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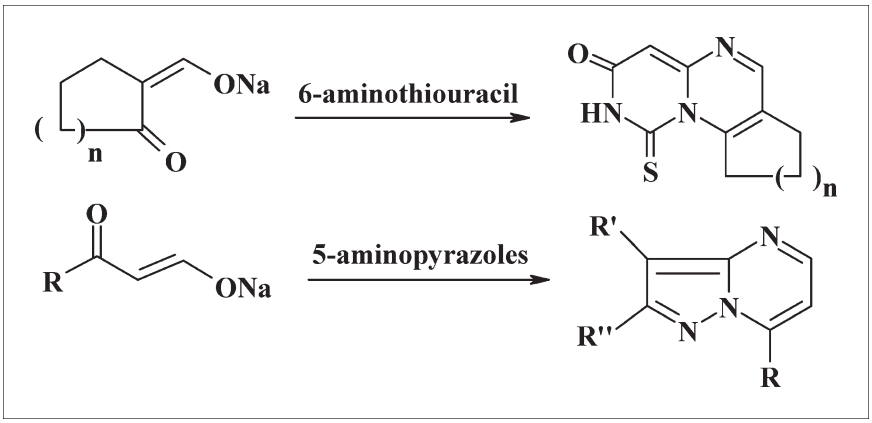

An easy and efficient route for synthesis of some pyrimido[1,6-*a*]pyrimidine and pyrazolo[1,5-*a*]pyrimidine derivatives was described through the reaction of sodium salts of formyl ketones with 6-aminothiouracil and 5-aminopyrazole derivatives, respectively. The characterization of the reaction products was confirmed by using elemental analysis and spectral data.

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INTRODUCTION

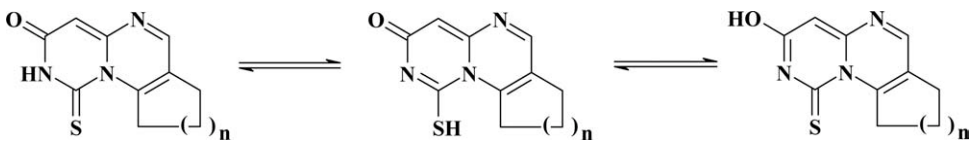
Pyrimidopyrimidines, analogs of folic acid (one of the B vitamins that is a key factor in the synthesis of nucleic acids RNA and DNA) and an important class of annulated uracil and thiouracil, are pharmacologically useful as powerful inhibitors of aggregation of thrombocytes [1], hepatoprotective [2], bronchodilators, anticancer [3–5], vasodilators [6], antiallergic [7], and antihypertensive [8] agents. It was also reported that pyrimidopyrimidine derivatives inhibited lipid peroxidation in human and rat liver [9]. Here, an easy construction of some new and interesting pyrimidopyimidines, the ring systems that can be found in marine-derived natural products such as crambescidin [10] and batzelladine alkaloids has been achieved [11]. On the other hand, pyrazolopyrimidine systems, as they are structurally related to purine, are considered as typical examples for purine analogs that are reported as inhibitors for the synthesis of DNA and RNA in the cells of some kinds of cancers [12] and viruses [13,14] and many other biological activities for these compounds are reported [15–21]. It was also reported that some 3(*H*)-pyrimidopyrimidine derivatives exhibited potent antihyperlipidemic and antihyperglycemic activity in alloxan diabetic–hypercholesterolemic and streptozotocin diabetic rats, respectively [22–32].

RESULTS AND DISCUSSION

The construction of pyrimido[1,6-*a*]pyrimidine ring systems are mostly multistep synthesis [33,34]. However, our synthetic strategy commences from the reaction of easily available compounds, 6-aminothiouracil and the sodium salts of formyl ketones, which led to the direct construction of the novel pyrimido[1,6-*a*]pyrimidine nucleus. Thus, fusion of 6-aminothiouracil with the formyl salts (**1**) in piperidine acetate and acetic acid afforded, with considerable yields, the cyclocondensed pyrimido[1,6-*a*]pyrimidines **4a–d** as outlined in Chart 1.

The reaction mode for the formation of the products is suggested to proceed through the initial nucleophilic attack by the exocyclic amino group of 6-aminothiouracil at the formyl group of compound (**2**), that formed *in situ* due to the reaction of the formyl salts (**1**) with water, followed by cyclization through the elimination of two water molecules leading to the formation of the nonplanner products (**4**) rather than the planner products (**6**) [35–37].

The identity of compounds (**4a–d**) was proven on the basis of their elemental analyses and spectral data. However, the fact that the nucleus of pyrimido[1,6-*a*]pyrimidine has more than one resonating forms must be taken into consideration while discussing their spectral data. This ring system may be found in three resonating forms:



Thus, the IR spectra of **4c** revealed bands at ύ = 3400 cm^{-1} (NH); 2927 (paraffinic CH); 1680 (C=O); 1613 (C=N); and 1245 (C=S). The ^{1}H-NMR spectrum showed signals at δ = 1.29–1.67 ppm (m, 4H, $2CH_2$); 2.42–2.92 (m, 4H, $2CH_2$); 3.22–3.41 (m, 4H, $2CH_2$), 7.99 (s, 1H, pyrimidine N=C—H); 8.01 (s, 1H, pyrimidine C=CH); and 11.91 (br s, 1H, SH). The mass spectrum of this compound showed a molecular ion peak at m/z = 261 (100%), coincident with the molecular weigh of the compound (261.35).

A successful trial for establishment of the phenomenon has been carried out by the reaction of 6-aminothiouracil with sodium salts of acyclic ketones. Thus, the reaction of 6-aminothiouracil with sodium formyl

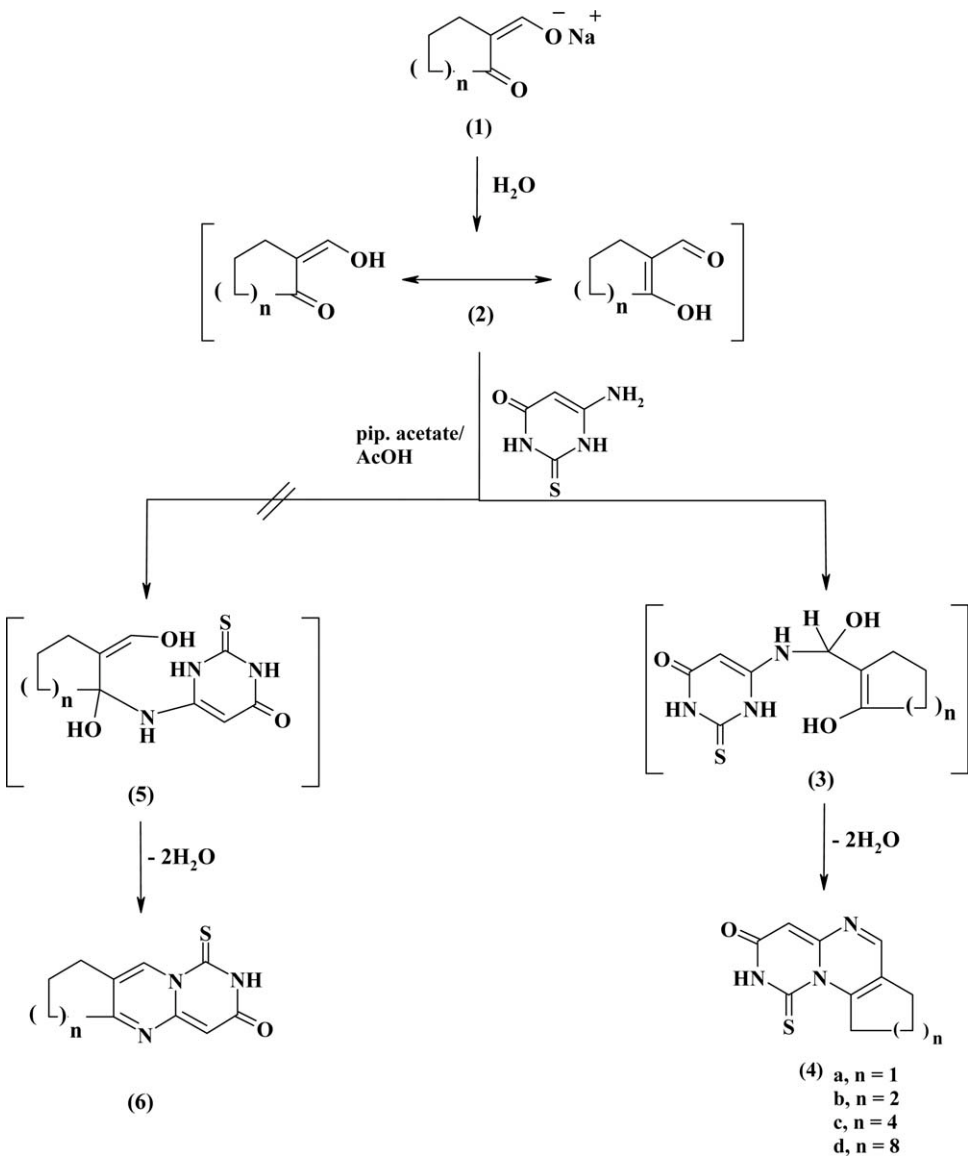


Chart 1

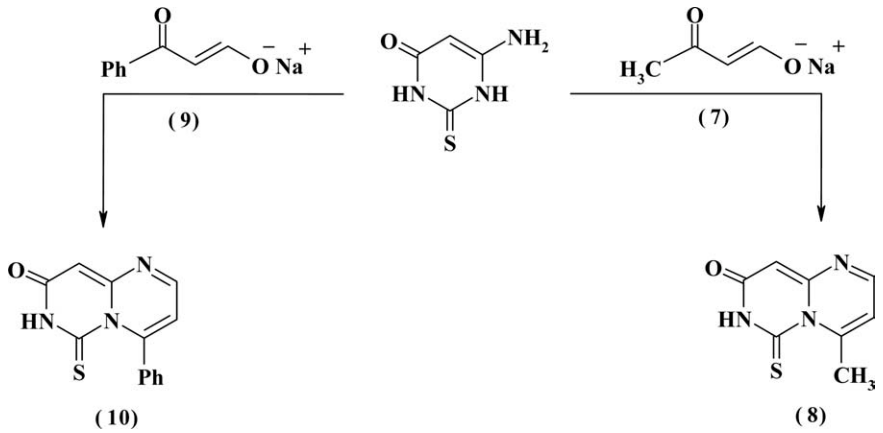
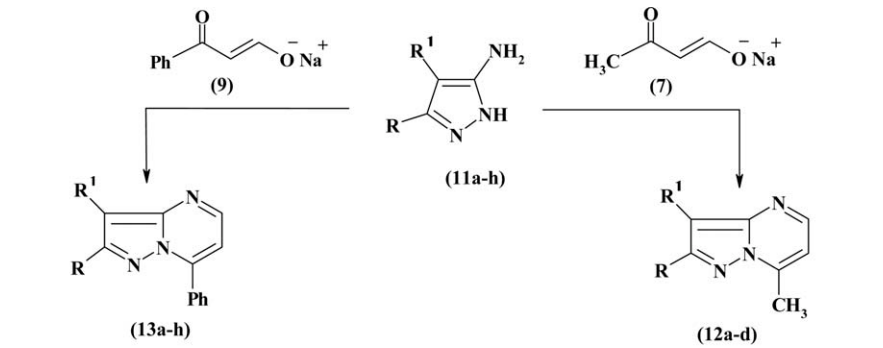


Chart 2

acetone **7** and sodium formyl acetophenone **9** under the same reaction conditions and following the same reaction mechanism afforded 4-methyl-6-thioxo-6,7-dihydro-8*H*-pyrimido[1,6-*a*]pyrimidin-8-one (**8**) and 4-phenyl-6-thioxo-6,7-dihydro-8*H*-pyrimido[1,6-*a*]pyrimidin-8-one (**10**), respectively, as shown in Chart 2.

The structure of compound **8** was established by its elemental analysis and the IR spectrum which revealed bands at ύ = 3368 cm^{-1} (NH); 1627 (C=O); and 1243 (C=S). The mass spectrum showed a molecular ion peak at *m*/*z* = 193 (37.4%) coincident with its molecular weight (193.23) and the base peak appeared at *m*/*z* = 189 (100%). The IR spectra of compound **10** showed bands at ύ = 3325 cm^{-1} (NH); 1630 (C=O); and 1243 (C=S). The mass spectrum showed the molecular ion peak at *m*/*z* = 255 (2.9%) coincident with its molecular weight (255.30).

In a similar manner, the behavior of aminopyrazoles toward the sodium formyl salts of aliphatic and aromatic acyclic ketones was also investigated. Thus,



(11,13)	R	R^1
a	NHPh	CONHPh
b	NHPh	CONHPhMe-p
c	NHPh	CONHPhCl-p
d	NHPh	CONHPhOMe-p
e	NHPh	CONHPhBr-p
f	NHPhCl-p	CONHPhMe-p
g	NHPhCl-p	CONHPhCl-p
h	NHCOPh	CONHPh

(12)	R	R^1
a	NHPh	CONHPh
b	NHPh	CONHPhMe-p
c	NHPh	CONHPhCl-p
d	NHPh	CONHPhOMe-p

Chart 3

condensation of 5-aminopyrazole derivatives **11a–d** with sodium formylacetone **7** afforded the 7-methyl-2-(phenylamino)pyrazolo[1,5-*a*]pyrimidine-3-(*N*-aryl)carboxamides **12a–d**. On the other hand, **11a–h** reacted with sodium formyl acetophenone **9** to give the 7-phenyl-2-(phenylamino)pyrazolo[1,5-*a*]pyrimidine-3-(*N*-aryl)carboxamides **13a–h** as shown in Chart 3.

The structures of compounds **12** and **13** were confirmed on the basis of their elemental analysis and spectral data. Thus, **12a** showed a correct elemental analysis that was compatible with the molecular formula $C_{20}H_{17}N_5O$. The IR spectrum showed that the absence of the peaks was related to NH_2 of the starting pyrazole and revealed bands at ύ = 3304 cm^{-1} (NH) and at 1653 cm^{-1} (enolic C=O). Its ^{1}H-NMR spectra revealed a singlet at δ = 2.77 ppm related to the CH_3 group; 6.68–7.76 ppm (m, 10H, aromatic protons); 8.32 (s, 1H, pyrimidine C=CH); 8.34 (s, 1H, pyrimidine N=CH); 9.54 (s, 1H, NH); and 9.88 (s, 1H, NH). The mass spectrum of this compound revealed a molecular ion peak at *m*/*z* = 343 (38.7%) coincident with its molecular weight (343.39) and showed the base peak at *m*/*z* = 251.

CONCLUSIONS

In this work, an easy construction for interesting pyrimido[1,6-*a*]pyrimidine and pyrazolo[1,5-*a*]pyrimidine derivatives has been described. In a separate work, some derivatives of these newly synthesized compounds are under investigation for their biological activities such as antihyperglycemic, antihyperlipidemic, and antioxidant.

EXPERIMENTAL

All melting points were determined on an electrothermal apparatus and are uncorrected. IR spectra were recorded (KBr discs) on a Bruker IFS-25 FTIR spectrophotometer at the region of 400–4000 cm^{-1}. ^{1}H-NMR and ^{13}C-NMR spectra were recorded in $CDCl_3$ and $(CD_3)_2SO$ solutions on a Varian Gemini 300 MHz spectrometer, and chemical shifts are expressed in δ units using TMS as an internal reference. Mass spectra were recorded on a GC-MS QP 1000 EX Shimadzu. Elemental analyses were carried out at the Microanalytical Center of the Cairo University, Giza, Egypt. Piperidine acetate was prepared by addition of 5 mL of piperidine to a mixture of 4 mL of acetic acid and 10 mL of water [38].

Synthesis of pyrimido[1,6-*a*]pyrimidine derivatives (4a–d), (8), and (10). ***General procedure.*** A mixture of equivalent amounts of sodium salts (**1**), (**7**) or (**9**) (0.012 moles) and 6-aminothiouracil was refluxed with a solution of piperidine acetate (1.5 mL) for 15–20 min. The reaction mixture is then diluted with 20 mL of ethanol and refluxed for another 1 h. The reaction was quenched by the addition of 1.5 mL of acetic acid, then the mixture was cooled and solid product was collected by filtration and recrystallized from the appropriate solvent.

Synthesis of pyrazolo[1,5-*a*]-pyrimidine derivatives (12a–d) and (13a–h). ***General procedure.*** Respective mixtures of 5-aminopyrazoles **11a–d** or **11a–h** (0.01 mole) were refluxed with a solution of sodium salts **7** or **9** (0.012 mole) and piperidine acetate (1.5 mL) for 3–5 min. The hot reaction mixture was neutralized with acetic acid (1.5 mL), then cooled and the solid products were collected by filtration and recrystallized from the suitable solvent.

1-Thioxo-1,2,8,9-tetrahydrocyclopenta[e]pyrimido[1,6-*a*]pyrimidin-3(7*H*)-one (4a). Pale brown crystals (from EtOH); yield, 66.3%; mp 276–278°C. IR (KBr) cm^{-1}: 3325 (NH); 2967 (—CH); 1671 (C=O); 1609 (C=N); and 1243 (C=S). ^{1}H-NMR ($CDCl_3$) δ_H (ppm): 1.89–1.96 (quin, 2H, CH_2); 2.64–2.88 (m, 4H, $2CH_2$); 7.97 (s, 1H, pyrimidine HC=N); 8.11 (s, 1H, pyrimidine HC=CO) and 8.92 (s, 1H, NH). Mass (*m*/*z*): 221 (M + 2, 6.6%); 219 (M^+, 100.0%); 161 (34.8%); 131 (14.5%); 104 (19.6%); and 77 (18.8%). Anal. Calcd. for $C_{10}H_9N_3OS$ (219): C, 54.78; H, 4.14; N, 19.16; S, 14.62. Found: C, 54.88; H, 4.21; N, 19.0; S, 14.60.

1-Thioxo-1,2,7,8,9,10-hexahydro-3*H*-pyrimido[1,6-*a*]quinazolin-3-one (4b). Yellow crystals (from EtOH); yield, 58.8%; mp 230–232°C. IR (KBr) cm^{-1}: 3390 (NH); 2936 (—CH); 1658 (C=O); 1624 (C=N); and 1255 (C=S). ^{1}H-NMR ($CDCl_3$) δ_H (ppm): 1.24–1.72 (m, 4H, $2CH_2$); 2.60–2.81 (m, 4H, $2CH_2$); 7.97 (s, 1H, pyrimidine HC=N); 8.14 (s, 1H, pyrimidine HC=CO) and 11.10 (s, 1H, SH). ^{13}C-NMR (DMSO) δ_C (ppm): 19.8, 21.7, 24.6, 27.1 ($4CH_2$); 125.5, 144.2, 156 (pyrimidine Cs); 162.3 (N—C—N—); 94.9 (=CH—CO); 199.8 (C=O); 211.0 (C=S). Mass (*m*/*z*): 235 (M + 2, 6.7%); 233 (M^+, 100.0%); 175 (18.1%); 143 (31.7%); 119 (15.8%), and 68 (25.2%). Anal. Calcd for $C_{11}H_{11}N_3OS$ (233): C, 56.63; H, 4.75; N, 18.01; S, 13.74. Found: C, 56.66; H, 4.66; N, 18.22; S, 13.71.

1-Thioxo-1,2,7,8,9,10,11,12-octahydro-3*H*-cycloocta[e]pyrimido[1,6-*a*]pyrimidin-3-one (4c). Pale yellow crystals (from EtOH); yield, 69.8%; mp 249–251°C. IR (KBr) cm^{-1}: 3400 (NH); 2927 (—CH); 1680 (C=O); 1613 (C=N); and 1245 (C=S). ^{1}H-NMR ($CDCl_3$) δ_H (ppm): 1.29–1.67 (m, 4H, $2CH_2$); 2.42–2.92 (m, 4H, $2CH_2$); 3.22–3.41 (m, 4H, $2CH_2$), 7.99 (s, 1H, pyrimidine N=C—H); 11.91 (s, 1H, pyrimidine O=C=CH); and 12.91 (br s, 1H, SH). Mass (*m*/*z*): 261 (M^+, 100.0%); 323 (15.0%); 173 (7.4%); 103 (3.6%), and 77 (11.8%). Anal. Calcd. for $C_{13}H_{15}N_3OS$ (261): C, 59.72; H, 5.79; N, 16.08; S, 12.27. Found: C, 59.59; H, 5.89; N, 15.99; S, 12.26.

1-Thioxo-1,2,7,8,9,10,11,12,13,14,15,16-dodecahydro-3*H*-cyclo-dodeca[e]pyrimido[1,6-*a*]pyrimidin-3-one (4d). Yellow crystals (from EtOH); yield, 60.3%; mp 228–230 °C. IR (KBr) cm^{-1}: 3352 (NH); 2923 (—CH); 1679 (C=O); 1621 (C=N); and 1246 (C=S). Mass (*m*/*z*): 319 (M^+ + 2, 19.8%); 317 (M^+, 94.0%); 246 (25.5 %); 207 (100.0%); 147 (21.2%); and 91 (19.0%). Anal. Calcd for C17H23N3OS (317): C, 64.32; H, 7.30; N, 13.24; S, 10.10. Found: C, 64.34; H, 7.45; N, 13.33; S, 9.88.

4-Methyl-6-thioxo-6,7-dihydro-8*H*-pyrimido[1,6-*a*]pyrimidin-8-one (8). Pale yellow crystals (from EtOH); yield 61.1%; mp 266–268°C. IR (KBr) cm^{-1}: 3368 (NH); 2970 (—CH); 1627 (C=O); 1591 (C=N); and 1243 (C=S). ^{1}H-NMR (DMSO) δ_H (ppm): 1.44 (s, 3H, CH_3); 8.00 (s, 1H, pyrimidine N=C—H); 8.16 (s, 1H, pyrimidine C=CH); 8.26 (s, 1H, pyrimidine HC=C=O); and 11.87 (s, 1H, SH). Mass (*m*/*z*): 193

(M^+, 37.4%); 189 (100.0%); 161 (25.2%); 91 (20.3%); and 75 (42.3%). Anal. Calcd for C8H7N3OS (193): C, 49.73; H, 3.65; N, 21.75; S, 16.59. Found: C, 49.63; H, 3.61; N, 21.65; S, 16.65.

4-Phenyl-6-thioxo-6,7-dihydro-8*H*-pyrimido[1,6-*a*]pyrimidin-8-one (10). Yellowish green needles (from EtOH/DMF); yield, 63%; mp 288–291°C. IR (KBr) cm^{-1}: 3325 (NH); 2970 (—CH); 1630 (C=O); 1592 (C=N); and 1243 (C=S). ^{1}H-NMR (DMSO) δ_H (ppm): 6.89–7.89 (m, 5H, Ar); 8.10 (s, 1H, pyrimidine N=C—H); 8.21 (s, 1H, pyrimidine C=CH); 8.26 (s, 1H, pyrimidine HC=C=O); and 9.21 (s, broad, 1H, NH). Mass (*m*/*z*): 255 (M^+, 2.9%); 151 (65.5); 95 (81.5%); 80 (17.3%); and 67 (100.0). Anal. Calcd for $C_{13}H_9N_3OS$ (255): C, 61.16; H, 3.55; N, 16.46; S, 12.56. Found: C, 61.24; H, 3.42; N, 16.45; S, 12.71.

2-Anilino-7-methyl-*N*-phenylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (12a). Yellow crystals (from EtOH); yield, 89.2%; mp 188–190°C. IR (KBr) cm^{-1}: 3304 (NH); 1653 (enolic C=O); 1597 (C=N). ^{1}H-NMR ($CDCl_3$) δ_H (ppm): 2.77 (s, 3H, CH_3); 6.68–7.76 (m, 10H, Ar); 8.32 (s, 1H, pyrimidine C=CH); 8.34 (s, 1H, pyrimidine N=CH); 9.54 (s, 1H, NH); and 9.88 (s, broad, 1H, NH). ^{13}C-NMR (DMSO) δ_C (ppm): 21.2 (CH_3), 111.3–143.6 (Ar Cs); 98.8, 101.6, 114.2 (3C, pyrimidine ring); 92.9, 122.3, 100.4 (3C, pyrazole ring); 188.9 (C=O). Mass (*m*/*z*): 343 (M^+, 38.7%); 251 (100.0%); 223 (3.6%); 132 (1.40%); 105 (2.0%); 78 (4.1%); and 64 (13.9%). Anal. Calcd for $C_{20}H_{17}N_5O$ (343): C, 69.96; H, 4.99; N, 20.39. Found: C, 69.84; H, 4.69; N, 20.44.

2-Anilino-7-methyl-*N*-(4-methylphenyl)pyrazolo[1,5-*a*]pyrimidine-3-carboxamide (12b). Yellow powder (from EtOH); yield, 72.8%; mp 187–188°C. IR (KBr) cm^{-1}: 3308 (NH); 1659 (enolic C=O); and 1600 (C=N). Mass (*m*/*z*): 358 (M + 1, 14.2%); 251 (46.8%); 121 (12.0%); 111 (4.2%); and 64 (9.0%). Anal. Calcd for $C_{21}H_{19}N_5O$ (357): C, 70.57; H, 5.36; N, 19.59. Found: C, 70.52; H, 5.29; N, 19.50.

2-Anilino-*N*-(4-chlorophenyl)-7-methylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (12c). Orange crystals (from EtOH); yield, 69.5%; mp 199–200°C. IR (KBr) cm^{-1}: 3304 (NH); 1661 (enolic C=O); and 1596 (C=N). ^{1}H-NMR (DMSO) δ_H (ppm): 2.71 (s, 3H, CH_3); 6.66–7.98 (m, 9H, Ar); 8.41 (s, 1H, pyrimidine C=CH); 8.43 (s, 1H, pyrimidine N=CH); 9.55–958 (broad s, 1H, NH); and 9.85 (s, 1H, NH). Mass (*m*/*z*): 379 (M^+ +2, 12.2%); 286 (63.5%); 210 (12.3%); 198 (3.4%); 106 (4.2%); and 76 (11.3%). Anal. Calcd for $C_{20}H_{16}N_5OCl$ (377.5): C, 63.58; H, 4.27; N, 18.54. Found: C, 63.88; H, 4.25; N, 18.22.

2-Anilino-*N*-(4-methoxyphenyl)-7-methylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (12d). Pale yellow needles (from EtOH); yield, 60.7%; mp 180–182°C. IR (KBr) cm^{-1}: 3300 (NH); 1664 (enolic C=O); and 1601 (C=N). Mass (*m*/*z*): 373 (M^+, 10.5%); 266 (53.4%); 210 (11.9%); 169 (11.4%); 111 (8.9%); and 76 (13.8%). Anal. Calcd for $C_{21}H_{19}N_5O_2$ (373): C, 67.55; H, 5.13; N, 18.76. Found: C, 67.29; H, 5.30; N, 18.56.

2-Anilino-*N*,7-diphenylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (13a). Reddish yellow crystals (from Dioxan); yield, 65.5%; mp 205–207°C. IR (KBr) cm^{-1}: 3311 (NH); 1648 (enolic C=O); and 1597 (C=N). ^{1}H-NMR ($CDCl_3$) δ_H (ppm): 6.98–8.22 (m, 15H, Ar); 8.53 (s, 1H, pyrimidine C=CH); 8.55 (d, 1H, pyrimidine N=CH); 9.65 (s, 1H, NH); and 10.14 (s, 1H, NH). Mass (*m*/*z*): 405 (M^+, 59.7%), 313 (100.0%); 285 (4.0%); 193 (1.70%); 90 (1.60%); and 64 (30.0%). Anal. Calcd for $C_{25}H_{19}N_5O$ (405): C, 74.06; H, 4.72; N, 17.27. Found: C, 74.21; H, 4.66; N, 17.54.

2-Anilino-*N*-(4-methylphenyl)-7-phenylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (13b). Orange crystals (from Dioxan); yield, 62.9%; mp 255–257°C. IR (KBr) cm^{-1}: 3314 (NH); 1649 (C=O) and 1612 (C=N). ^{1}H-NMR (DMSO) δ_H (ppm): 2.11 (s, 3H, CH_3); 6.99–8.00 (m, 14H, Ar); 8.46 (s, 1H, pyrimidine C=CH); 8.56 (d, 1H, pyrimidine N=CH); and 9.71–9.99 (broad, 2H, 2NH). Mass (*m*/*z*): 420 (M^+ + 1, 8.9%), 313 (100.0%); 302 (65.0%); 189 (3.25%); and 90 (2.96%). Anal. Calcd for $C_{26}H_{21}N_5O$ (419): C, 74.44; H, 5.05; N, 16.70. Found: C, 74.33; H, 5.11; N, 16.59.

2-Anilino-*N*-(4-chlorophenyl)-7-phenylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (13c). Yellow crystals (from Dioxan); yield, 66.0%; mp 261–263°C. IR (KBr) cm^{-1}: 3316, 3259 (NH); 1652 (C=O); and 1603 (C=N). ^{1}H-NMR (DMSO) δ_H (ppm): 6.85–7.89 (m, 14H, Ar); 8.44 (s, 1H, pyrimidine C=CH); 8.60 (d, 1H, pyrimidine N=CH); 9.25 (broad, H, NH); and 9.36 (broad, H, NH). Anal. Calcd for $C_{25}H_{18}N_5OCl$ (439.5): C, 68.26; H, 4.12; N, 15.92. Found: C, 68.00; H, 4.11; N, 15.99.

2-Anilino-*N*-(4-methoxyphenyl)-7-phenylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (13d). Orange crystals (from Dioxan); yield, 68.8%; mp 233–234°C. IR (KBr) cm^{-1}: 3302, 3260 (NH); 1651 (C=O); and 1600 (C=N). ^{1}H-NMR (DMSO) δ_H (ppm): 2.89 (s, 3H, OCH_3); 7.00–8.12 (m, 14H, Ar); 8.25 (s, 1H, pyrimidine C=CH); 8.33 (d, 1H, pyrimidine N=CH); 9.65 (broad s, 1H, NH); and 9.69 (s, 1H, NH). Mass (*m*/*z*): 436 (M^+ + 1, 65.2%), 329 (100.0%). Anal. Calcd for $C_{26}H_{21}N_5\ O_2$ (435): C, 71.71; H, 4.86; N, 16.08. Found: C, 71.51; H, 4.85; N, 15.88.

2-Anilino-*N*-(4-bromophenyl)-7-phenylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (13e). Yellow crystals (from Dioxan); yield, 62.9%; mp 242–244°C. IR (KBr) cm^{-1}: 3304 (NH); 1655 (C=O); and 1597 (C=N). Mass (*m*/*z*): 485 (M^+ + 1, 19.1%), 313 (100.0%); 103 (11.5%); and 77 (21.4%). Anal. Calcd for $C_{25}H_{18}N_5OBr$ (484): C, 61.99; H, 3.75; N, 14.46. Found: C, 61.90; H, 3.44; N, 14.99.

2-[(4-Chlorophenyl)amino]-*N*-(4-methylphenyl)-7-phenylpyrazolo-[1,5-*a*]pyrimidine-3-carboxamide (13f). Orange crystals (from Dioxan); yield, 70.0%; mp 270–272°C. IR (KBr) cm^{-1}: 3308 (NH); 1662 (C=O); and 1611 (C=N). ^{1}H-NMR (DMSO) δ_H (ppm): 1.42 (s, 3H, CH_3); 6.95–8.00 (m, 13H, Ar); 8.11 (s, 1H, pyrimidine C=CH); 8.28 (d, 1H, pyrimidine N=CH); and 9.67–9.69 (broad s, 2H, 2NH). Anal. Calcd for $C_{26}H_{20}N_5OCl$ (453.5): C, 68.80; H, 4.44; N, 15.43. Found: C, 68.99; H, 4.85; N, 15.00.

***N*-(4-Chlorophenyl)-2-[(4-chlorophenyl)amino]-7-phenylpyrazolo-[1,5-*a*]pyrimidine-3-carboxamide (13g).** Brown crystals (from Dioxan); yield, 63.8%; mp 259–261°C. IR (KBr) cm^{-1}: 3335 (NH); 1655 (C=O); and 1601 (C=N). Mass (*m*/*z*): 476 (M^+ + 2, 63.3%), 405 (100.0%); 364 (11.2%); 298 (2.3%); 182 (11.6%); and 106 (31.6%). Anal. Calcd for $C_{25}H_{17}N_5OCl_2$ (474): C, 63.30; H, 3.61; N, 14.76. Found: C, 63.46; H, 3.60; N, 14.65.

2-(Benzoylamino)-7-phenyl-*N*-phenylpyrazolo[1,5-*a*]pyrimidine-3-carboxamide (13h). Yellow crystals (from Dioxan); yield, 69.2%; mp 171–173°C. IR (KBr) cm^{-1}: 3377, 3273 (NH); 1665 (C=O); 1650 (C=O); and 1659 (C=N). ^{1}H-NMR ($CDCl_3$) δ_H (ppm): 6.98–8.25 (m, 15H, Ar); 8.21–8.31 (broad

s, 2H, pyrimidine Hs) 9.74 (s, 1H, NH) and 10.01 (s, 1H, NH). ^{13}C-NMR (DMSO) δ_C (ppm): 98.6, 115.0, 118.4, 132.4 (4C, pyrimidine ring); 96.2, 141.2 (2C pyrazole ring); 121.2–136.9 (Ar Cs); 179.8 (2 C=O). Mass (*m*/*z*): 433 (M^+, 3.93%), 398 (100.0%); 356 (10.1%); 298 (8.2%); and 105 (22.3%). Anal. Calcd for $C_{26}H_{19}N_5O_2$ (433): C, 72.04; H, 4.42; N, 16.16. Found: C, 72.11; H, 3.99; N, 15.98.

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