A SIMPLE SYNTHESIS OF 1-SUBSTITUTED 5-AMINOPYRAZOLES AND PYRAZOLO[1,5-*a*]-*s*-TRIAZINE DERIVATIVE

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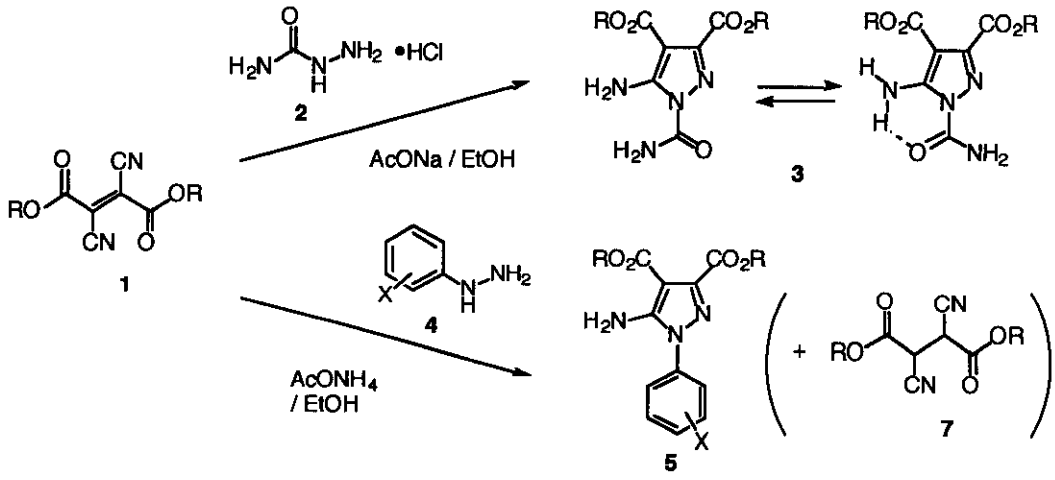
Abstract — Dialkyl 5-amino-1-carbamoylpyrazole-3,4-dicarboxylates (**3**) and the 1-aryl derivatives (**5**) are synthesized directly by the reaction of semicarbazide (**2**) or arylhydrazines (**4**) with dialkyl (*E*)-2,3-dicyanobutendioates (**1**) in the presence of organic salts, such as ammonium acetate or sodium acetate. Furthermore, the reaction of the 1,3-diamino compound (**3**; R= Et) with trimethyl orthoformate in acetic acid led to the formation of diethyl 7-hydroxypyrazolo[1,5-*a*]-*s*-triazine-2,3-dicarboxylate (**6**).

In view of the synthesis of useful polyheterocycles, 5-aminopyrazoles having three or more functional groups are potential intermediates.[1-7] It is known that 5-aminopyrazoles bearing one or two cyano groups were obtained from some tetrasubstituted ethylenes, such as dicyanoketene acetals[8] and tetracyanoethylene.[9] However, the preparation of title compounds starting from dialkyl (*E*)-2,3-dicyanobutendioates (**1**) has not yet been reported. In previous papers we described a new method leading to excellent yields of **1**[10] and a novel synthesis of heterocyclic compounds such as 1,6-diamino-2-pyridones and [1,2,4]triazolo-[1,5-*a*]pyridine derivatives[11] starting from **1**. We now describe a simple method for the synthesis of novel dialkyl 5-amino-1-carbamoylpyrazole-3,4-dicarboxylates (**3**) and dialkyl 5-amino-1-arylpyrazole-3,4-dicarboxylates (**5**) through a reaction of semicarbazide (**2**) and arylhydrazines (**4**) with **1**, respectively (Scheme 1), and diethyl 7-hydroxypyrazolo[1,5-*a*]-*s*-triazine-2,3-dicarboxylate (**6**) from **3a** and trimethyl orthoformate (Scheme 3).

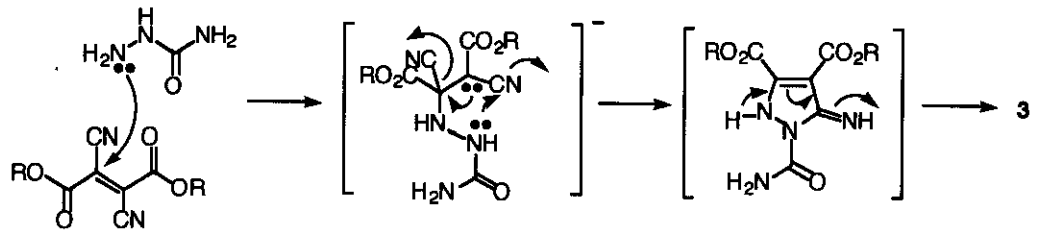
As part of our continuing program using **1** as the starting material for the preparation of nitrogen-containing heterocycles,[11] we have designed a simple synthetic method for five-membered heterocycles from the reaction of **1** with the hydrazine (**2**) or (**4**). It was found that the expected 5-amino-1-carbamoylpyrazoles (**3**) and the 1-aryl derivatives (**5**) are easily obtained in good yields by this method. The reaction of **1** with **2** or **4** in a 1 : 1-1.3

molar ratio was carried out in refluxing ethanol in the presence of ammonium acetate or sodium acetate to afford the 1-substituted 5-aminopyrazoles. The reaction may be assumed to proceed as shown in Scheme 2, and it involves the Michael addition of **2** (or **4**) to **1**. The resulting adduct undergoes cyclization by nucleophilic attack to the cyano group to give the pyrazole ring with an elimination of hydrogen cyanide and imine-enamine tautomerization.



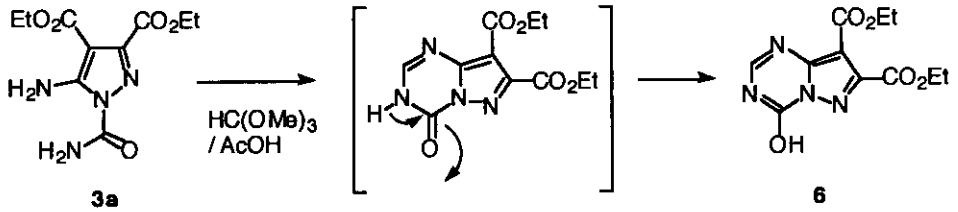
1, 3	R	5	R	X	5	R	X
a	Et	**a**	Et	*m*-Cl	**g**	*i*-Pr	*p*-F
b	Pr	**b**	Et	*p*-Cl	**h**	*i*-Pr	*p*-Cl
c	*i*-Pr	**c**	Et	*m*-NO_2	**i**	*i*-Pr	*p*-Br
d	Bu	**d**	Et	*p*-NO_2			
e	*i*-Bu	**e**	*i*-Pr	*m*-NO_2			
f	*s*-Bu	**f**	*i*-Pr	*p*-NO_2			

Scheme 1



Scheme 2

Compounds of the type (**3**) are of interest because of this system bearing suitable substituents as an intermediate for the preparation of fused heterocycles.[11] Indeed, the resulting **3a** is, in turn, readily cyclized to expected pyrazolo[1,5-*a*]-*s*-triazine (**6**) in 75 % yield by reacting with trimethyl orthoformate in acetic acid under reflux for 10 min (Scheme 3).



Scheme 3

In some our initial investigations, the reaction of **1** with **4**, in general, gave pyrazole derivatives (**5**) in low yields due to a simultaneous hydrogenation of **1** affording dialkyl 2,3-dicyanobutandioates (**7**). It seems that the fumarate ester (**1**) is easily reduced to the succinate ester (**7**) by arylhydrazines (**4**) before the addition reaction is completed. Whereas the same reaction in the presence of catalytic amount of ammonium acetate or sodium acetate gave **5** in higher yields and no hydrogenated by-product (**7**).

The IR spectrum of **3a** showed absorption bands in the 3472-3261 cm^{-1} region (four bands) due to an amino group of the 5-position and a carbamoylamino group, and at 1751, 1718, and 1685 cm^{-1} due to ester carbonyl (two bands) and amide carbonyl groups, respectively. Also, **5a** showed absorption bands at 3411 and 3323 cm^{-1} due to an amino group and at 1715 and 1690 cm^{-1} due to ester carbonyl groups, but these compounds (**3** and **5**) exhibit no characteristic band for a cyano group.

The ^1H NMR spectra of **5** revealed broad signal corresponding to two protons at δ 5.31-5.60 ppm. This was assigned to the 5-amino protons. In contrast, however, 5-amino protons of **3** showed two broad signals each corresponding to one proton at δ 5.33-5.39 and 6.92-6.93 ppm. These observations would indicate the presence of an intramolecular hydrogen-bond between 5-amino group and 1-carbamoyl group of **3** (Scheme 1).

On the other hand, in the IR spectrum of **6**, the stretching bands of the ethoxy carbonyl (1763 and 1742 cm^{-1}) shifted to higher frequencies from 25 to 50 cm^{-1} than those of **3a** or **5a**. This spectrum gave no absorption band for amido carbonyl vibration, but a new band appeared at 3438 cm^{-1}, and the ^1H NMR spectrum showed a broad singlet corresponding to one proton at δ 13.24 ppm. These spectral data suggest the presence of a hetero-aromatic hydroxyl group[11] in the type (**6**) (Scheme 3).

The molecular formula of obtained compounds (**3**, **5**, and **6**) was confirmed by the elemental analysis and MS spectral data. The assignment of ^{13}C NMR spectra was based on 1-D

and 2-D NMR technique, such as DEPT (determination of CH_3, CH_2, CH, or quaternary carbon), HMQC ($^1J_{CH}$ correlation), and HMBC ($^2J_{CH}$ or $^3J_{CH}$ correlation).

The principal advantages of the method described here are that the time of reaction is short, the work up is convenient, and the reaction is easily carried out and proceeds under mild conditions to give, in general, good yields of pyrazole and fused triazine rings.

Table 1 NMR Data of Compounds (**3**, **5**, and **6**)

Product	^{1}H-NMR (DMSO-d_6/TMS) δ (ppm), J (Hz)	^{13}C-NMR (DMSO-d_6/TMS) δ (ppm)
3a	1.32 (t, 3H, J=7.3, CH_3), 1.39 (t, 3H, J=7.3, CH_3), 4.28 (q, 2H, J=7.3, CH_2), 4 40 (q, 2H, J=7.3, CH_2), 5.38 (br s, 1H, NH), 6.93 (br s, 1H, NH), 7.00 (br s, 2H, NH_2)	14.1, 14.3 (each CH_3), 60.2, 62.1 (each OCH_2), 93.2 (C4), 145.7, 152.8 (C3 and C5), 153.3 ($CONH_2$), 162.7, 163.0 (each COO)
3b	0.97 (t, 3H, J=7.3, CH_3), 0 99 (t, 3H, J=7.3, CH_3), 1.70 (sext, 2H, J=7.3, CH_2), 1.78 (sext, 2H, J=7.3, CH_2), 4.18 (t, 2H, J=6.8, CH_2), 4.30 (t, 2H, J=6.8, CH_2), 5.39 (br s, 1H, NH), 6.93 (br s, 1H, NH), 7.00 (br s, 2H, NH_2)	10.4 ($2CH_3$), 21.9, 22.1 (each CH_2), 65.9, 67.7 (each OCH_2), 93.2 (C4), 145.8, 152.8 (C3 and C5), 153.3 ($CONH_2$), 162.8, 163.1 (each COO)
3c	1.31 (d, 6H, J=6.4, CH_3), 1.40 (d, 6H, J=6.4, CH_3), 5.17 (sept, 1H, J=6.4, CH), 5.25 (sept, 1H, J=6.4, CH), 5.37 (br s, 1H, NH), 6.93 (br s, 1H, NH), 6.98 (br s, 2H, NH_2)	21.8, 22.0 (each $2CH_3$), 67.9, 70.2 (each OCH), 93.3 (C4), 146.2, 152.9 (C3 and C5), 153.2 ($CONH_2$), 162.4, 162.6 (each COO)
3d	0.95 (t, 3H, J=7.3, CH_3), 0.96 (t, 3H, J=7.3, CH_3), 1.36-1.49 (m, 4H, CH_2), 1.62-1.69 (m, 2H, CH_2), 1.70-1.77 (m, 2H, CH_2), 4.22 (t, 2H, J=6.8, CH_2), 4.33 (t, 2H, J=6.8, CH_2), 5.35 (br s, 1H, NH), 6.93 (br s, 1H, NH), 7.00 (br s, 2H, NH_2)	13.7 ($2CH_3$), 19.1 ($2CH_2$), 30.5, 30.8 (each CH_2), 64.1, 66.0 (each OCH_2), 93.2 (C4), 145.8, 152.8 (C3 and C5), 153.3 ($CONH_2$), 162.8, 163.1 (each COO)
3e	0.96 (d, 6H, J=6.8, CH_3), 0.99 (d, 6H, J=6.8, CH_3), 1.97 (sept, 1H, J=6.8, CH), 2.06 (sept, 1H, J=6.8, CH), 4.01 (d, 2H, J=6.8, CH_2), 4.12 (d, 2H, J=6.8, CH_2), 5.36 (br s, 1H, NH), 6.92 (br s, 1H, NH), 7.01 (br s, 2H, NH_2)	19.1 ($4CH_3$), 27.7, 27.9 (each CH), 70.4, 72.1 (each OCH_2), 93.1 (C4), 145.8, 152.8 (C3 and C5), 153.4 ($CONH_2$), 162.8, 163.1 (each COO)
3f	0.93 (t, 3H, J=7.3, CH_3), 0.98 (t, 3H, J=7 3, CH_3), 1.27 (d, 3H, J=6.3, CH_3), 1.37 (d, 3H, J=6.3, CH_3), 1.55-1.80 (m, 4H, CH_2), 5.01 (sext, 1H, J=6.3, CH), 5.09 (sext, 1H, J=6.3, CH), 5.33 (br s, 1H, NH), 6.92 (br s, 1H, NH), 6.99 (br s, 2H, NH_2)	9.7 ($2CH_3$), 19.2, 19.6 (each CH_3), 28.7, 29.0 (each CH_2), 72.4, 74.7 (each OCH), 93.3 (C4), 146.2, 152.9 (C3 and C5), 153 2 ($CONH_2$), 162.5, 162.8 (each COO)
5a	1.35 (t, 3H, J=7.1, CH_3), 1.40 (t, 3H, J=7.1, CH_3), 4.32 (q, 2H, J=7.1, OCH_2), 4.42 (q, 2H, J=7.1, OCH_2), 5.45 (br s, 2H, NH_2), 7.41-7.46 (m, 3H, ArH), 7.60 (s, 1H, ArH)	14.2, 14.3 (each CH_3), 60.3, 61.8 (each OCH_2), 94.7 (C4), 122.1, 124.7, 128 9, 130.8 (each CH), 135.7, 138.0 (each Ar), 144.8, 150.0 (C3 and C5), 162.8, 163.7 (each COO)

Table 1 (Continued)

Product	^{1}H-NMR (DMSO-d_6/TMS) δ (ppm), J (Hz)	^{13}C-NMR (DMSO-d_6/TMS) δ (ppm)
5b	1.35 (t, 3H, J=7.1, CH_3), 1.40 (t, 3H, J=7.1, CH_3), 4.32 (q, 2H, J=7.1, OCH_2), 4.42 (q, 2H, J= 7.1, OCH_2), 5.39 (br s, 2H, NH_2), 7.47-7.52 (m, 4H, ArH)	14 2, 14 3 (each CH_3), 60.2, 61.8 (each OCH_2), 94.7 (C4), 125.7, 130.1 (each 2CH), 134.7, 135.4 (each Ar), 144.7, 150.0 (C3 and C5), 162.8, 163.7 (each COO)
5c	1 36 (t, 3H, J=7.1, CH_3), 1.42 (t, 3H, J=7.1, CH_3), 4.33 (q, 2H, J=7 1, OCH_2), 4.43 (q, 2H, J=7.1, OCH_2), 5.54 (br s, 2H, NH_2), 7.73 (t, 1H, J=8 3), 7.97(dd, 1H, J=8.3, 1.0), 8.28 (dd, 1H, J=8.3, 1.0), 8.48(s, 1H, ArH)	14.2, 14.3 (each CH_3), 60.4, 61 9 (each OCH_2), 95.3 (C4), 118.9, 123.1, 129.6, 130.9 (each CH), 138 2, 149.0 (each Ar), 145.4, 150.1 (C3 and C5), 162.6, 163.6 (each COO)
5d	1.35 (t, 3H, J=7.1, CH_3), 1.41 (t, 3H, J=7.1, CH_3), 4.32 (q, 2H, J=7.1, OCH_2), 4.42 (q, 2H, J=7.1, OCH_2), 5.60 (br s, 2H, NH_2), 7.82-7.84 (m, 2H, ArH), 8.37-8.39 (m, 2H, ArH)	14.2, 14.3 (each CH_3), 60.5, 62.0 (each OCH_2), 95.5 (C4), 123 9, 125.4 (each 2CH), 142.2, 146.8 (each Ar), 145.8, 150.3 (C3 and C5), 162.7, 163.5 (each COO)
5e	1.34 (d, 6H, J=6.3, $2CH_3$), 1.41 (d, 3H, J=6.3, $2CH_3$), 5.21 (sept, 1H, J=6.3, OCH), 5.27 (sept, 1H, J=6.3), 5.51 (br s, 2H, NH_2), 7.72 (t, 1H, J=8.3), 7.96 (dd, 1H, J=8.3, 1.0), 8.27 (dd, 1H, J=8.3, 1.0), 8.48 (s, 1H, ArH)	21.8, 22.0 (each $2CH_3$), 68.1, 70.0 (each OCH), 95.4 (C4), 118.9, 123.0, 129.6, 130.9 (each CH), 138.3, 149 0 (each Ar), 146.0, 149.9 (C3 and C5), 162.5, 163 1 (each COO)
5f	1.34 (d, 6H, J=6.3, $2CH_3$), 1.41 (d, 3H, J=6.3, $2CH_3$), 5.21 (sept, 1H, J=6.3, OCH), 5.27 (sept, 1H, J=6.3), 5.57 (br s, 2H, NH_2), 7.82 (d, 2H, J=8.8), 8.38 (d, 2H, J=8.8)	21.8, 21.9 (each $2CH_3$), 68.2, 70.1 (each OCH), 95.6 (C4), 123.8, 125.4 (each 2CH), 142.5, 146.7 (each Ar), 146.3, 150.1 (C3 and C5), 162.5, 163.1 (each COO)
5g	1.33 (d, 6H, J=6.3, $2CH_3$), 1.40 (d, 3H, J=6.3, $2CH_3$), 5.20 (sept, 1H, J=6.3, OCH), 5 26 (sept, 1H, J=6.3), 5 31 (br s, 2H, NH_2), 7.20 (dd, 2H, J=8 8, J_{HF}=8.3), 8.38 (dd, 2H, J=8.8, J_{HF}=4.8)	21.8, 22 0 (each $2CH_3$), 67.8, 69.7 (each OCH), 94.6 (C4), 116.9 (d, 2CH, J_{CF}=22.1), 126 7 (d, 2CH, J_{CF}=9.2), 133.0 (Ar), 145.1, 149.9 (C3 and C5), 162.4 (d, J_{CF}=-250.0, Ar), 162.8, 163.3 (each COO)
5h	1.33 (d, 6H, J=6.3, $2CH_3$), 1.40 (d, 3H, J=6 3, $2CH_3$), 5.20 (sept, 1H, J=6 3, OCH), 5.26 (sept, 1H, J=6.3), 5.36 (br s, 2H, NH_2), 7.49 (s, 4H, ArH)	21.8, 22.0 (each $2CH_3$), 67.8, 69.7 (each OCH), 94.7 (C4), 125.7, 130.0 (each 2CH), 134.6 (Ar), 135.5 (Ar), 145.3, 149.7 (C3 and C5), 162.7, 163.2 (each COO)
5i	1.33 (d, 6H, J=6.3, $2CH_3$), 1.40 (d, 3H, J=6.3, $2CH_3$), 5.20 (sept, 1H, J=6.3, OCH), 5.26 (sept, 1H, J=6.3), 5.36 (br s, 2H, NH_2), 7.43 (d, 2H, J=8.5), 7.63 (d, 2H, J=8.5)	21.8, 22.0 (each $2CH_3$), 67.9, 69.8 (each OCH), 94.8 (C4), 122.5 (Ar), 125.9, 133.0 (each 2CH), 136 1 (Ar), 145.4, 149.7 (C3 and C5), 162.8, 163.3 (each COO)
6	1.27 (t, 3H, J=7.1, CH_3), 1.32 (t, 3H, J=7.1, CH_3), 4.27 (q, 3H, J=7.1, OCH_2), 4.37 (q, 3H, J=7.1, OCH_2), 8.27 (s, 1H, CH=N), 13.24 (br s, 1H, OH)	13.8, 14.0 (each CH_3), 60.5, 61.8 (each OCH_2), 103.7, 143.2, 147.9 (each quaternary C), 148.5 (CH=N), 149.6 (quaternary C), 160.5, 161.8 (each COO)

EXPERIMENTAL

Melting points are uncorrected. IR spectra were recorded on a Perkin-Elmer FT-IR 1000 PC spectrophotometer. ^{1}H NMR spectra were recorded on a JEOL EX-400 (400 MHz) or a Varian VXR-300 (300 MHz) instrument. ^{13}C NMR (100 MHz) spectra were taken on a JEOL EX-400 (100 MHz) instrument. The DEPT spectra were run in a standard manner, using θ=135° pulse to separate CH/CH_3 and CH_2 lines phased "up" and "down", respectively. Moreover, the signals caused by quaternary carbons were identified by the comparison between ^{13}C NMR and DEPT spectra. The ^{1}H-detected heteronuclear multiple-quantum coherence (HMQC, using C-H spin-spin coupling constant $^1J_{CH}$=140 Hz), and ^{1}H-detected multiple-bond heteronuclear multiple-quantum coherence (HMBC, using C-H long range coupling constant $^nJ_{CH}$=8 Hz) experiments were also carried out with a JEOL EX-400 instrument. MS spectra were obtained with a JEOL AX-500 spectrometer (EI: 70 eV).

Dialkyl 5-Amino-1-carbamoylpyrazole-3,4-dicarboxylates (3)

General Procedure: A mixture of dialkyl (*E*)-2,3-dicyanobutendioate (1) (0.20 mmol), semicarbazide hydrochloride (2) (0.22 g, 0.20 mmol), and sodium acetate trihydrate (0.27 g, 0.20 mmol) was refluxed in ethanol (10 mL) for 30 min. After the solution was cooled to rt, the reaction mixture was poured into water (50 mL) with vigorous stirring. The stirring was continued for 30 min and then left at rt for 18 h. The deposited products were collected by filtration and recrystallized from aqueous ethanol to give **3a-f** as colorless needles.

Diethyl 5-Amino-1-carbamoylpyrazole-3,4-dicarboxylate (3a)

3a: Yield 57%; mp 143.5-144 ℃; IR (KBr): 3472, 3423, 3364, 3261 (NH), 1751, 1718 (COO), 1685 (N-C=O); MS *m/z* (int. %): 270 (M^+, 21), 227 (100), 181 (96), 136 (25), 134 (37); *Anal.* Calcd for $C_{10}H_{14}N_4O_5$: C, 44.44; H, 5.12; N, 20.74. Found: C, 44.34; H,5.15; N, 20.79.

Dipropyl 5-Amino-1-carbamoylpyrazole-3,4-dicarboxylate (3b)

3b: Yield 64%; mp 104-105.5 ℃; IR (KBr): 3449, 3400, 3340, 3275 (NH), 1751, 1718 (COO), 1691 (N-C=O); MS *m/z* (int. %): 298 (M^+, 19), 255 (100), 213 (22), 195 (53), 153 (85); *Anal.* Calcd for $C_{12}H_{18}N_4O_5$: C, 48.32; H, 6.04; N, 18.79. Found: C, 48.05; H,6.03; N, 18.95.

Di-*i*-propyl 5-Amino-1-carbamoylpyrazole-3,4-dicarboxylate (3c)

3c: Yield 60%; mp 158-159 ℃; IR (KBr): 3453, 3347, 3308 (NH), 1769, 1724 (COO), 1685 (N-C=O); MS *m/z* (int. %): 298 (M^+, 25), 255 (37), 213 (45), 195 (53), 171 (98), 153 (100); *Anal.* Calcd for $C_{12}H_{18}N_4O_5$: C, 48.32; H, 6.04; N, 18.79. Found: C, 48.20; H,6.06; N, 18.77.

Dibutyl 5-Amino-1-carbamoylpyrazole-3,4-dicarboxylate (3d)

3d: Yield 66%; mp 135-137 ℃; IR (KBr): 3431, 3321, 3294 (NH), 1751, 1718 (COO), 1690 (N-C=O); MS *m/z* (int. %): 326 (M^+, 26), 283 (100), 227 (37), 209 (28), 171 (32), 153 (73); *Anal.*

Calcd for $C_{14}H_{22}N_4O_5$: C, 51.53; H, 6.79; N, 17.18. Found: C, 51.46; H,6.80; N, 17.10.

Di-*i*-butyl 5-Amino-1-carbamoylpyrazole-3,4-dicarboxylate (3e)

3e: Yield 72%; mp 135-137 ℃; IR (KBr): 3445, 3400, 3335, 3284 (NH), 1754, 1718 (COO), 1687 (N-C=O); MS *m/z* (int. %): 326 (M^+, 27), 283 (78), 227 (54), 171 (100), 153 (94).

Di-*s*-butyl 5-Amino-1-carbamoylpyrazole-3,4-dicarboxylate (3f)

3f: Yield 72%; mp 135-137 ℃; IR (KBr): 3460, 3347, 3294 (NH), 1734, 1723 (COO), 1687 (N-C=O); MS *m/z* (int. %): 326 (M^+, 20), 283 (15), 227 (32), 171 (100), 153 (63); *Anal.* Calcd for $C_{14}H_{22}N_4O_5$: C, 51.53; H, 6.79; N, 17.18. Found: C, 51.50; H,6.73; N, 17.07.

Dialkyl 5-Amino-1-arylpyrazole-3,4-dicarboxylates (5)

General Procedure: A mixture of dialkyl (*E*)-2,3-dicyanobutendioate (1) (2.0 mmol), arylhydrazine (4) (2.6 mmol), and 10 mol% of ammonium acetate (15 mg, 0.20 mmol) was refluxed in ethanol (6 mL) for 30 min. After the solution was cooled to rt, the reaction mixture was added dropwise to H_2O (100 mL) with vigorous stirring. After the stirring was continued for 30 min, the whole was allowed to stand overnight. The deposited solid was isolated by filtration, and recrystallized from 2-propanol to give **5a-i** as colorless plates.

Diethyl 5-Amino-1-(*m*-chlorophenyl)pyrazole-3,4-dicarboxylate (5a)

5a: Yield 79%; mp 99-100 ℃; IR (KBr): 3411, 3323 (NH), 1718, 1687 (COO); MS *m/z* (int. %): 339 (34), 337 (M^+, 98), 291 (100), 263 (27), 245 (38); *Anal.* Calcd for $C_{15}H_{16}N_3O_4Cl$: C, 53.34; H, 4.77; Cl, 10.50; N, 12.44. Found: C, 53.19; H, 4.71; Cl, 10.46; N, 12.43.

Diethyl 5-Amino-1-(*p*-chlorophenyl)pyrazole-3,4-dicarboxylate (5b)

5b: Yield 71%; mp 102.5-103.5 ℃; IR (KBr): 3410, 3323 (NH), 1715, 1691 (COO); MS *m/z* (int. %): 339 (30), 337 (M^+, 87), 291 (100), 263 (35), 245 (31); *Anal.* Calcd for $C_{15}H_{16}N_3O_4Cl$: C, 53.34; H, 4.77; Cl, 10.50; N, 12.44. Found: C, 53.30; H, 4.72; Cl, 10.44; N, 12.38.

Diethyl 5-Amino-1-(*m*-nitrophenyl)pyrazole-3,4-dicarboxylate (5c)

5c: Yield 65%; mp 139-140 ℃; IR (KBr): 3369, 3320 (NH), 1718, 1681 (COO); MS *m/z* (int. %): 348 (M^+, 100), 302 (97), 274 (30), 256 (66), 228 (26), 122 (21); *Anal.* Calcd for $C_{15}H_{16}N_4O_6$: C, 51.72; H, 4.63; N, 16.09. Found: C, 51.78; H,4.59; N, 16.16.

Diethyl 5-Amino-1-(*p*-nitrophenyl)pyrazole-3,4-dicarboxylate (5d)

5d: Yield 88%; mp 167-168 ℃; IR (KBr): 3385, 3315 (NH), 1727, 1676 (COO); MS *m/z* (int. %): 348 (M^+, 98), 302 (100), 274 (40), 256 (47), 228 (19), 122 (12); *Anal.* Calcd for $C_{15}H_{16}N_4O_6$: C, 51.72; H, 4.63; N, 16.09. Found: C, 51.72; H,4.59; N, 16.07.

Di-*i*-propyl 5-Amino-1-(*m*-nitrophenyl)pyrazole-3,4-dicarboxylate (5e)

5e: Yield 72%; mp 123-124 ℃; IR (KBr): 3380, 3307 (NH), 1717, 1675 (COO); MS *m/z* (int. %): 376 (M^+, 33), 334 (33), 317 (11), 292 (85), 274 (100), 256 (25).

Di-*i*-propyl 5-Amino-1-(*p*-nitrophenyl)pyrazole-3,4-dicarboxylate (5f)

5f: Yield 85%; mp 115-115.5 ℃; IR (KBr): 3408, 3330 (NH), 1725, 1680 (COO); MS *m/z*

(int. %): 376 (M^+, 25), 334 (24), 317 (10), 292 (73), 274 (100), 256 (18).

Di-*i*-propyl 5-Amino-1-(*p*-fluorophenyl)pyrazole-3,4-dicarboxylate (5g)

5g: Yield 58%; mp 100-100.5 ℃; IR (KBr): 3388, 3313 (NH), 1724, 1689 (COO); MS *m/z* (int. %): 349 (M^+, 33), 307 (16), 290 (10), 265 (41), 247 (100), 229 (18); *Anal.* Calcd for $C_{17}H_{20}N_3O_4F$: C, 58.45; H, 5.77; N, 12.03. Found: C, 58.46; H, 5.78; N, 11.94.

Di-*i*-propyl 5-Amino-1-(*p*-chlorophenyl)pyrazole-3,4-dicarboxylate (5h)

5h: Yield 86%; mp 106.5-107 ℃; IR (KBr): 3395, 3320 (NH), 1724, 1686 (COO); MS *m/z* (int. %): 367 (14), 365 (M^+, 37), 323 (16), 306 (10), 281 (51), 263 (100), 245 (15).

Di-*i*-propyl 5-Amino-1-(*p*-bromophenyl)pyrazole-3,4-dicarboxylate (5i)

5i: Yield 85%; mp 90.5-91.5 ℃; IR (KBr): 3398, 3323 (NH), 1722, 1684 (COO); MS *m/z* (int. %): 411 (55), 409 (M^+, 53), 369 (20), 367 (21), 327 (49), 325 (61), 309 (100), 307 (94); *Anal.* Calcd for $C_{17}H_{20}N_3O_4Br$: C, 49.77; H, 4.91; N, 10.24. Found: C, 49.64; H, 4.85; N, 10.06.

Diethyl 7-Hydroxypyrazolo[1,5-*a*]-*s*-triazine-2,3-dicarboxylate (6)

To a solution of diethyl 5-amino-1-carbamoylpyrazole-3,4-dicarboxylate (**3a**) (0.27 g, 1.0 mmol) in acetic acid (2 mL) was added trimethyl orthoformate (2 mL). The reaction mixture was heated under reflux for 30 min and the whole was allowed to rt. After standing overnight, the crystals precipitated were filtered, washed with cold ethanol to give **6** (0.21 g, 75 %) as colorless plates, mp 278.5-279 ℃ (decomp); IR (KBr): ν 3438 (OH), 1763, 1742 cm^{-1} (C=O); MS (70 eV): *m/z* (int. %) 280 (M^+, 23), 235 (M-OEt, 85), 207 (M-COOEt, 100), 164 (88), 136 (94); *Anal.* Calcd for $C_{11}H_{12}N_4O_5$: C, 47.15; H, 4.32; N,19.99. Found: C, 47.09; H, 4.26; N, 19.92.

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