

SHORT
COMMUNICATIONSReaction of 5,5-Dialkyl-2-halo-6-hydroxy-5,6-dihydro-1*H*-pyridine-3,4,4-tricarbonitriles with Aldehyde Oximes

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Studies on new methods for modification of hydrogenated pyridines having unusual functional environment attract much interest from the viewpoint of development of the chemistry of heterocyclic compounds. In the recent time, the number of publications concerning reactions of polycyano compounds with ketone and aldehyde oximes has increased considerably [1].

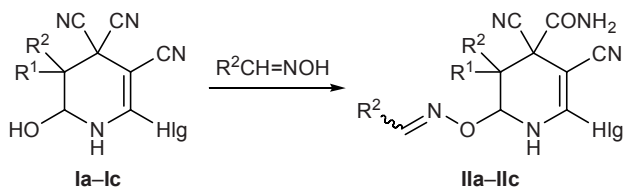
While studying reactions of 5,5-dialkyl-2-halo-6-hydroxy-5,6-dihydro-1*H*-pyridine-3,4,4-tricarbonitriles **Ia–Ic** [2] with aldehyde oximes we isolated the corresponding 2-alkylideneaminoxy-3,3-dialkyl-4,5-dicyano-6-halo-1,2,3,4-tetrahydropyridine-4-carboxamides **IIa–IIc** in 90–95% yield. The reactions occurred under mild conditions (room temperature), and no catalyst was necessary; either anhydrous aldehyde oxime or anhydrous acetonitrile can be used as solvent. We believe that the electrophilic carbon atom in the axial cyano group on C⁴ favors replacement of the hydroxy group according to “push–pull” mechanism; as a result, the cyano group is converted into carbamoyl.

The structure of compounds **IIa–IIc** was determined on the basis of their IR, ¹H NMR, and mass spectra. The IR spectra of **IIa–IIc** contained strong absorption bands in the region 1680–1700 cm⁻¹ due to stretching vibrations of the carbonyl group and C=N bond in the oxime fragment; a strong band at

2220 cm⁻¹ was assigned to the conjugated cyano group, and medium-intensity band at 2260 cm⁻¹, to the nonconjugated cyano group; stretching vibrations of the N–H bonds were observed in the region 3200–3300 cm⁻¹. Compounds **IIa–IIc** displayed in the ¹H NMR spectra a doublet at δ 9.90–9.54 ppm from the NH proton in the tetrahydropyridine ring, two singlets in the region δ 7.95–7.72 ppm from the amide NH₂ group, and a quartet at δ 7.04–7.01 ppm (**IIa**, **IIb**) or a singlet at δ 6.70 ppm (**IIc**) from the N=CH proton; in addition, signals from alkyl and furyl (**IIc**) protons were present.

6-Bromo-4,5-dicyano-2-ethylideneaminoxy-3,3-dimethyl-1,2,3,4-tetrahydropyridine-4-carboxamide (IIa). Compound **Ib**, 0.24 g (1 mmol), was dissolved in 1 ml of acetaldehyde oxime, the solution was kept for 36 h, and the precipitate was filtered off and washed with acetone. Yield 0.31 g (90%), mp 200–202°C. IR spectrum, ν, cm⁻¹: 3200 (N–H); 2220, 2260 (C≡N); 1690 (C=O); 1660 (C=N). ¹H NMR spectrum, δ, ppm: 9.54 d (1H, 1-H), 7.85 s (1H, CONH₂), 7.72 s (1H, CONH₂), 7.01 q (1H, N=CH), 4.82 d (1H, 2-H), 1.85 d (3H, N=CHCH₃), 1.35 s and 0.95 s (3H each, 3-Me). Found, %: C 42.31; H 4.18; N 20.53. C₁₂H₁₄BrN₅O₂. Calculated, %: C 42.37; H 4.15; N 20.59.

6-Bromo-4,5-dicyano-3,3-diethyl-2-ethylideneaminoxy-1,2,3,4-tetrahydropyridine-4-carboxamide (IIb) was synthesized in a similar way. Yield 0.34 g (92%), mp 197–198°C. IR spectrum, ν, cm⁻¹: 3200 (N–H); 2220, 2260 (C≡N); 1700 (C=O); 1690 (C=N). ¹H NMR spectrum, δ, ppm: 9.61 d (1H, 1-H), 7.95 s (1H, CONH₂), 7.88 s (1H, CONH₂), 7.04 q (1H, N=CH), 4.8 d (1H, 2-H), 1.95 m (2H, CH₂CH₃), 1.85 d (3H, N=CHCH₃), 1.47 m and 1.35 m (1H each,



Hlg = Br, R¹ = R² = Me (**a**); Hlg = Br, R¹ = Et, R² = Me (**b**);
Hlg = Cl, R¹ = Et, R² = 2-furyl (**c**).

CH₂CH₃), 0.92 t and 0.85 t (3H each, CH₂CH₃). Mass spectrum, *m/z* (*I*_{rel}, %): 367/369 (10/10) [*M*]⁺, 323 (5), 325 (5), 325 (4), 327 (8), 309 (10), 311 (10), 265 (10), 267 (10), 236 (20), 238 (20). Found, %: C 45.62; H 4.89; N 18.96. C₁₄H₁₈BrN₅O₂. Calculated, %: C 45.66; H 4.93; N 19.02.

6-Chloro-4,5-dicyano-3,3-diethyl-2-furfurylideneaminoxy-1,2,3,4-tetrahydropyridine-4-carboxamide (IIc). 2-Furaldehyde oxime, 0.05 g (0.5 mmol), was added to a solution of 0.07 g (0.25 mmol) of tetrahydropyridine **Ic** in 0.5 ml of acetonitrile. The mixture was kept for 48 h, and the precipitate was filtered off and washed with acetone. An additional amount of the product can be isolated by diluting the filtrate with water. Yield 0.09 g (95%), mp 245–246°C. IR spectrum, *v*, cm⁻¹: 3200 (N–H); 2220, 2260 (C≡N); 1700 (C=O); 1690 (C=N). ¹H NMR spectrum, *δ*, ppm: 9.90 d (1H, 1-H), 7.86 t (1H, furan), 7.85 s (1H, CONH₂), 7.80 s (1H, CONH₂), 7.72 s (1H, furan), 7.28 d (1H, furan), 6.7 s (1H, N=CH), 5.0 d (1H, 2-H), 2.08 m and 2.0 m (1H each, CH₂CH₃), 1.65 m and 1.4 m (1H each, CH₂CH₃), 1.0 t and 0.95 t (3H each, CH₂CH₃). Mass spectrum, *m/z* (*I*_{rel}, %): 331 [*M* – 43]⁺ (5), 281 (5), 265 (5), 222 (5), 192 (47). Found, %:

C 54.36; H 4.86; N 18.68. C₁₇H₁₈ClN₅O₃. Calculated, %: C 54.33; H 4.83; N 18.64.

The IR spectra were recorded on an FSM 1210 instrument from samples dispersed in mineral oil. The ¹H NMR spectra were recorded on a Bruker AM-500 spectrometer (500.13 MHz) from solutions in DMSO-*d*₆. The mass spectrum (electron impact, 70 eV) was obtained on a Simadzu GCMS-QP2010S DI instrument.

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REFERENCES

1. Bokach, N.A. and Kukushkin, V.Yu., *Usp. Khim.*, 2005, vol. 74, p. 164.
2. Eremkin, A.V., Molko, S.N., Ershov, O.V., Kayukov, Y.S., Nasakin, O.E., Tafeenko, V.A., and Nurieva, E.V., *Mendeleev Commun.*, 2006, vol. 16, p. 115.