REACTION OF THIENO[2,3-d]PYRIMIDINES WITH MERCURY SALTS

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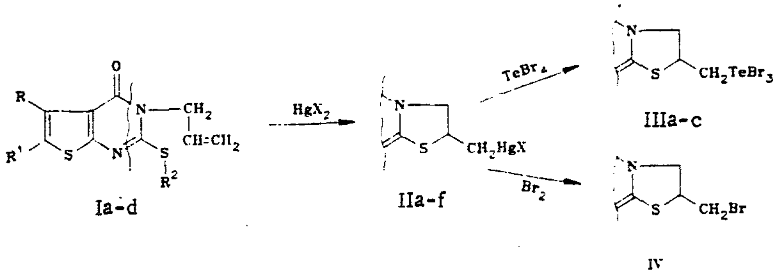
The reaction of mercury salts with thieno[2,3-d]pyrimidine derivatives was studied. It was shown that even in nucleophilic solvents the solvatomercuration of thienopyrimidines is accompanied by intramolecular ring closure involving the sulfur atom of the thioureide group.

Mercury(II) salts can undergo addition at the double bond of olefins in methanol [1, 2]. This reaction attracts investigators' interest because organomercury compounds are widely used as disinfectants, antiseptics, diuretics, preservatives, and seed disinfectants. Many of them exhibit high bacteriostatic activity [3].

Ring closure occurs in the reaction of mercury salts with o-allylphenol, with the formation of dihydrobenzofuran [4]. To obtain organomercury condensed heterocyclic compounds, we studied the use of mercury salts for ring closure of 2-thio-3-allylthieno[2,3-d] pyrimidines Ia-d which, like o-allylphenol, contain electron-donor and allyl groups:



Ia,d,IIa,b,IIIa, IV $R+R^1=(CH_2)_4$; Ib, IIc,d,IIIb $R+R^1=(CH_2)_3$; Ic, IIe,f,IIIc
$R=R^1=CH_3$; Ia-c $R^2=H$; Id $R^2=COC_6H_5$

The reaction of mercury chloride or bromide with derivatives Ia-d in methanol or ethanol affords condensed heterocyclic compounds IIa-f in 50-100% yield, which are easily recovered as a crystalline precipitate. When mercury nitrate or acetate is used, the reaction mixture resinifies, which makes it difficult to recover the target products.

The mercuration of compounds Ia-d was carried out with 1:1, 1:2, and 1:3 reactant ratios of the substrate and the mercury(II) halide. In all cases, only cyclic products IIa-f were formed. In the reaction of mercury chloride or bromide with compound Id, the benzoyl group was abstracted, with the formation of cyclic products IIa and IIb. The composition and structure of heterocycles IIa-f were confirmed by the data of elemental analysis and proton NMR and IR spectra (Table 1). The proton NMR spectra of compounds IIa-f contained no signals of olefin protons in the region of 5.0-6.0 ppm; the signals of the methine proton of the CHS groups were manifested in the region of 4.23-4.75 ppm, and the signals of the methylene protons of CH_2HgX were manifested at 2.10 ppm, which is in agreement with the data of [5].

The IR spectra of compounds IIa-f and IIIa-c contained bands of stretching vibrations of the C=C and C=S groups; there were bands of CSC and C=O at 650 and 1650 cm^{-1}, respectively.

The structure of compounds IIa-f was also confirmed by their reactions. In the reaction of tetrabromotellurium with compounds IIa, IIc, and IIe in dry ether, the halomercury group was replaced by the tribromotellurium group. In the reaction of bromine with compound

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TABLE 1. Characteristics of Compounds IIa-f and IIIa-c

Compound	T_{mp}, °C	R_f	IR spectrum, cm^{-1}	Proton NMR spectrum, δ, ppm	Found N (Hg) %	Empirical formula	Calculated N (Hg), %	Yield, %
IIa	196—198	0,34	1650, 1520, 1180, 780, 700	2.13 (2H, d, CH_2HgBr); 1.78—2,82 [8H, s, $(CH_2)_4$]; 4.74 (2H, s, NCH_2); 5,81 (1H, m, CH)	4.9 (35,9)	$C_{13}H_{13}BrHgN_2OS$	5.0 (36.0)	100,0
IIb	218—219	0,46	1650, 1520, 1180, 780, 720	2,35 (2H, d, CH_2HgCl); 1.72—2.82 [8H, s, $(CH_2)_4$]; 4,73 (2H, s, NCH_2); 5.83 (1H, m, CH)	5,5	$C_{13}H_{13}ClHgN_2OS_2$	5.4	54,2
IIc	203—204	0,38	1650, 1520, 1180, 780, 710	2.15 (2H, d, CH_2HgBr); 3.0 [6H, s, $(CH_2)_3$]; 4,75 (2H, s, NCH_2); 5,81 (1H, m, CH)	5.3 (38,3)	$C_{12}H_{11}BrHgN_2OS_2$	5.2 (36,9)	88.6
IId	235—237	0,37	1650, 1520, 1180, 780, 710	2,30 (2H, d, CH_2HgCl); 3.02 [6H, s, $(CH_2)_3$]; 4.80 (2H, s, NCH_2); 5,80 (1H, m, CH)	5.7	$C_{12}H_{11}ClHgN_2OS_2$	5,6	81,6
IIe	194—195	0,30	1650, 1520, 1180, 780, 710	2.15 (2H, d, CH_2HgBr); 2.33 (6H, d, $2CH_3$); 4,70 (2H, s, $N{-}CH_2$); 5.18 (1H, m, CH)	5,3 (38,5)	$C_{11}H_{11}BrHgN_2OS_2$	5,3 (37,8)	75,6
IIf	215—216	0,33	1650, 1520, 1180, 780, 710	2,30 (2H, d, CH_2HgCl); 2.38 (6H, d, $2CH_3$); 4,70 (2H, s, NCH_2); 5,77 (1H, m, CH)	5,7	$C_{11}H_{11}ClHgN_2OS_2$	5,7	96,7
IIIa	163—165		1650, 1520, 1180, 780, 730		4,3	$C_{13}H_{13}Br_3N_2OS_2Te$	4,3	95,6
IIIb	166—169		1650, 1520, 1180, 780, 730		4,4	$C_{12}H_{11}Br_3N_2OS_2Te$	4,4	50,0
IIIc	150—153		1650, 1520, 1180, 780, 730		4,5	$C_{11}H_{11}BrN_2OS_2Te$	4,5	66,0

IIa in ethanol in the presence of potassium bromide, the halomercury group was replaced by bromine, and compound IV, described previously [6], was formed.

Thus, the mercuration of 2-thio-3-allyl-4-oxothieno[2,3-d]pyrimidine derivatives by mercury chloride or bromide in ethanol or methanol affords 2-(halomercurimethyl)thieno[3,2-e]-thiazolo[2,3-b]pyrimidine derivatives.

EXPERIMENTAL

The IR spectra were recorded on a UR-10 instrument in tablets with KBr, the proton NMR spectra were recorded on a Brucker instrument (100 MHz) in DMSO-D_6, and the internal standard was TMS. The purity of the substances was monitored chromatographically on Silufol-254 plates in the ethanol—chloroform system (1:2). Compounds Ia-d were synthesized according to [7].

2-(Bromomercurimethyl)-5-oxo-2,3,4,5,6,7,8,9-octahydrobenzo[b]thieno[3,2-e]thiazolo[2,3-b]pyrimidine (IIa). To a solution of 0.14 g (0.5 mmole) of compound Ia in 50 ml of ethanol or methanol was added 0.55 g (1.5 mmoles) of mercury bromide in 20 ml of ethanol or methanol. In 2-3 min a precipitate formed from the reaction mixture. The mixture was boiled on a water bath for 20 min more. The precipitate was filtered, washed several times on the filter with alcohol and then ether, and dried.

Compounds IIb-f were similarly synthesized, and their yields and characteristics are given in Table 1.

2-(Tribromotelluromethyl)-5-oxo-2,3,4,5,6,7,8,9-octahydrobenzo[b]thieno[3,2-e]thiazolo-[2,3-b]pyrimidine (IIIa). To a solution of 0.2 g (0.35 mmole) of compound IIa in 50 ml of dry ether was added a solution of 1.5 g (3.3 mmoles) of tellurium tetrabromide in ether. The mixture was left for 24 h at 20°C, with periodic stirring. The precipitate was filtered, washed several times with ether, and dried.

Compounds IIIb and IIIc were similarly prepared (Table 1).

2-(Bromomethyl)-5-oxo-2,3,4,5,6,7,8,9-octahydrobenzo[b]thieno[3,2-e]thiazolo[2,3-b]pyramidine (IV). To 0.55 g (1 mmole) of compound IIa were added 0.16 g (1 mmole) of bromine and 0.1 g of potassium bromide in 50 ml of ethanol. The mixture was boiled on a water bath for 2 h. The hot solution was filtered. The precipitate that formed from the filtrate was separated and recrystallized from methanol, with mp 149-150°C, the same mp as according to the data of [6].

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