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

M. M. Tsitsika, S. M. Khripak,
and I. V. Smolanka

UDC 547.792.5:542.951.1

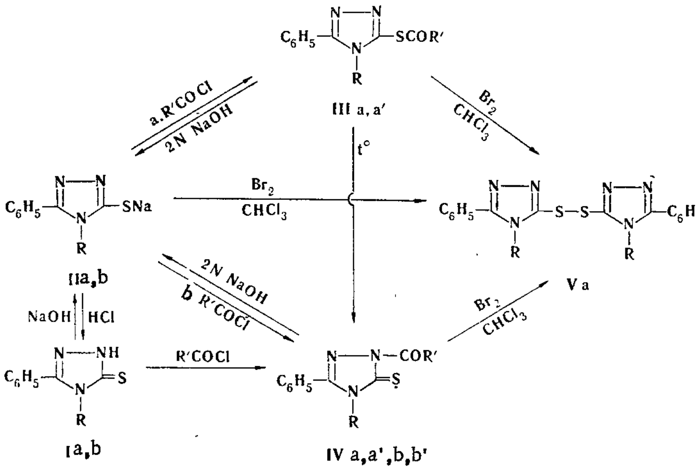
Acylation of some substituted 1,2,4-triazole-3-thiones in the presence of triethylamine gives N-substituted derivatives. S-Substituted derivatives, which are readily transacylated to the N-substituted derivatives on heating, are formed in the case of 4-phenyltriazolethiones in alkaline media. In the case of 4-allyltriazolethiones acylation in alkaline media gives only the N-substituted derivatives. Bromination of the acyl derivatives gives the disulfides.

It is known [1] that acylation of thiourea with acid chlorides depends on the conditions used to carry out the reaction. The reactions proceed by means of S,N-transacylation. It was of interest to investigate the acylation of 4,5-substituted 1,2,4-triazole-3-thiones (Ia, b) with acid chlorides.

We were unable to acylate Ia, b with acid chlorides (benzoyl chloride and cinnamoyl chloride) in benzene solution on prolonged heating- the starting Ia, b were isolated from the mixtures.

However, N-acyl derivatives (IVa, a', b, b') are formed in the presence of triethylamine. The action of an aqueous alcohol solution of sodium hydroxide on Ia, b gives sodium salts IIa, b. Reaction of IIa with acid chlorides (benzoyl and cinnamoyl chlorides) in benzene at room temperature gave the S-derivatives (IIIa, a'), which were not identical to the substances obtained by reaction of Ia with acid chlorides in the presence of triethylamine. Heating S-derivatives IIIa, a' in benzene solution for 30 min gives N-derivatives (IVa, a').

When the S-derivatives (IIIa, a') are melted, they undergo transacylation to N-derivatives (IVa, a'). It is noteworthy that IIIa' undergoes partial melting at 152-154°, turns yellow (the N-derivatives are yellow), again solidifies, and melts at 205-206° (like N-derivative IVa).



Ia, IIa, IIIa, IVa, Va $R=C_6H_5$; $R'=C_6H_5$; IIIa', IVa' $R=C_6H_5$; $R'=CH_2=CH—C_6H_5$;
Ib, IIb, IVb $R=CH_2—CH=CH_2$; $R'=C_6H_5$; IVb', $R=CH_2—CH=CH_2$; $R'=CH_2=CH—C_6H_5$

Uzhgorod State University. Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 6, pp. 851-853, June, 1975. Original article submitted April 13, 1973.

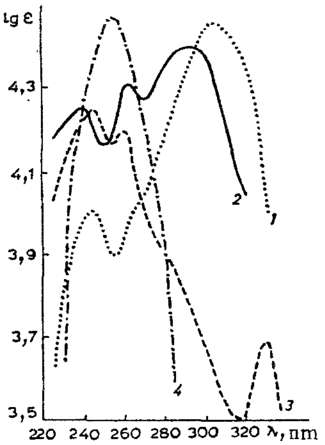


Fig. 1

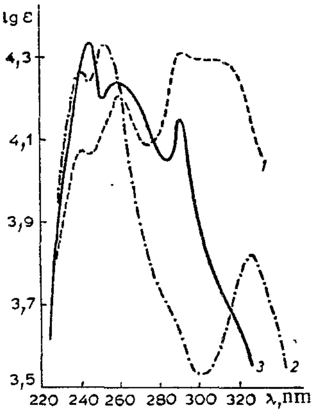


Fig. 2

Fig. 1. UV spectra of: 1) IIIa'; 2) IVa'; 3) IVa; 4) IIIa.

Fig. 2. UV spectra of: 1) IVb'; 2) IVb; 3) Va.

TABLE 1. Characteristics of the Compounds Obtained

Compound	mp, °C	Empirical formula	N, %		Yield, % (method)
			found	calc.	
IIIa	204—205	$C_{21}H_{15}N_3OS$	11,9	11,8	68
IIIa'	206—207	$C_{23}H_{17}N_3OS$	11,0	11,0	70
IVa	204—205	$C_{21}H_{15}N_3OS$	11,8	11,8	51 (A) 91 (B)
IVa'	206—207	$C_{23}H_{17}N_3OS$	10,9	11,0	42 (A) 90 (C)
IVb	82—83	$C_{18}H_{15}N_3OS$	13,0	13,1	47
IVb'	122—123	$C_{20}H_{17}N_3OS$	12,0	12,1	61

Hydrolysis of S-derivatives IIIa, a' and N-derivatives IVa, a', b, b' at room temperature with a 2 N aqueous alcohol solution of alkali gives the starting IIa, b, which give triazolethiones Ia, b on acidification with hydrochloric acid.

When there is an allyl substituent in the 4 position, acylation of sodium salt IIb with acid chlorides in benzene gives only N-acyl derivatives IVb, b', which are identical to the compounds obtaind by acylation of Ib in the presence of triethylamine.

Bromination of IIa, IIIa, a', and IVa, a' gives only one disulfide – Va. Bromination of IIb and IVb, b' gave oily substances that could not be purified.

The UV spectra of N-derivatives IVa, a' are similar to one another but differ from the UV spectra of S-derivatives IIIa, a' (Fig. 1). The UV spectra of the substances obtained by acylation of Ib and IIb are similar (Fig. 2).

EXPERIMENTAL

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

Sodium Salt of 4,5-Diphenyl-1,2,4-triazole-3-thione (IIa). A 2.53-g (0.01 mole) sample of Ia was added to an alcohol solution of 0.4 g (0.01 mole) of sodium hydroxide, and the mixture was heated on a water bath until the solid had dissolved completely. It was then cooled, and the resulting precipitate was removed by filtration and washed with cold ethanol to give 2.6 g (95%) of product.

Sodium Salt of 4-Allyl-5-phenyl-1,2,4-triazole-3-thione (IIb). A 2.17-g (0.01 mole) sample of Ib was added to an alcohol solution of 0.4 g (0.01 mole) of sodium hydroxide, and the mixture was heated until all of the solid had dissolved. The solution was cooled, and ether was added to precipitate 2.2 g (92%) of a crystalline substance.

4,5-Diphenyl-3-cinnamoylthio-1,2,4-triazole (IIIa'). A suspension of 0.66 g (2.4 mmole) of IIa and 0.38 g (2.4 mmole) of cinnamoyl chloride in benzene was stirred at room temperature for 20 min. The precipitated sodium chloride was removed by filtration, and a crystalline substance was precipitated from the filtrate by the addition of ether.

A similar procedure was used to obtain IIIa, IVb, b' (see Table 1).

4,5-Diphenyl-2-cinnamoyl-1,2,4-triazole-3-thione (IVa'). A) A mixture of 0.5 g (0.2 mmole) of Ia, 0.31 g (0.2 mmole) of cinnamoyl chloride, and 1 g of triethylamine in benzene was refluxed for 30 min. It was then cooled, and the resulting crystals were removed by filtration and washed with ether. Compounds IVa, b, b' were similarly obtained (see Table 1).

B) A 0.3 g (0.8 mmole) of IIIa' was refluxed for 30 min to give IVa'. Compound IVa was similarly obtained (see Table 1).

No melting-point depressions were observed for mixtures of the substances obtained by the various methods.

Bis(4,5-Diphenyl-1,2,4-triazol-3-yl) Disulfide (Va). C) A solution of 0.13 g (0.75 mmole) of bromine in carbon tetrachloride was added dropwise with cooling and stirring to 0.44 g (1.5 mmole) of IIa in chloroform, and the resulting precipitate was removed by filtration and washed with ether to give 0.35 g (71%) of Va with mp 221-222° (from alcohol). Found: N 16.8%. $C_{28}H_{20}N_6S_2$. Calculated: N 16.7%.

D) A mixture of 0.26 g (0.7 mmole) of IVa' and 0.11 g (0.35 mmole) of bromine in chloroform was stirred at room temperature for 30 min, and the resulting precipitate was removed by filtration and washed with ether to give 0.15 g (86%) of Va with mp 221-222° (from alcohol). Found: N 16.8. $C_{28}H_{20}N_6S_2$. Calculated: N 16.7%.

Compound Va was obtained by method D by bromination of IIIa, a' and IVa. No melting-point depression was observed for mixtures of substances obtained by the different methods.

LITERATURE CITED

1. T. Wieland and H. Hornig, Ann., 600, 12 (1956).