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The Constituents of Diterpenoids from *Isodon excisa*[*]

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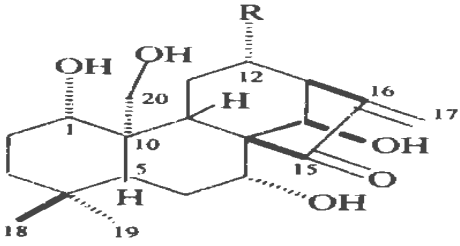
Abstract Four *ent*-kaurene diterpenoids were isolated from the leaves of *Isodon excisa*. Their structures were elucidated on the basis of spectral analysis. One of them has not been found in this plant.

Keywords *Isodon excisa*, Labiatae, *ent*-kaurene, diterpenoid
Classificational number O 656.4

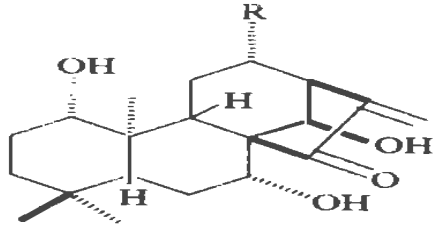
The plants of *Isodon* are rich in *ent*-kaurene diterpenoids, and the diterpenoids of *Isodon* species have cytotoxicity, antitumor activity, inhibition of oxidative phosphorylation, anti-feeding activity and growth inhibitiory activity[1]. Recently, an investigation of the bioactive compounds in *Isodon excisa* (Labiatae) has been performanced. And four *ent*-kaurene diterpenoids were isolated from a methanol extract of this plant. In this paper, the structure elucidation of the four compounds is presented.

1 Results and discussion

Compound **1**, $C_{20}H_{30}O_6$ ([M+ 1]$^+$ *m*/*z* 367), showed the presence of two methyl car-



1. R = OH
4. R = H



2. R = OH
3. R = OAc

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bons, five methylenes, seven methines, three quaternary carbons, two olefinic carbons and a ketonic carbon in its ^{13}C NMR and DEPT spectra. It contains a five membered ring with a ketone conjugated with an exo-methylene group from the following spectral data: UV λ_{max} 232 nm (lgε 3.52); IR ν_{max}/cm^{-1}: 1 713 and 1 645; ^{1}H NMR (δ/ppm) 6.30 and 5.41 (each 1H, s); ^{13}C NMR (δ/ppm) 147.7 (s), 117.0 (t) (exo-methylene), 209.1 (s) (ketone). The above data and the presence of two tertiary methyl signals at δ 0.79 (s) and 0.86 (s), a methylene signal at δ 63.3 (t), 4.75 and 4.73 (each d, J = 12.0 Hz) suggested that this compound has an *ent*-20-oxy-16-kauren-15-one nucleus as the basic skeleton[1,2].

Compound **1** was found to have four secondary hydroxy groups and one hydroxy group at a methylene carbon based on the following spectroscopic data: IR ν_{max}/cm^{-1}: 3 359 and 3 287; ^{1}H NMR (δ/ppm): 3.80 (dd, J = 4.8, 12.4 Hz), 4.87 (dd, J = 4.3, 11.8 Hz), 4.33 (m), 6.00 (br. s), 4.75 and 4.73 (each 1H, ABd, J = 12.0 Hz); ^{13}C NMR (δ/ppm): 83.5, 73.9, 72.1 and 75.0 (each CH), and 63.3 (CH_2). The locations of five hydroxy groups were deduced as follows. Between compound **1** and kamebakaurin, the similiarity of chemical shift value of carbons suggested that there be three oxygen substituents at the 1α, 7α and 14β-position respectively, and one oxygen substituent on C-20[2]. The chemical shift values of C-11 and C-13 (28.6 and 55.0 ppm), as well as the chemical shift value of proton at 4.33 ppm (1H, overlap) suggested that there be an oxygen substituent at 12α-position[3]. Thus, compound **1** was elucidated as 1α, 7α, 12α, 14β, 20-pentahydroxy-ent-kaur-16-ene-15-one[4].

Compound **2** molecular formula $C_{20}H_{30}O_5$ ([M]$^+$, m/z 350), the following differences between compound **1** and **2** indicated that there was no substituent on C-20. (1) Compound **2** added one methyl at δ 1.38 (3H, s) in place of the AB doublet at δ 4.75 and 4.73 (each 1H, d, J = 12.0 Hz) in compound **1**. (2) The chemical shift values of C-10 and C-20 were at δ 45.0 (quaternary carbon) and 18.6 (CH_3) respectively in compound **2**. Thus, compound **2** was elucidated as 1α, 7α, 12α, 14β-tetrahydroxy-*ent*-kaur-16-ene-15-one[2].

Compound **3**, $C_{22}H_{32}O_6$ ([M]$^+$, m/z 392), differs from compound **2** by the addition of one acetoxy group [^{1}H NMR δ 2.07 (3H, s); ^{13}C NMR: δ 170.0 (quaternary carbon) and 21.3 (CH_3)]. The doublet peak at δ 5.22 (1H, d, J = 8.0 Hz) and the chemical shift value of C-12 (δ 75.2) indicated that there was an acetoxy group at C-12 in compound **3**. Thus, compound **3** was elucidated as 1a, 7a, 14b-trihydroxy-12a-acetoxy-*ent*-kaur-16-ene-15-one[2].

Compound **4**, molecular formula $C_{20}H_{30}O_5$ ([M]$^+$, m/z 350). Its ^{1}H NMR, ^{13}C NMR and DEPT spectra showed the similarity to the known compound, kamebakaurin[2].

2 Experiment

(1) General. MPs: uncorr; IR: KBr; UV: MeOH; ^{1}H NMR (400.134 MHz); ^{13}C NMR (100.62 MHz, broad band and DEPT), pyridine-d_5, TMS as int. standard; EIMS: 70 eV.

(2) Plant material. The leaves of Isodon excisa were collected in North Korea, Au-

gust, 1993.

(3) Extraction and isolation. Dried and powered leaves (5 kg) were extracted with MeOH at room temperature for three times and the solvent evaporated. The residue (390 g) was dissolved in EtOH/H_2O (9∶1) and partitioned with petrol ether. The layer of EtOH was evaporated and partitioned with EtOAc. The EtOAc solution was evaporated and the residue (122 g) was subjected to CC (silica gel) eluting with petrol ether–Me_2CO (9∶1~6∶4). The fraction (8∶2 part) was further purified by silica gel CC yielding compound **3** and compound **4**. The fraction (6∶4 part) was purified by silica gel CC yielding compound **1** and compound **2**.

(4) Physical and spectral data of compounds **1**, **2**, **3** and **4**

Compound **1**, $C_{20}H_{30}O_6$, yellow powder, $[\alpha]_D$ – 39.2 (0.51, MeOH); λ_{max} (MeOH): 232 nm (lg ε 3.52); ν_{max}/cm^{-1}: 3 359, 3 287, 1 731, 1 713, 1 645, 1 548, 1 440, 1 275, 1 052; MS (FAB): 367 ([M+1]$^+$), 349, 331, 283, 267; ^{1}H NMR: 3.80 (1β–H, dd, J= 4.8, 12.4 Hz), 4.87 (7β–H, dd, J= 4.3, 11 Hz), 4.33 (12β–H, overlap), 3.54 (13α–H, m), 6.00 (14α–H, br. s), 6.30 and 5.43 (17–Ha and 17–Hb, each s), 4.75 and 4.73 (20–Ha and 20–Hb, each d, J= 12.0 Hz), 0.79 and 0.86 (18–Me and 19–Me); ^{13}C NMR: 83.5 (d, C–1), 30.1 (t, C–2), 39.6 (t, C–3), 33.9 (s, C–4), 52.8 (d, C–5), 29.7 (t, C–6), 73.9 (d, C–7), 62.1 (s, C–8), 56.1 (d, C–9), 47.5 (s, C–10), 28.6 (t, C–11), 72.1 (d, C–12), 55.0 (d, C–13), 75.0 (d, C–14), 209.1 (s, C–15), 147.7 (s, C–16), 117.0 (s, C–17), 33.2 (q, C–18), 22.8 (q, C–19), 63.3 (t, C–20).

Compound **2**, $C_{20}H_{30}O_5$, θ_{mp}: 262~264℃; λ_{max} (MeOH): 232 nm (lg ε 3.93); ν_{max}/cm^{-1}: 3 420, 3 360, 1 705, 1 640; MS (EI): 350 ([M]$^+$), 332, 314, 192, 174, 140; ^{1}H NMR: 3.17 (1β–H, dd, J= 4.4, 11.0 Hz), 4.14 (7β–H, dd, J= 4.2, 12.1 Hz), 3.91 (12β–H, t, J= 3.6 Hz), 5.18 (14α–H, br. s), 6.06 and 5.41 (17–Ha and 17–Hb, each s), 0.79, 0.86 and 1.38 (18–Me, 19–Me and 20–Me, each 3H, s); ^{13}C NMR: 82.1 (d, C–1), 30.3 (t, C–2), 40.7 (t, C–3), 34.1 (s, C–4), 52.9 (d, C–5), 29.7 (t, C–6), 75.7 (d, C–7), 62.6 (s, C–8), 59.3 (d, C–9), 45.0 (s, C–10), 28.6 (t, C–11), 73.9 (d, C–12), 55.6 (d, C–13), 72.3 (d, C–14), 210.5 (s, C–15), 147.8 (s, C–16), 118.2 (s, C–17), 33.6 (q, C–18), 21.9 (q, C–19), 18.6 (q, C–20).

Compound **3**, $C_{22}H_{32}O_6$, θ_{mp}: 240~243℃; λ_{max} (MeOH): 230 nm (lg ε 3.85); ν_{max}/cm^{-1}: 3 410, 1 725, 1 710, 1 640; MS (EI): 392 ([M]$^+$), 332, 314, 292, 281, 268; ^{1}H NMR: 3.34 (1β–H, dd, J= 8.0, 9.0 Hz), 4.79 (7β–H, dd, J= 4.7, 11.9 Hz), 5.22 (12β–H, d, J= 8.0 Hz), 5.44 (14α–H, br. s), 6.29 and 5.56 (17–Ha and 17–Hb, each s), 4.75 and 4.73 (20–Ha and 20–Hb, each d, J= 12.0 Hz), 0.83, 0.87 and 1.51 (18–Me, 19–Me and 20–Me), 2.07 (OAc); ^{13}C NMR: 80.3 (d, C–1), 29.8 (t, C–2), 39.6 (t, C–3), 33.2 (s, C–4), 51.9 (d, C–5), 29.7 (t, C–6), 74.4 (d, C–7), 61.8 (s, C–8), 56.5 (d, C–9), 44.3 (s, C–10), 25.3 (t, C–11), 75.2 (d, C–12), 51.6 (d, C–13), 71.6 (d, C–14), 208.3 (s, C–15), 146.8 (s, C–16), 118.1 (s, C–17), 33.2 (q, C–18), 21.6 (q, C–19), 12.9 (q, C–20), 190.0, 21.3 (OAc).

Compound **4**, $C_{20}H_{30}O_5$, θ_{mp}: 232~234℃; λ_{max} (MeOH): 234 nm (lg ε 3.91); ν_{max}/cm^{-1}: 3 460, 1 720, 1 640; MS (EI): 350 ([M]$^+$), 332, 314, 296, 253, 245, 187; ^{1}H NMR: 3.62 (β–

H, dd, J= 4.9, 9.1 Hz), 4.89(7β-H, dd, J= 5.4, 13.8 Hz), 5.40(14α-H, br. s), 6.34 and 5.69(17-Ha and 17-Hb, each s), 4.69 and 4.41(20-Ha and 20-Hb, each d, J= 12.0 Hz), 0.83 and 0.92(18-Me and 19-Me);[13] C NMR: 81.4(d, C-1), 30.8(t, C-2), 39.1(t, C-3), 33.0(s, C-4), 52.3(d, C-5), 30.4(t, C-6), 74.9(d, C-7), 62.2(s, C-8), 56.9(d, C-9), 48.2(s, C-10), 21.5(t, C-11), 31.6(t, C-12), 48.1(d, C-13), 76.6(d, C-14), 209.4(s, C-15), 150.9(s, C-16), 115.3(s, C-17), 33.4(q, C-18), 22.4(q, C-19), 62.2(t, C-20).

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尾叶香茶菜二萜成份研究

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摘 要 从唇形科尾叶香茶菜叶子的甲醇提取物中,分离提取了 4个对映-贝壳杉烯型二萜,并利用核磁共振氢谱和碳谱,以及质谱、红外光谱和紫外光谱等方法,对以上各化合物进行了结构鉴定.化合物 **1**在该植物的文献中未见报道.

关键词 唇形科,尾叶香茶菜,对映-贝壳杉烯,二萜化合物

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