NEW TETRACYCLIC HETEROAROMATIC RING SYSTEM 3*H*-BENZO[*b*]PYRAZOLO[3, 4-*h*]-1, 6-NAPHTHYRIDINES

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ABSTRACT: Various derivatives of the tetracyclic ring system 3*H*-Benzo[*b*]pyrazolo[3.4-*h*]-1.6-naphthyridine were prepared from 4-anilino-1*H*-pyrazolo[3.4-*b*]pyridine-5- carboxylic acids by intramolecular cyclization employing phophoryl chloride.^{1}H NMR spectra of the various derivatives were recorder.

INTRODUCTION

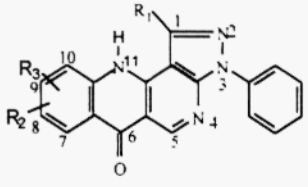
During our investigation on the chemistry of pyrazolo[3.4-*b*]pyridine and thieno[2.3-*b*] and thieno[3.2-*b*]pyridine ring systems. we were able to prepared their derivates which enabled us to build-up some new tri and tetracyclic heteroaromatic system based on pyrazolo[3.4-*b*]pyridine[1,2].

Several new 1H-pyrazolo[3.4-b]pyridine derivatives were prepared and evaluated on the catalytic activity of recombinant reverse transcriptase (RT) of HIV-1 and on the human DNA polymerases α and ε. Some of them inibited the RT activity at micromolar concentrations. whereas they were not able to inhibit the placental DNA polymerase activity[3].

RESULTS AND DISCUSSION

A halogen in the 4- position and an ester group in the 5- position of pyrazolo[3.4-*b*]pyridine reacts readily with nucleophiles[2-3] and is as good precursor for the synthesis of the present ring system. These ethyl 4-chloropyrazolo[3.4-*b*]pyridine-5-carboxylates were either available in our laboratories with could easily be prepared from 5-aminopyrazoles through condensation with diethyl ethoxymethylenemalonate followed by "chlorocyclization" by means of phosphoryl chloride[2b,2c,3,4,5]. These ethyl 4-chloropyrazolo[3.4-*b*]pyridines-5-carboxylates (5- and 6) on fusion with various anilines gave the required ethyl 4-anilinopyrazolo[3.4-*b*]pyridine-5- carboxylates in good yields. Better results (better yields and cleaner products) were however obtained when these reactions were carried out in solvents such as *N.N*- dimethylformamide.
These ethyl 4-anilinopirazolo[3.4-*b*]pyridine-5-carboxilates (7-30) were hydrolyzed to the corresponding acids (31-47) and cyclized to the corresponding derivatives(48-52) of the tetracyclic heteroaromatic system 3*H*-benzo[*b*]pyrazolo[3.4-*h*]-1.6-naphthyridine (scheme 1).
Its was expected that the cyclization step will result in the formation of 6 cloro derivatives of the system but expect for one reaction (54). The various reactions are represented in scheme 1 and the cyclization provided 6-oxo derivatives.
The intermediate "anilino ester" and "anilino acids" were characterised through their element analyses. infrared (IR). ^{1}H nuclear magnetic resonanse (^{1}H NMR) spectra.
The tetracyclic system derivatives spectra (IR. ^{1}H NMR) were in accordance with the structure.

The products (48-53) have been represented here in the "oxo" rather than the "hydroxy" tautomer . This is in conformity with the predominal "oxo" form reported for such related system[3]. The infrared spectra of these compounds strongly supported such an assertion since in all the compounds obtained after cyclization reaction displayed broad absorption bands in the region assigned to NH frequencie (3400 cm^{-1}). This is completed with carbonyl absorption between 1640- 1720 cm^{-1}.



48 - R_1=H R_2= o-Cl
49 - R_1=H R_2= m-Cl
50 - R_1=H R_2= m-Cl
51 - R_1=H R_2= p-Cl
52 - R_1=H R_2= m-Cl R_3= p-Cl
53 - R_1= CH_3, R_2= p-OCH_3

EXPERIMENTAL

The ^1H nuclear magnetic resonance spectra were obtained on a Varian model Unity Plus spectrometer operating at 300 MHz and Brucker AM- 500 spectrometer (TMS as internal standard). Fourier transform infrared (FT IR) absorption spectra were recorded on a Perkin-Elmer mode 727 spectrophotometer. The solid samples were measured as potassium bromide pellets. Elemental analysis were determined on a Perkin- Elmer 240 and are in full agreement with the calculated values. Melting points (m.p) were determined with a Fisher-Johns apparatus and are uncorrected.

Various 3*H*-benzo[***b***]pyrazolo[3.4-***h***]-1.6-naphthyridines obtained during this work as well as the intermediate "anilino esters" and "anilino acids" and their spectral date are presented in table 1- 3.

Ethyl 4- chloro-1-phenyl-1*H*-pyrazolo[3,4-*b*]pyridine-5-carboxilate(5) and ethyl 4- chloro-3 methyl-1-phenyl-1*H*-pyrazolo[3, 4- *b*]pyridine-5-carboxilate(6).

These were prepared according to literature method: 5. m.p.98^{0}C (literature[5] m.p.97-9^{0}C): 6. m.p. 110^{0}C (literature[2 b]. m.p. 110^{0}C).

Ethyl 4- anilino-1-phenyl-1*H*-pyrazolo[3, 4-*b*]pyridine-5-carboxilate (7- 30) .

Method A: An equimolar (5 mmoles) mixture of 5 or 6 and an aniline in 10mL of *N, N*-dimethylformamide (DMF) was heated under reflux for a period of 4 h. The reaction mixture. after cooling. was poured into 50 mL of ice cold water. The precipitated "aniline esters" were filtered. dried and crystallized from an appropriate solvent. The reaction when carried out in xylene gave lower yields of "aniline esters".

Method B: A mixture of 4 mmoles of 6 and 6 mmoles of an aniline was heated in silicone bath at 140^{0}C for 2 h. After cooling the reaction mixture was diluted with water. basified with conc. ammonia and filtered. The residue was crystallized from an appropiate solvent to give the "aniline ester".

4-Anilino-1-phenyl-1*H*-pyrazolo[3,4-*b*]pyridine-4-carboxylic acids (31- 47)

A mixture of 3 mmoles of an "anilino ester". 10 mL of 20% sodium hydroxide solution and 10 mL of ethanol was heated under reflux for an hour to 3 hours. On cooling mixture was acidfied

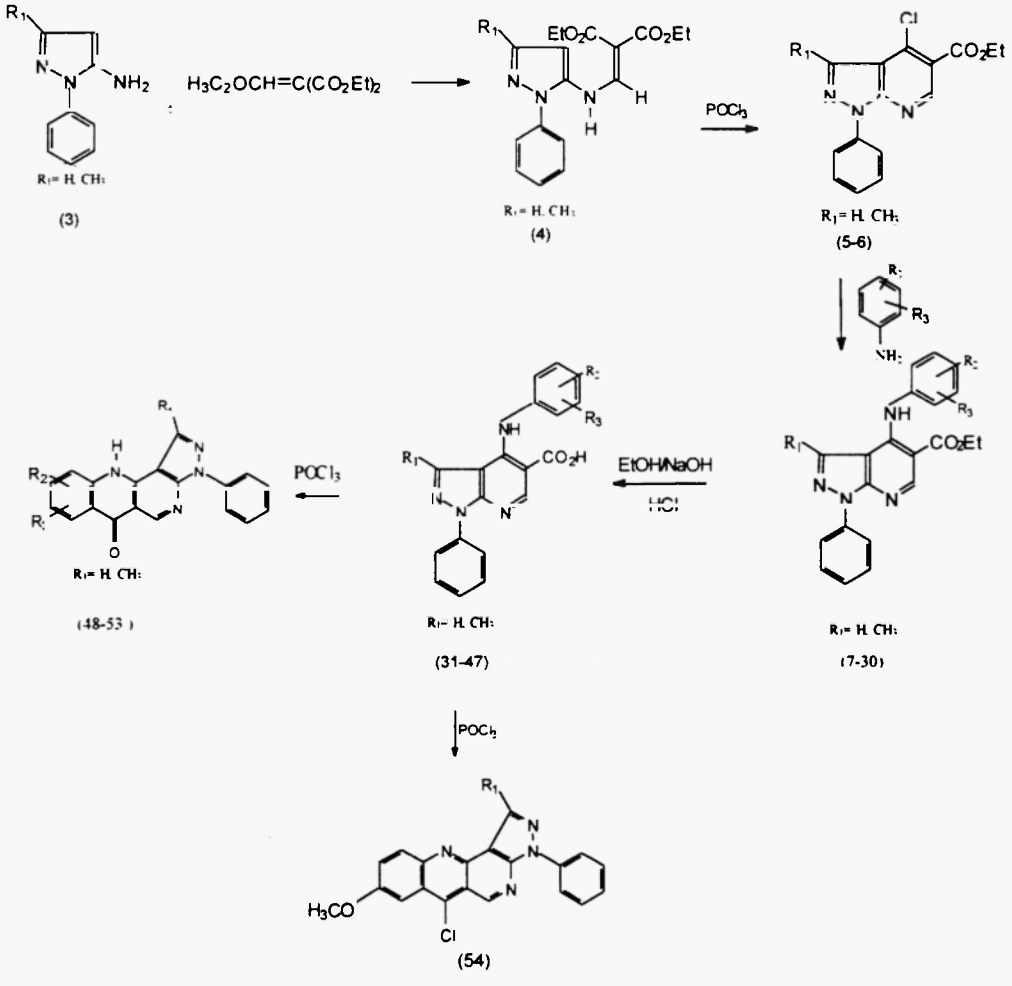
with dilute hydrochloric acid (1: 3). the precipitated "anilino acids" was filtered and crystallized from an appropriate solvent.

3-Phenyl-3*H*, 11*H*-benzo[*b*]pyrazolo[3, 4-h]-1,6-naphthyridin-6-ones (48- 53)

A mixture of 1g of the "anilino" acids and 5 mL of phosphoryl chloride was heated under reflux for 1 h. The reaction mixture was inverted over crushed ice (in some cases the excess of phosphoryl chloride was removed under reduced pressure before inverting over crushed ice) and neutralized with water. dried and crystallized from a suitable solvent.

6-Chloro-3-phenyl-3*H*-benzo[*b*]pyrazolo[3, 4-*h*]-1,6-naphthyridine (54)

In one of the cyclization. a mixture of 0.5g de **46** and 5 mL of phosphoryl chloride was heated under reflux in a round bottom flash fitted with a calcium chloride drying tube. After two hours. the reaction mixture was inverted over crushed ice and filtered to give 0.53g of yellow solid which on TLC plate showed two products. Chromatografy on a silica column allowed the separation. Elution which chloroform gave 54 ($C_{21}H_{13}N_3ClO$) m.p. 230-2^{0}C ; yield 0.212g: 42%: ^{1}H NMR δ($CDCl_3$) : 9.52(1H.s.H-5): 3.04(3H.s.CH_3): 3.94(3H.s.OCH_3): 7.60-8.26(8H.m.arom).



Scheme 1

Table1. Ethyl 4-anilino-1-phenyl-1*H*-pyrazolo[3, 4-*b*]pyridine-5-carboxilate

Compd	Method	Yield	m.p° (from)	Molecular Formula	IR(cm^{-1})	^1H NMR/ δ em ppm(J in Hz) in $CDCl_3$)
7	A	76	188 (EtOH)	$C_{21}H_{18}N_4O_2$	3400(br.NH) 1670(c =O)	1.43(3H, t, J = 7, CH_3);4.41(2H, q, J = 7, CH_2); 6.81(1H, s, H- 3); 7.27- 7.48 e 8.08- 8.10 (10H, m, arom.), 9.04(1H, s, H- 6); 10.61(1H, Br. NH).
8	A	59	180 (EtOH)	$C_{21}H_{20}N_4O_2$	3400(br.NH) 1670(c =O)	1.42(3H,t,J=7,1,CH_3);4.42(2H,q,J=7.10 ,CH_2); 6.81 (1H,s,H-3);8.09(2H,d,J=8.7, H_2-H_6');7.51-7.26 (8H, m,arom.);9.04(1H,s,H-6);10.61(1H,Br NH).
9	A	56	172 (EtOH)	$C_{21}H_{20}N_4O_2$	3400(br.NH) 1670(c =O)	1.43(3H, t, J = 7, CH_3); 2.40(2H, s, H- 3); 4.41(2H, g, J = 7, CH_2); 6.83(1H, s, H- 3); 7.17- 7.50 e 8.07- 8.09 (9H, m, arom.), 9.03(1H, s, H- 6); 10.85(1H, Br. NH).
10	A	80	130 (EtOH)	$C_{22}H_{20}N_4O_2$	3400(br.NH) 1670(c =O)	1.43(3H, t, J = 7, CH_3); 3.78(3H, s, OCH_3); 4.41(2H, g, J = 7, CH_2); 6.94(1H, s, H- 3); 7.01- 7.56 e 8.09- 8.11 (9H, m, arom.), 9.03(1H, s, H- 6); 10.38(1H, Br. NH).
11	A	65	152 (EtOH)	$C_{22}H_{20}N_4O_3$	3400(br.NH) 1720(c =O)	1.43(3H, t, J = 7, CH_3); 3.77(3H, s, OCH_3); 4.41(2H, g, J = 7, CH_2); 6.60(1H, s, H- 3); 7.25- 7.55 e 8.18- 8.20 (9H, m, arom.), 9.03(1H, s, H- 6); 10.63(1H, Br. NH).
12	A	80	130 (EtOH)	$C_{23}H_{20}N_4O_2$	3400(br.NH) 1670(c =O)	1.38(3H, t, J = 7, CH_3); 2.20(3H, s, CH_3); 4.37(2H, g, J = 7, OCH_2CH_3); 7.31(1H, s, H- 3); 7.47- 7.52 e 8.12 - 8.14 (8H, m, arom.); 9.03(1H, s, H- 6); 9.03(1H, Br. NH).
13	A	80	130 (EtOH)	$C_{23}H_{22}N_4O_4$	3400(br.NH) 1670(c =O)	1.42(3H, t, J = 7, CH_3); 3.72(3H, s, OCH_3); 3.86(3H, s, OCH_3); 4.40(2H, g, J = 7, CH_2);6.86(1H, s, H- 3); 7.23- 7.49 e 8.09- 8.11 (8H, m, arom.); 9.00(1H, s, H- 6); 10.19(1H, Br. NH).
14	A	182	130 (EtOH)	$C_{22}H_{17}ClN_4O_7$	34000(br.NH) 1670(c =O)	1.42(3H, t, J = 7, CH_3); 4.42(2H, s, CH_2); 7.00(1H, s, H- 3); 7.25- 7.51 e 8.07- 8.09 (9H, m, arom.); 9.05 (1H, s, H- 6); 10.66(1H, Br. NH).
15	A	35	186 (C_6H_6- elther)	$C_{21}H_{17}ClN_4O_2$	3400(br.NH) 1670(c =O)	1.44(3H, t, J = 7, CH_3); 4.42(2H, g, J = 7, CH_2); 6.94 (1H, s, H- 3); 7.25- 7.51 e 8.07- 8.09 (9H, m, arom.); 9.04(1H, s, H- 6); 10.58(1H, Br. NH).
16	A	48	178 (EtOH)	$C_{21}H_{17}BrN_4O_2$	3400(br.NH) 1680(c =O)	1.42(3H, t, J = 7, CH_3); 4.40(2H, g, J = 7, CH_2); 6.99 (1H, s, H- 3); 7.28- 7.55 e 8.10- 8.11 (9H, m, arom.); 9.03(1H, s, H- 6); 10.61(1H, Br. NH).
17	A	54	188 (EtOH)	$C_{21}H_{17}BrN_4O_2$	3400(br.NH) 1720(c =O)	1.44(3H, t, J = 7, CH_3); 4.42(2H, g, J = 7, CH_2); 6.96 (1H, s, H- 3); 7.25- 7.63 e 8.08- 8.10 (9H, m, arom.); 9.40(1H, s, H- 6); 10.56(1H, Br. NH).

18	A	21	100 (EtOH)	$C_{21}H_{16}Cl_2N_4O_2$	3400(br.NH) 1700(c =O)	1.39(3H, t, J = 7, CH_3); 4.37(2H, g, J = 7, CH_2); 7.25 (1H, s, H- 3); 7.25- 7.52 c 8.12- 8.14 (8H, m, arom.); 8.28(1H, s, H- 6); 8.70(1H, Br. NH).
20	A	30	100 (EtOH)	$C_{21}H_{16}Cl_2N_4O_2$	3400(br.NH) 1700(c =O)	1.43(3H, t, J = 7, CH_3); 4.39(2H, g, J = 7, CH_2); 7.01 (1H, s, H- 3); 7.21- 7.54 e 8.09- 8.11 (8H, m, arom.); 9.03(1H, s, H- 6); 10.57(1H, Br. NH).
21	A B	73 70	154 (EtOH)	$C_{22}H_{20}N_4O_2$	3200(br.NH) 1675(c =O)	1.42(3H, t, J = 7, OCH_2CH_3); 1.76(3H, s, CH_3-3) 4.42 (2H,g J = 7, OCH_2CH_3) 7.08- 7.64 e 8.06- 8.28 (9H, m, arom.); 9.07(1H, s, H- 6); 10.38(1H, Br. NH).
22	A B	65 55	165 (EtOH)	$C_{23}H_{22}N_4O_2$	3200(br.NH) 1675(c =O)	1.45(3H, t, J = 7, OCH_2CH_3); 1.63(3H, s, CH_3-3) 2.44 (2H,g J = 7, OCH_2CH_3) 7.00- 7.66 e 8.06- 8.28 (9H, m, arom.); 9.07(1H, s, H- 6); 10.28(1H, Br. NH).
23	B	55	154 (EtOH)	$C_{23}H_{22}N_4O_2$	3240(br.NH) 1670(c =O)	1.40(3H, t, J = 7, OCH_2CH_3); 1.78(3H, s, CH_3-3) 2.32 (2H, g, J = 7, OCH_2CH_3) 6.84- 7.60 e 8.00- 8.20 (9H, m, arom.); 9.00(1H, s, H- 6); 10.29(1H, Br. NH).
24	B	54	145 (EtOH)	$C_{23}H_{22}N_4O_2$	3220(br.NH) 1670(c =O)	1.42(3H, t, J = 7, OCH_2CH_3); 1.76(3H, s, CH_3-3) 2.36 (3H, s, CH_3); 4.42 (2H, g, J = 7, OCH_2CH_3) 7.08- 7.62 e 8.06- 8.28 (9H, m, arom.); 9.06(1H, s, H- 6); 10.37(1H, br. NH).
25	A	70	150 (C_6H_6-elther)	$C_{23}H_{22}N_4O_3$	3450(br.NH) 1670(c =O)	1.43(3H, t, J = 7, OCH_2CH_3); 3.77(3H, s, OCH_3) 4.44 (3H, g, J = 7,OCH_2CH_3);7.03- 7.49 e 8.10- 8.12 (9H, m, arom.); 9.03(1H, s, H- 6); 10.37(1H, br. NH).
26	B	53	152 (sublime)	$C_{23}H_{22}N_4O_3$	3250(br.NH) 1670(c =O)	1.42(3H, t, J = 7, OCH_2CH_3); 1.86(3H, s, CH_3- 3); 3.76(3H, s, OCH_3); 4.38(2H, g, J = 7, OCH_2CH_3); 7.04- 7.60 e 8.02- 8.20 (9H, m, arom.); 9.06(1H, s, H- 6); 0.29(1H, br. NH).
27	A B	45 65	149 (EtOH)	$C_{23}H_{22}N_4O_3$	3220(br.NH) 1675(c =O)	1.42(3H, t, J = 7, OCH_2CH_3); 1.74(3H, s, CH_3-3) 3.80 (3H, s, OCH_3); 6.74- 7.58 e 8.00 8.18 (9H, m, arom.); 9.00(1H, s, H- 6); 10.36(1H, Br. NH).
28	B	61	155 (EtOH)	$C_{23}H_{19}ClN_4O_3$	3220(br.NH) 1680(c =O)	1.42(3H, t, J = 7, OCH_2CH_3); 1.80(3H, s, CH_3-3) 4.42 (3H, g, J = 7, OCH_2CH_3) ; 7.00- 7.60 e 8.00 8.22 (9H , m, arom.); 9.04(1H, s, H- 6); 10.21(1H, br. NH).
29	A B	45 60	170 (EtOH)	$C_{21}H_{19}BrN_4O_2$	3220(br.NH) 1670(c =O)	1.42(3H, t, J = 7, OCH_2CH_3); 1.83(3H, s, CH_3-3) 7.00-7.60 e 8.02- 8.20 (9H, m, arom.); 9.02(1H, s, H- 6); 10.21(1H, Br. NH).
30	A	55	164 (EtOH)	$C_{22}H_{19}BrN_4O_2$	3400(br.NH) 1700(c =O)	1.42(3H, t, J = 7, OCH_2CH_3); 1.86(3H, s, CH_3-3) 4.39 (3H, s, CH_3); 4.42 (2H, g, J = 7, OCH_2CH_3) 7.09- 7.51 e 8.11- 8.13 (9H, m, arom.); 9.06(1H, s, H- 6); 10.33(1H, Br. NH).

Table 2. 4-aniline-1-phenyl-1*H*-pyrazolo[3,4-*b*]pyridine-5-carboxylic acids

Compd Nº	Yield	m.p° .(from)	Molecular formula[a]	IR(cm^{o-1})	^{1}H NMR/ δ em ppm(J in H_Z) in $CDCl_3$)
31	69	252dec (AcOH)	$C_{19}H_{16}N_4O_2$	3400(br.NH) 3150(br.OH) 1720(C =O)	2.42(3H,s,CH_3);7.01(IH,s,H-3);8.30(2H,d,J=8.1,H_2'-H_6');7.60(2H,dd,J=7.5,H_3'-H_5');7.42(1H,dd,J=8.4, H_4');7.27-7.24(4H,m,arom.);9.12(1H,s,H-6);12.47 (1H,COOH).
32	46	260dec (AcOH)	$C_{21}H_{18}N_4O_2$	3400(br.NH) 3250(br.OH) 1650(C =O)	2.27(3H,s,CH_3);6.31(IH,s,H-3);8.23(2H,d,J=8.7,H_2'-H_6');7.63(2H,dd,J=7.5,H_3'-H_5');7.44(1H,dd,J=8.1 ,H_4');7.54-7.49(4H,m,arom.);9.01(1H,s,H-6);10.78 (1H,COOH).
33	60	220dec (AcOH)	$C_{21}H_{18}N_4O_2$	3400(br.NH) 3050(br.OH) 1650(C =O)	6.31(IH,s,H-3);8.23(2H,d, J=8.7,H_2'-H_6');7.64 (2H, dd, J=7.5,H_3'-H_5');7.45(1H,dd, J=8.1,H_4');7.42(1H, s,H_3");6.81(2H,d,J=8.7,H_5"-H_6"), 9.01 (1H,s,H-6) ;10.80 (1H, COOH) .
34	50	220dec (AcOH)	$C_{19}H_{13}ClN_4O_2$	3400(br.NH) 3050(br.OH) 1660(C =O)	2.48(1H, br.OH); 7.04(1H, s, H-3);7.04- 7.45(9H, m, arom.); 8.13(1H, s, H- 6); 9.00(1H, br., NH) (DMSO- D_6)
35	57	220dec (AcOH)	$C_{19}H_{13}ClN_4O_2$	3400(br.NH) 3200(br.OH) 1670(C =O)	7.12(IH,s,H-3);8.30(2H,d, J=8.2,H_2-H_6');7.57 (2H , dd, J=7.5,H_3'-H_5');7.45(1H,dd, J=8.1,H_4');7.67(1H, s,H_2");7.64(IH,d,J=8.7,H_4") 7.51(2H,d,J=7.8,H_5"-H_6"), 9.01 (1H,s,H-6) ;11.79 (1H, COOH) .
36	61	258dec (AcOH)	$C_{19}H_{13}ClN_4O_2$	3400(br.NH) 3100(br.OH) 1650(C =O)	2.49(1H, br.OH); 6.79(1H, s, H-3);7.31- 7.59(9H, m, arom.); 8.09(1H, s, H- 6); 8.87(1H, br., NH) (DMSO- d_6)
40	65	245dec (AcOH)	$C_{19}H_{13}BrN_4O_2$	3400(br.NH) 3150(br.OH) 1650(C =O)	2.48(1H, br.OH); 6.82(1H, s, H-3);7.30- 771(9H m, arom.); 8.09(1H, s, H- 6); 8.88(1H, br., NH) (DMSO- d_6)
41	49	260dec (AcOH)	$C_{19}H_{13}BrN_4O_2$	3400(br.NH) 3300(br.OH) 1660(C =O)	6.96(IH,s,H-3);8.23(2H,d, J=8.2,H_2'-H_6');7.65 (2H, dd, J=7.5,H_3'-H_5');7.47(1H,dd, J=8.1,H_4');7.57(1H, s,H_2"-H_6"); 7.85(2H,d,J=7.8,H_3"-H_5"), 9.01 (1H,s,H-6) ;10.8 (1H, COOH) .
42	50	260dec (AcOH)	$C_{19}H_{12}Cl_2N_4O_2$	3400(br.NH) 3150(br.OH) 1670(C =O)	7.20(IH,s,H-3);8.25(2H,d, J=8.2,H_2'-H_6'); 7.66 (2H, dd, J=7.5,H_3'-H_5');7.47(1H,dd, J=8.1,H_4') ;7.93 (1H, s,H_2"); 7.87(2H,d,J=8.7,H_5"-H_6'), 9.04(1H,s,H-6) ;10.82 (1H, COOH) .
43	90	235dec (AcOH)	$C_{20}H_{16}N_4O_2$	3400(br.NH) 3250(br.OH) 1640(C =O)	1.72(3H, s, CH_3)2.36(1H, br.OH); 7.06- 7.62 & 8.08 -8.28(10H, m, arom.) 9.01(1H, s, H- 6); 10.06(1H, br., NH) (DMSO- d_6).
44	94	239dec (AcOH)	$C_{21}H_{18}N_4O_2$	3400(br. NH) 2500(br. OH), 1670 (C =O)	1.72(3H,s,H_3) 2.36(1H, br.OH); 7.00- 7.60 & 8.06-8.30(9H, m, arom.) 9.02(1H, s, H- 6); 10.60(1H, br., NH) (DMSO- d_6)

45	92	231dec (AcOH)	$C_{21}H_{18}N_4O_3$	3400(br. NH) 2500(br. OH), 1670 (C =O)	1.76(3H, s, CH_3) 3.92 (3H, s, OCH_3); 6.76- 7.66 & 8.08-8.30(9H, m, arom.) 9.03(1H, s. H- 6); 10.30 (1H, br., NH), ($CDCl_3$ + DMSO- Dd)
46	95	254dec (EtOH)	$C_{21}H_{18}N_4O_3$	3400(br. NH) 2500(br. OH), 1670 (C =O)	1.60(3H, s, CH_3) 3.65 (3H, s, OCH_3); 6.65- 7.60 & 7.90-8.20(9H, m, arom.) 8.70(1H, s. H- 6); 10.47 (1H, br., NH), ($CDCl_3$ + DMSO- d_6)
47	95	245dec (EtOH)	$C_{20}H_{15}ClN_4O_3$	3400(br. NH) 2500(br. OH), 1670 (C =O)	181(3H, s, CH_3) 7.02-7.64 & 8.06-8.28(9H, m, arom.) 9.04(1H, s, H- 6); 10.50(1H, br., NH). ($CDCl_3$ + DMSO- d_6)

Table 3. 3-Phenyl-3*H*,11*H*-benzo[*b*]pyrazolo[3,4-*h*]-1,6-naphthyridin-6-ones

Compd Nº	Yield	m.p° .(from)	Molecular formula[a]	IR(cm^{o-1})	^{1}H NMR/ δ em ppm(J in H_Z) in (DMSO)
48	63	250dec (THF/H_2O)	$C_{19}H_{11}N_4O$	3400(br. NH) 1640 (C = O)	6.01 (IH,s,H-3);8.35(2H,d, J=8.4,H_2-H_6);7.48(2H,dd, J=7.0,H_3-H_5);7.54(1H,dd, J=7.2,H_4); 7.82 (1H,d, J=7.0,H-5);7,74(2H,dd,J=7.8,H-6,H-7) 8.94(1H,s,H-10), 9.33 (1H,s,NH).
49	60	320dec (DMSO)	$C_{19}H_{11}ClN_4O$	3400(br. NH) 1640 (C = O)	6.94 (IH,s,H-3);8.35(2H,d, J=8.1,H_2-H_6);7.73(2H,dd, J=8.1,H_3-H_5);7.53(1H,dd, J=7.2,H_4);7.85-7.77 (3H, m,ar);8.90(1H,s,H-10); 9.33(1H,s,NH) .
50	70	352dec (DMSO)	$C_{19}H_{11}BrN_4O$	3400(br. NH) 1640 (C = O)	6.01 (IH,s,H-3);8.35(2H,d, J=8.4,H_2-H_6);7.75(2H,dd, J=7.0,H_3-H_5);7.54(1H,dd, J=7.2,H_4); 8.01(1H,d, J=2.1,H-5);7.85(2H,dd,J=7.0-2.7,H-7) 7.74 (IH,d, J=7.2,H-8);8.96(1H,s,H-10), 9.40 (1H,s,NH).
51	73	320dec (THF/H_2O)	$C_{19}H_{11}BrN_4O$	3400(br. NH) 1720 (C = O)	5.91 (IH,s,H-3);8.35(2H,d, J=8.4,H_2-H_6);7.33(2H,dd, J=7.5,H_3-H_5);7.54(1H,dd, J=7.5,H_1);7.83 (1H,d, J=8.7,H-5);8.11(IH,dd,8.7,H-6);8.48(1H,d,J=2.4,H-8) 8.95(1H,s,H-10), 9.42 (1H,s,NH).
52	30	235dec (THF/H_2O)	$C_{19}H_{10}Cl_2N_4O_2$	3400(br. NH) 1670 (C = O)	6.01 (IH,s,H-3);8.35(2H,d, J=7.5,H_2-H_6);7.72(2H,dd, J=7.8,H_3-H_5);7.54(1H,dd, J=7.5,H_4);8.02(1H,H-5); 8.04(IH,d,J=7.2,H-8);8.91(1H,s,H-10), 9.36 (1H,s,H).
53	49	300 dec (CH_3Cl/ETOH)	$C_{21}H_{16}N_4O_2$	3400(br. NH) 1640 (C = O)	3.32(3H,s,CH_3);4.22(3H,s,OCH_3);7.60-8.80 (10H,m, arom).

CONCLUSION

In conclusion, these five new derivatives benzo[*b*]pyrazolo[3.4-*h*]-1.6-naphthyridin-6-ones (48-53) were synthesized in good yields. The new derivatives 4-aniline-1-phenyl-1*H*-pyrazolo[3.4-*b*]pyridine-5-carboxylic acids (31-47) were also synthesized from the corresponding ester. The substances were characterised through their element, infrared(IR) and nuclear magnetic resonance(NMR) spectra.

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