RESEARCH IN THE IMIDAZOLE SERIES

XCI.* HYDROLYSIS OF 7-CYANO DERIVATIVES OF PYRROLO[1,2-a]IMIDAZOLE

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UDC 547.785.5'75 : 542.938

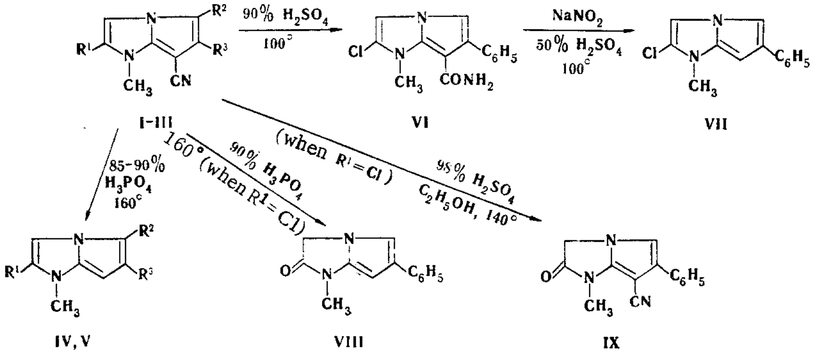
The hydrolysis of 7-cyano derivatives of pyrrolo[1,2-a]imidazole in 85-90% sulfuric acid at 100°C gives amides of pyrroloimidazole-7-carboxylic acids. Under more severe conditions, the resulting carboxylic acids are decarboxylated to the corresponding pyrroloimidazole derivatives with a free 7 position.

In order to synthesize the previously undescribed carboxylic acids of the pyrrolo[1,2-a]imidazole series and their derivatives, we studied the hydrolysis of 7-cyanopyrroloimidazoles (I-III) [2]. It was found that I-III are quite resistant to hydrolysis and are not affected by prolonged heating in alkaline media. In addition, the nitrile group does not undergo hydrolysis when nitrile II is heated for many hours in ethanol in the presence of sulfuric acid in a sealed tube (140°C). In this case only saponification of the chlorine atom in the 2 position of the two ring system to give the corresponding pyrrolo[1,2-a]imidazol-2-one (IX, Table 1) is observed.

The corresponding pyrroloimidazole-6-carboxylic acids, which, however, are also unstable under the reaction conditions and undergo decarboxylation to pyrroloimidazole derivatives (IV, V), are probably formed in the hydrolysis of I-III in 85-90% H_3PO_4 at 160°. Moreover, in the case of nitrile II, the chlorine atom is also saponified to give pyrrolo-2-imidazolone (VIII), as is also the case when it is treated with H_2SO_4 in ethanol.

Nitrile II undergoes hydrolysis to amide VI when it is heated for 10 h in 85-90% H_2SO_4 at 100°. When amide VI was treated with sodium nitrite in dilute H_2SO_4, instead of the expected acid, we isolated its decarboxylation product (VII); this also constitutes evidence for the instability of pyrroloimidazole-7-carboxylic acids.

The structures of the compounds were confirmed by the results of elementary analysis and their IR spectra.



I, IV $R^1=R^2=H$, $R^3=C_6H_5$; II $R^1=Cl$, $R^2=H$, $R^3=C_6H_5$; III, V $R^1=H$, $R^2=R^3=CH_3$

EXPERIMENTAL

The IR spectra of mineral oil suspensions of the compounds were recorded with a UR-10 spectrometer.

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*See [1] for communication XC.

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TABLE 1. Pyrrolo[1,2-a]imidazole Derivatives (IV-IX)

Compound	mp, °C*	Empirical formula	Found, %				Calculated, %				Yield, %
			C	H	Cl	N	C	H	Cl	N	
IV	90—92	$C_{13}H_{12}N_2$	79,6	6,2	—	14,3	79,6	6,2	—	14,3	27
V	120—122	$C_9H_{12}N_2 \cdot C_6H_3N_3O_7$	—	—	—	18,2	—	—	—	18,6	6
VI	154—155	$C_{14}H_{12}ClN_3O$	61,5	4,4	12,9	15,0	61,4	4,4	13,0	15,3	72
VII	201—202	$C_{13}H_{11}ClN_2 \cdot H_2SO_4 \cdot H_2O$	45,5	4,1	10,2	—	45,0	4,4	10,2	—	16
VIII	138—140	$C_{13}H_{12}N_2O$	73,0	5,5	—	13,7	73,5	5,7	—	13,2	84
IX	210—212	$C_{14}H_{11}N_3O$	70,6	4,5	—	17,5	70,9	4,7	—	17,7	21

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*The compounds were purified by crystallization: IV, V, VII, and VIII from ethanol, VI from isopropyl alcohol, and IX from anhydrous ethanol.

1-Methyl-6-phenyl-, 1-methyl-2-chloro-6-phenyl-, and 1,5,6-trimethyl-7-cyanopyrrolo[1,2-a]imidazoles I-III were obtained by the method in [2].

1-Methyl-6-phenylpyrrolo[1,2-a]imidazole (IV). A 1-g sample of nitrile I was heated with stirring on an oil bath (160-165°) in 10 ml of 85-90% H_3PO_4 until the evolution of CO_2 bubbles ceased completely (~2 h), after which the mixture was poured over ice, the solution was made alkaline to pH 10 with ammonium hydroxide, and the precipitate was removed by filtration.

1,5,6-Trimethylpyrrolo[1,2-a]imidazole (V). This compound was obtained from nitrile III by the method presented above, except that the mixture was extracted with ether after alkalization, an ether solution of picric acid was added to the ether extract, and V was isolated as the picrate.

1-Methyl-2-chloro-6-phenyl-7-carbamoylpyrrolo[1,2-a]imidazole (VI). A solution of 1.96 g of nitrile II in 20 ml of 90% H_2SO_4 was heated at 98-100° for 10 h, after which it was worked up as described for the preparation of IV. IR spectrum, cm^{-1}: 1740 (CO); 3140 and 3460 (NH_2).

1-Methyl-2-chloro-6-phenylpyrrolo[1,2-a]imidazole (VII). A total of 10 ml of 5% aqueous $NaNO_2$ solution was added dropwise to a boiling solution of 1 g of amide VI in 75 ml of 50% H_2SO_4, and the mixture was refluxed for 20 min. It was then cooled, and the precipitated sulfate of VII was removed by filtration.

1-Methyl-6-phenylpyrrolo[1,2-a]imidazol-2-one (VIII). A solution of 1 g of nitrile II in 10 ml of 90% H_3PO_4 was heated at 160° for 1 h, after which it was cooled and worked up as described for IV. IR spectrum, cm^{-1}: 1728 (CO).

1-Methyl-6-phenyl-7-cyanopyrrolo[1,2-a]imidazole-2-one (IX). A solution of 2.6 g of II in 25 ml of absolute ethanol and 3 ml of concentrated H_2SO_4 was heated in a sealed tube at 140° for 16 h, after which it was cooled, and the resulting precipitate was removed by filtration.

The physical characteristics of all of the compounds obtained in this research are presented in Table 1.

LITERATURE CITED

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2. P. M. Kochergin, A. A. Druzhinina, and R. M. Palei, Khim. Geterotsikl. Soedin., No. 11, 1549 (1976).