attached phenyl ring, the torsion angle C14—C15—N17—O19 being −3.1 (3)°. The crystal packing is characterized by van der Waals interactions.

Experimental

3-Nitrophenothiazine was prepared by the reaction of mercaptoaniline with chloro-2,4-dinitrobenzene in ethanol containing sodium acetate (Gupta, 1988; Saraswat *et al.*, 1993). Phase transfer catalysis was used for the alkylation of the N10 atom, with toluene as solvent and triethylbenzylammonium chloride as dispersant, the aqueous phase being a 50% potassium hydroxide solution. Purple square-needle-shaped crystals were obtained by evaporation of a water–methanol (80:20) solution.

Crystal data

$C_{14}H_{12}N_2O_2S$
M_r = 272.32
Orthorhombic
Pnaa
a = 7.654 (1) Å
b = 11.282 (2) Å
c = 29.404 (4) Å
V = 2539.1 (7) Å^3
Z = 8
D_x = 1.425 Mg m^{-3}
D_m = 1.41 (2) Mg m^{-3}
D_m measured by flotation in benzene–chloroform
Mo $K\alpha$ radiation
λ = 0.71073 Å
Cell parameters from 25 reflections
θ = 9–16°
μ = 0.254 mm^{-1}
T = 293 (2) K
Square prism cut from a needle
0.41 × 0.32 × 0.29 mm
Purple

Data collection

Enraf–Nonius CAD-4 diffractometer
$\omega/2\theta$ scans
Absorption correction: none
3271 measured reflections
3271 independent reflections
2342 reflections with $I > 2\sigma(I)$
θ_{max} = 30.16°
$h = 0 \rightarrow 10$
$k = 0 \rightarrow 15$
$l = 0 \rightarrow 41$
2 standard reflections
frequency: 60 min
intensity decay: none

Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)]$ = 0.039
$wR(F^2)$ = 0.082
S = 0.992
3271 reflections
208 parameters
H-atom coordinates refined with $U = 1.2U_{eq}$(parent atom)
$w = 1/[\sigma^2(F_o^2) + (0.032P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.001
$\Delta\rho_{max}$ = 0.213 e Å^{-3}
$\Delta\rho_{min}$ = −0.240 e Å^{-3}
Extinction correction: none
Scattering factors from *International Tables for Crystallography* (Vol. C)

Table 1. *Selected geometric parameters (Å, °)*

C5—N10	1.403 (2)	C9—N10	1.391 (2)
C6—S7	1.7600 (14)	N10—C11	1.475 (2)
S7—C8	1.7465 (14)		
C8—S7—C6	100.15 (7)	C9—N10—C11	117.72 (14)
C9 N10 C5	122.84 (13)	C5 N10 C11	118.23 (13)
N10—C5—C6—S7	−5.7 (2)	C5—N10—C11—C12	82.9 (2)
S7—C8—C9—N10	8.0 (2)	C14—C15—N17—O19	−3.1 (3)
C9—N10—C11—C12	−84.9 (2)		

Data collection: *CAD-4 Operations Manual* (Enraf–Nonius, 1977). Cell refinement: *CAD-4 Operations Manual*. Data reduction: *DATARED* (Pèpe, 1979). Program(s) used to solve structure: *SHELXS86* (Sheldrick, 1985). Program(s) used to refine structure: *SHELXL93* (Sheldrick, 1993). Molecular graphics: *ORTEP*II (Johnson, 1976). Software used to prepare material for publication: *SHELXL93*.

Supplementary data for this paper are available from the IUCr electronic archives (Reference: CF1230). Services for accessing these data are described at the back of the journal.

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(Z)-5-(1-Methoxy-2-naphthylmethylene)-4-oxo-2-thioxo-1,3-thiazolidine-3-acetic Acid Dimethyl Sulfoxide Solvate

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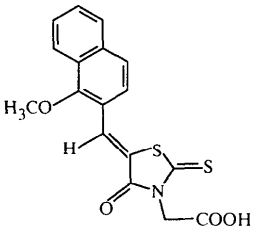
Abstract

The title compound (1-OCH_3-NOTA) is a potent aldose reductase (AR) inhibitor. It is found to co-crystallize with the solvent dimethyl sulfoxide (DMSO), *i.e.* $C_{17}H_{13}NO_4S_2.C_2H_6OS$. The skeleton of 1-$OCH_3$-NOTA is highly planar, except for the acetic acid group

and the methoxy substituent. This particular conformation confers on this molecule an optimum geometrical complement to the shape of the aldose reductase (AR) active pocket. Molecules of 1-OCH_3-NOTA, related by a centre of symmetry in the crystal structure of the DMSO solvate, are held together by van der Waals and ring-to-ring interactions. The stability of the crystal is enhanced by a hydrogen bond which links the DMSO molecule to 1-OCH_3-NOTA through its carboxyl group.

Comment

In the search for new inhibitors of aldose reductase (AR), the 5-(2-naphthylmethylidene)-4-oxo-2-thioxo-3-thiazolidineacetic acid (1-H-NOTA) compound and its methoxy-substituted derivative, 1-OCH_3-NOTA, appear to be good candidates. Molecular-interaction modelling of substituted and non-substituted NOTA suggested that they may form stable NOTA–AR complexes. In both cases, the NOTA molecule is found to be sandwiched between the two hydrophobic amino acids (Leu_{300} and Trp_{111}) lining the active pocket of AR. However, complexes of AR with substituted derivatives may be more stable due to the presence of additional hydrophobic interactions between the OCH_3 group of the host molecule, and the guest molecule. This finding is consistent with recent *in vitro* activity studies (Fresneau *et al.*, 1998) which indicate that the 1-OCH_3-NOTA derivative exhibits an AR inhibitor activity one order of magnitude greater than that of the non-substituted derivative.



1-OCH_3-NOTA

The accurate molecular geometry of both compounds is needed for a better understanding of their interactions with AR molecules. Until recently, due to a lack of single crystals of the substituted form, only the geometry of 1-H-NOTA was known accurately (TranQui *et al.*, 1998). The present study reports the crystal and molecular structure of 1-OCH_3-NOTA. As expected, the naphthalene group and the thiazolidine heterocycle are essentially planar; the dihedral angle between them is 1.41 (9)°. The methoxy substituent and the acetic acid group are approximately perpendicular to their attached rings, making dihedral angles of 85.36 (11) and 81.37 (7)°, respectively. DMSO, used as solvent in the crystal growth, is present in the crystal. The displacement parameters of its constituent atoms are similar to those of the other atoms in 1-OCH_3-NOTA, indicating that DMSO is ordered. Its contribution to the stability of the crystal is evidenced by a strong O3···O5 hydrogen bond linking the two molecular species through the carboxylic acid group of 1-OCH_3-NOTA [O3···O5 2.584 (2), H3···O5 1.807 (6) Å and O3—H3···O5 157.3 (15)°]. Otherwise, the molecules are packed together by pure van der Waals interactions and by ring-to-ring contacts. The molecular geometry is very similar for 1-OCH_3-NOTA and 1-H-NOTA. Docking simulation calculations suggest that the presence of the methoxy group enhances docking with the active site of aldose reductase by generating additional hydrophobic interactions.

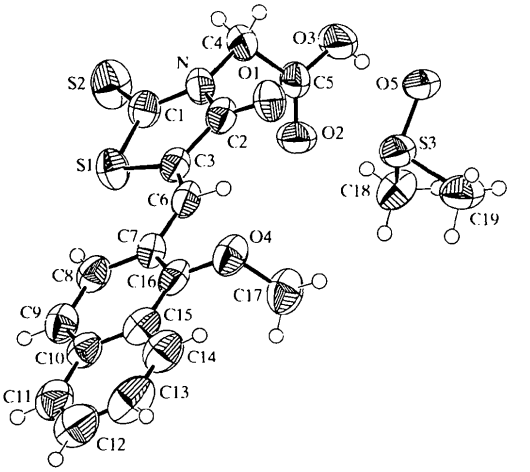


Fig. 1. View of 1-OCH_3-NOTA.C_2H_6OS with ellipsoids at 50% probability levels. H atoms are drawn as small spheres of arbitrary radii.

Experimental

The title compound was synthesized according to a procedure described by Fresneau (1996). Single crystals were obtained from DMSO solution by very slow (about one month) evaporation at room temperature. These crystals are very unstable in open atmosphere.

Crystal data

$C_{17}H_{13}NO_4S_2.C_2H_6OS$
M_r = 437.53
Monoclinic
$C2/c$
a = 34.201 (5) Å
b = 5.219 (2) Å
c = 23.179 (4) Å
β = 98.57 (5)°
V = 4091.1 (18) Å^3
Z = 8
D_x = 1.421 Mg m^{-3}
D_m not measured

Mo $K\alpha$ radiation
λ = 0.71073 Å
Cell parameters from 25 reflections
θ = 8.2–20.7°
μ = 0.393 mm^{-1}
T = 293 (2) K
Prismatic
0.26 × 0.16 × 0.12 mm
Colourless

Data collection

Enraf–Nonius CAD-4 diffractometer	$\theta_{max} = 24.98°$
$2\theta/\omega$ scans	$h = -38 \rightarrow 38$
Absorption correction: none	$k = 0 \rightarrow 6$
3603 measured reflections	$l = 0 \rightarrow 26$
3603 independent reflections	3 standard reflections
3285 reflections with $I > 2\sigma(I)$	every 100 reflections
	frequency: 120 min
	intensity decay: 4%

Refinement

Refinement on F^2	$(\Delta/\sigma)_{max} = 0.053$
$R[F^2 > 2\sigma(F^2)] = 0.054$	$\Delta\rho_{max} = 0.311$ e Å^{-3}
$wR(F^2) = 0.121$	$\Delta\rho_{min} = -0.291$ e Å^{-3}
$S = 1.128$	Extinction correction: none
3285 reflections	Scattering factors from *International Tables for Crystallography* (Vol. C)
259 parameters	
H atoms riding	
$w = 1/[\sigma^2(F_o^2) + (0.0808P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$	

Table 1. *Selected geometric parameters (Å, °)*

S1—C1	1.738 (2)	O2—C5	1.203 (2)
S1—C3	1.736 (2)	O3—C5	1.293 (2)
S2—C1	1.617 (2)	C2—C3	1.482 (2)
N—C1	1.385 (2)	C3—C6	1.352 (2)
N—C2	1.397 (2)	C4—C5	1.513 (2)
N—C4	1.431 (2)	C6—C7	1.443 (2)
O1—C2	1.197 (2)		
C1—S1—C3	92.96 (8)	N—C2—C3	109.46 (12)
C1—N—C2	116.78 (13)	C6—C3—C2	119.36 (13)
C1—N—C4	123.57 (13)	C6—C3—S1	130.21 (13)
C2—N—C4	118.61 (12)	C2—C3—S1	110.42 (11)
N—C1—S2	126.24 (13)	N—C4—C5	110.93 (14)
N—C1—S1	110.34 (11)	O2—C5—O3	125.0 (2)
S2—C1—S1	123.42 (10)	O2—C5—C4	123.35 (15)
O1—C2—N	122.4 (2)	O3—C5—C4	111.69 (14)
O1—C2—C3	128.12 (15)	C3—C6—C7	131.89 (14)

Most H atoms were geometrically placed, except for H3 which was unambiguously located by difference Fourier methods, and were constrained with a riding model.

Data collection: *CAD-4 Software* (Enraf–Nonius, 1989). Cell refinement: *CAD-4 Software*. Data reduction: *CAD-4 Software*. Program(s) used to solve structure: *SHELXS86* (Sheldrick, 1990). Program(s) used to refine structure: *SHELXL93* (Sheldrick, 1993). Molecular graphics: *Xtal_GX* (Hall & du Boulay, 1995) and *PLUTON92* (Spek, 1992).

Supplementary data for this paper are available from the IUCr electronic archives (Reference: CF1236). Services for accessing these data are described at the back of the journal.

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2,2′-Biphenol

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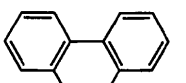
Abstract

The structure of anhydrous 2,2′-biphenol, $C_{12}H_{10}O_2$, is described, together with the hydrogen-bonding scheme. The first hydrogen bond is an intramolecular one, while the second one connects the biphenol molecules to build infinite chains running in the **b** direction. A comparison with the structure of 2,2′-biphenol monohydrate is made.

Comment

In relation to the synthesis of Lewis acid derivatives of biphenol (Schaverien *et al.*, 1992), we are interested in the organization of pure phenols in the solid state. Recently, biphenol has been used as an activator of coordination catalysts (Matsukawa & Mikami, 1996; Mikami & Matsukawa, 1997), but little is known about the structures of these complexes. The structure of 2,2′-biphenol monohydrate, (II), was recently described (Chen *et al.*, 1996), and a comparison can be made of the structures of the monohydrate, (II), and the anhydrous form, (I).



(I)

All bond lengths and angles found in (I) (Table 1) agree with those in the literature (Allen *et al.*, 1987). The C6—C7 single bond is significantly longer than the C—C bonds in the two aromatic rings. The dihedral angles between the aromatic rings, namely 48.4 (1)° in (I) and 67.6 (1)° in (II), are significantly different.