

Tableau 1. *Coordonnées atomiques et facteurs d'agitation thermique isotrope équivalents (Å²)*

$$B_{eq} = (4/3) \sum_i \sum_j \beta_{ij} \mathbf{a}_i \cdot \mathbf{a}_j$$

	<i>x</i>	<i>y</i>	<i>z</i>	<i>B_{eq}</i>
S	0,3868 (1)	0,1679 (1)	0,40615 (8)	5,36 (2)
S1	0,8542 (1)	0,3721 (2)	0,4710 (1)	8,34 (4)
S2	0,2887 (1)	0,0550 (2)	0,6045 (1)	8,53 (4)
N	0,3638 (3)	0,4536 (4)	0,3292 (3)	7,2 (1)
O	0,5987 (2)	0,3909 (3)	0,4328 (2)	6,04 (7)
C1	0,5347 (3)	0,2342 (4)	0,5455 (3)	5,13 (9)
C2	0,4094 (3)	0,2578 (4)	0,5127 (3)	4,60 (9)
C10	0,7455 (3)	0,2930 (4)	0,5251 (3)	4,89 (9)
C11	0,7885 (4)	0,2159 (5)	0,5945 (3)	6,4 (1)
C12	0,9109 (4)	0,2204 (6)	0,6033 (4)	7,7 (1)
C13	0,9560 (4)	0,3002 (6)	0,5391 (4)	7,6 (1)
C14	0,6257 (3)	0,3141 (4)	0,4954 (3)	4,88 (9)
C20	0,3251 (3)	0,2188 (4)	0,5833 (3)	4,86 (9)
C21	0,2746 (3)	0,3047 (4)	0,6471 (3)	4,94 (9)
C22	0,2082 (4)	0,2344 (6)	0,7059 (4)	7,9 (1)
C23	0,2071 (4)	0,1013 (6)	0,6935 (4)	8,3 (1)
C201	0,2597 (4)	0,2471 (4)	0,3631 (3)	5,15 (9)
C202	0,2634 (4)	0,3801 (5)	0,3289 (3)	5,5 (1)
C203	0,1600 (4)	0,4388 (6)	0,2946 (3)	7,0 (1)
C204	0,0585 (4)	0,3657 (6)	0,2901 (3)	7,9 (1)
C205	0,0543 (4)	0,2342 (6)	0,3221 (3)	7,7 (1)
C206	0,1551 (4)	0,1755 (5)	0,3590 (3)	6,5 (1)

Tableau 2. *Paramètres géométriques (Å, °)*

S—C2	1,817 (4)	C10—C14	1,448 (5)
S—C201	1,757 (4)	C11—C12	1,412 (6)
S1—C10	1,695 (4)	C12—C13	1,347 (8)
S1—C13	1,675 (5)	C20—C21	1,404 (6)
S2—C20	1,692 (4)	C21—C22	1,364 (7)
S2—C23	1,703 (5)	C22—C23	1,318 (8)
N—C202	1,362 (6)	C201—C202	1,400 (6)
O—C14	1,226 (5)	C201—C206	1,394 (6)
C1—C2	1,524 (5)	C202—C203	1,402 (6)
C1—C14	1,521 (6)	C203—C204	1,370 (7)
C2—C20	1,498 (6)	C204—C205	1,375 (8)
C10—C11	1,355 (6)	C205—C206	1,390 (7)
C2—S—C201	101,1 (2)	S2—C20—C2	122,8 (3)
C10—S1—C13	92,1 (2)	S2—C20—C21	109,6 (3)
C20—S2—C23	92,1 (2)	C2—C20—C21	127,3 (4)
C2—C1—C14	115,3 (3)	C20—C21—C22	112,2 (4)
S—C2—C1	107,9 (3)	C21—C22—C23	114,5 (5)
S—C2—C20	113,7 (3)	S2—C23—C22	111,6 (4)
C1—C2—C20	111,6 (3)	S—C201—C202	120,5 (3)
S1—C10—C11	110,9 (3)	S—C201—C206	120,1 (3)
S1—C10—C14	120,2 (3)	C202—C201—C206	119,3 (4)
C11—C10—C14	129,0 (4)	N—C202—C201	121,8 (4)
C10—C11—C12	112,9 (4)	N—C202—C203	119,6 (4)
C11—C12—C13	111,2 (5)	C201—C202—C203	118,6 (4)
S1—C13—C12	112,9 (4)	C202—C203—C204	121,0 (5)
O—C14—C1	121,5 (3)	C203—C204—C205	120,9 (5)
O—C14—C10	122,1 (4)	C204—C205—C206	118,9 (4)
C1—C14—C10	116,4 (3)	C201—C206—C205	121,2 (5)
S1—C10—C14—O	-1,9 (6)	C14—C1—C2—C20	-159,4 (3)
S1—C10—C14—C1	177,5 (3)	C1—C2—C20—S2	-77,8 (4)
C10—C14—C1—C2	-179,8 (4)	C1—C2—C20—C21	94,9 (5)
C2—C1—C14—O	-0,5 (6)	C1—C2—S—C201	-162,6 (3)
C14—C1—C2—S	75,0 (4)		

Correction des facteurs de Lorentz-polarisation. Localisation des atomes non-H par les méthodes directes grâce au logiciel SIR88 (Burla *et al.*, 1988). Localisation des atomes H par série de Fourier des différences. Affinement des coordonnées *x*, *y*, *z* des atomes H à l'exception de H131, H205, H211, H221 (*B* des atomes H = 1,3 fois celui des atomes porteurs). Tous les programmes utilisés appartiennent au système *MolEN* (Fair, 1990).

Collecte des données: *CAD-4 Software* (Enraf-Nonius, 1989). Affinement des paramètres de la maille: *CAD-4 Soft-*

ware. Réduction des données: *MolEN* (Fair, 1990). Graphisme moléculaire: *ORTEPII* (Johnson, 1976). Logiciel utilisé pour préparer le matériel pour publication: *MolEN*.

Les listes des facteurs de structure, des facteurs d'agitation thermique anisotrope, des coordonnées des atomes d'hydrogène, des distances et angles des atomes d'hydrogène, des équations des différents plans moyens et des contacts de van der Waals ont été déposées au dépôt d'archives de l'UICr (Référence: PA1196). On peut en obtenir des copies en s'adressant à: The Managing Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, Angleterre.

Références

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2',6'-Dihydroxyflavone and a New Polymorph of 2'-Hydroxyflavonol

E. MOLINS,^a C. MIRAVITLLES,^a J.-C. WALLET^{b*} AND E. M. GAYDOU^b

^aInstitut de Ciència de Materials de Barcelona, Campus Universitat de Bellaterra, CSIC, 08193 Cerdanyola, Spain, and ^bLaboratoire de Phytchimie, ENSSPICAM, Faculté des Sciences et Techniques de Saint-Jérôme, 13397 Marseille CEDEX 20, France

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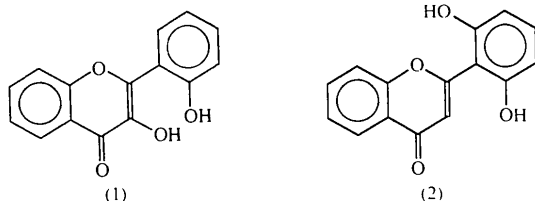
Abstract

The structure of 2'-hydroxyflavonol [3-hydroxy-2-(2-hydroxyphenyl)-4*H*-1-benzopyran-4-one, C₁₅H₁₀O₄] has been described in the triclinic system [Inuma, Tanaka, Ito & Mizuno (1987). *Chem. Pharm. Bull.* **35**, 660–667]. We describe here a new polymorph which crystallizes in the monoclinic system. The conformation, characterized by the torsion angle between the γ -benzopyrone moiety and the phenyl ring, is very similar to that described for the triclinic system. The conformation of 2',6'-dihydroxyflavone [2-(2,6-dihydroxyphenyl)-4*H*-1-benzopyran-4-one, C₁₅H₁₀O₄] is determined by intermolecular hydrogen bonds. Hydroxyl groups form two sets of

hydrogen bonds, with the O(2')—H group bonding to the carbonyl group of a neighbouring molecule along the *b* axis and the O(6')—H group bonding to the O(2') atom of a molecule located in the *ab* plane.

Comment

2'-Hydroxyflavonol, (1), and 2',6'-dihydroxyflavone, (2), are isomers. In both cases, hindrance around the bond linking the two parts of the molecule opposes a planar conformation. 2'-Oxygenated flavonols have specific ultraviolet properties and have been described as 'distorted flavonols' (Abboud, Simonsen, Mabry & Fang, 1989) due to the steric hindrance which diminishes mesomeric effects.



In 2'-hydroxyflavonol, (1), intramolecular hydrogen bonding produces both a seven-membered ring involving donation of the 2'-hydroxyl H atom to the 3-hydroxyl O atom and a five-membered ring involving donation of the 3-hydroxyl H atom to the 4-carbonyl group (Fig. 1). Such a network of intramolecular hydrogen bonds is also found in morin (Cody & Luft, 1994). The 3-hydroxyl group also forms an intermolecular hydrogen bond to the carbonyl O atom of a symmetry-related molecule (Table 3). This is a common bimolecular association for flavonols (Etter, Urbańczyk-Lipkowska, Baer & Barbara, 1986; Wallet, Gaydou, Molins & Miravittles, 1994). The molecules of the two polymorphs have the

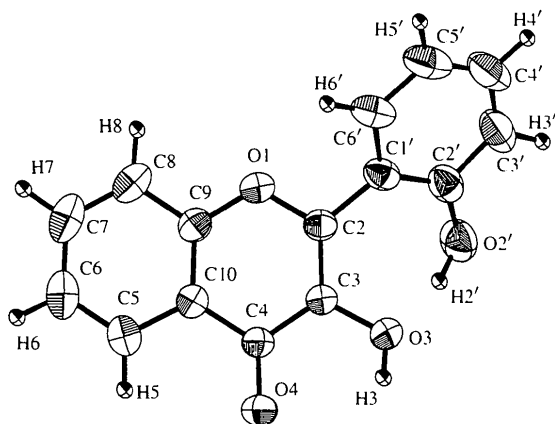


Fig. 1. The numbering of atoms and conformation of 2'-hydroxyflavonol. The displacement ellipsoids are drawn at the 50% probability level.

same conformation since compound (1) has a C(3)—C(2)—C(1')—C(2') torsion angle of 42.8(3)°, a value similar to that of 43.69° found in the triclinic system (Iinuma, Tanaka, Ito & Mizuno, 1987).

A few examples of polymorphism among flavones and flavonols are known (Moses & Dahlbom, 1965; Castleden, Hall, Nimgirawath, Thadaniti & White, 1985; Wallet & Cody, 1995). Flavonols have been the subject of extensive photophysical studies (Hayashi, Kawai, Ohno, Iitaka & Akimoto, 1974) and can be used as protein-binding-site fluorescence probes (Sytnik, Gormin & Kasha, 1994; Griffiths, 1994).

No structure having a 2',6'-dihydroxy substitution pattern has been described previously and since a possible intramolecular hydrogen bond between the 2'- or 6'-hydroxyl group and the cyclic O atom of the pyrone ring has been suggested for such derivatives (Gallagher, Hughes, O'Donnell, Philbin & Wheeler, 1953), we have resolved the structure of (2) in order to investigate the hydrogen bonding.

The torsion angle which describes the principal degree of freedom of the molecule is O(1)—C(2)—C(1')—C(6') of -70.6(2)° (Fig. 2). The conformation is influenced by the intermolecular environment. Hydroxyl groups are involved in two hydrogen-bond networks; the O(2')—H(2') group binds to the carbonyl group of a neighbouring molecule along the *b* axis [O(2')...O(4)(-x - 1/2, y + 1/2, 1/2 - z) 2.607(2) Å] and the O(6')—H(6') group binds to the O(2') atom of a molecule located in the *ab* plane [O(6')...O(2')(1/2 - x, y - 1/2, 1/2 - z) 2.770(2) Å]. Hydrogen bonding induces deformations of the pyrone ring [C(3)—C(4)—C(10) 114.6(2)°] and in-plane deformation of the dihydroxyphenyl ring [O(1)—C(2)—C(1') 112.0(1)°]. The torsion angles of (2) are in the same range as those found for the three conformers of 2',6'-dimethoxyflavone (Tinant, Declercq, Wallet, Gaydou & Baldy, 1991). Molecules are oriented along the *c* axis, but form layers parallel to the *ab* plane, which are bound together through the already mentioned hydrogen bonds.

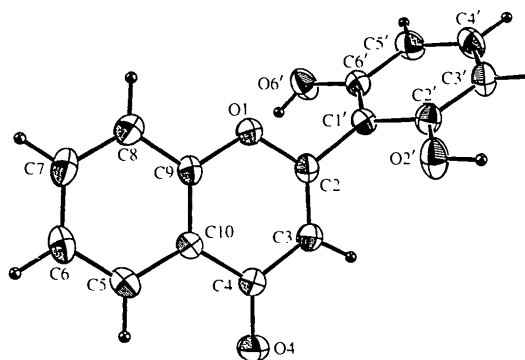


Fig. 2. The numbering of atoms and conformation of 2',6'-dihydroxyflavone. The displacement ellipsoids are drawn at the 50% probability level.

2',6'-Dihydroxyflavones are not usual natural compounds. The few that are known exhibit specific biological properties, for example, they inhibit Epstein-Barr virus activation (Konoshima, Kokumai, Kozuka, Iinuma, Mizuno, Tanaka, Tokuda, Nishino & Iwashima, 1992) and ATPase activity (Ryu & Ahn, 1987). Their spectral properties (UV, NMR and MS) have been reviewed (Tanaka, Iinuma & Mizuno, 1986) and, in the case of the study of the ATPase activity, a correlation with UV spectra has been found.

Experimental

2'-Hydroxyflavonol and 2',6'-dihydroxyflavone were obtained by demethylation of 2'-methoxyflavonol (Wallet, Gaydou, Molins & Miravittles, 1994) and 2',6'-dimethoxyflavone (Tinant, Declercq, Wallet, Gaydou & Baldy, 1991), respectively, with aluminium chloride in benzene. Crystals for analysis were grown from ethanol solutions of the compounds at room temperature.

Compound (1)

Crystal data

C₁₅H₁₀O₄

$M_r = 254.24$

Monoclinic

$C2/c$

$a = 18.285 (2) \text{ \AA}$

$b = 7.726 (1) \text{ \AA}$

$c = 16.927 (2) \text{ \AA}$

$\beta = 102.15 (1)^\circ$

$V = 2337.7 (5) \text{ \AA}^3$

$Z = 8$

$D_x = 1.445 \text{ Mg m}^{-3}$

D_m not measured

Data collection

Enraf-Nonius CAD-4 diffractometer

ω -2 θ scans

Absorption correction:

empirical via ψ scan

(*MolEN*; Fair, 1990)

$T_{\min} = 0.945$, $T_{\max} = 0.999$

3640 measured reflections

3529 independent reflections

Refinement

Refinement on F^2

$R(F) = 0.0424$

$wR(F^2) = 0.1290$

$S = 0.786$

3529 reflections

204 parameters

Only H-atom U' s refined

$w = 1/[\sigma^2(F_o)^2 + (0.0715P)^2 + 0.7135P]$

where $P = [\max(0, F_o^2) + 2F_c^2]/3$

Mo $K\alpha$ radiation

$\lambda = 0.71073 \text{ \AA}$

Cell parameters from 25 reflections

$\theta = 16\text{--}20^\circ$

$\mu = 0.106 \text{ mm}^{-1}$

$T = 293 \text{ K}$

Rod

$0.58 \times 0.40 \times 0.26 \text{ mm}$

Colourless

2268 observed reflections
[$I > 2\sigma(I)$]

$R_{\text{int}} = 0.0135$

$\theta_{\text{max}} = 30.4^\circ$

$h = -25 \rightarrow 26$

$k = -10 \rightarrow 0$

$l = -24 \rightarrow 0$

3 standard reflections

frequency: 60 min

intensity decay: 0.4%

Table 1. Fractional atomic coordinates and equivalent isotropic displacement parameters (\AA^2) for (1)

$$U_{\text{eq}} = (1/3)\sum_i \sum_j U_{ij} a_i^* a_j^* \mathbf{a}_i \cdot \mathbf{a}_j.$$

	<i>x</i>	<i>y</i>	<i>z</i>	U_{eq}
O(1)	0.0142 (1)	-0.0237 (1)	0.6613 (1)	0.043 (1)
C(2)	0.0481 (1)	0.1347 (2)	0.6671 (1)	0.037 (1)
C(3)	0.0226 (1)	0.2616 (2)	0.6125 (1)	0.036 (1)
O(3)	0.0592 (1)	0.4159 (2)	0.6195 (1)	0.047 (1)
C(4)	-0.0409 (1)	0.2368 (2)	0.5471 (1)	0.037 (1)
O(4)	-0.0638 (1)	0.3536 (2)	0.4976 (1)	0.051 (1)
C(5)	-0.1356 (1)	0.0202 (2)	0.4804 (1)	0.047 (1)
C(6)	-0.1651 (1)	-0.1431 (3)	0.4773 (1)	0.057 (1)
C(7)	-0.1350 (1)	-0.2649 (3)	0.5362 (1)	0.060 (1)
C(8)	-0.0758 (1)	-0.2241 (2)	0.5975 (1)	0.052 (1)
C(9)	-0.0456 (1)	-0.0576 (2)	0.6002 (1)	0.039 (1)
C(10)	-0.0748 (1)	0.0660 (2)	0.5425 (1)	0.037 (1)
C(1')	0.1144 (1)	0.1394 (2)	0.7340 (1)	0.042 (1)
C(2')	0.1341 (1)	0.2817 (2)	0.7850 (1)	0.048 (1)
O(2')	0.0939 (1)	0.4308 (2)	0.7794 (1)	0.061 (1)
C(3')	0.1962 (1)	0.2705 (3)	0.8488 (1)	0.063 (1)
C(4')	0.2391 (1)	0.1234 (4)	0.8613 (1)	0.070 (1)
C(5')	0.2212 (1)	-0.0172 (4)	0.8104 (1)	0.068 (1)
C(6')	0.1586 (1)	-0.0105 (3)	0.7480 (1)	0.055 (1)

Table 2. Selected geometric parameters (\AA , $^\circ$) for (1)

O(1)—C(9)	1.363 (2)	C(7)—C(8)	1.369 (3)
O(1)—C(2)	1.366 (2)	C(8)—C(9)	1.397 (2)
C(2)—C(3)	1.361 (2)	C(9)—C(10)	1.391 (2)
C(2)—C(1')	1.474 (2)	C(1')—C(2')	1.398 (2)
C(3)—O(3)	1.360 (2)	C(1')—C(6')	1.404 (2)
C(3)—C(4)	1.439 (2)	C(2')—O(2')	1.358 (2)
C(4)—O(4)	1.243 (2)	C(2')—C(3')	1.396 (3)
C(4)—C(10)	1.452 (2)	C(3')—C(4')	1.371 (3)
C(5)—C(6)	1.369 (3)	C(4')—C(5')	1.382 (4)
C(5)—C(10)	1.405 (2)	C(5')—C(6')	1.385 (3)
C(6)—C(7)	1.397 (3)		
C(9)—O(1)—C(2)	120.44 (11)	O(1)—C(9)—C(8)	116.8 (2)
C(3)—C(2)—O(1)	120.73 (13)	C(10)—C(9)—C(8)	121.2 (2)
C(3)—C(2)—C(1')	127.78 (14)	C(9)—C(10)—C(5)	118.6 (2)
O(1)—C(2)—C(1')	111.38 (12)	C(9)—C(10)—C(4)	119.32 (13)
C(2)—C(3)—O(3)	118.73 (13)	C(5)—C(10)—C(4)	122.05 (14)
C(2)—C(3)—C(4)	122.18 (13)	C(2')—C(1')—C(6')	118.7 (2)
O(3)—C(3)—C(4)	119.08 (12)	C(2')—C(1')—C(2)	123.90 (14)
O(4)—C(4)—C(3)	121.64 (14)	C(6')—C(1')—C(2)	117.4 (2)
O(4)—C(4)—C(10)	122.97 (14)	O(2')—C(2')—C(1')	123.9 (2)
C(3)—C(4)—C(10)	115.37 (12)	O(2')—C(2')—C(3')	116.6 (2)
C(6)—C(5)—C(10)	120.3 (2)	C(1')—C(2')—C(3')	119.4 (2)
C(5)—C(6)—C(7)	120.0 (2)	C(4')—C(3')—C(2')	121.1 (2)
C(8)—C(7)—C(6)	121.1 (2)	C(3')—C(4')—C(5')	120.2 (2)
C(7)—C(8)—C(9)	118.7 (2)	C(6')—C(5')—C(4')	119.7 (2)
O(1)—C(9)—C(10)	121.95 (13)	C(5')—C(6')—C(1')	120.9 (2)

Table 3. Hydrogen-bonding geometry (\AA , $^\circ$) for (1)

$D\text{---}H\cdots A$	$D\text{---}H$	$H\cdots A$	$D\cdots A$	$D\text{---}H\cdots A$
O(2')—H(2') \cdots O(3)	0.890	1.811	2.649	156.0
O(3)—H(3) \cdots O(4)	0.831	2.406	2.775	156.0
O(3)—H(3) \cdots O(4')	0.831	1.897	2.679	156.0

Symmetry code: (i) $-x, 1 - y, 1 - z$.

Compound (2)

Crystal data

C₁₅H₁₀O₄

$M_r = 254.24$

Mo $K\alpha$ radiation

$\lambda = 0.71073 \text{ \AA}$

Monoclinic
 $P2_1/n$
 $a = 6.033 (1) \text{ \AA}$
 $b = 8.209 (3) \text{ \AA}$
 $c = 23.091 (5) \text{ \AA}$
 $\beta = 93.55 (1)^\circ$
 $V = 1141.3 \text{ \AA}^3$
 $Z = 4$
 $D_x = 1.475 \text{ Mg m}^{-3}$

Cell parameters from 23 reflections
 $\theta = 12\text{--}18^\circ$
 $\mu = 0.10 \text{ mm}^{-1}$
 $T = 294 \text{ K}$
 Prismatic
 $0.30 \times 0.30 \times 0.07 \text{ mm}$
 Colourless

C(5)—C(6)	1.370 (3)	C(5')—C(6')	1.389 (3)
C(5)—C(10)	1.407 (3)		
C(2)—O(1)—C(9)	118.0 (1)	C(8)—C(9)—C(10)	122.1 (2)
O(1)—C(2)—C(3)	123.4 (2)	C(4)—C(10)—C(5)	121.8 (2)
O(1)—C(2)—C(1')	112.0 (1)	C(4)—C(10)—C(9)	120.1 (2)
C(3)—C(2)—C(1')	124.6 (2)	C(5)—C(10)—C(9)	118.1 (2)
C(2)—C(3)—C(4)	122.0 (2)	C(2)—C(1')—C(2')	119.2 (1)
O(4)—C(4)—C(3)	123.6 (2)	C(2)—C(1')—C(6')	122.2 (2)
O(4)—C(4)—C(10)	121.8 (2)	C(2')—C(1')—C(6')	118.7 (2)
C(3)—C(4)—C(10)	114.6 (2)	O(2')—C(2')—C(1')	117.1 (2)
C(6)—C(5)—C(10)	120.2 (2)	O(2')—C(2')—C(3')	122.1 (2)
C(5)—C(6)—C(7)	120.1 (2)	C(1')—C(2')—C(3')	120.8 (2)
C(6)—C(7)—C(8)	121.3 (2)	C(2')—C(3')—C(4')	119.0 (2)
C(7)—C(8)—C(9)	118.1 (2)	C(3')—C(4')—C(5')	121.6 (2)
O(6')—C(6')—C(1')	123.0 (2)	C(4')—C(5')—C(6')	119.5 (2)
O(1)—C(9)—C(8)	116.0 (2)	O(6')—C(6')—C(5')	116.6 (2)
O(1)—C(9)—C(10)	121.9 (2)	C(1')—C(6')—C(5')	120.4 (2)

Data collection

Enraf-Nonius CAD-4 diffractometer
 ω -2 θ scans
 Absorption correction: empirical via ψ scan (MolEN; Fair, 1990)
 $T_{\min} = 0.935$, $T_{\max} = 0.999$
 3993 measured reflections
 3459 independent reflections

1645 observed reflections
 $[F_o > 3\sigma(F_o)]$
 $R_{\text{int}} = 0.035$
 $\theta_{\text{max}} = 30.4^\circ$
 $h = -8 \rightarrow 0$
 $k = -11 \rightarrow 0$
 $l = -32 \rightarrow 32$
 3 standard reflections
 frequency: 60 min
 intensity decay: 0.4%

The structures of the title compounds were solved with a straightforward run of *MULTAN11/82* (Main, Fiske, Hull, Lessinger, Germain, Declercq & Woolfson, 1982) and refined using *SHELXL93* (Sheldrick, 1993) for (1) and *MolEN* (Fair, 1990) for (2). Molecular graphics were produced using *ORTEP* (Johnson, 1965).

Refinement

Refinement on F
 $R = 0.040$
 $wR = 0.050$
 $S = 1.58$
 1645 reflections
 212 parameters
 Only H-atom U 's refined
 $w = 4F_o/\sigma(F_o)$

$(\Delta/\sigma)_{\text{max}} = 0.04$
 $\Delta\rho_{\text{max}} = 0.20 (4) \text{ e \AA}^{-3}$
 $\Delta\rho_{\text{min}} = -0.18 (4) \text{ e \AA}^{-3}$
 Extinction correction: none
 Atomic scattering factors from *International Tables for X-ray Crystallography* (1974, Vol. IV)

Lists of structure factors, anisotropic displacement parameters, H-atom coordinates and complete geometry for both compounds, and torsion angles for compound (2) have been deposited with the IUCr (Reference: PA1197). Copies may be obtained through The Managing Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

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Table 4. Fractional atomic coordinates and equivalent isotropic displacement parameters (\AA^2) for (2)

	x	y	z	B_{eq}
O(1)	0.3600 (2)	0.1876 (2)	0.20822 (5)	2.38 (2)
O(4)	-0.1809 (2)	-0.0407 (2)	0.12963 (5)	3.10 (3)
O(2')	-0.0445 (2)	0.3094 (2)	0.30569 (6)	3.07 (3)
O(6')	0.5770 (2)	-0.0518 (2)	0.30384 (6)	3.09 (3)
C(2)	0.2059 (3)	0.1113 (2)	0.23950 (7)	1.96 (3)
C(3)	0.0285 (3)	0.0348 (2)	0.21534 (8)	2.33 (4)
C(4)	-0.0181 (3)	0.0304 (2)	0.15358 (8)	2.22 (3)
C(5)	0.1179 (3)	0.1283 (3)	0.05948 (8)	2.84 (4)
C(6)	0.2761 (4)	0.2057 (3)	0.02948 (9)	3.54 (5)
C(7)	0.4581 (3)	0.2766 (3)	0.05907 (9)	3.69 (5)
C(8)	0.4857 (3)	0.2701 (3)	0.11850 (9)	3.04 (4)
C(9)	0.3260 (3)	0.1896 (2)	0.14846 (7)	2.16 (3)
C(10)	0.1419 (3)	0.1172 (2)	0.12035 (8)	2.15 (3)
C(1')	0.2569 (3)	0.1276 (2)	0.30282 (7)	2.02 (3)
C(2')	0.1199 (3)	0.2251 (2)	0.33539 (8)	2.20 (3)
C(3')	0.1562 (3)	0.2370 (3)	0.39509 (8)	2.64 (4)
C(4')	0.3345 (3)	0.1554 (3)	0.42207 (8)	2.94 (4)
C(5')	0.4749 (3)	0.0620 (3)	0.39125 (8)	2.81 (4)
C(6')	0.4359 (3)	0.0466 (2)	0.33157 (8)	2.20 (3)

Table 5. Selected geometric parameters (\AA , $^\circ$) for (2)

O(1)—C(2)	1.364 (2)	C(6)—C(7)	1.385 (3)
O(1)—C(9)	1.383 (2)	C(7)—C(8)	1.373 (3)
O(4)—C(4)	1.243 (2)	C(8)—C(9)	1.388 (3)
O(2')—C(2')	1.360 (2)	C(9)—C(10)	1.385 (2)
O(6')—C(6')	1.362 (2)	C(1')—C(2')	1.402 (3)
C(2)—C(3)	1.334 (2)	C(1')—C(6')	1.400 (2)
C(2)—C(1')	1.481 (2)	C(2')—C(3')	1.386 (3)
C(3)—C(4)	1.437 (3)	C(3')—C(4')	1.382 (3)
C(4)—C(10)	1.456 (3)	C(4')—C(5')	1.374 (3)

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2-(2-Amino-5-bromobenzoyl)pyridine

PHILIP J. COX,^{a*} ABU T. MD. ANISUZZAMAN,^b
 R. HOWARD PRYCE-JONES,^b NORMAN SHANKLAND^b AND
 GRAHAM G. SKELLERN^b

^a*School of Pharmacy, The Robert Gordon University, Schoolhill, Aberdeen AB9 1FR, Scotland, and* ^b*Department of Pharmaceutical Sciences, University of Strathclyde, Glasgow G1 1XW, Scotland. E-mail: paspj@pharmacy.rgu.ac.uk*

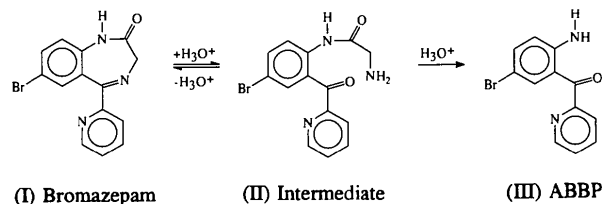
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Abstract

Molecules of the title compound, C₁₂H₉BrN₂O, are non-planar and are held together in the crystal by both inter- and intramolecular hydrogen bonding.

Comment

The drug bromazepam is a benzodiazepine prescribed for the short-term relief of severe anxiety. It is metabolized mainly by hydroxylation and hydrolysis, and 2-(2-amino-5-bromobenzoyl)pyridine (ABBP) is a minor metabolite excreted in the urine of human patients (de Silva *et al.*, 1974). In acidic media, bromazepam undergoes a two-step sequential hydrolysis reaction *via* a labile ring-opened intermediate to give ABBP and glycine (Inui, Yamamoto, Nakae & Asada, 1982). The kinetics of this reaction have been investigated (Anisuzzaman, 1995) and the crystal structure of bromazepam is known (Butcher, Hamor & Martin, 1983). Crystals of ABBP were obtained by hydrolysing bromazepam with aqueous HCl and allowing the solution to stand for several days at room temperature. The scheme below shows the proposed reaction sequence for the hydrolysis of bromazepam to 2-(2-amino-5-bromobenzoyl)pyridine.



In ABBP (Fig. 1), an intramolecular N1—H1A···O bond is present; N1—H1A 0.91 (7), H1A···O 1.97 (7), N1···O 2.679 (7) Å and N1—H1A···O 135 (5)°. This

bond completes a six-membered ring which adopts a sofa conformation, with the H atom slightly displaced [0.17 (6) Å] from the planar portion of the ring. The O atom (coordinates transposed by $\frac{1}{2} - x, -\frac{1}{2} + y, \frac{1}{2} - z$) is also involved in intermolecular hydrogen bonding; N1—H1B 0.96 (8), H1B···O 2.18 (8), N1···O 3.025 (7) Å and N1—H1B···O 146 (6)° (Fig. 2). A similar hydrogen-bonding scheme is present in crystals of 2-aminobenzophenone (Antolini, Vezzosi, Battaglia & Corradi, 1985). The N2···H6 and O···H12 distances in ABBP are 2.404 (6) and 2.638 (6) Å, respectively, the former being shorter than the sum of the van der Waals radii (Glusker, Lewis & Rossi, 1994). The Br···Br intermolecular separation across an inversion centre (1 - x, -y, -z) is also short at 3.724 (2) Å and a

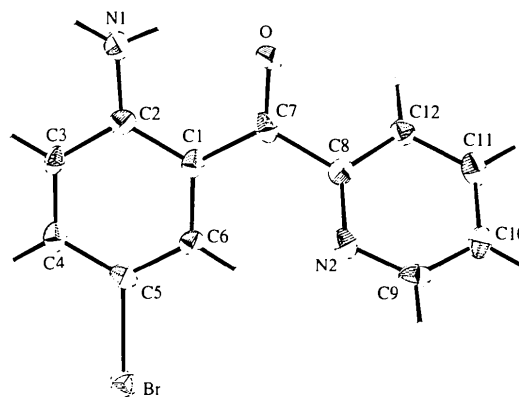


Fig. 1. The atomic arrangement in the title molecule. Displacement ellipsoids are shown at the 50% probability level and H atoms are shown as small spheres of arbitrary radii.

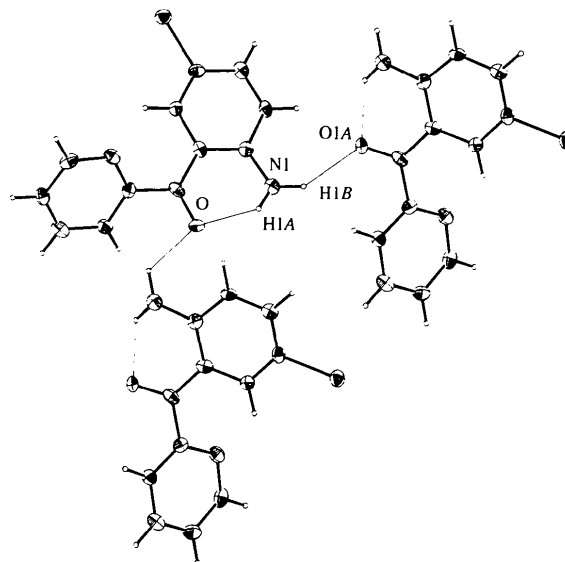


Fig. 2. The hydrogen-bonding network in the title crystal (50% probability ellipsoids). The O1A atom is the O atom transposed by $\frac{1}{2} - x, -\frac{1}{2} + y, \frac{1}{2} - z$.