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3-HYDROXY-3-METHYLGLUTARYL DOLABELLANE DITERPENES FROM *CHROZOPHORA OBLIQUA*

KHALED M. MOHAMED, KAZUHIRO OHTANI,* RYOJI KASAI* and KAZUO YAMASAKI*†

Department of Pharmacognosy, Faculty of Pharmacy, Assiut University, Assiut, Egypt; *Institute of Pharmaceutical Sciences, Hiroshima University School of Medicine, 1-2-3 Kasumi, Minami-ku, Hiroshima 734, Japan

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Key Word Index—*Chrozophora obliqua*; Euphorbiaceae; 16-*O*-(3-hydroxy-3-methylglutaryl)-dolabellane diterpenoids.

Abstract—From the aerial part of *Chrozophora obliqua*, 14 novel dolabellane diterpenoids have been isolated, all of them are naturally acylated at the C-16 hydroxyl group with 3-hydroxy-3-methylglutaric acid (HMG). The structures of the isolated compounds were assigned on the basis of deacylation reactions as well as NMR and FAB-MS spectroscopic studies.

INTRODUCTION

As part of our investigation of the chemical constituents of *Chrozophora obliqua*, we have described the isolation and structural determination of dolabellane diterpene glucosides [1]. In a continuation of our study on the same plant, we now report on the isolation and structural elucidation of 14 novel 16-*O*-(3-hydroxy-3-methylglutaryl)-dolabellane diterpenoids (**1**–**14**). This is the first example of diterpenes linked with HMG as the acyl moiety.

RESULTS AND DISCUSSION

The chloroform-soluble fraction of the total methanolic extract of the aerial part of *C. obliqua* was subjected to repeated silica gel, reversed phase RP-18 column chromatography and preparative HPLC to afford 14 compounds (**1**–**14**).

The various techniques of NMR spectral analysis established that compounds **1**–**14** were dolabellane type diterpenoids similar to those reported before [11].

Compound **1** was shown to have the molecular formula $C_{26}H_{42}O_8$ by negative HR-FAB-MS spectral analysis. From the spectra, the presence of HMG as the acyl moiety was suggested by the presence of a peak at *m/z* 161 corresponding to the molecular formula $C_6H_{10}O_5$. Elucidation of the structure was achieved by means of different NMR spectral techniques such as ^{13}C (Table 1), DEPT ^{13}C, ^1H (Tables 2 and 3), H–H COSY, HSQC (heteronuclear single quantum coherence), C–H HOHAHA (homonuclear Hartmann-Hahn) and HMBC [2] and by comparison with the previously published data [3–6].

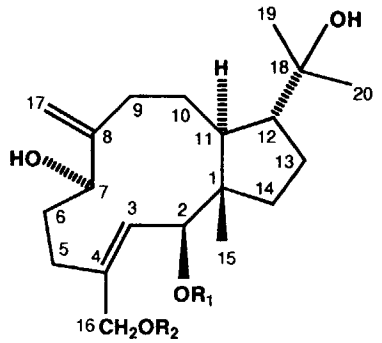
†Author to whom correspondence should be addressed.

Deacylation of **1** at room temp. using 2.5% aq. methanolic KOH gave **1a** ($C_{20}H_{34}O_4$) the physical properties (see Experimental) and ^1H NMR data (Table 2) of which were identical with those of chrozophorogenin A isolated from the same plant [1]. The ^1H NMR data of **1** suggested that the site of attachment of HMG was the C-16 hydroxyl group because of the downfield shift of H-16b to δ5.32 (1H, *d*, J = 12.2) when compared to the corresponding shift in **1a**. The ^{13}C NMR data of **1** supported the above results i.e. downfield shift of C-16 to δ 62.7 and upfield shift of C-4 to δ134.4 when compared with the corresponding shifts in chrozophorogenin A (δ60.3 and 140.5, respectively). The correlation peak between H-16 and C-1′ of HMG in an HMBC experiment with **1** also confirmed this connectivity. Therefore, **1** was characterized as (1*R**, 2*R**, 3*E*, 7*R**, 11*R**, 12*S**)-16-*O*-(3-hydroxy-3-methylglutaryl)-dolabella-3,8(17)-dien-2,7,16,18-tetrol.

All of the other compounds (**2**–**14**) also had the presence of the HMG moiety confirmed by the methods mentioned above.

Deacylation of **2** at room temp. afforded **1a**. The ^{13}C and ^1H NMR spectral data of **2** (Tables 1 and 2) showed additional signals at δ_C 21.2 (*q*) and 171.0 (*s*), and δ_H 2.00 (3H, *s*) attributable to one acetoxyl group. Its location at C-2 was suggested from the downfield shift of H-2 in **2** to δ_H5.07 (1H, *d*, J = 10.5) in **1a**. HMBC spectral analysis for **2** confirmed this suggestion, as a correlation peak had appeared between H-2 and the ketonic carbon of the acetoxyl group. Consequently, **2** was formulated as (1*R**, 2*R**, 3*E*, 7*R**, 11*R**, 12*S**)-2-*O*-acetyl-16-*O*-(3-hydroxy-3-methylglutaryl)-dolabella-3,8(17)-dien-2,7,16,18-tetrol.

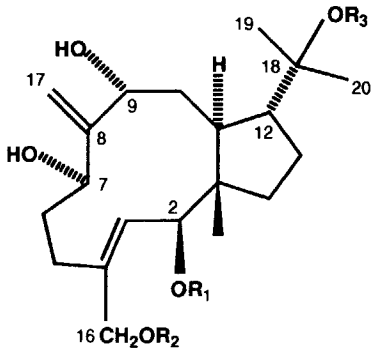
Compound **3** was assigned the molecular formula $C_{26}H_{42}O_9$ (negative HR-FAB-MS). Its ^{13}C and ^1H NMR spectral data (Tables 1 and 2) showed a close



1 R_1= H, R_2= HMG

1a R_1, R_2= H

2 R_1= Ac, R_2= HMG



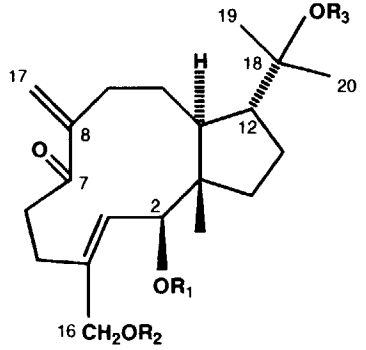
3 R_1, R_3= H, R_2= HMG

3a R_1, R_2, R_3= H

4 R_1= Ac, R_2= HMG, R_3= H

5 R_1= H, R_2= HMG, R_3= Ac

5a R_1, R_2= H, R_3= Ac

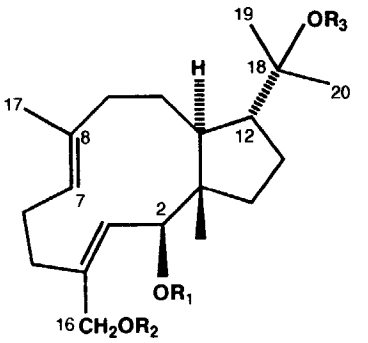


6 R_1= Ac, R_2= HMG, R_3= H

6a R_1, R_2, R_3= H

7 R_1, R_3= Ac, R_2= HMG

7a R_1, R_2= H, R_3= Ac



8 R_1, R_3= H, R_2= HMG

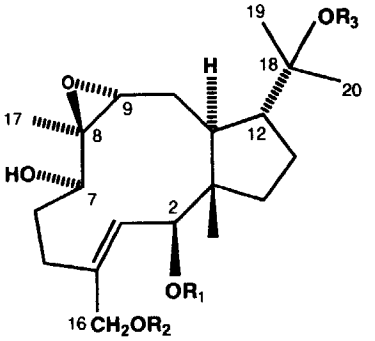
8a R_1, R_2, R_3 = H

9 R_1= Ac, R_2= HMG, R_3= H

10 R_1= H, R_2= HMG, R_3= Ac

10a R_1, R_2= H, R_3= Ac

11 R_1, R_3= Ac, R_2= HMG



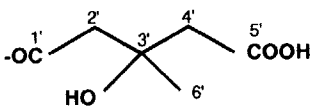
12 R_1, R_3= H, R_2= HMG

12a R_1, R_2, R_3= H

13 R_1= Ac, R_2= HMG, R_3= H

14 R_1= H, R_2= HMG, R_3=Ac

14a R_1, R_2= H, R_3= Ac



HMG

Table 1. ^{13}C NMR chemical shifts of **1–14** and their derivatives (400 MHz, C_5D_5N)

C	1	2*	3	4	5	6	6a	7	8	8a	9	10	10a	11	12	12a	13	14
1	51.5	49.6	51.6	49.9	51.7	49.4	50.9	49.4	51.1	50.9	50.2	50.4	50.4	49.8	50.1	50.3	48.9	50.3
2	73.9	75.9	73.6	75.4	73.8	76.2	73.7	75.5	69.7	69.7	72.5	71.4	71.6	72.6	73.4	73.2	76.0	73.3
3	132.7	125.5	132.8	125.1	132.6	126.9	130.0	126.7	134.3†	131.2	128.7	133.2	129.9	127.8	134.2	130.2	127.1	134.0
4	134.4	138.0	134.9	139.6	134.9	137.9	138.9	138.1	134.3†	137.9	135.9	136.2	139.5	136.5	134.3	140.2	139.2	134.4
5	31.2	29.7	31.8	30.7	30.9	28.6	28.8	29.9[a]	34.9	36.8	34.9	34.5	34.6	34.5	34.8	34.9	34.7	34.7
6	33.7	32.7	34.5	34.0	35.4	34.6	35.3	34.7[b]	24.4	25.1	24.6	24.4	24.6	24.7	32.1	32.3	32.2	32.1
7	73.5	73.7	72.6[a]	72.3[a]	72.6[a]	205.8	206.6	205.4	127.8	127.0	127.7	126.1	126.4	126.9	81.2	81.5	81.2	80.9
8	153.0	150.9	155.4	154.5	156.1	150.5	150.9	150.1	132.7	133.7	134.2	133.5	135.7	134.8	64.9	65.0	64.8	64.7
9	34.9	33.2	72.2[a]	71.6[a]	72.1[a]	34.8	35.5	34.8[b]	37.9	37.9	37.9	37.9	37.8	37.9	63.8	63.8	63.4	63.1
10	29.0	28.2	38.7	38.2	38.0	31.8	32.2	30.0[a]	33.2	33.2	32.7	31.9	31.8	31.6	33.5	33.5	33.6	32.8
11	42.0	41.2	41.0	40.8	41.3	41.5	41.5	42.3	39.9	39.5	39.3	41.5	41.2	40.5	43.4	43.1	43.4	43.0
12	59.9	58.9	59.9	59.4	56.3	59.9	60.2	57.6	60.7	60.3	60.2	58.7	59.8	58.7	59.4	59.4	59.4	56.5
13	27.5	26.7	27.9	27.2	27.5	27.3	27.5	26.6	25.4	25.4	25.4	26.4	26.3	25.9	27.4	27.4	27.0	26.8
14	40.9	40.3	41.1	40.2	39.7	40.8	41.3	39.5	37.2	37.1	37.2	37.4	37.2	37.2	40.9	40.8	40.7	40.4
15	16.3	16.3	16.6	16.8	17.0	16.2	15.8	16.9	17.7	17.3	18.3	17.3	17.0	18.3	17.4	17.4	17.7	17.2
16	62.7	62.3	62.6	62.1	61.7	61.4	59.3	61.4	61.9	61.1	62.3	61.6	58.5	61.7	60.6	58.9	61.2	60.5
17	108.7	109.1	110.4	110.7	109.2	126.8	125.6	126.3	16.6	16.5	16.3	16.9	16.7	16.2	11.5	11.5	11.4	11.6
18	72.6	74.3	73.1	72.5	85.6	71.6	72.0	84.7	71.8	72.2	71.5	85.3	85.1	84.8	72.2	72.2	72.0	85.0
19	25.4	25.1	25.3	24.9	23.2	26.7	26.8	23.8	29.7	29.4	28.9	22.8	22.9	23.3	25.6	25.6	25.8	23.0
20	32.3	31.9	32.7	32.3	27.1	31.9	31.9	26.5	30.3	30.1	30.4	26.5	26.1	26.1	32.0	31.8	31.7	26.3
2-*O*-Ac	—	21.2	—	20.8	—	21.0	—	20.9	—	—	21.2	—	—	21.2	—	—	21.0	—
	—	171.0	—	170.3	—	170.3	—	170.3†	—	—	170.9	—	—	170.6	—	—	170.4	—
18-*O*-Ac	—	—	—	—	22.6	—	—	22.8	—	—	—	21.2	22.8	22.7	—	—	—	22.7
	—	—	—	—	170.2	—	—	170.3†	—	—	—	170.5	170.5	170.7	—	—	—	170.2
HMG																		
1′	172.2	171.9	171.9	171.8	171.9	171.7	—	171.7	172.7	—	172.2	172.3	—	171.8	171.8	—	171.7	171.8
2′	47.2[a]	45.2[a]	47.1[b]	47.1[b]	47.1[b]	46.5	—	46.6[c]	46.1	—	45.7	45.6	—	45.5	47.1	—	46.7	46.8
3′	70.3	70.0	70.3	69.8	70.3	70.1	—	70.4	70.4	—	70.4	70.8	—	70.3	70.3	—	70.2	70.2
4′	48.4[a]	45.4[a]	47.8[a]	48.2[b]	48.1[b]	47.0	—	47.4[c]	47.8	—	46.6	47.5	—	46.7	48.0	—	47.4	47.6
5′	179.5	174.4	180.6	179.2	179.0	175.3	—	176.0	179.7	—	177.0	177.0	—	177.5	177.0	—	179.6	175.8
6′	28.3	27.5	28.3	28.0	28.3	28.1	—	28.0	27.8	—	27.3	27.3	—	27.0	28.3	—	28.0	28.2

*Compound **2** measured in $CDCl_3$.

†Overlapped signals.

[a,b,c]Assignment may be interchangeable in each column.

Table 2. ^{1}H NMR chemical shifts of **1**–**5** and their derivatives (400 MHz, C_5D_5N, TMS)

H	**1**	**2***	**1a***	**1a**	**3**	**3a**	**4**	**5**	**5a**
2	4.87, 1H, *d* (10.0)	5.07, 1H, *d* (10.5)	4.09, 1H, *d* (10.2)	4.59, 1H, *d* (10.3)	4.86, 1H, *d* (10.2)	4.59, 1H, *d* (10.5)	5.56, 1H, *d* (10.5)	4.79, 1H, *d* (10.0)	4.52, 1H, *d* (10.2)
	5.92, 1H, *d* (10.0)	5.40, 1H, *d* (10.5)	5.43, 1H, *d* (10.2)	5.85, 1H, *d* (10.3)	5.91, 1H, *d* (10.2)	5.85, 1H, *d* (10.5)	5.68, 1H, *d* (10.5)	5.94, 1H, *d* (10.0)	5.84, 1H, *d* (10.2)
7	4.22, 1H, *m*	3.90, 1H, *m*	3.91, 1H, *m*	4.30, 1H, *dd* (2.2, 6.8)	†4.69, 1H, *m*	†4.76, 1H, *m*	4.62, 1H, *brd* (9.5)	†5.01, 1H, *m*	†4.94, 1H, *m*
9					†4.69, 1H, *m*	†4.76, 1H, *m*	4.71, 1H, *m*	†5.01, 1H, *m*	†4.94, 1H, *m*
15	1.31, 3H, *s*	1.10, 3H, *s*	1.02, 3H, *s*	1.35, 3H, *s*	1.35, 3H, *s*	1.46, 3H, *s*	1.30, 3H, *s*	1.46, 3H, *s*	1.47, 3H, *s*
16a	4.49, 1H, *d* (12.2)	4.72, 1H, *d* (12.5)	4.02, 1H, *d* (12.1)	4.56, 1H, *d* (12.2)	4.49, 1H, *d* (11.7)	4.52, 1H, *d* (12.4)	5.12, 1H, *d* (12.6)	4.57, 1H, *d* (11.5)	4.45, 1H, *d* (11.7)
16b	5.32, 1H, *d* (12.2)	4.92, 1H, *d* (12.5)	4.32, 1H, *d* (12.1)	4.97, 1H, *d* (12.2)	5.32, 1H, *d* (11.7)	4.98, 1H, *d* (12.4)	5.42, 1H, *d* (12.6)	5.27, 1H, *d* (11.5)	5.27, 1H, *d* (11.7)
17a	5.72, 1H, *s*	5.22, 1H, *s*	5.20, 1H, *s*	5.73, 1H, *s*	5.79, 1H, *s*	5.83, 1H, *s*	5.86, 1H, *s*	5.65, 1H, *s*	5.64, 1H, *s*
17b	5.81, 1H, *s*	5.26, 1H, *s*	5.21, 1H, *s*	5.79, 1H, *s*	6.18, 1H, *s*	6.24, 1H, *s*	6.21, 1H, *s*	5.88, 1H, *s*	5.86, 1H, *s*
19	1.41, 3H, *s*	1.19, 3H, *s*	1.17, 3H, *s*	1.36, 3H, *s*	1.38, 3H, *s*	1.34, 3H, *s*	1.36, 3H, *s*	1.58, 3H, *s*	1.50, 3H, *s*
20	1.42, 3H, *s*	1.25, 3H, *s*	1.25, 3H, *s*	1.40, 3H, *s*	1.40, 3H, *s*	1.41, 3H, *s*	1.39, 3H, *s*	1.59, 3H, *s*	1.59, 3H, *s*
2-*O*-Ac	—	2.00, 3H, *s*	—	—	—	—	2.03, 3H, *s*	—	—
18-*O*-Ac	—	—	—	—	—	—	—	1.88, 3H, *s*	1.83, 3H, *s*
2′, 4′	2.82, 4H, *m*	2.67, 4H, *m*	—	—	2.94, 4H, *m*	—	2.90, 4H, *m*	2.93, 4H, *m*	—
6′	1.56, 3H, *m*	1.38, 3H, *s*	—	—	1.60, 3H, *s*	—	1.57, 3H, *s*	1.63, 3H, *s*	—

*Compounds **2** and **1a** measured in $CDCl_3$.

†Overlapped signals.

Signals indicated as *m* were unresolved.

Chemical shifts in ppm, *J* values in parentheses are recorded in Hz.

Table 3. ^{1}H NMR chemical shifts of **6–11** and their derivatives (400 MHz, $CDCl_3$, TMS)

H	6*	6a*	7*	7a*	8	8a	9	10	10a	11
2	5.58, 1H, *d* (10.5)	4.54, 1H, *d* (10.7)	5.46, 1H, *d* (10.5)	4.40, 1H, *d* (10.2)	4.22, 1H, *d* (9.8)	4.26, 1H, *d* (10.2)	5.19, 1H, *d* (10.3)	4.07, 1H, *d* (10.0)	4.03, 1H, *d* (10.3)	†5.19, 1H, *m*
3	5.52, 1H, *d* (10.5)	5.75, 1H, *d* (10.7)	5.38, 1H, *d* (10.5)	5.70, 1H, *d* (10.2)	5.28, 1H, *d* (9.8)	5.22, 1H, *d* (10.2)	5.32, 1H, *d* (10.3)	5.29, 1H, *d* (10.0)	5.17, 1H, *d* (10.3)	†5.19, 1H, *m*
5a	2.56 1H, *ddd* (4.0, 8.8, 12.8)	2.24, 1H, *ddd* (4.1, 8.4, 12.4)	2.52, 1H, *m*	2.31, 1H, *ddd* (4.2, 8.7, 12.5)	1.98, 1H, *m*	2.02, 1H, *ddd* (4.3, 8.1, 12.2)	2.00, 1H, *m*	2.03, 1H, *m*	2.03, 1H, *m*	2.05, 1H, *m*
5b	2.82, 1H, *m*	3.14, 1H, *ddd* (4.1, 9.1, 12.4)	2.77, 1H, *m*	3.18, 1H, *ddd* (4.2, 8.1, 12.5)	2.34, 1H, *m*	2.45, 1H, *ddd* (4.3. 10.0, 12.2)	2.39, 1H, *m*	2.42, 1H, *m*	2.61, 1H, *ddd* (4.1, 10.3, 11.9)	2.44, 1H, *m*
6a	1.49, 1H, *m*	1.62, 1H, *m*	1.32, 1H, *m*	1.40, 1H, *m*	2.03, 1H, *m*	2.07, 1H, *dd dd* (3.2, 4.3, 8.1, 13.4)	2.04, 1H, *m*	2.10, 1H, *m*	1.83, 1H, *m*	2.09, 1H, *m*
6b	1.66, 1H, *m*	1.94, 1H, *m*	1.48, 1H, *m*	1.92, 1H, *m*	2.26, 1H, *m*	2.30, 1H, *m*	2.24, 1H, *m*	2.18, 1H, *m*	2.17, 1H, *dd dd* (3.1, 4.6, 8.3, 12.7)	2.22, 1H, *m*
7	—	—	—	—	4.85, 1H, *brd* (10.7)	4.92, 1H, *brd* (10.8)	4.86, 1H, *brd* (11.0)	4.90, 1H, *m*	4.88, 1H, *dd* (3.9, 10.7)	4.90, 1H, *dd* (3.9, 10.5)
9a	2.22, 1H, *ddd* (3.9, 7.8, 12.5)	2.60, 1H, *ddd* (4.0, 8.7, 12.7)	2.24, 1H, *m*	2.38, 1H, *ddd* (4.3, 7.8, 12.4)	2.05, 1H, *m*	2.25, 1H, *m*	2.16, 1H, *m*	2.08, 1H, *m*	1.87, 1H, *m*	2.11, 1H, *m*
9b	3.69, 1H, *ddd* (3.9, 8.6, 12.5)	3.78, 1H, *ddd* (4.0, 9.0, 12.7)	3.59, 1H, *m*	3.67, 1H, *ddd* (4.3, 8.7, 12.4)	2.29, 1H, *m*	2.32, 1H, *m*	2.28, 1H, *m*	2.16, 1H, *m*	2.02, 1H, *ddd* (3.8, 8.2, 12.1)	2.20, 1H, *m*
10a	2.01, 1H, *dd dd* (4.0, 8.8, 10.9, 13.9)	2.83, 1H, *m*	2.13, 1H, *m*	2.54, 1H, *m*	1.54, 1H, *m*	1.53, 1H, *m*	1.56, 1H, *m*	1.59, 1H, *m*	†1.43, 1H, *m*	†1.64, 1H, *m*
10b	2.91, 1H, *m*	2.97, 1H, *m*	2.83, 1H, *m*	2.92, 1H, *dd dd* (2.4, 5.9, 8.5, 11.5)	1.65, 1H, *m*	1.65, 1H, *m*	1.67, 1H, *m*	1.64, 1H, *m*	†1.43, 1H, *m*	†1.64, 1H, *m*

(*Contd*)

Table 3. *Continued*

H	6*	6a*	7*	7a*	8	8a	9	10	10a	11
11	1.71, 1H, *m*	1.64, 1H, *m*	1.72, 1H, *m*	1.45, 1H, *m*	1.40, 1H, *m*	1.37, 1H, *m*	1.42, 1H, *m*	1.39, 1H, *m*	1.20, 1H, *m*	1.35, 1H, *m*
12	1.54, 1H, *m*	1.80, 1H, *m*	1.39, 1H, *m*	1.59, 1H, *m*	1.67, 1H, *m*	1.63, 1H, *m*	1.65, 1H, *m*	2.12, 1H, *m*	1.81, 1H, *m*	2.13, 1H, *m*
13a	1.85, 1H, *m*	1.55, 1H, *m*	1.84, 1H, *m*	1.34, 1H, *m*	1.38, 1H, *m*	1.60, 1H, *m*	1.36, 1H, *m*	1.30, 1H, *m*	1.16, 1H, *m*	1.36, 1H, *m*
13b	1.93, 1H, *m*	1.75, 1H, *m*	2.11, 1H, *m*	1.51, 1H, *m*	1.63, 1H, *m*	2.11, 1H, *m*	1.63, 1H, *m*	1.57, 1H, *m*	1.23, 1H, *m*	1.53, 1H, *m*
14a	1.43, 1H,*m*	1.71, 1H, *m*	1.27, 1H, *m*	1.64, 1H, *m*	1.19, 1H, *m*	1.21, 1H, *m*	1.32, 1H, *m*	1.23, 1H, *m*	1.08, 1H, *ddd* (6.3, 7.2, 12.5)	1.25, 1H, *m*
14b	1.58, 1H, *m*	2.08, 1H, *m*	1.43, 1H, *m*	2.21, 1H, *m*	1.70, 1H, *m*	1.28, 1H, *m*	1.70, 1H, *m*	1.66, 1H, *m*	2.25, 1H, *m*	1.66, 1H, *m*
15	1.08, 3H, *s*	1.23, 3H, *s*	1.00, 3H, *s*	1.17, 3H, *s*	1.07, 3H, *s*	1.10, 3H, *s*	1.16, 3H, *s*	1.03, 3H, *s*	1.01, 3H, *s*	1.12, 3H, *s*
16a	5.41, 1H, *d* (13.2)	4.67, 1H, *d* (12.7)	5.16, 1H, *d* (13.2)	4.55, 1H, *d* (12.9)	4.07, 1H, *d* (12.7)	4.03, 1H, *d* (12.6)	4,51, 1H, *d* (12.3)	4.22, 1H, *d* (11.5)	3.83, 1H, *d* (12.3)	4.57, 1H, *d* (12.3)
16b	5.55, 1H, *d* (13.2)	4.93, 1H, *d* (12.7)	5.32, 1H, *d* (13.2)	4.89, 1H, *d* (12.9)	5.27, 1H, *d* (12.7)	4.10, 1H, *d* (12.6)	5.08, 1H, *d* (12.3)	4.99, 1H, *d* (11.5)	4.34, 1H, *d* (12.3)	4.85, 1H, *d* (12.3)
17a	6.18, 1H, *s*	6.03, 1H, *s*	5.71, 1H, *s*	5.68, 1H, *s*	1.57, 3H, *s*	1.56, 3H, *s*	1.59, 3H, *s*	1.54, 3H, *s*	1.50, 3H, *s*	1.56, 3H, *s*
17b	6.21, 1H, *s*	6.15, 1H, *s*	6.10, 1H, *s*	5.97, 1H, *s*	—	—	—	—	—	—
19	1.26, 3H, *s*	1.26, 3H, *s*	1.51, 3H, *s*	1.54, 3H, *s*	1.17, 3H, *s*	1.17, 3H, *s*	1.17, 3H, *s*	1.44, 3H, *s*	1.41, 3H, *s*	1.45, 3H, *s*
20	1.38, 3H, *s*	1.38, 3H, *s*	1.55, 3H, *s*	1.57, 3H, *s*	1.22, 3H, *s*	1.25, 3H, *s*	1.23, 3H, *s*	1.51, 3H, *s*	1.49, 3H, *s*	1.52, 3H, *s*
2-*O*-Ac	1.98, 3H, *s*	—	1.99, 3H, *s*	—	—	—	2.01, 3H, *s*	—	—	2.01, 3H, *s*
18-*O*-Ac	—	—	2.06, 3H, *s*	1.96, 3H, *s*	—	—	—	1.94, 3H, *s*	1.95, 3H, *s*	1.99, 3H, *s*
2′	3.19, 2H, *brs*	—	2.99, 2H, *brs*	—	2.58, 2H, *brs*	—	2.62, 2H, *brs*	2.60, 2H, *brs*	—	2.63, 2H, *brs*
4′	3.16, 2H, *brs*	—	2.94, 2H, *brs*	—	2.49, 2H, *brs*	—	2.52, 2H, *brs*	2.54, 2H, *brs*	—	2.54, 2H, *brs*
6′	1.76, 3H, *s*	—	1.65, 3H, *s*	—	1.25, 3H, *s*	—	1.35, 3H, *s*	1.25, 3H, *s*	—	1.37, 3H, *s*

*Compounds measured in C_5D_5N.
†Overlapped signals.
Chemical shifts in ppm, *J* values in parentheses are recorded in Hz.
Signals indicated as *m* were unresolved.

similarity to **1**, except for the carbon chemical shift at δ72.2 (*d*) due to a hydroxylated methine carbon C-9 in addition to the downfield shifts of C-8 to δ155.4 and C-17 to δ110.4 with δ_H 5.79 and 6.18 (each *s*). Deacylation of **3** at room temp. gave **3a** which was identified as chrozophorogenin C [1] by comparison of their chromatographic and spectroscopic data. Thus, **3** was identified as (1*R**, 2*R**, 3*E*, 7*R**, 11*R**, 12*S**)-16-*O*-(3-hydroxy-3-methyl-glutaryl)-dolabella-3,8(17)-dien-2,7,9,16,18-pentol.

The ^{13}C and ^{1}H NMR spectral data of **4** (Tables 1 and 2) were very similar to those of **3** except for the presence of extra signals corresponding to one acetoxyl group at δ_C 20.8 (*q*) and 170.3 (*s*), and δ_H 2.03 (3H, *s*). Its location at C-2 was established from the downfield shift of C-2 to δ_C 75.4 and the upfield shifts of both C-1 and C-3 to δ49.9 and 125.1, respectively, in relation to **3**. HMBC spectral analysis of **4** in addition to a deacylation experiment at room temp. to give **3a** clearly confirmed the above data. Thus **4** was identified as (1*R**, 2*R**, 3*E*, 7*R**, 11*R**, 12*S**)-2-*O*-acetyl-16-*O*-(3-hydroxy-3-methylglutaryl)-dolabella-3,8(17)-dien-2,7,9,16,18-pentol.

Compound **5** was identified as the 18-*O*-acetylated derivative of **3** from the downfield shift of C-18 to δ_C 85.6, in addition to the upfield shifts of C-12, -19 and -20 to δ56.3, 23.2 and 27.1, respectively (Table 1), compared with those of **3**. Deacylation of **5** at room temp. afforded **5a** (18-*O*-acetylated **3a**) as deduced from the NMR spectral data (Table 2) and FAB-MS spectral analysis. For further confirmation, **5a** was deacylated with 2.5% aq. methanolic KOH under reflux conditions and the obtained derivative was identified as **3a** according to its physical properties including FAB-MS and NMR data. From the aforementioned results, we concluded that **5** was (1*R**, 2*R**, 3*E*, 7*R**, 11*R**, 12*S**)-16-*O*-(3-hydroxy-3-methylglutaryl)-18-*O*-acetyldolabella-3,8(17)-dien-2,7,9,16,18-pentol.

Compound **6** was assigned the molecular formula $C_{28}H_{42}O_9$ (negative HR-FAB-MS). Its ^{13}C and ^{1}H NMR spectral data (Tables 1 and 3) showed characteristic peaks attributable to HMG as in all of the above mentioned compounds. Compound **6**, deacylated at room temp., gave the derivative **6a** with the molecular formula $C_{20}H_{32}O_4$. The ^{13}C and ^{1}H NMR spectra of **6a** (Tables 1 and 3) showed a close relatedness to **1a**, except for a signal due to one ketonic group at δ_C 206.6. 2D NMR spectral analysis by H–H COSY, HSQC, C–H HOHAHA and HMBC clarified the proposed structure of **6a** as another new dolabellane diterpenoid with a ketonic group as C-7. For further confirmation, the 2D NMR spectral measurements were also recorded for **6**, they also established the attachment of the acetoxyl group at C-2. The ^{13}C and ^{1}H NMR spectral data of **6** supported the above results from the downfield shifts of C-2 and C-16 to δ_C 76.2 and 61.4, respectively, as well as of H-2 to δ_H5.58 (1H, *d*, J = 10.5) and H-16 to δ5.41 and 5.55 (each 1H, *d*, J = 13.2) when compared with the shifts in **6a**.

A ROESY experiment with **6a** (Fig. 1) with the help of molecular models indicated that it had the same stereochemistry as that previously reported for dolabellane diterpenes [1]. From the above mentioned data, **6** was formulated as (1*R**, 2*R**, 3*E*, 11*R**, 12*S**)-2-*O*-acetyl-16-*O*-(3-hydroxy-3-methylglutaryl)-2,16,18-trihydroxy-dolabella-3,8(17)-dien-7-one.

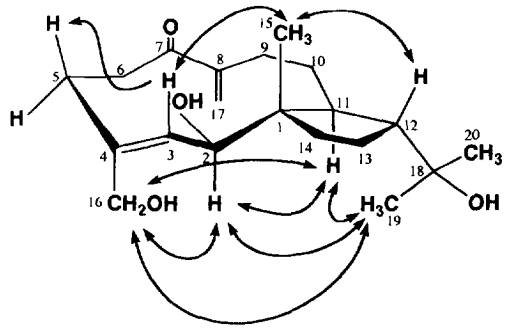


Fig. 1. Preferred conformation for **6a** as determined from 2D ROESY ROE (↷).

The ^{13}C and ^{1}H NMR spectra of **7** (Tables 1 and 3) showed that it was an 18-*O*-acetylated congener of **6**, particularly from the downfield shift of C-18 to δ_C 84.7 as well as the upfield shifts of C-12, -19 and -20 to δ57.6, 23.8 and 26.5, respectively. Deacylation of **7** at room temp. afforded **7a** (^{1}H NMR, Table 2) and under reflux conditions gave **6a**, both of these findings confirmed the above mentioned results. Therefore, **7** was identified as (1*R**, 2*R**, 3*E*, 11*R**, 12*S**)-2,18-*O*-diacetyl-16-*O*-(3-hydroxy-3-methylglutaryl)-2,16,18-trihydroxydolabella-3,8(17)-dien-7-one.

Compound **8** was assigned the molecular formula $C_{26}H_{42}O_7$ (negative HR-FAB-MS). It was deacylated at room temp. to give **8a** with molecular formula $C_{20}H_{34}O_3$. The ^{13}C and ^{1}H NMR spectra of **8a** (Tables 1 and 3) showed that it had a different dolabellane skeleton than the above mentioned compounds as shown by the presence of signals due to two olefinic carbons at δ133.7 (*s*) and 127.0 (*d*) with δ_H 4.92 (1H, *brd*, J = 10.8) and another tertiary methyl group at δ16.5 with δ_H1.56 (3H, *s*). The results of various 2D NMR experiments (H–H COSY, C–H COSY, HSQC, C–H HOHAHA and HMBC) conducted with **8** and **8a** showed that they were new dolabellane diterpenoids with a trisubstituted double bond at C-7 and tertiary methyl group at C-17.

NOE differential spectroscopy (Fig. 2) with the help of molecular models indicated that **8a** has the same stereochemistry as the previously reported dolabellane diterpenes [1]. The C-7–C-8 double bond proved to have *trans* geometry (*E* configuration) from the chemical shift value of the C-17 methyl signal [7] and the absence of a NOE between H-7 and the C-17 methyl protons. From the above mentioned data, **8** was formulated as (1*R**, 2*R**, 3*E*, 7*E*, 11*R**, 12*S**)-16-*O*-(3-hydroxy-3-methylglutaryl)-dolabella-3,7-dien-2,16,18-triol.

The ^{13}C and ^{1}H NMR spectral data of **9** (Tables 1 and 3) were very similar to those of **8**, except for the presence of signals at δ_C 21.2 (*q*) and 170.9 (*s*), and δ_H2.01 (3H, *s*) corresponding to one acetoxyl group. The downfield shift

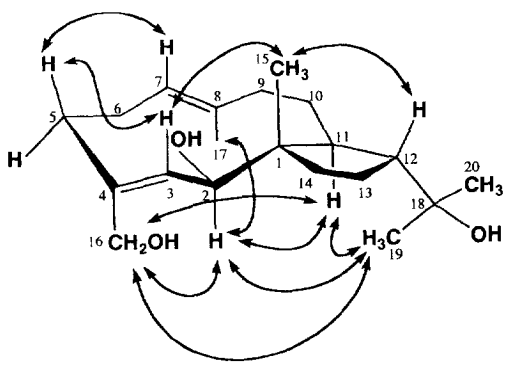


Fig. 2. Preferred conformation for **8a** NOE (↷).

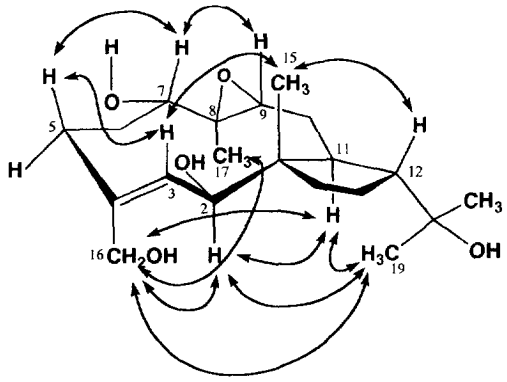


Fig. 3. Preferred conformation for **12a** as determined from PSNOESY NOE (↷).

of C-2 to δ_C 72.5 and the upfield shifts of both C-1 and C-3 to δ50.2 and 128.7, respectively, compared to **8** placed the acetate attachment at C-2. HMBC spectral analysis of **2** in addition to a deacylation experiment at room temp. which gave **8a** clearly confirmed the above data. Therefore, **9** was the 2-*O*-acetylated congener of **8** and it was identified as (1*R**, 2*R**, 3*E*, 7*E*, 11*R**, 12*S**)-2-*O*-acetyl-16-*O*-(3-hydroxy-3-methylglutaryl)-dolabella-3,7-dien-2,16,18-triol.

Compound **10** was found to have the same molecular formula as **9** and its ^{13}C and ^{1}H NMR data (Tables 1 and 3) showed their close similarity, except for the location of the acetate functionality at C-18 instead of C-2 as shown by the downfield shift of C-18 to δ_C 85.3 and the upfield shifts of both C-19 and C-20 to δ22.8 and 26.5, respectively, when compared with those in **8** and **9**. The deacylation of **10** at room temp. to afford **10a** and under reflux conditions to give **8a**, as well as the results of various 2D NMR analyses performed on **10a**, all confirmed the above assignments. Thus, **10** was shown to be the 18-*O*-acetylated homologue of **8** and was, therefore, identified as (1*R**, 2*R**, 3*E*, 7*E*, 11*R**, 12*S**)-16-*O*-(3-hydroxy-3-methylglutaryl)-18-*O*-acetyldolabella-3,7-dien-2,16,18-triol.

The ^{13}C and ^{1}H NMR data of **11** (Tables 1 and 3) showed the presence of two acetoxyl groups [δ_C 21.2, 170.6, 22.7 and 170.7 with δ_H 2.01 and 1.99 (each 3H, *s*)], and suggested that it was a 2,18-*O*-diacetylated derivative of **8** from the downfield shifts of both C-2 and C-18 to δ_C 72.6 and 84.8, respectively, in comparison to the corresponding shifts in **8**. Deacylation of **11** at room temp. gave **10a** and under reflux conditions afforded **8a**. This strongly supported the above data and showed that **11** was (1*R**, 2*R**, 3*E*, 7*E*, 11*R**, 12*S**)-2,18-*O*-diacetyl-16-*O*-(3-hydroxy-3-methylglutaryl)-dolabella-3,7-dien-2,16,18-triol.

Compound **12** was assigned the molecular formula $C_{20}H_{42}O_9$ (negative HR-FAB-MS). It was deacylated at room temp. to give **12a** with molecular formula $C_{20}H_{34}O_5$. The ^{13}C NMR spectrum of **12a** (Table 1) with signals at δ_C 6.5 (*s*), 63.8 (*d*) and 11.5 (*q*) in conjunction with ^{1}H NMR resonances (Table 4) at δ_H 3.30 (1H, *dd*, J = 3.2, 10.5) and 18.2 (3H, *s*) established that **12a** possessed a methyl-substituted epoxide group [8, 9]. They showed also the presence of an oxygenated carbon at δ81.5 (*d*) with δ_H 3.54 (1H, *brd*, J = 10.6). The 2D NMR as H–H COSY, HSQC and HMBC data allowed the identification of the chemical structure of **12a** which can be satisfactorily accommodated in a dolabellane framework. The location of the methyl-substituted epoxide group at C-17–8–9 was established from HMBC spectral analysis in which cross peaks for direct correlations between C-8 and each of the H-7, H-9 and H-17 methyl protons as well as correlation peaks between C-17 and H-7 and H-9 were observed.

The NOESY spectrum of **12a** (Fig. 3) defined its relative configuration as that previously reported [1] for the above mentioned compounds, the observation of a NOE between H-7 and H-9 showed that they were sterically localized on the same face and identified the chirality at C-7, C-8 and C-9 as *R**, *S** and *R**, respectively. For complete structural identification, the above mentioned techniques of 2D NMR were carried out for **12**. The results obtained supported the above results and confirmed the attachment of HMG at C-16. From the above mentioned results, we concluded that **12** was (1*R**, 2*R**, 3*E*, 7*R**, 8*S**, 9*R**, 11*R**, 12*S**)-16-*O*-(3-hydroxy-3-methylglutaryl)-8,9-epoxydolabell-3-en-2,7,16,18-tetrol.

Deacylation of **13** at room temp. afforded **12a** which indicated its close similarity to **12**. The ^{13}C and ^{1}H NMR spectral data of **13** (Tables 1 and 4) showed additional signals at δ_C 21.0 (*q*) and 170.4 (*s*), and δ_H 2.03 (3H, *s*) assignable to one acetoxyl group. Its location at C-2 was suggested from the downfield shifts of C-2 to δ_C 76.0 and H-2 to δ_H 5.60 (1H, *d*, J = 10.4) and the upfield shifts of both C-1 and C-3 to δ48.9 and 127.1, respectively, in relation to **12** and **12a**. This was confirmed by HMBC spectral analysis of **13**. Consequently, **13** was shown to be a 2-*O*-acetylated congener of **12** i.e. (1*R**, 2*R**, 3*E*, 7*R**, 8*S**, 9*R**, 11*R**, 12*S**)-2-*O*-acetyl-16-*O*-(3-hydroxy-3-methylglutaryl)-8,9-epoxydolabell-3-en-2,7,16,18-tetrol.

The ^{13}C and ^{1}H NMR spectral data of **14** (Tables 1 and 4) showed that it was an 18-*O*-acetylated homologue of **12** i.e. presence of signals at δ_C 22.7 (*q*) and 170.2 (*s*), and δ_H1.91 (3H, *s*) with a downfield shift of C-18 to δ85.0 and upfield shifts of both C-19 and C-20 to δ23.0

Table 4. ^{1}H NMR chemical shifts of **12**–**14** and their derivatives (400 MHz, C_5D_5N, TMS)

H	12	12a	13	14	14a
2	4.58, 1H, *d* (10.0)	4.66, 1H, *d* (10.0)	5.60, 1H, *d* (10.4)	4.51, 1H, *d* (10.0)	4.58, 1H, *d* (10.1)
3	5.93, 1H, *d* (10.0)	5.83, 1H, *d* (10.0)	5.67, 1H, *d* (10.4)	5.91, 1H, *d* (10.0)	5.79, 1H, *d* (10.1)
5a	2.21, 1H, *m*	2.18, 1H, *m*	2.05, 1H, *m*	2.18, 1H, *m*	2.16, 1H, *m*
5b	2.83, 1H, *m*	3.25, 1H, *m*	2.68, 1H, *m*	2.85, 1H, *m*	3.19, 1H, *m*
6a	2.13, 1H, *m*	2.12, 1H, *m*	2.00, 1H, *m*	2.09, 1H, *m*	2.10, 1H, *m*
6b	2.41, 1H, *m*	2.60, 1H, *m*	2.20, 1H, *m*	2.25, 1H, *m*	2.58, 1H, *m*
7	3.44, 1H, *brd* (10.1)	3.54, 1H, *brd* (10.6)	3.46, 1H, *brd* (10.5)	3.49, 1H, *brd* (10.9)	3.51, 1H, *brd* (10.7)
9	3.25, 1H, *dd* (3.5, 10.6)	3.30, 1H, *dd* (3.2, 10.5)	3.17, 1H, *dd* (3.1, 10.6)	3.23, 1H, *dd* (3.4, 10.5)	3.27, 1H, *dd* (3.2, 10.5)
10a	2.32, 1H, *m*	2.29, 1H, *m*	2.09, 1H, *m*	2.23, 1H, *m*	2.23, 1H, *m*
10b	2.57, 1H, *m*	2.53, 1H, *m*	2.45, 1H, *m*	2.45, 1H, *m*	2.48, 1H, *m*
11	1.79, 1H, *m*	1.80, 1H, *m*	1.83, 1H, *m*	1.92, 1H, *m*	1.73, 1H, *m*
12	1.87, 1H, *m*	1.85, 1H, *m*	1.89, 1H, *m*	2.03, 1H, *m*	1.85, 1H, *m*
13a	1.51, 1H, *m*	1.47, 1H, *m*	1.43, 1H, *m*	1.39, 1H, *m*	1.48, 1H, *m*
13b	1.68, 1H, *m*	1.67, 1H, *m*	1.64, 1H, *m*	1.86, 1H, *m*	1.62, 1H, *m*
14a	1.55, 1H, *m*	1.55, 1H, *ddd* (6.1, 8.8, 12.4)	1.46, 1H, *m*	1.48, 1H, *m*	1.60, 1H, *m*
14b	2.50, 1H, *m*	2.48, 1H, *m*	2.38, 1H, *m*	2.38, 1H, *m*	2.41, 1H, *m*
15	1.40, 3H, *s*	1.42, 3H, *s*	1.36, 3H, *s*	1.36, 3H, *s*	1.37, 3H, *s*
16a	4.99, 1H, *d* (12.2)	4.62, 1H, *d* (12.5)	5.32, 1H, *d* (12.9)	4.96, 1H, *d* (12.4)	4.55, 1H, *d* (12.4)
16b	5.40, 1H, *d* (12.2)	5.08, 1H, *d* (12.5)	5.46, 1H, *d* (12.9)	5.33, 1H, *d* (12.4)	4.99, 1H, *d* (12.4)
17	1.82, 3H, *s*	1.82, 3H, *s*	1.79, 3H, *s*	1.86, 3H, *s*	1.66, 3H, *s*
19	1.39, 3H, *s*	1.34, 3H, *s*	1.27, 3H, *s*	1.57, 3H, *s*	1.55, 3H, *s*
20	1.41, 3H, *s*	1.36, 3H, *s*	1.37, 3H, *s*	1.58, 3H, *s*	1.58, 3H, *s*
2-*O*-Ac	—	—	2.03, 3H, *s*	—	—
18-*O*-Ac	—	—	—	1.98, 3H, *s*	1.91, 3H, *s*
2′	2.96, 2H, *brs*	—	3.06, 2H, *brs*	3.06, 2H, *brs*	—
4′	2.86, 2H, *brs*	—	3.03, 2H, *brs*	2.99, 2H, *brs*	—
6′	1.61, 3H, *s*	—	1.67, 3H, *s*	1.65, 3H, *s*	—

Chemical shifts in ppm, *J* values in parentheses are recorded in Hz.
Signals indicated as *m* were unresolved.

and 26.3, respectively. Compound **14** was deacylated at room temp. to give **14a** which was the 18-*O*-acetylated derivative of **12a**, as suggested from the ^{1}H NMR spectral data (Table 4) and confirmed by deacylation of **14a** under reflux conditions to afford **12a**. Therefore, **14** was identified as (1*R**, 2*R**, 3*E*, 7*R**, 8*S**, 9*R**, 11*R**, 12*S**)-16-*O*-(3-hydroxy-3-methylglutaryl)-18-*O*-acetyl-8,9-epoxydolabell-3-en-2,7,16,18-tetrol.

At the present time, the absolute configuration of the isolated dolabellane diterpenes from *C. obliqua* as well as the chirality of HMG (C-3) are still under investigation.

EXPERIMENTAL

For general experimental procedures, plant material and extraction see ref. [1].

Isolation of diterpenoids **1**–**14**. The chloroform fraction (50 g) was subjected to a silica gel CC using hexane–EtOAc and EtOAc–MeOH gradients to give 18 frs. Fr. no. 15 (8.20 g) was sepd by CC on reversed-phase silica gel, LiChroprep RP-18 using a 70–80% aq. MeOH gradient and prep. ODS-HPLC using 67% and 70% MeOH with 0.05% TFA to give **2** (68 mg), **6** (227 mg), **7** (81 mg), **8** (24 mg), **9** (1.09 g), **10** (57 mg) and **11** (396 mg). Fr. no. 18 (7 g) was subjected to reversed-phase silica gel CC, LiChroprep RP-18 using a 45–50% aq. MeOH gradient, then prep. ODS-HPLC using 40–55% MeOH with 0.05% TFA to give **1** (38 mg), **3** (8 mg), **4** (27 mg), **5** (14 mg), **12** (16 mg), **13** (32 mg) and **14** (20 mg).

(1R*, 2R*, 3E, 7R*, 11R*, 12S*)-16-O-(3-*Hydroxy*-3-*methylglutaryl*)-*dolabella*-3,8(17)-*dien*-2,7,16,18-*tetrol* (**1**). Amorphous powder; $[\alpha]_D^{19}$ + 100.9° (MeOH; *c* 2.13);

HR-FAB-MS (−ve) *m/z*: 481.2826 $[M-H]^-$ ($C_{26}H_{41}O_8$ req. 481.2802), 161.0436 ($C_6H_9O_5$ req. 161.0440) corresponding to HMG; ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 2.

(1R*, 2R*, 3E, 7R*, 11R*, 12S*)-2-O-*Acetyl*-16-O-(3-*hydroxy*-3-*methylglutaryl*)-*dolabella*-3,8(17)-*dien*-2,7,16,18-*tetrol* (**2**). Amorphous powder; $[\alpha]_D^{19}$ + 66.4 (MeOH; *c* 2.86); HR-FAB-MS (−ve) *m/z*: 523.2923 $[M-H]^-$ ($C_{28}H_{43}O_9$ req. 523.2907); ^{13}C and ^1H NMR ($CDCl_3$): Tables 1 and 2.

(1R*, 2R*, 3E, 7R*, 9R*, 11R*, 12S*)-16-O-(3-*hydroxy*-3-*methylglutaryl*)-*Dolabella*-3,8(17)-*dien*-2,7,9,16,18-*pentol* (**3**). Amorphous powder; $[\alpha]_D^{19}$ − 13.04° (MeOH; *c* 0.46); HR-FAB-MS (−ve) *m/z*: 497.2747 $[M-H]^-$ ($C_{26}H_{41}O_9$ req. 497.2751); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 2.

(1R*, 2R*, 3E, 7R*, 9R*, 11R*, 12S*)-2-O-*Acetyl*-16-O-(3-*hydroxy*-3-*methylglutaryl*)-*dolabella*-3,8(17)-*dien*-2,7,9,16,18-*pentol* (**4**). Amorphous powder; $[\alpha]_D^{19}$ + 3.9° (MeOH; *c* 1.26); HR-FAB-MS (−ve) *m/z*: 539.2862 $[M-H]^-$ ($C_{28}H_{43}O_{10}$ req. 539.2856); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 2.

(1R*, 2R*, 3E, 7R*, 9R*, 11R*, 12S*)-16-O-(3-*hydroxy*-3-*methylglutaryl*)-18-O-*Acetyldolabella*-3,8(17)-*dien*-2,7,9,16,18-*pentol* (**5**). Amorphous powder; $[\alpha]_D^{19}$ − 10.0° (MeOH; *c* 0.4); HR-FAB-MS (−ve) *m/z*: 539.2855 $[M-H]^-$ ($C_{28}H_{43}O_{10}$ req. 539.2856); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 2.

(1R*, 2R*, 3E, 11R*, 12S*)-2-O-*Acetyl*-16-O-(3-*hydroxy*-3-*methylglutaryl*)-2,16,18-*trihydroxydolabella*-3,8(17)-*dien*-7-*one* (**6**). Amorphous powder; $[\alpha]_D^{19}$ + 38.4° (MeOH; *c* 3.46); HR-FAB-MS (−ve) *m/z*: 521.2757 $[M-H]^-$ ($C_{28}H_{41}O_9$ req. 521.2751); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 3.

(1R*, 2R*, 3E, 11R*, 12S*)-2,18-O-*Diacetyl*-16-O-(3-*hydroxy*-3-*methylglutaryl*)-2,16,18-*trihydroxydolabella*-3,8(17)-*dien*-7-one (**7**). Amorphous powder: $[\alpha]_D^{19}$ + 36.6° (MeOH; *c* 2.7); HR-FAB-MS (−ve) *m/z*: 563.2814 $[M-H]^-$ ($C_{30}H_{43}O_{10}$ req. 563.2857); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 3.

(1R*, 2R*, 3E, 7E, 11R*, 12S*)-16-O-(3-*hydroxy*-3-*methylglutaryl*)-8,9-*Epoxydolabella*-3,7-*dien*-2,16,18-*triol* (**8**). Amorphous powder; $[\alpha]_D^{19}$ − 7.5° (MeOH; *c* 1.07); HR-FAB-MS (−ve) *m/z*: 465.2864 $[M-H]^-$ ($C_{26}H_{41}O_7$ req. 465.2852); ^{13}C and ^1H NMR ($CDCl_3$): Tables 1 and 3.

(1R*, 2R*, 3E, 7E, 11R*, 12S*)-2-O-*Acetyl*-16-O-(3-*hydroxy*-3-*methylglutaryl*)-*Dolabella*-3,7-*dien*-2,16,18-*triol* (**9**). Amorphous powder; $[\alpha]_D^{19}$ + 4.7° (MeOH; *c* 0.86); HR-FAB-MS (−ve) *m/z*: 507.2931 $[M-H]^-$ ($C_{28}H_{43}O_8$ req. 507.2958); ^{13}C and ^1H NMR ($CDCl_3$): Tables 1 and 3.

(1R*, 2R*, 3E, 7E, 11R*, 12S*)-16-O-(3-*hydroxy*-3-*methylglutaryl*)-18-O-*Acetyldolabella*-3,7-*dien*-2,16,18-*triol* (**10**). Amorphous powder; $[\alpha]_D^{19}$ − 1.7° (MeOH; *c* 0.3); HR-FAB-MS (−ve) *m/z*: 507.2979 $[M-H]^-$ ($C_{28}H_{43}O_8$ req. 507.2958); ^{13}C and ^1H NMR ($CDCl_3$): Tables 1 and 3.

(1R*, 2R*, 3E, 7E, 11R*, 12S*)-2,18-O-*Diacetyl*-16-O-(3-*hydroxy*-3-*methylglutaryl*)-*dolabella*-3,7-*dien*-2,16,18-*triol* (**11**). Amorphous powder; $[\alpha]_D^{19}$ + 18.6° (MeOH; *c* 0.7); HR-FAB-MS (−ve) *m/z*: 549.3079 $[M-H]^-$ ($C_{30}H_{45}O_9$ req. 549.3063); ^{13}C and ^1H NMR ($CDCl_3$): Tables 1 and 3.

(1R*, 2R*, 3E, 7R*, 8S*, 9R*, 11R*, 12S*)-16-O-(3-*hydroxy*-3-*methylglutaryl*)-8,9-*Epoxydolabell*-3-*en*-2,7,16,18-*tetrol* (**12**). Amorphous powder; $[\alpha]_D^{19}$ − 30.0° (MeOH; *c* 0.3); HR-FAB-MS (−ve) *m/z*: 497.2741 $[M-H]^-$ ($C_{26}H_{41}O_9$ req. 497.2750); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 4.

(1R*, 2R*, 3E, 7R*, 8S*, 9R*, 11R*, 12S*)-2-O-*Acetyl*-16-O-(3-*hydroxy*-3-*methylglutaryl*)-8,9-*epoxydolabell*-3-*en*-2,7,16,18-*tetrol* (**13**). Amorphous powder; $[\alpha]_D^{19}$ + 10.4° (MeOH; *c* 0.67); HR-FAB-MS (−ve) *m/z*: 539.2851 $[M-H]^-$ ($C_{28}H_{43}O_{10}$ req. 539.2856); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 4.

(1R*, 2R*, 3E, 7R*, 8S*, 9R*, 11R*, 12S*)-16-O-(3-*hydroxy*-3-*methylglutaryl*)-18-O-*Acetyl*-8,9-*epoxydolabell*-3-*en*-2,7,16,18-*tetrol* (**14**). Amorphous powder; $[\alpha]_D^{19}$ + 4.3° (MeOH; *c* 0.93); HR-FAB-MS (−ve) *m/z*: 539.2855 $[M-H]^-$ ($C_{28}H_{43}O_{10}$ req. 539.2856); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 4.

Deacylation of **1**–**14**. A mixt. of each compound in 1 ml MeOH and 2 ml 2.5% aq. methanolic KOH was allowed to stand at room temp. for 3 hr. The mixt. was then neutralized with dilute HCl and extracted with EtOAc (3 × 20) in the cases of **1** and **2**, *n*-BuOH (3 × 20) **2**–**5** and **12**–**14** and CH_2Cl_2 (3 × 20) **6**–**11**. The organic layers in the case of each sample were combined, dried over anhydrous Na_2SO_4 and the solvent was evapd to yield the deacylated derivative which was further purified on silica gel CC. Deacylation of **1** (6 mg) and **2** (23 mg) afforded **1a** (2.1 and 8 mg, respectively); powder; $[\alpha]_D^{19}$ + 7.51° (MeOH; *c* 0.13); HR-FAB-MS (−ve) *m/z*: 337.2382 $[M-H]^-$ ($C_{20}H_{33}O_4$ req. 337.2379); ^1H NMR ($CDCl_3$ and C_5D_5N): Table 2. Deacylation of **3** (5 mg) and **4** (8 mg) gave **3a** (1.8 mg and 5 mg, respectively); crystals (from MeOH), mp 137–138°; $[\alpha]_D^{19}$ − 15.2° (MeOH; *c* 0.33); HR-FAB-MS (−ve) *m/z*: 353.2332 $[M-H]^-$ ($C_{20}H_{33}O_5$ req. 353.2328); ^1H NMR (C_5D_5N): Table 2. Deacylation of **5** (8 mg) afforded **5a** (5 mg); amorphous powder; $[\alpha]_D^{19}$ − 24.2° (MeOH; *c* 0.33); HR-FAB-MS (−ve) *m/z*: 395.2435 $[M-H]^-$ ($C_{22}H_{35}O_6$ req. 395.2434); ^1H NMR (C_5D_5N): Table 2. Deacylation of **6** (30 mg) yielded **6a** (6 mg); crystals (from MeOH), mp 123–124°; $[\alpha]_D^{19}$ + 22.5° (MeOH; *c* 0.4); HR-FAB-MS (−ve) *m/z*: 335.2226 $[M-H]^-$ ($C_{20}H_{31}O_4$ req. 335.2222); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 3. Deacylation of **7** (30 mg) gave **7a** (2.4 mg); amorphous powder; $[\alpha]_D^{19}$ + 18.7° (MeOH; *c* 0.16); HR-FAB-MS (−ve) *m/z*: 377.2377 $[M-H]^-$ ($C_{22}H_{33}O_5$ req. 377.2328); ^1H NMR (C_5D_5N): Table 3. Deacylation of **8** (8 mg) and **9** (60 mg) afforded **8a** (3 and 39 mg, respectively); crystals (from MeOH); mp 158–159°; $[\alpha]_D^{19}$ − 16.4° (MeOH; *c* 0.73); HR-FAB-MS (−ve) *m/z*: 321.2395 $[M-H]^-$ ($C_{20}H_{33}O_3$ req. 321.2430); ^{13}C and ^1H NMR ($CDCl_3$): Tables 1 and 3. Deacylation of **10** (8 mg) and **11** (22 mg) gave **10a** (3 mg and 11 mg, respectively); amorphous powder; $[\alpha]_D^{19}$ − 21.5° (MeOH; *c* 0.19); HR-FAB-MS

(− ve) *m/z*: 363.2521 $[M-H]^-$ ($C_{22}H_{35}O_4$ req. 363.2535); ^{13}C and ^1H NMR ($CDCl_3$): Tables 1 and 3. Deacylation of **12** (3 mg) and **13** (20 mg) afforded **12a** (1.8 mg and 12 mg, respectively); crystals (from MeOH); mp 192–193°; $[\alpha]_D^{19}$ + 16.3° (MeOH; *c* 0.8); HR-FAB-MS (− ve) *m/z*: 353.2331 $[M-H]^-$ ($C_{20}H_{33}O_5$ req. 353.2323); ^{13}C and ^1H NMR (C_5D_5N): Tables 1 and 4. Deacylation of **14** (10 mg) gave **14a** (4 mg); amorphous powder; $[\alpha]_D^{19}$ − 12.5° (MeOH; *c* 0.24); HR-FAB-MS (− ve) *m/z*: 395.2435 $[M-H]^-$ ($C_{22}H_{35}O_6$ req. 395.2434); ^1H NMR (C_5D_5N): Table 4.

Deacylation of **5a**, **7**, **10a**, **11** *and* **14a** *under reflux conditions.* Two millilitres 2.5% aq. methanolic KOH was added to a soln of **5a** (2 mg) in 1 ml MeOH and the mixt. refluxed for 5 hr. Normal work-up gave **3a** (1.3 mg), **7** (8 mg), **10a** (2 mg), **11** (28 mg) and **14a** (3 mg) and were deacylated using the same procedure as **5a** to obtain **6a** (1.8 mg), **8a** (1.2 mg), **8a** (10 mg) and **12a** (2.1 mg), respectively.

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