SYNTHESIS OF S-SUBSTITUTED DERIVATIVES OF CYCLIC THIONAMIDES

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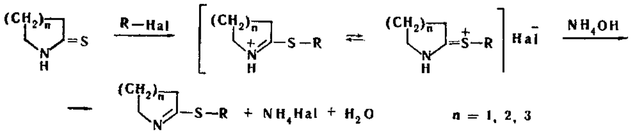
A new preparative method for synthesizing S-substituted derivatives of cyclic thionamides by the cleavage of salts of thionamides with five-, six-, and seven-membered rings has been developed. It has been shown that the onium salts of the N-substituted derivatives of cyclic thionamides undergo cleavage at the C—S bond under the action of water or a weak base with the formation of N-substituted lactams and mercaptans.

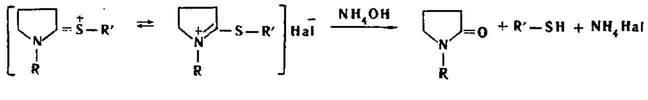
Cyclic thionamides and their derivatives are extremely reactive substances and can take part in various chemical reactions. Reactive reaction centers are the exocyclic sulfur atom and the nitrogen atom that forms part of the ring.

We have previously obtained S-substituted thionamides by heating their sodium salts with alkyl halides [1], i.e., the capacity of cyclic thionamides for reacting in the mercaptide form in an alkaline medium was used [2, 3]. However, we did not succeed in synthesizing allylthiopiperidone in the pure state by the reaction of sodiothiopiperidone with allyl bromide, since the sodium salt of thiopiperidone decomposes at about 80° C and the reaction does not take place at this temperature.

In our previous communication it was shown that cyclic thionamides and their derivatives readily form onium salts [4]. In the present work we have developed a new general method of synthesizing S-substituted derivatives of cyclic thionamides which are formed in good yields when these salts of unsubstituted thionamides are treated with a weak solution of ammonia at room temperature. The reaction takes place in the following way.



When salts of N-substituted thionamides are treated with ammonia or water, the cleavage of the C—S bond takes place very readily, giving N-substituted lactams and the corresponding mercaptans.



The structure of the S-substituted thionamide derivatives obtained was shown by independent synthesis and by a spectral study. The IR spectra were found to contain characteristic absorption bands for the C=N bond at 1670 cm^{-1}.

EXPERIMENTAL

Synthesis of the onium salts. The onium salts were synthesized by the following general method. A halogen derivative was added in excess to a solution of a thionamide in acetone. The reaction mixture was left at room temperature. The salt obtained was separated off by filtration and dried. The reaction conditions and the constants of the onium salts are given in Table 1.

Synthesis of S-substituted thionamide derivatives. The appropriate onium salt was treated with 15% ammonia solution at room temperature. The S-substituted thionamide obtained was extracted with ether, dried over calcium chloride, and distilled (see Table 2).

Independent synthesis of S-substituted thionamide derivatives. The sodiothionamide was obtained by heating 0.1 g-atom of sodium finely dispersed in 20 ml of xylene. At 70–75° C, 1.5–2 ml of methanol was added to the reaction mixture formed (to dissolve the sodiothionamide partially) and it was heated to 110–115° C. Then 0.12 mole of benzoyl chloride was added and the mixture was heated at this temperature for 1 1/2 hr. After cooling, the precipitate was filtered off. The solvent was driven off from the filtrate in vacuum, and the residue was fractionated. In this way S-benzylthiopyrrolidone and S-benzylthiocaprolactam were synthesized, and they proved to be identical with the compounds obtained by the method described above.

N-allylthiopyrrolidone methiodide. 7 g of methyl iodide was added to a solution of 7 g of N-allylthiopyrrolidone in 10 ml of ether. The mixture was left at room temperature for 2 hr. The salt that had deposited was filtered off, washed twice with ether, and dried. Yield 11.2 g (82.3%). Found, %: I 44.53, 44.61. Calculated for $C_8H_{14}INS$, %: I 44.80.

Decomposition of N-allylthiopyrrolidone methiodide. When 25 ml of 15% ammonia solution was added to 10 g of the salt obtained, methyl mercaptan was liberated and N-allylpyrrolidone was formed; the latter was extracted with ether, dried, and distilled. This gave 3.1 g (70.5%) of N-allylpyrrolidone with bp 65°–66° C (2 mm); n_D^{20} 1.4850. According to the literature [5]: bp 61° C (1 mm); n_D^{28} 1.4821.

REFERENCES

1. F. P. Sidel'kovskaya, A. A. Avetisyan, and M. F. Shostakovskii, Izv. AN SSSR, OKhN, 702, 1965.
2. I. Tafel and P. Lawaczek, Ber., 38, 1592, 1905; 40, 2842, 1907.
3. I. V. Kostir and Z. Padr, Chem. Listy, 40, 276, 280, 1946.
4. A. A. Avetisyan, F. P. Sidel'kovskaya, and M. T. Dangyan, KhGS [Chemistry of Heterocyclic Compounds], 105, 1968.
5. M. F. Shostakovskii, F. P. Sidel'kovskaya, and F. L. Kolodkin, VMS [Vysokomolekulyarnye Soedinenii] BMC 12, 1795, 1960.

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Table 1

Synthesis of Quaternary Salts

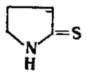
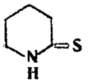
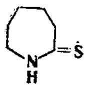
Initial compounds				Reaction time	Mp, °C	Empirical formula	Ionic halogen, %	
Cyclic thionamide	Amount, g	Alkyl halide	Amount, g				found	calculated
	10.1	CH_3I	15	30 min	132	$C_5H_{10}INS$	52.20 52.43	52.26
The same	10.1	$CH_2{=}CH{-}CH_2Br$	13	30 min	—	$C_7H_{12}BrNS$	36.12 36.21	36.04
„ „	10.1	$C_6H_5CH_2Cl$	15	6 hr	140	$C_{11}H_{14}ClNS$	15.23 15.51	15.60
	11.3	CH_3I	15	10 min	160	$C_6H_{12}INS$	49.03 49.36	49.41
The same	11.3	$CH_2{=}CH{-}CH_2Br$	13	30 min	—	$C_8H_{14}BrNS$	33.64 33.71	33.90
„ „	11.3	$C_6H_5CH_2Cl$	15	5 hr	133	$C_{12}H_{16}ClNS$	14.55 14.37	14.69
	12.5	CH_3I	15	15 min	—	$C_7H_{14}INS$	46.54 46.62	46.86
The same	12.5	$CH_2{=}CH{-}CH_2Br$	13	1 hr 30 min	—	$C_9H_{16}BrNS$	31.83 31.97	32.00
„ „	12.5	$C_6H_5CH_2Cl$	15	6 hr	102	$C_{13}H_{18}ClNS$	14.03 13.81	13.89

Table 2

Synthesis of S-Substituted Cyclic Thionamides

Onium salt	Amount, g	Bp, °C (pressure, mm)	n_D^{20}	Empirical formula	Found, %			Calculated, %			Yield, %
					C	H	N	C	H	N	
Allyl bromide derivative of thiopiperidone	14	67—68 (1.5)	1.5310	$C_8H_{13}NS$	61.90 61.81	8.12 8.25	9.03 9.30	61.93	8.39	9.03	84
Benzyl chloride derivative of thiopyrrolidone	10	150.5—151 (5)	1.5860	$C_{11}H_{13}NS$	69.12 69.08	6.96 6.87	7.59 7.41	69.11	6.81	7.32	91
Benzyl chloride derivative of thiopiperidone	10	151—152 (4)	1.5850	$C_{12}H_{15}NS$	69.88 70.11	7.50 7.23	6.76 6.93	70.25	7.31	6.89	90
Benzyl chloride derivative of thiocaprolactam	10	152—152.5 (4)	1.5830	$C_{13}H_{17}NS$	71.08 71.31	7.80 7.59	6.50 6.38	71.23	7.76	6.39	89