Synthesis of Benzo[*b*]thiophene Carboxamides Connected to 4-Arylpiperazines through a Benzylic Spacer: Potential Ligands with 5-HT_{1A} Binding Affinity

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Abstract: New benzothiophene arylpiperazine derivatives **8** (**a**–**f**) were synthesized as potential serotoninergic agents with 5-HT_{1A} receptor affinity. Preparation of the derivatives was performed by treating *N*-[2-(chloromethyl)phenyl]-4,7-dimethoxybenzo[*b*]thiophene-2-carboxamide (**7**) with a series of substituted 4-arylpiperazines.

Keywords: arylpiperazines, benzothiophene, depression, 5-HT_{1A}

INTRODUCTION

The long-chain arylpiperazine derivatives provide one of the most universal templates used for designing CNS-active agents, representing the main pharmacophoric fragment recognized for serotonergic, dopaminergic, and adrenergic

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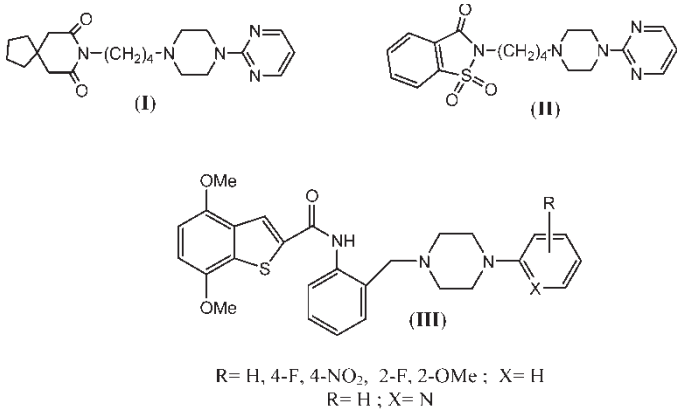


Figure 1. Buspirone(**I**), Ipsapirone(**II**), and Benzo[*b*]thiophene carboxamide derivatives (**III**)

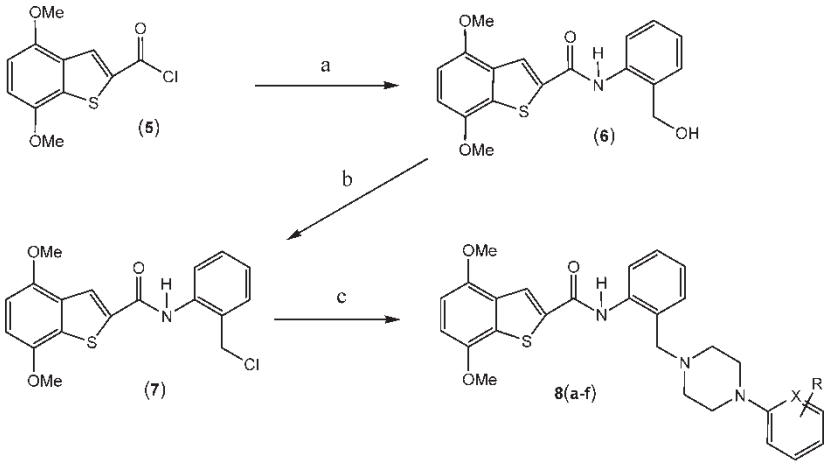
receptors.[1–3] Compounds of this class have been extensively studied, especially as 5-HT_{1A} receptor ligands, because of their potential antianxiety and antidepressant properties.[4,5] Among these, some long-chain arylpiperazines with a terminal imide fragment, such as buspirone (**I**) or ipsapirone (**II**) (Fig. 1) are effective as antianxiety and antidepressant drugs.[6,7]

Although a number of synthetic approaches to long-chain arylpiperazines with interesting 5-HT_{1A} bioactivity have been reported,[8–13] the preparation of arylpiperazinyl benzothiophene derivatives (**III**) with a benzylic spacer inserted between the basic nitrogen atom of the arylpiperazine moiety and the benzo[*b*]thiophene carboxamide nucleus, as far as we know, has not yet been investigated.

In this article, the synthesis of a series of 4,7-dimethoxy-*N*-{2-[(4-aryl-1-piperazinyl) methyl]phenyl}benzo[*b*]thiophene-2-carboxamides of general structure (**III**) closely related to bioactive long-chain arylpiperazines is reported (Fig. 1).

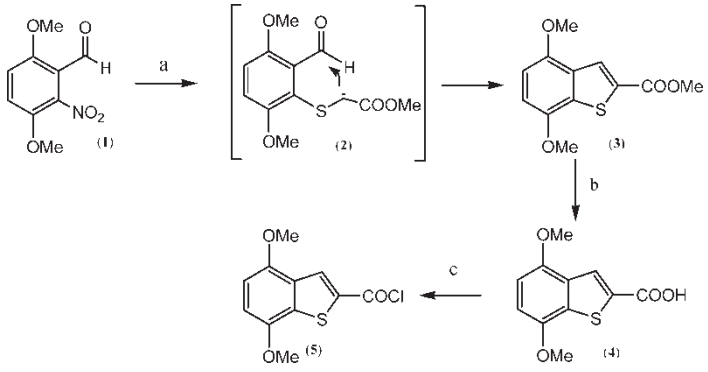
RESULTS AND DISCUSSION

The new compounds **8**(**a**–**f**) were synthesized from the aroyl benzothiophene (**5**) according to the sequence displayed in Scheme 1. The preparation of (**5**)[14] was carried out in three steps from the previously described 2-nitrobenzaldehyde (**1**),[15–17] which was converted to ester (**3**) by treatment with methyl thioglycolate in basic medium. The mechanism of the cyclization of the 2-nitrobenzaldehyde derivative is unknown. However, a reasonable mechanism probably involves thiol anion displacement of the activated nitro group followed by base-catalyzed aldol-condensation to afford (**3**). Subsequent basic hydrolysis of (**3**) to acid (**4**) followed by treatment with thionyl chloride under reflux conditions afforded compound (**5**) (Scheme 2).



Scheme 1. Reagents and conditions: a) 2-aminobenzyl alcohol/dry pyridine/anhydrous THF/N_2 atmosphere; b) mesyl chloride/anhydrous $N(Et)_3$/dry CH_2Cl_2; c) substituted 4-arylpiperazines/anhydrous K_2CO_3/CH_3CN, reflux.

The aroylchloride (**5**) was purified and reacted with 2-aminobenzyl alcohol under inert conditions to give the corresponding amide (**6**) in 89% yield. When (**6**) was treated with mesyl chloride in the presence of triethylamine, the chlorobenzyl carboxamide (**7**) in 86%, was obtained instead of the expected mesylate derivative. This product may arise from a nucleophilic attack by chloride on previously formed mesylate under the reaction conditions. In the final step, compound (**7**) was treated with substituted 4-arylpiperazines under reflux in acetonitrile to provide the expected benzothiophene arylpiperazine carboxamides **8** (**a**–**f**) in good yield (65–96%) (Table 1).



Scheme 2. Reagents and conditions: a) methyl thioglycolate/K_2CO_3/DMF, 65–70°C, 4 h. b) KOH–CH_3OH, 3 h, rt, H_3O^+; c) $SOCl_2$, reflux, 3 h.

Table 1. Products, melting points, and yields

Compound	R	Mp°C	Yield%
8a	R = H; X = CH	206–207	96
8b	R = 4-F; X = CH	188–189	74
8c	R = 2-F; X = CH	180–181	65
8d	R = H; X, = NH	186–187	95
8e	R = 4-NO_2; X = CH	244–245	78
8f	R = 2-OMe; X = CH	170–171	78

EXPERIMENTAL

Melting points were determined on a hot-stage apparatus and are uncorrected. The IR spectra were recorded on a FT-IR Bruker IFS 55 spectrophotometer for KBr discs, and wave numbers are reported in cm^{-1}. The ^1H NMR and ^{13}C NMR spectra were performed on a Bruker DRX-300 spectrometer (300 and 75 MHz) in deuteriochloroform, or DMSO-d_6. Chemical shifts were recorded in parts per million (ppm δ) relative to TMS as an internal standard. *J* values are given in hertz. Microanalyses were carried out on a Fisons EA 1108 analizer. Silica gel Merck 60 (70–230mesh) and DC-alufolien 60 F_{254} were used for column and thin-layer chromatography (TLC) chromatography, respectively.

N-[2-(Hydroxymethyl)phenyl]-4,7-dimethoxybenzo[*b*]thiophene-2-carboxamide (6)

Aroyl chloride (**5**) (348 mg, 1.36 mmol) in dry THF (20 mL) was slowly added to a stirred solution of 2-aminobenzyl alcohol (168 mg, 1.36 mmol) and dry pyridine (0.11 mL, 108 mg, 1.36 mmol) in dry THF (50 mL) at 0°C under nitrogen atmosphere. After stirring for 10 min, the mixture was allowed to warm to room temperature and was maintained at rt for 3 h. The mixture was then diluted with water (100 mL), extracted with ethyl acetate (3 × 50 mL), and dried over anhydrous Na_2SO_4. Concentration of the solvent in vacuo afforded the crude amide (**6**) (415 mg, 89%), which was purified by silica-gel column chromatography (AcOEt/CH_2Cl_2 1:2) to afford pure benzothiophene carboxamide (**6**) (326 mg, 70%) as a brown pale solid. Mp: 150–151°C; anal. calcd. for $C_{18}H_{17}NO_4S$: C, 62.91; H, 4.99; N, 4.08; S, 9.32. Found: C, 61.95; H, 4.97; N, 4.18; S, 9.28%. IR ν_{max}: 3350 (ArCONH), 3288 (O-H), 1635 (C═O). ^1H NMR (300 MHz,$CDCl_3$) δ: 3.86 (s, 6H, 2 × ArOMe), 4.55 (d, 2H, Ar-CH_2-OH, $J = 5.3$ Hz), 5.50 (t, 1H, OH, $J = 5.3$ Hz), 6.83 (d, 1H, 5-H, $J = 8.5$ Hz), 6.92 (d, 1H, 6-H, $J = 8.5$ Hz), 7.17–7.27 (m, 2H, 4′-H & 5′-H), 7.41 (d, 1H, 3′-H, $J = 7.4$ Hz), 7.56 (d, 1H, 6′-H, $J = 7.7$ Hz), 7.17–7.27 (m, 2H,

4′-H & 5′-H), 7.41 (d, 1H, 3′-H, J =7.4 Hz), 7.56(d, 1H, 6′-H, J = 7.7 Hz), 8.20 (s, 1H, 3-H), 10.27(s, 1H, NH-CO). ^{13}C NMR (75 MHz, $CDCl_3$): 56.6, 56.8, 61.3, 106.5, 107.9, 123.1, 125.4, 126.3, 128.0, 128.3, 131.23, 131.7, 135.9, 136.4, 139.7, 148.7, 150.5, 160.8.

N-[2-(Chloromethyl)phenyl]-4,7-dimethoxybenzo[*b*]thiophene-2-carboxamide (7)

To a solution of alcohol (**6**) (300 mg, 0.88 mmol) in dry CH_2Cl_2 (40 mL) at 0°C, mesyl chloride (0.17 mL, 2.2 mmol) and dry Et_3N (221 mg, 2.2 mmol) were added. The mixture was stirred for 3 h at room temperature, diluted with a saturated solution of $NaHCO_3$ (20 mL), extracted with CH_2Cl_2 (3 × 50 mL), and dried over $MgSO_4$. The organic layers were concentrated to afford 316 mg of a crude residue in cuantitative yield, which was purified by silica gel column chromatography (CH_2Cl_2) to afford pure benzothiophene chlorobenzyl carboxamide (**7**) (272 mg, 86%) as a viscous orange-brown oil. Anal. calcd. for $C_{18}H_{16}NO_3SCl$: C, 59.75; H, 4.46; N, 3.87; S, 8.86. Found: C, 55.89; H, 4.48; N, 3.77; S, 8.82%; IR ν_{max}: 3417 (ArCONH), 1637 (NHCO), 1575 (N-H). ^{1}H NMR (DMSO-d_6): δ 3.93 (s, 6H, 2 × Ar-OMe), 4.88 (s, 2H, Ar-CH_2-Cl), 6.91 (d, 1H, 5-H, J = 8.5 Hz), 6.99 (d, 1H, 6-H, J = 8.5 Hz), 7.32 (t, 1H, 4′-H, J = 6.3 Hz), 7.42–7.49 (m, 2H, 5′-H and 6′-H), 7.55 (d, 1H, 3′-H, J = 7.5 Hz), 8.45(s, 1H, 3-H), 10.30 (s, 1H, NH-CO). ^{13}C NMR (75 MHz, $CDCl_3$): δ 44.6, 55.8, 56.1, 104.8, 106.6, 122.9, 124.3, 125.3, 127.8, 130.0, 130.2, 131.4, 132.0, 136.4, 137.7, 148.5, 150.3, 160.4.

General Procedure for Preparation of 4,7-Dimethoxy-*N*-{2-[(4-aryl-1-piperazinyl) methyl] phenyl}benzo[*b*]thiophene-2-carboxamides 8 (a–f)

4,7-Dimethoxy-*N*-{2-[(4-phenyl-1-piperazinyl)-methyl]phenyl} benzo[*b*]thiophene-2-carboxamide (**8a**)

To a solution of chlorobenzyl benzo[*b*]thiophene (**7**) (105 mg, 0.29 mmol) in CH_3CN (20 mL), 1-phenyl piperazine (48 mg, 0.29 mmol) and anhydrous K_2CO_3 (40 mg, 0.29 mmol) were added. The mixture was stirred under reflux for 4 h and then diluted with water (50 mL). The solution was extracted with ethyl acetate (40 mL × 3), and the organic layers were dried over anhydrous Na_2SO_4. Removal of the solvent afforded benzo[*b*]thiophene-2-carboxamide (**8a**) (136 mg, 96%) as a white powder, which was purified by silica-gel column chromatography (CH_2Cl_2) (116 mg, 82%). Mp: 206–207°C (CH_2Cl_2/CH_3CN 1:2). Anal. calcd. for $C_{28}H_{29}N_3O_3S$: C, 68.97; H, 5.99; N, 8.62; S, 6.58. Found: C, 68.48; H, 5.90; N, 8.60; S, 6.38%. IR ν_{max}: 3450 (ArCONH), 3032 (C-H, Ar), 1666 (NHC═O), 1595 (N-H). ^{1}H NMR

(300 MHz,$CDCl_3$) δ: 2.75 (bs, 4H, Piper. 2″-H and 6″-H), 3.41 (bs, 4H, Piper. 3″-H and 5″-H), 3.58 (s, 3H, Ar-OMe,C-7), 3.74 (s, 2H, Ar-CH_2-), 3.92 (s, 3H, Ar-OMe, C-4), 6.59 (d, 1H, 5-H, $J = 8.5$ Hz), 6.71 (d, 1H, 6-H, $J = 8.5$ Hz), 6.88 (t, 1H, 4‴-H, $J =$ 7.3 Hz), 6.97 (d, 2H, 2‴-H and 6‴-H, $J = 8.0$ Hz), 7.10 (t, 1H, 5′-H, $J = 7.4$ Hz), 7.18 (d, 1H, 3′-H, $J = 6.5$ Hz), 7.27 (td, 2H, 3‴-H, 5‴-H, $J_o = 6.8$ Hz, $J_m = 2.4$ Hz), 7.36 (t, 1H, 4′-H, $J = 7.6$ Hz), 8.10 (s, 1H, 3-H), 8.40 (d, 1H, 6′-H, $J = 8.1$ Hz), 11.5 (s, 1H, NH-CO). ^{13}C NMR (75 MHz, $CDCl_3$): δ 48.9 (2C), 53.0 (2C), 55.2, 56.0, 62.6, 104.4, 106.2, 116.3 (2C), 120.0, 120.9, 121.8, 123.6, 125.0, 128.8, 129.2 (2C), 130.1, 131.4, 132.0, 138.5, 139.8, 148.5, 150.1, 151.2, 160.4.

N-{2-[(4-(4-Fluorophenyl)-1-piperazinyl)methyl]phenyl}-4,7-dimethoxibenzo[*b*]thiophene-2-carboxamide (**8b**)

This is analogous to (**8a**), prepared from (**7**) (91 mg, 0.25 mmol), 4-(4-fluorophenyl)piperazine (45 mg, 0.25 mmol), anhydrous K_2CO_3 (35 mg, 0.25 mmol), and CH_3CN (20 mL). Crude yield (94 mg, 74%); column chromatographed (CH_2Cl_2) (79 mg, 62.4%). Mp: 188–189°C. Anal. calcd. for $C_{28}H_{28}FN_3O_3S$: C, 66.51; H, 5.58; N, 8.31; S, 6.34. Found: C, 65.50; H, 5.73; N, 8.51; S, 6.20%. IR ν_{max}: 3442 (ArCONH), 3032 (C-H, Ar), 1662 (NHC = O), 1596 (N-H). ^{1}H-NMR (300 MHz, $CDCl_3$) δ: 2.75 (bs, 4H, Piper. 2″-H and 6″-H), 3.33 (bs, 4H, Piper. 3″-H and 5″-H), 3.59 (s, 3H, Ar-OMe, C-7), 3.74 (s, 2H, Ar-CH_2-), 3.92 (s, 3H, Ar-OMe, C-4), 6.50 (d, 1H, 5-H, J= 8.5 Hz), 6.72 (d, 1H, 6-H, $J = 8.5$ Hz), 7.01–6.90 (m, 4H, 2‴-H, 3‴-H, 5‴-H, 6‴-H), 7.06 (t, 1H, 5′-H, $J = 6.9$ Hz), 7.18 (d, 1H, 3′-H, $J = 6.3$ Hz), 7.37 (t, 1H, 4′-H, $J = 8.0$ Hz), 8.10 (s, 1H, 3-H), 8.49 (d, 1H, 6′-H, $J = 8.1$ Hz), 11.5 (s, 1H, NH-CO). ^{13}C NMR(75 MHz, $CDCl_3$): δ 49.8 (2C), 52.9 (2C), 55.1, 56.0, 62.5, 104.4, 106.1, 115.6 (d, 2C, $^2J = 22$ Hz), 118.02 (d, 2C, $^3J = 7.6$ Hz), 120.8, 121.7, 123.6, 124.9, 128.8, 130.1, 131.2, 131.9, 138.4, 139.8, 147.8, 148.5, 149.9, 157.3 (d, $^1J = 239$ Hz), 160.3.

N-{2-[(4-(2-Fluorophenyl)-1-piperazinyl) methyl] phenyl}-4,7-dimethoxibenzo[*b*]thiophene-2-carboxamide (**8c**)

This is analogous to (**8a**), prepared from (**7**) (181 mg, 0.5 mmol), 4-(2-fluorophenyl)piperazine (90 mg, 0.5 mmol), anhydrous K_2CO_3 (69 mg, 0.5 mmol), and CH_3CN (20 mL). Crude yield (164 mg, 65%); column chromatographed (CH_2Cl_2) (150 mg, 59%). Mp: 180–181°C. Anal. calcd. for $C_{28}H_{28}FN_3O_3S$: C, 66.51; H, 5.58; N, 8.31; S, 6.34. Found: C, 65.81; H, 5.47; N, 8.29; S, 6.33%. IR ν_{max}: 3440 (ArCONH), 1665 (NHC═O), 1592 (N-H). ^{1}H MNR (300 MHz, $CDCl_3$): δ 2.75 (m, 4H, Piper. 2″-H and 6″-H), 3.32 (m, 4H, Piper. 3″-H & 5″-H), 3.64 (s, 3H, Ar-OMe, C-7), 3.75 (s, 2H, Ar-CH_2-), 3.92 (s, 3H, Ar-OMe, C-4), 6.61 (d, 1H, 6-H, $J = 8.5$ Hz), 6.73 (d, 1H, 5-H, $J = 8.5$ Hz), 6.86–7.10 (m, 5H, 4′-H & 3‴-H, 4‴-H, 5‴-H and 6‴-H), 7.18 (dd, 1H, 3′-H, $J_o = 7.3$ Hz, $J_m = 1.3$ Hz), 7.36 (td, 1H, 5′-H, $J_o = 8.3$ Hz,

$J_m = 1.35$ Hz), 8.13 (s, 1H, 3-H), 8.42 (dd, 1H, 6′-H, $J_o = 8.2$ Hz, $J_m = 0.8$ Hz), 11.6 (s, 1H, NH-CO). ^{13}C NMR (75 MHz, $CDCl_3$): δ 50.1, 50.2, 53.0, 55.3, 56.0, 62.6, 104.5, 106.2, 116.2 (d, $^2J = 21$ Hz), 119.1 (d, $^4J = 2.9$ Hz), 120.9, 121.8, 122.7 (d, $^3J = 8.0$ Hz), 123.7, 124.5, 124.48 (d, $^{3'}J = 3.6$ Hz), 125.0, 128.8, 130.1, 131.4, 132.0, 138.5, 139.8, 140.0 (d, $^{2'}J = 8.6$ Hz), 148.6, 150.1, 155.7 (d, $^1J = 246$ Hz), 160.4.

4,7-Dimethoxy-*N*-{2-[(4-(2-pyridinyl)-1-piperazinyl) methyl]phenyl}-1-benzo[*b*]thio-phene-2-carboxamide (**8d**)

This is analogous to (**8a**), prepared from (**7**) (224 mg, 0.62 mmol), 1-(2-pyridinyl) piperazine (101 mg, 0.62 mmol), anhydrous K_2CO_3 (86 mg, 0.62 mmol), and CH_3CN (20 mL). Crude yield (289 mg, 95%); column chromatographed (CH_2Cl_2) (250 mg, 82.6%). Mp: 186–187°C; Anal. calcd. for $C_{27}H_{28}N_4O_3S$: C, 66.37; H, 5.78; N, 11.47; S, 6.56. Found: C, 65.82; H, 5.85; N, 11.69; S, 6.51%. IR ν_{max}: 3438 (ArCONH), 1665 (NHC═O), 1591 (N-H). ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.75 (s, 4H, 2″–H and 6″-H), 3.68 (s, 3H, Ar-OMe), 3.70–3.79 (m, 6H, Ar-CH_2- and Piper. 3″-H 5″-H), 3.92 (s, 3H, Ar-OMe), 6.58–6.72 (m, 4H, 5-H, 6-H, and 4‴-H & 6‴-H), 7.06 (td, 1H, 5′-H, $J_o = 6.9$ Hz; $J_m = 1.0$ Hz), 7.18 (d, 1H, 3′-H, $J = 6.2$ Hz), 7.49 (td, 1H, 4″-H, $J_o = 7.94$; $J_m = 1.95$ Hz), 7.37 (td, 1H, 4′-H, $J_o = 7.95$; $J_m = 1.43$ Hz), 8.11 (s,1H, 3-H), 8.22 (dd, 1H, $J_o = 4.78$ Hz; J_m= 1.38 Hz, 6′-H), 8.42 (d, 1H, 3‴-H, $J = 7.6$ Hz), 11.5 (s, 1H, NH-CO). ^{13}C NMR (75 MHz, $CDCl_3$): δ 44.9 (2C), 52.8 (2C), 55.3, 56.0, 62.7, 104.4, 106.2, 107.1, 113.7, 120.7, 121.7, 123.6, 124.9, 128.8, 130.1, 131.3, 132.0, 137.6, 138.5, 139.8, 148.0, 148.5, 150.1, 159.5, 160.4.

4,7-Dimethoxy-*N*-{2-[(4-(4-nitrophenyl)-1-piperazinyl)methyl]phenyl}-1-benzo[*b*]thio-phene-2-carboxamide (**8e**)

This is analogous to (**8a**), prepared from (**7**) (100 mg, 0.28 mmol), 1-(4-nitrophenyl) piperazine (58 mg, 0.24 mmol), anhydrous K_2CO_3 (38 mg, 0.28 mmol), and CH_3CN (20 mL). Crude yield (115 mg, 78.3%); column chromatographed (CH_2Cl_2). (108 mg, 73.6%). Mp: 244–245°C. Anal. calcd. for $C_{28}H_{28}N_4O_5S$: C, 63.14; H, 5.30; N, 10.52; S, 6.02. Found: C, 62.87; H, 5.59; N, 10.46; S, 5.97%. IR ν_{max}: 3445 (ArCONH), 1667 (NHC═O), 1595 (NO_2 asym.), 1324 (NO_2 sym.). ^{1}H NMR (300 MHz, DMSO-d_6): δ 2.76 (bs, 4H, 2″–H and 6″-H), 3.73 (bs, 4H, 3″-H and 5″-H), 3.85 (s, 3H, Ar-OMe, C-7), 3.93 (s, 3H, OMe, C-4), 3.74 (s, 2H, Ar-CH_2-), 6.95 (d, 1H, 5-H, $J = 8.4$ Hz), 7.07 (d, 1H, 6-H, $J = 8.4$ Hz), 7.24–7.40 (m, 3H, 2‴-H, 6‴-H and 4′-H), 7.54–7.65 (m, 2H, 3′-H and 5′-H), 8.32 (d,1H, 6′-H, $J = 9.2$ Hz), 8.35 (s, 1H, 3-H), 8.47 (d, 2H, 3‴-H and 5‴-H, $J = 8.1$ Hz), 11.6 (s, 1H, NHCO). ^{13}C NMR (75 MHz, DMSO-d_6): 47.0 (2C), 52.7 (2C), 56.5, 57.0, 61.6, 106.7, 108.4, 113.7 (2C), 121.3, 122.1, 122.3, 124.7, 126.5 (2C), 126.8, 129.0, 131.1, 131.5, 138.3, 138.8, 140.1, 148.8, 150.5, 155.6, 160.3.

4,7-Dimethoxy-*N*-{2-[(4-(2-methoxyphenyl)-1-piperazinyl)methyl]phenyl} -1-benzo[*b*]thiophene-2-carboxamide (**8f**)

This is analogous to (**8a**), prepared from (**7**) (140 mg, 0.39 mmol), 1-(2-methoxyphenyl) piperazine (75 mg, 0.39 mmol), anhydrous K_2CO_3 (54 mg, 0.39 mmol), and CH_3CN (20 mL). Crude yield (156 mg, 78%); column chromatographed (CH_2Cl_2) (148 mg, 74%). Mp: 170–171°C. Anal. calcd. for $C_{29}H_{31}N_3O_4S$: C, 67.29; H, 6.04; N, 8.12; S, 6.19. Found: C, 67.26; H, 6.11; N, 7.95; S, 6.02%. IR ν_{max}: 3441 (ArCONH), 1660 (NHC═O), 1590 (N-H). ^{1}H NMR (300 MHz, $CDCl_3$): δ 2.76 (bs, 4H, 2″-H and 6″-H), 3.29 (bs, 4H, 3″-H and 5″-H), 3.65 (s, 3H, Ar-OMe), 3.75 (s, 2H, Ar-CH_2-), 3.88 (s, 3H, Ar-OMe, 7-H), 3.96 (s, 3H, Ar-OMe, 4-H), 6.62 (d, 1H, 5-H, $J = 8.4$ Hz), 6.73 (d, 1H, 6-H, $J = 8.4$ Hz), 6.84–7.09 (m, 5H, 5′-H and 3‴H, 4‴-H, 5‴-H & 6‴-H), 7.18 (d,1H, 3′-H, $J = 6.9$ Hz), 7.35 (t, 1H, 4′-H, $J = 7.0$ Hz), 8.16 (s, 1H, 3-H), 8.40 (d, 1H, 6′-H, $J = 8.2$ Hz), 11.6 (s, 1H, CONH). ^{13}C NMR (75 MHz, $CDCl_3$): 50.7 (2C), 53.6 (2C), 55.7, 55.8, 56.4, 63.1, 104.8, 106.6, 111.7, 118.8, 121.3, 121.4, 122.2, 123.9, 123.5, 125.6, 129.1 (2C), 130.4, 131.8, 138.9, 140.3, 141.6, 148.9, 150.3, 152.7, 160.8.

ACKNOWLEDGMENTS

We thank Proyectos Fondecyt 1050289 and Proyecto Cepedeq–Facultad, Facultad de Ciencias Químicas y Farmacéuticas Universidad de Chile, Santiago, Chile.

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