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TWO DITERPENES FROM *ISODON EXCISA*

YANHONG WANG,* YAOZU CHEN,*† DONGSA KIM‡ and HANDONG SUN§‖

*State Key laboratory of Applied Organic Chemistry, Lanzhou University, Lanzhou, 730000, People's Republic of China; †Department of Chemistry, Zhejiang University, Hangzhou, 310027, People's Republic China; ‡The Botanical Institute, Academy of Sciences DPRK, Pyongyang, D.P.R. Korea; §Laboratory of Phytochemistry, Kunming Institute of Botany, The Chinese Academy of Sciences, Kunming, 650204, Yunnan, People's Republic of China

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Key Word Index—*Isodon excisa*; Labiatae; leaves; *ent*-kaurane; diterpenoid.

Abstract—Two *ent*-kaurane diterpenoids, excisanin D and E, were isolated from the leaves of *Isodon excisa* with structures elucidated on the basis of spectroscopic analysis. Copyright © 1997 Elsevier Science Ltd

INTRODUCTION

Isodon excisa (Labiatae) is distributed in northeast China and northern Korea. The leaves of this plant are used as a folk medicine for gastrointestinal disorders in Korea. Continuing with our investigation of the bioactive compounds in this plant [1, 2], two new diterpenoids, excisanin D (1) and E (2), and a series of known diterpenes, were isolated from the leaves of *I. excisa*. The structural elucidation of the two new compounds is the subject of this paper.

RESULTS AND DISCUSSION

Excisanin D (**1**), $C_{22}H_{32}O_6$([M]$^+$ *m/z* 392), showed the presence of two methyl carbons, six methylenes, six methines, three quaternary carbons, two olefinic carbons, a ketonic carbon and an acetoxy group in its ^{13}C NMR and DEPT spectra. It contains a five-member ring with a ketone conjugated with an exo-methylene group from the following spectral data: UV $\lambda_{max}^{methanol}$ 232 nm (log ε 3.81); IR ν_{max}^{KBr} 1728 and 1648 cm^{-1}; ^{1}H NMR δ 6.28 and 5.34 (each 1H, *s*); ^{13}C NMR δ 150.5, 115.6 (*t*) (exo-methylene), 208.5 (*s*) (ketone). The above data and the presence of two tertiary methyl signals at δ 1.43 and 0.85, a methylene signal at δ 72.4(*t*), 4.03 and 3.74 (each *d*, J = 11.0 Hz) suggested that this compound has an *ent*-18-oxy-16-kauren-15-one nucleus as the basic skeleton [3, 4].

Compound **1** was found to have three secondary hydroxyl groups and an acetoxy group based on the following spectroscopic data: IR ν_{max}^{KBr} cm^{-1}: 3681, 3512, 3369, 1728, 1703, 1246, 1034; ^{1}H NMR: δ 3.63 (*dd*, J = 4.8 and 14.4 Hz), 4.74 (*br t*, J = 7.5 Hz), 5.25 (*br s*), 4.03 and 3.74 (each 1H, AB, *d*, J = 11.0 Hz); ^{13}C NMR: 79.8, 74.2 and 75.9 ppm (each methine), and 72.4 ppm (methylene). The locations of four functional oxygen groups were deduced as follows. The chemical shift values of C-10 and C-20 (45.5 and 15.6) suggested that there was an oxygen substituent at the 1α-position [5]. In the ^{13}C NMR spectrum, C-4 at δ 36.6, C-19 at δ 17.6 and C-5 at δ 46.3 indicated that there was an oxygen substituent on C-18 [4]. The chemical shift values for C-13 and H-14, δ 47.4 and 5.25 (*br s*), respectively, suggested that there was also an oxygen substituent at the 14 β-position [3, 6]. Comparison of the above spectral data with those of *ent*-kaurene structures, as well as a consideration of the structure of diterpenoids which have been reported so far from *I. excisa* [1, 2], confirmed that the chemical structure of **1** is 1α,7α,14β-trihydroxy-18-acetoxy-*ent*-kaur-16-ene-15-one.

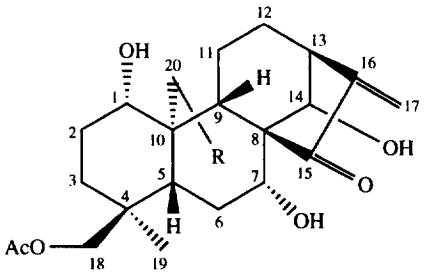
Excisanin E (**2**), $C_{22}H_{32}O_7$([M]$^+$, *m/z* 408), differs from **1** by the addition of one hydroxyl group (Tables 1 and 2). The AB doublet at δ 4.63 and 4.40 (each 1H, *d*, J = 12.0 Hz) and the chemical shift values of C-10 and C-20 (δ 48.1 and 62.2), respectively, indicated that there was a hydroxyl group at C-20 in **2**. Thus, **2** was elucidated as 1α, 7α, 14β, 20-tetrahydroxy-18-acetoxy-*ent*-kaur-16-ene-15-one.

EXPERIMENTAL

General. MPs: uncorr; IR: KBr; UV: MeOH; ^{1}H NMR (400.13 MHz); ^{13}C NMR (100.6 MHz, broad band and DEPT), pyridine-d_5, TMS as int. standard; EIMS: 70 eV.

Plant material. Leaves of *I. excisa* were collected

‖Author to whom correspondence should be addressed.



1 R = H
2 R = OH

near Pyongyang, D. P. R. Korea, in August 1993 and identified by Prof. H.-W. Li. A voucher specimen is deposited in the Herbarium of the Department of Taxonomy, Kunming Institute of Botany, Academia Sinica, Kunming, P. R. China.

Extraction and isolation. Dried and powdered leaves (5 kg) were extracted with MeOH (×3) and the solvent evapd. to yield the residue (390 g), which was dissolved in EtOH–H_2O(9:1) and partitioned with petrol. The aq. EtOH layer was evapd. and partitioned with EtOAc. The EtOAc soln was evapd and the residue (122 g) was subjected to CC(silica gel) eluting with petrol–Me_2CO(9:1–3:2). The fr. (7:3 part) was further purified by silica gel CC yielding **1** (283 mg) and **2** (375 mg).

Excisanin D (**1**). $C_{22}H_{32}O_6$, recrystallised (MeOH) needles, mp 140–142°; $[\alpha]_D$ −56° (*c* 0.42, MeOH); UV λ_{max}^{MeOH} nm (log ε): 232(3.81); IR ν_{max}^{KBr} cm^{-1}: 3681, 3369, 1728, 1703, 1648, 1512, 1458, 1389, 1246, 1034; FABMS *m/z* 393 $[M+1]^+$, 375, 357, 315, 303, 297, 279, 43 (base peak); ^1H NMR: Table 1; ^{13}C NMR: Table 2.

Excisanin E (**2**). $C_{22}H_{32}O_7$, yellow powder, $[\alpha]_D$ −46.1° (*c* 0.64, MeOH); UV λ_{max}^{MeOH} nm (log ε): 234(3.694); IR ν_{max}^{KBr} cm^{-1} .3351, 1730, 1648, 1550, 1304, 1240, 1035; EIMS *m/z*: 408 $[M^+]$, 390 $[M-H_2O]^+$, 372, 354, 281, 235, 43(base peak); ^1H NMR: Table 1; ^{13}C NMR: Table 2.

Table 2. ^{13}C NMR spectral data for compounds **1** and **2**

C	1	2
1	79.8(*d*)	81.0(*d*)
2	29.7(*t*)	30.3(*t*)
3	33.8(*t*)	33.4(*t*)
4	36.6(*s*)	36.5(*s*)
5	46.6(*d*)	46.6(*d*)
6	29.7(*t*)	30.3(*t*)
7	74.2(*d*)	74.8(*d*)
8	62.6(*s*)	62.5(*s*)
9	56.5(*d*)	57.0(*d*)
10	45.5(*s*)	48.1(*s*)
11	20.3(*t*)	21.6(*t*)
12	31.9(*t*)	31.8(*t*)
13	47.4(*d*)	48.1(*d*)
14	75.9(*d*)	76.8(*d*)
15	208.5(*s*)	209.4(*s*)
16	150.5(*s*)	150.9(*s*)
17	115.6(*t*)	116.1(*t*)
18	72.4(*t*)	72.7(*t*)
19	17.6(*q*)	18.5(*q*)
20	15.6(*q*)	62.2(*t*)
OAc	170.7(*s*)	171.2(*s*)
	20.6(*q*)	21.0(*q*)

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Table 1. ^1H NMR spectral data for compounds **1** and **2** (*J* values in parentheses)

H	1	2
1β	3.63(*dd*, 4.8, 14.4)	3.62 (*dd*, 4.2, 11.6)
7β	4.74(*br t*, 7.5)	4.76(*br t*, 6.9)
13α	3.47(*m*)	3.23(*m*)
14α	5.25(*br s*)	5.42(*br s*)
17-Ha	6.29(*s*)	6.30(*s*)
17-Hb	5.34(*s*)	5.60(*s*)
18-Ha	4.03(*d*, 11.0)	4.01 (*d*, 10.9)
18-Hb	3.74(*d*, 11.0)	3.77(*d*, 10.9)
19-Me	0.85(*s*)	0.96(*s*)
20-Me	1.43(*s*)	
20-Ha, Hb		4.63, 4.40(2*d*, 12.0)
OAc	1.87(*s*)	1.95(*s*)

s = singlet; *d* = doublet; *t* = triplet; *m* = multiplet; *br* = broad.

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