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SHORT COMMUNICATIONS

Unexpected Result of Imidazo[4,5-*b*]pyridine Bromination

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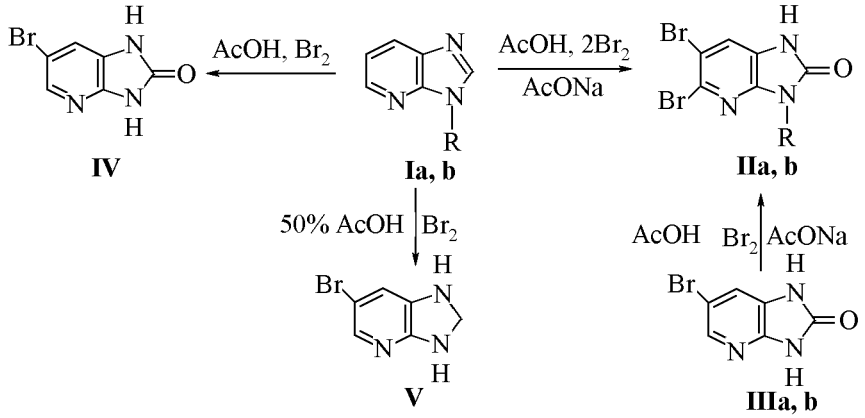
On heating imidazo[4,5-*b*]pyridine (**Ia**) [1] with excess bromine in the glacial acetic acid we unexpectedly obtained a compound containing two bromine atoms in a molecule and having in the IR spectrum absorption corresponding to an amido group. We assumed that the compound was 5,6-dibromoimidazo[3,5-*b*]pyridin-2-one (**IIa**) and confirmed by establishing its identity with an authentic sample of **IIa** prepared by treating with bromine imidazo[4,5-*b*]pyridine-2-one (**III**) [1] as we had described in [2] for 1,3-dimethylimidazo[4,5-*b*]-pyridine-2-one.

The bromination of base **Ia** in acetic acid in the presence of sodium acetate provided the same result. But the treating of compound Ia with bromine at the molar ratio 1 : 1 gave rise to 6-bromoimidazo[4,5-*b*]pyridin-2-one (**IV**) corresponding to compound described in [1]. It should be noted however that bromination of base **Ia** in 50% aqueous acetic acid furnished 6-bromoimidazo[4,5-*b*]pyridine (**V**) [3]: Thus here the reaction proceeded similarly to bromination of 1,2-dimethylimidazo[4,5-*b*]pyridine in the same medium [4]. In the same way as base **Ia** reacted with bromine 3-methylimidazo[4,5-*b*]pyridine



I–**III**, R = H (**a**), CH_3 (**b**).

(**Ib**) giving rise to dibromide **IIb** obtained also by bromination of imidazolone **IIIb**.

The formation mechanism of compounds **IIa, b** is yet unclear, but apparently first occurs covalent addition of acetic acid elements across the C=N bond of the imidazole fragment of substrate **I** followed by oxidation with bromine of the arising 1,2-dihydroimidazole into 2-acetoxyimidazole that further is cleaved by the generated hydrogen bromide giving-2-oxy-(oxo)imidazo[4,5-*b*]pyridine (**III**). The latter should readily take up bromine affording dibromide **II**.

5,6-Dibromoimidazo[4,5-*b*]pyridin-2-one (IIa). (a). To a solution of 0.6 g (5 mmol) of imidazo[4,5-*b*]pyridine (**Ia**) and 0.82 g (10 mmol) of CH_3COONa in 20 ml of acetic acid was added by portions at stirring a solution of 0.51 ml(10 mmol) of bromine in 3 ml of acetic acid. The reaction occurred with precipitate formation. The suspension obtained was heated at stirring for 5 h on a boiling water bath. The acetic acid was distilled off in a vacuum to dryness, and to residue was poured 15 ml of water, and the solution was neutralized with 25% water solution of ammonia. The separated precipitate was filtered off

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and recrystallized from a mixture DMF–water, 4:1, with addition of activated carbon. The obtained colorless crystalline compound was washed with hot ethanol and dried Yield 45 g (31%), mp > 360°C. IR spectrum, ν, cm^{-1}: 1695 (C=O). ^1H NMR spectrum, δ, ppm: 7.48 s (1H, H^7); 11.11 s (1H, H^1); 11.67 s (1H, H^3). Found, %: C 24.38; H 1.00; N 14.21. $C_6H_3Br_2N_3O$. Calculated, %: C 24.60; H 1.03; N 14.35.

(b) To a solution of 4.05 g (30 mmol) of imidazo-[4,5-*b*]pyridin-2-one (**IIIa**) and 5.1 g (62 mmol) of CH_3COONa in 80 ml of acetic acid was added dropwise a solution of 3.2 ml (62 mmol) of bromine in 10 ml of acetic acid. The mixture was heated with stirring on a water bath for 5 h. The precipitate was filtered off, washed with water, and dried. Yield 6.75 g (78%). mp > 360°C (from DMF). IR spectrum, ν, cm^{-1}: 1695 (C=O). ^1H NMR spectrum, δ, ppm: 7.49 s (1H, H^7); 11.12 s (1H, H^1); 11.68 s (1H, H^3). Found, %: C 24.45; H 1.01; N 14.23. $C_6H_3Br_2N_3O$. Calculated, %: C 24.60; H 1.03; N 14.35.

5,6-Dibromo-3-methylimidazo[4,5-*b*]pyridin-2-one (IIb). (a) Compound **IIb** was prepared under conditions described above under procedure (a) for compound **IIa**. From 0.66 g (5 mmol) of 3-methylimidazo[4,5-*b*]pyridine (**Ib**) [5], 0.82 g (10 mmol) of CCH_3COONa, 20 ml of acetic acid, and 0.51 ml (10 mmol) of bromine was obtained compound **IIb** in 0.57 g (38%) yield, mp 325–326°C (from DMF). IR spectrum, ν, cm^{-1}: 1695 (C=O). ^1H NMR spectrum, δ, ppm: 3.29 s (3H, N^3–CH_3); 7.64 s (1H, H^7); 11.40 (1H, br. signal, H^1). Found, %: C 27.24; H 1.61; N 13.55. $C_7H_5Br_2N_3O$. Calculated, %: C 27.39; H 1.64; N 13.69.

(b) Synthesis was carried out as in procedure (b) for compound **IIa**. From 0.6 g (4 mmol) of 3-methylimidazo[4,5-*b*]pyridin-2-one (**IIIb**) [6], 0.66 g (8 mmol) of CH_3COONa, 15 ml of acetic acid, and 0.42 ml (8 mmol) of bromine was obtained compound **IIb** in 0.82 g (67%) yield, mp 324–326°C (from DMF). IR spectrum, ν, cm^{-1}: 1695 (C=O). ^1H NMR spectrum, δ, ppm: 3.28 s (3H, N^3–CH_3); 7.64 s (1H, H^7); 11.41 (1H, br. signal, H^1). Found, %: C 27.27; H 1.62; N 13.65. $C_7H_5Br_2N_3O$. Calculated %: C 27.39; H 1.64; N 13.69.

6-Bromoimidazo[4,5-*b*]pyridin-2-one (IV). To a solution of 0.6 g (5 mmol) of imidazo [4,5-*b*]pyridine (**Ia**) [1] in 15 ml of acetic acid was added by portions at stirring 0.26 ml (5 mmol) of bromine in 7 ml of acetic acid. The reaction occurred with precipitate formation. The suspension obtained was heated for 5 h on a boiling water bath. Then the acetic acid was distilled off in a vacuum. The oily residue was dissolved in 15 ml of water, and the solution was neutralized with 25% water solution of ammonia. The separated gray-brown precipitate was filtered off and purified by recrystallization from 85% acetic acid. Off-white compound **IV** was obtained in 0.27 g (25%) yield, mp 361–363°C. IR spectrum, ν, cm^{-1}: 1710 (C=O). ^1H NMR spectrum, δ, ppm: 7.44 d (1H, H^7, *J* 1.96 Hz); 7.99 d (1H, H^5, *J* 1.96 Hz); 11.28 s (1H, H^1); 11.74 s (1H, H^3). Found, %: C 33.49; H 1.83; N 19.48. $C_6H_4BrN_3O$. Calculated, %: C 33.67; H 1.88; N 19.63.

6-Bromoimidazo[4,5-*b*]pyridine (V). To a solution of 0.6 g (5 mmol) of imidazo [4,5-*b*]pyridine (**Ia**) [1] in 27 ml of 50% acetic acid was added by portions at stirring while heating to 70°C 0.51 ml (10 mmol) of bromine. The reaction mixture was stirred at this temperature for 5 h, the solvent was evaporated to dryness, and the solid residue was dissolved in 20 ml of water and neutralized with 25% aqueous ammonia. The precipitate was filtered off, washed with a small portion of cold water and with ethanol–water mixture, 1:1, and dried. Yield 0.65 g (61%), mp 225–226°C (from ethanol), (publ. mp 227–228°C [3]). ^1H NMR spectrum, δ, ppm: 8.19 s (1H, H^2); 8.37 d (1H, H^7, *J* 1.98 Hz); 8.39 d (1H, H^5, *J* 1.98 Hz). Found, %: C 36.20; H 2. 00; N 21.05. $C_6H_4BrN_3$. Calculated, %: C 36.39; H 2.04; N 21.22.

^1H NMR spectra of compounds **IIa, b, IV, V** were registered on spectrometer Gemini-200 (operating frequency 200 MHz) from solutions in DMSO-d_6 , internal reference HMDS. IR spectra were recorded on spectrophotometer UR-20 from mulls in mineral oil. The purity and homogeneity of compounds synthesized was proved by TLC on Silufol UV-254 plates, eluent ethanol, development under UV irradiation or in iodine vapor.

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