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ALKALOIDS OF *DEHAASIA TRIANDRA**

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Key Word Index—*Dehaasia triandra*; Lauraceae; Iau-Guoo-Nan; bisbenzylisoquinoline alkaloids; dehatridine; dehatrine.

Abstract—Separation of the basic fraction from *Dehaasia triandra* afforded two new bisbenzylisoquinoline alkaloids, dehatridine and dehatrine, along with six known alkaloids, isocorydine, corytuberine, atheroline, nantenine, obaberine and a quaternary aporphine alkaloid, xanthoplanine (**5**).

INTRODUCTION

The Formosan lauraceous plant, *Dehaasia triandra* [*Endiandra lanyuensis* Chang; *D. lanyuensis* (Chang) Kostermans] (Chinese name; Iau-Guoo-Nan) [1] is a small evergreen tree growing on Orchid Island and in the Philippines. Detailed research on the alkaloids of *Dehaasia* sp. is still rare, although preliminary investigations showed that these plants contain alkaloids [2–4]. In a previous paper [5], two alkaloids, isocorydine (**1**) an aporphine, and obaberine (**6**) bisbenzyltetrahydroisoquinolines, were obtained. Because there are still several alkaloids which are not yet identified, a further study was made for confirmation of these unknown compounds. As a result two new bisbenzylisoquinoline alkaloids, dehatridine (**7**) and dehatrine (**8**), along with six known alkaloids, isocorydine (**1**), corytuberine (**2**), atheroline (**3**), nantenine (**4**), obaberine (**6**) and xanthoplanine (**5**) were isolated. Except for **6** and **8** which were obtained from the trunk, the other six alkaloids were obtained from the leaves. This paper reports the isolation and characterization of these alkaloidal components from *D. triandra*.

RESULTS AND DISCUSSION

Extraction and separation of alkaloids were performed by the usual procedures as described in the Experimental. The following alkaloids were isolated: (a) aporphines: (+)-isocorydine (**1**), (+)-corytuberine (**2**), (+)-nantenine (**4**) and (+)-xanthoplanine (**5**); (b) oxoaporphines: atheroline (**3**); (c) bisbenzylisoquinolines: obaberine (**6**) dehatridine (**7**) and dehatrine (**8**) [Table 1].

Isocorydine (**1**) was identified by direct comparison [mmp, TLC, UV, IR (KBr), ^{1}H NMR] with an authentic sample. Corytuberine (**2**) was derived from corytuberine (**2**) MeI which was identified by comparison of mmp and IR (KBr) with authentic magnoflorine (**9**) I. The xanthoplanine (**5**) iodide was recognized as *N*-methyl laurotetanine (**10**) MeI by comparison of mmp, IR (Nujol) and UV. The physical data [mp, $[\alpha]_D$, UV, IR (KBr) and ^{1}H NMR] of nantenine (**4**) were in agreement with those of nantenine (**4**) [6–8]. With Ac_2O in pyridine, atheroline (**3**) gave an *O*-acetyl derivative as yellow needles, mp 190–193°, which was identified by comparison with authentic *O*-acetylatheroline (**12**) [9, 10] by mmp, TLC and IR (KBr). The HBr salt of obaberine (**6**), a bisbenzyltetrahydroisoquinoline alkaloid, was identified [mmp, TLC, IR (KBr)] by comparison with an authentic sample.

Dehatridine (**7**) was isolated as colourless needles, mp 274–276° (MeOH), and $[\alpha]_D^{23}$ +98° (MeOH, *c* 0.1). The molecular formula $C_{35}H_{32}N_2O_6$ belonging to bisbenzylisoquinolines was determined by elemental analysis and mass spectrometry [*m/z* 576 $[M]^+$]. UV indicated that there is a benzylisoquinoline moiety and a phenolic OH group in the molecule [λ_{max}^{EtOH} nm: 202, 243, 282 and 335, shows bathochromic shift on addition of KOH]. In the mass spectrum, there are the intensive fragments at *m/z* (%) 576 ($[M]^+$, 100), 575 ($[M-1]^+$, 92), 190 (30) and 174 (60). This fragmentation indicates that an aromatic isoquinoline moiety is present in the molecule [11, 12]. In the ^{1}H NMR, there are two mutually coupled signals at δ 7.43 and 8.20 (each 1H, *d*, J = 5.48 Hz) corresponding to the aromatic protons existing on a substituted pyridine ring. On the other hand, there is a one pair doublet with a larger coupling constants at δ 3.85 and 4.66 (each 1H, *d*, J_{gem} = 12.5 Hz) corresponding to the benzylic methylene protons adjacent to the pyridine ring. Moreover, there is one N–Me at δ 2.56 (3H, *s*), two OMe at δ 3.38 and 3.82 (each 3H, *s*) and two phenolic OH groups at δ 8.65 and 9.03 (each 1H, *s*) which were exchangeable with D_2O. On the one hand, *O*-methylation with diazomethane on dehatridine (**7**) gave *O*,*O*-dimethyldehatridine (**13**). In the aromatic proton regions, there are 10 aromatic protons at δ 5.92, 6.62, 7.02 (each 1H, *s*), 6.60 (1H, *d*, J_m = 2 Hz), 6.69 (1H, *d*, J_o = 8.2 Hz), 6.82, 6.84, 6.94, 7.19, 7.66 (each 1H, *dd*, J_o = 8.2 Hz, J_m = 2 Hz). From their chemical shifts, each of them was assigned to H-8′, H-5′, H-5, H-10, H-13, H-10′, H-14, H-11′, H-13′ and H-14′, respectively. Spin decoupling supported these assignments. Although there is a benzylisoquinoline moiety in the molecule, reduction with $NaBH_4$, Zn + HOAc, Zn/Hg, Pd/C + H_2, Na or Na/Hg on dehatridine (**7**) did not give the expected

*Part 31 in the series 'Studies on the Alkaloids of Formosan Lauraceous Plants'. For Part 30, See Lu, S.-T and Tsai, I.-L. (1988) *Heterocycles* (in press).

Table 1. Alkaloids isolated from *Dehaasia triandra*

Bases	mp (°)	Leaves (6.19 kg) yields g	%	Wood (12.64 kg) yields g	%
A. Tertiary phenolic:					
Isocorydine(**1**)	187–188	4.700	0.0680	—	—
Corytuberine (**2**)	239–242	0.070	0.0011	—	—
Atheroline (**3**)	250–252	0.026	0.0004	—	—
Dehatridine (**7**)	274–276	0.950	0.0153	—	—
B. Quaternary:					
Xanthoplanine (**5**)	Cl salt 218–220	—	—	—	—
	picrate 227–228	7.450	0.1200	—	—
C. Tertiary non-phenolic:					
Nantenine (**4**)	131–134	0.012	0.0002	—	—
Obaberine (**6**)	HBr salt 263–265 (decomp.)	—	—	8.42	0.067
Dehatrine (**8**)	158–160	—	—	0.348	0.003

product, tetrahydrodehatridine [11]. Sodium/liquid ammonia cleavage of *O,O*-diethyldehatridine (**14**) afforded (+)-*N*-methylcoclaurine (**15**) from the phenolic base part and (±)-*O,O*-diethylcoclaurine (**16**) from the non-phenolic base part. It was assumed that 7,4′-diethoxy-6-methoxybenzylisoquinoline (**16a**) produced by Na/liq. NH_3 cleavage of the ether linkages of *O,O*-diethyldehatridine (**14**) was reduced to (±)-*O,O*-diethylcoclaurine (**16**). Both (+)-N-methylcoclaurine (**15**) and (±)-*O,O*-diethylcoclaurine (**16**) were identified [TLC, IR (KBr), ^{1}H NMR] by comparison with authentic samples derived from (±)-coclaurine (**18**), respectively. Therefore, the two ether linkages between the benzyltetrahydroisoquinoline moiety and the benzylisoquinoline moiety of dehatridine (**7**) are assumed to be at 8-7′, 11-12′ as found in the berbamine series. Moreover, the absolute configuration of H-1′ is *S*.

Dehatrine (**8**) was isolated as colourless needles, mp 158–160° (EtOH) and $[\alpha]_D^{27}$ +27° ($CHCl_3$, *c* 1.0) from the tertiary non-phenolic base part. It is a bisbenzylisoquinoline alkaloid [$C_{31}H_{38}N_2O_6$, *m/z* 606 $[M]^+$] whose UV and IR suggested that there is an imine group in the molecule [λ_{max}^{EtOH} nm: 223, 281, 310; ν_{max}^{KBr} cm^{-1}: 1620 (C=N)]. The ^{1}H NMR displayed a methylene group adjacent to the C=N of a 3,4-dihydroisoquinoline moiety at δ 4.12 and 5.32 (each 1H, *d*, J_{gem} = 2 Hz), one N–Me at δ 2.46 (3H, *s*), and four OMe at δ 3.51, 3.70 (each 3H, *s*) and 3.91 (6H, *s*). In the aromatic proton regions, there are 10 aromatic protons at 6.05, 6.42, 6.63 (each 1H, *s*, H-8′,5′,5), 6.66–6.88 (3H, *m*, H-10, 13, 14), 7.01 (2H, *d*, *J* = 8 Hz, H-11′,13′), and 7.35 (2H, *d*, *J* = 8 Hz, H-10′,14′). Sodium/liquid ammonia cleavage reaction afforded *R*-(−)-*O*-methylarmepavine ($[\alpha]_D^{29}$ −107°) (**17**) and (±)-coclaurine ($[\alpha]_D^{29}$ ±0°) (**18**) respectively), which were identified [mmp, TLC, IR (KBr), ^{1}H NMR] by comparison with authentic samples. Reduction with $NaBH_4$ of dehatrine (**8**) afforded 1,2-dihydrodehatrine (**19**), a bisbenzyltetrahydroisoquinoline alkaloid, [λ_{max}^{EtOH} 228, 280 nm ν_{max}^{KBr} absent 1620 cm^{-1} peak, the signals at δ 4.12 and 5.32 disappeared]. [13]. *N*-Methylation of 1,2-dihydrodehatrine (**19**) gave a mixture of isotetrandrine (**20**) and phaeanthine (**21**) which were separated by prep. TLC. The former was identified [mmp, TLC, IR (KBr), ^{1}H NMR] by comparison with authentic isotetrandrine (**20**). The physical data (mp, $[\alpha]_D$, UV) of the latter was compared with those of phaeanthine (**21**) [13]; they were all in agreement. Therefore, the two ether linkages between the benzyltetrahydroisoquinoline moiety and the 3,4-dihydrobenzylisoquinoline moiety of dehatrine (**8**), are assumed to be at 8-7′, 11-12′ as in the berbamine series. The absolute configuration of H-1 is *R*.

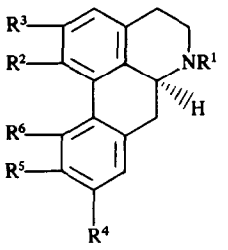
EXPERIMENTAL

Mps: uncorr. ^{1}H NMR were recorded at 60, 100 or 270 MHz with TMS as int. std; chemical shifts are recorded in δ(ppm) units. MS were measured at 75 eV. Silica gel (60–230 mesh) (Merck) and neutral alumina (Merck) were used for CC and silica gel GF-254 for TLC.

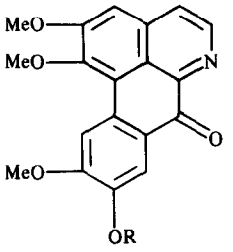
Leaves and trunks of *D. triandra* Merr. were collected at Orchid Island, in August, 1976. Air-dried plant material, was extracted with warm EtOH and the EtOH soln concd under red press to leave a dark brownish viscous residue. Bases in the EtOH extracts were extracted with 3% HOAc and the acidic soln treated with alkalis and $CHCl_3$–Et_2O.

Isocorydine (**1**). Part B (8.7 g from leaf extract) crystallized in contact with Me_2CO as colourless prisms, mp 187–188° (lit. 185–186°) and $[\alpha]_D^{23}$ +205° (MeOH, *c* 0.2) (lit. 194°) [14]. Gibbs test positive. UV and ^{1}H NMR were the same as ref. [5]. Identified [mmp, TLC, IR (KBr)] by comparison with authentic material.

Corytuberine (**2**). The residue remaining after the separation of isocorydine (**1**) was placed on a silica gel column and eluted with $CHCl_3$ gradually enriched with Me_2CO. Fractions eluting with $CHCl_3$–Me_2CO (1:1) provided corytuberine (**2**) as colourless prisms, mp 239–242°, (lit. 240°) [15], $[\alpha]_D^{23}$ +276° (MeOH, *c* 0.1)



	R^1	R^2	R^3	R^4	R^5	R^6
1	Me	OMe	OMe	H	OMe	OH
2	Me	OH	OMe	H	OMe	OH
4	Me	OMe	OMe	OCH_2O		H
5	$(Me)_2$	OMe	OMe	OH	OMe	H
9	$(Me)_2$	OH	OMe	H	OMe	OH
10	Me	OMe	OMe	OH	OMe	H
11	$(Me)_2$	OMe	OMe	OMe	OMe	H



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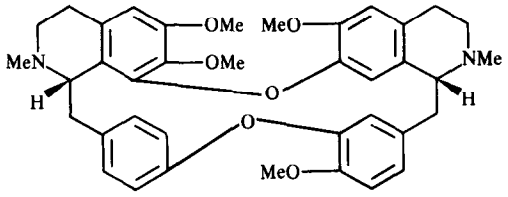
12 R = Ac



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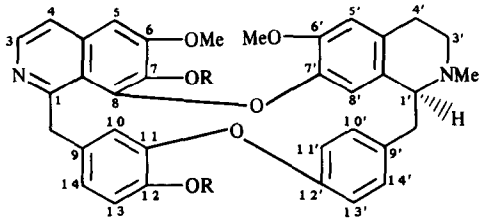
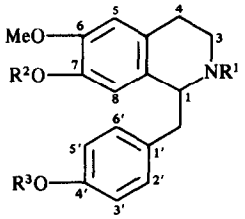


7 R = H
13 R = Me
14 R = Et



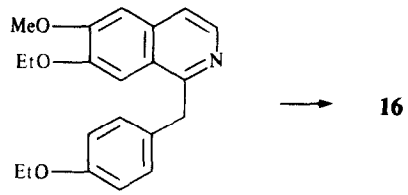
15 R^1 = Me, R^2 = R^3 = H
16 R^1 = H, R^2 = R^3 = Et
17 R^1 = R^2 = R^3 = Me
18 R^1 = R^2 = R^3 = H

(lit. 286°) [16]. MS *m/z*: 327 ($[M]^+$). IR ν_{max}^{KBr} cm^{-1}: 3400 (OH). UV λ_{max}^{EtOH} nm (log ε): 222 (4.4), 268 (4.0), 306 (3.5). UV $\lambda_{max}^{EtOH+KOH}$ nm (log ε): 208 (4.5), 226 (4.4), 276 (3.7), 318 (3.7). ^{1}H NMR (100 MHz, DMSO-d_6): δ 2.55 (3H, *s*, NMe), 3.75 (6H, *s*, OMe × 2), 4.50 (2H, *br s*, OH × 2, D_2O exchangeable), 6.53 (1H, *s*, H-3), 6.58 (1H, *d*, *J* = 8 Hz, H-9), 6.80 (1H, *d*, *J* = 8 Hz, H-8). MeI (**9**): colourless needles, mp 245–248°; $[\alpha]_D^{23}$ +195° (MeOH, *c* 0.1). Identified [mmp. TLC, IR (KBr)] by comparison with magnoflorine (**9**) I.

Atheroline (**3**). Part E from the extract (65 g) of the leaves was chromatographed on silica gel and eluted with $CHCl_3$ gradually enriched with Me_2CO. The fractions eluting with $CHCl_3$–Me_2CO (2:1) afforded atheroline (**3**) as reddish needles (MeOH), mp 250–252° (lit. 250–260°) [9]. $[\alpha]_D^{23}$ ±0° (MeOH, *c* 0.1). UV λ_{max}^{EtOH} nm (log ε): 242 (4.6), 272 (4.6), 292 (4.4), 352 (4.1), 380 (4.0), 433 (3.7), $\lambda_{max}^{EtOH+KOH}$ nm (log ε): 252 (4.7) 299 (4.6), 323 (4.6), 400 (4.2). $C_{19}H_{15}O_5N$, MS *m/z* (%): 337 ($[M]^+$, 100), 322 (30), 307 (22), 294 (26.8), 279 (17), 262 (19.5). ^{1}H NMR (100 MHz, DMSO-d_6): δ 4.00 (6H, *s*, OMe × 2), 4.05 (3H, *s*, OMe), 7.60 (1H, *s*, H-3), 7.73 (1H, *s*, H-8), 8.03 (1H, *d*, *J* = 5 Hz, H-4), 8.70 (1H, *s*, H-11), 8.80 (1H, *d*, *J* = 5 Hz, H-5). Atheroline (**3**) treated with Ac_2O and pyridine gave *O*-acetylatheroline (**12**) as light yellowish needles (Me_2CO), mp 190–193° (lit. 190–195°) [9]. It was identified [mmp, TLC, IR (KBr)] by comparison with authentic material.

Nantenine (**4**). Part G (4.8 g) from extract of leaves was placed on an alumina column and eluted with $CHCl_3$ to provide nantenine (**3**) as colourless needles (Me_2CO), mp 131–134° (lit. 139–141°) [6] and $[\alpha]_D^{20}$ +79° (MeOH, *c* 0.1) (lit. +93°) [7]. UV λ_{max}^{MeOH} nm (log ε) [8]. 223 (4.56), 272 sh (3.9), 282 (4.0), 308 (4.1), 318 sh (4.0). ^{1}H NMR (60 MHz, $CDCl_3$): δ 2.50 (3H, *s*, NMe), 3.63, 3.83 (each 3H, *s*, OMe), 5.93 (2H, *s*, OCH_2O), 6.57 (1H, *s*, H-3), 6.73 (1H, *s*, H-8), 7.90 (1H, *s*, H-11) [7]. The above data correspond with those of nantenine [6–8].

Xanthoplanine (**5**). When the quaternary base part of the leaves was purified by the ordinary method through the base Reineckate→ base sulphate→ base chloride, xanthoplanine (**5**) was obtained as the Cl salt [colourless needles, mp 218–220° (lit. 218–220°) [18], $[\alpha]_D^{18}$ +85° (MeOH, *c* 0.1); UV λ_{max}^{MeOH} nm (log ε): 225 (4.0), 286 (3.6), 310 (3.7); $\lambda_{max}^{MeOH+KOH}$ nm (log ε): 214 (4.5), 254sh (3.8), 343 (4.1); ^{1}H NMR (60 MHz, TFA): δ 3.20, 3.50 (each 3H, *s*, $=N^+Me_2$), 3.88 (3H, *s*, OMe), 4.06 (6H, *s*, OMe × 2), 6.90, 7.03, 8.07 (each 1H, *s*, H-3, 8, 11). Iodide: colourless prisms, mp 190–191° (lit. 148–149°) [18]. Identified [mmp, UV, IR (KBr)] with authentic xanthoplanine I. Picrate: yellow prisms, mp 227–228° (Me_2CO) (lit. 228° decomp.) [19]. *O*-Methylxanthopla-



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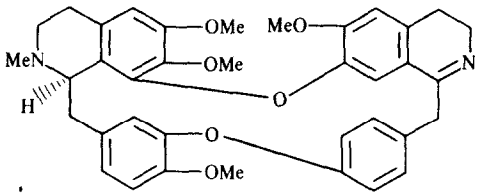

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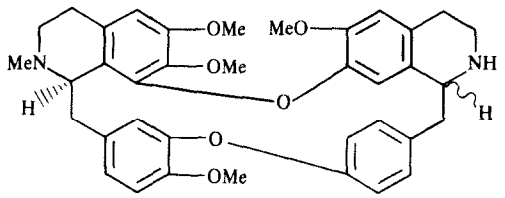

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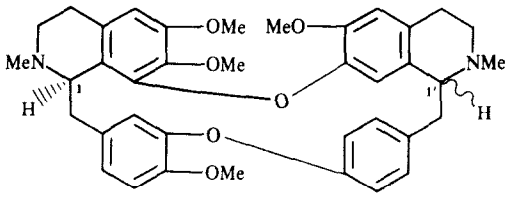

20 H-1 = *R*, H-1′ = *S*
21 H-1 = *R*, H-1′ = *R*

nine (**11**) I: *O*-methylation of xanthoplanine (**5**) I gave glaucine MeI which was identified [mmp, TLC, IR (KBr)] by comparison with an authentic sample.

Obaberine (**6**). Part C (19.6 g) from the extract of trunk was dissolved in Me_2CO and a Me_2CO soln of HBr was added to afford colourless needles (MeOH), mp 263–265° (decomp.) and $[\alpha]_D^{33}$ +165° (MeOH, *c* 0.1). The free base generated from the HBr was an oily substance, $[\alpha]_D^{30}$ +251° ($CHCl_3$, *c* 1.54). Spectra data were the same [TLC, IR ($CHCl_3$), ^1H NMR] as those of obaberine (**6**) [5]. The HBr was identified (mmp, TLC, IR) by comparison with an authentic sample.

Dehatridine (**7**). Part E (65 g) from the extract of leaves was placed on a silica gel column and eluted with $CHCl_3$ gradually enriched with Me_2CO. Fractions eluting with $CHCl_3$–Me_2CO (20:13) gave colourless needles (MeOH), mp 274–276° and $[\alpha]_D^{23}$ +98° (MeOH, *c* 0.1). MS *m/z* (%): 576 ($[M]^+$, 100), 575 (92), 190 (30), 174 (60). Anal.: calcd. for $C_{35}H_{32}O_6N_2$: C, 72.90; H, 5.59; N, 4.86. Found: C, 72.50; H, 5.50; N, 4.76. IR ν_{max}^{KBr} cm^{-1}: 3400 (OH). UV λ_{max}^{EtOH} nm (log ε): 202 (4.4), 243 (4.2), 282 (3.4) and 335 (3.2). $\lambda_{max}^{EtOH+KOH}$ nm (log ε): 207 (5.0), 263 (4.1), 293 sh (3.6) and 373 (3.3). ^1H NMR (270 MHz, DMSO-d_6): δ 2.56 (3H, *s*, NMe), 3.38, 3.82 (each 3H, *s*, 6′,6-OMe), 3.85, 4.66 [each 1H, *d*, J_{gem} = 12.5 Hz, (benzylic methylene)], 5.92 (1H, *s*, H-8′), 6.60 (1H, *d*, J_m = 2 Hz, H-10), 6.62 (1H, *s*, H-5′), 6.69 (1H, *d*, J_o = 8.2 Hz, H-13), 6.82 (1H, *dd*, J_o = 8.2 Hz, J_m = 2 Hz, H-10′), 6.84 (1H, *dd*, J_o = 8.2 Hz, J_m = 2 Hz, H-14), 6.94 (1H, *dd*, J_o = 8.2 Hz, J_m = 2 Hz, H-11′), 7.02 (1H, *s*, H-5), 7.19 (1H, *dd*, J_o = 8.2 Hz, H-13′), 7.43 (1H, *d*, J_o = 5.48 Hz, H-4), 7.66 (1H, *dd*, J_o = 8.2 Hz, J_m = 2 Hz, H-14′), 8.20 (1H, *d*, J_o = 5.48 Hz, H-3). 8.65, 9.03 (each 1H, *s*, OH, D_2O exchangeable).

O,O-*Dimethyldehatridine* (**13**). An Et_2O soln of CH_2N_2 [prepared from MeN(NO)$CONH_2$ (3 g), 50% KOH (40 ml) and Et_2O (130 ml)] was added to dehatridine (**7**) and left for 5 days at room temp. The mixt was evapd under red. pres. to give a yellowish viscous residue (40 mg). $[\alpha]_D^{23}$ +73° (MeOH, *c* 0.1). MS *m/z* (%): 604 ($[M]^+$, 93.8), 603 (100), 302 (22.5). ^1H NMR (60 MHz, $CDCl_3$): δ 2.60 (3H, *s*, NMe), 3.10, 3.40, 3.83, 3.87 (each 3H, *s*, 7,6′,6,12-OMe), 4.10, 5.00, [each 1H, *d*, J_{gem} = 12 Hz, (benzylic methylene)], 5.97 (1H, *s*, H-8′), 6.53 (1H, *s* H-5′), 6.64 (1H, *d*, J_o = 8 Hz, H-13), 6.67 (1H, *d*, J_m = 2 Hz, H-10), 6.80 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-10′), 6.86 (1H, *s*, H-5), 6.87 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-14), 7.00 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-11′), 7.13 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-13′), 7.27 (1H, *d*, J_o = 5 Hz, H-4), 7.50 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-14′), 8.30 (1H, *d*, J_o = 5 Hz, H-3).

O,O-*Diethyldehatridine* (**14**). When dehatridine (**7**) (50 mg) was treated with an Et_2O soln of $C_2H_4N_2$, *O,O*-diethyldehatridine (**14**) (50 mg) was obtained as colourless needles, mp 196–197° (Me_2CO) and $[\alpha]_D^{22}$ +106° (MeOH, *c* 0.1). MS *m/z* (%): 632 ($[M]^+$, 100), 631 (98.3), 316 (30). ^1H NMR (60 MHz, $CDCl_3$): δ 0.97 (3H, *t*, *J* = 8 Hz, 7-$OCH_2\underline{Me}$), 1.47 (3H, *t*, *J* = 8 Hz, 12-$OCH_2\underline{Me}$), 2.60 (3H, *s*, NMe), 3.37 (3H, *s*, 6′-OMe), 3.60 (2H, *q*, *J* = 8 Hz, 7-$O\underline{CH_2}Me$), 3.83 (3H, *s*, 6-OMe), 4.13 (2H, *q*, *J* = 8 Hz, 12-$O\underline{CH_2}Me$), 4.07, 4.97 [each 1H, *d*, *J* = 12 Hz, (benzylic methylene)], 5.97 (1H, *s*, H-8′), 6.53 (1H, *s*, H-5′), 6.63 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-13), 6.70 (1H, *d*, J_m = 2 Hz, H-10), 6.77 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-10′), 6.90 (1H, *s*, H-5), 6.93 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-14), 7.03 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-11′), 7.13 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-13′), 7.27 (1H, *d*, J_o = 5.6 Hz, H-4), 7.53 (1H, *dd*, J_o = 8 Hz, J_m = 2 Hz, H-14′), 8.33 (1H, *d*, J_o = 5.6 Hz, H-3).

Reduction of dehatridine (**7**). The reducing agents, Na, Na/Hg, Zn + HOAc, Zn + H_2SO_4, Zn/Hg, $NaBH_4$ and Pd/C + H_2 were used for the reduction of dehatridine (**7**) but it was resistant to these reducing agents.

Na/liq. NH_3 *cleavage of* O,O-*diethyldehatridine* (**14**). A THF soln of **14** (37 mg) was added dropwise to a Na (80 mg)/liq. NH_3 (30 ml) soln at −45 ~ −50° while stirring; stirring was than continued for 2 hr at the same temp. The reaction mixt was left overnight to remove NH_3 at room temp. A small amount of MeOH (2 ml) was added to the residue and then H_2O (20 ml) added. The mixt was evapd to remove the excess MeOH under red. pres. and the turbid H_2O soln extd with Et_2O. The Et_2O soln was dried (K_2CO_3) and evapd to leave a light yellowish residue of (±)-*O,O*-diethylcoclaurine (**16**) (12 mg). The aq layer was acidified with HCl, then basified with NH_4OH and extd with Et_2O. The Et_2O soln was dried (K_2CO_3) and evapd to yield (+)-*N*-methylcoclaurine (**15**) (15 mg).

(±)-O,O-*Diethylcoclaurine* (**16**). Light yellowish viscid base, $[\alpha]_D^{23}$ ±0° (MeOH, *c* 0.1), UV λ_{max}^{MeOH} nm (log ε): 230 (4.2) and 282 (3.6). ^1H NMR (60 MHz, $CDCl_3$): δ 1.27 (3H, *t*, *J* = 8 Hz, OCH_2Me), 1.40 (3H, *t*, *J* = 8 Hz, OCH_2Me), 3.80 (3H, *s*, OMe), 4.00 (4H, *q*, *J* = 8 Hz, OCH_2Me × 2), 6.60 (1H, *s*, H-8), 6.73 (1H, *s*, H-5), 6.87 (2H, *d*, J_o = 8 Hz, H-3′,5′), 7.03 (2H, *dd*, J_o = 8 Hz, H-2′, 6′). The $[\alpha]_D$, UV and ^1H NMR were in agreement with those of (±)-*O,O*-diethylcoclaurine.

(+)-N-*Methylcoclaurine* (**15**). $[\alpha]_D^{23}$ +64° (MeOH, *c* 0.1). UV λ_{max}^{MeOH} nm (log ε): 231 (4.1) and 288 (3.6). UV $\lambda_{max}^{MeOH+KOH}$ nm (log ε): 223 (4.3), 250 (4.0), 296 (3.6). ^{1}H NMR (60 MHz, $CDCl_3$): δ 2.47 (3H, *s*, NMe), 3.83 (3H, *s*, OMe), 5.03 (2H, *s*, OH × 2, D_2O exchangeable), 6.37 (1H, *s*, H-8), 6.53 (1H, *s*, H-5), 6.63 (2H, *d*, J_o = 8 Hz, H-3′, 5′), 6.93 (2H, *d*, J_o = 8 Hz, H-2′, 6′). Identified [TLC, UV, ^{1}H NMR, IR ($CHCl_3$)] by comparison with an authentic sample.

Dehatrine (**8**). The Me_2CO soln after separating obaberine (**6**) HBr was evapd under red. pres. at room temp to leave a dark brownish viscous residue. The residue was dissolved in $CHCl_3$ and the soln extracted with 2% H_2SO_4. The H_2SO_4 soln was basified with NH_4OH and extracted with Et_2O. The Et_2O soln was dried (K_2CO_3) and evapd to leave a yellowish viscous residue. This was placed on a silica gel column and eluted with $CHCl_3$ to give dehatrine (**8**) as colourless needles (EtOH), mp 158–160° and $[\alpha]_D^{27}$ +27° ($CHCl_3$, *c* 1.0). MS *m/z* (%): 606 ($[M]^+$, 100), 605 (70), 591 (35), 303 (68), 280 (15), 204 (20), 155 (15), 141 (45). UV λ_{max}^{MeOH} nm (log ε): 223 (4.5), 281 (3.8), 310 (3.5). IR ν_{max}^{KBr} cm^{-1}: 1620 (C=N). ^{1}H NMR (100 MHz, $CDCl_3$): δ 2.46 (3H, *s*, NMe), 3.51 (3H, *s*, OMe), 3.70 (3H, *s*, OMe), 3.91 (6H, *s*, OMe × 2), 4.12 and 5.32 [each 1H, *d*, *J* = 2 Hz, (benzylic methylene)], 6.05 (1H, *s*, H-8′), 6.42 (1H, *s*, H-5′), 6.63 (1H, *s*, H-5), 6.66–6.88 (3H, *m*, Ar. H), 7.01 (2H, *d*, *J* = 8 Hz, H-11′, 13′), 7.35 (2H, *d*, *J* = 8 Hz, H-10′, 14′). Anal.: calcd for $C_{37}H_{38}O_6N_2\ H_2O$, C, 70.25; H, 6.11; N, 4.34. Found: C, 70.41; H, 6.11; N, 4.28.

Na/liq. NH_3 *cleavage of dehatrine* (**8**). When a THF soln of **8** (450 mg) was treated with Na (700 mg)/liq. NH_3 (150 ml) as described for *O,O*-diethyldehatridine (**14**), *R*-(−)-*O*-methylarmepavine (**17**) (230 mg) and (±)-coclaurine (**18**) (205 mg) were obtained.

R-(−)-O-*Methylarmepavine* (**17**). Oxalate: colourless needles, mp 170–175° (EtOH) and $[\alpha]_D^{29}$ −107° (MeOH, *c* 1.25). UV λ_{max}^{EtOH} nm (log ε): 212 (4.0), 225 (4.0), 282 (3.5). MS *m/z* (%): 327 ($[M]^+$, 2), 206 (100), 191 (54), 190 (35), 152 (53), 151 (33). Anal.: calcd for $C_{20}H_{25}NO_3\ (COOH)_2\ H_2O$, C, 60.68; H, 6.71; N, 3.22. Found: C, 60.83; H, 6.53; N, 3.01. Identified [mmp, UV, IR (KBr)] by comparison with an authentic sample. ^{1}H NMR (100 MHz, $CDCl_3$) of *R*-(−)-*O*-methylarmepavine (**17**) generated from oxalate: δ 2.52 (3H, *s*, NMe), 3.56, 3.76 and 3.82 (each 3H, *s*, OMe), 6.00 (1H, *s*, H-8), 6.52 (1H, *s*, H-5), 6.78 (2H, *d*, J_o = 8 Hz, H-3′, 5′), 7.00 (2H, *d*, J_o = 2 Hz, H-2′, 6′). MeI: colourless prisms, mp 129–130° (swelling) (MeOH). Anal.: calcd. for $C_{18}H_{28}O_3NI\ 1\ 1/2\ H_2O$, C, 50.81; H, 6.29; N, 2.80. Found: C, 50.56; H, 6.32; N, 2.82. Identified [mmp, IR (KBr)] by comparison with an authentic sample.

(±)-*Coclaurine* (**18**). UV λ_{max}^{EtOH} nm (log ε): 207 (4.0), 225 (3.7), 283 (3.3). MS *m/z* (%): 285 ($[M]^+$, 4), 178 (67), 177 (100), 162 (79), 161 (31), 148 (21). Anal. Calcd. for $C_{17}H_{19}NO_3$ HBr 3/4 H_2O: C, 53.76; H, 5.71, N, 3.69. Found: C, 53.73; H, 5.81; N, 3.77. ^{1}H NMR (100 MHz, $CDCl_3$): δ 3.84 (3H, *s*, OMe), 4.08 (2H, *br s*, OH × 2, D_2O exchangeable), 6.52 (1H, *s*, H-8), 6.60 (1H, *s*, H-5), 6.72 (2H, *d*, *J* = 8 Hz, H-3′, 5′), 7.00 (2H, *d*, *J* = 8 Hz, H-2′, 6′). HBr: Light orange needles, mp 255–256° (decomp.) (MeOH). $[\alpha]_D^{30}$ ±0° (MeOH, *c* 0.1). Identified [mmp, IR (KBr)] by comparison with an authentic sample.

(±)-1′,2′-*Dihydrodehatrine* (**19**). Dehatrine (**8**) (60 mg) was reduced by $NaBH_4$ in MeOH at room temp to afford (±)-1′,2′-dihydrodehatrine (**19**) (58 mg). $[\alpha]_D^{23}$ −52° (MeOH, *c* 0.1). UV λ_{max}^{MeOH} nm (log ε): 228 (4.6), 280 (3.6). ^{1}H NMR (60 MHz, $CDCl_3$): δ 2.30 (3H, *s*, NMe), 3.20, 3.63, 3.73 and 3.90 (each 3H, *s*, OMe), 6.00 (1H, *s*, H-8′), 6.27 (1H, *s*, H-5′), 6.50 (1H, *s*, H-5), 6.63–7.25 (7H, *m*, Ar. H).

N-*Methylation of* 1′, 2′-*dihydrodehatrine* (**19**). Ten drops of 35% HCHO were added to a MeOH soln of **19** (58 mg) and stirred for 10 min at room temp. $NaBH_4$ (1 g) divided into three parts was then added to the MeOH soln while stirring. After 2 hr, the mixt. was acidified with 10% HOAc and evapd to remove MeOH under red. pres. The conc soln was basified with NH_4OH and extracted with Et_2O. The Et_2O soln was dried (K_2CO_3) and evapd to leave a light yellowish viscous residue. The residue $[\alpha]_D^{23}$ −42° (MeOH, *c* 0.1) was divided into two parts (R_f 0.56 and 0.6) by prep. TLC [silica gel, $CHCl_3$–MeOH (13:1)]. Isotetrandrine (**20**) (30 mg) and phaeanthine (**21**) (20 mg) were obtained from the zone R_f 0.56 and R_f 0.6, respectively.*

Isotetrandrine (**20**). Colourless prisms (Me_2CO), mp 189–190.5° and $[\alpha]_D^{23}$ +140° (MeOH, *c* 0.1). UV λ_{max}^{MeOH} nm (log ε): 216 (4.9), 240 sh (4.3), 284 (3.8). ^{1}H NMR (60 MHz, $CDCl_3$): δ 2.23, 2.53 (each 3H, *s*, NMe), 3.60, 3.73, 3.90 (each 3H, *s*, OMe), 6.00 (1H, *s*, H-8′), 6.30 (1H, *s*, H-5′), 6.40 (1H, *s*, H-5), 6.50–7.20 (7H, *m*, Ar. H). Identified [mmp, TLC, IR (KBr), ^{1}H NMR] by comparison with an authentic sample.

Phaeanthine (**21**). Colourless needles (Me_2CO), mp 142–145° and $[\alpha]_D^{23}$ −230° (MeOH, *c* 0.1). UV λ_{max}^{MeOH} nm (log ε): 218 (4.5), 240 sh (4.2), 280 (4.1). ^{1}H NMR (60 MHz, $CDCl_3$): δ 2.33, 2.60 (each 3H, *s*, NMe), 3.17 3.33, 3.70 and 3.90 (each 3H, *s*, OMe), 5.97 (1H, *s*, H-8′), 6.23 (1H, *s*, H-5′), 6.47 (1H, *s*, H-5), 6.53 (1H, *s*, H-10), 6.73–7.40 (6H, *m*, Ar. H). Its mp, $[\alpha]_D$, UV, MS and ^{1}H NMR were in agreement with those of phaeanthine in the lit. [13].

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