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Synthesis of a new class of 2-oxazolines and 2-thiazolines

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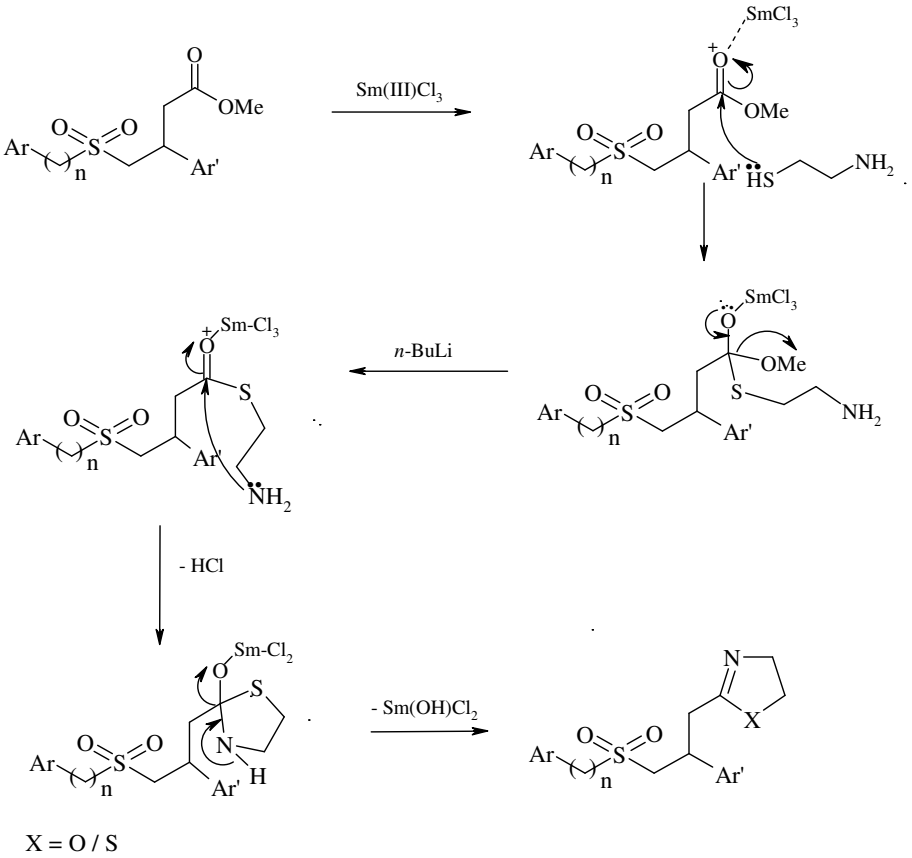
A new class of 2-oxazolines and 2-thiazolines **9/10** and **13/14** are prepared by base promoted cyclization of 3-aryl-*N*-(2-hydroxyethyl)-4-(arylsulfonyl)butanamide/3-aryl-*S*-(2-aminoethyl)-4-(arylsulfonyl)butanethioates with NaH in THF. **9/10** and **13/14** are also obtained by one pot methodology using samarium(III) chloride.

Keywords: 2-Aminoethanol, 2-aminoethanethiol, 2-oxazoline, 2-thiazoline, $SmCl_3$, NaH

The development of five membered heterocycles adopting simple, facile and efficient methodologies from readily available reagents is one of the major challenges in organic syntheses. In fact, the five membered heterocycles, oxazoles and thiazoles have gained importance because of their varied physiological activities. Oxazoline and thiazoline rings are important constituents of bioactive natural products and pharmaceuticals[1]. Several 2-oxazolines have been used as therapeutic agents. Because of their structural relationship to procaine, 2-oxazoline derivatives might be expected to have local anaesthetic properties[2]. Moreover, oxazole derivatives have prime importance as azadiene components for Diel's-Alder synthesis[3,4,5]. Different methods are known for simple cycloaddition of carboxylic acids and *p*-amino alcohols to yield oxazolines under high temperature using Dean-Stark's apparatus. However, the modified Appel reaction conditions provide a one pot methodology for oxazolines from acids and amino alcohols[6]. The cyclocondensation of tosylmethyl isocyanide with acid chlorides or esters also led to oxazoles[7,8]. On the other hand, the thionyl chloride induced cyclization of hydroxamides to oxazolines proceeds well[9]. Besides, phosphorus mediated reactions of hydroxamides gave 2-oxazolines[10]. Similarly, synthesis of thiazolines was reported by the coupling of imidates and esters with 2-aminothiols[11]. Cyclodehydration of hydroxamides resulted in thiazolines[12]. Apart from these, thiazolines were obtained by heterocyclic interconversions of oxazolines[13] or oxazolidines[14]. In view of the importance of oxazole and thiazole derivatives and in continuation[15,16] of our efforts to develop new heterocycles, the synthesis of 2-oxazolines and 2-thiazolines has been taken up.

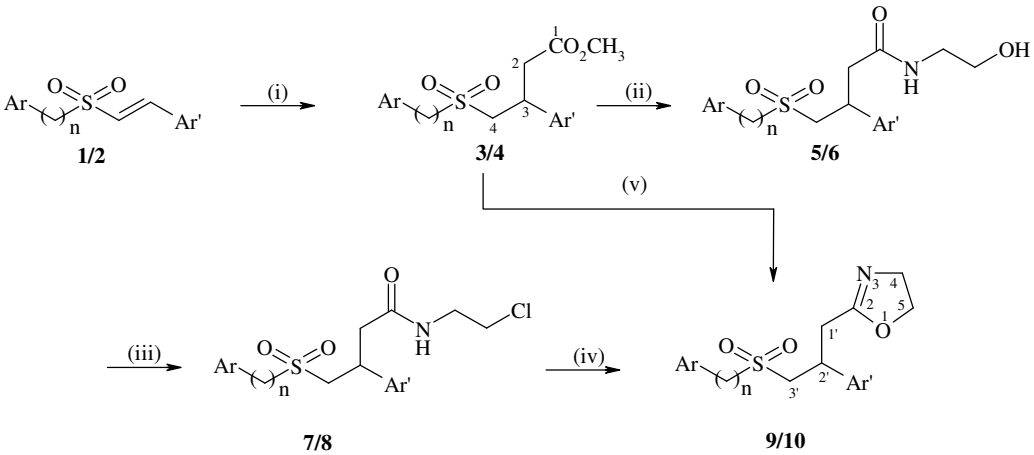
Results and Discussion

The synthetic intermediates methyl 4-arylsulfonyl-3-arylbutyrate **3** and methyl 4-arylmethanesulfonyl-3-arylbutyrate **4** were prepared by the Michael addition (**Figure 1)** of dimethyl malonate to aryl styryl sulfone **1** and arylmethane styryl sulfone **2** in the presence of Triton-B in toluene. The IR spectra of **3** and **4** exhibited absorption bands in the regions 1735-1750 for CO_2Me and 1320-1340 & 1120-1150 cm^{-1} for SO_2. The ^1H NMR spectra of 3**b** displayed four double doublets at δ 2.75, 2.94 (C_2-H), 3.16, 3.27 (C_4-H), a multiplet at 3.73-3.84 (C_3-H), a singlet at 2.26 (Ar-CH_3) and a singlet at 3.67 (OCH_3) in addition to a multiplet in the region 7.21-7.382 ppm for aromatic protons. The ^1H NMR spectra of 4**b** exhibited signals almost in the same regions as in **3b**. In addition to this, a singlet was observed at δ 3.96 ppm due to methylene protons flanked between aryl and sulfonyl groups. The reaction of **3/4** with 2-aminoethanol in the presence of sodium methoxide in methanol gave 3-aryl-*N*-(2-hydroxyethyl)-4-(arylsulfonyl)butanamide **5/**3-aryl-*N*-(2-hydroxyethyl)-4-(arylmethanesulfonyl)-butanamide **6** (**Scheme I** and **Table I**). The compounds **5** and **6** displayed absorption bands in the regions 3320-3340 (NH) and 3310-3330 (OH) in addition to absorption bands at 1640-1660 (C=O) and 1120-1140, 1325-1345 cm^{-1} (SO_2) (**Table II**). The ^1H NMR spectra of **5a** and **6a** showed two triplets at 3.35, 3.62 and 3.33, 3.60 ppm due to methylene



Mechanism

Figure 1



Ar	Ar'
a) Ph	Ph
b) Ph	4-Me.Ph
c) Ph	4-Cl.Ph
d) 4-Cl.Ph	Ph
e) 4-Cl.Ph	4-Cl.Ph

(i) DMM / Triton-B / Toluene
(ii) $NH_2CH_2CH_2OH$ / NaOMe / MeOH
(iii) $SOCl_2$/ MeOH
(iv) NaH / THF
(v) $NH_2CH_2CH_2OH$ / $Sm(III)Cl_3$ /*n*-Bu-Li/ Toluene

Scheme I

Table I — Physical data of compounds **3-14**

Compd	m.p. (°C)	Yield (%)	Mol. formula (Mol. wt.)	Found % (Calcd.)		
				C	H	N
3b	103-05	75	$C_{18}H_{20}O_4S$ (332.41)	65.11 (65.04	5.59 6.06	- -)
3d	115-17	70	$C_{17}H_{17}ClO_4S$ (352.05)	57.99 (57.87	4.76 4.85	- -
3e	122-24	74	$C_{17}H_{16}Cl_2O_4S$ (387.28)	52.65 (52.72	4.10 4.16	- -)
4b	107-09	74	$C_{19}H_{22}O_4S$ (346.44)	65.82 (65.87	6.35 6.40	- -)
4c	118-20	75	$C_{18}H_{19}ClO_4S$ (366.86)	58.98 (58.93	5.15 5.22	- -)
4d	109-11	70	$C_{18}H_{19}ClO_4S$ (366.86)	58.88 (58.93	5.17 5.22	- -)
4e	115-17	76	$C_{18}H_{18}Cl_2O_4S$ (401.30)	53.82 (53.87	4.47 4.52	- -)
5a	138-40	65	$C_{18}H_{21}NO_4S$ (347.43)	62.30 (62.23	6.12 6.09	4.09 4.03)
5b	147-49	62	$C_{19}H_{23}NO_4S$ (361.46)	63.22 (63.13	6.39 6.41	3.86 3.88)
5c	155-57	68	$C_{18}H_{20}ClNO_4S$ (381.87)	56.67 (56.61	5.31 5.28	3.71 3.67)
5d	160-62	60	$C_{18}H_{20}ClNO_4S$ (381.87)	56.56 (56.61	5.30 5.28	3.75 3.67)
5e	164-66	67	$C_{18}H_{19}Cl_2NO_4S$ (416.32)	51.98 (51.93	4.66 4.60	3.39 3.36)
6a	127-29	63	$C_{19}H_{23}NO_4S$ (361.46)	63.23 (63.13	6.45 6.41	3.92 3.88)
6b	119-21	60	$C_{20}H_{25}NO_4S$ (375.48)	64.04 (63.97	6.66 6.71	3.77 3.73)
6c	133-35	66	$C_{19}H_{22}ClNO_4S$ (395.90)	57.67 (57.64	5.64 5.60	3.62 3.54)
6d	137-39	64	$C_{19}H_{22}ClNO_4S$ (395.90)	57.60 (57.64	5.58 5.60	3.59 3.54)
6e	145-47	69	$C_{19}H_{21}Cl_2NO_4S$ (430.35)	53.12 (53.03	4.94 4.92	3.28 3.25)
7a	154-56	71	$C_{18}H_{20}ClNO_3S$ (365.87)	59.14 (59.09	5.55 5.51	3.90 3.83)
7b	167-69	74	$C_{19}H_{22}ClNO_3S$ (379.90)	60.14 (60.07	5.89 5.84	3.75 3.69)
7c	173-75	78	$C_{18}H_{19}Cl_2NO_3S$ (400.32)	54.05 (54.01	4.76 4.78	3.56 3.50)
7d	179-81	70	$C_{18}H_{19}Cl_2NO_3S$ (400.32)	53.95 (54.01	4.81 4.78	3.56 3.50)
7e	186-88	72	$C_{18}H_{18}Cl_3NO_3S$ 434.76	49.78 (49.73	4.14 4.17	3.26 3.22)
8a	155-57	75	$C_{19}H_{22}ClNO_3S$ (379.90)	60.14 (60.07	5.89 5.84	3.74 3.69)
8b	140-42	79	$C_{20}H_{24}ClNO_3S$ (393.93)	61.04 (60.98	6.11 6.14	3.60 3.56)
8c	158-60	73	$C_{18}H_{19}Cl_2NO_3S$ (400.32)	53.92 (54.01	4.81 4.78	3.47 3.50)

—Contd

Table I — Physical data of compounds **3-14** — *Contd*

Compd	m.p. (°C)	Yield (%)	Mol. formula (Mol. wt.)	Found % (Calcd.) C	H	N
8d	170-72	68	$C_{18}H_{19}Cl_2NO_3S$ (400.32)	54.05 (54.01	4.72 4.78	3.54 3.50)
8e	186-88	76	$C_{19}H_{20}Cl_3NO_3S$ (448.79)	50.80 (50.85	4.43 4.49	3.09 3.12)
9a	175-77	62 68*	$C_{18}H_{19}NO_3S$ (329.41)	65.74 (65.63	5.79 5.81	4.29 4.25)
9b	184-86	65 70*	$C_{19}H_{21}NO_3S$ (343.44)	66.54 (66.45	6.18 6.16	4.13 4.08)
9c	206-08	71 75*	$C_{18}H_{18}ClNO_3S$ (363.86)	59.50 (59.42	4.96 4.99	3.82 3.85)
9d	212-14	60 65*	$C_{18}H_{18}ClNO_3S$ (363.86)	59.48 (59.42	4.97 4.99	3.84 3.85)
9e	218-20	63 67*	$C_{18}H_{17}Cl_2NO_3S$ (398.30)	54.22 (54.28	4.33 4.30	3.57 3.52)
10a	208-10	68 74*	$C_{19}H_{21}NO_3S$ (343.44)	66.53 (66.45	6.20 6.16	4.16 4.08)
10b	195-97	72 76*	$C_{20}H_{23}NO_3S$ (357.47)	67.29 (67.20	6.46 6.49	3.98 3.92)
10c	210-12	65 70*	$C_{19}H_{20}ClNO_3S$ (377.88)	60.32 (60.39	5.30 5.33	3.76 3.71)
10d	216-18	62 68*	$C_{19}H_{20}ClNO_3S$ (377.88)	60.36 (60.39	5.32 5.33	3.74 3.71)
10e	228-30	67 73*	$C_{19}H_{19}Cl_2NO_3S$ (412.33)	55.30 (55.34	4.66 4.64	3.46 3.40)
11a	123-25	69	$C_{18}H_{21}NO_3S_2$ (363.49)	59.55 (59.48	5.85 5.82	3.91 3.85)
11b	117-19	64	$C_{19}H_{23}NO_3S_2$ (377.52)	60.50 (60.45	6.12 6.14	3.69 3.71)
11c	130-32	72	$C_{18}H_{20}ClNO_3S_2$ (397.94)	54.38 (54.33	5.11 5.07	3.55 3.52)
11d	136-38	63	$C_{18}H_{20}ClNO_3S_2$ (397.94)	54.27 (54.33	5.02 5.07	3.56 3.52)
11e	140-42	67	$C_{19}H_{21}Cl_2NO_3S_2$ (446.41)	51.16 (51.12	4.77 4.74	3.19 3.14)
12a	102-04	71	$C_{18}H_{22}NO_3S_2$ (364.50)	59.37 (59.31	6.12 6.08	3.87 3.84)
12b	112-14	68	$C_{20}H_{25}NO_3S_2$ (391.55)	61.42 (61.35	6.40 6.44	3.62 3.58)
12c	125-26	70	$C_{19}H_{22}ClNO_3S_2$ (411.97)	55.34 (55.39	5.39 5.38	3.38 3.40)
12d	132-34	65	$C_{19}H_{22}ClNO_3S_2$ (411.97)	55.41 (55.39	5.36 5.38	3.44 3.40)
12e	140-42	62	$C_{19}H_{21}Cl_2NO_3S_2$ (446.41)	51.08 (51.12	4.78 4.74	3.10 3.14)
13a	190-92	70 75*	$C_{18}H_{19}NO_2S_2$ (345.48)	62.70 (62.58	5.52 5.54	4.13 4.05)
13b	200-02	69 74*	$C_{19}H_{21}NO_2S_2$ (359.51)	63.56 (63.48	5.85 5.89	3.96 3.90)
13c	176-78	66 70*	$C_{18}H_{18}ClNO_2S_2$ (379.92)	56.96 (56.90	4.76 4.78	3.75 3.69)

—Contd

Table I — Physical data of compounds **3-14** — *Contd*

Compd	m.p. (°C)	Yield (%)	Mol. formula (Mol. wt.)	Found % (Calcd.) C	H	N
13d	180-82	70 74*	$C_{18}H_{18}ClNO_2S_2$ (379.92)	56.85 (56.90	4.74 4.78	3.78 3.69)
13e	190-92	73 79*	$C_{18}H_{17}Cl_2NO_2S_2$ (414.37)	52.27 (52.17	4.12 4.14	3.34 3.38)
14a	210-12	67 74*	$C_{19}H_{21}NO_2S_2$ (359.51)	63.55 (63.48	5.83 5.89	3.96 3.90)
14b	218-20	65 72*	$C_{20}H_{23}NO_2S_2$ (373.53)	64.42 (64.31	6.26 6.21	3.82 3.75)
14c	202-04	70 75*	$C_{19}H_{20}ClNO_2S_2$ (393.95)	57.88 (57.93	5.10 5.12	3.61 3.56)
14d	208-10	68 73*	$C_{19}H_{20}ClNO_2S_2$ (393.95)	57.89 (57.93	5.10 5.12	3.61 3.56)
14e	216-18	71 76*	$C_{19}H_{19}Cl_2NO_2S_2$ (428.40)	53.33 (53.27	4.50 4.47	3.32 3.27)

* Yield in the presence of Samarium(III) chloride catalyst

Table II — Spectral characterization data for **3-14**

Compd	IR Data (cm^{-1})	^{1}H NMR (δ ppm) (*J* in Hz)	^{13}C NMR (δ ppm)
3b	1125, 1336 (SO_2), 1735 (C=O).	2.26 (s, 3H, Ar-CH_3), 2.75 (dd, 1H, C_2-H, *J* = 7.9, 16.4 Hz), 2.94 (dd, 1H, C_2-H, *J* = 5.6, 16.5 Hz), 3.16 (dd, 1H, C_4-H, *J* = 7.1, 14.2 Hz), 3.27 (dd, 1H, C_4-H, *J* = 7.6, 14.7 Hz), 3.67 (s, 3H, OCH_3), 3.73-3.84 (m, 1H, C_3-H), 7.21-7.82 (m, 9H, Ar-H).	20.3 (Ar-CH_3), 36.1 (C-3), 38.2 (C-2), 52.9 (OCH_3), 56.3 (C-4), 173.4 (*C*O_2Me), 125.1, 126.8, 128.8, 129.3, 132.1, 138.4 (aromatic carbons).
3d	1136, 1324 (SO_2), 1744 (C=O).	2.62 (dd, 1H, C_2-H, *J* = 7.2, 15.9 Hz), 2.95 (dd, 1H, C_2-H, *J* = 6.7, 16.4 Hz), 3.20 (dd, 1H, C_4-H, *J* = 6.6, 14.1 Hz), 3.25 (dd, 1H, C_4-H, *J* = 7.3, 14.6 Hz), 3.65 (s, 3H, OCH_3), 3.84-3.95 (m, 1H, C_3-H), 7.19-7.45 (m, 9H, Ar-H).	36.3 (C-3), 41.8 (C-2), 52.9 (OCH_3), 54.8 (C-4), 173.2 (*C*O_2Me), 125.1, 126.4, 127.2, 128.0, 129.9, 130.6, 133.7, 138.4 (aromatic carbons).
3e	1142, 1333 (SO_2), 1741 (C=O).	2.74 (dd, 1H, C_2-H, *J* = 8.1, 16.3 Hz), 2.86 (dd, 1H, C_2-H, *J* = 6.4, 16.2 Hz), 3.24 (dd, 1H, C_4-H, *J* = 6.8, 14.8 Hz), 3.29 (dd, 1H, C_4-H, *J* = 7.5, 14.8 Hz), 3.59 (s, 3H, OCH_3), 3.96-3.98 (m, 1H, C_3-H), 7.21-7.46 (m, 8H, Ar-H).	36.9 (C-3), 38.6 (C-2), 53.4 (OCH_3), 51.9 (C-4), 173.4 (*C*O_2Me), 126.3, 128.4, 128.9, 129.7, 132.5, 139.8 (aromatic carbons).
4b	1134, 1326 (SO_2), 1735 (C=O).	2.28 (s, 3H, Ar-CH_3), 2.68 (dd, 1H, C_2-H, *J* = 7.8, 16.3 Hz), 2.88 (dd, 1H, C_2-H, *J* = 6.0, 16.0 Hz), 3.14 (dd, 1H, C_4-H, *J* = 6.3, 14.0 Hz), 3.29 (dd, 1H, C_4-H, *J* = 6.6, 14.3 Hz), 3.59 (s, 3H, OCH_3), 3.75-3.91 (m, 1H, C_3-H), 3.96 (s, 2H, Ar-CH_2), 7.23-7.56 (m, 9H, Ar-H).	21.8 (Ar-CH_3), 35.7 (C-3), 40.9 (C-2), 54.6 (OCH_3), 55.9 (C-4), 58.6 (Ar-CH_2), 172.1 (*C*O_2Me), 126.4, 128.0, 129.6, 132.8, 133.2, 139.0 (aromatic carbons).
4c	1131, 1334 (SO_2), 1744 (C=O).	2.76 (dd, 1H, C_2-H, *J* = 8.1, 16.5 Hz), 2.91 (dd, 1H, C_2-H, *J* = 6.2, 16.2 Hz), 3.17 (dd, 1H, C_4-H, *J* = 6.1, 14.3 Hz), 3.34 (dd, 1H, C_4-H, *J* = 6.8, 14.5 Hz), 3.64 (s, 3H, OCH_3), 3.72-3.89 (m, 1H, C_3-H), 3.91 (s, 2H, Ar-CH_2), 7.19-7.62 (m, 9H, Ar-H).	35.7 (C-3), 39.4 (C-2), 53.5 (OCH_3), 55.1 (C-4), 57.6 (Ar-CH_2), 172.9 (*C*O_2Me), 125.2, 128.8, 129.9, 131.8, 132.9, 138.4 (aromatic carbons).
4d	1141, 1329 (SO_2), 1741 (C=O).	2.72 (dd, 1H, C_2-H, *J* = 8.0, 15.9 Hz), 2.96 (dd, 1H, C_2-H, *J* = 6.2, 16.4 Hz), 3.15 (dd, 1H, C_4-H, *J* = 6.8, 14.3 Hz), 3.29 (dd, 1H, C_4-H, *J* = 6.5, 14.6 Hz), 3.61 (s, 3H, OCH_3), 3.76-3.82 (m, 1H, C_3-H), 3.99 (s, 2H, Ar-CH_2), 7.14-7.42 (m, 9H, Ar-H).	36.0 (C-3), 39.0 (C-2), 52.8 (OCH_3), 55.8 (C-4), 58.9 (Ar-CH_2), 172.0, (CO_2Me), 125.9, 129.1, 129.4, 132.1, 133.8, 138.4 (aromatic carbons).
5a	1125, 1333 (SO_2), 1643 (C=O), 3310 (OH), 3321 (NH).	2.75 (dd, 1H, C_2-H, *J* = 8.1, 16.2 Hz), 2.96 (dd, 1H, C_2-H, *J* = 6.0, 16.3 Hz), 3.11 (dd, 1H, C_4-H, *J* = 6.2, 13.5 Hz), 3.25 (dd, 1H, C_4-H, *J* = 6.0, 13.8 Hz), 3.35 (t, 2H, NH-C*H*$_2$, *J* = 4.8 Hz), 3.62 (t, 2H, C*H*$_2$-OH, *J* = 4.8 Hz), 3.79-3.81 (m, 1H, C_3-H), 7.08-7.37 (m, 10H, Ar-H), 8.51 (bs, 1H, NH).	35.3 (C-3), 39.9 (C-2), 49.5 (NH-CH_2), 51.4 (CH_2-OH), 55.6 (C-4), 164.7 (CONH), 125.8, 126.4, 127.5, 129.9, 132.1, 138.3 (aromatic carbons).

—Contd

Table II — Spectral characterization data for **3-14**— *Contd*

Compd	IR Data (cm^{-1})	^{1}H NMR (δ ppm) (*J* in Hz)	^{13}C NMR (δ ppm)
5b	1129, 1328 (SO_2), 1645 (C=O), 3312 (OH), 3326 (NH).	2.24, (s, 3H, Ar-CH_3), 2.72 (dd, 1H, C_2-H, *J* = 7.9, 16.0 Hz), 2.93 (dd, 1H, C_2-H, *J* = 6.0, 16.2 Hz), 3.15 (dd, 1H, C_4-H, *J* = 6.3, 13.8 Hz), 3.21 (dd, 1H, C_4-H, *J* = 6.1, 13.7 Hz), 3.30 (t, 2H, NH-CH_2, *J* = 4.7 Hz), 3.64 (t, 2H, CH_2-OH, *J* = 4.7 Hz), 3.74-3.83 (m, 1H, C_3-H), 7.10-7.42 (m, 9H, Ar-H), 8.56 (bs, 1H, NH).	21.3 (Ar-CH_3), 36.1 (C-3), 40.2 (C-2), 49.2 (NH-CH_2), 51.0 (CH_2-OH), 55.8 (C-4), 164.1 (CONH), 125.2, 126.0, 127.7, 129.3, 132.0, 138.6 (aromatic carbons).
5c	1132, 1337 (SO_2), 1653 (C=O), 3321 (OH), 3336 (NH)**.**	2.78 (dd, 1H, C_2-H, *J* = 8.2, 16.4 Hz), 2.95 (dd, 1H, C_2-H, *J* = 6.1, 16.2 Hz), 3.19 (dd, 1H, C_4-H, *J* = 6.6, 13.7 Hz), 3.28 (dd, 1H, C_4-H, *J* = 6.2, 13.9 Hz), 3.38 (t, 2H, NH-CH_2, *J* = 5.1 Hz), 3.66 (t, 2H, CH_2-OH, *J* = 5.1 Hz), 3.76-3.85 (m, 1H, C_3-H), 8.58 (bs, 1H, NH), 7.15-7.49 (m, 9H, Ar-H).	36.6 (C-3), 40.9 (C-2), 48.7 (NH-CH_2), 51.3 (CH_2-OH), 55.1 (C-4), 164.9 (CONH), 126.4, 126.9, 128.2, 129.9, 132.4, 138.1 (aromatic carbons).
5d	1138, 1334 (SO_2), 1658 (C=O), 3328 (OH), 3330 (NH).	2.73 (dd, 1H, C_2-H, *J* = 8.0, 16.1 Hz), 2.91 (dd, 1H, C_2-H, *J* = 6.0, 16.0 Hz), 3.17 (dd, 1H, C_4-H, *J* = 6.5, 13.9 Hz), 3.23 (dd, 1H, C_4-H, *J* = 6.3, 13.9 Hz), 3.36 (t, 2H, NH-CH_2, *J* = 4.9 Hz), 3.61 (t, 2H, CH_2-OH, *J* = 4.9 Hz), 3.72-3.80 (m, 1H, C_3-H), 7.12-7.53 (m, 9H, Ar-H), 8.54 (bs, 1H, NH).	35.7 (C-3), 41.0 (C-2), 49.6 (NH-CH_2), 51.7 (CH_2-OH), 55.1 (C-4), 165.0 (CONH), 125.4, 126.8, 127.6, 129.2, 132.9, 139.8 (aromatic carbons).
5e	1135, 1338 (SO_2), 1650 (C=O), 3325 (OH), 3335 (NH).	2.76 (dd, 1H, C_2-H, *J* = 8.2, 16.1 Hz), 2.92 (dd, 1H, C_2-H, *J* = 6.2, 16.3 Hz), 3.15 (dd, 1H, C_4-H, *J* = 6.2, 13.6 Hz), 3.26 (dd, 1H, C_4-H, *J* = 6.3, 13.5 Hz), 3.32 (t, 2H, NH-CH_2, *J* = 5.0 Hz), 3.68 (t, 2H, CH_2-OH, *J* = 5.0 Hz), 3.76-3.83 (m, 1H, C_3-H), 8.56 (bs, 1H, NH), 7.18-7.61 (m, 8H, Ar-H).	36.8 (C-3), 40.6 (C-2), 48.4 (NH-CH_2), 51.9 (CH_2-OH), 55.5 (C-4), 164.9 (CONH), 125.8, 126.7, 127.1, 128.7, 131.6, 138.6 (aromatic carbons).
6a	1121,1332 (SO_2), 1648 (C=O), 3317 (OH), 3327 (NH)	2.70 (dd, 1H, C_2-H, *J* = 7.8, 16.0 Hz), 2.96 (dd, 1H, C_2-H, *J* = 6.2, 16.0 Hz), 3.13 (dd, 1H, C_4-H, *J* = 6.4, 14.1 Hz), 3.20 (dd, 1H, C_4-H, *J* = 6.1, 14.0 Hz), 3.33 (t, 2H, NH-CH_2, *J* = 4.6 Hz), 3.60 (t, 2H, CH_2-OH, *J* = 4.6 Hz), 3.70-3.84 (m, 1H, C_3-H), 3.92 (s, 2H, Ar-CH_2), 7.18-7.37 (m, 10H, Ar-H), 8.57 (bs, 1H, NH).	36.2 (C-3), 39.4 (C-2), 49.1 (NH-CH_2), 51.8 (CH_2-OH), 55.2 (C-4), 58.5 (Ar-CH_2), 165.3 (CONH), 127.7, 128.6, 129.1, 131.8, 133.5, 139.4 (aromatic carbons).
6b	1134, 1326 (SO_2), 1641 (C=O), 3321 (OH), 3332 (NH).	2.56 (s, 3H, Ar-CH_3), 2.72 (dd, 1H, C_2-H, *J* = 8.2, 16.1 Hz), 2.92 (dd, 1H, C_2-H, *J* = 6.3, 16.2 Hz), 3.18 (dd, 1H, C_4-H, *J* = 6.9, 14.0 Hz), 3.23 (dd, 1H, C_4-H, *J* = 6.2, 14.1 Hz), 3.31 (t, 2H, NH-CH_2, *J* = 4.8 Hz), 3.58 (t, 2H, CH_2-OH, *J* = 4.8 Hz), 3.71-3.86 (m, 1H, C_3-H), 3.96 (s, 2H, Ar-CH_2), 7.11-7.32 (m, 9H, Ar-H), 8.52 (bs, 1H, NH).	22.4 (Ar-CH_3), 35.6 (C-3), 39.0 (C-2), 49.7 (NH-CH_2), 51.1 (CH_2-OH), 55.9 (C-4), 58.2 (Ar-CH_2), 165.8 (CONH), 127.2, 128.2, 129.9, 131.2, 133.9, 139.0 (aromatic carbons).
6c	1130, 1335 (SO_2), 1653 (C=O), 3316 (OH), 3336 (NH).	2.77 (dd, 1H, C_2-H, *J* = 8.4, 16.3 Hz), 2.97 (dd, 1H, C_2-H, *J* = 6.5, 16.4 Hz), 3.16 (dd, 1H, C_4-H, *J* = 6.7, 13.8 Hz), 3.22 (dd, 1H, C_4-H, *J* = 6.4, 14.0 Hz), 3.37 (t, 2H, NH-CH_2, *J* = 4.9 Hz), 3.56 (t, 2H, CH_2-OH *J* = 4.9 Hz), 3.74-3.89 (m, 1H, C_3-H), 4.02 (s, 2H, Ar-CH_2), 7.15-7.39 (m, 9H, Ar-H), 8.59 (bs, 1H, NH).	36.5 (C-3), 39.7 (C-2), 49.5 (NH-CH_2,), 51.4 (*C*H_2-OH), 55.6 (C-4), 58.7 (Ar-CH_2), 165.4 (CONH), 127.3, 128.8, 129.2, 131.8, 133.4, 139.2 (aromatic carbons).
6d	1132, 1340 (SO_2), 1644 (C=O), 3324 (OH), 3340 (NH).	2.74 (dd, 1H, C_2-H, *J* = 8.2, 16.2 Hz), 2.93 (dd, 1H, C_2-H, *J* = 6.6, 16.5 Hz), 3.14 (dd, 1H, C_4-H, *J* = 6.8, 13.7 Hz), 3.23 (dd, 1H, C_4-H, *J* = 6.5, 14.1 Hz), 3.35 (t, 2H, NH-CH_2, *J* = 5.1 Hz), 3.59 (t, 2H, CH_2-OH, *J* = 5.1 Hz), 3.72-3.85 (m, 1H, C_3-H), 4.06 (s, 2H, Ar-CH_2), 7.11-7.42 (m, 9H, Ar-H), 8.51 (bs, 1H, NH).	36.2 (C-3), 39.3 (C-2), 49.1 (NH-CH_2,), 51.6 (*C*H_2-OH), 55.1 (C-4), 58.5 (Ar-CH_2), 165.9 (CONH), 127.9, 128.1, 129.6, 131.2, 133.7, 139.8 (aromatic carbons).
6e	1140, 1345 (SO_2), 1657 (C=O), 3330 (OH), 3325 (NH).	2.73 (dd, 1H, C_2-H, *J* = 8.2, 16.1 Hz), 2.95 (dd, 1H, C_2-H, *J* = 6.4, 16.4 Hz), 3.12 (dd, 1H, C_4-H, *J* = 6.6, 13.5 Hz), 3.24 (dd, 1H, C_4-H, *J* = 6.7, 14.3 Hz), 3.39 (t, 2H, NH-CH_2, *J* = 5.3 Hz), 3.61 (t, 2H, CH_2-OH, *J* = 5.3 Hz), 3.71-3.83 (m, 1H, C_3-H), 4.04 (s, 2H, Ar-CH_2), 7.12-7.48 (m, 8H, Ar-H), 8.54 (bs, 1H, NH).	36.1 (C-3), 39.2 (C-2), 49.3 (NH-CH_2,), 51.9 (CH_2-OH), 55.9 (C-4), 58.1 (Ar-CH_2), 165.8 (CONH), 127.0, 128.5, 129.7, 131.5, 133.8, 139.9 (aromatic carbons).
7a	1121, 1332 (SO_2), 1644 (C=O), 3328 (NH).	2.71 (dd, 1H, C_2-H, *J* = 8.1, 16.2 Hz), 2.94 (dd, 1H, C_2-H, *J* = 6.2, 16.3 Hz), 3.10 (t, 2H, NH-CH_2, *J* = 4.8 Hz), 3.17 (dd, 1H, C_4-H, *J* = 6.4, 13.5 Hz), 3.25 (dd, 1H, C_4-H, *J* = 6.0, 13.8 Hz), 3.64 (t, 2H, CH_2-Cl, *J* = 4.8 Hz), 3.79-3.81 (m, 1H, C_3-H), 7.10-7.57 (m, 10H, Ar-H) 8.51 (bs, 1H, NH).	34.9 (C-3), 39.3 (C-2), 49.1 (NH-CH_2,), 52.8 (CH_2-Cl), 55.2 (C-4), 164.1 (CONH), 125.2, 126.1, 127.8, 129.2, 132.4, 137.7 (aromatic carbons).

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Table II — Spectral characterization data for **3-14**— *Contd*

Compd	IR Data (cm^{-1})	^{1}H NMR (δ ppm) (*J* in Hz)	^{13}C NMR (δ ppm)
7b	1133, 1330 (SO_2), 1653 (C=O), 3331 (NH).	2.25 (s, 3H, Ar-CH_3), 2.72 (dd, 1H, C_2-H, *J* = 7.9, 16.0 Hz), 2.93 (dd, 1H, C_2-H, *J* = 6.0, 16.1 Hz), 3.08 (t, 2H, NH-CH_2, *J* = 4.6 Hz), 3.14 (dd, 1H, C_4-H, *J* = 6.3, 13.3 Hz), 3.23 (dd, 1H, C_4-H, *J* = 6.1, 13.7 Hz), 3.68 (t, 2H, CH_2-Cl, *J* = 4.6 Hz), 3.77-3.84 (m, 1H, C_3-H), 7.16-7.64 (m, 9H, Ar-H), 8.48 (bs, 1H, NH).	21.3 (Ar-CH_3), 34.3 (C-3), 39.6 (C-2), 49.9 (NH-CH_2,), 52.1 (CH_2-Cl), 55.8 (C-4), 164.9 (CONH), 125.7, 126.9, 127.7, 129.8, 133.4, 135.5 (aromatic carbons).
7c	1128, 1336 (SO_2), 1655 (C=O), 3336 (NH).	2.74 (dd, 1H, C_2-H, *J* = 8.0, 16.1 Hz), 2.96 (dd, 1H, C_2-H, *J* = 6.3, 16.2 Hz), 3.06 (t, 2H, NH-CH_2, *J* = 4.5 Hz), 3.12 (dd, 1H, C_4-H, *J* = 6.2, 13.1 Hz), 3.20 (dd, 1H, C_4-H, *J* = 6.1, 13.5 Hz), 3.58 (t, 2H, CH_2-Cl, *J* = 4.5 Hz), 3.72-3.80 (m, 1H, C_3-H), 7.12-7.69 (m, 9H, Ar-H), 8.53 (bs, 1H, NH).	34.1 (C-3), 39.0 (C-2), 49.4 (NH-CH_2), 53.7 (CH_2-Cl), 55.6 (C-4), 164.3 (CONH), 125.9, 126.2, 127.8, 129.6, 132.4, 138.6 (aromatic carbons).
7d	1134, 1342 (SO_2), 1652 (C=O), 3338 (NH).	2.73 (dd, 1H, C_2-H, *J* = 8.0, 16.3 Hz), 2.91 (dd, 1H, C_2-H, *J* = 6.1, 16.1 Hz), 3.06 (t, 2H, NH-CH_2, *J* = 4.7 Hz), 3.16 (dd, 1H, C_4-H, *J* = 6.4, 13.3 Hz), 3.21 (dd, 1H, C_4-H, *J* = 6.2, 13.6 Hz), 3.62 (t, 2H, CH_2-Cl, *J* = 4.7 Hz), 3.75-3.85 (m, 1H, C_3-H), 7.21-7.72 (m, 9H, Ar-H), 8.56 (bs, 1H, NH).	33.6 (C-3), 38.8 (C-2), 49.8 (NH-CH_2), 53.1 (CH_2-Cl), 55.3 (C-4), 164.8 (CONH), 125.1, 127.1, 128.4, 129.1, 132.9, 137.2 (aromatic carbons).
7e	1139, 1333 (SO_2), 1648 (C=O), 3332 (NH).	2.77 (dd, 1H, C_2-H, *J* = 8.3, 16.5 Hz), 2.91 (dd, 1H, C_2-H, *J* = 6.0, 16.0 Hz), 3.01 (t, 2H, NH-CH_2, *J* = 4.9 Hz), 3.18 (dd, 1H, C_4-H, *J* = 6.5, 13.4 Hz), 3.28 (dd, 1H, C_4-H, *J* = 6.5, 13.5 Hz), 3.52 (t, 2H, CH_2-Cl, *J* = 4.9 Hz), 3.70-3.86 (m, 1H, C_3-H), 7.24-7.76 (m, 8H, Ar-H), 8.50 (bs, 1H, NH).	34.8 (C-3), 39.4 (C-2), 49.1 (NH-CH_2), 53.1 (CH_2-Cl), 55.2 (C-4), 164.9 (CONH), 125.6, 126.8, 127.3, 129.1, 132.7, 139.3 (aromatic carbons).
8a	1131, 1336 (SO_2), 1652 (C=O), 3327 (NH).	2.74 (dd, 1H, C_2-H, *J* = 8.0, 16.3 Hz), 2.99 (dd, 1H, C_2-H, *J* = 6.5, 16.4 Hz), 3.07 (t, 2H, NH-CH_2, *J* = 4.9 Hz), 3.15 (dd, 1H, C_4-H, *J* = 6.0, 13.1 Hz), 3.22 (dd, 1H, C_4-H, *J* = 6.0, 13.8 Hz), 3.58 (t, 2H, CH_2-Cl, *J* = 4.9 Hz), 3.74-3.83 (m, 1H, C_3-H), 4.09 (s, 2H, Ar-CH_2), 7.15-7.63 (m, 10H, Ar-H), 8.62 (bs, 1H, NH).	34.9 (C-3), 39.8 (C-2), 49.6 (NH-CH_2), 52.8 (CH_2-Cl), 55.8 (C-4), 58.9 (Ar-CH_2), 164.4 (CONH), 125.2, 126.1, 127.8, 129.2, 132.4, 137.9 (aromatic carbons).
8b	1129, 1328 (SO_2), 1646 (C=O), 3323 (NH).	2.23 (s, 3H, Ar-CH_3), 2.78 (dd, 1H, C_2-H, *J* = 8.2, 16.6 Hz), 2.95 (dd, 1H, C_2-H, *J* = 6.1, 16.1 Hz), 3.11 (t, 2H, NH-CH_2, *J* = 5.2 Hz), 3.13 (dd, 1H, C_4-H, *J* = 6.3, 13.4 Hz), 3.25 (dd, 1H, C_4-H, *J* = 6.1, 13.9 Hz), 3.61 (t, 2H, CH_2-Cl, *J* = 5.2 Hz), 3.71-3.80 (m, 1H, C_3-H), 3.92 (s, 2H, Ar-CH_2), 7.10-7.61 (m, 9H, Ar-H), 8.69 (bs, 1H, NH).	21.8 (Ar-CH_3), 34.3 (C-3), 39.1 (C-2), 49.0 (NH-CH_2), 52.3 (CH_2-Cl), 55.6 (C-4), 58.3 (Ar-CH_2), 164.5 (CONH), 125.7, 126.6, 127.2, 129.6, 132.8, 137.2 (aromatic carbons).
8c	1125, 1332 (SO_2), 1650 (C=O), 3336 (NH).	2.72 (dd, 1H, C_2-H, *J* = 8.0, 16.3 Hz), 2.92 (dd, 1H, C_2-H, *J* = 6.0, 16.1 Hz), 3.08 (t, 2H, NH-CH_2, *J* = 5.5 Hz), 3.19 (dd, 1H, C_4-H, *J* = 6.1, 13.2 Hz), 3.21 (dd, 1H, C_4-H, *J* = 6.3, 13.7 Hz), 3.64 (t, 2H, CH_2-Cl, *J* = 5.5 Hz), 3.73-3.85 (m, 1H, C_3-H), 3.98 (s, 2H, Ar-CH_2), 7.14-7.73 (m, 9H, Ar-H), 8.63 (bs, 1H, NH).	34.9 (C-3), 38.6 (C-2), 49.8 (NH-CH_2), 52.6 (CH_2-Cl), 55.1 (C-4), 58.8 (Ar-CH_2), 165.1 (CONH), 125.1, 126.9, 127.8, 129.9, 134.8, 138.2 (aromatic carbons).
8d	1131, 1337 (SO_2), 1642 (C=O), 3331 (NH).	2.72 (dd, 1H, C_2-H, *J* = 7.9, 16.1 Hz), 2.91 (dd, 1H, C_2-H, *J* = 6.0, 16.0 Hz), 3.03 (t, 2H, NH-CH_2, *J* = 5.6 Hz), 3.15 (dd, 1H, C_4-H, *J* = 6.3, 13.3 Hz), 3.28 (dd, 1H, C_4-H, *J* = 6.2, 13.7 Hz), 3.67 (t, 2H, CH_2-Cl, *J* = 5.6 Hz), 3.75-3.88 (m, 1H, C_3-H), 3.98 (s, 2H, Ar-CH_2), 7.11-7.79 (m, 9H, Ar-H), 8.61 (bs, 1H, NH).	33.9 (C-3), 39.7 (C-2), 49.2 (NH-CH_2), 52.8 (CH_2-Cl), 56.1 (C-4), 58.8 (Ar-CH_2), 164.9 (CONH), 125.1, 126.2, 127.8, 129.3, 132.1, 137.8 (aromatic carbons).
8e	1134, 1335 (SO_2), 1653 (C=O), 3338 (NH).	2.77 (dd, 1H, C_2-H, *J* = 8.1, 16.4 Hz), 2.93 (dd, 1H, C_2-H, *J* = 6.4, 16.3 Hz), 3.11 (t, 2H, NH-CH_2, *J* = 5.8 Hz), 3.22 (dd, 1H, C_4-H, *J* = 6.6, 13.5 Hz), 3.24 (dd, 1H, C_4-H, *J* = 6.4, 13.7 Hz), 3.76 (t, 2H, CH_2-Cl, *J* = 5.8 Hz), 3.72-3.81 (m, 1H, C_3-H), 3.95 (s, 2H, Ar-CH_2), 7.18-7.84 (m, 8H, Ar-H), 8.72 (bs, 1H, NH).	33.1 (C-3), 39.2 (C-2), 49.8 (NH-CH_2), 52.0 (CH_2-Cl), 56.7 (C-4), 58.1 (Ar-CH_2), 164.2 (CONH), 125.9, 126.7, 127.1, 129.9, 132.8, 137.2 (aromatic carbons).
9a	1130, 1338 (SO_2), 1575 (C=N).	2.74 (dd, 1H, C_1'-H, *J* = 8.0, 16.2 Hz), 2.95 (dd, 1H, C_1'-H, *J* = 6.1, 16.4 Hz), 3.14 (dd, 1H, C_3'-H, *J* = 6.3, 13.2 Hz), 3.24 (dd, 1H, C_3'-H, *J* = 6.4, 13.3 Hz), 3.72-3.80 (m, 1H, C_2'-H), 3.91 (t, 2H, C_4-H *J* = 5.1 Hz), 4.40 (t, 2H, C_5-H, *J* = 5.1 Hz), 7.21-7.74 (m, 10H, Ar-H).	34.5 (C-2'), 39.8 (C-1'), 52.1 (C-4), 54.9 (C-5), 55.6 (C-3'), 161.2 (C-2), 125.2, 126.7, 127.4, 129.0, 132.2, 138.5 (aromatic carbons).

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Table II — Spectral characterization data for **3-14**— *Contd*

Compd	IR Data (cm^{-1})	^{1}H NMR (δ ppm) (*J* in Hz)	^{13}C NMR (δ ppm)
9b	1136, 1333 (SO_2), 1578 (C=N).	2.27 (s, 3H, Ar-CH_3), 2.71 (dd, 1H, C_1'-H, *J* = 7.8, 16.1 Hz), 2.93 (dd, 1H, C_1'-H, *J* = 6.0, 16.2 Hz), 3.16 (dd, 1H, C_3'-H, *J* = 6.2, 13.4 Hz), 3.27 (dd, 1H, C_3'-H, *J* = 6.6, 13.2 Hz), 3.56-3.71 (m, 1H, C_2'-H), 3.92 (t, 2H, C_4-H, *J* = 5.3 Hz), 4.42 (t, 2H, C_5-H *J* = 5.3 Hz), 7.26-7.44 (m, 9H, Ar-H).	21.4 (Ar-CH_3), 34.3 (C-2'), 39.5 (C-1'), 52.6 (C-4), 54.7 (C-5), 55.3 (C-3'), 161.2 (C-2), 125.1, 126.4, 127.6, 129.1, 132.0, 138.1 (aromatic carbons).
9c	1131, 1339 (SO_2), 1584 (C=N).	2.76 (dd, 1H, C_1'-H, *J* = 8.2, 16.3 Hz), 2.98 (dd, 1H, C_1'-H, *J* = 6.2, 16.5 Hz), 3.19 (dd, 1H, C_3'-H, *J* = 6.1, 13.0 Hz), 3.24 (dd, 1H, C_3'-H, *J* = 6.2, 13.1 Hz), 3.59-3.68 (m, 1H, C_2'-H), 3.99 (t, 2H, C_4-H, *J* = 5.5 Hz), 4.46 (t, 2H, C_5-H, *J* = 5.5 Hz), 7.28-7.49 (m, 9H, Ar-H).	34.7 (C-2'), 39.2 (C-1'), 52.3 (C-4), 54.2 (C-5), 55.3 (C-3'), 159.5 (C-2), 125.6, 126.2, 127.8, 129.5, 132.8, 138.9 (aromatic carbons).
9d	1135, 1343 (SO_2), 1580 (C=N).	2.71 (dd, 1H, C_1'-H, *J* = 8.0, 16.2 Hz), 2.92 (dd, 1H, C_1'-H, *J* = 6.2, 16.1 Hz), 3.21 (dd, 1H, C_3'-H, *J* = 6.5, 13.3 Hz), 3.26 (dd, 1H, C_3'-H, *J* = 6.6, 13.5 Hz), 3.55-3.70 (m, 1H, C_2'-H), 4.04 (t, 2H, C_4-H, *J* = 5.6 Hz), 4.41 (t, 2H, C_5-H, *J* = 5.6 Hz), 7.25-7.52 (m, 9H, Ar-H).	33.9 (C-2'), 39.6 (C-1'), 52.7 (C-4), 54.2 (C-5), 55.1 (C-3'), 160.8 (C-2), 125.2, 126.8, 127.3, 129.2, 132.6, 138.6 (aromatic carbons).
9e	1132, 1334 (SO_2), 1585 (C=N).	2.73 (dd, 1H, C_1'-H, *J* = 8.0, 16.1 Hz), 2.90 (dd, 1H, C_1'-H, *J* = 6.0, 16.2 Hz), 3.25 (dd, 1H, C_3'-H, *J* = 6.3, 13.1 Hz), 3.29 (dd, 1H, C_3'-H, *J* = 6.7, 13.8 Hz), 3.73-3.79 (m, 1H, C_2'-H), 3.97 (t, 2H, C_4-H, *J* = 5.3 Hz), 4.45 (t, 2H, C_5-H, *J* = 5.7 Hz), 7.20-7.91 (m, 8H, Ar-H).	34.2 (C-2'), 39.7 (C-1'), 52.7 (C-4), 54.7 (C-5), 55.9 (C-3'), 160.1 (C-2), 125.8, 126.5, 127.3, 129.8, 132.3, 138.2 (aromatic carbons).
10a	1125, 1331 (SO_2), 1565 (C=N).	2.70 (dd, 1H, C_1'-H, *J* = 8.0, 16.1 Hz), 2.95 (dd, 1H, C_1'-H, *J* = 6.3, 16.6 Hz), 3.20 (dd, 1H, C_3'-H, *J* = 6.1, 13.2 Hz), 3.27 (dd, 1H, C_3'-H, *J* = 6.5, 13.8 Hz), 3.70-3.84 (m, 1H, C_2'-H), 3.87 (t, 2H, C_4-H *J* = 5.8 Hz), 3.97 (s, 2H, Ar-CH_2), 4.48 (t, 2H, C_5-H, *J* = 5.8 Hz), 7.19-7.71 (m, 10H, Ar-H).	34.7 (C-2'), 40.2 (C-1'), 52.9 (C-4), 54.1 (C-5), 55.9 (C-3'), 60.7 (Ar-CH_2), 160.6 (C-2), 125.9, 126.4, 127.9, 129.9, 131.8, 138.1 (aromatic carbons).
10b	1132, 1335 (SO_2), 1570 (C=N).	2.29 (s, 3H, Ar-CH_3), 2.75 (dd, 1H, C_1'-H, *J* = 8.0, 16.1 Hz), 2.94 (dd, 1H, C_1'-H, *J* = 6.1, 16.2 Hz), 3.16 (dd, 1H, C_3'-H, *J* = 6.0, 13.2 Hz), 3.24 (dd, 1H, C_3'-H, *J* = 6.3, 13.7 Hz), 3.71-3.78 (m, 1H, C_2'-H), 3.91 (t, 2H, C_4-H *J* = 5.6 Hz), 4.02 (s, 2H, Ar-CH_2), 4.45 (t, 2H, C_5-H, *J* = 5.6 Hz), 7.14-7.70 (m, 9H, Ar-H).	21.5 (Ar-CH_3), 34.9 (C-2'), 40.4 (C-1'), 52.2 (C-4), 54.9 (C-5), 55.2 (C-3'), 60.1 (Ar-CH_2), 161.8 (C-2), 125.2, 126.6, 127.4, 129.5, 131.4, 137.9 (aromatic carbons).
10c	1136, 1337 (SO_2), 1575 (C=N).	2.71 (dd, 1H, C_1'-H, *J* = 7.9, 16.0 Hz), 2.96 (dd, 1H, C_1'-H, *J* = 6.2, 16.3 Hz), 3.13 (dd, 1H, C_3'-H, *J* = 6.0, 13.0 Hz), 3.21 (dd, 1H, C_3'-H, *J* = 6.1, 13.4 Hz), 3.73-3.81 (m, 1H, C_2'-H), 3.88 (t, 2H, C_4-H, *J* = 5.8 Hz), 4.13 (s, 2H, Ar-CH_2), 4.48 (t, 2H, C_5-H, *J* = 5.8 Hz), 7.11-7.77 (m, 9H, Ar-H).	34.2 (C-2'), 40.7 (C-1'), 52.7 (C-4), 54.2 (C-5), 56.1 (C-3'), 60.9 (Ar-CH_2), 161.8 (C-2), 125.9, 126.1, 127.8, 128.4, 129.1, 138.2 (aromatic carbons).
10d	1131, 1340 (SO_2), 1583 (C=N).	2.77 (dd, 1H, C_1'-H, *J* = 8.1, 16.4 Hz), 2.99 (dd, 1H, C_1'-H, *J* = 6.3, 16.6 Hz), 3.19 (dd, 1H, C_3'-H, *J* = 6.1, 13.3 Hz), 3.25 (dd, 1H, C_3'-H, *J* = 6.4, 13.5 Hz), 3.70-3.86 (m, 1H, C_2'-H), 3.96 (t, 2H, C_4-H, *J* = 5.7 Hz), 4.06 (s, 2H, Ar-CH_2), 4.37 (t, 2H, C_5-H, *J* = 5.7 Hz), 7.16-7.81 (m, 9H, Ar-H).	35.3 (C-2'), 41.4 (C-1'), 52.1(C-4), 55.4 (C-5), 56.9 (C-3'), 59.4 (Ar-CH_2), 159.9 (C-2), 124.7, 126.7, 127.1, 128.9, 129.7, 138.4 (aromatic carbons).
10e	1132, 1334 (SO_2), 1581 (C=N).	2.74 (dd, 1H, C_1'-H, *J* = 8.0, 16.2 Hz), 2.93 (dd, 1H, C_1'-H, *J* = 6.2, 16.4 Hz), 3.16 (dd, 1H, C_3'-H, *J* = 6.0, 13.1 Hz), 3.22 (dd, 1H, C_3'-H, *J* = 6.1, 13.2 Hz), 3.72-3.88 (m, 1H, C_2'-H), 3.93 (t, 2H, C_4-H, *J* = 5.7 Hz), 4.01 (s, 2H, Ar-CH_2), 4.29 (t, 2H, C_5-H, *J* = 5.7 Hz), 7.10-7.89 (m, 8H, Ar-H).	35.9 (C-2'), 40.9 (C-1'), 52.8(C-4), 54.9 (C-5), 57.4 (C-3'), 60.5 (Ar-CH_2), 161.4 124.2, 126.9, 127.0, 128.1, 129.4, 139.6 (aromatic carbons).
11a	1137, 1339 (SO_2), 1645 (C=N), 3325, 3332 (NH_2).	2.71 (dd, 1H, C_2-H, *J* = 7.8, 16.1 Hz), 2.93 (dd, 1H, C_2-H, *J* = 6.0, 16.0 Hz), 3.14 (dd, 1H, C_4-H, *J* = 6.2, 13.3 Hz), 3.22 (dd, 1H, C_4-H, *J* = 5.9, 13.5 Hz), 3.33 (t, 2H, CH_2-NH_2, *J* = 4.7 Hz), 3.58 (t, 2H, S-CH_2, *J* = 4.7 Hz), 3.76-3.80 (m, 1H, C_3-H), 5.73 (bs, 2H, NH_2), 7.11-7.62 (m, 10H, Ar-H).	35.7 (C-3), 39.3 (C-2), 49.1 (CH_2-NH_2), 51.7 (S-CH_2), 55.3 (C-4), 164.1 (CO), 125.0, 126.8, 127.3, 129.6, 132.7, 138.8 (aromatic carbons).
11b	1129, 1334 (SO_2), 1651 (C=O), 3319, 3339 (NH_2).	2.25 (s, Ar-CH_3), 2.75 (dd, 1H, C_2-H, *J* = 7.6, 16.2 Hz), 2.91 (dd, 1H, C_2-H, *J* = 5.9, 16.0 Hz), 3.16 (dd, 1H, C_4-H, *J* = 6.1, 13.4 Hz), 3.26 (dd, 1H, C_4-H, *J* = 6.2, 13.7 Hz), 3.36 (t, 2H, CH_2-NH_2, *J* = 5.1 Hz), 3.54 (t, 2H, S-CH_2, *J* = 5.1 Hz), 3.74-3.77 (m, 1H, C_3-H), 5.64 (bs, 2H, NH_2), 7.16-7.93 (m, 9H, Ar-H).	21.9 (Ar-CH_3), 35.2 (C-3), 39.8 (C-2), 49.5 (CH_2-NH_2), 51.3 (S-CH_2), 55.0 (C-4), 164.7 (CO), 125.5, 126.2, 127.4, 129.2, 132.3, 137.7 (aromatic carbons).

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Table II — Spectral characterization data for **3-14**— *Contd*

Compd	IR Data (cm^{-1})	^1H NMR (δ ppm) (*J* in Hz)	^{13}C NMR (δ ppm)
11c	1133, 1331 (SO_2), 1658 (C=O), 3331, 3345 (NH_2).	2.71 (dd, 1H, C_2-H, *J* = 7.4, 16.1 Hz), 2.94 (dd, 1H, C_2-H, *J* = 6.0, 16.3 Hz), 3.14 (dd, 1H, C_4-H, *J* = 6.0, 13.1 Hz), 3.28 (dd, 1H, C_4-H, *J* = 6.1, 13.8 Hz), 3.39 (t, 2H, C*H*$_2$-NH_2, *J* = 5.1 Hz), 3.50 (t, 2H, S-CH_2, *J* = 5.0 Hz), 3.71-3.81 (m, 1H, C_3-H), 5.61 (bs, 2H, NH_2), 7.11-7.98 (m, 9H, Ar-H).	35.9 (C-3), 39.2 (C-2), 49.9 (CH_2-NH_2), 50.8 (S-CH_2), 55.7 (C-4), 164.1 (CO), 125.7, 126.9, 127.0, 128.7, 132.8, 137.1 (aromatic carbons).
11d	1131, 1342 (SO_2), 1655 (C=O), 3328, 3337 (NH_2).	2.78 (dd, 1H, C_2-H, *J* = 7.7, 16.4 Hz), 2.90 (dd, 1H, C_2-H, *J* = 6.0, 16.2 Hz), 3.19 (dd, 1H, C_4-H, *J* = 6.1, 13.3 Hz), 3.24 (dd, 1H, C_4-H, *J* = 6.2, 13.4 Hz), 3.31 (t, 2H, C*H*$_2$-NH_2, *J* = 5.1 Hz), 3.57 (t, 2H, S-CH_2, *J* = 5.1 Hz), 3.70-3.78 (m, 1H, C_3-H), 5.59 (bs, 2H, NH_2), 7.22-7.98 (m, 9H, Ar-H).	35.6 (C-3), 39.4 (C-2), 49.7 (CH_2-NH_2), 51.6 (S-CH_2), 55.4 (C-4), 164.5 (CO), 125.2, 126.9, 127.5, 129.9, 132.9, 138.6 (aromatic carbons).
11e	1139, 1336 (SO_2), 1646 (C=O), 3323, 3342 (NH_2).	2.75 (dd, 1H, C_2-H, *J* = 7.9, 16.6 Hz), 2.93 (dd, 1H, C_2-H, *J* = 6.2, 16.1 Hz), 3.15 (dd, 1H, C_4-H, *J* = 6.0, 13.2 Hz), 3.21 (dd, 1H, C_4-H, *J* = 6.1, 13.2 Hz), 3.35 (t, 2H, C*H*$_2$-NH_2, *J* = 5.3 Hz), 3.59 (t, 2H, S-CH_2, *J* = 5.3 Hz), 3.72-3.79 (m, 1H, C_3-H), 5.51 (bs, 2H, NH_2), 7.28-7.91 (m, 8H, Ar-H).	35.1 (C-3), 38.9 (C-2), 49.2 (CH_2-NH_2), 51.4 (S-CH_2), 55.9 (C-4), 164.8 (CO), 125.9, 126.2, 127.8, 129.2, 132.6, 138.1 (aromatic carbons).
12a	1125, 1330 (SO_2), 1645 (C=O), 3321, 3333 (NH_2).	2.74 (dd, 1H, C_2-H, *J* = 7.9, 16.3 Hz), 2.92 (dd, 1H, C_2-H, *J* = 6.3, 16.4 Hz), 3.17 (dd, 1H, C_4-H, *J* = 6.3, 13.5 Hz), 3.20 (dd, 1H, C_4-H, *J* = 5.9, 13.6 Hz), 3.42 (t, 2H, C*H*$_2$-NH_2, *J* = 5.5 Hz), 3.62 (t, 2H, S-CH_2, *J* = 5.5 Hz), 3.70-3.84 (m, 1H, C_3-H), 3.99 (s, 2H, Ar-CH_2), 5.57 (bs, 2H, NH_2), 7.14-7.66 (m, 10H, Ar-H).	35.1 (C-3), 40.5 (C-2), 50.6 (CH_2-NH_2), 51.1 (S-CH_2), 55.9 (C-4), 59.6 (Ar-CH_2), 164.9 (CO), 124.6, 125.9, 126.1, 127.7, 129.6, 136.8 (aromatic carbons).
12b	1122, 1335 (SO_2), 1656 (C=O), 3327, 3338 (NH_2).	2.24 (s, 3H, Ar-CH_3), 2.70 (dd, 1H, C_2-H, *J* = 7.3, 16.0 Hz), 2.90 (dd, 1H, C_2-H, *J* = 6.1, 16.2 Hz), 3.13 (dd, 1H, C_4-H, *J* = 6.2, 13.8 Hz), 3.23 (dd, 1H, C_4-H, *J* = 5.7, 13.7 Hz), 3.46 (t, 2H, C*H*$_2$-NH_2, *J* = 5.6 Hz), 3.67 (t, 2H, S-CH_2, *J* = 5.6 Hz), 3.72-3.87 (m, 1H, C_3-H), 3.94 (s, 2H, Ar-CH_2), 5.52 (bs, 2H, NH_2), 7.12-7.62 (m, 9H, Ar-H).	21.4 (Ar-CH_3), 35.8 (C-3), 40.1 (C-2), 50.2 (CH_2-NH_2), 51.7 (S-CH_2), 55.2 (C-4), 59.0 (Ar-CH_2), 164.2 (CO), 124.2, 125.3, 126.8, 127.2, 129.8, 136.7 (aromatic carbons).
12c	1132, 1338 (SO_2), 1652 (C=O), 3335, 3341 (NH_2).	2.72 (dd, 1H, C_2-H, *J* = 7.7, 16.2 Hz), 2.98 (dd, 1H, C_2-H, *J* = 6.2, 16.5 Hz), 3.17 (dd, 1H, C_4-H, *J* = 6.3, 13.5 Hz), 3.29 (dd, 1H, C_4-H, *J* = 6.2, 13.9 Hz), 3.39 (t, 2H, C*H*$_2$-NH_2, *J* = 5.3 Hz), 3.51 (t, 2H, S-CH_2, *J* = 5.3 Hz), 3.72-3.84 (m, 1H, C_3-H), 3.89 (s, 2H, Ar-CH_2), 5.51 (bs, 2H, NH_2), 7.14-7.77 (m, 9H, Ar-H).	36.2 (C-3), 41.9 (C-2), 51.5 (CH_2-NH_2), 52.9 (S-CH_2), 55.8 (C-4), 60.4 (Ar-CH_2), 165.0 (CO), 124.1, 125.9, 126.3, 128.6, 129.4, 139.3 (aromatic carbons).
12d	1129, 1341 (SO_2), 1657 (C=O), 3330, 3335 (NH_2).	2.75 (dd, 1H, C_2-H, *J* = 7.9, 16.4 Hz), 2.92 (dd, 1H, C_2-H, *J* = 6.1, 16.2 Hz), 3.14 (dd, 1H, C_4-H, *J* = 6.1, 13.3 Hz), 3.26 (dd, 1H, C_4-H, *J* = 6.0, 13.7 Hz), 3.34 (t, 2H, C*H*$_2$-NH_2, *J* = 5.5 Hz), 3.57 (t, 2H, S-CH_2, *J* = 5.5 Hz), 3.70-3.89 (m, 1H, C_3-H), 3.83 (s, 2H, Ar-CH_2), 5.59 (bs, 2H, NH_2), 7.16-7.81 (m, 9H, Ar-H).	36.8 (C-3), 41.2 (C-2), 51.9 (CH_2-NH_2), 52.3 (S-CH_2), 55.5 (C-4), 60.0 (Ar-CH_2), 165.8 (CO), 124.8, 125.2, 126.6, 128.2, 129.1, 138.6 (aromatic carbons).
12e	1133, 1332 (SO_2), 1649 (C=O), 3329, 3340 (NH_2).	2.76 (dd, 1H, C_2-H, *J* = 7.8, 16.3 Hz), 2.95 (dd, 1H, C_2-H, *J* = 6.1, 16.3 Hz), 3.22 (dd, 1H, C_4-H, *J* = 6.5, 13.6 Hz), 3.21 (dd, 1H, C_4-H, *J* = 6.0, 13.4 Hz), 3.36 (t, 2H, C*H*$_2$-NH_2, *J* = 5.4 Hz), 3.58 (t, 2H, S-CH_2, *J* = 5.4 Hz), 3.63-3.81 (m, 1H, C_3-H), 3.94 (s, 2H, Ar-CH_2), 5.58 (bs, 2H, NH_2), 7.16-7.89 (m, 8H, Ar-H).	36.4 (C-3), 41.7 (C-2), 51.2 (CH_2-NH_2), 52.2 (S-CH_2), 55.6 (C-4), 59.8 (Ar-CH_2), 164.6 (CO), 124.1, 125.6, 126.2, 128.8, 129.3, 139.6 (aromatic carbons).
13a	1132, 1334 (SO_2), 1560 (C=N)	2.79 (dd, 1H, C_1'-H, *J* = 8.1, 16.3 Hz), 2.98 (dd, 1H, C_1'-H, *J* = 6.3, 16.6 Hz), 3.17 (dd, 1H, C_3'-H, *J* = 6.5, 13.4 Hz), 3.22 (dd, 1H, C_3'-H, *J* = 6.3, 13.3 Hz), 3.42 (t, 2H, C_5-H, *J* = 7.7 Hz), 3.71-3.82 (m, 1H, C_2'-H), 4.13 (t, 2H, C_4-H, *J* = 7.7 Hz), 7.23-7.78 (m, 10H, Ar-H).	29.1 (C-5), 35.6 (C-2'), 39.9 (C-1'), 53.9 (C-4), 55.5 (C-3'), 159.5 (C-2), 125.6, 126.4, 127.3, 129.6, 132.4, 138.9 (aromatic carbons).
13b	1136, 1345 (SO_2), 1562 (C=N).	2.28 (s, Ar-CH_3), 2.72 (dd, 1H, C_1'-H, *J* = 7.9, 16.0 Hz), 2.94 (dd, 1H, C_1'-H, *J* = 6.1, 16.4 Hz), 3.16 (dd, 1H, C_3'-H, *J* = 6.4, 13.4 Hz), 3.25 (dd, 1H, C_3'-H, *J* = 6.2, 13.6 Hz), 3.48 (t, 2H, C_5-H, *J* = 7.9 Hz), 3.73-3.80 (m, 1H, C_2'-H), 4.44 (t, 2H, C_4-H, *J* = 7.9 Hz), 7.20-7.81 (m, 9H, Ar-H).	22.6 (Ar-CH_3), 29.6 (C-5), 34.5 (C-2'), 39.8 (C-1'), 53.5 (C-4), 55.4 (C-3'), 158.7 (C-2), 125.9, 126.2, 127.6, 129.9, 132.3, 138.4 (aromatic carbons).

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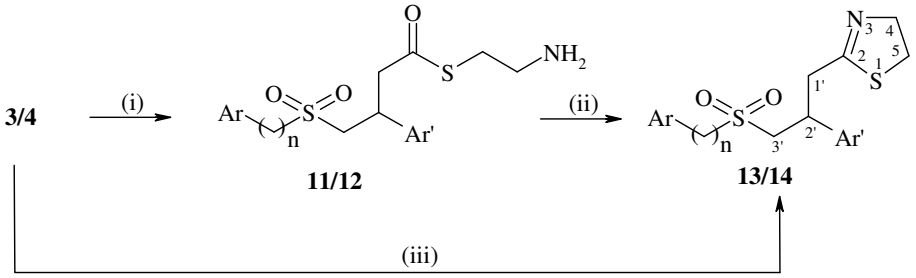
Table II — Spectral characterization data for **3-14**— *Contd*

Compd	IR Data (cm^{-1})	^1H NMR (δ ppm) (*J* in Hz)	^{13}C NMR (δ ppm)
13c	1137, 1339 (SO_2), 1558 (C=N).	2.77 (dd, 1H, C_1'-H, *J* = 8.0, 16.1 Hz), 2.92 (dd, 1H, C_1'-H, *J* = 6.0, 16.4 Hz), 3.13 (dd, 1H, C_3'-H, *J* = 6.2, 13.3 Hz), 3.27 (dd, 1H, C_3'-H, *J* = 6.3, 13.4 Hz), 3.35 (t, 2H, C_5-H, *J* = 8.1 Hz), 3.70-3.85 (m, 1H, C_2'-H), 4.18 (t, 2H, C_4-H, *J* = 8.1 Hz), 7.21-7.87 (m, 9H, Ar-H).	29.9 (C-5), 35.1 (C-2'), 39.1 (C-1'), 53.4 (C-4), 55.8 (C-3'), 158.1 (C-2), 125.8, 126.7, 127.2, 129.4, 132.4, 139.4 (aromatic carbons).
13d	1140, 1344 (SO_2), 1565 (C=N).	2.74 (dd, 1H, C_1'-H, *J* = 8.0, 16.2 Hz), 2.95 (dd, 1H, C_1'-H, *J* = 6.0, 16.6 Hz), 3.07 (dd, 1H, C_3'-H, *J* = 6.0, 13.1 Hz), 3.23 (dd, 1H, C_3'-H, *J* = 6.1, 13.3 Hz), 3.38 (t, 2H, C_5-H, *J* = 8.0 Hz), 3.72-3.86 (m, 1H, C_2'-H), 4.12 (t, 2H, C_4-H, *J* = 8.0 Hz), 7.20-7.83 (m, 9H, Ar-H).	29.5 (C-5), 34.3 (C-2'), 39.2 (C-1'), 53.1 (C-4), 55.9 (C-3'), 158.6 (C-2), 125.9, 126.3, 127.9, 129.6, 132.7, 139.3 (aromatic carbons).
13e	1131, 1335 (SO_2), 1554 (C=N).	2.72 (dd, 1H, C_1'-H, *J* = 8.3, 16.3 Hz), 2.93 (dd, 1H, C_1'-H, *J* = 6.1, 16.2 Hz), 3.10 (dd, 1H, C_3'-H, *J* = 6.1, 13.1 Hz), 3.24 (dd, 1H, C_3'-H, *J* = 6.2, 13.2 Hz), 3.31 (t, 2H, C_5-H, *J* = 8.2 Hz), 3.74-3.83 (m, 1H, C_2'-H), 4.16 (t, 2H, C_4-H, *J* = 8.2 Hz), 7.26-7.89 (m, 8H, Ar-H).	29.2 (C-5), 35.8 (C-2'), 39.3 (C-1'), 53.6 (C-4), 55.8 (C-3'), 157.7 (C-2), 125.3, 126.1, 127.3, 129.6, 132.9, 139.9 (aromatic carbons).
14a	1138, 1337 (SO_2), 1555 (C=N).	2.78 (dd, 1H, C_1'-H, *J* = 8.4, 16.4 Hz), 2.93 (dd, 1H, C_1'-H, *J* = 6.3, 16.5 Hz), 3.12 (dd, 1H, C_3'-H, *J* = 6.3, 13.1 Hz), 3.20 (dd, 1H, C_3'-H, *J* = 6.4, 13.3 Hz), 3.48 (t, 2H, C_5-H, *J* = 8.5 Hz), 3.74-3.89 (m, 1H, C_2'-H), 3.94 (s, Ar-CH_2), 4.04 (t, 2H, C_4-H, *J* = 8.1 Hz), 7.21-7.76 (m, 10H, Ar-H).	29.7 (C-5), 34.3 (C-2'), 39.7 (C-1'), 54.3 (C-4), 56.4 (C-3'), 60.6 (Ar-CH_2), 158.1 (C-2), 126.1, 127.4, 128.6, 129.9, 132.2, 137.4 (aromatic carbons).
14b	1131, 1341 (SO_2), 1560 (C=N).	2.28 (s, 3H, Ar-CH_3), 2.69 (dd, 1H, C_1'-H, *J* = 7.7, 16.1 Hz), 2.96 (dd, 1H, C_1'-H, *J* = 6.3, 16.3 Hz), 3.15 (dd, 1H, C_3'-H, *J* = 6.0, 13.0 Hz), 3.23 (dd, 1H, C_3'-H, *J* = 6.2, 13.4 Hz), 3.42 (t, 2H, C_5-H, *J* = 8.4 Hz), 3.70-3.86 (m, 1H, C_2'-H), 3.95 (s, Ar-CH_2), 4.12 (t, 2H, C_4-H, *J* = 8.4 Hz), 7.19-7.72 (m, 9H, Ar-H).	21.9 (Ar-CH_3), 29.3 (C-5), 34.9 (C-2'), 39.1 (C-1'), 54.0 (C-4), 57.1 (C-3'), 59.2 (Ar-CH_2), 159.6 (C-2), 126.9, 127.7, 128.1, 129.3, 132.9, 138.7 (aromatic carbons).
14c	1136, 1344 (SO_2), 1556 (C=N).	2.73 (dd, 1H, C_1'-H, *J* = 7.8, 16.1 Hz), 2.94 (dd, 1H, C_1'-H, *J* = 6.4, 16.5 Hz), 3.18 (dd, 1H, C_3'-H, *J* = 6.6, 13.4 Hz), 3.27 (dd, 1H, C_3'-H, *J* = 6.7, 13.5 Hz), 3.72-3.89 (m, 1H, C_2'-H), 3.49 (t, 2H, C_5-H, *J* = 8.3 Hz), 3.91 (s, Ar-CH_2), 4.16 (t, 2H, C_4-H, *J* = 8.3 Hz), 7.15-7.83 (m, 9H, Ar-H).	29.9 (C-5), 35.2 (C-2'), 38.7 (C-1'), 54.7 (C-4), 57.3 (C-3'), 60.3 (Ar-CH_2), 158.9 (C-2), 126.5, 127.9, 128.3, 131.1, 132.6, 139.1 (aromatic carbons).
14d	1144, 1342 (SO_2), 1562 (C=N).	2.75 (dd, 1H, C_1'-H, *J* = 8.0, 16.2 Hz), 2.92 (dd, 1H, C_1'-H, *J* = 6.1, 16.0 Hz), 3.20 (dd, 1H, C_3'-H, *J* = 6.7, 13.6 Hz), 3.25 (dd, 1H, C_3'-H, *J* = 6.5, 13.3 Hz), 3.46 (t, 2H, C_5-H, *J* = 8.5 Hz), 3.68-3.87 (m, 1H, C_2'-H), 3.99 (s, Ar-CH_2), 4.17 (t, 2H, C_4-H, *J* = 8.3 Hz), 7.13-7.87 (m, 9H, Ar-H).	30.2 (C-5), 35.8 (C-2'), 38.5 (C-1'), 54.2 (C-4), 57.9 (C-3'), 60.8 (Ar-CH_2), 168.5 (C-2), 126.1, 127.5, 128.9, 129.2, 132.9, 139.8 (aromatic carbons).
14e	1135, 1338 (SO_2), 1550 (C=N).	2.77 (dd, 1H, C_1'-H, *J* =8.2, 16.3 Hz), 2.99 (dd, 1H, C_1'-H, *J* = 6.4, 16.6 Hz), 3.24 (dd, 1H, C_3'-H, *J* = 6.6, 13.7 Hz), 3.29 (dd, 1H, C_3'-H, *J* = 6.7, 13.5 Hz), 3.48 (t, 2H, C_5-H, *J* = 7.5 Hz), 3.72-3.89 (m, 1H, C_2'-H), 3.96 (s, Ar-CH_2), 4.10 (t, 2H, C_4-H, *J* = 7.5 Hz), 7.11-7.92 (m, 8H, Ar-H).	30.9 (C-5), 35.6 (C-2'), 39.1 (C-1'), 54.8 (C-4), 57.2 (C-3'), 60.1 (Ar-CH_2), 158.2 (C-2), 126.4, 127.4, 128.2, 129.7, 132.1, 139.3 (aromatic carbons).

protons adjacent to NH and OH in addition to signals due to other methylene, methine protons. Besides a broad singlet was observed at δ 8.51 (**5a**) and 8.57 ppm (**6a**) for NH proton which was disappeared on deuteration. (**Table II**). Chlorination of **5** and **6** with thionyl chloride produced 3-aryl-*N*-(2-chloroethyl)-4-(arylsulfonyl)butanamide **7** and 3-aryl-*N*-(2-chloroethyl)-4-(arylmethanesulfonyl)butanamide **8** (**Scheme I** and **Table I**). The IR spectra of **7** and **8** exhibited absorption bands in the regions at 1645-1655 (C=O), 3325-3340 (NH) and 1120-1145 cm^{-1} (SO_2). The ^1H NMR spectra of **7a** and **8a** showed two triplets at δ 3.10, 3.64 and 3.07, 3.58 due to methylene protons adjacent to NH and Cl apart from signals due to other protons. The compounds **7** and **8** when subjected to base promoted cyclization with sodium hydride in tetrahydrofuran gave 4,5-dihydro-2-(2'-aryl-3'-(arylsulfonyl)propyl)oxazole **9** and 4,5-dihydro-2-(2'-aryl-3'-(arylmethanesulfonyl)propyl)-oxazole **10** (**Scheme I** and **Table I**). The ester functionality in **3** and **4** was also used to develop thiazoline ring. Thus, the reaction of **3** and **4** with 2-aminoethanethiol in the presence of sodium methoxide in methanol yielded 3-aryl-*S*-(2-aminoethyl)-4-(arylsulfonyl)butanethioate **11**



n = 0 (3,11,13)
n = 1 (4,12,14)

Ar	Ar'
a) Ph	Ph
b) Ph	4-Me.Ph
c) Ph	4-Cl.Ph
d) 4-Cl.Ph	Ph
e) 4-Cl.Ph	4-Cl.Ph

(i) $NH_2CH_2CH_2SH$ / NaOMe / MeOH
(ii) NaH / THF
(iii) $NH_2CH_2CH_2SH$ / $Sm(III)Cl_3$ / *n*-BuLi / Toluene

Scheme II

and 3-aryl-*S*-(2-aminoethyl)-4-(arylmethanesulfonyl)-butanethioate **12** (**Scheme II** and **Table I**). The IR spectra of **11** and **12** displayed bands in the regions 1125-1140, 1330-1345 (SO_2), 1645-1660 (C=O) and 3320-3335, 3330-3345 cm^{-1} (NH_2) (**Scheme II** and **Table II**). In the ^1H NMR spectra of **11a** and **12a** two triplets were observed at δ 3.33, 3.58 and 3.39, 3.62 due to methylene protons adjacent to NH_2 and S, respectively, besides signals due to other protons. In addition to these, a broad singlet was observed at δ 5.73 and 5.57 for NH_2 protons in **11a** and **12a** which was disappeared on deuteration (**Table II**). The cyclocondensation of **11** and **12** with sodium hydride in tetrahydrofuran resulted in 4,5-dihydro-2-(2'-aryl-3'-arylsulfonyl)-propyl)thiazole **13** and 4,5-dihydro-2-(2'-aryl-3'-arylmethanesulfonyl)propyl)thiazole **14** (**Scheme II**).

However, the use of lanthanide (III) compounds as catalysts or promoters in organic synthesis is of recent origin. We have adopted one pot methodology to get oxazolines and thiazolines using samarium (III) chloride as catalyst. The reaction of **3** and **4** with 2-aminoethanol and *n*-butyllithium in the presence of 5-10% molar equivalent of anhydrous $SmCl_3$ in toluene produced 4,5-dihydro-2-(2'-aryl-3'-arylsulfonyl)propyl)oxazole **9** and 4,5-dihydro-2-(2'-aryl-3'-arylmethanesulfonyl)propyl)oxazole **10** (**Scheme I**). The IR spectra of **9** and **10** showed absorption bands in the regions 1125-1140, 1330-1345 (SO_2) and 1565-1585 cm^{-1} (C=N) (**Table II**). The ^1H NMR spectra of **9a** and **10a** exhibited two triplets at δ 3.91, 4.40 and 3.87 4.48 for C_4-H and C_5-H of 2-oxazoline. Apart from these, four doublet of doublets (dd) at 2.74, 2.95 (C_1'-H), 3.14, 3.24 (C_3'-H) and a multiplet at 3.72-3.80 ppm (C_2'-H) were observed in **9a** whereas at 2.70, 2.95 (C_1'-H), 3.20, 3.27 (C_3'-H) and 3.70-3.84 ppm (C_2'-H) in **10a**. Besides, **10a** showed another singlet at 3.92 ppm (Ph-CH_2). The ^{13}C NMR spectra of **9a** and **10a** displayed signals at δ 34.5 (C-2'), 39.8 (C-1'), 52.1 (C-4), 54.9 (C-5), 55.6 (C-3'), 161.2 (C-2) and 34.7 (C-2'), 40.2 (C-1'), 52.9 (C-4), 54.2 (C-5), 55.9 (C-3'), 60.7 (Ar-CH_2), 160.6 (C-2) (**Table II**).

Adopting similar methodology, the reaction of **3** and **4** was carried out with 2-aminoethanethiol and *n*-butyllithium complexed with a suspension of 5-10% molar equivalent of anhydrous $SmCl_3$ in toluene to give 4,5-dihydro-2-(2'-aryl-3'-arylsulfonylpropyl)thiazole **13** and 4,5-dihydro-2-(2'-aryl-3'-arylmethanesulfonylpropyl)-thiazole **14** (**Scheme II**). The IR spectra of **13** and **14** exhibited absorption bands in the regions 1130-1145, 1335-1345 (SO_2) and 1550-1565 cm^{-1} (C=N) (**Table II**). The ^1H NMR spectra of **13a** and **14a** displayed two triplets at δ 4.13, 3.42 and 4.04, 3.48 for C_4-H and C_5-H of 2-thiazoline ring, apart from four doublet of doublets (dd) and a multiplet at 2.79, 2.98 (C_1'-H), 3.17, 3.22 (C_3'-H), 3.71-3.82 ppm (C_2'-H) in **13a** and 2.78, 2.93 (C_1'-H), 3.12, 3.20 (C_3'-H), 3.74-3.89 (C_2'-H) in **14a**. In addition to these, **14a** showed a sharp singlet at δ 3.94 due to benzylic protons. The ^{13}C NMR spectra of **13a** and **14a** showed signals at δ 29.1 (C-5), 35.6 (C-2'), 39.9 (C-1'), 53.9 (C-4), 55.8 (C-3'), 159.5 (C-2) and 29.7 (C-5), 34.3 (C-2'), 39.7 (C-1'), 54.3 (C-4), 56.4 (C-3'), 60.6 (Ar-CH_2), 158.1 (C-2) (**Table II**).

The 2-oxazolines and 2-thiazolines were developed from the corresponding esters adopting multistep methodology and also one-pot methodology using samarium (III) chloride as catalyst.

Experimental Section

Melting points were determined in open capillaries on a Mel-Temp apparatus and are uncorrected. The purity of the compounds was checked by TLC (silica gel H, BDH, ethyl acetate/hexane, 1:3). The IR spectra were recorded on a Thermo Nicolet FT-IR 200 spectrometer as KBr pellets and the wave numbers were given in cm^{-1}. The ^1H NMR spectra were recorded in $CDCl_3$ / DMSO-d_6 on a Varian EM-360 spectrometer (300 MHz). The ^{13}C NMR spectra were recorded in $CDCl_3$ / DMSO-d_6 on a Varian VXR spectrometer operating at 75.5 MHz. All chemical shifts were reported in δ (ppm) using TMS as an internal standard. The microanalyses were performed on a Perkin-Elmer 240C elemental analyzer. The synthetic intermediates methyl-4-arylsulfonyl-3-arylbutyrate **3** and methyl-4-arylmethanesulfonyl-3-arylbutyrate **4** were prepared by the literature procedure[17].

General procedure for the synthesis of 3-aryl-*N*-(2-hydroxyethyl)-4-(arylsulfonyl)-butanamide 5/3-aryl-*N*-(2-hydroxyethyl)-4-(arylmethanesulfonyl)-butanamide 6

A mixture of **3/4** (0.01 mole), aminoethanol (0.01 mole), methanol (5 mL), and NaOMe (1 mL) were refluxed for 7-10 hr. The solution was concentrated, cooled and poured onto crushed ice. The solid separated was filtered, dried and crystallized from methanol.

General procedure for the synthesis of 3-aryl-*N*-(2-chloroethyl)-4-(arylsulfonyl)-butanamide 7/3-aryl-*N*-(2-chloroethyl)-4-(arylmethanesulfonyl)butanamide 8

The compound **5/6** (0.01 mole) in methanol (10 mL) was taken and to this thionyl chloride (0.015 mole) was added slowly. The contents were refluxed for 11-13 hr. It was cooled and poured into crushed ice. The solid separated was filtered, dried and crystallized from methanol.

General procedure for the synthesis of 4,5-dihydro-2-(2'-aryl-3'-(arylsulfonyl)-propyl)oxazole 9 /4,5-dihydro-2-(2'-aryl-3'-(arylmethanesulfonyl)-propyl)oxazole 10

To a solution of **7/8** (0.001 mole) in tetrahydrofuran (3 mL), a catalytic amount of sodium hydride was added and refluxed for 4-7 hr. The reaction-mixture was allowed to attain RT and poured onto crushed ice. The solid obtained was filtered, dried and crystallized from methanol.

General procedure for the synthesis of 3-aryl-*S*-(2-aminoethyl)-4-(arylsulfonyl)-butanethioate 11/3-aryl-*S*-(2-aminoethyl)-4-(arylmethanesulfonyl)butanethioate 12

A mixture of **3/4** (0.001 mole), aminoethanethiol (0.0015 mole), methanol (5 mL) and NaOMe (0.5 mL) were refluxed for 3-5 hr. The solution was cooled and poured onto crushed ice. The solid separated was filtered, dried and crystallized from methanol.

General procedure for the synthesis of 4,5-dihydro-2-(2'-aryl-3'-arylsulfonyl)-propyl)thiazole 13/4,5-dihydro-2-(2'-aryl-3'-(arylmethanesulfonyl)-propyl) thiazole 14

To a solution of **11/12** (0.002 mole) in tetrahydrofuran (6 mL), a catalytic amount of sodium hydride was added and refluxed for 7-10 hr. The reaction-mixture was concentrated, cooled and poured onto crushed ice. The solid obtained was filtered, dried and crystallized from methanol.

General procedure for the synthesis of 4,5-dihydro-2-(2'-aryl-3'-(arylsulfonyl)-propyl)oxazole 9/4,5-dihydro-2-(2'-aryl-3'-(arylmethanesulfonyl)-propyl) oxazole 10 by using samarium(III) chloride

To a flask charged with anhydrous samarium(III)-chloride (0.0001 mole) and dry toluene (10 mL), 2-aminoethanol (0.002 mole) was added followed by *n*-butyllithium (0.0022 mole) at 0^oC. The reaction-mixture was stirred at 0^oC for 30 min. and heated to reflux. To this, methyl 4-arylsulfonyl-3-arylbutyrate (0.001mole)/methyl 4-arylmethanesulfonyl-3-arylbutyrate **3/4** was added to the contents and continued the refluxion for an additional period of 6-9 hr. The suspension was cooled to RT and filtered. The filtrate was extracted with chloroform, washed with water followed by brine solution. The solvent was removed *in vacuo*. The solid obtained was purified by column chromatography (silica gel, ethyl acetate: hexane-1:3).

General procedure for the synthesis of 4,5-dihydro-2-(2'-aryl-3'-arylsulfonyl)-propyl)thiazole 13/4,5-dihydro-2-(2'-aryl-3'-arylmethanesulfonyl)-propyl) thiazole 14 by using samarium(III) chloride

A mixture of 2-aminoethanethiol (0.002 mole) and *n*-butyllithium (0.0022 mole) at 0°C was added to a flask charged with anhydrous samarium(III)chloride (0.0001 mole) and dry toluene (10 mL). The reaction-mixture was stirred at 0°C for 30 min. and then heated to reflux. To this, methyl-4-arylsulfonyl-3-arylbutyrate/methyl-4-arylmethanesulfonyl-3-arylbutyrate (0.001 mole) **3/4** was added and continued the refluxion for an additional period of 10-12 hr. The suspension was cooled to RT and filtered. The filtrate was extracted with chloroform, washed with water followed by brine solution. The solvent was removed under reduced pressure. The resultant compound was purified by column chromatography (silica gel, ethyl acetate: hexane-1:2.5).

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