

SHORT  
COMMUNICATIONSSynthesis of 1-(Arylsulfonyl)pyrazolo[1,5-*a*]pyridines

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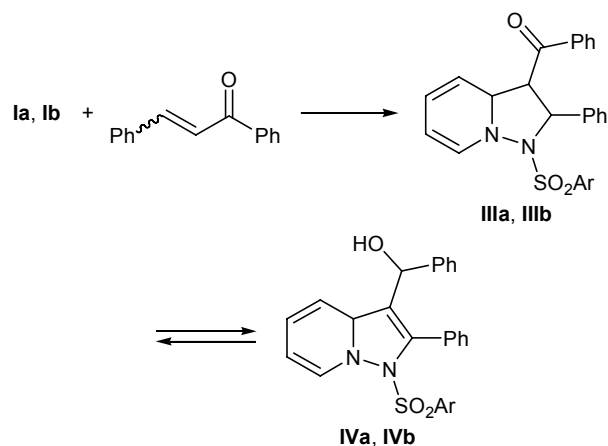
Among fused heterocyclic compounds, a specific place is occupied by pyrazolopyridines which exhibit a broad spectrum of biological activity. A promising method for their preparation is based on 1,3-dipolar cycloaddition to dipolarophiles. 1-Aminopyridinium derivatives are 1,3-dipolar compounds capable of readily undergoing heterocyclizations with formation of pyrazolo- and triazolopyridines [1–3]. The reactivity of different 1,3-dipolar structures was analyzed in [4, 5]. 1,3-Dipolar compounds containing an *N*-arylsulfonyl group have been poorly studied; methods of their preparation are either laborious [6] or indirect [7].

We examined 1,3-dipolar cycloaddition of 1-(arylsulfonylamino)pyridinium salts to such dipolarophiles as chloroacetonitrile, benzoin, and unsaturated ketones and obtained the corresponding 1-(arylsulfonyl)pyrazolo[1,5-*a*]pyridines. We found that the reactivity of dipolarophiles increases with rise in their strain and upon introduction of electron-withdrawing substituents. 1-(Arylsulfonylamino)pyridinium chlorides **Ia** and **Ib** were synthesized by reaction of *N*-chloroarene-sulfonamides (Chloramines B and T) with pyridines [8]. Compounds **Ia** and **Ib** reacted with dipolarophiles, e.g., with 2-(arylmethylidene)malononitriles to give 1-(arylsulfonyl)pyrazolo[1,5-*a*]pyridines **II** with high regioselectivity [9]. Neither electronegativity nor steric

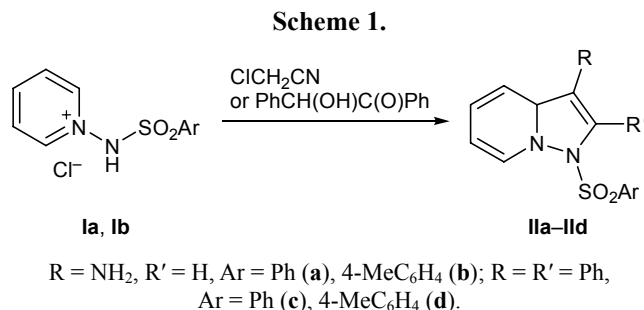
load of dipolarophile affected the 1,3-dipolar heterocyclization process due to high reactivity of compounds **I**. This may be illustrated by the reaction of compounds **Ia** and **Ib** with chloroacetonitrile and benzoin (Scheme 1).

By reaction of compounds **Ia** and **Ib** with 1,3-diphenylprop-2-en-1-one we obtained 1-(arylsulfonyl)pyrazolo[1,5-*a*]pyridines **IIIa** and **IIIb** containing a carbonyl group on C<sup>3</sup> (Scheme 2). Compounds **IIIa** and **IIIb** are readily converted into enol tautomers **IVa** and **IVb**. This is confirmed by their dissolution in 15–20% alkali. The occurrence of keto–enol equilibrium also followed from the IR and <sup>1</sup>H NMR spectra. The <sup>1</sup>H NMR spectrum of **IIIb** in DMSO-*d*<sub>6</sub> contained signals assignable to enolic hydroxy proton and CHOH proton.

Scheme 2.



**1-(Arylsulfonyl)-1,3a-dihydropyrazolo[1,5-*a*]pyridin-3-amines IIa and IIb (general procedure).** Compound **Ia** or **Ib**, 0.05 mol, and chloroacetonitrile, 0.06 mol, were dissolved in 40 ml of ethanol, a solu-



tion of 0.12 mol of sodium hydroxide in ethanol was added dropwise, and the mixture was heated under reflux until complete precipitation of NaCl (4–4.5 h). The mixture was cooled and filtered, the filtrate was evaporated by half and cooled, and the precipitate was filtered off and recrystallized from ethanol.

Compound **IIa**. Yield 79%, mp 213–215°C. Found, %: N 15.09. C<sub>13</sub>H<sub>11</sub>N<sub>3</sub>O<sub>2</sub>S. Calculated, %: N 15.43.

Compound **IIb**. Yield 71%, mp 228–230°C. <sup>1</sup>H NMR spectrum (DMSO-*d*<sub>6</sub>), δ, ppm: 1.1 t (CH<sub>3</sub>), 5.8 d (NH<sub>2</sub>), 6.8 s (2-H), 7.4 d (H<sub>arom</sub>); 7.6 s (2H), 8.0 d (2H), 8.2 s (1H) (pyridine). Found, %: C 58.62; H 5.68; N 14.26. C<sub>14</sub>H<sub>15</sub>N<sub>3</sub>O<sub>2</sub>S. Calculated, %: C 58.08; H 5.22; N 14.56.

**1-(Arylsulfonyl)-3,4-diphenyl-1,3a-dihydropyrazolo[1,5-*a*]pyridines IIc and II d (general procedure).** Compound **Ia** or **Ib**, 0.05 mol, and benzoin, 0.05 mol, were dissolved in 50 ml of ethanol, 10 ml of a 5 N solution of potassium hydroxide was added, and the mixture was heated for 3 h under reflux. The mixture was cooled, and the precipitate was filtered off, washed with water, dried, and recrystallized from ethanol.

Compound **IIc**. Yield 72%, mp 185–186°C. <sup>1</sup>H NMR spectrum (DMSO-*d*<sub>6</sub>), δ, ppm: 6.6–7.2 m (10H, C<sub>6</sub>H<sub>5</sub>), 7.3–7.6 m (5H, C<sub>6</sub>H<sub>5</sub>SO<sub>2</sub>); 7.0–7.0 m (2H), 7.8 m (2H), 7.1 m (1H) (pyridine). Found, %: C 72.41; H 4.12; N 7.45. C<sub>25</sub>H<sub>20</sub>N<sub>2</sub>O<sub>2</sub>S. Calculated, %: C 72.95; H 4.65; N 6.83.

Compound **II d**. Yield 69%, mp 198–199°C. Found, %: N 7.22. C<sub>26</sub>H<sub>22</sub>N<sub>2</sub>O<sub>2</sub>S. Calculated, %: N 6.61.

Compounds **IIIa** and **IIIb** were synthesized in a similar way.

**Phenyl{2-phenyl-1-phenylsulfonyl-1,2,3,3a-tetrahydropyrazolo[1,5-*a*]pyridin-3-yl}methanone (IIIa).** Yield 70%, mp 182–183°C. IR spectrum, ν, cm<sup>−1</sup>: 3440

(OH), 1740 (C=O), 1450 and 1160 (SO<sub>2</sub>). Found, %: C 70.38; H 5.63; N 6.59. C<sub>25</sub>H<sub>22</sub>N<sub>2</sub>O<sub>3</sub>S. Calculated, %: C 70.55; H 5.11; N 6.36.

**{1-(4-Methylphenylsulfonyl)-2-phenyl-1,2,3,3a-tetrahydropyrazolo[1,5-*a*]pyridin-3-yl}phenylmethanone (IIIb).** Yield 69%, mp 194–196°C. <sup>1</sup>H NMR spectrum (DMSO-*d*<sub>6</sub>), δ, ppm: 2.2 t (CH<sub>3</sub>), 3.6 s (1H, OH), 5.15 d (1H, CHO), 7.2 and 8.4 (10H, H<sub>arom</sub>), 7.6 (4H, H<sub>arom</sub>), 7.8 s and 8.8 s (2H each, pyridine), 8.15 s (1H, pyrazole). Found, %: N 6.71. C<sub>27</sub>H<sub>24</sub>N<sub>2</sub>O<sub>3</sub>S. Calculated, %: N 6.16.

The IR spectra were recorded on UR-20 and IR-430 spectrometers, and the <sup>1</sup>H NMR spectra were run on a Bruker-250 spectrometer at 90 MHz.

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