# The Alkaloids from Leaves of Croton hemiargyerius var. gymnodiscus

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**Abstract**: **Aim** Investigation of alkaloids from the leaves of Brazilian medicinal plant *Croton hemiargyerius* var. *gymnodiscus*. **Methods** Silica gel column chromatography was used repeatedly for the isolation and purification, and their structures were identified by extensive spectroscopy and comparison of the chemical and physical data with those of authentic samples reported in literature. **Results** Twelve alkaloids were isolated and their structures were identified. **Conclusion** Four new alkaloids named hemiargines A (**1**), B (**5**), C (**6**) and D (**7**), together with eight known alkaloids namely isocorydine (**2**), corydine (**3**), norcorydine (**4**), salutaridine (**8**), glaucine (**9**), tetrahydropalmatrubine (**10**), xylopinoine (**11**), and norlaudanosine (**12**) were isolated.

**Key words**: *Csroton hemiargyerius*; new alkaloids; hemiargines A, B, C, D

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## Introduction

The plants of Croton genus are quite abundant in the central part of Brazil; only in the State of Rio de Janeiro thirty-nine species of the genus have been identified. They are largely used as folk medicine for wound healing. A preliminary pharmacological investigation seemed to confirm the healing activity of the alkaloids. In previous work, Prof. R. A. Barnes and his group examined eight of fifteen species of the genus showing positive test for alkaloids[1] *Croton salutaris* contained salutaridine and its racemic form salutarine[2], and *C. celtidifolius* possessed two major alkaloids, isoboldine and thaliporphine[3,4]. *Croton hemiargerius* from Friburgo of Rio yielded two alkaloids, salutaridine and glaucine. *Croton hemiargyerius* Muel. var. *gymnodiscus* Muel collected in the State of Sao Paulo was a new variety of hemiargyerius, and its chemical constituents have not been submitted hitherto for chemical investigation. We examined the alkaloids fractions of its leaves in detail and isolated twelve alkaloids. Their structures were determined by IR, MS, extensive 1D and 2D NMR spectrum analysis in combination with chemical conversion and synthesis.

## Results and Discussion

Twelve alkaloids were isolated and purified, of which two major alkaloids, glaucine and isocorydine, contained 85% of the crude alkaloids, and the containing minor alkaloids were lower than 1‰ Their chemical stsuctures were further elucidated on the basis of IR, UV, MS (HRMS, EISM, CFMS), various 1D and 2D homo and hetero NMR spectra in combination with comparison of their physical and chemical properties with those of their respective authentic compounds, and chemical conversion. Four of them were identified as new alkaloids namely hemiargines A (**1**), B (**5**), C (**6**) and D (**7**), and the known alkaloids were isocorydine (**2**)[5], corydine (**3**)[6], norcorydine (**4**)[7], salutaridine (**8**)[8], glaucine (**9**)[9], tetrahydropalmatrubine (**10**)[9], xylopinoine (**11**)[9], and norlaudanosine (**12**)[9]. The berberine type alkaloid xylopinine was found in *Croton* genus for the first time. Hemiargine D was concluded to be simple isoquinoline structure, which seemed to undergo biosynthesis by special biogenetic pathway.

Hemiargine **A** has the molecular formula $C_{20}H_{23}NO_4$ afforded by HREIMS. Its $^1H$ NMR showed very similar

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signals with those of norcorydine. The typical aromatic protons at δ 6.85 (d , J = 8.0 Hz) , δ 6.79 (d , J = 8.0 Hz) and 6.62 (s) were attributed to H-8 , H-9 and H-3 , respectively , by comparison of its NMR data with those of known alkaloids **2 - 4**. The presence of four methoxyl groups [δ 3.90 (s) ; 3.89 (s) ; 3.88 (s) ; 3.82 (s) ] and absence of a methyl group attached to nitrogen led to propose its structure as 1-O-methylnorcorydine , named hemiargine **A**.

Hemiargine **B** afforded a molecular formula as $C_{19}H_{19}NO_4$ by means of $^1H$ and $^{13}C$ NMR spectra in combination with mass spectrum. It has one more unsaturation degree than isocorydine. The typical signals at δ 6.68 (d , J = 8.0 Hz) , and δ 6.72 (d , J = 8.0 Hz) , and the presence of two of the three methoxyl groups substituted at C-1 and C-2 were similar to those of isocorydine. A third methoxyl group was considered to be attached to C-10 due to the long range correlation between H-8 (δ 6.72 , d) and C-10 (δ 146.62 , s) , and between methoxyl protons δ 3.90 (s , $OCH_3$) and C-10. A couple of geminal protons at δ 4.28 (d , J = 15.2 Hz) and δ 3.55 (d , J = 15.2 Hz) were assigned to $CH_2$-7 , which implied that a double bond was formed between the nitrogen and C-6a , and the evidence was further supported by a typical carbon signal at δ 179.33 (s) for C-6a. Thus , the structure was proposed as **5**.

Hemiargine **C** was a polar minor alkaloid , and its molecular formula $C_{19}H_{21}NO_4$ with ten unsaturatuon , was afforded by the $^1H$ and $^{13}C$ NMR data in association with MS spectrum (molecular weight as *m/z* 327 $[M]^+$) . The typical signals at δ 7.62 (d , J = 10.5 Hz) and δ 7.81 (d , J = 10.5 Hz) in $^1H$ NMR spectrum suggested that the N-$C_{6a}$ bond was cleaved. The protons at δ 9.12 (s) and δ 7.05 (s) were characteristic of protons H-11 and H-8 , respectively , in comparison with those of N-methylsecoglaucine[10]. Its difference from N-methylsecoglaucine was the absence of a methoxyl group in hemiargine C , which induced chemical shilft of H-3 to high field at δ 6.91 (s) whereas that of N-methylsecoglaucine was δ 7.19 (s). The absence of correlation between hydroxyl proton and H-3 in NOESY spectrum indicated that the hydroxyl group was linked to C-1. The structure of **6** was therefore proposed as shown.

Hemiargine **D** has a molecular formula $C_{13}H_{19}N$ ($M^+$ , *m/z* 189.2222) with five degrees of unsaturation. IR absorption at 3 300 , 1 610 , 1 600 , 1 580 and 1 575 $cm^{-1}$ suggested the presence of NH and aromatic moiety. $^{13}C$ NMR data in combination with $^1H$ NMR data led to conclude a simple isoquinoline alkaloid. On the basis of DQF COSY spectrum , a methyl group at δ 1.45 (d , J = 6.8 Hz , 3H) coupled with the proton at δ 3.36 (q , J = 6.8 Hz) was assigned to be connected to C-6a. A quaternary carbon at C-5 was substituted by a methyl δ 1.18 (s , 3H) and an ethyl group (δ 0.96 , t , J = 7.2 Hz , 3H; δ 1.62 , q , J = 7.2 Hz , 2H) , respectively. The geminal proton signals δ 2.74 (d , J = 11.8 Hz) and δ 2.70 (d , J = 11.8 Hz) were concluded to be $CH_2$-4. Four aromatic protons between δ 7.09 and 7.28 (m , 4H) were concluded to be ring A of isoquinoline. The relative configurations of C-5 and C-6a were determined by the NOE correlation observed between the methyl protons H-7 and H-10. The structure was proposed as **7**.

## Experimental

### General

The melting points were observed by using Kofler apparatus and were uncorrected. The NMR spectra were recorded for $^1H$ and $^{13}C$ NMR in Varian Germini 200. The IR spectra were observed with Perkin Elmer model 559B , and MS spectra were examined using 70 eV with the Micromass 12F and VG Autospec apparatus. The silica gel and alumina were purchased from Merck Company.

### Plant material

The plant species was identified as *Croton hemiargyerius* var. *gymnodiscus* Muel. by Professor Arline Souza Oliveira of the Department of Botany , the Federal University of Rio de Janeiro , and the sample was deposited in State Key Laboratory of Natural and Biomimetic Drugs , Peking University.

### Extraction and isolation

The dried leaves and stems (0.80 kg) were ground and extracted by prolonged percolation with 95 % EtOH. After vacuum distillation , the residue was dissolved in 5 % HCl solution. After filtration and extraction with $CCl_4$ to remove chlorophyll , the acidic solution was made alkaline with ammonia to pH 10 and subsequently extracted with ether , EtOAc , and n-BuOH to afford three parts of

crude alkaloids. The ether extract contained two major alkaloids with very similar Rf values when tested by TLC. By repeated chromatography with columns of silica gel using hexane-acetone-ethylamine (1 ∶1 ∶0.1) as the eluting solvents, the isolation of corydine **(3)** (250 mg) and isocorydine **(2)** (125 mg) was accomplished. From higher Rf (higher than that of corydine) part of the collected fractions, hemiargine **C (6)** (11 mg), hemiargine **D (7)** (14 mg), tetrahydropalmatrubine **(10)** (25 mg), and glaucine **(9)** (12 mg) were isolated and purified by using low pressure liquid chromatography with silica gel and preparative TLC. From lower Rf parts of the collected fractions, salutaridine **(8)** (10 mg) and hemiargine **B (5)** (8 mg) were isolated. From EtOAc extract, norcorydine **(4)** (7 mg), norlaudanosine **(12)** (23 mg), xylopinine **(11)** (18 mg), and hemiargine **A (1)** (10 mg) were isolated and purified by repeated chromatography on silica gel columns.

**Structure identification:**

**Hemiargine A** Square crystal, mp 200 - 202 ℃, $[\alpha]_D^{25}$ + 122.2 ℃ (c 3.6, $CHCl_3$). IR (KBr) $cm^{-1}$: 3 350, 1 630, 1 615, 1 600, 1 583, 1 560, 1 500, 1 420, 1 210, 1 200, 1 150, 1 100. $^1H$ NMR δ ($CDCl_3$): 6.85 (d, J = 8.0 Hz), 6.79 (d, J = 8.0 Hz), 6.62 (s), 3.90 ($OCH_3$), 3.89 ($OCH_3$), 3.88 ($OCH_3$), 3.82 ($OCH_3$), 4.22 (dd, J = 10.2, 3.0 Hz, H-6a), 3.23, 3.19 (m, H-5), 3.20 (dd, J = 12.5, 3.0 Hz, H-7α), 2.70 (dd, J = 12.5, 10.2 Hz, H-7β), 2.90 (m, H-4). $^{13}C$ NMR δ: 145.79 (s, C-1), 147.22 (s, C-2), 126.23 (s, C-1a), 117.11 (s, C-1b), 112.43 (d, C-3), 128.47 (s, C-3a), 29.18 (t, C-4), 48.41 (t, C-5), 58.13 (d, C-6a), 36.91 (t, C-7), 129.22 (s, C-7a), 119.47 (d, C-8), 112.71 (d, C-9), 150.00 (s, C-10), 146.04 (s, C-11), 130.02 (s, C-11a), 56.87 (q, $OCH_3$), 59.21 (q, $OCH_3$), 60.01 (q, $OCH_3$), 55.86 (q, $OCH_3$). EI-MS *m/z*: 341 $[M]^+$, 326, 330, 192 (base peak), 176, 151, 150, 147, 131, 118, 107, 92, 77. HREI-MS *m/z*: 341.1671 (cacld. For $C_{20}H_{23}NO_4$ 341.1627).

**Hemiargine B** Amorphous, IR (KBr) $cm^{-1}$: 3 330, 2 970, 1 635, 1 610, 1 600, 1 580, 1 555, 1 510, 1 425, 1 210, 1 190, 1 150, 980, 975, 800. $^1H$ NMR δ ($CDCl_3$): 6.72 (d, J = 8.0 Hz), 6.68 (d, J = 8.0 Hz), 6.65 (s), 3.89 (s, $OCH_3$, 3.90 (s, $OCH_3$), 3.91 (s, $OCH_3$), 4.28 (d, J = 15.2 Hz, H-7), 3.55 (d, J = 15.2 Hz, H-7), 3.60 (dd, J = 12.5, 3.0 Hz, H-5), 3.20 (dd, J = 12.5, 11.5 Hz, H-5), 2.85 (dd, J = 12.0, 11.5 Hz, H-4), 2.70 (dd, J = 12.5, 3.0 Hz, H-4). 2.90 (m, H-4). $^{13}C$ NMR δ ($CDCl_3$): 144.42 (s, C-1), 121.45 (s, C-1a), 114.45 (s, C-1b), 146.62 (s, C-2), 110.98 (d, C-3), 137.71 (s, C-3a), 31.22 (t, C-4), 51.52 (C-5), 179.33 (s, C-6a), 32.11 (t, C-7), 136.62 (s, C-7a), 120.78 (d, C-8), 114.43 (d, C-9), 146.62 (s, C-10), 144.11 (s, C-11), 123.35 (s, C-11a), 58.81 (q, $OCH_3$), 55,53 (q, $OCH_3$), 55.78 (q, $OCH_3$). EI-MS *m/z*: 325 $[M]^+$, 300, 286, 192, 176.

**Hemiargine C** Amorphous, IR (KBr) $cm^{-1}$: 3 450, 3 300, 1 635, 1 610, 1 600, 1 510, 1 500, 1 420, 1 380, 1 300, 1 190, 1 150. $^1H$ NMR δ ($CD_3OD$): 9.12 (s, H-11), 7.81 (d, J = 10.5 Hz, H-7), 7.62 (d, J = 10.5 Hz, H-6a), 6.91 (s, H-3), 7.03 (s, H-5), 3.98 (s, $OCH_3$), 3.95 (s, $OCH_3$), 3.94 (s, $OCH_3$), 3.51 (t, J = 7.5 Hz, 2H, H-5), 2.87 (t, J = 7.5 Hz, H-4). $^{13}C$ NMR δ ($CD_3OD$): 148.32 (s, C-1), 151.45 (s, C-2), 109.72 (d, C-3), 125.10 (s, C-3a), 134.31 (s, C-1b), 124.62 (s, C-1a), 115.41 (d, C-6a), 124.12 (d, C-7), 128.32 (s, C-7a), 109.00 (d, C-8), 148.45 (s, C-9), 144.87 (s, C-9), 107.11 (d, C-11), 31.31 (t, C-4), 42.67 (t, C-5). 58.81 (q, $OCH_3$), 55.51 (q, $OCH_3$), 55.72 (q, $OCH_3$). EI-MS *m/z*: 327 $[M]^+$, 312, 296, 297, 265.

**Hemiargine D** Amorphous, IR (KBr) $cm^{-1}$: 3 220, 1 600, 1 510, 1 500, 1 420, 1 352, 1151, 987, 760. CI-MS *m/z*: 190 $[M+H]^+$, 147, 71, 43. $^1H$ and $^{13}C$ NMR data were shown in Table 1.

**Isocorydine** Square crystal, mp 240 - 242 ℃, $[\alpha]_D^{25}$ + 182.3 ° (c 1.3, $CHCl_3$). IR (KBr) $cm^{-1}$: 3 300, 1 650, 1 620, 1 570, 1 480, 1 460, 1 435, 1 150, 1 095, 920, 834. EI-MS *m/z*: 341 $[M]^+$, 326, 310, 295, 281, 266, 167, 150, 149, 139, 125, 105, 83, 71. $^1H$ NMR δ: 6.86 (s, H-3), 2.46 (ddd, J = 17.3, 3.9, 3.4 Hz, H-4a), 2.70 (dd, J = 17.3, 3.4 Hz, H-4b), 3.06 (dd, J = 13.0, 17.3, H-5b), 3.19 (ddd, J = 17.3, 17.3, 3.9 Hz, H-5a), 4.22 (m,

H-6a), 2.88 (d, J = 12.8 Hz, H-7a), 2.44 (dd, J = 12.8, 12.8 Hz, H-7b), 6.82 (d, J = 8.0 Hz, H-8), 6.84 (d, J = 8.0 Hz, H-9), 2.53 (N-$CH_3$), 3.90 ($OCH_3$): 3.90 ($OCH_3$), 3.70 ($OCH_3$). $^{13}$C NMR δ 142.19 (s, C-1), 125.00 (s, C-1a), 118.89 (s, C-1b), 149.11 (s, C-2), 111.12 (d, C-3), 129.22 (s, C-3a), 29.26 (t, C-4), 52.67 (t, C-5), 62.83 (d, C-6a), 35.85 (t, C-7), 129.87 (s, C-7a), 118.13 (d, C-8), 111.17 (d, C-9), 151.21 (s, C-10), 144.04 (s, C-11), 129.22 (s, C-11a), 43.77 (q, N-$CH_3$), 55.81 (q, $OCH_3$), 55.82 (q, $OCH_3$), 61.91 (q, $OCH_3$).

**Corydine** mp 150 - 152 ℃, $[\alpha]_D^{25}$ + 207° (c 1.0, $CHCl_3$). IR (KBr) $cm^{-1}$: 3 450, 2 980, 1 620, 1 550, 1 450, 1 200, 1 150, 820, 730. $^1$H NMR δ ($CDCl_3$): 6.71 (s, H-3), 2.50 (dd, J = 13.5, 17.0 Hz, H-4α), 3.10 (dd, J = 13.5, 4.0 Hz, H-5β), 2.65 (dd, J = 17.0, 2.5 Hz), 3.20 (ddd, J = 17.0, 17.0, 4.0 Hz, H-5α), 2.70 (dd, J = 13.0, 2.0 Hz, H-4), 7.11 (d, J = 8.0, H-8), 6.90 (d, J = 8.0 Hz, H-8), 3.96 (s, $OCH_3$), 3.95 (s, $OCH_3$), 3.76 (s, $OCH_3$), 2.60 (s, N-$CH_3$). EI-MS *m/z*: 341 $[M]^+$, 326, 310, 298, 324, 280, 268, 252, 170, 155, 139, 120, 105, 91, 74.

**Norcorydine** Amorphous, $[\alpha]_D^{25}$ + 67.2° (c 3.2, $CHCl_3$). IR (KBr) $cm^{-1}$: 3 450, 3 300, 2 970, 2 960, 1 632, 1 610, 1 550, 1 520, 1 420, 1 400, 1 220, 1 200, 1 170, 1 100, 850, 720, 700. $^1$H NMR δ ($CDCl_3$): 6.77 (s, H-3), 7.15 (d, J = 8.0 Hz), 6.95 (d, J = 8.0 Hz), 3.99 (s, $OCH_3$), 3.89 (s, $OCH_3$), 3.80 (s, $OCH_3$), 2.55 (dd, J = 14.0, 14.5 Hz, H-4α), 3.05 (m), 3.10 (m), 2.70 (m), 2.60 (dd, J = 14.0, 2.5 Hz), 2.92 (dd, J = 16.0, 14.0 Hz). EI-MS *m/z*: 327 $[M]^+$, 326, 312, 310, 298, 163.

**Salutaridine** mp 223 - 225 ℃, $[\alpha]_D^{25}$ + 140° (c 2.0, $CHCl_3$). IR (KBr) $cm^{-1}$: 3 320, 2 980, 1 670 (CO), 1 600, 1 580, 1 460, 1 400, 1 250, 1 170, 1 020, 1 000, 830, 790, 750. $^1$H NMR δ ($CDCl_3$): 6.81 (d, J = 8.3 Hz, H-1), 6.72 (d, J = 8.3 Hz, H-2), 7.60 (s, H-5), 6.38 (s, H-8), 3.95 (s, $OCH_3$), 3.80 (s, $OCH_3$), 3.40 (d, J = 18.5 Hz), 3.05 (dd, J = 18.5, 6.5 Hz), 3.75 (d, J = 6.5 Hz), 2.50 (N-$CH_3$), 2.25 (dd, J = 16.5, 8.5 Hz, H-15), 1.82 (ddd, J = 16.5, 16.5, 6.5 Hz, H-15), 2.65 (m), 2.40 (m, H-16). EI-MS *m/z*: 326 $[M]^+$, 190, 178, 58, 39.

**Table 1** The $^1$H and $^{13}$C NMR data of hemiargine D in $CDCl_3$

| No. | $^{13}$C(δ) | $^1$H(δ) | Hz |
|---|---|---|---|
| 1a | 126.20 d | 7.23 d | 7.6 |
| 1 | 126.56 d | 7.28 d | 7.6, 7.8 |
| 2 | 126.55 d | 7.09 d | 7.8, 7.8 |
| 3 | 131.09 d | 7.23 d | 7.8 |
| 3a | 135.00 s | | |
| 1b | 137.50 s | | |
| 4 | 29.59 t | 1.74 d | 11.8 |
| | | 2.70 d | 11.8 |
| 5 | 55.31 s | | |
| 6a | 61.34 d | 3.36 q | 6.8 |
| 7 | 18.74 q | 1.45 d | 6.8 |
| 8 | 21.64 t | 1.62 q | 7.2 |
| 9 | 11.81 q | 0.96 t | 7.2 |
| 10 | 18.02 q | 1.18 s | |

**Glaucine** mp 120 - 122 ℃, $[\alpha]_D^{25}$ + 128° (c 6.9, $CHCl_3$). IR (KBr) $cm^{-1}$: 2 800, 1 610, 1 605, 1 585, 1 450, 1 320, 1 200, 1 105, 970, 950. $^1$H NMR δ ($CDCl_3$): 8.10 (s, H-11), 6.98 (s, H-8), 6.63 (s, H-3), 3.90 (s, $OCH_3$), 3.88 (s, $OCH_3$), 3.78 (s, $OCH_3$), 3.70 (s, $OCH_3$), 2.52 (s, N-$CH_3$). EI-MS *m/z*: 355 $[M]^+$, 254, 340, 324, 312, 297, 281.

**Tetrahydropalmatrubine** Amorphous, IR (KBr) $cm^{-1}$: 2 980, 2 976, 1 615, 1 600, 1 550, 1 520, 1 430, 1 400, 1 355, 1 200, 1 150, 990, 875, 730. $^1$H NMR δ ($CDCl_3$): 6.78 (d, J = 8.0 Hz), 6.73 (d, J = 8.0 Hz), 7.00 (s), 6.62 (s), 4.28 (d, J = 15.0 Hz), 3.90 (s, 9H), 3.52 (d, J = 15.0 Hz), 3.30 (dd, J = 14.2, 3.0 Hz), 3.15 (m), 3.00 - 2.50 (m, 6H). $^{13}$C NMR δ ($CDCl_3$): 147.37 (s), 147.30 (s), 143.95 (s), 141.42 (s), 129.53 (s), 127.83 (s), 126.68 (s), 121.00 (s), 119.13 (d), 111.26 (d), 108.89 (d), 108.51 (d), 59.13 (d), 56.03 (q), 55.56 (q), 55.73 (q), 51.27 (t), 36.15 (t), 28.90 (t). EI-MS *m/z*: 327 $[M]^+$, 326, 312, 310, 298, 163.

**Xylopinoine** mp 182 - 183 ℃, IR ( KBr) $cm^{-1}$ : 2 980 , 2 975 , 1 610 , 1 580 , 1 550 , 1 510 , 1 420 , 1 215 , 1 155 , 870 , 720. 1H NMR δ ($CDCl_3$) : 6.71 (s) , 6.70 (s) , 6.62 (s) , 6.55 (s) , 4.26 (dd , J = 12.0 , 3.5 Hz) , 4.12 (dd , J = 14.0 , 6.0 Hz) , 3.90 (s , $OCH_3$) , 3.98 (d , J = 15.2 Hz) , 3.70 (d , J = 15.2 Hz) , 3.30 - 2.60 (m , 6H). $^{13}$C NMR δ ($CDCl_3$) : 129.60 (s , C-1a) , 108.46 (d , C-1) , 147.38 (s , C-2) , 147.38 (s , C-3) , 147.38 (s , C-3) , 111.24 (d , C-4) , 126.60 (s , C-4a) , 29.25 (t , C-5) , 51.23 (5 , C-6) , 58.20 (t , C-8) , 59.50 (d , C-9) , 35.97 (t , C-10) , 126.20 (s , C-11) , 109.14 (d , C-12) , 147.30 (s , C-13) , 147.30 (s , C-14) , 111.43 (d , C-15) , 55.95 (q , 4x $OCH_3$). EI-MS *m/z* : 355 $[M]^+$ , 354 , 340 , 324 , 281 , 94.

**Norlaudanosine** Amorphous , IR ( KBr) $cm^{-1}$ : 3 350 , 1 610 , 1 600 , 1 550 , 1 515 , 1 440 , 1 400 , 1 335 , 990 , 980 , 780. $^1$H NMR δ ($CDCl_3$) : 6.80 (dd , J = 8.0 1.8 Hz) , 6.78 (d , J = 8.0 Hz) , 6.80 (d , J = 1.8 Hz) , 6.58 (s) , 6.52 (s) , 4.26 (br) , 3.88 (s , $OCH_3$) , 3.87 (s , $OCH_3$) , 3.86 (s , $OCH_3$) , 3.72 (s , $OCH_3$) , 3.20 - 2.75 (m , 6H). $^{13}$C NMR δ ($CDCl_3$) : 111.17 (d , C-1) , 147.70 (s , C-2) , 147.70 (s , C-3) , 112.45 (d , C-4) , 28.00 (t , C-5) , 41.55 (t , C-6) , 56.15 (d , C-8) , 128.50 (s , C-9) , 126.80 (s , C-10) , 40.06 (t , C-11) , 130.07 (s , C-12) , 111.53 (d , C-13) , 148.84 (s , C-14) , 146.99 (s , C-15) , 109.38 (d , C-16) , 121.49 (d , C-17) , 55.69 (q) , 55.76 (q) , 55.67 (q) , 55.97 (q). EI-MS *m/z* : 343 $[M]^+$ , 327 , 191 , 151.

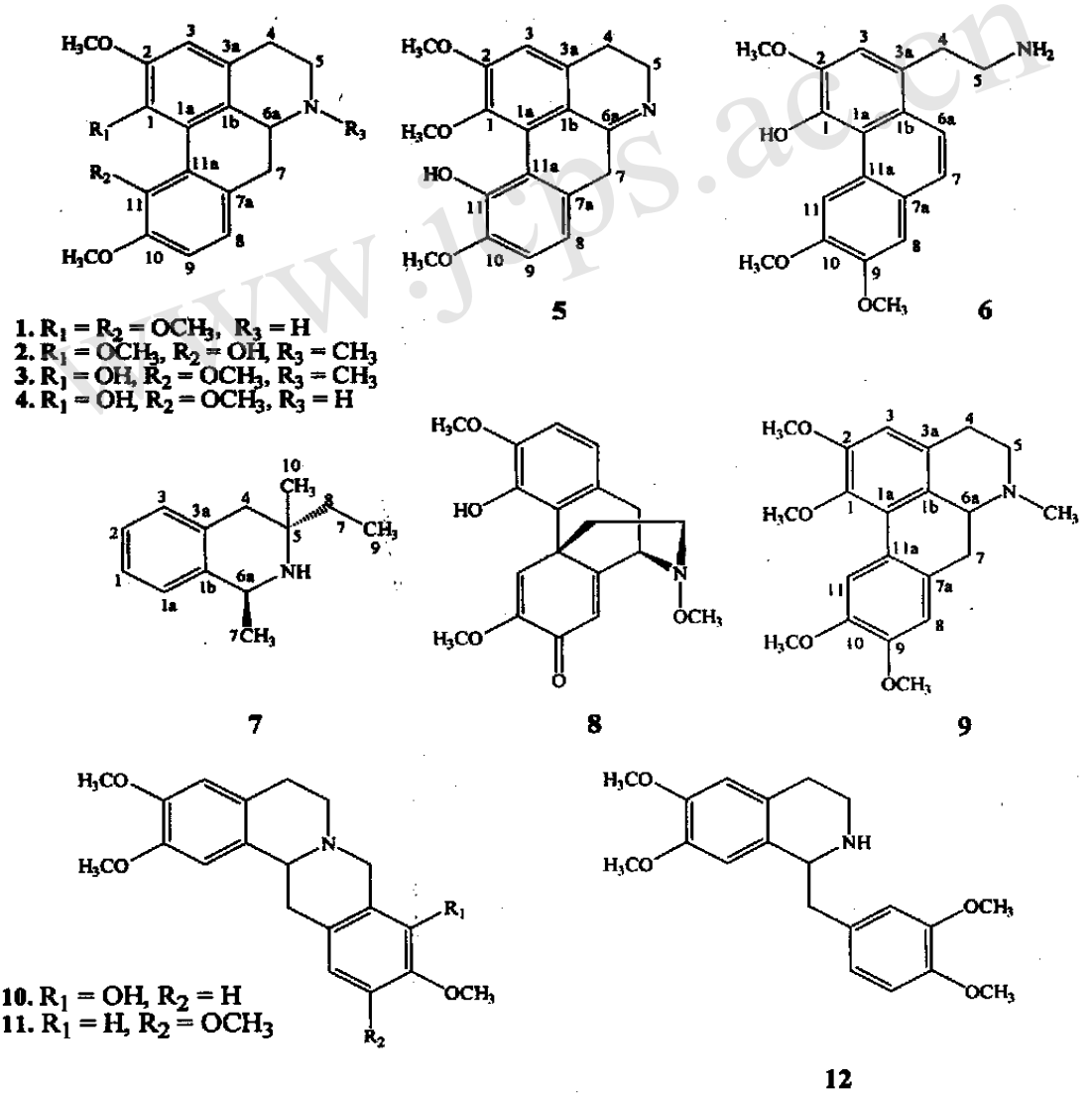


**Figure 1 Structure of compounds 1 - 12**

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# 巴豆属植物 *Croton hemiargyerius* var. *gymnodiscus* 中生物碱的研究

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**摘要** : **目的** 从巴西巴豆属药用植物的一新变种复制 Muel 的叶中分离生物碱成分。**方法** 应用硅胶柱层析法分离和纯化 ,波谱分析与已知化合物的波谱和理化性质比较得以确定化合物结构。**结果** 分离得到 12 个生物碱 ,其中 4 个为新生物碱 ,命名为 hemiargine **A (1) , B (5) , C (6) 和 D (7)** ; 8 个已知生物碱为 isocorydine **(2) ,** corydine **(3) ,** norcorydine **(4) ,** salutaridine **(8) ,** glaucine **(9) ,** tetrahydropalmatrubine **(10) ,** xylopinoine **(11) 和** norlaudanosine **(12)** 。**结论** 获得 4 种新化合物 , 除生物碱 **(8)** ,其余生物碱均为首次从该属植物中获得 。

**关键词** : *Croton hemiargyerius* ; **生物碱** ; hemiargine A , B , C 和 D