CONVERSION OF SOME SUBSTITUTED 1,2,4-TRIAZOLE-3-THIONES

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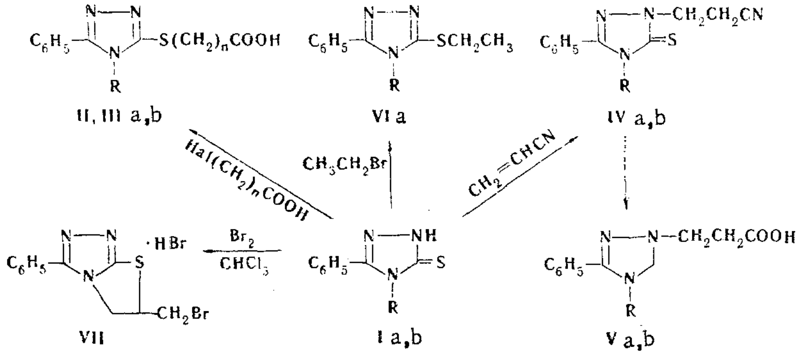
An N-phenyl substituent and an N-allyl substituent in the 4 position of some substituted 1,2,4-triazole-3-thiones do not affect the course of cyanoethylation and alkylation reactions. Cyanoethylation leads to N-substituted derivatives, whereas alkylation gives S-substituted derivatives.

A study of the properties of 1,2,4-triazolethioamides showed that an N-phenyl substituent plays a substantial role in the thione-thiol tautomerism of triazolinethiones [1]. Cyanoethylation of 1-phenyl-1,2,4-triazoline-3-thione gives an S-cyanoethyl derivative, whereas cyanoethylation of 1-phenyl-1,2,4-thiazoline-5-thione gives only the N-cyanoethyl derivative [1]. It was established that cyanoethylation of 4-aryl-5-arylamino-1,2,4-triazoline-3-thione takes place at the nitrogen atom of the thioamide group, whereas alkylation with chloroacetonitrile, alkyl halides, and monochloroacetic and β-chloropropionic acids takes place at the sulfur atom [2].

We have ascertained the effect of replacement of a hydrogen atom by phenyl and allyl groups in the 4 position of 5-phenyl-1,2,4-triazoline-3-thione (Ia,b) on the course of cyanoethylation and alkylation. Cyanoethylation of triazolythiones Ia and Ib in alcohol in the presence of triethylamine gives N-cyanoethyl derivatives IVa,b; cyanoethylation does not occur in acetic and formic acids. It should be noted that the cyanoethylation of Ib (in the presence of triethylamine) takes place even at room temperature, while the analogous cyanoethylation of Ia requires heating.



I-VI a $R=C_6H_5$, b $R=CH_2{-}CH{=}CH_2$; II n=1, Hal=Cl; III n=2, Hal=Br

Hydrolysis of nitriles IVa and IVb gives acids Va and Vb, which are not identical to acids IIIa and IIIb obtained by reaction of Ia and Ib with β-bromopropionic acid in alkaline media. We were able to isolate acid IIIa only on prolonged heating of β-bromopropionic acid with triazolylthione Ia. The action of monochloroacetic

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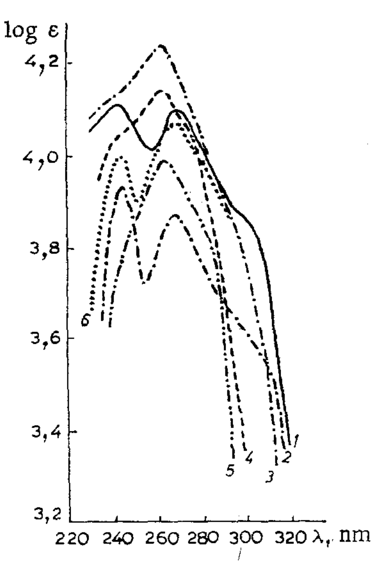

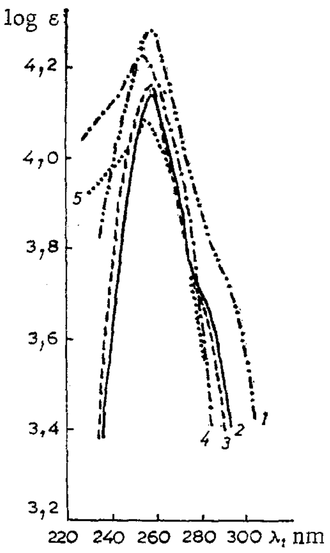

Fig. 1. UV spectra: 1) Ia; 2) Va; 3) IIIa; 4) VIa; 5) IIa; 6) IVa.

Fig. 2. UV spectra: 1) Ib; 2) Vb; 3) IVb; 4) IIIb; 5) IIb.

acid, ethyl bromide in alkaline aqueous alcohol solution, or of β-bromopropionic acid on Ia and Ib gives S-substituted derivatives IIa, IIb, and VIa; correspondingly, bromination of Ib in chloroform proceeds readily to give 2-bromomethyl-5-phenyl-1,3,4-triazolo[2,1-b]thiazolidine hydrobromide (VII).

The UV spectra of N-substituted derivatives IVa and Va are similar to one another and to the spectra of Ia but differ from the UV spectra of S-substituted acids IIa and IIIa, which are similar to the spectra of S-ethyl derivative VIa (Fig. 1). The UV spectra of Ib, IVb, and Vb are similar but differ from the UV spectra of IIb and IIIb (Fig. 2).

EXPERIMENTAL

The UV spectra of ethanol solutions of the compounds were recorded with an SF-4 spectrophotometer.

4,5-Diphenyl-1,2,4-triazole-3-thione (Ia). A 21.6-g (0.08 mole) sample of 1-phenyl-4-benzenethiosemicarbazide was refluxed in 50 ml of 2 N sodium hydroxide solution for 15 min. The solution was acidified with hydrochloric acid, and the resulting precipitate was removed by filtration and washed with water to give 18.4 g (91%) of a product with mp 282-283° (from ethanol). Found: N 16.7%. $C_{14}H_{11}N_3S$. Calculated: N 16.6%.

4-Allyl-5-phenyl-1,2,4-triazole-3-thione (Ib). This compound, with mp 118-118.5° (from ethanol), was obtained in 81% yield from 1-allyl-4-benzenethiosemicarbazide by the method used to synthesize Ia. Found: N 19.4%. $C_{11}H_{11}N_3S$. Calculated: N 19.4%.

4,5-Diphenyl-3-(β-carboxyethyl)thio-1,2,4-triazole (IIIa). A 0.63-g (2.5 mmole) sample of Ia was dissolved in an aqueous alcohol solution of 0.2 g (5 mmole) of sodium hydroxide, and 0.38 g (2.5 mmole) of β-bromopropionic acid was added. The mixture was refluxed on a water bath for 10 h. It was then cooled and acidified with hydrochloric acid, and the resulting precipitate was removed by filtration and washed with water. Compounds IIa, IIb, and IIIb were similarly obtained (see Table 1).

4,5-Diphenyl-2-(β-cyanoethyl)-1,2,4-triazoline-3-thione (IVa). A solution of 1.26 g (5 mmole) of triazolylthione Ia, 2.6 g (50 mmole) of acrylonitrile, and 2 g of thiethylamine was refluxed for 20 min in ethanol. It was then cooled, and the resulting crystals were removed by filtration and washed with alcohol and ether.

TABLE 1. Physical Constants and Yields of the Synthesized Compounds

Compound	mp, °C	Empirical formula	N, %		Yield, %
			found	calc.	
IIa	240—240,5	$C_{16}H_{13}N_3O_2S$	13,6	13,5	98
IIb	136—136,5	$C_{13}H_{13}N_3O_2S$	15,3	15,3	87
IIIa	264—265	$C_{17}H_{15}N_3O_2S$	12,9	12,9	70
IIIb	131—132	$C_{14}H_{15}N_3O_2S$	14,5	14,5	71
IVa	179—180	$C_{17}H_{14}N_4S$	18,6	18,3	79
IVb	141—142	$C_{14}H_{14}N_4S$	20,7	20,7	92
Va	134—135	$C_{17}H_{15}N_3O_2S$	12,8	12,9	80
Vb	50—50,5	$C_{14}H_{15}N_3O_2S$	14,6	14,5	75

Compound IVb was similarly obtained (see Table 1).

4,5-Diphenyl-2-(β-carboxy)ethyl-1,2,4-triazoline-3-thione (Va). A mixture of 0.61 g (2 mmole) of nitrile IVa and 15 ml of concentrated HCl was heated for 30 min. The resulting precipitate was crystallized from aqueous ethanol.

Compound Vb was similarly obtained (see Table 1).

4,5-Diphenyl-3-ethylthio-1,2,4-triazole (VIa). A 0.27-g (2.5 mmole) sample of ethyl bromide was added to a solution of 0.63 g (2.5 mmole) of Ia in an aqueous alcohol solution of 0.1 g (2.5 mmole) of sodium hydroxide, and the mixture was stirred for 30 min. The resulting precipitate was removed by filtration and washed with water to give 0.7 g (quantitative yield) of a product with mp 146-146.5° (from ethanol). Found: N 15.1%. $C_{16}H_{15}N_3S$. Calculated: N 14.9%.

2-Bromomethyl-5-phenyl-1,3,4-triazolo[2,1-b]thiazolidine Hydrobromide (VII). A solution of 0.34 g (2.1 mmole) of bromine in carbon tetrachloride was added dropwise with stirring and cooling to 0.54 g (2.1 mmole) of Ib, and the resulting precipitate was removed by filtration and washed with ether to give 0.35 g (44%) of a product with mp 172-173.5° (from ethanol). Found: N 11.2%. $C_{11}H_{11}Br_2N_3S$. Calculated: N 11.1%.

LITERATURE CITED

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