Letters to the Editor

Competition of imidazo-annulation and pyrrole-formation in the reactions of benzylamine with 3-acetylquinoxalin-2-ones

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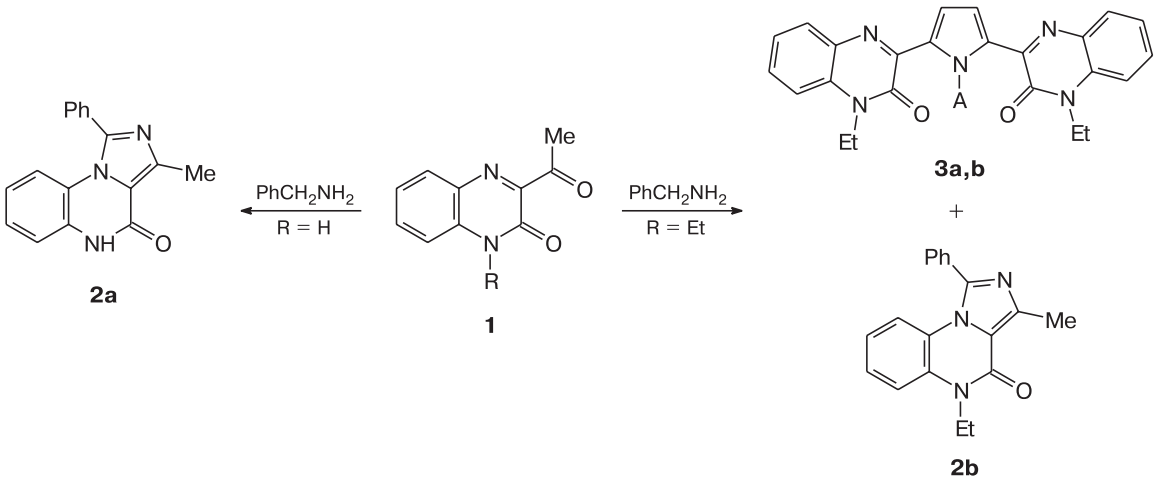
We found that a predominant direction and structures of products of the reaction of 3-acetylquinoxalin-2-ones **1** with benzylamine in hot (140±10 °C) DMSO depend on the presence of a substituent in the carbamoyl fragment of the quinoxaline system. A predominant direction of the reaction of benzylamine with 3-acetylquinoxalin-2(1*H*)-one (**1a**), similarly to the reaction with 3-benzoylquinoxalin-2-one,[1] is the formation of 1-phenylimi-

Scheme 1



A = H (**a**), Bn (**b**)

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dazo[1,5-*a*]quinoxalin-4(5*H*)-one (**2a**), whereas the reactions, leading to 2,5-bis(1-ethyl-2-oxo-1,2-dihydroquinoxalin-3-yl)pyrrole (**3a**), 1-benzyl-2,5-bis(1-ethyl-2-oxo-1,2-dihydroquinoxalin-3-yl)pyrrole (**3b**), and 5-ethyl-1-phenylimidazo[1,5-*a*]quinoxalin-4-one (**2b**), compete when 3-acetyl-1-ethylquinoxalin-2-one (**1b**) is used instead of **1a**.

Structures of compounds **2a**, **3a**, and **3b** were established by spectroscopy methods (IR spectroscopy, ^{1}H NMR spectroscopy, mass spectrometry), and additionally by X-ray analysis for compounds **3a** and **3b**. The formation of compound **2b** (in ~10% yield) was determined from the ^{1}H NMR spectrum of the reaction mixture by the presence of indicative signals[1] of H(8) proton (6.87 dd, 1 H, J = 8.4 Hz, J = 8.4 Hz) and of the protons of the methyl group 2.79 (s, CH_3).

The pyrrole ring is formed not only in the reaction of 3-acetyl-1-ethylquinoxalin-2-one (**1b**) with benzylamine, but also with other suppliers of the nitrogen atom, such as *m*-bis(aminomethyl)benzene, other primary amines, and NH_4OAc, which will be reported in one of our next papers, where the X-ray data will be presented and suggestions on the mechanism of the pyrrole ring formation will be considered.

IR spectra were recorded on a Bruker Vector-22 spectrometer in Nujol. ^{1}H NMR spectra were recorded on a Bruker MSL-400 spectrometer relatively to the residual signals of the solvent (DMSO-d_6). Mass spectra (electron ionization) were recorded on a Finnigan TRACE MS ThermoQuest instrument (Bace MS).

3-Methyl-1-phenylimidazo[1,5-*a*]quinoxalin-4(5*H*)-one (2a). A solution of 3-acetylquinoxalin-2(1*H*)-one (**1a**) (0.14 g, 0.75 mmol) and benzylamine (0.11 g, 1 mmol) in DMSO (5 mL) was stirred for 5 h at 140—150 °C, cooled, and poured in water. The crystals formed were filtered off, washed with water, dried, and purified by column chromatography on silica gel (eluent: chloroform). The yield was 60 mg (30%), m.p. 290—292. IR, ν/cm^{-1}: 469, 584, 670, 697, 838, 1122, 1253, 1332, 1409, 1504, 1573, 1618, 1673, 2500-3220. ^{1}H NMR, δ: 2.63 (s, 3 H, Me); 6.87 (ddd, 1 H, H(8), J = 8.5 Hz, J = 7.3 Hz, J = 1.6 Hz); 7.01 (d, 1 H, H(6), J = 8.5 Hz); 7.26 (ddd, 1 H, H(7), J = 8.1 Hz, J = 7.3 Hz, J = 1.2 Hz); 7.29 (dd, 1 H, H(9), J = 8.1 Hz, J = 1.6 Hz); 7.58—7.67 (m, 5 H, Ph). MS, m/z (I_{rel} (%)): 276 (26) $[M + 1]^{+\bullet}$, 275 $[M]^{+\bullet}$ (100), 274 (28), 234 (26), 206 (6), 172 (36), 144 (42), 143 (39), 118.1 (22), 104 (8), 90 (14), 81 (32), 69 (40). Found (%): C, 74.25; H, 4.82; N, 15.15. $C_{17}H_{13}N_3O$. Calculated (%): C, 74.17; H, 4.76; N, 15.26.

2,5-Bis(1-ethyl-2-oxo-1,2-dihydroquinoxalin-3-yl)pyrrole (3a) and 1-benzyl-2,5-bis(1-ethyl-2-oxo-1,2-dihydroquinoxalin-3-yl)pyrrole (3b). A solution of compound **1b** (0.32 g, 1.5 mmol) and benzylamine (0.17 g, 1.7 mmol) in DMSO (10 mL) was stirred for 6 h at 140—150 °C, cooled, and poured in water. The crystals formed were filtered off, washed with water, dried, and purified by column chromatography on silica gel (eluent: dichloromethane). The yield of compound **3a** was 35 mg (11%), of compound **3b**, 60 mg (16%).

2,5-Bis(1-ethyl-2-oxo-1,2-dihydroquinoxalin-3-yl)pyrrole (3a), m.p. 270—272 °C. IR, ν/cm^{-1}: 412, 475, 652, 741, 815, 1040, 1092, 1115, 1159, 1181, 1252, 1290, 1483, 1578, 1603, 1644, 3327. ^{1}H NMR, δ: 1.34 (t, 6 H, Me, J = 7.0 Hz); 4.41 (q, 4 H, CH_2, J = 7.0 Hz); 7.40 (s, 2 H, H(3), H(4)); 7.42 (ddd, 2 H, H(6) quinox., J = 8.4 Hz, J = 8.0 Hz, J = 1.3 Hz); 7.60 (ddd, 2 H, H(7) quinox., J = 8.4 Hz, J = 8.0 Hz, J = 1.3 Hz); 7.67 (d, 2 H, H(8) quinox., J = 8.0 Hz); 7.85 (dd, 2 H, H(5) quinox., J = 8.0 Hz, J = 1.3 Hz). MS EI, m/z (I_{rel} (%)): 412 $[M + 1]^{+\bullet}$ (29), 411 (100) $[M]^{+\bullet}$, 382 (7), 368 (11), 354 (12), 313 (14), 299 (11), 264 (9), 239 (10), 236 (14). Found (%): C, 70.11; H, 5.09; N, 17.13. $C_{24}H_{21}N_5O_2$. Calculated (%): C, 70.06; H, 5.14; N, 17.02.

1-Benzyl-2,5-bis(1-ethyl-2-oxo-1,2-dihydroquinoxalin-3-yl)pyrrole (3b), m.p. 286—288 °C. IR, ν/cm^{-1}: 477, 551, 586, 874, 1038, 1090, 1192, 1293, 1382, 1536, 1579, 1601, 1654. ^{1}H NMR, δ: 1.24 (t, 6 H, Me, J = 7.1 Hz); 4.29 (q, 4 H, CH_2CH_3, J = 7.1 Hz); 6.35 (s, 2 H, $\underline{CH}_2$Ph); 6.82 (d, 2 H, H(*o*-Ph), J = 8.4 Hz); 7.00 (dd, 1 H, H(*p*-Ph), J = 7.4 Hz, J = 6.9 Hz); 7.08 (dd, 2 H, H(*m*-Ph), J = 7.62 Hz, J = 7.4 Hz); 7.32—7.40 (m, 2 H, quinox.); 7.52 (s, 2 H, H(3), H(4)); 7.52—7.58 (m, 4 H, quinox.); 7.64 (d, 2 H, quinox., J = 7.6 Hz). MS EI, m/z (I_{rel} (%)): 501 (100) $[M]^{+\bullet}$, 472 (89), 444 (10), 425 (13), 424 (38), 412 (21), 366 (7), 340 (11), 328 (20), 300 (7), 251 (8), 199 (16), 170 (9), 156 (8), 130 (8), 91 (35), 86 (24), 44 (42), 28 (33). Found (%): C, 74.35; H, 5.48; N, 14.04. $C_{31}H_{27}N_5O_2$. Calculated (%): C, 74.23; H, 5.43; N, 13.96.

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References

1. V. A. Mamedov, A. A Kalinin, E. A. Gorbunova, I. Bayer, W. D. Habicher, *Zh. Org. Khim.*, 2004, **40**, 1082 [*Russ. J. Org. Chem.*, 2004, **40** (Engl. Transl.)].

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