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КРАТКИЕ СООБЩЕНИЯ

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CRYSTAL STRUCTURE OF 2-BUTYLAMINO-3-(4-FLUOROPHENYL) BENZOFURO[3,2-d]PYRIMIDIN-4(3H)-ONE

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The title compound ($C_{20}H_{18}FN_3O_2$, Mr = 351.37) is prepared and its crystal structure is determined by single crystal X-ray diffraction. The crystal is tetragonal, the *P*-42(1)*c* space group with $a = 11.0922(6)$, $b = 11.0922(6)$, $c = 28.6271(15)$ Å, $V = 3522.2(3)$ Å^3, $Z = 8$, $d_x = 1.325$ g/cm^3, $F(000) = 1472$, $\mu = 0.095$ mm^{-1}, MoK_α radiation ($\lambda = 0.71073$), $R = 0.0505$, $wR = 0.1090$ for 2433 observed reflections with $I > 2\sigma(I)$. The X-ray diffraction analysis reveals that all ring atoms in the benzo[4,5]furo[3,2-d]pyrimidinone moieties are almost coplanar.

Keywords: crystal structure, benzo[4,5]furo[3,2-d]pyrimidin-4(3H)-one, aza-Wittig reaction.

Derivatives of benzofuropyrimidines are of great importance because of their remarkable biological properties, such as the interesting analgesic, antihypertensive, antipyretic, antiviral, and anti-inflammatory activities. They are used in agriculture as pesticides or plant growth regulators as well. The related furo[3,2-d]pyrimidine derivatives were reported as antitumor, antibacterial and antiprotozoan agents as well as dihydrofolate reductase or thymidyates synthase inhibitors [1, 2]. In the recent years, we have been engaged in the preparation of derivatives of heterocycles *via* the aza-Wittig reaction [3, 4]. As a continuation of our previous studies on pyrimindine derivatives, the X-ray crystal structure determination of the title compound has been undertaken in order to better understand the influence of structural modifications upon overall molecular geometry and conformation and may be used as a new precursor for obtaining bioactive molecules.

Experimental. Synthesis. Melting point was uncorrected. MS was measured on a Finnigan Trace MS spectrometer. IR was recorded on a PE-983 infrared spectrometer as KBr pellet with absorption in cm^{-1}. NMR was recorded in $CDCl_3$ on a Varian Mercury 400 spectrometer and resonance was given in ppm (δ) relative to TMS. Elementary analysis was taken on a Vario EL III elementary analysis instrument.

Iminophosphorane **1** reacted with *p*-fluorophenyl isocyanate to give carbodiimides **2**, which were allowed to react with *n*-Butylamines to provide guanidine intermediates **3**. In the presence of catalytic amount of sodium ethoxide, **3** were converted easily to 2-dialkylamino-3-p-fluorophenyl-benzofuro[3,2-d]pyrimidin-4(3H)-ones **4** in satisfactory yields at room temperature (Scheme 1). ^{1}HNMR (400 MHz, $CDCl_3$) δ = 0.89 (t, $J = 7.2$ Hz, 3H, CH_3), 1.25—1.54 (m, 4H, $2CH_2$), 3.43—3.47 (m, 2H, NCH_2), 4.14 (s, 1H, NH), 7.29—8.01 (m, 8H, Ar—H); IR (KBr) cm^{-1} 1704 (C=O), 1533, 1340, 1115; MS *m*/*z* (%) = 351(78, M^+), 334(41), 308(35), 294(100), 185(48), 130(70), 102(82), 95(52); Anal. Calcd for $C_{20}H_{18}FN_3O_2$ (351.4): C, 68.36; H, 5.16; N, 11.96. Found: C, 68.33; H, 5.20; N, 11.89.

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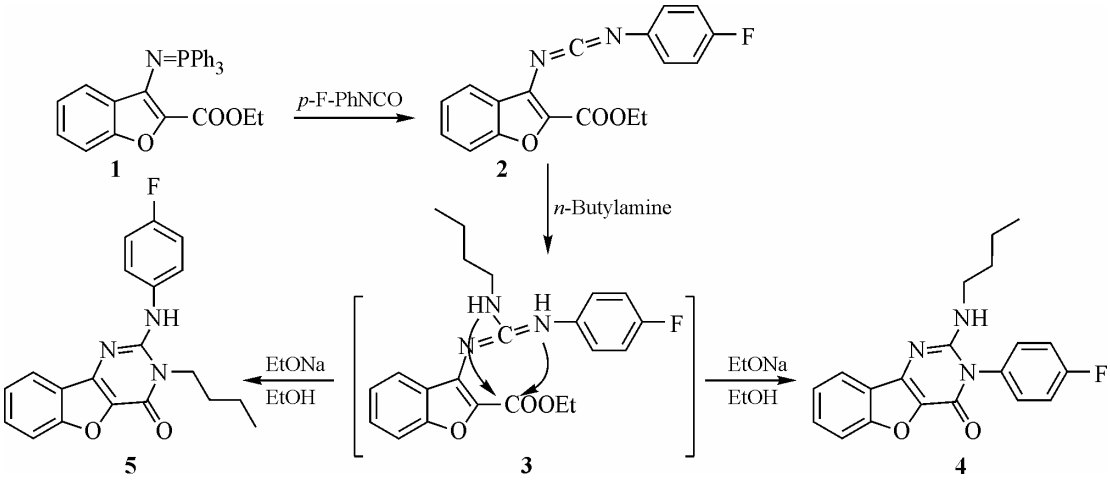

Crystal data and structure determination. Suitable crystals were obtained by vapor diffusion of ethanol and dichloromethane at room temperature. A colorless crystal of the title compound having approximate dimensions of 0.36×0.26×0.24 mm was mounted on a glass fiber in a random orientation at 295(2) K. The determination of unit cell and the data collection were performed with MoK_α radiation ($\lambda = 0.71073$ Å) on a BRUKER SMART APEX-CCD diffractometer with a ψ—ω scan mode. A total of 24418 reflections were collected in the range of $2.32 < \theta < 21.6°$ at room temperature, and 2433 were independent ($R_{int} = 0.0584$), of which 2433 observed reflections with $I > 2\sigma(I)$ were used in the structure determination and refinements. The structure was solved by direct methods with SHELXS-97 program [5] and expanded by Fourier technique. The non-hydrogen atoms were refined anisotropically, and the hydrogen atoms were determined with theoretical calculation. A full-matrix least-squares refinement gave the final $R = 0.0505$, $wR = 0.1090$ ($w = 1/[s^2(F_0^2) + (0.0569P)^2 + + 0.3461P]$, where $P = (F_0^2 + 2F_c^2)/3$), $S = 1.080$, $(\Delta\rho)_{max} = 0.184$ and $(\Delta\rho)_{min} = -0.145$e/ Å^3. All calculations were performed on a PC with SHELXS-97 program.

Results and discussion. We describe herein the structure of the title compound **4**, prepared using an iminophosphorane with *p*-F-phenyl isocyanate by a subsequent reaction with *n*-butylamine in the presence of catalytic amount of sodium ethoxide.

Theoretically, the cyclization of guanidine intermediate **3** may produce two isomers, **4** and **5** respectively. Here, however, we just got one of the isomers which have been identified as **4** by X-ray

T a b l e 1

Selected Bond Lengths (Å), *Bond Angles and Torsion Angles* (deg.)

Bond	Dist.	Bond Angle	deg.	Torsion Angle	deg.
C1—C6	1.386(4)	C5—C4—C3	121.4(3)	C7—C1—C2—C3	178.4(3)
C6—O1	1.376(3)	N1—C7—C8	124.7(2)	N1—C7—C8—C9	3.3 (4)
C7—N1	1.353(4)	N1—C7—C1	129.2(2)	O1—C8—C9—O2	−2.0(5)
C8—O1	1.391(3)	C8—C7—C1	106.0(2)	N2—C15—C20—C19	−177.7(3)
C10—N3	1.343(4)	C8—C9—N2	109.9(2)	N3—C10—N1—C7	177.5(2)
C10—N2	1.402(3)	N1—C10—N3	120.3(3)	N2—C10—N1—C7	−2.2(4)
C11—N3	1.455(4)	N1—C10—N2	123.0(2)	C8—C7—N1—C10	0.5(4)
C15—C16	1.369(4)	N3—C10—N2	116.6(2)	N1—C10—N2—C9	0.2(4)
C9—O2	1.231(3)	N3—C11—C12	113.5(2)	O2—C9—N2—C10	−177.4(2)
C18—C19	1.352(5)	C20—C15—N2	118.9(2)	O2—C9—N2—C15	4.1(4)
C18—F1	1.355(3)	C17—C18—F1	118.5(3)	N1—C10—N3—C11	0.3(4)
C19—C20	1.382(4)	C6—O1—C8	104.1(2)	C12—C11—N3—C10	76.8(3)

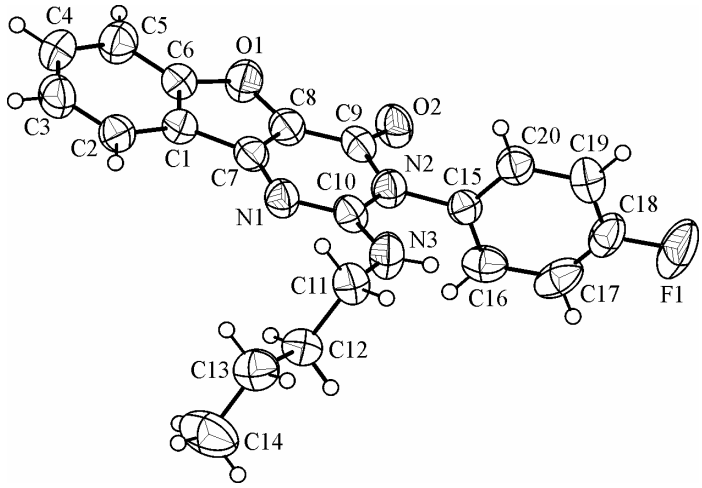

Fig. 1. Molecular structure of the title compound

crystallographic analyses. The formation of **4** can be rationalized as the guanidine intermediate 3 cyclized across the arylamino group rather than the alkylamino one. This is probably due to the preferential generation of —N—Ar from more acidic —NHAr under the catalysis of $EtO^{-}Na^{+}$.

The selected bond lengths and bond angles along with torsion angles are given in Table 1. Fig. 1 shows the molecular structure of the title compound, and the packing diagram in a unit cell is shown in Fig. 2.

In the molecule, the bond lengths and angles present no unusual features. All ring atoms in the benzofuro[3,2-d]pyrimidinone system are essentially coplanar, with maximum deviations being –0.019(1) Å and 0.022(1) Å for C5 and C2, respectively; the C15—C20 phenyl ring is twisted with respect to it, with a dihedral angle of 87.35(3)°. Intermolecular C---H…O and N---H…O hydrogen bonds link the molecules, helping to stabilize the crystal structure. The related bond lengths and angles are listed in Table 2. Further stability the crystal structure is provided by offset π—π stacking interact-

T a b l e 2

Hydrogen-Bonding Geometry (Å, deg.)

D—H…A	D—H	H…A	D…A	D—H…A
N3—H3A…O2^{i}	0.85	2.43	3.182(3)	149
C17—H17…O1^{ii}	0.93	2.40	3.227(3)	148
C20—H20…O2^{iii}	0.93	2.43	3.356(3)	173

Symmetry codes: i = *x*–1/2, –*y*+1/2, –*z*+1/2; ii = –*x*+1/2, *y*–1/2, –*z*+1/2; iii = –*x*, –*y*+1, *z*.

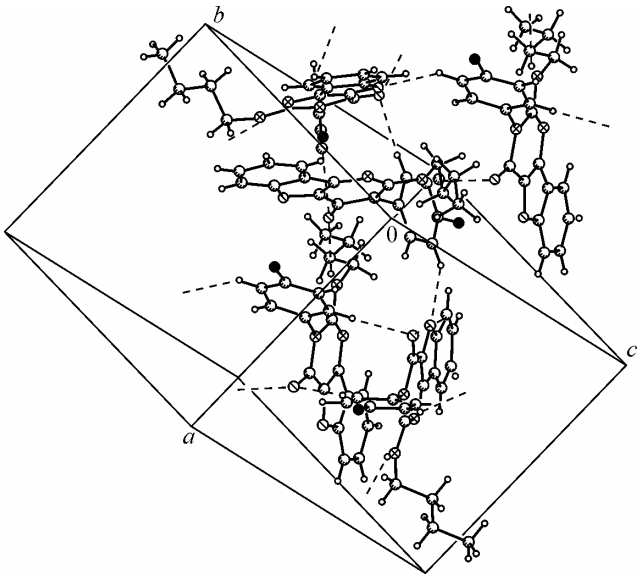

Fig. 2. Packing diagram in a unit cell, hydrogen bonds are shown as dashed lines

tions involving the fused benzofuro[3,2-d]pyrimidin system moieties. The interplanar distances are *ca* 3.4 and 3.7 Å, with distances between adjacent ring centroids of 3.8(1)—3.9(1) Å (symmetry code relating the adjacent rings: $-x$, $1-y$, z) (Fig. 2).

The structure has been deposited with the Cambridge Crystallographic Data Centre as supplementary publication No. CCDC 671114. Copies of the data can be obtained, free of charge, on application to CCDC, 12 Union Road, Cambridge CB2 1EZ.

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