Intramolecular cyclization of *N*-acetyl-6-(cyclopent-1-enyl)-2-methylaniline

R. R. Gataullin, I. S. Afon'kin, I. V. Pavlova, I. B. Abdrakhmanov, and G. A. Tolstikov*

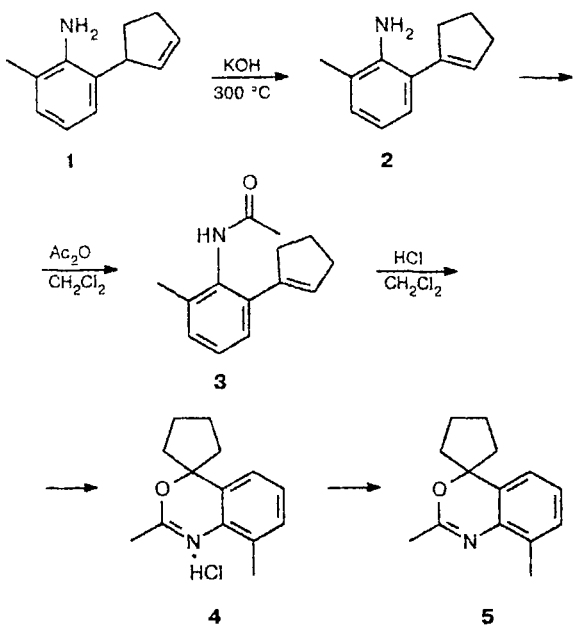
Institute of Organic Chemistry, Ufa Research Center of the Russian Academy of Sciences, 71 prosp. Oktyabrya, 450054 Ufa, Russian Federation. Fax: +7 (347 2) 35 6066. E-mail: root@chemorg.ufanet.ru

N-Acetyl-6-(cyclopent-1-enyl)-2-methylaniline underwent intramolecular cyclization in the presence of HCl in CH_2Cl_2 at 20 °C to form 2,8-dimethylspiro[cyclopentane-1,4′-4′*H*-3,1-benzooxazine] in quantitative yield.

Key words: *N*-acetyl-6-(cyclopent-1-enyl)-2-methylaniline, 2,8-dimethylspiro[cyclopentane-1,4′-4′*H*-3,1-benzooxazine].

ortho-(2-Alkenyl)arylamines, which are prepared by the aromatic Claisen rearrangement,[1–3] can be used in the synthesis of some alkaloids.[4–6]

With the aim of extending the applicability of *o*-(2-alkenyl)anilines in different synthetic procedures, we prepared 6-(cyclopent-1-enyl)-2-methylaniline (**2**) (yield 98%) by isomerization of 6-(cyclopent-2-enyl)-2-methylaniline (**1**) under the action of KOH at 300 °C. Acylation of compound **2** with Ac_2O in CH_2Cl_2 afforded *N*-acetyl-6-(cyclopent-1-enyl)-2-methylaniline (**3**) in 97% yield. When gaseous HCl was passed through a solution of compound **3** in CH_2Cl_2, intramolecular cyclization occurred to form 3,1-benzooxazine. The latter was isolated as hydrochloride **4** (Scheme 1).



Treatment of hydrochloride **4** with a 5% $NaHCO_3$ solution gave 3,1-benzooxazine (**5**). The structures of compounds **4** and **5** were unambiguously established by spectral methods and elemental analysis. Thus the IR spectra of both compounds have no characteristic absorption bands of the NH group[7] at 3280 cm^{-1}. The ^1H NMR spectrum of hydrochloride **4** has a broadened one-proton singlet signal for the proton of HCl at δ 15.2. The aromatic portions of the ^1H NMR spectra of compounds **4** and **5** contain two one-proton doublets and one one-proton triplet. The aliphatic portions of the spectra of compounds **4** and **5** are similar in character, but the signals for the Me groups in the spectrum of hydrochloride **4** are substantially shifted downfield (δ 2.8 and 3.0) compared to those of base **5** (δ 2.1 and 2.4). Multiplet signals for the cyclopentane fragment are observed at δ 1.80 and 2.20. In the ^{13}C NMR spectrum of compound **5**, four signals belong to the aliphatic fragment. Signals for the C atoms of the methyl groups are observed at δ 17.22 and 22.19. Signals for the C atoms of the cyclopentane fragment are present at δ 23.98 and 40.59 and signals for the spiro C atom and for the C(2) atom are observed at δ 88.28 and 159.10, respectively.[8]

Experimental

The ^1H and ^{13}C NMR spectra were recorded on a Bruker AM 300 instrument (operating at 300 and 75 MHz, respectively) with Me_4Si as the internal standard. The IR spectra were obtained on a UR-20 instrument. The purity of the compounds was checked on a Chrom-5 chromatograph and on Silufol UV-254 plates (CH_2Cl_2 : MeOH, 19 : 1).

6-(Cyclopent-1-enyl)-2-methylaniline (2). Arylamine **1** (10 g) and crystalline KOH (10 g) were heated at 300—310 °C for 45 min. The reaction mixture was cooled to 20—22 °C. The product was decanted from the solid precipitate and distilled *in vacuo*. The yield was 9.8 g (98%), b.p. 128 °C (6 Torr). Found (%): C, 82.50; H, 9.12; N, 7.83. $C_{12}H_{15}N$. Calculated (%): C,

Translated from *Izvestiya Akademii Nauk. Seriya Khimicheskaya*, No. 2, pp. 398—400, February, 1999.

1066-5285/99/4802-0396 $22.00

82.76; H, 9.20; N, 8.05. IR, ν/cm^{-1}: 3390, 3480 (NH_2). ^{1}H NMR, δ: 2.05 (m, 2 H, CH_2); 2.61—2.80 (m, 4 H, 2 CH_2); 2.25 (s, 3 H, CH_3); 3.74 (br.s, 2 H, NH_2); 6.03 (s, 1 H, =CH); 6.74 (t, 1 H, H(4), J = 7.47 Hz); 7.02 (d, 1 H, H(5)); 7.06 (d, 1 H, H(3)). ^{13}C NMR, δ: 17.64 (CH_3); 141.28 (C(1′)); 128.57 (C(2′)); 36.29 (C(3′)); 22.95 (C(4′)); 33.51 (C(5′)); 141.68 (C(1)); 123.28 (C(2)); 127.97 (C(3)); 117.35 (C(4)); 125.67 (C(5)); 121.99 (C(6)).

***N*-Acetyl-6-(cyclopent-1-enyl)-2-methylaniline (3).** Ac_2O (4.08 g, 40 mmol) was added to a solution of compound **2** (3.46 g, 20 mmol) in CH_2Cl_2 (10 mL). The reaction mixture was left for 18 h and then diluted with water. The product was extracted with CH_2Cl_2 (100 mL). The extract was washed with a 5% $NaHCO_3$ solution until elimination of CO_2 ceased and then with water (20 mL) and dried with $MgSO_4$. After evaporation of the solvent, acetanilide **3** was obtained in a yield of 4.18 g (97.2%), m.p. 95 °C, R_f 0.68. Found (%): C, 77.93; H, 7.80; N, 6.28. $C_{14}H_{17}NO$. Calculated (%): C, 78.14; H, 7.91; N, 6.51. IR, ν/cm^{-1}: 3280 (NH). ^{1}H NMR ($CDCl_3$), δ: 1.90—2.03 (m, 2 H, CH_2); 2.50 (dt, 2 H, CH_2, J_1 = 2.37 Hz, J_2 = 7.23 Hz); 2.61 (dt, 2 H, 3′-CH_2, J_1 = 1.94 Hz, J_2 = 7.36 Hz); 5.83 and 5.99 (both t, 1 H, H(2′), J = 1.94 Hz); 6.95—7.20 (m, 4 H, ArH, NH); 2.15 (s, 3 H, CH_3); 2.25 and 2.30 (both s, 3 H, CH_3).

2,8-Dimethylspiro[cyclopentane-1,4′-4′*H*-3,1-benzooxazine] hydrochloride (4). Gaseous HCl was passed through a solution of acetanilide **3** (0.22 g, 1 mmol) in CH_2Cl_2 (10 mL) for 6 h. The solvent was evaporated *in vacuo*, the residue was dried *in vacuo*, and hydrochloride **4** was obtained in a yield of 0.25 g (99%); R_f 0.48. Found (%): C, 66.53; H, 7.07; Cl, 13.83; N, 5.34. $C_{14}H_{18}ClNO$. Calculated (%): C, 66.80; H, 7.16; Cl, 14.12; N, 5.57. IR, ν/cm^{-1}: 810. ^{1}H NMR ($CDCl_3$), δ: 1.90—2.40 (m, 8 H, 4 CH_2); 2.79 (s, 3 H, CH_3); 2.96 (s, 3 H, CH_3); 6.98 (d, 1 H, H(7), J = 7.27 Hz); 7.23 (t, 1 H, H(6)); 7.26 (d, 1 H, H(5)); 15.20 (br.s, 1 H, HCl). ^{13}C NMR ($CDCl_3$), δ: 19.71 (CH_3); 20.22 (CH_3); 23.93 (C(3′), C(4′)); 41.95 (C(2′), C(5′)); 97.49 (C(4)); 120.80 (C(5)); 125.48 (C(8)); 126.50 (C(10)); 129.61 (C(6)); 132.29 (C(7)); 142.31 (C(9)); 172.31 (C(2)).

2,8-Dimethylspiro[cyclopentane-1,4′-4′*H*-3,1-benzooxazine] (5). Compound **4** was dissolved in CH_2Cl_2 (50 mL) and treated with a 5% $NaHCO_3$ solution (10 mL). The organic phase was washed with water (10 mL) and dried with $MgSO_4$. The solvent was evaporated *in vacuo*, and compound **5** was obtained in a yield of 0.2 g (93%); R_f 0.76. Found (%): C, 78.20; H, 7.79; N, 6.33. $C_{14}H_{17}NO$. Calculated (%): C, 78.14; H, 7.91; N, 6.51. IR, ν/cm^{-1}: 780, 810. ^{1}H NMR ($CDCl_3$), δ: 1.75—2.21 (m, 8 H, 4 CH_2); 2.09 (s, 3 H, 8-CH_3); 2.39 (s, 3 H, 2-CH_3); 6.89 (d, 1 H, H(7), J = 7.04 Hz); 7.00 (t, 1 H, H(6)); 7.05 (d, 1 H, H(5)). ^{13}C NMR ($CDCl_3$), δ: 17.22 (2-CH_3); 22.19 (8-CH_3); 23.97 (C(3′)), C(4′)); 40.60 (C(2′), C(5′)); 88.28 (C(4)); 119.68 (C(5)); 125.47 (C(7)); 128.77 (C(8)); 129.66 (C(6)); 132.16 (C(10)); 137.31 (C(9)); 159.10 (C(2)).

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Received July 7, 1998