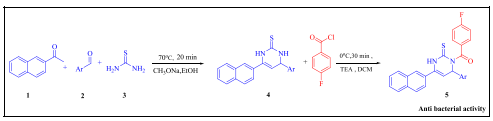
Synthesis and Antibacterial Activity of Novel (4-Fluorophenyl)(4-(naphthalen-2-yl)-6-aryl-2-thioxo-2,3-dihydropyrimidin-1(6*H*)-yl)methanone Derivatives

Thuraka Sekhar,[a] Pinnu Thriveni,[a]* Mypati Hari Krishna,[a] Kolluri Ramesh,[a] Sk Md Jasmine,[b] and Uday Sankar Allam[b]

[a]Department of Chemistry, Vikrama Simhapuri University, Nellore 524320, India
[b]Department of Biotechnology, Vikrama Simhapuri University, Nellore 524320, India
*E-mail: thriveni.vsu1@gmail.com

Received May 24, 2018
DOI 10.1002/jhet.3368
Published online 19 November 2018 in Wiley Online Library (wileyonlinelibrary.com).



A novel series of (4-fluorophenyl)(4-(naphthalen-2-yl)-6-aryl-2-thioxo-2,3-dihydropyrimidin-1(6*H*)-yl) methanone derivatives were synthesized from reaction of 6-(naphthalen-2-yl)-4-aryl-3,4-dihydropyrimidine-2(1*H*)-thiones with 4-fluorobenzoylchloride in dichloromethane in the presence of triethylamine. The synthesized compounds were screened for antibacterial activity against Gram positive bacteria, namely, *Staphylococcus aureus* ATCC25923 and *Listeria monocytogenes* MTCC657, and Gram negative bacteria, namely, *Escherichia coli* ATCC25922 and *Klebsiella pneumoniae* ATCC700603, respectively. Some of the tested compounds showed significant antimicrobial activity.

J. Heterocyclic Chem., **56**, 44 (2019).

INTRODUCTION

Pyrimidine-based organic materials represent a significant class of compounds, which acquired special attention in heterocyclic chemistry. Pyrimidine occupies an important position in the field of medicinal chemistry due to a variety of pharmacological and biological activity of its derivatives. On one hand, pyrimidine and its derivatives possess significant antibacterial, antifungal, anthelmintic, anticancer, and antitumor activity [1–9]. Pyrimidine is another important nitrogen containing heterocycles, which has various drug-related properties and have attracted extensive investigation for small molecule drug discovery [10–13]. On the other hand, pyrimidines also show versatile pesticidal activity as herbicides [14,15]. Comparatively, there is much less literature about the application of pyrimidine-containing compounds in agrochemical area than in medicinal area [16,17]. Naphthalene-substituted thiopyrimidine were reported to contain antibacterial activity. In view of these, we aimed the synthesis and bioassay of some novel pyrimidine-2[1*H*]-thione derivatives with a naphthyl group, fluorobenzoyl group, and with aryl (electron donating and electron withdrawing groups) as substituents [18]. The antimicrobial activities of these target compounds were evaluated and reported in this paper.

RESULTS AND DISCUSSION

New derivatives of (4-fluorophenyl)(4-(naphthalen-2-yl)-6-aryl-2-thioxo-2,3-dihydropyrimidin-1(6*H*)-yl)methanone were obtained in a two-step synthesis. The one-pot, three-component reaction of aryl ketones **1**, aryl aldehydes **2**, and thiourea **3** in the presence of sodium methoxide is processed rapidly in ethanol at 70°C to afford 6-(naphthalen-2-yl)-4-aryl-3,4-dihydropyrimidine-2(1*H*)-thiones **4** in good yield. The product **5**, that is, (4-fluorophenyl)(4-(naphthalen-2-yl)-6-aryl-2-thioxo-2,3-dihydropyrimidin-1(6*H*)-yl)methanone derivatives, was synthesized by the reaction of **4** with 4-fluorobenzoyl chloride in the presence of triethylamine in dichloromethane as solvent at 0–5°C (Table 1, entries 5a-l). The synthetic sequence is depicted in Scheme 1.

The structures of the compounds were elucidated by spectral data. The infrared (IR) spectra of the thiopyrimidine compounds (**5a**–**5l**) displayed absorption bands for NH (3309–3220 cm^{-1}), C═O (1692–1662 cm^{-1}), and SH (2351–2349 cm^{-1}) functional groups. The ^{1}H NMR (400 MHz in DMSO-d_6) spectrum of compounds (**5a**–**5l**) displayed two doublets at 5.79–5.9 and 5.98–6.50 ppm for C─H pyrimidine protons. Apart from these, **5a**–**5l** also showed signals at 8.54–11.72 ppm for NH pyrimidine proton. The signals of the other protons were appeared at the expected chemical shifts and integral values [19]. The structures of the compounds were further confirmed by ^{13}C NMR and mass spectra.

BIOLOGICAL ASSAY

Methodology. Antibacterial activity of the synthesized heterocyclic compounds was carried out using disk diffusion method against two Gram positive bacteria (*Staphylococcus aureus* ATCC25923 and *Listeria*

Table 1

Synthesis of (4-fluorophenyl)(4-(naphthalen-2-yl)-6-aryl-2-thioxo-2,3-dihydropyrimidin-1(6*H*)-yl)methanone derivatives.[a]

Compound	Ar	Yield %[b]
5a	3,4-Dimethoxyphenyl	81
5b	4-Chlorophenyl	80
5c	3-Bromophenyl	82
5d	1-Naphthyl	79
5e	3,4,5-Trimethoxyphenyl	83
5f	Phenyl	75
5g	4-Fluorophenyl	78
5h	3,4-Dichlorophenyl	82
5i	4-Methylphenyl	77
5j	4-Methoxyphenyl	81
5k	2-Chlorophenyl	77
5l	2,6-Dichlorophenyl	78

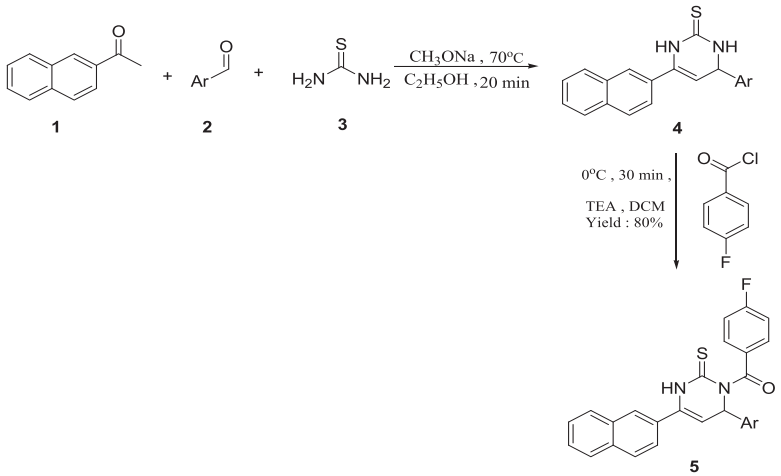
[a]Reaction of **4** with 4-fluorobenzoyl chloride in the presence of triethylamine in dichloromethane at 0°C.
[b]Isolated yield.

monocytogenes MTCC657) and two Gram negative bacteria (*Escherichia coli* ATCC25922 and *Klebsiella pneumoniae* ATCC700603). The bacterial culture media Luria–Bertani broth, Mueller–Hinton agar, solvent dimethylformamide (DMF), and antibiotic streptomycin sulfate were purchased from HiMedia, Mumbai.

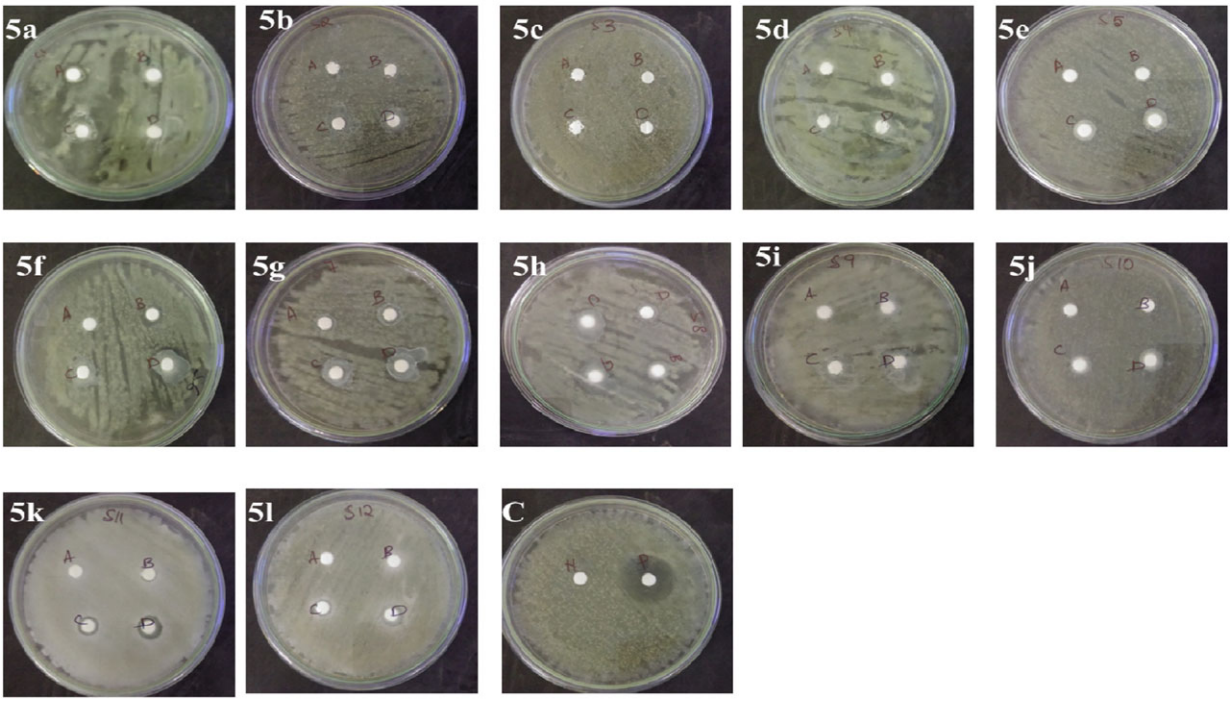
Antibacterial activity assay. Dimethylformamide was used as solvent to dissolve the test compounds. A stock concentration of 10 mg/mL was prepared with each of the test compounds. Sterile filter paper disks of about 6 mm are impregnated with four different working concentrations of the test solution from 100 to 400 μg/mL and air dried. A single colony was inoculated into 5 mL of the Luria–Bertani broth and incubated at 37°C for 8–10 h. After adjusting the turbidity to 0.5 Mac Farland standard (1.5×10^8 CFU/mL), the culture was swabbed onto the Mueller–Hinton agar media. The plates were left for 5–10 min for drying the excess swabbed culture. The dried filter paper disks were impregnated onto the culture plate not less than 24 mm from center to center. After gentle pressing of the disks onto the culture, the plates were incubated for about 24 h at 37°C. Streptomycin sulfate (30 μg/mL) was used as a positive control and DMF (30 μL) alone as negative control. Each of the test compounds was tested in duplicates.

Results. The results of heterocyclic compounds **5a**–**5l** are summarized in Table 2. The width of the zone of inhibition represents the potency of the synthesized compounds. The results revealed that majority of the synthesized compounds showed varying degrees of inhibition against the tested microorganisms. A strong inhibition was shown by the compounds **5g** and **5h** at a concentration of 400 μg/mL against Gram negative bacteria, while **5f** and **5l** found to have high rates of inhibition against Gram positive bacteria at the same concentration with zone of inhibition 15–20 mm. The synthesized heterocyclic compounds **5f**, **5g**, **5h**, **5j**, **5k**, and **5l** displayed mild and moderate activity at 200 and 300 μg/mL against both Gram positive and Gram negative organisms. However, no antibacterial activity was observed at a concentration of 100 μg/mL against all the tested organisms. Compound **5d** is the only heterocyclic molecule that has no antibacterial activity against any species at any concentration. DMF served as negative control with no zone of inhibition, and streptomycin sulfate as positive control proved to be an efficient drug against the organisms with a wider zone of inhibition. Thus, in 13 synthesized heterocyclic compounds, the aryl group with chloro and fluorophenyl derivatives were more active.

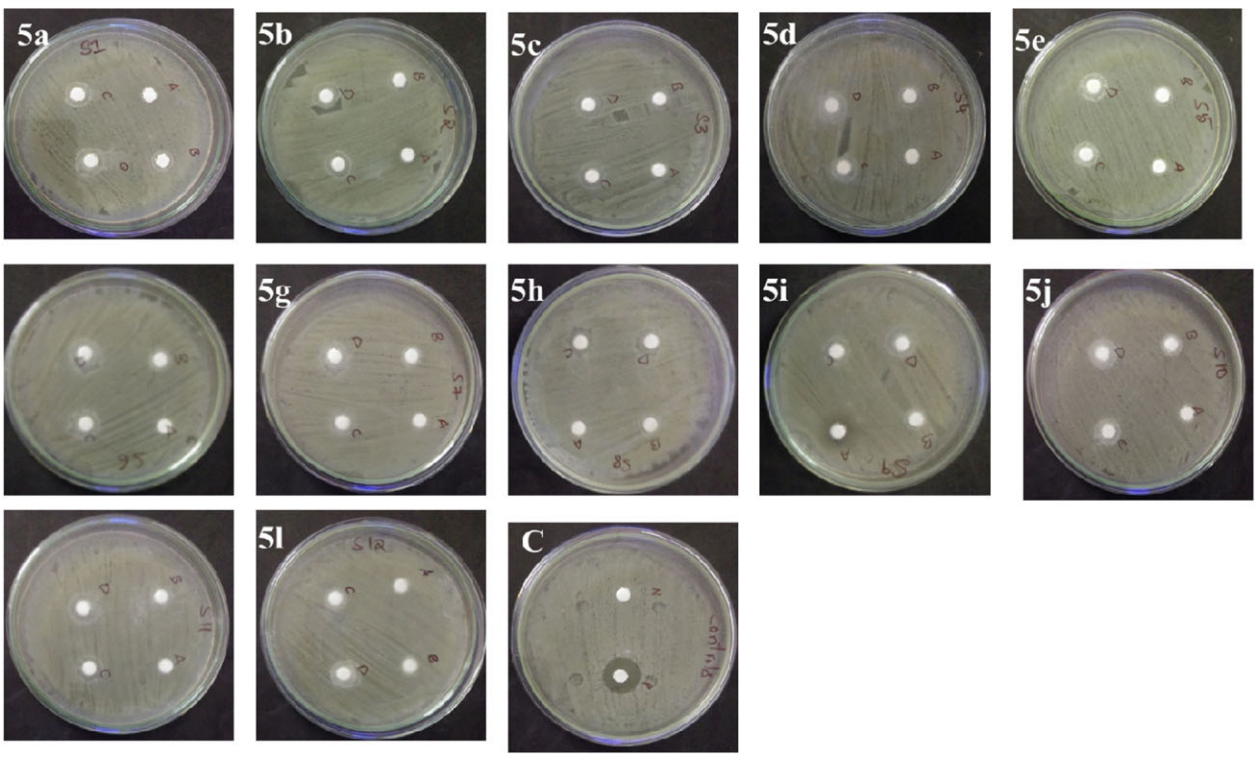
Scheme 1. Synthetic scheme of (4-fluorophenyl)(4-(naphthalen-2-yl)-6-aryl-2-thioxo-2,3-dihydropyrimidin-1(6*H*)-yl)methanone derivatives.



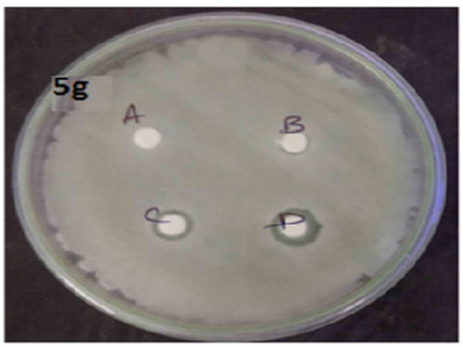
E. coli

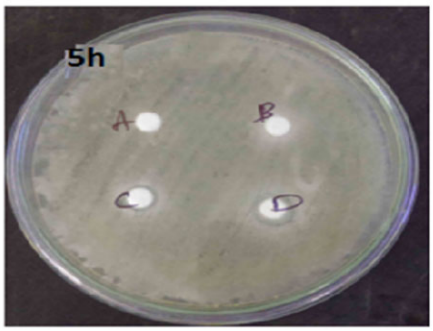


Staphylococcus aureus

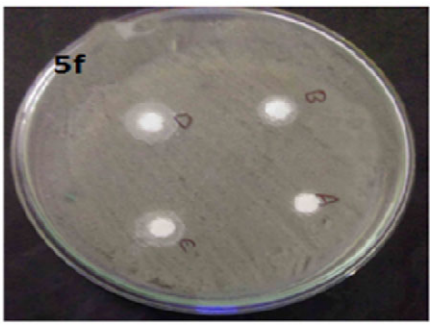


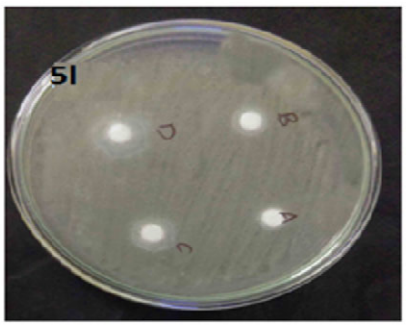
Klebsiella pneumoniae

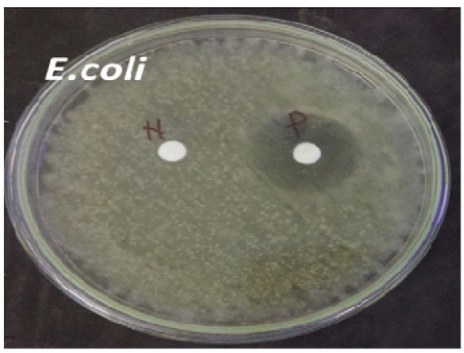


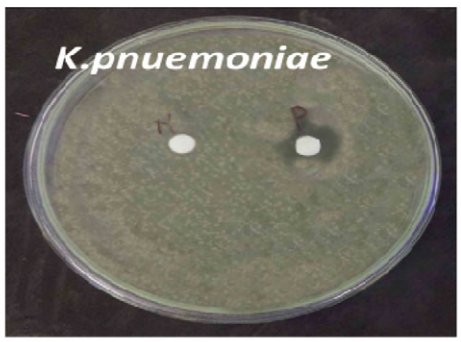


Listeria monocytogenes









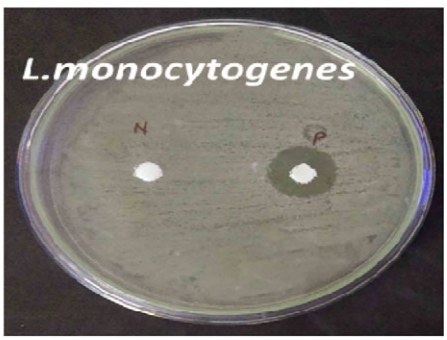


Table 2

Antibacterial activity of compounds **5a**–**5l**.

		Escherichia coli				*Klebsiella pneumoniae*				*Staphylococcus aureus*				*Listeria monocytogenes*			
S. no.	Compound	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
1	**5a**	–	–	–	–	–	–	–	–	–	–	+	++	–	–	+	+ +
2	**5b**	–	–	+	++	–	–	+	++	–	–	++	++	–	–	+	+ +
3	**5c**	–	–	–	+	–	–	++	++	–	–	++	++	–	–	++	+ +
4	**5d**	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5	**5e**	–	–	++	++	–	–	+	++	–	–	+	++	–	–	+	+ +
6	**5f**	–	+	++	++	–	+	++	++	–	+	++	+++	–	+	++	+ + +
7	**5g**	–	++	++	+++	–	–	+	+++	–	–	++	++	–	+	+	+ +
8	**5h**	–	+	++	+++	–	–	+	+++	–	+	++	++	–	+	++	+ +
9	**5i**	–	–	–	–	–	–	–	–	–	+	+	++	–	–	–	–
10	**5j**	–	–	+	++	–	–	+	++	–	+	+	++	–	+	+	+ +
11	**5k**	–	–	+	++	–	–	+	++	–	–	+	++	–	–	+	+ +
12	**5l**	–	–	–	–	–	–	–	–	–	–	+	+ + +	–	–	++	+ + +
13	Positive (30 μg/mL)		+++					+++				+++				+++	
14	Negative (DMF)		–					–				–				–	

DMF, dimethylformamide.
A = 100 μg/mL, B = 200 μg/mL, C = 300 μg/mL, D = 400 μg/mL.
No antibacterial activity (−): inhibition zone 0–5 mm; mild sensitivity (+): inhibition zone 5–10 mm; moderate sensitivity (++): inhibition zone 10–15 mm; highly sensitive (+++): inhibition zone 15–20 mm.

CONCLUSION

In summary, we have synthesized a series of (4-fluorophenyl)(4-(naphthalen-2-yl)-6-aryl-2-thioxo-2,3-dihydropyrimidin-1(6*H*)-yl)methanone derivatives, and their antibacterial activities have been evaluated. All the compounds are confirmed by their spectral data and showed potent inhibition against all the tested strains.

EXPERIMENTAL

All the chemicals were purchased from Merck (Merck Ltd, Mumbai, Maharshtra, India) and Sigma-Aldrich (Bangloore, Karntaka, India). All the reactions were performed and monitored by thin-layer chromatography (TLC) on Merck silica gel 60 F254 pre-coated plates (0.25 mm) and visualized by ultraviolet fluorescence lamp. IR spectra were recorded on Bruker 683(FT)-IR spectrometer (Bruker Corporation, Billerica, MA) with KBr pellets. ^{1}H NMR and ^{13}C NMR spectra are recorded on Bruker and Jiol Resonance (400 MHz) and (100 MHz) spectrometer respectively, using DMSO-d_6 or $CDCl_3$ as a solvent and TMS as an internal standard. Chemical shifts are reported in parts per million (ppm). Mass spectra are scanned on Agilent technologies spectrometer (Agilent Technologies, Santa Clara, CA).

General procedure for the synthesis of 6-(naphthalene-2-yl)-4-aryl-3,4-dihydropyrimidine-2(1*H*)-thione derivatives (4). Aryl ketone **1** (8 mmol), aryl aldehyde **2** (8 mmol), and thiourea **3** (8 mmol) in 25 mL ethanol were mixed in 50-mL round bottom flask, and sodium methoxide was added to the reaction mixture at room temperature. Then, the resulting mixture was heated to 70°C and stirred for 20 min. The progress of the reaction was monitored by TLC. After completion of the reaction, the reaction mixture was allowed at room temperature and diluted with 25 mL water. The compound was filtered and recrystallized from toluene to afford desired product 6-(naphthalene-2-yl)-4-aryl-3,4-dihydropyrimidine-2(1*H*)-thione derivatives **4**.

General procedure for the synthesis of (4-fluorophenyl)(4-(naphthalen-2-yl)-6-aryl-2-thioxo-2,3-dihydropyrimidin-1(6*H*)-yl)methanone derivatives (5a–5l). To 50-mL round bottom flask, compound **4** (8 mmol) dissolved in 25 mL of dichloromethane, and triethylamine (8 mmol) was added, and the reaction mixture was cooled to 0°C. 4-Fluorobenzoylchloride (8 mmol) was added to reaction mixture over a period of 10 min at 0°C and stirred for 30 min at the same temperature. The progress of the reaction was monitored by TLC. After completion of the reaction, solvent was evaporated under reduced pressure to get solid. The solid was taken into 20 mL water and stirred for 10 min and filtered. The solid was recrystallized from toluene.

(6-(3,4-Dimethoxyphenyl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)(4-fluorophenyl)methanone (5a). mp: 244°C; IR (KBr) cm^{-1}: 3232 (NH), 2350 (SH), 1662 (C═O), 1598 (C═C); ^{1}H NMR (400 MHz, $CDCl_3$-d_6): δ (ppm) 3.88 (3H, s, OCH_3), 3.9 (3H, s, OCH_3), 5.92 (1H, d, J = 6.0 Hz, C—H), 6.10 (1H, d, J = 6.0 Hz, C—H), 6.86 (1H, d, J = 8.8 Hz Ar—H), 7.07–7.14 (3H, m, Ar—H), 7.28 (1H, s, Ar—H), 7.58–7.67 (3H, m, Ar—H),

7.74–7.78 (2H, m, Ar—H), 7.89–7.96 (4H, m, Ar—H), 8.65 (1H, bs, NH); MS (*m/z*): 497.1 $[M - 1]^+$.

(6-(4-Chlorophenyl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)(4-fluorophenyl)methanone (5b). mp: 233°C; ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 5.94 (1H, d, *J* = 5.8 Hz, C—H), 6.52 (1H, d, *J* = 5.9 Hz, C—H), 7.28 (4H, d, *J* = 9.3 Hz, Ar—H), 7.58 (4H, s, Ar—H), 7.72 (2H, s, Ar—H), 7.80 (1H, d, *J* = 8.3 Hz, Ar—H), 7.98 (3H, m, Ar—H), 8.25 (1H, s, Ar—H), 11.73 (1H, bs, NH); MS (*m/z*): 471.1 $[M - 1]^+$.

(6-(3-Bromophenyl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)(4-fluorophenyl)methanone (5c). mp: 240°C; ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 5.94 (1H, d, *J* = 6.3 Hz, C—H), 6.54 (1H, d, *J* = 6.8 Hz, C—H), 7.26–7.36 (4H, m, Ar—H), 7.42–7.54 (4H, m, Ar—H), 7.68–7.94 (3H, m, Ar—H), 7.95–7.97 (3H, m, Ar—H), 8.19 (1H, s, Ar—H), 11.77 (1H, bs, NH); ^{13}C NMR (100 MHz, DMSO-d_6): δ (ppm) 56.16, 122.14, 124.40, 125.89, 125.98, 127.31, 127.47, 128.11, 128.78, 128.93, 129.55, 131.11, 131.40, 131.88, 133.06, 163.37, 165.86, 172.30, 179.00; MS (*m/z*): 516.9 $[M-1]^+$.

(4-Fluorophenyl)(6-(naphthalen-1-yl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)methanone (5d). mp: 247°C; ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 6.53 (1H, d, *J* = 6.5 Hz, C—H), 6.65 (1H, d, *J* = 6.3 Hz, C—H), 7.38 (2H, d, *J* = 8.3 Hz, Ar—H), 7.48–7.58 (3H, m, Ar—H), 7.62 (1H, dd, *J* = 12.8 Hz, *J* = 8. Hz, Ar—H), 7.70 (2H, d, *J* = 6.0 Hz Ar—H), 7.74–7.81 (2H, m, Ar—H), 7.91 (3H, m, *J* = 7.9 Hz Ar—H), 7.97 (1H, d, *J* = 5.7 Hz Ar—H), 8.02 (2H, d, *J* = 8. Hz Ar—H), 8.13 (1H, s, Ar—H), 8.46 (1H, d, *J* = 8.3 Hz Ar—H), 11.73 (1H, bs, NH); ^{13}C NMR (100 MHz, DMSO-d_6): δ (ppm) 56.07, 108.04, 115.95, 116.17, 122.82, 124.18, 124.27, 125.76, 126.16, 126.60, 127.25, 127.38, 128.05, 128.46, 128.69, 128.88, 129.30, 129.42, 129.97, 131.77, 131.87, 133.03, 133.56, 134.20, 135.58, 137.52, 163.36, 165.85, 172.48, 179.72; HRMS: (*m/z*) *Anal*. Calcd for $C_{31}H_{21}FN_2OS$ $[M + H]^+$, 488.14; Found, 488.1427.

(4-Fluorophenyl)(4-(naphthalen-2-yl)-2-thioxo-6-(3,4,5-trimethoxyphenyl)-2,3-dihydropyrimidin-1(6H)-yl)methanone (5e). mp: 240°C; IR (KBr) cm^{-1}: 3220 (NH), 2351(SH), 1665 (C═O), 1592 (C═C); ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 3.61–3.76 (9H, s, 3 × OCH_3), 6.45 (1H, d, *J* = 6.1 Hz, C—H), 6.54 (1H, d, *J* = 6.0 Hz, C—H), 6.99 (1H, s, Ar—H), 7.28 (2H, dd, *J* = 17.8 Hz, *J* = 8.9 Hz, Ar—H), 7.40 (1H, s, Ar—H), 7.55 (3H, d, *J* = 21.0 Hz Ar—H), 7.69 (1H, d, *J* = 25.0 Hz Ar—H), 7.82 (2H, dd, *J* = 19.3, *J* = 11 Hz Ar—H), 8.02 (2H, d, *J* = 8.7 Hz Ar—H), 8.22 (1H, s, Ar—H), 11.72 (1H, bs, NH); ^{13}C NMR (100 MHz, DMSO-d_6): δ (ppm) 56.47, 57.23, 60.52, 60.57, 104.06, 105.10, 108.77, 115.86, 116.09, 125.83, 127.40, 128.10, 128.74, 128.88, 153.47, 153.67, 170.16, 171.28, 172.19, 179.49, 179.76; HRMS: (*m/z*) *Anal*. Calcd for $C_{30}H_{25}FN_2O_4S$ $[M + H]^+$, 528.15; Found, 528.1587.

(4-Fluorophenyl)(4-(naphthalen-2-yl)-6-phenyl-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)methanone (5f). mp: 240°C; ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 5.93 (1H, d, *J* = 6.6 Hz, C—H), 6.54 (1H, d, *J* = 6.7 Hz, C—H), 7.31 (3H, d, *J* = 8.9 Hz, Ar—H), 7.42 (2H, t, *J* = 7.3 Hz, Ar—H), 7.63–7.51 (5H, m, Ar—H), 7.77–7.68 (2H, m, Ar—H), 7.79 (1H, d, *J* = 8.5 Hz, Ar—H), 8.00 (2H, d, *J* = 9.3 Hz, Ar—H), 8.24 (1H, s, Ar—H), 11.65 (1H, bs, NH); ^{13}C NMR (100 MHz, DMSO-d_6): δ (ppm) 56.79, 108.55, 115.88, 116.10, 125.91, 126.91, 127.29, 127.42, 128.17, 128.74, 128.90, 129.10, 130.06, 132.00, 131.76, 133.00, 133.64, 136.07, 140.76, 163.28, 165.76, 172.28, 179.14; MS (*m/z*): 439.13 $[M + 1]^+$.

(4-Fluorophenyl)(6-(4-fluorophenyl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)methanone (5g). mp: 225°C; ^{13}C NMR (100 MHz, DMSO-d_6): δ (ppm) 56.06, 108.29, 115.90, 116.03, 124.30, 125.81, 127.52, 127.90, 127.31, 128.76, 128.01, 129.12, 129.20, 131.20, 131.80, 132.91, 133.80, 136.60, 160.98, 163.31, 163.40, 165.18, 172.28, 178.99; HRMS: (*m/z*) *Anal*. Calcd for $C_{27}H_{19}F_2N_2OS$ $[M + H]^+$, 457.12; Found, 457.1175.

(6-(3,4-Dichlorophenyl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)(4-fluorophenyl)methanone (5h). mp: 249°C; IR (KBr) cm^{-1}: 3242 (N—H), 2350 (S—H), 1663 (C═O), 1594 (C═C); ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 6.07 (1H, d, *J* = 6.4 Hz, C—H), 6.26 (1H, d, *J* = 6 Hz, C—H), 7.11 (2H, t, *J* = 8.8 Hz, Ar—H), 7.30–7.32 (1H, m, Ar—H), 7.32–7,37 (1H, m, Ar—H), 7.46–7.58 (6H, m, Ar—H), 7.78–7.93 (3H, m, Ar—H), 8.108–8.12 (1H, m, Ar—H), 8.69 (1H, s, NH); MS (*m/z*): 505 $[M - 1]^+$.

(4-Fluorophenyl)(4-(naphthalen-2-yl)-2-thioxo-6-p-tolyl-2,3-dihydropyrimidin-1(6H)-yl)methanone (5i). mp: 229°C; IR (KBr) cm^{-1}: 3233 (N—H), 2350.11(S—H), 1656 (C═O), 1495 (C═C); ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 2.36 (3H, s, CH_3), 5.95 (1H, d, *J* = 6.4 Hz, C—H), 6.12 (1H, d, *J* = 6.4 Hz, C—H), 7.07–7.11 (1H, m, Ar—H), 7.19–7.28 (3H, m, Ar—H), 7.46 (1H, d, *J* = 8 Hz, Ar—H), 7.58–7.59 (2H, m, Ar—H), 7.59–7.66 (3H, m, Ar—H), 7.74–7.77 (2H, m, Ar—H), 7.90–7.93 (2H, m, Ar—H), 7.95–8.02 (1H, m, Ar—H), 8.54 (1H, s, NH); MS (*m/z*): 451 $[M - 1]^+$.

(4-Fluorophenyl)(6-(4-methoxyphenyl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)methanone (5j). mp: 235°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 3.81 (3H, s, OCH_3), 5.95 (1H, d, *J* = 6.0 Hz, C—H), 6.08 (1H, d, *J* = 6.0 Hz, C—H), 6.91 (2H, d, *J* = 8.8 Hz, Ar—H), 7.11–7.28 (2H, m, Ar—H), 7.48 (2H, d, *J* = 8.8 Hz, Ar—H), 7.58–7.59 (2H, m, Ar—H), 7.59–7.60 (1H, m, Ar—H), 7.64–7.64 (2H, m, Ar—H), 7.73–7.91 (3H, m, Ar—H), 7.92–8.03 (1H, m, Ar—H), 8.60 (1H, s, NH); MS (*m/z*): 467.1 $[M - 1]^+$.

(6-(2-Chlorophenyl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)(4-fluorophenyl)methanone (5k). mp: 236°C; ^{1}H NMR (400 MHz, $CDCl_3$): δ (ppm) 6.16

(1H, d, J = 6.0 Hz, C—H), 6.37 (1H, d, J = 6.4 Hz, C—H), 7.12–7.46 (5H, m, Ar—H), 7.55–7.64 (4H, m, Ar—H), 7.80–7.88 (4H, m, Ar—H), 7.81–8.21 (2H, m, Ar—H), 8.76 (1H, s, NH); MS (m/z): 473.09 $[M + 1]^+$.

(6-(2,6-Dichlorophenyl)-4-(naphthalen-2-yl)-2-thioxo-2,3-dihydropyrimidin-1(6H)-yl)(4-fluorophenyl)methanone (5l). mp: 240°C; IR (KBr) cm^{-1}: 3309 (N—H), 2349 (S—H), 1692 (C═O), 1585 (C═C); ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 5.70 (1H, d, J = 4.1 Hz, C—H), 6.65 (1H, d, J = 4.2 Hz, C—H), 7.23–7.34 (2H, m, Ar—H), 7.36 (1H, d, J = 8.5 Hz, Ar—H), 7.49 (2H, d, J = 7.9 Hz, Ar—H), 7.52–7.58 (2H, m, Ar—H), 7.72 (1H, d, J = 8.6 Hz, Ar—H), 7.95 (5H, m, Ar—H), 8.24 (1H, s, Ar—H), 11.17 (1H, bs, NH); ^{13}C NMR (100 MHz, DMSO-d_6): δ (ppm) 46.09, 57.33, 100.68, 116.12, 116.34, 124.32, 125.69, 127.17, 127.34, 128.03, 128.53, 128.89, 130.31, 130.21, 131.09, 132.49, 132.58, 133.60, 135.37, 136.06, 163.91, 166.41, 172.43, 177.32; HRMS: (m/z) *Anal*. Calcd for $C_{27}H_{27}Cl_2FN_2OS$ $[M + H]^+$, 507.05; Found, 507.0489.

Acknowledgments. Dr. P.Thriveni would like thank to IICT, Hyderabad, S.V. University, Tirupati and V.S. University, Nellore for providing us facilities of IR Spectra, ^{1}H NMR, ^{13}C NMR and Mass spectras.

REFERENCES AND NOTES

[1] Naik, S. M.; Naik, H. B. Asian J Chem 2000, 12, 1370.
[2] Akbas, E.; Berberb, I.; Akyazia, I.; Anilc, B.; Yildiza, E. Lett in Orga Chem 2011, 8, 663.
[3] Ritaand, E.; Shrivasthav, S. P. Eur J Chem 2010, 7, 935.
[4] Desai, N. C.; Pandya, D. D.; Satodiya, H. M.; Rajpara, K. M.; Joshi, V. V.; Vaghani, H. V. Med Chem Res 2012, 21, 4412.
[5] Abdel Samii, Z. K.; Abdel Fattah, H. A.; Abdel Rehem, R. M. World J Pharm Res 2015, 4, 73.
[6] El- Hashash, M. A.; Mahmoud, M. R. Madboli S A, Indian J Chem 1993, 3, 449.
[7] Alagarsamy, V.; Shankar, D.; Meena, S.; Thurumurugan, K.; Durai Ananda Kumar, T. Drug Dev Res 2007, 68, 134.
[8] Sondhi, S. M.; Singh, N.; Johara, M.; Kumarb, A. Bioorg Med Chem 2005, 13, 6158.
[9] Bruno, O.; Brullo, C.; Ranise, A.; Schenone, S.; Bondavalli, F.; Barocelli, E.; Ballabeni, V.; Chiavarini, M.; Tognolini, M.; Impicciatore, M. Bioorg Med Chem Lett 2001, 11, 1397.
[10] Nega, S.; Aionso, J.; Diazj, A.; Junquere, F. J Heterocyclic Chem 1990, 27, 269.
[11] Shishoo, C. J.; Jain, K. S. J Heterocyclic Chem 1992, 29, 883.
[12] Pathak, P.; Kaur, R.; Kaur, B. ARKIVOC 2006, 16, 160.
[13] Kidwai, M.; Mishra, M. J Serb Chem 2004, 69, 247.
[14] Brown, D. J. The Chemistry of Heterocyclic Compounds. The Pyrimidines; Wiley: New York, USA, 1994; Vol 52.
[15] Brown, D. J. In Comprehensive Heterocyclic Chemistry; Boulton, A. J.; McKillop, A. Eds.; Pergamon: Oxford, UK, 1984; Vol 3, p. 150.
[16] Panner Selvam, T.; Caido Richa, J.; Phadte Vijaysarathy, D.; Silveira Karyn, V. Res in Pharm 2012, 2, 1.
[17] Vinitha, S.; Nitin, C.; Ajay Kumar, A. Hindavi J Chem 2014 Article ID 202784.
[18] Mahammed, S.; Makki, T.; Reda, M.; Abdel, R. Hindavi J Chem 2013 Article ID 819462.
[19] Farouk, H.; Hajjar, A. L.; Yusuf, A.; Farkh, A. L.; Hayat, S. Hamoud, Can J Chem 2734, 1979, 56.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.