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2-[6-(3-Chlorophenyl)-2,4-dioxoperhydropyrimidin-3-yl]ethyl morpholine-4-carbodithioate

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In the title compound, $C_{17}H_{20}ClN_3O_3S_2$, the hexahydropyrimidine ring is puckered, the total puckering amplitude Q_T being 0.41 (1) Å. The morpholine ring displays orientational disorder. Molecules are linked in the crystal *via* N—H···O and C—H···O interactions to form infinite chains.

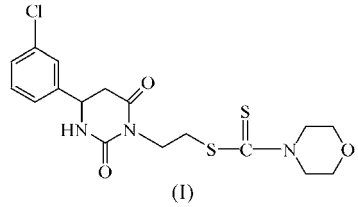
Comment

Although there are a number of antiepileptic drugs currently available, the development of more efficient compounds with lower toxicity remains a requirement for improved antiepileptic drug treatments (Brodie, 2001). In the last decade, new anticonvulsant compounds have emerged, with substantially different structures from the classical anticonvulsant drugs, in that they contain the ureido structure (Bialer *et al.*, 2002). For example, 3-substituted-6-arylhexahydropyrimidine-2,4-dione derivatives with a ureido structure have been reported as a new group of compounds found to be active in anticonvulsant therapy (Guillon *et al.*, 1996; Çalış & Köksal, 2001; Septioğlu *et al.*, 2004).

It is well known that pyrimidine derivatives have various pharmacological activities, such as diuretic, antihypertensive, anti-inflammatory, antiepileptic and anticancer properties (Skulnick *et al.*, 1986; Guillon *et al.*, 1996; Sanyal *et al.*, 1986). In addition, pyrimidine derivatives have been shown to have potential bacteriostatic, fungicidal and antiviral activities (Skulnick *et al.*, 1986; Özalp *et al.*, 2000).

In previous studies, we synthesized some new 3-alkyl-6-arylhexahydropyrimidine-2,4-dione derivatives and investigated their antimicrobial (Özalp *et al.*, 2000) and anticonvulsant activities (Çalış & Köksal, 2001). At the same time, 6-arylhexahydropyrimidine-2,4-dione derivatives with a mercapto group at the 3-position were found to be protective against subcutaneous metrazole (Guillon *et al.*, 1996).

Over the past 30 years, numerous dithiocarbamate derivatives have been synthesized and their pharmacological activities reported to be antibacterial, antifungal, antiviral, herbicidal, tubercolostatic and anticholinergic (Gupta & Garg, 1965; Kumar & Reddy, 1985; Chabric *et al.*, 1956; Ramrakhyani & Shukla, 1980; Weuffen & Kewitsch, 1967; Zsolnai, 1968; Çalış *et al.*, 1993).



(I)

These previous studies led us to synthesize several derivatives of 6-arylhexahydropyrimidine-2,4-dione with a dithiocarbamate functional group at the 3-position of the hexahydropyrimidine-2,4-dione ring. In this paper, we report the structure of one of these, the title compound, (I).

In the molecule of (I), the four C—N bond distances in the hexahydropyrimidine ring show a rather wide variation [1.3405 (17)–1.4592 (17) Å; Table 1]. These distances are somewhat longer than the mean value of 1.333 Å for pyrimidines in general (Allen *et al.*, 1987). The hexahydropyrimidine ring exhibits a puckered conformation, with puckering parameters (Cremer & Pople, 1975) q_2 = 0.3652 (14) Å, q_3 = −0.1931 (13) Å, Q_T = 0.4132 (15) Å, φ = 92.72 (2)° and θ = 117.87 (18)°. The largest deviations from the best plane are −0.256 (2) Å for C5 and 0.266 (2) Å for C6, and the ring makes a dihedral angle of 85.94 (4)° with the benzene ring.

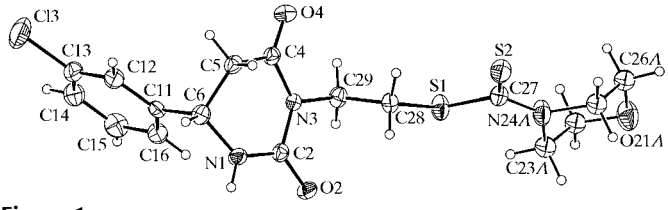


Figure 1
The molecular structure of (I), showing the atom-numbering scheme. Displacement ellipsoids are drawn at the 30% probability level and H atoms are shown as small spheres of arbitrary radii. For clarity, only the *A* component of the disordered morpholine ring is shown.

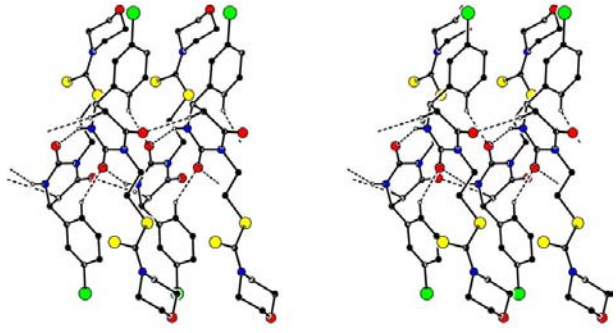


Figure 2
A stereoview of part of the crystal structure of (I). Molecules are linked by N—H···O and C—H···O hydrogen bonds to form a spiral chain extending along the *b* direction (horizontal). As in Fig. 1, only the *A* component of the disordered morpholine ring is shown.

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In the crystal structure of (I), the molecules are connected *via* N—H···O and C—H···O interactions to form infinite spiral chains extending along the *b* axis (Fig. 2 and Table 2).

Experimental

The potassium salt of the appropriate *N*,*N*-disubstituted dithiocarbamic acid (0.002 mol) was dissolved in methanol (25 ml) with constant stirring. 6-Aryl-3-(2-chloroethyl)hexahydropyrimidine-2,4-dione (0.002 mol) was added in portions to this solution. The mixture was heated for 3 h under reflux, after which the precipitate was filtered off, the solution concentrated *in vacuo*, and the precipitate which formed filtered off and crystallized from methanol (yield 64%; m.p. 415–416 K). Elemental analysis calculated: C 49.33, H 4.87, N 10.15, S 15.49%; found: C 49.71, H 5.31, N 10.02, S 14.82%. UV (MeOH), λ_{max} (log ε): 201.0 (4.48), 255.0 (3.90), 282.0 (3.94); IR (KBr, ν, cm^{-1}): 3308 (N—H), 1719–1673 (C—O), 1271 (C—S); ^{1}H NMR (DMSO-d_6, δ): 2.10 (*t*, 2H, –N—CH_2), 2.80 (*d*, 2H, –CH_2), 3.30 (*t*, 2H, –CH_2S–), 3.60–4.00 (*m*, 8H, morpholine), 4.80 (*d*, 1H, –CH–), 7.20–7.40 (*m*, 4H, aromatic), 8.40 (*s*, 1H, –NH).

Crystal data

$C_{17}H_{20}ClN_3O_3S_2$
M_r = 413.93
Monoclinic, $P2_1/c$
a = 10.2010 (12) Å
b = 5.0606 (4) Å
c = 36.290 (5) Å
β = 99.692 (10)°
V = 1846.6 (4) Å^3
Z = 4
D_x = 1.489 Mg m^{-3}
Mo $K\alpha$ radiation
Cell parameters from 5107 reflections
θ = 2.0–27.5°
μ = 0.46 mm^{-1}
T = 293 (2) K
Plate, colourless
0.50 × 0.20 × 0.02 mm

Data collection

Stoe IPDS-2 diffractometer
ω scans
13 939 measured reflections
3610 independent reflections
1270 reflections with $I > 2\sigma(I)$
R_{int} = 0.116
θ_{max} = 26.0°
$h = -12 \rightarrow 12$
$k = -6 \rightarrow 6$
$l = -44 \rightarrow 44$

Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)]$ = 0.032
$wR(F^2)$ = 0.121
S = 1.02
4241 reflections
237 parameters
H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.0756P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.003
$\Delta\rho_{max}$ = 0.25 e Å^{-3}
$\Delta\rho_{min}$ = −0.66 e Å^{-3}

Table 1
Selected geometric parameters (Å, °).

S1—C27	1.7621 (16)	N1—C6	1.4592 (17)
S1—C28	1.7875 (14)	N3—C2	1.3993 (16)
S2—C27	1.6530 (16)	N3—C4	1.4003 (15)
O2—C2	1.2201 (15)	C4—C5	1.4873 (18)
O4—C4	1.1974 (17)	C5—C6	1.5249 (19)
N1—C2	1.3405 (17)		
S1—C28—C29—N3	170.24 (9)		

Atoms O21, C22, C23, N24, C25 and C26 of the morpholine moiety show positional disorder, corresponding to an approximate 180° rotation about the O21···N24 axis. The two components of this disordered ring have the usual chair conformation, with site-occupancy factors of 0.5. The atoms of the two components are labelled with the suffixes *A* and *B*. A total of 12 restraints were used in the refinement. These were associated with ensuring reasonable geometry for the two morpholine rings. The anisotropic displacement parameters of the slightly disordered morpholine O and N atoms were constrained using *SHELXL*97 EADP commands (Sheldrick, 1997). The greatest deviation from the best ring plane are −0.256 (2) and 2.66 (2) Å for atoms C5 and C6, respectively. The disordered morpholine C atoms were refined isotropically. All H atoms were positioned geometrically and refined using a riding model, with N—H = 0.86 Å and C—H = 0.93–0.97 Å, and U_{iso}(H) = 1.2U_{eq} or 1.5U_{eq}(C,N).

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

D—H···A	D—H	H···A	D···A	D—H···A
N1—H1···O2^{i}	0.86	2.26	3.0598 (15)	154
C16—H16···O2^{ii}	0.93	2.37	3.1991 (18)	149
C5—H5B···O4^{iii}	0.97	2.53	3.4483 (18)	157

Symmetry codes: (i) $1-x, y-\frac{1}{2}, \frac{3}{2}-z$; (ii) $1-x, \frac{1}{2}+y, \frac{3}{2}-z$; (iii) $x, y-1, z$.

Data collection: *X-AREA* (Stoe & Cie, 2002); cell refinement: *X-AREA*; data reduction: *X-RED*32 (Stoe & Cie, 2002); program(s) used to solve structure: *SHELXS*97 (Sheldrick, 1997); program(s) used to refine structure: *SHELXL*97 (Sheldrick, 1997); molecular graphics: *ORTEP*III (Burnett & Johnson, 1996); software used to prepare material for publication: *WinGX* (Farrugia, 1997) and *PARST* (Nardelli, 1995).

Supplementary data for this paper are available from the IUCr electronic archives (Reference: OB1189). Services for accessing these data are described at the back of the journal.

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