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Synthesis and antimicrobial activity of 2-((4-(1*H*-benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl) pyrimidin-2-yl)thio)-N-methylacetamide

Sunitha Ch & Brahmeshwari G*

Department of Chemistry, Kakatiya University, Warangal 506 009, India

E-mail: sunitha.c82@gmail.com

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It has been possible to synthesise a brand new series of 2-((4-(1*H*-benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-methyl acetamide **4a-h**. The reaction of 1-(1*H*-benzimidazol-2-yl)ethanone with 2-ethylcyclopentane carbaldehyde with ethanol and KOH yields (E)-1-(1*H*-benzo[d]imidazol-2-yl)-3-(2-ethylcyclopentyl)prop-2-en-1-one **1a-c**. All compounds have been shown to have antimicrobial action *via* pharmacological study and are listed here. Chloramphenicol and Amphotericin B, two conventional antibiotics, have been compared to the antibacterial and antifungal properties of the synthetic compounds. It has been discovered that Schlenter products had spectroscopic properties worth investigating.

Keywords: Benzimidazole, pyrimidine, chloramphenicol, *in vitro* anti-bacterial activity, anti-fungal activity

The 4- and 5-positions of the benzene and imidazole rings fuse to form benzimidazole, a bicyclic hetero-aromatic chemical molecule[1] It is a crucial moiety in heterocyclic aromatic chemistry[2]. The benzimidazole moiety is formed by joining two imidazole and benzophenyl rings. Many heterocycles, including benzimidazole and its substituted variants, include a nitrogen atom[3]. Benzimidazoles have several uses in veterinary medicine, including ulcer therapy, antihelminth medication, and antihistamines[4-7].

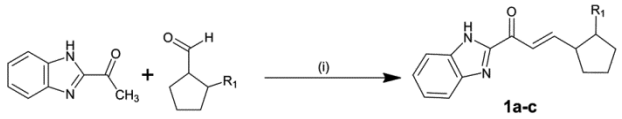
Benzimidazole derivatives with substituted benzene rings have piqued synthetic organic chemists' interest, leading to the development of catalytic heterocyclic molecules[8]. Benzimidazole derivatives have been studied for their fungicidal and antibacterial properties[9]. This core is related with anticancer, antiviral, antifungal, insecticidal, and herbicidal action[10-14]. Pyrimidine derivatives are vital in the pesticide business because to their high activity, low toxicity, and biocompatibility[15–17].

Results and Discussion

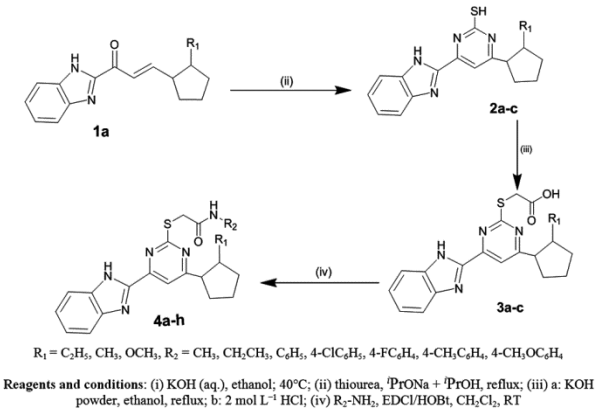
As seen in Scheme I, the target compounds are being synthesised as aldol condensation was used to synthesise, α,β-unsaturated ketones **1a-c** from 2-acetylbenzimidazole, which were subsequently cyclised in **1** and thiourea ^{i}PrONa + ^{i}PrOH solution at refluxing temperature to yield substituted pyrimidine-2-thiols **2a-c**. Chloroacetic acid react at 78°C in a KOH–ethanol solution to yield substituted (pyrimidin-2-yl) thioacetic acids **3a-c**. Intermediate **3** then reacted with various amines under the catalysis of EDCI/HOBt to form the desired compounds (**4a–h**, Scheme II).

Newly synthesised **1a-c** were described using the IR, ^{1}H and ^{13}C NMR spectra. There was an absorption band at 1760 cm^{-1} owing to the C=O group in compound **1**, whereas NH stretching bands appeared at 3400 cm^{-1} in the IR spectra. It is also possible to synthesise substituted pyrimidine-2-thilos **2a-c** by heating compound **1** with isopropanol and ^{i}ProNa/Hcl for 6 h at RT. Charcoal acetic acid and potassium hydroxide were used in the reaction of compound **2** to produce 2-((4*H*-benzo[d]imidazol-2-yl)-6*H*-(2 ethoxycyclopentyl)pyrimidin-2-yl thio)acetic acid **3a-c**. Another reaction occurs under the catalytic action of the EDCI/HOBt catalyst, which produces N-methylacetamide as a result of the reaction of different amines with EDCI/HOBt **4a-h**.

Compounds were characterised using ^{1}H and ^{13}C NMR, FT-IR, and elemental analysis. There was an NH signal of amide bond about 8.47 ppm when R_2 was CH_3 or OCH_3 (**4a**, **4b**, **4c**, **1b**, and **1c**), whereas around 3.80 ppm when other protons of benzene or



Scheme I — Synthetic pathway to (E)-1-(1*H*-benzo[d]imidazol-2-yl)-3-(2 ethylcyclopentyl)prop-2-en-1-one **1a-c**



Scheme II — The process used to make the desired compounds synthetically

benzoimidazole (**4a**, **4b**, **4c**, **1b**, **1c**). The benzimidazole ring's N–H stretching vibration was detected at 3300–3430 cm^{-1} in the IR spectra, whereas the amide bond's C=O stretching vibration was detected at 1658–1760 cm^{-1}. The structure of the isolated compounds was confirmed using their spectral data.

In vitro anti-microbial activity

The antibacterial activity of extracts was evaluated using well diffusion method. For sample preparation, the substance was dissolved in DMSO (1mg/mL) [18-20]. Antimicrobial (antibacterial and antifungal) activity was then tested on medium.

Anti-bacterial activity

On gram-positive bacteria such as *Staphylococcus aureus*[21] and on gram-negative bacteria such as *Escherichia coli*[22], the newly synthesised compounds were examined *in vitro*. The minimum inhibitory concentration (MIC,µg/mL) was defined as the lowest concentration (maximum dilution) required to stop the growth of bacteria[23,24]. The MIC values of the substances tested were determined and compared with the Chloramphenicol conventional antibiotics, the MIC values of the substances tested are listed in Table I [25].

Among the studied compounds, the compound (E)-1-(1*H*-benzo[d]imidazol-2-yl)-3-(2 ethylcyclopentyl) prop-2-en-1-one **1a** showed 10 mm[26] in *E. coli* and 20 mm in *Staphylococus*[27], while the compound (E)-1-(1*H*-benzo[d]imidazol-2-yl)-3-(2-methylcyclopentyl) prop-2-en-1-one **1b** showed 12 mm in *E. coli* and 23 mm in *Staphylococus*, and in the compound 4-(1*H*-benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl) pyrimidine-2-thiol **2** was found in *E. coli* at 15 mm and *Staphylococcus* at 22 mm [28,29], and in the combination 2-((4-(1*H*-benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-methylacetamide **4a** was found in *E. coli* at 05 mm and *Staphylococcus*[30,31] at 18 mm. The compounds **1c**, **3**, **4b-h** *Staphylococus* and *E. coli* demonstrated moderate to excellent inhibition, which was quantified and tabulated[32] (Figure 1).

Table I — *In vitro* anti-microbial activity of compounds

Compd	Bacteria		Fungi
	Escherichia coli (Gram negative)	*Staphylococcus aureus* (Gram positive)	*Aspergillus fumigatus*
1a	10	20	15
1b	12	23	42
1c	14	20	15
2a	15	22	20
2b	13	21	12
2c	16	23	22
3a	10	20	15
3b	08	20	15
3c	10	23	22
4a	05	18	38
4b	07	19	30
4c	10	20	18
4d	06	25	40
4e	15	22	20
4f	14	15	15
4g	13	16	13
4h	12	19	19

Anti fungal activity

The novel compounds were evaluated against[33] *Aspergillus fumigatus*. Each compound's antifungal activity was compared to that of Amphotericin B. The MIC (µg/mL) values of the substances tested were computed and compared to controls[34]. The test compounds were active against fungi[35].

The inhibition zones were measured in millimetres (mm), and the results are shown in Table I[36]. The mixture 2-((4-(1*H*-benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-methylacetamide **4a** Excellent action[37] was demonstrated, And the remaining compounds **1b-c**, **2**, **3**, **4b-h** were found to be moderate to compatible (Figure 1).

Experimental Section

The melting points were determined using Electrothermal 9002 melting point equipment. The FTS-6000 BIO-RAD equipment captured IR spectra. ^{1}H and ^{13}C NMR spectra in deuterated $CDCl_3$ and

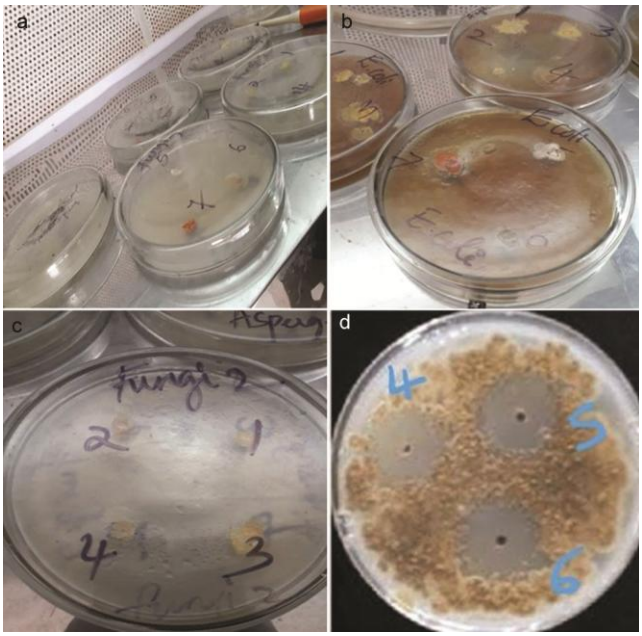


Figure 1 — Some pictures of *in vitro* anti-microbial activity of compounds

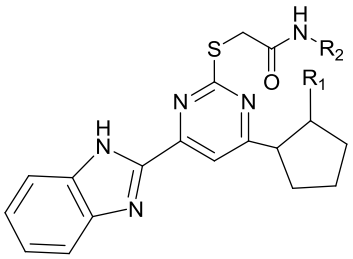
DMSO-d_6 were obtained on a Bruker AC-300. All chemical shifts were recorded in ppm, and coupling constants (*J*) in Hertz (Hz). Micromass LCT (ESI technique, positive mode) spectrometers were used for mass spectra (HRES-MS). All reactions were monitored using TLC on aluminium sheets of SDS silica gel 60 F254,0.2 mm.

General procedure for synthetic pathway to (E)-1-(1*H*-benzo[d]imidazol-2-yl)-3-(2 ethylcyclopentyl) prop-2-en-1-one, 1a-c

Compounds **1a–c** were synthesised using 2-acetylbenzimidazole and substituted carbaldehydes. 2-Acetylbenzimidazole (10mmol) reacted with substituted carbaldehydes (10mmol) and anhydrous potassium hydroxide **2g** was added with ethanol. The precipitated material was recovered by filtering, then washed with cold water, dried, and crystallised from ethanol to produce **1a-c** (Table II).

Yellow solid. Yield 78%. m.p.182-186°C. IR (KBr): 3300–3400, 1658–1760 cm^{-1}; ^{1}H NMR (500 MHz, DMSO-d_6): δ 1.06 (t, 3H-CH_3), 1.45 (m, 4H, Ar-H), 1.71 (m, 5H, Ar-H), 1.88 (s, 1H, Ar-H), 6.44 (d, *J*=11.7Hz,2H, Ar-H), 7.24 (d, *J*=4.6Hz, 2H, Ar-H), 7.57 (d, *J*=0.6Hz, 2H, Ar-H), 7.85 (s, 1H-NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 12.11, 24.53, 25.11, 31.45, 32.07, 45.96, 50.91, 115.12, 118.49, 123.47, 125.76, 137.59, 138.78, 148.13, 178.88; MS: (M+H): *m*/*z* 268.4. Found: 268.11. Anal. Cacld for $C_{17}H_{20}N_2O$; C, 76.09; H, 7.59; N, 10.44. Found: C, 76.51; H, 7.49; N, 10.37%.

Table II — Physical parameters of 2-((4-(1*H*-benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-alkylacetamide **4a-h**



Compd	Substituent (Ar)(R_2)	Mol. Formula	Yield (%)	m.p. (°C)
4a	CH_3NH_2	$C_{21}H_{25}N_5OS$	67	215-18
4b	C_6H_6ClN	$C_{26}H_{26}ClN_5OS$	71	225-28
4c	$C_7H_8N_2O_3$	$C_{27}H_{28}N_6O_4S$	74	210-15
4d	$C_9H_{13}N$	$C_{28}H_{31}N_5OS$	71	222-27
4e	C_6H_6FN	$C_{26}H_{26}FN_5OS$	75	215-20
4f	C_7H_8IN	$C_{26}H_{26}IN_5OS$	73	226-30
4g	$C_6H_6N_2O_2$	$C_{26}H_{26}N_6O_3S$	78	220-25
4h	$C_8H_{10}IN$	$C_{27}H_{28}IN_5OS$	72	227-30

(E)-1-(1*H*-Benzo[d]imidazole-2-yl)-3-(2-methylcyclopentyl) prop-2en-1one, 1b: Yellow solid. Yield 72%. m.p.194-198°C. IR (KBr): 3300–3400, 1658–1760 cm^{-1}; ^{1}H NMR (500 MHz, DMSO-d_6): δ 1.19 (t, 3H-CH_3), 1.45 (m, 4H, Ar-H), 1.71 (m, 4H, Ar-H), 6.45 (t, 3H, Ar-H), 6.65 (s, 1H, Ar-H), 7.23 (d, *J*=6.2Hz, 2H, Ar-H), 7.86 (s, 1H-NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 18.60, 24.32, 31.10, 34.65, 40.10, 52.66, 115.12, 118.49, 123.62, 125.42, 137.59, 138.78, 148.70, 178.88; MS: (M+H): *m*/*z* 254.3. Found: 254.11. Anal. Cacld for $C_{16}H_{18}N_2O$; C, 75.56; H, 7.13; N, 11.01. Found: C, 76.51; H, 7.49; N, 10.37%.

(E)-1-(1*H*-Benzo[d]imidazole-2-yl)-3-(2-methoxycyclopentyl)prop-2en-1-one, 1c: Yellow solid. Yield 73%. m.p.192-195°C. IR (KBr): 3300–3400, 1658–1760 cm^{-1}; ^{1}H NMR (500 MHz, DMSO-d_6): δ 1.45 (q, 4H, Ar-CH_2), 1.67 (m, 3H, Ar-CH_2), 2.18 (q, 3H, Ar-H), 3.31 (s, 1H, Ar-H), 3.38 (s, 1H, Ar-H), 6.40 (d, *J*=10.20Hz, 2H, Ar-H), 6.48 (d, *J*=6.4Hz, 2H, Ar-H), 7.44 (s, 1H, Ar-H) 7.63 (s, 1H, Ar-H); ^{13}C NMR (125 MHz, DMSO-d_6): δ 24.57, 29.17, 31.87, 50.86, 57.02, 86.02, 115.12, 118.49, 123.32, 123.62, 124.62, 137.69, 138.78, 146.67, 178.88; MS: (M+H): *m*/*z* 270.3. Found: 270.31. Anal. Cacld for $C_{16}H_{18}N_2O_2$; C, 70.09; H, 6.71; N, 10.36. Found: C, 70.12; H, 6.75; N, 10.39%.

4-(1*H*-Benzo[d]imidazol-2yl)-6-(2-ethylcyclopentyl)pyrimidine-2-thiol, 2a-c

With caution, the potassium was placed into 20 mL ^{i}PrOH and heated to 80°C until the sodium was depleted. Add thiourea (0.34 g, 4.5 mmol) and compound **1** (4.5 mmol). and the residue was dissolved in water (H_2O,40 mL). The precipitate was filtered, washed, and dried to yield yellow solid substituted pyrimidine-2-thiol. **2a**. m.p.192-195°C, **2b**, m.p. 164–166^{0}C; **2c**, m.p. 175–177°C.

Yellow solid. Yield 72%. IR (KBr): 3300–3400 cm^{-1}; ^{1}H NMR (200 MHz, DMSO-d_6): δ 0.98 (t, 3H, CH_3), 1.12 (d, *J*=8.2Hz, 2H-CH_2), 1.13 (s, 1H, Ar-CH), 1.64 (dd, *J*=15.55, 3.8Hz, 4H, Ar-H) 1.91 (d, *J*=18.4Hz, 2H, Ar-H) 2.44 (s, 1H, Ar-H), 3.47 (s, 1H-SH), 7.31 (d, *J*=7.1Hz, 2H, Ar-H), 7.58 (m, 3H, Ar-H), 7.85 (m, 1H-NH); ^{13}C NMR (50 MHz, DMSO-d_6): δ 12.11, 24.87, 32.45, 46.34, 49.14, 112.81, 115.12, 118.49, 123.48, 137.60, 148.09, 152.21, 167.13, 174.17; MS: (M+H): *m*/*z* 324.4. Found: 324.80. Anal. Cacld for $C_{18}H_{20}N_4S$; C, 66.63; H, 6.21; N, 17.27. Found: C, 66.53; H, 6.75; N, 17.39%.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidine-2-yl)thio)acetic acid, 3a-c

Sodium hydroxide (0.27 g, 6.6 mmol) and intermediate **2** (3.3 mmol) to ethanol (15 mL) (0.32 g, 3.3 mmol). To add water, the reaction mixture was refluxed for 5 hours, then cooled to RT. Substituted ((pyrimidin-2-yl)thio)acetic acid **3** was obtained by suction filtering the solution and washing it with H_2O(20 mL). **3a**, m.p. 223–225°C; **3b**, m.p. 192–196°C; **3c**, m.p. 175–179°C.

Yellow solid. Yield 72%. IR (KBr): 3300–3400 cm^{-1}; ^{1}H NMR (200 MHz, DMSO-d_6): δ 1.12 (t, 3H-CH_3), 1.28 (d, *J*=18.8Hz, 2H-CH_2), 1.63 (dd, *J*=18.6, 3.7Hz, 4H, Ar-H), 1.92 (d, *J*=15.5Hz, 2H-CH_2), 2.69 (s, 1H, Ar-H), 3.99 (m, 4H, Ar-H) 7.31 (d, *J*=7.1Hz, 2H, Ar-H) 7.50 (s, 1H, Ar-H) 7.58 (s, 1H-NH) 7.64 (d, *J*=7.9Hz, Ar-H); ^{13}C NMR (50 MHz, DMSO-d_6): δ 12.11, 24.87, 32.45, 33.04, 46.34, 49.14, 114.43, 115.12, 118.49, 123.48, 137.60, 148.09, 151.53, 166.10, 170.99, 174.82; MS: (M+H): *m*/*z* 382.5. Found: 382.80. Anal. Cacld for $C_{20}H_{22}N_4O_2S$; C, 62.80; H, 5.80; N, 14.65. Found: C, 62.83; H, 6.25; N, 15.39%.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl) pyrimidin-2-yl)thio)-N-alkylacetamide, 4a-h

Intermediate **3** (3.0 mmol) was dissolved in dry dichloromethane (CH_2Cl_2, 15 mL) and centrifuged for 15 minutes. Then proceeded alkylamine/benzylamine (3.0 mmol) and triethylamine (Et_3N, 0.32 g, 3.0 mmol) and 4 hours of agitation at RT. A suction filter was used to collect the precipitate when the reaction was complete. Crushing the crude product with dimethylformamide with water (1 + 2) gave the desired compound **4a-h**.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-methylacetamide, 4a: White solid. Yield 67%. IR (KBr): 3300–3400, 1658–1760 cm^{-1}; ^{1}H NMR (400 MHz, DMSO-d_6): δ 0.98 (t, 3H, CH_3), 1.11(s, 1H-CH_2), 1.17 (s, 1H-CH_2), 1.33 (s, 1H, Ar-CH_2) 1.59 (d, *J*=5.8Hz, 2H-CH_2), 1.62 (dd, *J*=8.4, 6.0Hz, 1H-CH_2), 1.74 (t, 4H, Ar-H) 1.95 (s, 1H, Ar-H), 2.52 (s, 1H, Ar-H), 2.82 (m, 3H-CH_3), 3.93 (m, 2H-CH_2), 7.31 (d, *J*=14.3Hz, 2H, Ar-H), 7.50 (s, 1H, Ar-H), 7.63 (d, *J*=16.7Hz, 2H, Ar-H), 8.47 (s, 1H-NH); ^{13}C NMR (100 MHz, DMSO-d_6): δ 12.11, 24.71, 25.02, 26.62, 31.59, 32.30, 32.59, 46.33, 49.13, 114.43, 115.12, 118.49, 123.32, 123.62, 137.59, 148.09, 151.52, 166.10, 170.90, 174.81; MS: (M+H): *m*/*z* 395.5. Found: 395.80. Anal. Cacld for $C_{21}H_{25}N_5OS$; C, 63.77; H, 6.37; N, 17.71. Found: C, 63.83; H, 6.25; N, 17.39%.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-(methoxy-2-nitrophenyl)acetamide, 4b: White solid. Yield 71%. IR (KBr): 3400, 1760 cm^{-1}; ^{1}H NMR (200 MHz, DMSO-d_6): δ 1.03 (t, 3H, CH_3), 1.32 (m, 5H-CH_2), 1.63 (dd, *J*=17.9, 5.5Hz, 4H-CH_2), 1.94 (d, *J*=4.5Hz, 2H, Ar-H), 3.65 (s, 1H, Ar-H), 3.99 (m, 4H-CH_2), 7.47 (m, 3H-CH_2), 7.89 (m, 3H, Ar-H), 9.98 (s, 1H-NH); ^{13}C NMR (50 MHz, DMSO-d_6): δ 12.11, 24.71, 33.12, 46.33, 49.13,114.33, 115.12, 118.49, 122.21, 123.47, 128.62, 129.23, 136.52, 137.59, 148.09, 151.52, 166.10, 168.72, 174.81; MS: (M+H): *m*/*z* 492.0. Found: 492.80. Anal. Cacld for $C_{26}H_{26}ClN_5OS$; C, 63.47; H, 5.33; N, 14.23. Found: C, 63.83; H, 6.25; N, 14.39%.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-(4-methoxy-2-chlorophenyl)acetamide, 4c: White solid. Yield 74%. IR (KBr): 3400, 1760 cm^{-1}; ^{1}H NMR (200 MHz, DMSO-d_6): δ 0.99 (t, 3H, CH_3), 1.19 (m, 5H-CH_2) 1.32 (s, 1H, Ar-H), 1.63 (dd, *J*=19.0, 5.6Hz, 4H, CH_2), 1.91 (d, *J*=16.1Hz, 2H-CH_2), 2.69 (s, 1H, Ar-H), 3.80 (m, 3H-CH_3), 3.96 (m, 2H-CH_2), 7.33 (t, *J*=6.0Hz, 3H, Ar-CH), 7.88 (m, 3H, Ar-H), 7.94 (s, 1H, Ar-H); ^{13}C NMR (50 MHz,

DMSO-d_6): δ 12.11, 24.86, 33.12, 46.33, 49.13, 56.03, 49.13, 56.03, 111.11, 114.33, 115.12, 118.59, 121.24, 123.47, 124.57, 127.86, 137.59, 138.77, 148.09, 151.12, 157.84, 166.10, 170.26, 174.81; MS: (M+H): *m*/*z* 532.6. Found: 532.80. Anal. Cacld for $C_{27}H_{28}N_6O_4S$; C, 60.89; H, 5.30; N, 15.78. Found: C, 60.83; H, 6.25; N, 15.39%.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-(3,5-dimethylphenyl)acetamide, 4d: White solid. Yield 71%. IR (KBr): 3400, 1760 cm^{-1}; ^{1}H NMR (200 MHz, DMSO-d_6): δ 1.54 (t, 3H-CH_3), 2.13 (m, 5H-CH_2), 3.3 (d, *J*=10.5Hz, 1H, Ar-H), 3.95 (s, 2H-CH_2) 6.92 (t, *J*=1.3Hz, 1H, Ar-CH), 7.23 (m, 4H, Ar-H), 7.58 (s, 1H-NH), 8.47 (m, 6H, Ar-H); ^{13}C NMR (50 MHz, DMSO-d_6): δ 12.11, 21.80, 24.86, 33.12, 46.33, 49.13, 114.43, 115.12, 118.52, 123.47, 127.93, 135.82, 137.60, 148.09, 151.52, 166.10, 168.72, 174.81; MS: (M+H): *m*/*z* 485.6. Found: 485.80. Anal. Cacld for $C_{28}H_{31}N_5OS$; C, 69.25; H, 6.43; N, 14.42. Found: C, 69.83; H, 6.55; N, 15.39%.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-(4-flourophenyl)acetamide, 4e: White solid. Yield 75%. IR (KBr): 3400, 1760 cm^{-1}; ^{1}H NMR (200 MHz, DMSO-d_6): δ 1.54 (t, 3H-CH_3), 2.13 (m, 5H-CH_2), 2.69 (q, *J*=8.9Hz, 1H, Ar-H), 3.96 (s, 2H-CH), 7.11 (m, 4H, Ar-CH), 7.44 (m, 6H, Ar-CH), 8.55 (m, 4H, Ar-CH), 9.27 (s, 1H-NH); ^{13}C NMR (50 MHz, DMSO-d_6): δ 12.11, 24.86, 33.12, 46.33, 49.13, 114.43, 115.12, 116.20, 118.49, 122.57, 123.47, 134.72, 137.59, 148.09, 151.52, 157.35, 162.59, 168.78, 174.84; MS: (M+H): *m*/*z* 475.6. Found: 475.80. Anal. Cacld for $C_{26}H_{26}F_5OS$; C, 65.66; H, 5.51; N, 14.33. Found: C, 65.83; H, 5.55; N, 15.39%.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-(4-iodophenyl)acetamide, 4f: White solid. Yield 73%. IR (KBr): 3400, 1760 cm^{-1}; ^{1}H NMR (200 MHz, DMSO-d_6): δ 0.97 (t, 3H, *J*=6.5Hz –CH_3), 1.69 (m, 5H, Ar-CH_2), 2.87 (m, 4H, Ar-CH), 3.95 (s, 1H, Ar-H), 7.13 (m, 5H, Ar-H), 7.48 (m, 4H, Ar-H)' 9.15 (s, 1H, Ar-H); ^{13}C NMR (50 MHz, DMSO-d_6): δ 12.11, 24.86, 46.33, 49.13, 93.15, 114.43, 115.12, 118.49,120.78, 123.47, 136.36, 137.96, 148.09, 151.52, 166.10, 168.72, 174.81; MS: (M+H): *m*/*z* 583.5. Found: 583.80. Anal. Cacld for $C_{26}H_{26}IN_5OS$; C, 53.52; H, 4.51; N, 14.33. Found: C, 53.83; H, 5.55; N, 15.39.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-(4-nitrophenyl)acetamide, 4g: White solid. Yield 78%. IR (KBr): 3400, 1760 cm^{-1}; ^{1}H NMR (200 MHz, DMSO-d_6): δ 0.98 (t, 3H, *J*=6.5Hz –CH_3), 1.69 (m, 5H, Ar-CH_2), 2.69 (q, *J*=8.9Hz, Ar-H), 3.96 (s, 2H-CH_2), 7.12 (m, 5H, Ar-H), 8.12 (s, 2H, Ar-H), 8.55 (m, 7H, Ar-CH), 9.27 (s, 1H-NH) ^{13}C NMR (50 MHz, DMSO-d_6): δ 12.11, 24.86, 32.58, 46.33, 49.13, 114.43, 115.12, 116.20, 118.49, 122.57, 123.47134.72, 137.59, 148.09, 151.52, 15.35, 162.59, 166.10, 168.72, 174.81; MS: (M+H): *m*/*z* 502.6. Found: 502.80. Anal. Cacld for $C_{26}H_{26}N_6O_3S$; C, 62.13; H, 5.21; N, 16.33. Found: C, 62.83; H, 5.55; N, 16.39%.

2-((4-(1*H*-Benzo[d]imidazol-2-yl)-6-(2-ethylcyclopentyl)pyrimidin-2-yl)thio)-N-(4-iodomethylphenyl)acetamide, 4h: White solid. Yield 72%. IR (KBr): 3400, 1760 cm^{-1}; ^{1}H NMR (500 MHz, DMSO-d_6): δ 0.97 (t, 3H-CH_3), 1.10 (s, 1H-CH_2) 1.13 (s, 1H- CH_2), 1.32 (s, 1H, Ar- CH_2), 1.59 (d, *J*=11.3Hz, 2H, Ar-H), 1.68 ((d, *J*=12.3Hz, 2H, Ar-CH_2), 1.88 (s, 1H, Ar-H), 1.94 (s, 1H, Ar-CH_2), 2.25 (m, 3H-CH_3), 3.13 (s, 1H, Ar-H), 3.91 (m, 2H, Ar-CH_2) 7.04, (s, 1H, Ar-H), 7.32 (d, *J*=12.3Hz, 2H, Ar-H), 7.63 (d, *J*=1.3Hz, 1H, Ar-H), 7.68 (dd, *J*=20.3, 15.6Hz, 4H, Ar-H), 9.12 (s, 1H-NH); ^{13}C NMR (125 MHz, DMSO-d_6): δ 12.11, 18.17, 24.71, 25.02,32.03, 32.59, 32.85, 46.33, 49.13, 86.14, 114.43, 115.12, 118.49,122.6, 123.32, 130.89, 135.43, 136.88, 137.50, 137.79, 138.02, 148.09, 151.52, 166.10, 170.26, 174.81; MS: (M+H): *m*/*z* 597.6. Found: 597.80. Anal. Cacld for $C_{27}H_{28}IN_5OS$; C, 54.27; H, 4.72; N, 11.72. Found: C, 54.83; H, 5.55; N, 11.39%.

Conclusion

Our approach for producing 2-(4-(1*H*-benzo[d]imidazo[l]-2-yl)-6-(2-ethylcyclopentyl) pyrimidin-2-ethyl)acetamide **4a-h** and its derivatives was exceedingly efficient. The compounds collected had good yields and were antimicrobial tested. This transformation demonstrates the process's maximum efficiency under moderate conditions, short response times, and operational simplicity. This agreement may be extended to a variety of substrates.

Supplementary Information

Supplementary information is available in the website http://nopr.niscair.res.in/handle/123456789/58776.

Compliance with Ethical Standards

It is not intended to include any of the authors' investigations with animals or human beings in this publication.

Conflict of Interests

Authors affirm to no conflicts of interest.

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