Chemical Constituents from *Dehaasia triandra*. 1. Three New Alkaloids, Isocorydione, Norisocorydione, and Dehatriphine, from the Leaves

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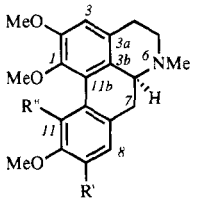
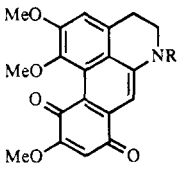
The reinvestigation of *Dehaasia triandra* Merr. resulted in the isolation of three novel alkaloids, besides the most abundant aporphine isocorydine (**1**) from the leaves. They are isocorydione (**2**), norisocorydione (**3**), and dehatriphine (**4**). Isocorydione has been prepared semisynthetically. Dehatriphine, the first ether-linked bisaporphine, was elucidated as 9-*O*-(8′-isocorydinyl)-*N*-methyllaurotetanine. Structural elucidation of these compounds was based on spectral analysis and chemical correlation.

Past studies on the constituents of *Dehaasia triandra* Merr. (Lauraceae) have resulted in the isolation of five aporphines from the leaves—isocorydine (**1**), corytuberine, atheroline, nantenine, and xanthoplanine—and three bisbenzylisoquinolines—dehatridine from the leaf and obaberine and dehatrine from the stem.[1,2] Being interested in the biological activities of the dimeric compounds, we reinvestigated this plant and report herein on the chemical constituents of the leaves.

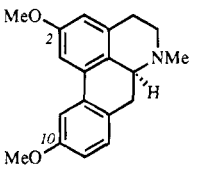
The EtOH extract of the leaves was triturated with 0.1 N HCl to give an aqueous fraction containing base salts, and exhaustive partitioning against $CHCl_3$ yielded the $CHCl_3$-soluble alkaloidal salts. This fraction was further fractionated by centrifugal partition chromatograph, Sephadex LH-20, and Si gel columns to give four bases. Among them, (+)-isocorydine (**1**) was identified by comparison with an authentic sample isolated from the same plant previously.[1]



1. R'=H, R"=OH
5. R'=OH, R"=H



2. R=Me
3. R=H



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Compound **2**, a violet amorphous solid, $C_{20}H_{19}NO_5$ (HREIMS), exhibited a conjugated IR carbonyl absorption (1654 cm^{-1}), and the ^{13}C-NMR spectrum displayed two carbonyl signals at δ 178.3 and 186.5, similar to 1,4-dicarbonyl signals in 2-methoxy-8-methyl-1,4-naphthoquinone.[3] The ^1H-NMR spectrum showed singlet signals for three aryl protons (δ 6.91, 6.89, and 5.87), three MeO (δ 3.94, 3.90, and 3.85), one NMe (δ 3.13), and two triplets for two vicinal coupled methylenes (δ 3.43 and 3.08, J = 6.6 Hz). These data were consistent with those reported for a *p*-quinone[4] prepared from **1** by oxidation with Fremy's salt. This structure was supported by NOESY and HMBC techniques. The NOESY spectrum spatially interconnects the 2-OMe to H-3, and H-9 to 10-OMe. The presence of 1-OMe was confirmed from the HMBC data, which indicated that C-1 is coupled to a methoxy singlet (δ 3.94) and H-3 (δ 6.89). Compound **2** is a new natural product and is named isocorydione.

Based on the NOESY, HMQC, and HMBC data, the ^1H- and ^{13}C-NMR assignments for **2** are listed (Table 1).

Compound **3**, another violet amorphous solid, has a molecular formula of $C_{19}H_{17}NO_5$ from HREIMS, which is 14 mass units fewer than **2**. The ^1H- and ^{13}C-NMR spectra showed an absence of the *N*-Me signals (δ H 3.13 and δ C 40.1 in **2**). These differences aside, compounds **2** and **3** had similar spectra. Hence, **3** is norisocorydione and is also novel. Its ^1H- and ^{13}C-NMR data (Table 1) were assigned by comparison with those of **2**.

Compound **4** showed a $[M]^+$, at *m/z* 680.3058 (HREIMS) for a formula of $C_{40}H_{44}N_2O_8$ (calcd 680.3098). Its ^1H-NMR spectrum displayed two *N*Me signals at δ 2.26 and 2.45; six MeO singlets at δ 3.95, 3.89, 3.87, 3.85, 3.73, and 3.68; five aromatic proton singlets at δ 8.16, 6.74, 6.68, 6.58, and 6.42; and a D_2O exchangeable singlet at δ 8.70. The D_2O exchangeable signal is characteristic for 1-OH or 11-OH in a 1,2,10,11- or a 1,2,3,10,11-oxygenated aporphine such as 11-OH in **1**, and the downfield aromatic singlet (δ 8.16) for H-11 in aporphines.[5] The IR spectrum of **4** showed absorption at 3436 cm^{-1}, but its UV spectrum under alkaline conditions failed to give the anticipated bathochromic shift of a free phenolic OH, thus indicating a hindered phenolic OH. The presence of two *N*Me signals, six methylene carbons, and two methine carbon signals was confirmed by the ^{13}C-NMR spectrum. In addition, the molecular formula requires 12 double bonds and an additional 8 ring-forming carbons and leads to the conclusion that **4** is a bisaporphine-type of dimeric isoquinolines. Subtracting the seven oxygens (6 × OMe and 1 × OH) from the formula leaves one oxygen to link the monomeric aporphines. This ether links two aromatic rings, as deduced from substitution pattern (total: 14, including 6 × OMe, 1 × OH, 5 × Ar-H), and the location of these substituents and the diphenyl ether linkage was determined as follows.

The ^1H-NMR spectrum of **4** displayed a relatively upfield-shifted H-7′β at δ 1.99 (t, J = 13.8 Hz), (δ 2.44 in **1**) and a relatively downfield-shifted H-7′α at δ 3.33 (dd, J = 3.3, 13.8 Hz) (δ 3.04 in **1**). The ^{13}C-NMR spectrum showed an upfield-shifted C-7′ at δ 28.07 (t) (δ 35.6 in **1**), identified by the correlation in a HMQC spectrum. This evidence suggested that C-8′ is oxygen-

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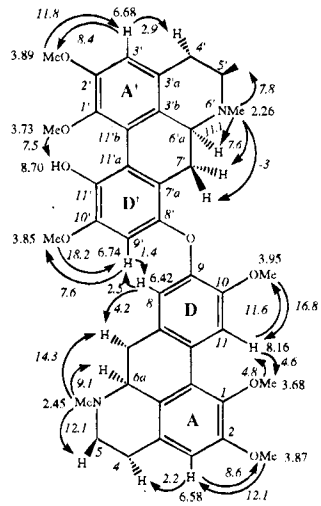
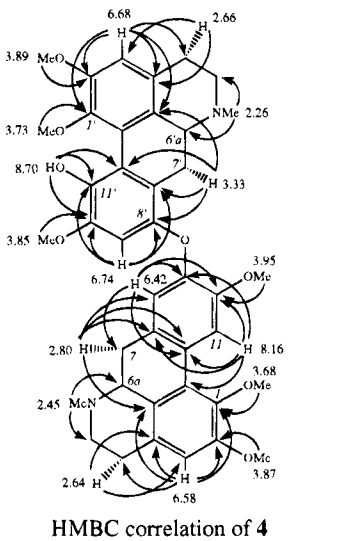
Table 1. ^{1}H- and ^{13}C-NMR Data (δ/ppm) for Compounds 2 and 3 and HMBC data for Compound 2 in $CDCl_3$

	^{1}H (mult) (Hz)		^{13}C (mult)		HMBC of 2 (J = 8 Hz)	
position	**2**	**3**	**2**	**3**	δ_H	δ_C
1			143.9 s	144.0 s		
2			152.2 s	152.6 s		
3	6.89 s	6.94 s	112.8 d	113.4 d	6.89	143.9 (C-1), 119.3 (C-3b), 29.2 (C-4)
3a			128.4 s	128.8 s		
3b			119.3 s	118.7 s		
4	3.08 t (6.6)	3.12 t (6.2)	29.2 t	29.2 t	3.08	112.8 (C-3), 128.4 (C-3a), 119.3 (C-3b), 50.2 (C-5)
5	3.43 t (6.6)	3.53 m	50.2 t	40.8 t	3.43	128.4 (C-3a), 29.2 (C-4), 150.3 (C-6a)
6-Me	3.13 s		40.1 q		3.13	50.2 (C-5), 150.3 (C-6a)
6a			150.3 s	149.6 s		
7	6.91 s	6.97 s	98.2 d	100.8 d	6.91	119.3 (C-3b), 186.5 (C-8), 118.0 (C-11a)
7a			136.4 s	136.5 s		
8			186.5 s	186.1 s		
9	5.87 s	5.89 s	105.2 d	105.2 d	5.87	136.4 (C-7a), 163.9 (C-10), 178.3 (C-11)
10			163.9 s	164.0 s		
11			178.3 s	178.4 s		
11a			118.0 s	118.5 s		
11b			126.9 s	127.3 s		
1-OMe	3.94 s	3.98 s	60.7 q	60.7 q	3.94	143.9 (C-1)
2-OMe	3.90 s	3.95 s	56.5 q	56.6 q	3.90	152.2 (C-2)
10-OMe	3.85 s	3.88 s	56.4 q	56.4 q	3.85	163.9 (C-10)

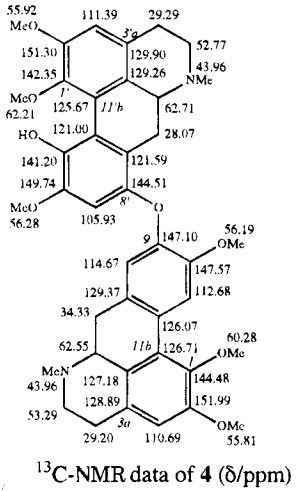


H-4α: 2.64 m
H-4β: 3.12 m
H-5α: 2.47 m
H-5β: 3.00 m
H-6a: 2.91 br d, J=13.8 Hz
H-7α: 2.80 dd, J=4.0, 13.8 Hz
H-7β: 2.41 t, J=13.8 Hz
H-4'α: 2.66 m
H-4'β: 3.12 m
H-5'α: 2.38 dt, J=3.2, 11.6 Hz
H-5'β: 2.94 m
H-6'a: 2.75 br d, J=13.8 Hz
H-7'α: 3.33 dd, J=3.3, 13.8 Hz
H-7'β: 1.99 t, J=13.8 Hz

NOEs (%, italics) and ^{1}H-NMR data of **4** (δ/ppm, $CDCl_3$)



HMBC correlation of **4**



^{13}C-NMR data of **4** (δ/ppm)

Figure 1. NMR data and HMBC of **4**.

ated.[6,7] The NOE difference studies of **4** depicted in Figure 1 indicated the NOE relationship of two aromatic protons in different aporphine units at δ 6.74 and 6.42, suggesting that both protons are ortho to the ether-linked position. The aromatic singlet (δ 6.74) showed an additional NOE to a MeO signal (δ 3.85), while the proton at δ 6.42 (H-8) showed an additional NOE to H-7α (δ 2.80, dd, J = 4.0, 13.8 Hz), identified from the correlation with C-7 (δ 34.33) in a HMQC spectrum. Hence, the diphenyl ether linkage could be located at C-8′ and C-9 of each aporphine unit and was confirmed by a HMBC spectrum (Figure 1). The HMBC spectrum revealed that the aromatic singlet at δ 6.74 couples to three oxygenated carbons and one non-oxygenated quaternary carbon (δ 121.59). Two of these three oxygenated aromatic carbons are methoxylated (δ 149.7) and phenolated (δ 141.20) from respective coupling to a MeO (δ 3.85) and a phenolic proton (δ 8.70). The remaining oxygenated carbon (δ 144.51) couples only to H-7′α without coupling to any MeO protons and is therefore the ether-linked carbon. These data established the location of substituents in ring D′ of **4**. Similarly, the presence of 1′-OMe and 2′-OMe in ring A′ were elucidated from NOEs, which displayed the NOE relationship of 1′-OMe (δ 3.73) to 11′-OH (δ 8.70), and H-3′ (δ 6.68) to 2′-OMe (δ 3.89) and H-4′α, and from HMBC, which showed the coupling of C-1′ (δ 142.35) to H-3′ and 1′-OMe. Consideration of these partial structures leads to the conclusion that isocorydine (**1**) is one of the aporphine units ether-linked to the other unit at C-8 position.

The other aporphine unit was elucidated as *N*-methyllaurotetanine (**5**) from the following spectral evidence. The NOE effects of H-11 (δ 8.16) showed two adjacent MeO groups ($\delta_{1\text{-OMe}}$ 3.68 and $\delta_{10\text{-OMe}}$ 3.95) located at C-1 and C-10 positions. In the HMBC spectrum, H-11 is coupled to two oxygenated carbons via two-bond (C-10, δ 147.57) and three-bond (C-9, δ 147.10) distances. Both carbon signals were distinguished by the coupling of C-10 to 10-OMe (δ 3.95). As the oxygenated C-9 (δ > 140 ppm) did not couple to any methoxy protons, it should be the ether-linked carbon. The large coupling of H-8 (δ 6.42) to C-10, combined with the above data, established the 9,10-substitution pattern for ring D. In the HMBC spectrum, C-1 (δ 144.48) was observed to couple to 1-OMe (δ 3.68) and an aromatic singlet (δ 6.58), assigned to the signal of H-3. In the NOE experiment, the enhancement of a MeO singlet (δ 3.87) and H-4α (δ 2.64, m) upon irradia-

tion of H-3 suggested a methoxy substitution at C-2. All these substitutions taken together identify *N*-methyllaurotetanine (**5**) as the second aporphine unit ether linked to the first unit at the C-9 position.

The stereochemistry in both aporphine units was deduced from the CD spectrum. Because both chiral centers are far apart, the CD curve of **4** is considered to be the sum of those of the biogenetically related aporphine monomers. This is suggested by the close resemblance of the CD curve of **4** to the summation of **1** and **5**, which exhibits four negative Cotton effects at 312, 300, 276 (274 nm for **1**+**5**), and 212 nm (215 nm for **1**+**5**), and a positive Cotton effect near 236 nm. Accordingly, **4** would possess *S* configuration at C-6a and C-6′a, the same as **1** and **5**. The Na in liquid NH_3 cleavage of **4** yielding (+)-2,10-dimethoxyaporphine (**6**) partially supports this conclusion.

Combination of the above structural moieties established **4** as (6a-*S*,6′a-*S*)-9-*O*-(8′-isocorydinyl)-*N*-methyllaurotetanine, which is apparently produced by oxidative coupling of **1** and **5** biogenetically. Common dimeric aporphinoid alkaloids are ether-linked dimers of aporphine and benzylisoquinoline.[8] Previously isolated or synthesized bisaporphines such as urabaine are C-C coupled.[9] Hence, compound **4** represents the first natural occurrence of an ether-linked bisaporphine and is named dehatriphine.

By analysis of NOEs and 2D NMR spectra (HMQC, HMBC), complete ^{1}H- and ^{13}C- NMR assignments of **4** were made and are shown in Figure 1.

Experimental Section

General Experimental Procedures. The physical data of the isolated compounds were obtained from the following instruments: Perkin-Elmer 1760-X infrared FT spectrometer; Hitachi 150-20 UV spectrophotometer; JASCO J-710 spectropolarimeter; JEOL JMX-HX110 mass spectrometer (70 eV); Bruker AMX-400 spectrometer using solvent peak ($CDCl_3$) as reference standard; 2D NMR spectra were recorded by using Bruker's standard pulse program: in the HMQC and HMBC experiments, $\Delta = 1$ s and $J = 140$, 8 Hz, respectively, the correlation maps consisted of 512 × 1K data points per spectrum, each composed of 16 to 64 transients.

Plant Material. The leaves of *Dehaasia triandra* were collected in August 1992, in Botel Tobago, Taitung, Taiwan. A specimen was authenticated by Dr. Ih-Sheng Chen, School of Pharmacy, Kaohsiung Medical College, Taiwan, where a voucher herbarium specimen is deposited.

Extraction and Isolation. The powdered, dry leaves (3.8 kg) were extracted with 95% EtOH (18 L × 5). Concentration of the EtOH extract afforded a residue (694 g) that was triturated with 0.1 N HCl (600 mL × 3). The combined acidic solution was exhaustively partitioned with $CHCl_3$ (600 mL × 10) to give a $CHCl_3$-soluble fraction (14.22 g). The aqueous layer was adjusted to pH 9 with 25% NH_3 solution, and the precipitate (8.12 g) was filtered. The filtrate was extracted with $CHCl_3$ (600 mL × 6) to give crude free bases (19.45 g). The aqueous layer, after being adjusted to pH 3 with conc. HCl, was treated with 20% $NaClO_4$ and 0.5% Reinecke solution successively to give crude quarternary alkaloids, 7.04 g and 1.43 g, respectively. The remaining aqueous layer was passed through an Amberlite XAD-II column to recover the polar ingredients (17.43 g).

The $CHCl_3$-soluble fraction (14.22 g) containing bases was redissolved in $CHCl_3$ (150 mL) and extracted with 6% NH_4OH (150 mL × 3) to remove acidic components. The organic layer was dried over Na_2SO_4 and evaporated to give 9.04 g of free bases, which were fractionated (4.52 g × 2) with a Sanki centrifugal partition chromatograph, LLN model, type 1000E cartridge × 6, under the following conditions: delivery system $CHCl_3$-MeOH-0.5%HOAc (5:5:3), flow rate 3 mL/min and rotation speed 1000 RPM, which gave rise to pressure 36−37 kg/cm^2, the eluate being collected in 17-mL fractions. CPC fractionation gave nine fractions, I to VI being obtained using the organic layer as stationary phase and the aqueous layer as mobile phase (total, 1350 mL), respectively, whereas fraction VII to IX were obtained by the reverse mode. Fraction VII contained pure isocorydine (1.55 g). Fraction VIII (142 mg), after purification on a Si gel column (70−230 mesh, 6.0 g) eluted with 0−0.5% MeOH in $CHCl_3$, yielded **2** (40 mg) as a violet amorphous solid. Fraction IX (3.81 g) was further fractionated on a Sephadex LH-20 column (680 mL) eluted with MeOH to given nine fractions (IX-1 to IX-9). Fraction IX-5 afforded isocorydine (3.08 g). Fraction IX-6 (247 mg) contained **2** as the major component. Fraction IX-7 (36 mg), after purification on a Si gel column (70−230 mesh, 4.0 g) eluted with 0−0.5% MeOH in $CHCl_3$, yielded **3** (13 mg) as a violet amorphous solid. Fraction IX-4 (519 mg) was passed through a Si gel column (230−400 mesh, 20 g) eluted with 0−5% MeOH in $CHCl_3$ to give **1** (41 mg) and **4** (190 mg).

Isocorydione (2). Amorphous powder: ^{1}H- and ^{13}C-NMR see Table 1; NOESY data 2-OMe ↔ H-3 ↔ H-4's ↔ H-5's ↔ 6-Me ↔ H-7, H-9 ↔ 10-OMe; HREIMS $[M]^+$ *m/z* 353.1265 ($C_{20}H_{19}NO_5$ requires 353.1264); EIMS *m/z* $[M]^+$ 353 (100), 338 (21), 336 (75), 310 (7), 295 (22).
Norisocorydione (3). Amorphous powder: UV-VIS (MeOH) λ max (log ϵ) 222 (4.36), 276 (4.07), 326 (4.20), 560 (3.57) nm; IR (KBr) ν max 3396 (NH), 2944, 1651, 1614, 1578, 1520, 1452, 1345, 1209, 1082, 1044, 827 cm^{-1}; ^{1}H- and ^{13}C-NMR data, see Table 1; HREIMS $[M]^+$ *m/z* 339.1113 ($C_{19}H_{17}NO_5$ requires 339.1107); EIMS *m/z* $[M]^+$ 339 (100), 322 (68), 296 (6).

Dehatriphine (4). Amorphous powder: $[\alpha]^{23}_D$ + 13.0° (*c* 1.0, MeOH); IR (KBr) ν max cm^{-1} 3436 (br m, OH), 3215 (H-bond OH), 2941, 1583, 1509, 1465, 1424, 1396, 1372, 1242, 1207, 1115, 1101, 1085, 1001, 835, 808, 753; UV (MeOH) λ max (log ϵ) 220 (4.76), 276 (4.30), 303 (4.25) nm; CD (MeOH, *c* 1.47 × 10^{-5} M) 328 ($\Delta\epsilon$ 0), 312 ($\Delta\epsilon$ −5.12), 307 ($\Delta\epsilon$ −6.24), 300 ($\Delta\epsilon$ −7.72), 294 ($\Delta\epsilon$ −7.22), 276 ($\Delta\epsilon$ −19.25), 253 ($\Delta\epsilon$ 0), 236 ($\Delta\epsilon$ +58.03), 220 ($\Delta\epsilon$ 0), 212 ($\Delta\epsilon$ −16.67, sh) nm; ^{1}H- and ^{13}C-NMR data, see Figure 1; HREIMS *m/z* $[M]^+$ 680.3058 ($C_{40}H_{44}N_2O_8$ requires 680.3098); EIMS *m/z* $[M]^+$ 680 (3), 355 (15), 341 (100), 340 (90), 325 (93), 310 (81), 282 (27).

Sodium in Liquid Ammonia Cleavage of Dehatriphine (4). A 30.0-mg sample of **4** in 1.5 mL of dry THF was added dropwise to the dark-blue solution of Na (0.13 g)/liquid NH_3 (30 mL), maintained with a dry ice/Me_2CO condenser under N_2, with stirring. The reaction continued for 2 h. The excess NH_3 was allowed to evaporate at room temperature. To the residue was added carefully MeOH (4 mL) to destroy the excess Na.

The solution was evaporated, and the residue was digested with H_2O (40 mL), partitioned with Et_2O (50 mL × 3). The Et_2O layers were dried over Na_2SO_4 and condensed to give a viscous residue (11.5 mg). The aqueous layer was adjusted to pH 9 and extracted with $CHCl_3$ (50 mL × 3), which yielded 4.5 mg of residue after workup. The Et_2O fraction gave an oily base (**6**, 7.6 mg) after purification on a Si gel column (3 g, 230–400 mesh) eluted with 10 to 15% Me_2CO in $C_6H_5CH_3$. The $CHCl_3$ fraction, however, contained several spots that did not show positive reaction to Dragendorff's spray reagent and was not further separated.

(+)-2,10-Dimethoxyaporphine (6). $[\alpha]^{26}D$ +115.0° (*c* 0.2, MeOH); UV (MeOH) λ max (log ϵ) 265 (4.13), 270 (4.13), 298 (3.79), 312 (sh, 3.85), 319 (3.86) nm;[10] CD (MeOH, *c* 3.39 × 10^{-5} M) 330 ($\Delta\epsilon$ 0), 318 ($\Delta\epsilon$ −1.72), 308 (sh, $\Delta\epsilon$ −1.44), 292 ($\Delta\epsilon$ −0.71), 271 ($\Delta\epsilon$ −10.22), 256 ($\Delta\epsilon$ 0), 238 ($\Delta\epsilon$ +80.79), 221 ($\Delta\epsilon$ 0) nm;[11] ^1H NMR ($CDCl_3$) δ 7.08 (1H, d, J = 2.4 Hz, H-1), 6.61 (1H, d, J = 2.4 Hz, H-3), 7.16 (1H, d, J = 8.2 Hz, H-8), 6.79 (1H, dd, J = 2.6, 8.2 Hz, H-9), 7.21 (1H, d, J = 2.6 Hz, H-11), 3.83 (3H, s, OMe-2), 3.84 (3H, s, OMe-10), 2.53 (3H, s, NMe); NOE data, 2-OMe to H-1 5.2% and H-3 9.2%, 10-OMe to H-9 8.0% and H-11 6.1%.

CD Data of (+)-isocorydine (1) and (+)-*N*-Methyllaurotetanine (5). CD of **1** (MeOH, *c* 2.93 × 10^{-5} M): 328 ($\Delta\epsilon$ 0), 320 ($\Delta\epsilon$ +0.40), 315 ($\Delta\epsilon$ 0), 295 ($\Delta\epsilon$ −1.33), 268 ($\Delta\epsilon$ −9.76), 248 ($\Delta\epsilon$ 0), 233 ($\Delta\epsilon$ +59.30), 219 ($\Delta\epsilon$ 0), 213 ($\Delta\epsilon$ −6.82) nm; CD of **5** (MeOH, *c* 2.93 × 10^{-5} M) 328 ($\Delta\epsilon$ 0), 313 ($\Delta\epsilon$ −3.42), 291 ($\Delta\epsilon$ −2.00), 279 ($\Delta\epsilon$ −4.44), 258 ($\Delta\epsilon$ 0), 242 ($\Delta\epsilon$ +41.33), 228 ($\Delta\epsilon$ 0), 216 ($\Delta\epsilon$ −22.85) nm; CD of **1**+**5** 326 ($\Delta\epsilon$ 0), 312 ($\Delta\epsilon$ −4.09), 301 ($\Delta\epsilon$ −4.10), 292 ($\Delta\epsilon$ −3.38), 274 ($\Delta\epsilon$ −12.98), 254 ($\Delta\epsilon$ 0), 235 ($\Delta\epsilon$ +82.79), 222 ($\Delta\epsilon$ 0), 215 ($\Delta\epsilon$ −29.05) nm.

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References and Notes

(1) Lu, S.-T.; Wang, E. C. *J. Taiwan Pharm. Assoc.* **1977**, *29*, 49.
(2) Lu, S.-T.; Tsai, I. L.; Leou, S.-P. *Phytochemistry* **1989**, *28*, 615.
(3) Breitmaier, E.; Voelter, W. *Carbon-13 NMR Spectroscopy*; VCH Publishers: New York, 1990; p 223.
(4) Castedo, L.; de Lera, A. R.; Saá, J. M.; Suau, R.; Villaverde, C.; *Heterocycles* **1980**, *14*, 1135.
(5) Shamma, M. *The Isoquinoline Alkaloids*; Academic Press: New York, 1972; p 220.
(6) Jossang, A.; Leboeuf, M.; Cavé, A.; Sévenet, T.; Padmawinata, K. *J. Nat. Prod.* **1984**, *47*, 504.
(7) Lee, S. S. Ph.D. Thesis, The Ohio State University, Columbus, OH, 1985, Chapter II.
(8) For a recent review, see: Guinaudeau, H.; Leboeuf, M.; Cavé, A. *J. Nat. Prod.* **1988**, *51*, 1025.
(9) Arango, G. J.; Cortes, D.; Cavé, A. *Phytochemistry* **1987**, *26*, 1227.
(10) Kupchan, S. M.; Yokoyama, N. *J. Am. Chem. Soc.* **1964**, *86*, 2177.
(11) Wu, W.-N.; Beal, J. L.; Doskotch, R. W. *Tetrahedron* **1977**, *33*, 2919.

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