MECONOPSIS CAMBRICA ALKALOIDS

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ABSTRACT.—The major alkaloid of the roots of *Meconopsis cambrica* was identified as the quaternary aporphine alkaloid (+)-magnoflorine (**1**). The tertiary proaporphine alkaloids (−)-mecambrine (**3**), (−)-pronuciferine (**4**), (−)-*N*-methylcrotonosine (**6**), the morphinandienone alkaloids (−)-flavinantine (**8**), (−)-amurine (**9**), the tetrahydroprotoberberine alkaloid (−)-mecambridine (**10**) and the benzophenanthridine alkaloid sanguinarine (**11**) were also isolated. The total tertiary alkaloid extracts of the roots, stems, flowers and fruits were shown to be qualitatively similar by tlc.

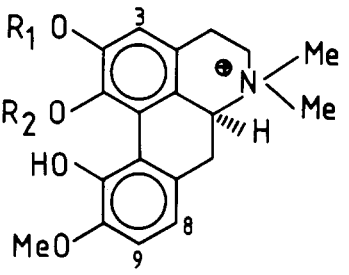
The genus *Papaver* has been investigated extensively for the presence of alkaloids in its many species but, in comparison, the closely related genus *Meconopsis* Vig. has received relatively little attention. *Meconopsis* is the second largest genus after *Papaver* in the tribe Papaverae and some 40 species, which are mainly indigenous to the Himalayas and China, are recognized. Protopine and sanguinarine have been reported from *M. aculeata* Royle, *M. betonicifolia* Franch., *M. horridula* Hook. f. and Thoms, *M. latifolia* Prain and *M. rudis* Prain (1). In addition, *M. rudis* yielded allocryptopine and magnoflorine (2), *M. paniculata*, coptisine (protoberberine-type) and *M. dhwojii* G. Taylor, sanguinarine (1). The only European representative of the genus, *M. cambrica* Vig. (the Welsh Poppy), has yielded mecambrine (proaporphine-type) (3, 4), mecambroline (aporphine-type) (3, 4) and mecambridine (tetrahydroprotoberberine-type (3, 5). The presence of sanguinarine has been indicated by paper chromatography (6), although another investigation failed to detect either this alkaloid or protopine or coptisine (3). It has been suggested, as a result of these previous investigations, that the alkaloidal-types found in the one European species of the genus are different from those of the Asiatic species (4). The abstract (7) of a short communication which was presented at the British Pharmaceutical Conference in 1975 reported briefly that magnoflorine was identified as the major alkaloid of the roots of *M. cambrica* growing in the U.K.; the presence of other alkaloids was also reported. The full text of this paper has not been published until now because of subsequent serious doubts about the correct identification of magnoflorine. These doubts have now been removed because of the recent publication of an elegant piece of work by Stermitz *et al.* (8) in which it was clearly demonstrated that magnoflorine (**1**) and its isomer *N*,*N*-dimethyllindcarpine (**2**) can readily be distinguished chromatographically and by ^{1}H nmr spectroscopy.

RESULTS AND DISCUSSION

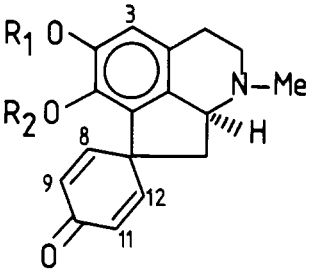
Roots, stems, flowers and fruits of fresh *M. cambrica* were extracted for tertiary and quaternary alkaloids. The major alkaloid isolated from the root was identified initially (7) as the quaternary aporphine alkaloid (+)-magnoflorine (**1**) on the basis

of its uv, ms, ^{1}H nmr and cd spectra (9) and by co-chromatography with reference alkaloid. This finding was not particularly surprising in view of the fact that it had been isolated previously from another species of *Meconopsis* (2); because of its reported isolation from other genera, it is not considered to be a rare alkaloid.

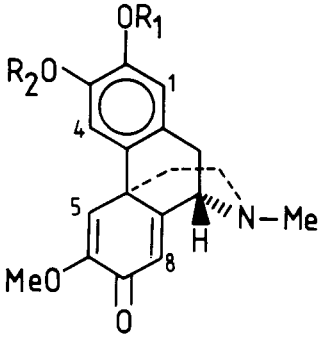
The tertiary alkaloid extracts obtained from roots, stems, flowers and fruits



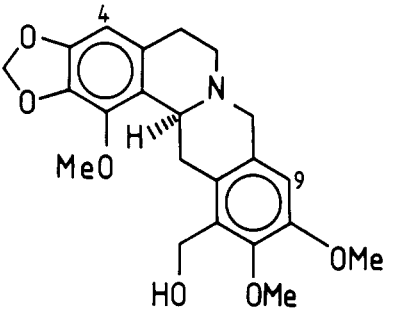
1 R_1 = Me, R_2 = H
2 R_1 = H, R_2 = Me



3 R_1–R_2 = $-CH_2-$
4 R_1 = R_2 = Me
5 R_1 = Me, R_2 = H
6 R_1 = H, R_2 = Me



7 R_1 = H, R_2 = Me
8 R_1 = Me, R_2 = H
9 R_1–R_2 = $-CH_2-$



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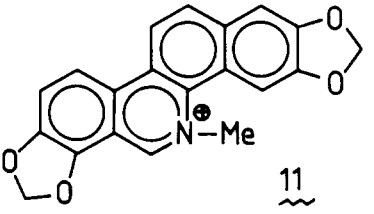

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appeared qualitatively similar by tlc; hence the extracts were combined before separation of the following alkaloids:

(a) proaporphines, (−)-mecambrine (**3**), (−)-pronuciferine (**4**), (−)-*N*-methylcrotonosine (**6**)
(b) morphinandienones, (−)-flavinantine (**8**), (−)-amurine (**9**)
(c) tetrahydroprotoberberine, (−)-mecambridine (**10**)
(d) benzophenanthridine, sanguinarine (**11**)

The proaporphine alkaloid mecambrine (**3**) was readily identified by its uv spectrum, ms fragmentation with fragment ions corresponding to M^+-1, M^+-29, M^+-43 (10), by its ^1H nmr spectrum (NMe, *ar* O-CH_2-O-*ar*, dienone signals), and by co-chromatography with reference alkaloid. Similarly the 1,2-dimethoxy-analogue, pronuciferine (**4**), was readily identified by its uv spectrum and ms and by co-chromatography. The third proaporphine alkaloid was identified as the A ring hydroxy-, methoxy- analogue of (**3**) and (**4**) by means of its uv and ms characteristics. Biogenetic considerations led initially to the assumption that the alkaloid was glaziovine (**5**), not *N*-methylcrotonosine (**6**) (7). The reason for this assumption was that the majority of proaporphine alkaloids which have been isolated from the Papaveraceae and which have hydroxy/methoxy-substituents in ring A have been proved to possess the 1-hydroxy, 2-methoxy-substitution pattern. Because magnoflorine (**1**) had been identified as the major alkaloid, it seemed reasonable to assume that the A ring substitution would probably be the same for both alkaloids. These assumptions were incorrect because, eventually, when reference samples were available for chromatography, the third proaporphine alkaloid proved to be *N*-methylcrotonosine (**6**), not glaziovine (**5**) (table 1). Support for this identification was obtained from the ^1H nmr spectrum (albeit weak) because the signal for the methoxyl group appeared at δ 3.54 in agreement with a C–1 methoxyl substituent; the corresponding signal in the spectrum of glaziovine appeared at δ 3.85 (11, 12). *N*-methylcrotonosine was previously isolated from *Papaver caucasicum* (13) and from *Croton linearis* (14). The cd spectra of the three *Meconopsis* proaporphine alkaloids showed negative Cotton effects in the 260–270 nm and 290–305 nm regions indicating that they were (−)-isomers (15).

TABLE 1. Thin layer hR_f values and color reactions.

Alkaloid	Spray reagent[a]		Solvent system[b]								
	I	II	A	B	C	D	E	F	G	H	I
magnoflorine (**1**)	pu→br	g	0	0	0	0	0	11	35	6	23
mecambrine (**3**)	g	y→g	50	36	20	—	—				
pronuciferine (**4**)	b→g	y	47	35	16	—	—				
glaziovine (**5**)	g	p	—	—	10	32	2				
N-methylcrotonosine (**6**)	g	p	33	24	6	10	0				
flavinantine (**8**)	p→br	p	25	16	3	11	0				
amurine (**9**)	y	p	37	24	9	52	10				
mecambridine (**10**)	pu/g	p	58	51	33	—	—				
sanguinarine (**11**)	or→gr	or→g/br	76	80	71	—	—				

[a]All alkaloids gave orange colors with Dragendorff reagent. I. 0.2 M ferric chloride in 35% perchloric acid, heated at 100° for 5 min. II. 66% sulphuric acid, heated at 100° for 5 min. Key to abbreviations: b=blue, br=brown, g=grey, gr=green, or=orange, p=pink, pu=purple, y=yellow.

[b]Details of solvent systems A–I are given in the Experimental section.

The two morphinandienone alkaloids were mainly identified by their uv spectra and by their ms fragmentation pattern with ion fragments corresponding to M^+, M^+–1, M^+–15, M^+–28, M^+–43 and M^+–59 (16, 17, 18). The uv spectrum of the major morphinandienone alkaloid exhibited a reversible bathochromic shift with alkali, indicating that it was a phenolic compound. The presence in the ms of a molecular ion of *m/e* 327 was consistent with the alkaloid being salutaridine, isosalutaridine (**7**) or flavinantine (**8**). The ^{1}H nmr spectrum confirmed the presence of two methoxyl groups, an *N*-methyl group and four uncoupled aromatic protons with signals between δ 6.32 and 6.93. Salutaridine was ruled out since the C–4 hydroxyl deshields the C–5 proton resulting in a low field signal at δ 7.56 (19). Again, from biogenetic speculation it was assumed that the alkaloid was probably isosalutaridine (**7**) because reticuline could be envisaged as being the precursor of this alkaloid as well as the major alkaloid magnoflorine (**1**) (7). The ^{1}H nmr spectrum of the phenolic morphinandienone *Meconopsis* alkaloid obtained from a deuteriochloroform solution differed from those published for isosalutaridine (deuteriochloroform solution) (18) and for flavinantine (hexadeuterated dimethylsulphoxide solution) (16). However, the chemical shifts in the ^{1}H nmr spectrum of the *O*-acetyl derivative were practically identical with the δ values reported for *O*-acetylflavinantine (both spectra recorded from solution in hexadeuterated dimethylsulphoxide) (16). Tlc R_f values of reference flavinantine and the *Meconopsis* alkaloid were identical (table 1), but isosalutaridine was not available for direct comparison. Confirmation of identification as flavinantine (**8**) was obobtained when it was shown that the *O*-acetyl derivative differed on tlc from reference *O*-acetyl isosalutaridine. Flavinantine has been isolated previously from *Croton flavescens*, Euphorbiaceae (16) but has not been reported from the Papaveraceae.

The second morphinandienone alkaloid was more readily identified as amurine (**9**) by comparison of its ms (M^+, *m/e* 325) and tlc behaviour with an authentic sample (table 1). Comparison of the cd curves obtained from authentic (+)-amurine which had negative Cotton effects at 213 and 306 nm and positive Cotton effects at 234, 250 and 279 nm showed that amurine from *Meconopsis* was enantiomeric since positive Cotton effects were obtained at 212 and 306 nm and negative Cotton effects at 232 and 248 nm (15). The cd spectrum of the isolated flavinantine was closely similar to that of (−)-amurine. The (−)-isomers of amurine and flavinantine have not been isolated previously as natural products.

Mecambridine (**10**), previously isolated from *M. cambrica*, was readily identified by its uv, ms, and ^{1}H nmr spectra and by co-chromatography with reference mecambridine (table 1). The cd spectrum had large negative Cotton effects at 210 and 270 nm indicating (−)-mecambridine (20). The presence of sanguinarine (**11**), previously indicated by paper chromatography (6), was confirmed by comparison of its uv, ms and co-chromatography with reference alkaloid (table 1).

As indicated previously, biogenetic speculation would infer that reticuline, the precursor of magnoflorine, would also yield the morphinandienone isosalutaridine (**7**) instead of flavinantine (**8**) and the proaporphine glaziovine (**5**) instead of *N*-methylcrotonosine (**6**). However, it has been reported in the literature that flavinantine is probably biosynthesized from reticuline-type precursors by *para-para* phenolic oxidative coupling followed by demethylation and then re-methylation at the adjacent position in the morphinandienone A ring (16). It would be of interest to determine whether the formation of *N*-methylcrotonosine in *Meconopsis* can also be rationalized by a similar demethylation step followed by remethyla-

tion. There is evidence for such a step in the biosynthesis of crotonosine since it is (+)-coclaurine and not isococlaurine, which is the precursor in *Croton linearis* Jacq. (21). Reticuline may also act as the precursor of magnoflorine by direct *ortho-ortho* phenolic oxidative coupling (22), but if the aporphine is formed via the proaporphine then the expected product might well be the isomeric *N*,*N*-dimethyllindcarpine (**2**).

Such considerations were sufficient to throw doubt on the original identification (7) of magnoflorine (**1**) from *M. cambrica*, and it seemed possible that the alkaloid was *N*,*N*-dimethyllindcarpine (**2**). Direct comparison of the isolated alkaloid with supplied samples of magnoflorine and *N*,*N*-dimethyllindcarpine (23) on numerous tlc systems (silica gel, alumina, cellulose), by paper chromatography, glc and hplc failed to separate these two reference compounds. A tlc system reported to separate the two alkaloids (24) also failed to differentiate the reference compounds.

Recently "*N*,*N*-dimethyllindcarpine" (**2**) was reported by one of us (25) to be present in *Coscinium fenestratum* (Menispermaceae). The identification was based on comparison of the physical data (uv, ms, ^{1}H nmr) with literature values and by tlc comparison with reference compound. Since this report, larger amounts of the alkaloid have been obtained, so ^{13}C nmr determinations have been made. According to one report (26), an *O*-methyl group at position 1 or 11 in the aporphine molecule would result in a chemical shift of about 60 ppm, whereas an *O*-methyl group at positions 2 or 10 would give rise to shifts at about 55 ppm. The alkaloid identified as "*N*,*N*-dimethyllindcarpine" gave a ^{13}C nmr spectrum with two signals at about 55 ppm indicating that the alkaloid was not *N*,*N*-dimethyllindcarpine.

The position has now been substantially clarified by a recent paper by Stermitz *et al.* (8) in which magnoflorine (**1**) was prepared by selective *O*-demethylation of *N*-methylisocorydine isolated from a *Zanthoxylum* species, and *N*,*N*-dimethyllindcarpine was prepared by *N*-methylation of *N*-methyllindcarpine isolated from a *Glaucium* species. The two quaternary alkaloids (**1**) and (**2**) separated readily by tlc on silica gel, in longwave uv light *N*,*N*-dimethyllindcarpine did not show the characteristic intense blue fluorescence exhibited by magnoflorine, and the ^{1}H nmr were clearly different. It was established (8) that the alkaloid previously isolated from *Menispermum canadense* and reported to be *N*,*N*-dimethyllindcarpine (24) was in fact magnoflorine. The reason for our inability to separate these two supposedly different alkaloids by chromatographic methods is now apparent, and it is evident that the alkaloid from *M. cambrica* is in fact magnoflorine (**1**). Nevertheless an explanation was needed for the differences which had been reported for the ^{1}H nmr spectra of the two alkaloids (24). In our hands magnoflorine, dissolved in deuteromethanol in which one drop of DCl was added, gave a spectrum identical with that reported for *N*,*N*-methyllindcarpine (24). Dropwise addition of NaOD solution to a deuteromethanol solution of magnoflorine resulted in a spectrum identical with that reported for magnoflorine in the literature (figures 1 and 2). Similar behaviour was observed for hexadeuterated dimethyl sulphoxide solutions when two different ^{1}H nmr spectra were obtained for magnoflorine depending upon the pH of the solutions. Further indication that the reported *N*,*N*-dimethyllindcarpine (24) is magnoflorine in the "acidic" form is obtained from the very similar chemical shifts reported for the ^{1}H nmr spectra of the *O*-acetyl derivatives. Interestingly enough, although magnoflorine (**1**) is such a common alkaloid, its isomer *N*,*N*-dimethyllindcarpine (**2**) remains to be discovered as a natural product.

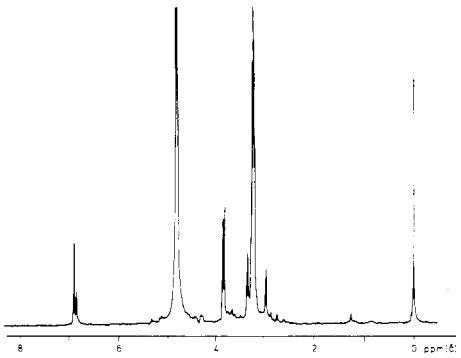

FIG. 1. 100 MHz ^{1}H nmr spectrum of magnoflorine in CD_3OD containing DCl.

δ values in ppm from TMS, 3.03 and 3.40 (2 x NMe), 3.89 and 3.91 (2x OMe), 6.90 and 6.96 (3 aromatic protons).

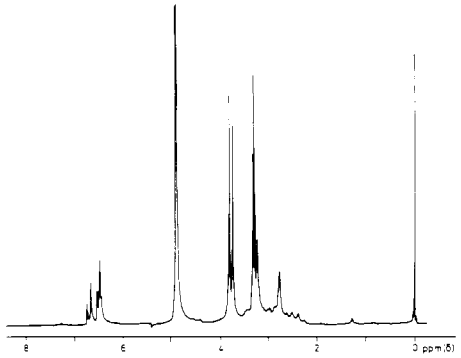

FIG. 2. 100 MHz ^{1}H nmr spectrum of magnoflorine in CD_3OD containing NaOD.

δ values in ppm from TMS, 2.77 and 3.23 (2 x NMe), 3.47 and 3.81 (2 x OMe), 6.39, 6.49, 6.62 and 6.70 (AB quartet, 2 aromatic protons), 6.44 (singlet, one aromatic proton).

EXPERIMENTAL[1]

PLANT MATERIAL.—*Meconopsis cambrica* Vig. was collected in the flowering and fruiting stage from the Experimental Garden of the School of Pharmacy, Myddelton House, Enfield. Voucher specimens have been retained.

THIN LAYER CHROMATOGRAPHY.—The following solvent systems were used: A. Toluene-acetone-methanol-conc. ammonia (40:40:6:1), B. Benzene-acetone-methanol (7:2:1), C. Ethylacetate-isopropanol-conc. ammonia (100:2:1), D. Chloroform-diethylether-ethanol (46:50:4), E. Heptane-chloroform-diethylether (4:5:1), F. Ethylacetate-isopropanol-conc. ammonia (43:35:20), G. Ethanol-water-25% aqueous ammonia (15:9:1), H. Methanol-diethylamine (8:2), and I. 0.1N hydrochloric acid. Silica gel G/GF_{254} was used for systems A, B, C, F, G, and H, alumina G with systems D and E, and cellulose with system I. The hR_f values and color reactions are given in table 1.

ISOLATION OF ALKALOIDS.—Fresh plant material was used (stems, 310 g; roots, 156 g; flowers, 16 g; green fruits, 66 g). Each plant part was blended with 2% ammonia in methanol and macerated overnight. The marc obtained after filtration was subjected to a second maceration with 2% ammonia in methanol overnight. The methanolic extracts of the individual plant parts were then tested as follows. The two extracts were combined and concentrated to low volume under reduced pressure, dissolved in methanol (5 ml), and extracted with 5% acetic acid (3 successive 50 ml portions). The combined acidic extracts were washed with light petroleum (2 x 20 ml), made alkaline with ammonia solution, and extracted with chloroform (4 x 50 ml). The combined chloroform extracts were washed with a little water, dried over anhydrous sodium sulfate, filtered, and concentrated to dryness. The total tertiary alkaloid extracts were: stem, 251 mg (0.08%); roots, 315 mg (0.2%); flowers, 63 mg (0.40%); fruits, 123 mg (0.19%). The aqueous ammonia extracts were made acidic with hydrochloric acid and aqueous picric acid added to precipitate any quaternary alkaloids; only the root extract gave a precipitate. The total picrate precipitate was dissolved in methanol and eluted from an Amberlite IRA 400 column (chloride form) with methanol. The methanol eluate, when concentrated to low volume, decolorized with charcoal and concentrated to dryness, yielded 301 mg (0.19%) of amorphous chloride, which showed the presence of only one compound on tlc

[1]The uv spectra were determined with a Perkin Elmer 402 uv spectrophotometer. 60 MHz nmr spectra were obtained from a Perkin Elmer R.12 A spectrometer; chemical shifts are reported in δ (ppm) values with TMS as an internal standard. ^{13}C nmr and ^{1}H 100 MHz spectra were determined with a Jeol PS 100 spectrometer. Low resolution ms were obtained at 70 eV with an AEI MS 902 mass spectrometer. Thin layer adsorbents were obtained from E. Merck, Darmstadt, and silica gel G/GF_{254} in a 2:1 mixture, alumina G or cellulose were used.

systems F–I. The alkaloid was characterized as magnoflorine. Tlc indicated that the tertiary alkaloid extracts from each plant part were qualitatively similar, hence, they were combined. Preparative tlc with combinations of solvent systems A, B and C and elution with chloroform produced the following alkaloids as amorphous solids: mecambrine (200 mg), flavinantine (63 mg), mecambridine (9.8 mg), *N*-methylcrotonosine (6.1 mg), sanguinarine (5.4 mg), amurine (4.1 mg), and pronuciferine (1.9 mg).

IDENTIFICATION OF ALKALOIDS.

(+)-*Magnoflorine chloride* (**1**) uv λ max (MeOH) 225–230, 273, 310 nm, λ min 253, 295 nm; uv λ max (MeOH+KOH) 282, 335 nm (27); ^{1}H nmr (60 MHz, DMSO-d6) δ 2.97 and 3.41 (2 x 3H, *s*; 2 x N$^+$-Me), 3.84 and 3.88 (2 x 3H, *s*; 2 x OMe), 6.96 (1H, *s*; C-3 H), 7.00 (2H, *s*; C-8 and C-9 Hs) (23, 27); ms (ei) peaks were observed at *m/e* (%) 342 (21, M$^+$), 341 (77, M$^+$–1), 328 (10), 327 (43, M$^+$–15), 326 (18), 312 (32, M$^+$–30), 310 (20), 297 (13), 296 (17), 295 (31, M$^+$–47), 294 (23), 284 (19, M$^+$–58), 283 (37, M$^+$–59), 165 (40), 152 (40), 139 (30), 122 (69), 105 (100), 58 (100), (28); cd (MeOH) $[\theta]_{205}$ −1.37 x 10^4, $[\theta]_{234}$ +15.77 x 10^4, $[\theta]_{267}$ −1.23 x 10^4, $[\theta]_{290}$ −2.05 x 10^3, $[\theta]_{316}$ +2.24 x 10^3 (9). The isolated alkaloid had identical R_f values in systems F–I (table 1), color reactions, and intense blue fluorescence with reference samples of magnoflorine from *Thalictrum rochebrunianum* and *Xanthoxylum* species and with "*N,N*-dimethyllindcarpine" from *Menispermum canadense*. *O,O*-Diacetylmagnoflorine chloride, ^{1}H nmr (60 MHz, DMSO-d6) δ 2.18 (6H, *s*; 2 x OAc), 2.98 and 3.48 (2 x 3H, *s*; 2 x N$^+$–Me), 3.82 and 3.85 (2 x 3H, *s*; 2 x OMe), 7.18 (1 H, *s*; C-3H), 7.20 and 7.42 (2H, AB *q*; C-8 and C-9Hs) (23).

(−)-*Mecambrine* (**3**) uv λ max (MeOH) 235, 291 nm (29); ^{1}H nmr (60 MHz, $CDCl_3$) δ 6.94 (2H, *m*, $J_{8,12}$ 2 Hz, $J_{8,9}$ 8 Hz; C-8 and C-12 Hs), 6.34 (2H, *m*, $J_{9,11}$ 1Hz, $J_{8,9}$ 8 Hz; C-9 and C-11 Hs), 6.57 (1H, *s*, C-3H), 5.83 (2H, *q*: ar-O-CH_2-O-*ar*), 2.24 (3H, *s*; NMe) (30); ms (ei) peaks were observed at *m/e* (%) 295 (100, M$^+$), 294 (34, M$^+$–1) 266 (36, M$^+$–29), 252 (29, M$^+$–43), 189(10), 165(13) (10); cd (MeOH) $[\theta]_{205}$ −1.20 x 10^4, $[\theta]_{227}$ +3.20 x 10^4, $[\theta]_{239}$ +2.81 x 10^4, $[\theta]_{266}$ −3.86 x 10^4, $[\theta]_{304}$ −3.96 x 10^3 (15). The isolated alkaloid had identical hR_f values and color reactions in systems, A, B, and C with authentic mecambrine (table 1).

(−)-*Pronuciferine* (**4**) uv λ max (MeOH) 231, 285 nm (30); ms (ei) *m/e* (%) 311 (100, M$^+$), 310 (51, M$^+$–1), 296 (28, M$^+$–15), 282 (46, M$^+$–29), 268 (46, M$^+$–43), 253 (19), 225 (24), 204 (10), 165 (18), 152 (15), 115 (16) (10); cd (MeOH) $[\theta]_{225}$ +9.74 x 10^3, $[\theta]_{237}$ +1.02 x 10^4, $[\theta]_{270}$ −1.41 x 10^4, $[\theta]_{295}$ −4.39 x 10^3 (15). The isolated alkaloid had identical hR_f values and color reactions in systems A, B, and C with authentic alkaloid (table 1).

(−)-*N-Methylcrotonosine* (**6**) uv λ max (MeOH) 225, 287 nm (30); ^{1}H nmr (60 MHz, $CDCl_3$) δ 6.95 (2H, *m*; C-8 and C-12 Hs), 6.40 (2H, *m*; C-9 and C-11 Hs), 6.74 (1H, *s*; C-3H), 3.54 (3H, *s*; C-1 OMe), 2.38 (3H, *s*; NME) (30); Ms (ei) *m/e* (%) 297 (100, M$^+$), 296 (46, M$^+$–1), 268 (56, M$^+$–29), 254 (34, M$^+$–43), 239 (19), 211 (17), 165 (19), 148.5 (4, M^{++}), 115 (21) (10); cd (MeOH) $[\theta]_{215}$ −4.09 x 10^3, $[\theta]_{227}$ +2.48 x 10^3, $[\theta]_{242}$ +2.74 x 10^3, $[\theta]_{273}$ +1.37 x 10^4, $[\theta]_{288}$ −1.02 x 10^4 (15). The isolated alkaloid had identical hR_f values and color reactions in systems A, B, C, and D with authentic alkaloid (table 1).

(−)-*Flavinantine* (**8**) uv λ max (MeOH) 242, 294 nm, λ max (MeOH+KOH) 256, 308 nm (16); ^{1}H nmr (60 MHz, $CDCl_3$) δ 6.93, 6.63, 6.37, 6.32 (4 x 1H, *s*; C-1 H, C-4 H, C-5 H, C-8 H), 3.87 and 3.79 (2 x 3H, *s*; 2 x OMe), 2.46 (3H, *s*; NMe) (16, spectrum recorded from DMSO-d6 solution); ms (ei) *m/e* (%) 327 (100, M$^+$), 326 (32, M$^+$–1), 312 (42, M$^+$–15), 299 (32, M$^+$–28), 298 (26), 284 (85, M$^+$–43), 268 (37, M$^+$–59), 256 (19), 242 (37), 139 (16), 58 (15) (16); cd (MeOH), $[\theta]_{211}$ +6.28 x 10^4, $[\theta]_{231}$ −4.17 x 10^4, $[\theta]_{248}$ −8.71 x 10^3 (sh), $[\theta]_{264}$ +3.50 x 10^3, $[\theta]_{281}$ −3.50 x 10^3, $[\theta]_{301}$ +6.60 x 10^3 (15). *O*-acetylflavinantine, ^{1}H nmr (60 MHz, $CDCl_3$) δ 7.02, 6.76, 6.33, 6.30 (4 x 1H, *s*), 3.81 and 3.80 (2 x 3H, *s*; 2 x OMe), 2.47 (3H, *s*; NMe), 2.31 (3H, *s*; acetyl); ^{1}H nmr (60 MHz, DMSO-d6) δ 7.40, 6.95, 6.81, 6.26 (4 x 1H, *s*), 3.78 and 3.71 (2 x 3H, *s*; 2 x OMe), 2.36 (3H, *s*; -NMe), 2.26 (3H, *s*; acetyl) (16).

The isolated alkaloid had identical hR_f values and color reactions in systems A, B, C, and D (table 1) with authentic flavinantine. The *O*-acetyl derivative differed in tlc behaviour with reference *O*-acetylsalutaridine.

(−)-*Amurine* (**9**) uv λ max (MeOH) 243, 300 nm (16); ms (ei) *m/e* (%) 325 (100, M$^+$), 324 (15), 310 (16), 297 (22, M$^+$–28), 282 (37, M$^+$–43), 266 (20, M$^+$–59), 240 (22) (16); cd (MeOH) $[\theta]_{212}$ +2.90 x 10^4, $[\theta]_{232}$ −2.34 x 10^4, $[\theta]_{248}$ −8.25 x 10^3 (sh), $[\theta]_{306}$ +5.28 x 10^3 (15). The isolated alkaloid had identical hR_f values and color reactions in systems A, B, C, D, and E (table 1) with authentic amurine.

(−)-*Mecambridine* (**10**) uv λ max (MeOH) 228, 283 nm; λ min 254 nm (5); ^{1}H nmr (60 MHz, $CDCl_3$) δ 6.59 and 6.34 (2 x 1H, *s*; C-4 and C-9 Hs), 5.88 (2H, *s*; *ar* –O–CH_2–O–*ar*), 4.70 (2H, *s*; ar CH_2O–), 3.99 (3H, *s*; OMe), 3.85 (6H, *s*; 2 x OMe) (5); ms (ei) *m/e* (%) 399 (100, M$^+$), 398 (27), 384 (15, M$^+$–15), 368 (4), 206 (59, M$^+$–193), 204 (64), 195 (56), 194 (82), 179 (53), 165 (13) (5); cd (MeOH) $[\theta]_{210}$ −14.03 x 10^4, $[\theta]_{224}$ −3.60 x 10^4, $[\theta]_{252}$ −1.19 x 10^3, $[\theta]_{268}$ −2.64 x 10^3, $[\theta]_{272}$ −2.51 x 10^3, $[\theta]_{291}$ −1.06 x 10^3 (20). The isolated alkaloid had identical hR_f values and color reactions in systems A, B, and C with authentic alkaloid (table 1).

Sanguinarine (**11**) uv λ max (MeOH) 250, 286, 324 nm; ms (ei) *m/e* (%) 332 (97, M$^+$). The isolated alkaloid had identical hR_f values and color reactions in systems A, B, and C with reference alkaloid (table 1).

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