



## Synthesis and Characterization of *N*-(2,3-Dihydro-1,5-dimethyl-3-oxo-2-phenyl-1*H*-pyrazol-4-yl)acetamide Hemi Acetic Acid Solvate

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The compound *N*-(2,3-dihydro-1,5-dimethyl-3-oxo-2-phenyl-1*H*-pyrazol-4-yl)acetamide ( $C_{13}H_{15}N_3O_2$ ) was synthesized and characterized by elemental analysis and IR spectra. The single crystal of the *N*-(2,3-dihydro-1,5-dimethyl-3-oxo-2-phenyl-1*H*-pyrazol-4-yl)acetamide hemi acetic acid ( $C_{14}H_{17}N_3O_3$ ,  $M_r = 275.31$ ) was synthesized and characterized by single crystal X-ray diffraction. X-Ray diffraction analysis revealed that the asymmetric unit of the title compound contains one *N*-(2,3-dihydro-1,5-dimethyl-3-oxo-2-phenyl-1*H*-pyrazol-4-yl)acetamide molecule and hemi acetic acid molecules, and the latter are disordered. The dihedral angle between the phenyl ring and the pyrazole ring is  $49.3(2)^\circ$ . The crystal structure of the title compound is stabilized by C-H...O, N-H...O and O-H...O hydrogen bonds interactions.

**Key Words:** Acetamide, Synthesis, Characterization, Crystal structure.

### INTRODUCTION

The nitrogen heterocycle compounds are important part of the chemical structures of many natural and synthetic products with a large number and variety of applications and a wide range of properties, from medical to toxic effects. A large number of new nitrogen heterocycle compounds have been synthesized<sup>1-3</sup>. Antipyrine (2,3-dimethyl-1-phenyl-5-pyrazolone) and its derivatives are a class of nitrogen heterocycle compounds and they exhibit a wide variety of potentially useful biological activities and applications<sup>4-6</sup>. Nowadays antipyrine and its derivatives are widely used in medicine as antiphlogistic species<sup>7</sup>. Therefore, the investigations of synthesis and properties of these antipyrine derivatives were very interesting<sup>7-12</sup>. However, the crystal structure of *N*-(2,3-dihydro-1,5-dimethyl-3-oxo-2-phenyl-1*H*-pyrazol-4-yl)acetamide have never been reported so far. Investigation of their structures may help us to explore the interactions among the molecules, design and synthesize new antipyrine derivatives, as well as evaluate the potential medicinal applications. In this paper, the synthesis and characterization of *N*-(2,3-dihydro-1,5-dimethyl-3-oxo-2-phenyl-1*H*-pyrazol-4-yl)acetamide (**I**) and the crystal structures of *N*-(2,3-dihydro-1,5-dimethyl-3-oxo-2-phenyl-1*H*-pyrazol-4-yl)acetamide hemi acetic acid solvate (**II**) are reported.

### EXPERIMENTAL

All the reagents were of AR grade and used without further purification. IR spectra ( $4000-400\text{ cm}^{-1}$ ), as KBr pellets, were

recorded on a Nicolet FT-IR 510P spectrometer. <sup>1</sup>H NMR spectra were measured with a Bruker ALP 80 nuclear magnetic resonance spectrometer ( $CD_3COCD_3$  as solvent, TMS as internal standard).

The synthesis of the compound **I** and **II** is described below:

The compound **I** was synthesized according to the literature<sup>13,14</sup>. To a solution of antipyrine (1.015 g, 5 mmol) in ethanol (20 mL), acetic anhydride (0.561 g, 5.5 mmol) was added drop by drop, the solution was stirred magnetically for 2 h at room temperature and then was filtered. The filtration was evaporated, the product was filtered and dried. Yield 87.4%. Anal. calcd. (%) for  $C_{13}H_{15}N_3O_2$ : C 63.67, H 6.12, N 17.14. Found (%): C 63.59, H 6.24, N 17.10. Selected IR data ( $cm^{-1}$ ): 1601, 1500 and  $1453\text{ cm}^{-1}$  (s, -Ar), 1724 and  $1669\text{ cm}^{-1}$  (s, -C=O).

A 15 mg of the compound **I** was dissolved in ethanol/acetic acid solution of 20 mL. The solution was filtered to remove impurities and then left for crystallization at room temperature. The single crystal of the compound **II** suitable for X-ray determination was obtained by evaporation from the solution after 10 d.

**Data collection and structure determination:** A selected crystal of the title compound was mounted on a SMART CCD diffractometer. The reflection data were measured at 298 K, using a graphite monochromator  $MoK_\alpha$  ( $\lambda = 0.71073\text{ \AA}$ ) radiation with an  $\omega$ - $2\theta$  scan mode. The total reflections were 5454 with 1975 independent ones ( $R_{int} = 0.0452$ ), of which

1210 were observed with  $I > 2\sigma(I)$ . Intensities were corrected for Lorentz and polarization effects and empirical absorption and all data were corrected using SADABB<sup>15</sup> program.

The structure was solved by direct methods using SHELXS-97<sup>16</sup> program. All the non-hydrogen atoms were refined on  $F^2$  anisotropically by full-matrix least squares method. All hydrogen atoms were placed in the geometrically calculated positions. The contributions of these hydrogen atoms were included in the structure factor calculations. The atomic scattering factors and anomalous dispersion corrections were taken from International Table for X-ray crystallography<sup>17</sup>. The final least-square cycle gave  $R = 0.0450$  and  $wR = 0.1086$  ( $w = 1/[\sigma^2(F_o^2) + (0.0602P)^2 + 0.0828P]$ , where  $P = (F_o^2 + 2F_c^2)/3$ ).  $S = 1.087$ ,  $(\Delta/\sigma)_{\max} = 0.001$ ,  $(\Delta\rho)_{\min} = -0.161$  and  $(\Delta\rho)_{\max} = 0.165 \text{ e}/\text{\AA}^3$ .

## RESULTS AND DISCUSSION

The atomic coordinates and equivalent isotropic thermal parameters for the non-H atoms in the title compound are given in Table-1. The selected bond distances and bond angles are given in Table-2. The hydrogen bond schemes are given in Table-3. A displacement ellipsoid plot with atomic numbering scheme is shown in Fig. 1 and a perspective view of the crystal packing in the unit cell in Fig. 2.

TABLE-1  
ATOMIC COORDINATES ( $\times 10^4$ ) AND  
THERMAL PARAMETERS ( $\text{\AA}^2 \times 10^3$ )

Atom	x	y	Z	U (eq)
N(1)	5789(1)	6696(3)	1272(1)	45(1)
N(2)	5461(1)	4865(3)	1177(1)	48(1)
N(3)	4180(1)	8080(3)	177(1)	45(1)
O(1)	5546(1)	9830(2)	826(1)	50(1)
O(2)	3512(1)	7613(3)	796(1)	66(1)
O(3)	4460(2)	7102(7)	1993(2)	80(1)
O(4)	4489(3)	10325(8)	2028(3)	114(2)
C(1)	5367(1)	8112(4)	887(1)	40(1)
C(2)	4746(1)	7119(3)	599(1)	39(1)
C(3)	4813(1)	5208(3)	791(1)	44(1)
C(4)	4306(1)	3606(4)	645(1)	62(1)
C(5)	5620(1)	3578(4)	1748(1)	65(1)
C(6)	6503(1)	6767(4)	1455(1)	48(1)
C(7)	6857(1)	5322(4)	1259(1)	65(1)
C(8)	7550(2)	5497(6)	1420(1)	81(1)
C(9)	7870(2)	7101(6)	1758(2)	83(1)
C(10)	7517(1)	8527(5)	1955(1)	76(1)
C(11)	6833(1)	8367(4)	1805(1)	61(1)
C(12)	3605(1)	8352(4)	316(1)	48(1)
C(13)	3081(1)	9577(4)	-159(1)	65(1)
C(14)	4698(2)	8694(8)	2224(2)	89(1)
C(15)	4698(2)	8694(8)	2224(2)	89(1)

As seen from Fig. 1, the asymmetric unit of the title compound contains one **I** molecule and hemi acetic acid molecules. And the latter are disordered. The phenyl ring is nearly planar to within  $0.004(2) \text{ \AA}$ . The pyrazole ring is nearly planar to within  $0.022(2) \text{ \AA}$ , the displacements of C4, C5, N3 and O1 are  $0.101(2)$ ,  $0.734(2)$ ,  $-0.022(2)$  and  $-0.105(3) \text{ \AA}$ , respectively, from this plane. The dihedral angle between the two planes is  $49.3(2)^\circ$ . The bond lengths and bond angles are as expected. The C-N bond lengths of  $1.346(3)$ - $1.465(3) \text{ \AA}$  conform to the

TABLE-2  
SELECTED BOND LENGTHS ( $\text{\AA}$ ) AND BOND ANGLES ( $^\circ$ )

Bond	Length ( $\text{\AA}$ )	Bond	Angle ( $^\circ$ )
N(1)-C(1)	1.388(3)	C(1)-N(1)-N(2)	109.36(18)
N(1)-N(2)	1.399(2)	N(2)-N(1)-C(6)	119.67(18)
N(1)-C(6)	1.424(3)	C(3)-N(2)-N(1)	106.62(17)
N(2)-C(3)	1.370(3)	N(1)-N(2)-C(5)	115.55(19)
N(2)-C(5)	1.465(3)	O(1)-C(1)-N(1)	123.6(2)
N(3)-C(12)	1.346(3)	O(2)-C(12)-N(3)	122.1(2)
N(3)-C(2)	1.406(3)	O(2)-C(12)-C(13)	122.1(2)
O(1)-C(1)	1.240(2)	N(3)-C(12)-C(13)	115.8(2)
O(2)-C(12)	1.227(3)	O(4)-C(14)-O(3)	126.8(5)
O(3)-C(14)	1.225(5)	C(11)-C(6)-N(1)	118.7(2)
O(4)-C(14)	1.212(5)	—	—

TABLE-3  
HYDROGEN BOND SCHEMES ( $\text{\AA}, ^\circ$ )

D-H...A	D-H	H...A	D-A	D-H...A
N3-H3...O1 <sup>i</sup>	0.86	1.983	2.809	161
O3-H3A...O2 <sup>ii</sup>	0.82	1.959	2.750	162
C5-H5C...O1 <sup>iii</sup>	0.96	2.504	3.203	130
C13-H13A...O2 <sup>iv</sup>	0.96	2.580	3.509	163

Symmetry codes: (i)  $-x, 1-y, -z$ ; (ii)  $-1/2-x, 1/2-y, -z$ ; (iii)  $x, -1+y, z$ ; (iv)  $-x, y, 1/2-z$ .

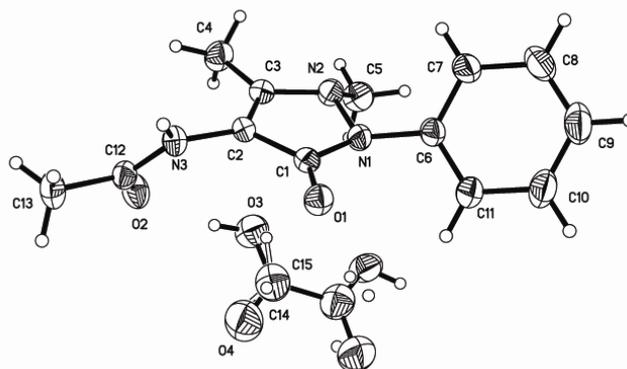


Fig. 1. Molecular structure with atomic numbering scheme

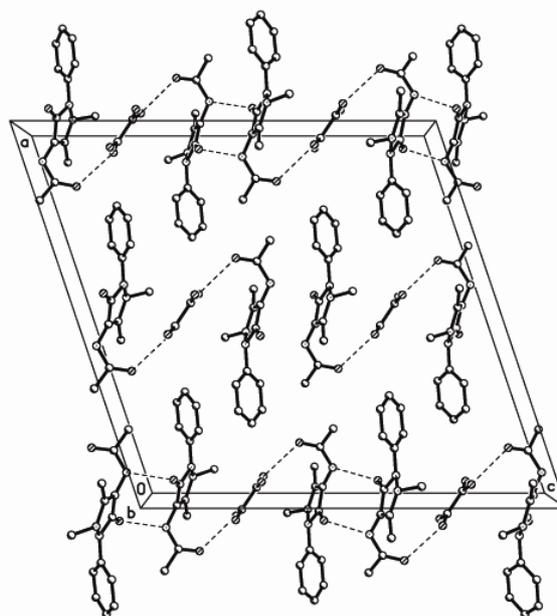


Fig. 2. View of crystal packing down the b-axis

value for a single bond. All the bond lengths and bond angles in the title compound are within normal ranges and comparable to those in the similar compound<sup>11,12</sup>. The crystal structure of the title compound is stabilized by C-H...O, N-H...O and O-H...O hydrogen bonds interactions (Fig. 2 and Table-3).

As seen from Table-3 and Fig. 2, in the crystal structure, the O atoms of the compound **I** act as hydrogen-bonding acceptors receiving H atoms from the another compound **I** and acetic acid, respectively, to form weak intermolecular C-H...O, N-H...O and O-H...O hydrogen bonds. Fig. 2 shows the molecules are interlinked, *via* the weak intermolecular hydrogen bonds interactions, to form a linear chain framework.

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### REFERENCES

1. A. Davoodnia, M. Roshani, E.S. Nadim, M. Bakavoli and N. Tavakoli-Hoseini, *Chin. Chem. Lett.*, **27**, 1327 (2007).
2. Y. Zhang, J.Z. Li and H.Q. Zhang, *Chin. J. Struct. Chem.*, **27**, 519 (2008).
3. Y.H. Wang, H. Lin and H.K. Lin, *Chin. J. Struct. Chem.*, **27**, 163 (2008).
4. A. Lodzinska, F. Golinska and F. Rozploch, *Polish J. Chem.*, **63**, 355 (1989).
5. E.I. Abd, S.S. Rehim, M.A.M. Ibrahim and K.F. Khalid, *Mater. Chem. Phys.*, **70**, 268 (2001).
6. P.N. Yadav, M.A. Demertzis, D. Kovala-Demertzi, S. Skoulika and D.X. West, *Inorg. Chim. Acta*, **349**, 30 (2003).
7. M.P. Marqucs, O.M. Takayanagui and V.L. Lanchotc, *Braz. J. Med. Biol. Res.*, **35**, 261 (2002).
8. T. Hökelek, Z. Kiliç and Z. Hayvali, *Anal. Sci.*, **18**, 495 (2002).
9. T. Hökelek, M. Isiklan and Z. Kiliç, *Acta Cryst.*, **C57**, 117 (2001).
10. M.H. Yang, G.B. Yan, Y.F. Zheng and C.N. Zhang, *Acta Cryst.*, **E57**, o4944 (2006).
11. H.Y. Jin, J.Z. Chen, X.W. Wang and S.E. Hou, *J. Chem. Cryst.*, **30**, 182 (2009).
12. F. Guo, C.F. Bi, Y.H. Fan, A.D. Wang, J.K. Xu and X. Zhang, *J. Ocean. Univ. Chin.*, **7**, 166 (2008).
13. J.L. Wang, Y. Yang, M.Z. Zhang, X. Zhang and F.M. Miao, *Chin. J. Struct. Chem.*, **22**, 351 (2003).
14. D.X. Shi, Y.Q. Feng, X.F. Li and S.X. Meng, *Acta Cryst.*, **E59**, o1068 (2003).
15. G.M. Sheldrick, SADABS, Program for Empirical Absorption Correction of Area Detector Data, University of Gottingen, Germany (1996).
16. G.M. Sheldrick, SHELXTL V 5.1 Software Reference Manual, Bruker AXS, Inc., Madison, Wisconsin, USA (1997).
17. Siemens, SMART and SAINT, Area Detector Control and Integration Software, Siemens Analytical X-Ray Systems, Inc., Madison, Wisconsin, USA (1996).