SYNTHESIS OF *N*-PHENYLSULFONYL PROTECTED FURO[3,2-*b*]PYRROLES

Vladimir BOBOSIK and Alzbeta KRUTOSIKOVA

Department of Organic Chemistry,
Slovak Technical University, 81237 Bratislava, The Slovak Republic

Received March 4, 1993
Accepted May 24, 1993

Protection of nitrogen atom of heterocyclic molecules, such as indole and pyrrole types, enables various reactions of these systems[1,2]. *N*-Phenylsulfonyl derivatives, which have been widely used for this purpose, were prepared in the indole series by the reaction of *N*-sodium[3] and *N*-lithium[4] salts with benzenesulfonyl chloride. This method requires waterfree and oxygenfree conditions. On the other hand, the phase transfer catalysis conditions used in this work[5] obviates these disadvantages. We therefore selected the latter method for the preparation of variously substituted 4-phenylsulfonylfuro[3,2-*b*]-pyrroles (*I – VII*) and 1-phenylsulfonylbenzo[*b*]furo[3,2-*b*]pyrroles (*VIII – IX*).

EXPERIMENTAL

Melting points were determined on a Kofler block and are uncorrected. ^{1}H NMR spectra were recorded on a Tesla BS 587 (80 MHz) spectrometer (TMS as internal standard), UV spectra were measured on a M-40 (Zeiss, Jena) spectrophotometer in ethanol (λ_{max}/log ε; λ_{max} in nm, ε in m^2 mol^{-1}). IR spectra were recorded on a FTIR PU 9802/25 (Philips) spectrophotometer using the KBr technique (0.5 mg/300 mg KBr, ν are given in cm^{-1}). The starting compounds were prepared according to refs[6 – 11].

Ethyl 4-Phenylsulfonylfuro[3,2-*b*]pyrrole-5-carboxylate (*I*)

A mixture of ethyl furo[3,2-*b*]pyrrole-5-carboxylate (0.179 g, 1 mmol), tetrabutylammonium bromide (0.032 g, 0.1 mmol), sodium hydroxide (0.7 g, 17.5 mmol), water (1 ml) and toluene (5 ml) was stirred for 5 min. To this mixture, benzenesulfonyl chloride (0.264 g, 1.5 mmol) was added and intensive stirring continued for 1 h at room temperature. The mixture was diluted with toluene (15 ml) and the organic layer was separated, washed with water, dried with sodium sulfate and the solvent removed in vacuo. The residue was crystallized. Yield 0.2 g, (65%); m.p. 115 °C (ethanol). For $C_{15}H_{13}NO_5S$ (319.3) calculated: 56.42% C, 4.10% H, 4.39% N, 10.04% S; found: 56.36% C, 4.18% H, 4.47% N, 9.63% S. IR spectrum: 1 717 (C=O), 1 358, 1 186 (SO_2). UV spectrum: 299 (3.24), 249 (3.08), 223 (2.95). ^{1}H NMR spectrum ($CDCl_3$): 8.07 – 7.49 m, 6 H (H-2, H arom.); 7.04 s, 1 H (H-6); 6.79 d, 1 H (H-3, $J_{2,3}$ = 2); 4.20 q, 2 H (OCH_2); 1.26 t, 3 H (CH_3).

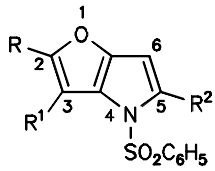
Compounds *II – IX* were prepared following this procedure. With *III* and *VIII* 1 mmol of tetrabutylammonium bromide was used and the reaction time was 3 h.

Ethyl 2-Methyl-4-phenylsulfonylfuro[3,2-*b*]pyrrole-5-carboxylate (*II*)

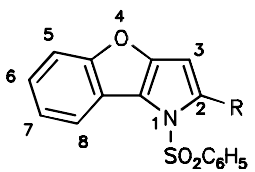
Yield 73%; m.p. 151 – 152 °C (ethanol). For $C_{16}H_{15}NO_5S$ (333.4) calculated: 57.65% C, 4.54% H, 4.20% N, 9.62% S; found: 57.59% C, 4.68% H, 4.36% N, 9.41% S. IR spectrum: 1 709 (C=O), 1 360, 1 180 (SO_2). UV spectrum: 310 (3.38), 249 (3.18), 224 (3.06). ^{1}H NMR spectrum ($CDCl_3$): 8.05 – 7.47 m, 6 H (H arom.); 6.98 s, 1 H (H-6); 6.60 d, 1 H (H-3); 4.17 q, 2 H (OCH_2); 2.45 s, 3 H (CH_3); 1.24 t, 3 H (CH_3).

Ethyl 2,3-Dimethyl-4-phenylsulfonylfuro[3,2-*b*]pyrrole-5-carboxylate (*III*)

Yield 72%; m.p. 103 – 104 °C (ethanol). For $C_{17}H_{17}NO_5S$ (347.4) calculated: 58.78% C, 4.93% H, 4.03% N, 9.23% S; found: 58.59% C, 4.84% H, 3.91% N, 8.89% S. IR spectrum: 1 721 (C=O), 1 372, 1 179 (SO_2). UV spectrum: 315 (3.23), 253 (2.92), 223 (2.99). ^{1}H NMR spectrum ($CDCl_3$):



	R	R^1	R^2
I	H	H	$COOC_2H_5$
II	CH_3	H	$COOC_2H_5$
III	CH_3	CH_3	$COOC_2H_5$
IV	C_6H_5	H	$COOC_2H_5$
V	$CH_3C_6H_4$	H	$COOC_2H_5$
VI	4-Cl-2-CH_3-C_6H_3O	H	$COOCH_3$
VII	4-Cl-2-CH_3-C_6H_3O	H	H



VIII, R = $COOC_2H_5$
IX, R = H

8.08 – 7.49 m, 6 H (H arom.); 6.94 s, 1 H (H-6); 4.22 q, 2 H (OCH_2); 2.37 s, 3 H (CH_3); 2.27 s, 3 H (CH_3); 1.26 t, 3 H (CH_3).

Ethyl 2-Phenyl-4-phenylsulfonylfuro[3,2-*b*]pyrrole-5-carboxylate (*IV*)

Yield 50%; m.p. 182 – 183 °C (ethanol). For $C_{21}H_{17}NO_5S$ (395.4) calculated: 63.79% C, 4.33% H, 3.54% N, 8.11% S; found: 63.84% C, 4.26% H, 3.69% N, 7.69% S. IR spectrum: 1 709 (C=O), 1 364, 1 177 (SO_2). UV spectrum: 336 (3.64), 262 (2.74), 227 (3.11). ^{1}H NMR spectrum ($CDCl_3$): 8.10 – 7.35 m, 10 H (H arom.); 7.25 s, 1 H (H-6); 7.07 s, 1 H (H-3); 4.21 q, 2 H (OCH_2); 1.26 t, 3 H (CH_3).

Ethyl 2-(4-Methylphenyl)-4-phenylsulfonylfuro[3,2-*b*]pyrrole-5-carboxylate (*V*)

Yield 60%; m.p. 175 °C (ethanol). For $C_{22}H_{19}NO_5S$ (409.5) calculated: 64.53% C, 4.68% H, 3.42% N, 7.83% S; found: 64.42% C, 4.80% H, 3.60% N, 7.42% S. IR spectrum: 1 713 (C=O), 1 368, 1 182 (SO_2). UV spectrum: 342 (3.66), 267 (3.07), 226 (3.11). ^{1}H NMR spectrum ($CDCl_3$): 8.10 – 7.25 m, 9 H (H arom.); 7.18 s, 1 H (H-6); 7.06 s, 1 H (H-3); 4.20 q, 2 H (OCH_2); 2.38 s, 3 H (CH_3); 1.26 t, 3 H (CH_3).

Methyl 2-(4-Chloro-2-methylphenoxy)-4-phenylsulfonylfuro[3,2-*b*]pyrrole-5-carboxylate (*VI*)

Yield 76%; m.p. 128 – 129 °C (ethanol). For $C_{21}H_{16}ClNO_6S$ (445.8) calculated: 56.57% C, 3.62% H, 3.14% N, 7.18% S; found: 56.23% C, 3.58% H, 3.28% N, 7.02% S. IR spectrum: 1 719 (C=O), 1 372, 1 175 (SO_2). UV spectrum: 314 (3.28), 247 (3.22). ^{1}H NMR spectrum ($CDCl_3$): 8.02 – 7.02 m, 8 H (H arom.); 7.00 s, 1 H (H-6); 6.06 s, 1 H (H-3); 4.20 q, 2 H (OCH_2); 3.72 s, 3 H (OCH_3); 2.33 s, 3 H (CH_3).

2-(4-Chloro-2-methylphenoxy)-4-phenylsulfonylfuro[3,2-*b*]pyrrole (*VII*)

Yield 59%; yellow oil. For $C_{19}H_{14}ClNO_4S$ (387.8) calculated: 58.84% C, 3.64% H, 3.61% N, 8.25% S; found: 58.99% C, 3.78% H, 3.48% N, 7.83% S. IR spectrum: 1 370, 1 170 (SO_2). UV spectrum: 240 (3.28). ^{1}H NMR spectrum ($CDCl_3$): 7.92 – 6.79 m, 9 H (H arom., H-5); 6.28 d, 1 H (H-6, $J_{5,6}$ = 3.6); 6.03 s, 1 H (H-3); 2.30 s, 3 H (CH_3).

Ethyl 1-Phenylsulfonylbenzo[*b*]furo[3,2-*b*]pyrrole-5-carboxylate (*VIII*)

Yield 55%; m.p. 135 – 136 °C (ethanol). For $C_{19}H_{15}NO_5S$ (369.4) calculated: 61.78% C, 4.09% H, 3.79% N, 8.68% S; found: 61.89% C, 4.22% H, 3.99% N, 8.17% S. IR spectrum: 1 717 (C=O), 1 368, 1 184 (SO_2). UV spectrum: 317 (3.50), 251 (3.38). ^{1}H NMR spectrum ($CDCl_3$): 8.33 – 7.25 m, 9 H (H arom.); 7.11 s, 1 H (H-3); 4.27 q, 2 H (OCH_2); 1.30 t, 3 H (CH_3).

1-Phenylsulfonylbenzo[*b*]furo[3,2-*b*]pyrrole (*IX*)

Yield 62%; m.p. 96 – 97 °C (ethanol). For $C_{16}H_{11}NO_3S$ (297.3) calculated: 64.63% C, 3.73% H, 4.91% N, 10.78% S; found: 64.58% C, 3.75% H, 4.84% N, 10.12% S. IR spectrum: 1 368, 1 169 (SO_2). UV spectrum: 300 (2.94), 244 (3.22), 226 (3.22). ^{1}H NMR spectrum ($CDCl_3$): 8.19 – 7.22 m, 10 H (H-2, H arom.); 6.45 d, 1 H (H-3, $J_{2,3}$ = 3.8); 4.27 q, 2 H (OCH_2); 1.30 t, 3 H (CH_3).

This study was supported by Grant Agency of Slovak Ministry of Education (Grant No. 1/141/92). Authors are indebted to Dr M. Dandarova, Mrs S. Markusova and M. Hrobonova for measurement of ^{1}*H NMR, IR and UV spectra.*

REFERENCES

1. Saulnier M. G., Gribble G. W.: J. Org. Chem. *47*, 2812 (1982).
2. Gharpure M., Stoller A., Bellamy F., Frinau G., Snieckus V.: Synthesis *1991*, 1079.
3. Sundberg R. J., Russell H. F.: J. Org. Chem. *38*, 3324 (1973).
4. Saulnier M. G., Gribble G. W.: J. Org. Chem. *47*, 758 (1982).
5. Illi V. O.: Synthesis *1979*, 136.
6. Hemetsberger R. H., Knittel D.: Monatsh. Chem. *103*, 194 (1972).
7. Krutosikova A., Kovac J., Dandarova M., Lesko J., Ferik S.: Collect. Czech. Chem. Commun. *46*, 2564 (1981).
8. Krutosikova A., Dandarova M., Chylova J., Vegh D.: Monatsh. Chem. *123*, 807 (1992).
9. Krutosikova A., Kovac J., Kralovicova E.: Collect. Czech. Chem. Commun. *48*, 772 (1983).
10. Krutosikova A., Dandarova M., Bobosik V.: Collect. Czech. Chem. Commun., in press.
11. Krutosikova A., Kovac J., Dandarova M., Bobalova M.: Collect. Czech. Chem. Commun. *47*, 3288 (1982).

Revised by J. Kovarova.