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N-[4-(2,4-Difluorophenyl)-5-(1*H*-1,2,4-triazol-1-yl)-1,3-thiazol-2-yl]-2-fluorobenzamide

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Key indicators

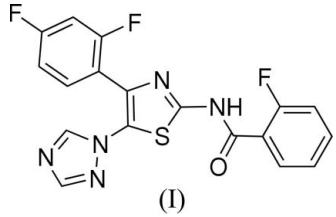
Single-crystal X-ray study
T = 294 K
Mean σ(C–C) = 0.006 Å
Disorder in main residue
R factor = 0.033
wR factor = 0.077
Data-to-parameter ratio = 8.8

For details of how these key indicators were automatically derived from the article, see http://journals.iucr.org/e.

As part of a search for potent fungicidal agents, the title compound, $C_{18}H_{10}F_3N_5OS$, has been synthesized and its structure determined. In the crystal structure, the molecules are linked by intermolecular N—H···N hydrogen bonds. The dihedral angles between the planes of the thiazole and triazole rings, and between the thiazole and 2,4-difluorophenyl rings are 58.6 (2) and 45.3 (3)°, respectively.

Comment

Thiazoles and their derivatives have been reported to exhibit various biological activities such as antitumor, antifungal, antibiotic and antivival activities (Hodgetts & Kershaw, 2002). Thiazolylbenzimidazole-4,7-diones, for example, possess potential antiproliferative activity (Garuti *et al.*, 2001). Triazoles appear frequently in many natural products and biologically active molecules (Robert, 1988); for instance, fluconazole is an agent for the treatment of mycoses (Sadao *et al.*, 2000).



(I)

In our previous work, we have synthesized some novel 2-aminothiazole derivatives by incorporating a triazole ring into 2-aminothiazole derivatives with the aim of improving the biological activity of the parent compounds (Shao *et al.*, 2004). A series of *N*-(cycloalkylamino)acyl-2-aminothiazoles were found to exhibit antitumor activity in mice (Misra *et al.*, 2004). By incorporation of a substituted benzoyl group into 4-(2,4-difluorophenyl)-5-(1*H*-1,2,4-triazol-1-yl)thiazol-2-amine, we synthesized the title compound, (I).

The dihedral angle between the planes of the thiazole and triazole rings is 58.6 (2)°, and that between the thiazole and 2,4-fluorobenzyl rings is 45.3 (3)°. The crystal structure is stabilized by intermolecular N—H···N hydrogen bonds (Table 2).

Experimental

To 4-(2,4-difluorophenyl)-5-(1*H*-1,24-triazol-1-yl)thiazol-2-amine (0.56 g, 2 mmol) dissolved in anhydrous dichloromethane was added dropwise 2-fluorobenzoyl chloride (0.32 g, 2 mmol) with pyridine as catalyst. After refluxing for 7 h (monitored with thin-layer chromatography), the mixture was washed with water. The solution was then

dried with anhydrous sodium sulfate and evaporated under reduced pressure and recrystallized from ethyl acetate to give colorless crystals.

Crystal data

$C_{18}H_{10}F_3N_5OS$
M_r = 401.37
Monoclinic, *Cc*
a = 6.986 (2) Å
b = 24.629 (7) Å
c = 10.333 (3) Å
β = 92.399 (5)°
V = 1776.3 (9) Å^3
Z = 4
D_x = 1.501 Mg m^{-3}
Mo *K*α radiation
Cell parameters from 1764 reflections
θ = 3.0–23.7°
μ = 0.23 mm^{-1}
T = 294 (2) K
Plate, colorless
0.26 × 0.22 × 0.16 mm

Data collection

Bruker SMART CCD area-detector diffractometer
φ and ω scans
Absorption correction: multi-scan (*SADABS*; Sheldrick, 1996)
T_{min} = 0.942, T_{max} = 0.964
4739 measured reflections
2348 independent reflections
1770 reflections with $I > 2\sigma(I)$
R_{int} = 0.032
θ_{max} = 26.3°
h = −8 → 8
k = −30 → 27
l = −6 → 12

Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)]$ = 0.033
$wR(F^2)$ = 0.077
S = 1.03
2348 reflections
267 parameters
H atoms treated by a mixture of independent and constrained refinement
$w = 1/[\sigma^2(F_o^2) + (0.0402P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.001
$\Delta\rho_{max}$ = 0.14 e Å^{-3}
$\Delta\rho_{min}$ = −0.21 e Å^{-3}
Absolute structure: Flack (1983), 547 Friedel pairs
Flack parameter: 0.00 (8)

Table 1
Selected geometric parameters (Å, °).

S1—C9	1.733 (3)	N1—C8	1.379 (4)
S1—C8	1.734 (3)	N3—N4	1.377 (4)
O1—C12	1.222 (4)	N3—C9	1.415 (4)
N1—C12	1.349 (4)		
C9—S1—C8	86.86 (14)		

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

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
N1—H1···N5^{i}	0.94 (3)	1.93 (3)	2.865 (4)	174 (3)

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

H atoms bonded to C were were placed in calculated positions, with C—H = 0.93 Å, and refined using a riding model, with U_{iso}(H) = 1.2U_{eq}(C). The H atom bonded to N was refined isotropically. The F atom of the fluorophenyl ring is disordered over the two *ortho* positions with site occupation factors of 0.896 (8) and 0.104 (8).

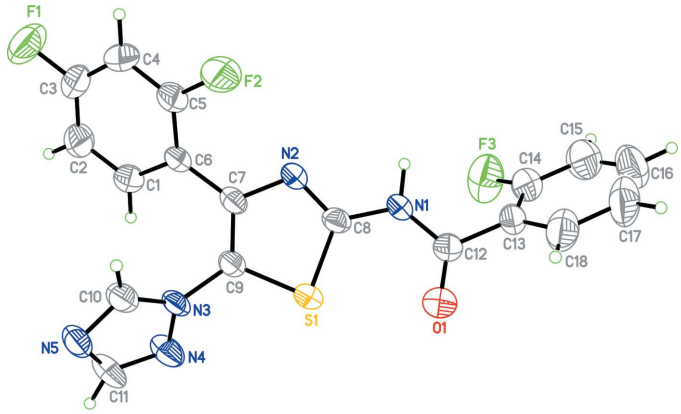


Figure 1
View of the title compound, with displacement ellipsoids drawn at the 50% probability level. The minor components of the disordered atoms are not shown.

Data collection: *SMART* (Bruker, 1998); cell refinement: *SAINT* (Bruker, 1999); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *SHELXTL* (Bruker, 1999); software used to prepare material for publication: *SHELXTL*.

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