Crystal structure of piperidinium 5-cyano-6-(3-chlorophenyl)-4-oxo-2-thiopyrimidinate, $(C_5H_{12}N)[C_{11}H_5ClN_3OS]$

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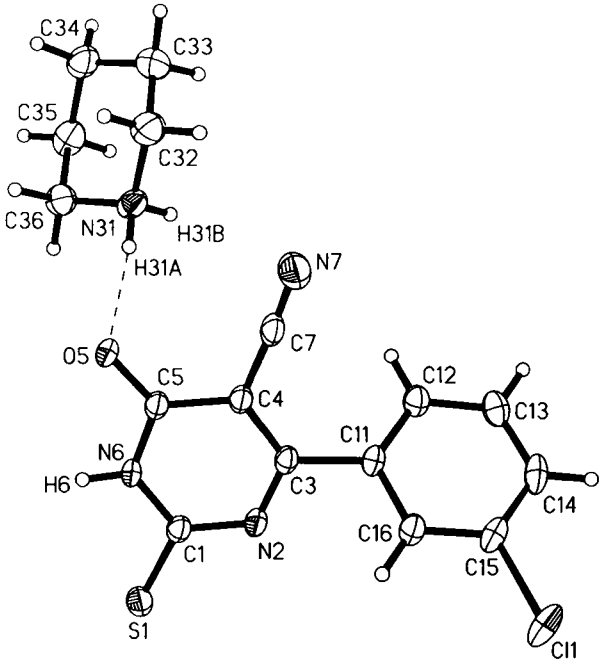

Abstract

$C_{16}H_{17}ClN_4OS$, triclinic, $P\bar{1}$ (no. 2), $a = 7.4861(2)$ Å, $b = 9.8257(3)$ Å, $c = 11.6947(2)$ Å, $\alpha = 100.175(1)°$, $\beta = 90.199(1)°$, $\gamma = 101.054(1)°$, $V = 830.4$ Å^3, $Z = 2$, $R_{gt}(F) = 0.033$, $wR_{ref}(F^2) = 0.087$, $T = 200$ K.

Source of material

5-Cyano-6-(3-chlorophenyl)-4-oxo-2-thioxo-1,2,3,4-tetrahydropyrimidine (thiopyrimidinone) piperidinium salt was synthesized in accordance with our new method via one-pot three component condensation of 3-chloro-benzaldehyde, alkyl cyanoacetate and thiourea in the presence of piperidine in reflux and microwave irradiation conditions. The solution of 2 mmol 3-chloro-benzaldehyde, 2.4 mmol alkyl cyanoacetate, 2 mmol thiourea and 2 mmol piperidine in 40 ml methanol was heated in reflux condition for 4 hours, which is equivalent to a microwave irradiation of this mixture in 5 ml methanol. After completion of the reaction (monitored by TLC; 6 h of reflux or 4-6 min by microwave irradiation), the mixture was filtered and the yellow precipitate was washed with a little cold water and dried. Further purification was done by recrystallization in MeOH. HR-MS (EI+) confirmed the structure of the zwitterionic character. HR-MS (EI)+: found – 264.9875, calc. for $C_{11}H_6{}^{37}ClN_3OS$ – 264.9891; found – 262.9913, calc. for $C_{11}H_6{}^{35}ClN_3OS$ – 262.9920.

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Experimental details

While the hydrogen atoms attached to carbon atoms were fixed at calculated positions, the H atoms bound to nitrogen atoms were located from Fourier difference maps and refined freely.

Discussion

Various analogues of thiopyrimidones have effective antibacterial, antifungal, antiviral, fungicidal, insecticidal, miticidal [1,2] and anti-leishmanial [3-5] activities. They are also starting materials for the production of some uracil derivatives and nucleosides [6-8]. The versatile biological activities of thiopyrimidones promoted us to take up this project for the synthesis of some of its novel derivatives.

The crystal structure of the piperidinium salt shows a proton abstraction from 2-thiopyrimidone skeleton. It seems that N2–H is more acidic, since it is influenced by the inductive effect of aryl group and the negative charge could be stabilized by sulfur atom. The piperidinium cation is linked to the anion by N–H···O hydrogen bond. Comparison of the C1—N bond lengths shows that the C1—N2 bond length (1.351(2) Å) is shorter than C1—N6 (1.375(2) Å) which could be related to the existence of negative charge on nitrogen and delocalization of negative charge in the resonance form with sulfur and also with the double bond. The crystal structure shows also the partial zwitterionic character of the planar thiopyrimidone molecule, of which the H atom is transferred to the piperidine ring N atom.

^{13}C NMR spectra of piperidinium salts of thiopyrimidinone exhibited the carbonyl groups at $\delta = 183$ ppm and the carbon atom of carbonyl groups in thiopyrimidinone derivative resonate at $\delta = 176$ ppm. Deshielding of carbonyl group in piperidinium salt can confirm intermolecular hydrogen bonding between piperidinium ion and carbonyl group in thiopyrimidone skeleton. In conclusion, we were able to synthesize 6-aryl-5-cyano-2-thiopyrimidones and their piperidinium salts using an efficient one-pot three-component condensation under reflux and microwave irradiation conditions. Piperidinium thiopyrimidone salts are stable and could be used for further transformation.

Table 1. Data collection and handling.

Crystal:	yellow polyhedron, size 0.08 × 0.26 × 0.28 mm
Wavelength:	Mo K_α radiation (0.71073 Å)
μ:	3.65 cm^{-1}
Diffractometer, scan mode:	Bruker SMART CCD, φ/ω
$2\theta_{max}$:	54.96°
$N(hkl)_{measured}$, $N(hkl)_{unique}$:	8710, 3780
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\,\sigma(I_{obs})$, 3068
$N(param)_{refined}$:	220
Program:	SHELXTL [9]

Table 2. Atomic coordinates and displacement parameters (in $Å^2$).

Atom	Site	x	y	z	U_{iso}
H(6)	2*i*	0.395(3)	0.547(2)	0.585(2)	0.035(5)
H(12)	2*i*	–0.3414	0.2302	0.4709	0.032
H(13)	2*i*	–0.6274	0.1191	0.5222	0.038
H(14)	2*i*	–0.6689	0.0614	0.7069	0.039
H(16)	2*i*	–0.1402	0.2364	0.7953	0.031
H(31A)	2*i*	0.242(3)	0.318(2)	0.263(2)	0.046(5)
H(31B)	2*i*	0.092(3)	0.345(2)	0.205(2)	0.039(5)
H(32A)	2*i*	0.1028	0.1164	0.1324	0.047
H(32B)	2*i*	0.3062	0.1694	0.0940	0.047
H(33A)	2*i*	0.1080	0.1331	–0.0699	0.055
H(33B)	2*i*	–0.0177	0.2318	–0.0003	0.055
H(34A)	2*i*	0.3448	0.3266	–0.0711	0.048
H(34B)	2*i*	0.1633	0.3636	–0.1203	0.048
H(35A)	2*i*	0.1231	0.5010	0.0580	0.044
H(35B)	2*i*	0.3252	0.5545	0.0183	0.044
H(36A)	2*i*	0.4447	0.4282	0.1438	0.037
H(36B)	2*i*	0.3293	0.5329	0.2171	0.037

Table 3. Atomic coordinates and displacement parameters (in $Å^2$).

Atom	Site	x	y	z	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
S(1)	2*i*	0.25516(5)	0.68328(4)	0.77349(3)	0.0226(2)	0.0307(2)	0.0299(2)	0.0017(1)	0.0023(1)	–0.0002(2)
Cl(1)	2*i*	–0.43365(6)	0.09816(5)	0.90343(4)	0.0465(3)	0.0493(3)	0.0422(2)	0.0094(2)	0.0217(2)	0.0263(2)
C(1)	2*i*	0.1818(2)	0.5327(2)	0.6779(1)	0.0179(6)	0.0283(7)	0.0218(7)	0.0049(5)	0.0019(5)	0.0085(6)
N(2)	2*i*	0.0183(2)	0.4496(1)	0.6871(1)	0.0173(6)	0.0291(6)	0.0246(6)	0.0015(5)	0.0041(5)	0.0072(5)
C(3)	2*i*	–0.0351(2)	0.3330(2)	0.6068(1)	0.0158(6)	0.0267(7)	0.0228(7)	0.0040(5)	0.0015(5)	0.0100(6)
C(4)	2*i*	0.0675(2)	0.2935(2)	0.5116(1)	0.0163(6)	0.0278(7)	0.0219(7)	0.0016(5)	0.0019(5)	0.0080(6)
C(5)	2*i*	0.2405(2)	0.3810(2)	0.5000(1)	0.0162(6)	0.0285(7)	0.0218(7)	0.0033(5)	0.0018(5)	0.0095(6)
O(5)	2*i*	0.3453(1)	0.3589(1)	0.41846(8)	0.0170(5)	0.0364(6)	0.0215(5)	0.0006(4)	0.0057(4)	0.0054(4)
N(6)	2*i*	0.2897(2)	0.4946(1)	0.5875(1)	0.0143(6)	0.0274(6)	0.0233(6)	–0.0013(5)	0.0037(5)	0.0056(5)
C(7)	2*i*	0.0187(2)	0.1658(2)	0.4288(1)	0.0158(7)	0.0332(8)	0.0291(8)	0.0024(6)	0.0046(6)	0.0083(7)
N(7)	2*i*	–0.0107(2)	0.0651(2)	0.3598(1)	0.0297(7)	0.0387(8)	0.0418(8)	0.0020(6)	0.0036(6)	–0.0023(7)
C(11)	2*i*	–0.2139(2)	0.2468(2)	0.6288(1)	0.0166(6)	0.0241(7)	0.0274(7)	0.0036(5)	0.0058(5)	0.0074(6)
C(12)	2*i*	–0.3583(2)	0.2096(2)	0.5469(1)	0.0207(7)	0.0291(8)	0.0301(8)	0.0039(6)	0.0023(6)	0.0081(6)
C(13)	2*i*	–0.5278(2)	0.1419(2)	0.5773(1)	0.0189(7)	0.0329(8)	0.0414(9)	0.0024(6)	–0.0002(6)	0.0067(7)
C(14)	2*i*	–0.5531(2)	0.1076(2)	0.6865(2)	0.0196(7)	0.0289(8)	0.049(1)	0.0009(6)	0.0115(7)	0.0099(7)
C(15)	2*i*	–0.4065(2)	0.1417(2)	0.7654(1)	0.0286(8)	0.0255(7)	0.0326(8)	0.0066(6)	0.0138(6)	0.0126(6)
C(16)	2*i*	–0.2383(2)	0.2120(2)	0.7391(1)	0.0211(7)	0.0285(8)	0.0279(7)	0.0037(6)	0.0047(6)	0.0088(6)
N(31)	2*i*	0.2003(2)	0.3258(2)	0.1928(1)	0.0239(7)	0.0427(8)	0.0231(7)	0.0113(6)	0.0029(5)	0.0075(6)
C(32)	2*i*	0.1849(3)	0.1948(2)	0.1051(2)	0.045(1)	0.0363(9)	0.0333(9)	0.0006(8)	0.0060(7)	0.0044(7)
C(33)	2*i*	0.1094(3)	0.2181(2)	–0.0098(2)	0.043(1)	0.057(1)	0.0297(9)	–0.0052(9)	–0.0013(7)	0.0016(8)
C(34)	2*i*	0.2229(2)	0.3460(2)	–0.0502(1)	0.0328(9)	0.063(1)	0.0252(8)	0.0070(8)	0.0011(7)	0.0134(8)
C(35)	2*i*	0.2434(2)	0.4748(2)	0.0440(1)	0.0327(9)	0.047(1)	0.0372(9)	0.0144(7)	0.0027(7)	0.0174(8)
C(36)	2*i*	0.3207(2)	0.4481(2)	0.1558(1)	0.0282(8)	0.0342(8)	0.0318(8)	0.0087(6)	0.0007(6)	0.0058(7)

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