

Dimethyl 4-{4-[2-(dimethylamino)ethoxy]-phenyl}-2,6-dimethyl-1,4-dihydropyridine-3,5-dicarboxylate

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Key indicators

Single-crystal X-ray study

T = 293 K

Mean $\sigma(C-C) = 0.002 \text{ \AA}$

R factor = 0.045

wR factor = 0.136

Data-to-parameter ratio = 13.8

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

In the molecule of the title compound, $C_{21}H_{28}N_2O_5$, the substituted 1,4-dihydropyridine (1,4-DHP) ring has a flattened-boat conformation. The carbonyl groups of the ester groups, at positions 3 and 5 in the 1,4-DHP ring, have *cis* configurations with respect to the double bonds in the 1,4-DHP ring. In the solid state, the molecules are linked by intermolecular $N-H \cdots N$ hydrogen bonds, which run parallel to the *c* axis with a graph-set motif $C(13)$. Weak inter- and intramolecular $C-H \cdots O$ interactions are also observed.

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Comment

Compounds containing the 1,4-dihydropyridine (1,4-DHP) entity exhibit calcium-antagonistic activity and are prescribed as drugs in the treatment of a variety of cardiovascular disorders, such as angina and hypertension (Triggle *et al.*, 1989). The present paper reports the structure and conformation of the title compound, (I), which was determined as a continuation of our investigation of a series of 1,4-DHP derivatives to determine the conformational changes due to different substituents effected at the 3-, 4- and 5-positions (Sundar, Parthasarathi, Bansal & Sridhar, 2006; Sundar, Parthasarathi, Narang *et al.*, 2006).

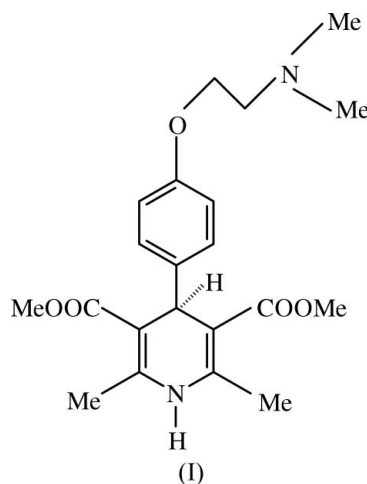


Fig. 1 shows the molecular structure of (I) with the atomic numbering scheme. The bond lengths and angles of the 1,4-DHP ring (Table 1) are comparable with those reported for similar structures (Sundar, Parthasarathi, Bansal & Sridhar, 2006; Sundar, Parthasarathi, Narang *et al.*, 2006). The substituted 1,4-DHP ring has a flattened-boat conformation [puckering parameters (Cremer & Pople, 1975) $Q = 0.342(2) \text{ \AA}$, $q_2 = 0.329(2) \text{ \AA}$, $q_3 = 0.096(2) \text{ \AA}$, $\theta = 73.7(3)^\circ$ and $\varphi = 180.7(3)^\circ$ for the atom sequence $N1/C2/C3/C4/C5/C6$]. Atoms N1 and C4 deviate by 0.169(2) and 0.409(2) \AA , respectively, from the

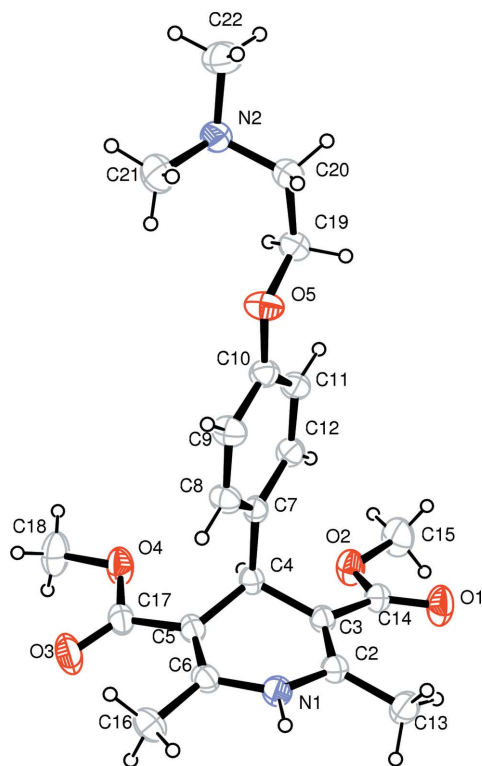


Figure 1
The molecular structure of (I), with the atom-labelling scheme. Displacement ellipsoids are drawn at the 30% probability level and H atoms are shown as circles of arbitrary radii.

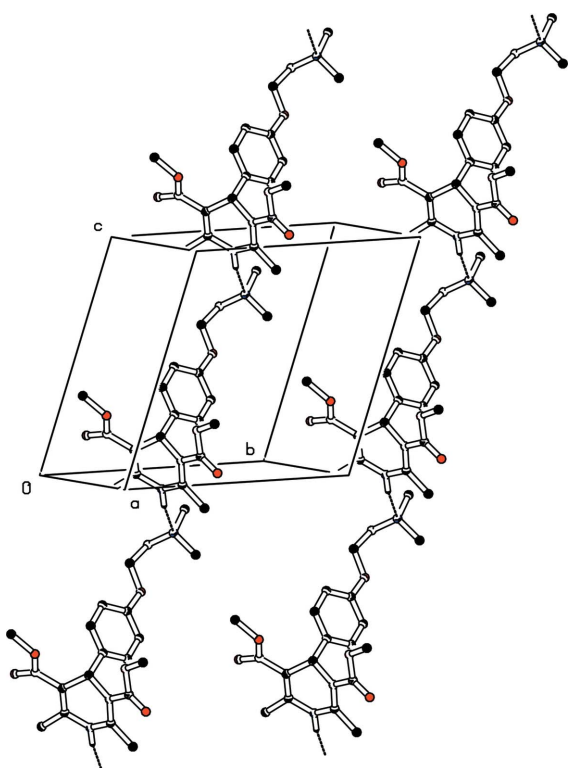


Figure 2
Part of the crystal structure of (I), showing the intermolecular N—H...N interactions linking the molecules into a chain running parallel to the *c* axis. Thin lines indicate hydrogen bonds.

base of the boat. The mean plane of the 1,4-DHP ring, defined by the atoms C2, C3, C5 and C6, makes angles of 27.9 (1) and 14.8 (2)° with the C3/C4/C5 and C2/N1/C6 planes, respectively.

In compound (I), the sum of the absolute values of the internal torsion angles of the 1,4-DHP ring, which is a measure of the planarity, is 19.99 (8)°, suggesting that the compound may share the moderate pharmacological activity of similar compounds (Rowan & Holt, 1996). The mean plane of the 1,4-DHP ring is almost perpendicular to the benzene ring substituted at C4, with a dihedral angle of 82.9 (1)°. Both carbonyl groups of the ester groups, at positions 3 and 5 in the 1,4-DHP ring, are *cis* with respect to the double bonds in the 1,4-DHP ring, as is evident from the torsion angles C2—C3—C14—O1 [−18.9 (3)°] and C6—C5—C17—O3 [−5.7 (3)°].

In the solid state, the molecules are linked by intermolecular N—H...N hydrogen bonds and weak inter- and intramolecular C—H...O interactions (Table 2). The N—H...N interaction links the molecules into chains, which run parallel to the *c* axis with a graph-set motif of C(13) (Bernstein *et al.*, 1995) (Fig. 2).

Experimental

2-(Dimethylamino)chloroethane hydrochloride (0.9 g, 6.30 mmol) was added to a stirred and refluxing suspension of dimethyl 4-(4-hydroxyphenyl)-2,6-dimethyl-1,4-dihydropyridine-3,5-dicarboxylate (1.0 g, 3.15 mmol) and anhydrous potassium carbonate (2 g) in ethyl methyl ketone (35 ml). The reaction mixture was further refluxed with continuous stirring and the completion of the reaction was monitored with thin-layer chromatography. After 6 h, the resulting slurry was filtered off and the solvent was removed under reduced pressure to yield a sticky residue, which was crystallized from a mixture of diethyl ether and ethyl acetate (9:1) to afford the title compound, (I) (yield 0.56 g, 45.78%; m.p. 442–444 K).

Crystal data

$C_{21}H_{28}N_2O_5$	$V = 1030.97 (11) \text{ \AA}^3$
$M_r = 388.45$	$Z = 2$
Triclinic, $P\bar{1}$	$D_x = 1.251 \text{ Mg m}^{-3}$
$a = 8.4072 (5) \text{ \AA}$	Mo $K\alpha$ radiation
$b = 11.2593 (7) \text{ \AA}$	$\mu = 0.09 \text{ mm}^{-1}$
$c = 11.5788 (7) \text{ \AA}$	$T = 293 (2) \text{ K}$
$\alpha = 71.036 (1)^\circ$	Block, brown
$\beta = 86.840 (1)^\circ$	$0.10 \times 0.06 \times 0.05 \text{ mm}$
$\gamma = 84.209 (1)^\circ$	

Data collection

Bruker SMART APEX CCD area-detector diffractometer	3617 independent reflections
ω scans	3131 reflections with $I > 2\sigma(I)$
Absorption correction: none	$R_{\text{int}} = 0.018$
10002 measured reflections	$\theta_{\text{max}} = 25.0^\circ$

Refinement

Refinement on F^2	$w = 1/[\sigma^2(F_o^2) + (0.0785P)^2 + 0.1721P]$
$R[F^2 > 2\sigma(F^2)] = 0.045$	where $P = (F_o^2 + 2F_c^2)/3$
$wR(F^2) = 0.136$	$(\Delta/\sigma)_{\text{max}} < 0.001$
$S = 1.06$	$\Delta\rho_{\text{max}} = 0.21 \text{ e \AA}^{-3}$
3617 reflections	$\Delta\rho_{\text{min}} = -0.12 \text{ e \AA}^{-3}$
263 parameters	
H atoms treated by a mixture of independent and constrained refinement	

Table 1

Selected geometric parameters (Å, °).

N1—C2	1.380 (2)	C4—C5	1.5124 (19)
C2—C3	1.351 (2)	C5—C6	1.348 (2)
C3—C4	1.5224 (19)		
C2—N1—C6	122.58 (13)	C5—C4—C3	109.78 (12)
C3—C2—N1	118.95 (13)	C6—C5—C4	119.43 (13)
C2—C3—C4	119.19 (12)	C5—C6—N1	118.98 (14)

Table 2

Hydrogen-bond geometry (Å, °).

<i>D</i> —H... <i>A</i>	<i>D</i> —H	H... <i>A</i>	<i>D</i> ... <i>A</i>	<i>D</i> —H... <i>A</i>
N1—H1...N2 ⁱ	0.93 (2)	2.25 (2)	3.136 (2)	159.7 (15)
C4—H4...O2	0.98	2.33	2.7503 (18)	105
C13—H13B...O1	0.96	2.20	2.885 (2)	128
C21—H21C...O5	0.96	2.52	3.087 (3)	118
C22—H22C...O3 ⁱⁱ	0.96	2.57	3.504 (3)	165

Symmetry codes: (i) *x*, *y*, *z* − 1; (ii) *x* − 1, *y*, *z* + 1.

Methyl H atoms were constrained to an ideal geometry (C—H = 0.96 Å), with $U_{\text{iso}}(\text{H}) = 1.5 U_{\text{eq}}(\text{C})$, but were allowed to rotate freely about their C—C bonds. Atom H1 attached to atom N1 was located in a difference map and refined isotropically. All remaining H atoms were placed in geometrically idealized positions, with C—H = 0.93–0.98 Å, and were constrained to ride on their parent atoms with $U_{\text{iso}}(\text{H}) = 1.2 U_{\text{eq}}(\text{C})$.

Data collection: *SMART* (Bruker, 2001); cell refinement: *SAINTE* (Bruker, 2001); data reduction: *SAINTE*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *ORTEP-3* (Farrugia, 1997) and *PLATON* (Spek, 2003); software used to prepare material for publication: *SHELXL97* and *PARST* (Nardelli, 1995).

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