Sulfamic Acid Catalyzed Atom Economic, Eco-friendly Synthesis of Novel 7-(Aryl)-10-thioxo-7,9,10,11-tetrahedro-6*H*-pyrimido-[5′4′:5,6] pyrano[3,2-c]quinoline-6,8(5*H*)-dione and its Derivatives

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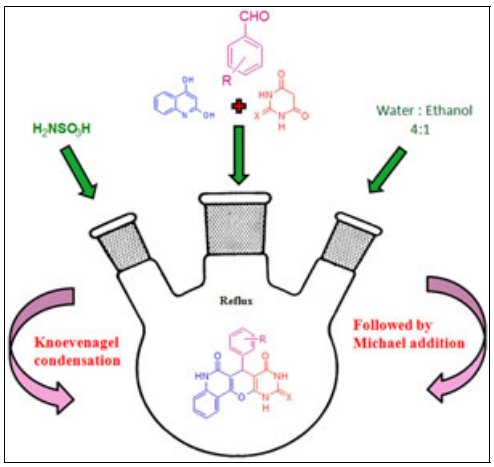


A series of novel 7-(3-chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6*H*-pyrimido-[5′4′:5,6] pyrano [3,2-c]quinoline-6,8(5*H*)-dione derivatives have been synthesized through the multi-component condensation of aromatic aldehydes, barbituric acid, and 2,4-dihydroxy quinoline, using heterogeneous sulfamic acid catalyst in water-ethanol (4:1) solvent system under reflux condition. The present protocol is endowed with charming description such as green synthetic procedure, short reaction time, easy work-up procedure, and excellent yield and high atom economy of pyranoquinoline derivatives. In this study, sulfamic acid is used as a heterogeneous catalyst that is easily recoverable and recyclable. The proposed multi-component reaction has been studied with detail mechanism and spectroscopic data. This is one of the potential greener synthetic approaches to build up the series of pyranoquinoline heterocycles.

INTRODUCTION

Multi-component reactions (MCRs) involve use of two or more simple and flexible building components to be combined; hence, it is considered as automated synthesis (Fig. 1) [1]. MCRs have fascinated interest owing to their outstanding synthetic effectiveness, high-bond forming efficiency, brevity, and molecular diversity [2]. MCRs play an important role in heterocyclic synthesis because of the ability to construct the new C–C and C-hetero bonds [3]. Thus, MCRs have attracted considerable interest owing to their exceptional synthetic efficiency.

The development of current heterocyclic synthesis is considerably dependent on further advances in heterocyclic MCRs methodology. According to current synthetic needs, ecologically pure multi-component procedures are particularly welcomed [4]. Thus, these single synthetic operational techniques are widely used in chemical and pharmaceutical combinatorial synthesis [5], which are enviro-economically advantageous because of their productivity, simple procedures, convergence, atom economy, use of non-toxic greener solvents for reaction, and facile execution. Moreover, under an umbrella of green chemistry, organic processes should be designed using water as a solvent or under solvent-free conditions [6]. Furthermore, water is referred as "the universal solvent." From economical and environmental point of view, water is accompanying with some interesting features like easy availability, ease of handling, non-toxicity, and non-volatility. In recent years, water has been employed as a solvent in many organic transformations even though the solubility is prerequisite for any heterocyclic compounds synthesis [7]. With growing consciousness of research community,

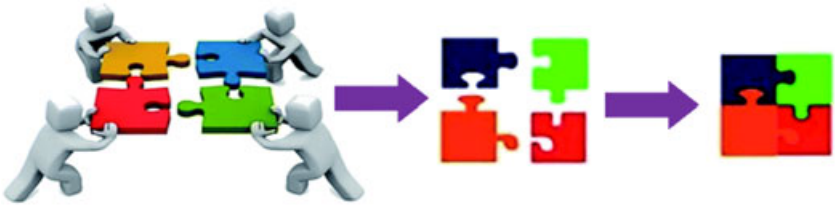


Figure 1. Multi-component reaction strategies. [Color figure can be viewed at wileyonlinelibrary.com]

researchers use water as a solvent for the MCRs [8]. Recently, using water as a solvent, 32% of pharmaceutical heterocyclic products have been synthesized [9].

It is well known that the nitrogen and oxygen containing heterocyclic compounds are important nuclei in various natural product syntheses [10,11]. Geibalasine (Fig. 2a), ribalinine (Fig. 2b), and findersine (Fig. 2c) are the few examples of natural products [12–15]. The nitrogen containing linomide (Fig. 2d) derivative is a well-known immunomodulator (Fig. 2) [16].

Thus, pyranoquinoline is one of the significant nitrogen and oxygen containing heterocyclic compounds having diverse significant biochemical processes [17–22]. Naturally, pyranoquinoline motifs are present in leaves and roots of *Toddalia asiatica* (L) Lam (Rutaceae) [23,24]. Pyranoquinolines are associated with a variety of pharmacological properties such as estrogenic [25,26], anti-inflammatory [27], antiproliferative, anti-tubulin activities [28], anti-microbial [29], and anti-viral [30].

Owing to the pharmacological significance of this class of compounds, several researchers have paid considerable attention towards the synthesis of pyranoquinoline derivatives [31–33]. Moreover, the literature designates that nitrogen and oxygen containing fused pyranoquinoline derivatives have been carried out by diverse catalyst such as ionic liquids [34], ammonium acetate [20], Et_3N [28], CAN [35], KF-Al_2O_3 [36], pyridine [37], sodium ethoxide [38], laccase [39], acetic acid [40], PPA [41], $FeCl_3$NaI [42], Au-TiO_2 [43], $Yb(OTf)_3$ [44], and phase transfer catalyst [45]. These methods have their own limitations such as tedious workup procedures, use of toxic reagents, carcinogenic solvents, and cost of reactant and catalyst. However, heterogeneous acid catalysts are more useful and act as an alternative for the conventional homogeneous acid catalysts. Sulfamic acid (H_2NSO_3H) is relatively stable, commercially available, non-volatile, and non-corrosive green heterogeneous catalysis [46]. It has been widely used as an effective catalyst in organic synthesis [46,47], owing to their properties and to outwit demerits of the previous reports with elevated interest in the heterocycle synthesis via greener method and efficient starting ingredients with economically chipper catalyst [48]. Herein, we successfully demonstrate an inexpensive, atom economic and eco-friendly way for synthesis of pyranoquinolines using water-ethanol (4:1) as a green non-toxic solvent system and reusable sulfamic acid catalyst in one-pot three-component condensation.

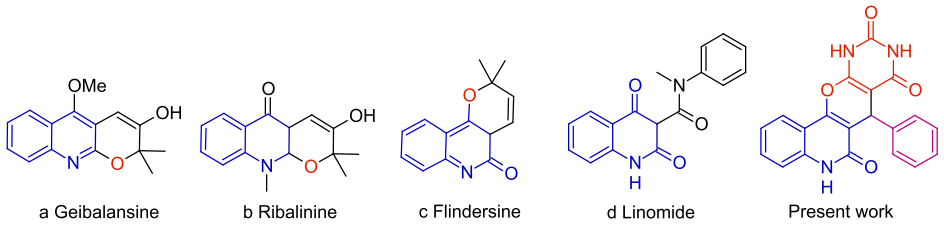
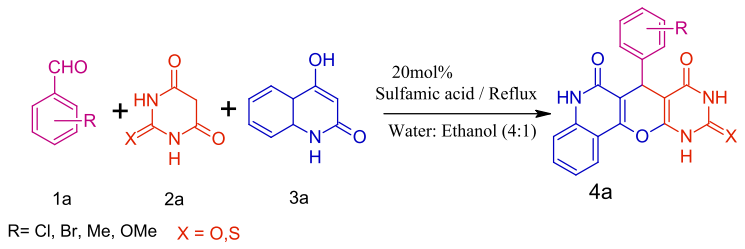


Figure 2. Nitrogen and oxygen containing fused heterocyclic natural product. [Color figure can be viewed at wileyonlinelibrary.com]

Scheme 1. Synthesis of pyranoquinoline derivatives. [Color figure can be viewed at wileyonlinelibrary.com]



RESULTS AND DISCUSSION

A model reaction (Scheme 1), 3-chlorobenzaldehyde (**1a**, 1 mmol) and thiobarbituric acid (**2a**, 1 mmol), was taken in 50 mL round-bottomed flask containing 5 mL of water-ethanol (4:1). The resultant reaction mixture was stirred at room temperature to complete the Knoevenagel reaction monitored by thin-layer chromatography (TLC). After the formation of Knoevenagel product, 2,4-dihydroxyquinoline (**3a**, 1 mmol) and sulfamic acid were introduced and reaction refluxed in an oil bath until completion of the reaction. Then reaction mixture was poured slowly on the crushed ice–water mixture with constant stirring. The product was recrystallized using ethanol. The IR spectrum of 7-(3-chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6*H*-pyrimido-[5′4′:5,6] pyrano[3,2-c]quinoline-6,8(5*H*)-dione shows aromatic C–H stretching band at 2929 cm^{-1}, and C═O and C═S group appeared at 1678 and 1636 cm^{-1}(see Supporting Information data). The ^{1}H NMR of the same compound showed a singlet for benzylic (−CH) proton at δ 6.19 ppm, and the remaining eight aromatic protons encountered between the aromatic region at δ 7.05–8.05 ppm. The characteristic −NH proton signals appeared as a singlet at δ 12.37 and 12.44 ppm. The ^{13}C NMR spectrum of the same compound exhibited a signal at δ 33.18 for benzylic carbon, and the remaining aromatic carbons appeared between the ranges at δ 95.65–137.55 ppm. The carbonyl carbon in the product was observed at δ 165.73 and 173.87 ppm (Supporting Information), which confirmed the formation of the desired compound. These initial results inspired us to optimize the reaction and study the scope of reaction in detail.

Optimization of reaction. For the optimization of reaction, it is essential to study the effect of solvent and amount of catalyst on the said MCR; the same reaction was carried out in various solvents and amount of catalysts included in the table (Table 1). In the trial case, when reactions were carried out at an uncatalyzed condition with variation of solvent (Table 1, entry 1–8), expected products were not obtained; however, the reaction proceeded up to the Knoevenagel condensation. Later on, the same reaction was performed using catalytic amount of acetic acid and sulfamic acid at room temperature as well as under reflux conditions up to 12 h (Table 1, entry 9–17). The catalytic efficiency of sulfamic acid was studied with respect to quantity used. The same reaction was extended with a varying amount of sulfamic acid in water-ethanol (Table 1, entry 18–22). It has been observed that 20 mol% of catalyst is sufficient for this

Table 1

Optimization of reaction[a] conditions for the synthesis of 7-(3-chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6*H*-pyrimido-[5′4′:5,6] pyrano[3,2-c]quinoline-6,8(5*H*)-dione derivatives.

Entry	Solvent	Temperature	Catalyst (20 mol%)	Time (h)	Yield (%)[b]
1	Water	RT	–	12	–
2	Acetonitrile	RT	–	12	–[c]
3	Methanol	RT	–	12	–[c]
4	Ethanol	RT	–	12	–[c]
5	Water	Reflux	–	12	–[c]
6	Acetonitrile	Reflux	–	12	–[c]
7	Methanol	Reflux	–	12	–[c]
8	Ethanol	Reflux	–	12	–[c]
9	DMF	Reflux	Acetic acid[d]	12	–[c]
10	Water	Reflux	Acetic acid[d]	12	–[c]
11	Acetonitrile	Reflux	Acetic acid[d]	12	–[c]
12	Methanol	Reflux	Acetic acid[d]	12	Trace
13	Ethanol	Reflux	Acetic acid[d]	12	36
14	Water	Reflux	Sulfamic acid[d]	12	47
15	Acetonitrile	Reflux	Sulfamic acid[d]	12	42
16	Methanol	Reflux	Sulfamic acid[d]	12	41
17	Ethanol	Reflux	Sulfamic acid[d]	12	64
18	Water:ethanol (4:1)	Reflux	Sulfamic acid[d]	1.30	92
19	Water:ethanol (4:1)	Reflux	5 mol% Sulfamic acid	1.30	62
20	Water:ethanol (4:1)	Reflux	10 mol% Sulfamic acid	1.30	75
21	Water:ethanol (4:1)	Reflux	15 mol% Sulfamic acid	1.30	85
22	Water:ethanol (4:1)	Reflux	25 mol% Sulfamic acid	1.30	88

[a]Reaction of 3-chlorobenzaldehyde (1 mmol), thiobarbituric acid (1 mmol), and 2,4-dihydroxyquinoline (1 mmol) was carried out at different reaction conditions and solvents.
[b]Obtained yield.
[c]Knoevenagel condensation product.
[d]Amount of catalyst is 20 mol%.

conversion (Table 1, entry 18). These results indicated that the water-ethanol (4:1) solvent system and 20 mol% of sulfamic acid are a good combination for the said MCRs.

These optimistic results inspired us to check the applicability of the present protocol to get a new library of 7-(3-chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6*H*-pyrimido-[5′4′:5,6] pyrano[3,2-c]quinoline-6,8(5*H*)-dione derivatives using experimentally designed optimum conditions with various substituted aldehydes and dicarbonyl compounds (Fig. 3**)** with electron-donating or electron-withdrawing substituent. Electronic effect was not observed on the said protocol with electron withdrawing and donating groups of aromatic aldehydes, but in case aliphatic aldehydes (butanal and 2-methyl

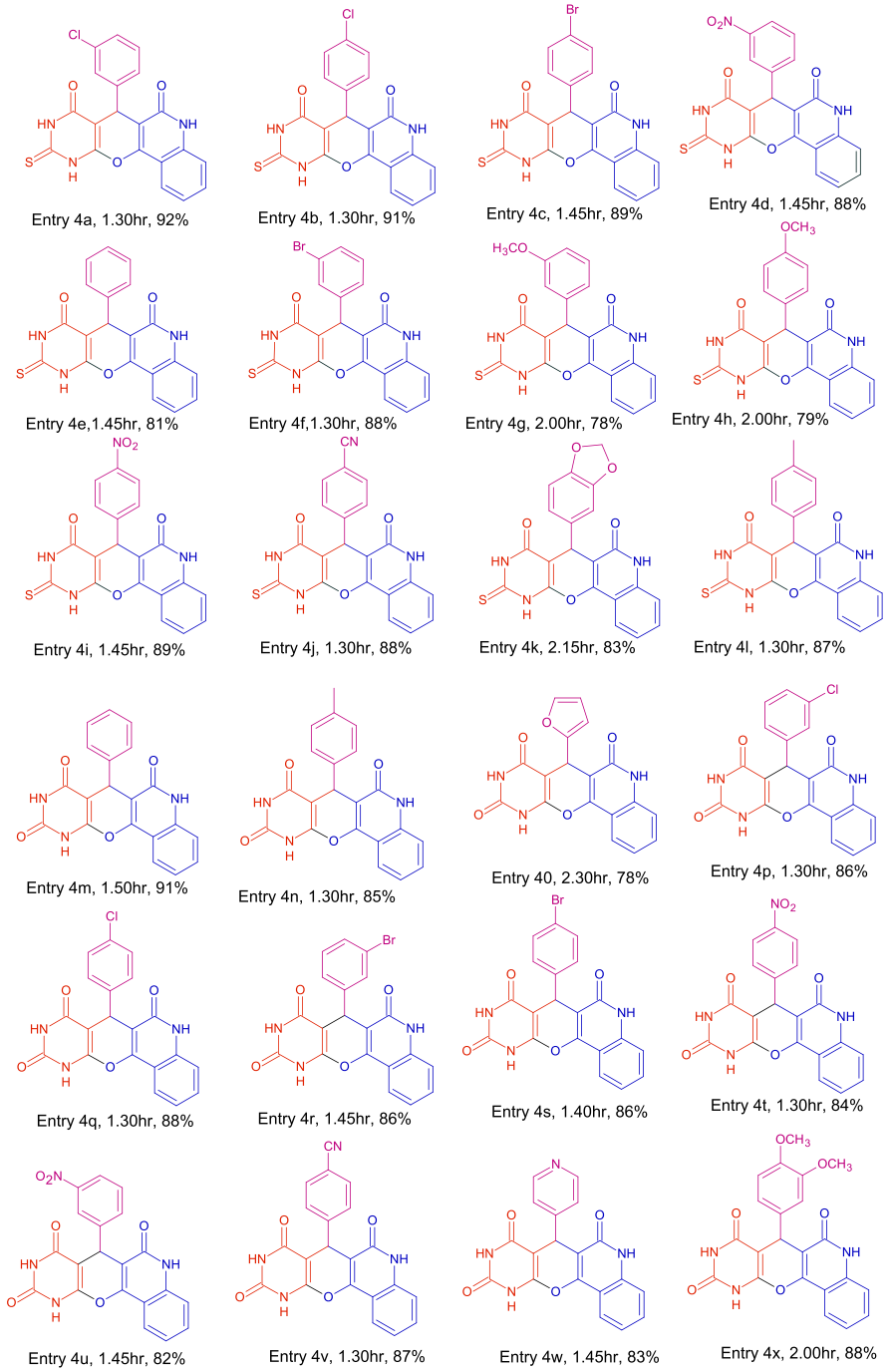


Figure 3. Synthesis of 7-(3-chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6*H*-pyrimido-[5′4′:5,6] pyrano[3,2-c]quinoline-6,8(5*H*)-dione derivatives. [Color figure can be viewed at wileyonlinelibrary.com]

propanal) failed to obtain the targeted compound. These results showed that this new methodology is very useful for the synthesis of the said compound. All the aromatic aldehyde precursors gave a good yield irrespective of their substitution pattern. Furthermore, the greener approach of this protocol was proved by its atom economy. Superior atom economy values and yields showed the greenness of this methodology (Fig. 4). Overall good to excellent yields of the desired pyranoquinoline derivatives were obtained.

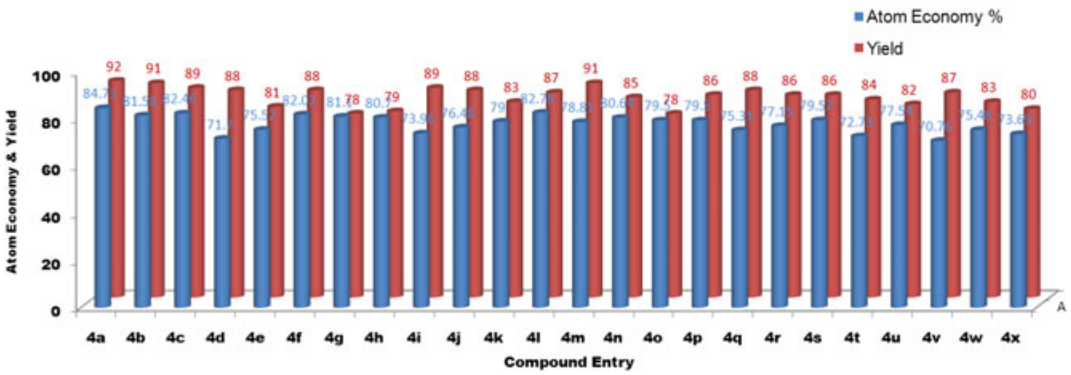
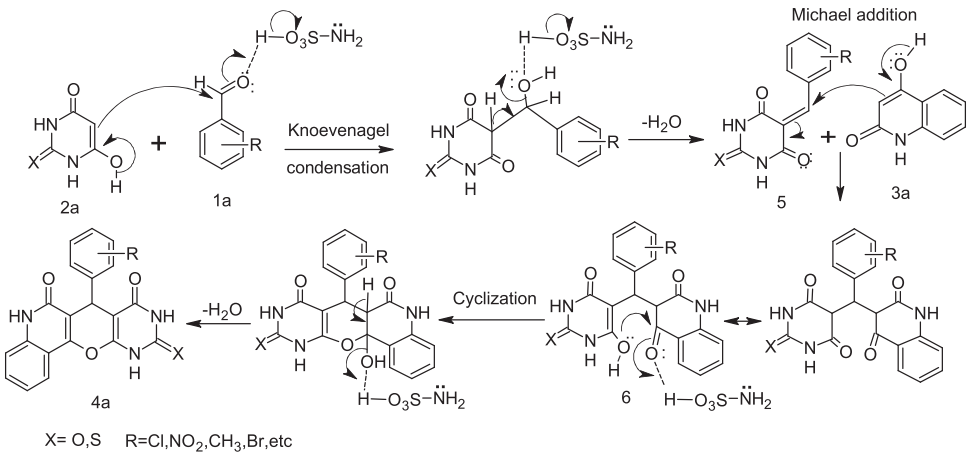


Figure 4. Atom economy and yield of a synthesized product. [Color figure can be viewed at wileyonlinelibrary.com]

Scheme 2. Plausible mechanism of the reaction.



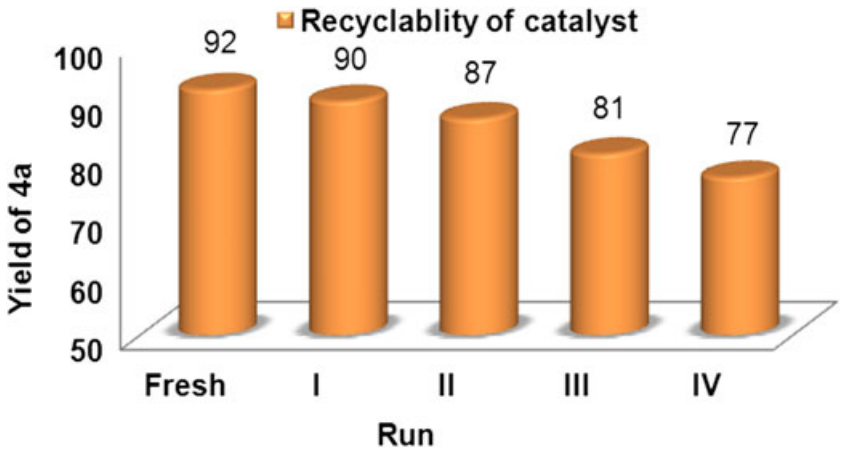


Figure 5. Recyclability of catalyst. [Color figure can be viewed at wileyonlinelibrary.com]

The plausible mechanism for the formation of 7-(3-chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6*H*-pyrimido-[5′4′:5,6] pyrano[3,2-c]quinoline-6,8(5*H*)-dione is depicted in Scheme 2. Initially, Knoevenagel condensation was carried out between aromatic aldehyde (1a) and thiobarbituric acid (2a) to form a Knoevenagel product (5-(3-chlorobenzylidene)-2-thioxodihydropyrimidine-4,6 (1*H*,5*H*)-dione). The Knoevenagel product (5) was subjected to Michael addition with the 2,4-dihydroxyquinoline (3a) that gave an intermediate (6), which subsequently cyclized followed by intramolecular dehydration to form a desired product (4a).

The reusability of catalyst (sulfamic acid) is one of the inspiring approaches of this methodology. The catalyst was present in the aqueous layer. This aqueous layer was evaporated under the reduced pressure and formed a solid sulfamic acid, which is further washed with diethyl ether (2 × 20 mL), dried at 80°C, and subjected to check the efficiency. Recyclability of catalyst was checked to fourth run having yield 92–77% (Fig. 5). Thus, the catalyst showed excellent recyclability.

CONCLUSION

In conclusion, we have developed an environmentally benign, simple, and cost-efficient method for the synthesis of a novel heterocyclic compounds 7-(3-chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6*H*-pyrimido-[5′ 4′:5,6] pyrano[3,2-c]quinoline-6,8(5*H*)-dione and its derivatives using sulfamic acid in water-ethanol (4:1) as a recyclable green catalyst and greener solvent system. The developed methodology has major advantages including its simplicity of operation, greener approach, easy workup procedure, selectivity, higher yields, and high-atom economic. Furthermore, the purification of the product is simple; there is no need to use a column chromatography technique, and moreover, the catalyst collected could be reused for the subsequent reactions.

EXPERIMENTAL

All the chemicals were purchased from Sigma-Aldrich and used without purification. The reaction was monitored by TLC. The melting points were determined in open-glass capillary tubes and were uncorrected. The structures of compounds have been confirmed by IR, ^{1}H NMR, and ^{13}C NMR. The IR spectra were recorded on a JASCO FT-IR 4600 spectrophotometer, and the values are expressed as ν max cm^{-1}. The ^{1}H NMR and ^{13}C-DEPT NMR spectra were recorded on Bruker Spectrospin Avance II-300 and 75 MHz spectrophotometer relative to tetramethylsilane as an internal standard using DMSO-d_6 as a solvent. The chemical shift values are expressed in δ ppm.

General synthetic procedure. Aromatic aldehyde (**1a**, 1 mmol) and thiobarbituric acid/barbituric acid (**2a**, 1 mmol) were mixed together in a 50 mL round-bottomed flask at a room temperature to get the Knoevenagel product monitored by TLC. Then 2,4-dihydroxyquinoline (**3a**, 1 mmol) and sulfamic acid (20 mol%) were added, and the same reaction mixture was refluxed using water-ethanol (4:1) as a solvent (5 mL) for 1.30 h. The progress of the reaction was monitored by TLC using ethyl acetate-petroleum ether (8:2 v/v). After completion, the reaction mixture was then poured slowly on crushed ice–water mixture with constant stirring. The desired product was isolated, filtered, and washed with ethanol (20 mL). Finally, the crude product was recrystallized using ethanol. The aqueous layer was evaporated under the reduced pressure and recovered sulfamic acid, which is further washed with diethyl ether (2 × 20 mL), dried at 80°C, and reused.

Spectral data of synthesized compounds. ***7-(3-Chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4a).*** White solid, yield: 92%: 0.377 gm, m.p. > 300°C (decompose). IR (KBr), ν max; 3074, 2929, 2767, 1720, 1676, 1636, 1604 cm^{-1}; ^{1}H NMR (300 MHz, DMSO-d_6): δ, 6.19 (s, 1H, −CH), 7.05–7.08 (d, J = 6 Hz, 2H, Ar-H), 7.22–7.37 (m, 4H, Ar-H), 7.46–7.67 (m, 1H, Ar-H), 8.03–8.05 (d, J = 9 Hz 1H, Ar-H), 12.37 (br.s, 2H, −NH), 12.44 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.18, 95.65, 11.23, 116.56, 116.79, 123.51, 123.75, 125.77, 126.26, 126.65, 130.37, 131.99, 133.36, 137.28, 142.29, 162.69, 165.73, 173.87 ppm. ^{13}C-DEPT 90 NMR (75 MHz, DMSO-d_6): 33.15, 116.79, 123.52, 123.75, 125.77, 126.26, 126.64, 130.38, 131.99 ppm. *Anal.* Calcd. for $C_{20}H_{12}$ ClN_3O_5S: C, 58.61; H, 2.95; N, 10.25%. Found: C, 58.57; H, 2.88; N, 10.19%.

7-(4-Chloro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano [3]quinoline-6,8(5H)-dione (4b). White solid, yield: 91%: 0.374 gm, m.p. 280–284°C (melt), IR (KBr), ν max: 3107, 2930, 1733, 1634, 1603 cm^{-1}; ^{1}H NMR (300 MHz, DMSO-d_6): δ, 5.87 (s, 1H, −CH), 7.05 (s, 2H, Ar-H), 7.01–7.02 (m, 2H, Ar-H), 7.44–7.53 (m, 2H, Ar-H), 7.98 (m, 2H, Ar-H), 12.50 (br. s, 2H, −NH), 12.51 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.08, 95.87, 111.25, 116.73, 123.59 (2C), 128.25 (2C), 128.56 (2C), 131.02 (2C), 131.76 (2C), 137.13, 137.55, 165.69, 173.79 (2C) ppm. *Anal.* Calcd. for $C_{20}H_{12}$ ClN_3O_3S: C, 58.61; H, 2.95; N, 10.25%. Found: C, 58.69; H, 3.00; N, 10.29%.

7-(4-Bromo-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4c). White solid, yield: 89%: 0404 gm, m.p. > 300°C (decompose), IR (KBr), ν max: 3070, 2929, 1725, 1682,

1636, 1605 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 6.13 (s, 1H, −CH), 7.03–7.06 (d, J = 9 Hz, 2H, Ar-H), 7.32–7.37 (t, 1H, Ar-H), 7.40–7.49 (m, 3H, Ar-H) 7.62–7.67 (t, 1H, Ar-H), 8.02–8.04 (d, J = 6 Hz, 1H, Ar-H), 12.37 (br.s, 3H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.01, 95.80, 111.36, 116.55, 116.76 (2C), 119.17, 123.51, 123.71, 129.28 (2C), 131.31 (2C), 131.97 (2C), 137.24, 138.95, 162.60, 165.75, 173.84 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ BrN_3O_3S: C, 52.88; H, 2.66; N, 09.25%. Found: C, 52.79; H, 2.59; N, 09.21%.

7-(3-Nitro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4d). Yellow solid, yield: 88%: 0.369 gm, m.p. > 300°C (decompose). IR (KBr), v max: 3084, 2981, 1700, 1683, 1643, 1524, 1387 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 6.32 (s, 1H, −CH), 7.35–7.38 (t, 1H, Ar-H), 7.47–7.68 (m, 4H, Ar-H), 7.85 (s, 1H, Ar-H), 8.05–8.07 (d, 2H, Ar-H), 12.36 (br.s, 2H, −NH), 12.45 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.37, 95.47, 110.87, 116.57, 116.84, 121.46, 123.59, 123.80, 130.08, 132.11, 134.09, 137.33, 142.30, 148.27, 162.96, 163.90, 165.68, 173.99 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ N_4O_5S: C, 57.14; H, 2.88; N, 13.33%. Found: C, 57.18; H, 2.81; N, 13.26%.

7-(Phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5' 4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4e). White solid, yield: 81%: 0.304 gm, m.p. 280–283°C. IR (KBr), v max: 3064, 2930, 1676, 1635, 1604 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 6.14 (s, 1H, −CH), 7.07–7.27 (m, 5H, Ar-H), 7.33–7.38 (t, 1H, Ar-H), 7.47–7.50 (d, J = 9 Hz, 1H, Ar-H), 7.62–7.67 (t, 1H, Ar-H), 8.03–8.05 (d, J = 6 Hz, 1H, Ar-H), 12.47, (3H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.32, 96.16, 111.72, 116.56, 116.79 (2C), 123.56, 123.67, 126.22 (2C), 126.80, 128.54 (2C), 131.92, 137.18 (2C), 138.94, 162.53, 165.90, 173.82 ppm. ^{13}C-DEPT 135 NMR (75 MHz, DMSO-d_6): 33.30, 116.79, 123.56, 123.66, 126.22, 126.79, 128.55, 131.93 ppm. ^{13}C-DEPT 90 NMR (75 MHz, DMSO-d_6): 33.29, 116.79, 123.56, 123.66, 126.22, 128.55, 131.93, 126.79 ppm. *Anal*. Calcd. for $C_{20}H_{13}$ N_3O_3S: C, 63.99; H, 3.49; N, 11.19%. Found: C, 64.04; H, 3.54; N, 11.25%.

7-(3-Bromo-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4f). White solid, yield: 88%: 0399 gm, m.p. > 300°C (decompose), IR (KBr), v max: 3100, 2978, 2858, 1725, 1644, 1605 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 6.20 (s, 1H, −CH), 7.06 (s, 1H, Ar-H), 7.09–7.23 (m, 2H, Ar-H), 7.30–7.36 (m, 2H, Ar-H), 7.43–7.46 (m, 1H, Ar-H), 7.60–7.65 (m, 1H, Ar-H), 7.99–8.03 (m, 1H, Ar-H), 12.25 (br.s, 3H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.08, 60.28, 95.49, 111.22, 116.65, 122.01, 123.45, 123.75, 126.14, 129.11, 129.43, 130.71, 131.96, 137.27, 142.82, 158.54, 162.66, 165.62, 170.94, 173.79. *Anal.* Calcd. for $C_{20}H_{12}$ BrN_3O_3S: C, 52.88; H, 2.66; N, 09.25. Found: C, 52.95; H, 2.71; N, 09.32%.

7-(3-Methoxy-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano [3,2-c]quinoline-6,8(5H)-dione (4g). Yellow solid, yield: 78%: 0.316 gm, m.p. > 300°C (decompose), IR (KBr), v max: 3070, 2929, 1725, 1682, 1636, 1605 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 3.66 (s, 3H, $-OCH_3$), 6.11 (s, 1H, −CH), 6.66–6.68 (d, J = 6 Hz, 2H, Ar-H), 6.75–6.77 (d, J = 6 Hz, 1H, Ar-H), 7.14–7.20 (t, 1H, Ar-H), 7.33–7.38 (t, 1H, Ar-H), 7.47–7.50 (m, 1H, Ar-H), 7.62–7.67 (t, 1H, Ar-H), 8.03–8.05 (s, 1H, Ar-H), 12.47 (br.s, 3H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.29, 55.36, 60.21, 95.08, 110.79, 111.73, 113.40, 116.80, 119.26, 123.53, 123.67, 126.43, 127.00, 127.19, 129.59, 131.92, 131.19, 159.68, 165.88, 168.78, 173.81 ppm. *Anal*. Calcd. for $C_{21}H_{15}$ N_3O_4S; C, 62.21; H, 3.73; N, 10.36%. Found: C, 62.16; H, 3.68; N, 10.31%.

7-(4-Methoxy-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4h). Yellow solid, yield: 79%: 0.319 gm, m.p. > 300°C (decompose), IR (KBr), v max: 3069, 2902, 1637, 1604 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 3.88 (s, 3H, $-OCH_3$), 5.87 (s, 1H, −CH), 7.06–7.09 (d, J = 9 Hz, 2H, Ar-H), 7.25 (s, 1H, Ar-H), 7.46–7.52 (t, 1H, Ar-H), 7.73–7.79 (s, 1H, Ar-H), 8.02 (s, 1H, Ar-H), 8.40–8.43 (d, J = 9 Hz, 2H, Ar-H), 11.27 (s, 1H, −NH), 12.30 (br.s, 1H, −NH), 12.39 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 55.42, 98.18, 113.93, 114.54, 115.59, 115.85, 116.01, 121.90, 123.17 (2C), 127.00 (2C), 127.89, 131.55, 135.34, 138.41, 160.41, 163.48, 164.02, 164.45, 178.14 ppm. *Anal*. Calcd. for $C_{21}H_{15}$ rN_3O_4S: C, 62.21; H, 3.73; N, 10.36%. Found: C, 62.19; H, 3.71; N, 10.40%.

7-(4-Nitro-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4i). Yellow solid, yield: 89%: 0.374 gm, m.p. > 300°C (decompose), IR (KBr), v max: 3071, 2930, 1733, 1634, 1604, 1560, 1391 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 6.13 (s, 1H, −CH), 7.35–7.47 (m, 4H, Ar-H), 7.61–7.65 (m, 1H, Ar-H), 8.01–8.12 (m, 3H, Ar-H), 12.22 (br.s, 3H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): 33.76, 95.44, 108.99, 110.99, 116.56, 116.79, 119.46, 123.52, 123.77 (2C), 128.13 (2C), 132.04, 132.45, 137.33, 146.09, 147.29, 162.84, 165.69, 173.93 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ N_4O_5S: C, 57.14; H, 2.88; N, 13.33%. Found: C, 57.20; H, 2.82; N 13.37%.

7-(4-Cyno-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4j). White solid, yield: 88%: 0.352 gm, m.p. 273–276°C (decompose), IR (KBr), v max: 3070, 2929, 2225, 1682, 1636, 1604 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 6.28 (s, 1H, −CH), 7.27–7.30 (d, 3H, Ar-H), 7.46 (s, 1H, Ar-H), 7.63–7.70 (m, 3H, Ar-H), 8.02 (s, 1H, Ar-H), 12.23 (br.s, 1H, −NH), 12.27 (br.s, 2H, −NH) ppm. ^{13}C

NMR (75 MHz, DMSO-d_6): δ, 33.74, 95.43, 111.07, 116.58, 116.72, 123.44 (2C), 123.69 (2C), 123.80 (2C), 128.33 (2C), 132.02, 137.38, 146.17, 148.73, 162.76, 165.64, 173.94 ppm. *Anal*. Calcd. for $C_{21}H_{12}$ N_4O_3S: C, 62.99; H, 3.02; N, 13.99%. Found: C, 63.03; H, 3.09; N, 13.91%.

7-(1,3-Benzodioxol-5-yl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4k). Orange solid, yield: 83%: 0.348 gm, m.p. > 300°C (decompose), IR (KBr), *v* max: 3126, 2921, 1706, 1689, 1653; ^{1}H NMR (300 MHz, DMSO-d_6): δ, 5.77 (s, 1H, Ar-H), 6.20 (s, 2H, −Ar-H), 7.08–7.13 (m, 2H, Ar-H), 7.20 (s, 1H, Ar-H), 7.64–7.81 (m, 2H, Ar-H), 8.22 (s, 1H, Ar-H), 8.29 (s, 1H, Ar-H), 1130. (s, 1H, −NH), 12.31 (br.s, 1H, −NH), 12.40 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.06, 98.51, 107.61, 108.19, 115.49, 115.67, 116.41, 121.63, 123.11 (2C), 127.36 (2C), 131.37, 134.86, 143.60, 147.87, 162.57, 163.07, 163.95, 173.75, 178.70 ppm. *Anal*. Calcd. for $C_{21}H_{13}$ N_3O_5S: C, 60.14; H, 3.12; N, 10.02%. Found: C, 60.18; H, 3.17; N, 10.09%.

7-(4-Methyl-phenyl)-10-thioxo-7,9,10,11-tetrahedro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8(5H)-dione (4l). White solid, yield: 87%: 0.338 gm, m.p. > 300°C (decompose), IR (KBr), *v* max: 3069, 2902, 1637, 1604, 1574 cm^{-1}; ^{1}H NMR (300 MHz, DMSO-d_6): 2.39 (s, 3H, $-CH_3$), 5.75 (s, 1H, −CH), 6.95–6.97 (d, J = 9.0 Hz, 1H, Ar-H), 7.03–06 (d, J = 9.0 Hz, 1H, Ar-H), 7.25–7.33 (m, 2H, Ar-H), 7.77–7.97 (d, J = 9.0 Hz, 1H, Ar-H), 8.13–8.16 (d, J = 9.0 Hz, 1H, Ar-H), 8.26 (s, 1H, Ar-H), 11.27 (br.s, 1H, −NH), 12.33 (br.s, 1H, −NH), 12.44 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 25.89, 37.14, 95.43, 101.12, 119.45, 123.78, 125.09, 126.08, 127.32 (2C), 127.83, 130.94 (2C), 135.00 (2C), 137.17, 156.64, 161.00, 163.16, 165.86, 173.90. *Anal*. Calcd. for $C_{21}H_{15}$ N_3O_5S: C, 64.77; H, 3.88; N, 10.79%. Found: C, 64.69; H, 3.81; N, 10.69%.

7-(Phenyl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4m). White solid, yield: 91%: 0.329 gm, m.p. 288–291°C, IR (KBr), *v* max: 3573, 3306, 3062, 2880, 1714, 1629, 1592, 1519 cm^{-1}; ^{1}H NMR (300 MHz, DMSO-d_6): δ, 5.76 (s, 1H, −CH), 7.11–7.14 (d, J = 9.0 Hz, 3H, Ar-H), 7.25 (s, 1H, Ar-H), 42–7.55 (m, 3H, Ar-H), 7.5–7.77 (d, J = 9.0 Hz, 1H, Ar-H), 7.93 (s, 1H, Ar-H), 11.17 (br.s, 1H, −NH), 11.28 (br.s, 1H, −NH), 12.35 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 36.34, 98.53, 115.60 (2C), 121.32, 123.03 (2C), 123.49 (2C), 128.27 (2C), 130.92, 137.15, 139.45 (2C), 162.54, 163.10, 164.42 ppm. *Anal*. Calcd. for $C_{20}H_{13}$ N_3O_4: C, 66.85; H, 3.65; N, 11.69%. Found: C, 66.83; H, 3.67; N, 11.71%.

7-(4-Methyl-phenyl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4n). White solid, yield: 85%: 0.317 gm, m.p. 278–280°C, IR (KBr), *v* max: 3192, 3074, 1713, 1636, 1607 cm^{-1}; ^{1}H NMR (300 MHz, DMSO-d_6): δ, 2.25 (s, 3H, $-CH_3$), 7.01 (s, 4H, −Ar-H), 7.27 (s, 1H, Ar-H), 7.43–7.45 (d, 1H, Ar-H), 7.55 (s, 1H, Ar-H), 7.86–7.98 (m, 2H, Ar-H), 11.18 (br.s, 1H, −NH), 12.28 (br.s, 1H, −NH), 12.34 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 20.98, 32.44, 112.75, 116.56 (2C), 123.11, 123.46, 126.56 (2C), 128.91, 131.24, 135.01 (2C), 137.13 (2C), 150.26, 162.25, 165.53, 167.07 ppm. *Anal*. Calcd. for $C_{21}H_{15}$ N_3O_4: C, 67.56; H, 4.05; N, 11.25%. Found: C, 67.61; H, 3.97; N, 11.31%.

7-(Furan-2-yl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano [3,2-c]quinoline-6,8,10(5H,9H)-trione (4o). Gray solid, yield: 78%: 0.272 gm, m.p. 280–283°C, IR (KBr), *v* max: 3613, 3321, 2851, 1762, 1745,1704,1647, 1564, 1540 cm^{-1}; ^{1}H NMR (300 MHz, DMSO-d_6): δ, 5.75 (s, 1H, −CH), 6.85 (s, 1H, Ar-H), 7.10 (s, 1H, Ar-H), 7.42 (s, 1H, Ar-H), 7.75–7.77 (d, J = 6 Hz, 1H, Ar-H), 8.06–8.08 (d, J = 6 Hz, 1H, Ar-H), 8.19 (s, 1H, Ar-H), 8.50 (s, 1H, Ar-H), 11.18 (br.s, 1H, −NH), 11.27 (br.s, 1H, −NH), 11.36 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 98.47, 112.73, 115.47, 115.56 (2C), 115.63, 123.04, 127.23, 138.05 (2C), 139.42, 150.58 (2C), 150.73, 151.39, 162.40, 163.13, 163.68 ppm. *Anal*. Calcd. for $C_{18}H_{11}$ N_3O_5: C, 61.89; H, 3.17; N, 12.03%. Found: C, 61.79; H, 3.32; N, 12.09%.

7-(3-Chloro-phenyl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4p). White solid, yield: 86%: 0.338 gm, m.p. > 300°C (decompose), IR (KBr), *v* max: 3221, 2909, 2767, 1713, 1634, 1610, 1568 cm^{-1}; ^{1}H NMR (300 MHz, DMSO-d_6): δ, 5.97 (s, 1H, −CH), 7.07–7.10 (d, J = 9.0 Hz, 2H, Ar-H), 7.21–7.29 (m, 2H, Ar-H), 7.44–7.47 (m, 1H, Ar-H), 7.57–7.59 (d, J = 6 Hz, 1H, Ar-H), 7.93 (s, 2H, Ar-H), 11.30 (br.s, 2H, −NH), 12.41 (s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 36.32, 87.17, 92.05, 116.65, 123.57, 125.50 (2C), 126.11, 126.15, 127.81 (2C), 129.00, 129.42, 129.99, 131.54, 133.49, 137.23, 148.52, 150.24, 162.63 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ ClN_3O_4: C, 61.00; H, 3.07; N, 10.67%. Found: C, 61.07; H, 3.12; N, 10.69%.

7-(4-Chloro-phenyl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4q). White solid, yield: 88%: 0.346 gm, m.p. > 300°C (decompose), IR (KBr), *v* max: 3154, 2907, 1715, 1635, 1607, 1557, 1520 cm^{-1}; ^{1}H NMR (300 MHz, DMSO-d_6): δ, 5.87 (s, 1H, −CH), 7.14 (s, 1H, Ar-H), 7.17 (t, 1H, Ar-H), 7.23–7.25 (d, J = 6 Hz, 2H, Ar-H), 7.29–7.31 (t, 1H, Ar-H), 7.44–7.46 (d, J = 6.0 Hz, 2H, Ar-H), 7.55 (s, 1H, Ar-H), 11.31 (br.s, 2H, −NH), 12.38 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 48.80, 81.08, 98.58, 115.59, 121.33, 123.03, 126.28 (2C), 128.03 (2C), 130.05, 130.96 (2C), 137.42, 139.49, 158.90, 163.02, 164.37, 168.11, 168.53 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ ClN_3O_4: C, 61.00; H, 3.07; N, 10.67%. Found: C, 61.08; H, 3.14; N, 10.71%.

7-(3-Bromo-phenyl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4r). White solid, yield: 86%: 0.376 gm, m.p. 290–294°C, IR (KBr), *v* max: 3193, 3071, 2920, 1715, 1634, 1610 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 5.88 (s, 1H, −CH), 7.13–7.28 (m, 2H, Ar-H), 7.43–7.45 (d, J = 6 Hz, 3H, Ar-H), 7.52–7.54 (d, J = 6 Hz, 1H, Ar-H), 7.97 (s, 1H, Ar-H), 8.07 (s, 1H, Ar-H), 11.20 (br.s, 1H, −NH), 11.32 (br.s, 1H, −NH), 12.38 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.50, 116.63, 118.91, 120.22, 122.06, 123.19, 123.55, 124.73 (2C), 125.80, 129.03 (2C), 129.48, 130.18, 131.44, 137.18, 150.26, 157.27, 162.44, 162.53 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ BrN_3O_4: C, 54.81; H, 2.76; N, 9.59%. Found: C, 54.69; H, 2.73; N, 9.52%.

7-(4-Bromo-phenyl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4s). White solid, yield: 86%: 0.376 gm, m.p. > 300°C (decompose), IR (KBr), *v* max: 3573, 3306, 3062, 2880, 1714, 1629, 1592, 1519 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 5.82 (s, 1H, −CH), 7.05–7.08 (d, J = 9.0 Hz, 2H, Ar-H), 7.26 (s, 1H, Ar-H), 7.34–7.37 (d, J = 9.0 Hz, 3H, Ar-H), 7.42–7.45 (d, J = 9.0 Hz, 1H, Ar-H), 7.51–7.54 (d, J = 9.0 Hz, 1H, Ar-H), 11.19 (br.s, 1H, −NH), 11.30 (br. s, 1H, −NH), 12.36 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.01, 116.60, 119.31, 120.69, 123.12, 123.51, 126.48 (2C), 127.12, 128.96 (2C), 131.07, 131.37, 135.76, 137.17, 150.25, 158.62, 163.37, 164.13, 165.41 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ BrN_3O_4: C, 54.81; H, 2.76; N, 9.59%. Found: C, 54.87; H, 2.79; N, 9.61%.

7-(4-Nitro-phenyl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4t). White solid, yield: 84%: 0.331 gm, m.p. 280–282°C, IR (KBr), *v* max: 3196, 2906, 1719, 1637, 1573, 1353 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 5.93 (s, 1H, −CH), 7.26 (s, 1H, Ar-H), 7.36–7.53 (m, 3H, Ar-H), 7.99 (s, 1H, Ar-H), 8.05–8.08 (d, J = 9.0 Hz, 3HAr-H), 11.35 (br.s, 2H, −NH), 12.40 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.40, 98.61, 104.93, 116.68, 120.31, 123.38, 123.59, 126.27 (2C), 128.03, 131.55 (2C), 137.24, 143.39, 146.18, 150.28, 151.90, 160.62, 165.65, 171.72 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ N_4O_6: C, 59.41; H, 2.99; N, 13.86%. Found: C, 59.45; H, 2.92; N, 13.84%.

7-(3-Nitro-phenyl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4u). White solid, yield: 82%: 0.339 gm, m.p. 284–287°C, IR (KBr), *v* max: 2947, 2776, 1712, 1635, 1523, 1339 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 5.97 (s, 1H, −CH), 7.28 (s, 1H, Ar-H), 7.47–7.56 (m, 4H, Ar-H), 7.92 (s, 1H, Ar-H), 8.01–8.03 (d, J = 6.0 Hz, 2H, Ar-H), 11.36 (s, 2H, −NH), 12.45 (s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 33.37, 95.47, 106.72, 116.57, 116.84, 121.27, 123.60, 123.79, 126.84 (2C), 131.65, 135.05, 137.24, 148.26, 150.08, 152.13, 157.82, 161.71, 164.16, 170.08 ppm. *Anal*. Calcd. for $C_{20}H_{12}$ N_4O_6: C, 59.41; H, 2.99; N, 13.86%. Found: C, 59.54; H, 3.04; N, 13.92%.

7-(4-Cyno–pheny)l-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4v). White solid, yield: 87%: 0.334 gm, m.p. 288–290°C, IR (KBr), *v* max: 3072, 2900, 2572, 2234, 1733, 1634, 1604, 1559 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 5.79 (s, 1H, −CH), 7.26–7.34 (t, 3H, Ar-H), 7.46–7.48 (d, J = 6.0 Hz, 2H, Ar-H), 7.62–7.31 (m, 2H, Ar-H), 8.00 (s, 1H, Ar-H), 10.43 (s, 1H, −NH), 11.26 (br.s, 1H, −NH), 12.47 (s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 40.29, 87.86, 101.41, 108.53, 112.31, 120.37, 123.83, 126.76 (2C), 128.32, 130.37 (2C), 132.46 (2C), 138.85, 141.20, 147.86, 152.05, 158.40, 163.43, 170.02 ppm. *Anal*. Calcd. for $C_{21}H_{12}$ N_4O_4: C, 65.62; H, 3.15; N, 14.58. Found: C, 65.68; H, 3.19; N, 14.61%.

7-(Pyridin-3-yl)-7,11-dihydro-6H-pyrimido-[5'4':5,6] pyrano [3,2-c]quinoline-6,8,10(5H,9H)-trione (4w). White solid, yield: 83%: 0.299 gm, m.p. 282–285°C, IR (KBr), *v* max: 3567, 3285, 3062, 2880, 2136, 1714, 1628, 1591,1519, 1501 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 6.56 (s, 1H, −CH), 7.09–7.14 (t, 1H, Ar-H), 7.25–7.27 (d, J = 6 Hz, 1H, Ar-H), 7.43–7.48 (t, 1H, Ar-H), 7.57–7.61 (t, 2H, Ar-H), 7.89–7.81 (t, 1H, Ar-H), 8.59–8.61 (d, J = 6 Hz, 2H, Ar-H), 9.92 (br.s, 1H, −NH), 10.29 (br. s, 1H, −NH), 11.30 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 43.07, 100.87, 103.76, 117.75, 122.68, 124.67 (2C), 125.04 (2C), 129.54, 131.46, 137.45, 140.00, 148.94 (2C), 156.63, 161.19, 165.07, 168.00 ppm. *Anal*. Calcd for $C_{19}H_{12}$ N_4O_4: C, 63.33; H, 3.36; N, 15.55%. Found: C, 63.32; H, 3.29; N, 15.48%.

7-(3,4-Dimethoxy-phenyl)-7,11-dihydro-6H-pyrimido-[5' 4':5,6] pyrano[3,2-c]quinoline-6,8,10(5H,9H)-trione (4x). Yellow solid, yield: 80%: 0.335 gm, m.p. 284–287°C, IR (KBr), *v* max: 3213, 3069, 1737, 1693, 1647, 1591,1570, 1540 cm^{-1}; ^1H NMR (300 MHz, DMSO-d_6): δ, 3.80 (s, 3H, $-OCH_3$), 3.88 (s, 3H, $-OCH_3$), 5.73(s, 1H, −CH), 7.10–7.16 (t, 2H, Ar-H), 7.46–7.51 (t, 1H, Ar-H), 7.75–7.78 (d, J = 9.1 Hz, Ar-H), 7.89–7.91 (d, 1H, Ar-H), 8.25 (s, 1H, Ar-H), 8.41 (s, 1H, Ar-H), 11.21 (br.s, 2H, −NH), 11.33 (br.s, 1H, −NH) ppm. ^{13}C NMR (75 MHz, DMSO-d_6): δ, 45.00, 57.65, 58.00, 93.67, 101.74, 114.93, 115.00, 117.46, 121.08, 123.64, 125.89 (2C), 130.38, 132.49, 134.04, 142.37, 145.46, 149.29, 157.89, 160.69, 164.68, 168.94 ppm. *Anal*. Calcd. for $C_{22}H_{17}$ N_3O_6: C, 63.01; H, 4.09; N, 10.02%. Found: C, 63.08; H, 3.99; N 10.00.

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