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NEO-CLERODANE DITERPENOIDS FROM *SCUTELLARIA ALTISSIMA* AND *S. ALBIDA*

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Key Word Index—*Scutellaria altissima*; *S. albida*; Labiatae; neo-clerodane diterpenes; scutalsin; scutalbins A–C.

Abstract—Three new neo-clerodane derivatives, scutalbins A–C, have been isolated from the acetone extract of the aerial parts of *Scutellaria albida*, in addition to the previously known diterpenes scutecolumnins A and B, jodrellin B and clerodin. *S. altissima* provided a new neo-clerodane, scutalsin, as the sole detectable diterpene constituent. The structures of the new compounds were established by chemical and spectroscopic means as (11*S*,13*S*,15*R* and *S*,16*R*,19*R*)-6α-acetoxy-19-isobutyryloxy-2α,19;4α,18;11,16;15,16-tetraepoxy-neo-clerodan-15-ol (scutalsin), (11*S*,13*S*,16*S*,19*S*)-6α-acetoxy-2α,19;4α,18;11,16;15,16-tetraepoxy-neo-clerod-14-en-19-ol (scutalbin A), (11*S*,13*S*,15*R* and *S*,16*R*,19*R*)-6α-acetoxy-19-(2′-methyl)butyryloxy-2α,19;4α,18;11,16;15,16-tetraepoxy-neo-clerodan-15-ol (scutalbin B) and (11*S*,13*S*,15*R* and *S*,16*R*,19*S*)-6α-acetoxy-2α,19;4α,18;11,16;15,16-tetraepoxy-neo-cleroda-15,19-diol (scutalbin C). Scutalsin and scutalbins B and C were isolated as 1:1 mixtures of the C-15 epimers.

INTRODUCTION

The neo-clerodane diterpenes isolated from *Scutellaria* species are of interest on account of their biological activity as insect antifeedants [1–4] and as antifungal agents against plant pathogenic fungi [5]. In continuation of our studies on *Scutellaria* plants [3, 6–9], we have now investigated the aerial parts of *S. altissima* and *S. albida*. We report here on the isolation and structure elucidation of several new neo-clerodane derivatives isolated from these plants.

RESULTS AND DISCUSSION

Scutalsin (**1**) was the only diterpene constituent isolated by us from the acetone extract of the aerial parts of *S. altissima*. It was homogeneous on TLC and its ^{1}H NMR spectrum (see Experimental) showed essentially the same signals as those present in the ^{1}H NMR spectrum of jodrellin B (**6**) [1]. The observed differences between the ^{1}H NMR spectra of **1** and **6** were in agreement with the former being a 1:1 mixture of the C-15 epimers of the 14,15-dihydro-15-hydroxy derivative of jodrellin B. Thus in **1** the H-11, H-15 and H-16 protons appeared as pairs of signals [10, 11] at δ 4.49 (*dd*, 0.5 H, J = 10.5 and 6.3 Hz, H-11α in the 15*S* epimer) and 3.95 (*dd*, 0.5 H, J = 11.3 and 4.8 Hz, H-11α in the 15*R* epimer), δ 5.62 (*br d*, 0.5 H, J = 3.3 Hz) and 5.51 (*d*, 0.5 H, J = 5.5 Hz; H-15), and δ 5.77 and 5.76 (both *d*, J = 5.3 Hz, 0.5 H each; H-16), instead of the single signals corresponding to the H-11, H-15 and H-16 protons of **6** [δ 3.99 *dd* (1H, J = 11.7 and 4.6 Hz), 6.45 *t* (1H, J = 2.5 Hz) and 6.01 *d* (1H, J = 6.2 Hz), respectively] [1]; the rest of the spectrum was identical in both compounds (**1** and **6**).

Oxidation of **1** with chromium trioxide–pyridine yielded a derivative (**2**, $C_{26}H_{36}O_9$), the IR and ^{1}H and ^{13}C NMR spectra of which revealed the existence of a γ-lactone moiety [ν_{CO} 1780 cm^{-1}, downfield resonance of the H-16 proton (δ 5.97 *d*), the C-14 methylene protons as the AB part of an ABX system, $\delta_{C\text{-}15}$ 175.0 *s* (see Tables 1 and 2)] [10, 11], thus confirming that scutalsin (**1**) was a mixture of hemiacetal epimers at C-15. Furthermore, NOE experiments on **2** supported that the ester group at C-19 had a 19*R* configuration for a neo-clerodane [12] absolute stereochemistry, because irradiation at δ 1.08 *s* (Me-20 protons) caused a noticeable NOE enhancement in the signal of the H-19α proton (δ 6.62 *s*) and vice versa [1, 3].

Treatment of **1** with an excess of Jones' reagent gave the dilactone **3** [$C_{22}H_{28}O_8$; ν_{CO} 1785 cm^{-1} (γ-lactone), 1750, 1730 cm^{-1} (δ-lactone and acetate); downfield shift of the H-2β and H-16 protons (δ 4.69 *m* and 5.99

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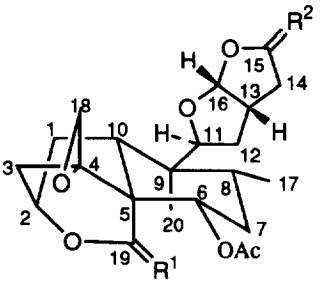
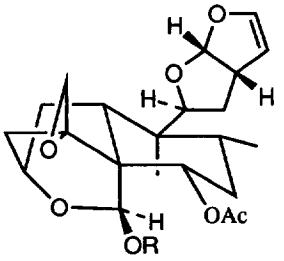
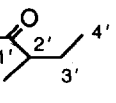


	R^1	R^2
1	αH, β-O-(2'-(4')-3')-1'	H,OH(*)
2	αH, β-O-	O
3	O	O
5	αH, β-O-	H,H
9	αH, β-O-	H,OH(*)
10	αH,βOH	H,OH(*)

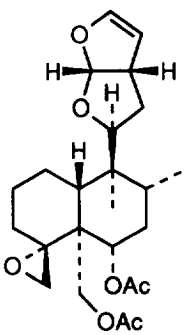
(*) Mixture (1:1) of 15*R* and 15*S* forms.



4 R= 

6 R= 

8 R= H



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d, respectively) and absence of the H-15 and H-19 proton signals with respect to **1**; δ_{CO} 174.9 *s* (C-15), 170.9 *s* and 170.8 *s* (C-19 and acetate [3]) (Tables 1 and 2 and Experimental)]. This reaction not only oxidized the C-15 hemiacetal function of **1** but also hydrolysed the isobutyrate ester group at the C-19 hemiacetalic position, as a consequence of the acidity of the reagent [3, 9, 13, 14], followed by oxidation of the resulting 19,2α-hemiacetal group to the corresponding δ-lactone. The transformation of scutalsin (**1**) into the derivative **3** firmly supported the location of the acetate and the isobutyric ester groups of **1** at the C-6 and C-19 positions, respectively.

From all the above data it was evident that scutalsin possessed the structure and relative stereochemistry depicted in **1**.

The acetone extract of the aerial parts of *S. albida* was subjected to extensive chromatography (see Experimental) to yield the already known neo-clerodane diterpenoids scutecolumnins A (**4**) and B (**5**) [6], jodrellin B (**6**) [1] and clerodin (**7**) [13] together with three new substances, scutalbins A–C, whose structures (**8–10**) were established as follows.

Scutalbin A (**8**) had the molecular formula $C_{22}H_{30}O_7$ and its IR spectrum showed hydroxyl absorption (3460 cm^{-1}). The ^1H and ^{13}C NMR spectra of this compound (Tables 1 and 2) were almost identical to those of scutecolumnin A (**4**) [6] and revealed that the former was devoid of the 2-methylbutyryl substituent at C-19 of the latter, i.e. no signals for this grouping were observed in **8** and its H-19 proton appeared shifted upfield ($\Delta\delta$ −0.98) and the C-19 hemiacetalic carbon was shifted downfield ($\Delta\delta$ +1.4) with respect to **4**. Moreover, **8** possessed an acetoxyl group at the C-6α position [$\delta_{H\text{-}6\beta}$ 4.66 *dd*, J = 11.3 and 4.8 Hz; δ 2.04 *s*, 3H (OAc); δ_C 69.6 *d* (C-6), 169.1 *s* and 21.2 *q* (OAc)] like scutecolumnin A [**4**: $\delta_{H\text{-}6\beta}$ 4.66 *dd*, J = 11.2 and 4.6 Hz; δ 1.95 *s*, 3H (OAc); δ_C 68.4 *d* (C-6), 170.1 *s* and 21.4 *q* (OAc)] [6].

Treatment of scutalbin A (**8**) with an excess of Jones' reagent yielded the dilactone **3** (see above) by oxidation of the C-19 hemiacetal and further oxidation

Table 1. ^{1}H NMR spectral data of compounds **2**, **3** and **8** (200 MHz, $CDCl_3$, δ values relative to residual $CHCl_3$ (δ 7.25))*

H	2	3	8	J (Hz)	2	3	8
2β	4.11 *m*†	4.69 *m*†	4.15 *m*†	1α,3α	‡	2.8	2.9
3α	‡	2.42 *dt*§	2.57 *dt*§	2β,3α	‡	2.8	2.9
6β	4.57 *dd*	4.65 *dd*	4.66 *dd*	3α,3β	‡	14.4	14.4
7β	‡	1.39 *ddd*	‡	6β,7α	11.3	11.9	11.2
11α	4.02 *dd*	4.01 *dd*	3.95 *dd*	6β,7β	4.8	4.8	4.8
12A	~1.60‡	1.62 *ddd*	‡	7α,7β	‡	12.8	‡
12B	‡	~2.02‡	‡	7β,8β	‡	3.0	‡
13β	3.09 *m*‖	3.13 *m*‖	3.51 *m*¶	8β,17	6.1	6.7	6.0
14A	2.34 *dd*	2.36 *dd*	4.79 *t*	11α,12A	5.3	5.3	4.7
14B	2.82 *dd*	2.86 *dd*	–	11α,12B	11.0	11.1	11.6
15	–	–	6.43 *t*	12A,12B	‡	12.8	‡
16β	5.97 *d*	5.99 *d*	5.99 *d*	12A,13β	‡	1.6	‡
Me-17	0.85 *d*	0.86 *d*	0.88 *d*	13β,14A	3.8	3.8	2.5
18A	2.35 *d*	2.56 *d*	2.42 *d*	13β,14B	10.5	10.5	–
18B	2.90 *d*	3.14 *d*	2.93 *d*	13β,15	–	–	2.5
19α	6.62 *s*	–	5.71 *s*	13β,16β	5.6	5.6	6.2
Me-20	1.08 *s*	1.00 *s*	1.09 *s*	14A,14B	18.6	18.6	–
OAc	1.87 *s*	2.00 *s*	2.04 *s*	14,15	–	–	2.5
2′	2.51 *sept*	–	–	18A,18B	4.4	4.1	4.1
Me-3′	1.18 *d*	–	–	2′,Me-3′	7.0	–	–
Me-4′	1.15 *d*	–	–	2′,Me-4′	7.0	–	–

*Spectral parameters were obtained by first-order approximation. All these assignments were confirmed by ^{1}H–^{1}H COSY spectra.

†$W_{1/2}$ = 8 Hz.

‡Overlapped signal.

§Equatorial proton.

‖$W_{1/2}$ = 25 Hz.

¶$W_{1/2}$ = 12 Hz.

of another hemiacetal at C-15, which must be formed from the 14,15-vinyl ether of the tetrahydrofurofuran moiety, because it is known [11, 13] that the 14,15 double-bond of these diterpenoids is very sensitive even to weak acidic conditions. Thus, except for the absolute stereochemistry, the structure of scutalbin A must be **8**.

Scutalbins B (**9**) and C (**10**) gave rise to ^{1}H NMR spectra (see Experimental) which are very similar to that of scutalsin (**1**), indicating that they were also 1 : 1 epimeric mixtures of the C-15 hemiacetal function. Moreover, scutalbin B (**9**) possessed a 2-methylbutyryloxy group at C-19 [$\delta_{H\text{-}19\alpha}$ 6.67 *s* and 6.66 *s*, 0.5 H each; 0.94 *t*, 3 H, J = 7.5 Hz (Me-4′) and 1.24 *d*, 3 H, J = 7.1 Hz (Me-5′)] [6] instead of the C-19 *O*-isobutyryl group of **1** [$\delta_{H\text{-}19\alpha}$ 6.69 *s* and 6.68 *s*, 0.5 H each; 2.56 *sept*, 1 H, J = 7.0 Hz (H-2′), 1.24 *d*, 3 H, J = 7.0 Hz (Me-3′) and 1.20 *d*, 3 H, J = 7.0 Hz (Me-4′)], whereas in the case of scutalbin C (**10**) the C-19 hemiacetal function was not esterified, as was revealed by the chemical shift of the C-19α proton (δ 5.71 *s* and

Table 2. ^{13}C NMR spectral data of compounds **2**, **3** and **8** (50.3 MHz, $CDCl_3$, δ values relative to the solvent signal (δ_{CDCl_3} 77.0))*

C	2	3	8	C	2	3	8
1	28.2 *t*	29.1 *t*	28.8 *t*	14	35.0 *t*	35.1 *t*	101.9 *d*
2	67.0 *d*	67.1 *d*	66.6 *d*	15	175.0 *s*	174.9 *s*	146.5 *d*
3	36.5 *t*	36.3 *t*	36.5 *t*	16	106.9 *d*	106.9 *d*	108.0 *d*
4	60.2 *s*	61.2 *s*	60.6 *s*	17	16.6 *q*	16.3 *q*	16.6 *q*
5	41.0 *s*	46.9 *s*	42.4 *s*	18	49.8 *t*	50.0 *t*	49.5 *t*
6	68.0 *d*	72.4 *d*	69.6 *d*	19	91.2 *d*	170.9 *s*[b]	92.9 *d*
7	33.2 *t*[a]	32.3 *t*[a]	32.2 *t*[a]	20	13.6 *q*	12.0 *q*	14.0 *q*
8	35.2 *d*	36.1 *d*	35.4 *d*	OAc	169.7 *s*	170.8 *s*[b]	169.1 *s*
9	41.2 *s*	41.7 *s*	40.8 *s*		21.1 *q*	21.2 *q*	21.2 *q*
10	40.9 *d*	41.4 *d*	40.6 *d*	1′	175.4 *s*	–	–
11	84.9 *d*	84.9 *d*	85.3 *d*	2′	34.1 *d*	–	–
12	32.9 *t*[a]	32.8 *t*[a]	32.7 *t*[a]	3′	18.8 *q*	–	–
13	37.6 *d*	37.5 *d*	45.5 *d*	4′	18.1 *q*	–	–

*Multiplicities were determined by the DEPT pulse sequence.

[a,b]These assignments may be reversed.

δ 5.70 *s*, 0.5 H each), which resonated at an identical field to that in **8** (δ 5.71 *s*, Table 1). The above conclusions on the structures of scutalbins B (**9**) and C (**10**) were confirmed by treating these compounds with Jones' reagent. In both cases compound **3** was obtained, thus establishing that the 2-methylbutyryloxy group of **9** was located at C-19.

The transformation of the new diterpenoids (**1**, **8**, **9** and **10**) into the same derivative (**3**) established that all of them possessed the same absolute stereochemistry. Although this structural feature was not ascertained, we assume that, on biogenetic grounds, these compounds belong to the neo-clerodane [12] class, like other diterpenes isolated from *Scutellaria* species and whose neo-clerodane absolute configuration has been established by X-ray diffraction analyses [3, 15] or by the CD exciton chirality method [8]. In addition, for the above reasons, the absolute stereochemistry at the C-2 asymmetric centre of the 2-methylbutyrate part of scutalbin B (**9**) is probably 2*S* [15].

From a chemotaxonomic point of view, it is important to indicate that clerodin (**7**), now isolated from *Scutellaria albida*, has previously been reported as a constituent of some species belonging to the Verbenaceae [13, 16]. This supports some recent papers on the need to reclassify the Labiatae and Verbenaceae [17].

EXPERIMENTAL

General. Mps: uncorr. The plants were cultivated in the Orto Botanico dell 'Università di Milano at Tuscolano (Brescia, Italy). Seeds of the species were provided by the Botanischer Garten der Universität Heidelberg and Botanischer Garten der Technischer Universität, Germany (*S. altissima*), and Botanischer Garten der Justus Liebig Universität at Giessen, Germany (*S. albida*). Both plants were collected in August 1994 and voucher specimens are deposited in the Herbarium of the Dipartimento di Biologia, University of Milan, Italy.

Extraction and isolation of the diterpenoids. Dried and finely powdered aerial parts of *S. altissima* L. (2.15 kg) were extracted with Me_2CO (3 × 5 l) at room temp. for 1 week. After filtration, the solvent was evapd to dryness under red. pres. and low temp. (30°) yielding a residue (100 g), which was subjected to CC (silica gel Merck No. 7734, deactivated with 10% H_2O, w/v, 750 g) eluting with a hexane–EtOAc gradient and finally with $CHCl_3$–MeOH (19:1). The frs eluted with the last mixt. were rechromatographed (CC, silica gel, CH_2Cl_2–MeOH, 49:1, as eluent) yielding scutalsin (**1**, 600 mg). No other diterpenoids were detected in the Me_2CO extract of this species.

Dried and powdered aerial parts of *S. albida* L. (4.6 kg) were extracted with Me_2CO (3 × 10 l), as above, to give an extract (220 g) which was subjected to CC (silica gel Merck No. 7734, deactivated as above, 1 kg) eluting with a petrol–EtOAc gradient and finally with EtOAc–MeOH (9:1). All the chromatographic frs were decolourized by filtration through a pad of a mixt. (1:1) of activated C and celite, eluting with EtOAc. The frs eluted with petrol–EtOAc (3:2) which contained different mixts of the diterpenoids were subjected to radial chromatography (silica gel disc, CH_2Cl_2–MeOH, 49:1, as eluent) to give the following compounds in order of increasing chromatographic polarity: scutecolumnin A (**4**, 500 mg) [6], jodrellin B (**6**, 450 mg) [1], clerodin (**7**, 200 mg) [13], scutalbin A (**8**, 1 g) and scutalbin B (**9**, 1.9 g). Radial chromatography (silica gel disc, petrol–EtOAc, 1:1, as eluent) of the residue of the frs eluted with EtOAc–petrol (4:1) yielded scutecolumnin B (**5**, 1 g) [6]. Finally, scutalbin C (**10**, 2.3 g) was isolated from the frs eluted with EtOAc and EtOAc–MeOH (9:1) after radial chromatography (silica gel disc, CH_2Cl_2–MeOH 19:1 as eluent).

The previously known compounds, scutecolumnins A (**4**) and B (**5**) [6], jodrellin B (**6**) [1] and clerodin (**7**) [13], were identified by their mp, $[\alpha]_D$, ^{1}H NMR and mass spectra and by comparison (mmp, TLC) with authentic samples.

Scutalsin (**1**). Amorphous powder; mixture (1:1) of the 15*R* and 15*S* forms. ^{1}H NMR (200 MHz, $CDCl_3$): δ 4.15 (*m*, 1H, $W_{1/2}$ = 8 Hz, H-2β) 4.62 (*dd*, 1H, *J* = 11.3 and 4.8 Hz, H-6β), 4.49 (*dd*, 0.5H, *J* = 10.5 and 6.3 Hz, H-11α of the 15*S* form), 3.95 (*dd*, 0.5H, *J* = 11.3 and 4.8 Hz, H-11α of the 15*R* form), 5.62 (*br d*, *J* = 3.3 Hz) and 5.51 (*d*, *J* = 5.5 Hz, 0.5H each, H-15 in the two C-15 epimers), 5.77 (*d*) and 5.76 (*d*, both *J* = 5.3 Hz, 0.5H each, H-16β), 0.90 (*d*) and 0.88 (*d*, both *J* = 6.1 Hz, 1.5H each, Me-17), 2.39 (*d*, 1H, *J* = 4.4 Hz, H_A-18), 2.97 (*d*) and 2.96 (*d*, both *J* = 4.4 Hz, 0.5H each, H_B-18), 6.69 (*s*) and 6.68 (*s*, 0.5H each, H-19α), 1.13 (*s*) and 1.12 (*s*, 1.5H each, Me-20), 1.92 (*s*, 3H, OAc), 2.56 (*sept*, 1H, *J* = 7.0 Hz, H-2′), 1.24 (*d*, 3H, *J* = 7.0 Hz, Me-3′), and 1.20 (*d*, 3H, *J* = 7.0 Hz, Me-4′).

Lactone **2** *from scutalsin* (**1**). To a soln of **1** (150 mg) in pyridine (5 ml) was added CrO_3 (100 mg) in pyridine (5 ml) at room temp. with stirring. The reaction mixt. was stirred for 24 hr and then diluted with H_2O (25 ml) and extracted with Et_2O (5 × 15 ml). The organic extract was washed with H_2O (3 × 50 ml), dried (Na_2SO_4) and evapd giving a residue (135 mg), which was purified by CC (silica gel, EtOAc as eluent). Crystallization from EtOAc–*n*-hexane gave **2** (115 mg): mp 254–256°; $[\alpha]_D^{20}$ −12.7° ($CHCl_3$; *c* 0.424). IR ν_{max}^{KBr} cm^{-1}: 3050 (epoxide), 1780 (γ-lactone), 1740, 1730, 1250 (OAc and isobutyrate), 2980, 2940, 2900, 1470, 1430, 1370, 1200, 1160, 1080, 1070, 990, 970, 930, 880, 865, 790; ^{1}H NMR: Table 1; ^{13}C NMR: Table 2; EI-MS (70 eV, direct inlet) *m/z* (rel. int.): $[M]^+$ absent, 405 $[M - isobutyrate]^+$ (8), 345 $[M - isobutyrate - HOAc]^+$ (0.5), 218 (1.2), 217 (1.5), 189 (4), 181 (7), 171 (8), 127 [C-9 side chain]$^+$ (9), 105 (5), 81 (8), 71 (23), 55 (11), 43 (100), 41 (21). (Found: C, 63.19; H, 7.60. $C_{26}H_{36}O_9$ requires: C, 63.40; H, 7.37%.)

Dilactone **3** *from scutalsin* (**1**). To a soln of **1** (220 mg) in Me_2CO (15 ml) was added an excess of

Jones' reagent at 0° with stirring. After 15 min, the excess of Jones' reagent was destroyed by addition of EtOH and then the reaction mixt. was diluted with H_2O (50 ml). Extraction with $CHCl_3$ (4 × 25 ml) and work-up as usual gave a crystalline solid homogeneous on TLC. Crystallization from EtOAc–*n*-hexane yielded 152 mg of **3**: mp 259–262° (decomp.); $[\alpha]_D^{20}$ −25.1° ($CHCl_3$; *c* 1.575). IR ν_{max}^{KBr} cm^{-1}: 3070 (epoxide), 1785 (γ-lactone), 1750, 1730, 1260 (OAc and δ-lactone), 2990, 2980, 2910, 1450, 1375, 1320, 1195, 1125, 1105, 1090, 1070, 990, 970, 930, 900, 870; ^1H NMR: Table 1; ^{13}C NMR: Table 2; EI-MS (70 eV, direct inlet) *m/z* (rel. int.): 421 $[M+H]^+$ (0.4), 420 $[M]^+$(0.05), 360 $[M-HOAc]^+$ (0.2), 377 (0.4), 293 [M − (C-9 side chain)]$^+$ (2), 264 (1), 246 (2), 233 (5), 207 (2), 201 (2), 189 (6), 171 (14), 159 (10), 157 (18), 127 [C-9 side chain]$^+$ (18), 119 (14), 109 (10), 91 (12), 83 (12), 81 (12), 79 (10), 69 (13), 55 (20), 43 (100), 41 (32). (Found: C, 62.80; H, 6.74. $C_{22}H_{28}O_8$ requires: C, 62.84; H, 6.71%.)

Scutalbin A (**8**). M 158–160° (EtOAc–*n*-hexane); $[\alpha]_D^{24}$ −50.4° ($CHCl_3$; *c* 0.402). IR ν_{max}^{KBr} cm^{-1}: 3460 (OH), 3090, 1615 (vinyl ether), 3050 (epoxide), 1730, 1270 (OAc), 2960, 2940, 1440, 1430, 1380, 1100, 1020, 1010, 950, 900, 860, 800 735; ^1H NMR: Table 1; ^{13}C NMR: Table 2; EI-MS (70 eV, direct inlet) *m/z* (rel. int.): $[M]^+$ absent, 347 $[M-OAc]^+$ (0.3), 346 $[M-HOAc]^+$ (0.3), 295 [M − (C-9 side chain)]$^+$ (0.3), 248 (8), 235 [M − HOAc − (C-9 side chain)]$^+$ (3), 219 (6), 207 (9), 190 (28), 175 (19), 173 (23), 172 (24), 171 (23), 161 (24), 159 (32), 157 (28), 147 (20), 145 (24), 133 (30), 121 (30), 111 [C-9 side chain]$^+$ (100), 105 (35), 91 (33), 83 (21), 81 (20), 69 (15), 55 (13), 43 (28). (Found: C, 64.92; H, 7.51. $C_{22}H_{30}O_7$ requires: C, 65.01; H, 7.44%.)

Scutalbin B (**9**). Amorphous powder; mixture (1:1) of the 15*R* and 15*S* forms. ^1H NMR (250 MHz, $CDCl_3$): δ 4.16 (*m*, 1H, $W_{1/2}$ = 8 Hz, H-2β), 4.63 (*dd*, 1H, *J* = 11.2 and 4.8 Hz, H-6β), 4.50 (*dd*, 0.5H, *J* = 10.7 and 6.3 Hz, H-11α of the 15*S* form), 3.95 (*dd*, 0.5H, *J* = 11.6 and 4.9 Hz, H-11α of the 15*R* form), 5.61 (*br d*, *J* = 3.9 Hz) and 5.51 (*d*, *J* = 5.5 Hz, 0.5H each, H-15 in the two C-15 epimers), 5.76 (*d*) and 5.75 (*d*, both *J* = 5.3 Hz, 0.5H each, H-16β), 0.90 (*d*) and 0.88 (*d*, both *J* = 6.2 Hz, 1.5H each, Me-17), 2.38 (*d*, 1H, *J* = 4.2 Hz, H_A-18), 2.97 (*d*) and 2.96 (*d*, both *J* = 4.2 Hz, 0.5H each, H_B-18), 6.67 (*s*) and 6.66 (*s*, 0.5H each, H-19α), 1.12 (*s*) and 1.11 (*s*, 1.5H each, Me-20), 1.92 (*s*, 3H, OAc), 0.94 (*t*, 3H, *J* = 7.5 Hz, Me-4′), and 1.24 (*d*, 3H, *J* = 7.1 Hz, Me-5′).

Scutalbin C (**10**). Amorphous solid; mixture (1:1) of the 15*R* and 15*S* forms. ^1H NMR (300 MHz, $CDCl_3$): δ 4.15 (*m*, 1H, $W_{1/2}$ = 8 Hz, H-2β), 2.56 (*dt*, 1H, $J_{3\alpha,3\beta}$ = 14.4 Hz, $J_{3\alpha,2\beta} = J_{3\alpha,1\alpha}$ = 2.8 Hz, H_{eq}-3α), 4.65 (*dd*, 1H, *J* = 11.2 and 4.8 Hz, H-6β), 4.48 (*dd*, 0.5H, *J* = 10.7 and 6.3 Hz, H-11α of the 15*S* form), 3.94 (*dd*, 0.5H, *J* = 11.6 and 4.9 Hz, H-11α of the 15*R* form), 2.80 (*m*, 1H, $W_{1/2}$ = 21 Hz, H-13β), 5.62 (*br d*, *J* = 3.7 Hz) and 5.51 (*d*, *J* = 6.1 Hz, 0.5H each, H-15 in the two C-15 epimers), 5.77 (*d*) and 5.76 (*d*, both *J* = 5.3 Hz, 0.5H each, H-16β), 0.90 (*d*) and 0.88 (*d*, both *J* = 6.1 Hz, 1.5H each, Me-17), 2.42 (*d*, 1H, *J* = 4.2 Hz, H_A-18); 2.94 (*d*) and 2.93 (*d*, both *J* = 4.2 Hz, 0.5H each, H_B-18), 5.71 (*s*) and 5.70 (*s*, 0.5H each, H-19α), 1.07 (*s*) and 1.06 (*s*, 1.5H each, Me-20), and 2.04 (*s*, 3H, OAc).

Oxidation of scutalbins A (**8**), *B* (**9**) *and C* (**10**) *to give dilactone* **3**. Treatment of **8** and the mixt. of the C-15 epimers of **9** and **10** (samples of 100 mg of each compound, in 20 ml of Me_2CO) with an excess of Jones' reagent as described above for **1**, gave the same derivative, which was identical (mp, $[\alpha]_D$, ^1H NMR and MS) to the dilactone **3** obtained from **1** (see above). Comparison (mmp, TLC) with an authentic sample confirmed the identity.

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