Triterpenoid Saponins from the Spikes of *Prunella vulgaris*

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Three new oleanane-skeleton triterpenoid saponins, 3β,4β,16α-17-carboxy-16,24-dihydroxy-28-norolean-12-en-3-yl 4-*O*-β-D-xylopyranosyl-β-D-glucopyranosiduronic acid (**1**), (3β,4β,16α)-17-carboxy-16,24-dihydroxy-28-norolean-12-en-3-yl β-D-glucopyranosiduronic acid methyl ester (**2**), and (3β,4β)-24-hydroxy-16-oxo-28-norolean-12-en-3-yl 4-*O*-β-D-xylopyranosyl-β-D-glucopyranosiduronic acid (**3**), together with eight known constituents, *i.e.*, the oleanane-type triterpenoids **4**–**6**, and the ursane-type triterpenoids **7**–**11**, were isolated from the spikes of *Prunella vulgaris*. The new structures were established by means of detailed spectroscopic analysis (IR, HR-ESI-MS, 1D- and 2D-NMR experiments). Compounds **1**–**3** were tested for their inhibition activity against the growth of tumor cell lines; only compound **3** displayed marginal inhibition activity.

Introduction. – *Prunella vulgaris* L. (Labiatae) is widely distributed in the temperate zone and tropical mountains of Europe and Asia. It has been used as a traditional Chinese medicine for the treatment of hypotensive, hypoglycemic, antibacterial, antiviral, anti-inflammatory, and antitumor activities [1]. From the 1980's to now, triterpenoid saponins, six ursolic acid derivatives, and two oleanolic acid derivatives have been isolated from the MeOH extract of *P. vulgaris* collected in France [2], and two oleanolic acid derivatives have been isolated from the EtOH extract of *P. vulgaris* collected in China [3][4]. However, no report was found about the biological activities of these saponins. To find the biologically active compounds, we isolated and elucidated three new oleanane-type triterpenoid saponins **1**–**3** and eight known triterpenoid compounds **4**–**11** from the spikes of this plant. Also the new triterpenoid saponins were tested for their inhibition activity *in vitro* against the growth of human-tumor cell lines following the conventional MTT method. Only compound **3** displayed marginal inhibition activity.

Results and Discussion. – The known compounds **4** [5], **5** [6], **6** [7], **7** [8], **8** [9], **9** [10], **10** [6], and **11** [7] were identified by comparison of their physical and spectral data with those reported in the literature. Compounds **1**–**3** were obtained as amorphous powders with adequate solubility in MeOH/H_2O. Their IR spectrum showed absorption bands for OH (3300–3500 cm^{-1}) and COOH (1710–1735 cm^{-1}) groups.

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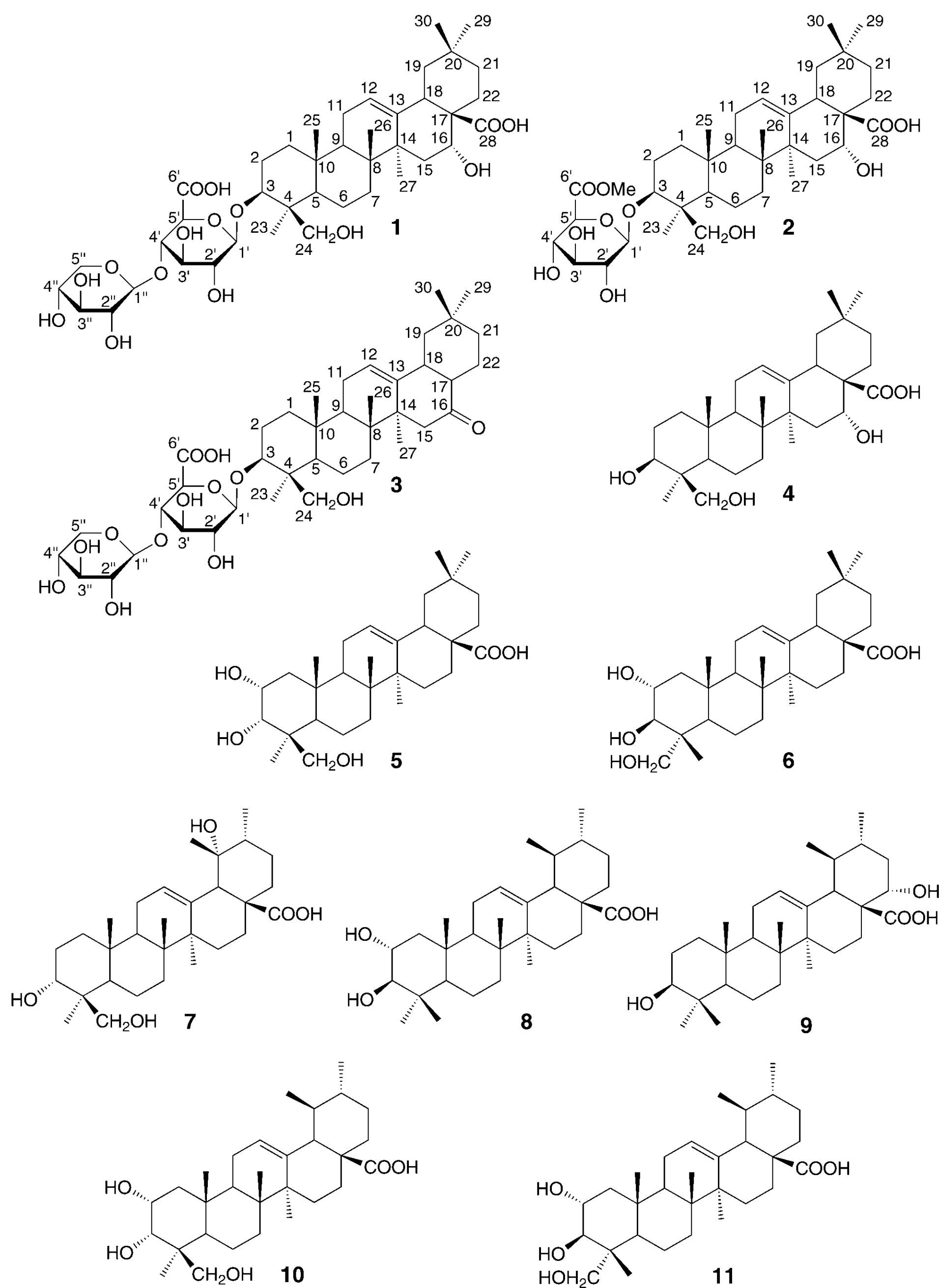

Compound **1**, obtained as a white amorphous powder, had the molecular formula $C_{41}H_{64}O_{15}$ according to HR-ESI-MS (*m/z* 819.4118 ([M+Na]$^+$)). The detailed analysis

of the ^{1}H- and ^{13}C-NMR (*Tables 1* and *2*), HMBC, HMQC, and ^{1}H,^{1}H-COSY data and comparison with literature data established the structure of **1** as (3β,4β,16α)-17-carboxy-16,24-dihydroxy-28-norolean-12-en-3-yl 4-*O*-β-D-xylopyranosyl-β-D-glucopyranosiduronic acid.

Table 1. *^{1}H-NMR Data for Compounds* **1**–**3** (500 MHz, pyridine)[a]). δ in ppm, J in Hz.

	1	**2**	**3**
CH_2(1)	0.84–0.87, 1.32–1.35 (2*m*)	0.84–0.87, 1.45–1.48 (2*m*)	1.10–1.13, 1.37–1.39 (2*m*)
CH_2(2)	1.95–1.98, 2.22–2.25 (2*m*)	1.99–2.01, 2.10–2.12 (2*m*)	1.92–1.97, 2.30–2.32 (2*m*)
H–C(3)	3.48 (*dd*, J=11.6, 4.2)	3.57–3.59 (*m*)	3.48 (*dd*, J=11.6, 4.4)
H–C(5)	0.89–0.92 (*m*)	0.91–0.94 (*m*)	0.82–0.86 (*m*)
CH_2(6)	1.30–1.32, 1.56–1.60 (2*m*)	1.33–1.37, 1.60–1.62 (2*m*)	1.37–1.39, 1.57–1.61 (2*m*)
CH_2(7)	1.32–1.35, 1.56–1.60 (2*m*)	1.33–1.37, 1.56–1.60 (2*m*)	1.13–1.16, 1.16–1.20 (2*m*)
H–C(9)	2.80 (*t*, J=13.6)	2.80 (*t*, J=13.1)	1.57–1.61 (*m*)
CH_2(11)	1.85–1.88, 1.85–1.88 (2*m*)	1.90–1.93, 1.90–1.93 (2*m*)	1.37–1.39, 2.30–2.32 (2*m*)
H–C(12)	5.58 (br. *s*)	5.59 (br. *s*)	5.38 (br. *s*)
CH_2(15)	1.69–1.72, 2.30–2.32 (2*m*)	1.71–1.74, 2.30–2.32 (2*m*)	2.13–2.16, 2.61–2.63 (2*m*)
H–C(16)	5.21 (br. *s*)	5.21 (br. *s*)	–
H–C(17)	–	–	1.92–1.97 (*m*)
H–C(18)	3.58 (*d*, J=13.1)	3.60 (*d*, J=13.8)	2.34–2.36 (*m*)
CH_2(19)	1.32–1.35, 1.69–1.72 (2*m*)	1.33–1.37, 1.71–1.74 (2*m*)	0.92–0.94, 1.71–1.74 (2*m*)
CH_2(21)	1.32–1.35, 2.47–2.50 (2*m*)	1.33–1.37, 2.47–2.50 (2*m*)	1.92–1.97, 1.69–1.72 (2*m*)
CH_2(22)	2.22–2.25, 2.38–2.41 (2*m*)	2.22–2.25, 2.38–2.41 (2*m*)	0.74–0.76, 1.31–1.34 (2*m*)
Me(23)	1.38 (*s*)	1.50 (*s*)	1.40 (*s*)
CH_2(24)	3.51, 4.32 (*d*, J=11.6)	3.58, 4.31(*d*, J=11.3)	3.54, 4.34 (*d*, J=11.6)
Me(25)	0.73 (*s*)	0.77 (*s*)	0.73 (*s*)
Me(26)	0.95 (*s*)	0.96 (*s*)	0.70 (*s*)
Me(27)	1.83 (*s*)	1.83 (*s*)	1.07 (*s*)
Me(29)	1.03 (*s*)	1.04 (*s*)	0.93 (*s*)
Me(30)	1.15 (*s*)	1.15 (*s*)	0.85 (*s*)
H–C(1′)	4.99 (*d*, J=7.6)	5.09 (*d*, J=7.8)	5.00 (*d*, J=7.6)
H–C(2′)	4.30–4.34 (*m*)	4.03–4.05 (*m*)	4.31–4.34 (*m*)
H–C(3′)	4.56–4.61 (*m*)	4.22–4.25 (*m*)	4.56–4.62 (*m*)
H–C(4′)	4.26–4.30 (*m*)	4.42–4.46 (*m*)	4.30–4.33 (*m*)
H–C(5′)	4.56–4.61 (*m*)	4.60–4.62 (*m*)	4.56–4.62 (*m*)
MeO	–	3.70 (*s*)	–
H–C(1″)	5.50 (*d*, J=7.5)	–	5.49 (*d*, J=7.5)
H–C(2″)	4.13–4.15 (*m*)	–	4.14–4.16 (*m*)
H–C(3″)	4.09–4.11 (*m*)	–	4.10–4.12 (*m*)
H–C(4″)	4.28–4.32 (*m*)	–	4.30–4.32 (*m*)
CH_2(5″)	3.61–3.65, 4.40–4.43 (2*m*)	–	3.63–3.65, 4.42–4.44 (2*m*)

[a]) Assignments were based on COSY, HMQC, and HMBC experiments, and due to severe overlapping, only detectable relative J [Hz] are reported.

The ^{1}H-NMR spectrum of **1** showed one C=C–H moiety at δ(H) 5.58 (br. *s*), and 6 Me-group *s* at δ(H) 0.73, 0.95, 1.03, 1.15, 1.38, and 1.83. The ^{13}C-NMR spectrum of **1** exhibited signals of a C=C moiety at δ(C) 122.3 and 145.1, and a COOH function at δ(C) 179.9, which were characteristic of an olean-12-en-28-oic acid type triterpenoid. The detailed NMR and MS data analysis and comparison with reference data [5] indicated that the aglycone is (3β,4β,16α)-3,16,24-trihydroxyolean-12-en-28-oic acid. In the

Table 2. *^{13}C-NMR Data for Compounds* **1**–**3** (125 MHz, pyridine)[a]). δ in ppm

	1	**2**	**3**		**1**	**2**	**3**
C(1)	38.8 (*t*)	38.6 (*t*)	38.7 (*t*)	C(22)	32.8 (*t*)	32.8 (*t*)	38.4 (*t*)
C(2)	26.7 (*t*)	26.9 (*t*)	26.6 (*t*)	C(23)	22.7 (*q*)	23.3 (*q*)	22.7 (*q*)
C(3)	90.5 (*d*)	89.1 (*d*)	90.4 (*d*)	C(24)	62.9 (*t*)	63.2 (*t*)	62.8 (*t*)
C(4)	44.3 (*s*)	44.8 (*s*)	44.2 (*s*)	C(25)	15.4 (*q*)	15.4 (*q*)	15.2 (*q*)
C(5)	56.5 (*d*)	56.3 (*d*)	56.4 (*d*)	C(26)	17.3 (*q*)	17.4 (*q*)	16.6 (*q*)
C(6)	18.8 (*t*)	18.9 (*t*)	18.9 (*t*)	C(27)	27.2 (*q*)	27.2 (*q*)	25.5 (*q*)
C(7)	33.7 (*t*)	33.8 (*t*)	33.4 (*t*)	C(28)	179.9 (*s*)	179.9 (*s*)	–
C(8)	39.8 (*s*)	39.9 (*s*)	38.6 (*s*)	C(29)	33.3 (*q*)	33.4 (*q*)	33.3 (*q*)
C(9)	47.0 (*d*)	47.1 (*d*)	47.3 (*d*)	C(30)	24.7 (*q*)	24.8 (*q*)	24.7 (*q*)
C(10)	36.7 (*s*)	36.8 (*s*)	36.9 (*s*)	C(1′)	105.1 (*d*)	106.5 (*d*)	105.2 (*d*)
C(11)	23.9 (*t*)	24.1 (*t*)	23.9 (*t*)	C(2′)	78.0 (*d*)	75.3 (*d*)	78.0 (*d*)
C(12)	122.3 (*d*)	122.3 (*d*)	125.2 (*d*)	C(3′)	73.2 (*d*)	77.8 (*d*)	73.2 (*d*)
C(13)	145.1 (*s*)	145.1 (*s*)	142.6 (*s*)	C(4′)	80.8 (*d*)	73.2 (*d*)	80.8 (*d*)
C(14)	42.1 (*s*)	42.2 (*s*)	42.8 (*s*)	C(5′)	77.6 (*d*)	77.3 (*d*)	77.7 (*d*)
C(15)	36.2 (*t*)	36.2 (*t*)	44.3 (*t*)	C(6′)	172.3 (*s*)	170.6 (*s*)	172.4 (*s*)
C(16)	74.7 (*d*)	74.7 (*d*)	213.8 (*s*)	MeO	–	52.0 (*q*)	–
C(17)	48.9 (*s*)	48.9 (*s*)	49.7 (*d*)	C(1″)	105.6 (*d*)	–	105.6 (*d*)
C(18)	41.4 (*d*)	41.5 (*d*)	37.0 (*d*)	C(2″)	75.7 (*d*)	–	75.8 (*d*)
C(19)	47.2 (*t*)	47.3 (*t*)	42.9 (*t*)	C(3″)	78.6 (*d*)	–	78.6 (*d*)
C(20)	31.0 (*s*)	31.1 (*s*)	30.6 (*s*)	C(4″)	70.8 (*d*)	–	70.8 (*d*)
C(21)	36.1 (*t*)	36.1 (*t*)	32.1 (*t*)	C(5″)	67.2 (*t*)	–	67.3 (*t*)

[a]) Assignments were based on COSY, HMQC, and HMBC experiments.

^{13}C-NMR spectra of **1**, the signals at δ(C) 172.3 (*s*), 105.1 (*d*), 80.8 (*d*), 78.0 (*d*), 77.6 (*d*), and 73.2 (*d*) indicated a β-D-glucopyranuronic acid moiety and those at δ(C) 105.6 (*d*), 78.6 (*d*), 75.7 (*d*), 70.8 (*d*), and 67.2 (*t*) a β-D-xylopyranose moiety. The disaccharide nature was deduced from the presence of two anomeric-proton signals at δ 4.99 (*d*, J=7.6 Hz) and 5.50 (*d*, J=7.5 Hz) in the ^{1}H-NMR spectrum and assigned to consist of pyranose forms with β-anomeric configuration. The ^{1}H,^{13}C-HMBC cross-peaks between H–C(3) at δ(H) 3.48 and C(1′) at δ(C) 105.1, as well as between H–C(1′) at δ(H) 4.99 and C(3) at δ(C) 90.5 indicated that the glucuronic acid unit was attached at C(3) of the aglycone. The attachment of the xylose unit to C(4′) was established by the following ^{1}H,^{13}C-HMBC correlations: H–C(4′) at *ca.* δ(H) 4.26 with C(1″) at δ(C) 105.6, and H–C(1″) at δ(H) 5.50 with C(4′) at δ(C) 80.8 (*Fig. 1*).

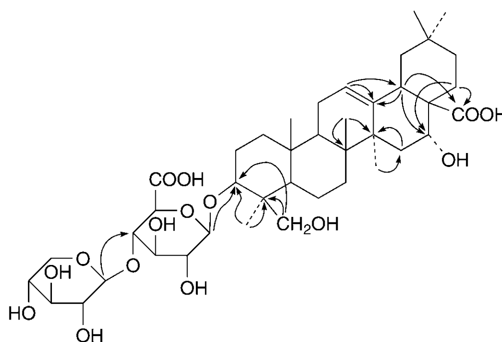

Fig. 1. *Key HMBC correlations of* **1**

Compound **2**, obtained as a white amorphous powder, was shown to have the molecular formula $C_{37}H_{58}O_{11}$ based on HR-ESI-MS (*m/z* 701.2164 ([*M*+Na]$^+$)). The ^{1}H- and ^{13}C-NMR data of **2** (*Tables 1* and *2*) were very similar to those of **1**, so compounds **1** and **2** shared the same aglycone. Its structure was established as (3*β*,4*β*,16*α*)-17-carboxy-16,24-dihydroxy-28-norolean-12-en-3-yl *β*-D-glucopyranosiduronic acid methyl ester.

In the ^{13}C-NMR, the signals at *δ*(C) 170.6 (*s*), 106.5 (*d*), 77.8 (*d*), 77.3 (*d*), 75.3 (*d*), 73.2 (*d*), and 52.0 (*q*) showed that **2** contains a *β*-D-glucopyranuronic acid methyl ester. The monosaccharide moiety attached at C(3) of the aglycone was established from the following HMBC correlations: H−C(3) at *δ*(H) *ca.* 3.57 with C(1′) at *δ*(C) 106.5, and H−C(1′) at *δ*(H) 5.09 (*d*, *J*=7.8 Hz) with C(3) at *δ*(C) 89.1.

Compound **3**, obtained as a white amorphous powder, was assigned the molecular formula $C_{40}H_{62}O_{13}$ by HR-ESI-MS (*m/z* 773.4051 ([*M*+Na]$^+$)). The ^{1}H- and ^{13}C-NMR (*Tables 1* and *2*), HMBC, HMQC, and ^{1}H,^{1}H-COSY data and comparison with those of **1** and camellenodiol (=(3*β*)-3,17-dihydroxy-28-norolean-12-en-16-one) [11] determined the structure of **3** to be (3*β*,4*β*)-24-hydroxy-16-oxo-28-norolean-12-en-3-yl 4-*O*-*β*-D-xylopyranosyl-*β*-D-glucopyranosiduronic acid.

The NMR data for the sugar part of **3** bore a close resemblance to those of **1**, revealing that **3** has a sugar-substitution pattern in common with **1**. The aglycone was a nortriterpenoid, $C_{29}H_{46}O_3$, identified by NMR and MS analysis. The ^{13}C-NMR data (*Table 2*) for the aglycones of **3** and camellenodiol were very close, except for those of C(17), C(18), C(22), C(23), and C(24). In the ^{13}C-NMR spectrum of camellenodiol, the signals at *δ*(C) 76.5 (*s*, C(17)), 52.5 (*d*, C(18)), 37.7 (*t*, C(22)), 28.1 (*q*, C(23)), and 15.4 (*q*, C(24)) were replaced in **3** by signals at *δ*(C) 49.7 (*d*), 37.0 (*d*), 38.4 (*t*), 22.7(*q*), and 62.8 (*t*), respectively, the HMBC correlation of H−C(17) and C(16) in **3** indicating that OH−C(17) of camellenodiol was absent in **3**, whereas an OH group at C(24) was present in **3** (*Fig. 2*).

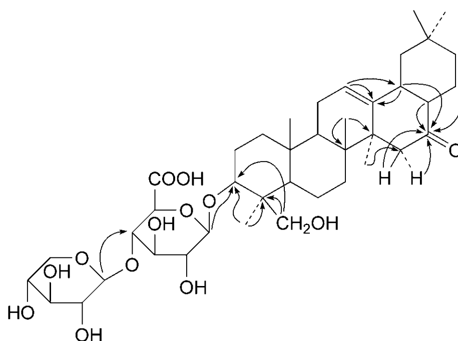

Fig. 2. *Key HMBC correlations of* **3**

Compounds **1**–**3** were tested for their inhibition activity *in vitro* against the growth of human hepatoma cells (SMMC-7721), human mammary-cancer cells (MCF7), and human cervical-carcinoma cells (HeLa) by the conventional MTT method. Only compound **3** displayed a marginal inhibition activity against cell lines SMMC-7721, with IC_{50} values around 35 μM.

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Experimental Part

General. TLC: silica gel GF_{254} (10–40 μm; *Qingdao Marine Chemical Factory*). Column chromatography (CC): silica gel (200–300 mesh; *Qingdao Marine Chemical Factory*); C_{18} reversed-phase silica gel (250 mesh; *Merck*); macroporous resin *D101* (*Shanghai Resin Factory*, China). Optical rotation (ORD): *Jasco P-1020* spectropolarimeter. IR Spectra: *Avatar 360-ESP* spectrophotometer (*Thermo Nicolet*); KBr pellets; in cm^{-1}. ^{1}H- and ^{13}C-NMR Spectra: *Bruker AV-500* spectrometers; (D_5)pyridine soln.; δ in ppm rel. to Me_4Si, J in Hz. HR-ESI-MS: *Bruker APEX-II* mass spectrometer; in m/z.

Plant Material. The spikes of *P. vulgaris* were collected in Xuyi County, Jiangsu Province, P. R. China, in June 2004, and were identified by Prof. *Shihui Qian*, Department of Pharmacognosy, Jiangsu Academy of Chinese Traditional Medicine. A voucher specimen (No. JPPWFC-2004525) was deposited in the Jiangsu Academy of Chinese Traditional Medicine.

Extraction and Isolation. The dried spikes of *P. vulgaris* (35 kg) were extracted at r.t. with 50% EtOH. The extract was concentrated and partitioned sequentially with petroleum ether, $CHCl_3$, and BuOH. The BuOH-soluble part was subjected to CC (macroporous resin *D101*, H_2O, then 50% EtOH). The fraction eluted with 50% EtOH was concentrated to yield a triterpene-enriched fraction (180 g), which was separated by CC (SiO_2, $CHCl_3$/MeOH 50 : 1, 20 : 1, 10 : 1, 5 : 1, 3 : 1, and 1 : 1): *Fractions 1–6*. *Fr. 4* was further separated by CC (1. SiO_2, $CHCl_3$/MeOH 6 : 1; 2. C_{18}, MeOH/H_2O 75 : 25): **2** (26.2 mg). *Fr. 5* was further separated by CC (1. SiO_2, $CHCl_3$/MeOH 4 : 1; 2. C_{18}, MeOH/H_2O 65 : 35): **1** (96.4 mg) and **3** (100.2 mg).

Assays of Cytotoxicity. Cell Cultures. Human hepatoma cells (SMMC-7721), human mammary-cancer cells (MCF7), and human cervical-carcinoma cells (HeLa) were cultivated at 37° in an atmosphere of 5% CO_2 in *RPMI-1640* medium (*Gibco*) supplemented with 10% of fetal calf serum. The survival rates were determined by the conventional MTT method.

MTT Colorimetric Assay. Compounds were prepared as 10 mM top stocks, dissolved in DMSO, and stored at 4°, protected from light. The tumor cells were routinely cultivated at 37° in an atmosphere of 5% CO_2 in *RPMI-1640* medium (*Gibco*) supplemented with 10% fetal calf serum (*Sijiqing Biomaterial Co.*, Hangzhou, China) and subcultured twice weekly to maintain continuous logarithmic growth. The cells ($5 \cdot 10^3$ cells/well) were cultured into 96-well microtiter plates and allowed to adhere for 24 h before drugs were introduced. Serial drug dilutions were added to each culture. At the time of drug addition (parallel triplicate wells were set) and following 48 h of exposure, MTT soln. (10 μl; 5 mg/ml) was added to each well. After a further 4 h of incubation, DMSO (150 μl) was added to each well, and the formazan crystals in each well were dissolved by stirring with a pipette. Absorbance was read on a systems plate reader (*Tohso MPR-A4i*) at 570 nm as a measure of cell viability. Thus, cell growth or drug toxicity was determined.

*(3β,4β,16α)-17-Carboxy-16,24-dihydroxy-28-norolean-12-en-3-yl 4-*O*-β-*D*-Xylopyranosyl-β-*D*-glucopyranosiduronic Acid* (**1**): White amorphous powder. M.p. 218–220°. $[\alpha]_D^{25} = -20.1$ (c = 0.2, MeOH). ^{1}H- and ^{13}C-NMR (DEPT): *Tables 1* and *2*. ^{1}H,^{13}C-HMBC: *Fig. 1*. HR-ESI-MS: 819.4118 ($[M + Na]^+$, $C_{41}H_{64}NaO_{15}^+$; calc. 819.4143).

*(3β,4β,16α)-17-Carboxy-16,24-dihydroxy-28-norolean-12-en-3-yl β-*D*-Glucopyranosiduronic Acid Methyl Ester* (**2**): White amorphous powder. M.p. 239–240°. $[\alpha]_D^{25} = -17.8$ (c = 0.2, MeOH). ^{1}H- and ^{13}C-NMR (DEPT): *Tables 1* and *2*. HR-ESI-MS: 701.2164 ($[M + Na]^+$, $C_{37}H_{58}NaO_{11}^+$; calc. 701.2187).

*(3β,4β)-24-Hydroxy-16-oxo-28-norolean-12-en-3-yl 4-*O*-β-*D*-Xylopyranosyl-β-*D*-glucopyranosiduronic Acid* (**3**): White amorphous powder. M.p. 209–210°. $[\alpha]_D^{25} = -34.1$ (c = 0.2, MeOH). ^{1}H- and ^{13}C-NMR (DEPT): *Tables 1* and *2*. ^{1}H,^{13}C-HMBC: *Fig. 2*. HR-ESI-MS: 773.4051 ($[M + Na]^+$, $C_{40}H_{62}NaO_{13}^+$; calc. 773.4088).

REFERENCES

[1] Jiangsu College of New Medicine, 'A Dictionary of the Traditional Chinese Medicines', People's Hygiene Publisher, Shanghai, 2004, p. 1827.
[2] Y. J. Zhang, C. R. Yang, *Acta Botanica Yunnanica* **1995**, *17*, 468.
[3] Z. J. Wang, Y. Y. Zhao, G. Z. Tu, S. L. Hong, Y. Y. Chen, *Acta Pharmaceutica Sin.* **1999**, *34*, 679.
[4] J. Tian, Z. Y. Xiao, Y. Y. Chen, Y. Y. Zhao, Z. J. Wang, *Acta Pharmaceutica Sin.* **2000**, *35*, 29.
[5] H. Kizu, T. Tomimori, *Chem. Pharm. Bull.* **1982**, *30*, 3340.
[6] H. Kojima, H. Tominaga, S. Sato, H. Ogura, *Phytochemistry* **1987**, *26*, 1107.
[7] D. J. Collins, C. A. Pilotti, A. F. A. Wallis, *Phytochemistry* **1992**, *31*, 881.
[8] M. Takani, K. Kubota, M. Nozawa, T. Ushiki, K. Takahashi, *Chem. Pharm. Bull.* **1977**, *25*, 981.
[9] H. Kojima, H. Ogura, *Phytochemistry* **1986**, *25*, 729.
[10] X. M. Zhang, C. F. Wang, D. G. Wu, *Acta Botanica Yunnanica* **1992**, *14*, 211.
[11] D. D. Rowan, R. H. Newman, *Phytochemistry* **1984**, *23*, 639.

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