Phytochemistry, Vol. 22, No. 8, pp. 1809–1813, 1983.
Printed in Great Britain.

0031–9422/83$3.00 + 0.00

ALKALOIDS OF *UNCARIA ELLIPTICA**

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(*Received* 25 *October* 1982)

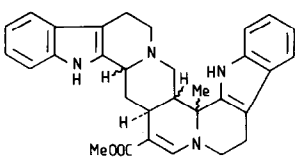
Key Word Index—*Uncaria elliptica*; Rubiaceae; diastereoisomeric pentacyclic heteroyohimbine alkaloids; 14-β-hydroxy-3-iso-rauniticine; rauniticine oxindole A; rauniticine pseudoindoxyl; 3-isorauniticine pseudoindoxyl; akuammigine pseudoindoxyl.

Abstract—Six samples of *Uncaria elliptica* leaves from Thailand were investigated for their alkaloid content. Seven diastereoisomers of the pentacyclic heteroyohimbine series of alkaloids, 14-β-hydroxy-3-isorauniticine and tetrahydroalstonine *N*-oxide were isolated. Rauniticine oxindole A, rauniticine pseudoindoxyl, 3-isorauniticine pseudoindoxyl and akuammigine pseudoindoxyl were isolated for the first time as natural products. The roxburghine alkaloids, previously isolated from *U. elliptica*, were not detected and the species is more varied chemically than was hitherto supposed. The ^{1}H NMR spectra of the eight diastereoisomeric pentacyclic heteroyohimbine alkaloids have been compared.

INTRODUCTION

U. elliptica R. Br. ex G. Don (syn. *U. dasyoneura* Korth.; *U. gambir* Thw.; *U. thwaitesii* Alston; *U. rostrata* Pierre ex Pitard) is a widely distributed species found in Sri Lanka, India, Burma, Thailand, Cambodia, Malaysia, Sumatra and Java. The square stems bear entire ovate to rounded stipules and the uniform elliptic to ovate leaves bear 5–7 lateral veins. The midribs are typically pubescent with long straight hairs, sometimes only finely pubescent with glabrous laminae [1]. *U. elliptica* belongs to group III of the seven informal groups proposed by Phillipson *et al.* [2] and is closely associated with *U. longiflora* (Poir.) Merr., *U. gambir* (Hunt.) Roxb. and *U. callophylla* Bl. ex Korth. The uses of *U. elliptica* are said to be similar to those of *U. gambir*, namely as a source of tannin, and as a folk medicine in south-east Asia ([2] and references cited therein).

A previous investigation of the alkaloids from small samples of leaves obtained from herbarium material revealed that *U. elliptica* was the only one of the 34 species to produce the roxburghine alkaloids (**1**) [2]. These alkaloids are unique to the genus in that each molecule is derived from two molecules of tryptamine and one molecule of secologanin. The leaf samples investigated previously were obtained from different parts of south-east Asia including Thailand, east Sumatra, Malaysia and South Vietnam. Alkaloidal extracts from all of these samples contained unidentified alkaloids and, hence, larger quantities were obtained from Thailand for further investigation of the alkaloid constituents. A preliminary communication in the form of an abstract has reported the presence of pentacyclic heteroyohimbine alkaloids in some of these samples [3].



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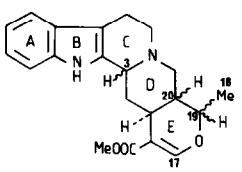

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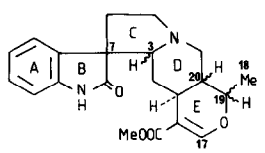

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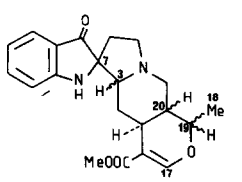

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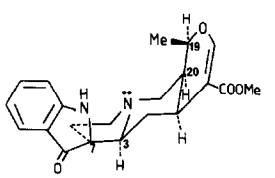

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RESULTS AND DISCUSSION

The leaves of six different collections of *U. elliptica* from Thailand were investigated for their alkaloid content and in particular for the presence of roxburghine-type alkaloids (**1**). The major alkaloids of all samples proved to be pentacyclic heteroyohimbines (**2**) and the roxburghines were not detected. These results contrast with the previous investigation into *U. elliptica* [2]. Furthermore, all of the

*Part 8 in the series "Alkaloids from *Uncaria* Species". For Part 7 see Tantivatana, P., Ponglux, D., Wongseripipatana, S. and Phillipson, J. D. (1980) *Planta Med.* **40**, 299.

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Table 1. Yield of heteroyohimbine alkaloids (2) expressed as percentage of total alkaloid obtained from six Thai samples of *U. elliptica* leaves

Diastereoisomeric type*	*allo*		*epiallo*		*normal*		*pseudo*	
C-18 methyl configuration	α	β	α	β	α	β	α	β
Alkaloid†	tha	rau	ak	isorau	aj	epi-aj	iso-aj	epi-isoaj
Sample A	2	11	—	13	—	0.5	10	12
Sample B‡	4	34	—	4	—	—	—	—
Sample C	5	63	—	23	—	—	—	—
Sample D	—	3	—	8	—	13	—	19
Sample E§	—	16	—	24	—	—	—	—
Sample F‖	—	—	—	—	11	6	24	5

*Defined as *allo*, H-3α, H-20α; *epiallo*, H-3β, H-20α; *normal*, H-3α, H-20β; *pseudo*, H-3β, H-20β.

†Abbreviations of alkaloid names: tha, tetrahydroalstonine; rau, rauniticine; ak, akuammigine; isorau, 3-isorauniticine; aj, ajmalicine; epi-aj, 19-epiajmalicine; iso-aj, 3-isoajmalicine; epi-isoaj, 19-epi-3-isoajmalicine.

‡Additional alkaloids isolated: 1.7% 14-β-hydroxy-3-iso-rauniticine, 1% rauniticine pseudoindoxyl, 0.3% akuammigine pseudoindoxyl.

§Additional alkaloids isolated: 3% isorauniticine pseudoindoxyl, 2.4% rauniticine oxindole A, 0.4% tetrahydroalstonine *N*-oxide.

‖Additional alkaloids isolated: 15% mitraphylline, 10% isomitraphylline, 5% uncarine A, 5% uncarine B.

samples varied in the composition of alkaloids present (Table 1).

Seven of the eight possible diastereoisomers of the pentacyclic heteroyohimbine series of alkaloids were isolated from the six different collections, akuammigine (2, H-3α, H-20α, Me-18α) being the only diastereoisomer which was not detected. Identification of pentacyclic heteroyohimbines (2) may pose problems even though they can be separated by TLC and GC [4] or by HPLC [5]. Mass spectrometry has also proved to be of diagnostic value, particularly for distinguishing between those isomers which possess either the *cis* or the *trans* D/E ring junctions [4]. The finding of seven of the eight possible diastereoisomers of 2 in the same species during the present investigation enabled direct comparison to be made between the 250 MHz ^{1}H NMR spectra of all diastereoisomers. The findings are in close agreement with those reported previously [6, 7] and illustrate that ^{1}H NMR allows for rapid distinction to be made between the eight diastereoisomers of 2 (Table 2). The signal for the C-18 methyl substituent is particularly useful for identification purposes since the *allo/epiallo** isomers with *cis* D/E ring junctions yield spectra with chemical shifts in the region of δ1.34–1.45 in contrast to the spectra of the *normal/pseudo** isomers with *trans* D/E ring junctions, the corresponding values being in the range of δ0.92–1.36. Tetrahydroalstonine, rauniticine, ajmalicine, 3-isoajmalicine and 19-epi-3-isoajmalicine can clearly be distinguished by this signal, whereas akuammigine, 3-isorauniticine and 19-epiajmalicine have signals with very similar chemical shifts for the C-18 methyl group (δ1.34–1.37). These three alkaloids can be distinguished by the chemical shifts of the multiplet signals for the C-3 protons, that for akuammigine occurring at δ3.78. that for 3-isorauniticine at δ3.13 and that for 19-epiajmalicine at δ3.40 (Table 2). In general, the multiplet signal for the C-3 proton appears at δ3.33–3.49 in the spectra of the four diastereoisomers with H-3α configuration (*allo* and *normal*) but is usually at lower field, δ3.78–4.56 for the corresponding H-3β configuration isomers (*epiallo* and *pseudo*). The exceptionally high field value of δ3.13 for this signal in the spectrum of 3-isorauniticine (2, H-3β, H-20α, Me-18β) is indicative of conformational changes in the C/D rings). The quartet signal for the C-19 proton occurs in the region of δ3.57–4.50 and the particular chemical shift together with the coupling constant for H-19/H-20 are again valuable from the diagnostic viewpoint (Table 2). 3-Isorauniticine can also be differentiated from the other seven diastereoisomers because of the low field value of the singlet due to the C-17 olefinic proton (δ7.64) which occurs at δ7.51–7.56 in the spectra of the other seven diastereoisomers. The chemical shifts of the signals for the N-1 proton is characteristic for each pair of *allo*, *normal* and *pseudo* diastereoisomers, irrespective of the configuration of the C-18 methyl group, whereas for the *epiallo* isomers, two distinctly different values were obtained (akuammigine, δ8.29; 3-isorauniticine, δ7.95) (Table 2).

Four of the six samples of Thai *U. elliptica* leaves (samples A–C and E) contained *cis* D/E ring alkaloids rauniticine (2, *allo*, H-3α, H-20α, Me-18β) and/or 3-isorauniticine (2, *epiallo*, H-3β, H-20α, Me-18β) as the major alkaloids and in five of the six samples, pentacyclic heteroyohimbines containing the Me-18 group with β-configuration, predominated (Table 1). Alkaloids of this type having the C-18 methyl group with β-configuration are less common in nature than their corresponding analogues with C-18 methyl groups with α-configuration

*The terms *allo*, *epiallo*, *normal* and *pseudo* are defined in Table 1.

Table 2. 250 MHz ^{1}H NMR spectral data of the eight diastereoisomeric pentacyclic heteroyohimbine alkaloids (**2**)*

Diastereoisomeric type†	*allo*		*epiallo*		*normal*		*pseudo*	
C-18 methyl configuration	α	β	α	β	α	β	α	β
Alkaloid‡	tha	rau	ak	isorau	aj	epi-aj	iso-aj	epi-isoaj
Me-18 (*d*)	1.40	1.45	1.34	1.37	1.19	1.36	0.92	1.28
($J_{18,19}$ Hz)	(6.4)	(7.0)	(6.4)	(6.6)	(6.4)	(6.4)	(6.6)	(6.4)
H-3 (*m*)	3.33	3.49	3.78	3.13	3.42	3.40	4.56	4.52
H-19 (*q*)	4.50	4.42	4.43	4.14	4.43	3.88	4.34	3.57
($J_{19,20}$ Hz)	(10)	(6)	(6)	(1)	(4)	(10)	(4)	(11)
H-17 H (*s*)	7.56	7.51	7.56	7.64	7.53	7.56	7.51	7.52
NH (*s*)	7.86	7.87	8.29	7.95	7.94	7.92	8.16	8.16
COOMe (*s*)	3.74	3.74	3.74	3.65	3.74	3.73	3.73	3.73

*Data obtained from seven heteroyohimbine alkaloids isolated from Thai *U. elliptica* leaves; akuammigine was obtained by Dr. P. J. Houghton.

†Defined in Table 1.

‡Abbreviated names: key given in Table 1.

and are generally rare in the genus *Uncaria* [2]. Rauniticine has only been reported once previously from the genus (*U. attenuata*) [8] while 3-isorauniticine has not previously been isolated from *Uncaria* species. Tetrahydroalstonine, ajmalicine, 19-epiajmalicine and 3-iso-19-epiajmalicine have not previously been reported as constituents of *U. elliptica*.

Three of the six samples of Thai *U. elliptica* leaves (samples A, D and F) contained *trans* D/E ring alkaloids ajmalicine (**2**, *normal*, H-3α, H-20β, Me-18α), 3-isoajmalicine (**2** *pseudo*, H-3β, H-20β, Me-18α), 19-epiajmalicine (**2**, *normal*, H-3α, H-20β, Me-18β) and 19-epi-3-isoajmalicine (**2**, *pseudo* H-3β, H-20β, Me-18β) as major alkaloids (Table 1). However, all three samples were different with 3-iso-ajmalicine and 19-epi-3-ajmalicine predominating in sample A, 19-epiajmalicine and 19-epi-3-isoajmalicine predominating in sample D and ajmalicine and 3-isoajmalicine predominating in sample F. Sample F was distinctly different from the other five samples in that no alkaloids with *cis* D/E ring configurations were detected and also because the oxindole alkaloids isomitraphylline (**3**, *normal*, H-3α, H-20β, Me-18α, C-7 A configuration*) and mitraphylline (**3**, *normal*, H-3α, H-20β, Me-18α, C-7 B configuration*) were major alkaloids (Table 2). The corresponding analogues with C-18 methyl β configuration, uncarines A and B, were also present in sample F. Hence, sample F contained all four possible pentacyclic heteroyohimbine diastereoisomers (**2**) with *trans* D/E ring junctions (*normal* and *pseudo* configurations) and their corresponding four *normal* oxindole analogues (**3**).

*Oxindole alkaloids exist in A and B configurations depending upon the stereochemistry of the C-7 spiro carbon. They are defined on the basis of the lactam carbonyl being below (A) or above (B) the plane of the C/D rings.

Two other pentacyclic heteroyohimbines were identified as minor alkaloids. Sample E contained tetrahydroalstonine *N*-oxide. This alkaloid did not correspond to any of the known eight diastereoisomers of **2** on TLC plates and its mass spectrum clearly indicated the loss of 16 a.m.u. which is characteristic of *N*-oxides [9]. The mass spectrum was indicative of a pentacyclic heteroyohimbine with *allo/epiallo* configuration (m/z 184 < 169, 170; 209 < 223, 251) [4] while the ^{1}H NMR spectrum and TLC R_f values confirmed the identity as tetrahydroalstonine *N*-oxide [10]. The other minor pentacyclic heteroyohimbine alkaloid was identified as the rare 14-β-hydroxy-3-isorauniticine previously isolated from *U. attenuata* [8]. The identity was confirmed by comparison of spectral data (UV, mass spectra, ^{1}H NMR, CD) and co-chromatography on TLC with the alkaloid obtained from *U. attenuata* [8].

Although oxindole alkaloids are common in the genus [2], only two of the six samples of Thai *U. elliptica* leaves (samples E and F) contained oxindole alkaloids (Table 1). The only oxindole alkaloid to be isolated from sample E was identified as rauniticine oxindole A. The colour reaction with ferric chloride–perchloric acid spray reagent on TLC plates was characteristic of a pentacyclic oxindole alkaloid [4] and confirmation was obtained from the characteristic UV and mass spectra. The ^{1}H NMR spectrum contained a signal for a three-proton doublet at δ1.44, attributable to the C-18 methyl group and a signal for a one-proton multiplet at δ4.43 for the C-19 proton was indicative of the pentacyclic E ring structure (**3**). The low field position of the C-18 methyl signal is indicative of a *cis* D/E ring junction and the coupling constant of 6 Hz between H-19 and H-20 observed in the signal for the C-19 proton is indicative of a *cis* relationship between these two protons. The ^{1}H NMR spectrum was similar to that of rauniticine (Table 2) and it is proposed that this alkaloid possesses structure **3** and has a *cis* D/E ring junction and C-18 methyl group with a β-configuration.

The presence of a doublet at δ7.59 was attributed to the C-9 aromatic proton which is deshielded by the N-4 lone pair electrons and, hence, it was concluded that the alkaloid possesses the C-7 A configuration. Rauniticine oxindole A (**3**, *allo*, H-3α, H-20α, Me-18β, C-7 A configuration) has not previously been isolated as a natural product.

Four minor alkaloids were isolated from samples B–D of the Thai *U. elliptica* leaves. Rauniticine pseudoindoxyl (**4**, H-3α, H-20α, Me-18β) was isolated from sample B which contains rauniticine as the major alkaloid. The mass spectrum had an $M^{+\cdot}$ at *m/z* 368 and a base peak at *m/z* 222 which was indicative of a pentacyclic pseudoindoxyl alkaloid (**4**). The ^{1}H NMR spectrum confirmed the pentacyclic nature of the alkaloid and in particular the signals for the C-18 methyl group at δ1.44 and the H-19 at δ4.41 ($J_{19,20}$ = 6 Hz) showed close agreement with the ^{1}H NMR spectrum of rauniticine (Table 2). Rauniticine pseudoindoxyl was synthesized from rauniticine and the synthetic product proved to be identical in spectral (UV, mass spectrum) and TLC properties with the natural product. Only one pseudoindoxyl was obtained from rauniticine and this is in agreement with previous findings for the preparation of pseudoindoxyls from yohimbine, ajmalicine, tetrahydroalstonine, isoreserpiline and dihydrocorynantheine [11, 12]. The C-7 isomer with A configuration would be expected to predominate in basic conditions and, by analogy with the previous findings in the pseudoindoxyl series, it is proposed that rauniticine pseudoindoxyl possesses structure **5**. Rauniticine pseudoindoxyl has not previously been reported as a natural product.

Sample B yielded another minor alkaloid with UV and mass spectral properties indicative of a pentacyclic pseudoindoxyl alkaloid. The chemical shift for the C-18 methyl group was observed in the ^{1}H NMR spectrum at δ1.34 indicating that the alkaloid was the pseudoindoxyl of either akuammigine or 3-isorauniticine or 19-epi-ajmalicine (Table 2). The chemical shift for the C-19 proton signal at δ4.46 ruled out 19-epiajmalicine and was closer to the value for akuammigine (δ4.43) rather than for 3-isorauniticine (δ4.14). The coupling constant (J = 4 Hz) for the C-19/C-20 protons was also similar to that of akuammigine and, hence, the ^{1}H NMR data would indicate that the minor alkaloid is akuammigine pseudoindoxyl (**4**, *epiallo*, H-3β, H-20α, Me-18α) which has not been isolated previously as a natural product.

Sample E also contained a minor alkaloid which was similarly characterized by its UV and mass spectra as a pseudoindoxyl derivative of a pentacyclic heteroyohimbine. The chemical shifts of the signals for the C-18 methyl group (δ1.35), the C-19 proton (δ4.13) and the C-3 proton (δ3.11) are in close agreement with the chemical shifts recorded for 3-isorauniticine (Table 2). Hence, this alkaloid is identified as 3-isorauniticine pseudoindoxyl (**4**, *epiallo*, H-3β, H-20α, Me-18β) which has not been reported previously as a natural product. A further pseudoindoxyl alkaloid was isolated from sample C and although the UV and mass spectra indicated that it was a pentacyclic pseudoindoxyl, no satisfactory ^{1}H NMR spectrum could be obtained. TLC clearly showed that it was different from the other three pseudoindoxyl alkaloids isolated.

It has been suggested that pseudoindoxyl alkaloids may be artifacts formed by oxidation of heteroyohimbine alkaloids during extraction and isolation [13]. The present investigation would indicate that they are natural products since they were isolated from only three of the six samples of *U. elliptica* which were extracted under identical conditions and they were not detected in the other three samples. Pseudoindoxyls and oxindoles may be derived *in vitro* from heteroyohimbines via indolenine intermediates using either basic or acidic conditions, respectively. The presence of these three types of alkaloids in the same species leads to the suggestion that such intermediates may be present in the plant. It is conceivable that the transition of heteroyohimbines to either pseudoindoxyls or oxindoles may be related to differences in cell pH values.

The finding of pseudoindoxyl alkaloids, pentacyclic heteroyohimbines with Me-19β configuration and the rare 14-β-hydroxy-3-isorauniticine in *U. elliptica* demonstrates that the species is more varied chemically than was previously realized and that there is close similarity in the alkaloid content between some strains of *U. elliptica* and some strains of *U. attenuata*. In Ridsdale's revision of the genus, the species were arranged into seven informal groups with *U. attenuata* being assigned to group I and *U. elliptica* to group III [2]. Both of these species are very variable in their alkaloid composition in contrast to some of the other species of *Uncaria* (e.g. *U. lanosa*) which appear to be remarkably uniform in alkaloid composition.

EXPERIMENTAL

Plant material. Six samples of *U. elliptica* dried leaves were obtained from Thailand and were identified by Dr. C. E. Ridsdale of the Rijksherbarium, Leiden. Reference samples are retained at the College of Pharmacy, Chulalongkorn University, Bangkok. Five of the leaf samples, coded A–E, were collected from different areas of Patew, Chumporn Province, during June 1975 and sample F was obtained from Kao Chong, Trang Province, during January 1980.

Analytical techniques. The 250 MHz ^{1}H NMR spectra were recorded in solns prepared in $CDCl_3$ using TMS as ref. HRMS were determined at 70 eV with inlet temps. between 210 and 240°. The prep. TLC systems and GC conditions were as described previously [3]. Analytical TLC was carried out on Si gel G/GF-254 (2:1) (Merck) plates using the following solvent systems: (A) $CHCl_3$–Me_2CO (5:4); (B) $CHCl_3$–EtOH (19:1); (C) $CHCl_3$–MeOH (49:1); (D) EtOAc–Et_2O (1:1). Alkaloids were visualized with Dragendorff's reagent and oversprayed with 3.2% $FeCl_3$ in 35% aq. $HClO_4$ followed by heating at 100° [3].

Extraction and separation of alkaloids. The extraction method was identical with that previously described [14]. The alkaloids were separated by prep. TLC [3] and the following results were obtained.

Sample A. 22.4 g yielded 566 mg (2.48%) of total alkaloid. Prep. TLC of 200 mg resulted in the isolation of isorauniticine (26 mg), rauniticine (22 mg), 19-epi-3-isoajmalicine (24 mg), 3-isoajmalicine (19 mg), tetrahydroalstonine (3 mg), 19-epiajmalicine (1 mg).

Sample B. 31.5 g yielded 437 mg (1.39%) total alkaloid. Prep. TLC of 300 mg resulted in the isolation of rauniticine (103 mg), isorauniticine (13 mg), tetrahydroalstonine (12 mg), 14-β-hydroxy-3-isorauniticine (5 mg), rauniticine pseudoindoxyl (3 mg) and akuammigine pseudoindoxyl (1 mg).

Sample C. 10.0 g yielded 69 mg (0.69%) total alkaloid. Prep. TLC of 60 mg resulted in the isolation of rauniticine (38 mg), 3-isorauniticine (14 mg), tetrahydro-alstonine (3 mg) and an unidentified pseudoindoxyl alkaloid (4 mg).

Sample D. 15.0 g yielded 692 mg (4.60%) total alkaloid. Prep. TLC of 100 mg resulted in the isolation of 19-epi-3-isoajmalicine

(19 mg), 19-epiajmalicine (13 mg), isorauniticine (8 mg) and rauniticine (3 mg).

Sample E. 5.0 g yielded 163 mg (3.25%) total alkaloid. Prep. TLC resulted in the isolation of isorauniticine (24 mg), rauniticine (16 mg), rauniticine oxindole A (2.4 mg), tetrahydroalstonine *N*-oxide (0.4 mg), 3-isorauniticine pseudoindoxyl (3 mg).

Sample F. 25.0 g yielded 398 mg (1.59%) total alkaloid. Prep. TLC of 300 mg resulted in the isolation of 3-isoajmalicine (73 mg), ajmalicine (33 mg), 19-epi-3-isoajmalicine (18 mg), 19-epiajmalicine (15 mg), mitraphylline (44 mg), isomitraphylline (29 mg), uncarine B (16 mg) and uncarine A (16 mg).

These results are summarized briefly in Table 1.

Identification of alkaloids. Heteroyohimbines (**2**). Tetrahydroalstonine (*allo*, H-3α, H-20α, Me-18α), rauniticine (*allo*, H-3α, H-20α, Me-18β), 3-isorauniticine (*epiallo*, H-3β, H-20α, Me-18β), ajmalicine (*normal*, H-3α, H-20β, Me-18α), 19-epiajmalicine (*normal*, H-3α, H-20β, Me-18β), 3-isoajmalicine (*pseudo*, H-3β, H-20β, Me-18α), 19-epi-3-isoajmalicine (*pseudo*, H-3β, H-20β, Me-18β) were identified by comparison of their UV, MS, ^{1}H NMR, TLC, GC and HPLC properties with reference alkaloids [4–6]. The 250 MHz ^{1}H NMR spectral characteristics are recorded in Table 2.

Tetrahydroalstonine N-oxide. UV λ_{max}^{MeOH} nm: 226, 285, 295; MS, *m/z* (%) 368 $[M]^{+\cdot}$ (19), 352 [M − 16] (100), 351 (94), 337 (40), 251 (15), 239 (4), 225 (12), 223 (44), 209 (15), 184 (15), 170 (19), 169 (31), 156 (41); 250 MHz ^{1}H NMR: δ1.44 (3H, *d*, *J* = 6 Hz, Me-18), 3.74 (3H, *s*, OMe), 3.30 (1H, *m*, H-3), 4.40 (1H, *m*, H-19); TLC R_f values identical with tetrahydroalstonine *N*-oxide [10].

14-β-Hydroxy-3-isorauniticine UV, ^{1}H NMR, CD mass spectra and TLC R_f values were identical to values reported for this alkaloid isolated previously from *U. attenuata* [8].

Oxindoles (**3**). Isomitraphylline (*normal*, H-3α, H-20β, Me-18α, C-7 A configuration), mitraphylline (*normal*, H-3α, H-20β, Me-18α, C-7 B configuration), uncarine A (*normal*, H-3α, H-20β, Me-18β, C-7 A configuration) and uncarine B (*normal*, H-3α, H-20β, Me-18β, C-7 B configuration) were identified on the basis of their identical TLC R_f values, UV, ^{1}H NMR and mass spectra with reference samples.

Rauniticine oxindole A (*allo*, H-3α, H-20α, Me-18β C-7 A configuration) UV λ_{max}^{MeOH} nm: 212, 242, 290; 250 MHz ^{1}H NMR: δ1.44 (3H, *d*, *J* = 6.9 Hz, Me-18), 3.71 (3H, *s*, OMe), 3.26 (1H, *m*, H-3), 4.43 (1H, *m*, $J_{19,20}$ = 6 Hz, H-19), 7.54 (1H, *s*, H-17), 7.59 (1H, *d*, H-9); MS *m/z* (%): 368 $[M]^{+\cdot}$ (100), 351 (39), 337 (10), 223 (55), 208 (19), 180 (11), 146 (27), 145 (16), 144 (23), 130 (31), 69 (50); accurate mass measured 368.1734; $C_{21}H_{24}N_2O_4$ calc. for 368.1736; measured 223.1209; $C_{12}H_{17}NO_3$ calc. for 223.1208; TLC R_f values, system A 0.50; B, 0.65; D, 0.47; pink colour on heating after spraying with $FeCl_3$–$HClO_4$ reagent [4].

Pseudoindoxyls (**4**). Rauniticine pseudoindoxyl (*allo*, H-3α, H-20α, Me-18β). UV λ_{max}^{MeOH} nm: 209, 245; 250 MHz ^{1}H NMR: δ1.44 (3H, *d*, *J* = 6.9 Hz, Me-18), 3.32 (1H *d*, *J* = 9.2 Hz, H-3), 3.72 (3H, *s*, OMe), 4.41 (1H, *m*, $J_{19,20}$ = 6 Hz, H-19), 7.59 (1H, *s*, H-17); MS *m/z* (%): 368 $[M]^{+\cdot}$ (66), 351 (57), 337 (11), 223 (49), 222 (100), 208 (18), 180 (6), 146 (20), 145 (13), 144 (14), 130 (29); accurate mass measured 368.1734; $C_{21}H_{24}N_2O_4$ calc. for 368.1736; measured 222.1132; $C_{12}H_{16}NO_3$ calc. for 222.1130; TLC R_f values, system A, 0.16; B, 0.45.

Preparation of rauniticine pseudoindoxyl. Rauniticine (2 mg) was dissolved in DMSO (2 ml) and NaOMe in MeOH (1 ml of 1 g in 15 ml dry MeOH) added. O_2 was bubbled through the soln which was maintained at 50° for 45 min. The cooled reaction mixture was diluted with H_2O and extracted with EtOAc which was washed and dried (Na_2SO_4) prior to concn to dryness. The major component was isolated by prep. TLC (system A) to yield 0.4 mg of an amorphous solid which was identical in its UV and mass spectra and in TLC R_f values with the alkaloid isolated from *U. elliptica*.

3-Isorauniticine pseudoindoxyl (*epiallo*, H-3β, H-20α, Me-18β). UV λ_{max}^{MeOH} nm: 220, 242, 292; 250 MHz ^{1}H NMR: δ1.35 (3H, *d*, *J* = 7 Hz, Me-18), 3.69 (3H, *s*, OMe), 3.11 (1H, *m*, H-3), 4.13 (1H, *m*, $J_{19,20}$ = 1 Hz, H-19), 7.57 (1H, *s*, H-17); MS *m/z* (%): 368 $[M]^{+\cdot}$ (18), 351 (100), 337 (9), 223 (18), 222 (42), 209 (6), 208 (7), 197 (8), 184 (3), 169 (6), 156 (7), 146 (5), 145 (4), 144 (5), 130 (10); accurate mass measured 368.1736; $C_{21}H_{24}N_2O_4$ calc. for 368.1736; measured 222.1135; $C_{12}H_{16}NO_3$ calc. for 222.1130; TLC R_f values, system A, 0.38; B, 0.17.

Akuammigine pseudoindoxyl (*epiallo*, H-3β, H-20α, Me-18α). UV λ_{max}^{MeOH} nm: 219, 245; 250 MHz ^{1}H NMR: δ1.34 (3H, *d*, *J* = 6.5 Hz, Me-18), 3.70 (1H, *m*, partly hidden, H-3), 3.70 (3H, *s*, OMe), 4.46 (1H, *m*, $J_{19,20}$ = 4 Hz, H-19), 7.55 (1H, *s*, H-17); MS *m/z* (%) 368 $[M]^{+\cdot}$ (53), 351 (40), 337 (10), 223 (40), 222 (100), 208 (17), 180 (10), 146 (13), 145 (12), 144 (13), 130 (20); accurate mass measured 368.1730; $C_{21}H_{24}N_2O_4$ calc. for 368.1736; measured 222.1131; $C_{12}H_{16}NO_3$ calc. for 222.1130; TLC R_f values, system A, 0.61; B, 0.42.

Unidentified pseudoindoxyl. UV λ_{max}^{MeOH} nm: 225, 295; MS *m/z* (%) 368 $[M]^{+\cdot}$ (37), 351 (86), 337 (29), 223 (57), 222 (100), 208 (26), 146 (23), 145 (31), 144 (37), 130 (74); TLC R_f values, system A, 0.35; B, 0.14.

Acknowledgements—We thank Mr. D. Carter for determination of mass spectra and the staff of the NMR Spectroscopy Units, King's College and Queen Mary College, for determination of 250 MHz ^{1}H NMR spectra. Akuammigine was kindly supplied by Dr. P. J. Houghton of Chelsea College. We are grateful to Dr. C. E. Ridsdale, Rijksherbarium, Leiden, for identification of plant material.

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