# Synthesis of Some New Nitrogen Bridge-head Triazolopyridines, Pyridotriazines, and Pyridotriazepines Incorporating 6-Methylchromone Moiety



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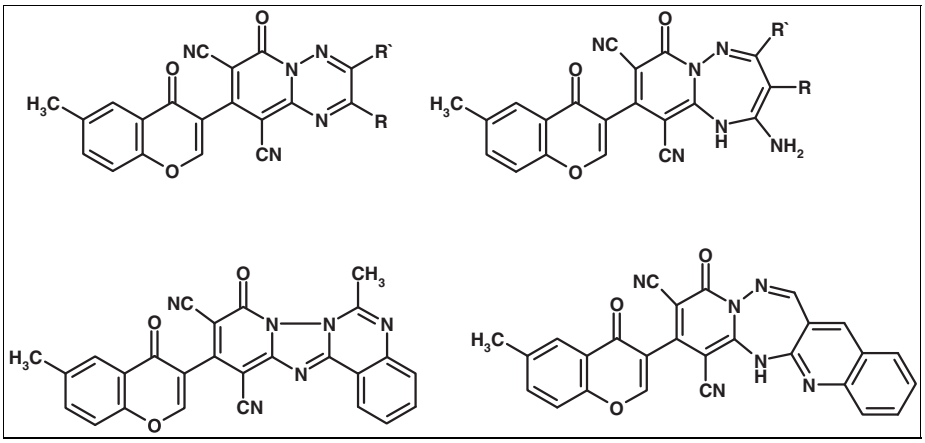
Received August 17, 2011
DOI 10.1002/jhet.1608
Published online 18 May 2013 in Wiley Online Library (wileyonlinelibrary.com).



Some new triazolo[1,5-*a*]pyridines, pyrido[1,2-*b*][1,2,4]triazines, and pyrido[1,2-*b*][1,2,4]triazepines incorporating 6-methylchromone moiety were prepared from the reaction of 1,6-diamino-4-(6-methyl-4-oxo-4*H*-chromen-3-yl)-2-oxo-1,2-dihydropyridine-3,5-dicarbonitrile (**4**) with some electrophilic reagents.

*J. Heterocyclic Chem.*, **50**, 615 (2013).

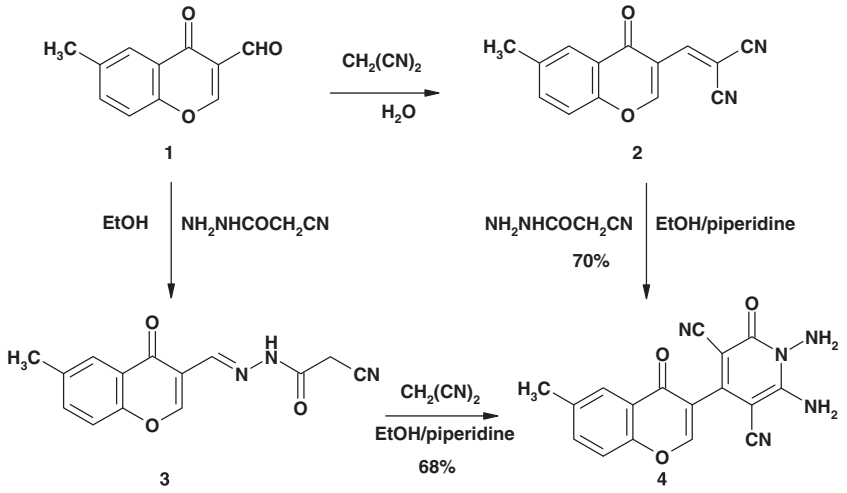
## INTRODUCTION

Chromone derivatives exhibited significant biological activities such as anticancer[1,2], antitumor [3,4], antiviral [5], antibiotic [6], antimicrobial [7], antifungal [8], antioxidant [9,10], plant growth inhibitors [11], and physiological activity [12]. Polyfunctional pyridines are highly reactive intermediates that have been extensively used in heterocyclic synthesis [13–15]. On the other hand, 1,2,4-triazoles [16], 1,2,4-triazines [17], and 1,2,4-triazepines [18] are considered as important nitrogen heterocyclic rings because of their interesting biological activity. *o*-Diamines are very active substrates for building of various heterocyclic systems [19,20]. In symmetrical diamines, the product will be the same irrespective of which amine participates first in the reaction. In the case of unsymmetrical diamines, the electron-withdrawing/donating nature of substituents influences the initial participation of a particular amino group in the reaction, resulting in chemoselective products. On the basis of above observations and as a part of our aforementioned work directed for the synthesis of new polynuclear bioactive heterocyclic systems [21,22], the present work aims to study the chemical reactivity of 1,6-diamino-4-(6-methyl-4-oxo-4*H*-chromen-3-yl)-2-oxo-1,2-dihydropyridine-3,5-dicarbonitrile (**4**) toward various electrophilic reagents to furnish some new nitrogen bridge-head triazolo[1,5-*a*] pyridines, pyrido [1,2-*b*][1,2,4]triazines, and pyrido[1,2-*b*][1,2,4]triazepines linked 6-methyl chromone moiety.

## RESULTS AND DISCUSSION

The starting compound 1,6-diamino-4-(6-methyl-4-oxo-4*H*-chromen-3-yl)-2-oxo-1,2-dihydropyridine-3,5-dicarbonitrile (**4**) was prepared by refluxing an alcoholic solution of [(6-methyl-4-oxo-4*H*-chromen-3-yl)methylene]malononitrile (**2**) [23] with cyanoacetohydrazide or *N*′-[6-methyl-4-oxo-4*H*-chromone-3-yl]-2-cyanoacetohydrazone (**3**) [24] with malononitrile in the presence of piperidine as a catalyst (Scheme 1) [25]. The IR spectrum of compound **4** showed characteristic absorption bands at 3418, 3313 (2 $NH_2$), 2262 (2 C≡N), 1680 ($C{=}O_{pyridone}$), and 1634 $cm^{-1}$ ($C{=}O_{\gamma\text{-pyrone}}$). Also, the $^1H$ NMR spectrum of compound **4** revealed three characteristic singlet signals at 2.26, 8.50, and 9.40 ppm attributed to the $CH_3$, $H\text{-}5_{chromone}$ and $H\text{-}2_{chromone}$, respectively. In addition, the $^1H$ NMR spectrum showed two exchangeable signals at 4.59 and 10.22 ppm because of the *N*-$NH_2$ and *C*-$NH_2$ protons, respectively; these results confirm the difference in nucleophilicity between the two amino groups. Thus, it is

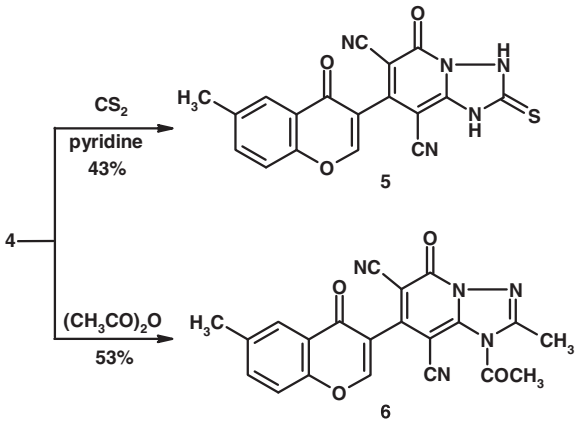
**Scheme 1.** Formation of 1,6-diaminopyridone **4**.




expected that the hydrazide β-nitrogen (*N*-$NH_2$) is more nucleophilic and will react more rapidly with the electron deficient carbon than the second amino group (*C*-$NH_2$). Compound **4** was further deduced from its mass spectrum that showed the molecular ion peak at *m/z* 333, which agrees well with the molecular formula $C_{17}H_{11}N_5O_3$ and supports the identity of the structure.

*o*-Diamines are ready-made nucleophilic centers for the synthesis of fused nitrogen heterocyclic rings [19,20]. Thus, compound **4** is a useful precursor for the synthesis of some new triazolopyridones by the reaction with some monoelectrophilic reagents such as carbon disulfide, acetic anhydride, and anthranilic acid. Heterocyclization of compound **4** with $CS_2$ in pyridine under reflux yielded 7-(6-methyl-4-oxo-4*H*-chromen-3-yl)-5-oxo-2-thioxo-1*H*-2,3,4,5-tetrahydro[1,2,4]triazolo[1,5-*a*]pyridine-6,8-dicarbonitrile (**5**) (Scheme 2) [26]. Formation of compound **5** occurs via a nucleophilic addition of the amino group (*N*-$NH_2$) to $CS_2$ followed by triazole ring-closure through the loss of one molecule of $H_2S$. The IR spectrum of compound **5** showed characteristic absorption bands at 3396, 3185 (2 NH), 2216 (2C≡N), 1680 (C=$O_{pyridone}$), 1630 (C=$O_{\gamma\text{-pyrone}}$) and 1300 $cm^{-1}$ (C=S). In addition, the $^1$H NMR spectrum showed two exchangeable signals at 7.88 and 8.85 ppm because of two NH protons. The $^{13}$C NMR spectrum showed characteristic signals at 19.8, 187.0, and 192.5 ppm assigned to $CH_3$, C=S, and C=$O_{\gamma\text{-pyrone}}$, respectively.

**Scheme 2.** Cyclocondensation of **4** with $CS_2$ and $Ac_2O$.

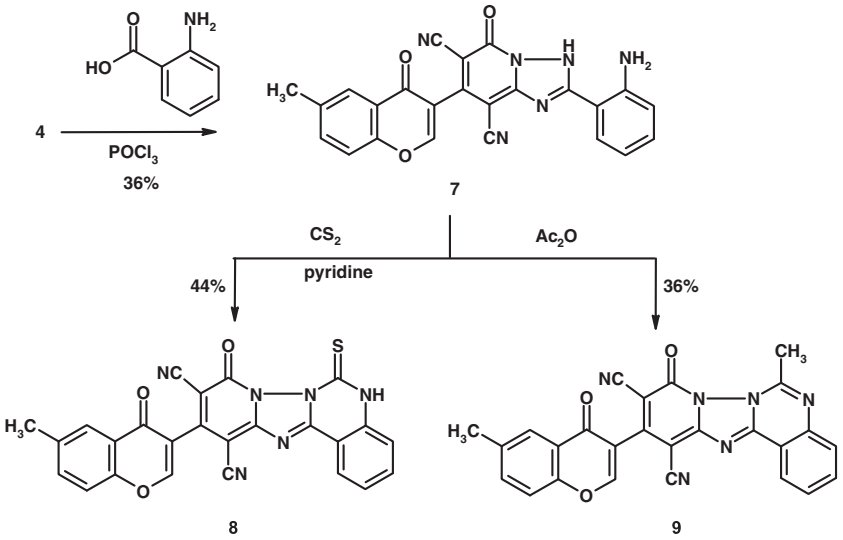



Also, treatment of diaminopyridone **4** with acetic anhydride under reflux afforded 1-acetyl-7-(6-methyl-4-oxo-4*H*-chromen-3-yl)-2-methyl-5-oxo-1,5-dihydro-[1,2,4]triazolo [1,5-*a*]pyridine-6,8-dicarbonitrile (**6**) (Scheme 2). The IR and $^1$H NMR spectra of compound **6** confirmed the absence of the two $NH_2$ groups. The IR spectrum showed characteristic absorption bands at 2225 (2 C≡N), 1763 (C=$O_{acetyl}$), 1700 (C=$O_{pyridone}$), and 1616 $cm^{-1}$ (C=$O_{\gamma\text{-pyrone}}$). The $^1$H NMR spectrum showed the presence of three methyl groups at δ 1.89 ($CH_{3\ triazole}$), 2.01 ($CH_{3\ chromone}$), and 2.35 ($CH_{3\ acetyl}$).

Treating compound **4** with anthranilic acid in phosphorus oxychloride gave 2-[(2-aminophenyl)]-7-[(6-methyl-4-oxo-4*H*-chromen-3-yl)]-5-oxo-3,5-dihydro-[1,2,4]triazolo [1,5-*a*] pyridine-6,8-dicarbonitrile (**7**) (Scheme 3) [27]. The IR spectrum of compound **7** exhibited characteristic absorption bands at 3428, 3210 (NH, $NH_2$), 2219 (2 C≡N), 1677 (C=$O_{pyridone}$ and C=$O_{\gamma\text{-pyrone}}$), and 1589 $cm^{-1}$ (C=N and C=C). Also, its $^1$H NMR spectrum showed exchangeable signals at 4.71 and 9.96 ppm assigned to the $NH_2$ and NH protons, respectively. The mass spectrum of compound **7** showed the molecular ion peak at *m/z* 434, which is coincident with the molecular weight (434.42).

Compound **7** was used as a precursor for the synthesis of pyridotriazoloquinazoline derivatives via the reaction with monoelectrophilic reagents. Thus, condensation of compound **7** with $CS_2$ and acetic anhydride afforded chromenylpyridotriazoloquinazolines **8** and **9**, respectively (Scheme 3). The $^1$H NMR spectrum of compound **8** showed one exchangeable signal at 4.57 ppm assigned

**Scheme 3.** Formation of pyridotriazoloquinazoline derivatives **8** and **9**.



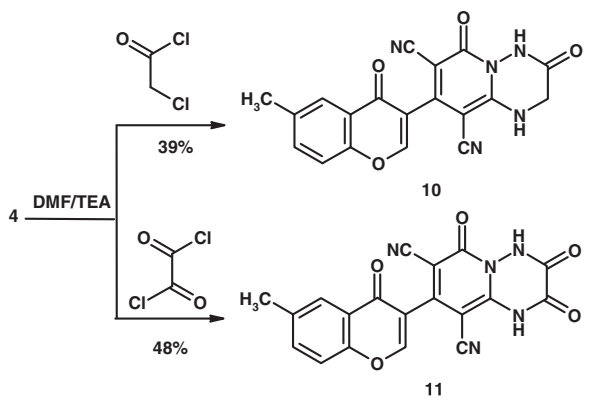

to the NH proton, whereas the $^1$H NMR spectrum of compound **9** showed characteristic singlet at 1.91 ppm attributed to the methyl protons in the quinazoline moiety. Also, the mass spectrum of compound **9** revealed the molecular ion peak at *m*/*z* 458 corresponding to the molecular formula $C_{26}H_{14}N_6O_3$, which agrees well with the molecular weight (458.44) and supports the identity of the structure.

Herein, we aimed to use diaminopyridone **4** in the synthesis of nitrogen bridge-head pyrido[1,2-*b*][1,2,4]triazines of expected biological activity, via the reaction of **4** with α,β-bifunctional electrophiles. Thus, cyclocondensation of compound **4** with chloroacetyl chloride and oxalyl chloride gave pyrido[1,2-*b*][1,2,4]triazines **10** and **11**, respectively (Scheme 4). The $^1$H NMR spectrum of compound **10** revealed characteristic singlet for the $CH_2$ protons at 2.78 ppm, in addition to two exchangeable signals at 8.50 and 10.30 ppm attributable to 2NH protons. The $^1$H NMR spectrum of compound **11** showed two exchangeable signals at 9.90 and 10.30 ppm assignable to the two NH protons.

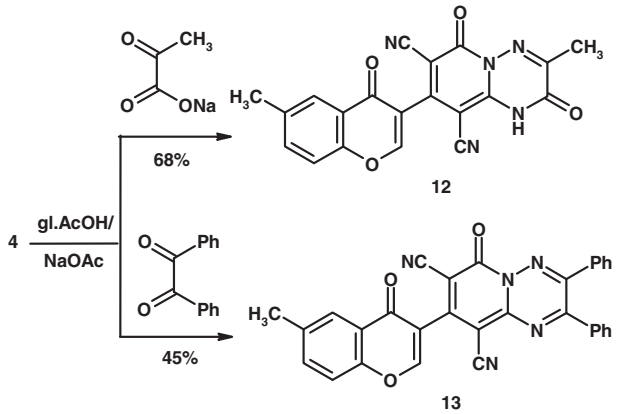
Condensation of compound **4** with sodium pyruvate in glacial acetic acid containing freshly fused sodium acetate under reflux afforded 8-(6-methyl-4-oxo-4*H*-chromen-3-yl)-3-methyl-2,6-dioxo-1,2,6-trihydropyrido[1,2-*b*][1,2,4] triazine-7,9-dicarbonitrile (**12**) (Scheme 5). The $^{13}$C NMR spectrum of compound **12** showed characteristic signals at 17.9 ($CH_{3\ triazine}$), 19.8 ($CH_{3\ chromone}$), 150.1 ($C_2$ as C═O), 154.6 ($C_3$ as C═N), 161.9 ($C_6$ as C═$O_{pyridone}$), and 192.5 ppm ($C_4'$ as C═$O_{\gamma\text{-pyrone}}$). The mass spectrum of compound **12** showed the molecular ion peak at *m*/*z* 386 (M + 1), which agrees with the molecular weight (385.34).

Also, cyclocondensation of diaminopyridone **4** with benzil in glacial acetic acid containing freshly fused sodium acetate produced 2,3-diphenylpyrido[1,2-*b*][1,2,4]triazine derivative **13** (Scheme 5). The IR and $^1$HNMR spectra of compound **13** showed the disappearance of two amino

**Scheme 4.** Formation of pyrido[1,2-*b*][1,2,4]triazines **10** and **11**.




**Scheme 5.** Formation of pyrido[1,2-*b*][1,2,4]triazines **12** and **13**.



groups that were appeared in the IR and $^1$H NMR spectra of compound **4**. Moreover, the mass spectrum showed the molecular ion peak at *m/z* 507, which agrees with the molecular weight (507.51) and supports the structure.

Further, condensation of diaminopyridone **4** with cyclic α-dicarbonyl compounds was studied. Thus, refluxing compound **4** with indol-2,3-dione (isatin) in glacial acetic acid containing freshly fused sodium acetate afforded chromenylindolopyridotriazine derivative **14** (Scheme 6). The $^1$H NMR spectrum of compound **14** showed one exchangeable signal at 10.85 ppm because of $NH_{indole}$ proton.

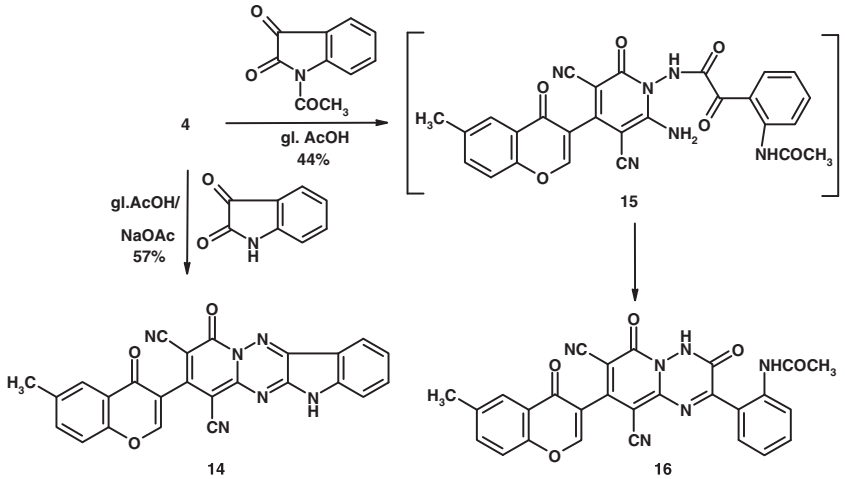
*N*-Acetylisatin showed a different behavior [28]. Thus, reaction of diaminopyridone **4** with *N*-acetylisatin in glacial acetic acid led to 2-(2-acetanilido)-8-(6-methyl-4-oxo-4*H*-chromen-3-yl)-3,6-dioxo-3,6-dihydro-4*H*-pyrido [1,2-*b*][1,2,4]triazine-7,9-dicarbonitrile (**16**) (Scheme 6). This reaction can be explained by an increase in the positive charge on the α-carbon atom in comparison with isatine itself because of the electron-withdrawing acetyl group that facilitates the nucleophilic attack of more nucleophilic amino group (*N*-$NH_2$) at this position with concomitant opening of five-membered ring. Apparently, the reaction can be claimed to proceed via intermediate **15**, as also observed by previous workers in reaction with other diamines [29]. However, this type of intermediate was reported to be unstable and not isolated. The $^1$H NMR of compound **16** showed characteristic signals at 1.92 ($CH_3$ in $CH_3CONH$-), 10.19 (NH in $CH_3CONH$-), and 11.01 ppm (NH in triazine). Also, the IR spectrum showed characteristic absorption bands at 3310, 3121 (2 NH), 2219 (2 C≡N), 1720 ($C{=}O_{acetanilido}$), 1680 ($C{=}O_{pyridone}$), 1660 ($C{=}O_{triazine}$), 1639 ($C{=}O_{\gamma\text{-pyrone}}$), and 1601 $cm^{-1}$ (C=N).

On the other hand, diaminopyridone **4** is a useful building block for nitrogen bridge-head pyrido[1,2-*b*][1,2,4]triazepine derivatives via the reaction with some α,γ-bifunctional electrophiles. Thus, treatment of compound **4** with 2-cyano-3,3-bis(methylthio)acrylonitrile afforded 2-amino-9-(6-methyl-4-oxo-4*H*-chromen-3-yl)-4-methylthio-7-oxo-5*H*-pyrido [1,2-*b*][1,2,4]triazepine-3,8,10-tricarbonitrile (**17**) (Scheme 7). The reaction may proceed via nucleophilic displacement of $SCH_3$ group by the more nucleophilic amino group (*N*-$NH_2$) with concomitant cycloaddition of the other amino group (*C*-$NH_2$) onto nitrile function to produce the target product **17**. The IR spectrum showed absorption bands at 3434, 3156 ($NH_2$, NH), 2263, 2230 (3C≡N), 1685 ($C{=}O_{pyridone}$), 1632 ($C{=}O_{\gamma\text{-pyrone}}$), and 1599 $cm^{-1}$ (C=N and C=C). Also, its $^1$H NMR spectrum exhibited characteristic signals assigned to two methyl groups at 2.24 ($CH_{3\ chromone}$) and 2.76 ppm ($SCH_3$), in addition to two exchangeable signals at 7.93 and 10.05 ppm attributed to $NH_2$ and NH protons, respectively.

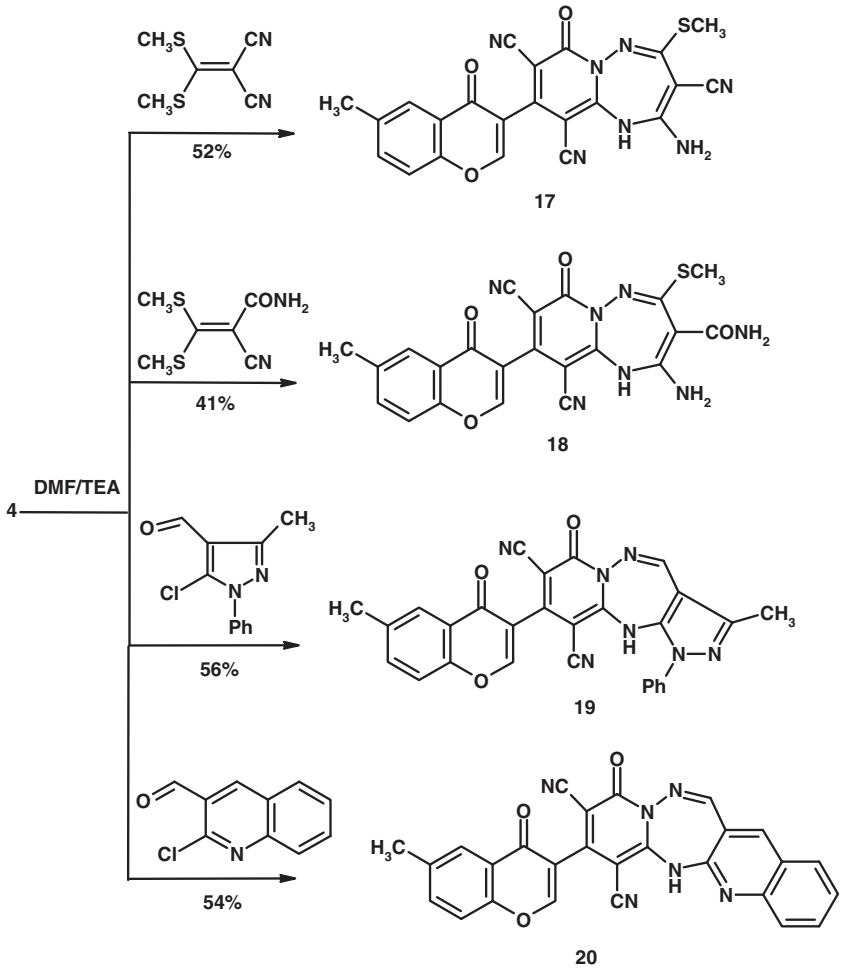
Similarly, condensation of compound **4** with 2-cyano-3,3-bis(methylthio)prop-2-enamide under similar conditions gave 2-amino-8,10-dicyano-9-(6-methyl-4-oxo-4*H*-chromen-3-yl)-4-(methylthio)-7-oxo-1,7-dihydropyrido [1,2-*b*][1,2,4]triazepine-3-carboxamide (**18**).

The study was extended to investigate the behavior of diaminopyridone **4** toward some heterocyclic *o*-chloroaldehydes [30]. Thus, condensation of **4** with 5-chloro-3-methyl-1-phenylpyrazole-4-carboxaldehyde [31] and 2-chloro-3-formylquinoline [32] in DMF containing few drops in triethylamine afforded the heteroannulated pyrido[1,2-*b*][1,2,4]triazepines **19** and **20**, respectively (Scheme 7). The $^1$H NMR spectra of compounds **19** and **20** showed characteristic singlet signals because of H-$7_{triazepine}$ at 8.56 and 8.55 ppm, respectively. Also, the spectrum of compound **20** showed characteristic singlet at 8.90 ppm attributed to the H-4 of the quinoline nucleus. Further, the mass spectrum of compound **20** revealed the molecular ion peak at *m/z* 469 (M-1) corresponding to the molecular formula $C_{27}H_{14}N_6O_3$, which is coincident with the formula weight (470.45) and supports the identity of the structure.

**Scheme 6.** Condensation of **4** with isatin and *N*-acetylisatin.



**Scheme 7.** Formation of pyrido[1,2-*b*][1,2,4]triazepine derivatives **17–20**.

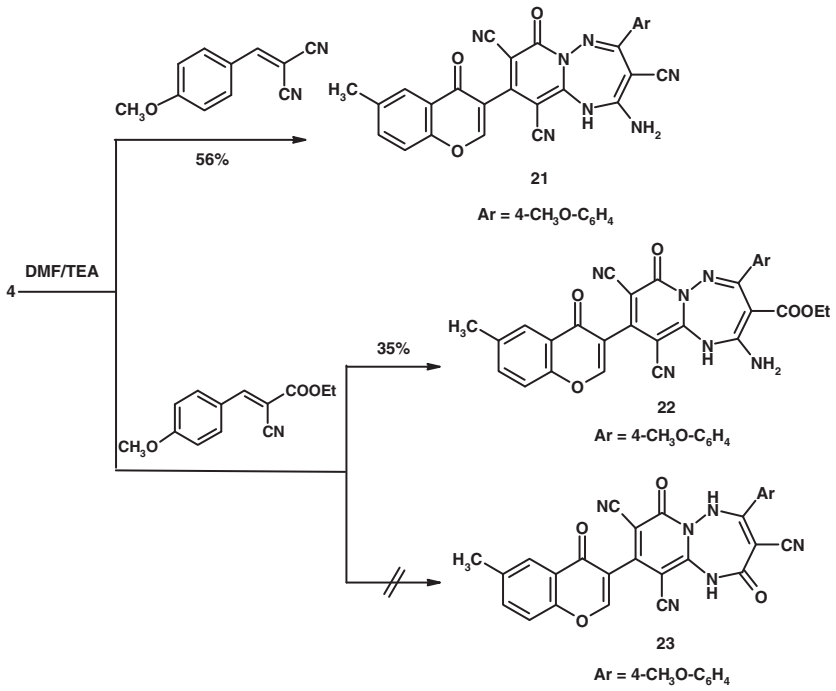



Next, we aimed to study the reactivity of compound **4** toward some arylidenenitriles. Thus, treating diaminopyridone **4** with *p*-methoxybenzylidene-malononitrile in DMF containing two drops of triethylamine gave 2-amino-4-(4-methoxyphenyl)-7-oxo-5,7-dihydro-9-(6-methyl-4-oxo-4*H*-chromen-3-yl)-pyrido[1,2-*b*][1,2,4]triazepine-3,8,10-tricarbonitrile (**21**) (Scheme 8). The $^1$H NMR spectrum of compounds **21** showed characteristic singlet signals at 3.87 ppm attributed to methoxy protons. The mass spectrum of compound **21** did not recorded the molecular ion peak at *m/z* 515 but record a peak at *m/e* 484 (M-31) corresponding to the molecular weight after loss of the methoxy group. Also, condensation of **4** with ethyl 2-cyano-3-(4-methoxyphenyl)prop-2-enoate under the same reaction conditions yielded ethyl 2-amino-8,10-dicyano-4-(4-methoxyphenyl)-9-(6-methyl-4-oxo-4*H*-chromen-3-yl)-7-oxo-5,7-dihydropyrido[1,2-*b*][1,2,4]triazepine-3-carboxylate (**22**) and not the other possible product **23** (Scheme 8); the reaction may proceed nucleophilic addition of amino group (*N*-$NH_2$) to the activate double bond followed by cycloaddition of the other amino group (*C*-$NH_2$) to the nitrile function with concomitant dehydrogenation to produce the target compound **22**. The $^1$H NMR spectrum showed triplet and quartet signals at 1.28 and 4.28 ppm attributed to the ethoxy protons, the spectrum also revealed characteristic singlet at 3.85 ppm assigned to the methoxy protons.

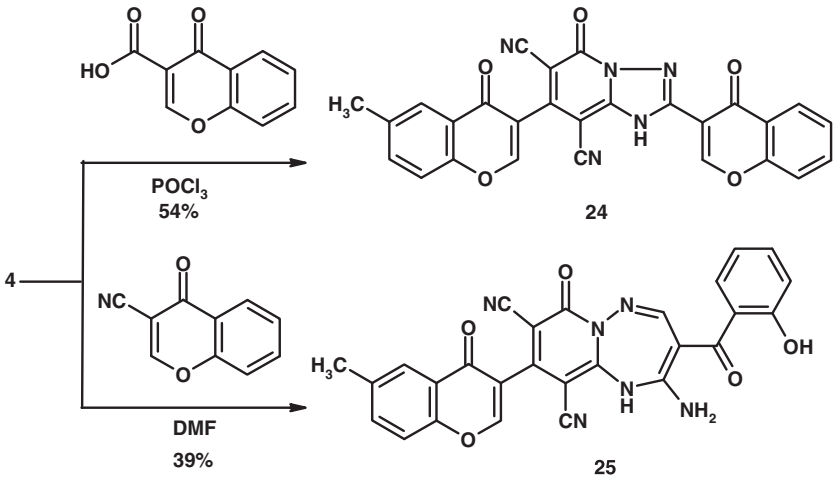
The chemical behavior of diaminopyridone **4** was studied toward chromone-3-carboxylic acid [33] and chromone-3-carbonitrile [34]. Thus, treatment of compound **4** with chromon-3-carboxylic acid in $POCl_3$ produced 7-(6-methyl-4-oxo-4*H*-chromene-3-yl)-2-(4-oxo-4*H*-chromene-3-yl)-5-oxo-3,5-dihydro-1,2,4-triazolo[1,5-*a*]pyridine-6,8-dicarbonitrile (**24**) (Scheme 9). The IR spectrum recorded characteristic absorption bands at 3402 (NH), 2219 (2 C≡N), 1670 (C═$O_{pyridone}$), 1650 (2 C═$O_{\gamma\text{-pyrone}}$), and 1601 $cm^{-1}$ (C═N and C═C). Also, its $^1$H NMR spectrum showed characteristic signals at 9.23 (H–$2'_{chromone}$), 9.44 (H–$2_{chromone}$), in addition to an exchangeable signal at 10.20 ppm attributed to $NH_{triazole}$.

Finally, treatment of **4** with chromone-3-carbonitrile gave pyridotriazepine derivative **25** (Scheme 9). The reaction may proceed via ring opening of the γ-pyrone ring by

**Scheme 8.** Reaction of **4** with arylidinenitriles.




**Scheme 9.** Reaction of **4** with chromone-3-carboxylic acid and chromone-3-carbonitrile.




the more nucleophilic amino group with concomitant cycloaddition of the other amino group to the nitrile function. The IR spectrum of compound **25** showed characteristic absorption bands at 3405, 3315, 3211 (OH, $NH_2$, NH), 2259, 2220 (2 C≡N), 1684 ($C{=}O_{pyridone}$), 1629 ($C{=}O_{\gamma\text{-pyrone}}$ and $C{=}O_{hydrogen\ bonded}$), and 1600 $cm^{-1}$ (C=C and C=N). The $^1H$ NMR spectrum of compound **25** showed characteristic singlet at 8.46 ppm because of the H-$7_{triazepine}$ [35].

## EXPERIMENTAL

Melting points were determined on a digital Stuart SMP3 apparatus. Infrared spectra were measured on Perkin-Elmer 293 spectrophotometer ($cm^{-1}$), using KBr disks. $^1H$ NMR (300 MHz) and $^{13}C$ NMR (75 MHz) spectra were measured on Mercury-300BB, using DMSO-$d_6$ as a solvent and TMS (δ) as the internal standard. Mass spectra were obtained using Jeol-AMS-AX-500 instrument mass spectrometer (70 eV). Elemental microanalyses were performed at microanalysis unit in National Research Center, Dokki, Giza, Egypt.

***1,6-Diamino-4-(6-methyl-4-oxo-4H-chromen-3-yl)-2-oxo-1,2-dihydropyridine-3,5-dicarbonitrile (4).***

***Method A.*** A mixture of (6-methyl-4-oxo-4*H*-chromen-3-yl) methylenemalononitrile (**2**) (2.36 g, 10 mmol) and cyano-acetohydrazide (0.99 g, 10 mmol), in absolute ethanol (50 mL) containing two drops of piperidine, was heated under reflux for 3 h. The orange-yellow precipitate obtained during heating was filtered and crystallized from ethanol to give **4** as orange-yellow crystals, yield (2.33 g, 70%), mp 242–243°C.

***Method B.*** A mixture of *N*`-[(6-methyl-4-oxo-4*H*-chromen-3-yl)methylene]-2-cyano acetohydrazide (**3**) (1.35, 5 mmol) and malononitrile (0.33 g, 5 mmol), in absolute ethanol (50 mL) containing two drops of piperidine, was heated under reflux for 3 h. The orange-yellow precipitate obtained during heating was filtered and crystallized from ethanol to give **4** as orange-yellow crystals, yield (1.1 g, 68%), mp 242–243°C. IR (KBr, $cm^{-1}$): 3418, 3313 (2 $NH_2$), 3050 ($CH_{arom.}$), 2924 ($CH_{aliph.}$), 2262 (2C≡N), 1680 (C═$O_{pyridone}$), 1634 (C═$O_{\gamma\text{-pyrone}}$), 1591 (C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.26 (s, 3H, $CH_3$), 4.59 (bs, 2H, N-$NH_2$ exchangeable with $D_2O$), 6.92 (d, 1H, $J$ = 8.4 Hz, H-$8_{chromone}$), 7.31 (d, 1H, $J$ = 8.4 Hz, H-$7_{chromone}$), 8.50 (s, 1H, H-$5_{chromone}$), 9.40 (s, 1H, H-$2_{chromone}$), 10.22 (bs, 2H, C-$NH_2$ exchangeable with $D_2O$). *m/z* (*I*%): 333 (4), 319 (4), 298 (12), 280 (2), 209 (3), 184 (6), 170 (7), 157 (30), 134 (45), 130 (7), 116 (12), 108 (19), 88 (100), 68 (76). *Anal*. Calcd for $C_{17}H_{11}N_5O_3$ (333.31); C, 61.26; H, 3.33; N, 21.01%. Found: C, 60.90; H, 3.40; N, 20.70%.

***7-(6-Methyl-4-oxo-4H-chromen-3-yl)-5-oxo-2-thioxo-1H-2,3,4,5-tetrahydro[1,2,4] triazolo[1,5-a]pyridine-6,8-dicarbonitrile (5).*** A mixture of compound **4** (0.67 g, 2 mmol) and carbon disulfide (0.16 mL, 2 mmol) in pyridine (20 mL) was heated under reflux for 8 h. After cooling, the reaction mixture was poured onto ice/water and neutralized with conc. HCl. The precipitated solid was filtered, washed with water, air dried, and crystallized from methanol to give **5** as yellow crystals, yield (0.32 g, 43%), mp 195°C. IR (KBr, $cm^{-1}$): 3396, 3185 (2 NH), 3067 ($CH_{arom.}$), 2970, 2940 ($CH_{aliph.}$), 2216 (2C≡N), 1680 (C═$O_{pyridone}$), 1630 (C═$O_{\gamma\text{-pyrone}}$), 1604 (C═C), 1300 (C═S). $^1$H NMR (DMSO-$d_6$, δ): 2.25 (s, 3H, $CH_3$), 6.92 (d, 1H, $J$ = 7.8 Hz, H-$8_{chromone}$), 7.29 (d, 1H, $J$ = 7.5 Hz, H-$7_{chromone}$), 7.88 (s, 1H, NH exchangeable with $D_2O$), 8.27 (s, 1H, H-$5_{chromone}$), 8.85 (s, 1H, NH exchangeable with $D_2O$), 9.36 (s, 1H, H-$2_{chromone}$). $^{13}$C NMR (DMSO-$d_6$, δ): 19.8 ($CH_3$), 116.3 (C-9), 116.9 (C-7), 119.6 (C≡N), 123.5 (C≡N), 125.4 (C-3′), 126.6 (C-4′a), 128.2 (C-8′), 130.9 (C-5′), 132.3 (C-6′), 134.3 (C-7′), 143.2 (C-8), 154.6 (C-8`a), 159.4 (C-9a), 160.5 ($C_6$ as C═O), 161.9 (C-2`), 187.0 ($C_2$ as C═S), 192.5 ($C_4'$ as C═$O_{\gamma\text{-pyrone}}$). *Anal*. Calcd for $C_{18}H_9N_5O_3S$ (375.37); C, 57.60; H, 2.42; N, 18.66; S, 8.54%. Found: C, 57.80; H, 2.60; N, 18.30; S, 8.20%.

***1-Acetyl-7-(6-methyl-4-oxo-4H-chromen-3-yl)-2-methyl-5-oxo-1,5-dihydro-[1,2,4]triazolo[1,5-a]pyridine-6,8-dicarbonitrile (6).*** A mixture of compound **4** (0.67 g, 2 mmol) and acetic anhydride (10 mL) was heated under reflux for 2 h. After cooling, the reaction mixture was poured onto ice/water. The precipitated solid was filtered, washed with water, air dried, and crystallized from acetic acid to give **6** as brown crystals (0.42 g, 53%), mp 290°C. IR (KBr, $cm^{-1}$): 3070 ($CH_{arom.}$), 2960, 2927 ($CH_{aliph.}$), 2225 (2C≡N), 1763 (C═$O_{acetyl}$), 1700 (C═$O_{pyridone}$), 1616 (C═$O_{\gamma\text{-pyrone}}$), 1589 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 1.89 (s, 3H, $CH_{3\ triazole}$), 2.01 (s, 3H, $CH_{3\ chromone}$), 2.35 (s, 3H, $CH_{3\ acetyl}$), 7.23 (d, 1H, H-$8_{chromone}$), 7.50 (d, 1H, H-$7_{chromone}$), 8.51 (s, 1H, H-$5_{chromone}$), 9.44 (s, 1H, H-$2_{chromone}$). *Anal*. Calcd for $C_{21}H_{13}N_5O_4$ (399.37): C, 63.16; H, 3.28; N, 17.54%. Found: C, 63.39; H, 3.30; N, 17.63%.

***2-[(2-Aminophenyl)]-7-[(6-methyl-4-oxo-4H-chromen-3-yl)]-5-oxo-3,5-dihydro-[1,2,4]triazolo[1,5-a]pyridine-6,8-dicarbonitrile (7).*** A mixture of compound **4** (0.67 g, 2 mmol) and anthranilic acid (0.27 g, 2 mmol) in $POCl_3$ (10 mL) was heated under reflux on a water bath for 4 h. After cooling, the reaction mixture was poured onto ice/water. The precipitated solid was filtered, washed with water, air dried, and crystallized from DMF to give **7** as pale brown crystals, yield (0.32 g, 36%), mp 274°C. IR (KBr, $cm^{-1}$): 3428, 3210 ($NH_2$, NH), 3059 ($CH_{arom.}$), 2987, 2928 ($CH_{aliph.}$), 2219 (2C≡N), 1677 (C═$O_{pyridone}$, C═$O_{\gamma\text{-pyrone}}$), 1589 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.22 (s, 3H, $CH_3$), 4.71 (bs, 2H, $NH_2$ exchangeable with $D_2O$), 6.96–7.88 (m, 6H, Ar-H), 8.46 (s, 1H, H-$5_{chromone}$), 9.20 (s, 1H, H-$2_{chromone}$), 9.95 (br, 1H, NH exchangeable with $D_2O$). *m/z* (*I*%): 434 (1), 301 (3), 285 (2), 261 (3), 232 (2), 186 (3), 159 (2), 133 (6), 119 (5), 106 (5), 92 (3), 78 (8), 63 (100). *Anal*. Calcd for $C_{24}H_{14}N_6O_3$ (434.42): C, 66.36; H, 3.25; N, 19.35%. Found: C, 66.10; H, 3.30; N, 19.40%.

***2-(6-Methyl-4-oxo-4H-chromen-3-yl)-4-oxo-7-thioxo-4,7-dihydro-8H-pyrido[1′,2′:2,3][1,2,4]triazolo[1,5-c]quinazoline-1,3-dicarbonitrile (8).*** A mixture of compound **7** (0.86 g, 2 mmol) and carbon disulfide (0.16 mL, 2 mmol) in pyridine (25 mL) was heated under reflux for 8 h. After cooling, the reaction mixture was poured onto ice/water and neutralized with conc. HCl. The precipitated solid was filtered, washed with water, air dried, and crystallized from dioxane to give **8** as brownish crystals, yield (0.42 g, 44%), mp 259°C. IR (KBr, $cm^{-1}$): 3317 (NH), 3071 ($CH_{arom.}$), 2956, 2925 ($CH_{aliph.}$), 2235 (2C≡N), 1660 (C═$O_{pyridone}$, C═$O_{\gamma\text{-pyrone}}$), 1611 (C═N and C═C), 1301 (C═S). $^1$H NMR (DMSO-$d_6$, δ): 2.26 (s, 3H, $CH_3$), 4.57 (bs, 1H, NH exchangeable with $D_2O$), 6.94 (d, 1H, H-$8_{chromone}$), 7.33–7.80 (m, 5H, Ar-H), 7.95 (s, 1H, H-$5_{chromone}$), 8.58 (s, 1H, H-$2_{chromone}$). *Anal*. Calcd for $C_{25}H_{12}N_6O_3S$ (476.48): C, 63.02; H, 2.54; N, 17.64; S, 6.73%. Found: 62.80; H, 2.40; N, 17.50; S, 6.80%.

***2-(6-Methyl-4-oxo-4H-chromen-3-yl)-7-methyl-4-oxo-4H-pyrido[1′,2′:2,3][1,2,4]triazolo[1,5-c]quinazoline-1,3-dicarbonitrile (9).*** A mixture of compound **8** (0.86 g, 2 mmol) and acetic anhydride (10 mL) was heated under reflux for 3 h. After cooling, the reaction mixture was poured onto ice/water. The precipitated solid was filtered, washed with water, air dried, and crystallized from DMF to give **9** as yellow crystals, yield (0.33 g, 36%), mp >300°C. IR (KBr, $cm^{-1}$): 3073 ($CH_{arom.}$), 2925 ($CH_{aliph.}$), 2237 (2C≡N), 1672 (C═$O_{pyridone}$, C═$O_{\gamma\text{-pyrone}}$), 1613 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 1.91 (s, 3H, $CH_{3\ pyrimidine}$), 2.26 (s, 3H, $CH_{3chromone}$), 6.94 (d, 1H, H-$8_{chromone}$), 7.34–7.72 (m, 5H, Ar-H), 8.20 (s, 1H, H-$5_{chromone}$), 9.25 (s, 1H, H-$2_{chromone}$). *m/z* (*I*%): 458 (41), 443 (8), 429 (17), 415 (12), 209 (12), 184 (16), 160 (10), 135 (24), 121 (56), 107 (16), 91 (14), 78 (65), 63 (100). *Anal*. Calcd for $C_{26}H_{14}N_6O_3$ (458.44); C, 68.12; H, 3.08; N, 18.33%. Found: C, 68.00; H, 3.20; N, 18.30%.

***8-(6-Methyl-4-oxo-4H-chromen-3-yl)-3,6-dioxo-1,3,4,6-tetrahydro-2H-pyrido[1,2-b][1,2,4]triazine-7,9-dicarbonitrile (10).*** A mixture of compound **4** (0.67 g, 2 mmol) and chloroacetyl chloride (0.16 mL, 2 mmol) in DMF (10 mL) containing few drops of triethylamine was heated under reflux for 4 h. After cooling, the reaction mixture was poured onto ice/water. The formed solid was filtered, washed with water, air dried, and crystallized from ethanol to give **10** as pale yellow crystals, yield (0.29 g, 39%), mp 244°C. IR (KBr, $cm^{-1}$): 3404 (2 NH), 2970 ($CH_{aliph.}$), 2261 (2C≡N), 1682 (C═$O_{pyridone}$, C═$O_{triazinone}$), 1633 (C═$O_{\gamma\text{-pyrone}}$).

$^1$H NMR (DMSO-$d_6$, δ): 2.26 (s, 3H, $CH_3$), 2.78 (s, 2H, $CH_2CO$), 6.92 (d, 1H, $J$ = 7.8 Hz, H-8$_{chromone}$), 7.28 (d, 1H, $J$ = 8.1 Hz, H-7$_{chromone}$), 8.29 (s, 1H, H-5$_{chromone}$), 8.50 (s, 1H, NH exchangeable with $D_2O$), 9.38 (s, 1H, H-2$_{chromone}$), 10.30 (bs, 1H, NH exchangeable with $D_2O$). *Anal*. Calcd $C_{19}H_{11}N_5O_4$ (373.33); C, 61.13; H, 2.97; N, 18.76%. Found: C, 60.90; H, 2.80; N, 18.80%.

***8-(6-Methyl-4-oxo-4H-chromen-3-yl)-2,3,6-trioxo-1,2,3,4,6-pentahydro-2H-pyrido[1,2-b][1,2,4[triazine-7,9-dicarbonitrile (11).*** A mixture of compound **4** (0.67 g, 2 mmol) and oxalyl chloride (0.2 mL, 2 mmol) in DMF (15 mL) was heated under reflux for 2 h. After cooling, the reaction mixture was concentrated to one-third its original volume. The formed precipitate was filtered and crystallized from dioxane to give **11** as yellow crystals, yield (0.37 g, 48%), mp 268°C. IR (KBr, $cm^{-1}$): 3383, 3250 (2 NH), 3050 (CH$_{arom.}$), 2924 (CH$_{aliph.}$), 2218 (2C≡N), 1680 (C═O$_{pyridone}$), 1650 (2C═O$_{triazine}$), 1622 (C═O$_{\gamma\text{-pyrone}}$). $^1$H NMR (DMSO-$d_6$, δ): 2.26 (s, 3H, $CH_3$), 6.92 (d, 1H, $J$ = 8.7 Hz, H-8$_{chromone}$), 7.33 (d, 1H, H-7$_{chromone}$), 8.63 (s, 1H, H-5$_{chromone}$), 9.49 (s, 1H, H-2$_{chromone}$), 9.90 (br, 1H, NH exchangeable with $D_2O$), 10.30 (br, 1H, NH exchangeable with $D_2O$). *Anal*. Calcd for $C_{19}H_9N_5O_5$ (387.31): C, 58.92; H, 2.34; N, 18.08%. Found: C, 58.80; H, 2.40; N, 18.00%.

***8-(6-Methyl-4-oxo-4H-chromen-3-yl)-3-methyl-2,6-dioxo-1,2,6-trihydropyrido[1,2-b][1,2,4]triazine-7,9-dicarbonitrile (12).*** A mixture of compound **4** (0.67 g, 2 mmol) and sodium pyruvate (0.22 g, 2 mmol), in glacial acetic acid containing freshly fused sodium acetate, was heated under reflux for 3 h. After cooling, the reaction mixture was poured onto ice/water. The formed precipitate was filtered, washed with water, air dried, and crystallized from ethanol to give **12** as yellow crystals, yield (0.52 g, 68%), mp 283°C. IR (KBr, $cm^{-1}$): 3432 (NH), 3064 (CH$_{arom.}$), 2231 (2C≡N), 1728 (C═O$_{pyridone}$ and C═O$_{triazinone}$), 1633 (C═O$_{\gamma\text{-pyrone}}$), 1610 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 1.90 (s, 3H, CH$_{3triazine}$), 2.25 (s, 3H, CH$_3$ $_{chromone}$), 6.92 (d, 1H, H-8 $_{chromone}$), 7.28 (d, 1H, H-7$_{chromone}$), 8.29 (s, 1H, H-5$_{chromone}$), 8.50 (s, 1H, NH exchangeable with $D_2O$), 9.38 (s, 1H, H-2$_{chromone}$). $^{13}$C NMR (DMSO-$d_6$, δ): 17.9 ($CH_3$), 19.8 ($CH_3$), 116.4 (C-9), 116.9 (C-7), 119.6 (C≡N), 120.9 (C≡N), 123.5 (C-3′), 125.4 (C-4′a), 128.3 (C-8`), 130.6 (C-5′), 132.4 (C-6`), 134.3 (C-7′), 144.4 (C-8), 150.1 ($C_2$ as C═O), 154.6 ($C_3$ as C═N), 156.5 (C-8′a), 159.4 (C-9a), 161.9 ($C_6$ as C═O), 163.0 (C-2`), 192.5 ($C_4'$ as C═O$_{\gamma\text{-pyrone}}$). *m/z* (*I*%): 386 (M + 1; 5), 317 (62), 302 (11), 289 (21), 274 (9), 261 (5), 246 (5), 134 (100), 106 (22), 79 (20), 66 (15). *Anal*. Calcd for $C_{20}H_{11}N_5O_4$ (385.34); C, 62.34; H, 2.88; N, 18.17%. Found: C, 62.45; H, 2.49; N, 18.23%.

***8-(6-Methyl-4-oxo-4H-chromen-3-yl)-2,3-diphenyl-6-oxo-pyrido [1,2-b][1,2,4]triazine-7,9-dicarbonitrile (13).*** A mixture of compound **4** (0.67 g, 2 mmol) and benzil (0.42 g, 2 mmol), in glacial acetic acid containing freshly fused sodium acetate, was heated under reflux for 4 h. The solid obtained after cooling was filtered and crystallized from acetic acid to give **13** as yellow crystals, yield (0.46 g, 45%), mp 285°C. IR (KBr, $cm^{-1}$): 2924, 2853 ($CH_3$), 2219 (2C≡N), 1655 (C═O$_{pyridone}$ and C═O$_{\gamma\text{-pyrone}}$), 1580 (C═N), 1541 (C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.25 (s, 3H, $CH_3$), 6.92 (d, 1H, H-8$_{chromone}$), 7.27 (d, 1H, H-7$_{chromone}$), 7.62–7.93 (m, 10H, Ar-H), 8.40 (s, 1H, H-5$_{chromone}$), 9.10 (s, 1H, H-2$_{chromone}$). *m/z* (*I*%): 507 (2), 238 (3), 210 (11), 179 (11), 134 (5), 106 (49), 93 (5), 77 (17), 65 (73), 51 (100). *Anal*. Calcd for $C_{31}H_{17}N_5O_3$ (507.51); C, 73.37; H, 3.38; N, 13.80%. Found: C, 73.20; H, 3.40; N, 13.60%.

***8-(6-Methyl-4-oxo-4H-chromen-3-yl)--10-oxo-11-hydroindolo [2,3-e]pyrido[1,2-b][1,2,4]triazine-7,9-dicarbonitrile (14).*** A mixture of compound **4** (0.67 g, 2 mmol) and indol-2,3-dione (0.30 g, 2 mmol), in glacial acetic acid containing freshly fused sodium acetate, was heated under reflux for 4 h. the solid obtained during heating was filtered and crystallized from DMF to give **14** as pale red crystals, yield (0.51 g, 57%), mp 275°C. IR (KBr, $cm^{-1}$): 3387 (NH), 2231 (2C≡N), 1728 (C═O$_{pyridone}$), 1672 (C═O$_{\gamma\text{-pyrone}}$), 1619 (C═N), 1570 (C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.27 (s, 3H, $CH_3$), 6.91 (d, 1H, H-8$_{chromone}$), 7.30–7.85 (m, 5H, Ar-H), 8.25 (s, 1H, H-5$_{chromone}$), 9.30 (s, 1H, H-2$_{chromone}$), 10.85 (s, 1H, NH exchangeable with $D_2O$). *m/z* (*I* %): 443 (M-1; 3), 313 (42), 285 (5), 239 (15), 210 (10), 134 (55), 119 (27), 106 (11), 91 (27), 78 (28). *Anal*. Calcd for $C_{25}H_{12}N_6O_3$ (444.41): C, 67.57; H, 2.72; N, 18.91%. Found: C, 67.70; H, 2.60; N, 18.70%.

***2-(2-Acetanilido)-8-(6-methyl-4-oxo-4H-chromen-3-yl)-3,6-dioxo-3,6-dihydro-4H-pyrido[1,2-b][1,2,4]triazine-7,9-dicarbonitrile (16).*** A mixture of compound **4** (0.67 g, 2 mmol) and *N*-acetylisatin (0.38 g, 2 mmol) in glacial acetic acid (30 mL) was heated under reflux for 4 h. The solid obtained after cooling was filtered and crystallized from ethanol to give **16** as yellow crystals, yield (0.48 g, 44%), mp. 201°C. IR (KBr, $cm^{-1}$): 3310, 3121 (2 NH), 3039 (CH$_{arom.}$), 2931 (CH$_{aliph.}$), 2219 (2C≡N), 1720 (C═O$_{acetanilido}$), 1680 (C═O$_{pyridone}$), 1660 (C═O$_{triazine}$), 1639 (C═O$_{\gamma\text{-pyrone}}$), 1601 (C═N), 1598 (C═C). $^1$H NMR (DMSO-$d_6$, δ): 1.92 (s, 3H, CH$_3$ $_{acetanilido}$), 2.24 (s, 3H, CH$_3$ $_{chromone}$), 6.89–8.30 (m, 6H, Ar-H), 8.46 (s, 1H, H-5$_{chromone}$), 9.37 (s, 1H, H-2$_{chromone}$), 10.19 (bs, 1H, NH exchangeable with $D_2O$), 11.01 (bs, 1H, NH exchangeable with $D_2O$). *Anal*. Calcd for $C_{27}H_{16}N_6O_5$ (504.43) C, 64.28; H, 3.17; N, 16.66%. Found: C, 64.10; H, 3.00; N, 16.50%.

***2-Amino-9-(6-methyl-4-oxo-4H-chromen-3-yl)-4-methylthio-7-oxo-5H-pyrido[1,2-b][1,2,4]triazepine-3,8,10-tricarbonitrile (17).*** A mixture of compound **4** (0.67 g, 2 mmol) and 2-cyano-3,3-bis (methylthio) acrylonitrile (0.34 g, 2 mmol) in DMF (30 mL) containing two drops of triethylamine was heated under reflux for 4 h. The solid obtained after cooling was filtered, washed with ethanol, and crystallized from DMF/EtOH to give **17** as yellow crystals, yield (0.47 g, 52%), mp 242°C. IR (KBr, $cm^{-1}$): 3434, 3156 ($NH_2$, NH), 3049 (CH$_{arom.}$), 2926 (CH$_{aliph}$), 2263, 2230 (3C≡N), 1685 (C═O$_{pyridone}$), 1632 (C═O$_{\gamma\text{-pyrone}}$), 1599 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.24 (s, 3H, CH$_3$ $_{chromone}$), 2.76 (s, 3H, $SCH_3$), 6.90 (d, 1H, $J$ = 8.4 Hz, H-8$_{chromone}$), 7.22 (d, 1H, $J$ = 8.1 Hz, H-7$_{chromone}$), 7.93 (bs, 2H, $NH_2$ exchangeable with $D_2O$), 8.49 (s, 1H, H-5$_{chromone}$), 9.31 (s, 1H, H-2$_{chromone}$), 10.05 (bs, 1H, NH exchangeable with $D_2O$). *m/z* (*I*%): 453 (M-2; 4), 439 (3), 409 (2), 390 (5), 317 (9), 302 (4), 289 (15), 274 (3), 263 (6), 237 (6), 209 (5), 159 (4), 134 (12), 116 (6), 107 (13), 91 (5), 78 (45), 73 (100), 50 (12). *Anal*. Calcd for $C_{22}H_{13}N_7O_3S$ (455.46): C, 58.02; H, 2.88; N, 21.53; S, 7.04%. Found: C, 57.80; H, 2.80; N, 21.30; S, 6.90%.

***2-Amino-8,10-dicyano-9-(6-methyl-4-oxo-4H-chromen-3-yl)-4-(methylthio)-7-oxo-1,7-dihydropyrido[1,2-b][1,2,4]triazepine-3-carboxamide (18).*** A mixture of compound **4** (0.67 g, 2 mmol) and 2-cyano-3,3-bis(methylthio)prop-2-enamide (0.38 g, 2 mmol) in DMF (30 mL) containing two drops of triethylamine was heated under reflux for 4 h. The solid obtained after cooling was filtered, washed with ethanol, and crystallized from DMF to give **18** as yellow crystals, yield (0.39 g, 41%), mp 142°C. IR (KBr, $cm^{-1}$): 3428, 3200 (2$NH_2$, NH), 2925 (CH$_{aliph}$), 2194 (2C≡N), 1695 (C═O$_{carboxamide}$), 1682 (C═O$_{pyridone}$), 1652 (C═O$_{\gamma\text{-pyrone}}$), 1600 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.23 (s, 3H, CH$_3$ $_{chromone}$), 2.72 (s, 3H, $SCH_3$), 6.87 (d, 1H, $J$ = 7.2 Hz, H-

$8_{chromone}$), 7.15 (d, 1H, $J = 7.8$ Hz, H-$7_{chromone}$), 7.60 (bs, 2H, $NH_2$), 7.94 (bs, 2H, $NH_2$), 8.55 (s, 1H, H-$5_{chromone}$), 8.74 (s, 1H, H-$2_{chromone}$), 10.02 (bs, 1H, NH). *Anal*. Calcd for $C_{22}H_{15}N_7O_4S$ (473.46): C, 55.81; H, 3.19; N, 20.71; S, 6.77%. Found: C, 55.81; H, 3.19; N, 20.71; S, 6.77%.

***3-Methyl-9-(6-methyl-4-oxo-4H-chromen-3-yl)-7-oxo-7,11-dihydro-1-phenyl-1H-pyrazolo[3,4-e]pyrido[1,2-b][1,2,4]triazepine-8,10-dicarbonitrile (19).*** A mixture of compound **4** (0.67 g, 2 mmol) and 5-chloro-3-methyl-1-phenylpyrazole-4-carbaldehyde (0.44 g, 2 mmol) in DMF (20 mL) containing two drops of triethylamine was heated under reflux for 4 h. The solid obtained during heating was filtered and crystallized from DMF to give **19** as yellow crystals, yield (0.56 g, 56%), mp 281°C. IR (KBr, $cm^{-1}$): 3332 (NH,), 3063 ($CH_{arom.}$), 2933 ($CH_{aliph.}$), 2226 (2C≡N), 1681 (C═$O_{pyridone}$), 1633 (C═$O_{\gamma\text{-pyrone}}$), 1589 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.07 (s, 3H, $CH_{3\ pyrazole}$), 2.38 (s, 3H, $CH_{3\ chromone}$), 6.90–7.80 (m, 7H, Ar-H), 8.15 (s, 1H, H-$5_{chromone}$), 8.56 (s, 1H, H-$7_{triazepine}$), 9.35 (s, 1H, H-$2_{chromone}$), 11.41 (bs, 1H, NH exchangeable with $D_2O$). *Anal*. Calcd for $C_{28}H_{17}N_7O_3$ (499.49): C, 67.33; H, 3.43; N, 19.63%. Found: C, 67.10; H, 3.30; N, 19.40%.

***2-(6-Methyl-4-oxo-4H-chromen-3-yl)-4-oxo-4H-quinolino[2,3-e]pyrido[1,2-b][1,2,4]triazepine-1,3-dicarbonitrile (20).*** A mixture of compound **4** (0.67 g, 2 mmol) and 3-formyl-2-chloroquinoline (0.38 g, 2 mmol) in DMF (20 mL) containing two drops of triethylamine was heated under reflux for 4 h. The solid obtained during heating was filtered and crystallized from ethanol to give **20** as yellow crystals, yield (0.38 g, 54%), mp 290°C. IR (KBr, $cm^{-1}$): 3401 (NH), 3063 ($CH_{arom.}$), 2922, 2860 ($CH_{aliph.}$), 2226 (2C≡N), 1681 (C═$O_{pyridone}$), 1630 (C═$O_{\gamma\text{-pyrone}}$), 1590 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.27 (s, 3H, $CH_3$), 6.93 (d, 1H, $J = 8.7$ Hz, H-$8_{chromone}$), 7.32 (d, 1H, $J = 6.9$ Hz, H-$7_{chromone}$), 7.76 (t, 1H, $J = 7.2$ Hz, H-$7_{quinoline}$), 7.78 (t, 1H, $J = 7.2$ Hz, H-$6_{quinoline}$), 8.01 (d, 1H, $J = 7.5$ Hz, H-$8_{quinoline}$), 8.17 (d, 1H, $J = 7.8$ Hz, H-$5_{quinoline}$), 8.31 (s, 1H, H-$5_{chromone}$), 8.55 (s, 1H, H-$7_{triazepine}$), 8.90 (s, 1H, H-$4_{quinoline}$), 9.12 (bs, 1H, NH exchangeable with $D_2O$), 9.23 (s, 1H, H-$2_{chromone}$). *m/z* (*I*%): 469 (M-1; 6), 413 (5), 334 (74), 316 (33), 290 (21), 288 (84), 259 (17), 234 (15), 220 (27), 209 (18), 168 (20).152 (21), 135 (39), 107 (28), 91 (17), 88 (21), 77 (78), 73 (12), 62 (100). *Anal*. Calcd for $C_{27}H_{14}N_6O_3$ (470.45): C, 68.93; H, 3.00; N, 17.86%. Found: C, 68.80; H, 3.40; N, 17.90%.

***2-Amino-4-(4-methoxyphenyl)-7-oxo-5,7-dihydro-9-(6-methyl-4-oxo-4H-chromen-3-yl)-pyrido[1,2-b][1,2,4]triazepine-3,8,10-tricarbonitrile (21).*** A mixture of compound **4** (0.67 g, 2 mmol) and *p*-methoxybenzylidene-malononitrile (0.36 g, 2 mmol) in DMF (15 mL) containing two drops of triethylamine was heated under reflux for 4 h. The solid obtained during heating was filtered and crystallized from DMF/MeOH to give **21** as orange crystals, yield (0.58 g, 56%), mp 268°C. IR (KBr, $cm^{-1}$): 3399, 3197 ($NH_2$, NH), 3024 ($CH_{arom.}$), 2850 ($CH_{aliph.}$), 2217 (3C≡N), 1682 (C═$O_{pyridone}$), 1630 (C═$O_{\gamma\text{-pyrone}}$), 1596 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.26 (s, 3H, $CH_3$), 3.87 (s, 3H, $OCH_3$), 6.95 (d, 1H, H-$8_{chromone}$), 7.15 (d, 2H, Ar-H), 7.31 (d, 1H, H-$7_{chromone}$), 8.01 (d, 2H, Ar-H), 8.26 (s, 1H, H-$5_{chromone}$), 8.67 (bs, 2H, $NH_2$ exchangeable with $D_2O$), 9.32 (s, 1H, H-$2_{chromone}$), 10.22 (bs, 1H, NH exchangeable with $D_2O$). *m/z* (*I*%): 515 (not recorded), 484 (M-$OCH_3$; 5), 457 (42), 409 (44), 393 (10), 317 (7), 288 (4), 259 (3), 209 (3), 182 (6), 168 (6), 121 (63), 107 (19), 76 (12), 43 (100). *Anal*. Calcd for $C_{28}H_{17}N_7O_4$ (515.49): C, 65.24; H, 3.32; N, 19.02%. Found: C, 65.20; H, 3.4; N, 19.00%.

***Ethyl 2-amino-8,10-dicyano-4-(4-methoxyphenyl)-9-(6-methyl-4-oxo-4H-chromen-3-yl) -7-oxo-5, 7-dihydropyrido[1,2-b][1,2,4]triazepine-3-carboxylate (22).*** A mixture of compound **4** (0.67 g, 2 mmol) and ethyl 2-cyano-3-(4-methoxyphenyl)prop-2-enoate (0.46 g, 2 mmol) in DMF (30 mL) containing two drops of triethylamine was heated under reflux for 4 h. The solid obtained during heating was filtered and crystallized from DMF/$H_2O$ to give **22** as reddish orange crystals, yield (0.39 g, 35%), mp 285°C. IR (KBr, $cm^{-1}$): 3377, 3200 ($NH_2$, NH), 3032 ($CH_{arom.}$), 2933, 2841 ($CH_{aliph.}$), 2220 (2C≡N), 1710 (C═$O_{ester}$), 1685 (C═$O_{pyridone}$), 1634 (C═$O_{\gamma\text{-pyrone}}$), 1593 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 1.28 (t, 3 H, $J = 7.2$ Hz, $CH_2CH_3$), 2.26 (s, 3H, $CH_{3\ chromone}$), 3.85 (s, 3H, $OCH_3$), 4.28 (q, 2H, $J = 7.2$ Hz, $CH_2CH_3$), 6.93 (d, 1H, $J = 8.7$ Hz, H-$8_{chromone}$), 7.12 (d, 2H, Ar-H), 7.33 (d, 1H, $J = 8.7$ Hz, H-$7_{chromone}$), 8.05 (d, 2H, Ar-H), 8.26 (s, 1H, H-$5_{chromone}$), 8.44 (bs, 1H, NH exchangeable with $D_2O$), 8.52 (bs, 1H, NH exchangeable with $D_2O$), 9.32 (s, 1H, H-$2_{chromone}$), 10.24 (bs, 1H, NH exchangeable with $D_2O$). *Anal*. Calcd for $C_{30}H_{22}N_6O_6$ (562.55): C, 64.05; H, 3.94; N, 14.94%. Found: C, 64.09; H, 4.05; N, 14.72%.

***7-(6-Methyl-4-oxo-4H-chromen-3-yl)-2-(4-oxo-4H-chromen-3-yl)-5-oxo-3,5-dihydro[1,2,4]triazolo[1,5-a]pyridine-6,8-dicarbonitrile (24).*** A mixture of compound **4** (0.67 g, 2 mmol) and chromone-3-carboxylic acid (0.38 g, 2 mmol) in phosphorus oxychloride (30 mL) was heated under reflux on a water bath for 4 h. After cooling, the reaction mixture was poured onto ice/water. The precipitated solid was filtered, washed with water, air dried, and crystallized from ethanol to give **24** as yellow crystals, yield (0.53 g, 54%), mp >300°C. IR (KBr, $cm^{-1}$): 3402 (NH), 3039 ($CH_{arom.}$), 2925 ($CH_{aliph.}$), 2219 (2C≡N), 1670 (C═$O_{pyridone}$), 1650 (2C═$O_{\gamma\text{-pyrone}}$), 1601 (C═N and C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.28 (s, 3H, $CH_3$), 6.92 (d, 1H, $J = 8.7$ Hz, H-$8_{chromone}$), 7.33 (d, 1H, $J = 6.6$ Hz, H-$7_{chromone}$), 7.57 (t, 1H, $J = 7.2$ Hz, H-6`$_{chromone}$), 7.77 (d, 1H, $J = 8.1$ Hz, H-8`$_{chromone}$), 7.89 (t, 1H, $J = 7.5$ Hz, H-7`$_{chromone}$), 8.15 (d, 1H, $J = 7.8$ Hz, H-5`$_{chromone}$), 8.34 (s, 1H, H-$5_{chromone}$), 9.23 (s, 1H, H-2`$_{chromone}$), 9.44 (s, 1H, H-$2_{chromone}$), 10.20 (bs, 1H, NH exchangeable with $D_2O$). *Anal*. Calcd for $C_{27}H_{13}N_5O_5$ (487.44): C, 66.53; H, 2.69; N, 14.37%. Found: C, 66.20; H, 3.00; N, 14.10%.

***2-Amino-3-(2-hyroxyphenyl)carbonyl-7-oxo-9-(6-methyl-4-oxo-4H-chromen-3-yl)-5H-pyrido[1,2-b][1,2,4]triazepine-8,10-dicarbonitrile (25).*** A mixture of compound **4** (0.67 g, 2 mmol) and chromone-3-carbonitrile (0.34 g, 2 mmol) in DMF (30 mL) was heated under reflux for 4 h. The solid obtained after cooling was filtered, washed with cold ethanol, and crystallized from DMF to give **25** as yellow crystals, yield (0.39 g, 39%), mp >300°C. IR (KBr, $cm^{-1}$): 3405, 3315, 3211 ($NH_2$, NH, OH), 3050 ($CH_{arom.}$), 2968, 2922 ($CH_{aliph.}$), 2259, 2220 (2C≡N), 1684 (C═$O_{pyridone}$), 1629 (C═$O_{\gamma\text{-pyrone}}$ and C═$O_{hydrogen\ bonded}$), 1600 (C═C). $^1$H NMR (DMSO-$d_6$, δ): 2.24 (s, 3H, $CH_3$), 6.89 (d, 1H, H-$8_{chromone}$), 7.26 (d, 1H, H-$7_{chromone}$), 7.40–7.90 (m, 4H, A-H), 8.24 (s, 1H, H-$5_{chromone}$), 8.46 (s 1H, H-$7_{triazepine}$), 8.58 (bs, 1H, NH), 9.03 (bs, 1H, NH), 9.34 (s, 1H, H-$2_{chromone}$), 10.13 (bs, 1H, NH). *Anal*. Calcd for $C_{27}H_{16}N_6O_5$ (504.47): C, 64.29; H, 3.20; N, 16.66%. Found: C, 64.30; H, 3.10; N, 10.38%.

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