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The crystal structure of ethyl 2-amino-4-(3,5-difluorophenyl)-7,7-dimethyl-5-oxo-5,6,7,8-tetrahydro-4*H*-chromene-3-carboxylate, $C_{20}H_{21}F_2NO_4$

Table 1: Data collection and handling.

Crystal:	Colourless block
Size:	0.25 × 0.19 × 0.10 mm
Wavelength:	Mo K α radiation (0.71073 Å)
μ :	0.10 mm ⁻¹
Diffractometer, scan mode:	PHOTON II M14, φ and ω
$\theta_{\max}$, completeness:	28.4°, >99%
$N(hkl)_{\text{measured}}$, $N(hkl)_{\text{unique}}$, R_{int} :	28588, 4754, 0.039
Criterion for I_{obs} , $N(hkl)_{\text{gt}}$:	$I_{\text{obs}} > 2 \sigma(I_{\text{obs}})$, 3493
$N(\text{param})_{\text{refined}}$:	255
Programs:	Bruker [1], SHELX [2, 3], Olex2 [4], PubCIF [5]

Source of material

The title compound, ethyl 2-amino-4-(3,5-difluorophenyl)-7,7-dimethyl-5-oxo-5,6,7,8-tetrahydro-4*H*-chromene-3-carboxylate, was obtained by a multicomponent reaction of ethyl 2-cyanoacetate, 3,5-difluorobenzaldehyde and 5,5-dimethylcyclohexane-1,3-dione. To a clear solution of ethyl 2-cyanoacetate (10 mmol, 1 ml) and 3,5-difluorobenzaldehyde (10 mmol, 1.42 g) in ethanol, was added 5,5-dimethylcyclohexane-1,3-dione (10 mmol, 1.4 g). The reaction mixture was refluxed for 5 h in the presence of 4-(dimethylamino)pyridine (DMAP, 1.1 mmol, 160 mg) catalyst [6]. After completion of reaction (TLC checked), the temperature of reaction mixture was cooled down to room temperature and kept for 24 h to give precipitations. The solid was filtered and recrystallized from an ethanol to give crystals of the title compound.

Experimental details

Data collections and reduction were carried out using the Bruker software APEX2 and SAINT including SADABS [1]. Hydrogen atoms were placed in their geometrically idealized positions and constrained to ride on their parent atoms.

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Abstract

$C_{20}H_{21}F_2NO_4$, triclinic, $P\bar{1}$ (no. 2), $a = 8.6363(11)$ Å, $b = 9.9144(11)$ Å, $c = 11.8734(15)$ Å, $\alpha = 81.891(4)^\circ$, $\beta = 72.889(4)^\circ$, $\gamma = 80.972(3)^\circ$, $V = 954.7(2)$ Å³, $Z = 2$, $R_{\text{gt}}(F) = 0.0466$, $wR_{\text{ref}}(F^2) = 0.1339$, $T = 223(2)$ 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.

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

Atom	X	Y	Z	U _{iso} [*] /U _{eq}
C1	0.43924 (18)	0.20758 (16)	−0.03580 (14)	0.0372 (3)
O1	0.54672 (14)	0.16606 (14)	0.01311 (11)	0.0495 (3)
C2	0.47666 (2)	0.28001 (19)	−0.15938 (15)	0.0471 (4)
H2A	0.4989	0.2117	−0.2161	0.057*
H2B	0.5757	0.3241	−0.1745	0.057*
C3	0.3383 (2)	0.38891 (17)	−0.18094 (15)	0.0435 (4)
C4	0.1826 (2)	0.31989 (17)	−0.14847 (15)	0.0424 (4)
H4A	0.0888	0.3908	−0.1448	0.051*
H4B	0.1884	0.2628	−0.2109	0.051*
C5	0.15624 (18)	0.23315 (15)	−0.03326 (13)	0.0350 (3)
O2	−0.00320 (13)	0.20861 (12)	0.01128 (10)	0.0415 (3)
C6	−0.04388 (18)	0.11542 (16)	0.10913 (14)	0.0374 (3)
C7	0.06193 (18)	0.06107 (15)	0.17376 (13)	0.0344 (3)
C8	0.22943 (17)	0.10738 (15)	0.14505 (13)	0.0325 (3)
H8	0.3108	0.0252	0.1460	0.039*
C9	0.27027 (17)	0.18349 (15)	0.02295 (13)	0.0330 (3)
C10	0.3782 (3)	0.4440 (2)	−0.31244 (18)	0.0642 (5)
H10A	0.2900	0.5122	−0.3256	0.096*
H10B	0.3910	0.3690	−0.3601	0.096*
H10C	0.4788	0.4856	−0.3347	0.096*
C11	0.3175 (3)	0.5065 (2)	−0.1059 (2)	0.0651 (6)
H11A	0.2292	0.5745	−0.1192	0.098*
H11B	0.4179	0.5484	−0.1279	0.098*
H11C	0.2922	0.4715	−0.0229	0.098*
N1	−0.19745 (18)	0.09019 (18)	0.12918 (17)	0.0511 (4)
H1A	−0.253 (3)	0.128 (2)	0.0792 (19)	0.061 (6)*
H1B	−0.233 (3)	0.033 (2)	0.1927 (19)	0.057 (6)*
C12	0.00812 (19)	−0.03686 (16)	0.27452 (14)	0.0385 (3)
O3	−0.12584 (15)	−0.07888 (13)	0.30908 (12)	0.0518 (3)
O4	0.12358 (14)	−0.07933 (12)	0.33160 (10)	0.0421 (3)
C13	0.0770 (2)	−0.17161 (18)	0.43860 (16)	0.0483 (4)
H13A	0.0549	−0.2586	0.4198	0.058*
H13B	−0.0217	−0.1305	0.4939	0.058*
C14	0.2171 (2)	−0.1955 (2)	0.49238 (18)	0.0618 (5)
H14A	0.3132	−0.2382	0.4376	0.093*
H14B	0.1895	−0.2553	0.5656	0.093*
H14C	0.2393	−0.1084	0.5088	0.093*
C15	0.23872 (17)	0.19888 (16)	0.23538 (13)	0.0338 (3)
C16	0.3450 (2)	0.1610 (2)	0.30491 (15)	0.0462 (4)
H16	0.4159	0.0786	0.2964	0.055*
C17	0.3447 (2)	0.2468 (2)	0.38686 (17)	0.0566 (5)
C18	0.2452 (2)	0.3684 (2)	0.40379 (17)	0.0560 (5)
H18	0.2476	0.4252	0.4602	0.067*
C19	0.1425 (2)	0.40175 (19)	0.33355 (16)	0.0511 (4)
C20	0.1365 (2)	0.32154 (17)	0.24985 (15)	0.0435 (4)
H20	0.0641	0.3495	0.2030	0.052*
F1	0.44787 (18)	0.20793 (19)	0.45508 (14)	0.0983 (5)
F2	0.03871 (19)	0.52054 (13)	0.34815 (13)	0.0850 (4)

Comment

The multicomponent reaction (MCR) is a method of effectively producing complex compounds through a

one-step reaction using three or more reactants [7]. Recently, MCR methods using microwave [8], ultrasound [9], organo-catalysts [10] have been developed to improve it. Polysubstituted 4*H*-pyran derivatives can also be synthesized through one-pot reaction of MCR by combination of aromatic aldehydes, cyanoacetate, and β -ketoesters. Polysubstituted 2-amino-4*H*-pyran-3-carboxylate derivatives has demonstrated wide range of pharmacological activities of anticancer [11], antidepressant [12], antimicrobial [13], enzyme-inhibitory [14]. In continuation of our research program to build a new library of heterocyclic compounds with diverse biological activities [15, 16], we synthesized the title compound *via* a multicomponent reaction and determined its single-crystal structure compound, C₂₀H₂₁F₂NO₄, crystallized in space group $P\bar{1}$.

In the title compound, the 4-hydropyran (C5–C9/O2) ring is slightly twisted from planarity, with a maximum deviation of 0.113 Å at C8 (r.m.s. deviation = 0.073 Å). The dihedral angle formed between the plane of the 4-hydropyran (C5–C9/O2) ring and difluoro-phenyl moiety (C15–C20) ring is 89.67°. An intramolecular N1–H1B...O3 hydrogen bond generates a ring motif classified using the S(6) graph set descriptor according to the Etter-nomenclature. In the crystal, pairs of C4–H4B...O3 hydrogen bonds generate dimers with graph-set notation R₂²(16). Additional N1–H1A...O1 hydrogen bond interactions link the dimers into the chains of molecules along *a* axis. Geometric parameters are all in the expected ranges [6, 17].

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