Minor Triterpenoids from the Mediterranean Sponge, Raspaciona aculeata

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MINOR TRITERPENOIDS FROM THE MEDITERRANEAN SPONGE, *RASPACIONA ACULEATA*

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ABSTRACT.—Eight new minor triterpenoids have been characterized from a lipid-soluble extract of *Raspaciona aculeata*. All are based on the same carbon skeleton as raspacionin [**1**]. The full assignment of all ^{1}H- and ^{13}C-nmr resonances has led to the rationalization of the effects of certain substituents on the chemical shifts of atoms in the perhydrobenzoxepine system.

Raspacionin [**1**] and raspacionins A [**2**], and B [**3**] are three terpenoids recently found in the encrusting red sponge, *Raspaciona aculeata* Johnston (family Raspailiidae) (1–3). Their structures have been elucidated by X-ray analysis and by extensive nmr investigations. Their absolute stereochemistry has been suggested either by applying high-resolution ^{1}H nmr (2,4) to the Mosher method (5,6), as successfully proposed for sipholenol A [**4**] by Kakisawa's group (7–10), or by comparison of cd spectra (3).

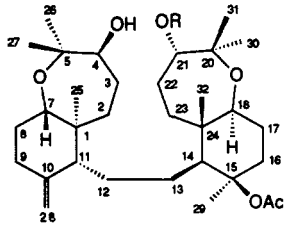
In this communication we now report the structural characterization of a further eight [**5–12**] minor components of *Raspaciona aculeata*, all based on the same triterpenoid skeleton as raspacionin [**1**]. The structures of the new raspacionins display different functionalizations at carbons 4, 10, 15, and 21. The full nmr characterization of **5–12** has revealed that some shifts of the substituents are diagnostic for both ring location and stereochemical orientation.

The only previous triterpenoids related to raspacionins, besides those from *Raspaciona aculeata*, have been those from the sponge *Siphonocalina siphonella* (11–15) and, more recently, from the South African purple-brown fan sponge *Axinella weltneri* (16).

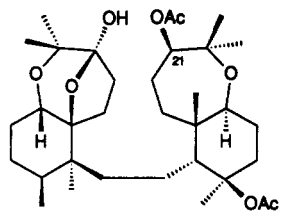
RESULTS AND DISCUSSION

The lipid-soluble extract from *Raspaciona aculeata* was submitted to the usual work-up (2,3) yielding, along with **1** and a mixture of **2** and **3**, a more polar fraction (R_f 0.27, petroleum ether-Et_2O, 3:7) that was purified by hplc (Spherisorb Silica column, *n*-hexane-EtOAc, 7:3) giving seven main fractions which, after further hplc purification, yielded eight pure isolates [**5–12**]. The structural characterization of the products is reported herein, starting from compound **5**, which was most closely related to raspacionin [**1**], and then reporting the other metabolites according to their chemical affinity with **1**.

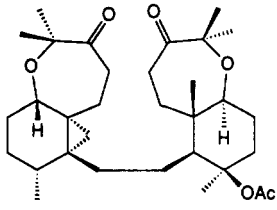
21-Deacetyl-raspacionin [**5**] is an optically active compound with elemental composition $C_{32}H_{54}O_6$ determined by hreims on the fragment ion peak at *m/z* 474.3698 $[M-HOAc]^+$ ($C_{30}H_{50}O_4$ requires 474.3709). The ^{1}H-nmr spectrum of **5** was almost identical to that of raspacionin [**1**]; diagnostic differences were the chemical shift of H-21 (δ 3.82; δ 4.97 for **1**) and the absence of the acetyl methyl singlet at δ 2.17. All ^{1}H- and ^{13}C-nmr resonances (Tables 1 and 2) were assigned by 1D and 2D nmr experiments (DEPT, ^{1}H-^{13}C HETCOR, ^{1}H-^{1}H COSY). By comparing the nmr data of **5** with those of raspacionin [**1**], it was observed that the absence of an acetyl group at C-21 induces, besides the expected shifts for the atoms near C-21, two ^{1}H-nmr downfield shifts for H-14 (δ 0.83; δ 0.74 for **1**) and H-18 (δ 3.55; δ 3.41 for **1**). Methanolysis of **1** yielded a compound identical in all aspects to **5**.



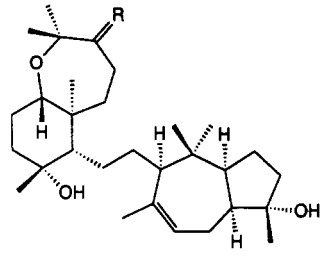
1 R=Ac
5 R=H



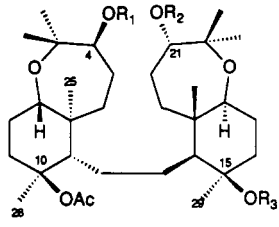
2



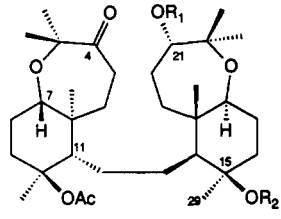
3



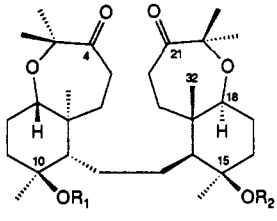
4 R=β-OH, H
13 R=O



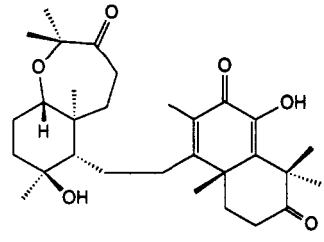
6 R_1=H; R_2=H; R_3=Ac
10 R_1=Ac; R_2=Ac; R_3=H



7 R_1=H; R_2=Ac
8 R_1=H; R_2=H
9 R_1=Ac; R_2=H



11 R_1=Ac; R_2=H
12 R_1=H; R_2=Ac



14

10-Acetoxy-21-deacetyl-28-hydroraspacionin [**6**], exhibited a molecular formula of $C_{34}H_{58}O_8$, deduced from hreims at *m/z* 474.3684 (main mass fragment peak, $[M-2HOAc]^+$; $C_{30}H_{50}O_4$ requires 474.3709). The ^{1}H-nmr spectrum of **6** was differentiated from that of **1** by the absence of the exomethylene protons and by the presence of two singlet methyls at δ 1.89 ($OCOCH_3$-10) and δ 1.48 (H_3-28), consistent with a different substitution pattern at carbons 10 and 28 in **6**. The ^{13}C-nmr resonance of C-28 at δ 19.71 supported an axial orientation of this methyl functionality. The stereochemistry at C-10 was differentiated from that at C-15 by a series of diagnostic shifts. Thus, the equatorial orientation of the acetoxy group at C-10 induced ^{1}H-nmr upfield shifts for the equatorial H-9 (δ 2.63; H-16 eq δ 2.78) and for H_3-25 (δ 0.83; H_3-32 δ 0.96) and downfield shifts for C-8 (δ 30.32; C-17 δ 26.62), C-9 (δ 35.49; C-16 δ 33.06), and H-11 (δ 1.53; H-14 δ 0.80).

TABLE 1. ^{13}C-Nmr Chemical Shifts of Raspacionin [**1**] and Related Triterpenes **5**–**12**.[a]

Carbon	1	5	6	7	8	9	10	11	12
C-1	43.37[b]	43.44	42.82*	42.16	42.14	42.14	42.85	42.14	42.03
C-2	33.90	33.85	34.24**	40.27	40.14	40.27	35.89*	40.30*	41.32*
C-3	26.10	26.05	25.32	35.07	35.02	35.06	23.20**	34.98	35.03**
C-4	77.00	77.06	76.96°	217.51	217.56	217.30	78.76	nd[c]	217.78°
C-5	77.57	77.56	77.88	82.66	82.65	82.64	77.47	82.68	82.63
C-7	76.01	76.03	75.84	80.70	80.68	80.63	76.16	80.60	80.97
C-8	33.02	33.09	30.32	30.24	30.37	30.39	30.50	30.35	26.45
C-9	35.74	35.76	35.49	35.26	35.24	35.29	35.38	35.25	40.00
C-10	147.17	147.28	87.13	86.40	86.27	86.29	86.92	86.29	73.22
C-11	53.65	54.00	56.06	55.65	55.68	55.87	56.19	55.58	57.93
C-12	27.59	27.97	28.17	27.97	27.96	27.95	28.00	27.94	28.76
C-13	25.48	25.88	29.10	29.02	28.87	29.02	29.05	28.83	29.79
C-14	58.18	58.08	57.99	57.95	55.68	55.87	56.02	55.52	57.93
C-15	83.81	83.92	84.25	84.11	72.20	72.08	72.25	72.00	83.58
C-16	33.21	33.09	33.06	33.03	39.25	39.37	39.41	39.27	32.91
C-17	26.59	26.73	26.62	26.60	26.54	26.43	26.43	26.40	30.12
C-18	76.74	76.29	76.21	76.10	76.25	76.62	76.64	81.03	80.97
C-20	77.33	77.87	77.88	77.91	77.76	nd[c]	77.47	82.42	82.57
C-21	79.14	77.06	77.03°	76.96	77.17	79.07	79.02	nd[c]	217.55°
C-22	23.08	25.34	25.32	25.25	25.09	23.02	23.10**	34.98	35.09**
C-23	35.32	34.19	34.63**	34.32	34.12	35.42	35.49*	39.88*	40.49*
C-24	42.80[b]	43.06	42.96*	42.81	42.55	42.45	42.45	41.84	41.75
C-25	12.20	12.13	13.16	12.53	12.49	12.65	13.27	12.50	12.25
C-26	29.11	29.12	28.90°°	26.45	26.42	26.43	29.00°	26.57	26.48
C-27	21.23	21.23	21.46	20.48	20.45	20.46	21.53°°	20.46	20.46
C-28	107.38	107.36	19.71	19.85	19.69	19.71	19.72	19.77	23.54
C-29	25.26	25.25	24.67	24.73	30.31	30.39	30.41	30.52	24.48
C-30	21.56	21.46	21.46	21.43	21.31	21.49	21.48°°	20.47	20.46
C-31	28.96	29.04	29.00°°	28.96	29.00	28.96	28.81°	26.40	26.45
C-32	12.81	12.81	12.92	12.85	12.93	12.90	13.09	12.20	12.25
$OCOCH_3$-4	—	—	—	—	—	—	170.23	—	—
$OCOCH_3$-10	—	—	170.09	170.06	170.20	170.12	170.23	nd[c]	—
$OCOCH_3$-15	170.16	170.29	169.93	170.00	—	—	—	—	170.09
$OCOCH_3$-21	170.16	—	—	—	—	170.12	170.23	—	—
$OCOCH_3$-4	—	—	—	—	—	—	21.29	—	—
$OCOCH_3$-10	—	—	22.88	22.82	23.05	23.08	23.20	23.07	—
$OCOCH_3$-15	22.51	22.52	22.40	22.38	—	—	—	—	22.53
$OCOCH_3$-21	21.23	—	—	—	—	21.28	21.29	—	—

[a]$CDCl_3$; Bruker AMX-500 spectrometer. Chemical shifts referenced to $CDCl_3$ at 77.00 ppm.
[b]These values were erroneously reported (1) inverted.
[c]Nd=Not detected.
*,**,°,°°Values with the same superscripts may be interchanged.

Surprisingly, the resonance of C-13 (δ 29.10) was shifted downfield almost 4 ppm from the values recorded for **1** (δ 25.48) and **5** (δ 25.88). It is likely that a dominant conformation displaying a δ effect between C-13 and the substituent at C-10 can explain this apparent anomaly. All the ^{1}H- and ^{13}C-nmr resonance assignments were confirmed by 2D experiments (Tables 1 and 2).

10-Acetoxy-21-deacetyl-4-oxo-28-hydroraspacionin [**7**] exhibited an elemental composition of $C_{34}H_{56}O_8$, based on hreims of the ion fragment peak at *m/z* 514.3645 $[M-HOAc-H_2O]^+$; 514.3658 calcd for $C_{32}H_{50}O_5$. The spectral data of **7** were compared with those of **6** revealing an additional ^{13}C-nmr resonance at δ 217.51 that, along with the absence of one of the two carbinol protons at δ 3.82, supported the presence in **7** of a carbonyl group at C-4. Moreover, comparison with **6** revealed that the different functionalization at C-4 induced some diagnostic shifts for all protons and carbons of the seven-membered ring and, in addition, H-7 and H-11 were shifted upfield to δ 2.97 (δ 3.63 for **6**) and δ 1.46 (δ 1.53 for **6**), respectively. All ^{1}H- and ^{13}C-nmr resonances were confirmed by 2D experiments (Tables 1 and 2).

10-Acetoxy-15,21-dideacetyl-4-oxo-28-hydroraspacionin [**8**] possessed the molecular formula $C_{32}H_{54}O_7$, deduced by hreims at *m/z* 472.3535 $[M-HOAc-H_2O]^+$,

TABLE 2. ^{1}H-Nmr Chemical Shifts of Raspacionin [**1**] and of the Triterpenoids **5**–**12**.[a]

Proton	1	5	6	7	8	9	10	11	12
H-2	1.48	1.49	1.59	1.32	1.33	1.32	1.26	1.31	1.29
	1.65	1.66	nd[b]	1.87	1.87	1.80	1.41	1.80	1.79
H-3	1.82	1.79	1.74	2.13	2.13	2.13	1.75	2.13	2.14*
	2.00	1.98	2.02	3.18	3.18	3.20	2.00	3.19	3.20
H-4	3.83	3.82	3.82	—	—	—	4.99	—	—
H-7	3.68	3.67	3.63	2.97	2.97	2.96	3.48	2.95	2.92**
H-8	1.38	1.36	1.43	1.33	1.36	1.27	1.41	1.30	nd[b]
	1.62	1.63	1.53	1.61	1.56	1.58	1.57	1.61	nd[b]
H-9	1.95	1.95	1.66	1.67	1.69	1.62	1.66	1.67	1.79
	2.24	2.25	2.63	2.65	2.67	2.68	2.66	2.66	nd[b]
H-11	1.64	1.66	1.53	1.46	1.45	1.42	1.47	1.43	1.00
H-12	1.50	1.52	1.47	nd[b]	nd[b]	nd[b]	1.34*	nd[b]	1.29
	1.62	1.68	nd[b]	1.60	1.62	1.60	1.57	1.60	1.54
H-13	1.18	1.12	nd[b]	1.35	1.30	1.33	1.38*	nd[b]	1.29
	1.72	1.68	1.77	1.74	1.69	1.70	1.75	1.74	1.75
H-14	0.74	0.83	0.80	0.79	0.83	0.74	0.76	0.69	0.66
H-16	1.31	1.26	1.26	1.26	1.47	1.45	1.47	1.45	1.23
	2.80	2.76	2.78	2.78	1.60	1.61	1.64	1.64	2.84
H-17	1.39	1.36	1.36	1.37	1.39	1.40	1.41	1.45	1.47
	1.51	1.43	1.46	1.46	1.71	1.74	1.73	1.88	1.60
H-18	3.41	3.55	3.56	3.55	3.50	3.35	3.37	2.89	2.93**
H-21	4.97	3.82	3.82	3.83	3.82	4.97	4.98	—	—
H-22	1.81	1.75	1.74	1.74	1.73	1.76	1.75	2.09	2.12*
	2.00	1.98	2.02	2.03	2.02	1.98	2.00	3.23	3.23
H-23	1.27	1.38	1.45	1.38	1.37	1.22	1.26	1.17	1.20
	1.45	1.57	1.69	1.56	1.53	1.60	1.41	1.80	1.79
H_3-25	0.70	0.69	0.83	0.98	0.99	0.99	0.87	0.96	0.93
H_3-26	1.12	1.12*	1.11*	1.25	1.25	1.25	1.20**	1.27*	1.27°
H_3-27	1.27	1.26**	1.26**	1.31	1.31	1.31	1.14°	1.30**	1.31°°
H's-28	4.60	4.61	1.48	1.50	1.50	1.50	1.50	1.50	1.18
	4.89	4.88	—	—	—	—	—	—	—
H_3-29	1.53	1.51	1.53	1.52	1.17	1.20	1.24	1.18	1.53
H_3-30	1.15	1.27**	1.27**	1.26	1.27	1.15	1.15°	1.31**	1.30°°
H_3-31	1.20	1.11*	1.13*	1.14	1.13	1.20	1.18**	1.25*	1.26°
H_3-32	0.94	0.93	0.96	0.94	0.99	0.97	1.00	1.12	1.08
$OCOCH_3$-4	—	—	—	—	—	—	2.15°°	—	—
$OCOCH_3$-10	—	—	1.89	1.90	1.97	1.96	1.98	1.96	—
$OCOCH_3$-15	1.95	1.93	1.93	1.93	—	—	—	—	1.96
$OCOCH_3$-21	2.17	—	—	—	—	2.15	2.16°°	—	—

[a]$CDCl_3$; Bruker AMX-500 spectrometer. Chemical shifts referenced to $CHCl_3$ at 7.26 ppm.
[b]Nd=Not detected.
*,**,°,°°Values with the same superscripts may be interchanged.

($C_{30}H_{48}O_4$ requires 472.3552) and showed a ^{13}C-nmr signal at δ 217.56 that suggested the presence of a C=O group; its ^{1}H- and ^{13}C-nmr spectra are reported in Tables 1 and 2. The ^{1}H-nmr spectrum of **8** was almost identical to that of **7** with the only differences due to the absence of the acetyl group at C-15 that shifted C-15 to δ 72.20 (δ 84.11 for **7**), C-16 to δ 39.25 (δ 33.03 for **7**), C-29 to δ 30.31 (δ 24.73 for **7**) and, surprisingly, C-14 to δ 55.68 (δ 57.95 for **7**). All the nmr resonances were confirmed by 2D experiments. In particular, HMBC experiments exhibited a series of ^{1}H-^{13}C long-range hetero-correlations (see Experimental) that further supported the assignments of all other raspacionin derivatives.

10-Acetoxy-15-deacetyl-4-oxo-28-hydroraspacionin [**9**] gave $C_{34}H_{56}O_8$, assigned by hreims at *m/z* 532.3752 $[M-HOAc]^+$ ($C_{32}H_{52}O_6$ requires 532.3764). The spectral data were closely related to those of **8** and, in particular, the ^{1}H-nmr resonance at δ 4.97 (H-21; δ 3.82 for **8**), suggested a structure **9** that was easily confirmed by acetylation of **8**.

10-Acetoxy-4-acetyl-15-deacetyl-28-hydroraspacionin [**10**] exhibited $C_{36}H_{60}O_9$ that was assigned by hreims at *m/z* 516.3803 $[M-2\ HOAc]^+$ ($C_{32}H_{52}O_5$ requires 516.3814). The ^{1}H- and ^{13}C-nmr spectra of **10** (Tables 1 and 2) displayed resonances similar to those of **9** but with the ^{13}C-nmr resonance at δ 217.30 substituted by a signal

at δ 78.76, consistent with the presence of a secondary carbon (C-4) bearing an acetoxy group. The β-orientation of the substituent at C-4 was suggested by comparison of the nmr data of **10** (C-4 δ 78.76, H-4 δ 4.99) with those, already reported (2), of **2** (C-21 δ 80.80, H-21 δ 4.70). Compound **10** is also related to **6**, but with a different acetylation pattern. In fact, the ^{1}H-nmr resonances of H-4 and H-21 were shifted to δ 4.99 and 4.98, respectively, whereas the deacetylation at C-15 was supported by the diagnostic ^{13}C-nmr values of C-15 (δ 72.25), C-16 (δ 39.41) and C-29 (δ 30.41).

10-Acetoxy-15-deacetyl-4,21-dioxo-28-hydroraspacionin [**11**] possessed the molecular formula $C_{32}H_{52}O_7$, as determined by hreims at *m/z* 488.3490 $[M-HOAc]^+$ ($C_{30}H_{48}O_5$ requires 488.3501). The nmr data of **11** suggested a structure closely related to **10** but displaying two carbonyls at C-4 and C-21. It differed from **9** only by the functionalization at C-21 that shifted H_3-32 to δ 1.12 (0.97 for **9**) and H-18 to δ 2.89 (3.35 for **9**). The perhydrobenzoxepine half of **11**, bearing the hydroxy group, displayed ^{1}H- and ^{13}C-nmr values almost identical to those of the corresponding partial structure in sipholenone A [**13**] (12).

10-Hydroxy-4,21-dioxo-28-hydroraspacionin [**12**] exhibited $C_{32}H_{52}O_7$ by hreims at *m/z* 488.3482 $[M-HOAc]^+$ ($C_{30}H_{48}O_5$ requires 488.3501). The same functionalization of **11** was observed in **12**, but with interchange of the acetoxy and hydroxy groups at carbons 10 and 15. The different functionalization of the oxygenated substituents at C-10 and C-15 induced a series of shifts on the vicinal carbons, including a surprising ^{13}C-nmr downfield acetylation effect on C-14 (δ 57.93 for **12**; δ 55.52 for **11**). By analogy with **11**, the unacetylated unit of **12** was identical to the perhydrobenzoxepine moiety of sodwanone A [**14**] (16) as confirmed by comparison of nmr data.

All raspacionins (**7**, **8**, **9**, **11**, and **12**) containing a ketone moiety displayed a positive cd maximum at ca. 302 nm that suggested an absolute stereochemistry identical to those of the 4-oxo-derivative of raspacionin [**1**], the 21-oxo-derivative of raspacionin A [**2**], and raspacionin B [**3**] (3). The same absolute stereochemistry is presumably also possessed by the other raspacionins.

EXPERIMENTAL

GENERAL EXPERIMENTAL PROCEDURES.—Ft-ir spectra were recorded with a Biorad FTS-7 instrument. Low-resolution ms were determined on a VG Trio-2000. High-resolution ms were determined on a Kratos MS-50 spectrometer. Optical rotations were recorded on a Jasco DIP-370 polarimeter. Cd measurements were carried out on a Jasco J-710 dicograph. Hplc was performed on a Waters apparatus equipped with a differential refractometer. Commercial Si gel (70–230 mesh ASTM) was used for column chromatography. Analytical tlc was carried out using precoated Si gel Merck F_{254} plates.

1D and 2D nmr spectra were recorded at room temperature with a Bruker AMX-500 spectrometer (^{1}H, 500.13 MHz; ^{13}C, 125.76 MHz), equipped with a X32 data system. ^{1}H- and ^{13}C-nmr chemical shifts were referenced to $CHCl_3$, resonating at δ 7.26 and 77.00 ppm, respectively. The DEPT spectra were obtained using polarization transfer pulses of 135°. Two dimensional experiments were performed using standard Bruker microprograms.

EXTRACTION AND ISOLATION OF RASPACIONINS.—The sponge *Raspaciona aculeata* was collected by hand in Blanes (northeastern Spain) during December 1991, using scuba in an overhang at a depth of 10–15 m. A voucher specimen is deposited at the Centre d'Estudios Avanzados (Blanes). The Et_2O-soluble fraction (1.15 g) from the Me_2CO extract of the fresh sponge (dry wt 12.0 g) was fractionated on a Si gel flash column using light petroleum ether with increasing amounts of Et_2O as eluent to afford, along with the main metabolite **1** (158 mg) (tlc, R_f 0.45, light petroleum ether-Et_2O, 1:1) and a fraction (115 mg) containing a mixture of **2** and **3** (tlc, R_f 0.70, light petroleum ether-Et_2O, 1:1), a more polar fraction (116 mg) (tlc, R_f 0.27, light petroleum ether-Et_2O, 3:7) containing a mixture of the new triterpenoids **5**–**12**. This fraction was chromatographed by hplc using a Spherisorb Silica S5W column (25 cm×10 mm, particle size 5 μm, flow rate 2.5 ml/min^{-1}) and *n*-hexane-EtOAc (7:3) as eluent, yielding seven main fractions: A (4.8 mg), B (17.0 mg), C (11.0 mg), D (6.0 mg), E (13.0 mg), F (10.0 mg), and G (6.8 mg). Each fraction was further purified by hplc using a Spherisorb 5 Sil column (25 cm×4.6 mm, particle size 5 μm) and different eluents. In particular, elution of A with $CHCl_3$ (flow rate 1.0 ml/min^{-1}) yielded 3.1 mg of **11**; elution of B with *n*-

hexane-*i*-PrOH (92:8) (flow rate 1.0 ml/min^{-1}) yielded 5.7 mg of **9** and 3.5 mg of **7**; elution of C with *n*-hexane-*i*-PrOH (92:8) (flow rate 1.0 ml/min^{-1}) yielded 2.7 mg of **5**; elution of D with $CHCl_3$ (flow rate 1.0 ml/min^{-1}) yielded 3.1 mg of **12**; elution of E with $CHCl_3$ (flow rate 1.0 ml/min^{-1}) yielded 2.5 mg of **10**; elution of F with *n*-hexane-*i*-PrOH (9:1) (flow rate 1.5 ml/min^{-1}) yielded 2.6 mg of **6**; elution of G with *n*-hexane-*i*-PrOH (9:1) (flow rate 1.5 ml/min^{-1}) yielded 2.7 mg of **8**.

METHANOLYSIS OF **1** TO GIVE **5**.—Raspacionin [**1**] (2.5 mg) was treated with 1.0 ml of a solution of KOH (3% in MeOH) stirring at room temperature. The reaction was monitored by tlc (light petroleum ether-Et_2O, 4:6) and stopped after 2 h, when the starting product spot disappeared. The usual work up gave 3.0 mg of a residue that was purified on Si gel contained in a Pasteur pipette using petroleum ether-Et_2O (3:7) as eluent, to give 2.0 mg of pure compound **5**.

ACETYLATION OF **8** TO GIVE **9**.—A few drops of Ac_2O were added to a solution of **8** (1.4 mg) in dry pyridine (500 ml) and the reaction mixture was kept at room temperature overnight. After removal of the solvent *in vacuo*, the usual work up gave 1.0 mg of pure compound **9**.

Raspacionin [**1**].—Cd (c=5.78×10^{-4} M; EtOH) 20° $[\theta]_{206.60}$ +3469.

21-Deacetyl-raspacionin [**5**].—Amorphous powder: $[\alpha]^{25}D$ −49.1° (c=0.25, $CHCl_3$); cd (c=5.20×10^{-4} M; EtOH) 20° $[\theta]_{206.50}$+2677; ir ν max (liquid film, $CHCl_3$) 2974, 2934, 1730, 1712 cm^{-1}; eims *m/z* 474 $[M-C_2H_4O_2]^+$ (5), 416 $[M-C_2H_4O_2-C_3H_6O]^+$ (5), 398 $[M-C_2H_4O_2-C_3H_6O-H_2O]^+$ (2), 372 (10), 314 (15); hreims *m/z* 474.3698 $[M-C_2H_4O_2]^+$ ($C_{30}H_{50}O_4$ requires 474.3709); ^{1}H- and ^{13}C-nmr data, see Tables 1 and 2.

10-Acetoxy-21-deacetyl-28-hydroraspacionin [**6**].—Amorphous powder: $[\alpha]^{25}D$ −27.7° (c=0.26, $CHCl_3$); cd (c=4.86×10^{-4} M; EtOH) 20° $[\theta]_{210.60}$ −80.76; ir ν max (liquid film, $CHCl_3$) 2973, 2933, 2866, 1727 cm^{-1}; eims *m/z* 474 $[M-2C_2H_4O_2]^+$ (3), 416 $[M-2C_2H_4O_2-C_3H_6O]^+$ (5), 314 (7); hreims *m/z* 474.3684 ($C_{30}H_{50}O_4$ requires 474.3709); ^{1}H- and ^{13}C-nmr data, see Tables 1 and 2.

10-Acetoxy-21-deacetyl-4-oxo-28-hydroraspacionin [**7**].—Amorphous powder: $[\alpha]^{25}D$ −38.5° (c=0.37, $CHCl_3$); cd (c=4.17×10^{-4} M; EtOH) 20° $[\theta]_{209.50}$ +9472, $[\theta]_{302.50}$ +8897; ir ν max (liquid film, $CHCl_3$) 2972, 2940, 2867, 1718 cm^{-1}; eims *m/z* 514 $[M-C_2H_4O_2-H_2O]^+$ (0.15), 472 $[M-2C_2H_4O_2]^+$ (13), 414 $[M-2C_2H_4O_2-C_3H_6O]^+$ (4), 386 (2); hreims *m/z* 514.3645 $[M-C_2H_4O_2-H_2O]^+$ ($C_{32}H_{50}O_5$ requires 514.3658); ^{1}H- and ^{13}C-nmr data, see Tables 1 and 2.

10-Acetoxy-15,21-dideacetyl-4-oxo-28-hydroraspacionin [**8**].—Amorphous powder: $[\alpha]^{25}D$ −9.5° (c=0.36, $CHCl_3$); cd (c=7.27×10^{-4} M; EtOH) 20° $[\theta]_{209.90}$+1200, $[\theta]_{302.10}$+1109; ir ν max (liquid film, $CHCl_3$) 2922, 2852, 1716 cm^{-1}; eims *m/z* 472 $[M-C_2H_4O_2-H_2O]^+$ (1), 432 $[M-C_2H_4O_2-C_3H_6O]^+$ (2), 414 $[M-C_2H_4O_2-C_3H_6O-H_2O]^+$ (1), 372 (3); hreims *m/z* 472.3535 ($C_{30}H_{48}O_4$ requires 472.3552); ^{1}H- and ^{13}C-nmr data, see Tables 1 and 2; HMBC data (J=10 Hz) δ 42.14 (C-1) 0.99 (H_3-25), 2.13 (H-3); 40.14 (C-2) 0.99 (H_3-25), 2.13 (H-3), 2.97 (H-7), 3.18 (H-3); 35.02 (C-3) 1.87 (H-2); 217.56 (C-4) 3.18 (H-3); 82.65 (C-5) 1.25 (H_3-26), 1.31 (H_3-27), 2.13 (H-3), 2.97 (H-7); 80.68 (C-7) 0.99 (H_3-25), 1.87 (H-2), 2.67 (H-9); 35.24 (C-9) 1.50 (H_3-28); 86.27 (C-10) 1.50 (H_3-28), 2.67 (H-9); 55.68 (C-11) 0.99 (H_3-25), 1.50 (H_3-28), 1.69 (H-9 and/or H-13), 2.67 (H-9); 27.96 (C-12) 0.83 (H-14), 1.45 (H-11); 28.87 (C-13) 0.83 (H-14); 55.68 (C-14) 0.97 (H_3-32), 1.17 (H_3-29), 1.60 (H-16); 72.20, (C-15) 1.17 (H_3-29), 1.60 (H-16), 1.69 (H-13); 39.25 (C-16) 1.17 (H_3-29); 76.25 (C-18) 0.97 (H_3-32), 1.39 (H-17), 1.60 (H-16); 77.76 (C-20) 1.13 (H_3-31), 1.27 (H_3-30), 3.50 (H-18); 77.17 (C-21) 1.13 (H_3-31), 1.27 (H_3-30), 1.73 (H-22); 25.09 (C-22) 1.53 (H-23), 3.82 (H-21); 34.12 (C-23) 0.83 (H-14), 0.97 (H_3-32), 2.02 (H-22), 3.50 (H-18), 3.82 (H-21); 42.55 (C-24) 0.83 (H-14), 0.97 (H_3-32), 1.69 (H-13); 12.49 (C-25) 2.97 (H-7); 26.42 (C-26) 1.31 (H_3-27); 20.45 (C-27) 1.25 (H_3-26); 30.31 (C-29) 0.83 (H-14); 21.31 (C-30) 1.13 (H_3-31); 29.00 (C-31) 1.27 (H_3-30), 3.82 (H-21); 12.93 (C-32) 0.83 (H-14), 1.37 (H-23), 3.50 (H-18).

10-Acetoxy-15-deacetyl-4-oxo-28-hydroraspacionin [**9**].—Amorphous powder: $[\alpha]^{25}D$ −18.2° (c=0.50, $CHCl_3$); cd (c=5.63×10^{-4} M; EtOH) 20° $[\theta]_{210.50}$ +9288, $[\theta]_{302.60}$+8689; ir ν max (liquid film, $CHCl_3$) 2973, 2940, 2862, 1721 cm^{-1}; eims *m/z* 532 $[M-C_2H_4O_2]^+$ (1), 472 $[M-2C_2H_4O_2]^+$ (2), 414 $[M-2C_2H_4O_2-C_3H_6O]^+$ (1); hreims *m/z* 532.3752, ($C_{32}H_{52}O_6$ requires 532.3764); ^{1}H- and ^{13}C-nmr data, see Tables 1 and 2.

10-Acetoxy-4-acetyl-15-deacetyl-28-hydroraspacionin [**10**].—Amorphous powder: $[\alpha]^{25}D$ −35.1° (c=0.05, $CHCl_3$); cd (c=4.36×10^{-4} M; EtOH) 20° $[\theta]_{206.50}$+1820; ir ν max (liquid film, $CHCl_3$) 2971, 2938, 2865, 1726 cm^{-1}; eims *m/z* 516 $[M-2C_2H_4O_2]^+$ (1), 498 $[M-2C_2H_4O_2-H_2O]^+$ (1), 432 (3), 414 (4), 372 (3); hreims *m/z* 516.3803 ($C_{32}H_{52}O_5$ requires 516.3814); ^{1}H- and ^{13}C-nmr data, see Tables 1 and 2.

10-Acetoxy-15-deacetyl-4,21-dioxo-28-hydroraspacionin [**11**].—Amorphous powder: $[\alpha]^{25}D$ −36.1° (c=0.1, $CHCl_3$); cd (c=6.08×10^{-4} M; EtOH) 20° $[\theta]_{211.40}$+10420, $[\theta]_{301.70}$+10210; ir ν max (liquid film, $CHCl_3$) 2971, 2937, 2869, 1704 cm^{-1}; eims *m/z* 488 $[M-C_2H_4O_2]^+$ (2), 430 $[M-C_2H_4O_2-C_3H_6O]^+$ (2),

412 $[M-C_2H_4O_2-C_3H_6O-H_2O]^+$ (2); hreims *m/z* 488.3490 ($C_{30}H_{48}O_5$ requires 488.3501); ^{1}H- and ^{13}C-nmr data, see Tables 1 and 2.

10-Hydroxy-4,21-dioxo-28-hydroraspacionin [**12**].—Amorphous powder: $[\alpha]^{25}D$ −5.9° (*c*=0.28, $CHCl_3$); cd (*c*=6.81×10^{-4} M; EtOH) 20° $[\theta]_{302.70}$+6500, $[\theta]_{302.70}$+6569; ir *ν* max (liquid film, $CHCl_3$) 2974, 2936, 2863, 1707 cm^{-1}; eims *m/z* 488 $[M-C_2H_4O_2]^+$ (2), 470 $[M-C_2H_4O_2-H_2O]^+$ (2), 430 $[M-C_2H_4O_2-C_3H_6O]^+$ (2), 412 $[M-C_2H_4O_2-C_3H_6O-H_2O]^+$ (2); hreims *m/z* 488.3482 ($C_{30}H_{48}O_5$ requires 488.3501); ^{1}H- and ^{13}C-nmr data, see Tables 1 and 2.

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