# organic compounds

# 3-(1-Ethyl-1H-pyrrole-2-carboxamido)-propionic acid monohydrate

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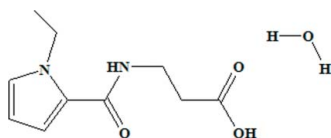Correspondence e-mail: xczeng@126.com

The title compound, $C_{10}H_{14}N_2O_3 \cdot H_2O$, was synthesized by alkylation of methyl 3-(1H-pyrrole-2-carboxamido)propionate with ethyl bromide, followed by saponification and acidification. In the crystal structure, intermolecular O—H···O and N—H···O hydrogen bonds link the molecules, forming layers parallel to the *ac* plane.

## Related literature

For pyrroles sourced from marine organisms, see: Liu *et al.* (2005). For the bioactivity of pyrrole derivatives, see: Banwell *et al.* (2006); Sosa *et al.* (2002). For related structures, see: Zeng *et al.* (2005); Liu *et al.* (2006); Tang *et al.* (2008).



## Experimental

### Crystal data

$C_{10}H_{14}N_2O_3 \cdot H_2O$
$M_r$ = 228.25
Monoclinic, $P2_1/c$
$a$ = 5.2814 (12) Å
$b$ = 31.795 (7) Å
$c$ = 7.0226 (16) Å
$\beta$ = 106.392 (4)°

$V$ = 1131.3 (4) Å$^3$
$Z$ = 4
Mo $K\alpha$ radiation
$\mu$ = 0.10 mm$^{-1}$
$T$ = 173 K
0.47 × 0.44 × 0.15 mm

### Data collection

Bruker SMART 1K CCD area-detector diffractometer
Absorption correction: multi-scan (*SADABS*; Sheldrick, 1996)
$T_{min}$ = 0.953, $T_{max}$ = 0.985

5260 measured reflections
2215 independent reflections
1772 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.028

### Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.052
$wR(F^2)$ = 0.163
$S$ = 1.14
2215 reflections
155 parameters

H atoms treated by a mixture of independent and constrained refinement
$\Delta\rho_{max}$ = 0.30 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.26 e Å$^{-3}$

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

| $D$—H···$A$ | $D$—H | H···$A$ | $D$···$A$ | $D$—H···$A$ |
|---|---|---|---|---|
| O3—H3···O4$^{i}$ | 0.84 | 1.83 | 2.669 (3) | 173 |
| N2—H2···O4$^{ii}$ | 0.88 | 2.28 | 3.091 (3) | 154 |
| O4—H4A···O1$^{iii}$ | 0.96 (3) | 1.79 (3) | 2.737 (2) | 170 (3) |
| O4—H4B···O2$^{iv}$ | 0.81 (3) | 2.08 (4) | 2.863 (3) | 164 (3) |

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

Data collection: *SMART* (Bruker, 1999); cell refinement: *SAINT-Plus* (Bruker, 1999); data reduction: *SAINT-Plus*; 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*.

## References

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**supplementary materials**

## 3-(1-Ethyl-1*H*-pyrrole-2-carboxamido)propionic acid monohydrate

**D. D. Li, G. H. Tang, X. C. Zeng, G. Huang and X. Y. Xu**

### Comment

Pyrrole derivatives are well known constituents of many marine organisms (Liu *et al.*, 2005), and some of them show important bioactivities, such as antitumor (Banwell *et al.*, 2006) and protein kinase inhibiting (Sosa *et al.*, 2002) activities. As a continuation of our studies in this field, which have recently resulted in the communication of the crystal structure of 3-(4-bromo-1*H*-pyrrole-2-carboxamido)propanoic acid (Zeng *et al.*, 2005), 3-(1-methyl-1H-pyrrole-2-carboxamido)propanoic acid (Liu *et al.*, 2006) and methyl 2-(1*H*-pyrrole-2-carboxamido)acetate (Tang *et al.*, 2008), we report herein the synthesis and crystal structure of the title compound.

In the molecule of the title compound (Fig. 1), bond lengths and angles are unexceptional. In the crystal structure, molecules are linked by intermolecular O—H···O and N—H···O hydrogen bonds (Table 1) involving water molecules to form two-dimensional layers parallel to the *ac* plane (Fig. 2, Fig. 3)

### Experimental

A suspension of potassium carbonate (2.10 mg, 15.0 mmol), ethyl bromide (1.87 ml, 25.0 mmol) and methyl 3-(1*H*-pyrrole-2-carbonyl)aminopropionate (0.98 g, 5.0 mmol) in acetonitrile (12 ml) was refluxed for 40 h. After evaporation of the solvent, the residue was dissolved in ethyl acetate (15 ml) and washed twice with water. The organic layer was dried over sodium sulfate and evaporated *in vacuo*. Then the alkylated product was added to a solution of 10% aqueous sodium hydroxide (10 ml) and ethanol (2 ml), and the mixture was stirred at room temperature for 24 h. The hydrolyzed mixture was made acidic with 10% hydrochloric acid to pH 2–3. After filtration, the precipitate was collected as a yellow solid (m.p. 320 K, 92.3% yield). Pale yellow crystals suitable for X-ray analysis were obtained over a period of one week by slow evaporation at room temperature of an ethanol/water solution (3:2 v/v).

### Refinement

All non-H atoms were refined with anisotropic displacement parameters. The water H atoms were located in a difference Fourier map and refined freely. All other H atoms were positioned geometrically and refined using a riding model, with C—H = 0.95-0.99Å, N—H = 0.88 Å, O—H = 0.84 Å, and with $U_{iso}$ = 1.2 $U_{eq}$(C, N) or 1.5 $U_{eq}$(C, O) for methyl and hydroxy H atoms.
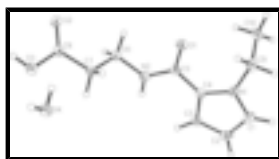
### Figures



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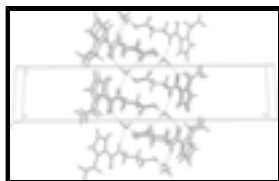
# supplementary materials



Fig. 2. Crystal packing of the title compound viewed along the *a* axis. Dashed lines indicate hydrogen bonds.
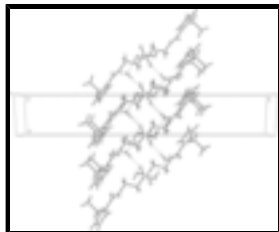


Fig. 3. Crystal packing of the title compound viewed along the *c* axis. Dashed lines indicate hydrogen bonds.

## 3-(1-Ethyl-1*H*-pyrrole-2-carboxamido)propionic acid monohydrate

*Crystal data*

| | |
|---|---|
| $C_{10}H_{14}N_2O_3 \cdot H_2O$ | $F_{000} = 488$ |
| $M_r = 228.25$ | $D_x = 1.340$ Mg m$^{-3}$ |
| Monoclinic, $P2_1/c$ | Melting point: 320 K |
| Hall symbol: -P 2ybc | Mo $K\alpha$ radiation, $\lambda = 0.71073$ Å |
| $a = 5.2814\ (12)$ Å | Cell parameters from 2595 reflections |
| $b = 31.795\ (7)$ Å | $\theta = 2.6$–$28.0°$ |
| $c = 7.0226\ (16)$ Å | $\mu = 0.10$ mm$^{-1}$ |
| $\beta = 106.392\ (4)°$ | $T = 173$ K |
| $V = 1131.3\ (4)$ Å$^3$ | Plate, pale yellow |
| $Z = 4$ | $0.47 \times 0.44 \times 0.15$ mm |

*Data collection*

| | |
|---|---|
| Bruker SMART 1K CCD area-detector diffractometer | 2215 independent reflections |
| Radiation source: fine-focus sealed tube | 1772 reflections with $I > 2\sigma(I)$ |
| Monochromator: graphite | $R_{int} = 0.028$ |
| $T = 173$ K | $\theta_{max} = 26.0°$ |
| $\varphi$ and $\omega$ scans | $\theta_{min} = 1.3°$ |
| Absorption correction: multi-scan (SADABS; Sheldrick, 1996) | $h = -6 \rightarrow 4$ |
| $T_{min} = 0.953$, $T_{max} = 0.985$ | $k = -39 \rightarrow 33$ |
| 5260 measured reflections | $l = -8 \rightarrow 8$ |

*Refinement*

| | |
|---|---|
| Refinement on $F^2$ | Secondary atom site location: difference Fourier map |
| Least-squares matrix: full | Hydrogen site location: inferred from neighbouring sites |
| $R[F^2 > 2\sigma(F^2)] = 0.052$ | H atoms treated by a mixture of independent and constrained refinement |

$wR(F^2) = 0.163$

$w = 1/[\sigma^2(F_o^2) + (0.087P)^2 + 0.3989P]$

where $P = (F_o^2 + 2F_c^2)/3$

$S = 1.14$

$(\Delta/\sigma)_{max} = 0.001$

2215 reflections

$\Delta\rho_{max} = 0.30$ e Å$^{-3}$

155 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 $F^2 > \sigma(F^2)$ 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$^2$)*

|  | $x$ | $y$ | $z$ | $U_{iso}$*/$U_{eq}$ |
|---|---|---|---|---|
| O2 | −0.2174 (3) | 0.48016 (5) | 0.1312 (3) | 0.0377 (4) |
| O1 | 0.4540 (3) | 0.36651 (5) | 0.1693 (2) | 0.0350 (4) |
| N1 | 0.9087 (4) | 0.32234 (6) | 0.4136 (3) | 0.0281 (5) |
| O3 | 0.0271 (4) | 0.53444 (5) | 0.2775 (3) | 0.0370 (5) |
| H3 | −0.1105 | 0.5479 | 0.2213 | 0.055* |
| N2 | 0.3901 (4) | 0.39704 (6) | 0.4423 (3) | 0.0307 (5) |
| H2 | 0.4458 | 0.3994 | 0.5723 | 0.037* |
| C4 | 0.7462 (4) | 0.34863 (6) | 0.4836 (3) | 0.0254 (5) |
| C6 | 0.1614 (4) | 0.42138 (7) | 0.3356 (3) | 0.0295 (5) |
| H6A | 0.0205 | 0.4183 | 0.4023 | 0.035* |
| H6B | 0.0936 | 0.4103 | 0.1990 | 0.035* |
| C5 | 0.5200 (4) | 0.37122 (6) | 0.3528 (3) | 0.0250 (5) |
| C7 | 0.2283 (4) | 0.46754 (7) | 0.3265 (3) | 0.0277 (5) |
| H7A | 0.3132 | 0.4778 | 0.4627 | 0.033* |
| H7B | 0.3567 | 0.4707 | 0.2485 | 0.033* |
| C8 | −0.0108 (5) | 0.49402 (7) | 0.2343 (3) | 0.0267 (5) |
| C3 | 0.8518 (5) | 0.35132 (7) | 0.6881 (3) | 0.0319 (6) |
| H3A | 0.7824 | 0.3673 | 0.7761 | 0.038* |
| C9 | 0.8797 (5) | 0.30933 (8) | 0.2082 (3) | 0.0361 (6) |
| H9A | 1.0516 | 0.2987 | 0.1980 | 0.043* |
| H9B | 0.8319 | 0.3342 | 0.1206 | 0.043* |
| C1 | 1.1074 (5) | 0.30880 (8) | 0.5705 (4) | 0.0350 (6) |
| H1 | 1.2446 | 0.2901 | 0.5629 | 0.042* |
| C10 | 0.6725 (6) | 0.27552 (8) | 0.1358 (4) | 0.0407 (6) |
| H10A | 0.7317 | 0.2493 | 0.2084 | 0.061* |

| | | | |
|---|---|---|---|
| H10B | 0.6457 | 0.2708 | −0.0065 | 0.061* |
| H10C | 0.5060 | 0.2846 | 0.1585 | 0.061* |
| C2 | 1.0782 (5) | 0.32635 (8) | 0.7411 (4) | 0.0366 (6) |
| H2A | 1.1912 | 0.3223 | 0.8715 | 0.044* |
| O4 | 0.5768 (4) | 0.57638 (6) | 0.1280 (3) | 0.0343 (4) |
| H4A | 0.584 (6) | 0.5980 (10) | 0.034 (5) | 0.057 (9)* |
| H4B | 0.465 (7) | 0.5596 (10) | 0.074 (5) | 0.051 (9)* |

*Atomic displacement parameters (Å$^2$)*

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{12}$ | $U^{13}$ | $U^{23}$ |
|---|---|---|---|---|---|---|
| O2 | 0.0288 (9) | 0.0372 (9) | 0.0415 (10) | 0.0021 (7) | 0.0009 (8) | −0.0031 (7) |
| O1 | 0.0450 (10) | 0.0355 (9) | 0.0196 (8) | 0.0068 (8) | 0.0013 (7) | −0.0001 (6) |
| N1 | 0.0253 (10) | 0.0322 (10) | 0.0270 (10) | −0.0003 (8) | 0.0077 (8) | 0.0016 (7) |
| O3 | 0.0413 (11) | 0.0273 (8) | 0.0404 (10) | 0.0022 (7) | 0.0087 (8) | −0.0014 (7) |
| N2 | 0.0350 (11) | 0.0324 (10) | 0.0220 (9) | 0.0048 (8) | 0.0038 (8) | 0.0004 (8) |
| C4 | 0.0285 (12) | 0.0239 (10) | 0.0227 (11) | −0.0027 (9) | 0.0057 (9) | 0.0011 (8) |
| C6 | 0.0255 (12) | 0.0301 (12) | 0.0309 (12) | 0.0011 (9) | 0.0048 (9) | −0.0013 (9) |
| C5 | 0.0290 (11) | 0.0225 (10) | 0.0222 (11) | −0.0043 (9) | 0.0049 (9) | 0.0010 (8) |
| C7 | 0.0255 (11) | 0.0311 (12) | 0.0265 (11) | −0.0032 (9) | 0.0076 (9) | −0.0026 (9) |
| C8 | 0.0311 (12) | 0.0292 (11) | 0.0219 (10) | −0.0009 (9) | 0.0110 (9) | −0.0003 (8) |
| C3 | 0.0376 (13) | 0.0312 (12) | 0.0235 (11) | −0.0002 (10) | 0.0029 (10) | 0.0005 (9) |
| C9 | 0.0368 (14) | 0.0459 (14) | 0.0306 (12) | 0.0049 (11) | 0.0179 (11) | 0.0016 (10) |
| C1 | 0.0258 (12) | 0.0371 (13) | 0.0393 (13) | 0.0020 (10) | 0.0044 (10) | 0.0052 (10) |
| C10 | 0.0506 (16) | 0.0392 (14) | 0.0304 (13) | 0.0054 (12) | 0.0082 (12) | −0.0061 (10) |
| C2 | 0.0341 (13) | 0.0394 (14) | 0.0282 (12) | −0.0038 (11) | −0.0044 (10) | 0.0039 (10) |
| O4 | 0.0431 (11) | 0.0282 (9) | 0.0289 (9) | −0.0011 (8) | 0.0058 (8) | 0.0009 (7) |

*Geometric parameters (Å, °)*

| | | | |
|---|---|---|---|
| O2—C8 | 1.210 (3) | C7—H7A | 0.9900 |
| O1—C5 | 1.245 (3) | C7—H7B | 0.9900 |
| N1—C1 | 1.359 (3) | C3—C2 | 1.395 (4) |
| N1—C4 | 1.384 (3) | C3—H3A | 0.9500 |
| N1—C9 | 1.466 (3) | C9—C10 | 1.516 (4) |
| O3—C8 | 1.323 (3) | C9—H9A | 0.9900 |
| O3—H3 | 0.8400 | C9—H9B | 0.9900 |
| N2—C5 | 1.335 (3) | C1—C2 | 1.370 (4) |
| N2—C6 | 1.452 (3) | C1—H1 | 0.9500 |
| N2—H2 | 0.8800 | C10—H10A | 0.9800 |
| C4—C3 | 1.388 (3) | C10—H10B | 0.9800 |
| C4—C5 | 1.473 (3) | C10—H10C | 0.9800 |
| C6—C7 | 1.515 (3) | C2—H2A | 0.9500 |
| C6—H6A | 0.9900 | O4—H4A | 0.96 (3) |
| C6—H6B | 0.9900 | O4—H4B | 0.81 (3) |
| C7—C8 | 1.504 (3) | | |
| C1—N1—C4 | 108.54 (19) | O2—C8—O3 | 123.0 (2) |
| C1—N1—C9 | 123.4 (2) | O2—C8—C7 | 124.0 (2) |

| | | | |
|---|---|---|---|
| C4—N1—C9 | 128.08 (19) | O3—C8—C7 | 113.00 (19) |
| C8—O3—H3 | 109.5 | C4—C3—C2 | 107.7 (2) |
| C5—N2—C6 | 123.23 (18) | C4—C3—H3A | 126.1 |
| C5—N2—H2 | 118.4 | C2—C3—H3A | 126.1 |
| C6—N2—H2 | 118.4 | N1—C9—C10 | 113.3 (2) |
| N1—C4—C3 | 107.2 (2) | N1—C9—H9A | 108.9 |
| N1—C4—C5 | 123.25 (19) | C10—C9—H9A | 108.9 |
| C3—C4—C5 | 129.3 (2) | N1—C9—H9B | 108.9 |
| N2—C6—C7 | 111.60 (19) | C10—C9—H9B | 108.9 |
| N2—C6—H6A | 109.3 | H9A—C9—H9B | 107.7 |
| C7—C6—H6A | 109.3 | N1—C1—C2 | 109.2 (2) |
| N2—C6—H6B | 109.3 | N1—C1—H1 | 125.4 |
| C7—C6—H6B | 109.3 | C2—C1—H1 | 125.4 |
| H6A—C6—H6B | 108.0 | C9—C10—H10A | 109.5 |
| O1—C5—N2 | 122.0 (2) | C9—C10—H10B | 109.5 |
| O1—C5—C4 | 121.9 (2) | H10A—C10—H10B | 109.5 |
| N2—C5—C4 | 116.13 (18) | C9—C10—H10C | 109.5 |
| C8—C7—C6 | 112.51 (19) | H10A—C10—H10C | 109.5 |
| C8—C7—H7A | 109.1 | H10B—C10—H10C | 109.5 |
| C6—C7—H7A | 109.1 | C1—C2—C3 | 107.3 (2) |
| C8—C7—H7B | 109.1 | C1—C2—H2A | 126.3 |
| C6—C7—H7B | 109.1 | C3—C2—H2A | 126.3 |
| H7A—C7—H7B | 107.8 | H4A—O4—H4B | 108 (3) |
| C1—N1—C4—C3 | 0.7 (2) | N2—C6—C7—C8 | −174.39 (18) |
| C9—N1—C4—C3 | 179.4 (2) | C6—C7—C8—O2 | −19.0 (3) |
| C1—N1—C4—C5 | 175.90 (19) | C6—C7—C8—O3 | 161.00 (19) |
| C9—N1—C4—C5 | −5.3 (3) | N1—C4—C3—C2 | −0.3 (3) |
| C5—N2—C6—C7 | −106.2 (2) | C5—C4—C3—C2 | −175.1 (2) |
| C6—N2—C5—O1 | 0.6 (3) | C1—N1—C9—C10 | 101.2 (3) |
| C6—N2—C5—C4 | −179.44 (19) | C4—N1—C9—C10 | −77.4 (3) |
| N1—C4—C5—O1 | 3.2 (3) | C4—N1—C1—C2 | −0.8 (3) |
| C3—C4—C5—O1 | 177.3 (2) | C9—N1—C1—C2 | −179.6 (2) |
| N1—C4—C5—N2 | −176.8 (2) | N1—C1—C2—C3 | 0.6 (3) |
| C3—C4—C5—N2 | −2.6 (3) | C4—C3—C2—C1 | −0.2 (3) |

*Hydrogen-bond geometry (Å, °)*

| *D*—H⋯*A* | *D*—H | H⋯*A* | *D*⋯*A* | *D*—H⋯*A* |
|---|---|---|---|---|
| O3—H3⋯O4[i] | 0.84 | 1.83 | 2.669 (3) | 173 |
| N2—H2⋯O4[ii] | 0.88 | 2.28 | 3.091 (3) | 154 |
| O4—H4A⋯O1[iii] | 0.96 (3) | 1.79 (3) | 2.737 (2) | 170 (3) |
| O4—H4B⋯O2[iv] | 0.81 (3) | 2.08 (4) | 2.863 (3) | 164 (3) |

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

**Fig. 1**

**Fig. 2**

**Fig. 3**