

Short Report

Jatrowediol, a Lathyrane Diterpene from *Jatropha weddelliana*

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A partir das raízes de *Jatropha weddelliana* foram isolados os diterpenóides jatrogrossidiona, 4Z-jatrogrossidentadiona, 15-epi-4Z-jatrogrossidentadiona, 4E-jatrogrossidentadiona, 15-epi-4E-jatrogrossidentadiona, 2-hidroxiisojatrogrossidiona, 2-epi-hidroxiisojatrogrossidiona e jatrowediol. A elucidação da estrutura do jatrowediol, um novo diterpenóide latirânico, foi realizada por meio de análises por técnicas de RMN e de difração de raios-X.

Jatrogrossidion, 4Z-jatrogrossidentadion, 15-epi-4Z-jatrogrossidentadion, 4E-jatrogrossidentadion, 15-epi-4E-jatrogrossidentadion, 2-hydroxyisojatrogrossidion, 2-epi-hydroxyisojatrogrossidion and jatrowediol have been isolated from the stems of *Jatropha weddelliana*. The elucidation of the structure of the latter, a novel lathyrane, was accomplished by detailed NMR investigation and X-ray diffraction analysis.

Keywords: *Jatropha weddelliana*, Euphorbiaceae, diterpene, lathyrane, jatrowediol, Pantanal, X-ray diffraction analysis

Introduction

Jatropha weddelliana is a shrub found in calcimorphic and dry soils of the highlands of the bearing the pantanal of Mato Grosso do Sul, Brazil¹.

In this work we describe the chemical studies with the dichloromethane extract of the stems of *J. weddelliana*, that yielded a novel lathyrane diterpene, jatrowediol (**1**), and other seven known diterpenes: jatrogrossidion (**2**)², 4Z-jatrogrossidentadion (**3**)², 15-epi-4Z-jatrogrossidentadion (**4**)², 4E-jatrogrossidentadion (**5**)², 15-epi-4E-jatrogrossidentadion (**6**)^{2,3}, 2-hydroxyisojatrogrossidion (**7**)², and 2-epi-hydroxyisojatrogrossidion (**8**)².

Experimental

General experimental procedures

¹H, ¹³C NMR, DEPT, HETCOR, NOE and INEPT experiments: Bruker AM 300 and Varian Gemini 300

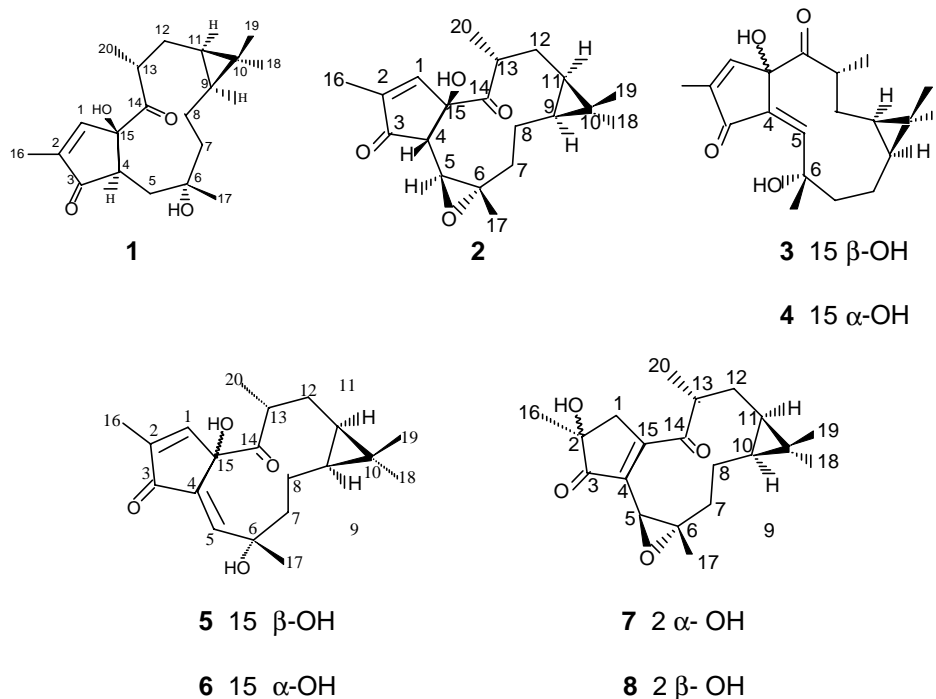
spectrometers; UV spectra: Hitachi U 3000 spectrometer; FT-IR spectra: BOMEN MB spectrometer; EI/MS and ES/MS Mass spectra: FISIONS VG Plataform II spectrometer, 70 eV.

Extraction and isolation

The powdered stems (2.3 kg) were exhaustively extracted with cold hexane and CH₂Cl₂. Repeated CC (silica gel; hexane with increasing amounts of Me₂CO) of the CH₂Cl₂ extract (73.4 g) afforded **1** (166.2 mg), **2** (8.7 mg), **3** (34 mg), **4** (10 mg), **5** (16 mg), **6** (92 mg), a mixture of **7** and **8** (140 mg) and **8** (20.5 mg).

Jatrowediol (1): white, amorphous powder, subl. at 220 °C. $[\alpha]_D^{20} +52.7$ (c 2.0, CHCl₃); UV, λ_{max} /nm (CHCl₃): 239.5; IR (ν_{max} /cm⁻¹): 3518-3407 (OH), 1716 (C=O) (KBr); ESMS (*m/z*): 334 [M]⁺ (0), 333 [M - H]⁺ (14), 335 [M + H]⁺ (17.5), 357 [M + Na]⁺ (9.0), 373 [M + K]⁺ (8.9), 352 [M + H₂O]⁺ (5.7), 316 [M - H₂O]⁺ (17.8), 299 [M - 2H₂O + H]⁺ (26); ¹H NMR (C₅D₅N) and ¹³C NMR (C₅D₅N): see Table 1.

Jatrogrossidion (2): colourless crystals, subl. at 230°C. ESMS (*m/z*): 332 [M]⁺ (0), 333 [M + H]⁺ (100), 355 [M+Na]⁺ (25.3), 371 [M + K]⁺ (18.4), 315 [M - H₂O + H]⁺ (95.1), 297 [M - 2H₂O + H]⁺ (53.6). ¹H- and ¹³C NMR data identical to the literature².

**Table 1.** NMR data of **1** in C₅D₅N.

Position	H	C
1	7.34 s	154.3
2		140.4
3		210.5
4	4.16 dd (5.5; 2.0 Hz)	47.8
5	2.62 dd (5.5; 14.7 Hz)	34.9
6		71.5
7	2.07 m (7a) and 1.79 m (7b)	41.0
8	1.45 m (8a) and 1.23 m (8b)	17.5
9	0.33 m	27.1
10		15.7
11	0.79 m	20.0
12	2.50 d (14.8Hz, 12a) and 1.97 dd (14.8; 4.8 Hz, 12b)	28.2
13	3.99 m	40.3
14		213.3
15	8.05 s	85.9
16	1.62 s	9.9
17	1.53 s	29.0
18	1.03 s	28.9
19	0.91 s	15.1
20	1.39 d (6.9 Hz)	15.4

4Z-Jatrogrossidentadion (3): colourless crystals, m.p. 167-168 °C; UV λ_{\max} /nm (CHCl₃): 239; IR (ν_{\max} /cm⁻¹): 3409 (OH), 1710, 1676, 1632 (C=O, C=C-C=O) (KBr); EIMS (m/z): 332 [M]⁺ (0), 314 [M - H₂O]⁺ (3.6), 271 (9.3), 163 (41.1), 69 (86.9), 67 (100); ¹³C NMR (CDCl₃): δ 153.8 (C-1), 146.7 (C-2), 196.4 (C-3), 134.6 (C-4), 149.0 (C-5), 73.9 (C-6), 43.5 (C-7), 18.9 (C-8), 24.8 (C-9), 16.8 (C-10), 22.0 (C-11), 28.3 (C-12), 37.2 (C-13), 210.8 (C-14), 84.1 (C-15), 10.8 (C-16), 29.0 (C-17), 28.6 (C-18), 15.4 (C-19), 19.4 (C-20). The assignments for C-1 and C-5 have been revised with respect to the literature².

15-epi-4Z-Jatrogrossidentadion (4): yellow solid; IR (ν_{\max} /cm⁻¹): 3426 (OH), 1698, 1653 (C=O, C=C-C=O) (CHCl₃ film); ESMS (m/z): 332 [M]⁺ (0), 355 [M + Na]⁺ (6.7), 371 [M + K]⁺ (7.8), 297 [M - 2H₂O + H]⁺ (9.5); ¹H- and ¹³C NMR data identical to the literature².

4-E-Jatrogrossidentadione (5): colourless crystals, m.p. 181-182 °C; UV λ_{\max} /nm (CHCl₃): 243; IR (ν_{\max} /cm⁻¹): 3488 (OH), 1709, 1697, 1645 (C=O, C=C-C=O) (KBr); ¹³C NMR (CDCl₃): δ 150.7 (C-1), 145.3 (C-2), 195.8 (C-3), 132.3 (C-4), 149.0 (C-5), 73.5 (C-6), 38.7 (C-7), 18.0 (C-8), 27.4 (C-9), 17.8 (C-10), 20.0 (C-11), 29.9 (C-12), 43.6 (C-13), 213.5 (C-14), 85.1 (C-15), 10.7 (C-16), 28.6 (C-17), 29.1 (C-18), 15.0 (C-19), 16.7 (C-20). The assignments for the pairs C-2 and C-5, C-7, C-13, Me-17 and Me-18, have been revised with respect to the literature².

15-epi-4E-Jatrogrossidentadione (6): colourless crystals, m.p. 173-174 °C; UV λ_{\max} /nm (CHCl₃): 259; IR (ν_{\max} /cm⁻¹): 3320 (OH), 1722, 1699, 1647, 1629 (C=O, C=C-C=O) (KBr); ESMS (m/z): 332 [M]⁺ (0), 333 [M + H]⁺ (27.6), 355 [M + Na]⁺ (44), 371 [M + K]⁺ (9.8), 315 [M - H₂O + H]⁺ (100), 297 [M - 2H₂O + H]⁺ (38.9); ¹H- and ¹³C NMR data identical to the literature^{2,3}.

2-Hydroxyisojatrogrossidion (7): yellow solid material. ESMS (m/z): 332 [M]⁺. IR (ν_{\max} /cm⁻¹): 3407 (OH), 1721 (C=O) (CHCl₃); ¹H- and ¹³C NMR data identical to the literature².

2-epi-Hydroxyisojatrogrossidion (8): white, amorphous powder, m.p. 181-182 °C; UV λ_{\max} /nm (CHCl₃): 250; IR (ν_{\max} /cm⁻¹): 3482 (OH), 1721, 1698 (C=O, C=C-C=O) (KBr); ESMS (m/z): 332 [M]⁺ (0), 333 [M + H]⁺ (43.8),

315 [M - H₂O + H]⁺ (100), 297 [M - 2H₂O + H]⁺ (28.9) 355 [M + Na]⁺ (10.9), 371 [M + K]⁺ (6.8); ¹H- and ¹³C NMR data identical to the literature².

X-ray crystal structure analysis of **1**

A colourless plate single crystal (0.50 x 0.33 x 0.07 mm) of **1** (C₂₀H₃₀O₄) was mounted on an Enraf-Nonius CAD-4 diffractometer with graphite-monochromated Mo K α radiation and ω -2 θ scan-technique. The unit cell and the orientation matrix for the data collection were obtained by a least-squares fit of 25 centered reflections ($8.69 < \theta < 14.1^\circ$). The intensities of three standard reflections were measured every 60 min and varied about 1.0% throughout the experiment. The intensity data were corrected for Lorentz and polarization effects, but not absorption corrections [$\mu(\text{Mo-K}\alpha) = 0.080 \text{ mm}^{-1}$]. The number of measured reflections was 4930 in the range $-10 \leq h \leq 10$, $-9 \leq k \leq 12$, $0 \leq l \leq 46$, with 3530 unique reflections, and 2529 with the condition $I \geq 3\sigma(I)$ were considered observed. Equivalent reflections were merged with $R_{\text{int}} = 3.27\%$. Crystal data: orthorhombic, P2₁2₁2₁ (no.19), $a = 8.833$ (2), $b = 10.749$ (2), $c = 39.837$ (8) Å, $Z = 8$, with two independent molecules in the asymmetric unit. The structure was solved by means of direct methods using SHELXS97 computer program⁴ and refined by full-matrix least-squares techniques on F² with SHELXL97 computer program⁵. H atoms were placed geometrically except those on the hydroxyl groups. The final refinement gave R (on F) factor of 0.055, wR (on F²) = 0.152 for 446 refined parameters.

Results and Discussion

Jatrowediol (**1**) was obtained from the dichloromethane extract of the stems of *J. weddelliana* as a dextrorotatory powder. The molecular formula C₂₀H₃₀O₄ was deduced from the NMR data and the molecular ion ([M+1] at m/z 335) from the Electron Spray Mass Spectrum. The IR spectrum indicated the presence of carbonyl (1716 cm⁻¹) and hydroxyl groups (3495 cm⁻¹). The UV spectrum in CHCl₃ afforded a λ_{max} at 239.5 nm (-C=C-C=O). The ¹³C NMR and DEPT spectra presented twenty carbon signals, including characteristic signals due to a trisubstituted double bond (δ_{C} 154.3 and 140.4), two carbonyls (δ_{C} 210.5 and 213.3), two carbinols hydroxyls (δ_{C} 71.5 and 85.9), five methyls, four methylenes, four methines and a quaternary carbon. Triplets at δ_{H} 0.34 (t, 1H) and 0.79 (lt, 1H) in the ¹H NMR spectrum suggested the presence of a cyclopropane moiety in the molecule. The unambiguous assignment of the protonated carbons was obtained by the

HETCOR measurements (Table 1) and decoupling experiments, while that of quaternary carbons came from the long-range HETCOR spectrum and selective INEPT experiments (Table 2). Together, the above data suggested a lathyrane gross structure for **1**.

The relative stereochemistry of methyl groups and of carbons C-6 to C-15 was confirmed by a series of difference NOE experiments (Table 3). However, the stereochemistry of cyclopentanone ring junction with the macrocycle could not be confirmed. The signal at δ_{H} 8.0 could not be unambiguously assigned as referring to the hydroxyl on C-15 or on C-6 or both. The absolute configuration of **1** was determined by single a crystal X-ray analysis (Figure 1). The two independent molecules of the asymmetric unit have the same absolute configuration.

Compounds **2-8**²⁻³ were also isolated from the dichloromethane extract of the stems and identified by 2D NMR experiments. In particular, some assignments of the carbon signals for compounds **3** and **5** have been revised.

Table 2. Long-Range NMR connectivities of compound **1**

Irradiated proton	H-C*		C-H+	
	Connected carbons	Carbon	Connected protons	
H-1	C2, C15, Me-16	C-1	Me-16	
H-4	C3, C15, C6, C5	C-2	Me-16	
H-7	C6, Me-17	C-3	H-1	
H-9	Me-18	C-4	H-5	
H-11	C-10	C-5	Me-17	
H-12	C-11, Me-20	C-6	H-5, Me-17	
H-13	C-11	C-7	H-5, Me-17	
Me-16	C-3, C1, C2	C-10	Me-18, Me-19	
Me-17	C6, C5	C-15	H-1, H-5	
Me-18	C9, Me-19	Me-17	H-7	
Me-19	C9, C10	Me-18	Me-19	
Me-20	C-14, C-13, C-12			

* Selective INEPT experiments; + Long-Range HETCOR.

Table 3. NOE connectivities of compound **1**

Irradiations	Connectivities
7.34 (H-1)	3.99 (H-13), 1.62 (Me-16)
1.53 (Me-17)	2.62 (H-5 _a), 1.23 (H-8 _b)
0.91 (Me-19)	2.51 (H-12 _a)
1.03 (Me-18)	0.34 (H-9), 0.79 (H-11)
1.39 (Me-20)	0.79 (H-11), 0.34 (H-9)
0.79 (H-11)	1.39 (Me-20), 0.34 (H-9)
0.34 (H-9)	1.39 (Me-20), 1.03 (Me-18), 0.79 (H-11)

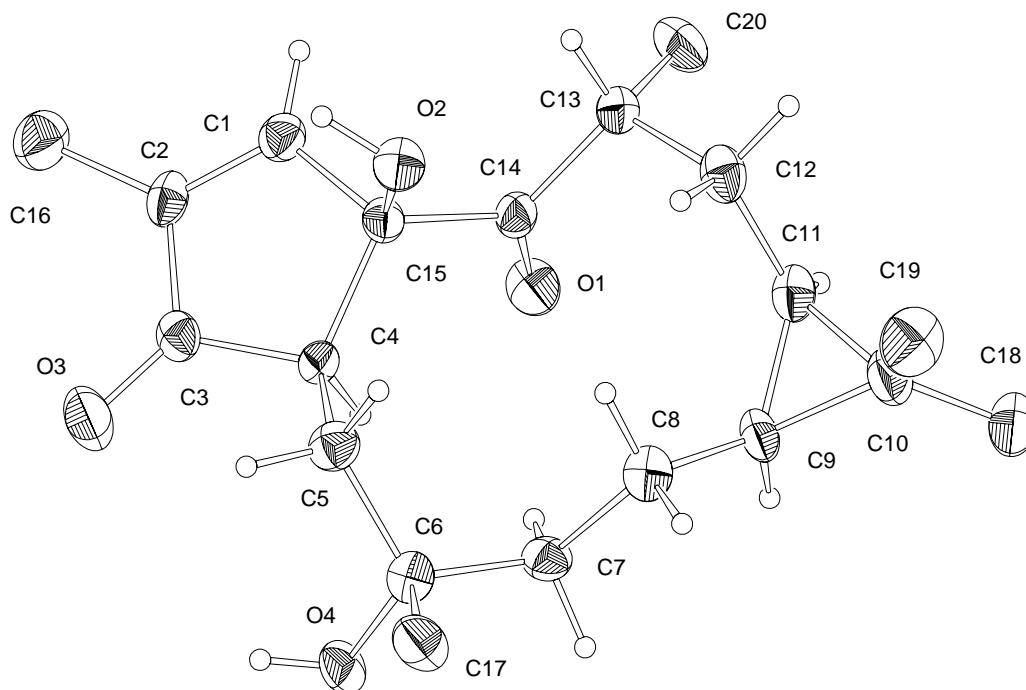


Figure 1. ZORTEP⁶ drawing of molecule of jatrowediol (**1**). The methyl H-atoms were omitted for clarity. Displacement ellipsoids are shown at the 30% probability level.

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Supplementary Material

Crystallographic data (excluding structure factors) for the structures in this paper have been deposited with the Cambridge Crystallographic Data Centre as supplementary publication no CCDC 15883. Copies of the data can be obtained, free of charge, on application to CCDC, 12 Union Road, Cambridge CB2 1EZ, UK, (fax: +44 1223 336033 or e-mail: deposit@ccdc.cam.ac.uk).

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