REACTIVITY OF CYANODITHIOFORMATE TOWARDS PRIMARY AMINES

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Abstract-The two electrophilic carbon atoms of methyl cyanodithioformate 1 are able to react with primary amines giving a variety of different products depending upon the nature of amines. The one step reaction with o-dinucleophiles giving condensed heterocompounds in moderate to good yields is of interest.

Reports on the reactivity of methyl cyanodithioformate 1 mainly deal with its capability as dienophile.[1,2] However its two electrophilic carbon atoms can react with nucleophiles to give heterocycles. In this work we have explored the possibilities of using 1 in heterocyclic synthesis through the study of its reactivity towards different types of amines. Compound 1 was prepared according to Simmons et al.[3]

Reactions were performed in dry ethanol at room temperature in most cases to avoid thermal decomposition of 1.[3] The reaction time was always 16 h (see Table I). Elemental analyses, Ir, ^{1}H nmr and mass spectra (if possible) were in accordance with the proposed structures.

Compounds 2 and 3 were obtained by using 2 equivalent amines. Equivalent amounts of reagents gave complex mixtures of unidentified products. Increasing the amount of amine (1:3) did not improve the yields of compounds 2 and 3 and further condensations of 2 with excess of amine to oxalamidines did not occur. Compounds 2a, 2b, 2d and 3 were previously prepared by other methods.[4-6] The behaviour of the ester 1 to give compounds 2 or 3 is analogous to the one shown by sodium cyanodithioformate salt with some primary amines.[5] Two competitive reactions (Scheme 1) with extrusion of either hydrogen sulphide or methyl mercaptane to give the unisolated N-substituted cyanothioformamide seem to take place.

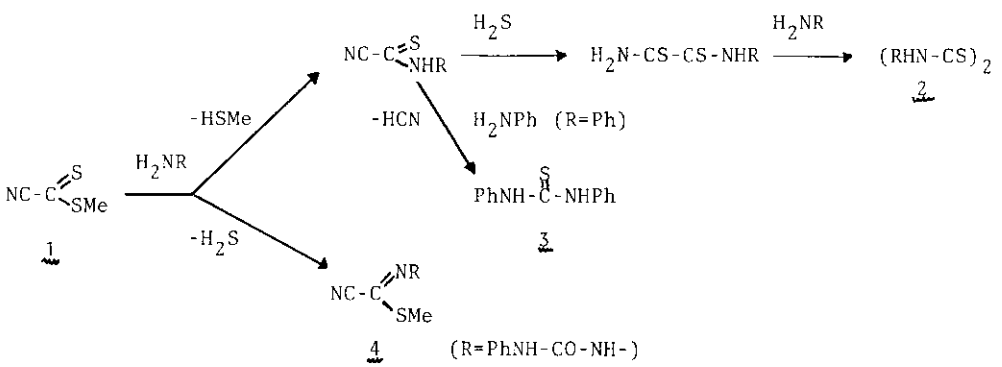
Table I

Amine	M.R.[a]	Reaction Product	Yield(%)	mp (°C)[b]	Lit. mp (°C)
Benzylamine	1:2	2a	26	115-116[c]	120-120.8[4], 115-116[8]
Phenethylamine	1:2	2b	24	106-107[c]	115-115.7[4]
n-Butylamine	1:2	2c	25	31-32[d]	
Cyclohexylamine	1:2	2d	30	148-149[c]	149-149.5[4], 156[5]
Aniline	1:2	3	10	154-155[e]	154-155[6]
4-Phenylsemicarbazide	1:1	4	32	200-201[c]	
o-Phenylenediamine	1:1	5a	41	>300[e]	>300[9,10]
"	1:1	6[f]	17	>300[g]	>300[11]
4-Methyl-o-phenylenediamine	1:1	5b	22	>300[e]	
o-Aminophenol	1:1	7a	42	179-180[g]	
2-Amino-4-nitrophenol	1:1	7b	68	>300[h]	

[a]Molar ratio of 1 to amine. [b]Uncorrected. [c]From ethanol. [d]From ethanol/water. [e]Purified by dissolving in hot K_2CO_3 solution and precipiting with conc. HCl. [f]In refluxing ethanol. [g]From acetone. [h]From acetonitrile.

The addition of the liberated hydrogen sulphide to the cyano group followed by a transamination reaction would afford compounds 2. Several data about the addition of hydrogen sulphide to activated cyano groups[7] and transamination reactions of thioamides[4,8] support the proposed mechanism.

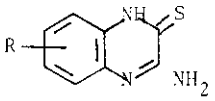
Scheme 1



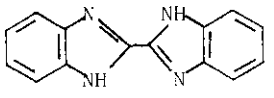
Since the condensation products 5a and 5b could not be conveniently purified by standard procedures, the structure of 5a was determined by its alkylation. Treatment of 5a with ethyl bromide in alkali gave an analytical sample which had a ^{1}H nmr spectrum corresponding to a 2:1 mixture of its S- and N-ethyl derivatives 8 and 9.[12] Compound 5b, with Ir absorption pattern similar to that of 5a, is expected to be a mixture of 6- and 7-methyl-3-amino-2(1H)quinoxalinothione.

The isolation of compounds 5 or 6 originated from 1 and o-phenylenediamines, shows the possibility of 1 to form five or six membered rings as in the case of oxalic acid derivatives. Compound 5a was previously obtained by more complex procedures.[9,10]

Analytical and spectroscopic data of compounds 7a and 7b were in agreement with the proposed structures.



R=H - 5a
R=Me- 5b



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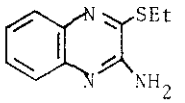

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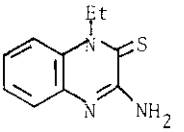

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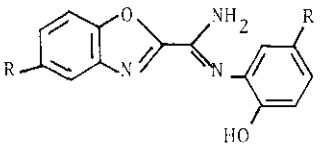

R=H - 7a
R=NO_2 - 7b

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12. ^{1}H nmr ($DCCl_3$) of compounds 8 and 9 (δ): 7.9-7.2 (m, 4H); 5.6 (s, 2H); 4.5 and 3.35 (2q, 2H) and 1.45 (t, 3H).

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