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NEW ALKALOIDS FROM *TABERNAEMONTANA DIVARICATA**

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Key Word Index—*Tabernaemontana divaricata;* Apocynaceae; root bark; sterols; triterpenes; benzoic acid; aurantiamide acetate; indole alkaloids; ibogamine; coronaridine; coronaridine hydroxyindolenine; 5-hydroxy-6-oxocoronaridine; 5-oxocoronaridine; 6-oxocoronaridine; 3-oxocoronaridine; (±)-19-hydroxy-coronaridine; voacamine.

Abstract—A re-investigation of the root bark of *Tabernaemontana divaricata* resulted in the isolation of 18 compounds, viz. α-amyrin acetate, lupeol acetate, α-amyrin, lupeol, cycloartenol, β-sitosterol, campesterol, benzoic acid, aurantiamide acetate, coronaridine, coronaridine hydroxyindolenine (**1**), ibogamine, 5-hydroxy-6-oxocoronaridine (**6**), 5-oxocoronaridine (**9**), 6-oxocoronaridine (**10**), (±)-19-hydroxycoronaridine (**11**), 3-oxocoronaridine (**12**) and voacamine. The alkaloids **6, 9, 10** and **11** are new compounds, whereas cycloartenol, campesterol, ibogamine, benzoic acid, aurantiamide acetate and coronaridine hydroxyindolenine are reported from this plant for the first time.

INTRODUCTION

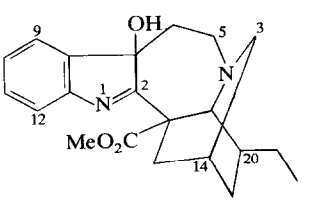
The isolation of several indole alkaloids of biogenetic interest from the leaves of *Tabernaemontana divaricata* R. Br. ex Roem and Schult (Apocynaceae) was reported earlier from this laboratory [1]. Interestingly, tabernaemontanine and voaphylline which were isolated in minute quantities and voacangine isolated in good yield from the leaves of this plant could not be detected in the root bark in our present investigation. The confirmed anticancer activity in the chloroform extract of the root bark of variety 1 (with petals in single whorl) prompted us to re-examine it in detail. The results are described in the present communication.

RESULTS AND DISCUSSION

The substances α-amyrin acetate, lupeol acetate, α-amyrin, lupeol, cycloartenol, β-sitosterol, campesterol, benzoic acid, aurantiamide acetate, coronaridine, ibogamine, 3-oxocoronaridine and voacamine are known compounds and were identified by either comparison of their spectral data reported in the literature or mmp, co-TLC and superimposable IR spectra with authentic samples.

The alkaloid A, $C_{21}H_{26}N_2O_3$ (M^+ 354) showed UV λ_{max} 231, 260 and 290 nm characteristic of an indolenine chromophore. The appearance of a band at 3400 cm^{-1} in the IR spectrum and a fragment ion at *m/e* 337 ($M^+ - 17$) in the MS confirmed the presence of a hydroxyl function. The occurrence of intense peaks of *m/e* 136 and 122 confirmed it to be an *Iboga* derivative. A combination of these data suggested structure **1** for alkaloid A which was confirmed when a methanolic hydrochloric acid solution of **1** on refluxing for 2 hr yielded coronaridine pseudoindoxyl **2**. Coronaridine hydroxyindolenine has been known as a semi-synthetic product [2] and recently was isolated from *Conopharyngia durissima* [3]. However, its occurrence has not been reported from any of the *Tabernaemontana* species so far.

The alkaloid B, $C_{21}H_{24}N_2O_4$ (M^+ 368), $[\alpha]_D^{25°}$ −43.8° (pyridine), UV λ_{max} 218, 248 and 310 nm, showed a bathochromic shift on addition of alkali indicating a 3-acylindole chromophore [4]. The intense bands at 1730 and 1640 cm^{-1} in the IR spectrum were assigned to methoxycarbonyl and α,β-unsaturated carbonyl functions, respectively. In addition it showed a broad band at 3190 cm^{-1} assigned to NH and/or OH. The ^1H NMR spectrum in pyridine-d_5 at 300 MHz showed a broad singlet at δ 11.68 (1H) assigned to an indolic NH. A sharp singlet at δ 10.68 (1H) was assigned to a hydroxyl proton. Usually the indolic NH resonates in the region 8.5–8.0 and a hydroxyl at 8–6 (although the position may vary with



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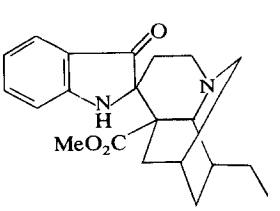

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*C.D.R.I. Communication No. 2356. The numbering system used in this paper follows the one recommended by Le Men and Taylor (1965) *Experientia* **21,** 508. This assigns, to each atom, the same number as their presumed equivalents in yohimbine, the presumption being that this reflects their common genesis: Schlittler, E. and Taylor, W. I. (1960) *Experientia* **16,** 244.

concentration). But such a low field occurrence was attributed to hydrogen bonding with pyridine. The low field chemical shift for the hydroxyl proton as well as the geminal protons has been noted when the spectra were taken in pyridine-d_5 [5]. The doublets at δ 8.77 (1H, $J = 6$ Hz) and 7.55 (1H, $J = 6$ Hz) were assigned to aromatic protons H-9 and H-12, respectively. The low field occurrence of H-9 substantiated the assignment of carbonyl function at C-6. A sharp singlet at δ 8.36 (1H) was assigned to the proton attached to the carbon bearing a hydroxyl group on one hand and a nitrogen atom on the other. The usual chemical shift in such an environment is δ 5.3–4.3 [6]. Once again the high deshielding was attributed to a pyridine-induced solvent shift. The multiplet at δ 7.32 (2H) was assigned to two aromatic protons at H-10 and H-11. The singlet at δ 5.26 (1H) was assigned to a bridge-head hydrogen adjacent to nitrogen. A sharp singlet at δ 3.52 (3H) was ascribed to methoxycarbonyl protons. An AB quartet centred at δ 3.32 (2H, $J = 12$ Hz) was assigned to two methylene protons at C-3 or C-5. The triplet at δ 0.82 (3H, $J = 6$ Hz) was assigned to the methyl group of the ethyl side chain.

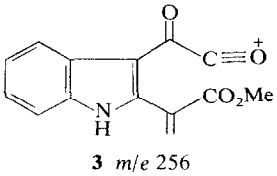
The high resolution MS of alkaloid B showed a M^+ at *m/e* 368 compatible with the molecular formula $C_{21}H_{24}N_2O_4$. The intense peak at *m/e* 122 indicated that it may belong to the *Iboga* class of alkaloids. Diagnostically important fragment ions occurred at *m/e* 350 ($C_{21}H_{22}N_2O_3$), 339 ($C_{19}H_{19}N_2O_4$), 336 ($C_{20}H_{20}N_2O_3$), 308 ($C_{19}H_{20}N_2O_2$), 280 ($C_{18}H_{20}N_2O$), 256 ($C_{14}H_{10}NO_4$), 230 ($C_{13}H_{12}NO_3$), 202 ($C_{12}H_{12}NO_2$), 200 ($C_{12}H_{10}NO_2$) and 199 ($C_{12}H_9NO_2$). The loss of 18 amu from the M^+ confirmed the presence of a hydroxyl function in alkaloid B. The loss of $C_6H_{10}NO$, $C_8H_{12}NO$ and $C_9H_{12}NO_2$ units from the M^+ to give *m/e* 256, 230 and 202, respectively, was from the alicyclic portion of the molecule and the plausible structures **3–5** for these ions led to the structure **6** for alkaloid B.

The ^1H NMR spectrum of 3-hydroxycoronaridine (Rastogi, K., Kapil, R. S. and Popli, S. P., unpublished observations) (prepared by oxidation of coronaridine with iodine) in pyridine-d_5 showed the indolic NH at δ 11.2 (broad singlet) and the hydroxyl proton at δ 8.5 substantiating our previous assignments in structure **6** for alkaloid B. When 3-hydroxycoronaridine was oxidized with Corey's reagent (pyridinium chlorochromate) it furnished 3-oxocoronaridine (**12**) while on acetylation with pyridine/acetic anhydride it gave 3-acetoxycoronaridine. The hydroxyl group in alkaloid B was resistant to oxidation with Corey's reagent and it could not be acetylated even under refluxing conditions with pyridine and acetic anhydride. Based on these observations, the hydroxyl group in alkaloid B was placed at the C-5 position. Final support for this structure was provided by partial synthesis. Potassium permanganate oxidation of coronaridine yielded a mixture of compounds from which 5-hydroxy-6-oxocoronaridine was isolated in 5% yield by a combination of column chromatography and PLC over silica gel. This product was found identical with alkaloid B by full spectroscopic studies (UV, IR, NMR and MS).

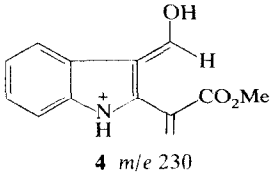
Reduction of alkaloid B with sodium borohydride afforded two substances, B_1 and B_2, separated by PLC on silica gel. The IR spectra of B_1 and B_2 did not show any absorption band for the presence of methoxycarbonyl function. In the MS of B_1 and B_2, the M^+ peaks appeared at *m/e* 340 and 324, respectively. The formation of intense peaks at *m/e* 310 in B_1 and 296 in B_2 led to structure **7** and **8** for substances B_1 and B_2 respectively.

The reduction of a methoxycarbonyl function to a primary alcohol with sodium borohydride is not a general phenomenon. From this observation it may be concluded that the strong electron-withdrawing function C=N generated by the presence of a carbonyl group at C-6 plays a major role which, by enhancing the electrophilic character of methoxycarbonyl function, makes it more vulnerable for reduction [7].

The alkaloid C, $C_{21}H_{24}N_2O_3$ (M^+ 352), mp 272–275°, $[\alpha]_D^{25} - 10.7°$ (pyridine), exhibited UV λ_{max} 229, 285 and 292 nm indicative of an indolic chromophore. The IR spectrum showed bands at 3220 (indolic NH), 1735 (COOMe) and 1630 (NCO; seven-membered lactam) cm^{-1}. The ^1H NMR spectrum showed a broad singlet at δ 8.0 (1H) exchangeable with D_2O and H was assigned to an indolic NH. The multiplets in the region δ 7.5–7.0 (four ArH) were assigned to an *O*-substituted benzene ring. A doublet at δ 4.6 (1H, $J = 1.5$ Hz) was assigned to the bridge-head hydrogen adjacent to nitrogen. An AB quartet centred at δ 3.91 (2H) clearly indicated that the carbonyl function was at C-5 [8]. A sharp singlet at δ 3.7 (3H) and a triplet at 0.91 (3H) were assigned to methoxycarbonyl and methyl protons of the ethyl side chain respectively. The MS of alkaloid C showed an intense peak at *m/e* 122 and the pattern was characteristic of *Iboga* alkaloids confirming its structure as **9**. Finally oxidation of coronaridine with potassium permanganate in boiling acetone yielded a mixture of products from which



3 *m/e* 256



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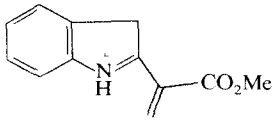
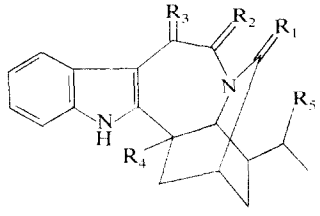


5 *m/e* 202



6 $R_1 = H_2$, $R_2 = H$, OH, $R_3 = O$, $R_4 = CO_2Me$, $R_5 = H$
7 $R_1 = H_2$, $R_2 = H$, OH, $R_3 = O$, $R_4 = CH_2OH$, $R_5 = H$
8 $R_1 = H_2$, $R_2 = H_2$, $R_3 = O$, $R_4 = CH_2OH$, $R_5 = H$
9 $R_1 = H_2$, $R_2 = O$, $R_3 = H_2$, $R_4 = CO_2Me$, $R_5 = H$
10 $R_1 = H_2$, $R_2 = H_2$, $R_3 = O$, $R_4 = CO_2Me$, $R_5 = H$
11 $R_1 = H_2$, $R_2 = H_2$, $R_3 = H_2$, $R_4 = CO_2Me$, $R_5 = OH$
12 $R_1 = O$, $R_2 = H_2$, $R_3 = H_2$, $R_4 = CO_2Me$, $R_5 = H$

5-oxocoronaridine was isolated in 5% yield by column chromatography over silica gel. This product was identical with alkaloid C (mp, mmp and superimposable IR).

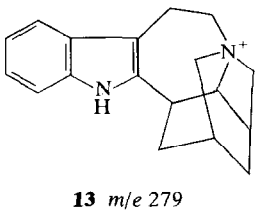
Alkaloid D, $C_{21}H_{24}N_2O_3$ (M^+ 352), mp 264–267°, $[\alpha]_D^{25}$ −33.8° (methanol), UV λ_{max} 218, 255 and 335 nm, showed a bathochromic shift on addition of alkali and was indicative of a 3-acylindole chromophore. The IR spectrum showed bands at 3240 (NH), 1730 (COOMe) and 1645 (C=CCO) cm^{-1} similar to alkaloid B.

The 300 MHz NMR spectrum of alkaloid D showed a broad singlet at δ 14.5 (1H) assigned to indolic NH. The doublets at δ 8.61 (1H, J = 6 Hz) and 7.5 (1H, J = 6 Hz) were assigned to H-9 and H-12, respectively. The multiplet centred at δ 7.34 (2H) was assigned to aromatic protons H-10 and H-11. The doublet at δ 4.64 (1H, J = 1.5 Hz) was assigned to the bridge-head hydrogen adjacent to nitrogen. The doublets at δ 3.88 (1H, J = 12 Hz) and 3.09 (1H, J = 12 Hz) were due to non-identical protons on C-3. A sharp singlet at δ 3.54 (3H) was assigned to methoxycarbonyl protons. The doublet at δ 3.33 (1H, J = 12 Hz) was assigned to one of the two non-identical protons at C-5 while its counterpart appeared at δ 1.8 (1H, J = 12 Hz). The high field occurrence of this proton was attributed to the shielding effect of the carbonyl function at C-6. The triplet at δ 0.68 (3H) was assigned to methyl protons of ethyl side chain.

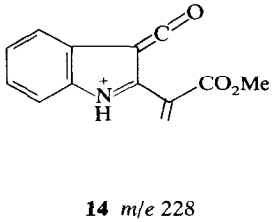
In the high resolution MS of alkaloid D the important fragment ion appeared at m/e 122. This observation coupled with the similarity of its UV spectrum with alkaloid B confirmed it to be an *Iboga* derivative. The absence of a fragment ion at m/e 136 clearly demonstrated that either C-5 or C-6 positions are substituted by a carbonyl function. Diagnostically important fragment ions were observed at m/e 324 ($M^+ - CO$), 322 ($M^+ - OMe$), 244 ($M^+ - CO_2Me$), 279 ($M^+ - C_3H_5O_2$) (**13**) and 228 ($M^+ - C_8H_{14}N$) (**14**). The plausible structures of the latter two fragment ions are shown below which directly indicated structure **10** for alkaloid D.

It is interesting to note that the characteristic peak at m/e 136 for *Iboga* alkaloids is not observed in the MS of alkaloids B, C and D. The formation of this peak has been rationalized by the breakage of C-5–C-6 bond and concomitant transfer of a hydrogen atom from C-5. However, the substituents of C-5 or C-6 in all 3 new alkaloids did not permit the formation of this peak.

The alkaloid E, $C_{21}H_{26}N_2O_3$, mp 159°, $[\alpha]_D^{25}$ ±0°, exhibited UV λ_{max} 230, 285 and 294 nm indicative of an indolic chromophore. The IR spectrum showed bands at 3400 (OH), 3220 (NH) and 1725 (COOMe) cm^{-1}. The ^1H NMR as well as MS data were in agreement with the reported values of heyneanine (**11**) which clearly indicated alkaloid E to be in its racemic form.



13 m/e 279



14 m/e 228

EXPERIMENTAL

All mps are uncorr. UV spectra were recorded in MeOH and IR spectra as KBr discs. ^1H NMR spectra were recorded at 60 or 300 MHz using TMS as internal standard. Al_2O_3 (neutral) and Si gel were utilized for column chromatography but only Si gel was used for PLC. For elution of PLC MeOH–$CHCl_3$ (1:9) was utilized. TLC spots were visualized by spraying either with 1% acidic $KMnO_4$ soln or with Dragendorff's reagent.

Isolation of constituents. The powdered air-dried root bark of *T. divaricata* (30 kg) was extracted with 95% EtOH (5×60 l.) by cold percolation. Solvent was evapd *in vacuo* to 2.5 l. and residue macerated with 6% HOAc (4×1.). The aq. acidic layer was extracted with $CHCl_3$ (4×3 l.) for acidic, neutral and weakly basic substances and dried over dry Na_2SO_4. Solvent was removed *in vacuo* to afford the residue (410 g). Part of this material (100 g) was chromatographed on a column of neutral Al_2O_3 (4 kg) and elution was effected with hexane, C_6H_6 and EtOAc with increasing polarity. Elution with hexane yielded acetates of α-amyrin (3 g) and lupeol (2 g). Further elution with a mixture of hexane, hexane–C_6H_6 (1:1) afforded α-amyrin (100 mg) and lupeol (50 mg). Elution with C_6H_6 furnished coronaridine (3 g), mp 92–94°. Later fractions from the same eluant were a mixture of coronaridine and sterols. Coronaridine was crystallized as its HCl, mp 220–221° (lit. [9] mp 235°), while the mixture of sterols was purified by PLC in C_6H_6–EtOAc (19:1) to afford cycloartenol, mp 80° which was identified by its conversion to cycloartenone, mp 100° and cycloartenol acetate, mp 116° (lit. [10] mp 80°, 106° and 122°, respectively). Further elution with C_6H_6–EtOAc (9:1) yielded β-sitosterol (2.5 gm), campesterol (100 mg) and alkaloid A (coronaridine hydroxyindolenine) (**1**), mp 98–100° (50 mg); $[\alpha]_D^{25}$ −16° (MeOH); UV λ_{max}^{MeOH} nm: 231, 260 and 290; IR (KBr) cm^{-1}: 3400, 2900, 1725, 1675, 1550, 1090, 1080, 660 and 595; ^1H NMR ($CDCl_3$): δ 7.5–7. (*m*, 4×Ar-H), 3.8 (*s*, NCH), 3.64 (*s*, CO_2CH_3) and 0.87 (*t*, CH_2CH_3); MS m/e (rel. int.): 354 (99%), 339 (30), 337 (100), 325 (12), 295 (12), 230 (10), 188 (18), 160 (14) and 122 (12).

Coronaridine pseudoindoxyl (**2**) *hydrochloride.* A soln of **1** (38 mg) in methanolic HCl (1 ml) was heated at 100° for 1 hr. The solvent was then removed and the residue crystallized with MeOH–Me_2CO to give **2** HCl (25 mg), mp 278–279°; UV λ_{max} nm: 255, 282, 320 and 393; IR (KBr) cm^{-1}: 3200, 2900, 1730, 1695, 1610, 1495 and 750; MS m/e (rel. int.): 354 (100%), 339 (10), 295 (30), 279 (5), 217 (10), 209 (15), 151 (15), 149 (15), 138 (50) and 122 (40). The latter eluate of C_6H_6–EtOAc (9:1) yielded benzoic acid (150 mg), mp 122°, aurantiamide acetate (15 mg), mp 188°. Further elution with C_6H_6–EtOAc (4:1) afforded a complex mixture of spots which were separated by PLC using C_6H_6–EtOAc (7:3) as developing system to furnish alkaloid B (5-hydroxy-6-oxocoronaridine) (**6**) (120 mg), mp 285–288°; $[\alpha]_D^{25}$ 43.8° (Py); UV λ_{max} nm: 218, 248, 263 (sh), 267 (sh) and 310; $\lambda_{max}^{MeOH-KOH}$ nm: 222, 272 and 340; IR (KBr) cm^{-1}: 3190, 1730, 1640, 1582, 1448, 1240 and 760; ^1H NMR (Py-d_5): δ 11.68 (*bs*, 1H, NH), 10.68 (*s*, 1H, C-5 OH), 8.77 (*d*, 1H, C-9 H, J = 6 Hz), 7.55 (*d*, 1H, C-12 H, J = 6 Hz), 8.36 (*s*, 1H, C-5 H), 7.32 (*s*, 3H, CO_2CH_3), 5.26 (*s*, 1H, NCH), 3.52 (*s*, 3H, CO_2CH_3), 3.32 (*q*, 2H, C-3 H_2, J = 12 Hz) and 0.82 (*t*, 3H, CH_2CH_3); MS m/e (rel. int.): 368 (100%), 350 (6), 339

(8), 336 (25), 308 (25), 280 (6), 257 (20), 256 (73), 230 (30), 199 (36), 192 (22), 141 (18) and 122 (15) (Found: *m/e* 368.1731, 350.1626, 336.1470, 308.1538, 280.1562, 256.0971, 230.0820, 202.0855, 200.0698 and 199.0637. $C_{21}H_{24}N_2O_4$, $C_{21}H_{22}N_2O_3$, $C_{20}H_{20}N_2O_3$, $C_{19}H_{20}N_2O_2$, $C_{18}H_{20}N_2O$, $C_{15}H_{14}NO_3$, $C_{13}H_{12}NO_3$, $C_{12}H_{12}NO_2$, $C_{12}H_{10}NO_2$ and $C_{12}H_9NO_2$ require: *m/e* 368.1728, 350.1623, 336.1467, 308.1518, 280.1569, 256.0969, 230.0813, 202.0864, 200.0708 and 199.0630, respectively); alkaloid C (5-oxocoronaridine) (**9**) (60 mg), mp 272–275°; $[\alpha]_D^{25}$ −10.7° (Py); UV λ_{max} nm: 229, 285 and 292; IR (KBr) cm^{-1}: 3220, 1735, 1630, 1440, 1240, 1080 and 740; ^{1}H MR ($CDCl_3$): δ 8.0 (*bs*, 1H, NH), 7.5–7.0 (*m*, 4 × Ar–H), 4.57 (*m*, 1H, CONCH), 3.91 (*q*, 2H, $NCOCH_2$, *J* = 15.5 Hz), 3.7 (*s*, 3H, CO_2CH_3) and 0.91 (*t*, 3H, CH_2CH_3); MS *m/e* (rel. int.): 352 (100%), 338 (2), 325 (4), 324 (4), 321 (4), 295 (16), 256 (12), 226 (14), 217 (50), 199 (8), 198 (14), 196 (10), 157 (50) and 121 (80) (Found: *m/e* 352.1783. $C_{21}H_{24}N_2O_3$ requires: M^+ 352.1789); alkaloid D (6-oxocoronaridine) (**10**) (90 mg), mp 262–267°, $[\alpha]_D^{25}$ −33.8° (MeOH); UV λ_{max} nm: 218, 255, 260 (sh), 268 (sh) and 335; $\lambda_{max}^{MeOH\text{-}KOH}$ nm: 218, 260, 280 and 365; IR (KBr) cm^{-1}: 3240, 2850, 1730, 1645, 1470, 1398, 1250, 880, 755 and 745; ^{1}H NMR (Py-d_5): δ 14.52 (*bs*, 1H, NH), 8.61 (*d*, 1H, C-9, *J* = 6 Hz), 7.5 (*d*, 1H, C-12 H, *J* = 6 Hz), 7.34 (*m*, 2H, C-10 and C-11 H), 4.64 (*d*, 1H, NCH, *J* = 1.5 Hz), 3.88 and 3.09 (*q*, 2H, C-3 H_2), 3.54 (*s*, 3H, CO_2CH_3), 3.24 and 1.8 (*q*, 2H, C-5 CH_2) and 0.68 (*t*, 3H, CH_2CH_3); MS *m/e* (rel. int.): 352 (100%), 322 (25), 279 (25), 228 (24), 141 (38) and 121 (5) (Found: *m/e* 352.1809. $C_{21}H_{24}N_2O_3$ requires: M^+ 352.1789) and ibogamine (5 mg), mp 160–162°, UV λ_{max} nm: 226, 287 and 292; IR (KBr) cm^{-1}: 3250, 1605 and 740; MS *m/e* (rel. int.): 280 (100%), 265 (25), 195 (42), 149 (42), 136 (95) and 122 (30).

$NaBH_4$ *reduction of 5-hydroxy-6-oxocoronaridine.* To a stirred soln of **6** (50 mg) in MeOH (2 ml) was added $NaBH_4$ (150 mg) in 15 min. The stirring was continued for another 12 hr. Solvent was removed under red. pres., diluted with H_2O (2 ml) and the soln extracted with CH_2Cl_2 (3 × 15 ml). The organic layer was washed with H_2O, dried (Na_2SO_4) and solvent removed to afford a residue (45 mg) which showed two spots on TLC besides the starting material. The two compounds separated by PLC to afford substance B_1 (5-hydroxy-16-hydroxymethylene-6-oxoibogamine) (**7**) (10 mg); IR (KBr) cm^{-1}: 3300, 2960, 1650, 1380, 1150 and 750; MS *m/e* (rel. int.): 340 (25%), 325 (50), 310 (20), 295 (20), 293 (20), 212 (20), 187 (60), 185 (60), 141 (100), 122 (62) and 121 (50) and B_2 (16-hydroxymethylene-6-oxoibogamine) (**8**) (7 mg); IR (KBr) cm^{-1}: 3300, 2960, 1650, 1380, 1080, 910 and 740; MS *m/e* (rel. int.): 324 (100%), 295 (45), 294 (25), 279 (45), 212 (25), 194 (25), 187 (90), 185 (80), 149 (95), 122 (30) and 121 (25). Elution with C_6H_6–EtOAc (3:1) yielded 3-oxocoronaridine (500 mg), mp 140° followed by substance E ((±)-19-hydroxycoronaridine) (**11**) (30 mg), mp 159°; UV λ_{max} nm: 230, 285 and 294; IR (KBr) cm^{-1}: 3400, 3220, 2920, 1720, 1060 and 740; ^{1}H NMR ($CDCl_3$): δ 7.8 (*bs*, 1H, NH), 7.4 (*m*, 1H, C-9 H), 7.2–6.9 (*m*, 3 × Ar-H), 4.15 (*m*, 1H, CH(OH)Me), 3.84 (*s*, 1H, NCH), 3.7 (*s*, 3H, CO_2CH_3) and 1.05 (*d*, 3H, $CH(OH)CH_3$); MS *m/e* (rel. int.): 354 (100%), 339 (37), 336 (54), 310 (13), 295 (6), 277 (6), 267 (4), 253 (4), 224 (11), 214 (33), 195 (37), 180 (11), 175 (15), 154 (10), 141 (21), 140 (28), 130 (20) and 122 (15). Further elution with C_6H_6–EtOAc (1:1) yielded a complex mixture of spots which on PLC in C_6H_6–EtOAc (1:1) furnished voacamine (15 mg), mp 220°.

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REFERENCES

1. Raj, K., Shoeb, A., Kapil, R. S. and Popli, S. P. (1974) *Phytochemistry* **13,** 1621.
2. Hwang, B., Weisbach, J. A., Douglas, B., Raffauf, R., Cava, M. P. and Bessho, K. (1969) *J. Org. Chem.* **34,** 412.
3. Das, B. C., Fellion, E. and Plat, M. (1967) *C.R.* **264,** 1765.
4. Rosenmund, P., Hasse, W. H. and Bauer, J. (1969) *Tetrahedron Letters* 4121.
5. Demarco, P. V., Farkas, E., Doddrell, D., Mylari, B. L. and Wenkert, E. (1968) *J. Am. Chem. Soc.* **90,** 5480.
6. Ling, N. C. and Djerassi, C. (1970) *J. Am. Chem. Soc.* **92,** 6019.
7. Meschino, J. A. and Bond, C. H. (1963) *J. Org. Chem.* **28,** 3129.
8. Buchi, G., Kulsa, P. and Rosati, R. L. (1968) *J. Am. Chem. Soc.* **90,** 2448.
9. Gorman, M., Neuss, N., Cone, N. J. and Deyrup, J. A. (1960) *J. Am. Chem. Soc.* **82,** 1142.
10. Bentley, H. R., Henry, J. A., Irvine, D. S. and Spring, F. S. (1953) *J. Chem. Soc.* 3673.