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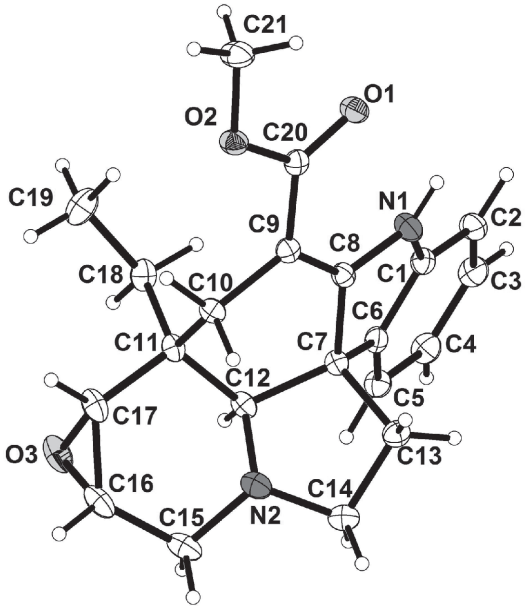
Crystal structure of methyl 2b-ethyl-1a,2a,2b,2b^1, 3,5,10,11-octahydro-1*H*-oxireno[2′,3′:6,7]indolizino[8,1-*cd*]carbazole-4-carboxylate, $C_{21}H_{24}N_2O_3$



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Abstract

$C_{21}H_{24}N_2O_3$, orthorhombic, $P2_12_12_1$ (no. 19), $a = 9.7186(12)$ Å, $b = 13.4479(16)$ Å, $c = 13.6679(17)$ Å, $V = 1786.3(4)$ Å^3, $Z = 4$, $R_{gt}(F) = 0.0393$, $wR_{ref}(F^2) = 0.0937$, T = 173 K.

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The asymmetric unit of the tilte crystal structure is shown in the figure. Tables 1 and 2 contain details of the measurement method and a list of the atoms including atomic coordinates and displacement parameters.

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Table 1: Data collection and handling.

Crystal:	Colourless needle
	Size 0.46 × 0.43 × 0.42 mm
Wavelength:	Mo *Kα* radiation (0.71073 Å)
μ:	0.9 cm^{-1}
Diffractometer, scan mode:	Bruker SMART, ω
$2\theta_{max}$, completeness:	54.2°, >99%
$N(hkl)_{measured}$, $N(hkl)_{unique}$, R_{int}:	10249, 3922, 0.018
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\ \sigma(I_{obs})$, 3592
$N(param)_{refined}$:	237
Programs:	Bruker programs [7], SHELX [8], OLEX2 [9]

Source of material

The *Catharanthus roseus* was purchased from Vinca Pharmaceutical Co., Ltd. HaiNan, China. The powdered twigs and leaves of *C. roseus* (8.5 kg) were extracted with 95% ethanol. The solution was evaporated in vacuum to get a residue (1234 g). The residue was dissolved in water to form a suspension and then adjusted to pH 6 with diluted (3%) H_2SO_4. The acidic suspension was partitioned with $CHCl_3$. The aqueous phase was basified with an ammonia solution (2%) to pH 8 and then extracted with $CHCl_3$ to obtain the raw alkaloid (105 g), which was subjected to silica gel column chromatography (8 × 150 cm, 1000 g) eluting with a gradient of $CHCl_3$-CH_3OH (100:0, 99:1, 98:2, 96:4, 93:7, 90:10, 85:15, 80:20, 70:30, 0:100, each 10 L to give twenty fractions. Fraction 3 (2.72 g) was subjected to silica gel column chromatography (4 × 80 cm, 250 g) [eluted with n-hexane-EtOAc (9:1, 8:2, 7:3, 5:5, each 1 L)] to afford eight subfractions (3-1∼3-8). Subfraction 3-4 (346 mg) was purified by silica gel column chromatography (2 × 60 cm, 40 g) [eluted with $CHCl_3$-CH_3OH (100:0, 99:1, 98:2, 95:5, each 400 mL)] to afford the pure title compound.

Experimental details

The C-bound H atoms were positioned geometrically and were included in the refinement in the riding-model approximation. The crystal structure was solved by direct method and refined by full-matrix least-squares refinement with SHELX program [8].

Table 2: Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å^2).

Atom	*x*	*y*	*z*	U_{iso}*/U_{eq}
C1	0.4940(2)	0.29914(15)	0.25706(15)	0.0277(4)
C2	0.6346(2)	0.31259(18)	0.26874(16)	0.0335(5)
H2	0.6808	0.3674	0.2397	0.040*
C3	0.7059(2)	0.24262(19)	0.32472(16)	0.0358(5)
H3	0.8025	0.2493	0.3330	0.043*
C4	0.6380(2)	0.16362(17)	0.36840(16)	0.0342(5)
H4	0.6885	0.1164	0.4055	0.041*
C5	0.4958(2)	0.15295(15)	0.35829(15)	0.0293(4)
H5	0.4491	0.0996	0.3895	0.035*
C6	0.4241(2)	0.22061(14)	0.30251(14)	0.0255(4)
C7	0.27161(19)	0.23440(14)	0.28302(14)	0.0234(4)
C8	0.2756(2)	0.30714(14)	0.19794(14)	0.0239(4)
C9	0.1748(2)	0.31335(14)	0.12948(14)	0.0243(4)
C10	0.0598(2)	0.23769(14)	0.13498(15)	0.0245(4)
H10A	0.0118	0.2341	0.0712	0.029*
H10B	−0.0078	0.2582	0.1853	0.029*
C11	0.1197(2)	0.13424(15)	0.16134(15)	0.0257(4)
C12	0.18175(19)	0.14042(14)	0.26462(15)	0.0252(4)
H12	0.2369	0.0792	0.2783	0.030*
C13	0.2029(2)	0.28330(15)	0.37573(15)	0.0297(4)
H13A	0.2732	0.3111	0.4204	0.036*
H13B	0.1380	0.3366	0.3567	0.036*
C14	0.1278(2)	0.19643(17)	0.42266(16)	0.0330(5)
H14A	0.1917	0.1517	0.4579	0.040*
H14B	0.0548	0.2192	0.4679	0.040*
C15	−0.0045(2)	0.05744(17)	0.35023(18)	0.0364(5)
H15A	−0.0836	0.0691	0.3944	0.044*
H15B	0.0562	0.0072	0.3809	0.044*
C16	−0.0549(2)	0.01968(16)	0.25342(19)	0.0367(5)
H16	−0.1535	−0.0016	0.2508	0.044*
C17	0.0035(2)	0.05829(15)	0.16209(19)	0.0342(5)
H17	−0.0599	0.0598	0.1045	0.041*
C18	0.2303(2)	0.10004(16)	0.08803(16)	0.0315(5)
H18A	0.3128	0.1424	0.0963	0.038*
H18B	0.2571	0.0309	0.1041	0.038*
C19	0.1859(3)	0.1039(2)	−0.01941(18)	0.0459(6)
H19A	0.2590	0.0762	−0.0606	0.069*
H19B	0.1686	0.1730	−0.0383	0.069*
H19C	0.1016	0.0648	−0.0281	0.069*
C20	0.1935(2)	0.38065(14)	0.04768(15)	0.0246(4)
C21	0.1084(3)	0.4374(2)	−0.10497(16)	0.0412(6)
H21A	0.0251	0.4337	−0.1452	0.062*
H21B	0.1876	0.4150	−0.1434	0.062*
H21C	0.1231	0.5063	−0.0840	0.062*
N1	0.40036(18)	0.35554(13)	0.20148(13)	0.0290(4)
H1	0.4187	0.4129	0.1733	0.035*
N2	0.07076(18)	0.14928(13)	0.33618(13)	0.0298(4)
O1	0.29034(15)	0.43840(11)	0.03840(11)	0.0315(3)
O2	0.09263(15)	0.37451(11)	−0.02002(10)	0.0303(3)
O3	0.04108(18)	−0.03961(11)	0.19778(14)	0.0434(4)

Discussion

Catharanthus roseus is a member of the family Apocynaceae. It is a well-known medicinal plant because of its anti-tumor activity. Up to now more than one hundred alkaloids have been isolated from the plant and most of them are indole alkaloids. In our study on *Catharanthus roseus*, we have obtained lochnericine. Lochnericine has also been isolated from *Amsonia angustifolia* [1], *Vinca pusilla* [2], *Alstonia lanceolata* [3], *Tabernaemontana citrifolia* [4], *Amsonia sinensis* [5]. The title compound is composed of one benzo moiety, two five-membered rings and two six-membered rings. The atoms C9, C20, C21, O1, O2 are coplanar (mean deviation 0.0115). The atoms C7, C8, C9, C10 form another plane (mean deviation 0.0177 Å). The dihedral angle between the benzo moiety and the methyl ester group is 30.30(7)°, while it is 20.55(9)° between the benzo moiety and the plane defined by C7, C8, C9, C10. The distance between C8 and C9 is 1.357(2) Å, which is within the normal range of double bond. The five-membered ring A[N1, C1, C6, C7, C8] adopts a half chair conformation, while the ring B [N2, C12, C7, C13, C14] adopts a envelope conformation with the puckering parameters [6] Q = 0.215(2) Å, φ = 307.76(61)° and Q = 0.445(3) Å, φ = 329.61(82)°, respectively. The six-membered ring C [N2, C12, C11, C17, C16, C15] adopts a half chair conformation with the puckering parameters Q = 0.53(19) Å, θ = 127.8(3)°, φ = 208.66(27)° and ring D [C7, C8, C9, C10, C11, C12] adopts a screw-boat conformation with the puckering parameters Q = 0.58(55) Å, θ = 67.7(7)°, φ = 214.61(47)°. There is an intramolecular hydrogen bond N1-H1···O1.

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