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Synthesis and Characterization of Some New 2-Amino-4-(4'-substituted)-6-(4''-substituted)diphenyl Pyrimidines

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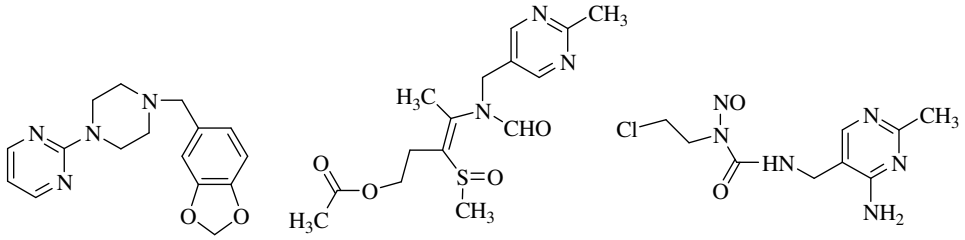
Synthesis and characterization of some novel 2-amino-4-(4'-substituted)-6-(4"-substituted)diphenyl pyrimidines has been carried out by the conversion of variably substituted acetophenones and benzaldehydes into corresponding chalcones followed by cyclization with guanidine hydrochloride in the presence of an oxidizing agent.

Key Words: Synthesis, Chalcones, Cyclization, Pyrimidines.

INTRODUCTION

Pyrimidines have been shown to possess diverse biological activities. For example, compound **1** a new dopamine receptor stimulant[1] is reported to have produced significant improvement in activity in daily living (ADL) in patients suffering from Parkinson's syndrome. Compound **2**, is a new lipid soluble form of thiamine having therapeutic use in beriberi, polyneuritis, encephalopathy, pain, malnutrition and alcoholism and especially in the treatment of long-standing insulin dependant diabetes mellitus[2]. Compound **3** has been reported to be an important therapeutic agent against cancer[3].



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We were interested in the development of efficient method for constructing 2,4,6-trisubstituted pyrimidines, given their value as potential pharmaceuticals. Since chalcones have been very interesting starting materials in synthetic organic chemistry from the initial years; they are easy to prepare with tremendous variability at two aromatic rings and the enone provides a bifunctional site for 1,3-dinucleophiles affording several heterocyclic ring systems while incorporating other diversity elements[4].

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Herein, we report the reaction of variably substituted chalcones with guanidinium hydrochloride to synthesize the title compounds.

Some synthetic methods for the synthesis of 2,4,6-trisubstituted pyrimidines, have been previously reported by others. On the basis of reaction of alkynone with amidines or guanidines, Bagley *et al.*[5] prepared pyrimidine libraries using microwave assisted synthesis. However, a limitation of this method is that it is not easy to obtain diverse alkynones from either commercial sources or chemical synthesis. Katritzky *et al.*[6] reported a synthetic method for 2,4,6-trisubstituted pyrimidines using solid-phase-bound chalcones. Agarwal *et al.*[7] also published a similar method. Although this solid-phase synthesis method is suitable for the preparation of 2,4,6-trisubstituted pyrimidines, a method for linking chalcones to solid support must be developed. In fact not all the chalcones can be linked to a solid phase if there is not suitable group or framework of chalcones or their building blocks.

EXPERIMENTAL

All the 1,3-diaryl propenones were prepared according to known literature procedure[8]. FT IR spectra were recorded on Bio-Rad Merlin spectrophotometer using KBr discs. The ^{1}H NMR (300 MHz) and ^{13}C NMR (75.43 MHz) spectra were recorded on Bruker AM-250 spectrometer in DMSO and $CDCl_3$ solution respectively, using TMS as internal standard. EIMS data were collected on VG:70 SE mass spectrometer. Chemical analysis was carried out on Leuco 93 instrument. The melting points were recorded on Gallenkamp melting point apparatus (MFB-595-101 M) and are uncorrected.

To synthesize 2-amino-4-(4'-substituted)-6-(4''-substituted)diphenyl pyrimidines (**19-36**)variably substituted acetophenones were reacted with differently substituted benzaldehydes in 10 % NaOH and ethanol to yield the corresponding chalcones **1-18**. The chalcones **1-18** were further cyclized with guanidinium hydrochloride in the presence of potassium ethaoxide (synthesized *in situ* by adding potassium hydroxide and ethanol) to afford the title compounds **19-36**.

Synthesis of 2-amino-4-(4'-substituted)phenyl-6-(4''-substituted)phenyl pyrimidines:

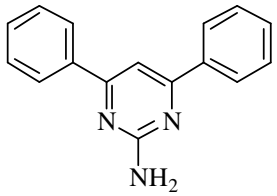
2-Amino-4,6-diphenyl pyrimidine (19): To a solution of 1.5 equiv. of guanidinium hydrochloride in 50 mL of potassium hydroxide, 1,3-diphenyl propenone 1.0 equiv. were added and refluxed for 3 h. To the reaction mixture 20 mL of 30 % H_2O_2 was added drop wise over a period of 0.5 h. The reaction mixture was subjected to reflux for 1 h. The solvent was evaporated under reduced pressure in a rotary evaporator and water was added to the residue. The precipitated compounds were filtered off and crude product was purified by crystallization from ethanol. 2-Amino-4,6-diphenyl pyrimidine **19** was obtained as yellow crystals. The molecular formula of the compound **19** was found to be $C_{16}H_{13}N_3$ (m.w. 247), the FT-IR spectrum showed stretching frequencies at 3475, 3372, 1535, 1580 cm^{-1} which are characteristics of N-H, C=N, C=C(Ar), respectively.

The mass spectrum of compound **19** showed characteristic peaks of molecular ion peak $M^{+\cdot}$, at m/z 247. The characteristic peaks at m/z 205, 103, 77 and 51 appear due to fragmentation as a result of loss of side chain.

The ^{1}H NMR spectrum of 2-amino-4,6-diphenyl pyrimidine showed a characteristic singlet at 6.82 ppm for H^a and a multiplet for unsubstituted phenyl rings at 7.27-7.57 ppm. A broad singlet at 3.34-3.43 ppm confirmed the presence of NH_2.

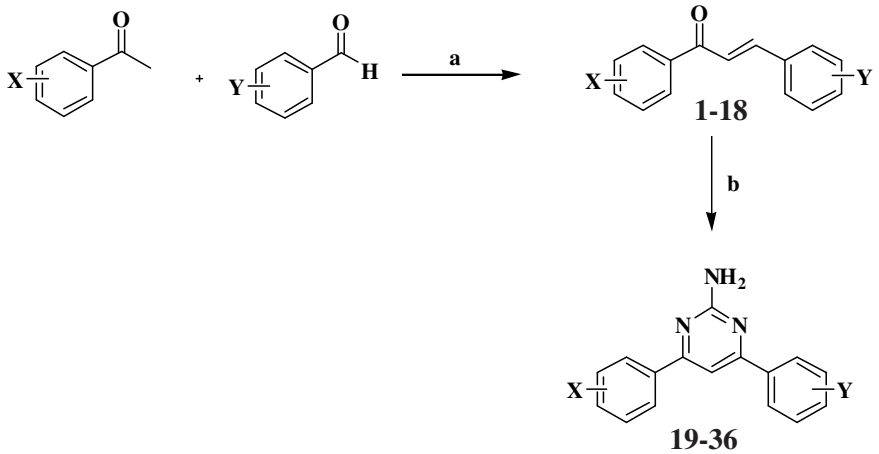
The ^{13}C NMR spectrum of 2-amino-4,6-diphenyl pyrimidine showed characteristic peaks at 102.2, 164.4 and 158.7 ppm for pyrimidine ring carbons and at 125.9-130.9 for aromatic ring carbons.

The interpretation of IR, Mass, NMR spectral data and physical constants confirmed the structure of 2-amino-4,6-diphenyl pyrimidine as follows:



Yield (75 %, yellow crystals); m.p. 137-139 °C; IR (KBr, ν_{max}, cm^{-1}): 3475 $\nu_{as}(NH_2)$, 3372 $\nu_s(NH_2)$, 1535 (pyrimidin-skeletal), 1580 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.34-3.43 (bs, 2H, NH_2), 6.82 (s, 1H, H-5), 7.27-7.57 (m, 9H, ArH); δ_C ppm (DMSO-d_6): 102.2 (C-5), 158.7 (C-2), 125.9-130.9 (ArC); MS (EI): 247 (100 %), 205, 103, 77, 51; Anal. calcd. (%) for $C_{16}H_{13}N_3$: C, 77.71; H, 5.30; N, 16.99; found (%) C, 78.21; H, 5.32; N, 17.01.

For the synthesis and structure elucidation of pyrimidines (**20-36**), the same experimental procedure as described for the synthesis of pyrimidine (**19**) was adopted (**Scheme-I**). However, instead of 1,3-diphenyl propenone, variably substituted 1,3-diphenyl propenones were used (Table-1).



Scheme-I: Reagents and conditions: (a) 10 % NaOH, ethanol, 0 °C RT, 3-4 h, stir; (b) i- guanidinium hydrochloride, 50 % KOH, EtOH, reflux, 3-4 h, ii- 30 % H_2O_2.

TABLE-1
STRUCTURE OF PROPENONES FOR THE SYNTHESIS OF PYRIMIDINES **19-36**

Compd. No.	Substituent		Name of propenone used
	X	Y	
19	H	H	1,3-Diphenyl propenone
20	H	F	1-Phenyl-3-(4'-fluoro)phenyl propenone
21	H	Cl	1-Phenyl-3-(4'-chloro)phenyl propenone
22	H	Br	1-Phenyl-3-(4'-bromo)phenyl propenone
23	H	OCH_3	1-Phenyl-3-(4'-methoxy)phenyl propenone
24	H	NO_2	1-Phenyl-3-(4'-nitro)phenylpropenone
25	Br	H	1-(4'-Bromo)phenyl-3-phenyl propenone
26	Br	F	1-(4'-Bromo)phenyl-3-(4"-fluoro)phenyl propenone
27	Br	Cl	1-(4'-Bromo)phenyl-3(4"-chloro)phenyl propenone
28	Br	Br	1-(4'-Bromo)phenyl-3-(4"-bromo)phenyl propenone
29	Br	OCH_3	1-(4'-Bromo)phenyl-3-(4"-methoxy)phenyl propenone
30	Br	NO_2	1-(4'-Bromo)phenyl-3-(4"-nitro)phenyl propenone
31	Cl	H	1-(4'-Chloro)phenyl-3-phenyl propenone
32	Cl	F	1-(4'-Chloro)phenyl-3-(4"-fluoro)phenyl propenone
33	Cl	Cl	1-(4'-Chloro)phenyl-3-(4"-chloro)phenyl propenone
34	Cl	Br	1-(4'-Chloro)phenyl-3-(4"-bromo)phenyl propenone
35	Cl	OCH_3	1-(4'-Chloro)phenyl-3-(4"-methoxy)phenyl propenone
36	Cl	NO_2	1-(4'-Chloro)phenyl-3-(4"-nitro)phenyl propenone

2-Amino-4-(4'-fluoro)phenyl-6-phenyl pyrimidine (20): Yield (74 %, dark yellow crystals); m.p. 108-110 °C; IR (KBr, ν_{max}, cm^{-1}): 3550 $\nu_{as}(NH_2)$, 3432 $\nu_s(NH_2)$, 1530 (pyrimidine-skeletal), 1550 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.33-3.47 (bs, 2H, NH_2), 6.71 (s, 1H, H-5), 7.03-7.48 (m, 9H, ArH); δ_C ppm (DMSO-d_6): 108.0 (C-5), 157.9 (C-2), 125.8-130.2 (ArC); MS (EI): 265 (100 %), 223, 121, 103, 77, 51; Anal. calcd. (%) for $C_{16}H_{12}N_3F$: C, 72.44; H, 4.56; N, 15.84; found (%) C, 73.25; H, 4.58; N, 16.21.

2-Amino-4-(4'-chloro)phenyl-6-phenylpyrimidine (21): Yield (77 %, dark yellow crystals); m.p. 146-148 °C; IR (KBr, ν_{max}, cm^{-1}): 3491 $\nu_{as}(NH_2)$, 3312 $\nu_s(NH_2)$, 1532 (pyrimidine-skeletal), 1554 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.32-3.41 (bs, 2H, NH_2), 6.85 (s, 1H, H-5), 7.22-7.48 (m, 9H, ArH); δ_C ppm (DMSO-d_6): 101.0 (C-5), 155.1(C-2), 124.9-132.1 (ArC); MS (EI): 281 (100 %), 239, 137, 103, 77, 51; Anal. calcd. (%) for $C_{16}H_{12}N_3Cl$: C, 68.21; H, 4.29; N, 14.91; found (%) C, 69.35; H, 4.32; N, 15.06.

2-Amino-4-(4'-bromo)phenyl-6-phenyl pyrimidine (22): Yield (85 %, dark yellow crystals); m.p. 110-112 °C; IR (KBr, ν_{max}, cm^{-1}): 3492 $\nu_{as}(NH_2)$, 3361 $\nu_s(NH_2)$, 1536 (pyrimidine-skeletal), 1589 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.34-3.45 (bs, 2H, NH_2), 6.87 (s, 1H, H-5), 7.27-7.49 (m, 9H, ArH); δ_C ppm (DMSO-d_6): 105.0 (C-5), 150.8 (C-2), 125.6-129.9 (ArC); MS (EI): 325 (100 %), 283, 181, 103, 77, 51; Anal. calcd. (%) for $C_{16}H_{12}N_3Br$: C, 58.91; H, 3.71; N, 12.88; found (%) C, 59.62; H, 3.75 N, 13.16.

2-Amino-4-(4'-methoxy)phenyl-6-phenyl pyrimidine (23): Yield (76 %, light orange crystals); m.p. 158-160 °C; IR (KBr, ν_{max}, cm^{-1}): 3512 $\nu_{as}(NH_2)$, 3465 $\nu_s(NH_2)$,1534 (pyrimidine-skeletal), 1592 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.33-3.43 (bs, 2H, NH_2), 6.78 (s, 1H, H-5), 6.83-7.48 (m, 9H, ArH); δ_C ppm (DMSO-d_6): 107.1 (C-5), 155.0 (C-2), 126.7-134.2 (ArC); MS (EI): 277 (100 %), 235, 133, 103, 77, 51; Anal. calcd. (%) for $C_{17}H_{15}N_3O$: C, 73.63; H, 5.45; N, 15.15; found (%) C, 72.99; H, 5.32; N, 15.65.

2-Amino-4-(4'-nitro)phenyl-6-phenyl pyrimidine (24): Yield (71 %, orangish red crystals); m.p. 120-122 °C; IR (KBr, ν_{max}, cm^{-1}): 3365 $\nu_{as}(NH_2)$, 3292 $\nu_s(NH_2)$, 1531 (pyrimidine-skeletal), 1565 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.31-3.42 (bs, 2H, NH_2), 6.90 (s, 1H, H-5), 7.24-8.25 (m, 9H, ArH); δ_C ppm (DMSO-d_6): 104.7 (C-5), 159.3 (C-2), 123.8-135.2 (ArC); MS (EI): 292 (100 %), 250, 148, 103, 77, 51; Anal. calcd. (%) for $C_{16}H_{12}N_4O_2$: C, 65.75; H, 4.14; N, 19.17; found (%) C, 66.01; H, 4.09; N, 19.25.

2-Amino-4-phenyl-6-(4''bromo)phenyl pyrimidine (25): Yield (75 %, Dark yellow crystals); m.p. 110-112 °C; IR (KBr, ν_{max}, cm^{-1}): 3490 $\nu_{as}(NH_2)$, 3309 $\nu_s(NH_2)$, 1531 (pyrimidine-skeletal), 1565 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.34-3.46 (bs, 2H, NH_2), 6.81 (s, 1H, H-5), 7.27-7.49 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 104.7 (C-5), 151.2 (C-2), 125.6-129.9 (ArC); MS (EI): 325 (100 %), 283, 181, 155, 103, 77, 51; Anal. calcd. (%) for $C_{16}H_{12}N_3Br$: C, 58.91; H, 3.71; N, 12.88; found (%) C, 59.60; H, 3.70 N, 13.16.

2-Amino-4-(4'-fluoro)phenyl-6-(4''-bromo)phenyl pyrimidine (26): Yield (70 %, dark orange crystals); m.p. 153-155 °C; IR (KBr, ν_{max}, cm^{-1}): 3545 $\nu_{as}(NH_2)$, 3492 $\nu_s(NH_2)$,1543 (pyrimidine-skeletal), 1578 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.31-3.42 (bs, 2H, NH_2), 6.87 (s, 1H, H-5), 7.03-7.49 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 109.9 (C-5), 156.5 (C-2), 125.9-133.7 (ArC) ; MS (EI): 343 (100 %), 301, 181, 155, 121, 95, 76, 50; Anal. calcd. (%) for $C_{16}H_{11}N_3BrF$: C, 55.83; H, 3.22; N, 12.21; found (%) C, 54.73; H, 3.21; N, 13.31.

2-Amino-4-(4'-chloro)phenyl-6-(4''-bromo)phenyl pyrimidine (27): Yield (73 %, orangish red crystals); m.p. 183-185 °C; IR (KBr, ν_{max}, cm^{-1}: 3562 $\nu_{as}(NH_2)$, 3440 $\nu_s(NH_2)$, 1547 (pyrimidine-skeletal), 1567 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.36-3.40 (bs, 2H, NH_2), 6.79 (s, 1H, H-5), 7.33-7.49 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 103.4 (C-5), 159.0 (C-2), 126.9-136.1 (ArC); MS (EI): 359(100 %), 317, 181, 155, 137, 111, 75, 49; Anal. calcd. (%) for $C_{16}H_{11}N_3BrCl$: C, 53.29; H, 3.07; N, 11.65; found (%) C, 54.19; H, 3.11; N, 12.65.

2-Amino-4-(4'-bromo)phenyl-6(4''-bromo)phenyl pyrimidine (28): Yield (70 %, dark orange crystals); m.p. 127-129 °C; IR (KBr, ν_{max}, cm^{-1}): 3495 $\nu_{as}(NH_2)$, 3352 $\nu_s(NH_2)$, 1548 (pyrimidine-skeletal), 1596 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.37-3.41 (bs, 2H, NH_2), 6.74 (s, 1H, H-5), 7.37-7.49 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 106.7 (C-5), 156.6 (C-2), 125.9-137.6 (ArC); MS (EI): 403 (100 %). 361, 181, 155, 76, 50; Anal. calcd. (%) for $C_{16}H_{11}N_3Br_2$: C, 47.44; H, 2.74; N, 10.37; found (%) C, 48.25; H, 2.94; N, 11.36.

2-Amino-4-(4'-methoxy)phenyl-6-(4''-bromo)phenyl pyrimidine (29): Yield (78 %, dark orange crystals); m.p. 180-182 °C; IR (KBr, ν_{max}, cm^{-1}): 3516 $\nu_{as}(NH_2)$, 3429 $\nu_s(NH_2)$, 1546 (pyrimidine-skeletal), 1587 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.35-3.42 (bs, 2H, NH_2), 6.83 (s, 1H, H-5), 6.89-7.49 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 102.4 (C-5), 157.2 (C-2), 122.9-136.3 (ArC); MS (EI): 355 (100 %), 313, 181, 155, 133, 107, 76, 50; Anal. calcd. (%) for $C_{17}H_{14}N_3OBr$: C, 57.32; H, 3.96; N, 41.80; found (%) C, 58.12; H, 3.93; N, 42.08.

2-Amino-4-(4'-nitro)phenyl-6-(4''-bromo)phenyl pyrimidine (30): Yield (73 %, red crystals); m.p. 162-164 °C; IR (KBr, ν_{max}, cm^{-1}): 3515 $\nu_{as}(NH_2)$, 3437 $\nu_s(NH_2)$, 1544 (pyrimidine-skeletal), 1595 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.37-3.44 (bs, 2H, NH_2), 6.80 (s, 1H, H-5), 7.37-8.25 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 111.3 (C-5), 158.3 (C-2), 123.9-138.7 (ArC); MS (EI): 370 (100 %), 328, 181, 155, 148, 122, 76, 50; Anal. calcd. (%) for $C_{16}H_{11}N_4O_2Br$: C, 51.77; H, 2.99; N, 15.09; found (%) C, 52.65; H, 3.01; N, 15.29.

2-Amino-4-phenyl-6-(4''-chloro)phenyl pyrimidine (31): Yield (76 %, dark yellow crystals); m.p. 146-148 °C; IR (KBr, ν_{max}, cm^{-1}): 3489 $\nu_{as}(NH_2)$, 3359 $\nu_s(NH_2)$, 1529 (pyrimidine-skeletal), 1565 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.32-3.41 (bs, 2H, NH_2), 6.77 (s, 1H, H-5), 7.21-7.48 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 101.2 (C-5), 155.5 (C-2), 124.9-132.1 (ArC); MS (EI): 281 (100 %), 239, 137, 111, 103, 77, 51; Anal. calcd. (%) for $C_{16}H_{12}N_3Cl$: C, 68.21; H, 4.29; N, 14.91; found (%) C, 69.35; H, 4.32; N, 15.06.

2-Amino-4-(4'-fluoro)phenyl-6-(4''-chloro)phenyl pyrimidine (32): Yield (75 %, light orange crystals); m.p. 139-142 °C; IR (KBr, ν_{max}, cm^{-1}): 3495 $\nu_{as}(NH_2)$, 3362 $\nu_s(NH_2)$,1534 (pyrimidine-skeletal), 1573 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.35-3.48 (bs, 2H, NH2), 6.91 (s, 1H, H-5), 7.03-7.47 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 109.2 (C-5), 153.6 (C-2), 127.9-138.8 (ArC); MS (EI): 299 (100 %), 257, 137, 121, 111, 95, 76, 50; Anal. calcd. (%) for $C_{16}H_{11}N_3ClF$: C, 64.11; H, 3.70; N, 14.02; found (%) C, 64.18; H, 3.76; N, 14.22.

2-Amino-4-(4'-chloro)phenyl-6-(4''-chloro)phenyl pyrimidine (33): Yield (80 %, light orange crystals); m.p. 157-159 °C; IR (KBr, ν_{max}, cm^{-1}): 3492 $\nu_{as}(NH_2)$, 3345 $\nu_s(NH_2)$, 1545 (pyrimidine-skeletal), 1584 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.34-3.46 (bs, 2H, NH_2), 6.81 (s, 1H, H-5), 7.27-7.49 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 107.2 (C-5), 159.7 (C-2), 124.9-130.1 (ArC); MS (EI): 315 (100 %), 273, 137, 111, 75, 49; Anal. calcd. (%) for $C_{16}H_{11}N_3Cl_2$: C, 60.78; H, 3.51; N, 13.29; found (%) C, 61.38; H, 3.56; N, 13.55.

2-Amino-4-(4'-bromo)phenyl-6-(4''-chloro)phenyl pyrimidine (34): Yield (75 %, dark orange crystals); m.p. 183-185 °C; IR (KBr, ν_{max}, cm^{-1}): 3557 $\nu_{as}(NH_2)$, 3442 $\nu_s(NH_2)$, 1532 (pyrimidine-skeletal), 1566 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.31-3.42 (bs, 2H, NH_2), 6.87 (s, 1H, H-5), 7.03-7.49 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 104.7 (C-5), 151.2 (C-2), 125.6-129.9 (ArC); MS (EI): 359 (100 %), 317, 181, 155, 137, 111, 76, 50; Anal. calcd. (%) for $C_{16}H_{11}N_3BrCl$: C, 53.29; H, 3.07; N, 11.65; found (%) C, 54.19; H, 3.11; N, 12.65.

2-Amino-4-(4'-methoxy)phenyl-6-(4''-chloro)phenyl pyrimidine (35): Yield (73 %, light orange crystals); m.p. 148-150 °C; IR (KBr, ν_{max}, cm^{-1}): 3498 $\nu_{as}(NH_2)$, 3335 $\nu_s(NH_2)$,1530 (pyrimidine-skeletal), 1593 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.36-3.40 (bs, 2H, NH_2), 6.79 (s, 1H, H-5), 7.33-7.49 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 109.9 (C-5), 156.5 (C-2), 125.9-133.7 (ArC); MS (EI): 311 (100 %), 269, 137, 133, 111, 107, 76, 50; Anal. calcd. (%) for $C_{17}H_{14}N_3OCl$: C, 65.49; H, 4.53; N, 13.48; found (%) C, 65.79; H, 4.68; N, 13.82.

2-Amino-4-(4'-nitro)phenyl-6-(4''-chloro)phenyl pyrimidine (36): Yield (77 %, red crystals); m.p. 147-149 °C; IR (KBr, ν_{max}, cm^{-1}): 3496 $\nu_{as}(NH_2)$, 3312 $\nu_s(NH_2)$, 1557 (pyrimidine-skeletal), 1582 $\nu_{as}(C_{Ar}\ C_{Ar})$; δ_H ppm (DMSO-d_6): 3.39-3.48 (bs, 2H, NH_2), 6.91 (s, 1H, H-5), 7.13-7.47 (m, 8H, ArH); δ_C ppm (DMSO-d_6): 103.4 (C-5), 159.0 (C-2), 126.9-136.1 (ArC); MS (EI): 326 (100 %), 284, 148, 137, 122, 111, 76, 50; Anal. calcd. (%) for $C_{16}H_{11}N_4O_2Cl$: C, 58.82; H, 3.39; N, 17.15; found (%) C, 58.97; H, 3.48; N, 17.65.

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