

## Research Article



## A Facile Green Synthesis of 1, 3-Disubstituted-(1H,3H)-6-Methylpyrimidine-2,4-Diones through Chapman Rearrangement of 2, 4-Diaryloxy-6-Methylpyrimidines

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### ABSTRACT

2, 4-diaryloxy-6-methylpyrimidines underwent *Chapman rearrangement* under conventional heating as well as on microwave irradiation to afford corresponding 1, 3-disubstituted-(1H, 3H)-6-methylpyrimidine-2, 4-diones.

**Keywords:** 2,4-diaryloxy-6-methylpyrimidines, 1,3-disubstituted-6-methylpyrimidine-2,4-diones, Chapman rearrangement, Imidates, Microwave irradiation.

### INTRODUCTION

Pyrimidines are biologically important molecules and valuable heterocyclic nuclei for the design of pharmaceutical agents.<sup>1,2</sup> 2, 4-(1H, 3H)-pyrimidinedione was used to synthesize antibacterial<sup>3</sup> and antitumor agents.<sup>4</sup> Some of the derivatives of 2, 4-(1H, 3H)-pyrimidinedione exhibit significant pharmacological activity and have been used as antitumor, antibacterial, and antiviral drugs.<sup>5</sup>

The most prominent representatives are 5-fluoro-1H, 3H-pyrimidine-2, 4-dione and 5-Methyl-(1H, 3H)-pyrimidine-2, 4-dione derivatives.<sup>6,7</sup> Uramustine, 5-[N, N'-bis (2'-chloroethyl) amino] pyrimidine-2, 4-dione, is used orally in the treatment of several leukemias<sup>8</sup> and 5-nitro-(1H, 3H)-pyrimidine-2, 4-dione derivatives exhibit macrophage growth inhibition.<sup>9</sup> 1-Aryl-5-substituted pyrimidine-2, 4-diones are also useful intermediate in the synthesis of other 2, 4-(1H, 3H)-pyrimidinedione derivatives.<sup>10-12</sup> Some pyrimidinedione derivatives are used for treating or preventing metabolic disorders, dyslipidemia, neurological disorders, hematological diseases, cancer, inflammation, respiratory diseases, gastroenterological diseases, diabetic complications, obesity-related disorders and non-alcoholic fatty liver diseases.<sup>13</sup>

Many pyrimidinedione derivatives are used in agrochemicals as pesticides, antiphotosynthetic herbicides; since they contain an active ingredient and exhibit preventing and controlling effects against harmful living things, especially agricultural pests, sanitary insect pests, stored product insect pests, house insect pests etc.<sup>14-16</sup>

1-Aryl pyrimidine-2, 4-diones have been synthesized from substituted ureidopropanoic acids or 1-acryloyl-3-arylureas.<sup>17</sup> 6-methyl-1, 3-oxazine-2, 4-(3H)-dione when treated with an excess of arylamines was transformed into the appropriate 1-aryl-6-methyl pyrimidine-2, 4-diones.<sup>18</sup> Pyrimidine-2, 4-dione derivatives, in reactions with diarylidonium salts, gave the appropriate N-mono-

and N, N'-diarylation products with high regioselectivity.<sup>19,20</sup>

Attempts at direct N-arylation of 2, 4-(1H, 3H)-pyrimidinedione derivatives have also been reported.<sup>19,21</sup> All these methods are tedious and involve substrates that are not easily accessible.

### MATERIALS AND METHODS

The melting points were determined using capillary tube and are uncorrected. The FTIR spectra were recorded on Spectrum One Perkin Elmer (US). The 1H-NMR spectra were recorded on a Bruker AVANCE (300 MHz) spectrometer (with TMS as internal references). 13C-NMR spectra were recorded on Bruker AVANCE (75 MHz) spectrometer. Mass spectra were recorded on API-3000MD-series (US). UV spectra were recorded on Shimaduz 2401 PC and Shimaduz 2450, Japan, Spectrophotometer. Elemental analyses were carried out in EA 3000, EuroVector, Italy. The purity of the compounds was checked by TLC on pre-coated SiO<sub>2</sub> gel (200mesh). Modified LG microwave laboratory oven was used for microwave irradiation. The solvents were purified by distillation before use.

### RESULTS AND DISCUSSION

In view of the biological importance of pyrimidinediones, we were interested to prepare them from readily available chemicals. Herein, we wish to report the synthesis of 1, 3-diaryl-2, 4-(1H, 3H)-6-methylpyrimidine diones via Chapman rearrangement of 2, 4-diaryloxy-6-methyl pyrimidines.

The thermal conversion of aryl N-arylbenzimidates to N-aryldiphenylamines is known as the *Chapman rearrangement*.<sup>22</sup> Though imidates of many classes of compounds have been subjected to *Chapman rearrangement*, 2, 4-diaryloxy-6-methylpyrimidines have not been investigated.



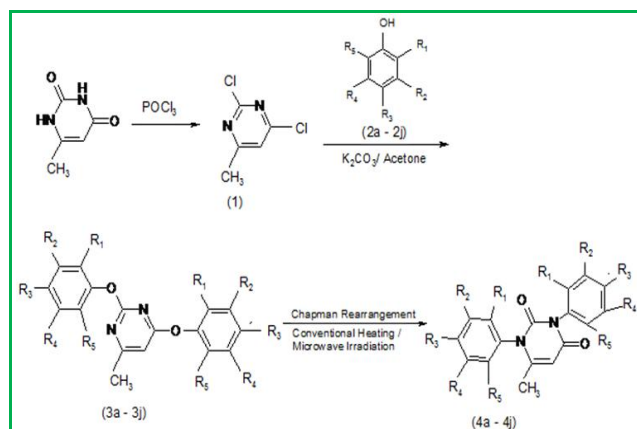
In light of the observations from literature survey as well as our interest in evolving new, simpler, ecofriendly, convenient methodologies in organic synthesis and absence of reports on the *Chapman rearrangement* of 2, 4-diaryloxy-6-methylpyrimidines led us to undertake the present work.


For this purpose, 6-methyl-(1H, 3H)-pyrimidine-2, 4-dione was visualized as the starting substrate. This on chlorination followed by condensation with various phenols yielded the respective aryloxy products. These were then subjected to *Chapman rearrangement* to afford the corresponding 1, 3-diaryl-6-methylpyrimidine-2, 4-diones. (**Scheme**)

2, 4-dichloro-6-methylpyrimidine (**1**) has been synthesized as per literature procedure.<sup>23</sup>

### General Procedure for preparation of 2, 4-diaryloxy-6-methylpyrimidine (3a-3j)

A mixture of 2, 4-dichloro-6-methylpyrimidine (**1**) (0.02M), different phenols (**2a-2j**)



Compounds	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>
2a, 3a, 4a	CH <sub>3</sub>	H	H	H	H
2b, 3b, 4b	H	H	CH <sub>3</sub>	H	H
2c, 3c, 4c	COOC <sub>2</sub> H <sub>5</sub>	H	H	H	H
2d, 3d, 4d	H	H	COOCH <sub>3</sub>	H	H
2e, 3e, 4e	H	H		H	H
2f, 3f, 4f	OCH <sub>3</sub>	H	COOC <sub>2</sub> H <sub>5</sub>	H	OCH <sub>3</sub>
2g, 3g, 4g	OC <sub>2</sub> H <sub>5</sub>	H	H	H	H
2h, 3h, 4h	H	OC <sub>2</sub> H <sub>5</sub>	H	H	H
2i, 3i, 4i	H	CH <sub>3</sub>	Cl	CH <sub>3</sub>	H
2j, 3j, 4j	H	H	H	H	H

(0.04M) and K<sub>2</sub>CO<sub>3</sub> (0.04M) in dry acetone (50 ml) was slowly refluxed for 5-6 hours under dry conditions. After completion of the reaction (TLC), the acetone was recovered by flash distillation. The reaction mass was cooled to room temperature and quenched in water (50ml) under stirring. The heterogeneous solution was extracted in ether (3 x 25ml) followed by washing with 5% NaOH solution (1 x 25ml). The combined ether extracts were given water washing (2 x 25ml) and dried over

sodium sulphate. Recovery of ether followed by purification afforded solid/ oil.

### 2, 4-di (2-methylphenoxy)-6-methylpyrimidine (3a)

Yield: 58%. m.p.: 106°C. IR (KBr, cm<sup>-1</sup>): 1240 (C-O-C stretch.), 1345 (C-N stretch.), 1609 (C=C stretch.Ar), 2976-3040 (-CH<sub>3</sub> stretch.), 3093 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>): δ 2.2 (s, 9H), 6.3-7.0 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>): δ 12.31, 16.12, 115.32, 119.91, 124.13, 126.98, 132.09, 132.13, 152.19, 155.78, 156.91, 158.92. MS: *m/z* (%): 306 (24), 301 (18), 272 (21), 246 (23), 206 (23), 181 (100), 152 (22), 116 (18), 82 (31), 65 (23), 44 (17). UV spectrum: λ<sub>max</sub> 211.4, abs. 0.931. Molecular formula: C<sub>19</sub>H<sub>18</sub>N<sub>2</sub>O<sub>2</sub>. Elemental analysis: Calculated: C (74.51%), H (5.88%), N (9.15%). Found: C (74.58%), H (5.75%), N (9.21%).

### 2, 4-di (4-methylphenoxy)-6-methylpyrimidine (3b)

Yield: 66%. IR (KBr, cm<sup>-1</sup>): 1246 (C-O-C stretch.), 1336 (C-N stretch), 1616 (C=C stretch.Ar), 2955-3065 (-CH<sub>3</sub> stretch.), 3090 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>): δ 2.3 (s, 9H), 6-7.2 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>): δ 11.98, 20.17, 116.12, 128.12, 129.13, 130.21, 153.24, 154.31, 155.32, 158.67. MS: *m/z* (%): 306 (42), 283 (13), 267 (36), 239 (14), 221 (13), 216 (100), 198 (21), 171 (18), 162 (22), 141 (16), 121(30), 109 (13), 63 (17), 34 (23). UV spectrum: λ<sub>max</sub> 228.6, abs. 0.641. Molecular formula: C<sub>19</sub>H<sub>18</sub>N<sub>2</sub>O<sub>2</sub>. Elemental analysis: Calculated: C (74.51%), H (5.88%), N (9.15%). Found: C (74.59%), H (5.92%), N (9.95%).

### 2, 4-di (2-carbethoxyphenoxy)-6-methylpyrimidine (3c)

Yield 63%. mp.:109°C. IR (KBr, cm<sup>-1</sup>): 1237 (C-O-C stretch.), 1350 (C-N stretch.), 1428 (C-O- stretch.), 1605 (C=C stretch.Ar), 1720, 1750 (-C=O stretch.Ester), 2854-2095 (-CH<sub>2</sub>, -CH<sub>3</sub> stretch.), 3088 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>): δ 1.15-1.4 (t, J=6.7 Hz, 6H), 2.4(s, 3H), 4.1-4.4(q, J=7.3 Hz, 4H), 6.4-7.8 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>): δ 12.31, 14.33, 62.91, 114.81, 122.11, 128.32, 131.98, 135.12, 138.24, 155.02, 155.52, 166.54, 167.12. MS: *m/z* (%): 422(31), 415 (26), 399 (27), 386 (18), 362 (27), 348 (100), 333 (22), 323 (15), 302 (24), 281 (20), 252 (16), 233 (18), 212 (51), 193 (15), 171 (16), 143 (22), 106 (18), 81 (18), 67 (23), 55 (13), 41 (19). UV spectrum: λ<sub>max</sub> 212.9, abs. 0.738. Molecular formula: C<sub>23</sub>H<sub>22</sub>N<sub>2</sub>O<sub>6</sub>. Elemental analysis: Calculated: C (65.40%),

H (5.21%), N (6.64%). Found: C (65.49%), H (5.16%), N (6.55%).

### 2, 4-di (4-carbomethoxyphenoxy)-6-methylpyrimidine (3d)

Yield 56%. Viscous oil. IR (KBr, cm<sup>-1</sup>): 1217 (-C-O stretch. Ester), 1249 (C-O-C stretch.), 1352 (C-N stretch), 1610 (C=C stretch. Ar), 1730 (-C=O stretch. Ester), 2870-2957 (-CH<sub>3</sub> stretch.), 3094 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>): δ 2.2(s, 3H), 3.8(s, 6H), 6.3-7.6(m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>): δ 12.15, 53.02, 112.12, 114.82, 115.79, 131.72, 139.21, 154.11, 157.91, 167.91, 168.11. MS: *m/z* (%): 394 (24), 365 (32), 349 (17), 331 (100), 312 (45), 296 (23), 278 (34), 261 (15), 236 (36), 220 (33), 201 (16), 173

(27), 156 (33), 147 (30), 134 (17), 122 (19), 99 (17), 78 (42), 55 (13), 42 (23), 34 (19). UV spectrum:  $\lambda_{\max}$  260.6, abs. 0.342. Molecular formula:  $C_{21}H_{18}N_2O_6$ . Elemental analysis: Calculated: C (63.96%), H (4.57%), N (7.11%). Found: C (63.88%), H (4.65%), N (7.17%).

### 2, 4-di (2-naphthoxy)-6-methylpyrimidine (3e)

Yield 55%. m.p.: 113°C. IR (KBr,  $cm^{-1}$ ): 1240 (C-O-C stretch), 1600, 1610 (C=C stretch.Ar), 2956-3003 (-CH<sub>3</sub> stretch.), 3086 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  2.3 (s, 3H), 6.2-7.20 (m, 15H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  12.16, 108.89, 117.79, 123.81, 126.53, 127.69, 128.92, 129.41, 129.62, 134.58, 134.89, 153.22, 154.79, 155.92, 159.62. MS:  $m/z$  (%): 378 (26), 349 (24), 338 (13), 311 (21), 302 (16), 299 (15), 283 (28), 272 (100), 261 (22), 253 (11), 241 (22), 226 (42), 203 (14), 173 (12), 149 (21), 123 (28), 92 (19), 76 (31), 53 (16), 41 (16). UV spectrum:  $\lambda_{\max}$  210.8, abs. 0.902. Molecular formula:  $C_{25}H_{18}N_2O_2$ . Elemental analysis: C (79.37%), H (4.76%), N (7.41%). Found: C (79.28%), H (4.84%), N (7.33 %).

### 2, 4-di (4-carbethoxy-2, 6-dimethoxyphenoxy)-6-methylpyrimidine (3f)

Yield 53%. m.p.: 112°C. IR (KBr,  $cm^{-1}$ ): 1198 (-C-O stretch. Ester), 1241 (C-O-C stretch.), 1339 (C-N stretch), 1612(C=C stretch.Ar), 1712, 1718 (-C=O stretch. Ester), 2854-2985 (-CH<sub>2</sub>, -CH<sub>3</sub> stretch.), 3087 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  1.4(t, J=7.1 Hz, 6H), 2.1(s, 3H), 3.9(s, 12H), 4.5(q, J=7.8 Hz, 4H), 6.4-7.5 (m, 5H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  12.05, 14.31, 55.93, 63.91, 106.52, 134.05, 138.56, 140.29, 147.38, 153.63, 155.82, 157.23, 159.34, 167.23. MS:  $m/z$  (%): 542 (21), 525 (26), 509 (17), 486 (20), 471 (100), 458 (14), 431 (24), 404 (35), 376 (27), 341 (20), 324 (16), 303 (21), 285 (24), 248 (15), 206 (40), 176 (30), 134 (16), 119 (24), 77 (31), 41 (33). UV spectrum:  $\lambda_{\max}$  205.7, abs. 0.789. Molecular formula:  $C_{27}H_{30}N_2O_{10}$ . Elemental analysis: Calculated: C (59.78%), H (5.54%), N (5.17%). Found: C (59.89%), H (5.61%), N (5.21 %).

### 2, 4-di (2-ethoxyphenoxy)-6-methylpyrimidine (3g)

Yield 59%. m.p.: 92°C. IR (KBr,  $cm^{-1}$ ): 1232 (C-O-C stretch.), 1346 (C-N stretch), 1608 (C=C stretch.Ar), 2834-2975(-CH<sub>2</sub>, -CH<sub>3</sub> stretch.), 3090 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  1.3(t, J=6.9 Hz, 6H), 2.4 (s, 3H), 4.1 (q, J=7.8Hz, 4H), 6.1-7.5 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  12.09, 14.27, 63.81, 111.23, 122.26, 126.85, 149.31, 152.23, 157.15, 158.42, 159.11. MS:  $m/z$  (%): 366 (43), 353 (20), 341 (21), 324 (17), 311 (30), 302 (12), 287 (100), 271 (16), 249 (24), 221 (31), 209 (17), 197 (46), 181 (48), 169 (39), 142 (21), 130 (26), 98 (16), 58 (17), 34 (24). UV spectrum:  $\lambda_{\max}$  212.3, abs. 1.201. Molecular formula:  $C_{21}H_{22}N_2O_4$ . Elemental analysis: Calculated: C (68.85%), H (6.01%), N (7.65%). Found: C (68.91%), H (5.89%), N (7.69 %).

### 2, 4-di (3-ethoxyphenoxy)-6-methylpyrimidine (3h)

Yield 61%. m.p.: 92°C. IR (KBr,  $cm^{-1}$ ): 1238 (C-O-C stretch.), 1341 (C-N stretch), 1600 (C=C stretch.Ar), 2874-2950 (-CH<sub>2</sub>, -CH<sub>3</sub> stretch.), 3084 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300

MHz, CDCl<sub>3</sub>):  $\delta$  1.5(t, J=6.8 Hz, 6H), 2.3 (s, 3H), 4.2 (q, J=7.9Hz, 4H), 6.0-7.3 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  12.22, 14.71, 63.71, 108.21, 121.26, 127.21, 153.21, 155.32, 156.31, 158.02, 159.58. MS:  $m/z$  (%): 366 (53), 342 (17), 329 (23), 316 (100), 291 (35), 279 (11), 252 (17), 238(20), 217 (27), 196 (15), 174(18), 153 (18), 104 (16), 73 (29), 64 (22), 50 (13), 36 (31). UV spectrum:  $\lambda_{\max}$  212.4, abs. 1.201. Molecular formula:  $C_{21}H_{22}N_2O_4$ . Elemental analysis: Calculated: C (68.85%), H (6.01%), N (7.65%). Found: C (68.94%), H (6.13%), N (7.73%).

### 2, 4-di (4-chloro-3, 5-dimethylphenoxy)-6-methylpyrimidine (3i)

Yield 62%. m.p.: 114°C. IR (KBr,  $cm^{-1}$ ): 774 (-Cl stretch.), 1233 (C-O-C stretch.), 1352 (C-N stretch), 1610 (C=C stretch.Ar), 2980-3012 (-CH<sub>3</sub> stretch.), 3095 (C-H stretch. Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  2.3 (s, 3H); 2.5 (s, 12H), 6.2-7.2 (m, 5H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  12.14, 20.22, 115.31, 126.41, 130.12, 137.51, 153.18, 155.31, 156.13, 159.21. MS:  $m/z$  (%): 403 (46), 384 (13), 362 (31), 350 (18), 331 (14), 312 (31), 273 (24), 242 (23), 213 (18), 208 (100), 191 (37), 169 (16), 138 (12), 129 (27), 101 (12), 86 (13), 54(21). UV spectrum:  $\lambda_{\max}$  216.7, abs. 0.875. Molecular formula:  $C_{21}H_{20}N_2O_2Cl_2$ . Elemental analysis: Calculated: C (62.53%), H (4.96%), N (6.95%), Cl (17.62%). Found: C (62.59%), H (5.02%), N (7.01%); Cl (17.69%).

### 2, 4-diphenoxy-6-methylpyrimidine (3j)

Yield: 69%. m. p.: 97°C<sup>24</sup>

#### General procedure for preparation of 1, 3-diaryl-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4a-4j) by Chapman rearrangement of 2, 4-diaryloxy-6-methylpyrimidines (3a-3j) under conventional heating.

In a flask, equipped with water condenser 2, 4-diaryloxy-6-methylpyrimidine (**3a-3j**) (0.0038 M) was heated under stirring in nitrogen atmosphere at 180°C-200°C for 50-100 minutes. After completion, (TLC) the reaction mass was cooled to room temperature and petroleum ether (25 ml) was added. It was purified to afford crystals/ oil.

Thus, 2, 4-diaryloxy-6-methylpyrimidines (**3a-3j**) smoothly underwent *Chapman rearrangement* but the reaction times were larger and percentage yields were moderate. It was therefore thought worthwhile to carryout the *Chapman rearrangement* of these compounds under microwave irradiation.

Reduced reaction times, less effect on the environment and better reaction yields are some of the common advantages of using microwave irradiation for chemical reactions.<sup>25</sup>

#### General procedure for preparation of 1, 3-diaryl-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4a-4j) by Chapman rearrangement of 2, 4-diaryloxy-6-methylpyrimidines (3a-3j) under microwave irradiation.

In a flask, equipped with water condenser 2, 4-diaryloxy-6-methylpyrimidine (**3a-3j**) (0.01 M) was irradiated (900



W) in a microwave oven for 13-20 minutes. After completion (TLC), the reaction mass was cooled to room temperature and petroleum ether (25 ml) was added under stirring. It was purified to afford crystals/ oil.

Percentage Yield and reaction time under conventional heating and microwave irradiation are presented in the Table.

**1, 3-di (2-methylphenyl)-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4a)**

Viscous oil. IR (KBr,  $\text{cm}^{-1}$ ): 1343 (C-N stretch), 1607, 1641(C=C stretch.Ar), 1683, 1694 (N-C=O stretch), 2943-3017 (-CH<sub>3</sub> stretch.), 3096 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  1.5 (s, 6H), 1.8 (s, 3H), 6.1-7.5 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  12.18, 15.76, 110.82, 115.34, 120.81, 124.31, 126.93, 131.21, 138.78, 153.25, 153.91, 168.07. MS: *m/z* (%): 306 (37), 289 (29), 274 (19), 260 (24), 247 (52), 238 (36), 222 (18), 214 (20), 198 (39), 188 (29), 175 (21), 166 (100), 151 (19), 147 (16), 132 (19), 120 (53), 101 (24), 86 (32), 74 (24), 59 (17), 48 (28). UV spectrum:  $\lambda_{\text{max}}$  208.6, abs. 0.489. Molecular formula: C<sub>19</sub>H<sub>18</sub>N<sub>2</sub>O<sub>2</sub>. Elemental analysis: Calculated: C (74.51%), H (5.88%), N (9.15%). Found: C (74.42%), H (5.92%), N (8.99%).

**1, 3-di (4-methylphenyl)-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4b)**

Viscous oil. IR (KBr,  $\text{cm}^{-1}$ ): 1336 (C-N stretch), 1616, 1642(C=C stretch.Ar), 1681, 1694 (N-C=O stretch), 2850-2954 (-CH<sub>3</sub> stretch.), 3087 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  1.3 (s, 6H), 1.5 (s, 3H), 6.1-7.3 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  11.79, 20.41, 110.32, 115.32, 127.39, 130.45, 139.12, 152.54, 153.67, 167.88. MS: *m/z* (%): 306 (19), 295 (21), 268 (18), 249 (23), 232 (14), 218 (38), 201 (19), 189 (21), 175 (65), 162 (100), 149 (14), 141(19), 132 (35), 123 (25), 103 (17), 89 (71), 73 (22), 69 (18), 60 (11), 57 (41), 55 (76). UV spectrum:  $\lambda_{\text{max}}$  212.6, abs. 0.621. Molecular formula: C<sub>19</sub>H<sub>18</sub>N<sub>2</sub>O<sub>2</sub>. Elemental analysis: Calculated: C (74.51%), H (5.88%), N (9.15%). Found: C (74.62%), H (5.99%), N (8.96%).

**1, 3-di (2-carbethoxyphenyl)-(1H, 3H)-6-methylpyrimidine -2, 4-dione (4c)**

m.p.:144°C. IR (KBr,  $\text{cm}^{-1}$ ): 1210 (C-O-C stretch), 1360 (C-N stretch), 1605, 1633(C=C stretch.Ar), 1678, 1710 (N-C=O stretch), 1710, 1722 (-C=O stretch. Ester), 2998-3000 (-CH<sub>2</sub>, -CH<sub>3</sub> stretch.), 3091 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  1.2-1.4 (t, J=6.9 Hz, 6H), 2.2 (s, 3H), 4.05-4.4 (q, J=7.7 Hz, 4H), 6.4-7.7 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  11.89, 14.12, 61.21, 111.2, 122.49, 123.41, 127.45, 128.12, 131.45, 138.12, 152.49, 153.57, 167.41, 168.21. MS: *m/z* (%): 422 (31), 413 (14), 391(52), 379 (17), 361 (17), 343 (28), 328 (22), 304 (37), 298 (16), 280 (21), 271 (100), 257 (25), 242 (32), 223 (13), 206 (15), 191 (32), 182 (34), 163 (18), 142(19), 131 (42), 112 (21), 93 (14), 79 (14), 65 (16), 51 (32). UV spectrum:  $\lambda_{\text{max}}$  208.4, abs. 0.819. Molecular formula: C<sub>23</sub>H<sub>22</sub>N<sub>2</sub>O<sub>6</sub>. Elemental analysis: Calculated: C (65.40%), H (5.21%), N (6.64%). Found: C (65.47%), H (5.27%), N (6.71%).

**1, 3-di (4-carbomethoxyphenyl)-(1H, 3H)-6-methylpyrimidine -2, 4-dione (4d)**

Viscous oil. IR (KBr,  $\text{cm}^{-1}$ ): 1221 (-C-O stretch. Ester), 1347 (C-N stretch), 1608, 1634 (C=C stretch.Ar), 1680, 1685 (N-C=O stretch), 1700 (-C=O stretch. Ester), 2955 (-CH<sub>3</sub> stretch.), 3092 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  2.2(s, 3H), 3.9(s, 6H), 6.3-7.2 (m, 9H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  12.15, 53.02, 112.12, 114.82, 115.79, 131.67, 131.72, 139.21, 154.11, 157.91, 167.91, 168.11. MS: *m/z* (%): 394 (51), 381 (23), 368 (32), 359 (17), 341(16), 328 (16), 304 (23), 281 (24), 269 (14), 246 (100), 229 (15), 208 (15), 184 (25), 171 (17), 154 (14), 131 (16), 118 (19), 91 (26), 80 (23), 74 (13), 51 (19), 34 (15). UV spectrum:  $\lambda_{\text{max}}$  207.6, abs. 0.673. Molecular formula: C<sub>21</sub>H<sub>18</sub>N<sub>2</sub>O<sub>6</sub>. Elemental analysis: Calculated: C (63.96%), H (4.57%), N (7.11%). Found: C (64.05%), H (4.62%), N (7.15%).

**1, 3-di (2-naphthyl)-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4e)**

Viscous oil. IR (KBr,  $\text{cm}^{-1}$ ): 1335(C-N stretch), 1608, 1640(C=C stretch.Ar), 1682, 1689 (N-C=O stretch), 2874-2989 (-CH<sub>3</sub> stretch.), 3090 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  2.0 (s, 3H), 6-7.4 (m, 15H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  11.45, 108.4, 110.71, 118.11, 124.12, 125.89, 126.61, 128.23, 129.88, 130.21, 133.89, 139.09, 153.91, 154.09, 168.12. MS: *m/z* (%): 378 (54), 366 (17), 254 (34), 243 (14), 231 (63), 222 (24), 216 (32), 205 (100), 190(18), 187 (16), 179 (52), 164 (34), 160 (31), 151 (37), 146(18), 132 (24), 124 (17), 117 (56), 104 (26), 98 (46), 84 (13), 77 (13), 70 (16), 56 (19). UV spectrum:  $\lambda_{\text{max}}$  205.4, abs. 0.891. Molecular formula: C<sub>25</sub>H<sub>18</sub>N<sub>2</sub>O<sub>2</sub>. Elemental analysis: C (79.37%), H (4.76%), N (7.41%). Found: C (79.45%), H (4.65%), N (7.51%).

**1, 3-di (4-carbethoxy-2, 6-dimethoxy phenyl)-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4f)**

Viscous oil. IR (KBr,  $\text{cm}^{-1}$ ): 1200 (-C-O stretch. Ester), 1244 (C-O-C stretch.), 1341 (C-N stretch), 1600, 1640(C=C stretch.Ar), 1680, 1691 (N-C=O stretch), 1715 (-C=O stretch. Ester), 2854-2998 (-CH<sub>2</sub>, -CH<sub>3</sub> stretch.), 3091 (C-H stretch.Ar-H). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>):  $\delta$  1.4 (t, J=6.7 Hz, 6H), 2.3 (s, 3H), 3.8 (s, 12H), 4.38 (q, J=7.4 Hz, 4H), 6.2-7.5 (m, 5H). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>):  $\delta$  12.11, 15.02, 55.83, 60.89, 107.12, 111.12, 138.82, 140.32, 142.23, 146.89, 152.79, 158.41, 167.09, 167.82. MS: *m/z* (%): 542 (23), 531 (16), 512 (21), 482(16), 468 (15), 444 (28), 431 (17), 403 (23), 383 (13), 369 (19), 352 (31), 317 (100), 298 (24), 268 (15), 224 (21), 203 (12), 183 (25), 161 (14), 134 (27), 109 (11), 87 (40), 69 (20), 48 (13), 36 (17). UV spectrum:  $\lambda_{\text{max}}$  211.4, abs. 1.178. Molecular formula: C<sub>27</sub>H<sub>30</sub>N<sub>2</sub>O<sub>10</sub>. Elemental analysis: Calculated: C (59.78%), H (5.54%), N (5.17%). Found: C (59.87%), H (5.47%), N (5.29%).

**2, 4-di (2-ethoxyphenyl)-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4g)**

Viscous oil. IR (KBr,  $\text{cm}^{-1}$ ): 1240(C-O-C stretch.), 1349 (C-N stretch), 1614, 1640 (C=C stretch.Ar), 1680, 1691 (N-C=O stretch), 2854-2955 (-CH<sub>2</sub>, -CH<sub>3</sub> stretch.), 3092 (C-H



stretch.Ar-H).  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  1.5(t,  $J=7.8\text{Hz}$ , 6H), 2.0 (s, 3H), 4.1 (q,  $J=7.8\text{Hz}$ , 4H), 6.2-7.3 (m, 9H).  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  11.89, 13.91, 64.68, 109.82, 110.51, 123.89, 127.12, 139.01, 147.92, 154.01, 157.77, 168.11. MS:  $m/z$  (%): 366 (53), 357 (48), 342 (26), 332 (19), 317 (15), 302 (14), 291 (31), 282 (14), 271 (100), 258 (16), 241 (18), 230 (26), 213 (19), 197(13), 181 (14), 173 (26), 149 (16), 131 (29), 106 (17), 93 (15), 76 (28), 61 (24), 41(18). UV spectrum:  $\lambda_{\text{max}}$  212.8, abs. 0.768. Molecular formula:  $\text{C}_{21}\text{H}_{22}\text{N}_2\text{O}_4$ . Elemental analysis: Calculated: C (68.85%), H (6.01%), N (7.65%). Found: C (68.96%), H (6.12%), N (7.71%).

### 2, 4-di (3-ethoxyphenyl)-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4h)

Viscous oil. IR (KBr,  $\text{cm}^{-1}$ ): 1232 (C-O-C stretch.), 1342 (C-N stretch), 1600, 1640(C=C stretch.Ar), 1678, 1690 (N-C=O stretch), 2854-2961(- $\text{CH}_2$ , - $\text{CH}_3$  stretch.), 3086 (C-H stretch.Ar-H).  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ): 1.4 (t,  $J=7.6\text{Hz}$ , 6H), 2.2 (s, 3H), 4.3 (q,  $J=8.1\text{Hz}$ , 4H), 6.0-7.3 (m, 9H).  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  12.05, 15.03, 64.11, 102.31, 107.11, 107.93, 110.69, 130.33, 138.78, 153.89, 157.03, 160.11, 168.25. MS:  $m/z$  (%): 366 (25), 349 (26), 336 (19), 324 (17), 312 (17), 306 (16), 297 (100), 280 (16), 268 (20), 252 (26), 243 (38), 219 (18), 193 (16), 179 (31), 170 (24), 153 (22), 140 (14), 129 (19), 109 (13), 89(19), 70 (18), 52 (16), 39 (14). UV spectrum:  $\lambda_{\text{max}}$  210.3, abs. 0.548. Molecular formula:  $\text{C}_{21}\text{H}_{22}\text{N}_2\text{O}_4$ . Elemental analysis: Calculated: C (68.85%), H (6.01%), N (7.65%). Found: C (68.97%), H (6.10%), N (7.52%).

### 1, 3-di (4-chloro-3, 5-dimethylphenyl)-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4i)

m.p.: 153°C. IR (KBr,  $\text{cm}^{-1}$ ): 784 (-Cl stretch.), 1356 (C-N stretch), 1611, 1632 (C=C stretch.Ar), 1684, 1695 (N-C=O stretch), 2876-2955 (- $\text{CH}_3$  stretch.), 3091 (C-H stretch.Ar-H).  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  1.4 (s, 12H), 1.8 (s, 3H), 6.2-7.5 (m, 5H).  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  11.58, 21.10, 111.23, 115.72, 126.21, 138.11, 139.25, 151.92, 152.98, 167.9. MS:  $m/z$  (%): 403 (18), 388 (19), 264 (18), 249 (32), 223 (32), 221 (100), 207 (11), 201 (19), 194 (15), 193 (18), 183 (14), 181 (11), 179 (21), 158 (12), 140 (14), 139 (16), 120 (23), 104 (16), 91 (26), 78 (14), 67 (12), 65 (16). UV spectrum:  $\lambda_{\text{max}}$  212.1, abs. 0.768. Molecular formula:  $\text{C}_{21}\text{H}_{20}\text{N}_2\text{O}_2\text{Cl}_2$ . Elemental analysis: Calculated: C (62.53%), H (4.96%), N (6.95%), Cl (17.62%). Found: C (62.45%), H (5.05%), N (6.85%), Cl (17.53%).

### 1, 3-diphenyl-(1H, 3H)-6-methylpyrimidine-2, 4-dione (4j)

m.p.:109°C. IR (KBr,  $\text{cm}^{-1}$ ): 1335 (C-N stretch), 1608, 1640 (C=C stretch.Ar), 1682, 1689 (N-C=O stretch), 2874-2989 (- $\text{CH}_3$  stretch.), 3092 (C-H stretch.Ar-H).  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  2.0 (s, 3H), 6.2-7.5 (m, 11H).  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  12.19, 113.21, 116.2, 120.89, 129.12, 135.89, 152.92, 154.79, 167.79. MS:  $m/z$  (%): 278 (17), 256 (19), 251 (12), 229 (21), 207 (100), 190 (24), 179 (16), 154 (14), 132 (41), 118 (37), 101 (30), 89 (22), 67 (17), 49 (16), 34 (20). UV spectrum:  $\lambda_{\text{max}}$  210.7, abs. 1.231.

Molecular formula:  $\text{C}_{17}\text{H}_{14}\text{N}_2\text{O}_2$ . Elemental analysis: Calculated: C (73.38%), H (5.04%), N (10.07%). Found: C (73.47%), H (4.96%), N (10.11%).

**Table 1:** Time and yield of the synthesized compounds 4a-4j

	Conventional heating		Microwave irradiation	
	Time (minutes)	% Yield	Time (minutes)	% Yield
4a	50	48	16	71
4b	90	43	18	68
4c	90	46	18	66
4d	80	47	13	71
4e	100	44	17	69
4f	90	43	18	65
4g	65	47	20	71
4h	85	43	15	61
4i	80	44	15	69
4j	70	42	16	65

## CONCLUSION

2, 4-diaryloxy-6-methylpyrimidines for the first time underwent facile *Chapman rearrangement* to afford the corresponding 1, 3-disubstituted-6-methylpyrimidine-2, 4-diones under conventional heating as well as microwave irradiation.

Microwave assisted method of synthesis provides a simpler and environmental-friendly alternative for the conventional procedures.

The synthesis of novel heterocycles reported in this paper has the potential of exhibiting agrochemical and pharmacological activities.

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