Synthesis of Some 4-Oxo-1-phenyl-5,6-dihydro-1*H*,4*H*-pyrano[2,3-*c*]pyrazole Derivatives

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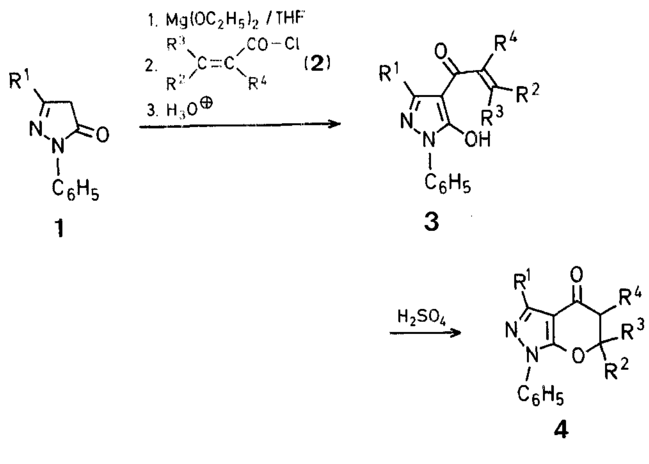
In recent years, a number of studies have been published on the *C*-alkylation of 2-pyrazolin-5-ones **1**[1-5], but *α,β*-unsaturated acyl chlorides have not been used. The present work describes the synthesis of 4-oxo-1-phenyl-5,6-dihydro-1*H*,4*H*-pyrano[2,3-*c*]pyrazole derivatives **4** by *C*-acylation of compounds **1** with *α,β*-unsaturated acyl chlorides **2**.

Treatment of 2-pyrazolin-5-ones **1** with magnesium ethoxide in tetrahydrofuran generates the corresponding anions which, on reaction with the alkenoyl chlorides **2**, afford the 4-acylated derivatives **3**. Compounds **3** are easily converted to **4** by treatment with concentrated sulfuric acid at room temperature without prior purification. The structures of products **4** are confirmed by microanalytical, I.R., U.V., and ^{1}H-N.M.R. spectral data (Table).



3-Methyl- (**1a**)[6], 3-*n*-propyl- (**1b**)[7], and 3-phenyl- (**1c**)[8] 1-phenyl-2-pyrazolin-5-ones are prepared according to the procedures described in the literature.

4-Oxo-1-phenyl-5,6-dihydro-1*H*,4*H*-pyrano[2,3-*c*]pyrazole 4, General Procedure:

A mixture of **1** (0.01 mol), magnesium ethoxide (1.14 g, 0.01 mol), and dry tetrahydrofuran (50 ml) is magnetically stirred and heated to reflux for 4 h. The mixture is then cooled to 0–5 °C with an ice/water bath and a solution of the *α,β*-unsaturated acyl chloride **2** (0.01 mol) in tetrahydrofuran (25 ml) is added dropwise with efficient stirring. The cooling bath is removed and the mixture is allowed to stand at room temperature for 3 h, then poured on to cold 10% hydrochloric acid (200 ml), and extracted with chloroform (3 × 50 ml). The combined extracts are washed with water (2 × 50 ml), dried with sodium sulfate, and rotary-evaporated. The residue (crude compounds **3**) is cooled and concentrated sulfuric acid is added (50 ml) with stirring. The mixture is allowed to stand at room temperature overnight, then poured on to ice/water (400 g), and extracted with chloroform (3 × 50

Table. 4-Oxo-1-phenyl-5,6-dihydro-1*H*,4*H*-pyrano[2,3-*c*]pyrazoles **4** prepared

Product No.	R^1	R^2	R^3	R^4	Yield [%]	m.p. [°C] (solvent)	Molecular formula[a]	I.R. ($CHCl_3$) $\nu_{C=O}$ [cm^{-1}]	U.V. (C_2H_5OH) λ_{max} [nm] (ε)	^{1}H-N.M.R.[b] ($CDCl_3$) δ [ppm]
4a	CH_3	CH_3	H	H	60	93–94° (hexane)	$C_{14}H_{14}N_2O_2$ (242.3)	1680	256 (20600)	1.60 (d, 3H, J=6 Hz); 2.50 (s, 3H); 2.53 (s, 1H); 2.62 (dd, 1H, J_{AB}=16 Hz)[d]; 4.9 (m, 1H); 7.3–7.7 (m, 3H); 7.7–7.9 (m, 2H)
4b	n-C_3H_7	CH_3	H	H	65	97–98° (hexane)	$C_{16}H_{18}N_2O_2$ (270.3)	1680	256 (22600)	1.00 (t, 3H, J=7 Hz); 1.60 (d, 3H, J=6 Hz); 1.77 (sex, 2H, J=7 Hz)[e]; 2.52 (s, 1H); 2.61 (dd, 1H, J_{AB}=16 Hz)[d]; 2.83 (t, 2H, J=7 Hz); 4.9 (m, 1H); 7.25–7.6 (m, 3H); 7.7–7.9 (m, 2H)
4c	C_6H_5	CH_3	H	H	85	134–135° (2:1 C_2H_5OAc/hexane)	$C_{19}H_{16}N_2O_2$ (304.3)	1680	254 (31500)	1.55 (d, 3H, J=6 Hz); 2.56 (s, 1H); 2.65 (dd, 1H, J_{AB}=16 Hz)[d]; 4.9 (m, 1H); 7.25–7.65 (m, 6H); 7.75–8.0 (m, 2H); 8.15–8.4 (m, 2H)
4d	CH_3	H	H	CH_3	35[c]	110–111° (hexane)	$C_{14}H_{14}N_2O_2$ (242.3)	1675	256 (19400)	1.48 (d, 3H, J=7 Hz); 2.48 (s, 3H); 2.80 (m, 1H); 4.38 (dd, 1H, J_{AB}=11 Hz, J_{AX}=10 Hz); 4.75 (dd, 1H, J_{AB}=11 Hz, J_{BX}=5 Hz)[f]; 7.3–7.6 (m, 3H); 7.7–7.9 (m, 2H)
4e	C_6H_5	H	H	CH_3	50[c]	133–132° (C_2H_5OH)	$C_{19}H_{16}N_2O_2$ (304.3)	1685	254 (29900)	1.26 (d, 3H, J=7 Hz); 2.85 (m, 1H); 4.41 (dd, 1H, J_{AB}=11 Hz, J_{AX}=10 Hz); 4.77 (dd, 1H, J_{AB}=11 Hz, J_{BX}=5 Hz)[f]; 7.2–7.7 (m, 6H); 7.8–8.0 (m, 2H); 8.15–8.5 (m, 2H)
4f	CH_3	CH_3	CH_3	H	69	122–123° (1:2 C_2H_5OAc/hexane)	$C_{15}H_{16}N_2O_2$ (256.3)	1675	260 (21200)	1.58 (s, 6H); 2.50 (s, 3H); 2.61 (s, 2H); 7.25–7.6 (m, 3H); 7.7–7.85 (m, 2H)
4g	C_6H_5	CH_3	CH_3	H	40	143–144° (1:4 C_2H_5OAc/hexane)	$C_{20}H_{18}N_2O_2$ (318.3)	1675	255 (32500)	1.61 (s, 6H); 2.71 (s, 2H); 7.3–7.65 (m, 6H); 7.8–8.0 (m, 2H); 8.25–8.45 (m, 2H)

[a] The microanalyses were in satisfactory agreement with the calculated values (C ±0.21; H ±0.19; N ±0.13).
[b] 80-MHz Bruker Spectrometer.
[c] Yield after column chromatography.
[d] AB part of degenerated ABX system.
[e] Partially masked by the CH_3 group at C-6.
[f] AB part of ABX system, in first order treatment.

ml). The combined extracts are washed with 5% aqueous sodium carbonate (2×30 ml), water (2×30 ml), dried with sodium sulfate, and evaporated to give the crude compounds **4**. Purified compounds are obtained in the case of **4a, b, c, f,** and **g** by recrystallization from a suitable solvent (Table) and in the case of **4d,** by column chromatography on silica gel with ether as eluent.

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