2-Amino-7,7-dimethyl-5-oxo-4-phenyl-1,4,5,6,7,8-hexahydroquinoline-3-carbonitrile hemihydrate

Shujiang Tu,* Jinpeng Zhang, Xiaotong Zhu, Jianing Xu and Qian Wang

Department of Chemistry, Xuzhou Normal University, Xuzhou 221116, People's Republic of China

Correspondence e-mail: laotu2001@263.net

The title compound, $C_{18}H_{19}N_3O\cdot0.5H_2O$, was synthesized by the reaction of benzaldehyde with malononitrile, dimedone and ammonium acetate under microwave irradiation. X-ray analysis reveals that in both crystallographically independent molecules in the asymmetric unit, the dihydropyridine rings adopt distorted boat conformations and the cyclohexene rings adopt envelope conformations.

Comment

The design and synthesis of 1,4-dihydropyridines has attracted much attention over the past 30 years due to the calcium antagonist effect they display (Mayler, 1989). The establishment of the pharmacological action as drugs for the treatment of cardiovascular diseases such as angina, hypertension or arrhythmia was mainly based on the structural studies carried out by X-ray diffraction on differently substituted 1,4-dihydropyridines (Triggle *et al.*, 1989). In this paper, we report the crystal structure of the title compound, (I).
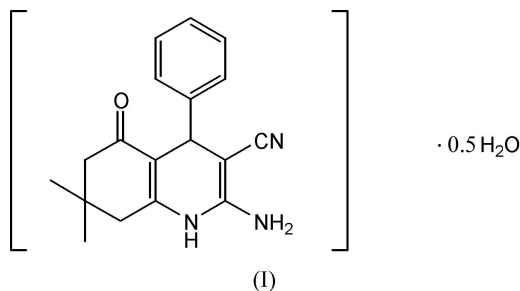
The asymmetric unit of (I) contains two molecules of the quinoline derivative and one water molecule (Fig. 1). The
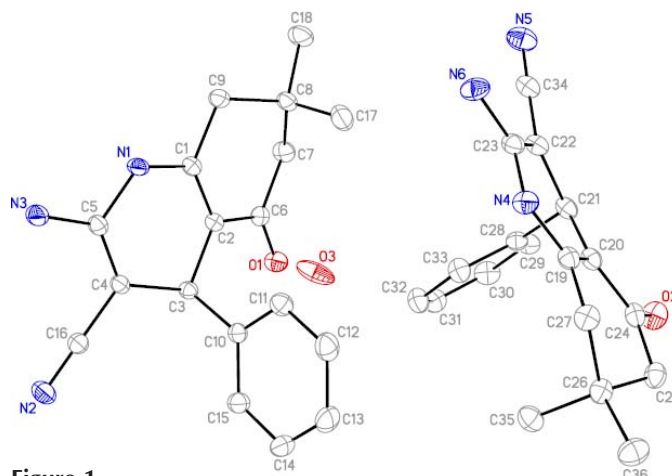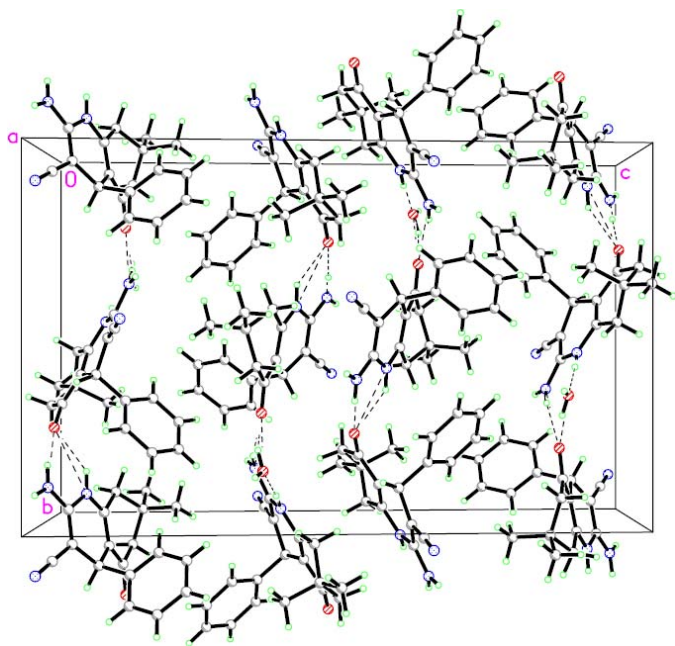

Figure 1
The asymmetric unit of (I), showing 30% probability displacement ellipsoids and the atom-numbering scheme. H atoms have been omitted.

Figure 2
The molecular packing of (I), viewed along the *a* axis. Dashed lines indicate hydrogen bonds.

corresponding bond distances and angles agree with each other (Table 1). In one molecule, the pyridine ring adopts a distorted boat conformation, with atoms N1 and C3 deviating from the C1/C2/C4/C5 plane by 0.088 (3) and 0.247 (3) Å, respectively [atoms N4 and C21 deviate from the C19/C20/C22/C23 plane by 0.070 (3) and 0.257 (3) Å, respectively, in the other molecule]. In both molecules, the cyclohexene rings adopt envelope conformations; atom C8 deviates from the C1/C2/C6/C7/C9 plane by 0.638 (3) Å and atom C26 deviates from the C19/C20/C24/C25/C27 plane by 0.652 (3) Å. The dihedral angle between the C1/C2/C4/C5 plane and the C10—C15 benzene ring is 83.58 (7)° [86.29 (8)° in the other molecule]. The crystal packing shows that intermolecular O—H···O, O—H···N, N—H···O and N—H···N hydrogen bonds (Table 2) form a three-dimensional network (Fig. 2).

Experimental

Compound (I) was prepared by the reaction of benzaldehyde (1 mmol) with malononitrile (1 mmol), ammonium acetate (3 mmol) and dimedone (1 mmol) under microwave irradiation (yield 85%; m.p. 553–554 K). Single crystals of (I) suitable for X-ray diffraction were obtained by slow evaporation of an ethanol solution.

Crystal data

$C_{18}H_{19}N_3O\cdot0.5H_2O$	$D_x = 1.265$ Mg m^{-3}
$M_r = 302.37$	Mo $K\alpha$ radiation
Monoclinic, $P2_1/c$	Cell parameters from 12424
$a = 9.1652$ (13) Å	reflections
$b = 14.716$ (2) Å	$\theta = 3.1$–27.5°
$c = 23.596$ (3) Å	$\mu = 0.08$ mm^{-1}
$\beta = 93.918$ (4)°	$T = 193$ (2) K
$V = 3175.1$ (7) Å^3	Block, yellow
$Z = 8$	$0.48 \times 0.39 \times 0.20$ mm

Data collection

Rigaku Mercury diffractometer	5982 reflections with $I > 2\sigma(I)$
ω scans	$R_{int} = 0.043$
Absorption correction: multi-scan	$\theta_{max} = 27.5°$
(Jacobson, 1998)	$h = -11 \rightarrow 11$
$T_{min} = 0.962$, $T_{max} = 0.984$	$k = -19 \rightarrow 19$
35240 measured reflections	$l = -25 \rightarrow 30$
7266 independent reflections	

Refinement

Refinement on F^2	$w = 1/[\sigma^2(F_o^2) + (0.0465P)^2$
$R[F^2 > 2\sigma(F^2)] = 0.068$	$+ 1.3409P]$
$wR(F^2) = 0.143$	where $P = (F_o^2 + 2F_c^2)/3$
$S = 1.17$	$(\Delta/\sigma)_{max} = 0.001$
7266 reflections	$\Delta\rho_{max} = 0.22$ e Å^{-3}
419 parameters	$\Delta\rho_{min} = -0.28$ e Å^{-3}
H atoms treated by a mixture of independent and constrained refinement	

Table 1
Selected bond lengths (Å).

O1—C6	1.237 (2)	N5—C34	1.155 (3)
O2—C24	1.233 (2)	N6—C23	1.352 (2)
N1—C1	1.367 (2)	C1—C2	1.353 (3)
N1—C5	1.380 (2)	C4—C5	1.363 (3)
N2—C16	1.154 (2)	C4—C16	1.411 (3)
N3—C5	1.343 (2)	C19—C20	1.358 (3)
N4—C19	1.366 (2)	C22—C23	1.367 (3)
N4—C23	1.378 (3)	C22—C34	1.413 (3)

Table 2
Hydrogen-bonding geometry (Å, °).

D—H···A	D—H	H···A	D···A	D—H···A
N1—H1···O2^i	0.88	2.14	2.892 (2)	144
N3—H3A···N2^{ii}	0.88	2.15	2.990 (2)	159
N3—H3B···O2^i	0.88	2.14	2.927 (2)	148
O3—H3C···O1	0.85 (1)	2.02 (2)	2.763 (2)	146 (3)
O3—H3D···N5^{iii}	0.84 (1)	2.16 (2)	2.935 (3)	152 (3)
N4—H4···O3^i	0.88	1.87	2.744 (2)	174
N6—H6B···O1^i	0.88	2.09	2.911 (2)	156

Symmetry codes: (i) $1 - x, y - \frac{1}{2}, \frac{1}{2} - z$; (ii) $-x, 1 - y, 1 - z$; (iii) $2 - x, \frac{1}{2} + y, \frac{1}{2} - z$.

Water H atoms were located in a difference Fourier map and were refined isotropically, with O—H and H···H distance restraints of 0.84 (1) and 1.37 (2) Å, respectively. All other H atoms were placed in geometrically idealized positions (N—H = 0.88 Å and C—H = 0.95–1.00 Å) and allowed to ride on their parent atoms, with the U_{iso}(H) values set at $1.5U_{eq}$(C) for the methyl H atoms and at $1.2 U_{eq}$(C) for other H atoms.

Data collection: *CrystalClear* (Rigaku, 1999); cell refinement: *CrystalClear*; data reduction: *CrystalStructure* (Rigaku/MSC, 2000–2003); program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997a); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997a); molecular graphics: *SHELXTL* (Sheldrick, 1997b); software used to prepare material for publication: *SHELXTL*.

Medicinal Plants of Jiangsu Province (No. 01AXL 14) for financial support.

References

Jacobson, R. (1998). Private communication to the Rigaku Corporation, Tokyo, Japan.

Mayler, W. G. (1989). *Calcium Antagonist*. London: Academic Press.

Rigaku (1999). *CrystalClear*. Rigaku Corporation, Tokyo, Japan.

Rigaku/MSC (2000–2003). *CrystalStructure*. Rigaku/MSC, 9009 New Trails Drive, The Woodlands, TX 77381-5209, USA.

Sheldrick, G. M. (1997a). *SHELXS97* and *SHELXL97*. University of Göttingen, Germany.

Sheldrick, G. M. (1997b). *SHELXTL*. Version 5.1. Bruker AXS Inc., Madison, Wisconsin, USA.

Triggle, D. J., Langs, D. A. & Jamis, R. A. (1989). *Med. Res. Rev.* **9**, 123–180.