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ORIGINAL PAPER

Synthesis of a new series of biologically interesting 6′-chloro-1′,1′-dioxospiro[4*H*-benzo[*d*][1,3,7]oxadiazocine-4,3′(2′*H*)-[1,4,2]benzodithiazine]-2,6(1*H*,5*H*)dione derivatives

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Abstract A series of 6′-chloro-1′,1′-dioxospiro[4*H*-benzo[*d*][1,3,7]oxadiazocine-4,3′(2′*H*)-[1,4,2]benzodithiazine]-2,6(1*H*,5*H*)dione derivatives have been synthesized from isatoic anhydride and 3-(R^2-amino)-1,4,2-benzodithiazine 1,1-dioxides. Some synthetic limitations are discussed on the basis of quantum chemical calculations performed by use of the Hartree–Fock method.

Keywords Benzodithiazine · Isatoic anhydride · Synthesis · RHF · Spiro compounds · Quantum chemistry

Introduction

Compounds containing the 1,1-dioxo-1,4,2-benzodithiazine ring system were synthesized in our laboratories in 1984 and have attracted much attention for several years because of their wide range of biological activity. It has been demonstrated that many 6-chloro-1,4,2-benzodithiazine derivatives (Fig. 1, type **I**) have low acute toxicity to mice and rats and, depending on their structure, act as potential radio-protective [1, 2], diuretic [1–5], or cholagogue [5] agents. It has also been shown that some 6-chloro-1,1-dioxo-1,4,2-benzodithiazines have remarkable antitumor activity (Fig. 1, types **I** [6–8] and **II** [9, 10]) or anti-HIV activity (Fig. 1, types **I** [11, 12], **II** [9], and **III** [13]).

Furthermore, 6-chloro-3-methylthio-1,4,2-benzodithiazine 1,1-dioxides have attracted our investigative attention because of their suitability for chemical transformation into otherwise not readily obtained 4-chloro-2-mercaptobenzenesulfonamide derivatives of type **IV** (Fig. 1). These compounds have remarkable structure-dependent antitumor activity [14–26], anti-HIV activity [14–17, 27–30], antibacterial activity [31], or strong inhibitory activity of human carbonic anhydrase (CA) isozymes I, II, IX, and XII [32–34]. Some of the compounds have been reported to be novel HIV-1 integrase inhibitors (MBSAs) [8, 11–13].

Recently, we have reported the synthesis and some chemical properties of 6′-chloro-1′,1′-dioxospiro[4*H*-benzo[*d*][1,3,7]oxadiazocine-4,3′(2′*H*)-[1,4,2]benzodithiazine]-2,6(1*H*,5*H*)dione derivatives of type **V** (Fig. 1) [35]. More recently the compound **V** (R^1 = 7′-Me) and its potential metabolite **VI** [35] have been tested in vitro at the National Cancer Institute (Bethesda MD, USA) at a single dose (10 μM) in the full NCI 60-cell lines panel. The most susceptible were lung cancer cells (HOP-92) and melanoma (MALME-3 M) carcinoma cell lines whose growth was inhibited by 34 and 28 % by compounds of type **V** (R^1 = 7′-Me) and **VI**, respectively. In this work, the possibility of using reaction of 3-amino-6-chloro-1,4,2-benzodithiazine 1,1-dioxide derivatives with isatoic anhydride for synthesis of novel series of spiro compounds of type **VII** (Fig. 1) with potential biological activity or as useful starting materials for further chemical transformation has been investigated.

Synthesis of nitrogen-containing heterocyclic systems from isatoic anhydrides has been reported in the literature since 1981 [36, 37]. This work covers both direct transformation of the anhydrides into such heterocyclic systems, and processes leading initially to formation of anthranilic acid derivatives which are then transformed into the heterocyclic compounds in one or several stages. It is important that such transformations result in the formation of new five and six-membered heterocyclic systems. Furthermore, regioselective three-component reaction of

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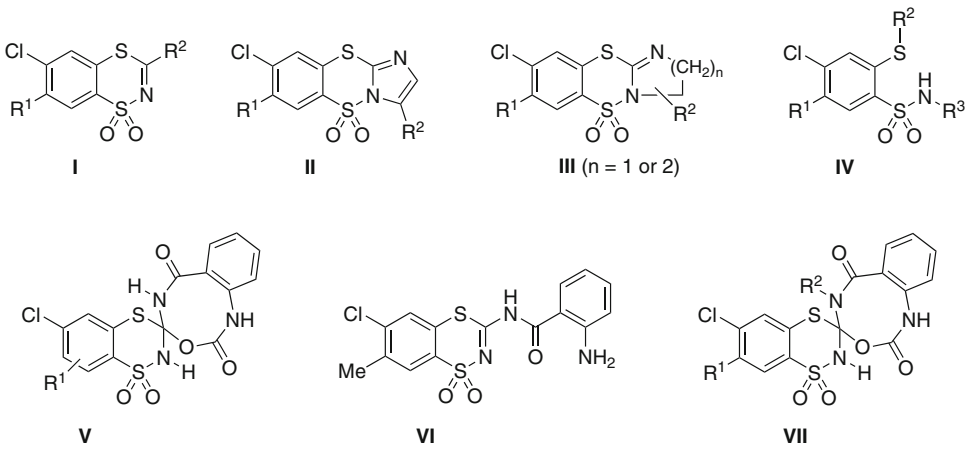
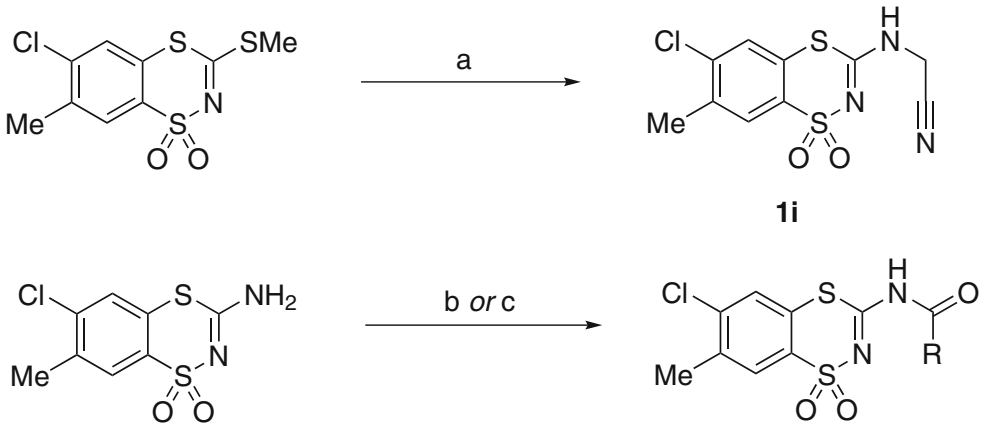


Fig. 1 General structures of 6-chloro-1,4,2-benzodithiazine 1,1-dioxide derivatives **I**, **II**, **III**, and **VI**, 2-mercaptobenzenesul fonamides **IV**, and spiro [4*H*-benzo[*d*][1,3,7]oxadiazocine-4,3′(2′*H*)-[1,4,2] benzodithiazine]-2,6(1*H*,5*H*) dione derivatives **V** and **VII**

Scheme 1



(a) aminoacetonitrile hydrochloride (1.0 molar equiv.), 4-dimethylaminopyridine (1.05 molar equiv.), dry benzene, room temp. 4 h, 60 h, 81%; (b) acetic anhydride (2.0 molar equiv.) dry toluene, reflux, 10 h, 80%; (c) benzoic anhydride (2.33 molar equiv.) 170-175 °C, 3 h, dry toluene, reflux 2 h, 85%

Compd	R
1j	Me
1k	Ph

isatoic anhydride, primary amines, and isatins to spirooxindole derivatives has also been reported [38].

Results and discussion

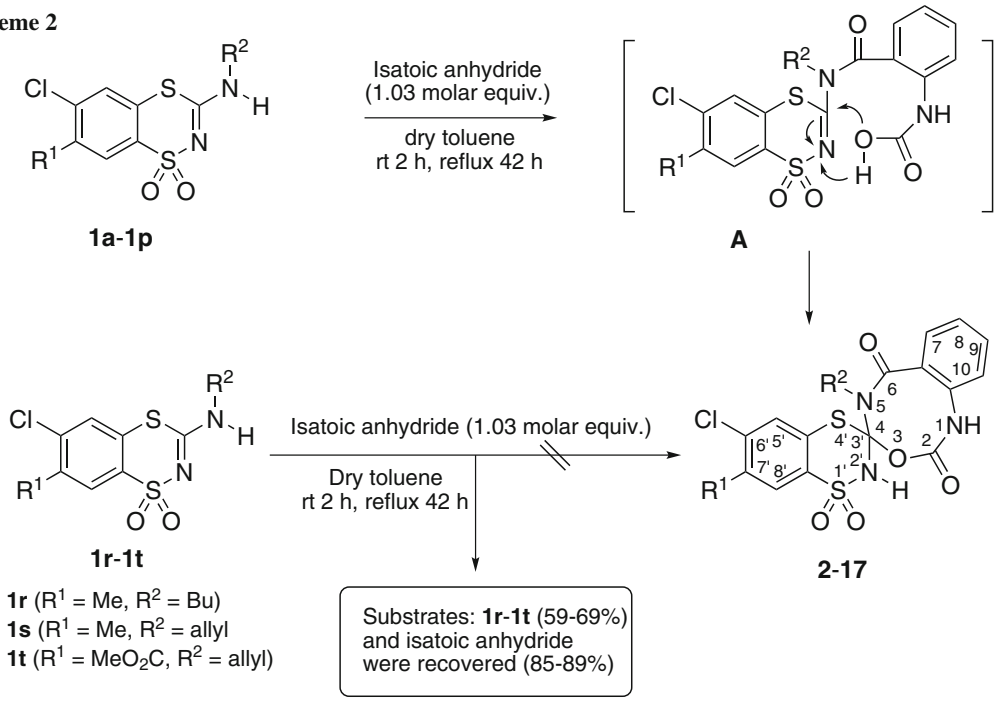
Chemistry

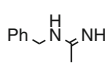
Previously described methods were used for synthesis of 3-amino-6-chloro-1,4,2-benzodithiazine derivatives **1a**-**1e** [3], **1f**, **1g** [27], **1h** [39], **1l**–**1p** [9], **1r** [40], **1s**, and **1t** [41]. Similar methods were used to prepare the new starting benzodithiazines **1i**, **1j**, and **1k** (Scheme 1).

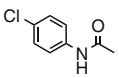
As shown in Scheme 2, synthesis of the target 6′-chloro-1′,1′-dioxospiro[4*H*-benzo[*d*][1,3,7]oxadiazocine-4,3′(2′*H*)-[1,4,2]benzodithiazine]-2,6(1*H*,5*H*)dione derivatives **2**–**17** was achieved in good to excellent yield (81–97 %) by a convenient procedure starting from isatoic anhydride and benzodithiazines **1a**–**1p**. However, reaction with benzodithiazines **1r**, **1s**, and **1t** failed. In these instances the substrates, only, were recovered from the resulting reaction mixture, i.e. isatoic anhydride (85–89 %) and the corresponding 3-aminobenzodithiazines **1r** (69 %), **1 s** (59 %), or **1t** (69 %).

It is supposed that reaction of isatoic anhydride with benzodithiazines **1a**–**1t** depends on the electronic effect of

Scheme 2



Comp	R^1	R^2	Yield /%
1a, 2	Me	2-MeOPh	94
1b, 3	Me	2-BrPh	96
1c, 4	Me	4-ClPh	90
1d, 5	Me	2,4-diClPh	93
1e, 6	Me		82
1f, 7	Me		97
1g, 8	Me		97

Comp	R^1	R^2	Yield /%
1h, 9	Me	Me_2N-	95
1i, 10	Me	NC-CH_2-	97
1j, 11	Me	Me(C=O)-	94
1k, 12	Me	Ph(C=O)-	92
1l, 13	EtO_2C	4-FPh	97
1m, 14	NC-	4-ClPh	95
1n, 15	H_2NCO-	Ph	95
1o, 16	H_2NCO-	4-ClPh	96
1p, 17		Ph	95

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their substituents R^2. Thus, only 3-aminobenzodithiazines **1r**–**1t**, bearing substituents R^2 with electron-donating effects were unsuitable for formation of intermediate compounds of type **A** (Scheme 2) and further conversion to the desired spiro compounds of type **2**–**17** by cycloaddition reaction. Trying to understand and to explain this phenomenon we also undertook studies using ab-initio calculations for molecules **1a**–**1t** (in toluene), by use of the Hartree–Fock method.

The structures of the new compounds were confirmed by elemental analysis and by IR and NMR spectroscopy; the results are given in the "Experimental" section. Inspection of the ^{13}C NMR spectra of spiro-cyclic compounds **2**–**17** revealed the characteristic signals of the spiro carbon atom (C-4,3′) in the upfield region $\delta = 110.27$–110.95 ppm, and the presence of two carbonyl groups at positions 2 and 6 of the benzo[*d*][1,3,7]oxadiazocine ring was indicated by characteristic signals in the regions 153.58–160.57 and 160.00–166.32 ppm, respectively. The ^1H NMR spectra contained characteristic signals in the regions $\delta = 7.02$–7.19 (d, $J = 7.9$–8.3 Hz) for H-10, 7.24–7.28 (t, $J = 7.1$–8.1 Hz) for H-9, 7.56–7.75 (t, $J = 7.1$–8.3 Hz) for H-8, 7.83–7.99 (d, $J = 7.1$–9.0 Hz) or 7.91 (dd, $J_{ortho} = 7.9$, $J_{meta} = 1.2$ Hz) for H-7, 8.10–12.95 as singlet for H-1, 8.10–11.82 (s) for H-2′, 7.38–8.37 (s) for H-5′, and 7.24 (s) for H-8′. The IR spectra of compounds **2**–**17** contained strong absorption bands of the two carbonyl C=O groups in the regions 1,720–1,730 and 1,765 cm^{-1}.

Molecular modeling studies

Quantum chemical calculations were performed by use of Spartan 08 software [42] to study the molecular geometry and electronic structure of 6-chloro-7-R^1-3-(R^2-amino)-1,4,2-benzodithiazine 1,1-dioxides **1a**–**1t**. The full optimized geometries of compounds **1a**–**1t** in toluene were calculated by use of the ab-initio restricted Hartree–Fock (RHF) method with the 6-31G* polarization basis set. The calculated relative tautomer energies with the Boltzmann distribution term equal to unity confirm experimental results that 3-(R^2-amino)-1,4,2-benzodithiazine is a low-energy tautomer, more stable than the 3-(R^2-imino)-1,4,2-benzodithiazine isomer.

The electrostatic atomic charges of the starting 3-aminobenzodithiazines **1a**–**1t** (Table 1) and electrostatic potential surface maps (Fig. 2), as affected by their R^2 substituents, provide information about the reactivity of the molecules in reactions with electrophiles.

The relative reactivity can be judged from the values of the atomic charges calculated for the nucleophilic centers of the compounds. Thus, the higher negative electrostatic charges found on the nitrogen atom of the amine groups of compounds **1a**–**1p** explained the different chemical behavior of 3-aminobenzodithiazines **1s**–**1t** in reactions with isatoic anhydride (Table 1).

The plots of electrostatic potential as maps in Fig. 2 show the electron charge density of representative compounds **1a** and **1s**. Compound **1a** has a region of high negative charge on the N atom whereas compound **1s** has less negative charge on this nitrogen atom, which explains its low reactivity.

Conclusion

We have developed a method for preparation of new series of 6′-chloro-1′,1′-dioxospiro[4*H*-benzo[*d*][1,3,7]oxadiazocine-4,3′(2′*H*)-[1,4,2]benzodithiazine]-2,6(1*H*,5*H*)dione derivatives **2**–**17** by reaction of isatoic anhydride with 3-(R^2-amino)-6-chloro-1,4,2-benzodithiazine 1,1-dioxide derivatives bearing R^2 substituents of diverse electronic nature. For substrates **1a**–**1t** geometry optimization was performed, by use of Spartan 08 software and the ab-initio restricted Hartree–Fock (RHF) method at the 6-31G* level. Theoretical studies enabled explanation of the different chemical behavior of 3-aminobenzodithiazines toward isatoic anhydride. The unreactive substrates **1r**–**1t** were characterized by less negative charge and greater electrostatic potential on the nitrogen atom of the amine group than the reactive compounds **1a**–**1p**. Further structural modification and biological evaluation of these compounds are in progress and will be reported elsewhere.

Table 1 Electrostatic atomic charges of the heterocyclic rings and amine groups of the starting 6-chloro-7-R^1-3-(R^2-amino)-1,4,2-benzodithiazine 1,1-dioxides **1a**–**1t**

Compound	SO_2			N-2	C-3	S-4	Amine group N
	S-1	O-1	O-2				
1a	1.488	–0.677	–0.659	–0.756	0.617	–0.113	–0.550
1b	1.492	–0.676	–0.659	–0.726	0.590	–0.113	–0.599
1c	1.463	–0.670	–0.649	–0.747	0.642	–0.133	–0.637
1d	1.481	–0.669	–0.653	–0.726	0.570	–0.110	–0.534
1e	1.489	–0.676	–0.651	–0.737	0.632	–0.130	–0.614
1f	1.461	–0.667	–0.644	–0.718	0.585	–0.077	–0.599
1g	1.489	–0.674	–0.651	–0.720	0.550	–0.049	–0.572
1h	1.578	–0.704	–0.676	–0.792	0.508	–0.148	–0.197
1i	1.561	–0.699	–0.662	–0.740	0.616	–0.116	–0.341
1j	1.463	–0.656	–0.649	–0.701	0.519	–0.056	–0.674
1k	1.435	–0.651	–0.643	–0.703	0.629	–0.050	–0.600
1l	1.454	–0.653	–0.647	–0.744	0.600	–0.120	–0.586
1m	1.458	–0.661	–0.641	–0.738	0.628	–0.121	–0.628
1n	1.442	–0.663	–0.645	–0.751	0.621	–0.142	–0.607
1o	1.449	–0.671	–0.638	–0.743	0.652	–0.136	–0.647
1p	1.456	–0.674	–0.642	–0.743	0.658	–0.142	–0.651
1r	1.497	–0.682	–0.660	–0.782	0.579	–0.142	–0.386
1s	1.503	–0.680	–0.662	–0.768	0.559	–0.146	–0.390
1t	1.524	–0.685	–0.660	–0.760	0.486	–0.134	–0.260

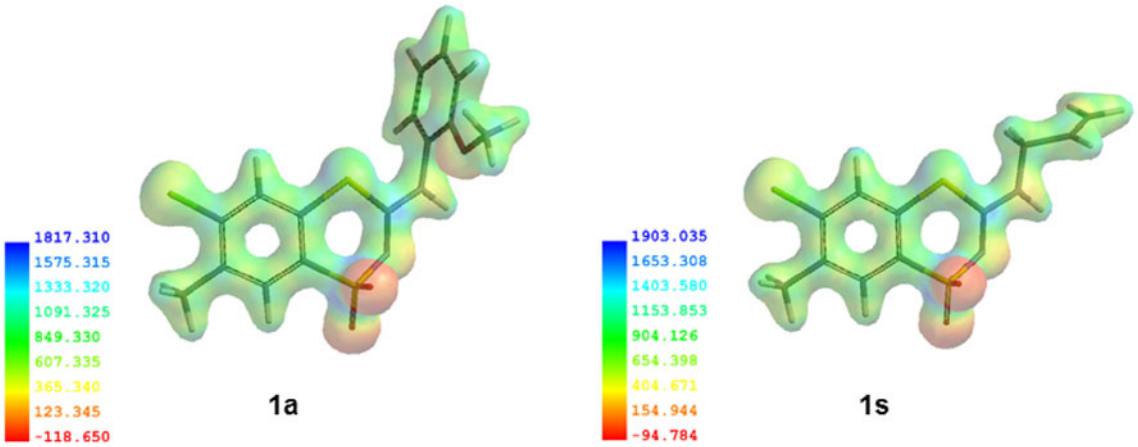

Fig. 2 Electrostatic potential maps of representative benzodithiazines **1a** and **1s**. Color ranges, in kJ mol^{-1}: **1a** from *red* −118.650 to *blue* +1,817.310, **1s** from *red* −94.784 to *blue* +1,903.035. RHF/6-31G* basis set (color figure online)

Experimental

The instrumentation and conditions used were: melting points Büchi 535 apparatus; IR spectra: KBr pellets, 400–4,000 cm^{-1}, Perkin Elmer 1600 FT-IR spectrophotometer; ^{1}H NMR and ^{13}C NMR: Varian Gemini 200 apparatus at 200 and 50 MHz, respectively; spectra were recorded in dimethyl sulfoxide-d_6 (DMSO-d_6); chemical shifts are expressed as δ values relative to Me_4Si as standard; coupling constants (J) are given in hertz; multiplicity in ^{1}H NMR is reported as singlet (s), broad singlet (br s), doublet (d), doublet of doublets (dd), triplet (t), quartet (q), and multiplet (m). The results of elemental analysis for C, H, and N were in agreement with calculated values within ±0.3 %. Thin-layer chromatography (TLC) was performed on Merck silica gel 60F254 plates and visualized by UV illumination. The starting 6-chloro-7-methyl-3-methylthio-1,4,2-benzodithiazine 1,1-dioxide and 3-amino-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide were obtained by use of previously described procedures [2, 43].

2-(6-Chloro-7-methyl-1,4,2-benzodithiazin-3-ylamino)acetonitrile 1,1-dioxide (**1i**, $C_{10}H_8ClN_3O_2S_2$)
A mixture of 5.88 g 6-chloro-7-methyl-3-methylthio-1,4,2-benzodithiazin 1,1-dioxide (0.02 mol), 1.85 g aminoacetonitrile hydrochloride (0.02 mol), and 2.56 g 4-dimethylaminopyridine (0.021 mol) in 50 cm^3 dry benzene was stirred at room temperature for 4 h, followed by reflux until evolution of CH_3SH had ceased (55–60 h) (CAUTION: because of high toxicity, CH_3SH should be trapped in aqueous NaOH solution). The solvent was evaporated under reduced pressure to give an oily residue and 70 cm^3 water was added, with stirring. The resulting suspension (pH ~7.8) was acidified to pH 2 by addition of 1 % hydrochloric acid. After stirring at room temperature for 6 h, the crude product was collected by filtration, washed with water (6 × 5 cm^3), dried, and purified by recrystallization from 40 cm^3 glacial acetic acid. Yield: 4.9 g (81 %); m.p.: 228–229 °C; $R_f = 0.76$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu}$ = 3,340 (NH), 2,255 (C≡N), 1,560 (C=N), 1,345, 1,315, 1,165 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 2.43$ (s, 3H, CH_3), 4.52 (s, 2H, CH_2), 7.96 (s, 1H, H-5), 8.03 (s, 1H, H-8), 10.34 (s, 1H, NH) ppm; ^{13}C NMR: δ = 19.58, 30.88, 116.28, 126.88, 127.25, 128.47, 130.87, 137.63, 137.94, 163.83 ppm.

3-Acetylamino-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1j**, $C_{10}H_9ClN_2O_3S_2$)
A mixture of 5.25 g 3-amino-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (0.02 mol) and 4.10 g acetic anhydride (0.04 mol) in 50 cm^3 dry toluene was stirred under reflux for 10 h. After cooling to room temperature, the precipitate was collected by filtration, washed successively with toluene (3 × 5 cm^3), methanol (2 × 5 cm^3), and acetonitrile (3 × 5 cm^3), and dried. Yield: 4.9 g (80 %); m.p.: 264–265 °C; $R_f = 0.74$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu}$ = 3,220, 3,190 (NH), 1,710 (C=O), 1,555 (C=N), 1,345, 1,310, 1,160 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 2.19$ (s, 3H, CH_3), 2.40 (s, 3H, CH_3C=O), 8.00 (s, 1H, H-5), 8.06 (s, 1H, H-8), 12.15 (s, 1H, NH) ppm; ^{13}C NMR: δ = 19.60, 23.95, 126.52, 128.42, 129.00, 129.35, 138.06, 138.91, 163.41, 172.27 ppm.

3-Benzoylamino-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1k**, $C_{15}H_{11}ClN_2O_3S_2$)
A mixture of 3.94 g 3-amino-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (0.015 mol) and 7.92 g benzoic anhydride (0.035 mol) was stirred at 170–175 °C for 3 h. After cooling to 105 °C, 60 cm^3 dry toluene was added to the reaction mixture. The resulting suspension was further stirred under reflux for 2 h. After cooling to room temperature and standing overnight, the precipitate was collected by filtration, washed with toluene

(3×5 cm^3) and ethanol (3×5 cm^3), and dried. Yield: 4.7 g (85 %); m.p.: 279–280 °C; IR (KBr): $\bar{\nu} = 3{,}260$ (NH), 1,695 (C=O), 1,565 (C=N), 1,345, 1,305, 1,170 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 2.46$ (s, 3H, CH_3), 7.58 (t, $J = 7.8$ Hz, 2H, H-3 and H-5, PhC=O), 7.70 (t, $J = 7.3$ Hz, 1H, H-4, PhC=O), 8.02 (d, $J = 7.8$ Hz, 2H, H-2 and H-6, PhC=O), 8.05 (s, 1H, H-5 benzodithiazine), 8.08 (s, 1H, H-8 benzodithiazine), 12.90 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.56$, 126.55, 128.47, 128.94, 129.20, 129.40, 129.64, 131.29, 134.07, 138.12, 138.96, 165.11, 168.46 ppm.

General procedure for the preparation of spiro-[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-2,6(1H,5H)dione derivatives ***2–17***

A mixture of 0.84 g isatoic anhydride (5.15 mmol) and the corresponding 6-chloro-7-R^1-3-(R^2-amino)-1,4,2-benzodithiazine 1,1-dioxide **1a**–**1p** (5 mmol) in dry toluene (15 cm^3 for 1 g benzodithiazine) was stirred at room temperature for 2 h, followed by reflux for 42 h. After cooling to room temperature, the precipitate was collected by filtration, and washed successively with toluene (3×4 cm^3), methanol (5×3 cm^3), and petroleum ether (3×3 cm^3). In this manner, the following spiro compounds were obtained (analogous reactions with 3-(R^2-amino)-1,4,2-benzodithiazine 1,1-dioxide **1r**, **1s**, and **1t**, bearing R^2-substituents with strong or weak electron-donating effect, failed).

6′-Chloro-5-(2-methoxyphenyl)-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-2,6(1H,5H)dione (**2**, $C_{23}H_{18}ClN_3O_6S_2$)
Starting from 1.85 g 6-chloro-7-methyl-3-(2-methoxyphenylamino)-1,4,2-benzodithiazine 1,1-dioxide (**1a**), the title compound **2** was obtained. Yield: 2.5 g (94 %); m.p.: 200–201 °C (dec.); TLC: $R_f = 0.95$ ($CHCl_3$–MeOH 16:3); IR (KBr): $\bar{\nu} = 3{,}315$, 3,240, 3,175 (NH), 1,765, 1,730 (C=O), 1,340, 1,310, 1,155 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 2.42$ (s, 3H, CH_3), 3.82 (s, 3H, CH_3O), 7.02 (d, $J = 8.1$ Hz, 1H, H-10), 7.15–7.24 (m, 2H, arom), 7.28–7.41 (m, 3H, arom), 7.74 (t, $J = 7.6$ Hz, 1H, H-8), 7.89 (d, $J = 7.6$ Hz, 1H, H-7), 7.93 (s, 1H, H-5′), 7.99 (s, 1H, H-8′), 11.06 (br s, 1H, NH), 11.70 (br s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.56$, 56.08, 110.53, 112.76, 115.59, 120.83, 123.77, 124.00, 126.70, 126.90, 127.85, 127.92, 128.41, 128.92, 129.20, 131.14, 137.19, 137.39, 137.71, 141.66, 147.36, 153.58, 160.14 ppm.

5-(2-Bromophenyl)-6′-chloro-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-2,6(1H,5H)dione (**3**, $C_{22}H_{15}BrClN_3O_5S_2$)
Starting from 2.09 g 3-(2-bromophenylamino)-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1b**), the title compound **3** was obtained. Yield: 2.8 g (96 %); m.p.: 222–223 °C (dec.); TLC: $R_f = 0.78$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}245$, 3,185 (NH), 1,765, 1,725 (C=O), 1,365, 1,330, 1,155 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 2.13$ (s, 3H, CH_3), 7.15 (d, $J = 8.2$ Hz, 1H, H-10), 7.24 (t, $J = 8.1$ Hz, 1H, H-9), 7.36–7.39 (m, 1H, arom), 7.46–7.52 (m, 2H, arom), 7.68–7.71 (m, 1H, arom), 7.74 (t, $J = 7.8$ Hz, 1H, H-8), 7.91 (dd, $J_{ortho} = 7.9$ Hz, $J_{meta} = 1.2$ Hz, 1H, H-7), 7.97 (s, 1H, H-5′), 8.00 (s, 1H, H-8′), 11.46 (s, 1H, NH), 11.73 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.58$, 110.53, 115.59, 123.78, 126.80, 127.52, 128.54, 129.11, 129.20, 129.79, 130.00, 130.16, 130.41, 130.87, 133.59, 137.20, 137.55, 137.95, 141.66, 147.36, 158.00, 160.14 ppm.

6′-Chloro-5-(4-chlorophenyl)-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]-benzodithiazine]-2,6(1H,5H)dione (**4**, $C_{22}H_{15}Cl_2N_3O_5S_2$)
Starting from 1.87 g 6-chloro-3-(4-chlorophenylamino)-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1c**), the title compound **4** was obtained. Yield: 2.4 g (90 %); m.p.: 296–297 °C (dec.); TLC: $R_f = 0.76$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}270$, 3,200, 3,125 (NH), 1,765, 1,725 (C=O), 1,315, 1,290, 1,145 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 2.44$ (s, 3H, CH_3), 7.15 (d, $J = 8.1$ Hz, 1H, H-10), 7.28 (t, $J = 7.6$ Hz, 1H, H-9), 7.50 (d, $J = 8.8$ Hz, 2H, 4-ClPh), 7.66 (d, $J = 8.8$ Hz, 2H, 4-ClPh), 7.73 (t, $J = 8.3$ Hz, 1H, H-8), 7.91 (d, $J = 7.0$ Hz, 1H, H-7), 7.99 (s, 1H, H-5′), 8.04 (s, 1H, H-8′), 11.63 (s, 1H, NH), 11.66 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.34$, 110.27, 115.34, 123.35, 123.52, 126.63, 127.53, 128.30, 128.94, 129.09, 129.67, 130.47, 136.60, 136.94, 137.40, 137.69, 141.41, 147.10, 159.88, 160.69 ppm.

6′-Chloro-5-(2,4-dichlorophenyl)-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]-benzodithiazine]-2,6(1H,5H)dione (**5**, $C_{22}H_{14}Cl_3N_3O_5S_2$)
Starting from 2.04 g 6-chloro-3-(2,4-dichlorophenylamino)-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1d**), the title compound **5** was obtained. Yield: 2.6 g (93 %); m.p.: 213–214 °C (dec.); TLC: $R_f = 0.77$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}335$, 3,240, 3,175 (NH), 1,765, 1,730 (C=O), 1,365, 1,325, 1,165 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 2.43$ (s, 3H, CH_3), 7.19 (d, $J = 8.1$ Hz, 1H, H-10), 7.24 (t, $J = 7.1$ Hz, 1H, H-9), 7.56 (s, 2H, H-5 and H-6, 2,4-diClPh), 7.73 (t, $J = 7.1$ Hz, 1H, H-8), 7.83 (s, 1H, H-3, 2,4-diClPh), 7.91 (d, $J = 7.1$ Hz, 1H, H-7), 7.99 (s, 1H, H-5′), 8.01 (s, 1H, H-8′), 11.50 (s, 1H, NH), 11.73 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.58$, 110.53, 115.59, 123.79, 126.86, 128.41, 128.56, 128.64, 129.20, 130.00, 130.50, 130.75, 133.01, 133.11, 133.18, 137.20, 137.63, 138.04, 141.66, 147.36, 160.02, 163.68 ppm.

6′-Chloro-5-(2-chloro-3-pyridinyl)-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]-benzodithiazine]-2,6(1H,5H)dione (**6**, $C_{21}H_{14}Cl_2N_4O_5S_2$)
Starting from 1.87 g 6-chloro-3-(2-chloro-3-pyridinyl-amino)-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1e**), the title compound **6** was obtained. Yield: 2.2 g (82 %); m.p.: 218–219 °C (dec.); TLC: $R_f = 0.71$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}285$, 3,215, 3,175 (NH), 1,765, 1,730 (C=O), 1,620 (C=N), 1,365, 1,155 (SO_2) cm^{-1}; ^1H NMR: $\delta = 2.43$ (s, 3H, CH_3), 7.15 (d, $J = 7.9$ Hz, 1H, H-10), 7.24 (t, $J = 7.5$ Hz, 1H, H-9), 7.58 (t, $J = 5.8$ Hz, 1H, H-5, 3-pyridinyl), 7.73 (t, $J = 7.3$ Hz, 1H, H-8), 7.90 (d, $J = 7.5$ Hz, 1H, H-7), 7.92–8.20 (m, 3H, H-4 and H-6, 3-pyridinyl, and H-5′), 8.44 (s, 1H, H-8′), 11.62 (s, 1H, NH), 11.73 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.59$, 110.51, 115.59, 123.77, 124.29, 126.89, 127.36, 128.57, 129.19, 130.66, 131.15, 137.19, 137.70, 138.11, 138.48, 141.66, 141.06, 147.36, 149.01, 160.13, 163.76 ppm.

6′-Chloro-5-[imino(piperidin-1-yl)methyl]-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-2,6(1H,5H)dione
(**7**, $C_{22}H_{22}ClN_5O_5S_2$)
Starting from 1.64 g 6-chloro-7-methyl-3-(piperidine-1-carboximidamino)-1,4,2-benzodithiazine 1,1-dioxide (**1f**), the title compound **7** was obtained. Yield: 2.6 g (97 %); m.p.: 211–212 °C (dec.); TLC: $R_f = 0.75$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}370$, 3,280, 3,210 (NH), 1,765, 1,725 (C=O), 1,620 (C=N), 1,360, 1,345, 1,155 (SO_2) cm^{-1}; ^1H NMR: $\delta = 1.58$ (br s, 6H, piperidine), 2.39 (s, 3H, CH_3), 3.51 (br s, 4H, piperidine), 7.15 (d, $J = 8.0$ Hz, 1H, H-10), 7.25 (t, $J = 8.0$ Hz, 1H, H-9), 7.69 (s, 1H, H-5′), 7.73 (t, $J = 8.1$ Hz, 1H, H-8), 7.89 (s, 1H, H-8′), 7.93 (d, $J = 8.0$ Hz, 1H, H-7), 8.22 (br s, 2H, NH), 11.73 (s, 1H, C=NH) ppm; ^{13}C NMR: $\delta = 19.50$, 23.64, 25.51, 45.94, 110.53, 115.60, 123.77, 126.28, 127.23, 129.20, 131.09, 131.31, 133.10, 135.97, 136.78, 137.20, 141.67, 147.36, 157.20, 164.77 ppm.

5-(N-Benzylcarbamimidoyl)-6′-chloro-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-2,6(1H,5H)dione
(**8**, $C_{24}H_{20}ClN_5O_5S_2$)
Starting from 1.98 g 3-(3-benzylguanidino)-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1 g**), the title compound **8** was obtained. Yield: 2.7 g (97 %); m.p.: 194–195 °C (dec.); TLC: $R_f = 0.74$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}425$, 3,340, 3,285, 3,180 (NH and C=NH), 1,765, 1,730 (C=O), 1,620 (C=N), 1,360, 1,330, 1,140 (SO_2) cm^{-1}; ^1H NMR: $\delta = 2.40$ (s, 3H, CH_3), 4.42 (s, 2H, $PhCH_2NH$), 7.15 (d, $J = 8.3$ Hz, 1H, H-10), 7.24 (t, $J = 7.6$ Hz, 1H, H-9), 7.30 (s, 5H, Ph), 7.38 (s, 1H, H-5′), 7.71 (t, $J = 7.6$ Hz, 1H, H-8), 7.74 (s, 1H, H-8′), 7.90 (d, $J = 7.6$ Hz, 1H, H-7), 8.10 (br s, 1H, NH), 8.35 (br s, 1H, NH), 8.87 (t, $J = 6.0$ Hz, 1H, $PhCH_2NH$), 11.73 (s, 1H, C=NH) ppm; ^{13}C NMR: $\delta = 19.52$, 44.49, 110.53, 115.60, 123.77, 126.35, 127.28, 127.35, 127.47, 127.64, 127.74, 128.79, 129.20, 130.89, 131.15, 136.16, 136.96, 137.19, 141.67, 147.36, 158.42, 160.00 ppm.

6′-Chloro-5-(dimethylamino)-7′-methyl-1′,1′-dioxospiro-[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]-benzodithiazine]-2,6(1H,5H)dione (**9**, $C_{18}H_{17}ClN_4O_5S_2$)
Starting from 1.53 g 6-chloro-7-methyl-3-(2,2-dimethyl-hydrazino)-1,4,2-benzodithiazine 1,1-dioxide (**1h**), the title compound **9** was obtained. Yield: 2.2 g (95 %); m.p.: 207–208 °C (dec.); TLC: $R_f = 0.70$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}240$, 3,170 (NH), 1,765, 1,725 (C=O), 1,360, 1,315, 1,160 (SO_2) cm^{-1}; ^1H NMR: $\delta = 2.40$ (s, 3H, CH_3), 2.60 (s, 6H, CH_3–N–CH_3), 7.15 (d, $J = 8.3$ Hz, 1H, H-10), 7.26 (t, $J = 7.3$ Hz, 1H, H-9), 7.73 (t, $J = 7.3$ Hz, 1H, H-8), 7.83 (d, $J = 7.4$ Hz, 1H, H-7), 7.88 (s, 1H, H-5′), 7.94 (s, 1H, H-8′), 10.98 (br s, 1H, NH), 11.62 (br s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.52$, 46.68, 110.52, 115.59, 123.77, 126.40, 128.36, 129.04, 129.20, 130.63, 137.11, 137.19, 137.33, 141.66, 147.35, 160.01, 166.63 ppm.

6′-Chloro-7′-methyl-1′,1′,2,6-tetraoxo-1,2-dihydrospiro-[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]-benzodithiazine]-5(6H)-acetonitrile
(**10**, $C_{18}H_{13}ClN_4O_5S_2$)
Starting from 1.51 g 2-(6-chloro-7-methyl-1,4,2-benzodithiazin-3-ylamino)acetonitrile 1,1-dioxide (**1i**), the title compound **10** was obtained. Yield: 2.3 g (97 %); m.p.: 194–195 °C (dec.); TLC: $R_f = 0.70$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}345$, 3,240, 3,175 (NH), 2,245 (C≡N), 1,765, 1,725 (C=O), 1,365, 1,320, 1,165 (SO_2) cm^{-1}; ^1H NMR: $\delta = 2.43$ (s, 3H, CH_3), 4.51 (s, 2H, N≡C–CH_2N), 7.14 (d, $J = 8.1$ Hz, 1H, H-10), 7.20 (t, $J = 8.0$ Hz, 1H, H-9), 7.74 (t, $J = 8.1$ Hz, 1H, H-8), 7.91 (dd, $J_{meta} = 1.2$ Hz, $J_{ortho} = 7.9$ Hz, 1H, H-7), 7.95 (s, 1H, H-5′), 8.02 (s, 1H, H-8′), 10.32 (br s, 1H, NH), 11.72 (br s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.58$, 30.90, 110.53, 115.59, 116.29, 123.77, 126.89, 127.27, 128.48, 129.20, 130.90, 137.20, 137.64, 137.95, 141.66, 147.36, 160.01, 163.82 ppm.

5-Acetyl-6′-chloro-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]-benzodithiazine]-2,6(1H,5H)dione (**11**, $C_{18}H_{14}ClN_3O_6S_2$)
Starting from 1.52 g 3-(acetylamino)-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1j**), the title compound **11** was obtained. Yield: 2.2 g (94 %); m.p.: 210–211 °C (dec.); TLC: $R_f = 0.70$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}225$, 3,185 (NH), 1,765, 1,730, 1,685 (C=O), 1,365, 1,310, 1,165 (SO_2) cm^{-1}; ^1H NMR: $\delta = 2.18$ (s, 3H, CH_3), 2.44 (s, 3H, CH_3C=O), 7.14 (d, $J = 8.1$ Hz, 1H, H-10), 7.24 (t, $J = 7.5$ Hz, 1H, H-9), 7.73 (t, $J = 7.7$ Hz, 1H,

H-8), 7.90 (d, $J = 7.7$ Hz, 1H, H-7), 8.02 (s, 1H, H-5′), 8.04 (s, 1H, H-8′), 11.72 (s, 1H, NH), 12.48 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.60$, 23.97, 110.51, 115.59, 123.77, 126.53, 128.42, 129.02, 129.19, 129.39, 137.18, 138.06, 138.91, 141.66, 147.35, 160.02, 163.40, 172.29 ppm.

5-Benzoyl-6′-chloro-7′-methyl-1′,1′-dioxospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]-benzodithiazine]-2,6(1H,5H)dione (**12**, $C_{23}H_{16}ClN_3O_6S_2$)
Starting from 1.83 g 3-(benzoylamino)-6-chloro-7-methyl-1,4,2-benzodithiazine 1,1-dioxide (**1k**), the title compound **12** was obtained. Yield: 2.4 g (92 %); m.p.: 230–232 °C (dec.); TLC: $R_f = 0.77$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}240$, 3,180 (NH), 1,765, 1,730, 1,695 (C=O), 1,365, 1,170 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 2.46$ (s, 3H, CH_3), 7.14 (d, $J = 8.1$ Hz, 1H, H-10), 7.24 (t, $J = 7.5$ Hz, 1H, H-9), 7.56 (t, $J = 7.4$ Hz, 1H, H-8), 7.66–7.77 (m, 3H, H-3, H-4 and H-5, PhC=O), 7.91 (d, $J = 7.8$ Hz, 1H, H-7), 8.02 (d, $J = 7.6$ Hz, 2H, H-2 and H-6, PhC=O), 8.02 (s, 1H, H-5′), 8.07 (s, 1H, H-8′), 11.73 (s, 1H, NH), 12.95 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 19.64$, 110.53, 115.59, 123.77, 126.56, 128.48, 128.95, 129.20, 129.41, 129.66, 131.32, 134.07, 137.19, 138.12, 141.66, 147.36, 160.02, 165.11, 168.49 ppm.

Ethyl 6′-chloro-5-(4-fluorophenyl)-1′,1′,2,6-tetraoxo-1,2,5,6-tetrahydrospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-7′-carboxylate
(**13**, $C_{24}H_{17}ClFN_3O_7S_2$)
Starting from 2.07 g ethyl 6-chloro-3-(4-fluorophenylamino)-1,1-dioxo-1,4,2-benzodithiazine-7-carboxylate (**1l**), the title compound **13** was obtained. Yield: 2.8 g (97 %); m.p.: 216–217 °C (dec.); TLC: $R_f = 0.71$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}270$, 3,265, 3,225 (NH), 1,765, 1,725, 1,685 (C=O), 1,365, 1,325, 1,170, 1,155 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 1.34$ (t, $J = 7.1$ Hz, 3H, CH_3CH_2O), 4.37 (q, $J = 7.1$ Hz, 2H, CH_3CH_2O), 7.15 (d, $J = 8.1$ Hz, 1H, H-10), 7.24 (t, $J = 7.9$ Hz, 1H, H-9), 7.33 (d, $J = 8.9$ Hz, 2H, H-2 and H-6 of 4-FPh), 7.62–7.68 (m, 2H, H-3 and H-5 of 4-FPh), 7.70 (t, $J = 8.1$ Hz, 1H, H-8), 7.91 (dd, $J_{meta} = 1.2$ Hz, $J_{ortho} = 7.9$ Hz, 1H, H-7), 8.02 (s, 1H, H-5′), 8.35 (s, 1H, H-8′), 11.61 (s, 1H, NH), 11.72 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 14.21$, 62.38, 110.53, 115.59, 116.01, 116.46, 123.77, 124.39, 124.57, 126.94, 129.20, 130.54, 130.81, 130.88, 134.31, 135.82, 137.19, 141.67, 147.36, 160.00, 160.17, 163.34 ppm.

6′-Chloro-5-(4-chlorophenyl)- 1′,1′,2,6-tetraoxo-1,2,5,6-tetrahydrospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-7′-carbonitrile
(**14**, $C_{22}H_{12}Cl_2N_4O_5S_2$)
Starting from 1.92 g 6-chloro-3-(4-chlorophenylamino)-1,1-dioxo-1,4,2-benzodithiazine-7-carbonitrile (**1m**), the title compound **14** was obtained. Yield: 2.8 g (95 %); m.p.: 219–220 °C (dec.); TLC: $R_f = 0.64$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}275$, 3,195, 3,125 (NH), 2,238 (C≡N), 1,765, 1,725 (C=O), 1,360, 1,320, 1,150 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 7.14$ (d, $J = 8.1$ Hz, 1H, H-10), 7.24 (t, $J = 7.6$ Hz, 1H, H-9), 7.62 (d, $J = 8.7$ Hz, 2H, 4-ClPh), 7.65 (d, $J = 8.7$ Hz, 2H, 4-ClPh), 7.73 (t, $J = 7.7$ Hz, 1H, H-8), 7.90 (d, $J = 7.6$ Hz, 1H, H-7), 8.37 (s, 1H, H-5′), 8.60 (s, 1H, H-8′), 11.72 (s, 1H, NH), 11.87 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 110.81$, 112.97, 114.84, 115.58, 123.77, 123.93, 129.19, 129.43, 130.01, 130.22, 130.31, 130.71, 131.33, 136.71, 137.19, 138.93, 141.65, 147.34, 159.01, 160.15 ppm.

6′-Chloro-1′,1′,2,6-tetraoxo-5-phenyl-1,2,5,6-tetrahydrospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-7′-carboxamide
(**15**, $C_{22}H_{15}ClN_4O_6S_2$)
Starting from 1.84 g 6-chloro-1,1-dioxo-3-phenylamino-1,4,2-benzodithiazine-7-carboxamide (**1n**), the title compound **15** was obtained. Yield: 2.5 g (95 %); m.p.: 282–283 °C (dec.); TLC: $R_f = 0.54$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}435$, 3,325, 3,255, 3,200, 3,140 (NH_2, NH), 1,765, 1,725, 1,675 (C=O), 1,365, 1,330, 1,140 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 7.15$ (d, $J = 8.1$ Hz, 1H, H-10), 7.24 (t, $J = 7.4$ Hz, 1H, H-9), 7.45 (t, $J = 7.5$ Hz, 1H, H-8), 7.61 (s, 2H, O=C–NH_2), 7.65–7.77 (m, 3H, H-3, H-4, H-5 of Ph), 7.87 (d, $J = 6.6$ Hz, 2H, H-2 and H-6 of Ph), 7.95 (d, $J = 8.2$ Hz, 1H, H-7), 8.11 (s, 1H, H-5′), 8.16 (s, 1H, H-8′), 11.58 (s, 1H, NH), 11.72 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 110.53$, 115.60, 122.19, 122.26, 122.44, 123.77, 124.49, 126.34, 129.20, 129.47, 129.71, 130.71, 131.51, 134.03, 137.20, 137.62, 141.66, 147.36, 160.00, 166.32 ppm.

6′-Chloro-5-(4-chlorophenyl)-1′,1′,2,6-tetraoxo-1,2,5,6-tetrahydrospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-7′-carboxamide
(**16**, $C_{22}H_{14}Cl_2N_4O_6S_2$)
Starting from 2.01 g 6-chloro-3-(4-chlorophenylamino)-1,1-dioxo-1,4,2-benzodithiazine-7-carboxamide (**1o**), the title compound **16** was obtained. Yield: 2.7 g (96 %); m.p.: 286–287 °C (dec.); TLC: $R_f = 0.54$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} = 3{,}455$, 3,355 (O=C–NH_2), 3,315, 3,190 (NH), 1,765, 1,730, 1,660 (C=O), 1,365, 1,315, 1,165 (SO_2) cm^{-1}; ^{1}H NMR: $\delta = 7.15$ (d, $J = 8.2$ Hz, 1H, H-10), 7.24 (t, $J = 7.5$ Hz, 1H, H-9), 7.52 (d, $J = 8.8$ Hz, 2H, H-3 and H-5 of 4-ClPh), 7.67 (d, $J = 8.8$ Hz, 2H, H-2 and H-6 of 4-ClPh), 7.73 (t, $J = 8.2$ Hz, 1H, H-8), 7.87 (s, 2H, O=C–NH_2), 7.95 (d, $J = 9.0$ Hz, 1H, H-7), 8.12 (s, 1H, H-5′), 8.17 (s, 1H, H-8′), 11.62 (s, 1H, NH), 11.74 (s, 1H, NH) ppm; ^{13}C NMR: $\delta = 110.53$, 115.60, 123.68, 123.77, 124.55, 129.20, 129.29, 129.41, 129.73, 130.00, 130.55, 131.43, 134.11, 136.66, 137.19, 137.68, 141.66, 147.36, 160.05, 166.28 ppm.

6′-Chloro-N-(4-chlorophenyl)-1′,1′,2,6-tetraoxo-5-phenyl-1,2,5,6-tetrahydrospiro[4H-benzo[d][1,3,7]oxadiazocine-4,3′(2′H)-[1,4,2]benzodithiazine]-7′-carboxamide
(**17**, $C_{28}H_{18}Cl_2N_4O_6S_2$)
Starting from 2.40 g 6-chloro-*N*-(4-chlorophenyl)-1,1-dioxo-3-(phenylamino)-1,4,2-benzodithiazine-7-carboxamide (**1p**), the title compound **17** was obtained. Yield: 3.1 g (95 %); m.p.: 278–279 °C (dec.); TLC: $R_f = 0.64$ (benzene–EtOH 4:1); IR (KBr): $\bar{\nu} =$ 3,285, 3,280, 3,205, 3,140 (NH), 1,765, 1,730, 1,675 (C=O), 1,360, 1,310, 1,145 (SO_2) cm^{-1}; ^1H NMR: $\delta = 7.13$ (d, $J = 8.3$ Hz, 1H, H-10), 7.21–7.24 (m, 2H, arom), 7.41–7.45 (m, 5H, arom), 7.63–7.72 (m, 5H, arom), 7.89 (d, $J = 7.8$ Hz, 1H, H-7), 8.19 (s, 1H, H-8′), 10.83 (s, 1H, NH), 11.59 (s, 1H, NH), 11.71 (s, 1H, NH) ppm; ^{13}C NMR: $\delta =$ 110.95, 116.01, 122.08, 122.61, 124.19, 125.44, 126.73, 128.52, 129.48, 129.62, 129.72, 129.88, 130.17, 131.28, 132.66, 134.71, 137.41, 137.61, 138.15, 142.08, 147.79, 160.57, 160.99, 163.42 ppm.

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