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TRITERPENOID ACIDS FROM *Eriobotrya japonica*

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The leaves of *Eriobotrya japonica* (Thunb.) Lindl. (Rosaceae) were commonly recognized as a traditional Chinese medicine (TCM) to treat various skin diseases and diabetes mellitus. Phytochemical investigations on the leaves of *E. japonica* revealed their predominant secondary metabolites as triterpenoids including triterpenoid acids [1]. Our previous study showed that triterpenoid acids can decrease the excitability of cortical pyramidal neurons and acts in epilepsy [2]. In our ongoing search for novel and bioactive triterpenoid acids, a detail chemical investigation on the dried leaves of *E. japonica* was carried out. As a result, 13 triterpenoid acids were isolated and identified on the basis of extensive spectral methods, among which compounds **1**, **2**, and **4** were isolated from *E. japonica* for the first time.

The air-dried and powdered leaves of *E. japonica* (10.0 kg) were extracted with MeOH (50 L × 3) under reflux conditions at 70°C, three hours each time. After removal of the organic solvent under reduced pressure, the extract (1.0 kg) was suspended in H_2O (4 L), and then successively partitioned with petroleum ether, EtOAc, and *n*-BuOH. The *n*-BuOH fraction (100 g) was subjected to silica gel column chromatography (CC) ($CHCl_3$–MeOH, 1:0–0:1) to afford four fractions, Frs.A–D. Fraction A (15 g) was subjected to CC over silica gel (petroleum ether–acetone, 10:1–1:9) and Sephadex LH-20 (MeOH) and then purified by semipreparative HPLC with a C_{18} column (MeOH–H_2O, 1:1–1:0) to afford compounds **1** (17 mg), **2** (16 mg), **3** (40 mg), **4** (30 mg), **5** (200 mg), **6** (150 mg), **7** (100 mg), **8** (32 mg), **9** (20 mg), **10** (23 mg), **11** (25 mg), **12** (11 mg), and **13** (14 mg).

3*β*-*O*-*cis*-*p*-Coumaroyl-2*α*-hydroxy-12-ursen-28-oic Acid (1). $C_{39}H_{54}O_6$, white amorphous powder. ESI-MS *m/z* 617 [M – H]$^-$. ^{1}H NMR (400 MHz, pyridine-d_5, δ, ppm, J/Hz): 0.99 (3H, s, Me-23), 0.95 (3H, s, Me-24), 0.94 (3H, s, Me-25), 1.03 (3H, s, Me-26), 1.17 (3H, s, Me-27), 1.07 (3H, d, J = 6.4, Me-29), 1.03 (3H, d, J = 6.1, Me-30), 6.08 (1H, d, J = 12.0, H-2′), 6.92 (1H, d, J = 12.0, H-3′), 7.14 (2H, d, J = 8.0, H-9′, 5′), 8.13 (2H, d, J = 8.0, H-8′, 6′), 5.43 (1H, m, H-12), 5.20 (1H, m, H-3), 4.22 (1H, m, H-2) [3].

Jacoumaric Acid (2). $C_{39}H_{54}O_6$, white amorphous powder. ESI-MS *m/z* 617 [M – H]$^-$. ^{1}H NMR (500 MHz, pyridine-d_5, δ, ppm, J/Hz): 0.96 (3H, s, Me-23), 0.94 (3H, s, Me-24), 0.95 (3H, s, Me-25), 1.02 (3H, s, Me-26), 1.21 (3H, s, Me-27), 1.05 (3H, d, J = 6.5, Me-29), 1.03 (3H, d, J = 6.3, Me-30), 6.67 (1H, d, J = 16.0, H-2′), 7.99 (1H, d, J = 16.0, H-3′), 7.17 (2H, d, J = 8.5, H-9′, 5′), 7.55 (2H, d, J = 8.5, H-8′, 6′), 5.44 (1H, s, H-12), 5.25 (1H, m, H-3), 4.09 (1H, m, H-2) [3].

3-*O*-*trans*-Feruloyl Euscaphic Acid (3). $C_{40}H_{56}O_8$, white amorphous powder. ESI-MS *m/z* 663 [M – H]$^-$. ^{1}H NMR (400 MHz, pyridine-d_5, δ, ppm, J/Hz): 0.92 (3H, s, Me-23), 0.78 (3H, s, Me-24), 0.93 (3H, s, Me-25), 0.86 (3H, s, Me-26), 1.27 (3H, s, Me-27), 1.19 (3H, s, Me-29), 0.98 (3H, d, J = 6.5, Me-30), 6.71 (1H, d, J = 15.8, H-2′), 8.00 (1H, d, J = 15.8, H-3′), 5.57 (1H, s, H-12), 5.25 (1H, m, H-3), 4.39 (1H, m, H-2) [4].

2*α*,3*α*,19*α*,23-Tetrahydroxy-12-ursen-28-oic Acid (4). $C_{30}H_{48}O_6$, white amorphous powder. ESI-MS *m/z* 503 [M – H]$^-$. ^{1}H NMR (600 MHz, pyridine-d_5, δ, ppm, J/Hz): 1.05 (3H, s, Me-24), 0.88 (3H, s, Me-25), 1.11 (3H, s, Me-26), 1.68 (3H, s, Me-27), 1.40 (3H, s, Me-29), 1.13 (3H, d, J = 6.1, Me-30), 5.57 (1H, s, H-12), 4.32 (1H, m, H-2), 3.74 (1H, m, H-3), 3.07 (1H, m, H-18), 3.77 (1H, d, J = 10.8, H-23*α*), 3.94 (1H, d, J = 10.8, H-23*β*) [5].

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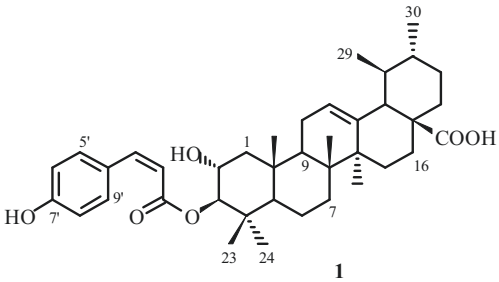

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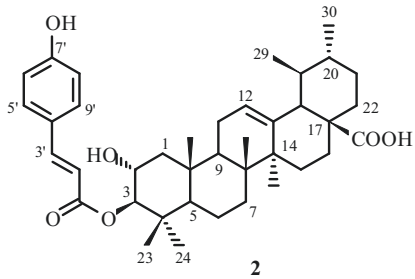

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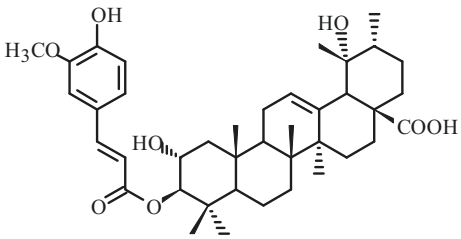

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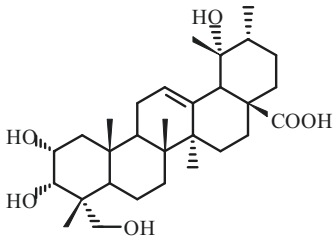

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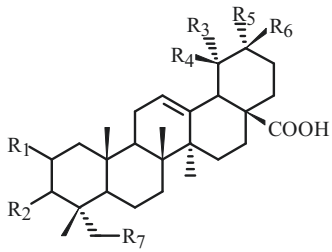

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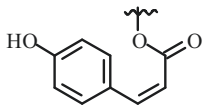

CO (*Z*)

5: $R_1 = R_2 = \alpha OH$, $R_3 = OH$, $R_4 = R_5 = CH_3$, $R_6 = R_7 = H$; **6:** $R_1 = R_3 = R_6 = R_7 = H$, $R_2 = \beta OH$, $R_4 = R_5 = CH_3$
7: $R_1 = \alpha OH$, $R_2 = \beta OH$, $R_3 = R_4 = R_7 = H$, $R_5 = R_6 = CH_3$; **8:** $R_1 = \alpha OH$, $R_2 = \beta OH$, $R_3 = R_6 = R_7 = H$, $R_4 = R_5 = CH_3$
9: $R_1 = \alpha OH$, $R_2 = \beta OH$, $R_3 = OH$, $R_4 = R_7 = H$, $R_5 = R_6 = CH_3$; **10:** $R_1 = R_2 = \alpha OH$, $R_3 = R_6 = R_7 = H$, $R_4 = R_5 = CH_3$
11: $R_1 = R_3 = R_4 = R_7 = H$, $R_2 = \beta OH$, $R_5 = R_6 = CH_3$; **12:** $R_1 = R_2 = \alpha OH$, $R_3 = R_4 = H$, $R_5 = R_6 = CH_3$, $R_7 = OH$
13: $R_1 = \alpha OH$, $R_2 = \beta CO(Z)$, $R_3 = OH$, $R_4 = R_5 = CH_3$, $R_6 = R_7 = H$

Euscaphic Acid (5). $C_{30}H_{48}O_5$, white amorphous powder. ESI-MS *m/z* 487 $[M – H]^–$. ^1H NMR (400 MHz, pyridine-d_5, δ, ppm): 0.92 (3H, s, Me-23), 0.86 (3H, s, Me-24), 0.78 (3H, s, Me-25), 0.93 (3H, s, Me-26), 1.27 (3H, s, Me-27), 1.19 (3H, s, Me-29), 0.98 (3H, d, J = 6.2, Me-30), 5.29 (1H, s, H-12), 3.92 (1H, dd, J = 2.8, H-2), 3.31 (1H, d, J = 2.4, H-3), 2.58 (1H, m, H-18) [6].

Ursolic Acid (6). $C_{30}H_{48}O_3$, white amorphous powder. ESI-MS *m/z* 455 $[M – H]^–$ [6].

Maslinic Acid (7). $C_{30}H_{48}O_4$, white amorphous powder. ESI-MS *m/z* 471 $[M – H]^–$. ^1H NMR (400 MHz, pyridine-d_5, δ, ppm, J/Hz): 1.06 (3H, s, Me-23), 0.93 (3H, s, Me-24), 1.24 (3H, s, Me-25), 1.00 (3H, s, Me-26), 1.26 (3H, s, Me-27), 0.97 (3H, s, Me-29), 0.98 (3H, s, Me-30), 5.45 (1H, s, H-12), 3.37 (1H, d, J = 9.3, H-3), 3.92 (1H, m, H-2), 3.28 (1H, m, H-18) [6].

Corosolic Acid (8). $C_{30}H_{48}O_4$, white amorphous powder. ESI-MS *m/z* 471 $[M – H]^–$. ^1H NMR (400 MHz, pyridine-d_5, δ, ppm, J/Hz): 1.05 (3H, s, Me-23), 0.95 (3H, s, Me-24), 1.18 (3H, s, Me-25), 1.01 (3H, s, Me-26), 1.25 (3H, s, Me-27), 0.90 (3H, d, J = 6.2, Me-29), 0.93 (3H, d, J = 6.5, Me-30), 5.47 (1H, s, H-12), 3.49 (1H, m, H-3), 4.09 (1H, m, H-2), 2.60 (1H, m, H-18) [6].

Arjunic Acid (9). $C_{30}H_{48}O_5$, white amorphous powder. ESI-MS *m/z* 487 $[M – H]^–$. ^1H NMR (500 MHz, pyridine-d_5, δ, ppm, J/Hz): 1.07 (3H, s, Me-23), 1.00 (3H, s, Me-24), 1.26 (3H, s, Me-25), 1.03 (3H, s, Me-26), 1.62 (3H, s, Me-27), 1.10 (3H, s, Me-29), 1.18 (3H, s, Me-30), 5.54 (1H, s, H-12), 3.38 (1H, d, J = 10.5, H-3), 4.11 (1H, m, H-2) [7].

2α,3α-Dihydroxy-12-ursen-28-oic Acid (10). $C_{30}H_{48}O_4$, white amorphous powder. ESI-MS *m/z* 471 $[M – H]^–$. ^1H NMR (600 MHz, pyridine-d_5, δ, ppm, J/Hz): 1.05 (3H, s, Me-23), 0.90 (3H, s, Me-24), 1.11 (3H, s, Me-25), 0.95 (3H, s, Me-26), 1.36 (3H, s, Me-27), 0.92 (3H, d, J = 5.4, Me-29), 0.93 (3H, d, J = 5.7, Me-30), 5.46 (1H, s, H-12), 3.79 (1H, d, J = 2.4, H-3), 4.33 (1H, m, H-2), 2.60 (1H, d, J = 11.4, H-18) [8].

Oleanic Acid (11). $C_{30}H_{48}O_3$, white amorphous powder. ESI-MS *m/z* 455 $[M – H]^–$ [9].

2α,3α,23-Trihydroxyolean-12-en-28-oic Acid (12). $C_{30}H_{48}O_5$, white amorphous powder. ESI-MS *m/z* 487 $[M – H]^–$. ^1H NMR (400 MHz, pyridine-d_5, δ, ppm, J/Hz): 1.06 (3H, s, Me-24), 0.90 (3H, s, Me-25), 0.98 (3H, s, Me-26), 1.19 (3H, s, Me-27), 1.06 (3H, s, Me-29), 1.02 (3H, s, Me-30), 5.46 (1H, s, H-12), 4.26 (1H, m, H-2), 2.30 (1H, m, H-18), 3.29 (1H, d, J = 10.0, H-23α), 3.29 (1H, d, J = 10.4, H-23β) [10].

3-*O*-*cis*-*p*-Coumaroyltormentic Acid (13). $C_{39}H_{54}O_7$, white amorphous powder. ESI-MS *m/z* 633 $[M – H]^–$. ^1H NMR (400 MHz, pyridine-d_5, δ, ppm, J/Hz): 1.05 (3H, s, Me-23), 1.03 (3H, s, Me-24), 0.96 (3H, s, Me-25), 1.10 (3H, s, Me-26), 1.71 (3H, s, Me-27), 1.46 (3H, s, Me-29), 1.12 (3H, d, J = 6.6, Me-30), 6.08 (1H, d, J = 12.8, H-2′), 6.90 (1H, d, J = 13.2, H-3′), 7.13 (2H, d J = 8.4, H-9′, 5′), 8.13 (2H, d, J = 8.4, H-8′, 6′), 5.55 (1H, m, H-12), 5.18 (1H, m, H-3), 4.24 (1H, m, H-2) [11].

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