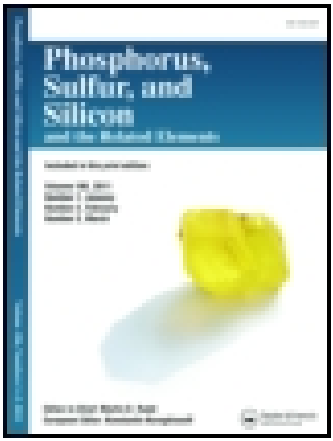

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Synthesis and Antimicrobial of Some Novel-5-carbomethoxy-2-pyridone Derivatives Containing Sulfonamide Moiety

Fatma El-Mariah [a] & Ekhlass Nassar [a]
[a] Department of Chemistry, Faculty of Girls , Ain Shams University , Cairo, Egypt
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Synthesis and Antimicrobial of Some Novel-5-carbomethoxy-2-pyridone Derivatives Containing Sulfonamide Moiety

Fatma El-Mariah and Ekhlass Nassar
Department of Chemistry, Faculty of Girls, Ain Shams University, Cairo, Egypt

Dimethyl 4-(methoxymethylene)-2-pentenedioate ***2*** *was selected as the starting material for the synthesis of some novel 2 - pyridones containing sulfonamide moiety, which we expected to have biological activities such as bactericidal and fungicidal or other applications of certain interest.*

Keywords Antimicrobial activity; coumalic acid; p-substituted aniline; n-substituted 5-carbomethoxy-2-pyridones

INTRODUCTION

A number of biologically active compounds possessing 2-pyridone moiety have been known.[1–3] On the other hand, 5-carboxy-2-pyridone has been used as a key intermediate for the synthesis of recently developed insecticide. There have been several reports for the synthesis of carboalkoxy-2-pyridones from alkylcoumalate.[4] However, preparations of alkylcoumalate from coumalic acid **1** have some problems such as low yield or use of expensive coupling agents.[5] Also, the yields for the synthesis of N-aryl-5-carboalkoxy-2-pyridones, from alkylcoumalate were poor.[4a] Other synthetic methods for carboalkoxy-2-pyridones consist of cyclization of dienamino esters prepared from enamino ester[6a] or cyclic sulfonamide.[6b] We have been interested in the synthesis of some heterocycles containing sulfonamide moiety.[7] This is because they have been found to possess a wide range of

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Address correspondence to Ekhlass Nassar, Department of Chemistry, Faculty of Girls, Ain Shams University, Cairo. E-mail: ekhlass_nassar@hotmail.com

biological activities[8]such as anticonvulsant, hypoglycemic, antihypertensive, histamine-H_2-receptor antagonistic, and herbicidal activities.[3]

RESULTS AND DISCUSSION

We now wish to report a new and facile synthesis of 2-pyridones containing the sulfonamide moiety using a microwave oven based methodology with the aim of finding compounds with promising biological activities.

The precursor, dimethyl 4-(methoxymethylene)-2-pentene dioate **2** was synthesized using a published procedure[1] through the reaction of coumalic acid **1** with acetyl chloride in methanol at refluxing temperature (Scheme 1).

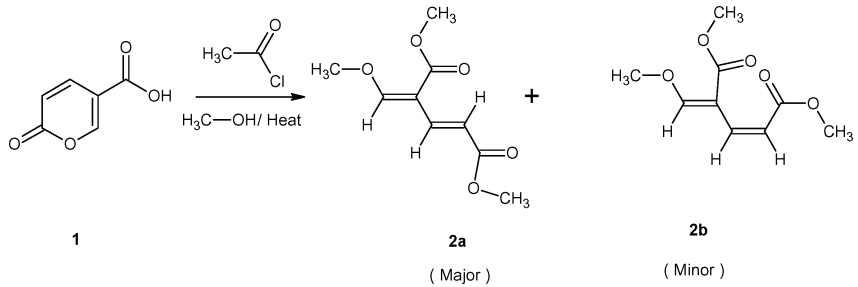
The reactivity of **2a**,**b** with amines was studied in the aim to form pyridone derivatives with potential biological activity. Thus the reaction of compound **2** with *p*-substituted aniline[9] gave one isomer of dienamino ester **3a–j**. The structures of the latter products were based on analytical and spectral data.

Compounds **3a–j** underwent ready cyclization[1] when irradiated in a microwave oven in the presence of dimethyl formamide for 3 minutes to give the corresponding N-substituted 5-carbomethoxy-2-pyridones **4a–j** (Scheme 2).

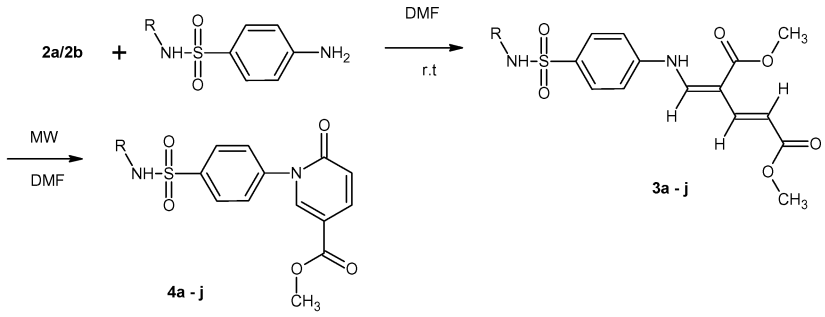
The structures of these products were established on the basis of their analytical and spectral data. All the synthesized compounds were screened for antimicrobial activity against representative Gram positive and Gram negative bacteria, and fungi.

Antimicrobial Activity

Applying the agar plate diffusion technique,[10]some of the newly synthesized compounds were screened in vitro for antimicrobial activity



SCHEME 1



3, 4 a, R = H **f**, R = $C_6H_4CH_3$ (*p* -)

b, R = n-Pr **g**, R = C_6H_4OCH3 (*p* -)

c, R = $PhCH_2$ **h,** R = C_6H_4Cl (*p* -)

d, R = PhNH **i,** R = $C_6H_4NO_2$ (*o*-)

e, R = Ph **j**, R = $C_6H_4NO_2$ (*p* -)

SCHEME 2

against representative Gram positive bacteria *(Staphylococcus aureus*, *Bacillus subtilis),* Gram negative bacteria (*Escherichia coli, Pseudomonas aeruginosa*), yeast, *(Candida albicans),* and fungi, (*Aspergillus niger*). In this method a standard 5-mm diameter sterilized filter paper disc impregnated with the compound (0.3 mg/0.1 ml of dimethyl-formamide) was placed on an agar plate seeded with the tested organism. The plates were incubated for 24 h at 37°C for bacteria and 28°C for fungi. The zone of inhibition of bacterial and fungal growth around the disc was observed. The screened results given in Table I revealed that the synthesized compounds showed high or moderate antimicrobial activity against tested Gram positive bacteria *staphylococcus aureus*, (compounds number; **3a**, **3c**, **3g**, **3h**, **3i**, **3j**, **4a**, **4b**, **4c**, **4g**, **4h**, **4i**) and *Bacillus subtilis* (compounds number; **3c**, **3h**, **4a**, **4b**, **4c**, **4e**, **4i**, **4j**). Only six compounds (**3c, 3h, 4a, 4b, 4c, 4i**), showed antimicrobial activity against both tested organisms, this is because these compounds contain (R = $PhCH_2$, C_6H_4Cl ($p-$), *H*, n-Pr, $PhCH_2$, $C_6H_4NO_2$($o-$)), respectively.

On the other hand, all synthesized compounds showed high (number; **3d, 3f, 3j, 4a, 4c, 4d, 4g, 4i, 4j**) or moderate (number; **3a, 3b, 3c, 3e, 3g, 3h, 3i, 4b, 4e, 4f, 4h**) antimicrobial activity against tested Gram negative bacteria *Escherichia coli*. On the other hand no antimicrobial activity obtained against tested Gram negative bacteria

TABLE I Antibacterial and Antifungal Activity

No.	*Staphylococcus aureus*	*Bacillus subtilis*	*Escherichia coli*	*Pseudomonas aeruginosa*	*Candida albicans*	*Aspergillus nigar*
3a	++	−	++	−	−	−
3b	−	−	++	−	−	−
3c	+++	++	++	−	−	−
3d	−	−	+++	−	−	−
3e	−	−	++	−	−	−
3f	−	−	+++	−	−	−
3g	++	−	+	−	−	−
3h	++	+++	++	−	−	−
3i	++	−	++	−	−	−
3j	++	−	+++	−	−	−
4a	+++	+++	+++	−	−	−
4b	++	++	++	−	−	−
4c	++	++	+++	−	−	−
4d	−	−	+++	−	−	−
4e	−	++	++	−	−	−
4f	−	−	+	−	−	−
4g	++	−	+++	−	−	−
4h	++	−	++	−	−	−
4i	++	++	+++	−	−	−
4j	−	++	+++	−	−	−
Ciprofloxacin	+++	+++	+++	+++	−	−
Fungicide Nystin	−	−	−	−	+++	+++

Zone of inhibition: + = 10–15 mm; ++ = 15–20 mm; +++ = 20–25 mm; − = No inhibition.

Pseudomonas aeruginosa. It should be mentioned here that (compounds number **3a, 3c, 3g, 3h, 3i, 3j, 4a, 4b, 4c, 4e, 4g, 4h, 4i, 4j**) showed antimicrobial activity against both tested Gram positive and Gram negative bacteria, whereas the highest antimicrobial activity was obtained by compound (**4a)**, which contains (R=H). Moreover synthesized compounds did not show any antimicrobial activity against both tested yeast, (*Candida albicans*) and fungi, *(Aspergillus nigar)*.

Finally, results of antimicrobial activity revealed that synthesized compounds showed high antimicrobial activity against bacteria than fungi. It could be concluded from these results that the biologically active compounds are nearly as active as standard antibiotic Ciprofloxacin against the tested both Gram positive bacteria *Staphylococcus aureus* and *Bacillus subtilis* and Gram negative bacteria

Escherichia coli and are completely inactive against tested yeast, (*Candida albicans*) and fungi,*(Aspergillus nigar)*.

EXPERIMENTAL

Melting points were determined in open glass capillaries and are uncorrected. Elemental analyses were carried out in the microanalytical laboratory of the Faculty of Science, Cairo, University. The IR spectra of compounds were recorded on a Perkin-Elmer; spectrophotometer model 1430 as potassium bromide pellets and frequencies are reported in Cm^{-1}. The mass spectra were recorded on a mass spectrometer HP model MS 5988 El 70 eV. The ^{1}H-NMR spectra were observed on Perkin-Elmer R12B spectrometer and chemical shifts δ are in ppm relative to internal TMS. Microwave oven (1000 watt, 30−80% of its total power), input 230−240 volt 50 Hz, 1400 Watt. Output 2450 M. Hz 900 Watt. Reactions were routinely followed by thin layer chromatography (TLC) on silica gel F_{254} aluminum sheets (Merck). The spots were detected by U.V irradiation at 254−336 nm. Compound 1 and 2 were synthesized as reported previously.[10,11]

Synthesis of Dienamino Benzene Sulfonamido Esters (3a-j)—General Procedure

P-substituted aniline (2.5 mmol) was added to a solution of dimethyl 4-(methoxymethylene)-2-pentenedioate **2a,b** (2.5 mmol, 0.5 g) in dimethylformamide (5 ml). The reaction mixture was stirred at room temperature for 15 min, poured into water and extracted with ethyl acetate. The organic layer was washed with brine and water, dried over magnesium sulfate, evaporated under reduced pressure, to afford crude solid product which was recrystallized from ethanol to give **3a–j**.

Dimethyl (2E,4Z)-4-{[(4-sulfamoylphenyl) amino] methylene}pent-2-enedioate (3a)

Yield (0.41 g, 82%), m.p. 210−211°C; IR: 3369, 3300 (NH, Amine and Sulfonamide), 3100, 851 (C−H, Ar), 1760 (C=O, Ester), 1658 (C=C, Alkene), 1595 (C=C, Ar-ring), 1370 (S=O, Asy.), 1156 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 340 (M^+, 1), 255 (2), 199 (2), 173 (10), 172 (100), 156 (43), 92 (13),. Anal. calcd. for $C_{14}H_{16}N_2O_6S$:C, 49.40; H, 4.74; N, 8.23; Found: C, 49.70; H, 4.80; N, 8.40.

Dimethyl (2E,4Z)-4-({[4-(propylsulfamoyl) phenyl] amino}methylene)pent-2-enedioate (3b)

Yield (0.4 g, 80%), m.p. 124–126°C; IR: 3468, 3375 (NH, Amine and Sulfonamide), 3098, 835 (C–H, Ar), 1734 (C=O, Ester), 1632 (C=C, Alkene) 1595 (C=C, Ar-ring), 1360 (S=O, Asy.), 1161 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 382 (M^+, 5), 368 (11), 337 (13), 336 (7), 321 (7), 293 (9), 264 (13), 240 (100), 239 (37), 238 (9), 213 (30), 199 (20), 122 (53), 92 (42), 91 (21), 60 (38), 57 (68). ^{1}H-NMR (DMSO-d_6): δ 0.89–0.91 (t, 3H, CH_3), 1.26–2.12 (m, 2H, CH_2), 2.18–2.25 (t, 1H, NH),3.17–3.20 (t, 2H, CH_2), 3.76 (s, 6H, $2OCH_3$), 4.0 (s, 1H, NH), 6.51–6.54 (dd, 2H, Ar), 6.68 (s, 1H, =CH), 6.70–6.71 (d, 1H, =CH), 7.56–7.59 (d, 1H, =CH), 7.65–7.68 (dd, 2H, Ar). Anal calcd. for $C_{17}H_{22}N_2O_6S$: C, 53.39; H, 5.80; N, 7.33; Found: C, 53.10; H, 5.90; N, 7.50.

Dimethyl (2E,4Z)-4-({[4-(benzylsulfamoyl) phenyl]amino}methylene) pent-2-enedioate (3c)

Yield (0.37 g, 74%), m.p. 180–181°C; IR: 3488, 3389 (NH, Amine and Sulfonamide), 3075, 829 (C-H, Ar.), 1720 (C=O, Ester), 1631 (C=C, Alkene), 1595 (C=C, Ar-ring), 1388 (S=O, Asy.), 1149 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 431 (M^++1, 2), 387 (2), 261 (2), 249 (3), 171 (2), 106 (4), 107 (7), 91 (10), 79 (14), 77 (8) 69 (100), 68 (20), 67 (31), 57 (62). Anal. calcd. for $C_{21}H_{22}N_2O_6S$: C, 58.59; H, 5.15; N, 6.51; Found: C, 58.30; H, 5.00; N, 6.60.

Mimethyl (2E,4Z)-4-({[4-(phenylhydrazinosulfamoyl) phenyl]amino}methylene) pent-2-enedioate (3d)

Yield (0.39g, 78%), m.p. 168–170°C; IR: 3567, 3367(NH, Amine and Sulfonamide), 3060, 830 (C-H, Ar), 1725 (C=O, Ester), 1628 (C=C, Alkene), 1594 (C=C, Ar-ring), 1400 (S=O, Asy.), 1153 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 431 (M^+, 14), 156 (34), 108 (28), 93 (19), 92 (42), 77 (72), 65 (100). Anal. calcd. for $C_{20}H_{21}N_3O_6S$: C, 55.67; H, 4.91; N, 9.74; Found: C, 55.90; H, 5.00; N, 9.60.

Dimethyl (2E,4Z)-4-({[4-(phenylsulfamoyl) phenyl] amino}methylene)pent-2-enedioate (3e)

Yield (0.4 g, 80%), m.p. 181–182°C; IR: 3476, 3350 (NH, Amine and Sulfonamide), 3040, 830 (C-H, Ar), 1720 (C=O, Ester), 1640 (C=C Alkene) 1595 (C=C, Ar-ring), 1316 (S=O, Asy.) 1151 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 416 (M^+, 5), 403 (18), 347(7), 306 (9), 280 (17), 254(12), 238 (7); 165 (29), 106 (100). Anal calcd. for $C_{20}H_{20}N_2O_6S$: C, 57.68; H, 4.84, N, 6.73; Found: C, 57.40; H, 4.90; N, 6.90.

Dimethyl(2E,4Z)-4-[({4-[(4- methylphenyl)sulfamoyl] phenyl}amino) methylene]pent-2- enedioate (3f)

Yield (0.35g, 70%), m.p. 180−182°C; IR: 3413, 3344 (NH, Amine and Sulfonamide), 3024, 811 (C-H, Ar), 1734 (C=O, Ester), 1635 (C=C, Alkene), 1596 (C=C, Ar-ring), 1320 (S=O, Asy.), 1154 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 430 (M^+, 11), 357, (12), 262 (92), 156 (57), 106 (100), 92 (77), 77 (92).^{1}H NMR (DMSO-d_6): δ 2.49 (s, 3H, CH_3), 3.63 (s, 6H, $2OCH_3$), 4.1 (s, 1H, NH), 4.3 (s, 1H, NH), 6.53–6.55 (d, 1H, =CH), 6. –6.53 (dd, 2H, Ar), 6.58−6.60 (dd, 2H, Ar),6.88−6.92 (dd, 2H, Ar), 6.93 (s, 1H, =CH), 7.38−7.41(d, 1H, =CH), 7.45−7.48 (dd, 2H, Ar). Anal.calcd.for$C_{21}H_{22}N_2O_6S$: C, 58.59; H, 5.15; N, 6.51; Found: C, 58.90; H, 5.30; N, 6.40.

Dimethyl (2E,4Z)-4-[({4-[(4- methoxyphenyl) sulfamoyl] phenyl}amino)methylene]pent-2- enedioate (3g)

Yield (0.43g, 86%), m.p. 188−189°C; IR: 3487, 3388 (NH, Amine and Sulfonamide), 3075, 829 (C-H, Ar), 1721 (C=O, Ester), 1632 (C=C, Alkene), 1595 (C=C, Ar-ring), 1388 (S=O, Asy.), 1148 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 447 (M^+, 20), 364 (25), 266 (22), 123 (44), 122 (100), 78 (48) ^{1}H NMR (DMSO-d_6):δ 3.30 (s, 3H, OCH_3), 3.65 (s, 6H, $2OCH_3$), 3.70 (s, 1H, NH), 3.80 (s, 1H, NH), 6.45−6.48 (d, 1H, =CH), 6.50 – 6.53 (dd, 2H, Ar), 6.55−6.58 (dd, 2H, Ar), 6.70−6.74 (dd, 2H, Ar), 6.95 (s, 1H, =CH), 7.25− 7.27 (d, 1H, =CH),7.30−7.33 (dd, 2H, Ar). Anal. calcd. for $C_{21}H_{22}N_2O_7S$: C, 56.49; H, 4.97; N, 6.28; Found: C, 56.10;H, 4.90; N, 6.10.

Dimethyl (2E,4Z)-4-[({4-[(4- chlorophenyl) sulfamoyl] phenyl}amino)methylene]pent-2-enedioate (3h)

Yield (0.42 g, 84%), m.p. 190−191°C; IR: 3416, 3344 (NH, Amine and Sulfonamide), 3100, 826(C-H, Ar), 1720 (C=O, Ester), 1640 (C=C, Alkene), 1595 (C=C, Ar-ring), 1312 (S=O, Asy.), 1148 (S=O, Sym.) Cm^{-1}; MS (*m/z,%):* 450 (M^+, 2), 282 (22), 156 (100), 126 (17), 92 (61),. Anal. calcd. for $C_{20}H_{19}ClN_2O_6S$: C, 53.27; H, 4.25; N, 6.21; Found: C, 53.50; H, 4.40; N, 6.00.

Dimethyl(2E,4Z)-4-[({4-[(2- nitrophenyl)sulfamoyl] phenyl}amino)methylene]pent-2-enedioate (3i)

Yield (0.41g, 82%), m.p. 125−127°C; IR: 3566, 3399 (NH, Amine and Sulfonamide), 2955, 844 (C-H, Ar), 1733 (C=O, Ester), 1600 (C=C, Alkene), 1595 (C=C, Ar-ring), 1389 (S=O, Asy.), 1162 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 461 (M^+, 2), 387 (4), 372 (3), 343 (4), 317 (5) 293 (6), 277(6), 221 (100), 140 (10), 122 (8), 77 (19), 76 (16), 59 (85). Anal. calcd. for

$C_{20}H_{19}N_3O_8S$: C, 52.06; H, 4.15; N, 9.11; Found: C, 52.30; H, 4.10, N, 9.30.

Dimethyl(2E,4Z)-4-[({4-[(4- nitrophenyl)sulfamoyl] phenyl}amino)methylene]pent-2-enedioate (3j)

Yield (0.45g, 90%), m.p. 149–150°C; IR: 3413, 3342 (NH, Amine and Sulfonamide), 3075, 847 (C–H, Ar), 1721 (C=O, Ester), 1631 (C=C, Alkene), 1596 (C=C, Ar-ring), 1345 (S=O, Asy.), 1156 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 464 (M^++3, 0.4), 293 (13), 137 (3), 92 (100). Anal. calcd. for $C_{20}H_{19}N_3O_8S$: C, 52.06; H, 4.15, N, 9.11; Found: C, 51.80; H, 4.30; N, 8.90.

Synthesis of 2-Pyridones (4a-j)—General Procedure

Enamino esters **3a–j** (1.0 mmol) in (0.1 ml) dimethyl-formamide was irradiated in a microwave oven for 3 minutes. the reaction was routinely checked by thin layer chromatography (TLC). The reaction mixture was extracted with diethyl ether, washed with brine, water and dried over anhydrous magnesium sulfate. The organic layer was evaporated. The residue was recrystallized from ethanol to give **(4a–j)**.

Methyl 2-oxo-1-(4-sulfamoylphenyl)-1,2-dihydropyridine-5-carboxylate (4a)

Yield (0.28 g, 90%), m.p. 120–122°C; IR: 3348 (NH, Sulfonamide), 3096, 834 (C-H, Ar), 1726 (C=O, Ester), 1594 (C=C, Ar-ring), 1336 (S=O, Asy), 1159 (S=O, Sym.) Cm^{-1}; MS (*m/z*,%): 308 (M^+, 7), 279 (13), 249 (13), 185 (6), 172 (23), 156 (28), 149 (100).^{1}H NMR (DMSO-d_6): δ 2.25 (s, 2H, NH_2), 3.76 (s, 3H, OCH_3), 6.56–6.59 (d, 1H, =CH), 6.85–7.15 (d, 1H, =CH),7.85–7.88 (dd, 2H, Ar), 7.92–7.95 (dd, 2H, Ar),8.30 (s, 1H, =CH). Anal. calcd. for $C_{13}H_{12}N_2O_5S$: C, 50.64; H, 3.92; N, 9.09; Found: C, 50.90; H, 4.00; N, 9.20.

Methyl 2-oxo-1-[4-(propylsulfamoyl) phenyl]-1,2-dihydropyridine-5-carboxylate (4b)

Yield (0.30 g, 85.7%), m.p. 105–106°C; IR: 3437, 3370 (NH, Sulfonamide), 3065, 834 (C–H, Ar), 1703 (C=O, Ester), 1632 (C=C, Alkene), 1596 (C=C, Ar-ring), 1335 (S=O, Asy.), 1161 (S=O, Sym.) Cm^{-1};MS (*m/z*, %): 353 (M^++3, 12), 227 (21), 225 (11), 213 (34), 199 (19), 123 (36), 69 (100). ^{1}H NMR (DMSO-d_6): δ 1.27–1.32 (t, 3H, CH_3), 1.42–1.66 (m, 2H, CH_2), 2.22 (s, 1H, NH), 2.96–3.10 (t, 2H, CH_2), 3.76 (s, 3H, OCH_3),6.63–6.66 (d, 1H, =CH), 6.69–6.71 (d, 1H, =CH), 7.57–7.60 (dd, 2H, Ar), 7.69–7.72 (dd, 2H, Ar), 8.42 (s, 1H, =CH). Anal. calcd. for

$C_{16}H_{18}N_2O_5S$: C, 54.84; H, 5.18; N, 8.00; Found: C, 54.60; H, 5.10; N, 8.10.

Methyl 1-[4-(benzylsulfamoyl)phenyl]-2-oxo-1,2-dihydropyridine-5-carboxylate (4c)

Yield (0.38 g, 95%), m.p. 78–80°C; IR: 3378 (NH, Sulfonamide), 829 (C-H, Ar), 1725 (C=O, Ester), 1657 (C=C, Alkene), 1596 (C=C, Ar-ring), 1328 (S=O, Asy.), 1150 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 398 (M^+, 3), 369 (6), 275 (6), 246 (2), 169 (2), 122 (100), 106 (2), 105 (8). Anal. calcd. for $C_{20}H_{18}N_2O_5S$: C, 60.29; H, 4.55; N, 7.03; Found: C, 60.00; H, 4.60; N, 6.90.

Methyl 2-oxo-1-{4-[(2- phenylhydrazino) sulfonyl]phenyl}-1,2-dihydropyridine-5-carboxylate (4d)

Yield (0.39 g, 97.5%); m.p. 154–155°C; IR: 3424, 3330 (NH, Sulfonamide), 835 (C-H, Ar), 1734 (C=O, Ester), 1653 (C=C, Alkene), 1595 (C=C, Ar-ring), 1376 (S=O, Asy.), 1162 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 399 (M^+; 0.5), 261 (1), 248 (31), 171 (1), 108 (51), 107 (5), 93 (26), 92 (95), 77 (8), 65 (100). Anal. calcd. for $C_{19}H_{17}N_3O_5S$: C, 57.13; H, 4.29; N, 10.52; Found: C, 56.90; H, 4.20; N, 10.40.

Methyl 2-oxo-1-[4(phenylsulfamoyl)phenyl]-1,2-dihydropyridine-5-carboxylate (4e)

Yield (0.35g, 92%), m.p. 160–161°C; IR: 3419, 3350 (NH, Sulfonamide), 3100, 831 (C–H, Ar), 1719 (C=O, Ester), 1630 (C=C, Alkene), 1595 (C=C, Ar-ring), 1317 (S=O, Asy.), 1154 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 384 (M^+, 0.1), 248 (22), 156 (62), 92 (62), 77 (2), 65 (100). Anal. calcd. for $C_{19}H_{16}N_2O_5S$: C, 59.36; H, 4.20, N, 7.29; Found: C, 59.60; H, 4.30; N, 7.40.

Methyl 1-{4-[(4- methylphenyl) sulfamoyl]phenyl}-2-oxo-1,2-dihydropyridine-5-carboxylate (4f)

Yield (0.36 g, 90%), m.p. 140–141°C; IR: 3471, 3378 (NH, Sulfonamide), 3033, 821 (C–H, Ar), 1719 (C=O, Ester), 1668 (C=C, Alkene), 1594 (C=C, Ar-ring), 1322 (S=O, Asy.), 1154 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 398 (M^+; 37), 276 (34) 253 (34), 170 (42), 106 (100), 77 (61), 59 (42). ^1H NMR (DMSO-d_6): δ 2.3 (s, 3H, CH_3), 3.75 (s, 3H, OCH_3), 4.11 (s, 1H, NH), 6.42–6.46 (d, 1H, =CH), 6.49–6.52 (dd, 2H, Ar), 681–6.83 (dd, 2H, Ar), 6.93–6.95 (d, 1H, =CH), 7.84–7.86 (dd, 2H, Ar), 7.91–7.93 (dd, 2H, Ar) 8.16 (s, 1H, =CH),.Anal. calcd. for $C_{20}H_{18}N_2O_5S$: C, 60.29; H, 4.55; N, 7.03; Found: C, 6.00; H, 4.50; N, 7.20.

Methyl 1-{4-[(4-methoxyphenyl) sulfamoyl]phenyl}-2-oxo-1,2-dihydropyridine-5-carboxylate (4g)

Yield (0.39g, 95%), m.p. 165–167°C; IR: 3486, 3388 (NH, Sulfonamide), 3074, 829 (C–H, Ar), 1724 (C=O, Ester), 1666 (C=C, Alkene), 1595 (C=C, Ar-ring), 1389 (S=O, Asy.), 1149 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 414 (M^+, 0.44), 123 (13), 122 (100), 108 (12), 107 (3), 77 (3), 65 (62).^{1}H NMR (DMSO-d_6): δ 3.73 (s, 3H, OCH_3), 3.76 (s, 3H, OCH_3), 4.0 (s, 1H, NH), 6.46–6.48 (dd, 2H, Ar), 6.50–6.52 (d, 1H, =CH), 6.55–6.58 (dd, 2H, Ar),6.93–6.95 (d, 1H, =CH), 7.70–7.72 (dd, 2H, Ar), 7.78–7.80 (dd, 2H, Ar), 7.81 (s, 1H, =CH). Anal. calcd. for $C_{20}H_{18}N_2O_6S$: C, 57.96; H, 4.38; N, 6.76; Found: C, 57.70; H, 4.30; N, 6.80.

Methyl 1-{4-[(4- chlorophenyl) sulfamoyl]phenyl}-2-oxo-1,2-dihydropyridine-5-carboxylate (4h)

Yield (0.40 g, 95%), m.p. 135–36°C; IR: 3469, 3378 (NH, Sulfonamide), 3100, 829 (C–H, Ar), 1727 (C=O, Ester), 1662 (C=C, Alkene), 1594 (C=C, Ar-ring), 1389 (S=O, Asy.), 1156 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 418 (M^+, 1%), 361 (1), 297 (1), 282 (11), 190 (2), 126 (23), 111 (4), 92 (100), 77 (1), 65 (65). Anal. calcd. for $C_{19}H_{15}ClN_2O_5S$: C, 54.48; H, 3.61; N, 6.69; Found: C, 54.70; H, 3.70; N, 6.80.

Methyl 1-{4-[(2- nitrophenyl) sulfamoyl]phenyl}-2-oxo-1,2-dihydropyridine-5-carboxylate (4i)

Yield (0.37g, 74%), m.p. 90–91°C; IR: 3448, 3374 (NH, Sulfonamide), 3100, 842 (C–H, Ar), 1723 (C=O, Ester), 1655 (C=C, Alkene), 1580 (C=C, Ar-ring), 1346 (S=O, Asy.), 1162 (S=O, sym.) Cm^{-1}; MS (*m/z*, %): 429 (M^+, 2), 370 (5), 305 (5), 278 (5), 201 (5), 138 (43), 137 (28), 122 (8), 77 (16), 69 (100). Anal. calcd. for $C_{19}H_{15}N_3O_7S$: C, 53.14; H, 3.52; N, 9.79; Found: C, 53.40; H, 3.60; N, 9.90.

Methyl 1-{4-[(4- nitrophenyl) sulfamoyl]phenyl}-2-oxo-1,2-dihydropyridine-5-carboxylate (4j)

Yield (0.40 g, 93%), m.p. 120–121°C; IR: 3381 (NH, Sulfonamide), 3084, 848 (C–H, Ar), 1734 (C=O, Ester), 1654 (C=C, Alkene), 1596 (C=C, Ar-ring), 1342 (S=O, Asy.), 1157 (S=O, Sym.) Cm^{-1}; MS (*m/z*, %): 429 (M^+, 23), 414 (27), 370 (27), 317 (40), 276 (23), 201 (33), 137 (27) 122 (30), 76 (27), 54 (100). Anal. calcd. for $C_{19}H_{15}N_3O_7S$: C, 53.14; H, 3.52; N, 9.79; Found: C, 52.90; H, 3.60; N, 9.60.

CONCLUSION

An expedient route has been developed for the preparation of biologically active N-substituted 5-carbomethoxy-2-pyridones containing sulfonamide moiety by cyclizing of dienamino esters using a microwave oven based methodology.

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