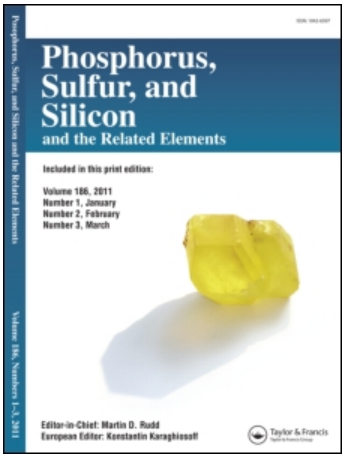

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2-CYANOETHANETHIOAMIDE IN HETEROCYCLIC SYNTHESIS: NOVEL SYNTHESIS OF THIENO[2,3-B]PYRIDINE, PYRAZOLO[3,4-B]PYRIDINE AND PYRIDOPYRAZOLO- 1,2,4-TRIAZINE DERIVATIVES

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2-CYANOETHANETHIOAMIDE IN HETEROCYCLIC SYNTHESIS: NOVEL SYNTHESIS OF THIENO[2,3-B]PYRIDINE, PYRAZOLO[3,4-B]PYRIDINE AND PYRIDOPYRAZOLO- 1,2,4-TRIAZINE DERIVATIVES

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Several new synthesis of thieno[2,3-b]pyridine, pyrazolo[3,4-b]pyridine and pyridopyrazolo-1,2,4-triazine derivatives via the reactions of pyridinethiones with halogenated compounds, hydrazine hydrate and active methylene compounds.

Keywords: pyridinethione; thieno[2,3-b]pyridine; pyrazolo[3,4-b]pyridine; pyridopyrazolo-1,2,4-triazine

INTRODUCTION

In continuation of the work[1-10] in the chemistry of cyanothioacetamide (1), the present paper deals with the synthesis of several new heterocyclic compounds which exhibit biological activities as well as several chemical transformations. The reported biological activities of both pyridines as antimycotic[11], anti- depressant[12], fungicidal agents[13] and pyrazoles as inhibitors and deactivators of liver alcohol dehydrogenase[14,15] stimulated our interest in the synthesis of several new derivatives of these ring systems which are required for midicinal chemistry program.

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RESULTS AND DISCUSSION

It has been found that the arylidene derivatives of **3a** reacted with ethyl acetoacetate (**4**) in ethanol and pyridine to afford a reaction product of molecular formula $C_{16}H_{13}BrN_2O_2S$ which corresponded to equimolecular addition of **4** to **3a** and loss of one molecule of water. The IR (cm^{-1}) spectrum of this reaction product showed the presence of NH (3193), CN (2218), CO-ester (1722), C=S (1525) and saturated CH_2, CH_3 (2985) groups. Moreover its ^{1}H-NMR (ppm) revealed among its signals those of NH of pyridine (s, br., 5.3). Based on the above data, the reaction product was formulated as 6-methyl-5-ethoxycarbonyl-4(4-bromophenyl)-3-cyanopyridine-2-thione **5a** (cf. Chart 1 and table I and II). In the same manner compound **3b** reacted with **4** in ethanol and pyridine to give the corresponding pyridinethione derivative **5b**[16]. The reaction products **5a,b** were taken as starting materials for the present work owing to contain more than one active site.

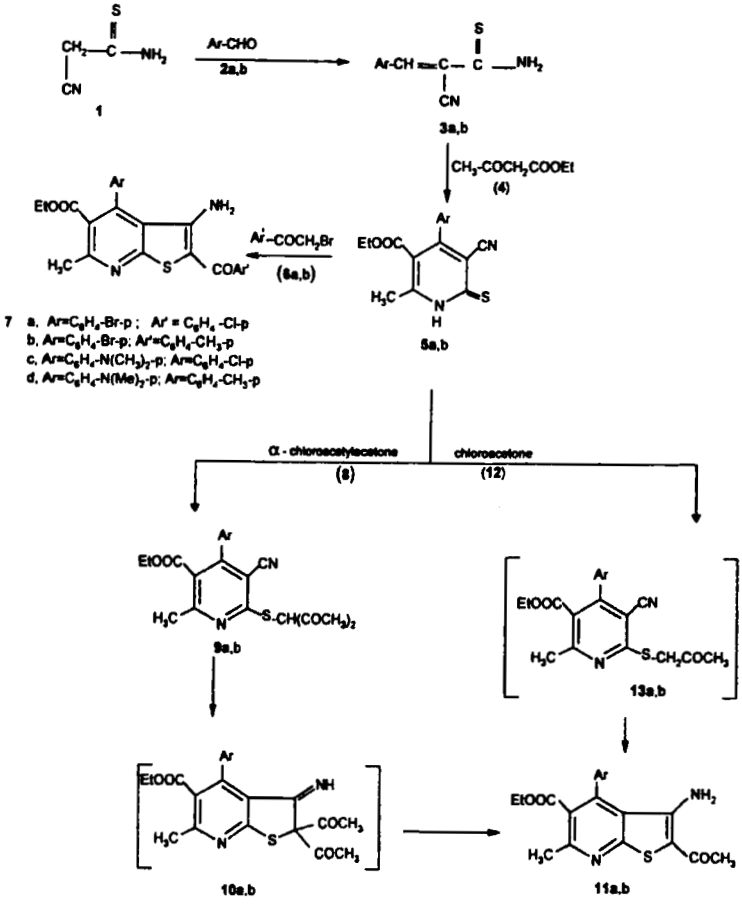
TABLE I Characterization data of the newly synthesized compounds

Comp. (Colour)	*M.P. (°C) (Solvent)*	*Yield (%)*	*Molecular Formula*	*% Analysis Calcd./Found*				
				C	*H*	*N*	*S*	*Br*
5a	228	80	$C_{16}H_{13}BrN_2O_2S$	50.93	3.45	7.43	8.48	21.22
(yellow)	(ethanol)			50.9	3.3	7.3	8.5	21.1
7a	194	65	$C_{24}H_{18}BrClN_2O_3S$	54.39	3.40	5.29	6.04	15.11
(yellow)	(ethanol)			54.3	3.3	5.2	5.9	15.0
7b	130	75	$C_{25}H_{21}BrN_2O_3S$	58.94	4.13	5.50	6.29	15.72
(yellow)	(ethanol)			58.7	4.0	5.5	6.2	15.5
7c	162	70	$C_{26}H_{24}ClN_3O_3S$	63.22	4.86	8.51	6.48	---
(yellow)	(ethanol)			63.1	4.7	8.5	6.3	---
7d	190	55	$C_{27}H_{27}N_3O_3S$	68.50	5.71	8.88	6.77	---
(yellow)	(ethanol)			68.4	5.5	9.0	6.7	---
9a	120	85	$C_{21}H_{19}BrN_2O_4S$	53.05	4.00	5.89	6.74	16.84
(white)	(ethanol)			52.8	3.8	5.7	6.8	16.9
9b	170	80	$C_{23}H_{25}N_3O_4S$	62.87	5.69	9.57	7.29	---
(white)	(ethanol)			62.6	5.8	9.5	7.1	---
11a	190–2	75	$C_{19}H_{17}BrN_2O_3S$	52.66	3.93	6.47	7.39	18.47
(yellow)	(ethanol)			52.5	3.8	6.5	7.3	18.3
11b	150	64	$C_{21}H_{23}N_3O_3S$	63.48	5.79	10.5	8.06	---
(yellow)	(ethanol)			63.5	5.5	10.4	8.0	---

Comp. (Colour)	M.P. (°C) (Solvent)	Yield (%)	Molecular Formula	% Analysis Calcd./Found				
				C	H	N	S	Br
14a	100	70	$C_{17}H_{15}BrN_2O_2S$	52.17	3.84	7.16	8.18	20.46
(yellow)	(ethanol)			52.5	3.7	7.2	8.0	20.2
14b	162	85	$C_{19}H_{21}N_3O_2S$	64.20	5.95	11.82	9.02	---
(yellow)	(ethanol)			64.0	5.8	11.8	9.1	---
15a	268	70	$C_{16}H_{15}BrN_4O_2$	51.23	4.03	14.93	---	21.29
(green)	(acetic acid)			51.1	4.2	14.8	---	21.1
15b	276	65	$C_{18}H_{21}N_5O_2$	63.70	6.24	20.64	---	---
(green)	(acetic acid)			63.5	6.2	20.5	---	---
16a	140	72	$C_{23}H_{20}BrN_5O_2S$	54.12	3.95	13.72	6.28	15.66
(yellow)	(ethanol)			54.2	3.8	13.8	6.2	15.5
16b	220	79	$C_{25}H_{26}N_6O_2S$	63.27	5.52	17.71	6.76	---
(white)	(ethanol)			63.1	5.4	17.5	6.7	---
17a	162 decomp.	64	$C_{16}H_{13}ClBrN_5O_2$	45.47	3.10	16.57	---	18.93
(white)	(ethanol)			45.3	5.5	16.5	---	18.8
17b	140 decomp.	62	$C_{18}H_{19}ClN_6O_2$	55.89	4.95	21.73	---	---
(white)	(ethanol)			55.8	4.9	21.6	---	---
19a	126	81	$C_{21}H_{19}BrN_6O_4$	50.51	3.84	16.83	---	16.00
(red)	(ethanol)			50.5	3.7	16.7	---	15.8
19b	>300	67	$C_{25}H_{18}BrN_7O_2S$	53.58	3.24	17.49	5.72	14.26
(yellow)	(acetic acid)			53.4	3.3	17.4	5.8	14.3
19c	>300	56	$C_{19}H_{16}BrN_7O_2S$	46.92	3.32	20.16	6.59	16.43
(yellow)	(ethanol)			46.8	3.2	19.8	6.4	16.3
19d	274	85	$C_{23}H_{25}N_7O_4$	59.60	5.44	21.15	---	---
(yellow)	(acetic acid)			59.5	5.3	21.2	---	---
19e	>300	69	$C_{27}H_{24}N_8O_2S$	61.82	4.61	21.36	6.11	---
(brown)	(acetic acid)			61.9	4.5	21.2	6.0	---
19f	>300	73	$C_{21}H_{22}N_8O_2S$	55.98	4.92	24.87	7.11	---
(brown)	(ethanol)			55.8	4.9	24.8	6.9	---
20a	142	68	$C_{21}H_{19}BrN_6O_4$	50.51	3.84	16.83	---	16.00
(buff)	(ethanol)			50.5	3.9	16.8	---	15.9
20b	>300	65	$C_{25}H_{18}BrN_7O_2S$	53.58	3.24	17.49	5.72	14.26
(yellow)	(acetic acid)			53.4	3.2	17.4	5.6	14.1
20c	>300	80	$C_{19}H_{16}BrN_7O_2S$	46.92	3.32	20.16	6.59	16.43
(yellow)	(ethanol)			46.8	3.3	20.0	6.5	16.3
20d	296–8	64	$C_{23}H_{25}N_7O_4$	59.60	5.44	21.15	---	13.81
(yellow)	(ethanol)			59.5	5.3	21.2	---	13.7
20e	>300	72	$C_{27}H_{24}N_8O_2S$	61.82	4.61	21.36	6.11	---
(yellow)	(acetic acid)			61.7	4.5	21.2	6.0	---

Comp. (Colour)	*M.P. (°C) (Solvent)*	*Yield (%)*	*Molecular Formula*	*% Analysis Calcd./Found*				
				C	*H*	*N*	*S*	*Br*
20f	>300	81	$C_{21}H_{22}N_8O_2S$	55.98	4.92	24.87	7.12	---
(yellow)	(ethanol)			55.8	4.9	24.6	7.1	---
20g	252	62	$C_{19}H_{14}BrN_7O_2$	50.46	3.12	21.68	---	17.67
(brown)	(ethanol)			50.4	3.1	21.7	---	17.6
20h	>300	56	$C_{21}H_{20}N_8O_2$	60.57	4.84	26.91	---	---
(red)	(ethanol)			60.5	4.7	26.8	---	---
22a	254	85	$C_{21}H_{18}BrN_5O_3$	53.85	3.87	14.95	---	17.06
(yellow)	(ethanol)			53.8	3.8	14.8	---	17.0
22b	170	62	$C_{22}H_{20}BrN_5O_4$	53.02	4.04	14.05	---	16.03
(yellow)	(ethanol)			52.9	4.0	13.9	---	16.1
22c	240	73	$C_{23}H_{24}N_6O_3$	63.87	5.59	19.43	---	---
(red)	(ethanol)			63.7	5.5	19.3	---	---
22d	>300	68	$C_{24}H_{26}N_6O_4$	62.33	5.66	18.17	---	---
(yellow)	(ethanol)			62.2	5.6	18.1	---	---
24a	180	65	$C_{27}H_{24}BrN_5O_5$	56.07	4.18	12.11	---	13 82
(yellow)	(ethanol)			56.1	4.1	12.0	---	13.7
24b	190	80	$C_{29}H_{30}N_6O_5$	64.19	5.57	15.49	---	---
(yellow)	(ethanol)			64.1	5.4	15.4	---	---
25a	258	64	$C_{27}H_{22}BrN_5O_4$	57.87	3.96	12.49	---	14.26
(green)	(ethanol)			57.8	4.0	12.4	---	14.3
25b	>300	72	$C_{29}H_{28}N_6O_4$	66.39	5.38	16.02	---	---
(yellow)	(ethanol)			66.3	5.2	16.0	---	---
28a	220	81	$C_{25}H_{19}BrN_6O_3S$	53.29	3.39	14.91	5.69	14.18
(white)	(ethanol)			53.3	3.4	15.1	5.5	14.1
28b	210	62	$C_{27}H_{25}N_6O_3S$	61.46	4.77	18.58	6.08	---
(yellow)	(ethanol)			61.3	4.7	18.4	5.9	---
29a	240	70	$C_{29}H_{23}N_6O_5S$	53.79	3.58	12.97	4.95	12.34
(white)	(acetic acid)			53.6	3.6	12.8	4.8	12.2
29b	256	85	$C_{31}H_{29}N_7O_5S$	60.87	4.78	16.03	5.24	---
(yellow)	(acetic acid)			60.7	4.7	16.1	5.2	---
30a	>300	62	$C_{25}H_{18}BrN_5O_4S$	53.20	3.22	12.41	5.68	14.16
(yellow)	(ethanol)			53.1	3.2	12.2	5.6	14.2
30b	280	75	$C_{27}H_{24}N_6O_4S$	61.35	4.58	15.89	6.07	---
(brown)	(ethanol)			61.2	4.5	15.7	5.9	---

Compounds 7a, 7c, 17a and 17b, the % of chlorine calcd./found : 6.70/ 6.5; 7.19/ 7.0; 8.40/8.3; 9.17/9.0 respectively.



a. Ar=C_6H_4Br-p
b. Ar=$C_6H_4NMe_2$-p

CHART I

TABLE II IR and ^1H NMR data

Comp.	*IR [KBr, cm^{-1}]*	*^1H NMR [δ ppm]*
5a	3193 (NH); 3057 (CH aromatic); 2985 (CH sat.); 2218 (CN); 1722 (CO-ester); 1608 (C=C) and 1525 (C=S).	0.9 (t, 3H, CH_2CH_3); 1.3 (s, 3H, CH_3); 3.7 (q, 2H, CH_2CH_3); 5.3 (s, br., 1H, NH)[a] and 7.3–7.8(m, 4H, ArH's).
7a	3480, 3318 (NH_2); 3085 (CH aromatic); 2980 (CH sat.); 1728 (CO- ester); and 1605 (C=C).	1.0 (t, 3H, CH_2CH_3); 1.2 (s, 3H, CH_3); 3.9 (q, 2H, CH_2CH_3); 5.2 (s, br., 2H, NH_2)[a] and 7.3–7.8 (m, 8H, ArH's).
7b	3480, 3328 (NH_2); 3080 (CH aromatic); 2980 (CH sat.); 1725 (CO-ester) and 1605 (C=C).	1.0 (t, 3H, CH_2CH_3); 1.3 (s, 3H, CH_3); 1.6 (s, 3H, CH_3 at Ar') 3.7 (q, 2H, CH_2CH_3); 5.2 (s, br., 2H, NH_2)[a] and 7.3–7.8 (m, 8H, ArH's).
7c	3483, 3317 (NH_2); 3080 (CH aromatic); 2980 (CH sat.); 1724 (CO-ester); and 1605 (C=C).	0.8 (t, 3H, CH_2CH_3); 1.4 (s, 3H, CH_3); 3.1 (s, 6H, N $(CH_3)_2$); 3.7 (q, 2H, CH_2CH_3); 5.2 (s, br., 2H, NH_2)[a] and 7.3–7.8 (m, 8H, ArH's).
7d	3190, 3336 (NH_2); 3085 (CH aromatic); 2981 (CH sat.); 1732 (CO- ester); and 1606 (C=C).	0.9 (t, 3H, CH_2CH_3); 1.3 (s, 3H, CH_3 at pyridine); 1.6 (s, 3H, CH_3 at Ar'); 3.1 (s, 6H, $N(CH_3)_2$); 3.7 (q, 2H, CH_2CH_3); 5.2 (s, br., 2H, NH_2)[a] and 7.3- 7.8 (m, 8H, ArH's).
9a	3050 (CH aromatic); 2987 (CH sat.); 2223 (CN); 1732 (CO-ester); and 1600 (C=C).	0.8 (t, 3H, CH_2CH_3); 1.3 (s, 3H, CH_3); 2.4 (s, 6H, SCH $(COCH_3)_2$); 3.2 (s, 1H, $SCH(COCH_3)_2$); 3.7 (q, 2H, CH_2CH_3); and 7.3–7.8 (m, 4H, ArH's).
9b	3058 (CH aromatic); 2981 (CH sat.); 2220 (CN); 1732 (CO-ester); and 1600 (C=C).	0.8 (t, 3H, CH_2CH_3); 1.3 (s, 3H, CH_3); 2.4 (s, 6H, CH $(COCH_3)_2$); 2.9 (s, 6H, $N(CH_3)_2$); 3.2 (s, 1H, $SCH(COCH_3)_2$); 3.7 (q, 2H, CH_2CH_3); and 7.3- 7.8 (m, 4H, ArH's).
11a	3490, 3336 (NH_2); 3050 (CH aromatic); 2985 (CH sat.); 1732 (CO-ester); and 1605 (C=C).	0.8 (t, 3H, CH_2CH_3); 1.2 (s, 3H, CH_3); 1.5 (s, 3H, $-COCH_3$); 3.7 (q, 2H, CH_2CH_3); 5.2 (s, br., 2H, NH_2)[a] and 7.3–7.8 (m, 4H, ArH's).
11b	3485, 3335 (NH_2); 3054 (CH aromatic); 2983 (CH sat.); 1730 (CO-ester); and 1608 (C=C).	0.8 (t, 3H, CH_2CH_3); 1.2 (s, 3H, CH_3); 1.7 (s, 3H, $COCH_3$); 3.2 (s, 6H, N $(CH_3)_2$); 3.7 (q, 2H, CH_2CH_3); 5.2 (s, br., 2H, NH_2)[a] and 7.3–7.8(m, 4H, ArH's).
14a	3060 (CH aromatic); 2985 (CH sat.); 2218 (CN); 1729 (CO-ester); and 1605 (C=C).	0.9 (t, 3H, CH_2CH_3); 1.3 (s, 3H, CH_3); 1.8 (s, 3H, SCH_3); 3.7 (q, 2H, CHH_3) and 7.4–7.7 (m, 4H, ArH's).

Comp.	*IR [KBr, cm^{-1}]*	*^1H NMR [δ ppm]*
14b	3070 (CH aromatic); 2987 (CH sat.); 2222 (CN); 1730 (CO-ester); and 1600 (C=C).	0.9(t, 3H, $CH_2\mathbf{CH_3}$); 1.2 (s, 3H, CH_3); 1.9 (s, 3H, SCH_3); 3.2 (s, 6H, N $(CH_3)_2$); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); and 7.2–7.7 (m, 4H, ArH's).
15a	3450, 3303, 3200 (NH and NH_2); 3060 (CH aromatic); 2985 (CH sat.); 1710 (CO-ester); 1630 (C=N) and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.3 (s, 3H, CH_3); 3.8 (q, 2H, $\mathbf{CH_2}$-CH_3); 5.4 (s, br., 2H, NH_2)* 5.9 (s, 1H, NH)[a]and 7.3–7.8 (m, 4H, ArH's).
15b	3400, 3298, 3193 (NH and NH_2); 3060 (CH aromatic); 2985 (CH sat.); 1716 (CO-ester); 1629 (C=N) and 1598 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$); 1.2 (s, 3H, CH_3); 3.2 (s, 6H, N $(CH_3)_2$); 3.7 (q, 2H, $\mathbf{CH_2}$-CH_3); 5.4 (s, br., 2H, NH_2)[a]; 5.9(s, 1H, NH)[a]and 7.3–7.8 (m, 4H, ArH's).
16a	3392, 3200 (three NH); 3070 (CH aromatic); 2980 (CH sat.); 1725 (CO-ester); 1550 (C=S) and 1608 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$); 1.2 (s, 3H, CH_3); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 6.0–6.5 (s, br., 3H, three NH)[a] and 7.3–7.8 (m, 9H, ArH's).
16b	3394, 3200, (three NH); 3060 (CH aromatic); 2987 (CH sat.); 1728 (CO-ester); 1535 (C=S) and 1608 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 3.2 (s, 6H, N $(CH_3)_2$); 6.2–6.5(s, br., 3H, three NH)[a] and 7.3–7.8 (m, 9H, ArH's).
17a	3185(NH); 3060 (CH aromatic); 2985 (CH sat.); 1729 (CO-ester); 1620 (C=N) and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.3 (s, 3H, CH_3); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 5.9 (s, 1H, NH)[a] and 7.4–7.7 (m, 4H, ArH's).
17b	3180 (NH); 3070 (CH aromatic); 2987 (CH sat.); 1730 (CO-ester); 1620 (C=N) and 1610 (C=C).	0.9(t, 3H, $CH_2\mathbf{CH_3}$); 1.2 (s, 3H, CH_3); 3.2 (s, 6H, N $(CH_3)_2$); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 5.8 (s, 1H, NH)[a] and 7.0–7.7 (m, 4H, ArH's).
19a	3301, 3198 (two NH); 3095 (CH aromatic); 2987 (CH sat.); 2219 (CN); 1720, 1697 (two CO-ester) and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$ at pyridine); 1.1 (s, 3H, CH_3); 1.6 (t, 3H, $CH_2\mathbf{CH_3}$ at pyrazole); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$ at pyridine); 4.0(q, 2H, $\mathbf{CH_2}CH_3$at pyrazole); 5.3 (s, br., 2H. two NH)[a] and 7.3- 7.8 (m, 4H, ArH's).
19b	3328, 3190 (two NH); 3050 (CH aromatic); 2985 (CH sat.); 2220 (CN); 1725 (CO-ester); and 1608 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 52 (s, br., 2H, two NH)[a] and 7.3–7.8 (m, 8H, ArH's).
19c	3328, 3320, 3290, 3285 (two NH and NH_2); 3050 (CH aromatic); 2985(CH sat.); 2217(CN); 1731 (CO-ester); 1608 (C=C) and 1535(C=S).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 5.3 (s, br., 4H, two NH and NH_2)[a]and 7.3–7.8(m, 4H, ArH's).

Comp.	*IR [KBr, cm^{-1}]*	*^1H NMR [δ ppm]*
19d	3343, 3298 (two NH); 3095 (CH aromatic); 2987 (CH sat.); 2219 (CN); 1725, 1697 (two CO-ester); and 1605 (C=C).	0.9 (t, 3H, CH_2CH_3 at pyridine); 1.1(s, 3H, CH_3); 1.6 (t, 3H, CH_2CH_3 at pyrazole); 3.2 (s, 6H, $N(CH_3)_2$); 3.7(q, 2H, CH_2CH_3 at pyridine); 4.0(q, 2H, CH_2CH_3 at pyrazole); 5.3 (s, br., 2H, two NH)[a] and 7.3–7.8(m, 4H, ArH's).
19e	3328, 3290 (two NH); 3050 (CH aromatic); 2985 (CH sat.); 2220 (CN); 1725 (CO-ester); and 1608 (C=C).	0.9 (t, 3H, CH_2CH_3); 1.1 (s, 3H, CH_3); 3.2 (s, 6H, N $(CH_3)_2$); 3.9 (q, 2H, CH_2CH_3); 5.3 (s, br., 2H, two NH)[a] and 7.3–7.8 (m, 8H, ArH's).
19f	3328, 3320, 3290, 3285 (two NH and NH_2); 3050 (CH aromatic); 2985 (CH sat.); 2217 (CN); 1725 (CO- ester); 1608 (C=C) and 1535 (C=S).	0.8(t, 3H, CH_2CH_3); 1.1 (s, 3H, CH_3); 3.2 (s, 6H, $N(CH_3)_2$); 3.7 (q, 2H, CH_2CH_3); 5.3 (s, br., 4H, two NH and NH_2)[a] and 7.3–7.8 (m, 4H, ArH's).
20a	3343, 3298 (NH_2); 3095 (CH aromatic); 2987 (CH sat.); 1725 (CO- ester); 1697 (CO ester with H- bonding); and 1605 (C=C).	0.9 (t, 3H, CH_2CH_3 at pyridine); 1.1 (s, 3H, CH_3); 1.6 (t, 3H, CH_2CH_3 at triazine); 3.7 (q, 2H, CH_2CH_3 at pyridine); 4.0(q, 2H, CH_2CH_3at triazine); 5.3 (s, br., 2H, NH_2)[a] and 7.3- 7.8 (m, 4H, ArH's).
20b	3328, 3290 (NH_2); 3050 (CH aromatic); 2985(CH sat.); 1731 (CO- ester); and 1608 (C=C).	0.9 (t, 3H, CH_2CH_3); 1.1 (s, 3H, CH_3); 3.7 (q, 2H, CH_2CH_3); 5.3 (s, br., 2H, NH_2)[a] and 7.3- 7.8 (m, 8H, ArH's).
20c	3328, 3320, 3290, 3285 (two NH_2); 3050 (CH aromatic); 2985 (CH sat.); 1725 (CO-ester); 1608 (C=C) and 1535 (C=S).	0.9 (t, 3H, CH_2CH_3); 1.1 (s, 3H, CH_3); 3.7 (q, 2H, CH_2CH_3); 5.3 (s, br., 4H, two NH_2)[a] and 7.3–7.8(m, 4H, ArH's)
20d	3343, 3298 (NH_2); 3095 (CH aromatic); 2987 (CH sat.); 1725 (CO- ester); 1697 (CO ester with H- bonding); and 1605 (C=C).	0.9 (t, 3H, CH_2CH_3 at pyridine); 1.1 (s, 3H, CH_3); 1.6 (t, 3H, CH_2CH_3 at triazine); 3.2 (s, 6H, $N(CH_3)_2$); 3.7(q, 2H, CH_2CH_3 at pyridine); 4.0 (q, 2H, CH_2CH_3 at triazine); 5.2- 5.3 (s, br., 2H, NH_2)[a] and 7.3–7.8 (m, 4H, ArH's).
20e	3343, 3298 (NH_2); 3095 (CH aromatic); 2987 (CH sat.); 1728 (CO-ester); and 1605 (C=C).	0.8 (t, 3H, CH_2CH_3); 1.1 (s, 3H, CH_3); 3.2 (s, 6H, N $(CH_3)_2$); 3.7 (q, 2H, CH_2CH_3); 5.2–5.3 (s, br., 2H, NH_2)[a] and 7.3–7.8 (m, 8H, ArH's).
20f	3328, 3390, 3290, 3285 (two NH_2); 3050 (CH aromatic); 2985(CH sat.); 1725 (CO-ester); 1608 (C=C) and 1535 (C=S).	0.9 (t, 3H, CH_2CH_3); 1.1(s, 3H, CH_3); 3.2 (s, 6H, N $(CH_3)_2$); 3.7 (q, 2H, CH_2CH_3); 5.2–5.3 (s, br., 4H, two NH_2)[a] and 7.3–7.8 (m, 4H, ArH's)

Comp.	*IR [KBr, cm^{-1}]*	*^1H NMR [δ ppm]*
20g	3339, 3284 (NH_2); 3060 (CH aromatic); 2985 (CH sat.); 2218 (CN); 1729 (CO-ester); and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.3 (s, 3H, CH_3); 3.8 (q, 2H, $\mathbf{CH_2}CH_3$); 5.2–5.3 (s, br. 2H, NH_2)[a]and 7.4–7.7 (m, 4H, ArH's).
20h	3339, 3284 (NH_2); 3060 (CH aromatic); 2985 (CH sat.); 2218 (CN); 1729 (CO-ester); and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.3 (s, 3H, CH_3); 3.1 (s, 6H, $N(CH_3)_2$); 3.8 (q, 2H, $\mathbf{CH_2}CH_3$); 5.2–5.3 (s, br., 2H, NH_2)[a] and 7.4–7.7 (m, 4H, ArH's).
22a	3060 (CH aromatic); 2985 (CH sat.); 1729 (CO-ester); 1689 (CO-acetyl); and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3 at pyridine); 1.3 (s, 3H, CH_3 at triazine); 1.8 (s, 3H, $COCH_3$); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); and 7.4- 7.7 (m, 4H, ArH's).
22b	3060 (CH aromatic); 2985 (CH sat); 1729 (two CO-ester); and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$ at pyridine); 1.1(s, 3H, CH_3 at pyridine); 1.3 (s, 3H, CH_3at triazine); 1.6 (t, 3H, $CH_2\mathbf{CH_3}$ at triazine); 3.4 (q, 2H. $\mathbf{CH_2}CH_3$ at pyridine); 4.0 (q, 2H, $\mathbf{CH_2}CH_3$ at triazine); and 7.4–7.7 (m, 4H, ArH's).
22c	3060 (CH aromatic); 2985 (CH sat.); 1697 (CO-acetyl); 1729 (CO-ester); and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3 at pyridine); 1.3 (s, 3H, CH_3 at triazine); 1.8 (s, 3H, $COCH_3$); 3.2 (s, 6H, $N(CH_3)_2$); 3.7 (q, 2H. $\mathbf{CH_2}CH_3$); and 7.4–7.7 (m, 4H, ArH's).
22d	3060 (CH aromatic); 2985 (CH sat.); 1700 (CO-ester at triazine); 1729 (CO-ester at pyridine); and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$ at pyridine); 1.1 (s, 3H, CH_3 at pyridine); 1.3 (s, 3H, CH_3at triazine); 1.8 (t, 3H, $CH_2\mathbf{CH_3}$ at triazine); 3.2 (s, 6H, $N(CH_3)_2$); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$ at pyridine); 4.0 (q, 2H, $\mathbf{CH_2}CH_3$ at triazine); and 7.4–7.7 (m, 4H, ArH's).
24a	3350, 3298 (two NH); 3060 (CH aromatic); 2985 (CH sat.); 1729 (CO-ester); 1699 (CO-benzoyl) and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$ at pyridine); 1.1 (s, 3H, CH_3); 1.8 (t, 3H, $CH_2\mathbf{CH_3}$ at pyrazole); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$ at pyridine); 4.0 (q, 2H, $\mathbf{CH_2}CH_3$at pyrazole); 5.3 (s, br., 2H, NH)[a] and 7.4–7.7 (m, 9H, ArH's).
24b	3125 (two NH); 3060 (CH aromatic); 2985 (CH sat.); 1729 (CO-ester); 1684 (CO-benzoyl) and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$ at pyridine); 1.1 (s, 3H, CH_3); 1.8 (t, 3H, $CH_2\mathbf{CH_3}$ at pyrazole); 3.2 (s, 6H, $N(CH_3)_2$); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$ at pyridine); 4.0 (q, 2H, $\mathbf{CH_2}CH_3$ at pyrazole); 5.3 (s, br., 2H, NH)[a] and 7.4–7.7 (m, 9H, ArH's).
25a	3060 (CH aromatic); 2985(CH sat.); 1720 (two CO-ester); and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$ at pyridine); 1.1 (s, 3H, CH_3); 1.8 (t, 3H, $CH_2\mathbf{CH_3}$ at pyrazole); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$ at pyridine); 4.1 (q, 2H, $\mathbf{CH_2}CH_3$at pyrazole); and 7.4–7.7 (m, 9H, ArH's).

Comp.	*IR [KBr. cm^{-1}]*	*^1H NMR [δ ppm]*
25b	3060 (CH aromatic); 2985 (CH sat.); 1720 (two CO-ester); and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$ at pyridine); 1.1 (s, 3H, CH_3); 1.6 (t, 3H, $CH_2\mathbf{CH_3}$ at pyrazole); 3.1 (s, 6H, $N(CH_3)_2$); 3.8 (q, 2H, $\mathbf{CH_2}CH_3$ at pyridine); 4.1 (q, 2H, $\mathbf{CH_2}CH_3$ at pyrazole); and 7.4–7.7 (m, 9H, ArH's).
28a	3332, 3290 (two NH); 3060 (CH aromatic); 2986 (CH sat.); 1729 (CO-ester); 1680 (CO-benzoyl); and 1605 (C=C). 3342, 3290 (two NH); 3060 (CH aromatic); 2985 (CH sat.); 1729 (CO-ester); 1649 (CO-benzoyl) and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 5.3 (s, br., 2H, NH)[a] and 7.4- 7.7 (m, 9H, ArH's). 0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.2 (s, 6H, $N(CH_3)_2$); 3.8 (q, 2H, $\mathbf{CH_2}CH_3$); 5.3 (s, br., 2H, NH)[a] and 7.4–7.7 (m, 9H, ArH's).
28b	3332, 3290 (two NH); 3060 (CH aromatic); 2986 (CH sat.); 1729 (CO-ester); 1680 (CO-benzoyl); and 1605 (C=C). 3342, 3290 (two NH); 3060 (CH aromatic); 2985 (CH sat.); 1729 (CO-ester); 1649 (CO-benzoyl) and 1605 (C=C).	0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 5.3 (s, br., 2H, NH)[a] and 7.4- 7.7 (m, 9H, ArH's). 0.9 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.2 (s, 6H, $N(CH_3)_2$); 3.8 (q, 2H, $\mathbf{CH_2}CH_3$); 5.3 (s, br., 2H, NH)[a] and 7.4–7.7 (m, 9H, ArH's).
29a	3060 (CH aromatic); 2985 (CH sat.); 1699 (CO-benzoyl and acetyl); 1729 (CO-ester) and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.4 (s, 3H, $COCH_3$ at pyrazole); 3.6 (s, 3H, $COCH_3$ at thia-diazole); 3.9 (q, 2H, $\mathbf{CH_2}CH_3$); and 7.4–7.7 (m, 9H, ArH's).
29b	3060 (CH aromatic); 2985(CH sat.); 1699 (CO-benzoyl and acetyl); 1729 (CO-ester) and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.1 (s, 6H, $N(CH_3)_2$) 3.4(s, 3H, $COCH_3$ at pyrazole); 3.6 (s, 3H, $COCH_3$at thiadiazole); 3.9 (q, 2H, $\mathbf{CH_2}CH_3$); and 7.4–7.7 (m, 9H, ArH's).
30a	3342 (NH); 3060 (CH aromatic); 2985 (CH sat.); 1705 (thiadiazinone and benzoyl CO); 1729 (CO-ester) and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.7 (q, 2H, $\mathbf{CH_2}CH_3$); 5.3 (s, br., 1H, NH)[a] and 7.4- 7.7 (m, 9H, ArH's).
30b	3342 (NH); 3060 (CH aromatic); 2985 (CH sat.); 1699 (thiadiazinone and benzoyl CO); 1729 (CO-ester) and 1605 (C=C).	0.8 (t, 3H, $CH_2\mathbf{CH_3}$); 1.1 (s, 3H, CH_3); 3.9 (q, 2H, $\mathbf{CH_2}CH_3$); 3.2 (s, 6H, $N(CH_3)_2$); 5.3 (s, br., 1H, NH)[a] and 7.4–7.7 (m, 9H, ArH's).

a. Lost after D_2O exchange

Compounds **5a,b** were reacted with several halogenated ketones such as ω-bromo-4-chloroacetophenone, ω-bromo-4-methylacetophenone, α-chloroacetyl acetone and chloroacetone. It has been found that, compound **5a** reacted with ω-bromo-4-chloroacetophenone (**6a**) to give the reaction product **7a**. The IR (cm^{-1}) spectrum of **7a** was free from the nitrile function and newly born of NH_2 absorption band. Moreover, its ^{1}H-NMR (ppm) revealed among its signals those of NH_2group. Based on elemental analysis and spectral data, compound **7a** was assigned as thienopyridine derivative **7a**. Moreover the mass spectrum of compound **7a** gave m/e = M^+= 529(50.2%), m/e=M+1=530(100%) and m/e=M+2=531(66.1%) which is the same molecular weight required for a compound with molecular formula $C_{24}H_{18}N_2O_3SBrCl$ (cf. Chart 1). Analogously compound **5a** reacted with ω-bromo-4-methylacetophenone (**6b**) to afford **7b** corresponding to thienopyridine derivative. In the same manner **5b** reacted with **6a,b** to yield the corresponding pyridinethione derivatives **7c,d**. The structure of **7c,d** were assigned based on the correct elemental analysis and spectral data as **7a,b** described before. Moreover the mass spectrum of compound **7d** gave m/e=M^+= 473(99.7%) and m/e=M+1=474(100%) which is the same molecular weight required for a compound with molecular formula $C_{27}H_{27}N_3O_3S$ (cf. Chart 1 and table I and II)

Compound **5a** reacted also with α-chloroacetylacetone (**8**) in methanolic sodium methoxide followed by loss of hydrogen chloride to afford 2-S-diacetylmethylpyridine derivative **9a**. The IR (cm^{-1}) spectrum of this reaction product showed the absorption bands of CN (2223), CO-ester (1732), and saturated CH_2, CH_3 (2987) groups. Its ^{1}H.NMR revealed the signals assigned with the structure (cf. Chart 1 and Experimental Part). Further elucidation of **9a** was confirmed via its cyclization in sodium methoxide solution on hot to afford the cyclized product **11a**. The IR (cm^{-1}) spectrum of this reaction product was free from the absorption band of nitrile function and newly born of NH_2 group. Moreover its ^{1}H-NMR revealed among its signals the signal of newly NH_2 group. Based on elemental analysis and spectral data compound **11a** was assigned as thienopyridine derivative. The formation of **11a** through this cyclization reaction is assumed to proceed via initial addition of methine group of **9a** to the nitrile function to give the corresponding non-isolable 2,2-diacetyl-3-iminothieno[2,3-b]pyridine derivative **10a** which then underwent acetic acid cleavage and this followed by intramolecular attack of the intermediate carbanion on the imine to afford **11a**. The structure of **11a** was further confirmed via alternative synthesis,

thus compound **5a** reacted with chloroacetone (**12**) to give directly the final isolable product **11a**. Compound **11a** which prepared via this route was found to be identical in all aspects with that **11a** prepared as described before (cf. Chart 1 and Experimental Part). In the same manner compound **5b** reacted with **8** and **12** to give the reaction products **9b** and **11b**. Moreover, the structures of **9b** and **11b** were established on the basis of elemental analysis and spectral data as **9a** and **11a** described before. Moreover the mass spectrum of compound **11b** gave m/e = M^+= 397(91.9%) which is the same molecular weight required for a compound with molecular formula $C_{21}H_{23}N_3O_3S$ (cf. Chart 1)

The work was extended by the reaction of **5a,b** with methyl iodide to afford the corresponding 2-S-methylpyridine derivatives **14a,b**. Compounds **14a,b** were reacted with hydrazine hydrate to give a sulfur free reaction products **15a,b**. The IR (cm^{-1}) spectra of these reaction products showed the newly born absorption bands of NH_2 and absence of nitrile absorption bands. Their ^{1}H-NMR (ppm) spectra revealed the signals of NH and NH_2 at (s, br., 5.4). On shaking compounds **15a** and **15b** with deuterium oxide (D_2O) the singlet broad signal at 5.4 ppm which corresponding to NH_2 and NH groups disappeared and two new signals appeared. The first is the singlet at 4.6 ppm for 1H of DOH due to the exchanging proton at NH with D_2O and the second is the singlet signal at 4.9 ppm for 2H of H_2O due to the exchanging proton at NH_2 with D_2O. The mass spectrum of compound **15b** gave m/e = M^+= 339(100%) which is the same molecular weight required for a compound with molecular formula $C_{18}H_{21}N_5O_2$ (cf. Chart 2 and Experimental part).

Compounds **15a,b** were taking as starting materials for synthesis of a new series of heterocyclic compounds. Compound **15a** reacted with phenyl isothiocyanate to afford pyrazolo[3,4-b]pyridine-3-yl phenylthiourea derivative **16a**. The IR (cm^{-1}) spectrum of **16a** showed the absorption bands of three NH, CO-ester and C=S groups. Moreover its ^{1}H-NMR (ppm) spectrum revealed the signals of three NH, CH_2CH_3, CH_3 in addition to the aromatic protons. Based on the above data compound **16a** was formulated as thiourea derivative. In the same manner **5b** reacted with phenyl isothiocyanate to yield **16b**. The mass spectrum of **16b** gave m/e=476 (1.5%) and a base peak at m/e=384 (100%) via loss of the moiety phNH (cf. Chart 2 and Experimental part).

The synthetic potential of **15a,b** was investigated via their reaction with nitrous acid to afford the isolable diazonium salts **17a,b**. The IR (cm^{-1})

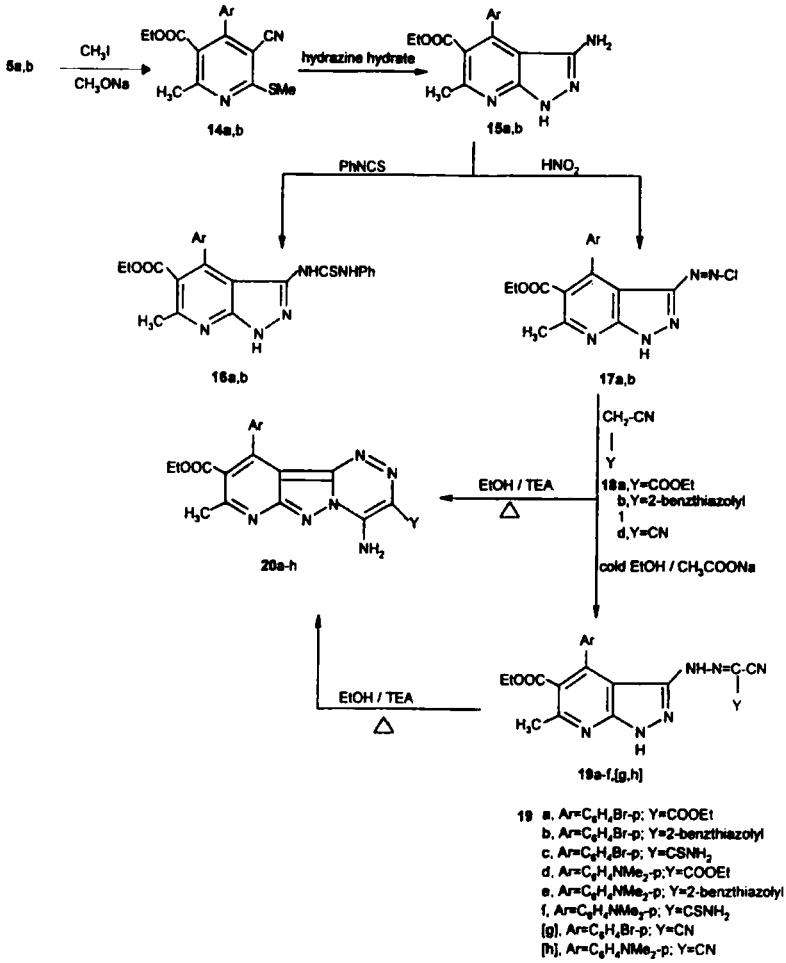


CHART 2

spectra of these reaction products have no any absorption bands corresponding to the NH_2 groups. Their ^{1}H-NMR (ppm) spectra do not revealed any signals corresponding to NH_2 group. Based on the above data compounds **17a,b** were formulated as pyrazolo-pyridinediazonium chloride derivatives. Compounds **17a,b** were reacted with some active methylene compounds.

Thus, it has been found that **17a** reacted with ethylcyanoacetate (**18a**) to yield a reaction product **19a**. The IR (cm^{-1}) spectrum of this reaction product showed the absorption bands of two NH (3301, 3198), two CO-ester (1720, 1697), CN (2219) and saturated CH_2 and CH_3 (2987) groups. The ^{1}H-NMR (ppm) spectrum of **19a** revealed the absorption bands of two NH (s, br., 5.3), CH_2CH_3 at pyridine (t, 0.9; q, 3.7), CH_2CH_3at pyrazole (t, 1.6; q, 4.0), CH_3 (s, 1.1) in addition to the aromatic protons (m, 7.3–7.8). Based on the above data compound **19a** was formulated as pyrazolopyridine derivative (cf. Chart 2 and Experimental Part). Further elucidation of structure of **19a** via its cyclization in boiling ethanol in the presence of triethyl amine to yield the cyclized product corresponding to pyrido[2',3':3,4]pyrazolo[5,1-c]-1,2,4-triazine derivative **20a**. The IR (cm^{-1}) spectrum of **20a** showed the absence of nitrile absorption band, and newly born NH_2 absorption band at (3343, 3298). It's ^{1}H-NMR (ppm) spectrum revealed among its signals those of NH_2 (s, br., 5.3)., compound **20a** was prepared via another route by the reaction of **18a** with **17a** in boiling ethanol in the presence of triethyl amine to give pyridopyrazolotriazine, compound **20a** prepared via this route is the same identical in all aspects with that previously prepared.

Analogously benzothiazoloacetonitrile (**18b**) and cyanothioacetamide (**1**) reacted with **17a** to afford the corresponding pyrazolopyridine derivatives **19b,c** which were cyclized by the action of boiling ethanol in the presence of triethyl amine to yield the corresponding pyridopyrazolotriazine derivatives **20b,c**. The structures of **19b,c** and **20b,c** were assigned based on the correct elemental analysis and spectral data as **19a** and **20a** described before. In the same manner compound **17b** reacted with **18a,b** and **1** to yield the corresponding pyrazolopyridine derivatives **19d-f** which were cyclized by the action of boiling ethanol and triethyl amine to afford the corresponding pyridopyrazolotriazine derivatives **20d-f**. In a contrast behavior, compounds **17a,b** reacted with malononitrile (**18d**) to give directly the cyclized product corresponded to pyridopyrazolotriazine derivatives **20g,h**. The structures assigned of **20g,h** were based on the correct elemental analysis and spectral data (cf. Chart 2 and Tables I & II).

Our investigation was also extended to study the reaction of **17a** with acetyl acetone (**21a**) to give a reaction product **22a**. The IR (cm^{-1}) spectrum of **22a** showed the absorption bands of CO-ester (1729), CO-acetyl (1689) and saturated CH_2, CH_3 (2985) groups. It's ^{1}H-NMR (ppm) spectrum revealed the signals of CH_2-CH_3(t, 0.8; q, 3.7), CH_3CO (s, 1.8), CH_3

(s, 1.1) and aromatic protons (7.4–7.7). Based on the above data compound **22a** was formulated as pyridopyrazolotriazine derivative.

Analogously compound **17a** reacted with ethyl acetoacetate (**21b**) to give the corresponding pyridopyrazolotriazine derivative **22b**. In the same manner compound **17b** reacted with **21a,b** to give the corresponding pyridopyrazolotriazine derivative **22c,d**. The structure of the **22c,d** was confirmed based on the correct elemental analyses and spectral data as **22a,b** describe before (cf. Experimental part). Compound **17a** reacts with ethylbenzoylacetate (**23**) to yield the corresponding pyrazolopyridine derivative **24a**. The IR (cm^{-1}) spectrum of **24a** showed the absorption bands of two NH (3350, 3298), CO-ester (1729), CO benzoyl (1699) and saturated CH_2, CH_3 (2985) groups. It's ^{1}H-NMR (ppm) spectrum revealed the signals of two NH (s, br., 5.3), CH_2CH_3 at pyridine (t, 0.8; q, 3.7), CH_2-CH_3 at pyrazole (t, 1.8; q, 4.0), CH_3 (1.1) and aromatic protons (7.4–7.7). Based on the above data compound **24a** was formulated as hydrazopyrazolo[3,4-b]pyridine derivative. The structure of **24a** was further elucidated by the action of boiling ethanol and triethyl amine to yield the cyclized product corresponding to pyridopyrazolotriazine derivative **25a** (cf. Chart 3 and Tables I & II). The structure of **25a** was assigned based on the correct elemental analysis and spectral data. In the same manner **17b** reacted with **23** to afford the corresponding hyrazopyrazolopyridine derivative **24b**. Compound **24b** by the action of boiling ethanol and triethyl amine gave a cyclized product **25b**. Compounds **24b** and **25b** were assigned based on the correct elemental analysis and spectral data as **24a** and **25a** described before. Finally **17a** reacted with ω-thiocynatoacetophenone (**26**) to yield a cyclized product **28a**. The IR (cm^{-1}) spectrum of **28a** showed the absorption bands of two NH (3332, 3290), CO-ester (1729), CO-benzoyl (1680) and saturated CH_2, CH_3 (2986) groups. It's ^{1}H-NMR (ppm) spectrum revealed the signals of two NH (s, br., 5.3), CH_2-CH_3 (t, 0.9; q, 3.7), CH_3 (1.1) in addition to the aromatic protons (m, 7.4–7.7). Based on the above data compound **28a** was formulated as iminothiadiazolylpyrazolopyridine derivative **28a**. The formation of the iminothiadiazole ring in **28a** proceed via the addition of NH to the nitrile function. Further elucidation of **28a** by it's reaction with acetic anhydride and hydrogen peroxide to give the N-acetyl and thiadiazolone derivatives **29a** and **30a**. The IR (cm^{-1}) spectrum of these reaction products showed the absence of NH absorption bands. The mass spectrum of compound **29a** gave m/e= M^++2= 647(100%) which is the same molecular weigh required for a compound with molecular formula $C_{29}H_{23}BrN_6O_5S$ (cf. Chart 3 and Exper-

imental part). Their ^{1}H-NMR (ppm) spectrum do not revealed any signals corresponding to the NH group. In the same manner **17b** reacted with **26** to yield the corresponding iminothiadiazolylpyrazolopyridine derivative **28b**. Compound **28b** reacted with acetic anhydride and hydrogen peroxide to afford N-acetyl and thiadiazolone derivatives **29b** and **30b**. The structures assigned for each of **28b, 29b** and **30b** based on the correct elemental analysis and spectral data as **28a, 29a** and **30a** described before.

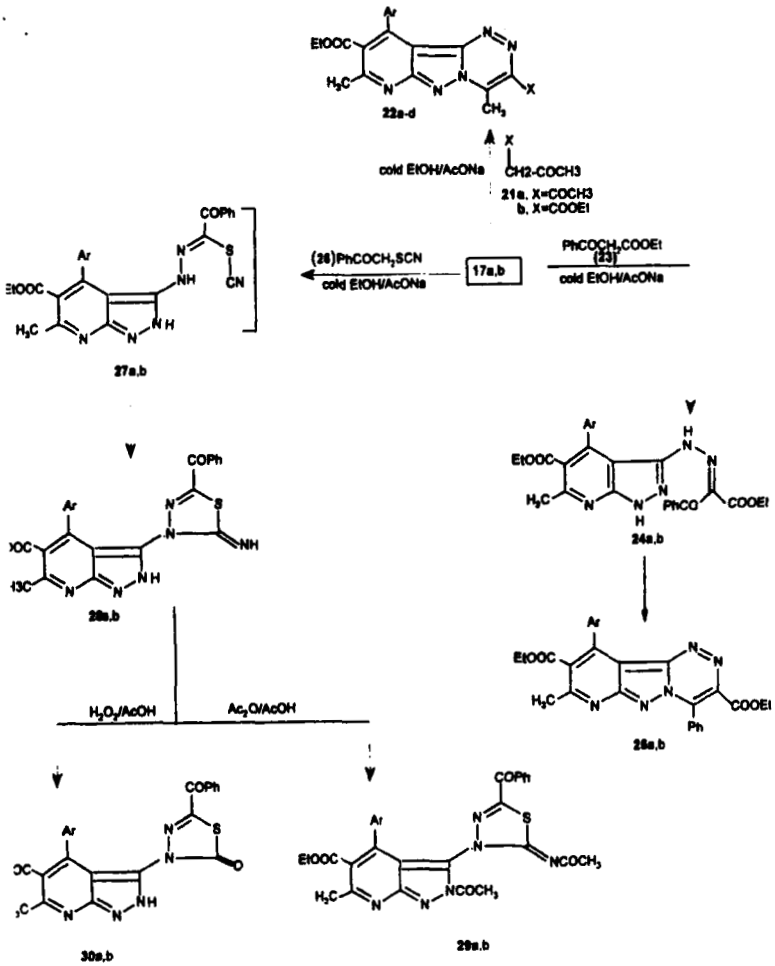


CHART 3

EXPERIMENTAL

All melting points are uncorrected. IR spectra were recorded (KBr disc) on a Pye Unicam SP- 1100 and Perkin- Elmer FT-IR type 4 Spectrophotometers. ^{1}H- NMR spectra were recorded on Gemini 200 Hz and Brucker WP-80 spectrometers using TMS as an internal standard. Chemical shifts are expressed as δ ppm units using DMSO-d_6, $CDCl_3$ and $(CD_3)_2CO$ as solvents. Mass spectra were recorded on Hewlett – Packard GC-MS type 2988 series A using DIP technique at 15 eV and 70 eV.

Microanalyses were performed by the Microanalytical center at Cairo University using Perkin- Elmer 2400 CHN Elemental analyzer. Compound **5b**[16] was prepared according to literature procedure.

Reactions of 5a,b with different reagents in methanolic sodium methoxide

A solution of each of **5a,b** (0.01mole) and each of the reagents **6a,b, 8, 12** or methyl iodide (0.01mole) was heated under reflux in methanolic sodium methoxide for 5 hours. The reaction products obtained on hot or after cooling were filtered off and crystallized from the proper solvents to yield the reaction products **7a-d, 9a,b, 11a,b** and **14a,b** respectively (cf. Tables I and II).

Reactions of 17a,b with different reagents in cold ethanol in the presence of sodium acetate

A solution of each of **17a,b** (0.01mole) in ethanol (30ml) in the presence of sodium acetate (1g) was treated with each of the reagents **18a-b, 21a,b, 23, 26** and the whole was stirred at room temperature for one hour. The solid products obtained were filtered off, washed with water, and crystallized from the proper solvents to yield the reaction products **19a-f, 20g,h, 22a-d, 24a,b** and **28a,b** respectively (cf. Tables I and II).

Reactions in hot ethanolic triethylamine

A solution of each of **19a-f, 24a,b** (0.01mole) in ethanol (30ml) in the presence of triethylamine (0.5ml) was heated under reflux for 2–3 hours. The solids obtained on hot or after cooling were filtered off, and crystal-

lized from the proper solvents to yield the reaction products **20a-f** and **25a,b** respectively (cf. Tables I and II).

Reaction with hydrazine hydrate

A solution of **14a,b** (0.01mole) in ethanol (30ml) was treated with hydrazine hydrate (10ml) and then heated under reflux for 6 hours. The solids obtained on hot or after cooling were filtered off, and crystallized from the proper solvents to yield the reaction products **15a,b** respectively (cf. Tables I and II).

Reaction with nitrous acid

A cold solution of each of **15a,b** (0.01mole) in concentrated hydrochloric acid (5ml) was treated with a cold solution of sodium nitrite (0.015 mole) and then stirred in an ice -cold bath for one hour. The solid products obtained were filtered, washed with water and recrystallized from the proper solvents to yield the reaction products **17a,b** respectively (cf. Tables I and II).

Reaction with phenylisothiocyanate

A cold solution of each of **15a,b** (0.01mole) in pyridine (30ml) was treated with phenylisothiocyanate (0.01mole). The reaction mixture was heated under reflux for 5 hours then cooled, poured into ice-cold water and acidified by dilute hydrochloric acid. The solid products obtained were filtered, and recrystallized from the proper solvents to yield the reaction products **16a,b** respectively (cf. Tables I and II).

References

1. M. A. A. Elneairy; Phosphorus, Sulfur and Silicon, **148**, 189 (1999).
2. F.A. Attaby, S. M. Eldin and M. A. A. Elneairy; Heteroatom Chem., **9**, 571 (1998).
3. F.A. Attaby, A. M. Abdel-fattah; Phosphorus, Sulfur and Silicon, **155**, 253 (1999).
4. A. M. Abdel-fattah; Phosphorus, Sulfur and Silicon, **156**, 53 (2000).
5. F.A. Attaby; Phosphorus, Sulfur and Silicon, **126**, 27 (1997).
6. F.A. Attaby; Phosphorus, Sulfur and Silicon, **139**, 1 (1998).
7. F.A. Attaby, S. M. Eldin and M. Abdel-Razik; Phosphorus, Sulfur and Silicon, **106**, 21 (1996).
8. F.A. Attaby, S. M. Eldin, W. M. Bassouni and M. A. A. Elneairy; Phosphorus, Sulfur and Silicon, **108**, 31 (1996).

9. F.A. Attaby, M.A.A. Elneairy and M. S. Elsayed; Phosphorous, Sulfur and Silicon, **149**, 29, (1999).
10. F.A. Attaby, Sanaa M. Eldin and M. A. A. Elneairy; J. Chem. Res., (S)**10**, 632; (M) **10**, 2754 (1998).
11. G. Lohaus and W. Dittmar; S. Afric. Patent, 6 906 036 (1968); C. A., **73**, 120308 (1968).
12. G. A. Youngdale, U. S. Patent, 4 288 440, (1980), C. A. **96**, 6596c (1982).
13. A. H. Todd, Br. Patent, 1 203 149, (1970), C. A. **73**, 120508b (1970).
14. R. W. Fries, D. P. Bohlken and B. V. Plapp, J. Med. Chem., **22**, 356m (1979).
15. B. R. Tolf, R. Bahlbom, Theorell and A. Akenson, Acta Chem. Scand., Ser. B., **36**, 101(1982).
16. A. Krause, E. Liepins, J. Pelcers, Z. Kalme, L. Dipans and G. Duburs, Kim. Geterosikl. Soedin, **1**, 92, (1985); C. A. **103**, 71161 (1985).