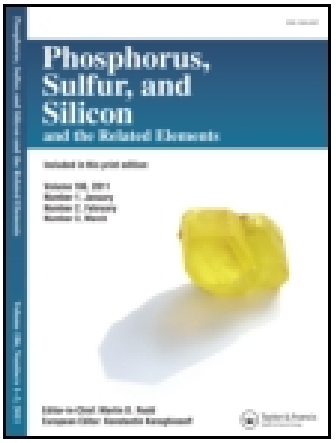

Phosphorus, Sulfur, and Silicon and the Related Elements

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Utility of Nitrogen Nucleophiles: a Simple Route for the Synthesis of 2-Substituted Benzimidazolylpyrimidines

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UTILITY OF NITROGEN NUCLEOPHILES: A SIMPLE ROUTE FOR THE SYNTHESIS OF 2-SUBSTITUTED BENZIMIDAZOLYLPYRIMIDINES

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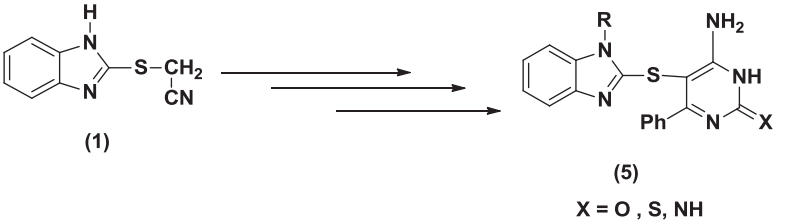
GRAPHICAL ABSTRACT



Abstract *An efficient and simple route for the synthesis of 2-substituted benzimidazolylpyrimidines **5a-i** has been developed from benzimidazolylunsaturated nitriles **2** using nitrogen nucleophiles. Treatment of **2** with thiourea/urea/guanidine hydrochloride in aq. KOH under reflux for 30 min gave **3**, which on further alkylation with an alkylating agent under PTC conditions gave **5a-i.** Alternatively **5a-i** could also be prepared by treatment of **2** with an alkylating agent under PTC conditions followed by treatment with thiourea /urea/guanidine hydrochloride in aq. KOH for 30 min.*

Keywords Benzimidazolylpyrimidines; 2-mercaptobenzimidazole; benzaldehyde; nitrogen nucleophiles; phase transfer catalyst

INTRODUCTION

Benzimidazole derivatives have been found to possess various pharmacological activities.[1–7] Pyrimidines and their derivatives are known for their pharmacological properties including antiviral, antibacterial[8–13] effects. As a result of their pharmacological, biological, physiological, and medical significance, substituted and condensed pyrimidines form a class of compounds of importance and still growing interests. Keeping this in view, it was thought of interest to synthesize certain pyrimidobenzimidazoles with the expectation of their activities supplemented or at least comparable to those of benzimidazole and pyrimidine derivatives.[14].

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Table 1 Physical data of the synthesized compounds 5a-i

Substrate	Reagent	Product
3a	DMS	5a
3a	DES	5b
3a	$PhCH_2Cl$	5c
3b	DMS	5d
3b	DES	5e
3b	$PhCH_2Cl$	5f
3c	DMS	5g
3c	DES	5h
3c	$PhCH_2Cl$	5i
4a	thiourea	5a
4a	urea	5b
4a	Guanidine hydrochloride	5c
4b	thiourea	5d
4b	urea	5e
4b	Guanidine hydrochloride	5f
4c	thiourea	5g
4c	urea	5h
4c	Guanidine hydrochloride	5i

Mohsen *et al.*[15] reported that dihydropyrimidines can be prepared by ternary condensation of benzaldehyde with thiourea and ethyl cyanoacetate. Preparation of 4-(4-methylbenzylidene)-1-phenyl-3,4-dihydropyrimido[1,6]benzimidazole by condensation of 5-(4-methylbenzylidene)-2-phenyl-5,6-dihydro-4*H*-[1,3]oxazin-6-one with o-phenylenediamine in 1:1 molar ratio in the presence of dry benzene was reported[16] by Sharma *et al.* Zeynizadeh *et al.* reported[17] that 3,4-dihydropyrimidin-2-(1H)-ones (or thiones) could be prepared by the reaction of aromatic aldehydes with β-dicarbonyls, and urea/thiourea using $NaHSO_4.H_2O$/ultrasound. Elgemei *et al.* [18] reported that tetrahydropyrimidines can be prepared by treatment of α, β-unsaturated nitriles with urea or thiourea and K_2CO_3 under were reflux for 5 h.

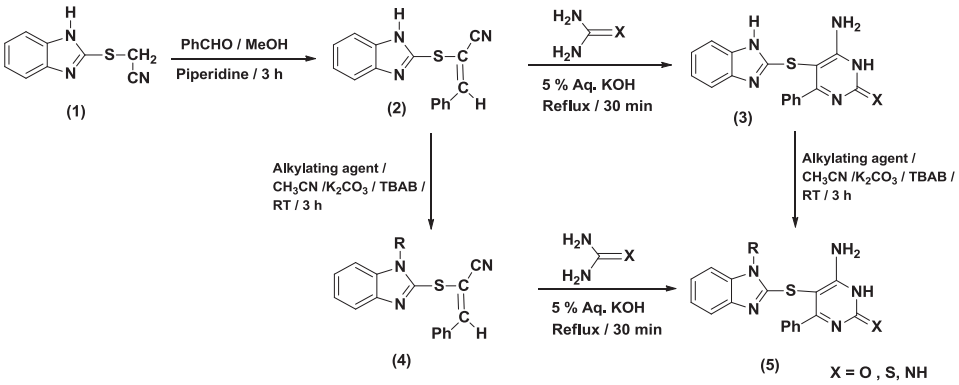
It is obvious from the few literature citations given above that these types of reactions (i.e., reaction between unsaturated nitriles with nitrogen nucelophiles) will be of much interest from organic synthesis considerations. In continuation of our earlier studies,[19] we now wish to report our extensive and intensive studies on the preparation of benzimidazolylmercaptopyrazoles.

RESULTS AND DISCUSSION

2-((1H-benzimidazol-2-yl)thio)acetonitrile **1** on reaction with benzaldehyde in methanol containing piperidine as a base at RT for 3 h gave previously reported[19] 2-((1H-benzimidazol-2-yl)thio)-3-phenylacrylonitrile **2**, which on treatment with nitrogen nucleophiles such as thiourea/urea/guanidine in aq. KOH under reflux for 30 min gave 5-((1H-benzimidazol-2-yl)thio)-6-amino-4-phenylpyrimidine-2(1H)-thione **3a**, 5-((1H-benzimidazol-2-yl)thio)-6-amino-4-phenylpyrimidin-2(1H)-one **3b** and 5-((1H-benzimidazol-2-yl)thio)-2-imino-6-phenyl-2,3-dihydropyrimidin-4-amine **3c** respectively. The structures of **3a-c** have been assigned on the basis of their spectral data. Thus, its infrared spectrum showed absorptions for 3a at 3400–2800 cm^{-1} (br, m, $-NH$, $-NH_2$),

2560 (−SH). ^{1}H-NMR showed signals at 7.05–6.80 (m, 4H, Ar-H), 7.24 (s, 2H, J = 7.68 Hz, Ar-H), 7.58 (d, 2H, $-NH_2$), 7.72–6.99 (m, 3H, Ar-H), 10.82 (s, 1H, −NH of imadazole), 12.27 (s, 1H, −SH) and its CI mass spectrum showed an ion peak at 352 (M^++1) corresponding to the mass of 351. For 3b and 3c, see Experimental Section for further details.

3a–c on further treatment with each of an alkylating agent, i.e., dimethylsulfate, diethylsulfate and benzyl chloride individually in CH_3CN containing K_2CO_3 as a base and tetrabutylammonium bromide (TBAB) as a phase transfer catalyst (PTC) at RT for 3 h gave respectively 5−((1−alkylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-(thiol/ol/amine) **5a–i**. **5a–i** could also be prepared in an alternative way by alkylation of 2-((1H-benzimidazol-2-yl)thio)-3-phenylacrylonitrile **2** under Phase Transfer Catalyst (PTC) conditions for 3 h giving 2-((1-alkylbenzimidazol-2-yl)thio)-3-phenylacrylonitrile **4a–c** followed by treatment with thiourea / urea / guanidine hydrochloride in aq KOH under reflux for 30 min. (For details please see Table 1). Its IR spectrum showed absorptions for **5a** is 3400–2800 cm^{-1} (br, m, $-NH_2$), 2550 (−SH); ^{1}H-NMR (400 MHz, DMSO-d_6/ TMS): δ 3.54 (s, 3H, $-CH_3$), 7.10–6.78 (m, 4H, Ar-H), 7.22 (s, 2H, J = 7.51 Hz, Ar-H), 7.55 (s, 2H, $-NH_2$), 7.79 -6.89 (m, 3H, Ar-H), 12.25 (s, 1H, −SH), and its CI mass spectrum showed an ion peak at 366 (M^++1) corresponding to the mass of 365.



Scheme 1

EXPERIMENTAL SECTION

General

Melting points were determined in open capillaries in sulfuric acid bath and are uncorrected. Thin-layer chromatography (TLC) analyses were done on glass plates coated with silica gel GF-254 and spotting was done using Iodine or UV lamp. ^{1}H NMR were recorded in $CDCl_3$ / DMSO using Varian 400-MHz instrument, ^{13}C NMR were recorded in DMSO/$CDCl_3$ using VNMR100 MHz instrument and Mass spectra were recorded on an Agilent LC-MS instrument giving only M^+ values in Q+1 mode. The Supplemental Materials contains sample ^{1}H and ^{13}C spectra for 5a and 5c (Figures S1–S4)

General Procedure for the Preparation of 3 from 2[20]

A mixture of **2** (5 mM), thiourea (5 mM) in aq. KOH was reflux for 30 min. After completion of the reaction, the reaction mixture was poured into ice-cold water (≈50 mL). The separated solid was filtered, washed with water (2 × 10 mL) and dried to obtain crude **3** which on recrystallization from ethyl acetate gave pure **3.**

General Procedure for the Preparation of 4a–c from 2

A mixture of **2** (5 mM), K_2CO_3 (10 mM), TBAB (10 mg), CH_3CN (20 mL), and the alkylating agent (i.e., dimethylsulfate, diethylsulfate or benzyl chloride) (5 mM) was stirred at room temp for 3 h. At the end of this period, the reaction mixture was poured into ice-cold water (≈50 mL). The separated solid was filtered, washed with water (2 × 10 mL) and dried to obtain crude **4a-c** which on recrystallization from ethyl acetate gave pure **4a-c.**

General Procedure for Preparation of 5a–i from 3a–c

A mixture of **3a-c** (5 mM), K_2CO_3 (10 mM), TBAB (10 mg), CH_3CN (20 mL) and the alkylating agent (i.e. dimethylsulfate, diethylsulfate, or benzyl chloride) (5 mM) individually was stirred at room temp for 3 h. At the end of this period, the reaction mixture was poured into ice-cold water (≈50 mL). The separated solid was filtered, washed with water (2 × 10 mL) and dried to obtain crude **5a–i** which on recrystallization from ethyl acetate gave pure **5a-i.**

Alternative Procedure for Preparation of 5a–i from 4a–c

A mixture of **4a–c** (5 mM), thiourea/urea/guanidine (5 mM) in aq. KOH individually was reflux for 30 min. After completion of the reaction, the reaction mixture was poured into ice-cold water (≈50 mL). The separated solid was filtered, washed with water (2×10 mL) and dried to obtain crude **5a–i** which on recrystallization from ethyl acetate gave pure **5a–i**.

CHARACTERIZATION DATA

5-((1H-benzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-thiol 3a: yield: 72**%;** m.p. 223–225°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH, $-NH_2$), 2560 (−SH); ^{1}H-NMR (400 MHz, DMSO-d_6/ TMS): δ 7.05–6.80 (m, 4H, Ar-H), 7.24 (s, 2H, J = 7.68 Hz, Ar-H), 7.58 (d, 2H, $-NH_2$), 7.72–6.99 (m, 3H, Ar-H), 10.82 (s, 1H, −NH of imadazole), 12.27 (s, 1H, −SH); ^{13}C NMR: δ 156.5 (**C**=N), 154.7 (**C**=C−Ph), 138.2 (Ar-**C**), 133.2 (Ar-**C**), 129.7 (Ar-**C**), 127.4 (2 Ar-**C**), 123.3 (2 Ar-**C**), 115.3 (**C**=CH) ppm; MS (CI): m/z 352 [$M^{\cdot+}$+1]; HRMS ($C_{17}H_{13}N_5S_2$): Calcd for [$M^{\cdot+}$+H], 352.4641 found 352.4638.

5-((1H-benzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-ol 3b: yield: 72**%;** m.p. 199–201°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH-, $-NH_2$), 3200 (−OH); ^{1}H-NMR (400 MHz, DMSO-d_6/ TMS): δ 7.09–6.93 (m, 4H, Ar-H), 7.52–6.65 (m, 3H, Ar-H), 7.80 (d, 2H, J = 7.58 Hz, Ar-H), 11.0 (s, 1H, −NH of imadazole), 12.16 (s, 1H, −OH); ^{13}C NMR: δ 158.5 (**C**=N), 154.2 (**C**=C−Ph), 136.2 (Ar-**C**), 132.2 (Ar-**C**), 128.7 (Ar-**C**), 127.4 (2 Ar-**C**), 122.3 (2 Ar-**C**), 114.3 (**C**=CH) ppm; MS (CI): m/z 336 [$M^{\cdot+}$+1]; HRMS ($C_{17}H_{13}N_5OS$): Calcd for [$M^{\cdot+}$+H], 336.4641 found 336.4638.

5-((1H-Benzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-amine 3c: yield: 72%; m.p. 212–214°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH-, $-NH_2$); ^{1}H-NMR (400 MHz, DMSO-d_6/ TMS): δ 6.55 (m, 4H, Ar-H), 7.25 (s, 4H, $-NH_2$), 7.48–7.52 (d, 2H, J = 7.73 Hz, Ar-H), 7.62–6.80 (m, 3H, Ar-H), 11.2 (s, 1H, −NH of imadazole); ^{13}C NMR: δ 155.5 (**C**=N), 151.7 (**C**=C−Ph), 136.2 (Ar-**C**), 133.2 (2 Ar-**C**), 128.7 (Ar-**C**), 121.3 (Ar-**C**), 114.3 (**C**=CH) ppm; MS (CI): m/z 335 [$M^{\cdot+}$+1]; HRMS ($C_{17}H_{14}N_6S$): Calcd for [M^++H], 335.3153 found 335.3146.

***2-((1-Methylbenzimidazol-2-yl)thio)-3-phenylacrylonitrile 4a*:** yield: 72%; m.p. 228–230°C; IR (KBr): 2169 cm^{-1} (−CN); ^{1}H-NMR (400 MHz, DMSO-d_6/ TMS): δ 3.71 (s, 3H, -NCH_3), 7.66–7.33 (m, 3H, Ar-H), 7.85–7.13 (m, 4H, J = 7.65 Hz, Ar-H), 8.10 (d, 2H, Ar-H), 8.23 (s, 1H,-C=CH-); ^{13}C NMR: δ 140.5 (**C**=N), 138.5 (2 Ar-**C**), 135.0 (C=**C**H), 132.4 (C≡N), 128.5 (2 Ar-**C**), 128.3 (Ar-C), 126.9 (2 Ar-**C**), 124.5 (2 Ar-**C**), 115.5 (**C**=CH), 33.4 (**C**H_3) ppm; MS (CI): m/z 292 [$M^{\cdot+}$+1]; HRMS ($C_{17}H_{13}N_3S$): Calcd for [M^++H], 292.5848 found 292.5842.

***2-((1-Ethylbenzimidazol-2-yl)thio)-3-phenylacrylonitrile 4b*:** yield: 76%; m.p. 206–208°C; IR (KBr): 2234 cm^{-1} (−CN); ^{1}H- NMR (400 MHz, DMSO-d_6/ TMS): δ 1.28 (m, 2H, J = 6.76 Hz, $-NCH_2$ of ethyl), 3.62 (t, 3H, J = 7.10 Hz, $-CH_3$ of ethyl), 7.72–7.15 (m, 3H, Ar-H), 7.05–6.84 (m, 4H, J = 7.48 Hz, Ar-H), 8.19 (d, 2H, Ar-H), 8.42 (s, 1H,-C = CH-); ^{13}C NMR: δ 141.5 (**C**=N), 136.4 (2 Ar-**C**), 134.0 (C=**C**H), 133.4 (C≡N), 127.3 (2 Ar-**C**), 121.7 (Ar-C), 110.0 (2 Ar-**C**), 124.5 (2 Ar-**C**), 114.5 (**C**=CH), 32.4 (**C**H_3), 27.2 (**C**H_2) ppm; MS (CI): m/z 306 [$M^{\cdot+}$+1]; HRMS ($C_{18}H_{15}N_3S$): Calcd for [M^++H], 306.0565 found 306.0573.

***2-((1-Benzylbenzimidazol-2-yl)thio)-3-phenylacrylonitrile 4c*:** yield: 79%; m.p. 232–234°C; IR (KBr): 2256 cm^{-1} (−CN); ^{1}H-NMR (400 MHz, DMSO-d_6/ TMS): δ 2.96 (s, 2H), 7.12–6.34 (m, 6H, Ar-H), 7.66–7.33 (m, 6H, Ar-H), 8.16 (d, 2H, J = 7.57 Hz, Ar-H), 8.25 (s,1H, −C=CH−); ^{13}C NMR: δ 139.5 (**C**=N), 137.5 (2 Ar-**C**), 134.0 (C=**C**H), 130.4 (C≡N), 126.3 (2 Ar-**C**), 122.7 (4 Ar-C), 118.5 (2 Ar-**C**), 112.5 (2 Ar-**C**), 109.5 (**C**=CH), 28.4 (**C**H_2) ppm; MS (CI): m/z 368 [$M^{\cdot+}$+1]; HRMS ($C_{23}H_{17}N_3S$): Calcd for [M^++H], 368.4641 found 368.4638.

5-((1-Methylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-thiol 5a: yield: 72%; m.p. 212–214°C; IR (KBr): 3400–2800 cm^{-1} (br, m, $-NH_2$), 2550 (−SH); ^{1}H-NMR (400 MHz, DMSO-d_6/ TMS): δ 3.84 (s, 3H, $-CH_3$), 7.10–6.58 (m, 4H, Ar-H), 7.22 (s, 2H, J = 7.51 Hz, Ar-H), 7.55 (s, 2H, $-NH_2$), 7.79–6.89 (m, 3H, Ar-H), 12.25 (s, 1H, −SH); ^{13}C NMR: δ 144.5 (**C**=C), 138.2 (**C**−Ph), 134.5 (Ar-C), 131.2 (2 Ar-C), 127.7 (2 Ar-C), 125.8 (2 Ar-C), 123.5 (Ar-C), 118.3 (Ar-C), 34.6 (−**C**H_3) ppm; MS (CI): m/z 366 [$M^{\cdot+}$+1]; HRMS ($C_{18}H_{15}N_5S_2$): Calcd for [M^++H], 366.5623 found 366. 5629.

5-((1-Methylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-ol 5b: yield: 68%; m.p. 202–205°C; IR (KBr): 3400–2800 cm^{-1} (br, m, $-NH_2$), 3220 (−OH); ^{1}H−NMR (400 MHz, DMSO-d_6/ TMS): δ 3.52 (s, 3H, $-CH_3$), 7.15–6.95 (m, 4H, Ar-H), 7.56–6.68 (m, 3H, Ar-H), 7.85 (d, 2H, J = 7.45 Hz, Ar-H), 12.16 (s, 1H, −OH); ^{13}C NMR: δ 155.5 (**C**=C), 154.2 (**C**−Ph), 134.2 (Ar-C), 130.2 (2 Ar-C), 126.7 (2 Ar-C), 125.4 (2 Ar-C), 122.5 (Ar-C),115.3 (Ar-C), 33.6 (−**C**H_3) ppm; MS (CI): m/z 350 [$M^{\cdot+}$+1]; HRMS ($C_{18}H_{15}N_5OS$): Calcd for [M^++H], 350.0571 found 350.0565.

5-((1-Methylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-amine 5c: yield: 63%; m.p. 252–255°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH-, $-NH_2$), ^{1}H−NMR (400 MHz, DMSO-d_6/TMS): δ 3.82 (s, 3H, $-CH_3$), 6.32 (s, 4H, $-NH_2$), 7.46–6.83 (m, 4H, Ar-H), 7.55 (d, 2H, J = 7.75 Hz, Ar-H), 7.65–6.83 (m, 3H, Ar-H), ^{13}C NMR: δ 162.5

(**C**=C), 159.2 (**C**−Ph), 144.2 (Ar-C), 138.2 (2 Ar-C), 127.7 (2 Ar-C), 125.6 (2 Ar-C), 121.5 (Ar-C), 116.3 (Ar-C), 32.4 (−**C**H_3) ppm; MS (CI): m/z 349 [$M^{\cdot+}$+1]; HRMS ($C_{18}H_{16}N_6S$): Calcd for [$M.^+$+H], 349.5642 found 349.5637.

5-((1-Ethylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-thiol 5d: yield: 75**%;** m.p. 189–191°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH_2), 2550 (−SH); ^{1}H−NMR (400 MHz, DMSO-d_6/ TMS): δ 1.27 (m, 2H, J = 7.14 Hz, −NCH_2 of ethyl), 3.65 (t, 3H, J = 7.24 Hz, −CH_3 of ethyl), 7.12–6.79 (m, 4H, Ar-H), 7.12 (s, 2H, J = 7.56 Hz, Ar-H), 7.59 (s, 2H, −NH_2), 7.72–6.86 (m, 3H, Ar-H),12.20 (s, 1H, −SH); ^{13}C NMR: δ 156.5 (**C**=C), 151.2 (**C**−Ph), 134.5 (Ar-C), 131.7 (2 Ar-C), 127.6 (2 Ar-C), 124.6 (2 Ar-C), 125.9 (Ar-C),114.8 (Ar-C), 33.2 (−**C**H_3), 28.6 (−CH_2) ppm; MS (CI): m/z 390 [$M.^+$+1]; HRMS ($C_{18}H_{16}N_6S$): Calcd for [$M.^+$+H], 390.5848 found 390.5842.

5-((1-Ethylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-ol 5e: yield: 66**%;** m.p. 164–166°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH_2), 3220 (−OH); ^{1}H−NMR (400 MHz, DMSO-d_6/ TMS): δ 1.32 (m, 2H, J = 7.36 Hz −NCH_2 of ethyl), 3.75 (t, 3H, J = 7.28 Hz, −CH_3 of ethyl),7.14–6.95 (m, 4H, Ar-H), 7.58–6.68 (m, 3H, Ar-H), 7.84 (d, 2H, J = 7.78 Hz, Ar-H), 12.18 (s, 1H, −OH); ^{13}C NMR: δ 154.5 (**C**=C), 152.2 (**C**−Ph), 139.2 (Ar-C), 132.2 (2 Ar-C), 124.7 (2 Ar-C), 125.4 (2 Ar-C), 120.5 (Ar-C),115.5 (Ar-C), 33.6 (−**C**H_3), 27.6 (−CH_2) ppm; MS (CI): m/z 365 [$M^{\cdot+}$+1]; HRMS ($C_{19}H_{17}N_5OS$): Calcd for [$M.^+$+H], 365.0571 found 365.0565.

5-((1-Ethylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-amine 5f: yield: 61**%;** m.p. 205–207°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH-, −NH_2), ^{1}H−NMR (400 MHz, DMSO-d_6/ TMS): δ 1.17 (m, 2H, J = 7.29 Hz −NCH_2 of ethyl), 3.60 (t, 3H, J = 7.22 Hz, −CH_3 of ethyl), 7.35 (s, 4H, −NH_2), 7.48–6.59 (m, 4H, Ar-H), 7.52 (d, 2H, J = 7.85 Hz, Ar-H), 7.60–6.81 (m, 3H, Ar-H), ^{13}C NMR: δ 155.8 (**C**=C), 152.7 (**C**−Ph), 137.2 (Ar-C), 131.2 (2 Ar-C), 125.7 (2 Ar-C), 122.4 (2 Ar-C), 120.5 (Ar-C),118.5 (Ar-C), 32.6 (−**C**H_3), 28.6 (−CH_2) ppm; MS (CI): m/z 364 [$M^{\cdot+}$+1]; HRMS ($C_{19}H_{18}N_6S$): Calcd for [$M.^+$+H], 364.0521 found 364.0527.

5-((1-Benzylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-thiol 5g: yield: 69**%;** m.p. 191–194°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH_2), 2550 (−SH); ^{1}H−NMR (400 MHz, DMSO-d_6/ TMS): δ 2.89 (s, 2H), 7.10–6.78 (m, 4H, Ar-H), 7.22 (d, 4H, J = 7.90 Hz, Ar-H), 7.55 (s, 2H, −NH_2), 7.68–6.89 (m, 6H, Ar-H), 12.20 (s, 1H, −SH); ^{13}C NMR: δ 156.5 (**C**=C), 152.7 (**C**−Ph), 134.5 (2 Ar-C), 133.9 (2 Ar-C), 128.7 (2 Ar-C), 126.4 (2 Ar-C), 123.9 (2 Ar-C),112.4 (2 Ar-C), 27.4 (−CH_2) ppm; MS (CI): m/z 443 [$M^{\cdot+}$+1]; HRMS ($C_{24}H_{19}N_5S_2$): Calcd for [$M.^+$+H], 443.1613 found 443.1607.

5-((1-Benzylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-ol 5h: yield: 71**%;** m.p. 236–238°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH_2), 3220 (−OH); ^{1}H−NMR (400 MHz, DMSO-d_6/ TMS): δ 2.79 (s, 2H), 7.14–6.95 (m, 6H, Ar-H), 7.66 -6.58 (m, 6H, Ar-H), 7.82 (d, 2H, J = 7.61 Hz, Ar-H), 12.18 (s, 1H, −OH); ^{13}C NMR: δ 154.5 (**C**=C), 154.2 (**C**−Ph), 134.2 (2 Ar-C), 131.9 (2 Ar-C), 126.7 (2 Ar-C), 122.4 (2 Ar-C), 120.5 (2 Ar-C),115.3 (2 Ar-C), 28.6 (−CH_2) ppm; MS (CI): m/z 427 [$M^{\cdot+}$+1]; HRMS ($C_{24}H_{19}N_5OS$): Calcd for [$M.^+$+H], 427.6246 found 427.6252.

5-((1-Benzylbenzimidazol-2-yl)thio)-4-amino-6-phenylpyrimidine-2-amine 5i: yield: 65**%;** m.p. 185–187°C; IR (KBr): 3400–2800 cm^{-1} (br, m, −NH-, −NH_2), ^{1}H−NMR (400 MHz, DMSO-d_6/ TMS): δ 2.68 (s, 2H), 7.36 (s, 4H, −NH_2), 7.56–6.53 (m, 6H, Ar-H), 7.51 (d, 2H, J = 7.69 Hz, Ar-H), 7.61–6.82 (m, 6H, Ar-H); ^{13}C NMR: δ 154.8 (**C**=C), 150.7 (**C**−Ph), 138.2 (2 Ar-C), 132.2 (2 Ar-C), 126.7 (2 Ar-C), 123.4 (2 Ar-C), 121.5 (2 Ar-C),114.8 (2 Ar-C), 27.6 (−CH_2) ppm; MS (CI): m/z 349 [$M^{\cdot+}$+1]; HRMS ($C_{24}H_{20}N_6S$): Calcd for [$M.^+$+H], 349.5752 found 349.5744.

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SUPPLEMENTAL MATERIAL

Supplementary data for this article can be accessed on the publisher's website, at http://dx.doi.org/10.1080/10426507.2014.947409

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