

## Three New diterpenoids from *Isodon Gesneroides*

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**Abstract-** Three new diterpenoids, gesneroidins **D-F** (**1-3**), were isolated from *Isodon gesneroides*. The structure was determined as 3 $\beta$ , 7 $\beta$ , 11 $\beta$ , 15 $\beta$ -tetraacetoxy-*ent*-kaur-16-*en*-6-one; 15 $\beta$ -hydroxy-1 $\alpha$ , 3 $\beta$ , 6 $\alpha$ , 7 $\beta$ , 11 $\beta$ -pentaacetoxy-*ent*-kaur-16-*ene*; 6 $\alpha$ , 11 $\beta$ -dihydroxy-3 $\beta$ , 7 $\beta$ -diacetoxy-*ent*-kaur-16-*en*-15-one based on 1D and 2D NMR techniques (COSY, NOESY, HXTCOR, COLOC).

In the previous paper<sup>[1]</sup>, we reported the bioactive diterpenoids, named as gesneroidin A-C, were isolated from this plant. Further investigation of this plant let to isolation of three new diterpenoids named as gesneroidins **D-F**(**1-3**). This paper will deal with their structural elucidation.

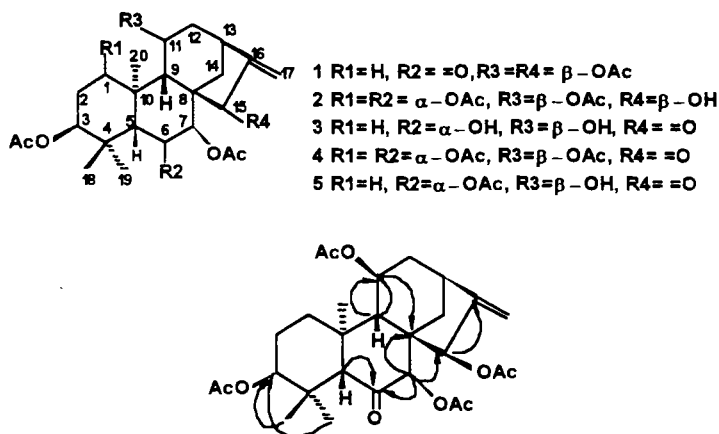


Figure 1. The <sup>1</sup>H-<sup>13</sup>C long-range COSY of 1

Gesneroidin **D** (**1**), crystallized from acetone, mp 129.5-130.5°C; HRMS (518.2477, calc. 518.2516) suggested the formula C<sub>28</sub>H<sub>38</sub>O<sub>9</sub>. EIMS (70 eV) *m/z* (rel. int. %): 518[M]<sup>+</sup>(10), 458(30), 416(35), 356(85), 296(100). Due to the absences of the characteristic absorption in UV and IR at about 230 nm and 1700 and 1640 cm<sup>-1</sup> for an  $\alpha$ ,  $\beta$ -unsaturated *exo*-methylene ketone, it is obvious that the *exo*-methylene group ( $\delta$  150.29, 108.20) and the ketone ( $\delta$  206.24) were unconjugated. The <sup>1</sup>H-<sup>1</sup>H COSY and <sup>13</sup>C-<sup>1</sup>H COSY spectra of **1** revealed the following partial structure -CHCHCH<sub>2</sub>-CHCH<sub>2</sub>- (C-9, C-11 to C-14). The COLOC experiment exhibited cross peaks between C-4 and H-5, Me-18 and M-19, between C-8 and H-7, H-9 and H-11 and between C-10 and H-5, H-9 and Me-20, therefore **1** was deduced as polysubstituted *ent*-20-nonoxygenated kaurene diterpenoid. The location of the four acetoxy groups and the carbonyl function were determined from the COLOC spectrum (Figure 1). The <sup>13</sup>C NMR data are listed in Table 1. The relative configuration of substituents was established from following evidences: the coupling constants H-3 with H-2 $\alpha$  (*J*=2.7Hz) and H-2 $\beta$

( $J=2.7\text{Hz}$ ); the NOE effects between H-11 with H-1 $\alpha$  and H-20, H-7 with H-15 and the latter with H-14 $\beta$ . Therefore, the structure of **1** deduced is 3 $\beta$ , 7 $\beta$ , 11 $\beta$ , 15 $\beta$ -tetraacetoxyl-*ent*-kaur-16-en-6-one.

Gesneroidin **E** (**2**),  $\text{C}_{30}\text{H}_{42}\text{O}_{11}$  [HRMS positive FAB 579.2865( $M+1$ ), calc. 579.2805], was obtained as crystals mp 149-151.5°C. EIMS (70 eV)  $m/z$  (rel. int. %): 518[ $M\text{-HOAc}$ ] $^+$ (10), 458(20), 398(45), 338(55), 296(53), 278(100), 263(60). Its mass spectrum showed a molecular ion two amu more than that of known diterpenoids, 3-acetylcalicolin **A** **4**<sup>[1, 2]</sup>, which is also isolated from this plant. The  $^1\text{H}$ , and  $^{13}\text{C}$  and DEPT NMR spectra showed that **2** had one more hydroxyl group, one more methine, and less one carbonyl group than that of **4**. Inspection of the COSY, NOESY and COLOC spectra indicated that **2** had a hydroxyl function at the C-15 $\beta$  position (NOE effects between H-15 with H-7 $\alpha$  and H-14 $\beta$ ), and led to an unambiguous assignment of the  $^{13}\text{C}$  NMR data as shown in Table 1. Therefore, **2** is 15 $\beta$ -hydroxy-1 $\alpha$ , 3 $\beta$ , 6 $\alpha$ , 7 $\beta$ , 11 $\beta$ -pentaacetoxyl-*ent*-kaur-16-ene.

Gesneroidin **F** (**3**) was obtained as colourless crystals, mp 78-79°C. The quasi-molecular ion peak at  $m/z$  at 435.2389 HRFABMS (positive) indicated the molecular formula  $\text{C}_{24}\text{H}_{34}\text{O}_7$ . EIMS (70 eV)  $m/z$  (rel. int. %): 374[ $M\text{-HOAc}$ ] $^+$ (30), 314(85), 299(100), 281(45). It has the characteristic UV and IR absorptions at 242 nm and 1710, 1650 $\text{cm}^{-1}$  for five membered ring  $\alpha$ ,  $\beta$ -unsaturated *exo*-methylene conjugated with a ketone. Because of the similarity of its  $^1\text{H}$ ,  $^{13}\text{C}$ , DEPT NMR spectra of **3** and those of dawoensin **A**(**5**)<sup>[1, 3]</sup>. The difference between **3** and **5** was that **3** had less acetoxyl group and one more a hydroxy group than **5**. The location of the hydroxy group was determined by analyzing of the COSY and COLOC spectra of **3**. The  $^{13}\text{C}$  NMR data are listed in Table 1. The relative configurations of the substituents were indicated by the coupling constants H-3 with H-2 $\alpha$  ( $J=2.6\text{Hz}$ ) and H-2 $\beta$ ( $J=2.6\text{Hz}$ ), H-7 with H-6 $\beta$ ( $J=3\text{Hz}$ ), H-11 with H-12 $\beta$ ( $J=4.3\text{Hz}$ ), whereas, H-6 $\beta$  appeared a broad singlet signal. Therefore, the structure of **3** could be elucidated as 6 $\alpha$ ,11 $\beta$ -dihydroxy-3 $\beta$ , 7 $\beta$ -diacetoxyl-*ent*-kaur-16-en-15-one.

Table 1.  $^{13}\text{C}$  NMR data for gesneroidin **D-F**(**1-3**) in  $\text{CDCl}_3$  (100.6 MHz,  $\delta$  in ppm)

C	1	2*	3	C	1	2*	3
1	34.74(t)	81.32(d)	35.56(t)	16	150.92(s)	157.07(s)	150.20(s)
2	22.54(t)	30.00(t)	22.53(t)	17	108.20(t)	105.56(t)	112.25(t)
3	77.17(d)	78.40(d)	78.73(d)	18	27.05(q)	27.93(q)	28.09(q)
4	35.71(s)	37.57(s)	36.87(s)	19	22.25(q)	23.33(q)	23.82(q)
5	53.64(d)	42.32(d)	43.90(d)	20	17.93(q)	15.12(q)	19.12(q)
6	206.24(s)	70.60(d)	69.04(d)	OAc	169.91	170.43	170.66
7	84.93(d)	76.02(d)	74.98(d)		169.84	170.12	170.37
8	50.57(s)	46.11(s)	48.20(s)		169.58	169.95	21.27
9	50.25(d)	49.17(d)	59.22(d)		169.06	169.72	21.03
10	44.09(s)	42.79(s)	37.86(s)		21.52	169.05	
11	67.28(d)	70.60(d)	65.83(d)		21.27	21.72	
12	39.70(t)	39.81(t)	40.91(t)		21.05	21.72	
13	37.96(d)	38.65(d)	36.71(d)		20.29	21.26	
14	33.14(t)	34.90(t)	35.35(t)			20.92	
15	78.70(d)	81.68(d)	206.01(s)			20.76	

\* The data are recorded in the solution of  $\text{C}_5\text{D}_5\text{N}$ .

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