Synthesis of 1-Aryl-5-arylazo-3-phenylsulfonylpyrazol-4-ols from 1-Chloro-3-phenylsulfonyl-2-propanone

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Treatment of 1-chloro-3-phenylsulfonyl-2-propanone (**2**) with arenediazonium chlorides gave 1-arylhydrazono-3-chloro-1-phenylsulfonyl-2-propanones **4**, which were cyclized in the presence of sodium acetate to 1-aryl-3-phenylsulfonylpyrazol-4-ols **5B**. Further treatment of **5B** with arenediazonium chlorides yielded 1-aryl-5-arylazo-3-phenylsulfonylpyrazol-4-ols.

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In connection with our program dealing with sulfonyl compounds as building blocks for heterocycles [1] we found that 1-aryl-5-arylazo-3-phenylsulfonylpyrazol-4-ols **6** were prepared in one step from 1-bromo-3-phenylsulfonyl-2-propanone (**1**) [1c], and it was proposed that the initially formed hydrazones **3** cyclized to yield pyrazol-4-ones **5A** or its tautomers **5B**, which were attacked by another diazonium salt to give **6**. Moreover, these pyrazoles **6** were found to show strong antimicrobial activities to *Treponema hyodysenteriae* [2]. Since the leaving ability of chlorine is weaker than bromine, the reaction would stop at the stage of 1-arylhydrazono-3-chloro-1-phenylsulfonyl-2-propanones **4** when 1-chloro-3-phenylsulfonyl-2-propanone (**2**) [3] is used instead of **1**. Dehydrochlorination of **4** would result in the formation of **5** and subsequent treatment with different arenediazonium chlorides would afford new pyrazoles **7** which have different aryl groups at N-1 and C-5 positions.

A solution of **2** in pyridine was treated with benzenediazonium chloride in a usual manner to give 3-chloro-1-phenylhydrazono-1-phenylsulfonyl-2-propanone (**4a**) in 46% yield. Cyclization of this hydrazone to 1-phenyl-3-phenylsulfonylpyrazol-4-ol (**5a**) was achieved in 65% yield on refluxing the mixture of **4a** and sodium acetate as the base in aqueous tetrahydrofuran for 6 hours. The ir and ^{1}H-nmr spectra of **5a** indicated the absence of a carbonyl and a methylene group which were obviously observed at 1680 cm^{-1} and δ 4.92 ppm in the spectra of **4a**. Accordingly, this pyrazole is not in the form of 2-pyrazolin-4-one (**5A**) but in the form of pyrazol-4-ol (**5B**) [4]. Physical properties and spectral data of **4a-d** and **5a-b** are shown in Table 1 and 2, respectively. It has been known that pyrazole itself does not react with diazonium salts under the usual reaction conditions but those which have electron-donating substituents such as hydroxyl or amino group can form azo-coupling products [5]. Further treatment of **5a** in pyri-

Scheme

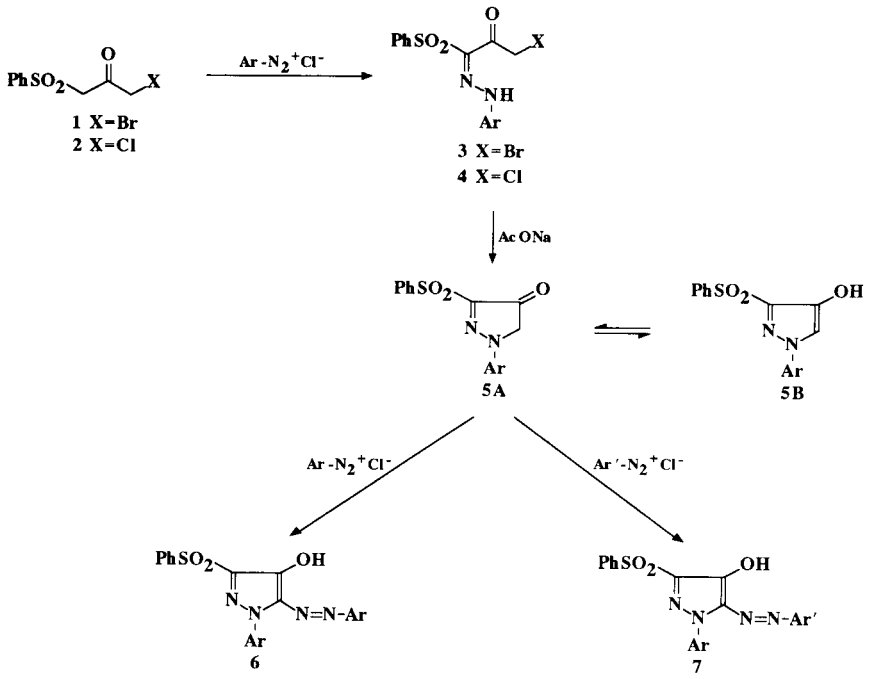

Table 1

Physical Properties of Compounds **4**, **5**, **6a**, and **7**

	Ar	Ar'	Yield %	Mp °C	Molecular Formula (Molecular Weight)	Found (Calcd.) C%	H%	N%
4a	C_6H_5		46	169-172 (MeOH)	$C_{15}H_{13}ClN_2O_3S$ (336.79)	53.55 (53.49	4.03 3.89	8.10 8.32)
4b	4-MeC_6H_4		30	152-154 (MeOH)	$C_{16}H_{15}ClN_2O_3S$ (350.82)	54.76 (54.78	4.32 4.31	7.94 7.99)
4c	4-ClC_6H_4		18	156-158 (MeOH)	$C_{15}H_{12}Cl_2N_2O_3S$ (371.24)	48.71 (48.53	3.37 3.26	7.43 7.55)
4d	4-BrC_6H_4		36	151-153 (MeOH)	$C_{15}H_{12}BrClN_2O_3S$ (415.69)	43.32 (43.34	2.93 2.91	6.90 6.74)
5a	C_6H_5		65	88-89 ($CHCl_3$-C_6H_{14})	$C_{15}H_{12}N_2O_3S \cdot H_2O$ (318.35)	56.32 (56.59	4.34 4.43	8.43 8.80)
5b	4-MeC_6H_4		88	60-61 ($CHCl_3$-C_6H_{14})	$C_{16}H_{14}N_2O_3S \cdot H_2O$ (332.38)	57.92 (57.82	5.01 4.85	7.87 [a] 8.43)
6a	C_6H_5		74	180-182 (MeOH)	(lit. [1c] mp 181-183° C)			
7a	C_6H_5	4-MeC_6H_4	65	192-194 (MeOH)	$C_{22}H_{18}N_4O_3S$ (418.47)	63.09 (63.14	4.36 4.34	13.09 13.39)
7b	C_6H_5	4-ClC_6H_4	64	212-214 (MeOH)	$C_{21}H_{15}ClN_4O_3S$ (438.89)	57.65 (57.47	3.60 3.44	12.59 12.77)
7c	C_6H_5	2-ClC_6H_4	68	214-216 (MeOH)	$C_{21}H_{15}ClN_4O_3S$ (438.89)	57.76 (57.47	3.51 3.44	12.58 12.77)
7d	C_6H_5	3,4-$Cl_2C_5H_3$	76	214-216 (MeOH)	$C_{21}H_{14}Cl_2N_4O_3S$ (473.33)	53.33 (53.29	3.04 2.98	11.65 11.84)
7e	C_6H_5	4-BrC_4H_4	79	218-220 (MeOH)	$C_{21}H_{15}BrN_4O_3S$ (483.33)	52.26 (52.19	3.20 3.13	11.33 11.59)
7f	C_6H_5	4-$MeOC_6H_4$	44	214-216 (MeOH)	$C_{22}H_{18}N_4O_4S$ (434.47)	60.94 (60.82	4.17 4.18	12.73 12.90)
7g	4-MeC_6H_4	C_6H_5	62	196-198 (MeOH)	$C_{22}H_{18}N_4O_3S$ (418.47)	63.25 (63.14	4.58 4.34	12.83 13.39)

[a] This value for nitrogen is the best value obtainable.

Table 2

Spectral Data of Compounds **4**, **5**, and **7**

	MS m/z (M^+)	IR cm^{-1} (KBr)					^{1}H-NMR δ ppm
4a	336	3200	1680	1520	1475	1285	4.92 (*s*, 2H), 7.32-8.18 (m, 10H), 12.43 (*s*, 1H) (DMSO-d_6)
4b	350	3200	1680	1525	1290	1190	2.38 (*s*, 3H), 4.53 (*s*, 2H), 7.18-8.16 (m, 9H) 12.52 (br *s*, 1H) ($CDCl_3$)
4c	370	3200	1680	1525	1285	1190	4.50 (*s*, 1H), 7.28-8.11 (m, 9H), 12.51 (br *s*, 1H) ($CDCl_3$)
4d	416	3200	1680	1520	1470	1190	4.47 (*s*, 2H), 7.05-8.11 (m, 9H), 12.53 (br *s*, 1H) ($CDCl_3$)
5a	300	3540	1570	1495	1400	1315	7.27-8.12 (m) ($CDCl_3$)
5b	314	3550	1565	1520	1400	1315	2.36 (*s*, 3H), 6.95-8.13 (m, 9H) ($CDCl_3$)
7a	418	1595	1540	1490	1380	1330	2.40 (*s*, 3H), 7.13-8.21 (m, 9H) ($CDCl_3$)
7b	438	1540	1490	1330	1145	1080	7.31-8.22 (m) ($CDCl_3$)
7c	438	1575	1540	1495	1440	1380	7.22-8.20 (m) ($CDCl_3$)
7d	472	1550	1500	1400	1330	1150	7.32-8.15 (m) ($CDCl_3$)
7e	482	1540	1485	1400	1330	1145	7.39-8.17 (m) ($CDCl_3$)
7f	434	1600	1500	1380	1330	1250	3.83 (*s*, 3H), 6.97-8.13 (m, 14H) (DMSO-d_6)
7g	418	1545	1515	1440	1390	1330	2.40 (*s*, 3H), 7.15-8.24 (m) ($CDCl_3$)

dine with an aqueous solution of benzenediazonium chloride under ice-cooled conditions afforded a red crystalline product **6a** (Ar = phenyl) in 74% yield, which was identical in all respects with the authentic specimen reported in the previous paper [1c]. Thus, the route from **1** to **6** which was suggested in the previous paper [1c] has been proved. When **5a** and **b** were treated with arenediazonium chlorides other than benzene- and *p*-toluenediazonium chloride, respectively, 1-aryl-5-arylazo-3-phenylsulfonylpyrazol-4-ols **7** which have different aryl groups at N-1 and C-5 positions were obtained and their physical and spectral data are shown in Table 1 and 2.

EXPERIMENTAL

Melting points were determined on a Yanagimoto micromelting point apparatus and uncorrected. The ^{1}H-nmr, ir, and mass spectra were measured with a JEOL JNM-PMX 60, JASCO A-102, and JEOL JMS DX-300, respectively. Microanalysis was performed with a Yanako CHN Coder MT-5. The starting material **2** was prepared according to the literature method [3c].

1-Arylhydrazono-3-chloro-1-phenylsulfonyl-2-propanones **4a-d**.

General Procedure.

A solution of **2** (1.0 mmole) in pyridine (1 ml) was ice-cooled below 5° and stirred vigorously. An aqueous solution (10 ml) of aryldiazonium chloride which was prepared from arylamine (1.5 mmoles), sodium nitrite (1.5 mmoles), and concentrated hydrochloric acid (3 ml) in the usual manner was added dropwise to the above pyridine solution during 30 minutes. After an additional stirring for 3 hours below 5° the precipitates were collected by filtration and were once recrystallized from methanol to give **4** as yellow needles.

1-Aryl-3-phenylsulfonylpyrazol-4-ols **5a-b**.

General Procedure.

A solution of **4** (1.0 mmole) and sodium acetate (3.0 mmoles) in a solvent mixture of tetrahydrofuran (3 ml) and water (1 ml) was refluxed for 6 hours. After concentration of the mixture the residue was extracted with chloroform (20 ml). The chloroform layer was washed with water (30 ml), dried over mgnesium sulfate, and evaporated. The residue was recrystallized from chloroform-hexane to give **5** as white needles.

1-Aryl-5-arylazo-3-phenylsulfonylpyrazol-4-ols **6a, 7a-g**.

General Procedure.

A solution of **5** (1.0 mmole) in pyridine (1 ml) was ice-cooled below 5° and stirred vigorously. An aqueous solution (10 ml) of aryldiazonium chloride which was prepared from arylamine (1.5 mmoles) in the usual manner was added dropwise to the above pyridine solution during 30 minutes. After an additional stirring for 3 hours below 5°, the precipitate was collected by filtration and once recyrstallized from methanol to give **7** as red needles.

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