PERGAMON

Phytochemistry 51 (1999) 479–486

PHYTOCHEMISTRY

Minor N_b,C(21)-secocuran alkaloids of *Strychnos myrtoides*

Marie-Thérèse Martin[a], Philippe Rasoanaivo[b], Giovanna Palazzino[c], Corrado Galeffi[c,*], Marcello Nicoletti[d], François Trigalo[e], François Frappier[e]

[a]*Institut de Chimie des Substances Naturelles, CNRS, Avenue de la Terrasse, 91198 Gif-sur-Yvette, France*
[b]*Institut Malgache de Recherches Appliquées, Laboratoire de Phytochimie-Pharmacologie, B.P. 3833, Antananarivo 101, Madagascar*
[c]*Laboratorio di Chimica del Farmaco, Istituto Superiore di Sanità, V.le Regina Elena 299, 00161 Rome, Italy*
[d]*Dipartimento di Biologia Vegetale, Università degli Studi di Roma 'La Sapienza', P.le A. Moro 5, 00185 Rome, Italy*
[e]*Muséum National d'Histoire Naturelle, 63, rue Buffon, 75231 Paris Cedex 05, France*

Received 30 September 1998; received in revised form 4 January 1999; accepted 12 January 1999

Abstract

From the stem bark of *Strychnos myrtoides* in addition to strychnobrasiline and malagashanine, four minor alkaloids, viz. malagashanol, 12-hydroxy-19-*epi*-malagashanine, myrtoidine and 11-demethoxymyrtoidine were isolated and their structures were established by 2-D NMR techniques. They belong to the series N_b,C(21)-secocuran and the two last show an additional α–β unsaturated γ-lactonic ring among C(18)–C(21). The biogenesis of these alkaloids is also discussed. © 1999 Elsevier Science Ltd. All rights reserved.

Keywords: *Strychnos myrtoides*; Loganiaceae; N_b,C(21)-Secocuran alkaloids; Malagashanol; 12-Hydroxy-19-*epi*-malagashanine; Myrtoidine; 11-Demethoxymyrtoidine

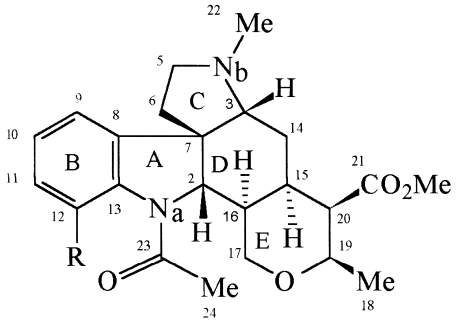
1. Introduction

As a result of the scientific follow-up of the traditional use of stem bark of *Strychnos myrtoides* Gilg and Buss (Leeuwenberg, 1984) (Loganiaceae) as an adjuvant of chloroquine to reinforce its action against chronic malaria, two predominant bioactive constituents, strychnobrasiline, **1** and malagashanine, **2**, were isolated (Rasoanaivo et al., 1994). While strychnobrasiline is an alkaloid belonging to the well known N_b,C(3)-secocuran series, malagashanine was the first N_b,C(21)-secocuran alkaloid described. Its structure was established by the use of the ^1H–^{13}C long range correlation technique HMBC and the examination of the HETCOR, whereas the configurations of the chiral centers C(3), C(15) and C(16) were assumed by analogy with other curan alkaloids (Rasoanaivo, Galeffi, Palazzino, & Nicoletti, 1996). The X-ray analysis however reversed the proposed configuration of C(3) from *S* to *R* (viz. H-3 β instead of α) (Caira, & Rasoanaivo, 1995). The conformation now established through the NOESY spectra is in agreement with the configuration established by the X-ray analysis. Analogue considerations apply to the previously isolated 12-hydroxymalagashanine, **3**.

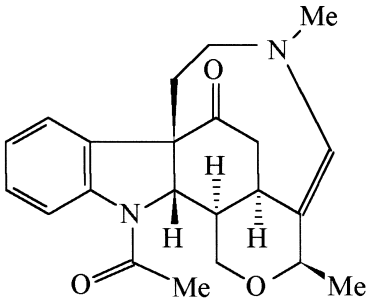
The promising in vitro and in vivo chloroquine-enhancing action of malagashanine has prompted us to carry on a phytochemical investigation of the minor alkaloids of *S. myrtoides*. This has resulted in the isolation by counter-current distribution (CCD) of four new alkaloids of the N_b,C(21)-secocuran series, viz., 12-hydroxy-19-*epi*-malagashanine, **4**, myrtoidine, **5**, 11-demethoxymyrtoidine, **6**, (these two with an unusual α–β unsaturated γ-lactonic ring) and malagashanol, **7**. A tentative biogenetic scheme of these alkaloids is also discussed.

* Corresponding author.

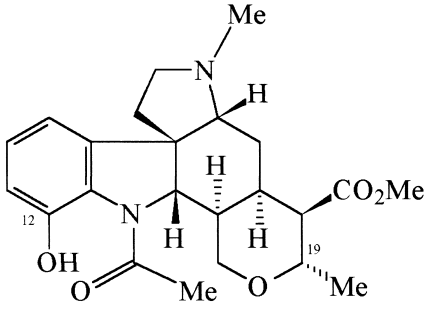
0031-9422/99/$ - see front matter
PII: S0031-9422(99)00033-3



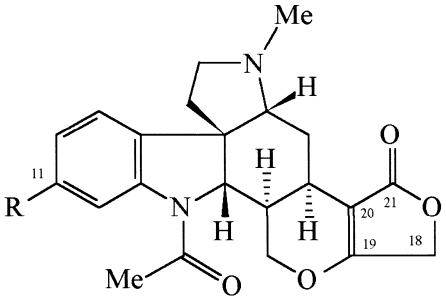
2 R = H malagashanine
3 R = OH 12-hydroxymalagashanine



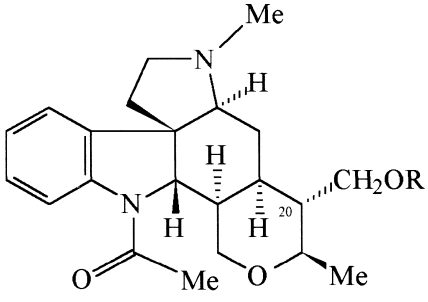
1 strychnobrasiline



4 12-hydroxy-19-*epi*-malagashanine



5 R = OMe myrtoidine
6 R = H 11-demethoxymyrtoidine



7 R = H malagashanol
8 R = Ac acetylmalagashanol

2. Results and discussion

Malagashanine, **2**, possesses a N–Me pyrrolidinic ring, whose conformation is intermediate between an envelope and a twisted form, whereas the cyclohexane D ring and the tetrahydropyran E ring are both in a chair conformation. The NOESY spectrum, where cross peaks between H-9 and H-14a and between H-5a

Table 1
NMR data of malagashanine, **2** and of 12-hydroxy-19-*epi*-malagashanine, **4**, *Z* conformers, at 300 K

Atom	δ_C of **2**	NOESY of **2**	δ_C of **4**	δ_H of **4** (*J* in Hz)	HMBC of **4**	NOESY of **4**
2	66.3	6b, 17b, 24	69.0	3.70 s	6, 7, 8, 13, 16, 23	3, 6, 16, 24
3	64.4		64.1	2.60 m		6, 14b
5a		5b, 6a, 9		3.33 m		5b, 6, 9
5b	52.7	6b	53.4	2.38 m		6
6	36.8	6b	38.0	1.89 m		
7	55.0		52.8			
8	137.8		139.0			
9	125.8	10, 14a	116.3	7.28 d (7.3)		10, 14a
10	124.1	11	127.8	7.00 dd (8.1, 7.3)	8, 12	11
11	127.3	12	118.1	6.81 d (8.1)	9, 12, 13	OH
12	119.3		146.0			
13	140.8		125.3			
14a		14b, 15		1.36 m		14b, 15
14b	28.1	15, 20	21.9	1.90 m		19
15	36.0	16, 17a, 19, 20	29.8	2.03 m		
16	38.5	17a, 17b	44.9	2.05 m		
17a		17b, 19		3.51 dd (11.0, −11.5)	15, 16, 19	17b
17b	68.2	24	69.0	3.80 dd (4.9, −11.5)	15, 16, 19	3
18	18.2	19, 20	19.8	1.18 d (5.8)	19, 20	19, 20
19	74.8	20	69.4	3.77 dq (10.0, 5.8)	18	
20	48.4		50.7	2.27 dd (10.0, 6.3)	16, 19	
21	174.2		172.2			
22	41.2		40.7	2.38 s		
23	170.6		168.5			
24	23.8		23.3	2.29 s	23	
OMe	51.5		51.4	3.52 s	21	
OH				10.81 br s	11, 12, 13	

and H-9, H-15 and H-17a, respectively, were observed, was in agreement with the results obtained by X-ray analysis and thus corroborated the stereochemistry β for H-3. At variance with strychnobrasiline (Martin, Frappier, Rasoanaivo, & Randrianarivolojara, 1996) and other N_a-acetylindoline alkaloids for which the conformational equilibrium due to the rotational barriers of the acyl was described (Galeffi, Ciasca Rendina, Miranda Delle Monache, & Marini-Bettolo, 1971), only one conformation was observed for malagashanine, **2**. NOE between H-2 and Me(24) allowed unambiguous assignation of the *Z* nature of this conformer. The NMR data of **2** are reported in Table 1.

Alkaloid **4** corresponds to raw formula $C_{23}H_{30}N_2O_5$ (in HREIMS *m*/*z* 414.2111) and its ^1H and ^{13}C NMR data suggested that its structure was closely related to that of **2**. The aromatic coupling pattern was consistent with a 1,2,3-tri-substituted aromatic ring while the absence of the downfield signal of H-12 and the shielding of the ^1H and ^{13}C signals *ortho* and *para* to C-12 with respect to **2** accounted for the presence of a hydroxy group in this position. The downfield shift of its signal (δ_H 10.81, br s, exchangeable with D_2O) was attributed to hydrogen bonding with the N_a–Ac carbonyl group, resulting in a fixed *Z* conformation as supported by the observation of a NOE contour between H-2 and Me(24). Full assignments of the ^1H and ^{13}C NMR of **4** were assisted by the concerted interpretation of COSY, HMQC and HMBC spectra (Table 1). As for malagashanine, cross peaks observed in the NOESY spectrum between H-9 and H-14a and H-5a and H-9 allowed us to assign the β-configuration to H-3. At variance with 12-hydroxymalagashanine, **3**, wherein the coupling constant between H-19 and H-20 was 3.5 Hz (Rasoanaivo et al., 1996), in alkaloid **4** the relationship between the same hydrogens was *trans* diaxial ($J = 10.0$ Hz). This observation and NOE observed between H-14b and H-19 were indicative of the α-equatorial configuration for Me(18) and the β-equatorial one for the carbomethoxy at C(20). These results strongly indicated that ring E took a chair conformation, which was only consistent with a boat conformation for ring D, as evidenced by NOE contour between H-17b and H-3. Alkaloid **4** is therefore 12-hydroxy-19-*epi*-malagashanine and, as in *Strychnos splendens* (Koch, Plat, & Le Men, 1969), in *S. myrtoides* there is the cooccurrence of indolinic alkaloids of series *normal* and *iso*, viz. with Me(18) in β and α configuration, respectively.

Alkaloid **5**, named myrtoidine, corresponds to a molecular formula of $C_{23}H_{26}N_2O_5$ (in HREIMS *m*/*z* 410.1852). Its UV spectrum (λ_{max} 220, 242,sh, 289 nm) was at variance with classical N_a-acylindolinic alka-

Table 2
NMR Data of Myrtoidine, **5**, *E* and *Z* conformers, at 243 K and of 11-demethoxy-myrtoidine, **6**, *E* conformer, at 300 K

Atom	δ_C of **5** *E*	δ_C of **5** *Z*	δ_H of **5** (*J* in Hz)	HMBC of **5**	NOESY of **5**	$\delta_C$of **6** *E*	δ_H of **6** *E* (*J* in Hz)
2	64.4	67.0	4.75 d (8.8)	6, 7, 8, 13, 17	3, 6b	65.9	4.67 d (8.8)
3	63.7	63.9	2.29 dd (12.4, 2.4)		6b, 14b, 22	63.9	2.20 dd (12.4, 2.4)
5a			3.29 m	3, 6	5b, 6a, 9		3.12 m
5b	52.1	52.1	2.39m		6b	52.4	2.28 m
6a			1.67m	7, 8	6b		1.56 m
6b	36.6	36.2	1.94 m	5		37.7	1.86 m
7	52.7	53.4				53.6	
8	130.8	128.2				139.1	
9	127.1	126.0	7.77 d (8.4)	7, 11, 13	10, 14a	127.1	7.78 d (7.9)
10	107.4	110.0	6.70 dd (8.4, 1.9)	8, 11, 12	OMe	124.5	7.04 t (7.9)
11	158.8	158.8				127.3	7.18 t (7.9)
12	105.4	105.9	6.80 d (1.9)	8, 10, 11, 13	24	117.0	7.08 d (7.9)
13	140.9	141.5				140.2	
14a			1.59 m	3, 15, 20	14b		1.60 m
14b	22.2	22.1	2.88 m			22.7	2.75 m
15	29.1	29.6	2.97 m		16	29.0	2.80 m
16	37.2	37.1	1.86 m	2, 15, 20	17a	36.8	1.51 m
17a			4.25 br d (−10.9)	2, 15			4.11 br d (−10.7)
17b	71.8	70.9	4.79 m (−10.9)	15, 19		71.8	4.65 m (−10.7)
18a			4.80 d (−15.7)	19, 20, 21			4.57 d (−15.7)
18b	66.0	65.7	4.75 d (−15.7)	19, 20, 21		64.5	4.66 d (−15.7)
19	175.2	174.5				174.9	
20	99.9	101.0				100.4	
21	172.0	171.4				171.6	
22	41.1	41.0	2.46 s	3, 5	3	40.8	2.33 s
23	168.9	167.8				168.8	
24	23.5	23.0	2.52 s			23.1	2.36 s
OMe	55.6	55.5	3.91 s	11			

loids and showed the intermediate absorption as a shoulder of the first maximum instead of a separate maximum. This suggested the overlapping of another independent chromophore. The preliminary analysis of ^1H and ^{13}C NMR spectra of **5** in $CDCl_3$ at 300 K indicated the presence of two differently populated conformers, which coalesced progressively with the temperature increase. The same spectra registered at 243 K (Table 2) showed the presence of two conformers due to the restricted rotation of the N_a-acetyl (δ_H 2.52) around the amidic bond. As no interconversion was observed in the phase-sensitive NOESY spectrum, the NOESY correlations could be therefore interpreted as independent interactions within each conformer and in these conditions the concerted interpretation of the COSY, HMQC and HMBC data led us to propose structure **5** for myrtoidine. In effect the chemical shift values, the coupling pattern of the aromatic hydrogens and the correlations observed in the HMBC spectrum between H-9 and C(7), C(11) and C(13) were characteristic of a 11-methoxy (δ_H 3.91) N_a-acetylindoline. At room temperature this compound appeared predominantly in the *E* conformation as supported by the presence of a cross-peak between H-12 and Me(24) in the NOESY spectrum. H-2 (δ 4.75, d, $J=8.8$ Hz) showed coupling with H-16 (δ 1.86, m) and this was further coupled with H-15 (2.97, m) and H-17a (δ 4.25) and H-17b (δ 4.79). The diagnostic cross peaks in the HMBC spectrum between the signal of Me–N_b (δ 2.46) and the methylene at δ 52.1, C(5) and the methine at δ 63.7, C(3), strongly indicated that myrtoidine, as **2** and **4**, belongs to the N_b,C(21)-secocuran alkaloids. The α–β unsaturated γ-lactonic ring, suggested by the lacking of the signals of Me(18) and H-19 and H-20, was identified by the observation of cross peaks between H-18a and 18b and C(19), δ 175.2 and 174.5, C(20), δ 99.9 and 101.0 and C(21), δ 172. 0 and 171.4. The drastic shielding of C(20) and the strong deshielding of C(19) were due to the mesomeric effect of the α–β unsaturated γ-lactone. The UV spectrum observed for myrtoidine is consistent with the overlapping of the N_a-acetylindoline and the α–β unsaturated γ-lactone chromophores. The strong positive Cotton effect of the CD curve at 252 nm, $[\Theta]=+62700$, was in agreement with the A–D *cis* junction (2*S*,7*R*) according to the Klyne's rule (Klyne, Swan, Gorman, Guggisberg, & Schmid, 1968) for the *N*-acetyl indolinic chromophore.

Alkaloid **6** corresponds to a molecular formula of $C_{22}H_{24}N_2O_4$ (in HREIMS *m*/*z* 380.1740). The analysis of the UV, ^1H and ^{13}C NMR spectra suggested that it was closely related to myrtoidine, **5**. In particular, the

Table 3
NMR Data of Malagashanol, **7**, *Z* conformer and of Acetylmalagashanol, **8**, at 300 K

Atom	δ_C of **7**	δ_H of **7** (*J* in Hz)	HMBC of **7**	NOESY of **7**	δ_C of **8**	δ_H of **8**
2	65.4	4.33 d (10.9)	6, 7, 8, 13, 16, 17, 23	6b, 20, 24	65.1	4.38
3	65.8	2.89 dd (4.2, 3.1)	2, 7, 15, 22	9, 14a, 22	66.3	3.00
5a		2.38 ddd (9.2, 5.6, −10.3)		5b		2.27
5b	53.9	3.18 ddd (7.2, 7.2, −10.3)	3, 6, 7, 22	6b	54.3	3.36
6a		1.66 ddd (9.2, 7.2, −13.0)		6b		1.68
6b	38.4	2.00 ddd (7.2, 5.6, −13.0)	2, 3, 5, 7		38.2	2.17
7	54.7				54.4	
8	137.6				138.3	
9	121.3	7.11 br d (7.3)	7, 11, 13	10	121.3	7.12
10	124.6	7.03 dd (7.3, 7.3)	8, 12	11	124.5	7.10
11	127.8	7.18 dd (7.9, 7.3)	9, 13	12	127.7	7.21
12	119.5	7.93 br d (7.9)	8, 10		119.5	7.95
13	141.2				141.2	
14a		1.54 ddd (4.9, 4.2, −15.3)	3, 15, 20	14b		1.58
14b	25.9	2.17 ddd (3.1, 1.8, −15.3)	2, 15, 16		24.6	2.24
15	34.9	1.88 m (4.9, 1.8)		16, 17a, 19	33.3	2.22
16	38.6	1.36 m (10.9, 2.4)		17a, 17b	38.4	1.90
17a		3.38 dd (2.4, −12.3)	2, 15, 19	17b, 19		3.40
17b	67.8	3.86 d (−12.3)	3, 15, 16, 19	24	68.0	3.91
18	19.9	1.28 d (6.0)	19, 20	19, 20, 21a, 21b	19.7	1.34
19	76.0	3.31 dq (9.1, 6.0)			76.1	3.39
20	45.2	1.88 m (9.1, 3.4, 1.8)		21	42.0	2.30
21a		3.71 dd (1.8, −11.3)	15, 19, 20	21b		4.45
21b	61.4	3.59 dd (3.4, −11.3)	15, 19, 20		62.4	4.31
22	42.5	2.40 s	3, 5		41.3	2.07
23	169.5				169.5	
24	23.2	2.34 s	23		23.2	2.38
O*C*OMe					171.0	
OCO*M*e					20.8	2.38

comparison of their ^{1}H NMR data showed that the only relevant difference was the disappearance in **6** of the methoxy group and the consequent presence of four aromatic hydrogens. This observation suggested that **6** was the 11-demethoxymyrtoidine. The ^{1}H and ^{13}C NMR data of the predominant *E* conformer at 300 K are reported in Table 2.

The α–β unsaturated γ-lactonic ring among C(18)–C(21) present in **5** as well as in **6**, which results into a furo[3,4-e]pyran system, has never been found among the indolic alkaloids.

Alkaloid **7**, named malagashanol, corresponds to a molecular formula of $C_{22}H_{30}N_2O_3$ (in HREIMS *m*/*z* 370.2272). It is likely to be an alcohol on account of the MS peak in EIMS at *m*/*z* 353 (10) and to have the sequence N_a-acetylindoline–β-CH_2–CH_2–N_b on account of the MS peaks in EIMS at *m*/*z* 144 (32) and 130 (17). The downfield shift of aromatic H-12 (δ 7.93, br d, *J* = 7.9 Hz) was related to the *cisoid* conformation (*Z* conformer) also evidenced by the NOE observed between H-2 and Me(24). The three-bond connectivity in the HMBC spectrum between Me–N_b (δ 2.40) and the methine at δ 65.8, C(3) and the methylene at δ 53.9, C(5), accounted for the N_b,C(21)-secocuran series for **7** as for **2** and **4**–**6**. The coupling pattern of the aliphatic hydrogens of the tryptamine moiety was established, the proton connectivities of the D and E rings were unambiguously assigned starting from the chemical shift of H-2 (δ 4.33, d, *J* = 10.9 Hz) (see Table 3 wherein the NMR data of acetylmalagashanol, **8**, are also reported) and the ^{13}C chemical shifts of all protonated carbons were assigned by the use of HMQC and HMBC techniques from the knowledge of the ^{1}H chemical shifts. These data suggested that malagashanol was strictly related to malagashanine wherein the carbomethoxy group was replaced by a hydroxymethylene group. As for malagashanine, the strong positive Cotton effect of **7** at 251 nm, $[\Theta] = +29500$, was in agreement with the A–D *cis* junction (2*S*, 7*R*) viz. H-2 β oriented.

The analysis of the NOESY spectrum showed that in malagashanol the D–E junction was *cis* and H-15 and H-16 had α-configuration. One relevant difference of **7** with respect to **2** and **4**–**6** was the α configuration of H-3 established by the presence of a NOE contour between H-3 and H-9 and by the lack of cross-peaks between H-9 and H-14a and between H-5a and H-9. Furthermore the *trans* diaxial relationship between H-19 and H-20 (*J* = 9.1 Hz), along with a NOE between H-2 and H-20, accounted for the α orientation for

CH_2OH(21) and the β equatorial orientation for Me(18), both cycles D and E taking boat conformations.

Except for malagashanol (**7**), the other N_b–C(21)secocuran alkaloids (**2**–**6**) of *S. myrtoides* have a uncommon H-3 β configuration. Furthermore myrtoidine, **5**, and 11-demethoxymyrtoidine, **6**, showed an α–β unsaturated γ-lactonic ring hitherto not found among *Strychnos* alkaloids.

A suggested biogenetic pathway which can explain the formation of the N_b–C(21) secocuran alkaloids and the cooccurrence of alkaloids epimer at C(3) and C(20) is reported in Scheme 1. Strychnobrasiline, **1**, by electrophilic attack of a proton at C(20) and subsequent hydrolysis of the resulting unstable ammonium ion with fission of the N_b–C(21) bond, gives an aldehyde group and by rearrangement a α-hydroxypyrrolidinic ring. The new ammonium ion, resulting from the attack of a proton with the elimination of a water molecule, gives rise by nonstereoselective reduction to the H-3 β and H-3 α secocuran alkaloids.

The four new minor alkaloids, **4**–**7**, displayed in vitro chloroquine-enhancing effect against the resistant strain FCM29/Cameroon of *Plasmodium falciparum*, less than the parent compound, malagashanine, **2**.

3. Experimental

A Craig–Post apparatus (200 stages, 10:10 ml, upper and lower phase) was used for separations by CCD. NMR spectra were recorded in $CDCl_3$ on a Bruker AM 400 spectrometer using a triple resonance probe head with gradient selection of coherence transfer pathway. The ^1H and ^{13}C chemical shifts are given in ppm relative to TMS (internal standard). The homonuclear ^1H–^1H shift correlated two-dimensional diagrams were obtained using the COSY-90 pulse sequence, HMBC experiments were monitored using 70 ms evolution delay for CH long range coupling. HREIMS spectra were obtained with VG 7070EQ-HF instrument and EIMS (70 eV) spectra on a HP 5989A instrument. CD curves were recorded on a Jasco 710.

3.1. Plant material

Stem bark of *S. myrtoides* Gilg and Buss was collected in Reserve Nationelle d'Ankarafantsika, western region of Madagascar. The botanical identification was made by Mr. A. Rakotozafy, Department of Botany, Parc Botanique et Zoologique de Tsimbazaza, Antananarivo. Voucher samples are kept at the Institut Malgache de Recherches Appliquées.

3.2. Extraction and separation

The air-dried, milled stem bark (1 kg) was exhaustively extracted with 2% aqueous AcOH. The combined extracts were made alkaline by $NaHCO_3$ and extracted twice with CH_2Cl_2 to afford crude alkaloids (25.2 g). This extract was fractionated by portions of 5 g by CCD between CH_2Cl_2 and phosphate/citric acid buffer (mobile phase) at discontinuously decreasing pH. At pH 7 was eluted strychnofendlerine ($K_r \times K_b = 10^{-7}$), at pH 5 strychnobrasiline, **1**, (6×10^{-10}), at pH 4.8 malagashanol, **7**, (4.5×10^{-10}), at pH 4 by recycling 11-demethoxymyrtoidine, **6**, (6.5×10^{-11}) and myrtoidine, **5**, (4.5×10^{-11}), at pH 3.6 malagashanine, **2**, (1.5×10^{-11}) and at pH 3.2 by recycling 12-hydroxy-malagashanine, **3** (7.5×10^{-12}) and 12-hydroxy-19-*epi*-malagashanine, **4**, (3×10^{-12}).

3.3. 12-Hydroxy-19-epi-malagashanine (*4*)

Crystals from *n*-hexane, m.p. 93–95°C. $[\alpha]_D^{20} = -69.4$ ($CHCl_3$, *c* 0.3). HREIMS, *m/z*: found 414.2111, calcd for $C_{23}H_{30}N_2O_5$ 414.2154. EIMS, *m/z* (rel. int.): 414 (46, M^+), 399 (100), 383 (10), 371 (25), 355 (20), 328 (30), 167 (34), 160 (30), 149 (94). UV (MeOH), λ_{max} ($\log\varepsilon$): 212 (4.39), 256 (4.00), 291 (3.39). CD (MeOH): $[\Theta]_{254}$ +32900.

3.4. Myrtoidine (*5*)

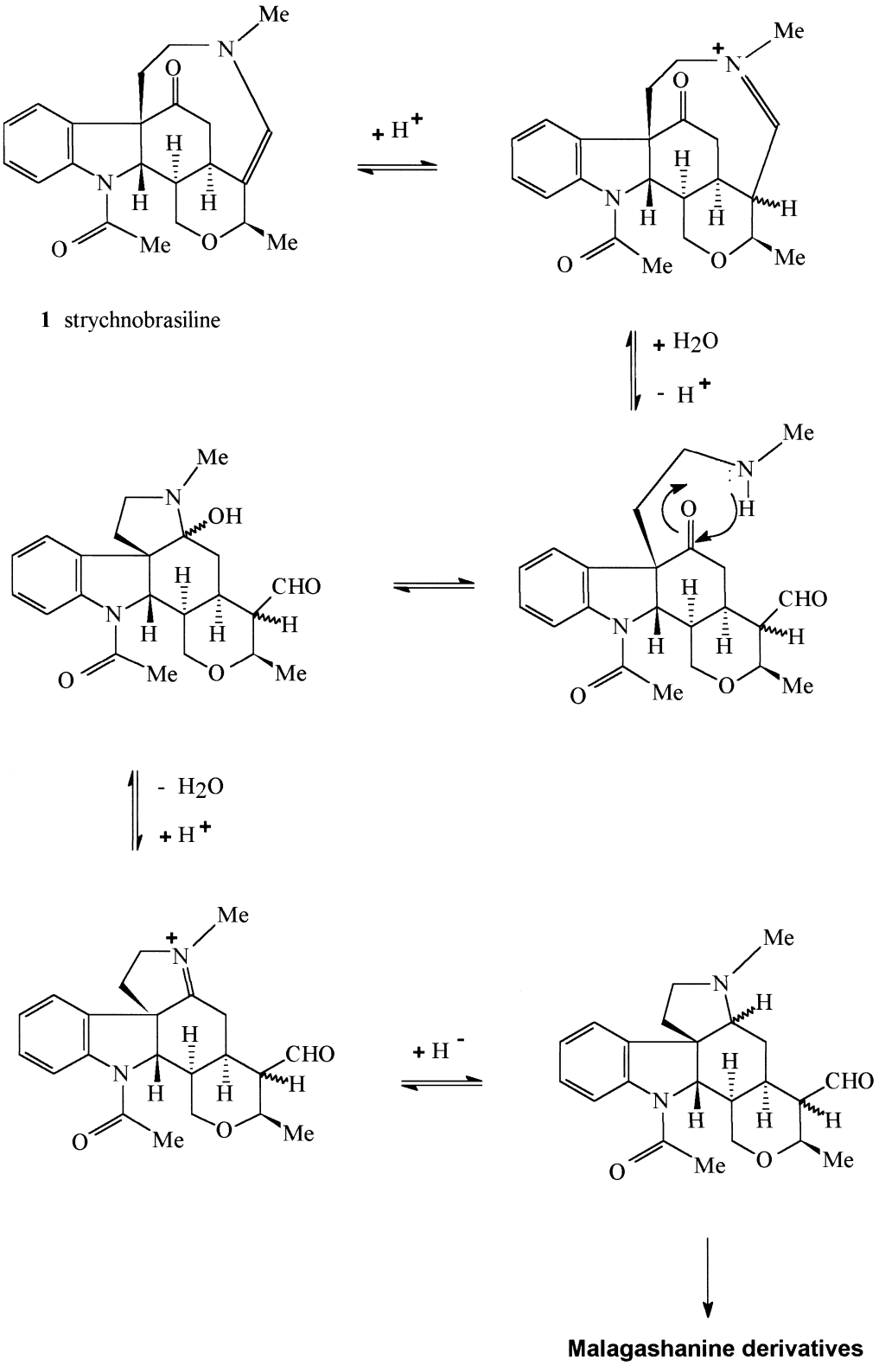
Crystals from EtOAc and cyclohexane which char without melting. $[\alpha]_D^{20} = -46.6$ (CH_2Cl_2; *c* 0.5). HREIMS, *m/z*: found 410.1852, calcd for $C_{23}H_{26}N_2O_5$ 410.1842. EIMS, *m/z* (rel. int.): 410 (100, M^+), 395 (53), 366 (87), 323 (47), 257 (40), 215 (66), 174 (56),148 (52). UV (MeOH), λ_{max} ($\log\varepsilon$): 220 (4.10), 242, sh (3.72), 289 (3.18). CD (MeOH): $[\Theta]_{228}$ −34800, $[\Theta]_{252}$ +62700, $[\Theta]_{286}$ +10400.

3.5. 11-Demethoxymyrtoidine (*6*)

Crystals from EtOAc and *n*-hexane, m.p. 237–240°C. $[\alpha]_D^{20} = -28.9$ (CH_2Cl_2; *c* 0.4). HREIMS, *m/z*: found 380.1740, calcd for $C_{22}H_{24}N_2O_4$ 380.1736. EIMS, *m/z* (rel. int.): 381 (100, $M^+ + 1$), 365 (14), 336 (29), 293 (13), 243 (20), 185 (17), 144 (33), 130 (17). UV (MeOH), λ_{max} ($\log\varepsilon$): 207 (4.00), 241 (3.74), 277, sh (2.96). CD (MeOH): $[\Theta]_{211}$ −17900, $[\Theta]_{249}$ +41800.

3.6. Malagashanol (*7*)

Crystals from EtOAc and *n*-hexane which char without melting. $[\alpha]_D^{20} = +23.3$ (CH_2Cl_2, *c* 0.3). HREIMS, *m/z*: found 370.2272, calcd for $C_{22}H_{30}N_2O_3$ 370.2256. EIMS, *m/z* (rel. int.): 371 (100, $M^+ + 1$), 353 (10), 334



Scheme 1. Suggested biogenesis for N_b,C(21) secocuran alkaloids.

(11), 313 (15), 269 (17), 185 (18), 144 (32), 130 (17). UV (MeOH), λ_{max} (log ε): 251 (3.89), 278, sh (3.28), 285 (3.17). CD (MeOH): $[\Theta]_{218}$ −27500, $[\Theta]_{251}$ +29500, $[\Theta]_{283}$ −1250.

3.7. Acetylmalagashanol (*8*)

Obtained by acetylation of *7* with pyridine and acetic anhydride. Oily. $[\alpha]_D^{20} = -14.7$ ($CHCl_3$, *c* 1.1).

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