Synthesis and reactivity of N-[3-amino-4-(benzoxazol-2-yl)pyrazol-5-yl]phenylamine

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Pyrazolo[5,1-*a*]pyrimidines and pyrazolo[5,1-c][1,2,4]triazines containing benzooxazole moiety are synthesised from *N*-[3-amino-4-(benzoxazol-2-yl)pyrazol-5-yl]phenylamine or its diazonium chloride with the appropriate active methylene compounds. The newly synthesised compounds were elucidated by elemental analysis, spectral data and alternative synthetic route whenever possible.

Keywords: pyrazolo[5,1-*a*]pyrimidines, pyrazolo[5,1-c][1,2,4]triazines, benzoxazoles, activated nitriles

Benzoxazoles have been extensively studied for their antibacterial and antifungal activity,[1,2] anticancer activity,[3] and also as new non-nucleoside topoisomerase I poisons[4] and HIV-1 reverse transcriptase inhibitors.[5,6] Benzoxazoles are also interesting fluorescent probes that show high Stokes shift and present thermal and photophysical stability due to an excited state intramolecular proton transfer mechanism.[7] They interfere with the biosynthesis of coloured carotenoids by inhibiting the enzyme phytoene desaturase so they are studied as potential bleaching herbicides.[8] Benzoxazoles can be considered as structural isosteres of the naturally occurring nucleic bases adenine and guanine, which allow them to interact easily with polymers of living systems. They have shown low toxicity in warm-blooded animals.[9]

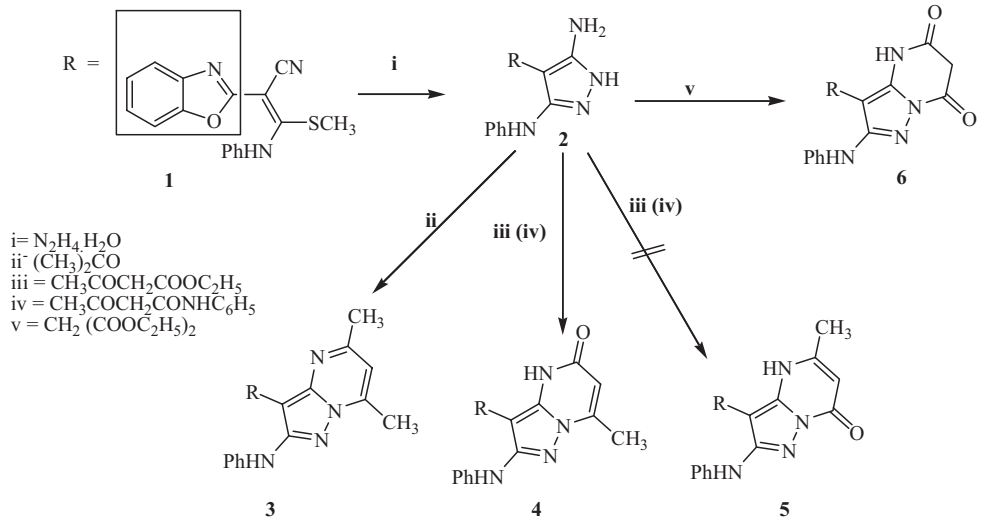
Results and discussions

2-(Benzoxazol-2-yl)-3-(phenylamino)-3-(methylsulfanyl) propenenitrile (**1**[10]) reacted with hydrazine hydrate to afford *N*-[3-amino-4-(benzoxazol-2-yl)pyrazol-5-yl]phenylamine (**2**) in a good yield. Treatment of **2** with pentane-2,4-dione in acetic acid under reflux gave *N*-[3-(benzoxazol-2-yl)-5,7-dimethylpyrazolo[1,5-*a*]pyrimidin-2-yl]phenylamine (**3**) Scheme 1. Structure **3** was confirmed on the basis of elemental analysis and spectral data. Thus, ^{1}H NMR spectrum of **3** showed signals at δ = 2.65 (s, 3H, CH_3), 2.75 (s, 3H, CH_3), 3.45 (s, 1H, pyrimidine C-5), 7.0–7.95 (m, 9H, ArHs) and 9.75 (s, 1H, NH). Its IR spectrum revealed bands at 3301 (NH), 1639 (C=N) and 1602 (C=C).

Similarly, **2** reacted with ethyl acetoacetate in acetic acid under reflux to afford 3-(benzoxazol-2-yl)-7-methyl-2-(phenylamino)-4,5-dihydropyrazolo[1,5-a]pyrimidin-5-one (**4**). Structure **4** was elucidated by elemental analysis, spectral data, and alternative synthesis. Thus, ^{1}H NMR spectrum of **4** showed signals at δ = 2.40 (s, 3H, CH_3), 5.57 (s, 1H, CH), 6.95–7.80 (m, 10H, ArHs and OH) and 9.15 (s, 1H, NH). Its IR (cm^{-1}) spectrum revealed bands at 3324 (NH), 1677 (CO), 1643 (C=N) and 1598(C=C). Thus, compound **2** reacted also with acetoacetanilide to afford product identical in all aspects (m.p., mixed m.p. and spectra) with **4**.

Analogously, compound **2** reacted with diethyl malonate afforded 3-(benzoxazol-2-yl)-2-(phenylamino)pyrazolo[1,5-*a*] pyrimidine-5,7(4*H*,6*H*)-dione (**6**). Structure **6** was confirmed on the basis of elemental analysis and spectral data. Thus, IR (cm^{-1}) spectrum of **6** revealed bands at 3428 (OH), 3313 (NH), 1704 (CO) and 1598 (C=C). Its ^{1}H NMR (δ ppm) spectrum showed signals at δ = 3.75 (s, 1H,), 3.80 (s, 1H), 6.55–7.85 (m, 10H), and 8.75 (s, 1H, NH).

On the other hand, compound **2** reacted with benzylidenemalononitrile in ethanol under reflux to give 7-amino-3-(benzoxazol-2-yl)-5-phenyl-2(phenyl-amino)-4,5-dihydropyrazolo[1,5-*a*]pyrimidine-6-carbonitrile (**7**) Scheme 2. Structure of **7** was confirmed by elemental analysis, spectral data, and alternative synthesis. Thus, ^{1}H NMR spectrum of **7** showed signals at δ = 5.45 (s, 1H), 5.48 (s, 1H), 6.24 (s, 2H, NH_2), 7.24–7.66 (m, 14H, ArHs) and 8.58 (s, 1H, NH). IR spectrum of **7** revealed bands at 3455, 3305 (NH_2),



Scheme 1

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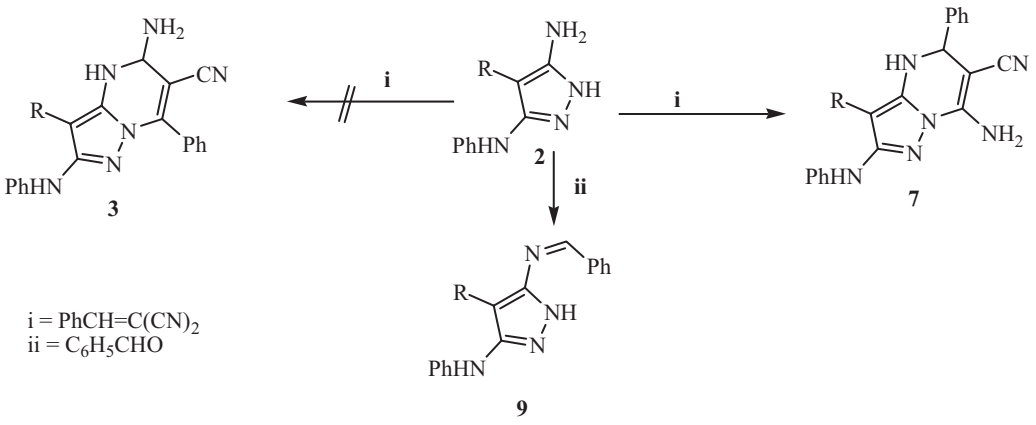


Scheme 2

2188 (CN), 1600 (C=N). Its mass spectrum showed peaks *m/z* = 445, 368, 291, 77. Also, a stirred mixture of **2**, malononitrile and benzaldehyde in ethanol containing piperidene as a catalyst gave products identical in all aspects (m.p., mixed m.p. and spectra) with **7** (Scheme 2).

Thus, malononitrile reacted with *N*-[5-(1-aza-2-phenylvinyl)-4-(benzoxazol-2-yl)-1*H*-pyrazol-3yl]phenylamine (**9**) in ethanol containing piperidene to afford product identical in all aspects (m.p., mixed m.p. and spectra) with **7** (Scheme 2). The formation of the product can be explained via addition of the exo NH to the α,β-unsaturated nitrile through Michael adduct which readily cyclised to the final product **7**.

Treatment of amine **2** with ethyl α-cyanocinnamate in ethanol containing piperidine afforded one isolable product; seem to be one from structures **10–13** (Scheme 3). Thus, IR spectrum of the product revealed bands at 3440 (OH), 2206 (CN) and 1612 (C=N). Its ^{1}H NMR spectrum showed signals at δ = 6.91–8.07 (m, 16H, ArHs and 2NH), and 9.37 (s, 1H, OH). Also, ethyl cyanoacetate reacted with **9** in ethanol containing piperidine to afford product identical in all aspects (m.p., mixed m.p. and spectra) with **10**. The formation of product **10** can be explained via addition of one molecule of amine to ethyl α-cyanocinnamate (via Michael addition) which, readily cyclised through elimination of ethanol to give 3-(benzoxazol-2-yl)-7-oxo-5-phenyl-2-(phenylamino)-4,5,6,7-tetrahydropyrazolo[1,5-*a*]pyrimidine-6-carbonitrile (**10**).

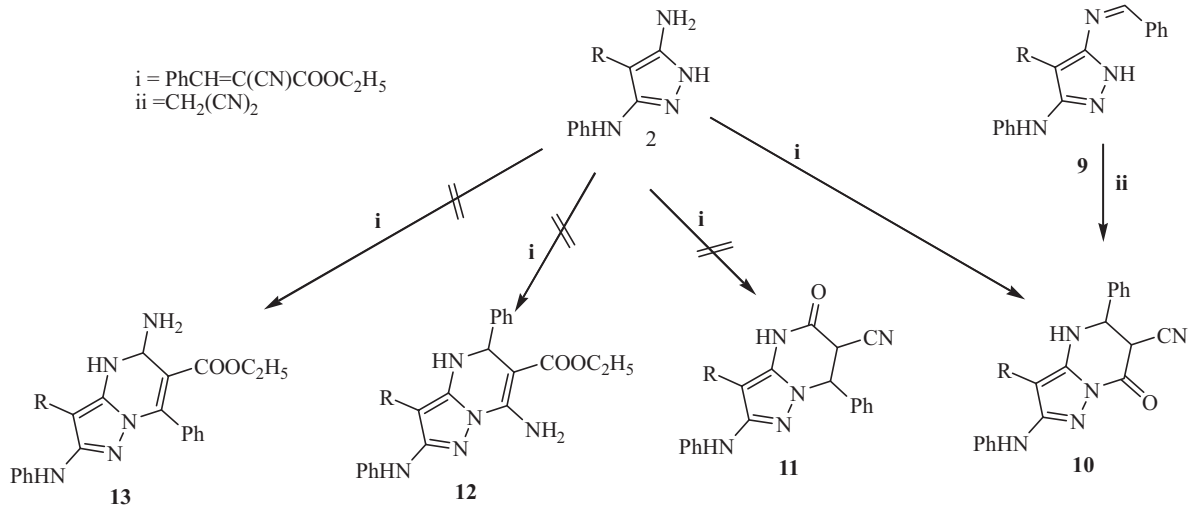
Compound **2** reacted with nitrous acid to give the corresponding diazonium chloride **14** which coupled with the appropriate 2,4-pentanedione, ethyl acetoacetate, malononitrile or ethyl cyanoacetate in ethanolic sodium acetate solution to afford pyrazolo[5,1-*c*][1,2,4]-triazines **15–18**, respectively (Scheme 4).

Structures **15–18** were confirmed by elemental analysis and spectral data. Thus, ^{1}H NMR spectrum of **15** showed signals at δ = 2.25 (s, 3H, CH_3), 2.67 (s, 3H, CH_3), 7.31–8.31 (m, 9H, ArHs) and 9.52 (s, br, 1H, NH). Its mass spectrum showed peaks *m/z* 384 (100%), 274 (26.1%) and 77 (43%).

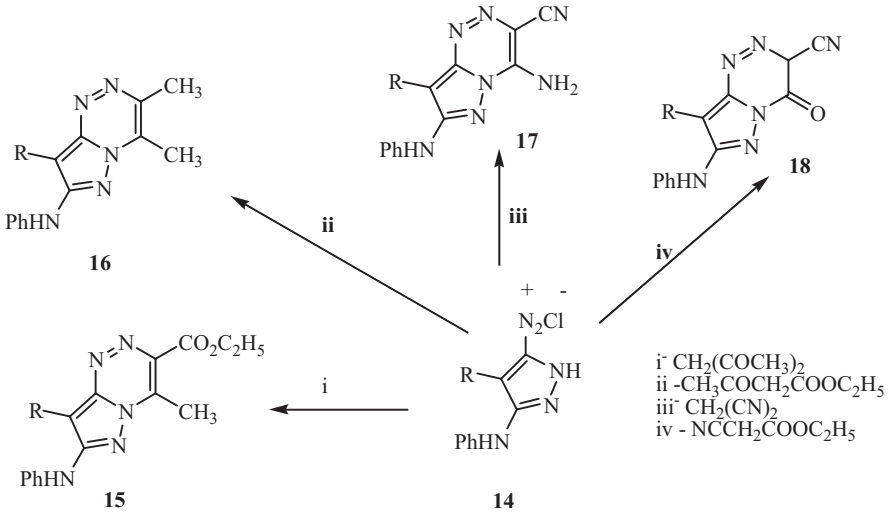
Also, 2-(benzoxazol-2-yl)ethanenitrile (**19**) reacted with ethyl 2-chloro-2-(phenylhydrazono)-2-acetate **20a** in presence of sodium ethoxide to afford ethyl 5-amino-4-(benzoxazol-2-yl)-1-phenylpyrazole-3-carboxylate (**21a**) (Scheme 5). Structure **21a** was elucidated by elemental analysis and spectral data. Thus, IR spectrum of **21a** revealed bands at 3382, 3293 (NH_2), 2967 (C-H, aliphatic), 1718 (CO, ester) and 1627 (C=N). Its ^{1}H NMR spectrum showed signals at δ = 1.45 (t, 3H, $CH_2C\underline{H}_3$), 4.50 (q, 2H, $C\underline{H}_2CH_3$), 5.96 (s, br, 2H, NH_2, exchangeable) and 7.26–7.68 (m, 9H, ArHs).

Analogously, the appropriate hydrazonoyl halides **20b–d** reacted with **19** in ethanolic sodium ethoxide solution to give 4-aminopyrazole derivatives **21b–d**, respectively.

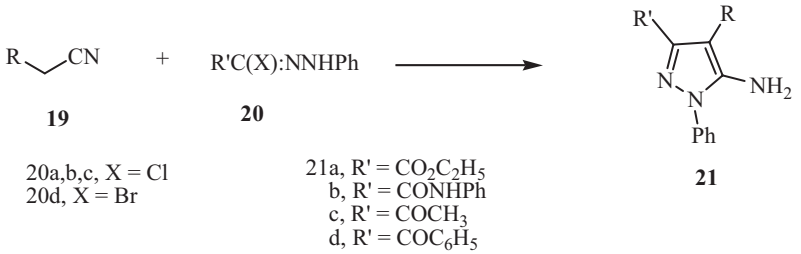
2-(Benzoxazol-2-yl)ethanenitrile (**19**) reacted with the appropriate diazonium chloride **22a–d** in ethanolic sodium acetate solution to afford the hydrazones **23a–d**, respectively. Structure **23** was confirmed by elemental analysis, spectral data and chemical transformation. IR spectrum of **23b** revealed bands near 3400 (NH) and 2223 (CN). Its ^{1}H NMR spectrum showed signals at δ = 2.31 (s, 3H, CH_3), 7.22–7.77 (m, 8H, ArHs) and 9.34 (s, 1H, NH). Thus, compounds **23a–c** reacted



Scheme 3



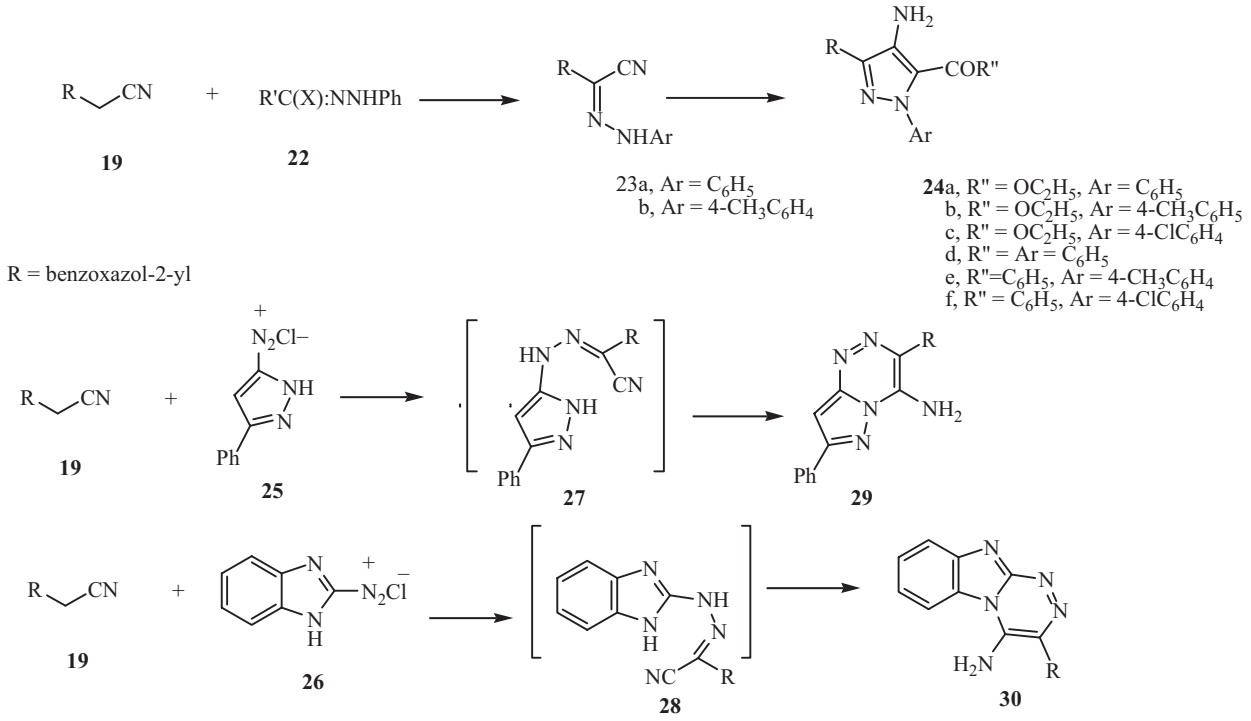
Scheme 4



Scheme 5

with each of ethyl chloroacetate and ω-bromoacetophenone in *N,N*-dimethylformamide containing potassium carbonate and triethylamine to give the aminopyrazoles **24a–f**, respectively (Scheme 6). Structure of **24** was elucidated by elemental analysis and spectral data. Thus, IR spectrum of **24a–c** revealed bands near 3460, 3340 (NH_2) and 1712–1654 (CO). ^{1}H NMR spectrum of **24a** showed signals at δ = 1.15 (t, 3H, CH_2CH_3), 4.22 (q, 2H, CH_2CH_3), 5.25 (s, br, 2H, NH_2, exchangeable) and 7.20-7.55 (m, 9H, ArHs).

In contrast, diazotised 3-amino-5-phenylpyrazole **25** and diazotised 2-aminobenzimidazole **26** reacted with 2-(benzoxazol-2-yl)ethanenitrile (**19**) in ethanolic sodium acetate



Scheme 6

Table 1 Characterisation data of the newly synthesised compound

Compd no.	M.p./°C Solvent	Yield/% Colour	Mol. formula Mol. wt.	% Analyses, Calcd./Found		
				C	H	N
3	> 350	53	$C_{21}H_{17}N_5O$	70.97	4.82	19.711
	Ethanol	Colourless	355.40	71.10	4.50	9.59
4	> 350	64	$C_{20}H_{15}N_5O_2$	67.22	4.23	19.60
	DMF	Colourless	357.35	67.00	4.20	19.51
6	233–235	63	$C_{19}H_{13}N_5O_3$	63.51	3.65	19.49
	Ethanol	Colourless	359.32	63.60	3.70	19.10
7	281–283	85	$C_{26}H_{19}N_7O$	70.10	4.30	22.01
	Benzene	Yellow	445.49	70.00	4.00	21.90
9	196–199	63	$C_{23}H_{17}N_5O$	72.82	4.52	18.46
	Benzene-pet.	Yellow	379.42	72.60	4.80	18.62
10	246–249	87	$C_{26}H_{18}N_6O_2$	69.95	4.06	18.82
	Ethanol	Yellow	446.47	69.90	4.00	18.50
15	275–277	62	$C_{21}H_{16}N_6O_2$	65.62	4.20	21.86
	Dioxan	Orange	384.40	65.30	4.00	21.51
16	163–165	67	$C_{22}H_{18}N_6O_3$	63.76	4.38	20.28
	Ethanol	Yellow	414.43	63.42	4.11	19.98
17	> 300	62	$C_{19}H_{12}N_8O$	61.95	3.28	30.42
	Dioxan	Yellow	368.36	61.80	3.08	30.46
18	270–271	62	$C_{19}H_{11}N_7O_2$	61.79	3.00	26.55
	Benzene	Yellow	369.35	61.52	2.91	26.31
21a	98	55	$C_{19}H_{16}N_4O_3$	65.51	4.63	16.08
	n-hexan	Pale yellow	348.36	65.80	4.30	16.00
21b	210–122	53	$C_{23}H_{17}N_5O_2$	69.86	4.33	17.71
	Ethanol	Pale yellow	395.42	69.80	4.12	17.52
21c	151–152	53	$C_{18}H_{14}N_4O_2$	67.92	4.43	17.60
	Ethanol	Pale yellow	318.43	67.53	4.23	17.43
21d	248–250	65	$C_{23}H_{16}N_4O_2$	72.60	4.24	14.73
	Benzene	Colourless	380.163	72.40	4.50	14.60
23a	185–187	53	$C_{15}H_{10}N_4O$	68.69	3.84	21.36
	Ethanol	Yellow	262.27	68.35	3.40	21.21
23b	213–215	57	$C_{16}H_{12}N_4O$	69.55	4.38	20.28
	Ethanol	Yellow	276.30	69.40	4.50	20.31
23c	192–193	70	$C_{15}H_9N_4OCl$	60.72	3.06	18.88
	Ethanol	Yellow	296.72	60.50	3.40	18.63
23d	195–197	45	$C_{20}H_{16}N_6O_2$	64.51	4.33	22.57
	Ethanol	Yellow	372.39	64.30	4.10	22.50
24a	236–239	68	$C_{19}H_{16}N_4O_3$	65.51	4.63	16.08
	Benzene	Yellow	348.36	65.50	4.70	16.12
24b	230–233	63	$C_{20}H_{18}N_4O_3$	66.29	5.01	15.46
	Benzene	Yellow	362.39	66.80	4.80	15.99
24c	255–257	67	$C_{19}H_{15}N_4O_3Cl$	59.62	3.95	14.64
	Benzene	Yellow	382.81	59.64	4.00	14.59
24d	190–192	76	$C_{23}H_{16}N_4O_2$	72.62	4.24	14.73
	Benzene	Yellow	380.41	72.58	4.13	14.35
24e	228–29	63	$C_{24}H_{18}N_4O_2$	73.08	4.60	14.20
	Ethanol	Yellow	394.44	73.10	4.51	14.11
24f	207–209	65	$C_{23}H_{15}N_4O_2Cl$	66.59	3.46	13.51
	Ethanol	Yellow	414.85	66.74	3.49	13.42
29	356–358	65	$C_{18}H_{12}N_6O$	65.85	3.68	25.60
	Dioxan	Yellow	328.34	66.00	3.50	25.59
30	340–341	62	$C_{16}H_{10}N_6O$	63.57	3.33	27.80
	DMF	Yellow	302.30	63.50	3.50	27.59

at 0°C to afford 3-benzoxazol-2-yl-7-phenylpyrazolo[5,1-*c*][1,2,4]triazin-4-amine (**29**) and 3-benzoxazol-2-yl-1,2,4-triazino[4,3-*a*]benzimidazol-4-amine (**30**). Structure of **29** was confirmed on by elemental analysis and spectral data. Thus, IR spectrum of **29** revealed bands at 3350, 3280 (NH_2) and 1637 (C=N). Its ^{1}H NMR spectrum showed signals at δ = 6.20 (s, br, 2H, NH_2, D_2O exchangeable), 6.40 (s, 1H, pyrazole C-4) and 7.31–8.32 (m, 9H, ArHs). IR spectrum of **30** revealed bands at 3380, 3150 (NH_2) and 1630 (C=N). Its ^{1}H NMR spectrum showed signals, which were found to be in a good agreement.

Experimental

N-[3-amino-4-(benzoxazol-2-yl)pyrazol-5-yl]phenylamine (**2**).

A mixture of 2-(Benzoxazol-2-yl)-3-(phenylamino)-3-(methylsulfanyl)propenenitrile (**1**) (1.53 g, 0.005 mol) in absolute ethanol (25 ml) and hydrazine hydrate [0.5 g (0.5 ml), 0.01 mol] was heated under reflux for 3 h, the solid, so formed, was collected and crystallised from ethanol to give **2** (Tables 1 and 2). *N*-[3-(benzoxazol-2-yl)-5,7-dimethylpyrazolo[1,5-*a*]pyrimidin-2-yl]phenylamine (**3**), 3-(benzoxazol-2-yl)-7-methyl-2-(phenylamino)-4,5-dihydropyrazolo[1,5-a]pyrimidin-5-one (**4**) and 3-(benzoxazol-2-yl)-2-(phenylamino) pyrazolo[1,5-*a*]pyrimidine-5,7(4*H*,6*H*)-dione (**6**)

General procedure

A mixture of *N*-[3-amino-4-(benzoxazol-2-yl)pyrazol-5-yl]phenylamine (**2**) (2.91 g, 10 mmol) in acetic acid (10 ml), and the appropriate of pentane-2,4-dione, ethyl acetoacetate (acetoacetanilide) and diethyl malonate (10 mmol), the reaction mixture was refluxed for 4 h and the reaction was left to cool, then poured over ice/water mixture. The resulting solid was filtered off, dried and crystallised from the appropriate solvent to give **3,4** and **6**, respectively (Tables 1 and 2).

N-[5-(1-aza-2-phenylvinyl)-4-(benzoxazol-2-yl)-1*H*-pyrazol-3yl]phenylamine (**9**): A mixture of compound **2** (2.91 g, 10 mmol), and benzaldehyde (1.06 g, 10 mmol) and dry toluene (20 ml) was refluxed for 12 h. The solvent was evaporated and solid so formed was collected and crystallised the product from benzene–petroleum ether to give **9** (Tables 1 and 2).

Table 2 IR and ^{1}H NMR spectra of the some newly synthesis compounds

Compd No.	Spectral data
9	IR (KBr): 3235 (NH) and 1610 (C=N). ^{1}H NMR: 7.21–7.7 (m, 14H, ArHs) and 8.51 (s, 1H, NH).
16	IR (KBr): 3311 (NH), 2921(CH_3), 1718 (C=O) and 1645 (C=N). ^{1}H NMR ($CDCl_3$): 1.3 (t, 3H, $C\underline{H}_3$ CH_2), 3.20 (s, 1H, CH_3), 4.4 (q, 2H, $C\underline{H}_2CH_3$), 7.2–7.9 (m, 10H, ArHs and NH) and 11.3 (s, 1H, NH).
17	IR (KBr): 3297 (NH), 1694 (C=O), 1644 (C=N) and 1600 (C=C).
18	IR (KBr): 3297, 3156 (NH_2) and 2227 (CN). ^{1}H NMR ($CDCl_3$): 7.08–8.9 (m, 9H, ArHs) and 9.40 (s, 1H, NH).
21b	IR (KBr): 3399, 3285 (NH_2), 2925 (CH-aliphatic), 1676 (CO) and 1622 (C=N). ^{1}H NMR ($CDCl_3$): 5.2 (s, br, 2H, NH_2) and 7.10–7.90 (m, 14H, ArHs).
21c	IR (KBr): 3403, 3294 (NH_2), 1653 (CO) and 1621 (C=N). ^{1}H NMR ($CDCl_3$, ä ppm): 2.5 (s, 1H, CH_3), 6.9 (s, 2H, NH_2) and 7.3–7.9 (m, 9H, ArHs).
21d	IR (KBr): 3400–3290 (NH_2), 1650 (CO). ^{1}H NMR ($CDCl_3$): 6.9 (s, 2H, NH_2) and 7.3–7.7 (m, 14H, ArHs).
23b	IR (KBr): 2223 (CN) and 1608 (C=N). ^{1}H NMR ($CDCl_3$): 2.31 (s, 3H, CH_3), 7.23–7.77 (m, 8H, ArHs) and 9.34 (s, 1H, NH).
23c	IR (KBr): 2231 (CN), 1604 (C=N). ^{1}H NMR ($CDCl_3$): 7.22–7.70 (m, 9H, ArHs) and 9.34 (s, 1H, NH).
23d	IR (KBr): 2220 (CN), 1700 (C=O), 1664 (C=N).
24b	IR (KBr): 3459, 3349 (NH_2) and 1640 (CO). ^{1}H NMR (ä $CDCl_3$): 1.21 (t, 3H, CH_3-CH_2), 2.35 (s, 3H, p-CH_3), 4.22 (q, 2H, CH_2-CH_3), 5.60 (s, 2H, NH_2) and 7.30–7.8 (m, 9H, ArHs).
24c	IR (KBr): 3498, 3390 (NH_2) and 1720 (CO). ^{1}H NMR ($CDCl_3$): 1.15 (t, 3H, CH_3-CH_2), 4.22 (q, 2H, CH_2-CH_3), 5.25 (s, 2H, NH_2) and 7.20–7.55 (m, 8H, ArHs).
24d	IR (KBr): 3459, 3349 (NH_2) and 1640 (CO). ^{1}H NMR ($CDCl_3$): 5.15 (s, 2H, NH_2) and 7.20–7.81 (m, 14H, ArHs).
24e	IR (KBr): 3465, 3359 (NH_2) and 1634 (CO). ^{1}H NMR ($CDCl_3$): 2.35 (s, 3H, CH_3), 5.18 (s, 2H, NH_2) and 7.20–7.81 (m, 13H, ArHs).
24f	IR (KBr): 3450, 3249 (NH_2) and 1640 (CO). ^{1}H NMR ($CDCl_3$): 5.55 (s, 2H, NH_2) and 7.20–7.81 (m, 13H, ArHs).
30	IR (KBr, cm^{-1}): 3350, 3280 (NH_2) and 1630 (C=N). ^{1}H NMR ($CDCl_3$): 6.25 (s, 2H, NH_2) and 7.20–7.55 (m, 8H, ArHs).

7-amino-2-(benzoxazol-2-yl)-5-phenyl-2(phenylamino)-4,5-dihydropyrazolo[1,5-a]pyrimidine-6-carbonitrile (**7**): *Method A*: A mixture of **2** (2.91 g, 10 mmol) and 1,1-dicyano-2-phenylethene (1.5 g, 10 mmol), in ethanol (50 ml) with catalytic amount of piperidine (three drops) was refluxed for 3 h. The resulting product was collected by filtration and crystallised from benzene to give **7** (Tables 1 and 2). *Method B*: A mixture of **9** (3.7 g, 10 mmol), malononitrile (0.66 g, 10 mmol) and piperidine (three drops) in ethanol (20 ml) was refluxed for 3 h. The solid, so formed was collected and crystallised from benzene to give product identical in all aspects (m.p., mixed, and spectra) with compound obtained in method A. *Method C*: A mixture of **2** (2.91 g, 10 mmol), benzaldehyde (1.06 g, 10 mmol) and malononitrile (0.66 g, 10 mmol) and piperidine (three drops) in ethanol (10 ml) was refluxed for 4 h. The solid, so formed was collected and crystallised from benzene to give product identical in all aspects (m.p., mixed, and spectra) with compound obtained from each method A or B.

3-(Benzoxazol-2-yl)-7-oxo-5-phenyl-2-(phenylamino)-4,5,6,7-tetrahydropyrazolo[1,5-a]pyrimidine-6-carbonitrile (**10**): A mixture of **2** (2.91 g, 10 mmol), ethyl α-cyanocinnamate (2.01 g, 10 mmol) in ethanol (50 ml) with 3–5 drops piperidine, the reaction mixture was refluxed for 3 h. The resulting solid was collected and recrystallised from ethanol to give **10** (Tables 1 and 2).

Synthesis of pyrazolo[5,1-c][1,2,4]-triazines **15**–**18**: Dissolve **2** (2.91 g, 10 mmol) in hydrochloric acid (6 ml, 6N) and cooled at 0–5°C. Sodium nitrite (0.69 g, 10 mmol) in water (10 ml) was added dropwise while stirring for 10 min. The diazonium salt was added to mixture containing the appropriate of acetylacetone, ethyl acetoacetate, malonitrile or ethyl cyanoacetate and sodium acetate (1.3 g, 10 mmol) in ethanol (50 ml) at 0–5°C, and the reaction mixture was stirred at 0–5°C for 3 h. The solid was collected and crystallised from the appropriate solvent to give compounds **15–18**, respectively (Tables 1 and 2).

Synthesis of 5-aminopyrazole derivatives **21a**–**d**: *General procedure:* The appropriate hydrazonoyl halide **20a-d** (10 mmol) added to a mixture of 2(benzoxazol-2-yl)ethanenitrile (**19**) (1.58 g, 10 mmol) and sodium ethoxide (sodium 0.21 g-atom in ethanol (20 ml)). The above mixture was stirred for 30 min. and left to stand overnight. The solid was collected by and crystallised from the proper solvent to give pyrazoles **21a–d**, respectively (Tables 1 and 2).

Synthesis of 3-aza-2-(benzoxazole-2-yl)-3-(4-substituted)prop-2-enenitrile **23a**–**d**: *General procedure:* To a cold solution of 2-(benzoxazol-2-yl)ethanenitrile (**19**) (1.58 g, 10 mmol) in ethanol (20 ml) containing sodium acetate trihydrate (1.3 g, 10 mmol). The appropriate diazonium chloride, prepared by adding sodium nitrite (0.69 g, 10 mmol in water) to a cold solution of the appropriate aromatic amine (10 mmol) or 4-amino-antiprine in hydrochloric acid (6 ml, 6 N) was added while stirring for 1 h. The resulting solid was collected and recrystallised from ethanol to give compounds **23a-d**, respectively (Tables 1 and 2).

Synthesis of 4-aminopyrazole derivatives **24a**–**f**: *General procedure:* A mixture of the appropriate **23a–c** (10 mmol) in *N,N*-dimethylformamide (20 ml), anhydrous potassium carbonate (2.66 g, 20 mmol), and appropriate weight of ethyl chloroacetate (1.06 ml, 10 mmol) heated at 120°C about 2 h, then cooled at 80–90°C. Triethylamine (1 ml) was added and the reaction mixture was heated at 90°C for 1 h. The reaction mixture was cooled and poured onto ice cold water (150–160 ml). The resulting solid was collected and recrystallised from the proper solvent to give 4-aminopyrazoles **24a–c**, respectively (Tables 1 and 2). Also, using phenacyl bromide (1.9 g, 10 mmol) in stead ethyl chloroacetate, the 4-aminopyrazoles **24e–f** were obtained (Tables 1 and 2).

3-(Benzoxazol-2-yl)-7-phenylpyrazolo[5,1-*c*][1,2,4]triazin-4-yl amine (**29**): Diazotised 3-amino-5-phenylaminopyrazole (**25**) [prepared by adding sodium nitrite solution (0.69 g, 10 mmol) in water (10 ml) to a mixture of aminopyrazole (1.58 g, 10 mmol), hydrochloric acid (6 ml, 6 N) and acetic acid (1 ml) at 0°C] was added to a mixture of (benzoxazole-2-yl)ethanenitril (**19**) (1.58 g, 0.01 mol), sodium acetate (1.3 g) in ethanol (50 ml) at 0–5°C for 1 h. The solid was collected by filtration, washed and with water and crystallised from dioxan to give **29** (Tables 1 and 2).

3-(Benzoxazol-2-yl)-[1,2,4]-triazino[4,3-a]benzimidazol-4-amine (**30**): 2-Aminobenzimidazolediazonium sulfate **26** (10 mmol) was added dropwise to a cold solution of 2-(benzoxazol-2-yl)ethanenitrile (**19**) (1.58 g, 10 mmol) in ethanol (50 ml) containing sodium acetate trihydrate (1.3 g, 10 mmol) while stirring. The reaction mixture was stirred at 0–5°C for 1 h. The resulting product was collected by filtration and recrystallised from *N,N*-dimethylformamide to give **30** (Tables 1 and 2).

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