

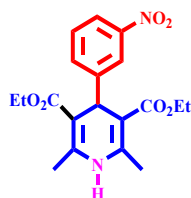
Supplementary Information

Efficient one-pot synthesis of 1,4-dihydropyridines catalyzed by magnetic MnFe_2O_4 nanoparticles

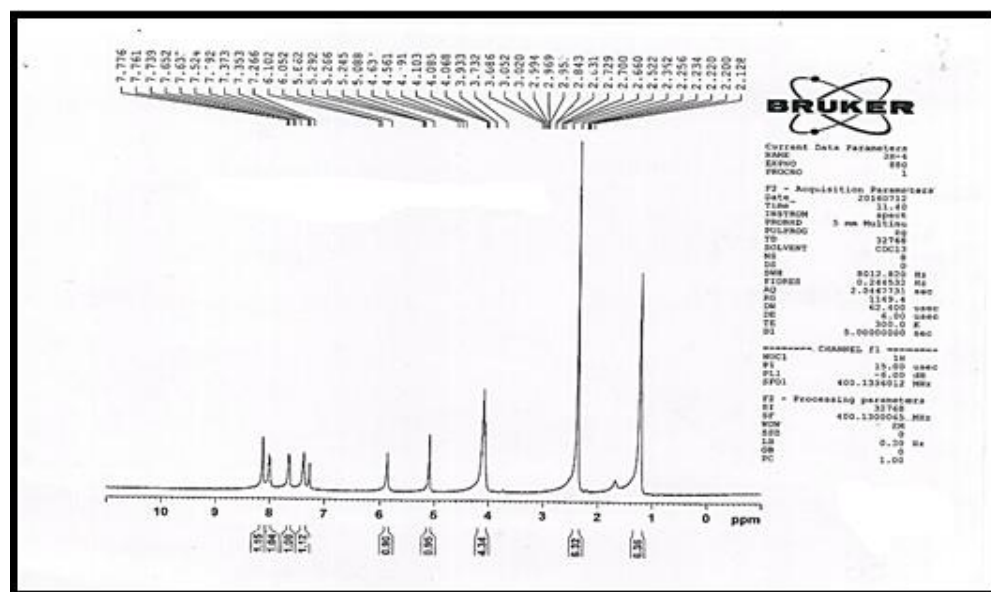
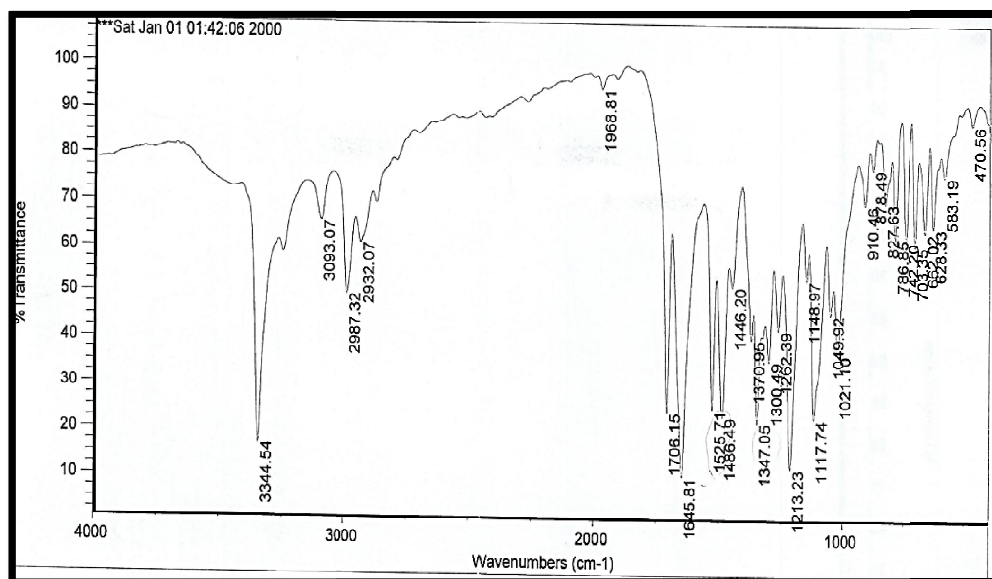
Somayeh Moradi, Mohsen Moradian, Hossein Naeimi*

Characterization data of all known compounds listed in Table 4

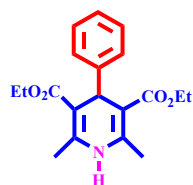
Diethyl-1,4-dihydro-2,6-dimethyl-4-(3-nitrophenyl) pyridine-3,5-dicarboxylate;



Yellow solid. m.p= 162-167°C; IR (KBr)/ ν (cm^{-1}): 3344 (NH), 3093 ($=\text{CH}_2$), 2987 ($-\text{CH}$, sp^3), 1706 ($\text{C}=\text{O}$), 1645 ($\text{C}=\text{C}$), 1213 ($\text{C}-\text{O}$); ^1H NMR (400 MHz, CDCl_3) δ ppm = 1.23 (t, $J=7.2$ Hz, 6H, 2 CH_3), 2.36 (s, 6H, 2 CH_3), 4.08 (q, 4H, 2 CH_2), 5.08 (s, 1H), 5.86 (s, 1H, NH), 7.37 (t, $J=8$ Hz, 1H, ArH), 7.64 (d, $J=7.6$ Hz, 1H, ArH), 7.99 (d, $J=7.2$ Hz, 1H, ArH), 8.12

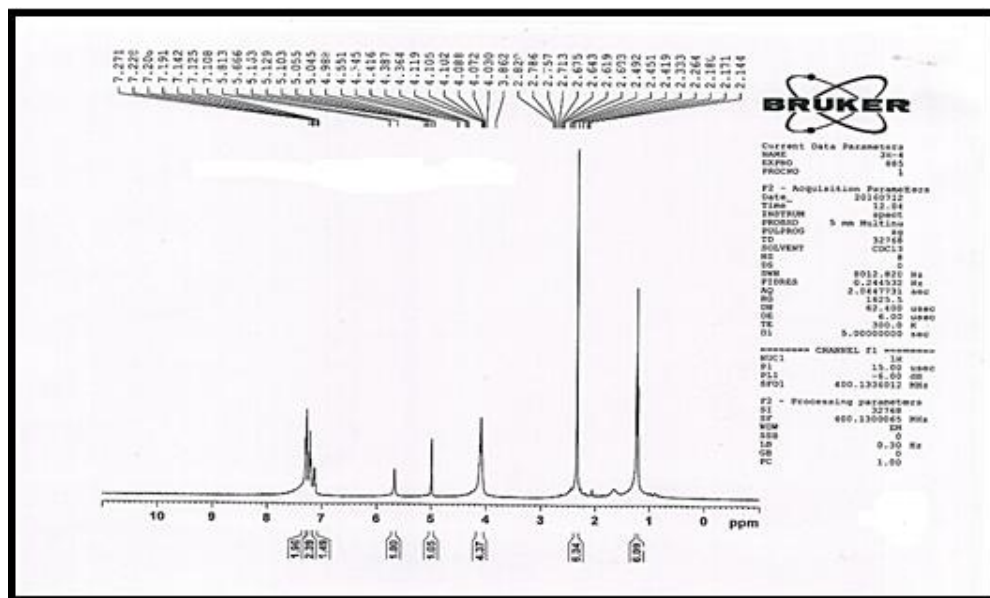
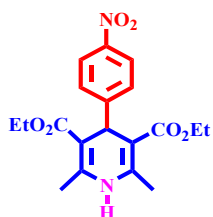


Diethyl-1,4-dihydro-2,6-dimethyl-4-phenyl pyridine-3,5-dicarboxylate;

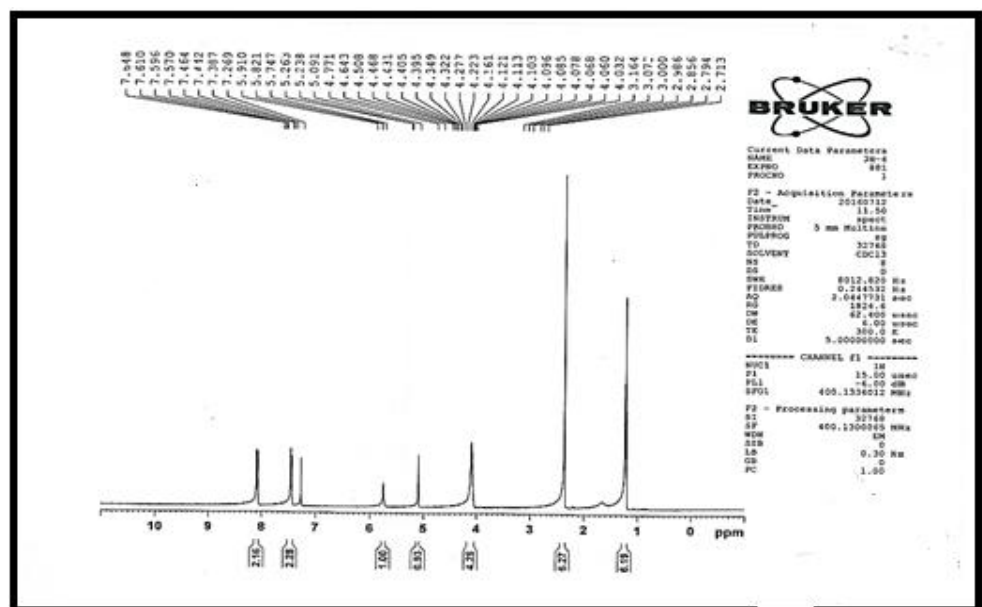


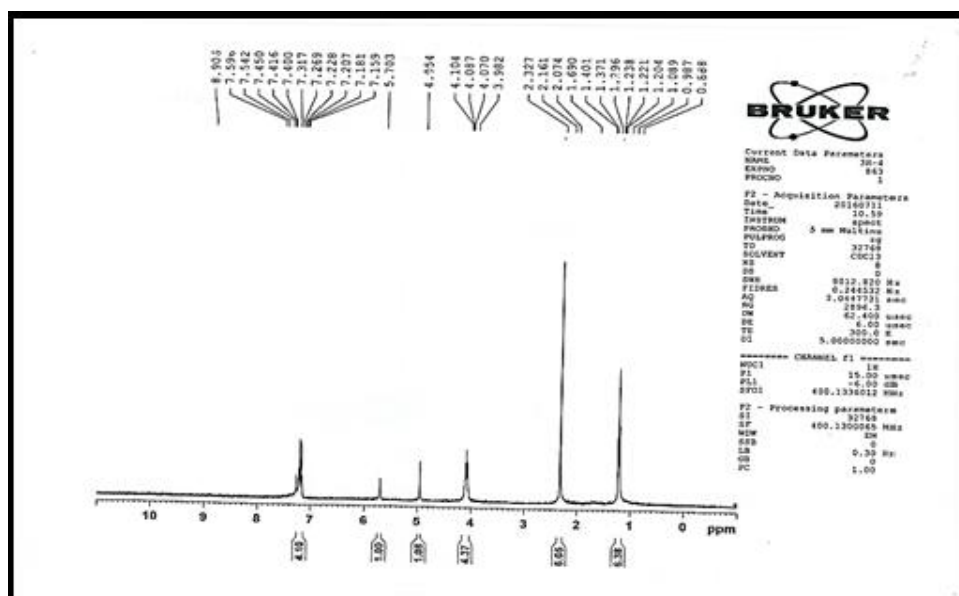
Yellow solid. m.p = 150-155 °C; IR (KBr)/ ν (cm⁻¹): 3342 (NH), 3061 (=CH₂), 2980 (-CH, sp³), 1690 (C=O), 1651 (C=C (الكن)), 1211 (C-O); ¹H NMR (400 MHz, CDCl₃) δ ppm = 1.22 (t, J =7.2 Hz, 6H,

Diethyl-1,4-dihydro-2,6-dimethyl-4-(4-nitrophenyl) pyridine-3,5-dicarboxylate;

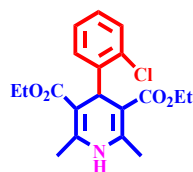


Diethyl-4-(4-Chlorophenyl)-1,4-dihydro-2,6-dimethyl pyridine-3,5-dicarboxylate;

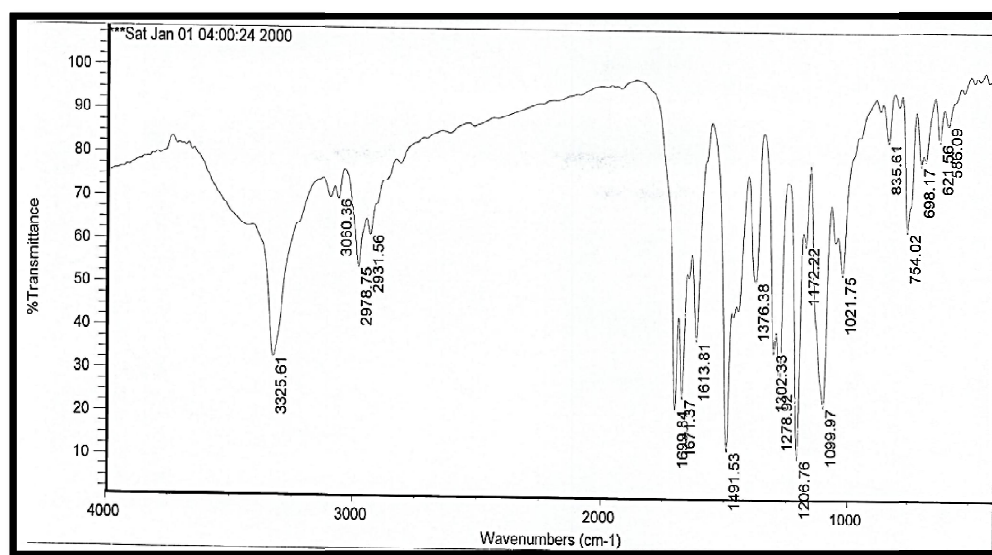


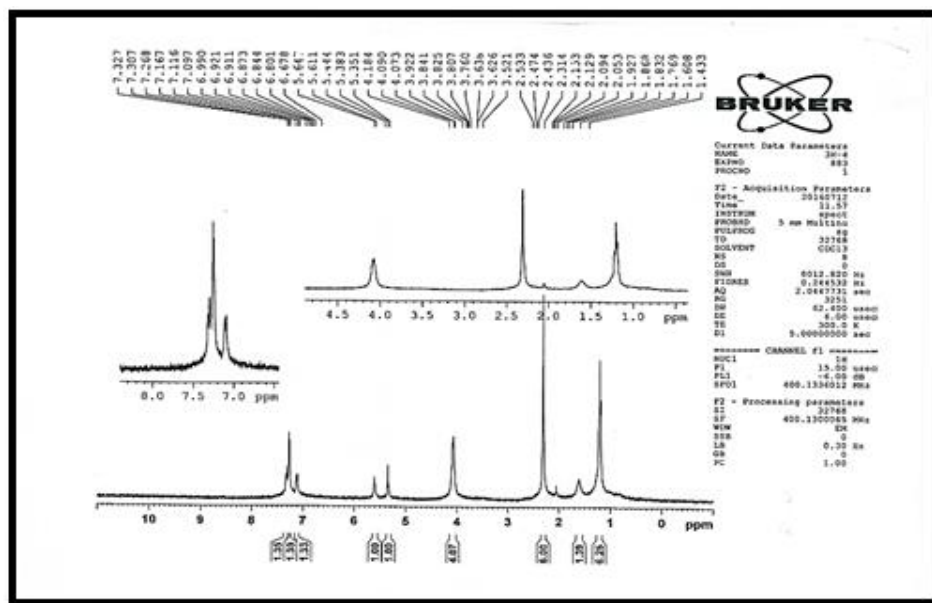
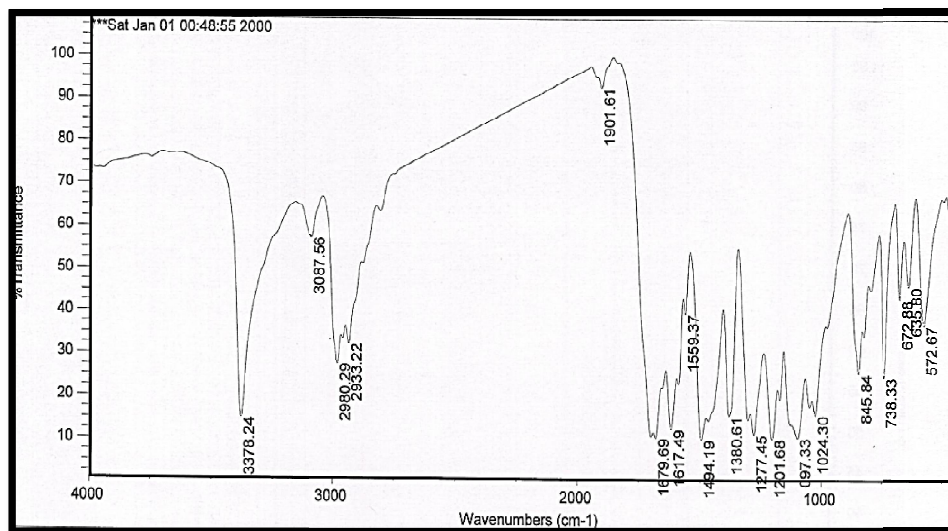


Diethyl-4-(2-Chlorophenyl)-1,4-dihydro-2,6-dimethyl pyridine-3,5-dicarboxylate;

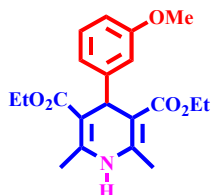


White solid. m.p = 118-120 °C; IR (KBr)/ ν (cm^{-1}): 3325 (NH), 3060 ($=\text{CH}_2$), 2978 ($-\text{CH}$, sp^3), 1699 ($\text{C}=\text{O}$), 1671 ($\text{C}=\text{C}$), 1613 $\text{ \& } 1491$ ($\text{C}=\text{C}$, Ar), 1206 ($\text{C}-\text{O}$); ^1H NMR (400 MHz, CDCl_3) δ ppm = 1.20 (t, $J=7.2$ Hz, 6H, 2CH_3), 2.31 (s, 6H, 2CH_3), 4.07 (q, 4H, 2CH_2), 5.39 (s, 1H), 5.65 (s, 1H, NH), 7.04 (t, $J=7.6$ Hz, 1H, ArH), 7.12 (t, $J=7.6$ Hz, 1H, ArH), 7.22 (d, $J=8$ Hz, 1H, ArH), 7.37 (d, $J=1.6$ Hz, 1H, ArH).



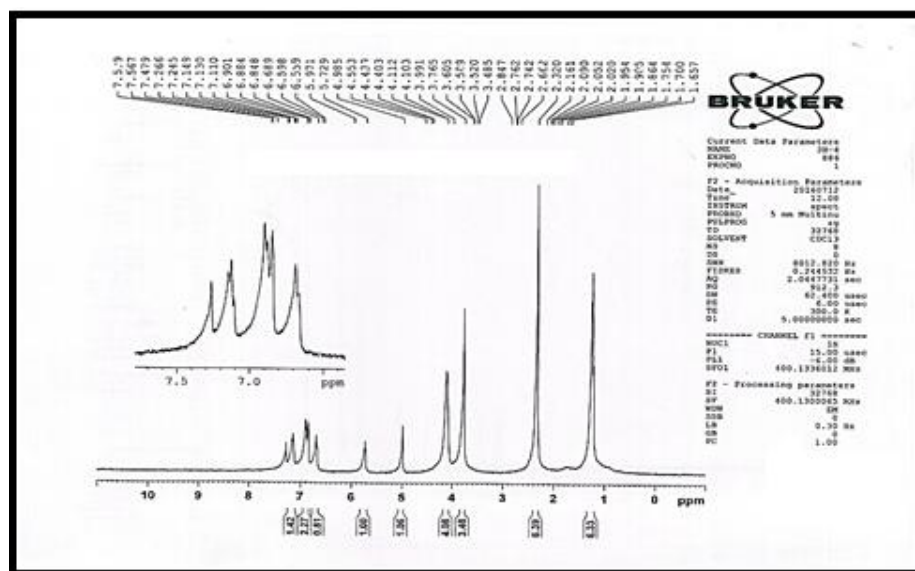
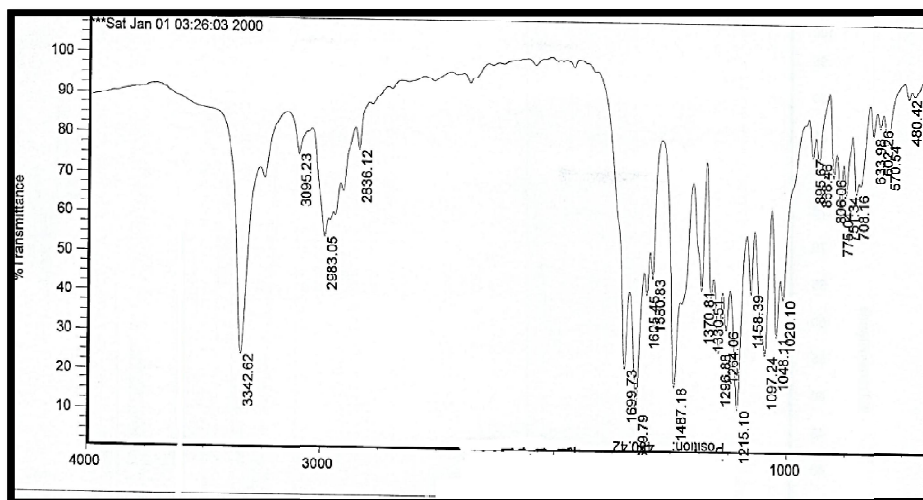


Diethyl-1,4-dihydro-2,6-dimethyl-4-(3-methoxyphenyl) pyridine-3,5-dicarboxylate;

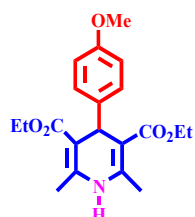


Yellow solid. m.p = 119-123 °C; IR (KBr)/ ν (cm⁻¹): 3342 (NH), 3095 (=CH₂), 2983 (-CH, sp³), 1699 (C=O), 1649 (C=C), 1605, 1487 (C=C, Ar), 1215 (C-O); ¹H NMR (400 MHz, CDCl₃) δ ppm = 1.23

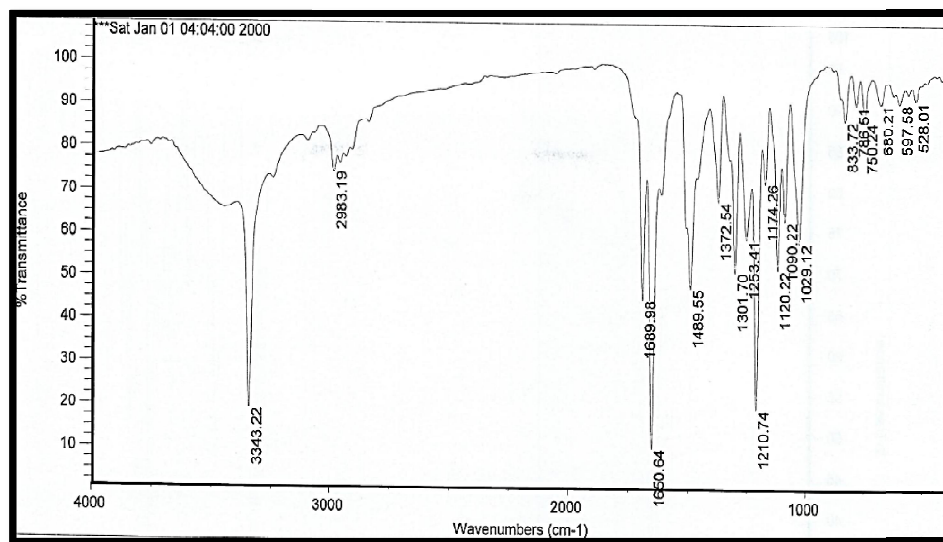
(t, $J=7.2$ Hz, 6H, 2CH₃), 2.32 (s, 6H, 2CH₃), 3.76 (s, 3H, CH₃), 4.11 (q, 4H, 2CH₂), 4.98 (s, 1H), 5.72 (s, 1H, NH), 6.67 (d, $J=8.8$ Hz, 1H, ArH), 6.84 (s, 1H, ArH), 6.89 (d, $J=6.8$ Hz, 1H, ArH), 7.13 (t, $J=8$ Hz, 1H, ArH).

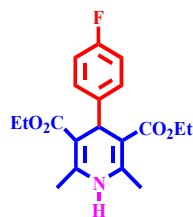


Diethyl-1,4-dihydro-2,6-dimethyl-4-(4-methoxyphenyl) pyridine-3,5-dicarboxylate;

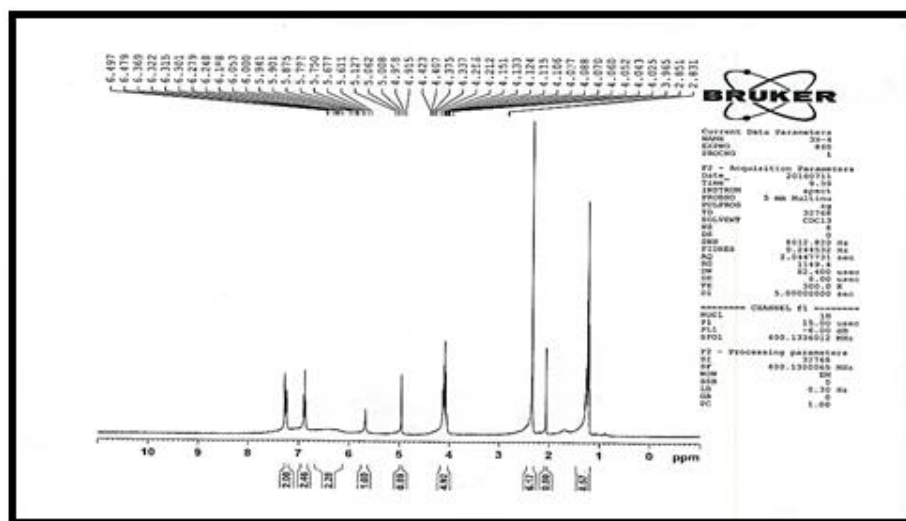
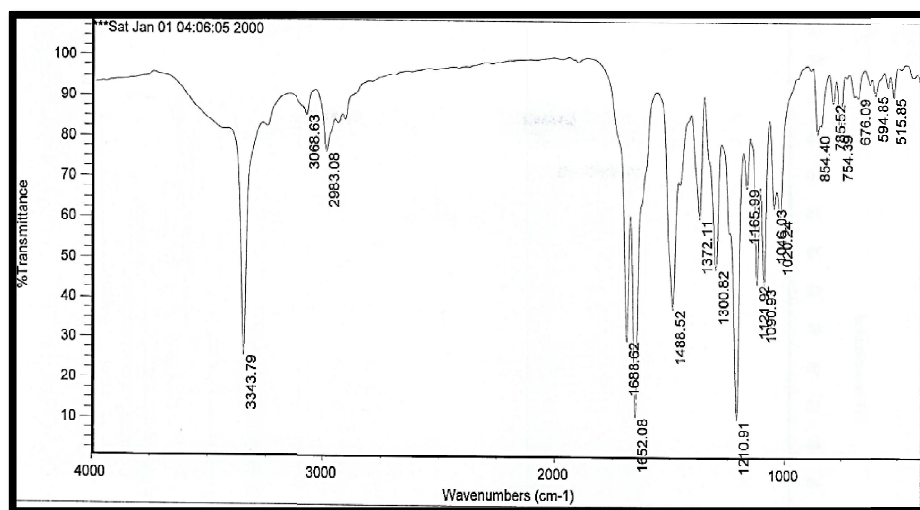


Diethyl-1,4-dihydro-2,6-dimethyl-4-(4-fluorophenyl) pyridine-3,5-dicarboxylate;

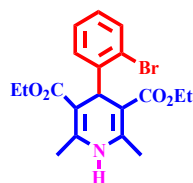




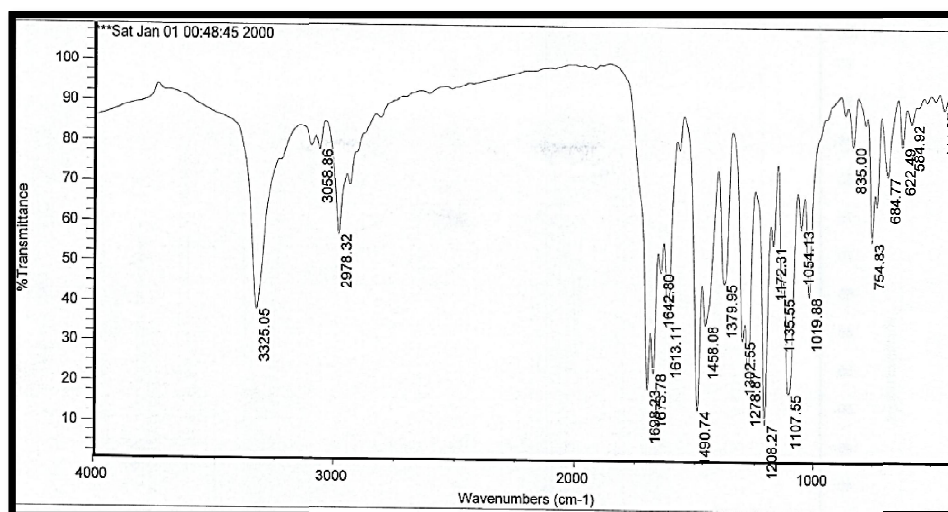
Yellow solid. m.p = 145-147 °C; IR (KBr)/ ν (cm⁻¹): 3343 (NH), 3068 (=CH₂), 2983(-CH, sp³), 1688 (C=O), 1652 (C=C), 1210 (C-O), ¹H NMR (400 MHz, CDCl₃) δ ppm = 1.21 (t, J =7.2 Hz, 6H, 2CH₃), 2.33 (s, 6H, 2CH₃), 4.04 (q, 4H, 2CH₂), 4.95 (s, 1H), 5.67 (s, 1H, NH), 6.88 (t, J =8.4 Hz, 2H, ArH), 7.23 (t, J =5.6 Hz, 2H, ArH).

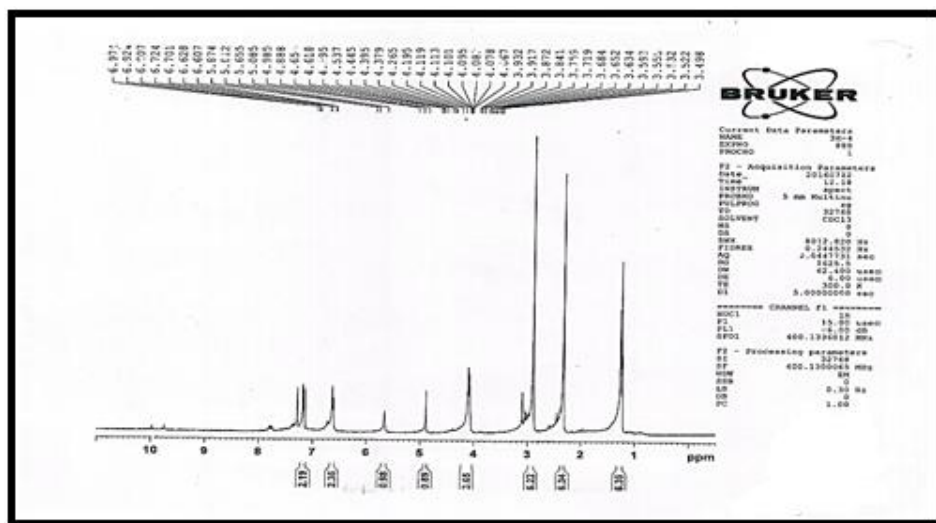


Diethyl-1,4-dihydro-2,6-dimethyl-4-(2-bromophenyl) pyridine-3,5-dicarboxylate;

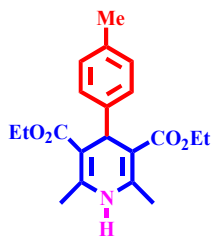


Yellow solid. m.p = 128-131 °C; IR (KBr)/ ν (cm⁻¹): 3325 (NH), 3058 (=CH₂), 2978 (-CH, sp³), 1698 (C=O), 1673 (C=C), 1613 , 1490 (C=C, Ar), 1208 (C-O); ¹H NMR (400 MHz, CDCl₃) δ ppm = 1.20 (t, J =7.2 Hz, 6H, 2CH₃), 2.30 (s, 6H, 2CH₃), 4.08 (q, 4H, 2CH₂), 5.36 (s, 1H), 5.62 (s, 1H, NH), 6.96 (t, J =8.8 Hz, 1H, ArH), 7.17 (t, J =7.2 Hz, 1H, ArH), 7.38 (d, J =1.6 Hz, 1H, ArH), 7.42 (d, J =8 Hz, 1H, ArH).

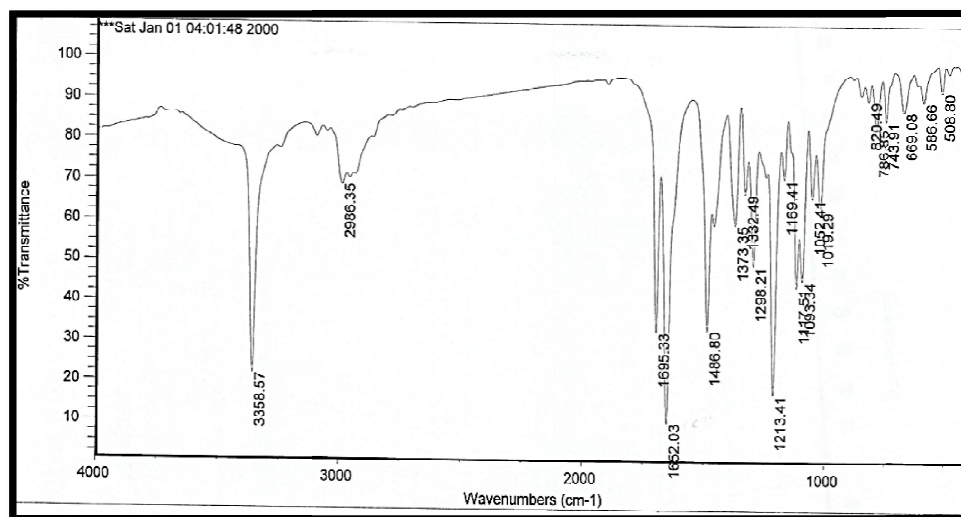


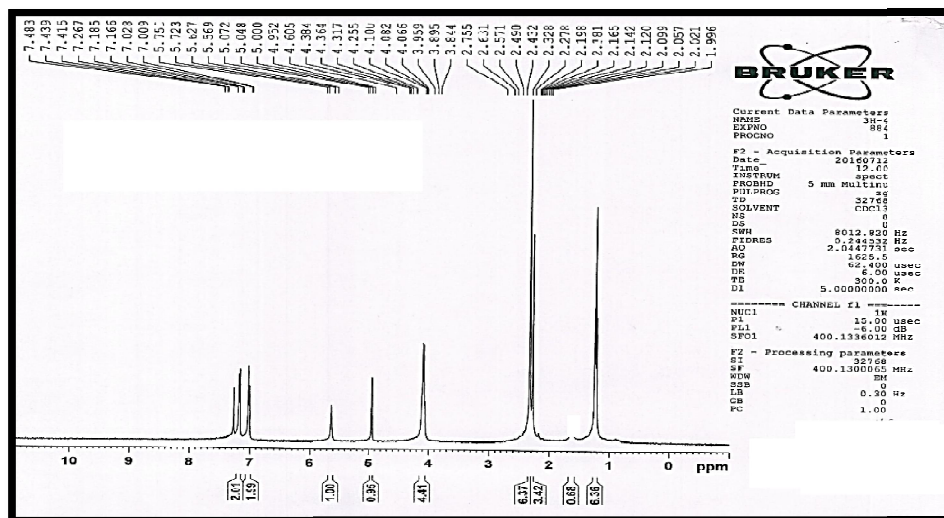


Diethyl-1,4-dihydro-2,6-dimethyl-4-para-tolylpyridine-3,5-dicarboxylate;

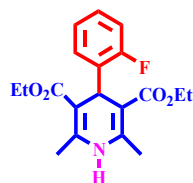


White solid. m.p = 139-140 °C; IR (KBr)/ ν (cm^{-1}): 3358 (NH), 2986 ($-\text{CH}$, sp^3), 1695 ($\text{C}=\text{O}$), 1652 ($\text{C}=\text{C}$), 1203 ($\text{C}-\text{O}$); ^1H NMR (400 MHz, CDCl_3) δ ppm= 1.23 (t, $J=7.2$ Hz, 6H, 2CH_3), 2.27 (s, 3H, CH_3), 2.32 (s, 6H, 2CH_3), 4.08 (q, 4H, 2CH_2), 4.95 (s, 1H), 5.62 (s, 1H, NH), 7.01 (d, $J=7.6$ Hz, 2H, ArH), 7.17 (d, $J=8$ Hz, 2H, ArH).

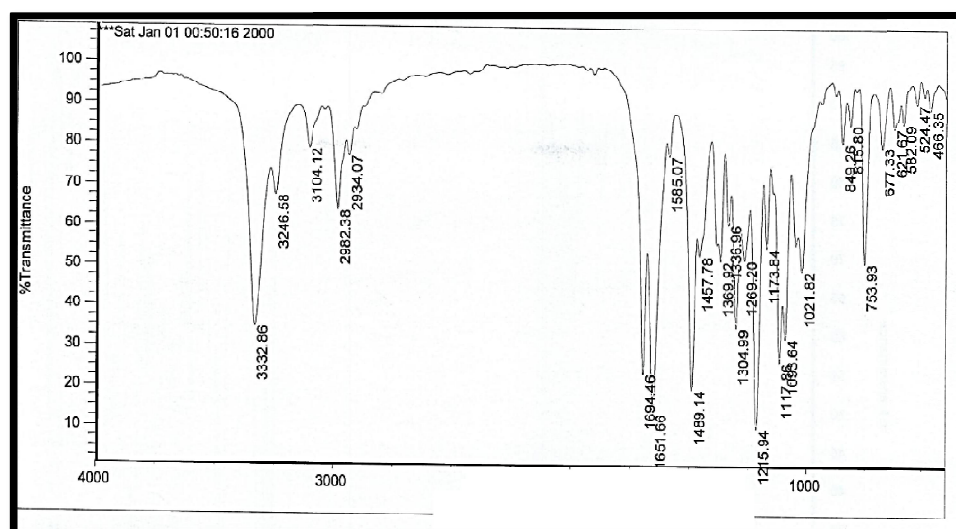


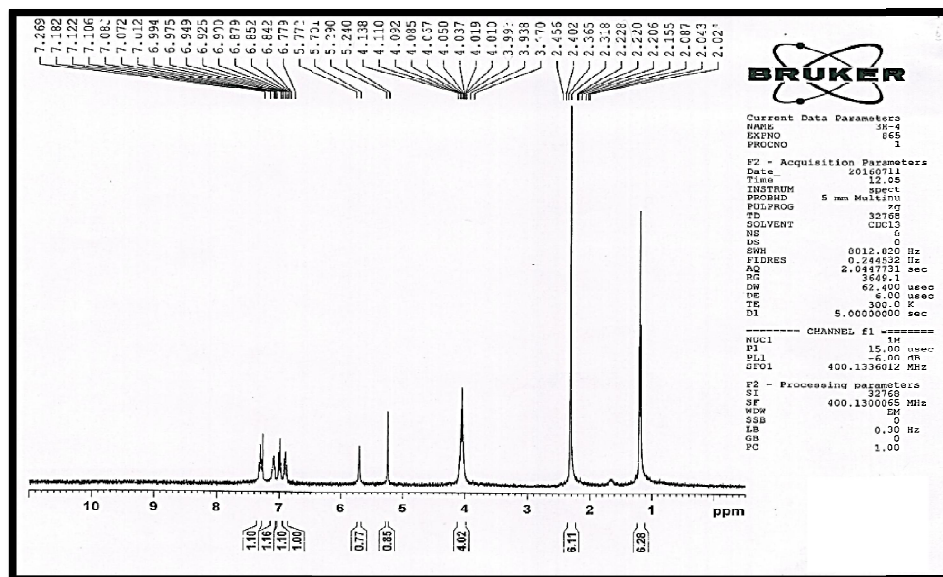


Diethyl-1,4-dihydro-2,6-dimethyl-4-(2-fluorophenyl) pyridine-3,5-dicarboxylate;

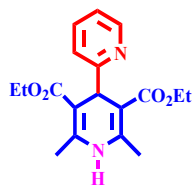


Yellow solid. m.p = 155-157 °C; IR (KBr)/ ν (cm⁻¹): 3332 (NH), 3104 (=CH₂), 2982 (-CH, sp³), 1694 (C=O), 1651 (C=C), 1215 (C-O); ¹H NMR (400 MHz, CDCl₃) δ ppm= 1.19 (t, J =7.2 Hz, 6H, 2CH₃), 2.31 (s, 6H, 2CH₃), 4.03 (q, 4H, 2CH₂), 5.24 (s, 1H), 5.70 (s, 1H, NH), 6.92 (t, J =9.6 Hz, 1H, ArH), 6.99 (t, J =7.6 Hz, 1H, ArH), 7.08 (t, J =7.2 Hz, 1H, ArH), 7.30 (t, J =7.2 Hz, 1H, ArH).

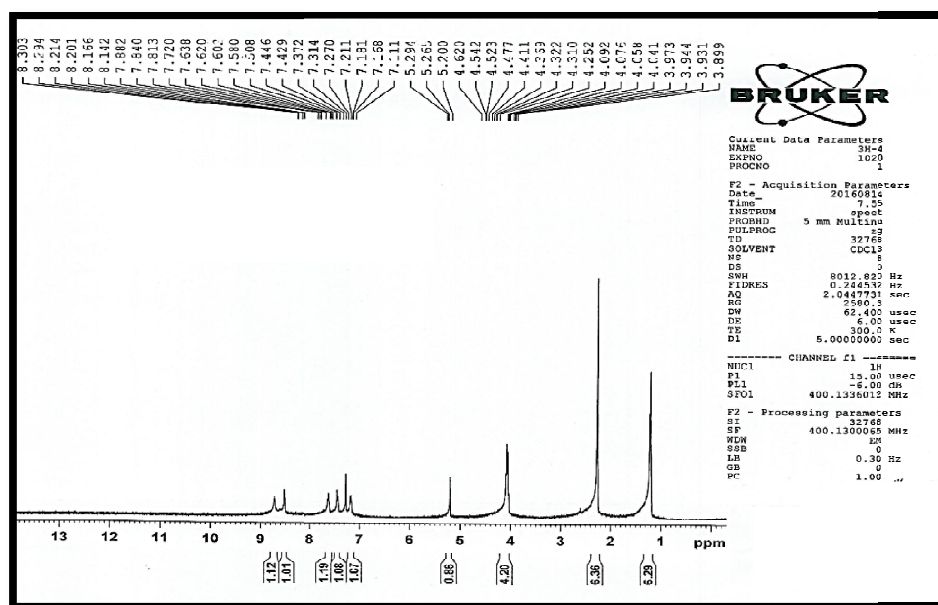
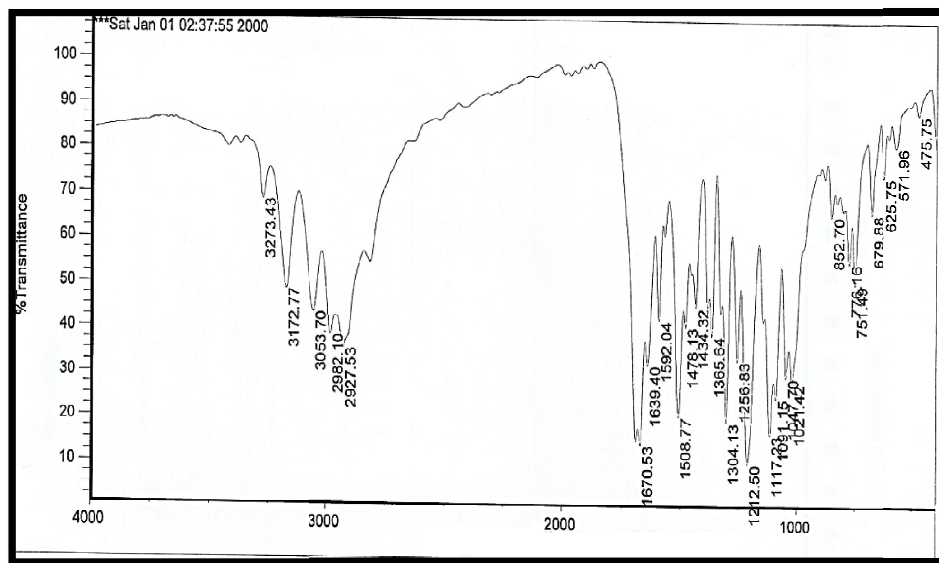




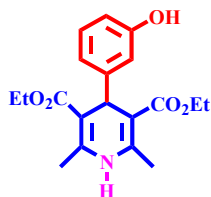
Diethyl-1,4-dihydro-2,6-dimethyl-(2,4-bipyridine)-3,5-dicarboxylate;



Brown solid. m.p = 188-1191 °C; IR (KBr)/ ν (cm⁻¹): 3172 (NH), 2982 (-CH, sp³), 1695 (C=O), 1670 (C=C), 1478 3 1639 (C=C, Ar), 1212 (C-O); ¹H NMR (400 MHz, CDCl₃) δ ppm= 1.20 (t, *J*=7.2 Hz, 6H, 2CH₃), 2.26 (s, 6H, 2CH₃), 4.05 (q, 4H, 2CH₂), 5.20 (s, 1H), 7.17 (d, *J*=5.2 Hz, 1H, ArH), 7.43 (d, *J*=6.8 Hz, 1H, ArH), 7.62 (t, *J*=7.2 Hz, 1H, ArH), 8.51 (d, *J*=4.4 Hz, 1H, ArH), 8.71 (s, 1H, NH).

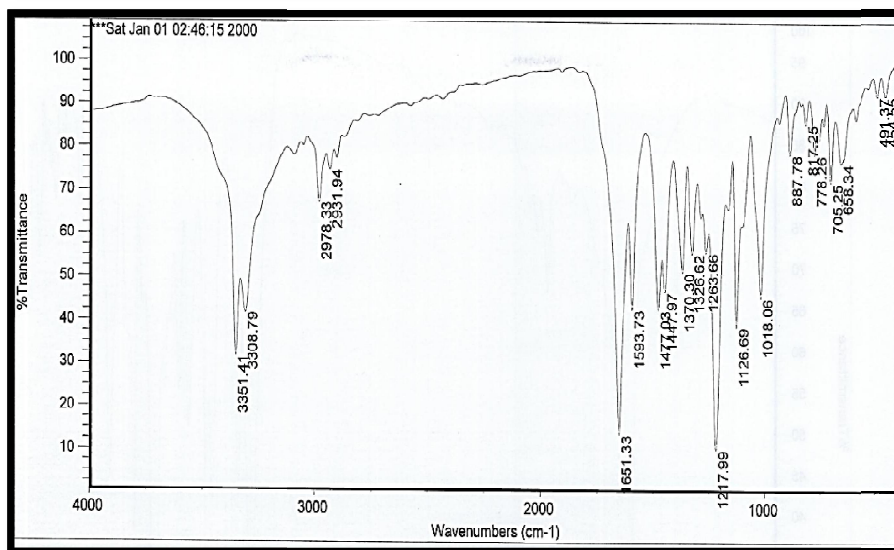
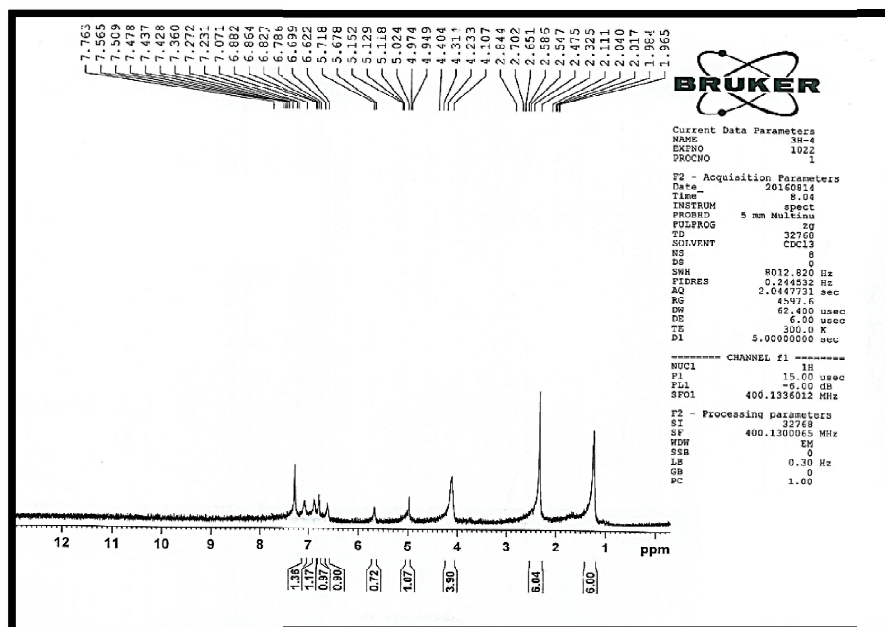


Diethyl-1,4-dihydro-2,6-dimethyl-4-(3-hydroxyphenyl) pyridine-3,5-dicarboxylate;

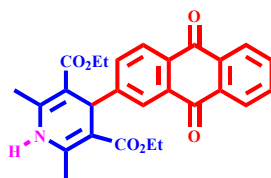


White solid. m.p = 168-170 °C; IR (KBr)/ ν (cm⁻¹): 3351 (NH), 2978 (-CH, sp³), 1651 (C=O), 1593 (C=C), 1217 (C-O); ¹H NMR (400 MHz, CDCl₃) δ ppm = 1.23 (t, J =7.2 Hz 6H, 2CH₃), 2.32 (s, 6H,

2CH₃), 4.10 (q, 4H, 2CH₂), 4.97 (s, 1H), 5.71 (s, 1H, NH), 6.62 (d, *J*=7.2 Hz, 1H, ArH), 6.78 (s, 1H, ArH), 6.87 (d, *J*=7.2 Hz, 1H, ArH), 7.07(t, *J*=7.6 Hz, 1H, ArH).



Diethyl-1,4-dihydro-2,6-dimethyl-4-(9,10-dihydroanthracene-2-yl)pyridine-3,5-dicarboxylate;



Brown solid. m.p = 195-200 °C; IR (KBr)/ ν (cm⁻¹): 3293 (NH), 2983 (-CH, sp³), 1670 (C=O), 1637 (C=C), 1214 (C-O); ¹H NMR (400 MHz, CDCl₃) δ ppm= 1.20 (t, J =7.2 Hz, 6H, 2CH₃), 2.32 (s, 6H, 2CH₃), 4.05 (q, 4H, 2CH₂), 5.33 (s, 1H), 6.17 (s, 1H, NH), 7.74 (m, 4H, ArH), 8.01 (d, J =8 Hz, 1H, ArH), 8.21 (m, 2H, ArH).

