3-Chloro-6-ethylisoindolo[2,1-*a*]quinazol-5-one (IIb). This compound was similarly obtained from 3 g of 3-chloro-6-ethylisoindolo[2,1-*a*]quinazole-5-one tosylate. Workup gave 1.8 g (95%) of orange crystals with mp 200-202°C (DMF). IR spectrum: C=O 1650 cm^{-1}. PMR spectrum (in $CDCl_3$): 1.56 t (3H, NCH_2CH_3), J = 7.5 Hz; 4.61 q (2H, NCH_2CH_3), J = 7.5 Hz; 7.09-8.43 (8H, arom.). Found: Cl 11.6; N 9.2%. $C_{17}H_{13}ClN_2O$. Calculated: Cl 11.9; N 9.4%.

3-Chloro-6-alkyl-11-acetylisoindolo[2,1-*a*]quinazol-5-ones (IIc,d). A 0.01-mole sample of IIa,b was refluxed for 5 min with 3 ml of acetic anhydride, and the precipitated crystals were removed by filtration and washed with ether. See Table 1 for data on IIc,d.

3-Chloro-6-alkyl-11-benzoylisoindolo[2,1-*a*]quinazol-5-ones (IIe,f). A 0.01-mole sample of benzoyl chloride was added to 0.01 mole of bases IIa,b in 5 ml of dry pyridine, and the mixture was heated on a water bath for 5 min. It was then diluted with water and washed with water and alcohol. See Table 1 for data on IIe,f.

3-Chloro-6-methyl-11-phenylazoisoindolo[2,1-*a*]quinazol-5-one (IIg). A solution of benzenediazonium chloride was added dropwise at 5°C to a solution of 0.28 g of IIa in 5 ml of acetic acid, after which the mixture was diluted with water and neutralized with sodium carbonate. The crystals were washed with water and alcohol. The yield was 0.2 g.

3-Chloro-6-alkyl-11-phenyl(thio)carbamoylisoindolo[2,1-*a*]quinazol-5-ones (IIh-k). Equimolar amounts of IIa,b and phenyl iso(thio)cyanate were mixed, and the resulting crystals were removed by filtration and washed with ether. The products of the reaction with phenyl isothiocyanate were yellow crystals, and their thio analogs were red crystals. See Table 1 for data on IIh-k.

LITERATURE CITED

1. F. S. Babichev and A. K. Tyltin, Ukr. Khim. Zh., 36, 175 (1970).
2. Hoffman-La Roche, Inc., U.S. Patent No. 3812143 (1974).
3. Sandoz-Wander. Inc., U.S. Patent No. 3773783 (1973).
4. E. D. Bergmann and S. Berkovic, J. Org. Chem., 26, 919 (1961).
5. K. Nakanishi, Infrared Absorption Spectroscopy, Tokyo (1962).

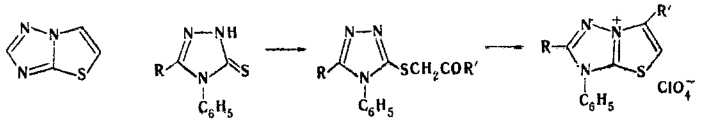
1H-THIAZOLO[3,2-b]-1,2,4-TRIAZOLIUM SALTS

F. S. Babichev, V. A. Kovtunenko,
A. K. Tyltin, and I. G. Lelyukh

UDC 547.792.9'789

The alkylation of 4H-triazole-5-thiones with α-halo ketones takes place at the sulfur atom. 1H-Thiazolo[3,2-b]-1,2,4-triazolium – a new heteroaromatic cation – derivatives were obtained by intramolecular cyclization of the resulting β-keto sulfides.

Derivatives of the thiazolo[3,2-b]-1,2,4-triazole (I) system have been known for quite some time [1] and have been well studied [2, 3]; 1H-thiazolo[3,2-b]-1,2,4-triazolium – a new heteroaromatic cation – salts (II) were obtained by intramolecular cyclization of β-keto sulfides IV [4]. As starting compounds we used 1,2,4-triazole-5-thiones IIIa-c, which were alkylated with α-halo ketones after conversion to the corresponding anions.



I IIIa-c IV II

IIIa R = H; b R = CH_3; c R = C_6H_5

T. G. Shevchenko Kiev State University, Kiev 252017. Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 8, pp. 1132-1134, August, 1977. Original article submitted July 8, 1976.

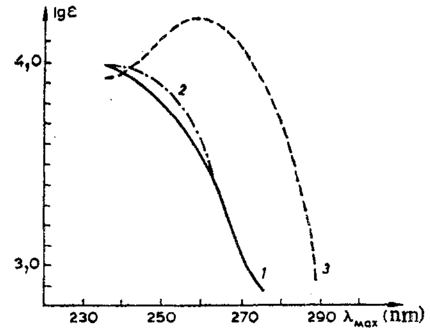


Fig. 1. UV spectrum in methanol: 1) IVc; 2) 3-methyl-4-phenyl-5-methylthio-1,2,4-triazole [5]; 3) IIIb.

The UV spectrum of S-methyl [5] derivative IIIb (Fig. 1) coincides with the UV spectrum of alkylation product IIIb, which has a thione structure [6]. On the basis of this, we feel that the alkylation of IIIa-c with α-halo ketones also takes place at the sulfur atom to give IV.

The IR spectra of β-keto sulfides IV contain a strong C=O absorption band at 1690-1735 cm^{-1}. The signal of the protons of the $S-CH_2$ group in the PMR spectra of IVa-f (4.17-5.06 ppm) occupies a rather broad interval and, as demonstrated by the data in Table 1, does not depend on the nature of the 3-R substituent but is determined by the character of R'.

Compounds IVa-e undergo cyclization to 1H-thiazolo[3,2-b]-1,2,4-triazolium salts IIa-e when solutions of the β-keto sulfides in sulfuric acid are stirred for a long time. Salt IIf was obtained by cyclization of IVf in polyphosphoric acid (PPA) after unsuccessful attempts to use CF_3COOH or H_2SO_4 for this purpose.

The UV spectra of IIa-f contain one absorption maximum at 244-260 nm (log ε 4.0), and the UV spectra contain a very strong band of a ClO_4^- anion at 1100 cm^{-1}. In addition to the bands of C−H stretching vibrations at 3140 cm^{-1}, the spectrum contains an intense band at 1545 cm^{-1}. Data on the PMR spectra of salts IIa-f are presented in Table 2.

TABLE 1. β-Keto Sulfides IV

Compound	R	R'	mp, ℃	Found, %		Empirical formula	Calc., %		Charac. of PMR spectra				Yield, %
				N	S		N	S	$S-CH_2$	3-R	$N-C_6H_5$	R'	
IVa	H	CH_3	76—78*	18,1	13,5	$C_{11}H_{11}N_3OS$	18,1	13,7	4,32 s	8,36 s	7,55 m	2,43 s	96
IVb	H	C_6H_5	108	14,5	10,9	$C_{16}H_{13}N_3OS$	14,2	10,8	5,06 s	8,37 s	7,58 m	8,10 m	74
IVc	CH_3	CH_3	101	16,8	13,1	$C_{12}H_{13}N_3OS$	16,9	12,9	4,17 s	2,32 s	7,45 m	2,35 s	90
IVd	CH_3	C_6H_5	105	13,5	10,4	$C_{17}H_{15}N_3OS$	13,5	10,3	4,92 s	2,36 s	7,43 m	7,89 m	96
IVe	C_6H_5	CH_3	153	13,9	10,7	$C_{17}H_{15}N_3OS$	13,5	10,3	4,31 s	7,25—7,60 m		2,44 s	87
IVf	C_6H_5	C_6H_5	181	11,1	8,5	$C_{22}H_{17}N_3OS$	11,3	8,6	5,03 s	7,25—7,60 m		8,06 m	73

---

* The compounds were purified by recrystallization from CCl_4 (IVa, c-e), ethanol (IVb), and chloroform (IVf). IR spectra: IVa C=O 1735, $S-CH_2$ 1425 cm^{-1}; IVb C=O 1690, $S-CH_2$ 1430 cm^{-1}.

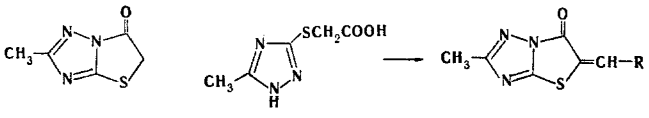
TABLE 2. 1H-Thiazolo[3,2-b]-1,2,4-triazolium Perchlorates IIa-f

Comp.	R	R'	mp, ℃	Found, %			Empirical formula	Calc., %			Charac. of PMR spectra				Yield, %
				Cl	N	S		Cl	N	S	2-R	$N-C_6H_5$	5-R'	6-H	
IIa	H	CH_3	215*	11,8	12,9	10,4	$C_{11}H_{10}ClN_3O_4S$	11,2	13,3	10,1	9,22 s	7,95 s	2,92 d	7,76 d	79
IIb	H	C_6H_5	242	9,3	10,9	8,6	$C_{16}H_{12}ClN_3O_4S$	9,4	11,1	8,5	9,16 s	7,86 s	7,63—8,15 m		78
IIc	CH_3	CH_3	151	10,8	12,6	9,9	$C_{12}H_{12}ClN_3O_4S$	10,7	12,7	9,7	2,78 s	7,68 m	2,80 d	7,26 d	66
IId	CH_3	C_6H_5	291	9,0	10,6	8,1	$C_{17}H_{14}ClN_3O_4S$	9,0	10,7	8,2	2,74 s	7,41—8,01 m			87
IIe	C_6H_5	CH_3	168—169	9,2	10,8	8,3	$C_{17}H_{14}ClN_3O_4S$	9,0	10,7	8,2	7,67—7,90 m		2,93 d	7,56 d	74
IIf	C_6H_5	C_6H_5	243	7,8	9,1	7,0	$C_{22}H_{16}ClN_3O_4S$	7,8	9,3	7,0	7,61—8,36 m				98

---

* Compound IIc was purified by recrystallization from methanol, IIf was purified by recrystallization from ethanol, and the remaining compounds were purified by recrystallization from acetic acid. The coupling constant (J) in the PMR spectra of IIa,c,e was 1.5 Hz.

In addition to salts IIa-f, we also attempted to obtain the previously unknown thiazolo[3,2-b]-1,2,4-triazol-5(6H)-one (V) by cyclization of S-(3-methyl-1,2,4-triazol-5-yl)thioglycolic acid (VI) by a method similar to the method used in the imidazole series [7]. These experiments were unsuccessful. However, we were able to obtain a number of V derivatives. Thus products VIIa,b were obtained when VI was heated with p-dialkylaminobenzaldehydes, and condensation of VI with ethyl orthoformate gave VIIc. The fact that cyclization takes place at the 1-N atom rather than at the 4-N atom was established in [8] during a study of the reaction of VI with intermediates that lead to the formation of cyanine dyes.



V VI VII

VII a $R=4\text{-}C_6H_4N(CH_3)_2$; b $R=4\text{-}C_6H_4N(C_2H_5)_2$; c $R=OC_2H_5$

EXPERIMENTAL

The UV spectra of $5 \cdot 10^{-5}$ M solutions of the compounds were recorded with an SF-4A spectrophotometer. The IR spectra of KBr pellets of the compounds were recorded with a UR-20 spectrometer. The PMR spectra of 0.2 M solutions of the compounds (in $CDCl_3$ for IV and in CF_3COOH for II) were recorded with a ZKR-60 spectrometer with tetramethylsilane as the internal standard. Compounds IIIa,c were obtained by the method in [9], and IIIb was obtained by the method in [10].

β-Keto Sulfides IVa-f (Table 1). A 0.01-mole sample of the appropriate III was added to a solution of sodium methoxide (0.01 g-atom of sodium in 30 ml of methanol), and a solution of 0.01 mole of the α-halo ketone in 50 ml of methanol was added dropwise with stirring. The mixture was then refluxed for 3 h, after which the solvent was removed in vacuo. The solid residue was crystallized from a suitable solvent.

1H-Thiazolo[3,2-b]-1,2,4-triazolium Salts IIa-e (Table 2). A solution of 0.01 mole of β-keto sulfide IVa-e in 40 ml of concentrated H_2SO_4 was stirred at room temperature for 5 days, after which the dark solution was poured over ice, and the aqueous mixture was treated with excess 42% perchloric acid. The mixture was allowed to stand briefly, and the resulting precipitate was removed by filtration, washed with water, and crystallized from a suitable solvent.

1,2,5-Triphenyl-1H-thiazolo[3,2-b]-1,2,4-triazolium Perchlorate (IIf). A 3.71-g (0.01 mole) sample of IVf was dissolved in 25 g of PPA (100 g of 85% phosphoric acid plus 25 g of P_2O_5), and the mixture was stirred at 90°C for 11 h. The resulting solution was poured over ice, excess perchloric acid was added, and the precipitate was removed by filtration, washed with water, and crystallized from alcohol to give 4.4 g of IIf.

S-(3-Methyl-1,2,4-triazol-5-yl)thioglycolic Acid (VI). A 1.15-g (0.01 mole) sample of 3-methyl-1,2,4-triazole-5-thione was mixed with 0.95 g (0.01 mole) of monochloroacetic acid and 1.5 g of fused sodium acetate, after which 20 ml of glacial acetic acid was added, and the mixture was refluxed for 3 h. The resulting crystals were removed by filtration and washed with warm water to give 1.7 g (96%) of a product with mp 232°C (from CH_3COOH) (mp 226°C [8]). PMR spectrum (in CF_3COOH): 2.97 s (3H, 3-CH_3), 4.35 s (2H, S—CH_2). Found: N 24.1; S 18.3%. $C_5H_7N_3O_2S$. Calculated: N 24.2; S 18.5%.

2-Methyl-6-(4-dialkylaminophenyl)methylenethiazolo[3,2-b]-1,2,4-triazol-5-one (VIIa,b). A 0.01-mole sample of VI was mixed with 0.01 mole of p-dialkylaminobenzaldehyde, 15 ml of acetic anhydride was added, and the mixture was refluxed for 1 h. Workup gave VIIa, with mp 235°C (from DMF), in 82% yield. UV spectrum: λ_{max} 462 nm (alcohol) (log ε 4.1). PMR spectrum (in $CDCl_3$): 2.62 s (3H, 2-CH_3), 3.20 s [6H, $N(CH_3)_2$], 7.67 d (2H, 3',3'-CH, J = 9 Hz), 6.91 d (2H, 2',2'-CH, J = 9 Hz). Found: N 19.5; S 10.9%. $C_{14}H_{14}N_4OS$. Calculated: N 19.6; S 11.1%. Compound VIIb, with mp 185°C (from DMF), was obtained in 86% yield. UV spectrum: λ_{max} 462 nm (alcohol) (log ε 4.0). PMR spectrum (in $CDCl_3$): 2.58 s (3H, 2-CH_3), 8.14 s (1H, =CH—), 7.56 d (2H, 3'3'-CH, J = 9.5 Hz), 6.79 d (2H, 2',2'-CH, J = 9.5 Hz), 3.54 q [4H, $(CH_2CH_3)_2$, J = 7.5 Hz], 1.26 t [6H, $(CH_2CH_3)_2$, J = 7.5 Hz]. Found: N 17.7; S 10.6%. $C_{16}H_{18}N_4OS$. Calculated: N 17.8; S 10.3%.

2-Methyl-6-ethoxymethylenethiazolo[3,2-b]-1,2,4-triazol-5-one (VIIc). A 1.73-g (0.01 mole) sample of VI was mixed with 1.6 ml (0.01 mole) of ethyl orthoformate, 10 ml of acetic anhydride was added, and the mixture was refluxed for 20 min. Workup gave 1.8 g (85%) of a product with mp 152°C (alcohol). IR spectrum: C=O 1740, C=CH 1640, and a band at 1535 cm^{-1}. PMR spectrum (in $CDCl_3$): 2.61 s (3H, 2-CH_3), 8.17 s (1H, =CH—), 4.53 q (2H, OCH_2CH_3, J = 8 Hz), 1.54 t (3H, OCH_2CH_3, J = 8 Hz). Found: N 19.7; S 15.1%. $C_8H_9N_3O_2S$. Calculated: N 19.9; S 15.2%.

LITERATURE CITED

1. E. Näf, Ann., 265, 1226 (1891).
2. W. Dymek, B. Janik, A. Cygankiewicz, and H. Gawron, Acta Polon. Pharm., 24, 97 (1967).
3. K. T. Potts and S. Husain, J. Org. Chem., 36, 10 (1971).
4. V. A. Kovtunenko, V. N. Bubnovskaya, and F. S. Babichev, Khim. Geterotsikl. Soedin., No. 1, 138 (1975).
5. J.-L. Barascut, J. Daunis, and R. Jacquier, Bull. Soc. Chim. France, 138 (1973).
6. S. Kubota and M. Oda, Chem. Pharm. Bull., 21, 1342 (1973).
7. A. Mustafa, Mohamed J. Ali, M. M. Abou-State, and Abou-Elfotoch Hamman, J. Prakt. Chem., 314, 785 (1972).
8. Ilford Ltd., British Patent No. 634951; Chem. Abstr., 44, 9287 (1950).
9. M. Pesson, G. Polmanss, and S. Dupen, Compt. Rend., 248, 1677 (1959).
10. G. F. Duffin, J. D. Kendall, and H. R. Waddington, J. Chem. Soc., 3804 (1959).