Available online at www.sciencedirect.com
ScienceDirect
Tetrahedron 63 (2007) 3042–3048
Tetrahedron

A new synthetic method for the 2*H*-[1,2,3]thiadiazolo[5,4-*b*]indoles

Maria L. Kondratieva,[a] Anna V. Pepeleva,[a] Natalia P. Belskaia,[a,*] Alexandr V. Koksharov,[a] Paul V. Groundwater,[b] Koen Robeyns,[c] Luc Van Meervelt,[c] Wim Dehaen,[c] Zhi-Jin Fan[d] and Vasiliy A. Bakulev[a]

[a]*Department of Chemistry, Urals State Technical University, 620002 Ekaterinburg, Mira Str. 19, Russia*
[b]*University of Sunderland, Warncliffe Street, Sunderland SR1 3SD, UK*
[c]*Department of Chemistry, K.U. Leuven, Celestijnenlaan 200F, B-3001, Leuven, Belgium*
[d]*State Key Laboratory of Elemento-Organic Chemistry, Nankai University, Tianjin 300071, People's Republic of China*

Received 21 October 2006; revised 19 January 2007; accepted 25 January 2007
Available online 30 January 2007

Abstract—The systematic study of oxidative cyclization of 3-hydrazono-1,3-dihydroindole-2-thiones has been carried out and a series of new 2*H*-[1,2,3]thiadiazolo[5,4-*b*]indoles has been prepared. The elaborated reaction represents an efficient method for the synthesis of fused 1,2,3-thiadiazoles.

1. Introduction

Synthetic methods for preparation of 1,2,3-thiadiazoles annelated to other ring systems continue to attract considerable attention because of their importance in medicinal chemistry, and especially due to the fact that the first chemical plant activator was found to be a derivative of benzo-[1,2,3]-thiadiazole.[1–3] The known methods leading to fused 1,2,3-thiadiazoles include reactions of hydrazones of cyclic ketones with thionyl chloride (Hurd–Mori synthesis),[4] generation and concomitant cyclization of α-diazothiocarbonyl compounds (Wolff synthesis),[4,5] ring transformation of other sulfur-containing heterocyclic compounds and inter- and intramolecular cyclization of preformed 1,2,3-thiadiazoles.[4]

Previously, we reported that oxidative cyclization of 2-hydrazonothiocarbonyl compounds with halogens proceeded smoothly to afford corresponding monocyclic 1,2,3-thiadiazoles, namely, 2-aryl-2,5-dihydro-1,2,3-thiadiazol-5-imines.[6] We decided to extend this method to prepare 1,2,3-thiadiazole fused with heterocycle system. A convenient heterocycle model for this type of investigation is indole as the starting 3-hydrazono-1,3-dihydro-indol-2-ones are readily available and due to the interesting biological property of indoles.[7–9]

It should be noted that only two derivatives of 4*H*-[1,2,3]thiadiazolo[5,4-*b*]indole are known and they were prepared by diazo group transfer with tosyl azide in indole-2-thiones.[9] But this method has not found wider application because of the formation of a by-product—bi-indoline-2,2′-thione, taking a different course of reaction and because of a rather moderate yield of the parent compounds.

Indeed, the purpose of our work was synthesis of the 3-hydrazono-2,3-dihydroindolthiones and investigation of their oxidative cyclization leading to 1,2,3-thiadiazoloindoles.

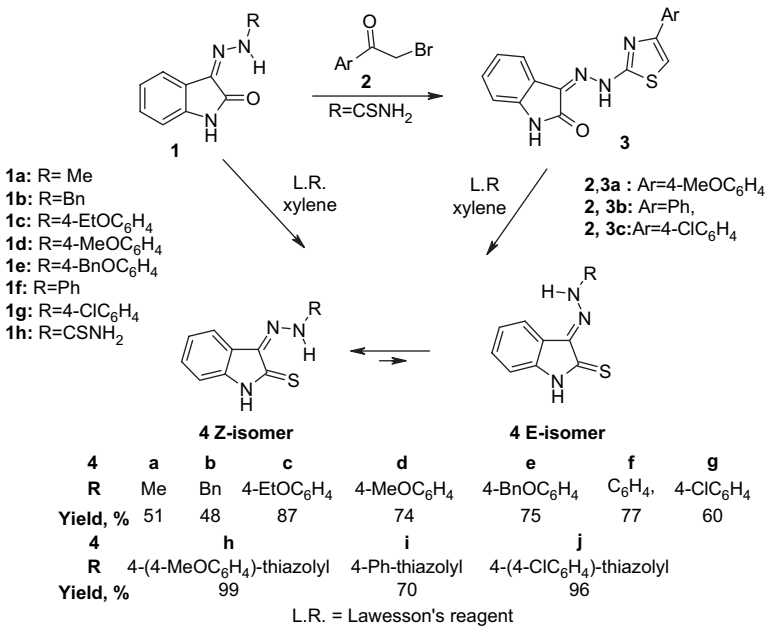
2. Results and discussion

The starting hydrazones **1a–g** were prepared either by condensation of isatin with hydrazines[10,11] or azocoupling of aryldiazonium salts with indole-2-one.[12] 3-[(Thiazol-2-yl)-hydrazono]-1,3-dihydroindole-2-ones **3a–c** were prepared by reacting thiosemicarbazone **2g** with bromoacetophenones **2a–c** in ethanol in 90% yield (Scheme 1).

Transformation of the amide group into thioamide function was carried out by reacting indoles **1a–f** and **3a–c** with Lawesson's reagent in boiling xylene (Scheme 1). ^{1}H NMR spectra of isatin hydrazones **1**,**3** and corresponding thiones **4a–j** show that they exist predominantly as the *Z* (cis) conformation in DMSO-d_6 solution, presumably due to intramolecular hydrogen bond between the NH of the hydrazone moiety and the carbonyl (or thiocarbonyl) group of the indolinone. It should be noted that in some analogues where a heteroatom (O or N)-containing functionality was substituted at the 4-position of the oxoindole, allowing formation of the

Keywords: Thioamide; Indole; 1,2,3-Thiadiazole; Hydrazone; Oxidative cyclization; 1,2,3-Thiadiazolo[5,4-*b*]indoles.
* Corresponding author. E-mail: belska@htf.ustu.ru

0040–4020/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.tet.2007.01.059



Scheme 1.

alternative hydrogen bond with NH function in *E* (trans) conformation, ^{1}H NMR spectra revealed the mixture of *Z* and *E* isomers.[11]

Of particular significance is the low field resonance for the NH proton of the hydrazone group (at δ 2.5 ppm) in arylhydrazono-1,3-dihydroindole-2-thiones **4** in comparison with the parent hydrazones **1**,**3**. The substituent in the aryl group has the strongest effect on the NH-resonance of the hydrazone fragment and less on the NH-resonance of the indole. Electron-withdrawing groups lead to significant deshielding of the former signal (to 2.09 ppm) and less deshielding of the latter one (to 0.5 ppm). The same influence was observed in the ^{13}C spectra for the signals of the thiocarbonyl and C^3 indole atoms. Electron-withdrawing groups increase the polarization of the thiocarbonyl and C^3 atom, thereby causing deshielding of the carbon atom (CS for 2.5 ppm, C^3 for 1.3 ppm).

The X-ray analysis (Fig. 1) of compound **4a** confirms that the hydrazono-1,3-dihydroindole-2-thiones adopt the *Z* (cis) conformation. The weak hydrogen bond between the sulfur atom and the NH proton of the hydrazone group (NH···S) practically forms a third six-membered ring, in the same plane as the indole group (d(NH)=0.86 Å, d(H···S)=2.37 Å, ang(NH···S)=140.6°).

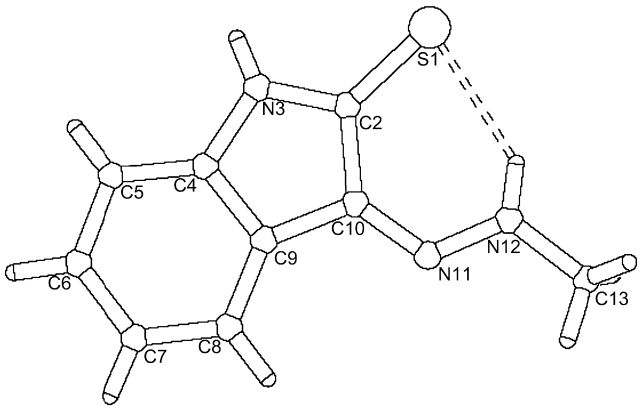


Figure 1. X-ray crystal structure of **4a**.

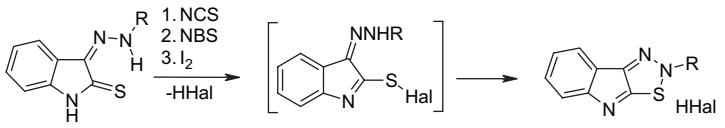
Thus, a series of 3-hydrazono-1,3-dihydroindole-2-thiones **4a**–**j**, containing alkyl-, aryl- and heteroarylhydrazono groups were successfully prepared. It should be noted that conformation of *Z*-isomer is more suitable for the following interaction between sulfur atom and NH-hydrazone fragment.

We have investigated the following protocols for oxidative cyclization of hydrazonothiocarbonyl compounds **4a**–**j**: (a) bromine in acetic acid, (b) *N*-chlorosuccinimides in ethyl acetate at 0–5 °C, (c) iodine in ethanol. One can conclude from the experimental data that the oxidation with bromine in acetic acid (a) and with *N*-chlorosuccinimide (b) are the methods of choice (Scheme 2).

Based on what is known on the formation of corresponding monocyclic 1,2,3-thiadiazoles[6] we propose that the mechanism of the reaction leading to thiadiazoloindoles **5** involves the formation of intermediate adduct **A** followed by cyclization with the participation of a nitrogen atom of the hydrazono group to give the final products **5** (Scheme 2).

In a similar way to the monocyclic 1,2,3-thiadiazol-5-imines, **5** are unstable and therefore they were characterized as their salts with hydrogen halides.

In contrast to the starting thioamides **4**, NMR spectra of **5** do not contain proton signals of hydrazone. The signals of the aromatic protons are shifted downfield by about 0.5 ppm. Moreover, the proton signals by the methyl and benzyl groups in compounds **5a**,**g**,**h**,**n**, are also shifted downfield by 0.5–1 ppm. These signals are displayed as doublets in



4 a-n **A** **5 a-n**

5	a	b	c	d	e	f
HHal	HCl	HCl	HCl	HCl	HCl	HCl
R	Me	4-$EtOC_6H_4$	4-$BnOC_6H_4$	4-ClC_6H_4	4-(4-$MeOC_6H_4$)-thiazolyl	4-(4-ClC_6H_4)-thiazolyl
Yield, %	85	60	69	51	42	33

5	g	h	i	j	k	l	m	n
HHal	HBr	HBr	HBr	HBr	HBr	HBr	HI	HI
R	Me	Bn	4-$EtOC_6H_4$	4-$MeOC_6H_4$	Ph	4-Ph-thiazolyl	Me	Ph
Yield, %	93	60	60	57	99	86	55	57

Scheme 2.

the thioamides **4** and as singlets in thiadiazoles **5**. The ^{13}C NMR spectra show that annelation of the thiadiazole ring to the indole leads to a downfield shift of the C-2 and C-3 indole signals by 30–40 ppm. It is remarkable that almost all signals of thiadiazoloindoles **5** are downfield shifted by 2–5 ppm in comparison with those for the starting 3-arylhydrazono-1,3-dihydroindole-2-thiones **4**. Most significantly, the signals corresponding to the carbons at 2 and 4 positions are shifted by 17–18 ppm and by 8–10 ppm, respectively. It is worth noting that signals of C-2 are displayed as doublets with J=2.3–3.2 Hz for starting hydrazonothioamides **4** and as singlets for thiadiazoloindoles **5**.

The mass spectra of 1,2,3-thiadiazoles **5a**–**n** show the molecular ion in 10–100% intensity of the base peak. The fragmentation is very similar to that observed for 2-aryl-2,5-dihydro-[1,2,3]-thiadiazoles.[3] The most typical for the mass spectra of **5** are the peaks corresponding to $[M-C_6H_4N_2S]^+$ (3–100%) and $[M-C_8H_4N_2]^+$ (17–84%). In contrast to monocyclic 1,2,3-thiadiazoles, mass spectra of compounds **5** do not have the peak corresponding to $[M-S]^+$.

3. Conclusion

This successful synthesis of 2*H*-[1,2,3]thiadiazolo[5,4-*b*]-indoles demonstrated that oxidative cyclization of hydrazonothiocarbonyl compounds is a feasible method for the synthesis of fused 1,2,3-thiadiazoles. This protocol can be used for the synthesis of thiadiazoloindoles involving other derivatives of isatin and by involving other ring systems bearing an α-hydrazonothiocarbonyl fragment.

4. Experimental

4.1. General methods

Melting points are uncorrected. The IR data (potassium bromide) were obtained using UR-20 spectrometer. ^1H NMR spectra were recorded on 400 MHz for ^1H and 100 MHz for ^{13}C. Chemical shifts and coupling constants are expressed in parts per million (δ) and J (Hz) with respect to tetramethylsilane. The mass spectra were obtained using a Varian MATT 311A spectrometer using the electron impact ionization technique (40–200 °C, 70 eV). Reactions were monitored by TLC, which was performed on Sorbfil UV-254.

The hydrazones **1a**–**h** were prepared by a standard procedure[12] through coupling of diazotized arylamines with oxoindole or condensation of hydrazines with isatin.[11]

4.1.1. 3-{[4-(4-Methoxyphenyl)-thiazol-2-yl]-hydrazono}-1,3-dihydroindol-2-one (3a). A solution of the 2-bromoacetophenone **2a** (320 mg, 1.4 mmol) and thiosemicarbazide **1h** (308 mg, 1.4 mmol) in 50 mL ethanol was heated at reflux for 5 h. After cooling, the precipitated solid was collected. Recrystallization from ethanol afforded 436 mg, 89% **3a** as orange crystals. Mp 269–270 °C. IR ν: 3440, 3060, 3020 (NH), 2990, 2960, 2940, 2900, 2820 (CH), 1680 (CO) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 13.34 (s, 1H, NH), 11.25 (s, 1H, NH), 7.83 (d, J=8.8 Hz, 1H, Ar-H), 7.55 (d, J=7.5 Hz, 1H, Ar-H), 7.46 (s, 1H, CH), 7.35 (ddd, J=7.7, 7.5, 1.2 Hz, 1H, Ar-H), 7.10 (ddd, J=7.6, 7.8, 0.9 Hz, 1H, Ar-H), 7.0–6.96 (m, 3H, Ar-H), 3.8 (s, 3H, OCH_3). MS m/z (I, %): 350 (M^+, 100%). Anal. Calcd for $C_{18}H_{14}N_4O_2S$: C, 61.70, H, 4.03, N, 15.99%. Found: C, 61.44, H, 3.81, N, 16.30%.

4.1.2. 3-[(4-Phenylthiazol-2-yl)-hydrazono]-1,3-dihydroindol-2-one (3b). According to the preparation of **3a**, compound **3b** was obtained from 2-bromoacetophenone **2b** (279 mg, 1.4 mmol) and thiosemicarbazide **1h** (308 mg, 1.4 mmol) as yellow needles. Yield: 421 mg, 94%. Mp 169–170 °C. IR ν: 3440, 3190, 3060, 3020 (NH), 2810 (CH), 1695 (CO) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 13.37 (s, 1H, NH), 11.26 (s, 1H, NH), 7.92 (d, J=9.0 Hz, 2H, Ar-H), 7.64 (s, 1H, CH), 7.56 (d, J=7.6 Hz, 1H, Ar-H), 7.46–7.42 (m, 2H, Ar-H), 7.38–7.32 (m, 2H, Ar-H). MS m/z (I, %): 320 (M^+, 100%). Anal. Calcd for $C_{17}H_{12}N_4OS$: C, 63.73, H, 3.78, N, 17.49%. Found: C, 63.54, H, 3.94, N, 17.70%.

4.1.3. 3-{[4-(4-Chlorophenyl)-thiazol-2-yl]-hydrazono}-1,3-dihydroindol-2-one (3c). According to the preparation of **3a**, compound **3c** was obtained from 2-bromoacetophenone **2c** (326 mg, 1.4 mmol) and thiosemicarbazide **1h** (308 mg, 1.4 mmol) as yellow crystals. Yield: 475 mg, 96%. Mp 289–290 °C. IR ν: 3500, 3260, 3180, 3140, 3120 (NH), 3070, 2820 (CH), 1700 (CO) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 13.35 (s, 1H, NH), 11.26 (s, 1H, NH), 7.93 and 7.48 (AA′BB′, J=8.6 Hz, 4H, Ar-H), 7.7 (s,

1H, CH), 7.54 (d, J=7.5 Hz, 1H, Ar-H), 7.34 (dd, J=7.7, 7.6 Hz, 1H, Ar-H), 7.1 (dd, J=7.7, 7.6 Hz, 1H, Ar-H), 6.97 (d, J=7.8 Hz, 1H, Ar-H). MS m/z (I, %): 354 (M^+, 100%). Anal. Calcd for $C_{17}H_{11}ClN_4OS$: C, 57.55, H, 3.12, Cl, 9.99, N, 15.79%. Found: C, 57.76, H, 3.33, Cl, 10.37, N, 15.51%.

4.2. General procedure (GP) for the synthesis of the 3-hydrazono-1,3-dihydroindole-2-thiones 4a–j

A mixture of 3-hydrazono-1,3-dihydroindol-2-one **1a–g**, **3a–c** (2 mmol) and Lawesson's reagent (570 mg, 1.4 mmol) was heated at reflux in xylenes (50 mL) for 1–3 h. The solution was evaporated and the thiones **4** were recrystallized from ethanol.

4.2.1. 3-(Methylhydrazono)-1,3-dihydroindole-2-thione (4a). According to the GP **4a** was obtained as bright yellow crystals. Yield: 194 mg, 51%. Mp 127–128 °C. IR ν: 3450, 3260, 3180 (NH), 2920, 2840 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 13.81 (q, J=4.1 Hz, 1H, NH), 12.43 (s, 1H, NH), 7.49 (d, J=7.6 Hz, 1H, Ar-H), 7.21 (dd, J=8.0, 7.6 Hz, 1H, Ar-H), 7.10 (dd, J=8.0, 7.6 Hz, 1H, Ar-H), 7.06 (d, J=8.0 Hz, 1H, Ar-H), 3.47 (d, J=4.1 Hz, 3H, $NHCH_3$). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 172.0 (d, J=3.1 Hz, C-2,), 139.3 (m, C-3), 129.0 (m, C-9), 125.9 (dd, J=160.4, 7.8 Hz, HC-Indole), 125.1 (m, C-4), 122.3 (dd, J=159.7, 7.1 Hz, HC-Indole), 116.9 (dd, J=160.1, 9.2 Hz, HC-Indole), 110.1 (dd, J=162.3, 9.2 Hz, HC-Indole), 40.2 (q, J=143.4 Hz, CH_3). MS m/z (I, %): 191 (M^+, 100%). Anal. Calcd for $C_9H_9N_3S$: C, 56.52, H, 4.74, N, 21.97, S, 16.75%. Found: C, 56.74, H, 4.61, N, 22.17, S, 16.75%.

4.2.1.1. X-ray structure analysis. Crystal data: $C_9H_9N_3S_1$ was crystallized from ethanol. Crystal dimensions 0.16×0.20×0.50 mm, monoclinic, $P2_1/n$, a=9.04880(10) Å, b=10.82860(10) Å, c=9.12250(10) Å, β=91.9490(10)°, V=893.36(2) $Å^3$; Z=4, ρ_{calcd} =1.422 g cm^{-3}, $2\theta_{max}$=142°, μ(Cu Kα)=2.823 cm^{-1}, Bruker SMART 6000 detector, Cu Kα (λ=1.54178 Å), crossed Göbel mirrors, T=100 K, 9077 measured reflections, 1675 independent reflections. The data were corrected for Lorentz absorption and polarization effects. Structure was solved by direct methods. Full matrix least-squares refinement based on $|F^2|$, 127 parameters, hydrogen atoms placed at calculated positions with temperature factors 20% higher than parent atom and the hydrogen bond distances were free to refine, R_1=0.0300 (for 1639 with $I>2\sigma(I)$), ωR_2=0.0823, max/min residual electron density 0.26/−0.28 e$Å^{-3}$.

Crystallographic data (excluding structure factors) for the structure reported in this paper have been deposited with the Cambridge Crystallographic Data Centre as supplementary publication no. CCDC-616795. Copies of the data can be obtained free of charge on application to CCDC, 12 Union Road, Cambridge CB2 1EZ, UK (fax: +44(0) 1223 336033 or e-mail: deposit@ccdc.cam.ac.uk).

4.2.2. 3-(Benzylhydrazono)-1,3-dihydroindole-2-thione (4b). Compound **4b** was obtained as orange crystals. Yield: 160 mg, 48%. Mp 84–85 °C. ^1H NMR (DMSO-d_6, 400 MHz) δ: 14.4 (t, J=4.0 Hz, 1H, NH), 12.31 (s, 1H, NH), 7.51 (d, J=7.6 Hz, 1H, Ar-H), 7.05–7.5 (m, 8H, Ar-H), 4.89 (d, J=4.0 Hz, 2H, CH_2). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 172.7 (d, J=2.6 Hz, C-2), 139.6 (dd, C-3), 137.3 (m, C-Ar), 129.5 (m, C-3), 128.7 (dd, J=162.0, 8.3 Hz, 2CH, HC-Ar), 127.8 (d, J=162.0 Hz, 2C, HC-Ar), 127.7 (d, J=162.0 Hz, HC-Ar), 126.4 (d, J=161.7 Hz, HC-Indole), 125.1 (m, C-4), 122.4 (dd, J=159.5, 7.1 Hz, HC-Indole), 117.2 (dd, J=160.3, 8.2 Hz, HC-Indole), 110.2 (dd, J=162.8, 8.1 Hz, HC-Indole), 55.6 (q, J=136.4 Hz, CH_2). MS m/z (I, %): 267 (M^+, 29%). Anal. Calcd for $C_{15}H_{13}N_3S$: C, 67.39, H, 4.90, N, 15.72, S, 11.99. Found: C, 67.64, H, 5.11, N, 15.57, S, 11.99%.

4.2.3. 3-[(4-Ethoxyphenyl)-hydrazono]-1,3-dihydroindole-2-thione (4c). According to the GP **4c** was obtained as brown crystals. Yield: 517 mg, 87%. Mp 174–175 °C. IR ν: 3450, 3200 (NH), 2910 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 12.68 (s, 1H, NH), 11.3 (s, 1H, NH), 7.68 (d, J=7.6 Hz, 1H, Ar-H), 7.49 and 7.02 (AA′BB′, J=8.8 Hz, 4H, Ar-H), 7.28 (dd, J=7.6, 7.5 Hz, 1H, Ar-H), 7.17 (dd, J=7.6, 7.5 Hz, 1H, Ar-H), 7.11 (d, J=7.8 Hz, 1H, Ar-H), 4.04 (q, J=6.9 Hz, 2H, OCH_2), 1.34 (t, J=6.9 Hz, 3H, CH_3). MS m/z (I, %): 297 (M^+, 100%). Anal. Calcd for $C_{16}H_{15}N_3OS$: C, 64.62, H, 5.08, N, 14.13, S, 10.78%. Found: C, 64.89, H, 5.17, N, 14.54, S, 10.55%.

4.2.4. 3-[(4-Methoxyphenyl)-hydrazono]-1,3-dihydroindole-2-thione (4d). According to the GP **4d** was obtained as red-brown crystals. Yield: 419 mg, 74%. Mp 189–190 °C. IR ν: 3200, 3190 (NH), 2920, 2960 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 15.81 (s, 1H, NH), 12.7 (s, 1H, NH), 7.68 (d, 1H, J=7.6 Hz, Ar-H), 7.5 and 7.04 (AA′BB′, 4H, J=9 Hz, Ar-H), 7.29 (dd, 1H, J=7.6, 7.2 Hz, Ar-H), 7.18 (dd, 1H, J=7.6, 7.2 Hz, Ar-H), 7.11 (d, 1H, J=7.6 Hz, Ar-H), 3.80 (s, 3H, OCH_3). MS m/z (I, %): 283 (M^+, 100%). Anal. Calcd for $C_{15}H_{13}N_3S$: C, 63.58, H, 4.62, N, 14.83, S, 11.32%. Found: C, 63.74, H, 4.75, N, 14.65, S, 11.63%.

4.2.5. 3-[(4-Benzyloxyphenyl)-hydrazono]-1,3-dihydroindole-2-thione (4e). According to the GP **4e** was obtained as red-brown needles. Yield: 531 mg, 74%. Mp 188–189 °C. IR ν: 3440, 3190 (NH), 3060, 3020, 2920 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 15.77 (s, 1H, NH), 12.48 (s, 1H, NH), 7.64–6.95 (m, 13H, Ar-H), 5.1 (s, 2H, CH_2). MS m/z (I, %): 359 (M^+, 37%). Anal. Calcd for $C_{21}H_{17}N_3OS$: C, 70.17, H, 4.77, N, 11.69, S, 8.92%. Found: C, 70.35, H, 4.86, N, 11.52, S, 8.77%.

4.2.6. 3-(Phenylhydrazono)-1,3-dihydroindole-2-thione (4f). According to the GP **4f** was obtained as red-brown crystals. Yield: 390 mg, 77%. Mp 219–220 °C. IR ν: 3440, 3170 (NH), 2920 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 15.67 (s, 1H, NH), 12.81 (s, 1H, NH), 7.71 (d, J=7.6 Hz, 1H, Ar-H), 7.49–7.35 (m, 4H, Ar-H), 7.27–7.21 (m, 1H, Ar-H), 7.20–7.14 (m, 3H, Ar-H). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 174.5 (d, J=3.2 Hz, C-2), 141.6 (m, C-Ar), 140.6 (m, C-3), 130.7 (m, C-9), 129.8 (dd, J=160.0, 8.3 Hz, 2C, C-Ar), 127.7 (dd, J=160.7, 8.0 Hz, HC-Indole), 124.7 (dt, J=162.9, 6.9 Hz, HC-Ar), 124.5 (m, C-4), 122.9 (dd, J=160.7, 7.2 Hz, HC-Indole), 118.4 (dd, J=161.1, 8.0 Hz, HC-Indole), 115.7 (2C, d, J=160.6 Hz, HC-Ar), 110.6 (dd, J=163.5, 8.2 Hz, HC-Indole). MS m/z (I, %): 253 (M^+, 100%). Anal. Calcd for $C_{14}H_{11}N_3S$: C, 66.38, H,

4.38, N, 16.59, S, 12.66%. Found: C, 66.54, H, 4.21, N, 16.40, S, 12.85%.

4.2.7. 3-[(4-Chlorophenyl)-hydrazono]-1,3-dihydroindole-2-thione (4g). According to the GP **4g** was obtained as orange crystals. Yield: 344 mg, 60%. Mp 259–260 °C. IR ν: 3400, 3190, 3100, 2970 (NH), 2920, 2840 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 15.61 (s, 1H, NH), 12.61 (s, 1H, NH), 7.64 (d, 1H, J=7.6 Hz, Ar-H), 7.47 and 7.3 (AA′BB′, J=8.5 Hz, 4H, Ar-H), 7.27–7.21 (m, 1H, Ar-H), 7.15–7.04 (m, 2H, Ar-H). MS m/z (I, %): 287 (M^+, 100%). Anal. Calcd for $C_{14}H_{10}ClN_3S$: C, 58.43, H, 3.50, Cl, 12.32, N, 14.60, S, 11.14%. Found: C, 58.64, H, 3.78, Cl, 12.17, N, 14.69, S, 11.35%.

4.2.8. 3-{[4-(4-Methoxyphenyl)-thiazol-2-yl]-hydrazono}-1,3-dihydroindole-2-thione (4h). According to the GP **4h** was obtained as red-brown crystals. Yield: 725 mg, 99%. Mp 229–230 °C. IR ν: 3450, 3200, 3100 (NH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 15.89 (s, 1H, NH), 12.9 (s, 1H, NH), 7.8 and 6.91 (AA′BB′, J=8.8 Hz, 4H, Ar-H), 7.65–7.6 (m, 1H, Ar-H), 7.35 (s, 1H, HC-Thiazole), 7.3 (d, J=7.6 Hz, 1H, Ar-H), 7.18–7.08 (2H, m, Ar-H), 3.83 (3H, s, OCH_3). MS m/z (I, %): 366 (M^+, 63%). Anal. Calcd for $C_{18}H_{14}N_4OS_2$: C, 59.00, H, 3.85, N, 15.29, S, 17.50%. Found: C, 59.24, H, 3.97, N, 15.40, S, 17.75%.

4.2.9. 3-[(4-Phenylthiazol-2-yl)-hydrazono]-1,3-dihydroindole-2-thione (4i). According to the GP **4i** was obtained as red-brown crystals. Yield: 470 mg, 70%. Mp 119–120 °C. IR ν: 3440, 3200, 3100, 3090 (NH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 15.9 (s, 1H, NH), 12.91 (s, 1H, NH), 7.89 (d, J=7.3 Hz, 2H, Ar-H), 7.63 (d, J=7.3 Hz, 1H, Ar-H), 7.52 (s, 1H, HC-Thiazole), 7.42–7.22 (m, 4H, Ar-H), 7.19–7.08 (m, 2H, Ar-H). MS m/z (I, %): 336 (M^+, 100%). Anal. Calcd for $C_{17}H_{12}N_4S_2$: C, 60.69, H, 3.60, N, 16.65, S, 19.06%. Found: C, 60.43, H, 3.41, N, 16.31, S, 18.85%.

4.2.10. 3-{[4-(4-Chlorophenyl)-thiazol-2-yl]-hydrazono}-1,3-dihydroindole-2-thione (4j). According to the GP **4j** was obtained as red-brown crystals. Yield: 710 mg, 96%. Mp 264–265 °C. IR ν: 3400, 3200, 3100 (NH), 2920 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 15.89 (s, 1H, NH), 12.93 (s, 1H, NH), 7.91 and 7.39 (AA′BB′, J=8.5 Hz, 4H, Ar-H), 7.63 (d, J=7.5 Hz, 1H, Ar-H), 7.61 (s, 1H, HC-Thiazole), 7.3 (d, J=7.5 Hz, 1H, Ar-H), 7.19–7.09 (m, 2H, Ar-H). MS m/z (I, %): 370 (M^+, 100%). Anal. Calcd for $C_{17}H_{11}ClN_4S_2$: C, 55.05, H, 2.99, Cl, 9.56, N, 15.11, S, 17.29%. Found: C, 55.34, H, 3.16, Cl, 9.35, N, 15.34, S, 17.45%.

4.3. Procedure for oxidation of 3-hydrazono-1,3-dihydroindole-2-thiones 4a–j

4.3.1. Method A. NCS or NBS (0.6 mmol) was added to a solution of 3-hydrazono-1,3-dihydroindole-2-thione **4** (0.3 mmol) in 50 mL EtOAc and the reaction mixture was stirred at 0 °C for 2 h. The precipitate was filtered off.

4.3.1.1. Hydrochloride of 2-methyl-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5a). According to the Method A **5a** was obtained as a greenish solid. Yield: 58 mg, 85%. Mp 215–217 °C. IR ν: 3450, 3180 (NH), 3060, 3020, 2980, 2920 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 8.2 (d, J=7.6 Hz, 1H, Ar-H), 7.93 (d, J=8.0 Hz, 1H, Ar-H), 7.64 (ddd, J=7.2, 7.2, 1.2 Hz, 1H, Ar-H), 7.46 (dd, J=8.0, 7.2 Hz, 1H, Ar-H), 4.05 (s, 3H, NCH_3). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 154.2 (s, C-2), 143.8 (dd, J=10.5, 8.1 Hz, C-3), 142.3 (dd, J=2.3, 1.1 Hz, C-9), 127.9 (dd, J=161.3, 7.5 Hz, HC-Indole), 122.9 (dd, J=162.2, 7.8 Hz, HC-Indole), 120.2 (dd, J=163.9, 7.3 Hz, HC-Indole), 117.2 (dd, J=8.9, 5.6 Hz, C-4), 114.6 (dd, J=165.8, 8.0 Hz, HC-Indole), 43.2 (q, J=143.4 Hz, NCH_3). MS m/z (I, %): 189 (M^+−HCl, 100%), 160 ($C_8H_4N_2S$, 32), 102 (C_7H_4N, 31), 61 (CH_3NS, 20). Anal. Calcd for $C_9H_8ClN_3S$: C, 47.90, H, 3.54, Cl, 15.74, N, 18.62, S 14.19%. Found: C, 47.75, H, 3.66, Cl, 16.13, N, 18.37%.

4.3.1.2. Hydrochloride of 2-(4-ethoxyphenyl)-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5b). According to the Method A **5b** was obtained as an orange solid. Yield: 60 mg, 60%. Mp 219–220 °C. IR ν: 3440 (NH), 3200, 2960 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) δ: 12.53 (s, 1H, NH), 8.13 (d, J=7.6 Hz, 1H, Ar-H), 7.99 (d, J=8.2 Hz, 1H, Ar-H), 7.81 and 7.01 (AA′BB′, J=8.9 Hz, 4H, Ar-H), 7.56 (dd, J=8.0, 7.6 Hz, 1H, Ar-H), 7.41 (dd, J=8.0, 7.2 Hz, 1H, Ar-H), 4.1 (q, J=7.2 Hz, 2H, CH_2), 1.42 (t, J=6.9 Hz, 3H, CH_3). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 160.4 (m, C-Ar_{para}), 155.6 (s, C-2), 144.7 (C-3), 143.7 (C-9), 134.6 (C-Ar_{ipso}), 129.2 (HC-Indole), 124.2 (HC-Indole), 123.9 (2C, HC-Ar_{ortho}), 121.5 (HC-Indole), 118.6 (C-4), 116.6 (2C, C-Ar_{meta}), 115.6 (HC-Indole), 64.6 (CH_2), 15.4 (CH_3). MS m/z (I, %): 295 (M^+−HCl, 37%), 167 ($EtOC_6H_5NS$, 18), 160 ($C_8H_4N_2S$, 6), 135 ($EtOC_6H_5N$, 72), 102 (C_7H_4N, 10), ($C_{10}H_8N_2OS_2$, 22), 204 ($C_{10}H_8N_2OS$, 56), 160 ($C_8H_4N_2S$, 86), 102 (C_7H_4N, 2). Anal. Calcd for $C_{16}H_{14}ClN_3OS$: C, 57.91, H, 4.22, Cl, 10.71, N, 12.66, S, 9.65%. Found: C, 58.26, H, 4.17, Cl, 10.49, N, 12.96, S, 9.95%.

4.3.1.3. Hydrochloride of 2-(4-benzyloxyphenyl)-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5c). According to the Method A **5c** was obtained as an orange solid. Yield: 81 mg, 69%. Mp 227–228 °C. ^1H NMR (DMSO-d_6, 400 MHz) δ: 12.57 (br s, 1H, NH), 8.14 (d, J=7.5 Hz, 1H, Ar-H), 7.98 (d, J=8.3 Hz, 1H, Ar-H), 7.86 and 7.07 (AA′BB′, J=9.2 Hz, 4H, Ar-H), 7.57 (dd, J=7.8, 7.7 Hz, 1H, Ar-H), 7.51–7.21 (m, 6H, Ar-H), 5.2 (s, 2H, OCH_2). MS m/z (I, %): 357 (M^+, 9%), 102 (C_7H_4N, 4), 91 ($C_6H_5CH_2$, 100). Anal. Calcd for $C_{21}H_{16}ClN_3OS$: C, 64.00, H, 4.07, Cl, 9.02, N, 10.67, S, 8.13%. Found: C, 64.30, H, 3.83, Cl, 9.39, N, 11.01, S, 8.31%.

4.3.1.4. Hydrochloride of 2-(4-chlorophenyl)-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5d). According to the Method A **5d** was obtained as an orange solid. Yield: 50 mg, 51%. Mp 282–283 °C. ^1H NMR (DMSO-d_6, 400 MHz) δ: 8.12 (d, J=7.6 Hz, 1H, Ar-H), 8.0–7.8 (m, 3H, Ar-H), 7.4–7.7 (m, 3H, Ar-H), 7.59 (dd, J=7.6, 7.4 Hz, 1H, Ar-H). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 157.7 (s, C-2), 145.3 (C-3), 143.8 (s, C-9), 140.8 (C-Ar_{ipso}), 134.8 (C-Ar_{para}), 131.0 (dd, J=168.0, 5.6 Hz, 2C, C-Ar_{meta}), 129.4 (dd, J=160.8, 8.0 Hz, HC-Indole), 124.3 (dd, J=162.5, 7.4 Hz, HC-Indole), 123.1 (dd, J=165.5, 5.6 Hz, 2C, HC-Ar_{ortho}), 121.6 (dd, J=163.4, 8.6 Hz, HC-Indole), 119.2 (dd, C-4), 115.5 (dd, J=166.7, 7.6 Hz, HC-Indole). MS m/z (I, %):

285.5 (M^+−HCl, 8%), 160 ($C_8H_4N_2S$, 8), 157.5 (ClC_6H_4NS, 72), 125.5 (ClC_6H_4N, 100), 102 (C_7H_4N, 2). Anal. Calcd for $C_{14}H_9Cl_2N_3S$: C, 52.17, H, 2.80, Cl, 22.05, N, 13.04, S, 9.94%. Found: C, 52.30, H, 2.58, Cl, 22.35, N, 12.78, S, 9.60%.

4.3.1.5. Hydrochloride of 2-[4-(4-methoxyphenyl)-thiazol-2-yl]-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5e). According to the Method A **5e** was obtained as a dark-red solid. Yield: 50 mg, 42%. Mp 204–205 °C. ^{1}H NMR (DMSO-d_6, 400 MHz) δ: 10.92 (br s, 1H, NH), 8.15 (d, J=8.3 Hz, 1H, HC-Indole), 7.96–7.89 (3H, m, HC-Indole+Ar-H), 7.8 (s, 1H, HC-Thiazole), 7.6 (dd, J=8.0, 7.3 Hz, 3H, HC-Indole), 7.45 (dd, J=8.3, 7.0 Hz, 3H, HC-Indole), 7.0 (d, J=8.9 Hz, 2H, Ar-H), 3.81 (s, 3H, CH_3). MS *m/z* (I, %): 364 (M^+−HCl, 100%). Anal. Calcd for $C_{18}H_{13}ClN_4OS_2$: C, 53.93, H, 3.25, Cl, 8.86, N, 13.98, S, 8.0%. Found: C, 53.71, H, 3.12, Cl, 8.52, N, 14.21, S, 8.23%.

4.3.1.6. Hydrochloride of 2-[4-(4-chlorophenyl)-thiazol-2-yl]-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5f). According to the Method A **5f** was obtained as an orange solid. Yield: 40 mg, 33%. Mp 244–245 °C. ^{1}H NMR (DMSO-d_6, 400 MHz) δ: 12.9 (br s, 1H, NH), 8.13 (d, J=8.0 Hz, 1H, Ar-H), 8.02–7.86 (m, 4H, Ar-H+H-Thiazole), 7.60 (dd, J=8.0, 7.5 Hz, 1H, Ar-H), 7.3 (d, J=8.5 Hz, 3H, Ar-H). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 160.6 (C-Thiazole), 159.9 (s, C-2), 152.1 (C-3), 145.9 (s, C-9), 144.5 (C-Thiazole), 134.4 (C-Ar$_{para}$), 132.9 (C-Ar$_{ipso}$), 130.3 (HC-Indole), 129.8 (d, J=165.9 Hz, 2C, HC-Ar$_{meta}$), 128.5 (d, J=162.0 Hz, 2C, C-Ar$_{ortho}$), 124.9 (HC-Indole), 122.2 (HC-Indole), 119.2 (C-4), 115.8 (d, J=165.0 Hz, HC-Indole), 114.5 (d, J=190.4 Hz, HC-Thiazole). MS *m/z* (I, %): 368 (M^+−HCl, 53%), 240 ($C_9H_5ClN_2S_2$, 20), 208 ($C_9H_5ClN_2S$, 27), 160 ($C_8H_4N_2S$, 100), 102 (C_7H_4N, 27). Anal. Calcd for $C_{17}H_{10}Cl_2N_4S_2$: C, 50.43, H, 2.47, Cl, 17.55, N, 13.84, S, 7.91%. Found: C, 50.65, H, 2.70, Cl, 17.68, N, 13.70, S, 8.20%.

4.3.2. Method B. A solution of bromine (1.3 g, 8 mmol) in 5 mL AcOH was added to a solution of 3-hydrazono-1,3-dihydroindole-2-thione **4** (2 mmol) in 100 mL AcOH at room temperature and the reaction mixture was stirred at ambient temperature for 5 h. The precipitate was filtered off.

4.3.2.1. Hydrobromide of 2-methyl-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5g). According to the Method B **5g** was obtained as a yellowish solid. Yield: 50 mg, 93%. Mp 246–247 °C. MS *m/z* (I, %): 189 (M^+−HBr, 91%). Anal. Calcd for $C_9H_8BrN_3S$: C, 40.00, H, 2.96, Br, 29.63, N, 15.56, S, 11.85%. Found: C, 40.25, H, 2.76, Br, 29.85, N, 15.37, S, 12.02%.

4.3.2.2. Hydrobromide of 2-benzyl-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5h). According to the Method B **5h** was obtained as a light brown solid. Yield: 40 mg, 60%. Mp 124–125 °C. IR ν: 3420, 3240 (NH), 3020, 2920 (CH) cm^{-1}. ^{1}H NMR (DMSO-d_6, 400 MHz) δ: 12.41 (br s, 1H, NH), 8.06 (d, J=7.8 Hz, 1H, Ar-H), 7.93 (d, J=8.2 Hz, 1H, Ar-H), 7.55–7.32 (m, 7H, Ar-H), 5.91 (s, 2H, CH_2). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 154.7 (C-2), 145.2 (C-3), 145.0 (C-9), 135.8 (C-Ar$_{ipso}$), 129.9 (5C, HC-Ar), 129.4 (HC-Indole), 124.2 (HC-Indole), 121.6 (HC-Indole), 117.9 (C-4), 115.6 (HC-Indole), 60.54 (CH_2). MS *m/z* (I, %): 265 (M^+−HBr, 29%), 105 ($C_6H_5CH_2$, 3), 102 (C_7H_4N, 10), 91 ($C_6H_4CH_2$, 100). Anal. Calcd for $C_{15}H_{12}BrN_3S$: C, 52.02, H, 3.47, Br, 23.12, N, 12.14, S, 9.25%. Found: C, 52.28, H, 3.23, Br, 23.25, N, 12.31, S, 9.37%.

4.3.2.3. Hydrobromide of 2-(4-ethoxyphenyl)-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5i). According to Method B **5i** was obtained as a brown solid. Yield: 45 mg, 60%. Mp 219–220 °C. IR ν: 3440 (NH), 3200, 2960 (CH) cm^{-1}. ^{1}H NMR (DMSO-d_6, 400 MHz) δ: 12.53 (s, 1H, NH), 8.13 (d, J=7.6 Hz, 1H, Ar-H), 7.99 (d, J=8.2 Hz, 1H, Ar-H), 7.81 and 7.01 (AA′BB′, J=8.9 Hz, 4H, Ar-H), 7.56 (dd, J=8.0, 7.6 Hz, 1H, Ar-H), 7.41 (dd, J=8.0, 7.2 Hz, 1H, Ar-H), 4.1 (q, J=7.2 Hz, 2H, CH_2), 1.42 (t, J=6.9 Hz, 3H, CH_3). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 160.4 (m, C-Ar$_{para}$), 155.6 (s, C-2), 144.7 (C-3), 143.7 (C-9), 134.6 (C-Ar$_{ipso}$), 129.2 (HC-Indole), 124.2 (HC-Indole), 123.9 (2C, HC-Ar$_{ortho}$), 121.5 (HC-Indole), 118.6 (C-4), 116.6 (2C, C-Ar$_{meta}$), 115.6 (HC-Indole), 64.6 (CH_2), 15.4 (CH_3). MS *m/z* (I, %): 295 (M^+−HBr, 37%), 167 ($EtOC_6H_5NS$, 18), 160 ($C_8H_4N_2S$, 6), 135 ($EtOC_6H_5N$, 72), 102 (C_7H_4N, 10). Anal. Calcd for $C_{16}H_{14}BrN_3OS$: C, 51.06, H, 3.72, Br, 21.28, N, 11.17%. Found: C, 51.28, H, 3.92, N, 10.96%.

4.3.2.4. Hydrobromide of 2-(4-methoxyphenyl)-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5j). According to Method B **5j** was obtained as brown solid. Yield: 41 mg, 57%. Mp 254–255 °C. IR ν: 3190 (CH), 2960 (CH_3) cm^{-1}. ^{1}H NMR (DMSO-d_6, 400 MHz) δ: 12.58 (br s, 1H, NH), 8.13 (d, J=7.6 Hz, 1H, Ar-H), 7.99 (d, J=8.2 Hz, 1H, Ar-H), 7.84 and 7.14 (AA′BB′, J=8.6 Hz, 4H, Ar-H), 7.56 (dd, J=7.5, 7.3 Hz, 1H, Ar-H), 7.43 (dd, J=7.7, 7.4 Hz, 1H, Ar-H), 3.88 (s, 3H, OCH_3). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 160.2 (m, C-Ar), 154.8 (s, C-2), 143.8 (dd, J=10.3, 9.9 Hz, C-3), 142.7 (d, J=2.8 Hz, C-9), 133.8 (tt, J=9.3, 2.4 Hz, C-Ar), 128.3 (dd, J=160.7, 7.3 Hz, HC-Indole), 123.3 (dd, J=164.1, 10.1 Hz, HC-Indole), 123.0 (dd, J=163.9, 5.9 Hz, 2C, C-Ar), 120.6 (dd, J=164.1, 8.5 Hz, HC-Indole), 117.7 (dd, J=5.6, 9.0 Hz, C-4), 115.4 (dd, J=162.2, 5.1 Hz, 2C, HC-Ar), 114.7 (dd, J=163.2, 8.2 Hz, HC-Indole), 55.7 (q, J=144.2 Hz, OCH_3). MS *m/z* (I, %): 281 (M^+−HBr, 35%), 160 ($C_8H_4N_2S$, 3), 153 ($MeOC_6H_4NS$, 22), 121 ($MeOC_6H_5N$, 100), 102 (C_7H_4N, 5). Anal. Calcd for $C_{15}H_{12}BrN_3OS$: C, 49.72, H, 3.31, Br, 22.10, N, 11.60, S, 8.84%. Found: C, 49.46, H, 3.57, Br, 22.35, N, 11.86, S, 8.61%.

4.3.2.5. Hydrobromide of 2-phenyl-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5k). According to Method B **5k** was obtained as a yellow solid. Yield: 66 g, 99%. Mp 244–245 °C. IR ν: 3190 (NH), 2920 (CH) cm^{-1}. ^{1}H NMR (DMSO-d_6, 100 MHz) δ: 12.81 (br s, 1H, NH), 8.28 (d, J=7.6 Hz, 1H, Ar-H), 8.02–7.99 (m, 2H, Ar-H), 7.96 (dd, J=7.6 Hz, 1H, Ar-H), 7.72–7.67 (m, 3H, Ar-H), 7.61 (dd, J=7.6, 7.2 Hz, 1H, Ar-H), 7.52 (dd, J=7.6, 7.2 Hz, 1H, Ar-H). ^{13}C NMR (DMSO-d_6, 100 MHz) δ: 155.9 (C-2), 145.4 (C-3), 145.3 (C-9), 141.2 (C-Ar$_{ipso}$), 131.3 (2C, HC-Ar$_{meta}$), 130.8 (HC-Indole), 129.9 (HC-Indole), 124.6 (HC-Ar$_{para}$), 122.0 (3C, HC-Indole and HC-Ar$_{ortho}$), 118.4 (C-4), 115.8 (HC-Indole). MS *m/z* (I, %): 251 (M^+−HBr, 65%), 160 ($C_9H_6N_2S_2$, 5), 123 ($C_9H_6N_2S$, 8), 91 (C_6H_5N,

100), 102 (C_7H_4N, 10). Anal. Calcd for $C_{14}H_{10}BrN_3S$: C, 50.60, H, 3.01, Br, 24.10, N, 12.65, S, 9.64%. Found: C, 50.36, H, 2.85, Br, 24.35, N, 12.40, S, 9.78%.

4.3.2.6. Hydrobromide of 2-(4-phenylthiazol-2-yl)-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5l). According to Method B **5l** was obtained as a light brown solid. Yield: 71 mg, 86%. Mp 234–235 °C. IR *ν*: 3150 (NH), 1620 (CH) cm^{-1}. ^1H NMR (DMSO-d_6, 400 MHz) *δ*: 12.91 (br s, 1H, NH), 8.14 (d, *J*=8.0 Hz, 1H, HC-Indole), 7.99–7.96 (m, 3H, HC-Indole+Ar-H), 7.8 (s, 1H, HC-Thiazole), 7.59 (dd, *J*=7.6, 7.0 Hz, 1H, HC-Indole), 7.49–7.33 (m, 4H, HC-Indole+Ar-H). ^{13}C NMR (DMSO-d_6, 100 MHz) *δ*: 159.9 (C-Thiazole), 153.5 (C-2), 146.1 (C-3), 144.6 (C-9), 134.2 (C-Thiazole), 130.4 (d, *J*=156.0 Hz, HC-Ph), 129.8 (d, *J*=159.1 Hz, 2C, HC-Ph), 129.6 (d, *J*=160.0 Hz, HC-Indole), 126.9 (d, *J*=159.3 Hz, 2C, HC-Ph), 125.1 (d, *J*=163.6 Hz, HC-Indole), 122.4 (d, *J*=163.9 Hz, HC-Indole), 119.3 (C-4), 115.9 (d, HC-Indole), 113.9 (d, *J*=191.3 Hz, HC-Thiazole). MS *m*/*z* (I, %): 334 (M^+−HBr, 100%), 206 ($C_9H_6N_2S_2$, 33), 174 ($C_9H_6N_2S$, 93), 160 ($C_8H_4N_2S$, 81), 102 (C_7H_4N, 34). Anal. Calcd for $C_{17}H_{11}BrN_4S_2$: C, 49.16, H, 2.65, Br, 19.27, N, 13.49, S, 7.71%. Found: C, 49.44, H, 2.88, Br, 19.55, N, 13.71, S, 7.45%.

4.3.3. Method C. A saturated solution of iodine in ethanol was added to a solution of hydrazone (0.5 mmol) in 10 mL of ethanol until the iodine colour persisted. The reaction mixture was stirred at 0 °C for 2 h. The precipitate was filtered off.

4.3.3.1. Hydroiodide of 2-methyl-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5m). According to Method C **5m** was obtained as a yellow-green solid. Yield: 87 mg, 55%. Mp 227–228 °C. MS *m*/*z* (I, %): 189 (M^+−HI, 95%). Anal. Calcd for $C_9H_8IN_3S$: C, 33.96, H, 2.52, N, 13.21, S, 10.06%. Found: C, 34.36, H, 2.21, N, 12.90, S, 10.31%.

4.3.3.2. Hydroiodide of 2-phenyl-2*H*-[1,2,3]thiadiazolo[5,4-*b*]indole (5n). According to Method C **5n** was obtained as a brown solid. Yield: 108 mg, 57%. Mp 186–187 °C. MS *m*/*z* (I, %): 251 (M^+−HI, 63%). Anal. Calcd for $C_{14}H_{10}IN_3S$: C, 44.33, H, 2.64, N, 11.08, S, 8.44%. Found: C, 44.36, H, 2.31, N, 10.90, S, 8.26%.

Acknowledgements

This research was supported by Russian fund for basic research (grant N 04-03-32926a), F.W.O.-Vlaanderen and K.U. Leuven.

References and notes

1. Gozzo, F. *J. Agric. Food Chem.* **2003**, *51*, 4487.
2. Stanetty, P.; Kremslehner, M.; Jaksits, M. *Pestic. Sci.* **1998**, *54*, 316.
3. Iriti, M.; Faoro, F. *J. Phytopathol.* **2003**, *151*, 171.
4. Bakulev, V.; Dehaen, W. *The Chemistry of 1,2,3-Thiadiazoles*; Wiley: New York, NY, 2004; pp 155–191.
5. Stanetty, P.; Kremslehner, M.; Mullner, M. *J. Heterocycl. Chem.* **1996**, *33*, 1759.
6. Thomas, E. W. *Comprehensive Heterocyclic Chemistry II*; Katritzky, A. R., Rees, C. W., Eds.; Elsevier: Oxford, 1996; Vol. 4, p 289.
7. Vasil'eva, M. L.; Mukhacheva, M. V.; Belskaia, N. P.; Bakulev, V. A.; Anderson, R. J.; Groundwater, P. V. *Russ. J. Org. Chem.* **2004**, *40*, 818.
8. Han, Q.-P.; Dryhurst, G. *J. Med. Chem.* **1996**, *39*, 1494.
9. Audia, J. E.; Evrard, D. A.; Murdoch, G. R.; Droste, J. J.; Nisse, J. S.; Fludzinski, S. P.; Lucaites, V. L.; Nelson, D. L.; Cohen, M. L. *J. Med. Chem.* **1996**, *39*, 2773.
10. Bailey, S.; Seager, J. F.; Rashid, Z. *J. Chem. Soc., Perkin Trans. 1* **1974**, 2384.
11. Karali, N.; Gursoy, A.; Terzioglu, N.; Ozkirimli, S.; Ozer, H.; Ekinci, A. C. *Arch. Pharm. Pharm. Med. Chem.* **1998**, *331*, 254.
12. Bramson, H. N.; Corona, J.; Davis, S. T.; Dickerson, S. H.; Edelstein, M.; Frye, S. V.; Gampe, R. T., Jr.; Harris, P. A.; Hassel, A.; Holmes, W. D.; Hunter, R. N.; Lackey, K. E.; Lovejoy, B.; Luzzio, M. J.; Montana, V.; Rocque, W. J.; Rusnak, D.; Shewchuk, L.; Veal, J. M.; Walker, D. H.; Kuyper, L. F. *J. Med. Chem.* **2001**, *44*, 4339.