

Short Note

1-Phenylpyrazolo[4',3':5,6]pyrano[3,2-*c*]pyridine-4(1*H*)-thione

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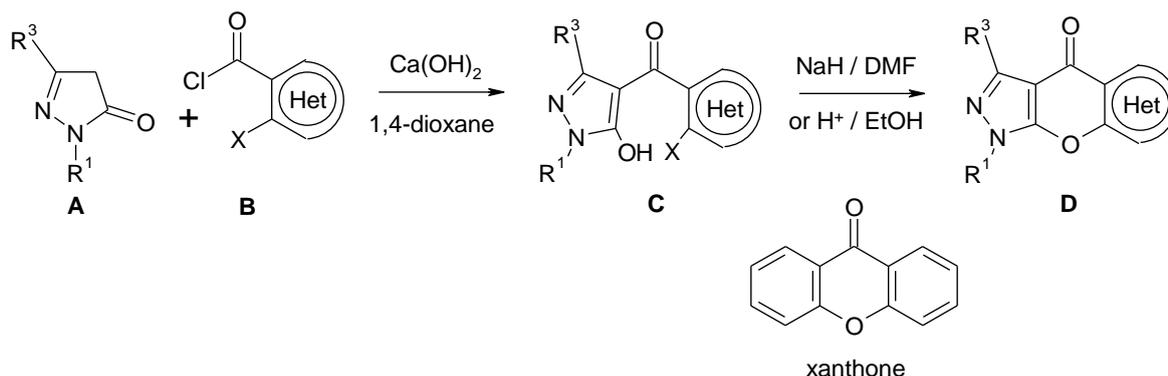
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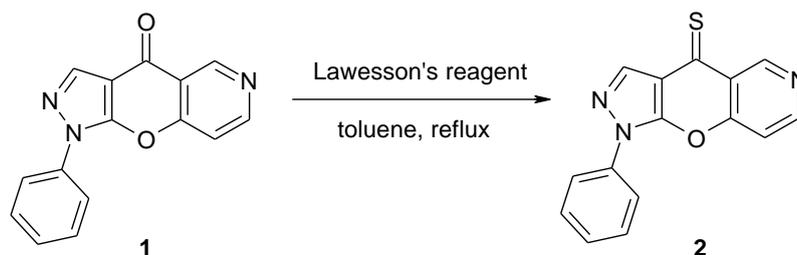
Abstract: The title compound is prepared by treatment of 1-phenylpyrazolo[4',3':5,6]pyrano[3,2-*c*]pyridin-4(1*H*)-one with Lawesson's reagent in refluxing toluene. Detailed spectroscopic data (¹H NMR, ¹³C NMR, ¹⁵N NMR, MS) are presented.

Keywords: phenylpyrazolo[4',3':5,6]pyrano[3,2-*c*]pyridine-4(1*H*)-thiones; Lawesson's reagent; thionation; NMR

Recently, we presented a short and generally applicable synthesis of various fused pyrano [2,3-*c*]pyrazol-4(1*H*)-ones of type **D** [1–7] *via* reaction of 1-substituted or 1,3-disubstituted 2-pyrazolin-5-ones (**A**) with *o*-halo(hetero)arenecarbonyl chlorides **B** under the conditions described by *Jensen* for the C-4 acylation of pyrazolones (calcium hydroxide, dioxane, reflux) [8]. The formed 4-arylpyrazol-5-ols **C** can be smoothly cyclized into the target systems **D** in alkaline or occasionally acidic [7] medium (Figure 1). Type **D** compounds can be recognized as heterocyclic analogues of xanthone in which one benzene ring of the parent xanthone molecule is replaced by a pyrazole system and the other one by a variable heteroaromatic moiety (Figure 1). In consideration of the fact that thio analogues of flavones, xanthenes and related systems have received considerable attention due to the importance of such molecules in biology and photochemistry as well as their usefulness as synthetic building blocks [9], we here report on the synthesis of a thio analogue **2** of the 'azaxanthone' **1**, in which the pyran-4-one moiety is replaced by the corresponding pyran-4-thione (Scheme 1). Compound **2** is a supplement to similar thiones we recently presented in the course of an NMR study [10].

Figure 1. Synthesis of fused [2,3-*c*]pyrazol-4(1*H*)-ones **D**.

The conversion of ketones into the corresponding thiones can be achieved by the application of different reagents [9,11,12]. The 2,4-bis(4-methoxyphenyl)-1,3,2,4-dithiadiphosphetane 2,4-disulfide, known as Lawesson's reagent, has been commonly used for this purpose and usually permits efficient conversion of ketones into thioketones [13–15]. Employing this method, namely by treatment of compound **1** with 0.5 equivalents of Lawesson's reagent in boiling toluene, we obtained the corresponding target compound **2** in 97% yield (Scheme 1).

Scheme 1. Synthesis of the title compound **2**.

A detailed characterization of **2** including MS and NMR (^1H , ^{13}C , ^{15}N) spectral data as well as microanalytical data is given in the Experimental. Full and unambiguous assignment of all ^1H , ^{13}C and ^{15}N NMR resonances was achieved by combined application of standard NMR spectroscopic techniques such as ^1H -coupled ^{13}C -NMR (gated decoupling), APT, COSY, TOCSY, NOESY, gs-HSQC and gs-HMBC [16].

Experimental

The melting point was determined on a Kofler hot-stage microscope and is uncorrected. The mass spectrum was obtained on a Shimadzu QP 1000 instrument (EI, 70 eV). The elemental analysis was performed at the Microanalytical Laboratory, University of Vienna. The NMR spectra were recorded from CDCl_3 solutions at 298 K on a Varian UnityPlus instrument (300 MHz for ^1H , 75.4 MHz for ^{13}C) and on a Bruker Avance 500 instrument with a 'directly' detecting broadband observe probe (BBFO) (500.13 MHz for ^1H , 50.68 MHz for ^{15}N). The center of the solvent signal was used as an internal standard which was related to TMS with $\delta = 7.26$ ppm (^1H in CDCl_3) and $\delta = 77.0$ ppm (^{13}C in CDCl_3). The digital resolution was 0.2 Hz/data point in the ^1H and 0.4 Hz/data point in the ^1H -coupled

^{13}C -NMR spectra (gated decoupling). The ^{15}N NMR spectrum (gradient-selected ^{15}N , ^1H -HMBC) was referenced against external nitromethane.

1-Phenylpyrazolo[4',3':5,6]pyrano[3,2-c]pyridin-4(1H)-thione (2)

To a solution of 1-phenylpyrazolo[4',3':5,6]pyrano[3,2-c]pyridin-4(1H)-one (**1**) [1] (263 mg, 1 mmol) in toluene (15 mL) was added Lawesson's reagent (202 mg, 0.5 mmol) and the mixture was heated to reflux overnight (~14 h). Then the solvent was removed under reduced pressure and the residue was subjected to column chromatography (silica gel, eluent: CH_2Cl_2 -MeOH, 100 + 2) to afford 271 mg (97%) of the title compound **2** as an orange-brown solid of mp 192–194 °C.

MS (EI, 70 eV): (m/z , %) 280 ($\text{M}^+ + 1$, 21), 279 (M^+ , 100), 278 ($\text{M}^+ - 1$, 74), 138 (35), 77 (85), 51 (54).

^1H NMR (300 MHz, CDCl_3): δ (ppm) 7.45 (d, 1H, H-8, $^3J(\text{H}8, \text{H}7) = 5.8$ Hz), 7.46 (m, 1H, Ph H-4), 7.58 (m, 2H, Ph H-3,5), 7.86 (m, 2H, Ph H-2,6), 8.40 (s, 1H, H-3), 8.85 (d, 1H, H-7, $^3J(\text{H}7, \text{H}8) = 5.8$ Hz), 9.83 (s, 1H, H-5).

^{13}C NMR (75 MHz, CDCl_3): δ (ppm) 112.4 (C-8, $^1J(\text{C}8, \text{H}8) = 168.2$ Hz, $^2J(\text{C}8, \text{H}7) = 8.7$ Hz, $^4J(\text{C}8, \text{H}5) = 1.5$ Hz), 119.6 (C-3a, $^2J(\text{C}3a, \text{H}-3) = 9.5$ Hz), 121.5 (Ph C-2,6), 122.6 (C-4a, $^2J(\text{C}4a, \text{H}5) = 6.8$ Hz, $^3J(\text{C}4a, \text{H}8) = 3.9$ Hz, $^4J(\text{C}4a, \text{H}7) = 1.3$ Hz), 128.3 (Ph C-4), 129.6 (Ph C-3,5), 136.5 (Ph C-1), 138.8 (C-3, $^1J(\text{C}3, \text{H}3) = 196.3$ Hz), 145.2 (C-9a, $^3J(\text{C}9a, \text{H}3) = 4.7$ Hz), 152.3 (C-5, $^1J(\text{C}5, \text{H}5) = 187.1$ Hz, $^3J(\text{C}5, \text{H}7) = 12.0$ Hz), 153.4 (C-7, $^1J(\text{C}7, \text{H}7) = 183.0$ Hz, $^2J(\text{C}7, \text{H}8) = 1.4$ Hz, $^3J(\text{C}7, \text{H}5) = 13.7$ Hz), 155.3 (C-8a, $^2J(\text{C}8a, \text{H}8) = 3.9$ Hz, $^3J(\text{C}8a, \text{H}7) = 9.8$ Hz, $^3J(\text{C}8a, \text{H}5) = 7.7$ Hz), 195.7 (C-4).

^{15}N NMR (50 MHz, CDCl_3): δ (ppm) -186.8 (N-1), -83.5 (N-2), -75.8 (N-6).

Anal. Calcd for $\text{C}_{15}\text{H}_9\text{N}_3\text{OS}$: C, 64.50%; H, 3.25%; N, 15.04%. Found: C, 64.42%; H, 3.18%; N 14.70%.

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