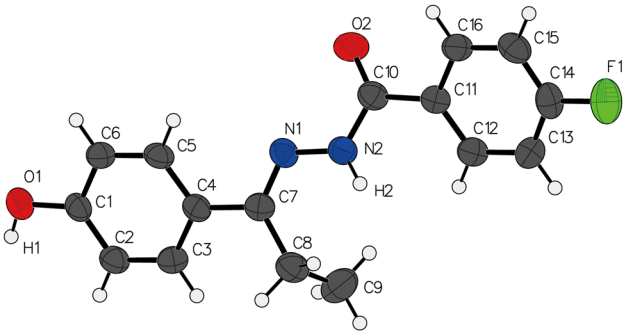
Juanjuan Wen, Langlang Liu, Wenqiang Tang* and Bin Liu

The crystal structure of (*E*)-4-fluoro-*N*′-(1-(4-hydroxyphenyl)propylidene)benzohydrazide, $C_{16}H_{15}FN_2O_2$



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Abstract

$C_{16}H_{15}FN_2O_2$, orthorhombic, $P2_12_12_1$ (no. 19), a = 7.2516(6) Å, b = 11.3780(9) Å, c = 17.1177(13) Å, V = 1412.36(19) Å^3, Z = 4, R_{gt}(F) = 0.0498, $wR_{ref}(F^2)$ = 0.1201, T = 293 K.

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The molecular structure is shown in the figure. Table 1 contains crystallographic data and Table 2 contains the list of the atoms including atomic coordinates and displacement parameters.

Table 1: Data collection and handling.

Crystal:	Colorless block
Size:	0.32 × 0.25 × 0.22 mm
Wavelength:	Mo *K*α radiation (0.71073 Å)
μ:	0.10 mm^{-1}
Diffractometer, scan mode:	SuperNova, ω
θ_{max}, completeness:	29.2°, >99 %
$N(hkl)_{measured}$, $N(hkl)_{unique}$, R_{int}:	4708, 2860, 0.016
Criterion for I_{obs}, $N(hkl)_{gt}$:	I_{obs} > 2 σ(I_{obs}), 2160
$N(param)_{refined}$:	192
Programs:	CrysAlis^{PRO} [1], SHELX [2, 3], Olex2 [4]

1 Source of materials

The synthesis and crystallization of the title compound were conducted following established laboratory protocols. In a 100 mL round-bottom flask, equipped with a stir bar and rubber septum, 4-fluorobenzohydrazide (0.15 g, 1 mmol) and 4-hydroxypropiophenone (0.15 g, 1 mmol) were combined with 5 drops of glacial acetic acid. To this mixture, 25 mL of absolute alcohol was added, and the resulting solution was stirred for 10 min at 50 °C. The stirring was continued for an additional 5 h to allow completion of the desired reactions. Subsequently, the solvent was evaporated to dryness using a rotary evaporator, yielding the crude product. The crude product was dissolved in a minimal amount of hot ethanol under controlled heating conditions, and the solution was gradually cooled to room temperature. During this cooling process crystal formed.

2 Experimental details

The crystal structure was solved in SHELXT [2] and refined in SHELXL [3]. The crystal structure was visually represented using the OLEX2 software package [4].

3 Comment

The benzohydrazide moiety has demonstrated its versatility in the development of biologically active compounds, establishing

***Corresponding author: Wenqiang Tang**, Xianyang Key Laboratory of Molecular Imaging and Drug Synthesis, School of Pharmacy, Shaanxi Institute of International Trade & Commerce, Xianyang, Shaanxi, China, E-mail: twqsxcq@163.com. https://orcid.org/0000-0001-5150-4549
Juanjuan Wen, School of Pharmacy, Shaanxi Institute of International Trade & Commerce, Xianyang, 712046, Shaanxi, China; and School of Chemistry and Chemical Engineering, Shaanxi Normal University, Xi'an 710119, Shaanxi, China
Langlang Liu, Shaanxi Baotashan Paint Co., Ltd., Xingping 713100, Shaanxi, China
Bin Liu, Xianyang Key Laboratory of Molecular Imaging and Drug Synthesis, School of Pharmacy, Shaanxi Institute of International Trade & Commerce, Xianyang, Shaanxi, China. https://orcid.org/0000-0003-2852-7739

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Table 2: Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å^2).

Atom	*x*	*y*	*z*	U_{iso}*/U_{eq}
C1	0.4179 (4)	0.5129 (2)	0.14129 (18)	0.0378 (7)
C2	0.4952 (4)	0.4202 (3)	0.18177 (18)	0.0418 (8)
H2A	0.546372	0.357113	0.154920	0.050*
C3	0.4959 (5)	0.4220 (3)	0.26259 (18)	0.0423 (8)
H3	0.546971	0.358864	0.289482	0.051*
C4	0.4223 (4)	0.5156 (2)	0.30491 (17)	0.0372 (7)
C5	0.3438 (4)	0.6076 (3)	0.26239 (18)	0.0410 (7)
H5	0.292256	0.670936	0.288907	0.049*
C6	0.3412 (4)	0.6064 (3)	0.18199 (19)	0.0435 (8)
H6	0.287755	0.668473	0.154834	0.052*
C7	0.4290 (5)	0.5198 (3)	0.39095 (17)	0.0390 (7)
C8	0.4582 (5)	0.4076 (3)	0.43688 (19)	0.0489 (8)
H8A	0.424803	0.341036	0.404390	0.059*
H8B	0.376914	0.407758	0.481886	0.059*
C9	0.6562 (6)	0.3924 (4)	0.4646 (2)	0.0710 (12)
H9A	0.736559	0.386673	0.420201	0.107*
H9B	0.665753	0.322066	0.495323	0.107*
H9C	0.691194	0.458888	0.495791	0.107*
C10	0.4252 (5)	0.7362 (3)	0.53709 (17)	0.0410 (7)
C11	0.4259 (4)	0.7309 (3)	0.62433 (16)	0.0366 (7)
C12	0.5028 (5)	0.6387 (3)	0.66628 (19)	0.0462 (8)
H12	0.557782	0.576515	0.639811	0.055*
C13	0.4983 (5)	0.6384 (3)	0.7468 (2)	0.0499 (8)
H13	0.548701	0.576391	0.775074	0.060*
C14	0.4180 (5)	0.7314 (3)	0.78400 (18)	0.0467 (8)
C15	0.3408 (5)	0.8241 (3)	0.7453 (2)	0.0483 (9)
H15	0.286070	0.885714	0.772458	0.058*
C16	0.3465 (4)	0.8238 (3)	0.66471 (19)	0.0431 (8)
H16	0.296476	0.886608	0.637130	0.052*
F1	0.4154 (3)	0.7316 (2)	0.86353 (11)	0.0733 (7)
N1	0.4175 (4)	0.6235 (2)	0.42101 (14)	0.0411 (6)
N2	0.4213 (4)	0.6301 (2)	0.50161 (14)	0.0437 (6)
H2	0.421044	0.566907	0.529132	0.052*
O1	0.4081 (4)	0.51687 (19)	0.06185 (12)	0.0533 (6)
H1	0.457084	0.458080	0.043487	0.080*
O2	0.4244 (4)	0.82914 (19)	0.50187 (13)	0.0633 (7)

itself as a promising structural motif for drug discovery [5]. Previous single crystal structure studies have revealed that these compounds can exhibit either cis or trans conformation around the C=N double bond, with intramolecular hydrogen bond interactions occurring [6–9]. In this study, we present a crystal structure, which exhibits a hydrogen bonding network involving the hydroxy group and hydrazide group.

The compound's molecular configuration demonstrates an *E* conformation with regards to the C7=N1 bond, and exhibits torsion as evidenced by a dihedral angle of 56.7° between the two aryl rings. Within the crystal structure, intermolecular interactions are formed via O1–H1···O2 hydrogen bonds, arranging the molecules into parallel sheets aligned with the *bc* plane. Supplementary π···π interactions contribute to the formation of a three-dimensional network. All bond lengths fall within typical ranges and are consistent with those reported for similar compounds [10–14].

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References

1. Rigaku Oxford Diffraction Ltd. *CrysAlis^{Pro}*; Rigaku Oxford Diffraction: Abingdon, Oxfordshire, England, 2023.
2. Sheldrick G. M. *SHELXTL* – integrated space-group and crystal-structure determination. *Acta Crystallogr.* 2015, *A71*, 3–8.
3. Sheldrick G. M. Crystal structure refinement with SHELXL. *Acta Crystallogr.* 2015, *C71*, 3–8.
4. Dolomanov O. V., Bourhis L. J., Gildea R. J., Howard J. A. K., Puschmann H. OLEX2: a complete structure solution, refinement and analysis program. *J. Appl. Cryst.* 2009, *42*, 339–341.
5. Korkmaz I. N., Türkeş C., Demir Y., Öztekin A., Özdemir H., Beydemir Ş. Biological evaluation and in silico study of benzohydrazide derivatives as paraoxonase 1 inhibitors. *J. Biochem. Mol. Toxic.* 2022, *36*, e23180.
6. Liu B., Liu H., Zhang H., Di Q., Zhang H. Crystal engineering of a hydrazone molecule toward high elasticity and bright luminescence. *J. Phys. Chem. Lett.* 2020, *11*, 9178–9183.
7. Alifu Z., Nizhamu M., Ablajan K. Efficient synthesis of N′-benzylidene-2-hydroxymethylbenzohydrazides from the one-pot reaction of phthalide, hydrazine and aldehydes. *Res. Chem. Intermediat.* 2019, *45*, 4779–4788.
8. Hao Y.-M. Crystal structure of 2-chloro-N′-(2-methoxybenzylidene) benzohydrazide, $C_{15}H_{13}ClN_2O_2$. *Z. Kristallogr. N. Cryst. Struct.* 2011, *226*, 11–12.
9. Ajayeoba T. A., Woods J. O., Ayeni A. O., Ajayi T. J., Akeem R. A., Hosten E. C., Akinyele O. F. Synthesis, crystallographic, computational and molecular docking studies of new acetophenone-benzoylhydrazones. *J. Mol. Struct.* 2021, *1237*, 130275.
10. Fun H.-K., Horkaew J., Chantrapromma S. (*E*)-4-Hydroxy-N′-(3-hydroxy-4-methoxybenzylidene)benzohydrazide. *Acta Crystallogr*. 2011, *E67*, o2644–o2645.
11. Xue L.-W., Han Y.-J., Zhao G.-Q., Feng Y.-X. Synthesis, characterization and crystal structures of N′-(5-bromo-2-hydroxybenzylidene)-

2-fluorobenzohydrazide in unsolvated and monohydrate forms. *J. Chem. Crystallogr*. 2011, *41*, 1599–1603.
12. Zhu H.-Y. Synthesis, characterization, and crystal structures of 3-bromo-N′-(2-methoxybenzylidene)benzohydrazide and N′ -(2-methoxybenzylidene)-3,4-methylenedioxybenzohydrazide. *J. Chem. Crystallogr.* 2011, *41*, 1785–1789.
13. Ferraresi-Curotto V., Echeverría G. A., Piro O. E., Pis-Diez R., González-Baró A. C. Structural, spectroscopic and DFT study of 4-methoxybenzohydrazide Schiff bases. A new series of polyfunctional ligands. *Spectrochim. Acta, Part A* 2015, *137*, 692–700.
14. Bai Z.-C., Li H., Liu Y., Jing Z.-L. N′-(2,4-Dichlorobenzylidene)-2-methoxybenzohydrazide. *Acta Crystallogr*. 2006, *E62*, o2295–o2296.