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X-ray Structure Analysis Online

Synthesis and Crystal Structure of *N*-*p*-Tolyl-2-acetylamino-4,5,6,7-tetrahydrobenzo[*b*]thiophene-3-carboxamide

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N-*p*-tolyl-2-acetylamino-4,5,6,7-tetrahydrobenzo[*b*]thiophene-3-carboxamide (**2**) has been synthesized and characterized by X-ray diffraction method. The compound **2** crystallizes in monoclinic space group $P2_1/c$ with cell parameters a = 12.651(8)Å, b = 12.429(2)Å, c = 21.752(3)Å, β = 99.138(6)˚and Z = 8. The structure exhibits both intra and intermolecular hydrogen bonds.

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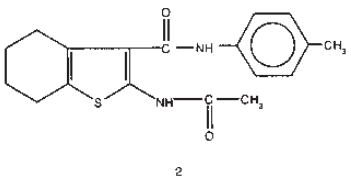
Several thiophenes[1,2] and Schiff bases[3,4] have been found to show interesting biological activities, like antitubercular, bacteriostatic and antifungal activities. The concept of preparing thiophene containing biologically active compounds has stimulated researchers in the pharmaceutical chemistry; it now appears that at least one thiophene analog has been prepared for every important therapeutic compound containing a benzene nucleus. These observations stimulated us to presume that Schiff bases of thiophene would produce new compounds of better biological activity. Some derivatives of thiophenes have been reported[5] to possess analgesic and anti-inflammatory activities. These observations prompted us to synthesize some new thiophene-containing compounds for analgesic and anti-inflammatory activities. In view of the above, compound **2** was synthesized and characterized by X-ray studies.



2

Fig. 1 Chemical structure.

Table 1 Experimental crystallographic data

Formula	$C_{18}H_{20}O_2N_2S$
Formula weight	328.42
Crystal system	monoclinic
Space group	$P2_1/c$, Z = 8
a	12.651(8)Å
b	12.429(2)Å
c	21.752(3)Å
β	99.138(6)˚
V	3376.9(6)Å^3
D_x	1.292 Mg/m^3
$2\theta_{max}$	44.42˚ with Mo K_α
No. of reflections used	3764
R	0.0689
$(\Delta/\sigma)_{max}$	0.033
$(\Delta\rho)_{max}$	0.737 eÅ^{-3}
$(\Delta\rho)_{min}$	– 0.516 eÅ^{-3}
Measurement	DipLabo Kappa
Program system	Denzo
Structure determination	SHELXS-97
Refinement	full matrix: SHELXL-97

Initially *p*-tolylcyanoacetamide was condensed with cyclohexanone in the presence of benzene for 10 h. The yielded product (*N*-*p*-tolyl-cyano-cyclohexylideneacetamide) was

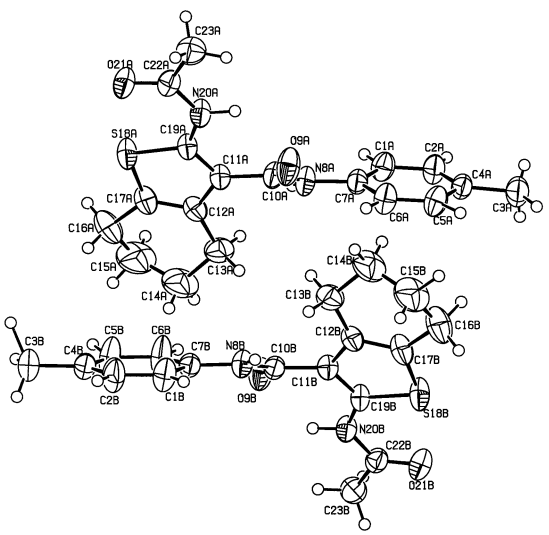


Fig. 2 ORTEP drawing of molecule **2** at 50% probability.

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Table 2 Atomic coordinates and equivalent thermal parameters (Å²).

Atom	*x*	*y*	*z*	U_{eq}
C1A	0.8973(4)	0.0179(4)	0.0706(2)	0.0490(12)
C2A	0.9147(4)	0.1227(4)	0.0575(2)	0.0500(12)
C3A	0.8754(4)	0.3199(4)	0.0632(2)	0.0605(14)
C4A	0.8528(3)	0.2046(3)	0.07543(19)	0.0405(11)
C5A	0.7723(4)	0.1754(4)	0.1080(2)	0.0509(12)
C6A	0.7529(3)	0.0708(4)	0.1219(2)	0.0493(12)
C7A	0.8159(3)	-0.0107(3)	0.10379(19)	0.0374(11)
N8A	0.8063(3)	-0.1191(3)	0.11975(17)	0.0430(9)
O9A	0.6271(2)	-0.1283(3)	0.12125(18)	0.0638(10)
C10A	0.7164(3)	-0.1720(4)	0.1291(2)	0.0422(11)
C11A	0.7297(3)	-0.2856(3)	0.14701(19)	0.0376(10)
C12A	0.8177(3)	-0.3359(4)	0.18734(19)	0.0409(11)
C13A	0.9124(4)	-0.2783(4)	0.2243(2)	0.0548(13)
C14A	0.9763(5)	-0.3518(5)	0.2718(3)	0.0829(19)
C15A	0.9836(6)	-0.4616(6)	0.2534(3)	0.098(2)
C16A	0.8781(4)	-0.5180(5)	0.2318(3)	0.0691(16)
C17A	0.8035(4)	-0.4418(4)	0.1927(2)	0.0472(12)
S18A	0.68417(9)	-0.48665(10)	0.14997(6)	0.0507(5)
C19A	0.6512(3)	-0.3581(3)	0.12533(19)	0.0386(11)
N20A	0.5559(3)	-0.3328(3)	0.08670(17)	0.0433(9)
O21A	0.4848(2)	-0.4975(3)	0.07763(16)	0.0532(9)
C22A	0.4776(3)	-0.4023(4)	0.0652(2)	0.0428(11)
C23A	0.3808(4)	-0.3566(4)	0.0251(2)	0.0577(13)
C1B	0.5997(4)	-0.2521(4)	0.4222(2)	0.0581(14)
C2B	0.5861(4)	-0.3551(4)	0.4390(3)	0.0638(15)
C3B	0.6368(5)	-0.5492(4)	0.4489(3)	0.0671(15)
C4B	0.6570(4)	-0.4352(4)	0.4314(2)	0.0484(12)
C5B	0.7445(4)	-0.4059(4)	0.4053(3)	0.0705(16)
C6B	0.7595(4)	-0.3018(4)	0.3872(3)	0.0694(16)
C7B	0.6881(3)	-0.2225(3)	0.39531(18)	0.0376(10)
N8B	0.6956(3)	-0.1143(3)	0.37679(16)	0.0409(9)
O9B	0.8721(2)	-0.1051(2)	0.36982(15)	0.0534(9)
C10B	0.7832(3)	-0.0615(3)	0.36495(18)	0.0376(11)
C11B	0.7692(3)	0.0530(3)	0.34922(18)	0.0378(11)
C12B	0.6792(3)	0.1053(4)	0.31269(19)	0.0424(11)
C13B	0.5825(4)	0.0511(4)	0.2755(2)	0.0527(13)
C14B	0.5183(3)	0.1267(4)	0.2300(2)	0.0771(18)
C15B	0.5102(3)	0.2353(4)	0.2531(2)	0.086(2)
C16B	0.6165(4)	0.2912(5)	0.2741(3)	0.0711(16)
C17B	0.6934(4)	0.2130(4)	0.3104(2)	0.0530(13)
S18B	0.81457(10)	0.25479(10)	0.35123(6)	0.0550(5)
C19B	0.8490(3)	0.1247(3)	0.3710(2)	0.0392(11)
N20B	0.9473(3)	0.0958(3)	0.40644(16)	0.0404(9)
O21B	1.0154(3)	0.2606(3)	0.42309(16)	0.0552(9)
C22B	1.0254(3)	0.1641(4)	0.43045(19)	0.0407(11)
C23B	1.1233(4)	0.1144(4)	0.4673(2)	0.0524(13)

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

Table 3 Hydrogen-bonding geometry (Å, °)

D-H...A	H-A	*D*-A	*D*-H...A	Symmetry Codes
N8A–H9...O21B	2.13	2.977(3)	146	$2-x,-1/2+y,1/2-z$
N8B–H10...O21A	2.16	3.003(5)	146	$1-x,1/2+y,1/2-z$
C1A–H29...O21B	2.58	3.379(6)	140	$2-x,-1/2+y,1/2-z$
C1B–H31...O21A	2.52	3.340(6)	143	$1-x,1/2+y,1/2-z$
N20B–H4...O9B	2.09	2.746(3)	124	
N20A–H5...O9A	2.12	2.761(3)	123	
C6A–H32...O9A	2.41	2.941(6)	122	
C6B–H43...O9B	2.32	2.884(6)	117	

stirred for one hour at 45 – 50˚C in the presence of sulfur, ethanol and diethylamine to obtain 2-amino-3-(*N*-*p*-tolylcarboxamido-4,5,6,7-tetrahydrobenzo[*b*]thiophene (**1**) (Gewald reaction). A mixture of **1** and acetic anhydride (10 ml) was heated on a steam bath for 2 h and the mixture was cooled and left overnight; the solid was filtered, washed with cold ethanol and recrystallised from ethanol, yielding a colorless crystalline product (**2**). Yield 70%. M. P. 162˚C. ^{1}H NMR (400 Hz $CDCl_3$): δ 1.8 – 2.0(d, 4H, –CH_2 group).

A single crystal of **2** having dimensions of 0.2 × 0.3 × 0.2 mm was chosen for X-ray diffraction studies. The measurements were made on a DIPLabo Imaging Plate system with graphite-monochromated radiation (Mo K_α). The structure was solved by direct methods and expanded by fourier techniques. All of the non-hydrogen atoms were revealed in the first map, itself. An anisotropic refinement using SHELXL-97 was started at this stage and *R*1 finally converged to 0.0674. The hydrogen atoms were placed at calculated positions and were not refined. Details of the crystal data and refinement are given in Table 1. Table 2 gives the details of the final coordinates and equivalent thermal parameters of non-hydrogen atoms.

There are two molecules in an asymmetric unit. The structure has both intra and intermolecular hydrogen bonds (Table 3). The five-membered and phenyl rings of both molecules are planar with a maximum deviation of 0.018(3)Å for C19B. The heterocyclic ring of both molecules are apparently planar with a maximum deviation of 0.268 Å for C15A and 0.290 Å for C15B. A packing diagram of the molecules shows stacking in pairs when viewed down the *b* axis. These pairs are linked *via* hydrogen bonds which in turn, form a linear chain polymer structure.

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