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A FACILE ACCESS FOR SYNTHESIS OF NOVEL ISOQUINOLINE-BASED HETEROCYCLES

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Abstract - Hydrazonoyl halides **2**, **7** and **12** react with alkyl 2-(3,4-dihydro-6,7-dimethoxy-2*H*-isoquinoline-1-ylidene)carboxylate **1** to give 4-(3,4-dihydro-6,7-dimethoxy-2*H*-isoquinoline-1-ylidene)-2,5-diaryl-2,4-dihydropyrazol-3-one **6**, alkyl 2-arylazo-5,6-dihydro-8,9-dimethoxy-3-alkyl(or aryl)pyrrolo[2,1-*a*]isoquinoline-1-carboxylate **10** and alkyl 2-(2-arylhydrazono)-2,3,5,6-tetrahydro-8,9-dimethoxy-3-oxopyrrolo[2,1-*a*]isoquinoline-1-carboxylate **15**, respectively. The structures of the new compounds were elucidated on the basis of elemental analyses, spectral data and X-ray crystallographic analyses.

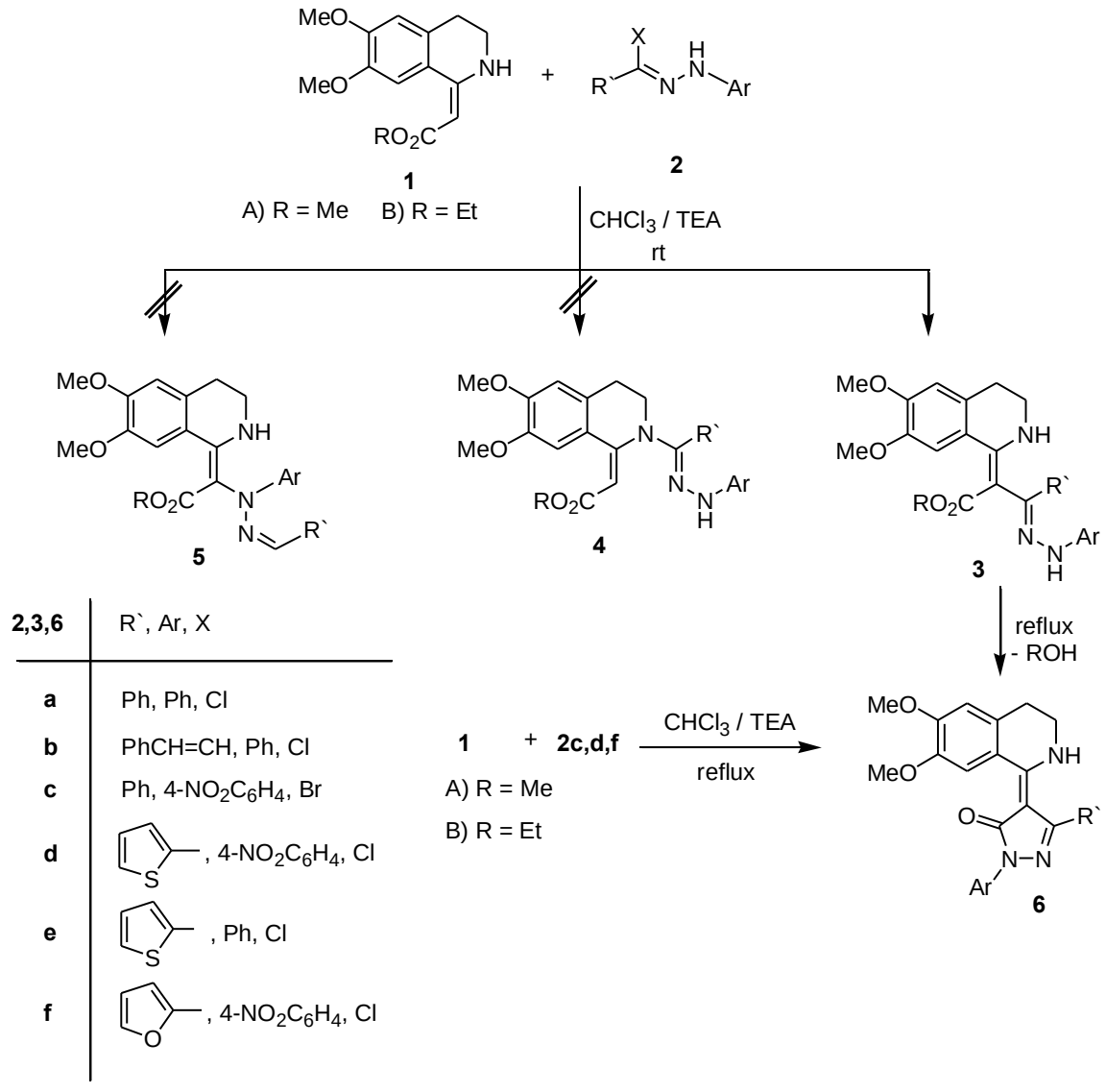
INTRODUCTION

Isoquinolines are a very interesting class of compounds because of their wide range significant biological and pharmaceutical activities.[1-3] In view of our interest in developing efficient routes for synthesis of isoquinolines–based heterocycles,[4-7] we study in this article the reaction of different types of hydrazonoyl halide **2,7** and **12** with isoquinoline derivatives **1A,B** under different conditions .

RESULTS AND DISCUSSION

In our preliminary communication[7] we report that compound **2a** reacted with isoquinoline **1B** to give the corresponding hydrazone structure of type **5**. The identity of the product from this reaction has to be reinvestigated. Accordingly, we have studied the reaction of methyl 2-(3,4-dihydro-6,7-dimethoxy-2*H*-

isoquinoline-1-ylidene)acetate **1A** with hydrazonoyl halides **2a-f** at room temperature in chloroform in the presence of triethylamine to give amidrazone of type **3** as single product (Scheme 1). The structure of the product was established based on X-ray crystallographic analysis of methyl 2-(3,4-dihydro-6,7-dimethoxy-2*H*-isoquinoline-1-ylidene)-3-(2-phenylhydrazono)-3-phenylpropanoate **(3Aa)** (Figure 1). The ^{1}H NMR spectrum of the formed product revealed the absence of olefinic proton -OCO-CH= and indicated two NH bands, thus structures **4** and **5** were excluded (Scheme 1).



Scheme 1

Furthermore structure **3A** was confirmed by refluxing **3A** in chloroform for 2 h to give only one cyclized product of type **6** *via* elimination of methanol. Structure **6** was confirmed by elemental analyses and spectral data (IR, MS, ^{1}H NMR, and ^{13}C NMR). The product **6** can also obtained directly by reaction of hydrazonoyl halide **2** with **1A** in refluxing chloroform in the presence of triethylamine. Also structure

6c,d,f were further confirmed by their alternate synthesis *via* reaction of **1B** with hydrazonoyl halide **2c,d,f**, in chloroform in the presence of triethylamine under reflux. The products obtained are identical in all respects (mp, mixed mp, spectral data) with those obtained from reaction of **1A** with **2c,d,f**.

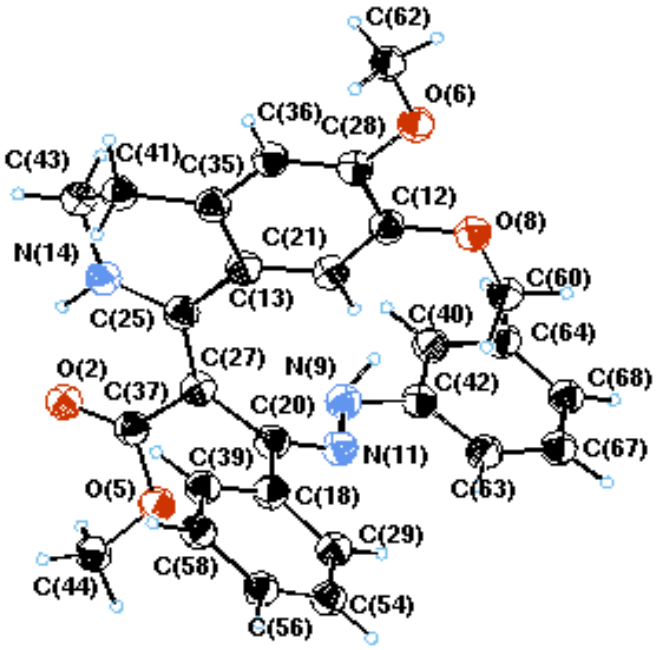
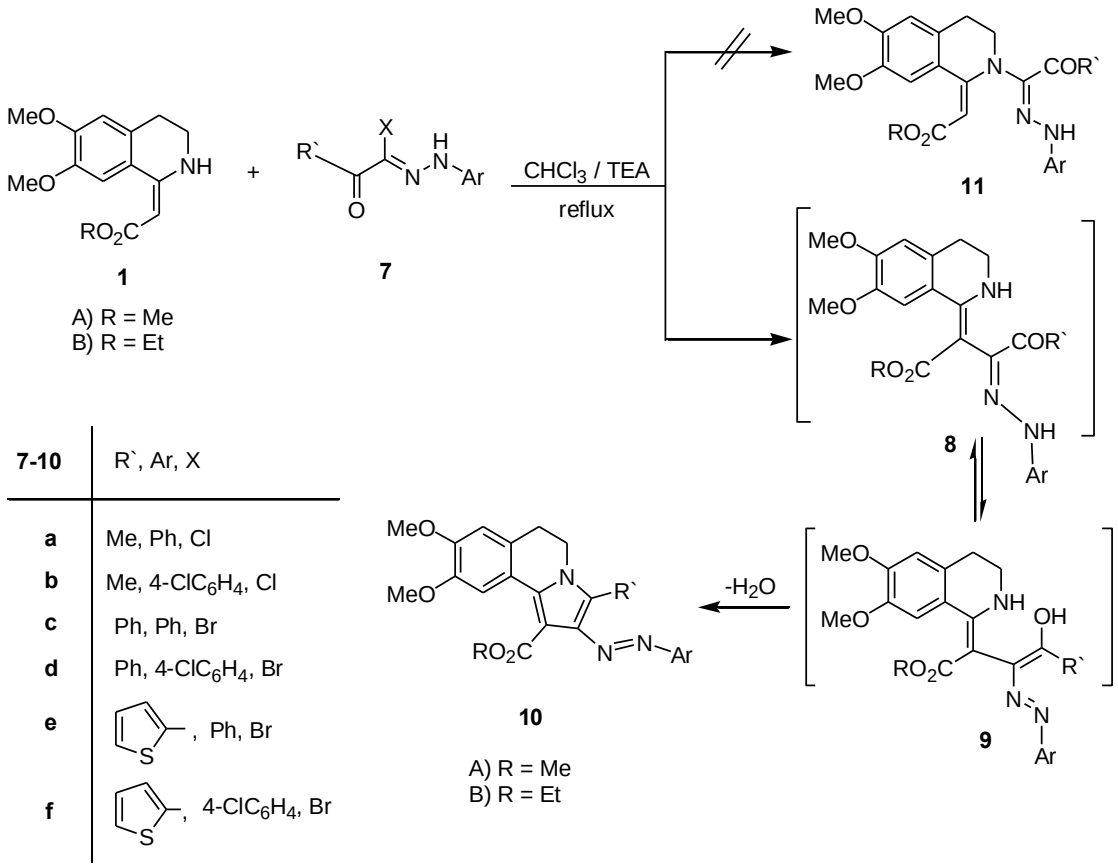


Figure 1. X-Ray structure of compound **3Aa**

Next, we study the reaction of α-ketohydrazonoyl halides of type **7** with isoquinoline derivatives **1**. The reaction gives one product in each case as evidenced by TLC. The isolated products **10** gave satisfactory elemental analyses and spectroscopic data (IR, MS, ^{1}H NMR, and ^{13}C NMR) for the proposed structure. In addition, single crystal X-ray analysis of one example of the reaction products namely ethyl 2-(2-(4-chlorophenyl)azo)-5,6-dihydro-8,9-dimethoxy-3-(2-thienyl)pyrrolo[2,1-*a*]isoquinoline-1-carboxylate **10Bf** (Figure 2) provided a good evidence for the formation of the structure **10** and ruled out the other possible structure **11** as outlined in Scheme 2.

A conceivable reaction mechanism proposed pathway for the formation of **10** from **1** and **7** is outlined in Scheme 2. The reaction involves initial nucleophilic substitution to give **8**, which tautomarize to give **9**, the latter is then cyclized *via* elimination of water to give **10**.

Finally, we study the reaction of hydrazonoyl halides of type **12** with the starting compound **1B**. Thus compound **12** reacts with **1B** at room temperature to give the substitution product **14B**. Structure of **14B** was confirmed based on spectral data (IR, MS, ^{1}H NMR, and ^{13}C NMR). Moreover, structure **14B** was confirmed by X-ray crystallographic analysis of 1,4-diethyl 3-(2-(4-chlorophenyl)hydrazono)-2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)succinate **14Bd** (Figure 3).



Scheme 2

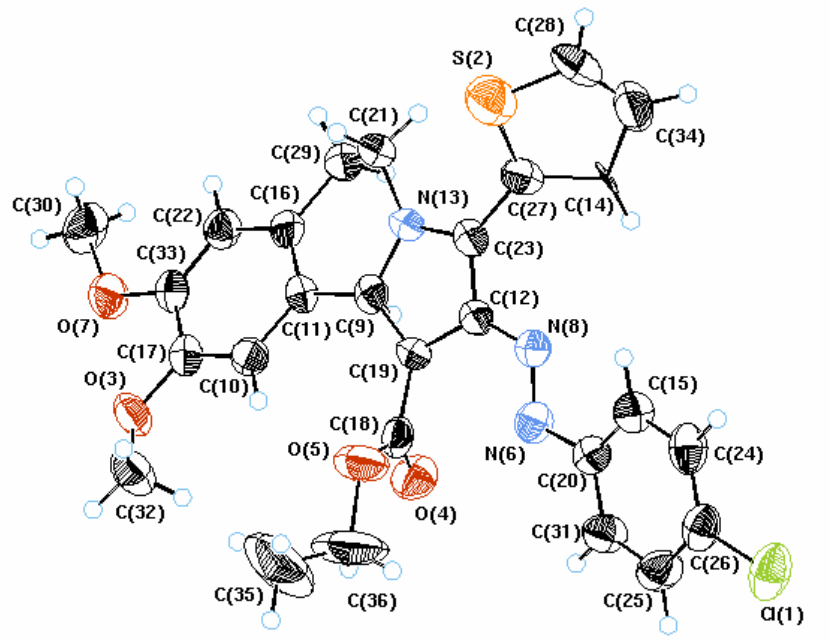
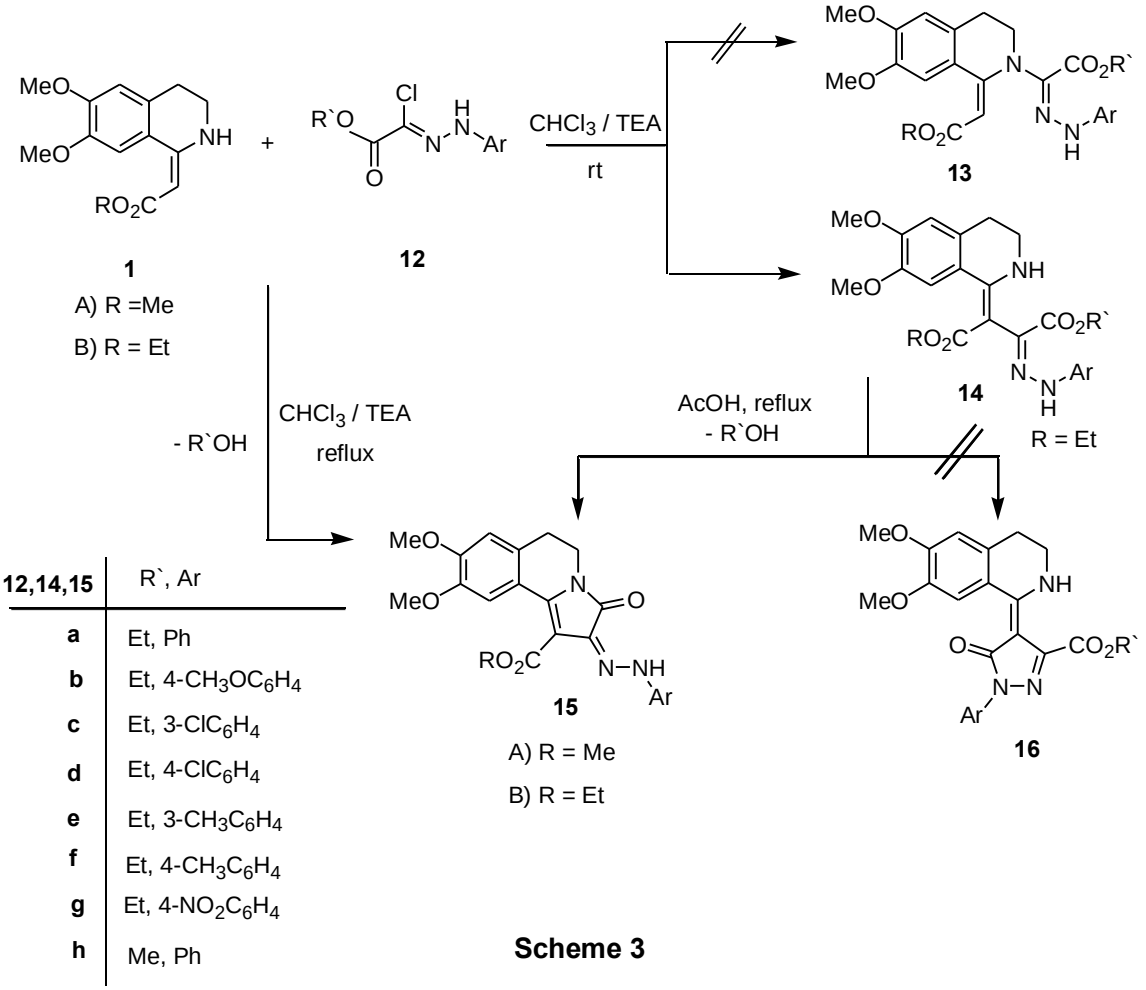


Figure 2. X-Ray structure of compound **10Bf**

Structure **13** was ruled out based on the absence of the olefinic proton OCOCH= in ^{1}H NMR spectra and on X-ray data of **14Bd**. Also, the ^{1}H NMR spectra indicated in all cases, two NH bands and hence

structure **14B** was considered most likely. On the other hand, reaction of hydrazonoyl halides **12** with **1B** in refluxing chloroform in the presence of triethylamine gave only in each case, one cyclized product that can be either **15** or **16** (Scheme 3). The ^{1}H NMR spectra, in all cases, revealed triplet and quartet signals assignable to the ethoxycarbonyl group. The IR spectra showed one NH band. Also, the mass spectrum of each compound gave an intense peak corresponding to the molecular ion peak. Also structure **15** formed *via* cyclization of compound **14B** by refluxing in glacial acetic acid. Also, structure **15** was confirmed by alternate synthesis of **15Ba** *via* stirring equimolar amounts of **12h** with **1B** in the presence of triethylamine in chloroform at room temperature. Refluxing the latter product **14h** in glacial acetic acid gave a product which was found to be identical in all physical and spectral data with structure **15Ba** (Scheme 3).



12,14,15	R`, Ar
a	Et, Ph
b	Et, 4-$CH_3OC_6H_4$
c	Et, 3-ClC_6H_4
d	Et, 4-ClC_6H_4
e	Et, 3-$CH_3C_6H_4$
f	Et, 4-$CH_3C_6H_4$
g	Et, 4-$NO_2C_6H_4$
h	Me, Ph

Scheme 3

The reaction pathway that seems to be reasonable for the formation of **15** from **1** and **12** is outlined in Scheme 3. It is proposed that the reaction involves a nucleophilic substitution to give **14**. The latter in turn cyclized on heating *via* elimination of ethanol or methanol to give **15**.

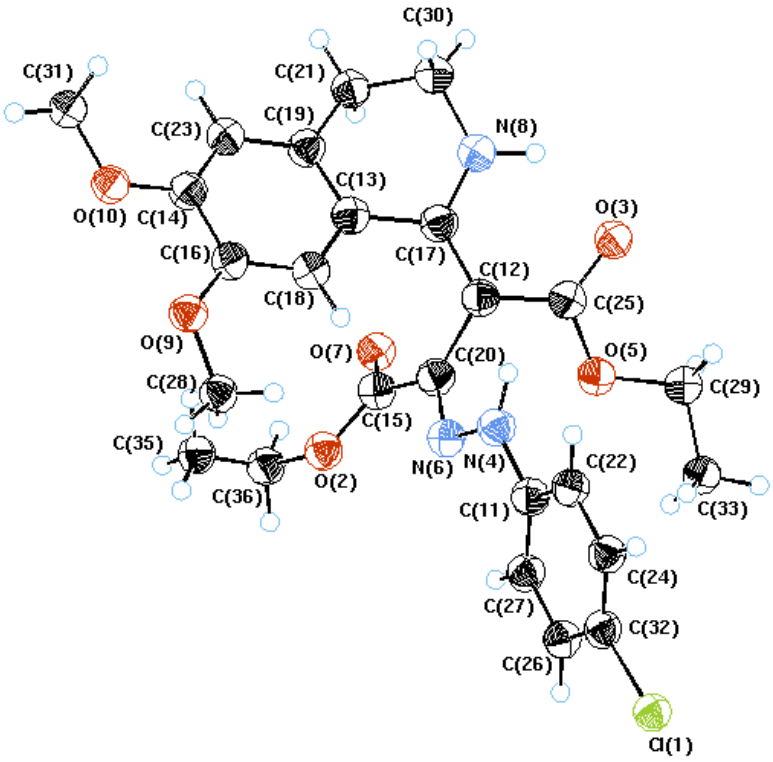


Figure 3. X-Ray structure of compound **14Bd**

EXPERIMENTAL

All melting points are uncorrected and were measured on a Gallenkamp apparatus. IR spectra were recorded on Shimadzu FT-IR 8101 PC infrared spectrophotometer. NMR spectra were determined in $CDCl_3$ or DMSO-d_6 at 200 MHz (^{1}H NMR) and at 75 MHz (^{13}C NMR) on a Varian Mercury VX 200 NMR spectrometer using TMS as an internal standard. Mass spectra were measured on a GCMS-QP1000 EX spectrometer at 70 e.V. Elemental analyses were carried out at the Microanalytical Center of Cairo University. Alkyl 2-(3,4-dihydro-6,7-dimethoxy-2*H*-isoquinoline-1-ylidene)carboxylate **1**,[8] hydrazo-noyl halides **2**,[9] **7**[10] and **12**[11] were prepared according to the procedures reported in literature.

Synthesis of methyl (or ethyl) 3-(2-arylhydrazono)-2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)propanoate 3

To a solution of the appropriate hydrazonoyl halide **2** (5 mmol) and **1A,B** (5 mmol) in $CHCl_3$ (30 mL) was added triethylamine (1.4 mL, 10 mmol). The reaction mixture was stirred at rt for 4 h. The solvent was evaporated under reduced pressure and the residue was triturated with MeOH (10 mL) where it is solidified. The crude product was collected and recrystallized from EtOH.

Methyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-phenylhydrzono)-3-phenyl-propanoate 3Aa: Yellowish green crystals; mp 197-199 °C; yield (83%); IR (KBr) ν 1711 (C=O), 3250

(NH) cm^{-1}; ^1H NMR ($CDCl_3$) δ 2.66-2.99 (m, 2H, isoquinoline-CH_2), 3.34-3.58 (m, 2H, isoquinoline-CH_2), 3.41 (s, 3H, ester-CH_3), 3.59 (s, 3H, OCH_3), 3.80 (s, 3H, OCH_3), 6.54-7.80 (m, 12H, Ar H), 8.14 (s, 1H, NH), 10.55 (s, 1H, NH); ^{13}C NMR ($CDCl_3$) 31.3, 41.0, 53.0, 57.6, 57.7, 82.4, 112.1, 113.3, 115.1, 121.7, 122.6, 127.7, 129.4, 130.1,131.2, 132.9, 141.7, 145.9, 146.9, 149.3, 152.8, 160.5, 172.3. Anal. Calcd for $C_{27}H_{27}N_3O_4$: C, 70.88; H, 5.95; N, 9.18. Found: C, 70.59; H, 5.73; N, 9.34%.

Methyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-phenylhydrazono)-3-strylpropanoate 3Ab: Yellow crystals; mp 182-183 °C; yield (75%); IR(KBr) ν 1640 (C=O), 3257, 3312 (2NH) cm^{-1}; ^1H NMR ($CDCl_3$) δ 2.68-3.00 (m, 2H, isoquinoline-CH_2), 3.25-3.50 (m, 2H, isoquinoline-CH_2), 3.55 (s, 3H, ester-CH_3), 3.63 (s, 3H, OCH_3), 3.82 (s, 3H, OCH_3), 6.36 (d, 1H, *J* = 12Hz, CH=CH), 6.44 (d, 1H, *J* = 12Hz, CH=CH), 6.57 (s, 1H, isoquinoline-CH), 6.80-7.38 (m, 11H, Ar H), 8.18 (s, 1H, NH), 10.50 (s, 1H, NH); ^{13}C NMR ($CDCl_3$) 29.3, 38.9, 51.0, 55.7, 55.9, 79.1, 110.1, 111.1, 113.0, 119.9, 120.6, 126.5, 127.2, 128.4, 129.1, 129.9, 130.7, 137.4, 144.3, 145.9, 147.4, 150.8, 155.6, 158.7, 170.0; MS: *m/z* 483 (M^+, 2.9%), 454, 422, 393, 363, 178 , 121, 103. Anal. Calcd for $C_{29}H_{29}N_3O_4$: C, 72.03; H, 6.05; N, 8.69. Found: C, 71.85; H; 6.37; N, 8.51%.

Methyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-(4-nitrophenyl)hydrazono)-3-(2-thienyl)propanoate 3Ad: Orange crystals; mp 200-202 °C; yield (85%); IR (KBr) ν 1636 (C=O), 3241, 3389 (2NH) cm^{-1}; ^1H NMR (DMSO-d_6) δ 2.15-2.24 (m, 2H, isoquinoline-CH_2), 3.18-3.24 (m, 2H, isoquinoline-CH_2), 3.60 (s, 3H, ester-CH_3), 3.69 (s, 3H, OCH_3), 3.80 (s, 3H, OCH_3), 6.87 (s, 1H, isoquinoline-CH), 7.0 (s, 1H, isoquinoline-CH), 7.18-8.3 (m, 8H, Ar H) 8.40 (s, 1H, NH); MS: *m/z* 508 (M^+, 1.7%), 462, 432, 178.0, 93. Anal. Calcd for $C_{25}H_{24}N_4O_6S$: C, 59.04; H, 4.76; N, 11.02; S, 6.30. Found: C, 59.29; H; 4.54; N, 11.17; S, 6.48%.

Methyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-phenylhydrazono)-3-(2-thienyl)-propanoate 3Ae: Yellow crystals; mp 202-204 °C; yield (81%); IR (KBr) ν 1634 (C=O), 3252 (NH) cm^{-1}; ^{13}C NMR (DMSO-d_6) 30.2, 52.2, 56.6, 57.2, 58.0, 83.2, 112.5, 112.7, 114.5, 120.6, 122.3, 125.2, 126.8, 128.9, 130.6, 133.3, 140.6, 147.2,148.2, 149.1, 152.1, 159.3, 170.5; MS: *m/z* 463 (M^+, 51.6%), 434, 402, 312, 298, 282, 263, 232, 200, 91. Anal. Calcd for $C_{25}H_{25}N_3O_4S$: C, 64.78; H, 5.44, N, 9.06; S, 6.92. Found: C, 64.58; H, 5.27; N, 8.94; S, 7.16%.

***Ethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-(4-nitrophenyl)hydrazono)-3-phenylpropanoate 3Bc*:** Red crystals; mp 141-143 °C; yield (70%); IR (KBr) ν 1634 ((C=O), 3235 (NH) cm^{-1}; ^1H NMR δ ($CDCl_3$) 0.97-1.04 (t, 3H, *J* = 7Hz, ester-CH_3), 2.75-2.88 (m, 2H, isoquinoline-CH_2), 3.38 (s, 3H, OCH_3), 3.4-3.72 (m, 2H, isoquinoline-CH_2), 3.78 (s, 3H, OCH_3), 4.01-4.11 (q, 2H, *J* = 7Hz,

ester-CH_2), 6.54-8.16 (m, 11H, Ar H), 8.52 (s, 1H, NH), 10.56 (s, 1H, NH); MS: *m/z* 517 (M^+, 2.6%), 486, 470, 441. Anal. Calcd for $C_{28}H_{28}N_4O_6$: C, 65.11; H, 5.46; N, 10.85. Found: C, 65.28; H, 5.57; N, 10.73 %.

Ethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-(4-nitrophenyl)hydrazono)-3-(2-thienyl)propanoate 3Bd: Yellow crystals; mp 135-136 °C; yield (72%); IR (KBr) ν 1631 (C=O), 3244 (NH) cm^{-1}; ^1H NMR δ ($CDCl_3$) 1.04-1.11 (t, 3H, *J* = 7Hz, ester-CH_3), 2.65-3.00 (m, 2H, isoquinoline-CH_2), 3.25-3.45 (m, 2H, isoquinoline-CH_2), 3.52 (s, 3H, OCH_3), 3.81 (s, 3H, OCH_3), 4.00-4.20 (q, 2H, *J* = 7Hz, ester-CH_2) 6.57-8.16 (m, 9H, Ar H), 8.44 (s, 1H, NH), 10.57 (s, 1H, NH); ^{13}C NMR (DMSO-d_6) 12.9, 36.3, 41.8, 54.9, 55.2, 59.4, 78.6, 111.9, 112.2, 112.7, 119.8, 123.9, 124.4, 126.8, 126.9, 128.1, 131.6, 132.8, 143.0, 145.5, 146.3, 146.3, 149.3, 161.9; MS: *m/z* 522 (M^+, 2.6%), 476, 447,144. Anal. Calcd for $C_{26}H_{26}N_4O_6S$: C, 59.76; H, 5.02; N, 10.72; S, 6.14. Found: C, 59.62; H, 5.33; N, 10.60; S, 6.35%.

Ethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-phenylhydrazono)-3-(2-thienyl)-propanoate 3Be: Yellow crystals; mp 178-180 °C; yield (74%); IR (KBr) ν 1630 (C=O), 3261 (NH) cm^{-1}; ^1H NMR ($CDCl_3$) δ 1.00 (t, 3H, *J* = 7Hz, ester-CH_3), 2.56-2.90 (m, 2H, isoquinoline-CH_2), 3.20-3.40 (m, 2H, isoquinoline-CH_2), 3.48 (s, 3H, OCH_3), 3.75 (s, 3H, OCH_3), 3.91 (q, 2H, *J* = 7Hz, ester-CH_2), 6.49-7.19 (m, 10H, Ar H), 7.91 (s, 1H, NH), 10.45 (s, 1H, NH); ^{13}C NMR ($CDCl_3$) 16.6, 31.3, 40.9, 57.7, 61.4, 83.1, 112.1, 113.3, 115.0, 121.7, 122.7, 126.1, 127.0, 128.7, 131.1, 132.7, 142.2, 146.8, 148.6, 149.4, 152.8, 160.7, 171.5. MS: *m/z* 477 (M^+, 97.8%), 402, 339, 298, 205, 91. Anal. Calcd for $C_{26}H_{27}N_3O_4S$: C, 65.39; H, 5.70; N, 8.80; S, 6.71. Found: C, 65.50; H, 5.42; N, 8.61; S, 6.54%.

Ethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-(4-nitrophenyl)hydrazono)-3-(2-furyl)propanoate 3Bf: Red crystals; mp 174-175 °C; yield (74%); IR (KBr) ν 1635 (C=O), 3245 (NH) cm^{-1}; ^1H NMR ($CDCl_3$) δ 1.04-1.11 (t, 3H, *J* = 7Hz, ester-CH_3), 2.68-3.00 (m, 2H, isoquinoline-CH_2), 3.26-3.60 (m, 2H, isoquinoline-CH_2), 3.53 (s, 3H, OCH_3), 3.82 (s, 3H, OCH_3), 4.00-4.23 (q, 2H, *J* = 7Hz, ester-CH_2), 6.24-8.15 (m, 9H, Ar H), 8.54 (s, 1H, NH), 10.55 (s, 1H, NH); Anal. Calcd for $C_{26}H_{26}N_4O_7$: C, 61.65; H, 5.17; N, 11.06. Found: C, 61.43; H, 5.33; N, 11.25 %.

Synthesis of 4-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-2,5-diaryl-2,4-dihydropyrazol-3-one 6

To a solution of the appropriate hydrazonoyl halide **2** (5 mmol) and **1** (5 mmol) in $CHCl_3$ (30 mL) was added triethylamine (1.4 mL, 10 mmol) at rt. The reaction mixture was refluxed for 6 h then left to cool to rt. The solvent was evaporated under reduced pressure and the residue was triturated with MeOH (10 mL)

where it solidified. The crude product was collected and crystallized from suitable solvent to give product **6**.

4-(3,4-Dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-2,4-dihydro-2-(4-nitrophenyl)phenylpyrazol-3-one 6c: Dark red crystals; mp 238-240 °C; (MeCN); yield (83%); IR (KBr) ν 1635 (C=O) cm^{-1}, ^1H NMR (DMSO-d_6) δ 2.26 (m, 2H, isoquinoline-CH_2), 3.06 (m, 2H, isoquinoline-CH_2), 3.52 (s, 3H, OCH_3), 3.65 (s, 3H, OCH_3), 6.56 (s, 1H, isoquinoline-CH), 6.88 (s, 1H, isoquinoline-CH), 7.0-8.50 (m, 10H, Ar H); MS: *m/z* 470 (M^+, 80.0%), 276, 226, 75. Anal. Calcd for $C_{26}H_{22}N_4O_5$: C, 66.37; H, 4.71; N, 11.91. Found: C, 66.54; H, 4.78; N, 12.07%.

4-(3,4-Dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-2,4-dihydro-2-(4-nitrophenyl)-5-(2-thienyl)-pyrazol-3-one 6d: Red crystals; mp 252-254 °C; (dioxane); yield (86%); IR (KBr) ν 1642 (C=O), 3219 (NH) cm^{-1}; ^1H NMR ($CDCl_3$) δ 2.96-3.03 (m, 2H, isoquinoline-CH_2), 3.28 (s, 3H, OCH_3), 3.62-3.65 (m, 2H, isoquinoline-CH_2), 3.95 (s, 3H, OCH_3) 6.60-8.46 (m, 9H, Ar H), 11.50 (s, 1H, NH); MS: *m/z* 476 (M^+,100.0%), 298, 225, 204, 111, 90. Anal. Calcd for $C_{24}H_{20}N_4O_5S$: C, 60.49; H, 4.23; N, 11.76; S, 6.73. Found: C, 60.25; H, 4.57; N, 11.44; S, 6.48%.

4-(3,4-Dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-2,4-dihydro-2-(4-nitrophenyl)-5-(2-furyl)-pyrazol-3-one 6f: Crimson red crystals; mp 272-274 °C; (DMF); yield (78%); IR (KBr) ν 1637 (C=O) cm^{-1}; MS: *m/z* 460 (M^+, 100.0%) 406, 323, 266, 75. Anal. Calcd for $C_{24}H_{20}N_4O_6$: C, 62.60; H, 4.38; N, 12.17. Found: C, 62.75; H, 4.02; N, 12.41%.

Synthesis of alkyl 2-arylazo-5,6-dihydro-8,9-dimethoxy-3-aryl(or alkyl)pyrrolo[2,1-a]isoquinoline-1-carboxylate 10

These compounds were prepared by the same method described for the synthesis of **6** using hydrazonoyl halide **7** instead of **2**. The crude product was collected in each case and recrystallized from a suitable solvent.

Methyl 5,6-dihydro-8,9-dimethoxy-3-methyl-2-(2-phenylazo)pyrrolo[2,1-a]isoquinoline-1-carboxylate 10Aa: Yellow crystals; mp 183-185 °C (EtOH); yield (80%); IR (KBr) ν 1711 (C=O) cm^{-1}, ^1H NMR ($CDCl_3$) δ 2.59 (s, 3H, CH_3), 2.94-3.00 (m, 2H, isoquinoline-CH_2), 3.88 (s, 6H, $2OCH_3$), 3.90 (s, 3H, ester-CH_3), 3.92-4.00 (m, 2H, isoquinoline-CH_2), 6.68-7.78 (m, 7H, Ar H); ^{13}C NMR (DMSO-d_6) 10.9, 29.4, 53.6, 57.2, 57.41, 103.1, 109.1, 113.8, 121.0, 123.2, 127.7, 129.6, 131.0, 136.2, 138.9, 149.7, 150.3, 154.3, 170.1. MS: *m/z* 405 (M^+, 50.07%) 373, 311, 169, 77. Anal. Calcd for $C_{23}H_{23}N_3O_4$: C, 68.13; H, 5.72; N, 10.36. Found: C, 68.35; H, 5.86; N, 10.14%.

Methyl 5,6-dihydro-8,9-dimethoxy-2-(2-phenylazo)-3-(2-thienyl)pyrrolo[2,1-a]isoquinoline-1-carboxylate 10Ae: Yellowish orange crystals; mp 209-211 °C (AcOH); yield (84%); IR (KBr) ν 1705 (C=O) cm^{-1}; ^1H NMR ($CDCl_3$) δ 2.94-2.98 (m, 2H, isoquinoline-CH_2), 3.89 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 3.92 (s, 3H, ester-CH_3), 4.20-4.27 (m, 2H, isoquinoline-CH_2), 6.75-7.81 (m, 10H, Ar H); MS: *m/z* 473 (M^+, 74.3%), 338, 295, 221, 148, 77. Anal. Calcd for $C_{26}H_{23}N_3O_4S$: C, 65.95; H, 4.90; N, 8.87; S, 6.77. Found: C, 66.15; H, 4.97; N, 8.67; S, 6.83%.

Ethyl 2-(2-(4-chlorophenyl)azo)-5,6-dihydro-8,9-dimethoxy-3-methylpyrrolo[2,1-a]isoquinoline-1-carboxylate 10Bb: Red crystals; mp 199-200 °C (Me CN); yield (76%); IR (KBr) ν 1704 (C=O) cm^{-1}; ^1H NMR (DMSO-d_6) δ 1.31 (t, 3H, *J* = 7Hz, ester-CH_3), 2.63 (s, 3H, CH_3), 3.01-3.10 (m, 2H, isoquinoline-CH_2), 3.93 (s, 3H, OCH_3), 3.95 (s, 3H, OCH_3), 4.00-4.10 (m, 2H, isoquinoline-CH_2), 4.35 (q, 2H, *J* = 7Hz, ester-CH_2), 6.76 (s, 1H, isoquinoline-CH), 7.30-7.80 (m, 5H, Ar H); ^{13}C NMR (DMSO-d_6), 11.4, 16.3, 30.6, 42.9, 58.9, 58.0, 63.1, 104.4, 108.5, 110.2, 113.7, 122.3, 125.1, 127.0, 130.9, 135.7, 136.6, 140.0, 150.4, 150.6, 153.7, 170.5; MS: *m/z* 453 (M^+, 50.6%), 407, 270, 226, 111, 75, Anal. Calcd for $C_{24}H_{24}N_3O_4Cl$: C, 63.50; H, 5.33; N, 9.26. Found: C, 63.77; H, 5.15; N, 9.43%.

Methyl 5,6-dihydro-8,9-dimethoxy-2-(2-phenylazo)-3-phenylpyrrolo[2,1-a]isoquinoline-1-carboxylate 10Ac: Dark red crystals; mp 210-212 °C (AcOH), yield (83%); IR (KBr) ν 1710 (C=O) cm^{-1}; ^1H NMR (DMSO-d_6) δ 2.86-2.94 (m, 2H, isoquinoline-CH_2), 3.84 (s, 3H, OCH_3), 3.86 (s, 6H, isoquinoline OCH_3 + ester-CH_3), 4.00-4.09 (m, 2H, isoquinoline-CH_2), 6.68-7.65 (m, 12H, Ar H). Anal. Calcd for $C_{28}H_{25}N_3O_4$: C, 71.93; H, 5.39; N, 8.99. Found: C, 71.88; H, 5.09; N, 8.74%.

Ethyl 2-(2-(4-chlorophenyl)azo)-5,6-dihydro-8,9-dimethoxy-3-phenylpyrrolo[2,1-a]isoquinoline-1-carboxylate 10Bd: Red crystals; mp 239-241 °C (Dioxane); yield (77%); ^1H NMR (DMSO-d_6) δ 1.31 (t, 3H, *J* = 7Hz, ester-CH_3), 2.95-3.03 (m, 2H, isoquinoline-CH_2), 3.93 (s, 3H, OCH_3), 3.94 (s, 3H, OCH_3), 4.10 (m, 2H, isoquinoline-CH_2), 4.38 (q, 2H, *J* = 7Hz, ester-CH_2), 6.76 (s, 1H, isoquinoline-CH), 7.35-7.65 (m, 10H, Ar H). Anal. Calcd for $C_{29}H_{26}N_3O_4Cl$: C, 67.50; H, 5.08; N, 8.14. Found: C, 67.68; H, 5.23; N, 8.37%.

Ethyl 2-(2-(4-chlorophenyl)azo)-5,6-dihydro-8,9-dimethoxy-3-(2-thienyl)pyrrolo[2,1-a]isoquinoline-1-carboxylate 10Bf: Dark red crystals; mp 194-196 °C (AcOH); yield (80%); MS: *m/z* 521 (M^+, 69.6%) 338, 294, 148, 111, 75. Anal. Calcd for $C_{27}H_{24}N_3O_4SCl$: C, 62.12; H, 4.63; N, 8.05; S, 6.14. Found: C, 62.40; H, 4.58; N, 7.83; S, 6.40%.

Synthesis of 1,4-dialkyl-3-(2-arylhydrazono)-2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-

ylidene)succinate 14

These compounds were prepared by the same method described for the synthesis of **3** using hydrazonoyl halide **12** instead of **2**. The crude product in each case was collected and recrystallized from EtOH.

1,4-Diethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-phenylhydrazono)succinate 14Ba: Yellowish orange crystals; mp169-170 °C; yield (82%); IR (KBr) ν 1631 (C=O), 1705 (C=O), 3263 (NH) cm^{-1}; ^1H NMR ($CDCl_3$) δ 1.07-1.17 (m, 6H, $2CH_3$ ester), 2.60-3.02 (m, 2H, isoquinoline-CH_2), 3.22-3.60 (m, 2H, isoquinoline-CH_2), 3.64 (s, 3H, OCH_3), 3.85 (s, 3H, OCH_3), 4.00-4.23 (m, 4H, $2CH_2$ ester), 6.63 (s, 1H, isoquinoline-CH), 6.91 (s, 1H, isoquinoline-CH), 6.94-7.30 (m, 5H, Ar H), 8.41 (s, 1H, NH), 10.41 (s, 1H, NH), ^{13}C NMR (DMSO-d_6) 13.9, 14.3 , 29.8, 38.6, 55.7, 59.1, 60.4, 79.0, 110.3 ,110.4, 113.8, 121.0, 121.5, 129.9, 131.1, 135.5, 143.4, 147.3, 151.0, 158.7, 166.5, 169.3; MS: *m/z* 467 (M^+, 27.2%), 421, 376, 302 , 257, 205, 130, 77. Anal. Calcd for $C_{25}H_{29}N_3O_6$: C, 64.23; H, 6.25; N, 8.99. Found: C, 63.91; H, 6.46; N, 8.70%.

1,4-Diethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-(4-methoxyphenyl)hydrazono)succinate 14Bb: Yellowish green crystals; mp 178-180 °C; yield (73%); IR (KBr) ν 1632 (C=O), 1699 (C=O), 3250 (NH) cm^{-1}, ^1H NMR (DMSO-d_6) δ 1.00-1.11 (m, 6H, $2CH_3$ ester), 2.52-2.95 (m, 2H, isoquinoline-CH_2), 3.15-3.53 (m, 2H, isoquinoline-CH_2), 3.59 (s, 3H, $CH_3OC_6H_4$), 3.70 (s, 3H, OCH_3), 3.80 (s, 3H, OCH_3), 3.90-4.16 (m, 4H, $2CH_2$ ester), 6.58 (s, 1H, isoquinoline-CH), 6.70-6.90 (m, 2H, Ar H), 7.00-7.10 (m, 2H, Ar H), 7.20 (s, 1H, Ar H), 8.26 (s, 1H, NH), 10.33 (s, 1H, NH); ^{13}C NMR (DMSO-d_6) 16.2, 16.6, 31.2, 41.0, 57.6, 57.9, 61.3, 62.5, 81.1, 112.2, 112.5, 116.7, 117.0, 123.1, 133.0, 136.4, 139.4, 149.4, 153.0, 156.8, 161.6, 167.4, 171.3, 182.8. MS: *m/z* 497 (M^+, 55.8%), 451, 350, 205, 122. Anal. Cacld for $C_{26}H_{31}N_3O_7$: C, 62.76; H, 6.28; N, 8.44. Found: C, 62.51; H, 6.21; N, 8.23%.

1,4-Diethyl 3-(2-(3-chlorophenyl)hydrazono)-2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)succinate 14Bc: Yellowish orange crystals; mp 158-160 °C; yield (72%); IR (KBr) ν 1630 (C=O), 1704 (C=O), 3249 (NH) cm^{-1}; ^1H NMR (DMSO-d_6) δ 1.07-1.16 (m, 6H, $2CH_3$ Ester), 2.60-3.00 (m, 2H, isoquinoline-CH_2), 3.20-3.60 (m, 2H, isoquinoline-CH_2), 3.70 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 4.00-4.18 (m, 4H, $2CH_2$ ester), 6.64 (s, 1H, isoquinoline-CH), 6.90 (s, 1H, isoquinoline-CH), 6.95-7.25 (m, 4H, Ar H), 8.38 (s, 1H, NH), 10.38 (s, 1H, NH); MS: *m/z* 501 (M^+, 41.0%), 455, 404, 302, 257, 205, 63. Anal. Calcd for $C_{25}H_{28}N_3O_6Cl$: C, 59.81; H, 5.62; N, 8.37. Found: C, 59.62; H, 5.68; N, 8.27%.

1,4-Diethyl 3-(2-(4-chlorophenyl)hydrazono)-2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)succinate 14Bd: Pale orange crystals; mp 180-181 °C; yield (76%); IR (KBr) ν 1630(C=O), 1710

(C=O), 3248 (NH) cm^{-1}, ^1H NMR (DMSO-d_6) δ 1.00-1.10 (m, 6H, $2CH_3$ Ester), 2.55-2.95 (m, 2H, isoquinoline-CH_2), 3.15-3.50 (m, 2H, isoquinoline-CH_2), 3.58 (s, 3H, OCH_3), 3.80 (s, 3H, OCH_3), 3.91-4.18 (m, 4H, $2CH_2$ ester), 6.58 (s, 1H, isoquinoline-CH), 6.80 (s, 1H, isoquinoline-CH), 7.00-7.19 (m, 4H, Ar H), 8.30 (s, 1H, NH), 10.30 (s, 1H, NH), MS: *m/z* 501 (M^+, 41.2%), 455, 416, 354, 302, 242, 205, 111. Anal. Calcd for $C_{25}H_{28}N_3O_6Cl$: C, 59.81; H, 5.62; N, 8.37. Found: C, 59.72; H, 5.49; N, 8.58%.

1,4-Diethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-(3-methylphenyl)-hydrazono)succinate 14Be*:* Yellow crystals; mp 140-142 °C; yield (72%); IR (KBr) ν 1630(C=O), 1716 (C=O), 3249 (NH) cm^{-1}, ^1H NMR (DMSO-d_6) δ 1.07-1.18 (m, 6H, $2CH_3$ ester), 2.30 (s, 3H, CH_3), 2.60-3.15 (m, 2H, isoquinoline-CH_2), 3.20-3.60 (m, 2H, isoquinoline-CH_2), 3.68 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 4.00-4.24 (m, 4H, $2CH_2$ ester), 6.62 (s, 1H, isoquinoline-CH), 6.70-7.20 (m, 5H, Ar H), 8.40 (s, 1H, NH), 10.40 (s, 1H, NH), MS: *m/z* 481(M^+, 8.8%) 435, 389, 302, 257, 91. Anal. Calcd for $C_{26}H_{31}N_3O_6$: C, 64.85; H, 6.49; N, 8.73. Found: C, 64,73; H, 6.80; N, 8.97%.

1,4-Diethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-(4-methylphenyl)-hydrazono)succinate 14Bf*:* Yellow crystals; mp 168-170 °C; yield (75%); IR (KBr) ν 1631(C=O), 1702 (C=O), 3250 (NH) cm^{-1}; ^1H NMR ($CDCl_3$) δ 1.07-1.18 (m, 6H, $2CH_3$ ester), 2.28 (s, 3H, CH_3), 2.60-3.03 (m, 2H, isoquinoline-CH_2), 3.22-3.59 (m, 2H, isoquinoline-CH_2), 3.64 (s, 3H, OCH_3), 3.86 (s, 3H, OCH_3), 4.0-4.26 (m, 4H, $2CH_2$ ester), 6.63 (s, 1H, isoquinoline-CH), 6.89 (s, 1H, isoquinoline-CH), 7.06 (m, 4H, Ar H), 8.37 (s, 1H, NH), 10.39 (s, 1H, NH). MS: *m/z* 481 (M^+, 66.7%), 435, 257, 205, 112, 91. Anal. Calcd for $C_{26}H_{31}N_3O_6$: C, 64.85; H, 6.49; N, 8.73. Found: C, 64.80; H, 6.86; N, 8.60%.

1-Ethyl 2-(3,4-dihydro-6,7-dimethoxy-2H-isoquinoline-1-ylidene)-3-(2-phenylhydrazono)-4-methyl-succinate 14Bh*:* Pale orange crystals; mp189-190 °C; yield (79%); IR (KBr) ν 1631 (C=O), 1709(C=O), 3243 (NH) cm^{-1}, ^1H NMR (DMSO-d_6) δ 1.04 (t, 3H, J = 7Hz, ester-CH_3), 2.58-3.00 (m, 2H, isoquinoline-CH_2), 3.20-3.50 (m, 2H, isoquinoline-CH_2), 3.54 (s, 3H, OCH_3), 3.60 (s, 3H, OCH_3), 3.80 (s, 3H, $COOCH_3$), 3.95 (q, 2H, J = 7Hz, ester-CH_2), 6.57 (s, 1H, isoquinoline-CH), 6.81 (s, 1H, isoquinoline-CH), 6.88-7.29 (m, 5H, Ar H), 10.34 (s, 1H, NH); ^{13}C NMR (DMSO-d_6)16.6, 31.1, 40.9, 54.0, 57.8, 61.3, 81.0, 112.4, 116.0, 123.0, 123.6, 131.2, 133.1, 137.2, 145.3, 149.4, 153.0, 161.6, 168.0, 171.1; MS: *m/z* 453 (M^+, 27.4%), 421, 375, 288, 205, 115, 77. Anal. Calcd for $C_{24}H_{27}N_3O_6$: C, 63.56; H, 6.00; N, 9.27. Found: C, 63.43; H, 5.67; N, 9.01%.

Synthesis of alkyl 2-(2-arylhydrazono)-2,3,5,6-tetrahydro-8,9-dimethoxy-3-oxopyrrolo[2,1-a]isoquino-line-1-carboxylate 15

These compounds were prepared by the same method described for the synthesis of **6** by using

hydrazonoyl halide **12** instead of **2**. The product was collected and crystallized from suitable solvent.

Methyl 2,3,5,6-tetrahydro-8,9-dimethoxy-3-oxo-2-(2-phenylhydrazono)pyrrolo[2,1-a]isoquinoline-1-carboxylate 15Aa: Dark red crystals; mp 181-183 °C (EtOH); yield (86%); ^{1}H NMR ($CDCl_3$) δ 2.91-3.00 (m, 2H, isoquinoline-CH_2), 3.75-3.81 (m, 2H, isoquinoline-CH_2), 3.84 (s, 3H, OCH_3), 3.90 (s, 3H, OCH_3), 3.94 (s, 3H, ester-CH_3), 6.64-7.78 (m, 7H, Ar H), 12.57 (s, 1H, NH); MS: *m/z* 407 (M^+, 48.1%), 375, 242, 200, 77. Anal. Calcd for $C_{22}H_{21}N_3O_5$: C, 64.86; H, 5.20; N, 10.31. Found: C, 64.57; H, 4.96; N, 10.54%.

Ethyl 2,3,5,6-tetrahydro-8,9-dimethoxy-3-oxo-2-(2-phenylhydrazono)pyrrolo[2,1-a]isoquinoline-1-carboxylate 15Ba: Red crystals; mp 217-219 °C (MeCN); yield (84%); IR (KBr) ν 1666(C=O) cm^{-1}, ^{1}H NMR (DMSO-d_6) δ 1.36 (t, 3H, *J* = 7Hz, ester-CH_3), 2.90 (m, 2H, isoquinoline-CH_2), 3.75 (m, 2H, isoquinoline-CH_2), 3.87 (s, 3H, OCH_3), 3.88 (s, 3H, OCH_3), 4.29 (q, 2H, *J* = 7Hz, ester-CH_2), 6.65 (s, 1H, isoquinoline-CH), 7.15-7.35 (m, 5H, Ar H), 8.04 (s, 1H, Ar H), 13.09 (s, 1H, NH); MS: *m/z* 421 (M^+, 30.9%), 375, 200, 77. Anal. Calcd for $C_{23}H_{23}N_3O_5$: C, 65.55; H, 5.50; N, 9.97. Found: C, 65.69; H, 5.4; N, 10.07%.

Ethyl 2,3,5,6-tetrahydro-8,9-dimethoxy-2-(2-(4-methoxyphenyl)hydrazono)-3-oxopyrrolo[2,1- a]-isoquinoline-1-carboxylate 15Bb: Orange crystals; 190-192 °C (AcOH); yield (77%); ^{1}H NMR ($CDCl_3$) δ 1.42-1.49 (t, 3H, *J* = 7Hz, ester-CH_3), 2.91-3.00 (m, 2H, isoquinoline-CH_2), 3.80-3.90 (m, 2H, isoquinoline-CH_2), 3.84 (s, 3H, OCH_3), 3.95 (s, 6H, $2OCH_3$), 4.35-4.48 (q, 2H, *J* = 7Hz, ester-CH_2), 6.71-8.09 (m, 6H, Ar H), 13.24 (s, 1H, NH); MS: *m/z* 451 (M^+, 50.0%), 405, 203, 173, 149, 107, 77. Anal. Calcd for $C_{24}H_{25}N_3O_6$: C, 63.85; H, 5.58; N, 9.31. Found: C, 63.64; H, 5.38; N, 9.52%.

Ethyl 2-(2-(3-chlorophenyl)hydrazono)-2,3,5,6-tetrahydro-8,9-dimethoxy-3-oxopyrrolo[2,1-a]isoquinoline-1-carboxylate 15Bc: Scarlet orange crystals;180-182 °C (AcOH); yield (81%); IR (KBr) ν 1670 (C=O), 1692 (C=O) cm^{-1}; ^{1}H NMR (DMSO-d_6) δ 1.38 (t, 3H, *J* = 7Hz, ester-CH_3), 2.89 (m, 2H, isoquinoline-CH_2), 3.73 (m, 2H, isoquinoline-CH_2), 3.80 (s, 3H, OCH_3), 3.88 (s, 3H, OCH_3) 4.25 (q, 2H, *J* = 7Hz, ester-CH_2), 6.65 (s, 1H, isoquinoline-CH), 6.88-7.40 (m, 4H, Ar H), 8.05 (s, 1H, Ar H), 13.00 (s, 1H, NH); MS: *m/z* 455 (M^+, 50.0%), 355, 319, 173, 127, 77. Anal. Calcd for $C_{23}H_{22}N_3O_5Cl$: C, 60.59, H, 4.86, N, 9.22. Found: C, 60.72; H, 4.99; N, 8.96%.

Ethyl 2-(2-(4-chlorophenyl)hydrazono)-2,3,5,6-tetrahydro-8,9-dimethoxy-3-oxopyrrolo[2,1-a]isoquinoline-1-carboxylate 15Bd: Yellow crystals; mp 210-211 °C (dioxane); yield (79%); IR(KBr) ν1673 (C=O), 1701 (C=O) cm^{-1}; ^{1}H NMR (DMSO-d_6) δ 1.43 (t, 3H, *J* = 7Hz, ester-CH_3), 2.96 (m, 2H,

isoquinoline-CH_2), 3.83 (m, 2H, isoquinoline-CH_2), 3.94 (s, 3H, OCH_3), 3.96 (s, 3H, OCH_3), 4.28 (q, 2H, *J* = 7Hz, ester-CH_2), 6.71 (s, 1H, isoquinoline-CH), 7.23-7.30 (m, 4H, Ar H), 8.10 (s, 1H, Ar H), 13.12 (s, 1H, NH); MS: *m/z* 455 (M^+, 46.2%), 389, 292, 172, 91. Anal. Calcd for $C_{23}H_{22}N_3O_5Cl$: C, 60.59; H, 4.86; N, 9.22. Found: C, 60.54; H, 5.16; N, 8.97%.

Ethyl 2,3,5,6-tetrahydro-8,9-dimethoxy-2-(2-(3-methylphenyl)hydrazono)-3-oxopyrrolo[2,1-a]isoquinoline-1-carboxylate 15Be: Orange crystals; mp175-177 °C (MeCN); yield (83%); IR (KBr) ν 1663 (C=O), 1692 (C=O) cm^{-1}; ^1H NMR ($CDCl_3$) δ 1.42-1.49 (t, 3H, *J* = 7Hz, ester-CH_3), 2.34 (s, 3H, CH_3), 2.42 (m, 2H, isoquinoline-CH_2), 3.80 (m, 2H, isoquinoline-CH_2), 3.91 (s, 3H, OCH_3), 3.92 (s, 3H, OCH_3), 4.33 (q, 2H, *J* = 7Hz, ester-CH_2), 6.69 (s, 1H, isoquinoline-CH), 6.80-7.24 (m, 4H, Ar H), 8.09 (s, 1H, Ar H),13.10 (s, 1H, NH); MS: *m/z* 435 (M^+, 65.7%), 389, 334, 290, 200, 91. Anal. Calcd for $C_{24}H_{25}N_3O_5$: C, 66.19; H, 5.79; N, 9.65. Found: C, 66.42; H, 5.48; N, 9.49%.

Ethyl 2,3,5,6-tetrahydro-8,9-dimethoxy-2-(2-(4-methylphenyl)hydrazono)-3-oxopyrrolo[2,1-a]isoquinoline-1-carboxylate 15Bf: Red crystals; mp 198-200 °C (dioxane); yield (75%); IR (KBr) ν 1665 (C=O), 1685 (C=O) cm^{-1}; ^1H NMR (DMSO-d_6) δ 1.41 (t, 3H, *J* = 7Hz, ester-CH_3), 2.32 (s, 3H, CH_3), 2.93 (m, 2H, isoquinoline-CH_2), 3.80 (m, 2H, isoquinoline-CH_2), 3.91 (s, 3H, OCH_3), 3.93 (s, 3H, OCH_3), 4.23 (q, 2H, *J* = 7Hz, ester-CH_2), 6.69 (s, 1H, isoquinoline-CH), 7.12-7.27 (m, 4H, Ar H), 8.09 (s, 1H, Ar H), 13.16 (s, 1H, NH); MS: *m/z* 435 (M^+, 54.3%), 389, 200, 91. Anal. Calcd for $C_{24}H_{25}N_3O_5$: C, 66.19; H, 5.79; N, 9.65. Found: C, 65.93; H, 5.69; N, 9.74%.

Ethyl 2,3,5,6-tetrahydro-8,9-dimethoxy-2-(2-(4-nitrophenyl)hydrazono)-3-oxopyrrolo[2,1-a]isoquinoline-1-carboxylate 15Bg: Dark red crystals; mp 229-230 °C (DMF); yield (74%); IR (KBr) ν 1680 (C=O) cm^{-1}, ^1H NMR (DMSO-d_6) δ 1.32 (t, 3H, *J* = 7Hz, ester-CH_3), 2.80-2.90 (m, 2H, isoquinoline-CH_2), 3.65-3.74 (m, 2H, isoquinoline-CH_2), 3.80 (s, 3H, OCH_3), 3.84 (s, 3H, OCH_3), 4.26 (q, 2H, *J* = 7Hz, ester-CH_2), 6.58 (s, 1H, isoquinoline-CH), 7.16-7.25 (m, 2H, Ar H), 7.97(s, 1H, Ar H), 8.05-8.12 (m, 2H, Ar H), 13.04 (s, 1H, NH); ^{13}C NMR (DMSO-d_6) 16.5, 30.7, 38.4, 58.0, 58.2, 62.7, 102.4, 108.5, 112.7, 115.1, 115.7, 119.7, 127.8, 132.6, 135.2, 144.6, 145.8, 149.8, 149.9, 153.8, 161.0, 165.7. MS: *m/z* 466 (M^+, 100.0%), 422, 361, 256, 127, 80. Anal. Calcd for $C_{23}H_{22}N_4O_7$: C, 59.22; H, 4.75; N, 12.01. Found: C, 59.51; H, 4.45; N, 11.84%.

3.5 X-Ray Structure Determination of Compounds 3Aa, 10Bf and 14Bd

The X-ray diffraction measurement was made on using maXus (Bruker Nonius, Delft & MacScience, Japan) at temperature 300 (2) K and wavelength 0.71073 Å; radiation: Mo *K*α. Crystal data for compound **3Aa** $C_{27}H_{27}N_3O_4$: unit cell parameters: 14.3017(4) Å, b = 14.6465 (6) Å, c = 14.8867 (9) Å, α = 79.152

(2)°, β = 62.653 (2)°, γ = 61.117 (4)°.

Crystal data for compound **10Bf** $C_{27}H_{24}N_3O_4SCl$: a = 11.5763(4) Å, b = 16.6564 (6) Å, c = 14.1166 (5) Å, β = 111.297 (2) ° and crystal data for compound **14Bd** $C_{25}H_{28}N_3O_6Cl$: a = 8.1648(2) Å, b = 16.8715 (5) Å, c = 19.2972 (9) Å, β = 105.52 (18) °, space group: P 21/c.

Crystallographic data for the structural analysis of compounds **14Bd, 10Bf and 3Aa** has been deposited with the Cambridge Crystallographic Data Centre (CCDC) under the numbers 703102-703104 respectively. Copies of the information may be obtained free of charge from The Director, CCDC, 12 Union Road, Cambridge CB2 1EZ, UK (Fax: +44-01223-336033; e-mail: **deposit@ccdc.cam.ac.uk** or www:**http://www.ccdc.cam.ac.uk).**

REFERENCES

1. (a) T. L. Gilchrist, *Heterocyclic Chemistry, 3rd ed.*, Addison Wesley Longman, Essex (UK), 1997; (b) J. Harris and W. Pope, *J. Chem. Soc.*, 1992, **121**, 1029; (c) A. R. Katritzky, C. W. Rees and E. F. Scriven, (eds.), *Comprehensive Heterocyclic Chemistry II*, Vol. 7, Pergamon Press, Oxford, 1996, p. 431; (d) A. R. Katritzky and A. F. Pozharskii, *Handbook of Heterocyclic Chemistry, 2nd ed*., Elsevier, Oxford (UK), 2000.
2. (a) M. Shamma, *The Isoquinoline Alkaloids*.; Academic: London, 1972; pp. 194-228; (b) H. Guinaudeau, M. Leboeuf, and A. Cave, *J. Nat. Prod.*, 1988, **51**, 389; (c) H. Guinaudeau, *J. Nat. Prod.*, 1994, **57**, 1033.
3. (a) A. B. J. Bracca and T. S. Kaufman, *Tetrahedron*, 2004, **60**, 10575; (b) E. L. Larghi, M. Amongero, A. B. J. Bracca, and T. S. Kaufman, *ARKIVOC*, 2005, **12**, 98.
4. (a) E. M. Awad, N. M. Elwan, H. M. Hassaneen, A. Linden, and H. Heimgartner, *Helv. Chim. Acta*, 2001, **84**, 1172; (b) E. M. Awad, N. M. Elwan, H. M. Hassaneen, A. Linden, and H. Heimgartner, *Helv. Chim. Acta*, 2002, **85**, 320; (c) T. A. Abdallah, H. A. Abdelhadi, A. A. Ibrahim, and H. M. Hassaneen, *Synth. Commun.*, 2002, **32**, 581; (d) T. A. Abdallah, H. A. Abdelhadi, H. M. Hassaneen, and H. M. Hassaneen, *Molecules*, 2002, **7**, 540.
5. T. A. Abdallah, *Heterocycles*, 2008, **75**, 2779.
6. T. A. Abdallah, H. M. Hassaneen, and H. A. Abdelhadi, *Heterocycles*, 2009, **78**, 337.
7. T. A. Abdallah, *Synth. Commun.*, 2002, **32**, 2459.
8. J. Osbond, *J. Chem. Soc.*, 1951, 3464.
9. (a) P. Wolkoff, *Canadian J. Chem.*, 1975, **53**, 1333; (b) H. M. Hassaneen, R. H. Hilal, N. M. Elwan, A. Harhash, and A. S. Shawali, *J. Heterocycl. Chem.*, 1984, **21**,1013; (c) J. B. Aylward and F. L. Scott, *J. Chem. Soc. (B)*, 1969, 1080; (d) H. M. Hassaneen, H. A. H. Mousa, N. M. Abed, and A. S. Shawali,

Heterocycles, 1988, **27**, 695; (e) A. S. Shawali, H. M. Hassaneen, H. A. Ibrahim, S. T. Mekki, and A. A Fahmi, *Arch. Pharm. Res*., 1990, **13**, 126.

10. (a) N. F. Eweiss and A. Osman, *J. Heterocycl. Chem*., 1980, **17**, 1713; (b) A. S. Shawali and A. O. Abdelhamid, *Bull. Chem. Soc. Japan*, 1976, **49**, 321; (c) A. M. Farag and M. S. Algharib, *Org. Prep. Proced. Int*., 1988, **20**, 521.
11. (a) A. S. Shawali, N. F. Eweiss, H. M. Hassaneen, and M. Sami, *Bull. Chem. Soc. Japan*, 1975, **48**, 365; (b) R. Huisgen and H. Jaochim, *Ann*., 1955, **591**, 200; (c) R. Huisgen and H. Koch, *Ann*., 1955, **591**, 218; (d) R. Fusco and P. C. Dalla, *Gazz. Chim. Ital*., 1971, **101**, 703.