Synthesis and *In Vitro* Antimicrobial Screening of New Azetidin-2-ones of 5-Ethyl Pyridine-2-ethanol

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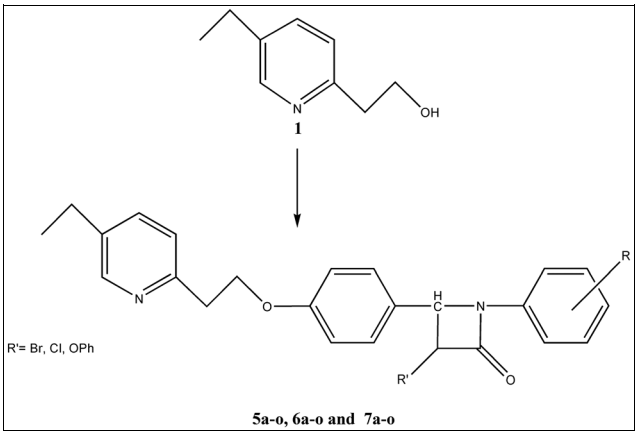

A new series of azetidinones is described in this paper; Schiff base (**4a–o**) were synthesized from 4-[2-(5-ethylpyridin-2-yl)ethoxy]benzaldehyde, which was used to synthesize azetidinones (**5a–o**), (**6a–o**), and (**7a–o**). The structures of the synthesized compounds were assigned on the basis of elemental analysis, IR, ^{1}H NMR, and ^{13}C NMR spectral data. All the products were screened against different strains of bacteria and fungi. Most of the monosubstituted and disubstituted chloro groups are more effective to both bacterial and fungal species in comparison with the standard drugs.

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INTRODUCTION

Schiff bases are typically formed by the condensation of a primary amine and aldehyde, which are important intermediates for the synthesis of various bioactive compounds. They are reported to show a variety of biological activities including antimicrobial [1–5], antitubercular [6–8], antioxidant, and antiproliferative activities [9]. The β-lactum (2-azetidinone) skeleton is the key structural unit in penicillins (e.g., amoxicillin (AMOX), ampicillin (AMP), penicillin G (PEN G), oxacillin (OXA), and cloxacillin (CLOX)), and cephalosporins (e.g., cephapirin (CEP)) for antimicrobial agents. In penicillins and cephalosporins, β-lactam ring is responsible for the antibacterial activity; besides this, 2-azetidinone-containing compounds were reported for antimicrobial [10–15], anti-inflammatory [16–19], analgesic, CNS depressant, and muscle relaxant activities [19]. Pyridine derivatives also exhibit various biological activities such as anticancer [20,21], anticonvulsant [22], antiproliferative [23], and also used as γ-secretase modulators [24], JAK2 kinase inhibitors [25], cyclooxygenase-2 (COX-2) inhibitors [26], and so forth.

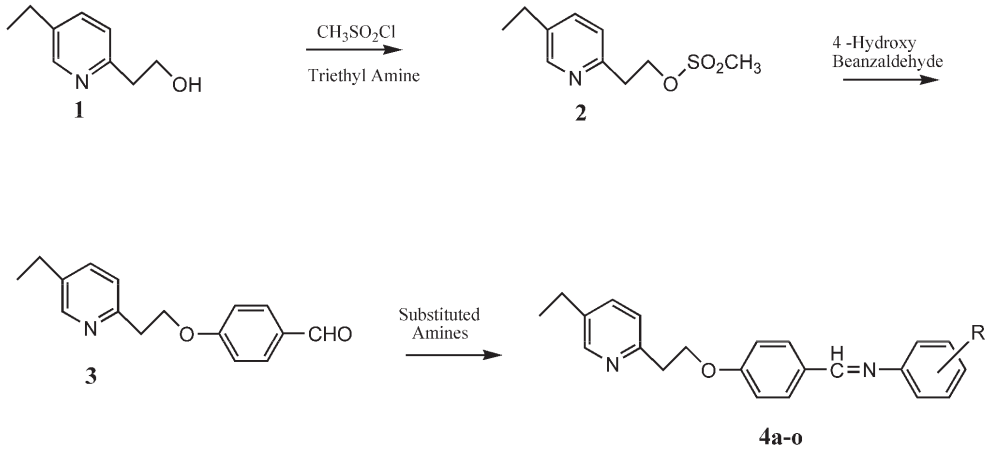
In view of future scope and better enhancement of such active molecule for new biodynamic fascinating scaffolds, still modifications are possible to study the different activities; hence, we have synthesized new 2-azetidinones from 4-[2-(5-ethylpyridin-2-yl)ethoxy]benzaldehyde and studied their antimicrobial activity.

RESULT AND DISCUSSION

Chemistry. The synthesis of Schiff bases and azetidinones was performed in different synthetic steps as shown in Scheme 1. Schiff bases **4a–o** were synthesized by condensing 4-[2-(5-ethylpyridin-2-yl)ethoxy]benzaldehyde with appropriate aromatic amine in absolute alcohol and 2–3 drops of glacial acetic acid at refluxed temperature. Azetidinones **5a–o** and **6a–o** were synthesized from appropriate Schiff base with bromo acetyl bromide and chloro acetyl chloride respectively in 1,4-dioxane solvent and triethyl amine as catalyst; **7a–o** were synthesized from appropriate Schiff base and phenoxy acetic acid in the presence of thionyl chloride. The purity of the compounds was checked by TLC and elemental analysis. Spectral data (IR, ^{1}H NMR, and ^{13}C NMR) of all the compounds were in full agreement with the proposed structures.

The synthesis of **4a–o** and **5a–o** was confirmed by the IR and NMR spectra. The band of –CH=N observed at 1627 cm^{-1} showed the confirmation of Schiff base. Asymmetric and symmetric band of C–O–C ether linkage was observed at 1227 and 1046 cm^{-1}, respectively. A singlet at δ 8.25 attributed to the –CH=N protons; δ 161.4 ppm was

Scheme 1. Synthesis of **4a–o**.



R:-	4-F	3,4-F	2-Cl	3-Cl
	3,5-F	2-Br, 4-F	2-F	4-CH_3
	4-Cl	3-Cl, 4-CH_3	2,5-Cl	3,4-Cl
	3,5-Cl	2,3-Cl		

attributed to the –CH═N confirmed by ^{13}C NMR. In **5a–o**, the absence of –CH═N band at 1627 cm^{-1} and presence of 1725 cm^{-1} of –C═O (β-lactam ring) confirmed the conversion of Schiff base in to azetidinones by IR, the signal appeared at δ 5.40 and δ 5.15 for the –CH–Cl and –CH of azetidinones, respectively, in ^{1}H NMR, and –C═O carbon that clearly appeared at δ 162.5 was also observed in ^{13}C NMR. For compounds **6a–o**, the sharp band of –C═O is observed at 1730 cm^{-1}. In ^{1}H NMR spectra, two signals are observed at δ 5.35 and δ 5.20 for the –CH–Br and –CH of azetidinone ring, respectively, whereas –C═O carbon appeared at δ 170.8.

For compounds **7a–o**, the disappearance of –CH═N band at 1627 cm^{-1} and appearance of 1722 cm^{-1} of –C═O lactam ring gave the confirmation of 2-azetidinone. A signal at δ 5.31 and δ 5.29 for the –CH–OPh and –CH of 2-azetidinone and carbonyl carbon of azetidinone appeared at δ 165.1. The aforementioned spectral data confirmed the conversion of Schiff base into 2-azetidinone.

Biological activity. The minimum inhibitory concentrations (MICs) of all compounds were carried out by broth microdilution method as described by Rattan [29]. All MTCC cultures were collected from the Institute of Microbial Technology, Chandigarh, India. Antibacterial and antifungal activity data of compounds **4a–o**, **5a–o**, **6a–o**, and **7a–o** are described in Tables 1–6, respectively.

Antibacterial activity. The MICs of **4a–o** and **5a–o** were tested *in vitro* against two Gram-positive (*S. aureus* MTCC 96 and *S. pyogenus* MTCC 443) and two Gram-negative (*E. coli* MTCC 442 and *P. aeruginosa* MTCC 2488) bacteria are shown in Table 1, 3, and 5. From the screening results, most of the compounds possessed very good activity (MIC, 100–250 μg/mL) against *S. aureus*; some of them possessed excellent compared with ampicillin.

Most of the compounds possessed very good activity (MIC, 100–250 μg/mL) against *S. aureus*; **4e** and **4n** containing chloro and dichloro groups showed significant activity of 100 μg/mL against *E.* coli. **4e** also showed excellent activity of 100 μg/mL against *P. aeruginosa* comparable with ampicillin. Compounds **4g**, **4l**, **4m**, and **4o** displayed very good activity at 100–200 μg/mL indicating that these compounds are very effective against *S. aureus*. The remaining compounds **4d**, **4e**, **4h**, **4k**, and **4n** are also active having promising activity with ampicillin. All Schiff bases were very poor against *S. pyogenus*. Azetidinones (**5a–o**), **5d**, **5e**, and **5g** displayed MIC of 100 μg/mL against *E. coli*, which are similar as standard drug. Compound **5d** possessed MIC of 150 μg/mL against *P. aeruginosa*, which is nearer to ampicillin. **5b**, **5g**, **5j**, and **5k** displayed MIC in the range of 100–200 μg/mL against *S. aureus*, which is better compared with ampicillin. Compound **5a** possessed better MIC at 250 μg/mL against *S. aureus*, whereas **5j** found very active against *S. pyogeneus*; **5b** and **5i** are moderate against the aforementioned species. The rest of the compounds possessed moderate to poor activity against all four bacterial species. Azetidinones **(6a–o)**, **6a** possessed MIC of 100 μg/mL

Table 1

Antibacterial activity of **4a–o** and **5a–o**.

	Minimal bactericidal concentration μg/mL			
	Gram-negative		Gram-positive	
Compounds	*E. coli*	*P. aeruginosa*	*S. aureus*	*S. pyogenus*
4a	250	500	500	500
4b	500	500	1000	1000
4c	1000	1000	1000	1000
4d	200	250	250	250
4e	100	100	250	500
4f	250	250	500	500
4g	250	250	200	250
4h	500	500	250	500
4i	1000	1000	500	500
4j	500	500	500	500
4k	250	200	250	500
4l	500	250	150	200
4m	250	200	100	250
4n	100	150	250	250
4o	150	200	100	250
5a	250	500	250	250
5b	500	500	200	200
5c	250	500	500	500
5d	100	150	200	200
5e	100	250	500	500
5f	500	500	1000	500
5g	100	250	100	250
5h	500	250	500	500
5i	250	500	500	200
5j	125	250	200	100
5k	500	500	200	250
5l	500	250	500	500
5m	500	500	1000	500
5n	500	500	250	500
5o	500	250	250	250
Ampicillin	**100**	**100**	**250**	**100**

Table 2

Antifungal activity of **4a–o** and **5a–o**.

	Minimal fungicidal concentration μg/mL		
Compounds	*C. albicans*	*A.niger*	*A. clavatus*
4a	500	>1000	>1000
4b	>1000	1000	1000
4c	>1000	>1000	>1000
4d	200	500	500
4e	250	500	500
4f	500	>1000	>1000
4g	500	500	1000
4h	500	1000	1000
4i	>1000	>1000	>1000
4j	1000	1000	1000
4k	500	500	500
4l	500	1000	1000
4m	500	1000	>1000
4n	1000	1000	1000
4o	>1000	>1000	>1000
5a	500	500	500
5b	1000	1000	1000
5c	500	>1000	>1000
5d	200	500	500
5e	500	1000	1000
5f	250	250	250
5g	250	1000	1000
5h	200	500	>1000
5i	>1000	500	>1000
5j	>1000	>1000	>1000
5k	500	500	>1000
5l	500	>1000	500
5m	>1000	>1000	>1000
5n	250	500	>1000
5o	500	500	>1000
Nystatin	**100**	**100**	**100**
Greseofulvin	**500**	**100**	**100**

against *E. coli*, which is equipotent to reference drug. Compounds **6b**, **6c**, **6d**, and **6j** displayed MIC in the range of 100–200 μg/mL against *S. aureus*. Compounds **7j** and **7i** having chloro and dichloro substituents possessed MIC in the range of 62.5–100 μg/mL against *E. coli*. Compound **7i** possessed very good MIC of 100 μg/mL against *P. aeruginosa*, whereas **7a**, **7e**, **7f**, **7g**, **7h**, **7i**, **7k**, and **5l** displayed promising activity of 100–250 μg/mL against *S. aureus*. Azetidinones are found to be very poor against *S. pyogeneus*; the remaining compounds possessed moderate to poor activity against all four bacterial species.

Antifungal activity. Minimum inhibition concentrations (MICs for fungus) of the synthesized compounds are shown in Tables 2, 4, and 6; three fungal species *C. albicans* MTCC 227, *A. niger* MTCC 282, and *A. clavatus* MTCC 1323 were used and compared with greseofulvin. Most of the compounds possessed very good antifungal activity against *C. albicans*; their MICs were in the range of 100–500 μg/mL.

Schiff base, **4a**, **4d**, **4e**, **4f**, **4g**, **4h**, **4k**, **4l**, and **4m**, showed significant activity of 200–500 μg/mL against *C. albicans* and comparable with greseofulvin, whereas the remaining Schiff bases possessed poor activity against *A. niger* and *A. clavatus*. Azetidinones **(5a–o)**, **5a**, **5c**, **5d**, **5e**, **5f**, **5g**, **5h**, **5k**, **5l**, **5n**, and **5o** possessed excellent activity of 200–500 μg/mL against *C. albicans*, which is equipotent to greseofulvin, whereas the remaining compounds showed moderate to poor activity against *A. niger* and *A. clavatus*. Azetidinones **(6a–o)**, **6n** displayed better activity of 100 μg/mL against *C. albicans*, which showed that this compound is more active when compared with greseofulvin and similar as nystatin drug. Compounds **6a**, **6c**, **6d**, **6e**, **6h**, and **6k** showed to possess very good activity of 200–500 μg/mL against *C. albicans* with greseofulvin; the remaining compounds showed moderate to poor activity against all four fungal species.

Azetidinone, **7a**, **7h**, and **7k**, possessed excellent activity of 200–500 μg/mL against *C. albicans*, **7j** having chloro group displayed significant activity of 100 μg/mL against

Table 3

Antibacterial activity of **6a–o**.

	Minimal bactericidal concentration μg/mL			
	Gram-negative		Gram-positive	
Compounds	*E. coli*	*P. aeruginosa*	*S. aureus*	*S. pyogeneus*
6a	100	200	250	500
6b	250	250	150	200
6c	200	250	100	200
6d	250	250	200	250
6e	500	500	250	250
6f	500	500	250	250
6g	250	250	500	500
6h	500	500	1000	1000
6i	250	250	500	500
6j	150	200	200	500
6k	250	200	500	500
6l	250	250	500	500
6m	500	500	1000	1000
6n	250	500	250	500
6o	500	500	500	500
Ampicillin	**100**	**100**	**250**	**100**

Table 4

Antifungal activity of **6a–o**.

	Minimal fungicidal concentration μg/mL		
Compounds	*C. albicans*	*A.niger*	*A. clavatus*
6a	500	500	500
6b	1000	1000	1000
6c	500	1000	>1000
6d	200	200	200
6e	250	500	500
6f	1000	1000	1000
6g	1000	1000	1000
6h	500	500	500
6i	>1000	>1000	>1000
6j	>1000	>1000	>1000
6k	500	500	500
6l	1000	>1000	>1000
6m	1000	>1000	>1000
6n	100	500	1000
6o	500	500	500
Nystatin	**100**	**100**	**100**
Greseofulvin	**500**	**100**	**100**

Table 5

Antibacterial activity of **7a–o**.

	Minimal bactericidal concentration μg/mL			
	Gram-negative		Gram-positive	
Compounds	*E. coli*	*P. aeruginosa*	*S. aureus*	*S. pyogenus*
7a	150	200	200	500
7b	250	250	500	500
7c	250	500	500	1000
7d	250	200	500	500
7e	200	200	200	250
7f	250	250	150	200
7g	200	200	100	250
7h	250	500	150	150
7i	100	100	200	200
7j	62.5	200	500	500
7k	250	250	200	500
7l	250	500	250	500
7m	500	200	500	500
7n	250	250	500	500
7o	200	250	500	500
Ampicillin	**100**	**100**	**250**	**100**

Table 6

Antifungal activity of **7a–o**.

	Minimal fungicidal concentration μg/mL		
Compounds	*C. albicans*	*A.niger*	*A. clavatus*
7a	250	200	200
7b	1000	1000	1000
7c	1000	500	500
7d	1000	>1000	>1000
7e	1000	>1000	>1000
7f	1000	1000	1000
7g	1000	500	500
7h	500	>1000	>1000
7i	1000	>1000	>1000
7j	100	200	200
7k	200	500	500
7l	1000	500	500
7m	1000	>1000	>1000
7n	1000	>1000	>1000
7o	1000	1000	>1000
Nystatin	**100**	**100**	**100**
Greseofulvin	**500**	**100**	**100**

C. albicans comparable with nystatin, whereas the remaining compounds showed poor activities against *A. niger* and *A. clavatus*.

CONCLUSIONS

- All the Schiff bases and azetidinones are excellent against Gram-positive bacteria *S. aureus* and very good against fungal species *C. albicans*.
- Structure activity relationship study shows that effect of substituent group plays an important role in the biological activity following for Schiff bases; compounds bearing **2,4-Cl** found to be very active against bacterial species, promising towards the *C. albicans* and poor against the other fungi compared with the compounds bearing other substituents such as **F** or **–CH_3**.
- Similar results are observed for azetidinones from structure activity relationship study such as compound having

2-Cl is active against *E. coli* and *C. albicans*; another compound bearing **3,5-Cl** group is excellent against all bacteria.

EXPERIMENTAL

Laboratory chemicals were supplied by Rankem India Ltd. and Ficher Scientific Ltd. Melting points were determined by the open tube capillary method and are uncorrected. The purity of the compounds was determined by TLC plates (silica gel G) in the solvent system toluene:ethyl acetate (7.5:2.5). The spots were observed by exposure to iodine vapors or by UV light. The IR spectra were obtained on a PerkinElmer 1720 FTIR spectrometer (KBr pellets). The ^{1}H NMR and ^{13}C NMR spectra were recorded on a Bruker Avance II 400 spectrometer by using TMS as an internal standard in $CDCl_3$. Elemental analysis of the newly synthesized compounds were carried out on Carlo Erba 1108 analyzer.

Procedure for the synthesis of 4-[2-(5-ethylpyridin-2-yl) ethoxy]benzaldehyde (3). 4-[2-(5-Ethylpyridin-2-yl)ethoxy] benzaldehyde (**3**) was synthesized by the method described in the literature[27,28].

General preparation of the compounds (4a–o). A mixture of 4-[2-(5-ethylpyridin-2-yl)ethoxy]benzaldehyde (0.01 mol) and aromatic amine (0.01 mol) was taken in absoluted ethanol, and few drops of glacial acetic acid were added. Then, the mixture was refluxed for 6–8 h on water bath. The excess solvent was distilled off, and then the remaining residue poured in to ice cold water. The separated solid was filtered, washed, and recrystalized from ethanol (Fig. 1).

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-4-fluorobenzenamine (4a).** This compound was obtained as off white solid; yield, 70%; mp 85–87°C. R_f: 0.45. IR ν_{max}: 3055 (Ar–H), 2956, 2844 (−CH_2–), 1628 (−CH═N), 1227, 1045 (C–O–C), 972 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.12 (t, 3H, –CH_3), 2.50 (q, 2H, –CH_2), 3.17 (t, 2H, –CH_2), 4.32 (t, 2H, –CH_2–O), 7.00–7.87 (m, 8H, Ar–H), 7.34–8.34 (m, 3H, Pyridine–H), 8.27 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.4 (C_8), 32.5 (C_7), 37.5 (C_9), 67.6 (C_{10}), 115.2–155.4 (C_{11}–C_{16}), 116.5–161.4 (C_{18}–C_{23}), 123.3–157.3 (C_2–C_6), 160.6 (C_{17}); *Anal*. Calcd for $C_{22}H_{21}N_2OF$: C 75.84, H 6.08, N 8.04; found C 75.82, H 6.09, N 8.05.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-3,5-difluorobenzenamine (4b).** This compound was obtained as off white solid; yield, 72%; mp 100–103°C. R_f: 0.43. IR ν_{max}: 3058 (Ar–H), 2958, 2845 (−CH_2–), 1627 (−CH═N), 1228, 1046 (C–O–C), 974 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.13 (t, 3H, –CH_3), 2.52 (q, 2H, –CH_2), 3.15 (t, 2H, –CH_2), 4.33 (t, 2H, –CH_2–O), 6.72–7.85 (m, 7H, Ar–H), 7.34–8.36 (m, 3H, Pyridine–H), 8.26 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.7 (C_8), 32.6 (C_7), 37.5 (C_9), 67.3 (C_{10}), 115.2–155.4 (C_{11}–C_{16}), 123.7–151.3 (C_{18}–C_{23}), 123.2–157.6 (C_2–C_6), 160.7 (C_{17}); *Anal*. Calcd for $C_{22}H_{20}N_2OF_2$: C 72.12, H 5.50, N 7.65; found C 72.13, H 5.51, N 7.62.

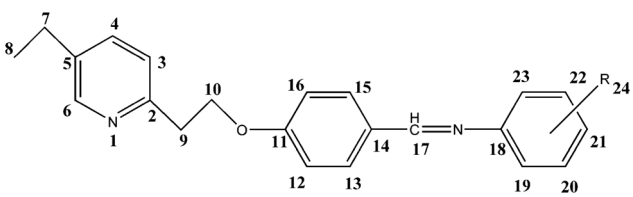


Figure 1. Schiff base **4a–o**.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-4-chlorobenzenamine (4c).** This compound was obtained as off yellow solid; yield, 80%; mp 113–115°C. R_f: 0.47. IR ν_{max}: 3056 (Ar–H), 2960, 2844 (−CH_2–), 1626 (−CH═N), 1227, 1044 (C–O–C), 745 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.15 (t, 3H, –CH_3), 2.54 (q, 2H, –CH_2), 3.16 (t, 2H, –CH_2), 4.30 (t, 2H, –CH_2–O), 7.05–7.87 (m, 8H, Ar–H), 7.35–8.35 (m, 3H, Pyridine–H), 8.28 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.7 (C_8), 32.6 (C_7), 37.5 (C_9), 67.3 (C_{10}), 115.2–155.4 (C_{11}–C_{16}), 123.7–151.3 (C_{18}–C_{23}), 123.2–157.6 (C_2–C_6), 160.7 (C_{17}); *Anal*. Calcd for $C_{22}H_{21}N_2OCl$: C 72.42, H 5.80, N 7.68; found C 72.41, H 5.79, N 7.66.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-3,4-dichlorobenzenamine (4d).** This compound was obtained as off yellow liquid; yield, 78%; mp limpid. R_f: 0.43. IR ν_{max}: 3057 (Ar–H), 2957, 2845 (−CH_2–), 1629 (−CH═N), 1228, 1046 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.14 (t, 3H, –CH_3), 2.56 (q, 2H, –CH_2), 3.13 (t, 2H, –CH_2), 4.33 (t, 2H, –CH_2–O), 7.09–7.86 (m, 7H, Ar–H), 7.33–8.35 (m, 3H, Pyridine–H), 8.25 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.6 (C_8), 32.5 (C_7), 37.7 (C_9), 67.4 (C_{10}), 115.4–155.6 (C_{11}–C_{16}), 121.8–152.6 (C_{18}–C_{23}), 123.4–157.4 (C_2–C_6), 160.5 (C_{17}); *Anal*. Calcd for $C_{22}H_{20}N_2OCl_2$: C 66.17, H 5.05, N 7.02; found C 66.15, H 5.04, N 7.00.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-2,4-dichlorobenzenamine (4e).** This compound was obtained as off yellow liquid; yield, 75%; mp limpid. R_f: 0.50. IR ν_{max}: 3056 (Ar–H), 2957, 2847 (−CH_2–), 1624 (−CH═N), 1227, 1043 (C–O–C), 745 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.13 (t, 3H, –CH_3), 2.54 (q, 2H, –CH_2), 3.15 (t, 2H, –CH_2), 4.35 (t, 2H, –CH_2–O), 6.70–7.88 (m, 7H, Ar–H), 7.34–8.35 (m, 3H, Pyridine–H), 8.26 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.4 (C_8), 32.6 (C_7), 37.5 (C_9), 67.5 (C_{10}), 115.3–155.7 (C_{11}–C_{16}), 125.1–141.3 (C_{18}–C_{23}), 123.5–157.3 (C_2–C_6), 160.4 (C_{17}); *Anal*. Calcd for $C_{22}H_{20}N_2OCl_2$: C 66.17, H 5.05, N 7.02; found C 66.16, H 5.06, N 7.01.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-3,4-difluorobenzenamine (4f).** This compound was obtained as yellow solid; yield, 68%; mp 120–122°C. R_f: 0.51. IR ν_{max}: 3059 (Ar–H), 2954, 2845 (−CH_2–), 1626 (−CH═N), 1226, 1045 (C–O–C), 973 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.16 (t, 3H, –CH_3), 2.53 (q, 2H, –CH_2), 3.13 (t, 2H, –CH_2), 4.36 (t, 2H, –CH_2–O), 6.89–7.85 (m, 7H, Ar–H), 7.34–8.37 (m, 3H, Pyridine–H), 8.25 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.7 (C_8), 32.4 (C_7), 37.6 (C_9), 67.6 (C_{10}), 115.0–155.5 (C_{11}–C_{16}), 111.2–150.3 (C_{18}–C_{23}), 123.1–157.4 (C_2–C_6), 160.8 (C_{17}); *Anal*. Calcd for $C_{22}H_{20}N_2OF_2$: C 72.12, H 5.50, N 7.65; found C 72.11, H 5.51, N 7.64.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene2-bromo)-4-fluorobenzenamine (4g).** This compound was obtained as off brown liquid; yield, 59%; mp limpid. R_f: 0.46. IR ν_{max}: 3056 (Ar–H), 2955, 2844 (−CH_2–), 1627 (−CH═N), 1225, 1046 (C–O–C), 972 (C–F), 857 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.14 (t, 3H, –CH_3), 2.57 (q, 2H, –CH_2), 3.16 (t, 2H, –CH_2), 4.34 (t, 2H, –CH_2–O), 6.89–7.86 (m, 7H, Ar–H), 7.30–8.38 (m, 3H, Pyridine–H), 8.27 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.8 (C_8), 32.5 (C_7), 37.4 (C_9), 67.7 (C_{10}), 115.2–155.3 (C_{11}–C_{16}), 112.6–163.5 (C_{18}–C_{23}), 123.2–157.6 (C_2–C_6), 160.7 (C_{17}); *Anal*. Calcd for $C_{22}H_{20}N_2OFBr$: C 61.84, H 4.72, N 6.56; found C 61.80, H 4.71, N 6.53.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)3-chloro-4-methyl benzenamine (4h).** This compound was obtained as off brown solid; yield, 62%; mp 135–137°C. R_f: 0.48. IR ν_{max}: 3058 (Ar–H), 2958, 2845 (−CH_2–), 1628 (−CH═N), 1228, 1046 (C–O–C), 744 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.18 (t, 3H, –CH_3), 2.35 (s, 3H, –CH_3), 2.58 (q, 2H, –CH_2), 3.15 (t, 2H, –CH_2), 4.33 (t, 2H, –CH_2–O), 7.00–7.82 (m, 7H, Ar–H), 7.35–8.36 (m, 3H, Pyridine–H), 8.24 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.6 (C_8), 20.1 (C_{24}), 32.6 (C_7), 37.6 (C_9), 67.5 (C_{10}), 115.8–155.4 (C_{11}–C_{16}), 120.0–151.5 (C_{18}–C_{23}), 123.4–157.8 (C_2–C_6), 160.3 (C_{17}); *Anal*. Calcd for $C_{23}H_{23}N_2OCl$: C 72.91, H 6.12, N 7.39; found C 72.90, H 6.10, N 7.36.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-3,5-dichlorobenzenamine (4i).** This compound was obtained as off yellow solid; yield, 77%; mp 110–112°C. R_f: 0.43. IR ν_{max}: 3056 (Ar–H), 2956, 2843 (−CH_2–), 1627 (−CH═N), 1224, 1045 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.17 (t, 3H, –CH_3), 2.58 (q, 2H, –CH_2), 3.15 (t, 2H, –CH_2), 4.33 (t, 2H, –CH_2–O), 7.05–7.84 (m, 7H, Ar–H), 7.35–8.36 (m, 3H, Pyridine–H), 8.24 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.6 (C_8), 32.6 (C_7), 37.6 (C_9), 67.5 (C_{10}), 115.8–155.4 (C_{11}–C_{16}), 120.5–156.1 (C_{18}–C_{23}), 123.4–157.6 (C_2–C_6), 160.5 (C_{17}); *Anal*. Calcd for $C_{22}H_{20}N_2OCl_2$: C 66.17, H 5.05, N 7.02; found C 66.18, H 5.04, N 7.04.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-2-chlorobenzenamine (4j).** This compound was obtained as brown liquid; yield, 78%; mp limpid. R_f: 0.44. IR ν_{max}: 3057 (Ar–H), 2957, 2846 (−CH_2–), 1627 (−CH═N), 1229, 1047 (C–O–C), 745 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.15 (t, 3H, –CH_3), 2.56 (q, 2H, –CH_2), 3.14 (t, 2H, –CH_2), 4.34 (t, 2H, –CH_2–O), 7.08–7.82 (m, 8H, Ar–H), 7.34–8.37 (m, 3H, Pyridine–H), 8.22 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.4 (C_8),), 32.5 (C_7), 37.7 (C_9), 67.6 (C_{10}), 115.5–155.3 (C_{11}–C_{16}), 123.–143.4 (C_{18}–C_{23}), 123.5–157.3 (C_2–C_6), 160.2 (C_{17}); *Anal*. Calcd for $C_{22}H_{21}N_2OCl$: C 72.42, H 5.80, N 7.68; found C 72.44, H 5.81, N 7.67.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-2-fluorobenzenamine (4k).** This compound was obtained as brown liquid; yield, 69%; mp limpid. R_f: 0.47. IR ν_{max}: 3056 (Ar–H), 2958, 2845 (−CH_2–), 1627 (−CH═N), 1227, 1048 (C–O–C), 975 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.16 (t, 3H, –CH_3), 2.57 (q, 2H, –CH_2), 3.16 (t, 2H, –CH_2), 4.36 (t, 2H, –CH_2–O), 7.00–7.85 (m, 8H, Ar–H), 7.35–8.38 (m, 3H, Pyridine–H), 8.24 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.1 (C_8), 32.5 (C_7), 37.2 (C_9), 67.5 (C_{10}), 115.4–155.4 (C_{11}–C_{16}), 116.8–153.2 (C_{18}–C_{23}), 123.4–157.4 (C_2–C_6), 160.3 (C_{17}); *Anal*. Calcd for $C_{22}H_{21}N_2OF$: C 75.84, H 6.08, N 8.04; found C 75.82, H 6.06, N 8.03.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-2,5-dichlorobenzenamine (4l).** This compound was obtained as brown liquid; yield, 75%; mp limpid. R_f: 0.42. IR ν_{max}: 3059 (Ar–H), 2955, 2845 (−CH_2–), 1629 (−CH═N), 1225, 1049 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.19 (t, 3H, –CH_3), 2.53 (q, 2H, –CH_2), 3.17 (t, 2H, –CH_2), 4.37 (t, 2H, –CH_2–O), 7.06–7.88 (m, 7H, Ar–H), 7.33–8.36 (m, 3H, Pyridine–H), 8.26 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.3 (C_8), 32.6 (C_7), 37.4 (C_9), 67.6 (C_{10}), 115.5–155.6 (C_{11}–C_{16}), 124.0–144.6 (C_{18}–C_{23}), 123.5–157.7 (C_2–C_6), 160.7 (C_{17}); *Anal*. Calcd for $C_{22}H_{20}N_2OCl_2$: C 66.17, H 5.05, N 7.02; found C 66.15, H 5.03, N 7.04.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-2,3-dichlorobenzenamine (4m).** This compound was obtained as brown liquid; yield, 71%; mp limpid. R_f: 0.43. IR ν_{max}: 3056 (Ar–H), 2957, 2845 (−CH_2–), 1627 (−CH═N), 1227, 1046 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.20 (t, 3H, –CH_3), 2.58 (q, 2H, –CH_2), 3.15 (t, 2H, –CH_2), 4.35 (t, 2H, –CH_2–O), 7.07–7.83 (m, 7H, Ar–H), 7.32–8.36 (m, 3H, Pyridine–H), 8.28 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.4 (C_8), 32.4 (C_7), 37.7 (C_9), 67.5 (C_{10}), 115.2–155.4 (C_{11}–C_{16}), 121.8–144.6 (C_{18}–C_{23}), 123.2–157.4 (C_2–C_6), 160.5 (C_{17}); *Anal*. Calcd for $C_{22}H_{20}N_2OCl_2$: C 66.17, H 5.05, N 7.02; found C 66.16, H 5.04, N 7.03.

***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-3-chlorobenzenamine (4n).** This compound was obtained as brown liquid; yield, 76%; mp limpid. R_f: 0.51. IR ν_{max}: 3056 (Ar–H), 2956, 2846 (−CH_2–), 1626 (−CH═N), 1226, 1046 (C–O–C), 744 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.24 (t, 3H, –CH_3), 2.52 (q, 2H, –CH_2), 3.15 (t, 2H, –CH_2), 4.32 (t, 2H, –CH_2–O), 7.03–8.23 (m, 8H, Ar–H), 7.33–8.34 (m, 3H, Pyridine–H), 8.27 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.7 (C_8), 32.5 (C_7), 37.6 (C_9), 67.6 (C_{10}), 115.3–155.7 (C_{11}–C_{16}), 120.4–154.6 (C_{18}–C_{23}), 123.5–157.5 (C_2–C_6), 160.6 (C_{17}); *Anal*. Calcd for $C_{22}H_{21}N_2OCl$: C 72.42, H 5.80, N 7.68; found C 72.43, H 5.82, N 7.69.

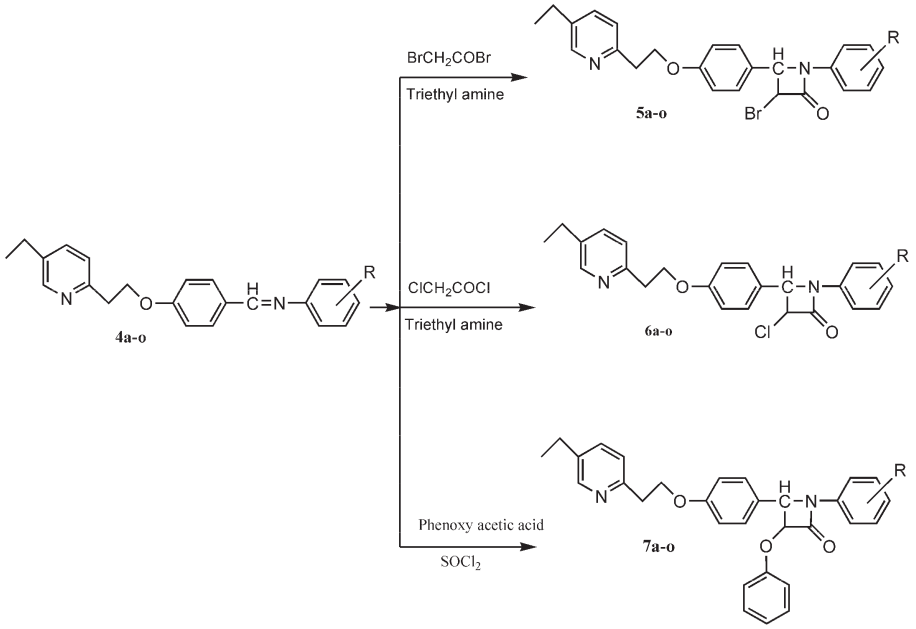
***N*-(4-(2-(5-ethylpyridin-2-yl)ethoxy)benzylidene)-4-methylbenzenamine (4o).** This compound was obtained as off white solid; yield, 70%; mp 80–83°C. R_f: 0.52. IR ν_{max}: 3056 (Ar–H), 2957, 2845 (−CH_2–), 1627 (−CH═N), 1227, 1046 (C–O–C); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.13 (t, 3H, –CH_3), 2.24 (s, 3H, –CH_3), 2.52 (q, 2H, –CH_2), 3.17 (t, 2H, –CH_2), 4.29 (t, 2H, –CH_2–O), 6.85–7.69 (m, 8H, Ar–H), 7.34–8.30 (m, 3H, Pyridine–H), 8.25 (s, 1H, –CH═N–); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.4 (C_8), 25.7 (C_{24}), 32.4 (C_7), 37.4 (C_9), 67.4 (C_{10}), 115.2–155.3 (C_{11}–C_{16}), 120.8–148.9 (C_{18}–C_{23}), 123.4–158.9 (C_2–C_6), 161.4 (C_{17}); *Anal*. Calcd for $C_{23}H_{24}N_2O$: C 80.20, H 7.02, N 8.13; found C 80.22, H 7.03, N 8.11.

General preparation of the compounds (5a–o). To a stirred solution **4a–o** (0.05 mol) in 1,4-dioxane (100 mL), bromo acetyl bromide (0.05 mol) was added dropwise at 0–5°C temperature in presence of triethyl amine. The reaction mixture was stirred for about 6–10 h, and the precipitated was filtered off. The filtrate was refluxed for 4–6 h and completion of reaction monitored by TLC. (toluene:ethylacetate, 7:3) and the separated solid was recrystallized from alcohol (Scheme-2) (Figure-2).

3-Bromo-1-(4-fluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (5a). This compound was obtained as brown liquid; yield, 55%; mp semi-solid. R_f: 0.78. IR ν_{max}: 3050 (Ar–H), 2947, 2845 (−CH_2–), 1730 (−C═O of β-lactam ring), 1222, 1028 (C–O–C), 855 (C–Br), 974 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.27 (t, 3H, –CH_3), 2.87 (q, 2H, –CH_2), 3.66 (t, 2H, –CH_2), 4.58 (t, 2H, –CH_2–O), 5.25 (d, 1H, –CH–Br), 6.70–7.22 (m, 8H, Ar–H), 7.32–8.62 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.1 (C_8), 32.5 (C_7), 37.2 (C_9), 50.2 (C_{18}), 64.3 (C_{17}), 67.5 (C_{10}), 114.9–155.2 (C_{11}–C_{16}), 122.3–157.3 (C_2–C_6), 115.7–158.2 (C_{20}–C_{25}), 170.9 (C_{19}). *Anal*. Calcd for $C_{24}H_{22}N_2O_2FBr$: C 61.42, H 4.72, N 5.97; found C 61.41, H 4.71, N 5.95.

3-Bromo-1-(3,5-difluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (5b). This compound was obtained as brown solid; yield, 58%; mp 134–136°C. R_f: 0.72. IR ν_{max}: 3047 (Ar–H), 2944, 2846 (−CH_2–), 1728 (−C═O of β-lactam ring), 1221, 1029 (C–O–C), 854 (C–Br), 973 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.26 (t, 3H, –CH_3), 2.86 (q, 2H, –CH_2), 3.65 (t, 2H, –CH_2), 4.56 (t, 2H, –CH_2–O), 5.23 (d, 1H,

Scheme 2. Synthesis of **5a–o**, **6a–o**, and **7a–o**.



R:-	4-F	3,4-F	2-Cl	3-Cl
	3,5-F	2-Br, 4-F	2-F	4-CH_3
	4-Cl	3-Cl, 4-CH_3	2,5-Cl	3,4-Cl
	3,5-Cl	2,3-Cl		

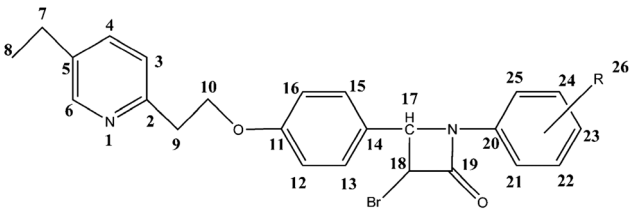


Figure 2. Azetidinone **5a–o**.

–CH–Br), 6.55–7.23 (m, 7H, Ar–H), 7.34–8.64 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.2 (C_8), 32.6 (C_7), 37.4 (C_9), 50.4 (C_{18}), 64.5 (C_{17}), 67.2 (C_{10}), 114.5–155.4 (C_{11}–C_{16}), 122.4–157.5 (C_2–C_6), 100.2–164.7 (C_{20}–C_{25}), 170.8 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2F_2Br$: C 59.15, H 4.34, N 5.75; found C 59.16, H 4.32, N, 5.76.

3-Bromo-1-(4-chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (5c). This compound was obtained as brown solid; yield, 62%; mp 155–156°C. R_f: 0.75. IR ν_{max}: 3046 (Ar–H), 2946, 2842 (−CH_2–), 1729 (−C═O of β-lactam ring), 1220, 1026 (C–O–C), 744 (C–Cl), 855 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.25 (t, 3H, –CH_3), 2.85 (q, 2H, –CH_2), 3.63 (t, 2H, –CH_2), 4.54 (t, 2H, –CH_2–O), 5.29 (d, 1H, –CH–Br), 6.72–7.45 (m, 8H, Ar–H), 7.34–8.66 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.4 (C_8), 32.5 (C_7), 37.3 (C_9), 50.2 (C_{18}), 64.4 (C_{17}), 67.4 (C_{10}), 114.3–155.5 (C_{11}–C_{16}), 122.3–157.4 (C_2–C_6), 123.0–139.5 (C_{20}–C_{25}), 170.7 (C_{19}). *Anal*. Calcd for $C_{24}H_{22}N_2O_2ClBr$: C 59.34, H 4.56, N 5.77; found C 59.35, H 4.54, N 5.76.

3-Bromo-1-(3,4-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (5d). This compound was obtained as brown solid; yield, 65%; mp 140–142°C. R_f: 0.78. IR ν_{max}: 3045 (Ar–H), 2943, 2842 (−CH_2–), 1725 (−C═O of β-lactam ring), 1225, 1025 (C–O–C), 746 (C–Cl), 853 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.27 (t, 3H, –CH_3), 2.84 (q, 2H, –CH_2), 3.65 (t, 2H, –CH_2), 4.56 (t, 2H, –CH_2–O), 5.27 (d, 1H, –CH–Br), 6.71–7.25 (m, 7H, Ar–H), 7.36–8.67 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.5 (C_8), 32.4 (C_7), 37.2 (C_9), 50.4 (C_{18}), 64.3 (C_{17}), 67.6 (C_{10}), 114.4–155.3 (C_{11}–C_{16}), 122.4–157.6 (C_2–C_6), 121.4–141.3 (C_{20}–C_{25}), 170.5 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_2Br$: C 55.41, H 4.07, N 5.38; found C 55.42, H 4.06, N 5.39.

3-Bromo-1-(2,4-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (5e). This compound was obtained as brown solid; yield, 64%; mp 137–138°C. R_f: 0.74. IR ν_{max}: 3047 (Ar–H), 2947, 2846 (−CH_2–), 1726 (−C═O of β-lactam ring), 1220, 1029 (C–O–C), 746 (C–Cl), 854 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.26 (t, 3H, –CH_3), 2.86 (q, 2H, –CH_2), 3.63 (t, 2H, –CH_2), 4.56 (t, 2H, –CH_2–O), 5.37 (d, 1H, –CH–Br), 5.26 (s, 1H, –CH–Br), 7.35–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.2 (C_8), 32.5 (C_7), 37.3 (C_9), 50.8 (C_{18}), 64.4 (C_{17}), 67.8 (C_{10}), 114.6–155.7 (C_{11}–C_{16}), 122.3–157.5 (C_2–C_6), 124.4–138.4 (C_{20}–C_{25}), 170.6 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_2Br$: C 55.41, H 4.07, N,5.38; found C 55.40, H 4.05, N, 5.37.

3-Bromo-1-(3,4-difluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (5f). This compound was obtained as brown liquid; yield, 57%; mp semi-solid. R_f: 0.72. IR ν_{max}: 3051 (Ar–H), 2950, 2843 (−CH_2–), 1729 (−C═O of β-lactam ring), 1224, 1025 (C–O–C), 852 (C–Br), 974 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.28 (t, 3H, –CH_3), 2.87 (q, 2H, –CH_2), 3.66 (t, 2H, –CH_2), 4.53 (t, 2H, –CH_2–O), 5.21 (d, 1H, –CH–Br), 6.72–7.22 (m, 7H, Ar–H), 7.30–8.67 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.4 (C_8), 32.1 (C_7), 37.6 (C_9), 50.4 (C_{18}), 64.5 (C_{17}), 67.9 (C_{10}), 114.3–155.4 (C_{11}–C_{16}), 122.5–157.4 (C_2–C_6), 111.6–149.6 (C_{20}–C_{25}), 170.5 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2F_2Br$: C 59.15, H 4.34, N 5.75; found C 59.14, H 4.33, N, 5.76.

3-Bromo-1-(2-bromo-4-fluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy)phenyl) azetidin-2-one (5g). This compound was obtained as off brown solid; yield, 50%; mp 178–180°C. R_f: 0.77. IR ν_{max}: 3048 (Ar–H), 2948, 2842 (−CH_2–), 1725 (−C═O of β-lactam ring), 1223, 1027 (C–O–C), 854 (C–Br), 972 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.26 (t, 3H, –CH_3), 2.58 (q, 2H, –CH_2), 3.65 (t, 2H, –CH_2), 4.54 (t, 2H, –CH_2–O), 5.23 (d, 1H, –CH–Br), 6.72–7.23 (m, 7H, Ar–H), 7.32–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.7 (C_8), 32.2 (C_7), 37.5 (C_9), 50.3 (C_{18}), 64.3 (C_{17}), 67.5 (C_{10}), 114.2–155.6 (C_{11}–C_{16}), 122.4–157.6 (C_2–C_6), 114.5–160.6 (C_{20}–C_{25}), 170.4 (C_{19}). *Anal.* Calcd for $C_{24}H_{21}N_2O_2FBr_2$: C 52.58, H 3.86, N 5.11; found C 52.57, H 3.84, N 5.10.

3-Bromo-1-(3-chloro-4-methylphenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy)phenyl) azetidin-2-one (5h). This compound was obtained as yellow solid; yield, 52%, mp 125–127°C. R_f: 0.78. IR ν_{max}: 3052 (Ar–H), 2946, 2843 (−CH_2–), 1726 (−C═O of β-lactam ring), 1226, 1027 (C–O–C), 745 (C–Cl), 854 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.29 (t, 3H, –CH_3), 2.32 (s, 3H, –CH_3), 2.85 (q, 2H, –CH_2), 3.64 (t, 2H, –CH_2), 4.56 (t, 2H, –CH_2–O), 5.25 (d, 1H, –CH–Br), 6.72–7.22 (m, 7H, Ar–H), 7.34–8.67 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.3 (C_8), 20.5 (C_{26}), 32.4 (C_7), 37.1 (C_9), 50.3 (C_{18}), 64.7 (C_{17}), 67.8 (C_{10}), 114.0–155.2 (C_{11}–C_{16}), 122.5–157.1 (C_2–C_6), 119.5–140.1 (C_{20}–C_{25}), 170.8 (C_{19}). *Anal*. Calcd for $C_{25}H_{24}N_2O_2ClBr$: C 60.07, H 4.84, N 5.60; found C 60.05, H 4.83, N 5.61.

3-Bromo-1-(3,5-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (5i). This compound was obtained as brown liquid; yield, 61%; mp semi-solid. R_f: 0.71. IR ν_{max}: 3049 (Ar–H), 2949, 2846 (−CH_2–), 1728 (−C═O of β-lactam ring), 1223, 1025 (C–O–C), 745 (C–Cl). 855 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.26 (t, 3H, –CH_3), 2.86 (q, 2H, –CH_2), 3.65 (t, 2H, –CH_2), 4.57 (t, 2H, –CH_2–O), 5.27 (d, 1H, –CH–Br), 6.72–7.25 (m, 7H, Ar–H), 7.35–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.0 (C_8), 32.4 (C_7), 37.2 (C_9), 50.6 (C_{18}), 64.2 (C_{17}), 67.3 (C_{10}), 114.4–155.5 (C_{11}–C_{16}), 122.1–157.4 (C_2–C_6), 120.5–144.6 (C_{20}–C_{25}), 170.7 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_2Br$: C 55.41, H 4.07, N 5.38; found C 55.40, H 4.06, N 5.36.

3-Bromo-1-(2-chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (5j). This compound was obtained as brown liquid; yield, 63%; mp semi-solid. R_f: 0.73. IR ν_{max}: 3047 (Ar–H), 2947, 2847 (−CH_2–), 1727 (−C═O of β-lactam ring), 1222, 1027 (C–O–C), 744 (C–Cl), 854 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.26 (t, 3H, –CH_3), 2.86 (q, 2H, –CH_2), 3.65 (t, 2H, –CH_2), 4.57 (t, 2H, –CH_2–O), 5.23 (d, 1H, –CH–Br), 6.74–7.51 (m, 8H, Ar–H), 7.35–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.5 (C_8), 32.2 (C_7), 37.5 (C_9), 50.3 (C_{18}), 64.4 (C_{17}), 67.8 (C_{10}), 114.2–155.0 (C_{11}–C_{16}), 122.3–157.3 (C_2–C_6), 123.0–140.5 (C_{20}–C_{25}), 170.6 (C_{19}). *Anal*. Calcd for $C_{24}H_{22}N_2O_2ClBr$: C 59.34, H 4.56, N 5.77; found C 59.32, H 4.55, N 5.75.

3-Bromo-1-(3-fluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (5k). This compound was obtained as brown liquid; yield, 55%; mp semi-solid. R_f: 0.78. IR ν_{max}: 3048 (Ar–H), 2946, 2846 (−CH_2–), 1726 (−C═O of β-lactam ring), 1228, 1028 (C–O–C), 856 (C–Br), 973 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.25 (t, 3H, –CH_3), 2.84 (q, 2H, –CH_2), 3.64 (t, 2H, –CH_2), 4.56 (t, 2H, –CH_2–O), 5.28 (d, 1H, –CH–Br), 6.73–7.25 (m, 8H, Ar–H), 7.35–8.67 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.6 (C_8), 32.1 (C_7), 37.6 (C_9), 50.2 (C_{18}), 64.3 (C_{17}), 67.2 (C_{10}), 114.5–155.2 (C_{11}–C_{16}), 122.4–157.7 (C_2–C_6), 115.7–163.0 (C_{20}–C_{25}), 170.2 (C_{19}). *Anal*. Calcd for $C_{24}H_{22}N_2O_2FBr$: C 61.42, H 4.72, N 5.97; found C 61.40, H 4.70, N, 5.96.

3-Bromo-1-(2,5-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (5l). This compound was obtained as brown liquid; yield, 55%; mp semi-solid. R_f: 0.76. IR ν_{max}: 3045 (Ar–H), 2945, 2845 (−CH_2–), 1725 (−C═O of β-lactam ring), 1220, 1023 (C–O–C), 745 (C–Cl), 854 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.27 (t, 3H, –CH_3), 2.85 (q, 2H, –CH_2), 3.63 (t, 2H, –CH_2), 4.57 (t, 2H, –CH_2–O), 5.30 (d, 1H, –CH–Br), 6.72–7.55 (m, 7H, Ar–H), 7.37–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.4 (C_8), 32.3 (C_7), 37.5 (C_9), 50.7 (C_{18}), 64.1 (C_{17}), 67.9 (C_{10}), 114.6–155.4 (C_{11}–C_{16}), 122.3–157.6 (C_2–C_6), 123.5–141.6 (C_{20}–C_{25}), 170.4 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_2Br$: C 55.41, H 4.07, N 5.38; found C 55.43, H 4.06, N 5.39.

3-Bromo-1-(2,3-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (5m). This compound was obtained as pale yellow solid; yield, 58%; mp 134–136°C. R_f: 0.75. IR ν_{max}: 3047 (Ar–H), 2946, 2848 (−CH_2–), 1728 (−C═O of β-lactam ring), 1225, 1027 (C–O–C), 746 (C–Cl), 854 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.25 (t, 3H, –CH_3), 2.87 (q, 2H, –CH_2), 3.61 (t, 2H, –CH_2), 4.52 (t, 2H, –CH_2–O), 5.32 (d, 1H, –CH–Br), 6.72–7.76 (m, 7H, Ar–H), 7.35–8.69 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.7 (C_8), 32.3 (C_7), 37.2 (C_9), 50.5 (C_{18}), 64.3 (C_{17}), 67.4 (C_{10}), 114.7–155.6 (C_{11}–C_{16}), 122.5–157.5 (C_2–C_6), 121.2–141.6 (C_{20}–C_{25}), 170.3 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_2Br$: C 55.41, H 4.07, N 5.38; found C 55.40, H 4.05, N 5.37.

3-Bromo-1-(3-chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (5n). This compound was obtained as brown liquid; yield, 64%; mp semi-solid. R_f: 0.77. IR ν_{max}: 3047 (Ar–H), 2946, 2848 (−CH_2–), 1728 (−C═O of β-lactam ring), 1225, 1027 (C–O–C), 746 (C–Cl), 854 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.25 (t, 3H, –CH_3), 2.87 (q, 2H, –CH_2), 3.61 (t, 2H, –CH_2), 4.52 (t, 2H, –CH_2–O), 5.31 (d, 1H, –CH–Br), 6.72–7.76 (m, 7H, Ar–H), 7.35–8.69 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.2 (C_8), 32.4 (C_7), 37.4 (C_9), 50.2 (C_{18}), 64.5 (C_{17}), 67.3 (C_{10}), 114.5–155.3 (C_{11}–C_{16}), 122.2–157.2 (C_2–C_6), 119.7–143.5 (C_{20}–C_{25}), 170.6 (C_{19}) *Anal*. Calcd for $C_{24}H_{22}N_2O_2ClBr$: C 59.34, H 4.56, N 5.77; found C 59.33, H 4.54, N 5.75.

3-Bromo-1-(4-methylphenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (5o). This compound was obtained as pale brown solid; yield, 62%; mp 110–112°C, R_f: 0.75. IR ν_{max}: 3047 (Ar–H), 2946, 2842 (−CH_2–), 1720 (−C═O of β-lactam ring), 1220, 1027 (C–O–C), 836 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.29 (t, 3H, –CH_3), 2.35 (s, 3H, –CH_3), 2.83

(q, 2H, $-CH_2$), 3.69 (t, 2H, $-CH_2$), 4.55 (t, 2H, $-CH_2-O$), 5.20 (d, 1H, –CH–Br), 7.00–7.81 (m, 8H, Ar–H), 7.31–8.61 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 15.3 (C_8), 25.7 (C_{26}), 32.0 (C_7), 37.2 (C_9), 50.1 (C_{18}), 64.2 (C_{17}), 67.4 (C_{10}), 114.8–155.2 (C_{11}–C_{16}), 122.3–159.5 (C_2–C_6), 122.2–137.2 (C_{20}–C_{25}), 170.2 (C_{19}). *Anal*. Calcd for $C_{25}H_{25}N_2O_2Br$: C 64.52, H 5.41, N 6.02; found C 64.51, H 5.40, N 6.04.

General preparation of the compounds (6a–o). To a stirred solution **4a–o** (0.05 mol) in 1,4-dioxane (100 mL), chloro acetyl chloride (0.05 mol) was added dropwise at 0–5°C temperature in presence of triethyl amine. The reaction mixture was stirred for about 6–12 h, and the precipitated amine hydrochloride was filtered off. The filtrate was refluxed for 10–12 h and completion of reaction monitored by TLC. (toluene:ethylacetate, 7:3) and the separated solid was recrystallized from alcohol (Scheme 2, Fig. 3).

3-Chloro-1-(4-fluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)azetidin-2-one (6a). This compound was obtained as dark brown solid; yield, 58%; mp 115–118°C. R_f: 0.78. IR ν_{max}: 3052 (Ar–H), 2942, 2845 ($-CH_2-$), 1725 (−C═O of β-lactam ring), 1225, 1026 (C–O–C), 745 (C–Cl), 973 (C–F); ^1H NMR (δ $CDCl_3$, 400 MHz): 1.15 (t, 3H, $-CH_3$), 2.54 (q, 2H, $-CH_2$), 3.12 (t, 2H, $-CH_2$), 4.29 (t, 2H, $-CH_2-O$), 5.12 (d, 1H, –CH–Cl), 6.72–7.22 (m, 8H, Ar–H), 7.32–8.62 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.6 (C_8), 32.2 (C_7), 36.4 (C_9), 62.3 (C_{18}), 63.4 (C_{17}), 67.3 (C_{10}), 114.6–155.5 (C_{11}–C_{16}), 122.3–157.3 (C_2–C_6), 115.7–158.6 (C_{20}–C_{25}), 163.5 (C_{19}). *Anal*. Calcd for $C_{24}H_{22}N_2O_2FCl$: C 67.84, H 5.22, N 6.59; found C 67.83, H 5.21, N 6.58.

3-Chloro-1-(3,5-difluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (6b). This compound was obtained as brown solid; yield, 49%; mp 120–122°C. R_f: 0.72. IR ν_{max}: 3052 (Ar–H), 2942, 2845 ($-CH_2-$), 1725 (−C═O of β-lactam ring), 1225, 1026 (C–O–C), 745 (C–Cl), 973 (C–F); ^1H NMR (δ $CDCl_3$, 400 MHz): 1.12 (t, 3H, $-CH_3$), 2.53 (q, 2H, $-CH_2$), 3.15 (t, 2H, $-CH_2$), 4.30 (t, 2H, $-CH_2-O$), 5.14 (d, 1H, –CH–Cl), 6.66–7.22 (m, 7H, Ar–H), 7.30–8.63 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.5 (C_8), 32.3 (C_7), 36.4 (C_9), 62.4 (C_{18}), 63.5 (C_{17}), 67.6 (C_{10}), 114.3–155.1 (C_{11}–C_{16}), 122.1–157.0 (C_2–C_6), 100.0–164.5 (C_{20}–C_{25}), 163.2 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2F_2Cl$: C 65.09, H 4.78, N 6.33; found C 65.11, H 4.79, N 6.34.

3-Chloro-1-(4-chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (6c). This compound was obtained as brown liquid; yield, 54%; mp semi-solid. R_f: 0.71. IR ν_{max}: 3051 (Ar–H), 2940, 2845 ($-CH_2-$), 1722 (−C═O of β-lactam ring), 1222, 1021 (C–O–C), 743 (C–Cl); ^1H NMR (δ $CDCl_3$, 400 MHz): 1.13 (t, 3H, $-CH_3$), 2.52 (q, 2H, $-CH_2$), 3.13 (t, 2H, $-CH_2$), 4.25 (t, 2H, $-CH_2-O$), 5.13 (d, 1H, –CH–Cl), 6.73–7.46 (m, 8H, Ar–H), 7.29–8.60 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.2 (C_8), 32.1 (C_7), 36.5 (C_9), 62.2 (C_{18}), 63.1 (C_{17}), 67.4 (C_{10}), 114.2–155.3 (C_{11}–C_{16}), 122.2–157.3 (C_2–C_6), 123.1–139.8 (C_{20}–C_{25}), 163.0 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2F_2Cl$: C 65.09, H 4.78, N 6.33; found C 65.11, H 4.79, N 6.34.

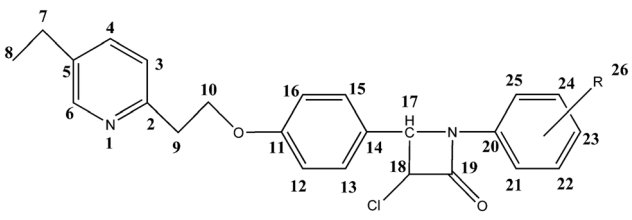


Figure 3. Azetidinone **6a–o**.

3-Chloro-1-(3,4-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (6d). This compound was obtained as off brown solid; yield, 58%; mp 151–153°C. R_f: 0.75. IR ν_{max}: 3053 (Ar–H), 2942, 2846 ($-CH_2-$), 1723 (−C═O of β-lactam ring), 1226, 1025 (C–O–C), 746 (C–Cl); ^1H NMR (δ $CDCl_3$, 400 MHz): 1.17 (t, 3H, $-CH_3$), 2.55 (q, 2H, $-CH_2$), 3.20 (t, 2H, $-CH_2$), 4.21 (t, 2H, $-CH_2-O$), 5.10 (d, 1H, –CH–Cl), 6.72–7.26 (m, 7H, Ar–H), 7.32–8.61 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.3 (C_8), 32.3 (C_7), 36.5 (C_9), 62.5 (C_{18}), 63.3 (C_{17}), 67.5 (C_{10}), 114.1–155.0 (C_{11}–C_{16}), 122.8–157.2 (C_2–C_6), 121.1–141.5 (C_{20}–C_{25}), 163.6 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_3$: C 60.58, H 4.45, N 5.89; found C 60.56, H 4.44, N, 5.88.

3-Chloro-1-(2,4-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (6e). This compound was obtained as off brown solid; yield, 58%; mp 147–148°C. R_f: 0.72. IR ν_{max}: 3054 (Ar–H), 2943, 2845 ($-CH_2-$), 1722 (−C═O of β-lactam ring), 1225, 1026 (C–O–C), 745 (C–Cl); ^1H NMR (δ $CDCl_3$, 400 MHz): 1.18 (t, 3H, $-CH_3$), 2.53 (q, 2H, $-CH_2$), 3.12 (t, 2H, $-CH_2$), 4.22 (t, 2H, $-CH_2-O$), 5.12 (d, 1H, –CH–Cl), 6.72–7.33 (m, 7H, Ar–H), 7.32–8.59 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.5 (C_8), 32.5 (C_7), 36.1 (C_9), 62.2 (C_{18}), 63.4 (C_{17}), 67.5 (C_{10}), 114.3–155.4 (C_{11}–C_{16}), 122.3–157.1 (C_2–C_6), 124.4–138.5 (C_{20}–C_{25}), 163.4 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_3$: C 60.58, H 4.45, N 5.89; found C 60.57, H 4.46, N 5.90.

3-Chloro-1-(3,4-difluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (6f). This compound was obtained as brown solid; yield, 52%; mp 172–173°C. R_f: 0.73. IR ν_{max}: 3052 (Ar–H), 2943, 2842 ($-CH_2-$), 1728 (−C═O of β-lactam ring), 1222, 1021 (C–O–C), 742 (C–Cl), 973 (C–F); ^1H NMR (δ $CDCl_3$, 400 MHz): 1.19 (t, 3H, $-CH_3$), 2.49 (q, 2H, $-CH_2$), 3.16 (t, 2H, $-CH_2$), 4.25 (t, 2H, $-CH_2-O$), 5.16 (d, 1H, –CH–Cl), 6.72–7.22 (m, 7H, Ar–H), 7.31–8.63 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.1 (C_8), 32.5 (C_7), 36.2 (C_9), 62.4 (C_{18}), 63.1 (C_{17}), 67.3 (C_{10}), 114.2–155.6 (C_{11}–C_{16}), 122.1–157.4 (C_2–C_6), 111.7–145.2 (C_{20}–C_{25}), 163.2 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2F_2Cl$: C 65.09, H 4.78, N 6.33; found C 65.11, H 4.77, N 6.34.

3-Chloro-1-(2-bromo-4-fluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy)phenyl) azetidin-2-one (6g). This compound was obtained as brown solid; yield, 57%; mp 160–163°C. R_f: 0.74. IR ν_{max}: 3055 (Ar–H), 2941, 2845 ($-CH_2-$), 1723 (−C═O of β-lactam ring), 1221, 1026 (C–O–C), 743 (C–Cl), 851 (C–Br), 974 (C–F); ^1H NMR (δ $CDCl_3$, 400 MHz): 1.15 (t, 3H, $-CH_3$), 2.52 (q, 2H, $-CH_2$), 3.17 (t, 2H, $-CH_2$), 4.25 (t, 2H, $-CH_2-O$), 5.21 (d, 1H, –CH–Cl), 6.72–7.22 (m, 7H, Ar–H), 7.32–8.64 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.3 (C_8), 32.4 (C_7), 36.3 (C_9), 62.2 (C_{18}), 63.5 (C_{17}), 67.4 (C_{10}), 114.7–155.5 (C_{11}–C_{16}), 122.6–157.2 (C_2–C_6), 114.5–160.2 (C_{20}–C_{25}), 163.4 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2FClBr$: C 57.22, H 4.20, N 5.56; found C 57.24, H, 4.21, N, 5.57.

3-Chloro-1-(3-chloro-4-methylphenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy)phenyl) azetidin-2-one (6h). This compound was obtained as dark brown solid; yield, 53%; mp 135–137°C. R_f: 0.72. IR ν_{max}: 3056 (Ar–H), 2943, 2841 ($-CH_2-$), 1720 (−C═O of β-lactam ring), 1228, 1026 (C–O–C), 747 (C–Cl); ^1H NMR (δ $CDCl_3$, 400 MHz): 1.14 (t, 3H, $-CH_3$), 2.20 (s, 3H, $-CH_3$), 2.54 (q, 2H, $-CH_2$), 3.14 (t, 2H, $-CH_2$), 4.30 (t, 2H, $-CH_2-O$), 5.12 (d,

1H, –CH–Cl), 6.68–7.22 (m, 7H, Ar–H), 7.36–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.6 (C_8), 20.5 (C_{26}), 32.5 (C_7), 36.2 (C_9), 62.4 (C_{18}), 63.6 (C_{17}), 67.5 (C_{10}), 114.3–155.2 (C_{11}–C_{16}), 122.2–157.4 (C_2–C_6), 119.5–140.2 (C_{20}–C_{25}), 163.1 (C_{19}). *Anal*. Calcd for $C_{25}H_{24}Cl_2N_2O_2$: C 65.94, H 5.31, N 6.15; found C 65.96, H 5.34, N, 6.14.

3-Chloro-1-(3,5-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (6i). This compound was obtained as brown solid; yield, 65%; mp 155–156°C. R_f: 0.75. IR ν_{max}: 3052 (Ar–H), 2943, 2842 (−CH_2–), 1721 (−C═O of β-lactam ring), 1225, 1025 (C–O–C), 744 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.16 (t, 3H, –CH_3), 2.54 (q, 2H, –CH_2), 3.12 (t, 2H, –CH_2), 4.24 (t, 2H, –CH_2–O), 5.18 (d, 1H, –CH–Cl), 6.72–7.23 (m, 7H, Ar–H), 7.35–8.68 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.7 (C_8), 32.5 (C_7), 36.1 (C_9), 62.1 (C_{18}), 63.3 (C_{17}), 67.6 (C_{10}), 114.3–155.2 (C_{11}–C_{16}), 122.3–157.5 (C_2–C_6), 120.2–144.2 (C_{20}–C_{25}), 163.2 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_3$: C 60.58, H 4.45, N 5.89; found C 60.57, H 4.43, N 5.90.

3-Chloro-1-(2-chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (6j). This compound was obtained as brown limpid; yield, 60%; mp semi-solid. R_f: 0.74. IR ν_{max}: 3053 (Ar–H), 2947, 2840 (−CH_2–), 1722 (−C═O of β-lactam ring), 1225, 1027 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.19 (t, 3H, –CH_3), 2.51 (q, 2H, –CH_2), 3.14 (t, 2H, –CH_2), 4.32 (t, 2H, –CH_2–O), 5.13 (d, 1H, –CH–Cl), 6.72–7.52 (m, 8H, Ar–H), 7.32–8.64 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.3 (C_8), 32.8 (C_7), 36.3 (C_9), 62.8 (C_{18}), 63.7 (C_{17}), 67.2 (C_{10}), 114.5–155.6 (C_{11}–C_{16}), 122.4–157.0 (C_2–C_6), 123.2–140.2 (C_{20}–C_{25}), 163.2 (C_{19}). *Anal*. Calcd for $C_{24}H_{22}N_2O_2Cl_2$: C 65.31, H 5.02, N 6.35; found C 65.33, H 5.04, N 6.34.

3-Chloro-1-(2-flourophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (6k). This compound was obtained as brown limpid; yield, 58%; mp semi-solid. R_f: 0.71. IR ν_{max}: 3058 (Ar–H), 2944, 2843 (−CH_2–), 1724 (−C═O of β-lactam ring), 1226, 1023 (C–O–C), 747 (C–Cl), 975 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.18 (t, 3H, –CH_3), 2.55 (q, 2H, –CH_2), 3.13 (t, 2H, –CH_2), 4.22 (t, 2H, –CH_2–O), 5.16 (d, 1H, –CH–Cl), 6.72–7.25 (m, 8H, Ar–H), 7.33–8.63 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.5 (C_8), 32.6 (C_7), 36.4 (C_9), 62.5 (C_{18}), 63.6 (C_{17}), 67.4 (C_{10}), 114.3–155.4 (C_{11}–C_{16}), 122.5–157.3 (C_2–C_6), 123.2–163.2 (C_{20}–C_{25}), 162.5 (C_{19}). *Anal*. Calcd for $C_{24}H_{22}N_2O_2FCl$: C 67.84, H 5.22, N 6.59; found C 67.86, H 5.23, N 6.58.

3-Chloro-1-(2,5-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (6l). This compound was obtained as dark brown liquid; yield, 62%; mp semi-solid. R_f: 0.72. IR ν_{max}: 3056 (Ar–H), 2949, 2845 (−CH_2–), 1726 (−C═O of β-lactam ring), 1224, 1025 (C–O–C), 743 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.16 (t, 3H, –CH_3), 2.52 (q, 2H, –CH_2), 3.20 (t, 2H, –CH_2), 4.26 (t, 2H, –CH_2–O), 5.17 (d, 1H, –CH–Cl), 6.72–7.55 (m, 7H, Ar–H), 7.36–8.66 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.6 (C_8), 32.3 (C_7), 36.5 (C_9), 62.2 (C_{18}), 63.1 (C_{17}), 67.3 (C_{10}), 114.2–155.4 (C_{11}–C_{16}), 122.5–157.3 (C_2–C_6), 123.4–140.5 (C_{20}–C_{25}), 163.5 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_3$: C 60.58, H 4.45, N 5.89; found C 60.59, H 4.46, N 5.88.

3-Chloro-1-(2,5-dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl) azetidin-2-one (6m). This compound was obtained as dark brown liquid; yield, 63%; mp semi-solid. R_f: 0.74. IR ν_{max}: 3055 (Ar–H), 2948, 2845 (−CH_2–), 1725 (−C═O of β-lactam ring), 1223, 1026 (C–O–C), 744 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.16 (t, 3H, –CH_3), 2.48 (q, 2H, –CH_2), 3.19 (t, 2H, –CH_2), 4.25 (t, 2H, –CH_2–O), 5.10 (d, 1H, –CH–Cl), 6.72–7.75 (m, 7H, Ar–H), 7.31–8.62 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.2 (C_8), 32.4 (C_7), 36.3 (C_9), 62.6 (C_{18}), 63.4 (C_{17}), 67.7 (C_{10}), 114.3–155.5 (C_{11}–C_{16}), 122.3–157.4 (C_2–C_6), 121.1–141.5 (C_{20}–C_{25}), 163.0 (C_{19}). *Anal*. Calcd for $C_{24}H_{21}N_2O_2Cl_3$: C 60.58, H 4.45, N 5.89; found C 60.59, H 4.47, N 5.89.

3-Chloro-1-(3-chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (6n). This compound was obtained as brown solid; yield, 60%; mp 118–120°C. R_f: 0.76. IR ν_{max}: 3053 (Ar–H), 2945, 2846 (−CH_2–), 1724 (−C═O of β-lactam ring), 1222, 1023 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.18 (t, 3H, –CH_3), 2.54 (q, 2H, –CH_2), 3.17 (t, 2H, –CH_2), 4.26 (t, 2H, –CH_2–O), 5.11 (d, 1H, –CH–Cl), 6.72–7.40 (m, 8H, Ar–H), 7.34–8.64 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.7 (C_8), 32.5 (C_7), 36.6 (C_9), 62.3 (C_{18}), 63.3 (C_{17}), 67.5 (C_{10}), 114.2–155.1 (C_{11}–C_{16}), 122.4–157.5 (C_2–C_6), 119.5–143.1 (C_{20}–C_{25}), 163.2 (C_{19}). *Anal*. Calcd for $C_{24}H_{22}N_2O_2Cl_2$: C 65.31, H 5.02, N 6.35; found C 65.30, H 5.03, N 6.34.

3-Chloro-1-(4-methylphenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)azetidin-2-one (6o). This compound was obtained as brown solid; yield, 69%; mp 142–144°C. R_f: 0.74. IR ν_{max}: 3052 (Ar–H), 2942, 2845 (−CH_2–), 1725 (−C═O of β-lactam ring), 1225, 1026 (C–O–C), 745 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.12 (t, 3H, –CH_3), 2.13 (s, 3H, –CH_3), 2.52 (q, 2H, –CH_2), 3.15 (t, 2H, –CH_2), 4.29 (t, 2H, –CH_2–O), 5.15 (d, 1H, –CH–Cl), 6.85–7.35 (m, 8H, Ar–H), 7.33–8.30 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 14.7 (C_8), 25.0 (C_{26}), 32.5 (C_7), 36.5 (C_9), 62.5 (C_{18}), 63.2 (C_{17}), 67.3 (C_{10}), 114.7–155.4 (C_{11}–C_{16}), 123.4–158.8 (C_2–C_6), 120.7–137.2 (C_{20}–C_{25}), 162.4 (C_{19}). *Anal*. Calcd for $C_{25}H_{25}N_2O_2Cl$: C 71.33, H 5.99, N 6.66; found C 71.32, H 5.97, N 6.65.

General preparation of the compounds (7a–o). A mixture of Schiff base (0.01 mol) and phenoxyacetic acid (0.01 mol) was dissolved in dry benzene (20 mL) with constant stirring, and thionyl chloride (10 mL) was added to a mixture at 0°C. After the complete addition, a solid mass separated out and stir it for 2–4 h, which was filtered off, dried *in vacuo*, and recrystallized from ethanol (Scheme-2) (Figure-4).

1-(4-Fluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7a). This compound was obtained as yellow solid; yield, 75%; mp 125–127°C. R_f: 0.82. IR ν_{max}: 3045 (Ar–H), 2942, 2851 (−CH_2–), 1725 (−C═O of

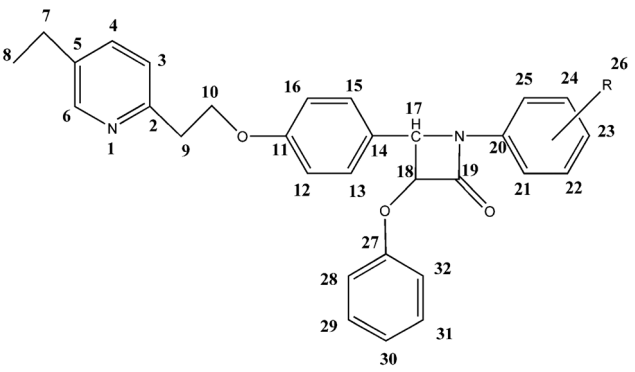


Figure 4. Azetidinone **7a–o**.

β-lactam ring), 1234, 1025 (C–O–C), 974 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.34 (t, 3H, $–CH_3$), 2.85 (q, 2H, $–CH_2$), 3.84 (t, 2H, $–CH_2$), 4.52 (t, 2H, $–CH_2–O$), 5.34 (s, 1H, –CH of aze), 5.32 (s, 1H, –CH), 6.74–7.28 (m, 13H, Ar–H), 7.19–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.4 (C_8), 33.4 (C_7), 36.2 (C_9), 60.2 (C_{17}), 67.5 (C_{10}), 80.2 (C_{18}), 114.2–157.5 (C_{11}–C_{16}), 123.2–158.4 (C_2–C_6), 115.6–158.5 (C_{20}–C_{25}), 165.1 (C_{19}), 114.5–148.6 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{27}N_2O_3F$: C 74.67, H 5.64, N 5.81; found C 74.66, H 5.66, N 5.80.

1-(3,5-Difluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7b). This compound was obtained as yellow solid; yield, 78%; mp 129–132°C. R_f: 0.83. IR ν_{max}: 3045 (Ar–H), 2942, 2851 (−CH_2–), 1725 (−C═O of β-lactam ring), 1234, 1025 (C–O–C), 974 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.32 (t, 3H, $–CH_3$), 2.81 (q, 2H, $–CH_2$), 3.82 (t, 2H, $–CH_2$), 4.50 (t, 2H, $–CH_2–O$), 5.33 (s, 1H, –CH of aze), 5.31 (s, 1H, –CH), 6.58–7.27 (m, 12H, Ar–H), 7.20–8.66 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.5 (C_8), 33.2 (C_7), 36.4 (C_9), 60.1 (C_{17}), 67.6 (C_{10}), 80.4 (C_{18}), 114.1–157.2 (C_{11}–C_{16}), 123.4–158.3 (C_2–C_6), 100.6–164.5 (C_{20}–C_{25}), 165.3 (C_{19}), 114.2–148.1 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{26}F_2N_2O_3$: C 71.99, H 5.24, N 5.60; found C 71.97, H 5.23, N 5.62.

1-(4-Chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy)phenyl)-3-phenoxy azetidin-2-one (7c). This compound was obtained as yellow solid; yield, 83%; mp 132–133°C. R_f: 0.85. IR ν_{max}: 3041 (Ar–H), 2945, 2852 (−CH_2–), 1727 (−C═O of β-lactam ring), 1233, 1026 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.36 (t, 3H, $–CH_3$), 2.83 (q, 2H, $–CH_2$), 3.84 (t, 2H, $–CH_2$), 4.52 (t, 2H, $–CH_2–O$), 5.34 (s, 1H, –CH of aze), 5.30 (s, 1H, –CH), 6.72–7.47 (m, 13H, Ar–H), 7.24–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.2 (C_8), 33.3 (C_7), 36.2 (C_9), 60.2 (C_{17}), 67.4 (C_{10}), 80.3 (C_{18}), 114.5–157.3 (C_{11}–C_{16}), 123.2–158.4 (C_2–C_6), 123.1–139.8 (C_{20}–C_{25}), 165.4 (C_{19}), 114.4–148.2 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{27}N_2O_3Cl$: C 72.21, H 5.45, N 5.61; found C 72.20, H 5.44, N 5.60.

1-(3,4-Dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7d). This compound was obtained as yellow solid; yield, 85%; mp 145–147°C. R_f: 0.80. IR ν_{max}: 3044 (Ar–H), 2941, 2854 (−CH_2–), 1726 (−C═O of β-lactam ring), 1234, 1025 (C–O–C), 745 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.35 (t, 3H, $–CH_3$), 2.80 (q, 2H, $–CH_2$), 3.81 (t, 2H, $–CH_2$), 4.55 (t, 2H, $–CH_2–O$), 5.33 (s, 1H, –CH of aze), 5.29 (s, 1H, –CH), 6.72–7.27 (m, 12H, Ar–H), 7.25–8.62 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.4 (C_8), 33.4 (C_7), 36.3 (C_9), 60.3 (C_{17}), 67.5 (C_{10}), 80.2 (C_{18}), 114.2–157.4 (C_{11}–C_{16}), 123.4–158.6 (C_2–C_6), 121.4–141.3 (C_{20}–C_{25}), 165.1 (C_{19}), 114.4–148.2 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{26}N_2O_3Cl_2$: C 67.55, H 4.91, N 5.25; found C 67.53, H 4.90, N 5.23.

1-(2,4-Dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7e). This compound was obtained as yellow solid; yield, 86%; mp 151–152°C. R_f: 0.79. IR ν_{max}: 3047 (Ar–H), 2943, 2850 (−CH_2–), 1730 (−C═O of β-lactam ring), 1231, 1022 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.33 (t, 3H, $–CH_3$), 2.82 (q, 2H, $–CH_2$), 3.84 (t, 2H, $–CH_2$), 4.51 (t, 2H, $–CH_2–O$), 5.32 (s, 1H, –CH of aze), 5.30 (s, 1H, –CH), 6.72–7.28 (m, 12H, Ar–H), 7.20–8.64 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.3 (C_8), 33.5 (C_7), 36.1 (C_9), 60.4 (C_{17}), 67.3 (C_{10}), 80.3 (C_{18}), 114.0–157.1 (C_{11}–C_{16}), 123.2–158.4 (C_2–C_6), 124.4–138.3 (C_{20}–C_{25}), 165.2 (C_{19}), 114.5–148.4 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{26}N_2O_3Cl_2$: C 67.55, H 4.91, N 5.25; found C 67.56, H 4.92, N 5.26.

1-(3,4-Difluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7f). This compound was obtained as yellow solid; yield, 81%; mp 160–162°C. R_f: 0.78. IR ν_{max}: 3048 (Ar–H), 2944, 2852 (−CH_2–), 1729 (−C═O of β-lactam ring), 1232, 1024 (C–O–C), 975 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.34 (t, 3H, $–CH_3$), 2.85 (q, 2H, $–CH_2$), 3.82 (t, 2H, $–CH_2$), 4.54 (t, 2H, $–CH_2–O$), 5.34 (s, 1H, –CH of aze), 5.31 (s, 1H, –CH), 6.72–7.25 (m, 12H, Ar–H), 7.22–8.66 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.1 (C_8), 33.3 (C_7), 36.2 (C_9), 60.1 (C_{17}), 67.4 (C_{10}), 80.4 (C_{18}), 114.2–157.3 (C_{11}–C_{16}), 123.1–158.3 (C_2–C_6), 111.4–150.0 (C_{20}–C_{25}), 165.4 (C_{19}), 114.2–148.6 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{26}F_2N_2O_3$: C 71.99, H 5.24, N 5.60; found C 71.98, H 5.25, N 5.62.

1-(2-Bromo-4-fluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)-3-phenoxy azetidin-2-one (7g). This compound was obtained as yellow solid; yield, 75%; mp 155–156°C. R_f: 0.81. IR ν_{max}: 3045 (Ar–H), 2942, 2851 (−CH_2–), 1725 (−C═O of β-lactam ring), 1234, 1025 (C–O–C), 974 (C–F), 855 (C–Br); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.30 (t, 3H, $–CH_3$), 2.81 (q, 2H, $–CH_2$), 3.80 (t, 2H, $–CH_2$), 4.52 (t, 2H, $–CH_2–O$), 5.31 (s, 1H, –CH of aze), 5.24 (s, 1H, –CH), 6.72–7.27 (m, 12H, Ar–H), 7.27–8.69 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.3 (C_8), 33.2 (C_7), 36.4 (C_9), 60.3 (C_{17}), 67.5 (C_{10}), 80.1 (C_{18}), 114.5–157.4 (C_{11}–C_{16}), 123.3–158.1 (C_2–C_6), 114.4-160.1 (C_{20}–C_{25}), 165.4 (C_{19}), 114.2–148.6 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{26}N_2O_3FBr$: C 64.18, H 4.67, N 4.99; found C 64.19, H 4.65, N 4.98.

1-(3-Chloro-4-methylphenyl)-4-(4-(2-(5-ethylpyridin-2-yl) ethoxy)phenyl)-3-phenoxy azetidin-2-one (7h):. This compound was obtained as yellow solid; yield, 77%; mp 143–145°C. R_f: 0.77. IR ν_{max}: 3041 (Ar–H), 2945, 2852 (−CH_2–), 1727 (−C═O of β-lactam ring), 1230, 1026 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.35 (t, 3H, $–CH_3$), 2.32 (s, 3H, $–CH_3$), 2.84 (q, 2H, $–CH_2$), 3.84 (t, 2H, $–CH_2$), 4.56 (t, 2H, $–CH_2–O$), 5.32 (s, 1H, –CH of aze), 5.25 (s, 1H, –CH), 6.80–7.29 (m, 12H, Ar–H), 7.15–8.65 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.3 (C_8), 25.6 (C_{26}), 33.4 (C_7), 36.6 (C_9), 60.2 (C_{17}), 67.4 (C_{10}), 80.2 (C_{18}), 114.7–157.6 (C_{11}–C_{16}), 123.4–158.5 (C_2–C_6), 119.6–140.2 (C_{20}–C_{25}), 165.3 (C_{19}), 114.7–148.8 (C_{27}–C_{32}). *Anal*. Calcd for $C_{31}H_{29}N_2O_3Cl$: C 72.58, H 5.70, N 5.46; found C 72.57, H 5.71, N 5.45.

1-(3,5-Dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7i). This compound was obtained as yellow solid; yield, 82%; mp 123–125°C. R_f: 0.77. IR ν_{max}: 3046 (Ar–H), 2946, 2852 (−CH_2–), 1724 (−C═O of β-lactam ring), 1232, 1027 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.29 (t, 3H, $–CH_3$), 2.82 (q, 2H, $–CH_2$), 3.83 (t, 2H, $–CH_2$), 4.51 (t, 2H, $–CH_2–O$), 5.34 (s, 1H, –CH of aze), 5.30 (s, 1H, –CH), 6.73–7.26 (m, 12H, Ar–H), 7.26–8.70 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.6 (C_8), 33.4 (C_7), 36.2 (C_9), 60.7 (C_{17}), 67.1 (C_{10}), 80.2 (C_{18}), 114.6–157.2 (C_{11}–C_{16}), 123.4–158.3 (C_2–C_6), 120.4–141.5 (C_{20}–C_{25}), 165.3 (C_{19}), 114.4–148.4 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{26}N_2O_3Cl_2$: C 67.55, H 4.91, N 5.25; found C 67.56, H 4.92, N 5.26.

1-(2-Chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7j). This compound was

obtained as yellow limpid; yield, 86%; mp limpid. R_f: 0.78. IR ν_{max}: 3048 (Ar–H), 2945, 2854 (−CH_2–), 1725 (−C═O of β-lactam ring), 1235, 1026 (C–O–C), 742 (C–Cl; ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.32 (t, 3H, –CH_3), 2.86 (q, 2H, –CH_2), 3.85 (t, 2H, –CH_2), 4.53 (t, 2H, –CH_2–O), 5.32 (s, 1H, –CH of aze), 5.26 (s, 1H, –CH), 6.72–7.26 (m, 13H, Ar–H), 7.26–8.70 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.8 (C_8), 33.6 (C_7), 36.1 (C_9), 60.2 (C_{17}), 67.3 (C_{10}), 80.4 (C_{18}), 114.5–157.4 (C_{11}–C_{16}), 123.0–158.4 (C_2–C_6), 123.4–140.5 (C_{20}–C_{25}), 165.4 (C_{19}), 114.7–148.5 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{27}N_2O_3Cl$: C 72.21, H 5.45, N 5.61; found C 72.23, H 5.46, N 5.62.

1-(2-Fluorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7k). This compound was obtained as yellow limpid; yield, 82%; mp limpid. R_f: 0.79. IR ν_{max}: 3043 (Ar–H), 2944, 2852 (−CH_2–), 1728 (−C═O of β-lactam ring), 1237, 1026 (C–O–C), 973 (C–F); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.35 (t, 3H, –CH_3), 2.84 (q, 2H, –CH_2), 3.82 (t, 2H, –CH_2), 4.56 (t, 2H, –CH_2–O), 5.34 (s, 1H, –CH of aze), 5.27 (s, 1H, –CH), 6.72–7.27 (m, 13H, Ar–H), 7.26–8.75 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.5 (C_8), 33.4 (C_7), 36.6 (C_9), 60.4 (C_{17}), 67.1 (C_{10}), 80.3 (C_{18}), 114.8–157.0 (C_{11}–C_{16}), 123.2–158.1 (C_2–C_6), 115.4–163.1 (C_{20}–C_{25}), 165.4 (C_{19}), 114.7–148.5 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{27}N_2O_3F$: C 74.67, H 5.64, N 5.81; found C 74.66, H 5.65, N 5.82.

1-(2,5-Dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7l). This compound was obtained as yellow limpid; yield, 84%; mp limpid. R_f: 0.80. IR ν_{max}: 3046 (Ar–H), 2942, 2857 (−CH_2–), 1726 (−C═O of β-lactam ring), 1234, 1028 (C–O–C), 746 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.32 (t, 3H, –CH_3), 2.79 (q, 2H, –CH_2), 3.82 (t, 2H, –CH_2), 4.54 (t, 2H, –CH_2–O), 5.32 (s, 1H, –CH of aze), 5.28 (s, 1H, –CH), 6.72–7.55 (m, 12H, Ar–H), 7.25–8.68 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.2 (C_8), 33.2 (C_7), 36.3 (C_9), 60.6 (C_{17}), 67.4 (C_{10}), 80.1 (C_{18}), 114.6–157.2 (C_{11}–C_{16}), 123.4–158.3 (C_2–C_6), 123.4–141.1 (C_{20}–C_{25}), 165.0 (C_{19}), 114.8–148.9 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{26}N_2O_3Cl_2$: C 67.55, H 4.91, N 5.25; found C 67.56, H 4.92, N 5.24.

1-(2,3-Dichlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7m). This compound was obtained as yellow limpid; yield, 86%; mp limpid. R_f: 0.79. IR ν_{max}: 3048 (Ar–H), 2945, 2853 (−CH_2–), 1728 (−C═O of β-lactam ring), 1233, 1029 (C–O–C), 743 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.33 (t, 3H, –CH_3), 2.80 (q, 2H, –CH_2), 3.83 (t, 2H, –CH_2), 4.52 (t, 2H, –CH_2–O), 5.34 (s, 1H, –CH of aze), 5.30 (s, 1H, –CH), 6.73–7.76 (m, 12H, Ar–H), 7.24–8.66 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.4 (C_8), 33.2 (C_7), 36.6 (C_9), 60.2 (C_{17}), 67.0 (C_{10}), 80.4 (C_{18}), 114.1–157.4 (C_{11}–C_{16}), 123.2–158.5 (C_2–C_6), 121.2–141.5 (C_{20}–C_{25}), 165.2 (C_{19}), 114.6–148.4 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{26}N_2O_3Cl_2$: C 67.55, H 4.91, N 5.25; found C 67.57, H 4.93, N 5.26.

1-(3-Chlorophenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7n). This compound was obtained as yellow limpid; yield, 85%; mp limpid. R_f: 0.76. IR ν_{max}: 3044 (Ar–H), 2942, 2856 (−CH_2–), 1729 (−C═O of β-lactam ring), 1235, 1026 (C–O–C), 745 (C–Cl); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.36 (t, 3H, –CH_3), 2.84 (q, 2H, –CH_2), 3.81 (t, 2H, –CH_2), 4.53 (t, 2H, –CH_2–O), 5.32 (s, 1H, –CH of aze), 5.25 (s, 1H, –CH), 6.73–7.28 (m, 13H, Ar–H), 7.25–8.68 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.7 (C_8), 33.5 (C_7), 36.3 (C_9), 60.4 (C_{17}), 67.2 (C_{10}), 80.1 (C_{18}), 114.4–157.0 (C_{11}–C_{16}), 123.3–158.3 (C_2–C_6), 119.5–143.5 (C_{20}–C_{25}), 165.4 (C_{19}), 114.2–148.5 (C_{27}–C_{32}). *Anal*. Calcd for $C_{30}H_{27}N_2O_3Cl$: C 72.21, H 5.45, N 5.61; found C 72.23, H 5.44, N 5.62.

1-(4-Methylphenyl)-4-(4-(2-(5-ethylpyridin-2-yl)ethoxy) phenyl)-3-phenoxy azetidin-2-one (7o). This compound was obtained as yellow solid; yield, 83%; mp 135–137°C. R_f: 0.78. IR ν_{max}: 3042 (Ar–H), 2948, 2852 (−CH_2–), 1722 (−C═O of β-lactam ring), 1232, 1020 (C–O–C); ^{1}H NMR (δ $CDCl_3$, 400 MHz): 1.32 (t, 3H, –CH_3), 2.34 (s, 3H, –CH_3), 2.86 (q, 2H, –CH_2), 3.82 (t, 2H, –CH_2), 4.58 (t, 2H, –CH_2–O), 5.31 (d, 1H, –CH of aze), 5.29 (d, 1H, –CH), 7.03–8.33 (m, 13H, Ar–H), 7.16–8.61 (m, 3H, Pyridine–H); ^{13}C NMR (δc, $CDCl_3$, 100 MHz): 19.5 (C_8), 25.7 (C_{26}), 33.5 (C_7), 36.4 (C_9), 60.6 (C_{17}), 67.3 (C_{10}), 80.1 (C_{18}), 114.5–157.7 (C_{11}–C_{16}), 123.1–158.2 (C_2–C_6), 120.6–137.2 (C_{20}–C_{25}), 165.1 (C_{19}), 114.6–148.7 (C_{27}–C_{32}). *Anal*. Calcd for $C_{31}H_{30}N_2O_3$: C 77.80, H 6.32, N 5.85; found C 77.81, H 6.33, N 5.84.

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