Acta Crystallographica Section E
Structure Reports
Online
ISSN 1600-5368

(*S*)-*N*-Benzyl-2-methyl-1,2,3,4-tetrahydroisoquinoline-3-carboxamide

Tricia Naicker,[a] Thavendran Govender,[a] Hendrik. G. Kruger[b] and Glenn. E.M. Maguire[b]*

[a]School of Pharmacy and Pharmacology, University of KwaZulu Natal, Durban 4000, South Africa, and [b]School of Chemistry, University of KwaZulu Natal, Durban 4000, South Africa
Correspondence e-mail: maguireg@ukzn.ac.za

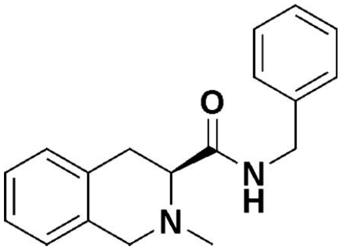
Received 12 November 2010; accepted 1 December 2010

Key indicators: single-crystal X-ray study; T = 173 K; mean σ(C–C) = 0.005 Å; R factor = 0.036; wR factor = 0.088; data-to-parameter ratio = 9.0.

The structure of the title compound, $C_{18}H_{20}N_2O$, at 173 K has hexagonal ($P6_1$) symmetry. The *N*-containing six-membered ring assumes a half-chair conformation. In the crystal, intermolecular N—H···O hydrogen bonding *via* the amide groups cross-link the molecules along the *a* axis. The absolute configuration was confirmed by 2D NMR studies.

Related literature

The title compound is a precursor to chiral ligands involving a tetrahydroisoquinoline backbone. For the application of these ligands as catalysts, see: Chakka *et al.* (2009); Peters *et al.* (2010); Naicker *et al.* (2010*a*). For related structures, see: Chakka *et al.* (2010). For a related structure with the same chiral centre and conformation of the six-membered ring, see: Naicker *et al.* (2010*b*).



Experimental

Crystal data

$C_{18}H_{20}N_2O$
M_r = 280.36
Hexagonal, $P6_1$
a = 10.1838 (13) Å
c = 25.965 (3) Å
V = 2332.1 (5) Å^3
Z = 6
Mo $K\alpha$ radiation
μ = 0.08 mm^{-1}
T = 173 K
0.22 × 0.12 × 0.03 mm

Data collection

Bruker Kappa DUO APEXII diffractometer
18777 measured reflections
1759 independent reflections
1358 reflections with $I > 2\sigma(I)$
$R_{\rm int}$ = 0.059

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.036
$wR(F^2)$ = 0.088
S = 1.05
1759 reflections
195 parameters
2 restraints
H atoms treated by a mixture of independent and constrained refinement
$\Delta\rho_{\rm max}$ = 0.14 e Å^{-3}
$\Delta\rho_{\rm min}$ = −0.14 e Å^{-3}

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

D—H···A	D—H	H···A	D···A	D—H···A
N2—H2···O1$^{\rm i}$	0.96 (2)	1.92 (2)	2.852 (3)	165 (3)

Symmetry code: (i) $y, -x+y+1, z-\frac{1}{6}$.

Data collection: *APEX2* (Bruker, 2006); cell refinement: *SAINT* (Bruker, 2006); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *OLEX2* (Dolomanov *et al.*, 2009); software used to prepare material for publication: *SHELXL97*.

The authors wish to thank Dr Hong Su of the Chemistry Department of the University of Cape Town for her assistance with the crystallographic data collection.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HG2752).

References

Bruker (2006). *APEX2* and *SAINT*. Bruker AXS Inc., Madison, Wisconsin, USA.
Chakka, S., Andersson, P. G., Govender, T., Kruger, H. G. & Maguire, G. E. M. (2009). *Eur. J. Org. Chem.* pp. 972–980.
Chakka, S. K., Govender, T., Kruger, H. G. & Maguire, G. E. M. (2010). *Acta Cryst.* E**66**, o1818.
Dolomanov, O. V., Bourhis, L. J., Gildea, R. J., Howard, J. A. K. & Puschmann, H. (2009). *J. Appl. Cryst.* **42**, 339–341.
Naicker, T., Govender, T., Kruger, H. G. & Maguire, G. E. M. (2010*b*). *Acta Cryst.* E**66**, o638.
Naicker, T., Petzold, K., Singh, T., Arvidsson, P. I., Kruger, H. G., Maguire, G. E. M. & Govender, T. (2010*a*). *Tetrahedron Asymmetry*. In the press. doi: 10.1016/j.tetasy.2010.11.010.
Peters, B. K., Chakka, S. K., Naicker, T., Maguire, G. E. M., Kruger, H. G., Andersson, P. G. & Govender, T. (2010). *Tetrahedron Asymmetry*, **21**, 679–687.
Sheldrick, G. M. (2008). *Acta Cryst.* A**64**, 112–122.

supplementary materials

Acta Cryst. (2011). E**67**, o67 [**doi:10.1107/S1600536810050361**]

(*S*)-*N*-Benzyl-2-methyl-1,2,3,4-tetrahydroisoquinoline-3-carboxamide

T. Naicker, T. Govender, H. G. Kruger and G. E. M. Maguire

Comment

The title compound (Fig. 1) is a precursor in the synthesis of novel chiral ligands involving a tetrahydroisoquinoline backbone. Recently, we have reported the application of these ligands as useful catalysts for transfer hydrogenation of prochiral ketones (Chakka *et al.*, 2009), Henry reactions, hydrogenation of olefins (Peters *et al.* 2010) and Diels-Alder reactions (Naicker *et al.*, 2010*a*).

Compound 1 was derived from commercially available *S*-phenyl glycine and formaldehyde. The absolute stereochemistry was confirmed to be S at the C9 position from proton NMR spectroscopy. (Peters *et al.* 2010).

From the crystal structure it is evident that the *N*-containing six membered ring assumes a half chair conformation (Fig. 1), in which the 1—N1—C9—C8 bond has a torsion angle of 68.7 (3)°. This observation is similar to analogous structures that we have reported recently (Chakka *et al.*, 2010) and (Naicker *et al.*, 2010*b*).

The molecule exhibits intermolecular hydrogen bonding, which involves the atom O1 which links the molecules together see Table 1 and Fig. 2.

Experimental

(*S*)-2-methyl-1,2,3,4-tetrahydroisoquinoline-3-carboxylic acid (1.5 g, 7.8 mmol) was dissolved in DMF (15 ml) followed by addition of 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide (EDC) hydrochloride (8.8 mmol), hydroxybenzotriazole (0.81 g, 8.3 mmol), a catalytic amount of 4-dimethylaminopyridine and benzyl amine (8.3 mmol). The reaction mixture was then stirred at room temperature until no more starting material could be detected by TLC analysis (approximately 1 h). The reaction mixture was poured into 30 volumes of chilled water; the mixture was then extracted twice with ethyl acetate. The extracts were combined, washed with 5% HCl (aq) to remove latent EDC urea, dried over anhydrous magnesium sulfate and then concentrated to dryness affording the crude product which was purified by column chromatography.

Melting point 91–95 ^{o}C. $[\alpha]^{20}_{D}$ -7.93 (*c* 0.21 in $CHCl_3$).

IR (neat) n_{max}: 3281, 2923, 1646, 1548, 1454, 1240, 739, 696 cm^{-1}.

^{1}H NMR (400 MHz, $CDCl_3$) $\delta = 2.78$ (d, 3H), 3.12 (m, 2), 3.52 (t, 1H), 3.66 (m, 3H), 3.78 (d, 1H), 6.99 (d, 1H), 7.19 (m, 3H), 7.30 (m, 6H)

Recrystallization from EtOAc afforded colourless crystals suitable for X-ray analysis.

Refinement

All hydrogen atoms on carbons were positioned geometrically with C—H distances ranging from 0.95 Å to 1.00 Å and refined as riding on their parent atoms, with U_{iso} (H) = 1.2 - 1.5 U_{eq} (C). The position of amine hydrogen H2 was located in the difference electron density maps and refined with simple bond length constraints. The Flack *x* parameter is -0.5 (15) without merging Friedel pairs, so Friedel pairs were merged at the final refinement.

Figures

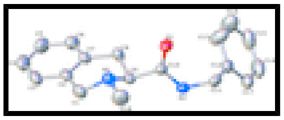


Fig. 1. The molecular structure of compound 1 with the atom numbering scheme. Displacement ellipsoids are drawn at the 50% probability level. Hydrogen atoms have been omitted for clarity.

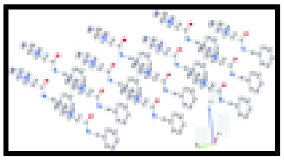


Fig. 2. Hydrogen bonding interactions between atoms N2—H2···O1.

(*S*)-*N*-Benzyl-2-methyl-1,2,3,4-tetrahydroisoquinoline-3-carboxamide

Crystal data

$C_{18}H_{20}N_2O$
M_r = 280.36
Hexagonal, $P6_1$
Hall symbol: P 61
a = 10.1838 (13) Å
c = 25.965 (3) Å
V = 2332.1 (5) Å^3
Z = 6
F(000) = 900

D_x = 1.198 Mg m^{-3}
Melting point: 365 K
Mo $K\alpha$ radiation, λ = 0.71073 Å
Cell parameters from 18777 reflections
θ = 2.3–27.2°
μ = 0.08 mm^{-1}
T = 173 K
Needle, colourless
0.22 × 0.12 × 0.03 mm

Data collection

Bruker Kappa DUO APEXII diffractometer
Radiation source: fine-focus sealed tube
graphite
0.5° φ scans and ω scans
18777 measured reflections
1759 independent reflections

1358 reflections with $I > 2\sigma(I)$
R_{int} = 0.059
θ_{max} = 27.2°, θ_{min} = 2.3°
$h = -13 \rightarrow 12$
$k = -12 \rightarrow 13$
$l = -33 \rightarrow 33$

Refinement

Refinement on F^2

Secondary atom site location: difference Fourier map

Least-squares matrix: full

$R[F^2 > 2\sigma(F^2)] = 0.036$

$wR(F^2) = 0.088$

$S = 1.05$

1759 reflections

195 parameters

2 restraints

Primary atom site location: structure-invariant direct methods

Hydrogen site location: inferred from neighbouring sites

H atoms treated by a mixture of independent and constrained refinement

$w = 1/[\sigma^2(F_o^2) + (0.0377P)^2 + 0.3273P]$
where $P = (F_o^2 + 2F_c^2)/3$

$(\Delta/\sigma)_{max} < 0.001$

$\Delta\rho_{max} = 0.14$ e Å^{-3}

$\Delta\rho_{min} = -0.14$ e Å^{-3}

Extinction correction: *SHELXL97* (Sheldrick, 2008), $Fc^* = kFc[1+0.001xFc^2\lambda^3/\sin(2\theta)]^{-1/4}$

Extinction coefficient: 0.0033 (7)

Special details

Experimental. Half sphere of data collected using *SAINT* strategy (Bruker, 2006). Crystal to detector distance = 40 mm; combination of φ and ω scans of 0.5°, 30 s per °, 2 iterations.

Geometry. All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted *R*-factor *wR* and goodness of fit *S* are based on F^2, conventional *R*-factors *R* are based on *F*, with *F* set to zero for negative F^2. The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating *R*-factors(gt) *etc*. and is not relevant to the choice of reflections for refinement. *R*-factors based on F^2 are statistically about twice as large as those based on *F*, and *R*- factors based on ALL data will be even larger.

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

	x	*y*	*z*	U_{iso}*/U_{eq}
O1	0.73695 (19)	0.77313 (19)	0.97396 (7)	0.0450 (5)
N1	0.9118 (2)	1.1026 (2)	0.98992 (8)	0.0385 (5)
N2	0.7085 (2)	0.8382 (2)	0.89310 (8)	0.0362 (5)
H2	0.747 (3)	0.915 (2)	0.8671 (9)	0.051 (8)*
C1	1.0391 (3)	1.2586 (3)	0.98885 (11)	0.0465 (7)
H1A	1.0402	1.3099	1.0214	0.056*
H1B	1.0241	1.3139	0.9602	0.056*
C2	1.1898 (3)	1.2671 (3)	0.98225 (10)	0.0406 (6)
C3	1.3244 (4)	1.4003 (3)	0.99539 (12)	0.0537 (8)
H3	1.3197	1.4848	1.0087	0.064*
C4	1.4632 (3)	1.4096 (3)	0.98919 (13)	0.0595 (8)
H4	1.5535	1.4999	0.9984	0.071*
C5	1.4714 (3)	1.2876 (4)	0.96964 (13)	0.0581 (8)
H5	1.5671	1.2941	0.9652	0.070*
C6	1.3402 (3)	1.1566 (3)	0.95657 (11)	0.0463 (7)
H6	1.3461	1.0725	0.9436	0.056*
C7	1.1987 (3)	1.1457 (3)	0.96216 (10)	0.0374 (6)

C8	1.0561 (3)	1.0021 (3)	0.94725 (11)	0.0378 (6)
H8A	1.0356	0.9225	0.9730	0.045*
H8B	1.0718	0.9668	0.9135	0.045*
C9	0.9188 (3)	1.0240 (3)	0.94379 (10)	0.0345 (5)
H9	0.9283	1.0859	0.9126	0.041*
C10	0.7785 (3)	0.8671 (3)	0.93857 (10)	0.0343 (5)
C11	0.5866 (3)	0.6863 (3)	0.87851 (10)	0.0393 (6)
H11A	0.5110	0.6958	0.8573	0.047*
H11B	0.5349	0.6288	0.9100	0.047*
C12	0.6459 (3)	0.6001 (3)	0.84871 (9)	0.0373 (6)
C13	0.7331 (4)	0.5489 (4)	0.87268 (12)	0.0623 (9)
H13	0.7528	0.5655	0.9085	0.075*
C14	0.7920 (4)	0.4739 (4)	0.84516 (14)	0.0685 (10)
H14	0.8523	0.4402	0.8622	0.082*
C15	0.7643 (4)	0.4478 (4)	0.79358 (13)	0.0615 (9)
H15	0.8053	0.3967	0.7747	0.074*
C16	0.6769 (4)	0.4962 (4)	0.76946 (13)	0.0680 (10)
H16	0.6565	0.4782	0.7337	0.082*
C17	0.6180 (4)	0.5713 (3)	0.79703 (12)	0.0529 (7)
H17	0.5568	0.6037	0.7798	0.063*
C18	0.7705 (3)	1.1059 (4)	0.99296 (14)	0.0573 (8)
H18A	0.6846	1.0019	0.9935	0.086*
H18B	0.7619	1.1594	0.9629	0.086*
H18C	0.7700	1.1586	1.0245	0.086*

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
O1	0.0379 (9)	0.0402 (10)	0.0409 (10)	0.0076 (8)	−0.0062 (8)	0.0136 (8)
N1	0.0387 (12)	0.0377 (11)	0.0414 (12)	0.0208 (10)	0.0035 (9)	0.0012 (9)
N2	0.0370 (11)	0.0366 (11)	0.0349 (11)	0.0183 (9)	−0.0024 (9)	0.0071 (9)
C1	0.0571 (16)	0.0354 (14)	0.0488 (16)	0.0245 (13)	−0.0015 (13)	−0.0017 (12)
C2	0.0453 (14)	0.0287 (12)	0.0408 (14)	0.0133 (11)	−0.0010 (12)	0.0058 (11)
C3	0.065 (2)	0.0303 (14)	0.0522 (18)	0.0137 (14)	−0.0029 (14)	0.0044 (12)
C4	0.0422 (16)	0.0433 (16)	0.065 (2)	0.0006 (13)	−0.0056 (15)	0.0107 (15)
C5	0.0371 (15)	0.0565 (18)	0.067 (2)	0.0128 (14)	−0.0042 (14)	0.0108 (16)
C6	0.0365 (14)	0.0439 (15)	0.0532 (17)	0.0162 (12)	0.0031 (12)	0.0094 (13)
C7	0.0381 (13)	0.0290 (12)	0.0388 (13)	0.0121 (11)	0.0011 (11)	0.0073 (11)
C8	0.0336 (12)	0.0299 (12)	0.0459 (14)	0.0130 (11)	0.0036 (11)	−0.0001 (11)
C9	0.0349 (13)	0.0321 (12)	0.0340 (12)	0.0149 (10)	0.0029 (10)	0.0071 (10)
C10	0.0315 (12)	0.0360 (13)	0.0356 (13)	0.0170 (10)	0.0005 (10)	0.0067 (10)
C11	0.0295 (13)	0.0442 (14)	0.0403 (14)	0.0156 (11)	−0.0071 (11)	0.0036 (11)
C12	0.0300 (12)	0.0325 (13)	0.0375 (14)	0.0067 (10)	0.0004 (11)	0.0021 (11)
C13	0.073 (2)	0.097 (3)	0.0420 (17)	0.061 (2)	−0.0073 (15)	−0.0093 (16)
C14	0.069 (2)	0.089 (3)	0.067 (2)	0.054 (2)	−0.0099 (18)	−0.0217 (19)
C15	0.0525 (18)	0.0532 (18)	0.064 (2)	0.0151 (15)	0.0066 (16)	−0.0209 (16)
C16	0.085 (3)	0.0545 (19)	0.0404 (16)	0.0168 (18)	−0.0052 (17)	−0.0131 (15)
C17	0.0631 (19)	0.0404 (15)	0.0440 (16)	0.0174 (14)	−0.0140 (14)	−0.0050 (13)

C18	0.0526 (17)	0.067 (2)	0.065 (2)	0.0395 (16)	0.0052 (15)	−0.0012 (16)

Geometric parameters (Å, °)

O1—C10	1.239 (3)	C8—H8A	0.9900
N1—C18	1.458 (3)	C8—H8B	0.9900
N1—C9	1.462 (3)	C9—C10	1.527 (3)
N1—C1	1.465 (3)	C9—H9	1.0000
N2—C10	1.334 (3)	C11—C12	1.504 (4)
N2—C11	1.469 (3)	C11—H11A	0.9900
N2—H2	0.957 (10)	C11—H11B	0.9900
C1—C2	1.503 (4)	C12—C17	1.373 (4)
C1—H1A	0.9900	C12—C13	1.383 (4)
C1—H1B	0.9900	C13—C14	1.383 (4)
C2—C7	1.386 (4)	C13—H13	0.9500
C2—C3	1.406 (4)	C14—C15	1.367 (5)
C3—C4	1.378 (4)	C14—H14	0.9500
C3—H3	0.9500	C15—C16	1.365 (5)
C4—C5	1.382 (5)	C15—H15	0.9500
C4—H4	0.9500	C16—C17	1.385 (5)
C5—C6	1.377 (4)	C16—H16	0.9500
C5—H5	0.9500	C17—H17	0.9500
C6—C7	1.396 (4)	C18—H18A	0.9800
C6—H6	0.9500	C18—H18B	0.9800
C7—C8	1.508 (4)	C18—H18C	0.9800
C8—C9	1.524 (3)		

C18—N1—C9	112.1 (2)	C8—C9—C10	107.39 (19)
C18—N1—C1	109.0 (2)	N1—C9—H9	109.5
C9—N1—C1	108.61 (19)	C8—C9—H9	109.5
C10—N2—C11	122.5 (2)	C10—C9—H9	109.5
C10—N2—H2	119.4 (18)	O1—C10—N2	123.2 (2)
C11—N2—H2	117.6 (18)	O1—C10—C9	121.5 (2)
N1—C1—C2	112.9 (2)	N2—C10—C9	115.3 (2)
N1—C1—H1A	109.0	N2—C11—C12	111.9 (2)
C2—C1—H1A	109.0	N2—C11—H11A	109.2
N1—C1—H1B	109.0	C12—C11—H11A	109.2
C2—C1—H1B	109.0	N2—C11—H11B	109.2
H1A—C1—H1B	107.8	C12—C11—H11B	109.2
C7—C2—C3	119.0 (3)	H11A—C11—H11B	107.9
C7—C2—C1	120.8 (2)	C17—C12—C13	117.6 (3)
C3—C2—C1	120.2 (3)	C17—C12—C11	121.8 (3)
C4—C3—C2	120.6 (3)	C13—C12—C11	120.6 (2)
C4—C3—H3	119.7	C12—C13—C14	120.9 (3)
C2—C3—H3	119.7	C12—C13—H13	119.5
C3—C4—C5	120.1 (3)	C14—C13—H13	119.5
C3—C4—H4	119.9	C15—C14—C13	120.6 (3)
C5—C4—H4	119.9	C15—C14—H14	119.7
C6—C5—C4	119.7 (3)	C13—C14—H14	119.7
C6—C5—H5	120.2	C16—C15—C14	119.2 (3)

C4—C5—H5	120.2	C16—C15—H15	120.4
C5—C6—C7	121.0 (3)	C14—C15—H15	120.4
C5—C6—H6	119.5	C15—C16—C17	120.2 (3)
C7—C6—H6	119.5	C15—C16—H16	119.9
C2—C7—C6	119.6 (2)	C17—C16—H16	119.9
C2—C7—C8	120.0 (2)	C12—C17—C16	121.5 (3)
C6—C7—C8	120.4 (2)	C12—C17—H17	119.3
C7—C8—C9	112.5 (2)	C16—C17—H17	119.3
C7—C8—H8A	109.1	N1—C18—H18A	109.5
C9—C8—H8A	109.1	N1—C18—H18B	109.5
C7—C8—H8B	109.1	H18A—C18—H18B	109.5
C9—C8—H8B	109.1	N1—C18—H18C	109.5
H8A—C8—H8B	107.8	H18A—C18—H18C	109.5
N1—C9—C8	109.34 (19)	H18B—C18—H18C	109.5
N1—C9—C10	111.7 (2)		

C18—N1—C1—C2	−176.3 (2)	C1—N1—C9—C10	−172.63 (19)
C9—N1—C1—C2	−53.9 (3)	C7—C8—C9—N1	−48.2 (3)
N1—C1—C2—C7	20.3 (4)	C7—C8—C9—C10	−169.6 (2)
N1—C1—C2—C3	−161.2 (2)	C11—N2—C10—O1	−7.5 (4)
C7—C2—C3—C4	−1.0 (4)	C11—N2—C10—C9	170.4 (2)
C1—C2—C3—C4	−179.6 (3)	N1—C9—C10—O1	−53.7 (3)
C2—C3—C4—C5	0.4 (5)	C8—C9—C10—O1	66.2 (3)
C3—C4—C5—C6	−0.2 (5)	N1—C9—C10—N2	128.3 (2)
C4—C5—C6—C7	0.8 (4)	C8—C9—C10—N2	−111.8 (2)
C3—C2—C7—C6	1.6 (4)	C10—N2—C11—C12	−94.2 (3)
C1—C2—C7—C6	−179.9 (2)	N2—C11—C12—C17	−109.0 (3)
C3—C2—C7—C8	−179.4 (2)	N2—C11—C12—C13	70.0 (3)
C1—C2—C7—C8	−0.8 (4)	C17—C12—C13—C14	1.2 (5)
C5—C6—C7—C2	−1.5 (4)	C11—C12—C13—C14	−177.9 (3)
C5—C6—C7—C8	179.4 (3)	C12—C13—C14—C15	−0.4 (6)
C2—C7—C8—C9	14.7 (3)	C13—C14—C15—C16	−0.3 (5)
C6—C7—C8—C9	−166.2 (2)	C14—C15—C16—C17	0.3 (5)
C18—N1—C9—C8	−170.9 (2)	C13—C12—C17—C16	−1.1 (4)
C1—N1—C9—C8	68.7 (2)	C11—C12—C17—C16	177.9 (3)
C18—N1—C9—C10	−52.2 (3)	C15—C16—C17—C12	0.4 (5)

Hydrogen-bond geometry (Å, °)

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
N2—H2···O1$^{\rm i}$	0.96 (2)	1.92 (2)	2.852 (3)	165 (3)

Symmetry codes: (i) *y*, −*x*+*y*+1, *z*−1/6.

Fig. 1

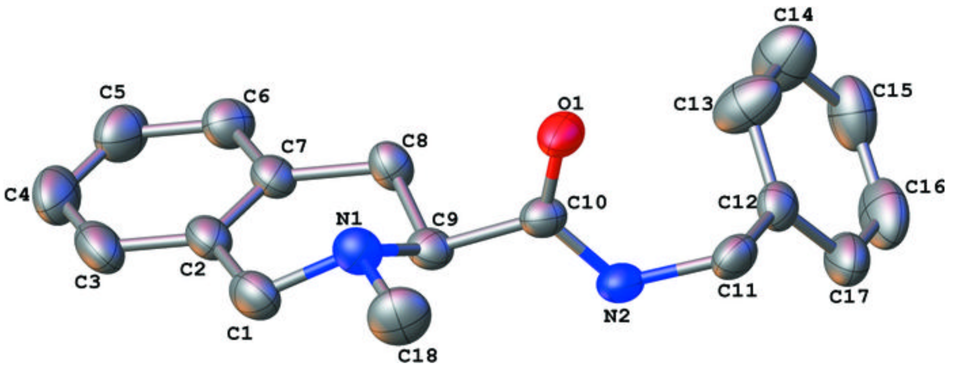

C14
C5
C6
O1
C13
C15
C7
C8
C4
C10
C12
C16
N1
C9
C2
C3
N2
C11
C17
C1
C18

Fig. 2