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REACTION OF 2-(2-OXO-1,2-DIHYDRO-3H-INDOL-3-YLIDENE)ACETIC ACID ESTERS WITH 1,2-DIAMINES

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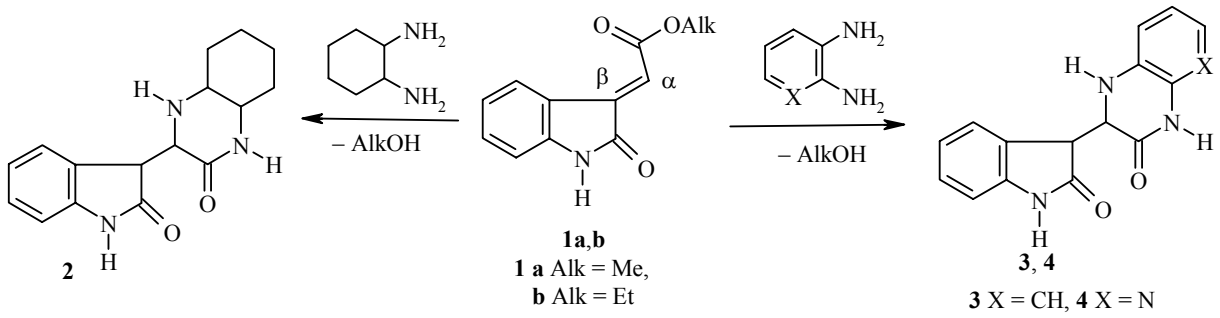
Keywords: 2-oxo-2,3-dihydro-1H-indol-3-yl derivatives of quinoxalin-2(1H)-ones and pyrido[2,3-*b*]-pyrazin-3(2H)-one; 2-(2-oxo-1,2-dihydro-3H-indol-3-ylidene)acetic acid esters; reactions with 1,2-diaminocyclohexane, *o*-phenylenediamine and 2,3-diaminopyridine.

The reaction of 3-(2-oxo-2-(het)arylethylidene)-1H-indol-2-ones with *o*-phenylenediamine leads to 1,3-dihydrospiro[1,5-benzodiazepine-2,3'-indol]-2'(1'H)-ones [1-3], where the amino group of the reagent is added at the activated (het)aroyl acceptor of the exoethylene bond at the β-position ($C_{(3)}$ of the indole ring) followed by spiroheterocyclization with participation of the second *o*-amino functional group. We recently showed that in contrast to (het)aroyl derivatives of ylidene oxindoles, the structurally similar 2-(2-oxo-1,2-dihydro-3H-indol-3-ylidene)acetic acid esters **1** react differently with monofunctional amines, forming the products of regioselective addition of the latter at the exoethylene bond in the α-position relative to the ester group: 2-amino-substituted 2-(2-oxo-2,3-dihydro-1H-indol-3-yl)acetic acid esters [4].

For the first time we have established that treatment of 2-(2-oxo-1,2-dihydro-3H-indol-3-ylidene)acetic acid esters **1a** or **1b** with 1,2-diamines (1,2-diaminocyclohexane, *o*-phenylenediamine, or 2,3-diaminopyridine) when the mixture is boiled in ethanol leads to preparative yields of 2-oxo-2,3-dihydro-1H-indol-3-yl derivatives of octahydroquinoxalin-2(1H)-ones (**2**) and 3,4-dihydroquinoxalin-2(1H)-one (**3**) or accordingly 2-(2-oxo-2,3-dihydro-1H-indol-3-yl)-1,4-dihydropyrido[2,3-*b*]pyrazin-3(2H)-one (**4**).



Compounds **2-4** are formed as a result of regioselective addition of the amino group of the reagents at the exoethylene bond of the substrate **1**, not at the β-$C_{(3')}$ position as might be assumed, but rather at the α-$C_{(2)}$ position relative to the ester unit, followed by heterocyclization with participation of the latter and the free *o*-amino group.

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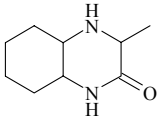
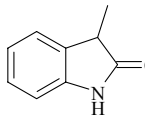
The ^{1}H NMR spectra were obtained on a Bruker DRX-500 (500 MHz) spectrometer, TMS, in DMSO-d_6. The IR spectra were taken on a Specord M-80, thin film in nujol.

Reaction of 2-(2-Oxo-1,2-dihydro-3H-indol-3-ylidene)acetic Acid Esters with 1,2-Diamines. A mixture of 2-(2-oxo-1,2-dihydro-3H-indol-3-ylidene)acetic acid methyl ester **1a** (1.01 g, 0.005 mol) or 2-(2-oxo-1,2-dihydro-3H-indol-3-ylidene)acetic acid ethyl ester **1b** (1.09 g, 0.005 mol) [5] and 1,2-diaminocyclohexane (0.57 g, 0.005 mol), *o*-phenylenediamine (0.54 g, 0.005 mol) or 2,3-diaminopyridine (0.55 g, 0.005 mol) in EtOH (50-70 ml) was boiled for 1.5-3 h. The precipitate was filtered out and recrystallized from EtOH or $CHCl_3$.

3-(2-Oxo-2,3-dihydro-1H-indol-3-yl)octahydroquinoxalin-2(1H)-one (2). Yield 0.90 g (63%) (from the starting compound **1a**); mp 242-243°C (with decomposition, from EtOH). ^{1}H NMR spectrum, δ, ppm: 1.08-2.40 (8H, group of signals, $C_{(5)}H_2$, $C_{(6)}H_2$, $C_{(7)}H_2$, $C_{(8)}H_2$); 2.62 (1H, group of signals, $C_{(4a)}H$); 2.86 (1H, group of signals, $C_{(8a)}H$); 3.27 (1H, s, $N_{(1)}H$); 3.59 (1H, s, $C_{(3)}H$); 4.08 (1H, s, $C_{(3')}H$); 6.72-7.48 (4H, m, C_6H_4); 10.10 (1H, s, $N_{(1')}H$).

Mass spectrum (Finnigan MAT INCOS 50), *m*/*z* (I_{rel}, %): 285 $[M]^+$, (5), 256 $[M–CO–H]^+$ (2), 203 (3), 172 (2), 161 (3), 160 $[M–C_6H_{11}–N=C=O]^+$ (3), 154 (7), 153 $[M–C_8H_6NO]^+$ or [] = $C_8H_{13}NO]^+$ (100, 152 (3), 145 $[C_9H_7NO]^+$ (4), 134 (5), 133 $[M–C_8H_{12}N_2O]^+$ or [] = $C_8H_7NO]^+$ (28), 125 $[C_6H_{11}–N=C=O]^+$ (6), 117 (4), 104 (9), 96 (5), 85 (5), 81 (8), 77 (4), 69 (4), 56 (5). Found, %: C 67.52; H 6.94; N 14.56. $C_{16}H_{19}N_3O_2$. Calculated, %: C 67.35; H 6.71; N 14.73.

3-(2-Oxo-2,3-dihydro-1H-indol-3-yl)-3,4-dihydroquinoxalin-2(1H)-one (3). Yield 1.10 g (79%) (from the starting compound **1a**) or 0.95 g (68%) (from compound **1b**); mp 234-235°C (with decomposition, from EtOH). IR spectrum, ν, cm^{-1}: 3287 ($N_{(4)}H_{amine}$), 3188 ($N_{(1)}H_{amide}$), 1686, 1620 (CO_{amide}). ^{1}H NMR spectrum, δ, ppm: 3.71 (1H, s, $C_{(3)}H$); 4.58 (1H, s, $C_{(3')}H$); 6.21 (1H, s, $N_{(4)}H$); 6.57-7.22 (8H, m, C_6H_4); 10.02 (1H, s, $N_{(1)}H$); 10.21 (1H, s, $N_{(1')}H$). Found, %: C 68.56; H 4.90; N 14.88. $C_{16}H_{13}N_3O_2$. Calculated, %: C 68.81; H 4.69; N 15.05.

2-(2-Oxo-2,3-dihydro-1H-indol-3-yl)-1,4-dihydropyrido[2,3-*b*]pyrazin-3(2H)-one (4). Yield, 0.70 g (50%) (from the starting compound **1a**); mp 252-253°C (with decomposition) (from CHCl3). ^{1}H NMR spectrum, δ, ppm: 3.26 (1H, s, $N_{(4)}H$); 3.85 (1H, s, $C_{(2)}H$); 4.38 (1H, s, $C_{(3')}H$); 6.45-7.78 (7H, m, C_6H_4, C_5H_3N); 9.84 (1H, br. s, $N_{(1)}H$); 10.73 (1H, s, $N_{(1')}H$). Found, %: C 63.97; H 4.48; N 19.72. $C_{15}H_{12}N_4O_2$. Calculated, %: C 64.28; H 4.32; N 19.99.

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