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MEDICINAL CHEMISTRY RESEARCH

ORIGINAL RESEARCH

Synthesis of some new indolo[2,3-c]isoquinolinyl pyrazoles, -1,3,4-oxadiazoles and their biological activities

Anand R. Saundane · Vaijinath A. Verma · Katkar Vijaykumar

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Abstract A new series of novel compounds [10-substituted 6*H,* 7*H*-indolo[2,3-c]isoquinolin-5-one-6-yl]carbohydrazides (**3a–c**), 1-[10-substituted 6*H,* 7*H*-indolo[2,3-c]isoquinolin-5-one-6-yl]fomyl-, -3′,5′-dimethylpyrazoles (**4a–c**), -3′,5′-diphenylpyrazoles (**5a–c**), -3′-methylpyrazol-5′-ones (**6a–c**) and -1′,3′,4′-oxidiazole-2′-thiones (**7a–c**) linked to indoloisoquinoline at position-6 through formyl bridge was prepared. The structures of these newly synthesized compounds were confirmed by their spectral studies and elemental analysis. These compounds have been screened for their antimicrobial and antioxidant activities. Compounds **4a**, **4b**, **5a, 5b**, **5c**, **6b**, **7a,** and **7c** exhibited the maximum zone of inhibition against *A. niger, A. flavus*, and *A. fumigatus.* Compounds **4a**, **5a**, **5c**, **6b**, **6c**, **7a,** and **7b** showed good antibacterial activity. Compounds **4b**, **4c**, **5b**, **5c, 6a**, **6b, 7a**, **7b**, and **7c** showed good radical scavenging activity compared with standards.

Keywords Indolo[23-c]isoquinoline · Pyrazole · Pyrazolone · Oxadizole · Antimicrobial · Antioxidant

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A. R. Saundane (✉) · K. Vijaykumar
Department of Post-Graduate Studies and Research in Chemistry, Gulbarga University, Gulbarga 585 106, Karnataka, India
e-mail: arsaundane@rediff.com

V. A. Verma
Shri Prabhu Arts, Science & J. M. Bohra Commerce College, Shorapur 585 224, India

Introduction

Pyridoindoles (Carbolines) are known for their wide spectrum of biological activities, viz., anticoagulant (Cohen and Cattanach, 1967), anticonvulsant (Saxena *et al*., 1969), antidepressant (Garmaise and Parks, 1973), anti-inflammatory, antibacterial (Winter *et al*., 1979), antitumor (Ishizumi and Katsube, 1980; Sumitomo, 1983), and antihistaminic (Kosuge et al., 1973). However, there are few reports on the antimicrobial activities of α-carbolines (Azimvand, 2012; Thakur *et al.,* 2010), and recently we have reported the antioxidant and antimicrobial activities (Saundane *et al.,* 2012) of compounds containing this system. Apart from this, pyrazole and its derivatives have been found to exhibit antimicrobial, anthelmintic, oxytocic (Hiremath *et al.,* 1993; 1995; 1997), anti-inflammatory, analgesic (Saundane *et al.,* 1998a), ulcerogenic, and lipid peroxidation (Amir and Kumar 2005) activities. Some of the pyrazole analogs were reported as antimicrobial (Sridhar *et al*., 2004; Bondock et al. 2010), fungicides (Chen *et al*., 2000; Vicentini *et al*., 2007), and antioxidant (Burgute *et al*., 2007) activities. In addition, 1,3,4-oxadiazoles are also known for their biologic importance, viz., anticancer (Rajyalakshmi *et al.,* 2011), antifungal (Abdel-Rahman, 2004), antibacterial (Padmavathi *et al.,* 2009), and antioxidant (Padmavathi *et al.,* 2010) activities. The aim of the present study was both to explore the effect of the synthesized compounds on the tested pathogens and to find lead compounds having potent antimicrobial and/or antioxidant activity. Hence, in the continuation of our work on the synthesis of biologically important α-carbolines, we are reporting the synthesis, antimicrobial and antioxidant activities of the title compounds in the present communication.

Results and discussion

The reaction sequence employed for the synthesis of title compounds is illustrated in Scheme 1. The starting compounds 10-substituted 6*H, 7H*-indolo[2,3-c]isoquinolin-5-ones (**1a–c**), ethyl[10-substituted 6*H, 7H*-indolo[2,3-c]isoquinolin-5-one-6-yl]formates (**2a–c**) and [10-substituted 6*H, 7H*-indolo[2,3-c]isoquinolin-5-one-6-yl]carbohydrazides (**3a–c)** were prepared according to the reported method (Hiremath *et al.,* 1995). The hydrazide (**3a**) were subjected to cyclocondensation with acetyl acetone or dibenzoyl methane or ethyl acetoacetate in dry methanol containing catalytic amount of conc. hydrochloric acid under reflux temperature to yield 1′-[10-chloro-6*H,* 7*H*-indolo[2,3-c] isoquinolin-5-one-6-yl]formyl-, -3′,5′-dimethylpyrazole (**4a**), -3′,5′-diphenylpyrazole (**5a)** and -3′-methylpyrazol-5′-one (**6a**), respectively.

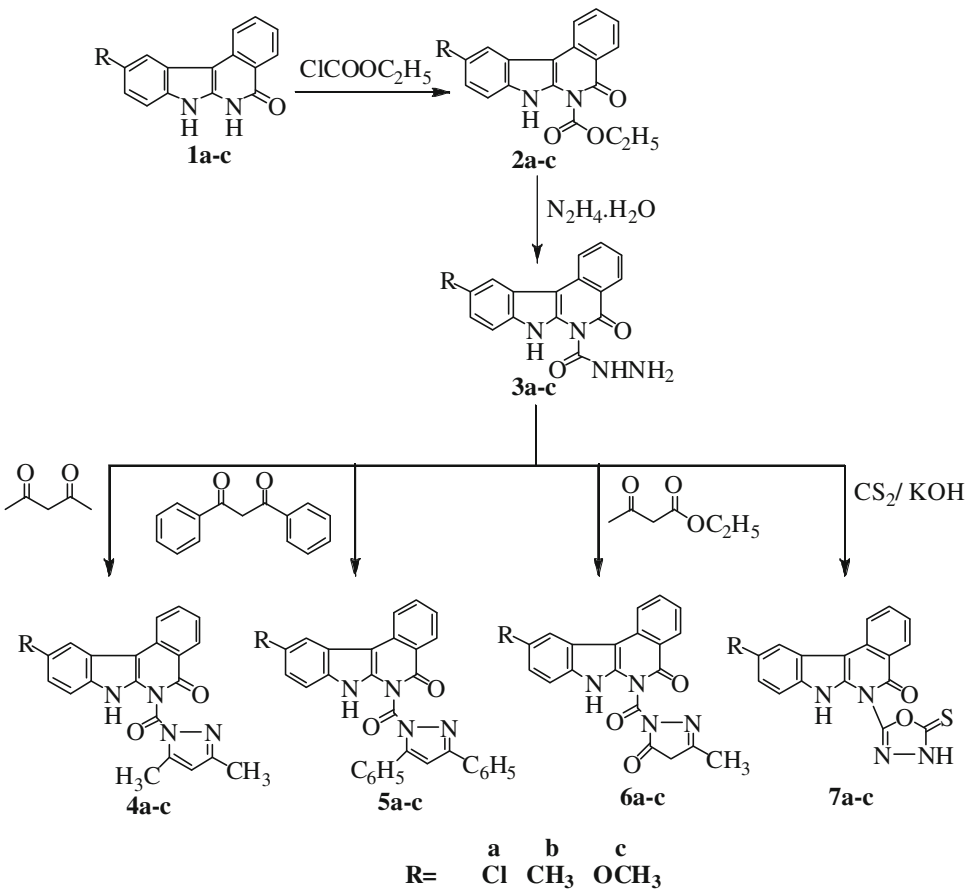
Compound (**3a**) on reaction with carbon disulfide and potassium hydroxide in dry methanol under reflux conditions afforded 5′-[10-chloro-6*H,* 7*H*-indolo[2, 3-c]isoquinolin-5-one- 6-yl]-1′, 3′, 4′-oxidiazol-2′-thione (**7a)**. Similarly, other derivatives in the series were prepared and structures of these compounds were confirmed by their spectral studies and elemental analysis.

Biological activities

Literature survey reveals that most of the synthesized compounds contain the biologically active pharmacophores –N–CO–N–, –N–CO–N–CO– and oxdiazoles which exhibited the wide range of activities such as, antimicrobial (Dhansay *et al*., 2010; Jaiswal *et al*., 2012; Latthe *et al*., 2006; Patel *et al*., 2007; Aanandhi *et al*., 2011), antioxidant (George *et al*., 2008; Aanandhi *et al*., 2010; Amornraksa *et al*., 2009), anti-inflammatory (Amir Mohd *et al*., 2007), and anticancer (Aboraia *et al*., 2006), etc. Therefore, based on these observations, the synthesized compounds have been screened for their antimicrobial and antioxidant activities.

Antimicrobial activity

The newly synthesized compounds (**4–7**) were screened for their antimicrobial activity by Cup-plate method (Indian pharmacopoeia, 1985; Saundane *et al*., 1998b). *Escherichia coli, Bacillus subtilis*, and *Pseudomonas putida* were used for antibacterial activity. Antifungal activity was evaluated against *Asperigillus niger, Asperigillus flavus,* and *Asperigillus fumigatus.* For the screening, nutrient agar medium



Scheme 1 Schematic pathway for the synthesis of compounds 4–7

Table 1 Antimicrobial activity of synthesized compounds (**4–7**)

Compd. no	Antibacterial activity (zone of inhibition in mm)			Antifungal activity (zone of inhibition in mm)		
	E. coli	*B. subtilis*	*P. putida*	*A. niger*	*A. flavus*	*A. fumigatus*
4a	09	11	19	16	11	15
4b	13	11	10	08	16	11
4c	11	08	10	10	08	04
5a	10	13	18	04	09	15
5b	05	09	13	15	13	04
5c	11	11	17	09	17	15
6a	07	10	15	06	09	13
6b	10	08	18	12	14	15
6c	17	10	10	09	07	04
7a	18	19	20	17	16	17
7b	11	11	19	08	13	10
7c	13	10	07	10	10	15
S_1	19	20	22	–	–	–
S_2	–	–	–	18	19	18

Where, S_1 Streptomycin (Standard), S_2 Fluconazole (Standard)

and potato dextrose agar medium were used for antibacterial and antifungal activity. The compounds were tested at 1 mg/ml concentration. Streptomycin and fluconazole were used as standards for antibacterial and antifungal activities, respectively. The results are reported in (Table 1).

The investigation of antibacterial screening revealed that compounds **6c** and **7a** exhibited maximum zone of inhibition against *E. coli*. Compound **7a** exhibited maximum inhibitory zone against *B. subtilis*. Whereas, compounds **5a, 5c**, **6b**, **7a,** and **7b** exhibited maximum zone of inhibition against *P. putida.*

In the case of antifungal activity, compounds **4a**, **5b**, and **7a** showed maximum zone of inhibition against *A. niger.* Compounds **4b**, **5c,** and **7a** exhibited good activity against *A. flavus*. Compounds **4a**, **5a, 5c**, **6b**, **7a**, and **7c** showed good activity against *A. fumigatus*. Rest of the compounds showed either lower activity or inactive against the organisms tested. From the results of antimicrobial activities, it could be assumed that the majority of synthesized compounds having chloro and methoxy substituents exhibited better activity.

Antioxidant activity

1, 1-Diphenyl-2-picryl hydrazyl (DPPH) radical scavenging activity (RSA)

DPPH has an odd electron and has strong absorption band at 517 nm. The reduction capability of DPPH radical was determined by decrease in its absorption at 517 nm induced by antioxidant. The RSA of the newly synthesized compounds (**4–7**) was carried out by following literature procedure (Hatano *et al.,* 1988) using ascorbic acid (AA), 2-*tert*-butyl-4-methoxy phenol (butylated hydroxy anisole, BHA), and 2-(1,1-dimethylethyl)-1,4-benzenediol (tertiary butylated hydroquinone, TBHQ) as standards. The RSA of test compounds in methanolic solution at 25, 50, 75, and 100 µg/ml concentrations containing freshly prepared DPPH solution (0.004 % w/v) was carried out and compared with those of standards AA, BHA, and TBHQ. All the test analyses were performed on three replicates and results were averaged. The results in percentage were expressed as the ratio of absorption decrease in the presence of test compounds and absorption of DPPH solution in the absence of test compounds at 517 nm on Elico SL 171 Mini Spec spectrophotometer. The results are shown in the Figs. 1 and 2.

The analysis of results indicated that compounds **5b**, **5c, 6a**, **6b**, **7a**, **7b**, and **7c** exhibited good radical scavenging activity (56.21, 60.05, 67.45, 57.98, 68.35, 57.69, and 60.75 %) at 25 µg/ml concentration, respectively. Compounds **5b**, **6b**, **7a**, **7b,** and **7c** showed radical scavenging ability (56.86, 64.20, 69.82, 65.38, and 67.75 %) at 50 µg/ml concentration, respectively. While compounds **4c, 6b,** and **7a** showed radical scavenging ability (53.84,

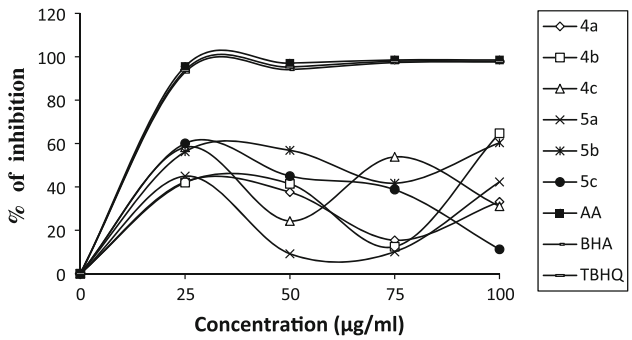


Fig. 1 Antioxidant activity of compounds (4–5)

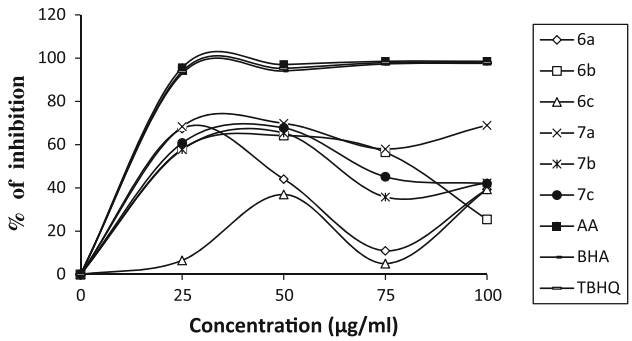


Fig. 2 Antioxidant activity of compounds (6–7)

56.50, and 57.98) at 75 μg/ml concentration, respectively. The compounds **4b** and **7a** exhibited RSA (64.74 and 68.93 %) at 100 μg/ml concentration, respectively. Compound **7a** showed maximum RSA may be due to presence of chloro and methoxy group. However, none of the compounds exhibited better RSA than the standards.

Conclusion

The present study revealed that the compounds having chloro and methoxy substituents exhibited good antimicrobial and antioxidant activities.

Experimental procedure

Chemistry

Materials and methods

All the reagents were obtained commercially and used by further purification. Melting points were determined by an open capillary method and are uncorrected. Purity of the compounds was checked by TLC using silica gel-G coated alumininum plates (Merck) and spots were visualized by exposing the dry plates in iodine vapors. The IR (KBr) spectra were recorded using a Perkin-Elmer Spectrum on FT-IR spectrometer. The ^{1}H NMR (DMSO) spectra recorded using Marcy Plus (Varian 400 MHz) and the chemical shifts were expressed in ppm (δ scale) and ^{13}C NMR (125 MHz, DMSO) spectra recorded on Bruker NMR. Mass spectra were recorded using a ILS-CHU-C-41-VBV4 MS mass spectrometer.

*General procedure for the synthesis of 10-substituted 6H, 7H-indolo[2,3-c]isoquinolin-5-ones (**1a–c**), ethyl [10-substituted 6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formates (**2a–c**) and [10-substituted 6H, 7H-indolo[2,3-c] isoquinolin-5-one-6-yl]carbohydrazides (**3a–c**).* These compounds were prepared by reported literature methods (Hiremath *et al.,* 1995).

*General procedure for the synthesis of 1′-[10-substituted 6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl]formyl-, -3′,5′-dimethylpyrazoles (**4a–c**), -3′,5′-diphenylpyrazoles (**5a–c**) and -3′-methylpyrazole-5′-ones (**6a–c**).* A mixture of hydrazides (**3a–c**) (0.001 mol) and acetyl acetone or dibenzoyl methane or ethyl acetoacetate (0.001 mol) in dry methanol containing 4–5 drops of conc. HCl was refluxed for 4 h on steam bath. The excess of solvent was distilled off under reduced pressure and the residue was cooled to room temperature. The separated solid was filtered off, washed with cold methanol (5-7 mL), dried, and recrystallized from ethanol to furnish pure **4a–c**, **5a–c** and **6a–c**.

*1′-[10-chloro-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′,5′-dimethylpyrazole (**4a**)* Yield: 72 %, mp > 300 °C; Rf, 0.65 ethyl acetate:acetone (6:4) mixture; FTIR (KBr) cm^{-1}: 3,278 (Indole NH); 1,654 (C=O); 1,630 (C=O); 1,620 (C=N); ^{1}H NMR (DMSO-d_6, δ, ppm), 10.90 (s, 1H, indole NH); 7.20–8.40 (m, 7H, Ar–H); 6.10 (s, 1H, Pyrazole-H); 3.50 (s, 3H, CH_3); 2.33 (s, 3H, CH_3); ^{13}C-NMR (DMSO-d_6, 125 MHz, δ), 162.8, 161.0, 145.5, 139.1, 138.8, 136.1, 134.6, 132.9, 132.4, 130.9, 130.7, 130.2 129.7, 128.6, 126.1, 125.4, 122.0, 120.9, 120.3, 22.8, 20.6; MS (EI) *m/z* 390 (M^+); 392 (M^++2). Anal. % $C_{21}H_{15}N_4O_2Cl$: C, 64.54; H, 3.87; N, 14.34. Found: C, 64.41; H, 3.82; N, 14.29.

*1′-[10-methyl-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′,5′-dimethylpyrazole (**4b**)* Yield: 68 %, mp > 300 °C; Rf, 0.71 ethyl acetate:acetone (6:4) mixture; FTIR (KBr) cm^{-1}: 3,388 (Indole NH); 1,700 (C=O); 1,658 (C=O); 1,623 (C=N); ^{1}H NMR (DMSO-d_6, δ, ppm) 11.09 (s, 1H, indole NH); 7.00–8.06 (m, 7H, Ar–H); 6.10 (s, 1H, Pyrazole-H); 2.58 (s, 3H, CH_3); 2.52 (s, 3H, CH_3); 2.21 (s, 3H, CH_3); Anal. % $C_{22}H_{18}N_4O_2$: C, 71.34; H, 4.90; N, 15.13. Found: C, 71.31; H, 4.82; N, 15.29.

*1′-[10-methoxy-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′,5′-dimethylpyrazole (**4c**)* Yield: 70 %, mp > 300 °C; Rf, 0.45 ethyl acetate:acetone (6:4) mixture; FTIR (KBr) cm^{-1}: 3,300 (Indole NH); 1,684 (C=O); 1,650 (C=O); 1,630 (C=N); ^{1}H NMR (DMSO-d_6, δ, ppm) 11.82 (s, 1H, indole NH); 7.10–8.23 (m, 7H, Ar–H); 6.22 (s, 1H, Pyrazole-H); 3.67 (s, 3H, OCH_3); 2.35 (s, 3H, CH_3); 2.25 (s, 3H, CH_3); Anal. % $C_{22}H_{18}N_4O_3$: C, 68.38; H, 4.70; N, 14.50. Found: C, 68.41; H, 4.82; N, 14.39.

*1′-[10-chloro-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′,5′-diphenylpyrazole (**5a**)* Yield: 72 %, mp > 300 °C; Rf, 0.65 ethyl acetate:acetone (6:4) mixture; FTIR (KBr) cm^{-1}: 3,214 (indole-NH); 1,739 (C=O); 1,700 (C=O); 1,630 (C=N); ^{1}H NMR (DMSO-d_6, δ, ppm), 11.00 (s, 1H, indole NH); 7.05–8.21 (m, 17H, Ar–H); 6.10 (s, 1H, Pyrazole-H); ^{13}C-NMR (DMSO-d_6, 125 MHz, δ), 163.0, 160.8, 146.3, 140.4, 135.8, 135.3, 135.1, 134.3, 133.9, 131.3, 129.8, 129.3, 129.2, 129.1, 128.8, 128.7, 128.3, 128.5, 128.2, 127.4, 127.3, 127.2, 127.1, 126.4, 126.3, 126.2, 126.1, 126.0, 121.8, 121.4, 121.3; MS (EI) *m/z* 514 (M^+); 516 (M^++2). Anal. % $C_{31}H_{19}N_4O_2Cl$: C, 72.30; H, 3.72; N, 10.88. Found: C, 72.21; H, 3.82; N, 10.71.

*1′-[10-methyl-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′,5′-diphenylpyrazole (**5b**)* Yield: 72 %, mp 298–99 °C; Rf, 0.72 ethyl acetate:acetone (6:4) mixture; FTIR (KBr) cm^{-1}: 3,385 (indole-NH); 1,721 (C=O); 1,700 (C=O); 1,628 (C=N); ^{1}H NMR (DMSO-d_6, δ, ppm), 11.82 (s, 1H, indole NH); 7.19–8.08 (m, 17H, Ar–H); 6.24 (s, 1H, Pyrazole-H); 2.48 (s, 3H, CH_3); Anal. % $C_{32}H_{22}N_4O_2$: C, 77.72; H, 4.48; N, 11.33. Found: C, 77.75; H, 3.78; N, 10.68.

*1′-[10-methoxy-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′,5′-diphenylpyrazole (**5c**)* Yield: 72 %, mp 265-66 °C; Rf, 0.52 ethyl acetate:acetone (6:4) mixture; FTIR (KBr) cm^{-1}: 3,306 (indole-NH); 1,725 (C=O); 1,700 (C=O); 1,630 (C=N); ^{1}H NMR (DMSO-d_6, δ, ppm), 11.82 (s, 1H, indole NH); 7.19-8.08 (m, 17H, Ar–H); 6.38 (s, 1H, Pyrazole-H); 3.46 (s, 3H, OCH_3); Anal. % $C_{32}H_{22}N_4O_3$: C, 75.28; H, 4.34; N, 10.97. Found: C, 75.20; H, 4.28; N, 11.25.

*1′-[10-chloro-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′-methylpyrazole-5′-one (**6a**)* Yield: 66 %, mp > 300 °C; Rf, 0.70 ethyl acetate:methanol (9:1) mixture; FTIR (KBr) cm^{-1}: 3,290 (indole-NH); 1,700 (C=O); 1,660 (C=O); 1,655 (C=O); ^{1}H NMR (DMSO-d_6, δ, ppm), 11.00 (s, 1H, indole NH); 7.41–8.40 (m, 7H, Ar–H); 3.09 (s, 2H, CH_2); 2.21 (s, 3H, CH_3); ^{13}C-NMR (DMSO-d_6, 125 MHz, δ), 163.3, 160.4, 158.0, 148.1, 139.8, 139.1, 135.8, 133.1, 132.4, 131.9, 130.1, 129.8, 129.1, 128.9, 126.3, 125.8, 122.5, 120.9, 120.1, 39.50, 19.6; MS (EI) *m/z* 392 (M^+); 394 (M^++2). Anal. % $C_{20}H_{13}N_4O_3Cl$: C, 61.16; H, 3.34; N, 14.26. Found: C, 62.00; H, 3.22; N, 14.18.

*1′-[10-methyl-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′-methylpyrazole-5′-one (**6b**)* Yield: 82 %, mp 288–89 °C; Rf, 0.52 ethyl acetate:methanol (9:1) mixture; FTIR (KBr) cm^{-1}: 3,330 (indole-NH); 1,700 (C=O); 1,682 (C=O); 1,664 (C=O); ^{1}H NMR (DMSO-d_6, δ, ppm), 11.84 (s, 1H, indole NH); 7.00–8.25 (m, 7H, Ar–H); 3.10 (s, 2H, CH_2); 2.58 (s, 3H, CH_3); 2.18 (s, 3H, CH_3); Anal. % $C_{21}H_{16}N_4O_3$: C, 67.73; H, 4.33; N, 15.05. Found: C, 67.82; H, 4.28; N, 15.18.

*1′-[10-methoxy-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] formyl-3′-methylpyrazole-5′-one (**6c**)* Yield: 58 %, mp > 300 °C; Rf, 0.63 ethyl acetate:methanol (9:1) mixture; FTIR (KBr) cm^{-1}: 3,300 (indole-NH); 1,713 (C=O); 1,700 (C=O); 1,682 (C=O); ^{1}H NMR (DMSO-d_6, δ, ppm), 11.68 (s, 1H, indole NH); 7.10–8.20 (m, 7H, Ar–H); 3.25 (s, 2H, CH_2); 3.58 (s, 3H, OCH_3); 2.18 (s, 3H, CH_3); Anal. % $C_{21}H_{16}N_4O_4$: C, 64.94; H, 4.15; N, 14.43. Found: C, 65.11; H, 4.28; N, 14.38.

*General procedure for the synthesis of 5′-[10-substituted 6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl]-1′,3′,4′-oxidiazole-2′-thiones (**7a–c**).* A mixture of hydrazides (**3a–c**) (0.005 mol), KOH (0.005 mol), and CS_2 (5 ml) in methanol (50 ml) was refluxed on a steam bath until the evolution of H_2S ceased (45–48 h). The solvent was then evaporated and residue dissolved in ice-cold water. The resulting clear solution was filtered and the filtrate was acidified with dilute HCl. The separated solid was filtered, washed with water, dried, and recrystallized from ethanol to furnish pure **7a–c.**

*5′-[10-chloro-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] -1′,3′,4′-oxidiazole-2′-thione (**7a**)* Yield: 62 %, mp > 300 °C; Rf, 0.62 ethyl acetate:methanol (9:1) mixture; FTIR (KBr) cm^{-1}: 3,283 (indole-NH); 3,154 (NH); 1,658 (C=O); 1,201 (C=S); ^{1}H NMR (DMSO-d_6, δ, ppm) 11.32 (s, 1H, indole NH); 9.21 (s, 1H, NH); 7.23–8.12 (m, 7H, Ar–H); ^{13}C-NMR (DMSO-d_6, 125 MHz, δ), 176.2, 163.5, 158.1, 148.3, 139.2, 137.1, 136.7, 136.1, 129.8, 129.1, 128.9, 128.5, 127.3, 127.1, 121.4, 121.2, 120.9; MS (EI) *m/z* 368 (M^+); 370 (M^++2). Anal. % $C_{17}H_9N_4O_2SCl$: C, 55.36; H, 2.46; N, 15.19. Found: C, 55.41; H, 2.40; N, 15.11.

*5′-[10-methyl-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] -1′,3′,4′-oxidiazole-2′-thione (**7b**)* Yield: 60 %, mp 244–45 °C; Rf, 0.52 ethyl acetate:methanol (9:1) mixture; FTIR (KBr) cm^{-1}: 3,333 (indole-NH); 3,282 (NH); 1,700 (C=O); 1,213 (C=S); ^{1}H NMR (DMSO-d_6, δ, ppm), 11.74 (s, 1H, indole NH); 9.00 (s, 1H, NH); 7.03–8.00 (m, 7H, Ar–H); 2.18 (s, 3H, CH_3); Anal. % $C_{18}H_{12}N_4O_2S$: C, 62.06; H, 3.47; N, 16.08. Found: C, 61.86; H, 3.40; N, 16.11.

*5′-[10-methoxy-6H, 7H-indolo[2,3-c]isoquinolin-5-one-6-yl] -1′,3′,4′-oxidiazole-2′-thione (**7c**)* Yield: 56 %, mp 295–96 °C; Rf, 0.45 ethyl acetate:methanol (9:1) mixture; FTIR (KBr) cm^{-1}: 3,315 (indole-NH); 3,245 (NH); 1,701 (C=O); 1,210 (C=S); ^{1}H NMR (DMSO-d_6, δ, ppm), 11.59 (s, 1H, indole NH); 8.75 (s, 1H, NH); 7.00–8.12 (m, 7H, Ar–H); 3.68 (s, 3H, OCH_3); Anal. % $C_{18}H_{12}N_4O_3S$: C, 59.33; H, 3.32; N, 15.38. Found: C, 60.06; H, 3.40; N, 15.31.

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