Eudesmane Derivatives and Other Sesquiterpenes from *Laggera alata*

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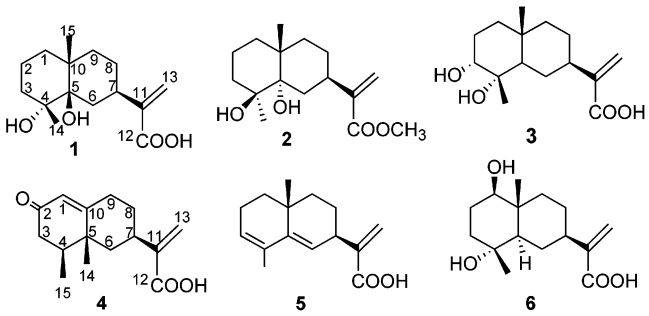
Three new eudesmane sesquiterpenes, 5*β*-hydroxyilicic acid (**1**), 5α-hydroxyl-4-*epi*-ilicic acid methyl ester (**2**), and 3α-hydroxyilicic acid (**3**), together with 12 known sesquiterpenes were isolated from the aerial part of *Laggera alata*. Their structures were elucidated primarily by NMR and mass spectroscopic methods. The structures of **1** and **2** were confirmed by X-ray crystallography.

Laggera (Compositae, tribe Inulea, subtribe Inulinea) is a small genus of about 20 species. *Laggera alata* (D. Don) Sch.-Bip. Ex. Olivier and *Laggera pterodonta* are the only two species of *Laggera* found in China. Previously, *L. pterodonta* was reported to contain several new eudesmane sesquiterpenes.[1,2] *L. alata* distributed in Madagascar and Namibia has also been shown to contain some characteristic eudesmane derivatives.[3,4] However, no chemical study has been published on *L. alata* grown in China. This prompted us to investigate the title plant that is used traditionally in southwestern China as an herbal medicine. Investigation of the EtOH extract of the title plant led to the isolation of a number of compounds including three new eudesmanoids, 5*β*-hydroxyilicic acid (**1**), 5α-hydroxyl-4-*epi*-ilicic acid methyl ester (**2**), and 3α-hydroxyilicic acid (**3**); a known eremophilane derivative, tessaric acid (**4**);[5,6] and 11 eudesmane derivatives, 3,5,11(13)-trieneudesma-12-oic acid (**5**),[7] 1*β*-hydroxylilicic acid (**6**),[8] isocostic acid,[9] costic acid,[10] 5α-hydroxylcostic acid,[11] 5α-hydroxyl-*β*-costic acid,[12] 3-oxo-isocostic acid,[13] 1*β*-hydroxylcostic acid,[14] 5*β*-hydroxylcostic acid,[15] eudesma-4(14),11(13)-dien-12,5*β*-olide,[15] and ilicic acid.[16] The details of the isolation and structural elucidation of **1**−**3** are discussed in this paper.



Results and Discussion

The HREIMS spectrum of **1** exhibited its $[M]^+$ at *m*/*z* 268.1684, corresponding to the molecular formula $C_{15}H_{24}O_4$.

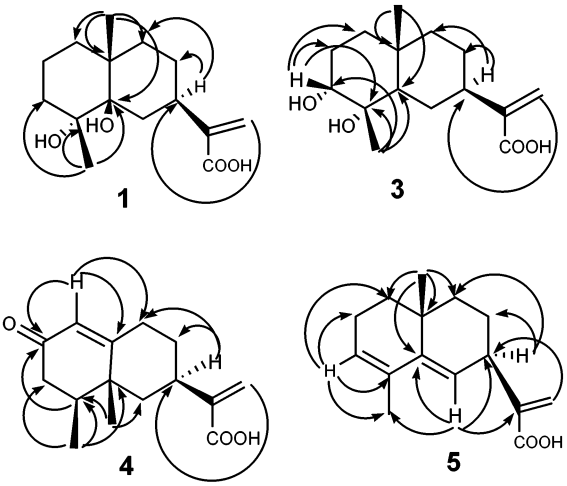


Figure 1. Selected HMBC correlations for compounds **1**, **3**, **4**, and **5**.

Its IR spectrum exhibited bands at 3571 and 3523 cm^{-1} (hydroxyl), as well as a methylene conjugated with a carboxylic group at 1667 cm^{-1}. The EIMS of **1** exhibited fragments at *m*/*z* 250 $[M - H_2O]^+$ and *m*/*z* 232 $[M - 2 \times H_2O]^+$. Two oxygenated quaternary carbon signals at *δ* 76.4 and 76.8 in the ^{13}C NMR spectrum indicated the presence of two tertiary hydroxyl groups. The ^{13}C NMR spectrum of **1** disclosed a carboxyl signal at *δ* 170.2 and an olefinic methylene carbon signal at *δ* 122.4, indicating the presence of an allylic acid moiety. The above-mentioned ^1H and ^{13}C NMR spectra of **1** showed a close similarity to those of ilicic acid.[16] However, the methine carbon signal at *δ* 55.8 of C-5 in ilicic acid was absent in the ^{13}C NMR spectrum of **1**. Instead, a quaternary carbon signal appearing at *δ* 76.8 was observed. This suggested that **1** was a 5-hydroxyl derivative of ilicic acid. This conclusion was confirmed by detailed HMQC and HMBC experiments (Figure 1). The relative configuration of **1** was derived from NOESY correlations of H-14/H-6*β*, H-14/H-8*β*, and H-8*β*/H-13 (Figure 2). These were consistent with the observed coupling constants, viz., $J_{6\alpha,7} = 4.5$ Hz, $J_{6\beta,7} = 12.0$ Hz, $J_{7,8\alpha} = 4.5$ Hz, and $J_{7,8\beta} = 12.0$ Hz. Further evidence for the structure of **1** was subsequently obtained from the X-ray crystallography results (Figure 3), which showed a cis-fused A/B ring system with a chair−chair conformation. The crystal

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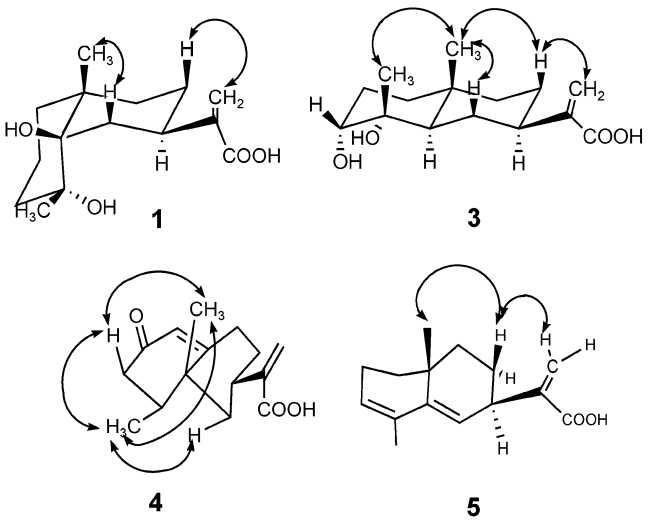

Figure 2. Key NOESY correlations for compounds **1**, **3**, **4**, and **5**.

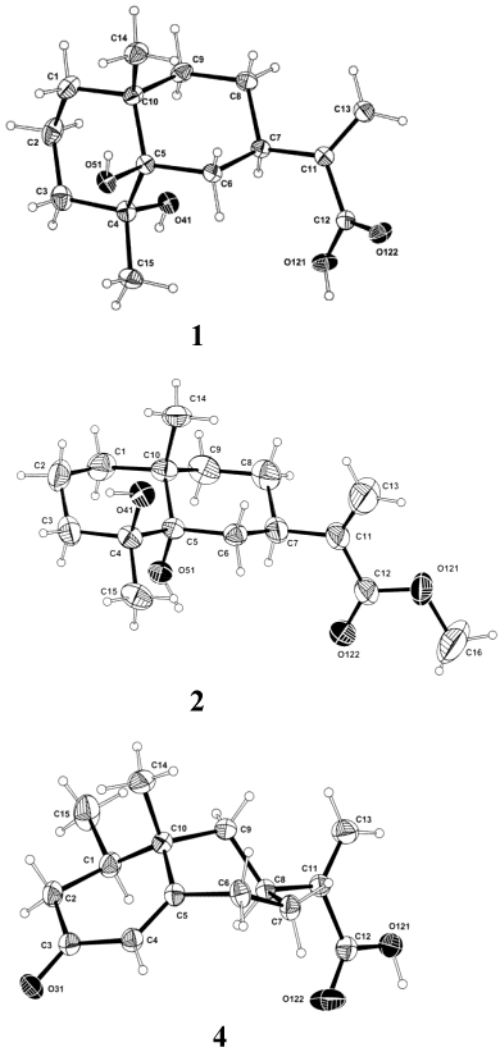

Figure 3. X-ray single-crystal diffraction structures of compounds **1**, **2**, and **4**.

study further showed an intermolecular H-bond between the hydroxyl group of **1** and the water molecule cocrystallized.

The ^{1}H and ^{13}C NMR spectral data of compound **2** showed close resemblance to those of **1** (see Experimental Section). However, a methoxy group was present in **2**, as disclosed by signals appearing at δ 3.77 (3H, s) and at δ 52.3 in the ^{1}H and ^{13}C NMR spectra of **2**, respectively. The presence of a methoxy group was also supported by an IR absorption band at 1697 cm^{-1}. The HREIMS of **2** exhibited a molecular ion peak at *m*/*z* 282.1836 (calcd 282.1831), corresponding to a molecular formula of $C_{16}H_{26}O_4$ (14 mass units higher than that of **1**), suggesting that **2** was a methyl ester of **1**. The X-ray single-crystal diffraction experiment showed that **2** was 5α-hydroxyl-4-*epi*-ilicic acid methyl ester and the A/B rings of **2** were found to be trans-fused (Figure 3). Only a few plants, such as *Inula viscosa*,[17] have been found containing 4-*epi*-eudesemane derivatives.

The HREIMS of **3** indicated a molecular formula of $C_{15}H_{24}O_4$. The observation of mass fragments due to $[M - H_2O]^+$ and $[M - 2 \times H_2O]^+$ appearing at *m*/*z* 250 and 232, respectively, indicated the presence of at least two hydroxyl groups. This was supported by the IR spectrum of **3**, which showed absorption bands at 3458 and 3469 cm^{-1}. The latter also suggested the presence of a conjugated carboxyl functionality, supported by the ^{13}C NMR resonances at δ 170.5 (*C*═O), 147.6 (*C*), and 122.8 (*C*H$_2$) in the ^{13}C NMR spectrum of **3**. In the ^{1}H NMR spectrum of **3**, two tertiary methyl signals appeared at δ 1.03 and 1.13, suggesting that **3** was also an eudesmane derivative, especially in view of the strong similarity of the ^{1}H NMR data of **3** with those of 3α-acetylilicic acid (**3a**).[18] However, the oxymethine proton (H-3) appearing at δ 4.75 as well as the acetyl signal at δ 2.12 in 3α-acetylilicic acid were absent in the ^{1}H NMR spectrum of **3**. Instead, the H-3 signal of **3** appeared at δ 4.02. All the above suggested that **3** was most likely 3-hydroxyilicic acid. The β-orientation of H-3 was deduced from the coupling constants ($J_{2\alpha,3} = J_{2\beta,3} = 4.5$ Hz) and was confirmed by 2D experiments including HMQC and HMBC (Figure 1) and NOESY (Figure 2). Additional evidence was provided by acetylation of **3**; the ^{1}H NMR and $[\alpha]_D$ data of acetylated **3** were in good accordance with those of 3α-acetylilicic acid.[18] Therefore, **3** was identified as 3α-hydroxyilicic acid, which is an epimer of 3β-hydroxyilicic acid isolated from the Jordanian medicinal plant *Inula viscosa*.[17]

Compound **4** was assigned as tessaric acid. This known sesquiterpene was identified by its IR, HREIMS, 1D and 2D NMR, $[\alpha]_D$, CD, and X-ray single-crystal diffraction (Figure 3). This is the first eremophilane compound reported from the genus *Laggera*.

Compound **5** was reported as a synthetic artifact from bromination of ilicic acid.[7] Compound **6** was obtained by biotransformation of ilicic acid using a cell culture of *Cunningamella echinulata*.[8] To our knowledge, both **5** and **6** have not been isolated previously from a natural source.

It is notable that most eudesmane derivatives isolated from *L. alata* collected in China have a characteristic allylic moiety, and all of them have the 7α-H-orientation. However, the reported eudesmanoids obtained from Madagascar or Namibia possess no carboxylic group, and some possess the 7β-H-orientation. This difference could be of interest to plant taxonomists. The different environmental conditions under which the plant grows in China, however, could also explain this subtle phytochemical difference.

Compounds **1**, **2**, **3**, **5**, and **6** exhibited weak cytotoxicity against KB cells with IC_{50} values larger than 10^{-4} mol/L. Ilicic acid also exhibited an inhibition ratio of 23.6% to the SK-MEL cell line and of 10.3% to the A-549 cell line, respectively, at the concentration of 20 μg/mL.

Experimental Section

General Experimental Procedures. Melting points were recorded on a Kofler hot-stage instrument and were uncorrected. Optical rotations were determined on a Perkin-Elmer

241 polarimeter, and IR spectra were obtained on a Perkin-Elmer 577 spectrometer using KBr pellets. EIMS data were obtained on a Finnigan-4510 spectrometer at 70 eV. FABMS spectra were recorded on a VG ZAB-HS spectrometer. The NMR spectra were obtained on a Bruker AM-400 FT-NMR spectrometer with TMS as internal standard. Preparative TLC was performed using silica gel GF_{254} and RP-18 plates (Merck). Crystals were mounted on an Enraf-Nonius Kappa-CCD diffractometer. A full sphere of data was collected by ϕ axis rotation with an increment of 2° over 360° and 120 s of **1** (40 s of **2** and **4**) exposure per degree. "Denzingering" was accomplished by measuring each frame twice. Data were analyzed using Kappa-CCD software. Cell dimensions were refined with HKl-scalepack, and data reduction was performed with Denzo. The structure was solved by direct methods (SHELXS-86) and was refined on F^2 for all reflections by least-squares methods using SHELXL-93.

Plant Material. The whole plant of *Laggera alata* (Compositae) was collected in November 1994 at Quibei county, Yunnan province, China, and identified by Prof. Zhong-wen Lin. A voucher specimen (941102) is on deposit at the State Key Laboratory of Phytochemistry and Plant Resource in West China, Kunming Institute of Botany, Chinese Academy of Sciences.

Extraction and Isolation. The air-dried aerial parts of the *L. alata* (5.8 kg, dry weight) were powdered and extracted twice with 95% EtOH at 70 °C, 2 h each time, and the alcoholic extracts were combined and evaporated to dryness (426 g). The residue was suspended in H_2O and then partitioned successively with petroleum ether (60−90 °C) (1.5 L × 4, 122 g), EtOAC (1.2 L × 6, 204 g), and BuOH (1.2 L × 6, 94 g). Part of the petroleum ether extract (110 g) was decolored by passage over a macroporous resin column (Diaion HP-50) and washed with MeOH−H_2O (7:3). The elute (64 g) was obtained by removal of solvent in vacuo, 60 g of which was mixed with silica gel (200−300 mesh, 98 g) and then subjected to column chromatography on silica gel (200−300 mesh, 2200 g), using a solvent of petroleum ether containing gradually increasing percentages of acetone (100:0−0:100), 1 L each eluate. Based on TLC analysis, 15 fractions were obtained.

Repeated chromatography of fraction 7 on a silica gel column, eluted with *n*-hexane−acetone (100:3, containing 0.5% of HCOOH), gave 35 mg of costic acid. Further chromatography of fraction 9 over a silica gel column eluted with *n*-hexane−acetone (95:5, containing 0.5% of HCOOH) yielded 18 mg of compound **5**, which was further purified on a RP-18 gel column eluted with MeOH−H_2O (7:3). The combined fractions 10 and 11 (8.4 g) were subjected to RP-18 gel chromatography eluted with MeOH−H_2O (65:35) to give 150 mg of isocostic acid and 1.4 g of ilicic acid.

The EtOAC portion (200 g) was mixed with silica gel (200−300 mesh, 180 g) and then subjected to column chromatography on 2.5 kg of silica gel (200−300 mesh) eluted with a $CHCl_3$−MeOH gradient (1:0−1:1). Based on TLC analysis, 16 fractions were obtained. Fraction 1 was chromatographed on a Sephadex LH-20 column eluted with acetone and was further separated on a silica gel column to give eudesma-4(14),11(13)-dien-12,5β-olide (48 mg). From fraction 2, 5α-hydroxy-β-costic acid (78 mg) and 5α-hydroxycostic acid (32 mg) were obtained by silica gel column chromatography eluted with $CHCl_3$−EtOAC (20:1) followed by RP-18 gel column chromatography eluted with MeOH−H_2O (65:35). From fraction 4, 3-oxo-isocostic acid (12 mg) was obtained by silica gel column chromatography eluted with petroleum ether−EtOAC of increasing polarity (20:1−5:1, containing 0.5% of HCOOH). Fraction 5 was chromatographed over a silica gel column eluted with petroleum ether−2-propanol of increasing polarity (80:1−5:1, containing 0.5% of HCOOH) to give 44 mg of 1β-hydroxycostic acid and 22 mg of 5β-hydroxlcostic acid. Fraction 7 was separated by silica gel column chromatography eluted with $CHCl_3$−2-propanol (40:1) followed by RP-18 gel chromatography eluted with MeOH−H_2O (3:2) to give 68 mg of **3**. Fraction 9 was separated on a Diaion HP-50 column eluted with MeOH−H_2O (0:1−1:0) followed by silica gel column chromatography eluted with $CHCl_3$−MeOH (60:1, containing 0.5% of HCOOH) to give 3.8 g of ilicic acid. Fraction 11 was separated on a Sephadex LH-20 column eluted with $CHCl_3$−MeOH (1:1) followed by RP-18 gel chromatography eluted with MeOH−H_2O (3:2) to give 35 mg of 1β-hydroxyilicic acid. Fraction 12 was separated over a Sephadex LH-20 column eluted with $CHCl_3$−MeOH (1:1) followed by a RP-18 gel chromatography eluted with MeOH−H_2O (3:2) and then silica gel column chromatography again eluted with $CHCl_3$−MeOH (95:5) to give 62 mg of **1** and 53 mg of **2**. Fraction 14 was separated on a Sephadex LH-20 column eluted with $CHCl_3$−MeOH (1:1) followed by preparative TLC developed with $CHCl_3$−MeOH (10:1) to give 48 mg of **4**.

All the known compounds were identified by comparing their physical and spectroscopic properties (mp, MS, IR, NMR, and $[\alpha]_D$) with literature values, and some were compared directly with authentic samples.

5β-Hydroxylilicic acid (1): colorless needles (Me_2CO), mp 160−161.5 °C; $[\alpha]^{20}_D$ +5.39° (*c* 0.8, MeOH), IR ν_{max} 3571, 3523, 3447, 2962, 2914, 2858, 2498, 1985, 1667, 1623, 1443, 1405 cm^{-1}; ^1H NMR (CD_3OD, 400 Hz) δ 1.02 (1H, ddd, J = 13.5, 4.8, 4.8 Hz, H-1α), 1.76 (1H, ddd, J = 13.5, 11.0, 4.8 Hz, H-1β), 1.90 (1H, dddd, J = 13.5, 12.0, 7.0, 4.5 Hz, H-2α), 1.68 (1H, dddd, J = 13.5, 7.0, 4.5, 4.5 Hz, H-2β), 1.38 (1H, ddd, J = 13.5, 12.0, 6.8 Hz, H-3α), 2.68 (1H, ddd, J = 13.5, 12.0, 6.8 Hz, H-3β), 2.06 (1H, dd, J = 13.5, 4.5 Hz, H-6α), 1.48 (1H, dd, J = 13.5, 12.0 Hz, H-6β), 3.50 (1H, dddd, J = 12.0, 12.0, 4.5, 4.5 Hz, H-7α), 1.18 (1H, m, H-8α), 1.72 (1H, m, H-8β), 1.70 (1H, ddd, J = 13.2, 9.8, 3.5 Hz, H-9α), 1.28 (1H, ddd, J = 13.2, 3.5, 3.0 Hz, H-9β), 6.10 (1H, br s, H-13), 5.56 (1H, br s, H-13′), 0.99 (3H, s, H-14), 1.26 (3H, s, H-15); ^{13}C NMR (CD_3OD, 100 MHz) δ 171.2 (s, C-12), 148.4 (s, C-11), 122.4 (t, C-13), 76.8 (s, C-5), 76.4 (s, C-4), 38.8 (t, C-1), 38.8 (s, C-10), 38.3 (d, C-7), 37.2 (t, C-3), 36.7 (t, C-6), 35.2 (t, C-9), 27.6 (t, C-8), 26.8 (q, C-15), 25.6 (q, C-14), 18.2 (t, C-2); EIMS *m*/*z* 268 $[M]^+$ (11), 250 (44), 232 (66), 204 (25), 192 (60), 180 (59), 111 (100), 84 (89), 71 (73), 55 (75); HREIMS *m*/*z* 268.1684 (calcd for $C_{15}H_{24}O_4$, 268.1675).

X-ray Crystallographic Analysis of 1. Crystal data: $[C_{15}H_{24}O_4]\cdot H_2O$, mol wt = 286.36, monoclinic, space group $P2_12_12_1$, a = 7.222(3) Å, b = 7.801(3) Å, c = 13.797(6) Å, V = 751.2(5) Å^3, Z = 2, λ = 0.7107 Å. The asymmetric unit consisted of one molecule of **1** and one molecule of water cocrystallized.[19]

5β-Hydroxyilicic acid methyl ester (2): colorless needles (MeOH), mp 120−121 °C; $[\alpha]^{20}_D$ +13.4° (*c* 0.49, MeOH); IR ν_{max} 3463, 2942, 2864, 1697, 1620, 1440, 1380; ^1H NMR (CD_3OD) δ 1.02 (1H, m, H-1α), 1.98 (1H, m, H-1β), 2.00 (1H, m, H-2α), 1.92 (1H, m, H-2β), 1.37 (1H, m, H-3α), 1.98 (1H, m, H-3β), 1.92 (1H, m, H-6α), 1.59 (1H, m, H-6β), 3.03 (1H, m, H-7α), 1.59 (1H, m, H-8α), 1.68 (1H, m, H-8β), 0.99 (1H, m, H-9α), 1.40 (1H, m, H-9β), 6.17 (1H, br s, H-13), 5.68 (1H, br s, H-13′), 1.16 (1H, s, H-14), 1.29 (1H, s, H-15), 3.77 (3H, s, CO_2CH_3); ^{13}C NMR (CD_3OD, 100 MHz) δ 169.5 (s, C-12), 147.5 (s, C-11), 123.6 (t, C-13), 77.1 (s, C-5), 75.8 (s, C-4), 52.3 (q, OCH_3), 38.7 (t, C-1), 37.9 (s, C-10), 36.9 (t, C-3), 36.0 (d, C-7), 35.6 (t, C-6), 31.9 (t, C-9), 28.0 (t, C-8), 25.8 (q, C-15), 22.8 (q, C-14), 18.8 (t, C-2); EIMS *m*/*z* 282 $[M]^+$ (36), 264 (34), 246 (26), 232 (60), 205 (56), 111 (100), 84 (79), 55 (80); HREIMS *m*/*z* 282.1837 (calcd for $C_{16}H_{26}O_4$, 2812.1831).

X-ray Crystallographic Analysis of 2. Crystal data: $C_{16}H_{26}O_4$, mol wt = 282.37, orthorhombic, space group $P2_12_12_1$, a = 8.937(4) Å, b = 9.455(4) Å, c = 19.139(7), V = 1617.2(12) Å, Z = 4, λ = 0.7107 Å. The asymmetric unit consists of one molecule of **2** and one molecule of water cocrystallized.[19]

3α-Hydroxyilicic acid (3): colorless needles, mp 177−178 °C; $[\alpha]_D^{20}$ −48° (*c* 0.3, $CHCl_3$); IR ν_{max} 3540, 3458, 3469, 2925, 2350, 1710, 1615 cm^{-1}; ^1H NMR (CD_3OD, 400 MHz) δ 1.38 (1H, m, H-1α), 1.18 (1H, m, H-1β), 1.80 (2H, ddt, J = 12.5, 12.5, 2.5 Hz, H-2α, H-6β), 1.45 (1H, m, H-2β), 4.16 (1H, t, J = 3.6 Hz, H-3), 1.62 (1H, dd, J = 12.5, 4.0 Hz, H-5), 1.28 (1H, m, H-6α), 2.46 (1H, dddd, J = 12.5, 12.5, 4.0, 4.0 Hz, H-7α), 1.60 (1H, m, H-8α), 1.45 (1H, m, H-8β), 1.40 (2H, m, H-9α, H-9β), 6.10 (1H, br s, H-13), 5.56 (1H, br s, H-13′), 1.03 (3H, s, H-14), 1.13 (3H, s, H-15); ^{13}C NMR (MeOH, 100 MHz) δ 170.5 (s,

C-12), 147.6 (s, C-11), 122.8 (t, C-13), 72.1 (s, C-4), 68.6 (d, C-3), 55.1 (d, C-5), 49.2 (t, C-1), 47.2 (t, C-8), 46.1 (t, C-9), 41.5 (d, C-7), 34.9 (s, C-10), 28.2 (t, C-2), 27.2 (t, C-6), 24.4 (q, C-15), 20.6 (q, C-14); EIMS *m/z* 268 $[M]^+$ (4), 250 (12), 232 (39), 149 (48), 89 (100), 68 (54), 55 (63); HREIMS *m/z* 268.1685 (calcd for $C_{15}H_{24}O_4$ 268.1675). Acetylation of **3** in pyridine afforded **3a**, which was identified by NMR spectral data, optical rotation value, and mp.

Tessaric acid (4): colorless needles (Me_2CO); mp 157−158 °C; $[\alpha]_D^{20}$ −156.2° (*c* 0.3, $CHCl_3$); IR ν_{max} 3433, 2967, 1706, 1630, 1460, 1418, 1363 cm^{-1}; ^1H NMR (MeOH, 400 MHz) δ 5.91 (1H, br s, H-1), 2.34 (1H, m, H-3α), 2.40 (1H, m, H-3*β*), 2.36 (1H, m, H-4), 2.41 (1H, m, H-6α), 1.98 (1H, m, H-6*β*), 2.63 (1H, dddd, J = 11.0, 10.0, 4.5, 4.5 Hz, H-7α), 2.00 (1H, m, H-8α), 2.76 (1H, dddd, J = 13.5, 11.0, 11.0, 4.5 Hz, H-8*β*), 1.70 (1H, ddd, J = 13.5, 11.0, 4.5 Hz, H-9α), 1.92 (1H, ddd, J = 13.5, 4.5, 4.5 Hz, H-9*β*), 6.26 (1H, br s, H-13), 5.70 (1H, br s, H-13′), 1.16 (3H, s, H-14), 1.05 (3H, d, J = 6.0 Hz, H-15); ^{13}C NMR (MeOH, 100 MHz) δ 201.9 (s, C-2), 177.6 (s, C-12), 170.2 (s, C-11), 146.3 (s, C-10), 126.0 (d, C-1), 123.6 (t, C-13), 42.9 (t, C-9), 41.7 (s, C-5), 40.7 (t, C-3), 37.3 (d, C-7), 33.8 (d, C-4), 30.0 (t, C-8), 30.0 (t, C-6), 19.3 (q, C-14), 15.7 (q, C-15); EIMS *m/z* 248 $[M]^+$ (71), 230 (46), 215 (17), 206 (92), 182 (48), 108 (88), 79 (77), 55 (100); HREIMS *m/z* 248.1415 (calcd for $C_{15}H_{20}O_3$, 248.1412).

X-ray Crystallographic Analysis of 4. Crystal data: colorless crystal from acetone; $C_{15}H_{20}O_3$, mol wt = 268.2, monoclinic, space group $P2_12_12_1$, a = 6.748(3) Å, b = 13.518-(5) Å, c = 8.074(3) Å, β = 106.29(4)°, V = 706.9(5) $Å^3$, Z = 2, λ = 0.7107 Å.[19]

3,5,11(13)-Trieneudesma-12-oic acid (5): colorless gum; $[\alpha]_D^{20}$ +7.5° (*c* 0.4, $CHCl_3$); IR ν_{max} 3450, 2926, 2860, 2332, 1701, 1697, 1693, 1650, 1453, 1375 cm^{-1}; ^1H NMR ($CDCl_3$, 400 MHz) δ 1.60 (1H, m, H-1α), 2.05 (1H, m, H-1*β*), 2.06 (1H, ddd, J = 12.5, 4.5, 4.5 Hz, H-2α), 2.64 (1H, ddd, J = 12.5, 11.0, 4.5 Hz, H-2*β*), 5.56 (1H, br s, H-3), 5.39 (1H, br s, H-6), 3.42 (1H, ddd, 10.0, 7.5 3.0 Hz, H-7α), 1.44 (1H, m, H-8α), 1.40 (1H, m, H-8*β*), 1.54 (1H, m, H-9α), 1.56 (1H, m, H-9*β*), 5.70 (1H, br s, H-13), 6.34 (1H, br s, H-13′), 1.00 (3H, s, H-14), 1.79 (3H, s, H-15); ^{13}C NMR ($CDCl_3$, 100 MHz) δ 172.6 (s, C-12), 145.1 (s, C-11), 143.2 (s, C-5), 131.0 (s, C-4), 126.1 (t, C-13), 124.9 (d, C-3), 121.6 (d, C-6), 38.5 (d, C-7), 38.2 (t, C-9), 37.1 (t, C-1), 31.3 (s, C-10), 26.3 (t, C-3), 23.4 (q, C-15), 22.8 (t, C-2), 20.1 (q, C-14); EIMS *m/z* 232 $[M]^+$ (100), 217 (72), 203 (45), 187 (24), 171 (47), 121 (73), 91 (63), 79 (44), 55 (49); HREIMS *m/z* 232.1459 (calcd for $C_{15}H_{20}O_2$, 232.1463).

Cytotoxicity Assay. KB cells were obtained from the American Type Culture Collection.[20] Effects of compounds on the growth of the cells were monitored at the Laboratoire de Cultures Cellulaires, ICSN, Gif-sur-Yvette, France. The IC_{50} values refer to the concentration of drug corresponding to 50% growth inhibition after 72 h incubation.[21]

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Supporting Information Available: The X-ray datasets of compounds **1**, **2**, and **4** are available free of charge via the Internet at http://pubs.acs.org. In addition, another 13 known compounds have also been isolated from the title plant. Although they are not reported in this paper, detailed information on the isolation procedures of all the components including these 13 known compounds is also available free of charge at http://pubs.acs.org for reference.

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