Available online at www.sciencedirect.com
ScienceDirect
Mendeleev Commun., 2006, **16(1)**, 56–57
Mendeleev Communications

New synthesis of 3-(2-furyl)biphenyls

Galina P. Sagitullina,* Larisa V. Glyzdinskaya and Reva S. Sagitullin

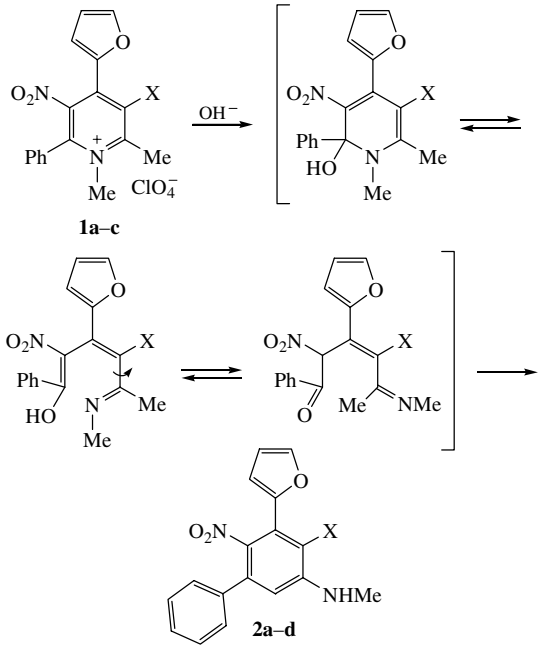
Department of Organic Chemistry, Omsk State University, 644077 Omsk, Russian Federation.
Fax: +7 3812 64 2410; e-mail: Sagitullina@orgchem.univer.omsk.su

DOI: 10.1070/MC2006v016n01ABEH002204

3-(2-Furyl)biphenyls **2a–d** were prepared by the rearrangement of 4-(2-furyl)-1,2-dimethyl-5-nitro-6-phenylpyridinium salts under the action of an alkali solution in aqueous ethanol.

The main synthetic routes to 3-(2-furyl)biphenyls were cross-coupling reactions,[1] the cyclization of isonitrosofuroylacetone with enamines[2] and the Michael addition of alkylidenemalononitriles to furfurylidenemalononitrile or furylideneacetophenone with ethyl crotonate followed by the intramolecular Thorpe and Claisen cyclization of the adducts.[3–5]

Here, we report the synthesis of 3-(2-furyl)biphenyles by recyclization of quaternary 4-(2-furyl)-1,2-dimethyl-5-nitro-6-phenylpyridinium salts **1a–c** under the action of an alkali solution in aqueous ethanol. As depicted in Scheme 1, the reaction occurred *via* an initial attack of the hydroxyl anion at the most electron-deficient α-position of the pyridine ring (*ortho*- to the nitro group) followed by C–N bond breaking. The benzene ring closure occurred as a result of intramolecular crotonic condensation of the benzoyl group formed after pyridine ring opening with the methyl group of the open intermediate. 3-(2-Furyl)biphenyls **2a–d** were easily isolated in 42–55% yields.† Substituents at the 2- and 6-positions of the benzene ring of 3-(2-furyl)biphenyl were derived from the pyridinium salt. Pyridinium salts **1a–c** were synthesised by the alkylation



1a–c

2a–d

a X = COPh **c** X = CO_2Et
b X = COMe **d** X = CO_2H

Scheme 1

† *Synthesis of 3-(2-furyl)biphenyls* **2a–d** *by the rearrangement of 4-furyl-substituted pyridinium salts of* **1a–c** *(general procedure).* To a suspension of the corresponding pyridinium salt **1a–c** (1 mmol) in ethanol (4 ml), a 10% aqueous solution of NaOH (1.8 ml, 5 mmol) was added. The reaction mixture was stirred at room temperature (**2a** and **2c**, for 18 h; **2b**, for 4 h) and then diluted with water. Precipitated compounds **2a–c** were filtered off, washed with water, dried and recrystallised from ethanol. The filtrate of **2c** was acidified with 50% acetic acid to isolate **2d**.

of corresponding Hantzsch 4-(2-furyl)-5-nitropyridines, which were obtained *via* the cyclocondensation of furylidenenitroacetophenone with various enamines, with dimethyl sulfate.

The structures of compounds **2a–d** were confirmed by elemental analysis, ^{1}H NMR and IR spectroscopy and mass spectrometry.‡

This work was supported by the Russian Foundation for Basic Research (grant no. 04-03-32652).

‡ *Analytical and spectral data for* **2a**: yield 58%, yellow crystals, mp 179–180 °C. ^{1}H NMR (200 MHz, $CDCl_3$) δ: 2.87 (s, 3H, Me), 5.89 (br. s, 1H, NH), 6.03 (dd, 1H, 4′-H, $J_{4'\text{-H},3'\text{-H}}$ 3.5 Hz, $J_{4'\text{-H},5'\text{-H}}$ 1.8 Hz), 6.28 (dd, 1H, 3′-H, $J_{3'\text{-H},4'\text{-H}}$ 3.5 Hz, $J_{3'\text{-H},5'\text{-H}}$ 0.7 Hz), 6.65 (s, 1H, 4-H), 7.13 (dd, 1H, 5′-H, $J_{5'\text{-H},4'\text{-H}}$ 1.8 Hz, $J_{5'\text{-H},3'\text{-H}}$ 0.7 Hz), 7.21–7.56 (m, 10H, Ph, COPh). IR ($CHCl_3$, ν/cm^{-1}): 3440 (NH), 1650 (CO), 1530 and 1350 (NO_2). MS (EI, 70 eV), *m*/*z* (%): 398 $M^{+\cdot}$ (21), 381 $[M - OH]^+$ (22), 369 (26), 353 $[M - OH - CO]^+$ (27), 325 $[M - NO_2 - HCN]$+ (25), 285 $[M - NO_2 - C_4H_3O]^{+\cdot}$ (47), 284 (21), 256 (23), 105 (100), 77 (67), 28 (24). Found (%): C, 72.69; H, 4.74; N, 6.70. Calc. for $C_{24}H_{18}N_2O_4$ (%): C, 72.35; H, 4.55; N, 7.03.

For **2b**: yield 42%, yellow crystals, mp 134–135 °C. ^{1}H NMR (200 MHz, $CDCl_3$) δ: 1.81 (s, 3H, COMe), 2.89 (s, 3H, Me), 6.53 (dd, 1H, 4′-H, $J_{4'\text{-H},3'\text{-H}}$ 3.5 Hz, $J_{4'\text{-H},5'\text{-H}}$ 1.8 Hz), 6.61 (s, 1H, 4-H), 6.64 (dd, 1H, 3′-H, $J_{3'\text{-H},4'\text{-H}}$ 3.5 Hz, $J_{3'\text{-H},5'\text{-H}}$ 0.7 Hz), 7.05 (br. s, 1H, NH), 7.37–7.49 (m, 5H, Ph), 7.58 (dd, 1H, 5′-H, $J_{5'\text{-H},4'\text{-H}}$ 1.8 Hz, $J_{5'\text{-H},3'\text{-H}}$ 0.7 Hz). IR ($CHCl_3$, ν/cm^{-1}): 3420 (NH), 1660 (CO), 1530 and 1360 (NO_2). MS (EI, 70 eV), *m*/*z* (%): 336 $M^{+\cdot}$ (50), 319 $[M - OH]^+$ (81), 307 (33), 291 $[M - OH - CO]^+$ (45), 277 (31), 263 $[M - NO_2 - HCN]^+$ (27), 250 (36), 249 (100), 248 (30), 247 (42), 234 (39), 232 (32), 221 (72), 220 (52), 219 (31), 207 (34), 206 (62), 204 (38), 194 (40), 193 (61), 191 (37), 189 (40), 165 (39), 152 (32), 77 (24), 43 (77), 28 (33). Found (%): C, 67.74; H, 4.92; N, 8.08. Calc. for $C_{19}H_{16}N_2O_4$ (%): C, 67.85; H, 4.79; N, 8.33.

References

1 K. H. Reuter and W. J. Scott, *J. Org. Chem.*, 1993, **58**, 4722.
2 E. Yu. Belyaev, G. A. Suboch and A. V. El'tsov, *Zh. Org. Khim.*, 1978, **14**, 1506 [*J. Org. Chem. USSR* (*Engl. Transl.*), 1978, **14**, 1407].
3 Yu. A. Sharanin, Yu. A. Baskakov, Yu. T. Abramenko, Yu. G. Putsykin, A. F. Vasiliev and E. B. Nazarova, *Zh. Org. Khim.*, 1980, **16**, 2192 [*J. Org. Chem. USSR* (*Engl. Transl.*), 1980, **16**, 1870].
4 C. Ivanov and T. Tcholakova, *Synthesis*, 1981, 392.
5 K. Eichinger, P. Nussbaumer, S. Balkan and G. Schulz, *Synthesis*, 1987, 1061.

Received: 27th June 2005; Com. 05/2535

For **2c**: yield 11%, yellow crystals, mp 120–121 °C. ^{1}H NMR (200 MHz, $CDCl_3$) δ: 1.01 (t, 3H, CO_2Et, *J* 7.1 Hz), 2.91 (d, 3H, Me, *J* 5.1 Hz), 4.06 (q, 2H, CO_2Et, *J* 7.1 Hz), 6.42–6.49 (m, 2H, 4′-H, 3′-H), 6.60 (s, 1H, 4-H), 6.79 (br. s, 1H, NH), 7.34–7.46 (m, 5H, Ph), 7.48 (s, 1H, 5′-H). IR ($CHCl_3$, ν/cm^{-1}): 3420 (NH), 1680 (CO), 1530 and 1360 (NO_2). MS (EI, 70 eV), *m*/*z* (%): 366 $M^{+\cdot}$ (63), 349 $[M - OH]^+$ (18), 337 (15), 321 (17), 293 $[M - NO_2 - HCN]^+$ (9), 277 (59), 275 (52), 249 (62), 248 (66), 247 (52), 221 (70), 220 (100), 219 (98), 206 (37), 205 (50), 193 (51), 192 (30), 191 (31). Found (%): C, 65.38; H, 5.11; N, 7.89. Calc. for $C_{20}H_{18}N_2O_5$ (%): C, 65.57; H, 4.95; N, 7.65.

For **2d**: yield 55%, white crystals, mp 213–215 °C. ^{1}H NMR (200 MHz, $CDCl_3$) δ: 2.79 (d, 3H, Me, *J* 5.0 Hz), 5.51 (br. s, 1H, NH), 6.56 (dd, 1H, 4′-H, $J_{4'\text{-H},3'\text{-H}}$ 3.3 Hz, $J_{4'\text{-H},5'\text{-H}}$ 2.0 Hz), 6.66 (dd, 1H, 3′-H, $J_{3'\text{-H},4'\text{-H}}$ 3.3 Hz, $J_{3'\text{-H},5'\text{-H}}$ 0.7 Hz), 7.11 (s, 1H, 4-H), 7.39–7.45 (m, 5H, Ph), 7.65 (dd, 1H, 5′-H, $J_{5'\text{-H},4'\text{-H}}$ 2.0 Hz, $J_{5'\text{-H},3'\text{-H}}$ 0.7 Hz), 12.32 (s, 1H, CO_2H). IR ($CHCl_3$, ν/cm^{-1}): 3430 (NH), 1640 (CO), 1530 and 1360 (NO_2). MS (EI, 70 eV), *m*/*z* (%): 338 $M^{+\cdot}$ (4), 322 (20), 321 $[M - OH]^+$ (100), 293 $[M - OH - CO]^+$ (11), 290 (62), 279 (50), 265 $[M - NO_2 - HCN]^+$ (7), 262 (51), 251 (32), 232 (36), 207 (31), 206 (32), 179 (35), 178 (49), 176 (35), 165 (34), 139 (30), 77 (20), 28 (17). Found (%): C, 63.66; H, 3.97; N, 7.99. Calc. for $C_{18}H_{14}N_2O_5$ (%): C, 63.90; H, 4.17; N, 8.28.

The English language edited by Valentin V. Makhlyarchuk, Moscow
Typeset by Sergei I. Ososkov, Moscow
Printed in the UK by Cambrian Printers, Aberystwyth