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Synthesis and characterization of 2-methoxy-6-phenyl-5h-pyrrolo [3,4-b]pyrazine-5,7(6h)-dione and 7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5h-pyrrolo[3,4-b]pyrazine-5-one and some derivatives

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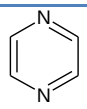
Abstract

The process of producing a series of chemical combinations of 2-methoxy-6-phenyl-5H-pyrrolo[3,4-b]pyrazine-5,7(6H)-dione descendant [103-110] and 7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5H-pyrrolo[3,4-b]pyrazine-5-one descendant [111-119], magnetized significant regard in prospective of curative requisition. The fusion was conved by conducting 2-hydroxyfuro [3,4-b]pyrazine-5,7-dione with equimolar Bromomethane in dry toluene at 0-5°C to get combination 2-methoxyfuro[3,4-*b*]pyrazine-5,7-dione which further at reflux condense with aniline derivatives to 2-methoxy-6-phenyl-5H-pyrrolo[3,4-b]pyrazine-5,7(6H)-dione derivatives with Potassium borohydride granules in methanol at 0-20°C converted to 7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5H-pyrrolo[3,4-b]pyrazine-5-one descendant. The distinctive nature of all the incorporated combinations have been described by manipulating basic inspection (elemental analysis), IR, ^{1}H NMR, ^{13}C NMR spectroscopical.

Keywords: descendant; equimolar; incorporated; manipulating; granules.

1. Introduction

Heterocyclic compositions are plentiful in the creation and are of extraordinarily importance to existence for the reason that their constitutional centavo survive innumerous unprocessed artefact such as vitamins, hormones, and disinfectants [1,2]. For this reason, they have hypnotized appreciable awareness in the proposal of naturally industrious particles [3,4] and present methodical chemistry [5,6]. Additionally in the group of heterocyclic compositions nitrogen accommodating Heterocyclic are an indispensable category of compositions in the curative chemistry and too subscribed to the community from biotic and commercial area which



Sketch 1

Assist to apprehended existence procedures [**7**]. A completely unsaturated six membered -ring having nitrogen is known as azine [8] with two nitrogen atoms it is known as diazine [9]. And with a nitrogen at 1, 2-location, it is known as pyridazine, at 1, 3-location as Pyrimidine and at 1,4- location as pyrazine (Sketch 1). Nevertheless, the accepted assessment basis on the consequence of Pyrimidines group of disinfectant representative across accompanied by non-emotional and in vitro request of pyrimidine descendant to ease the evolution of additional powerful moreover as successful disinfectant negotiator.

Pyrimidines [10] are the heterocyclic aromatic compositions alike to benzene and pyridine holding two nitrogen atoms at location 1 and 3 of the six membered rings. Heterocycles having pyrimidine component are of extremely regard because they compose an indispensable category of unprocessed and processed commodity, numerous of which display functional biotic action and non-emotional request [11,12]. Substituted purines and pyrimidines arise extremely considerably in living creatures and were few of the first compositions calculated by the organic chemists [13].

More awareness has spend to the composite of Heterocyclic combinations having nitrogen atoms accommodating ring system, like Pyrazine mainly due to their elevated materia medica.

The interpretation of the data exhibit that the Pyrazines are compositly adaptable substances and therefore can be used for the composite of a huge variation of heterocyclic combinations. This heterocyclic component has extraordinarily biotic and curative importance. Various pyrazine by-products have been combined and effectively assess like representative with multiple pharmacological outcome (counting but not restricted to antiproliferative, anti-infective, and effects on neurotic structure) and some of them have become non-emotional old medicines universally [14].

Encouraged by the various pharmacological consequences of Pyrazine compositions, it was determined to produce an up to date sequence of Pyrazine descendant. These descendants accommodate Pyrazine anhydride centre. Documentation contemplate release that fusion of 2-hydroxy-6-phenyl-5H-pyrrolo[3,4-b]pyrazine-5,7(6H)-dione descendant [1(e)-9(e), and bromomethane. In the current association 2-hydroxy-6-phenyl-5H-pyrrolo[3,4-b]pyrazine-5,7(6H)-dione descendant [1(e)-9(e)] was reacted with bromomethane in dry toluene at reflux temperature to form Combinations 2-methoxy-6-phenyl-5H-pyrrolo[3,4-b]pyrazine-5,7(6H)-dione descendant [1(i)-9(i)], which furthermore reacts with equimolar potassium borohydride in methanol (4v/w) media at 0-10°C produces 7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5H-pyrrolo[3,4-b]pyrazine-5-one descendant [1(k)-9(k)] intend Combinations respectively.

The compositions of all combined combinations were nominated on the support of IR, ^{1}H NMR , ^{13}C NMR spectral data and Elemental analysis.

2. Experimental

2.1 material and methods

Pyrazine-2, 3-dicarboxylic acid combination and other required chemicals were purchased from E. Merck. Melting points were determined by the open capillary tubes and are uncorrected. The purity and formation of the combinations was determined by thin layer chromatography (TLC- F_{254}) using solvent-system and spots were observed by iodine-system and UV light chamber.

The IR spectra were recorded by Perkin Elmer 1720 FT-IR spectrometer (KBr pellets). ^{1}H NMR and ^{13}C NMR were determined in $CDCl_3$ solution on a Bruker Ac 400 MHz spectrometer. All compounds were purified by recrystallization with suitable organic solvents. The results are in agreements with the structures assigned. Precursors Combinations 2-hydroxyfuro[3,4-b]pyrazine-5,7-dione (100) and 2-methoxyfuro[3,4-*b*]pyrazine-5,7-dione (101), were synthesized by using literature methods [15- 17].

2.2. Synthesis of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (100):

Furo[3,4-b]pyrazine-5,7-dione (20.0 g, 97% purity, 0.129 moles, 1 eq.) and water solution of hydrogen peroxide (H_2O_2, 16.08 g, 30% purity, 0.142 moles, 1.1 eq.) is stirred at 90-92°C for 2 hrs. is added and progress of the reaction checked by TLC. When reaction complies then the reaction mixture is added to 12% water solution of disodium metabisulfite and reaction mass washed with water. Two phases are separated and organic phase is evaporated to obtain furo[3,4-b]pyrazine-5,7-dione-1-oxide (21.60 g), dry the contents at 80-85°C for 8-10 hrs and used for next step. Refluxing of furo[3,4-b]pyrazine-5,7-dione-1-oxide (20.0 g) with acetic anhydride (60.0 ml) for 3.0 hrs, cool to 20-30°C, and reaction mass is added to 50.0 ml dichloromethane, stirred for 30 min then filter, washed contents with dichloromethane to obtain 2-hydroxy furo[3,4-b]pyrazine-5,7-dione (100) light tallow powders, 19.5 g; Yield: 97.5%. m.p. 105°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 7.68(1H, pyraz),7.45-8.5(m,5H,Ar-H),4.52(b,1H,OH), ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 3540(hump, OH), Anal. Calcd for $C_6H_2N_2O_4$: C, 43.39; H, 1.21; N, 16.87; Found: C, 44.49; H, 2.21; N, 15.87%.

2.3. Synthesis of 2-methoxyfuro [3,4-*b*]pyrazine-5,7-dione (101):

2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (19.0 g; purity, 99.37%; 0.114 moles) was stirred 30.0 min in toluene (5.0 times v/w; 100.0 ml) at 25-30°C, and 1.1 mole equivalent bromomethane(12.60 g; purity, 95%; 0.125 moles) was drop wise added to solution at 0-5°C, in 66 min, immediately evolution of hydrogen bromide gas from the reaction mass was observed. Stirred mass for 2 hrs at 40-45°C then cool to 15-20°C and adjust P^{H} to 8-9 using triethyl amine, water added and organic layer separated, washed with water dried on sodium sulfate and concentrated to get crude mass which on further

purification in n-hexane gives light yellow colour pure solid compound 2-methoxyfuro[3,4-*b*]pyrazine-5,7-dione (101) 27.0 g; Yield: 87.1%. M.P. 118°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 7.78(1H, pyraz), 3.76 (three proton singlet, OCH_3), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3, 139.2, 148.7(4C-pyrz.)171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), Anal. Calcd for $C_7H_4N_2O_4$: C, 46.68; H, 2.24; N, 15.55; Found: C, 48.88; H, 3.44; N, 15.53%.

2.3.1. Synthesis of 2-methoxy-6-phenyl-5h-pyrrolo [3, 4-b] pyrazine-5, 7(6h)-dione (102):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (12.0 ml), aniline (1.72 gm, 0.0185 mol; 1.1 eq.) was added drop wise in 10 minute. The resultant solution was stirred for 5 hours at reflux temperature, and then poured onto dichloromethane; the product was isolated and washed with chilled dichloromethane (5.0 ml) to obtain pure compound 2-methoxy-6-phenyl-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 3.24 g; Yield: 67.92 %, mp 180-183°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 7.76(1H, pyraz), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3, 139.2, 148.7(4C-pyrz.)171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), Anal. Calcd for $C_{13}H_9N_3O_3$: C, 61.18; H, 3.55; N, 16.46; Found: C, 62.37; H, 3.99; N, 15.40%.

2.3.2. synthesis of 6-(3-chlorophenyl)-2-methoxy-5h-pyrrolo[3,4-b]pyrazine-5,7(6h)-dione(103):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (12.0 ml), 3-chloroaniline (2.37 gm, 0.0185 mol; 1.1 eq.) was added drop wise in 12 minute. The resultant solution was stirred for 4 hours at reflux temperature, and then poured onto dichloromethane; the product was isolated and washed with chilled n-hexane (5.0 ml) to obtained pure compound 6-(3-chlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 4.57 g; Yield: 84.31 %, m.p. 183-184°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 7.76(1H, pyraz), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3,139.2,148.7 (4C-pyrz.), 171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), 735, 702 (C-Cl str.), Anal. Calcd for $C_{13}H_8ClN_3O_3$: C, 53.90; H, 2.78; Cl, 12.24; N, 14.51; Found: C, 54.93; H,3.98; Cl, 12.39; N, 14.31%.

2.3.3. synthesis of 6-(4-chlorophenyl)-2-methoxy-5*h*-pyrrolo[3,4-*b*]pyrazine-5,7(6*h*)-dione(104):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (12.0 ml), 3-chloroaniline (2.37 gm, 0.0185 mol; 1.1 eq.) was added drop wise in 12 minute. The resultant solution was stirred for 6 hours at reflux temperature, and then poured onto dichloromethane; the product was isolated and washed with chilled n-hexane (5.0 ml) to obtain pure compound 6-(4-chlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 4.67 g; Yield: 86.16 %, mp 183-184.5°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 7.76(1H, pyraz), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3,139.2,148.7 (4C-pyrz.), 171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), 735, 702 (C-Cl str.), Anal. Calcd for $C_{13}H_8ClN_3O_3$: C, 53.90; H, 2.78; Cl, 12.24; N, 14.51; Found: C, 54.91; H, 2.98; Cl, 12.44; N, 14.50%.

2.3.4. synthesis of 6-(2,5-dichlorophenyl)-2-methoxy-5*h*-pyrrolo[3,4-*b*]pyrazine-5,7(6*h*)-dione(105):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (12.0 ml), 2,5-dichloroaniline (3.29 gm, 0.0203 mol; 1.2 eq.) was added drop wise in 16 minute. The resultant solution was stirred for 7 hours at reflux temperature, and then poured onto dichloroethane; the product was isolated and washed with chilled dichloromethane (7.0 ml) to obtain pure compound 6-(2,5-dichlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 5.42 g; Yield: 85.49 %, mp 187.5-188.5°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 7.76(1H, pyraz), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3,139.2,148.7 (4C-pyrz.), 171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), 738, 712 (2C-Cl str.), Anal. Calcd for $C_{13}H_7Cl_2N_3O_3$: C, 48.17; H, 2.18; Cl, 21.88; N, 12.96; Found: C, 48.77; H, 2.28; Cl, 21.98; N, 12.89%.

2.3.5. synthesis of 6-(2,6-diethylphenyl)-2-methoxy-5*h*-pyrrolo[3,4-*b*]pyrazine-5,7(6*h*)-dione (106):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (14.0 ml), 2,6-diethylaniline (3.28 gm, 0.022 mol; 1.3 eq.) was added drop wise in 27 minute. The resultant solution was stirred for 12 hours at reflux temperature, and then poured onto dichloroethane; the product was isolated and washed with chilled dichloromethane (8.0 ml) to obtain pure compound 6-(2,6-

diethylphenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 5.90 g; Yield: 93.21 %, mp 192.7-193.3°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 1.17 (doublet of three proton triplet, CH_3 of ethyl), 2.3 (doublet of two proton quartet), 7.76(1H, pyraz.), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3,139.2,148.7 (4C-pyrz.), 171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), Anal. Calcd for $C_{17}H_{17}N_3O_3$: C, 65.58; H, 5.50; N, 13.50; Found: C, 65.89; H, 5.97; N, 13.40%.

2.3.6. synthesis of 2-methoxy-6-(3-methylphenyl)-5*h*-pyrrolo[3,4-*b*]pyrazine-5,7(6*h*)-dione(107):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (14.0 ml), 3-methylaniline (2.01 g, 0.0185 mol; 1.1 eq.) was added drop wise in 7 minute. The resultant solution was stirred for 2 hours at reflux temperature, and then poured onto dichloromethane; the product was isolated and washed with chilled methanol (4.0 ml) to obtain pure compound 2-methoxy-6-(3-methylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 4.67 g; Yield: 92.29 %, mp 189.2-190.3°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 2.17 (three proton singlet, CH_3), 7.76(1H, pyraz.), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3,139.2,148.7 (4C-pyrz.), 171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), Anal. Calcd for $C_{14}H_{11}N_3O_3$: C, 62.45; H, 4.12; N, 15.61; Found: C, 63.55; H, 4.42; N, 14.31%.

2.3.7. synthesis of 2-methoxy-6-(4-methylphenyl)-5*h*-pyrrolo[3,4-*b*]pyrazine-5,7(6*h*)-dione (108):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (14.0 ml), 3-methylaniline (2.01 g, 0.0185 mol; 1.1 eq.) was added drop wise in 7 minute. The resultant solution was stirred for 2.5 hours at reflux temperature, and then poured onto dichloromethane; the product was isolated and washed with chilled acetone (4.0 ml) to obtain pure compound 2-methoxy-6-(4-methylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 4.87 g; Yield: 96.25 %, mp 189.2-190.7°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 2.17 (three proton singlet, CH_3), 7.76(1H, pyraz.), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3,139.2,148.7 (4C-pyrz.), 171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), Anal. Calcd for $C_{14}H_{11}N_3O_3$: C, 62.45; H, 4.12; N, 15.61; Found: C, 62.48; H, 4.22; N, 15.51%.

2.3.8. Synthesis of 2-methoxy-6-(3-ethylphenyl)-5*h*-pyrrolo[3,4-*b*]pyrazine-5,7(6*h*)-dione (109):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (10.0 ml), 3-ethylaniline (1.47 g, 0.0122 mol; 1.2 eq.) was added drop wise in 12.0 minute. The resultant solution was stirred for 2.5 hours at reflux temperature, and then poured onto dichloromethane; the product was isolated and washed with chilled dichloromethane (6.0 ml) to obtain pure compound 2-methoxy-6-(3-ethylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 2.98 g; Yield: 85.87 %, mp 183.7-185.2°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 1.18 (three proton triplet, CH_3 of ethyl), 2.7 (two proton quartet), 7.76(1H, pyraz.), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3,139.2,148.7 (4C-pyrz.), 171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), Anal. Calcd for $C_{15}H_{13}N_3O_3$: C, 63.60; H, 4.63; N, 14.83; Found: C, 63.93; H, 4.98; N, 13.83%.

2.3.9. synthesis of 2-methoxy-6-(4-ethylphenyl)-5*h*-pyrrolo[3,4-*b*]pyrazine-5,7(6*h*)-dione(110):

To a stirred suspension of 2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione (3.05 g; 0.0169 mol) in dry acetic anhydride (10.0 ml), 4-ethylaniline (1.47 g, 0.0122 mol; 1.2 eq.) was added drop wise in 12.0 minute. The resultant solution was stirred for 2.0 hours at reflux temperature, and then poured onto dichloromethane; the product was isolated and washed with chilled methanol (4.0 ml) to obtain pure compound 2-methoxy-6-(4-ethylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione, 3.35 g; Yield: 96.54 %, m.p. 183.7-185.4°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 1.18 (three proton triplet, CH_3 of ethyl), 2.7 (two proton quartet), 7.76(1H, pyraz.), 3.79 (three proton singlet, OCH_3), 7.0-7.6 (C-H, Benzene), ^{13}C NMR (400MHz, δ in ppm): 110.9, 114.3,139.2,148.7 (4C-pyrz.), 171.3(2C=O), IR [(KBr) V (cm^{-1})], 1850, 1789(C=O), 3087(C-H str pyrz.)1650-1430(C=C, C=N str in ring), 2840 (C-H str. -OCH_3), 1135 (C-O str. OCH_3), 3084 (C-H str. Aromatic), Anal. Calcd for $C_{15}H_{13}N_3O_3$: C, 63.60; H, 4.63; N, 14.83; Found: C, 64.69; H, 4.66; N, 14.30%.

2.4. General procedure for the partial reduction of synthesized compounds (102-110):

To a stirred solution of dione in methanol solvent at 0-20°C, there is lot wise addition of potassium borohydride (1.0-1.3 mole equivalent) solid crystals, instant colour change of reaction mass observed, stirred continue

for 30-60 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water to get pure compound.

2.4.1. Synthesis of 7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one(111):

To a stirred solution of 2-methoxy-6-phenyl-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione (2.0 g, 0.007 moles) in methanol solvent at 0-5°C, there is lot wise addition of potassium borohydride (0.29 g; 1.1 eq.; 0.008 moles) solid crystals, instant colour change of reaction mass observed, stirred continue for 30 min. then added chilled water (cool to 0-5°C), filter, wash contents with chilled water to get pure compound 1.98 g, Yield 85.69%, m.p. 183°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,5H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3), ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),111.2,120.3,121.7,122.6,128.3,144(6C-Ar), 74.4(C-OCH_3), IR [(KBr) V (cm^{-1})], 1726,1689(C=O),3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.), 3640(hump, OH),2833(C-H str. OCH_3), Anal. Calcd for $C_{13}H_{11}N_3O_3$: C, 60.70; H, 4.31; N, 16.33; Found: C, 61.80, H, 4.61, N, 16.13%.

2.4.2. Synthesis of 6-(3-chlorophenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one (112)

To a stirred solution of 6-(3-chlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione (2.0 g; 0.006 moles) in methanol solvent at 0-10°C, there is lotwise addition potassium borohydride (0.26 g; 0.007 moles; 1.1 eq.) solid crystals, instant colour change of reaction mass observed, stirred continue for 40 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water to get pure compound 1.97 g, 86.65%, m.p. 184.5-185.7°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,4H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3); ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),112.2,130.3,126.7,127.6,128.3,144(6C-Ar), 74.4(C-OCH_3); IR [(KBr) V (cm^{-1})]: 1826,1789(C=O),3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.),735,702(C-Cl str), 3640(hump, OH), 2833(C-H str. OCH_3); Anal. Calcd for $C_{13}H_{10}ClN_3O_3$; C, 53.53; H, 3.46; Cl, 12.15; N, 14.41; Found: C, 53.97; H, 4.56; Cl, 12.95; N, 14.40%.

2.4.3. Synthesis of 6-(4-chlorophenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one (113)

To a stirred solution of 6-(4-chlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione (2.0 g;0.006 moles) in methanol solvent at 0-5°C, there is lot wise addition of potassium borohydride (0.26 g;0.007 moles;1.1 eq.) solid crystals, instant colour change of reaction mass observed, stirred continue for 50 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water to get pure compound 1.99 g, Yield 87.53%, m.p. 185°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,4H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3); ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),112.2,130.3,126.7,127.6,132.3,144(6C-Ar), 74.4(C-OCH_3),; IR [(KBr) V (cm^{-1})]: 1826,1789(C=O),3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.),735,702(C-Cl str), 3640(hump, OH), 2833(C-H str. OCH_3); Anal. Calcd for $C_{13}H_{10}ClN_3O_3$: C, 53.53; H, 3.46; Cl, 12.15; N, 14.41; Found: C, 53.91; H, 3.66; Cl, 12.20; N, 14.31%.

2.4.4. Synthesis of 6-(2,5-dichlorophenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one (114)

To a stirred solution of 6-(2,5-dichlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione (2.0 g;0.005 moles) in methanol solvent at 10-20°C, there is lot wise addition of potassium borohydride (0.27 g; 0.007 moles; 1.3 eq) solid crystals, instant colour change of reaction mass observed, stirred continue for 60 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water to get pure compound 2.01 g, Yield 88.68%. m.p. 190°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,5H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3),; ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),112.2,130.3,126.7,127.6,138.3,149(6C-Ar), 74.4(C-OCH_3),; IR [(KBr) V (cm^{-1})]: 1826,1789(C=O),3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.),735-,702(C-Cl str), 3640(hump, OH), 2833(C-H str. OCH_3),; Anal. Calcd for $C_{13}H_9Cl_2N_3O_3$: C, 47.88; H, 2.78; Cl, 21.74; N, 12.88 Found: C, 48.78; H, 3.21; Cl, 22.89; N, 12.81%.

2.4.5. Synthesis of 6-(2, 6-diethylphenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one (115)

To a stirred solution of 6-(2,6-diethylphenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione (2.0 g; 0.007 moles) in methanol solvent at 10-20°C, there is lot wise addition of potassium borohydride (0.27 g; 0.008 moles, 1.3 eq.) solid crystals, instant colour change of reaction mass observed, stirred continue for 60 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water to get pure compound 2.10 g, 91.26%, m.p. 196-196.9°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,3H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3); ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),111.2,120.3,121.7,122.6,128.3,144(6C-Ar),24.2,65.3(C-Aliph), 74.4(C-OCH_3), IR [(KBr) V (cm^{-1})]: 1826, 1789(C=O), 3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.),2983,2942,2894(CH-aliph), 3640(hump, OH), 2833(C-H str. OCH_3); Anal. Calcd for $C_{17}H_{19}N_3O_3$: C, 65.16; H, 6.11; N, 13.41; Found: C, 66.36; H, 7.11; N, 13.38%.

2.4.6. Synthesis of 7-hydroxy-3-methoxy-6-(3-methylphenyl)-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one (116)

To a stirred solution of 2-methoxy-6-(3-methylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione(2.0 g; 0.007 moles) in methanol solvent at 0-5°C, there is lot wise addition of potassium borohydride(0.27 g; 0.007 moles; 1.1 eq) solid crystals, instant colour change of reaction mass observed, stirred continue for 30 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water and purified in n-hexane to get pure compound 2.11 g, 91.96%, m.p. 193.6-194.3°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,4H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3),; ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),111.2,120.3,121.7,122.6,128.3,144(6C-Ar),23.2, (C-Aliph), 74.4(C-OCH_3); IR [(KBr) V (cm^{-1})]: 1826,1789(C=O),3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.),2983(CH-aliph), 3640(hump, OH), 2833(C-H str. OCH_3),; Anal. Calcd for $C_{14}H_{13}N_3O_3$: C, 61.99; H, 4.83; N, 15.49; Found: C, 62.10; H, 4.93; N, 15.40%.

2.4.7. Synthesis of 7-hydroxy-3-methoxy-6-(4-methylphenyl)-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one (117)

To a stirred solution of 2-methoxy-6-(4-methylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione (2.0 g; 0.007 moles) in methanol solvent at 0-5°C, there is lot wise addition of potassium borohydride(0.27 g; 0.007 moles; 1.1 eq) solid crysals , instant colour change of reaction mass observed, stirred continue for 35 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water and purified in n-hexane to get pure compound 2.12 g, Yield 92.40%, m.p. 194.6-195.8°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,4H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3); ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),111.2,120.3,121.7,122.6,128.3,144(6C-Ar),23.3, (C-Aliph), 74.4(C-OCH_3); IR [(KBr) V (cm^{-1})]: 1826,1789(C=O),3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.),2986(CH-aliph), 3640(hump, OH), 2833(C-H str. OCH_3); Anal. Calcd for $C_{14}H_{13}N_3O_3$: C, 61.99; H, 4.83; N, 15.49; Found: C, 62.29; H,5.85; N,15.30%.

2.4.8. Synthesis of 6-(3-ethylphenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one (118):

To a stirred solution of 6-(3-ethylphenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione (2.0 g; 0.006 moles) in methanol solvent at 0-8°C, there is lot wise addition of potassium borohydride (0.24 g; 0.006 moles, 1.1 eq.) solid crystals, instant colour change of reaction mass observed, stirred continue for 40 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water and purified in dichloromethane to get pure compound 2.16 g, Yield 94.74%, m.p. 189°C.

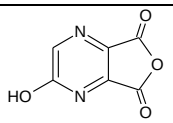
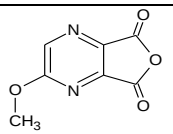
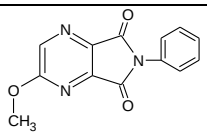
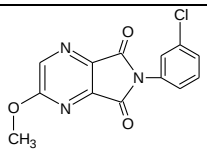
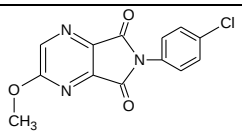
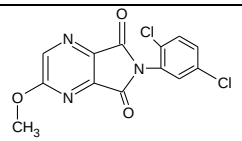
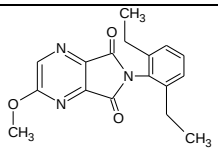
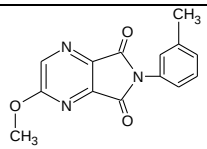
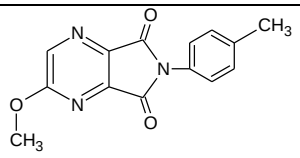
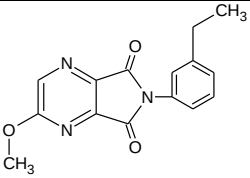
^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,4H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3); ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),111.2,120.3,121.7,122.6,128.3,144(6C-Ar),21.2,62.0(C-Aliph), 74.4(C-OCH_3); IR [(KBr) V (cm^{-1})]: 1826,1789(C=O),3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.),2983,2942,2894(CH-aliph), 3640(hump, OH), 2833(C-H str. OCH_3); Anal. Calcd for $C_{15}H_{15}N_3O_3$: C,63.15; H,5.30; N,14.73; Found: C,64.25; H,5.90; N,15.77%.

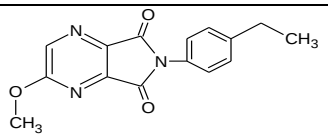
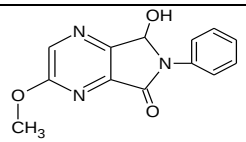
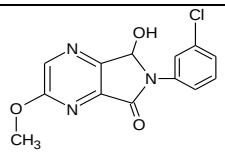
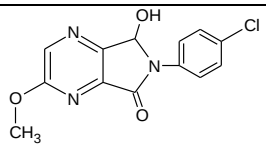
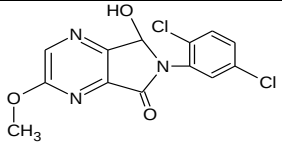
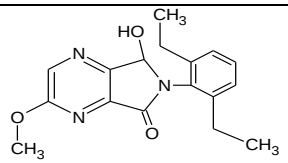
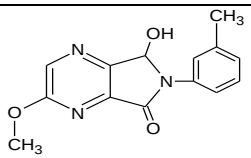
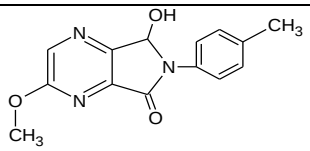
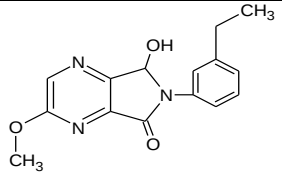
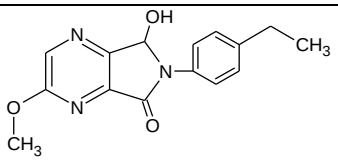
2.4.9. Synthesis of 6-(4-ethylphenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one (119):

To a stirred solution of 6-(4-ethylphenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione (2.0 g; 0.006 moles) in methanol solvent at 0-7°C, there is lot wise addition of potassium borohydride (0.24 g; 0.006 moles, 1.1 eq.) solid crystals, instant colour change of reaction mass observed, stirred continue for 30 min. then added chilled water and cool to 0-5°C, filter, wash contents with chilled water and purified in dichloromethane to get pure compound 2.17 g, Yield 95.18%, m.p. 191°C.

^{1}H NMR ($CdCl_3$,δ in ppm): 8.65(1H, pyraz),7.45-8.5(m,4H,Ar-H),8.02(b,1H,OH), 2.75(s,3H, OCH_3); ^{13}C NMR (400MHz, δ in ppm): 110.9,114.3,139.2,148.7(4C-pyrz.)173.3(2C=O),111.2,120.3,121.7,122.6,128.3,144(6C-Ar),21.2,61.9 (C-Aliph), 74.4(C-OCH_3); IR [(KBr) V (cm^{-1})]: 1826,1789(C=O),3040(C-H str pyrz.)1600-1430(C=C,C=N str in ring),1535,1340(nitro),3070(CH str arom.), 2983,2942,2894(CH-aliph), 3640(hump, OH), 2833(C-H str. OCH_3); Anal. Calcd for $C_{15}H_{15}N_3O_3$: C, 63.15; H, 5.30; N, 14.73 Found: C, 64.45; H,5.97; N,14.30%.

Table 5: Entry, IUPAC Name and Structure of Synthesised Combinations (molecules)

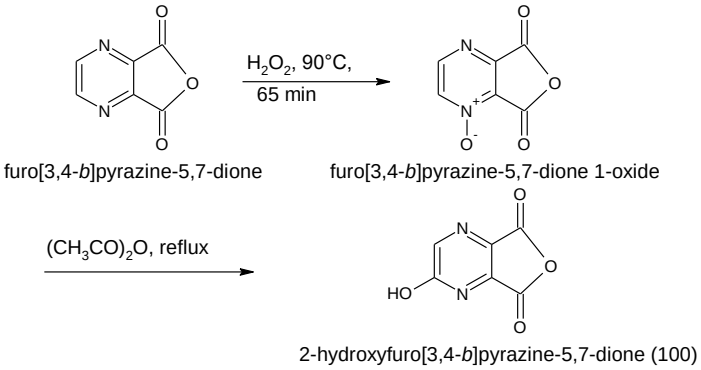
Sr. No.	Entry	IUPAC Name	Chemical Structure
1	100	2-hydroxyfuro [3, 4-b] pyrazine-5, 7-dione	 SKETCH 2
2	101	2-methoxyfuro[3,4-*b*]pyrazine-5,7-dione	 SKETCH 3
3	102	2-methoxy-6-phenyl-5*H*-pyrrolo [3, 4-*b*] pyrazine-5, 7(6*H*)-dione	 SKETCH 4
4	103	6-(3-chlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione	 SKETCH 5
5	104	6-(4-chlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione	 SKETCH 6
6	105	6-(2,5-dichlorophenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione	 SKETCH 7
7	106	6-(2,6-diethylphenyl)-2-methoxy-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione	 SKETCH 8
8	107	2-methoxy-6-(3-methylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione	 SKETCH 9
9	108	2-methoxy-6-(4-methylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione	 SKETCH 10
10	109	2-methoxy-6-(3-ethylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione	 SKETCH 11

11	110	2-methoxy-6-(4-ethylphenyl)-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione	 SKETCH 12
12	111	7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one	 SKETCH 13
13	112	6-(3-chlorophenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one	 SKETCH 14
14	113	6-(4-chlorophenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one	 SKETCH 15
15	114	6-(2,5-dichlorophenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one	 SKETCH 16
16	115	6-(2, 6-diethylphenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one	 SKETCH 17
17	116	7-hydroxy-3-methoxy-6-(3-methylphenyl)-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-on	 SKETCH 18
18	117	7-hydroxy-3-methoxy-6-(4-methylphenyl)-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-on	 SKETCH 19
19	118	6-(3-ethylphenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one	 SKETCH 20
20	119	6-(4-ethylphenyl)-7-hydroxy-3-methoxy-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one	 SKETCH 21

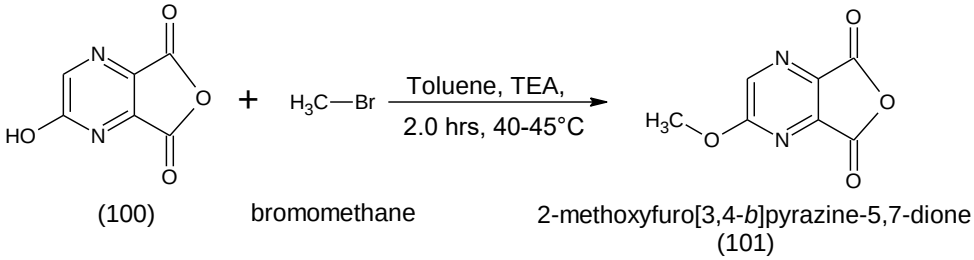
3. Results and Discussion

Synthesis of 2-methoxy-6-phenyl-5H-pyrrolo[3,4-b]pyrazine-5,7(6H)-dione and descendants (102-110) is outlined in Scheme-6, and synthesis of 7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5H-pyrrolo[3,4-b]pyrazine-5-one and descendants (111-119) is outlined in Scheme 7, were synthesized by Gabriel phthalimide synthesis reactions and Luche reduction reaction respectively. Precursor combinations such as 2-hydroxyfuro[3,4-b]pyrazine-5,7-dione(100) is outlined in Scheme 4, and 2-methoxyfuro[3,4-b]pyrazine-5,7-dione(101) is outlined in Scheme 5, were synthesized by Guareschi-Thorpe Condensation, Chichibabin pyridine synthesis and Williamson Ether Synthesis (An S_N2 reaction) respectively.

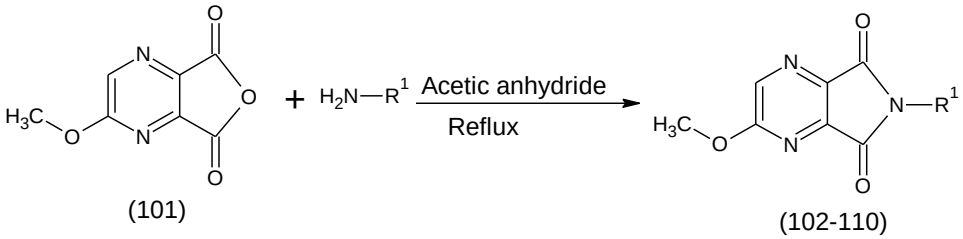
The procedure to get combinations 102, 103, 104, 107, and 108 was carried out with 1.1 equivalent of aniline and descendants in acetic anhydride by stirring at reflux, but procedure to get 105,109 and 110 was carried out with 1.2 equivalent of aniline descendants in acetic anhydride at reflux due to steric effects but procedure to get 106 was carried out with 1.3 equivalent of 2,6-diethylaniline in acetic anhydride by stirring 12 hours at reflux to overcome steric hindrance produced due to presence of ethyl substituents. Similarly, the procedure to get 111, 112, 113,116, 117, 118, 119, was carried out with 1.1 equivalent of potassium borohydride in methanol at 0-10°C but the procedure to get 114 and 115 was carried out with 1.2 and 1.3 equivalent potassium borohydride respectively in methanol by stirring 60 min at 10-20°C in order to overcome steric effects.



Reaction scheme 4. Synthesis of 2-hydroxyfuro [3,4-b]pyrazine-5,7-dione (100)

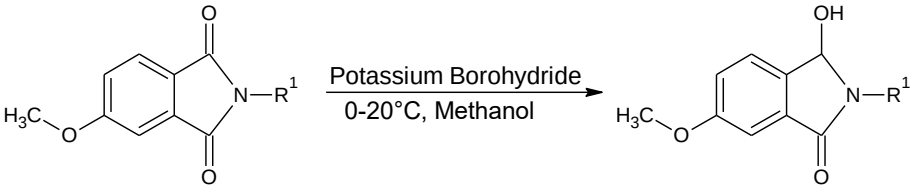


Reaction scheme 5. Synthesis of 2-methoxyfuro[3,4-b]pyrazine-5,7-dione (101)



H_2N-R^1= Aniline(for 102); 3-chloroaniline(for 103); 4-chloroaniline(for 104); 2,5-dichloroaniline(for 105); 2,6-diethylaniline(for 106); 3-methylaniline(for 107); 4-methylaniline(for 108); 3-ethylaniline(for 109); 4-ethylaniline (for 110).

Reaction scheme 6. Synthesis of 2-methoxy-6-phenyl-5*h*-pyrrolo[3,4-*b*]pyrazine-5,7(6*h*)-dione and descendants (102-110)



(102-110) (111-119)

Reaction scheme 7. Synthesis of 7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5*h*-pyrrolo[3,4-*b*]pyrazin-5-one and descendants (111-119)

4. Conclusion

In closure, we have incorporated 2-hydroxyfuro[3,4-b]pyrazine-5,7-dione (100), 2-methoxyfuro[3,4-b]pyrazine-5,7-dione (101) and a sequence of narrative 2-methoxy-6-phenyl-5*H*-pyrrolo[3,4-*b*]pyrazine-5,7(6*H*)-dione and descendants (102-110) and 7-hydroxy-3-methoxy-6-phenyl-6,7-dihydro-5*H*-pyrrolo[3,4-*b*]pyrazin-5-one and descendants (111-119) in superior yield, signalized by disparate incorporeal learning like ^{1}H NMR, ^{13}C NMR, IR, Thin Layer Chromatography, and Elemental analysis. Amid the incorporated combinations there is effective steric hindrance in combinations 106, and 115. The current slog will have a narrative collision on researcher and can be moreover used in medicinal trading for humanity.

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