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New Macrocyclic Diterpenoids from *Jatropha multifida*[1)]

Biswanath DAS,*[,a] Bommena RAVIKANTH,[a] Keetha LAXMINARAYANA,[a] Bethapudi RAMARAO,[a] and
Tuniki Venugopal RAJU[b]

[a] *Organic Chemistry Division–I, Indian Institute of Chemical Technology; and* [b] *NMR Division, Indian Institute of Chemical Technology; Hyderabad–500 007, India.*
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Chemical investigation on the stems of *Jatropha multifida* resulted in the isolation of two new macrocyclic diterpenoids whose structures were established by extensive studies of their 1D and 2D-NMR spectra. The occurrence of ten other known compounds in this species is reported here for the first time.

Key words *Jatropha multifida*; Euphorbiaceae; stem; macrocyclic diterpenoid; structure elucidation

Jatropha multifida LINN (Euphorbiaceae), a shrub, is found in different parts of India. The plant is known to exhibit antibiotic activity.[2)] Earlier examination of the latex of the plant afforded some cyclic peptides, phenolics and glucosides.[3—5)] However, the investigation on other parts of the plant has not yet been reported.

In continuation of our work[6—9)] on the constituents of *Jatropha* species we examined the stems of *Jatropha multifida* and isolated two new macrocyclic diterpenoids, **1** and **2** along with ten known compounds. Here, we describe the isolation of these constituents and structure elucidation of the unknown compounds.

Compound **1** was isolated as a semi solid. Its molecular formula was deduced to be $C_{22}H_{30}O_5$ from its mass spectrum, elemental analysis and ^{13}C-NMR spectrum. The IR spectrum of the compound indicated the presence of carbonyl group and unsaturation. The ^{1}H- and ^{13}C-NMR spectral data of **1** (Table 1) clearly suggested that its structure is related to that of japodagrone (**3**)[10)] (a known constituent of *Jatropha* species) which has also presently been isolated from the investigated plant. All of the signals for the protons and carbons in the ^{1}H- and ^{13}C-NMR spectra respectively, were assigned from 2D NMR (^{1}H–^{1}H correlation spectroscopy (COSY), nuclear Overhauser effect spectroscopy (NOESY), heteronuclear single quantum coherence (HSQC) and heteronuclear multiple bonding connectivity (HMBC)) and dis-

Table 1. NMR Spectral Data of Compounds **1** and **2**[a,b)]

Position	Compound **1**			Compound **2**		
	^{1}H-NMR	Multiplicity (J in Hz)	^{13}C-NMR	^{1}H-NMR	Multiplicity (J in Hz)	^{13}C-NMR
1	7.30	s	150.3	7.01	s	153.3
2	—	—	144.7	—	—	143.0
3	—	—	195.2	—	—	208.2
4	—	—	132.5	4.31	d	50.4
5	6.81	s	139.7	5.02	d	114.7
6	—	—	81.6	—	—	150.0
7	(a) 1.89	m	37.6	(a) 1.93	m	33.1
	(b) 1.86	m	37.6	(b) 1.91	m	33.1
8	(a) 1.82	m	25.5	(a) 1.88	m	22.1
	(b) 1.65	m		(b) 0.54	m	
9	3.73	t (6.5)	88.1	0.36	m	26.8
10	—	—	35.7	—	—	15.8
11	(a) 1.30	m	34.4	0.65	m	19.1
	(b) 0.41	m			m	
12	(a) 2.26	m	30.9	(a) 1.86	m	27.8
	(b) 1.32	m		(b) 1.76	m	
13	2.78	m	43.5	3.61	m	39.6
14	—	—	204.6	—	—	213.1
15	—	—	88.9	—	—	84.7
16	1.93	s	10.7	1.80	s	10.2
17	1.27	s	24.0	1.82	s	22.6
18	0.91	s	28.2	0.99	s	28.7
19	0.73	s	23.4	0.78	s	14.8
20	0.97	d (7.0)	20.6	1.22	d (7.0)	15.9
–OH	—	—	—	2.54	br s	—
–OAc	2.09	s	169.3	—	—	—
			22.1			

a) The spectra were run in $CDCl_3$ at 500 MHz (^{1}H-NMR), 100 MHz (^{13}C-NMR). *b*) The signals were assigned with the help of 2D-NMR (^{1}H–^{1}H COSY, HMBC and NOESY) and DEPT experiments.

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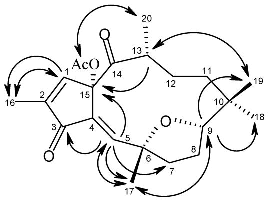
* To whom correspondence should be addressed. e-mail: biswanathdas@yahoo.com

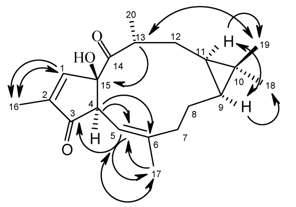
tortionless enhancement by polarization transfer (DEPT) experiments. These spectral data clearly revealed that the new compound **1** is the acetyl derivative of **3** which contains a hydroxyl group at C-15. The acetoxy group in **1** was properly placed at C-15 as in the ^{13}C-NMR spectrum this carbon (δ 88.9) showed a downfield shift compared to the position of the corresponding carbon (δ 82.4)[10] of **3**. In the ^{1}H-NMR spectrum H-1 also showed a downfield shift (δ 7.30 in **1** while δ 6.80 in **3**)[10] due to the deshielding effect of the –OAc group at C-15. Additionally, in the HMBC experiment (Fig. 1) C-15 showed correlations with H-5 (δ 6.81) and H-13 (δ 2.78). The NOESY experiment suggested that both compounds **1** and **3** possess a similar relative stereochemistry.[10] The –OAc group at C-15 showed correlation with Me-20 (Fig. 1). The structure of **1** was thus clearly settled as 15-*O*-acetyl japodagrone.

Compound **2** was obtained as a white solid. Its molecular formula was assigned as $C_{20}H_{28}O_3$ from its mass spectrum, elemental analysis and ^{13}C-NMR spectrum. The IR spectrum of the compound showed the presence of hydroxyl and carbonyl groups and unsaturation. The ^{1}H-NMR spectral data (Table 1) revealed the presence of a cyclopropane moiety, two olefinic protons, a hydroxyl and five methyl groups. On the other hand, the ^{13}C-NMR spectral data (Table 1) showed the presence of two tri-substituted double bonds, two carbonyl groups, five methyls, three methylenes, four methines and two quaternary carbons. A comparision of these ^{1}H- and ^{13}C-NMR spectral data of **2** with those of the known constituents of *Jatropha* species suggested that the structure of the new compound is related to that of (4*E*)-jatrogrossidentadione (**4**).[11] However, the double bond in the macrocyclic ring has been shifted to C-5, C-6 position in **2**. This was evident from the 2D-NMR experiments. The ^{1}H–^{1}H COSY experiment showed that H-4 (δ 4.31) was correlated to H-5 (δ 5.02) while HMBC experiment demonstrated that H-4 was related to C-1 (δ 153.3), C-6 (δ 150.0) and C-14 (δ 213.1), H-5 to C-3 (δ 208.2), C-15 (δ 84.7) and C-17 (δ 22.6) and Me-17 (δ 1.82) to C-5 (δ 114.7) and C-7 (δ 33.1). The configuration of the double bond at C-5, C-6 was deduced to be (*Z*) from NOESY experiment which showed a clear correlation between H-5 and Me-17. This experiment also indicated the similar stereochemistry of **2** at C-9, C-11 and C-13 as possessed by **4**. H-11 (δ 0.65) was found to correlate with H-9 (δ 0.36), Me-18 (δ 0.99) and Me-20 (δ 1.22) suggesting that these are all α-oriented. H-9 showed correlation with one of the protons (δ 1.93) at C-7 which again showed correlation with H-4. Similarly, Me-19 (δ 0.78) showed correlation with one of the protons (δ 1.76) at C-12 which in turn showed correlation with the hydroxyl group (δ 2.54) at C-15. The NOESY results have also been shown in a conformational structure (**2a**) which has been established by following the X-ray crystallographic structure of a related molecule.[12] H-4 and OH-15 was thus suggested to be α- and β-oriented respectively. Consequently the stereochemistry of the cyclopentenone ring junction with the macrocycle is derived to be *trans*. Thus the structure of the second new diterpenoid was deduced clearly as **2**.

Along with new compounds **1** and **2** ten other constituents, tetradecyl-(*E*)-ferulate,[13] jatropholone-A,[14] jatropholone-B,[14] jatrophenone,[6] 4-butyl-2-chloro-5-formyl-1*H*-imidazole,[9] 15-epi-(4*E*)-jatrogrossidentadione,[11] (4*E*)-jatrogrossidentadione,[11] 3β-acetoxy-12-methoxy-13-methyl-podocarpa-8,11,13-trien-7-one,[8] 3β,12-dihydroxy-13-methyl-podocarpane-8,10,13-triene[8] and japodagrone[10] were also isolated. The structures of the known compounds were established by comparision of their physical and spectral properties with those reported in the literature. The occurrence of these known compounds in the investigated plant is reported here for the first time.



1



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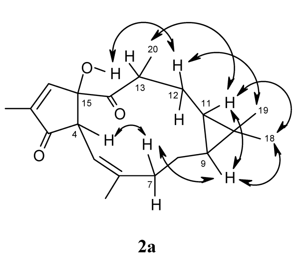
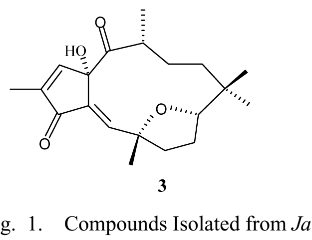


2a

Selected **HMBC** (↷) and **NOESY** correlations (↔)



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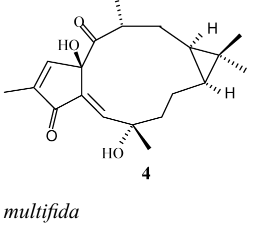

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Fig. 1. Compounds Isolated from *Jatropha multifida*

Experimental

General Melting points were measured in a Buchi-510 instrument and are uncorrected. The spectra were recorded with the following instruments; IR, Perkin Elmer RX1 FT-IR spectrophotometer; NMR, Varian Gemini 200 MHz, Brucker 300 MHz, Unity 400 MHz, Inova 500 MHz and Avance 600 MHz; EI-MS: Micromass VG 7070 H (70 eV), LSI-MS: Micromass Quattro LC, ESI-MS: LC-MSD-Trap-SL and HRMS: Applied Biosystems QSTAR XL instruments. The optical rotations were measured on a Jasco DIP-360 polarimeter, Column chromatography was performed over silica gel (BDH, 100—200 mesh) and TLC with silica gel GF_{254}.

Plant Material The stems of *Jatropha multifida* were collected from the botanical garden, Osmania University campus, Hyderabad in June 2006. A voucher specimen (No. 56109) is preserved in IICT herberium.

Extraction and Isolation The shade dried plant material (6 kg) was powdered and extracted three times (72 h in each case) with $CHCl_3$–MeOH (1 : 1, 4 l) at room temperature. The total extract was concentrated to afford a thick brown mass (120.4 g). The residue (120 g) was subjected to column chromatography and the column was eluted with solvents of increasing polarity using hexane and EtOAc, separation of the components in the mixture being monitored by TLC.

The fractions eluted with hexane–EtOAc (8 : 2) contained a compound which was purified by rechromatography to yield tetradecyl-(*E*)-ferulate (1.32 g). From the fractions eluted with hexane–EtOAC (7 : 3) a mixture of three compounds were obtained and these were purified by rechromatography to afford jatropholone-A (1.85 g), jatropholone-B (1.17 g) and jatrophenone (1.08 g). The fractions eluted with hexane–EtOAc (6 : 4) were the mixture of three compounds, which on rechromatography furnished 4-butyl-2-chloro-5-formyl-1*H*-imidazole (180 mg), 15-epi-(4*E*)-jatrogrossidentadione

(152 mg) and (4*E*)-jatrogrossidentadione (82 mg). Purification of the fractions with hexane–EtOAC (1 : 1) yielded 3β-acetoxy-12-methoxy-13-methyl-podacarpane-8,11,13-trien-7-one (83 mg), 3β,12-dihydroxy-13-methyl-podocarpane-8,10,13-triene (51 mg) and japodagrone (29 mg) while the purification of the fractions eluted with hexane–EtOAc (4 : 6) afforded compound **1** (10 mg) and compound **2** (4 mg).

Compound **1**: Semi solid, $[\alpha]_D^{25}$ -370.6 (c=0.001, $CHCl_3$); IR (KBr) ν_{max}: 1748, 1712, 1629, 1460, 1224 cm^{-1}; ^{1}H- and ^{13}C-NMR: Table 1; ESI-MS *m*/*z*: 397 $[M+Na]^+$ HR-MS *m*/*z*: 397.1988 (Calcd for $C_{22}H_{30}O_5Na$: *m*/*z* 397.1990) (Found: C, 70.09; H, 8.02. $C_{22}H_{30}O_5$ required: C, 70.59; H, 8.02%).

Compound **2**: White solid, mp 143—145 °C, $[\alpha]_D^{25}$ $+271.1$ (c=0.001, $CHCl_3$); IR (KBr) ν_{max}: 3436, 1722, 1642, 1461, 1216 cm^{-1}; ^{1}H- and ^{13}C-NMR: Table 1; ESI-MS *m*/*z*: 317 $[M+H]^+$. HR-MS *m*/*z*: 339.1950 (Calcd for $C_{20}H_{28}O_3Na$: *m*/*z* 339.1936) (Found: C, 75.48; H, 8.78. $C_{20}H_{28}O_3$ required: C, 75.95; H, 8.86%).

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References and Notes

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