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SYNTHESIS, STRUCTURE, AND ALKYLATION OF N-METHYLMORPHOLINIUM 5-[2-CYANOETHYL-1-(4-HYDROXY-3-METHOXYPHENYL)-2-THIOCARBAMOYL]-2,2-DIMETHYL-6-OXO-1,3-DIOXA-4-CYCLOHEXEN-4-OLATE

S. G. Krivokolysko[1], **A. N. Chernega**[2] **and V. P. Litvinov**[3]

N-Methylmorpholinium 5-[2-cyanoethyl-1-(4-hydroxy-3-methoxyphenyl)-2-thiocarbamoyl]-2,2-dimethyl-6-oxo-1,3-dioxa-4-cyclohexen-4-olate was obtained from the reaction of 4-hydroxy-3-methoxybenzaldehyde with cyanothioacetamide and Meldrum's acid in the presence of N-methylmorpholine. The molecular and crystal structure of the title compound have been established and its alkylation has been studied.

Keywords: 4-hydroxy-3-methoxybenzaldehyde, Meldrum's acid, tetrahydropyridines, cyanothioacetamide, cyclohexan-4-olate, X-ray crystallographic analysis.

Recently the reaction of structural analogs – dimedone and Meldrum's acid – with arylmethylenecyanothioacetamides, or aromatic aldehydes and cyanothioacetamide in the presence of secondary and tertiary amines, which produce the corresponding adducts of Michael addition, has been described. The conversion of the latter into substituted tetrahydropyridines and hexahydroquinolines [1-7] has been studied, but a number of questions remain open with respect to their structure and the direction of cyclization and alkylation [8]. Recently the structure of adducts obtained from dimedone has been established. The preparation of the previously unknown sulfur-containing octahydroquinolines [9] has necessitated a study of their structure and the corresponding Michael adducts formed with the participation of Meldrum's acid.

We have synthesized N-methylmorpholinium 5-[2-cyanoethyl-1-(4-hydroxy-3-methoxyphenyl)-2-thiocarbamoyl]-2,2-dimethyl-6-oxo-1,3-dioxa-4-cyclohexen-4-olate (**4**) from the reaction of 4-hydroxy-3-methoxybenzaldehyde (**1**) with cyanothioacetamide (**2**) and Meldrum's acid (**3**) in ethanol (~20°C) in the presence of N-methylmorpholine. Its structure has been determined unambiguously by X-ray crystallography.

The six-membered heterocycle $O_{(3)}O_{(4)}C_{(12\text{-}15)}$ is distinctly non-planar: the atoms $O_{(3)}$, $O_{(4)}$, $C_{(12)}$, $C_{(13)}$ and $C_{(15)}$ are coplanar within limits of 0.017 Å, but atom $C_{(14)}$ is 0.55 Å out of this plane. The modified Kremer-Pople parameters [10] calculated for this ring ($S = 0.65$, $\theta = 41.5°$, $\Psi = 4.1$) correspond to a conformation of a somewhat compressed "semi-chair". The interatomic distances $O_{(5)}{=}C_{(13)}$ 1.241(5), $C_{(12)}{-}C_{(13)}$ 1.385(6), $C_{(12)}{=}C_{(15)}$ 1.398(6), $O_{(6)}{-}C_{(15)}$ 1.227(5) Å indicate the considerable delocalization of electron density in this system of bonds.

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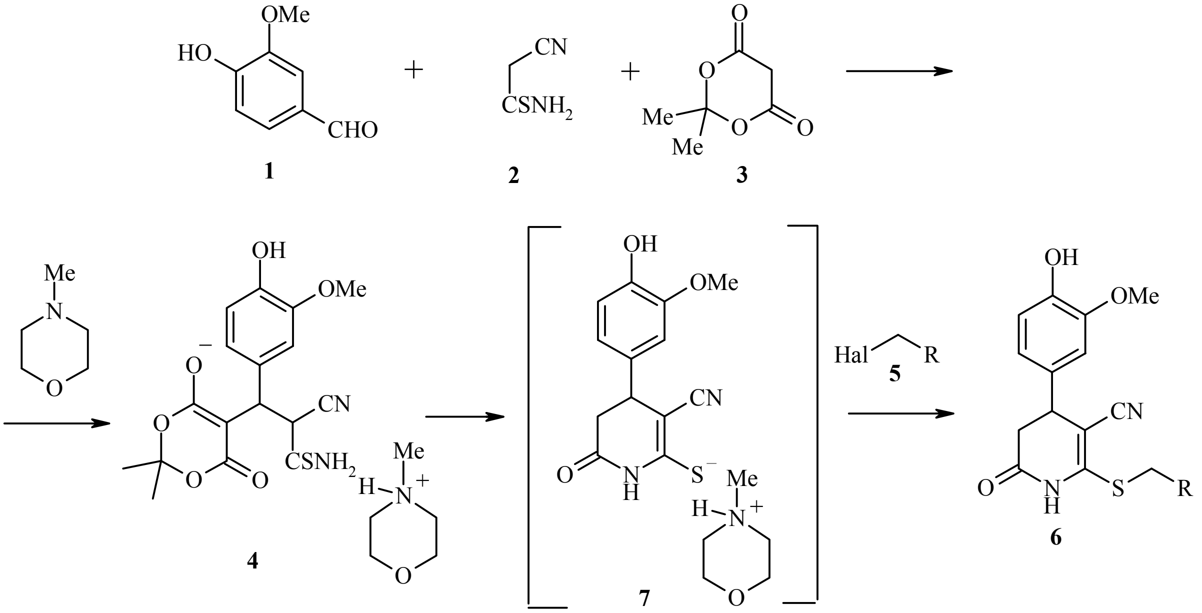
[1] Eastern Ukraine State University, Lugansk 91034, Ukraine. [2] Institute of Organic Chemistry, Ukraine National Academy of Sciences, Kiev, 02094, Ukraine; e-mail: iochkiev@ukrpack.net. [3] N. D. Zelinsky Institute of Organic Chemistry, Russian Academy of Sciences, Moscow 117913, Russia; e-mail: vpl@cacr.ioc.ac.ru. Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 10, 1438-1444, October, 2002. Original article submitted February 8, 2000.



5 a,**c-g** Hal = Cl, **b** Hal = Br; **5**, **6 a** R = Ph, **b** R = CH_2=CH, **c** R = COOEt, **d** R = $CONH_2$,
e R = 4-BrC_6H_4CONH, **f** R = 2,5-$Me_2C_6H_3CONH$, **g** R = 2-MeC_6H_4CONH

The geometric parameters of the morpholinium cation are normal. In the crystal the cations and the anions form pairs linked by very strong [11, 12] hydrogen bond $O_{(5)}\cdots H_{(4)}–N_{(3)}$ [$O_{(5)}\cdots N_{(3)}$ 2.730(5), $O_{(5)}\cdots H_{(4)}$ 1.74(5), $N_{(3)}–H_{(4)}$ 1.00(5) Å, angle $O_{(5)}H_{(4)}N_{(3)}$ 170(3)° ($N_{(3)}$ is the nitrogen atom of the N-methylmorpholinium cation (see Fig. 2)]. In their turn weaker H-bonds $O_{(6)}\cdots H_{(2)}–N_{(1)}$ [$O_{(6)}\cdots N_{(1)}$ 2.888(5), $O_{(6)}\cdots H_{(2)}$ 1.95(5), $N_{(3)}$-$H_{(4)}$ 1.00(5) Å, angle $O_{(6)}H_{(2)}N_{(1)}$ 173(3)°] couple the anions into centrosymmetric dimers. In addition the geometric parameters [$O_{(1)}\cdots O_{(3)}$ 3.051(6), $O_{(1)}–H_{(1)}$ 0.82(5), $O_{(3)}\cdots H_{(1)}$ 2.305 Å, angle $O_{(1)}H_{(1)}O_{(3)}$ 152.2(3)°] indicate the possibility of formation in the crystal of compound **4** of an infinite network on account of relatively weak [11, 12] intermolecular hydrogen bonds, $O_{(1)}–H_{(1)}\cdots O_{(3)}$.

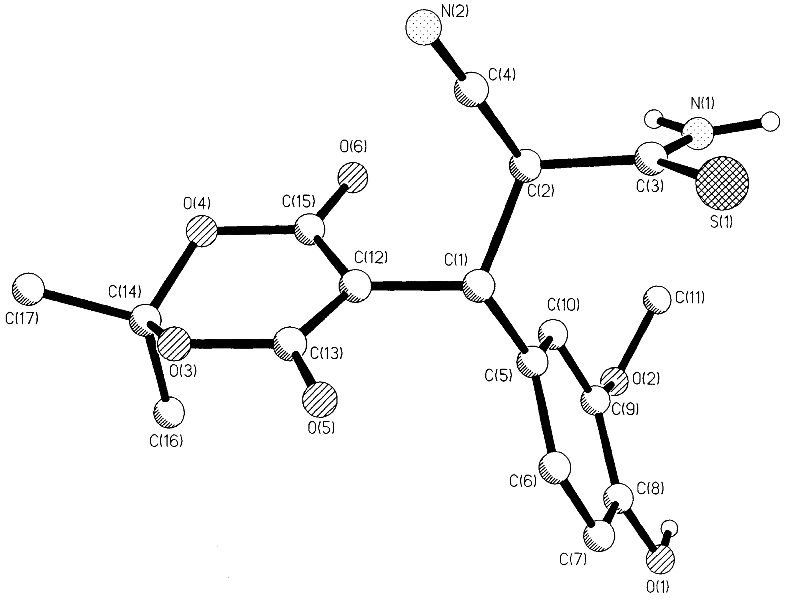


Fig. 1 General view of molecule **4** with numbering of atoms.

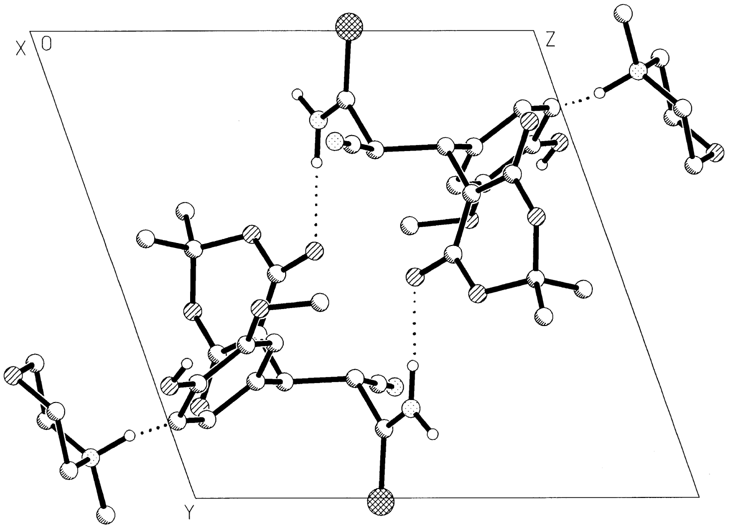


Fig. 2. Crystal packing (projection on *bc*) of compound **4**. The broken lines represent hydrogen bonds.

The ^{1}H NMR spectrum of compound **4** contains signals of the diastereomers **A** and **B** ($^3J_{H(1)\text{-}H(2)}$ = 12.2 Hz) and the enethiol **C**. It is interesting that compound **4** consists of isomer **B** only in the crystalline state (the corresponding torsion angles have the following values: $C_{(5)}C_{(1)}C_{(2)}C_{(3)}$ -54.59°, $C_{(5)}C_{(1)}C_{(2)}C_{(4)}$ -175.74°, $H_{(11)}C_{(1)}C_{(2)}C_{(3)}$ 63.23°, $H_{(11)}C_{(1)}C_{(2)}C_{(4)}$ -57.91°, $H_{(11)}C_{(1)}C_{(2)}H_{(21)}$ -174.75°, $H_{(21)}C_{(2)}C_{(1)}C_{(5)}$ 67.44°, $H_{(21)}C_{(2)}C_{(1)}C_{(12)}$ -62.10°).

TABLE 1. Basic Bond Lengths (*d*) and Bond Angles (ω) in the Molecule of Compound **4**

Bond	*d*, Å	Angle	ω, deg
$S_{(1)}–C_{(3)}$	1.660(5)	$C_{(13)}–O_{(3)}–C_{(14)}$	116.9(4)
$O_{(1)}–C_{(8)}$	1.380(6)	$C_{(14)}–O_{(4)}–C_{(15)}$	117.0(4)
$O_{(2)}–C_{(9)}$	1.374(6)	$S_{(1)}–C_{(3)}–N_{(1)}$	124.7(4)
$O_{(2)}–C_{(11)}$	1.368(7)	$S_{(1)}–C_{(3)}–C_{(2)}$	121.1(4)
$O_{(3)}–C_{(13)}$	1.383(5)	$N_{(1)}–C_{(3)}–C_{(2)}$	114.2(4)
$O_{(3)}–C_{(14)}$	1.436(5)	$N_{(2)}–C_{(4)}–C_{(2)}$	178.2(3)
$O_{(4)}–C_{(14)}$	1.417(5)	$C_{(1)}–C_{(12)}–C_{(13)}$	117.9(4)
$O_{(4)}–C_{(15)}$	1.379(5)	$C_{(1)}–C_{(12)}–C_{(15)}$	121.7(4)
$O_{(5)}–C_{(13)}$	1.241(5)	$C_{(13)}–C_{(12)}–C_{(15)}$	120.4(4)
$O_{(6)}–C_{(15)}$	1.227(5)	$O_{(3)}–C_{(13)}–O_{(5)}$	114.0(4)
$N_{(1)}–C_{(3)}$	1.307(6)	$O_{(3)}–C_{(13)}–C_{(12)}$	118.4(4)
$N_{(2)}–C_{(4)}$	1.127(7)	$O_{(5)}–C_{(13)}–C_{(12)}$	127.5(4)
$C_{(12)}–C_{(13)}$	1.385(6)	$O_{(4)}–C_{(15)}–O_{(6)}$	114.6(4)
$C_{(12)}–C_{(15)}$	1.398(6)	$O_{(4)}–C_{(15)}–C_{(12)}$	117.9(4)
		$O_{(6)}–C_{(15)}–C_{(12)}$	127.5(5)

It is known that reactions of compounds like **4** with α-bromoketones in DMF is accompanied by loss of Meldrum's acid and leads to the formation of substituted 2-thiazolylcyanoethylenes [4, 5, 8]. The results of interaction of Michael adducts with other alkyl halides have not been described. Tetrahydropyridones **6** were obtained by heating salt **4** with alkyl halides **5** for a short time. It is probable that an intermediate **7** is formed in the course of the above reaction, as has been noted earlier for isostructural analogs of compound **4** [6, 7].

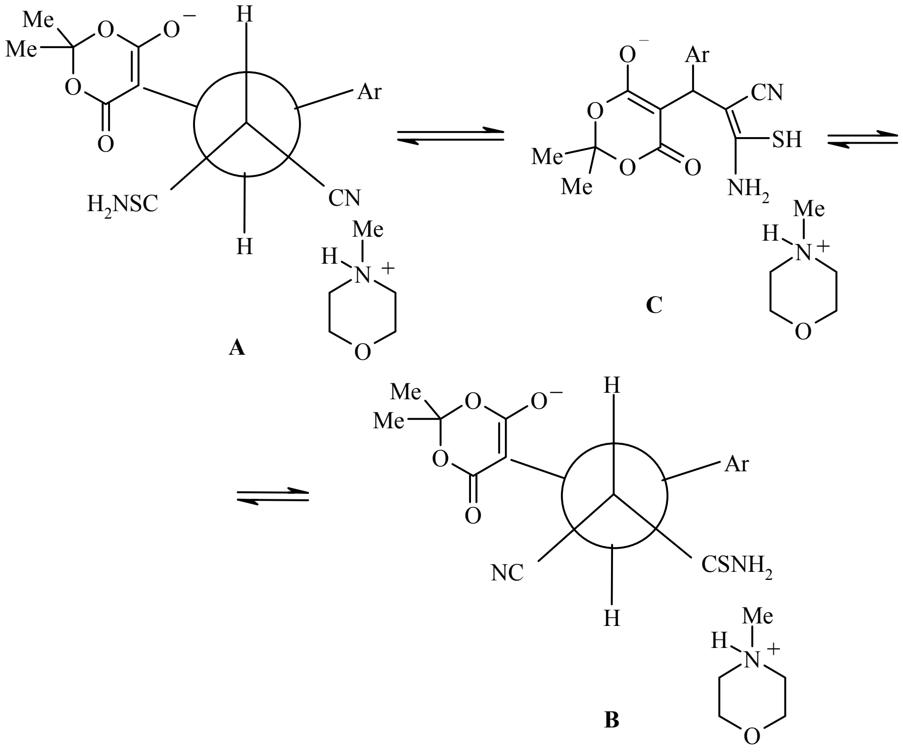


TABLE 2. Atomic Coordinates and Equivalent Isotropic Thermal Parameters, U_{eq}, for the Structure **4**

Atom	*x*	*y*	*z*	U_{eq}, Å^2
1	2	3	4	5
S(1)	0.14971(17)	-0.00815(12)	0.63578(14)	0.0611
O(1)	-0.4012(5)	0.2392(4)	0.9722(4)	0.0503
O(2)	-0.3691(4)	0.4045(4)	0.7394(3)	0.0863
O(3)	0.3328(3)	0.3989(3)	0.8741(3)	0.0412
O(4)	0.2273(4)	0.5640(3)	0.7034(3)	0.0450
O(5)	0.3097(3)	0.1942(3)	0.9277(3)	0.0447
O(6)	0.0908(4)	0.5279(3)	0.5911(3)	0.0498
O(7)	0.1807(6)	0.2621(5)	1.2749(5)	0.0974
N(1)	-0.0247(5)	0.1910(4)	0.5095(4)	0.0451
N(2)	0.3834(6)	0.2368(5)	0.5269(5)	0.0676
N(3)	0.3652(5)	0.0868(4)	1.1789(4)	0.0491
C(1)	0.1191(5)	0.2478(4)	0.7433(4)	0.0279
C(2)	0.1344(6)	0.2548(4)	0.6004(4)	0.0320
C(3)	0.0791(6)	0.1477(4)	0.5776(4)	0.0362
C(4)	0.2752(9)	0.2431(5)	0.5584(5)	0.0423
C(5)	-0.0217(5)	0.2489(4)	0.7991(4)	0.0286

TABLE 2 (continued)

1	2	3	4	5
C(6)	-0.0434(6)	0.1677(4)	0.9230(4)	0.0348
C(7)	-0.1689(6)	0.1647(4)	0.9813(5)	0.0386
C(8)	-0.2753(7)	0.2442(5)	0.9158(5)	0.0343
C(9)	-0.2548(7)	0.3272(5)	0.7923(5)	0.0431
C(10)	-0.1300(6)	0.3311(4)	0.7359(4)	0.0391
C(11)	-0.3875(7)	0.4178(7)	0.6165(6)	0.0945
C(12)	0.1838(5)	0.3489(4)	0.7619(4)	0.0280
C(13)	0.2727(5)	0.3074(4)	0.8564(4)	0.0325
C(14)	0.2667(5)	0.5324(4)	0.8287(4)	0.0402
C(15)	0.1610(5)	0.4791(4)	0.6823(4)	0.0370
C(16)	0.1483(6)	0.5550(5)	0.9161(5)	0.0608
C(17)	0.3681(7)	0.6135(5)	0.8186(6)	0.0695
C(18)	0.2291(9)	0.0597(6)	1.2312(6)	0.0742
C(19)	0.1381(7)	0.1857(8)	1.2156(7)	0.0929
C(20)	0.3066(9)	0.2887(6)	1.2231(6)	0.0800
C(21)	0.4054(6)	0.1670(6)	1.2409(5)	0.0624
C(22)	0.4630(7)	-0.0355(6)	1.1894(6)	0,0956
H(1)	-0.456(6)	0.287(5)	0.922(5)	0.07(2)
H(2)	-0.054(5)	0.282(5)	0.476(5)	0.07(2)
H(3)	-0.060(6)	0.136(5)	0.485(5)	0.07(2)
H(4)	0.349(5)	0.134(4)	1.087(5)	0.06(2)

EXPERIMENTAL

^{1}H NMR spectra of DMSO-d_6 solutions with TMS as internal standard were recorded with a Bruker AM-300 (300 MHz) apparatus, IR spectra of nujol mulls were recorded on an IKS-29 spectrophotometer. Elemental analysis was carried out on Perkin-Elmer C,H,N Analyser. The course of reactions and the purity of products were monitored by TLC on Silufol UV-254 strips using 3:5 acetone–hexane as eluent. Melting points were measured on a Kofler block.

X-ray diffraction analysis of a monocrystal of compound **4** with linear dimensions 0.19×0.34×0.47 mm was carried out at 20°C on an automatic four-circle Enraf-Nonius CAD-4 diffractometer (Mo$K\alpha$ radiation, relative rate of scanning $\omega/2\theta = 1.2$, $\theta_{max} = 23°$, segment of sphere $0 \le h \le 12$, $-13 \le k \le 13$, $-13 \le l \le 13$). 2572 reflexions were collected, of which 2359 were symmetrically independent ($R_{int} = 0.017$). Crystals of compound **4** are triclinic, $a = 10.348(1)$, $b = 11.134(3)$, $c = 11.206(1)$ Å; $\alpha = 69.49(1)$, $\beta = 82.51(1)$, $\gamma = 77.56(2)°$; $V = 1182.8$ Å^3; M = 479.55; $Z = 2$; $d_{calc} = 1.34$ g/cm^3; $\mu = 1.74$ cm^{-1}; space group $P(1)$ (No. 2). The structure was solved by direct method and refined by least squares in the full-matrix anisotropic approximation using the CRYSTALS suite of programmes [13]. 1523 reflexions with $I > 3(I)$ were used in the refinement. All H atoms were found from difference synthesis of the electron density and were included in the calculation with fixed positional and thermal parameters. Only atoms $H_{(1-4)}$, bonded to atoms $O_{(1)}$, $N_{(1)}$, and $N_{(3)}$ were refined isotropically. Calculation of absorption in the crystal was carried out by the azimuthal scanning method [14]. A unit weighting scheme was used in the refinement. The final residual factors were $R = 0.038$ and $R_w = 0.038$. Residual electron densities from the final Fourier difference synthesis were 0.19 and -0.17 e/Å^3. Atomic coordinates are cited in Table 2.

N-Methylmorpholinium 5-[2-Cyanoethyl-1-(4-hydroxy-3-methoxyphenyl)-2-thiocarbamoyl]-2,2-dimethyl-6-oxo-1,3-dioxa-4-cyclohexen-4-olate (4). Mixture of aldehyde **1** (3.04 g, 20 mmol), cyanothioacetamide (**2**) (2 g, 20 mmol), Meldrum's acid (**3**) (2.88 g, 20 mmol), and N-methylmorpholine

(2.53 ml, 25 mmol) in ethanol (30 ml) (~20°C) was stirred until the starting materials dissolved and was then kept for 12 h. The precipitate formed was filtered off, and washed with ethanol and hexane. Yield of salt **4** 8.54 g (89%); mp 185-187°C. IR spectrum, ν, cm^{-1}: 3240, 3450 (OH, NH$_2$, NH$^+$); 2243 (C≡N); 1680 (C=O). ^{1}H NMR spectrum, δ, ppm, *J* (Hz): signals of the major diastereomer: 1.46 and 1.69 (6H, both br. s, Me$_2$); 2.68 (3H, s, NMe); 2.84 (4H, m, CH$_2$NCH$_2$); 3.68 (4H, m CH$_2$OCH$_2$); 3.74 (3H, s, OMe); 4.51 (1H, d, ^3J = 12.2, C$\underline{\text{H}}$Ar); 5.39 (1H, d, ^3J = 12.2, C$\underline{\text{H}}$CN); 6.46 d and 6.77 d (both ^3J = 8.2); 7.18 (3H, s, H arom); 8.34 (1H, br. s, OH); 9.35 (2H, br. s, NH$_2$); signals of the minor diastereomer: 1.46 and 1.69 (6H, both br. s, Me$_2$); 2.68 (3H, s, NMe); 2.84 (4H, m, CH$_2$NCH$_2$); 3.68 (4H, m, CH$_2$OCH$_2$); 3.74 (3H, s, OMe); 4.28 (1H, d, ^3J = 12.2, C$\underline{\text{H}}$Ar); 5.29 (1H, d, ^3J = 12.2, C$\underline{\text{H}}$CN); 6.59 d and 6.87 d (both ^3J = 8.2); 7.78 (3H, s, H arom); 8.52 (1H, br. s, OH); 9.64 and 9.88 (2H, both s, NH$_2$); signals of the enethiol: 1.38 and 1.73 (6H, both br. s, Me$_2$); 2.68 (3H, s, NMe); 2.84 (4H, m CH$_2$NCH$_2$); 3.68 (4H, m, CH$_2$OCH$_2$); 3.82 (3H, s OMe); 4.01 (1H, s C$\underline{\text{H}}$Ar); 7.44 d and 7.79 d (both ^3J = 8.2); 8.06 (3H, s, H arom); 8.91 (1H, s, OH); 9.35 (2H, br. s, NH$_2$). Ratio of the diastereomers and the enethiol – 5:3:2. Found, %: C 55.26; H 5.89; N 8.88. $C_{17}H_{17}N_2O_6S \cdot C_5H_{12}NO$. Calculated, %: C 55.10; H 6.10; N 8.76.

Tetrahydropyridones 6 (General Method). Mixture of salt **4** (2.4 g, 5 mmol) and the corresponding halide **5** (5 mmol) in 80% ethanol (15 ml) was boiled for 2 min and filtered through paper. After 12 h, the precipitate formed in the filtrate was separated and washed with ethanol and hexane.

6-Benzylthio-5-cyano-4-(4-hydroxy-3-methoxyphenyl)-1,2,3,4-tetrahydropyridin-2-one (6a). Yield 1.15 g (63%); mp 195-197°C. IR spectrum, ν, cm^{-1}: 3210, 3450 (OH, NH); 2200 (C≡N); 1678 (C=O). ^{1}H NMR spectrum, δ, ppm, *J*(Hz): 2.43 (dd, ^3J = 7.9) and 2.63 (dd, ^3J = 9.2) (2H, both ^2J = 15.7, C$_{(3)}$H$_2$); 3.73 (1H, dd, ^3J = 7.9 and 9.2, C$_{(4)}$H); 3.79 (3H, s, OMe); 4.29 (2H, s, SCH$_2$); 6.39 (d, ^3J = 8.3); 6.63, s, 6.68 (d, ^3J = 8.3) (3H, H arom); 7.32 (5H, m, Ph); 8.63 (1H, br. s, OH); 10.54 (1H, s, NH). Found, % C 65.72; H 5.12; N 7.42. $C_{20}H_{18}N_2O_3S$. Calculated, %: C 65.56; H 4.97; N 7.64.

6-Allylthio-5-cyano-4-(4-hydroxy-3-methoxyphenyl)-1,2,3,4-tetrahydropyridin-2-one (6b). Yield 1.06 g (67%); mp 141-143°C. IR spectrum, ν, cm^{-1}: 3240-3269 (OH, NH); 2200 (C≡N); 1710 (C=O). ^{1}H NMR spectrum, δ, ppm, *J* (Hz): 2.58 (dd, ^3J = 7.7) and 2.82 (dd, ^3J = 9.1) (2H, both ^2J = 16.6, C$_{(3)}$H$_2$); 3.75 (6H, m, C$_{(4)}$H, SCH$_2$, OMe); 5.17 (d, ^3J = 8.9) and 5.22 (d, ^3J = 14.1) (2H, CH$_2$=); 5.86 (1H, m, CH=); 6.58 (d, ^3J = 8.4); 6.73 s, 6.75 d (^3J = 8.4) (3H arom); 8.64 (1H, br. s, OH); 10.54 (1H, s, NH). Found, %: C 60.61; H 5.32; N 8.95. $C_{16}H_{16}N_2O_3S$. Calculated, %: C 60.74; H 5.10; N 8.85.

5-Cyano-6-ethoxycarbonylmethylthio-4-(4-hydroxy-3-methoxyphenyl)-1,2,3-4-tetrahydropyridin-2-one (6c). Yield 1.4 g (77%); mp 131-133°C. IR spectrum, ν, cm^{-1}: 3180, 3450 (OH, NH); 2190 (C≡N); 1680, 1728 (2 C=O). ^{1}H NMR spectrum, δ, ppm, *J* (Hz): 1.27 (3H, t, ^3J = 6.4, Me); 2.63 (dd, ^3J = 7.4) and 2.83 (dd, ^3J = 9.1) (2H, both ^2J = 17.5, C$_{(3)}$H$_2$); 3.81 (3H, s, OMe); 3.89 (3H, m, C$_{(4)}$H, SCH$_2$); 4.17 (2H, q, ^3J = 6.4, OCH$_2$); 6.59 (d, ^3J = 8.3); 6.74 (d, ^3J = 8.4); 6.77 (3H, s, H arom); 8.67 (1H, br. s, OH); 10.44 (1H, s, NH). Found, %: C 56.52; H 5.16; N 7.64. $C_{17}H_{18}N_2O_5S$. Calculated, %: C 56.34; H 5.01; N 7.73.

6-Carbamoylmethylthio-5-cyano-4-(4-hydroxy-3-methoxyphenyl)-1,2,3,4-tetrahydropyridin-2-one (6d). Yield 1.2 g (72%); mp 142-144°C. IR spectrum, ν, cm^{-1}: 3240-3420 (OH, NH, NH$_2$); 2190 (C≡N); 1680, 1720 (2 C=O). ^{1}H NMR spectrum, δ, ppm, *J* (Hz): 2.63 (dd, ^3J = 7.2) and 2.85 (dd, ^3J = 9.2) (2H, both ^2J = 16.8, C$_{(3)}$H$_2$); 3.64 and 3.74 (2H, both d, ^2J =15.8, SCH$_2$); 3.84 (4H, m, C$_{(4)}$H, OMe); 6.59 (d, ^3J = 8.3); 6.73 (d, ^3J = 8.3); 6.78 (3H, s, H arom); 7.42 and 7.79 (2H, both br. s, CONH$_2$); 8.65 (1H, br. s, OH); 11.01 (1H, s, NH). Found, %: C 54.21; H 4.73; N 12.55. $C_{15}H_{15}N_3O_4S$. Calculated, %: C 54.04; H 4.54; N 12.60.

6-(4-Bromophenyl)carbamoylmethylthio-5-cyano-4-(4-hydroxy-3-methoxyphenyl)-1,2,3,4-tetrahydropyridin-2-one (6e). Yield 2.05 g (84%); mp 217-219°C. IR spectrum, ν, cm^{-1}: 3305, 3450 (OH, 2NH); 2210 (C≡N); 1675, 1706 (2 C=O). ^{1}H NMR spectrum, δ, ppm, *J* (Hz): 2.62 (dd, ^3J = 6.9) and 2.87 (dd, ^3J = 8.8) (2H, both ^2J = 16.9, C$_{(3)}$H$_2$); 3.79 (3H, s, OMe); 3.85 (1H, dd, ^3J = 6.9 and 8.8, C$_{(4)}$H); 3.93 (2H, s, SCH$_2$); 6.59 (d, ^3J = 8.3); 6.74 (d, ^3J = 8.3); 6.78 (3H, s, H arom); 7.44 and 7.57 (4H, both d, ^3J = 8.1, H arom); 8.63 (1H, br. s, OH); 10.37 and 10.58 (2H, both br. s, 2 NH). Found, %: C 51.88; H 3.55; N 8.71. $C_{21}H_{18}BrN_3O_4S$. Calculated, %: C 51.65; H 3.72; N 8.60.

5-Cyano-4-(4-hydroxy-3-methoxyphenyl)-6-(2,5-dimethylphenyl)carbamoylmethylthio-1,2,3,4-tetrahydropyridin-2-one (6f). Yield 1.77 g; mp 233-235°C. IR spectrum, ν, cm^{-1}: 3270-3360 (OH, 2NH); 2210 (C≡N); 1695, 1718 (2 C=O). ^{1}H NMR spectrum, δ, ppm, *J* (Hz): 2.21 and 2.32 (6H, both s, 2 Me); 2.62 (dd, ^3J = 6.8) and 2.88 (dd, ^3J = 8.9) (2H, both ^2J = 16.9, $C_{(3)}H_2$); 3.78 (3H, s, OMe); 3.84 (1H, dd, ^3J = 6.8 and 8.9, $C_{(4)}H$); 3.94 (2H, s, SCH_2); 6.61 (d, ^3J = 8.2); 6.72 (d, ^3J = 8.2); 6.75 (3H, s, H arom); 6.92 (d, ^3J = 8.1); 7.19 (d, ^3J = 8.1); 7.27 (3H, s, H arom); 8.78 (1H, br. s, OH); 9.59 and 10.74 (2H, both br. s, 2 NH). Found, %: C 63.31; H 5.22; N 9.73. $C_{23}H_{23}N_3O_4S$. Calculated, %: C 63.14; H 5.30; N 9.60.

5-Cyano-4-(4-hydroxy-3-methoxyphenyl)-6-(2-methylphenyl)carbamoylmethylthio-1,2,3,4-tetrahydropyridin-2-one (6g). Yield 1.88 g (89%); mp 212-215°C. IR spectrum, ν, cm^{-1}: 3390, 3475 (OH, 2 NH); 2205 (C≡N); 1667, 1725 (2 C=O). ^{1}H NMR spectrum, δ, ppm, *J* (Hz): 2.27 (3H, s, Me); 2.61 (dd, ^3J = 6.9) and 2.86 (dd, ^3J = 8.7) (2H, both ^2J = 17.2, $C_{(3)}H_2$); 3.78 (3H, s, OMe); 3.86 (1H, dd, ^3J = 6.9 and 8.7, $C_{(4)}H$); 3.97 (2H, s, SCH_2); 6.59 (d, ^3J = 8.3); 6.71 (d, ^3J = 8.3); 6.73 (3H, s, H arom); 7.15 m and 7.43 d (^3J = 8.1) (4H, H arom); 8.77 (1H, br. s, OH); 9.66 and 10.72 (2H, both br. s, 2 NH). Found, %: C 62.64; H 5.21; N 10.11. $C_{22}H_{21}N_3O_4S$. Calculated, %: C 62.40; H 5.00; N 9.92.

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