Bioinspired $NiCoO_2$ nanocomposites derived from *Moringa oleifera* as a recyclable catalyst for multicomponent reactions with potent antimicrobial efficiency

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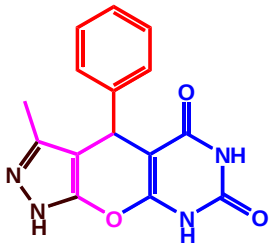
General:

Synthesisofpyrazolopyrano[2,3-d]pyrimidine:

In 50 ml round bottom flask, equimolar amounts of aromatic aldehyde (1mmol), ethylacetoacetate (1mmol), hydrazine hydrate (1mmol) and barbuteric acid (1mmol) were combined with $NiCoO_2$nanocomposite (5 mol%) anddissolved this mixture in 10 ml of solvent system (1:1 water : ethanol) andreaction carried out under ultrasonication. The progressofreactionwas monitoredbyTLC.After completionofreactionthe ensuing product was subjected to structuralanalysis using FT-IR, ^{1}H NMR, and ^{13}C NMR spectroscopy.



[TableNo.3,Entry-2]3-methyl-4-phenyl-4,8-dihydropyrazolo[4',3':5,6]pyrano[2,3-d]pyrimidine-5,7(1H,6H)-dione

FTIR–500cm^{-1}, 1000cm$^{-1,}$1450cm^{-1},1600cm^{-1},2900cm^{-1},3400cm^{-1}.

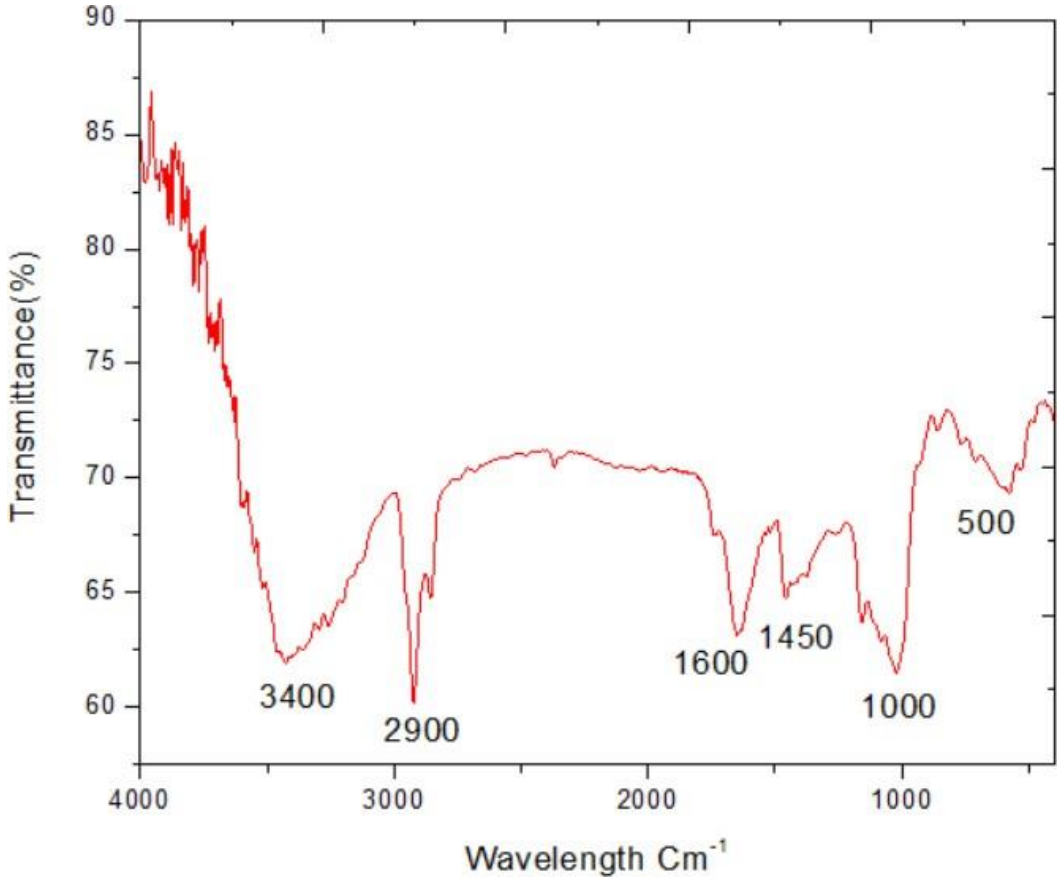


Figure1.FTIRspectrumof3-methyl-4-phenyl-4,8-dihydropyrazolo[4',3':5,6] pyrano[2,3-d]pyrimidine-5,7(1H,6H)-dione

^{1}HNMR-(400MHz,$CDCl_3$)-δppm:δ2.31(s,3H,CH_3),δ5.50(2,1H,CH),δ7.13(d, J=7.2Hz, 2H,Ar-H), δ 7.40(t, J=7.8Hz, 1H,Ar-H), δ 7.82(t, J=7.3Hz, 2H,Ar-H), δ 10.50(s, 2H, NH), 13.50 (br s,1H NH)

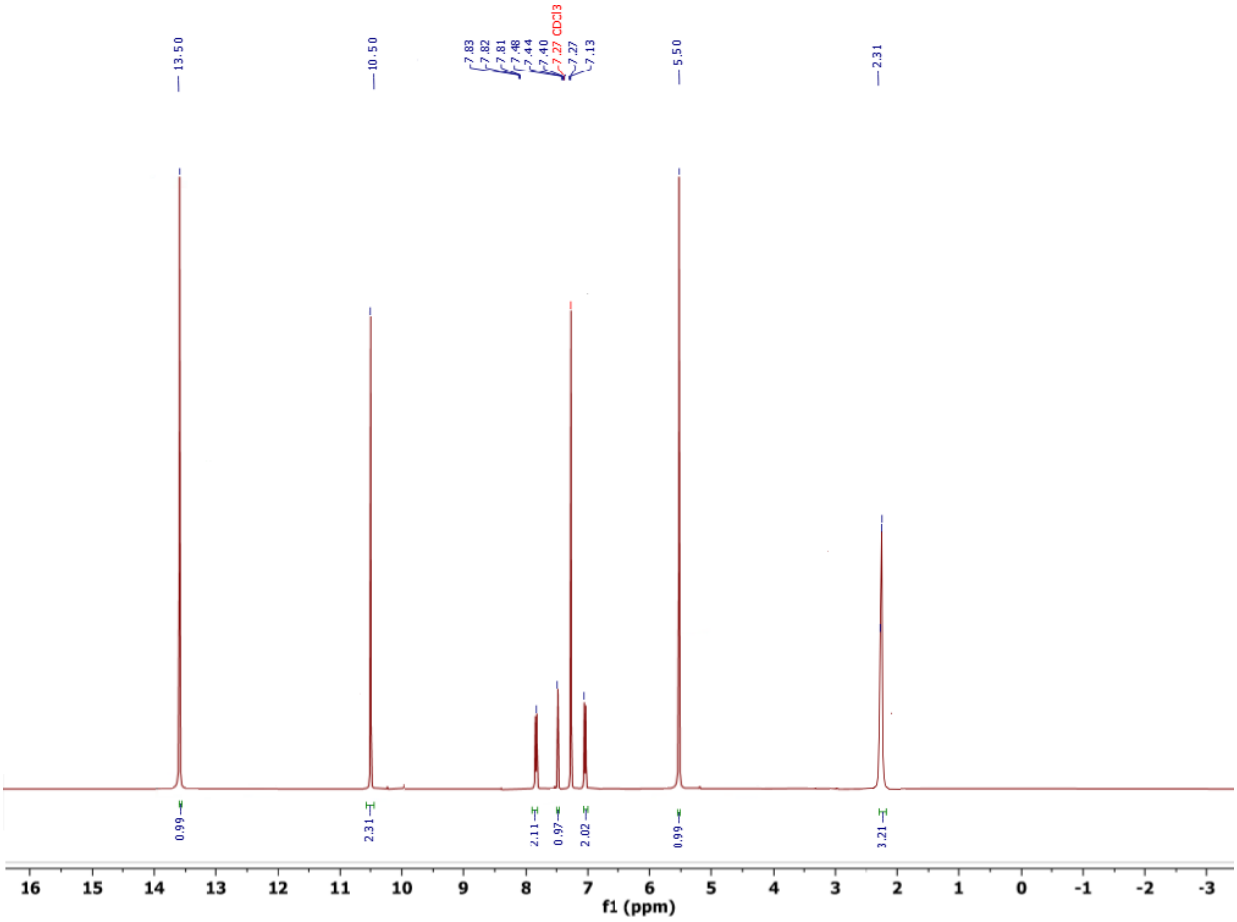


Figure2.^{1}HNMRof3-methyl-4-phenyl-4,8-dihydropyrazolo[4',3':5,6]

pyrano[2,3d]pyrimidine-5,7(1H,6H)-dione

^{13}CNMR:δ9.75(1C,s),36.24(1C,s),97.07(1C,s),113.40(1C,s),127.90(1C,d),135.40 (1C,s),144.40(1C,s),150.40(1C,s),153.90(1C,s),161.53(1C,s)

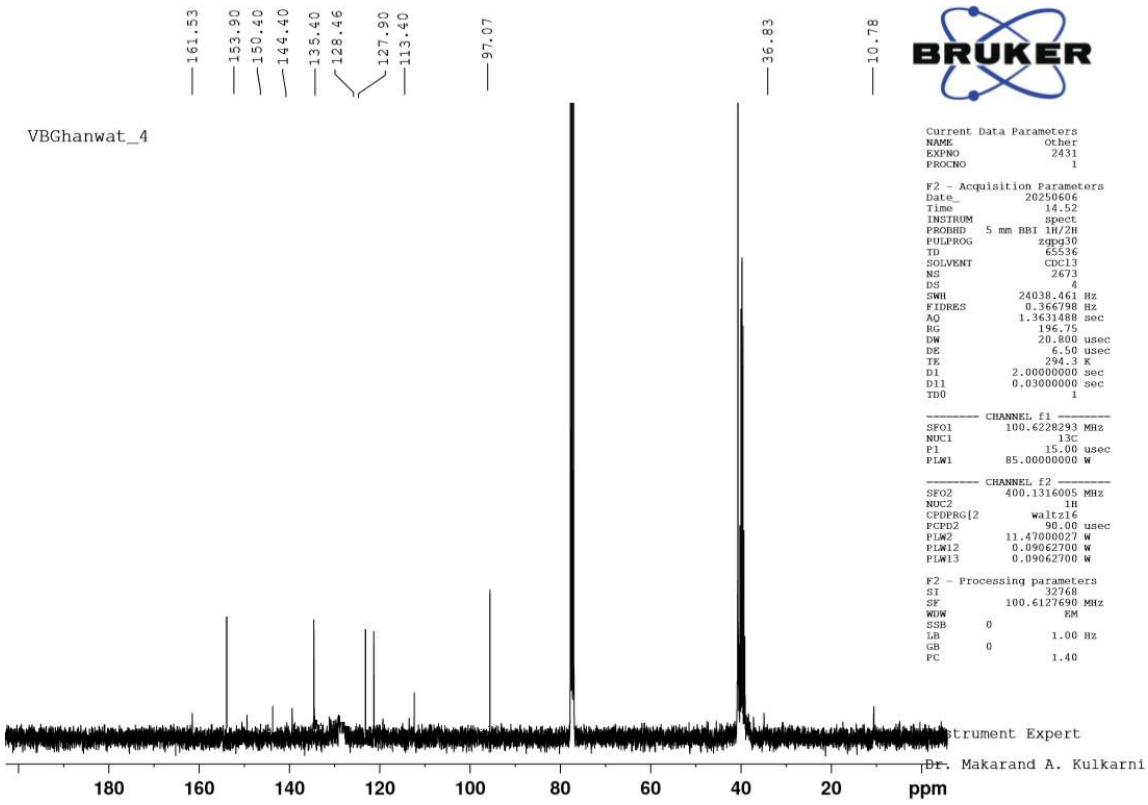
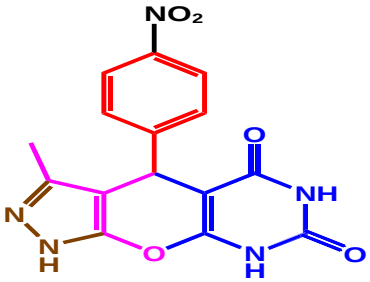


Figure3.^{13}CNMRspectrumof3-methyl-4-phenyl-4,8-dihydropyrazolo[4',3':5,6] pyrano[2,3-d]pyrimidine-5,7(1H,6H)-dione



[TableNo.3,Entry-3]3-Methyl-4-(4-nitrophenyl)-4,8-dihydropyrazolo[3′,4′:5,6] Pyrano [2,3-d] pyrimidine 5,7(1H,6H)-dione

FTIR:500cm^{-1},1000cm^{-1},1450,1600cm^{-1},2900cm^{-1},3400cm^{-1}.

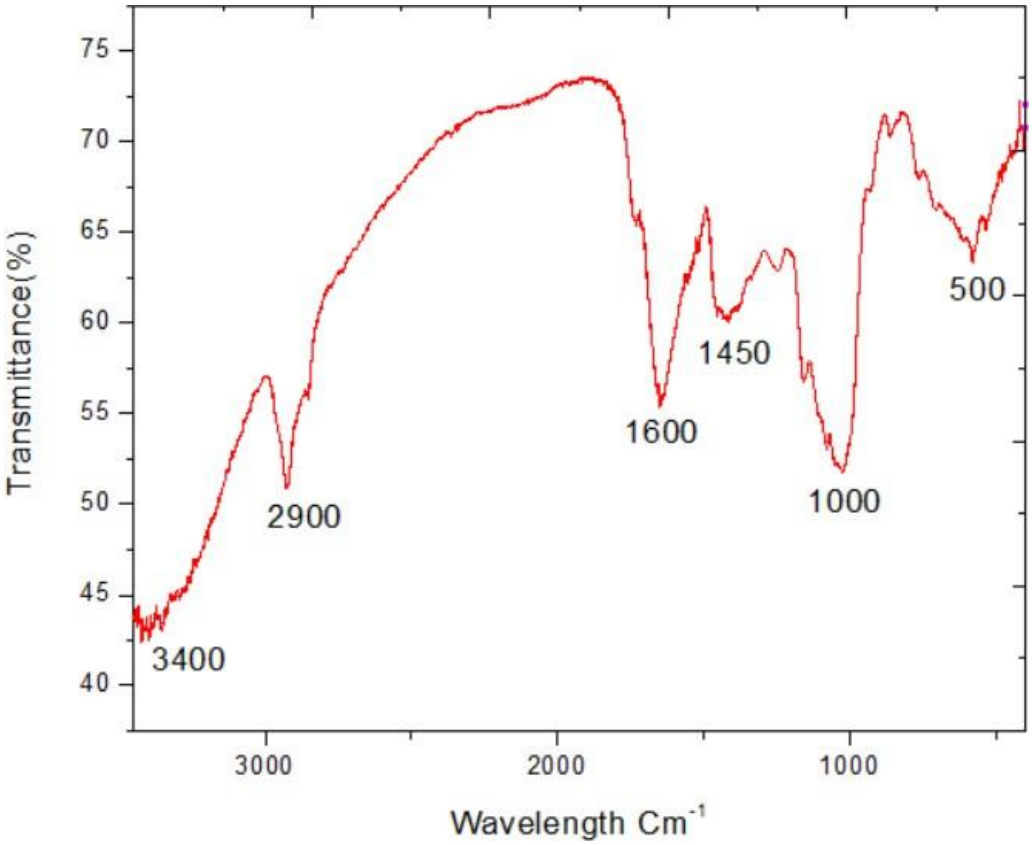


Figure4.FTIRspectrumof3-Methyl-4-(4-nitrophenyl)-4,8-dihydropyrazolo[3′,4′:5,6] Pyrano [2,3-d] pyrimidine 5,7(1H,6H)-dione

^{1}HNMR(400MHz,$CDCl_3$) -δppm: δ3.15(s,3H,CH_3),δ5.17(2,1H,CH), δ7.28(d,J=7.2Hz, 2H,Ar-H),δ7.83(d,J=7.3Hz,2H,Ar-H),δ10.32(s,2H,NH),13.20(brs,1H NH)

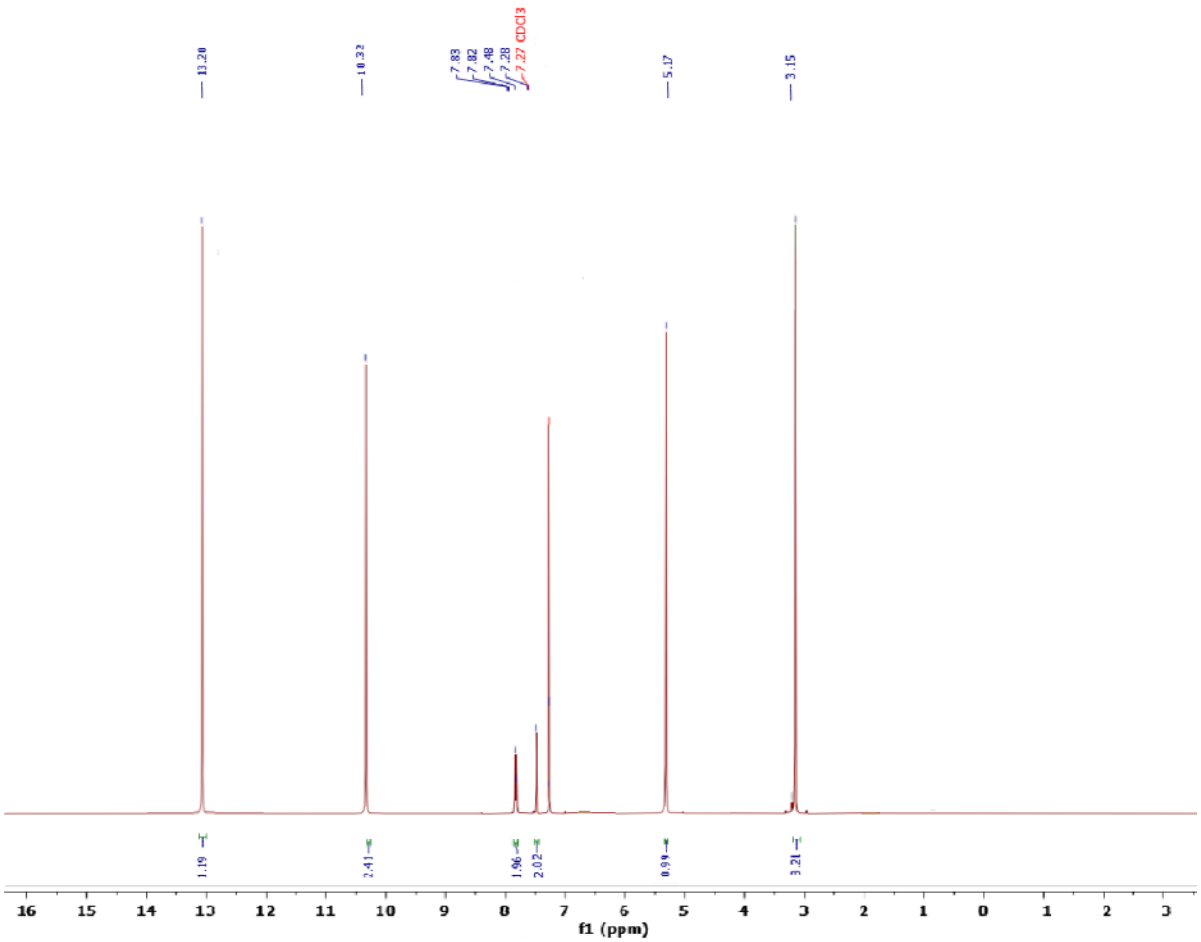


Figure5.^{1}HNMRof3-Methyl-4-(4-nitrophenyl)-4,8-dihydropyrazolo[3′,4′:5,6] Pyrano [2,3-d] pyrimidine 5,7(1H,6H)-dione

^{13}CNMR(101MHz,$CDCl_3$)-δ ppm: δ10.78,36.83,97.07,113.40,133.40,144.40, 135.40,161.53

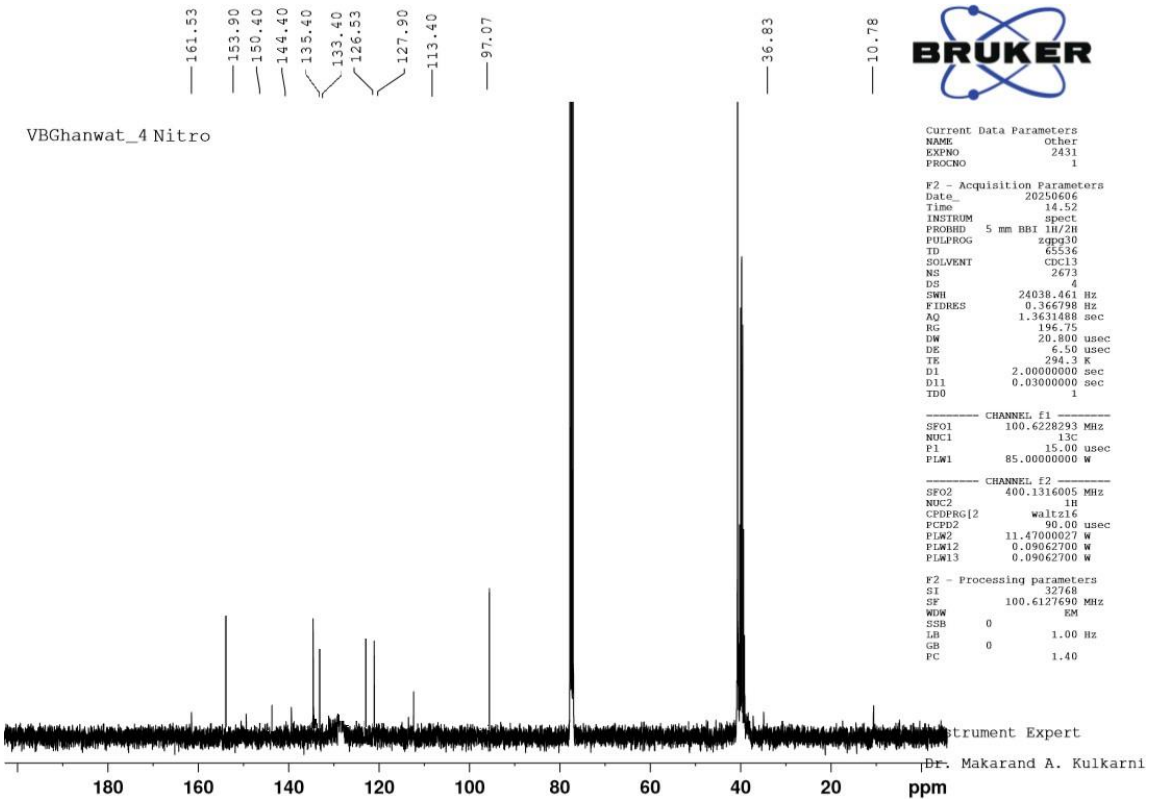
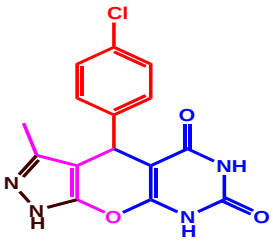


Figure6.^{13}CNMRof3-Methyl-4-(4-nitrophenyl) -4,8-dihydropyrazolo[3′,4′:5,6] Pyrano [2,3-d] pyrimidine 5,7(1H,6H)-dione



[TableNo.3,Entry-5]5-(2-hydroxyphenyl)-1,2,4-triazolidine-3-thione

FTIR: 500 cm^{-1}, 1000 cm^{-1},1400, 1600 cm^{-1}, 2900 cm^{-1}, 3450 cm^{-1}.

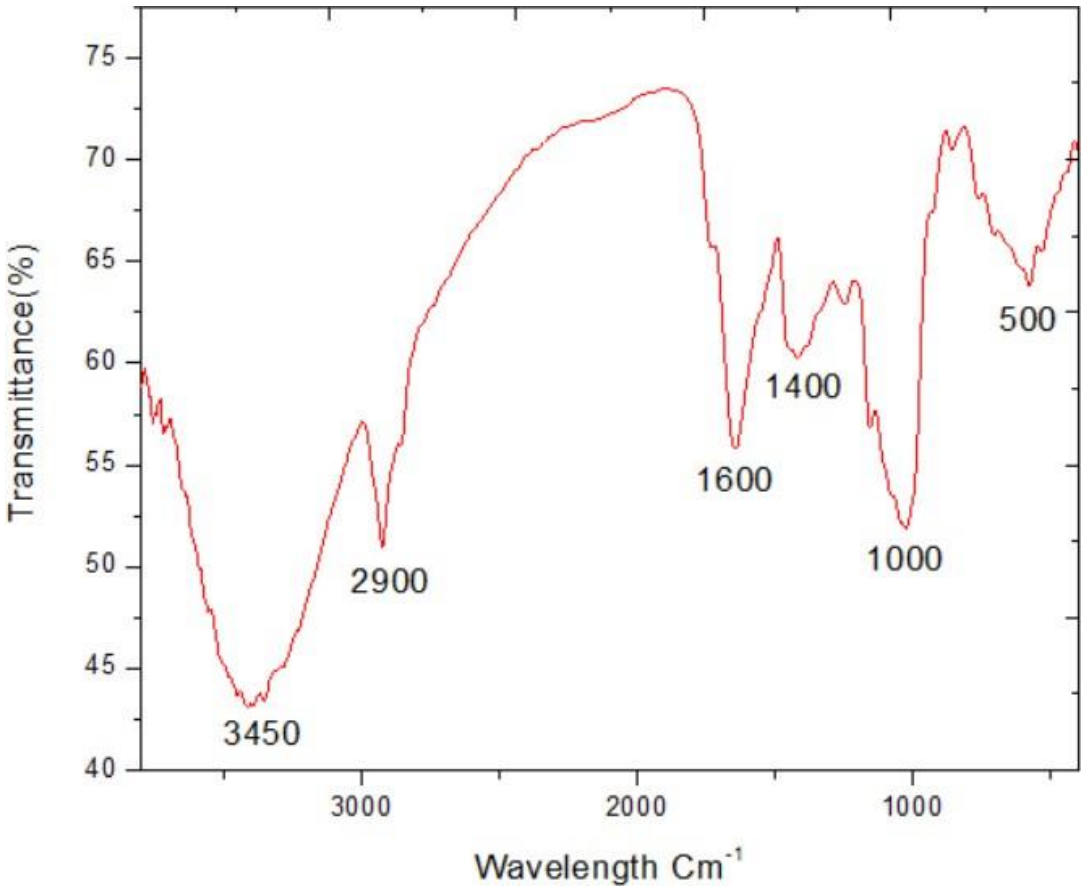


Figure7.FTIRspectrumof4-(4-chlorophenyl)-3methyl-4,8-dihydropyrazolo[3′,4′: 5,6] Pyrano [2,3-d] pyrimidine 5,7(1H,6H)-dione

^{1}H NMR(400MHz,$CDCl_3$)-δ ppm:δ2.27(s,3H,CH_3),δ5.68 (2,1H,CH), δ7.15 (d, J=7.2Hz,2H,Ar-H),δ7.82(d,J=7.3Hz,2H,Ar-H),δ10.58(s,2H,NH),13.68(brs,1HNH)

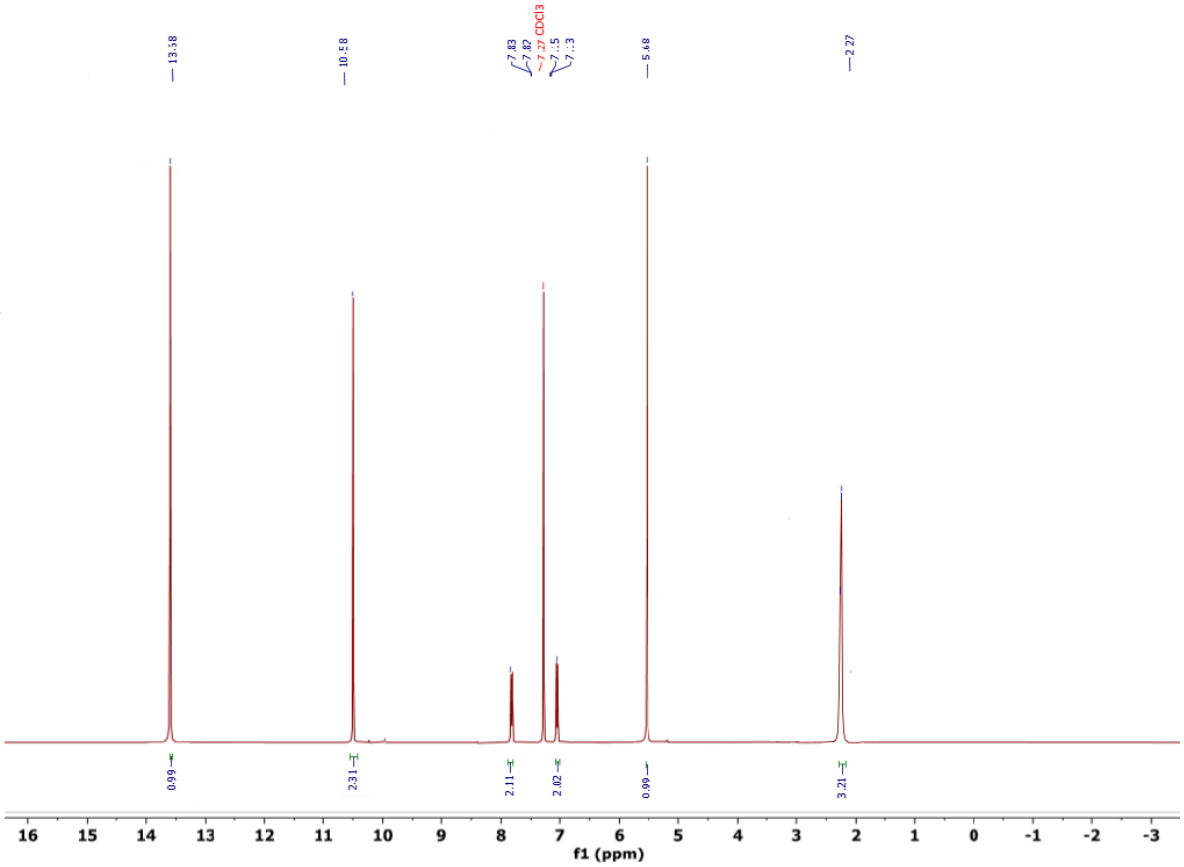


Figure8.^{1}HNMRof4-(4-chlorophenyl) -3methyl-4,8-dihydropyrazolo[3′,4′:5,6] Pyrano [2,3-d] pyrimidine 5,7(1H,6H)-dione

^{13}CNMR(101MHz,$CDCl_3$)-δppm:δ10.78, 36.83,97.07,113.40,127.90,135.40,144.40, 1150.40,153.90,161.53

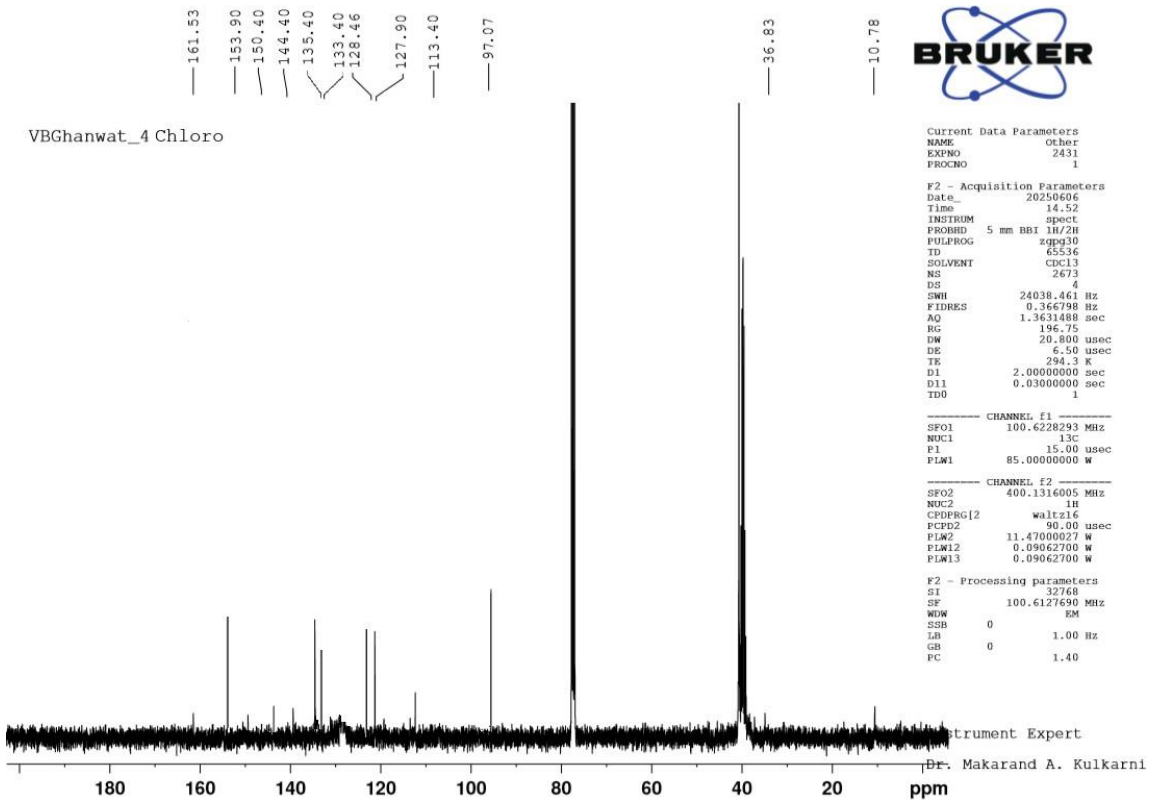


Figure9.^{13}CNMRof4-(4-chlorophenyl)-3methyl-4,8-dihydropyrazolo[3′,4′:5,6] Pyrano [2,3-d] pyrimidine 5,7(1H,6H)-dione