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The crystal structure of 3-(6-fluoro-*1H*-indol-3-yl)-1-methylquinoxalin-2(*1H*)-one, $C_{17}H_{12}FN_3O$

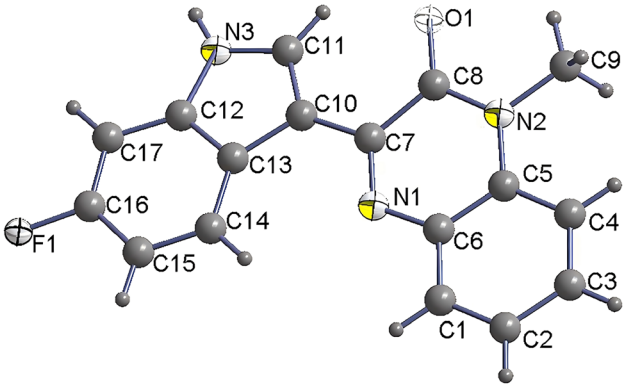

Table 1: Data collection and handling.

Crystal:	Colourless needle
Size:	0.16 × 0.05 × 0.03 mm
Wavelength:	Ga *Kα* radiation (1.34139 Å)
μ:	0.55 mm^{-1}
Diffractometer, scan mode:	Bruker D8 Venture, φ and ω
θ_{max}, completeness:	60.6°, >99 %
$N(hkl)_{measured}$, $N(hkl)_{unique}$, R_{int}:	35,195, 2,942, 0.101
Criterion for I_{obs}, $N(hkl)_{gt}$:	2,184
$N(param)_{refined}$:	200
Programs:	SHELX,[1,2] Diamond,[3] Olex2[4]

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Abstract

$C_{17}H_{12}FN_3O$, orthorhombic, *Pbca* (no. 61), a = 14.7608(7) Å, b = 7.2802(4) Å, c = 24.4842(13) Å, V = 2,631.1(2) $Å^3$, Z = 8, $R_{gt}(F)$ = 0.0900, $wR_{ref}(F_2)$ = 0.1841, T = 170 K.

CCDC no.: 2356296

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.

1 Source of materials

The 3-(6-fluoro-*1H*-indol-3-yl)-1-methylquinoxalin-2(*1H*)-one was obtained through an economic iron chloride catalyzed oxidative cross-coupling approach. In detail, a Schlenk-tube equipped with a magnetic stir bar was charged with 1-methylquinoxalin-2(*1H*)-one (0.5 mmol, 80.0 mg) and 6-fluoro-*1H*-indole (1.0 mmol, 135.1 mg). $FeCl_3$ solution (0.01 mmol/mL in CH_3CN, 5 mL) and di-tert-butyl peroxide (DTBP, 1.0 mmol, 184.1 µL) were added. Then, the reaction mixture was stirred at 30 °C for 24 h. After that, the resulting mixture was analyzed by HPLC, and the mixture was filtered to give the pure yellow product 3-(6-fluoro-*1H*-indol-3-yl)-1-methylquinoxalin-2(*1H*)-one (92.8 mg) in a 63 % yield. ^{1}H NMR (400 MHz, DMSO-d_6) δ 11.81 (s, 1H), 8.97–8.82 (m, 2H), 7.89 (d, J = 7.9 Hz, 1H), 7.52 (t, J = 2.8 Hz, 2H), 7.37 (s, 1H), 7.30 (d, J = 9.7 Hz, 1H), 7.07 (t, J = 9.3 Hz, 1H), 3.71 (d, J = 2.0 Hz, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 159.25 (d, J = 236.4 Hz), 153.55, 150.30, 136.40 (d, J = 12.5 Hz), 133.73 (d, J = 2.6 Hz), 132.82, 131.58, 128.43, 128.42, 124.14 (d, J = 9.6 Hz), 123.42, 123.01, 114.43, 111.45, 109.07 (d, J = 23.4 Hz), 98.06 (d, J = 25.7 Hz), 29.08. HRMS (ESI): *m/z* calcd. for $C_{17}H_{12}N_3OF[M+H]^+$: 294.1043. Found: 294.1046.

Preparing of crystals of 3-(6-fluoro-*1H*-indol-3-yl)-1-methylquinoxalin-2(*1H*)-one: dissolve the compound (5.0 mg) in ethyl acetate to obtain a pale-yellow transparent solution. Allow the solution to stand at room temperature and let it evaporate naturally. Transparent block crystals will form at the bottom of the vessel, which are the single crystals of the described compound.

2 Experimental details

After absorption correction, the crystal structure was solved using the Olex2 software[1] and the programs SHELXT[2]

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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}
F1	0.68276 (14)	0.3525 (3)	0.07452 (8)	0.0334 (6)
O1	0.94911 (14)	0.7494 (3)	0.35277 (9)	0.0243 (6)
N1	0.71291 (17)	0.6754 (4)	0.32795 (10)	0.0173 (6)
C1	0.5860 (2)	0.7586 (5)	0.38344 (13)	0.0206 (7)
H1	0.546862	0.727991	0.354016	0.025*
N2	0.83105 (17)	0.7873 (4)	0.41100 (10)	0.0164 (6)
C2	0.5498 (2)	0.8176 (5)	0.43244 (13)	0.0228 (7)
H2	0.486042	0.827756	0.436662	0.027*
N3	0.92398 (18)	0.4840 (4)	0.20256 (11)	0.0231 (6)
H3	0.973187	0.449892	0.184977	0.028*
C3	0.6074 (2)	0.8621 (5)	0.47573 (13)	0.0231 (7)
H3A	0.582123	0.900087	0.509585	0.028*
C4	0.7007 (2)	0.8518 (5)	0.47015 (13)	0.0206 (7)
H4	0.739271	0.883258	0.499778	0.025*
C5	0.7374 (2)	0.7944 (4)	0.42014 (12)	0.0166 (7)
C6	0.6804 (2)	0.7437 (4)	0.37678 (13)	0.0169 (7)
C7	0.8008 (2)	0.6700 (4)	0.32002 (12)	0.0165 (7)
C8	0.8670 (2)	0.7389 (4)	0.36154 (13)	0.0179 (7)
C9	0.8931 (2)	0.8421 (5)	0.45489 (13)	0.0231 (7)
H9A	0.882586	0.971297	0.464237	0.035*
H9B	0.955810	0.826383	0.442633	0.035*
H9C	0.882308	0.765399	0.487128	0.035*
C10	0.8336 (2)	0.5937 (4)	0.26894 (12)	0.0171 (7)
C11	0.9218 (2)	0.5550 (5)	0.25400 (13)	0.0201 (7)
H11	0.973418	0.574955	0.276368	0.024*
C12	0.8367 (2)	0.4739 (4)	0.18233 (13)	0.0191 (7)
C13	0.7774 (2)	0.5389 (4)	0.22290 (12)	0.0175 (7)
C14	0.6838 (2)	0.5369 (5)	0.21243 (13)	0.0197 (7)
H14	0.642080	0.578940	0.239201	0.024*
C15	0.6533 (2)	0.4726 (5)	0.16242 (13)	0.0226 (7)
H15	0.590255	0.469167	0.154598	0.027*
C16	0.7159 (2)	0.4130 (5)	0.12373 (13)	0.0233 (7)
C17	0.8077 (2)	0.4114 (5)	0.13159 (13)	0.0234 (7)
H17	0.848727	0.370414	0.104291	0.028*

program and refined with SHELXL[3] and the molecular graphics were drawn by using DIAMOND software.[4] All hydrogens were generated geometrically (C–H bond fixed at 0.96 Å), assigned isotropic thermal parameters, and allowed to ride on their parent carbon atoms before the final cycle of refinement.

3 Comment

Fluorinated compounds, distinguished by their unique physical, chemical, and physiological properties, have been extensively leveraged across a myriad of sectors, notably within the pharmaceuticals, agricultural, materials, and electronics industries.[5–7] The application of fluorinated compounds within the realm of medicinal chemistry has been marked by their unique impact on the bioavailability, metabolic stability, and target specificity of therapeutic agents, thereby significantly advancing the development of novel pharmaceuticals.

Quinoxalinones represent a prominent class of heterocyclic compounds, with a broad spectrum of applications in the fields of medicinal chemistry and the development of advanced functional materials.[8–12] Specifically, the subclass of 3-(indol-3-yl)quinoxalin-2-one derivatives, which integrates both a quinoxalinone framework and an indole moiety, has demonstrated remarkable biological activities, such as potent antibacterial effects, inhibition of platelet aggregation, and a suppression of human tumor cell proliferation.[13–15] Traditionally, Brønsted acids have been utilized as catalysts for the cross-coupling of quinoxalinones with indoles, typically under elevated temperature conditions.[16] Additionally, molecular iodine has been recognized for its efficacy in facilitating this reaction.[17] The emergence of electrochemical and photochemical approaches has introduced innovative methodologies into the reaction system.[18–21]

In this study, we present the single-crystal structure of a novel fluorinated derivative of 3-(indol-3-yl)quinoxalin-2-one, which could hold significant implications for its application across the pharmaceutical, agricultural, materials, and electronics industries.

The newly formed C–C single bond in the structure connects two rigid rings, and with the exception of the two hydrogen atoms on the methyl group, almost all atoms lie in the same plane along the *a*-axis direction. Geometric parameters are all in the expected ranges. The oxygen atom of each molecule forms a zigzag one-dimensional chain structure through hydrogen bonding interactions with the hydrogen $H_3{}^a$ (a = 2 − x, 0.5 + y, 0.5 − z) on the nitrogen of adjacent molecules, denoted as N_3–$H_3\cdots O_1$. Furthermore, the fluorine atom on the molecule simultaneously interacts with the hydrogen $H_2{}^b$ on the benzene carbon C_2 and the hydrogen $H_{9c}{}^c$ on the methyl group of two other adjacent quinolone molecules, where (b = 1 − x, −0.5 + y, 0.5 − z, c = 1.5 − x, 1 − y, −0.5 + z), resulting in a three-dimensional supramolecular architecture.

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