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## Structure Reports

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# Ethyl 2-(3-chloro-2-pyridyl)-5-oxopyrazolidine-3-carboxylate

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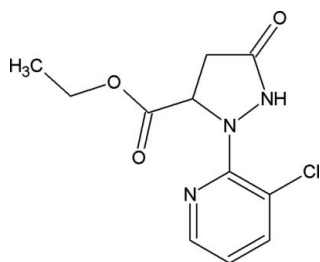
Received 20 May 2009; accepted 1 June 2009

Key indicators: single-crystal X-ray study;  $T = 298$  K; mean  $\sigma(\text{C}-\text{C}) = 0.004$  Å;  $R$  factor = 0.043;  $wR$  factor = 0.110; data-to-parameter ratio = 13.9.

In the molecule of the title compound,  $\text{C}_{11}\text{H}_{12}\text{ClN}_3\text{O}_3$ , the five membered ring adopts an envelope conformation. In the crystal structure, intermolecular  $\text{N}-\text{H}\cdots\text{O}$  hydrogen bonds link the molecules into centrosymmetric dimers.

## Related literature

For the synthetic procedure, see: Lahm *et al.* (2007). For bond-length data, see: Allen *et al.* (1987).



## Experimental

### Crystal data

 $\text{C}_{11}\text{H}_{12}\text{ClN}_3\text{O}_3$ 
 $M_r = 269.69$ 

 Orthorhombic, *Pbca*
 $a = 15.488$  (3) Å

 $b = 10.009$  (2) Å

 $c = 16.249$  (3) Å

 $V = 2518.9$  (8) Å<sup>3</sup>
 $Z = 8$ 

 Mo  $K\alpha$  radiation

 $\mu = 0.31$  mm<sup>-1</sup>
 $T = 298$  K

 $0.30 \times 0.20 \times 0.10$  mm

### Data collection

Enraf–Nonius CAD-4

diffractometer

 Absorption correction:  $\psi$  scan

 (North *et al.*, 1968)

 $T_{\min} = 0.913$ ,  $T_{\max} = 0.970$ 

4453 measured reflections

2273 independent reflections

 1635 reflections with  $I > 2\sigma(I)$ 
 $R_{\text{int}} = 0.029$ 

3 standard reflections

frequency: 120 min

intensity decay: none

### Refinement

 $R[F^2 > 2\sigma(F^2)] = 0.043$ 
 $wR(F^2) = 0.110$ 
 $S = 1.03$ 

2273 reflections

164 parameters

H-atom parameters constrained

 $\Delta\rho_{\max} = 0.29$  e Å<sup>-3</sup>
 $\Delta\rho_{\min} = -0.23$  e Å<sup>-3</sup>
**Table 1**

Hydrogen-bond geometry (Å, °).

<i>D</i> — <i>H</i> ⋯ <i>A</i>	<i>D</i> — <i>H</i>	<i>H</i> ⋯ <i>A</i>	<i>D</i> ⋯ <i>A</i>	<i>D</i> — <i>H</i> ⋯ <i>A</i>
$\text{N1}-\text{H1A}\cdots\text{O2}^i$	0.86	2.14	2.910 (3)	149

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

Data collection: *CAD-4 Software* (Enraf–Nonius, 1985); cell refinement: *CAD-4 Software*; data reduction: *XCAD4* (Harms & Wocadlo, 1995); program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXTL*.

The authors thank Dr Shan Liu and Dr Rui Liu of the College of Science, Nanjing University of Technology, for useful discussions and the Center of Testing and Analysis, Nanjing University, for support.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HK2697).

## References

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**supplementary materials**

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## Ethyl 2-(3-chloro-2-pyridyl)-5-oxopyrazolidine-3-carboxylate

H.-J. Tan, H.-B. He, M. Xia, X.-N. Zhang and H.-J. Zhu

### Comment

The title compound is one of the most important intermediates used for the synthesis of Rynaxypyre, a new insecticidal anthranilic diamide as a potent and selective ryanodine receptor activator (Lahm *et al.*, 2007). We report herein the crystal structure of the title compound.

In the molecule of the title compound (Fig 1), the bond lengths (Allen *et al.*, 1987) and angles are within normal ranges. Ring B (N3/C7-C11) is, of course, planar. Ring A (N1/N2/C4-C6) adopts envelope conformation with atom C4 displaced by  $-0.375(3)$  Å from the plane of the other ring atoms.

In the crystal structure, intermolecular N-H $\cdots$ O hydrogen bonds (Table 1) link the molecules into centrosymmetric dimers (Fig. 2), in which they may be effective in the stabilization of the structure.

### Experimental

The title compound was synthesized according to a literature method (Lahm *et al.*, 2007). Crystals 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, 0.97 and 0.96 Å for aromatic, methine, methylene and methyl H, respectively, and constrained to ride on their parent atoms, with  $U_{\text{iso}}(\text{H}) = xU_{\text{eq}}(\text{C,N})$ , where  $x = 1.5$  for methyl H and  $x = 1.2$  for all other H atoms.

### Figures

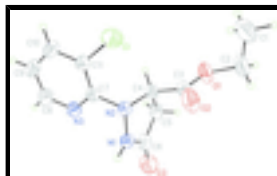


Fig. 1. The molecular structure of the title molecule, with the atom-numbering scheme. Displacement ellipsoids at the 50% probability level.

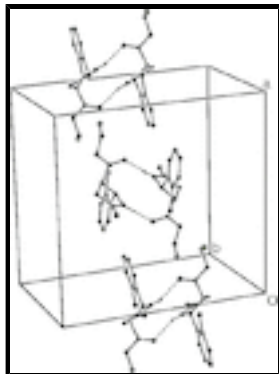


Fig. 2. A partial packing diagram of the title compound. Hydrogen bonds are shown as dashed lines.

### Ethyl 2-(3-chloro-2-pyridyl)-5-oxopyrazolidine-3-carboxylate

#### Crystal data

$C_{11}H_{12}ClN_3O_3$

$M_r = 269.69$

Orthorhombic, *Pbca*

Hall symbol: -P 2ac 2ab

$a = 15.488$  (3) Å

$b = 10.009$  (2) Å

$c = 16.249$  (3) Å

$V = 2518.9$  (8) Å<sup>3</sup>

$Z = 8$

$F_{000} = 1120$

$D_x = 1.422$  Mg m<sup>-3</sup>

Mo  $K\alpha$  radiation

$\lambda = 0.71073$  Å

Cell parameters from 25 reflections

$\theta = 0.9$ – $1.0^\circ$

$\mu = 0.31$  mm<sup>-1</sup>

$T = 298$  K

Block, colorless

$0.30 \times 0.20 \times 0.10$  mm

#### Data collection

Enraf–Nonius CAD-4  
diffractometer

Radiation source: fine-focus sealed tube

Monochromator: graphite

$T = 298$  K

$\omega/2\theta$  scans

Absorption correction:  $\psi$  scan  
(North *et al.*, 1968)

$T_{\min} = 0.913$ ,  $T_{\max} = 0.970$

4453 measured reflections

2273 independent reflections

1635 reflections with  $I > 2\sigma(I)$

$R_{\text{int}} = 0.029$

$\theta_{\max} = 25.3^\circ$

$\theta_{\min} = 2.5^\circ$

$h = 0 \rightarrow 18$

$k = 0 \rightarrow 12$

$l = -19 \rightarrow 19$

3 standard reflections

every 120 min

intensity decay: none

#### Refinement

Refinement on  $F^2$

Least-squares matrix: full

$R[F^2 > 2\sigma(F^2)] = 0.043$

Hydrogen site location: inferred from neighbouring sites

H-atom parameters constrained

$w = 1/[\sigma^2(F_o^2) + (0.0473P)^2 + 0.824P]$

$wR(F^2) = 0.110$	where $P = (F_o^2 + 2F_c^2)/3$
$S = 1.03$	$(\Delta/\sigma)_{\max} < 0.001$
2273 reflections	$\Delta\rho_{\max} = 0.29 \text{ e } \text{Å}^{-3}$
164 parameters	$\Delta\rho_{\min} = -0.23 \text{ e } \text{Å}^{-3}$
Primary atom site location: structure-invariant direct methods	Extinction correction: SHELXL, $F_c^* = kFc[1+0.001xFc^2\lambda^3/\sin(2\theta)]^{-1/4}$
Secondary atom site location: difference Fourier map	Extinction coefficient: 0.0065 (7)

*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  $F^2 > \sigma(F^2)$  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 ( $\text{Å}^2$ )*

	$x$	$y$	$z$	$U_{\text{iso}}^*/U_{\text{eq}}$
Cl	0.45523 (4)	0.14184 (7)	0.43566 (5)	0.0629 (3)
O1	0.30427 (10)	0.43898 (19)	0.31272 (11)	0.0561 (5)
O2	0.34478 (11)	0.4578 (2)	0.44373 (11)	0.0597 (5)
O3	0.55616 (12)	0.7407 (2)	0.33051 (13)	0.0667 (6)
N1	0.54947 (12)	0.55100 (18)	0.40815 (12)	0.0372 (5)
H1A	0.5776	0.5814	0.4497	0.045*
N2	0.51613 (11)	0.41865 (17)	0.40548 (11)	0.0328 (4)
N3	0.66149 (12)	0.3566 (2)	0.37919 (13)	0.0456 (5)
C1	0.1756 (2)	0.3232 (4)	0.3592 (2)	0.0876 (11)
H1B	0.1163	0.3358	0.3745	0.131*
H1C	0.2069	0.2863	0.4049	0.131*
H1D	0.1789	0.2631	0.3133	0.131*
C2	0.21401 (15)	0.4539 (3)	0.3359 (2)	0.0666 (9)
H2A	0.1820	0.4915	0.2902	0.080*
H2B	0.2096	0.5152	0.3820	0.080*
C3	0.36204 (14)	0.4419 (2)	0.37295 (15)	0.0389 (6)
C4	0.45184 (14)	0.4216 (2)	0.33772 (13)	0.0363 (5)
H4A	0.4542	0.3381	0.3063	0.044*
C5	0.48079 (15)	0.5388 (3)	0.28374 (15)	0.0471 (6)
H5A	0.5154	0.5078	0.2378	0.056*
H5B	0.4315	0.5878	0.2627	0.056*
C6	0.53378 (15)	0.6246 (3)	0.34130 (15)	0.0434 (6)
C7	0.58184 (14)	0.3194 (2)	0.39697 (13)	0.0332 (5)

## supplementary materials

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C8	0.72260 (16)	0.2612 (3)	0.37550 (18)	0.0565 (8)
H8A	0.7790	0.2872	0.3639	0.068*
C9	0.70658 (18)	0.1279 (3)	0.38781 (17)	0.0548 (7)
H9A	0.7509	0.0655	0.3842	0.066*
C10	0.62367 (17)	0.0884 (3)	0.40552 (16)	0.0490 (6)
H10A	0.6104	-0.0013	0.4134	0.059*
C11	0.56048 (14)	0.1858 (2)	0.41127 (15)	0.0389 (6)

### Atomic displacement parameters ( $\text{\AA}^2$ )

	$U^{11}$	$U^{22}$	$U^{33}$	$U^{12}$	$U^{13}$	$U^{23}$
Cl	0.0487 (4)	0.0514 (4)	0.0885 (6)	-0.0128 (3)	0.0079 (4)	0.0135 (4)
O1	0.0322 (9)	0.0815 (14)	0.0546 (11)	0.0039 (9)	-0.0095 (8)	-0.0041 (10)
O2	0.0367 (10)	0.0944 (16)	0.0479 (11)	0.0071 (10)	0.0002 (8)	-0.0127 (11)
O3	0.0629 (12)	0.0508 (12)	0.0864 (16)	-0.0110 (10)	-0.0068 (10)	0.0283 (11)
N1	0.0399 (10)	0.0307 (10)	0.0411 (11)	-0.0008 (8)	-0.0056 (9)	-0.0020 (9)
N2	0.0301 (9)	0.0308 (10)	0.0374 (10)	0.0009 (8)	-0.0036 (8)	-0.0011 (8)
N3	0.0314 (10)	0.0402 (12)	0.0650 (14)	0.0003 (9)	0.0035 (10)	-0.0027 (10)
C1	0.0537 (19)	0.097 (3)	0.112 (3)	-0.0200 (19)	0.0081 (19)	-0.017 (2)
C2	0.0295 (13)	0.087 (2)	0.084 (2)	0.0059 (14)	-0.0081 (14)	-0.0055 (18)
C3	0.0339 (12)	0.0399 (14)	0.0429 (14)	0.0027 (10)	-0.0047 (11)	-0.0039 (11)
C4	0.0342 (11)	0.0409 (13)	0.0339 (12)	0.0046 (10)	-0.0039 (9)	-0.0051 (10)
C5	0.0389 (13)	0.0647 (17)	0.0377 (13)	0.0061 (12)	-0.0017 (10)	0.0091 (12)
C6	0.0364 (13)	0.0465 (16)	0.0474 (15)	0.0045 (11)	0.0034 (11)	0.0107 (12)
C7	0.0318 (11)	0.0340 (12)	0.0337 (12)	0.0022 (10)	-0.0027 (10)	-0.0002 (10)
C8	0.0323 (12)	0.0542 (18)	0.083 (2)	0.0046 (12)	0.0019 (13)	-0.0045 (15)
C9	0.0498 (16)	0.0481 (16)	0.0666 (19)	0.0201 (13)	-0.0077 (14)	-0.0037 (13)
C10	0.0581 (16)	0.0342 (13)	0.0548 (15)	0.0072 (13)	-0.0068 (13)	0.0069 (12)
C11	0.0379 (13)	0.0351 (13)	0.0439 (14)	-0.0019 (10)	-0.0037 (10)	0.0032 (11)

### Geometric parameters ( $\text{\AA}$ , $^\circ$ )

Cl—C11	1.735 (2)	C2—H2A	0.9700
O1—C2	1.456 (3)	C2—H2B	0.9700
O1—C3	1.326 (3)	C3—C4	1.518 (3)
O2—C3	1.191 (3)	C4—C5	1.531 (3)
O3—C6	1.226 (3)	C4—H4A	0.9800
N1—N2	1.422 (2)	C5—C6	1.512 (4)
N1—C6	1.335 (3)	C5—H5A	0.9700
N1—H1A	0.8600	C5—H5B	0.9700
N2—C4	1.485 (3)	C7—C11	1.396 (3)
N2—C7	1.429 (3)	C8—C9	1.372 (4)
N3—C7	1.321 (3)	C8—H8A	0.9300
N3—C8	1.346 (3)	C9—C10	1.374 (4)
C1—C2	1.485 (4)	C9—H9A	0.9300
C1—H1B	0.9600	C10—C11	1.385 (3)
C1—H1C	0.9600	C10—H10A	0.9300
C1—H1D	0.9600		

C3—O1—C2	117.0 (2)	C3—C4—H4A	110.1
N2—N1—H1A	122.5	C5—C4—H4A	110.1
C6—N1—N2	115.02 (19)	C6—C5—C4	103.85 (18)
C6—N1—H1A	122.5	C6—C5—H5A	111.0
N1—N2—C7	113.08 (17)	C4—C5—H5A	111.0
N1—N2—C4	104.33 (16)	C6—C5—H5B	111.0
C7—N2—C4	114.82 (17)	C4—C5—H5B	111.0
C7—N3—C8	117.8 (2)	H5A—C5—H5B	109.0
C2—C1—H1B	109.5	O3—C6—N1	126.0 (2)
C2—C1—H1C	109.5	O3—C6—C5	127.1 (2)
H1B—C1—H1C	109.5	N1—C6—C5	106.8 (2)
C2—C1—H1D	109.5	N3—C7—C11	121.9 (2)
H1B—C1—H1D	109.5	N3—C7—N2	119.3 (2)
H1C—C1—H1D	109.5	C11—C7—N2	118.7 (2)
O1—C2—C1	111.1 (2)	N3—C8—C9	123.8 (2)
O1—C2—H2A	109.4	N3—C8—H8A	118.1
C1—C2—H2A	109.4	C9—C8—H8A	118.1
O1—C2—H2B	109.4	C8—C9—C10	118.6 (2)
C1—C2—H2B	109.4	C8—C9—H9A	120.7
H2A—C2—H2B	108.0	C10—C9—H9A	120.7
O2—C3—O1	124.3 (2)	C9—C10—C11	118.2 (2)
O2—C3—C4	126.0 (2)	C9—C10—H10A	120.9
O1—C3—C4	109.70 (19)	C11—C10—H10A	120.9
N2—C4—C3	109.73 (17)	C10—C11—C7	119.7 (2)
N2—C4—C5	104.11 (18)	C10—C11—Cl	120.06 (19)
C3—C4—C5	112.46 (19)	C7—C11—Cl	120.25 (17)
N2—C4—H4A	110.1		
C6—N1—N2—C7	108.8 (2)	C4—C5—C6—O3	-164.6 (2)
C6—N1—N2—C4	-16.6 (2)	C4—C5—C6—N1	13.3 (2)
C3—O1—C2—C1	-85.7 (3)	C8—N3—C7—C11	-0.3 (3)
C2—O1—C3—O2	-1.2 (4)	C8—N3—C7—N2	176.9 (2)
C2—O1—C3—C4	178.6 (2)	N1—N2—C7—N3	-10.9 (3)
N1—N2—C4—C3	-97.1 (2)	C4—N2—C7—N3	108.6 (2)
C7—N2—C4—C3	138.54 (19)	N1—N2—C7—C11	166.3 (2)
N1—N2—C4—C5	23.4 (2)	C4—N2—C7—C11	-74.1 (3)
C7—N2—C4—C5	-100.9 (2)	C7—N3—C8—C9	1.1 (4)
O2—C3—C4—N2	2.4 (3)	N3—C8—C9—C10	-0.5 (4)
O1—C3—C4—N2	-177.44 (18)	C8—C9—C10—C11	-0.9 (4)
O2—C3—C4—C5	-113.0 (3)	C9—C10—C11—C7	1.7 (4)
O1—C3—C4—C5	67.2 (2)	C9—C10—C11—Cl	-178.6 (2)
N2—C4—C5—C6	-22.5 (2)	N3—C7—C11—C10	-1.1 (4)
C3—C4—C5—C6	96.2 (2)	N2—C7—C11—C10	-178.3 (2)
N2—N1—C6—O3	179.8 (2)	N3—C7—C11—Cl	179.22 (18)
N2—N1—C6—C5	1.8 (3)	N2—C7—C11—Cl	2.0 (3)

Hydrogen-bond geometry ( $\text{\AA}$ ,  $^\circ$ )

<i>D</i> —H $\cdots$ <i>A</i>	<i>D</i> —H	H $\cdots$ <i>A</i>	<i>D</i> $\cdots$ <i>A</i>	<i>D</i> —H $\cdots$ <i>A</i>
N1—H1A $\cdots$ O2 <sup>i</sup>	0.86	2.14	2.910 (3)	149

# supplementary materials

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

Fig. 1

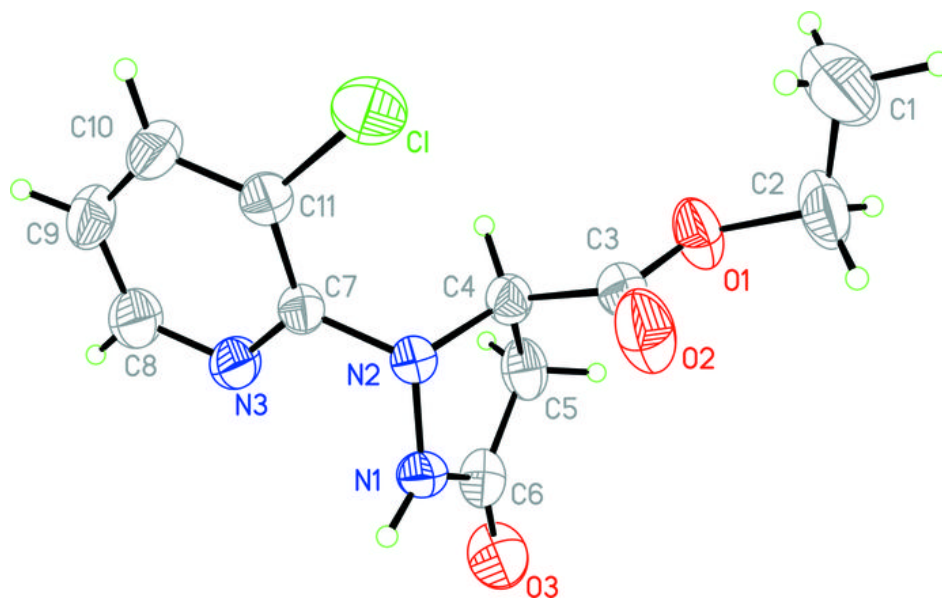


Fig. 2

