Plus (Sheldrick, 1990). Program(s) used to solve structure: *SHELXTL-Plus*. Program(s) used to refine structure: *SHELXL93* (Sheldrick, 1993). Molecular graphics: *SHELXTL-Plus*. Software used to prepare material for publication: *SHELXL93*.

The authors thank the Swiss National Science Foundation for financial support.

Lists of atomic coordinates, displacement parameters, structure factors and complete geometry have been deposited with the IUCr (Reference: AB1423). Copies may be obtained through The Managing Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

References

Bosshard, C., Sutter, K., Schlesser, R. & Günter, P. (1993). *J. Opt. Soc. Am.* **B10**, 867–884.
Flack, H. D. (1983). *Acta Cryst.* A**39**, 876–881.
Jacques, J., Collet, A. & Wilen, S. H. (1981). *Enantiomers, Racemates and Resolutions*, pp. 1–23. New York: Wiley Interscience.
Lu, Z.-L., Duan, C.-Y., Tian, Y.-P., You, X.-Z., Fun, H.-K. & Sivakumar, K. (1996). *Acta Cryst.* C**52**, 1507–1509.
Sheldrick, G. M. (1990). *SHELXTL-Plus. Structure Determination, Refinement and Molecular Graphics Software Programs.* Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.
Sheldrick, G. M. (1993). *SHELXL93. Program for the Refinement of Crystal Structures.* University of Göttingen, Germany.
Siemens (1992). *P3 Users Manual.* Version 4.2. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.
Wong, M. S., Bosshard, C., Pan, F. & Günter, P. (1996). *Adv. Mater.* **8**, 677–680.
Wong, M. S., Meier, U., Pan, F., Gramlich, V., Bosshard, C. & Günter, P. (1996). *Adv. Mater.* **8**, 416–420.

Acta Cryst. (1997). C**53**, 759–761

Planar Chirality in 2,2-Diphenyl-1,3,6,9-tetraoxacycloundecane

HATSUE TAMURA,[a] SHINYA UENO,[a] KAZUHIDE OGAWA,[b] TOSHIKAZU NAGAI[a] AND TAKUMI OSHIMA[a]

[a]*Department of Applied Chemistry, Faculty of Engineering, Osaka University, 1-16 Machikaneyama, Toyonaka, Osaka 560, Japan, and* [b]*Institute of Chemistry, Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560, Japan. E-mail: tamura@ch.wani.osaka-u.ac.jp*

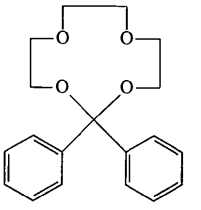
(*Received 6 November 1996; accepted 21 January 1997*)

Abstract

The crystal of benzophenone crown ether acetal, $C_{19}H_{22}O_4$, with an 11-membered ring has two crystallographically independent molecules in the unit cell. The bond lengths and angles in the ring moiety are similar to those of analogous crown ethers. The 11-membered rings are greatly twisted to adopt planar–chiral structures and the unit cell contains two sets of enantiomers.

Comment

A number of studies have been carried out on the crystal structures of a wide variety of crown ethers and their cation-binding complexes (Izatt & Christensen, 1978). However, X-ray crystal structure analyses of analogous crown ether acetals, which are characterized by the incorporation of an acetal functional group in the cyclic polyether linkage, have seldom been conducted. The structure of benzophenone crown ether acetal, (I), is reported and compared with those of unsubstituted crown ethers.



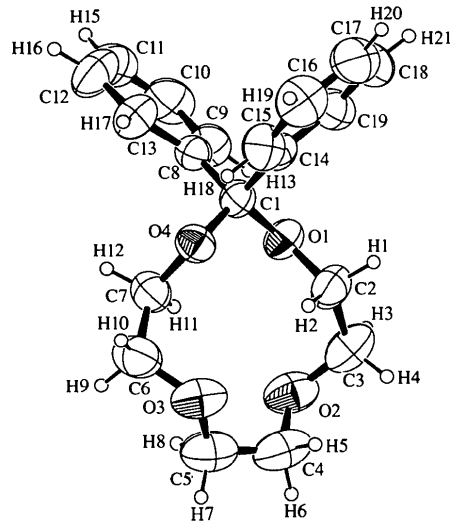
(I)

The molecular structure of the benzophenone crown ether acetal is shown in Fig. 1. The unit cell contains two crystallographically independent molecules (*A* and *B*).

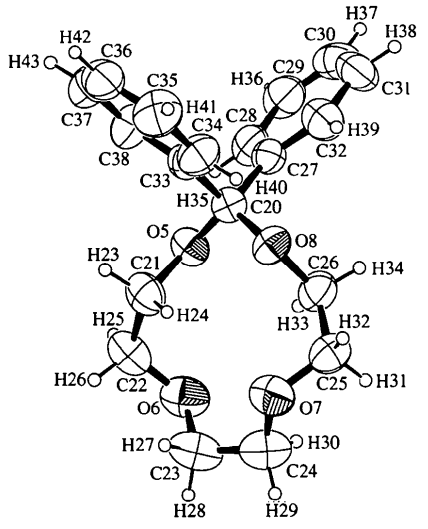
The average values of C—C, C—O, C—O—C and C—C—O of the ring moiety are 1.496, 1.418 Å, 115.1 and 110.5° for molecule *A*, and 1.492, 1.419 Å, 115.3 and 110.8° for molecule *B*, respectively. These bond distances and angles are similar for both molecules and are also similar to those of 18-crown-6 (1.507, 1.411 Å, 113.5 and 109.8°; Dunitz & Seiler, 1974) and benzo-15-crown-5 (1.485, 1.419 Å, 115.7 and 110.0°; Hanson, 1978).

The torsion angles of the ring constituent C—C—O—C are |85.5 (3)|–|89.4 (3)|° and |125.4 (3)|–|157.5 (3)|°. The average value of 141.5° for the latter torsion angles is different from the average values of 168.3° in 18-crown-6 (|155.2|–|175.5|°) and 168.3° in benzo-15-crown-5 (|163|–|171|°). The O—C—C—O torsion angles are in the range |68.3 (3)|–|77.8 (3)|°. These values are comparable to those of the relatively rigid benzo-15-crown-5 (|66|–|72|°), while the more flexible 18-crown-6 has torsion angles of −67.6, 75.4 and 174.7°. The replacement of a dioxyethylene unit by an acetal functional group markedly decreases the flexibility of the macrocyclic ring. As a result, the 11-membered ring of the title compound is largely twisted to adopt a planar–chiral structure.

The O(acetal)—C(acetal)—C(aromatic)—C(aromatic *o*-position) torsion angles are in the range |11.6 (3)|–|18.2 (13)|° to reduce the steric repulsion between



Molecule *A*



Molecule *B*

Fig. 1. *ORTEP*II (Johnson, 1976) plot of the two molecules *A* and *B* of 2,2-diphenyl-1,3,6,9-tetraoxacycloundecane, with the atom-numbering schemes. Displacement ellipsoids of the non-H atoms are drawn at the 50% probability level.

the acetal O atom and the *ortho*-H atom, and also between the two phenyl groups. Intramolecular C—H···O contacts within the sum of the van der Waals radii (2.4 Å) are observed between the acetal O atom and the phenyl C—H bond; O···H (O···C) distances range from 2.33 to 2.35 Å [2.673 (3)–2.692 (3) Å].

Experimental

The title compound was prepared according to the procedure described by Oshima, Nishioka, Ueno & Nagai (1982) and recrystallized from hexane–diethyl ether solutions at room temperature.

Crystal data

$C_{19}H_{22}O_4$
M_r = 314.38
Triclinic
$P\bar{1}$
a = 13.476 (2) Å
b = 14.040 (1) Å
c = 10.3145 (9) Å
α = 103.953 (8)°
β = 105.200 (8)°
γ = 67.291 (8)°
V = 1715.6 (3) Å^3
Z = 4
D_x = 1.217 Mg m^{-3}
D_m = 1.21 Mg m^{-3}
D_m measured by flotation

Cu $K\alpha$ radiation
λ = 1.5418 Å
Cell parameters from 25 reflections
θ = 12.61–27.62°
μ = 0.69 mm^{-1}
T = 296 K
Prismatic
0.30 × 0.20 × 0.15 mm
Colorless

Data collection

Rigaku AFC-5*R* diffractometer
ω scans
Absorption correction: none
5326 measured reflections
5079 independent reflections
3712 reflections with $I > 2\sigma(I)$

R_{int} = 0.021
θ_{max} = 60°
$h = -15 \rightarrow 14$
$k = -15 \rightarrow 15$
$l = 0 \rightarrow 11$
3 standard reflections
every 53 reflections
intensity decay: −2.17%

Refinement

Refinement on F
R = 0.046
wR = 0.049
S = 1.69
3712 reflections
415 parameters
H atoms not refined
Weighting scheme based on measured e.s.d.'s

$(\Delta/\sigma)_{max}$ = 0.03
$\Delta\rho_{max}$ = 0.13 e Å^{-3}
$\Delta\rho_{min}$ = −0.21 e Å^{-3}
Extinction correction: none
Scattering factors from *International Tables for X-ray Crystallography* (Vol. IV)

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

O1—C1	1.413 (3)	O6—C23	1.419 (3)
O1—C2	1.434 (3)	O7—C24	1.422 (3)
O2—C3	1.408 (3)	O7—C25	1.407 (3)
O2—C4	1.421 (3)	O8—C20	1.414 (3)
O3—C5	1.410 (3)	O8—C26	1.434 (3)
O3—C6	1.408 (3)	C2—C3	1.500 (4)
O4—C1	1.409 (3)	C4—C5	1.486 (4)
O4—C7	1.438 (3)	C6—C7	1.501 (4)
O5—C20	1.409 (3)	C21—C22	1.493 (3)
O5—C21	1.443 (3)	C23—C24	1.492 (4)
O6—C22	1.407 (3)	C25—C26	1.492 (3)
C1—O1—C2—C3	153.9 (2)	C20—O5—C21—C22	−157.5 (2)
C1—O4—C7—C6	153.4 (2)	C20—O8—C26—C25	−149.9 (2)
C2—C3—O2—C4	−88.1 (3)	C21—C22—O6—C23	85.5 (3)
C3—O2—C4—C5	127.5 (3)	C22—O6—C23—C24	−125.4 (3)
C4—C5—O3—C6	130.9 (3)	C23—C24—O7—C25	−133.2 (3)
C5—O3—C6—C7	−88.8 (3)	C24—O7—C25—C26	89.4 (3)

Data collection: *MSC/AFC Diffractometer Control Software* (Molecular Structure Corporation, 1988). Cell refinement: *MSC/AFC Diffractometer Control Software*. Data reduction: *TEXSAN* (Molecular Structure Corporation, 1992). Program(s) used to solve structure: *SHELXS*86 (Sheldrick, 1985). Program(s) used to refine structure: *TEXSAN*. Molecular graphics: *ORTEP*II (Johnson, 1976). Software used to prepare material for publication: *TEXSAN*.

Lists of atomic coordinates, displacement parameters, structure factors and complete geometry have been deposited with the IUCr (Reference: OA1021). Copies may be obtained through The Managing Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

References

Dunitz, J. D. & Seiler, P. (1974). *Acta Cryst.* B**30**, 2739–2741.

Hanson, I. R. (1978). *Acta Cryst.* B**34**, 1026–1028.

Izatt, R. M. & Christensen, J. J. (1978). In *Synthetic Multidentate Macrocyclic Compounds*. New York/London: Academic Press.

Johnson, C. K. (1976). *ORTEP*II. Report ORNL-5138. Oak Ridge National Laboratory, Tennessee, USA.

Molecular Structure Corporation (1988). *MSC/AFC Diffractometer Control Software*. MSC, 3200 Research Forest Drive, The Woodlands, TX 77381, USA.

Molecular Structure Corporation (1992). *TEXSAN. TEXRAY Structure Analysis Package*. MSC, 3200 Research Forest Drive, The Woodlands, TX 77381, USA.

Oshima, T., Nishioka, R., Ueno, S. & Nagai, T. (1982). *J. Org. Chem.* **47**, 2114–2117.

Sheldrick, G. M. (1985). *SHELXS*86. *Program for the Solution of Crystal Structures*. University of Göttingen, Germany.

Acta Cryst. (1997). C**53**, 761–762

The Antifungal Agent 1-[2-(4-Chlorobenzylamino)benzyl]-1*H*-imidazole

ALESSANDRO ETTORRE,[a] MARIANGELA BIAVA,[b] ROSSELLA FIORAVANTI[b] AND GIULIO CESARE PORRETTA[b]

[a]*Menarini Ricerche S.p.A., via T. Speri 10, 00040 Pomezia (Roma), Italy, and* [b]*Dipartimento di Studi di Chimica e Tecnologia delle Sostanze Biologicamente Attive, Univ. degli Studi di Roma 'La Sapienza', p. le A. Moro 5, 00185 Roma, Italy. E-mail: alex@isc.mlib.cnr.it*

(*Received 10 October 1996; accepted 20 January 1997*)

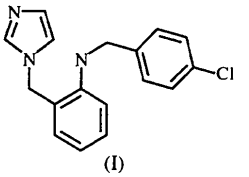
Abstract

The crystal structure of the title compound, $C_{17}H_{16}ClN_3$, and its global minimum-energy structure are not compatible with the model proposed in a recent CoMFA 3D-QSAR (comparative molecular-field analysis 3D-quantitative structure–activity relationship) analysis in which the fixed conformation of the model is used to align all the structures of the inhibitors studied. This result suggests the hypothesis that this molecule belongs to another class of antifungal agents.

Comment

Cytochrome P-450 (Ortiz de Mantellano, 1986) dependent lanosterol 14α-demethylase (P-450$_{DM}$) catalyzes the first step of the biochemically important conversion of lanosterol to cholesterol (mammals) or ergosterol (fungi), which are important constituents of the cell membrane, by causing the removal of the 14α-methyl group of lanosterol to give the Δ^{14-15} desaturated sterol.

N-Substituted imidazole and triazole antifungal compounds are used in therapy and cure mycoses inhibiting the fungal P-450$_{DM}$ at concentrations which are not expected to affect the host corresponding enzyme. We have previously reported on the synthesis and activity of several new derivatives containing different heterocyclic rings (Porretta *et al.*, 1993, 1995; Fioravanti *et al.*, 1995; Biava *et al.*, 1995) in the course of work on new potential antimicrobial compounds related to natural or synthetic agents of therapeutical value. We particularly pointed out that the title compound, (I), showed very good *in vitro* and *in vivo* activity, comparable with that of miconazole and ketoconazole (Panico, Villa, Simonetti, Porretta & Scalzo, 1990).



(I)

The conformation of the structure is described by the torsion angles given in Table 1. The dihedral angle between the imidazole ring (r.m.s. deviation 0.002 Å) and the adjacent plane formed by the atoms from C14 to N1 (r.m.s. deviation 0.027 Å) is 85.7 (1)°. The second plane makes a dihedral angle of 70.8 (1)° with a third more distorted plane (r.m.s. deviation 0.034 Å) given by the atoms from C7 to Cl. The crystal structure and the global minimum-energy structure emerging from a conformational analysis (program *BKM*; Tafi *et al.*, 1996) showed that the title compound is not compatible with the model of the more recent available CoMFA 3D-QSAR analysis (Tafi *et al.*, 1996) because it occupies a different conformational space and is not superimposable on the model following the same alignment rules. CoMFA-3D-QSAR (Cramer, Patterson & Bunce, 1988; Marshall & Cramer, 1988) is a technique which should be able to explain and predict the activity of a data set of inhibitors on the basis of structural and physiochemical

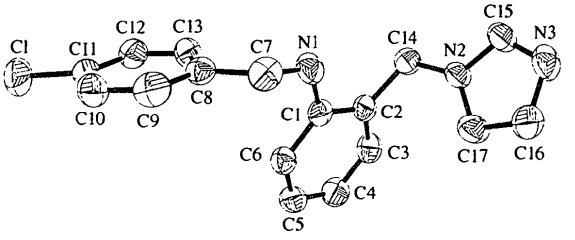


Fig. 1. The molecular structure of (I) showing 50% probability displacement ellipsoids. H atoms have been omitted for clarity.