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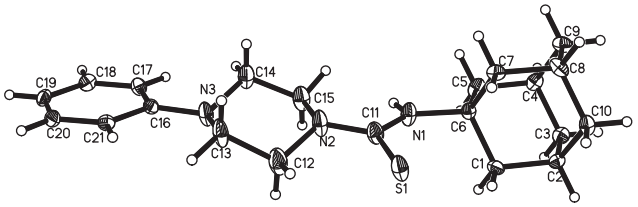
Crystal structure of *N*-(adamantan-1-yl)-4-phenylpiperazine-1-carbothioamide, $C_{21}H_{29}N_3S$



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Abstract

$C_{21}H_{29}N_3S$, orthorhombic, *Pbca* (No. 61), $a = 9.8658(7)$ Å, $b = 11.7298(9)$ Å, $c = 31.960(2)$ Å, $V = 3698.5(5)$ Å^3, $Z = 8$, $R_{gt}(F) = 0.0644$, $wR_{ref}(F^2) = 0.1684$, $T = 100$ K.

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The crystal structure is shown in the figure. Tables 1 and 2 contain details of the measurement method and a list of the atoms including atomic coordinates and displacement parameters.

Source of material

A mixture of 1-adamantyl isothiocyanate (1.93 g, 0.01 mol) and 1-phenylpiperazine (1.62 g, 0.01 mol) in ethanol (20 mL), was heated under reflux for two hours. On cooling, the precipitated crude product was filtered, washed with cold ethanol, dried, and crystallized from ethanol to yield 3.24 g

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Table 1: Data collection and handling.

Crystal:	Colourless, block
	Size 0.52 × 0.45 × 0.12 mm
Wavelength:	Mo K_α radiation (0.71073 Å)
μ:	1.8 cm^{-1}
Diffractometer, scan mode:	Bruker APEX-II, φ and ω
$2\theta_{max}$, completeness:	74°, >99%
$N(hkl)_{measured}$, $N(hkl)_{unique}$, R_{int}:	28135, 3251, 0.038
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\,\sigma(I_{obs})$, 2913
$N(param)_{refined}$:	230
Programs:	SHELX [24], Bruker programs [25]

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

Atom	*x*	*y*	*z*	U_{iso}*/U_{eq}
S1	0.87571(9)	0.33935(6)	0.80858(2)	0.0325(3)
N1	0.8866(3)	0.5665(2)	0.81759(8)	0.0268(6)
H1N1	0.895(3)	0.626(3)	0.8066(11)	0.028(9)*
N2	0.8699(3)	0.5019(2)	0.74984(8)	0.0332(7)
N3	0.8784(3)	0.5489(2)	0.66160(7)	0.0297(6)
C1	0.9991(3)	0.5098(2)	0.88485(8)	0.0220(6)
H1A	1.0849	0.5360	0.8736	0.026*
H1B	0.9910	0.4288	0.8792	0.026*
C2	0.9947(3)	0.5311(2)	0.93243(8)	0.0213(6)
H2A	1.0689	0.4892	0.9458	0.026*
C3	1.0100(3)	0.6581(2)	0.94189(9)	0.0229(6)
H3A	1.0963	0.6855	0.9314	0.027*
H3B	1.0074	0.6706	0.9719	0.027*
C4	0.8941(3)	0.7228(2)	0.92086(8)	0.0206(6)
H4A	0.9037	0.8046	0.9264	0.025*
C5	0.8988(3)	0.7016(2)	0.87356(9)	0.0235(6)
H5A	0.9848	0.7280	0.8625	0.028*
H5B	0.8271	0.7445	0.8600	0.028*
C6	0.8816(3)	0.5742(2)	0.86386(8)	0.0185(6)
C7	0.7454(3)	0.5332(2)	0.88128(8)	0.0195(6)
H7A	0.7335	0.4528	0.8753	0.023*
H7B	0.6719	0.5749	0.8681	0.023*
C8	0.7431(3)	0.5532(2)	0.92892(8)	0.0218(6)
H8A	0.6567	0.5261	0.9403	0.026*
C9	0.7582(3)	0.6812(2)	0.93783(9)	0.0239(6)
H9A	0.6849	0.7228	0.9246	0.029*
H9B	0.7536	0.6948	0.9677	0.029*
C10	0.8599(3)	0.4885(2)	0.94976(8)	0.0221(6)
H10A	0.8570	0.5002	0.9798	0.026*

Table 2 (continued)

Atom	x	y	z	U_{iso}*/U_{eq}
H10B	0.8507	0.4074	0.9444	0.026*
C11	0.8780(3)	0.4761(3)	0.79153(9)	0.0279(7)
C12	0.9169(5)	0.4153(3)	0.71935(10)	0.0501(11)
H12A	0.8937	0.3398	0.7294	0.060*
H12B	1.0147	0.4195	0.7167	0.060*
C13	0.8520(4)	0.4345(3)	0.67681(9)	0.0381(9)
H13A	0.8877	0.3794	0.6570	0.046*
H13B	0.7549	0.4227	0.6789	0.046*
C14	0.8242(4)	0.6309(3)	0.69110(9)	0.0343(8)
H14A	0.7265	0.6219	0.6924	0.041*
H14B	0.8429	0.7071	0.6808	0.041*
C15	0.8803(4)	0.6202(3)	0.73424(9)	0.0336(8)
H15A	0.9746	0.6434	0.7342	0.040*
H15B	0.8311	0.6707	0.7529	0.040*
C16	0.8728(3)	0.5705(2)	0.61828(8)	0.0190(6)
C17	0.8895(3)	0.6817(2)	0.60288(9)	0.0221(6)
H17A	0.8990	0.7420	0.6216	0.026*
C18	0.8921(3)	0.7028(3)	0.56024(9)	0.0232(6)
H18A	0.9024	0.7773	0.5508	0.028*
C19	0.8798(3)	0.6152(3)	0.53140(8)	0.0227(6)
H19A	0.8817	0.6299	0.5028	0.027*
C20	0.8643(3)	0.5047(3)	0.54633(8)	0.0222(6)
H20A	0.8571	0.4446	0.5275	0.027*
C21	0.8595(3)	0.4825(2)	0.58882(8)	0.0205(6)
H21A	0.8472	0.4080	0.5980	0.025*

(91%) of the title compound ($C_{21}H_{29}N_3S$) as colourless block crystals. M.P.: 447–449 K. Single crystals suitable for X-ray diffraction were obtained by slow evaporation of a solution of the title compound in EtOH/$CHCl_3$ (2:1) at room temperature. **^{1}H NMR** (DMSO-d_6, 500.13 MHz): δ 1.63 (s, 6H, Adamantane-H), 1.96–2.05 (s, 3H, Adamantane-H), 2.27 (s, 6H, Adamantane-H), 3.16–3.20 (m, 4H, Piperazine-H), 3.84–3.88 (m, 4H, Piperazine-H), 6.64 (s, 1H, NH), 6.77–6.80 (m, 1H, Ar—H), 6.92–6.94 (m, 2H, Ar—H), 7.21–7.24 (m, 2H, Ar—H). **^{13}C NMR** (DMSO-d_6, 125.76 MHz): δ 29.08, 36.08, 40.90, 46.96 (Adamantane-C), 47.66, 53.80 (Piperazine-C), 115.15, 118.82, 128.95, 150.48 (Ar—C), 180.41 (C = S). **ESI-MS**, *m/z*: 356.4 $(M+H)^+$.

Experimental details

Carbon-bound H atoms were placed in calculated positions (C—H 0.93 Å) and were included in the refinement in the riding model approximation, with U_{iso}(H) set to 1.2U_{eq}(C). The nitrogen-bound H atoms was located on a difference Fourier map and refined freely.

Discussion

Adamantane derivatives were early known for their diverse pharmacological activities [1]. Several adamantyl-bearing analogues are currently employed as potent medications for the control of viral infections [2–5], hyperglycemia [6] and central nervous disorders [7, 8]. In addition, numerous adamantane derivatives were reported to exhibit potent anticancer [9, 10], bactericidal, fungicidal [11, 12] and antimalarial [13] activities. Moreover, various *N*-(1- and 2-adamantyl)carboxamides and *N*-(substituted)carbothioamides were reported to display diverse pharmacological activities [14–17]. As a part of our ongoing research interest in the chemotherapeutic [18–21] and structural [22, 23] properties of adamantane derivatives, we recently reported the synthesis, antibacterial and hypoglycemic activities of the title compound [21], and we report herein its crystal structure.

The crystal structure of the title compound, $C_{17}H_{22}N_2S$, contains one molecule in the asymmetric unit. All bond lengths and angles are in the expected ranges. The central piprazine ring (N2—C12—C13—N3—C14—C15) has the typical chair conformation. In the crystal structure, molecules are connected at least by one intermolecular hydrogen bond, of which S1 works as hydrogen bond acceptor and C5 works as hydrogen bond donor (Symmetry code: $-x+3/2$, $y-1/2$, z).

The NH group (N1) is not involved in any hydrogen bonding interaction, as this group is shielded by two adjacent CH_2 groups.

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