Structure of 3,3-Dimethoxyindolin-2-one

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Abstract. $C_{10}H_{11}NO_3$, $M_r = 193 \cdot 20$, monoclinic, $P2_1/n$, $a = 10 \cdot 186$ (1), $b = 11 \cdot 494$ (1), $c = 8 \cdot 535$ (1) Å, $\beta = 99 \cdot 710$ (8), $V = 984 \cdot 9$ (2) Å^3, $Z = 4$, $D_m = 1 \cdot 31$ (flotation in tribromoethane–bromoform), $D_x = 1 \cdot 303$ Mg m^{-3}, λ(Cu $K\alpha$) = $1 \cdot 5418$ Å, $\mu = 0 \cdot 77$ mm^{-1}, $F(000) = 408$, $T = 298$ K, $R = 0 \cdot 053$ for 1415 reflections with $I > 2\sigma(I)$. In the indoline moiety the geometry about C(1) is planar, but C(3) and C(8) are displaced by $0 \cdot 118$ (4) and $0 \cdot 076$ (3) Å, respectively, from the least-squares plane through C(1), C(2), N(1) and O(1). The six-membered ring is planar and inclined at a dihedral angle of $5 \cdot 5$ (1)° to this plane. The C(1)—C(2) bond is a single bond of length $1 \cdot 569$ (3) Å. The crystal structure is stabilized by a three-dimensional network of N(1)—H(N1)···O(1) hydrogen bonds.

Introduction. Anti-epileptic drugs have diverse chemical structures and complex physiological and pharmacological actions. The search for potential antiepileptic drugs and their mechanism of action has been difficult because of their complexity. A series of spiro(1,3-dioxane-2,3′-indolin)-2′-ones and structural analogues active against electrically and chemically induced seizures have been studied. These compounds contain both an oxindole and a dioxolane moiety which have been seen independently in other anticonvulsants (Popp, 1977, 1984). The basic model compound mentioned above was used to study the effects of various electron-donating, electron-withdrawing and hydrophobic groups on the activity of the molecule. Introduction of a halogen in the oxindole portion of the model compound led to more active compounds. In general a bulky hydrophobic substituent at the 1′-position (oxindole N) tends to decrease the activity.

In the present compound the dioxolane moiety has been replaced by a less rigid group and it is observed that the potency has been decreased. Since no common target site has yet been established, the properties of anticonvulsants must be sought from the structural information currently available and hence the X-ray analysis is undertaken as part of a project to search for the common conformational features which may help in the understanding of the mechanism of action of such compounds at the molecular level.

Experimental. Single crystals of the compound were prepared by slow evaporation of a ethanol solution at room temperature. Needle-shaped crystals appeared after one week. Space group and preliminary unit-cell dimensions determined from Weissenberg photographs. A crystal with dimensions $0 \cdot 28 \times 0 \cdot 26 \times 0 \cdot 40$ mm was used. Rigaku AFC-5 diffractometer operating at 40 kV/200 mA, graphite monochromatized Cu $K\alpha$ radiation. Accurate cell parameters and orientation angles determined by least-squares refinement of the θ values of 25 reflections with $12 < \theta < 20°$. The intensity data were collected by $2\theta/\omega$ scan, scan rate 6° min^{-1}, scan range
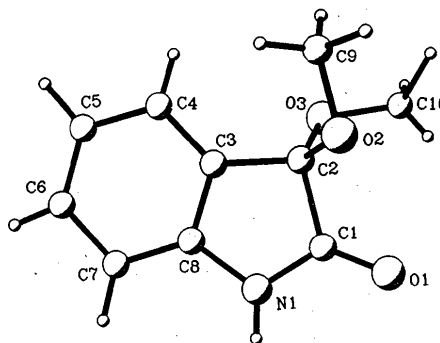

Fig. 1. Perspective view of the molecule showing the atomic labelling scheme.

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Table 1. *Fractional atomic coordinates and equivalent isotropic thermal parameters* (Å^2) *for the non-H atoms with e.s.d.'s in parentheses*

$$U_{eq} = (1/3)\Sigma_i\Sigma_j U_{ij}a_i^*a_j^*\mathbf{a}_i.\mathbf{a}_j.$$

	x	y	z	U_{eq}
O(1)	0·1067 (2)	0·9084 (2)	0·1504 (3)	0·0499 (8)
O(2)	0·3887 (2)	0·8874 (2)	0·1435 (3)	0·0491 (8)
O(3)	0·2838 (2)	0·7113 (2)	0·0601 (3)	0·0512 (8)
N(1)	0·1286 (3)	0·9524 (3)	−0·1067 (3)	0·0467 (10)
C(1)	0·1644 (3)	0·9008 (3)	0·0358 (4)	0·0407 (10)
C(2)	0·2955 (3)	0·8303 (3)	0·0304 (4)	0·0402 (10)
C(3)	0·3122 (3)	0·8455 (3)	−0·1409 (4)	0·0436 (11)
C(4)	0·4020 (4)	0·7983 (4)	−0·2271 (5)	0·0626 (17)
C(5)	0·3934 (5)	0·8303 (4)	−0·3849 (5)	0·0777 (17)
C(6)	0·2973 (5)	0·9067 (4)	−0·4552 (5)	0·0718 (19)
C(7)	0·2027 (4)	0·9542 (4)	−0·3716 (5)	0·0570 (14)
C(8)	0·2134 (3)	0·9206 (3)	−0·2144 (4)	0·0437 (11)
C(9)	0·5254 (4)	0·8538 (5)	0·1466 (7)	0·0720 (20)
C(10)	0·2737 (6)	0·6802 (4)	0·2203 (6)	0·0677 (19)

Table 2. *Bond distances* (Å) *and angles* (°) *for the non-H atoms with e.s.d.'s in parentheses*

O(1)—C(1)	1·226 (4)	O(2)—C(2)	1·398 (4)
O(2)—C(9)	1·441 (5)	O(3)—C(2)	1·400 (4)
O(3)—C(10)	1·434 (6)	N(1)—C(1)	1·347 (4)
N(1)—C(8)	1·412 (4)	C(1)—C(2)	1·569 (5)
C(2)—C(3)	1·510 (5)	C(3)—C(4)	1·378 (5)
C(3)—C(8)	1·392 (5)	C(4)—C(5)	1·385 (6)
C(5)—C(6)	1·375 (7)	C(6)—C(7)	1·403 (6)
C(7)—C(8)	1·383 (5)		

C(2)—O(2)—C(9)	115·4 (3)	C(2)—O(3)—C(10)	116·0 (3)
C(1)—N(1)—C(8)	111·8 (3)	O(1)—C(1)—N(1)	126·6 (3)
O(1)—C(1)—C(2)	125·8 (3)	N(1)—C(1)—C(2)	107·6 (3)
O(2)—C(2)—O(3)	113·7 (3)	O(2)—C(2)—C(1)	102·7 (3)
O(2)—C(2)—C(3)	116·1 (3)	O(3)—C(2)—C(1)	113·6 (3)
O(3)—C(2)—C(3)	108·4 (3)	C(1)—C(2)—C(3)	101·8 (3)
C(2)—C(3)—C(4)	131·6 (3)	C(2)—C(3)—C(8)	108·5 (3)
C(4)—C(3)—C(8)	119·9 (3)	C(3)—C(4)—C(5)	118·4 (4)
C(4)—C(5)—C(6)	121·2 (4)	C(5)—C(6)—C(7)	121·7 (4)
C(6)—C(7)—C(8)	115·9 (4)	N(1)—C(8)—C(3)	110·0 (3)
N(1)—C(8)—C(7)	127·1 (3)	C(3)—C(8)—C(7)	122·9 (3)

$(1·2 + 0·15\tan\theta)°$, $2\theta_{max} = 125°$. 1569 reflections, unique data only, measured with $h = -11$ to 11, $k = 0$ to 13, $l = 0$ to 9. The conditions limiting possible reflection, $h0l$: $h + l = 2n$; $0k0$, $k = 2n$ confirm space group $P2_1/n$. Three reference reflections monitored after every 2 h of X-ray exposure time showed no crystal movement or decay. Intensities corrected for Lorentz and polarization effects, but no absorption correction was applied.

The structure was solved by direct methods using *SHELXS86* (Sheldrick, 1985) and refined on F by the full-matrix least-squares technique (*SHELX76*; Sheldrick, 1976). Function minimized: $\Sigma w(F_o - F_c)^2$ with $w = 1/\sigma^2(|F_o|)$. Non-H-atom coordinates were refined with anisotropic thermal parameters; H-atom coordinates were located on ΔF synthesis and refined isotropically. Final $R = 0·053$, $wR = 0·053$, $S = 0·81$ for 1415 observed reflections [$|F_o| > 4\sigma(F_o)$], 171 parameters refined. Max. Δ/σ in the final cycle refinement is 0·06, max. and min. peak heights in difference Fourier map were 0·21 and $-0·28 \text{ e Å}^{-3}$. Atomic scattering factors were those incorporated in

SHELX76. The geometrical parameters of the molecule were computed with the program *PLATON* (Spek, 1990).

Discussion. A perspective view of the molecule together with the atom-numbering scheme is shown in Fig. 1. The final atomic parameters are listed in Table 1,* while Table 2 lists the intramolecular bond distances and angles.

In the five-membered ring, the C—NH—CO—C grouping resembles a *cis* peptide bond. The six atoms of this group [C(8), N(1), H(N1), C(1), O(1), C(2)] are almost planar, but the OC—N bond distance [1·347 (4) Å] is not as short as the normal peptide bond [1·325 Å; Dickerson & Geis, 1969) and there are some distortions in the bond angles also. These may be due to the substituents at C(2) and the cyclic nature of the system which hinders the favourable overlapping of atomic orbitals. However, the geometry at the N atom is planar and the lengthening of the carbonyl double bond to 1·226 (4) Å and the shortening of the N(1)—C(8) distance to 1·412 Å are consistent with electron delocalization over the —NH—CO moiety. Similar geometries have also been observed in other structures (James & Williams, 1972; Codding, Lee & Richardson, 1984; De, 1990; De & Kusunoki, 1991). The C(2)—C(3) separation [1·510 (5) Å] is typical of an C_{sp^3}—C_{sp^2} single bond and similar to values found in other indoline nuclei (Itai, Iitaka & Yubo, 1978; Chakraborty & Tala-patra, 1985; De, 1990). However, the C(1)—C(2) distance [1·569 (5) Å] is longer than normal, again presumably because of ring strain and the C(2) substituents.

In the indoline group the six-membered ring is planar within experimental error, but the five-membered ring is only quasi-planar. The dihedral angle between the least-squares planes through these two rings is 2·9 (2)°. The plane containing the atoms C(2), O(2) and O(3) is inclined to the overall plane through the indoline group by 71·4 (3)°
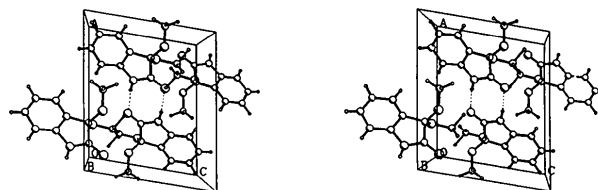
Fig. 2. Stereoview (*PLUTO*; Motherwell & Clegg, 1978) of the packing of the molecule.

A stereoscopic view of the packing of the molecule is shown in Fig. 2. The amide nitrogen, N(1), forms a hydrogen bond with a carbonyl oxygen, O(1), related by a centre of symmetry [N(1)—H(N1) = 0·86 (3), N(1)···O(1)(−x, −y, −z) = 2·853 (4), H(N1)···O(1)(−x, −y, −z) = 2·00 (3) Å, N(1)—HN(1)···O(1) = 172°]. The molecules thus form an infinite hydrogen-bonded network.

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Structure of L-Prolyl-L-tyrosine Monohydrate

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Abstract. $C_{14}H_{18}N_2O_4.H_2O$, $M_r = 296·32$, triclinic, $P1$, $a = 5·524$ (3), $b = 6·621$ (2), $c = 10·307$ (2) Å, $\alpha = 78·82$ (3), $\beta = 86·82$ (4), $\gamma = 84·96$ (4)°, $V = 368·11$ Å^3, $Z = 1$, $D_x = 1·34$ g cm^{-3}, $\lambda(Mo\ K\alpha_1) = 0·70930$ Å, $\mu = 1·10$ cm^{-1}, $F(000) = 158$, $T = 298$ K, final $R = 0·044$ for 2182 observed reflections. The molecule crystallizes as a zwitterion with the peptide backbone folded and a water molecule of hydration. The water molecule and the dipeptide molecule are involved in an extensive hydrogen-bond network.

Introduction. The crystal structure of the hydrate of the dipeptide L-prolyl-L-tyrosine is reported here as part of a research project involving the X-ray studies of crystalline samples of amino acids and small peptides. We are interested not only in the solid-state structure but also in the intermolecular interactions that occur between dipeptide molecules and those that result from any co-crystallized water.

Experimental. L-Prolyl-L-tyrosine obtained from Sigma Chemical Company, recrystallized from aqueous ethanol to give colorless crystals, approximate dimensions 0·50 × 0·30 × 0·20 mm. Enraf–Nonius CAD-4 diffractometer with graphite-crystal-monochromatized Mo $K\alpha$ radiation. Unit-cell dimensions, lack of systematic absences and successful solution of the structure determined space group as $P1$. Unit-cell dimensions were determined by least-squares fit of 25 centered reflections with $43 \le 2\theta \le 60°$. Three-dimensional intensity data collected in $\omega:2\theta$ scan mode; total of 2256 independent reflections, 2182 observed with $I > 3\sigma(I)$; $1 \le 2\theta \le 60°$; $[(\sin\theta)/\lambda]_{max} = 0·70$ Å^{-1}; $-7 \le h \le 7$, $-9 \le k \le 9$, $0 \le l \le 14$. Data corrected for Lorentz and polarization effects. Three standard reflections measured every 2 h during data collection (200, 040, 002) showed no significant change in intensity. Absorption as a function of ψ was corrected empirically (maximum relative transmission 99·91%, minimum relative transmission 85·17%). Structure solved by direct methods using the MULTAN11/82 series of programs (Main, Fiske, Hull, Lessinger, Germain, Declercq & Woolfson, 1982). Initial E map con-