organic papers

Conformational isomers in (2*RS*,3*SR*,6*SR*)-3-ethyl-2,6-diphenyl-1-phenylacetyl-4-piperidone determined from synchrotron data at 120 K

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In the title compound, $C_{27}H_{27}NO_2$, the conformations of the two independent molecules differ in the shape of the piperidone rings, the orientation of the *N*-acyl substituents and the axial/equatorial disposition of the ethyl and phenyl groups. The molecules are linked into complex chains by four independent C—H···O hydrogen bonds.

Comment

In piperidone derivatives containing *N*-chloroacetyl or *N*-ethoxycarbonyl substituents, the piperidone rings generally adopt distorted boat conformations (Ponnuswamy *et al.*, 2002; Nallini *et al.*, 2003). This study of the title compound, (I) (Figs. 1 and 2), was undertaken to investigate the effect of an *N*-phenylacetyl substituent upon the molecular conformation of the piperidone ring.


(I)
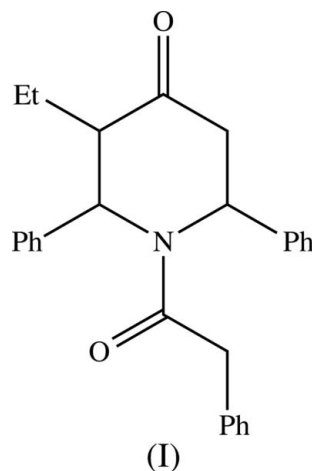
Compound (I) forms extremely small crystals of rather indifferent quality, and synchrotron radiation was necessary to obtain usable diffraction data. It crystallizes with $Z' = 2$ in the space group $P2_1/c$ (Figs. 1 and 2): molecules 1 and 2 contain atoms N11 and N21, respectively. The conformations of the two independent molecules are significantly different. Firstly, the ring-puckering parameters (Cremer & Pople, 1975) for the piperidone rings are, for the atom sequences N*n*1—C*n*2—C*n*3—C*n*4—C*n*5—C*n*6, $\theta = 94.0\ (8)°$ and $\varphi = 254.6\ (8)°$ when $n = 1$, and $\theta = 88.3\ (7)°$ and $\varphi = 124.1\ (7)°$ when $n = 2$, indicating an almost ideal twist-boat conformation in molecule 2, but a conformation midway between boat and twist-boat for molecule 1. Secondly, the orientation of the *N*-acyl substituent is entirely different in the two molecules, as indicated by the leading torsion angles (Table 1). Finally, in molecule 1, the substituents at C12 and C13 are axial and that at C16 is equatorial; in molecule 2 the substituents at C22 and C23 are
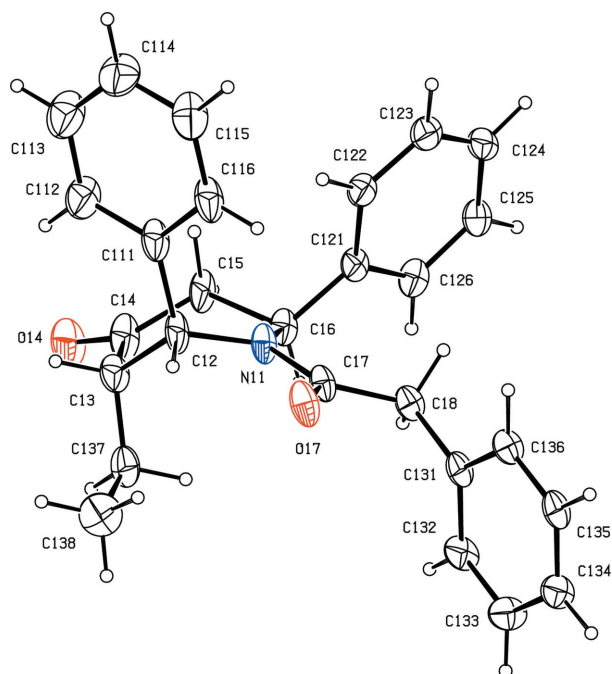
Figure 1
The *RSS* enantiomer of molecule 1 of compound (I), showing the atom-labelling scheme. Displacement ellipsoids are drawn at the 20% probability level.
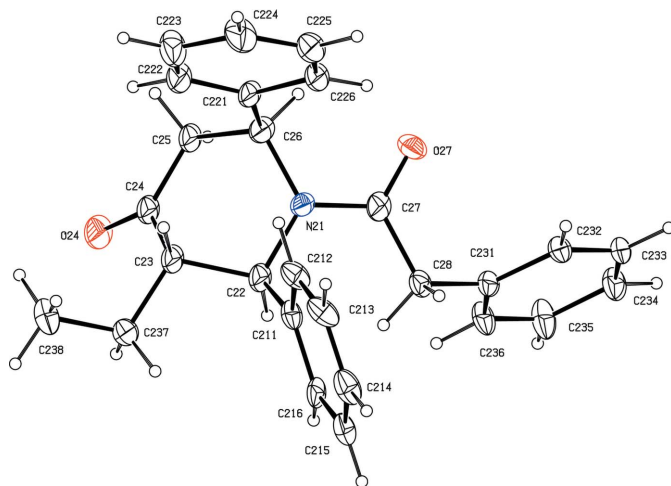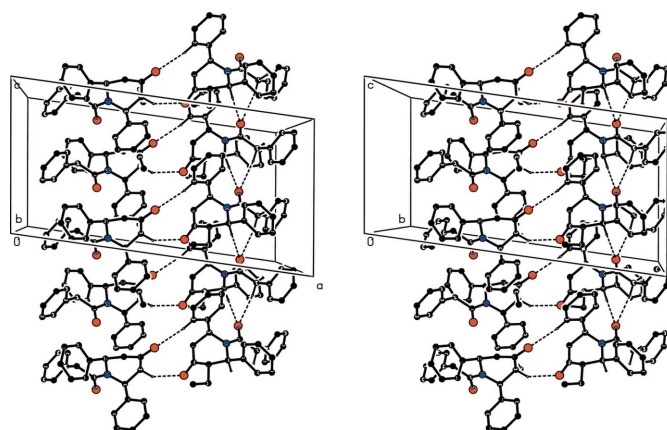

Figure 2
The *RSS* enantiomer of molecule 2 of compound (I), showing the atom-labelling scheme. Displacement ellipsoids are drawn at the 20% probability level.

equatorial and that at C26 is axial (Figs. 1 and 2, and Table 1). The two molecules are thus conformational isomers and this in itself precludes the possibility of any additional crystallographic symmetry.

The molecules are linked into rather complex chains by a combination of four C—H···O hydrogen bonds (Table 2). Atoms C22 and C28 in the type 2 molecule at (x, y, z) both act as hydrogen-bond donors to atom O24 in the type 2 molecule at $(x, \frac{3}{2} - y, \frac{1}{2} + z)$, so forming a $C(4)C(5)[R_2^1(7)]$ chain of rings (Bernstein *et al.*, 1995) along [001]. This chain is formed by type 2 molecule only and the type 1 molecules are pendent

Figure 3
Stereoview of part of the crystal structure of compound (I), showing the formation of a [001] chain of rings containing only type 2 molecules, with type 1 molecules pendent from the chain. For the sake of clarity, H atoms not involved in the motifs shown have been omitted.

from it. Atoms C13 and *C*222 at (x, y, z) act as hydrogen-bond donors respectively to atoms O24 and O14 at $(1 - x, 1 - y, 1 - z)$, so forming a non-centrosymmetric $R_2^2(11)$ ring (Fig. 3). Antiparallel pairs of these chains, related to one another by inversion, are weakly linked by a single C—H···π(arene) interaction (Table 2).

Experimental

The title compound was prepared by the condensation of equimolar quantities of phenylacetyl chloride and 3-ethyl-2,6-diphenylpiperidin-4-one in anhydrous benzene, in the presence of triethylamine as the base. Crystals suitable for single-crystal X-ray diffraction were grown by slow evaporation of a solution in aqueous ethanol (m.p. 368–371 K).

Crystal data

$C_{27}H_{27}NO_2$	Synchrotron radiation
$M_r = 397.50$	$\lambda = 0.6712$ Å
Monoclinic, $P2_1/c$	Cell parameters from 1257
$a = 19.355$ (6) Å	reflections
$b = 22.944$ (8) Å	$\theta = 2.6–18.5°$
$c = 9.959$ (3) Å	$\mu = 0.08$ mm^{-1}
$\beta = 97.905$ (6)$°$	$T = 120$ (2) K
$V = 4381$ (2) Å^3	Lath, colourless
$Z = 8$	$0.08 \times 0.02 \times 0.002$ mm
$D_x = 1.205$ Mg m^{-3}	

Data collection

Bruker SMART APEX2 CCD diffractometer	2533 reflections with $I > 2\sigma(I)$
Fine–slice ω scans	$R_{int} = 0.123$
Absorption correction: none	$\theta_{max} = 20.7°$
16316 measured reflections	$h = -19 \rightarrow 20$
5346 independent reflections	$k = -24 \rightarrow 24$
	$l = -10 \rightarrow 10$

Refinement

Refinement on F^2	$w = 1/[\sigma^2(F_o{}^2) + (0.195P)^2]$
$R[F^2 > 2\sigma(F^2)] = 0.108$	where $P = (F_o{}^2 + 2F_c{}^2)/3$
$wR(F^2) = 0.338$	$(\Delta/\sigma)_{max} = 0.002$
$S = 1.04$	$\Delta\rho_{max} = 0.81$ e Å^{-3}
5346 reflections	$\Delta\rho_{min} = -0.29$ e Å^{-3}
526 parameters	Extinction correction: *SHELXL97*
H-atom parameters constrained	Extinction coefficient: 0.030 (5)

Table 1
Selected torsion angles (°).

C12—C13—C137—C138	67.5 (11)	C22—C23—C237—C238	154.9 (7)
N11—C12—C111—C112	130.2 (10)	N21—C22—C211—C212	57.0 (10)
N11—C16—C121—C122	−41.2 (10)	N21—C26—C221—C222	−118.6 (9)
C12—N11—C17—C18	173.3 (7)	C22—N21—C27—C28	−4.2 (9)
N11—C17—C18—C131	−162.0 (7)	N21—C27—C28—C231	158.6 (6)
C17—C18—C131—C132	98.1 (9)	C27—C28—C231—C232	79.2 (8)

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

D—H···A	D—H	H···A	D···A	D—H···A
C13—H13···O24^i	1.00	2.35	3.232 (10)	147
C22—H22···O27^{ii}	1.00	2.19	3.190 (10)	175
C28—H28A···O27^{ii}	0.99	2.52	3.486 (9)	165
C222—H222···O14^i	0.95	2.54	3.478 (10)	169
C123—H123···Cg^{iii}	0.95	2.89	3.811 (10)	165

Symmetry codes: (i) $-x + 1, -y + 1, -z + 1$; (ii) $x, -y + \frac{3}{2}, z - \frac{1}{2}$; (iii) $x, y, z + 1$. Cg is the centroid of ring (C221–C226)

Diffraction data were collected at the Daresbury SRS, station 9.8, UK (Cernik *et al.*, 1997; Clegg, 2000). The very small crystal size and weak diffraction led to a relatively high R_{int} and to a low $2\theta_{max}$ for the data used in the refinement. All H atoms were located in difference maps and then treated as riding atoms, with C—H = 0.95 (aromatic), 0.98 (CH$_3$), 0.99 (CH$_2$) or 1.00 Å (aliphatic CH), and with U_{iso}(H) = $1.2U_{eq}$(C) or $1.5U_{eq}$(C) for the methyl groups.

Data collection: *APEX2* (Bruker, 2003); cell refinement: *APEX2* and *SAINT* (Bruker, 2001); data reduction: *SAINT*; program(s) used to solve structure: *OSCAIL* (McArdle, 2003) and *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *OSCAIL* and *SHELXL97* (Sheldrick, 1997); molecular graphics: *PLATON* (Spek, 2003); software used to prepare material for publication: *SHELXL97* and *PRPKAPPA* (Ferguson, 1999).

References

Bernstein, J., Davis, R. E., Shimoni, L. & Chang, N.-L. (1995). *Angew. Chem. Int. Ed. Engl.* **34**, 1555–1573.
Bruker (2001). *SAINT*. Version 6.02. Bruker AXS Inc., Madison, Wisconsin, USA.
Bruker (2003). *APEX2*. Bruker AXS Inc., Madison, Wisconsin, USA.
Cernik, R. J., Clegg, W., Catlow, C. R. A., Bushnell-Wye, G., Flaherty, J. V., Greaves, G. N., Hamichi, M., Burrows, I., Taylor, D. J. & Teat, S. J. (1997). *J. Synchotron Rad.* **4**, 279–286; corrigendum: *J. Synchotron Rad.* **7**, 40.
Clegg, W. (2000). *J. Chem. Soc. Dalton Trans.* pp. 3223–3232.
Cremer, D. & Pople, J. A. (1975). *J. Am. Chem. Soc.* **97**, 1354–1358.
Ferguson, G. (1999). *PRPKAPPA*. University of Guelph, Canada.
McArdle, P. (2003). *OSCAIL for Windows*. Version 10. Crystallography Centre, Chemistry Department, NUI Galway, Ireland.
Nallini, A. L., Saraboji, K., Ponnuswamy, M. N., Venkatraj, M. & Jeyaraman, R. (2003). *Mol. Cryst. Liq. Cryst.* **403**, 49–56.
Ponnuswamy, S., Venkatraj, M., Jeyaraman, R., Sureshkumar, M., Kumaran, D. & Ponnuswamy, M. N. (2002). *Ind. J. Chem. Sect. B*, **41**, 614–627.
Sheldrick, G. M. (1997). *SHELXS97* and *SHELXL97*. University of Göttingen, Germany.
Spek, A. L. (2003). *J. Appl. Cryst.* **36**, 7–13.