ISSN 1070-3632, Russian Journal of General Chemistry, 2012, Vol. 82, No. 7, pp. 1319–1321. © Pleiades Publishing, Ltd., 2012.
Original Russian Text © H.S. Attaryan, V.I. Rstakyan, S.S. Hayotsyan, G.V. Asratyan, 2012, published in Zhurnal Obshchei Khimii, 2012, Vol. 82, No. 7, pp. 1222–1224.

LETTERS TO THE EDITOR

Non-Catalytic Alkylation of Phenol and Aniline with 1-Hydroxymethylpyrazole

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Received February 21, 2012

DOI: 10.1134/S1070363212070274

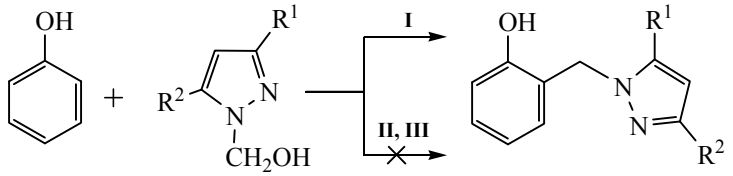
We have previously shown that the reaction of (1,3,5-trimethyl-1*H*-pyrazol-4-yl)methanol with hexyl and benzyl alcohols, phenol, and aniline in the absence of catalysts and solvents results in the corresponding *O*-, *C*-, and *N*-alkylated products [1–3].

In this work we studied the non-catalytic alkylation of phenol and aniline with 1-hydroxymethylpyrazoles **I–III**.

We found that only (1*H*-pyrazol-1-yl)methanol **I** reacted with phenol. The reaction occurs as the *C*-alkylation of aromatic ring by analogy with (1,3,5-trimethyl-1*H*-pyrazol-4-yl)methanol [1]. When the ratio compound **I**:phenol is equal to 1:9, the yield of the alkylation product **IV** reaches 57%. The product structure was proved by the IR and ^{1}H NMR spectroscopy.

The IR spectrum of compound **IV** contains characteristic absorption bands of the hydroxy group and aromatic ring at 3100–3300 and 1600 cm^{-1}, respectively.

In the ^{1}H NMR spectrum of compound **IV** there is a signal of OH proton in a weak field (9.46 ppm), which indicates that the *C*-alkylation of the aromatic ring occurs. The integral intensities of the benzene ring protons show the formation of the *ortho*-substituted isomer. In the ^{1}H NMR spectrum of compound **IV** there are also the signals of the pyrazole ring protons (6.15, 7.33, and 7.55 ppm).



I–III **IV**

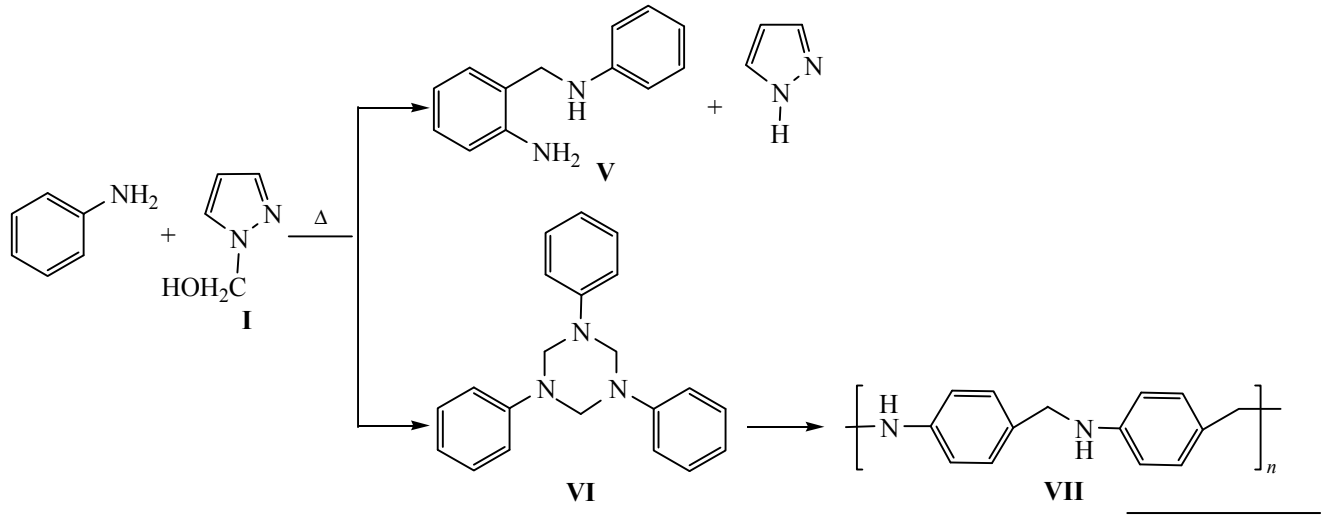
I, IV, $R^1 = R^2 = H$; **II**, $R^1 = CH_3$, $R^2 = H$ or $R^1 = H$, $R^2 = CH_3$; **III**, $R^1 = R^2 = CH_3$.

The presence of the electron-donor methyl groups in the pyrazole ring does not allow to obtain in similar conditions the corresponding substituted pyrazoles. In these cases, the oxymethyl pyrazole derivatives are converted into the corresponding pyrazoles [4, 5].

The difference in the reagents behavior in the alkylation of 1-pyrazolyl-carbinoles **I–III** in the absence of the catalyst can be attributed to the different electrophilicity of the carbon atoms of hydroxymethyl groups [6].

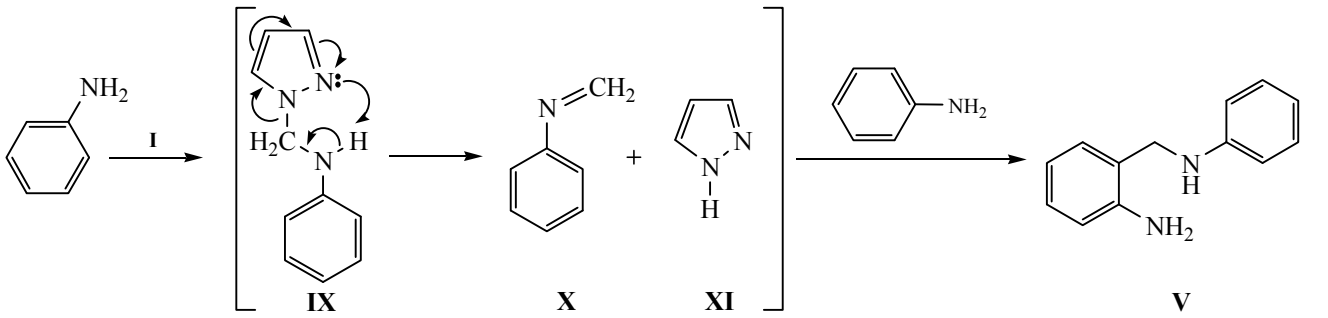
The alkylation of aniline with hydroxy-1-methylpyrazoles **II** and **III** under the same conditions (in the absence of the catalysts and solvent) was not observed. As in the case of phenol derivatives, the oxymethylpyrazole derivatives **II** and **III** converted into the corresponding pyrazoles.

In the reaction of aniline with compound **I** the main product is *N*-(2-aminobenzyl)aniline **V** and polymer **VII** of 1,3,5-triphenyl-1,3,5-triazine **VI**.



The formation of the anhydroformaldehydeaniline trimer **VI** and its polymer **VII** was described earlier [7], but the formation of *N*-(2-aminobenzyl)aniline **V** was unexpected since aniline is known to be unable to form the corresponding carbocation in the reaction with formaldehyde in the absence of acid [8], which would lead to the formation of compound **V**.

The formation of compound **V** proceeds presumably as follows:



Compound **I** reacts with the aniline excess apparently forming compound **IX** followed by transforming it into **X**, which eventually reacts with an excess of aniline. In the case of pyrazoles **II** and **III** only a polymer is formed from the aniline trimer that also supports this hypothesis.

The structure of compounds **V** and **VII** was confirmed by the IR and ^{1}H NMR spectroscopy. In the IR spectra of these compounds there are the characteristic absorption bands of NH- and NH_2-moieties at 3300–3350 cm^{-1} and of the benzene ring at 1500–1600 cm^{-1}. The ^{1}H NMR spectrum of compound **V** contains the proton signals of CH_2-, NH-, and NH_2-groups at 4.10–4.82 ppm and of benzene ring at 6.92–7.11 ppm.

2-(1*H*-Pyrazol-1-yl)methylphenol (IV). A mixture of 28 g of phenol and 3 g of 1*H*-pyrazol-1-ylmetanol **I** was refluxed for 4–5 h. The phenol excess was distilled off, and the residue was refluxed in water (30 ml). After cooling, the crystalline precipitate formed was filtered off. Yield 3 g (57%), mp 125°C. IR spectrum ν, cm^{-1}: 1590 (Ar), 3100–3300 (OH). ^{1}H NMR spectrum δ, ppm: 5.24 s (2H, CH_2), 6.15 d.d (1H, H_4, J_1 2.2, J_2 1.8 Hz), 6.69 d.d.d (1H, CH, Ar, J_1 7.6, J_2 7.2, J_3 1.1 Hz), 6.82 d.d (1H, CH, Ar, J_4 8.1, J_3 1.1 Hz), 6.91 d.d (1H, CH, Ar, J_1 7.6, J_5 1.7 Hz), 7.05 d.d.d (1H, CH, Ar, J_4 8.1, J_2 7.2, J_5 1.7 Hz), 7.33 d.d (1H, H_3, J_2 1.8, J_3 0.7 Hz), 7.51 d.d (1H, H_5, J_2 2.2, J_3 0.7 Hz), 9.46 s (1H, OH). Found, %: C 68.47; H 5.32; N 16.32. $C_{10}H_{10}N_2O$. Calculated, %: C 68.96; H 5.74; N 16.09.

***N*-(2-Aminobenzyl)aniline (V).** A mixture of 27 g of aniline and 3 g of 1*H*-pyrazol-1-ylmetanol **I** was

refluxed for 4–5 h. After removing the aniline excess, the residue was distilled in a vacuum to give 1.3 g (22.1%) of compound **V**, bp 193°C (2 mm Hg), mp 83°C (hexane). IR spectrum, ν, cm^{-1}: 1590 (Ar), 3300, 3350 (NH, NH_2). ^1H NMR spectrum, δ, ppm: 4.10 (2H, CH_2), 4.82 br. s (3H, NH and NH_2), 6.50–6.67 m (5H, Ar), 6.92–7.11 m (4H, Ar). Found, %: C 78.85, H 7.38; N 14.37. $C_{13}H_{14}N_2$. Calculated, %: C 78.78; H 7.07; N 14.14. The residue after distillation was dissolved in 20.0 ml of DMF. Polymer **VII** (0.8 g) was isolated from the solution by precipitating with water, and then it was dried at 55°C (1 mm Hg). Decomposition point 80–120°C [7]. IR spectrum, ν, cm^{-1}: 3300 (NH), 1600, 1630 (Ar). ^1H NMR spectrum δ, ppm: 4.0–4.8 m (CH_2), 5.0–5.6 m (NH), 6.2–7.4 m (Ar). An insoluble cross-linked polymer (0.5 g) was also isolated from the distillation residue.

The IR spectra were recorded on a Specord 75-IR (thin layer) and Nicolet Avatar 330 Sci IR spectrometers. The NMR spectra were registered on a Varian Mercury spectrometer (300 MHz) in DMSO-d_6.

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