

# **X-Ray Crystallographic Investigation and Crystal Structure of 6-(2-Hydroxy-4,6- dimethyl-phenyl)-4-(2-methoxy-phenyl)5- nitro-3,4-dihydro-1H-pyrimidine-2-one, Methanol**

R. A. Barot<sup>1</sup>, U. H. Patel<sup>1</sup>, Y. T. Naliapara<sup>2</sup> and C. V. Bhuv<sup>2</sup>

Department of Physics, Sardar Patel University, V. V. Nagar, Gujarat, India<sup>1</sup>

Department of Chemistry, Saurashtra University, Rajkot, Gujarat, India<sup>2</sup>

**ABSTRACT:** The title compound, 6-(2-Hydroxy-4,6-dimethyl-phenyl)-4-(2-methoxy-phenyl)5-nitro-3,4-dihydro-1H-pyrimidine-2-one, Methanol,  $C_{20}H_{23}N_3O_6$  is one of the significant members of pyrimidine derivative. Pyrimidine derivatives are of interest because of their wide range of biological activities. The crystal structure is determined using X-Ray crystallographic technique. The title compound crystallizes in monoclinic space group  $P2_1/n$  with  $Z=4$ . The crystallographic parameters are  $a=13.4804(4)$  Å,  $b=8.4765(3)$  Å,  $c=17.5985(5)$  Å and  $\beta=98.451(2)^\circ$ . The stability of the structure is due to weak but significant C-H...O, N-H...O,  $\pi$ - $\pi$ , and O-H...O interactions observed in the molecular packing of the title compound.

**KEYWORDS:** pyrimidine-2-one, X-ray crystallography, Crystal structure, molecular packing.

## **I. INTRODUCTION**

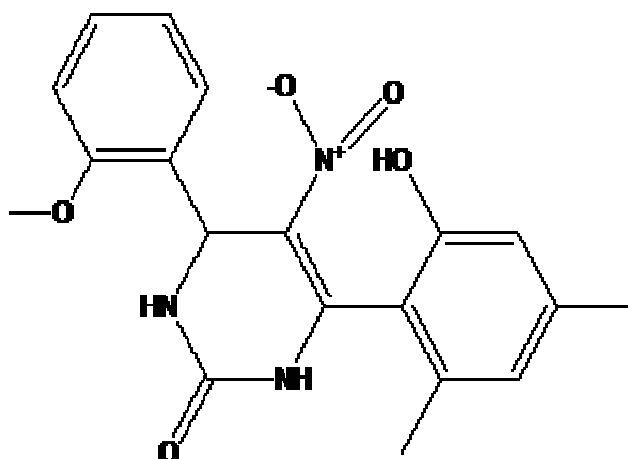
Pyrimidine derivatives are of interest because of their wide spectrum of pharmacological properties [1] such as antitumor, antibacterial, insulin releasing and anti-inflammatory activities [2-3] and also they occur in nature as components of nucleic acids. In the present work, X-ray crystal structure analysis has been undertaken in order to confirm the molecular structure and elucidation of intermolecular interactions involved therein. As part of our ongoing research on systematic characterization of novel heterocyclic compounds, we synthesized a pyrimidine derivative 6-(2-Hydroxy-4,6-dimethyl-phenyl)-4-(2-methoxy-phenyl)5-nitro-3,4-dihydro-1H-pyrimidine-2-one, Methanol. The chemical structure of the title compound is shown in Fig. 1.

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**Fig. 1:** The chemical structure of title compound

## II. MATERIALS AND METHODS

A suitable sample of single crystal of size  $(0.39 \times 0.25 \times 0.2) \text{ mm}^3$  is selected for crystallographic study. All diffraction measurements are performed at room temperature 296(2) K using graphite monochromated  $\text{MoK}\alpha$  radiation of wavelength  $0.71073 \text{ \AA}$ . The three dimensional X-ray intensity data are collected for  $\theta$  ranging from  $1.8^\circ$  to  $27.5^\circ$  using  $\omega$ - $2\theta$  scan mode on a KAPPA APEX II CCD Diffractometer [4] at Department of Physics, Sardar Patel University, Vallabh Vidyanagar.

## III. STRUCTURE SOLUTION AND REFINEMENT

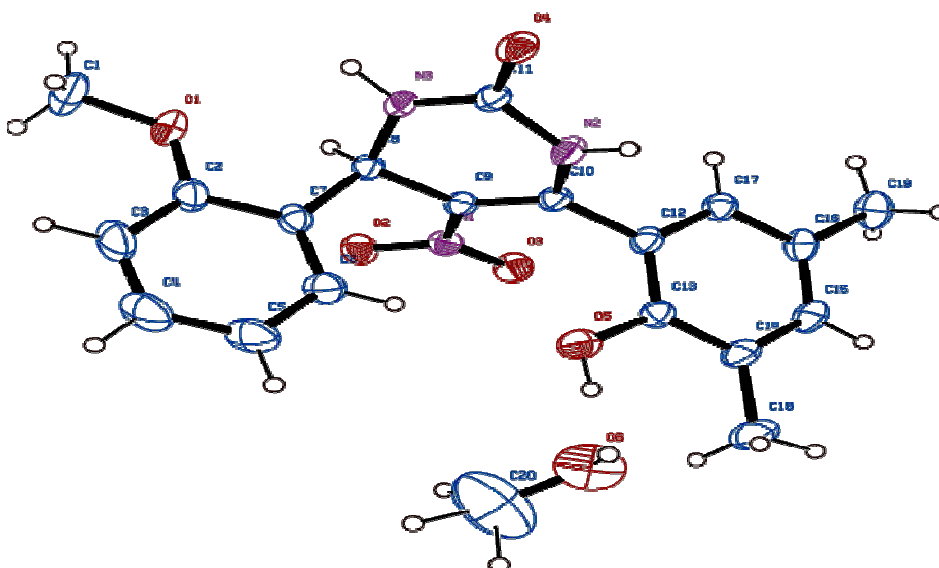
SHELXS-97 [5] and SHELXL-97 [6] built in WinGX [7] programme package are used to determine the phases, to locate the atomic positions and for refinement of the data to obtain a precise model of the structure. The phases obtained from the set are incorporated to generate an E-map. The values of  $R_{\text{int}} = 0.0239$  and  $R_{\text{sigma}} = 0.0247$  show that the quality of data is satisfactory. Full matrix least square refinement has been carried out using SHELX-97 software. Few cycles of isotropic refinement followed by another few cycles of anisotropic refinement of non hydrogen atoms led to an R-value of 0.09. All the hydrogen atoms are geometrically fixed and located from difference Fourier map and included in the refinement cycle which are allowed to ride on the corresponding non-hydrogen atoms with  $\text{C-H} = 0.93 - 0.97 \text{ \AA}$  and  $\text{O-H} = 0.82 \text{ \AA}$ . Final R value is 0.067 for 1953 ( $I > 2\sigma(I)$ ) reflections and 283 parameters. The weighting scheme employed is of the type  $W = \frac{1}{[\sigma^2(F_o^2) + (0.1022P)^2 + 0.7371P]}$  where  $P = (F_o^2 + 2F_c^2)/3$  with goodness of fit  $S = 1.04$  for 0 restraint. The crystallographic data along with the intensity and refinement data are summarized in Table 1. The ORTEP [8] diagram of the molecule showing 30% probability of the displacement ellipsoids is depicted in Fig. 2. The intermolecular hydrogen bonding interactions and the molecular graphics are prepared using PLATON [9] software programme. The selected bond lengths and bond angles are listed in Table 2.

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**Fig 1:** An ORTEP diagram of the title compound showing 30 % probability displacement ellipsoids

**Table 1:** The crystallographic data along with the intensity and refinement detail

Chemical name	:	6-(2-Hydroxy-4,6-dimethyl-phenyl)-4-(2-methoxyphenyl)-5-nitro-3,4-dihydro-1H-pyrimidin-2-one, Methanol
Chemical formula	:	C <sub>20</sub> H <sub>23</sub> N <sub>3</sub> O <sub>6</sub>
Molecular weight	:	401.41
Crystal system	:	Monoclinic
Space group	:	P2 <sub>1</sub> /n
a	:	13.4804(4) Å
b	:	8.4765(3) Å
c	:	17.5985(5)
$\alpha$	:	90.00 (0)°
$\beta$	:	98.451(2)°
$\gamma$	:	90.00 (0)°
Volume (V)	:	1989.09(11) Å <sup>3</sup>
Z	:	4
$\rho_c$	:	1.334 gm/cm <sup>3</sup>
$\mu$	:	0.10
Absorption correction	:	Not applied
F(000)	:	848
$\theta$ range for data collection (°)	:	1.8 to 27.5
Limiting indices	:	-17 ≤ h ≤ 16; -11 ≤ k ≤ 11; -22 ≤ l ≤ 21
measured reflections	:	16968
independent reflections	:	4549 (3358 reflections with $I > 2\sigma(I)$ )
R[F <sup>2</sup> > 2 $\sigma$ (F <sup>2</sup> )]	:	0.057

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wR(F <sup>2</sup> )	:	0.189
Goodness of fit (S)	:	1.02
Largest diff. peak and hole (e Å <sup>-3</sup> )	:	0.63 and -0.23
Software used to data collection	:	Bruker Smart Apex-II
Software used to refine the structure	:	SHELXL – 97
Software used for Molecular Graphics	:	PLATON

**Table 2:** The selected bond lengths (Å) and bond angles(°)

Atoms	Bond lengths (Å)	Atoms	Bond lengths (Å)
O1—C1	1.425 (3)	O6—N4	1.371 (6)
O1—C2	1.360 (3)	C9—N1	1.415 (2)
N1—O2	1.240 (2)	C10—N2	1.361 (3)
N1—O3	1.242 (2)	C10—C12	1.487 (2)
N3—C11	1.328 (2)	C13—O5	1.360 (2)
N3—C8	1.466 (2)	C20—O6	1.345(6)
O4—C11	1.222 (2)	C11—N2	1.399 (2)
Atoms	Bond angles (°)	Atoms	Bond angles (°)
N1—C9—C8	115.24 (15)	O4—C11—N3	125.38 (17)
O1—C2—C3	125.6 (2)	O4—C11—N2	119.09 (17)
O1—C2—C7	114.61 (18)	O5—C13—C14	123.55 (19)
C2—O1—C1	118.7 (2)	O5—C13—C12	116.09 (16)
C2—C7—C8	117.38 (18)	C9—C8—C7	114.19 (15)
N2—C10—C12	115.13 (16)	C9—C10—C12	127.06 (17)
O2—N1—O3	120.99 (16)	C9—C10—N2	117.76 (16)
O2—N1—C9	117.19 (15)	C10—C9—N1	122.09 (15)
N3—C8—C9	108.12 (14)	C10—N2—C11	124.53 (17)
N3—C8—C7	110.30 (15)	C11—N3—C8	125.76 (16)
N3—C11—N2	115.51 (17)	C13—C14—C18	121.3 (2)
O3—N1—C9	121.81 (15)	C16—C15—C14	123.26 (18)

## IV. RESULTS AND DISCUSSION

In the title molecule the N-C bond lengths of pyrimidine ring vary over a wide range from 1.328(2) to 1.466(2) Å and C11-N3-C8 opens up to 125.76(16)° respectively. The central dihydro pyrimidine ring with a chiral C8 atom is significantly puckered to adopt a twist boat conformation. The ring puckering parameters [10] for the pyrimidine ring are Q(2) = 0.233 (2) Å,  $\phi(2) = 172.5 (5)^\circ$  and  $\theta = 110.5 (4)^\circ$ . The atoms C8 and N2 deviate from the mean plane of the remaining ring atoms (N3/C9/C10/C11) by -0.1579 (2) Å and -0.0958 (2) Å respectively. Both the phenyl rings are planar. Substituents methyl, methoxy, hydroxyl group are almost occupying the same plane with the respective rings whereas nitrogen N1 deviated significantly out of pyrimidine ring plane. The least square plane of puckered central pyrimidine ring is almost perpendicular to both the substituted phenyl ring with dihedral angles of 78.18(6)° & 72.81(6)°

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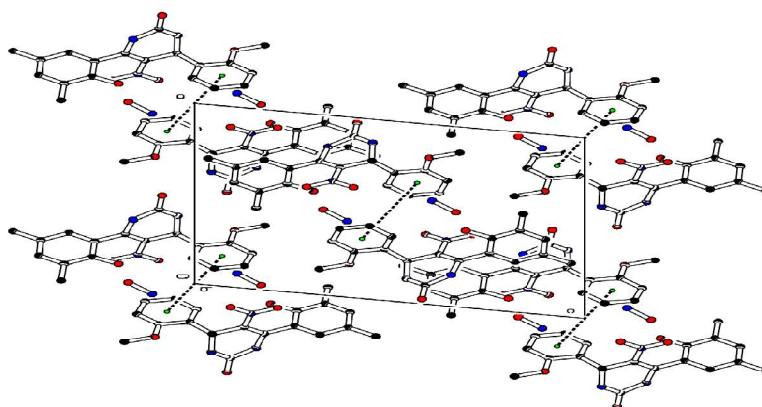
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respectively. Molecular stacking is supported by weak but rare face to face  $\pi$ - $\pi$  stacking interaction (Figure 3.) observed between the centroids of the planes of six membered phenyl rings (C2-C7) at 1-x,-y,1-z with their centroids separated by 4.858 Å and dihedral angle 0°.

Hydroxyl oxygen O5 acts as bifurcated donor to Nitric oxide oxygen O6 & nitrogen N4: O5 via H5a works as donor to nitric oxide O6 forming pseudo six- membered ring of S (6) graph set motif and hydroxyl oxygen O5 as acceptor to C6 of methoxy phenyl ring. Both the pyrimidine nitrogens N3 and N2 work as donor via H3A and H2A to oxygen O4 and O3 at 2-x,-y,1-z and 3/2-x,-1/2+y,1/2-z respectively. Molecular packing is further stabilized by weak but quite a good no of C-H...O interactions (Figure 4). Phenyl ring carbon atom C5 in the molecule at (x, y, z) acts as donor to atom O2 at (1-x,-y,1-z). Further stability of compound due to N-H...O hydrogen bond interactions as shown in the Figure 5. Hydroxyl oxygen O5 forms O-H...O interaction with O6 via H5A are shown in Figure 6. All these weak but significant hydrogen bond interactions play important role for molecular stability.

**Table 3:** Intra and intermolecular N-H...O, C-H...O, O-H...O and  $\pi$ ... $\pi$  interactions (distances in Å, angles in °)

A. $\pi$ - $\pi$ interaction						
Cg(I)- Cg(J)	Cg(I)...Cg(J) $^{\circ}$	$\alpha$	$\beta$	$\gamma$	Cg(I)...P $^{\circ}$	Cg(J)...P $^{\circ}$
Cg2- Cg2(ii)	4.858	0	46.3	46.3	3.3581(11)	3.3581(11)
B. Hydrogen bond interactions						
D-H...A	d(D-H) $^{\circ}$	d (D-A) $^{\circ}$	d (H- A) $^{\circ}$		$\angle$ D-H...A $^{\circ}$	
C6-H6...O5	0.93	3.443(3)	2.513(2)		179.04(13)	
O5 - H5A ...N4	0.82	3.478(7)	2.878(7)		131.68(19)	
C18 - H18C ...O6	0.96	3.426(4)	2.755(3)		127.59(17)	
N3-H3A...O4 (iv)	0.90(2)	2.884(2)	1.990(2)		174.28(28)	
N2 - H2A ...O3 (v)	0.84(2)	3.099(2)	2.31(2)		157.63(22)	
C5-H5...O2 (iii)	0.93	3.342(3)	2.599(2)		137.16(18)	
O5 - H5A...O6 (vi)	0.82	2.742(3)	2.102(3)		134.80(15)	
C. Symmetry Code						
(ii)	3/2-x,1/2+y,1/2-z	(iii)	-x+1,-y,-z+1			
(iv)	2-x,-y,1-z	(v)	3/2-x,-1/2+y,1/2-z			
(vi)	1/2-x,-1/2+y,1/2-z					
Note: Cg (2) represents the centroid of the ring (C2-C7).						



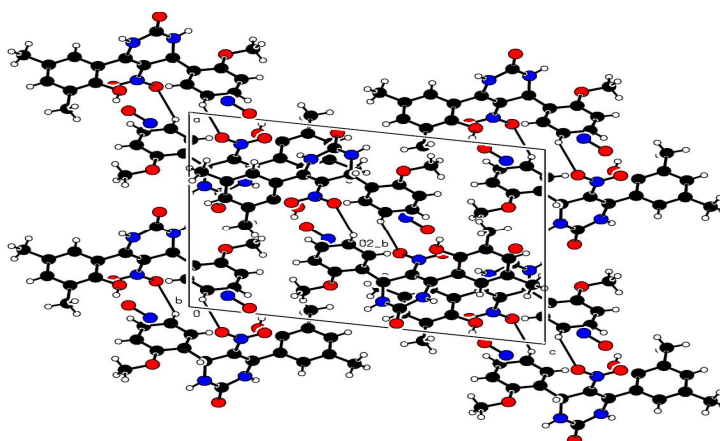
**Fig. 3:** Part of molecular packing diagram displaying the  $\pi$ - $\pi$  interaction on ac plane

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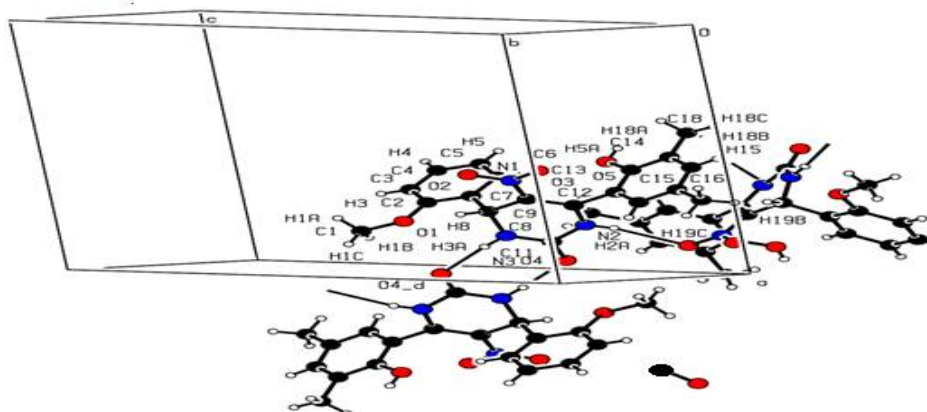
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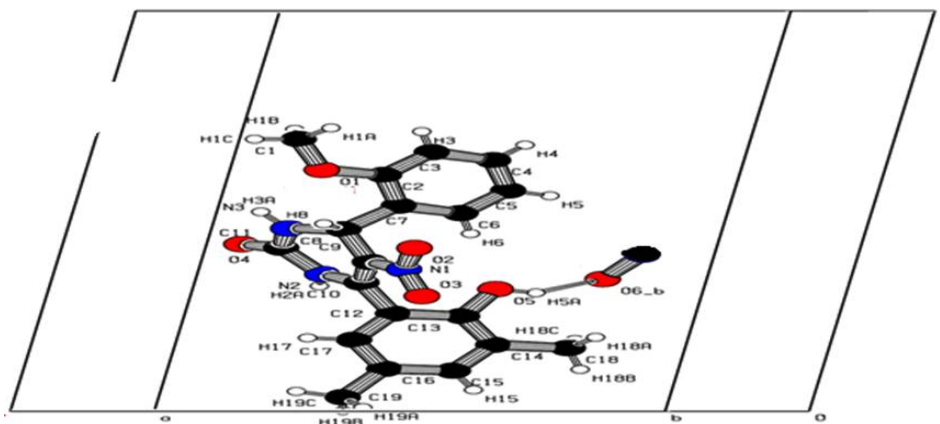
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**Fig. 4:** Part of molecular packing diagram showing C5-H5...O2 interactions



**Fig. 5:** N-H...O hydrogen bond interactions



**Fig. 6:** O5-H5A...O6 hydrogen bond interaction

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## V. CONCLUSION

Single crystals of the title compound are successfully grown from methanol solution by slow evaporation technique. The title compound characterized by single crystal X-ray diffraction technique and its three dimensional structures is worked out. The stability of the molecule is given by the hydrogen bond C-H...O, N-H...O and O-H...O interactions. The contribution of  $\pi$ -  $\pi$  interaction also plays significant role in molecular stability.

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