A new ring transformation in the series of 1,2,3-thiadiazoles. Synthesis of 5*H*-[1,2,3]triazolo[5,1-*b*][1,3,4]thiadiazines

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DOI: 10.1070/MC2000v010n01ABEH001218

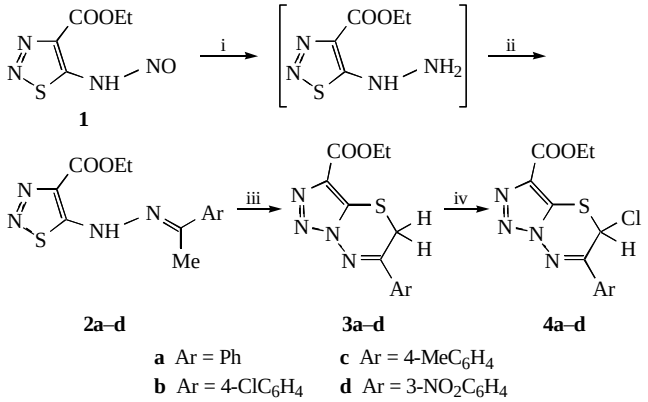
The first example of the ring transformation of 1,2,3-thiadiazoles involving four atoms of the side chain to form 5*H*-[1,2,3]triazolo-[5,1-*b*][1,3,4]thiadiazines is presented.

Several types of ring transformation reactions and rearrangements of 1,2,3-thiadiazoles leading to various heterocyclic compounds have been discovered.[1] These processes are governed by the following factors: (i) the facile cleavage of the weak N–S bond, (ii) the existence of an equilibrium between 1,2,3-thiadiazoles and α-diazo thiocarbonyl compounds and (iii) the capacity of both thiocarbonyl and diazo groups to cyclise onto electrophilic and nucleophilic functionalities. It was shown that 1,2,3-thiadiazoles could be transformed with involvement of one (Dimroth type rearrangement),[2] two (Conforth type)[3] or three (L'abbé type)[4] atoms of the side chain. This paper presents the first example of the ring transformation of 1,2,3-thiadiazoles with the participation of four atoms of the side chain.

Starting compounds **2a**–**d** for this novel ring transformation were obtained by one pot synthesis from 5-*N*-nitrosylamino-1,2,3-thiadiazole[5] **1** (Scheme 1).† We found that compounds **2** are transformed to ethyl 6-aryl-5-chloro-5*H*-[1,2,3]triazolo[5,1-*b*]-[1,3,4]thiadiazin-3-carboxylates **4a**–**d** in moderate yields by a treatment with thionyl chloride at room temperature for 1 h. The structures of products **4a**–**d** were assigned on the basis of elemental analyses, IR, mass and NMR spectra.‡

We have also found that this reaction being carried out at –80 °C for 30 min leads to intermediate compounds **3a**–**d** that could be transformed further into **4a**–**d** under similar conditions. The structures of compounds **3a**–**d** obtained as triazolothiazines were confirmed by ^{1}H NMR and mass spectrometry.§ The fact that the melting points and NMR spectra of **3a**,**b** were found to be identical to those of compounds obtained earlier by the reaction of ethyl 1-amino-5-mercapto-1,2,3-thiadiazol-4-carboxylate with bromoacetophenones[6] also confirmed the structures of **3a**–**d**.

The rearrangement probably involves a Dimroth rearrangement and chlorination by thionyl chloride. The order in which these processes occur is not clear and will be the subject of a further study.



1 **2a–d** **3a–d** **4a–d**

a Ar = Ph **c** Ar = 4-MeC_6H_4
b Ar = 4-ClC_6H_4 **d** Ar = 3-$NO_2C_6H_4$

Scheme 1 *Reagents and condition*: i, $SnCl_2$, 1 M HCl, 3 h, room temperature; ii, ArCOMe, 1 M HCl, Et_4NCl, 10 h, room temperature; iii, $SOCl_2$, –80 °C, 30 min; iv, $SOCl_2$, room temperature, 2 h.

† The ^{1}H and ^{13}C NMR spectra were recorded in [$^2H_6$]DMSO solutions with a Bruker DRX-500 instrument (500 MHz for ^{1}H and 125 MHz for ^{13}C), and the IR spectra were recorded in KBr using a UR-20 spectrometer.

Synthesis of **2**. A suspension of *N*-nitrosoamine **1** (4 g, 0.02 mol) in 200 ml of 1 M HCl was treated with $SnCl_2$ (4.7 g, 0.025 mol) at 10–15 °C. After stirring for 3 h, the reaction mixture was filtered. To the filtrate 0.02 mol of a ketone and 0.1 g of Et_4NCl were added, and the mixture was stirred at room temperature for 12 h. The precipitate of **2** was filtered off and recrystallised from ethanol.

For **2a**: yield 62%, mp 120–122 °C. ^{1}H NMR, δ: 10.45 (s, 1H, NH), 7.79–7.83 (m, 2H, ArH), 7.44–7.48 (m, 3H, ArH), 4.44 (q, 2H, OCH_2, *J* 7.3 Hz), 2.42 (s, 3H, Me), 1.40 (t, 3H, Me, *J* 7.3 Hz).

For **2b**: yield 57%, mp 190–192 °C. ^{1}H NMR, δ: 10.47 (s, 1H, NH), 7.81 (d, 2H, ArH, *J* 8.85 Hz), 7.52 (d, 2H, ArH, *J* 8.85 Hz), 4.43 (q, 2H, OCH_2, *J* 7.0 Hz), 2.40 (s, 3H, Me), 1.40 (t, 3H, Me, *J* 7.3 Hz).

For **2c**: yield 65%, mp 144–146 °C. ^{1}H NMR, δ: 10.41 (s, 1H, NH), 7.70 (d, 2H, ArH, *J* 8.24 Hz), 7.27 (d, 2H, ArH, *J* 8.24 Hz), 4.43 (q, 2H, OCH_2, *J* 7.0 Hz), 2.38 (s, 3H, Me), 1.39 (t, 3H, Me, *J* 7.0 Hz).

For **2d**: yield 49%, mp 205–206 °C. ^{1}H NMR, δ: 10.6 (s, 1H, NH), 8.54–8.55 (m, 1H, ArH), 8.20–8.28 (m, 2H, ArH), 7.69–7.76 (m, 1H, ArH), 4.46 (q, 2H, OCH_2, *J* 7.3 Hz), 2.50 (s, 3H, Me), 1.44 (t, 3H, Me, *J* 7.3 Hz).

‡ *Synthesis of* **4**. A suspension of hydrazone **1** (0.02 mol) in 50 ml of $SOCl_2$ was stirred for 2 h at room temperature, and the excess of $SOCl_2$ was removed at a reduced pressure. The product was recrystallised from ethanol.

For **4a**: yield 45%, mp 150–152 °C. ^{1}H NMR, δ: 8.05–8.15 (m, 2H, ArH), 7.62–7.74 (m, 3H, ArH), 7.57 (1H, s, CHCl), 4.39 (q, 2H, OCH_2, *J* 7.3 Hz), 1.36 (t, 3H, Me, *J* 7.3 Hz). MS, *m*/*z*: 324 (9%, M + 2), 322 (20%, M^+).

For **4b**: yield 55%, mp 196–198 °C. ^{1}H NMR, δ: 8.14 (d, 2H, ArH, *J* 10.0 Hz), 7.65 (d, 2H, ArH, *J* 10 Hz), 7.50 (1H, s, CHCl), 4.41 (q, 2H, OCH_2, *J* 7.5 Hz), 1.42 (t, 3H, Me, *J* 7.5 Hz). ^{13}C NMR, δ: 159.9 (CO), 149.0 (C_{3a}), 139.7 (C_{ArCl}), 134.8 (C_3), 129.8 (C_{ArH}), 129.0 (C_{ArH}), 128.9 (C_{Ar}), 122.2 (C_6), 61.8 (OCH_2), 46.2 (C_5), 14.1 (Me). MS, *m*/*z*: 359 (3.5%, M + 2), 357 (8.3%, M^+).

For **4c**: yield 65%, mp 162–164 °C. ^{1}H NMR, δ: 8.03 (d, 2H, ArH, *J* 8.24 Hz), 7.44 (d, 2H, ArH, *J* 8.24 Hz), 7.46 (1H, s, CHCl), 4.40 (q, 2H, OCH_2, *J* 7.3 Hz), 1.42 (t, 3H, Me, *J* 7.3 Hz). MS, *m*/*z*: 338 (4.5%, M + 2), 336 (8.3%, M^+).

For **4d**: yield 48%, mp 215–216 °C. ^{1}H NMR, δ: 8.91–8.93 (m, 1H, ArH), 8.44–8.58 (m, 2H, ArH), 7.91–7.98 (m, 1H, ArH), 7.74 (s, 1H, CHCl), 4.44 (q, 2H, OCH_2, *J* 10.0 Hz), 1.43 (t, 3H, Me, *J* 10.0 Hz). MS, *m*/*z*: 369 (1.5%, M + 2), 367 (2.3%, M^+).

§ *Synthesis of* **3**. A suspension of hydrazone **1** (0.02 mol) in 50 ml of $SOCl_2$ was stirred at –80 °C for 30 min, and the excess of $SOCl_2$ was removed at a reduced pressure. The product was recrystallised from ethanol.

For **3a**: yield 35%, mp 183–185 °C (lit.,[6] 185 °C). ^{1}H NMR ($CDCl_3$) δ: 7.95–8.15 (m, 2H, ArH), 7.46–7.54 (m, 3H, ArH), 4.40 (q, 2H, OCH_2, *J* 7.0 Hz), 3.95 (s, 2H, CH_2), 1.45 (t, 3H, Me, *J* 7.0 Hz). MS, *m*/*z*: 288 (8%, M).

For **3b**: yield 23%, mp 215–216 °C (lit.,[6] 216 °C). ^{1}H NMR ($CDCl_3$) δ: 8.05 (d, 2H, ArH), 7.52 (d, 2H, ArH), 4.45 (q, 2H, OCH_2, *J* 7.3 Hz), 3.95 (s, 2H, CH_2), 1.40 (t, 3H, Me, *J* 7.3 Hz). MS, *m*/*z*: 324 (9%, M + 2), 322 (20%, M^+).

For **3c**: (mixture with **4c**) ^{1}H NMR, δ: 7.98 (d, 2H, ArH, *J* 7.9 Hz), 7.36 (d, 2H, ArH, *J* 7.9 Hz), 4.36 (q, 2H, OCH_2, *J* 7.3 Hz), 4.26 (s, 2H, CH_2), 2.26 (s, 3H, Me), 1.31 (t, 3H, Me, *J* 7.3 Hz). MS, *m*/*z*: 302 (19%, M).

For **3d**: (mixture with **4d**) ^{1}H NMR, δ: 8.87 (dd, 1H, ArH), 8.55 (dd, 1H, ArH), 8.47 (dd, 1H, ArH), 7.87 (dd, 1H, ArH), 4.37 (q, 2H, OCH_2, *J* 7.0 Hz), 4.41 (s, 2H, CH_2), 1.40 (t, 3H, Me, *J* 7.0 Hz). MS, *m*/*z*: 333 (10%, M).

Thus, we have found the first example of the ring transformation of 1,2,3-thiadiazole where four atoms of the side chain take part in the reaction to afford 5*H*-[1,2,3]triazolo[5,1-*b*]-[1,3,4]thiadiazine.

This work was supported by the Russian Foundation for Basic Research (grant no. 98-03-33045a).

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Received: 1st November 1999; Com. 99/1546