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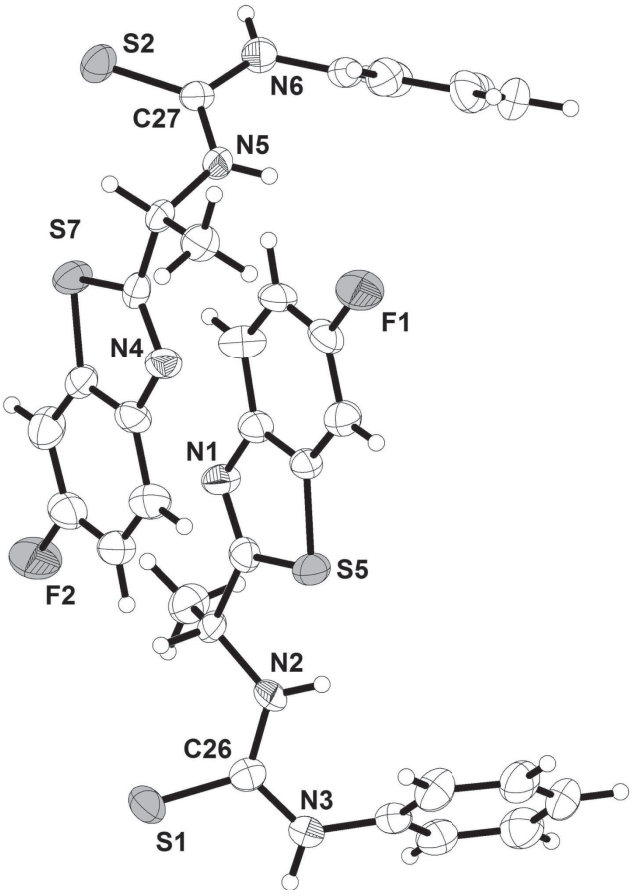
Crystal structure of (*R*)-1-(1-(6-fluorobenzo[d] thiazol-2-yl)ethyl)-3-phenylthiourea



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Abstract

$C_{16}H_{14}FN_3S_2$, orthorhombic, P 21, $a = 7.1583(9)$ Å, $b = 28.524(4)$ Å, $c = 7.6021(8)$ Å, $\alpha = 90.00°$, $\beta = 94.443(11)°$, $\gamma = 90.00°$, $V = 1547.6(3)$ Å^3, $Z = 4$, $R_{gt}(F) = 0.0547$, $wR_{ref}(F^2) = 0.1346$, $T = 293(2)$ K.

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Table 1: Data collection and handling.

Crystal:	Colourless, block, size 0.1×0.18×0.26 mm
Wavelength:	Mo K_α radiation (0.71073 Å)
μ:	3.53 cm^{-1}
Diffractometer, scan mode:	multiwire proportional, φ and ω scans
$2\theta_{max}$:	52.74°
$N(hkl)_{measured}$, $N(hkl)_{unique}$:	11985, 6179
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\ \sigma(I_{obs})$, 4911
$N(param)_{refined}$:	397
Programs:	SHELXS-97 (SHELDRICK, 1990) [8, 9]

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

Atom	Site	*x*	*y*	*z*	U_{iso}
H(2A)	2*a*	0.0502	0.7337	0.1406	0.047
H(28A)	2*a*	−0.0748	0.6517	−0.2664	0.057
H(30A)	2*a*	−0.1704	0.7501	0.4057	0.044
H(44A)	2*a*	0.5702	0.8506	0.5234	0.054
H(51A)	2*a*	0.2825	0.9694	0.5872	0.053
H(58A)	2*a*	0.3111	0.6765	0.135	0.061
H(64A)	2*a*	0.0064	0.934	0.4799	0.06
H(69A)	2*a*	0.1502	0.6641	−0.4638	0.068
H(70A)	2*a*	0.534	0.6884	−0.0639	0.066
H(71A)	2*a*	−0.3912	0.7583	0.1669	0.082
H(71B)	2*a*	−0.2709	0.7981	0.0893	0.082
H(71C)	2*a*	−0.363	0.806	0.2673	0.082
H(80A)	2*a*	0.4529	0.684	−0.3626	0.071
H(5A)	2*a*	0.5943	0.9904	0.901	0.042
H(20A)	2*a*	0.4308	0.9773	1.2108	0.04
H(33A)	2*a*	0.0994	0.7562	0.7785	0.06
H(41A)	2*a*	0.7559	0.9661	1.2206	0.064
H(41B)	2*a*	0.7289	0.926	1.0797	0.064
H(41C)	2*a*	0.6584	0.919	1.2681	0.064
H(49A)	2*a*	1.0531	1.036	0.6949	0.062
H(53A)	2*a*	0.6761	1.0566	0.2884	0.061
H(55A)	2*a*	0.3726	0.7929	0.8878	0.059
H(57A)	2*a*	0.826	1.048	0.8904	0.052
H(62A)	2*a*	0.4447	1.0661	0.4797	0.053
H(74A)	2*a*	−0.2004	0.8727	0.85	0.062
H(78A)	2*a*	0.9795	1.0412	0.3946	0.068
H(3A)	2*a*	−0.088	0.6251	0.0721	0.052
H(6A)	2*a*	0.4009	1.0899	0.8013	0.051

Source of material

All chemicals were obtained from commercial sources and used without further purification except for (6-fluorobenzo[d]thiazol-2-yl)ethanamine which is distilled under

Table 3: Atomic displacement parameters (Å^2).

Atom	Site	*x*	*y*	*z*	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
S(1)	2*a*	−0.2654(2)	0.66264(5)	0.3325(2)	0.0552(8)	0.0467(8)	0.0454(7)	−0.0202(7)	0.0109(6)	−0.0041(6)
S(5)	2*a*	0.2488(2)	0.78818(4)	0.3825(2)	0.0403(7)	0.0351(7)	0.0560(8)	−0.0038(6)	0.0069(6)	−0.0118(6)
F(1)	2*a*	0.6051(4)	0.9346(1)	0.6276(4)	0.057(2)	0.058(2)	0.076(2)	−0.021(2)	−0.000(2)	−0.022(2)
N(2)	2*a*	−0.0448(5)	0.7269(1)	0.1984(5)	0.037(2)	0.033(2)	0.048(2)	−0.015(2)	0.010(2)	−0.005(2)
N(1)	2*a*	−0.0378(6)	0.8439(1)	0.3810(5)	0.042(2)	0.030(2)	0.046(2)	−0.001(2)	0.001(2)	−0.007(2)
C(14)	2*a*	0.0952(7)	0.6628(2)	−0.0453(6)	0.043(3)	0.028(2)	0.046(3)	0.002(2)	0.005(2)	0.000(2)
C(24)	2*a*	0.1196(7)	0.8698(2)	0.4401(6)	0.041(3)	0.035(3)	0.035(3)	−0.007(2)	0.002(2)	−0.005(2)
C(26)	2*a*	−0.1073(7)	0.6822(2)	0.1942(6)	0.034(3)	0.035(3)	0.035(2)	0.000(2)	−0.004(2)	−0.004(2)
C(28)	2*a*	0.0473(8)	0.6592(2)	−0.2253(7)	0.051(3)	0.042(3)	0.050(3)	−0.001(3)	−0.002(3)	−0.011(3)
C(30)	2*a*	−0.1312(7)	0.7641(2)	0.2966(6)	0.037(3)	0.036(3)	0.040(3)	−0.008(2)	0.015(2)	−0.016(2)
C(38)	2*a*	0.2888(7)	0.8455(2)	0.4513(6)	0.045(3)	0.031(3)	0.032(2)	−0.008(2)	0.008(2)	−0.006(2)
C(44)	2*a*	0.4569(7)	0.8667(2)	0.5147(7)	0.044(3)	0.042(3)	0.048(3)	−0.003(2)	0.006(2)	−0.007(2)
C(51)	2*a*	0.2819(7)	0.9382(2)	0.5523(7)	0.059(3)	0.028(3)	0.046(3)	−0.011(3)	0.008(2)	−0.008(2)
C(52)	2*a*	0.4440(7)	0.9129(2)	0.5631(7)	0.044(3)	0.040(3)	0.041(3)	−0.018(2)	0.005(2)	−0.004(2)
C(58)	2*a*	0.2784(7)	0.6740(2)	0.0146(7)	0.044(3)	0.060(4)	0.048(3)	0.006(3)	−0.002(3)	−0.012(3)
C(60)	2*a*	0.0104(7)	0.8013(2)	0.3483(6)	0.038(3)	0.040(3)	0.030(2)	−0.006(2)	0.006(2)	−0.002(2)
C(64)	2*a*	0.1178(8)	0.9171(2)	0.4895(7)	0.058(4)	0.034(3)	0.056(3)	0.002(3)	−0.008(3)	−0.004(2)
C(69)	2*a*	0.1818(9)	0.6667(2)	−0.3432(7)	0.072(4)	0.053(4)	0.045(3)	0.002(3)	0.004(3)	−0.003(3)
C(70)	2*a*	0.4113(8)	0.6813(2)	−0.1045(8)	0.042(3)	0.057(4)	0.067(4)	0.006(3)	0.008(3)	−0.008(3)
C(71)	2*a*	−0.3050(7)	0.7834(2)	0.1958(8)	0.036(3)	0.054(4)	0.073(4)	−0.003(3)	0.006(3)	−0.016(3)
C(80)	2*a*	0.3634(9)	0.6783(2)	−0.2828(9)	0.058(4)	0.053(4)	0.071(4)	0.010(3)	0.030(3)	−0.003(3)
S(2)	2*a*	0.2501(2)	1.05365(5)	1.0835(2)	0.0445(7)	0.0426(7)	0.0455(7)	0.0153(6)	0.0094(6)	0.0032(6)
S(7)	2*a*	0.1139(2)	0.93626(4)	0.9975(2)	0.0327(6)	0.0365(7)	0.0626(8)	0.0027(6)	0.0028(6)	−0.0113(6)
N(4)	2*a*	0.4049(5)	0.8821(1)	1.0027(5)	0.037(2)	0.028(2)	0.049(2)	0.004(2)	0.004(2)	0.003(2)
F(2)	2*a*	−0.2253(5)	0.7892(1)	0.7356(5)	0.070(2)	0.062(2)	0.082(2)	−0.023(2)	−0.005(2)	−0.019(2)
N(5)	2*a*	0.5119(5)	0.9965(1)	0.9743(5)	0.039(2)	0.030(2)	0.039(2)	0.007(2)	0.014(2)	0.003(2)
C(18)	2*a*	0.2529(7)	0.8556(2)	0.9359(6)	0.047(3)	0.029(3)	0.038(3)	0.000(2)	0.004(2)	0.008(2)
C(20)	2*a*	0.4851(6)	0.9618(2)	1.1118(6)	0.030(2)	0.032(2)	0.038(2)	0.008(2)	0.010(2)	−0.001(2)
C(27)	2*a*	0.4183(6)	1.0372(2)	0.9532(6)	0.031(2)	0.027(2)	0.038(3)	0.000(2)	0.000(2)	−0.002(2)
C(33)	2*a*	0.0972(8)	0.7873(2)	0.8148(7)	0.067(4)	0.037(3)	0.049(3)	−0.006(3)	0.016(3)	−0.004(3)
C(35)	2*a*	0.6107(6)	1.0565(2)	0.7049(6)	0.037(3)	0.027(2)	0.043(3)	0.001(2)	0.004(2)	0.000(2)
C(41)	2*a*	0.6745(6)	0.9413(2)	1.1760(7)	0.034(3)	0.041(3)	0.053(3)	0.007(2)	0.000(2)	0.004(2)
C(46)	2*a*	0.0793(7)	0.8792(2)	0.9227(6)	0.039(3)	0.037(3)	0.037(3)	0.000(2)	0.008(2)	−0.008(2)
C(49)	2*a*	0.9305(8)	1.0424(2)	0.6521(8)	0.035(3)	0.055(4)	0.066(4)	−0.005(3)	0.010(3)	0.005(3)
C(53)	2*a*	0.7057(8)	1.0543(2)	0.4094(7)	0.068(4)	0.045(3)	0.041(3)	−0.002(3)	0.010(3)	−0.001(3)
C(55)	2*a*	0.2595(8)	0.8091(2)	0.8805(7)	0.055(3)	0.037(3)	0.057(3)	0.003(3)	0.005(3)	0.002(2)
C(57)	2*a*	0.7945(7)	1.0488(2)	0.7694(7)	0.037(3)	0.046(3)	0.047(3)	0.001(2)	0.001(2)	−0.003(2)
C(61)	2*a*	0.3528(6)	0.9237(2)	1.0409(6)	0.031(2)	0.039(3)	0.030(2)	0.009(2)	0.008(2)	0.003(2)
C(62)	2*a*	0.5671(7)	1.0599(2)	0.5236(6)	0.047(3)	0.040(3)	0.043(3)	−0.001(2)	−0.005(2)	0.002(2)
C(63)	2*a*	−0.0660(8)	0.8116(2)	0.8036(7)	0.058(4)	0.048(3)	0.042(3)	−0.018(3)	0.005(3)	−0.009(3)
C(74)	2*a*	−0.0852(8)	0.8574(2)	0.8572(7)	0.042(3)	0.060(4)	0.055(3)	0.002(3)	0.009(3)	−0.007(3)
C(78)	2*a*	0.8868(9)	1.0453(2)	0.4724(8)	0.060(4)	0.057(4)	0.057(4)	−0.002(3)	0.029(3)	−0.009(3)
N(3)	2*a*	−0.0419(6)	0.6529(1)	0.0756(5)	0.048(2)	0.031(2)	0.053(3)	−0.008(2)	0.014(2)	−0.004(2)
N(6)	2*a*	0.4654(6)	1.0647(1)	0.8195(5)	0.045(2)	0.034(2)	0.049(2)	0.012(2)	0.011(2)	0.011(2)

reduced pressure before use. The title compound was prepared following the similar reported procedure [1]. (6-fluorobenzo[d]thiazol-2-yl)ethanamine (0.12 g, 0.6 mmol) and phenyl isothiocyanate (0.113 g, 0.8 mmol) were dissolved in dichloromethane (10 mL) at 0°C. The mixture was then allowed to reach room temperature. After stirring for 24 h, the reaction was quenched with saturated aqueous water (10 mL). The product was separated and the aqueous phase extracted with dichloromethane (3×10 mL). The combined organic phases were concentrated under reduced pressure. The resulting residue was purified by the column chromatography on silica gel with petroleum ether/EtOAc as the developing solvent (0.19 g, yield: 95%). Suitable single crystals of the title compound were obtained after one week by slow evaporation from an ethyl acetate solution. m. p. = 164.9 – 165.4°C; $[\alpha]^{20}_{D} = -172.2$ (c = 0.5, in $CHCl_3$); **1H NMR** (400 MHz, $CDCl_3$) δ = 1.72 (d, J = 6.9 Hz, 3H), 1.79 (s, 1H), 6.07 (p, J = 6.9 Hz, 1H), 6.98 (d, J = 7.8 Hz, 1H), 7.18 (td, J = 8.9, 2.6 Hz, 1H), 7.32

(dt, J = 7.1, 2.6 Hz, 3H), 7.49 (ddd, J = 15.6, 11.0, 5.2 Hz, 3H), 7.83 (dd, J = 9.0, 4.8 Hz, 1H), 8.49 (s, 1H); **13C NMR** ($CDCl_3$, 100 MHz): δ = 21.3, 53.3, 107.8, 108.1, 114.7, 114.9, 123.8, 125.1, 127.4, 130.2, 136.0, 149.2, 159.2, 161.6, 172.1, 180.0.

Discussion

Substituted benzothiazole derivatives have acquired conspicuous significance due to their wide spectrum of biological activities in recent years [2, 3], diverse biological activities such as antibacterial, fungicidal, anti-tumor, anticonvulsant. Moreover, the combinations of urea or thiourea derivatives with fluoro-substituted benzothiazole have produced DNA topoisomerase or HIV reverse transcriptase inhibitors [4–6]. Generally it can be noted that benzothiazoles can serve as unique and versatile scaffolds for experimental drug design. Thus, in continuation of development for the design of novel biological molecule and importance to keep in mind the application of thiourea and benzothiazole derivatives, the new fluoro-substituted benzothiazolylthiourea has been synthesized. The new title compound, which is a 1-[(1*R*)-1-(6-fluoro-1,3-benzothiazol-2-yl)ethyl]-3-substituted phenyl thiourea, was synthesized by the condensation from (1*R*)-1-(6-fluoro-1,3-benzothiazol-2-yl)ethanamine and phenyl isocyanate under the mild condition in good yield. In the title structure the bond lengths and angles are within normal ranges. There are two crystallographically independent molecules in the asymmetric unit. The N2—C26 and N3—C26 bond distances [1.349(6) Å and 1.340(6) Å], are shorter than a typical N—C single bond [1.443(4) Å]. The C—N bonds have double bond properties due to interconversion of thiourea structure. The same is true for the second molecule in the asymmetric unit. The S—C bond lengths are within the normal range of C = S groups. All bond lengths in the molecule are within normal values [7].

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