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Green Chemistry and Biginelli Reaction

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Abstract

Synthesis of some 5-acetyl-6-methyl-4-aryl-3,4-dihydropyrimidne-2-one, 5-acetyl-6-methyl-4-aryl-3,4-dihydropyrimidne-2-thione, 5-ethoxycarbonyl-6-methyl-4-aryl-3,4-dihydropyrimidine-2-one and 5-ethoxycarbonyl-6-methyl-4-aryl-3,4-dihydropyrimidine-2-thione by green chemistry methods without catalysis and without solvent, the reaction progress was followed by TLC analysis and the chemical structure confirmed by spectroscopic analysis (UV, IR and MS).

Keywords: Green chemistry; Biginelli; reaction.

1. Introduction

Green chemistry is synthetic pathways for pollution prevention, green chemistry is a new way of looking at chemicals and their manufacturing processes to minimize any negative environmental effects [1]. These can achieved by prevent waste, synthetic methods should designed to maximize the incorporation of all materials used in the process into the final product and the use of auxiliary substances should be made unnecessary whenever possible and innocuous when used [2]. Biginelli reaction involves the condensation of β-ketoester with aromatic aldehyde and urea in the presence of HCl as catalyst and ethanol as solvent [3].

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2. Materials and methods

All chemicals used in this work were of analytical grade, melting point were determined by Gallenkamp melting point apparatus and were incorrect. UV- spectrophotometer model (shimadzu, Japan) the wavelength express in nm. IR spectrum (in KBr disk) is recorded using FTIR 4800s instrument model (shimadzu, Japan) the frequency are expressed in cm^{-1}.

2.1 General procedure for synthesis of 5-acetyl-6-methyl-4-aryl-3,4-dihydropyrmidne-2-one

in a 1 litre round bottom flask equipped with a reflux condenser were placed 0.01mol of the required aromatic aldehyde , 0.01mol acetyacetone and 0.01mol urea the mixture was heating with stirring under reflux for 5hours, after complete the reaction as indicate by TLC developing system methanol: chloroform (2:8), the resulting mixture kept overnight in refrigerator and then pour in 15ml cool water with shaking to precipitate the product.

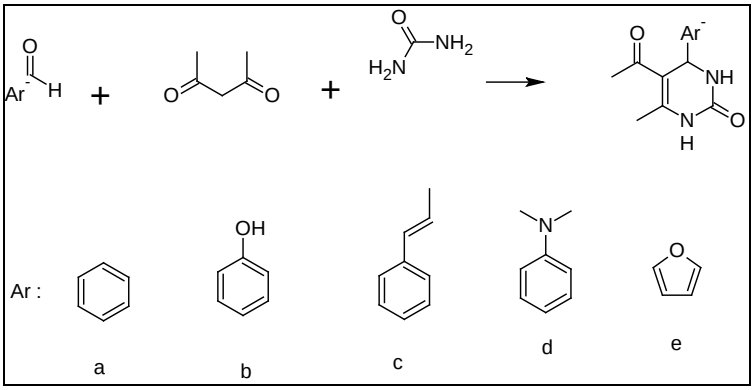

Figure 1: chemical structure of 5-acetyl-6-methyl-4-aryl-3,4-dihydropyrimidine-2-one

I_a- 5-acetyl-6-methyl-4-phenyl-3,4-dihydropyrimidine-2-one :**yield** 95.5% ; **mp** 245-246°C ; **UV-VIS (nm)** λmax 323 ; **IR (KBr, cm^{-1})** 3257(N-H_s) 3124 (C-H_s) 2920 (C-H_s) 1701(C=O_s) 1598(C=C_s) 705(Ar-H_b); **MS** 229 molecular ion 153base peak m/z 50,68,91,110,131,169,187,215..

I_b -5-acetyl-6-methyl-4-(2-hydroxy-phenyl)3,4-dihydropyrimidine-2-one : **yield** 80%; **mp** 207-209°C; **UV-VIS (nm)** λmax 252.5; **IR (KBr, cm^{-1})** 3110 (N-H_s) 3024 (C-H_s) 2941 (C-H_s) 1712(C=O_s) 1508(C=C_s) 3236(O-H) ; **MS** 246 molecular ion 203base peak m/z 50,57,77,91,111,144,160,189.

I_c- 5-acetyl-6-methyl-4-(cinnamyl)-3,4-dihydropyrimidine-2-one : **yield** 61%; **mp** 222-225°C; **UV-VIS (nm)** λmax 256.3; **IR (KBr, cm^{-1})** 3278 (N-H_s) 3116 (C-H_s) 2945 (C-H_s) 1695 (C=O_s) 999 (C=C_s) **; MS** 257 molecular ion 196 base peak m/z 50, 63 ,77 ,115, 141, 168, 211. .

I_d -5.acetyl-6-methyl-4-(4-dimethylamino-phenyl)-3,4-dihydropyrimidine-2-one: **yield** 92%; **mp** 220-221°C; **UV-VIS (nm)** λmax 260, 322; **IR (KBr, cm^{-1})** 3294 (N-H_s) 3114 (C-H_s) 2900 (C-H_s) 1697 (C=O_s) 1610 (C=C_s) 1236 (C-N_s) ; **MS** - molecular ion 177base peak m/z 50, 65,77 ,94,, 106, 122,

134,149,166,191,203,220..

I_a- 5-acetyl-6-methyl-4-furyl-3,4-dihydropyrimidine-2-one : **yield** 68%; **mp** 216-217°C; **UV-VIS (nm)** λmax 324; **IR (KBr, cm^{-1})** 3334(N-H_s) 3101 (C-H_s) 2952 (C-H_s) 1693 (C=O_s) 1620 (C=C_s) 1234 (C-O_s) ; **MS** 220 molecular ion 177 base peak m/z 50, 68 ,77 ,94, 106, 122, 149,166,191,203.. .

2.2 General procedure for synthesis of 5-acetyl-6-methyl-4-aryl-3,4-dihydropyrmidne-2-thione

in a 1 litre round bottom flask equipped with a reflux condenser were placed 0.01mol of the required aromatic aldehyde , 0.01mol acetyacetone and 0.01mol thiourea the mixture was heating with stirring under reflux for 5hours, after complete the reaction as indicate by TLC developing system methanol: chloroform (1:9), the resulting mixture kept overnight in refrigerator and then pour in 15ml cool water with shaking to precipitate the product.

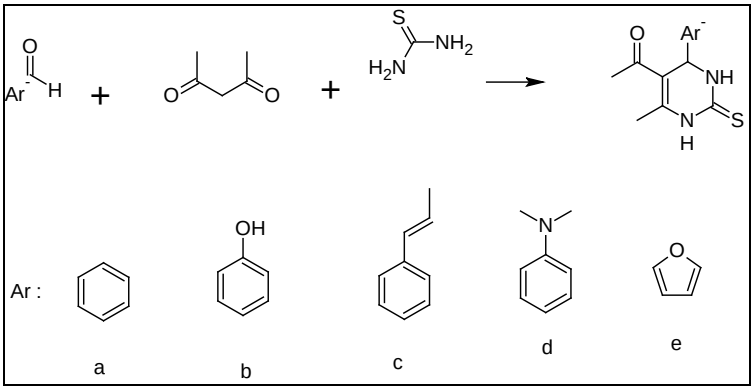

Figure 2: chemical structure of 5-acetyl-6-methyl-4-aryl-3,4-dihydropyrimidine-2-thione

II_a -5-acetyl-6-methyl-4-phenyl-3,4-dihydropyrimidine-2-thione : **yield** 88%; **mp** 234-235°C; **UV-VIS (nm)** λmax 300; **IR (KBr, cm^{-1})** 3296 (N-H_s) 3199 (C-H_s) 2993 (C-H_s) 1608 (C=O_s) 1577(C=C_s) 1180 (C=S_s) 757(Ar-H_b) ; **MS**- molecular ion 274 base peak m/z 50, 67, 77, 91, 110, 120, 137, 144, 155,175, 230, 239, 288.303.

II_b -5-acetyl-6-methyl-4(2-hydroxy-phenyl)-3,4-dihydropyrimidine-2-thione : **yield** 84%; **mp** 210-211°C; **UV-VIS (nm)** λmax 288; **IR (KBr, cm^{-1})** 3145 (N-H_s) 2954 (C-H_s) 1714(C=O_s) 1568(C=C_s) 1089 (C=S_s) 3226(O-H) ; **MS** 261 molecular ion 220 base peak m/z 50, 65, 77, 91, 104, 120, 127, 145, 160, 205.

II_c -5-acetyl-6-methyl-4-(cinnamyl)-3,4-dihydropyrimidine-2-thione : **yield** 48%; **mp** 240-241°C; **UV-VIS (nm)** λmax 255, 285, 293; **IR (KBr, cm^{-1})** 3280 (N-H_s) 3170 (C-H_s) 2995 (C-H_s) 1616 (C=O_s) 1573 (C=C_s) 1186(C=S) 1014(C=C) ; **MS** 271 molecular ion 245 base peak m/z 51, 68, 77, 91, 110, 115, 130, 144, 160, 169,187, 202, 219, 261.

II_d -5_acetyl-6-methyl-4-(4-dimethylamino-phenyl)-3,4-dihydropyrimidine-2-thione: **yield** 34%; **mp** 228-229°C; **UV-VIS (nm)** λmax 259, 300; **IR (KBr, cm^{-1})** 3286(N-H_s) 3180 (C-H_s) 2887 (C-H_s) 1612 (C=O_s) 1579(C=C_s)

1235(C-N_s) ; **MS** -molecular ion 181 base peak m/z 50, 68, 77, 91, 110, 128, 153, 196, 212, 229, 239, 255, 272. II_e -5-acetyl-6-methyl-4-furyl-3,4-dihydropyrimidine-2-thione : **yield** 70%; **mp** 244-245°C; **UV-VIS (nm)** λmax 296; **IR (KBr, cm^{-1})** 3286(N-H_s) 3193 (C-H_s) 2987(C-H_s) 1610 (C=O_s) 11573 (C=C_s) 1180(C=S_s) 1112(C-Os) ; **MS** 236 molecular ion 236 base peak m/z 51, 65, 77, 94, 106, 121, 134, 162,176,193,203,219. .

2.3 General procedure for synthesis of 5-ethoxycarbonyl-6-methyl-4-aryl-3,4-dihydropyrmidne-2-one

In a 1 litre round bottom flask equipped with a reflux condenser were placed 0.01mol of the required aromatic aldehyde , 0.01mol ethyl acetoacetate and 0.01mol urea the mixture was heating with stirring under reflux for 5hours, after complete the reaction as indicate by TLC developing system methanol: chloroform (2:8), the resulting mixture kept overnight in refrigerator and then pour in 15ml cool water with shaking to precipitate the product.

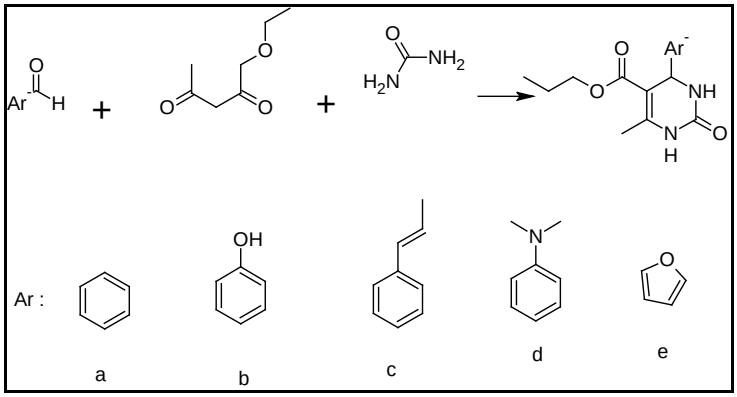

Figure 3: chemical structure of 5-ethoxycarbonyl-6-methyl-4-aryl-3,4-dihydropyrimidine-2-one

III_a -5-ethoxycarbonyl-6-methyl-4-phenyl-3,4-dihydropyrimidine-2-one: **yield** 88%; **mp** 210-212°C; **UV-VIS (nm)** λmax 337,240; **IR (KBr, cm^{-1})** 3440(N-H_s) 3344(C-H_s) 2804(C-H_s) 1681(C=O_s) 1623(C=C)788(Ar-H_b) 1153(C-Os) ; **MS** 260 molecular ion 183 base peak m/z 51, 67, 77, 96, 110, 137, 144, 155, 172, 214, 231, 245.

III_b -5-ethoxycarbonyl-6-methyl-4-(2-hydroxy-phenyl)-3,4-dihydropyrimidine-2-one: **yield** 89%; **mp** 207-209°C; **UV-VIS (nm)** λmax 254; **IR (KBr, cm^{-1})** 3330(N-H_s) 3074(C-H_s) 2941(C-H_s) 1749 (C=O_s)1508(C=C) 3238(O-H_s) 1244(C-Os). **MS** - molecular ion 193 base peak m/z 50, 65, 77, 94, 106, 121, 134, 153, 178, 237, 266.

III_c -5-ethoxycarbonyl-6-methyl-4-cinnamyl-3,4-dihydropyrimidine-2-one : **yield** 89%; **mp** 240-242°C; **UV-VIS (nm)** λmax 330; **IR (KBr, cm^{-1})** 3242(N-H_s) 3110(C-H_s) 2975(C-H_s) 1720(C=O_s) 779 (C=$C_{s,cis}$) 1286(C-Os). **MS** - molecular ion 73 base peak m/z 51, 69, 85, 98, 115, 130, 149, 207. III_d -5-ethoxycarbonyl-6-methyl-4-(4-dimethylaminophenyl)-3,4-dihydropyrimidine-2-one: **yield** 50%; **mp** 248-250°C; **UV VIS (nm)** λmax274; **IR (KBr, cm^{-1})** 3448(N-H_s) 3244(C-H_s) 2925(C-H_s) 1701(C=O_s) 1166(C-N_s) 1230(C-Os). **MS** - molecular ion 257 base peak m/z 50, 67, 77, 91, 110, 137, 151, 183, 213,240, 286

III_e 5-ethoxycarbonyl-6-methyl-4-furyl-3,4-dihydropyrimidine-2-one : **yield** 51% **mp** 203-205°C **UV-VIS (nm)**

λmax258, 281**; IR (KBr, cm^{-1})** 3452(N-H_s) 2920(C-H_s) 1654(C=O_s) 1546 (C=$C_{s,}$) 1230(C-Os). **MS** 250molecular ion 177 base peak m/z 52, 65, 77, 94, 110, 124, 137, 150, 162,193,203,221,233.

2.4 General procedure for synthesis of 5-ethoxycarbonyl-6-methyl-4-aryl-3,4-dihydropyrmidne-2-thione

in a 1 litre round bottom flask equipped with a reflux condenser were placed 0.01mol of the required aromatic aldehyde , 0.01mol ethyl acetoacetate and 0.01mol thiourea the mixture was heating with stirring under reflux for 5hours, after complete the reaction as indicate by TLC developing system methanol: chloroform (1:9), the resulting mixture kept overnight in refrigerator and then pour in 15ml cool water with shaking to precipitate the product.

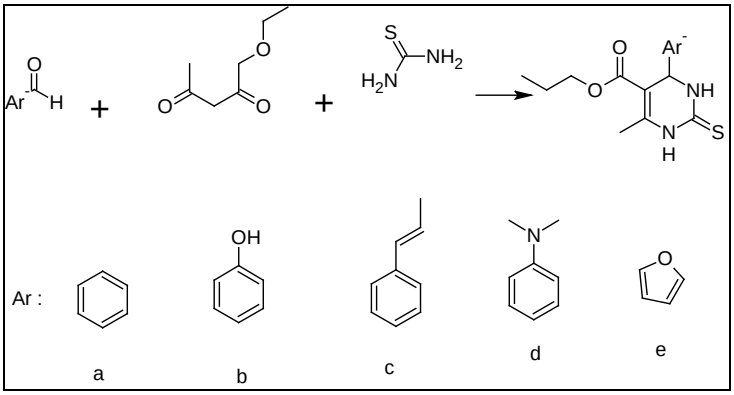

Figure 4: chemical structure of 5-ethoxycarbonyl-6-methyl-4-aryl-3,4-dihydropyrimidine-2-thione

IV_a5-ethoxycarbonyl-6-methyl-4-phenyl-3,4-dihydropyrimidine-2-thione: **yield** 89% **; mp** 208-210°C**; UV VIS (nm)** λmax 216, 296 ; **IR (KBr, cm^{-1})** 3328(N-H_s) 3174(C-H_s) 2979(C-H_s) 1670 (C=O_s) 1118(C=S) 761(Ar-H_b) ; **MS** 276 molecular ion 199 base peak m/z 50, 67, 77, 91, 103, 115, 128, 153,171,230,24,161.

IV_b5-ethoxycarbonyl-6-methyl-4-(2-hydroxy-phenyl)-3,4-dihydropyrimidine-2-thione: **yield** 85.5%; **mp** 198°C**; UV VIS (nm)** λmax 257, 306 ; **IR (KBr, cm^{-1})** 3365(N-H_s) 3170(C-H_s) 2705(C-H_s) 1728(C=O_s) 1087(C=S) 2378(O-H_S) ; **MS -**molecular ion 328 base peak m/z 51, 67, 77, 91, 105, 115, 127, 152, 167, 221, 239, 267, 295, 315.

IV_c5-ethoxycarbonyl-6-methyl-4-cinnamyl-3,4-dihydropyrimidine-2-thione: **yield** 60%; **mp** 166°C**; UV VIS (nm)** λmax253; **IR (KBr, cm^{-1})** 3161(N-H_s) 2979(C-H_s) 1706(C=O_s) 1191(C=S)752(C=$C_{s\ cis}$) ; **MS-** molecular ion 60 base peak m/z 55,73,95, 98, 129,207.

IV_d5-ethoxycarbonyl-6-methyl-4-(4-dimethylaminophenyl)-3,4-dihydropyrimidine-2-thione: **yield** 50%; **mp** 207-209°C**; UV VIS (nm)** λmax308 ; **IR (KBr, cm^{-1})**3326(N-H_s) 3172(C-H_s) 2981(C-H_s) 1670(C=O_s) 1182(C=S)1116(C-N_s) ; **MS-** molecular ion 193 base peak m/z 50, 53, 65, 77, 94, 106, 121, 134, 153, 178, 237, 266.

IV_e5-ethoxycarbonyl-6-methyl-4-furyl-3,4-dihydropyrimidine-2-thione: **yield** 73%; **mp** 206-208°C; **UV VIS**

(nm) λmax257, 308 ; **IR (KBr, cm^{-1})** 3311(N-H_s) 3176(C-H_s) 2983(C-H_s) 1662(C=O_s) 1186(C=S) 1112(C-O_s) ; **MS** 266 molecular ion 193 base peak m/z 50, 65, 77, 94,106, 221, 237.

3. Conclusion

The green chemistry getting so much attention due to the generation over the exact nature of the environmental hazards that have been generated as a result of the release of various synthetic chemicals into the environment, so chemists must try to make the work they do and the substances they use as environmentally benign as possible is that we can, most published of Biginelli reaction involved catalyst and solvent as part of reaction the modified in this research is the Biginelli reaction carried out without catalyst and solvent.

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