Synthesis of 3-carbamoyl-1,2,4-triazoles

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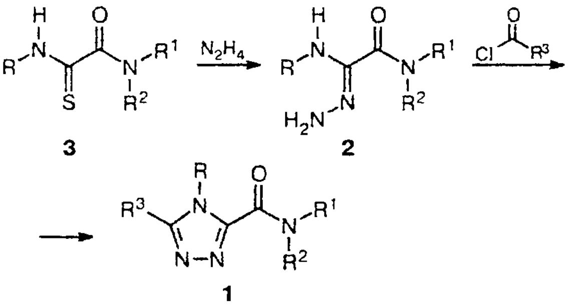
3-Carbamoyl-1,2,4-triazoles were synthesized by the reaction of monothiooxamides with acid hydrazides.

Key words: monothiooxamides, hydrazides, 3-carbamoyl-1,2,4-triazoles.

3-Carbamoyl-1,2,4-triazoles (**1**) are of considerable interest as herbicides[1,2] and anticonvulsants.[3]

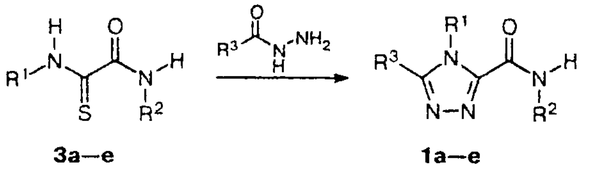
The known[4] method for the synthesis of such compounds is based on the cyclization of amidrazones (**2**) in the presence of acid chlorides. The corresponding amidrazones are prepared from monothiooxamides (**3**) and hydrazine (Scheme 1).

Scheme 1



We showed that 3-carbamoyl-1,2,4-triazoles (**1a—e**) can be obtained by the reaction of *N*(*O*)-aryl-*N*(*S*)-(het)arylthiooxamides with acid hydrazides (Scheme 2) in 70—90% yield.

Scheme 2



	a	b	c	d	e
R^1	Ph	2-Py	Ph	Ph	Ph
R^2	Ph	Ph	Ph	4-ClC_6H_4	3,4-$Cl_2C_6H_3$
R^3	Ph	Ph	4-$NO_2C_6H_4$	4-$NO_2C_6H_4$	Ph

The structures of the compounds synthesized were confirmed by data from ^{1}H NMR spectroscopy and mass spectrometry.

Thus, we proposed a one-step method for the synthesis of 3-carbamoyl-1,2,4-triazoles from monothiooxamides.

Experimental

IR spectra were recorded on a Specord IR-80 spectrophotometer (KBr). ^{1}H NMR spectra were recorded on Bruker WM-200 (200 MHz) and Bruker WM-250 instruments (250 MHz) in DMSO-d_6 with reference to HMDS. Mass spectra were recorded on a Varian MAT CH-6 instrument (direct inlet into the ion source, ionization energy 70 eV, accelerating voltage 1.75 kV). Melting points were measured on a Boetius hot stage and are uncorrected. All reaction mixtures were analyzed and the purity of the products isolated was checked by TLC on Silufol UV-254 plates in the EtOAc—hexane system (1 : 1, v/v).

The starting monothiooxamides **3a—e** were prepared according to the known procedure.[5]

4,5-Diphenyl-4*H*-1,2,4-triazole-3-carboxanilide (1a). A solution of monothiooxamide **3a** (0.15 g, 0.6 mmol) and benzohydrazide (0.23 g, 1.7 mmol) in 10 mL of pyridine was stirred at ~20 °C for 2 h and refluxed for 12 h. When the reaction was completed (TLC), the reaction mixture was poured into 50 mL of water. After 12 h, the precipitate that formed was filtered off and recrystallized from an ethanol—water mixture (1 : 1). Yield 0.18 g (90%), m.p. 147—150 °C. Found (%): C, 74.38; H, 4.87; N, 16.35. $C_{21}H_{16}N_4O$. Calculated (%): C, 74.10; H, 4.74; N, 16.46. ^{1}H NMR, δ: 7.10 (t, 2 H, H arom.); 7.15 (t, 1 H, H arom.); 7.30—7.40 (m, 4 H, H arom.); 7.60—7.70 (m, 4 H, H arom.); 7.85 (m, 2 H, H arom.); 8.10 (m, 2 H, H arom.); 11.50 (s, 1 H, NH). MS, *m/z*: 340 $[M]^+$.

Compounds **1b—e** were obtained analogously.

5-Phenyl-4-(2-pyridyl)-4*H*-1,2,4-triazole-3-carboxanilide (1b) was synthesized from monothiooxamide **3b** and benzohydrazide, yield 75%, m.p. 189—192 °C. Found (%): C, 70.58; H, 4.36; N, 20.79. $C_{20}H_{15}N_5O$. Calculated (%): C, 70.37; H, 4.43; N, 20.52. ^{1}H NMR, δ: 7.10—7.20 (m, 2 H, H arom.); 7.35—7.50 (m, 4 H, H arom.); 7.50—7.70 (m, 4 H, H arom.); 7.80—8.00 (m, 2 H, H arom.); 8.15 (m, 2 H, H arom.); 11.25 (s, 1 H, NH). MS, *m/z*: 341 $[M]^+$.

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5-(4-Nitrophenyl)-4-phenyl-4*H*-1,2,4-triazole-3-carboxanilide (1c) was obtained from monothiooxamide **3c** and 4-nitrobenzohydrazide, yield 85%, m.p. 263—265 °C. Found (%): C, 65.58; H, 4.12; N, 18.10. $C_{21}H_{15}N_5O_3$. Calculated (%): C, 65.45; H, 3.92; N, 18.17. ^{1}H NMR, δ: 7.10 (m, 2 H, H arom.); 7.35 (m, 2 H, H arom.); 7.50—7.80 (m, 8 H, H arom.); 8.15 (m, 2 H, H arom.); 10.35 (s, 1 H, NH). MS, *m/z*: 385 $[M]^+$.

***N*-(4-Chlorophenyl)-5-(4-nitrophenyl)-4-phenyl-4*H*-1,2,4-triazole-3-carboxamide (1d)** was synthesized from monothiooxamide **3d** and 4-nitrobenzohydrazide, yield 88%, m.p. 245—248 °C. Found (%): C, 60.12; H, 3.28; Cl, 9.00; N, 16.74. $C_{21}H_{14}ClN_5O_3$. Calculated (%): C, 60.08; H, 3.36; Cl, 8.44; N, 16.68. ^{1}H NMR, δ: 7.40 (m, 2 H, H arom.); 7.70 (m, 2 H, H arom.); 8.10 (m, 4 H, H arom.); 8.40 (m, 5 H, H arom.); 11.00 (s, 1 H, NH). MS, *m/z*: 419 $[M]^+$.

***N*-(3,4-Dichlorophenyl)-4,5-diphenyl-4*H*-1,2,4-triazole-3-carboxamide (1e)** was obtained from monothiooxamide 3e and benzohydrazide, yield 76%, m.p. 184—187 °C. Found (%): C, 61.56; H, 3.37; Cl, 17.41; N, 13.61. $C_{21}H_{14}Cl_2N_4O$. Calculated (%): C, 61.63; H, 3.45; Cl, 17.32; N, 13.69. ^{1}H NMR, δ: 7.25—7.75 (m, 8 H, H arom.); 8.90 (m, 3 H, H arom.); 8.10 (m, 2 H, H arom.); 8.20 (m, 4 H, H arom.); 10.60 (s, 1 H, NH). MS, *m/z*: 333 $[M - Ph]^+$.

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