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Crystal structure of *tert*-butyl (Z)-4-(2-(5-methoxy-3-(2-((methylthio)carbonothioyl)hydrazono)-2-oxoindolin-1-yl)ethyl)piperazine-1-carboxylate, C₂₂H₃₁N₅O₄S₂

Table 1: Data collection and handling.

Crystal:	Block, clear reddish red
Size:	0.30 × 0.25 × 0.20 mm
Wavelength:	Cu K α radiation (1.54184 Å)
μ :	2.22 mm ⁻¹
Diffractometer, scan mode:	XtaLAB Pro, ω -scans
$\theta_{\max}$, completeness:	66.6°, >98%
$N(hkl)_{\text{measured}}$, $N(hkl)_{\text{unique}}$, R_{int} :	13898, 4400, 0.025
Criterion for I_{obs} , $N(hkl)_{\text{gt}}$:	$I_{\text{obs}} > 2 \sigma(I_{\text{obs}})$, 3901
$N(\text{param})_{\text{refined}}$:	303
Programs:	CrysAlis ^{Pro} [1], SHELX [2], OLEX2 [3]

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Abstract

C₂₂H₃₁N₅O₄S₂, triclinic, $P\bar{1}$ (no. 2), $a = 9.0366(1)$ Å, $b = 10.3253(2)$ Å, $c = 14.9997(2)$ Å, $\alpha = 72.790(1)^\circ$, $\beta = 82.301(1)^\circ$, $\gamma = 71.080(1)^\circ$, $V = 1263.54(3)$ Å³, $Z = 2$, $R_{\text{gt}}(F) = 0.0443$, $wR_{\text{ref}}(F^2) = 0.1294$, $T = 271$ K.

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The crystal structure is shown in the figure. Tables 1 and 2 contain details on crystal structure and measurement conditions and a list of the atoms including atomic coordinates and displacement parameters.

Source of material

The title compound was synthesized *via* a three-step synthetic protocol. The reaction of 5-methoxyindoline-2,3-dione (0.9 g, 5 mmol) with 1,2-dibromoethane (2.8 g, 15 mmol) in 15 mL of *N,N*-dimethylformamide (DMF) in the presence of potassium carbonate (1.0 g, 7.2 mmol) at 40–50 °C gave 1-(2-bromoethyl)indoline-2,3-dione [4]. Next, 1-(2-bromoethyl)indoline-2,3-dione (0.6 g, 2.0 mmol) was reacted with *tert*-butyl piperazine-1-carboxylate (1.1 g, 0.6 mmol) in DMF

(5 mL) for 12 h at room temperature to yield 1-((4-(*tert*-butyloxycarbonyl)piperazin-1-yl)ethyl)-5-methoxyindolin-2,3-dione. Finally, condensation of 1-((4-(*tert*-butyloxycarbonyl)piperazin-1-yl)-5-methoxyindolin-2,3-dione (0.4 g, 1 mmol) with methyl hydrazinecarbodithioate (0.1 g, 1 mmol) in 5 mL methanol at room temperature for 12 h gave a solid, which was collected by filtration and dried in air. The crude product was purified by recrystallization from methanol (yield 60%; m.p. 421–423 K). Crystals of the title compound were obtained by slow evaporation of the mixed solvent dichloromethane and methanol (5:1, v/v).

Experimental details

H atoms were placed in calculated positions. The U_{iso} values of the hydrogen atoms of methyl groups were set to $1.5U_{\text{eq}}(\text{C})$ and the U_{iso} values of all other hydrogen atoms were set to $1.2U_{\text{eq}}(\text{C}, \text{N})$.

Discussion

Indolin-2-one derivatives exhibit promising antitumor activity by targeting different biomacromolecules [5, 6], of which 3-hydrazinoindolin-2-one derivatives have particularly attracted intensive attention [7, 8]. In our previous work, methyl hydrazinecarbodithioate derivatives of 5-fluoro-1-(2-morpholinoethyl)indolin-2-one and 5-methoxy-1-(2-morpholinoethyl)indolin-2-one were used as ligands to achieve two new Pt(II) complexes, which exhibited cytotoxicity against cancer cells by inducing apoptosis [9].

As a continuous work, herein we report a new methyl hydrazinecarbodithioate derivative. X-ray single-crystal diffraction analysis revealed that the hydrazinecarbodithioate and

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Table 2: Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å²).

Atom	<i>x</i>	<i>y</i>	<i>z</i>	<i>U</i> _{iso} [*] / <i>U</i> _{eq}
S1	0.86259(7)	0.72163(6)	0.56844(4)	0.06572(19)
S2	0.93686(8)	0.86122(7)	0.36715(5)	0.0788(2)
O1	0.5294(2)	0.16350(18)	0.74428(11)	0.0721(4)
O2	0.7827(2)	0.52608(19)	0.29371(11)	0.0746(5)
O3	0.2372(2)	0.7811(2)	−0.08058(11)	0.0815(5)
O4	0.0215(2)	0.7585(3)	0.00940(12)	0.1034(7)
N1	0.8318(2)	0.64173(19)	0.42569(13)	0.0613(4)
H1	0.8411	0.6384	0.3685	0.074 [*]
N2	0.77230(19)	0.54791(18)	0.49205(12)	0.0550(4)
N3	0.6714(2)	0.34697(19)	0.36750(12)	0.0585(4)
N4	0.4210(2)	0.48759(19)	0.21774(11)	0.0549(4)
N5	0.2416(2)	0.7144(2)	0.07638(12)	0.0717(5)
C1	0.9309(3)	0.8618(3)	0.57635(19)	0.0747(6)
H1A	0.8610	0.9517	0.5452	0.112 [*]
H1B	1.0339	0.8515	0.5473	0.112 [*]
H1C	0.9346	0.8575	0.6409	0.112 [*]
C2	0.8765(2)	0.7405(2)	0.44860(15)	0.0579(5)
C3	0.7254(2)	0.4627(2)	0.46264(14)	0.0526(5)
C4	0.6583(2)	0.35330(19)	0.52068(14)	0.0490(4)
C5	0.6230(2)	0.3128(2)	0.61511(14)	0.0525(5)
H5A	0.6407	0.3597	0.6550	0.063 [*]
C10	0.4475(4)	0.0634(3)	0.7820(2)	0.0938(9)
H10A	0.4346	0.0483	0.8485	0.141 [*]
H10B	0.5053	−0.0247	0.7679	0.141 [*]
H10C	0.3465	0.0983	0.7553	0.141 [*]
C6	0.5602(2)	0.1999(2)	0.64948(14)	0.0549(5)
C7	0.5325(3)	0.1314(2)	0.58972(16)	0.0597(5)
H7A	0.4907	0.0561	0.6138	0.072 [*]
C8	0.5664(3)	0.1735(2)	0.49432(16)	0.0612(5)
H8A	0.5475	0.1274	0.4543	0.073 [*]
C9	0.6282(2)	0.2847(2)	0.46057(14)	0.0527(5)
C11	0.7318(2)	0.4538(2)	0.36337(15)	0.0590(5)
C12	0.6606(3)	0.2983(3)	0.28722(16)	0.0703(6)
H12A	0.7067	0.1959	0.3021	0.084 [*]
H12B	0.7210	0.3402	0.2347	0.084 [*]
C13	0.4939(3)	0.3362(2)	0.25879(16)	0.0685(6)
H13A	0.4933	0.2851	0.2141	0.082 [*]
H13B	0.4311	0.3040	0.3134	0.082 [*]
C14	0.2526(3)	0.5167(3)	0.21277(17)	0.0761(7)
H14A	0.2079	0.4891	0.2754	0.091 [*]
H14B	0.2346	0.4593	0.1769	0.091 [*]
C15	0.1712(3)	0.6701(3)	0.16869(17)	0.0870(9)
H15A	0.0610	0.6836	0.1638	0.104 [*]
H15B	0.1800	0.7277	0.2073	0.104 [*]
C16	0.4081(3)	0.6899(3)	0.07957(17)	0.0688(6)
H16A	0.4257	0.7487	0.1145	0.083 [*]
H16B	0.4519	0.7166	0.0166	0.083 [*]
C17	0.4889(3)	0.5361(3)	0.12496(15)	0.0657(6)
H17A	0.4809	0.4786	0.0861	0.079 [*]
H17B	0.5990	0.5231	0.1297	0.079 [*]
C18	0.1726(3)	0.7530(2)	−0.00518(15)	0.0608(5)
C19	−0.0854(3)	0.8048(3)	−0.06525(18)	0.0785(7)
C20	−0.0390(6)	0.7027(7)	−0.1223(5)	0.190(3)
H20A	0.0729	0.6630	−0.1241	0.285 [*]
H20B	−0.0737	0.7507	−0.1847	0.285 [*]

Table 2 (continued)

Atom	<i>x</i>	<i>y</i>	<i>z</i>	<i>U</i> _{iso} [*] / <i>U</i> _{eq}
H20C	−0.0861	0.6280	−0.0954	0.285 [*]
C21	−0.2374(4)	0.7999(9)	−0.0160(3)	0.246(4)
H21A	−0.2250	0.7084	0.0279	0.368 [*]
H21B	−0.3127	0.8156	−0.0606	0.368 [*]
H21C	−0.2732	0.8725	0.0165	0.368 [*]
C22	−0.0854(6)	0.9457(5)	−0.1267(4)	0.186(3)
H22A	−0.1071	1.0121	−0.0899	0.278 [*]
H22B	−0.1645	0.9774	−0.1718	0.278 [*]
H22C	0.0152	0.9392	−0.1584	0.278 [*]

the indolin-2-moieties are almost coplanar. Intramolecular hydrogen bonding ($D \cdots A = 2.742(2)$ Å) occurs between the O2 atom and N1–H1 group. The indolin-2-one ring system links to piperazine ring (chair configuration) *via* a $-\text{CH}_2-\text{CH}_2-$ bridge with the N3–C12–C13–N4 torsion angle of $69.7(3)^\circ$. The bond length of C3=N2 ($1.292(3)$ Å) and the angle of N2–C3–C11 ($127.5(2)^\circ$) are in agreement with those of the structure of an analogous hydrazinecarbodithioate ($1.288(4)$ Å, $128.1(3)^\circ$) [10]. Furthermore, there is a torsion angle O4–C18–N5–C15 of $5.8(4)^\circ$.

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