Two New Isochondodendrine-Type Alkaloids from the Roots of *Anisocycla jollyana*

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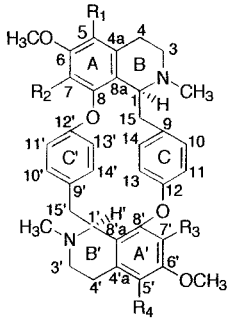
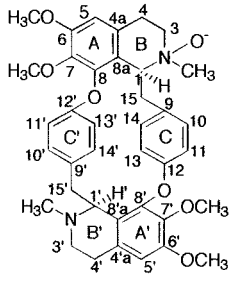
Two new isochondodendrine-type alkaloids jollyanine (**5**) and fastrine (**6**) have been isolated from the roots of *Anisocycla jollyana* together with nine known alkaloids, (−)-cycleanine (**1**), (−)-isochondodendrine (**2**), (−)-norcycleanine (**3**), (−)-cycleanine *N*-oxide (**4**), (+)-dehydro-1,2 apateline, (+)-*O*-methyl-12 cocsoline, (+)-homoaromaline, (+)-limacusine, and (+)-limacusine-2′-*β*-*N*-oxide. Their structures were elucidated by a combination of chemical and spectrometric methods including ^{1}H-NMR, ^{1}H-^{13}C COSY, ^{1}H-^{1}H COSY, HMQC, and HMBC experiments. Compounds **5** and **6** represent the first isochondodendrine-type alkaloids bearing an oxygen substituent at the 5-position.

Anisocycla species (menispermaceae) continue to be a rich source of unique alkaloids belonging to the protoberberine, aporphine, bisbenzylisoquinoline (oxyacanthine and berbamine types), phenanthrene, and seco-bisbenzylisoquinoline groups. These alkaloids were first studied in 1972 by Schlittler et al.[1] More recently, we have reported the isolation and the identification of more than 30 alkaloids from *Anisocycla cymosa*[2−4] and *A. jollyana*.[5,6]

Until now, isochondodendrine-type alkaloids have never been isolated from the genus *Anisocycla*. We describe herein the isolation and structure elucidation of two new isochondodendrine-type alkaloids, (−)-jollyanine (**5**) and (+)-fastrine (**6**), and of four known related derivatives, (−)-cycleanine (**1**), (−)-isochondodendrine (**2**), (−)-norcycleanine (**3**), and (−)-cycleanine *N*-oxide (**4**), as well as the identification of two isotrilobine-type alkaloids, (+)-dehydro-1,2-apateline, (+)-*O*-methyl-12-cocsoline, and of three dimers, (+)-homoaromaline, (+)-limacusine, and (+)-limacusine 2′-*β*-*N*-oxide.





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1 R_1 = H, R_2 = OMe, R_3 = OMe, R_4 = H
2 R_1 = H, R_2 = OH, R_3 = OH, R_4 = H
3 R_1 = H, R_2 = OMe, R_3 = OH, R_4 = H
5 R_1 = H, R_2 = OMe, R_3 = OMe, R_4 = OH
6 R_1 = OH, R_2 = OMe, R_3 = OMe, R_4 =OH

Results and Discussion

The MeOH extract of dry, powdered roots (300 g) of *A. jollyana* was fractionated as described in the Experimental Section, affording an alkaloidal fraction (3 g) that was further purified by chromatography on a Al_2O_3 column and by Si gel preparative TLC to give 11 alkaloids, **1** (10.0%), **2** (25.0%), **3** (1.0%), **4** (0.3%), **5** (3.0%), **6** (2.0%), as well as (+)-dehydro-1,2-apateline (0.3%), (+)-*O*-methyl-12-cocsoline (0.5%), (+)-homoaromaline (5.0%), (+)-limacusine (1.0%), and (+)-limacusine *N*-oxide (0.5%).

The four known isochondodendrine-type alkaloids, **1**, **2**, **3**, and **4**, were identified as (−)-cycleanine, (−)-isochondodendrine, (−)-norcycleanine, and (−)-cycleanine *N*-oxide, respectively, by their physical and spectral data (^{1}H NMR, MS), which were in good agreement with those already published.[7−10] However, the assignments of some protons and carbons previously reported[8−10] were revised and completed as shown in Tables 1 and 2 by using of HMQC, HMBC, and COSY experiments.

Compound **5** was isolated as an amorphous white powder. Its UV spectrum displayed two maxima at 212 nm and 278 nm, which were in agreement with those observed for bisbenzylisoquinoline alkaloids.[11] The IR spectrum shows absorption for a hindered hydroxyl group at 3420 cm^{-1}, which was related to a phenolic group, as further supported by the bathochromic shifts observed in the UV λ_{max} after alkalinization. The EIMS showed a molecular ion of medium intensity at *m*/*z* 638 (70%), which was consistent with $C_{38}H_{42}N_2O_7$, accompanied by two strong peaks at *m*/*z* 328 (72%) and 312 (100%) and six significant ions at *m*/*z* 220 (21%), 204 (51%), 190 (28%), 174 (35%), 159 (21%), and 145 (26%). These data were indicative for two head-to-tail ether-linked isoquinoline coclaurine units joined at C-8 and C-12′, and C-8′ and C-12, which characterize isochondodendrine-type alkaloids.[12,13] The presence of two base peaks at *m*/*z* 312 and 328 indicated that the alkaloid structure was asymmetric.[13,14] The ^{1}H-NMR data, presented in Tables 1 and 2, indicated that structure **5** (*m*/*z* 638, M^+) was closely related to that of (−)-cycleanine (**1**), another isochondodendrine-type alkaloid (*m*/*z* 622, M^+)[10] but with an additional hydroxyl. This hypothesis was also supported by the presence of a sole one-proton singlet at *δ* 6.58 in the ^{1}H-NMR

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Table 1. ^{1}H NMR (600 MHz) Chemical Shift Data (δ, ppm) for Compounds **1**−**3** and **5**−**6** (J values, in Hz, in parentheses)

	compound (δ_H)				
position	**1**[a]	**2**[b]	**3**[a]	**5**[a]	**6**[a]
H-1	4.30 d, $J = 10$	4.40 d, $J = 10$	4.25 t, $J = 10$	4.32 t, $J = 9.8$	4.35 d, $J = 10$
H-1′	4.30 d, $J = 10$	4.40 d, $J = 10$	4.25 t, $J = 10$	4.32 t, $J = 9.8$	4.35 d, $J = 10$
H-3	α 3.25 m, β 2.90[c]	α 3.25 m, β 2.97 m[c]	α 2.90 m, β 2.90 m[c]	α 2.90 m, β 3.25 m[c]	α 2.96 m, β 3.29 m[c]
H−3′	α′ 3.25 m, β′ 2.90[d]	α[1] 2.97 m, β′ 2.97 m[d]	α′ 2.90 m, β′ 2.90 m[d]	α′ 2.98 m, β′ 3.29 m[d]	α′ 2.96 m, β′ 3.29 m[d]
H-4	α 3.05 m, β 2.90[e]	α 3.00 m, β 2.97 m[e]	α 2.90 m, β 3.00 m[e]	α 2.90 m, β 3.05 m[e]	α 2.74 m, β 3.05 m[e]
H-4′	α′ 2.90 m, β′ 2.90[f]	α′ 2.97 m, β′ 2.97 m[f]	α′ 2.91 m, β′ 3.00 m[f]	α′ 2.74 m, β′ 3.10 m[f]	α′ 2.74 m, β′ 3.05 m[f]
H-5	6.58 s	6.60 s	6.60 s	6.58 s	
H-5′	6.58 s	6.60 s	6.48 s		
H-10	7.10 dd (8.60; 2.19)	7.10 dd (8.01; 2.19)	7.01 dd (8.56; 1.98)	7.05 dd (8.59; 2.20)	7.02 dd (8.59; 2.20)
H-10′	7.10 dd (8.60; 2.19)	7.10 dd (8.01; 2.19)	7.05 dd (8.56; 1.98)	7.06 dd (8.59; 2.20)	7.02 dd (8.59; 2.20)
H-11	6.60 dd (8.50; 2.73)	6.65 dd (8.62; 2.78)	6.62 dd (8.42; 2.65)	6.61 dd (8.48: 2.79)	6.58 dd (8.47; 2.80)
H-11′	6.60 dd (8.50; 2.73)	6.65 dd (8.62; 2.78)	6.62 dd (8.42; 2.65)	6.58 dd (8.47; 2.80)	6.58 dd (8.47; 2.80)
H-13	5.81 dd (8.32; 2.64)	5.82 dd (8.40; 2.78)	5.81 dd (8.34; 2.73)	5.85 dd (8.32; 2.80)	5.78 dd (8.35; 2.78)
H-13′	5.81 dd (8.32; 2.64)	5.82 dd (8.40; 2.78)	5.80 dd (8.31; 2.70)	5.77 dd (8.35; 2.79)	5.78 dd (8.35; 2.78)
H-14	6.27 dd (8.23; 2.22)	6.31 dd (7.90; 2.03)	6.25 dd (8.37)	6.30 dd (8.25; 2.25)	6.25 dd (8.24; 2.24)
H-14′	6.27 dd (8.23; 2.22)	6.31 dd (7.90; 2.03)	6.25 dd (8.37)	6.28 dd (8.24; 2.23)	6.25 dd (8.24; 2.24)
H-15	α 2.52 m, β 3.25 m[g]	α 2.48 m, β 3.25 m[g]	α 2.49 m, β 3.20 m[g]	α 2.52 m, β 3.21 m[g]	α 2.55 m, β 3.29 m[g]
H-15′	α′ 2.53 m, β′3.26 m[h]	α′ 2.50 m, β′ 3.22 m[h]	α′ 2.50 m, β′ 3.21 m[h]	α′ 2.52 m, β′ 3.25 m[h]	α′ 2.55 m, β′ 3.29 m[h]
6-OMe	3.82 s	3.87 s	3.81 s	3.82 s	3.88 s
6′-OMe	3.82 s	3.87 s	3.82 s	3.87 s	3.88 s
7-OMe	3.40 s		3.40 s	3.41 s	3.46 s
7′-OMe	3.40 s			3.46 s	3.46 s
N-Me	2.53 s	2.48 s	2.30 s	2.54 s	2.54 s
N′-Me	2.55 s	2.50 s	2.54 s	2.54 s	2.54 s

2.54 s[a] Spectra were recorded in $CDCl_3$. [b] Spectra were recorded in $CDCl_3$-CD_3OD (9:1). [c−h] Signals may be interchanged.

Table 2. ^{13}C-NMR (600 MHz) Chemical Shift (δ, ppm) Data for Compounds **1**−**3** and **5**−**6**

	compound (δ_C)				
carbon[a]	**1**	**2**	**3**	**5**	**6**
1 (1′)	60.17	59.65	59.94 (59.76)	60.14 (59.79)	59.81
3 (3′)	45.21	44.81	45.08 (44.78)	45.08 (44.37)	44.32
4 (4′)	25.22	24.46	24.75 (24.75)	25.04 (18.95)	18.88
4a (4′a)	130.98	124.53	130.93 (130.78)	130.78 (115.61)	115.64
5 (5′)	109.97	108.62	109.82 (108.39)	109.83 (136.90)	137.14
6 (6′)	152.63	148.68	152.60 (148.56)	152.49 (139.08)	139.20
7 (7′)	139.71	136.34	139.74 (136.75)	139.64 (142.99)	143.21
8 (8′)	144.38	139.25	144.62 (139.52)	144.28 (144.20)	144.35
8a (8′a)	125.89	124.53	125.72 (124.63)	125.52 (127.94)	128.07
9 (9′)	130.20	130.34	130.00 (130.00)	130.61 (130.78)	130.82
10 (10′)	129.31	129.29	129.40 (129.40)	129.26 (129.90)	129.55
11 (11′)	118.03	118.28	118.10 (118.31)	118.07 (118.07)	118.13
12 (12′)	154.87	154.50	154.58 (154.90)	154.72 (155.24)	155.48
13 (13′)	114.62	114.46	114.47 (114.55)	114.41 (113.84)	113.92
14 (14′)	128.81	128.79	128.72 (129.08)	128.70 (128.87)	129.04
15 (15′)	38.45	37.96	38.46 (39.12)	38.86 (38.23)	38.50
N-Me (N′-Me)	42.85	41.88	42.55 (42.92)	42.72 (42.58)	42.51
6-OMe (6′-OMe)	56.58	56.38	56.51 (56.40)	56.59 (61.76)	61.77
7-OMe (7′-OMe)	60.52		60.54	60.59 (60.64)	60.64

[a] Data obtained at 600 MHz in $CDCl_3$, TMS as internal standard.

spectrum of **5**, suggesting that this hydroxyl group must be located on the aromatic A or A′ ring. The location of the hydroxyl group at C-5′ of A′ ring and not at C-5 of A ring was presumed from the similarity of the proton and carbon chemical shifts of the ABC moieties of **5** and **1** in contrast to the significant differences between several proton and carbon chemical shifts of the other parts A′B′C′ of **5** and **1** (Tables 1 and 2). The definitive location of the hydroxyl group at C-5′ was deduced from the following features. The C-4 and C-4′ resonances of **5** appeared at δ 25.0 and 18.9, respectively. The deshielding effect observed on the C-4′ signal was related to the presence of the hydroxyl at C-5′ as earlier observed for *N*-methylthaicanine, a tetrahydroprotoberberine isolated from *A. cymosa*.[15] In addition, the C-5′ signal (δ 136.9) in **5** was shifted downward at δ 155.6 in the spectrum of the methylated derivative. Finally, the aromatic quaternary carbon C-4a or C-4′a of the bisbenzylisoquinoline alkaloids that usually resonate at about δ 130 (see Table 3) were upshielded at δ 115.6 in **5**. From comparison of the ^{13}C-NMR spectra data of **5**, **1**, and **2**, it appears that the presence of an oxygen substituent at C-5(5′) causes the shielding of C-4a (4′a), C-4(4′), and C-6(6′) and the deshielding of C-7(7′) and C-8a(8′a) carbons, as shown in Tables 1 and 2. The unambiguous ^{1}H-NMR and ^{13}C-NMR assignments of the quaternary groups and aliphatic protons were completed by the HMQC and HMBC experiments (Tables 1, 2, and 3). On the basis of all collected experimental results, we proposed for this new alkaloid structure **5**, for which we suggest the name jollyanine. As established for **2** (isochondodendrine),[16] **5** possesses a *RR′* configuration. In addition, this assessment was also supported by the similarity of the DCI curves of **1** and **5**.

The EIMS of compound **6** displayed a molecular ion at *m/z* 654 consistent with $C_{38}H_{42}N_2O_8$. It also gave, as described for **5**, a strong peak at *m/z* 328 (100%) and five significant ions at *m/z* 220, 206, 190, 175, and 162.

Table 3. The NMR Data (^{1}H-^{1}H COSY, HMQC, HMBC) of Compounds **5**[a] and **6**[a]

	jollyanine (**5**)			fastrine (**6**)		
position	^{1}H-^{1}H COSY	HMBC (^{1}H to ^{13}C)	HMQC	^{1}H-^{1}H COSY	HMBC (^{1}H to ^{13}C)	HMQC
H-1	H-15α,*β*	C-3,C-4a,C-5,C-8a,C-15	C-1	H-15α,*β*	C-3,C-4a,C-5,C-8a,C-9,C-15	C-1
H-1′	H-15′α,*β*	C-3′,C-4′a,C-5′,C-8′a,C-9′,C-15′	C-1′	H-15′α,*β*	C-3′,C-4′a,C-5′,C-8′a,C-9′,C-15′	C-1′
H-3α[b]	H-3*β*,H-4*β*	C-4, C-1	C-3	H-3*β*,H-4α,*β*	C-1,C-4,C-4a	C-3
H-3*β*[b]	H-3α,H-4α	C-1,C-4,C-4a,1-NMe	C-3	H-3α,H-4α	C-1,C-8a,1-NMe	C-3
H-3′α[c]	H-3′*β*,H-4α	C-1′,C-4′,C-4′a	C-3′	H-3′*β*,H-4′A,*β*	C-1′,C-4′,C-4′a	C-3′
H-3′*β*[c]	H-3′α,H-4α	C-4′,C-8′a,1′-NMe	C-3′	H-3′α,H-4′α	C-1′,C-8′a,1′-NME	C-3′
H-4α[d]	H-4*β*,H-3*β*	C-1, C-3, C-4, C-4a, C-8a	C-4	H-3α,*β*,H-4*β*	C-3, C-4a, C-8	C-4
H-4*β*[d]	H-4α,H-3*β*	C-3, C-4a, C-8, C-8′a	C-4	H-3α,*β*,H-4α	C-3, C-4a, 6-MeO, C-8, C-8a	C-4
H-4′α[e]	H-4′*β*,H-3′*β*	C-3′, C-4′a, C-8′	C-4′	H-3′α,*β*,H-4′*β*	C-3′,C-4′a, C-8′	C-4′
H-4′*β*[e]	H-4′α,H-3′*β*	C-3′, C-4′a, C-8′	C-4′	H-3′α,*β*,H-4′α	C-3′, C-4′a,6′-MeO, C-8′, C-8′a	C-4′
H-5	H-4*β*,6-OMe	C-1, C-6, C-7, C-8, C-8a, C-15	C-5			
H-5′			C-5′			
H-10	H-11, H-14	C-12, C-14, C-15	C-10	H-11, H-14	C-12, C-14, C-15	C-10
H-10′	H-11′, H-14′	C-12′, C-14′, C-15′	C-10′	H-11′, H-14′	C-12′, C-14′, C-15′	C-10′
H-11	H-10, H-13	C-9, C-12, C-13	C-11	H-10, H-13	C-9, C-12, C-13	C-11
H-11′	H-10′, H-13′	C-9′, C-12′, C-13′	C-11′	H-10′, H-13′	C-9′, C-12′, C-13′	C-11′
H-13	H-14, H-11	C-9, C-11, C-12	C-13	H-11, H-14	C-9, C-11, C-12	C-13
H-13′	H-14′, H-11′	C-9′, C-11′, C-12′	C-13′	H-11′, H-14′	C-9′, C-11′, C-12′	C-13′
H-14	H-13, H-10	C-10, C-12, C-15	C-14	H-10, H-13	C-10, C-12, C-15	C-14
H-14′	H-13′, H-10′	C-10′, C-12′, C-15′	C-14′	H-10′, H-13′	C-10′, C-12′, C-15′	C-14′
H-15α[f]	H-1, H-15*β*	C-8a, C-9, C-10, C-14	C-15	H-15α	C-9, C-10	C-15
H-15*β*[f]	H-1, H-15α	C-1, C-8a, C-9, C-10, C-14, 1-NMe	C-15	H-15*β*	C-1, C-9, NMe	C-15
H-15′α[g]	H-1′, H-15′*β*	C-8′a, C-9′, C-10′, C-14′	C-15′	H-15′α	C-9′, C-10′	C-15′
H-15′*β*[g]	H-1′, H-15′α	C-1′, C-8′a, C-9′, C-10′, C-14′, 1′-NMe	C-15′	H-15′*β*	C-1′, C-9′, N′Me	C-15′
6-MeO			C-6			C-6
6′-MeO			C-6′			C-6′
7-MeO			C-7			C-7
7′-MeO			C-7′			C-7′
1-NMe			1-NMe		C-1, C-3	1-NMe
1′-Me			1′-NMe		C-1′, C-3′	1′-NMe

[a] Obtained at 600 MHz in $CDCl_3$, TMS as internal standard. [b–g] Signals may be interchanged.

This typical fragmentation was attributable to trisubstituted A and B rings of isochondodendrine-type alkaloids as previously observed with **5**. The phenolic nature of **6** was supported by the bathochromic shifts of the UV λ_{max} after alkalinization. On the other hand, the presence of one single peak at *m/z* 328 (100%) indicated the symmetric nature of the molecule.[12,13] This hypothesis was further supported by the similarities of the EIMS, ^{1}H-NMR and ^{13}C-NMR spectra of **6** with those of **5** (see Tables 1−3). The presence of the same partial substructure ABC or A′B′C′ in **6** was supported by detailed comparisons of the COSY, DEPT, HMQC, and HMBC data (Table 3). A last evidence of two hydroxyls, at C-5 and C-5′ in **6**, was deduced from the additional methoxyl signal at δ 3.88 (6 H) of its methyl ether, prepared with CH_2N_2. As observed in **5**, the C-4(4′) resonance of **6** was strongly shielded because of the presence of an oxygen substitutent at C-5(5′). Structure **6** was unambiguously supported by all these data. For this compound, we suggest the name fastrine. As established for **2** (isochondodendrine) conformation,[16] **6** possesses the *RR′* configuration. This assignment was supported by the similarity of the DCI curves of **1** and **6**.

The other alkaloids were identified by direct comparison of their TLC behavior as well as their UV, ^{1}H-NMR, ^{13}C-NMR, and EIMS data with those of alkaloids isolated previously.[2−6,7−10,17−19]

This study and our previous studies[2−6] on *Anisocycla* sp. show that they elaborate alkaloids of the trilobine and berbamine types and benzylisoquinoline alkaloids bearing an oxygen substituent at the 5-position on ring A. These alkaloids characterize the *Anisocycla* genus and possess chemotaxonomic value. Furthermore, the presence of protoberberine alkaloids in *A. cymosa* and isochondodendrine-type alkaloids in *A. jollyana* enables the two species to be differentiated phytochemically.

Experimental Section

General Experimental Procedures. UV spectra were recorded on a Shimadzu UV-265 FS spectrophotometer and IR spectra on a Perkin-Elmer 177 spectrophotometer. Optical rotations were measured on a Perkin-Elmer 141 polarimeter. The DCI curves were recorded with an Auto-Dichrograph Mark V from ISA Jobin Yvon. EIMS were recorded with a VG Micromass 7070 F apparatus (70 eV). NMR spectra were recorded on a Bruker WP 250 spectrometer, operating at 250 MHz for ^{1}H NMR, and on a Varian-Unit 600 instrument for ^{1}H NMR and ^{13}C NMR, operating at 600 MHz using TMS as internal reference. Chemical shift data are in parts per million. The DEPT sequence was used to distinguish the methylene carbon signals from those due to methine, Me, and, quaternary carbons; one-bond ^{1}H-^{13}C and ^{1}H-^{1}H connectivities were determined via 2D proton-detected HMQC and COSY experiments, respectively; two- and three-bond ^{1}H-^{13}C correlations were determined using 2D proton-detected HMBC experiments optimized for J_{CH} = 5 Hz, 10 Hz. Si gel 60 (E. Merck, Darmstadt, Germany) and neutral Al_2O_3 (M. Woelm, Eschwege, Germany) were used for column chromatography, and Si gel 60 PF_{254} (E. Merck, Darmstadt, Germany, layer thickness 1.0 mm) was used for TLC. The TLC chromatograms were visualized under UV at 254 nm and/or sprayed with Dragendorff's and potassium iodoplatinate reagents.

Plant Material. Roots of *A. jollyana* (Pierre) Engl. (Menispermaceae) were collected in 1994, near Kivuza/Kiasi-Kole, in the province of Bas-Zaire (Zaire) and identified by Mr. Bavukinina−Ngoma and Mr. Mena-

vanza, Institut de Recherches en Sciences de la Santé, Kinshasa, Zaire. A voucher specimen has been deposited in the Herbarium of the Institut de Recherches en Sciences de la Santé, Kinshasa, Zaire (ref. no. 124).

Extraction and Isolation. Powdered, dry roots (300 g) were extracted exhaustively with MeOH (3 L) by percolation. The MeOH extract was evaporated to dryness under reduced pressure, and the residue was taken up with 5% aqueous HCl (2 × 100 mL). After filtration, the solution was extracted several times with petroleum ether (300 mL). After alkalinization with aqueous 25% NH_4OH, the aqueous phase was extracted four times with $CHCl_3$ (4 × 100 mL). The combined $CHCl_3$ extracts were washed with H_2O and dried on anhydrous Na_2SO_4 then evaporated to dryness, yielding the alkaloidal fraction (3 g). A part of this extract (1 g) was chromatographed on a column packed with neutral Al_2O_3 with a mixture of $CHCl_3$−MeOH (4:1). The less polar tertiary bases were further separated on a Si gel column (70−200 mesh, 100 g) eluted with $CHCl_3$ containing increasing amounts of MeOH; the final purification was achieved by preparative TLC on Si gel, using the following mobile phase: $CHCl_3$−MeOH−NH_4-OH 25% (38:2:0.2). This procedure allowed the isolation of 11 alkaloids **1** (15 mg), **2** (10 mg), **3** (18 mg), **4** (17 mg), **5** (14 mg), **6** (40 mg), (+)-dehydro-1,2-apateline (30 mg), (+)-*O*-methyl-12-cocsoline (50 mg), (+)-homoaromaline (50 mg), (+)-limacusine (50 mg), and (+)-limacusine *N*-oxide (50 mg).

(−)-Cycleanine (1): colorless needles; UV λ_{max} (MeOH) nm (log ϵ) 275 (3.6); $[\alpha]^{20}_D$ −11.2° (*c* 0.021, $CHCl_3$); EIMS *m/z* (rel int) $[M]^+$, 622 (67), 312 (100), 204 (40), 190 (24), 174 (22), 159 (20), 145 (15); ^{1}H NMR ($CDCl_3$, 600 MHz), see Table 1; ^{13}C NMR ($CDCl_3$, 600 MHz), see Table 2.

(−)-Isochondodendrine (2): white powder; UV λ_{max} (MeOH) nm (log ϵ) 278 (3.7); UV λ_{max} (MeOH + KOH) nm (log ϵ) 285 (3.7); $[\alpha]^{20}_D$ −5.4° (*c* 5.3, $CHCl_3$); EIMS *m/z* (rel int) $[M]^+$ 594 (44), 298 (100), 190 (24), 162 (22), 148 (9), 132 (7). ^{1}H NMR ($CDCl_3$, 600 MHz), see Table 1; ^{13}C NMR ($CDCl_3$, 600 MHz), see Table 2.

(−)-Norcycleanine (3): white powder; UV λ_{max} (MeOH) nm (log ϵ) 277 (3.70); UV λ_{max} (MeOH + KOH) nm (log ϵ) 278; $[\alpha]^{20}_D$ −0.73° (*c* 0.023, $CHCl_3$) EIMS *m/z* (rel int) $[M]^+$ 608 (83), 312 (100), 298 (79), 204 (39), 190 (42), 174 (24), 162 (17), 145 (21), 132 (7); ^{1}H NMR ($CDCl_3$, 600 MHz), see Table 1; ^{13}C NMR ($CDCl_3$, 600 MHz), see Table 2.

(−)-Cycleanine *N*-oxide (4): white powder; UV λ_{max} (MeOH) nm (log ϵ) 277 (3.5); $[\alpha]^{20}_D$ −23.3° (*c* 0.003, $CHCl_3$); EIMS *m/z* (rel int) $[M]^+$ 638 (6), 622 (62), 312 (100), 298 (19), 204 (42), 190 (28), 174 (28), 159 (15), 145 (21); ^{1}H NMR (250 MHz, $CDCl_3$) δ 2.50−3.80 (aliph. protons), 2.50 (NMe), 3.16 (N′Me), 3.40 (OMe at C-7), 3.45 (OMe at C-7′), 3.82 (OMe at C-6), 3.85 (OMe at C-6′), 4.25 (1H, d, J = 9.3 Hz, H-1), 4.65 (1H, m, H-1′), 5.81 (2H, dd, H-13, H-13′), 6.25 (2H, dd, H-14, H-14′), 6.57 (1H, s, H-5), 6.60 (1H, s, H-5′), 6.61 (2H, dd, H-11, H-11′), and 7.05 (2H, dd, H-10, H-10′).

(−)-Jollyanine (5): white powder; UV λ_{max} (MeOH) nm (log ϵ) 276 (3.6) and 284 (3.6); UV λ_{max} (MeOH + KOH) nm (log ϵ) 285 (3.7) and 302 (3.5); CD MeOH, $\Delta\epsilon$ (λ nm) + 17.5 (288), +36.2 (245); $[\alpha]^{20}_D$ −70° (*c* 0.011, $CHCl_3$); IR λ_{max} (KBr) cm^{-1} 3420, 2930, 1599, 1504 1449, 1417, 1213, 1112, 1009, 942, 842, 510; EIMS *m/z* (rel int) $[M]^+$ 638 (70), 328 (72), 312 (100), 274 (7), 220 (21), 204 (51), 190 (28), 174 (35), 159 (21), 145 (26); ^{1}H NMR ($CDCl_3$, 600 MHz), see Table 1; ^{13}C NMR ($CDCl_3$, 600 MHz), see Table 2.

(+)-Fastrine (6): white powder; UV λ_{max} (MeOH) nm (log ϵ) 278 (3.6) and 285 (3.7); UV λ_{max} (MeOH + KOH) nm (log ϵ) 289 (3.7) and 298 (3.6); CD $CHCl_3$, $\Delta\epsilon$ (λ nm) + 25.9 (289), + 38.1 (245); $[\alpha]^{20}_D$ + 49° (*c* 0.013, $CHCl_3$); IR λ_{max} (KBr) cm^{-1} 3410, 2930, 1603, 1505, 1453, 1418, 1368, 1217, 1110, 1037, 940, 844, 521; EIMS *m/z* (rel int) $[M]^+$ 654 (67), 328 (100), 282 (11), 220 (28), 206 (33), 190 (21), 175 (25), 162 (18); ^{1}H NMR ($CDCl_3$, 600 MHz), see Table 1; ^{13}C NMR ($CDCl_3$, 600 MHz), see Table 2.

Methylation of 5. Compound **5** (10 mg) was dissolved in MeOH and an excess of CH_2N_2 in Et_2O was added. The mixture was allowed to stand for 24 h. Workup afforded a compound that exhibited a fifth MeO group at δ 3.88 in the ^{1}H-NMR spectrum.

Methylation of 6. Compound **6** (10 mg) was dissolved in MeOH, and an excess of CH_2N_2 in Et_2O was added. The mixture was allowed to stand for 24 h. Workup afforded a compound that exhibited two additional MeO groups at δ 3.88 in the ^{1}H-NMR spectrum.

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