Acta Crystallographica Section C
Crystal Structure Communications
ISSN 0108-2701

(4*S*)-3-[(2*R*,3*S*)-3-Hydroxy-2-methyl-3-phenylpropionyl]-4-isopropyloxazolidin-2-one

In-Chul Hwang,[a] Jung Hee Jang,[b] Taek Hyeon Kim[b]* and Kwang Ha[b]*

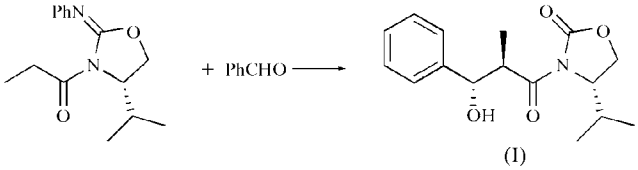
[a]Department of Chemistry, Pohang University of Science and Technology, Pohang 790-784, Republic of Korea, and [b]Faculty of Applied Chemical Engineering, Chonnam National University, Gwangju 500-757, Republic of Korea
Correspondence e-mail: thkim@chonnam.ac.kr, hakwang@chonnam.ac.kr

Received 18 January 2006
Accepted 9 February 2006
Online 18 March 2006

The molecule of the title compound, $C_{16}H_{21}NO_4$, is chiral and has three asymmetric centres. The absolute configuration was not determined *via* diffraction measurements on the crystal, but was established from the known absolute configuration of the starting material. In the crystal structure, the molecules assemble through intermolecular hydrogen bonds into a macrostructure with helical channels.

Comment

Chiral auxiliary-based aldol reactions have been the focus of much interest as the strategy of choice for accessing single isomers of β-hydroxy acid derivatives as chiral building blocks for bioactive compounds (Evans *et al.*, 1981; Ager *et al.*, 1996, 1997; Arya *et al.*, 2000; Evans, Downey *et al.*, 2002; Evans, Tedrow *et al.*, 2002). We recently reported that the use of a new *N*-acyl phenyliminooxazolidine auxiliary resulted in high diastereoselectivity in alkylation reactions (Lee *et al.*, 2002). During our ongoing studies of chiral auxiliary-based asymmetric reactions, the unexpected title compound, (I), was formed in an aldol reaction and its structure is reported here.



(I)

Compound (I) has three chiral C atoms and is one of eight possible stereoisomers. Crystallographically, the absolute configuration has not been established by anomalous dispersion effects, but the *R* and *S* configurations of the chiral centres could be assigned by reference to an unchanging asymmetric centre in the reaction procedure. Atoms C7, C8 and C13 have *S*, *R* and *S* configurations, respectively (Fig. 1).

In the crystal structure, molecules of (I) are assembled by two intermolecular hydrogen-bonding interactions, *viz*. O1—H1···O2^{i} and C12—H12*A*···O4^{ii}, with O1···O2^{i} = 2.871 (3) Å and C12···O4^{ii} = 3.369 (4) Å [symmetry codes: (i) $1-x, \frac{1}{2}+y, -z$; (ii) $1-x, -\frac{1}{2}+y, 1-z$]. Atom O1 of the

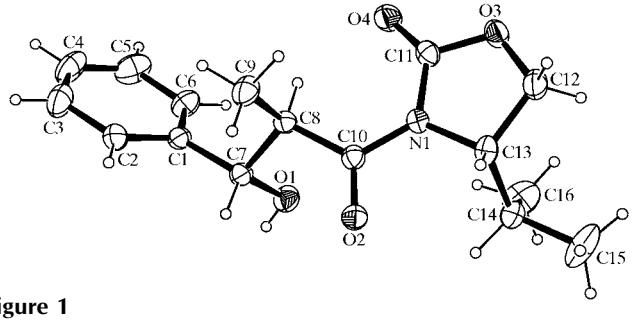


Figure 1
The structure of (I), showing the atom-numbering scheme. Displacement ellipsoids are drawn at the 30% probability level and H atoms are represented by circles of arbitrary size.

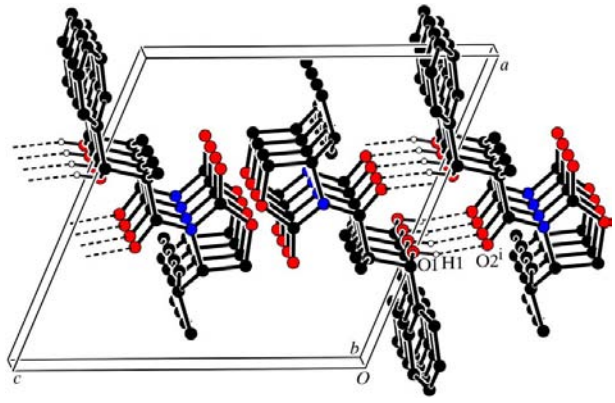


Figure 2
A view of the O—H···O hydrogen-bond interactions (dashed lines) in the crystal structure of (I). [Symmetry code: (i) $1-x, \frac{1}{2}+y, -z$.]

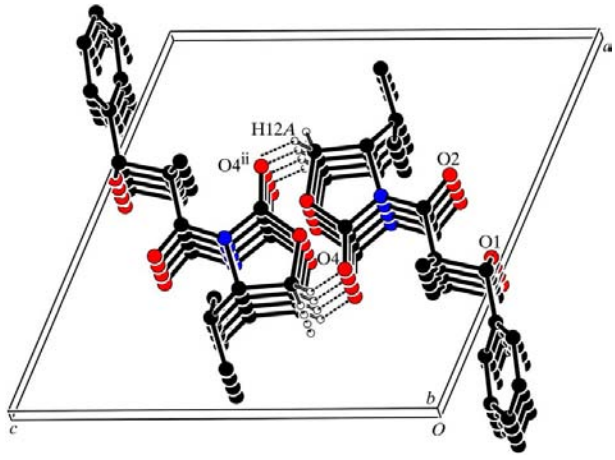


Figure 3
A view of the C—H···O hydrogen-bond interactions (dashed lines) in the crystal structure of (I). [Symmetry code: (ii) $1-x, -\frac{1}{2}+y, 1-z$.]

  DOI: 10.1107/S0108270106004884

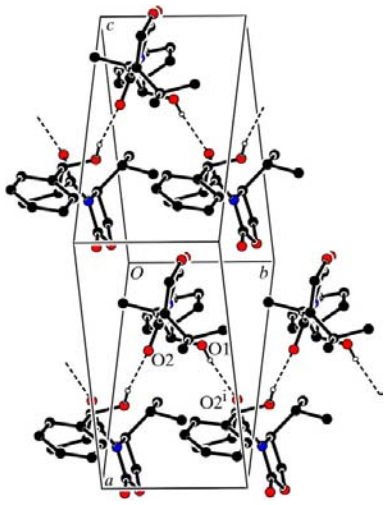


Figure 4
A side view of the hydrogen-bonded left-handed helical chain structure along the *b* axis. Dashed lines indicate hydrogen bonds. [Symmetry code: (i) $1-x, \frac{1}{2}+y, -z$.]

alcohol group and atom C12 in the oxazolidinone ring act as hydrogen-bond donors, and atoms O2 and O4 of the ketone groups act as acceptors (Table 2). The molecules are extended *via* these hydrogen bonds into a macrostructure, with a left-handed helical chain (O1—H1···O2^{i}; Fig. 2) and a right-handed helical chain (C12—H12*A*···O4^{ii}; Fig. 3) along the *b* axis. The cavity of the channel in Fig. 2 has a minimum diameter of 2.816 Å. The molecules stack in layers along the *b* axis, and the distance between the layers is 6.175 Å. The side view of the hydrogen-bonded left-handed helical chain structure is shown in Fig. 4. The helices are packed in a hexagonal-based array.

Examination of the structure with *PLATON* (Spek, 2003) reveals a short ring–ring interaction (< 6 Å) for oxazolidinone rings. The centroid–centroid distance between *Cg*1 (the centroid of the five-membered ring N1/C11/O3/C12/C13) and *Cg*1^{ii} is 4.222 Å and the dihedral angle between the ring planes is 35.9°. For phenyl rings, the shortest distance between *Cg*2 (the centroid of the phenyl ring C1–C6) and *Cg*2^{iii} [symmetry code: (iii) $-x, -\frac{1}{2}+y, -z$] is 5.175 Å and the dihedral angle is 42.2°.

Experimental

The title compound was synthesized following an analogous procedure to that described by Evans, Downey *et al.* (2002) for related compounds. To a round-bottomed flask in a glove-box was added $MgBr_2{\cdot}OEt_2$ (36 mg, 0.5 equivalents). The flask was fitted with a septum cap and removed to an ambient atmosphere, where it was charged with *N*-acylated phenyliminooxazolidine (0.28 mmol, 72 mg, 1 equivalent), EtOAc (3 ml), benzaldehyde (0.30 mmol, 31 µl, 1.1 equivalents), Et_3N (0.55 mmol, 77 µl, 2 equivalents) and trimethylsilyl chloride (0.41 mmol, 53 µl, 1.5 equivalents). The reaction mixture was stirred for 26 h and then filtered directly through a plug of silica gel (5.5 cm × 4.0 cm) and eluted with Et_2O. The eluent was concentrated, dissolved in tetrahydrofuran (50 ml) and treated with 1.0 *N* HCl (10 ml). After stirring for 1 h, the mixture was diluted with Et_2O (100 ml) and water (100 ml). The organic layer was extracted with saturated $NaHCO_3$ (50 ml), dried, filtered and concentrated. Flash chromatography (EtOAc–hexane = 2:8) afforded pure compound (I) in 58% yield. Single crystals suitable for an X-ray diffraction study were obtained by slow evaporation of a toluene solution over a period of one week. ^{1}H NMR ($CDCl_3$): δ 7.42–7.29 (*m*, 5H), 4.75 (*bt*, 1H, *J* = 6.3 Hz), 4.46–4.17 (*m*, 4H), 3.17 (*bd*, 1H, *J* = 6.6 Hz), 2.30–2.23 (*m*, 1H), 1.10 (*d*, 1H, *J* = 6.9 Hz), 0.87 (*d*, 1H, *J* = 7.1 Hz), 0.70 (*d*, 1H, *J* = 6.9 Hz); ^{13}C NMR ($CDCl_3$): δ 176.7, 154.2, 142.2, 128.5, 128.0, 126.5, 77.4, 63.2, 58.8, 43.9, 28.3, 17.9, 14.8, 14.3; MS (EI) *m*/*z* 291 (M^+).

Crystal data

$C_{16}H_{21}NO_4$
M_r = 291.34
Monoclinic, $P2_1$
a = 11.6191 (10) Å
b = 6.1749 (5) Å
c = 12.0431 (10) Å
β = 113.394 (2)°
V = 793.02 (11) Å^3
Z = 2
D_x = 1.220 Mg m^{-3}
Mo $K\alpha$ radiation
Cell parameters from 634 reflections
θ = 1.8–28.2°
μ = 0.09 mm^{-1}
T = 243 (2) K
Block, colourless
0.1 × 0.1 × 0.1 mm

Data collection

Bruker SMART 1000 area-detector CCD diffractometer
φ and ω scans
5052 measured reflections
1976 independent reflections
908 reflections with $I > 2\sigma(I)$
R_{int} = 0.041
θ_{max} = 28.2°
h = −15 → 10
k = −7 → 7
l = −12 → 15

Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)]$ = 0.040
$wR(F^2)$ = 0.061
S = 0.82
1976 reflections
194 parameters
H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.0121P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max} < 0.001$
$\Delta\rho_{max}$ = 0.10 e Å^{-3}
$\Delta\rho_{min}$ = −0.11 e Å^{-3}

Table 1
Selected geometric parameters (Å, °).

O1—C7	1.434 (3)	N1—C11	1.392 (4)
O2—C10	1.224 (3)	N1—C13	1.482 (4)
O3—C11	1.357 (3)	C1—C6	1.379 (4)
O3—C12	1.443 (3)	C1—C2	1.383 (4)
O4—C11	1.192 (3)	C1—C7	1.508 (4)
N1—C10	1.384 (4)	C12—C13	1.512 (4)
C11—O3—C12	110.4 (3)	N1—C10—C8	119.9 (3)
C11—N1—C13	111.3 (3)	O4—C11—O3	121.1 (3)
O1—C7—C1	112.0 (3)	O4—C11—N1	130.2 (3)
O1—C7—C8	104.9 (3)	O3—C11—N1	108.7 (3)
C1—C7—C8	109.7 (3)	O3—C12—C13	106.5 (2)
O2—C10—N1	117.5 (3)	N1—C13—C12	101.2 (3)
O2—C10—C8	122.4 (3)		

Table 2
Hydrogen-bond geometry (Å, °).

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
O1—H1···O2^{i}	0.83	2.07	2.871 (3)	161
C12—H12*A*···O4^{ii}	0.98	2.48	3.369 (4)	150

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

In the absence of significant anomalous scattering, Friedel opposites were merged. All H atoms were positioned geometrically and allowed to ride on their respective carrier atoms, with O1—H = 0.83 Å and U_{iso}(H) = 1.5U_{eq}(O1), and C—H = 0.94–0.99 Å and U_{iso}(H) = 1.2U_{eq}(C) or 1.5U_{eq}(methyl C).

Data collection: *SMART* (Bruker, 2000); cell refinement: *SMART*; data reduction: *SAINT* (Bruker, 2000); program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *ORTEP-3* (Farrugia, 1997); software used to prepare material for publication: *SHELXL97*.

This work was supported by the Basic Research Programme of the Korean Science and Engineering Foundation (grant No. R05-2004-000-11207-0) (now controlled under the authority of the Korea Research Foundation). Spectroscopic data were obtained from the Korea Basic Science Institute, Gwangju branch.

Supplementary data for this paper are available from the IUCr electronic archives (Reference: AV1281). Services for accessing these data are described at the back of the journal.

References

Ager, D. J., Prakash, J. & Schaad, D. R. (1996). *Chem. Rev.* **96**, 835–876.
Ager, D. J., Prakash, J. & Schaad, D. R. (1997). *Aldrichim. Acta*, **30**, 3–12.
Arya, P. & Qin, H. (2000). *Tetrahedron Lett.* **56**, 917–947.
Bruker (2000). *SMART* (Version 5.618) and *SAINT* (Version 6.02a). Bruker AXS Inc., Madison, Wisconsin, USA.
Evans, D. A., Bartroli, J. & Shih, T. L. (1981). *J. Am. Chem. Soc.* **103**, 2127–2129.
Evans, D. A., Downey, C. W. D., Shaw, J. T. & Tedrow, J. S. (2002). *Org. Lett.* **4**, 1127–1130.
Evans, D. A., Tedrow, J. S., Shaw, J. T. & Downey, C. W. (2002). *J. Am. Chem. Soc.* **124**, 392–393.
Farrugia, L. J. (1997). *J. Appl. Cryst.* **30**, 565.
Lee, G.-J., Kim, T. H., Kim, J. N. & Lee, U. (2002). *Tetrahedron Lett.* **13**, 9–12.
Sheldrick, G. M. (1997). *SHELXS97* and *SHELXL97*. University of Göttingen, Germany.
Spek, A. L. (2003). *J. Appl. Cryst.* **36**, 7–13.