Acta Crystallographica Section E
Structure Reports Online
ISSN 1600-5368

Methyl 4-(4-fluorophenyl)-6-isopropyl-2-(methylamino)pyrimidine-5-carboxylate

Wei He, Hong-Shun Sun, Ye-ming Xu, Shi-gui Tang and Cheng Guo*

Department of Applied Chemistry, College of Science, Nanjing University of Technology, Xinmofan Road No. 5 Nanjing, Nanjing 210009, People's Republic of China
Correspondence e-mail: guocheng@njut.edu.cn

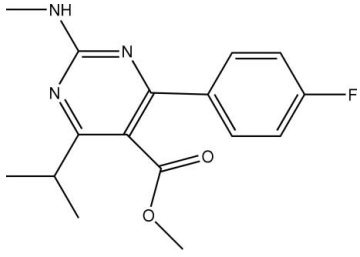
Received 17 September 2007; accepted 20 September 2007

Key indicators: single-crystal X-ray study; T = 294 K; mean σ(C–C) = 0.007 Å; R factor = 0.089; wR factor = 0.201; data-to-parameter ratio = 16.4.

In the title compound, $C_{16}H_{18}FN_3O_2$, the benzene and pyrimidine rings are oriented at a dihedral angle of 55.92 (2)°. In the crystal structure, intermolecular N—H···N and C—H···F hydrogen bonds are found.

Related literature

For related literature, see: Laufer & Wagner (2002); Gompper *et al.* (1997). For bond-length data, see: Allen *et al.* (1987).



Experimental

Crystal data

$C_{16}H_{18}FN_3O_2$
M_r = 303.33
Monoclinic, $P2_1/c$
a = 12.900 (3) Å
b = 8.6750 (17) Å
c = 14.775 (3) Å
β = 102.51 (3)°
V = 1614.2 (6) Å^3
Z = 4
Mo $K\alpha$ radiation
μ = 0.09 mm^{-1}
T = 294 (2) K
0.30 × 0.20 × 0.10 mm

Data collection

Enraf–Nonius CAD-4 diffractometer
Absorption correction: ψ scan (North *et al.*, 1968)
T_{min} = 0.972, T_{max} = 0.990
3308 measured reflections
3165 independent reflections
1547 reflections with $I > 2\sigma(I)$
R_{int} = 0.042
3 standard reflections
frequency: 120 min
intensity decay: none

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.089
$wR(F^2)$ = 0.201
S = 1.06
3165 reflections
193 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.55 e Å^{-3}
$\Delta\rho_{min}$ = −0.61 e Å^{-3}

Table 1
Hydrogen-bond geometry (Å, °).

D—H···A	D—H	H···A	D···A	D—H···A
N3—H3A···N1^{i}	0.86	2.41	3.270 (4)	177
C16—H16C···F^{ii}	0.96	2.53	3.331 (8)	141

Symmetry codes: (i) $-x+2, -y, -z$; (ii) $-x+1, -y+1, -z$.

Data collection: *CAD-4 Software* (Enraf–Nonius, 1989); cell refinement: *CAD-4 Software*; data reduction: *XCAD4* (Harms & Wocadlo, 1995); program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *SHELXTL* (Siemens, 1996); software used to prepare material for publication: *SHELXTL*.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HK2328).

References

Allen, F. H., Kennard, O., Watson, D. G., Brammer, L., Orpen, A. G. & Taylor, R. (1987). *J. Chem. Soc. Perkin Trans. 2*, pp. S1–19.
Enraf–Nonius (1989). *CAD-4 Software*. Version 5.0. Enraf-Nonius, Delft, The Netherlands.
Gompper, R., Mair, H.-J. & Polborn, K. (1997). *Synthesis*, p. 696.
Harms, K. & Wocadlo, S. (1995). *XCAD4*. University of Marburg, Germany.
Laufer, S. A. & Wagner, G. K. (2002). *J. Med. Chem.* **45**, 2733–2740.
North, A. C. T., Phillips, D. C. & Mathews, F. S. (1968). *Acta Cryst.* A**24**, 351–359.
Sheldrick, G. M. (1997). *SHELXS97* and *SHELXL97*. University of Göttingen, Germany.
Siemens (1996). *SHELXTL*. Version 5.06. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.

supplementary materials

Acta Cryst. (2007). E**63**, o4157 [**doi:10.1107/S1600536807046181**]

Methyl 4-(4-fluorophenyl)-6-isopropyl-2-(methylamino)pyrimidine-5-carboxylate

W. He, H.-S. Sun, Y. Xu, S. Tang and C. Guo

Comment

Pyrimidines are an important class of heteroaromatic compounds and have widespread applications from pharmaceuticals (Laufer & Wagner, 2002) to materials (Gompper *et al.*, 1997). As part of our studies in this area, we report herein the synthesis and crystal structure of the title compound, (I).

In the molecule of (I) (Fig. 1), the ligand bond lengths and angles are within normal ranges (Allen *et al.*, 1987). Rings A (C1—C6) and B (N1/N2/C7/C8/C10/C14) are, of course, planar and they are oriented at a dihedral angle of 55.92 (2)°.

In the crystal structure, intermolecular N—H···N and C—H···F hydrogen bonds (Table 1) link the molecules (Fig. 2), in which they seem to be effective in the stabilization of the structure.

Experimental

For the preparation of the title compound, (I), a solution of methylamine (71.9 ml, 5 N) in ethanol (72 ml) is added gradually to a solution of 4-(4-fluorophenyl)-6-isopropyl-2-methanesulfonyl-pyrimidine-5-carboxylic acid methyl ester (50.7 g, 144 mmol) in absolute ethanol (500 ml), under ice-cooling. The reaction mixture is warmed to room temperature, stirred for 1 h and evaporated under reduced pressure. Water is added to the residue, and the mixture is extracted with ether, dried and evaporated under reduced pressure to give the title compound, (I) (yield; 44.9 g, 76%, m.p. 358 K). Crystals of (I) suitable for X-ray analysis were obtained by slow evaporation of an ethanol solution.

Refinement

H atoms were positioned geometrically, with N—H = 0.86 Å (for NH) and C—H = 0.93, 0.98 and 0.96 Å for aromatic, methine and methyl H, and constrained to ride on their parent atoms, with U_{iso}(H) = xU_{eq}(C,*N*), where x = 1.5 for methyl H, and x = 1.2 for all other H atoms.

Figures

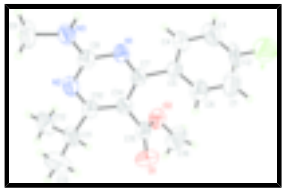


Fig. 1. The molecular structure of the title molecule, with the atom-numbering scheme. Displacement ellipsoids are drawn at the 30% probability level.

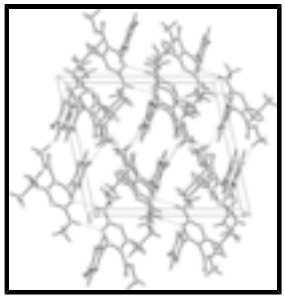


Fig. 2. A packing diagram for (I). Hydrogen bonds are shown as dashed lines.

Methyl 4-(4-fluorophenyl)-6-isopropyl-2-(methylamino)pyrimidine-5-carboxylate

Crystal data

$C_{16}H_{18}FN_3O_2$	F_{000} = 640
M_r = 303.33	D_x = 1.248 Mg m^{-3}
Monoclinic, $P2_1/c$	Mo $K\alpha$ radiation λ = 0.71073 Å
Hall symbol: -P 2ybc	Cell parameters from 25 reflections
a = 12.900 (3) Å	θ = 9–12º
b = 8.6750 (17) Å	μ = 0.09 mm^{-1}
c = 14.775 (3) Å	T = 294 (2) K
β = 102.51 (3)º	Block, colorless
V = 1614.2 (6) Å^3	0.30 × 0.20 × 0.10 mm
Z = 4	

Data collection

Enraf–Nonius CAD-4 diffractometer	R_{int} = 0.042
Radiation source: fine-focus sealed tube	θ_{max} = 26.0º
Monochromator: graphite	θ_{min} = 1.6º
T = 294(2) K	h = −15→15
ω/2θ scans	k = 0→10
Absorption correction: ψ scan (North *et al.*, 1968)	l = 0→18
T_{min} = 0.972, T_{max} = 0.990	3 standard reflections
3308 measured reflections	every 120 min
3165 independent reflections	intensity decay: none
1547 reflections with $I > 2\sigma(I)$	

Refinement

Refinement on F^2	Secondary atom site location: difference Fourier map
Least-squares matrix: full	Hydrogen site location: inferred from neighbouring sites
$R[F^2 > 2\sigma(F^2)]$ = 0.089	H-atom parameters constrained
$wR(F^2)$ = 0.201	$w = 1/[\sigma^2(F_o^2) + (0.04P)^2 + 2.5P]$

	where $P = (F_o^2 + 2F_c^2)/3$
$S = 1.06$	$(\Delta/\sigma)_{max} < 0.001$
3165 reflections	$\Delta\rho_{max} = 0.55$ e Å^{-3}
193 parameters	$\Delta\rho_{min} = -0.61$ e Å^{-3}
Primary atom site location: structure-invariant direct methods	Extinction correction: none

Special details

Geometry. All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted *R*-factor *wR* and goodness of fit S are based on F^2, conventional *R*-factors *R* are based on F, with F set to zero for negative F^2. The threshold expression of $F^2 > 2\text{sigma}(F^2)$ is used only for calculating *R*-factors(gt) *etc*. and is not relevant to the choice of reflections for refinement. *R*-factors based on F^2 are statistically about twice as large as those based on F, and R– factors based on ALL data will be even larger.

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

	x	*y*	*z*	U_{iso}*/U_{eq}
F	0.6304 (3)	0.6065 (4)	−0.0554 (2)	0.101
O1	0.5706 (3)	−0.0685 (5)	0.1532 (3)	0.0833 (12)
O2	0.6494 (2)	0.1523 (4)	0.2054 (2)	0.0643 (9)
N1	0.8941 (2)	0.0035 (4)	0.0741 (2)	0.0415 (8)
N2	0.9043 (3)	−0.2017 (4)	0.1841 (2)	0.0500 (9)
N3	1.0321 (3)	−0.1679 (4)	0.1009 (2)	0.0563 (10)
H3A	1.0530	−0.1223	0.0563	0.068*
C1	0.6090 (5)	0.3378 (8)	−0.0376 (4)	0.0944 (18)
H1A	0.5390	0.3451	−0.0704	0.113*
C2	0.6747 (5)	0.4669 (7)	−0.0202 (4)	0.0786 (16)
C3	0.7757 (5)	0.4633 (6)	0.0259 (4)	0.0760 (15)
H3B	0.8170	0.5522	0.0345	0.091*
C4	0.8161 (4)	0.3257 (5)	0.0599 (3)	0.0562 (12)
H4A	0.8862	0.3202	0.0925	0.067*
C5	0.7545 (3)	0.1920 (5)	0.0468 (3)	0.0481 (11)
C6	0.6536 (4)	0.1955 (7)	−0.0030 (3)	0.0693 (14)
H6A	0.6140	0.1053	−0.0143	0.083*
C7	0.8023 (3)	0.0461 (5)	0.0918 (3)	0.0417 (10)
C8	0.9410 (3)	−0.1220 (5)	0.1200 (3)	0.0445 (10)
C9	1.0985 (4)	−0.2888 (6)	0.1494 (4)	0.0800 (17)
H9A	1.1608	−0.2993	0.1243	0.120*
H9B	1.0599	−0.3842	0.1422	0.120*
H9C	1.1190	−0.2633	0.2141	0.120*
C10	0.8103 (3)	−0.1588 (5)	0.1997 (3)	0.0478 (11)
C11	0.7731 (4)	−0.2473 (5)	0.2754 (3)	0.0576 (12)
H11A	0.7137	−0.1901	0.2907	0.069*

C12	0.8595 (4)	−0.2599 (6)	0.3634 (3)	0.0782 (16)
H12A	0.8852	−0.1588	0.3830	0.117*
H12B	0.9169	−0.3214	0.3514	0.117*
H12C	0.8308	−0.3074	0.4113	0.117*
C13	0.7324 (5)	−0.4065 (7)	0.2423 (4)	0.0943 (19)
H13A	0.6761	−0.3967	0.1882	0.141*
H13B	0.7061	−0.4575	0.2905	0.141*
H13C	0.7892	−0.4658	0.2274	0.141*
C14	0.7545 (3)	−0.0341 (5)	0.1540 (3)	0.0443 (10)
C15	0.6489 (4)	0.0108 (6)	0.1706 (3)	0.0552 (12)
C16	0.5490 (4)	0.2113 (8)	0.2158 (5)	0.099 (2)
H16A	0.5584	0.3131	0.2419	0.149*
H16B	0.5202	0.1450	0.2563	0.149*
H16C	0.5010	0.2154	0.1563	0.149*

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
F	0.101	0.101	0.101	0.000	0.022	0.000
O1	0.052 (2)	0.092 (3)	0.106 (3)	−0.019 (2)	0.017 (2)	0.004 (2)
O2	0.058 (2)	0.069 (2)	0.064 (2)	0.0203 (18)	0.0113 (16)	0.0050 (19)
N1	0.0464 (19)	0.039 (2)	0.0361 (19)	0.0022 (17)	0.0018 (15)	−0.0007 (16)
N2	0.058 (2)	0.045 (2)	0.048 (2)	0.0121 (18)	0.0148 (18)	0.0086 (18)
N3	0.060 (2)	0.058 (2)	0.056 (2)	0.015 (2)	0.0231 (19)	0.015 (2)
C1	0.083 (4)	0.120 (5)	0.077 (4)	0.037 (3)	0.012 (3)	0.031 (4)
C2	0.094 (4)	0.073 (3)	0.072 (3)	0.056 (3)	0.026 (3)	0.044 (3)
C3	0.099 (4)	0.057 (3)	0.077 (4)	0.018 (3)	0.030 (3)	0.015 (3)
C4	0.071 (3)	0.048 (3)	0.047 (3)	0.010 (2)	0.007 (2)	0.008 (2)
C5	0.044 (2)	0.056 (3)	0.045 (2)	0.008 (2)	0.0116 (19)	0.009 (2)
C6	0.062 (3)	0.083 (3)	0.057 (3)	0.006 (3)	−0.002 (2)	0.014 (3)
C7	0.042 (2)	0.045 (3)	0.032 (2)	−0.002 (2)	−0.0042 (18)	−0.0015 (19)
C8	0.046 (2)	0.043 (3)	0.042 (3)	−0.001 (2)	0.004 (2)	−0.006 (2)
C9	0.096 (4)	0.069 (4)	0.074 (4)	0.043 (3)	0.016 (3)	0.023 (3)
C10	0.051 (3)	0.046 (3)	0.044 (3)	0.005 (2)	0.007 (2)	0.000 (2)
C11	0.069 (3)	0.054 (3)	0.054 (3)	0.011 (2)	0.021 (2)	0.014 (2)
C12	0.114 (4)	0.066 (4)	0.054 (3)	0.000 (3)	0.017 (3)	0.019 (3)
C13	0.112 (5)	0.079 (4)	0.095 (5)	−0.034 (4)	0.029 (4)	0.005 (4)
C14	0.046 (2)	0.044 (3)	0.039 (2)	−0.002 (2)	0.0028 (19)	−0.001 (2)
C15	0.047 (3)	0.065 (3)	0.050 (3)	0.010 (3)	0.003 (2)	0.021 (3)
C16	0.074 (4)	0.111 (5)	0.119 (5)	0.037 (4)	0.033 (4)	0.010 (4)

Geometric parameters (Å, °)

F—C2	1.390 (5)	C6—H6A	0.9300
O1—C15	1.203 (5)	C7—C14	1.399 (5)
O2—C15	1.331 (6)	C9—H9A	0.9600
O2—C16	1.432 (5)	C9—H9B	0.9600
N1—C7	1.319 (5)	C9—H9C	0.9600
N1—C8	1.354 (5)	C10—C14	1.390 (5)

N2—C10	1.335 (5)	C10—C11	1.518 (6)
N2—C8	1.340 (5)	C11—C13	1.519 (7)
N3—C8	1.328 (5)	C11—C12	1.523 (6)
N3—C9	1.443 (5)	C11—H11A	0.9800
N3—H3A	0.8600	C12—H12A	0.9600
C1—C2	1.395 (8)	C12—H12B	0.9600
C1—C6	1.410 (7)	C12—H12C	0.9600
C1—H1A	0.9300	C13—H13A	0.9600
C2—C3	1.334 (7)	C13—H13B	0.9600
C3—C4	1.354 (6)	C13—H13C	0.9600
C3—H3B	0.9300	C14—C15	1.488 (6)
C4—C5	1.395 (6)	C16—H16A	0.9600
C4—H4A	0.9300	C16—H16B	0.9600
C5—C6	1.349 (6)	C16—H16C	0.9600
C5—C7	1.499 (6)		
C15—O2—C16	116.2 (4)	H9B—C9—H9C	109.5
C7—N1—C8	116.7 (3)	N2—C10—C14	121.9 (4)
C10—N2—C8	116.8 (4)	N2—C10—C11	115.4 (4)
C8—N3—C9	124.7 (4)	C14—C10—C11	122.5 (4)
C8—N3—H3A	117.6	C10—C11—C13	111.4 (4)
C9—N3—H3A	117.6	C10—C11—C12	112.0 (4)
C2—C1—C6	116.9 (5)	C13—C11—C12	110.3 (4)
C2—C1—H1A	121.6	C10—C11—H11A	107.6
C6—C1—H1A	121.6	C13—C11—H11A	107.6
C3—C2—F	119.2 (6)	C12—C11—H11A	107.6
C3—C2—C1	124.2 (5)	C11—C12—H12A	109.5
F—C2—C1	116.5 (5)	C11—C12—H12B	109.5
C2—C3—C4	117.7 (5)	H12A—C12—H12B	109.5
C2—C3—H3B	121.2	C11—C12—H12C	109.5
C4—C3—H3B	121.2	H12A—C12—H12C	109.5
C3—C4—C5	121.3 (5)	H12B—C12—H12C	109.5
C3—C4—H4A	119.3	C11—C13—H13A	109.5
C5—C4—H4A	119.4	C11—C13—H13B	109.5
C6—C5—C4	120.7 (4)	H13A—C13—H13B	109.5
C6—C5—C7	121.1 (4)	C11—C13—H13C	109.5
C4—C5—C7	118.2 (4)	H13A—C13—H13C	109.5
C5—C6—C1	119.1 (5)	H13B—C13—H13C	109.5
C5—C6—H6A	120.4	C10—C14—C7	116.7 (4)
C1—C6—H6A	120.4	C10—C14—C15	121.4 (4)
N1—C7—C14	122.2 (4)	C7—C14—C15	121.9 (4)
N1—C7—C5	116.7 (3)	O1—C15—O2	123.0 (4)
C14—C7—C5	120.9 (4)	O1—C15—C14	124.8 (5)
N3—C8—N2	117.4 (4)	O2—C15—C14	112.2 (4)
N3—C8—N1	117.1 (4)	O2—C16—H16A	109.5
N2—C8—N1	125.5 (4)	O2—C16—H16B	109.5
N3—C9—H9A	109.5	H16A—C16—H16B	109.5
N3—C9—H9B	109.5	O2—C16—H16C	109.5
H9A—C9—H9B	109.5	H16A—C16—H16C	109.5
N3—C9—H9C	109.5	H16B—C16—H16C	109.5

H9A—C9—H9C	109.5		
C6—C1—C2—C3	0.4 (8)	C7—N1—C8—N2	−3.0 (6)
C6—C1—C2—F	179.3 (4)	C8—N2—C10—C14	−2.1 (6)
F—C2—C3—C4	179.6 (4)	C8—N2—C10—C11	−177.7 (4)
C1—C2—C3—C4	−1.6 (8)	N2—C10—C11—C13	−76.0 (5)
C2—C3—C4—C5	0.3 (7)	C14—C10—C11—C13	108.4 (5)
C3—C4—C5—C6	2.3 (7)	N2—C10—C11—C12	48.1 (6)
C3—C4—C5—C7	−175.9 (4)	C14—C10—C11—C12	−127.4 (5)
C4—C5—C6—C1	−3.4 (7)	N2—C10—C14—C7	−1.0 (6)
C7—C5—C6—C1	174.7 (4)	C11—C10—C14—C7	174.3 (4)
C2—C1—C6—C5	2.1 (7)	N2—C10—C14—C15	178.8 (4)
C8—N1—C7—C14	−0.6 (5)	C11—C10—C14—C15	−5.9 (6)
C8—N1—C7—C5	175.4 (3)	N1—C7—C14—C10	2.5 (6)
C6—C5—C7—N1	127.6 (4)	C5—C7—C14—C10	−173.4 (4)
C4—C5—C7—N1	−54.2 (5)	N1—C7—C14—C15	−177.4 (4)
C6—C5—C7—C14	−56.3 (6)	C5—C7—C14—C15	6.8 (6)
C4—C5—C7—C14	121.9 (4)	C16—O2—C15—O1	−4.1 (7)
C9—N3—C8—N2	−5.4 (7)	C16—O2—C15—C14	174.5 (4)
C9—N3—C8—N1	173.3 (4)	C10—C14—C15—O1	−63.2 (6)
C10—N2—C8—N3	−177.1 (4)	C7—C14—C15—O1	116.6 (5)
C10—N2—C8—N1	4.3 (6)	C10—C14—C15—O2	118.3 (4)
C7—N1—C8—N3	178.4 (4)	C7—C14—C15—O2	−61.9 (5)

Hydrogen-bond geometry (Å, °)

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
N3—H3A···N1^{i}	0.86	2.41	3.270 (4)	177
C16—H16C···F^{ii}	0.96	2.53	3.331 (8)	141

Symmetry codes: (i) −*x*+2, −*y*, −*z*; (ii) −*x*+1, −*y*+1, −*z*.

Fig. 1

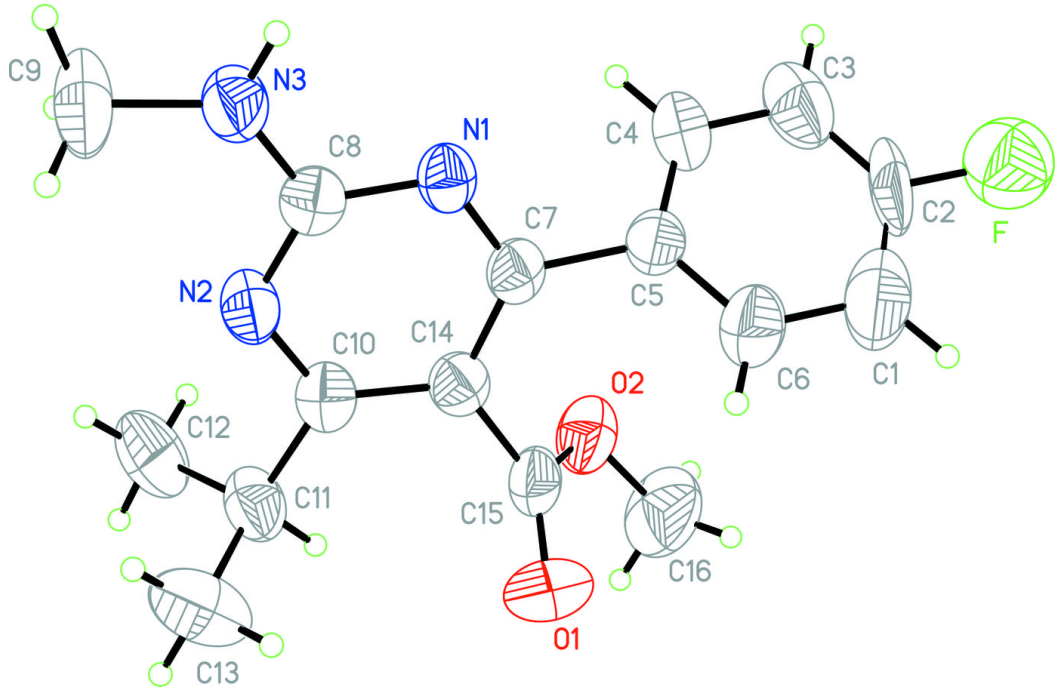

C9
N3
C8
N1
C4
C3
C2
F
C7
N2
C5
C10
C14
C6
C1
O2
C12
C11
C15
C16
O1
C13

Fig. 2