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4-Hydrazino-7*H*-pyrrolo[2,3-*d*]pyrimidines (**4**) were cyclocondensed with formic acid or triethyl orthoformate to give 7*H*-1,2,4-triazolo[1,5-*c*]pyrrolo[3,2-*e*]pyrimidines (**5**) and 7*H*-1,2,4-triazolo[4,3-*c*]pyrrolo-[3,2-*e*]pyrimidines (**6**) respectively. The [4,3-*c*]-isomers (**6**) were rearranged into thermodynamically more stable [1,5-*c*]-isomers (**5**). The identical compounds (**5**) were prepared using another route by reacting 3-amino-4-imino-7*H*-pyrrolo[2,3-*d*]pyrimidines (**3**) with formic acid or triethylorthoformate. Reaction of 2-amino-3-cyanopyrroles (**1**) with triethyl orthoformate followed by hydrazinolysis afforded (**3**) *via* the formation of *N*-ethoxymethylene-2-amino-3-cyanopyrroles (**2**).

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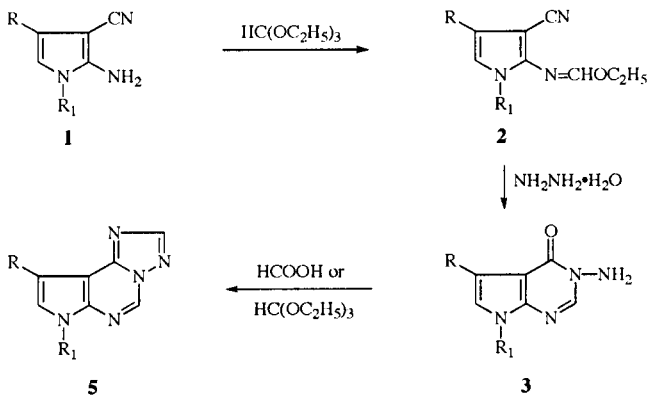
The thermal rearrangement of isomeric triazoles to its thermodynamically more stable isomers has rarely been studied in di- and triheterocycles [1-3]. A number of reports have been found for the synthesis of fused pyrimidines by cyclocondensation of 4-hydrazinopyrimidines with various one carbon donor moieties [4-11]. In many instances formic acid was used as a cyclizing agent in which the possibility of the formation of isomeric triazolopyrimidines has been overlooked [11-14]. However, the possibility of isomeric rearrangement was taken into consideration in the reaction of 4-hydrazinothienopyrimidines and 4-hydrazinopyrazolopyrimidines with one carbon donor moieties yielding respective isomeric triazolothienopyrimidines [2,3] and triazolopyrazolopyrimidines [15]. So far, there has not been any report of isomeric conversion in the triazolopyrrolopyrimidine system. A series of 4-hydrazinopyrrolo[2,3-*d*]pyrimidines, the useful intermediates in the construction of biologically important triazolopyrrolopyrimidines [16-20], have been prepared and reacted with triethyl orthoformate or formic acid to form novel triheterocyclic triazolopyrrolopyrimidines. Therefore, in continuation of our interest in fused triheterocyclic pyrimidines [21-24], it was thought of interest to report the synthesis of 7*H*-1,2,4-triazolo[1,5-*c*]pyrrolo[3,2-*e*]pyrimidines and 7*H*-1,2,4-triazolo[1,5-*c*]pyrrolo[3,2-*e*]pyrimidines, by the annellation of the triazole ring onto the existing pyrrolo[2,3-*d*]-pyrimidine systems. Furthermore, the isomeric rearrangement of triazolopyrrolopyrimidines to the more stable form has also been studied.

1,4-Disubstituted 2-amino-3-cyanopyrroles (**1**) [25] were reacted in boiling triethyl orthoformate to give 1,4-disubstituted *N*--ethoxymethylene-2-amino-3-cyanopyrroles (**2**), which on hydrazinolysis with hydrazine hydrate afforded 5,7-disubstituted 3-amino-4-imino-7*H*-pyrrolo[2,3-*d*]pyrimidines (**3**). The cyclocondensation of (**3**) with one carbon donor moiety such as triethyl orthoformate or formic acid under reflux conditions yielded the target 7,9-disubstituted 7*H*-1,2,4-triazolo[1,5-*c*]pyrrolo-[3,2-*e*]pyrimidines (**5**) (Method A) (Scheme 1).

Scheme 1

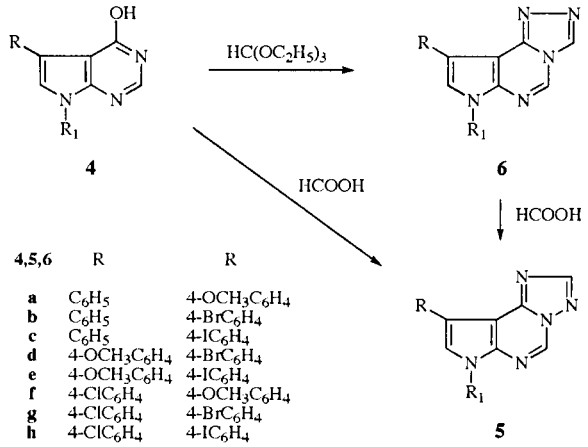


1,2,3,5	R	R	1,2,3,5	R	R
a	C_6H_5	4-$OCH_3C_6H_4$	e	4-$OCH_3C_6H_4$	4-IC_6H_4
b	C_6H_5	4-BrC_6H_4	f	4-$OClC_6H_4$	4-$OCH_3C_6H_4$
c	C_6H_5	4-IC_6H_4	g	4-$OClC_6H_4$	4-BrC_6H_4
d	4-$OCH_3C_6H_4$	4-BrC_6H_4	h	4-$OClC_6H_4$	4-IC_6H_4

The identical triazolopyrrolopyrimidines (**5**) were synthesized by another route (Method B) in which 5,7-disubstituted 4-hydrazino-7*H*-pyrrolo[2,3-*d*]pyrimidines (**4**) [21] were condensed with formic acid under boiling condition. The attempted reaction was believed to initiate with the formation of **6**, which were rearranged to the more stable isomers (**5**) in the presence of a strong nucleophile under thermal conditions. The reaction between **4** and triethyl orthoformate provided 7,9-disubstituted 7*H*-1,2,4-triazolo-[4,3-*c*]pyrrolo[3,2-*e*]pyrimidines (**6**). The [4,3-*c*]-isomers (**6**) on heating with formic acid were isomerized to the thermodynamically more stable unsymmetrical [1,5-*c*]-isomers (**5**) *via* Dimroth rearrangement [2,3,26] (Scheme 2).

The uv (methylene chloride) spectra of 1,4-disubstituted *N*-ethoxymethylene-2-amino-3-cyanopyrroles show two prominent λmax near 297 and 249 nm. The ir (potassium bromide) spectra of 1,4-disubstituted *N*-ethoxymethylene-2-amino-3-cyanopyrroles (**2**) exhibit a sharp absorption near 2210 cm^{-1} due to cyano group. ^1H nmr (deuteriochloroform) spectra of **2** display a triplet at δ 1.20-1.46 and a quartet at δ 4.20-4.35 integrating for three and two protons respectively

Scheme 2

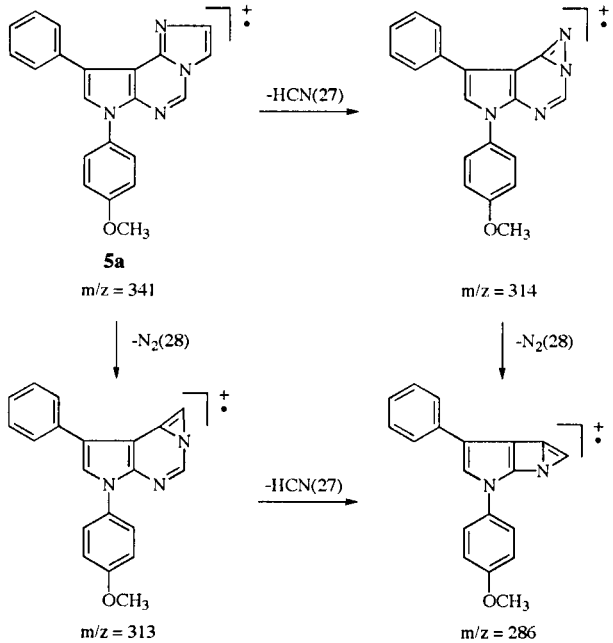


4,5,6	R	R
a	C_6H_5	4-$OCH_3C_6H_4$
b	C_6H_5	4-BrC_6H_4
c	C_6H_5	4-IC_6H_4
d	4-$OCH_3C_6H_4$	4-BrC_6H_4
e	4-$OCH_3C_6H_4$	4-IC_6H_4
f	4-ClC_6H_4	4-$OCH_3C_6H_4$
g	4-ClC_6H_4	4-BrC_6H_4
h	4-ClC_6H_4	4-IC_6H_4

because of the ethyl protons of ethoxymethylene group. A multiplet responsible for aromatic protons was appeared near δ 7.10-7.76. The proton resonance of the pyrrole ring is observed as a singlet at δ 6.85-6.91 and the aliphatic -CH proton of the ethoxymethylene functionality appear in the downfield region at δ 8.85-8.92 as a singlet.

The uv (methylene chloride) spectra of 5,7-disubstitued 3-amino-4-imino-7*H*-pyrrolo[2,3-*d*]pyrimidines (**3**) show two λ*max* at 293 and 246 nm respectively. The ir (potassium bromide) spectra of 5,7-disubstituted 3-amino-4-imino-7*H*-pyrrolo[2,3-*d*]pyrimidines (**3**) exhibited stretching vibrations in the region 3440-3140 cm^{-1} together with a bending vibration at 1648-1632 cm^{-1} because of imino and amino functionalities. A broad singlet at δ 5.43-5.47

Scheme 3



and a multiplet at δ 7.20-8.10 was assigned to amino and aromatic protons respectively in the ^1H nmr (deuteriochloroform) spectra of **3**. The imino proton was found to be merged with aromatic protons.

The uv (methylene chloride) spectra of 7,9-disubstituted 7*H*-1,2,4-triazolo[1,5-*c*]pyrrolo[3,2-*e*]pyrimidines (**5**) displayed two λ*max* at 247 and 257-293 nm. The ir (potassium bromide) spectra of **5** and **6** exhibited absorption bands in the region of 1628-1496 cm^{-1} for aromatic C=C, C=N stretching vibrations whereas the resonance due to aromatic protons as multiplet was obtained at δ 7.0-8.46 in the ^1H nmr (deuteriochloroform) spectra of compounds **5** and **6**. The more shielded triazole ring proton in the [1,5-*c*]isomers **5** present at position-2 appear as a singlet at δ 9.05-9.22 whereas the proton at position-3 in the [4,3-*c*]isomers **6** was found to appear at little downfield in the region δ 9.39-9.49 in the form of a singlet [2, 3, 15, 26].

The mass fragmentation pattern of compounds **5a** is depicted in Scheme 3 which was in agreement with the pattern of fused triazolopyrimidines [2-3] giving a molecular

Table 1

Physical and Analytical Data for Compounds **2a-h** and **3a-h**

Compound No.	Yield %	mp°C Crystallization Solvent	Molecular formula	Analysis Calcd.\Found C	H	N
2a	70	120-121 [a]	$C_{21}H_{19}N_3O_2$	73.02	5.54	12.17
				73.32	5.65	12.39
2b	72	152-153 [a]	$C_{20}H_{16}BrN_3O$	60.92	4.09	10.66
				60.81	3.89	10.46
2c	71	156-157 [a]	$C_{20}H_{16}IN_3O$	54.44	3.66	9.52
				54.22	3.43	9.29
2d	80	147-148 [a]	$C_{21}H_{18}BrN_3O_2$	59.44	4.28	9.90
				59.22	4.44	9.69
2e	70	158-159 [a]	$C_{21}H_{18}IN_3O_2$	53.52	3.85	8.92
				53.29	3.66	8.63
2f	80	157-158 [a]	$C_{21}H_{18}ClN_3O_2$	66.40	4.78	11.06
				66.23	4.61	10.88
2g	85	192-193 [a]	$C_{20}H_{15}BrClN_3O$	56.03	3.53	9.80
				56.43	3.19	10.02
2h	88	191-192 [a]	$C_{20}H_{15}ClIN_3O$	50.49	3.18	8.83
				50.33	2.99	9.09
3a	87	155-156 [b]	$C_{19}H_{17}N_5O$	68.86	5.17	21.14
				68.56	4.99	21.40
3b	72	151-152 [c]	$C_{18}H_{14}BrN_5$	56.85	3.71	18.42
				56.61	3.52	18.33
3c	60	194-196 [b]	$C_{18}H_{14}IN_5$	50.60	3.30	16.39
				50.41	3.41	16.49
3d	71	162-163 [b]	$C_{19}H_{16}BrN_5O$	55.62	3.93	17.07
				55.41	4.11	16.91
3e	80	191-193 [c]	$C_{19}H_{16}IN_5O$	49.90	3.53	15.32
				49.72	3.33	15.21
3f	75	200-202 [b]	$C_{19}H_{16}ClN_5O$	62.38	4.41	19.15
				62.18	4.61	19.01
3g	86	229-231 [c]	$C_{18}H_{13}BrClN_5$	52.13	3.16	16.89
				52.01	3.02	16.64
3h	88	213-215 [c]	$C_{18}H_{13}ClIN_5$	46.83	2.84	15.17
				46.63	2.65	15.01

[a] = Ethanol, [b] = benzene and [c] = dioxane.

Table 2

Physical and Analytical Data for Compounds **5a-h**

Compound No.	Yield % Method A	Yield % Method B	mp°C Crystallization solvent	Molecular formula	Analysis Calcd.\found C	H	N
5a	51	65	206-207	$C_{20}H_{15}N_5O$	70.37	4.43	20.52
			[a]		70.19	4.31	20.19
5b	65	70	220-222	$C_{19}H_{12}BrN_5$	58.47	3.10	17.95
			[a]		58.27	2.99	17.81
5c	42	55	228-230	$C_{19}H_{12}IN_5$	52.19	2.77	16.02
			[b]		51.88	2.61	16.19
5d	68	72	191-192	$C_{20}H_{14}BrN_5O$	57.16	3.36	16.67
			[a]		57.28	3.49	16.79
5e	59	67	211-212	$C_{20}H_{14}IN_5O$	51.41	3.02	14.99
			[b]		51.09	3.48	14.77
5f	70	74	238-240	$C_{20}H_{14}ClN_5O$	63.92	3.76	18.64
			[b]		63.75	3.61	18.49
5g	55	72	239-241	$C_{19}H_{11}BrClN_5$	53.73	2.61	16.49
			[b]		53.21	2.41	16.28
5h	65	69	263-265	$C_{19}H_{11}ClIN_5$	48.38	2.35	14.85
			[b]		48.21	2.21	14.49

[a] = dioxane and [b] = a mixture of *N,N*-dimethylformamide:ethanol (4:6 v/v)

Table 3

Physical and Analytical Data for Compounds **6a-h**

Compound No.	Yield %	mp °C	Molecular formula	Analysis Calcd\found C	H	N
6a	75	209-210	$C_{20}H_{15}N_5O$	70.37	4.43	20.52
		[a]		70.20	4.33	20.24
6b	77	246-248	$C_{19}H_{12}BrN_5$	58.47	3.10	17.95
		[a]		58.27	2.99	17.81
6c	71	243-245	$C_{19}H_{12}IN_5$	52.19	2.77	16.02
		[a]		51.88	2.61	16.19
6d	78	248-250	$C_{20}H_{14}BrN_5O$	57.16	3.36	16.67
		[a]		57.28	3.49	16.79
6e	72	238-240	$C_{20}H_{14}IN_5O$	51.41	3.02	14.99
		[a]		51.09	3.48	14.77
6f	79	279-281	$C_{20}H_{14}ClN_5O$	63.92	3.76	18.64
		[a]		63.75	3.61	18.49
6g	74	299-301	$C_{19}H_{11}BrClN_5$	53.73	2.62	16.49
		[a]		53.20	2.29	16.32
6h	70	322-324	$C_{19}H_{11}ClIN_5$	48.38	2.35	14.85
		[a]		48.25	2.25	14.58

[a] = a mixture of *N,N*-dimethylformamide : ethanol (4:6 v/v)

ion peak at 341. The fragments at 313, 314 and 286 were obtained due to subsequent elimination of nitrogen and hydrogen cyanide or hydrogen cyanide and nitrogen molecules.

EXPERIMENTAL

Melting points are uncorrected and were determined in open capillaries. The uv (methylene chloride) spectra were taken on Backman Du-64 spectrophotometer. The infrared spectra were recorded in cm^{-1} on a Buck-500 spectrophotometer using potassium bromide technique. The ^1H nmr spectra were recorded on Varian 300 MHz spectrometer using deuteriochloroform as solvent and tetramethyl silane as the internal standard. The chemical shifts are expressed in δ ppm. The mass spectra was taken on LKB 9000 mass spectrometer. The purity of the compounds was checked by tlc using silica gel G and spots were visualized by exposing the dried plates to iodine vapour.

General Procedure for the Synthesis of 1,4-Disubstituted *N*-Ethoxymethylene-2-amino-3-cyanopyrroles (**2a-h**).

1,4-Disubstituted 2-amino-3-cyanopyrroles (**1**, 0.01 mole) were refluxed with triethyl orthoformate (10 ml) for 3.0-4.0 hours. After completion of the reaction, the excess of triethyl orthoformate was recovered *in vacuo*. The solid thus obtained was treated with cold water, filtered, dried and crystallized (Table 1).

General Procedure for the Synthesis of 5,7-Disubstituted 3-Amino-4-imino-7*H*-pyrrolo[2,3-*d*]pyrimidines (**3a-h**).

A mixture of 1,4-disubstituted *N*-ethoxymethylene-2-amino-3-cyanopyrroles (**2**, 0.01 mole) and hydrazine hydrate (99%, 10 ml) was heated under reflux condition for 3.5-4.0 hours. The reaction mixture was allowed to cool, poured onto the crushed ice and neutralized with aqueous acetic acid (50%, v/v). The solid thus obtained was filtered, washed with water, dried and crystallized (Table 1).

General Procedure for the Synthesis of 7,9-Disubstituted 7*H*-1,2,4-Triazolo[1,5-*c*]pyrrolo[3,2-*e*]pyrimidines (**5a-h**).

Method A.

5,7-Disubstituted 3-Amino-4-imino-7*H*-pyrrolo[2,3-*d*]pyrimidines (**3**, 0.01 mole) were heated with boiling formic acid (15 ml) for 6.0-7.0 hours. The cold reaction mixture was poured onto the crushed ice and neutralized with sodium hydroxide solution (1*N*). The solid obtained was filtered, washed with water, dried and crystallized (Table 2).

Table 4

Ir and ^{1}H nmr Spectral Data for Compounds **2a-h**, **3a-h**, **5a-h** and **6a-h**

Compound. No	ir (potassium bromide) cm^{-1}	^{1}H nmr (δ ppm)
2a	3070, 2840 (CH), 2210 (CN), 1612, 1520 (C=C, C=N)	1.20-1.40 (t, 3H, OCH_2CH_3), 3.85 (s, 3H, OCH_3), 4.20-4.31 (q, 2H, OCH_2CH_3), 6.85 (s, 1H, H at C_5), 7.20-7.70 (m, 9H, Ar-H), 8.85 (s, 1H, $CHOC_2H_5$)
2b	3080, 2860 (CH),2210 (CN), 1600, 1498 C=C, C=N)	1.23-1.44 (t, 3H, OCH_2CH_3), 4.25-4.33 (q, 2H, OCH_2CH_3), 6.87 (s, 1H, H at C_5), 7.25-7.72 (m, 9H, Ar-H), 8.86 (s, 1H, $CHOC_2H_5$)
2c	3070, 2850 (CH), 2200 (CN), 1604, 1508 (C=C, C=N)	1.24-1.44 (t, 3H, OCH_2CH_3), 4.28-4.35 (q, 2H, OCH_2CH_3), 6.87 (s, 1H, H at C_5), 7.23-7.75 (m, 9H, Ar-H), 8.91 (s, 1H, $CHOC_2H_5$)
2d	3090, 2840 (CH),2205 (CN), 1612, 1496 (=C, C=N)	1.22-1.41 (t, 3H, OCH_2CH_3), 3.85 (s, 3H, OCH_3), 4.20-4.31 (q, 2H, OCH_2CH_3), 6.88 (s, 1H, H at C_5), 7.30-7.77 (m, 8H, Ar-H), 8.90 (s, 1H, $CHOC_2H_5$)
2e	3100, 2850 (CH), 2220 (CN), 1612, 1492 (C=C, C=N)	1.23-1.43 (t, 3H, OCH_2CH_3), 3.88 (s, 3H, OCH_3), 4.20-4.31 (q, 2H, OCH_2CH_3), 6.89 (s, 1H, H at C_5), 7.30-7.76 (m, 8H, Ar-H), 8.86 (s, 1H, $CHOC_2H_5$)
2f	3070, 2840 (CH), 2200 (CN), 1600, 1520 (C=C, C=N)	1.22-1.40 (t, 3H, OCH_2CH_3), 3.95 (s, 3H, OCH_3), 4.24-4.30 (q, 2H, OCH_2CH_3), 6.91 (s, 1H, H at C_5), 7.29-7.71 (m, 8H, Ar-H), 8.85 (s, 1H, $CHOC_2H_5$)
2g	3090, 2860 (CH), 2220 (CN), 1608, 1516 (C=C, C=N)	1.23-1.43 (t, 3H, OCH_2CH_3), 4.25-4.33 (q, 2H, OCH_2CH_3), 6.87 (s, 1H, H at C_5), 7.25-7.72 (m, 8H, Ar-H), 8.86 (s, 1H, $CHOC_2H_5$)
2h	3080, 2870 (CH), 2200 (CN), 1604, 1504 (C=C, C=N)	1.25-1.46 (t, 3H, OCH_2CH_3), 4.25-4.33 (q, 2H, OCH_2CH_3), 6.87 (s, 1H, H at C_5), 7.25-7.72 (m, 8H, Ar-H), 8.92 (s, 1H, $CHOC_2H_5$)
3a	3340, 3280, 3140 (NH), 3030, 2960 (CH), 1632 (NH), 1600, 1520 (C=C, C=N),	3.95 (s, 3H, OCH_3), 5.40 (s, 2H, NH_2), 7.20-7.95 (m, 12H Ar-H + NH)
3b	3380, 3280, 3180 (NH), 3060, 2970 (CH), 1648 (NH), 1624, 1500 (C=C, C=N)	5.43 (s, 2H, NH_2), 7.26-8.0 (m, 12H, Ar-H + NH)
3c	3370, 3280, 3150 (NH), 3050, 2960 (CH), 1644 (NH), 1598, 1512 (C=C, C=N)	5.45 (s, 2H, NH_2), 7.30-8.03 (m, 12H, Ar-H + NH)
3d	3350, 3300, 3180 (NH), 3060, 2840 (CH), 1632 (NH), 1612, 1492 (C=C, C=N)	3.85 (s, 3H, OCH_3), 5.46 (s, 2H, NH_2), 7.20-7.86 (m, 11H, Ar-H + NH)
3e	3440, 3300, 3180 (NH), 3010, 2840 (CH), 1636 (NH), 1596, 1488 (C=C, C=N)	3.89 (s, 3H, OCH_3), 5.46 (s, 2H, NH_2), 7.28-7.99 (m, 11H, Ar-H + NH)
3f	3340, 3280, 3160 (NH), 3050, 2880 (CH), 1648 (NH), 1620, 1516 (C=C, C=N)	3.85 (s, 3H, OCH_3), 5.44 (s, 2H, NH_2), 7.22-8.05 (m, 11H, Ar-H + NH)
3g	3380, 3290, 3180 (NH), 3060, 2950 (CH), 1648 (NH), 1628, 1504 (C=C, C=N)	5.46 (s, 2H, NH_2), 7.28-8.10 (m, 11H, Ar-H + NH)
3h	3370, 3300, 3170 (NH), 3070, 2190 (CH), 1644 (NH), 1624, 1496 (C=C, C=N)	5.47 (s, 2H, NH_2), 7.28-8.12 (m, 11H, Ar-H + NH)
5a	3090, 2860 (CH), 1624, 1520 (C=C, C=N)	3.83 (s, 3H, OCH_3), 7.0-8.30 (m, 11H, Ar-H), 9.05 (s, 1H, H at C_2)
5b	3090, 2930 (CH), 1620, 1512 (C=C, C=N)	7.10-8.20 (m, 11H, Ar-H), 9.12 (s, 1H, H at C_2)
5c	3050, 2880 (CH), 1612, 1508 (C=C, C=N)	7.0-8.10 (m, 11H, Ar-H), 9.15 (s, 1H, H at C_2)
5d	3090, 2820 (CH), 1616, 1496 (C=C, C=N)	3.87 (s,3H,OCH_3), 7.07-8.34 (m, 10H, Ar-H), 9.22 (s, 1H, H at C_2)
5e	3090, 2860 (CH), 1628, 1500 (C=C, C=N)	3.80 (s, 3H, OCH_3), 7.0-8.0 (m, 10H, Ar-H), 9.10 (s, 1H, H at C_2)
5f	3070, 2840 (CH), 1628, 1520 (C=C, C=N)	3.65 (s, 3H, OCH_3), 7.10-8.20 (m, 10H, Ar-H), 9.12 (s, 1H, H at C_2)
5g	3090, 2980 (CH), 1628, 1504 (C=C, C=N)	7.20-8.20 (m, 10H, Ar-H), 9.10 (s, 1H, H at C_2)
5h	3080, 2990 (CH), 1628, 1508 (C=C, C=N)	7.10-8.10 (m, 10H, Ar-H), 9.12 (s, 1H, H at C_2)
6a	3090, 2950 (CH), 1620, 1516 (C=C, C=N)	3.83 (s, 3H, OCH_3), 7.0-8.29 (m, 11H, Ar-H), 9.42 (s, 1H, H at C_3)
6b	3070, 2830 (CH), 1620, 1512 (C=C, C=N)	7.10-8.21 (m, 11H, Ar-H), 9.46 (s, 1H, H at C_3)
6c	3060, 2870 (CH), 1612, 1504 (C=C, C=N)	7.01-8.10 (m, 11H, Ar-H), 9.45 (s, 1H, H at C_3)
6d	3090, 2930 (CH), 1616, 1500 (C=C, C=N)	3.87 (s, 3H,OCH_3), 7.10-8.46 (m, 10H, Ar-H), 9.39 (s, 1H, H at C_3)
6e	3060, 2950 (CH), 1624, 1512 (C=C, C=N)	3.80 (s, 3H, OCH_3), 7.02-8.0 (m, 10H, Ar-H), 9.43 (s, 1H, H at C_3)
6f	3070, 2940 (CH), 1624, 1520 (C=C, C=N)	3.65 (s, 3H, OCH_3), 7.08-8.20 (m, 10H, Ar-H), 9.42 (s, 1H, H at C_3)
6g	3080, 2980 (CH), 1622, 1508 (C=C, C=N)	7.20-8.20 (m, 10H, Ar-H), 9.44 (s, 1H, H at C_3)
6h	3070, 2980 (CH), 1622, 1504 (C=C, C=N)	7.10-8.10 (m, 10H, Ar-H), 9.46 (s, 1H, H at C_3)

Method B.

A mixture of 5,7-Disubstituted 4-hydrazino-7*H*-pyrrolo[2,3-*d*]-pyrimidines (**4**, 0.01 mole) and formic acid (20 ml) was refluxed for 7.0-8.0 hours. Then the reaction mixture was allowed to cool, poured on to the crushed ice and neutralized with sodium hydroxide solution (1*N*). The obtained precipitates were filtered, washed with water, dried and crystallized to get title compounds **5** (Table 2).

General Procedure for the Synthesis of 7,9-Disubstituted 7*H*-1,2,4-Triazolo[4,3-*c*]pyrrolo[3,2-*e*]pyrimidines (**6a-h**).

A mixture of 5,7-disubstituted 4-hydrazino-7*H*-pyrrolo[2,3-*d*]-pyrimidines (**4**, 0.01 mole) and triethyl orthoformate (20 ml) was refluxed for 1.0 hour at 100°C. The excess of reagent was distilled under pressure and to the cold reaction mixture was added methanol (10 ml). Thus obtained solid was filtered, dried and crystallized to get the title compounds (**6**) (Table 3).

General Procedure for the Conversion of Compounds **6** to **5**.

7,9-Disubstituted 7*H*-1,2,4-triazolo[4,3-*c*]pyrrolo[3,2-*e*]pyrimidines (**6**, 1.0 g) were heated with formic acid (10 ml) under reflux condition for 3.0-4.0 hours. The reaction mixture was allowed to cool, poured onto crushed ice, filtered, washed with water till neutralized, dried and crystallized to get compounds (**5**).

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REFERENCES AND NOTES

[1] A. R. Katritski, Fu-Bao Ji, W. Fan, J. K. Gallos, J. V. Greenhill, and R. W. King, *J. Org. Chem.*, **57**, 148 (1992).

[2] C. J. Shishoo, M. B. Devani, G. V. Ullas, S. Ananthan, and V. S. Bhadti, *J. Heterocyclic Chem.*, **18**, 43 (1981).

[3] C. J. Shishoo, M. B. Devani, G. V. Ullas, S. Ananthan, and V. S. Bhadti, *J. Heterocyclic Chem.*, **24**, 1125 (1981).

[4] G. S. Sidhu, G. Tyagarajan, and R. Nagabhushan, *Naturwissenschaften*, **50**, 732 (1963); *Chem. Abstr.*, **60**, 6841 (1964).

[5] K. Kottke and H. Kuchsmedt, *Pharmazie*, **33**, 507 (1978); *Chem. Abstr.*, **89**, 215340 (1978).

[6] K. Kottke and H. Kuchsmedt, *Pharmazie*, **35**, 800 (1980); *Chem. Abstr.*, **92**, 765150 (1980).

[7] M. A. E. Shaban, M. A. M. Taha, and E. E. M. Sharshira, *Alexandria J. Pharm. Sci.*, **6**, 219 (1992); *Chem. Abstr.*, **118**, 95458 (1993).

[8] J. Bourguignon, E. Gougeon, G. Queguiner, and P. Pastour, *Bull. Soc. Chem. Fr.* (3-4, pt 2), 815 (1975); *Chem. Abstr.*, **83**, 114329 (1975).

[9] Y. Michihiro, K. Masao, and Y. Hisao, German Patent, 2,805,124 (1978); *Chem. Abstr.*, **89**, 197593 (1978).

[10] K. Hiedo and M. Yasuo, Japan Patent 5577 (1959); *Chem. Abstr.*, **54**, 14280 (1960).

[11] M. Robba, M. Cugnon de servicourt, and J. M. Lecomte, *J. Heterocyclic Chem.*, **12**, 525 (1975).

[12] M. Robba, P. Touzot, and J. M. Lacomte, *C. R. Acad. Sci.*, **276**, 53 (1975); *Chem. Abstr.*, **78**, 111243 (1975).

[13] V. P. Arya, *Indian J. Chem.*, **10**, 1141 (1972).

[14] F. Sauter and P. Stanetty, *Monatsh Chem.*, **106**, 1111(1975).

[15] F. Gatta and M. Luciani, *J. Heterocyclic Chem.*, **26**, 613 (1988).

[16] J. E. Francis, W. D. Cash, B. S. Barbaz, P. S. Bernard, and R. A. Lovell, *J. Med. Chem.*, **31**, 1014 (1988).

[17] J. E. Francis, *J. Med. Chem.*, **34**, 281 (1991).

[18] U. D. Truener and H. Breuer, U. S. Patent 4,053,474 (1976); *Chem. Abstr.*, **88**, 37826 (1978).

[19] G. E. Hardtmann and F. G. Kathawala, German Patent 2261095 (1973); *Chem. Abstr.*, **79**, 66385 (1973).

[20] Mochida Pharmaceutical Co. Ltd.; Japan Kokai Tokkyo Koho Jp 8235,593 (1982); *Chem. Abstr.*, **97**, 110028 (1982).

[21] C. G. Dave and R. D. Shah, *J. Heterocyclic Chem.*, **35**, 1295 (1998).

[22] C. G. Dave, A. B. Shah, and H. C. Shah, *J. Heterocyclic Chem.*, **34**, 937 (1997).

[23] C. G. Dave and R. D. Shah, *Heterocycles*, **51**, 1819 (1999).

[24] C. G. Dave and M. C. Shukla, *J. Heterocyclic Chem.*, **34**, 1805 (1997).

[25] K. Gewald and M. Henschel, *J. Pract. Chem.*, **318**, 663 (1976).

[26] G. A. Bhat and L. B. Townsend, *J. Chem. Soc., Perkin Trans., 1*, 2387 (1981).