679 cm^{-1} and 253 nm in the IR and UV spectra of **4**, respectively. The close chemical shifts of the two CO groups (δ(C)

201.7, 198.8) and of the two olefinic C-atoms (δ(C) 146.9, 141.9) in **4** differentiated from those of in VE-FPL (δ(C) 205.0, 207.1 and 139.3, 163.1), indicating the left ring to be a six-membered in **4** instead of the five-membered in VE-FPL. This deduction was confirmed by the correlations of δ(H) 2.09 (*s*, Me(2′)[1])) with δ(C) 201.7 (*s*, C(5)) and 141.9 (*s*, C(6)), of δ(H) 2.10 (*s*, Me(3′)) with δ(C) 146.9 (*s*, C(7)) and 198.8 (*s*, C(8)) in the HMBC spectrum (*Fig. 2*) of **4**. Furthermore, the correlations of δ(H) (3.86, *s*, OH) with δ(C) 201.7 (*s*, C(5)), 93.3 (*s*, C(4a)), and 81.2 (*s*, C(8a)), of δ(H) 1.39 (*s*, Me(4′)) with δ(C) 93.3 (*s*) and 81.2 (*s*), of δ(H) 1.36 (*s*, Me(1′)) with δ(C) 87.0 (*s*, C(2)) and 36.4 (*t*, C(3)) were also observed. The relative configurations of the OH and the Me(4′) groups were assigned as α, based on the observation of the correlations of δ(H) 3.86 (*s*, OH) with δ(H) 1.36 (*s*, Me(1′)) and 1.39 (*s*, Me(4′)) in the ROESY spectrum (*Fig. 3*). Thus, compound **4** was identified as (2*R*,4a*R*,8a*R*)-3,4,4a,8a-tetrahydro-4a-hydroxy-2,6,7,8a-tetramethyl-2-(4,8,12-trimethyltridecyl)-2*H*-chromene-5,8-dione.

Experimental Part

General. Column chromatography (CC): silica gel (SiO_2; *Qingdao Marine Chemical Inc.*, P. R. China) and *RP-18* (20–40 μm, *Merck*). Optical rotations: *Horiba SEPA-300* spectropolarimeter. UV Spectra: *Shimadzu 210-A* double-beam spectrophotometer; λ_{max} (log ε) in nm. IR Spectra: *Bruker Tensor 27* spectrometer, KBr pellet and $\tilde{\nu}$ in cm^{-1}. NMR Spectra: *Bruker AM-500* spectrometer; δ in ppm with TMS as internal standard, *J* in Hz. HR-ESI-MS: *VG Autospec-3000* spectrometer.

Plant Material. The aerial parts of *Ricinus communis* L. were collected in Kunming, Yunnan province, P. R. China, in March, 2007, and identified by Dr. *Chun-Xia Zeng*, Kunming Institute of Botany. A voucher specimen (NO. KUN20070310) has been deposited with the Herbarium of Kunming Institute of Botany, Chinese Academy of Sciences.

Extraction and Isolation. The air-dried aerial parts (16.0 kg) of *Ricinus communis* L. were crushed and extracted with 95% aq. MeOH (30 l × 3) at r.t. (48 h × 3). After evaporation of MeOH, the viscous concentrate was dissolved in H_2O and partitioned with AcOEt (3 l × 4) to afford AcOEt and H_2O extracts. The AcOEt extract (325 g) was subjected to SiO_2 CC (2.2 kg, 200–300 mesh) and eluted with $CHCl_3$/Me_2CO (1:0 → 1:1) to give eight fractions (*Fr. I–VIII*). *Fr. III* (63.0 g) was subjected to CC (SiO_2; 700 g) and eluted with petroleum ether (PE)/acetone (20:1 → 8:1) to afford five subfractions (*Subfr. III1–III5*). *Subfr. III3* (6.1 g) was chromatographed on *RP-18* CC (MeOH/H_2O, 4:1 → 1:0), and then purified by SiO_2 CC (PE/AcOEt 12:1) to afford compound **4** (18.3 mg). *Fr. V* (103 g) was subjected to SiO_2 (1 kg) CC and eluted with PE/acetone (5:1 → 1:1) to afford six subfractions (*Subfr. V1–V6*). *Subfr. V2* (6.28 g) was subjected to *RP-18* CC (MeOH/H_2O, 3:1 → 1:0), and then purified by SiO_2 CC (Pt/acetone 10:1) to afford compound **3** (34.8 mg). Separation of *Subfr. V4* (4.5 g) with *RP-18* CC (MeOH/H_2O, 4:1 → 1:0) to give compound **1** (102 mg). *Subfr. V6* (7.8 g) was first subjected to *RP-18* CC (MeOH/H_2O, 4:1 → 1:0) and then to SiO_2 CC (PE/AcOEt 8:1) to afford compound **2** (16.4 mg).

*(3*E*,7*Z*,11*E*)-19-Hydroxycasba-3,7,11-trien-5-one* (= rel-*(1*R*,2*E*,10*E*,14*S*)-7-(Hydroxymethyl)-3,11,15,15-tetramethylbicyclo[12.1.0]pentadeca-2,6,10-trien-4-one*; **1**). Colorless oil. $[\alpha]_D^{20} = -16.8$ (*c* = 0.72, $CHCl_3$). UV ($CHCl_3$): 270 (4.74), 236 (4.46), 202 (4.29). IR (KBr): 3426, 2926, 1652, 1452, 1274, 1066, 1003. ^{1}H- and ^{13}C-NMR ($CHCl_3$): *Table 1*. HR-ESI-MS: 325.2147 ($[M+Na]^+$, $C_{20}H_{30}NaO_2^+$; calc. 325.2143).

6α-Hydroxy-10β-methoxy-7α,8α-epoxy-5-oxocasban-20,10-olide (= rel-*(1*R*,5*R*,6*R*,8*E*,10*S*,12*R*)-6-Hydroxy-1-methoxy-3,8,11,11-tetramethyl-4,17-dioxatetracyclo[13.2.1.0^{3,5}.0^{10,12}]octadeca-8,15(18)-diene-7,16-dione*; **2**). White amorphous powder. $[\alpha]_D^{20} = -38.7$ (*c* = 0.29, $CHCl_3$). UV ($CHCl_3$): 270 (4.78), 233 (4.54), 205 (4.45). IR (KBr): 3432, 1742, 1649, 1614, 1150, 960. ^{1}H- and ^{13}C-NMR ($CHCl_3$): *Table 1*. HR-ESI-MS: 399.1788 ($[M+Na]^+$, $C_{21}H_{28}NaO_6^+$; calc. 399.1783).

15α-Hydroxylup-20(29)-en-3-one (**3**). White amorphous powder. $[\alpha]_D^{20} = +48.3$ (*c* = 0.41, $CHCl_3$). IR (KBr): 3434, 2960, 2868, 1697, 1461, 1384. ^{1}H- and ^{13}C-NMR ($CHCl_3$): *Table 2*. HR-ESI-MS: 463.3545 ($[M+Na]^+$, $C_{30}H_{48}NaO_2^+$; calc. 463.3552).

rel-*(2*R*,4a*R*,8a*R*)-3,4,4a,8a-Tetrahydro-4a-hydroxy-2,6,7,8a-tetramethyl-2-(4,8,12-trimethyltridecyl)-2*H*-chromene-5,8-dione* (**4**). Colorless oil. $[\alpha]_D^{20} = -12.7$ ($c = 0.11$, $CHCl_3$). UV ($CHCl_3$): 352 (3.05), 339 (3.08), 253 (4.66), 228 (4.36), 210 (4.24), 201 (4.22). IR (KBr): 3487, 2954, 1679, 1462, 1377. ^{1}H- and ^{13}C-NMR ($CHCl_3$): *Table 2*. HR-ESI-MS: 485.3606 ($[M+Na]^+$, $C_{29}H_{50}NaO_4^+$; calc. 485.3601).

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