Pergamon

0031-9422(95)00514-5

Phytochemistry, Vol. 40, No. 6, pp. 1743–1750, 1995

0031-9422/95 $9.50 + 0.00

DITERPENES FROM *EUPHORBIA SEGUIERIANA*

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(*Received* 1 *June* 1995)

IN HONOUR OF PROFESSOR ANTONIO G. GONZALEZ

Key Word Index—*Euphorbia seguieriana*; Euphorbiaceae; diterpenes; abietanes; myrsinanes.

Abstract—An extract of the whole plant of *Euphorbia seguieriana* afforded a known and three new diterpene lactones of the abietane type, seven myrsinanes and a tetracarbocyclic diterpene related to myrsinane. The structures were elucidated by means of high field NMR spectroscopy.

INTRODUCTION

The genus *Euphorbia* is the largest in the spurge family, comprising about 1100 species in today's widely accepted narrow circumscription [1]. Most of the representatives are characterized by the occurrence of highly irritant latex [2]. The irritant properties are due to diterpenes of the macrocyclic type, mainly with either a tigliane or an ingenane skeleton [3]. *E. seguieriana*, a species occurring in drier habitats in Europe (except the north and extreme south) and western Asia, is a perennial erect or ascending herb of up to 60 cm. Several varieties of subspecies have been described [4, 5]. The material used in this study belongs to *E. seguieriana* var. *seguieriana* neck taken from the native population at the Botanical Garden Berlin-Dahlem.

RESULTS AND DISCUSSION

An extract of the whole plant of *E. seguieriana* var. *seguieriana*, collected in summer 1993, contained in addition to some widespread triterpenes (Experimental), the myrsinol esters **1**–**7**, the related tetracarbocyclic derivative **8**, three new abietane lactones (**9**–**11**) and the known abietane lactone jolkinolide B (**12**) [6, 7].

The ^{1}H NMR spectra of compounds **1**–**7** (Table 1) were similar to each other. In particular, the signals due to the skeleton part indicated that we were dealing with different polyesters of the same parent alcohol. Thus, the structural elucidation of **1**, discussed in detail, is representative for the whole group. The ^{1}H NMR spectrum of the polyester **1**, molecular formula $C_{39}H_{44}N_2O_{11}$, revealed the presence of two acetate groups, a propionate group and two sets of signals characteristic of a nicotinoate group. The parent alcohol $C_{20}H_{30}O_6$ calculates for six degrees of unsaturation. As signals for two double bonds, an exocyclic and a vic-disubstituted (Tables 1 and 2), were visible, a tetracyclic compound was present. In the ^{13}C NMR spectrum, seven signals for oxygen-bearing carbons appeared; consequently, in view of the molecular formula, an ether ring had to be assumed. By spin decoupling the sequence H-1 through H-5 with a secondary methyl group at C-2 (H-16) was established. The other sequence starting with H-7 through H-9 continued with H-11 and H-12 with an isopropenyl group at C-11 (long range coupling between H-11 and H-20). The remaining signals in the spectrum were due to a tertiary methyl group, an oxymethylene group and an isolated methyne group. All proton-bearing carbon signals were assigned by a two-dimensional hetero correlated HMQC experiment. The connectivities of interrupted sequences and isolated fragments were realized from two- or three-bond long range correlations observed in an HMBC experiment (Scheme 1).

The results are summarized in Table 3. The position of the heterocycle was settled from the correlations between H-20(^2J) and H-17(^3J), both with C-13 (a W-long range coupling observed in the ^{1}H NMR spectrum between H-5 and H-17 was helpful for the assignment of H-17 signals). The correlations of H-3, H-5, H-7 and H-14 with the respective ester carbonyl signal established the relative position of all but one ester group. The remaining acetate had to be placed at C-15. The stereochemistry was deduced from the results of NOE experiments (Table 3), which were in full agreement with the HMBC observations. H-4 and H-5, *trans* oriented as indicated by the large coupling $J_{4,5}$ = 11.5 Hz, were used as reference points. On saturation of the H-4 resonance frequency an

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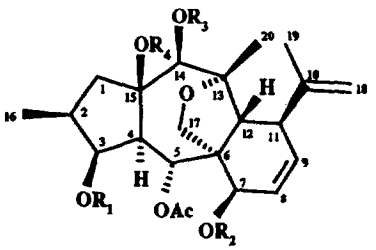

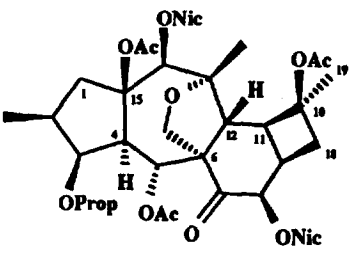

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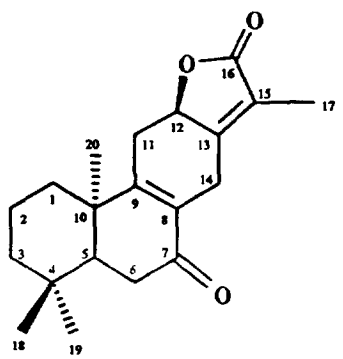
	R_1	R_2	R_3	R_4
1	Prop	Nic	Nic	Ac
2	Ac	Nic	Nic	Ac
3	Ac	Benz	Nic	Ac
4	Prop	Benz	Nic	Ac
5	Prop	Benz	Ac	Ac
6	Prop	Nic	Ac	Ac
7	Prop	Benz	Ac	H



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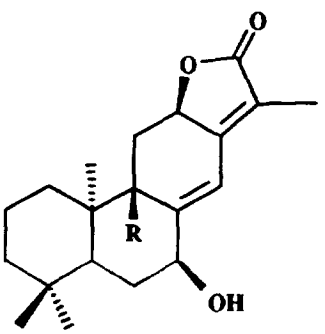
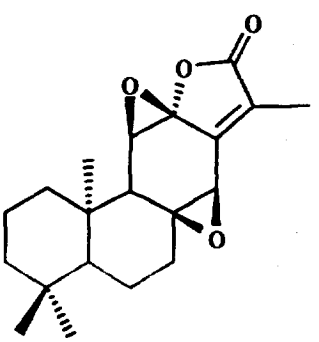


R	
10	H
11	OH



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increase in intensity of signals for H-2, H-3, H-14 and H-17 was observed. On the other hand, H-5 showed an interaction with H-7, H-12, both acetate signals and H-2 of the nicotinoate at C-7. A weak interaction with H-7, which itself was weakly coupled with H-17, could be explained in terms of a pseudoaxial ester residue in a β-position at C-7. The isopropenyl group must also be placed in the β-position, based on the strong effect between H-2 of the nicotinoate at C-7 and the olefinic methyl group. Several significant dipolar interactions between ester groups were noteworthy (Table 3). All the results agree with the energy minimized conformation calculated with PCMODEL [8] (Scheme 1). A literature survey for compounds with this skeleton revealed the myrsinol polyesters [9]. The couplings for the parent alcohol, myrsinol, resembled those observed in the present study. The stereochemistry of myrsinol was deduced from an X-ray study [9]. However, as in the case of lathyranes [10] the stereochemistry at C-5 was obviously wrongly assigned and should be corrected. We have named our compounds as derivatives of myrsinols with a 5β hydrogen. The coupling $J_{4,5} = 11.5$ Hz is better described by *trans* diaxial orientation of the hydrogens.

The relative positions of the ester residues in compounds **2–7** were deduced from HMBC experiments. In each case, correlations between the protons at the ester-bearing carbon and the corresponding carbonyl group were observed. Furthermore, the chemical shifts of certain protons, depending on the substituent, were of diagnostic value. The acetate at C-15 was the most downfield shifted methyl signal. An aromatic group at C-7 caused a slight upfield shift of the C-5 acetate and a stronger shift of the signals for the C-3 ester residue (OAc 1.84; OProp 2.13, 0.94). As expected, strong differences were visible on replacement of the aromatic ester group by acetate (Table 1).

Table 1. ^{1}H NMR data for compounds **1–8** ($CDCl_3$, 400 MHz, int. standard solvent peak = 7.26 ppm)

H	1	2	3	4	5	6	7*	8
1	2.79	2.81	2.80	2.79	2.79	2.79	1.72 *dd*	2.86 *dd*
1′	2.69	2.67	2.68	2.69	2.55	2.54	2.53 *dd*	2.50 *m*
2	2.17	2.19	2.20	2.20	2.17	2.18	2.17 *m*	2.26 *m*
3	5.30	5.27	5.26	5.30	5.26	5.27	5.23 *dd*	5.52 *dd*
4	3.21	3.19	3.19	3.22	3.12	3.12	2.84 *dd*	3.03 *dd*
5	6.07	6.09	6.13	6.12	6.00	5.97	5.87 *dd*	6.11 *dd*
7	5.15	5.13	5.09	5.08	5.02	5.07	5.03 *d*	—
8	6.26	6.27	6.27	6.27	6.29	6.29	6.25 *ddd*	5.31 *d*
9	5.90	5.91	5.86	5.85	5.89	5.94	5.89 *dd*	2.94 *dddd*
11	3.29	3.29	3.30	3.30	3.14	3.14	3.14 *br d*	2.33 *m*
12	3.46	3.45	3.44	3.45	3.31	3.32	3.82 *br d*	4.21 *d*
14	5.31	5.31	5.31	5.31	5.03	5.03	4.98 *s*	5.39 *s*
16	0.81	0.81	0.84	0.83	0.82	0.81	0.87 *d*	0.87 *d*
17	4.14	4.16	4.14	4.14	4.07	4.05	4.05 *d*	4.36 *d*
17′	3.62	3.62	3.62	3.62	3.59	3.59	3.57 *dd*	3.71 *dd*
18	4.91	4.91	4.90	4.90	4.71	4.75	4.69 *br s*	2.66 *ddd*
18′	4.78	4.78	4.80	4.80	4.64	4.62	4.63 *br s*	2.45 *m*
19	1.89	1.90	1.88	1.88	1.85	1.87	1.87 *br s*	1.62 *s*
20	1.33	1.34	1.34	1.35	1.29	1.28	1.29 *br s*	1.25 *s*
15-OH							2.89 *s*	
3-OAc		1.84	1.84					*s*
5-OAC	1.96	1.96	1.97	1.96	1.94	1.94	1.94	1.86 *s*
10-OAc								1.86 *s*
14-OAc					2.06	2.06	2.17	
15-OAc	2.19	2.21	2.20	2.21	2.19	2.20		1.96 *s*
3-OProp	2.14			2.15	2.13	2.12	2.13	2.40 *q*
	0.94			0.96	0.95	0.95	0.95	1.05 *t*
7-ONic or	9.18	9.19				9.13		9.53 *brd*
8-ONic	8.26	8.27				8.24		8.42 *ddd*
	7.37	7.37				7.36		7.44 *br dd*
	8.75	8.76				8.74		8.82 *dd*
7-OBz			8.02	8.02	7.98		7.95	AA′
			7.54	7.54	7.52		7.50	BB′
			7.39	7.38	7.36		7.36	C
14-ONic	9.08	9.09	9.09	9.09				9.16 *br d*
	8.26	8.27	8.27	8.27				8.31 *ddd*
	7.42	7.41	7.42	7.42				7.38 *br dd*
	8.79	8.79	8.79	8.80				8.76 *dd*

*Same multiplicity for **1–7**.

J (Hz): compounds **1–6**: 1, 1′ = 16; 1, 2 = 10.5; 1′, 2 = 9; 2, 3 = 3, 4 = 4; 2, 16 = 7, 8 = 6.5; 4, 5 = 11; 5, 17 = 8, 11 = 1.5; 8, 9 = 10; 9, 11 = 6; 11, 12 = 3.5; 18, 19 = 1; compound **7**: 1, 1′ = 14.5; 1, 2 = 8, 9 = 10; 2, 3 = 3, 4 = 11, 12 = 3.5; 4, 5 = 11; 2, 16 = 7, 8 = 6.5; 5, 17 = 8, 11 = 1.5; 9, 11 = 5.5; 18, 19 = 1; compound **8**: 1, 1′ = 16; 1, 2 = 4, 5 = 11; 1′, 2 = 9, 11 = 9, 18 = 9; 2, 3 = 3, 4 = 4; 4, 5 = 11; 2, 16 = 8, 9 = 7; 5, 17 = 1.5; 9, 18′ = 17, 17′ = 10; 11, 12 = 12; 11, 18 = 3.5; 18, 18′ = 13; OProp: 2, 3 = 7.5; ONic: 2, 4 = 2; 4, 5 = 8; 4, 6 = 2; 5, 6 = 5.

Traces of a related tetracarbocyclic compound (**8**) were obtained. While the signals for the A/B rings resembled those of compounds **1–7**, substantial differences were visible for the residual part (Table 1). The complete sequence was easily determined by spin decoupling. Similar compounds differing only in ester residues were isolated by Wu *et al.* from *E. prolifera* [11]. The relative positions of the ester residues were again deduced from the results of a HMBC experiment. We have named the parent functionalized compound without ester residues cyclomyrsinol.

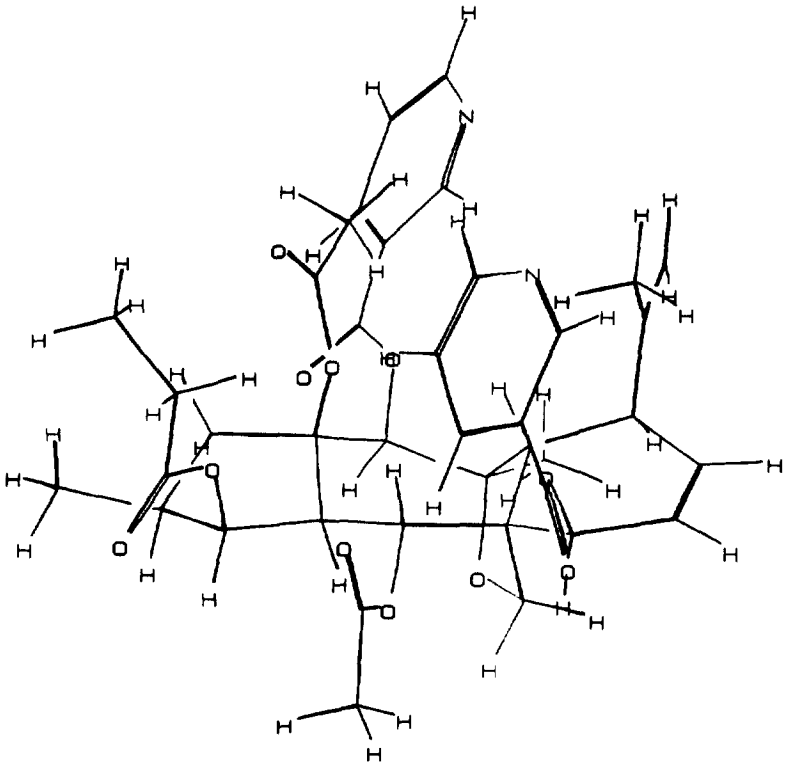
The compounds seem to be of chemotaxonomic relevance. Their possible biogenesis is depicted in Scheme 2. They probably have a common precursor of the lathyrane type. The opening of the epoxide ring by attack of the Δ^{12} double bond and simultaneous formation of the heterocycle would give a tetracyclic system with a cyclopropane moiety. A functional group at C-18 is necessary for further rearrangement, leading to related compounds. In a similar way, the formation of euphoractines [12] can be explained. The stereochemistry of the cyclization products reflects the conformational behaviour of the proposed precursor. Indeed, such conformations were observed in molecular mechanics calculations [13] and NOE experiments [14] with similar lathyranes. The direction of cyclization is probably dictated by the functional group at C-14. A keto group leads to

Table 2. ^{13}C NMR data for compounds **1**–**5** and **8** ($CDCl_3$, 100 MHz, int. standard $CDCl_3$, 77.0 ppm)

C	1	2	3	4	5	8	Mult.
1	43.8	43.6	43.7	43.8	43.6	43.2	*t*
2	36.7	36.5	36.6	36.7	36.6	36.1	*d*
3	76.5	76.7	76.8	76.5	76.4	76.7	*d*
4	51.7	51.8	51.9	51.8	51.7	51.5	*d*
5	69.1	69.1	69.2	69.1	69.1	68.4	*d*
6	54.5	54.5	54.5	54.5	54.9	62.3	*s*
7	65.1	65.1	64.5	64.6	64.6	203.6	*d* (*s* in **8**)
8	122.8	122.8	123.2	123.2	123.6	73.7	*d*
9	134.0	134.0	135.5	133.4	133.5	30.6	*d*
10	146.7	146.7	146.8	146.9	146.9	77.7	*s*
11	41.8	41.8	41.9	41.9	41.1	42.2	*d*
12	40.6	40.5	40.6	40.6	40.9	41.7	*d*
13	89.2	89.2	89.1	89.1	88.9	90.0	*s*
14	82.1	82.1	82.1	82.2	81.1	84.0	*d*
15	89.8	89.8	89.8	89.9	90.2	90.2	*s*
16	14.0	14.1	14.1	14.1	14.1	14.0	*q*
17	69.2	69.2	69.2	69.2	69.1	67.6	*t*
18	113.0	113.0	113.0	113.0	112.3	36.4	*t*
19	20.6	20.6	20.5	20.5	20.8	24.3	*q*
20	24.6	24.5	24.6	24.5	24.5	22.3	*q*
3OAc		170.9	170.9				*s*
		20.7	20.7				*q*
5-OAc	169.1	169.2	168.9	168.8	168.8	169.1	*s*
	20.8	20.8	20.9	20.7	20.9	20.8	*q*
10-OAc						170.1	*s*
						23.4	*q*
14-OAc					170.3		*s*
					20.9		*q*
15-OAc	168.2	168.2	168.1	168.1	168.5	168.4	*s*
	22.6	22.6	22.4	22.5	22.5	22.0	*q*
3-OProp	174.1			174.0	174.0	174.3	*s*
	27.7			27.7	27.7	27.3	*t*
	8.8			8.8	8.8	9.1	*q*
14-ONic	150.9	150.8	150.9	150.9		150.9	*d*
	125.7	125.7	125.7	125.7		125.8	*s*
	137.1	137.5	137.5	137.5		137.5	*d*
	123.4	123.4	123.4	123.3		123.4	*d*
	153.5	153.4	153.5	153.5		153.5	*d*
	164.6	164.5	164.5	164.5		164.7	*s*
7-ONic	150.6	150.6				151.0	*d*
or 8-ONic	126.6	126.6				125.8	*s*
	137.5	137.2				138.0	*d*
	123.1	123.1				123.2	*d*
	153.1	153.0				153.8	*d*
	164.6	164.5				166.1	*s*
7-OBz			130.6	130.6	130.6		*s*
			129.6	129.6	129.6		*d*
			127.9	127.9	127.8		*d*
			132.7	132.7	132.6		*d*
			165.7	165.6	165.6		*s*

euphoractines while an oxy group gives myrsinols and related compounds.

In addition to diterpenes of the macrocyclic type, very small amounts of jolkinolide B (**12**) [6, 7] and three new abietane lactones (**9**–**11**) were obtained. The structures followed from the ^1H NMR spectral data (Table 4). Spin decoupling allowed the assignment of all relevant signals. The stereochemistry was deduced from the NOE experiments. In each case a strong NOE effect was observed at H-12 on irradiating the H-20 resonance. Therefore, in each case the substituent at C-9 has to be in the β-position. The axial orientation of the 7-hydroxyl group in compounds **9** and **10** followed from the small couplings of H-7. The ^{13}C NMR data for **11** (Table 4) confirmed the structure.



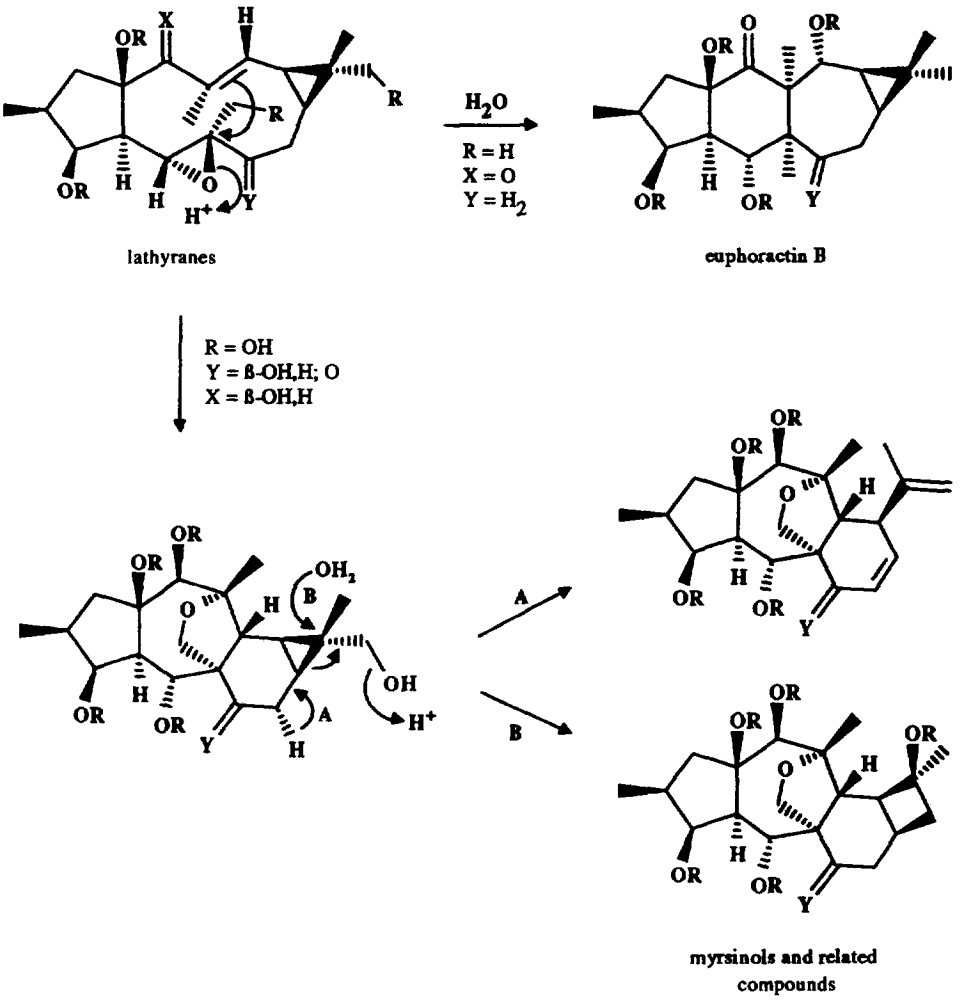
Scheme 1. Calculated conformation of 1.

Table 3. Hetero long range correlations and NOE effects with compound **1**

	C			
H	^2J	^3J	Saturated H	Observed NOEs*
1	2, 15	16	3	4 (7); 5 (2); 16 (w)
1′	2	3, 4, 14	4	3 (5); 14 (5); 17 (3);
3		15,C=O_{OProp}	5	3 (1); 7 (2); 12 (5); 5-OAc (*m*); 15-OAc (*m*); H-$2_{7\text{-ONic}}$ (3); H-$4_{7\text{-ONic}}$ (3)
4	5	14	7	5 (1.5); 17 (1.5); 17 (1); 5-OAc (*m*)
5	4, 6	17, C=O_{OAc}	11	9 (7); 12 (2); 18 (1); 19 (*m*); 20 (vs)
7	6, 8	5, 12, C=O_{ONic}	12	5 (10); 20 (vs); 15-OAc (*s*); H-$2_{7/14\text{-ONic}}$ (< 1); H-$4_{7\ 14\text{-ONic}}$ (< 0.5)
8	7	6, 11	14	1′ (5); 4 (8); 20 (*m*)
9	11	7, 12	16	1 (2.5); 3 (1.5)
11	9, 10, 12		17	4 (4); 7 (2)
12	6, 11	10	17′	7 (2); 8 (0.5); 9 (< 0.5)
14	13	1, 4, 13, C=O_{ONic}	20	12 (2); 14 (7); 19 (*m*); 11 (12); 17′ (1.5); 18′ (2); H-$2_{14\text{-ONic}}$ (2); H-$4_{14\text{-ONic}}$ (0.5)
16	2	1, 3	5-OAc	3 (1.5); 5 (1); 7(2)
17	6	5, 12, 13	$2_{7\text{-ONic}}$	5 (3); 19 (*m*); 15-OAc (*s*)
17′		5, 13	$2_{14\text{-ONic}}$	20 (w); 19 (*m*); 15-OAc (*m*)
18		11, 19		
18′		11, 19		
19	10	11, 18		
20	12	13, 14		

*Percentage intensity increase in parentheses.
w = meak; m = medium; s = strong; vs = very strong.

The present investigation and the results with other *Euphorbia* species (unpublished work) indicate a much higher accumulation of diterpenes than assumed from results by bioactivity-guided investigations. In particular, non-irritant diterpenes are more abundant and could have been overlooked in previous investigations.



Scheme 2. Proposed biogenesis of euphoractines and myrsinols.

EXPERIMENTAL

The air-dried material (collected in 1993 in the Botanical Garden Berlin-Dahlem, reference specimen: Schwerdtfeger 23678, B) was extracted at room temp. with a mixt. of petrol–MTB (methyl *tert*-butyl ether)–MeOH (1:1:1). After removal of waxy material by treatment with MeOH at −20° the filtrate was evpd and sepd by open column reversed-phase-chromatography (RP8, 30 × 100 mm) with mixts of MeOH and H_2O into five frs. Fr. 1 (MeOH–H_2O, 1:1) and fr. 2 (MeOH–H_2O, 3:2) gave carbohydrates and other polar components which were not further characterized. Fr. 3 (MeOH–H_2O, 7:3) gave nothing of interest. Fr. 5 (MeOH) gave taraxerol, cycloartenol and 24-methylenecycloartenol. Fr. 4 (MeOH–H_2O, 4:1) was sepd by HPLC (RP8, 8 × 250 mm, MeOH–H_2O, 7:3). The resulting mixts were further sepd by TLC (CH_2Cl_2–MTB–toluene, 7:6:7). Fr. 1 (R_t = 4.5 min) gave 2 mg **8** (R_f = 0.25) and 1 mg **10** (R_f = 0.3). Fr. 2 (R_t = 4.8 min) gave 2 mg **11** (R_f = 0.5). Fr. 3 (R_t = 5.8 min) gave 4 mg **2** R_f = 0.1) and 2 mg **6** (R_f = 0.2). Fr. 4 (R_t = 6.5 min) gave 1 mg **12** (R_f = 0.9), 1 mg **9** (R_f = 0.5) and 6 mg **1** (R_f = 0.3). Fr. 5 (R_t = 7.2 min) gave 1 mg **7** (R_f = 0.1). Fr. 6 (R_t = 8.5 min) gave 3 mg **3** (R_f = 0.6). Fr. 7 (R_t = 10.5 min) gave 2 mg **5** (R_f = 0.8) and 3 mg **4** (R_f = 0.6). Known compounds were identified by comparing their spectral data with those of authentic material.

14-*Desoxo*-3-O-*propionyl*-5,15-*di*-O-*acetyl*-7-O-*nicotinoyl*-*myrsinol*-14β-*nicotinoate* (**1**). IR $\nu_{max}^{CCl_4}$ cm^{-1}: 1738, 1592, 1420, 1272, 1226; EIMS (probe, 70 eV) *m/z* (rel. int.): 716.295 $[M]^+$ (5.5) (calc. for $C_{39}H_{44}O_{11}N_2$: 716.295), 656 $[M - AcOH]^+$ (51), 610 $[M - C_5H_4NCO]^+$ (99), 550 $[610 - AcOH]^+$ (30), 534 $[610 - PropOH]^+$ (55), 421 (64), 399 (24), 378 (43), 296 (43), 173 (100), 124 $[C_5H_4NCO_2H + H]^+$ (51), 106 $[C_5H_4NCO]^+$ (39); $[\alpha]_D^{20}$ −31° ($CHCl_3$; *c* 0.7).

14-*Desoxo*-3,5,15-*tri*-O-*acetyl*-7-O-*nicotinoyl*-*myrsinol*-14β-*nicotinoate* (**2**). EIMS (probe, 70 eV) *m/z* (rel. int.): 702.279 $[M]^+$ (4) (calc. for $C_{38}H_{42}O_{11}N_2$: 702.279), 642 $[M - AcOH]^+$ (44), 596 $[M - C_5H_4NCO]^+$ (100),

Table 4. ^{1}H NMR data for compounds **9**–**11** ($CDCl_3$, 400 MHz, int. standard solvent peak = 7.26 ppm) and ^{13}C NMR data for compound **11** ($CDCl_3$, 100 MHz, int. standard $CDCl_3$, 77.0 ppm)

H	9	10	11	C	11
1ax	1.19 *m*	1.18 *m*	1.77 *m*	1	31.7 *t*
1eq	1.84 *m*	1.91 *m*	1.61 *m*	2	18.7 *t*
2ax	1.70 *m*	1.65 *m*	1.60 *m*	3	41.6 *t*
2eq	*m*	*m*	— *m*	4	33.2 *s*
3ax	— *m*	— *m*	1.55 *m*	5	39.9 *d*
3eq	1.45 *m*	1.25 *m*	1.48 *m*	6	31.0 *t*
5	1.73 *dd*	1.72 *dd*	2.03 *dd*	7	74.4 *d*
6ax	2.42 *dd*	1.63 *ddd*	1.63 *ddd*	8	148.4 *s*
6eq	2.57 *dd*	1.94 *ddd*	1.99 *ddd*	9	79.1 *s*
7	—	4.47 *dd*	4.53 *brs*	10	44.7 *s*
9	—	2.71 *brdd*		11	38.4 *t*
11ax	2.15 *dddd*	1.48 *ddd*	1.47 *dd*	12	77.2 *d*
11eq	3.13 *dd*	2.61 *dd*	3.04 *dd*	13	153.9 *s*
12	4.74 *brddq*	4.90 *ddq*	4.85 *ddq*	14	118.8 *d*
14ax	3.40 *brdd*	6.46 *d*	6.58 *s*	15	130.0 *s*
14eq	3.28 *brdq*	—	—	16	174.3 *s*
17	1.85 *dd*	1.86 *d*	1.90 *d*	17	8.6 *q*
18	0.90 *s*	0.93 *s*	0.97 *s*	18	33.8 *q*
19	0.94 *s*	0.86 *s*	0.96 *s*	19	22.0 *q*
20	1.15 *s*	0.92 *s*	0.90 *s*	20	17.4 *q*

J (Hz): compound **9**: 5, 6ax = 6ax, 6eq = 14; 5, 6eq = 6eq, 7 = 3; 6ax, 7 = 2.5; 11ax, 11eq = 11ax, 12 = 13; 11eq, 12 = 6.5; 12, 17 = 1.5; compound **10**: 5, 6ax = 6ax, 6eq = 13; 5, 6eq = 2; 6eq, 7 = 6ax, 7 = 2.5; 9, 11ax = 8.5; 9, 14 = 1; 11ax, 11eq = 11ax, 12 = 13.5; 11eq, 12 = 6.5; 12, 17 = 1.5; compound **11**: 5, 6ax = 14; 6ax, 6eq = 11ax, 11eq = 17.5; 5, 6eq = 3.5; 11ax, 12 = 10; 11eq, 12 = 7; 12, 17 = 11ax, 14 = 14′, 17 = 2; 14, 14′ = 20.

536 $[596 - AcOH]^+$ (36), 520 $[610 - PropOH]^+$ (31), 407 (70), 399 (25), 364 (45), 296 (37).

14-*Desoxo*-3,5,15-*tri*-O-*acetyl*-7-O-*benzoyl*-*myrsinol*-14β-*nicotinoate* (**3**). EIMS (probe, 70 eV) *m/z* (rel. int.): 701.284 $[M]^+$ (77) (calc. for $C_{39}H_{43}O_{11}N$: 701.284), 641 $[M - AcOH]^+$ (85), 595 $[M - C_5H_4NCO]^+$ (31), 579 $[M - PhCO_2H]^+$ (26), 519 $[641 - PhCO_2H]^+$ (71), 477 (29), 407 (91), 364 (70), 295 (99), 173 (100), 124 $[C_5H_4NCO_2H + H]^+$ (43), 106 $[C_5H_4NCO]^+$ (61), 105 $[PhCO]^+$ (81).

14-*Desoxo*-3-O-*propionyl*-5,15-*di*-O-*acetyl*-7-O-*benzoyl*-*myrsinol*-14β-*nicotinoate* (**4**). EIMS (probe, 70 eV) *m/z* (rel. int.): 715.299 $[M]^+$ (33) (calc. for $C_{40}H_{45}O_{11}N$: 715.299), 655 $[M - AcOH]^+$ (35), 610 $[M - PhCO]^+$ (13), 533 $[610 - PropOH]^+$ (31), 491 (13), 421 (39), 399 (13), 378 (32), 295 (48), 173 (95), 124 $[C_5H_4NCO_2H + H]^+$ (56), 106 $[C_5H_4NCO]^+$ (57), 105 $[PhCO]^+$ (100).

14-*Desoxo*-3-O-*propionyl*-5,15-*di*-O-*acetyl*-7-O-*benzoyl*-*myrsinol*-14β-*acetate* (**5**). EIMS (probe, 70 eV) *m/z* (rel. int.): 652.288 $[M]^+$ (2) (calc. for $C_{36}H_{44}O_{11}$: 652.288), 592 $[M - AcOH]^+$ (22), 532 $[M - 2AcOH]^+$ (7), 470 $[592 - PhCO_2H]^+$ (13), 295 (60), 175 (100), 173 (87), 105 $[PhCO]^+$ (45), 57 $[C_2H_5CO]^+$ (87).

14-*Desoxo*-3-O-*propionyl*-5,15-*di*-O-*acetyl*-7-O-*nicotinoyl*-*myrsinol*-14β-*acetate* (**6**). EIMS (probe, 70 eV) *m/z* (rel. int.): 653.284 $[M]^+$ (2.5) (calc. for $C_{35}H_{43}O_{11}N$: 653.284), 593 $[M - AcOH]^+$ (15), 579 $[M - PropOH]^+$ (3), 470 $[593 - C_5H_4NCO_2H]^+$ (7), 399 (7), 336 (7), 296 (28), 173 (85), 124 $[C_5H_4NCO_2H + H]^+$ (100), 106 $[C_5H_4NCO]^+$ (70), 57 $[C_2H_5CO]^+$ (57).

14-*Desoxo*-3-O-*propionyl*-5-O-*acetyl*-7-O-*nicotinoyl*-*myrsinol*-14β-*acetate* (**7**). EIMS (probe, 70 eV) *m/z* (rel. int.): 610.278 $[M]^+$ (7) (calc. for $C_{34}H_{42}O_{10}$: 610.278), 550 $[M - AcOH]^+$ (22), 476 $[550 - PropOH]^+$ (7), 428 $[550 - PhCO_2H]^+$ (27), 354 (12), 295 (35), 173 (59), 105 $[PhCO]^+$ (100), 57 $[C_2H_5CO]^+$ (99).

3-O-*Propionyl*-5,10,15-*tri*-O-*acetyl*-8,14-*di*-O-*nicotinoyl*-*cyclomyrsinol* (**8**). EIMS (probe, 70 eV) *m/z* (rel. int.): 790.295 $[M]^+$ (1) (calc. for $C_{41}H_{46}O_{14}N_2$: 790.295), 684 $[M - C_5H_4NCO]^+$ (2), 624 $[684 - AcOH]^+$ (6), 608 $[684 - PropOH]^+$ (1), 421 (2), 378 (6), 270 (12), 124 $[C_5H_4NCO_2H + H]^+$ (62), 106 $[C_5H_4NCO]^+$ (100); $[\alpha]_D^{20}$ + 12.5° ($CHCl_3$; *c* 0.2).

7-*Oxo*-ent-*abieta*-8,13(15)-*dien*-12α,16-*olide* (**9**). EIMS (probe, 70 eV) *m/z* (rel. int.): 316.208 $[M]^+$ (11) (calc. for $C_{20}H_{28}O_3$: 316.208), 298 $[M - H_2O]^+$ (31), 283 $[298 - Me]^+$ (16), 273 (12), 213 (12), 193 (15), 149 (87), 123 (100); $[\alpha]_D^{20}$ − 45° ($CHCl_3$; *c* 0.1).

7β-*Hydroxy*-ent-*abieta*-8(14),13(15)-*dien*-12α,16-*olide* (**10**). EIMS (probe, 70 eV) *m/z* (rel. int.): 314.188 $[M - H_2O]^+$ (10) (calc. for $C_{20}H_{26}O_3$: 314.1882), 279 (23), 256 (15), 239 (11), 226 (15), 191 (61), 149 (100), 124 (38), 109 (43); $[\alpha]_D^{20}$ + 155° ($CHCl_3$; *c* 0.1).

7β,9β-*Dihydroxy*-ent-*abieta*-8(14),13(15)-*dien*-12α,16-*olide* (**11**). EIMS (probe, 70 eV) *m/z* (rel. int.): 314.1882

$[M]^+$ (10) (calc. for $C_{20}H_{26}O_3$: 314.1882), 299 (14), 229 (100), 191 (15), 167 (16), 149 (66), 124 (26); $[\alpha]_D^{20} = +63^\circ$ ($CHCl_3$; *c* 0.2).

Acknowledgements—We should like to thank the Botanical Garden Berlin-Dahlem for permission to collect material, and specifically D. Wichert, who assisted in the collection, and Birgit Garmatter for assistance in the laboratory.

REFERENCES

1. Webster, G. L. (1994) *Ann. Missouri Bot. Garden* **81**, 33.
2. Webster, G. L. (1986) *Clin. Derm.* **4**, 36.
3. Evans, F. J. and Taylor, S. E. (1983) *Prog. Chem. Org. Nat. Prod.* **44**, 1.
4. Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine, D. H., Walters, S. M. and Webb, D. A. (eds) (1968) *Flora Europaea*, Vol. 3. Cambridge, U.K.
5. Oudejans, R. C. H. M. (1992) *Collect Bot. (Barcelona)* **21**, 183.
6. Uemura, D. and Hirata, Y. (1972) *Tetrahedron Letters* 1387.
7. Uemura, D., Katayama, C. and Hirata, Y. (1977) *Tetrahedron Letters* 283.
8. PCMODEL, Serena Software, Vers. 4.0, Bloomington, U.S.A.
9. Rentzea, R., Hecker, E. and Lotter, H. (1982) *Tetrahedron Letters* 1781.
10. Adolf, W., Köhler, I. and Hecker, E. (1984) *Phytochemistry* **23**, 1461.
11. Wu, D., Sorg, B. and Hecker, E. (1995) *J. Nat. Prod.* **58**, 408.
12. Shi, J.-G., Jia, Z.-J. and Yang, L. (1993) *Phytochemistry* **32**, 208.
13. Shizuri, Y., Kosemura, S., Ohtsuka, J., Terada, Y., Yamamura, S. and Yokohama, H. (1983) *Tetrahedron Letters* 2577.
14. Uemura, D., Nobuhara, K., Nakayama, Y., Shizuri, Y. and Hirata, Y. (1976) *Tetrahedron Letters* 4593.