Acta Crystallographica Section E
Structure Reports Online
ISSN 1600-5368

(2″*S*,5″*R*,7″*S*)-2-[2′-(2″-Methyl-1″,6″-dioxaspiro-[4.5]dec-7″-yl)ethylsulfonyl]-1,3-benzothiazole

George R. Clark,* James E. Robinson and Margaret A. Brimble

Chemistry Department, University of Auckland, Private Bag 92019, Auckland, New Zealand

Correspondence e-mail: g.clark@auckland.ac.nz

Received 31 January 2006
Accepted 21 February 2006

The crystal structure of the title compound, $C_{18}H_{23}NO_4S_2$, has been investigated in order to establish the relative stereochemistry at the spiro ring junction and the absolute stereochemistry of the molecule. The title compound is a key intermediate for the synthesis of the spiroacetal-containing anti-*Helicobacter pylori* agent, spirolaxine methyl ether, for which the absolute stereochemistry has not previously been reported.

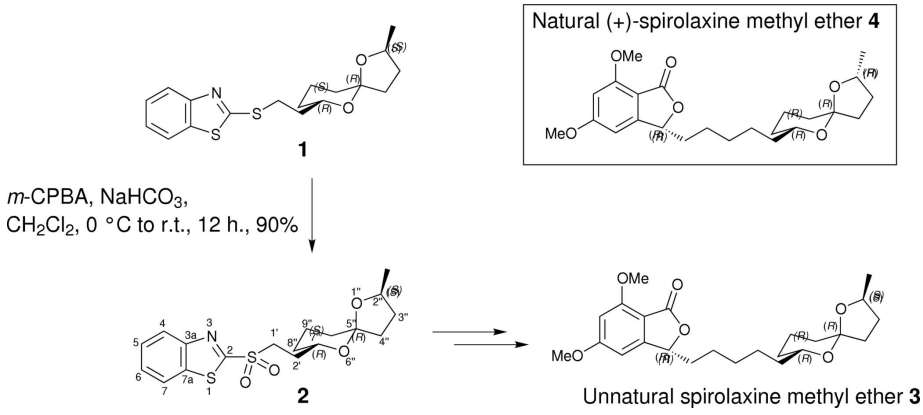
Key indicators

Single-crystal X-ray study
T = 84 K
Mean σ(C–C) = 0.002 Å
R factor = 0.022
wR factor = 0.058
Data-to-parameter ratio = 16.3

For details of how these key indicators were automatically derived from the article, see http://journals.iucr.org/e.

Comment

Spirolaxine methyl ether, (4), is produced by various strains of white rot fungi belonging to the genera *Sporotrichum* and *Phanerochaete* (Gaudliana *et al.*, 1996). It exhibits potent activity against the microaerophilic Gram-negative bacterium *Helicobacter pylori*, which is responsible for most gastric and duodenal ulcers and has been strongly associated with the development of gastric cancer (Blaser, 1992; Rathbone, 1993; Walsh & Peterson, 1995).



The title spiroacetal sulfone, (2), has been used as a key intermediate in synthetic studies towards spirolaxine methyl ether, (4) (Robinson & Brimble, 2005), which resulted in the synthesis of an non-natural isomer of the natural product, (3).

The structure of spiroacetal sulfone (2) was used to determine unequivocally the absolute stereochemistry of the spirocentre, C5″, as the absolute stereochemistry at C2″ and C7″ in sulfone (2) was derived from starting materials of known absolute configuration. The conformation of the [5,6]-spiroacetal ring system is also reported here. The [5,6]-spiroacetal ring system is also confirmed to adopt a conformation wherein the six-membered ring adopts a chair conformation with the O atom of the five-membered ring occupying an axial position thus gaining maximum stability from the anomeric effect.

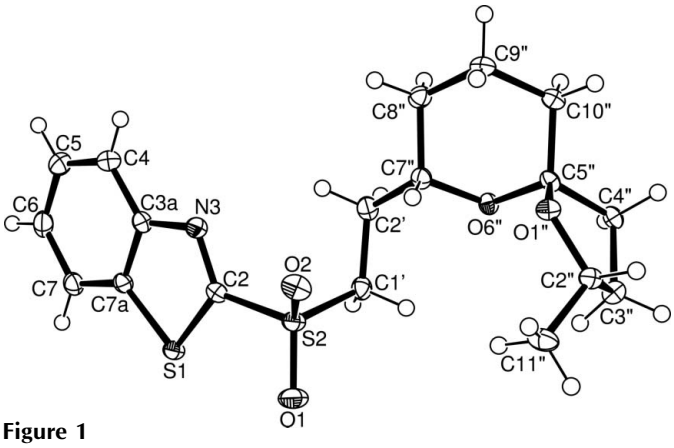


Figure 1
The structure of (2), showing 50% probability displacement ellipsoids and the atom-numbering scheme. H atoms are drawn as arbitary spheres.

Experimental

To a solution of thioether (1) (461 mg, 1.32 mmol) in dichloromethane (5 ml) at 273 K under an atmosphere of nitrogen was added sodium bicarbonate (554 mg, 6.59 mmol) and a solution of *m*-chloroperoxybenzoic acid (569 mg, 3.30 mmol) in dichloromethane (5 ml). After stirring the solution for 12 h, saturated aqueous sodium bicarbonate (2 ml) and saturated aqueous sodium thiosulfate (2 ml) were added. The aqueous layer was extracted with dichloromethane (3 × 10 ml). The combined extracts were dried over magnesium sulfate, filtered, and the solvent removed under reduced pressure. The resultant oil was purified by flash column chromatography using hexane–diethyl ether (8:2–6:4) as eluent to afford a white solid, which was recrystallized from diethyl ether to give the title compound, (2) (453 mg, 90%) as colourless needles (m.p. 347–350 K). Spectroscopic analysis: $[\alpha]_D$ +24.8 (*c* 0.40 in $CHCl_3$); IR (ν_{max}, film, cm^{-1}): 2930, 2870, 1472, 1458, 1328 (*s*, SO), 1236, 1221, 1148 (*s*, SO), 1072, 1026, 977, 877, 855, 763 and 730; ^{1}H NMR (400 MHz, $CDCl_3$, δ, p.p.m.): 1.12–1.24 (1H, *m*, H8*A*), 1.24 (3H, *d*, *J* = 6.2 Hz, Me), 1.50–1.58 (3H, *m*, H8″*B* and H10″), 1.59–1.72 (3H, *m*, H3′*A*, H4″*A* and H9″*A*), 1.72–1.84 (1H, *m*, H9″*B*), 1.84–2.03 (4H, *m*, H3″*B*, H4″*B* and H2′), 3.47 (1H, *ddd*, *J* = 14.4, 11.3 and 4.8 Hz, H1′*A*), 3.74 (1H, *ddd*, *J* = 14.4, 11.3 and 4.8 Hz, H1′*B*), 3.86–3.92 (1H, *m*, H7″), 4.19 (1H, *qdd*, *J* = 6.2, 6.2 and 1.9 Hz, H2″), 7.57 (1H, *td*, *J* = 7.3 and 1.5 Hz, H6), 7.64 (1H, *td*, *J* = 7.3 and 1.5 Hz, H5), 8.01 (1H, *dd*, *J* = 7.3 and 1.5 Hz, H7), 8.22 (1H, *dd*, *J* = 7.3 and 1.5 Hz, H4); ^{13}C NMR (100 MHz, $CDCl_3$, δ, p.p.m.): 20.0 (CH_2, C9″), 23.4 (CH_3, Me), 29.1 (CH_2, C2′), 30.8 (CH_2, C8″), 31.9 (CH_2, C3″), 33.4 (CH_2, C10″), 39.3 (CH_2, C4″), 51.9 (CH_2, C1′), 68.0 (CH, C7″), 76.9 (CH, C2″), 106.0 (quat., C5″), 122.3 (CH, C7), 125.5 (CH, C4), 127.6 (CH, C5), 128.0 (CH, C6), 136.8 (quat., C7a), 152.8 (quat., C3a), 165.7 (quat., C2); MS *m*/*z* (EI): 381 (M^+, 2%), 366 (M − Me, 3), 282 (18), 217 (15), 189 (34), 149 (30), 135 (52), 98 (100), 55 (40), 41 (34); HRMS (EI), found: M^+ 381.10540; $C_{18}H_{23}NO_4S_2$ requires: 381.10685.

Crystal data

$C_{18}H_{23}NO_4S_2$	D_x = 1.382 Mg m^{-3}
M_r = 381.49	Mo $K\alpha$ radiation
Monoclinic, $P2_1$	Cell parameters from 8192 reflections
a = 7.8132 (1) Å	θ = 1.3–27.1°
b = 7.3784 (1) Å	μ = 0.31 mm^{-1}
c = 15.8984 (1) Å	T = 84 (2) K
β = 90.628 (1)°	Plate, colourless
V = 916.47 (2) Å^3	0.68 × 0.40 × 0.17 mm
Z = 2	

Data collection

Siemens SMART CCD area-detector diffractometer	3685 independent reflections
	3592 reflections with $I > 2\sigma(I)$
ω scans	R_{int} = 0.023
Absorption correction: multi-scan (*SADABS*; Sheldrick, 1996)	θ_{max} = 27.1°
	$h = -9 \rightarrow 9$
T_{min} = 0.789, T_{max} = 0.912	$k = -9 \rightarrow 9$
9314 measured reflections	$l = -20 \rightarrow 20$

Refinement

Refinement on F^2	$w = 1/[\sigma^2(F_o^2) + (0.0305P)^2 + 0.1652P]$ where $P = (F_o^2 + 2F_c^2)/3$
$R[F^2 > 2\sigma(F^2)]$ = 0.022	
$wR(F^2)$ = 0.058	
S = 1.05	$(\Delta/\sigma)_{max}$ = 0.001
3685 reflections	$\Delta\rho_{max}$ = 0.33 e Å^{-3}
226 parameters	$\Delta\rho_{min}$ = −0.23 e Å^{-3}
H-atom parameters constrained	Absolute structure: Flack (1983), with 1536 Friedel pairs
	Flack parameter: 0.02 (4)

H atoms were placed in calculated positions and refined using a riding model, with C—H = 0.93–0.97 Å, and with U_{iso}(H) = 1.2 or 1.5 times U_{eq}(C).

Data collection: *SMART* (Siemens, 1995); cell refinement: *SAINT* (Siemens, 1995); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *ORTEPIII* (Burnett & Johnson, 1996); software used to prepare material for publication: *SHELXTL* (Siemens, 1995).

References

Blaser, M. J. (1992).*Clin. Infect. Dis.* **15**, 386–391.
Burnett, M. N. & Johnson, C. K. (1996). *ORTEPIII*. Report ORNL-6895. Oak Ridge National Laboratory, Tennessee, USA.
Flack, H. D. (1983). *Acta Cryst.* A**39**, 876–881.
Gaudliana, M. A., Huang, L. H., Kaneko, T. & Watts, P. C. (1996). PCT Int. Appl. WO 9605204. CAN 125:58200.
Rathbone, B. (1993). *Scrip Mag*. pp. 25–27.
Robinson, J. E. & Brimble, M. A. (2005). *Chem. Commun.* pp. 1560–1562.
Sheldrick, G. M. (1996). *SADABS*. University of Göttingen, Germany.
Sheldrick, G. M. (1997). *SHELXS97* and *SHELXL97*. University of Göttingen, Germany.
Siemens (1995). *SHELXTL* (Version 5), *SMART* (Version 4.050) and *SAINT* (Version 4.050). Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.
Walsh, J. H. & Peterson, W. L. (1995). *New Engl. J. Med.* **333**, 984–991.