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Key indicators

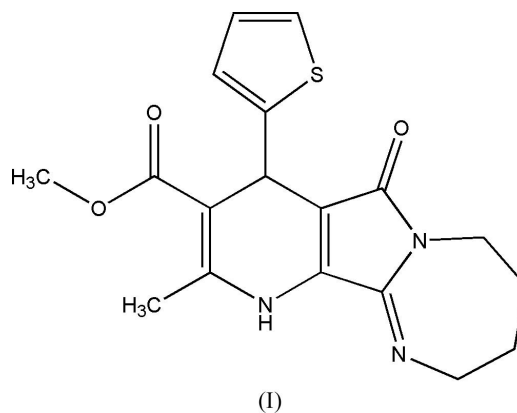
Single-crystal X-ray study
 $T = 298$ K
Mean $\sigma(\text{C}-\text{C}) = 0.004$ Å
 R factor = 0.058
 wR factor = 0.191
Data-to-parameter ratio = 15.2For details of how these key indicators were automatically derived from the article, see <http://journals.iucr.org/e>.

Methyl 2-methyl-5-oxo-4-(2-thienyl)-1,5,7,8,9,10-hexahydro-4H-pyrido[2',3':3,4]pyrrolo[1,2-a][1,3]-diazepine-3-carboxylate

The crystal structure of the title compound, $\text{C}_{18}\text{H}_{19}\text{N}_3\text{O}_3\text{S}$, is formed by single molecules linked by $\text{N}-\text{H}\cdots\text{O}$ hydrogen bonds into infinite linear chains along the ac diagonal. The thiophene ring is nearly planar and is approximately perpendicular to the mean plane of the 1,4-dihydropyridine ring. The ester group has a *trans* geometry with respect to the adjacent ring double bond. The dihydropyridine and pyrrole rings are coplanar.

Comment

A number of 4-aryl-1,4-dihydropyridine derivatives have been prepared and tested for cardiovascular activity. Some of them have been found to possess potent vasodilating activity due to their calcium-blocking effect and are now undergoing clinical trials or therapeutic use for the treatment of cardiovascular diseases (Triggle *et al.*, 1980; Natale *et al.*, 1990; Goldmann *et al.*, 1991; Alajarin *et al.*, 1995). In recent years, some examples of heterocyclic rings fused to the seven-membered diazepine ring system have been reported. Some of these compounds are known to have psychotropic activity (DeWald *et al.*, 1981; Chimirri *et al.*, 1993).



We have studied the crystal structure of the title compound, (I), and present it here. The X-ray analysis shows that the molecule contains a seven-membered diazepine ring fused to a pyrrolopyridine moiety (Fig. 1). The 1,3-diazepine ring exhibits a chair conformation. The displacements of atoms N6, C7 and C63 from the mean C61/C62/C64/N71 plane are 0.563 (2), 0.306 (2) and -0.721 (4) Å, respectively. The molecules are linked by an intermolecular hydrogen bond between N1—H1 and O5($\frac{1}{2} + x, \frac{1}{2} - y, \frac{1}{2} + z$) [$\text{N}\cdots\text{O} = 2.961$ (3) Å and $\text{N}-\text{H}\cdots\text{O} = 153.8$ (2) $^\circ$]. The 1,4-dihydropyridine ring has a conformation that is approximately half-way between that of a shallow boat and that of a half chair. Atoms N1 and C4 lie

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0.073 (2) and 0.217 (3) Å, respectively, from the mean plane defined by the remaining four atoms of the dihydropyridine ring. The thiophene ring is approximately perpendicular to the mean plane of the tricyclic part of the molecule. The dihedral angle between the mean planes of the 1,4-dihydropyridine and the thiophene rings is 86.69 (9)°. The ester group has a *trans* geometry with respect to the adjacent ring double bond and is rotated slightly out of the mean dihydropyridine C2/C3/C8/C9 plane, with a C2—C3—C31—O32 torsion angle of 9.0 (4)°. The carbonyl C5=O5 bond length of 1.227 (3) Å is somewhat longer than typical carbonyl bonds. This fact may be due to the involvement of atom O5 in an intermolecular C—H···O hydrogen bond.

Experimental

The title compound, (I), was prepared by a cyclocondensation reaction of 2-formyl-1,4-dihydropyridine with 1,4-butanediamine. A mixture of dimethyl 2-formyl-6-methyl-4-(thien-2-yl)-1,4-dihydropyridine-3,5-dicarboxylate (0.74 g, 2.3 mmol) and 1,4-butanediamine (0.20 g, 2.3 mmol) in methanol (10 ml) was treated with a catalytic amount of potassium *tert*-butoxide and the mixture was refluxed for 3 h. After cooling, the resulting precipitate of the tricyclic title compound was collected by filtration and recrystallized from methanol. Crystals were obtained in a yield of 61% (0.50 g). Yellow prismatic single crystals were prepared by recrystallization from a methanol solution (m.p. 493–495 K). Analysis calculated for C₁₈H₁₉N₃O₃S: C 60.49, H 5.36, N 11.76%; found: C 60.28, H 5.30, N 11.59%. IR (KBr): 3266 (N—H), 2944 (C—H), 1698, 1663 (C=O), 1501, 1397, 1366, 1265, 1240, 1190, 1084 cm⁻¹; ¹H NMR: δ 1.77–1.93 (*m*, 4H, 2 × CH₂), 2.40 (*s*, 3H, CH₃), 3.50–3.59 (*m*, 2H, N-CH₂), 3.63 (*s*, 3H, OCH₃), 3.60–3.66 (*m*, 2H, CH₂—N), 5.31 (*s*, 1H, H4), 6.82–6.90 (*m*, 3H, H3', 4' and NH), 7.09 (*t*, 1H, H5', *J* = 3.4 Hz); EIMS, *m/z*: (*M*⁺, 357).

Crystal data

C ₁₈ H ₁₉ N ₃ O ₃ S	<i>D</i> _x = 1.363 Mg m ⁻³
<i>M</i> _r = 357.42	Mo <i>K</i> α radiation
Monoclinic, <i>P</i> ₂ ₁ / <i>n</i>	Cell parameters from 43 reflections
<i>a</i> = 10.050 (3) Å	<i>θ</i> = 40.1–44.9°
<i>b</i> = 16.492 (5) Å	<i>μ</i> = 0.21 mm ⁻¹
<i>c</i> = 10.737 (5) Å	<i>T</i> = 298 (2) K
<i>β</i> = 101.94 (2)°	Prism, yellow
<i>V</i> = 1741.2 (11) Å ³	0.60 × 0.50 × 0.40 mm
<i>Z</i> = 4	

Data collection

Stoe STADI-4 diffractometer	<i>θ</i> _{max} = 26.1°
Profile-fitted <i>θ</i> / <i>2θ</i> scans	<i>h</i> = -12 → 12
Absorption correction: <i>ψ</i> scan (North <i>et al.</i> , 1968)	<i>k</i> = 0 → 20
<i>T</i> _{min} = 0.885, <i>T</i> _{max} = 0.921	<i>l</i> = 0 → 13
3436 measured reflections	3 standard reflections
3436 independent reflections	frequency: 120 min
2379 reflections with <i>F</i> ² > 2σ(<i>F</i> ²)	intensity decay: none

Refinement

Refinement on <i>F</i> ²	$w = 1/[\sigma^2(F_o^2) + (0.0977P)^2 + 0.9592P]$
$R[F^2 > 2\sigma(F^2)] = 0.058$	where $P = (F_o^2 + 2F_c^2)/3$
$wR(F^2) = 0.191$	(Δ/σ) _{max} < 0.001
<i>S</i> = 1.06	$\Delta\rho_{max} = 0.37 \text{ e } \text{Å}^{-3}$
3436 reflections	$\Delta\rho_{min} = -0.37 \text{ e } \text{Å}^{-3}$
226 parameters	
H-atom parameters constrained	

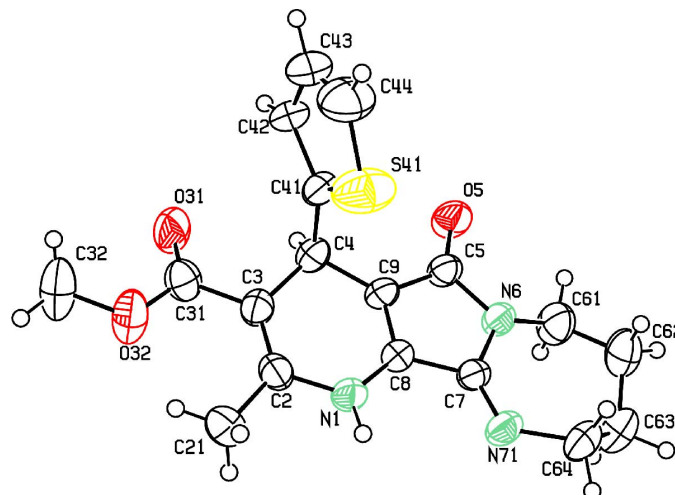


Figure 1
The molecular structure of (I), with the atomic numbering scheme. Displacement ellipsoids are drawn at the 50% probability level.

Table 1

Selected geometric parameters (Å, °).

S41—C44	1.676 (4)	N71—C7	1.261 (3)
S41—C41	1.689 (3)	N71—C64	1.465 (4)
N1—C8	1.351 (3)	C3—C31	1.481 (4)
N1—C2	1.407 (3)	C3—C4	1.531 (4)
N6—C5	1.398 (3)	C4—C41	1.506 (4)
N6—C61	1.473 (3)	C7—C8	1.481 (3)
C44—S41—C41	93.10 (19)	C9—C4—C3	108.3 (2)
C8—N1—C2	119.0 (2)	N6—C7—C8	104.9 (2)
C5—N6—C61	119.3 (2)	O31—C31—C3	122.3 (3)
C7—N71—C64	123.3 (2)	C43—C42—C41	104.3 (3)
C2—C3—C4—C41	-105.8 (3)	C4—C3—C31—O31	11.2 (4)
O5—C5—C9—C8	177.7 (3)	C2—C3—C31—O32	9.0 (4)
C32—O32—C31—O31	0.0 (5)	C3—C4—C41—S41	73.2 (3)

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

Data collection: *DIF4* (Stoe & Cie, 1991); cell refinement: *DIF4*; data reduction: *REDU4* (Stoe & Cie, 1993); program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *ORTEPII* (Johnson, 1976); software used to prepare material for publication: *SHELXL97*.

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References

- Alajarin, R., Vaguero, J. J., Alvarez-Builla, J., Pastor, M., Sunkel, C., Fau de Casa-Juana, M., Priego, J., Statkow P. R., Sanz-Aparicio, J. & Fonseca, I. (1995). *J. Med. Chem.* **38**, 2830–2841.
- DeWald, H. A., Lobbestaell, S. & Poschel, B. P. H. (1981). *J. Med. Chem.* **24**, 982–987.
- Chimirri, A., Gitto, R., Grasso, S., Monforte, A. M., Romeo, G. & Zappala, M. (1993). *Heterocycles*, **36**, 865–890.
- Goldmann, S., Born, L., Kazda, S., Pittel, B. & Schramm, M. (1990). *J. Med. Chem.* **33**, 1413–1418.

- Johnson, C. K. (1976). *ORTEP II*. Report ORNL-5138. Oak Ridge National Laboratory, Tennessee, USA.
- Natale, N. R., Triggle, D. J., Palmer, R. B., Lefler, B. J. & Edwards, W. D. (1990). *J. Med. Chem.* **33**, 2255–2259.
- North, A. C. T., Phillips, D. C. & Mathews, F. S. (1968). *Acta Cryst.* **A24**, 351–359.
- Stoe & Cie (1991). *DIF4* (Version 7.08). Stoe & Cie, Darmstadt, Germany.
- Stoe & Cie (1993). *REDU4*. Version 7.08. Stoe & Cie, Darmstadt, Germany.
- Sheldrick, G. M. (1997). *SHELXS97* and *SHELXL97*. University of Göttingen, Germany.
- Triggle, A. M., Shefter, E. & Triggle, D. J. (1980). *J. Med. Chem.* **23**, 1442–1445.