Tetrahedron Letters 49 (2008) 6289–6292

Contents lists available at ScienceDirect

Tetrahedron Letters

journal homepage: www.elsevier.com/locate/tetlet

New quinolizidine and diaza-adamantane alkaloids from *Acosmium dasycarpum* (Vog.) Yakovlev—Fabaceae

Tânia Cecília Trevisan [a], Eliane A. Silva [a], Evandro Luiz Dall'Oglio [a], Luiz Everson da Silva [a], Eudes da Silva Velozo [b], Paulo Cezar Vieira [c], Paulo Teixeira de Sousa Jr. [a,*]

[a] Department of Chemistry, Universidade Federal de Mato Grosso, Cuiabá 78060-900, MT, Brazil
[b] Department of Pharmacy, Universidade Federal da Bahia, BA, Brazil
[c] Department of Chemistry, Universidade Federal de São Carlos, SP, Brazil

ARTICLE INFO

Article history:
Received 6 February 2007
Revised 27 June 2008
Accepted 30 June 2008
Available online 4 July 2008

Keywords:
Acosmium dasycarpum
Quinolizidine alkaloids
Diaza-adamantane Alkaloids

ABSTRACT

The phytochemical investigation of the methanol crude extract obtained from *Acosmium dasycarpum* (Vog.) Yakovlev root bark led to the isolation of the quinolizidine alkaloids lupanine, acosmine, acosminine and lupanacosmine, as well as the diaza-adamantane alkaloids panacosmine and dasycarpumine. Lupanacosmine (**4**) and dasycarpumine (**6**) have been described for the first time herein.

Acosmium dasycarpum (Vog.)Yakovlev,[1–3] occurs predominantly at the Brazilian savannahs (the 'Cerrados'),[3,4] being locally known as perobinha, chapada, pau paratudo, or unha d'anta.[4–6] The tea prepared from the root bark of this species has been described in the first edition of the Brazilian Pharmacopoeia as a sedative. In folk medicine, the stem and root tea preparation have been used to treat inflammation, skin diseases, and disturbances from central nervous and cardio-vascular systems.[7–10] Quinolizidine alkaloids (QAs) are secondary compounds found in seeds of many species of plants, possibly protecting them against pathogens and seed predators. Structural, spectroscopic and computational studies on both natural and synthetic quinolizidines are also reported regularly and have shown to be an important class of alkaloid with biological significance.[11] Studies on the biological activity of compounds containing azabicyclic building blocks (e.g., rigid bicyclic peptidomimetics) are gaining momentum because this class is attractive as nematicidal and has shown to be especially active at the muscarinic receptor, enhancing insulin secretion and also presenting diuretic properties.[12] On the other hand, diaza-adamantane skeleton was firstly encountered in a natural product, isolated from the seeds of *Acosmium panamense*.[1] This class of compounds is uncommon, but due to the high pharmacological activities it has recently drawn great attention in folk medicine research.[13]

Aiming the isolation and identification of bioactive substances, we have isolated several alkaloids during the conventional chromatographic fractioning of the methanol crude extract from the root bark of *A. dasycarpum*. The alkaloids lupanine **1**, acosmine **2**, acosminine **3**, and panacosmine **5** have been previously reported in *Acosmium*.[1,14] However, the alkaloids lupanacosmine **4** and dasycarpumine **6** have been described for the first time herein. *Acosmium dasycarpum* aerial roots were collected at Chapada dos Guimarães, state of Mato Grosso, Brazil and identified by Dr. M. Macedo (Universidade Federal de Mato Grosso—UFMT). Voucher specimens numbered 24079 (01/02/2000) were deposited at UFMT Central Herbarium. The dried root barks (3.3 kg) were sequentially extracted with hexane (3 L) and methanol (5 L). A portion (55.0 g) of the crude methanol extract (EBMeOH) dissolved in methanol (200 mL) was acidified with 10% acetic acid (pH 2.5–3.0), extracted with $CHCl_3$ (3 × 50 mL) and alkalinized with NH_4OH (pH 8.9–9.0), affording the alkaloids fraction FA-I (5.5 g; 9.98%). FA-I was submitted to column chromatography, affording compound **6** (11.5 mg; 0.02%). Compound **1** (3.3 mg; 0.006%) was obtained after HPLC purification.[15] Another EBMeOH portion (150.0 g) was acidified with 5% HCl (pH 2.5–3.0), extracted with ethyl ether (4 × 50 mL) and alkalinized with 28% NH_4OH (pH 8.5–9.0), affording the alkaloids fraction FA-II (3.8 g; 2.53%). Preparative thin-layer chromatography carried out on FA-II led to the isolation of **2** (15.3 mg; 0.01%),[1] **3** (21.2 mg; 0.14%),[1] **4** (56.4 mg; 0.04%),[16] and **5** (8.1 mg; 0.01%).[1,17] Compound **1** has shown, in its IR spectrum, typical amide absorption at 1620 cm^{-1}. This absorption is coherent with the ^{13}C NMR signal at δ 172.0. These and the other spectral

* Corresponding author. Tel.: +55 65 3615 8767; fax: +55 65 3615 8798.
E-mail address: teixeira@ufmt.br (P. T. de Sousa).

0040-4039/$ - see front matter © 2008 Published by Elsevier Ltd.
doi:10.1016/j.tetlet.2008.06.124

data obtained for compound **1** were fully consistent with the literature description for the quinolizidine alkaloid lupanine.[12,14,18] Mass spectra for compound **2** has shown an odd molecular ion [M^+] at 357, pointing out to the presence of an odd number of nitrogen atoms in its structure. The DEPT experiment has presented a methinic signal at δ 70.9. Therefore in comparison with compound **1**, compound **2** must have a substituent at C-10. The absence of an amide carbonyl group at C-2, as well as the evidences for the presence of the substituent at C-10, could be demonstrated from the HMBC data, correlating H-10 (δ 2.36) to C-2 (δ 52.9) C-8 (δ 27.9), C-9 (δ 37.3), C-11 (δ 60.8), C-18 (δ 117.4), C-19 (δ 24.7), and C-23 (δ 123.0) (Fig. 1A; Table 2). In the same experiment, the correlation of H-23 (δ 6.67/7.27) to C-10 (δ 70.9), C-19 (δ 24.7) and C-21 (δ 40.4) (Fig. 1B; Table 2) and the correlation of H-25 (δ 2.20/2.15) to C-23 (δ 123.0/122.0) and C-24 (δ 168.0) (Table 2) has also been observed. The coupling of H-23 (δ 6.67/ 2.15) to C-23 (δ 123.0/122.0) has been shown by the COSY and HSQC experiments. HMBC experiments has shown that the methylic H-25 (δ 2.20/7.27) correlates to C-24 (δ 168.0) and C-23 (δ 123.0/122.0), confirming the presence of an acetylamide portion at the substituent (Fig. 1B). Restricted rotation around C–N bond at the acetylamide moiety has caused the doubling of ^{13}C NMR signals at C-23 and C-25 (Table 2). The same has been observed in ^{1}H NMR spectra, at positions H-23 and H-25, as previously observed in the literature.[1,14] The stereochemistry of the substituent at C-10 in compound **2** has been demonstrated to be equatorial, as it could be seen by the coupling of H-8_{ax} with H-10_{ax} in the COSY experiment (Table 2). These data are fully supportive of structure **2**, previously reported by the literature.[14] However, literature ^{13}C NMR spectral data have shown the following attribution to C-6 (δ 57.9), C-7 (δ 37.1), C-9 (δ 44.8), C-11 (δ 67.6), C-19 (δ 33.3), and C-20 (δ 25.7).[14] These data are not consistent with the ones we have

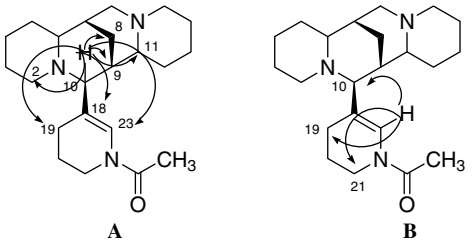


Figure 1. Main ^{1}H–^{13}C long-range correlation signal in the HMBC spectrum of **2**.

Table 1
^{13}C NMR spectral data of compounds **1**–**4**

C	1	2	3	4
2	172.0	52.9	53.2	54.6
3	33.1	26.1	26.0	26.2
4	19.5	25.1	24.9	25.6
5	27.5	30.1	30.0	30.3
6	60.8	67.5	67.3	67.0
7	31.7	33.0	36.8	33.6
8	26.4	27.9	27.8	27.8
9	34.3	37.3	33.1	34.3
10	46.5	70.9	70.7	70.7
11	64.6	60.8	57.8	59.3
12	32.1	34.3	42.9	31.7/30.7
13	23.8	25.1	68.6	136.1
14	24.1	25.7	34.2	116.3
15	55.6	56.0	52.2	42.4/42.3
17	52.1	53.3	52.8	50.9
18		117.4	117.5	118.0
19		24.7	25.5/34.2	25.4
20		21.6	21.5/22.2	21.6/22.2
21		40.4	40.2/44.5	40.4
23		123.0/122.0	122.8/123.5	123.4/121.8
24		168.0	167.9	168.2/167.5
25		21.6/22.6	21.2/22.2	22.0/23.0

Table 2
^{1}H and ^{13}C NMR attributions and nuclear correlations of **2**

H Position	δ_H	COSY	HMBC	δ_C
H_2a	1.48	n.o	n.o.	
H_2b	3.33	n.o.	C_2, C_{10}	52.9
H_3ax, equiv	1.56	H_2	n.o.	26.1
H_4ax	1.74	H_5 ax,equiv	n.o	
$H_{4'}$equiv	1.60	n.o.	n.o.	25.1
H_5ax	1.31	H_4ax	n.o.	
$H_{5'}$equiv	1.31	H_4ax,equiv, H6ax	C_4	30.1
$H_{6'}$	1.95	H_4ax, H_7, H_{17}ax	n.o.	67.5
$H_{7'}$	1.95	H_6, H_9, H_{17}	C_{17}	33.0
H_{8ax}	2.24	H_8 , H_9, H_{10ax}	n.o.	
H_{8equiv}	1.15	H_8	C_{11}	27.9
H_9	1.53	H_8, H_{10}, H_7	C_7	37.3
H_{10}ax	2.36	H_9, H_{11}	C_2, C_8, C_9, C_{11}, C_{18}, C_{19}, C_{23}	70.9
$H_{11'}$	1.97	H_9, H_{10}, H_{15}ax, H_{17}ax	C_{17}	60.8
H_{12}ax	1.12	H_{11}, H_{12}ax, H_{13}ax	C_{13}, C_{11}	
$H_{12'}$equiv	1.41	H_{11}, H_{12}ax, H_{13}ax	n.o	34.3
H_{13}ax	1.60	H_{13}equiv	n.o.	
H_{13}equiv		n.o.	n.o.	25.1
H_{14}ax,equiv	1.89	H_{15}	n.o	
		n.o.	n.o	25.7
H_{15}ax,equiv	2.94	H_{14}	n.o.	56.0
		n.o.		
H_{17}ax	2.83	H_6, H_{11}, H_{17}equiv	C_{11}	53.3
H_{17}equiv	2.36	H_{17}ax	n.o.	
C_{18}	n.a.	n.a.	n.a.	117.4
H_{19}a	1.75	H_{20}b, H_{19}b	n.o.	24.7
H_{19}b	1.24	H_{19}a	n.o.	
H_{20}a	1.75	H_{21}b	n.o.	
H_{20}b		H_{21}a	n.o.	21.6
H_{21}a	3.77	H_{20}b	n.o.	40.4
H_{21}b	3.53	H_{20}a	n.o.	
$H_{23'}$	6.67/7.27	—	C_{10}, C_{19}, C_{21}	123.0/122.0
C_{24}	n.a.	n.a.	n.a.	168.0
$H_{25'}$	2.20/2.15	—	C_{23}, C_{24}	21.6/22.6

a;b: Stereochemistry not observed.; n.o.: not observed.; n.a.: not apply.

Table 3
Homo (^{1}H–^{1}H) and heteronuclear (^{1}H–^{13}C) correlations of **4**

H	δ_H	COSY/HSQC	HMBC	C
H_2	H_{2x} = 1.59	H_{2y}, H_6	n.o	54.6
	H_{2y} = 3.32	H_{2x}	J^3 C_4, J^3 C_6	
H_3	1.53	n.o.	n.o.	26.2
H_4	1.79	H_{5ax}	J^2 C_5, J^3 C_2, J^3 C_6	25.6
H_5	H_{5ax} = 1.37	H_4	J^3 C_3	30.3
	H_{5equiv} = 1.60	H_6	n.o.	
H_6	2.04	H_2	J^5 C_{15}, J^3 C_{17}	67.0
H_7	1.83	H_{17}, H_{8x}, H_{8y}	n.o.	33.6
H_8	H_{8x} = 1.33	H_{8y}, H_7	J^3 C_6, J^3 C_{10}, J^3 C_{11}, J^3 C_{17}	27.8
	H_{8y} = 1.97	H_{8x},H_9, H_7	J^3 C_6, J^3 C_{10}	
H_9	1.66	H_{8x}, H_{8y}, H_{10}, H_{11}	n.o.	34.3
H_{10}	2.57	H_9	J^2 C_{18}, J^3 C_{23}, J^3 C_{11}	70.7
H_{11}	2.59	H_{12}, H_9	n.o.	59.3
H_{12}	2.16	H_{11}, H_{12}, H_{13}	J^3 C_9, J^2 C_{11}, J^2 C_{13}, J^3 C_{14}	31.7/30.7
H_{13}	5.56	H_{14}, H_{12}	n.o.	136.1
$H_{14a,b}$	5.02	$H_{14x,y}$, H_{13}	J^3 C_{12}	116.3
H_{15}	2.24	n.o.	J^3 C_{11}, J^3 C_{17}	42.4/42.3
$H_{17a,b}$	2.65	$H_{17x,y}$	n.o.	50.9
C_{18}	n.a.	n.a.	n.a.	118.0
H_{19}	1.85	n.o.	n.o.	25.4
H_{20}	1.79	H_{20}	n.o.	21.5
H_{21}	H_{21x}= 3.55	H_{21y}, H_{20}	n.o.	40.4
	H_{21y} = 3.59	H_{21x}	n.o.	
H_{23}	6.89/7.24	n.o.	J^3 C_{10}, J^3 C_{21}, J^4 C_{19}	123.4/121.8
C=O	n.a.	n.a.	n.a.	168.2/167.5
H_{25}	2.18	H_{11}	J^2 C_{24}, J^4 C_{23}	22.0/23.0

x and *y*: Stereochemistry not defined.; n.a.: not apply; n.o.: not observed.

observed, namely at C-6 (δ 67.5), C-7 (δ 33.0), C-9 (δ 37.3), C-11 (δ 60.8), C-19 (δ 24.7), and C-20 (δ 21.6). Our attribution can be considered more reliable, however, since it was based in 2-D experiments, not available at the time of the previous literature report. The spectral data for compound **3** were similar to those observed for **2**, except for ring **D**. Mass spectrum for compound **3** has shown a molecular ion at *m/z* 373, sixteen units higher than compound **2**, suggesting the presence of a hydroxyl group. Further evidence for the presence of this group was observed by the IR absorption at 3393 cm^{-1}, by DEPT experiment showing a carbinolic signal at δ 68.6 and by the shifting of C-12 and C-14 ^{13}C NMR signal from δ 34.3 to δ 42.9 and from δ 25.7 to δ 34.2, respectively (Table 1). The γ-gauche effect observed by analyzing C-11 and C-15 ^{13}C NMR signals of compound **3**, when compared to the equivalent signals in **2** (Table 1), has shown that the hydroxyl group is in an axial position. These data were consistent with the literature structure for the alkaloid acosminine.[14] Typically, quinolizidine alkaloids ^1H NMR spectra show poorly resolved signals at the region δ 3.75–1.25. The presence of two methyl groups, attached to electronegative atoms, at δ 2.24 and δ 2.18, however, could be observed in ^1H NMR spectra from **4**, differing from compound **3** by presenting an extra methyl group. Olefinic hydrogens were evidenced by the multiplet centered at δ 5.57 and the double duplet at δ 5.02 at ^1H NMR spectra.[1] The respective olefinic carbons could be observed in ^{13}C NMR spectra at δ 136.1 and δ 116.3, relating to trisubstituted (=CH–) and bi-substituted ($=CH_2$) carbons, respectively, according to the DEPT spectra. The analysis of the HMBC spectra analysis has shown that the methyl hydrogen H-15 (δ 2.24) correlated to C-11 (δ 59.3) and C-17 (δ 50.9), showing that this methyl group is bonded to the nitrogen atom at ring C in compound **4**. H-12 (δ 2.16) methylenic hydrogen correlating to C-9 (δ 34.3) and C-11 (δ 59.3) as well as the allylic group C-13 (δ 136.1) and C-14 (δ 116.3) (Table 3) has also been observed. COSY spectrum has shown H-6 and H-2_x coupling with each other, as well as the coupling of H-2_x with H-2_y and H-6, suggesting a chair conformation to ring **A** in compound **4** (Fig. 2). The non-observation of H-10 coupling to H-8 indicates that the acetylamide group is in an equatorial position. This equatorial stereochemistry was further confirmed by the correlation of H-9 with axial H-10 and H-9 with H-8_x and H-8_y, with small *J* values, justifying the observed H-9 large singlet. The diaza-adamantane alkaloid **5**, namely panacosmine, has been previously described in the literature[1] and the spectral data (^{13}C and ^1H NMR, IR and high resolution MS) are fully consistent with the ones we have obtained.[17] The newly described compound **6** spectral data[19] were compared with the related

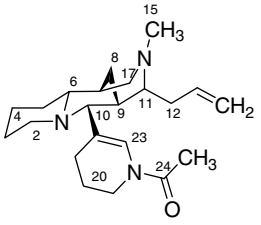
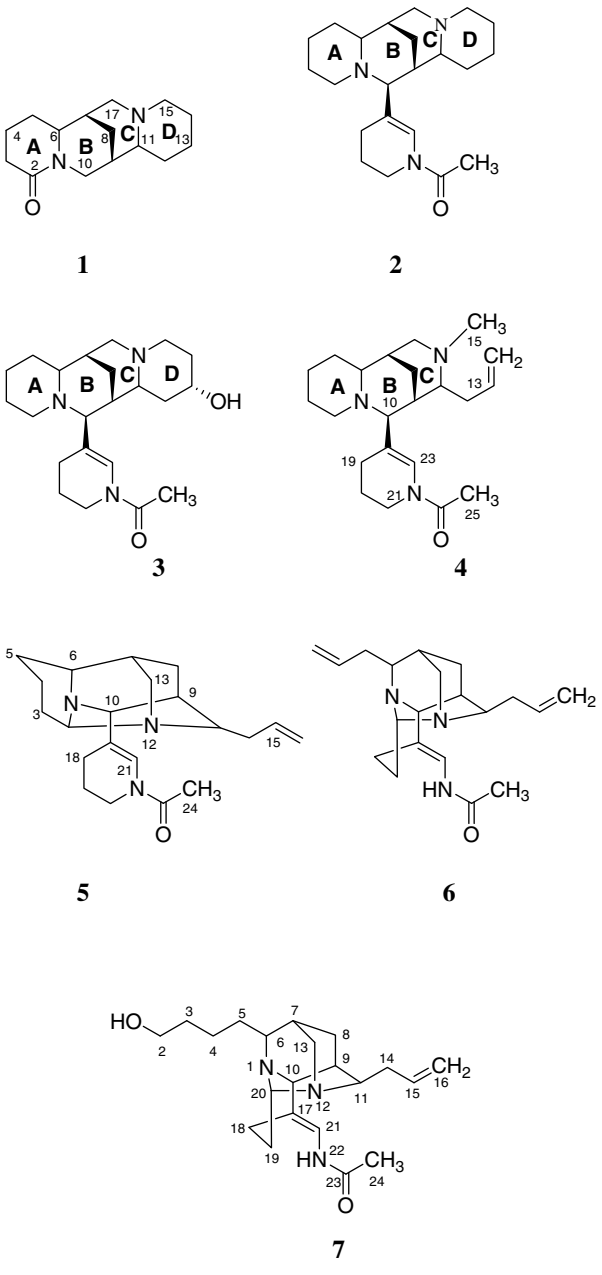


Figure 2. Chair conformation to ring **A** in compound **4**.

Table 4
Spectral data of compound **6**

Position	δ_H	HMBC	C
H_3	5.06	J^3 C_5	116.7
H_4	5.65 (1H, m)	J^2 C_5	134.6
H_5	2.54 (2H, m)	J^2 C_4, J^3 C_3, J^2 C_6, J^3 C_7	35.0
H_6	3.05 (1H, t, *J* = 7.40 Hz)	n.o.	64.6
H_7	1.51 (1H, s)	n.o.	24.9
H_8	2.37 (1H, dd, *J* = 7.13 Hz, 7.28 Hz)	J^2 C_9, J^3 C_{10}	31.0
H_8	1.90 (1H, d, *J* = 13.20 Hz)		
H_9	1.56 (1H, s)	n.o.	34.9
H_{10}	3.84	J^2 C_9, J^3 C_{11}, J^3 C_{18}	64.5
H_{11}	3.66	J^2 C_9, J^3 C_{13}	52.8
H_{13}	3.48 (*J* = 13.80 Hz)	J^3 C_{13}, J^3 C_6, J^3 C_{20}	45.9
H_{13}	3.36 (*J* = 13.80 Hz)		
H_{14}	2.54 (2H, m)	J^2 C_{11}, J^2 C_{15}, J^3 C_{16}	35.5
H_{15}	5.73 (1H, m)	J^2 C_{14}	135.5
H_{16}	5.08 (2H, m)	J^3 C_{14}	117.2
H_{17}	n.a.	n.a.	119.8
H_{18}	2.31 (1H, m)	J^2 C_{19}, J^3 C_{10}, J^2 C_{19}	19.7
	2.50 (1H, m)		
H_{19}	2.33	J^2C_{20}, J^2 C_{18}	26.0
	2.08		
H_{20}	4.78 (1H, d, *J* = 7.70 Hz)	J^3 C_{10}, J^3 C_{11}, J^3 C_{18}	68.8
H_{21}	6.68 (1H, d, *J* = 10.40 Hz)	J^3 C_{10}, J^3 C_{19}	117.5
H_{22}	7.35 (1H, d, *J* = 10.40 Hz)		
C=O	n.a.	n.a.	167.3
H_{24}	2.08 (3H, s)	J^2 C_{23}	23.4

n.o.: not observed; n.a.: not apply.



compound **7**.[1] Heteronuclear HMBC spectra have shown H-15 (δ 5.73) and H-16 (δ 5.08) coupling to C-14 (δ 35.5), as well as H-14 (δ 2.54) coupling to C-11 (δ 52.8), C-15 (δ 135.6), and C-16 (δ 117.2) (Table 4), demonstrating, therefore, that this allylic group is bonded to C-11, in accordance with compound **7** reported data.[1] Compound **6** ^{13}C and ^{1}H NMR spectra have shown, in addition, signals at δ 35.0, δ 134.6, δ 116.7 and a multiplet at δ 5.65, respectively, demonstrating the presence of a second allylic portion. HMBC correlations from H-3 (δ 5.06) to C-5 (δ 35.0), from H-4 (δ 5.65) to C-5 (δ 35.0) and from H-5 (δ 2.54) to C-4 (δ 134.6), C-3 (116.7), C-6 (δ 64.6) and C-7 (δ 24.9) (Table 4) placed this second allylic group at C-6.

Acknowledgement

We wish to thank FAPEMAT, CAPES, CNPq, and CPP for financial support.

Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.tetlet.2008.06.124.

References and notes

1. (a) Nuzillard, J. M.; Connolly, J. D.; Delaude, C.; Richard, B.; Zèches-Anrot, M.; Men-Olivier, L. *Tetrahedron* **1999**, *5*, 11511–11518; (b) Connolly, J. D. *Pure Appl. Chem.* **2001**, *73*, 567–571; (c) Michael, J. P. *Nat. Prod. Rep.* **2004**, *21*, 625–649.
2. Ricker, M.; Daly, D. C.; Veen, G.; Robbins, E. F.; Sinta, M.; Chota, J.; Czygan, F. C.; Kinghorn, A. D. *Brittonia* **1999**, *51*, 34–43.
3. Bridgewater, S. G. M.; Stirton, C. H. *Kew Bull.* **1997**, *52*, 471–475.
4. Lorenzi, H. *Árvores* brasileiras: manual de identificação e cultivo de plantas arbóreas do Brasil; Plantarum, 2nd ed; 1998.
5. Rodrigues, A. A. G. Ph.D Thesis. Instituto de Biociências da Universidade Estadual Paulista, Rio Claro, 1996.
6. Lewis, G. P. *Legumes of Bahia*. Royal Botanic Garden, Kew, 1987.
7. Silva, V. N. T.; Oliveira, F. M.; Conserva, L. M. *Biochem. Syst. Ecol.* **2001**, *29*, 1189–1192.
8. Vieira, R. A.; Lapa, A. J.; Lima, T. C. M. *Simpósio de Plantas Medicinais do Brasil, XVI*, Recife, 2000.
9. Afiatpour, P. Ph.D. Thesis, Escola Paulista de Medicina, 1990.
10. Rocha, R. F. M.Sc Dissertation, Escola Paulista de Medicina, 1984.
11. Daly, J. W.; Garraffo, H. M.; Spande, T. F. In *Alkaloids: Chemical and Biological Perspectives*; Pelletier, S. W., Ed.; Pergamon: New York, 1999; Vol. 13, pp 1–161.
12. (a) Michael, J. P. *Nat. Prod. Rep.* **2001**, *18*, 520–542; (b) Michael, J. P. In *The Alkaloids*; Cordell, G. A., Ed.; Academic Press: New York, 2001; Vol. 55, pp 91–258.
13. Spasov, A. A.; Khamidova, T. V.; Bugaeva, L. I.; Morozov, I. S. *Pharm. Chem. J.* **2000**, *34*, 3–9.
14. (a) Balandrin, M. F. Ph.D Thesis, University of Illinois, 1982; (b) Andrade-Ceto, A.; Wiedenfeld, H. *J. Ethnopharmacol.* **2004**, *90*, 217–220.
15. (a) HPLC analysis was done with the help of SHIMADZU-LC-8A-Preparative Liquid Chromatograph equipment, with preparative column (CS310-2G SHODEX ASAHIPAK), 5 mL/min flux, 15 kgf/cm^2 pressure, methanol as eluent and UV-280 nm detector. Column chromatography was performed on MERCK®silica gel 60 (63–230 μm; Art. 7734), CH_2Cl_2:NH_4OH 28% (500:1) as eluent system, increasing the polarity with methanol. Preparative thin-layer chromatography experiments were carried out using MERCK® silica $GF_{254\ nm}$ (Art. TA 260949-835) with hexane:diethylamine (9:1) as eluent system. UV light at 365 and 254 nm and Dragendorff reagent were used to visualize the chromatographic plates.
16. *Lupanacosmine* **4**: Brown oil, $[\alpha]_D^{25}$ +26 (MeOH; *c* 0.5). IR (NaCl film): ν = 2930, 2857, 1646 (C=O), 1498, 1259, 990, 752 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.33, 1.37, 1.53, 1.59, 1.60, 1.66, 1.79, 1.83, 1.85, 1.97, 2.04, 2.16, 2.18 (3H, s), 2.24, 2.57, 2.59, 2.65, 3.32, 3.55, 5.02, 5.56, 6.89, 7.24. ^{13}C NMR (100 MHz, $CDCl_3$): δ 21.6, 22.0, 22.2, 23.0, 25.4, 25.6, 26.2, 27.8, 30.3, 30.7, 31.7, 33.6, 34.3, 40.4, 42.3, 42.4, 50.9, 54.6, 59.3, 67.0, 70.7, 116.3, 118.0, 121.8, 123.4, 136.1, 167.5, 168.2. HREIMS: *m*/*z* (%): 357 (3) [M$^+$], 316 (100), 273 (2), 233 (15), 164 (9), 138 (24), 96 (19), 84 (12), 55 (8). $C_{22}H_{35}N_3O$: requires 357.277998, found 357.28105.
17. *Panacosmine* **5**: Brown oil, $[\alpha]_D^0$ +70 (MeOH; *c* 0.05). IR (NaCl film): ν = 2924, 1648 (C=O), 1559, 1541, 1507, 1124 cm^{-1}. ^{1}H NMR (200 MHz, $CDCl_3$): δ 2.14 (3H, s), 2.44 (1H, dt, *J* = 13.0 = Hz, 3.3 = Hz), 5.16 (1H, dd, *J* = 13.9 Hz; 8.9 Hz), 5.78 (1H, m), 6.56 (1H, s). ^{13}C NMR (50 MHz, $CDCl_3$): δ 17.6, 21.5, 21.4, 23.3, 25.2, 27.8, 28.2, 30.2, 32.6, 35.6, 40.1, 44.0, 58.3, 59.9, 67.8, 70.6, 116.8, 117.9, 121.7, 123.0, 134.7, 168.0 (C=O). HREIMS: *m*/*z* (%) = 341 (18) [M$^+$], 301 (24), 300 (100), 257 (10), 247 (14), 203 (4), 138 (6), 122 (8), 96 (7), 84 (8), 55 (10). $C_{21}H_{31}N_3O$: requires 341.246700, found 341.24325.
18. (a) Wysocka, W.; Kolanos, R.; Borowiak, T.; Korzanski, A. *Mol. Struct.* **1999**, *474*, 207–214; (b) Mohamed, M. H.; Hassanean, H. A. *Phytochemistry* **1997**, *46*, 365–369; (c) Golebiewski, W. M. *Magn. Reson. Chem.* **1986**, *24*, 105–112; (d) Hopper, D. J.; Rogozinski, J.; Toczko, M. *Biochem. J.* **1991**, *279*, 105–109; (e) Skrzypczak-Jankun, E.; Hoser, A.; Kaluski, Z.; Perkowska, A. *Acta Crystallogr., B* **1980**, *B36*, 1517–1520; (f) Maluszynska, H.; Hoser, A.; Kaluski, Z. *Acta Crystallogr., B* **1979**, *35 4*, 970–973.
19. *Dasycarpumine* **6**: Brown oil, $[\alpha]_D^{25}$ −7 ($CHCl_3$; *c* 0.08). IR (NaCl film): ν = 2933, 2956, 1640 (C=O), 1264 cm^{-1}. ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.51 (1H, s), 1.56 (1H, s), 1.90 (1H, d, *J* = 13.20 Hz), 2.08 (3H, s), 2.31 (1H, m), 2.33, 2.37 (1H, dd, *J* = 7.13 Hz, 7.28 Hz), 2.50 (1H, m), 2.54 (m), 3.05 (1H, t, *J* = 7.40 Hz), 3.36 (*J* = 13.80 Hz), 3.48 (*J* = 13.80 Hz), 3.66, 3.84, 4.78 (1H, d, *J* = 7.70 Hz), 5.06, 5.08 (2H, m), 5.65 (m), 5.73 (1H, m), 6.68 (1H, d, *J* = 10.40 Hz), 7.35 (1H, d, *J* = 10.40 Hz). ^{13}C NMR (50 MHz, $CDCl_3$): δ 19.7, 23.4, 24.9, 26.0, 31.0, 34.9, 35.0, 35.5, 45.9, 52.8, 64.5, 64.6, 68.8, 116.7, 117.2, 117.5, 119.8, 134.6, 135.5, 167.3. HREIMS: *m*/*z* (%) = 327 (16) [M$^+$], 287 (20), 286 (100), 247 (5), 196 (5), 151 (14), 109 (17), 97 (14), 96 (10), 84 (12), 83 (14), 69 (18), 57 (23), 55 (27). $C_{20}H_{29}N_3O$: requires 327.231050; found 327.23003.