

Acta Crystallographica Section E

Structure Reports

Online

ISSN 1600-5368

2-(2-Furylmethylammonio)ethane-sulfonate methanol solvate

 Zhong-Xiang Du^{a*} and Ling-Zhi Wang^b
^aDepartment of Chemistry, Luoyang Normal University, Luoyang, Henan 471022, People's Republic of China, and ^bEquipment Department, Luoyang Normal University, Luoyang, Henan 471022, People's Republic of China

Correspondence e-mail: dzx6281@126.com

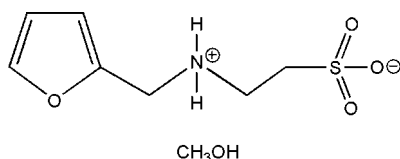
Received 23 May 2009; accepted 26 May 2009

 Key indicators: single-crystal X-ray study; $T = 294$ K; mean $\sigma(\text{C}-\text{C}) = 0.003$ Å; disorder in main residue; R factor = 0.041; wR factor = 0.109; data-to-parameter ratio = 15.7.

The organic molecule of the title compound, $\text{C}_7\text{H}_{11}\text{NO}_4\text{S}\cdot\text{CH}_3\text{OH}$, is a zwitterion and its furan ring displays positional disorder [occupancy 0.563 (5):0.437 (5)]. The crystal structure is extended into a three-dimensional supramolecular architecture through intermolecular $\text{O}-\text{H}\cdots\text{O}$ and $\text{N}-\text{H}\cdots\text{O}$ hydrogen bonds with participation of the methanol solvent molecules.

Related literature

For a number of reduced or unreduced Schiff base complexes derived from taurine, see: Jiang *et al.* (2004, 2006); Li *et al.* (2005, 2006a,b, 2007a,b, 2008a,b); Liao *et al.* (2007); Zeng *et al.* (2003); Zhang *et al.* (2005). For the crystal structure of a similar compound, 2-(2-pyridylmethylammonio) ethanesulfonate dihydrate, see: Li *et al.* (2006b).



Experimental

Crystal data

$\text{C}_7\text{H}_{11}\text{NO}_4\text{S}\cdot\text{CH}_4\text{O}$
 $M_r = 237.27$
 Monoclinic, $P2_1/c$
 $a = 10.729$ (10) Å
 $b = 9.174$ (8) Å
 $c = 11.270$ (10) Å

$\beta = 91.964$ (10)°
 $V = 1108.6$ (17) Å³
 $Z = 4$
 Mo $K\alpha$ radiation
 $\mu = 0.29$ mm⁻¹
 $T = 294$ K

 $0.39 \times 0.23 \times 0.19$ mm

Data collection

Bruker APEXII CCD area-detector diffractometer
 Absorption correction: multi-scan (SADABS; Sheldrick, 1996)
 $T_{\min} = 0.894$, $T_{\max} = 0.946$
 7971 measured reflections
 2056 independent reflections
 1675 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.025$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.041$
 $wR(F^2) = 0.109$
 $S = 1.06$
 2056 reflections
 131 parameters
 H-atom parameters constrained
 $\Delta\rho_{\text{max}} = 0.34$ e Å⁻³
 $\Delta\rho_{\text{min}} = -0.31$ e Å⁻³

Table 1

Hydrogen-bond geometry (Å, °).

$D-H\cdots A$	$D-H$	$H\cdots A$	$D\cdots A$	$D-H\cdots A$
$\text{N1}-\text{H1A}\cdots\text{O6}^i$	0.90	1.92	2.767 (3)	156
$\text{N1}-\text{H1B}\cdots\text{O2}^{ii}$	0.90	2.15	2.940 (3)	147
$\text{N1}-\text{H1B}\cdots\text{O2}^{iii}$	0.90	2.39	3.039 (3)	129
$\text{O6}-\text{H6}\cdots\text{O4}^{iv}$	0.82	1.90	2.720 (3)	175

Symmetry codes: (i) $x, y-1, z+1$; (ii) $x, -y+\frac{1}{2}, z+\frac{1}{2}$; (iii) $-x+1, y+\frac{1}{2}, -z+\frac{3}{2}$; (iv) $-x+1, y+\frac{1}{2}, -z+\frac{1}{2}$.

Data collection: APEX2 (Bruker, 2004); cell refinement: SAINT (Bruker, 2004); data reduction: SAINT; 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.

This work was supported by the National Natural Science Foundation of China (No. 20471026) and the Natural Science Foundation of Henan Province (No. 0311021200).

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: AT2791).

References

- Bruker (2004). APEX2 and SAINT. Bruker AXS Inc., Madison, Wisconsin, USA.
 Jiang, Y.-M., Li, J.-M., Xie, F.-Q. & Wang, Y.-F. (2006). *Chin. J. Struct. Chem.* **25**, 767–770.
 Jiang, Y.-M., Zeng, J.-L. & Yu, K.-B. (2004). *Acta Cryst.* **C60**, m543–m545.
 Li, J.-X., Jiang, Y.-M. & Chen, M.-J. (2008a). *J. Coord. Chem.* **61**, 1765–1773.
 Li, J.-X., Jiang, Y.-M. & Li, H.-Y. (2006a). *Acta Cryst.* **E62**, m2984–m2986.
 Li, J.-X., Jiang, Y.-M. & Lian, B.-R. (2008b). *J. Chem. Crystallogr.* **38**, 711–715.
 Li, J.-X., Jiang, Y.-M. & Liao, B.-L. (2006b). *Acta Cryst.* **E62**, o5609–o5611.
 Li, J.-X., Jiang, Y.-M. & Wang, J.-G. (2007a). *Acta Cryst.* **E63**, m213–m215.
 Li, J.-X., Jiang, Y.-M. & Wang, J.-G. (2007b). *Acta Cryst.* **E63**, m601–m603.
 Li, J.-M., Jiang, Y.-M., Wang, Y.-F. & Liang, D.-W. (2005). *Acta Cryst.* **E61**, m2160–m2162.
 Liao, B.-L., Li, J.-X. & Jiang, Y.-M. (2007). *Acta Cryst.* **E63**, m1974.
 Sheldrick, G. M. (1996). SADABS. University of Göttingen, Germany.
 Sheldrick, G. M. (2008). *Acta Cryst.* **A64**, 112–122.
 Zeng, J.-L., Jiang, Y.-M. & Yu, K.-B. (2003). *Acta Cryst.* **E59**, m1137–m1139.
 Zhang, S.-H., Jiang, Y.-M. & Yu, K.-B. (2005). *Acta Cryst.* **E61**, m209–m211.

supplementary materials

Acta Cryst. (2009). E65, o1459 [doi:10.1107/S1600536809020005]

2-(2-Furylmethylammonio)ethanesulfonate methanol solvate

Z.-X. Du and L.-Z. Wang

Comment

In the previous literatures, a number of reduced or unreduced Schiff base complexes derived from taurine have been reported (Jiang *et al.*, 2004, 2006; Li *et al.*, 2005, 2006*a*, 2007*a,b*, 2008*a,b*); Liao *et al.*, 2007; Zeng *et al.*, 2003; Zhang *et al.*, 2005), and they have shown novel chain (Li *et al.*, 2007*b*), cubical (Li *et al.*, 2008*a*) and isomeric (Li *et al.*, 2008*b*) structures except for the commonly seen mononuclear or binuclear compounds. Taurine, an amino acid containing sulfur, is indispensable to human beings and has important physiological functions. However, there have been sparse reports on the crystal structures of the corresponding free Schiff base ligands so far. In this paper, we report the crystal structure of a reduced Schiff base from taurine, (I) (Fig. 1).

The H atom of the sulfonic acid group is transferred to the amino N atom, forming the zwitterionic amino acid. This structure is completely similar to that of 2-(2-pyridylmethylammonio)ethanesulfonate dihydrate (Li *et al.*, 2006*b*), where the H atom of the sulfonic acid group is also transferred to the amino N atom. The difference between them is that the furan ring here is positionally disordered. The two positions of furan ring have a dihedral angle of 180°. Other bond length and angles are in good agreement. Methanol molecules are involved in hydrogen bonds both as donors and acceptors, whereas ammonium acts only as a double donor (Table 1, Fig.2). Fig. 3 shows the crystal packing of (I), with hydrogen bonds as dashed lines in *ac* plane. The crystal of (I) is stabilized *via* these intermolecular hydrogen bonding interactions.

Experimental

Furan-2-carbaldehyde (0.96 g, 10 mmol) in MeOH (10 ml) was dropwise added to a solution of 2-aminoethanesulfonic acid (1.25 g, 10 mmol) in methanol (10 ml) containing KOH (0.56 g, 10 mmol). The yellow solution was stirred for about 2 h at room temperature prior to cooling in an ice bath. The intermediate Schiff base that formed was reduced with an excess of KBH_4 (0.79 g, 15 mmol). The yellow colour slowly discharged, and after 3 h the solution was adjusted with concentrated HCl to pH = 6.0. The resulting white solid was filtered off, washed with anhydrous methanol and diethyl ether. The obtained solid was dissolved in a ethanol-methanol mixture (1:1 v/v, 20 ml) and heated. When cooling, colourless granular-shaped crystals were obtained in a yield of 76%. Analysis, found: C 40.42, H 6.37, N 5.85, S 13.55%; $\text{C}_8\text{H}_{15}\text{NO}_5\text{S}$ requires: C 40.50, H 6.33, N 5.91, S 13.50%. IR (KBr, ν , cm^{-1}): 768.7 [$\nu(\text{C}=\text{C}-\text{H})$], 741.0 (νCH_2); 1210.1, 1147.5, 1040.8 (νSO_3^-); 1607.6 ($\nu \text{C}=\text{C}$); 3428.4 ($\nu \text{O}-\text{H}$); 3098.8, 3021.3 ($\nu \text{N}-\text{H}$).

Refinement

The H atoms bonded to C and N atoms were positioned geometrically with C—H distance of 0.93–0.97 Å and N—H distances of 0.900 Å, and treated as riding atoms, with $U_{\text{iso}}(\text{H}) = 1.2$ or $1.5U_{\text{eq}}(\text{C}, \text{N})$. The O—H hydrogen atom was located in a difference Fourier map and their positional and isotropic displacement parameters were refined; the applied restraint of the O—H distance was 0.820 Å, with $U_{\text{iso}}(\text{H}) = 1.5U_{\text{eq}}(\text{O})$.

Figures

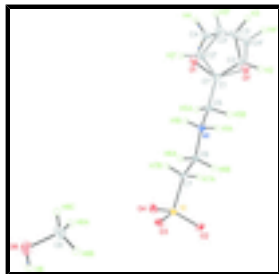


Fig. 1. Molecular structure of (I), with displacement ellipsoids drawn at the 15% probability level.

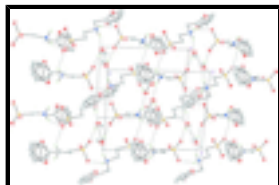


Fig. 2. The crystal packing of (I), showing hydrogen bonds as dashed lines in *bc* plane. H atoms on C atoms have been omitted.

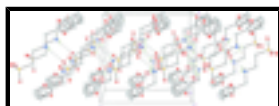


Fig. 3. The crystal packing of (I), showing hydrogen bonds as dashed lines in *ac* plane. H atoms on C atoms have been omitted.

2-(2-Furylmethylammonio)ethanesulfonate methanol solvate

Crystal data

$C_7H_{11}NO_4S \cdot CH_4O$

$M_r = 237.27$

Monoclinic, $P2_1/c$

Hall symbol: $-P\ 2ybc$

$a = 10.729\ (10)\ \text{\AA}$

$b = 9.174\ (8)\ \text{\AA}$

$c = 11.270\ (10)\ \text{\AA}$

$\beta = 91.964\ (10)^\circ$

$V = 1108.6\ (17)\ \text{\AA}^3$

$Z = 4$

$F_{000} = 504$

$D_x = 1.422\ \text{Mg m}^{-3}$

Mo $K\alpha$ radiation

$\lambda = 0.71073\ \text{\AA}$

Cell parameters from 2624 reflections

$\theta = 2.9\text{--}26.3^\circ$

$\mu = 0.29\ \text{mm}^{-1}$

$T = 294\ \text{K}$

Granular, colourless

$0.39 \times 0.23 \times 0.19\ \text{mm}$

Data collection

Bruker APEXII CCD area-detector diffractometer

Radiation source: fine-focus sealed tube

Monochromator: graphite

$T = 294\ \text{K}$

φ and ω scans

Absorption correction: multi-scan (SADABS; Sheldrick, 1996)

$T_{\min} = 0.894$, $T_{\max} = 0.946$

2056 independent reflections

1675 reflections with $I > 2\sigma(I)$

$R_{\text{int}} = 0.025$

$\theta_{\max} = 25.5^\circ$

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

$h = -12 \rightarrow 12$

$k = -11 \rightarrow 11$

7971 measured reflections

$l = -13 \rightarrow 13$

Refinement

Refinement on F^2

Secondary atom site location: difference Fourier map

Least-squares matrix: full

Hydrogen site location: inferred from neighbouring sites

$R[F^2 > 2\sigma(F^2)] = 0.041$

H-atom parameters constrained

$wR(F^2) = 0.109$

$$w = 1/[\sigma^2(F_o^2) + (0.0435P)^2 + 0.7985P]$$

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

$S = 1.06$

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

2056 reflections

$\Delta\rho_{\max} = 0.34 \text{ e } \text{\AA}^{-3}$

131 parameters

$\Delta\rho_{\min} = -0.31 \text{ e } \text{\AA}^{-3}$

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.

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 (\AA^2)

	x	y	z	$U_{\text{iso}}^*/U_{\text{eq}}$	Occ. (<1)
C1	0.15887 (16)	0.40087 (19)	1.03366 (18)	0.0405 (5)	0.563 (5)
C2	0.06631 (19)	0.3384 (3)	1.0916 (3)	0.0555 (12)	0.563 (5)
H2	0.0190	0.2592	1.0650	0.067*	0.563 (5)
C3	0.0522 (3)	0.4135 (4)	1.2010 (2)	0.0573 (19)	0.563 (5)
H3	-0.0047	0.3950	1.2595	0.069*	0.563 (5)
C4	0.1395 (4)	0.5157 (4)	1.1997 (2)	0.0619 (14)	0.563 (5)
H4	0.1532	0.5825	1.2608	0.074*	0.563 (5)
O1	0.2068 (3)	0.5129 (2)	1.0994 (2)	0.0578 (9)	0.563 (5)
O1'	0.0572 (2)	0.3157 (3)	1.0589 (3)	0.0578 (9)	0.437 (5)
C1'	0.15442 (16)	0.40368 (19)	1.03098 (18)	0.0405 (5)	0.437 (5)
C2'	0.1761 (2)	0.4964 (2)	1.11987 (19)	0.0555 (12)	0.437 (5)
H2'	0.2380	0.5675	1.1222	0.067*	0.437 (5)
C3'	0.0903 (3)	0.4705 (4)	1.2108 (2)	0.0573 (19)	0.437 (5)
H3'	0.0832	0.5187	1.2828	0.069*	0.437 (5)
C4'	0.0230 (3)	0.3605 (4)	1.1674 (3)	0.0619 (14)	0.437 (5)
H4'	-0.0418	0.3180	1.2078	0.074*	0.437 (5)
C5	0.2106 (2)	0.3793 (3)	0.9149 (2)	0.0455 (6)	

supplementary materials

H5A	0.1911	0.4519	0.8546	0.055*
H5B	0.1656	0.2896	0.8977	0.055*
C6	0.3852 (2)	0.2834 (3)	0.80019 (19)	0.0389 (5)
H6A	0.3740	0.3697	0.7512	0.047*
H6B	0.3372	0.2049	0.7635	0.047*
C7	0.5215 (2)	0.2421 (3)	0.80631 (19)	0.0385 (5)
H7A	0.5316	0.1509	0.8491	0.046*
H7B	0.5684	0.3165	0.8497	0.046*
N1	0.33791 (17)	0.3130 (2)	0.92132 (16)	0.0366 (4)
H1A	0.3355	0.2290	0.9624	0.044*
H1B	0.3908	0.3739	0.9604	0.044*
O2	0.51984 (16)	0.09645 (19)	0.60803 (14)	0.0475 (4)
O3	0.71519 (15)	0.2028 (2)	0.67984 (16)	0.0547 (5)
O4	0.54838 (17)	0.35667 (19)	0.59804 (16)	0.0541 (5)
S1	0.58193 (5)	0.22288 (6)	0.66156 (5)	0.03640 (19)
C8	0.1847 (3)	0.9586 (4)	0.0474 (3)	0.0661 (8)
H8A	0.2158	0.9121	0.1187	0.099*
H8B	0.1539	0.8861	-0.0075	0.099*
H8C	0.1184	1.0241	0.0660	0.099*
O6	0.2791 (2)	1.0353 (2)	-0.0028 (3)	0.0841 (8)
H6	0.3274	0.9783	-0.0334	0.126*

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
C1	0.0334 (12)	0.0395 (13)	0.0489 (14)	0.0009 (10)	0.0043 (10)	-0.0021 (11)
C2	0.054 (3)	0.057 (3)	0.056 (3)	-0.021 (2)	0.008 (2)	-0.008 (2)
C3	0.053 (3)	0.075 (5)	0.0450 (19)	0.007 (3)	0.015 (2)	-0.008 (3)
C4	0.065 (3)	0.071 (3)	0.051 (2)	0.007 (3)	0.016 (2)	-0.007 (2)
O1	0.0508 (17)	0.0572 (19)	0.0662 (18)	-0.0150 (15)	0.0137 (14)	-0.0136 (15)
O1'	0.0508 (17)	0.0572 (19)	0.0662 (18)	-0.0150 (15)	0.0137 (14)	-0.0136 (15)
C1'	0.0334 (12)	0.0395 (13)	0.0489 (14)	0.0009 (10)	0.0043 (10)	-0.0021 (11)
C2'	0.054 (3)	0.057 (3)	0.056 (3)	-0.021 (2)	0.008 (2)	-0.008 (2)
C3'	0.053 (3)	0.075 (5)	0.0450 (19)	0.007 (3)	0.015 (2)	-0.008 (3)
C4'	0.065 (3)	0.071 (3)	0.051 (2)	0.007 (3)	0.016 (2)	-0.007 (2)
C5	0.0374 (13)	0.0510 (15)	0.0482 (14)	0.0053 (11)	0.0042 (10)	0.0031 (11)
C6	0.0411 (12)	0.0455 (14)	0.0302 (11)	-0.0025 (10)	0.0026 (9)	-0.0033 (10)
C7	0.0417 (12)	0.0456 (13)	0.0282 (11)	0.0026 (10)	0.0018 (9)	-0.0035 (10)
N1	0.0373 (10)	0.0374 (10)	0.0351 (10)	-0.0016 (8)	0.0036 (8)	-0.0042 (8)
O2	0.0572 (11)	0.0450 (10)	0.0400 (9)	-0.0009 (8)	-0.0020 (8)	-0.0118 (7)
O3	0.0383 (9)	0.0731 (13)	0.0530 (11)	0.0057 (9)	0.0040 (8)	-0.0093 (9)
O4	0.0659 (12)	0.0465 (11)	0.0507 (10)	0.0079 (9)	0.0144 (9)	0.0144 (8)
S1	0.0405 (3)	0.0390 (3)	0.0299 (3)	0.0022 (2)	0.0039 (2)	-0.0017 (2)
C8	0.0571 (17)	0.068 (2)	0.074 (2)	-0.0017 (15)	0.0079 (15)	0.0062 (16)
O6	0.0751 (15)	0.0432 (11)	0.137 (2)	0.0023 (11)	0.0486 (14)	0.0045 (13)

Geometric parameters (\AA , $^\circ$)

C1—C2	1.3365 (17)	C5—H5A	0.9700
-------	-------------	--------	--------

C1—O1	1.3579 (17)	C5—H5B	0.9700
C1—C5	1.479 (3)	C6—N1	1.497 (3)
C2—C3	1.4241 (19)	C6—C7	1.510 (3)
C2—H2	0.9300	C6—H6A	0.9700
C3—C4	1.3255 (17)	C6—H6B	0.9700
C3—H3	0.9300	C7—S1	1.785 (3)
C4—O1	1.3616 (18)	C7—H7A	0.9700
C4—H4	0.9300	C7—H7B	0.9700
O1'—C4'	1.3528 (18)	N1—H1A	0.9000
O1'—C1'	1.3636 (18)	N1—H1B	0.9000
C1'—C2'	1.3288 (17)	O2—S1	1.4579 (19)
C1'—C5	1.476 (3)	O3—S1	1.449 (2)
C2'—C3'	1.4210 (18)	O4—S1	1.460 (2)
C2'—H2'	0.9300	C8—O6	1.371 (3)
C3'—C4'	1.3242 (17)	C8—H8A	0.9600
C3'—H3'	0.9300	C8—H8B	0.9600
C4'—H4'	0.9300	C8—H8C	0.9600
C5—N1	1.494 (3)	O6—H6	0.8200
C2—C1—O1	109.4	N1—C5—H5B	96.4
C2—C1—C5	133.87 (18)	H5A—C5—H5B	110.4
O1—C1—C5	116.63 (19)	N1—C6—C7	111.21 (18)
C1—C2—C3	108.6	N1—C6—H6A	109.4
C1—C2—H2	125.7	C7—C6—H6A	109.4
C3—C2—H2	125.7	N1—C6—H6B	109.4
C4—C3—C2	103.7	C7—C6—H6B	109.4
C4—C3—H3	128.2	H6A—C6—H6B	108.0
C2—C3—H3	128.2	C6—C7—S1	111.39 (15)
C3—C4—O1	113.0	C6—C7—H7A	109.3
C3—C4—H4	123.5	S1—C7—H7A	109.3
O1—C4—H4	123.5	C6—C7—H7B	109.3
C1—O1—C4	105.4	S1—C7—H7B	109.3
C4'—O1'—C1'	105.2	H7A—C7—H7B	108.0
C2'—C1'—O1'	108.7	C5—N1—C6	111.57 (17)
C2'—C1'—C5	134.33 (19)	C5—N1—H1A	109.3
O1'—C1'—C5	116.98 (18)	C6—N1—H1A	109.3
C1'—C2'—C3'	109.6	C5—N1—H1B	109.3
C1'—C2'—H2'	125.2	C6—N1—H1B	109.3
C3'—C2'—H2'	125.2	H1A—N1—H1B	108.0
C4'—C3'—C2'	102.7	O3—S1—O2	113.08 (11)
C4'—C3'—H3'	128.6	O3—S1—O4	113.72 (12)
C2'—C3'—H3'	128.6	O2—S1—O4	111.38 (12)
C3'—C4'—O1'	113.8	O3—S1—C7	105.68 (11)
C3'—C4'—H4'	123.1	O2—S1—C7	106.36 (11)
O1'—C4'—H4'	123.1	O4—S1—C7	105.89 (11)
C1'—C5—N1	114.81 (19)	O6—C8—H8A	109.5
C1—C5—N1	112.44 (19)	O6—C8—H8B	109.5
C1'—C5—H5A	115.6	H8A—C8—H8B	109.5
C1—C5—H5A	117.6	O6—C8—H8C	109.5
N1—C5—H5A	119.2	H8A—C8—H8C	109.5

supplementary materials

C1'—C5—H5B	95.2	H8B—C8—H8C	109.5
C1—C5—H5B	95.5	C8—O6—H6	109.5
O1—C1—C2—C3	0.2	O1'—C1'—C5—C1	-105.89 (12)
C5—C1—C2—C3	-175.1 (3)	C2'—C1'—C5—N1	71.6 (3)
C1—C2—C3—C4	-0.4	O1'—C1'—C5—N1	-108.9 (2)
C2—C3—C4—O1	0.4	C2—C1—C5—C1'	72.75 (19)
C2—C1—O1—C4	0.0	O1—C1—C5—C1'	-102.27 (13)
C5—C1—O1—C4	176.2 (2)	C2—C1—C5—N1	-110.2 (2)
C3—C4—O1—C1	-0.3	O1—C1—C5—N1	74.7 (2)
C4'—O1'—C1'—C2'	0.0	N1—C6—C7—S1	-174.72 (15)
C4'—O1'—C1'—C5	-179.6 (2)	C1'—C5—N1—C6	176.54 (19)
O1'—C1'—C2'—C3'	-0.2	C1—C5—N1—C6	176.41 (18)
C5—C1'—C2'—C3'	179.3 (3)	C7—C6—N1—C5	169.8 (2)
C1'—C2'—C3'—C4'	0.3	C6—C7—S1—O3	172.61 (17)
C2'—C3'—C4'—O1'	-0.3	C6—C7—S1—O2	-66.9 (2)
C1'—O1'—C4'—C3'	0.2	C6—C7—S1—O4	51.7 (2)
C2'—C1'—C5—C1	74.6 (2)		

Hydrogen-bond geometry (Å, °)

<i>D</i> —H... <i>A</i>	<i>D</i> —H	H... <i>A</i>	<i>D</i> ... <i>A</i>	<i>D</i> —H... <i>A</i>
N1—H1A...O6 ⁱ	0.90	1.92	2.767 (3)	156
N1—H1B...O2 ⁱⁱ	0.90	2.15	2.940 (3)	147
N1—H1B...O2 ⁱⁱⁱ	0.90	2.39	3.039 (3)	129
O6—H6...O4 ^{iv}	0.82	1.90	2.720 (3)	175

Symmetry codes: (i) $x, y-1, z+1$; (ii) $x, -y+1/2, z+1/2$; (iii) $-x+1, y+1/2, -z+3/2$; (iv) $-x+1, y+1/2, -z+1/2$.

Fig. 1

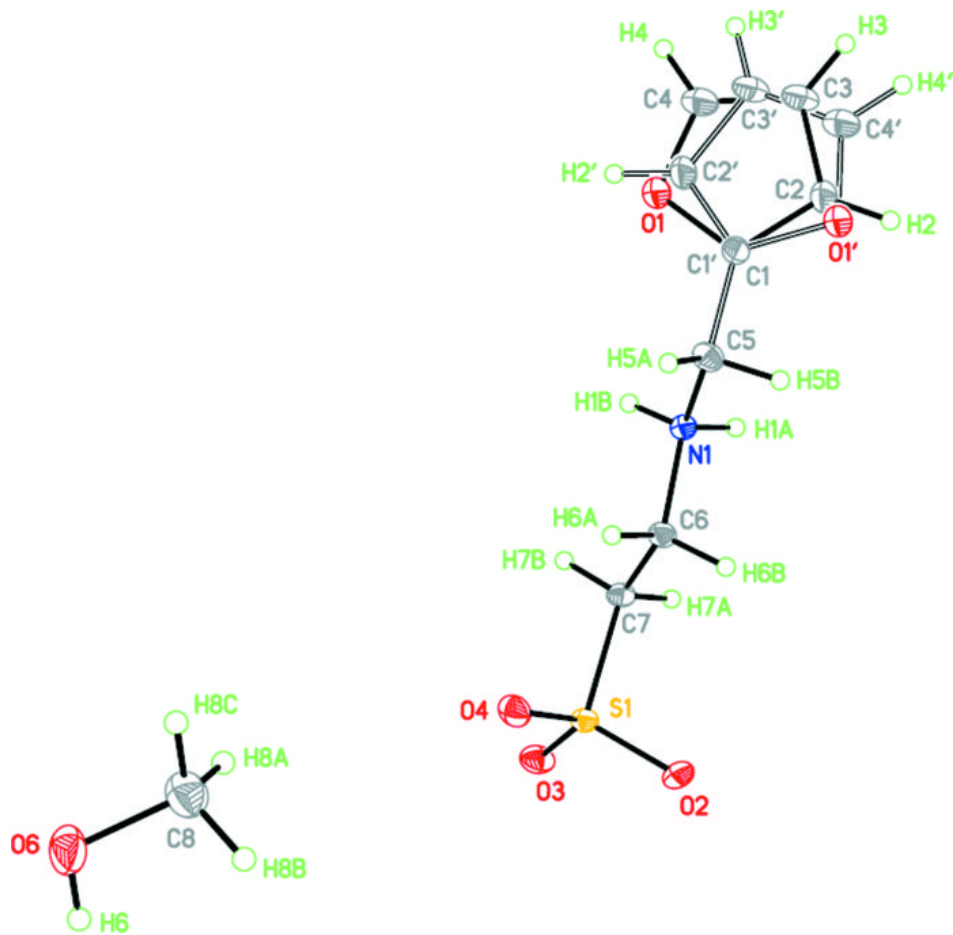


Fig. 2

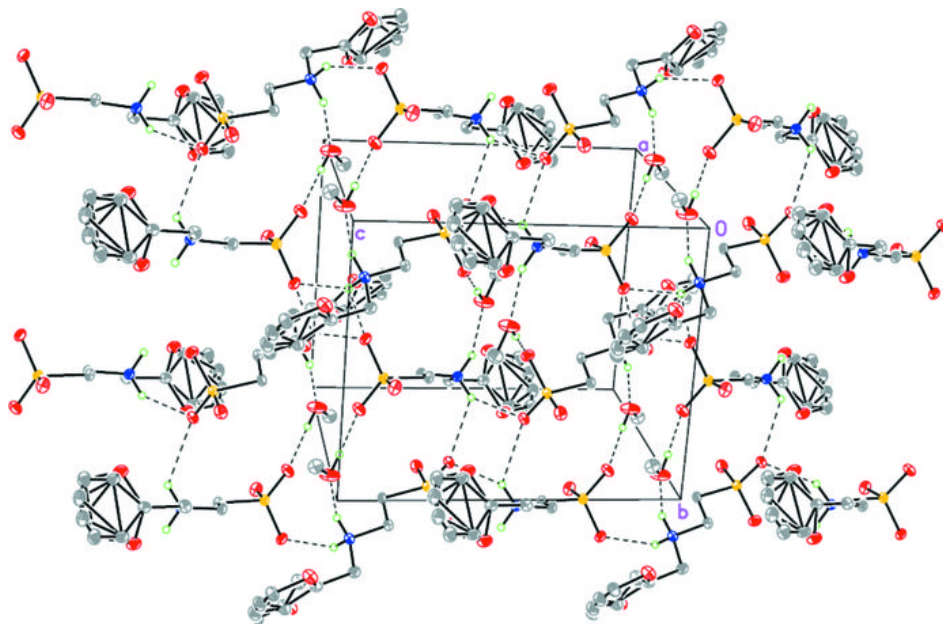


Fig. 3

