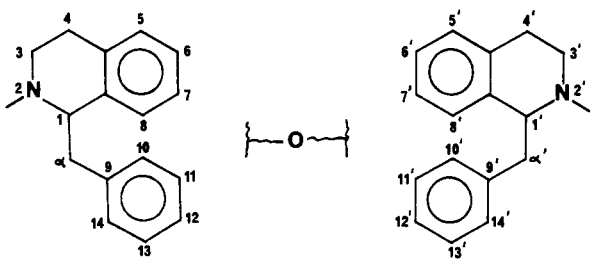
# BISBENZYLISOQUINOLINE ALKALOIDS

PAUL L. SCHIFF, JR.

*Department of Pharmacognosy, School of Pharmacy, University of Pittsburgh, Pittsburgh, Pennsylvania 15261*

The bisbenzylisoquinoline alkaloids are represented by approximately two hundred compounds which occur primarily in the Families Berberidaceae, Menispermaceae, Monimiaceae and Ranunculaceae (1). Although a number of reviews or books have been published concerning these alkaloids (1–14), the review of Guha *et al.* (1), which was published in this journal in early 1979 and reported on the literature through 1977, was the first comprehensive tabular compilation of spectral and related data for this group of alkaloids.

This present review is concerned with the literature from 1978 through 1981 (*Chemical Abstracts* volumes 88 through 95) and is, likewise, presented principally in a tabular form. The numbers of the alkaloids and the structural type nomenclature have been retained according to the review of Guha *et al.* (1) in order to maintain a consistency between that review and this one. Since the publication of the Guha review, approximately thirty-eight new bisbenzylisoquinoline alkaloids have been isolated and characterized. Furthermore, structural revision for several alkaloids has occurred with additional physiochemical and spectral data becoming available for numerous other alkaloids. Each alkaloid in the tabular section is described according to its name, molecular formula, molecular weight, melting point, specific rotation, and available spectral data, the last of which may include infrared, ultraviolet, proton magnetic resonance, carbon magnetic resonance, circular dichroism and mass spectra. The numbering of the skeleton and the systematic numerical classification describing the oxygenation and dimerization patterns of the alkaloids follow the convention established by Shamma and Moniot (162) as exemplified by:

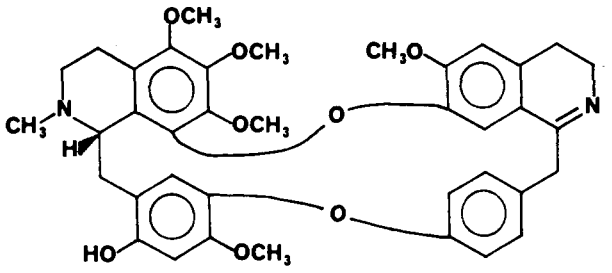



Unless otherwise stated, the ultraviolet spectra (nm, log $\epsilon$), the circular dichroism spectra, and the optical rotatory dispersion spectra were obtained in methanol, the infrared spectra ($cm^{-1}$) in the chloroform, and both the proton magnetic resonance and carbon magnetic resonance spectra in deuteriochloroform. Chemical shifts are in $\delta$ units and coupling constants in Hz. The fluorescence spectra were measured in ethanol at 285nm ($\phi_f$ = fluorescence quantum yield and $\tau_f$/ns = fluorescence lifetime), while the phosphorescence spectra were measured in ethanol at 285nm and 77°K ($\phi_p$ = phosphorescence quantum yield and $\tau_p$/ns = phosphorescence lifetime).

TABLE 1. Revised Structures of Previously Reported Bisbenzylisoquinoline Alkaloids (1)

**112.** THALIBRUNIMINE $C_{38}H_{40}O_6N_2$: 652.2785

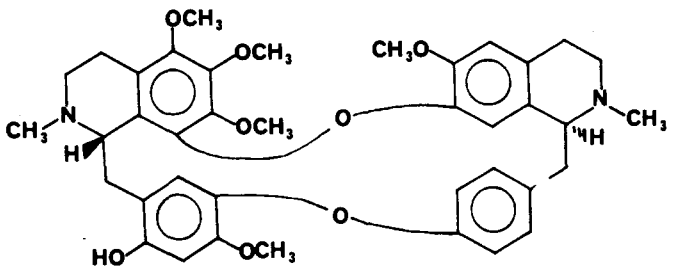
Type XVII[1] (*S*,−)5,6,7,8*,10,12,13$^+$−6,7*,12$^+$




Since thalibrunine was revised (36), thalibrunimine must be likewise revised (36).

**113.** THALIBRUNINE $C_{39}H_{44}O_8N_2$: 668.3098

Type XVII[1] (*S*,*S*)5,6,7,8*,10,12,13$^+$−6,7*,12$^+$




MP: 172–174° ($CH_3OH$) (36)

$^1$HNMR: ($[CD_3]_2CO$) $NCH_3$ 2.46, 2.52, $OCH_3$ 3.15, 3.38, 3.73, 3.79, 3.82; ArH 5.89, 6.37, 6.46, 6.64, split ABXY pattern of the disubstituted phenyl ring, each a one proton doublet of doublets 6.26 ($J$=2.0, 8.3 Hz), 6.36 ($J$=2.4, 8.3 Hz), 7.16 ($J$=2.4, 8.1 Hz), 7.37 ($J$=2.0, 8.1 Hz); OH 11.9 (36).

SOURCES: *Thalictrum rochebrunianum* (Ranunculaceae) (36)

DERIVATIVES: Thalibrunine acetate (Thalibrunine+pyr+$Ac_2O$) (36)

MP: 236–237° ($CH_3COOC_2H_5$) (36)

$[\alpha]^{22}D$: +161° (c=0.26, $CH_3CN$) (36)

IR: 1742 (36)

$^1$HNMR: $NCH_3$ 2.30, 2.63; $OCOCH_3$ 2.26; $OCH_3$ 3.17, 3.33, 3.77, 3.80, 3.90; ArH 5.96, 6.48, 6.60, 6.63, split ABXY pattern at 6.27 ($J$=1.9, 8.3 Hz), 6.78 ($J$=2.5, 8.3 Hz), 7.13 ($J$=2.5, 8.0 Hz), 7.35 ($J$=1.9, 8.0 Hz) (36)

CD: (1.0 x $10^{-3}$M in $CH_3CN$) 216 (+380,000), 245 (−77,000), 266 (+8,000), 287 (+46,000) (36)

DERIVATIVES: *N,N,*-Dimethylthalibrunine acetate diiodide (Thalibrunine+$CH_3I$ in $(CH_3)_2CO$) (36)

MP: 232–234° ($(CH_3)_2CO$) (36)

$[\alpha]^{22}D$: +210° (c=0.55, $CH_3OH$) (36)

IR: (Nujol) 1763 (36)

$^1$HNMR: ($[CD_3]_2SO$) $\overset{+}{N}(CH_3)_2$ 2.98, 3.08, 3.16, 3.46; $OCOCH_3$ 2.35; $OCH_3$ 3.18, 3.43, 3.73, 3.82, 3.84; ArH 6.05, 6.70, 6.90 (2), split ABXY pattern with multiplats centered at 6.48, 6.98, 7.03, 7.53 (36)

Also, $KMnO_4$ and $(NH_4)_2Ce(NO_3)_6$ were used to obtain oxidation products useful in the elucidation of structure (36)

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[1]Revised type XVII from that presented in the review by Guha *et al.* (1).

TABLE 2. Additional Physical and Spectral Data on Previously Reported Bisbenzylisoquinoline Alkaloids.

**3.** Dauricine $C_{38}H_{44}O_6N_2$: 624.3199
Fluorescence spectra: λmax 307nm, $\phi_f$ 0.211, $\tau_f$/ns 1.1 sec at 77K and λmax 316nm, $\phi_f$ 2.05 x $10^{-2}$ at 298K (107)
Phosphorescence spectrum: λmax 435nm, $\phi_p$ 6.92 x $10^{-2}$, $\tau_p$/ns 0.83 sec. (121)

**20.** Funiferine $C_{38}H_{42}O_6N_2$: 622.3043
The absolute configuration at C-1 and C-1' was determined to be *S* and *R* by relation to tiliageine (*O*-methylfuniferine = *O,O*-dimethyltiliageine) whose absolute configuration was established by biosynthetic studies in *Tiliacora racemosa* Colebr (Menispermaceae) (117)

**27.** Tiliageine $C_{37}H_{40}O_6N_2$: 608.2886
The absolute configuration at C-1 and C-1' was determined to be *S* and *R*, respectively, by tritium labelling studies utilizing (+)-*S*- and (−)-*R*-*N*-methylcoclaurines in *Tiliacora racemosa* (Menispermaceae) (117)

**45.** *O*-Methylrepandine $C_{38}H_{42}O_6N_2$: 622.3043
Fluorescence spectra: ($CH_3CH_2OH$) (285nm) λmax 305nm, $\phi_f$ 0.265, $\tau_f$/ns 0.8 sec at 77K and λmax 313nm, $\phi_f$ 1.97 x $10^{-2}$ at 298K (107)
Phosphorescence spectrum: ($CH_3CH_2OH$) (285nm) (77K) λmax 445nm, $\phi_p$ 4.31 x $10^{-2}$, $\tau_p$/ns 0.77 sec. (121)

**46.** Obaberine $C_{38}H_{42}O_6N_2$: 622.3043
Fluorescence spectra: λmax 310nm, $\phi_f$ 0.138, $\tau_f$/ns 1.2 sec. at 77K and λmax 314nm, $\phi_f$ 6.85 x $10^{-3}$ at 298K (107)
Phosphorescence spectrum: λmax 413nm, $\phi_p$ 4.66 x $10^{-2}$, $\tau_p$/ns 2.33 sec. (121)

**48.** Oxycanthine $C_{37}H_{40}O_6N_2$: 608.2886
Fluorescence spectra: λmax 310nm, $\phi_f$ 0.185, $\tau_f$/ns 1.9 sec. at 77K and λmax 316nm, $\phi_f$ 6.70 x $10^{-3}$ at 298K (107)
Phosphorescence spectrum: λmax 439nm, $\phi_p$ 1.79 x $10^{-2}$, $\tau_p$/ns 0.98 sec. (121)

**49.** Repandine $C_{37}H_{40}O_6N_2$: 608.2886
Fluorescence spectra: λmax 306nm, $\phi_f$ 0.139, $\tau_f$/ns 1.0 sec at 77K and λmax 319nm, $\phi_f$ 2.40 x $10^{-2}$ at 298K (107)
Phosphorescence spectrum: λmax 450nm, $\phi_p$ 2.12 x $10^{-2}$, $\tau_p$/ns 1.08 sec. (121)

**53.** Thalisopidine $C_{37}H_{40}O_7N_2$: 624.2836
CD: 209(Δε−69.7), 224(+34.4), 241(−22.9), 272(−6.90), 290(+3.51) (117); ($CH_3OH$+HCl) 210(−77.7), 221(+39.4), 241(−27.1), 272(−6.90) (129)

**54.** Thalisopine $C_{38}H_{42}O_7N_2$: 638.2992
CD: 208(Δε−55.0), 224(+38.0), 241(−25.1), 270(−5.91), 289(+3.87) (118); ($CH_3OH$+HCl) 207(−62.1), 221(+42.9), 240(−31.7), 268(−6.3) (129)

**56.** Atherospermoline $C_{30}H_{38}O_6N_2$: 594.2730
The review of Guha et al. (152) cited both $^1$HNMR $NCH_3$ resonances at 2.62(169) while a later reference (170) gave the following:
$^1$HNMR: $NCH_3$ 2.31(N-2), 2.62(N-2'); $OCH_3$ 3.30(C-6'), 3.76(C-6) (161)

**57.** Berbamine $C_{37}H_{40}O_6N_2$: 608.2886
$^{13}$CNMR[2]: 62.0(C-1), 44.7(C-3), 23.9(C-4), 129.0(C-4a), 105.4(C-5), 151.7(C-6), 136.8(C-7), 147.7(C-8), 120.1(C-8a), 37.5(C-α), 134.0(C-9), 115.3(C-10), 143.8 (C-11), 147.3(C-12), 114.6(C-13), 123.5(C-14), 63.4(C-1'), 45.2(C-3'), 24.8(C-4'), 127.9(C-4a'), 111.1(C-5'), 149.9(C-6'), 143.4(C-7'), 119.7(C-8'), 126.3(C-8a'), 38.2(C-α'), 134.6(C-9'), 130.0(C-10'), 121.2(C-11'), 153.9(C-12'), 121.4(C-13'), 132.0(C-14'), 42.6($NCH_3$), 42.0(N'$CH_3$), 55.7($OCH_3$), 55.7($OCH_3$), 60.3(C-7 $OCH_3$) (134)
Fluorescence spectra: λmax 312nm, $\phi_f$ 0.177, $\tau_f$/ns 1.1 sec at 77K and λmax 318nm, $\phi_f$ 1.44 x $10^{-2}$ at 298K (121)
Phosphorescence spectrum: λmax 424nm, $\phi_p$ 4.85 x $10^{-2}$, $\tau_p$/ns 1.35 sec. (121)

*O*-Acetylberbamine $C_{39}H_{42}O_7N_2$: 650.2992
$^{13}$CNMR[2]: 62.0(C-1), 44.8(C-3), 23.8(C-4), 127.1(C-4a), 105.4(C-5), 151.7(C-6), 137.8(C-7), 147.6(C-8), 120.3(C-8a), 37.6(C-α), 137.8(C-9), 116.9(C-10), 151.4 (C-11), 141.5(C-12), 121.2(C-13), 123.3(C-14), 63.7(C-1'), 45.9(C-3'), 25.5 (C-4'), 128.5(C-4a'), 111.0(C-5'), 149.7(C-6'), 143.3(C-7'), 119.6(C-8'), 126.6 (C-8a'), 38.1(C-α'), 135.2(C-9'), 130.1(C-10'), 121.9(C-11'), 153.9(C-12'), 121.7(C-13'), 132.1(C-14'), 42.7($NCH_3$), 42.7(N'$CH_3$), 55.7($OCH_3$), 55.5($OCH_3$), 60.4(C-7 $OCH_3$), 169.0($COCH_3$), 20.8($COCH_3$) (134)

**61.** Fangchinoline $C_{37}H_{40}O_6N_2$: 608.2886
Fluorescence spectra: λmax 309nm, $\phi_f$ 0.105, $\tau_f$/ns 0.9 sec at 77K and λmax 314nm, $\phi_f$ 1.10 x $10^{-2}$ at 298K (121)
Phosphorescence spectrum: λmax 465nm, $\phi_p$ 9.81 x $10^{-3}$, $\tau_p$/ns 1.17 sec (121)

**62.** Isotetrandrine $C_{38}H_{42}O_6N_2$: 622.3043
CD: 200(Δε+22.1), 225(+28.8), 242(−8.22), 282(+3.56) (118); ($CH_3OH$+HCl) 203(+19.9), 215(−5.86), 226(+24.4), 242(−6.24), 282(+3.56) (129)
Flourescence spectra: λmax 308nm, $\phi_f$ 0.137, $\tau_f$/ns 0.8 sec. at 77K and λmax 312nm, $\phi_f$ 8.55 x $10^{-3}$ at 298K (121)
Phosphorescence spectrum: λmax 426nm, $\phi_p$ 3.02 x $10^{-2}$, $\tau_p$/ns 1.22 sec. (121)

[2]The signals for carbons 4a, 4a', and 8a' may be reversed as well as signals for C-10' and C-14' and for N-2 and N-2'.

**66a.** 2'-*N*-Methylberbamine[3] $C_{38}H_{43}O_6N_2$: 623.3121
MP: Amorphous iodide (19)
UV: ($CH_3CH_2OH$) 282(3.87) (19)
$^1$HNMR: ($C_5D_5N$) $NCH_3$ 2.14; $N^+(CH_3)_2$ 3.20(2); $OCH_3$ 3.35(2), 3.57; ArH 6.35–7.10(10) (19)
MS: $M^+$ 622 (M–HI), 608(M–$CH_3$I), 417, 396, 395, 381, 198, 175, 174, 142, 127, 58(100) (19)
SOURCES: *Berberis oblonga* (Berberidaceae) (19)
DERIVATIVES: O-Methyl-2'-N-Methylberbamine(2'-N-Methylberbamine+$CH_2N_2$) (19)
MP: 220–222° (Tetrahydrofuran) (19)
$[\alpha]_D$: +29.2° (c=0.16, $CHCl_3$) (19)
$^1$HNMR: $NCH_3$ 2.15; $N^+(CH_3)_2$ 3.06; $OCH_3$ 3.31, 3.55, 3.72, 3.82; ArH 6.21–6.75(10) (19)
MS: $M^+$636(M–HI), 622(M–$CH_3$I), 607, 485, 431, 395, 381, 198, 175, 174, 142, 127, 58(100) (19)
Hofmann degradation of *O*-Methyl-2'-*N*-Methylberbamine afforded two monostilbenes, one of which was reductively cleaved (Birch-Na/$NH_3$) to *N*-Methylarmepavine and Dihydrode-N-methylcoclaurine (19)

**71.** Obamegine $C_{36}H_{38}O_6N_2$: 594.2730
$^1$HNMR: (360 MHz) $NCH_3$ 2.33, 2.50; $OCH_3$ 3.79, 3.94; ArH 6.07, 6.24 (d, J=2.2 Hz), 6.37, 6.44 (dd, J=2.9 and 8.6 Hz), 6.62 (dd, J=2.2 and 8.6 Hz), 6.75 (d, J=8.6 Hz), 6.77, 6.84(dd, J=2.9 and 8.6 Hz), 7.11(dd, J=2.9 and 8.6 Hz), 7.33(dd, J=2.9 and 8.6 Hz) (159)
$[\alpha]^{19}_D$: +225° (*c*=0.013, $CH_3CH_2OH$) (159)
Fluorescence spectra: λmax 302nm, $\phi_f$ 0.231, $\tau_f$/ns 1.2 sec. at 77K and λmax 317nm, $\phi_f$ 1.32 x $10^{-2}$ at 298K (121)
Phosphorescence spectrum: λmax 420nm; $\phi_p$ 1.34 x $10^{-1}$, $\tau_p$/ns 0.87 sec (121)

**74.** Phaeanthine $C_{38}H_{42}O_6N_2$: 622.3043
$^{13}$CNMR[2]: 61.4(C–1), 44.1(C–3), 22.1(C–4), 128.0(C–4a), 105.8(C–5), 151.2(C–6), 137.9(C–7), 148.2(C–8), 123.0(C–8a), 41.9(C–α), 134.9(C–9), 116.2 (C–10),146.9 (C–11), 149.3(C–12), 111.6(C–13), 122.6(C–14), 63.9(C–1'), 45.3(C–3'), 25.3 (C–4'), 128.1(C–4a'), 112.7(C–5'), 148.5(C–6'), 143.7(C–7'), 120.0(C–8'), 127.8 (C–8a'), 38.3(C–α'), 134.9(C–9'), 129.9(C–10'), 121.7(C–11'), 153.6(C–12'), 121.7 (C–13'), 132.4(C–14'), 42.3($NCH_3$), 42.6($NCH_3$), 55.8($OCH_3$), 56.1($OCH_3$), 60.1(C–7 $OCH_3$) (134)
Fluorescence spectra: λmax 307nm, $\phi_f$ 0.349, $\tau_f$/ns 0.6 sec. at 77K and λmax 312nm, $\phi_f$ 1.46 x $10^{-2}$ at 298K (121)
Phosphorescence spectrum: λmax 434nm, $\phi_p$ 4.39 x $10^{-4}$, $\tau_p$/ns 2.20 sec. (121)

**76.** Tetrandrine $C_{38}H_{42}O_6N_2$: 622.3043
Fluorescence spectra: λmax 307nm, $\phi_f$ 0.300, $\tau_f$/ns 0.5 sec at 77K and λmax 312nm, $\phi_f$ 1.46 x $10^{-2}$ at 298K (121)
Phosphorescence spectrum: λmax 438nm, $\phi_p$ 3.36 x $10^{-4}$, $\tau_p$/ns 2.30 sec. (121)

**81.** Hernandezine $C_{39}H_{44}O_7N_2$: 652.3149
CD: 197(Δε–87.2), 216(+96.4), 244(–12.6), 282(+7.79) (118); ($CH_3OH$+HCl) 197(–87.2), 215(+120.6), 244(–11.7), 283(+6.12) (129)
Fluorescence spectra: λmax 305nm, $\phi_f$/ 0.083, $\tau_f$/ns 1.2 sec at 77K and λmax 316nm, $\phi_f$ 4.12 x $10^{-3}$ plus λmax 398nm, $\phi_f$ 4.23 x $10^{-3}$ at 298K (121)
Phosphorescence spectrum: λmax 424nm, $\phi_p$ 3.63 x $10^{-5}$ (121)
Isohernandezine
CD: 207(Δε–43.3), 228(–30.6), 245(+23.3), 285(–7.20) (129) ($CH_3OH$+HCl) 204(–50.5), 215(+19.7), 228(–35.0), 243(+33.5), 283(–9.52) (129)

**85.** Thalsimidine $C_{37}H_{38}O_7N_2$: 622.2679
CD: 200(Δε–41.0), 220(+25.4), 251(–1.86), 274(+4.30), 290(–2.80), 323(–0.57) (129)
($CH_3OH$+HCl) 201(–42.0), 212(+29.0), 245(+14.5), 282(–2.22), 318(–2.71), 370(–0.41) (129)
*O*-Ethyldihydrothalsimidine $C_{39}H_{44}O_7N_2$: 652.3149
CD: 196(Δε–57.0), 216(+52.4), 246(–9.94), 282(+4.99) (129)
($CH_3OH$+HCl) 197(–57.0), 213(+64.4), 246(–8.55), 288(+3.96) (129)
*O*-Ethyldihydroisothalsimidine
CD: 203(Δε–2.41), 215(+5.71), 228(–5.09), 243(+5.79), 282(–2.28) (129)
($CH_3OH$+HCl) 201(–26.8), 215(+16.2), 228(–6.15), 242(+12.4), 282(–3.42) (129)

**86.** Thalsimine $C_{38}H_{40}O_7N_2$: 636.2836
CD: 206(Δε–23.0), 217(+11.4), 240(+16.8), 269(+4.95), 289(–2.58), 318(–0.91) (129)
($CH_3OH$+HCl) 204(–23.0), 216(+13.4), 246(+19.8), 293(–1.30), 318(–2.17), 360(–0.98) (129)

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[2]This alkaloid was cited in the review by Guha *et al*, (1) but the data was unavailable at that time.

**88** or **89**. Nortenuipine $C_{37}H_{38}O_7N_2$: 622.2679
$^{13}$CNMR[2]: 61.5(C-1), 44.0(C-3), 21.7(C-4), 123.0(C-4a), 104.7(C-5), 145.6(C-6), 134.3(C-7), 141.6(C-8), 123.0(C-8a), 42.2(C-$\alpha$), 136.5(C-9), 110.3(C-10), 143.1 (C-11), 133.3(C-12), 148.2(C-13), 104.5(C-14), 63.5(C-1'), 45.0(C-3'), 25.2(C-4'), 128.2(C-4a'), 112.8(C-5'), 148.6(C-6'), 143.3(C-7'), 120.4(C-8'), 127.7(C-8a'), 37.5(C-$\alpha$'), 135.1(C-9'), 129.9(C-10'), 121.4(C-11'), 153.1(C-12'), 121.4(C-13'), 132.3(C-14'), 42.2($NCH_3$), 42.2($NCH_3$), 56.0($OCH_3$), 101.2($CH_2O_2$) (134)
Fluorescence spectra: $\lambda$max 309nm, $\phi_f$ 0.192, $\tau_f$/ns 0.9 sec at 77K and $\lambda$max 315nm, $\phi_f$ 1.75 x $10^{-2}$ at 298K (121)
Phosphorescence spectrum: $\lambda$max 452nm, $\phi_p$ 7.43 x $10^{-2}$, $\tau_p$/ns 0.34 sec. (121)
O-Acetylnortenuipine $C_{39}H_{40}O_8N_2$: 664.2785
$^{13}$CNMR[2]: 61.4(C-1), 43.8(C-3), 22.0(C-4), 134.9(C-4a), 105.6(C-5), 149.7(C-6), 130.9(C-7), 147.0(C-8), 122.4(C-8a), 42.7(C-$\alpha$), 136.5(C-9), 110.5(C-10), 143.1 (C-11), 133.4(C-12), 148.4(C-13), 104.6(C-14), 64.1(C-1'), 45.5(C-3'), 24.9 (C-4'), 128.9(C-4a'), 112.5(C-5)', 148.7(C-6'), 142.6(C-7'), 120.5(C-8'), 127.7 (C-8a'), 39.7(C-$\alpha$'), 134.9(C-9'), 130.0(C-10'), 121.6(C-11'), 153.4(C-12'), 121.6(C-13'), 132.4(C-14'), 42.2($NCH_3$), 42.1($NCH_3$), 55.9($OCH_3$), 55.7($OCH_3$), 101.3($CH_2O_2$), 167.5(*C*$OCH_3$), 19.7(CO*C*$H_3$) (134)

**90**. Repandinine $C_{38}H_{40}O_7N_2$: 636.2836
Fluorescence spectra: $\lambda$max 306nm, $\phi_f$ 0.34, $\tau_f$/ns 1.3 sec at 77K and $\lambda$max 312nm, $\phi_f$ 1.49 x $10^{-2}$ at 298K (121)
Phosphorescence spectrum: $\lambda$max 449nm, $\phi_p$ 9.49 x $10^{-2}$, $\tau_p$/ns 0.34 sec. (121)

**91** or **92**. Tenuipine $C_{38}H_{40}O_7N_2$: 636.2836
$^{13}$CNMR[2]: ($CDCl_3$+$CD_3OD$) 61.4(C-1), 44.0(C-3), 22.0(C-4), 127.5(C-4a), 105.6 (C-5), 151.2(C-6), 136.6(C-7), 148.3(C-8), 122.4(C-8a), 42.2(C-$\alpha$), 136.4(C-9), 110.3(C-10), 143.1(C-11), 133.4(C-12), 148.1(C-13), 104.5(C-14), 63.7(C-1'), 45.0(C-3'), 24.8(C-4'), 127.9(C-4a'), 112.5(C-5'), 148.5(C-6'), 143.6(C-7'), 120.0(C-8'), 127.2(C-8a'), 38.2(C-$\alpha$'), 134.9(C-9'), 129.9(C-10'), 121.5(C-11)', 153.3(C-12'), 121.5(C-13'), 132.4(C-14'), 42.0($NCH_3$), 42.0($NCH_3$), 55.5($OCH_3$), 55.5($OCH_3$), 60.0(C-7 $OCH_3$), 101.2($CH_2O_2$) (134)

**96**. O-Methylthalicberine $C_{38}H_{42}O_6N_2$: 622.3043
CD: 197($\Delta\epsilon$−129.0), 215(+85.3), 250(−4.31), 286(+21.2) (129)
($CH_3OH$+HCl) 195(−162.0), 215(+98.4), 250(−6.80), 286(+23.3) (129)

**102**. Thalfine $C_{38}H_{36}O_8N_2$: 648.2472
CD: 207($\Delta\epsilon$+32.0), 232(+16.5), 262(+17.7), 288(−7.52), with two bands at very low intensity ($\Delta\epsilon$~0.2) in the 320–362nm region (129)
($CH_3OH$+HCl) 207(+52.3), 220(−16.5), 237(+29.4), 259(−2.59), 284(−1.18), 298(+1.40) (129)

**106a**. Thalabadensine[3] $C_{36}H_{38}O_6N_2$: 594.2724
MP: Amorphous (18)
$[\alpha]_D$: Not cited (18)
$^1$HNMR: $NCH_3$ 2.17, 2.56; $OCH_3$ 3.81, 3.87; OH 4.63(2); ArH 5.95–6.76(10) (18)
MS: 381(strong) (18)
SOURCES: *Thalictrum sultanabadense* (Ranunculaceae) (18,140)
DERIVATIVES: *O,O*-Dimethylthalabadensine (Thalabadensine+$CH_2N_2$) (same as *O*-Methylthalmine (18))
$^1$HNMR: Additional methoxy groups at 3.61(C-6) and 3.84 (18)
MS: $M^+$622, 395 (18)

**108**. Thalmine $C_{37}H_{40}O_6N_2$: 608.2886
CD: 207($\Delta\epsilon$−28.9), 242(+8.23), 274(−3.31), 292(+10.8) (118)
($CH_3OH$+HCl) 209(−60.0), 243(+18.5), 275(−2.58), 292(+7.50) (129)

**118**. Tiliacorine $C_{36}H_{36}O_5N_2$: 576.2624
The absolute configuration at C-1 and C-1' was determined to be *R* and *S*, respectively, by tritium labelling studies (116)

**119**. Tiliacorinine $C_{36}H_{36}O_5N_2$: 576.2624
The absolute configuration at C-1 and C-1' was determined to be *S* and *S*, respectively, by tritium labelling studies (116)

**120**. Tiliamosine $C_{36}H_{36}O_6N_2$: 592.2573
The absolute configuration at C-1 and C-1' was determined to be *S* and *S*, respectively, by consideration of the optical activity of the rigid triply linked nucleus in comparative studies (128)

**121**. *O,O*-Dimethylisochondodendrine (Cycleanine) $C_{38}H_{42}O_6N_2$: 622.3043
$^{13}$CNMR: 59.2(C-1,C-1'), 44.4(C-3,C-3'), 24.6(C-4,C-4'), 129.4(C-4a,4a'), 108.9 (C-5,C-5'), 151.4(C-6,C-6'), 138.5(C-7,C-7'), 143.3(C-8,C-8'), 125.2(C-8a, C-8a'), 130.1(C-9,C-9'), 127.7(C-10,C-10' or C-14,C-14'), 113.6(C-11,C-11' or C-13,C-13'), 153.7(C-12,C-12'), 117.0(C-13,C-13' or C-11,C-11'), 128.3(C-14, C-14' or C-10,C-10'), 37.6(C-15,C-15'), 59.7(C-7 $OCH_3$, C-7' $OCH_3$), 55.7(C-6 C-6' $OCH_3$), 42.1(N-2 $NCH_3$, N-2' $NCH_3$) (126)
$^{13}$CNMR: 59.5(C-1,C-1'), 44.7(C-3,C-3'), 24.8(C-4,C-4'), 129.6(C-4a,C-4a'), 109.3 (C-5,C-5'), 151.8(C-6,C-6'), 139.0(C-7,C-7'), 143.6(C-8,C-8'), 125.6(C-8a, C-8a'), 130.4(C-9,C-9'), 128.0, 128.6, 113.9, 117.3(C-10,C-10'; C-11,C-11'; C-12,C-12'; C-13,C-13'), 151.4(C-14,C-14'), 37.7(C-15,C-15'), 59.8(C-7 $OCH_3$, C-7' $OCH_3$), 56.0(C-6 $OCH_3$, C-6' $OCH_3$), 42.3(N-2 $NCH_3$, N-2' $NCH_3$) (50)

$^1$HNMR: (300 MHz) $OCH_3$, 3.39(C-7,C-7'), 3.80(C-6,C-6'); ArH ABCD with split doublets at 5.79(H-11,H-11') ($J_{CD}$=8.5 Hz and $J_{BD}$=2 Hz); 6.25(H-10, H-10') ($J_{CD}$=8.5 Hz and $J_{CA}$=3 Hz); 6.58(H-13,H-13') ($J_{BA}$=8.5 Hz and $J_{BD}$= 2 Hz); 7.02(H-14,H-14') ($J_{AB}$=8.5 Hz and $J_{AC}$=3 Hz) (50)

$^1$HNMR: $NCH_3$, 2.47; $OCH_3$ 3.39(C-7,C-7'), 3.77(C-6,C-6'); ArH 5.72, (H-11, H-11') ($J$=8.5 and 2.3 Hz), 6.22(H-10,H-10') ($J$=8.5 and 2.3 Hz), 6.45(H-5, H-5'), 6.56(H-13,H-13') ($J$=8.5 and 2.3 Hz), 7.00(H-14,H-14') ($J$=8.5 and 2.3 Hz (127)

($CF_3COOH$) $NCH_3$ 2.98, 3.42; $OCH_3$ 3.49(C-7,C-7'), 3.93(C-6,C-6'); ArH 5.94 (H-11,H-11') ($J$=8.2 and 2.3 Hz), 6.47(H-10,H-10') ($J$=8.2 and 2.3 Hz), 6.48 (H-13,H-13') ($J$=8.2 and 2.3 Hz), 6.88(H-5,H-5'), 7.21(H-14,H-14') ($J$=8.2 and 2.3 Hz) (127)

Temperature dependent NMR spectral analysis revealed that the macrocyclic ring at cycleanine existed in a single stable tub conformation. (127)

**122.** Isochondodendrine $C_{36}H_{38}O_6N_2$: 594.2730

$^{13}$CNMR: ($CDCl_3$+$CD_3OD$) 58.0(C-1,C-1'), 44.0(C-3,C-3'), 25.8(C-4,C-4'), 122.9 (C-4a,C-4a'), 107.3(C-5,C-5'), 149.9(C-6,C-6'), 135.7(C-7,C-7'), 139.4(C-8, C-8'), 124.8(C-8a,C-8a'), 129.0(C-9,C-9'), 127.2(C-10,C-10' or C-14,C-14'), 114.3(C-11,C-11' or C-13,C-13'), 153.3(C-12,C-12'), 117.4(C-13,C-13' or C-11, C-11'), 128.6(C-14,C-14' or C-10,C-10'), 33.8(C-15,C-15'), 55.2(C-6 $OCH_3$, C-6' $OCH_3$), 40.5($NCH_3$) (126)

*O,O*-Diacetylisochondodendrine $C_{40}H_{42}O_8N_2$: 678.2941

$^{13}$CNMR: 59.4(C-1,C-1'), 44.2(C-3,C-3'), 24.5(C-4,C-4'), 132.6(C-4a,C-4a'), 108.7 (C-5,C-5'), 150.5(C-6,C-6'), 129.3(C-7,C-7'), 142.8(C-8,C-8'), 124.8(C-8a, C-8a'), 130.8(C-9,C-9'), 128.0(C-10,C-10' or C-13,C-13'), 113.9(C-11,C-11' or C-14,C-14'), 153.5(C-12,C-12'), 117.3(C-13,C-13' or C-10,C-10'), 128.2(C-14, C-14' or C-11,C-11'), 39.1(C-15,C-15'), 55.8(C-6 $OCH_3$, C-6' $OCH_3$), 42.1(N-2 $NCH_3$, N-2' $NCH_3$), 166.9(C-7 $COCH_3$, C-7' $COCH_3$), 19.6(C-7 $COCH_3$), C-7' $COCH_3$) (126)

*N-N'*-Dimethylisochondodendrine Iodide

$^{13}$CNMR: ($D_2O$+$(CD_3)_2SO$) 69.2(C-1), 54.3(C-3), 23.8(C-4), 121.2(C-4a), 109.8 (C-5), 149.8(C-6), 137.5(C-7), 138.6(C-8), 119.2(C-8a), 37.7(C-$\alpha$), 127.4(C-9), 129.8(C-10), 118.2(C-11), 154.6(C-12), 114.9(C-13), 129.4(C-14), 69.2(C-1'), 54.3(C-3'), 23.8(C-4'), 121.2(C-4a), 109.8(C-5'), 149.8(C-6'), 137.5(C-7'), 138.6 (C-8'), 119.2(C-8a'), 37.7(C-$\alpha$'), 127.4(C-9'), 129.8(C-10'), 118.2(C-11'), 154.6 (C-12'), 114.9(C-13'), 129.4(C-14'), 51.8($N^+CH_3$), 51.8($N^+CH_3$), 53.0($N^+CH_3$), 53.0($N^+CH_3$), 57.0($OCH_3$), 57.0($OCH_3$) (133)

**130.** (*R,S*)-Chondocurine ((+)-Tubocurine) $C_{36}H_{38}O_6N_2$: 594.2730

$^{13}$CNMR: 59.3(C-1), 44.2(C-3), 23.2(C-4), 124.6(C-4a), 107.7(C-5), 146.7(C-6), 137.2(C-7), 137.9(C-8), 125.4(C-8a), 40.1(C-$\alpha$), 132.6(C-9), 121.0(C-10), 143.1 (C-11), 145.9(C-12), 115.4(C-13), 125.7(C-14), 64.4(C-1'), 46.5(C-3'), 25.2(C-4'), 128.6(C-4a'), 111.9(C-5'), 148.0(C-6'), 143.1(C-7'), 117.9(C-8'), 128.1(C-8a'), 39.0(C-$\alpha$'), 131.7(C-9'), 132.2(C-10'), 113.2(C-11'), 155.4(C-12'), 114.9(C-13'), 129.9(C-14'), 42.4(N-2 or N-2') ($NCH_3$), 42.5(N-2 or N-2') ($NCH_3$), 55.8($OCH_3$), 56.0($OCH_3$) (133)

$^1$HNMR: $NCH_3$ 2.30, 2.51; $OCH_3$ 3.83; ArH 5.58(H-8'), 6.58(H-5'), 6.61(H-5), 6.91(d, $J$=8.3 Hz) (H-13), 7.13(dd, $J$=2.0, 8.3 Hz) (H-14) (133)

**133.** (−)-Curine ((−)-Bebeerine) (*R,R*-Curine) $C_{36}H_{38}O_6N_2$: 594.2730

$^{13}$CNMR: ($CDCl_3$+$CD_3OD$) 59.8(C-1), 43.6(C-3), 21.6(C-4), 123.9(C-4a), 107.7 (C-5), 146.8(C-6), 137.3(C-7), 138.5(C-8), 124.0(C-8a), 39.5(C-$\alpha$), 133.2(C-9) 120.2(C-10), 142.8(C-11), 145.9(C-12), 115.2(C-13), 125.8(C-14), 64.7(C-1'), 44.6(C-3'), 24.1(C-4'), 128.4(C-4a'), 112.0(C-5'), 148.2(C-6'), 143.5(C-7'), 119.5(C-8'), 128.4(C-8a'), 39.5(C-$\alpha$'), 131.5(C-9'), 131.3(C-10'), 114.7(C-11'), 155.2(C-12'), 113.1(C-13'), 129.2(C-14'), 41.3(N-2,N-2') ($NCH_3$), 55.7($OCH_3$), 55.7($OCH_3$) (133)

$^1$HNMR: $NCH_3$ 2.35, 2.55; $OCH_3$ 3.97; ArH 6.04(H-8), 6.61(H-5), 6.75(H-5'), 6.66(d, $J$=2.0 Hz) (H-10), 6.87(d, $J$=8.3 Hz) (H-13), 7.03(dd, $J$=2.0 and 8.3 Hz) (H-14) (133)

Curine Hydrochloride (Berbeerine Hydrochloride)

$^{13}$CNMR: ($CDCl_3$–$CD_3OD$) 69.1(C-1), 45.0(C-3), 21.1(C-4), 120.0(C-4a), 107.9 (C-5), 148.9(C-6), 137.7(C-7), 138.2(C-8), 120.0(C-8a), 40.9(C-$\alpha$), 128.0(C-9), 120.0(C-10), 142.1(C-11), 147.7(C-12), 116.5(C-13), 126.0(C-14), 64.7(C-1'), 44.4 C-3'), 21.1(C-4'), 123.5(C-4a'), 112.3(C-5'), 149.2(C-6'), 144.2(C-7'), 116.8 (C-8'), 121.9(C-8a'), 39.7(C-$\alpha$'), 127.3(C-9'), 131.9(C-10'), 114.3(C-11'), 155.1 (C-12'), 113.7(C-13'), 130.1(C-14'), 40.4($N^+CH_3$), 40.4($N^+CH_3$), 55.9($OCH_3$), 55.9($OCH_3$). (133)

(*R,R*)-7-*O*-Acetyl-12-*O*-Methylcurine ( (*R,R*)-7-O-Acetyl-12-O-Methylbebeerine) $C_{39}H_{42}O_7N_2$: 650.2992

$^{13}$CNMR: 60.6(C-1), 43.2(C-3), 22.1(C-4), 132.0(C-4a), 108.7(C-5), 150.5(C-6), 131.2(C-7), 144.4(C-8), 124.3(C-8a), 39.3(C-$\alpha$), 134.0(C-9), 122.5(C-10), 144.2 (C-11), 149.2(C-12), 112.0(C-13), 125.4(C-14), 65.1(C-1'), 45.7(C-3'), 25.2(C-4'), 126.5(C-4a'), 112.4(C-5'), 148.1(C-6'), 143.3(C-7'), 116.3(C-8'), 127.2(C-8a'), 39.6(C-$\alpha$'), 132.7(C-9'), 132.0(C-10)', 115.0(C-11'), 154.7(C-12'), 113.6(C-13'), 129.3(C-14'), 41.5(N-2 or N-2') ($NCH_3$), 42.1(N-2 or N-2') ($NCH_3$), 55.9($OCH_3$), 55.9($OCH_3$), 55.9($OCH_3$), 168.2(C=O), 20.1($COCH_3$) (133)

$^1$HNMR: $OCOCH_3$ 2.07; $NCH_3$ 2.30, 2.55; $OCH_3$ 3.70, 3.85, 3.90; ArH 5.50 (H-8'), 6.57(H-5), 6.60(d, $J$=2.0 Hz) (H-10) 6.70(H-5'), 6.78(d, $J$=8.5 Hz) (H-13), 7.15(dd, $J$=2.0, 8.5 Hz) (H-14) (133)

(*R,R*)-12-*O*-Acetyl-7-*O*-Methylcurine ( (*R,R*)-12-O-Acetyl-7-O-Methylbebeerine) $C_{39}H_{42}O_7N_2$: 650.2992

$^{13}$CNMR: 60.4(C-1), 43.1(C-3), 21.6(C-4), 129.5(C-4a), 108.8(C-5), 151.7(C-6), 140.3(C-7), 145.0(C-8), 124.1(C-8a), 39.2(C-$\alpha$), 140.5(C-9), 121.8(C-10), 146.5 (C-11), 139.9(C-12), 122.4(C-13), 125.2(C-14), 64.6(C-1'), 45.0(C-3'), 24.6(C-4'), 127.1(C-4a'), 112.2(C-5'), 148.3(C-6'), 143.2(C-7'), 117.7(C-8'), 127.2(C-8a'), 40.1(C-$\alpha$'), 131.2(C-9'), 131.9(C-10'), 114.8(C-11'), 155.4(C-12'), 113.2(C-13'), 129.3(C-14'), 41.4(N-2 or N-2'), ($NCH_3$), 55.7($OCH_3$), 55.7($OCH_3$), 60.9(C-7) ($OCH_3$) 168.3(C=O), 20.3($COCH_3$) (133)

$^1$HNMR: $OCOCH_3$ 2.12; $NCH_3$ 2.30, 2.52; $OCH_3$ 3.70, 3.82, 3.85; ArH 5.60 (H-8'), 6.53(H-5'), 6.58(d, $J$=2.0 Hz) (H-10), 6.63(H-5), 6.91(d, $J$=8.5 Hz) (H-13), 7.18(dd, $J$=2.0, 8.5 Hz) (H-14) (133)

(*R,R*)-O,O-Diacetylcurine ( (*R,R*)-O,O-Diacetylbebeerine) $C_{40}H_{42}O_8N_2$: 678.2941

$^{13}$CNMR: 60.2(C-1), 42.9(C-3), 21.5(C-4), 132.0(C-4a), 108.4(C-5), 150.2(C-6), 130.9(C-7), 144.0(C-8), 123.7(C-8a), 38.7(C-$\alpha$), 140.1(C-9), 121.5(C-10), 146.4 (C-11), 139.9(C-12), 122.2(C-13), 124.9(C-14), 64.8(C-1'), 45.4(C-3'), 25.2(C-4'), 127.7(C-4a'), 112.0(C-5'), 147.9(C-6'), 142.8(C-7'), 117.4(C-8'), 128.0(C-8a'), 39.9(C-$\alpha$'), 132.3(C-9'), 131.7(C-10'), 114.6(C-11'), 154.4(C-12'), 113.6(C-13'), 129.0(C-14'), 41.1(N-2 or N-2') ($NCH_3$), 41.9(N-2 or N-2') ($NCH_3$), 55.5 $OCH_3$), 55.5($OCH_3$), 167.7(C=O), 168.1(C=O), 19.6($COCH_3$), 20.0($COCH_3$) (133)

$^1$HNMR: $OCOCH_3$ 2.06, 2.11; $NCH_3$ 2.30, 2.55; $OCH_3$ 3.70, 3.85, 3.90; ArH 5.50 (H-8'), 6.57(H-5), 6.60(d, $J$=2.0 Hz) (H-10), 6.70(H-5'), 6.78(d, $J$=8.5 Hz) (H-13), 7.15(dd, $J$=2.0, 8.5 Hz), (H-14) (133)

(*R,R*)-*N,N*-Dimethylcurine Iodide ( (*R,R*)-*N,N*-Dimethylbebeerine Iodide) $C_{38}H_{44}O_6N_2^{++}2I^-$: 624.3201

$^{13}$CNMR: ($CDCl_3$-$CD_3OD$) 65.9(C-1), 55.0(C-3), 23.6(C-4), 120.4(C-4a), 108.8 (C-5), 149.0(C-6), 137.5(C-7), 138.2(C-8), 119.9(C-8a), 36.8(C-$\alpha$), 129.1(C-9), 123.3(C-10), 142.0(C-11), 147.7(C-12), 117.1(C-13), 123.9(C-14), 72.5(C-1'), 55.0(C-3'), 23.6(C-4'), 123.1(C-4a'), 113.0(C-5'), 149.9(C-6'), 145.2(C-7'), 117.1(C-8'), 122.7(C-8a'), 38.0(C-$\alpha$'), 128.6(C-9'), 131.6(C-10'), 115.5(C-11'), 155.7(C-12'), 113.0(C-13'), 129.9(C-14'), 51.1($N^+CH_3$), 51.1($N^+CH_3$), 52.4 ($N^+CH_3$), 52.9($N^+CH_3$), 56.4($OCH_3$), 56.7($OCH_3$) (133)

(*R,R*)-7-*O*-Methylcurine ( (*R,R*)-7-*O*-Methylbeeberine) (3): $C_{37}H_{40}O_6N_2$: 608.2886

$^{13}$CNMR: 60.2(C-1), 43.5(C-3), 21.9(C-4), 129.4(C-4a), 108.8(C-5), 151.7(C-6), 140.4(C-7), 144.8(C-8), 124.2(C-8a), 39.4(C-$\alpha$), 133.4(C-9), 120.7(C-10), 143.1 (C-11), 146.1(C-12), 115.2(C-13), 126.3(C-14), 65.2(C-1'), 45.4(C-3'), 24.9(C-4'), 128.4(C-4a'), 112.0(C-5'), 148.4(C-6'), 143.5(C-7'), 119.3(C-8'), 128.3(C-8a'), 39.7(C-$\alpha$'), 131.3(C-9'), 132.0(C-10'), 115.2(C-11'), 155.6(C-12'), 113.0(C-13'), 129.6(C-14'), 41.5(N-2 or N-2'), ($NCH_3$), 41.8(N-2 or N-2') ($NCH_3$), 55.8 ($OCH_3$), 55.8($OCH_3$), 61.0(C-7) ($OCH_3$) (133)

$^1$HNMR: $NCH_3$ 2.32, 2.60; $OCH_3$ 3.80, 3.92, 3.95; ArH 6.00(H-8'), 6.64(H-5), 6.71(d, $J$=2.0 Hz) (H-10), 6.77(H-5'), 6.88(d, $J$=8.3 Hz) (H-13), 7.03 dd, $J$= 2.0, 8.3 Hz) (H-14) (133)

(*R,R*)-*N,N,O,O*-Tetramethylcurine Iodide ( (*R,R*)-*N,N,O,O*-Tetramethylbeeberine Iodide) $C_{40}H_{48}O_6N_2^{++}2I^-$: 652.3513

$^{13}$CNMR: ($D_2O$-$CD_3OD$) 66.5(C-1), 55.3(C-3), 24.3(C-4), 125.6(C-4a), 110.3(C-5), 154.4(C-6), 140.4(C-7), 144.9(C-8), 121.2(C-8a), 37.4(C-$\alpha$), 130.2(C-9), 124.0 (C-10), 143.0(C-11), 149.4(C-12), 114.1(C-13), 124.6(C-14), 73.4(C-1'), 55.5 (C-3'), 24.3(C-4'), 123.6(C-4a'), 113.7(C-5'), 151.4(C-6'), 145.4(C-7'), 117.9 (C-8'), 123.1(C-8a'), 38.8(C-$\alpha$'), 129.7(C-9'), 132.3(C-10'), 115.5(C-11'), 156.6 (C-12'), 113.7(C-13'), 130.9(C-14'), 51.4($N^+CH_3$), 51.6($N^+CH_3$), 52.8($N^+CH_3$), 53.5($N^+CH_3$), 56.7($OCH_3$), 56.9($OCH_3$), 57.3($OCH_3$), 61.4($OCH_3$) (133)

(*R,S*)-*O,O*-Dimethylchondrocurarine Iodide (*R,S*)-*N,N,O,O*-Tetramethylcurine Iodide (*R,S*)-*N,N,O,O*-Tetramethylbebeerine Iodide $C_{40}H_{48}O_6N_2^{++}2I^-$: 652.3513

$^{13}$CNMR: ($D_2O$-$CD_3OD$) 68.5(C-1), 54.7(C-3), 23.6(C-4), 125.4(C-4a), 109.7(C-5), 154.3(C-6), 140.4(C-7), 143.8(C-8), 119.9(C-8a), 39.7(C-$\alpha$), 130.8(C-9), 123.6 (C-10), 142.5(C-11), 149.2(C-12), 114.5(C-13), 127.8(C-14), 72.1(C-1'), 54.2 (C-3'), 23.6(C-4'), 123.2(C-4a'), 112.9(C-5'), 150.9(C-6'), 146.0(C-7'), 116.7 (C-8'), 121.3(C-8a'), 37.0(C-$\alpha$'), 129.5(C-9'), 134.1(C-10'), 114.5(C-11'), 156.5 (C-12'), 112.9(C-13'), 131.2(C-14'), 51.0 ($N^+CH_3$), 51.2($N^+CH_3$), 52.9($N^+CH_3$), 54.7($N^+CH_3$), 56.1($OCH_3$), 56.5($OCH_3$), 56.5($OCH_3$), 60.7($OCH_3$) (133)

**135.** *R,R-O,O*-Dimethylcurine (*R,R-O,O*-Dimethylbebeerine) $C_{38}H_{42}O_6N_2$: 622.3043

$^{13}$CNMR: 60.3(C-1), 43.1(C-3), 21.6(C-4), 129.4(C-4a), 108.7(C-5), 151.5(C-6), 140.1(C-7), 145.9(C-8), 124.2(C-8a), 38.9(C-$\alpha$), 133.9(C-9), 122.1(C-10), 143.9 (C-11), 148.9(C-12), 111.7(C-13), 125.0(C-14), 64.9(C-1'), 45.6(C-3'), 25.2(C-4'), 126.5(C-4a'), 112.1(C-5'), 147.8(C-6'), 143.2(C-7'), 116.2(C-8'), 127.9 (C-8a'), 39.4(C-$\alpha$'), 131.5(C-9'), 131.9(C-10'), 114.7(C-11'), 155.2(C-12'), 112.9(C-13'), 129.0(C-14'), 41.3(N-2 or N-2') ($NCH_3$), 42.1(N-2 or N-2') ($NCH_3$), 55.7($OCH_3$), 55.7($OCH_3$), 60.8(C-7) ($OCH_3$) (133)

$^1$HNMR: $NCH_3$ 2.34, 2.56; $OCH_3$ 3.74, 3.76, 3.91, 3.93; ArH 5.59(H-8'), 6.62(d, $J$= 2.0 Hz) (H-10), 6.64(H-5), 6.77(H-5'), 6.87(d, $J$=8.3 Hz) (H-13), 7.23(dd, $J$=2.0, 8.3 Hz) (H-14) (133)

**140.** (*R,R*)-12-*O*-Methylcurine ( (*R,R*)-12-*O*-Methylbebeerine): $C_{37}H_{40}O_6N_2$: 608.2886
$^{13}$CNMR: 60.2(C-1), 43.4(C-3), 21.4(C-4), 124.3(C-4a), 107.7(C-5), 146.5(C-6), 137.0(C-7), 138.5(C-8), 124.3(C-8a), 39.5(C-$\alpha$), 134.1(C-9), 121.4(C-10), 143.6 (C-11), 148.8(C-12), 112.8(C-13), 124.6(C-14), 64.7(C-1'), 45.0(C-3'), 24.4 (C-4'), 126.5(C-4a'), 111.9(C-5'), 148.3(C-6'), 143.3(C-7'), 117.2(C-8'), 127.5 (C-8a'), 39.5(C-$\alpha$'), 131.5(C-9'), 131.5(C-10'), 114.3(C-11'), 155.0(C-12'), 113.5 (C-13'), 129.3(C-14'), 41.4(N-2 or N-2') ($NCH_3$), 41.8(N-2 or N-2') ($NCH_3$), 56.0($OCH_3$), 56.0($OCH_3$), 56.0($OCH_3$) (133)
$^1$HNMR: $NCH_3$ 2.34, 2.51; $OCH_3$ 3.74, 3.90, 3.92; ArH 5.60(H-8'), 6.54(d, $J$=2.0 Hz) (H-10), 6.60(H-5), 6.74(H-5'), 6.86(d, $J$=8.3 Hz) (H-13), 7.23(dd, $J$=2.0, 8.3 Hz) (H-14) (133)

**142.**[4] (+)-Tubocurarine Chloride ( (*R,S*)-Tubocurarine Chloride) $C_{37}H_{41}O_6N_2^{++}2Cl^-$: 609.3042
$^{13}$CNMR: ($D_2O$-$CD_3OD$) 68.7(C-1), 54.5(C-3), 23.6(C-4), 120.1(C-4a), 108.7(C-5), 149.6(C-6), 138.8(C-7), 137.4(C-8), 119.8(C-8a), 38.6(C-$\alpha$), 129.0(C-9), 124.0 (C-10), 142.4(C-11), 148.8(C-12), 116.7(C-13), 127.4(C-14), 65.1(C-1'), 45.9 (C-3'), 22.6(C-4'), 124.4(C-4a'), 112.3(C-5'), 150.3(C-6), 146.4(C-7'), 118.4 (C-8'), 121.0(C-8a'), 40.0(C-$\alpha$'), 129.9(C-9'), 134.0(C-10'), 115.3(C-11'), 156.4 (C-12'), 113.1(C-13'), 130.8(C-14'), 40.5($N^+CH_3$), 51.3($N^+CH_3$), 54.5($N^+CH_3$), 56.4($OCH_3$), 56.4($OCH_3$) (133)

**148.** Dimethylwarifteine (*O*-Methylcissampereine) $C_{38}H_{40}O_6N_2$: 620.2886
X-ray crystallography: Determined by direct methods with crystallization in the orthorhombic space group $P2_12_12_1$ with a=14.714(4), b=14.827(4), c=15.365(4) Å, Z=4 (164)

TABLE 3. Known Natural Bisbenzylisoquinoline Alkaloids Reisolated From New Sources

**4.** Dauricinoline $C_{37}H_{42}O_6N_2$: 610.3043
Sources: *Menispermum dauricum* (Menispermaceae) (45)

**5.** Dauricoline $C_{36}H_{40}O_6N_2$: 596.2886
Sources: *Menispermum dauricum* (Menispermaceae) (45)

**14a.** Thaliracebine $C_{39}H_{44}O_7N_2$: 652.3149
Sources: *Thalictrum faberi* (Ranunculaceae) (143)

**17b.** Thalirugidine $C_{39}H_{46}O_8N_2$: 670.3254
Sources: *Thalictrum foliolosum* (Ranunculaceae) (53)

**19.** Dauricine $C_{38}H_{44}O_6N_2$: 624.3199
Sources: *Menispermum dauricum* (Menispermaceae) (45)

**20.** Daurinoline $C_{37}H_{42}O_6N_2$: 610.3043
Sources: *Menispermum dauricum* (Menispermaceae) (45)

**31.** Aromoline $C_{36}H_{38}O_6N_2$: 594.2730
Sources: *Berberis orthbotrys* (Berberidaceae) (46)
*Doryphora aromatica* (Monimiaceae) (21)
*Pycnarrhena longifolia* (Menispermaceae) (51)
*Thalictrum rugosum* (Ranunculaceae) (43)

**37.** Daphnandrine $C_{36}H_{38}O_6N_2$: 594.2730
Sources: *Doryphora aromatica* (Monimiaceae) (21)

**38.** Daphnoline $C_{35}H_{36}O_5N_2$: 580.2573
Sources: *Doryphora aromatica* (Monimiaceae) (21)
*Pycnarrhena longifolia* (Menispermaceae) (51)

**40.** (+)-Epistephanine $C_{37}H_{38}O_6N_2$: 606.2730
Sources: *Stephania hernandifolia* (Menispermaceae) (29)

**42.** Homoaromoline $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Cyclea barbata* (Menispermaceae) (130)
*Doryphora aromatica* (Monimiaceae) (21)
*Pycnarrhena longifolia* (Menispermaceae) (51)

**45.** *O*-Methylrepandine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Daphnandra johnsonii* (Monimiaceae) (24)
*Isopyrum thalictroides* (Ranunculaceae) (54)

**46.** Obaberine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Dehassia triandra* (Lauraceae) (27)
*Pycnarrhena longifolia* (Menispermaceae) (51)
*Thalictrum rugosum* (Ranunculaceae) (43)

**48.** Oxyacanthine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Berberis orthobotrys* (Berberidaceae) (46)
*Berberis vulgaris* (Berberidaceae) (26)

**49.** Repandine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Daphnandra johnsonii* (Monimiaceae) (24)

**51.** Stebisimine $C_{36}H_{34}O_6N_2$: 590.2417
Sources: *Triclisia gilletti* (Menispermaceae) (52)

**52.** Thalrugosamine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Limaciopsis loangensis* (Menispermaceae) (28)

[4]The structural representation cited by Guha *et al.* is incorrect. The correct structural representation is that cited for compound **129**, which was incorrectly designated chondocurarine (1).

**54.** Thalisopine (Thaligosine) $C_{38}H_{42}O_7N_2$: 638.2992
Sources: *Thalictrum foliolosum* (Ranunculaceae) (53)

**55.** Thalrugosaminine $C_{39}H_{44}O_7N_2$: 652.3149
Sources: *Thalictrum alpinum* (Ranunculaceae) (42)
*Thalictrum foliolosum* (Ranunculaceae) (53)

**57.** Berbamine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Berberis chilensis* (Berberidaceae) (49)
*Berberis lycium* (Berberidaceae) (22)
*Berberis orthobotrys* (Berberidaceae) (46)
*Berberis poiretii* (Berberidaceae) (16, 137)
*Berberis thunbergii* (Berberidaceae) (40)
*Berberis vulgaris* (Berberidaceae) (26)
*Limaciopsis loangensis* (Menispermaceae) (28)
*Pycnarrhena novoguineensis* (Menispermaceae) (25)

**62.** Isotetrandrine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Berberis poiretii* (Berberidaceae) (16)
*Berberis thunbergii* (Berberidaceae) (40)
*Doryphora aromatica* (Monimiaceae) (21)
*Isopyrum thalictroides* (Ranunculaceae) (54)
*Limaciopsis loangensis* (Menispermaceae) (28)

2'-*N*-Chloromethylisotetrandrine (artifact)
Sources: *Limaciopsis loangensis* (Menispermaceae) (28)

**63.** Krukovine $C_{36}H_{38}O_6N_2$: 594.2730
Sources: *Pycnarrhena longifolia* (Menispermaceae) (51)

**64.** Limacine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Pycnarrhena longifolia* (Menispermaceae) (51)
*Pycnarrhena novoguineensis* (Menispermaceae) (25)

**71.** Obamegine $C_{36}H_{38}O_6N_2$: 594.2730
Sources: *Triclisia gilletti* (Menispermaceae) (52)

**74.** Phaeanthine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Pycnarrhena novoguineensis* (Menispermaceae) (25)

**75.** Pycnamine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Pycnarrhena novoguineensis* (Menispermaceae) (25)

**76.** Tetrandrine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Cyclea barbata* (Menispermaceae) (130)
*Isopyrum thalictroides* (Ranunculaceae) (54)

**77.** (±)-Tetrandrine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Isopyrum thalictroides* (Ranunculaceae) (54)

**79.** Thalrugosine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Limaciopsis loangensis* (Menispermaceae) (28)
*Pycnarrhena novoguineensis* (Menispermaceae) (25)
*Stephania japonica* var. *australis* (Menispermaceae) (32)
*Thalictrum minus* Race B (Ranunculaceae) (44)
*Thalictrum sachalinense* (Ranunculaceae) (23)

**79.** Isofangchinoline (Preferably called thalrugosine)
Sources: *Pycnarrhena novoguineensis* (Menispermaceae) (25)

**81.** Hernandezine $C_{39}H_{44}O_7N_2$: 652.3149
Sources: *Thalictrum sultanabadense* (Ranunculaceae) (18, 140)

**83.** Thalidezine $C_{38}H_{42}O_7N_2$: 638.2992
Sources: *Thalictrum sultanabadense* (Ranunculaceae) (140)

**88.** Nortenuipine $C_{37}H_{38}O_7N_2$: 622.2679
Sources: *Daphnandra johnsonii* (Monimiaceae) (24)

**90.** Repandinine $C_{38}H_{40}O_7N_2$: 636.2836
Sources: *Daphnandra johnsonii* (Monimiaceae) (24)

**94.** *O*-Methylisothalicberine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Berberis chilensis* (Berberidaceae) (38)

**95.** *O*-Methylthalicberine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Thalictrum minus* (Ranunculaceae) (41)
*Thalictrum revolutum* (Ranunculaceae) (39)

**96.** *O*-Methylthalmethine ($C_{37}H_{38}O_6N_2$: 606.2730
Sources: *Thalictrum minus* (Ranunculaceae) (41)

**97.** Thalicberine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Thalictrum minus* (Ranunculaceae) (41)

**98.** Thalmethine $C_{36}H_{36}O_6N_2$: 592.2573
Sources: *Thalictrum minus* (Ranunculaceae) (41)

**100.** Thalidasine $C_{39}H_{44}O_7N_2$: 652.3149
Sources: *Thalictrum alpinum* (Ranunculaceae) (42)
*Thalictrum faberi* (Ranunculaceae) (139, 141, 143)

**101.** Thalrugosidine $C_{38}H_{42}O_7N_2$: 638.2992
Sources: *Thalictrum alpinum* (Ranunculaceae) (28)
*Thalictrum foliolosum* (Ranunculaceae) (53)

**103.** Thalfinine $C_{39}H_{42}O_8N_2$: 666.2941
Sources: *Thalictrum faberi* (Ranunculaceae) (143)

**121.** Cycleanine $C_{38}H_{42}O_6N_2$: 622.3043
Sources: *Cyclea tonkinensis* (Menispermaceae) (144)
*Limaciopsis loangensis* (Menispermaceae) (28)
*Synclisia scabrida* (Menispermaceae) (50, 137)

**122.** Isochondodendrine $C_{36}H_{38}O_6N_2$: 594.2730
Sources: *Cyclea barbata* (Menispermaceae) (130)
*Cyclea hainanensis* (Menispermaceae) (152)
*Sciadotenia toxifera* (Menispermaceae) (17)

**127.** Sciadenine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Sciadotenia toxifera* (Menispermaceae) (17)

**128.** Sciadoline $C_{36}H_{34}O_6N_2$: 590.2417
Sources: *Scidotenia toxifera* (Menispermaceae) (17)

**132. or 133.** Curine $C_{36}H_{38}O_6N_2$: 594.2730
Sources: *Cyclea barbata* (Menispermaceae) (30, 130)
*Cyclea hainanensis* (Menispermaceae) (30, 152)
*Stephania epigaea* (Menispermaceae) (30)
(±)-Curine dimethiodide (*N,N*-Dimethylcurine iodide) $C_{38}H_{44}O_6N_2^{++}2I^-$: 624.3199
Sources: *Cissampelos pareira* (Menispermaceae) (156)

**137.** Hayatine $C_{36}H_{38}O_6N_2$: 594.2730
Sources: *Cyclea hainanensis* (Menispermaceae) (152)

**139.** 4'*O*-Methylcurine $C_{37}H_{40}O_6N_2$: 608.2886
Sources: *Cyclea hainanensis* (Menispermaceae) (152)

**152.** Cocsoline $C_{34}H_{32}O_5N_2$: 548.2311
Sources: *Synclisia scabrida* (Menispermaceae) (137)

**153.** Cocsuline $C_{35}H_{34}O_5N_2$: 562.2468
Sources: *Synclisia scabrida* (Menispermaceae) (137)
*Triclisia dictyophylla* (Menispermaceae) (124)

**160.** Telobine $C_{35}H_{34}O_5N_2$: 562.2468
Sources: *Daphnandra apatela* (Monimiaceae) (20)

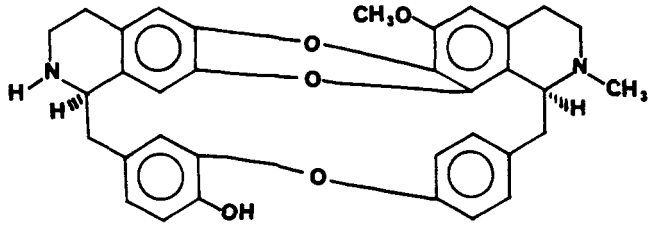
**162.** Trigilletimine $C_{35}H_{30}O_5N_2$: 558.2155
Sources: *Triclisia dictyophylla* (Menispermaceae) (124)

**163.** Trilobine $C_{35}H_{34}O_5N_2$: 562.2468
Sources: *Pachygone ovata* (Menispermaceae) (31)

TABLE 4. New Bisbenzylisoquinoline Alkaloids.[5]

**187.** APATELINE $C_{34}H_{32}O_5N_2$: 548.2311

Type XXIII (*R,S*) 6*,7+,11‡,12-6,7*,8+,12‡

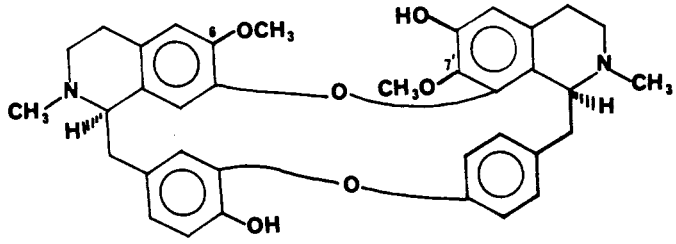



MP: 197–200° ($CH_3OH$) (20); Picrate 205–210° (20)
$[\alpha]_D$: +270°($CHCl_3$) (20)
UV: 283(3.5), 305(sh); ($CH_3O$ I+NaOH) 297(3.6) (20)
IR: 3548, 2935, 1630, 1592, 1505, 1450, 1368, 1280, 1125 (20)
$^1$HNMR: $NCH_3$ 2.55; $OCH_3$ 3.85; AlH 2.7–4.05(m,14); NH 5.22; ArH 6.25–7.3(m,10) (20)
MS: $M^+$ 548, 335, 321, 168 (20)
SOURCES: *Daphnandra apatela* (Monimiaceae) (20)
DERIVATIVES: *N*-Methylapateline (Apateline+$CH_2O$+$NaBH_4$) (20)
MP: 162–167° (dec) ($CH_3OH$, $CHCl_3$)
$[\alpha]^{20}_D$: +205° ($CHCl_3$)
IR: (Nujol) 3400, 1590, 1510, 1280, 1220, 1120 and 755
$^1$HNMR: $NCH_3$ 2.44, 2.48; $OCH_3$ 3.85; OH 5.07(br); AlH 2.05–4.0 (14); ArH 5.88–7.0 (10)
DERIVATIVES: *O*-Methylapateline (Apateline+$CH_2N_2$) (Telobine) (MP, MMP, TLC, $^1$HNMR, MS, SP ROTN) (20)
MP: 186–194° (dec.); Picrate 189–195°
*O*-Demthylapateline (Apateline+48% HBr+Δ) (20)
MP: 286–292° (dec) ($CHCl_3$-$CH_3OH$)
IR: (Nujol) 1615, 1580, 1265, 1210, 1100, 1035
MS: $M^+$ 534 (100)

[5]Not previously reported in the review by Guha *et al.* (1).

**188.** BALUCHISTINE $C_{36}H_{38}O_6N_2$: 594.2724

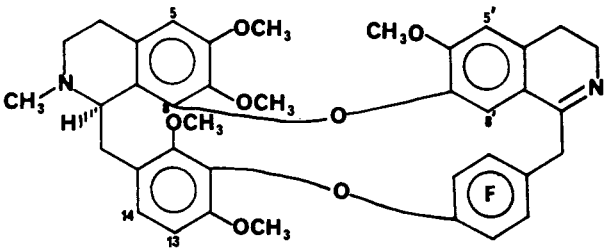
Type VI (*R,S*) 6,7*,11$^+$,12–6,7,8*,12$^+$




MP: 222–224° ($CH_3OH$) (33)
$[\alpha]^{26}D$: +333° (c=0.075, $CH_3OH$) (33)
UV: ($CH_3CH_2OH$) 283(3.67) (33)
($CH_3CH_2OH+OH^-$) 290(3.80) (33)
$^1$HNMR: $NCH_3$ 2.61(2); $OCH_3$ 3.23(C7'), 3.60(C6); OH 5.15(2); ArH 5.43–7.40(10) (33)
MS: $M^+$ 594(594.2732) (22), 487(0.2), 382(52), 381(100), 367(50), 207(10), 192(15), 191(78), 174(50), and 168(48) (33)
CD: (c=0.095) 208(0), 230(+110,000), 267(+6,200), 275(0), 283(−3,700), 287(0), 294(+3,700), 302(0) (33)
SOURCES: *Berberis baluchistanica* (Berberidaceae) (33)
DERIVATIVES: *O,O*-Dimethylbaluchistine (Baluchistine+$CH_2N_2$) (Same as (+)-Obaberine) (33)

**189.** CALAFATIMINE $C_{38}H_{40}O_7N_2$: 636.2836

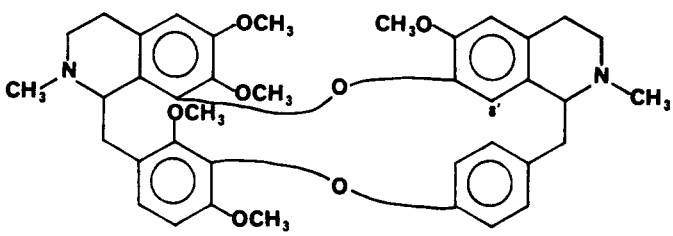
Type Xa[6] (*S*,−) 6,7,8*,10,11$^+$,12–6,7*,12$^+$




MP: 180–182° ($C_6H_6$–$C_6H_{12}$) (133)
$[\alpha]^{20}D$: −141° ($CHCl_3$) (133)
UV: 235(sh) (4.85), 280(4.40), 292(sh) (3.93) (127) with no shift on addition of 0.1N NaOH (133)
$^1$HNMR: $NCH_3$ 2.40; $OCH_3$ 3.38, 3.74, 3.80, 3.82, 3.90; ArH 5.52(H–8 or H–8'), 6.44(C–5), 6.63(C–5'); 6.80(d) (C–13) and 7.02(d) (C–14) with $J$=8 Hz; 5.98(dd), 6.44(dd), 7.23(dd) with $J_{app}$=2 Hz and 8 Hz with a fourth partially obscured at 7.02, all assignable to ring F protons (133)
MS: $M^+$ 636(100), 635, 606(4), 590(3), 575(5), 469(3), 381(85), 367(20), 318(4), 190.5(38), 184(13), 174(14) (133)
SOURCES: *Berberis buxifolia* (Berberidaceae) (133)
DERIVATIVES: *N*-Methyldihydrocalafatimine (Calafatimine+$NaBH_4$+$CH_2O$) (same as calafatine) (MP, IR, TLC) (133)

**190.** CALAFATINE $C_{39}H_{44}O_7N_2$: 652.3149

Type Xa[6] 6,7,8*,10,11$^+$,12–6,7*,12$^+$




MP: 135–137° ($C_6H_6$–$C_6H_{12}$) (35)
$[\alpha]D$: +280° ($CHCl_3$) (35) (The positive rotation and the type of this alkaloid strongly suggests that it is either an *R,S* or an *S,S* dimer [128])
UV: 258(3.32), 281(3.82) (35)

[6]This is a new class which supplements class X as presented in the review by Guha *et al.* (1).

$^1$HNMR: $NCH_3$ 2.31, 2.55; $OCH_3$ 3.27, 3.65, 3.71, 3.72, 3.83; ArH 5.38(H8'), 5.88(d), 6.34, 6.50, 6.34(d), 7.10(d) with $J$=2,10 Hz and 6.90(d) partially obscured by an asymmetrical doublet with the same frequency and $J_{app}$=10 Hz (35)

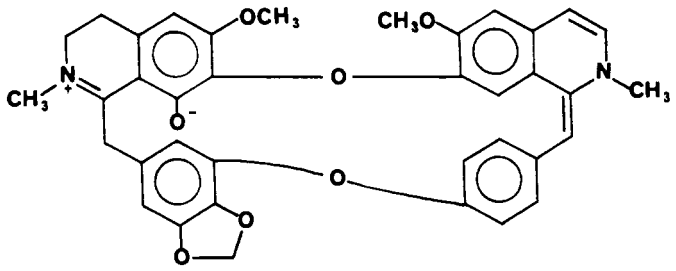
MS: $M^+$ 652, 485, 396, 198, 192, 174 (35)

SOURCES: *Berberis buxifolia* (Berberidaceae) (35)

DERIVATIVES: A single nonphenolic fragment was obtained via Birch reduction (Na-$NH_3$). This fragment was tentatively characterized as 6,7,2',4'-tetramethoxy-2-methyl-1-benzyltetrahydroisoquinoline (35)

**191.** DAPHNINE $C_{37}H_{32}O_7N_2$: 616.2209

Type Xb[6] 6,7*,8,11$^+$,12,13–6,7*,12$^+$



UV: ($CHCl_3$) 261(4.72), 326(4.27), 444(3.94) (156)

IR: (Nujol) 3350(s), 1632(w), 1610(s), 1572(s), 1534(w), 1506(s) (150, 156)

X-RAY: Daphnine dihydriodide (Monoclinic, space group $P2_1/n$, a=14.54(1), b=13.92(1), c=19.00(2) Å, $\beta$=94.52(5)° (148)

SOURCES: *Daphnandra repandula* (Monimiaceae) (148)

DERIVATIVES: Daphnine dihydrochloride (156)

UV: ($CH_3CH_2OH$) 257(4.69), 324(4.33), 420(3.78) (156)

IR: (Nujol) 3640(m), 3410(m), 3340(s), 3200(m) (156)

$^1$HNMR: ($D_2O$)~3.20(4?,m), 3.5(3), 3.85(3), 4.10(3), 4.45(3), ~4.90(4?,m), 5.55(2?,s), 5.98(2), 6.2–7.72(7?,m), 8.1–8.6(2,dd) (156)

Hexahydrodaphnine

UV: ($CH_3CH_2OH$) 280(3.76) (156)

IR: 3340(m), 1635(m), 1614(m), 1595(w), 1508(s), 1443(s), 1375(s), 1190(s), 1123(s), 1067(s) (156)

$^1$HNMR: 2.51(3), 2.53(3), 3.85(3), 3.96(3), 5.22(1), 5.90(2,dd), 6.19(1), 6.53(1), 6.3–7.2 (4,m), 6.44(1), 7.12(1) (156)

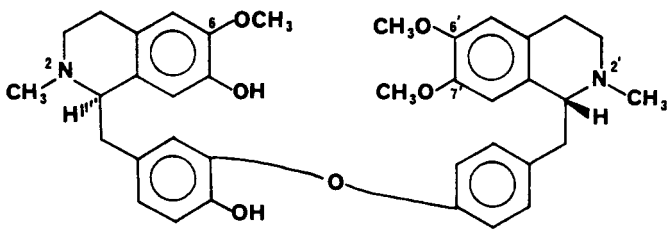
MS: $M^+$ 622(15), 381(55), 380(15), 367(12), 321(4), 192(23) 191.5(26), 191(100), 190(16), 178(12), 174(18), 168(18), 148(15) (156)

Dihydrodaphnine diacetate

$^1$HNMR: ($CD_3COOD$) Pulsed nOe (158)

**192.** DAURISOLINE $C_{37}H_{42}O_6N_2$: 610.3043

Type I (*R*,*R*) 6,7,11*,12–6,7,12*



MP: 96–102°

$[\alpha]^{20}_D$: −129° (c=0.65, $CH_3OH$) (45)

UV: 284(4.01); 257(3.54) (min) (45)

IR: (KBr) 3420, 3350, 2850, 1590, 1500, 1155, 1015 (45)

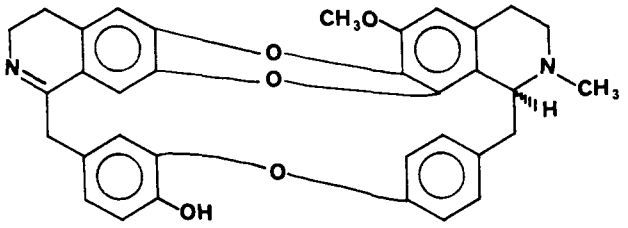
$^1$HNMR: $NCH_3$ 2.44(N2), 2.50(N2'); $OCH_3$ 3.60(C7'), 3.78(C6'), 3.82(C6); OH~5.0(2) ($D_2O$ exchanged); ArH 6.10–7.14(11) (45)

MS: $M^+$ 610, 206(93), 192(100), 177(5) (45)

SOURCES: *Menispermum dauricum* (Menispermaceae) (45)

**193.** 1,2-DEHYDROAPATELINE $C_{35}H_{32}O_5N_2$: 560.2311

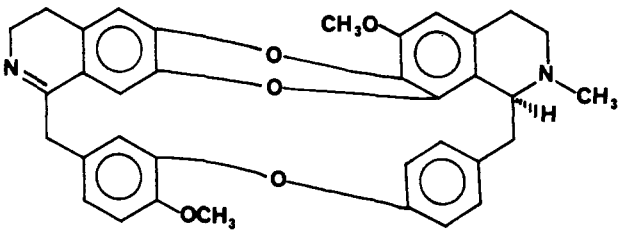
Type XXIII (−,*S*) 6*,7⁺,11‡,12-6,7*,8⁺,12‡




MP: 192–198° (dec.) (20); Picrate 198–202° (20)
$[\alpha]^{20}D$: +137° ($CHCl_3$) (20)
UV: 288(sh), 335(3.46) (20)
($CH_3OH+OH^-$) 292(sh), 337(3.56) (20)
IR: (Nujol) 1615, 1570, 1495, 1270, 1215, 1110, 1055 (20)
$^1$HNMR: $NCH_3$ 2.54; $OCH_3$ 3.87; AlH 2.50–4.10(14); ArH 6.35–7.00(10) (20)
MS: $M^+$ 546, 545(100), 364, 335, 333, 273 (20)
SOURCES: *Daphnandra apatela* (Monimiaceae) (20)
*Doryphora aromatica* (Monimiaceae) (21)
DERIVATIVES: Apateline (1,2-Dehydroapateline+$NaBH_4$) (MP, MMP, IR, $^1$HNMR TLC, UV, SP ROTN) (20)

**194.** 1,2-DEHYDROTELOBINE $C_{35}H_{32}O_5N_2$: 560.2311

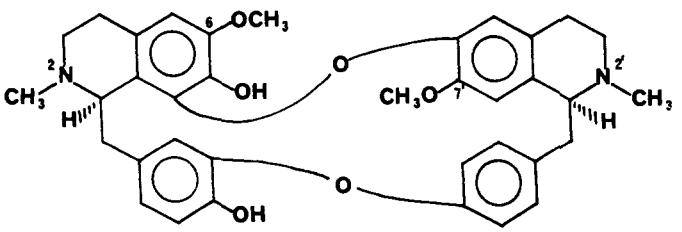
Type XXIII (−,*S*) 6*,7⁺,11‡,12-6,7*,8⁺,12‡




MP: 168–172° (dec.) (20); Picrate 187–192 (dec.) (20)
$[\alpha]^{19}D$: +172° ($CHCl_3$) (20)
UV: 287(sh), 336(3.65) with no change on addition of $OH^-$ (20)
IR: (Nujol) 1620, 1570, 1300, 1260, 1220, 1120, 740 (20)
$^1$HNMR: $NCH_3$ 2.57; $OCH_3$ 3.88(2); AlH 2.40–4.30(13); ArH 6.40–7.00(10) (20)
MS: $M^+$ 560(560.2278), 559, 558, 557, 544, 543, 350, 349, 347, 335, 175 (20)
SOURCE: *Daphnandra apatela* (Monimiaceae) (20)
DERIVATIVES: Telobine (1,2-Dehydrotelobine+$NaBH_4$) (MP, MMP, $^1$HNMR, IR, TLC, SP ROTN) (20)
N-Methyltelobine (1,2-Dehydrotelobine+$H_2$(Pd/C) then $CH_2O+NaBH_4$) (IR, $^1$HNMR, MP, MMP, TLC) (20)

**195.** 7-*O*-DEMETHYLISOTHALICBERINE $C_{36}H_{38}O_6N_2$: 594.2724

Type XI (*R*,*S*) 6,7,8*,11⁺,12-6*,7,12⁺

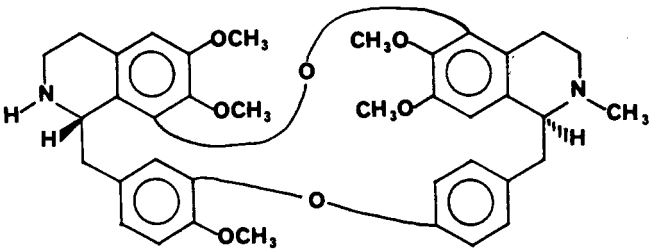



MP: 245–247° ($C_6H_{12}$–$CHCl_3$) (38)
$[\alpha]^{20}D$: +230° (c=0.2, $CHCl_3$) (38)
UV: ($CH_3CH_2OH$) 285(3.88) (38)
IR: 3560, 2860 (38)
$^1$HNMR: $NCH_3$ 2.33(N2), 2.57(N2'); $OCH_3$ 3.78(C7'), 3.83(C6); ArH 5.45(d, $J$=2 Hz), 6.2, 6.4, 6.53–6.83(5), 7.03(d, $J$=2 Hz), 7.55(dd, $J$=2.8 Hz) (38)

MS: $M^+$ 594(67), 392(30), 381(100), 367(7), 350(5), 191(4), 176(11), 174(8) (38)
ORD: 240(+28,000), 251(−18,600), 265(−3,600), 278(−14,000), 295(+7,100) (38)
SOURCES: *Berberis chilensis* (Berberidaceae) (38)
DERIVATIVES: *O*-Methylisothalicberine (7-*O*-Demethylisothalicberine+$CH_2N_2$) (TLC, UV, IR, NMR, SP ROTN, ORD) (38)
5'-Deutero-7-*O*-Demethylisothalicberine (7-*O*-Demethylisothalicberine+NaOD+$D_2O$ +Δ) (38)
MS: $M^+$ 595(70), 382(50), 381(100) (38)

**196.** *N*-DESMETHYLTHALIDASINE $C_{38}H_{42}O_7N_2$: 638.2992

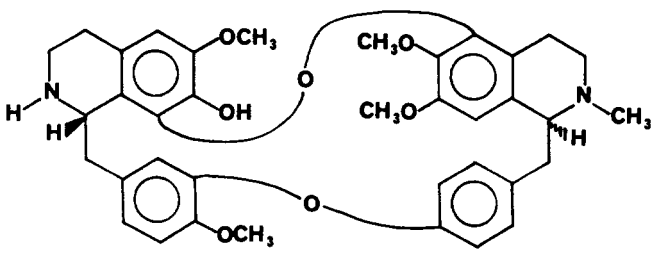
Type XII (*S,S*) 6,7,8*,11$^+$,12-5*6,7,12$^+$




MP: 137–139° (yellow amorphous powder) (142, 144)
$[\alpha]_D$: −86.9° (c=0.41, $CH_3OH$) (142, 144)
$^1$HNMR: $NCH_3$, 2.62; $OCH_3$ 3.25, 3.46, 3.75, 3.86, 3.89; ArH 6.20–7.57(9) (142, 144)
ORD: Same as thalidasine (135)
SOURCES: *Thalictrum faberi* (Ranunculaceae) (142, 144)
DERIVATIVES: Thalidasine (*N*-Desmethylthalidasine+$CH_2O$+$NaBH_4$) (MP, IR,$^1$HNMR, ORD) (142, 144)
Birch Reduction ($Na/NH_3$) afforded N-Methyl-6,7-dimethoxy-5,4'-dihydroxybenzyl-tetrahydroisoquinoline (142)

**197.** *N*-DESMETHYLTHALRUGOSIDINE $C_{37}H_{40}O_7N_2$: 624.2836

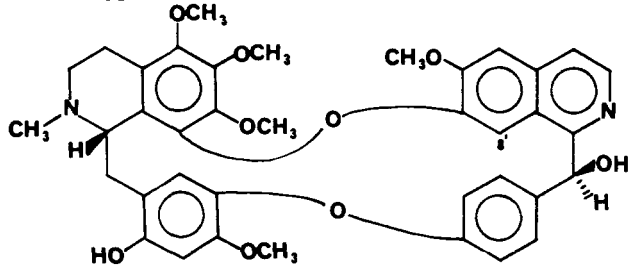
Type XII (*S,S*) 6,7,8*,11$^+$,12-5*,6,7,12$^+$




MP: 205–206° ($CH_3OH$) (42)
$[\alpha]^{21}_D$: −57° (c=0.23, $CH_3OH$) (42)
UV: 278(3.90), 2.83(3.91) with no shift in 0.01N NaOH or HCl (42)
IR: 3535 (42)
$^1$HNMR: $NCH_3$, 2.62; $OCH_3$ 3.52, 3.77, 3.88, 3.92; ArH 6.2–7.7(9) (42)
MS: $M^+$ 624(85), 623(17), 398(33), 397(100), 383(6), 222(4), 206(8), 199(55), 178(4) (42)
CD: (c=3.6 x $10^{-3}$) 225(−21,000), 232(0), 242(+67,000) 258(min) (+3,600), 270(+6,400), 273(0), 285(−24,000), 300(0) (42)
SOURCES: *Thalictrum alpinum* (Ranunculaceae) (42)
DERIVATIVES: Thalrugosidine (*N*-Desmethylthalrugosidine+$CH_2O$+$NaBH_4$) (TLC, MP, MMP, UV, IR, $^1$HNMR, SP ROTN, CD) (42)
*O*-Ethyl-N-Desmethylthalrugosidine (*N*-Desmethylthalrugosidine+$CH_3CHN_2$) (42)
MP: Amorphous (42)
TLC: 0.94 (Silica Gel G; $C_6H_6$-$(CH_3)_2CO$-$NH_4OH$ [10:10:0.3]) (42)
$^1$HNMR: $NCH_3$ 2.61; $OCH_3$ 3.54, 3.74, 3.86, 3.91; $OCH_2CH_3$ 0.73(t, $J$=7 )(42)
MS: $M^+$652(40), 637(7), 621(8), 426(27), 425(100), 411(7), 222(8), 213(63), 206(10), 204(17), 198(10), 192(7), 190(17), 188(3) (42)
Birch reduction ($Na/NH_3$) afforded (*S*)-(+)-6,4'-dimethoxy-7-ethoxy-benzyl-1,2,3,4-tetrahydroisoquinoline and (*S*)-(+)-5-hydroxyarmepavine (42)

**198.** DIHYDROTHALICTRININE $C_{38}H_{38}O_9N_2$: 666.2577

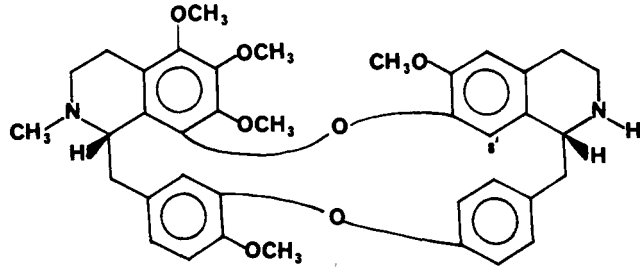
Type XVII[1] (*S*,−) 5,6,7,8*,10,12,13⁺–6,7*,12



MP: 194–197° ($CHCl_3$) (37)
TLC: 0.86 (Silica Gel G; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [10:10:0.3] ) (37)
$[\alpha]^{22}D$: −125° (c=0.13, $CH_3OH$) (37)
UV: 238(4.81), 249(sh) (4.73), 285(sh) (4.05), 299(sh) (3.95) (37)
($CH_3OH$ in 0.07N HCl) 210(sh) (4.96), 240(sh) (4.69), 252(4.75), 303(sh) (4.05), 340(sh) (3.74) (37)
IR: 3280 (37)
$^1$HNMR: (40°C) $NCH_3$ 2.49; $OCH_3$ 3.45, 3.70, 3.79, 3.86, 3.91; ArH 6.13(H8'), 6.46, 7.02(2), split ABXY pattern at ~6.47, 6.73(dd, $J$=2.5, 8.3 Hz), ~7.1, 7.82(dd, $J$=2.2, 8.0 Hz), an AB quartet at 7.48($J$=5.7 Hz) and 8.40($J$=5.7 Hz); OH 12.05($D_2O$ exchanged) (37)
MS: $M^+$ 666(666.2524) (100), 651(21), 635(7), 513(3), 409(1), 332(13), 325(3), 188(12), 142(38), 129(48), 112(13) (37)
CD: ($2.7 \times 10^{-4}$M) 217(+222,000), 231(0), 245(−266,000), 270(sh) (−70,000), 290(0) (37)
SOURCES: *Thalictrum rochebrunianum* (Ranunculaceae) (37)
PREPARATION: Via reduction ($NaBH_4$–$CH_3OH$) of thalictrinine (SP ROTN, IR, $^1$HNMR TLC, MP, MMP) (37)

**199.** EPINORHERNADAZINE (Semisynthetic) $C_{38}H_{42}O_7N_2$: 638.2992

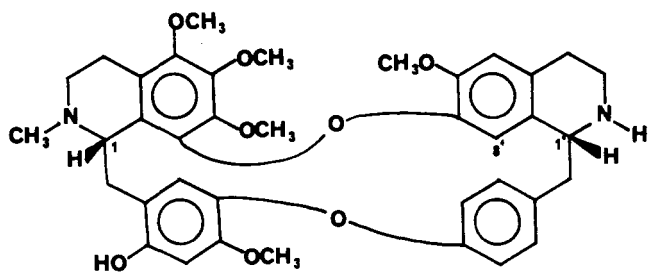
Type IX (*S*,*R*) 5,6,7,8*,11⁺,12–6,7*,12⁺



TLC: 0.54 (Silica Gel G; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [10:10:0.4] ) (37)
$[\alpha]^{22}D$: −62° (c=0.27, $CH_3OH$) (37)
$^1$HNMR: $NCH_3$ 2.26; $OCH_3$ 3.28, 3.63, 3.78, 3.81, 3.91; ArH 6.04(H8'), 6.2–7.4(8) (37)
MS: $M^+$ 638(10), 623(4), 607(3), 460(13), 425(17), 411(34), 397(22), 318(19), 220(17), 213(59) 206(100), 192(29), 191(29), 190(22) (37)
SOURCES: Via reduction ($NaBH_4$–$CH_3OH$) of thalisimine to afford epinorhernandazine and norhernandezine which were separated via volumn chromatography (37)

**200.** EPINORTHALIBRUNINE (Semisynthetic) $C_{36}H_{42}O_6N_2$: 654.2941

Type XVII[1] (*S*,*R*) 5,6,7,8*,10,12,13⁺–6,7*,12⁺

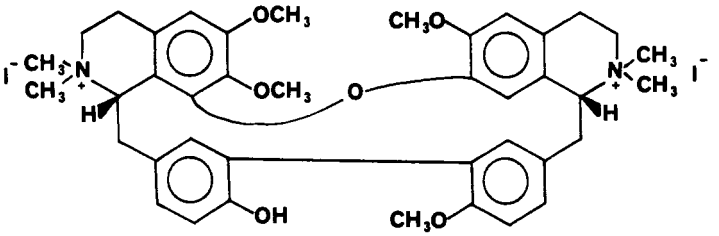


TLC: 0.61 (Silica Gel G: $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [10:10:0.4] ) (37)
$[\alpha]^{22}+D$: −242° (c1.36, $CH_3OH$) (37)

$^1$HNMR: ($C_5D_5N$) $NCH_3$ 2.37; $OCH_3$ 3.40, 3.51, 3.69, 3.76, 3.81; AlH 4.09(t, $J$=4 Hz), 4.41(dd, $J$=5,8 Hz for H1 and H1'); ArH 6.11(H8'), 6.70, 6.78, 6.8–7.4(5); OH 12.1 (37)
MS: $M^+$ 654(10), 639(4), 623(2), 476(9), 411(27), 397(19), 327(3, $M^+/2$), 238(13), 220(9), 206(100), 192(14), 191(27), 183(10), 178(14), 160(23), 132(13), 106(13) (37)
CD: (2.1 x $10^{-2}$M) 225(sh) (−100,000), 262(min) (−4,400), 286(−25,000), 320(0) (37)
SOURCES: Via reduction ($NaBH_4$–$CH_3OH$) of thalibrunimine to afford epinorthalibrunine and northalibrunine which were separated via column chromatography (37)

**201.** FUNIFERINE DIMETHIODIDE (*N,N*-DIMETHYLFUNIFERINE IODIDE) $C_{40}H_{48}O_6N_2^{++}2I^-$: 652.3512

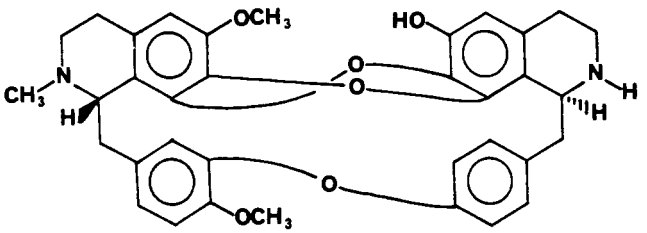
Type IV (*S,R*) 6,7,8*,12–6,7*,12(11–11)




MP: 268° ( $(CH_3)_2CO$) (48)
$[\alpha]^{29}D$: +14° (c=0.65, $CH_3OH$) (48)
UV: ($CH_3CH_2OH$) 229(4.82), 286(4.10) (48)
IR: (KBr) 3420, 2930, 1605, 1500, 1415 (48)
MS: 622($M^+$-2$CH_3I$) (100), 395(95), 381(35), 379(17), 198(68), 142(70), 128(5) and 127(17) (48)
SOURCES: *Tiliacora funifera* (Menispermaceae) (48)
PREPARATION: Via quaternization ($CH_3I$) of funiferine (TLC, MP, MMP, UV, IR, SP ROTN) (48)

**202.** GILLETINE $C_{35}H_{34}O_6N_2$: 578.2417

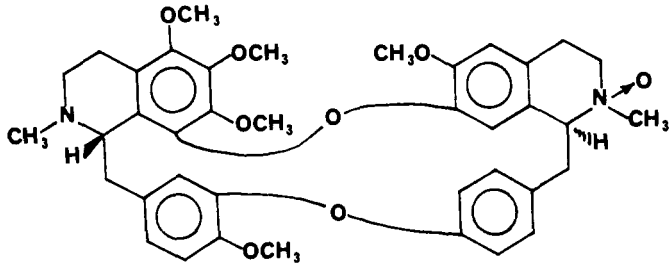
Type XXIV (*S,S*) 6,7*,8$^+$,11‡,12–6,7$^+$,8*,12‡




MP: 174–176° ($CHCl_3$-Ether) (15, 52)
$[\alpha]^{28}D$: +294° (c=0.56, $CH_3OH$) (15, 52)
UV: 237(4.34), 274(sh) (3.33), 290(3.41), 301(sh) (3.36) (15, 52)
IR: (KBr) 3520, 1505 (15, 52)
$^1$HNMR: $NCH_3$ 2.42; $OCH_3$ 3.95; NH 4.35; OH 5.16($D_2O$ exchanged); ArH 6.11, 6.53(2), 6.82(2), 6.90–7.07(m, 2), 7.59–7.68(m, 2) (15, 52)
MS: $M^+$ 578(33), 352(21), 351(100), 337(21), 176(27) (15, 52)
SOURCES: *Triclisia gilletii* (Menispermaceae) (15, 52)
DERIVATIVES: N-Methylgilletine (Gilletine+$CH_2O$+$NaBH_4$) (15)
MP: 156 157° ($CH_3OH$)
$[\alpha]^{30}D$: +310° (c=0.41, $CHCl_3$)
UV: 237(sh) (4.39), 277(sh) (3.39), 289(3.44), 3.04(sh) (3.37)
IR: (KBr) 3480, 1505
$^1$HNMR: $NCH_3$ 2.39, 2.57; $OCH_3$ 3.90, 3.93; OH 5.30 ($D_2O$ exchanged), ArH 6.16, 6.55(2), 6.87(2), 6.97–7.08(m, 2), 7.50–7.65(m, 2)
MS: $M^+$ 592(45), 366(25), 365(100), 351(33), 183(57)
*N,O*-Dimethylgilletine (*N*-Methylgilletine+$CH_2N_2$) (15)
MP: 201–203° ($CH_3OH$); Dimethiodide 261–263° [ $(CH_3)_2CO$]
$[\alpha]^{24}D$: +193° (c=1.73, $CHCl_3$)
UV: 237(sh) (4.57), 276(sh) (3.46), 291(3.51), 301(3.45)
IR: (KBr) 1503
$^1$HNMR: $NCH_3$ 2.38, 2.58; $OCH_3$ 3.82, 3.90, 3.95; ArH 6.17, 6.59(2), 6.88(2), 7.00–7.10 (m, 2), 7.52–7.58(m, 2)
MS: $M^+$ 606(41), 380(30), 379(100), 365(30), 190(53)
CD: 233(+97,700), 288(+20,400)

**203.** HERNANDEZINE-*N*-OXIDE $C_{39}H_{44}O_8N_2$: 668.3098

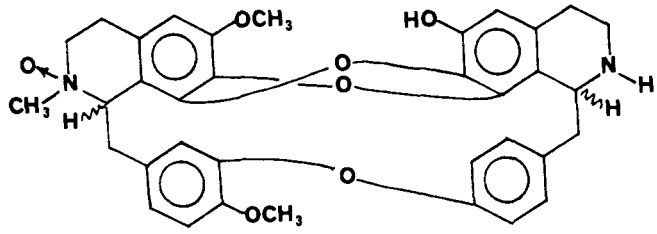
Type IX (*S*,*S*) 5,6,7,8*,11$^+$,12-6,7*,12$^+$



MP: 179–180° (141)
UV: 285(141)
$^1$HNMR: $NCH_3$ 2.31; $\overset{+}{N}CH_3$ 3.65; $OCH_3$ 3.15, 3.27,3.71(2), 3.81; ArH 5.97–7.15(9) (141)
MS: M$^+$ 668(15), 652(100), 461(25), 460(21), 425(34), 424(31), 411(62) (141)
SOURCES: *Thalictrum sultanabadense* (Ranunculaceae) (141)
DERIVATIVES: Hernandezine (Hernandezine-*N*-oxide+Zn+$H_2SO_4$) (141)

**204.** ISOGILLETINE-*N*-OXIDE $C_{35}H_{34}O_7N_2$: 594.2366

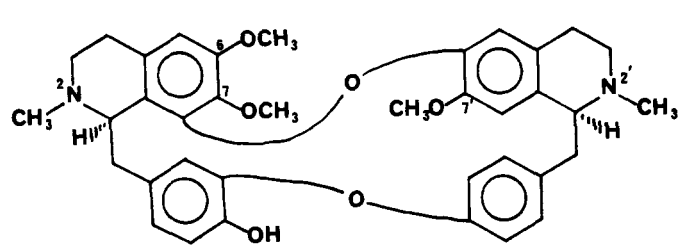
Type XXIV 6,7*,8$^+$,11‡,12-6,7$^+$,8*,12‡



MP: 218–220° ($CHCl_3$–$CH_3OH$) (52)
$[\alpha]^{29}D$: +216° (c=0.94, $CHCl_3$–MeOH [9:1] ) (52)
UV: 223(sh)(4.49), 229(sh)(4.54), 240(4.55), 289(3.80), 296(sh)(3.75) (52)
IR: (KBr) 3380(br), 2930, 1585, 1500, 1455, 1430, 1370, 1270, 1225, 1210, 1165, 1125, 1140, 990, 870, 830, 750 (52)
$^1$HNMR: $NCH_3$ 2.85; $OCH_3$ 3.83, 3.85; NH 4.30; OH 5.10; ArH 6.05–7.65(9) (52)
MS: M$^+$ 594(2), 578(10), 352(7), 351(29), 176(4), 57(100) (52)
SOURCES: *Triclisia gilletii* (Menispermaceae) (52)
DERIVATIVES: Gilletine diastereoisomer (Isogilletine-*N*-Oxide+$H_2SO_3$) (UV, IR, $^1$HMNR, MP) (52)

**205.** ISOTHALICBERINE $C_{37}H_{40}O_6N_2$: 608.2886

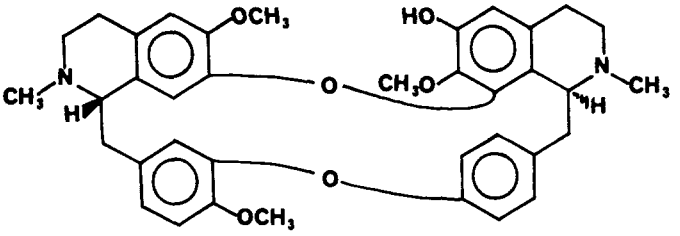
Type XI (*R*,*S*) 6,7,8*,11$^+$,12-6*,7,12$^+$



MP: 153–155° ($C_6H_{12}$–$CHCl_3$) (38)
$[\alpha]^{20}D$: −205° (c=0.4, $CHCl_3$) (38)
UV: ($CH_3CH_2OH$) 284(3.98) (38)
IR: 3575, 2875 (38)
$^1$HNMR: $NCH_3$ 2.33(N2), 2.57(N2'); $OCH_3$ 3.45(C7), 3.75(C7'), 3.80(C6); ArH 5.44(d, $J$= 2 Hz), 6.15, 6.4, 6.52–6.82(5), 7.03(d, $J$=2 Hz), 7.55(dd, $J$=2 and 8 Hz) (38)
MS: M$^+$ 608(70), 396(20), 395(61), 381(13), 205(9), 204(33), 198(100), 191(9), 190(28), 175(43), 174(46) (38)
ORD: 240(+30,000), 253(−12,600), 268(−1,900), 280(−7,500), 295(+3,000) (38)
SOURCES: *Berberis chilensis* (Berberidaceae) (38)
DERIVATIVES: *O*-Methylisothalicberine (Isothalicberine+$CH_2N_2$) (TLC, UV, IR, $^1$HNMR, SP ROTN, ORD) (38)

**206.** JOHNSONINE $C_{37}H_{40}O_6N_2$: 608.2886

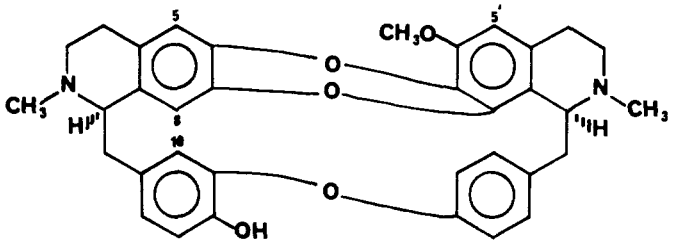
Type VI (*S,S*) 6,7*,11$^+$,12–6,7,8*,12$^+$




MP: 150–152° then dec. at 225° ($CH_3OH$) (24)
TLC: 0.25 (Silica Gel; $CHCl_3$-$Et_2N$ [9:1] ) (24)
0.42 (Silica Gel; $CHCl_3$-$CH_3OH$-$NH_4OH$ [90:10:1] ) (24)
0.50 (Silica Gel; $CH_3OH$-$NH_4OH$ [100:1.5] ) (24)
$[\alpha]^{19}D$: −86° ($CHCl_3$) (24)
UV: 281(3.82) and 257(3.02)(min); ($CH_3OH$+5% NaOH) 284(3.85) and 264(3.17)(min) (24)
IR: 3400, 1612, 1585, 1510, 1445, 1358, 1275, 1215, 1128, 1040, 1015, 752, 660 (24)
$^1$HNMR: $NCH_3$ 2.47, 2.53; $OCH_3$ 3.17, 3.35, 3.95; OH 4.70 ($D_2O$ exchanged); AlH 2.30–4.28(14); ArH 6.30–7.20(10) (24)
MS: $M^+$ 608(found 608.2883) (43), 607(32), 501(6), 382(31), 381(100), 367(34), 192(18), 191(62), 174(39), 168(52) (24)
SOURCES: *Daphnandra johnsonii* (Monimiaceae) (24)
DERIVATIVES: *O*-Methyljohnsonine (Johnsonine+$CH_2N_2$) (Same as *O*-Methylrepandine) (MP, MMP, TLC, UV, IR, $^1$HNMR, MS, SP ROTN) (24)

**207.** *N*-METHYLAPATELINE $C_{35}H_{34}O_5N_2$: 562.2468

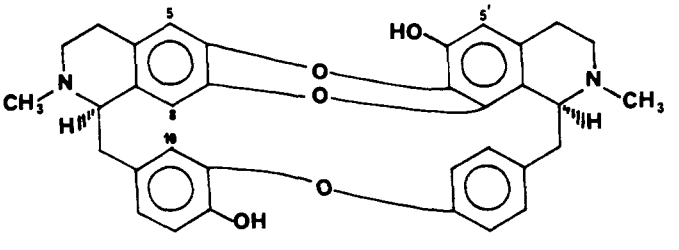
Type XXIII (*R,S*) 6*,7$^+$,11‡,12–6,7*,8$^+$,12‡




MP: 165–167° (sinter) 198–220° (dec) ($CH_3OH$) (24)
TLC: 0.35 (Silica Gel; $CHCl_3$-$Et_2N$ [9:1] ) (24)
0.49 (Silica Gel; $CHCl_3$-$CH_3OH$-$NH_4OH$ [90:10:1] ) (10)
0.42 (Silica Gel; $CH_3OH$-$NH_4OH$ [100:1.5] ) (24)
$[\alpha]^{19}D$: +212° ($CHCl_3$) (24)
UV: 280(3.61) and 258(3.35)(min) (24); ($CH_3OH$+5% NaOH) 290(3.72) and 270(3.47)(min) (24)
IR: 3400, 1585, 1505, 1445, 1350, 1275, 1210, 1110, 870, 750, (24)
$^1$HNMR: $NCH_3$ 2.45, 2.49; $OCH_3$ 3.85; OH 5.33 ($D_2O$ exchanged); AlH 2.20–4.10(14); ArH 5.90(H8), 6.25(H5), 6.35(H5'), 6.55(H10), 6.70–7.20(6) (24)
MS: $M^+$ 562 (found 562.2475)(58), 350(40), 349(100), 335(40), 175(54) (24)
SOURCES: *Daphnandra johnsonii* (Monomiaceae) (24)
DERIVATIVES: *N,O*-Dimethylapateline (*N*-Methylapateline+$CH_2N_2$) (Same as *N*-Methyltelobine) (24)

**208.** *N*-METHYLNORAPATELINE $C_{34}H_{32}O_5N_2$: 548.2311

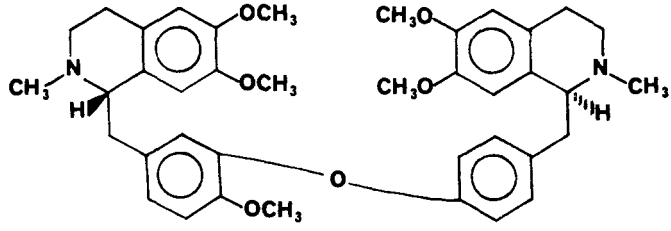
Type XXIII (*R,S*) 6*,7$^+$,11‡,12–6,7*,8$^+$,12‡



MP: 257–259° (dec) ($CHCl_3$) (24)
TLC: 0.19 (Silica Gel; $CHCl_3$-$Et_3N$ [9:1] ) (24)
0.32 (Silica Gel; $CHCl_3$–$CH_3OH$–$NH_4OH$ [90:10:1] ) (24)
0.25 (Silica Gel; $CH_3OH$–$NH_4OH$ [100:1.5] ) (24)
$[\alpha]^{19}D$: +235° ($CHCl_3$) (24)
UV: 282(3.72) and 258(3.47)(min) (24); ($CH_3OH$+5% NaOH) 302(3.95) and 272(3.69) (min) (24)
IR: 3450, 1585, 1500, 1445, 1350, 1270, 1210, 1108, 870, 748, 658 (24)
$^1$HNMR: ($CDCl_3$+$CD_3OD$) $NCH_3$ 2.44, 2.49; AlH 2.20–4.10(14); ArH 5.89(H8), 6.27(H5), 6.39(H5'), 6.60(H10), 6.77–7.20(6) (24)
MS: $M^+$ 548 (found 548.2307) (24), 336(38), 335(100), 321(32), 168(46) (24)
SOURCES: *Daphnandra johnsonii* (Monimiaceae) (24)
DERIVATIVES: *N,O*-Dimethylapateline (N-Methylnorapateline+$CH_2N_2$) (Same as *N*-Methyltelobine) (MP, MMP, TLC, UV, IR, MS, $^1$HNMR, SP ROTN) (24)

**209.** *O*-METHYLTHALIBRINE $C_{34}H_{32}O_6N_2$: 638.3356

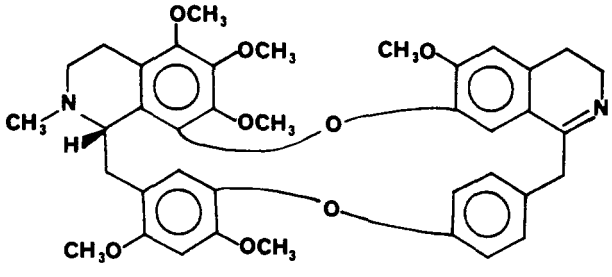
Type I (*S,S*) 6,7,11*,12–6,7,12*




MP: Amorphous (44)
TLC: 0.69 (Silica Gel G; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [20:20:0.7] ) (44)
$[\alpha]^{20}D$: +109° (c=0.22, $CH_3OH$) (44)
UV: 280(4.02), 285(sh)(4.01) (44)
$^1$HNMR: $NCH_3$ 2.49, 2.53; $OCH_3$ 3.60, 3.63, 3.78, 3.80, 3.83; ArH 6.10(H8), 6.16(H8'), 6.53(H5), 6.56(H5'), 6.6–7.2(7) (44)
MS: $M^+$ 638(<1), 206(100), 191(9), 190(9) (44)
CD: ($3.4 \times 10^{-3}$M, $CH_3OH$) 228(+75,000), 250(0), 270(0), 287(+15,500), 300(0) (44)
SOURCES: *Thalictrum minus* race B (Ranunculaceae) (44)
PREPARATION: Via methylation ($CH_2N_2$) of thalibrine (TLC, SP ROTN, UV, IR, $^1$HNMR, CD) (44)
DERIVATIVES: Birch Reduction ($Na/NH_3$) afforded (*S*)-(+)-*O*-methylarmepavine and (*S*)-(+)-Armepavine (44)
$KMnO_4$ oxidation afforded of *N*-methylcorydaldine and 2-methoxy-4',5-dicarboxydiphenylether (44)

**210.** *O*-METHYLTHALIBRUNIMINE[7] $C_{39}H_{42}O_8N_2$: 666.2941

Type XVII[1] (*S*,–) 5,6,7,8*,10,12,13$^+$–6,7*;12$^+$



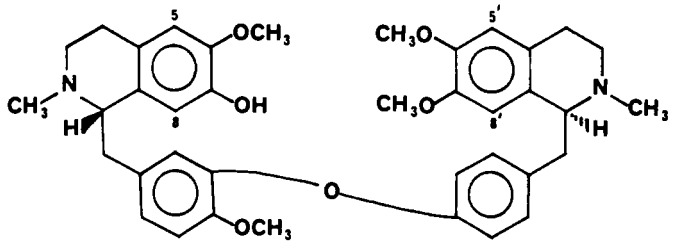

MP: 183–185° ($CHCl_3$) (47)
$[\alpha]D$: −103.7° (c=0.5, $CHCl_3$) (47)
UV: ($CH_3CH_2OH$) 240(sh)(4.46), 282(4.01), 305(sh)(3.92) (47)
$^1$HNMR[8]: $NCH_3$ 2.52; $OCH_3$ 3.45, 3.74, 3.81, 3.88, 3.92; $ArCH_2$ 4.39; ArH 6.02–7.60(7) (47)
MS[9]: 665(65), 664(100), 650(54), 635(26), 620(3), 605(13), 410(13), 395(3), 377(20), 363(20), 336(33), 234(6), 205(13) (47)

[7]The structural assignment of this alkaloid is in doubt due to inconsistent spectral data and the failure to directly compare the alkaloid or its derivatives with authentic samples. The structure of the alkaloid has been drawn to conform to revised type XVII (36).
[8]Six methoxy groups are cited in the paper but only five numerical signals with no integration is presented (47).
[9]The parent ion is incorrectly cited as *m/z* 665 which is impossible since the alkaloid contains two nitrogen atoms and therefore must have an even molecular ion/molecular weight.

SOURCES: *Thalictrum rochebrunianum* (Ranunculaceae) (47)
DERIVATIVES: N-Methyldihydro-O-Methylthalibrunimine (O-Methylthalibrunimine+$NaBH_4$ then $+CH_2O+NaBH_4$) (47)
MP: 130–135°
$^1$HNMR: Additional N-Methyl group at 2.49

**211.** NEOTHALIBRINE $C_{38}H_{44}O_6N_2$: 624.3199

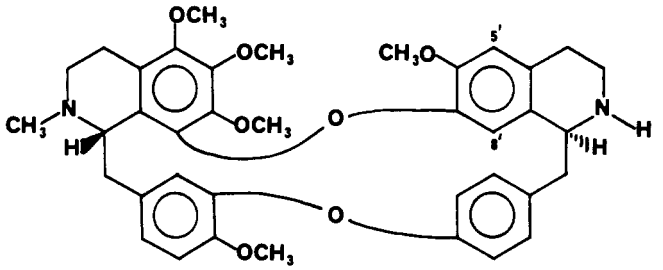
Type I (*S,S*) 6,7,11*,12–6,7,12*



MP: Amorphous (39)
$[\alpha]^{27}D$: +155° (c=0.5, $CH_3OH$) (39)
UV: 284(4.10) (39); ($CH_3OH+OH^-$) 285(4.10), 310(sh)(3.68) (39)
IR: 3540 (39)
$^1$HNMR: $NCH_3$ 2.43, 2.51; $OCH_3$ 3.59, 3.78(2), 3.82; ArH 6.09(H8'), 6.38(H8), 6.46, 6.56, an AA'BB' quartet at 6.78 and 6.98 ($J_{AB}$=8.8), an ABC multiplet between 6.6–6.9; OH 5.17 ($D_2O$ exchanged) (39)
MS: $M^+$ 624(0.1), 418, 206, 192 (39)
CD: ($8.0 \times 10^{-3}$) 231(+29,600), 250(−1,250), 288(+6,240) (39)
SOURCES: *Thalictrum alpinum* (Ranunculaceae) (42)
*Thalictrum revolutum* (Ranunculaceae) (39)
*Thalictrum rugosum* (Ranunculaceae) (43)
DERIVATIVES: *O*-Methylneothalibrine (Neothalibrine+$CH_2N_2$) (Same as *O*-Methylthalibrine) (IR, CD, $^1$HNMR, TLC) (39)
*O*-Ethylneothalibrine (Neothalibrine+$CH_3CHN_2$)
$^1$HNMR: $NCH_3$ 2.47, 2.52; $OCH_3$ 3.58, 3.78(2), 3.82; $OCH_2CH_3$ 1.33(t, $J$=7) and 3.83 (q, $J$=7): 6.09(H8'), 6.19(H8), 6.52(H5), 6.56(H5'), AA'BB' quartet at 6.78 and 6.99 ($J$=8.5), an ABC multiplet between 6.7–6.9.
MS: $M^+$ 652(0.1), 220(75), 206(100)
CD: ($c=5.9 \times 10^{-3}$) 231(+80,500), 259(+1,270), 288(+18,000)
Birch reduction ($Na/NH_3$) afforded (*S*)-(+)-armepavine and (*S*)-(+)-6,4'-Dimethoxy-7-ethoxy-2-methyl-1-benzyl-1,2,3,4-tetrahydroisoquinoline (39)

**212.** *N*'-NORHERNANDEZINE $C_{38}H_{42}O_7N_2$: 638.2992

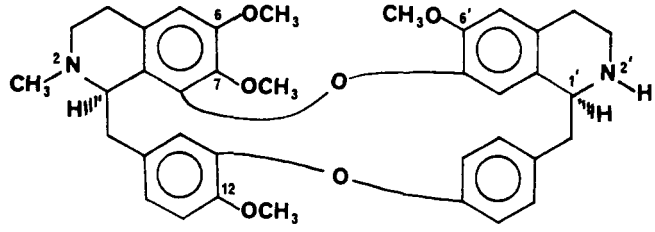
Type IX (*S,S*) 5,6,7,8*,11$^+$,12–6,7*,12$^+$



MP: Amorphous (37)
TLC: 0.46 (Silica Gel G; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [10:10:0.4] ) (37)
$[\alpha]^{22}D$: +143° (c=0.28, $CH_3OH$) (37)
$^1$HNMR: $NCH_3$ 2.30; $OCH_3$ 3.30, 3.35, 3.79, 3.82, 3.93; ArH 6.01(H8'), 6.87(H5'), ABXY pattern at 6.36, 6.81(dd each, 1H each, $J$=2,8 Hz) and 7.14, 6.37(dd, 1H each, $J$=2,8 Hz), ABC multiplet at 6.5–6.9 (37)
MS: $M^+$ 638(9), 623(4), 607(2), 501(1), 460(13), 425(15), 411(34), 397(22), 381(6), 238(10), 234(11), 222(8), 220(14), 213(58), 206(100), 198(22), 192(27), 191(26), 190(18), 183(11), 178(10), 176(12), 174(26), 160(20) (37)
CD: ($4.4 \times 10^{-3}$M, $CH_3OH$) 218(+169,000), 241(0), 247(−31,400), 261(0), 266(sh) (+4,000), 287(+17,300), 320(0) (37)
SOURCES: *Thalictrum rochebrunianum* (Ranunculaceae) (37)
PREPARATION: Via reduction ($NaBH_4$–$CH_3OH$) of thalisimine to afford epinorhernandezine and norhernandezine which were separated via column chromatography (37)

**213.** NOR-2'-ISOTETRANDRINE $C_{37}H_{40}O_6N_2$: 608.2886

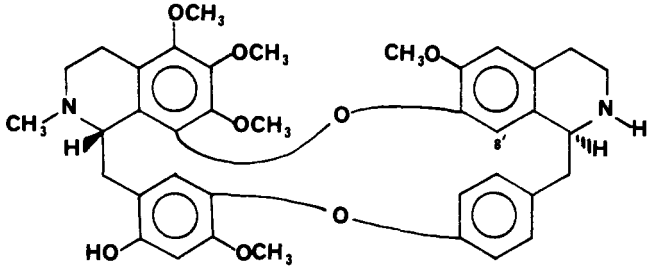
Type VIII (*R,S*) 6,7,8*,11$^+$,12–6,7*,12$^+$



MP: Noncrystalline (28)
$[\alpha]_D$: +26° ($CHCl_3$) (28)
UV: ($CH_3CH_2OH$) 282(4.11) (28)
$^1$HNMR: $NCH_3$ 2.30(N2); $OCH_3$ 3.20(C7), 3.63(C6'), 3.75(C6), 3.92(C12); ArH 6.00–7.35(10) (28)
MS: $M^+$ 608, 471, 431, 381, 367, 191(100) (28)
SOURCES: *Limaciopsis loangensis* (Menispermaceae) (28)
DERIVATIVES: Isotetrandrine (2'-Norisotetrandrine+$CH_2O$+$NaBH_4$) (28)

**214.** *N*'-NORTHALIBRUNINE $C_{38}H_{42}O_8N_2$: 654.2941

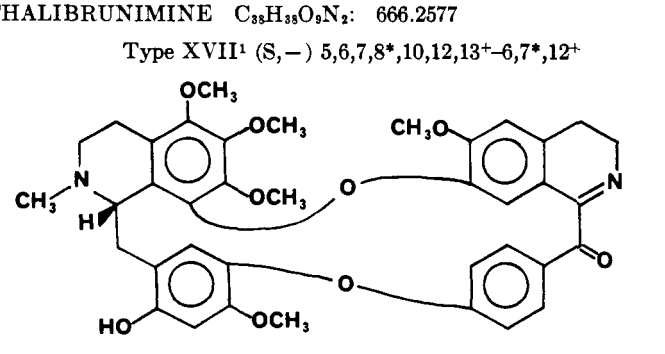
Type XVII[10] (*S,S*) 5,6,7,8*,10,12,13$^+$–6,7*,12$^+$



MP: 158–161° (37); Amorphous (47)
TLC: 0.43 (Silica Gel G; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [10:10:0.4] ) (developed twice) (37)
$[\alpha]^{20}_D$: +79° (c=0.16, $CH_3OH$) (37)
$[\alpha]_D$: +95° (c=1, $CHCl_3$) (47)
UV: ($CH_3CH_2OH$) 226(4.41), 236(4.56), 284(4.24) (47)
$^1$HNMR: $NCH_3$ 2.47; $OCH_3$ 3.23, 3.35, 3.77, 3.83, 3.89; ArH 5.92(H8'), 6.39, 6.48, 6.53, ABXY pattern with $\delta_{AB}$ 7.1–7.4, $\delta_x$ 6.4–6.7, $\delta_y$ 6.1–6.3 ($J_{AB} \approx J_{xy} \approx 8$ Hz) (37)
$NCH_3$ 2.48; $OCH_3$ 3.23, 3.35, 3.78, 3.83, 3.90; ArH 5.9–7.37 (47)
MS: $M^+$ 654(654.2954)(100), 639(30), 623(12), 476(7), 411(40), 397(27), 222(12), 206(37), 192(8), 177(23), 131(10), 111(36), 109(22), 108(15), 107(20), 106(15), 105(30), 104(20) (23)
$M^+$ 654(53), 653(34), 477(30), 412(100), 411(20), 397(68), 206(89), 178(14), 160(68) (47)
CD: (c=2.5 x $10^{-3}$) 220(+180,000), 236(0), 245(−114,000), 273(−36,000), 282(0), 294(+53,000), 320(0) (37)
SOURCES: *Thalictrum rochebrunianum* (Ranunculaceae) (37, 47)
PREPARATION: Via reduction ($NaBH_4$–$CH_3OH$) of thalibrunimine to afford epinorthalibrunine and northalibrunine which were separated via column chromatography (37)

**215.** OXOTHALIBRUNIMINE $C_{38}H_{38}O_9N_2$: 666.2577

Type XVII[1] (S,−) 5,6,7,8*,10,12,13$^+$–6,7*,12$^+$

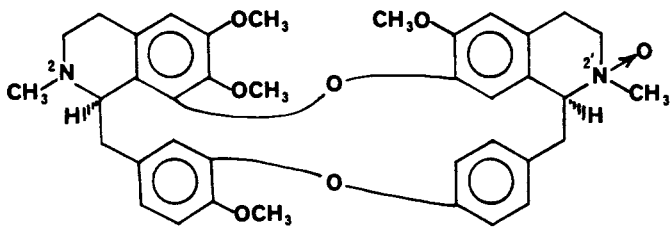


[10]Revised type XVII (37) from that presented in the review by Guha *et al.* (1).

MP: 198–200° (dec) ( $(CH_3)_2CO$) (37)
TLC: 0.72 (Silica Gel G; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [10:10:0.3] ) (37)
$[\alpha]^{22}D$: −70° (c=0.25, $CH_3OH$) (37)
UV: 220(4.34)(end), 240(sh)(4.10), 270(sh)(3.86), 330(sh)(3.40) (37)
($CH_3OH$ in 0.03N HCl) 250(sh)(4.00), 284(3.60), 346(sh)(3.31) (37)
IR: 1680, 1625, 1565 (37)
$^1$HNMR: $NCH_3$ 2.43; $OCH_3$ 3.35, 3.47, 3.79, 3.84, 3.91; ArH 5.95(H8'), 6.42, 6.52, 6.62, ABXY pattern with split doublets at 6.78 ($J$=2.2, 8.6 Hz), 7.05($J$=1.9, 8.6 Hz), 7.41($J$=2.2, 8.3 Hz) and 8.23($J$=1.9, 8.3 Hz); OH 12.86 (37)
$^{13}$CNMR: 192.2 (C=O), 165.0 (C=N) (37)
MS: $M^+$ 666(666.2592)(100), 651(37), 649(29), 638(3), 635(16), 410(2), 409(6) and 333(10) (37)
CD: (3.8 x $10^{-3}$M) 220(+28,000(end), 222(0), 243(−156,000), 270(0), 278(−6,700), 285(0), 299(+33,000), 320(sh)(+12,000), 342(0), 365(−9,900), 390(0) (37)
SOURCES: *Thalictrum rochebrunianum* (Ranunculaceae) (37)
PREPARATION: Via air oxidation of thalibrunimine (TLC, IR, $^1$HNMR, SP ROTN, MMP) (37)

**216.** *N*-OXY-2'-ISOTETRANDRINE $C_{38}H_{42}O_7N_2$: 638.2992

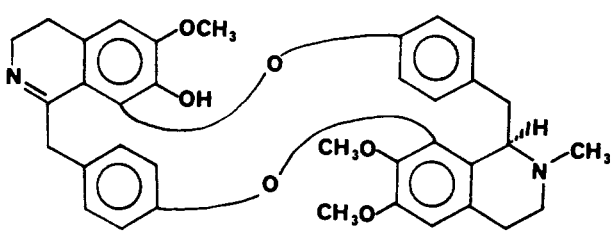
Type VIII (*R,S*) 6,7,8*,11$^+$,12–6,7*,12$^+$




MP: 191–192° ($CH_3OH$) (28)
$[\alpha]D$: +94° ($CHCl_3$) (28)
UV: 282(3.98) (28)
$^1$HNMR: $NCH_3$ 2.25(N2); $NCH_3$ 3.28(N2'); $OCH_3$ 3.15, 3.61, 3.77, 3.92; ArH(10) (no range given) (28)
MS: $M^+$ 638, 622, 585, 431, 396, 395, 381, 198, 175 (28)
SOURCES: *Limaciopsis loangensis* (Menispermaceae) (28)
DERIVATIVES: Isotetrandrine (2'-N-Oxyisotetrandrine+Zn+HCl) (28)

**217.** SCIADOFERINE $C_{36}H_{36}O_6N_2$: 592.2573

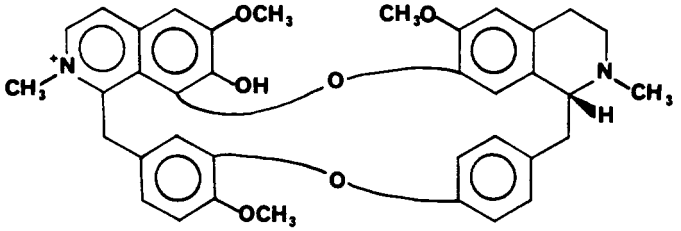
Type XX (−,*R*) 6,7,8*,12$^+$–6,7,8$^+$,12*




MP: 188–189 (EtOAc) (17)
$[\alpha]^{20}D$: +84.7° (c=1.2, $CHCl_3$) (17)
UV: 277(4.12), 312(3.86) (17)
IR: 1650 (17)
$^1$HNMR: $NCH_3$ 2.35; $OCH_3$ 3.56, 3.85, 3.92; CH–C=N 4.11 (br s) (17)
MS: $M^+$ 592 (17)
SOURCES: *Sciadotenia toxifera* (Menispermaceae) (17)
DERIVATIVES: Dihydrosciadoferine diastereoisomer mixture (Sciadoferine+$NaBH_4$) (17)
*O*-Methyldihydrosciadoferine (Dihydrosciadoferine diastereoisomer mixture+$CH_2N_2$) (17)
*N,O*-Dimethyldihydrosciadoferine (*O*-Methyldihydrosciadoferine diasteroisomer mixture+$CH_2O$+HCOOH) (17)
*O*-Ethyldihydrosciadoferine (Dihydrosciadoferine diastereoisomer mixture+$CH_3CHN_2$) (17)
Birch Reduction (Na/$NH_3$) afforded (*R*)-(−)-armepavine and 6-methoxy-7-ethoxy-4'-hydroxybenzyltetrahydroisoquinoline (17)
Sciadoline (Sciadoferine+maleic acid+Pd+Δ) (17)

**218.** 1,2,3,4-Tetradehydrolimacine[11] $C_{37}H_{37}O_6N_2$: 605.2652

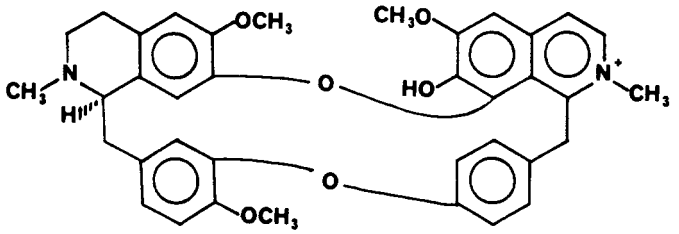
Type VIII 6,7,8*,11+,12–6,7*,12+



SOURCE: *Pycnarrhena longifolia* (Menispermaceae) (164); UV, IR, $^1$HNMR, $^{13}$CNMR, MS and Optical Rotation data were used along with chemical reactions and TLC to determine the structure but the data was not cited in this abstract (164).

**219.** 1',2',3',4'-TETRADEHYDROLIMACUSINE[12] $C_{37}H_{37}O_6N_2$: 605.2652

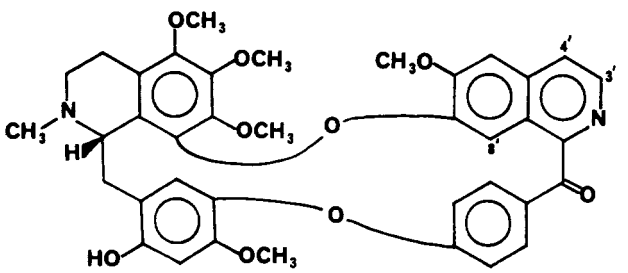
Type VI 6,7*,11+,12–6,7,8*,12+



SOURCE: *Pycnarrhena longifolia* (Menispermaceae) (154); UV, IR, $^1$HNMR, $^{13}$CNMR, MS and Optical Rotation data were used along with chemical reactions and TLC to determine the structure but the data was not cited in this abstract (164).

**220.** THALICTRININE $C_{38}H_{36}O_9N_2$: 664.2421

Type XVII[1] (*S*,–) 5,6,7,8*,10,12,13+–6,7*,12+



MP: 199–201° (dec) ( $(CH_3)_2CO$) (37)
TLC: 0.79 (Silica Gel; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [10:10:0.3] ) (37)
$[\alpha]^{22}D$: −255° (c=0.24, $CH_3OH$) (37)
UV: 205(sh)(4.79), 236(4.62), 251(sh)(4.50), 285(sh)(4.01), 301(sh)(3.84), 330(3.73) (37) ($CH_3OH$ in 0.1N HCl) 282(sh)(4.13), 340(3.64) (37)
IR: 1675 (37)
$^1$HNMR: $NCH_3$ 2.47; $OCH_3$ 3.28, 3.61, 3.79, 3.86, 3.90; ArH 6.05(H8'), 6.51, 6.84, 7.02, ABXY pattern with split doublets at ~6.8 and 6.9 ($J \approx 2{,}8$ Hz, obscured split AB quartet does not allow accurate measurement of shifts or $J$ values), 7.49 and 8.37 (dd, $J$=1.9, 8.3 Hz), AB quartet 7.64 and 8.62 (2d, 5.1, H4', H3'); OH 12.80 ($D_2O$ exchanged) (37)
$^{13}$CNMR: 194.3(C=O) (37)
MS: $M^+$ 664(664.2408)(100), 649(37), 332(15) (37)

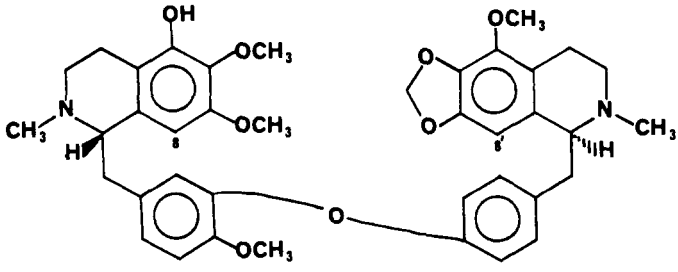
[11]Although no name was given to this alkaloid in the abstract (164), it was stated to be the corresponding berbaman-alkaloid to 1',2',3',4'-tetradehydrolimacusine (219).

[12]The name for this alkaloid in the abstract (164) was cited as 1',2',3',4'-tetrahydrolimacusine but the unsaturated nature of quaternary isoquinoline ring suggests the authors intended to use the term "dehydro" in the name.

CD: (3.6 x $10^{-3}$M) 230(+115,000)(end), 241(0), 254(−112,000), 275(sh)(−76,000), 310(0), 355(−35,000), 395(0) (37)
SOURCES: *Thalictrum rochebrunianum* (Ranunculaceae) (37)
PREPARATION: Via heating thalibrunimine with Pd/C and p-cymene (IR, $^1$HNMR, TLC, MP, MMP) (37)

**221.** THALISTINE $C_{39}H_{44}O_8N_2$: 668.3098

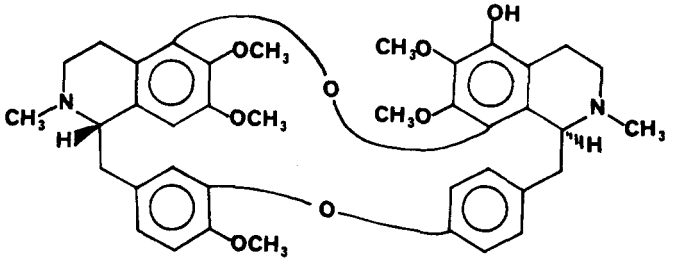
Type III (*S,S*) 5,6,7,11*,12–5,6,7,12*



MP: Amorphous (44)
TLC: 0.6 (Silica Gel G, $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [5:5:0.2] ) (44)
$[\alpha]^{20}D$: +104° (c=0.35, $CH_3OH$) (44)
UV: 278(3.90) (44)
IR: 3520 (44)
$^1$HNMR: $NCH_3$ 2.47, 2.50; $OCH_3$ 3.60, 3.63(2), 3.78(2); $CH_2O_2$ 5.88, OH 5.8 ($D_2O$ exchanged); ArH 5.76(H8 and H8'), 6.4–7.2(7) (44)
MS: $M^+$ 668(5), 667(1), 236(15), 222(100), 221(82), 220(91), 205(33), 204(31), 192(50), 176(10) (44)
CD: 226(+64,000), 290(−1,530) (44)
SOURCES: *Thalictrum minus* race B (Ranunculaceae) (44)
DERIVATIVES: O-Methylthalistine (Thalistine+$CH_2N_2$) (Same as N-Desmethylthalistyline) (TLC, UV, IR, $^1$HNMR, CD, SP ROTN) (44)
O-Ethylthalistine (Thalistine+$CH_3CHN_2$) (44)
TLC: 0.73 (Silica Gel G; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [10:10:0.3] ) (44)
$^1$HNMR: $OCH_2CH_3$ 1.33(t, $J$=7), 4.01(q, $J$=7); $NCH_3$ 2.44, 2.48; $OCH_3$ 3.60, 3.62, 3.77, 3.79; $CH_2O_2$ 5.88; ArH 5.73(H8), 5.94(H8'), 6.6–7.1(7) (44)
MS: $M^+$ 696(1), 695(0.5), 667(1), 250(96), 221(32), 220(100), 205(16), 204(11), 192(46), 176(10) (44)
Birch Reduction ($Na/NH_3$) afforded (*S*)-(+)-4',7-dimethoxy-5-ethoxy-2-methyl-benzyltetrahydroisoquinoline and 4',7-dihydroxy-5-methoxy-2-methyl-benzyltetrohydroisoquinoline (44)
$KMnO_4$ oxidation afforded 5-methoxy-2-methyl-6,7-methylenedioxy-1-oxo-1,2,3,4-tetrahydroisoquinoline, 6,7-dimethoxy-5-ethoxy-2-methyl-1-oxo-1,2,3,4-tetrahydroisoquinoline and 4',5-dicarboxy-2-methoxy-diphenyl ether (characterized as its dimethyl ester) (44)

**222.** THALMIRABINE $C_{39}H_{44}O_8N_2$: 668.3098

Type XIII (*S,S*) 5*,6,7,11$^+$,12–5,6,7,8*,12$^+$

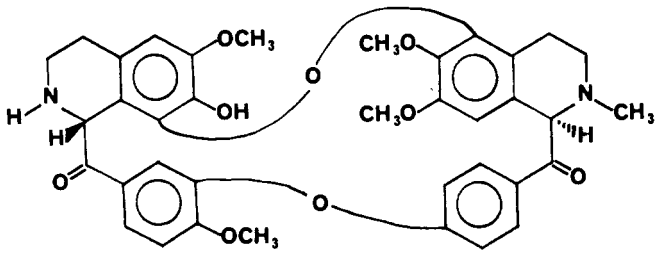


MP: Amorphous (44)
TLC: 0.59 (Silica Gel G; $C_6H_6$–$(CH_3)_2CO$–$NH_4OH$ [20:20:0.5] ) (44)
$[\alpha]^{20}D$: +116° (c=0.2, $CH_3OH$) (44)
UV: 280(3.95), 314(sh)(3.34) (44)
IR: 3530 (44)
$^1$HNMR: $NCH_3$ 2.36, 2.60; $OCH_3$ 3.38, 3.42, 3.72, 3.80, 3.86; OH 5.20 ($D_2O$ exchanged); ArH 6.00(H8), 6.4–7.3(7) (44)
MS: $M^+$ 668(37), 442(4), 222(56), 221(100), 206(18) (44)
CD: (3.0 x $10^{-3}$M) 230(+65,100), 269(0), 285(−11,000), 300(0) (44)

SOURCES: *Thalictrum minus* race B (Ranunculaceae) (44)
DERIVATIVES: *O*-Methylthalmirabine (Thalmirabine+$CH_2N_2$) (44)
TLC: 0.7 (Silica Gel G; $C_6H_6$-$(CH_3)_2CO$-$NH_4OH$ [20:20:0.5] )
$^1$HNMR: $NCH_3$ 2.37, 2.64; $OCH_3$ 3.38, 3.42, 3.74, 3.83(2), 3.88; ArH 5.99(H8), 6.4–7.5(7)
CD: (4.9 x $10^{-3}$M) 230(+43,000), 263(0), 285(−6,650), 305(0)
*O*-Ethylthalmirabine (Thalmirabine+$CH_3CHN_2$) (44)
TLC: 0.78 (Silica Gel G; $C_6H_6$-$(CH_3)_2CO$-$NH_4OH$ [20:20:0.5] )
$^1$HNMR: $OCH_2CH_3$ 1.40(t, $J$=7), 4.04(q, $J$=7); $NCH_3$ 2.38, 2.63; $OCH_3$ 3.40, 3.42, 3.79, 3.83, 3.88; ArH 6.03(H8), 6.4–7.4(7)
MS: $M^+$ 696(70), 470(23), 250(65), 235(100), 205(60)
Birch Reduction ($Na/NH_3$) afforded (*S*)-(+)-O-Methylarmepavine, (*S*)-(+)-5-hydroxy-2-methoxy-4',6,7—trimethoxybenzyltetrahydroisoquinoline and (*S*)-(+)-6,7-dimethoxy-5-ethoxy-4'-hydroxy-2-methylbenzyltetrahydroisoquinoline.
$KMnO_4$ oxidation followed by treatment of the acidic fraction with $CH_2N_2$ afforded 2-methoxy-4',5-dicarboxydiphenyl ether characterized as its dimethyl ester.

**223.** THALPINDIONE $C_{37}H_{36}O_9N_2$: 652.2421

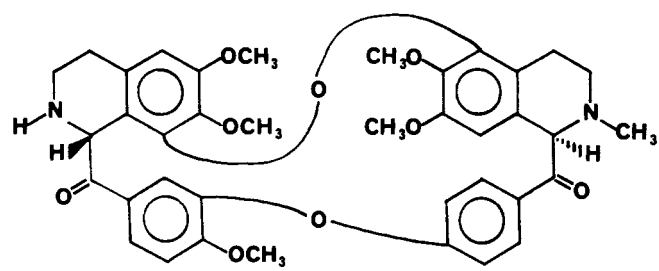
Type XII (*S,S*) 6,7,8*,11$^+$,12-5*,6,7,12$^+$




MP: Amorphous (42)
$[\alpha]^{21}D$: −42° (c=0.29, $CH_3OH$) (42)
UV: 275(3.78), 2.83(sh)(3.77) (42) with no change in 0.01N NaOH or HCl
IR: 3530, 1663 (42)
$^1$HNMR: $NCH_3$ 2.36; $OCH_3$ 3.47, 3.80, 3.89, 3.90; AlH (methine) 4.4–4.7(2); ArH 6.1–7.7(9); OH 5.2 ($D_2O$) exchanged) (42)
MS: $M^+$ 652(652.2436)(26) (42)
CD: (4.48 x $10^{-3}$M) 215(end), 227(0), 240(+78,000), 258(min)(+560), 265(+2,230), 270(0), 285(−22,900), 305(0) (42)
SOURCES: *Thalictrum alpinum* (Ranunculaceae) (42)
DERIVATIVES: *O*-Methylthalpindione (Thalpindione+$CH_2N_2$) (Same as thalrugosinone) (IR, UV, $^1$HNMR, CD) (42)

**224.** THALRUGOSINONE $C_{38}H_{38}O_9N_2$: 266.2577

Type XII (*S,S*) 6,7,8*,11$^+$,12-5*,6,7,12$^+$




MP: Amorphous (43)
TLC: 0.86 (Silica Gel G; $C_6H_6$-$(CH_3)_2CO$-$NH_4OH$ [20:20:0.5] ) (43)
$[\alpha]^{22}D$: −46° (c=0.125, $CH_3OH$) (43)
UV: 274(3.89), 283(3.86) with an important increase in absorption from higher wavelengths [300(3.46), 350(2.94), 400(2.52)] with no discernible shoulder, indicating additional absorption than observed for the usual bisbenzylisoquinoline alkaloids (43)
No shift in 0.01N NaOH or 0.01 NHCl was observed (43)
IR: 1660 (43)
$^1$HNMR: $NCH_3$ 2.64; $OCH_3$ 3.33, 3.48, 3.78, 3.88, 3.90; AlH 4.4–4.75(2); ArH 6.1–7.7(9) (43)
MS: $M^+$ 666(666.2591)(56), 412(16), 341(12), 325(100), 221(11), 207(8), 206(10), 205(6), 191(6) (43)
CD: (1.88 x $10^{-3}$M) 220(end)(−48,000), 230(0), 242(+67,000), 260(0), 268(+7,500), 274(0), 286(−25,000), 300(0) (43)
SOURCES: *Thalictrum rugosum* (Ranunculaceae) (43)

TABLE 5. Calculated Molecular Weights of New Bisbenzylisoquinoline Alkaloids[13].

548.2311: $C_{34}H_{32}O_5N_2$
Apateline (**187**) (20)
*N*-Methylnorapateline (**208**) (24)

560.2311: $C_{35}H_{32}O_5N_2$
1,2-Dehydroapateline (**193**) (20, 21)
1,2-Dehydrotelobine (**194**) (20)

562.2468: $C_{35}H_{34}O_5N_2$
*N*-Methylapateline (**207**) (24)

578.2417: $C_{35}H_{34}O_6N_2$
Gilletine (**202**) (15)

592.2573: $C_{36}H_{36}O_6N_2$
Sciadoferine (**217**) (17)

594.2366: $C_{35}H_{34}O_7N_2$
Isogilletine-*N*-Oxide (**204**) (52)

594.2724: $C_{36}H_{38}O_6N_2$
Baluchistine (**188**) (33)
7-O-Demthylisothalicberine (**195**) (38)

605.2652: $C_{37}H_{37}O_6N_2$
1,2,3,4-Tetradehydrolimacine (**218**) (163)
1',2',3',4'-Tetradehydrolimacusine (**219**) (163)

608.2886: $C_{37}H_{40}O_6N_2$
Isothalicberine (**205**) (38)
Johnsonine (**206**) (24)
Nor-2'-Isotetrandrine (**213**) (28)

610.3043: $C_{37}H_{42}O_6N_2$
Daurisoline (**192**) (45)

616.2209: $C_{37}H_{32}O_6N_2$
Daphnine (**191**) (147,155)

624.2836: $C_{37}H_{40}O_7N_2$
*N*-Desmethylthalrugosidine (**197**) (42)

624.3199: $C_{38}H_{44}O_5N_2$
Neothalibrine (**211**) (39,42,43)

636.2836: $C_{38}H_{40}O_7N_2$
Calafatimine (**189**) (132)

638.2992: $C_{38}H_{42}O_7N_2$
*N*-Desmethylthalidasine (**196**) 141,143)
Epinorhernandezine (semisynthetic) (**199**) (37)
*N*'-Norhernandezine (**212**) (37)
*N*-Oxy-2'-Isotetrandrine (**216**) (28)

638.3356: $C_{39}H_{46}O_6N_2$
*O*-Methylthalibrine (**209**) (44)

652.2421: $C_{37}H_{36}O_9N_2$
Thalpindione (**223**) (42)

652.3149: $C_{39}H_{44}O_7N_2$
Calafatine (**190**) (35, 132)

652.3512: $C_{40}H_{48}O_6N_2$
Funiferine dimethiodide (*N,N*-Dimethylfuniferine iodide) (**201**) (48)

654.2941: $C_{38}H_{42}O_8N_2$
Epinorthalibrunine (Semisynthetic) (**200**) (37)
*N*'-Northalibrunine (**214**) (37, 47)

664.2421: $C_{38}H_{36}O_9N_2$
Thalictrinine (**220**) (37)

666.2577: $C_{38}H_{38}O_9N_2$
Dihydrothalictrinine (**198**) (37)
Oxothalibrunimine (**215**) (37)
Thalrugosinone (**224**) (43)

666.2941: $C_{39}H_{42}O_8N_2$
*O*-Methylthalibrunimine (**210**) (47)

668.3098: $C_{39}H_{44}O_8N_2$
Hernandezine-N-Oxide (**203**) (140)
Thalistine (**221**) (44)
Thalmirabine (**222**) (44)

[13]These alkaloids were not previously reported in the review by Guha *et al.* (1).

TABLE 6. Distribution of the Different Types of New Bisbenzylisoquinoline Alkaloids in Different Genera and Families.[a]

| Family | Genus | Type | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | Ia | II | III | IV | V | VI | VII | VIII | IX |
| Menispermaceae | Limaciopsis | | | | | | | | | 2 | |
| | Menispermum | 1 | | | | | | | | | |
| | Pycnarrhena | | | | | | | 2 | | 1 | |
| | Sciadotenia | | | | | | | | | | |
| | Tiliacora | | | | | 1 | | | | | |
| | Triclisia | | | | | | | | | | |
| Ranunculaceae | Thalictrum | 2 | | | 1 | | | | | | 3 |
| Berberidaceae | Berberis | | | | | | | | | | |
| Monimiaceae | Daphnandra | | | | | | | 1 | | | |

TABLE 6. *Continued.*

| Family | Genus | Type | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | X | Xa[b] | Xb[c] | XI | XII | XIII | XIV | XV | XVI | XVII[d] |
| Menispermaceae | Limaciopsis | | | | | | | | | | |
| | Menispermum | | | | | | | | | | |
| | Pycnarrhena | | | | | | | | | | |
| | Sciadotenia | | | | | | | | | | |
| | Tiliacora | | | | | | | | | | |
| | Triclisia | | | | | | | | | | |
| Ranunculaceae | Thalictrum | | | | | 4 | 1 | | | | 6 |
| Berberidaceae | Berberis | | 2 | | 2 | | | | | | |
| Monimiaceae | Daphnandra | | | 1 | | | | | | | |

| Family | Genus | Type | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | XVIII | XIX | XX | XXI | XXII | XXIII | XXIV | XXV | XXVI |
| Menispermaceae | Limaciopsis | | | | | | | | | |
| | Menispermum | | | | | | | | | |
| | Pycnarrhena | | | | | | | | | |
| | Sciadotenia | | | 1 | | | | | | |
| | Tiliacora | | | | | | | | | |
| | Triclisia | | | | | | | 2 | | |
| Ranunculaceae | Thalictrum | | | | | | | | | |
| Berberidaceae | Berberis | | | | | | | | | |
| Monimiaceae | Daphnandra | | | | | | 5 | | | |

[a]These alkaloids were not previously reported in the review by Guha et al. (1).

[b]Type Xa is a new type which follows the numbering system 6,7,8*,10,11$^+$,12–6,7*,12$^+$ according to the precedent of Shamma and Moniot (163).

[c]Type Xb is a new type which follows the numbering system 6,7*,8,11$^+$,12,13–6,7*,12$^+$ according to the precedent of Shamma and Moniot (163).

[d]Type XVII has been revised from 5,6,7,8*,10$^+$,11,12–6,7*,12$^+$ to 5,6,7,8*,10,12,13$^+$–6,7*,12 (22) according to the precedent of Shamma and Moniot (163).

TABLE 7. Incompletely Characterized Alkaloids.

1. Alkaloid, $R_f$ 0.04 (20)
   $C_{35}H_{28}N_2O_5$: 556.1998
   $[\alpha]^{20}D$: +310° ($CHCl_3$)
   UV: 290(sh)(4.0), 340(sh)(3.7); ($CH_3OH$+NaOH) 354(4.2)
   $^1$HNMR: $NCH_3$ 2.62; $OCH_3$ 3.87; AlH 2.7–4.3; ArH 5.5–7.8
   MS: $M^+$ 556(556.2011), 540, 525, 445, 350, 333
   SOURCE: *Daphnandra apatela* (Monimiaceae)
2. Alkaloid, $R_f$ 0.46 (20)
   $C_{35}H_{30}N_2O_5$: 558.2155
   MP: 247–258(dec)
   $[\alpha]^{20}D$: +119° ($CHCl_3$)
   UV: 290(sh)(3.8), 337(3.6); ($CH_3OH$+NaOH) 227(3.7), 295(sh)(3.8)
   $^1$HNMR: $NCH_3$ 2.52; $OCH_3$ 3.87; AlH 2.5–4.1; ArH 6.44–7.4
   MS: $M^+$ 558(558.2136); 543, 527, 445, 348, 333, 319
   SOURCE: *Daphnandra apatela* (Monimiaceae)

TABLE 7. *Continued.*

3. Alkaloid B (17)
   SOURCE: *Sciadotenia toxifera* (Menispermaceae)
4. Alkaloid F (17)
   SOURCE: *Sciadotenia toxifera* (Menispermaceae)
5. Alkaloid T2 (25)
   $[\alpha]_D$: $-0.030°$ or $+1.21°$
   UV: 283, 302(sh)
   MS: 608(9), 595(11), $M^+$ 594(29), 593(20), 471(2), 403(6), 382(20), 381(70), 368(15), 367(22), 192(54), 191.5(25), 191(100), 190(19), 175(16), 174(22), 168.5(57), 168(31)
   SOURCE: *Pycnarrhena novoguineensis* (Menispermaceae)
6. Alkaloid T3 (25)
   $[\alpha]_D$: $-0.010°$ or $0.075°$
   UV: ($CH_3OH$) 283; ($CH_3OH+OH^-$) 283, 302(sh)
   SOURCE: *Pycnarrhena novoguineensis* (Menispermaceae)
7. Unidentified alkaloid (132)
   SOURCE: *Cyclea barbata* (Menispermaceae)

TABLE 8. Botanical Sources of Bisbenzylisoquinoline Alkaloids by Family.

BERBERIDACEAE
- *Berberis*
  - Aromoline (**31**) (46)
  - Baluchistine (**188**) (33)
  - Berbamine (**57**) (16,22,26,40,46,49,131)
  - Calafatimine (**189**) (132)
  - Calafatine (**190**) (21,132)
  - 7-*O*-Dimethylisothalicberine (**195**) (38)
  - Isotetrandrine (**62**) (16,40)
  - Isothalicberine (**205**) (38)
  - 2'-N-Methylberbamine (**66a**) (19)
  - *O*-Methylisothalicberine (**94**) (38)
  - Oxyacanthine (**48**) (26,46)
- *Mahonia*
  - Obaberine (**46**) (159)
  - Obamegine (**71**) (159)
  - Oxycanthine (**48**) (159)
  - Thalrugosine (**79**) (159)

LAURACEAE
- *Dehassia*
  - Obaberine (**46**) (27)

MENISPERMACEAE
- *Cissampelos*
  - (±)-Curine dimethiodide (*N,N*-Dimethylcurine iodide) (*N,N*-Dimethyl-(±)-**132**) (156)
- *Cyclea*
  - Curine (**132** or **133**) (30,130,133)
  - Cycleanine (**121**) (144)
  - Hayatine (**137**) (152)
  - Homoaromoline (**42**) (130)
  - (+)-Isochondodendrine (**122**) (130,152)
  - (+)-4"-*O*-Methylcurine (**139**) (152)
  - Tetrandrine (**76** or **77**) (130)
- *Limaciopsis*
  - Berbamine (**57**) (28)
  - *N*-2'-Chloromethylisotetrandrine (*N*-2'-Chloromethyl **62**) (28)
  - Cycleanine (**12**) (28)
  - Isotetrandrine (**62**) (28)
  - Nor-2'-Isotetrandrine (**213**) (28)
  - *N*-oxy-2'-Isotetrandrine (**216**) (28)
  - Thalrugosamine (**52**) (28)
  - Thalrugosine (**79**) (28)
- *Menispermum*
  - Dauricine (**3**) (45)
  - Dauricinoline (**4**) (45)
  - Dauricoline (**5**) (45)
  - Daurinoline (**6**) (45)
  - Daurisoline (**192**) (45)
- *Pachygone*
  - Trilobine (**163**) (31)

*Pycnarrhena*
- Aromoline (**31**) (51)
- Berbamine (**57**) (25)
- Daphnoline (**38**) (51)
- Homoaromoline (**42**) (51)
- Krukovine (**63**) (51)
- Limacine (**64**) (25,51)
- Obaberine (**46**) (51)
- Phaeanthine (**74**) (25)
- Pycnamine (**75**) (25)
- 1,2,3,4-Tetradehydrolimacine (**218**) (163)
- 1',2',3',4'-Tetradehydrolimacusine (**219**) (163)
- Thalrugosine (**79**) (25)

*Sciadotenia*
- Isochondodenrine (**122**) (17)
- Sciadenine (**127**) (17)
- Sciadoferine (**217**) (17)
- Sciadoline (**128**) (17)

*Stephania*
- (−)-Curine (**133**) (30)
- (+)-Epistephanine (**40**) (29)
- Thalrugosine (**79**) (32)

Synclisia
- Cocsoline (**152**) (137)
- Cocsuline (**153**) (137)
- Cycleanine (**121**) (50, 137)

*Tiliacora*
- Funiferine dimethiodide (*N,N*-Dimethylfuniferine iodide) (**201**) (48)

*Triclisia*
- Cocsuline (**152**) (124)
- Gilletine (**202**) (15,52)
- Isogilletine-*N*-Oxide (**204**) (52)
- Obamegine (**71**) (52)
- Stebisimine (**51**) (52)
- Trigilletimine (**162**) (124)

MONIMIACEAE

*Daphnandra*
- Apateline (**187**) (20)
- Daphnine (**191**) (147)
- 1,2-Dehydroapateline (**193**) (20)
- 1,2-Dehydrotelobine (**194**) (20)
- Johnsonine (**206**) (24)
- *N*-Methylapateline (**207**) (24)
- *N*-Methylnorapateline (**208**) (24)
- *O*-Methylrepandine (**45**) (24)
- (+)-Nortenuipine (**88**) (24)
- Repandine (**49**) (24)
- Repandinine (**90**) (24)
- Telobine (**160**) (20)

*Doryphora*
- Aromoline (**31**) (21)
- Daphnandrine (**37**) (21)
- Daphnoline (**38**) (21)
- 1,2-Dehydroapateline (**193**) (21)
- Homoaromoline (**42**) (21)
- Isotetrandrine (**62**) (21)

RANUNCULACEAE

*Isopyrum*
- Isotetrandrine (**62**) (54)
- *O*-Methylrepandine (**45**) (54)
- Tetrandrine (**76**) (54)
- (±)-Tetrandrine (77) (54)

*Thalictrum*
- Aromoline (**31**) (43)
- *N*-Desmethylthalidasine (**196**) (141,143)
- *N*-Desmethylthalrugosidine (**197**) (42)
- Dihydrothalictrinine (**198**) (37)
- Epinorhernandezine (semisynthetic) (**199**) (37)
- Epinorthalibrunine (semisynthetic) (**200**) (37)
- Hernandezine (**81**) (18,140)
- Hernandezine-N-Oxide (**203**) (140)
- *O*-Methylthalibrunimine (**210**) (47)
- *O*-Methylthalibrine (**209**) (44)
- *O*-Methylthalicberine (**95**) (39,41)
- *O*-Methylthalmethine (**96**) (41)
- Neothalibrine (**211**) (39,42,43)

*N*'-Norhernandezine (**212**) (37)
*N*'-Northalibrunine (**214**) (37,47)
Obaberine (**46**) (43)
Oxothalibrunimine (**215**) (37)
Thalbadensine (**106a**) (18,140)
Thalfinine (**103**) (143)
Thalibrunimine (**112**) (36)
Thalibrunine (**113**) (36)
Thalicberine (**97**) (41)
Thalictrinine (**220**) (37)
Thalidasine (**100**) (42,140,141,143)
Thalidezine (**83**) (140)
Thaliracebine (**14a**) (143)
Thalirugidine (**17b**) (53)
Thalisopine (**54**) (53)
Thalistine (**221**) (44)
Thalmethine (**96**) (41)
Thalmirabine (**222**) (44)
Thalpindione (**223**) (42)
Thalrugosaminine (**55**) (42,53)
Thalrugosidine (**101**) (42,53)
Thalrugosine (**79**) (23,44)
Thalrugosinone (**224**) (43)

TABLE 9. Botanical Sources of Bisbenzylisoquinoline Alkaloids.[a,b]

| Name of Plant | Plant Part | Alkaloid | Structural Type of Alkaloid |
|---|---|---|---|
| *Berberis baluchistanica* Ahrendt (Berberidaceae) | | Baluchistine (**188**) (33) | VI |
| *Berberis buxifolia* Lam. (Berberidaceae) | R,StB | Calafatine (**190**) (35,132) | Xa |
| | | Calafatimine (**189**) (132) | Xa |
| *Berberis chilensis* Gillies ex Hook (Berberidaceae) | L,St | Berbamine (**57**) (49) | VIII |
| | | 7-*O*-Demethylisothalicberine (**195**) (38) | XI |
| | | Isothalicberine (**205**) (38) | XI |
| | | *O*-Methylisothalicberine (**94**) (38) | XI |
| *Berberis lycium* (Berberidaceae) | R | Berbamine (**57**) (22) | VIII |
| *Berberis oblonga* (Berberidaceae) | R | 2'-*N*-Methylberbamine (**66a**) (19) | VIII |
| *Berberis orthobotrys* Bienert ex Aitch. (Berberidaceae) | R | Aromoline (**31**) (46) | VI |
| | | Berbamine (**57**) (46) | VIII |
| | | Oxyacanthine (**48**) (46) | VI |
| *Berberis poiretii* (Berberidaceae) | RB | Berbamine (**57**) (16,131) | VIII |
| | | Isotetrandrine (**62**) (16) | VIII |
| *Berberis thunbergii* DC (Berberidaceae) | Sd | Berbamine (**57**) (40) | VIII |
| | | Isotetrandrine (**62**) (40) | VIII |
| *Berberis vulgaris* (Berberidaceae) | RB,StB | Berbamine (**57**) (26) | VIII |
| | | Oxyacanthine (**48**) (26) | VI |
| *Cissampelos pareira* (Menispermaceae) | | (±)-Curine dimethiodide (*N,N*-dimethyl-(±)-(**132**) (156) *N,N*-Dimethylcurine iodide) | XXI |
| *Cyclea barbata* Wall. Miers (Menispermaceae) | R | Curine (**132** or **133**) (30,130) | XXI |
| | | Homoaromoline (**42**) (130) | VI |
| | | Isochondodendrine (**122**) (130) | XX |
| | | Tetrandrine (**76** or **77**) (130) | VIII |
| *Cyclea hainanensis* Merr. Menispermaceae) | L | Curine (**132** or **133**) (152) | XXI |
| | | Hayatine (**137**) (152) | XXI |
| | | (+)-Isochondodendrine (**122**) (152) | XX |
| | | (+)-4'-*O*-Methylcurine (**139**) (152) | XXI |
| *Cyclea tonkinensis* (Menispermaceae) | | Cycleanine (**121**) (144) | XX |
| *Daphnandra apatela* Schodde (Monimiaceae) | B | Apateline (**187**) (20) | XXIII |
| | | 1,2-Dehydroapateline (**193**) (20) | XXIII |
| | | 1,2-Dehydrotelobine (**194**) (20) | XXIII |
| | | Telobine (**160**) (20) | XXIII |
| *Daphnandra johnsonii* Schodde (Monimiaceae) | B,L,St | Johnsonine (**206**) (24) | VI |
| | | *N*-Methylapateline (**207**) (24) | XXIII |
| | | *N*-Methylnorapateline (**208**) (24) | XXIII |
| | | *O*-Methylrepandine (**45**) (24) | VI |
| | | (+)-Nortenuipine (**88**) (24) | X |
| | | Repandine (**49**) (24) | VI |
| | | Repandinine (**90**) (24) | X |

TABLE 9. *Continued.*

| Name of Plant | Plant Part | Alkaloid | Structural Type of Alkaloid |
|---|---|---|---|
| *Daphnandra repandula* (Monimiaceae) | B,L | Daphnine (**191**) (147,155) | Xb |
| *Dehassia triandra* Merr. (Lauraceae) | W | Obaberine (**46**) (27) | VI |
| *Doryphora aromatica* Schodde (Monimiaceae) | B | Aromoline (**31**) (21) | VI |
| | | Daphnandrine (**37**) (21) | VI |
| | | Daphnoline (**38**) (21) | VI |
| | | 1,2-Dehydroapateline (**193**) (21) | XXIII |
| | | Homoaromoline (**42**) (21) | VI |
| | | Isotetrandrine (**62**) (21) | VIII |
| *Isopyrum thalictroides* L. (Ranunculaceae) | R | Isotetrandrine (**62**) (54) | VIII |
| | | *O*-Methylrepandine (**45**) (54) | VI |
| | | Tetrandrine (**76**) (54) | VIII |
| | | (±)-Tetrandrine (**77**) (54) | VIII |
| *Limaciopsis loangensis* Engl. (Menispermaceae) | Fr,L,R, St | Berbamine (**57**) (28) | VIII |
| | | *N*-2'-Chloromethylisotetrandrine (*N*-2'-Chloromethyl-**62**) (artifact) (28) | VIII |
| | | Cycleanine (**121**) (28) | XX |
| | | Isotetrandrine (**62**) (28) | VIII |
| | | Nor-2'-Isotetrandrine (**213**) (28) | VIII |
| | | *N*-oxy-2'-Isotetrandrine (**216**) (28) | VIII |
| | | Thalrugosamine (**52**) (28) | VI |
| | | Thalrugosine (**79**) (28) | VIII |
| *Mahonia repens* (Lindl.) G. Don (Berberidaceae) | R,St | Obaberine (**46**) (159) | VI |
| | | Obamegine (**71**) (159) | VIII |
| | | Oxyacanthine (**48**) (159) | VI |
| | | Thalrugosine (**79**) (159) | VIII |
| *Menispermum dauricum* DC (Menispermaceae) | Rh | Dauricine (**3**) (45) | I |
| | | Dauricinoline (**4**) (45) | I |
| | | Dauricoline (**5**) (45) | I |
| | | Daurinoline (**6**) (45) | I |
| | | Daurisoline (**192**) (45) | I |
| *Pachygone ovata* Miers ex Hook. F. & Thoms. (Menispermaceae) | L | Trilobine (**163**) (31) | XXIII |
| *Pycnarrhena longifolia* (Decne. ex Miq.) Beccari (Menispermaceae) | St,R | Aromoline (**31**) (51) | VI |
| | | Daphnoline (**38**) (51) | VI |
| | | Homoaromoline (**42**) (51) | VI |
| | | Krukovine (**63**) (51) | VIII |
| | | Limacine (**64**) (51) | VIII |
| | | Obaberine (**46**) (51) | VI |
| | | 1,2,3,4-Tetrahydrolimacine (**218**) (163) | VIII |
| | | 1',2',3',4'-Tetrahydrolimacusine (**219**) (163) | VI |
| *Pycnarrhena novoguineensis* Miq. (Menispermaceae) | St | Berbamine (**57**) (25) | VIII |
| | | Limacine (**64**) (25) | VIII |
| | | Phaeanthine (**74**) (25) | VIII |
| | | Pycnamine (**75**) (25) | VIII |
| | | Thalrugosine (**79**) (25) | VIII |
| *Sciadotenia toxifera* Krukoff and A. C. Smith (Menispermaceae) | W | Isochondodendrine (**122**) (17) | XX |
| | | Sciadenine (**127**) (17) | XX |
| | | Sciadoferine (**217**) (17) | XX |
| | | Sciadoline (**128**) (17) | XX |
| *Stephania epigaea* (Menispermaceae) | Unknown | (−)-Curine (**133**) (30) | XXI |
| *Stephania hernandifolia* (Willd.) Walp. (Menispermaceae) | T | (+)-Epistephanine (**40**) (29) | VI |
| *Stephania japonica* (Thunb.) Miers var. *australis* (Menispermaceae) | St,Rh | Thalrugosine (**79**) (32) | VIII |
| *Synclisia scabrida* Miers (Menispermaceae) | R,St | Cocsoline (**152**) (137) | XXIII |
| | | Cocsuline (**153**) (137) | XXIII |
| | | Cycleanine (**121**) (50,137) | XX |
| *Thalictrum alpinum* L. (Ranunculaceae) | R | N-Desmethylthalrugosidine (**197**) (42) | XII |
| | | Neothalibrine (**211**) (42) | I |
| | | Thalidasine (**100**) (42) | XII |
| | | Thalpindione (**223**) (42) | XII |
| | | Thalrugosaminine (**55**) (42) | VII |
| | | Thalrugosidine (**101**) (42) | XII |

TABLE 9. *Continued.*

| Name of Plant | Plant Part | Alkaloid | Structural Type of Alkaloid |
|---|---|---|---|
| *Thalictrum faberi* Ulbr. (Ranunculaceae) | | *N*-Desmethylthalidasine (**196**) (142,143) | XII |
| | | Thalfinine (**103**) (143) | XIII |
| | | Thalidasine (**100**) (139,141,143) | XII |
| | | Thaliracebine (**14a**) (143) | Ia |
| *Thalictrum foliolosum* DC Ranunculaceae) | R | Thalirugidine (**17b**) (53) | III |
| | | Thalisopine (**54**) (53) | VII |
| | | Thalrugosaminine (**55**) (53) | VII |
| | | Thalrugosidine (**101**) (53) | XII |
| *Thalictrum minus* L. (Ranunculaceae) | T | *O*-Methylthalicberine (**95**) (41) | XI |
| | | *O*-Methylthalmethine (**96**) (41) | XI |
| | | Thalicberine (**97**) (41) | XI |
| | | Thalmethine (**98**) (41) | XI |
| *Thalictrum minus* L. race B (Ranunculaceae) | R | *O*-Methylthalibrine (**209**) (44) | I |
| | | Thalistine (**221**) (44) | III |
| | | Thalmirabine (**222**) (44) | XIII |
| | | Thalrugosine (**79**) (44) | VIII |
| *Thalictrum revolutum* DC (Ranunculaceae) | Fr | *O*-Methylthalicberine (**95**) (39) | XI |
| | | Neothalibrine (**211**) (39) | I |
| *Thalictrum rochebrunianum* Franc. and Sav. (Ranunculaceae) | R | Dihydrothalictrinine (**198**) (37) | XVII |
| | | Epinorhernandezine (semisynthetic) (**199**) (37) | IX |
| | | Epinorthalibrunine (semisynthetic) (**200**) (37) | XVII |
| | | *O*-Methylthalibrunimine (**210**) (47) | XVII |
| | | *N*'-Norhernandezine (**212**) (37) | IX |
| | | *N*'-Northalibrunine (**214**) (37,47) | XVII |
| | | Oxothalibrunimine (**215**) (37) | XVII |
| | | Thalibrunimine (**112**) (36) | XVII |
| | | Thalibrunine (**113**) (36) | XVII |
| | | Thalictrinine (**220**) (37) | XVII |
| *Thalictrum rugosum* Ait. (Ranunculaceae) | R | Aromoline (**31**) (43) | VI |
| | | Neothalibrine (**211**) (43) | I |
| | | Obaberine (**46**) (43) | VI |
| | | Thalrugosinone (**224**) (43) | XII |
| *Thalictrum sachalinense* Lecoyer. | Rh | Thalrugosine (**79**) (23) | VIII |
| *Thalictrum sultanabadense* (Menispermaceae) | T | Hernandezine (**81**) (18,140) | IX |
| | | Hernandezine-*N*-Oxide (**203**) (140) | IX |
| | | Thalbadensine (**106a**) (18,140) | XIV |
| | | Thalidezine (**83**) (140) | IX |
| *Tiliacora funifera* Engl. ex Diels (Menispermaceae) | R | Funiferine dimethiodide (**201**) (48) (N,N-Dimethylfuniferine iodide) | IV |
| *Triclisia dictyophylla* Diels (Menispermaceae) | WP | Cocsuline (**153**) (124) | XXIII |
| | | Trigilletimine (**162**) (124) | XXIII |
| *Triclisia gilletti* (DeWild.) Staner (Menispermaceae) | L | Gilletine (**202**) (15,52) | XXIV |
| | | Isogilletine-*N*-Oxide (**204**) (52) | XXIV |
| | | Obamegine (**71**) (52) | VII |
| | | Stebisimine (**51**) (52) | VI |

[a]Not previously reported in the review by Guha *et al.* (152).
[b]B = Bark, Fr = Fruits, L = Leaves, R = Roots, RB = Root Bark, Rh = Rhizomes, Sd = Seeds, St = Stems, StB = Stembark, T = Tops, W = Wood, WP = Whole Plant.

TABLE 10. Biosynthetis of Bisbenzylisoquinoline Alkaloids.

**27.** Tiliageine $C_{37}H_{40}O_6N_2$: 608.2886
The biosynthesis of tiliageine in *Tiliacora racemosa* Colebr. (Menispermaceae) was studied utilizing $^3H$ and $^{14}C$ labelled (±)-N-methylcoclaurine, (+)-(*S*)-*N*-methylcoclaurine and (−)-(*R*)-*N*-methylcoclaurine. The study demonstrated that tiliageine is biosynthesized from both the (+)-(*S*) and (−)-(*R*)-*N*-methylcoclaurines and that the configuration at the asymmetric centers C-1 and C-1' is (*S*) and (*R*), respectively (117).

**48.** Oxyacanthine $C_{37}H_{40}O_6N_2$: 608.2886
The biosynthesis of oxyacanthine in *Cocculus laurifolius* DC (Menispermaceae) was studied utilizing $^3H$ and $^{14}C$ labelled (±)-norcoclaurine, (±)-coclaurine, (+)-(*S*)-*N*-methylcoclaurine, and (−)-(*R*)-*N*-methylcoclaurine. The study supported the following sequence for the biosynthesis of oxyacanthine: tyrosine→norcoclaurine→coclaurine→(+)-(*S*)-methylcoclaurine+(−)-(*R*)-*N*-methylcoclaurine→oxidative dimerization→oxyacanthine (118).

**62.** Isotetrandrine $C_{38}H_{42}O_6N_2$: 622.3043
The biosynthesis of isotetrandrine in *Cocculus laurifolius* DC (Menispermaceae) was studied utilizing $^3H$ and $^{14}C$ labelled (±)-coclaurine, (±)-*N*-methylcoclaurine, didehydro-*N*-methylcoclaurinium iodide, (+)-(*S*)-methylcoclaurine and (−)-(*R*)-methylcoclaurine. The study supported the following sequence for the biosynthesis of isotetrandrine: coclaurine → (+)-(*S*)-*N*-methylcoclaurine+(−)-(*R*)-*N*-methylcoclaurine → inter- and intra-molecular oxidative coupling→isotetrandrine (119).

**76.** Tetrandrine $C_{38}H_{42}O_6N_2$: 622.3043
The biosynthesis of tetrandrine in *Cocculus laurifolius* DC (Menispermaceae) was studied utilizing $^3H$ and $^{14}C$ labelled (±)-coclaurine, (±)-norcoclaurine, dedehydro-*N*-methylcoclaurinium iodide, (+)-(*S*)-*N*-methylcoclaurine and (−)-(*R*)-*N*-methylcoclaurine. The study supported the following sequence for the biosynthesis of tetrandrine: tyrosine→ norcoclaurine → coclaurine → (+)-(*S*)-*N*-methylcoclaurine → oxidative dimerization → tetrandrine (120).

**153.** Cocsuline $C_{35}H_{34}O_5N_2$: 562.2468
(±)-*N*-Methylcoclaurine was found to be a specific precursor of cocsuline in *Cocculus laurifolius* DC (Menispermaceae) via oxidative dimerization. In addition, parallel feedings of both the (+)-(*S*) and (−)-(*R*)-isomeric *N*-methylcoclaurines demonstrated the maintenance of stereospecificity in the biosynthesis of cocsuline from its benzylisoquinoline monomer (114).

**164.** Cocsulinine $C_{35}H_{34}O_6N_2$: 578.2417
The biosynthesis of cocsulinine in *Cocculus laurifolius* DC (Menispermaceae) was studied utilizing $^3H$ and $^{14}C$ labelled (±)-norcoclaurine, (±)-coclaurine and (±)-*N*-methylcoclaurine. The biosynthetic pathway suggested by these studies supported the following sequence for the biosynthesis of cocsulinine: norcoclaurine→coclaurine→(+)-(*S*)-*N*-methylcoclaurine → dimerization → (+)-(*S,S*)-*O*-methylcocsulinine → (+)-(*S,S*)-cocsulinine (115).

TABLE 11. Pharmacological Activities of Bisbenzylisoquinoline Alkaloids.

| Alkaloid | Source | Activity | Reference |
|---|---|---|---|
| Berbamine | *Berberis poiretii* | An inducer of leukocytosis in leukopenic patients. | 60 |
| Cepharanthine | *Stephania* sp | Inhibitor of potassium ion release from erythrocytes with previously damaged cellular membranes. | 61 |
| | | Protective effect against mitomycin C induced hematopoietic suppression. | 61 |
| | | Inhibited tumor growth of Ehrlich tumor in mice while prolonging survival time and potentiating the formation of macrophage migration inhibition factor. | 66 |
| | | Caused no change in granuloma and thymus weights in rats implanted subcutaneously with formaldehyde-soaked filter paper. | 70 |
| | | Inhibits lipid peroxidation of biological membrane thus acting as a membrane-stabilizing agent and protecting against lipid peroxidation. This suggests a possible mechanism for the protective action of cepharanthine against radiation. | 72 |
| | | Decreased the activity of splenic suppressor cells on Graft vs. Host Response (GvHR) suppression and retarded tumor growth (Lewis Lung Carcinoma) (Mouse) | 142 |
| | | Protected against *in vitro* changes in mitochondrial function accompanying lipid peroxidation. $Fe^{+2}$ induced mitochondrial lipid peroxidation and ion compartmentation is inhibited by cepharanthine. Lipid peroxidation of soybean lecithin liposomes by $^{60}Co$-irradiation was also inhibited. | 145 |
| | | Presented both *in vitro* and *in vivo* hepatic damage by $CCl_4$ (Rat). | 153 |
| (−)-Curine | *Cyclea barbata*<br>*C. hainanensis*<br>*Stephania epigaea* | Muscle relaxant (Animal not specified) | 30 |
| (±)-Curine Dimethiodide | *Cissampelos pareira* | Muscle relaxant (Human) | 156 |
| (−)-Curine Dimethiodide | *Cyclea barbata* | Neuromuscular blocker (Human) | 130 |
| ((−)-Curine+$CH_3I$) | ((−)-Curine)<br>*Cyclea hainanensis* | Muscle relaxant (Animal not specified) | 152 |
| (−)-Curine Dimethochloride | *Cyclea hainanensis* | Muscle relaxant (Animal not specified) | 152 |
| Cycleanine dimethobromide (Cycleanine+$CH_3Br$) | *Cyclea* and other sp. (Cycleanine) | Hypotensive (Dog)<br>Ganglionic block mediates the hypotensive action (Dog) | 68, 69<br>154 |
| Dauricine | *Menispermum dauricum* | Muscle relaxant (Animal not specified) | 45 |
| Dauricholine | *Menispermum dauricum* | Muscle relaxant (Animal not specified) | 45 |
| Daurisoline | *Menispermum dauricum* | Muscle relaxant (Animal not specified) | 45 |

TABLE 11. *Continued.*

| Alkaloid | Source | Activity | Reference |
|---|---|---|---|
| Daurinoline | *Menispermum dauricum* | Muscle relaxant (Animal not specified) | 45 |
| Daurisoline Methyl Bromide (Daurisoline+ $CH_3Br$) | *Menispermum dauricum* (Daurisoline) | Muscle relaxant, respiratory paralysis, cardiac arrest (Mouse, rabbit) | 65 |
| *N*-Desmethylthalidasine | *Thalictrum faberi* | Antitumor (Animal not specified) | 141 |
| *N*-Desmethylthalistyline | *Thalictrum podocarpum* | Antimicrobial (*Mycobacterium smegmatis*) | 56 |
| | *T. longistylum* | Hypotensive (Dogs & rabbits) | 57 |
| | *T. longistylum* | Antimicrobial (*Mycobacterium smegmatis*) (*Staphylococcus aureus*) | 57 |
| Dimethylcurine Dimethochloride | *Cyclea barbata* ((−)-Curine) | Neuromuscular blocker (Human) | 130 |
| Dimethyltubocurarine (Metocurine) | | Activity more easily reversed with neostigmine than the activity of tubocurarine (Human) | 62 |
| | | Vagolytic action at the cardiac atrial pacemaker (Guinea pig) | 79 |
| | | Neuromuscular and clinical effects during halothane or nitrous oxide anesthesia (Human infants and children) | 84 |
| | | Possesses a lower neuromuscular blocking potency and stronger autonomic effect than (+)-tubocurarine and thus has a lower antonomic margin of safety (Cat) | |
| | | Comparative pharmacokinetics with tubocurarine (Human) | 95 |
| | | Prevention of halothane-induced malignant hyperthermia (Pig) | 98 |
| | | Produced dose dependent decrease in the isometric force and maximum velocity of force development in isolated canine heart muscle preparation (Dog). | 107 |
| | | Produced a 3.5 times as potent of neuromuscular blockade as (+)-tubocurarine (Rabbit) but was only 0.4 times as potent in the rodent phrenic nerve-diaphragm (Rat). Appeared to block postsynaptic cholinergic receptors. | 122 |
| | | The pharmacodynamics and pharmacokinetics were studied in neurosurgical patients with normal renal function, and in anephric patients during and following a renal transplant. Metcurine appears to be an acceptable neuromuscular blocking agent for patients in renal failure although no major advantage over (+)-tubocurarine and pancuronium was detected (Human). | 148 |
| (+)-Epistephanine | *Stephania kerandifolia* | Selective blockade at sympathetic nerve stimulation by epinephrine thus possessing a guanethidine-like activity (Rat, frog, rabbit). | 29 |
| Hernandesine | *Thalictrum podocarpum* | Antimicrobial (*Mycobacterium smegmatis*) | 56 |
| (+)-Isochondodendrine Hydrochloride | *Cyclea hainanensis* | Analgesic (Animal not specified) | 152 |
| Methothalistyline | *Thalictrum longistylum* | Hypotensive (Dog and Rabbit) | 57 |
| | *T. longistylum* | Antimicrobial (*Mycobacterium smegmatis*) (*Staphylococcus aureus*) | 57 |
| (+)-4″-*O*-Methylcurine Dimethiodide | *Cyclea hainanensis* | Muscle relaxant (Animal not specified) | 152 |
| +)-4″-*O*-Methylcurine Dimethochloride | *Cyclea hainanensis* | Muscle relaxant (Animal not specified) | 152 |
| *O*-Methylthalibrine | *Thalictrum minus* race B | Antimicrobial (*Candida albicans*) (*Mycobacterium smegmatis*) | 44 |
| *O*-Methylthalicberine | *Thalictrum revolutum* | Hypotensive (Rabbit) | 55 |
| *O*-Methylthalmethine | *Thalictrum revolutum* | Antimicrobial (*Mycobacterium smegmatis*) | 55 |
| (+)-Tetrandrine | | Inhibition of thymidine and uridine uptake by HeLa cells with no indication that DNA, RNA or protein synthesis is inhibited. | 67 |
| | | Anti-arrhythmic (Cat) | 123,146 |
| | | Partial inhibition of growth, mitotic activity and DNA formation of ECa 109 cell line *in vitro*. | 149 |
| | | Inhibition of silicotic fibrosis (Rat). | 150 |
| Thalfine | *Thalictrum minus* race B | Antimicrobial (*Mycobacterium smegmatis*) | 59 |
| Thalfinine | *Thalictrum minus* race B | Antimicrobial (*Mycobacterium smegmatis*) | 59 |
| | *Thalictrum faberi* | Hypotensive (Animal not specified) | 143 |
| Thalibrine | *Thalictrum longistylum* | Antimicrobial (*Mycobacterium smegmatis*) (*Staphylococcus aureus*) | 57 |
| Thalidasine | *Thalictrum revolutum* | Hypotensive (Rabbit) | 55 |

TABLE 11. *Continued.*

| Alkaloid | Source | Activity | Reference |
|---|---|---|---|
| | *Thalictrum* sp. | Antitumor (Mouse) Ascites and Lewis lung tumors with an $LD_{30}$ of 300mg $kg^{-1}$–520mg $kg^{-1}$ and an effective therapeutic dosage of 70–100mg $kg^{-1}$) | 71 |
| | *Thalictrum faberi* | Antitumor (Mouse) (70mg $kg^{-1}$ dog suppressed Ehrlich ascites tumor and S-180 sarcoma growth by 50% and 20%, respectively. Inhibited Lewis lung tumor by 58% at 100mg $kg^{-1}$ dog but had no inhibitory effect on hepotoma or uterine tumor. LD i.p.=520mg $kg^{-1}$, LD i.v.=120mg $kg^{-1}$. Pathologic changes observed at dosages >300 mg $kg^{-1}$. | 139,141 143 |
| | *Thalictrum faberi* | Antimicrobial | 143 |
| Thalidezine | *Thalictrum podocarpum* | Antimicrobial (*Mycobacterium smegmatis*) | 56 |
| Thaligoeidine | *Thalictrum rugosum* | Antimicrobial (*Mycobacterium smegmatis*) | 43 |
| Thaligosine | *Thalictrum rugosum* | Antimicrobial (*Klebsiella pneumoniae*) (*Mycobacterium smegmatis*) | 43 |
| Thaligosinine | *Thalictrum rugosum* | Antimicrobial (*Mycobacterium smegmatis*) | 43 |
| Thalirabine | *Thalictrum minus* race B | Antimicrobial (*Mycobacterium smegmatis*) | 59 |
| Thaliracebine | *Thalictrum minus* race B | Antimicrobial (*Mycobacterium smegmatis*) | 59 |
| | *Thalictrum faberi* | Hypotensive (Animal not specified) | 143 |
| Thalirugidine | *Thalictrum rugosum* | Antimicrobial (*Mycobacterium smegmatis*) | 43 |
| Thalirugine | *Thalictrum rugosum* | Antimicrobial (*Mycobacterium smegmatis*) | 43 |
| Thalisopine | *Thalictrum* sp. | Antiarrhythmic (Various animals) | 63 |
| Thalistine | *Thalictrum minus* race B | Antimicrobial (*Mycobacterium smegmatis*) (*Staphylococcus aureus*) | 44 |
| Thalistyline | *Thalictrum podocarpum* | Antimicrobial (*Mycobacterium smegmatis*) | 56 |
| | *T. longistylum* | Hypotensive (Dog & Rabbit) | 57 |
| | *T. longistylum* | Antimicrobial (*Mycobacterium smegmatis*) (*Staphylococcus aureus*) | 57 |
| Thalistyline methiodide | *Thalictrum podocarpum* | Antimicrobial (*Mycobacterium smegmatis*) | 56 |
| Thalmirabine | *Thalictrum minus* race B | Antimicrobial (*Mycobacterium smegmatis*) | 44 |
| Thalrugosaminine | *Thalictrum revolutum* | Antimicrobial (*Mycobacterium smegmatis*) | 55 |
| | | Hypotensive (Rabbit) | 55 |
| Thalsimine | *Thalictrum* sp. | Antitussive (Dog) | 64 |
| (+)-Tubocurarine | | Localization in rat liver lysosomes. | 73 |
| | | Potentiation of neuromuscular blockade by lithium chloride (Cat). | 74 |
| | | Did not affect heart rate or systolic time intervals when administered prior to minor surgery (Human). | 75 |
| | | A comparison of the autonomic blocking activities with those of N-methyl and O,O-N-trimethyltubocurarine (Cat). | 76 |
| | | A dose-dependent recession of the monocular near point of accomodation (Human). | 77 |
| | | Histamine release in the skin after administration (Human). | 78 |
| | | Vagolytic action at the cardiac atrial pacemaker (Guinea Pig). | 79 |
| | | New aspects of the contractile activity on intestinal muscle (Guinea Pig taeni coli muscle). | 80 |
| | | The influence of bile salt choleresis on the hepatic transport of organic cations (Rat). | 81 |
| | | Effect on maximum static pressure-volume characteristics of the respiratory system (Human). | 82 |
| | | Lack of cardia conditional response on treatment (Rat). | 83 |
| | | Blocked suxamethionium-induced hyperkalemia when administered concurrently (Cat). | 85 |
| | | Administration of high concentrations shortened the lifetime of the open channel as determined by impulse-evoked end-plate currents (Frog sartorius muscle). | 86 |
| | | Induced ganglionic blockade and shifted the mean frequency spectrum of spontaneous sympathetic action potentials (Cat). | 87 |
| | | Possesses a higher neuromuscular blocking potency and weaker autonomic effect than metocurine and thus has a higher autonomic margin of safety (Cat). | 88 |
| | | Simultaneous modeling of pharmacokinetics and pharmacodynamics (Human). | 89 |

TABLE 11. *Continued.*

| Alkaloid | Source | Activity | Reference |
|---|---|---|---|
| | | A less effective acetylcholine antagonist when the concentration of the divalent curare cation is increased. Hence, membrane surface potential changes may alter drug interactions. | 90 |
| | | Dosage-schedule independence of alkaloid pharmacokinetics and pharmacodynamics and recovery of neuromuscular function. | 91 |
| | | A review with 41 references on the description, physical properties, isolation, purification stability, degradation, metabolism and analysis. | 92 |
| | | A study of the pharmacokinetics and pharmacodynamics during nitrous oxide-narcotic and halothane anesthesia (Human). | 93 |
| | | A study of behavior, brain electrical activity and auditory evoked potential. A correlation between behavioral effects and electroencephalographic changes was observed (Cat). | 94 |
| | | Comparative pharmacokinetics with metocurine (Human). | 95 |
| | | Neuromuscular blockade in both intact and nepherectomized animals was found to be reversible (Dog). | 96 |
| | | Intracarotid infusion significantly increased the output of acetylcholine into perfused artificial cerebrospinal fluid (Dog). | 97 |
| | | Kinetic effects on skeletal muscle at high agonist concentrations (Frog). | 99 |
| | | Controlled catecholamine release by the adrenal medulla. | 100 |
| | | Competitive block and ion channel block as mechanisms of antagonist action on the skeletal muscle end-plate. (A review with 61 references). | 101 |
| | | Administration during cesarean delivery of repeated doses worsened the Apgar scores of newborn infants (Human). | 102 |
| | | Intracisternal administration in $\alpha$-chloralose-anesthestized animals produced a dose-related associated with seizures. When administered the animals pretreated with guanethidine, the same effect was observed but bilateral adrenalectomy abolished the pressor response (Dog). | 103 |
| | | The pharmacokinetics of (+)-tubocurarine (dTc) and urinary excretion of dTc were studied in neurosurgical patients with normal renal function. Results suggest that dTc is stored in certain body tissues and slowly released over a period of days to weeks (Human). | 104 |
| | | The effect on voltage-clamped end-plates of frog sartorius and cutaneous pectoris muscles was examined. Apparently, the drug has at least two distinct polyjunctional actions including blockage of the acetylcholine receptor and of the ionic channel associated with this receptor (Frog). | 105 |
| | | Increases in the concentration of potassium or calcium ion decreased the sensitivity of guinea pig nerve-lumbrical muscle preparations to the alkaloid (Guinea pig). | 106 |
| | | Produced dose-dependent decrease in the isometric force and maximum velocity of force development in isolated canine heart muscle preparation (Dog). | 107 |
| | | Produced a dose-dependent neuromuscular blockage (Rabbit). | 108 |
| | | Increased the duration and amplitude of the excitatory postsynaptic potential in isolated olfactory cortex slice preparations (Guinea pig). | 109 |
| | | Decreased the rate of coronary circulation, myocardial oxygen uptake and arterial pressure (Cat). | 110 |
| | | Temperature appeared to have little influence on the neuromuscular cellular potency (Mouse). | 111 |
| | | Excitatory effects on the central nervous system may be through inhibition of naturally occurring inhibitory substances like $\gamma$-aminobutyric acid or a closely related compound (Rat). | 112 |
| | | Demonstrated the relationship between respiratory muscle strength and vital capacity during partial curarization in awake subjects (Human). | 113 |

TABLE 11. *Continued.*

| Alkaloid | Source | Activity | Reference |
|---|---|---|---|
| | | Intrauterine administration to rat fetuses between the 17th and 18th day of pregnancy resulted in retarded growth and skeletal deformities (Rat). | 135 |
| | | Attenuated the cardiac depressant action and hypotension produced by electrical stimulation of the right vagus nerve in pentobarbitone-sodium anesthetized animals (Dog). | 136 |
| | | Binds competitively in ganglion neurons at their resting potential level (−50 to −60 mV) (Mammalian system). | 138 |
| | | Direct administration into the lateral cerebral ventricle produced a blockage of nicotinic receptors with a lowered metabolism, cutaneousvaso-dilation and hypothermia at ambient temperatures of 8–22° (Rat). | 151 |
| | | Induction of sensitivity to the decreased action potential of the drug on the sciatic nerve by collagenase and hyaluronidase pretreatment (Frog). | 158 |

TABLE 12. Names and Synonyms of Bisbenzylisoquinoline Alkaloids Cited in this Review[a]

*O*-Acetylberbamine **57** dvt. *a.d.*
(*R,R*)-7-*O*-Acetyl-12-O-Methylcurine **133** dvt. *a.d.*
(*R,R*)-12-*O*-Acetyl-7-*O*-Methylcurine **133** dvt. *a.d.*
*O*-Acetylnortenuipine **88** dvt. *a.d.*
Apateline **187** *n.a.*
Aromoline **31** *r.i.*
Atherospermoline **56** *a.d.*

Baluchistine **188** *n.a.*
(−)-Bebeerine **133** *a.d.*
(−)-Bebeerine hydrochloride **133** dvt. *a.d.*
Berbamine **57** *a.d., p.c., r.i.*

Calafatimine **189** *n.a.*
Calafatine **190** *n.a.*
Cepharanthine **34** *p.c.*
2'-*N*-Chloromethylisotetrandrine (artifact) **62** dvt. *r.i.*
(*R,S*)-Chondocurine **130** *a.d.*
Cocsoline **152** *b.s., r.i.*
Cocsuline **153** *r.i.*
Cocsulinine **164** *b.s.*
(−)-Curine **133** *a.d., p.c.*
(−)-Curine dimethiodide **133** dvt. *p.c.*
(−)-Curine dimethochloride **133** dvt. *p.c.*
(±)-Curine dimethiodide **132**+**133** dvt. *p.c., r.i.*
Curine hydrochloride **133** dvt. *a.d.*
Cycleanine **121** *a.d., r.i.*
Cycleanine dimethobromide **121** dvt. *p.c.*

Daphnandrine **37** *r.i.*
Daphnine **191** *n.a.*
Daphnoline **38** *r.i.*
Dauricine **19** *a.d., p.c., r.i.*
Dauricinoline **4** *p.c., r.i.*
Dauricoline **5** *p.c., r.i.*
Daurinoline **20** *p.c., r.i.*
Daurisoline **192** *n.a.*
Daurisoline methylbromide **192** dvt. *p.c.*
1,2-Dehydroapateline **193** *n.a.*
1,2-Dehydrotelobine **194** *n.a.*
7-*O*-Demthylisothalicberine **195** *n.a.*
*N*-Desmethylthalidasine **196** *n.a., p.c.*
*N*-Desmethylthalistyline **16** *p.c.*
*N*-Desmethylthalrugosidine **197** *n.a.*
(*R,R*)-*O,O*-Diacetylbebeerine **133** dvt. *a.d.*
(*R,R*)-*O,O*-Diacetylcurine **133** dvt. *a.d.*
*O,O*-Diacetylisochondodendrine **122** dvt. *a.d.*
Dihydrothalictrinine **198** *n.a.*
(*R,R*)-*O,O*-Dimethylbebeerine **135** *a.d.*
(*R,R*)-*N,N*-Dimethylbebeerine iodide **133** dvt. *a.d.*
(*R,S*)-*O,O*-Dimethylchondrocurarine iodide **133** dvt. *a.d.*
(*R,R*)-*O,O*-Dimethylcurine **135** *a.d.*
*O,O*-Dimethylcurine dimethochloride **135** dvt. *p.c.*
(*R,R*)-*N,N*-Dimethylcurine iodide **133** dvt. *a.d.*
*N,N*-Dimethylfuniferine iodide **201** *n.a.*
*O,O*-Dimethylisochondodendrine **121** *a.d.*
*N,N*-Dimethylisochondodendrine iodide **122** dvt. *a.d.*
Dimethyltubocurarine **142** dvt. *p.c.*
Dimethylwarifteine **148** *a.d.*

Epinorhernandezine **199** *n.a., s.s.*
Epinorthalibrunine **200** *n.a., s.s.*
(+)-Epistephanine **40** *p.c., r.i.*
*O*-Ethyldihydroisothalsimidine *a.d.*
*O*-Ethyldihydrothalsimidine **85** dvt. *a.d.*

Fangchinoline **61** *a.d.*
Funiferine **20** *a.d.*
Funiferine dimethiodide **201** *n.a.*

Gilletine **202** *m.a.*

Hayatine **137** *r.i.*
Hernandezine **81** *a.d., p.c., r.i.*
Hernandezine-*N*-Oxide **203** *n.a.*
Homoaromoline **42** *r.i.*

Isochondodendrine **122** *a.d., r.i.*
Isochondodendrine hydrochloride **122** dvt. *p.c.*
Isofangchinoline **79** *r.i.*
Isogilletine-*N*-Oxide **204** *n.a.*
Isotetrandrine **62** *a.d., b.s., r.i.*
Isothalicberine **205** *n.a.*

Johnsonine **206** *n.a.*

Krukovine **63** *r.i.*

Limacine **64** *r.i.*

TABLE 12. *Continued.*

Methostyline **17** *p.c.*
*N*-Methylapateline **207** *n.a.*
(*R,R*)-7-*O*-Methylbebeerine **133** dvt. *a.d.*
(*R,R*)-12-*O*-Methylbebeerine **140** *a.d.*
(*S,S*)-4"-*O*-Methylbebeerine dimethiodide **132** dvt. *p.c.*
(*S,S*)-4"-*O*-Methylbebeerine dimethochloride **132** dvt. *p.c.*
2'*N*-Methylberbamine **66a** *a.d.*
*O*-Methylcissampereine **148** *a.d.*
4"-*O*-Methylcurine **139** *r.i.*
(*R,R*)-7-*O*-Methylcurine **133** dvt. *a.d.*
(*R,R*)-12-*O*-Methylcurine **140** *a.d.*
(*S,S*)-4"-*O*-Methylcurine dimethiodide **132** dvt. *p.c.*
(*S,S*)-4"-*O*-Methylcurine dimethochloride **132** dvt. *p.c.*
*O*-Methylisothalicberine **94** *r.i.*
*N*-Methylnorapateline **208** *n.a.*
*O*-Methylrepandine **45** *a.d.*, *r.i.*
*O*-Methylthalibrine **209** *n.a.*, *p.c.*
*O*-Methylthalibrunimine **210** *n.a.*
*O*-Methylthalicberine **95** *a.d.*, *p.c.*, *r.i.*
*O*-Methylthalmethine **96** *p.c.*, *r.i.*

Neothalibrine **211** *n.a.*
*N*'-Norhernandezine **212** *n.a.*
Nor-2'-Isotetrandrine **213** *n.a.*
(+)-Nortenuipine **88** *a.d.*, *r.i.*
*N*'-Northalibrunine **214** *n.a.*

Obaberine **46** *a.d.*, *r.i.*
Obamegine **71** *a.d.*, *r.i.*
Oxothalibrunimine **215** *n.a.*
Oxyacanthine **48** *a.d.*, *b.s.*, *r.i.*
*N*-Oxy-2'-Isotetrandrine **216** *n.a.*

Phaeanthine **74** *a.d.*, *r.i.*
Pycnamine **75** *r.i.*

Repandine **49** *a.d.*, *r.i.*
Repandinine **90** *a.d.*, *r.i.*

Sciadenine **127** *r.i.*
Sciadoferine **217** *n.a.*
Sciadoline **128** *r.i.*
Stebisimine **51** *r.i.*

Telobine **160** *r.i.*
Tenuipine **91/92** *a.d.*
1,2,3,4-Tetradehydrolimacine **218** *n.a.*
1',2',3',4'-Tetradehydrolimacusine **219** *n.a.*
(*R,R*)-*N,N,O,O*-Tetramethylbebeerine iodide **133** dvt. *a.d.*
(*R,S*)-*N,N,O,O*-Tetramethylbebeerine iodide **133** dvt. *a.d.*
(*R,R*)-*N,N,O,O*-Tetramethylcurine iodide **133** dvt. *a.d.*
(*R,S*)-*N,N,O,O*-Tetramethylcurine iodide **133** dvt. *a.d.*
Tetrandrine **76** *a.d.*, *b.s.*, *p.c.*, *r.i.*
(±)-Tetrandrine **77** *r.i.*
Thalabadensine **106a** *a.d.*
Thalfine **102** *a.d.*, *p.c.*
Thalfinine **103** *p.c.*, *r.i.*
Thalibrine **14** *p.c.*
Thalibrunimine **112** *r.s.*
Thalibrunine **113** *r.s.*
Thalicberine **97** *r.i.*
Thalictrinine **220** *n.a.*
Thalidasine **100** *p.c.*, *r.i.*
Thalidezine **83** *p.c.*, *r.i.*
Thaligosidine **100a** *p.c.*
Thaligosine **52a** *p.c.*
Thaligosinine **52b** *p.c.*
Thalirabine **17a** *p.c.*
Thaliracebine **14a** *p.c.*, *r.i.*
Thalirugidine **17b** *p.c.*, *r.i.*
Thalirugine **14b** *p.c.*
Thalisopidine **53** *a.d.*
Thalisopine **54** *a.d.*, *p.c.*, *r.i.*
Thalistine **221** *n.a.*, *p.c.*
Thalistyline **18** *p.c.*
Thalistyline methiodide **18** dvt. *p.c.*
Thalmethine **98** *r.i.*
Thalmine **108** *a.d.*
Thalmirabine **222** *n.a.*, *p.c.*
Thalpindione **223** *n.a.*
Thalrugosamine **52** *r.i.*
Thalrugosaminine **55** *p.c.*, *r.i.*
Thalrugosidine **101** *r.i.*
Thalrugosine **79** *r.i.*
Thalrugosinone **224** *n.a.*
Thalsimidine **85** *a.d.*
Thalsimine **86** *a.d.*, *p.c.*
Tiliacorine **118** *a.d.*
Tiliacorinine **119** *a.d.*
Tiliageine **27** *a.d.*, *b.s.*
Tiliamosine **120** *a.d.*
(+)-Tubocurarine chloride **142** *a.d.*, *p.c.*
(+)-Tubocurine **130** *a.d.*
Trigilletimine **162** *r.i.*
Trilobine **163** *r.i.*

*a.d.* = additional work; *b.s.* = biosynthesis; *n.a.* = new alkaloid; *p.c.* = pharmacology; *r.i.* = reisolated; *r.s.* = revised structure; *s.s.* = semisynthetic; dvt. = derivative (meaning a derivative of an alkaloid with the preceding number).

## CIRCULAR DICHROISM

Moiseeva *et al.* utilized circular dichroism to study the stereochemistry of five types of bisbenzylisoquinoline alkaloids (129). These types were determined according to the nature and attachment of the ether bridges as: Type I (5,6,7,8*, 11$^+$, 12–6,7*,12$^+$ and 6,7,8*,11$^+$,12–6,7*,12$^+$), Type II (6,7,8*,11$^+$,12–6*,7,12$^+$), Type III (5,6,7,8*,12$^+$–6,7*,11$^+$,12), Type IV (6,7*.11$^+$,12–5*,6,7,12$^+$) and Type V (5*,6,7,11$^+$,12–5,6,7,8*,12$^+$). The parameters of the Cotton effects of the resultant spectra were dependent on the absolute configurations of the asymmetric centers, the positions of the oxygen bridges and on the conformation of the internal dioxide ring. The optical rotations of the dimeric bases did not obey the additivity rule, that is the rotation of the dimer was not the sum of the rotations of the true monomers. For Types I–IV, it was established that regardless of the nature

of the attachment of oxygen bridges, alkaloids with the (*SS*)-configuration have a positive Cotton effect in the 290nm region and a negative one in the 200nm region. Furthermore, alkaloids of type I with the (*SR*)-configuration are characterized by negative Cotton effects in the 280 and 200nm regions while those of the (*RS*)-configuration possess positive Cotton effects in the same regions. It was also noted that the nineteen-membered inner dioxide ring alkaloids of Type II show a marked rise in the intensity of the Cotton effect at 290nm compared to the eighteen-membered inner dioxide ring alkaloids of Type I. Protonation of the alkaloids of Type I with the (*SS*)-configuration causes a decrease in intensity of the Cotton effect at 290nm while those of type II are characterized by an increase in this Cotton effect. Type III alkaloids have an additional Cotton effect at 270nm which Type I alkaloids lack. Protonation of Type III alkaloids results in a loss of the Cotton effect in the 290nm region. The Cotton effect in the 270 nm region appears to be characteristic for bases with the $11^{+}$–$12^{+}$ lower oxygen bridge since it is additionally present in the spectra of the Type IV alkaloids. Alkaloids of the (*SS*)-configuration of Types I through III but not Type IV have a Cotton effect in the 220nm region. The spectra of dehydrogenated bases (imines) are characterized by overlapping of the $\pi$-orbitals of the aromatic ring or the azomethine function which result in a substantially complicated spectra. Protonation of these imine alkaloids results in the presence of one more positive Cotton effect in the long-wave regions of the spectra which may be due to the presence of a homoconjugated chromophore including a $sp^2$-hybridized nitrogen atom (129).

## LUMINESCENCE SPECTRA

A detailed study of the fluorescence and phosphorescence characterics of berbamine and oxyacanthine alkaloids showed that the emission parameters were dependent upon the absolute configuration of the alkaloids (121). The fluorescence emission of the berbamine-type alkaloids consists of single structureless bands with maxima at about 315nm. Hernandezine, however, had an additional long wavelength emission band with a maximum at 398nm. At 77K the fluorescence maxima of these alkaloids shift to shorter wavelengths and the longer wavelength fluorescence of hernandezine was not observed. The phosphorescence emission at 77K of these alkaloids consists of single structureless bands with maxima from 420–465nm. Methylation of phenolic berbamine alkaloids induces a hypsochromic shift in fluorescence maxima. In addition, there are changes in the fluorescent quantum yield at both 298 and 77K demonstrating that the photophysical properties of these complex alkaloids are sensitive to stereochemical differences as demonstrated with (*R,R*)-phaeanthine (**74**), *S,S*-tetrandrine (**76**), and (*R,S*)-isotetrandrine (**62**). At 298K the fluorescence emission of dauricine (**3**) and the oxyacanthine (**48**)-type alkaloids (*S,R*)-oxyacanthine (**48**), (*S,S*)-repandine (**49**), (*S,R*)-obaberine (**46**), and (*S,S*)-*O*-methylrepandine (**45**) consists of single structureless bands with maxima at about 315nm and quantum yields of the order of $10^{-2}$. Cooling to 77K results in a shift of emission maxima to higher energy with an increase in intensity. At longer wavelengths, broad structureless phosphorescence maxima are detectable from 413–450nm. In agreement with their structurally isomeric congeners, methylation of dauricine, oxyacanthine, or repandine results in a hypsochromic shift of fluorescence maxima with the (*S,S*)-stereoisomers having higher fluorescence quantum yields than the (*S,R*)-stereoisomers. The phosphorescence maxima of the oxyacanthine-type (**48**) alkaloids shows that the (*S,S*)-stereoisomers are found at shorter wavelengths than the (*S,R*)-stereoisomers and with higher phosphorescence quantum yields (21).

## SPECIFIC ROTATION

Cassels and Shamma tabulated the specific rotations for approximately 175 bisbenzylisoquinoline alkaloids (128). These bases have been classified according

to their oxygenation patterns and the nature and number of linkages between the monomeric benzylisoquinoline halves of the molecule. A consideration of the data from the tables showed that the optical rotations of the grouped alkaloids have the same sign independent of solvent in almost all of the configurationally defined subgroups and that within a particular subgroup that the specific rotation values appear to congregate at three levels: 10–150° (low), 150–300° (moderate), and 300–600° (high). Furthermore, when the values are low, the signs within a subgroup of identical stereochemistry may be positive or negative depending on the molecular substituents present and the solvent employed. *N*-methylation and/or *O*-methylation may induce changes in the preferred conformation of a dimer with resultant changes in specific rotation, particularly when the values are low/small.

Finally, the premises proposed in this classification are used to challenge the stereochemical assignment of thalisamine (**84**) as (*S,S*) and to propose stereochemical assignments for calafatine (**190**) as (*R,S*) or (*S,S*) and tiliamosine (**120**) as (*S,S*) (128).

## THIN-LAYER CHROMATOGRAPHY

Verpoorte *et al.* used ferric chloride in perchloric acid as a spray reagent to differentiate among various berbamine-type alkaloids. The color reaction was noted immediately after spraying (1ml 0.5M ferric chloride in 50ml 35% perchloric acid) and after heating for five minutes and ten minutes with a hair dryer. This reagent proved very useful in the investigation of the alkaloids of *Pycnarrhena novoguineensis* (25).

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