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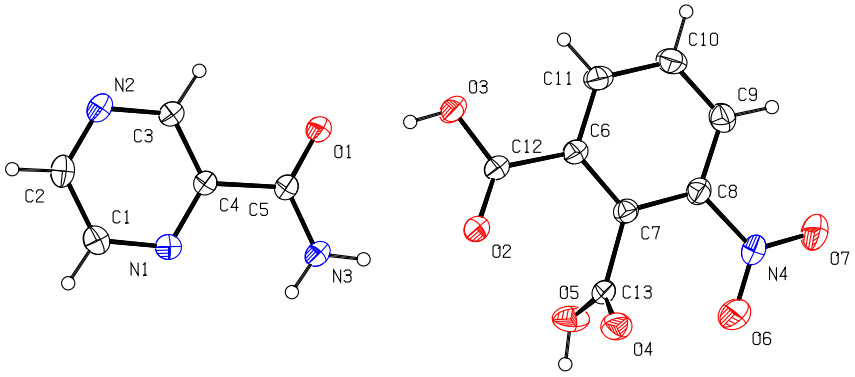
The crystal structure of 3-nitrobenzene-1,2-dicarboxylic acid—pyrazine-2-carboxamide(1/1), $C_{13}H_{10}N_4O_7$



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Abstract

$C_{13}H_{10}N_4O_7$, monoclinic, $P2_1/n$ (no. 14), a = 10.7017(7) Å, b = 7.1240(5) Å, c = 19.0878(13) Å, β = 99.280(3)°, V = 1436.19(17) Å^3, Z = 4, $R_{gt}(F)$ = 0.0586, $wR_{ref}(F^2)$ = 0.1746, T = 296.15 K.

CCDC no.: 2206393.

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:	Colourless block
Size:	0.48 × 0.35 × 0.29 mm
Wavelength:	Mo $K\alpha$ radiation (0.71073 Å)
μ:	0.13 mm^{-1}
Diffractometer, scan mode:	Bruker D8 Venture, φ and ω
θ_{max}, completeness:	27.2°, >99 %
$N(hkl)_{measured}$, $N(hkl)_{unique}$, R_{int}:	20,755, 3189, 0.034
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\sigma(I_{obs})$, 2684
$N(param)_{refined}$:	219
Programs:	Bruker [1], Olex2 [2], SHELX [3, 4]

Source of materials

The mixture of pyrazinamide and 3-nitrophthalic acid with a molar ratio of 1:1 was dissolved in deionized water, and the resulting mixed solution was stirred and dissolved in a constant temperature water bath at 30 °C to obtain a clear solution. The solution was filtered and placed in a sample vial, covered with membrane and punctured. The filtrate was slowly evaporated at room temperature to obtain crystals of the title compound.

Experimental details

Absorption corrections were applied by using multi-scan program [1]. Using Olex2 [2], the structure was solved with the ShelXT [3] structure solution program and refined with the ShelXL [4] refinement package. The H atoms were fixed, fixed U_{iso} were set to 1.2 times of all C(H) groups and N(H, H) groups; 1.5 times of O(H) groups.

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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}
O1	0.56030 (14)	0.6521 (2)	0.80568 (8)	0.0554 (4)
N1	0.39272 (16)	1.0651 (2)	0.83422 (10)	0.0491 (4)
N2	0.60064 (18)	1.1038 (3)	0.94184 (10)	0.0539 (5)
N3	0.36314 (15)	0.7425 (2)	0.75681 (9)	0.0475 (4)
H3A	0.352312	0.647621	0.728643	0.057*
H3B	0.303967	0.824517	0.756137	0.057*
C1	0.4089 (2)	1.2159 (3)	0.87595 (14)	0.0618 (6)
H1	0.349051	1.311502	0.868907	0.074*
C2	0.5118 (2)	1.2347 (3)	0.92937 (13)	0.0597 (6)
H2	0.518990	1.342165	0.957370	0.072*
C3	0.58626 (19)	0.9533 (3)	0.89993 (10)	0.0463 (5)
H3C	0.647217	0.859162	0.906400	0.056*
C4	0.48247 (16)	0.9344 (2)	0.84700 (9)	0.0371 (4)
C5	0.47010 (17)	0.7623 (3)	0.80088 (10)	0.0382 (4)
O2	0.38517 (13)	0.3770 (2)	0.68504 (8)	0.0546 (4)
O3	0.58489 (14)	0.3501 (3)	0.73787 (10)	0.0666 (5)
H3	0.570195	0.452311	0.754514	0.100*
O4	0.19355 (13)	0.1258 (2)	0.59364 (8)	0.0515 (4)
O5	0.31431 (14)	0.2893 (2)	0.53055 (8)	0.0550 (4)
H5	0.246717	0.335789	0.512353	0.083*
O6	0.2637 (2)	−0.0980 (3)	0.48266 (13)	0.1094 (10)
O7	0.3765 (2)	−0.3365 (3)	0.48143 (12)	0.0877 (7)
N4	0.35091 (17)	−0.1942 (2)	0.50934 (9)	0.0474 (4)
C6	0.50408 (16)	0.1122 (3)	0.65828 (9)	0.0374 (4)
C7	0.41254 (16)	0.0484 (2)	0.60224 (9)	0.0350 (4)
C8	0.43686 (17)	−0.1239 (3)	0.57199 (9)	0.0383 (4)
C9	0.54172 (19)	−0.2334 (3)	0.59650 (11)	0.0460 (5)
H9	0.552355	−0.349845	0.576264	0.055*
C10	0.6298 (2)	−0.1668 (3)	0.65125 (11)	0.0507 (5)
H10	0.701304	−0.237663	0.668069	0.061*
C11	0.61190 (18)	0.0054 (3)	0.68128 (10)	0.0463 (5)
H11	0.672964	0.050936	0.717525	0.056*
C12	0.48513 (17)	0.2934 (3)	0.69422 (10)	0.0396 (4)
C13	0.29354 (16)	0.1587 (2)	0.57572 (9)	0.0364 (4)

Comment

Pyrazinamide (PZA), a white crystalline powder, is the first-line drug for the treatment of pulmonary tuberculosis and the most effective antibacterial drug in short-course chemotherapy. Due to the low water solubility (15 μg/mL) and low bioavailability, its oral absorption effect is severely inhibited [5]. In recent years, drug co-crystal technology, as an emerging technology, enhances the efficacy of drugs by improving the solubility and permeability of drugs [6]. Therefore, PZA can be co-crystallized to improve its solubility and bioavailability. Cocrystals of pyrazinamide were obtained with 3-(4-hydroxyphenyl)prop-2-enoic acid (CCDC: 2026373, JAJYUS), thiophene-2,5-dicarboxylic acid (CCDC: 2026372, JAJZON), 2,6-dichlo-robenzoic acid (CCDC: 2026371, JAJZED), 5-hydroxybenzene-1,3-dicarboxylic acid (CCDC: 2069727, JAJZIH) [7], hydrochlorothiazide (CCDC: 1510703, EGENIP01) [8], 4-nitrobenzoic acid (CCDC: 963629, MUDVUE) [9] and so on.

In the title crystal, the main intermolecular force is the formation of hydrogen bonds. The O2 atom on the carboxyl groups of 3-nitrophthalic acid is a hydrogen bond acceptor. The H3A and H3B atoms on the amide group (N3–H3) of the pyrazinamide molecule are hydrogen bond donors, forming the intermolecular hydrogen bond N3–H3A···O2 [length 2.969(2) Å, angle 138.0°]. The O1 atom on the amide group of the pyrazinamide molecule is a hydrogen bond acceptor, and the H2 atom on the carboxyl group (O3–H3) of the 3-nitrophthalic acid molecule is a hydrogen bond donor, forming the intermolecular hydrogen bond O3–H3···O1 [length 2.546(2) Å, angle 167.8°]. The N1 atom on the pyrazine ring of the pyrazinamide molecule is a hydrogen bond acceptor, the H5 atom on the carboxyl group (O5–H5) of the 3-nitrophthalic acid molecule is a hydrogen bond donor, forming an intermolecular hydrogen bond O3–H3···O1 (symmetry code: $-1/2 + x$, $3/2 - y$, $-1/2 + z$) [length 2.725(2) Å, angle 160.2°].

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