A Novel Route To Polyfunctionally Substituted Methylpyrimidinylcarbonitriles and A Pyridopyrimidine

Yehya Mahmoud Elkholy[1],Abdel-Zaher Abdel-Aziz Elassar[1*] And, Mohamed Hilmy Elnagdi[2]

1)Chemistry Department, Faculty of Science, Helwan University, Helwan, Cairo, Egypt.
2)Chemistry Department, Faculty of Science, Kuwait University, P.O.Box 5969, 13060 Safat, Kuwait

Abstract: Compound 3 reacted with crotonaldehyde generated in situ to yield the pyrimidine derivative 4 which reacted with sulfur to yield thienopyrimidine 6. This latter compound reacted with maleic anhydride to afford quinoxaline 8. Compound 4 reacted with carbon disulfide in benzene containing sodium hydride followed by treatment with methyl iodide to yield pyridopyrimidine 10. Compound 4 reacted with benzyledinemalononitrile to yield quinoxaline derivative 12. Molecular mechanics, energy minimization techniques and related structural parameters for compounds 2a and 3 are reported.

Polyfunctionally substituted heteroaromatics are interesting as potential biodegradable agrochemicals(1,2), intermediates in the dye industry(3,4) and as pharmaceuticals(5). Despite recent interest in their chemistry general synthetic approaches to polyfunctionally substituted condensed heteroaromatics are rather limited(4). Recently we have developed a new general route to polyfunctionally substituted benzoazines utilizing alkylazinylcarbonitriles as building blocks (5-7). Since, literature preparation of suitably substituted alkylazinylcarbonitriles are multistageous and inefficient, we have also developed efficient syntheses of several alkyl pyridazinylcarbonitriles and alkylpyridinylcarbonitriles(5). This article reports a new route to spirocyclohexanylpyrimidine and methylpyrimidinylcarbonitrile derivatives. The potential utility of prepared compounds building as blocks in heterocyclic synthesis is also demonstrated.

Thus, we have found that a mixture of cyclohexanone 1a or acetaldehyde 1b; malononitrile and thiourea reacts in refluxing ethanol in presence of HCl to yield the dihydropyrimidines 2. It is assumed that the carbonyl compounds first condensed with malononitrile yield ylidenemalononitrile which undergoes Michael addition with thiourea followed by cyclization to yield 2. In the case of 2b air oxidation leads to 3 (8). Utility of in situ generated alkylidenemalononitrile from reaction of aldehydes and or ketones with malononitrile in ethanolic piperidene for synthesis of heterocycles has been reported earlier by one of us(9-11) The structures of 2a and 3 were confirmed by analytical and spectral data and their dimentions and geometry is determined by molecular mechanics(12), MM2, (Figure 1 and Tables 1,2,3,4 and 5). In order to define the molecular geometric of 2a and 3 and molecular mechanical calculation were made. Compound 3 undergoes further condensation with crotonaldehyde (generated in situ from acetaldehyde) to afford 4 which reacted readily with sulfur to yield thienopyrimidine 6.

Cyclic structure like 5 was ruled out based on ^{1}H NMR which revealed protons characteristic for crotoalimine. Compound 6 undergoes 4+2 cycloaddition with maleic anhydride to yield the quinoxaline 8 most likely via intermediacy of cycloadduct 7. Similar reactions of aminothienoazenes and aminothienobenzopyraneimines have recentyl been reported(5,13).

Synthesis of pyridopyrimidine from methylpyrimidine and carbon disulphide could beachieved utilizing approach similar to that reported recently by us(14)' Thus, compound 4 reacted with carbon disulphide in the presence of sodium hydride followed by methyl iodide treatment, to afford the pyrido [4,3-d] pyrimidine 10. The reaction is believed to proceed via the intermediate 9 (*cf.* Chart 1).Compound 4 reacts readily with benzylidenemalononitrile to afford quinoxaline12. Compound 12 could be obtained via independent route involving the condensation of the pyrimidine 4 with benzaldehyde, which afforded the styryl derivative 11 followed by reaction with malononitrile.This finds parallelism to reported formation of benzoazines from reaction of alkylazinyl carbonitriles and arylidenemalononitrile(5).

Table 1: Positional Parameters of the Atoms Compromising Compounds 2a and 3

Atom	X	Y	Z	Atom	X	Y	Z
C(1)	0.031	0.349	-0.160	C(1)	0.344	1.023	-0.020
C(2)	-1.266	-0.281	0.414	C(2)	-0.769	0.322	-0.428
C(3)	-1.071	-1.753	0.707	C(3)	-0.726	-1.122	-0.441
N(4)	-0.269	-2.460	-0.168	N(4)	0.408	-1.787	-0.051
C(5)	0.400	-1.875	-1.123	C(5)	1.462	-1.105	0.337
N(6)	0.489	-0.513	-1.245	N(6)	1.434	0.252	0.353
C(7)	1.158	0.424	0.907	C(7)	0.402	2.529	0.030
C(8)	-2.451	-0.144	-0.464	C(8)	-1.971	1.000	-0.843
N(9)	-1.684	-2.361	1.711	N(9)	-1.818	-1.797	-0.842
S(10)	1.172	-2.797	-2.151	S(10)	2.782	-1.843	0.792
C(11)	2.451	1.088	0.386	N(11)	-2.945	1.554	-1.179
C(12)	2.171	2.495	-0.180	H(12)	2.295	0.764	0.668
C(13)	1.071	2.452	-1.260	H(13)	0.638	2.863	1.040
C(14)	-0.214	1.766	-0.745	H(14)	-0.525	3.022	-0.263
N(15)	-3.369	-0.010	-1.158	H(15)	1.187	2.897	-0.632
				H(16)	-1.782	-2.846	-0.849
				H(17)	-2.694	-1.302	-1.143

Table 2: Steric Energy Parameters of Compounds 2a and 3

Stertch:	1.0420	0.2257
Bend:	3.0069	1.2532
Stretch-Bend:	-0.2034	-0.0242
Torsion:	6.1471	0.2812
Non-1,4 VDW:	-3.6072	-0.6923
1,4 VDW:	7.6691	3.9149
Dipole/Dipole:	3.5357	-1.0345
Total:	17.5903	3.9239

Table 3: Bond Lengths of Compounds 2a and 3

C(1)-C(2)	1.552	C(1)-C(2)	1.378
C(1)-N(6)	1.459	C(1)-N(6)	1.386
C(1)-C(7)	1.554	C(1)-C(7)	1.507
C(1)-C(14)	1.552	C(2)-C(3)	1.444
C(2)-C(3)	1.513	C(2)-C(8)	1.441
C(2)-C(8)	1.481	C(3)-N(4)	1.371
C(3)-N(4)	1.381	C(3)-N(9)	1.345
C(3)-N(9)	1.325	N(4)-C(5)	1.314
N(4)-C(5)	1.305	C(5)-N(6)	1.358
C(5)-N(6)	1.370	C(5)-S(10)	1.579
C(5)-S(10)	1.581	N(6)-H(12)	1.050

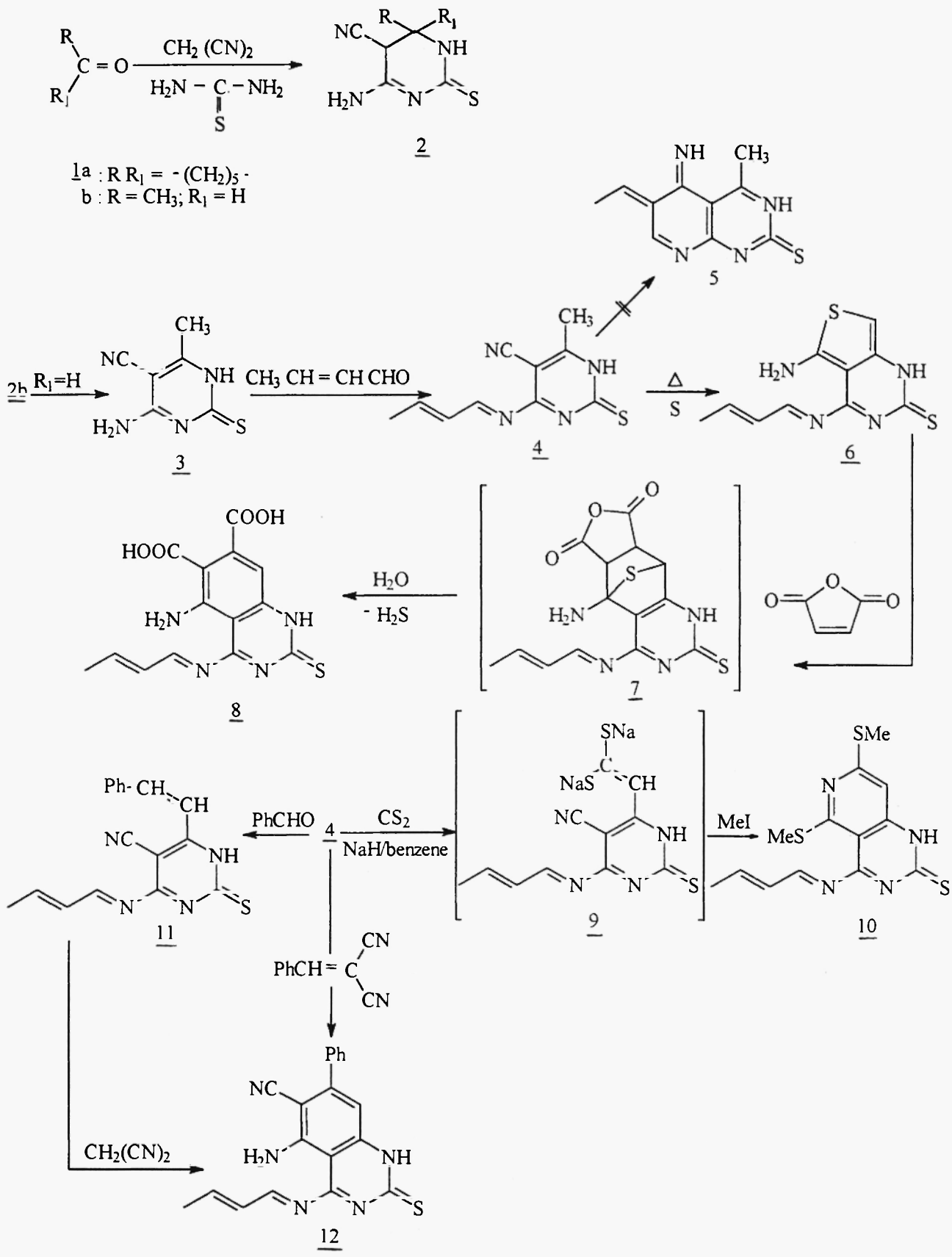
C(7)-C(11)	1.544	C(7)-H(13)	1.091
C(8)-N(15)	1.159	C(7)-H(14)	1.090
C(11)-C(12)	1.543	C(7)-H(15)	1.090
C(12)-C(13)	1.543	C(8)-N(11)	1.170
C(13)-C(14)	1.545	N(9)-H(16)	1.050
		N(9)-H(17)	1.050

Table 4: Bond Angles of Compounds 2a and 3

C(2)-C(1)-N(6)	107.284	C(2)-C(1)-N(6)	115.586
C(2)-C(1)-C(7)	111.789	C(2)-C(1)-C(7)	123.296
C(2)-C(1)-C(14)	112.207	N(6)-C(1)-C(7)	121.121
N(6)-C(1)-C(7)	108.157	C(1)-C(2)-C(3)	119.190
N(6)-C(1)-C(14)	107.975	C(1)-C(2)-C(8)	121.351
C(7)-C(1)-C(14)	109.267	C(3)-C(2)-C(8)	119.466
C(1)-C(2)-C(3)	111.023	C(2)-C(3)-N(4)	120.449
C(1)-C(2)-C(8)	114.289	C(2)-C(3)-N(9)	118.746
C(3)-C(2)-C(8)	107.919	N(4)-C(3)-N(9)	120.811
C(2)-C(3)-N(4)	116.775	C(3)-N(4)-C(5)	119.720
C(2)-C(3)-N(9)	122.261	N(4)-C(5)-N(6)	120.393
N(4)-C(3)-N(9)	120.891	N(4)-C(5)-S(10)	120.900
C(3)-N(4)-C(5)	122.161	N(6)-C(5)-S(10)	118.715
N(4)-C(5)-N(6)	122.885	C(1)-N(6)-C(5)	124.672
N(4)-C(5)-S(10)	117.716	C(1)-N(6)-H(12)	117.003
N(6)-C(5)-S(10)	119.381	C(5)-N(6)-H(12)	118.332
C(1)-N(6)-C(5)	120.084	C(1)-C(7)-H(13)	110.185
C(1)-C(7)-C(11)	113.320	C(1)-C(7)-H(14)	114.258
C(2)-C(8)-N(15)	178.621	C(1)-C(7)-H(15)	110.171
C(7)-C(11)-C(12)	111.367	H(13)-C(7)-H(14)	107.129
C(11)-C(12)-C(13)	111.121	H(13)-C(7)-H(15)	107.608
C(12)-C(13)-C(14)	111.857	H(14)-C(7)-H(15)	107.234
C(1)-C(14)-C(13)	113.516	C(2)-C(8)-N(11)	180.000
		C(3)-N(9)-H(16)	118.466
		C(3)-N(9)-H(17)	121.691
		H(16)-N(9)-H(17)	119.849

Table 5: Torsional Angles of Compounds 2a and 3

N(6)-C(1)-C(2)-C(3)	49.573	N(6)-C(1)-C(2)-C(3)	0.000
N(6)-C(1)-C(2)-C(8)	-72.774	N(6)-C(1)-C(2)-C(8)	-180.000
C(7)-C(1)-C(2)-C(3)	-68.840	C(7)-C(1)-C(2)-C(3)	-180.000
C(7)-C(1)-C(2)-C(8)	168.815	C(7)-C(1)-C(2)-C(8)	0.000
C(14)-C(1)-C(2)-C(3)	168.006	C(2)-C(1)-N(6)-C(5)	0.000
C(14)-C(1)-C(2)-C(8)	45.654	C(2)-C(1)-N(6)-H(12)	-180.000
C(2)-C(1)-N(6)-C(5)	-39.361	C(7)-C(1)-N(6)-C(5)	180.000
C(7)-C(1)-N(6)-C(5)	81.378	C(7)-C(1)-N(6)-H(12)	0.000
C(14)-C(1)-N(6)-C(5)	-160.497	C(2)-C(1)-C(7)-H(13)	122.075
C(2)-C(1)-C(7)-C(11)	-178.154	C(2)-C(1)-C(7)-H(14)	1.416
N(6)-C(1)-C(7)-C(11)	63.973	C(2)-C(1)-C(7)-H(15)	-119.351
C(14)-C(1)-N(7)-C(11)	-53.325	N(6)-C(1)-C(7)-H(13)	-57.906
C(2)-C(1)-C(14)-C(13)	177.065	N(6)-C(1)-C(7)-H(14)	-178.584
N(6)-C(1)-C(14)-C(13)	-64.925	N(6)-C(1)-C(7)-H(15)	60.672
C(7)-C(1)-C(14)-C(13)	52.489	C(1)-C(2)-C(3)-N(4)	0.000
C(1)-C(2)-C(3)-N(4)	-36.139	C(1)-C(2)-C(3)-N(9)	-180.000
C(1)-C(2)-C(3)-N(9)	147.056	C(8)-C(2)-C(3)-N(4)	180.000
C(8)-C(2)-C(3)-N(4)	89.832	C(8)-C(2)-C(3)-N(9)	0.000
C(8)-C(2)-C(3)-N(9)	-86.974	C(1)-C(2)-C(8)-N(11)	0.000
C(1)-C(2)-C(8)-N(15)	-39.503	C(3)-C(2)-C(8)-N(11)	180.000
C(3)-C(2)-C(8)-C(15)	163.944	C(2)-C(3)-N(4)-C(5)	0.000
C(2)-C(3)-N(4)-C(5)	6.748	N(9)-C(3)-N(4)-C(5)	180.000
N(9)-C(3)-N(4)-C(5)	-176.420	C(2)-C(3)-N(9)-H(16)	-180.000
C(3)-N(4)-C(5)-N(6)	7.667	C(2)-C(3)-N(9)-H(17)	0.000


CH2 (CN)2
H2N – C – NH2
S
2
1a : R R1 = -(CH2)5-
b : R = CH3; R1 = H
2b R1=H
3
CH3 CH = CH CHO
4
5
Δ
S
6
7
H2O
- H2S
8
PhCHO
CS2
NaH/benzene
9
MeI
10
11
PhCH = C(CN)2
12
CH2(CN)2

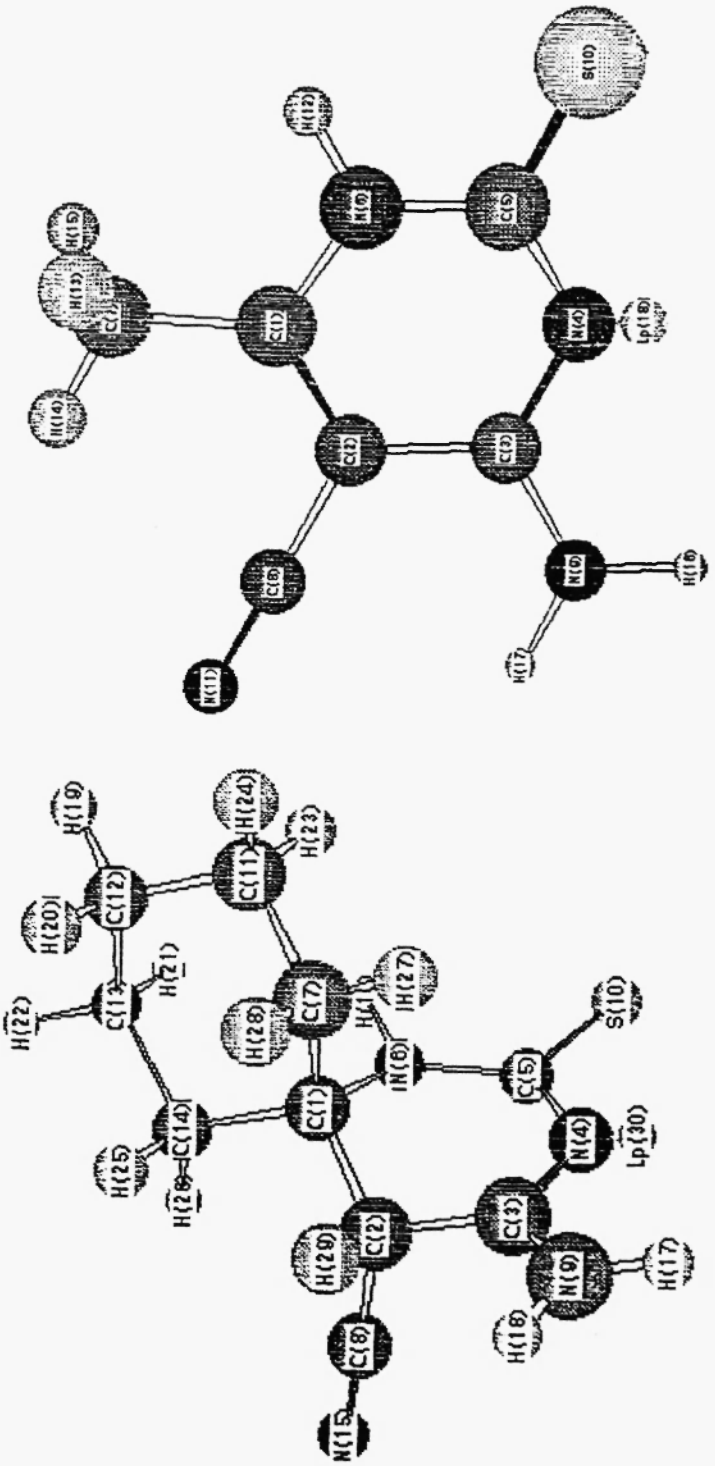


Figure 1: Molecular Structures of 2a and 3.

C(3)-N(4)-C(5)-S(10)	-174.110	N(4)-C(3)-N(9)-H(16)	0.000
N(4)-C(5)-N(6)-C(1)	11.254	N(4)-C(3)-N(9)-H(17)	180.000
S(10)-C(5)-N(6)-C(1)	-166.953	C(3)-N(4)-C(5)-N(6)	0.000
C(1)-C(7)-C(11)-C(12)	55.538	C(3)-N(4)-C(5)-S(10)	-180.000
C(7)-C(11)-C(12)-C(13)	-54.530	N(4)-C(5)-N(6)-C(1)	0.000
C(11)-C(12)-C(13)-C(14)	53.874	N(4)-C(5)-N(6)-H(12)	180.000
C(12)-C(13)-C(14)-C(1)	-54.057	S(10)-C(5)-N(6)-C(1)	-180.000
		S(10)-C(5)-N(6)-H(12)	0.000

EXPERIMENAL

All melting points are uncorrected. IR spectra (KBr) were recorded on a Pye Unicam SP- 100 spectrophotometer. ^{1}H NMR spectra (d_6 - DMSO as the solvent) were obtained on a Varian A -90 spectrometer using TMS as internal standard; chemical shifts are expressed as δ (ppm) values. Mass spectra were recorded on a LKB 9000 S spectrophotometer. Analytical data were obtained from the microanalytical data unit at Cairo University, Egypt.

Preparation of 4-Amino-1,2,5,6-tetrahydro-2-thioxo-6-spirocyclohexaneyl-pyrimidine-5-carbo-nitrile 2a; 4-Amino-1-hydro-2-thioxo-6-methyl-pyrimidine -5-carbonitrile 3 and 1,2-Dihydro-4-crotylamino-6-methyl-2-thioxo-pyrimidine-5-carbonitrile 4. General Procedure :

A mixture of malononitrile (0.01 mol); Thiourea (0.01 mol) and acetaldehyde or cyclohexanone (0.01 mol) and (50 ml) ethanol containing (10) drops of concentrated HCl was refluxed for 3hours. The solution was allowed to stand for two hours .The precipitated solid product was collected and recrystallized.

4-Amino-1,2,5,6-tetrahydro-2-thioxo-6-Spirocyclohexaneyl-Pyrimidine-5-Carbonitrile 2a: Formed pale brown crystals From ethanol; m.p. 186°C, yield 1.2 gm (55%). Ir (Cm^{-1}); 3450-3300 (NH_2,NH), 2210(CN); ^{1}H nmr : δ (ppm); 7.21-7.71(m,11H,Cyclohexane, NH); 4.6 (s,1H,Pyrimidine); 3.41 (s,2H,NH_2).Anal. Calcd. for $C_{10}H_{14}N_4S$ (222.34) (M/e = 222) . C, 54.01 ;H,6.35 ;N, 25.20 ; S , 14.41. Found: C, 54.31 ; H, 6.29 ; N, 25.31 ; S 14.20.

4-Amino-1-hydro-2-thioxo-6-methyl-pyrimidine-5-Carbonitrile 3: Formed yellow crystals from DimethylSulfoxide; m.p.201°C, Yield 0.49 g.(30%). Ir(Cm^{-1}); 3400-3350 (NH_2 and NH); 2210 (CN). ^{1}H nmr : δ (ppm); 12.2 (s,1H, NH) ; 4.5 (s, 2H, NH_2) ; 1.5 (s,3H,CH_3) . Anal. Calcd.for $C_6H_6N_4S$ (166.22). C, 43.35; H, 3.64; N,33.71; S, 19.28. Found : C, 43.20 ; H, 3.50 ; N , 33.60 ; S , 19.3O.

1,2-Dihydro-4-Crotylamino-6methyl-2-thioxo-Pyrimidine-5-Carbonitril 4: Formed Yellow Crystals form ethanol; m.p.130°C, Yield 1.59 g.(73%).Ir (Cm^{-1}), 3300 (NH), 2950 (CH_3), 2210(CN). ^{1}H nmr : δ (ppm); 12.1 (s,1H, NH) ; 2.6,2.1,1.9 (d, t,q respectively;3-CH=) ; 1.45 ; 1.55 (2s,6H,2CH_3) . Anal. Calcd.for $C_{10}H_{10}N_4S$ (218.30) (m/e=218.3).C, 55.01; H,4.62; N,25.67; S, 14.68. Found : C, 55.10 ; H, 4.59 ; N , 25.70 ; S , 14.7O.

Preparation of 5-Amino-4-crotylamino- 1,2- dihydrothieno [3,4-d] pyrimidine-2-thione 6:

Equimolar amount of 4(0.01 mol) and elemental Sulfur(0.01 mol) in ethanol (20 ml) were treated with few drops of piperidin. The reaction mixture was refluxed for three hours. The product so formed is collected and recrystallized.

5-Amino-4-crotylamino-1,2-Dihydrothieno[3,4,d]-Pyrimidine-2-thione 6: Formed pale brown crystals from ethanol; m.p..295°C, Yield 1.6g.(66%).Ir (Cm^{-1}), 3450-3200 (NH_2) ; ^1H nmr : δ (ppm); 3.41 (s,2H, NH_2) ,6.4(s,1H,Pyrimidine) 2.6,2.1,1.9 (d, t,q respectively;3-CH=) ; 1.4 (s,3H,CH_3) . Anal. Calcd.for $C_{10}H_{10}N_4S$ (250.36) .C, 47.97 ; H, 4.03 ; N,22.38 ; S, 25.61.Found : C, 48.01 ; H, 4.10 ; N , 22.50 ; S , 25.7O.

Preparation of 5-Amino-4-crotylamino-1,2-dihydro-2-thioxo-quinoxaline-6,7-dicarboxylate 8: To a suspension of 5 (0.01 mol) In dioxan/acetic acid mixture (50 ml) maleic anhydride (0.01 mol) were added. The reaction mixture was refluxed for three hours, then poured on ice cold water, the solid product, so formed, was collected and recrystallized.

5-Amino-4-crotylamion-1,2-dihydro-2-thioxo-quinoxaline-6,7-dicarboxylate 8: Formed brown crystals from dimethyl sulfoxide ; m.p.>.300°C, Yield 2.15g.(69%).Ir (Cm^{-1}), 3500 (OH) ;3450-3300 (NH_2) 1680 ; 1700 (CO). ^1H nmr : δ (ppm);10.12 10.23 (2s,2H,20H) ,6.6 - 7.1(m,2H,aromatic, Pyrimidine); 4.5, (s, 2H, NH_2) 2.6,2.1,1.19 (d,t,q respectively, 3-CH =), 1.16 (s,3H,CH_3) . Anal. Calcd.for $C_{14}H_{12}N_4O_4S$ (332.36) .C, 50.58 ; H, 3.64 ; N, 16.86 ; S,9.64. Found : C, 50.55 ; H, 3.82; N, 16.83 ; S , 9.90.

Preparation of 5,7-Dimethylmercapto - 4-crotylamino - 1,2 - dihydro- 2-thioxopyrido[4,3-d]-pyrimidine 10:

To a solution of 4 (0.01 mol) in benzene (20 ml) containing sodium hydride (0.01 mol), carbon disulphide (0.01 mol) was added. The reaction mixture was heated under reflux for two hours.After cooling to room temperature methyl iodide (0.01 mol) was added and heated under reflux for 30 min. The solid product formed on evaportion under vacuum, was neutralized with HCl, then collected and recrystallized.

5,7-Dimethylmercapto-4-Crotylamino-1,2-dihydro-2-thioxo-pyridio[4,3-d]Pyrimidine10:

Formed yellow crystals form ethanol/dimethyl formamide;m.p.>300°C;Yield 2.22g (69%).Ir(Cm^{-1}), 2210 (CN). ^1H nmr: δ (PPm); 6.2,5.3 (2s,2H, pyridine) ; 2.7,2.2,1.19 (d, t,q respectively;3-CH=) ; 1.6 ; 1.8 , 1.5 (3s,9H,$3CH_3$) . Anal. Calcd.for $C_{13}H_{14}N_4S_3$ (322.49) (m/e=322).C, 48.41; H,4.38; N,17.37; S, 29.82. Found : C, 48.10 ; H, 4.21 ; N , 17.40 ; S , 30.05.

Preparation of 4-crotylamino- 1,2- dihydro-thioxo-6-styryl-pyrimidine-5- carbonitrile 11 and 5-Amino-4-crotylamino-1,2-dihydro-2-thioxo-7-phenyl-quinoxaline-6-carbonitrile 12:

Method A:

To a solution of 4 (0.01 mol) in dioxane (20 ml) containing piperidine (5 drops) benzylde-nemalononitrile (0.01 mol) was added. The reaction mixture was heated under reflux for three hour. The solid product formed upon dilution with water was collected by filtration.

Method B:

To a solution of 4 (0.01 mol) in dioxane (30 ml) containing piperdine (5 drops), benzaldehyde (0.01 mol) was added. The reaction mixture was heated under reflux for three hours. The solid product formed is collected by filtration.

To a solution of 10 (0.01 mol) in dioxane (30 ml) containing piperidine (5 drops) malononitrile (0.01 mol) was added. The reaction mixture was heated under reflux for three hours. The solid product formed upon dilution by water, was collected by filtration and crystallized from ethanol to give compound 12 identical in all respects (m.p., mixed m.p. and Ir spectrum).

4-Crotylamino-1,2-dihydro-thioxo-6-styryl-Pyrimidine-5-Carbonitrile 11: Formed yellow crystals form ethanol m.p.215°C, Yield 2.17 g.(71%).Ir (Cm^{-1}), 2950 (NH aliphatic), 2210 (CN). ^1H nmr : δ (ppm); 7.21-7.31 (m,5H,C_6H_5) ; 2.5,2.2,1.14 (d, t,q 3H, 3-CH=), 1.54 (s,3H,CH_3). Anal. Calcd.for $C_{17}H_{14}N_4S$ (306.41).C, 66.63; H,4.61; N,18.28; S, 10.46. Found : C, 66.80 ; H, 4.41 ; N ,18.22 ; S , 10.41.

5-Amino-4-crotylamino-1,2-dihydro-2-thioxo-7-phenyl-quinoxaline-6-Carbonitrile 12: Formed brown crystals from dimethyl formamide/ethanol. m.p. 281°C, yield 2.48g.(72%).Ir (Cm^{-1}): 3450-3300 (NH_2),2210 (CN). ^1H nmr: δ (ppm);6.18 - 7.20 (m,5H,Aromatic Proton); 2.41,2.1, 1.2 (d,t,q 3H,3CH =); 3.41 (s,2H,NH_2); 1.16 (s,34,CH_3). Anal. Calcd.for $C_{14}H_{15}N_5$ S (285.40) .C, 58.91 ; H, 5.30 ; N, 24.45 ; S,11.23. Found : C, 58.81 ; H, 5.31 ; N , 24.21 ; S , 11.30..

ACKNOWIEDGEMENTS

The authors thank Dr. T.M. Madkour, Chemistry Department, Faculty of Science, Helwan University, for the molecular mechanics calculation.

REFERENCES

(1) K. Wellinga, A.C. Grosscurt, and R. van Hes, *J.Agric. Food Chem.* 988, 1977 A.C. Grosscurt, R. van Hes and K. Wellinga, Ibid **27**, 406 (1979)

(2) S.M. Fahmy, M. El-Hosami, S. El-Gawal and M.H. Elnagdi, *J. Chem. Tech.* and Biotech **32**, 1042 (1982); S.M. Fahmy, A.H. Badran, and M.H. Elnagdi, *Ibid* 30, 390, (1980)

(3) A.G. Gilman and L.S. Goodman; "The Pharmaceutical Basis of Therapeutics" p. 1109, Macmillan, New Yourk (1985)

(4) M.H. Elnagdi and A. W. Erian, *Ann.* 1215 (1990)

(5) M.H. Elnagdi, A.N. Negm, K.U. Sadek, *Synlet.* 1 (1994) and references therein

(6) M. Mubaroaka and T. Yamamoto, *J.Heterocycl. Chem.* **21**, 1445 (1984)

(7) M. Uher, D. Llavasky, J. Ffolotin and K. Shvareninova, *Collect. Czech. Chem. Commun.* **4545**, 2804 (1980)

(8) M.H. Elnagdi, A.H.H. Elghandour, M.K.A. Ibrahim and I.S.A. Hafiz, *Z. Naturforsch.* **47B**, 572 (1992)

(9) N.S. Ibrahim, M.H. Mohamed, Y.Mahfouz and M.H. Elnagdi, *Prakt. Chem.* 331, 375 (1989)

(10) M.H. Elnagdi, S.A.S. Ghazlan, F.M. Abdel Razek and M.A. Selim, *J.Chem, Res.(S)* 116, 1991; Chem. Res. (m) 1010 (1991)

(11) M.H. Elnagdi, A.A.Harb, A.H.H. Elghandour, A.M. Hussien and S.A. Metwally, *Gazz. Chim Ital.* 122, 299 (1992)

(12) L.N. Allinger, *J.Am. Chem.* Soc. **99**, 8127 (1977)

(13) E.N. Bonguen, E.S. Fodjo, Z. T. Fmum and D. Dopp, *J. Chem. Soc. Perkin Trans.*, 1, 2191 (1994)

(14) A. W. Erian, S.M. Sherif, A. A. Elassar and Y.M. Elkholy, *Tetrahedron* **50**, 1877 (1994)

Received on January 20, 1997