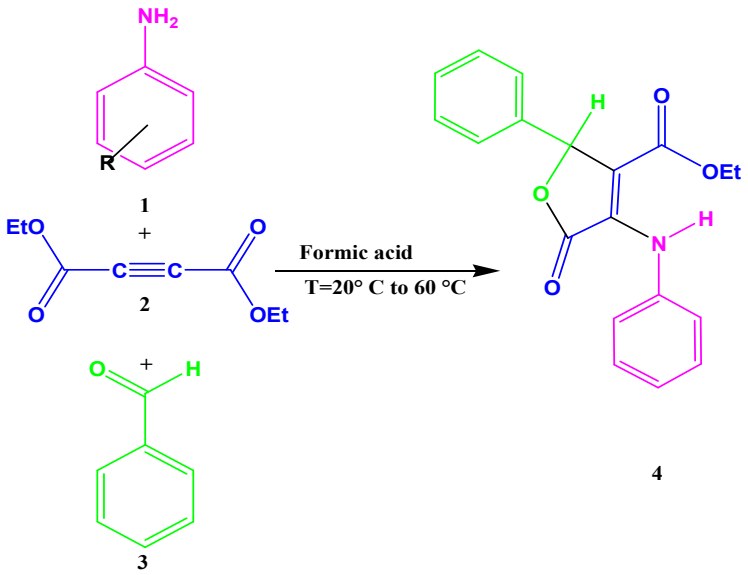
❖ **Analysis of chosen products including of physical and chemical data are demonstrated below:**



Reaction of substituted-Aniline **1**, dialkylacetylenedicarboxylate **2** and aryl aldehyde **3** in formic acid

Methyl 2,5-dihydro-2-(4-nitrophenyl)-5-oxo-4-(phenylamino)furan-3-carboxylate:

White solid; 0.300 g (96%); mp 130-131 °C; IR (KBr): 3321, 2976, 1697, 1597 cm–1 ; ^{1}H NMR (400 MHz, CDCl3) δ: 3.77 (s, 3H, OCH3), 5.89 (s, 1H, benzylic), 7.17 (t, J = 7.6, 1H), 7.30-7.34 (m, 3H, aromatic), 7.46 (d, J = 8 Hz, 4H), 8.15 (d, J = 8.8 Hz, 2H), 9.02 (br, 1H, NH); 13C NMR (100 MHz, CDCl3) δ: 164.6, 162.5 (ester CO), 156.4, 148.0, 142.6, 135.5, 129.3, 128.5, 126.5, 124.0, 122.1, 111.9 (10 C aromatic), 60.7(methoxy C), 52.3 (benzylic C). MS m/z (%): 69 (20), 81 (22), 83 (19), 84 (18), 93 (38), 96 (19), 97 (21), 98 (17), 175 (45), 203 (19), 295 (34), 354 (M+ , 100); Anal. calcd. for C19H17NO4: C, 70.58; H, 5.30; N, 4.33. Found: C, 70.71; H, 5.36; N, 3.40.

Methyl 2,5-dihydro-5-oxo-2-phenyl-4-(phenylamino)furan-3- carboxylate:

White solid; 0.284 g (92%); mp 195–196 8C; IR (KBr, cm–1): n 3260, 3208, 1702, 1661; 1H NMR (400 MHz, CDCl3): d 3.77 (s, 3 H, OCH3), 5.76 (s, 1H, benzylic), 7.13 (t, 1H, J = 7.3 Hz), 7.24–7.31 (m, 7H), 7.52 (d, 2H, J = 8 Hz), 8.90 (br, NH, 1H); 13C NMR (100 MHz, CDCl3): d 165.3 and 162.7 (ester CO), 156.3, 136.1, 134.9, 129.0, 128.7, 128.6, 127.4, 125.9, 122.3, 112.8 (aromatic C), 61.6 (methoxy C), 52.1 (benzylic C); MS (positive mode, m/z (%)): 57 (100), 97 (75), 152 (24), 213 (51), 240 (39), 250 (33), 309 (M+, 44); Anal. calcd. for C18H15NO4: C 69.89, H 4.89, N 4.53. Found: C 70.08, H 4.97, N 4.60.

Methyl 4-(p-tolylamino)-2,5-dihydro-5-oxo-2-phenylfuran-3- carboxylate:

White solid; 0.287 g (89%); mp 173–175 8C; IR (KBr, cm–1): n 3228, 2950, 1706, 1677, 1513; 1H NMR (400 MHz, CDCl3): d 2.27 (s, 3H, CH3), 3.76 (s, 3H, OCH3), 5.72 (s, 1H, benzylic), 7.09 (d, 2H, J = 8 Hz), 7.22–7.270 (m, 5H, aromatic), 7.34 (d, 2H, J = 8.4 Hz), 8.86 (br, 1H, NH); 13C NMR (100 MHz, CDCl3): d 165.3 and 162.8 (CO of ester), 156.4, 135.8, 135.0, 133.5, 129.6, 128.6, 128.5, 127.5, 122.4, 112.6 (C of aromatic), 61.3 (C of

methoxy), 52.0 (benzylic C), 20.95 (C of methyl); MS (m/z (%)): 130 (96), 131 (21), 133 (19), 158 (39), 189 (34), 263 (14), 264 (33), 265 (12), 291 (24), 323 (M+, 100); Anal. calcd. for C19H17NO4: C 70.58, H 5.30, N 4.33. Found: C 70.77, H 5.38, N 4.35

Ethyl 2-(4-cyanophenyl)-2,5-dihydro-5-oxo-4-(phenylamino)- furan-3-carboxylate: White solid; 0.324 g (93%); mp 188– 189 8C; IR (KBr, cm–1): n 3293 (NH), 2977, 2225 (CN), 1731, 1684, 1666, 1500; 1H NMR (400 MHz, CDCl3): d 1.23 (t, 3H, J = 7.2 Hz, CH3), 4.24 (q, 2H, J = 7.2 Hz, CH2), 5.82 (s, 1H, benzylic), 7.17 (t, 1H, J = 7.2 Hz), 7.32–7.47 (m, 6H, aromatic), 7.59 (d, 2H, J = 8 Hz), 9.03 (br, 1H, NH); 13C NMR (100 MHz, CDCl3): d 164.6, 162.5 (CO of ester), 156.89, 140.8, 135.7, 132.5, 129.2, 128.3, 126.3, 122.1, 118.1, 112.6 (aromatic C), 112.2 (C of CN), 61.6 (methoxy), 60.8 (benzylic), 14.02 (CH3 of ethoxy). MS (m/z (%)): 93 (17), 119 (9), 155 (70), 183 (29), 228 (13), 275 (59), 302 (14), 348 (M+, 100); Anal. calcd. for C20H16N2O4: C 68.96, H 4.63, N 8.04. Found: C 69.10, H 4.69, N 8.11.