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Synthesis and Primary Antitumor Screening of 4-[5-(1*H*-Indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamides

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Abstract—A preparative procedure was developed for the synthesis of 4-[5-(1-R-1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanoic acids which were converted to acid chlorides, and the latter reacted with aromatic and heterocyclic amines to afford a series of previously unknown 4-[5-(1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamides. The synthesized compounds showed a moderate antitumor activity against most malignant tumor cells. UO31 renal cancer cell line turned out to be most sensitive to most of the tested compounds.

Keywords: organic synthesis, 2-sulfanylidene-1,3-thiazolidin-4-one, indole, antitumor activity

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The chemistry of indole began to develop due to the study of indigo, a substance known to mankind long before the emergence of organic chemistry as a science. The unique properties of the indole ring became clear after the structures of many proteins, various alkaloids, and neurotransmitters have been determined and a large number of pharmacological agents of this class have been introduced into medical practice. Today, the indole heterocycle is considered privileged [1, 2], and research in the field of indole chemistry is performed by scientists working in different areas.

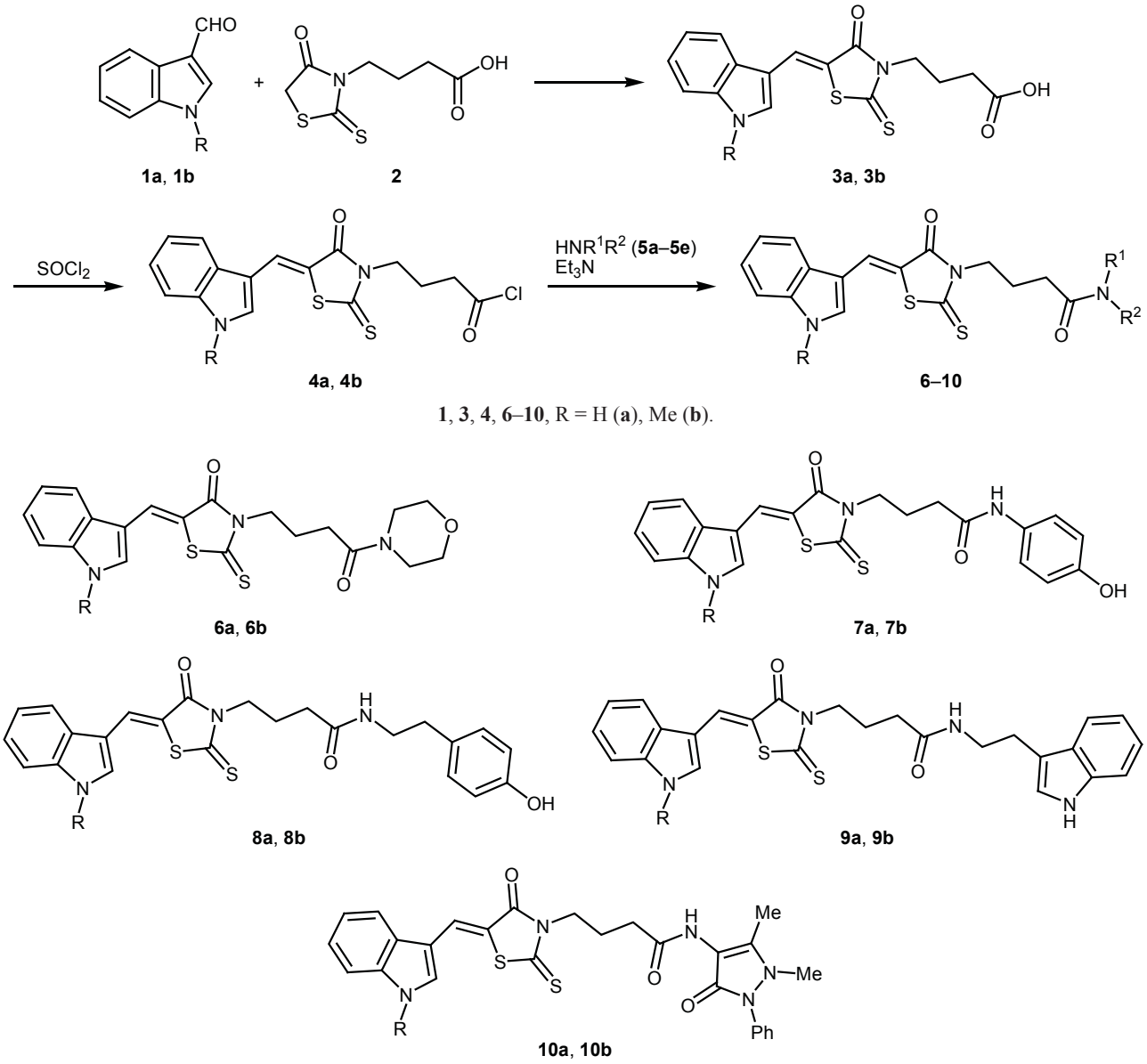
Similarly to indole, rhodanine (2-sulfanylidene-1,3-thiazolidin-4-one) and related heterocycles are also considered privileged. Compounds containing this pharmacophore exhibit a broad spectrum of biological activities. Biological properties of thiazolidin-4-one derivatives have been reviewed in [3–5].

Nevertheless, in-depth studies of the indole and 2-sulfanylidene-1,3-thiazolidin-4-one heterocyclic systems, synthesis of hybrids based thereon and study of their biological activity, and establishment of the relevant structure–activity relationships are of undoubted interest both from both theoretical viewpoint and in terms of directed search for potential drugs.

The present work continues our studies of biologically important heterocyclic compounds [6–20]. Herein, we report the synthesis and antitumor activity of 4-[5-(1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamides. It should be noted that 5-(1*H*-indol-3-ylmethylidene)-2-sulfanylidene-1,3-thiazolidin-4-one derivatives have been found to exhibit a broad spectrum of biological activity, including antimicrobial [21, 22], antiviral [23], and antitumor [24, 25], as well as inhibitory activity against various enzymes [26–29].

Initial 4-[5-(1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanoic acids **3a** and **3b** were prepared by the condensation of 1*H*-indole-3-carbaldehyde (**1a**) and its *N*-methyl derivative **1b** with 4-(4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl)butanoic acid (**2**). The optimal conditions for this transformation were boiling acetic acid as a solvent and the presence of sodium acetate as a base. The structure of **3a** and **3b** was confirmed by ^{1}H NMR spectra which contained signals from methylene protons of the aliphatic chain as two triplets and one multiplet at δ 1.85–4.14 ppm. The CH= proton resonated at δ 8.00–8.10 ppm, indicating *Z* configuration of the exocyclic double C=C bond.

Scheme 1.



Acids **3a** and **3b** were converted to acid chlorides **4a** and **4b** by treatment with thionyl chloride in anhydrous toluene under reflux until the initial acid completely dissolved. Acid chlorides **4a** and **4b** were isolated as orange crystalline solids soluble in benzene, dioxane, acetone, and DMF and insoluble in saturated hydrocarbons.

The target amides **6–10** were synthesized by reactions of **4a** and **4b** with aliphatic, aromatic, and heterocyclic amines **5a–5e** (Scheme 1) in 1,4-dioxane. The amines used were morpholine (**5a**), *p*-aminophenol (**5b**), tyramine [**5c**, 4-(2-aminoethyl)phenol], tryptamine (**5d**), and 4-amino-1,5-dimethyl-2-phenyl-1,2-dihydro-3*H*-pyrazol-3-one (**5e**). Morpholine (**5a**) is a classical alicyclic amine, and its reaction with acid chlorides **4** can be used to estimate the reactivity of the latter. Tyramine (**5c**) and tryptamine (**5d**) are simple alkaloids, and introduction of the corresponding fragments into organic molecules often gives rise to pharmacological activity. Likewise, a similar result is obtained by introduction of pharmacophoric *p*-aminophenol (**5b**) and aminophenazone (**5c**) fragments.

The structures of amides **6–10** are shown in Scheme 1. They were confirmed by ^{1}H NMR spectra which, as well as the spectra of **3a** and **3b**, showed signals at δ 1.85–4.12 ppm from aliphatic methylene protons [$(CH_2)_3$, $(CH_2)_2$]; the exocyclic CH= proton resonated as a singlet at δ 8.05–8.10 ppm,

Table 1. Cytotoxicity of compounds **6–10** at a concentration of 10^{-5} M against 60 cancer cell lines

Compound no.	Mitotic activity in 60 cancer cell lines, GP, %		Most sensitive cancer cell lines, GP, %
	average	range	
6a	98.67	73.93–127.05	UO-31 (renal cancer) 73.93 IGROV1 (ovarian cancer) 81.04
6b	99.48	75.79–124.96	UO-31 (renal cancer) 75.79 IGROV1 (ovarian cancer) 77.91
7a	96.27	67.77–133.75	UO-31 (renal cancer) 67.77 IGROV1 (ovarian cancer) 73.08
7b	95.44	71.31–113.28	UO-31 (renal cancer) 71.31 MOLT-4 (leukemia) 77.20
8a	98.18	67.00–127.84	UO-31 (renal cancer) 67.00 IGROV1 (ovarian cancer) 72.55
8b	81.83	42.20–126.36	UO-31 (renal cancer) 42.20 CCRF-CEM (leukemia) 44.56 SK-MEL-5 (melanoma) 47.89 MOLT-4 (leukemia) 50.35 K-562 (leukemia) 54.04 HL-60(TB) (leukemia) 55.83 MDA-MB-468 (breast cancer) 58.63 MCF7 (breast cancer) 59.06
9a	87.40	36.82–115.54	M14 (melanoma) 36.82 K-562 (leukemia) 46.55 UO-31 (renal cancer) 49.71
9b	79.67	35.50–108.43	UO-31 (renal cancer) 35.50 HL-60(TB) (leukemia) 37.22 K-562 (leukemia) 49.60 SK-MEL-5 (melanoma) 56.16 CCRF-CEM (leukemia) 57.53
10a	93.80	54.11–117.36	A498 (renal cancer) 54.11
10b	94.20	69.45–120.83	UO-31 (renal cancer) 69.45 SF-268 (central nervous system cancer) 75.01 A549/ATCC (non-small-cell lung cancer) 83.34

and the NH signal appeared in the region δ 9.75–10.30 ppm.

The in vitro antitumor activity of the synthesized compounds was studied by highly efficient biological screening according to the Developmental Therapeutic Program of the National Cancer Institute (National Institute of Health, Bethesda, Maryland, USA) [30–33] on 60 cancer cell lines encompassing virtually all spectrum of human cancers (including leukemia, non-small-cell lung cancer, epithelial colon cancer, melanoma, ovarian cancer, and breast cancer). Compounds **6–10** were tested at a concentration of 10^{-5} M. Their activity was evaluated as cancer cell growth percentage (GP, %) relative to control [30–33]. The results are summarized in Table 1. It is seen that all compounds **6–10** showed a moderate antitumor activity. Among them, the most active were **9b** (mean GP = 79.67%) and **9a** (mean GP = 87.40%) derived from tryptamine and **8b** (mean GP = 81.83%) derived from tyramine. The highest activity was observed for compound **9b** against UO-31 renal cancer cell line (GP = 35.50%), and this cancer cell line turned out to be the most sensitive to the majority of the other compounds tested.

In summary, we have developed a convenient procedure for the synthesis of 4-[5-(1*H*-indol-3-yl-

methylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamides. The synthesized compounds have been found to exhibit a moderate antitumor activity against a panel of human cancer cell lines.

EXPERIMENTAL

The ^{1}H NMR spectra were recorded from solutions in DMSO-d_6 on a Varian Mercury VX-400 spectrometer at 400 MHz using tetramethylsilane as internal standard.

4-(4-Oxo-2-sulfanylidene-1,3-thiazolidin-3-yl)-butanoic acid (2). A flat-bottom flask equipped with a reflux condenser was charged with 50 mmol of γ-aminobutyric acid, 5.7 g (5.5 mmol) of carbon disulfide, 5.6 g (100 mmol) of potassium hydroxide, and 15 mL of water. The mixture was stirred with a magnetic stirrer, and a solution of 5.2 g (5.5 mmol) of chloroacetic acid preliminarily neutralized with 5.5 mmol of sodium hydrogen carbonate in 25 mL of water was added dropwise with stirring over a period of 15 min. The mixture was left to stand at ~20°C for 2 days, 20 mL of 6 N aqueous HCl was added to the resulting solution, and the mixture was refluxed for 1 h. The mixture was cooled, and the precipitate was filtered off and recrystallized twice in succession from dilute acetic acid and ethanol. Yield 91%, mp 121–122°C.

4-[5-(1*H*-Indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanoic acids 3a and 3b (*general procedure***).** A round-bottom flask equipped with a refulx condenser was charged with 1.1 g (5 mmol) of acid **2**, 6 mmol of 1*H*-indole-3-carbaldehyde **1a** or **1b**, 0.41 g (5 mmol) of anhydrous sodium acetate, and 5 mL of acetic acid. The mixture was refluxed for 3 h and cooled, and the solid product was filtered off, washed with acetic acid and water, dried, and recrystallized from acetic acid.

4-[5-(1*H*-Indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanoic acid (3a). Yield 67%, mp 227–229°C. ^{1}H NMR spectrum, δ, ppm: 1.95–1.85 m (2H, $NCH_2C\mathbf{H}_2$), 2.29 t (2H, NCH_2, J = 7.2 Hz), 4.08 t (2H, CH_2CO, J = 6.9 Hz), 7.30–7.19 m (2H, indole), 7.51 d (1H, indole, J = 7.8 Hz), 7.91 s (1H, indole), 7.96 d (1H, indole, J = 7.5 Hz), 8.08 s (1H, =CH), 12.15 s (1H, COOH), 12.39 s (1H, NH). Found, %: C 55.29; H 4.01; N 8.01. $C_{16}H_{14}N_2O_3S_2$. Calculated, %: C 55.47; H 4.07; N 8.09.

4-[5-(1-Methyl-1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanoic acid (3b). Yield 83%, mp 223–225°C. ^{1}H NMR spectrum, δ, ppm: 2.04–1.89 m (2H, $NCH_2C\mathbf{H}_2$), 2.30 t (2H, NCH_2, J = 7.4 Hz), 3.97 s (3H CH_3), 4.14 t (2H, CH_2CO, J = 7.1 Hz), 7.33–7.22 m (2H, indole), 7.48 d (1H, indole, J = 7.6 Hz), 7.79 s (1H, indole), 7.88 d (1H, indole, J = 7.3 Hz), 8.00 s (1H, CH=). ^{13}C NMR spectrum, δ_C, ppm: 22.13, 31.01, 33.42, 43.53, 110.10, 110.95, 114.31, 118.62, 123.40, 125.32, 127.26, 133.89, 136.95, 166.74, 173.71, 192.41. Found, %: C 56.75; H 4.35; N 7.69. $C_{17}H_{16}N_2O_3S_2$. Calculated, %: C 56.65; H 4.47; N 7.77.

4-[5-(1*H*-Indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanoyl chlorides 4a and 4b (*general procedure***).** A 50-mL round-bottom flask was charged with 2 mmol of acid **3a** or **3b**, 1.2 mL of thionyl chloride, and 3 mL of anhydrous toluene, and the mixture was refluxed for 10 min until it became homogeneous. The hot solution was poured into 5 mL of petroleum ether, the mixture was cooled, and the precipitate was filtered off, washed with petroleum ether, dried, and recrystallized from toluene–petroleum ether.

4-[5-(1*H*-Indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanoyl chloride (4a). Yield 63%, mp 163–165°C.

4-[5-(1-Methyl-1*H*-Indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanoyl chloride (4b). Yield 92%, mp 154–155°C.

5-(1*H*-Indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamides 6–10 (*general procedure***).** Amine **5a**–**5e**, 2.1 mmol, was dissolved in 4 mL of anhydrous 1,4-dioxane with slight heating, a solution of 1 mmol of acid chloride **4a** or **4b** in 4 mL of anhydrous 1,4-dioxane was added, and the mixture was heated at 90–95°C for 10 min. The mixture was cooled and diluted with water acidified with a few drops of aqueous HCl, and the precipitate was filtered off, washed with water, dried, and recrystallized from acetic acid.

5-(1*H*-Indol-3-ylmethylidene)-3-[4-(morpholin-4-yl)-4-oxobutyl]-2-sulfanylidene-1,3-thiazolidin-4-one (6a). Yield 98%, mp 205–207°C. ^{1}H NMR spectrum, δ, ppm: 1.97–1.84 m (2H, $NCH_2C\mathbf{H}_2$), 2.38 t (2H, NCH_2, J = 7.1 Hz), 3.42–3.36 m and 3.59–3.47 m (4H each, morpholine), 4.08 t (2H, CH_2CO, J = 6.9 Hz), 7.31–7.19 m (2H, indole), 7.51 d (1H, indole, J = 7.8 Hz), 7.91 s (1H, indole), 7.96 d (1H, indole, J = 7.6 Hz), 8.07 s (1H, CH=), 12.39 s (1H, NH). Found, %: C 57.72; H 5.17; N 10.01. $C_{20}H_{21}N_3O_3S_2$. Calculated, %: C 57.81; H 5.09; N 10.11.

5-(1-Methyl-1*H*-indol-3-ylmethylidene)-3-[4-(morpholin-4-yl)-4-oxobutyl]-2-sulfanylidene-1,3-thiazolidin-4-one (6b). Yield 82%, mp 186–188°C. ^{1}H NMR spectrum, δ, ppm: 1.95–1.86 m (2H, NCH_2CH_2), 2.38 t (2H, NCH_2, J = 6.8 Hz), 3.42–3.36 m (4H, morpholine), 3.54 d (4H, morpholine, J = 16.8 Hz), 3.94 s (3H, CH_3), 4.06 t (2H, CH_2CO, J = 6.6 Hz), 7.27 t (1H, indole, J = 7.4 Hz), 7.34 t (1H, indole, J = 7.4 Hz), 7.57 d (1H, indole, J = 8.1 Hz), 8.00–7.94 m (2H, indole), 8.03 s (1H, CH=). Found, %: C 58.86; H 5.29; N 9.91. $C_{21}H_{23}N_3O_3S_2$. Calculated, %: C 58.72; H 5.40; N 9.78.

***N*-(4-Hydroxyphenyl)-4-[5-(1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamide (7a).** Yield 97%, mp 219–221°C. ^{1}H NMR spectrum, δ, ppm: 2.02–1.92 m (2H, NCH_2CH_2), 2.32 t (2H, NCH_2, J = 7.5 Hz), 4.11 t (2H, CH_2CO, J = 6.9 Hz), 6.65 d (2H, C_6H_4, J = 8.7 Hz), 7.31–7.24 m (2H, indole), 7.33 d (2H, C_6H_4, J = 8.7 Hz), 7.51 d (1H, indole, J = 7.8 Hz), 7.91 s (1H, indole), 7.96 d (1H, indole, J = 7.7 Hz), 8.09 s (1H, =CH), 9.13 s (1H, OH), 9.64 s (1H, CONH), 12.38 s (1H, NH). Found, %: C 60.21; H 4.28; N 9.75. $C_{22}H_{19}N_3O_3S_2$. Calculated, %: C 60.39; H 4.38; N 9.60.

***N*-(4-Hydroxyphenyl)-4-[5-(1-methyl-1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamide (7b).** Yield 90%, mp 223–225°C. ^{1}H NMR spectrum, δ, ppm: 2.03–1.91 m (2H, NCH_2CH_2), 2.32 t (2H, NCH_2, J = 7.4 Hz), 3.95 s (3H, CH_3), 4.10 t (2H, CH_2CO, J = 6.9 Hz), 6.65 d (2H, C_6H_4, J = 8.8 Hz), 7.38–7.23 m (4H, H_{arom}), 7.58 d (1H, indole, J = 8.1 Hz), 8.01–7.95 m (2H, indole), 8.05 s (1H, =CH), 9.17 br.s (1H, OH), 9.65 s (1H, CONH). Found, %: C 61.01; H 4.48; N 9.46. $C_{23}H_{21}N_3O_3S_2$. Calculated, %: C 61.18; H 4.69; N 9.31.

***N*-[2-(4-Hydroxyphenyl)ethyl]-4-[5-(1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamide (8a).** Yield 89%, mp 198–201°C. ^{1}H NMR spectrum, δ, ppm: 1.86 d (2H, $NCH_2CH_2CH_2$, J = 7.1 Hz), 2.11 t (2H, $NCH_2CH_2CH_2$, J = 7.6 Hz), 2.59 t (2H, $C_6H_4CH_2CH_2$, J = 7.6 Hz), 3.15 d.d (2H, $C_6H_4CH_2CH_2$, J = 14.2, 6.4 Hz), 4.04 t (2H, CH_2CO, J = 7.0 Hz), 6.64 d (2H, C_6H_4, J = 8.4 Hz), 6.95 d (2H, C_6H_4, J = 8.4 Hz), 7.29–7.23 m (2H, indole), 7.51 d (1H, indole, J = 7.9 Hz), 7.99–7.87 m (2H, indole), 8.09 s (1H, =CH), 9.17 s (1H, OH), 12.40 s (1H, NH). Found, %: C 61.78; H 5.03; N 8.89. $C_{24}H_{23}N_3O_3S_2$. Calculated, %: C 61.91; H 4.98; N 9.02.

***N*-[2-(4-Hydroxyphenyl)ethyl]-4-[5-(1-methyl-1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamide (8b).** Yield 84%, mp 208–210°C. ^{1}H NMR spectrum, δ, ppm: 1.93–1.84 m (2H, $NCH_2CH_2CH_2$), 2.12 t (2H, $NCH_2CH_2CH_2$, J = 7.6 Hz), 2.56 t (2H $C_6H_4CH_2CH_2$, J = 7.6 Hz), 3.17 d.d (2H, $C_6H_4CH_2CH_2$, J = 13.9, 6.7 Hz), 3.95 s (3H, CH_3), 4.04 t (2H, CH_2CO, J = 7.0 Hz), 6.65 d (2H, C_6H_4, J = 8.4 Hz), 6.96 d (2H, C_6H_4, J = 8.3 Hz), 7.28 t (1H, indole, J = 7.4 Hz), 7.35 t (1H, indole), 7.58 d (1H, indole, J = 8.1 Hz), 7.87 t (1H, indole, J = 5.6 Hz), 7.98 d (1H, indole, J = 8.5 Hz), 8.05 s (1H, =CH), 9.17 s (1H, OH). Found, %: C 62.55; H 5.17; N 8.84. $C_{25}H_{25}N_3O_3S_2$. Calculated, %: C 62.61; H 5.25; N 8.76.

***N*-[2-(1*H*-Indol-3-yl)ethyl]-4-[5-(1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamide (9a).** Yield 99%, mp 179–181°C. ^{1}H NMR spectrum, δ, ppm: 1.94–1.89 m (2H, $NCH_2CH_2CH_2$), 2.14 t (2H, $NCH_2CH_2CH_2$, J = 7.5 Hz), 2.80 t (2H, NCH_2CH_2, J = 7.4 Hz), 3.32–3.27 m (2H, NCH_2CH_2), 4.07 t (2H CH_2CO, J = 7.0 Hz), 6.94 t (1H, indole, J = 7.2 Hz), 7.04 t (1H, indole, J = 7.6 Hz), 7.13 s (1H, indole), 7.34–7.19 m (3H, indole), 7.51 t (2H, indole, J = 7.6 Hz), 7.91 d (1H, indole, J = 2.8 Hz), 7.96 d (2H, indole, J = 7.0 Hz), 8.10 s (1H, =CH), 10.81 s (1H, CONH), 12.36 s (1H, NH). Found, %: C 63.78; H 5.04; N 11.55. $C_{26}H_{24}N_4O_2S_2$. Calculated, %: C 63.91; H 4.95; N 11.47.

***N*-[2-(1*H*-Indol-3-yl)ethyl]-4-[5-(1-methyl-1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamide (9b).** Yield 88%, mp 134–136°C. ^{1}H NMR spectrum, δ, ppm: 1.95–1.85 m (2H, $NCH_2CH_2CH_2$), 2.15 t (2H, $NCH_2CH_2CH_2$, J = 7.5 Hz), 2.80 t (2H, NCH_2CH_2, J = 7.4 Hz), 3.32–3.27 m (2H, NCH_2CH_2), 3.94 s (3H, CH_3), 4.06 t (2H, CH_2CO, J = 7.2 Hz), 6.94 t (1H, indole, J = 7.4 Hz), 7.04 t (1H, indole, J = 7.4 Hz), 7.13 d (1H, indole, J = 2.1 Hz), 7.37–7.24 m (3H, indole), 7.50 d (1H, indole, J = 7.9 Hz), 7.58 d (1H, indole, J = 8.1 Hz), 8.01–7.93 m (3H, indole), 8.06 s (1H, =CH), 10.78 s (1H, CONH). Found, %: C 64.34; H 5.35; N 11.01. $C_{27}H_{26}N_4O_2S_2$. Calculated, %: C 64.52; H 5.21; N 11.15.

***N*-(1,5-Dimethyl-3-oxo-2-phenyl-2,3-dihydro-1*H*-pyrazol-4-yl)-4-[5-(1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamide (10a).** Yield 96%, mp 253–255°C. ^{1}H NMR spectrum, δ, ppm: 1.95–2.00 m (2H, NCH_2CH_2), 2.13 s (3H, CH_3), 2.36 t (2H, NCH_2, J = 7.4 Hz), 3.03 s (3H, CH_3), 4.12 t (2H, CH_2CO, J = 7.2 Hz), 7.37–7.20 m

(6H, H_{arom}), 7.53–7.47 m (3H, indole), 7.90 d (1H, indole, J = 2.6 Hz), 7.96 d (1H, indole, J = 7.7 Hz), 8.10 s (1H, =CH), 9.08 s (1H, CONH), 12.35 s (1H, NH). Found, %: C 61.17; H 4.86; N 13.01. $C_{27}H_{25}N_5O_3S_2$. Calculated, %: C 61.00; H 4.74; N 13.17.

***N*-(1,5-Dimethyl-3-oxo-2-phenyl-2,3-dihydro-1*H*-pyrazol-4-yl)-4-[5-(1-methyl-1*H*-indol-3-ylmethylidene)-4-oxo-2-sulfanylidene-1,3-thiazolidin-3-yl]butanamide (10b).** Yield 90%, mp 239–241°C. ^{1}H NMR spectrum, δ, ppm: 2.01–1.89 m (2H, NCH_2CH_2), 2.12 s (3H, CH_3), 2.35 t (2H, NCH_2, J = 7.4 Hz), 3.35 s (3H, CH_3), 3.95 s (3H, CH_3), 4.10 t (2H, CH_2CO, J = 7.0 Hz), 7.38–7.24 m (5H, Ph), 7.49 t (2H, indole, J = 7.7 Hz), 7.58 d (1H, indole, J = 8.0 Hz), 8.02–7.98 d (2H, indole, J = 6.9 Hz), 8.06 s (1H, CH=), 9.12 s (1H, NH). Found, %: C 61.77; H 5.08; N 12.97. $C_{28}H_{27}N_5O_3S_2$. Calculated, %: C 61.63; H 4.99; N 12.83.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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