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Crystal structure of 3-(1-benzyl-2-ethyl-4-nitro-1*H*-imidazol-5-ylthio)-propanoic acid, C₁₅H₁₇N₃O₄S

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:	Yellow needle
Size:	0.20 × 0.08 × 0.04 mm
Wavelength:	Mo K α radiation (0.71073 Å)
μ :	0.23 mm ⁻¹
Diffractometer, scan mode:	Xcalibur, ω
$\theta_{\max}$, completeness:	29.4°, >99%
$N(hkl)_{\text{measured}}$, $N(hkl)_{\text{unique}}$, R_{int} :	13496, 3872, 0.024
Criterion for I_{obs} , $N(hkl)_{\text{gt}}$:	$I_{\text{obs}} > 2 \sigma(I_{\text{obs}})$, 2949
$N(\text{param})_{\text{refined}}$:	210
Programs:	CrysAlis ^{PRO} [1], Olex2 [2], SHELX [3, 4]

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Abstract

C₁₅H₁₇N₃O₄S, monoclinic, $P2_1/c$ (no. 14), $a = 8.7938(5)$ Å, $b = 10.3071(4)$ Å, $c = 18.0413(7)$ Å, $\beta = 79.704(5)^\circ$, $V = 1608.91(13)$ Å³, $Z = 4$, $R_{\text{gt}}(F) = 0.0535$, $wR_{\text{ref}}(F^2) = 0.1447$, $T = 293(2)$ K.

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Source of material

The title compound was synthesized earlier [5] according to the following procedure. To a solution of 5-bromo-1-benzyl-2-ethyl-4-nitro-1*H*-imidazole [6] (3.10 g, 10.0 mmol) in iPrOH (50 mL) was added 3-mercapto-propanoic acid (1.06 g, 10.0 mmol) and KOH (0.56 g, 10.0 mmol) and stirred at 60–70 °C for 4 h. After cooling, the solution was neutralized with 1 N HCl to give the title compound (2.0 g, 60%) as a powder. **M.p.** = 167–170 °C (dec.). **MS-FAB** m/z : 358 ($M + Na$)⁺. **¹H-NMR** (500 MHz, CDCl₃, 298 K): δ [ppm] 10.8 (s, 1H, CO₂H); 7.35–7.26 (m, 3H, Ph-H); 6.99–6.95 (m, 2H, Ph-H); 5.35 (s, 2H, PhCH₂); 3.15 (t, 2H, $J = 6.8$ Hz, SCH₂CH₂); 2.66 (t, 2H, $J = 6.8$ Hz, SCH₂CH₂); 2.58 (q, 2H, $J = 6.8$ Hz, CH₂CH₃); 1.26 (t, 3H, $J = 6.8$ Hz, CH₂CH₃). **¹³C-NMR** (125 MHz, CDCl₃, 298K): δ [ppm] 174.8 (CO₂H); 150.7 (C-2); 134.9 (C-4); 129.3, 129.2, 128.4, 126.0, 125.7 (C-5, Ph-C); 48.6 (CH₂Ph); 34.1 (SCH₂CH₂CO₂H); 31.2 (SCH₂CH₂CO₂H); 21.3 (CH₂CH₃); 11.6 (CH₂CH₃). **Anal.** Calcd for C₁₅H₁₇N₃O₄S (335.38): C, 53.72; H, 5.11; N, 12.53. Found: C, 53.43; H, 5.00; N, 12.31.

Experimental details

Melting points were measured on a B-545 (Büchi Labortechnik AG, Switzerland) and are uncorrected. Microanalytical data were obtained with a Vario, Elementar apparatus (Shimadzu, Japan). NMR spectra were recorded on 300 MHz (¹H) and at

Table 2: Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å²).

Atom	x	y	z	U _{iso} */U _{eq}
C2	0.3431(2)	0.5935(2)	0.12722(11)	0.0415(5)
C4	0.5704(2)	0.57847(18)	0.14962(10)	0.0347(4)
C5	0.4858(2)	0.49883(17)	0.20211(10)	0.0346(4)
C6	0.1992(3)	0.4443(3)	0.22675(14)	0.0572(6)
H6A	0.2280	0.3607	0.2446	0.069*
H6B	0.1286	0.4289	0.1920	0.069*
C7	0.1166(3)	0.5209(2)	0.29258(12)	0.0436(5)
C8	0.0151(3)	0.4556(3)	0.34764(14)	0.0591(7)
H8	−0.0016	0.3671	0.3430	0.071*
C9	−0.0615(3)	0.5232(4)	0.40970(17)	0.0784(9)
H9	−0.1304	0.4795	0.4464	0.094*
C10	−0.0372(3)	0.6529(4)	0.41781(17)	0.0754(9)
H10	−0.0886	0.6969	0.4599	0.090*
C11	0.0630(3)	0.7177(3)	0.36372(16)	0.0633(7)
H11	0.0803	0.8059	0.3692	0.076*
C12	0.1386(3)	0.6525(2)	0.30091(13)	0.0535(6)
H12	0.2049	0.6976	0.2638	0.064*
C13	0.2072(3)	0.6336(3)	0.09344(15)	0.0556(6)
H13A	0.1136	0.6226	0.1305	0.067*
H13B	0.2167	0.7249	0.0803	0.067*
C14	0.1942(4)	0.5568(4)	0.02478(17)	0.0802(9)
H14A	0.2882	0.5647	−0.0113	0.120*
H14B	0.1093	0.5890	0.0032	0.120*
H14C	0.1766	0.4672	0.0382	0.120*
C15	0.4653(3)	0.4775(2)	0.35832(10)	0.0454(5)
H15A	0.3552	0.4926	0.3626	0.055*
H15B	0.4801	0.4213	0.3996	0.055*
C16	0.5440(3)	0.6050(2)	0.36621(11)	0.0457(5)
H16A	0.5199	0.6653	0.3287	0.055*
H16B	0.6550	0.5922	0.3572	0.055*
C17	0.4931(3)	0.6619(2)	0.44351(11)	0.0396(4)
N1	0.3383(2)	0.50834(17)	0.18600(9)	0.0410(4)
N3	0.4842(2)	0.63536(17)	0.10350(9)	0.0393(4)
N4	0.7315(2)	0.61092(19)	0.14151(11)	0.0493(5)
O1	0.7821(2)	0.6940(2)	0.09657(12)	0.0772(6)
O2	0.8101(3)	0.5537(3)	0.18006(15)	0.1054(9)
O3	0.3872(2)	0.62118(17)	0.48889(9)	0.0614(5)
O4	0.5777(2)	0.76200(18)	0.45648(9)	0.0647(5)
H4	0.5482	0.7882	0.4996	0.097*
S1	0.53533(9)	0.39477(5)	0.26997(3)	0.0542(2)

150.91 MHz (¹³C) spectrometers (Bruker) with TMS as standard. The following abbreviations are used to describe peak patterns: s = singlet, t = triplet, q = quartet, m = multiplet, bs = broad singlet. The ¹H and ¹³C-NMR chemical shift assignments are supported by data obtained from heteronuclear ¹H-¹³C HMQC and ¹H-¹³C HMBC. Mass spectra were recorded on EI and FAB MAT 8200 spectrometers (Finnigana MAT), using 3-nitrobenzyl alcohol (NBOH) or glycerol as matrixes. Molecular ions were detected by doping the sample with Na⁺ ion.

Single crystals of C₁₅H₁₇N₃O₄S were crystallized from CHCl₃/Et₂O. Using Olex2 [2], the structure was solved with the ShelXT [3] using Intrinsic Phasing and refined with the ShelXL [4] refinement package. All H atoms were refined as riding.

Comment

Imidazole is an important heterocyclic compound in the aromatic world of medicinal chemistry. It is also an important constituent of several natural products including purine, histidine and nucleic acid. The nitroimidazoles have shown great promise for targeting different types of cancers [6, 7]. 5-Halogeno-4-nitro-1*H*-imidazoles, as the most interesting class of these compounds, showed biological activity as antiparasitic agents [8] and imaging agents [9]. In view of the interest in the activity spectrum and profile of the nitroimidazoles and in continuation of our research on the synthesis and biological evaluation of imidazole analogs [10, 11] we here present the imidazolyl containing title structure.

Herein, the 3-mercapto-propanoic acid was coupled with imidazole ring to produce the target compound. This title crystal structure consists of the C₁₅H₁₇N₃O₄S molecule, in which all bond lengths are in normal ranges. The asymmetric unit contains the 3-(1-benzyl-2-ethyl-4-nitro-1*H*-imidazol-5-ylthio)-propanoic acid. The crystal is stabilized via NH⋯O hydrogen bonds forming a chain along the crystallographic *c* axis. [O4⋯N3' = 2.837 Å; ' = *x*, 1.5 − *y*, 0.5 + *z*].

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