Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)] = 0.034$
$wR(F^2) = 0.080$
$S = 0.796$
3644 reflections
285 parameters
H atoms: see below
$w = 1/[\sigma^2(F_o^2) + (0.045P)^2]$
where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{\max} < 0.001$
$\Delta\rho_{\max} = 0.180$ e Å^{-3}
$\Delta\rho_{\min} = -0.130$ e Å^{-3}
Extinction correction: *SHELXL*97 (Sheldrick, 1997)
Extinction coefficient: 0.0146 (16)
Scattering factors from *International Tables for Crystallography* (Vol. C)

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

O1=C1	1.2305 (19)	C9—O3	1.356 (2)
C1—N2	1.346 (2)	C10—O4	1.369 (2)
N2—N3	1.4016 (18)	C12=N13	1.285 (2)
N3—C12	1.405 (2)	N13—O14	1.4429 (18)
N3—C4	1.484 (2)	O3—C19	1.414 (2)
C4—O14	1.4492 (19)	O4—C20	1.413 (2)
O1=C1—N2	120.79 (16)	C12—N3—C4	104.02 (13)
O1=C1—C7	122.66 (15)	C12=N13—O14	106.41 (13)
N2—C1—C7	116.17 (15)	N13—O14—C4	106.78 (11)
C1—N2—N3	124.67 (15)	C9—O3—C19	117.87 (15)
N2—N3—C12	118.12 (13)	C10—O4—C20	117.72 (14)
N2—N3—C4	124.56 (13)		

Table 2. *Hydrogen-bonding geometry (Å, °)*

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
N2—H2···O1^i	0.859 (17)	1.983 (18)	2.830 (2)	168.5 (17)
C14—H14···N3	0.93	2.54	2.819 (2)	98
C26—H26···N3	0.93	2.65	2.944 (2)	99
C18—H18···O14	0.93	2.50	2.806 (2)	99

Symmetry code: (i) $1 - x, 1 - y, 1 - z$.

Reflection intensities were evaluated by profile fitting of a 96-step peak scan in shells of 2θ (Diamond, 1969) and then corrected for Lorentz–polarization effects. Standard deviations $\sigma(I)$ were estimated from counting statistics. All non-H atoms were refined anisotropically. H atoms were located in idealized positions (except H2 which was refined isotropically) and allowed to ride on the coordinates of their parent C atoms with a common isotropic displacement parameter ($U_{\rm iso} = 0.06$ Å^2). All calculations were performed on a MicroVAX 3400 and an AXP DecStation 3000/400.

Data collection: *P3/V Control Software* (Siemens, 1989). Cell refinement: *P3/V Control Software*. Data reduction: *SHELXTL-Plus* (Sheldrick, 1990). Program(s) used to solve structure: *SIR*92 (Altomare *et al.*, 1994). Program(s) used to refine structure: *SHELXL*97 (Sheldrick, 1997). Molecular graphics: *XPW* (Siemens, 1996). Software used to prepare material for publication: *PARST*97 (Nardelli, 1995) and *SHELXL*97.

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Supplementary data for this paper are available from the IUCr electronic archives (Reference: NA1353). Services for accessing these data are described at the back of the journal.

References

Allen, F. H. & Kennard, O. (1993). *Chem. Des. Autom. News*, **8**, 31–37.

Altomare, A., Cascarano, G., Giacovazzo, C., Guagliardi, A., Burla, M. C., Polidori, G. & Camalli, M. (1994). *J. Appl. Cryst.* **27**, 435.

Bernstein, J., Davis, R. E., Shimoni, L. & Chang N.-L. (1995). *Angew. Chem. Int. Ed. Engl.* **34**, 1555–1573.

Chimirri, A., De Sarro, G., De Sarro, A., Gitto, R., Grasso, S., Quartarone, S., Zappalá, M., Giusti, P., Libri, V., Constanti, A. & Chapman, A. G. (1999). *J. Med. Chem.* In the press.

Chimirri, A., Grasso, S., Monforte, A. M., Romeo, G. & Zappalá, M. (1993). *Heterocycles*, **36**, 601–637, 865–890.

Cremer, D. & Pople, J. A. (1975). *J. Am. Chem. Soc.* **97**, 1354–1358.

De Sarro, G., Chimirri, A., De Sarro, A., Gitto, R., Grasso, S., Giusti, P. & Chapman, A. G. (1995). *Eur. J. Pharmacol.* **294**, 411–422.

De Sarro, G., Zappalá, M., Grasso, S., Chimirri, A. & De Sarro, A. (1993). *Gen. Pharmacol.* **24**, 877–884.

De Sarro, G., Zappalá, M., Grasso, S., Chimirri, A., Spagnolo, C. & De Sarro, A. (1992). *Mol. Neuropharmacol.* **1**, 195–202.

Diamond, R. (1969). *Acta Cryst.* A**25**, 43–55.

Fogassy, E., Acs, M., Toth, G., Simon, K., Lang, T., Ladanyi, L. & Parkanyi, L. (1986). *J. Mol. Struct.* **147**, 143–146.

Laskos, E., Lianis, P. S., Rosios, N. A., Terzis, A. & Raptopoulou, C. P. (1995). *Tetrahedron Lett.* **36**, 5637–5640.

Nardelli, M. (1995). *J. Appl. Cryst.* **28**, 659.

Sheldrick, G. M. (1990). *SHELXTL-Plus*. Release 4.21/V. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.

Sheldrick, G. M. (1997). *SHELXL97. Program for the Refinement of Crystal Structures*. University of Göttingen, Germany.

Siemens (1989). *P3/V Control Software*. Release 4.21. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.

Siemens (1996). *XPW* in *SHELXTL*. Version 5.05. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.

Walsh, P. L., Maverick, E., Chiefari, J. & Lightner, D. A. (1997). *J. Am. Chem. Soc.* **119**, 3802–3806.

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(1*S*,*R*$_S$)-6,7-Dimethoxy-*N*-methyl-1-(*p*-tolylsulfinylmethyl)-1-trifluoromethyl-1,2,3,4-tetrahydroisoquinoline

Pierfrancesco Bravo, Eleonora Corradi, Marcello Crucianelli, Stefano Valdo Meille and Matteo Zanda

Dipartimento di Chimica, Politecnico di Milano, Via Mancinelli 7, 20131 Milano, Italy. E-mail: meille@dept.chem.polimi.it

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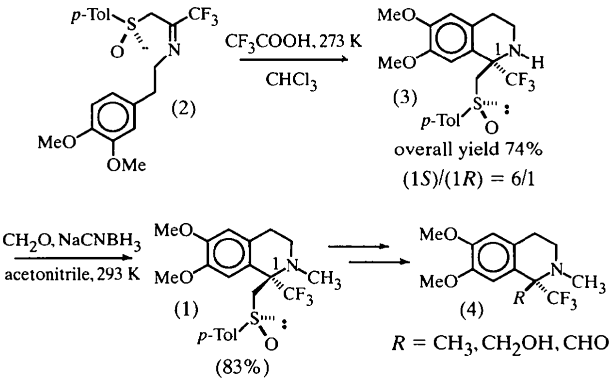
Abstract

The title compound, $C_{21}H_{24}F_3NO_3S$, is an intermediate in the synthesis of enantiomerically pure alkaloids; the molecular structure has been determined to establish its stereochemistry. The molecular conformation is largely determined by intramolecular interactions, while the

packing in the crystal does not show any unusual features.

Comment

Organofluorine compounds are of great interest in biomedicinal chemistry due to their peculiar activities. The title compound is an intermediate in the stereoselective total synthesis of enantiomerically pure 1-trifluoromethyltetrahydroisoquinoline alkaloids, (4), a new class of man-made biologically interesting substrates (Bravo *et al.*, 1998). Synthesis of the title compound was achieved according to the reported reaction scheme: the Pictet–Spengler cyclization (Cox & Cook, 1995) of the enantiopure starting material, (2), produced the tetrahydroisoquinoline sulfoxide, (3) (overall yield 74%), with a 71% diastereomeric excess in favour of the 1*S* form. Compound (3) was then transformed into (1) by reductive methylation (chemical yield 83%). Single crystals of compound (1) were analysed by X-ray diffraction, which indicated that the absolute configurations on C1 and S were *S* and *R*, respectively. The *ORTEP*II (Johnson, 1976) diagram of (1) with the atom-numbering scheme is shown in Fig. 1. Disorder involving essentially atom C3 is suggested by the unusually short distances involving this atom and by the features of its anisotropic displacement parameters.



The only non-aromatic six-membered ring, namely C1—N2—C3—C4—C5—C10, is found in a half-chair conformation, with C3 and N2 located out of the mean plane of the other four atoms by −0.400 (8) and 0.200 (4) Å, respectively. Such a ring conformation is not the most likely but it is quite similar to the one described in analogous alkaloids (Bravo *et al.*, 1998) and in a natural compound that shows a similarly constrained ring (Nasirov *et al.*, 1979). The endocyclic torsion angle C1—C10—C5—C4 measures 1.3 (7)°, but C5—C10—C1—N2 is also quite narrow [7.6 (6)°], and this is likely related to the substitution pattern on C1 and N2; the bulky group CF_3 plays a significant role in this respect.

A number of intramolecular interactions, involving the trifluoromethyl group and H atoms at distances close to the sum of the van der Waals radii, are apparent (F1···H20*A* 2.57, F1···H2*B* 2.24, F2···H3*A* 2.49, F3···H9 2.41 and F3···H20*B* 2.51 Å). We suggest that these interactions can hardly be attractive (Dunitz & Taylor, 1997) as the molecule deforms to reduce them: (i) the F—C—F angles are all smaller than 107°, (ii) the F—C—C angles are all greater than 112°, (iii) the dihedral angles involving C21 have unexpected values (C21—C1—C20—S1 has an almost *trans* conformation due to the steric hindrance of the ring bonded to S1, all the others have a value greater than the expected *gauche*), and (iv) the C3—N2—C2 angle [113.9 (4)°] is considerably smaller than C3—N2—C1 and C1—N2—C2 [119.3 (4) and 120.0 (4)°, respectively]. The crystal packing is mainly due to van der Waals interactions, but also weak electrostatic interactions should be taken into consideration [like the one suggested by the intermolecular contacts (2.85 Å) between H15 and F1 in the symmetry-equivalent position $(1+x, y, z)$] (Mele *et al.*, 1998).

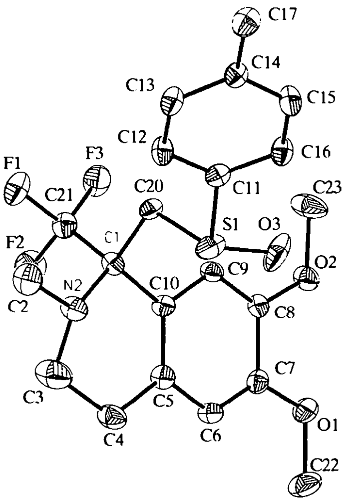


Fig. 1. The molecular structure of the title compound showing the atom-labelling scheme. Displacement ellipsoids of non-H atoms are plotted at the 20% probability level.

Experimental

The title compound was synthesized as described in the literature (Bravo *et al.*, 1998), then purified by flash chromatography on silica gel. Crystals suitable for X-ray diffraction were obtained by crystallization from diisopropyl ether. The melting point was found to be 408 K and $[\alpha]_D$ was −51.5 (c = 3 g dm^{-3}, chloroform).

Crystal data

$C_{21}H_{24}F_3NO_3S$
$M_r = 427.47$
Cu $K\alpha$ radiation
$\lambda = 1.54180$ Å

Orthorhombic
$P2_12_12_1$
$a = 9.185\,(1)$ Å
$b = 12.052\,(1)$ Å
$c = 18.899\,(1)$ Å
$V = 2092.1\,(2)$ Å^3
$Z = 4$
$D_x = 1.357$ Mg m^{-3}
D_m not measured

Cell parameters from 32 reflections
$\theta = 12$–$45°$
$\mu = 1.809$ mm^{-1}
$T = 293\,(2)$ K
Prism
$0.4 \times 0.3 \times 0.2$ mm
Colourless

Data collection

Siemens *P*4 diffractometer
$\theta/2\theta$ scan
Absorption correction: ψ scan (North *et al.*, 1968)
$T_{\min} = 0.472$, $T_{\max} = 0.696$
3644 measured reflections
1739 independent reflections (plus 1417 Friedel-related reflections)

2496 reflections with $I > 2\sigma(I)$
$R_{\rm int} = 0.025$
$\theta_{\max} = 69.28°$
$h = -11 \rightarrow 11$
$k = -12 \rightarrow 13$
$l = -22 \rightarrow 22$
3 standard reflections every 97 reflections intensity decay: <0.5%

Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)] = 0.058$
$wR(F^2) = 0.161$
$S = 1.057$
3156 reflections
268 parameters
H atoms treated by a mixture of independent and constrained refinement
$w = 1/[\sigma^2(F_o^2) + (0.0821P)^2 + 1.0523P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{\max} = 0.020$

$\Delta\rho_{\max} = 0.344$ e Å^{-3}
$\Delta\rho_{\min} = -0.238$ e Å^{-3}
Extinction correction: *SHELXL*97 (Sheldrick, 1997)
Extinction coefficient: 0.0058 (6)
Scattering factors from *International Tables for Crystallography* (Vol. C)
Absolute structure: Flack (1983)
Flack parameter = −0.03 (4)

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

N2—C3	1.416 (8)	C5—C4	1.497 (7)
N2—C1	1.462 (6)	C4—C3	1.474 (9)
N2—C2	1.461 (6)	C1—C21	1.551 (7)
C10—C1	1.542 (6)	C1—C20	1.544 (6)
C3—N2—C1	119.3 (4)	N2—C1—C10	110.2 (4)
C3—N2—C2	113.9 (4)	F2—C21—F3	106.0 (4)
C1—N2—C2	120.0 (4)	F2—C21—F1	106.0 (4)
C5—C10—C1	121.8 (4)	F3—C21—F1	105.0 (4)
C10—C5—C4	121.3 (4)	F2—C21—C1	113.0 (4)
C3—C4—C5	113.1 (5)	F3—C21—C1	113.7 (4)
N2—C3—C4	112.9 (6)	F1—C21—C1	112.5 (4)
C1—C10—C5—C4	1.3 (7)	C2—N2—C1—C20	51.4 (6)
C10—C5—C4—C3	16.0 (8)	C5—C10—C1—N2	7.6 (6)
C1—N2—C3—C4	56.9 (8)	C5—C10—C1—C21	−113.9 (5)
C5—C4—C3—N2	−42.8 (8)	C9—C10—C1—C21	66.6 (5)
C3—N2—C1—C10	−37.1 (7)	C5—C10—C1—C20	129.4 (5)
C3—N2—C1—C21	82.5 (6)	C21—C1—C20—S1	−179.4 (3)
C2—N2—C1—C21	−66.7 (6)	O3—S1—C11—C16	−15.2 (5)
C3—N2—C1—C20	−159.4 (6)	C20—S1—C11—C16	−126.0 (4)

H atoms were located at calculated positions and refined in the riding mode.

Data collection: *XSCANS* (Siemens, 1997). Cell refinement: *XSCANS*. Data reduction: *XSCANS*. Program(s) used to solve structure: *SIR*92 (Altomare *et al.*, 1994). Program(s) used to refine structure: *SHELXL*97 (Sheldrick, 1997). Molecular graphics: *SHELXTL-Plus* (Sheldrick, 1990). Software used to prepare material for publication: *SHELXL*97.

Supplementary data for this paper are available from the IUCr electronic archives (Reference: NA1386). Services for accessing these data are described at the back of the journal.

References

Altomare, A., Cascarano, O., Giacovazzo, C., Guagliardi, A., Burla, M. C., Polidori, G. & Camalli, M. (1994). *J. Appl. Cryst.* **27**, 435.
Bravo, P., Crucianelli, M., Farina, A., Meille, S. V., Volonterio, A. & Zanda, M. (1998). *Eur. J. Org. Chem.* pp. 435–440.
Cox, A. D. & Cook, J. M. (1995). *Chem. Rev.* **95**, 1797–1842.
Dunitz, J. D. & Taylor, R. (1997). *Chem. Eur. J.* **3**, 89–98.
Flack, H. D. (1983). *Acta Cryst.* A**39**, 876–881.
Johnson, C. K. (1976). *ORTEP*II. Report ORNL-5138. Oak Ridge National Laboratory, Tennessee, USA.
Mele, A., Vergani, B., Viani, F., Meille, S. V., Farina, A. & Bravo, P. (1998). *Eur. J. Org. Chem.* pp. 187–196.
Nasirov, S.-M., Israilov, I. A., Kuz'mina, L. G., Yunusov, M. S., Struchkov, Yu. T. & Yunusov, S. Yu. (1978). *Khim. Prir. Soedin.* 752–758; (1979). *Chem. Abstr.* **91**, 20 829.
North, A. C. T., Phillips, D. C. & Mathews, F. S. (1968). *Acta Cryst.* A**24**, 351–359.
Sheldrick, G. M. (1990). *SHELXTL-Plus.* Release 4.1. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.
Sheldrick, G. M. (1997). *SHELXL97. Program for the Refinement of Crystal Structures.* University of Göttingen, Germany.
Siemens (1997). *XSCANS. X-ray Single Crystal Analysis System.* Version 2.2. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.

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1-Acetyl-2-(3,3-dimethyl-2-butylidene)hydrazine: a monoclinic crystal structure with local orthorhombic pseudosymmetry

JAN W. BATS, MARC A. GRUNDL AND A. STEPHEN K. HASHMI

Institut für Organische Chemie, Universität Frankfurt, Marie-Curie-Straße 11, D-60439 Frankfurt am Main, Germany. E-mail: bats@indy2.org.chemie.uni-frankfurt.de

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Abstract

The crystal packing of the title molecule, 2′-(3,3-dimethylbut-2-ylidene)acetohydrazide, $C_8H_{16}N_2O$, shows layers with local pseudo-orthorhombic symmetry. The two independent molecules are related by a local non-crystallographic glide plane perpendicular to the *a* axis. The glide planes only act within a layer with a thickness of half the *c* cell parameter, resulting in an overall monoclinic symmetry for the structure.

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