



Zwitterionic 6-methyl-2-oxo-3-[1-(ureidoiminio)ethyl]-2 H -pyran-4-olate monohydrate

Amel Djedouani, Sihem Boufas, Magali Allain, Gilles Bouet, Mustayeen A. Khan

► To cite this version:

Amel Djedouani, Sihem Boufas, Magali Allain, Gilles Bouet, Mustayeen A. Khan. Zwitterionic 6-methyl-2-oxo-3-[1-(ureidoiminio)ethyl]-2 H -pyran-4-olate monohydrate. Acta Crystallographica Section E: Structure Reports Online [2001-2014], 2008, 64 (9), pp.o1785-o1785. 10.1107/S1600536808026032 . hal-03243903

HAL Id: hal-03243903

<https://univ-angers.hal.science/hal-03243903>

Submitted on 31 May 2021

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



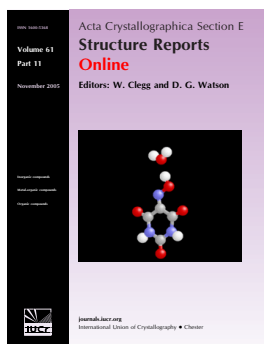
Distributed under a Creative Commons Attribution 4.0 International License

Zwitterionic 6-methyl-2-oxo-3-[1-(ureidoiminio)ethyl]-2H-pyran-4-olate monohydrate

Amel Djedouani, Sihem Boufas, Magali Allain, Gilles Bouet and
Mustayeen Khan

Acta Cryst. (2008). **E64**, o1785

This open-access article is distributed under the terms of the Creative Commons Attribution Licence <http://creativecommons.org/licenses/by/2.0/uk/legalcode>, which permits unrestricted use, distribution, and reproduction in any medium, provided the original authors and source are cited.



Acta Crystallographica Section E: Structure Reports Online is the IUCr's highly popular open-access structural journal. It provides a simple and easily accessible publication mechanism for the growing number of inorganic, metal-organic and organic crystal structure determinations. The electronic submission, validation, refereeing and publication facilities of the journal ensure very rapid and high-quality publication, whilst key indicators and validation reports provide measures of structural reliability. In 2007, the journal published over 5000 structures. The average publication time is less than one month.

Crystallography Journals **Online** is available from journals.iucr.org

Zwitterionic 6-methyl-2-oxo-3-[1-(ureidoiminio)ethyl]-2H-pyran-4-olate monohydrate

Amel Djedouani,^a Sihem Boufas,^{b*} Magali Allain,^c Gilles Bouet^d and Mustayeen Khan^d

^aLaboratoire d'Electrochimie des Matériaux Moléculaires et Complexes, Département de Génie des Procédés, Faculté des Science de l'Ingénieur, Université Farhet Abbes de Setif, DZ-19000 Sétif, Algeria, ^bUniversité 20 Aout 1955, Skikda, Algeria, ^cCIMM, CNRS UMR 6200, Faculté des Science, Angers Cedex, France, and ^dSONAS, EA 921, Université D'Angers, Faculté de Pharmacie, Angers Cedex, France
Correspondence e-mail: boufas_sihem@yahoo.fr

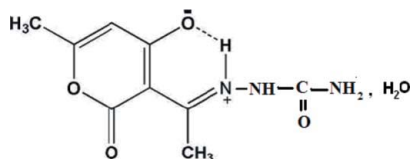
Received 5 August 2008; accepted 12 August 2008

Key indicators: single-crystal X-ray study; $T = 173$ K; mean $\sigma(\text{C}-\text{C}) = 0.003$ Å; R factor = 0.048; wR factor = 0.121; data-to-parameter ratio = 14.0.

The title compound, $\text{C}_9\text{H}_{11}\text{N}_3\text{O}_4 \cdot \text{H}_2\text{O}$, was prepared by the reaction of dehydroacetic acid and semicarbazide hydrochloride. It crystallizes in a zwitterionic form with cationic iminium and anionic enolate groups. In the crystal structure, the almost planar molecules are held together by $\text{N}-\text{H} \cdots \text{O}$, $\text{O}-\text{H} \cdots \text{O}$ and $\text{C}-\text{H} \cdots \text{O}$ hydrogen bonds, some of them involving the water molecules.

Related literature

For related literature, see: Tai *et al.* (2007); Zu-Pei Liang *et al.* (2007); Wojciechowski *et al.* (2003); Petek *et al.* (2006); Huang *et al.* (2006); Bernstein *et al.* (1995); Girija & Begum (2004a); Girija *et al.* (2004b); Gowda *et al.* (2007).



Experimental

Crystal data

$\text{C}_9\text{H}_{11}\text{N}_3\text{O}_4 \cdot \text{H}_2\text{O}$
 $M_r = 243.22$
Monoclinic, $P2_1/c$
 $a = 7.1731$ (4) Å
 $b = 12.6590$ (10) Å
 $c = 12.3698$ (3) Å
 $\beta = 104.603$ (6)°

$V = 1086.95$ (11) Å³
 $Z = 4$
Mo $K\alpha$ radiation
 $\mu = 0.12$ mm⁻¹
 $T = 173$ (2) K
 $0.35 \times 0.05 \times 0.02$ mm

Data collection

Nonius KappaCCD diffractometer

Absorption correction: none

11787 measured reflections
2485 independent reflections

1699 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.055$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.048$
 $wR(F^2) = 0.121$
 $S = 1.03$
2485 reflections
178 parameters

H atoms treated by a mixture of independent and constrained refinement
 $\Delta\rho_{\text{max}} = 0.33$ e Å⁻³
 $\Delta\rho_{\text{min}} = -0.26$ e Å⁻³

Table 1

Hydrogen-bond geometry (Å, °).

$D-H \cdots A$	$D-H$	$H \cdots A$	$D \cdots A$	$D-H \cdots A$
$\text{N1}-\text{H1A} \cdots \text{O3}^{\text{i}}$	0.84 (2)	2.18 (2)	3.015 (2)	176.3 (17)
$\text{N1}-\text{H1B} \cdots \text{O1W}^{\text{ii}}$	0.87 (2)	2.30 (2)	3.075 (2)	147.9 (19)
$\text{N2}-\text{H2} \cdots \text{O1W}^{\text{ii}}$	0.91 (2)	1.98 (2)	2.839 (2)	158 (2)
$\text{N3}-\text{H3} \cdots \text{O3}$	0.98 (2)	1.60 (3)	2.476 (2)	147 (2)
$\text{O1W}-\text{H11W} \cdots \text{O4}$	0.82 (3)	1.99 (3)	2.796 (2)	171 (3)
$\text{O1W}-\text{H21W} \cdots \text{O1}^{\text{iii}}$	0.82 (3)	2.00 (3)	2.823 (2)	178.0 (18)
$\text{C3}-\text{H3B} \cdots \text{O1}$	0.96	2.29	2.812 (3)	114
$\text{C7}-\text{H7} \cdots \text{O4}^{\text{iv}}$	0.93	2.49	3.294 (2)	145

Symmetry codes: (i) $-x+1, y-\frac{1}{2}, -z+\frac{1}{2}$; (ii) $x, -y-\frac{1}{2}, z+\frac{1}{2}$; (iii) $-x+2, -y, -z+1$; (iv) $-x+1, y+\frac{1}{2}, -z+\frac{1}{2}$.

Data collection: *COLLECT* (Nonius, 1997); cell refinement: *SCALEPACK* (Otwinowski & Minor, 1997); data reduction: *DENZO* (Otwinowski & Minor, 1997) and *SCALEPACK*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *ORTEP-3 for Windows* (Farrugia, 1997) and *Mercury* (Macrae *et al.*, 2006); software used to prepare material for publication: *WinGX* (Farrugia, 1999) and *PARST* (Nardelli, 1995).

This work was supported by Université Farhet Abbes de Sétif, Sétif, Algeria.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: WK2091).

References

- Bernstein, J., Davis, R. E., Shimoni, L. & Chang, N.-L. (1995). *Angew. Chem. Int. Ed. Engl.* **34**, 1555–1573.
Farrugia, L. J. (1997). *J. Appl. Cryst.* **30**, 565.
Farrugia, L. J. (1999). *J. Appl. Cryst.* **32**, 837–838.
Girija, C. R. & Begum, N. S. (2004a). *Acta Cryst.* **E60**, o535–o536.
Girija, C. R., Begum, N. S., Sridhar, M. A., Lokanath, N. K. & Prasad, J. S. (2004b). *Acta Cryst.* **E60**, o586–o588.
Gowda, B. T., Foro, S. & Fuess, H. (2007). *Acta Cryst.* **E63**, o3087.
Huang, L., Chen, D.-B., Qiu, D. & Zhao, B. (2006). *Acta Cryst.* **E62**, o5239–o5240.
Liang, Z.-P., Li, J., Wang, H.-L. & Wang, H.-Q. (2007). *Acta Cryst.* **E63**, o2939.
Macrae, C. F., Edgington, P. R., McCabe, P., Pidcock, E., Shields, G. P., Taylor, R., Towler, M. & van de Streek, J. (2006). *J. Appl. Cryst.* **39**, 453–457.
Nardelli, M. (1995). *J. Appl. Cryst.* **28**, 659.
Nonius (1997). *COLLECT*. Nonius BV, Delft The Netherlands.
Otwinowski, Z. & Minor, W. (1997). *Methods in Enzymology*, Vol. 276, *Macromolecular Crystallography*, Part A, edited by C. W. Carter Jr & R. M. Sweet, pp. 307–326. New York: Academic Press.
Petek, H., Albayrak, Ç., Ağar, E. & Kalkan, H. (2006). *Acta Cryst.* **E62**, o3685–o3687.
Sheldrick, G. M. (2008). *Acta Cryst.* **A64**, 112–122.
Tai, X.-S., Hao, M.-Y., Yin, J. & Liang, Z.-P. (2007). *Acta Cryst.* **E63**, o1725–o1726.
Wojciechowski, G., Ratajczak-Sitarz, M., Katrusiak, A., Schilf, W., Przybylski, P. & Brzezinski, B. (2003). *J. Mol. Struct.* **650**, 191–199.

supplementary materials

Acta Cryst. (2008). E64, o1785 [doi:10.1107/S1600536808026032]

Zwitterionic 6-methyl-2-oxo-3-[1-(ureidoiminio)ethyl]-2H-pyran-4-olate monohydrate

A. Djedouani, S. Boufas, M. Allain, G. Bouet and M. Khan

Comment

NLO materials play an important role in the field of fibre optic communications and optical signal processing. In the last two decades, extensive research has shown that organic crystals can exhibit nonlinear optical efficiencies which are two orders of magnitude higher than those of inorganic materials. Semicarbazones of substituted benzaldehydes and acetophenones were reported to be some of the potential organic NLO materials.

In this paper, the structure of the title compound (I), $C_9H_{13}N_3O_5$ is reported. The asymmetric unit of (I) contains one Dehydroacetic acid semicarbazide molecule and one water molecule (Fig. 1).

It is seen that the structure reported here adopts a zwitterion form, because, among other reasons, its $N^+—H$ bond distances [0.98 (3) Å] is comparable with those from similar zwitterions in the literature [1.11 (3) Å; 1.10 (3) Å] (Petek *et al.*, 2006; Wojciechowski *et al.*, 2003).

The bond distances shown in Table 1 indicate that the C2—N3 iminium bond length of 1.303 (2) Å agree with similar bond in related compounds (Girija & Begum, 2004a; Girija *et al.*, 2004b). This distance is slightly longer than a typical C=N bond (1.269 Å); but much shorter than the single carbon-nitrogen (1.409 Å) (Gowda *et al.* 2007), because of the resonance.

The C8—O3 bond length [1.282 (2) Å] is intermediate between single and double carbon to oxygen bond lengths (1.362 Å, 1.222 Å) the carbon-carbon bond connecting the enol and imine groups exhibit intermediate distances between a single and a double bond, being closer to latter one. C4—C8 = 1.423 (2) Å, C2—C4 = 1.452 (2) Å, indicate the zwitterionic character of the title compound (Wojciechowski *et al.* 2003). The molecular configuration is determined by the presence of the intramolecular hydrogen bond $O^{\cdots}H—N^+$ (Table 2).

The main molecule in (I) is essentially planar, with a maximum deviation from the mean plane for the non-hydrogen atoms of 0.022 (2) Å. The iminium atom H3, participates in a strong intramolecular hydrogen bond with the enolate atom, O1 (Table 1), which generates an S(6) ring motif (Bernstein *et al.* 1995). Similar intramolecular hydrogen bonds were reported in the above-mentioned zwitterionic phenolates (Huang *et al.* 2006). This six-membered pseudocycle is almost planar, the maximum deviation from the mean plane being 0.012 Å for atom C2. The bond lengths and angles are in usual ranges (*E*)-1-(4-Hydroxybenzylidene) semicarbazide hemihydrate (Tai *et al.*, 2007) and (*E*)-1-(4-Methoxybenzylidene) -semicarbazide (Liang *et al.*, 2007).

The crystal structure of (I) is stabilized by $N—H\cdots O$; $O—H\cdots O$, and $C—H\cdots O$ hydrogen bonds (Fig. 2 and Table 2).

Experimental

A mixture of dehydroacetic acid (0.01 mol) and semicarbazide hydrochloride (0.01 mol), in ethanol (20 ml) was refluxed for 1 h. After cooling, filtration and drying, the compound dehydroacetic acid semicarbazide was obtained. A small quantity

of this compound (10 mg) was dissolved in aqueous ethanol (95 / 12 ml), and the solution was then allowed to evaporate at room temperature. Prismatic yellow single crystals of the title compound were formed after 8 days.

Refinement

The O—H distances of the water molecules were restrained to 0.85 (1) Å, to ensure chemically reasonable geometry, with U_{iso} fixed at 1.5 $U_{\text{eq}}(\text{O})$. The iminium and ammino H atoms were located in a difference Fourier map and were refined isotropically. The methyl H atoms were constrained to an ideal geometry (C—H = 0.96 Å) with $U_{\text{iso}}(\text{H}) = 1.2U_{\text{eq}}(\text{C})$, but were allowed to rotate freely about the C—C bonds. H7 atom was placed in a geometrically idealized position (C—H = 0.93 Å) and constrained to ride on its parent atom with $U_{\text{iso}}(\text{H}) = 1.2U_{\text{eq}}(\text{C})$.

Figures

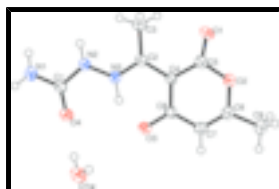


Fig. 1. The molecular structure of (I) showing the atom-labelling scheme. Displacement ellipsoids are drawn at the 50% probability level.

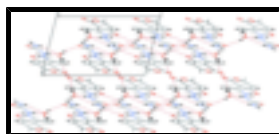


Fig. 2. The crystal packing of (I), viewed down the b axis. Dashed lines indicate the N—H...O and O—H...O interactions.

6-methyl-2-oxo-3-[1-(ureidoiminio)ethyl]-2H-pyran-4-olate monohydrate

Crystal data

$\text{C}_9\text{H}_{11}\text{N}_3\text{O}_4 \cdot \text{H}_2\text{O}$

$M_r = 243.22$

Monoclinic, $P2_1/c$

Hall symbol: -P 2ybc

$a = 7.1731$ (4) Å

$b = 12.6590$ (10) Å

$c = 12.3698$ (3) Å

$\beta = 104.603$ (6)°

$V = 1086.95$ (11) Å³

$Z = 4$

$F_{000} = 512$

$D_x = 1.486$ Mg m⁻³

Mo $K\alpha$ radiation

$\lambda = 0.71073$ Å

Cell parameters from 2841 reflections

$\theta = 3.1\text{--}25.8^\circ$

$\mu = 0.12$ mm⁻¹

$T = 173$ (2) K

Prism, yellow

$0.35 \times 0.05 \times 0.02$ mm

Data collection

Nonius KappaCCD diffractometer

Radiation source: fine-focus sealed tube

Detector resolution: 9 pixels mm⁻¹

$T = 173$ (2) K

1699 reflections with $I > 2\sigma(I)$

$R_{\text{int}} = 0.055$

$\theta_{\text{max}} = 27.5^\circ$

$\theta_{\text{min}} = 2.9^\circ$

CCD scans $h = -9 \rightarrow 9$
Absorption correction: none $k = -16 \rightarrow 15$
11787 measured reflections $l = -15 \rightarrow 16$
2485 independent reflections

Refinement

Refinement on F^2 Secondary atom site location: difference Fourier map
Least-squares matrix: full Hydrogen site location: inferred from neighbouring sites
 $R[F^2 > 2\sigma(F^2)] = 0.048$ H atoms treated by a mixture of independent and constrained refinement
 $wR(F^2) = 0.121$ $w = 1/[\sigma^2(F_o^2) + (0.0289P)^2 + 0.445P]$
where $P = (F_o^2 + 2F_c^2)/3$
 $S = 1.03$ $(\Delta/\sigma)_{\max} < 0.001$
2485 reflections $\Delta\rho_{\max} = 0.33 \text{ e } \text{\AA}^{-3}$
178 parameters $\Delta\rho_{\min} = -0.26 \text{ e } \text{\AA}^{-3}$
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.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters ($\text{\AA}^2$)

	<i>x</i>	<i>y</i>	<i>z</i>	$U_{\text{iso}}^*/U_{\text{eq}}$
C1	0.5343 (3)	-0.25527 (15)	0.37044 (14)	0.0287 (4)
C2	0.7633 (2)	-0.06094 (14)	0.56842 (14)	0.0253 (4)
C3	0.8032 (4)	-0.11552 (17)	0.67854 (16)	0.0476 (6)
H3A	0.7151	-0.1734	0.6744	0.057*
H3B	0.7871	-0.0666	0.7348	0.057*
H3C	0.9329	-0.1418	0.6974	0.057*
C4	0.8087 (2)	0.04894 (13)	0.55327 (13)	0.0240 (4)
C5	0.9088 (3)	0.11044 (14)	0.64744 (15)	0.0292 (4)
C6	0.8929 (3)	0.26084 (15)	0.52451 (15)	0.0305 (4)
C7	0.8054 (3)	0.20520 (15)	0.43545 (15)	0.0316 (4)
H7	0.7733	0.2375	0.3657	0.038*
C8	0.7593 (2)	0.09564 (14)	0.44518 (14)	0.0269 (4)
C9	0.9441 (3)	0.37503 (16)	0.52619 (18)	0.0422 (5)
H9A	0.9024	0.4034	0.452	0.051*
H9B	1.0812	0.3829	0.5527	0.051*
H9C	0.8817	0.4123	0.5749	0.051*
N1	0.4877 (3)	-0.35801 (14)	0.36960 (16)	0.0397 (4)
N2	0.6282 (2)	-0.21693 (12)	0.47382 (13)	0.0336 (4)

supplementary materials

N3	0.6811 (2)	−0.11234 (12)	0.47752 (12)	0.0272 (3)
O1	0.9689 (2)	0.08309 (11)	0.74427 (10)	0.0424 (4)
O3	0.6744 (2)	0.04451 (10)	0.35702 (10)	0.0369 (4)
O2	0.9464 (2)	0.21590 (10)	0.62831 (10)	0.0355 (3)
O4	0.4983 (2)	−0.19779 (11)	0.28793 (11)	0.0414 (4)
O1W	0.6521 (3)	−0.10956 (13)	0.12207 (12)	0.0470 (4)
H11W	0.597 (4)	−0.131 (2)	0.168 (2)	0.071*
H21W	0.763 (4)	−0.103 (2)	0.160 (2)	0.071*
H1A	0.440 (3)	−0.3872 (19)	0.308 (2)	0.048 (7)*
H1B	0.514 (3)	−0.3924 (17)	0.4326 (19)	0.037 (6)*
H2	0.650 (3)	−0.2591 (18)	0.5351 (19)	0.042 (6)*
H3	0.656 (4)	−0.069 (2)	0.410 (2)	0.075 (8)*

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

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
C1	0.0301 (9)	0.0304 (10)	0.0238 (8)	−0.0033 (7)	0.0036 (7)	−0.0023 (7)
C2	0.0258 (9)	0.0274 (9)	0.0222 (8)	0.0011 (7)	0.0049 (7)	0.0004 (7)
C3	0.0780 (16)	0.0371 (12)	0.0232 (10)	−0.0137 (11)	0.0043 (10)	0.0025 (8)
C4	0.0260 (9)	0.0241 (9)	0.0203 (8)	0.0006 (7)	0.0028 (7)	−0.0015 (6)
C5	0.0318 (10)	0.0288 (10)	0.0254 (9)	−0.0014 (8)	0.0042 (7)	−0.0023 (7)
C6	0.0341 (10)	0.0264 (9)	0.0306 (9)	−0.0012 (7)	0.0073 (8)	0.0002 (7)
C7	0.0379 (11)	0.0283 (10)	0.0256 (9)	0.0005 (8)	0.0023 (8)	0.0046 (7)
C8	0.0283 (9)	0.0260 (9)	0.0237 (9)	0.0027 (7)	0.0016 (7)	−0.0001 (7)
C9	0.0557 (13)	0.0270 (10)	0.0417 (12)	−0.0078 (9)	0.0082 (10)	−0.0023 (8)
N1	0.0568 (12)	0.0304 (9)	0.0295 (9)	−0.0110 (8)	0.0063 (8)	−0.0035 (8)
N2	0.0488 (10)	0.0240 (8)	0.0243 (8)	−0.0078 (7)	0.0023 (7)	0.0014 (6)
N3	0.0330 (8)	0.0230 (8)	0.0225 (7)	−0.0021 (6)	0.0016 (6)	0.0002 (6)
O1	0.0586 (9)	0.0412 (8)	0.0201 (6)	−0.0112 (7)	−0.0036 (6)	0.0005 (6)
O3	0.0539 (9)	0.0288 (7)	0.0204 (6)	−0.0043 (6)	−0.0046 (6)	0.0014 (5)
O2	0.0480 (8)	0.0284 (7)	0.0264 (7)	−0.0085 (6)	0.0024 (6)	−0.0033 (5)
O4	0.0562 (9)	0.0366 (8)	0.0248 (7)	−0.0108 (7)	−0.0018 (6)	0.0027 (6)
O1W	0.0593 (10)	0.0501 (10)	0.0294 (8)	−0.0083 (8)	0.0068 (7)	−0.0032 (7)

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

C1—O4	1.227 (2)	C6—C9	1.490 (3)
C1—N1	1.342 (2)	C7—C8	1.438 (3)
C1—N2	1.375 (2)	C7—H7	0.93
C2—N3	1.304 (2)	C8—O3	1.282 (2)
C2—C4	1.452 (2)	C9—H9A	0.96
C2—C3	1.489 (2)	C9—H9B	0.96
C3—H3A	0.96	C9—H9C	0.96
C3—H3B	0.96	N1—H1A	0.84 (3)
C3—H3C	0.96	N1—H1B	0.87 (2)
C4—C8	1.423 (2)	N2—N3	1.375 (2)
C4—C5	1.434 (2)	N2—H2	0.91 (2)
C5—O1	1.217 (2)	N3—H3	0.98 (3)
C5—O2	1.394 (2)	O1W—H11W	0.82 (3)

C6—C7	1.325 (3)	O1W—H21W	0.82 (3)
C6—O2	1.368 (2)		
O4—C1—N1	124.65 (17)	C6—C7—H7	119.5
O4—C1—N2	121.02 (17)	C8—C7—H7	119.5
N1—C1—N2	114.33 (16)	O3—C8—C4	122.81 (16)
N3—C2—C4	115.73 (15)	O3—C8—C7	119.05 (15)
N3—C2—C3	119.87 (17)	C4—C8—C7	118.13 (15)
C4—C2—C3	124.41 (16)	C6—C9—H9A	109.5
C2—C3—H3A	109.5	C6—C9—H9B	109.5
C2—C3—H3B	109.5	H9A—C9—H9B	109.5
H3A—C3—H3B	109.5	C6—C9—H9C	109.5
C2—C3—H3C	109.5	H9A—C9—H9C	109.5
H3A—C3—H3C	109.5	H9B—C9—H9C	109.5
H3B—C3—H3C	109.5	C1—N1—H1A	118.7 (16)
C8—C4—C5	119.53 (16)	C1—N1—H1B	118.7 (14)
C8—C4—C2	120.58 (15)	H1A—N1—H1B	122 (2)
C5—C4—C2	119.87 (15)	N3—N2—C1	115.93 (15)
O1—C5—O2	113.83 (16)	N3—N2—H2	123.4 (14)
O1—C5—C4	128.74 (18)	C1—N2—H2	120.7 (14)
O2—C5—C4	117.43 (15)	C2—N3—N2	124.75 (15)
C7—C6—O2	121.43 (17)	C2—N3—H3	113.8 (17)
C7—C6—C9	126.21 (18)	N2—N3—H3	121.4 (17)
O2—C6—C9	112.36 (16)	C6—O2—C5	122.49 (14)
C6—C7—C8	120.93 (17)	H11W—O1W—H21W	102 (3)

Hydrogen-bond geometry (Å, °)

<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 $\cdots$ O3 ⁱ	0.84 (2)	2.18 (2)	3.015 (2)	176.3 (17)
N1—H1B $\cdots$ O1W ⁱⁱ	0.87 (2)	2.30 (2)	3.075 (2)	147.9 (19)
N2—H2 $\cdots$ O1W ⁱⁱ	0.91 (2)	1.98 (2)	2.839 (2)	158 (2)
N3—H3 $\cdots$ O3	0.98 (2)	1.60 (3)	2.476 (2)	147 (2)
O1W—H11W $\cdots$ O4	0.82 (3)	1.99 (3)	2.796 (2)	171 (3)
O1W—H21W $\cdots$ O1 ⁱⁱⁱ	0.82 (3)	2.00 (3)	2.823 (2)	178.0 (18)
C3—H3B $\cdots$ O1	0.96	2.29	2.812 (3)	114
C7—H7 $\cdots$ O4 ^{iv}	0.93	2.49	3.294 (2)	145

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

Fig. 1

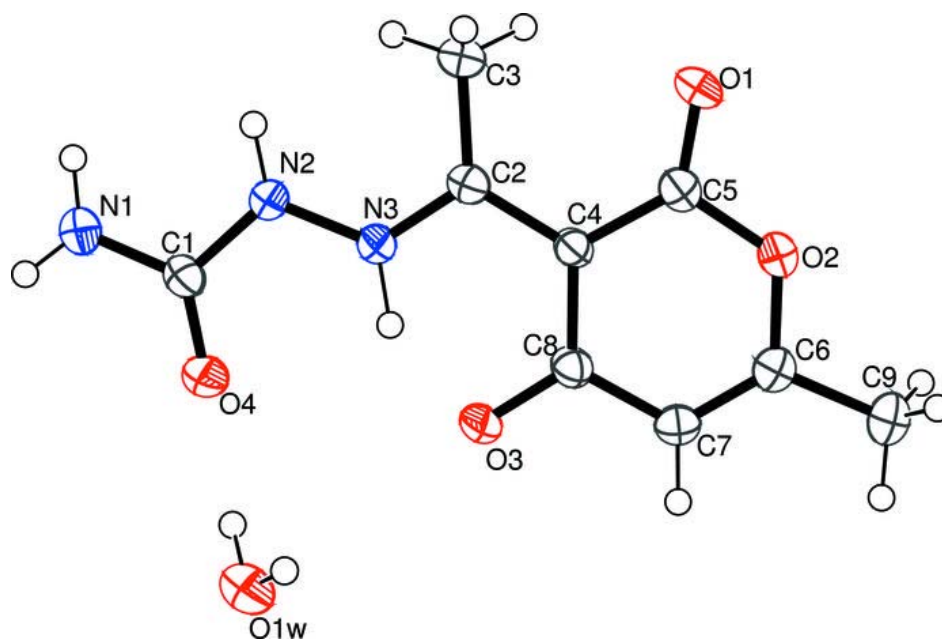


Fig. 2

