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Synthesis and crystal structure of 3-(2,5-dimethylphenyl)-1-(4-methoxyphenyl) 5-(thiophen-2-yl)-1H-pyrazole

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ABSTRACT

The title compound, $C_{22}H_{20}N_2OS$, was synthesized and the structure was investigated by X-ray Crystallography and characterised by NMR and IR spectroscopy. The compound crystallizes in the orthorhombic crystal class in the space group $P2_12_12_1$ with cell parameters a = 5.4290(3)Å, b = 15.9920(19)Å, c = 21.448(2)Å and Z = 4.

KEYWORDS

Pyrazole;
Crystal structure;
Biological activity;
Thiophen;
Antiperiplanar.

INTRODUCTION

Heterocycles bearing nitrogen, sulphur, oxygen and thiazole moieties constitute the core structure of a number of biologically interesting compounds. When one biologically active molecule is linked to another, the resultant molecule generally has increased potency. Pyrazole derivatives are well established in the literature as important biologically active heterocyclic compounds. These derivatives are the subject of many research studies due to their wide spread potential biological activities such as antifungal[1], antagonists[2], anti-inflammatory[3] and inhibitors of Hsp90[4]. Numerous compounds containing pyrazole moiety have been shown to exhibit pesticidal[5] and herbicidal[6] properties. In this context and as a part of our ongoing research on pyrazoles and their crystal structures, herein we report the synthesis and crystal structure of the title compound.

EXPERIMENTAL

Synthesis of 3-(2,5-dimethylphenyl)-1-(4-methoxyphenyl)-5-(thiophen-2-yl)

A mixture of (Z)-3-(2,5-dimethylphenyl)-1-(thiophen-2-yl)prop-2-en-1-one(2g, 0.008mol) and 4-methoxy phenyl hydrazine (1.1g, 0.008mol) in methanol (30ml) was refluxed for four hours then distilled completly and poured into water and extracted to dichloromethane. The dichloromethane was dried using anhydrous sodium sulphate, filtered, distilled completly, and purified using column chromotography (hexane: EA) yield = 82% (white colour solid), m.p.= 128° C. Figure 1 represents the schematic diagram of the molecule.

Spectral data

^{1}H NMR(400 MHz, DMSO-d_6): δ 2.3(s, 3H, -ArCH3), 2.5(s, 3H, -ArCH3), 3.7(s, 3H,- OCH3),

6.8 (s,1H,-Ar), 7.2-7.4(m, 7H,-Ar), 7.5(s, 1H, -Ar), 8.0-8.1(m, 2H, -Ar) IR(KBr) cm^{-1}: 3563, 1878, 1455, 1297. CHNS: C, 73.26(73.30); H, 5.54(5.59); N, 7.72(7.77); O, 4.38(4.44); S, 8.89(8.90). (m+1): 361.2

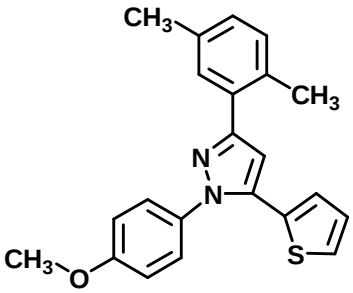

Figure 1 : Schematic diagram

Crystal structure determination

A single crystal of the title compound with the dimensions 0.30 × 0.27 × 0.25 mm was chosen for the X-ray diffraction study. The data were collected on a DIPLabo Image Plate system equipped with a normal focus, 3 kW sealed X-ray source (graphite monochromated MoKα). The crystal to detector distance was fixed at 120 mm with a detector area of 441 × 240 mm2. Thirty six frames of data were collected at room temperature by the oscillation method. Each exposure of the image plate was set to 400 s. Successive frames were scanned in steps of 5? per minute with an oscillation range of 5? . Image processing and data reduction were done using Denzo[7]. The reflections were merged with Scalepack[8]. All the frames could be indexed using a orthorhombic lattice. Absorption correction was not applied.

The structure was solved by direct methods using SHELXS- 97[9]. The structure was refined by a full matrix least-squares method with anisotropic temperature factors for non-hydrogen atoms using SHELXL-97[9]. The hydrogen atoms were placed at chemically acceptable positions and were allowed to ride on the parent atoms. 239 parameters were refined with 2809 unique reflections which saturated the residuals to R1 = 0.0514. The details of the crystal data and refinement are given in TABLE 1.

TABLE 1 : Crystal data and structure refinement table.

Empirical formula	$C_{22}H_{20}N_2OS$	θ range for data collection	2.55° to 25.02°
Formula weight	360.46	Index ranges	$-6 \le h \le 5$
Temperature	293(2) K		$-17 \le k \le 17$
Wavelength	0.71073 Å		$-25 \le l \le 25$
Crystal system	Orthorhombic	Reflections collected	4896
Space group	$P2_12_12_1$	Independent reflections	2809
Cell dimensions	a = 5.4290(3)	Absorption correction	None
	b = 15.9920(19) Å	Refinement method	Full-matrix least-squares on F^2
	c = 21.448(2) Å	Data/restraints/parameters	2809/0/239
Volume	1862.1(3) $Å^3$	Goodness-of-fit on F^2	1.090
Z	4	Final R indices	$R1$ = 0.0514, $wR2$ = 0.1443
Density(calculated)	1.286 Mg/m^3	R indices (all data)	$R1$ = 0.0596, $wR2$ = 0.1502
Absorption coefficient	0.187 mm^{-1}	Extinction coefficient	0.027(5)
F_{000}	760	Largest diff. peak and hole	0.377 and -0.404 e. $Å^{-3}$
Crystal size	0.30 × 0.27 × 0.25 mm	CCDC deposition number	790170

The final atomic coordinates and equivalent thermal parameters for all the non-hydrogen atoms are given in TABLE 2. The bond lengths and bond angles of all the non-hydrogen atoms are given in TABLE 3 and in TABLE 4 respectively. The torsion angles of non- hydrogen atoms are given in TABLE 5. Figure 2 represents the ORTEP diagram of the molecule with thermal ellipsoids drawn at 50% probability.

RESULTS AND DISCUSSION

The dihedral angle between planes of thiophen ring and pyrazole ring defined by the atoms S7-C6-C10-C9-C8 and N1-N2-C3-C4-C5 is 39.01(18)? . The methyl group sub- stituted at C18 position is in +synperiplanar conformation defined by the dihedral angle

TABLE 2 : Atomic coordinates and equivalent thermal parameters of the non-hydrogen atoms.

Atom	*x*	*y*	*z*	U_{eq}
N1	0.0691(5)	0.54320(17)	0.28246(11)	0.0516(7)
N2	-0.0466(5)	0.57828(17)	0.33240(11)	0.0523(6)
C3	-0.1028(6)	0.5141(2)	0.36894(14)	0.0510(8)
C4	-0.0254(6)	0.4384(2)	0.34296(14)	0.0538(8)
C5	0.0836(6)	0.4591(2)	0.28692(13)	0.0486(7)
C6	0.1896(6)	0.4039(2)	0.23949(14)	0.0536(8)
S7	0.4516(2)	0.42649(8)	0.19931(6)	0.0879(4)
C8	0.4468(8)	0.3347(3)	0.16114(16)	0.0704(10)
C9	0.2540(8)	0.2876(2)	0.17667(16)	0.0665(10)
C10	0.0894(5)	0.32146(18)	0.22253(12)	0.0433(7)
C11	0.1384(6)	0.59643(19)	0.23151(13)	0.0475(7)
C12	0.3407(7)	0.6470(2)	0.23532(16)	0.0623(9)
C13	0.4009(7)	0.7012(2)	0.18705(16)	0.0630(9)
C14	0.2580(6)	0.7015(2)	0.13395(15)	0.0534(8)
C15	0.0607(8)	0.6487(2)	0.12962(15)	0.0649(9)
C16	0.0007(6)	0.5973(2)	0.17785(14)	0.0599(9)
O17	0.2969(5)	0.75221(16)	0.08324(11)	0.0714(7)
C18	0.5105(9)	0.8041(3)	0.0823(2)	0.0927(15)
C19	-0.2354(6)	0.5325(2)	0.42865(13)	0.0492(7)
C21	-0.2840(8)	0.5226(2)	0.53845(16)	0.0671(10)
C20	-0.1630(7)	0.4962(2)	0.48527(14)	0.0561(8)
C22	-0.4712(8)	0.5802(3)	0.53707(16)	0.0693(10)
C23	-0.5472(7)	0.6144(2)	0.48123(16)	0.0621(9)
C24	-0.4264(6)	0.58937(19)	0.42731(14)	0.0526(8)
C25	0.0417(7)	0.4331(2)	0.49054(16)	0.0699(10)
C26	-0.7548(7)	0.6770(3)	0.4781(2)	0.0804(12)

TABLE 3 : Bond lengths (Å).

Atoms	Length	Atoms	Length
N1-C5	1.350(4)	C12-C13	1.389(5)
N1-N2	1.362(3)	C13-C14	1.378(5)
N1-C11	1.435(4)	C14-C15	1.367(5)
N2-C3	1.327(4)	C14-O17	1.373(4)
C3-C4	1.397(5)	C15-C16	1.361(4)
C3-C19	1.498(4)	O17-C18	1.426(5)
C4-C5	1.380(4)	C19-C24	1.380(5)
C5-C6	1.465(4)	C19-C20	1.402(4)
C6-C10	1.472(5)	C21-C22	1.372(6)
C6-S7	1.702(3)	C21-C20	1.382(5)
S7-C8	1.681(4)	C20-C25	1.506(5)
C8-C9	1.333(6)	C22-C23	1.379(5)
C9-C10	1.435(5)	C23-C24	1.388(4)
C11-C12	1.366(5)	C23-C26	1.510(6)
C11-C16	1.372(4)		

TABLE 4 : Bond angles (°).

Atoms	Angle	Atoms	Angle
C5-N1-N2	112.4(2)	C11-C12-C13	120.9(3)
C5-N1-C11	129.0(2)	C14-C13-C12	119.1(3)
N2-N1-C11	118.4(2)	C15-C14-O17	115.5(3)
C3-N2-N1	104.6(3)	C15-C14-C13	119.7(3)
N2-C3-C4	111.4(3)	O17-C14-C13	124.8(3)
N2-C3-C19	117.6(3)	C16-C15-C14	120.6(3)
C4-C3-C19	130.9(3)	C15-C16-C11	120.9(3)
C5-C4-C3	105.6(3)	C14-O17-C18	118.7(3)
N1-C5-C4	106.0(3)	C24-C19-C20	120.1(3)
N1-C5-C6	125.0(3)	C24-C19-C3	118.2(3)
C4-C5-C6	128.9(3)	C20-C19-C3	121.6(3)
C5-C6-C10	124.5(3)	C22-C21-C20	122.6(3)
C5-C6-S7	123.5(3)	C21-C20-C19	117.1(3)
C10-C6-S7	112.0(2)	C21-C20-C25	119.6(3)
C8-S7-C6	92.8(2)	C19-C20-C25	123.3(3)
C9-C8-S7	112.6(3)	C21-C22-C23	120.4(3)
C8-C9-C10	116.5(3)	C22-C23-C24	117.9(3)
C9-C10-C6	106.1(3)	C22-C23-C26	121.6(3)
C12-C11-C16	118.8(3)	C24-C23-C26	120.5(3)
C12-C11-N1	121.1(3)	C19-C24-C23	121.8(3)
C16-C11-N1	120.1(3)		

TABLE 5 : Torsion angles (°).

Atoms	Angle	Atoms	Angle
C5-N1-N2-C3	0.6(4)	N1-C11-C12-C13	-177.1(3)
C11-N1-N2-C3	175.6(3)	C11-C12-C13-C14	-2.1(6)
N1-N2-C3-C4	-0.2(4)	C12-C13-C14-C15	0.0(5)
N1-N2-C3-C19	-179.6(3)	C12-C13-C14-O17	179.6(4)
N2-C3-C4-C5	-0.2(4)	O17-C14-C15-C16	-178.1(3)
C19-C3-C4-C5	179.1(3)	C13-C14-C15-C16	1.5(6)
N2-N1-C5-C4	-0.7(4)	C14-C15-C16-C11	-0.8(6)
C11-N1-C5-C4	-175.0(3)	C12-C11-C16-C15	-1.3(5)
N2-N1-C5-C6	177.7(3)	N1-C11-C16-C15	178.6(3)
C11-N1-C5-C6	3.4(5)	C15-C14-O17-C18	-175.1(3)
C3-C4-C5-N1	0.6(4)	C13-C14-O17-C18	5.3(5)
C3-C4-C5-C6	-177.8(3)	N2-C3-C19-C24	43.3(4)
N1-C5-C6-C10	-141.4(3)	C4-C3-C19-C24	-136.0(4)
C4-C5-C6-C10	36.7(5)	N2-C3-C19-C20	-134.0(3)
N1-C5-C6-S7	41.0(5)	C4-C3-C19-C20	46.7(5)
C4-C5-C6-S7	-140.9(3)	C22-C21-C20-C19	1.5(6)
C5-C6-S7-C8	177.3(3)	C22-C21-C20-C25	179.7(3)
C10-C6-S7-C8	-0.6(3)	C24-C19-C20-C21	-2.5(5)
C6-S7-C8-C9	0.8(3)	C3-C19-C20-C21	174.7(3)
S7-C8-C9-C10	-0.7(4)	C24-C19-C20-C25	179.4(3)

Atoms	Angle	Atoms	Angle
C8-C9-C10-C6	0.3(4)	C3-C19-C20-C25	-3.4(5)
C5-C6-C10-C9	-177.6(3)	C20-C21-C22-C23	0.1(6)
S7-C6-C10-C9	0.3(3)	C21-C22-C23-C24	-0.8(5)
C5-N1-C11-C12	-108.7(4)	C21-C22-C23-C26	179.2(3)
N2-N1-C11-C12	77.3(4)	C20-C19-C24-C23	1.9(5)
C5-N1-C11-C16	71.4(5)	C3-C19-C24-C23	-175.3(3)
N2-N1-C11-C16	-102.6(3)	C22-C23-C24-C19	-0.2(5)
C26-C23-C24-C19	179.8(3)	C16-C11-C12-C13	2.8(6)

value of 5.3(5)?for the atoms C13–C14–O17–C18. The methyl group substi- tuted at C25 position is in +antiperiplanar conformation defined by the dihedral angle value of 179.7(4)? for atoms C25–C20–C21–C22. The pyrazole ring is almost planar. The atoms N1 and N2 of the pyrazole ring deviate from Cremer and Pople plane by -0.004(3) ÅA and 0.002(3) Å respectively. The sulphur atom in the thiophen ring deviates from Cremer and Pople plane by -0.0049(19) Å. The bond length between the atoms C5–C6 is 1.465(4) °A and C3–C19 is 1.498(4) Å. The lengths show a slight deviation fom the expected value (based on the hybridizations). There are no classic hydrogen bonds in the molecule.

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SUPPLEMENTARY INFORMATION

The crystallographic data have been deposited in Cambridge Crystallographic Data Center under reference CCDC number 790170 which consists of the supplementary crystallographic data for this paper. These data can be obtained free of charge via http://www.ccdc.cam.ac.uk/conts/retrieving.html. or from the Cambridge Crystallographic data center, 12 Union road, Cambridge CB21EZ, UK; fax: +45(0) 1223336033).

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