Four New Eudesmanes from *Caragana intermedia* and Their Biological Activities

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Four new eudesmanes, namely, 4(15)-eudesmene-1β,7α-diol (**1**), 4(15)-eudesmene-1β,7β-diol (**2**), 7-trinoreudesma-4(15),8-dien-1β-ol-7-one (**3**), and eudesma-4(15),7-dien-1β-ol (**4**), as well as three known compounds, 5-*epi*-eudesma-4(15)-ene-1β,6β-diol (**5**), 4(15)-eudesmene-1β,6α-diol (**6**), and 4(15)-eudesmene-1β,5α-diol (**7**), were isolated from the aerial part of *Caragana intermedia*. The structures were elucidated by spectroscopic and spectrometric analyses including 1D, 2D NMR, HRMS, and IR. The structures of compounds **1**, **5**, **6**, and **7** were confirmed by X-ray crystallographic analysis. Compound **7** showed glucose consumption activity with an IC value of 10.7 μg/mL in a C_2C_{12} muscle cell assay. The MIC value of this compound (100 mg/kg) in a db/db mice model is equivalent to that of metformin in vivo.

Caragana intermedia Kuang et H. C. Fu (family Leguminosae) is widely distributed in the desert of the northwest part of China. Its roots, blossoms, and stems have been used to heal the symptoms of menstrual disorders, fatigue, and asthenia in folk medicine.[1] Recently, our research showed that the crude extract of the plant exhibited antitumor activities inhibiting cervical and breast cancer in vitro and that the chloroform extracts and nonpolar fraction of its ethyl acetate extracts exhibited weak anti-HIV bioactivity. In the present work, the chemical investigation of the chloroform extract of the aerial part led to the isolation of seven eudesmane-type sesquiterpenes: 4(15)-eudesmene-1β,7α-diol (**1**), 4(15)-eudesmene-1β,7β-diol (**2**), 7-trinoreudesma-4(15),8-dien-1β-ol-7-one (**3**), and eudesma-4(15),7-dien-1β-ol (**4**), as well as three known compounds, 5-*epi*-eudesma-4(15)-ene-1β,6β-diol (**5**), 4(15)-eudesmene-1β,6α-diol (**6**), and 4(15)-eudesmene-1β,5α-diol (**7**). It is the first time that so many eudesmane-sesquiterenes were found from a plant in this family. The bioassay showed that compound **5** exhibited weak anti-HIV activity, with an IC_{50} value of 10μg/mL. Compounds **1**, **2**, and **7** showed anti-*Pyricularia oryzae* P-2b activities, with MIC values of 12, 16, and 20 μg/mL. Compound **7** showed glucose consumption activity using C_2C_{12} muscle cells with an IC_{50} value of 10.7 μg/mL and glucose consumption in db/db mice with an MIC value of 100 mg/kg. In this paper, the isolation, structural elucidation, and biological activities of compounds from *C. intermedia* are reported.

Results and Discussion

Compound **1** had a molecular formula of $C_{15}H_{26}O_2$ deduced from HRMS ([M$^+$] *m/z* 238.1926, calc 238.1933). The ^{1}H and ^{13}C NMR spectra (Tables 1 and 2) showed the presence of three methyls [a tertiary methyl (δ 0.66, s, 3H); two isopropyl methyls (δ 1.05, d, *J* 6.9 Hz, 3H; δ 0.91, d, *J* 6.9 Hz, 3H)], five methylenes, an olefinic methylene [exocyclic double bond (δ 4.47, s, 1H; δ 4.76, s, 1H)], two methines, an oxymethine (δ 3.51, dd, *J* 11.4, 4.1 Hz, 1H), an olefinic quaternary carbon (exocyclic double bond, δ 149.0), an oxyquaternary carbon (δ 73.6), and a quaternary carbon (δ 40.1). A hydroxyl group was indicated by the IR absorption band at 3416 cm^{-1}. Analysis of the HMQC and HMBC spectra (Figure 2) revealed the existence of a eudesmene skeleton. Thus, the structure of **1** was deduced to be a eudesmene with two hydroxyl groups at C-1 (δ 79.1) and C-7 (δ 73.6) and an exocyclic double bond at C-4 (δ 149.0) (Figure 1). Analysis of the coupling constants and NOESY data established the relative configuration and conformation of **1** as shown in Figure 3. NOE correlations between H-1 and H-5α and H-9α confirmed the orientation of the hydroxyl group at C-1, the H-5, and the C-14 methyl group as being β-, α-, and β-oriented, respectively. The β-orientation of the C-7 isopropyl group and α-orientation of the C-7 hydroxyl group were confirmed by X-ray analysis (Figure 4). Accordingly, the complete structure of **1** was elucidated to be 4(15)-eudesmene-1β,7α-diol.

Table 1. ^{13}C NMR Data of Compounds **1**−**7** (100 MHz, $CDCl_3$)

C	**1**	**2**	**3**	**4**	**5**	**6**	**7**
C-1	79.1	79.4	73.7	79.4	68.1	79.1	73.1
C-2	31.6	34.1	31.7	31.4	31.1	32.0	30.6
C-3	34.4	34.2	33.5	34.3	29.8	35.2	29.8
C-4	149.0	148.1	145.5	148.4	145.5	146.3	150.7
C-5	41.9	43.9	45.4	42.9	61.7	55.9	76.2
C-6	31.9	31.5	36.5	25.4	67.2	67.1	34.3
C-7	73.6	74.1	199.4	141.5	49.1	49.4	38.3
C-8	29.1	31.8	127.2	115.8	18.1	18.2	23.7
C-9	32.2	33.9	156.9	38.3	34.4	36.4	30.0
C-10	40.1	40.1	42.8	38.9	40.1	41.8	42.3
C-11	39.1	29.0		35.0	26.5	26.1	32.8
C-12	16.9	16.0		21.7	16.3	16.2	19.7
C-13	16.9	16.2		21.2	20.9	21.2	20.0
C-14	9.2	10.4	11.4	10.3	21.3	11.7	12.7
C-15	106.7	107.2	108.9	107.6	114.2	107.9	108.6

Compound **2** had a molecular formula of $C_{15}H_{26}O_2$ deduced from HRMS ([M$^+$] *m/z* 238.1926, calc 238.1933). ^{1}H NMR signals of **2** were similar to those of compound **1**. NOE correlations between H-1 and H-5α and H-9α confirmed the orientation of the hydroxyl group at C-1, H-5, and the C-14 methyl group as β-, α-, and β-oriented, respectively, which were identical to those in compound **1**. NOE correlations between H-5 and H-13 of **2** indicated the α-orientation of the C-7 isopropyl group and β-orientation of the C-7 hydroxyl group. Accordingly, the structure of compound **2** was elucidated to be 4(15)-eudesmene-1β,7β-diol.

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Table 2. ^{1}H NMR Data of Compounds **1**−**7** (500 MHz, $CDCl_3$, *J* in Hz)

H	1	2	3	4	5	6	7
H-1	3.51, dd (11.4,4.1)	3.43, dd (11.7,4.7)	3.65, dd (11.2,4.7)	3.47, dd (11.7,4.3)	3.94, dd (11.7,4.9)	3.42, dd (11.7,4.8)	4.05, dd (11.6,5.0)
H-2α	1.82, m	1.62, m	1.94, m	1.79, m	1.86, m	1.85, m	1.85, m
H-2*β*	1.59, m	2.12, td (13.2,4.7)	1.66, qd (13.7,5.3)	1.56, m	1.60, qd (11.7,5.8)	1.53, qd (11.7,5.0)	1.55, m
H-3α	2.30, dd (13.4,3.2)	2.34, dd (13.2,3.2)	2.38, ddd (13.7,4.5,1.6)	2.35, dq (11.0,1.6)	2.28, m	2.35, m	2.70, m
H-3*β*	2.14, m	1.84, m	2.16, td (13.7,5.3)	2.12, m	2.28, m	2.09, m	2.15, ddd (13.8,5.3,1.8)
H-4							
H-5	2.17, t (9.7)	1,78, m	2.50, m	1.95, m	1.84, d (10.2)	1.75, br d (9.8)	
H-6α	1.47, m	1.81, m	2.47, m	2.01, m	3.51, t (10.2)	3.71, td (9.8,1.7)	1.57, dd (13.2,4.1)
H-6*β*	1.55, m	1.52, m	2.50, m	1.95, m			1.54, m
H-7					1.22, tt (12.6,2.8)	1.30, m	1.58, m
H-8α	1.52, m	1.85, m	5.96, d (10.1)	5.34, t (5.2)	1.26, qd (12.9,2.8)	1.25, m	1.25, m
H-8*β*	1.52, m	1.58, m			1.45, dq (13.5,3.4)	1.53, m	1.60, m
H-9α	1.50, m	1.81, m	7.33, d (10.1)	1.93, d (5.2)	1.04, td (13.3,3.4)	1.20, m	1.68, m
H-9*β*	1.74, m	1.87, m		2.17, d (5.0)	2.06, dt (13.8,3.0)	1.90, m	1.68, dd (13.2,4.0)
H-10							
H-11	1.63, sept (6.8)	2.03, sept (6.9)		2.21, sept (6.9)	2.26, sept, d (7.1,2.1)	2.25, sept, d (7.0,2.4)	1.50, m
H-12	0.95, d (6.8)	0.89, d (6.9)		1.02, d (6.9)	0.85, d (7.1)	0.87, d (7.0)	0.92, d (6.8)
H-13	0.95, d (6.8)	0.93, d (6.9)		1.02, d (6.9)	0.94, d (7.1)	0.95, d (7.0)	0.90, d (6.8)
H-14	0.65, s	0.76, s	0.96, s	0.65, s	0.85, s	0.70, s	0.76, s
H-15α	4.47, s	4.53, s	4.60, s	4.65, d (1.1)	4.83, s	4.74, d (1.1)	4.85, s
H-15*β*	4.76, s	4.78, s	4.94, s	4.83, d (1.1)	4.97, s	5.02, d (1.1)	4.74, s

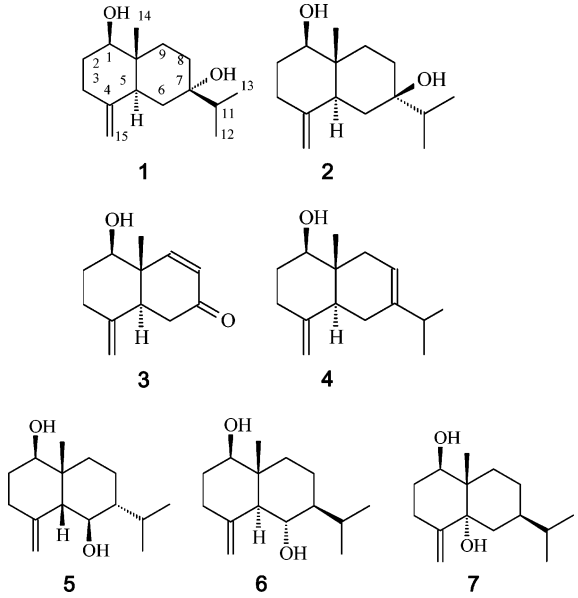

Figure 1. Structures of compounds **1**−**7**.

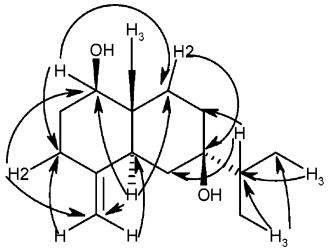

Figure 2. Selected HMBC correlations for compound **1**.

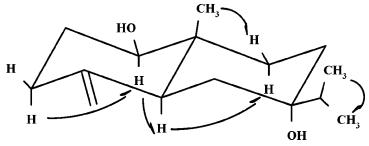

Figure 3. Selected NOESY correlations for compound **1**.

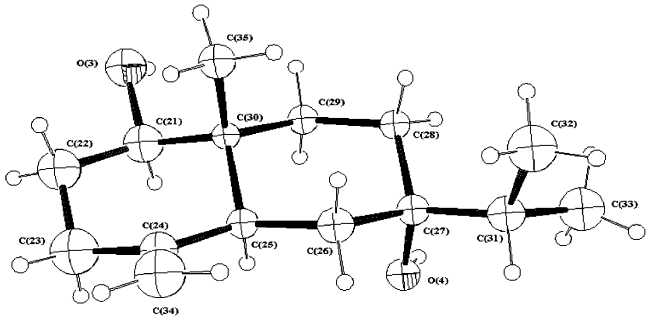

Figure 4. ORTEP drawing of compound **1**.

Compound **3** had a molecular formula of $C_{12}H_{16}O_2$ deduced from HRMS ($[M]^+$ *m/z* 192.1134, calc 192.1150) analysis. The NMR spectral data of **3** (Tables 1 and 2) showed the presence of a tertiary methyl (*δ* 0.96, s, 3H), three methylenes, an olefinic methylene (exocyclic double bond, *δ* 4.60, s, 1H; *δ* 4.96, s, 1H), two olefinic methines (*δ* 5.96, d, *J* 10.1 Hz, 1H; *δ* 7.33, d, *J* 10.1 Hz, 1H), one methine (*δ* 2.50, m, 1H), an oxymethine (*δ* 3.65, dd, *J* 11.2, 4.7 Hz, 1H), an olefinic quaternary carbon (exocyclic double bond, *δ* 145.5), a quaternary carbon (*δ* 42.8), and a carbonyl group (*δ* 199.4). Analysis of the HMQC and HMBC data (Figure 7) indicated that **3** was partially similar to **1**. The isopropyl group at C-7 (*δ* 73.6) in **1** was replaced by a carbonyl group at C-7 (*δ* 199.4) in **3**. The presence of the carbonyl group was confirmed by the IR absorption band at 1676 cm^{-1}. A hydroxyl group at C-1 (*δ* 73.7, *δ* 3.65, dd, *J* 11.2, 4.7 Hz) was confirmed by the IR absorption band

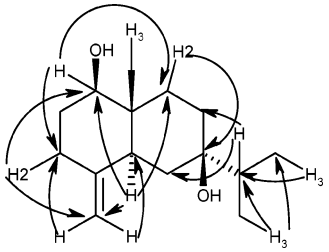

Figure 5. Selected HMBC correlations for compound **2**.

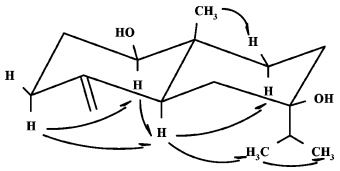

Figure 6. Selected NOESY correlations for compound **2**.

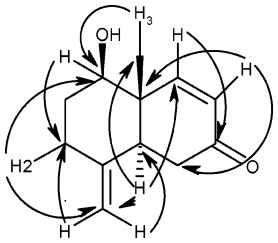

Figure 7. Selected HMBC correlations for compound **3**.

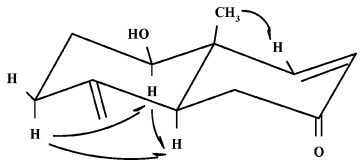

Figure 8. Selected NOESY correlations for compound **3**.

at 3608 cm^{-1}. Analysis of the HMBC spectrum of **3** indicated the presence of an α,β-unsaturated ketone. H-9 and H-8 occurred as doublets (J 10.1 Hz) at δ 7.33 and 5.96, respectively. The corresponding carbon resonance occurred at δ 156.9 and 127.2. The C-7 carbon resonance (δ 199.4) showed an HMBC correlation with H-9, and the C-9 resonance showed a correlation with the H-14 resonance at δ 0.96, confirming the location of the 8,9-double bond. Analysis of the coupling constants and NOESY data established the conformation and relative configuration of **3** as shown in Figure 8. The existence of NOE correlations between H-1 and H-5α and H-9α proposed the orientation of the hydroxyl group at C-1, H-5, and the C-14 methyl group as β-, α-, and β-oriented, respectively. Thus the structure of compound **3** was elucidated to be 7-trinoreudesma-4(15),8-dien-1β-ol-7-one.

Compound **4** had a molecular formula of $C_{15}H_{24}O$ deduced from HRMS ($[M]^+$ m/z 220.1835, calcd 220.1927) analysis. The NMR spectra (Tables 1 and 2) showed the presence of three methyls [a tertiary methyl (δ 0.65, s, 3H); two isopropyl methyls (δ 1.02, d, J 6.9 Hz, 3H; δ 1.02, d, J 6.9 Hz, 3H)], four methylenes, an olefinic methylene [exocyclic double bond (δ 4.65, d, J 1.1 Hz, 1H; δ 4.83, d, J 1.1 Hz, 1H)], an olefinic methine (δ 5.34, d, J 5.2 Hz, 1H; δ 115.8), a methine, two oxyquaternary carbons (δ 148.4, δ 141.5), a quaternary carbon (δ 38.9), and an oxymethine hydrogen (δ 3.47, dd, J 11.7, 4.3 Hz, 1H; δ 79.4). All protonated carbons were assigned from the HMQC spectrum. In the HMBC spectrum (Figure 9), there were similarities in correlation between signals of compound **4** and those of compound **1**. Their correlations suggested that

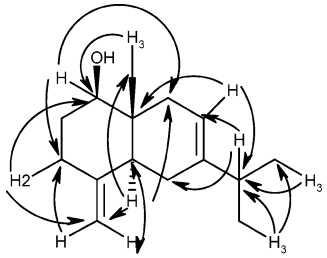

Figure 9. Selected HMBC correlations for compound **4**.

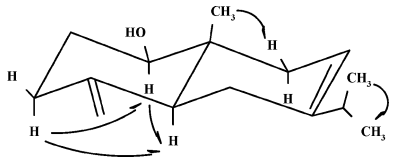

Figure 10. Selected NOESY correlations for compound **4**.

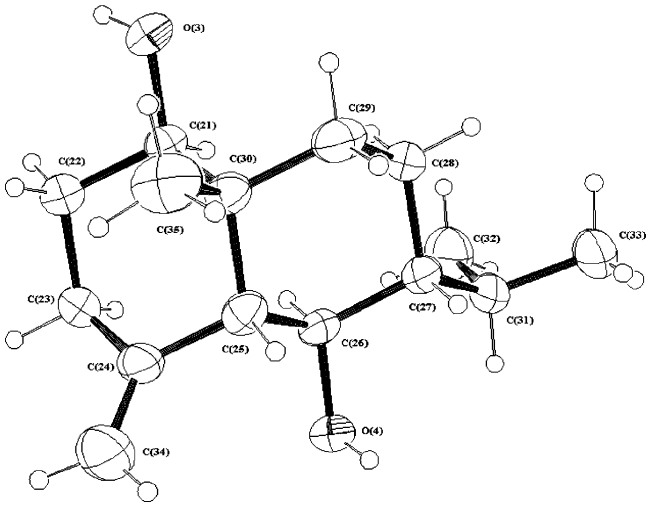

Figure 11. ORTEP drawing of compound **5**.

the double bond ($\Delta^{7,8}$) was connected to the isopropyl group at C-7 and to a quaternary carbon at C-10. The orientation of the hydroxyl group at C-1 was assigned as β due to the presence of NOE correlations between H-5α and H-1 (Figure 10). A literature search revealed that compound **4** was isolated previously as a monoacetate from subspecies *canescens* by Maqua et al.[2] Accordingly, the structure of compound **4** was elucidated to be eudesma-4(15),7-dien-1β-ol.

Compounds **5**, **6**, and **7** showed the same molecular formula of $C_{15}H_{26}O_2$ deduced from HRMS. Analysis of the ^1H and ^{13}C NMR spectra (Tables 1 and 2) revealed that the three compounds are isomers sharing many structural features including an exocyclic double bond and an isopropyl, a methyl, and two hydroxyl groups (Tables 1 and 2). Compounds **5**, **6**, and **7** were elucidated to be the known eudesmane sesquiterpenes 5-*epi*-eudesm-4(15)-ene-1β,6β-diol,[3] 4(15)-eudesmene-1β,6α-diol,[3–5] and 4(15)-eudesmene-1β,5α-diol,[6] respectively, by comparison with published spectroscopic data. Compound **5** was originally isolated from *Litsea verticillata*,[3] compound **6** from *Senscio* species,[4] and compound **7** from the fruit of *Torilis japonica*.[6] The relative configurations of compounds **5** and **6** were correctly assigned by ROESY experiments,[3] and the absolute configuration of compound **7** was established by the modified Mosher's method.[6] These structures were further confirmed by X-ray crystallographic analysis in our laboratory (Figures 11, 12, and 13). Compounds **1**, **2**, **3**, **4**, **6**, and **7** belong

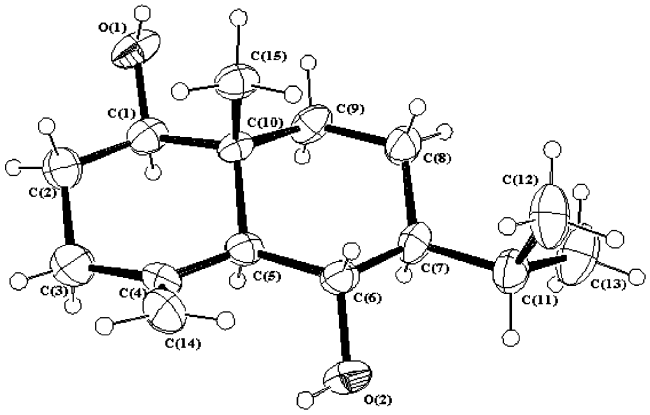

Figure 12. ORTEP drawing of compound **6**.

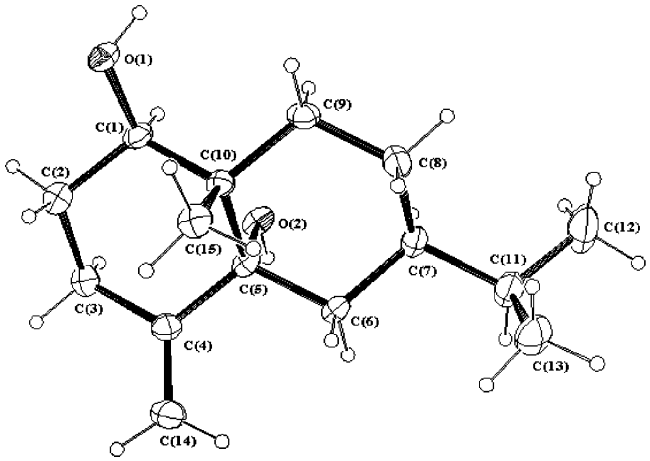

Figure 13. ORTEP drawing of compound **7**.

to the *trans*-eudesmane sesquiterpene series, whereas compound **5** is a rare natural *cis*-eudesmane.

Experimental Section

General Experimental Procedures. IR spectra were recorded on KBr disk with a Perkin-Elmer 783 IR spectrophotometer. Optical rotations were determined on a Jasco P-1020 polarimeter. HRFABMS spectra were taken with a VG AutoSpec 3000 mass spectrometer. 1D and 2D NMR spectra were recorded on a Bruker AM-500 spectrometer. Chemical shifts (δ) were expressed in ppm with reference to the solvent signals. Column chromatography was carried out on silical gel (200−400 mesh, Qindao Ocean Chemical Factory). Reversed-phase flash chromatography was done on RP-18 silica gel (25−40 μm, Merck Co.), and reversed-phase MPLC was carried out using a Büchi chromatography pump B-866 and C-8 column (40−63 μm, Merck Co.). Thin-layer chromatography was performed on HGF_{254} plates (Yantan zhiFuhuangwu Silical Experimental Plant) and RP-18 F_{254} plates (Merck Co.). Preliminary examination of X-ray and data collection were performed with Mo Kα radiation ($\lambda = 0.71073$ Å) on an Enraf-Nonius CAD4 computer-controlled kappa axis diffractometer with a graphite crystal, incident beam monochromator.

Plant Material. The plant material was collected from the south of Ganshu Province, People's Republic of China, in May, 2001. The specimen was identified by Prof. Yingxing Liu, Institute of Lanzhou Desert, Chinese Academy of Sciences. Duplicate voucher specimens have been deposited in Institute of Lanzhou Desert, Chinese Academy of Sciences, as Voucher No.1 Chenqinsheng Lanzhou.

Biological Assay for Glucose Consumption. C_2C_{12} myoblast cells (American Type Culture Collection, Rockville, MD) were maintained under subconfluent conditions in a growth medium containing Dulbecco's modified Eage's medium (DMEM) with 1.0 g/L glucose (Invitrogen), l-glutamine, penicillin/streptomycin (100 mg/mL), and 10% fetal bovine serum (Sigma Chemical, St. Louis, MO) in 24-well plates. Confluent cells were differentiated by lowering the serum concentration to 2% horse serum (Invitrogen) for 4 days. All cells were grown in a humidified 37 °C incubator with ambient oxygen and 5% CO_2. The bioassay results showed that compound **7** could improve glucose transformation at a concentration of 10.7 μg/mL using insulin as standard. In animal tests, compound **7** showed the same effect on oral glucose tolerance in db/db mice as metformin, with a value of 100 mg/mL.

Biological Assay for Anti-HIV and Anti-*Pyricularia oryzae* P-2b Activity. Compound **5** showed weak anti-HIV activity, with a value of 10 μg/mL in the MT-2 cell of infected HIV-IIIB virus. Compounds **1**, **2**, and **7** showed anti-*Pyricularia oryzae* P-2b activity with MIC values of 12, 16, and 20 μg/mL, respectively.

Extraction and Isolation. The plant material of *Caragana intermedia* (75 kg) was ground and exhaustively extracted with 95% EtOH. The solvent was evaporated in vacuo, and the extract was dissolved in 90% MeOH and partitioned with petroleum. After the MeOH solvent was evaporated in vacuo, the residue was extracted with $CHCl_3$. The $CHCl_3$-soluble fraction was chromatographed over silica gel with petroleum/EtOAc (8:1−0:1) as eluent to give fractions I−IV. Part of fraction II (60 g) was submitted to repeated column chromatography over silica gel. Then the FII-2 (2 g) and FII-4 (4 g) fractions were subjected to flash column chromatography using Sephadex LH-20 with MeOH/$CHCl_3$ (3:1) to remove impurities and over silica gel with petroleum/EtOAc (5:1−1:1), $CHCl_3$/EtOAc (6:1), and $CHCl_3$/acetone (8:1), respectively, to yield FII-2-b, FII-2-c, FII-4-a, FII-4-b, FII-4-d, and FII-4-e. The fractions were subjected to flash column chromatography using Lobar MPLC with C-8 material and silica gel to yield eudesma-4(15),7-dien-1β-ol (**4**) (520 mg) from FII-2-b, 5-*epi*-eudesm-4(15)-ene-1β,6α-diol (**5**) (250 mg) from FII-2-c, 4(15)-eudesmene-1β,6α-diol (**6**) (2.5 g) from FII-4-a, 4(15)-eudesmene-1β,5α-diol (**7**) (1.8 g) from FII-4-b, 7-trinoreudesma-4(15),8-dien-1β-ol-7-one (**3**) (20 mg) from FII-4-d, and 4(15)-eudesmene-1β,7α-diol (**1**) (100 mg) and 4(15)-eudesmene-1β,7β-diol (**2**) (25 mg) from FII-4-e.

4(15)-Eudesmene-1β,7α-diol (1): colorless needles (petroleum/EtOAc), $[\alpha]_D^{20}$ +35° (*c* 0.1, $CHCl_3$); IR(film) ν_{max} 3416, 3078, 2931, 2854, 1651, 1468, 1386, 1276, 1015, 987, 913, 660 cm^{-1}; ^1H and ^{13}C NMR data, see Tables 1 and 2; HRMS *m/z* 238.1926 $[M]^+$ (calc for $C_{15}H_{26}O_2$, 238.1933).

4(15)-Eudesmene-1β,7β-diol (2): colorless needles (petroleum/EtOAc), $[\alpha]_D^{20}$ −12° (*c* 0.1, $CHCl_3$); IR (film) ν_{max} 3416, 3078, 2931, 2854, 1651, 1468, 1386, 1276, 1015, 987, 913, 660 cm^{-1}; ^1H and ^{13}C NMR data, see Tables 1 and 2; HRMS *m/z* 238.1926 $[M]^+$ (calc for $C_{15}H_{26}O_2$, 238.1933).

7-Trinoreudesm-4(15),8-dien-1β-ol-7-one (3): colorless gum, $[\alpha]_D^{20}$ +128° (*c* 0.1, $CHCl_3$); IR (film) ν_{max} 3608, 3058, 2980, 2304, 1676, 1419, 1265, 1019, 893, 738, 705 cm^{-1}; ^1H and ^{13}C NMR data, see Tables 1 and 2; HRMS *m/z* 192.1134 $[M]^+$ (calc for $C_{12}H_{16}O_2$, 192.1150).

Eudesm-4(15),7-dien-1β-ol (4): colorless needles (petroleum/EtOAc), $[\alpha]_D^{20}$ −18° (*c* 0.1, $CHCl_3$); IR (film) ν_{max} 3415, 3060, 1635, 1230, 880, 800 cm^{-1};^1H and ^{13}C NMR data, see Tables 1 and 2; HRMS *m/z* 220.1842 $[M]^+$ (calc for $C_{15}H_{24}O$, 220.1827).

5-*epi*-Eudesm-4(15)-ene-1β,6β-diol (5): colorless monoclinic crystals (petroleum/EtOAc), $[\alpha]_D^{20}$ −88° (*c* 0.6, $CHCl_3$); IR(film) ν_{max} 3282, 3078, 2936, 2872, 1647, 1457, 1366, 1309, 1260, 1050, 1032, 987, 878, 737, 616 cm^{-1}; ^1H and ^{13}C NMR data, see Tables 1 and 2; HRMS *m/z* 238.1926 $[M]^+$ (calc for $C_{15}H_{26}O_2$, 238.1933).

4(15)-Eudesmene-1β,6α-diol (6): colorless needles (petroleum/EtOAc), $[\alpha]_D^{20}$ +45° (*c* 0.1, $CHCl_3$);^1H and ^{13}C NMR data, see Tables 1 and 2.

4(15)-Eudesmene-1β,5α-diol (7): colorless monoclinic crystals (petroleum/EtOAc), $[\alpha]_D^{20}$ +122° (*c* 0.7, $CHCl_3$); ^1H and ^{13}C NMR data, see Tables 1 and 2.

X-ray crystal structure of 4(15)-eudesmene-1β,7α-diol (1): colorless orthorhombic crystals, 0.40 × 0.35 × 0.15 mm, obtained from EtOAc/petroleum ether. Cell parameters: a =

15.151(15) Å, b = 22.945(14) Å, c = 11.441(8) Å, V = 2927(5) Å^3, space group $P2_12_12$, Z = 8, D_{calc} = 1.082 mg/cm^3, λ = 0.71073 Å, μ = 0.069 mm^{-1}, $F(000)$ = 1056, T = 293(2) K. Data collection yielded 3298 reflections, resulting in 3257 unique, averaged reflections. Full-matrix least-squares refinement on F^2 led to a final $R(4\sigma_F)$, R(all), and GOF(all) of 0.0861, 0.2632, and 1.053. There are two molecules in the asymmetric unit; however they have the same relevant configuration with different hydrogen interaction schemes. The CIF file of X-ray data of compound **1** was deposited in the CCDC (deposit number: 233547).

X-ray crystal structure of 5-*epi*-eudesm-4(15)-ene-1*β*,6*β*-diol (5): colorless trigonal crystals, 0.15 × 0.10 × 0.10 mm, obtained from EtOAc/petroleum ether. Compound belongs to trigonal space group $P3_221$. Cell parameters: $a = b$ = 12.156(2) Å, c = 35.931(10) Å, γ = 120°, V = 4598.3(17) Å^3, Z = 12, D_{calc} = 1.033 mg/cm^3, λ = 0.71073 Å, μ = 0.066 mm^{-1}, $F(000)$ = 1584, T = 293(2) K. Data collection yielded 23 244 reflections, resulting in 6764 unique, averaged reflections. Full-matrix least-squares refinement on F^2 led to a final $R(4\sigma_F)$, R(all), and GOF(all) of 0.0361, 0.0621, and 0.643. There are two unique molecules in the asymmetric unit; even if they have different hydrogen interaction schemes, the relevant configurations are the same. The CIF file of X-ray data of compound **5** was deposited in the CCDC (deposit number: 233545).

X-ray crystal structure of 4(15)-eudesmene-1*β*,6α-diol (6): colorless trigonal crystals, 0.30 × 0.2 × 0.2 mm, obtained from EtOAc/petroleum ether. Space group $R3$. Cell parameters: $a = b$ = 23.742(4) Å, c = 6.598(2) Å, γ = 120°, V = 3220.9(12) Å^3, Z = 9, D_{calc} = 1.106 mg/cm^3, λ = 0.71073 Å, μ = 0.071 mm^{-1}, $F(000)$ = 1188, T = 298(2) K. Data collection yielded 1709 reflections resulting in 1078 unique, averaged reflections. Full-matrix least-squares refinement on F^2 led to a final $R(4\sigma_F)$, R(all), and GOF of 0.0373, 0.0739, and 1.016. There is only one molecule in the asymmetric unit. The CIF file of X-ray data of compound **6** was deposited in the CCDC (deposit number: 233546).

X-ray crystal structure of 4(15)-eudesmene-1*β*,5α-diol (7): colorless monoclinic crystal, 0.45 × 0.45 × 0.08 mm, obtained from EtOAc/petroleum ether. Space group $P2_1$. Cell parameters: a = 6.051(5) Å, b = 12.894(4) Å, c = 8.967(3) Å, β = 91.01(3)°, V = 699.5(7) Å^3, Z = 2, D_{calc} = 1.132 mg/cm^3, λ = 0.71073 Å, μ = 0.073 mm^{-1}, $F(000)$ = 264, T = 293(2) K. Data collection yielded 1920 reflections, resulting in 1762 unique, averaged reflections. Full-matrix least-squares refinement on F^2 led to a final $R(4\sigma_F)$, R(all), and GOF(all) of 0.0429, 0.1100, and 1.034. There is only one molecule in the asymmetric unit. The CIF file of X-ray data of compound **7** was deposited in the CCDC (deposit number: 233544).

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