Acta Crystallographica Section E
Structure Reports Online
ISSN 1600-5368

4-[(4-Ethoxyphenyl)aminoacetyl]-1,2,3,4-tetrahydroquinoxalin-2-one

Rafal Kruszynski,[a]* Tadeusz J. Bartczak[a] and Elżbieta Mikiciuk-Olasik[b]

[a]Institute of General and Ecological Chemistry, Technical University of Łódź, ul. Żeromskiego 116, 90-924 Łódź, Poland, and [b]Department of Chemical Technology of Drugs, Medical University of Łódź, ul. Muszyńskiego 1, 90-145 Łódź, Poland

Correspondence e-mail: kruszyna@ck-sg.p.lodz.pl

Key indicators

Single-crystal X-ray study
T = 293 K
Mean σ(C–C) = 0.006 Å
R factor = 0.074
wR factor = 0.248
Data-to-parameter ratio = 15.7

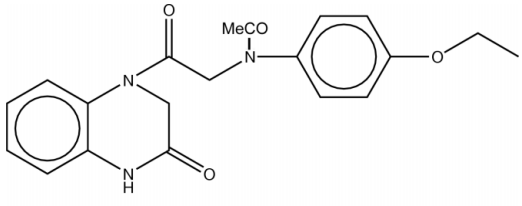
For details of how these key indicators were automatically derived from the article, see http://journals.iucr.org/e.

Received 13 December 2001
Accepted 19 December 2001
Online 11 January 2002

All interatomic distances in the title compound, $C_{20}H_{21}N_3O_4$, are normal. The heteroatom ring of the quinoxalinone system exists in a conformation intermediate between half-chair and sofa. The (4-ethoxyphenyl)amino moiety is nearly planar. The aminooxoethyl part can also be considered planar. There is one weak intramolecular C—H···O hydrogen bond in the structure. The structure is assembled by intermolecular N—H···O hydrogen bonds, to form a two-dimensional framework. One further C—H···O short intermolecular interaction is present in the structure.

Comment

Vast efforts have been invested in recent years into the synthesis of new complex heterocyclic systems. Upon the introduction of pharmacophoric substituents for a desired activity into those systems, it is expected that derivatives will be obtained exhibiting numerous favourable properties, such as analeptic activity, possible anticancer and anti-HIV activities, and forming potential radiopharmaceuticals (Bartczak *et al.*, 1995). Fused ten-membered hetero-rings with pendant arms are expected to possess catalytic properties comparable with the activity of enzymes, as observed by Hanson & Jakubke (1973) and Ivanov (1975). The possibility of linking metal ions to form stable complexes allows the utilization of heterocyclic systems with pendant arms for modelling the cation receptors in proteins, as reported by Ovchinnikov (1974) and Müller (1974). Many similar systems are also useful in environmental protection, in medicinal therapies using complexones, and in the treatment of poisoning with heavy and radioactive metals, as reported by Bandot & Jacque (1977) and Num *et al.* (1983).



(V)

Within these areas of research, a series of derivatives have been obtained (Mikiciuk-Olasik 1990, 1993, 1994; Szadowska *et al.*, 1991). The preliminary results of determining the crystal structures of derivatives of 2,3,4,5,6,7-hexahydro-1*H*-1,4,7-benzotriazone-2,5-dione were published previously (Mikiciuk-Olasik *et al.*, 1993), but only one complete structure {*N,N*′-bis[2-(4-ethoxyphenyl)amino]-4,5-dimethyl-*o*-phenylenediam-

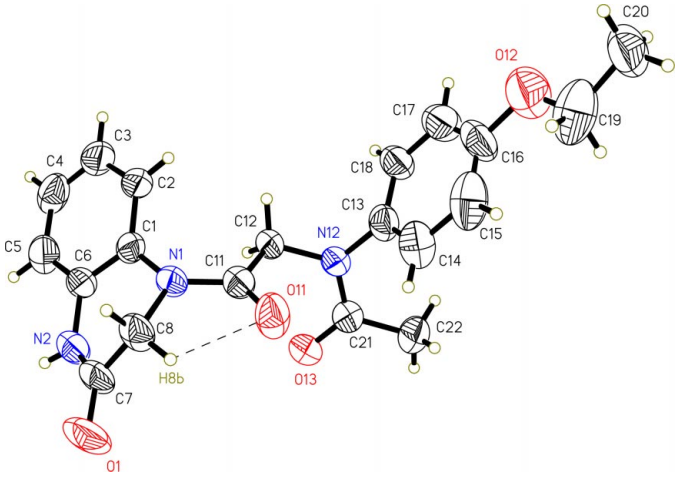


Figure 1
The molecular structure of the title compound, (V). Displacement ellipsoids are drawn at the 50% probability level. The weak intramolecular hydrogen bond is indicated by a dashed line.

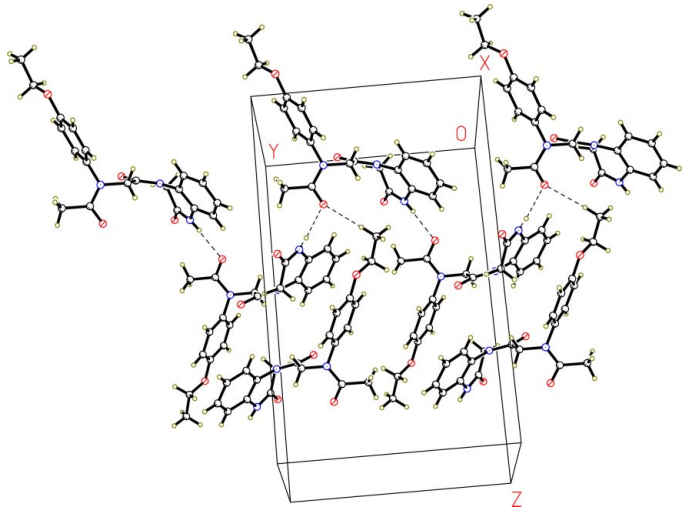


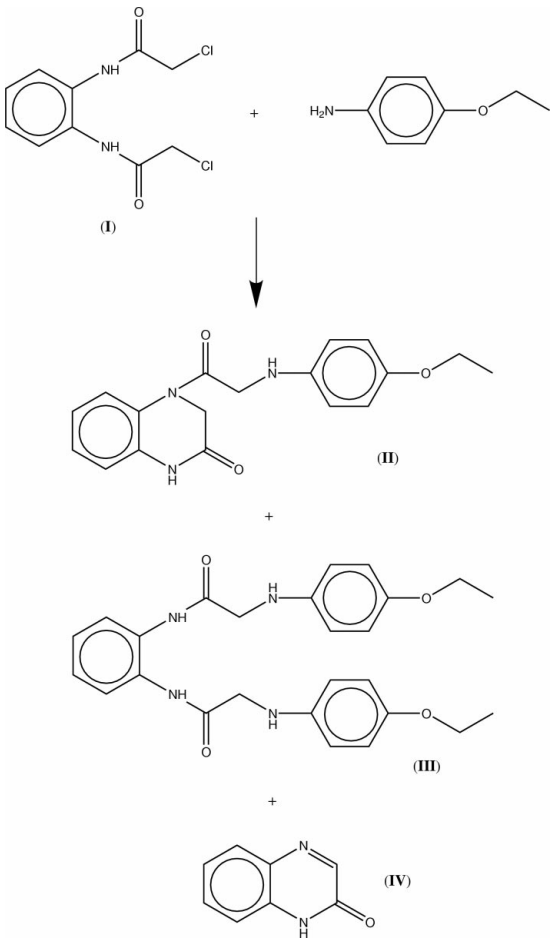
Figure 2
Part of the molecular packing of (V) showing intermolecular hydrogen bonds creating a three-dimensional net structure. Hydrogen bonds are indicated by dashed lines.

ine, (III*A*) hereafter} was reported (Kruszynski *et al.*, 2001). Thus, we now present full structural details of the title compound (V) [Cambridge Structural Database (CSD; Allen & Kennard, 1993) refcode WEWPOD (the preliminary studies)].

A perspective view of (V), together with the atom-numbering scheme, is shown in Fig. 1. All interatomic distances can be considered normal. The part of the molecule consisting of atoms O12, C19 and C20 shows some symptoms of disorder, but refinement of this model, although it slightly improves the quality of the structure, has no chemical sense; thus the model was rejected. The conformational analysis of the puckered heteroatomic ring of the quinoxalinone system shows a conformation intermediate between half-chair, with a local pseudo-twofold axis through the midpoints of the N1—C8 and N2—C5 bonds, and sofa, with a local pseudo-twofold axis along C1···C7 (Duax & Norton, 1975; Duax *et al.*, 1976). Values of the displacement asymmetry parameters (Nardelli, 1983) are ΔC_2(N1—C8) = 0.005 (1) and ΔC_2(C1) = 0.074 (1). The value of the total puckering amplitude (Cremer & Pople, 1975) Q_T is 0.435 (3) Å. The maximum deviation from the weighted least-squares plane calculated through all the quinalinone atoms is 0.239 (3) Å for C7. The atom O1 deviates by 0.238 (5) from this plane. The (4-ethoxyphenyl)amino part of the side branch is close to planarity. The maximum deviation is 0.084 (4) Å for C19. This weighted least-squares plane makes a dihedral angle of 15.42 (12)° with the quinoxalinone plane. The aminooxoethyl part can be considered as planar, with a maximum deviation of 0.054 (2) Å for C11. The adjacent quinoxalinone N atom deviates by 0.273 (6) Å from the above plane. This weighted least-squares plane makes dihedral angles of 61.59 (14) and 56.26 (12)° with the (4-ethoxyphenyl)amino and quinolinone weighted-least-squares planes, respectively. The part of the molecule consisting of atoms C12, N12, C13, C21, C22 and O13 is also close to planarity [maximum deviation 0.076 (3) Å for N12], involving the planar environment of atom N12 [the sum of interbond angles around this atom is equal to 358.8 (4)°]. The side-branch conformation (best described by torsion angles, for details see Table 1) is distinctly different from that of (III*A*). This may be explained by the absence of interbranch hydrogen bonds in (V); these stabilize the structure in (III*A*). There is one weak intramolecular C8—H8*B*···O11 hydrogen bond (Taylor & Kennard, 1982) (Table 2). The structure of the title compound is assembled by intermolecular N2—H3···O13 hydrogen bonds (Jeffrey & Saenger, 1994), to form a two-dimensional framework (Fig. 2 and Table 2). There is one further C20—H20*B*···O13 short intermolecular interaction, which, according to Desiraju & Steiner (1999), can be considered as a weak intermolecular hydrogen bond. As a result, the hydrogen-bonded network gains a third dimension. There are no unusual intermolecular short contacts apart from the hydrogen bonds listed in Table 2.

Experimental

Compound (V) was prepared according to the method depicted in the *Scheme* below. A mixture of 0.02 mol of (I) and 0.02 mol of *p*-phenetidine in 500 ml of anhydrous ethanol in the presence of anhydrous sodium carbonate (0.06 mol) was heated at boiling point under reflux for 15 h (Mikiciuk-Olasik *et al.*, 1993, 1994). The mixture was filtered and the solvent distilled off. Compounds (II), (III) and a small amount of (IV) were isolated by fractional crystallization of the solid residue. 0.01 g of (II) was dissolved in 10 ml of $(CH_3CO)_2O$, heated at 323 K for 1 h and then poured into 50 ml of water. The solid was dried and recrystallized from ethanol. Analytical data for (V): yield 32%, m.p. 486.6 K. IR (cm^{-1}): 1630, 1580 (N—CO); ^{1}H NMR (in DMSO/TMS, chemical shifts in p.p.m.): 1.5 (*t*, 3H, $OCH_2—CH_3$, J = 6 Hz), 1.9 (*s*, 3H, $COCH_3$), 4.22 (*q*, 2H, $O—CH_2—CH_3$), 4.5 (*s*, 4H, $N—CH_2—CO$), 4.7 (*s*, 4H, $N—CH_2—CO$), 7.4 (*m*, $8H_{ar}$), 11.0 (*s*, 1H, NHCO).



Crystal data

$C_{20}H_{21}N_3O_4$
M_r = 367.40
Monoclinic, $P2_1/n$
a = 8.289 (1) Å
b = 12.117 (2) Å
c = 19.225 (3) Å
β = 99.88 (1)°
V = 1902.3 (5) Å^3
Z = 4
D_x = 1.283 Mg m^{-3}
Cu Kα radiation
Cell parameters from 99 reflections
θ = 5–60°
μ = 0.75 mm^{-1}
T = 293 (2) K
Sphere, colourless
0.51 mm (radius)

Data collection

Kuma KM-4 diffractometer
ω–2θ scans
Absorption correction: numerical (*X-RED*; Stoe & Cie, 1999)
T_{min} = 0.692, T_{max} = 0.715
4204 measured reflections
3916 independent reflections
1952 reflections with $I > 2\sigma(I)$
R_{int} = 0.034
θ_{max} = 80.6°
$h = -9 \rightarrow 9$
$k = 0 \rightarrow 15$
$l = -24 \rightarrow 0$
2 standard reflections
every 100 reflections
intensity decay: −4.0%

Refinement

Refinement on F^2
$R[F^2 > 2\sigma(F^2)]$ = 0.074
$wR(F^2)$ = 0.248
S = 0.96
3916 reflections
250 parameters
H atoms treated by a mixture of independent and constrained refinement
$w = 1/[\sigma^2(F_o^2) + (0.1581P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.006
$\Delta\rho_{max}$ = 0.58 e Å^{-3}
$\Delta\rho_{min}$ = −0.33 e Å^{-3}

Table 1
Selected torsion angles (°).

C1—C6—N2—C7	20.2 (5)	C8—N1—C11—C12	166.0 (3)
C6—N2—C7—C8	−2.5 (5)	N1—C11—C12—N12	−167.1 (3)
N2—C7—C8—N1	−32.3 (4)	C11—C12—N12—C21	74.5 (4)
C7—C8—N1—C1	51.6 (4)	C11—C12—N12—C13	−93.1 (3)
C8—N1—C1—C6	−35.7 (4)	C12—N12—C13—C18	−75.5 (4)
N1—C1—C6—N2	0.1 (4)	C12—N12—C13—C14	103.6 (4)
C1—N1—C11—O11	−178.0 (3)	C15—C16—O12—C19	11.1 (6)
C8—N1—C11—O11	−12.6 (5)	C17—C16—O12—C19	−173.2 (4)
C1—N1—C11—C12	0.6 (5)	C16—O12—C19—C20	179.8 (4)

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

D—H···A	D—H	H···A	D···A	D—H···A
C8—H8B···O11	0.97	2.26	2.702 (4)	107
N2—H3···O13^{i}	0.78 (4)	2.11 (4)	2.891 (4)	174 (4)
C20—H20B···O13^{ii}	0.96	2.58	3.486 (6)	158

Symmetry codes: (i) $\frac{1}{2}-x, y-\frac{1}{2}, \frac{1}{2}-z$; (ii) $\frac{1}{2}+x, \frac{3}{2}-y, z-\frac{1}{2}$.

All H atoms, except that bonded to the ring N atom, were placed in calculated positions. The H atom bonded to the ring N atom was located in a difference Fourier synthesis calculated after four cycles of anisotropic refinement. All other H atoms were treated as riding on the adjacent C atom. The methyl groups were allowed to rotate about their local threefold axis.

Data collection: *KM-4 Software* (Kuma, 1993); cell refinement: *KM-4 Software*; data reduction: *DATAPROC* (Gałdecki *et al.*, 1998); program(s) used to solve structure: *SHELXS*97 (Sheldrick, 1990*a*); program(s) used to refine structure: *SHELXL*97 (Sheldrick, 1997); molecular graphics: *XP* in *SHELXTL/PC* (Sheldrick, 1990*b*) and *ORTEP*-3 (Farrugia, 1997).

This work was supported financially by statutory funds allocated by the State Committee for Scientific Research, Warsaw, Poland, to the Institute of General and Ecological Chemistry, Technical University of Łódź.

References

Allen, F. H. & Kennard, O. (1993). *Chem. Des. Autom. News*, **8**, 1, 31–37.
Bandot, Ph. & Jacque, M. (1977). *Toxicol. Appl. Pharmacol.* **41**, 13–14.
Bartczak, T. J., Kajkowski, T., Trzebinski, P., Mikiciuk-Olasik, E. & Kotelko, B. (1995). *Heteroatom Chem.* **6**, 495–498.
Cremer, D. & Pople, J. A. (1975). *J. Am. Chem. Soc.* **97**, 1354–1358.
Desiraju, G. R. & Steiner, T. (1999). *The Weak Hydrogen Bond in Structural Chemistry and Biology*. Oxford University Press.
Duax, W. L. & Norton, D. A. (1975). *Atlas of Steroid Structures*, Vol. 1, pp. 16–22. New York: IFI/Plenum.
Duax, W. L., Weeks, C. M. & Rohrer, D. C. (1976). *Topics in Stereochemistry*, Vol. 9, edited by N. L. Allinger and E. L. Eliel, pp. 271–383. New York: John Wiley.
Farrugia, L. J. (1997). *J. Appl. Cryst.* **30**, 565.
Gałdecki, Z., Kowalski, A. & Uszynski, I. (1998). *DATAPROC*. Version 10.0.4. Kuma Diffraction, Wrocław, Poland.
Hanson, H. & Jakubke, H. D. (1973). *Peptides 1972*. Proceedings of the Twelfth European Peptide Symposium. New York: Elsevier.
Ivanov, W. J. (1975). *Ann. N. Y. Acad. Sci.* **246**, 221–222.
Jeffrey, G. A. & Saenger, W. (1994). *Hydrogen Bonding in Biological Structures*. Berlin: Springer-Verlag.
Kruszynski, R., Bartczak, T. J. & Mikiciuk-Olasik, E. (2001). *Acta Cryst.* E**57**, o953–o955.
Kuma (1993). *KM-4 Software*. Kuma Diffraction, Wrocław, Poland.
Mikiciuk-Olasik, E. (1990). *Pharmazie*, **45**, 436–437.

Mikiciuk-Olasik, E., Kajkowski, T. & Bartczak, T. J. (1993). *Pharmazie*, **48**, 523–525.
Mikiciuk-Olasik, E., Trzebinski, P., Nowak, R. & Kotelko, B. (1994). *Acta Pol. Pharm. Drug Res.* **51**, 231–233.
Müller, W. A. (1974). *Naturwissenchaften*, **61**, 455–456.
Nardelli, M. (1983). *Acta Cryst.* C**39**, 1141–1142.
Num, A. D., Loberg, M. D. & Conley, R. A. (1983). *J. Nucl. Med.* **24**, 23–24.
Ovchinnikov, Y. A. (1974). *Membrane Active Complexones*. Amsterdam: Elsevier.
Sheldrick, G. M. (1990*a*). *Acta Cryst.* A**46**, 467–473.
Sheldrick, G. M. (1990*b*). *SHELXTL/PC*. Siemens Analytical X-ray Instruments Inc., Madison, Wisconsin, USA.
Sheldrick, G. M. (1997). *SHELXL*97. University of Göttingen, Germany.
Stoe & Cie (1999). *X-RED*. Version 1.18. Stoe & Cie GmbH, Darmstadt, Germany.
Szadowska, A., Pakulska, W. & Mikiciuk-Olasik, E. (1991). *Pharmazie*, **46**, 544–545.
Taylor, R. & Kennard, O. (1982). *J. Am. Chem. Soc.* **104**, 5063–5070.