Supplementary information

Bioactive Assessment of Hexahydroquinoline Derivatives Prepared via a Biochar/ Fe_3O_4@APTMS Magnetic Catalyst: Focus on Antidiabetic and Antibacterial Properties

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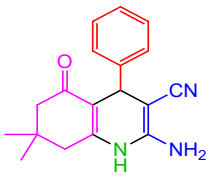
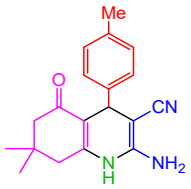
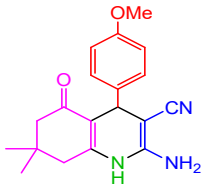
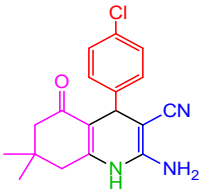
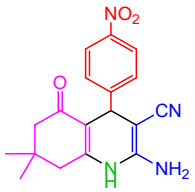
Table SI1 : characterization of hexahydroquinoline derivatives (5a-5j)

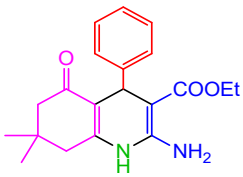
Product	NMR
	2-amino-7,7-dimethyl-5-oxo-4-phenyl-1,4,5,6,7,8-hexahydroquinoline-3-carbonitrile (**5a**): FT-IR (KBr) cm^{-1}: 3394-3325 (NH_2); 3215 (NH); 2200 (CN); 1660 (CO ketone). ^1H NMR (500 MHz, DMSO d_6) δ: 8.84 (s, 1H, NH), 7.25 (m, 2H, HAr), 7.11 (m, 3H, HAr), 6.96 (s, 2H, NH_2), 4.14 (s, 1H, CH), 2.07-2.22 (m, 4H, $2CH_2$), 1.01 (s, 3H, CH_3), 0.91 (s, 3H, CH_3) ppm. ^{13}C NMR (126 MHz, DMSO d_6) δ: 196.21 (C5), 163.04 (C2), 159.04 (C4b), 145.30 (C1'), 128.88 (C3'), 127.70 (C2'), 127.12 (C4'), 120.29 (CN), 113.29 (C4a), 58.85 (C3), 50.51 (C6), 40.30 (C8), 36.12 (C4), 32.35 (C7), 28.95 (CH_3), 27.34 (CH_3) ppm, mp = 283–285 °C[1].
	2-amino-7,7-dimethyl-5-oxo-4-(p-tolyl)-1,4,5,6,7,8-hexahydroquinoline-3-carbonitrile (**5b**): FT-IR (KBr) cm^{-1}: 3427, 3331 (NH2); 3219 (NH); 2193 (CN); 1678 (CO ketone). 1H NMR (500 MHz, DMSO d6) δ: 8.81 (s, 1H, NH), 7.05 (m, 2H, HAr), 6.99 (m, 2H, HAr), 6.92 (s, 2H, NH2), 4.10 (s, 1H, CH), 2.03-2.22 (m, 4H, 2CH2), 2.21 (s, 3H, CH3), 1.01 (s, 3H, CH3), 0.92 (s, 3H, CH3) ppm. 13C NMR (126 MHz, DMSO d6) δ: 196.18 (C5), 162.83 (C2), 158.98 (C4b), 142.32 (C1'), 136.17 (C4'), 129.43 (C3'), 127.63 (C2'), 120.31 (CN), 113.42 (C4a), 58.98 (C3), 50.53 (C6), 40.21 (C8), 35.73 (C4), 32.33 (C7), 28.97 (CH3), 27.30 (CH3), 21.14 (ArCH3) ppm, mp = 291–293 °C[1].
	2-amino-4-(4-methoxyphenyl)-7,7-dimethyl-5-oxo-1,4,5,6,7,8-hexahydroquinoline-3-carbonitrile (**5c**): FT-IR (KBr) cm^{-1}: 3373, 3304 (NH_2); 3203 (NH); 2198 (CN); 1662 (CO ketone). ^1H NMR (500 MHz, DMSO d_6) δ: 8.80 (s, 1H, NH), 7.01 (m, 2H, HAr), 6.92 (s, 2H, NH_2), 6.80 (m, 2H, HAr), 4.09 (s, 1H, CH), 3.67 (s, 3H, OCH_3), 2.05-2.20 (m, 4H, $2CH_2$), 0.99 (s, 3H, CH_3), 0.92 (s, 3H, CH_3) ppm. ^{13}C NMR (126 MHz, DMSO d_6) δ: 196.22 (C5), 162.69 (C2), 158.96 (C4'), 158.46 (C4b), 137.40 (C1'), 128.77 (C2'), 120.36 (CN), 114.21 (C3'), 113.54 (C4a), 59.10 (C3), 55.52 ($ArOCH_3$), 50.55 (C6), 40.20 (C8), 35.30 (C4), 32.32 (C7), 28.96 (CH_3), 27.30 (CH_3) ppm, mp = 283–286 °C[1].



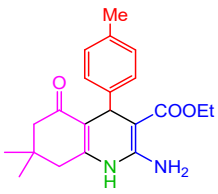
2-amino-4-(4-chlorophenyl)-7,7-dimethyl-5-oxo-1,4,5,6,7,8-hexahydroquinoline-3-carbonitrile (**5d**): FT-IR (KBr) cm^{-1}: 3379, 3329 (NH_2); 3180 (NH); 2189 (CN); 1677 (CO ketone). ^1H NMR (500 MHz, DMSO d_6) δ: 8.88 (s, 1H, NH), 7.31 (m, 2H, HAr), 7.14 (m, 2H, HAr), 7.03 (s, 2H, NH_2), 4.16 (s, 1H, CH), 2.07-2.21 (m, 4H, $2CH_2$), 0.99 (s, 3H, CH_3), 0.92 (s, 3H, CH_3) ppm. ^{13}C NMR (126 MHz, DMSO d_6) δ: 196.23 (C5), 163.17 (C2), 159.04 (C4b), 144.30 (C1'), 131.66 (C4'), 129.67 (C2'), 128.84 (C3'), 120.12 (CN), 112.87 (C4a), 58.30 (C3), 50.48 (C6), 40.21 (C8), 35.65 (C4), 32.34 (C7), 28.86 (CH_3), 27.39 (CH_3) ppm, mp = 287–290 °C[1].



2-amino-7,7-dimethyl-4-(4-nitrophenyl)-5-oxo-1,4,5,6,7,8-hexahydroquinoline-3-carbonitrile (**5e**): FT-IR (KBr) cm^{-1}: 3394, 3321 (NH_2); 3211 (NH); 2193 (CN); 1681 (CO ketone). ^1H NMR (500 MHz, DMSO d_6) δ: 8,99 (s, 1H, NH), 8.13 (m, 2H, HAr), 7.42 (m, 2H, HAr), 7.14 (s, 2H, NH_2), 4.34 (s, 1H, CH), 2.05-2.22 (m, 4H, $2CH_2$), 1.00 (s, 3H, CH_3), 0.92 (s, 3H, CH_3) ppm. ^{13}C NMR (126 MHz, DMSO d_6) δ: 196.23 (C5), 163.64 (C2), 152.84 (C1'), 146.79 (C4b), 129.16 (C2'), 124.20 (C3'), 119.88 (CN), 112.28 (C4a), 57.53 (C3), 50.39 (C6), 40.22 (C8), 36.21 (C4), 32.34 (C7), 28.78 (CH_3), 27.45 (CH_3) ppm, mp = 291–293 °C[1].

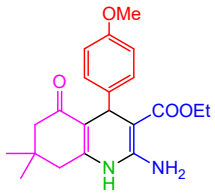


ethyl 2-amino-7,7-dimethyl-5-oxo-4-phenyl-1,4,5,6,7,8-hexahydroquinoline-3-carboxylate (**5f**): FT-IR (KBr) cm^{-1}: 3402, 3286(NH_2); 3215(NH); 1693(CO ester); 1664(CO ketone); 1369, 1037(C-O). ^1H NMR (400 MHz, DMSO d_6) δ: 8.89 (s, 1H, NH), 7.55 (s, 2H, NH_2), 7.16 (m, 5H, HAr), 4.53 (s, 1H, CH), 3.96 (m, 2H, CH_2), 2.06-2.26 (m, 4H, $2CH_2$), 1.07-1.11 (m, 2H, CH_2), 1.04 (s, 3H, CH_3), 0.90 (s, 3H, CH_3) ppm. ^{13}C NMR (100 MHz, DMSO d_6) δ: 196.24 (C5), 168.48 (C2), 162.58 (**C**OOEt), 159.63 (C4b), 146.84 (C1'), 128.16 (C3'), 128.13 (C2'), 126.26 (C4'), 116.06 (C4a), 78.37 (C3), 59.24 (O**C**H_2- CH_3), 50.45 (C6), 39.76 (C8), 33.76 (C4), 32.31 (C7), 29.11 (CH_3), 26.91 (CH_3), 14.65 (OCH_2- **C**H_3) ppm, mp = 158–161 °C[2].

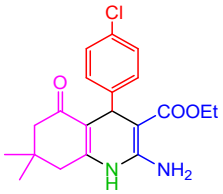


ethyl 2-amino-7,7-dimethyl-5-oxo-4-(p-tolyl)-1,4,5,6,7,8-hexahydroquinoline-3-carboxylate (**5g**): FT-IR (KBr) cm^{-1}: 3406, 3290(NH_2); 3230(NH); 1701(CO ester); 1660(CO ketone); 1357, 1037(C-O). ^1H NMR (400 MHz, DMSO d_6) δ: 8.85 (s, 1H, NH), 7.51 (s, 2H, NH_2), 7.01 (m, 4H, HAr), 4.47 (s, 1H, CH), 3.93 (m, 2H, CH_2), 2.02-2.27 (m, 4H, $2CH_2$), 2.21 (s, 3H, CH_3Ar), 1.10 (m, 3H, CH_3), 1.02 (s, 3H, CH_3), 0.91 (s, 3H, CH_3) ppm. ^{13}C

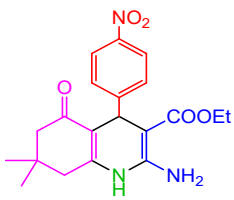
NMR (100 MHz, DMSO d_6) δ: 196.26 (C5), 168.51 (C2), 162.47 (**C**OOEt), 159.57 (C4b), 143.87 (C1'), 135.17 (C4'), 128.73 (C3'), 128.02 (C2'), 116.16 (C4a), 78.49 (C3), 59.24 (O**C**H_2- CH_3), 50.46 (C6), 39.75 (C8), 33.26 (C4), 32.32 (C7), 29.14 (CH_3), 26.91 (CH_3), 21.00 ($ArCH_3$), 14.68 (OCH_2- **C**H_3) ppm, mp = 156–159 °C[2].



ethyl 2-amino-4-(4-methoxyphenyl)-7,7-dimethyl-5-oxo-1,4,5,6,7,8-hexahydroquinoline-3-carboxylate (**5h**): FT-IR (KBr) cm^{-1}: 3410, 3304(NH_2); 3223(NH); 1691(CO ester); 1664(CO ketone); 1285, 1035(C-O). ^{1}H NMR (400 MHz, DMSO d_6) δ: 8.88 (s, 1H, NH), 7.50 (s, 2H, NH_2), 7.05 (m, 2H, HAr), 6.76 (m, 2H, HAr), 4.45 (s, 1H, CH), 3.95 (m, 2H, CH_2), 3.68 (s, 3H, CH_3-O), 2.04-2.25 (m, 4H, $2CH_2$), 1.11 (m, 3H, CH_3), 1.04 (s, 3H, CH_3), 0.91 (s, 3H, CH_3) ppm. ^{13}C NMR (100 MHz, DMSO d_6) δ: 196.30 (C5), 168.53 (C2), 162.34 (**C**OOEt), 159.55 (C4b), 157.79 (C4'), 138.97 (C1'), 129.05 (C2'), 116.24 (C3'), 113.53 (C4a), 78.61 (C3), 59.23 (O**C**H_2- CH_3), 55.33 ($ArOCH_3$), 50.47 (C6), 39.75 (C8), 33.82 (C4), 32.31 (C7), 29.12 (CH_3), 26.95 (CH_3), 14.70 (OCH_2- **C**H_3) ppm, mp = 134–136 °C[2].



Ethyl 2-amino-4-(4-chlorophenyl)-7,7-dimethyl-5-oxo-1,4,5,6,7,8-hexahydroquinoline-3-carboxylate (**5i**): FT-IR (KBr) cm^{-1}: 3481, 3332(NH_2); 3197(NH); 1695(CO ester); 1660(CO ketone); 1373, 1087(C-O). ^{1}H NMR (400 MHz, DMSO d_6) δ: 8.94 (s, 1H, NH), 7.59 (s, 2H, NH_2), 7.26 (m, 2H, HAr), 7.15 (m, 2H, HAr), 4.49 (s, 1H, CH), 3.95 (m, 2H, CH_2), 2.06-2.26 (m, 4H, $2CH_2$), 1.06-1.10 (m, 2H, CH_2), 1.03 (s, 3H, CH_3), 0.88 (s, 3H, CH_3) ppm. ^{13}C NMR (100 MHz, DMSO d_6) δ: 196.30 (C5), 168.31 (C2), 162.73 (**C**OOEt), 159.58 (C4b), 145.85 (C1'), 130.74 (C4'), 130.04 (C2'), 128.12 (C3'), 115.53 (C4a), 77.76 (C3), 59.31 (O**C**H_2- CH_3), 50.38 (C6), 40.00 (C8), 33.45 (C4), 32.32 (C7), 29.06 (CH_3), 26.94 (CH_3), 14.65 (OCH_2- **C**H_3) ppm, mp = 159–161 °C[2].



ethyl2-amino-4-(4-nitrophenyl)-7,7-dimethyl-5-oxo-1,4,5,6,7,8-hexahydroquinoline-3-carboxylate (**5j**): FT-IR (KBr) cm^{-1}: 3475, 3334(NH_2); 3199(NH); 1685(CO ester); 1656(CO ketone); 1348, 1043(C-O). ^{1}H NMR (400 MHz, DMSO d_6) δ: 9.09 (s, 1H, NH), 8.10 (m, 2H, HAr), 7.70 (s, 2H, NH_2), 7.42 (m, 2H, HAr), 4.62 (s, 1H, CH), 3.99 (m, 2H, CH_2), 2.06-2.27 (m, 4H, $2CH_2$), 1.05-1.09 (m, 2H, CH_2), 1.04 (s, 3H, CH_3), 0.88 (s, 3H, CH_3) ppm. ^{13}C NMR (100 MHz, DMSO d_6) δ: 196.28 (C5), 168.11 (C2), 163.17 (**C**OOEt), 159.60 (C1'), 154.63 red(C4b), 146.16 (C4'), 129.58 (C2'), 123.50 (C3'), 114.79 (C4a), 76.99 (C3), 59.40 (O**C**H_2- CH_3), 50.29 (C6), 39.96 (C8), 34.36

(C4), 32.32 (C7), 29.00 (CH_3), 26.96 (CH_3), 14.60 (OCH_2- **C**H_3) ppm, mp = 187–189 °C[2].

Copies of ^{13}C-NMR and ^{1}H-NMR spectral

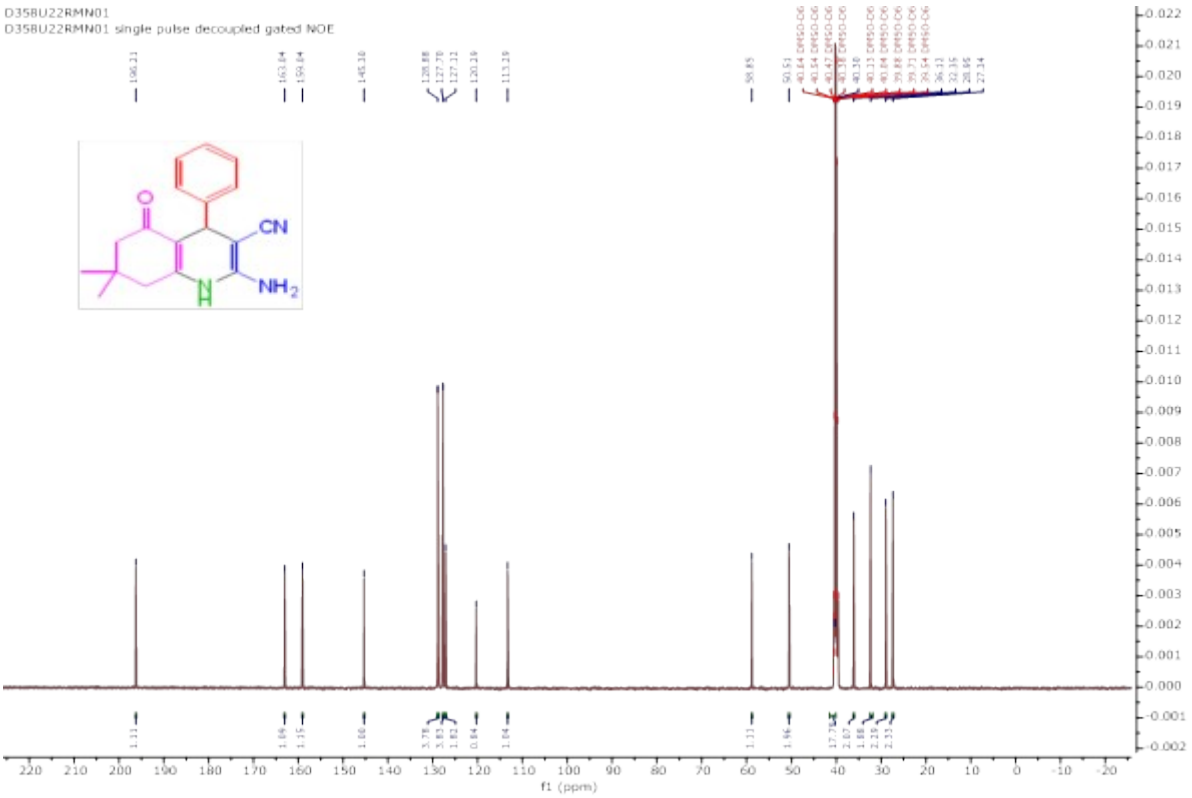


Fig. SI1. The ^{13}C-NMR spectrum of compound 5a

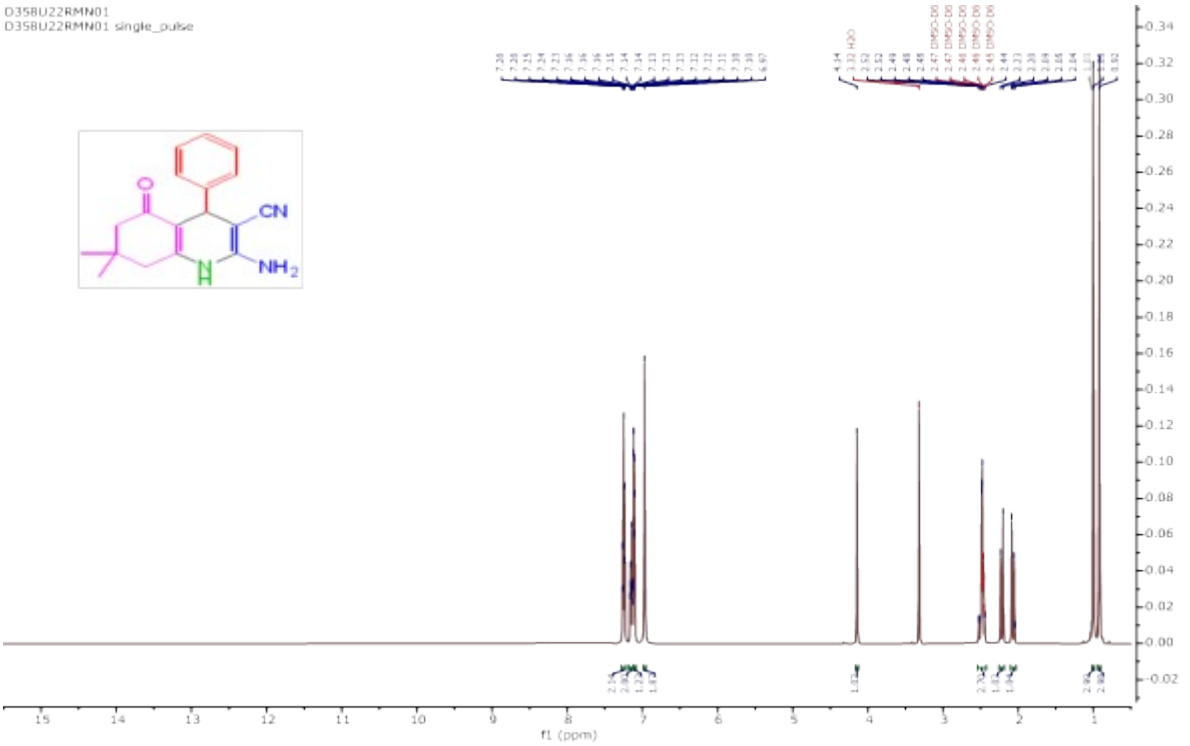


Fig. SI2. The ^{1}H-NMR spectrum of compound 5a

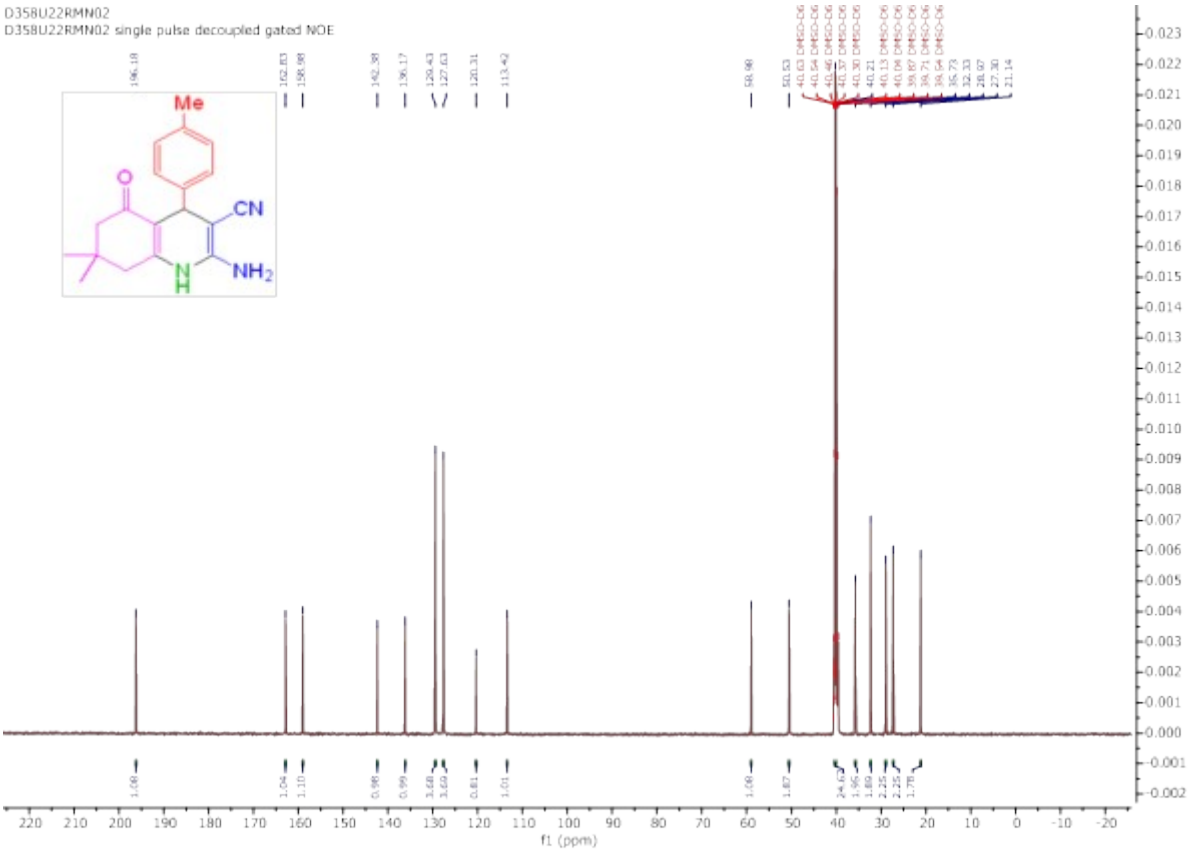


Fig. SI3. The ^{13}C-NMR spectrum of compound 5b

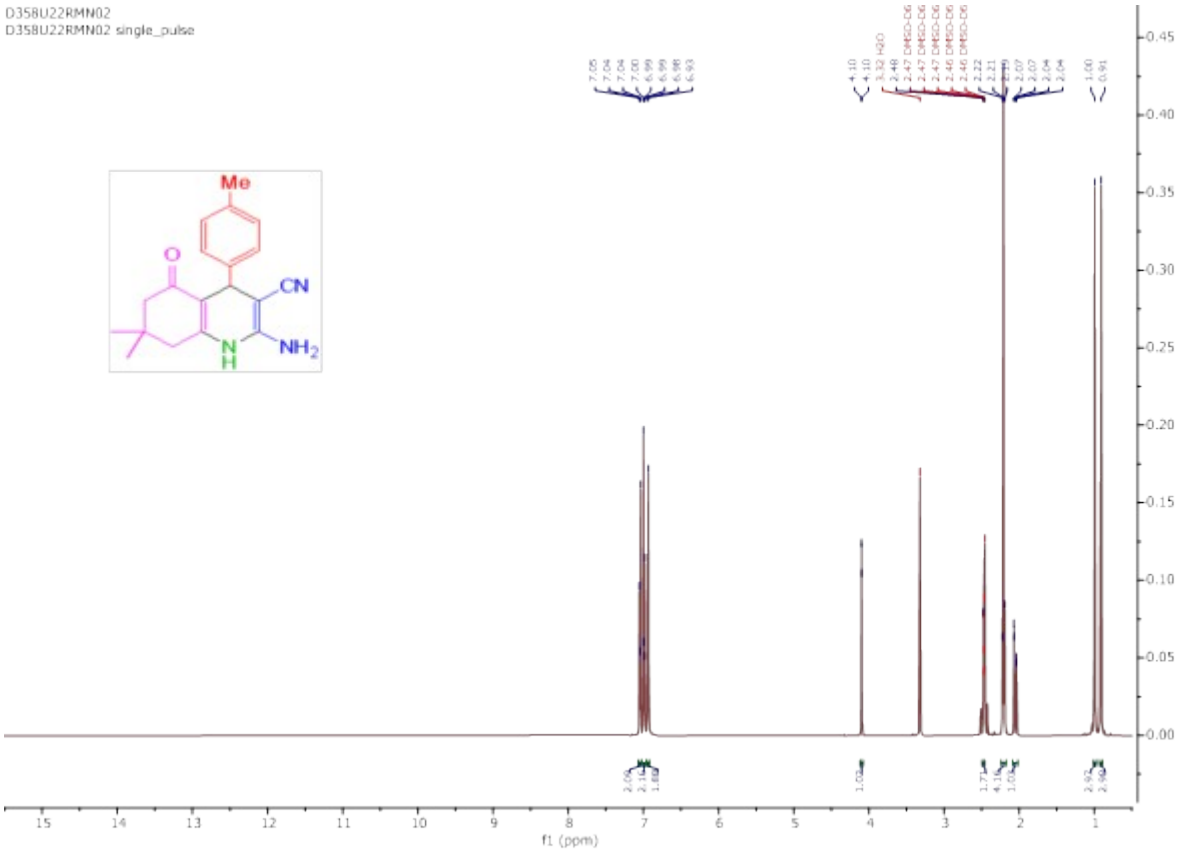


Fig. SI4. The ^{1}H-NMR spectrum of compound 5b

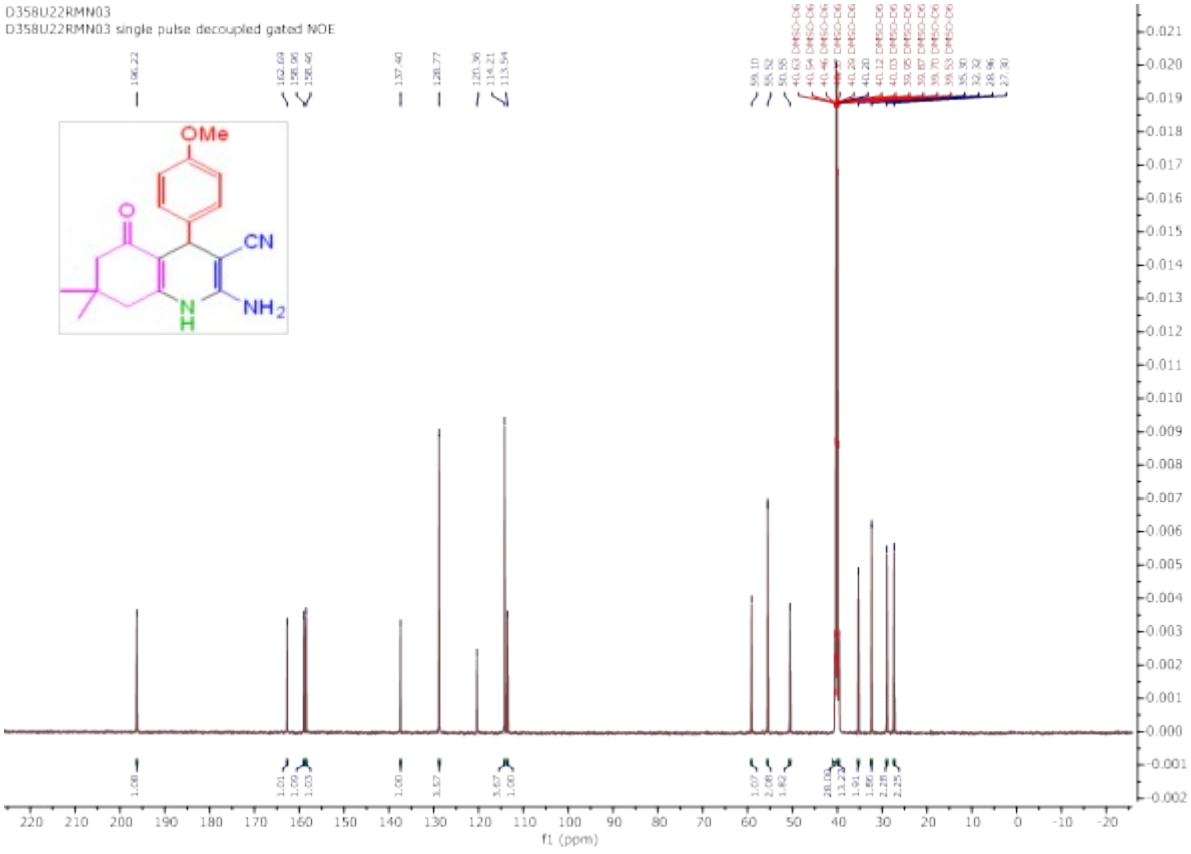


Fig. SI5. The ^{13}C-NMR spectrum of compound 5c

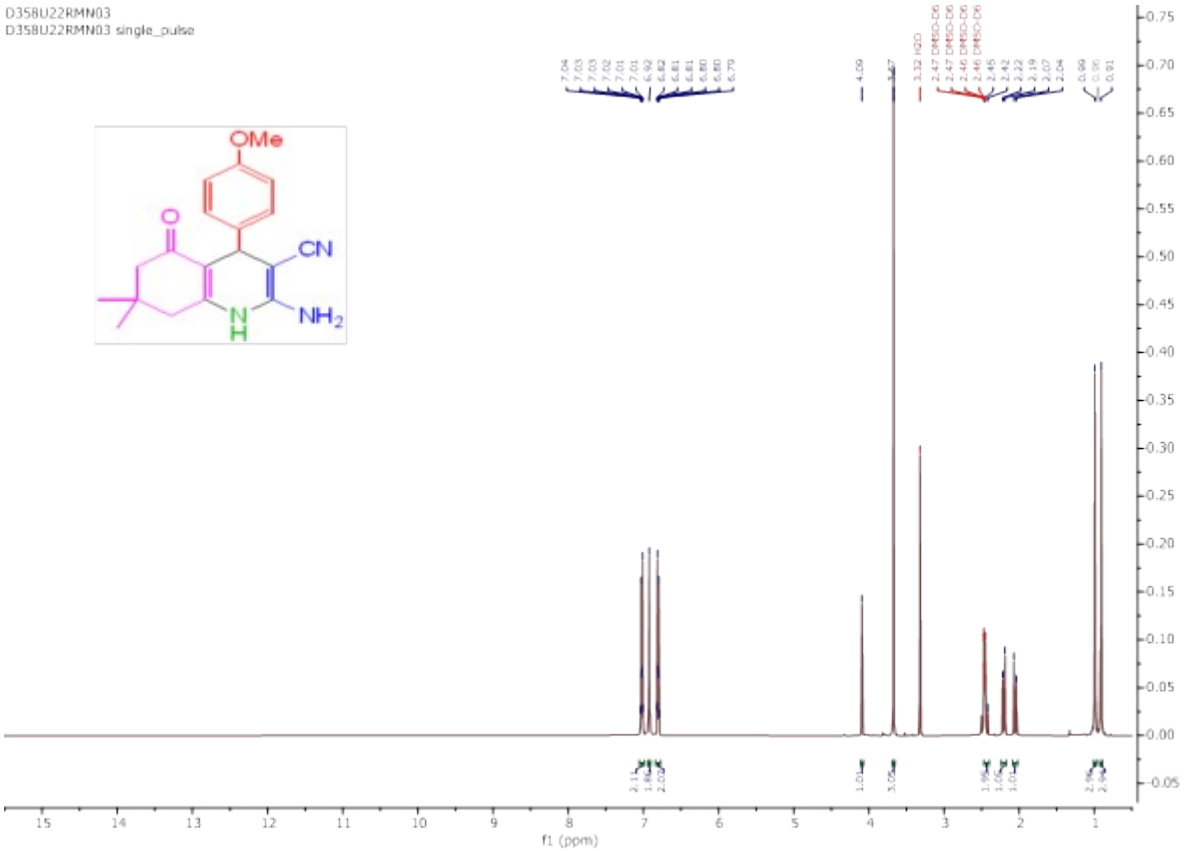


Fig. SI6. The ^{1}H-NMR spectrum of compound 5c

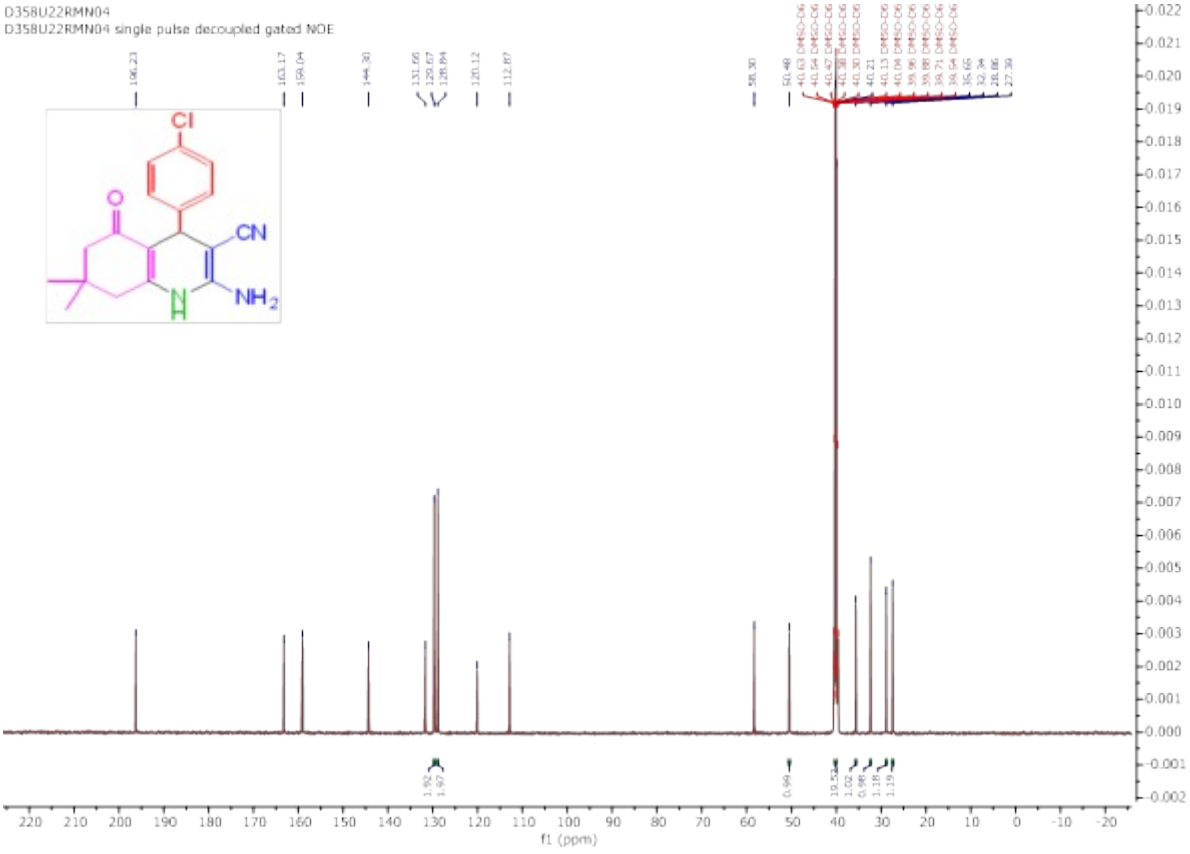


Fig. SI7. The ^{13}C-NMR spectrum of compound 5d

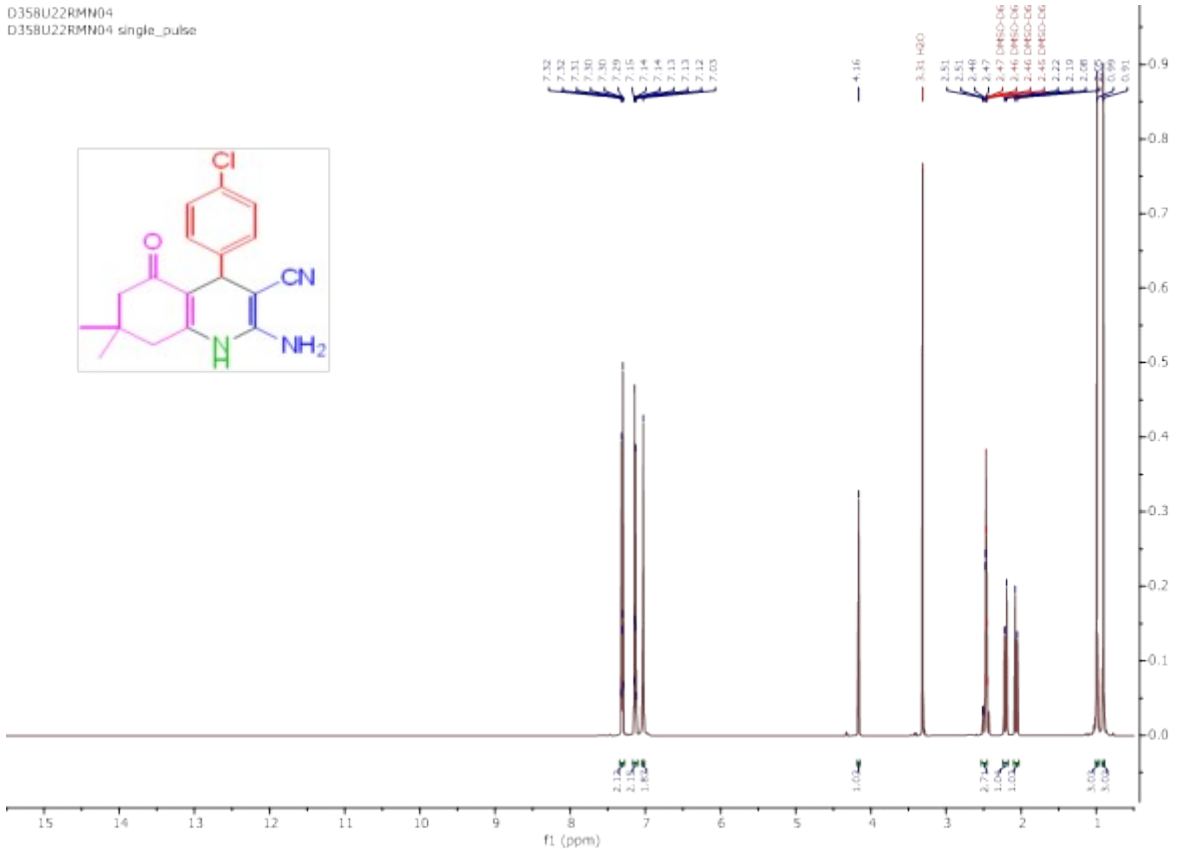


Fig. SI8. The ^{1}H-NMR spectrum of compound 5d

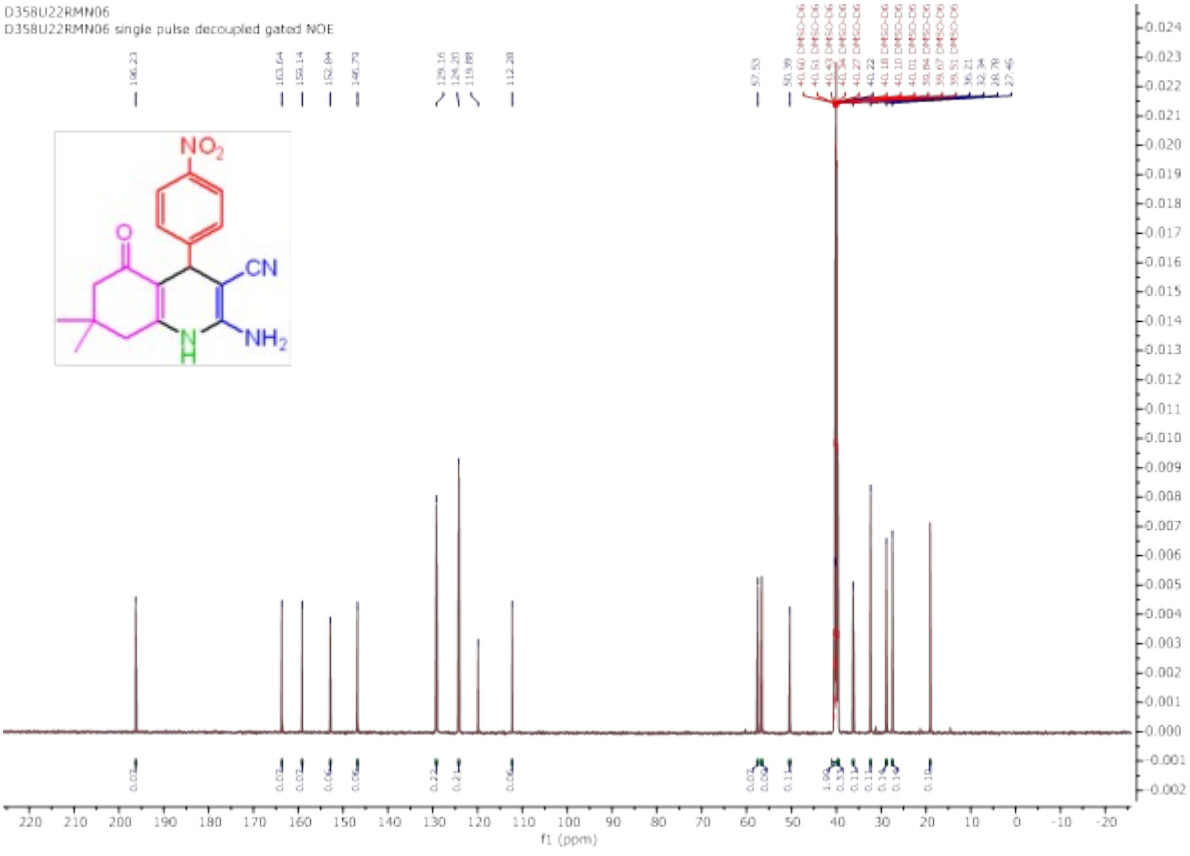


Fig. SI9. The ^{13}C-NMR spectrum of compound 5e

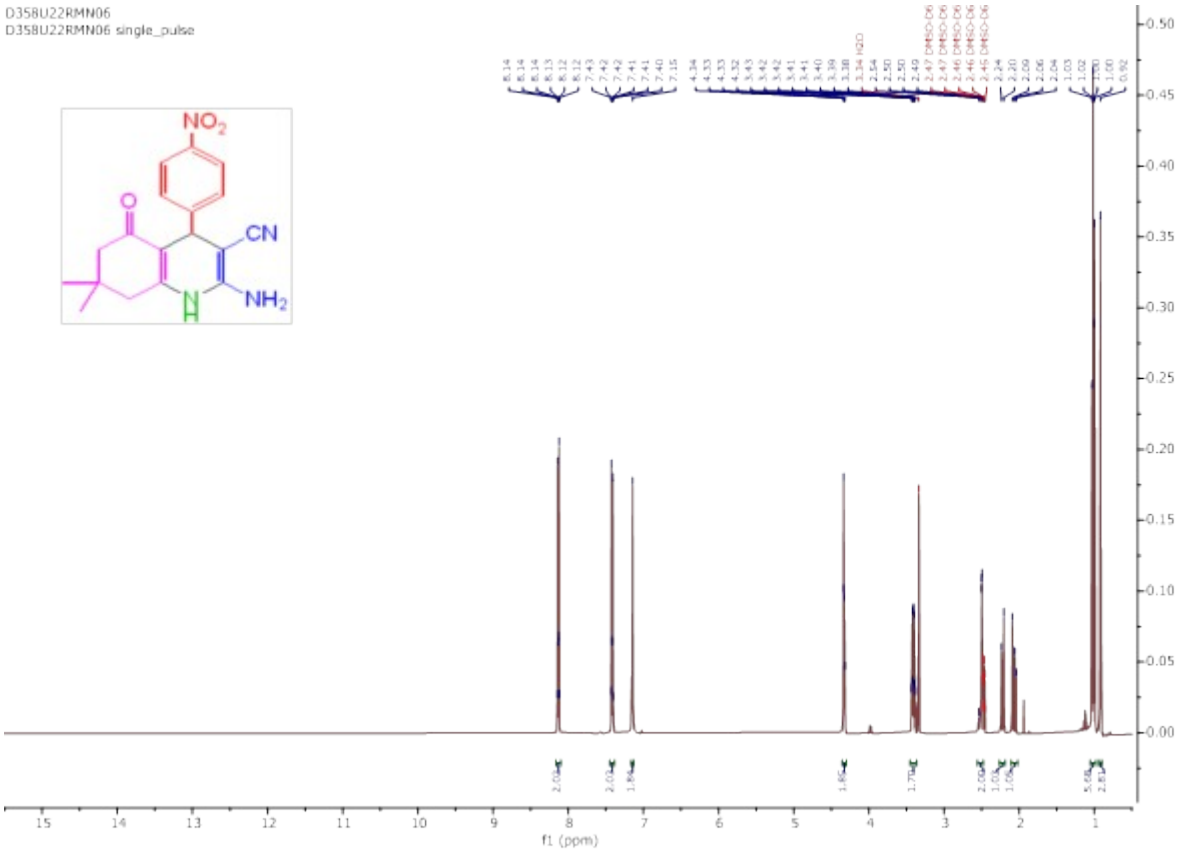


Fig. SI10. The ^{1}H-NMR spectrum of compound 5e

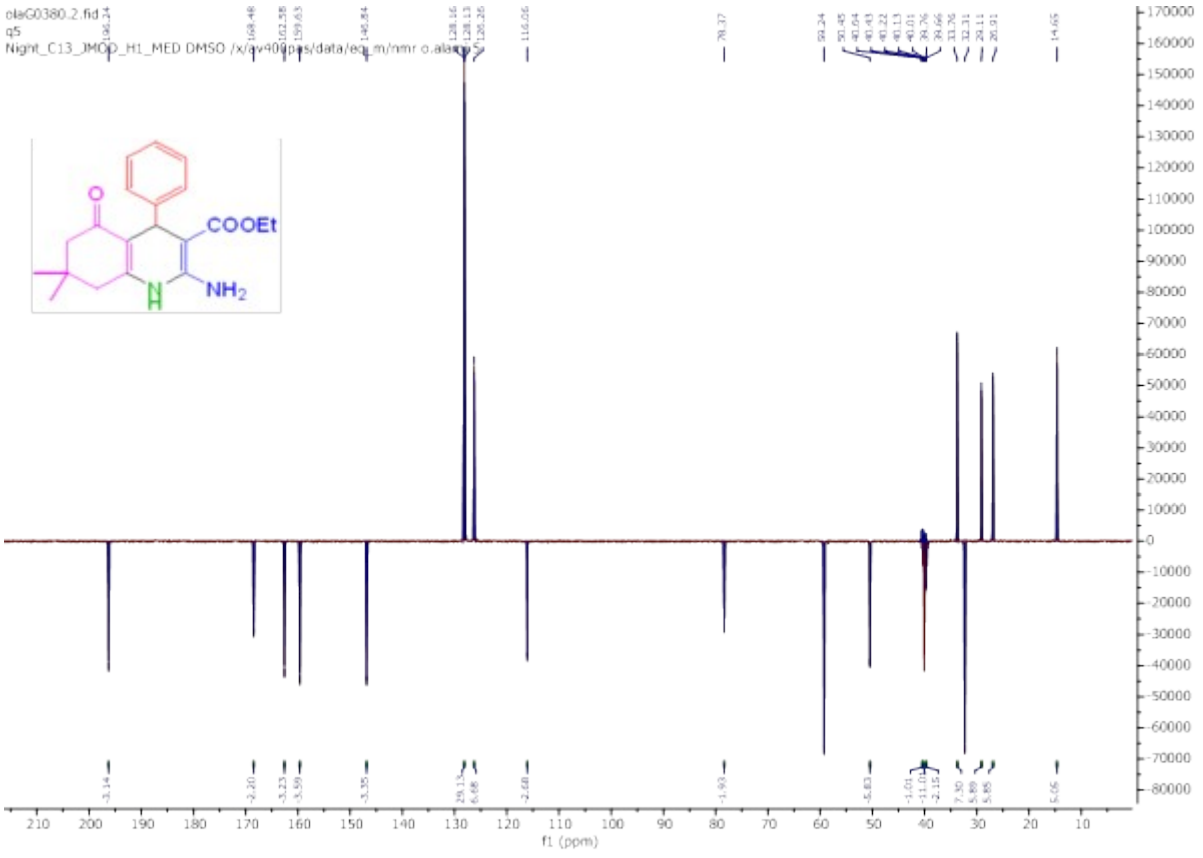


Fig. SI11. The ^{13}C-NMR spectrum of compound 5f

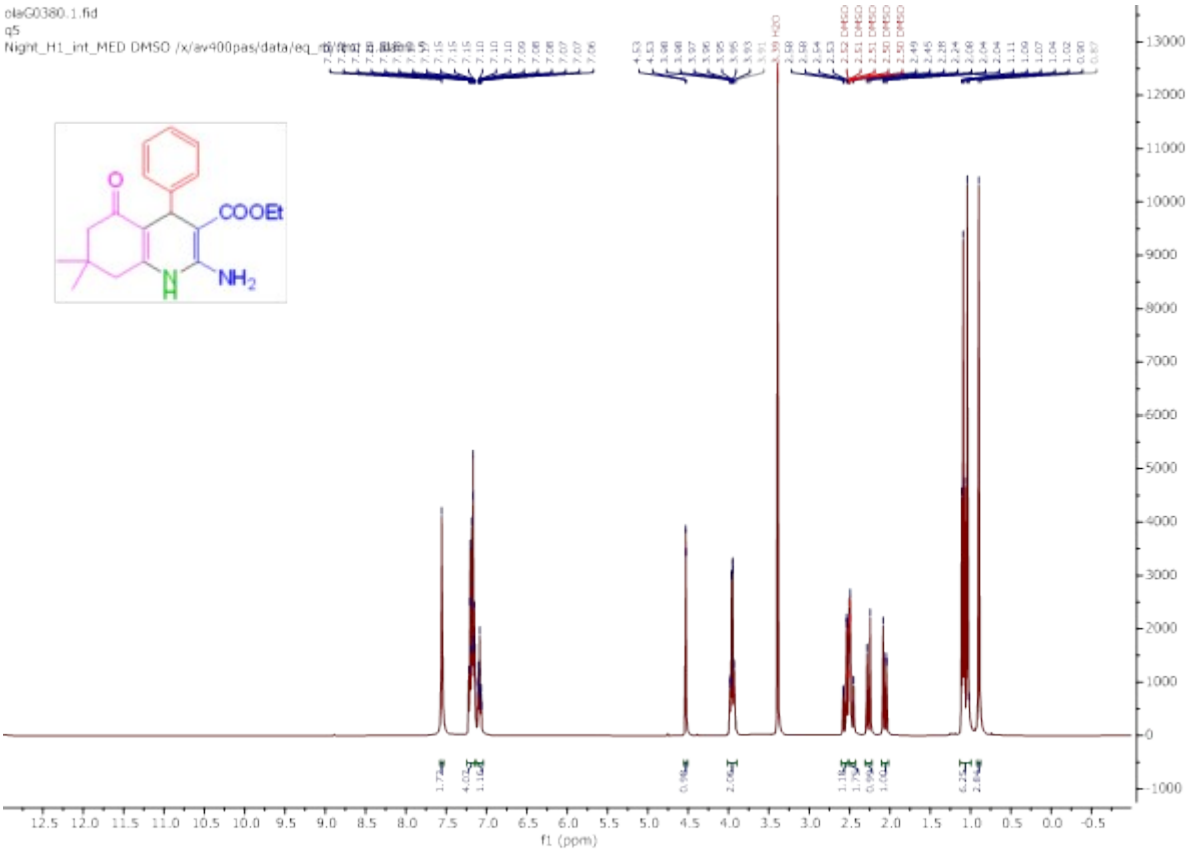


Fig. SI12. The ^{1}H-NMR spectrum of compound 5f

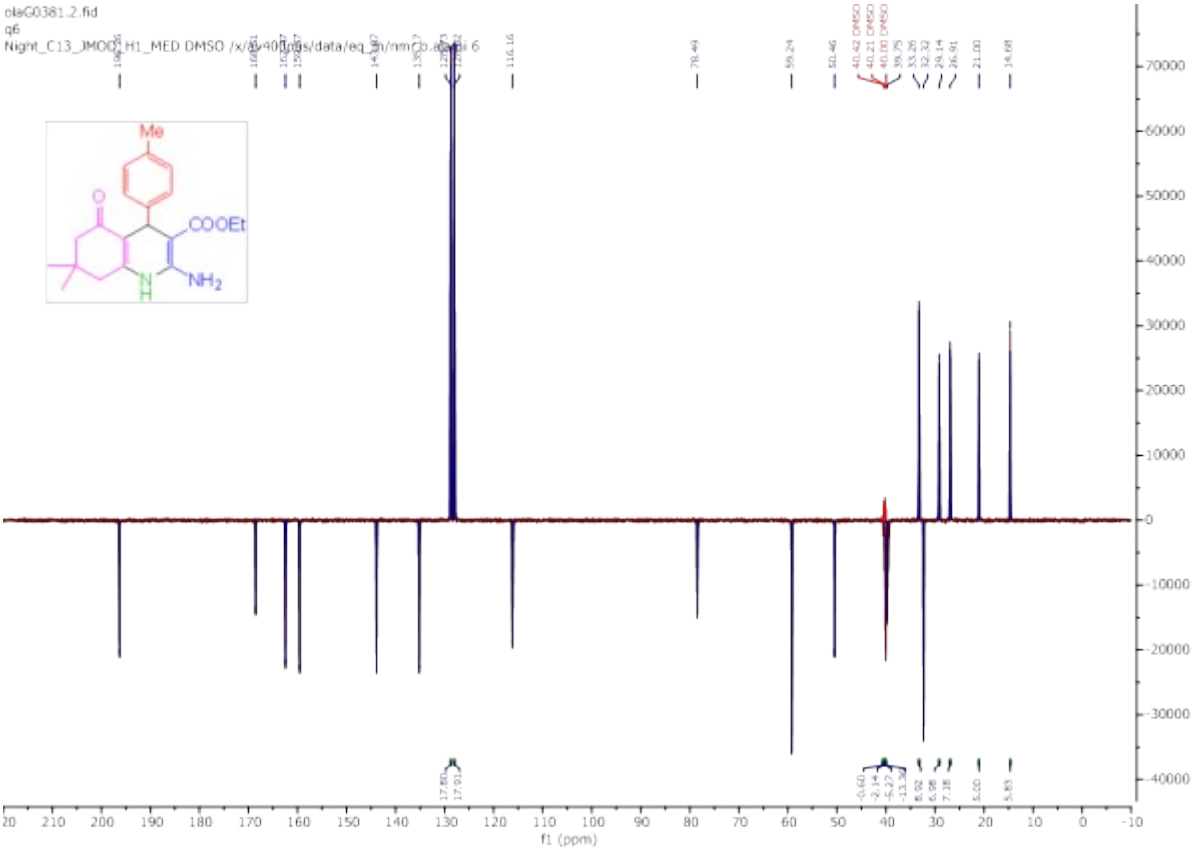


Fig. SI13. The ^{13}C-NMR spectrum of compound 5g

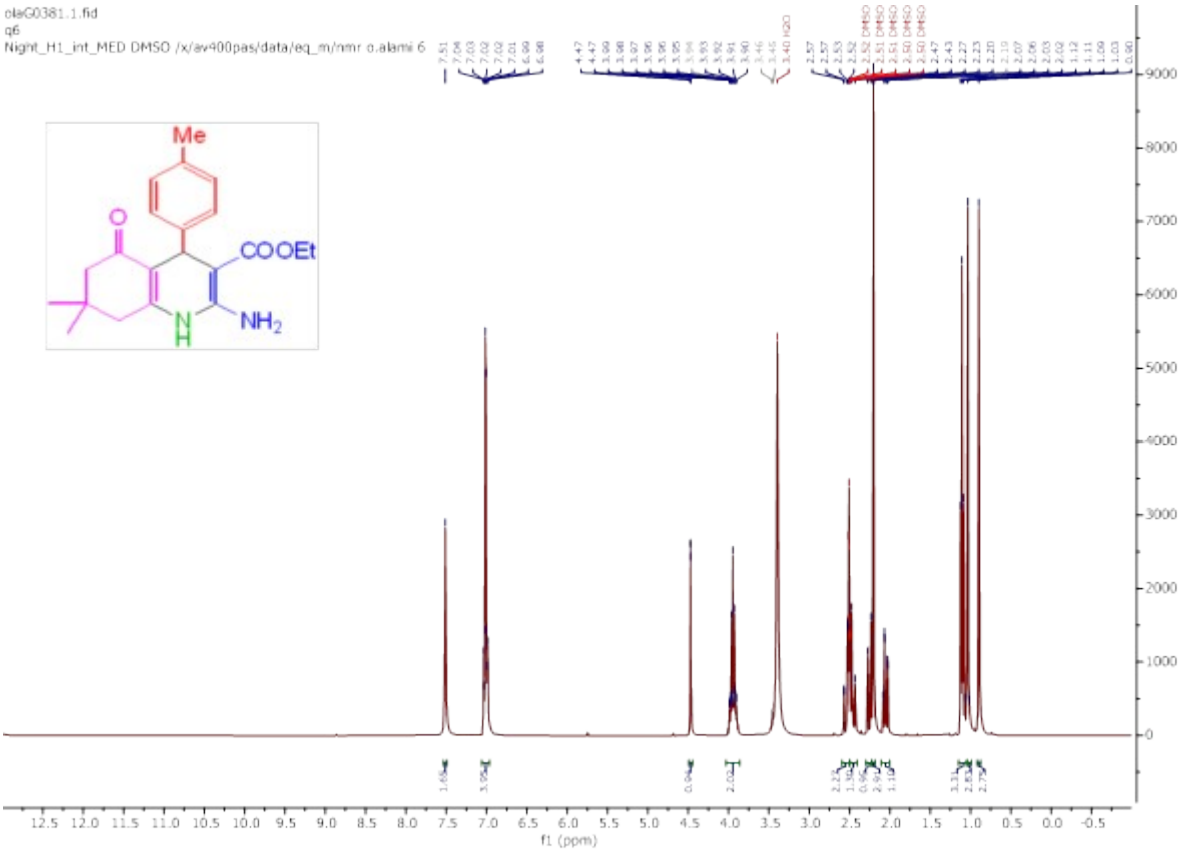


Fig. SI14. The ^{1}H-NMR spectrum of compound 5g

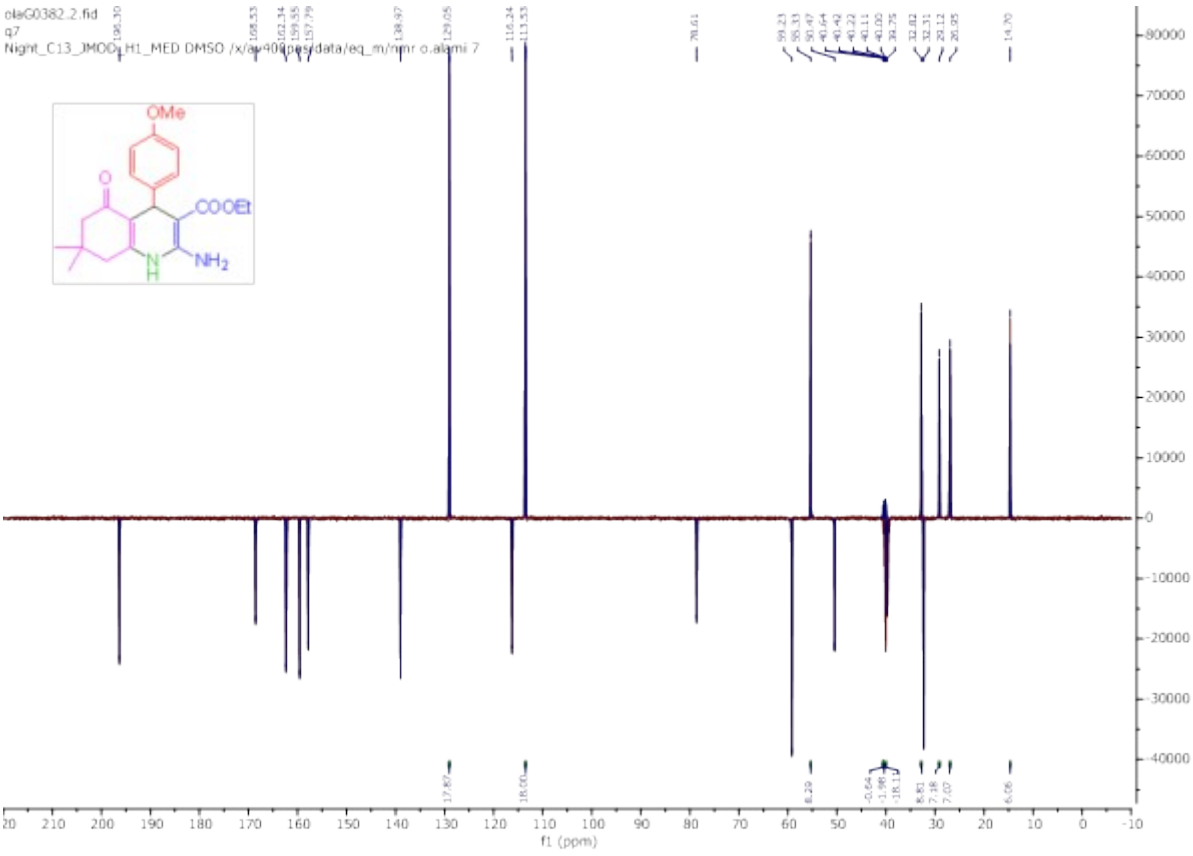


Fig. SI15. The ^{13}C-NMR spectrum of compound 5h

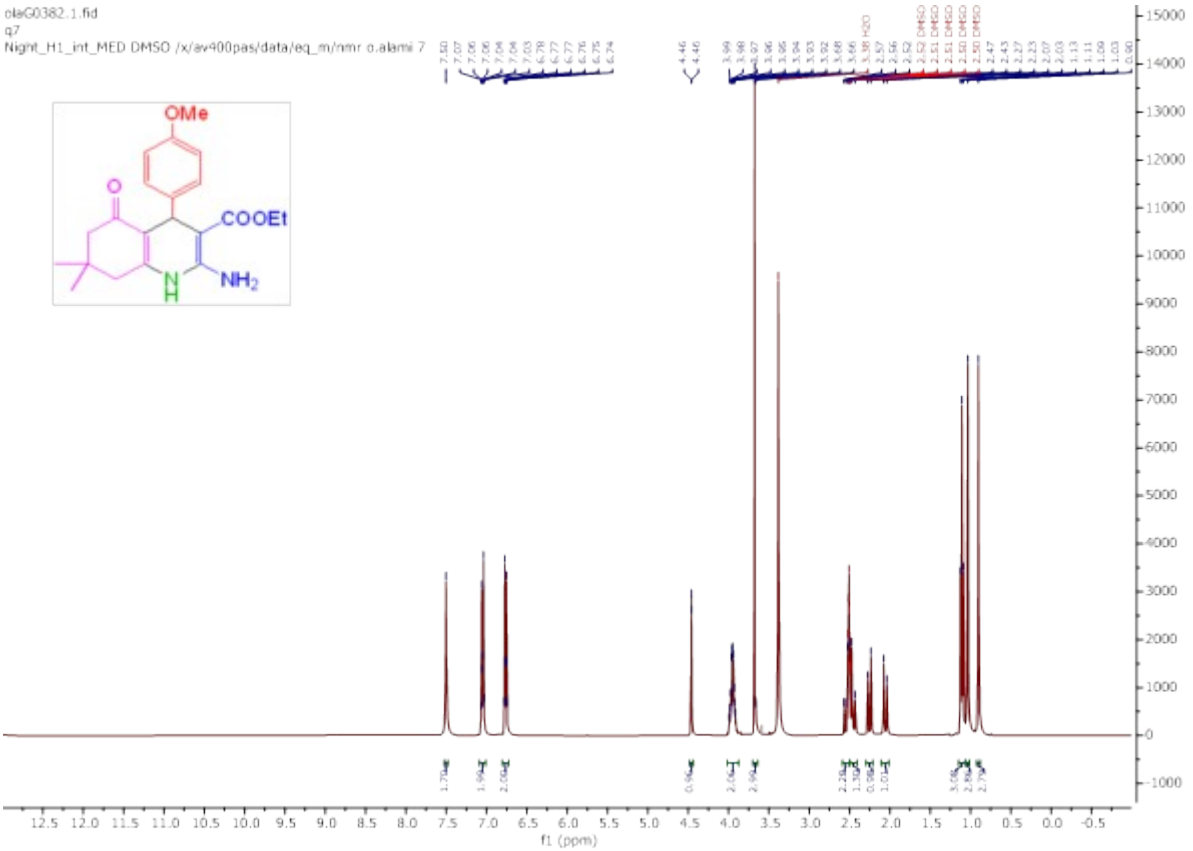


Fig. SI16. The ^{1}H-NMR spectrum of compound 5h

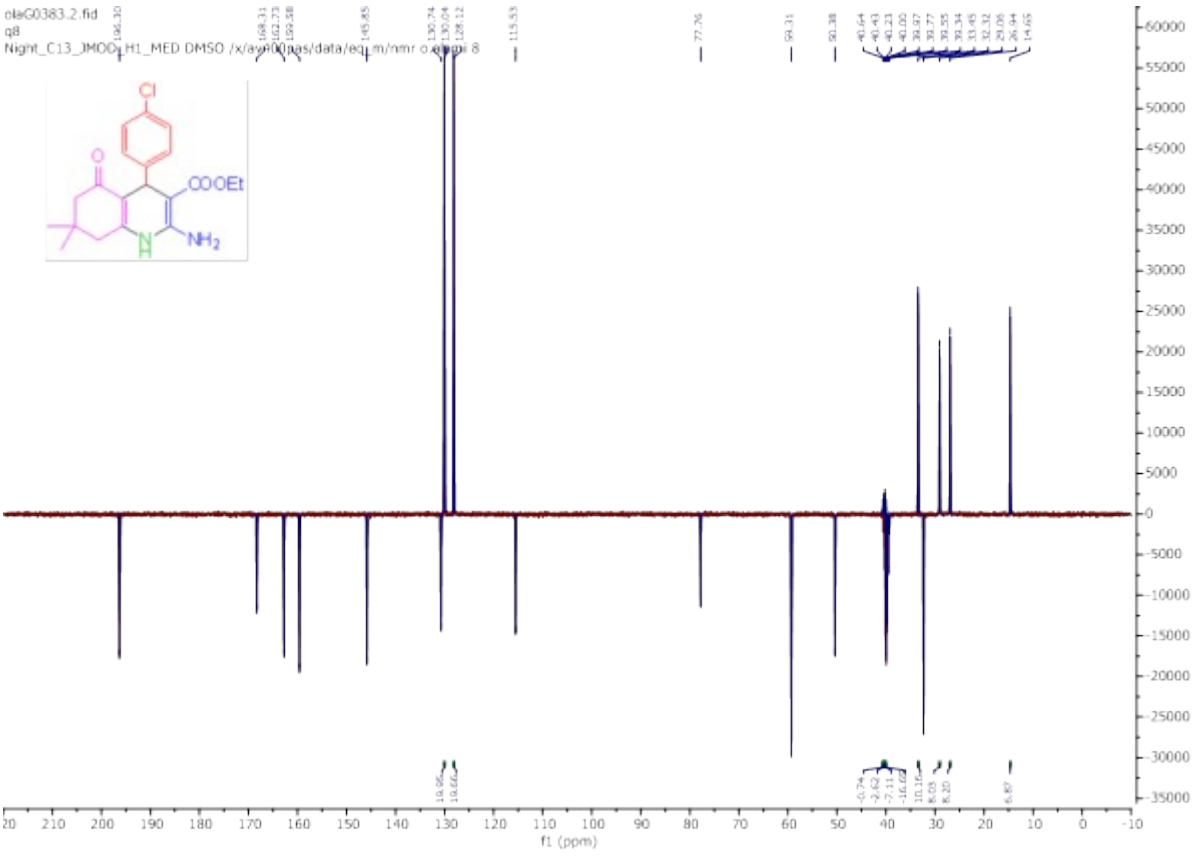


Fig. SI17. The ^{13}C-NMR spectrum of compound 5i

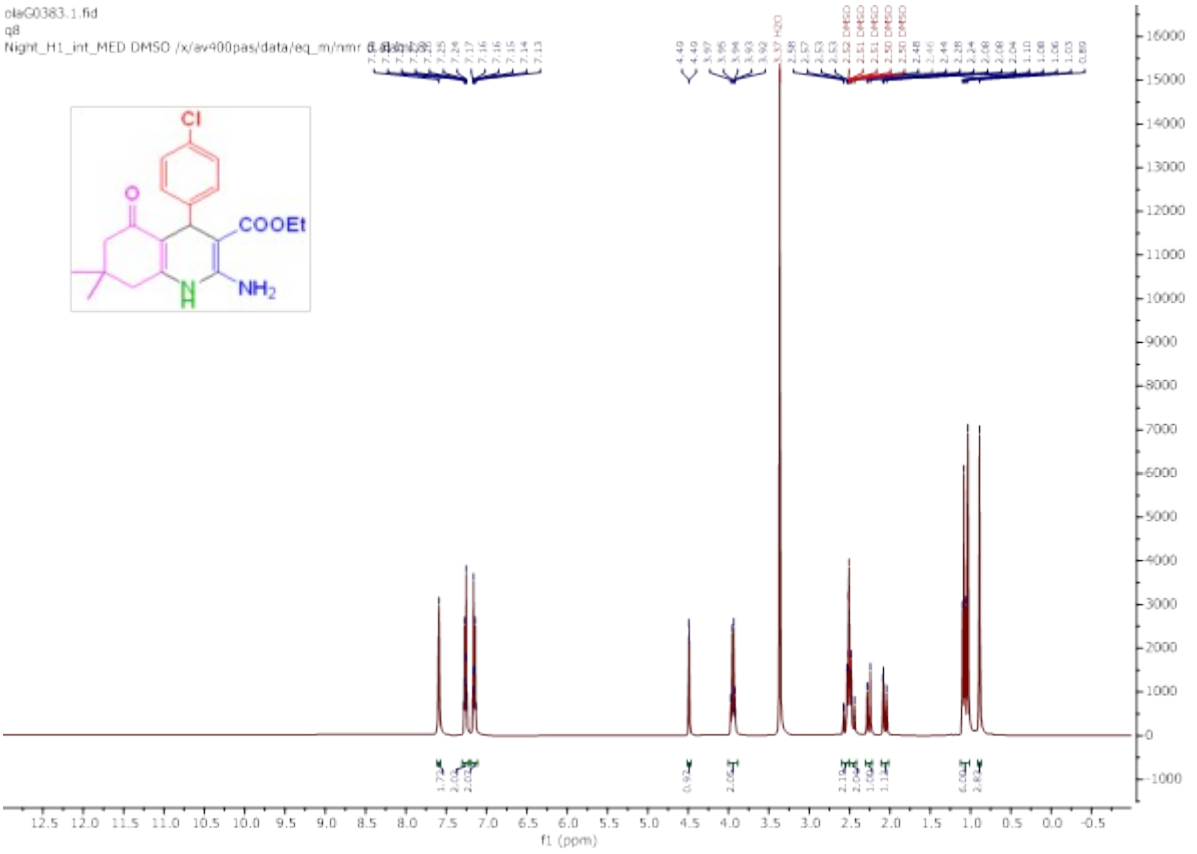


Fig. SI18. The ^{1}H-NMR spectrum of compound 5i

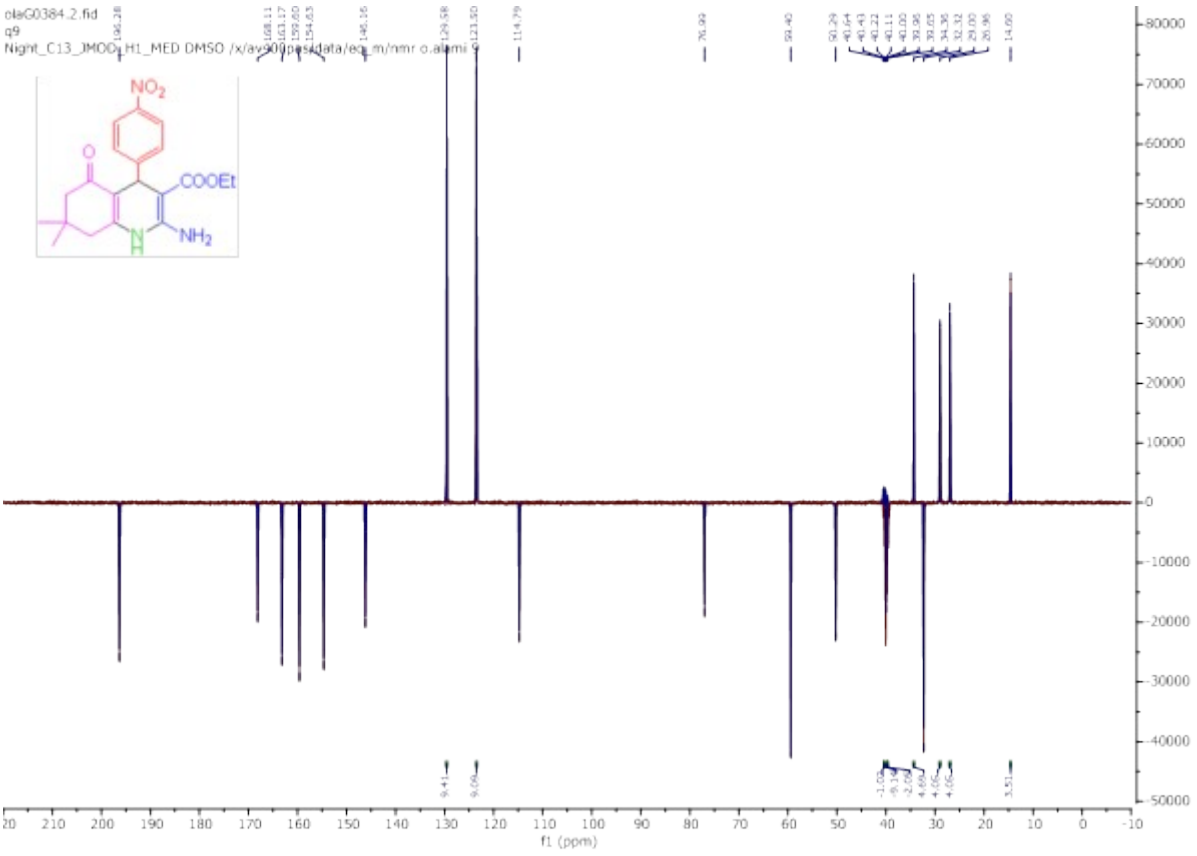


Fig. SI19. The ^{13}C-NMR spectrum of compound 5j

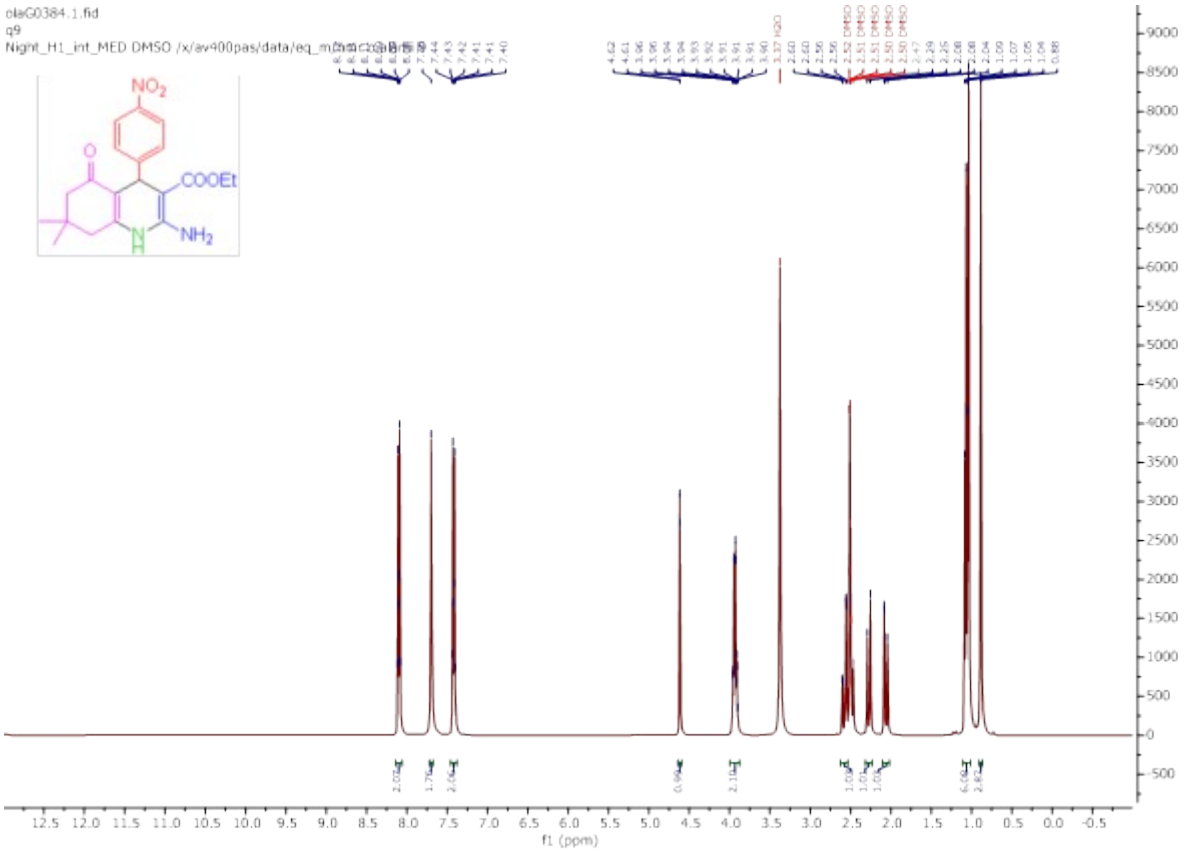


Fig. SI20. The ^{1}H-NMR spectrum of compound 5j

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