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Tetrahedron

Synthesis and tautomeric structure of 2-[*N*-aryl-2-oxo-2-arylethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinones

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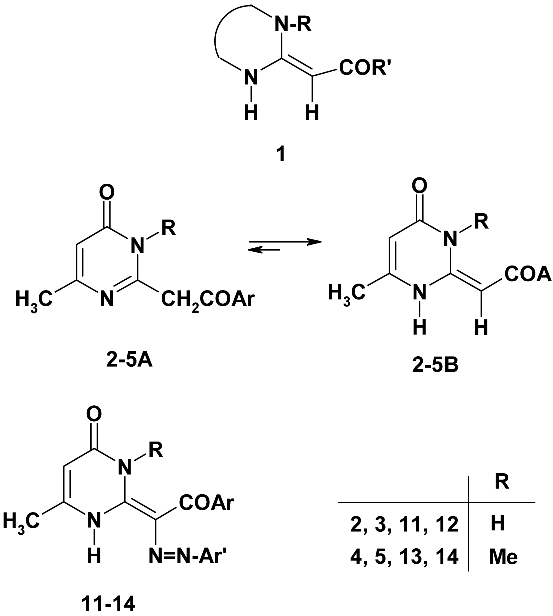
Abstract—Two series of 2-(*N*-aryl-2-oxo-2-arylethanehydrazonoyl)-6-methyl-4(3*H*)-pyrimidinones **11** (**12**) were prepared by coupling of diazotized anilines with 2-(aroylmethylene)-1,2-dihydro-6-methyl-4(3*H*)-pyrimidinones **2** (**3**). The spectral data of such compounds together with their 3-methyl analogs **13** (**14**) indicated that they exist predominantly in the hydrazone tautomeric form.

1. Introduction

Our group has recently been interested in the azo-hydrazone tautomerism of arylazo heterocycles in both ground and excited states as many of them are useful in the field of material sciences and theoretical chemistry.[1] Also, there have been diverse studies on various reactions of 1,2-cyclic ketene aminals **1** such as nucleophilic additions[2] and substitutions[3] with a variety of electrophiles and 1,3-dipoles.[4] The results of such studies proved **1** to be powerful and useful building blocks for synthesis of compounds that are difficult to access by other synthetic methods.[5] However, a literature survey revealed that the chemistry of 2-(aroylmethyl)-6-methyl-4(3*H*)-pyrimidinones **2-5** (Chart 1) has received little, if any, attention although **2** (**3**) were reported in 1988 and shown to exist in the ketene aminal form **2B** (**3B**) (Chart 1).[6] As a consequence of this, and in continuation of our previous studies of azo-hydrazone tautomerism of diazonium coupling products of active methylene compounds,[1] we studied the reactions of each of the ketene aminals **2** and **3** together with their *N*-methyl analogs **4** and **5** with diazonium salts in an attempt to synthesize the respective azo derivatives **11-14** (Scheme 1) and to elucidate their tautomeric structures. Theoretically five tautomeric structures **A-E** can be written for such compounds (Chart 2). This study of compounds **11-14** was also thought necessary prior to the intended exploration of their nonlinear optical properties, use as synthons for other heterocycles and a study of their biological activity. This is because numerous derivatives of pyrimidinone ring system have been prepared over the past years and their pharmacology evaluated.[7]



1

2-5A

2-5B

11-14

	R
2, 3, 11, 12	H
4, 5, 13, 14	Me

Chart 1.

2. Results and discussion

The starting ketene aminals **2** and **3** were prepared from 6-methyl-2-thiouracil **6** as previously described.[6] The other two ketene aminals **4** and **5**, which have not been previously reported, were synthesized in this work as outlined in Scheme 1. Thus, treatment of **6** with the appropriate phenacyl bromide in aqueous ethanolic sodium hydroxide afforded the respective 2-[(aroylmethyl)thio]-4(3*H*)-pyrimidinones **7** and **8**. Methylation of both **7** and **8** with methyl iodide in dimethylformamide in the presence of sodium carbonate afforded **9** and **10**. The structures of the novel derivatives **9** and **10** were confirmed by their spectra (MS,

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Keywords: Heterocycles; Hydrazones; Tautomerism.

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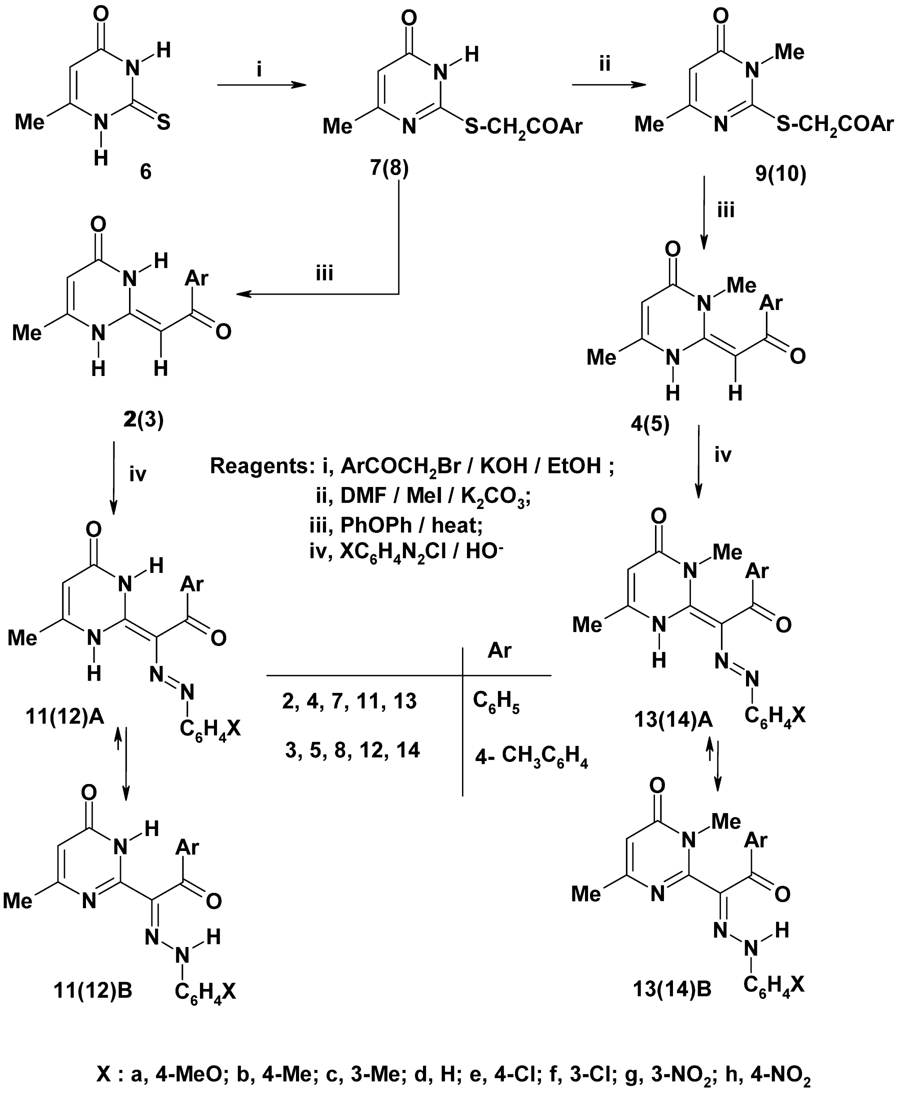

Scheme 1.

^{1}H NMR and IR) together with their elemental analyses. The ^{1}H NMR spectra revealed, in each case, four characteristic signals near δ 1.96, 3.53, 4.61 and 5.99 assignable to 6-CH_3, N–CH_3, –CH_2– and ring 5-CH protons, respectively.

Heating each of **9** and **10** in diphenyl ether at 200–210 °C gave the respective ketene aminals **4** and **5** in good yields (Scheme 1) via extrusion of sulfur. The structures of the new ketene aminals **4** and **5** were established by their analytical and spectroscopic data. The ^{1}H NMR spectra of **4** and **5** revealed in each case an NH proton signal near δ 15.20 which is lost on shaking the solution of each in chloroform-*d* with D_2O. In addition, the ^{1}H NMR spectra showed four characteristic singlet signals near δ 2.20, 3.38, 5.60, and 5.70 assignable to the pyrimidine 6-CH_3, N–CH_3, 5-CH and methine =CH– protons, respectively. This indicates that compounds **4** and **5**, like **2** and **3** exist predominantly in the enamine form (**B**).[6]

In aqueous ethanol in the presence of sodium hydroxide, each of compounds **2-5** reacted with diazotized anilines and afforded the respective arylazo derivatives **11-14**, respectively (Scheme 1). The mass spectra of the latter products revealed the molecular ion peaks at the expected *m*/*z* values with relative intensities varying from 40 to 100% and their elemental analysis data were consistent with their assigned structures. Their infrared spectral data (see Section 3) seem to be consistent more with the hydrazone structure (**B** or **C**) rather than the hydroxyazo tautomeric forms (**D** and **E**) (Chart 2). For example, all compounds exhibit two carbonyl bands in the regions 1689–1666 and 1640–1620 cm^{-1} corresponding to the stretching vibrations of the pyrimidinone and the benzoyl carbonyl groups, respectively. The observed wavenumber of the latter CO stretching band in the compounds **11-14** seems to result from strong chelation with the hydrazone NH and conjugation with the C=N double bond as required by both hydrazone forms **B** and **C** (Chart 2).[8] The fact that compounds **11-14** show evidence for strong intramolecular hydrogen bonding also excludes the azo form **A** (Chart 2).

To elucidate the actual tautomeric form of the studied compounds **11-14**, the electronic absorption spectra were measured. The data are summarized in Table 1. As shown, each of compounds **11-14** in dioxane exhibits two

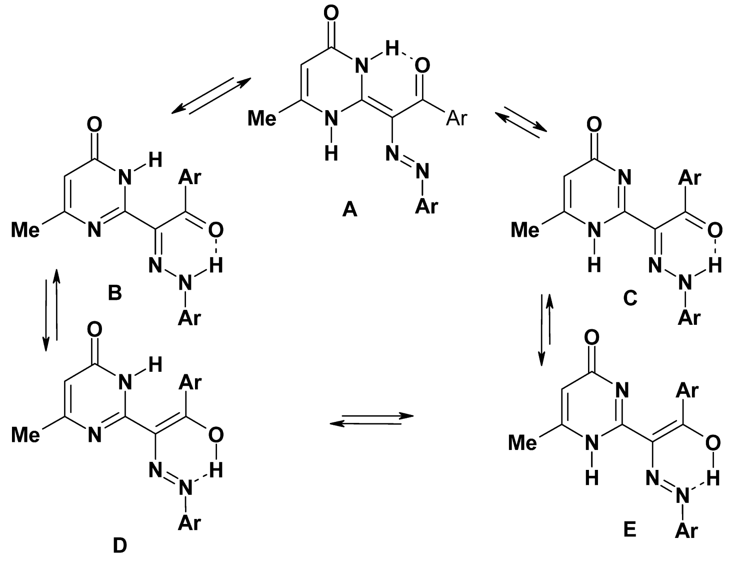

Chart 2.

Table 1. UV spectra of coupling products

Compound No.	λ_{max} (log ε)	Compound No.	λ_{max} (log ε)
11a	409 (4.49), 312 (4.10)	**12a**	410 (4.32), 312 (4.04)
11b	391 (4.13), 299 (3.73)	**12b**	396 (4.27), 306 (3.95)
11c	392 (4.20), 304 (3.83)	**12c**	392 (4.34), 303 (4.06)
11d[a]	389 (4.27), 301 (3.91)	**12d**[b]	390 (4.34), 302 (4.09)
11e	392 (4.21), 299 (3.85)	**12e**	393 (4.29), 306 (4.02)
11f	383 (4.27), 297 (3.93)	**12f**	383 (4.38), 298 (4.13)
11g	384 (4.30), 260 (3.86)	**12g**	384 (4.29), 262 (4.00)
11h	399 (4.17), 294 (3.70)	**12h**	400 (4.64), 296 (4.26)
13d	360 (5.20), 280 (5.00)	**14d**	357 (5.26), 286 (5.10)

[a] Solvent: λ_{max} (log ε): acetic acid 391 (4.29), 286 (4.15); chloroform 392 (4.37), 304 (4.01); ethanol 391 (4.36), 303 (4.01); cyclohexane 389 (3.98), 305 (3.60).

[b] Solvent: λ_{max} (log ε): acetic acid 391 (4.26), 299 (4.06); chloroform 393 (4.22), 306 (3.96); ethanol 392 (4.25), 304 (3.99); cyclohexane 389 (3.96), 305 (3.70).

characteristic absorption bands in the regions 400–380 and 304–290 nm. Such an absorption pattern is similar to that of typical hydrazone chromophore.[1b,9] Furthermore, the spectrum of **11d**, taken as a typical example of the two series studied was recorded in solvents of different polarities. The spectra obtained showed little, if any, shift (Table 1). The small shifts in λ_{max} of **11d** in different solvents are due to solute–solvent interaction. In agreement with this conclusion is the observation that the spectra of arylhydrazones derived from the reaction of quinones with *N*-alkyl-*N*-phenylhydrazine, unlike those of *o*- and *p*-hydroxyazo compounds are largely independent of the solvent polarity.[8]

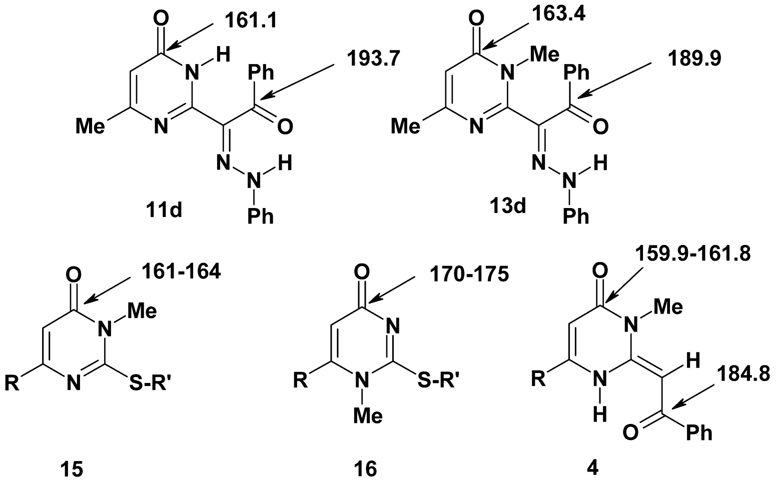

Chart 3.

This finding, while it excludes the azo tautomeric forms **A**, **D** and **E**, indicates that each of compounds **11**-**14** exists in one tautomeric form, namely **B** or **C** (Chart 1).

Finally, in order to distinguish between the two forms **B** and **C** (Chart 1), the ^{13}C NMR spectra of **11d** and **13d** were recorded and compared with those of compounds **4**, **15** and **16** (Chart 3). This is because literature reports[10,11] indicate that the chemical shift of the carbonyl group in pyrimidin-4(1*H*)-ones is markedly affected by the nature of the adjacent nitrogen, that is, N(3), pyridine type or pyrrole type, being larger for the former type (Chart 3). The ^{13}C NMR spectra of **11d** and **13d** revealed the signals for the ring carbonyl carbon at δ 161.1 and 163.4, respectively. These δ values suggest that N(3) is an sp3-hybridized nitrogen atom, that is, of pyrrole type, as it is similar to that found for the methyl derivatives **4** (δ 159.9) and **15** (δ 161–164) and different to that found for the pyrimidinones **16** (δ 170–175).[11] This finding indicates that the studied compounds **11**-**14** exist predominantly in the hydrazone tautomeric form **B** (Chart 2).

In conclusion, we have encountered two novel series of 2-(*N*-aryl-2-oxo-2-arylethanehydrazonoyl)-6-methyl-4(3*H*)-pyrimidinones **11** (**12**) and their spectral data presented here indicate collectively that such compounds exist predominantly in the hydrazone tautomeric form **B**.

3. Experimental

3.1. General

Melting points were determined on a Gallenkamp apparatus and are uncorrected. IR spectra were recorded in potassium bromide using Perkin Elmer FTIR 1650 and Pye-Unicam SP300 infrared spectrophotometers. ^{1}H NMR spectra were recorded in deuterated chloroform using a Varian Gemini 200 NMR spectrometer. Mass spectra were recorded on a GCMS-QP 1000 EX Shimadzu and GCMS 5988-A HP spectrometers. Electronic absorption spectra were recorded on Perkin–Elmer Lambada 40 spectrophotometer. Elemental analyses were carried out at the Microanalytical Laboratory of Cairo University, Giza, Egypt. 2-Mercapto-6-methyl-4(3*H*)-pyrimidinone **6**, 2-(Aroylmethylthio)-6-methyl-4(3*H*)-pyrimidinones **7** and **8** and the respective 2-(aroylmethylene)-1,2-dihydro-6-methyl-4(3*H*)-pyrimidinones **2** and **3** were prepared as previously described.[6]

3.2. 2-(Aroylmethylthio)-3,6-dimethyl-4(3*H*)-pyrimidinones (9 and 10)

To a stirred solution of **7** (0.05 mol) in dimethylformamide (100 ml) was added anhydrous potassium carbonate (3.0 g, 0.02 mol) and methyl iodide (7.5 g, 0.05 mol). The reaction was then left overnight while being stirred at room temperature, then was poured onto water. The crude solid that precipitated was collected by filtration and crystallized from methanol to give the respective **9** as white solid. Use of **8** in lieu in the above method afforded **10**.

3.2.1. 2-Benzoylmethylthio-3,6-dimethyl-4(3*H*)-pyrimidinone (9). (9.6 g, 70%) as white crystals, mp 102–104 °C. (Found: C, 61.3; H, 5.4; N, 10.5. $C_{14}H_{14}N_2O_2S$ (274.4) requires: C, 61.29; H, 5.14; N, 10.21%). δ_H (CDCl$_3$) 1.96 (s, 3H, 6-CH$_3$), 3.53 (s, 3H, N–CH$_3$), 4.61 (s, 2H, –CH$_2$–), 5.99 (s, 1H, 5-CH), 7.26–8.07 (m, 5H, ArH); ν_{max} (KBr) 1681 cm^{-1}. MS *m*/*z* (%) 274 (M$^+$, 2), 241 (12), 134 (23), 105 (100), 83 (16), 77 (28).

3.2.2. 2-(4-Methylbenzoylmethylthio)-3,6-dimethyl-4(3*H*)-pyrimidinone (10). (10.95 g, 76%) as white crystals, mp 105 °C. (Found: C, 62.5; H, 5.3; N, 9.5. $C_{15}H_{16}N_2O_2S$ (288.37) requires: C, 62.48; H, 5.59; N, 9.71%). δ_H (CDCl$_3$) 1.96 (s, 3H, 6-CH$_3$), 2.44 (s, 3H, ArCH$_3$), 3.53 (s, 3H, N–CH$_3$), 4.60 (s, 2H, –CH$_2$–), 5.99 (s, 1H, 5-CH), 7.52 (d, *J*=7 Hz, 2H, ArH), 7.77 (d, *J*=7 Hz,2H, ArH). ν_{max} (KBr) 1681 cm^{-1}. MS *m*/*z* (%) 288 (M$^+$, 1.9), 255 (9), 148 (18), 119 (100), 105 (2), 91 (26), 77 (2.6).

3.3. 2-(Aroylmethylene)-1,2-dihydro-6-methyl-4(3*H*)-pyrimidinones (2-5)

A solution of the appropriate compound **7** or **8** (2 mmol) in diphenyl ether (10 ml) was heated in an oil bath at 200–210 °C for 10 min, then cooled. To the cold mixture was added ether where a yellow solid product precipitated. After complete prcepitation, the solid product was collected, washed with ether and crystallized from ethanol to give **2** and **3**, respectively.

When this procedure was repeated using **9** and **10** each in place of **7** or **8**, 2-(aroylmethylene)-1,2-dihydro-3,6-dimethylpyrimidin-4(3*H*)-ones **4** and **5**, respectively, were produced.

3.3.1. 2-(Benzoylmethylene)-1,2-dihydro-6-methyl-4(3*H*)-pyrimidinone (2). (0.31 g, 69%), as pale yellow solid, mp 247–249 °C (lit. mp 247–250 °C).[6]

3.3.2. 2-(4-Methylbenzoylmethylene)-1,2-dihydro-6-methyl-4(3*H*)-pyrimidinone (3). (0.33 g, 69%) as pale yellow solid, mp 265 °C (lit. mp 267 °C).[6]

3.3.3. 2-(Benzoylmethylene)-1,2-dihydro-3,6-dimethyl-4(3*H*)-pyrimidinone (4). (0.34 g, 70%) as yellow solid, mp 138 °C. (Found: C, 69.3; H, 5.5; N, 11.4. $C_{14}H_{14}N_2O_2$ (242.28) requires: C, 69.41; H, 5.82; N, 11.56%). δ_H (CDCl$_3$) 2.25 (s, 3H, 6-CH$_3$), 3.39 (s, 3H, N–CH$_3$), 5.67 (s, 1H, 5-CH), 5.72 (s, 1H, =CH–), 7.26–7.90 (m, 5H, ArH), 15.23 (s, 1H, NH). δ_C (DMSO-*d*$_6$) 18.9, 28.3, 78.7, 101.6, 126.6, 128.3, 131.1, 139.1, 150.8, 155.6, 159.9, 184.6. ν_{max} (KBr) 3425, 1674 cm^{-1}. MS *m*/*z* (%) 243 (M$^+$+1, 6), 242 (M$^+$, 37), 225 (14), 213 (14), 165 (25), 137 (21), 105 (100), 84 (29), 77 (67).

3.3.4. 2-(4-Methylbenzoylmethylene)-1,2-dihydro-3,6-dimethyl-4(3*H*)-pyrimidin-one (5). (0.39 g, 75%) as yellow solid, mp 170 °C. (Found: C, 70.3; H, 6.2; N, 10.5. $C_{15}H_{16}N_2O_2$ (256.31) requires: C, 70.29; H, 6.29; N, 10.93%. δ_H (CDCl$_3$) 2.25 (s, 3H, 6-CH$_3$), 2.40 (s, 3H, ArCH$_3$), 3.38 (s, 3H, N–CH$_3$), 5.66 (s, 1H, 5-CH), 5.71 (s, 1H, =CH–), 7.23 (d, *J*=8 Hz, 2H, ArH), 7.77 (d, *J*=8 Hz, 2H, ArH), 15.20 (s, 1H, NH). δ_C (DMSO-*d*$_6$) 21.2, 22.7, 29.9, 75.1, 106.7, 128.3, 129.3, 133.9, 143.9, 160.7, 160.9, 161.4, 192.8. ν_{max} (KBr) 3417, 1681 cm^{-1}. MS *m*/*z* (%) 257

(M^++1, 6), 256 (M^+, 33), 239 (15), 213 (14), 165 (18), 137 (18), 119 (100), 91 (49), 77 (3).

3.4. 2-[*N*,2-Diaryl-2-oxo-ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (11)

To a stirred solution of the appropriate **2-5** (10 mmol) in ethanol (50 ml) was added sodium hydroxide (0.4 g, 10 mmol) and the mixture was cooled in an ice bath to 0–5 °C. To the resulting solution, while being stirred, was added dropwise over a period of 20 min a solution of the appropriate arenediazonium chloride, prepared as usual by diazotizing the respective aniline (10 mmol) in hydrochloric acid (6 M, 6 ml) with sodium nitrite (1 M, 10 ml). The whole mixture was then left a refrigerator overnight. The precipitated solid was collected, washed with water and finally crystallized from ethanol to give the respective hydrazone **11-14**, respectively.

3.4.1. 2-[*N*-(4-Methoxyphenyl)-2-oxo-2-phenylethane-hydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (11a). (Yield 2.54 g, 70%) as yellow crystals, mp 210 °C. (Found: C, 66.3; H, 5.2; N, 15.5. $C_{20}H_{18}N_4O_3$ (362.39) requires: C, 66.29; H, 5.01; N, 15.46%). δ_H ($CDCl_3$) 2.34 (s, 3H, 6-CH_3), 3.81 (s, 3H, OCH_3), 6.24 (s, 1H, 5-CH), 6.89 (d, *J*=8 Hz, 2H, ArH), 6.9–7.4 (m, 5H, ArH), 7.7 (d, *J*=8 Hz, 2H, ArH), 12.85 (s, 1H, NH), 16.20 (s, 1H, NH); δ_C (DMSO-d_6) 21.2, 23.1, 109.5, 113.2, 116.5, 125.9, 127.7, 129.6, 130.2, 131.8, 138.5, 139.3, 142.0, 152.4, 162.5, 191.5. ν_{max} (KBr) 3120, 1689, 1612 cm^{-1}. MS *m*/*z* (%) 363 (M^++1, 11.7), 362 (M^+, 56), 361 (100), 212 (11), 199 (15), 136 (27), 122 (30), 107 (14), 105 (65), 84 (16), 77 (84).

3.4.2. 2-[*N*-(4-Methylphenyl)-2-oxo-2-phenylethane-hydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (11b). (2.60 g, 75%) as yellow needles, mp 208 °C. (Found: C, 69.5; H, 5.4; N, 15.9. $C_{20}H_{18}N_4O_2$ (346.39) requires: C, 69.35; H, 5.24; N, 16.12%). δ_H ($CDCl_3$) 2.40 (s, 3H, Ar-CH_3), 2.45 (s, 3H, 6-CH_3), 6.25 (s, 1H, 5-CH), 6.89 (d, *J*=8 Hz, 2H, ArH), 6.9–7.4 (m, 5H, ArH), 7.73 (d, *J*=7 Hz, 2H, ArH), 12.80 (s, 1H, NH), 16.0 (s, 1H, NH). δ_C ($CDCl_3$) 21.7, 23.6, 113.3, 114.4, 116.4, 125.5, 128.4, 130.7, 135.5, 135.7, 142.8, 143.1, 153.1, 160.5, 161.3, 194.1. ν_{max} (KBr) 3159, 1666, 1616 cm^{-1}. MS *m*/*z* (%) 346 (M^+, 40), 345 (100), 226 (12), 183 (13), 136 (27), 119 (24), 91 (47), 84 (19), 77 (24).

3.4.3. 2-[*N*-(3-Methylphenyl)-2-oxo-2-phenylethane-hydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (11c). (2.39 g, 69%) as yellow crystals, mp 174 °C. (Found: C, 69.1; H, 5.4; N, 16.0. $C_{20}H_{18}N_4O_2$ (346.39) requires: C, 69.35; H, 5.24; N, 16.17%). δ_H ($CDCl_3$) 2.33 (s, 3H, Ar-CH_3), 2.42 (s, 3H, 6-CH_3), 6.26 (s, 1H, 5-CH), 6.89–7.81 (m, 9H, ArH), 12.80 (s, 1H, NH), 16.0 (s, 1H, NH); δ_C (DMSO-d_6) 21.8, 23.8, 110.0, 112.6, 113.7, 117.1, 126.5, 128.3, 129.4, 130.2, 130.7, 132.3, 139.0, 139.8, 142.6, 152.9, 164.0, 192.1. ν_{max} (KBr) 3179, 3059, 1682, 1620 cm^{-1}. MS *m*/*z* (%) 347 (M^++1, 42), 346 (M^+, 37), 345 (100), 212 (15), 183 (17), 136 (28), 119 (27), 105 (27), 91 (43), 84 (23), 77 (45).

3.4.4. 2-[*N*,2-Diphenyl-2-oxo-ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidin-one (11d). (2.66 g, 80%) as pale yellow solid, mp 204 °C. (Found: C, 68.3; H, 5.1; N, 16.6. $C_{19}H_{16}N_4O_2$ (332.36) requires: C, 68.66; H, 4.85; N, 16.86%). δ_H ($CDCl_3$) 2.41 (s, 3H, 6-CH_3), 6.25 (s, 1H, 5-CH), 7.15–7.80 (m, 10H, ArH), 12.80 (s, 1H, NH), 16.05 (s, 1H, NH), δ_C (DMSO-d_6) 23.6, 112.6, 116.5, 128.4, 129.4, 129.5, 129.6, 130.3, 130.7, 134.6, 139.0, 142.7, 152.8, 161.1, 193.7. ν_{max} (KBr) 3140, 1666, 1608 cm^{-1}. MS *m*/*z* (%) 332 (M^+, 38), 331 (100), 303 (10), 169 (12), 136 (33), 105 (29), 84 (21), 77 (74).

3.4.5. 2-[*N*-(4-Chlorophenyl)-2-oxo-2-phenylethane-hydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (11e). (2.86 g, 78%) as red crystals, mp 200 °C. (Found: C, 62.5; H, 4.0; N, 15.5. $C_{19}H_{15}ClN_4O_2$ (366.81) requires: C, 62.22; H, 4.12; N, 15.27%). δ_H ($CDCl_3$) 2.41 (s, 3H, 6-CH_3), 6.27 (s, 1H, 5-CH), 7.10 (d, *J*=7 Hz, 2H, ArH), 7.13–7.75 (m, 5H, ArH), 7.76 (d, *J*=7 Hz, 2H, ArH), 12.75 (s, 1H, NH), 16.1 (s, 1H, NH). ν_{max} (KBr) 3180, 3030, 1666, 1616 cm^{-1}. MS *m*/*z* (%) 369 (M^++2, 1), 368 (M^++1, 5), 367 (M^+, 14), 366 (14), 365 (36), 212 (11), 136 (50), 111 (17), 105 (66), 99 (12), 84 (18), 77 (100).

3.4.6. 2-[*N*-(3-Chlorophenyl)-2-oxo-2-phenylethane-hydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (11f). (2.57 g, 70%) as red solid, mp 222 °C. (Found: C, 62.0; H, 3.9; N, 15.1. $C_{19}H_{15}ClN_4O_2$ (366.81) requires: C, 62.22; H, 4.12; N, 15.27%). δ_H ($CDCl_3$) 2.42 (s, 3H, 6-CH_3), 6.28 (s, 1H, 5-CH), 7.04–7.80 (m, 9H, ArH), 12.69 (s, 1H, NH), 15.97 (s, 1H, NH); ν_{max} (KBr) 3067, 1686, 1620 cm^{-1}. MS *m*/*z* (%) 369 (M^++2, 4), 368 (M^++1, 13), 367 (M^+, 40), 366 (39), 365 (99), 337 (11), 212 (14), 203 (13), 136 (64), 116 (16), 105 (48), 89 (12), 84 (38), 77 (100).

3.4.7. 2-[*N*-(3-Nitrophenyl)-2-oxo-2-phenylethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (11g). (2.98 g, 79%) as orange crystals, mp 238 °C. (Found: C, 60.6; H, 4.2; N, 18.8. $C_{19}H_{15}N_5O_4$ (377.36) requires: C, 60.48; H, 4.01; N, 18.56%). δ_H ($CDCl_3$) 2.45 (s, 3H, 6-CH_3), 6.31 (s, 1H, 5-CH), 7.26–8.05 (m, 9H, ArH), 12.7 (s, 1H, NH), 16.10 (s, 1H, NH). δ_C (DMSO-d_6) 22.9, 109.7, 117.9, 121.6, 127.9, 128.9, 129.1, 130.0, 130.2, 130.9, 132.1, 134.4, 137.7, 143.8, 148.8, 164.1, 191.9. ν_{max} (KBr) 3030, 3059, 1681, 1625 cm^{-1}. MS *m*/*z* (%) 377 (M^+, 18), 376 (53), 212 (10), 136 (78), 116 (10), 105 (56), 84 (32), 78 (12), 77 (100).

3.4.8. 2-[*N*-(4-Nitrophenyl)-2-oxo-2-phenylethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (11h). (3.80 g, 80%) as deep red crystals, mp 280 °C. (Found: C, 60.2; H, 3.9; N, 18.7. $C_{19}H_{15}N_5O_4$ (377.36) requires: C, 60.48; H, 4.01; N, 18.56%). δ_H ($CDCl_3$) 2.48 (s, 3H, 6-CH_3), 6.31 (s, 1H, 5-CH), 7.67–7.54 (5H, m, ArH), 7.96 (d, *J*=9 Hz, 2H, ArH), 8.16 (d, *J*=7 Hz, 2H, ArH), 12.9 (s, 1H, NH), 18.2 (s, 1H, NH). ν_{max} (KBr) 3402, 3070, 1681, 1635 cm^{-1}. MS *m*/*z* (%) 377 (M^+, 33), 376 (100), 348 (14), 212 (13), 136 (58), 105 (43), 84 (20), 77 (75).

3.4.9. 2-[*N*-(4-Methoxyphenyl)-2-oxo-2-(4-methylphenyl)-ethane-hydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (12a). (2.97 g, 79%) as orange solid, mp 182 °C. (Found: C, 67.2; H, 5.5; N, 14.9. $C_{21}H_{20}N_4O_3$ (376.42) requires: C, 67.01; H, 5.36; N, 14.88%). δ_H ($CDCl_3$) 2.39 (s, 3H, ArCH_3), 2.45 (s, 3H, 6-CH_3), 3.81 (s, 3H, OCH_3), 6.23 (s, 1H, 5-CH), 6. 9 (d, *J*=9 Hz, 2H, ArH), 7.15 (d, *J*=9 Hz, 2H, ArH), 7.25 (d, J=8 Hz, 2H, ArH), 7.70 (d, J=8 Hz, 2H, ArH), 12.89 (s, 1H, NH), 16.15 (s, 1H, NH). $\nu_{\max}$ (KBr) 3147, 3074, 1685, 1608 cm^{-1}. MS m/z (%) 377 (M$^+$+1, 15), 376 (M$^+$, 63), 375 (100), 226 (15), 213 (12), 198 (11), 136 (19), 122 (22), 119 (54), 107 (16), 91 (53), 84 (11), 77 (12).

3.4.10. 2-[*N*-2-Di(4-methylphenyl)-2-oxo-ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (12b). (3.06 g, 85%) as orange plates, mp 238 °C. (Found: C, 70.2; H, 5.4; N, 15.6. $C_{21}H_{20}N_4O_2$ (360.42) requires: C, 69.98; H, 5.59; N, 15.54%). δ_H (CDCl$_3$) 2.35 (s, 3H, Ar-CH$_3$), 2.40 (s, 3H, 6-CH$_3$), 2.45 (s, 3H, 6-CH$_3$), 6.24 (s, 1H, 5-CH–), 7.10 (d, J=8 Hz, 2H, ArH), 7.16 (d, J=8 Hz, 2H, ArH), 7.25 (d, J=8 Hz, 2H, ArH), 7.71 (d, J=8 Hz, 2H, ArH), 12.82 (s, 1H, NH), 16.1 (s, 1H, NH); $\nu_{\max}$ (KBr) 3143, 1666, 1616 cm^{-1}. MS m/z (%) 360 (M$^+$, 42), 359 (100), 226 (12), 197 (17), 136 (29), 119 (40), 91 (75), 84 (18), 77 (16).

3.4.11. 2-[*N*-(3-Methylphenyl)-2-oxo-2-(4-methylphenyl)-ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (12c). (2.63 g, 73%) as orange solid, mp 190 °C. (Found: C, 70.3; H, 5.4; N, 15.6. $C_{21}H_{20}N_4O_2$ (360.42) requires: C, 69.98; H, 5.59; N, 15.54%). δ_H (CDCl$_3$) 2.33 (s, 3H, Ar-CH$_3$), 2.41 (s, 3H, ArCH$_3$), 2.45 (s, 3H, 6-CH$_3$), 6.24 (s, 1H, 5-CH), 6.98 (d, J=8 Hz, 2H, ArH), 7.00–7.28 (m, 4H, ArH), 7.72 (d, J=8 Hz, 2H, ArH), 12.82 (s, 1H, NH), 15.95 (s, 1H, NH). $\nu_{\max}$ (KBr) 3170, 1681, 1620 cm^{-1}. MS m/z (%) 360 (M$^+$, 40), 359 (100), 226 (10), 197 (13), 136 (24), 119 (27), 91 (56), 84 (14), 77 (10).

3.4.12. 2-[*N*-Phenyl-2-oxo-2-(4-methylphenyl)ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (12d). (2.79 g, 80%) as orange crystals, mp 260 °C. (Found: C, 69.2; H, 5.5; N, 16.1. $C_{20}H_{18}N_4O_2$ (346.39) requires: C, 69.35; H, 5.24; N, 16.17%). δ_H (CDCl$_3$) 2.41 (s, 3H, Ar-CH$_3$), 2.46 (s, 3H, 6-CH$_3$), 6.25 (s, 1H, 5-CH), 7.15 (d, J=8 Hz, 2H, ArH), 7.2–7.4 (m, 5H, ArH), 7.72 (2H, J=8 Hz, ArH), 12.80 (s, 1H, NH), 16.01 (s, 1H, NH). $\nu_{\max}$ (KBr) 3150, 3050, 1666, 1608 cm^{-1}. MS m/z (%) 346 (M$^+$, 40), 345 (100), 226 (12), 183 (13), 136 (27), 119 (24), 92 (10), 91 (47), 84 (18), 77 (24).

3.4.13. 2-[*N*-(4-Chlorophenyl)-2-oxo-2-(4-methylphenyl)-ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (12e). (2.86 g, 75%) as orange plates, mp 236 °C. (Found: C, 63.2; H, 4.9; N, 14.5. $C_{20}H_{17}ClN_4O_2$ (380.84) requires: C, 63.08; H, 4.50; N, 14.71%). δ_H (CDCl$_3$) 2.40 (s, 3H, ArCH$_3$), 2.46 (s, 3H, 6-CH$_3$), 6.26 (s, 1H, 5-CH), 7.12 (d, J=8 Hz, 2H, ArH), 7.25 (d, J=7 Hz, 2H, ArH), 7.32 (d, J=8 Hz, 2H, ArH), 7.70 (d, J=7 Hz, 2H, ArH), 12.74 (s, 1H, NH), 16.01 (s, 1H, NH). δ_C (DMSO-d_6) 21.7, 23.4, 111.9, 117.3, 118.1, 128.9, 129.3, 129.5, 130.1, 130.9, 136.1, 142.1, 142.8, 156.6, 162.8, 193.1; $\nu_{\max}$ (KBr) 3182, 1666, 1616 cm^{-1}. MS m/z (%) 382 (M$^+$+1, 3), 381 (M$^+$, 10), 380 (10), 379 (28), 136 (36), 119 (72), 99 (11), 91 (100), 89 (16), 84 (34), 76 (11).

3.4.14. 2-[*N*-(3-Chlorophenyl)-2-oxo-2-(4-methylphenyl)-ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (12f). (2.67 g, 70%) as orange crystals, mp 246 °C. (Found: C, 63.2; H, 4.9; N, 14.4. $C_{20}H_{17}ClN_4O_2$ (380.84) requires: C, 63.08; H, 4.50; N, 14.71%). δ_H (CDCl$_3$) 2.41 (s, 3H, Ar-CH$_3$), 2.46 (s, 3H, 6-CH$_3$), 6.27 (s, 1H, 5-CH), 7.10 (d, J=8 Hz, 2H, ArH), 7.14–7.31 (m, 4H, ArH), 7.72 (d, J=8 Hz, 2H, ArH), 12.73 (s, 1H, NH), 15.93 (s, 1H, NH). $\nu_{\max}$ (KBr) 3150, 1685, 1620 cm^{-1}. MS m/z (%) 382 (M$^+$+1, 12), 381 (M$^+$, 43), 379 (100), 226 (13), 217 (12), 136 (51), 119 (30), 91 (48), 84 (22).

3.4.15. 2-[*N*-(3-Nitrophenyl)-2-oxo-2-(4-methylphenyl)-ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (12g). (3.13 g, 80%) as orange solid, mp 244 °C. (Found: C, 61.1; H, 4.5; N, 17.6. $C_{20}H_{17}N_5O_4$ (391.39) requires: C, 61.38; H, 4.38; N, 17.89%). δ_H (CDCl$_3$) 2.44 (s, 3H, ArCH$_3$), 2.48 (s, 3H, 6-CH$_3$), 6.29 (s, 1H, 5-CH), 7.31 (d, J=8 Hz, 2H, ArH), 7.73 (d, J=8 Hz, 2H, ArH), 7.46–7.57 and 7.91–8.06 (m, 4H, ArH), 12.7 (s, 1H, NH), 16.00 (s, 1H, NH). $\nu_{\max}$ (KBr) 3425, 3093, 1689, 1620 cm^{-1}. MS m/z (%) 392 (M$^+$+1, 5), 391 (M$^+$, 24), 390 (73), 228 (11), 226 (17), 136 (87), 130 (10), 119 (62), 91 (100), 84 (34).

3.4.16. 2-[*N*-(4-Nitrophenyl)-2-oxo-2-(4-methylphenyl)-ethanehydrazonoyl]-6-methyl-4(3*H*)-pyrimidinone (12h). (3.13 g, 80%) as yellow solid, mp 296 °C. (Found: C, 60.3; H, 4.1; N, 17.7. $C_{20}H_{17}N_5O_4$ (391.39) requires: C, 61.38; H, 4.38; N, 17.89%). δ_H (CDCl$_3$) 2.44 (s, 3H, ArCH$_3$), 2.48 (s, 3H, 6-CH$_3$), 6.31 (s, 1H, 5-CH), 7.26 (d, J=8 Hz, 2H, ArH), 7.29 (d, J=8 Hz, 2H, ArH), 7.73 (d, J=9 Hz, 2H, ArH), 8.27 (d, J=9 Hz, 2H, ArH), 12.6 (s, 1H, NH), 16.05 (s, 1H, NH). $\nu_{\max}$ (KBr) 3417, 3086, 1689, 1631 cm^{-1}. MS m/z (%) 392 (M$^+$+1, 7), 391 (M$^+$, 35), 390 (100), 362 (11), 226 (16), 136 (52), 119 (36), 91 (55), 84 (16).

3.4.17. 2-(*N*-Phenyl-2-oxo-2-phenylethanehydrazonoyl)-3,6-dimethyl-4(3*H*)-pyrimidinone (13d). (2.58 g, 75%) as yellow solid, mp 195 °C. (Found: C, 69.15; H, 5.1; N, 16.0. $C_{20}H_{18}N_4O_2$ (346.39) requires: C, 69.35; H, 5.24; N, 16.17%). δ_H (CDCl$_3$) 2.38 (s, 3H, 6-CH$_3$), 3.36 (s, 3H, N–CH$_3$), 6.38 (s, 1H, 5-CH), 7.1–8.1 (m, 10H, ArH), 11.10 (s, 1H, NH). δ_C (DMSO-d_6) 23.6, 31.5, 112.4, 115.6, 123.8, 128.7, 130.0, 130.6, 132.7, 134.1, 137.9, 143.6, 153.6, 162.2, 163.4, 190.0; $\nu_{\max}$ (KBr) 3440, 1666, 1627 cm^{-1}. MS m/z (%) 348 (M$^+$+1, 0.3), 347 (M$^+$, 2), 226 (12), 169 (18), 158 (18), 150 (66), 136 (13), 105 (63), 89 (16), 77 (100).

3.4.18. 2-[*N*-Phenyl-2-oxo-2-(4-methylphenyl)ethanehydrazonoyl]-3,6-dimethyl-4(3*H*)-pyrimidinone (14d). (2.88 g, 80%) as yellow crystals, mp 170 °C. (Found: C, 69.5; H, 5.3; N, 15.6. $C_{21}H_{20}N_4O_2$ (360.4) requires: C, 69.98; H, 5.59; N, 15.54%). δ_H (CDCl$_3$) 2.24 (s, 3H, Ar-CH$_3$), 2.42 (s, 3H, 6-CH$_3$), 3.27 (s, 3H, N–CH$_3$), 6.38 (s, 1H, 5-CH), 7.2 (d, J=8 Hz, 2H, ArH), 7.3–7.5 (m, 5H, ArH), 7.91 (d, J=8 Hz, 2H, ArH), 10.98 (s, 1H, NH). δ_C (DMSO-d_6) 21.8, 23.6, 31.5, 112.4, 115.6, 123.7, 129.3, 130.0, 130.8, 134.2, 135.1, 143.1, 143.7, 153.7, 162.2, 163.4, 189.2. $\nu_{\max}$ (KBr) 3417, 1651, 1627 cm^{-1}. MS m/z (%) 361 (M$^+$+1, 5), 360 (M$^+$, 24.7), 359 (52), 240 (20), 183 (34), 158 (13), 150 (100), 119 (77), 106 (40), 91 (91), 77 (40).

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