

2-[(2-Methoxyethyl)sulfanyl]-4-(2-methylpropyl)-6-oxo-1,6-dihydropyrimidine-5-carbonitrile

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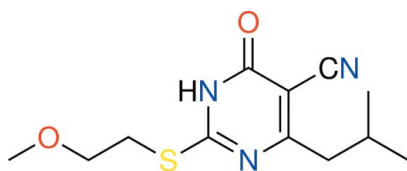
Received 21 March 2012; accepted 27 March 2012

Key indicators: single-crystal X-ray study; $T = 296$ K; mean $\sigma(\text{C}-\text{C}) = 0.003$ Å; R factor = 0.044; wR factor = 0.126; data-to-parameter ratio = 16.6.

In the title compound, $\text{C}_{12}\text{H}_{17}\text{N}_3\text{O}_2\text{S}$, the 4-methyl-2-methylsulfanyl-6-oxo-1,6-dihydropyrimidine-5-carbonitrile part of the molecule is almost planar (r.m.s deviation = 0.062 Å). In the crystal, molecules form centrosymmetric dimers *via* pairs of $\text{N}-\text{H}\cdots\text{O}$ hydrogen bonds.

Related literature

For related pyrimidine structures, see: Yan *et al.* (2011); El-Brollosy *et al.* (2011); Nasir *et al.* (2010); Tiekink (1989); Al-Deeb *et al.* (2012); Durkaya *et al.* (2011).



Experimental

Crystal data

$\text{C}_{12}\text{H}_{17}\text{N}_3\text{O}_2\text{S}$

$M_r = 267.35$

Triclinic, $P\bar{1}$

$a = 5.0379$ (5) Å

$b = 10.5453$ (10) Å

$c = 13.3936$ (13) Å

$\alpha = 85.274$ (8)°

$\beta = 82.170$ (8)°

$\gamma = 83.034$ (8)°

$V = 698.14$ (12) Å³

$Z = 2$

Mo $K\alpha$ radiation

$\mu = 0.23$ mm⁻¹

$T = 296$ K

$0.68 \times 0.47 \times 0.15$ mm

Data collection

Stoe IPDS 2 diffractometer

Absorption correction: integration

(*X-RED32*; Stoe & Cie, 2002)

$T_{\min} = 0.859$, $T_{\max} = 0.966$

6663 measured reflections

2725 independent reflections

2090 reflections with $I > 2\sigma(I)$

$R_{\text{int}} = 0.062$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.044$

$wR(F^2) = 0.126$

$S = 1.02$

2725 reflections

164 parameters

H-atom parameters constrained

$\Delta\rho_{\text{max}} = 0.28$ e Å⁻³

$\Delta\rho_{\text{min}} = -0.22$ e Å⁻³

Table 1

Hydrogen-bond geometry (Å, °).

$D-H\cdots A$	$D-H$	$H\cdots A$	$D\cdots A$	$D-H\cdots A$
$\text{N1}-\text{H1}\cdots\text{O1}^i$	0.86	1.89	2.747 (2)	175

Symmetry code: (i) $-x + 2, -y + 1, -z$.

Data collection: *X-AREA* (Stoe & Cie, 2002); cell refinement: *X-AREA*; data reduction: *X-RED32* (Stoe & Cie, 2002); program(s) used to solve structure: *WinGX* (Farrugia, 1997) and *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *ORTEP-3 for Windows* (Farrugia, 1997); software used to prepare material for publication: *WinGX* (Farrugia, 1999) and *PLATON* (Spek, 2009).

The authors thank Professor Orhan Büyükgüngör for his help with the data collection and acknowledge the Ondokuz Mayıs University Research Fund for financial support. The financial support of the Deanship of Scientific Research and the Research Center of the College of Pharmacy, King Saud University is greatly appreciated.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: BT5854).

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supplementary materials

Acta Cryst. (2012). E68, o1379 [doi:10.1107/S1600536812013372]

2-[(2-Methoxyethyl)sulfanyl]-4-(2-methylpropyl)-6-oxo-1,6-dihydro-pyrimidine-5-carbonitrile

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Comment

In continuation to our work on the chemical and pharmacological properties of pyrimidine derivatives, we synthesized the title compound as a potential chemotherapeutic agent. The 4-methyl-2-(methylthio)-6-oxo-1,6-dihydropyrimidine-5-carbonitrile part of the molecule is almost planar. Some pyrimidine structures have been described in the literature (Yan *et al.*, 2011; El-Brollosy *et al.*, 2011; Nasir *et al.*, 2010; Tiekink 1989; Al-Deeb *et al.*, 2012; Durkaya *et al.*, 2011) and the bond distances of our crystal structure is comparable with these structures.

In the crystal, the molecules form centrosymmetric dimers via intermolecular N—H···O hydrogen bonds.

Experimental

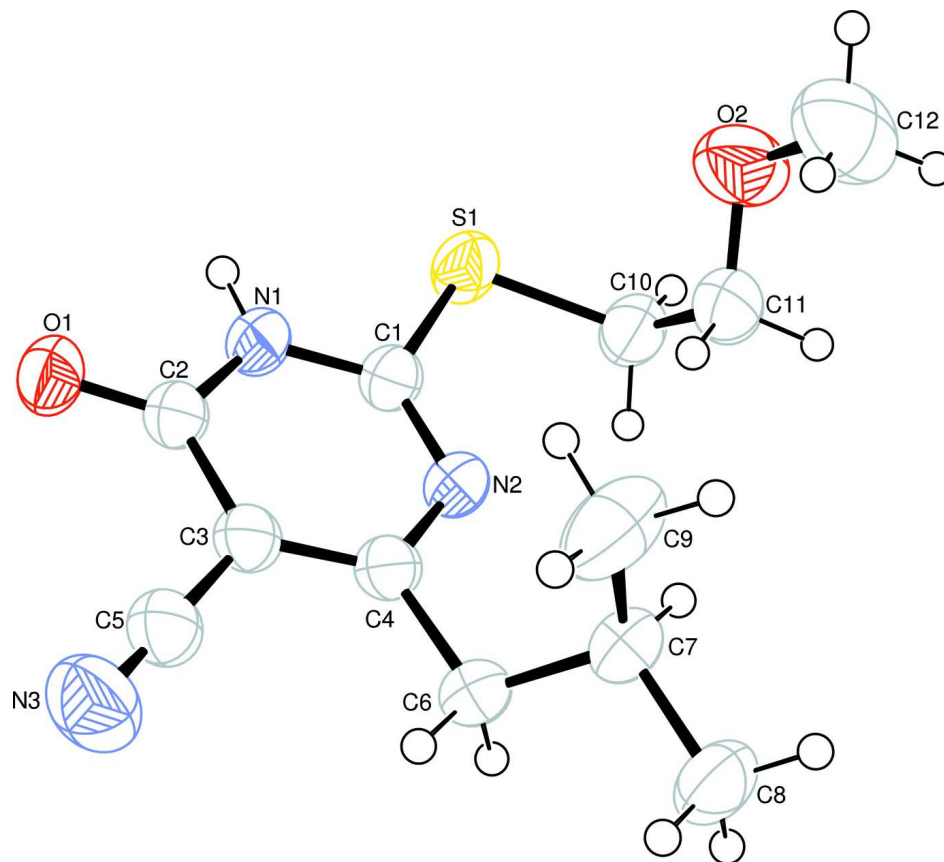
To a solution of 6-(2-methylpropyl)-4-oxo-2-sulfanylidene-1,2,3,4-tetrahydropyrimidine-5-carbonitrile (2.09 g, 0.01 mol) in DMF (10 ml), 1-bromo-2-methoxyethane (1.4 g, 0.01 mol) and anhydrous potassium carbonate (1.38 g, 0.01 mol) were added and the mixture was stirred at room temperature for 12 h. Water (15 ml) was then added and the mixture was stirred for further 30 min. The separated solid was filtered, washed with cold water, dried and crystallized from water to yield 1.15 g (43%) of the title compound (C₁₂H₁₇N₃O₂S) as colorless crystals. M.P.: 113–115 °C. Single crystals suitable for X-ray diffraction were obtained by slow evaporation of a solution of the title compound in EtOH at room temperature. ¹H NMR (DMSO-d₆, 500.13 MHz): δ 0.93 (d, 6H, CH₃, *J* = 7.0 Hz), 2.12–2.15 (m, 1H, CH), 2.53 (d, 2H, CH₂CH, *J* = 7.0 Hz), 3.27 (s, 3H, CH₃O), 3.53 (t, 2H, CH₂S, *J* = 6.5 Hz), 3.56 (t, 2H, OCH₂CH₂, *J* = 6.5 Hz), 13.55 (s, 1H, NH). ¹³C NMR (DMSO-d₆, 125.76 MHz): δ 22.55 (CH₃), 27.94 (CH), 30.19 (CH₂S), 45.30 (CH₂CH), 58.36 (CH₃O), 70.25 (OCH₂), 95.97 (C-5), 115.55 (CN), 162.05 (C-6), 166.19 (C=O), 174.50 (C-2).

Refinement

All H atoms were positioned geometrically [N—H = 0.860 Å and C—H = 0.960 Å, 0.970 Å or 0.980 Å] and treated as riding with $U_{\text{iso}}(\text{H})=1.2U_{\text{eq}}(\text{C,N})$.

Computing details

Data collection: *X-AREA* (Stoe & Cie, 2002); cell refinement: *X-AREA* (Stoe & Cie, 2002); data reduction: *X-RED32* (Stoe & Cie, 2002); program(s) used to solve structure: *WinGX* (Farrugia, 1997) and *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *ORTEP-3 for Windows* (Farrugia, 1997); software used to prepare material for publication: *WinGX* (Farrugia, 1999) and *PLATON* (Spek, 2009).

**Figure 1**

The asymmetric unit of the title compound, showing the atomic numbering scheme. Displacement ellipsoids are drawn at the 50% probability level.

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Crystal data

$C_{12}H_{17}N_3O_2S$

$M_r = 267.35$

Triclinic, $P\bar{1}$

Hall symbol: $-P\ 1$

$a = 5.0379$ (5) Å

$b = 10.5453$ (10) Å

$c = 13.3936$ (13) Å

$\alpha = 85.274$ (8)°

$\beta = 82.170$ (8)°

$\gamma = 83.034$ (8)°

$V = 698.14$ (12) Å³

$Z = 2$

$F(000) = 284$

$D_x = 1.272$ Mg m⁻³

Mo $K\alpha$ radiation, $\lambda = 0.71073$ Å

Cell parameters from 9417 reflections

$\theta = 3.1$ – 27.9 °

$\mu = 0.23$ mm⁻¹

$T = 296$ K

Prism, colorless

$0.68 \times 0.47 \times 0.15$ mm

Data collection

Stoe IPDS 2

diffractometer

Radiation source: fine-focus sealed tube

Graphite monochromator

rotation method scans

Absorption correction: integration

(*X-RED32*; Stoe & Cie, 2002)

$T_{\min} = 0.859$, $T_{\max} = 0.966$

6663 measured reflections

2725 independent reflections

2090 reflections with $I > 2\sigma(I)$

$R_{\text{int}} = 0.062$
 $\theta_{\text{max}} = 26.0^\circ$, $\theta_{\text{min}} = 3.1^\circ$
 $h = -6 \rightarrow 6$

$k = -12 \rightarrow 12$
 $l = -16 \rightarrow 16$

Refinement

Refinement on F^2
 Least-squares matrix: full
 $R[F^2 > 2\sigma(F^2)] = 0.044$
 $wR(F^2) = 0.126$
 $S = 1.02$
 2725 reflections
 164 parameters
 0 restraints
 Primary atom site location: structure-invariant
 direct methods
 Secondary atom site location: difference Fourier
 map

Hydrogen site location: inferred from
 neighbouring sites
 H-atom parameters constrained
 $w = 1/[\sigma^2(F_o^2) + (0.0743P)^2]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\text{max}} < 0.001$
 $\Delta\rho_{\text{max}} = 0.28 \text{ e } \text{\AA}^{-3}$
 $\Delta\rho_{\text{min}} = -0.22 \text{ e } \text{\AA}^{-3}$
 Extinction correction: *SHELXL97* (Sheldrick,
 2008), $F_c^* = kF_c[1 + 0.001 \times F_c^2 \lambda^3 / \sin(2\theta)]^{-1/4}$
 Extinction coefficient: 0.059 (9)

Special details

Geometry. All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted R -factor wR and goodness of fit S are based on F^2 , conventional R -factors R are based on F , with F set to zero for negative F^2 . The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating R -factors(gt) *etc.* and is not relevant to the choice of reflections for refinement. R -factors based on F^2 are statistically about twice as large as those based on F , and R -factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (\AA^2)

	x	y	z	$U_{\text{iso}}^*/U_{\text{eq}}$
C1	0.6121 (4)	0.32542 (17)	0.13412 (14)	0.0433 (4)
C2	0.9074 (4)	0.48214 (16)	0.15109 (15)	0.0450 (4)
C3	0.8266 (4)	0.46228 (16)	0.25758 (15)	0.0442 (4)
C4	0.6474 (4)	0.37554 (16)	0.29360 (14)	0.0437 (4)
C5	0.9463 (4)	0.53342 (18)	0.32209 (16)	0.0520 (5)
C6	0.5689 (4)	0.34539 (18)	0.40400 (14)	0.0495 (5)
H6A	0.3788	0.3735	0.4212	0.059*
H6B	0.6694	0.3929	0.4421	0.059*
C7	0.6216 (4)	0.20252 (19)	0.43492 (15)	0.0479 (4)
H7	0.5092	0.1569	0.3991	0.057*
C8	0.5377 (5)	0.1782 (2)	0.54676 (17)	0.0632 (6)
H8A	0.3491	0.2060	0.5625	0.076*
H8B	0.6398	0.2249	0.5837	0.076*
H8C	0.5710	0.0883	0.5652	0.076*
C9	0.9103 (5)	0.1502 (3)	0.4063 (2)	0.0851 (9)
H9A	1.0253	0.1946	0.4393	0.102*
H9B	0.9561	0.1620	0.3344	0.102*
H9C	0.9339	0.0606	0.4267	0.102*
C10	0.3129 (4)	0.1261 (2)	0.12329 (17)	0.0566 (5)
H10A	0.1835	0.1737	0.1707	0.068*
H10B	0.2118	0.0853	0.0808	0.068*

C11	0.4729 (5)	0.0231 (2)	0.18197 (18)	0.0646 (6)
H11A	0.5673	0.0621	0.2278	0.078*
H11B	0.3517	-0.0319	0.2218	0.078*
C12	0.7991 (8)	-0.1519 (3)	0.1697 (3)	0.1020 (10)
H12A	0.6742	-0.2072	0.2050	0.122*
H12B	0.8951	-0.1190	0.2173	0.122*
H12C	0.9246	-0.1993	0.1222	0.122*
N1	0.7874 (3)	0.40967 (14)	0.09326 (12)	0.0468 (4)
H1	0.8246	0.4179	0.0286	0.056*
N2	0.5378 (3)	0.30759 (14)	0.23047 (12)	0.0452 (4)
N3	1.0420 (5)	0.5910 (2)	0.37314 (18)	0.0761 (6)
O1	1.0717 (3)	0.55469 (13)	0.11167 (11)	0.0575 (4)
O2	0.6562 (4)	-0.04885 (17)	0.11760 (15)	0.0855 (6)
S1	0.50676 (11)	0.23771 (5)	0.04486 (4)	0.0547 (2)

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
C1	0.0492 (9)	0.0408 (9)	0.0385 (10)	-0.0040 (7)	-0.0042 (8)	0.0019 (7)
C2	0.0564 (10)	0.0373 (9)	0.0396 (10)	-0.0048 (7)	-0.0018 (8)	0.0007 (7)
C3	0.0553 (10)	0.0365 (9)	0.0393 (10)	-0.0011 (7)	-0.0048 (8)	-0.0003 (7)
C4	0.0518 (10)	0.0375 (8)	0.0388 (10)	0.0004 (7)	-0.0015 (8)	-0.0005 (7)
C5	0.0637 (12)	0.0444 (10)	0.0473 (11)	-0.0056 (8)	-0.0067 (9)	-0.0014 (9)
C6	0.0616 (11)	0.0483 (10)	0.0365 (10)	-0.0073 (8)	0.0017 (8)	-0.0027 (8)
C7	0.0479 (10)	0.0544 (10)	0.0402 (10)	-0.0077 (8)	-0.0033 (8)	0.0033 (8)
C8	0.0734 (14)	0.0715 (14)	0.0423 (12)	-0.0143 (11)	0.0004 (10)	0.0074 (10)
C9	0.0608 (14)	0.103 (2)	0.0744 (18)	0.0151 (13)	0.0095 (12)	0.0300 (16)
C10	0.0606 (12)	0.0580 (12)	0.0512 (12)	-0.0167 (9)	0.0002 (9)	-0.0007 (9)
C11	0.0896 (16)	0.0523 (11)	0.0507 (13)	-0.0130 (11)	-0.0013 (11)	-0.0013 (10)
C12	0.127 (3)	0.0788 (18)	0.096 (3)	0.0192 (17)	-0.029 (2)	-0.0031 (17)
N1	0.0598 (9)	0.0449 (8)	0.0347 (8)	-0.0099 (7)	-0.0015 (7)	0.0027 (6)
N2	0.0537 (8)	0.0448 (8)	0.0357 (8)	-0.0073 (6)	-0.0008 (7)	0.0007 (6)
N3	0.0948 (15)	0.0671 (12)	0.0729 (15)	-0.0169 (11)	-0.0209 (12)	-0.0147 (11)
O1	0.0751 (9)	0.0526 (8)	0.0456 (8)	-0.0238 (7)	0.0009 (7)	0.0019 (6)
O2	0.1202 (15)	0.0712 (11)	0.0588 (11)	0.0131 (10)	-0.0080 (10)	-0.0074 (9)
S1	0.0701 (4)	0.0594 (3)	0.0368 (3)	-0.0201 (2)	-0.0053 (2)	-0.0007 (2)

Geometric parameters (\AA , $^\circ$)

C1—N2	1.299 (2)	C8—H8B	0.9600
C1—N1	1.359 (2)	C8—H8C	0.9600
C1—S1	1.744 (2)	C9—H9A	0.9600
C2—O1	1.232 (2)	C9—H9B	0.9600
C2—N1	1.374 (2)	C9—H9C	0.9600
C2—C3	1.434 (3)	C10—C11	1.505 (3)
C3—C4	1.376 (3)	C10—S1	1.800 (2)
C3—C5	1.425 (3)	C10—H10A	0.9700
C4—N2	1.363 (2)	C10—H10B	0.9700
C4—C6	1.496 (3)	C11—O2	1.376 (3)
C5—N3	1.139 (3)	C11—H11A	0.9700

C6—C7	1.530 (3)	C11—H11B	0.9700
C6—H6A	0.9700	C12—O2	1.417 (3)
C6—H6B	0.9700	C12—H12A	0.9600
C7—C9	1.502 (3)	C12—H12B	0.9600
C7—C8	1.510 (3)	C12—H12C	0.9600
C7—H7	0.9800	N1—H1	0.8600
C8—H8A	0.9600		
N2—C1—N1	123.67 (18)	C7—C9—H9A	109.5
N2—C1—S1	122.84 (14)	C7—C9—H9B	109.5
N1—C1—S1	113.43 (14)	H9A—C9—H9B	109.5
O1—C2—N1	120.88 (18)	C7—C9—H9C	109.5
O1—C2—C3	125.26 (18)	H9A—C9—H9C	109.5
N1—C2—C3	113.85 (16)	H9B—C9—H9C	109.5
C4—C3—C5	122.88 (18)	C11—C10—S1	115.59 (16)
C4—C3—C2	120.35 (18)	C11—C10—H10A	108.4
C5—C3—C2	116.75 (17)	S1—C10—H10A	108.4
N2—C4—C3	121.83 (17)	C11—C10—H10B	108.4
N2—C4—C6	115.56 (15)	S1—C10—H10B	108.4
C3—C4—C6	122.56 (18)	H10A—C10—H10B	107.4
N3—C5—C3	179.5 (2)	O2—C11—C10	110.6 (2)
C4—C6—C7	112.75 (16)	O2—C11—H11A	109.5
C4—C6—H6A	109.0	C10—C11—H11A	109.5
C7—C6—H6A	109.0	O2—C11—H11B	109.5
C4—C6—H6B	109.0	C10—C11—H11B	109.5
C7—C6—H6B	109.0	H11A—C11—H11B	108.1
H6A—C6—H6B	107.8	O2—C12—H12A	109.5
C9—C7—C8	110.84 (19)	O2—C12—H12B	109.5
C9—C7—C6	112.29 (18)	H12A—C12—H12B	109.5
C8—C7—C6	110.23 (18)	O2—C12—H12C	109.5
C9—C7—H7	107.8	H12A—C12—H12C	109.5
C8—C7—H7	107.8	H12B—C12—H12C	109.5
C6—C7—H7	107.8	C1—N1—C2	122.62 (16)
C7—C8—H8A	109.5	C1—N1—H1	118.7
C7—C8—H8B	109.5	C2—N1—H1	118.7
H8A—C8—H8B	109.5	C1—N2—C4	117.66 (16)
C7—C8—H8C	109.5	C11—O2—C12	112.2 (2)
H8A—C8—H8C	109.5	C1—S1—C10	102.06 (10)
H8B—C8—H8C	109.5		
O1—C2—C3—C4	-177.90 (18)	N2—C1—N1—C2	1.5 (3)
N1—C2—C3—C4	0.9 (3)	S1—C1—N1—C2	-175.81 (14)
O1—C2—C3—C5	0.4 (3)	O1—C2—N1—C1	177.75 (17)
N1—C2—C3—C5	179.25 (15)	C3—C2—N1—C1	-1.1 (3)
C5—C3—C4—N2	-179.28 (17)	N1—C1—N2—C4	-1.5 (3)
C2—C3—C4—N2	-1.1 (3)	S1—C1—N2—C4	175.58 (13)
C5—C3—C4—C6	-1.9 (3)	C3—C4—N2—C1	1.3 (3)
C2—C3—C4—C6	176.28 (17)	C6—C4—N2—C1	-176.22 (16)
N2—C4—C6—C7	53.7 (2)	C10—C11—O2—C12	-176.3 (2)

C3—C4—C6—C7	-123.80 (19)	N2—C1—S1—C10	-3.49 (19)
C4—C6—C7—C9	56.1 (3)	N1—C1—S1—C10	173.88 (14)
C4—C6—C7—C8	-179.82 (18)	C11—C10—S1—C1	-70.78 (19)
S1—C10—C11—O2	-59.3 (2)		

Hydrogen-bond geometry (Å, °)

<i>D—H...A</i>	<i>D—H</i>	<i>H...A</i>	<i>D...A</i>	<i>D—H...A</i>
N1—H1...O1 ⁱ	0.86	1.89	2.747 (2)	175

Symmetry code: (i) $-x+2, -y+1, -z$.