

SHORT
COMMUNICATIONS

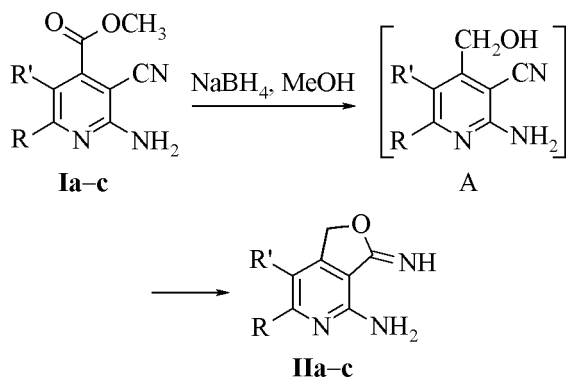
Synthesis of 6,7-Dialkyl-4-amino-3-imino-1,3-dihydrofuro[3,4-c]pyridines

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We formerly reported on the synthesis of alkyl 5,6-dialkyl-2-amino-3-cyanopyridine-4-carboxylates (**Ia-c**) [1] and on their reactions with O- and N-nucleophiles. In extension of these studies we investigated reaction of compound **I** with sodium borohydride in protic solvents (alcohols and amines). The reaction yielded 6,7-dialkyl-4-amino-3-imino-1,3-dihydrofuro[3,4-c]pyridines (**IIa-c**); even at large excess of borohydride the pyridine ring was not reduced. The result was unexpected since in the literature a selective reduction with borohydrides of the ring in electron-deficient pyridines (pyridinecarboxylates and pyridinecarbonitriles) was described, ester and cyano groups remaining intact [2, 3]. In our case the attack of hydride anion, same as that of the other nucleophiles, is directed first of all to the ester group. This is apparently due to the presence in the structure of a strong donor, amino group. Besides the X-ray diffraction analysis [1] has revealed that methoxycarbonyl group is not conjugated with the heterocycle and therefore its electron-withdrawing character is not fully realized.



Ia-c, **IIa-c**: R = CH₃, R' = H (**a**); R = R' = CH₃ (**b**);
R + R' = (CH₂)₄ (**c**).

In the first stage of the reaction the ester group is presumably reduced into hydroxymethyl group. The arising intermediate **A** undergoes further an intramolecular cyclization affording dihydrofuro[3,4-c]pyridines **IIa-c**. The structure of compounds obtained was deduced from ¹H NMR, IR, and mass spectra.

6,7-Dialkyl-4-amino-3-imino-1,3-dihydrofuro[3,4-c]pyridines (IIa-c). In 10 ml of methanol was dispersed at room temperature 0.001 mol of compound **Ia-c**. Into the dispersion was gradually added 5-fold excess (0.005 mol) of sodium borohydride. The reaction mixture was boiled for 3 h. On cooling to room temperature the mixture was diluted with water. The separated grey crystalline precipitate was filtered off, washed with 1 ml of 2-propanol, purified by sublimation in a vacuum, and dried in a vacuum-desiccator over P₂O₅.

4-Amino-3-imino-6-methyl-1,3-dihydrofuro[3,4-c]pyridine (IIa). Yield 0.082 g (50%), mp 185°C. IR spectrum, ν, cm⁻¹: 3150, 3290, 3410 (NH, NH₂), 1010 (C-æ-C). ¹H NMR spectrum (DMSO-*d*₆), δ, ppm: 2.37 s (3H, CH₃), 5.80 s (2H, CH₂O), 6.50 s (1H, CH), 6.72 s (2H, NH₂), 7.70 s (1H, NH). Found, %: C 58.93; H 5.60; N 25.75. C₈H₉N₃O. Calculated, %: C 58.89; H 5.56; N 25.75.

4-Amino-3-imino-6,7-dimethyl-1,3-dihydrofuro[3,4-c]pyridine (IIb). Yield 0.097 g (55%), mp 190°C. IR spectrum, ν, cm⁻¹: 3155, 3285, 3370 (NH, NH₂), 1010 (C-æ-C). Mass spectrum: *M* 177; further are given 10 intense peaks of fragment ions, *m/z* (*I*_{rel}, %): 162 (14), 148 (14), 132 (42), 122 (12), 107 (10), 92 (7), 79 (9), 65 (11), 52 (8), 42 (18). Found, %: C 61.02; H 6.22; N 23.68. C₉H₁₁N₃O. Calculated, %: C 61.00; H 6.26; N 23.71.

4-Amino-3-imino-6,7-tetramethylene-1,3,6,7,8,9-hexahydrofuro[3,4-c]quinoline (IIc). Yield

0.091 g (45%), mp 180°C. IR spectrum, ν , cm^{-1} : 3155, 3310, 3400 (NH, NH_2), 1010 (C-æ-C). ^1H NMR spectrum ($\text{DMSO-}d_6$), δ , ppm: 1.70 m (4H, $\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2$), 2.48 t (2H, CH_2CH_2), 2.68 t (2H, CH_2CH_2), 5.13 s (2H, CH_2O), 6.40 s (2H, NH_2), 7.49 s (1H, NH). Mass spectrum: M 203; further are given 10 intense peaks of fragment ions, m/z (I_{rel} , %): 186 (21), 175 (30), 159 (34), 157 (51), 147 (73), 146 (41), 131 (18), 130 (20), 66 (20), 65 (100). Found, %: C 65.01; H 6.41; N 20.65. $\text{C}_{11}\text{H}_{13}\text{N}_3\text{O}$. Calculated, %: C 65.01; H 6.45; N 20.67.

IR spectra were measured on spectrometer UR-20 from mulls in mineral oil. ^1H NMR spectra were registered on Bruker WM-250, Bruker AM-300, and Bruker DRX-500 instruments at operating frequencies

250.13, 300.13, and 500.13 MHz respectively from solutions in $\text{DMSO-}d_6$, internal reference TMS. The reaction progress was monitored and the purity of compounds synthesized was checked by TLC on Silufol UV-254 plates, development under UV irradiation or in iodine vapor.

REFERENCES

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