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SHORT COMMUNICATIONS

Synthesis of 1,3,6-Triaryl-6-trifluoromethyl-5,6-dihydro-1,3,5-triazine-2,4(1*H*,3*H*)-diones by Reaction of Aryl Trifluoromethyl Ketone Imines with Aryl Isocyanates

N. V. Mel'nichenko and M. V. Vovk

Institute of Organic Chemistry, National Academy of Sciences of Ukraine,
ul. Murmanskaya 5, Kiev, 02094 Ukraine
e-mail: mvovk@i.com.ua

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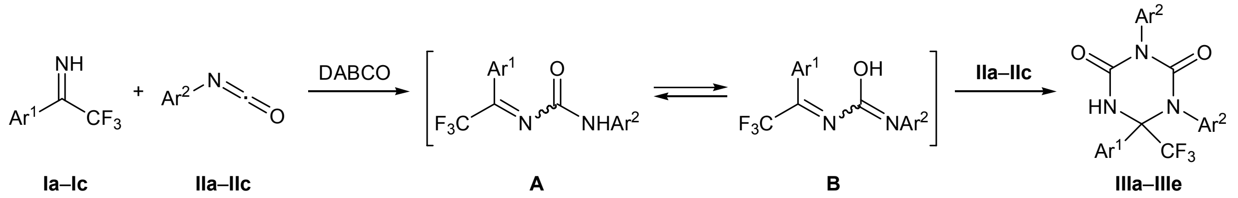
Because of reduced basicity, carbamoylation of aryl trifluoromethyl ketone imines at the nitrogen atom occurs under mild conditions only by the action of highly electrophilic reagents, such as trichloromethyl isocyanate [1], 1-aryl-1-chloro-2,2,2-trifluoroethyl isocyanates [2], and chlorocarbonyl isocyanate [3]. The reactions with 1-chloroalkyl isocyanates give the corresponding *N*,*N*′-bis(alkylidene)ureas which are intermediate products in the synthesis of trifluoromethyl-containing *N*,*N*′-bis(1-chloroalkyl)carbodiimides [4]. Our attempts to effect carbamoylation of aryl trifluoromethyl ketone imines with aryl isocyanates in the temperature range from 20 to 110°C were unsuccessful. Therefore, *N*-aryl-*N*′-(2,2,2-trifluoroethylidene)ureas as important initial compounds for the synthesis of 4-trifluoromethylquinazolin-2-ones [5] and their benzo analogs [6] were obtained by reaction of 1-aryl-1-chloro-2,2,2-trifluoroethyl isocyanates with aromatic amines. Taking into account recently reported data [7] on N-acylation of aryl trifluoromethyl ketone imines with alkyl chloroformates at elevated temperature, we examined the reaction of ketone imines **Ia**–**Ic** with aryl isocyanates **IIa**–**IIc** in boiling xylene with a view to synthesize *N*-aryl-*N*′-(2,2,2-trifluoroethylidene)ureas. However, imines **Ia**–**Ic** reacted with isocyanates **IIa**–**IIc** only in the presence of a catalytic amount of a strong organic base (1,4-diazabicyclo[2.2.2]octane, DABCO) to produce 1,3,6-triaryl-6-trifluoromethyl-5,6-dihydro-1,3,5-triazine-2,4(1*H*,3*H*)-diones **IIIa**–**IIIe**. The use of 2 equiv of aryl isocyanate **II** and prolonged heating (18–20 h) allowed us to attain a 52–70% yield of compounds **III**. Most probably, the initial step is base-catalyzed addition of aryl isocyanate **II** at the nitrogen atom of imine **I** with formation of *N*-(1-aryl-2,2,2-trifluoroethylidene)urea **A** which is capable of undergoing tautomeric transformation into 3-hydroxy-2,4-diaza-1,3-diene **B** at elevated temperature. Provided that excess aryl isocyanate is present in the reaction mixture, intermediate **B** does not undergo intramolecular cyclization with formation of quinazolin-2-one [5] but gives rise to triazinedione **III** via [4+2]-cycloaddition with the second aryl isocyanate molecule. The proposed scheme was indirectly supported by the GC–MS data, according to which the reaction mixtures contained up to 7–10% of *N*-alkylideneurea like **A**.

1,3,6-Triaryl-6-trifluoromethyl-5,6-dihydro-1,3,5-triazine-2,4(1*H*,3*H*)-diones IIIa–IIIe (*general procedure*). A mixture of 1 mmol of ketone imne **Ia**–**Ic**, 2 mmol of aryl isocyanate **IIa**–**IIc**, a catalytic



I, Ar^1 = Ph (**a**), 3-FC_6H_4 (**b**), 3-MeC_6H_4 (**c**); **II**, Ar^2 = 4-ClC_6H_4 (**a**), 4-*t*-BuC_6H_4 (**b**), 3,4-$Cl_2C_6H_3$ (**c**); **III**, Ar^1 = Ph, Ar^2 = 4-Cl_6H_4 (**a**), 3,4-$Cl_2C_6H_3$ (**b**); Ar^1 = 3-FC_6H_4, Ar^2 = 4-*t*-BuC_6H_4 (**c**), 3,4-$Cl_2C_6H_3$ (**d**); Ar^1 = 3-MeC_6H_4, Ar^2 = 4-ClC_6H_4 (**e**).

amount of DABCO, and 15 ml of xylene (isomer mixture) was heated for 18–20 h under reflux. The mixture was cooled, and the precipitate was filtered off, washed with hexane, and purified by recrystallization.

1,3-Bis(4-chlorophenyl)-6-phenyl-6-trifluoromethyl-5,6-dihydro-1,3,5-triazine-2,4(1*H*,3*H*)-dione (IIIa). Yield 59%, mp 225–227°C (from benzene–hexane, 2:1). IR spectrum, ν, cm^{-1}: 3265 (N–H), 1740, 1690 (C=O). ^{1}H NMR spectrum, δ, ppm: 7.24–7.86 m (13H, H_{arom}), 9.98 s (1H, NH). ^{13}C NMR spectrum, δ_C, ppm: 75.10 q (C^6, J_{CF} = 30.2 Hz), 124.76 q (CF_3, J_{CF} = 287.6 Hz), 128.24, 128.38, 128.40, 128.67, 130.25, 131.20, 132.19, 132.63, 132.68, 132.83, 133.98, 135.62 (C_{arom}), 150.45 (C=O), 150.49 (C=O). ^{19}F NMR spectrum: δ_F –73.81 ppm (CF_3). Found, %: C 54.75; H 3.07; N 8.56. *m*/*z* 481 $[M + 1]^+$. $C_{22}H_{14}Cl_2F_3N_3O_2$. Calculated, %: C 55.02; H 2.94; N 8.75. M 480.3.

1,5-Bis(3,4-dichlorophenyl)-6-phenyl-6-trifluoromethyl)-5,6-dihydro-1,3,5-triazine-2,4(1*H*,3*H*)-dione (IIIb). Yield 52%, mp 238–240°C (from benzene–hexane, 1:1). IR spectrum, ν, cm^{-1}: 3260 (N–H), 1745, 1695 (C=O). ^{1}H NMR spectrum, δ, ppm: 7.17–7.77 m (11H, H_{arom}), 10.09 s (1H, NH). ^{13}C NMR spectrum, δ_C, ppm: 75.31 q (C^6, J_{CF} = 29.8 Hz), 124.60 q (CF_3, J_{CF} = 284.8 Hz), 127.43, 128.46, 129.91, 130.05, 130.40, 130.49, 130.56, 130.82, 131.02, 131.10, 131.25, 131.55, 1341.89, 133.20, 134.89, 136.55 (C_{arom}), 150.18 (C=O), 150.20 (C=O). ^{19}F NMR spectrum: δ_F –73.76 ppm (CF_3). Found, %: C 48.39; H 2.04; N 7.50. *m*/*z* 550 $[M + 1]^+$. $C_{22}H_{12}Cl_4F_3N_3O_2$. Calculated, %: C 48.12; H 2.20; N 7.65. M 549.2.

1,5-Bis(4-*tert*-butylphenyl)-6-(3-fluorophenyl)-6-trifluoromethyl-5,6-dihydro-1,3,5-triazine-2,4(1*H*,3*H*)-dione (IIIc). Yield 58%, mp 245–247°C (from aqueous ethanol, 1:1). IR spectrum, ν, cm^{-1}: 3230 (N–H), 1735, 1680 (C=O). ^{1}H NMR spectrum, δ, ppm: 1.17 s and 1.27 s (9H each, *t*-Bu), 6.84–7.56 m (12H, H_{arom}), 9.89 s (1H, NH). ^{13}C NMR spectrum, δ_C, ppm: 30.85 and 31.09 (CH_3), 34.15 and 34.34 [**C**(CH_3)$_3$], 74.71 q (C^6, J_{CF} = 32.2 Hz), 124.25 q (CF_3, J_{CF} = 292.4 Hz), 115.93, 117.96, 124.91, 125.28, 125.37, 126.00, 128.73, 130.20, 130.47, 132.55, 133.96, 135.03, 143.95 (C_{arom}), 150.32 (C=O), 150.74 (C=O), 161.52 d ($C^{3'}F$, J = 251.6 Hz). ^{19}F NMR spectrum: δ_F –74.04 ppm (CF_3). Found, %: C 66.30; H 5.77; N 7.86. *m*/*z* 542 $[M + 1]^+$. $C_{30}H_{31}F_4N_3O_2$. Calculated, %: C 66.53; H 5.77; N 7.76. M 541.6.

1,5-Bis(3,4-dichlorophenyl)-6-(3-fluorophenyl)-6-trifluoromethyl-5,6-dihydro-1,3,5-triazine-2,4(1*H*,3*H*)-dione (IIId). Yield 63%, mp 239–241°C (from aqueous ethanol, 1:1). IR spectrum, ν, cm^{-1}: 3250 (N–H), 1730, 1685 (C=O). ^{1}H NMR spectrum, δ, ppm: 7.18–7.69 m (10H, H_{arom}), 10.17 s (1H, NH). ^{13}C NMR spectrum, δ_C, ppm: 74.64 q (C^6, J_{CF} = 31.4 Hz), 124.18 q (CF_3, J_{CF} = 298.8 Hz), 114.43, 116.96, 117.71, 124.78, 129.73, 129.79, 130.25, 130.39, 130.84, 131.15, 131.50, 133.19, 134.36, 134.83, 136.45, 140.80, 141.38 (C_{arom}), 150.03 (C=O), 150.15 (C=O), 161.74 d ($C^{3'}F$, J = 254.4 Hz). ^{19}F NMR spectrum: δ_F –74.12 ppm (CF_3). Found, %: C 46.68; H 2.22; N 7.66. *m*/*z* 567 $[M + 1]^+$. $C_{30}H_{31}F_4N_3O_2$. Calculated, %: C 46.59; H 1.95; N 7.41. M 567.2.

1,5-Bis(4-chlorophenyl)-6-(3-methylphenyl)-6-trifluoromethyl-5,6-dihydro-1,3,5-triazine-2,4(1*H*,3*H*)-dione (IIIe). Yield 54%, mp 162–163°C (from benzene–hexane, 1:1). IR spectrum, ν, cm^{-1}: 3240 (N–H), 1730, 1680 (C=O). ^{1}H NMR spectrum, δ, ppm: 2.32 s (3H, CH_3), 7.23–7.59 m (12H, H_{arom}), 9.91 s (1H, NH). ^{13}C NMR spectrum, δ_C, ppm: 20.97 (CH_3), 75.04 q (C^6, J_{CF} = 31.6 Hz), 125.22 q (CF_3, J_{CF} = 288.2 Hz), 128.15, 128.20, 128.26, 128.69, 129.23, 130.80, 131.22, 132.13, 132.63, 132.69, 132.84, 134.01, 135.66, 137.77 (C_{arom}), 150.47 (C=O), 150.53 (C=O). ^{19}F NMR spectrum: δ_F –73.78 ppm (CF_3). Found, %: C 48.77; H 2.64; N 7.31. *m*/*z* 564 $[M + 1]^+$. $C_{23}H_{14}Cl_4F_3N_3O_2$. Calculated, %: C 49.05; H 2.51; N 7.46. M 563.2

The IR spectra were recorded in KBr on a UR-20 instrument. The ^{1}H and ^{13}C NMR spectra were recorded from solutions in DMSO-d_6 on a Bruker Avance DRX-500 spectrometer at 500.13 and 125.75 MHz, respectively, using TMS as internal reference. The ^{19}F NMR spectra were measured from solutions in DMSO-d_6 on a Varian Gemini instrument at 188.14 MHz using $CFCl_3$ as internal reference. The mass spectra were obtained on an Agilent 1100\DAD\HSD\VLG 119562 GC–MS system. Initial imines **Ia**–**Ic** were synthesized as described in [1].

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