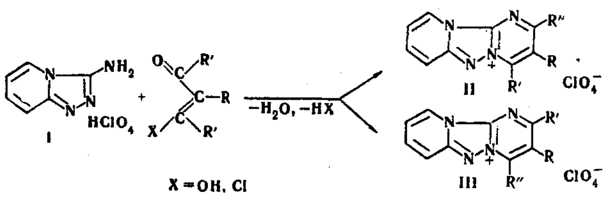
SYNTHESIS OF PYRIDO[1',2':4,3]-s-TRIAZOLO[1,5-a]-PYRIMIDINIUM SALTS

G. M. Golubushina and V. A. Chuiguk

UDC 547.791.8'853.07

Pyrido[1',2':4,3]-s-triazolo[1,5-a]pyrimidinium perchlorates were obtained by the condensation of 3-amino-s-triazolo[4,3-a]pyridinium perchlorate with β-diketones, β-chlorovinyl ketones, β-chlorovinyl aldehydes, and 1,1,3,3-tetraethoxypropane. Unsymmetrical β-diketones, β-chlorovinyl ketones, and β-chlorovinyl aldehydes in this reaction give mixtures of isomeric products that differ with respect to the position of the substituents in the pyrimidine ring. The structures of the reaction products and their ratios in the reaction mixture were determined by means of the PMR spectra.

Salts of nitrogen heterocycles containing an amino group in the 2 position relative to the ring-nitrogen atom react with β-diketones, β-chlorovinyl ketones, β-formyl ketones, and their acetals with closure of the pyrimidine ring and formation of the corresponding pyrimidinium salts with a bridge nitrogen atom [1-4]. In the present investigation, we used the perchlorate salt of 3-amino-s-triazolo[4,3-a]pyridine for this reaction and obtained a number of pyrido[1',2':4,3]-s-triazolo[1,5-a]pyrimidinium perchlorates with structures II and III.



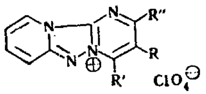
When R' and (or) R'' are CH_3, the condensation products give polymethine dyes. The II and III structures were confirmed by PMR spectra. The chemical shifts of the methyl groups in the 2 and 4 positions differ substantially. We assigned the large chemical shift to the methyl group in the 4 position, since it has been demonstrated that a methyl group in the α position relative to the quaternary nitrogen atom in similar pyrimidinium compounds has a larger chemical shift than the γ-methyl group [2]. On the basis of this assignment, one can readily determine the structures of the products of condensation with unsymmetrical components. The PMR spectra were first recorded for the crude reaction products; the ratio of isomers in the mixture thus reflected the direction of the condensation reaction. Mixtures of isomers that differ with respect to the position of the substituents in the pyrimidine ring are most often formed in this case. 1-Ethoxyacetylacetone forms a mixture with predominance (60%) of the isomer with the methyl group in the γ position, while benzoylacetone forms only this isomer. Methyl β-chlorovinyl ketones form a mixture of isomers with predominance (75%) of the isomer with a methyl group in the α position, phenyl β-chlorovinyl ketone forms one isomer with a phenyl group in the α position, while 3-chloro-2-buten-1-al and 3-chloro-2-methylbuten-2-al form isomers with a methyl group in the α position with a small amount (10%) of isomeric salts. Isomers containing a methyl group in the 4 position were isolated in pure form from the crude products by recrystallization.

In addition to the chemical shift of the methyl groups in the 2 and 4 positions, we also used the difference in the spin–spin coupling constants of the 2,3- and 3,4-protons in the pyrimidine ring to establish the structures of the isomers. Just as in other similar systems [5], $J_{H_2H_3} = 5$ Hz, and $J_{H_3H_4} = 7$ Hz. For

---

T. G. Shevchenko Kiev State University. Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 10, pp. 1433-1435, October, 1971. Original article submitted December 14, 1970.

TABLE 1. Pyrido[1',2':4,3]-s-triazolo[1,5-a]pyrimidinium Perchlorates



R	R'	R''	Mp, °C (dec.)	PMR spectr., ppm		Empirical formula	Found, %		Calc., %		Yield, %
				4-CH₃	2-CH₃		N	Cl	N	Cl	
H	H	H	>350			$C_9H_7ClN_4O_4$	20,95	13,10	20,70	13,10	56
H	CH_3	CH_3	280—283	2,72	2,59	$C_{11}H_{11}ClN_4O_4$	18,70	11,62	18,75	11,98	92
CH_3	CH_3	CH_3	277—279			$C_{12}H_{13}ClN_4O_4$	18,10	11,32	17,88	11,34	75
C_2H_5	CH_3	CH_3	265—267			$C_{13}H_{15}ClN_4O_4$	17,02	10,46	17,09	10,85	70
H	C_6H_5	C_6H_5	311—312			$C_{21}H_{15}ClN_4O_4$	13,18	8,32	13,25	8,39	89
H	CH_3	H	309—310	2,82	2,66[a]	$C_{10}H_9ClN_4O_4$	19,90	12,41	19,68	12,46	93[b]
H	CH_3	$CH_2OC_2H_5$	190—192	2,72	2,58[a]	$C_{13}H_{15}ClN_4O_5$	16,43	10,40	16,22	10,36	63[b]
H	C_6H_5	CH_3	295—297		2,63	$C_{16}H_{13}ClN_4O_4$	15,88	10,12	15,53	9,83	71
CH_3	CH_3	H	300—301	2,77	2,35[c]	$C_{11}H_{11}ClN_4O_4$	18,60	11,98	18,75	11,89	95[b]
H	C_6H_5	H	280			$C_{15}H_{11}ClN_4O_4$	16,28	10,23	16,16	10,23	90

---

[a] Spectrum of the crude product.
[b] Yield of the isomer mixture.
[c] The 3-CH_3 group.

the pure product of condensation of I with methyl β-chlorovinyl ketones we have δ_{CH_3} = 2.82 ppm (the signals of the methyl groups for the product of the condensation of acetylacetone are 2.72 and 2.59 ppm), and J of the pyrimidine protons is 5 Hz; the methyl group is consequently in the 4 position. On the basis of the J values of the pyrimidine protons (5 Hz), it was established that the product of condensation with phenyl β-chlorovinyl ketone has structure III (R" = Ph, R = R' = H).

Methyl β-chlorovinyl ketone and the isomeric β-chlorovinyl aldehyde form primarily the same isomer in the reaction under consideration. This apparently can be explained by different reaction mechanisms: the β-chlorovinyl ketone initially alkylates primarily the amino group in I followed by ring closure with water evolution; the carbonyl group proves to be more active in the β-chlorovinyl aldehyde and, as a result, an azomethine forms and is subsequently cyclized.

Unsubstituted pyrido[1',2':4:3]-s-triazolo[1,5-a]pyrimidinium perchlorate (II, R = R' = R" = H) was obtained by the condensation of III with 1,1,3,3-tetraethoxypropane.

The compounds of the IV type that we obtained are presented in Table 1.

EXPERIMENTAL

The PMR spectra of trifluoroacetic acid solutions were determined with a Varian A-60A spectrometer. The chemical shifts are presented in the δ scale with respect to tetramethylsilane.

Condensation of 3-Amino-s-triazolo[4,3-a]pyridinium Perchlorate (I) with β-Diketones. A mixture of I, prepared according to the method in [6], and the diketone in a molar ratio of 1 : 1.3 was heated at 110-115° for 20-30 min, and the product obtained on cooling was triturated with ether and crystallized from alcohol.

Condensation of I with β-Chlorovinyl Ketones (in analogy with [3]). A 0.01-mole sample of I was dissolved in alcohol, and 1-2 ml of 42% $HClO_4$ and 0.02 mole of the ketone were added. The mixture was allowed to stand for 2 to 3 days at room temperature, and the precipitate was removed by filtration, washed with alcohol, and crystallized from alcohol or aqueous alcohol.

Condensation of I with β-Chlorovinyl Aldehydes. A 0.02-mole sample of the aldehyde was added to a solution of 0.01 mole of I in the minimum amount of alcohol, and the mixture was allowed to stand overnight. The precipitate was removed by filtration and crystallized from alcohol.

Condensation of I with 1,1,3,3-Tetraethoxypropane. A 1-g (4.3 mmole) sample of I was dissolved by heating in the minimum amount of alcohol, and 1.5 ml of 1,1,3,3-tetraethoxypropane was added. The mixture was heated on a water bath for 30 min, and the precipitate that formed from the hot solution was crystallized from water.

LITERATURE CITED

1. S. I. Shul'ga and V. A. Chuiguk, Ukr. Khim. Zh., 36, 483 (1970).
2. S. I. Shul'ga and V. A. Chuiguk, Ukr. Khim. Zh., 37, 350 (1971).
3. A. I. Nesmeyanov and M. I. Rybinskaya, Dokl. Akad. Nauk SSSR, 118, 297 (1958).
4. A. I. Nesmeyanov and M. I. Rybinskaya, Dokl. Akad. Nauk SSSR, 125, 97 (1959).
5. L. M. Werbel, A. Curry, E. F. Elslanger, C. A. Hess, M. P. Hutt, and C. Yongstron, J. Heterocycl. Chem., 6, 787 (1969).
6. K. T. Potts and H. R. Burton, J. Org. Chem., 31, 260 (1966).