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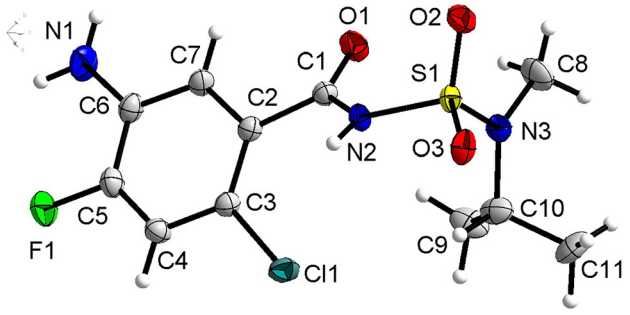
5-Amino-2-chloro-4-fluoro-*N*-(*N*-isopropyl-*N*-methylsulfamoyl) benzamide, $C_{11}H_{15}O_3ClFN_3S$



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Abstract

$C_{11}H_{15}O_3ClFN_3S$, triclinic, $P\bar{1}$ (no. 2), a = 7.8107(11) Å, b = 9.1644(13) Å, c = 11.3521(15) Å, α = 67.543(2)°, β = 72.776 (2)°, γ = 88.529 (2)°, V = 713.76(17) Å^3, Z = 2, $R_{gt}(F)$ = 0.0385, $wR_{ref}(F^2)$ = 0.1338, T = 296(2) K.

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The molecular structure is shown in the figure. Table 1 contains crystallographic data and Table 2 contains the list of the atoms including atomic coordinates and displacement parameters.

Table 1: Data collection and handling.

Crystal:	Colorless block
Size:	0.22 × 0.17 × 0.14 mm
Wavelength:	Mo *K*α radiation (0.71073 Å)
μ:	0.44 mm^{-1}
Diffractometer, scan mode:	Bruker APEX-II, φ and ω
θ_{max}, completeness:	25.5°, 99%
$N(hkl)_{measured}$, $N(hkl)_{unique}$, R_{int}:	5100, 2628, 0.018
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\sigma(I_{obs})$, 2438
$N(param)_{refined}$:	185
Programs:	Bruker [1], SHELX [2, 3], Diamond [4]

1 Source of materials

2-Chloro-4-fluoro-*N*-(*N*-isopropyl-*N*-methylsulfamoyl)-5-nitro benzamide (3.5 g, 10 mmol), NH_4Cl (2.7 g, 50 mmol) were dissolved in water (30 mL) and iron powder (1.7 g, 30 mmol) was added in three batches and the resulting solution was stirred at 50 °C for 1 h. The reaction was monitored by TLC analysis until the starting material disappears completely. Followed by filtration, the filter cake was washed with CH_2Cl_2 (3 × 50 mL) and the filtrate extracted with CH_2Cl_2 (3 × 50 mL). The combined organic layers were washed three times with water (3 × 50 mL) and dried over anhydrous Na_2SO_4. The organic solvent was distilled under reduced pressure. At last, the reaction mixture was allowed to recrystallize from methanol to obtain the title product.

2 Experimental details

H atoms were included in calculated positions and refined as riding atoms, with C–H = 0.90–0.97 Å with U_{iso}(H) = 1.5 U_{eq}(C) for methyl H atoms and 1.2 U_{eq}(C) for all other H atoms.

3 Comment

Benzylamide sulfonamide compounds, as an important intermediate in the synthesis of many drugs, have attracted the attention [5–8]. For instance, Moss *et al.* [9] have reported the structure of 3-isopropyl-1*H*-2,1,3-benzothiadiazin-4(3*H*)-one 2,2-dioxide *bentazon*. Gentles *et al.* [10] have reported preclinical characterization of the cyclopropylindolobenzazepine

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

Atom	*x*	*y*	*z*	U_{iso}*/U_{eq}
C1	0.1410 (3)	0.2849 (2)	0.17707 (19)	0.0341 (4)
C2	0.1640 (3)	0.2013 (2)	0.08355 (18)	0.0318 (4)
C3	0.2357 (3)	0.0560 (2)	0.09844 (19)	0.0333 (4)
C4	0.2599 (3)	−0.0018 (2)	−0.0012 (2)	0.0386 (5)
H4	0.3088	−0.0975	0.0073	0.046*
C5	0.2106 (3)	0.0845 (3)	−0.1124 (2)	0.0412 (5)
C6	0.1395 (3)	0.2284 (3)	−0.1333 (2)	0.0402 (5)
C7	0.1160 (3)	0.2841 (2)	−0.0312 (2)	0.0367 (4)
H7	0.0665	0.3798	−0.0404	0.044*
C8	0.3471 (4)	0.5247 (3)	0.3190 (3)	0.0603 (7)
H8A	0.4492	0.5530	0.3394	0.090*
H8B	0.2420	0.5634	0.3624	0.090*
H8C	0.3689	0.5711	0.2238	0.090*
C9	0.5971 (5)	0.3228 (4)	0.2075 (4)	0.0822 (10)
H9A	0.5273	0.3374	0.1477	0.123*
H9B	0.6848	0.2502	0.1953	0.123*
H9C	0.6573	0.4229	0.1886	0.123*
C10	0.4737 (3)	0.2560 (3)	0.3511 (3)	0.0494 (6)
H10	0.4261	0.1484	0.3712	0.059*
C11	0.5726 (5)	0.2447 (5)	0.4497 (4)	0.0944 (12)
H11A	0.6182	0.3492	0.4337	0.142*
H11B	0.6710	0.1812	0.4388	0.142*
H11C	0.4915	0.1967	0.5394	0.142*
Cl1	0.31003 (7)	−0.05650 (6)	0.23331 (5)	0.0456 (2)
F1	0.2336 (2)	0.0272 (2)	−0.20975 (15)	0.0616 (4)
N1	0.0968 (4)	0.3111 (3)	−0.2483 (2)	0.0675 (7)
H1A	0.1142	0.2734	−0.3092	0.081*
H1B	0.0526	0.4006	−0.2596	0.081*
N2	0.1042 (2)	0.19277 (19)	0.31098 (15)	0.0332 (4)
H2	0.0710	0.0934	0.3388	0.040*
N3	0.3185 (2)	0.35139 (19)	0.36715 (19)	0.0393 (4)
O1	0.1563 (3)	0.42838 (17)	0.13629 (16)	0.0509 (4)
O2	−0.0062 (2)	0.3760 (2)	0.43120 (18)	0.0515 (4)
O3	0.1046 (2)	0.12125 (19)	0.53781 (14)	0.0451 (4)
S1	0.12054 (6)	0.26391 (6)	0.42230 (4)	0.0331 (2)

BMS-791325, a potent allosteric inhibitor of the hepatitis C virus NS5B polymerase. Braga *et al.* [11] have explored the structure–properties relationships of two new polymorphic forms of the herbicide Bentazonthe; relative thermal stability of all forms, together with the effect of additives on the crystallization of one or a mixture of the three polymorphs. However, most of the compounds in these studies have benzoheterocyclic structures, while the reports on chain structure are rare. The important intermediate 5-amino-2-chloro-4-fluoro-*N*-(*N*-isopropyl-*N*-methylsulfamoyl)benzamide of herbicide saflufenacil was synthesized by us from 2-chloro-4-fluoro-*N*-(*N*-isopropyl-*N*-methylsulfamoyl)-5-nitrobenzamide.

In the molecules of the title structure bond lengths and angles are very similar to those given in the literature. In the title structure, the dihedral angles formed by the C2–C7 phenyl plane and the C1–O1–N2 amide plane is 31.1°. The torsion angles of C2–C1–N2–S1, C1–N2–S1–N3, N2–S1–N3–C8, N2–S1–N3–C10, S1–N3–C10–C9 and S1–N3–C10–C11 are 165.7°, −54.0°, 111.1°, −62.0°, 122.6°, and −122.417 (254)°, respectively. Intermolecular N–H···O hydrogen bonds between the amino N atom [N(1)] and two sulfonyl O atoms [O(2) and O(3)] link the compounds into a 2D hydrogen bonded network.

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Conflict of interest statement: The authors declare no conflicts of interest regarding this article.

References

1. Bruker. *APEX2*, *SAINT* and *SADABS*; Bruker AXS Inc.: Madison, Wisconsin, USA, 2009.
2. Sheldrick G. M. A short history of *SHELX*. *Acta Crystallogr.* 2008, *A64*, 112–122.
3. Sheldrick G. M. Crystal structure refinement with SHELXL. *Acta Crystallogr.* 2015, *C71*, 3–8.
4. Brandenburg K. *DIAMOND. Visual Crystal Structure Information System (Ver. 4.0)*; Crystal Impact: Bonn, Germany, 2015.
5. He S. C., Ponmani J., Avula S. R., Wang X. L., Zhang H. Z., Zhou C. H. Recent advance in sulfonamide-based medicinal chemistry. *Sci. China Chem.* 2016, *46*, 823–847.
6. Liu A. C., Yu Y., Zheng Y. Q., Wang L. Y. Study of synthetic process of novel herbicide Saflufenacil. *World Pest.* 2017, *39*, 35–38.
7. Wang B., Mao Y. J., Liu X. Y., Zhao Z. W., Bu L. H., Wang H. New and convergent synthesis of saflufenacil. *J. Heterocycl. Chem.* 2020, *57*, 151–156.
8. Gao Y. C., Chen Y. H., Zhou D., Li L. Synthesis and herbicidal activity of safl ufenacil. *Agrochemicals* 2012, *51*, 565–568.
9. Moss L. E., Karcher B. A., Richardson J. W., Jacobson R. A. Structure of 3-isopropyl-1*H*-2,1,3-benzothiadiazin-4-3*H*-one 2,2-dioxide bentazon. *Acta Crystallogr.* 1986, *C42*, 1785–1787.
10. Gentles R. G., Ding M., Bender J. A., Bergstrom C. P., Grant-Young K., Hewawasam P., Hudyma T., Martin S., Nickel A., Regueiro-Ren A. Discovery and preclinical characterization of the cyclopropylindolobenzazepine BMS-791325, a potent allosteric inhibitor of the hepatitis C virus NS5B polymerase. *J. Med. Chem.* 2014, *57*, 1855–1879.
11. Braga D., Grepioni F., Chelazzi L., Nanna S., Rubini K., Curzi M., Giaffreda S. L., Saxell H. E., Bratz M., Chiodo T. Bentazon: effect of additives on the crystallization of pure and mixed polymorphic forms of a commercial herbicide. *Cryst. Growth Des.* 2014, *14*, 5729–5736.