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trans-(1*R*,3*S*)-Methyl 1-methyl-1,2,3,4-tetrahydro-β-carboline-3-carboxylate

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Key indicators

Single-crystal X-ray study
T = 299 K
Mean σ(C–C) = 0.003 Å
R factor = 0.036
wR factor = 0.083
Data-to-parameter ratio = 9.0

For details of how these key indicators were automatically derived from the article, see http://journals.iucr.org/e.

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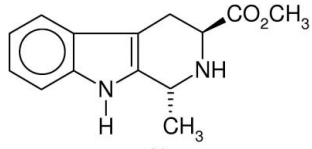
The title compound, $C_{14}H_{16}N_2O_2$, was obtained from the reaction between *S*-tryptophan methyl ester hydrochloride and acetaldehyde. The molecule adopts a *trans* configuration, with the methyl and methoxycarbonyl groups located on opposite sides of the central tetrahydro-β-carboline unit. Bifurcated intermolecular N—H···O/N hydrogen bonds link the molecules into chains.

Comment

Alkaloids comprise a large and complex group of naturally occurring organic compounds, many of which contain indole or indoline groups. A large number of these molecules are biologically active. For example, vincristine and vinblastine from *Catharanthus roseus* (Johnson *et al.*, 1963) have long been established as anti-tumour alkaloids of clinical significance. Others, such as reserpine (Bein, 1953) and ajmaline (Petter & Engelmann, 1974), exhibit important cardiovascular effects. Tetrahydro-β-carbolines have been isolated from *Vinca theiodora* and other plants of South American origin and employed by Indian tribes as botanical source of intoxicating snuffs (Agurell *et al.*, 1969). Recently, tetrahydro-β-carbolines have been found in chocolate and cocoa (Herraiz, 2000). We report here the crystal structure of the title tetrahydro-β-carboline compound, (I).



(I)

The molecule adopts a *trans* configuration (Fig. 1), with the methyl and methoxycarbonyl groups located on opposite sides of the central tetrahydro-β-carboline unit. The geometry of the molecule is unexceptional, and closely comparable to that observed for the 1-(2-methylpropenyl) derivative (Bailey *et al.*, 2001). Hydrogen bonds are formed between molecules (Table 1), with N1—H1*N* acting as bifurcated donor to two acceptors, N2^{iii} and O1^{iii} (symmetry code in Table 1). These interactions generate chains running along the *a* axis.

Experimental

S-Tryptophan methyl ester hydrochloride (1.0 g, 0.004 mol) and acetaldehyde (2.2 ml, 0.004 mol) were dissolved in a methanol/water solution (23 ml, 75/25%, *v*/*v*). The mixture was refluxed for 12 h, after which time thin-layer chromatography indicated the presence of two new components [R_F = 0.36, 0.26, chloroform/methanol (9:1)] in the

reaction medium. The reaction mixture was cooled and the solvent evaporated under vacuum. The residue was dissolved in 14% ammonium hydroxide, extracted with chloroform and dried over anhydrous sodium sulfate. The solvent was removed under reduced pressure to leave an oil (yield 0.69 g, 72%). The diastereomeric *cis*:*trans* ratio was found to be 40:60 by ^{1}H NMR. The oil separated into ether-soluble and ether-insoluble parts. On crystallization from chloroform, the ether-soluble part gave the *cis* isomer as a light yellow solid [yield 0.23 g, 29%; m.p. 347–349 K; R_F 0.36, chloroform–methanol (9:1)]. Crystallization of the ether-insoluble part from methanol gave colourless crystals of the *trans* isomer, (I) [yield 0.46 g, 43%; m.p. 466–468 K; R_F 0.26, chloroform/methanol (9:1)].

Crystal data

$C_{14}H_{16}N_2O_2$
M_r = 244.29
Orthorhombic, $P2_12_12_1$
a = 7.9948 (10) Å
b = 9.6751 (10) Å
c = 15.8301 (8) Å
V = 1224.5 (2) Å^3
Z = 4
D_x = 1.325 Mg m^{-3}
Mo $K\alpha$ radiation
μ = 0.09 mm^{-1}
T = 299 K
Block, colourless
0.60 × 0.24 × 0.14 mm

Data collection

Bruker–Nonius KappaCCD diffractometer
φ and ω scans
Absorption correction: none
12651 measured reflections
1468 independent reflections
1274 reflections with $I > 2\sigma(I)$
R_{int} = 0.057
θ_{max} = 26.5°

Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)]$ = 0.036
$wR(F^2)$ = 0.083
S = 1.10
1468 reflections
164 parameters
H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.032P)^2 + 0.29P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max} < 0.001$
$\Delta\rho_{max}$ = 0.16 e Å^{-3}
$\Delta\rho_{min}$ = −0.14 e Å^{-3}
Extinction correction: *SHELXL97*
Extinction coefficient: 0.028 (4)

Table 1
Hydrogen-bond geometry (Å, °).

D—H···A	D—H	H···A	D···A	D—H···A
N1—H1*N*···O1^{i}	0.92	2.18	2.976 (2)	145
N1—H1*N*···N2^{i}	0.92	2.46	3.142 (2)	131

Symmetry code: (i) $x-\frac{1}{2}, -y+\frac{3}{2}, -z+1$.

Due to the absence of significant anomalous scattering effects, Friedel pairs were merged prior to refinement. The absolute configuration was assigned on the basis of the unchanging *S* configuration at C11. Most H atoms were visible in difference Fourier maps, but those bound to C atoms were placed in calculated positions and allowed to ride during subsequent refinement with U_{iso}(H) = 1.2U_{eq}(C) [1.5U_{eq}(C) for methyl groups]. H atoms bound to N atoms were included in their as-found positions (N1—H1*N* = 0.92 and N2—H2*N* = 0.96 Å) and allowed to ride with U_{iso}(H) = 1.2U_{eq}(N).

Data collection: *COLLECT* (Nonius, 1999); cell refinement: *DIRAX/LSQ* (Duisenberg, 1992); data reduction: *EVALCCD* (Duisenberg *et al.*, 2003); program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *DIAMOND* (Brandenburg, 2006); software used to prepare material for publication: *maXus* (Mackay *et al.*, 1999).

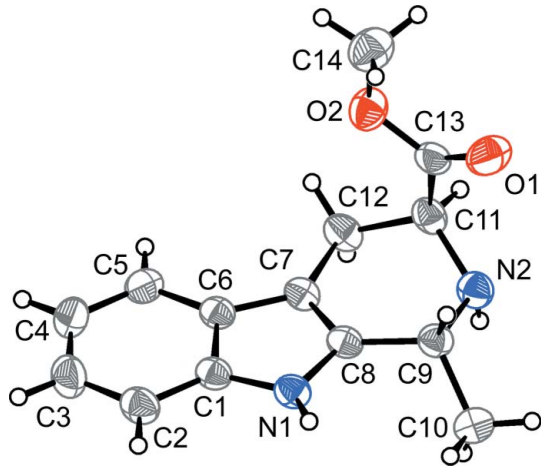


Figure 1
The molecular structure of (I), showing displacement ellipsoids drawn at the 50% probability level for non-H atoms.

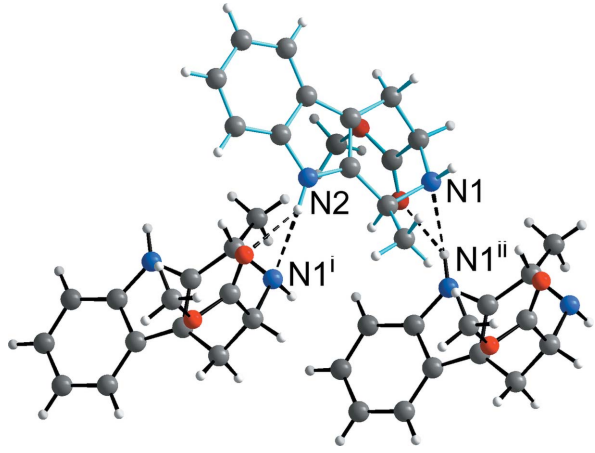


Figure 2
The hydrogen-bonding pattern in (I) (hydrogen bonds are shown as dashed lines). [Symmetry codes: (i) $x+\frac{1}{2}, -y+\frac{1}{2}, -z+1$; (ii) $x-\frac{1}{2}, -y+\frac{1}{2}, -z+1$.]

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