

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

Yury Yu. Morzherin,^a Tatiana V. Glukhareva,^a Irina N. Slepukhina,^a Vladimir S. Mokrushin,^a Alexey V. Tkachev^b and Vasilii A. Bakulev^{*a}

^a Department of Technology of Organic Synthesis, Urals State Technical University, 620002 Ekaterinburg, Russian Federation. Fax: +7 3432 745483; e-mail: morjerine@htf.ustu.ru

^b N. N. Vorozhtsov Novosibirsk Institute of Organic Chemistry, Siberian Branch of the Russian Academy of Sciences, 630090 Novosibirsk, Russian Federation. Fax: +7 3832 34 4752; e-mail: atkachev@nioch.nsc.ru

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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 **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 ¹H 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 bromoacetophenones⁶ 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.

[†] The ¹H and ¹³C NMR spectra were recorded in [2H₆]DMSO solutions with a Bruker DRX-500 instrument (500 MHz for ¹H and 125 MHz for ¹³C), and the IR spectra were recorded in KBr using a UR-20 spectrometer.

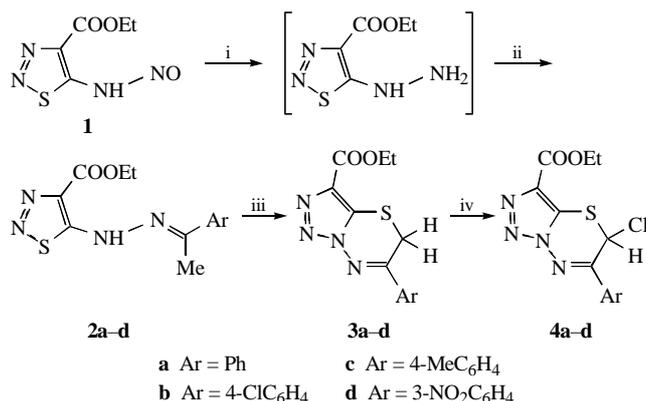
Synthesis of 2. A suspension of *N*-nitrosoamine **1** (4 g, 0.02 mol) in 200 ml of 1 M HCl was treated with SnCl₂ (4.7 g, 0.025 mol) at 10–15 °C. After stirring for 3 h, the reaction mixture was filtered. To the filtrate 0.02 mol of a ketone and 0.1 g of Et₄NCl were added, and the mixture was stirred 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. ¹H 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, OCH₂, *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. ¹H 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, OCH₂, *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. ¹H 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, OCH₂, *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. ¹H 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, OCH₂, *J* 7.3 Hz), 2.50 (s, 3H, Me), 1.44 (t, 3H, Me, *J* 7.3 Hz).



Scheme 1 Reagents and condition: i, SnCl₂, 1 M HCl, 3 h, room temperature; ii, ArCOMe, 1 M HCl, Et₄NCl, 10 h, room temperature; iii, SOCl₂, –80 °C, 30 min; iv, SOCl₂, room temperature, 2 h.

[‡] **Synthesis of 4.** A suspension of hydrazone **1** (0.02 mol) in 50 ml of SOCl₂ was stirred for 2 h at room temperature, and the excess of SOCl₂ was removed at a reduced pressure. The product was recrystallised from ethanol.

For **4a**: yield 45%, mp 150–152 °C. ¹H 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, OCH₂, *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. ¹H 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, OCH₂, *J* 7.5 Hz), 1.42 (t, 3H, Me, *J* 7.5 Hz). ¹³C NMR, δ : 159.9 (CO), 149.0 (C_{3a}), 139.7 (C_{ArCl}), 134.8 (C₃), 129.8 (C_{ArH}), 129.0 (C_{ArH}), 128.9 (C_{Ar}), 122.2 (C₆), 61.8 (OCH₂), 46.2 (C₅), 14.1 (Me). MS, *m/z*: 359 (3.5%, M + 2), 357 (8.3%, M⁺).

For **4c**: yield 65%, mp 162–164 °C. ¹H 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, OCH₂, *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. ¹H 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, OCH₂, *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 SOCl₂ was stirred at –80 °C for 30 min, and the excess of SOCl₂ was removed at a reduced pressure. The product was recrystallised from ethanol.

For **3a**: yield 35%, mp 183–185 °C (lit.⁶ 185 °C). ¹H NMR (CDCl₃) δ : 7.95–8.15 (m, 2H, ArH), 7.46–7.54 (m, 3H, ArH), 4.40 (q, 2H, OCH₂, *J* 7.0 Hz), 3.95 (s, 2H, CH₂), 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). ¹H NMR (CDCl₃) δ : 8.05 (d, 2H, ArH), 7.52 (d, 2H, ArH), 4.45 (q, 2H, OCH₂, *J* 7.3 Hz), 3.95 (s, 2H, CH₂), 1.40 (t, 3H, Me, *J* 7.3 Hz). MS, *m/z*: 324 (9%, M + 2), 322 (20%, M⁺).

For **3c**: (mixture with **4c**) ¹H NMR, δ : 7.98 (d, 2H, ArH, *J* 7.9 Hz), 7.36 (d, 2H, ArH, *J* 7.9 Hz), 4.36 (q, 2H, OCH₂, *J* 7.3 Hz), 4.26 (s, 2H, CH₂), 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**) ¹H 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, OCH₂, *J* 7.0 Hz), 4.41 (s, 2H, CH₂), 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.

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