TRANSFORMATION OF N_a-BOC-TETRAHYDROALSTONINE TO N_a-BOC-5β-CYANOTETRAHYDROALSTONINE, N_a-BOC-21α-CYANOTETRAHYDROALSTONINE, AND N_a-BOC-3,14-DIDEHYDROTETRAHYDROALSTONINE

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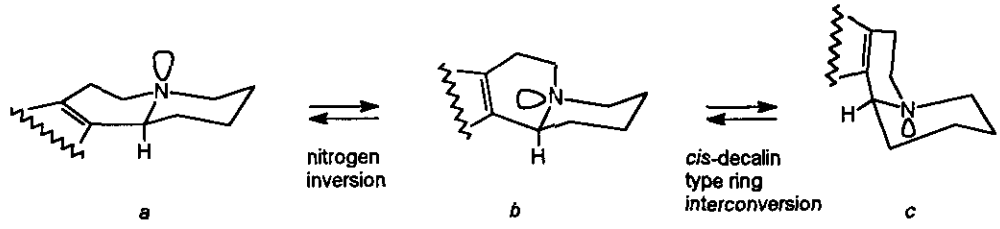
Abstract - Tetrahydroalstonine (**1**) was transformed to its N_a-Boc-derivative (**4**), which was then oxidized to the corresponding *cis*-N_b-oxide (**5a**). The modified Polonovski reaction of the *cis*-N_b-oxide (**5a**), followed by KCN treatment, led to N_a-Boc-5β-cyanotetrahydroalstonine (**7**), N_a-Boc-21α-cyanotetrahydroalstonine (**8a**), and N_a-Boc-3,14-didehydrotetrahydroalstonine (**9**), of which the first (**7**) is a good model for the naturally occurring 5β-carboxytetrahydroalstonine (**2b**) and the second (**8a**) the chemical equivalent of N_a-Boc-20,21-didehydro-tetrahydroalstonine (N_a-Boc-cathenamine) (**8b**).

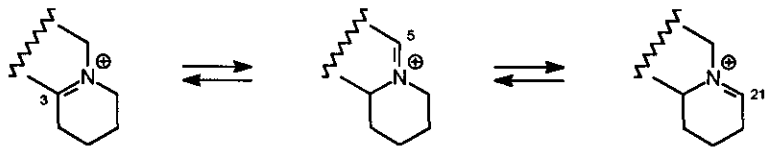
An indolo[2,3-*a*]quinolizidine system can exist in three conformations *a*, *b*, and *c*, with equilibration by nitrogen inversion and *cis*-decalin type ring interconversion (Scheme 1).[1-5] For pentacyclic indoloquinolizidines (*e.g.* heteroyohimbine alkaloids) the equilibrium between conformations *b* and *c* is possible only in compounds where the D/E ring juncture is *cis* [*e.g.* tetrahydroalstonine (**1**)]. In the corresponding indoloquinolizidine N_b-oxides the C/D ring juncture (*trans* or *cis*) is fixed, so that there is no equilibrium between conformation *a* (*trans* ring juncture) and conformations *b* and *c* (*cis* ring junctures).[2,4] For a more detailed discussion, see refs. 1-3.



Scheme 1.

The modified Polonovski reaction (Polonovski-Potier reaction) is widely used in the preparation of indolo[2,3-*a*]quinolizidine iminium ions (or the corresponding cyano-adducts, which are their chemical equivalents and easily prepared from iminium ions by cyano trapping) from the corresponding indolo[2,3-*a*]quinolizidine N_b-oxides.[6-9]

Thermodynamically most stable iminium ion will be formed as the main product when stereoelectronic requirements for an E2-type *trans*-diaxial elimination are fulfilled. In theory,[1,2] conformation *a* can lead to all three iminium ions ($\Delta^{4(3)}$, $\Delta^{4(5)}$, and $\Delta^{4(21)}$), of which $\Delta^{4(3)}$-iminium ion should be strongly favoured. Conformation *b* should lead to $\Delta^{4(5)}$-iminium ion and conformation *c* to $\Delta^{4(21)}$-iminium ion. However, the easy isomerization of iminium ions of the present type needs to be kept in mind (Scheme 2). For a more detailed discussion, see refs. 1 and 2.

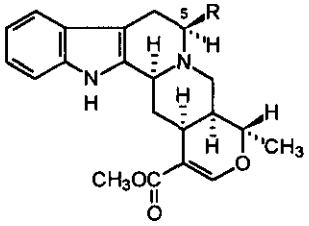


Scheme 2.

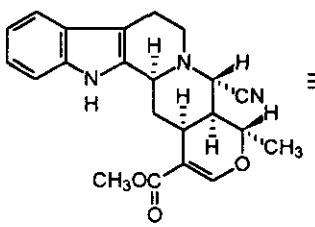
We have previously shown[10,11] that the *m*-CPBA oxidation of N_a-Boc-protected indolo[2,3-*a*]quinolizidines leads mainly, and in several cases exclusively, to *cis*-N_b-oxides. When the substitution pattern permits, these exist predominantly in conformation *b* (*vide supra*).

In the case of tetrahydroalstonine (**1**), which is an indolo[2,3-*a*]quinolizidine derivative, the $\Delta^{4(5)}$-iminium ion formation should permit an easy access to 5-cyanotetrahydroalstonine, which, especially if it possesses the 5β-cyano stereochemistry as in compound (**2a**), would be a good model and possible synthon for the naturally occurring, biogenetically important indole alkaloid 5β-carboxytetrahydroalstonine (**2b**).[12,13] Similarly, the $\Delta^{4(21)}$-iminium ion formation would permit the preparation of 21α-cyanotetrahydroalstonine (**3a**) (*vide infra*). This can be considered chemically equivalent to the biogenetically important indole alkaloid 20,21-didehydrotetrahydroalstonine (cathenamine) (**3b**).[14,15]

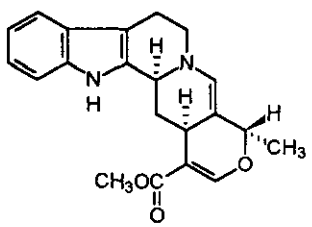
In the present paper we present our results concerning the treatment of N_a-Boc-protected tetrahydroalstonine *cis*-N_b-oxide with trifluoroacetic anhydride (modified Polonovski reaction conditions), followed by KCN trapping.



2a R=CN
2b R=COOH



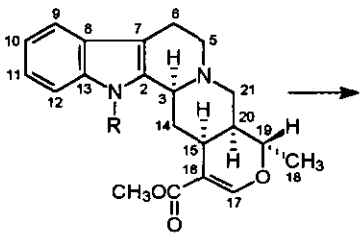
3a



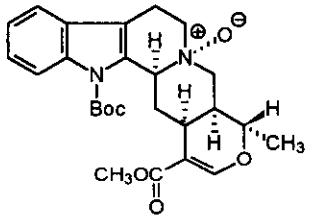
3b

RESULTS AND DISCUSSION

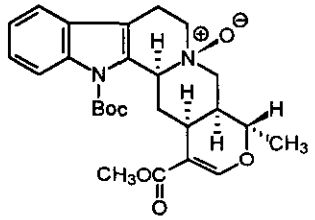
Treatment of tetrahydroalstonine (**1**) with di-*tert*-butyl dicarbonate [$(Boc)_2O$] afforded N_a-Boc-tetrahydroalstonine (**4**), which was oxidized with *m*-chloroperbenzoic acid (*m*-CPBA) to the corresponding N_a-Boc-tetrahydroalstonine *cis*-N_b-oxide (**5a**). The small amounts of the corresponding *trans*-N_b-oxide (**5b**) that formed, were separated (Scheme 3).



1 R=H
4 R=Boc



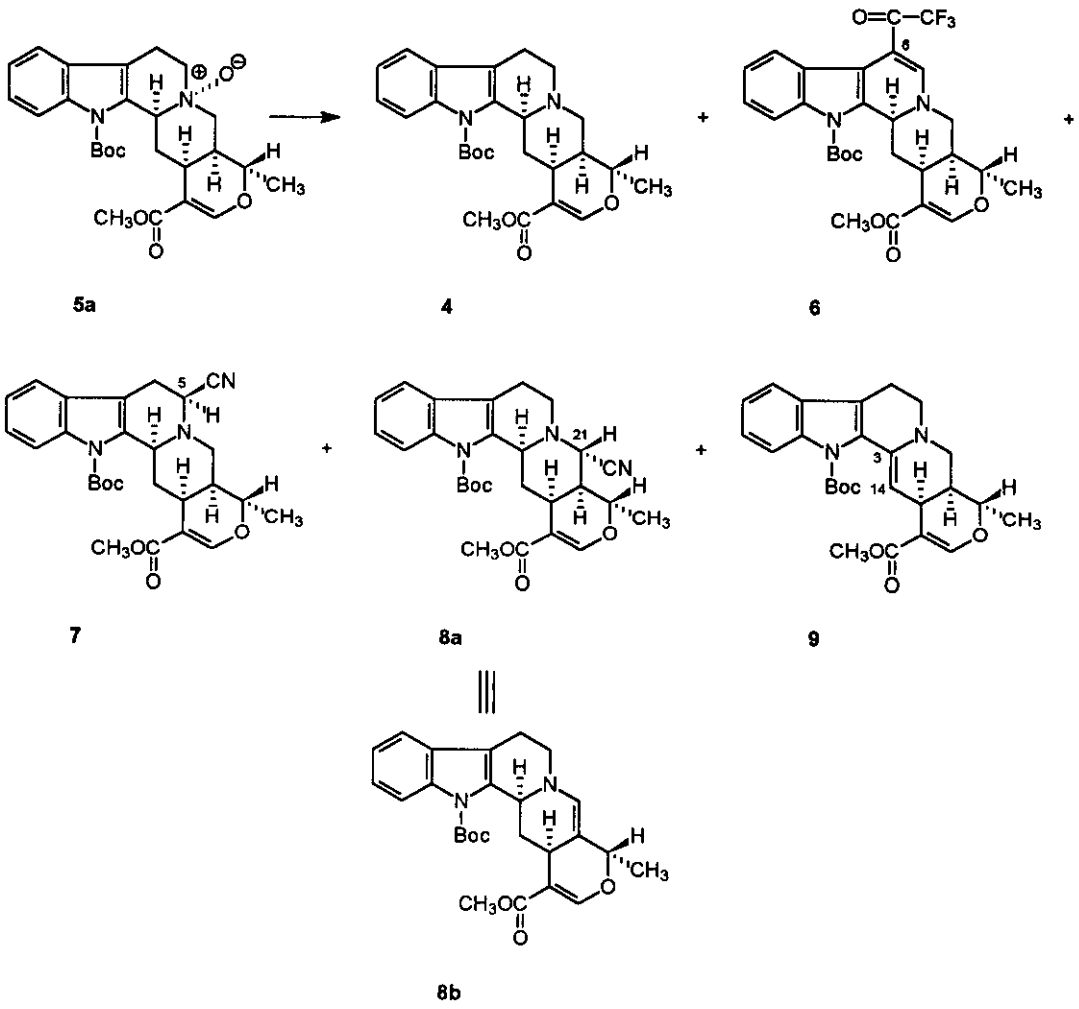
5a



5b

Scheme 3.

The modified Polonovski reaction carried out on the N_a-Boc-tetrahydroalstonine *cis*-N_b-oxide (**5a**), followed by KCN treatment, yielded a mixture from which five compounds were isolated: N_a-Boc-tetrahydroalstonine (**4**), N_a-Boc-6-trifluoroacetyl-5,6-didehydrotetrahydroalstonine (**6**), N_a-Boc-5β-cyanotetrahydroalstonine (**7**), N_a-Boc-21α-cyanotetrahydroalstonine (**8a**) [which can be considered chemically equivalent to N_a-Boc-20,21-didehydrotetrahydroalstonine (N_a-Boc-cathenamine) (**8b**)][15], and N_a-Boc-3,14-didehydrotetrahydroalstonine (**9**) (Scheme 4).



Scheme 4.

Comparison of the chemical shifts found for these compounds with those given earlier,[4,5,12] taking into account the conformational considerations (*vide supra*), provided clear evidence of the regio- and stereostructures depicted in the formulae.

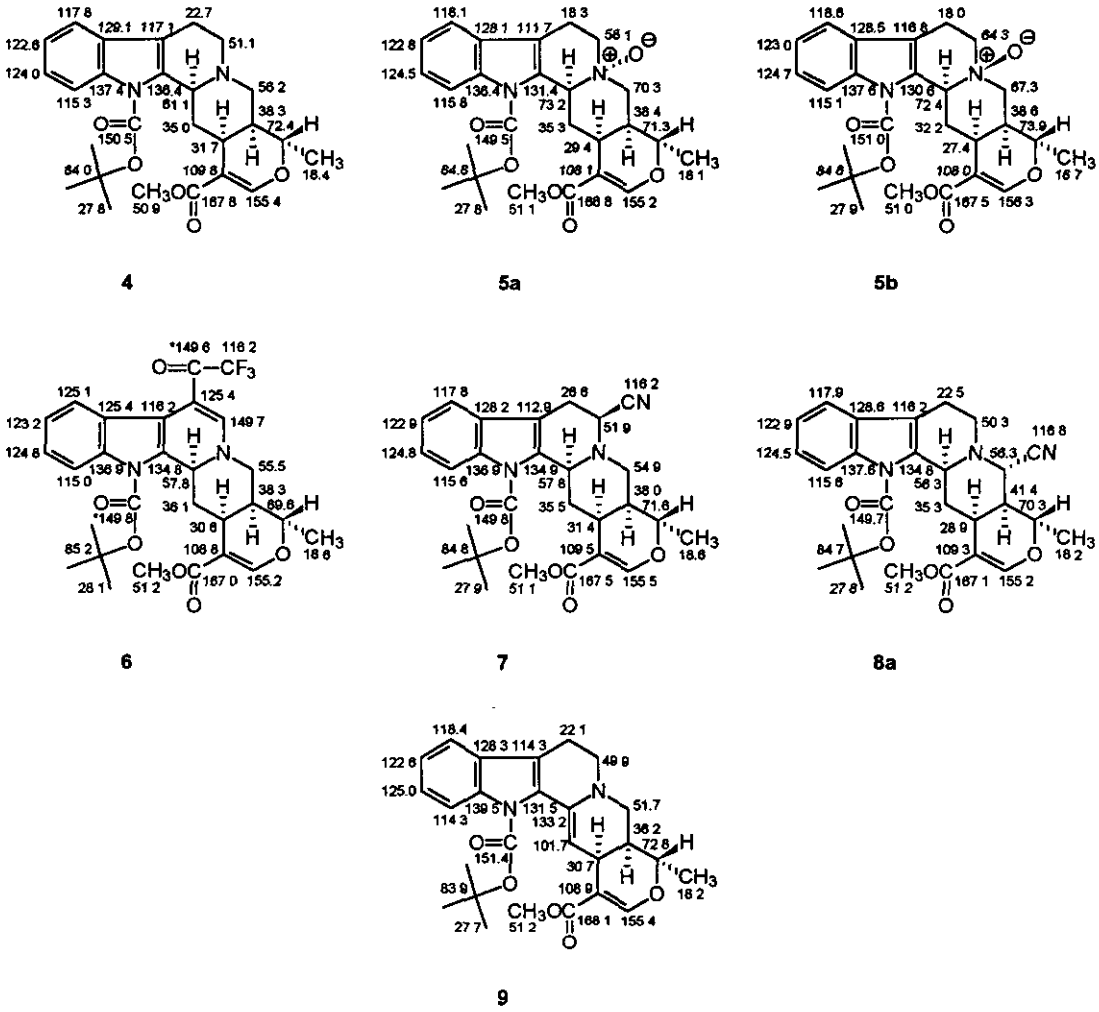


Figure 1. ^{13}C-nmr data of compounds (**4**), (**5a**), (**5b**), (**6**), (**7**), (**8a**), and (**9**).

CONCLUSIONS

Preparation of N_a-Boc-5β-cyanotetrahydroalstonine (**7**) and N_a-Boc-21α-cyanotetrahydroalstonine (**8a**) is of general interest: both compounds are good models and possible synthons for the biogenetically important indole alkaloids 5β-carboxytetrahydroalstonine (**2b**)[13] and 20,21-didehydrotetrahydroalstonine (cathenamine) (**3b**).[14,15]

Use of the N_a-Boc-derivative of tetrahydroalstonine (**4**) is important because it favors the contribution of

conformation *b* to the conformational equilibrium. However, the isolation of compounds (**6**), (**7**), (**8a**), and (**9**) shows that all three iminium ions ($\Delta^{4(3)}$-, $\Delta^{4(5)}$-, and $\Delta^{4(21)}$-) were present in the reaction mixture (*vide supra*). Since the initial attack of CN^- ions in the cyano trapping of iminium ions generally takes place in such a way that it leads to axial cyano groups,[16] the trappings in the present case gave cyano derivatives (**7**) and (**8a**) possessing the 5β- and 21α-stereostructures.

The isolation of N_a-Boc-3,14-didehydrotetrahydroalstonine (**9**) is of special interest because it represents those, relatively rare indoloquinolizidine enamines that are stable without a stabilizing group (*e.g.* CO_2Me) at the 3-position of the enamine system (*Cf.* ref. 17). The failure to trap the corresponding iminium ion with a CN^- ion is evidently due to steric reasons.

EXPERIMENTAL

Ir spectra were recorded with a Perkin-Elmer 700 spectrophotometer, in $CHCl_3$. Ir absorption bands are expressed in reciprocal centimeters (cm^{-1}). ^{1}H- and ^{13}C-nmr spectra were measured in $CDCl_3$ either with a Varian Gemini-200 spectrometer working at 199.975 MHz (^{1}H-nmr) and 50.289 MHz (^{13}C-nmr) or a Varian Unity 400 NMR spectrometer working at 399.952 MHz (^{1}H-nmr) and 100.577 MHz (^{13}C-nmr). Chemical shifts are given in ppm by reference to TMS (^{1}H-nmr; δ_H=0.0 ppm) and $CDCl_3$ (^{13}C-nmr; δ_C=77.0 ppm). Signal assignments were confirmed by H,H-COSY and H,C-COSY experiments. Abbreviations s, d, t, q, m, def, and br are used to designate singlet, doublet, triplet, quartet, multiplet, deformed, and broad, respectively. Mass spectrometry (EIms and HRms) was done on a Jeol DX 303/DA 5000 instrument.

Preparation of N_a-Boc-tetrahydroalstonine (4):

A solution of tetrahydroalstonine (**1**) (400 mg, 1.14 mmol), di-*tert*-butyl dicarbonate [$(Boc)_2O$] (372 mg, 1.70 mmol, 1.5 equiv.), and *p*-dimethylaminopyridine (DMAP) (14 mg, 0.11 mmol, 0.1 equiv.) in dry CH_2Cl_2 (6 ml) was stirred at room temperature for 3 h (Ar atm). Evaporation and purification by flash chromatography (silica gel, CH_2Cl_2/MeOH:98.5/1.5) gave compound (**4**).

Compound (**4**): Y. 437 mg (85%). Amorphous material. Ir: 1710 br (2 x C=O).^{1}H-Nmr: 1.33 (1H, ddd, $J_{3,14\beta}$=11 Hz, $J_{14\alpha,14\beta}$=12.5 Hz, $J_{14\beta,15}$=12 Hz, H-14β), 1.38 (3H, d, $J_{18,19}$=6.5 Hz, H-18), 1.62 (1H, m, H-20), 1.72 [9H, s, -C(CH_3)$_3$], 2.6-2.7 (2H, m, H-6α and H-6β), 2.62 (1H, ddd, $J_{3,14\alpha}\approx$2 Hz, $J_{14\alpha,14\beta}$ =12.5 Hz, $J_{14\alpha,15}$=4.5 Hz, H-14α), 2.8 (2H, m, H-5α and H-5β), 2.81 (1H, ddd, $J_{14\alpha,15}$=4.5 Hz, $J_{14\beta,15}$=12 Hz, $J_{15,20}\approx$4.5 Hz, H-15), 2.96 (1H, dd, $J_{20,21\alpha}$=3.5 Hz, $J_{21\alpha,21\beta}$=12.5 Hz, H-21α), 3.12 (1H, dd, $J_{20,21\beta}$=2 Hz, $J_{21\alpha,21\beta}$=12.5 Hz, H-21β), 3.70 (3H, s, -CO_2CH_3), 3.78 (1H, dd, $J_{3,14\alpha}\approx$2 Hz, $J_{3,14\beta}$=11

Hz, H-3), 4.46 (1H, m, H-20), 7.20 (1H, t-like, $J_{9,10}$=7 Hz, $J_{10,11}$=7 Hz, H-10), 7.25 (1H, t-like, $J_{10,11}$=7 Hz, $J_{11,12}$=7 Hz, H-11), 7.38 (1H, d, $J_{9,10}$=7 Hz, H-9), 7.52 (1H, s, H-17), 8.09 (1H, d, $J_{11,12}$=7 Hz, H-12). For the ^{13}C-nmr data, see Figure 1. Ms: 452 (M^+), 395 (100%), 352, 351, 337, 169, 156. HRms found: 452.2300. Calcd for $C_{26}H_{32}N_2O_5$: 452.2311.

Preparation of N_a-Boc-tetrahydroalstonine cis-N_b-oxide (5a) and N_a-Boc-tetrahydroalstonine trans-N_b-oxide (5b):

A solution of N_a-Boc-tetrahydroalstonine (**4**) (383 mg, 0.85 mmol) and *m*-chloroperbenzoic acid (*m*-CPBA, 25% H_2O) (219 mg, 1.3 mmol, 1.5 equiv.; dried with Na_2SO_4) in dry CH_2Cl_2 (7 ml) was stirred at room temperature for 3 h (Ar atm). Normal work-up and purification by column chromatography (alumina) yielded compound (**5b**) (CH_2Cl_2/MeOH:99.5/0.5) and compound (**5a**) (CH_2Cl_2/MeOH:98.5/1.5).

Compound (**5a**): Y. 362 mg (90%). Amorphous material. Ir: 1720 br (2 x C=O).^{1}H-Nmr: 1.5 (1H, m, H-14β), 1.52 (3H, d, $J_{18,19}$=6.5 Hz, H-18), 1.74 [9H, s, -C(CH_3)$_3$], 2.19 (1H, m, H-20), 2.82 (1H, ddd, $J_{5\alpha,6\beta}\approx$1 Hz, $J_{5\beta,6\beta}$=4.5 Hz, $J_{6\alpha,6\beta}$=15.5 Hz, H-6β), 3.05 (1H, ddd, $J_{14\alpha,15}$=4.5 Hz, $J_{14\beta,15}$=12 Hz, $J_{15,20}\approx$4.5 Hz, H-15), 3.1 (1H, m, H-14α), 3.42 (1H, ddd, $J_{5\alpha,5\beta}$=11 Hz, $J_{5\alpha,6\alpha}$=5.5 Hz, $J_{5\alpha,6\beta}\approx$1 Hz, H-5$\alpha$), 3.51 (1H, ddd, $J_{5\alpha,6\alpha}$=5.5 Hz, $J_{5\beta,6\alpha}$=10 Hz, $J_{6\alpha,6\beta}\approx$15.5 Hz, H-6$\alpha$), 3.62 (1H, ddd, $J_{5\alpha,5\beta}$=11 Hz, $J_{5\beta,6\alpha}\approx$10 Hz, $J_{5\beta,6\beta}$=4.5 Hz, H-5β), 3.71 (3H, s, -CO_2CH_3), 4.0 (2H, def, H-21α and H-21β), 4.22 (1H, m, H-19), 5.05 (1H, br dd, $J_{3,14\alpha}\approx$2 Hz, $J_{3,14\beta}$=11 Hz, H-3), 7.23 (1H, t-like, $J_{9,10}$=7 Hz, $J_{10,11}$=7 Hz, H-10), 7.29 (1H, t-like, $J_{10,11}$=7 Hz, $J_{11,12}$=7 Hz, H-11), 7.42 (1H, d, $J_{9,10}$=7 Hz, H-9), 7.53 (1H, s, H-17), 8.13 (1H, d, $J_{11,12}$=7 Hz, H-12). For the ^{13}C-nmr data, see Figure 1. Ms: 452 (M^+-16, <2%), 395, 352 (100%), 351, 337, 169, 156. HRms found: (M^+-16) 452.2310. Calcd for $C_{26}H_{32}N_2O_5$: 452.2311.

Compound (**5b**): Y. 41 mg (10%). Amorphous material. Ir: 1710 br (2 x C=O). ^{1}H-nmr: 1.56 (3H, d, $J_{18,19}$=6.5 Hz, H-18), 1.71 [9H, s, -C(CH_3)$_3$], 1.84 (1H, m, H-20), 2.40 (1H, ddd, $J_{3,14\beta}\approx$11 Hz, $J_{14\alpha,14\beta}$=13 Hz, $J_{14\beta,15}$=12 Hz, H-14β), 2.7 (1H, m, H-6α), 2.7 (1H, m, H-14α), 2.93 (1H, ddd, $J_{14\alpha,15}\approx$4 Hz, $J_{14\beta,15}$=12 Hz, $J_{15,20}\approx$4.5 Hz, H-15), 3.6 (3H, m, H-5α, H-5β, and H-6β), 3.7 (2H, def, H-21α and H-21β), 3.72 (3H, s, -CO_2CH_3), 4.73 (1H, br dd, $J_{3,14\alpha}\approx$2 Hz, $J_{3,14\beta}\approx$11 Hz, H-3), 5.14 (1H, m, H-19), 7.22 (1H, t-like, $J_{9,10}$=7 Hz, $J_{10,11}$=7 Hz, H-10), 7.28 (1H, t-like, $J_{10,11}$=7 Hz, $J_{11,12}$=7 Hz, H-11), 7.43 (1H, d, $J_{9,10}$=7 Hz, H-9), 7.63 (1H, s, H-17), 7.88 (1H, d, $J_{11,12}$=7 Hz, H-12). For the ^{13}C-nmr data, see Figure 1. Ms: 468 (M^+), 452, 411 (100%), 395, 367, 337, 311, 169, 156. HRms found: 468.2257. Calcd for $C_{26}H_{32}N_2O_6$: 468.2260.

Preparation of N_a-Boc-tetrahydroalstonine (4), N_a-Boc-6-trifluoroacetyl-5,6-didehydrotetrahydroalstonine (6), N_a-Boc-5β-cyanotetrahydroalstonine (7), N_a-Boc-21α-cyanotetrahydroalstonine (8a), and N_a-Boc-3,14-didehydrotetrahydroalstonine (9):

The cis-N_b-oxide (**5a**) (81 mg, 0.17 mmol) was dissolved in dry CH_2Cl_2 (4 ml) and the mixture cooled to -17°C with an ice/salt bath. Freshly distilled trifluoroacetic anhydride (TFAA) (0.05 ml, 0.34 mmol, 2 equiv.) was added with a syringe during 5 min and stirring was continued for 2 h, with the temperature kept at -17 °C with an ice/salt bath. During one further hour the temperature of the reaction mixture was allowed to rise to -10 °C, whereafter the bath was taken away. KCN (45 mg, 0.60 mmol, 4 equiv.) in H_2O (2 ml) was added, and the pH of the aqueous layer was adjusted to pH 5 by addition of solid NaOAc. The mixture was stirred for 45 min at room temperature, basified to pH 10 with 10% Na_2CO_3, and extracted with CH_2Cl_2. Normal work-up and purification by flash chromatography (silica gel) gave compounds (**6**), (**7**), and (**8a**) (CH_2Cl_2/hexane:80/20), compound (**4**) (CH_2Cl_2/MeOH:99/1), and compound (**9**) (CH_2Cl_2/MeOH:98/2). The mixture of compounds (**6**), (**7**), and (**8a**) was further fractionated by repeated tlc treatment (silica gel; CH_2Cl_2).

Compound (**4**): Y. 9 mg (11%). For analytical data, see above.

Compound (**6**) [slightly contaminated with compounds (**7**) and (**8a**)]: Y. 25 mg (26%). Amorphous material. Ir: 1720 br (3 x C=O). ^{1}H-Nmr: 1.51 (3H, d, $J_{18,19}$=6.5 Hz, H-18), 1.76 [9H, s, -C(CH_3)$_3$], 2.55 (1H, m, H-14α), 3.71 (3H, s, -CO_2CH_3), 4.28 (1H, m, H-19), 5.63 (1H, dd, $J_{3,14\alpha}\approx$2 Hz, $J_{3,14\beta}\approx$11 Hz, H-3), 7.2-7.3 (2H, m, H-10 and H-11), 7.41 (1H, s, H-5), 7.53 (1H, s, H-17), 8.13 (1H, d, $J_{11,12}$=7 Hz, H-12), 8.51 (1H, d, $J_{9,10}$=7 Hz, H-9). For the ^{13}C-nmr data, see Figure 1. Ms: 546 (M^+), 490, 446 (100%), 445, 349, 317, 265. HRms found: 546.1953. Calcd for $C_{28}H_{29}N_2O_6F_3$: 546.1978.

Compound (**7**) [slightly contaminated with compound (**6**)]: Y. 7 mg (8%). Amorphous material. Ir: 2380 (CN), 1730 br (2 x C=O). ^{1}H-Nmr: 1.37 (3H, d, $J_{18,19}$=6.5 Hz, H-18), 1.74 [9H, s, -C(CH_3)$_3$], 2.78 (1H, m, H-14α), 3.05 (1H, dd, $J_{20,21\beta}$=2 Hz, $J_{21\alpha,21\beta}$=12.5 Hz, H-21β), 3.71 (3H, s, -CO_2CH_3), 3.95 (1H, dd, $J_{5\alpha,6\alpha}\approx$5 Hz, $J_{5\alpha,6\beta}\approx$2 Hz, H-5$\alpha$), 4.05 (1H, dd, $J_{3,14\alpha}$=2 Hz, $J_{3,14\beta}$= 11 Hz, H-3), 4.39 (1H, m, H-19), 7.2-7.3 (2H, m, H-10 and H-11), 7.37 (1H, d, $J_{9,10}$=7 Hz, H-9), 7.52 (1H, s, H-17), 8.13 (1H, d, $J_{11,12}$=7 Hz, H-12). For the ^{13}C-nmr data, see Figure 1. Ms: 477 (M^+), 450, 420, 394, 377 (100%), 293, 169, 168, 156. HRms found: 477.2282. Calcd for $C_{27}H_{31}N_3O_5$: 477.2264.

Compound (**8a**) [slightly contaminated with compound (**6**)]: Y. 6 mg (7%). Amorphous material. Ir: 2400 (CN), 1730 br (2 x C=O). ^{1}H-Nmr: 1.32 (1H, ddd, $J_{3,14\beta}\approx$11 Hz, $J_{14\alpha,14\beta}$=12.5 Hz, $J_{14\beta,15}\approx$11 Hz, H-14β), 1.41 (3H, d, $J_{18,19}$=6.5 Hz, H-18), 1.74 [9H, s, -C(CH_3)$_3$], 1.92 (1H, ddd, $J_{15,20}$=4.5 Hz, $J_{19,20}\approx$10 Hz, $J_{20,21\beta}$=2 Hz, H-20), 2.7-2.9 (2H, m, H-6α and H-6β), 2.74 (1H, ddd, $J_{3,14\alpha}$=2 Hz, $J_{14\alpha,14\beta}$=12.5 Hz, $J_{14\alpha,15}\approx$4.5 Hz, H-14α), 2.9-3.0 (2H, m, H-5α and H-5β), 3.17 (1H, ddd, $J_{14\alpha,15}\approx$4.5 Hz, $J_{14\beta,15}\approx$11 Hz, $J_{15,20}$=4.5 Hz, H-15), 3.72 (3H, s, -CO_2CH_3), 4.17 (1H, d, $J_{20,21\beta}$=2 Hz, H-21β), 4.4 (1H, br dd, $J_{3,14\alpha}$=2 Hz, $J_{3,14\beta}\approx$11 Hz, H-3), 4.41 (1H, m, H-19), 7.23 (1H, t-like, $J_{9,10}$=7 Hz, $J_{10,11}$=7 Hz, H-10), 7.29 (1H, t-like, $J_{10,11}$=7 Hz, $J_{11,12}$=7 Hz, H-11), 7.39 (1H, d, $J_{9,10}$=7 Hz, H-9), 7.51 (1H, s, H-17), 8.15 (1H, d, $J_{11,12}$=7 Hz, H-12). For the ^{13}C-nmr data, see Figure 1. Ms: 477 (M^+), 450, 420, 394, 377 (100%), 293,

169, 156. HRms found: 477.2291. Calcd for $C_{27}H_{31}N_3O_5$: 477.2264.

Compound (**9**): Y. 20 mg (26%). Amorphous material. Ir: 1720 br (2 x C=O). ^{1}H-Nmr: 1.42 (3H, d, $J_{18,19}$=6.5 Hz, H-18), 1.63 [9H, s, -C(CH_3)$_3$], 1.83 (1H, m, H-20), 2.80 (1H, ddd, $J_{5\alpha,6\beta}$=3 Hz, $J_{5\beta,6\beta}$=5 Hz, $J_{6\alpha,6\beta}$=16 Hz, H-6β), 2.87 (1H, ddd, $J_{5\alpha,6\alpha}$=5.5 Hz, $J_{5\beta,6\alpha}\approx$11 Hz, $J_{6\alpha,6\beta}$ =16 Hz, H-6α), 3.09 (1H, ddd, $J_{5\alpha,5\beta}$=11 Hz, $J_{5\alpha,6\alpha}$=5.5 Hz, $J_{5\alpha,6\beta}$=3 Hz, H-5α), 3.17 (1H, ddd, $J_{5\alpha,5\beta}$=11 Hz, $J_{5\beta,6\alpha}\approx$11 Hz, $J_{5\beta,6\beta}$=5 Hz, H-5β), 3.22 (1H, dd, $J_{20,21\alpha}$=3 Hz, $J_{21\alpha,21\beta}$=12 Hz, H-21α), 3.37 (1H, dd, $J_{20,21\beta}$=2 Hz, $J_{21\alpha,21\beta}$=12 Hz, H-21β), 3.57 (1H, dd, $J_{14,15}\approx$1 Hz, $J_{15,20}$=5 Hz, H-15), 3.72 (3H, s, -CO_2CH_3), 4.13 (1H, m, H-19), 5.03 (1H, d, $J_{14,15}\approx$1 Hz, H-14), 7.19 (1H, t-like, $J_{9,10}$=7 Hz, $J_{10,11}$=7 Hz, H-10), 7.26 (1H, t-like, $J_{10,11}$=7 Hz, $J_{11,12}$=7 Hz, H-11), 7.39 (1H, d, $J_{9,10}$=7 Hz, H-9), 7.58 (1H, s, H-17), 7.89 (1H, d, $J_{11,12}$=7 Hz, H-12). ^{13}C-nmr data, see Figure 1. Ms: 450 (M^+), 394 (100%), 350, 349, 335, 241, 197, 168, 167, 156. HRms found: 450.2169. Calcd for $C_{26}H_{30}N_2O_5$: 450.2155.

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