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Diethyl 2-methyl-6-(2-thiazolidinyl)-4-(2-thienyl)-1,4-dihydropyridine-3,5-dicarboxylate

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Key indicators

Single-crystal X-ray study
T = 293 K
Mean σ(C–C) = 0.004 Å
R factor = 0.055
wR factor = 0.125
Data-to-parameter ratio = 21.6

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

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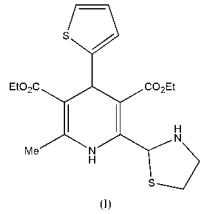
In the title compound, $C_{19}H_{24}N_2O_4S_2$, the substituted 1,4-dihydropyridine ring has a flat-boat conformation. The two ethoxycarbonyl groups are twisted in the same direction and the plane of the 2-thiophene ring is almost perpendicular to the 1,4-dihydropyridine ring.

Comment

1,4-Dihydropyridine (DHP) derivatives constitute a major class of calcium antagonists and have been a target of structure–activity relationship studies. Several crystallographic studies have correlated the pharmacological effects with the degree of puckering of DHP rings. Triggle and co-workers (Triggle *et al.*, 1980; Fossheim *et al.*, 1982; Janis & Triggle, 1983; Langs & Triggle, 1985) have identified some important structural requirements for biological activity which include: (*a*) the structural integrity of the DHP ring, (*b*) no substitution on the N atom at position 1, (*c*) the 2,6-positions to have alkyl substituents and the 3,5-positions to have ester substituents, (*d*) an aryl substituent at the 4 position of the DHP ring. We have studied the crystal structure of the title compound, (I), and present its structure here.



(I)

The molecular structure of (I) is shown in Fig. 1. The shortest intermolecular contact of 3.206 (3) Å is for N12···O13($-x$, $-y+2$, $-z$). The 1,4-DHP ring has a flat-boat conformation, with atoms N1 and C4 displaced by 0.180 (2) and 0.415 (3) Å, respectively, from the base of the boat. The 2-thiophene ring is nearly planar and is approximately perpendicular to the 1,4-DHP ring [dihedral angle 79.5 (1)°]. The 2-thiazolidine ring is twisted from the mean plane of the central 1,4-DHP mean plane by 56.4 (1)°. Both ester groups have *cis,cis* geometry with respect to the ring double bonds and are rotated slightly out of the 1,4-DHP plane, with a C6—C5—C22—O24 torsion angle of 177.3 (2)° and a C2—C3—C12—O14 torsion angle of −171.5 (2)°.

Experimental

The title compound, (I), was prepared by a condensation reaction of the starting diethyl 2-formyl-6-methyl-(2-thienyl)-1,4-dihydro-

pyridine-3,5-dicarboxylate (Marchalín *et al.*, 2001) with 2-aminoethanethiol. Yellow prismatic crystals of (I) were prepared by recrystallization from an ethanol solution.

Crystal data

$C_{19}H_{24}N_2O_4S_2$
M_r = 408.52
Triclinic, $P\overline{1}$
a = 8.9441 (18) Å
b = 11.222 (2) Å
c = 11.489 (2) Å
α = 69.21 (3)°
β = 71.47 (3)°
γ = 83.99 (3)°
V = 1022.0 (4) Å^3
Z = 2
D_x = 1.327 Mg m^{-3}
D_m = 1.33 (1) Mg m^{-3}
D_m measured by flotation in bromoform–hexane
Mo $K\alpha$ radiation
Cell parameters from 6596 reflections
θ = 12.4–28.6°
μ = 0.29 mm^{-1}
T = 293 (2) K
Prism, yellow
0.4 × 0.3 × 0.2 mm

Data collection

Oxford Diffraction Xcalibur CCD diffractometer
ω and φ scans
Absorption correction: none
6596 measured reflections
5344 independent reflections
2163 reflections with $I > 2\sigma(I)$
R_{int} = 0.032
θ_{max} = 29.1°
$h = -10 \rightarrow 12$
$k = -15 \rightarrow 15$
$l = -15 \rightarrow 15$

Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)]$ = 0.055
$wR(F^2)$ = 0.125
S = 0.96
5344 reflections
247 parameters
H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.0448P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.022
$\Delta\rho_{max}$ = 0.46 e Å^{-3}
$\Delta\rho_{min}$ = −0.48 e Å^{-3}

Table 1
Selected geometric parameters (Å, °).

C2—C3	1.346 (3)	C7—N12	1.439 (3)
C2—C7	1.517 (3)	C7—S8	1.861 (2)
C3—C4	1.517 (3)	C9—S8	1.806 (3)
C4—C17	1.524 (3)	C12—O13	1.204 (3)
C4—C5	1.527 (3)	C17—S18	1.717 (3)
C5—C6	1.343 (4)	C22—O23	1.205 (3)
C3—C2—N1	119.4 (2)	O23—C22—O24	121.8 (3)
C3—C4—C17	109.44 (19)	C2—N1—C6	122.3 (2)
C3—C4—C5	109.8 (2)	C9—S8—C7	92.38 (13)
C7—N12—C10	111.0 (2)	C19—S18—C17	92.42 (15)
O13—C12—O14	121.7 (2)		
C7—C2—C3—C4	169.4 (2)	C2—C3—C12—O14	−171.5 (2)
C2—C3—C4—C17	−89.3 (3)	C4—C5—C22—O23	171.9 (3)
C2—C3—C4—C5	34.2 (3)	C6—C5—C22—O24	177.3 (2)
C17—C4—C5—C6	90.9 (3)	C7—C2—N1—C6	161.5 (2)
S8—C7—N12—C10	−25.0 (2)	C5—C6—N1—C2	20.1 (3)
C4—C3—C12—O13	−170.6 (2)	C10—C9—S8—C7	20.1 (2)

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

D—H···A	D—H	H···A	D···A	D—H···A
N1—H1···N12	0.86	2.27	2.652 (2)	107

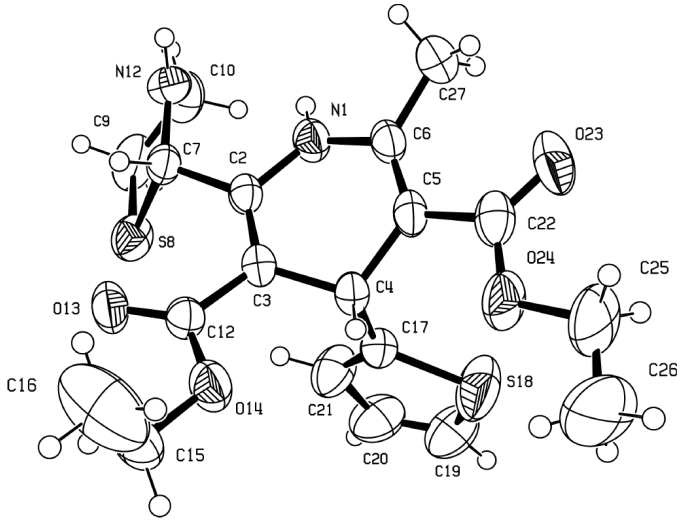


Figure 1
The molecular structure of (I), with the atomic numbering scheme. Displacement ellipsoids are drawn at the 50% probability level.

All H atoms were positioned geometrically and were treated as riding atoms (N—H = 0.86 Å and C—H = 0.93–0.98 Å), with U_{iso} values set at $1.2U_{eq}$ ($1.5U_{eq}$ for methyl) of the parent atom.

Data collection: *CrysAlisCCD* (Oxford Diffraction Limited, 2002); cell refinement: *CrysAlisRED* (Oxford Diffraction Limited, 2002); data reduction: *CrysAlisRED*; program(s) used to solve structure: *SHELXS*97 (Sheldrick, 1997); program(s) used to refine structure: *SHELXL*97 (Sheldrick, 1997); molecular graphics: *DIAMOND* (Brandenburg, 2001); software used to prepare material for publication: *SHELXL*97.

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