with a thermometer, mechanical stirrer, condenser, baffle, and N_2 inlet (vented through a safety bubbler) was charged with 30 mmol (10.5 g) of **2**, followed by the addition of 400 mL of 30% H_2SO_4. The suspension was heated to 107 °C (reflux) with rapid stirring until the mixture became a homogeneous orange solution (~1 h). Then 1.0 g of SG Extra charcoal was added, and the mixture was heated at reflux for 15 min, filtered over Celite, and then cooled to room temperature, whereupon the organic product was extracted into CH_2Cl_2 (3 × 100 mL). This CH_2Cl_2 solution was extracted first with 10% Na_2CO_3 solution (2 × 25 mL) and then with H_2O (2 × 25 mL) and dried over K_2CO_3. The dried solution was placed in a 500-mL distillation flask with 100 mL of hexane. Atmospheric distillation of ~350 mL of solvent, followed by cooling to 0 °C, produced crude solid TMBA. The crude solid was dissolved in boiling hexane. Insolubles, 0.5 g, were filtered and identified as the starting material **2** (accounting for ~5% of **2**). The filtered hexane solution was cooled, producing 5.6 g (95% yield) of white TMBA, mp 75-77 °C, which was spectroscopically identical with an authentic sample of commercially available material from the Monsanto Co. Inc.

Registry No. 1, 86-81-7; 2, 81340-18-3; 3, 4521-61-3; quinoline, 91-22-5.

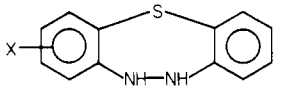
New Method for the Synthesis of Chloro-Substituted Dibenzo[*b*,*f*][1,4,5]thiadiazepines and Their 5,6-Dihydro Derivatives

Carlos Corral,* Jaime Lissavetzky, and Gloria Quintanilla

Instituto de Quimica Médica, Madrid-6, Spain

Received November 25, 1981

The parent compound (1, X = H) of the 5,6-dihydrodibenzo[*b*,*f*][1,4,5]thiadiazepine system has been of interest due to its potential aromatic character[1] and its acid-catalyzed reactions (benzidine rearrangement).[2] It has also been used as a key intermediate in the synthesis of the sulfur-bridged analogue of the antiinflamatory compound phenylbutazone.[3]



1

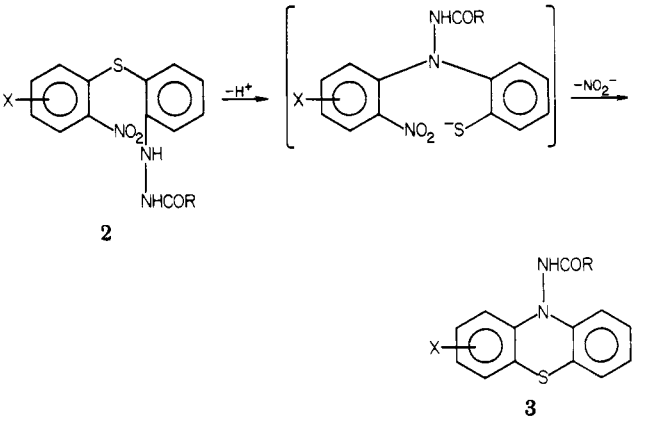
The first attempted syntheses[1,4] of this compound, based on the reductive cyclization of bis(*o*-nitrophenyl) sulfide, afforded it in very poor yield, and it was not until 1971 that Szmant[5,6] achieved this synthesis in an acceptable yield, following a four-step procedure.

In this paper, we report a new and apparently useful method for the preparation of substituted compounds 1 (X = electronegative group) and the corresponding dehydro compounds **7**.

The method is based on the previously reported synthesis[7] of 10-(acylamino)phenothiazine derivatives **3** by cyclization of compounds **2** via base-catalyzed Smiles rearrangement (Scheme I).

It was considered that this cyclization procedure could be applied to compounds **4**, which apparently meet the required conditions for the Smiles rearrangement and further cyclization to produce compounds **5** (Scheme II).

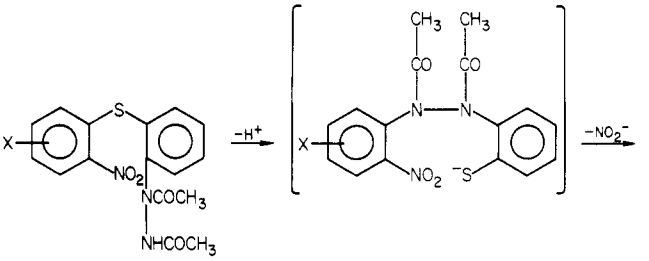
Scheme I



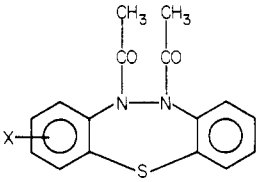
2

3

Scheme II



4a, X = 4-Cl
b, X = 5-Cl
c, X = 6-Cl
d, X = H



5a, X = 2-Cl
b, X = 3-Cl
c, X = 4-Cl

Table I. Properties and Yields of 2-Nitrophenyl 2-(α,β-Diacetylhydrazino)phenyl Sulfides[a]

compd	X	% yield	mp,[b] °C
4a	4-Cl	91	204-206
4b	5-Cl	89	150-152
4c	6-Cl	85	181-183
4d	H	78	110-112

[a] Satisfactory analyses (±0.3 for C, H, and N) were reported for all compounds in this table. [b] Recrystallized from benzene. All these compounds showed the following common IR and NMR spectroscopic data: IR (Nujol): 3270-3260 (NH), 1720-1715, 1660-1655 (C=O), 1520-1510; 1345-1340 cm^{-1} (NO_2); NMR (Me_2SO-d_6) δ 1.9-2.0 (s, 3 H, CH_3), 2.1 (s, 3 H, CH_3), 6.8-7.9 (m, 6 or 7 H, aromatic protons), 8.2-8.4 (m, 1 H, H-3, aromatic proton), 8.5-8.9 (s, 1 H, NH).

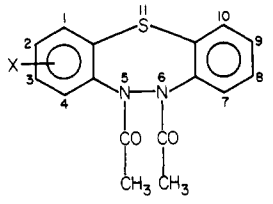
For reasons of simplicity, only the cases in which X in compound **4** is 4-Cl, 5-Cl, 6-Cl, and H (Table I) have been studied, i.e., substitution by a weak electronegative atom ortho, meta, and para to the sulfur atom and in the unsubstituted compound.

The reaction did not take place for compound **4d**, although no starting material was recovered. However, compounds **4a-c** did react to give compounds **5a** in 81%

(1) N. L. Allinger and G. A. Youngdale, *J. Am. Chem. Soc.*, **84**, 1020 (1962).
(2) L. D. Hartung and H. J. Shine, *J. Org. Chem.*, **34**, 1013 (1969).
(3) H. S. Lowrie, *J. Med. Pharm. Chem.*, **5**, 1362 (1962).
(4) M. F. Grundon and B. T. Johnson, *J. Chem. Soc. B*, **253** (1966).
(5) H. Harry Szmant and Y. L. Chow, *J. Org. Chem.*, **36**, 2887 (1971).
(6) K. Michel and M. Matter, *Helv. Chim. Acta*, **44**, 2204 (1961).
(7) C. Corral, J. Lissavetzky, and G. Quintanilla, *J. Heterocycl. Chem.* **15**, 1137 (1978).

0022-3263/82/1947-2214$01.25/0

Table II. Properties and Yields of 5,6-Diacetyl-5,6-dihydrodibenzo[b,f][1,4,5]thiadiazepines[a]



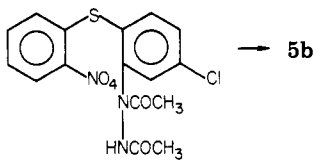
5

compd	X	% yield	mp,[b] °C
5a	2-Cl	81	150-151
5b	3-Cl	62 (from 4b), 44 (from 6)	200-202
5c	4-Cl	78	151-152
5d	H	0	

[a] See footnote a of Table I. [b] Recrystallized from benzene. All these compounds showed the following IR and NMR spectroscopic data: IR (Nujol) 1710-1700, 1685-1680 cm^{-1} (C=O); NMR (deuteriochloroform) δ 2.15-2.20 (s, 6 H, 2 CH_3), 7.3-7.7 (m, 7 H, aromatic protons).

yield, **5b** in 62% yield, and **5c** in 78% yield, respectively (Table II). These findings are consistent with the inductive as well as the mesomeric effects of the chloro substituents. The first should reinforce the action of the 2-NO_2 group in compounds **4**, making the charge on C-1 more positive and facilitating attack of the $^-NCOCH_3$ anion. The second should stabilize the transition state of the reaction. It is thus concluded that X must be an electronegative substituent for the reaction to take place.

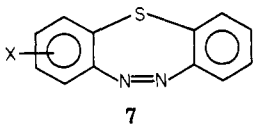
That a Smiles rearrangement preceeds the above cyclization reactions is shown by compound **6**, which when



6

subjected to the same reaction conditions as before gave a 44% yield of a compound which was identical with that obtained by cyclization of **4b**. The fact that **6** does cyclize and compound **4d** does not seems to point to a decisive charge-stabilizing effect of the 4'-chloro substituent on the rearranged intermediate anion.

Compounds **5** were easily hydrolyzed to **1** by refluxing under nitrogen in aqueous alcoholic potassium hydroxide. The hydrazo compounds **1** in ethanolic solution were oxidized spontaneously and quantitatively to the corresponding **7**.



7

This oxidation can be accelerated by bubbling air into the ethanolic solutions containing traces of potassium hydroxide.

Experimental Section

Melting points were determined on a Gallenkamp capillary apparatus and are uncorrected. Infrared spectra were recorded on a Perkin-Elmer 257 spectrometer. Proton nuclear magnetic resonance were recorded on a Perkin-Elmer R-12 spectrometer (Me_4Si as an internal standard).

Hydrazinodiphenyl sulfides were obtained as previously reported.[7]

2-Nitro-6-chlorophenyl 2-hydrazinophenyl sulfide was obtained according to this procedure as a yellow solid: 54% yield; mp 102-103 °C (benzene); IR (Nujol) 3330, 3300 ($NHNH_2$), 1520, 1340 cm^{-1} (NO,2); NMR (Me_2SO-d_6) δ 3.1-3.6 (br m, 2 H, NH_2), 6.7-7.7 (m, 6 H, aromatic protons), 8.20-8.35 (m, 1 H, H-3, aromatic proton). Anal. Calcd for $C_{12}H_{10}ClN_3O_2S$: C, 48.74; H, 3.38; N, 14.21. Found: C, 48.81; H, 3.46; N, 14.39.

2-Nitrophenyl 2-(α,β-Diacetyl)hydrazinophenyl Sulfides 4a-d and 6. General Procedure. To a suspension of 0.1 mol of the corresponding hydrazine in 120 mL of anhydrous benzene was added 0.2 mol (14.3 mL) of acetyl chloride dropwise. The reaction mixture was refluxed for 3 h and allowed to stand overnight at room temperature. The yellow solids so formed were filtered and recrystallized from benzene. Properties and yields of compounds **4a-d** are shown in Table I.

Compound **6** was also obtained as a yellow solid: mp 163-164 °C (benzene); 82% yield; IR (Nujol) 3270 (NH), 1720, 1670 cm^{-1} (C=O), 1520, 1340 (NO_2); NMR (Me_2SO-d_6) δ 1.9 (s, 3 H, CH_3), 2.1 (s, 3 H, CH_3), 6.8-7.8 (m, 6 H, aromatic protons), 8.3 (m, 1 H, H-3, aromatic proton), 8.7 (s, 1 H, NH).

5,6-Diacetyl-5,6-dihydrodibenzo[b,f][1,4,5]thiadiazepines (5). General Procedure. Anhydrous potassium carbonate (1.0 g, 0.01 mol) was added to a vigorously stirred solution of the corresponding 2-nitrophenyl 2-(α,β-diacetylhydrazinophenyl sulfide (0.01 mol) in 20 mL of *N*,*N*-dimethylformamide. The reaction mixture was heated under reflux for 15 min, cooled to room temperature, and poured into water. The solid thus obtained was filtered, dried, and recrystallized from benzene. Properties and yields of compounds **5** are shown in Table II.

5,6-Dihydrodibenzo[b,f][1,4,5]thiadiazepines (1). General Procedure. The corresponding compound **5** (3.3 g, 0.01 mol) was dissolved in 40 mL of ethanol containing 0.03 mol of potassium hydroxide. The reaction mixture was refluxed for 3 h under nitrogen. After the mixture cooled, a colorless solid crystallized which was washed with ethanol, dried, and recrystallized from ethanol. Properties and yields of compound **1** are shown in Table III.

Dibenzo[b,f][1,4,5]thiadiazepines (7). General Procedure. Air was bubbled into an ethanolic solution of the corresponding compound **1** containing traces of sodium hydroxide, and the crystalline yellow solid which formed was filtered and washed with ethanol. Properties of compounds **7** are shown in Table III.

Table III. Properties and Yields of 5,6-Dihydrodibenzo[b,f][1,4,5]thiadiazepines (1) and Dibenzo[b,f][1,4,5]thiadiazepines (7)[a]

compd	X	% yield	mp,[b] °C	compd	X	mp,[c] °C
1a	2-Cl	81	144-146	7a	2-Cl	92-94
1b	3-Cl	76	105-107	7b	3-Cl	127-128
1c	4-Cl	79	151-152	7c	4-Cl	84-85

[a] See footnote a of Table I. [b] Recrystallized from ethanol. All these compounds showed similar IR and the following common IR and NMR spectroscopic data: IR (Nujol) 3260, 3160 cm^{-1} (NHNH); NMR (deuteriochloroform) δ 5.8-6.3 (m, 2 H, NHNH), 6.8-7.7 (m, 7 H, aromatic protons). [c] Recrystallized from ethanol. All these compounds showed similar IR and the following common NMR spectroscopic data: NMR (deuteriochloroform) δ 7.3-7.7 (aromatic protons).

Acknowledgment. We are indebted to E. Alvarez Frejo for his aid in a part of this work and to our Department of Analysis and Instrumental Techniques for all the analytical and spectroscopic data.

Registry No. **1a**, 71693-43-1; **1b**, 81246-22-2; **1c**, 81246-23-3; **4a**, 71693-41-9; **4b**, 81246-24-4; **4c**, 81246-25-5; **4d**, 81246-26-6; **5a**, 71693-42-0; **5b**, 81246-27-7; **5c**, 81246-28-8; **6**, 81246-29-9; **7a**, 81246-30-2; **7b**, 81246-31-3; **7c**, 81246-32-4; 2-nitro-6-chlorophenyl-2'-hydrazino-phenyl sulfide, 81246-33-5.