Acta Crystallographica Section E
Structure Reports Online
ISSN 1600-5368

Ethyl 3-(4-chlorophenyl)-5-(ethoxycarbonyl)-1*H*-pyrazole-1-acetate

Wen-Liang Dong,[a] Wen-Liang Dong,[a,b] Yong Xia,[b] Yan-Qing Ge[b] and Bao-Xiang Zhao[b]*

[a]Shandong University of Traditional Chinese Medicine, Jinan 250355, People's Republic of China, and [b]School of Chemistry and Chemical Engineering, Shandong University, Jinan 250100, People's Republic of China
Correspondence e-mail: sduzhao@hotmail.com

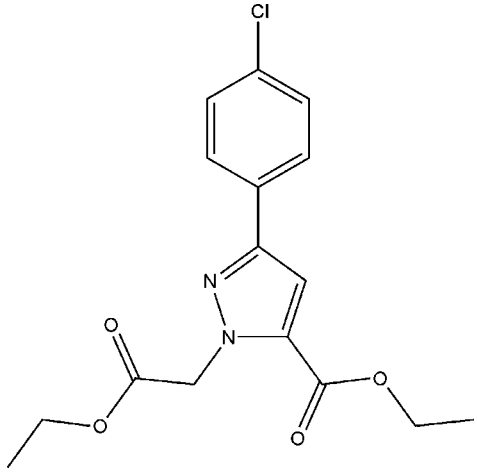
Received 20 October 2007; accepted 21 October 2007

Key indicators: single-crystal X-ray study; T = 296 K; mean σ(C–C) = 0.002 Å; R factor = 0.038; wR factor = 0.108; data-to-parameter ratio = 18.0.

In the title compound, $C_{16}H_{17}ClN_2O_4$, all bond lengths and angles show normal values. The dihedral angle between the pyrazole ring and the benzene ring is 5.75 (8)°. The molecules are linked into a network by intermolecular C—Cl$\cdots\pi$ interactions.

Related literature

For related literature, see: Allen *et al.* (1987); Brough *et al.* (2005); Cheng *et al.* (2006); Sehon *et al.* (2006); Wei *et al.* (2006); Xia *et al.* (2007).



Experimental

Crystal data

$C_{16}H_{17}ClN_2O_4$
M_r = 336.77
Triclinic, $P\overline{1}$
a = 6.9912 (1) Å
b = 10.8651 (2) Å
c = 12.2528 (3) Å
α = 108.407 (1)°
β = 99.878 (1)°
γ = 103.834 (1)°
V = 826.08 (3) Å^3
Z = 2
Mo $K\alpha$ radiation
μ = 0.25 mm^{-1}
T = 296 (2) K
0.48 × 0.40 × 0.37 mm

Data collection

Bruker APEX2 CCD area-detector diffractometer
Absorption correction: multi-scan (*APEX2*; Bruker, 2005)
T_{min} = 0.889, T_{max} = 0.913
12665 measured reflections
3784 independent reflections
3029 reflections with $I > 2\sigma(I)$
R_{int} = 0.020

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.038
$wR(F^2)$ = 0.108
S = 1.06
3784 reflections
210 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.17 e Å^{-3}
$\Delta\rho_{min}$ = −0.26 e Å^{-3}

Table 1
Y—$X\cdots\pi$-ring interactions.

Cg1 is the centroid of the pyrazole ring (N1/N2/C7/C8/C9).

Y—$X\cdots Cg$	Y—X	$X\cdots Cg$	$Y\cdots Cg$	Y—$X\cdots Cg$
C1—Cl1$\cdots Cg1^{i}$	1.7378 (16)	3.8281 (8)	3.6952 (17)	72.42 (6)

Symmetry code: (i) $-1+x, y, z$.

Data collection: *APEX2* (Bruker, 2005); cell refinement: *APEX2*; data reduction: *APEX2*; program(s) used to solve structure: *SIR97* (Altomare *et al.*, 1999); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *SHELXTL* (Bruker, 1997); software used to prepare material for publication: *WinGX* (Farrugia, 1999) and *PLATON* (Spek, 2003).

This study was supported by the Natural Science Foundation of Shandong Province (grant No. Y2005B12).

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: FJ2060).

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.
Altomare, A., Burla, M. C., Camalli, M., Cascarano, G. L., Giacovazzo, C., Guagliardi, A., Moliterni, A. G. G., Polidori, G. & Spagna, R. (1999). *J. Appl. Cryst.* **32**, 115–119.
Brough, P. A., Barril, X. & Beswick, M. (2005). *Bioorg. Med. Chem. Lett.* **15**, 5197–5201.
Bruker (1997). *SHELXTL*. Version 5.1. Bruker AXS Inc., Madison, Wisconsin, USA.
Bruker (2005). *APEX2*. Version 2.0-2. Bruker AXS Inc., Madison, Wisconsin, USA.
Cheng, H., Lundy DeMello, K. M., Li, J. & Sakya, S. M. (2006). *Bioorg. Med. Chem. Lett.* **16**, 2076–2080.
Farrugia, L. J. (1999). *J. Appl. Cryst.* **32**, 837–838.
Sehon, C., McClure, K., Hack, M., Morton, M., Gomez, L. & Li, L. (2006). *Bioorg. Med. Chem. Lett.* **15**, 1677–1680.
Sheldrick, G. M. (1997). *SHELXL97*. University of Göttingen, Germany.
Spek, A. L. (2003). *J. Appl. Cryst.* **36**, 7–13.
Wei, F., Zhao, B. X., Huang, B., Zhang, L., Sun, C. H., Dong, W. L., Shin, D. S. & Miao, J. Y. (2006). *Bioorg. Med. Chem. Lett.* **16**, 6342–6347.
Xia, Y., Dong, Z. W., Zhao, B. X., Ge, X., Meng, N., Shin, D. S. & Miao, J. Y. (2007). *Bioorg. Med. Chem.* **15**, 6893–6899.

 © 2007 International Union of Crystallography doi:10.1107/S1600536807052208

supplementary materials

Acta Cryst. (2007). E**63**, o4468 [**doi:10.1107/S1600536807052208**]

Ethyl 3-(4-chlorophenyl)-5-(ethoxycarbonyl)-1*H*-pyrazole-1-acetate

W.-L. Dong, W.-L. Dong, Y. Xia, Y.-Q. Ge and B.-X. Zhao

Comment

The pyrazole unit is one of the core structures in a number of natural products. Many pyrazole derivatives are known to exhibit a wide range of biological properties such as antagonists (Sehon *et al.*, 2006), anti-inflammatory (Cheng *et al.*, 2006), inhibitors of the Hsp90 (Brough *et al.*, 2005), antitumor (Wei *et al.*, 2006, Xia *et al.*, 2007). We report here the crystal structure of the title compound, (I).

In compound (I) (Fig. 1), all bond lengths and angles are normal (Allen *et al.*, 1987). The dihedral angle between the rings of the pyrazole and the benzene ring is 5.75 (8)°. The two ethyl carboxylate groups are inclined to the attached pyrazole ring by 1.09 (7)° and 78.21 (9)°, respectively. The molecules are linked into a network parallel by C—H···π interactions (Table 1) involving the pyrazole ring (centroid *Cg*1).

Experimental

A mixture of ethyl 3-(4-chlorophenyl)-1*H*-pyrazole-5-carboxylate (0.01 mol), ethyl chloroacetate (0.015 mol) and potassium carbonate (0.02 mol) in acetonitrile (50 ml) was heated to reflux for 15 h. The solvent was removed under reduced pressure, and the residue was dissolved in the mixture of water (50 ml) and ethyl acetate (50 ml). After separated, the water phase was extracted with ethyl acetate (25 ml), and then the organic phase was combined, dried over anhydrous magnesium sulfate and filtered. The solvent was removed under reduced pressure. The solid product was recrystallized from ethyl acetate (yield 64%). Crystals of (I) suitable for X-ray diffraction were obtained by slow evaporation of a solution of the solid in ethyl acetate at room temperature for 4 d.

Refinement

All H atoms were placed in geometrically calculated positions and refined using a riding model with C—H = 0.97 Å (for CH_2 groups) and 0.96 Å (for CH_3 groups). Their isotropic displacement parameters were set to 1.2 times (1.5 times for CH_3 groups) the equivalent displacement parameter of their parent atoms.

Figures

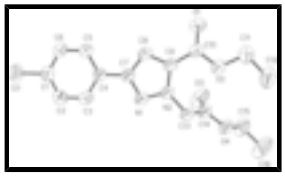


Fig. 1. The structure of the title molecule showing displacement ellipsoids drawn at the 50% probability level. Hydrogen atoms have been omitted for clarity.

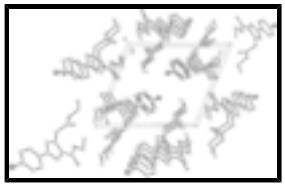


Fig. 2. Packing view of (I), shown down the *a* axis.

Ethyl 3-(4-chlorophenyl)-5-(ethoxycarbonyl)-1*H*-pyrazole-1-acetate

Crystal data

$C_{16}H_{17}ClN_2O_4$	$Z = 2$
$M_r = 336.77$	$F_{000} = 352$
Triclinic, $P\overline{1}$	$D_x = 1.354$ Mg m^{-3}
Hall symbol: -P 1	Mo $K\alpha$ radiation $\lambda = 0.71073$ Å
$a = 6.9912$ (1) Å	Cell parameters from 6319 reflections
$b = 10.8651$ (2) Å	$\theta = 2.2$–27.5º
$c = 12.2528$ (3) Å	$\mu = 0.25$ mm^{-1}
$\alpha = 108.407$ (1)º	$T = 296$ (2) K
$\beta = 99.878$ (1)º	Block, colourless
$\gamma = 103.834$ (1)º	0.48 × 0.40 × 0.37 mm
$V = 826.08$ (3) Å^3	

Data collection

Bruker APEX2 CCD area-detector diffractometer	3784 independent reflections
Radiation source: fine-focus sealed tube	3029 reflections with $I > 2\sigma(I)$
Monochromator: graphite	$R_{int} = 0.020$
$T = 296$(2) K	$\theta_{max} = 27.6$º
φ and ω scans	$\theta_{min} = 1.8$º
Absorption correction: multi-scan (APEX2; Bruker, 2005)	$h = -9 \rightarrow 9$
$T_{min} = 0.889$, $T_{max} = 0.913$	$k = -14 \rightarrow 14$
12665 measured reflections	$l = -15 \rightarrow 14$

Refinement

Refinement on F^2	Secondary atom site location: difference Fourier map
Least-squares matrix: full	Hydrogen site location: inferred from neighbouring sites
$R[F^2 > 2\sigma(F^2)] = 0.038$	H-atom parameters constrained
$wR(F^2) = 0.108$	$w = 1/[\sigma^2(F_o^2) + (0.0497P)^2 + 0.1299P]$ where $P = (F_o^2 + 2F_c^2)/3$
$S = 1.06$	$(\Delta/\sigma)_{max} = 0.001$
3784 reflections	$\Delta\rho_{max} = 0.17$ e Å^{-3}
210 parameters	$\Delta\rho_{min} = -0.26$ 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 $F^2 > 2\mathrm{sigma}(F^2)$ 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}
C1	1.4251 (2)	0.32582 (15)	0.55519 (14)	0.0539 (3)
C2	1.2529 (2)	0.21560 (17)	0.49049 (14)	0.0616 (4)
H2	1.2460	0.1574	0.4146	0.074*
C3	1.0909 (2)	0.19247 (15)	0.53954 (13)	0.0588 (4)
H3	0.9745	0.1181	0.4958	0.071*
C4	1.0977 (2)	0.27768 (13)	0.65283 (12)	0.0466 (3)
C5	1.2746 (2)	0.38795 (14)	0.71633 (13)	0.0556 (3)
H5	1.2832	0.4461	0.7925	0.067*
C6	1.4372 (2)	0.41210 (15)	0.66777 (14)	0.0592 (4)
H6	1.5543	0.4862	0.7108	0.071*
C7	0.9249 (2)	0.25142 (13)	0.70471 (12)	0.0472 (3)
C8	0.8980 (2)	0.33064 (13)	0.81219 (12)	0.0489 (3)
H8	0.9875	0.4138	0.8676	0.059*
C9	0.7116 (2)	0.25994 (13)	0.81884 (12)	0.0475 (3)
C10	0.6129 (2)	0.30064 (14)	0.91472 (13)	0.0535 (3)
C11	0.3153 (2)	0.24963 (19)	0.98225 (16)	0.0682 (4)
H11A	0.2796	0.3306	0.9823	0.082*
H11B	0.3955	0.2679	1.0618	0.082*
C12	0.1269 (3)	0.1310 (2)	0.9463 (2)	0.0836 (6)
H12A	0.0592	0.1055	0.8637	0.125*
H12B	0.0368	0.1557	0.9943	0.125*
H12C	0.1632	0.0553	0.9579	0.125*
C13	0.4440 (2)	0.03457 (14)	0.67921 (12)	0.0511 (3)
H13A	0.4209	−0.0216	0.5960	0.061*
H13B	0.3325	0.0728	0.6854	0.061*
C14	0.4434 (2)	−0.05372 (14)	0.75279 (13)	0.0545 (3)
C15	0.2261 (3)	−0.22815 (18)	0.79200 (18)	0.0764 (5)
H15A	0.2627	−0.1800	0.8778	0.092*
H15B	0.3126	−0.2854	0.7738	0.092*
C16	0.0075 (3)	−0.3130 (3)	0.7480 (3)	0.1160 (9)
H16A	−0.0768	−0.2549	0.7631	0.174*

H16B	−0.0169	−0.3752	0.7888	0.174*
H16C	−0.0251	−0.3638	0.6638	0.174*
Cl1	1.62997 (7)	0.35614 (5)	0.49404 (4)	0.07621 (16)
N1	0.76366 (17)	0.13804 (11)	0.64765 (10)	0.0512 (3)
N2	0.63518 (16)	0.14490 (11)	0.71761 (10)	0.0480 (3)
O1	0.69162 (19)	0.40359 (13)	1.00153 (11)	0.0874 (4)
O2	0.43116 (15)	0.21400 (10)	0.89587 (9)	0.0596 (3)
O3	0.59010 (18)	−0.05511 (14)	0.81726 (13)	0.0857 (4)
O4	0.25301 (15)	−0.13161 (10)	0.73253 (9)	0.0595 (3)

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
C1	0.0528 (8)	0.0533 (8)	0.0604 (8)	0.0151 (6)	0.0205 (6)	0.0259 (7)
C2	0.0627 (9)	0.0606 (9)	0.0529 (8)	0.0138 (7)	0.0169 (7)	0.0132 (7)
C3	0.0524 (8)	0.0532 (8)	0.0526 (8)	0.0019 (6)	0.0083 (6)	0.0099 (6)
C4	0.0453 (7)	0.0425 (7)	0.0486 (7)	0.0075 (5)	0.0098 (5)	0.0185 (6)
C5	0.0537 (8)	0.0468 (7)	0.0522 (8)	0.0012 (6)	0.0145 (6)	0.0105 (6)
C6	0.0515 (8)	0.0495 (8)	0.0629 (9)	−0.0003 (6)	0.0157 (7)	0.0151 (7)
C7	0.0451 (7)	0.0405 (6)	0.0478 (7)	0.0025 (5)	0.0065 (5)	0.0170 (5)
C8	0.0441 (7)	0.0403 (6)	0.0490 (7)	0.0000 (5)	0.0074 (6)	0.0119 (5)
C9	0.0442 (7)	0.0403 (6)	0.0457 (7)	0.0015 (5)	0.0047 (5)	0.0125 (5)
C10	0.0465 (7)	0.0483 (7)	0.0512 (8)	0.0016 (6)	0.0080 (6)	0.0120 (6)
C11	0.0577 (9)	0.0780 (11)	0.0666 (10)	0.0143 (8)	0.0242 (8)	0.0249 (8)
C12	0.0686 (11)	0.0831 (12)	0.1117 (15)	0.0156 (9)	0.0442 (11)	0.0481 (12)
C13	0.0451 (7)	0.0447 (7)	0.0453 (7)	−0.0050 (5)	0.0035 (5)	0.0114 (5)
C14	0.0493 (8)	0.0452 (7)	0.0562 (8)	0.0006 (6)	0.0085 (6)	0.0158 (6)
C15	0.0759 (11)	0.0638 (10)	0.0924 (13)	0.0060 (8)	0.0235 (10)	0.0442 (10)
C16	0.0892 (15)	0.0949 (16)	0.151 (2)	−0.0211 (12)	0.0157 (15)	0.0742 (16)
Cl1	0.0705 (3)	0.0778 (3)	0.0866 (3)	0.0186 (2)	0.0411 (2)	0.0317 (2)
N1	0.0498 (6)	0.0456 (6)	0.0465 (6)	0.0000 (5)	0.0107 (5)	0.0140 (5)
N2	0.0445 (6)	0.0417 (6)	0.0442 (6)	−0.0021 (4)	0.0067 (5)	0.0124 (5)
O1	0.0672 (7)	0.0733 (8)	0.0718 (8)	−0.0138 (6)	0.0244 (6)	−0.0144 (6)
O2	0.0503 (5)	0.0571 (6)	0.0559 (6)	−0.0016 (4)	0.0160 (5)	0.0135 (5)
O3	0.0566 (7)	0.0860 (9)	0.1089 (10)	0.0010 (6)	−0.0037 (7)	0.0582 (8)
O4	0.0517 (6)	0.0514 (6)	0.0666 (6)	−0.0016 (4)	0.0129 (5)	0.0252 (5)

Geometric parameters (Å, °)

C1—C6	1.376 (2)	C11—C12	1.491 (2)
C1—C2	1.377 (2)	C11—H11A	0.9700
C1—Cl1	1.7380 (15)	C11—H11B	0.9700
C2—C3	1.378 (2)	C12—H12A	0.9600
C2—H2	0.9300	C12—H12B	0.9600
C3—C4	1.390 (2)	C12—H12C	0.9600
C3—H3	0.9300	C13—N2	1.4515 (15)
C4—C5	1.3940 (19)	C13—C14	1.510 (2)
C4—C7	1.4693 (19)	C13—H13A	0.9700
C5—C6	1.380 (2)	C13—H13B	0.9700

C5—H5	0.9300	C14—O3	1.1885 (18)
C6—H6	0.9300	C14—O4	1.3287 (16)
C7—N1	1.3410 (16)	C15—O4	1.4499 (19)
C7—C8	1.3987 (19)	C15—C16	1.486 (3)
C8—C9	1.3757 (18)	C15—H15A	0.9700
C8—H8	0.9300	C15—H15B	0.9700
C9—N2	1.3639 (16)	C16—H16A	0.9600
C9—C10	1.466 (2)	C16—H16B	0.9600
C10—O1	1.1995 (17)	C16—H16C	0.9600
C10—O2	1.3205 (16)	N1—N2	1.3427 (16)
C11—O2	1.4532 (19)		
C6—C1—C2	120.87 (14)	H11A—C11—H11B	108.5
C6—C1—Cl1	119.57 (11)	C11—C12—H12A	109.5
C2—C1—Cl1	119.56 (12)	C11—C12—H12B	109.5
C1—C2—C3	119.19 (14)	H12A—C12—H12B	109.5
C1—C2—H2	120.4	C11—C12—H12C	109.5
C3—C2—H2	120.4	H12A—C12—H12C	109.5
C2—C3—C4	121.51 (13)	H12B—C12—H12C	109.5
C2—C3—H3	119.2	N2—C13—C14	112.21 (11)
C4—C3—H3	119.2	N2—C13—H13A	109.2
C3—C4—C5	117.91 (13)	C14—C13—H13A	109.2
C3—C4—C7	121.07 (12)	N2—C13—H13B	109.2
C5—C4—C7	121.01 (12)	C14—C13—H13B	109.2
C6—C5—C4	120.96 (14)	H13A—C13—H13B	107.9
C6—C5—H5	119.5	O3—C14—O4	125.27 (14)
C4—C5—H5	119.5	O3—C14—C13	125.56 (13)
C1—C6—C5	119.56 (13)	O4—C14—C13	109.16 (12)
C1—C6—H6	120.2	O4—C15—C16	107.41 (16)
C5—C6—H6	120.2	O4—C15—H15A	110.2
N1—C7—C8	110.55 (12)	C16—C15—H15A	110.2
N1—C7—C4	120.44 (12)	O4—C15—H15B	110.2
C8—C7—C4	129.01 (12)	C16—C15—H15B	110.2
C9—C8—C7	105.64 (11)	H15A—C15—H15B	108.5
C9—C8—H8	127.2	C15—C16—H16A	109.5
C7—C8—H8	127.2	C15—C16—H16B	109.5
N2—C9—C8	106.38 (12)	H16A—C16—H16B	109.5
N2—C9—C10	126.65 (12)	C15—C16—H16C	109.5
C8—C9—C10	126.96 (12)	H16A—C16—H16C	109.5
O1—C10—O2	123.87 (14)	H16B—C16—H16C	109.5
O1—C10—C9	122.42 (13)	C7—N1—N2	105.61 (11)
O2—C10—C9	113.71 (12)	N1—N2—C9	111.82 (10)
O2—C11—C12	107.11 (14)	N1—N2—C13	118.63 (11)
O2—C11—H11A	110.3	C9—N2—C13	129.55 (12)
C12—C11—H11A	110.3	C10—O2—C11	117.87 (12)
O2—C11—H11B	110.3	C14—O4—C15	116.38 (12)
C12—C11—H11B	110.3		
C6—C1—C2—C3	0.3 (2)	N2—C9—C10—O2	−0.7 (2)
Cl1—C1—C2—C3	−179.86 (12)	C8—C9—C10—O2	178.45 (13)

C1—C2—C3—C4	−0.1 (2)	N2—C13—C14—O3	−15.2 (2)
C2—C3—C4—C5	−0.2 (2)	N2—C13—C14—O4	165.85 (12)
C2—C3—C4—C7	−179.46 (14)	C8—C7—N1—N2	0.17 (15)
C3—C4—C5—C6	0.4 (2)	C4—C7—N1—N2	179.97 (11)
C7—C4—C5—C6	179.66 (14)	C7—N1—N2—C9	−0.48 (15)
C2—C1—C6—C5	−0.1 (2)	C7—N1—N2—C13	−179.80 (11)
Cl1—C1—C6—C5	−179.95 (12)	C8—C9—N2—N1	0.60 (15)
C4—C5—C6—C1	−0.3 (2)	C10—C9—N2—N1	179.87 (13)
C3—C4—C7—N1	5.6 (2)	C8—C9—N2—C13	179.83 (13)
C5—C4—C7—N1	−173.64 (13)	C10—C9—N2—C13	−0.9 (2)
C3—C4—C7—C8	−174.68 (14)	C14—C13—N2—N1	108.02 (14)
C5—C4—C7—C8	6.1 (2)	C14—C13—N2—C9	−71.16 (19)
N1—C7—C8—C9	0.19 (16)	O1—C10—O2—C11	3.6 (2)
C4—C7—C8—C9	−179.59 (13)	C9—C10—O2—C11	−176.19 (13)
C7—C8—C9—N2	−0.46 (15)	C12—C11—O2—C10	−175.19 (14)
C7—C8—C9—C10	−179.73 (13)	O3—C14—O4—C15	−1.9 (2)
N2—C9—C10—O1	179.51 (16)	C13—C14—O4—C15	177.03 (13)
C8—C9—C10—O1	−1.4 (2)	C16—C15—O4—C14	−174.51 (17)

Y—X···π-ring interactions

Y—*X*···*Cg*	Y—*X*	*X*···*Cg*	Y···*Cg*	Y—*X*···*Cg*
C1-Cl1···*Cg*1^{i}	1.7378 (16)	3.8281 (8)	3.6952 (17)	72.42 (6)

Symmetry code: (i) −1 + *x*, *y*, *z*. *Cg*^{i} is the centroid of the pyrazole ring (N1/N2/C7/C8/C9).

Fig. 1

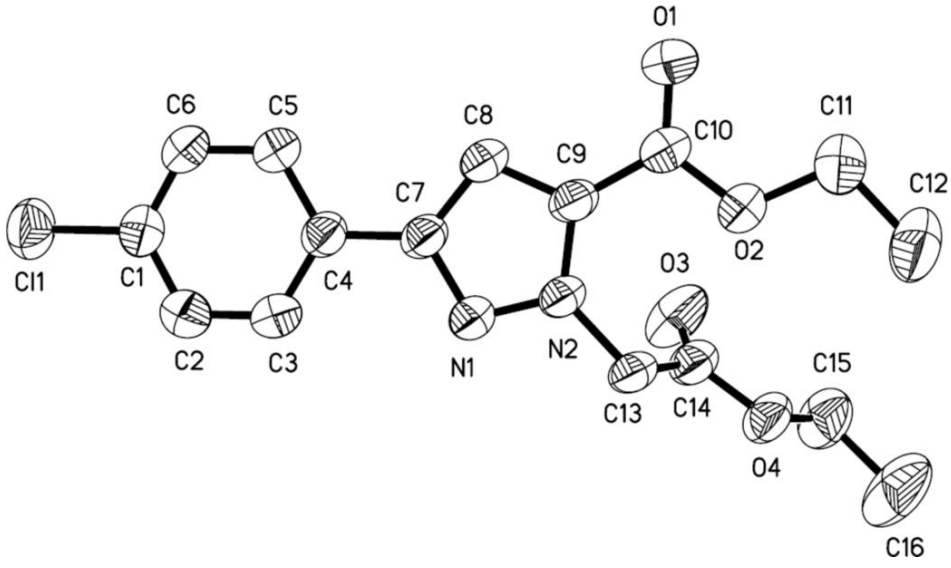

O1
C6
C5
C8
C10
C11
C9
C12
C7
O2
O3
Cl1
C1
C4
C2
C3
N1
N2
C15
C13
C14
O4
C16

Fig. 2