Nano $CoFe_2O_4$ supported antimony(III) as an efficient and recyclable catalyst for one-pot three-component synthesis of multisubstituted pyrroles

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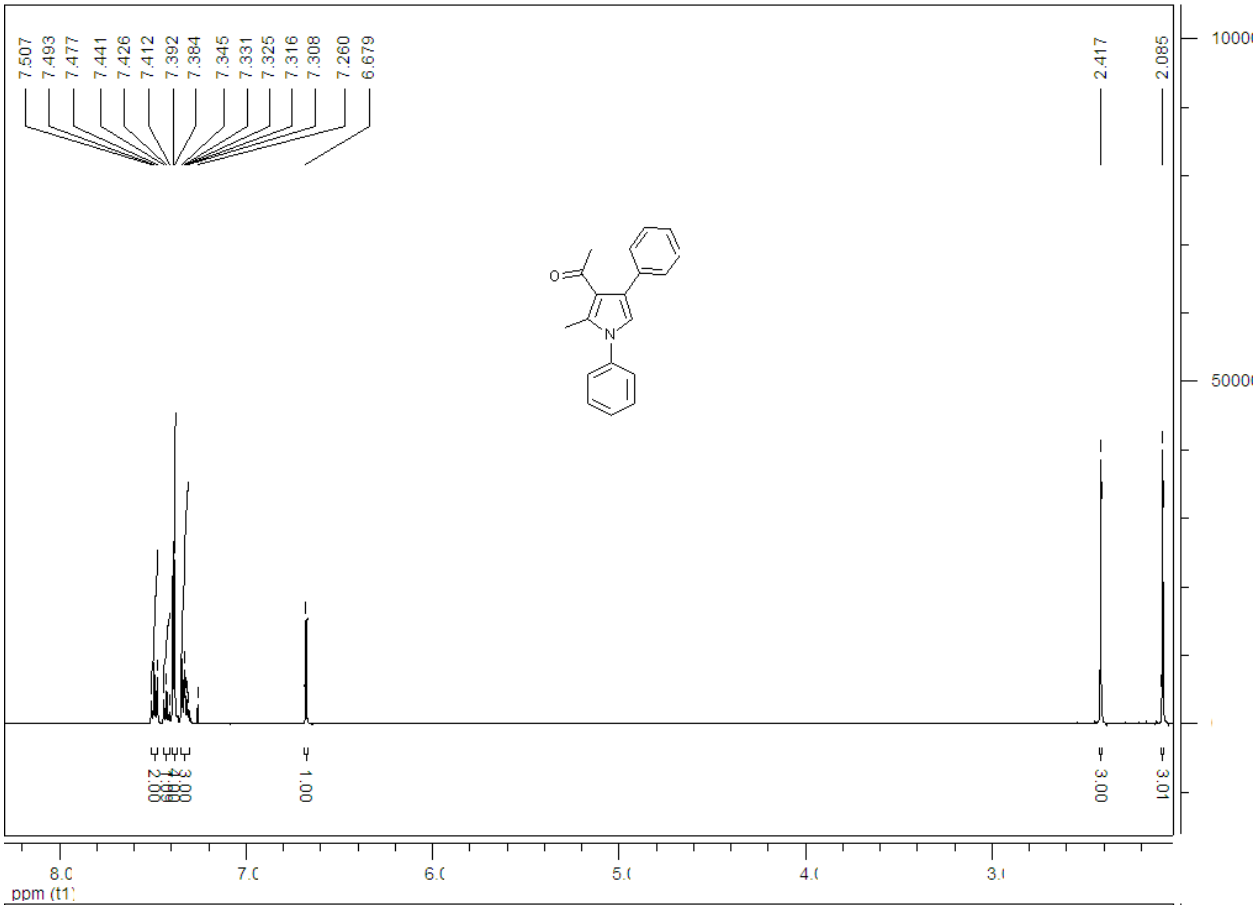
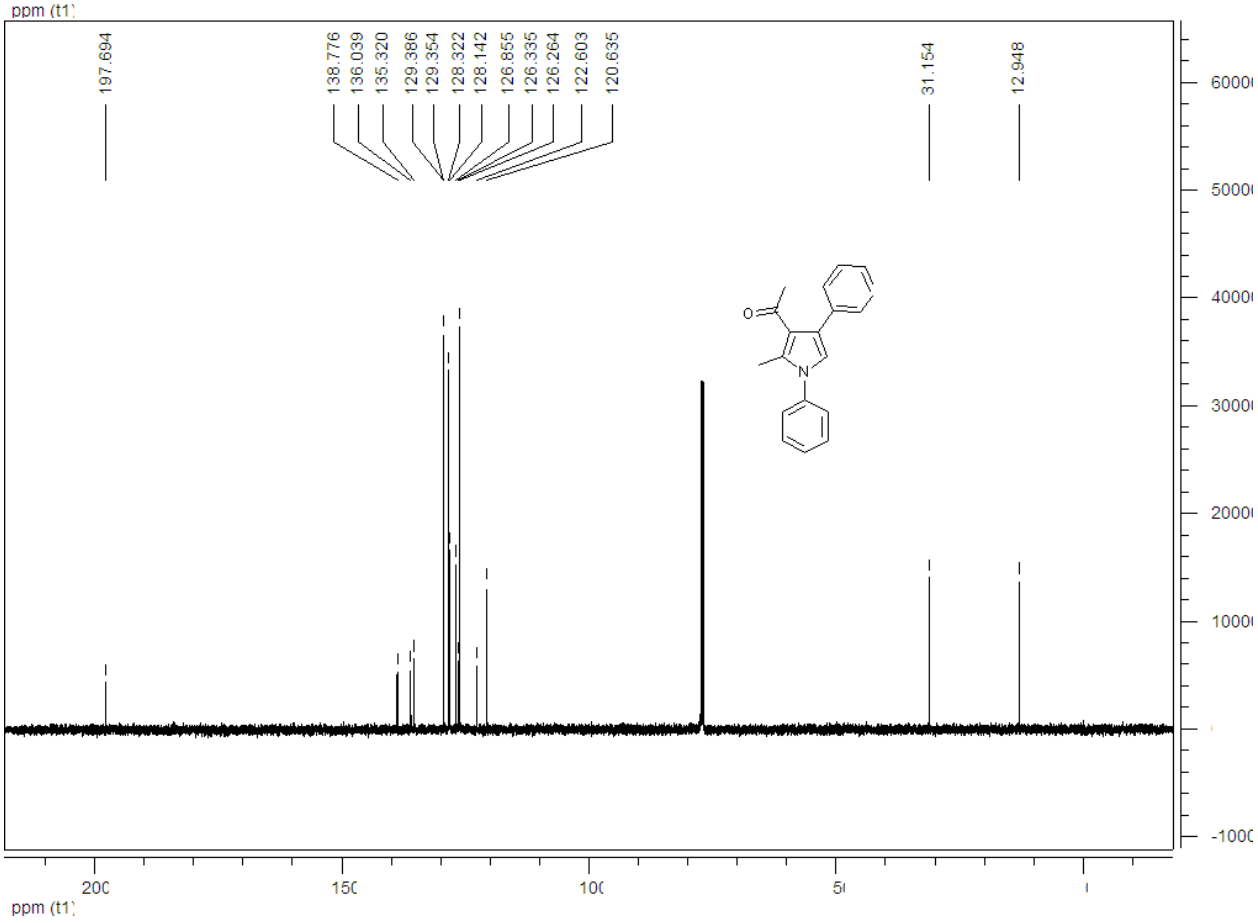
Supporting Information

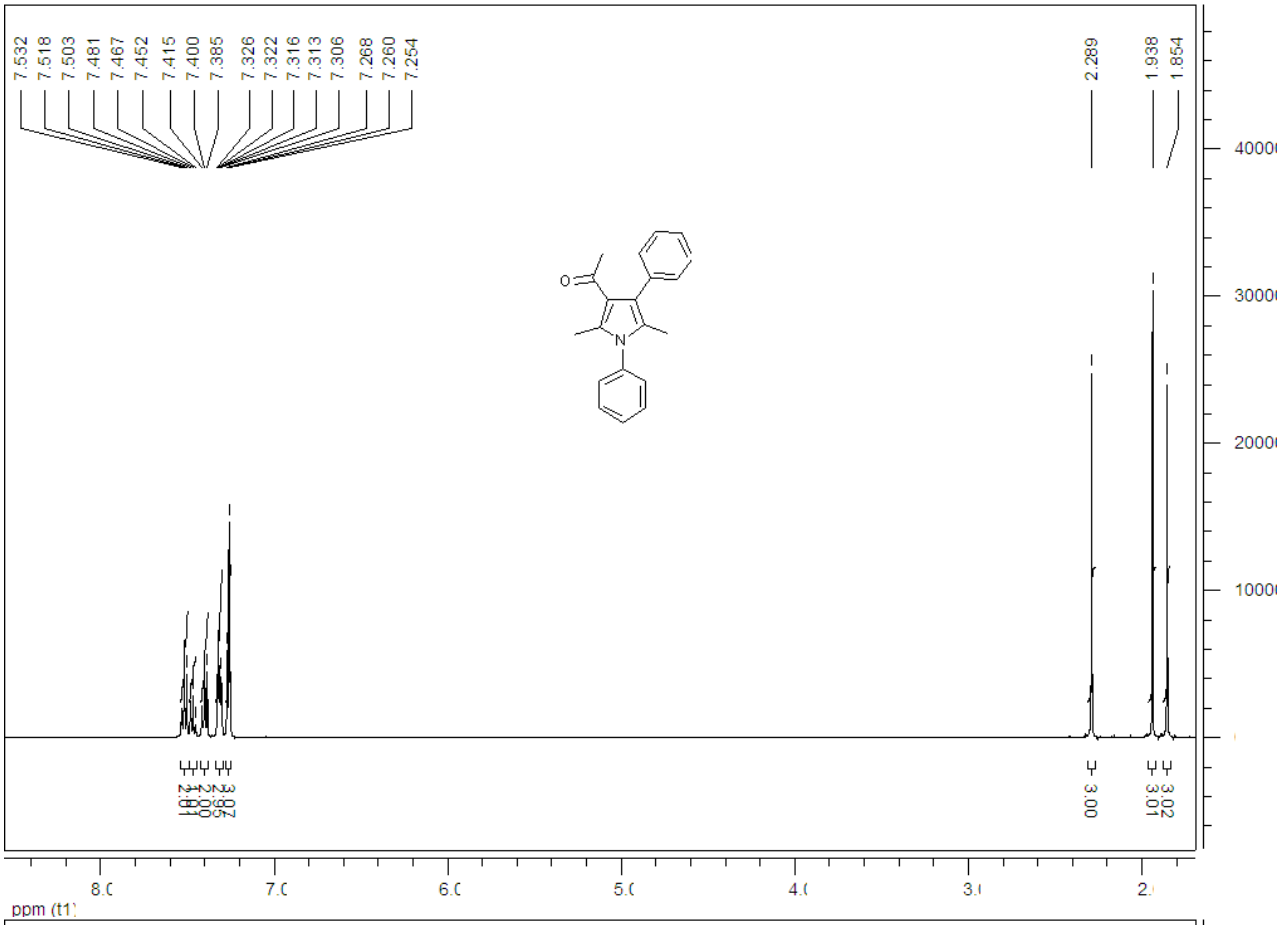
General Information. All solvents and chemicals were obtained commercially and were used as received. X-ray diffraction analysis was carried out using a PANalytical X'Pert Pro X-ray diffractometer. Surface morphology and particle size were studied using a Hitachi S-4800 SEM instrument. Transmission electron microscope (TEM) observation was performed using Hitachi H-7650 microscope at 80 KV. Elemental compositions were determined with a Hitachi S-4800 scanning electron microscope equipped with an INCA 350 energy dispersive spectrometer (SEM-EDS) presenting a 133 eV resolution at 5.9 keV. The ICP-MS analyses were carried out with an X Series 2 spectometer. Melting points were measured on an X-4 digital melting point apparatus are uncorrected. IR spectra were obtained as KBr pellets or as liquid films on KBr pellets with a Bruker-TENSOR 27 spectrometer. ^{1}H NMR (500 MHz) and ^{13}C NMR (125 MHz) spectra were recorded on Bruker DRX-500 spectrometer using $CDCl_3$ as the solvent and TMS as an internal standard. Elemental analyses were determined on a Vario EL III CHNOS elemental analyzer.

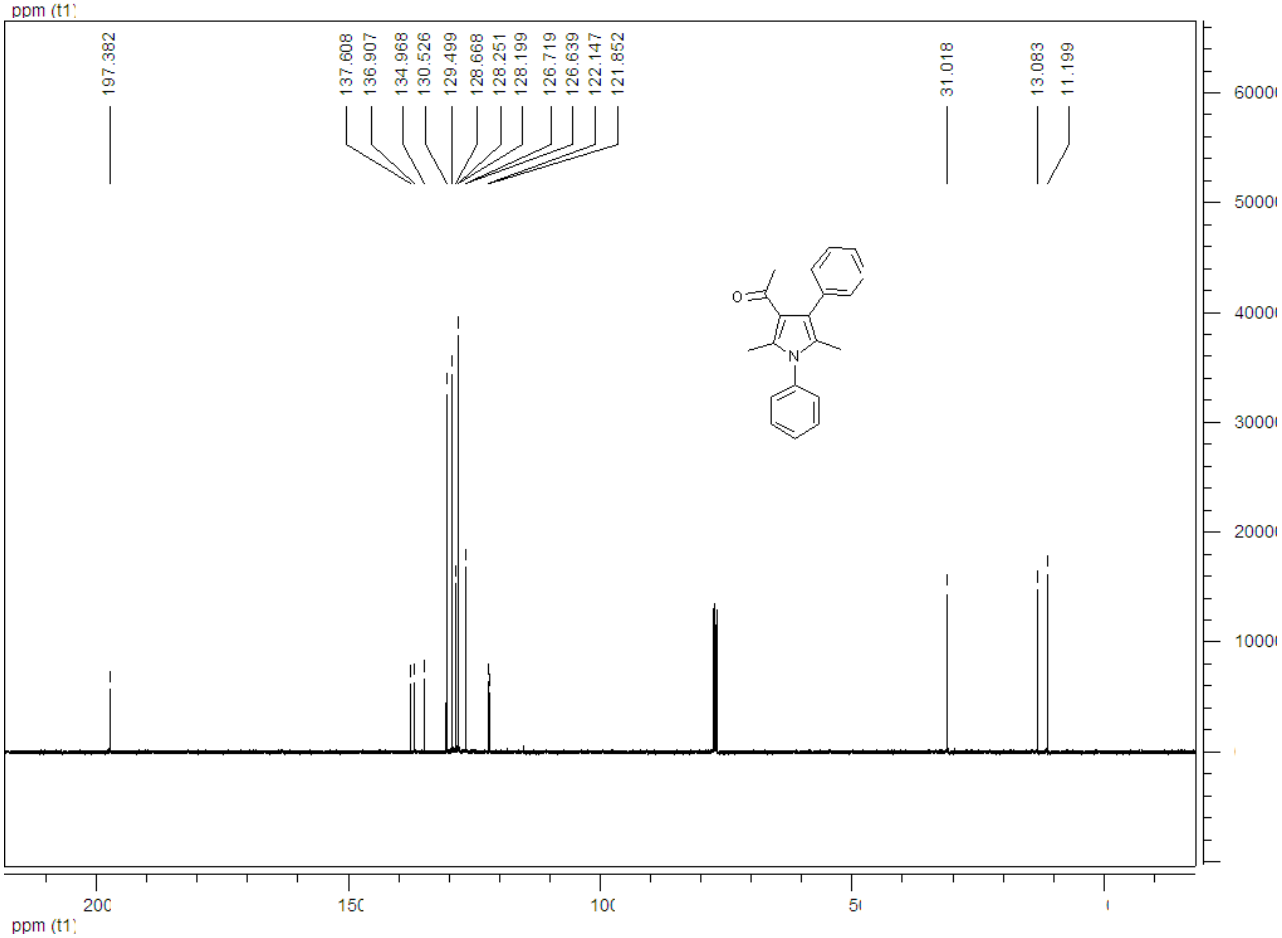
^{1}H NMR and ^{13}C NMR of compound **4a**



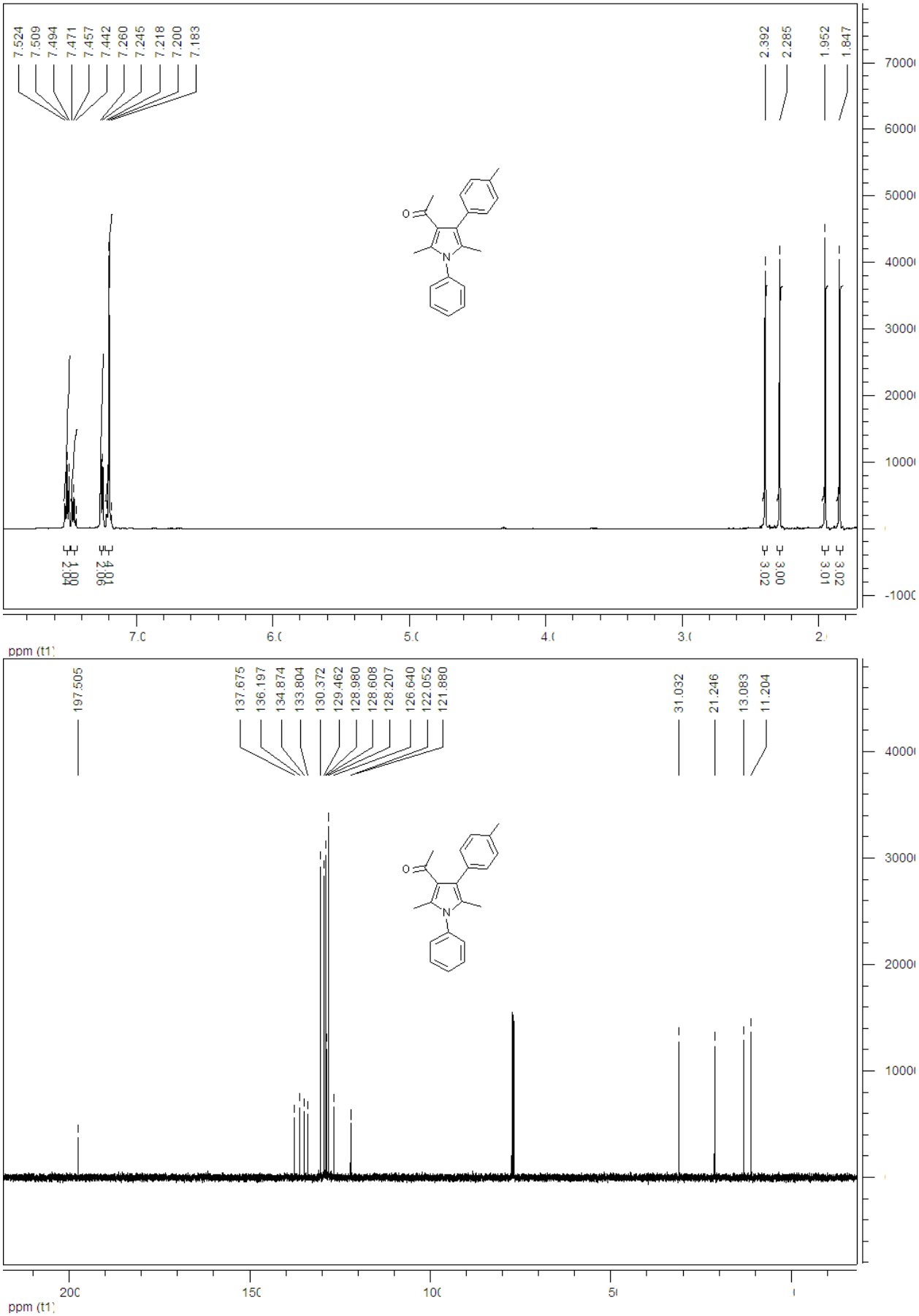


^{1}H NMR and ^{13}C NMR of compound **4b**

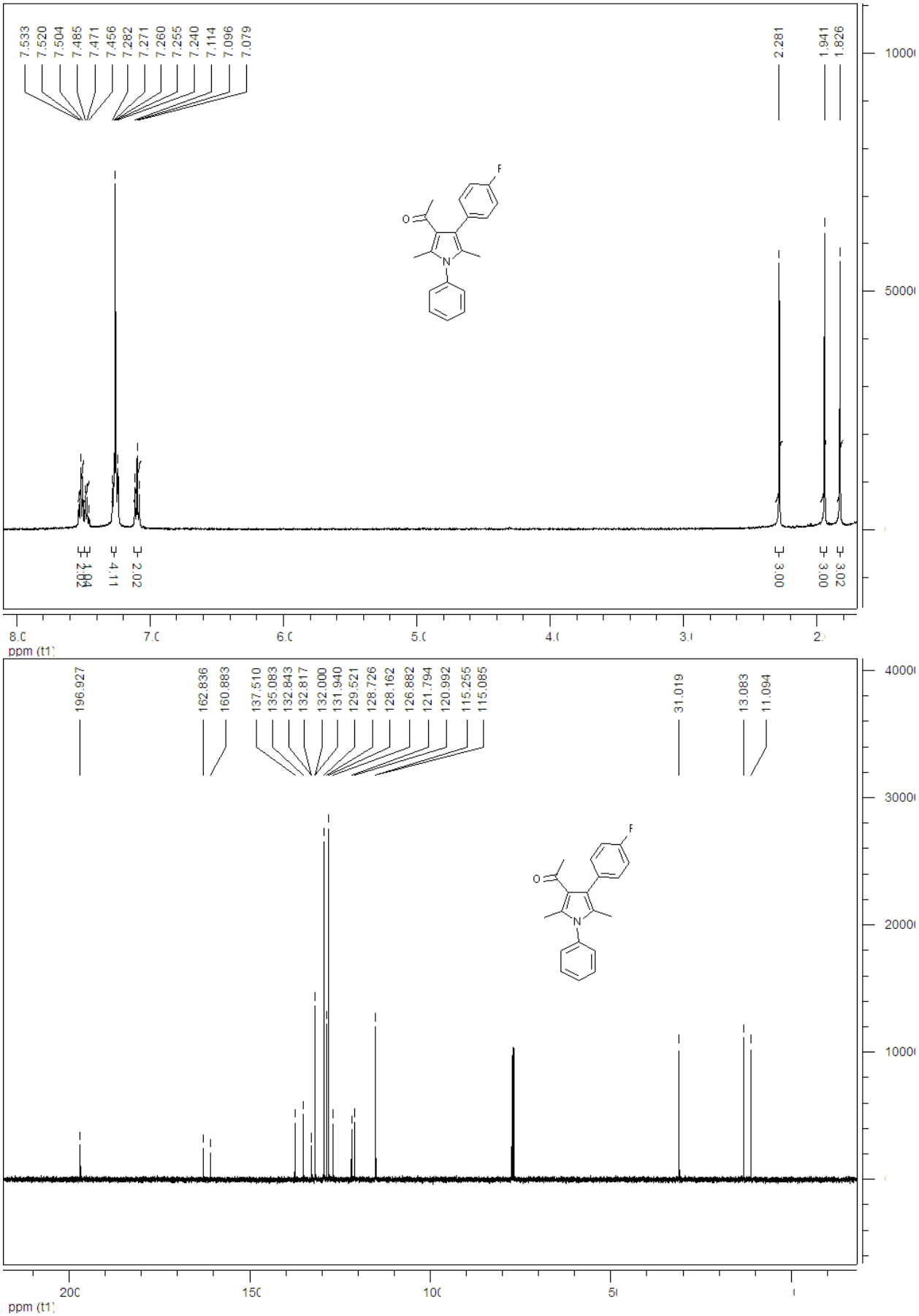




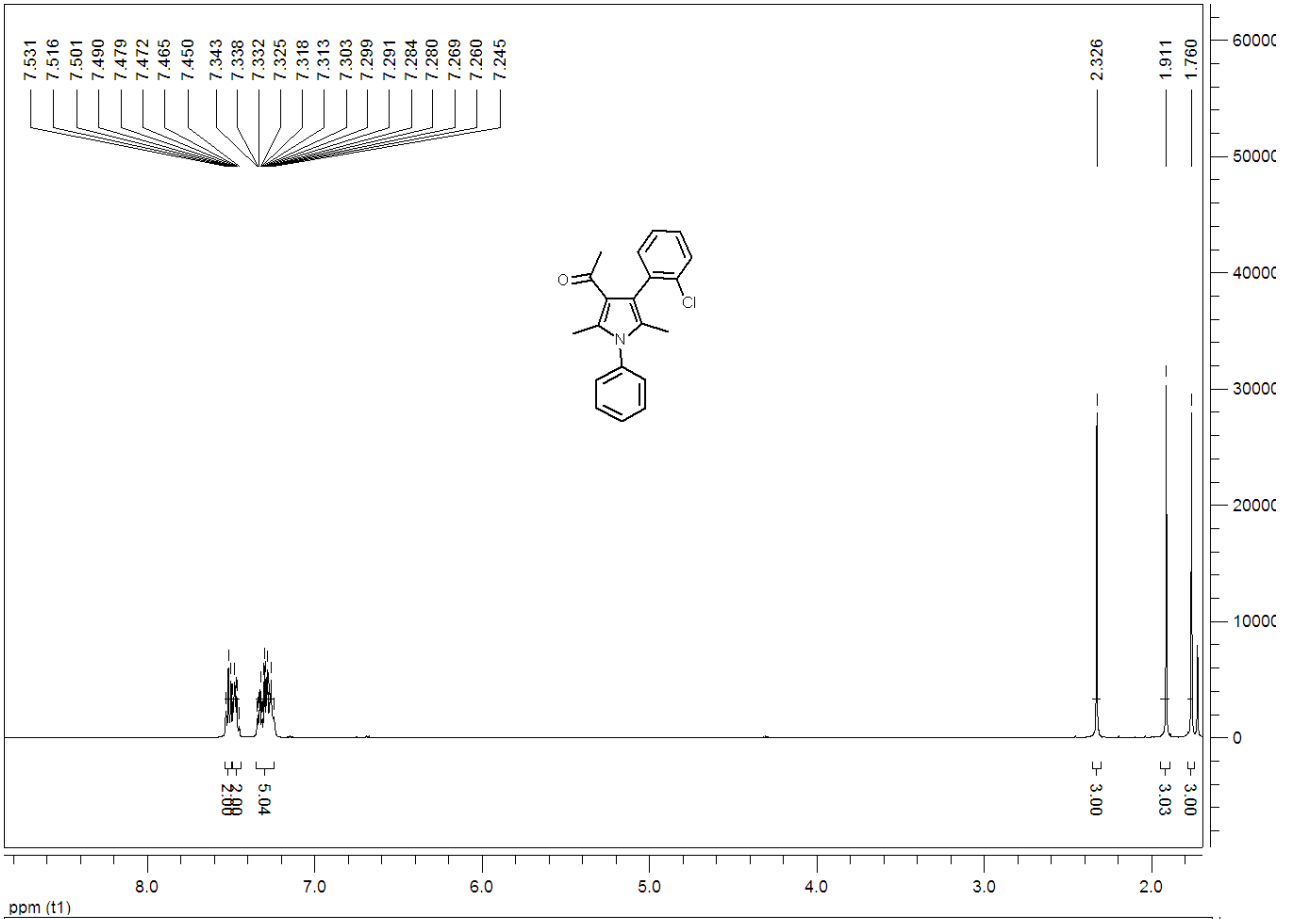
^{1}H NMR and ^{13}C NMR of compound **4c**

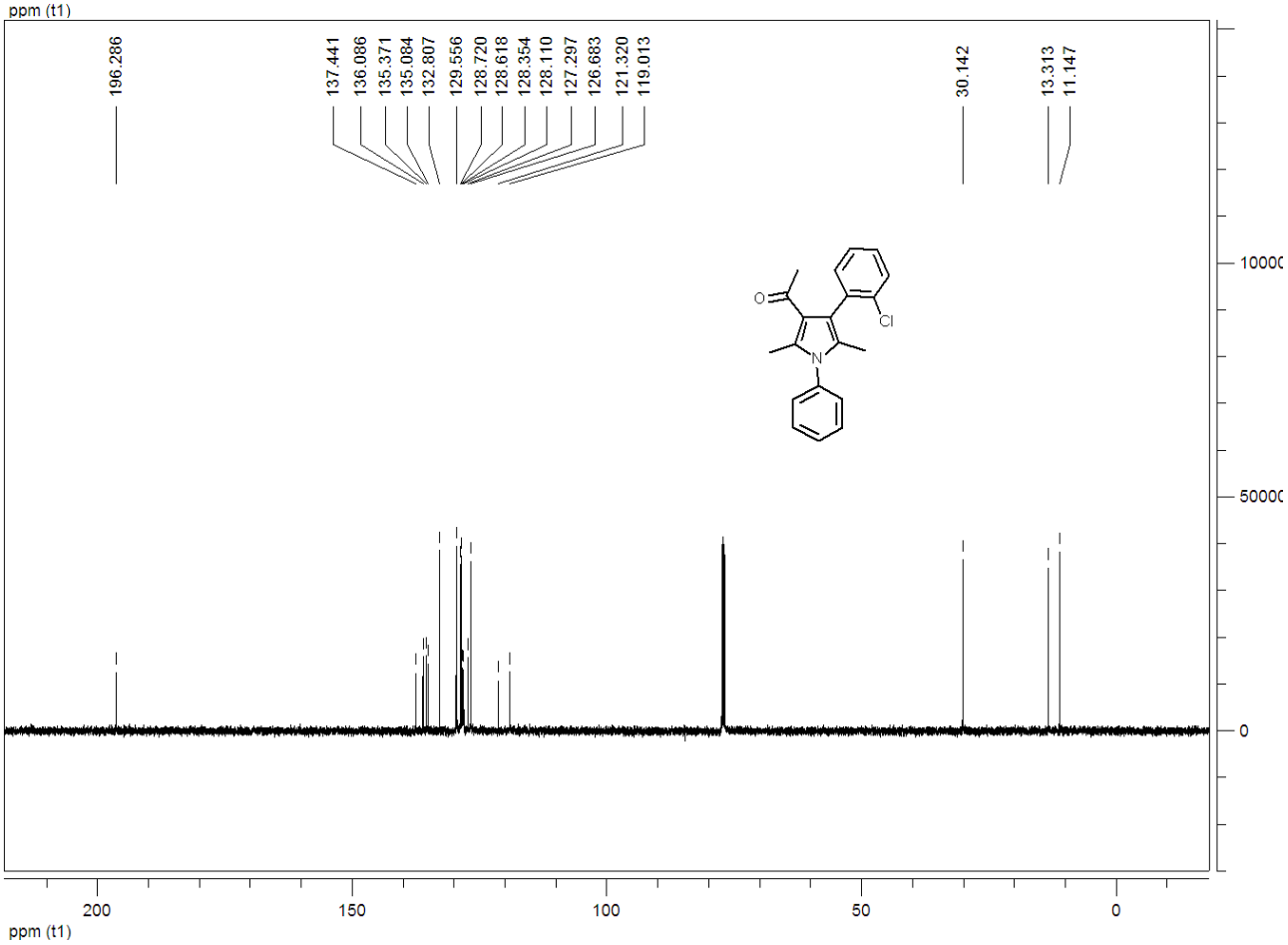


^{1}H NMR and ^{13}C NMR of compound **4d**

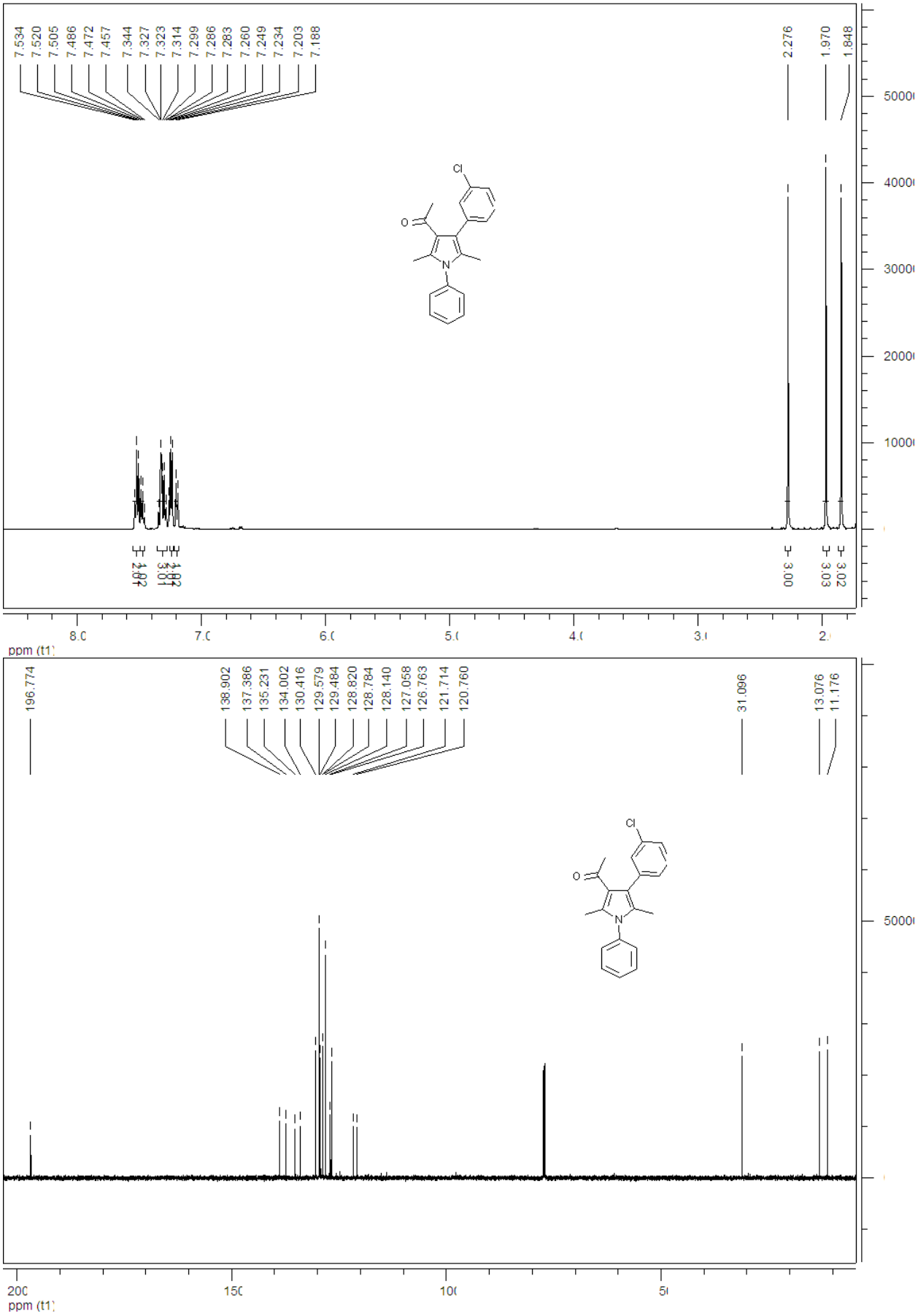


^{1}H NMR and ^{13}C NMR of compound **4e**

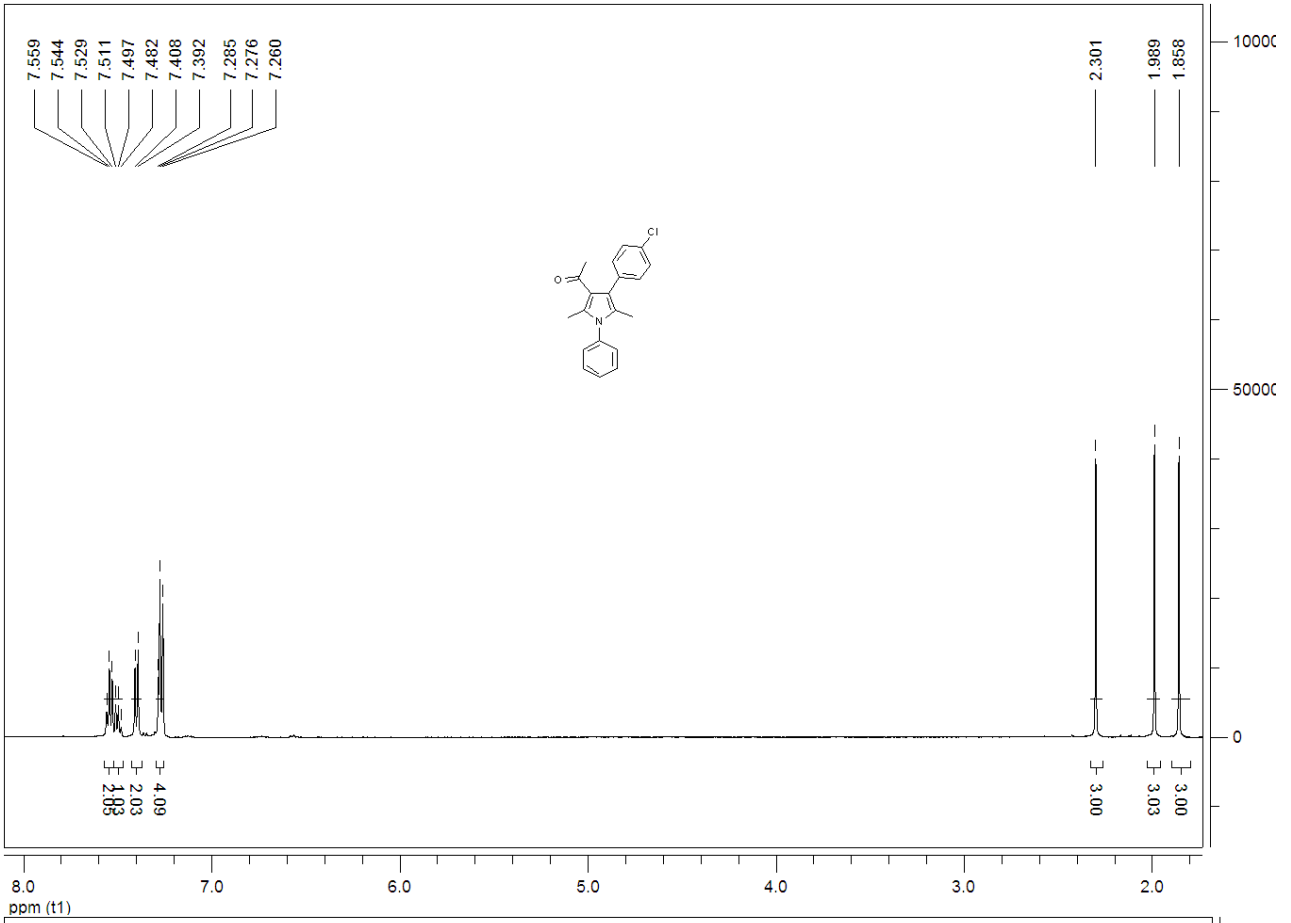


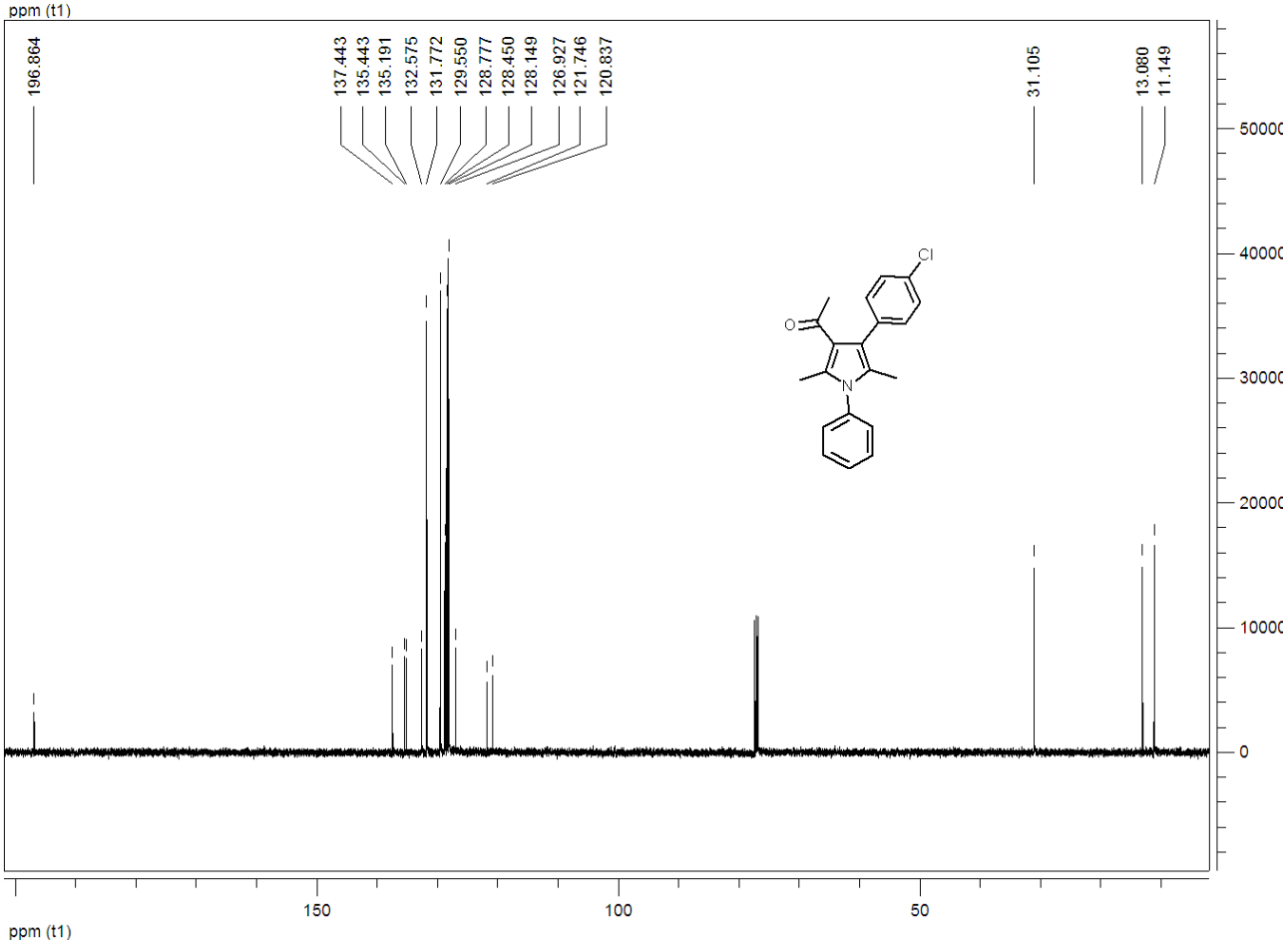


^{1}H NMR and ^{13}C NMR of compound **4f**

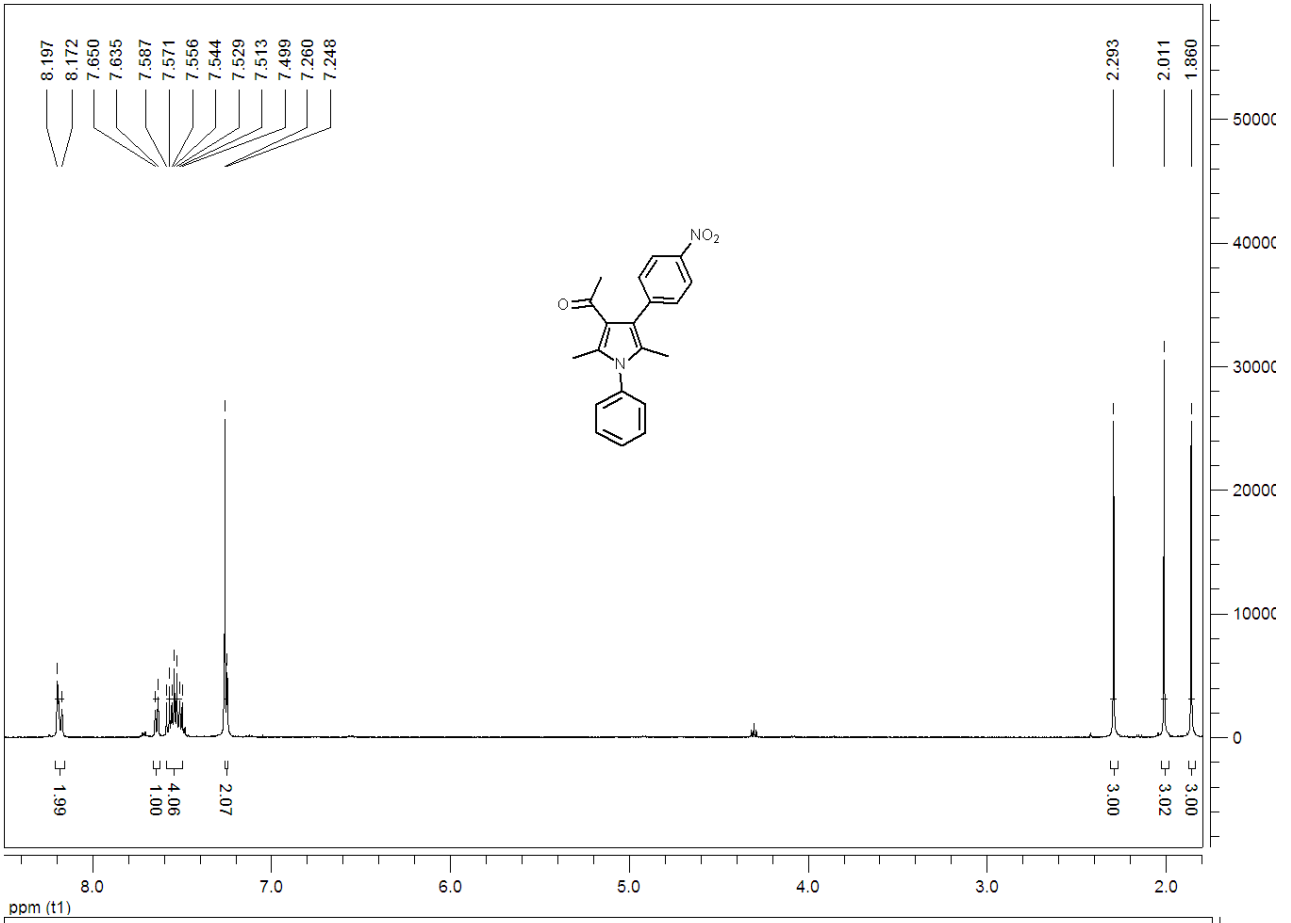


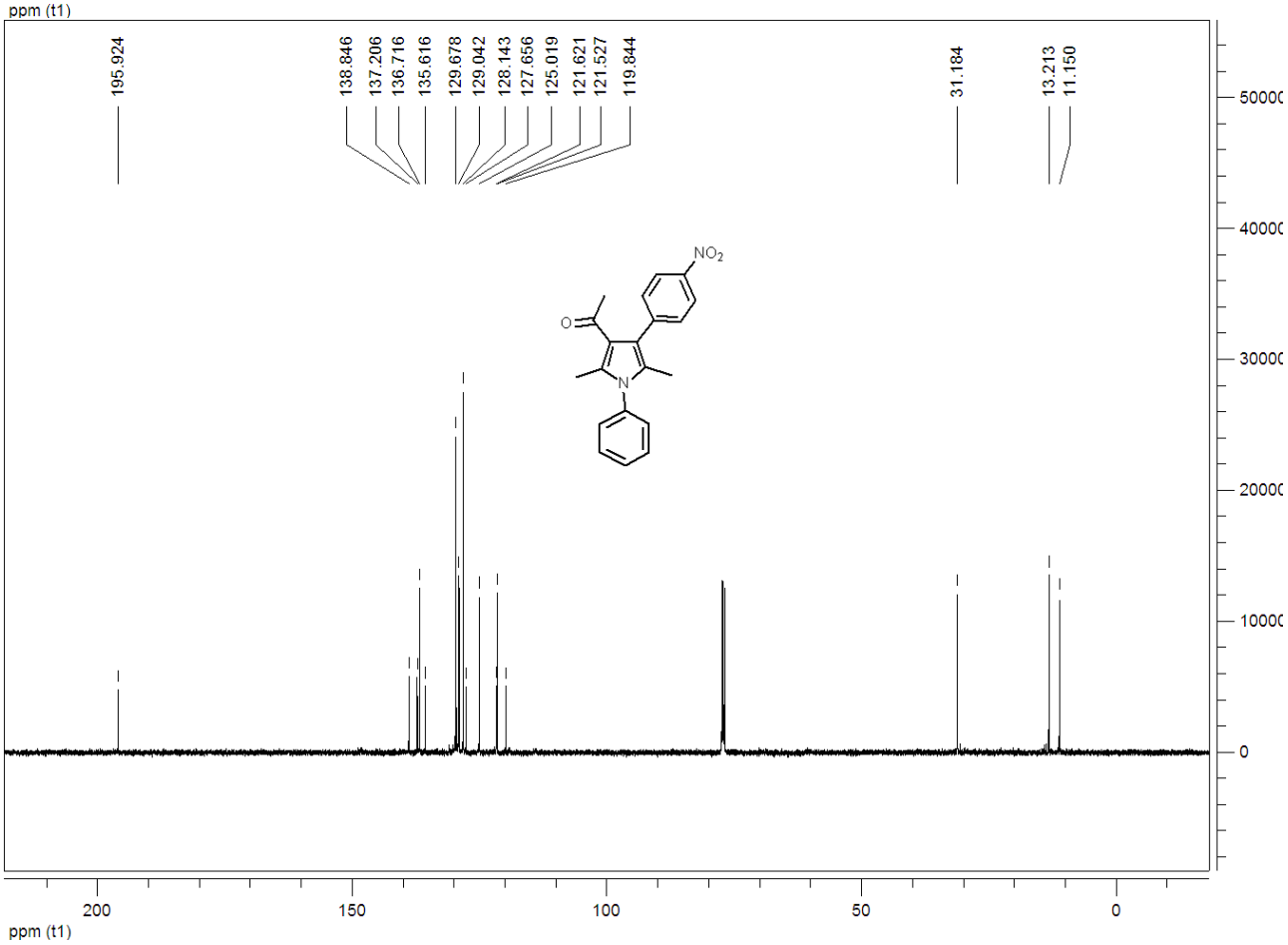
^{1}H NMR and ^{13}C NMR of compound **4g**



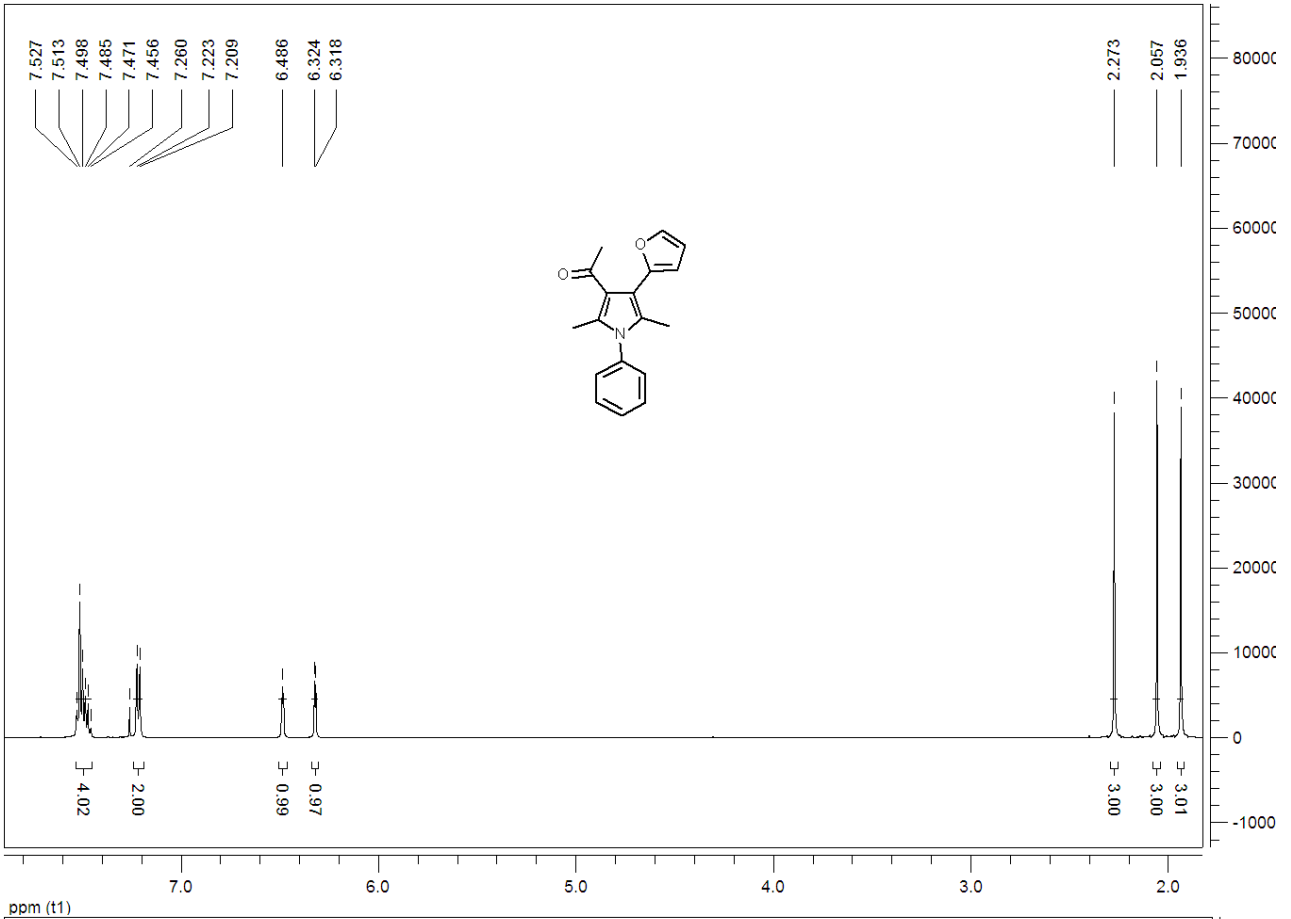


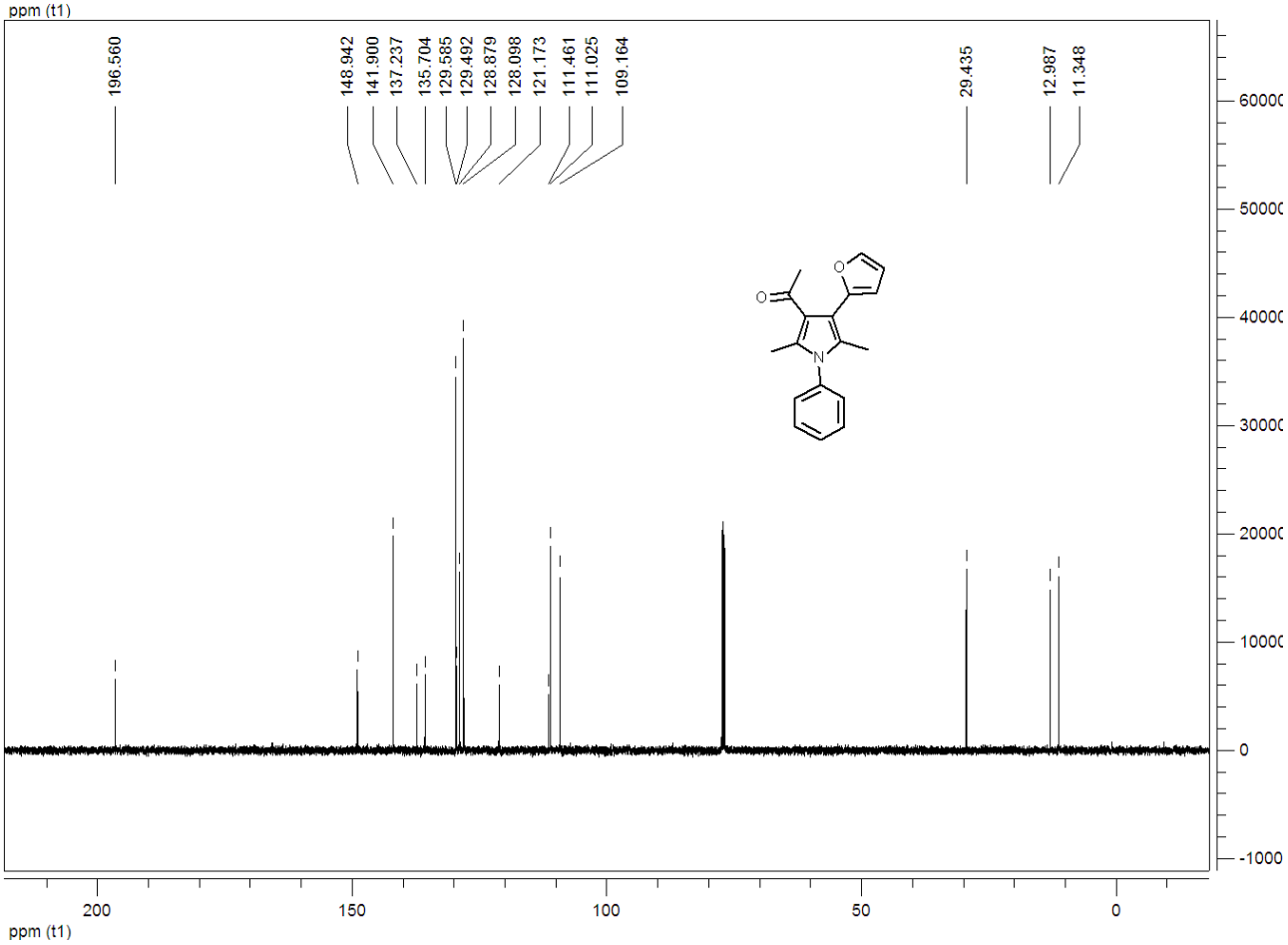
^{1}H NMR and ^{13}C NMR of compound **4h**



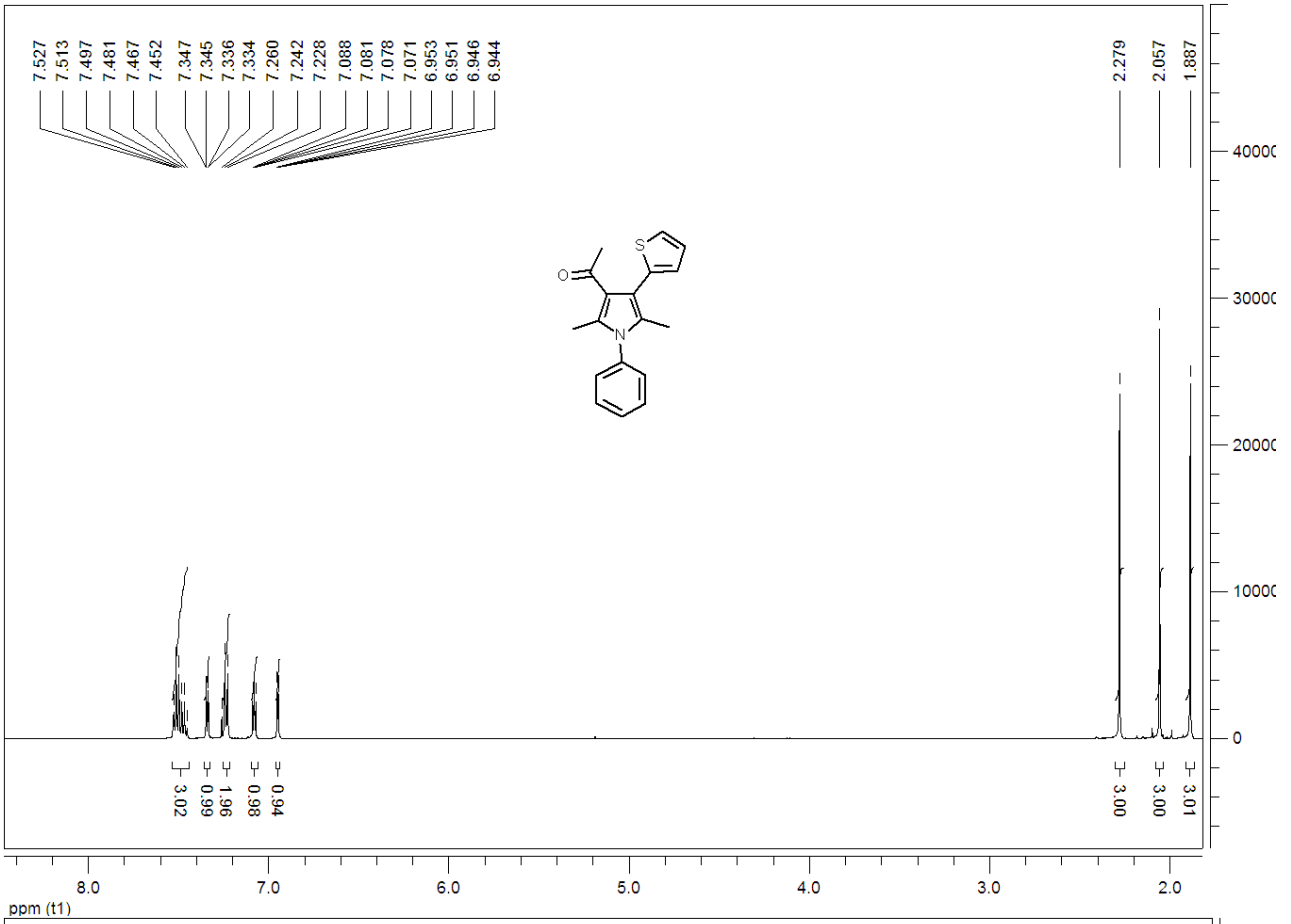


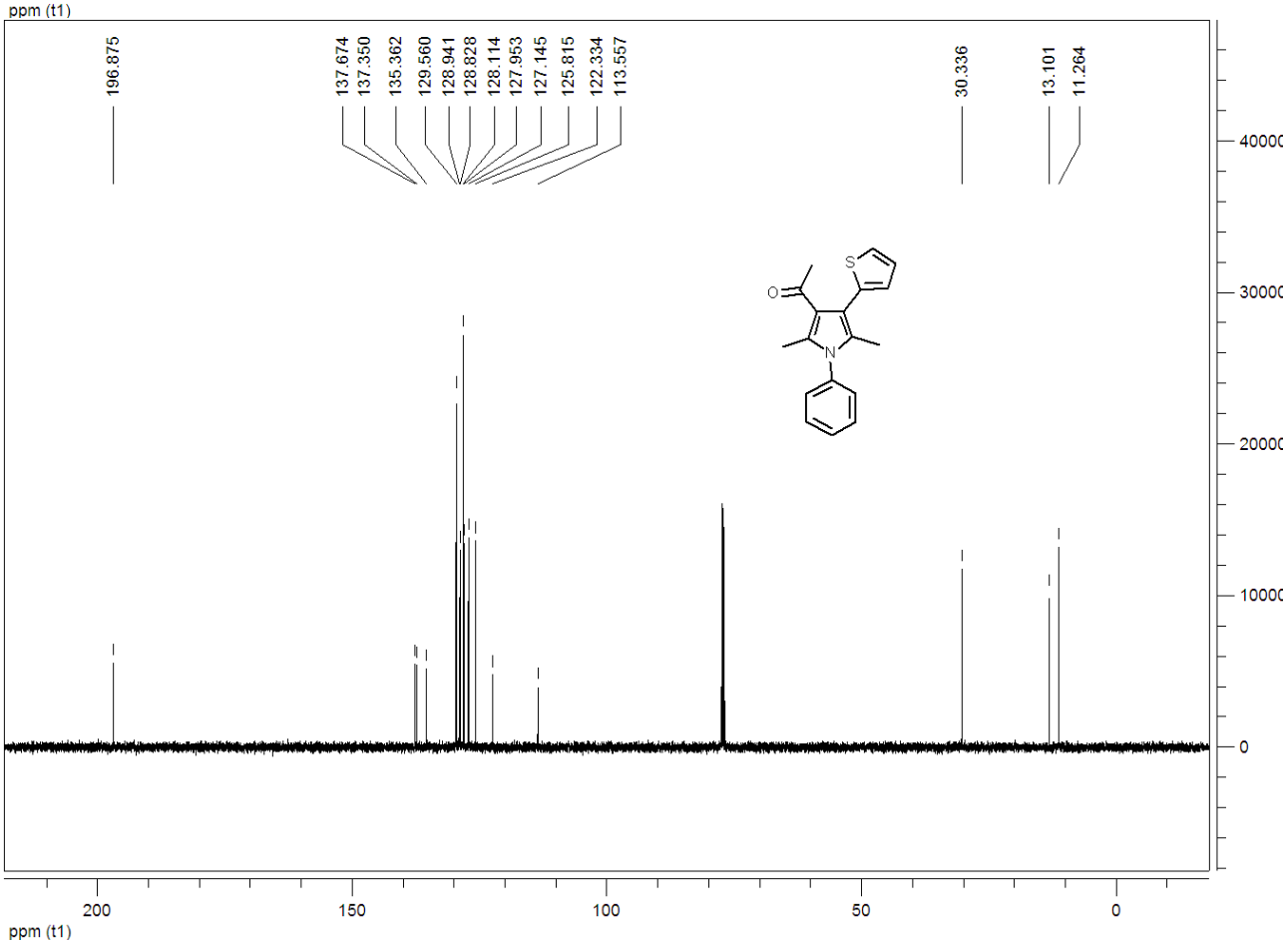
^{1}H NMR and ^{13}C NMR of compound **4i**



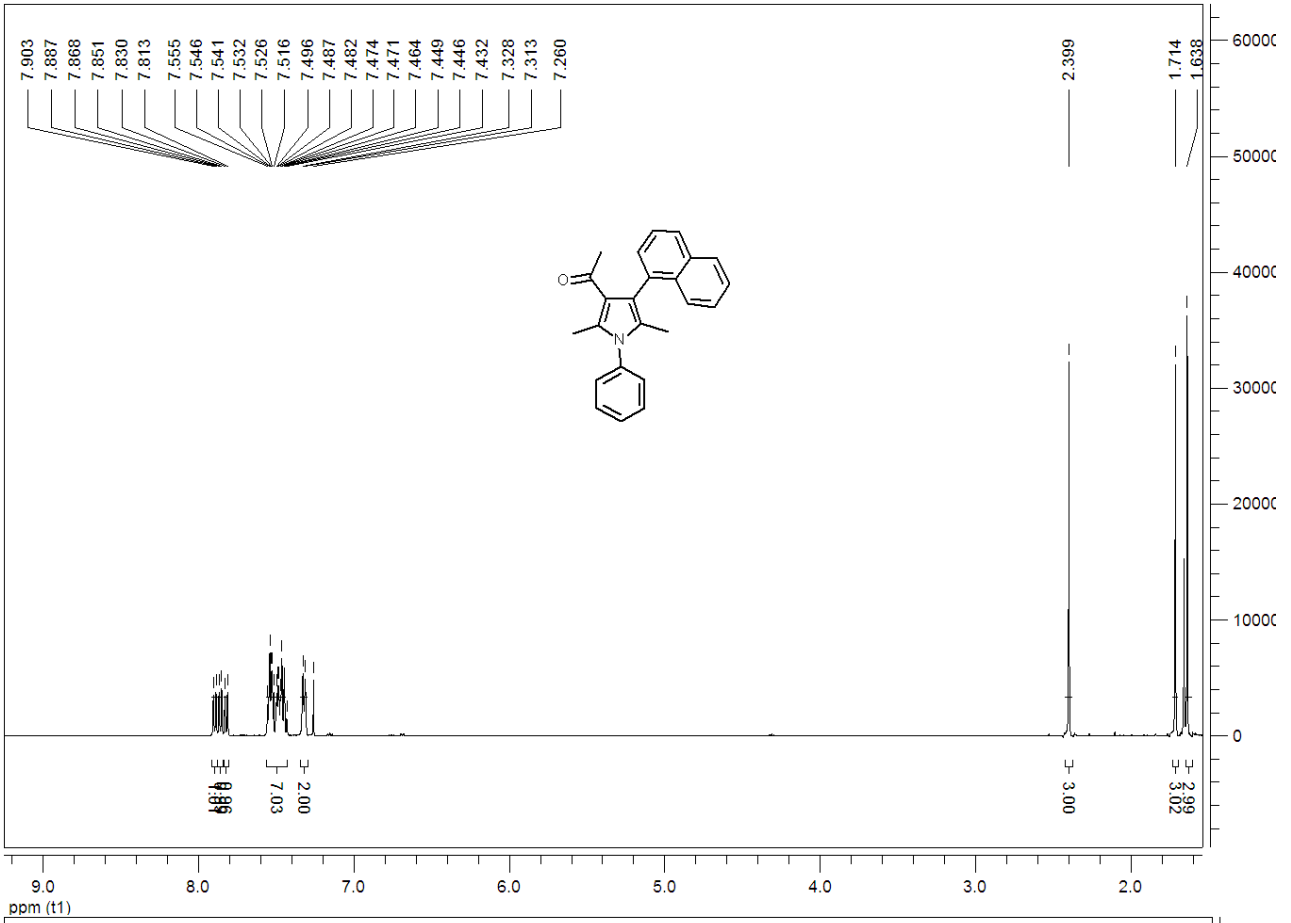


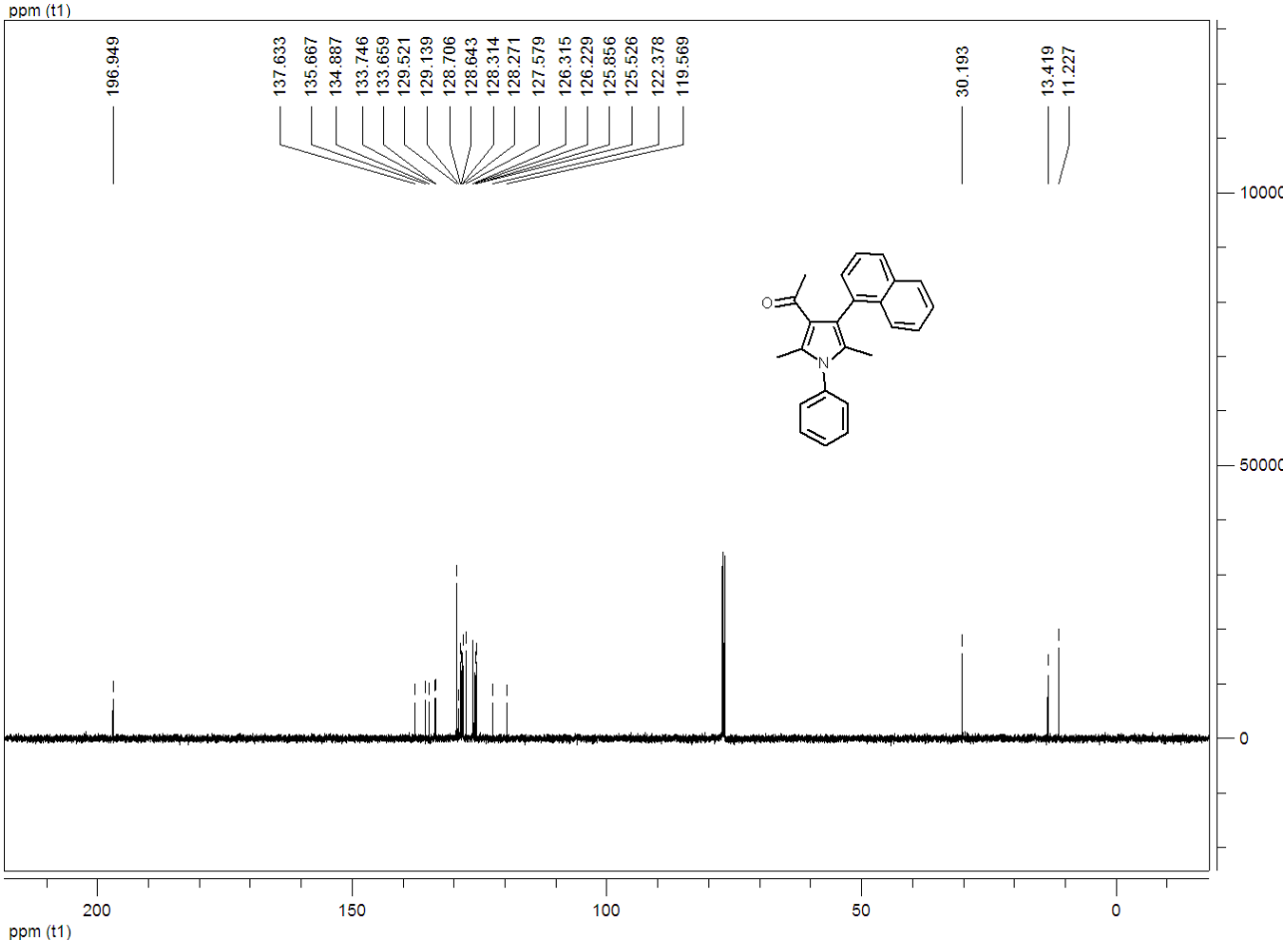
^{1}H NMR and ^{13}C NMR of compound **4j**



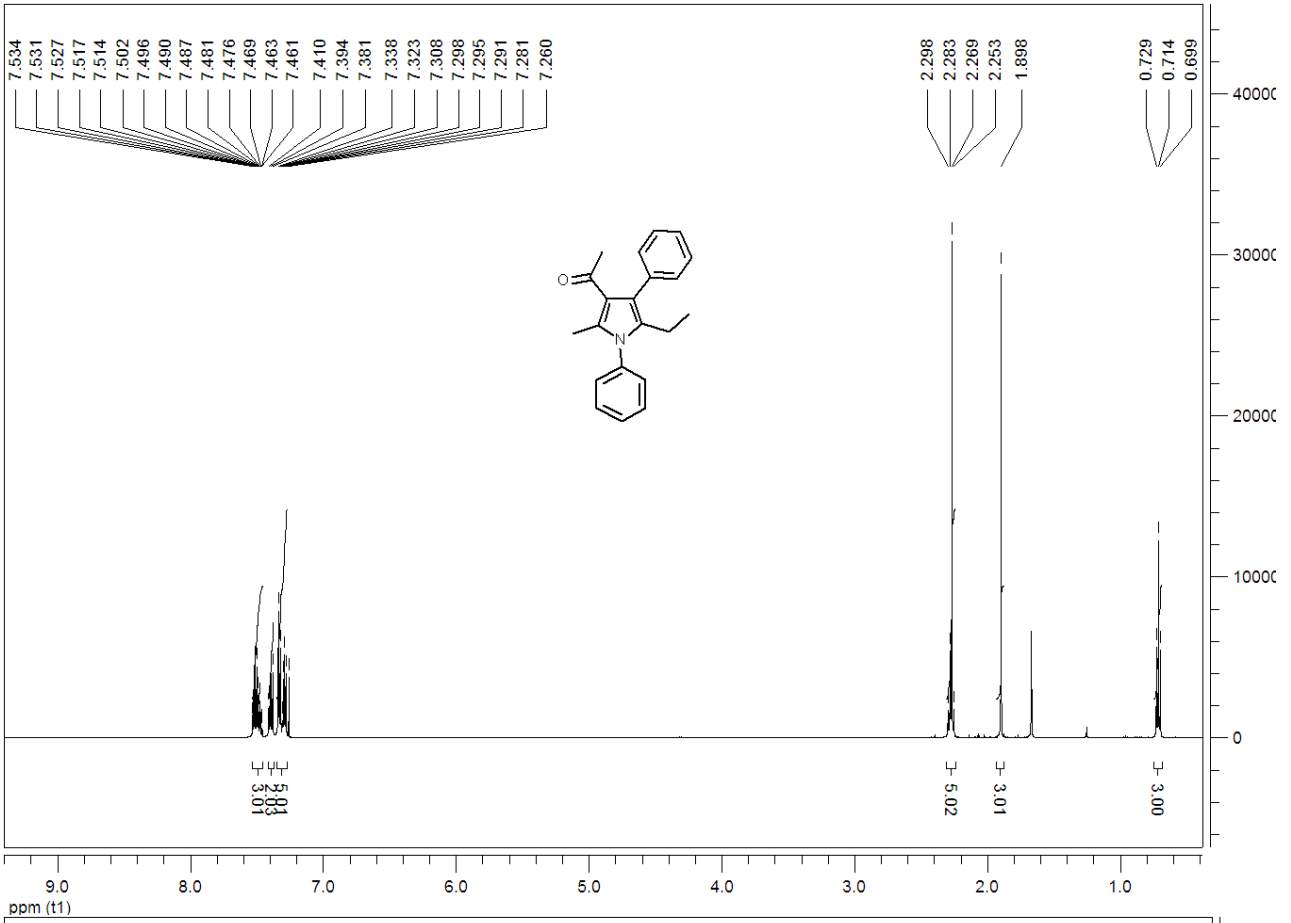


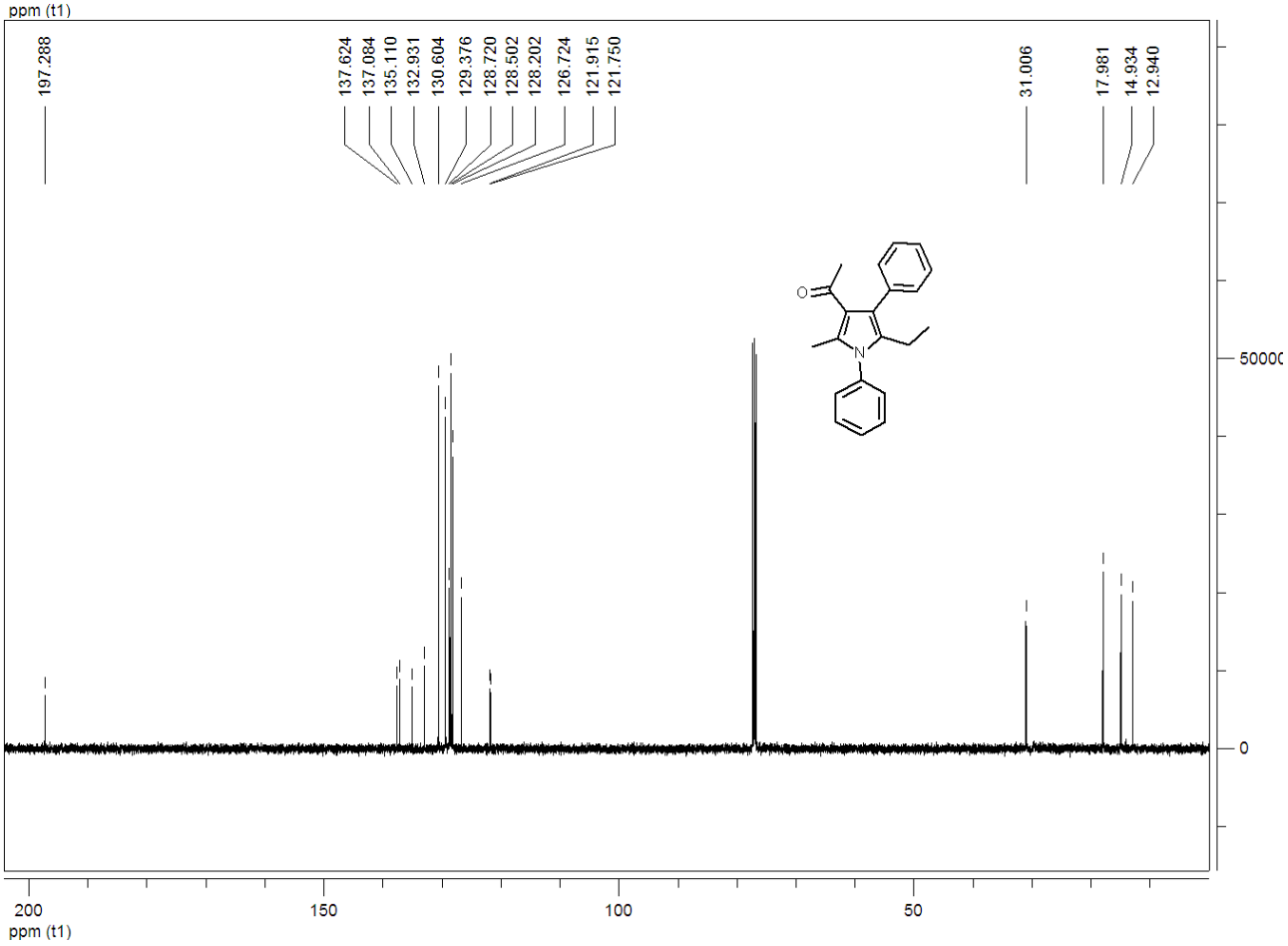
^{1}H NMR and ^{13}C NMR of compound **4k**



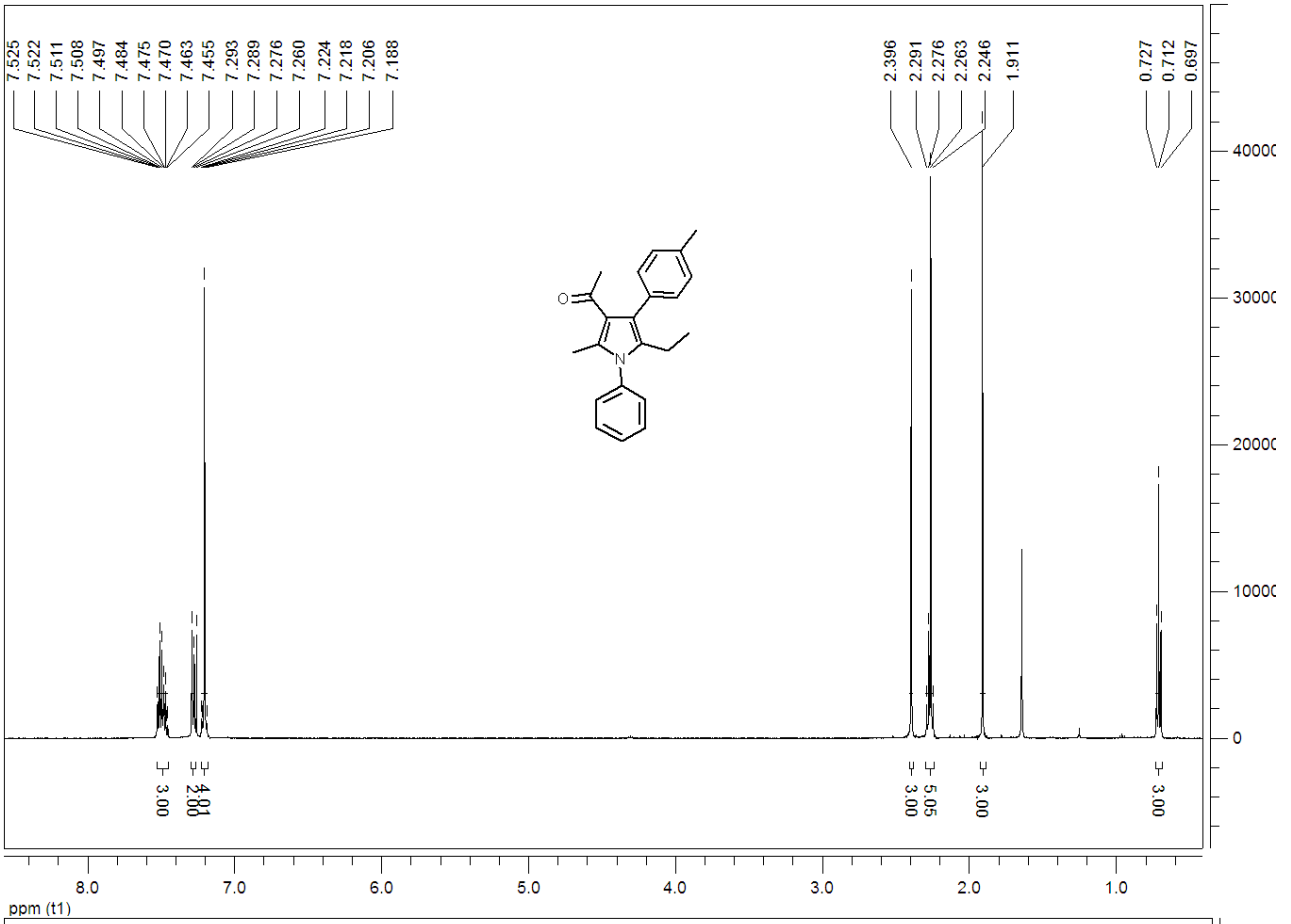


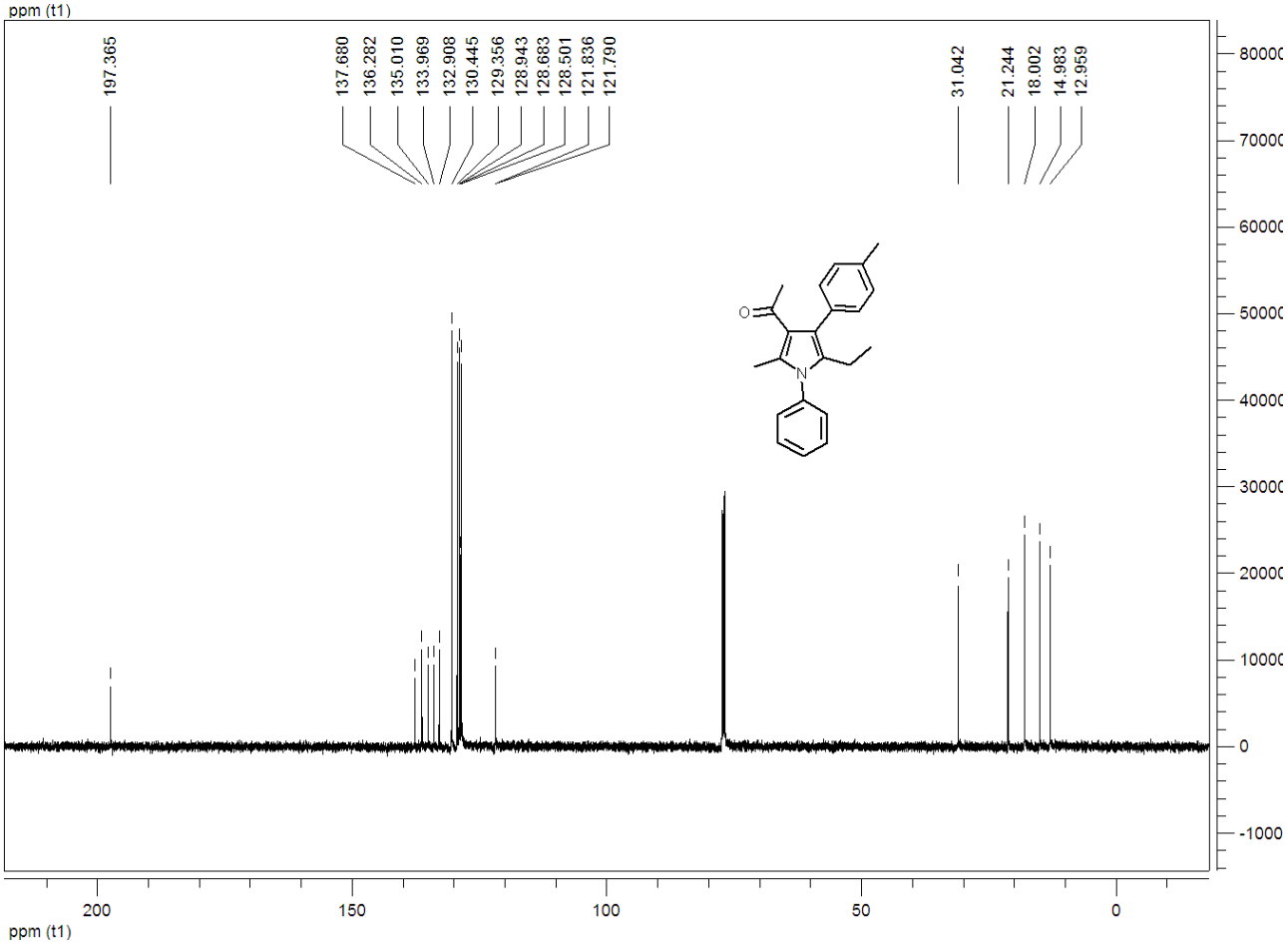
^{1}H NMR and ^{13}C NMR of compound **4l**



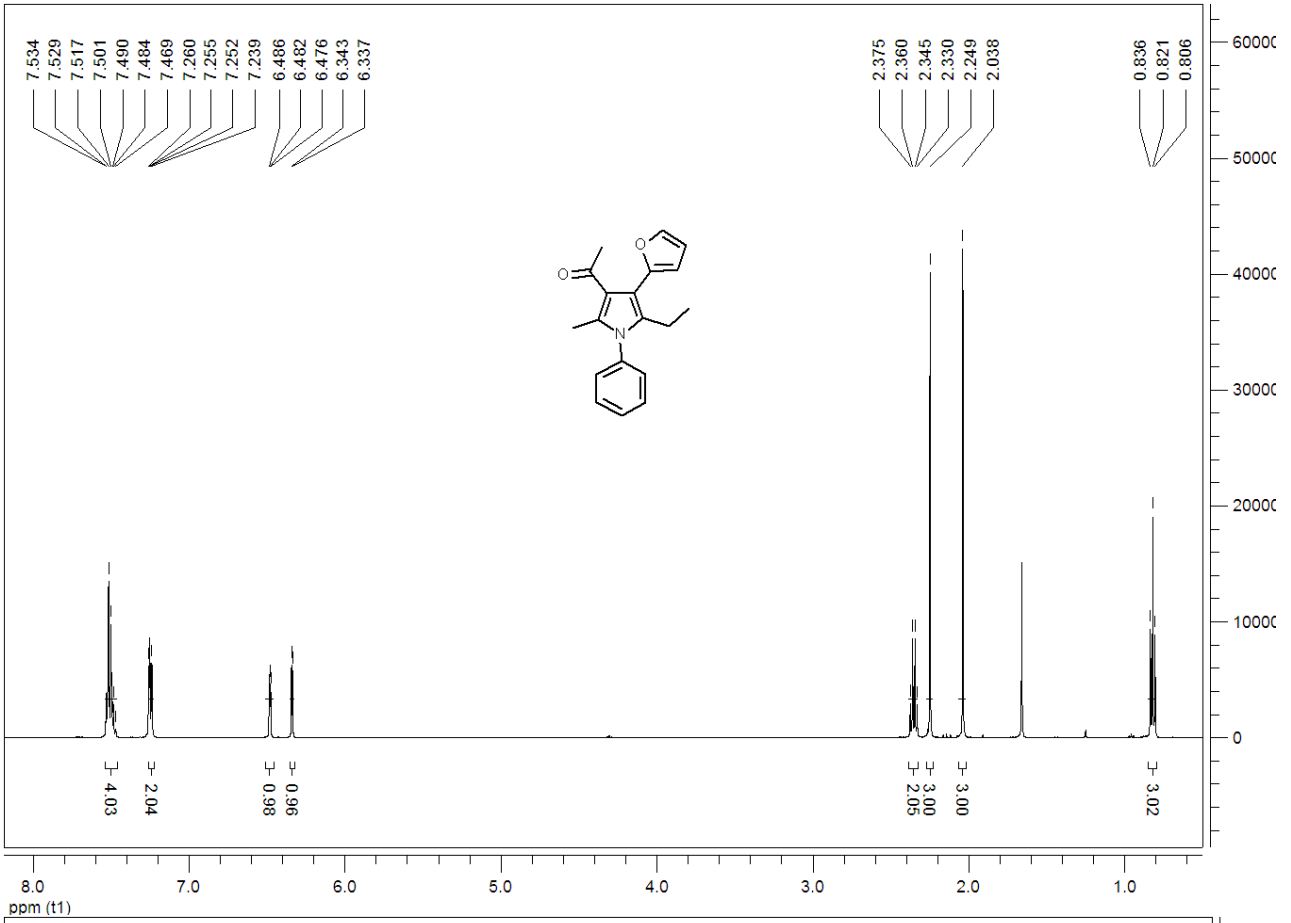


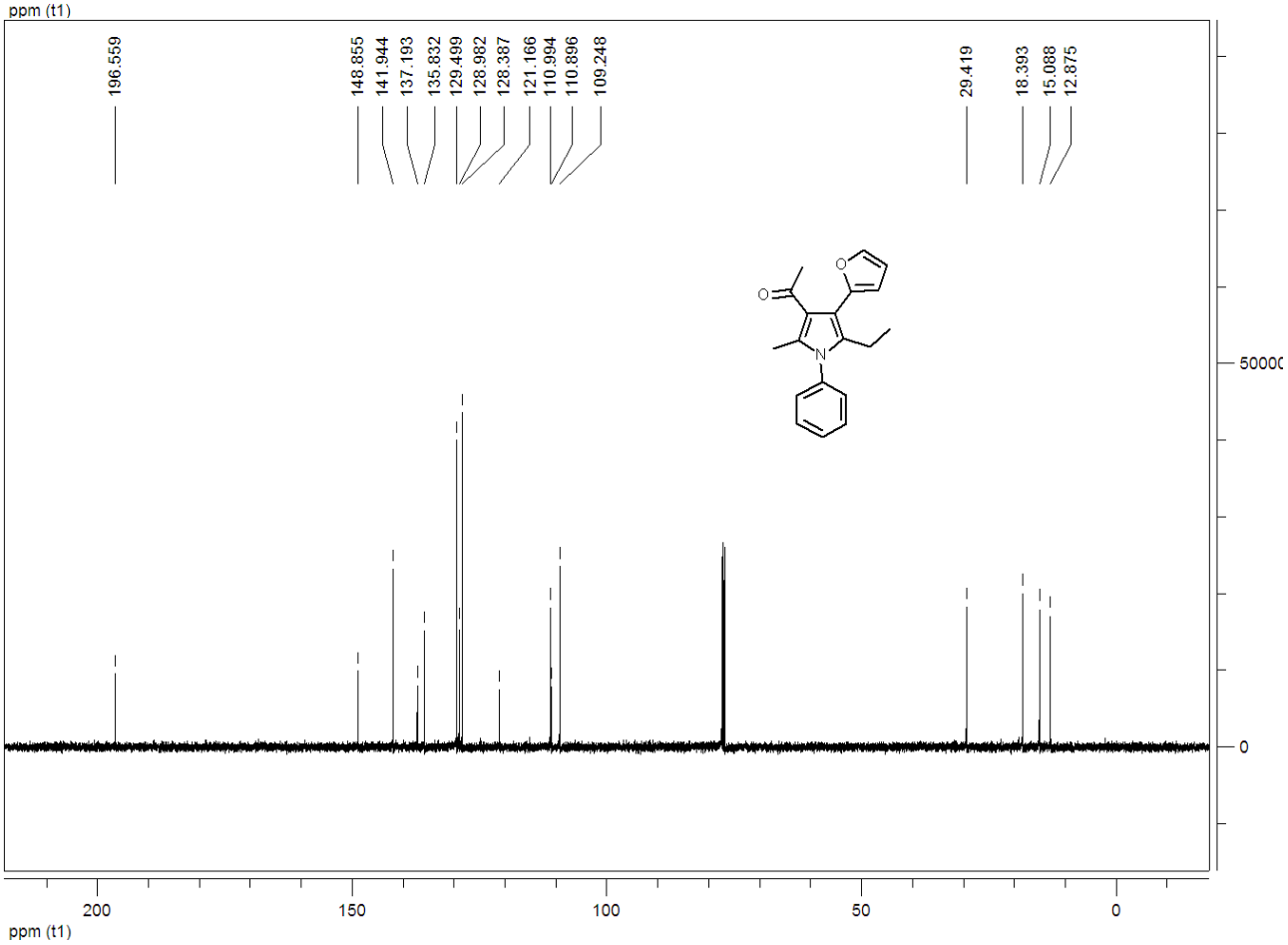
^{1}H NMR and ^{13}C NMR of compound **4m**



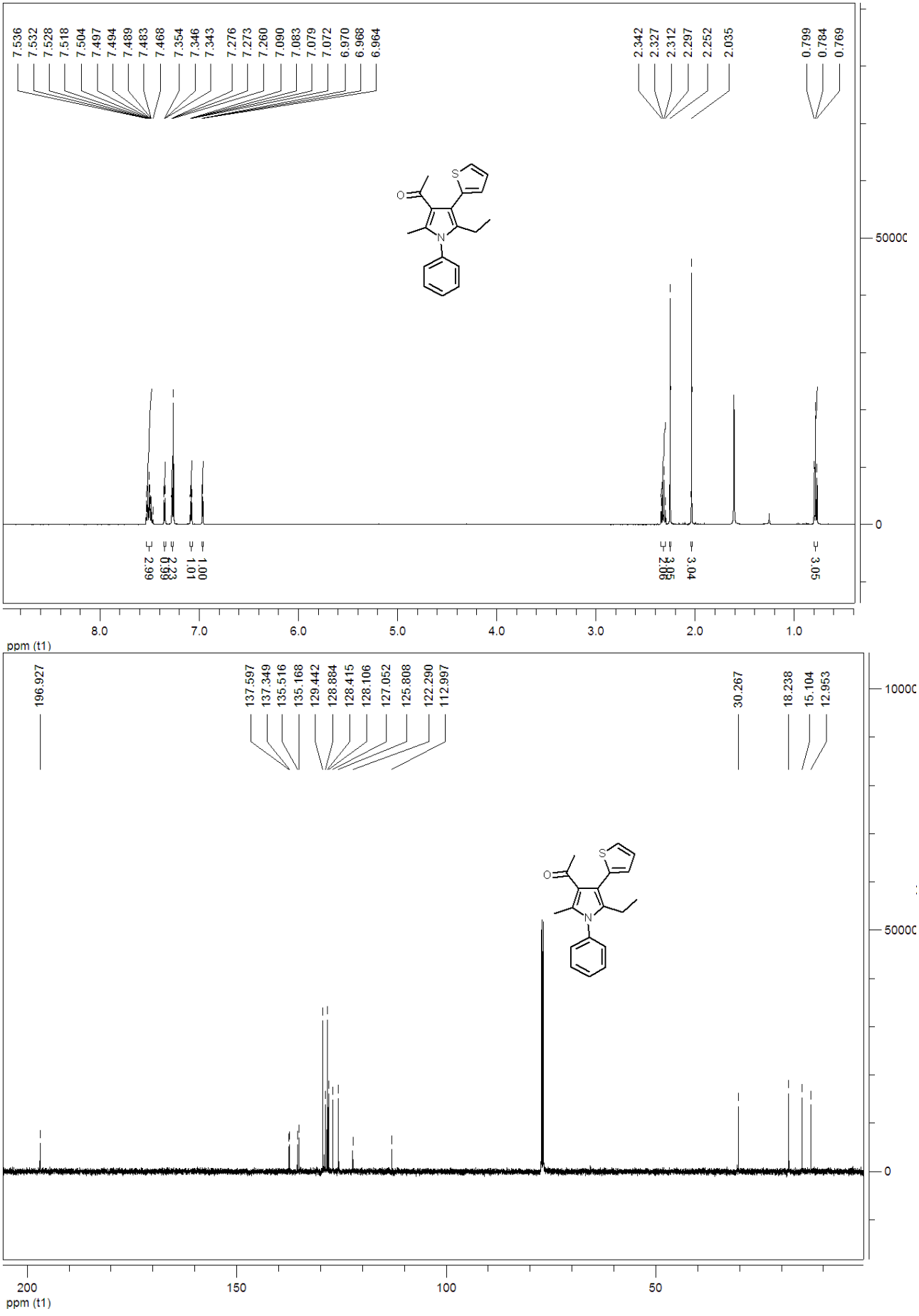


^{1}H NMR and ^{13}C NMR of compound **4n**

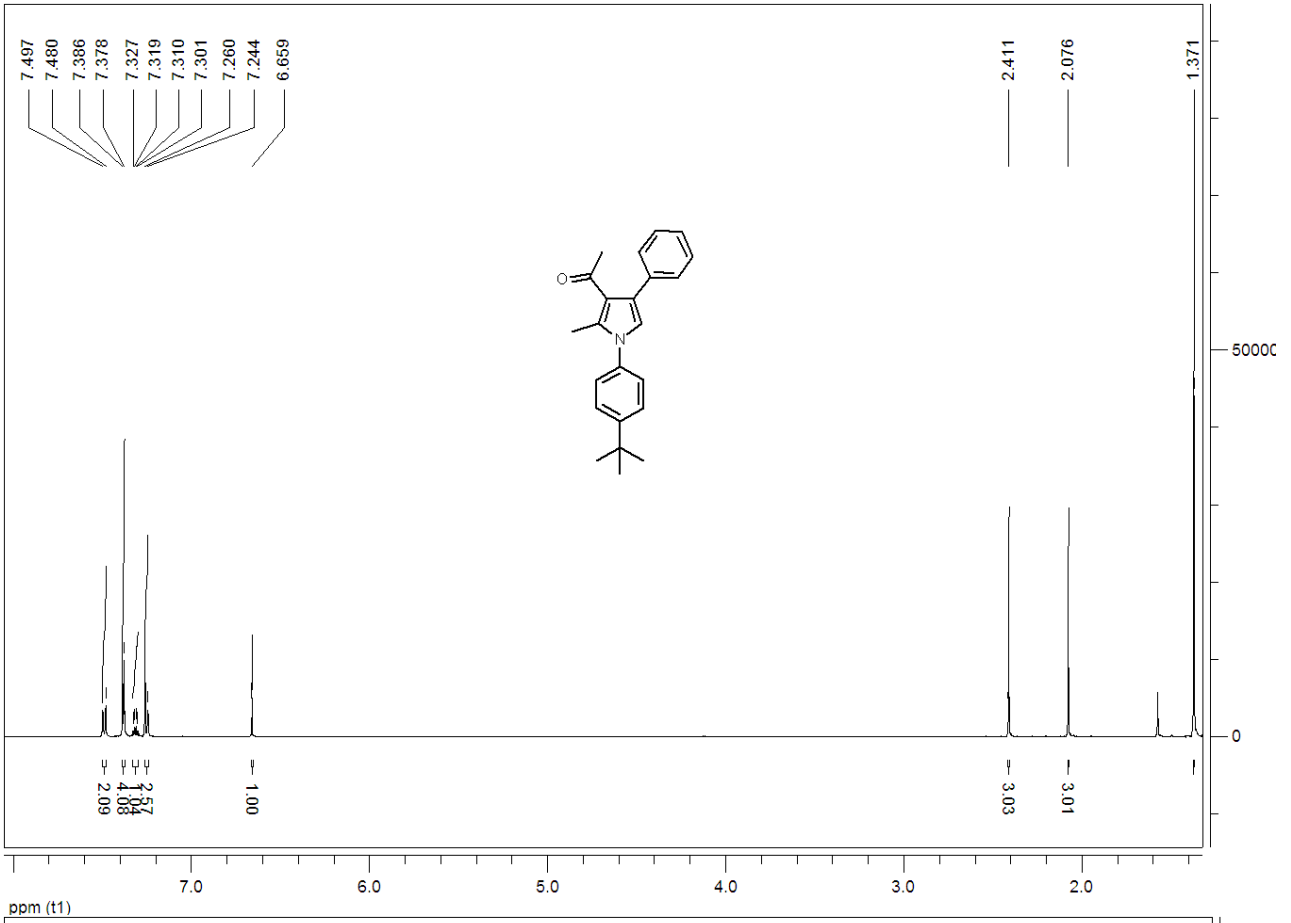


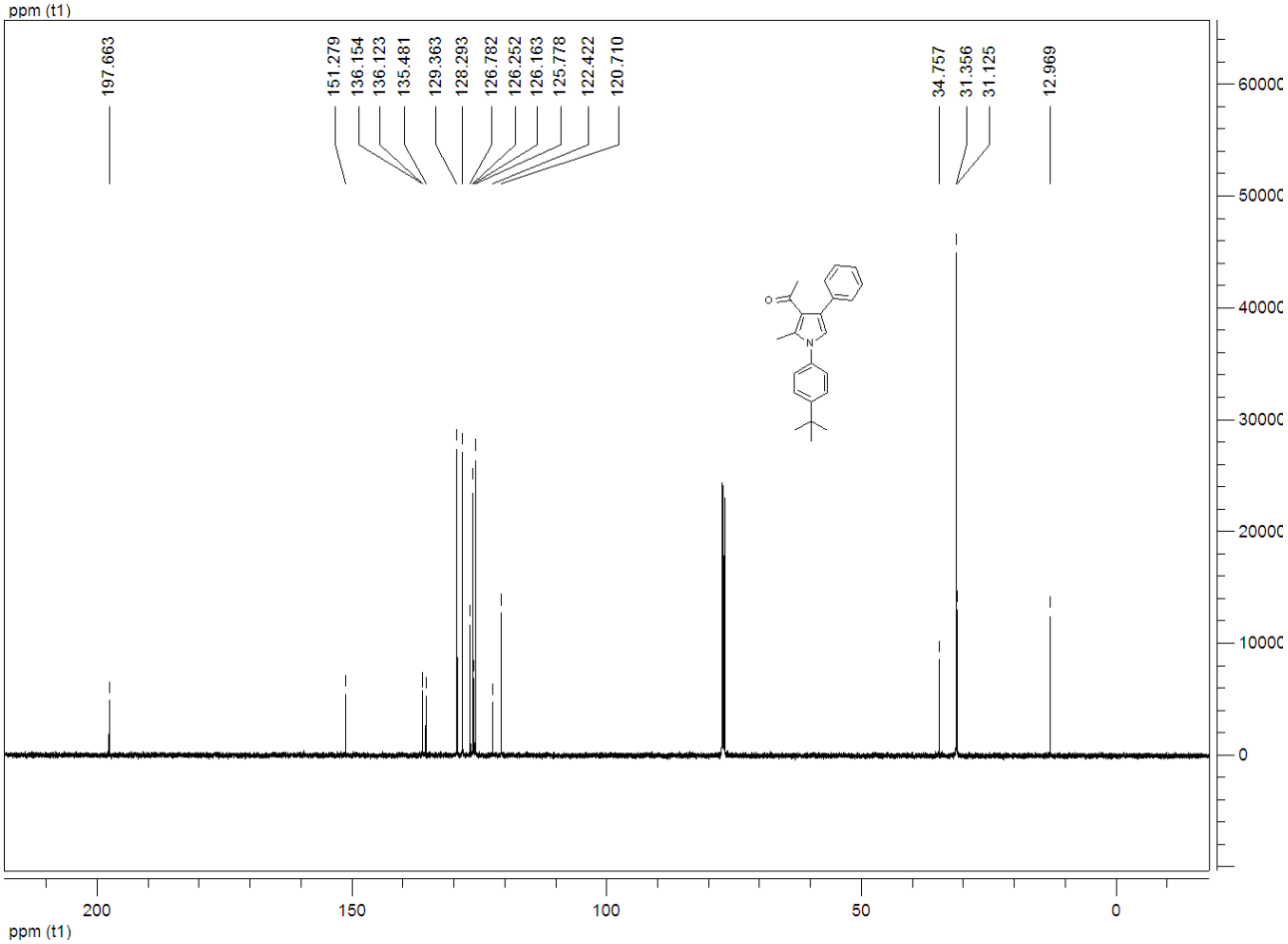


^{1}H NMR and ^{13}C NMR of compound **4o**

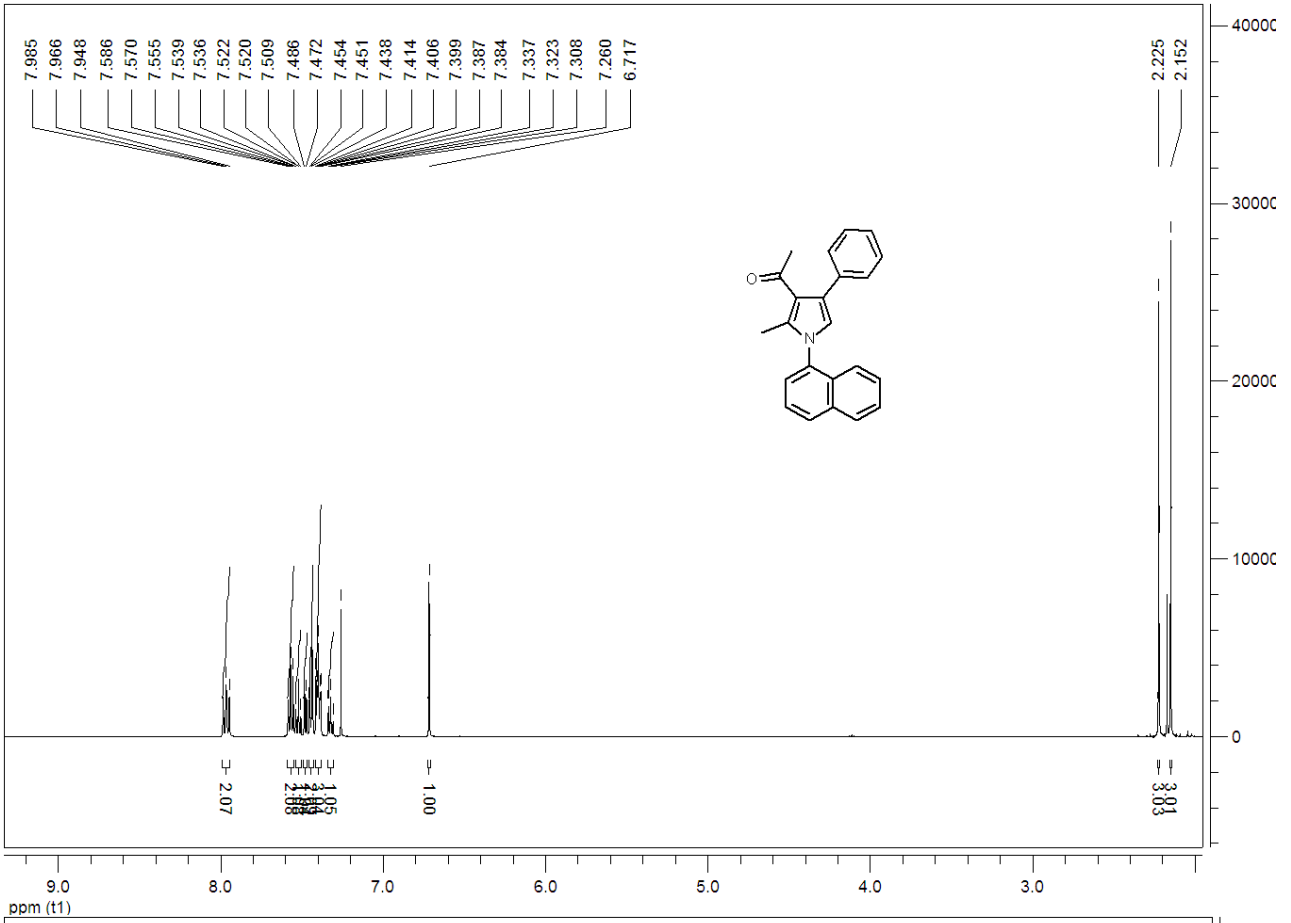


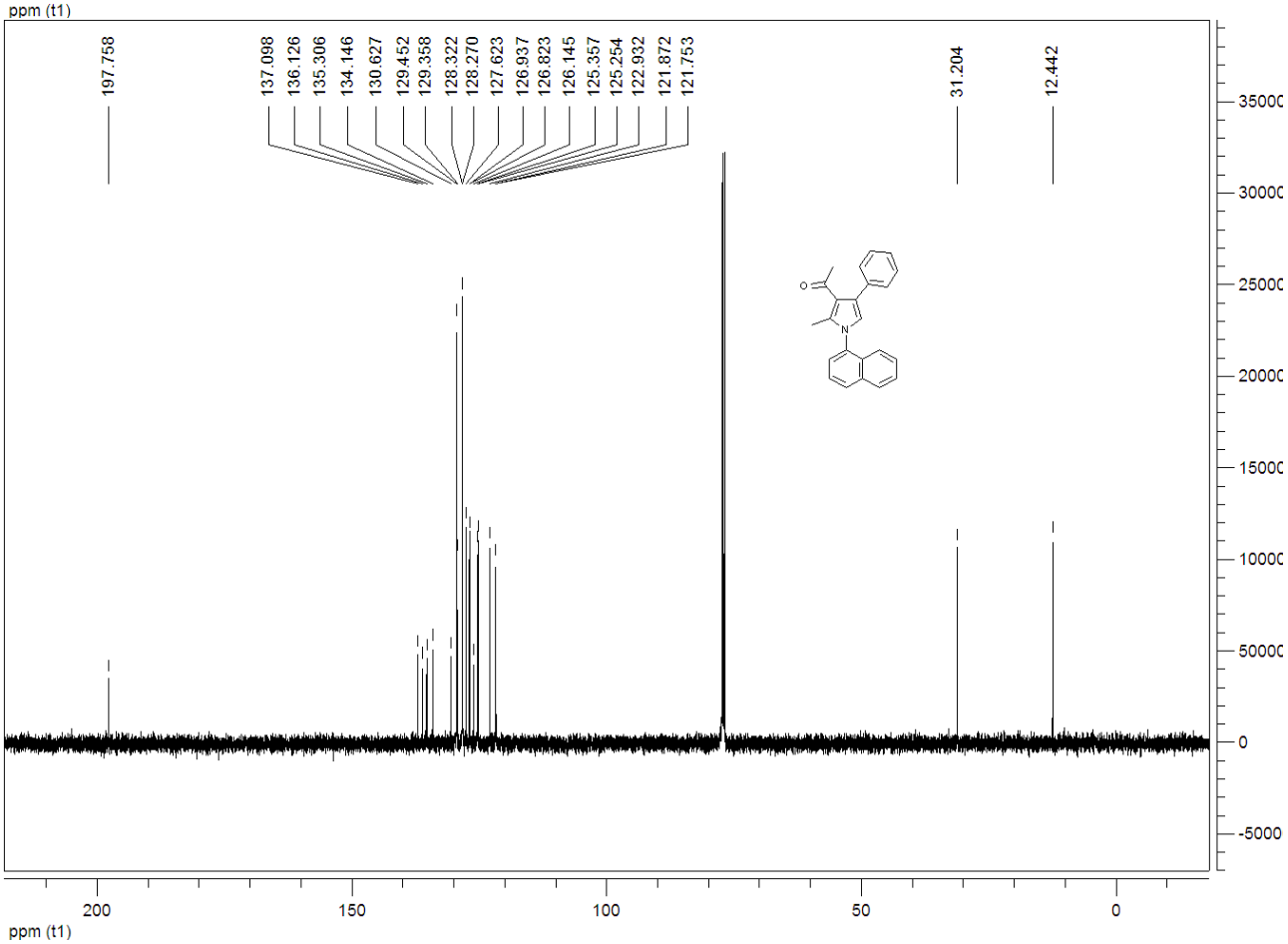
^{1}H NMR and ^{13}C NMR of compound **4p**



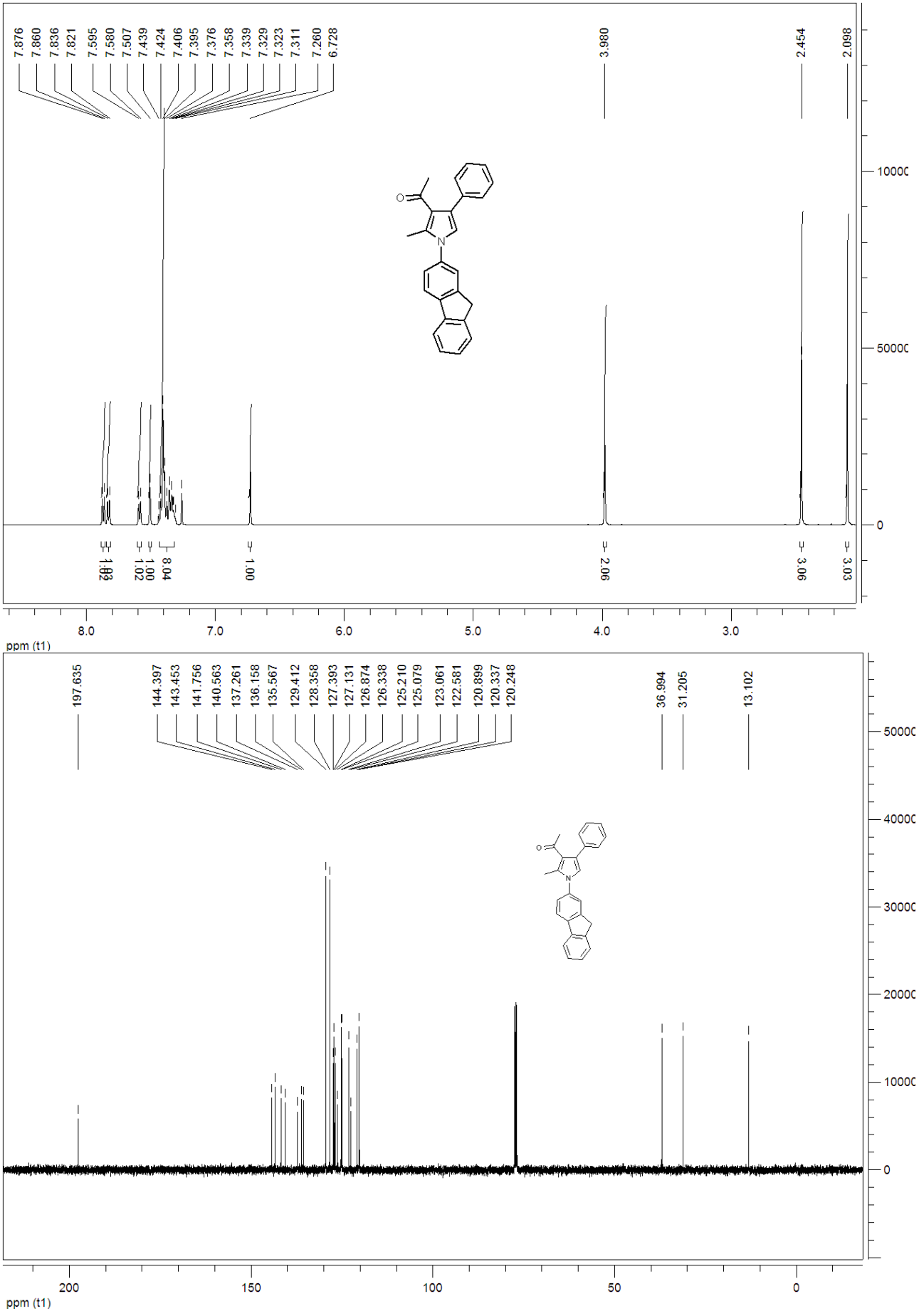


^{1}H NMR and ^{13}C NMR of compound **4q**

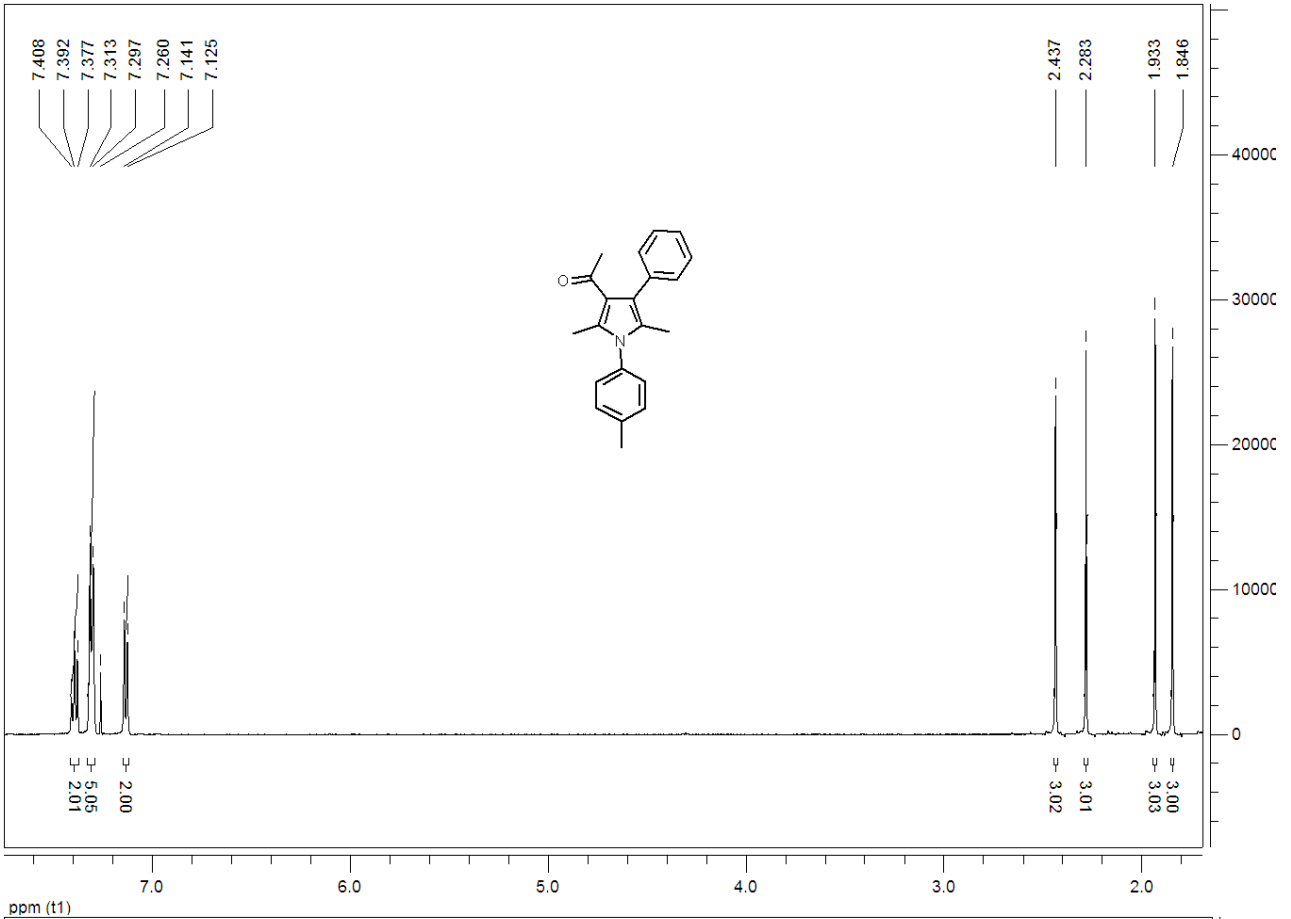


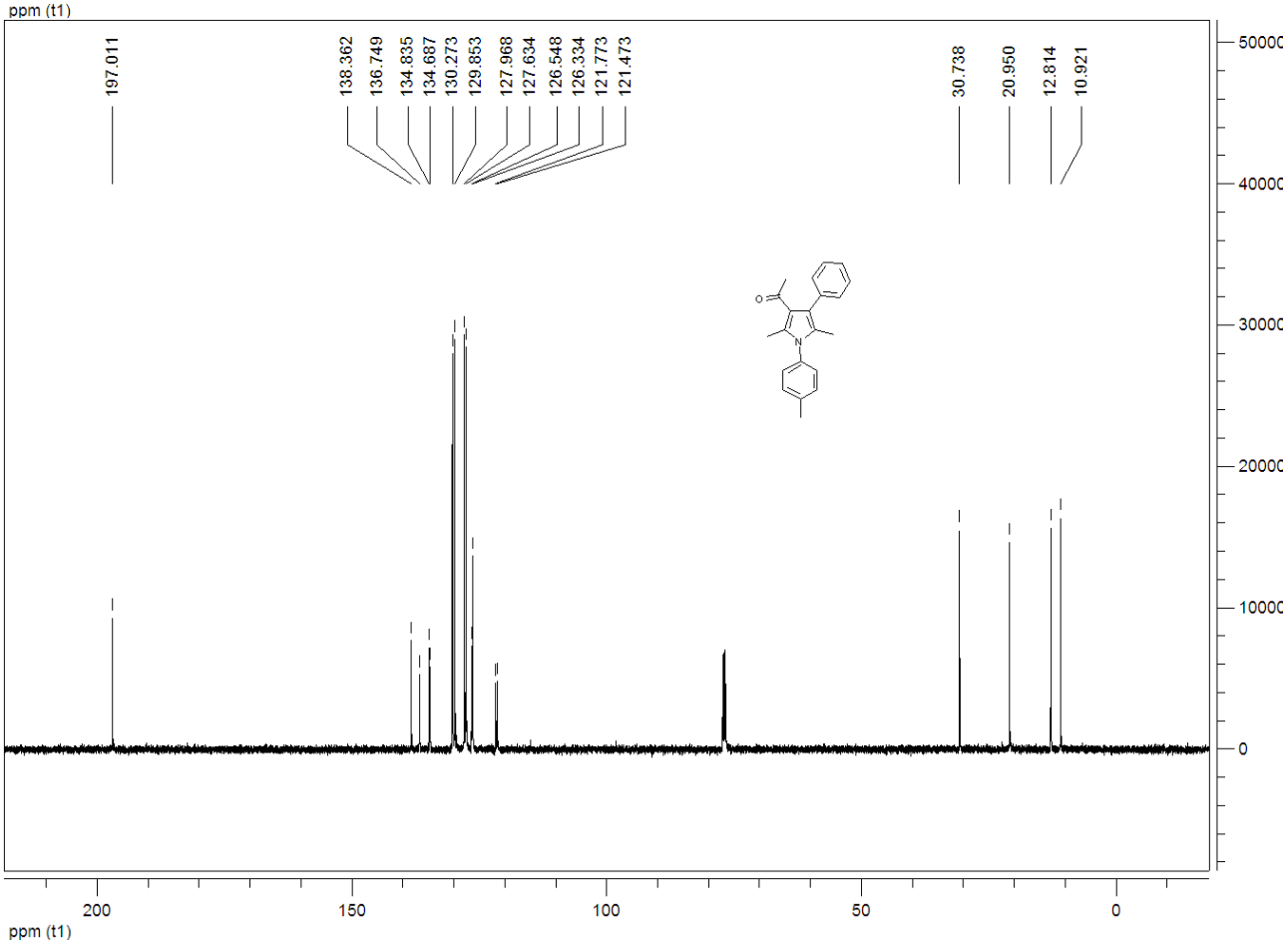


^{1}H NMR and ^{13}C NMR of compound **4r**

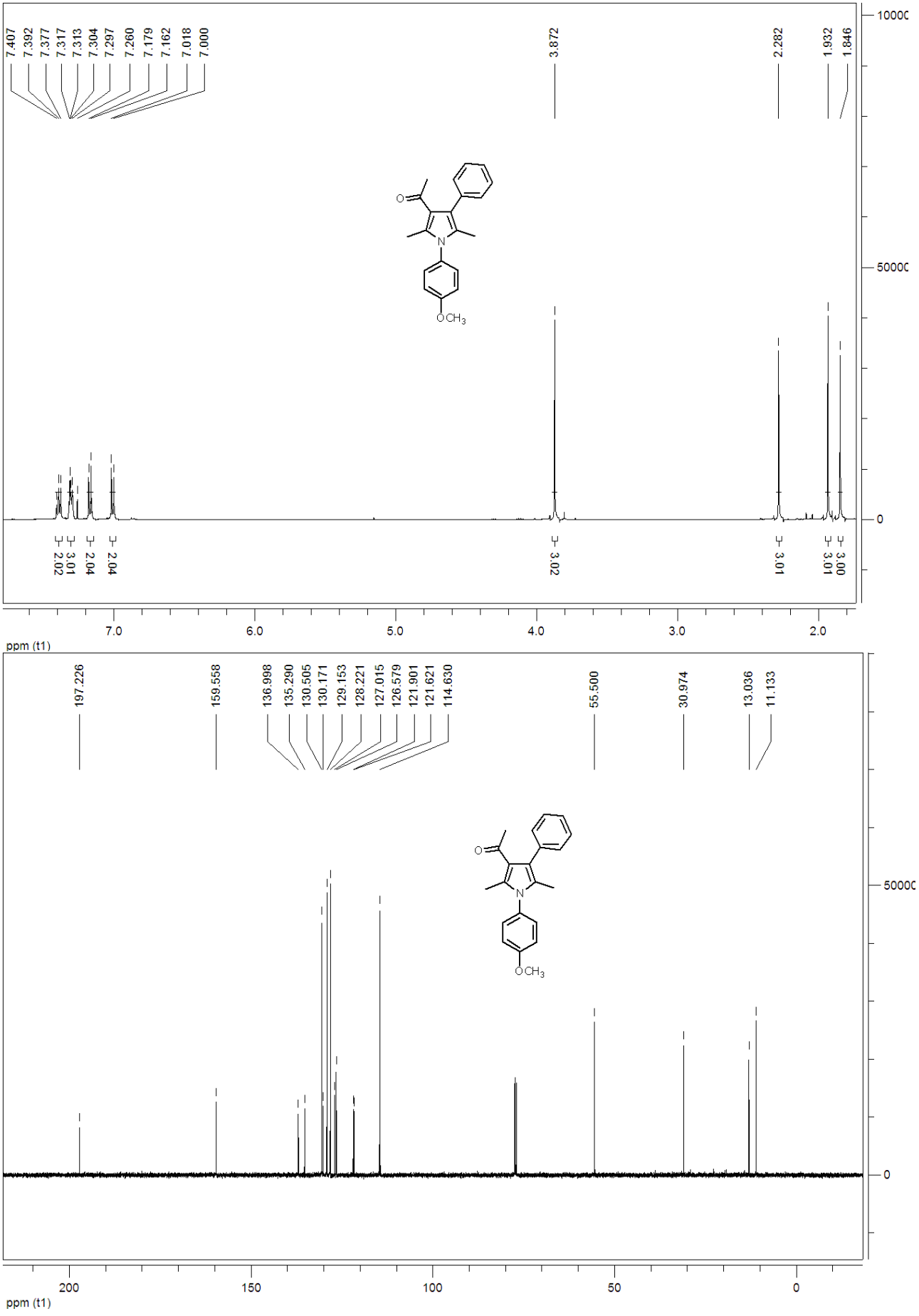


^{1}H NMR and ^{13}C NMR of compound **4s**

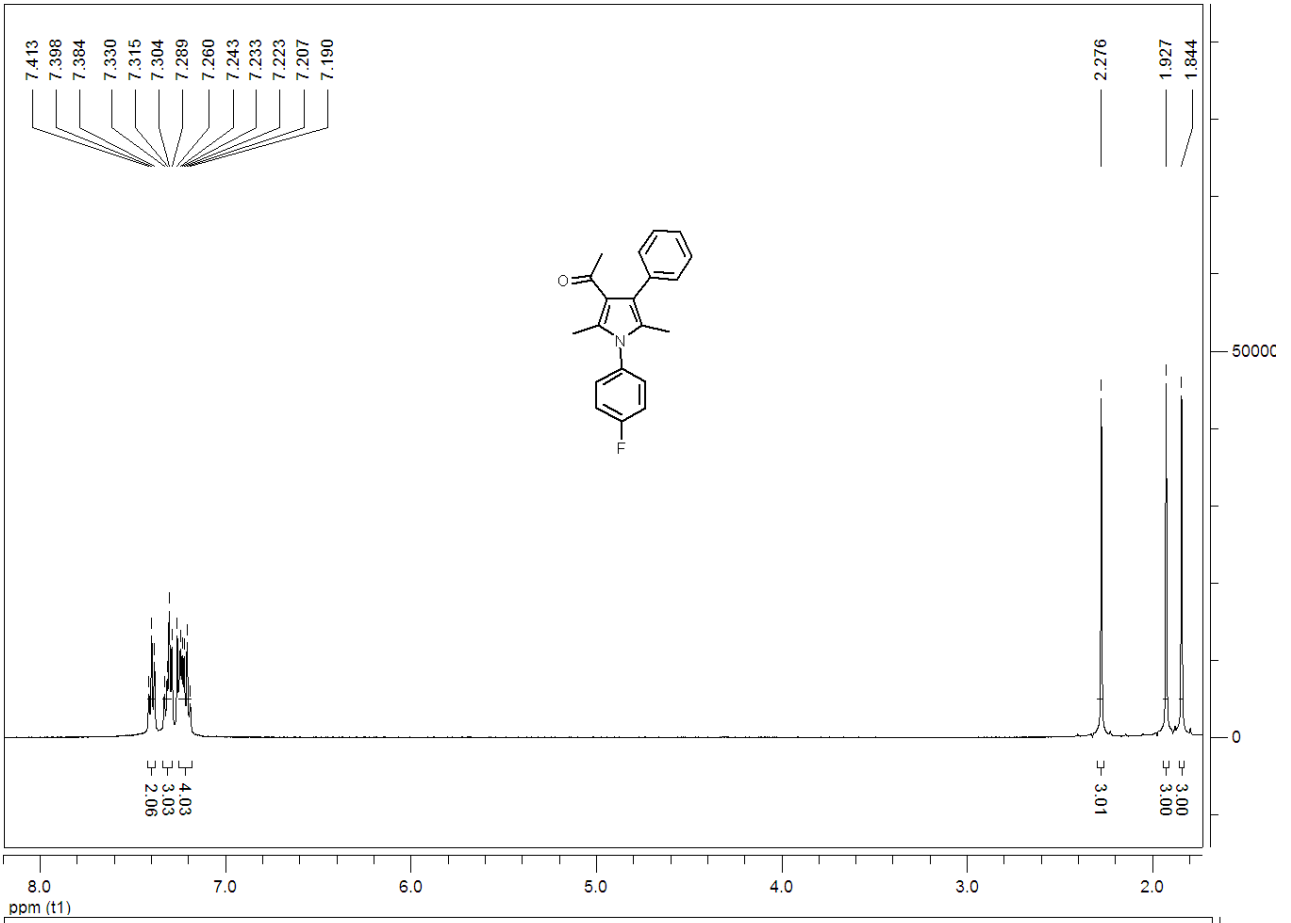


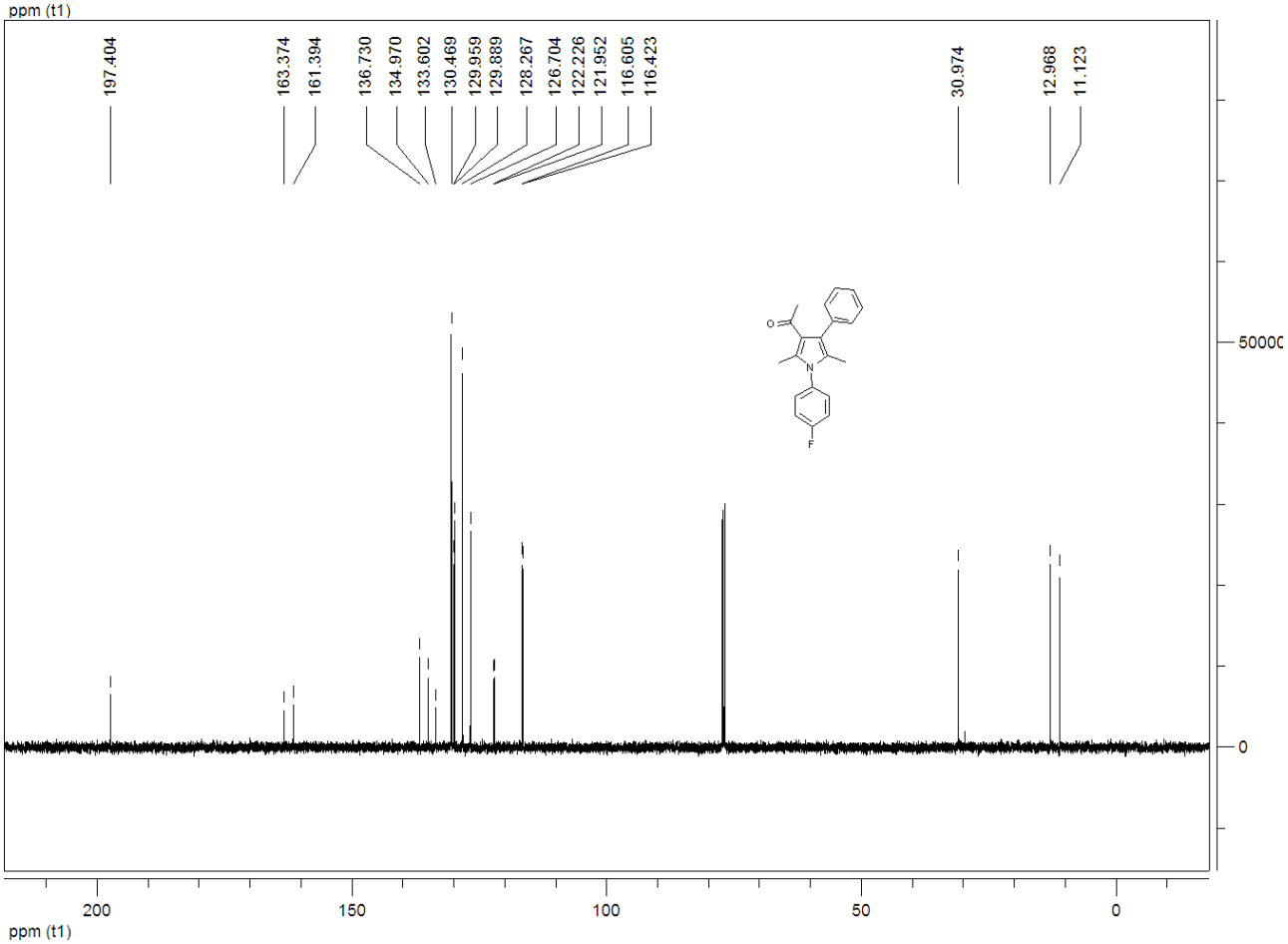


^{1}H NMR and ^{13}C NMR of compound **4t**

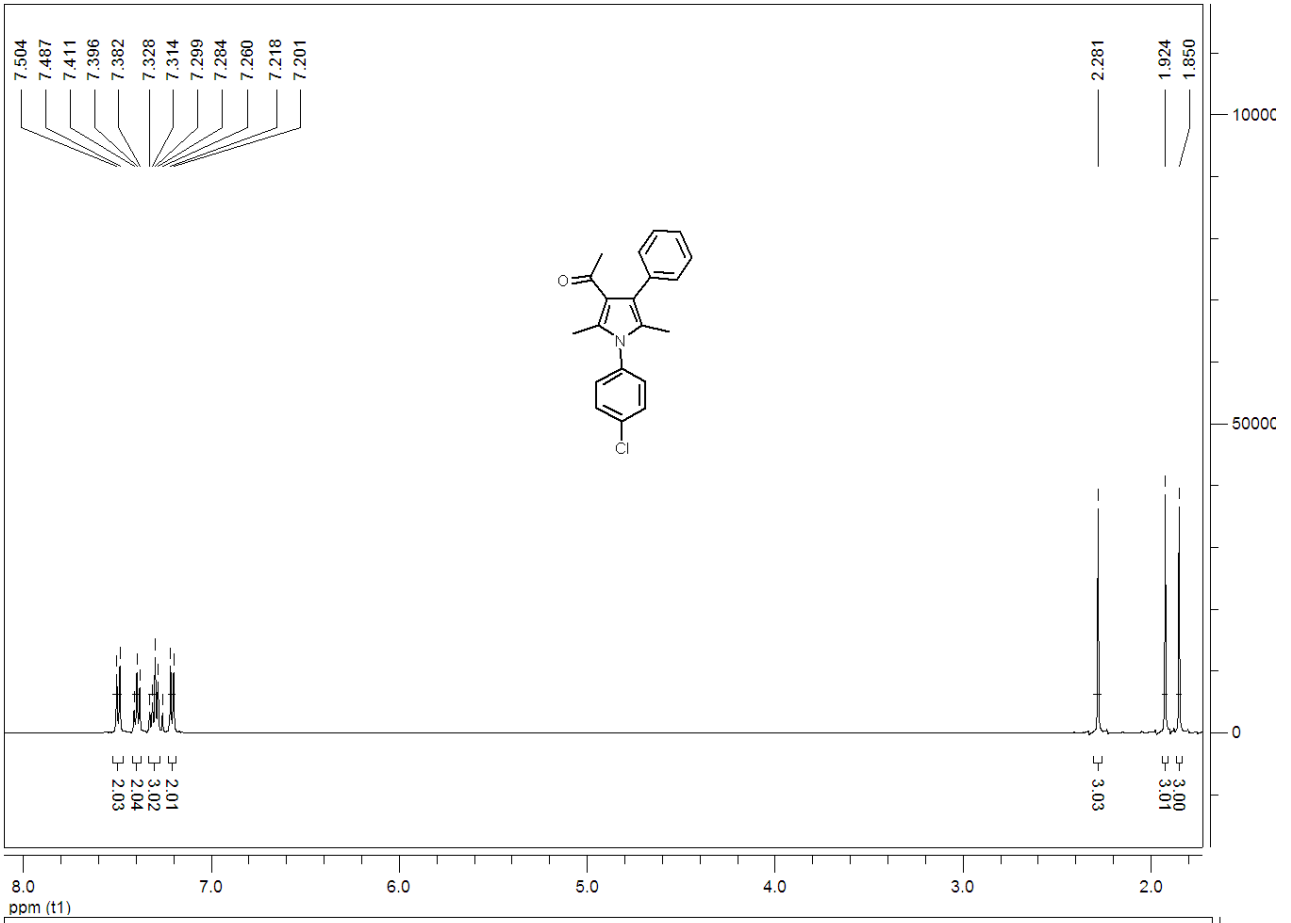


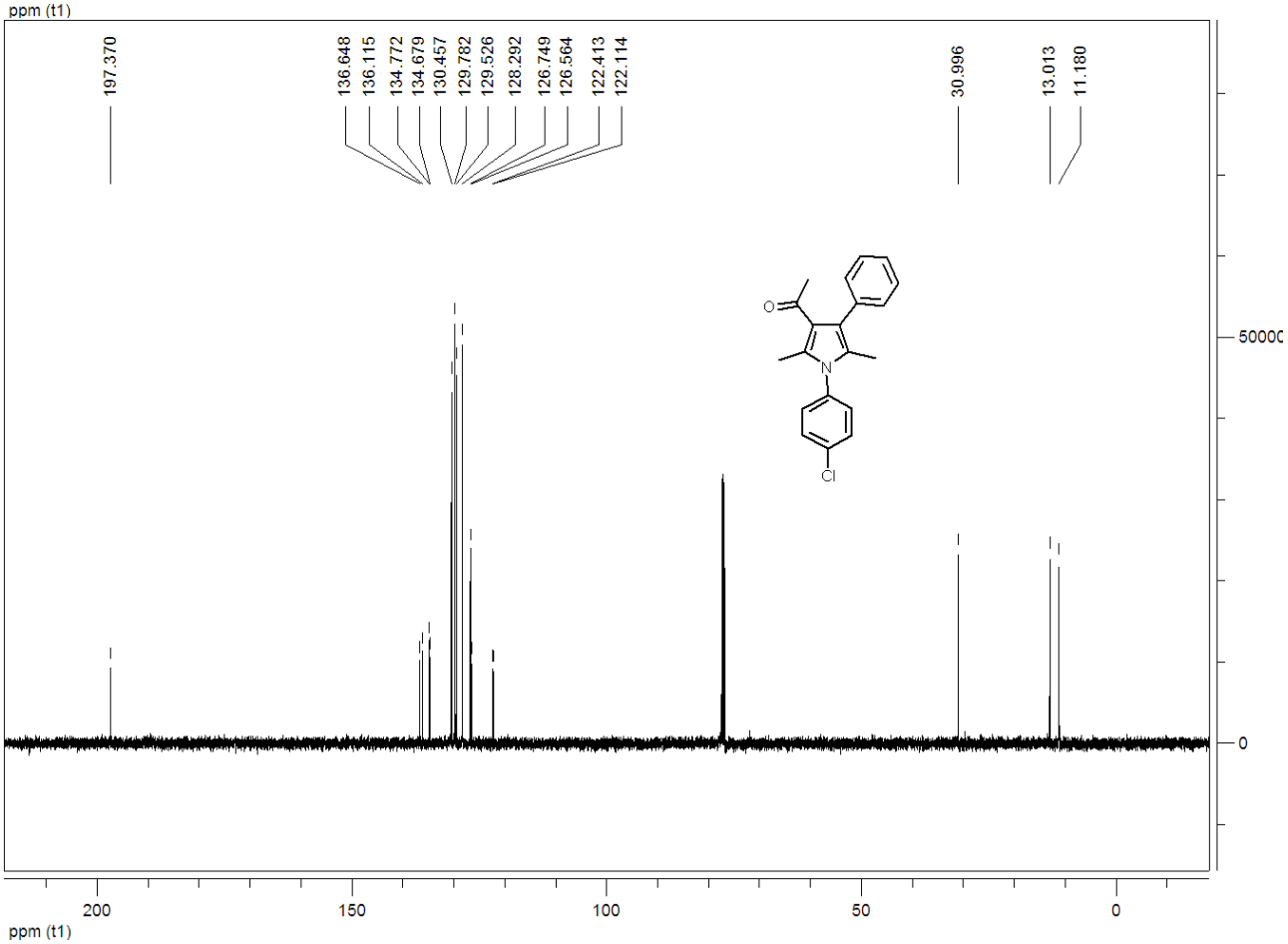
^{1}H NMR and ^{13}C NMR of compound **4u**



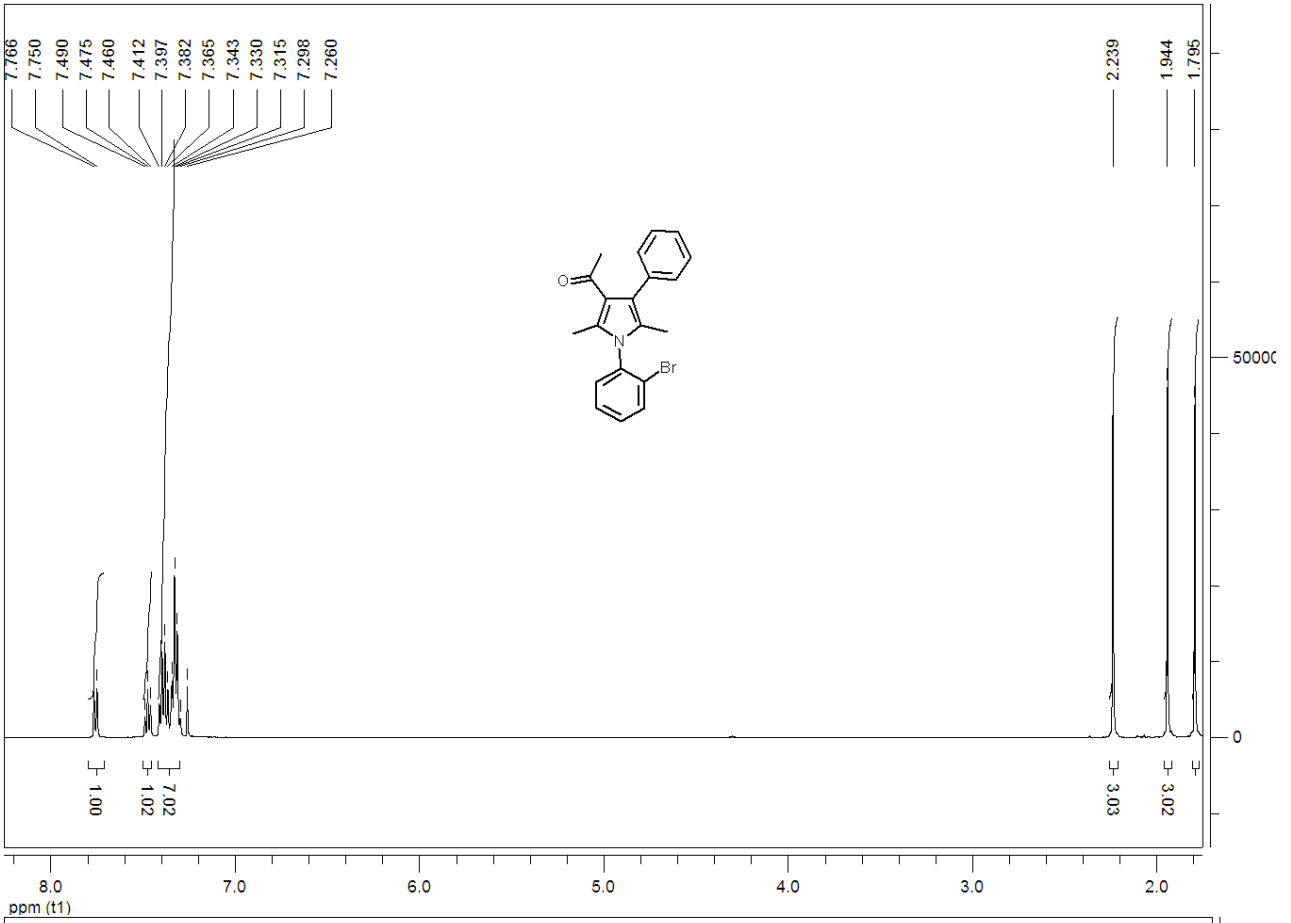


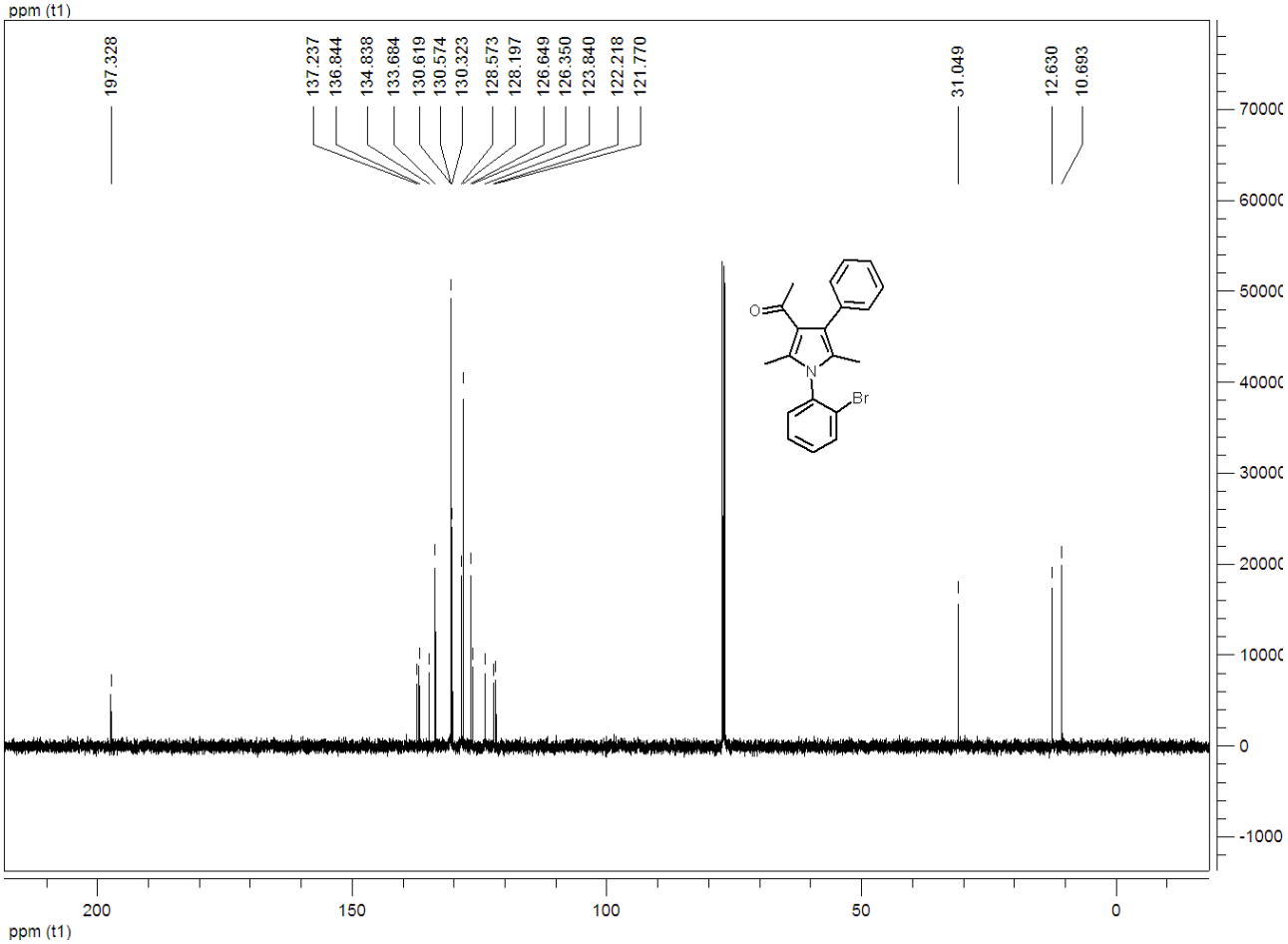
^{1}H NMR and ^{13}C NMR of compound **4v**



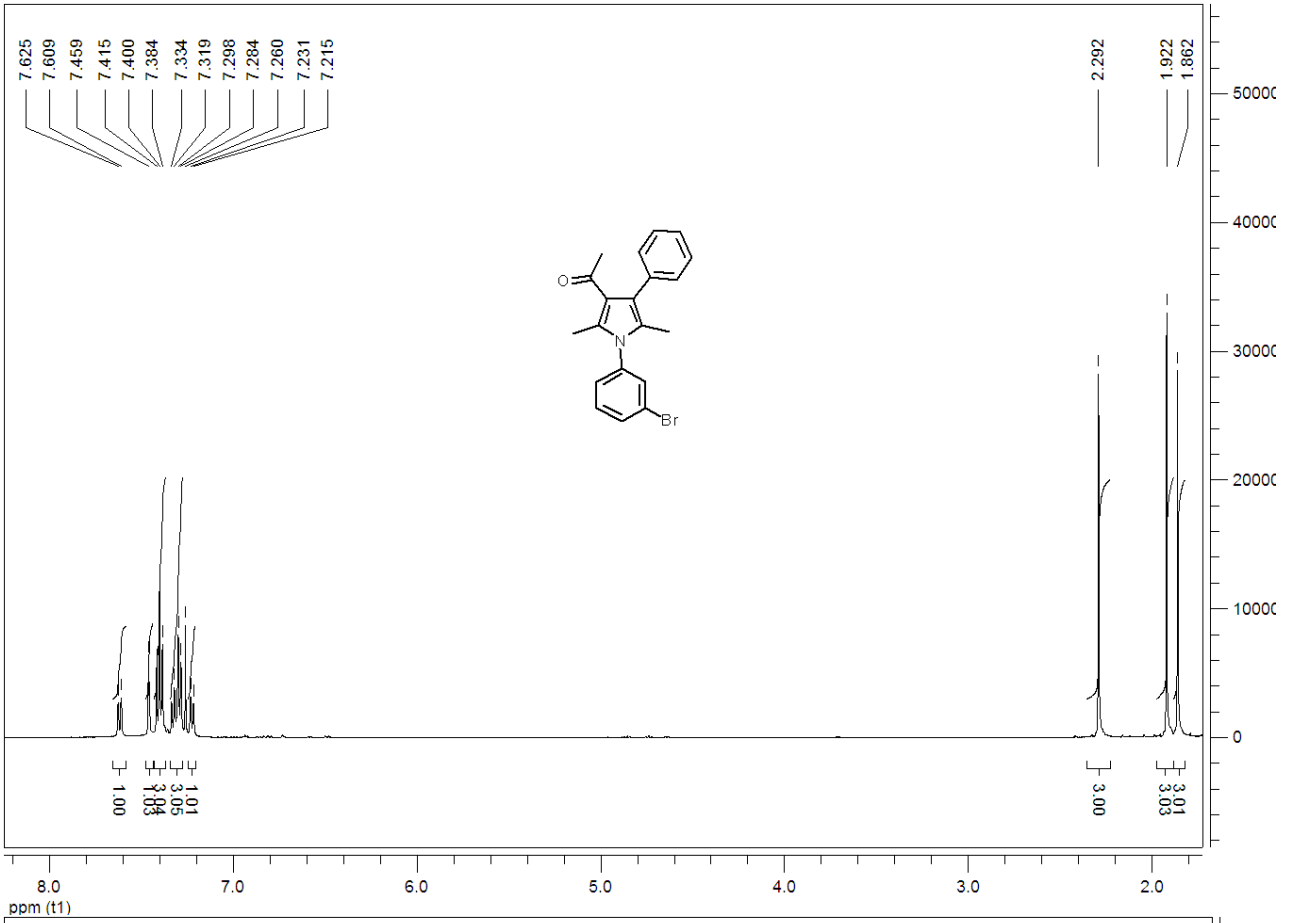


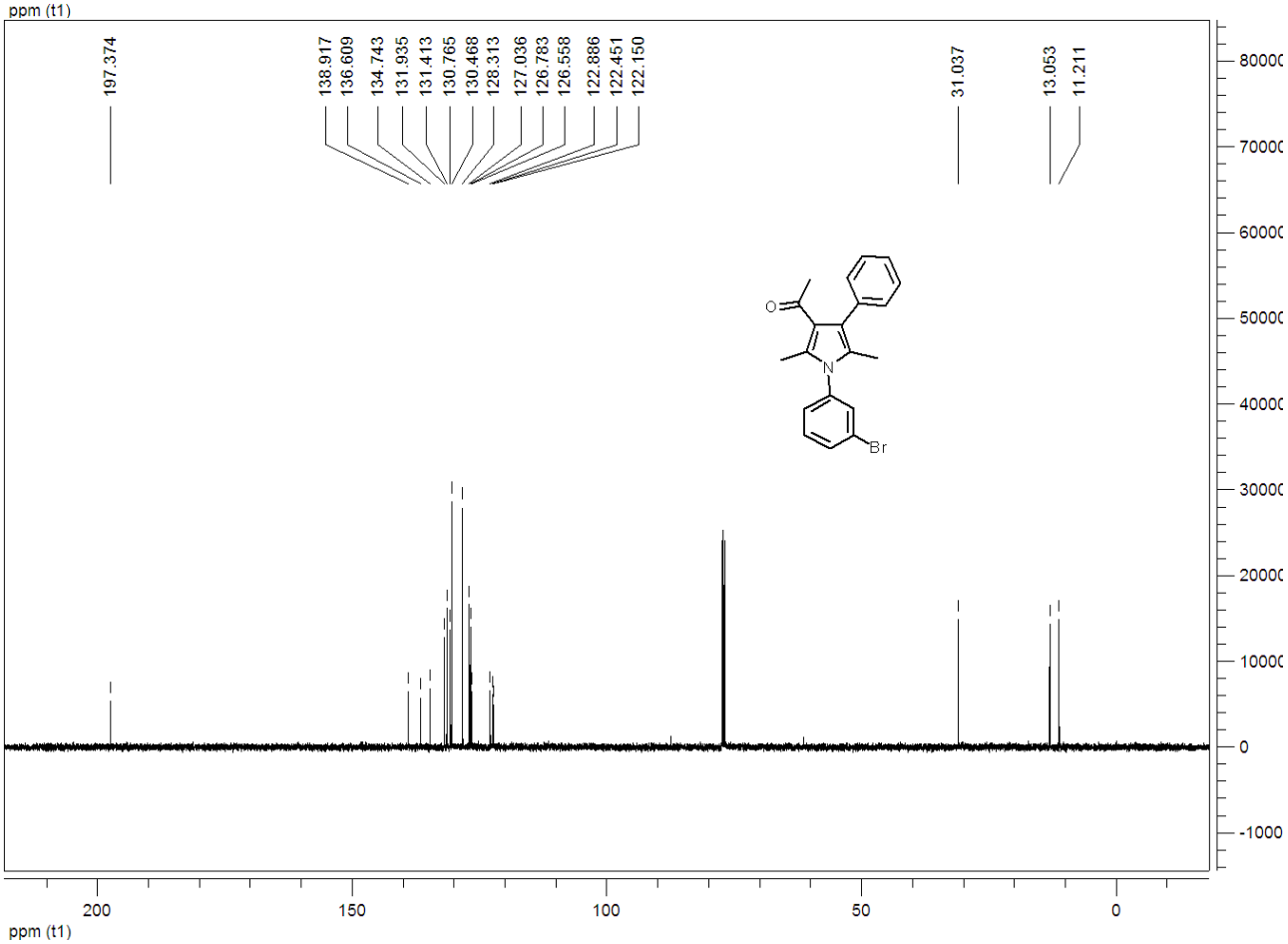
^{1}H NMR and ^{13}C NMR of compound **4w**



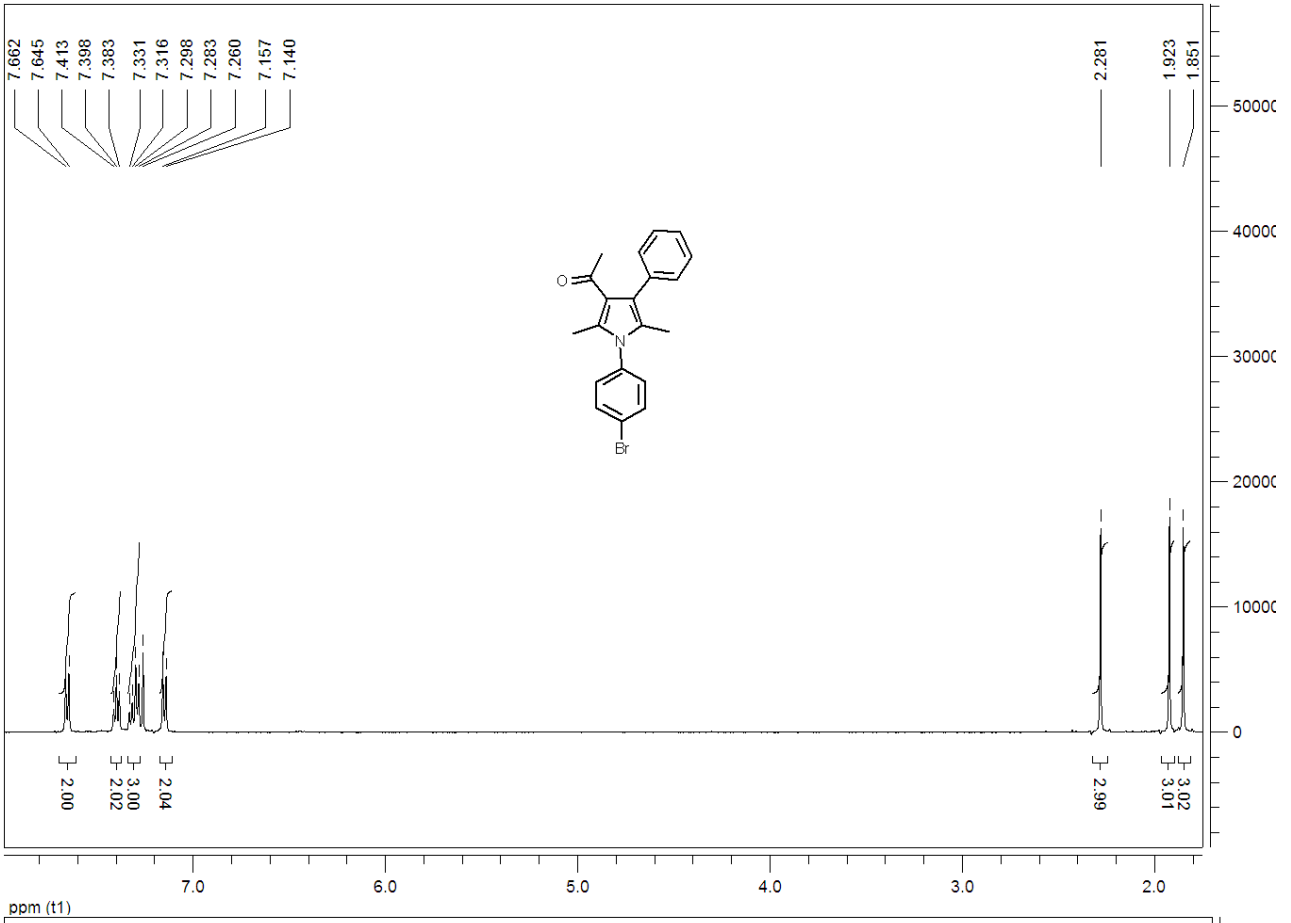


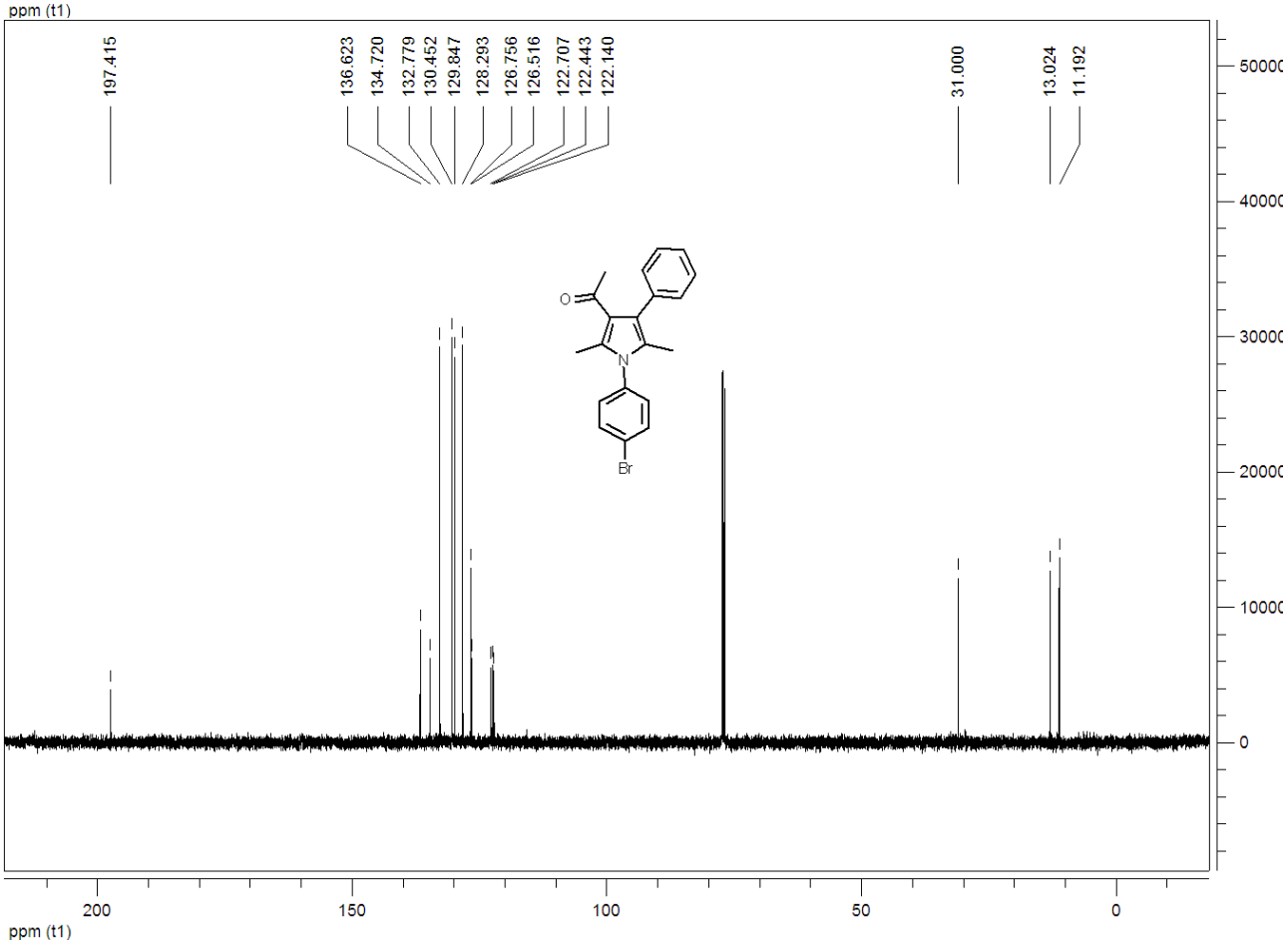
^{1}H NMR and ^{13}C NMR of compound **4x**



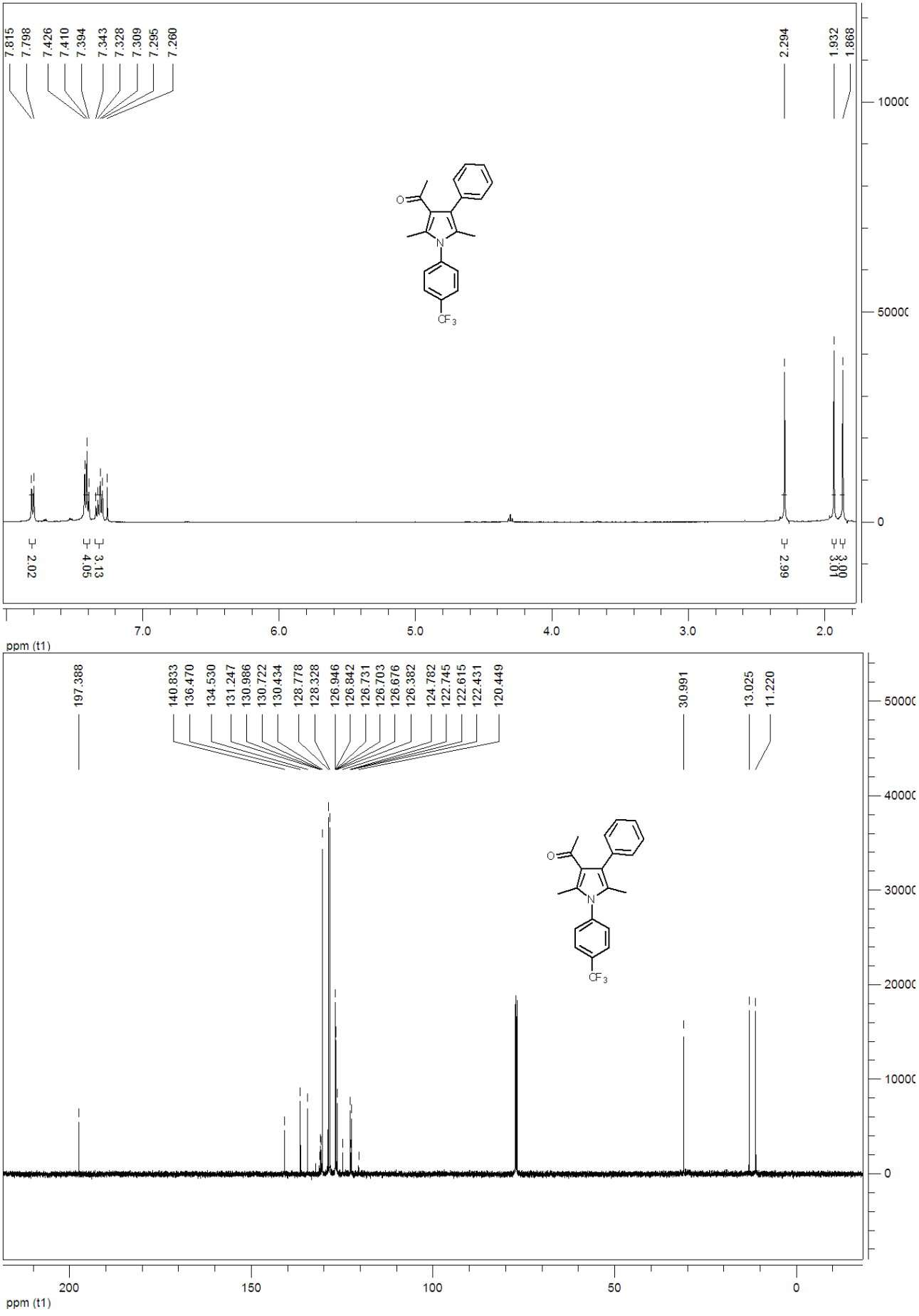


^{1}H NMR and ^{13}C NMR of compound **4y**

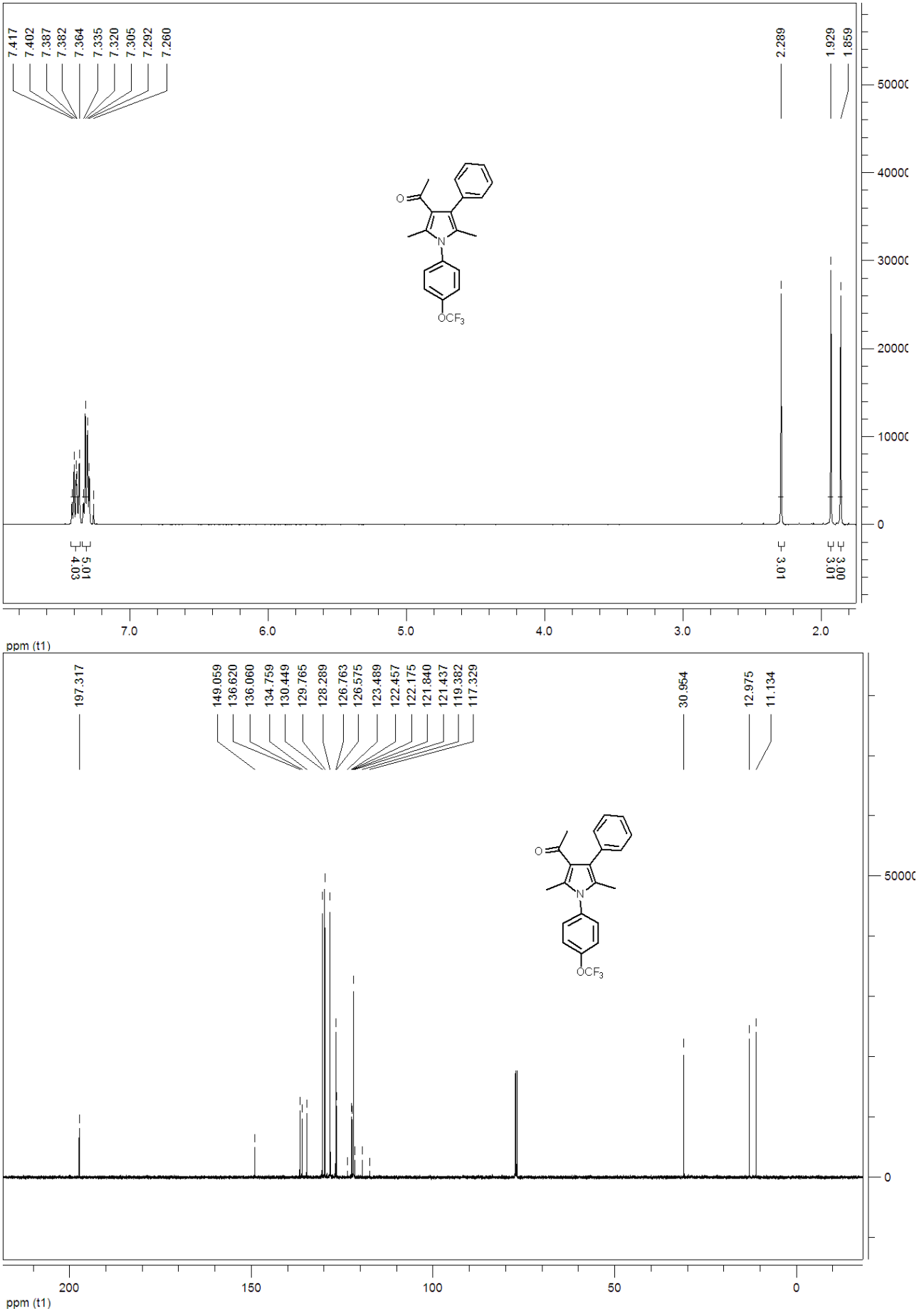




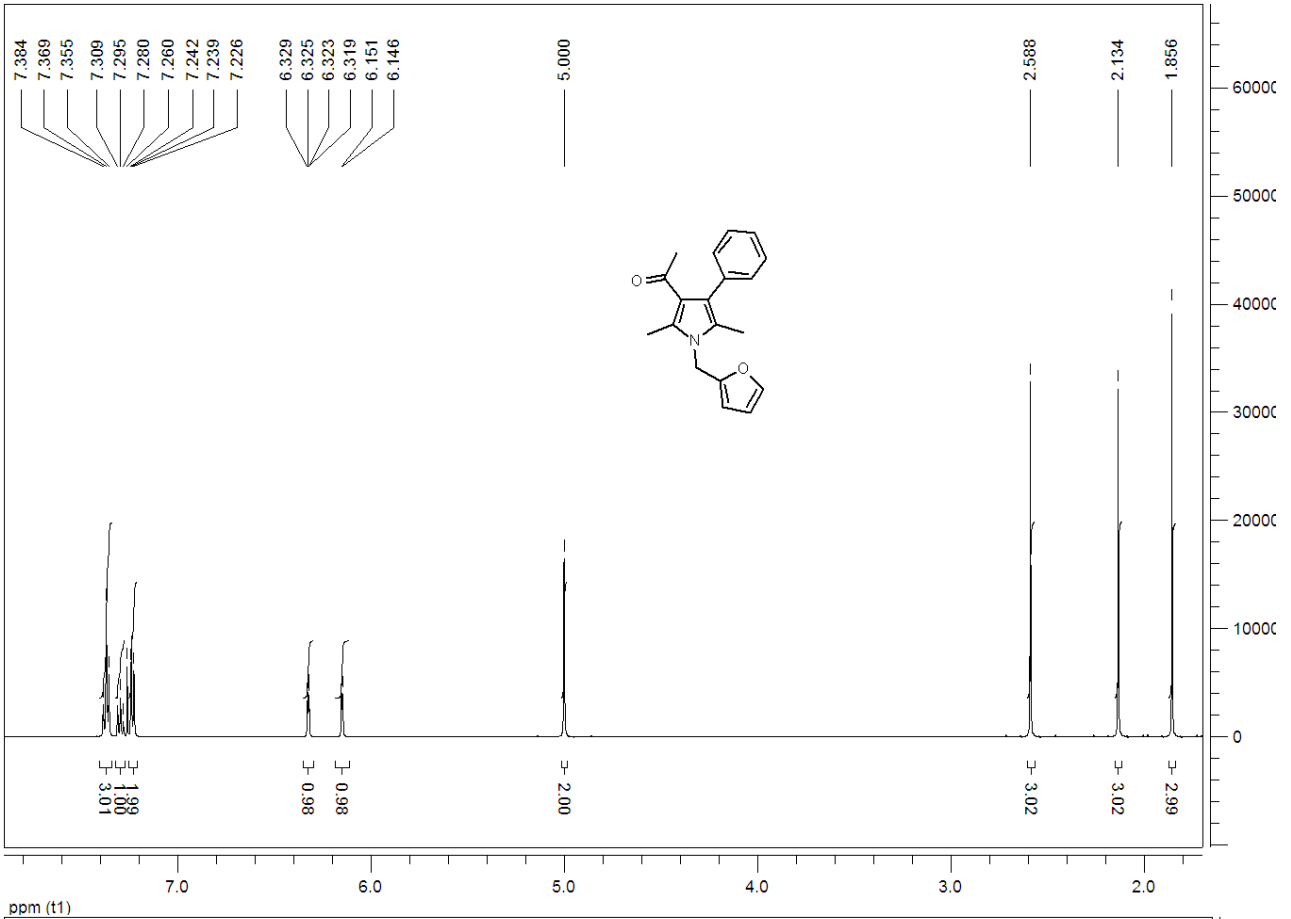
^{1}H NMR and ^{13}C NMR of compound **4z**

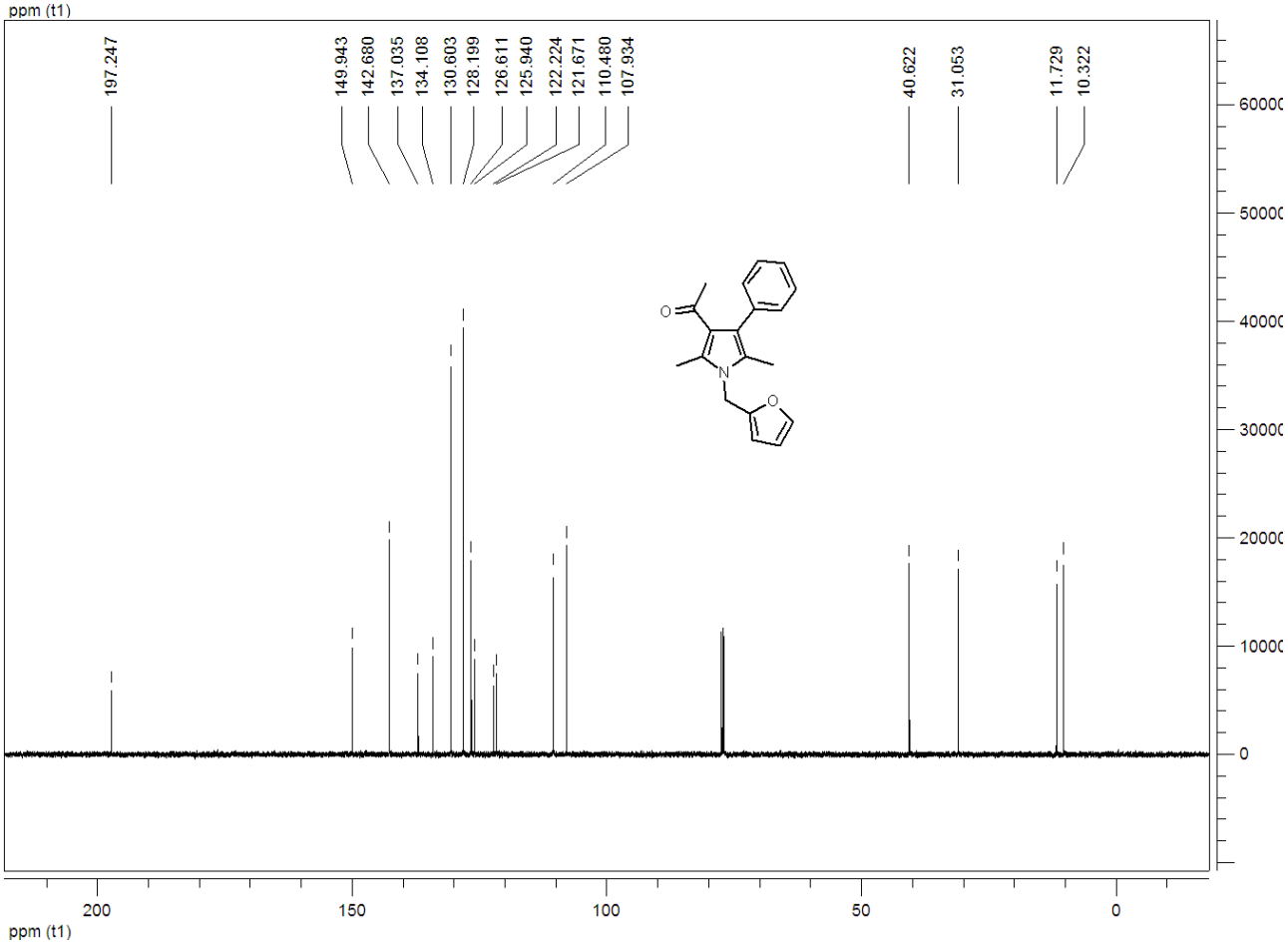


^{1}H NMR and ^{13}C NMR of compound **4aa**

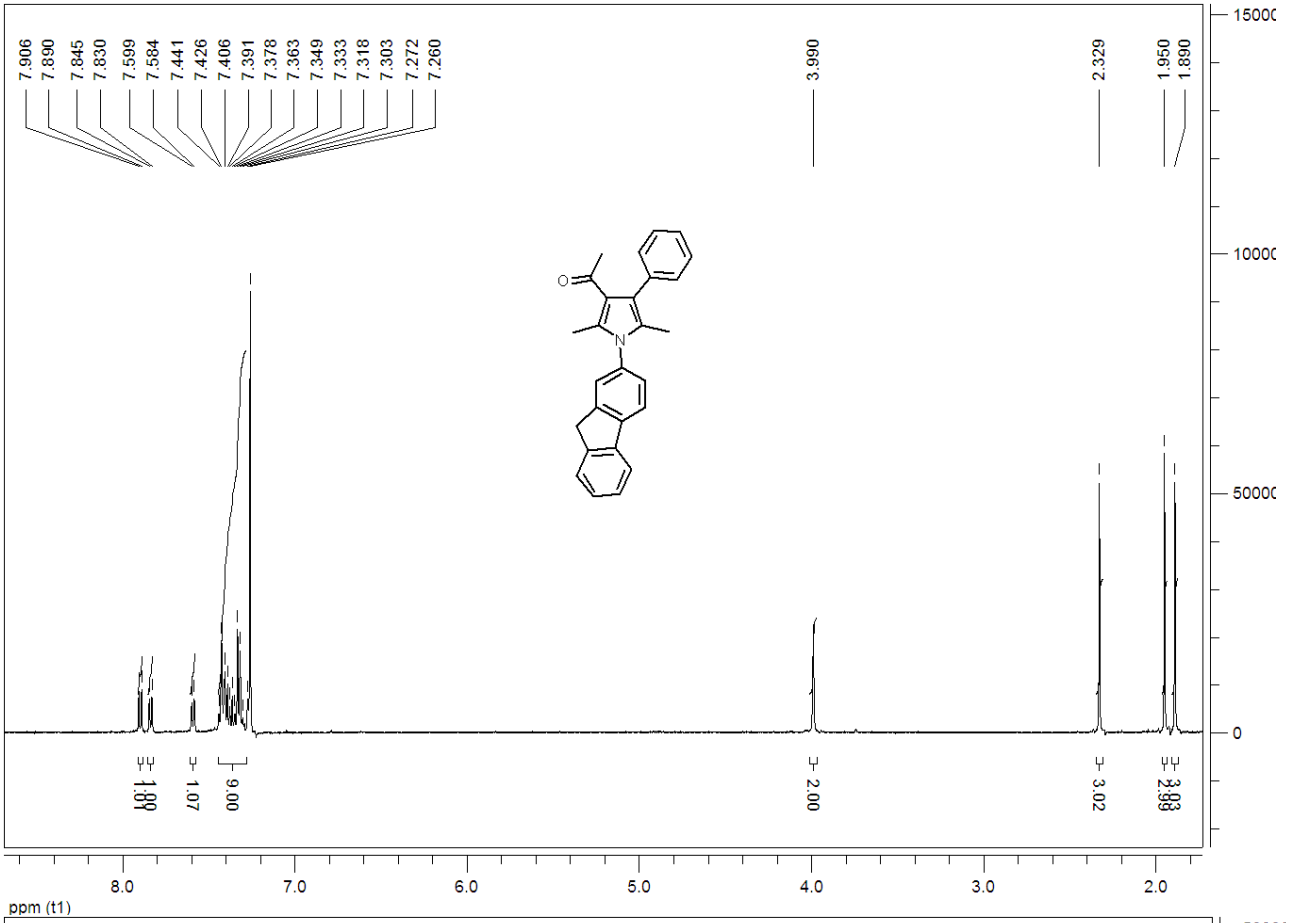


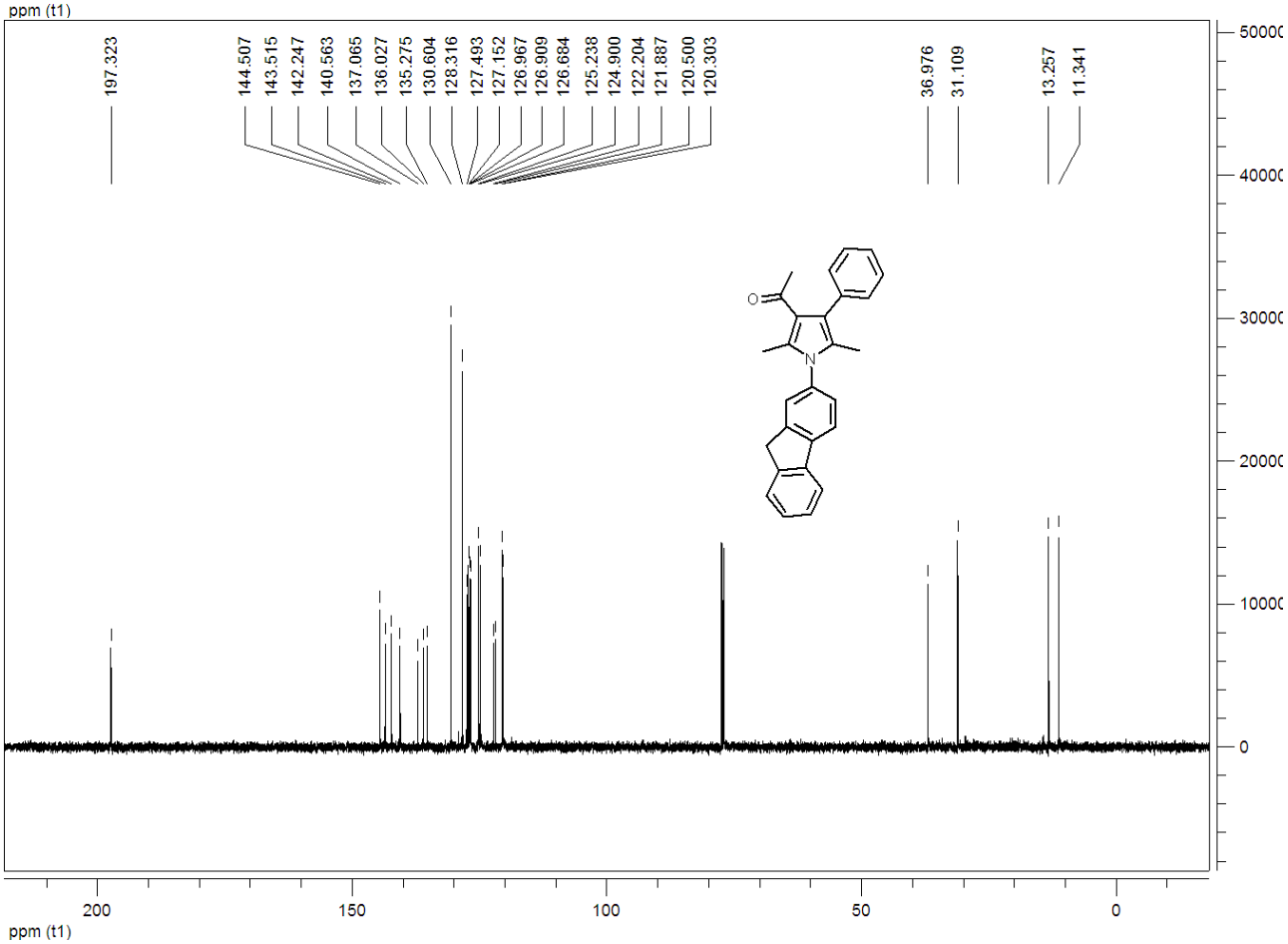
^{1}H NMR and ^{13}C NMR of compound **4ab**



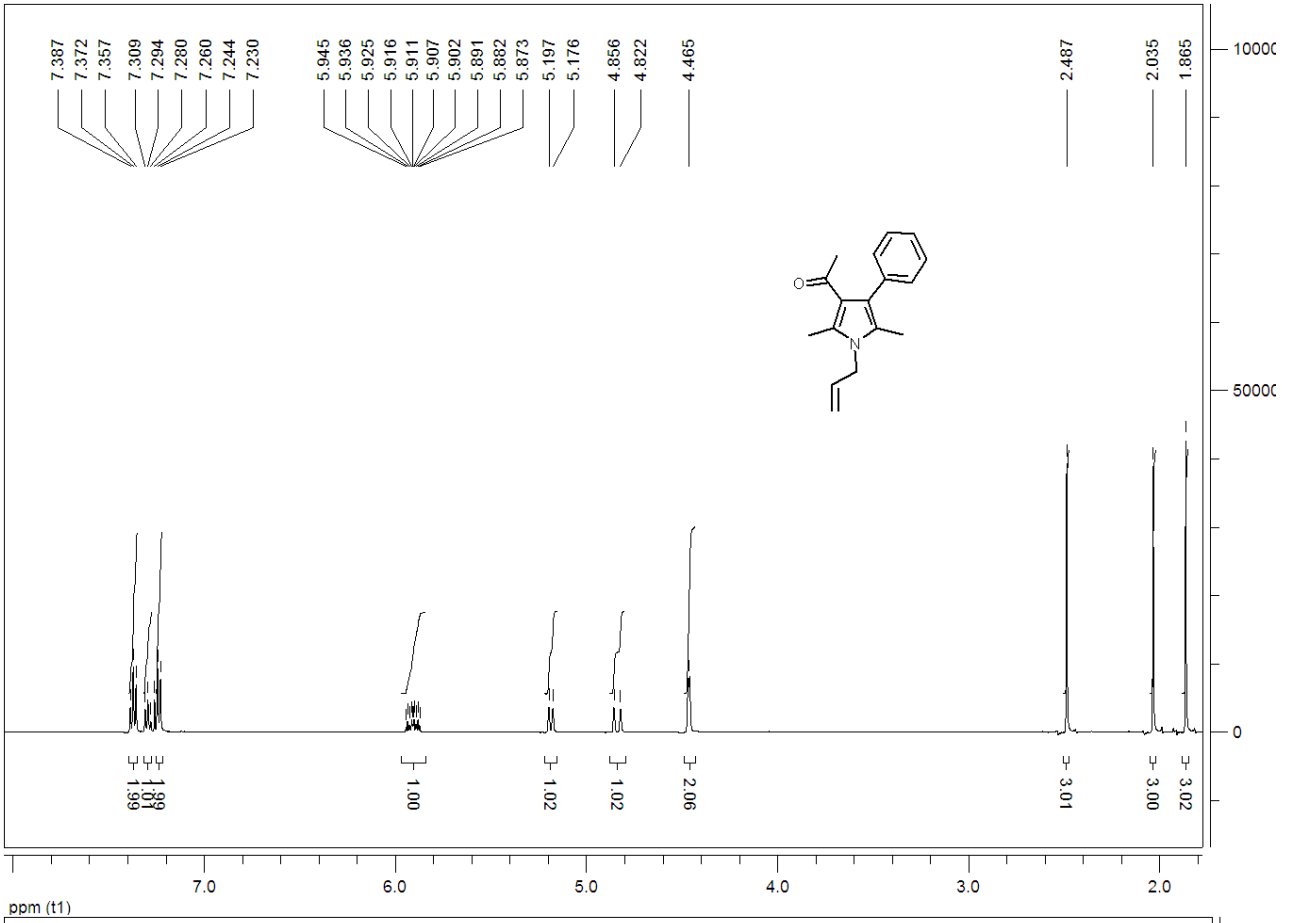


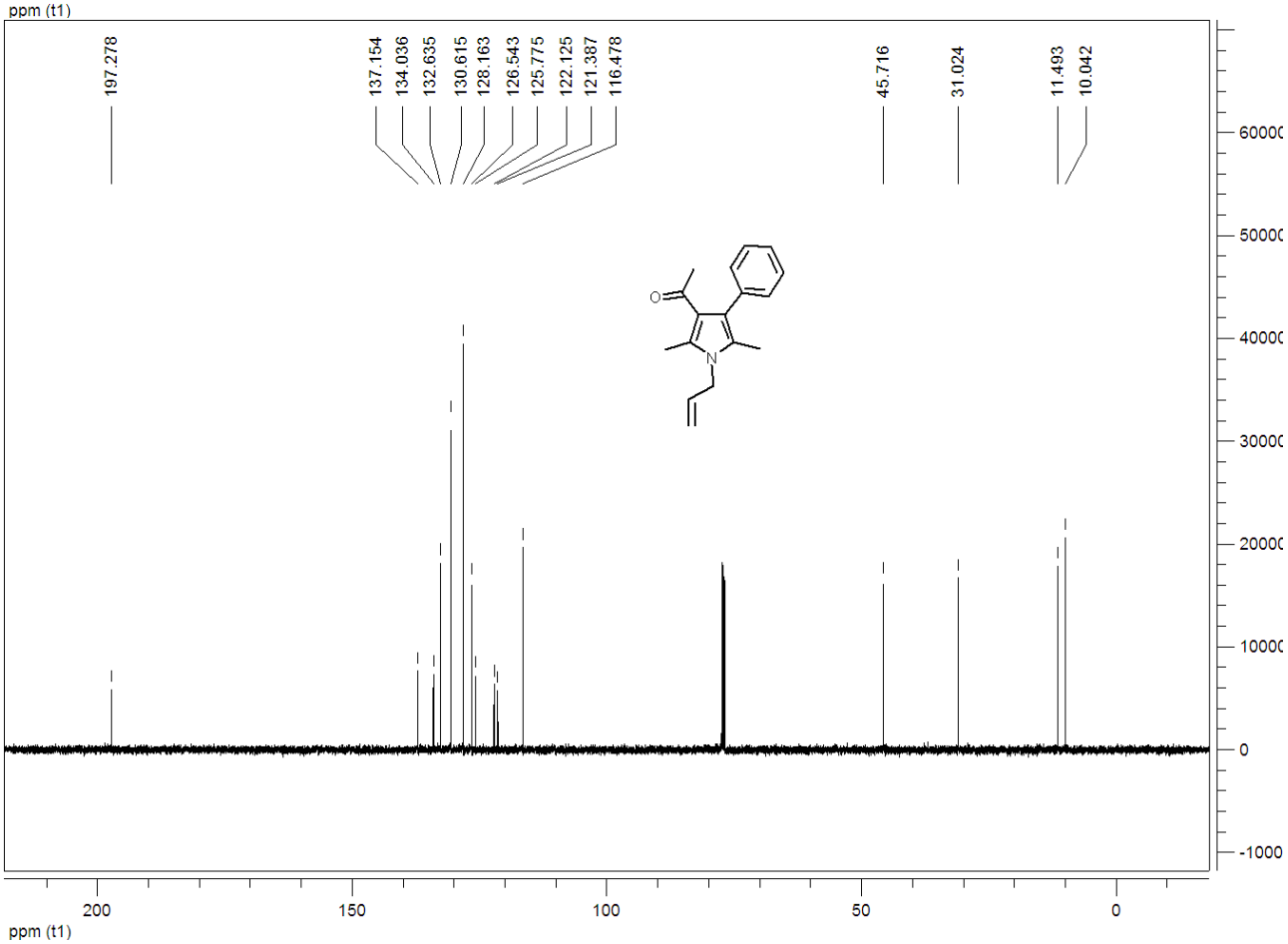
^{1}H NMR and ^{13}C NMR of compound **4ac**



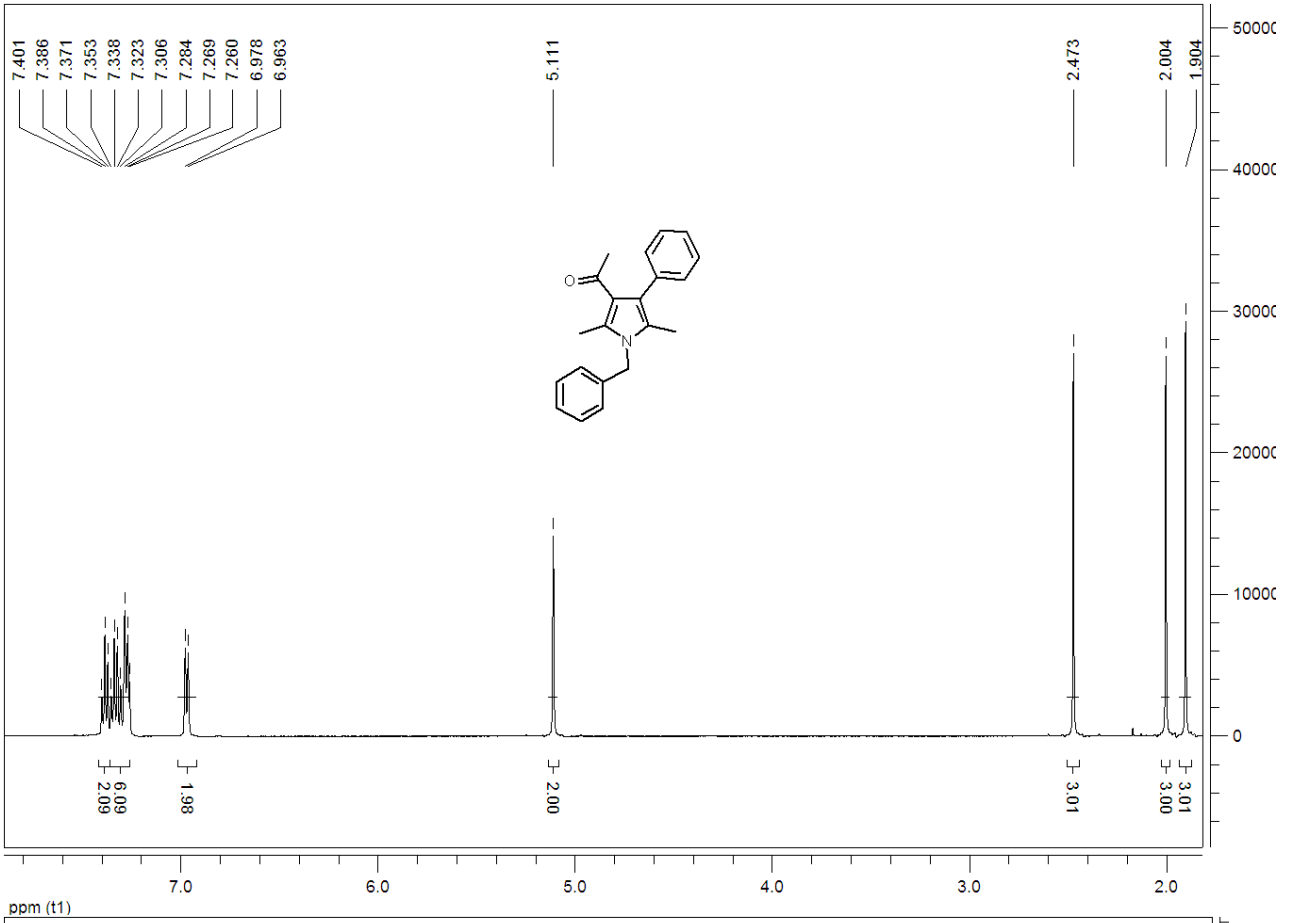


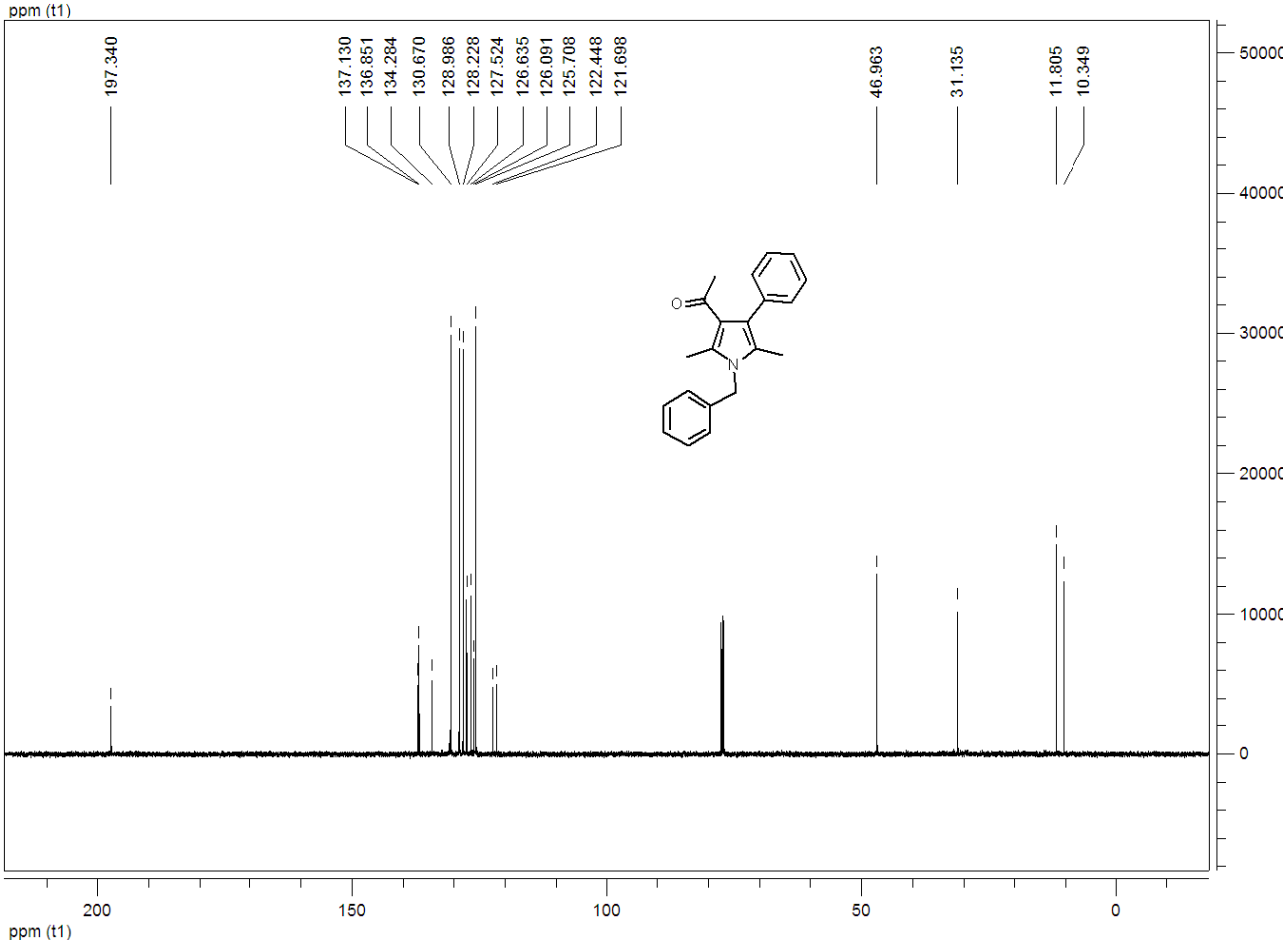
^{1}H NMR and ^{13}C NMR of compound **4ad**



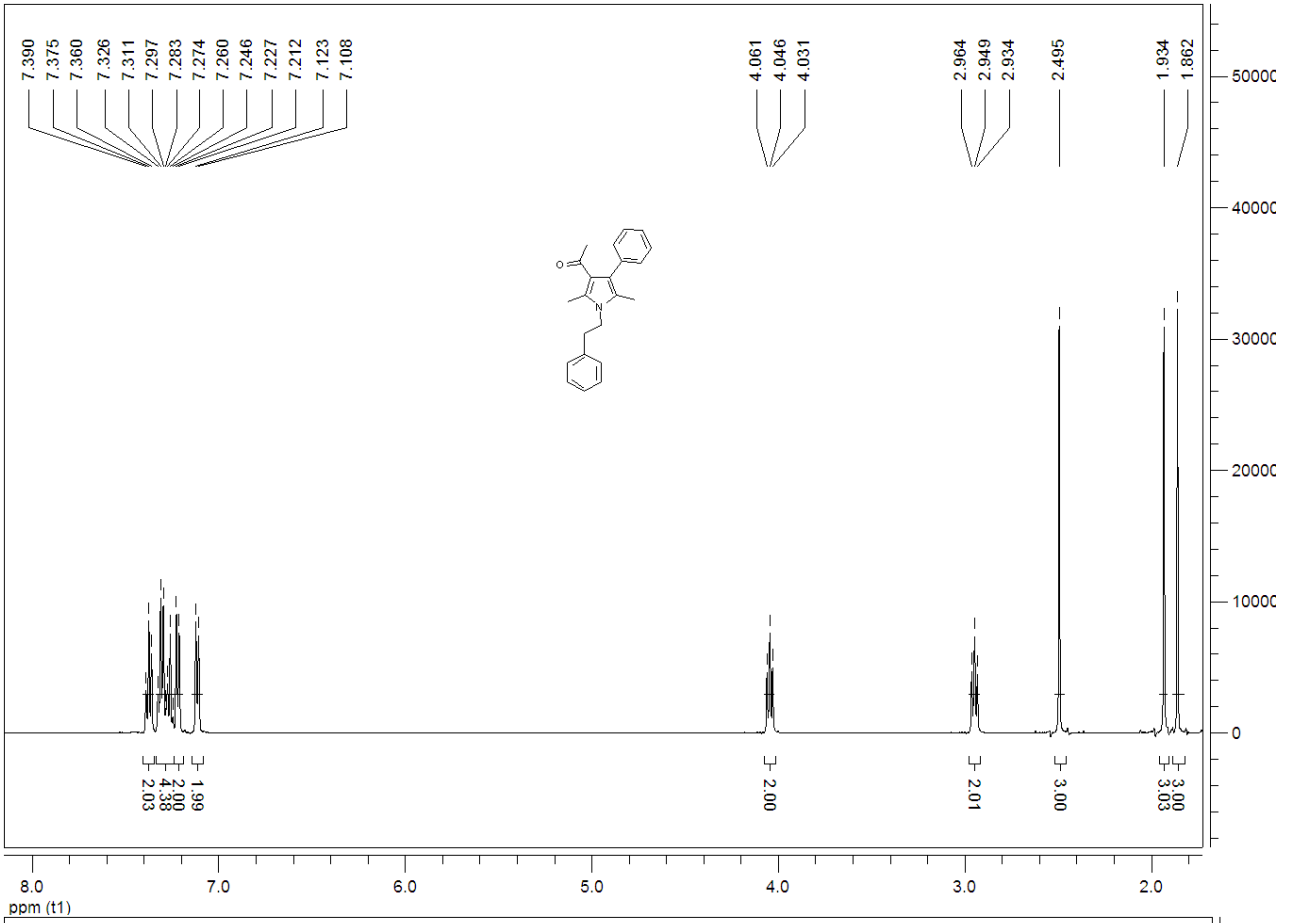


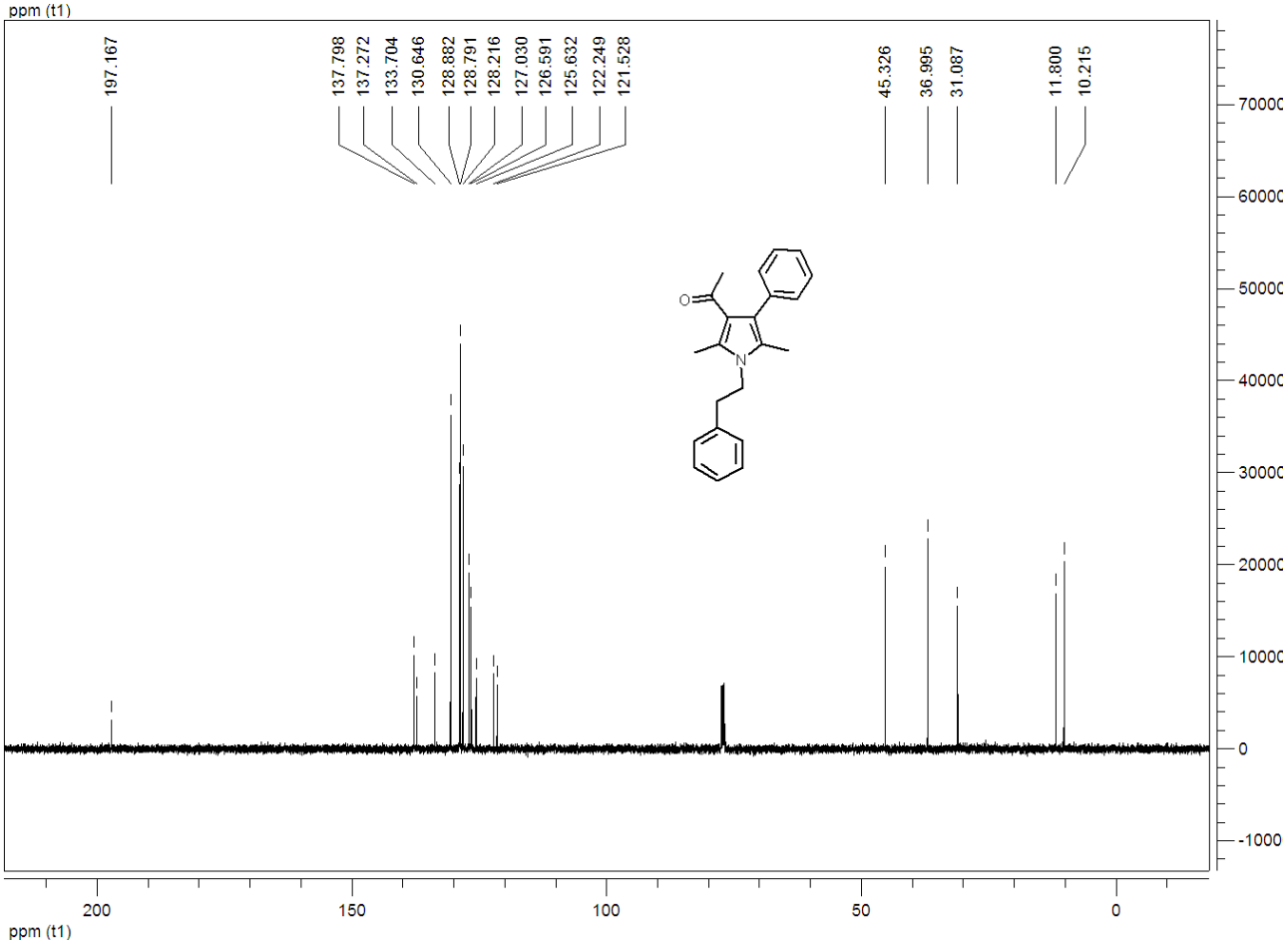
^{1}H NMR and ^{13}C NMR of compound **4ae**



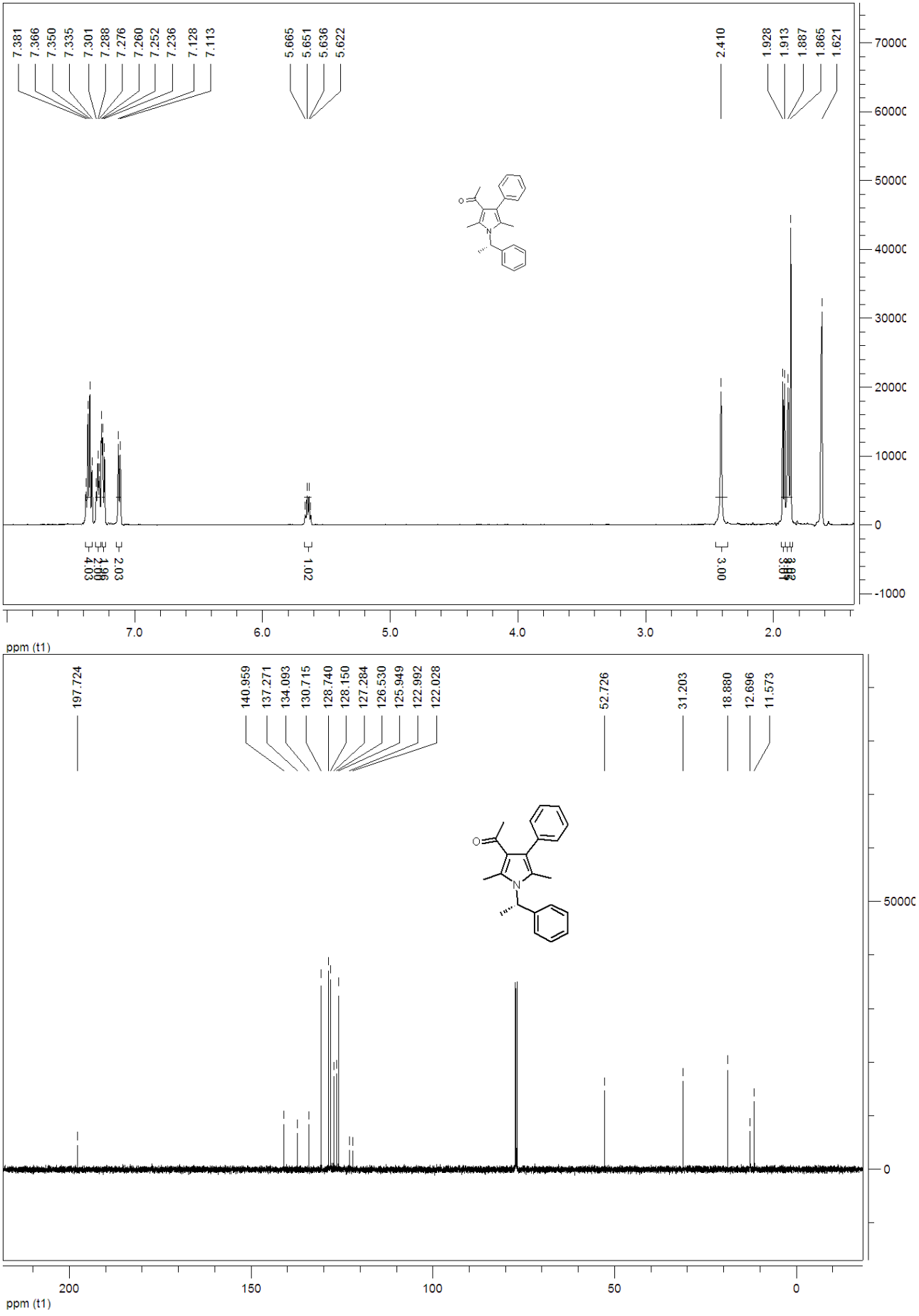


^{1}H NMR and ^{13}C NMR of compound **4af**

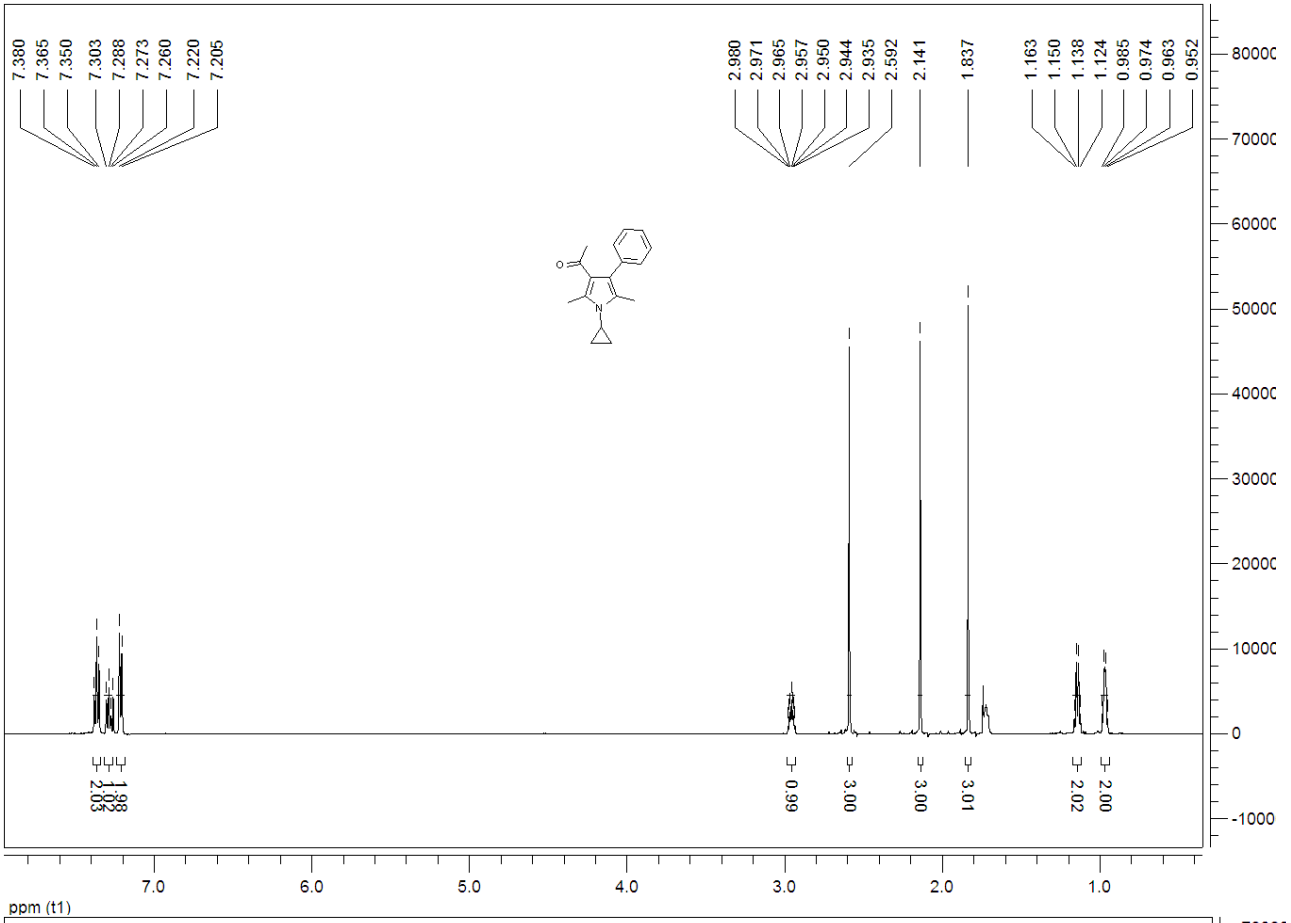


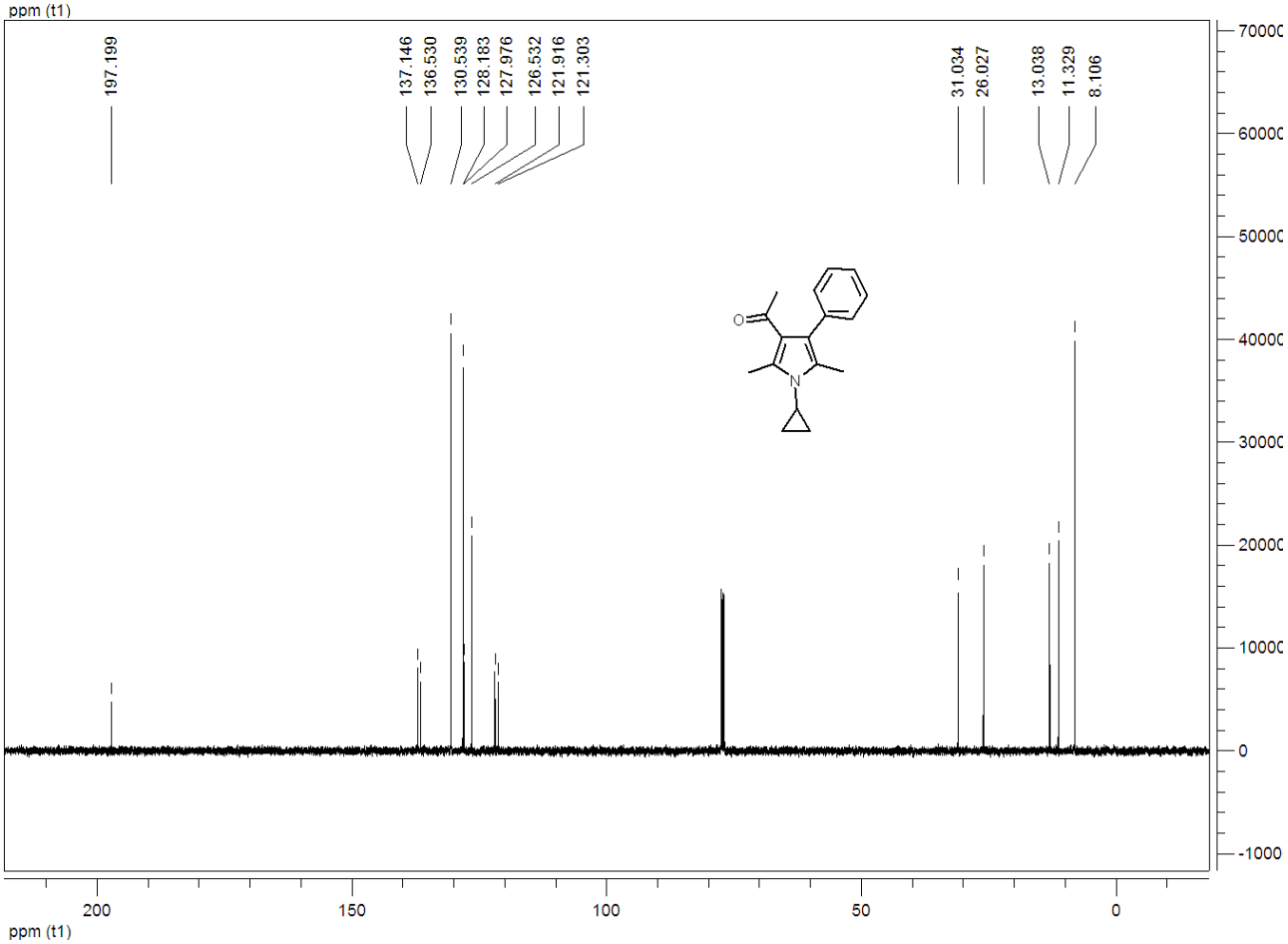


^{1}H NMR and ^{13}C NMR of compound **4ag**

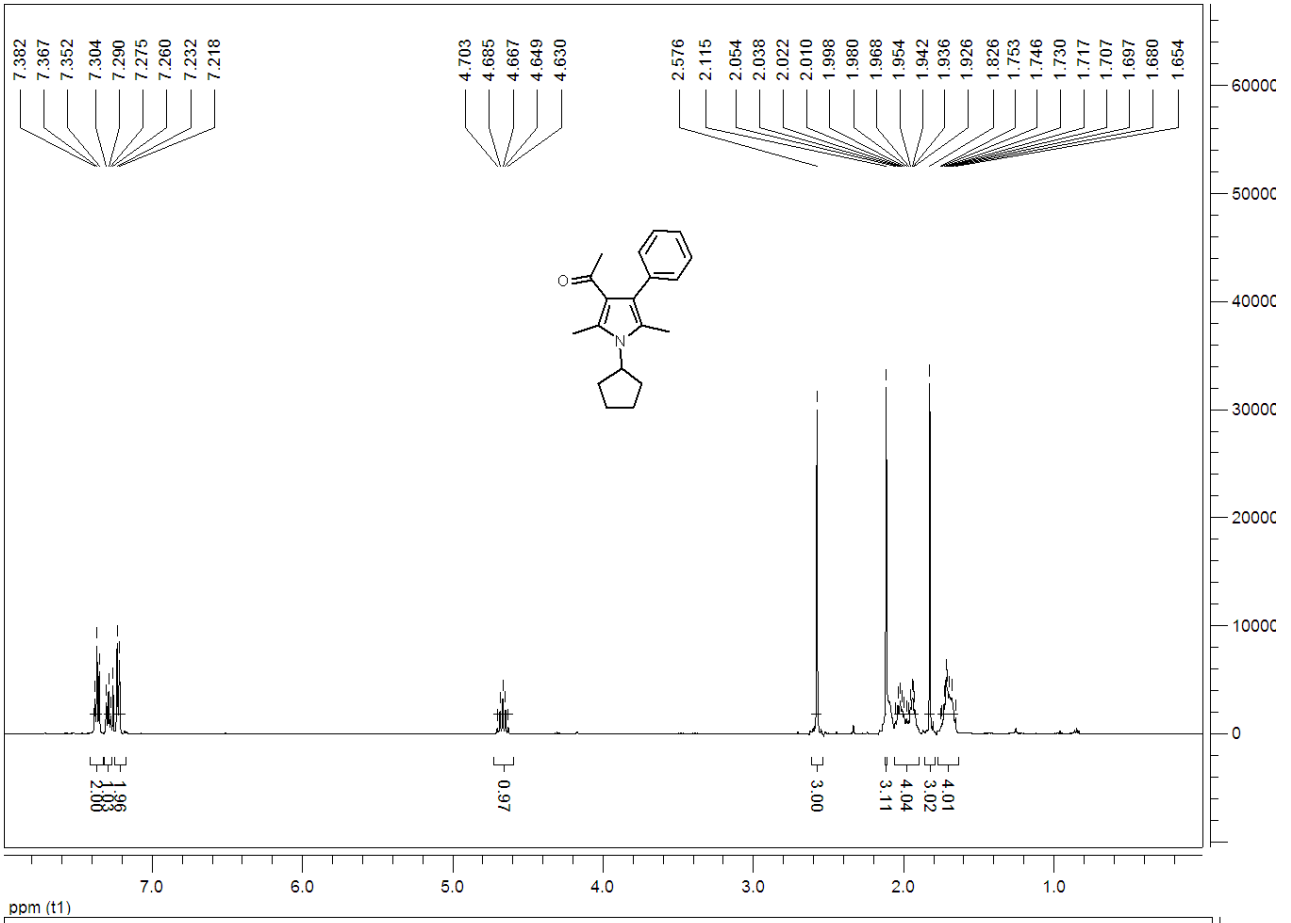


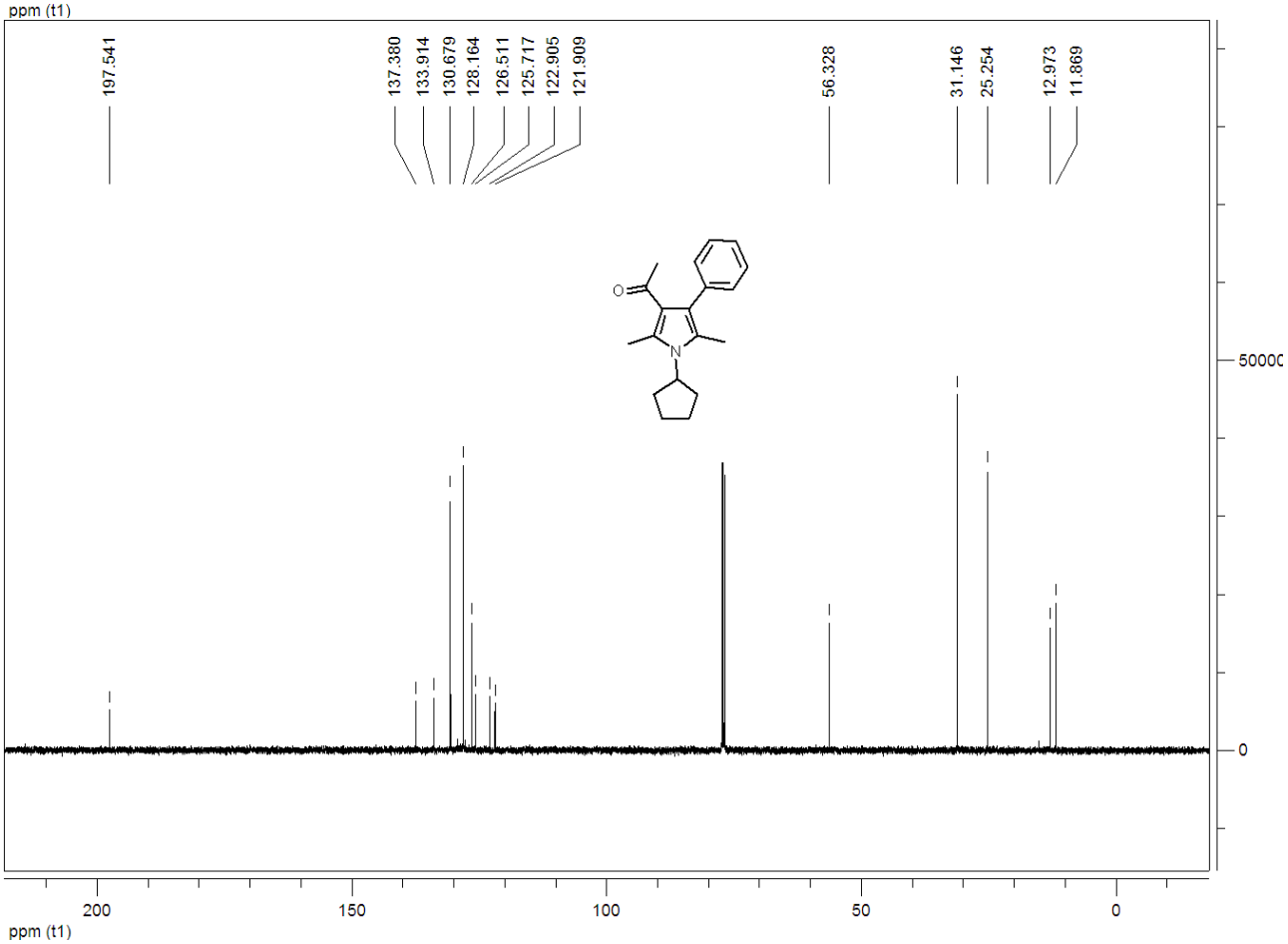
^{1}H NMR and ^{13}C NMR of compound **4ah**



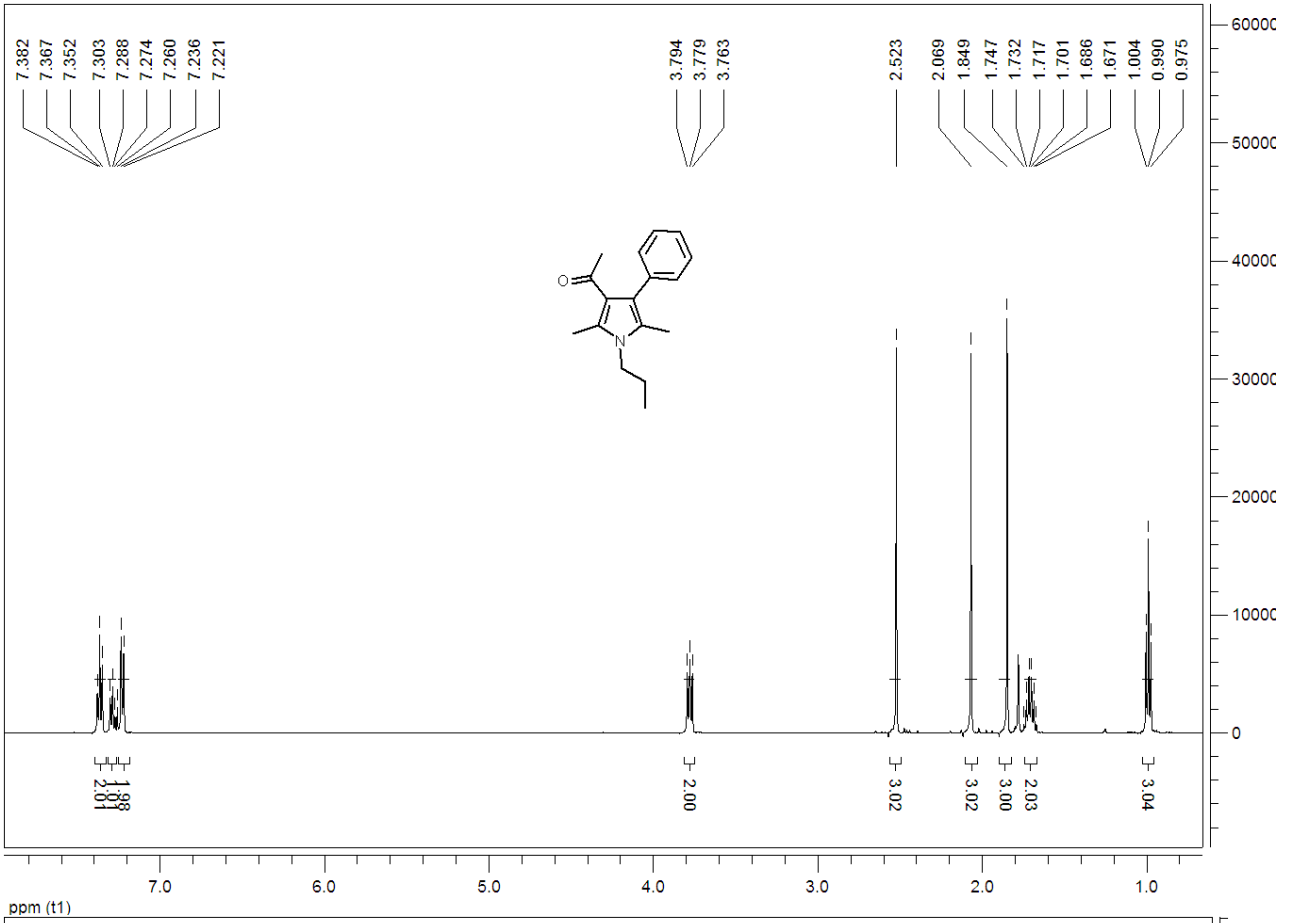


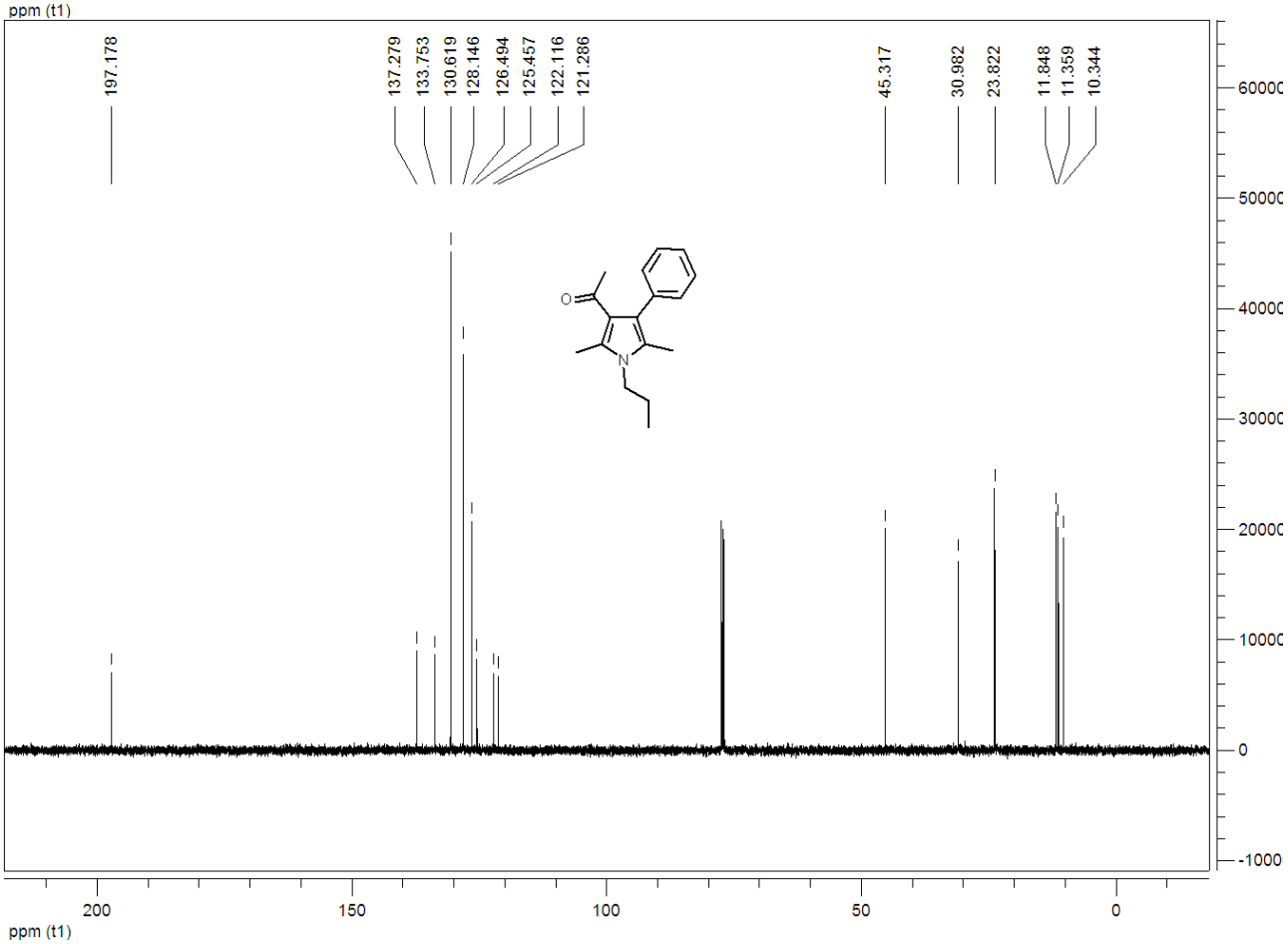
^{1}H NMR and ^{13}C NMR of compound **4ai**



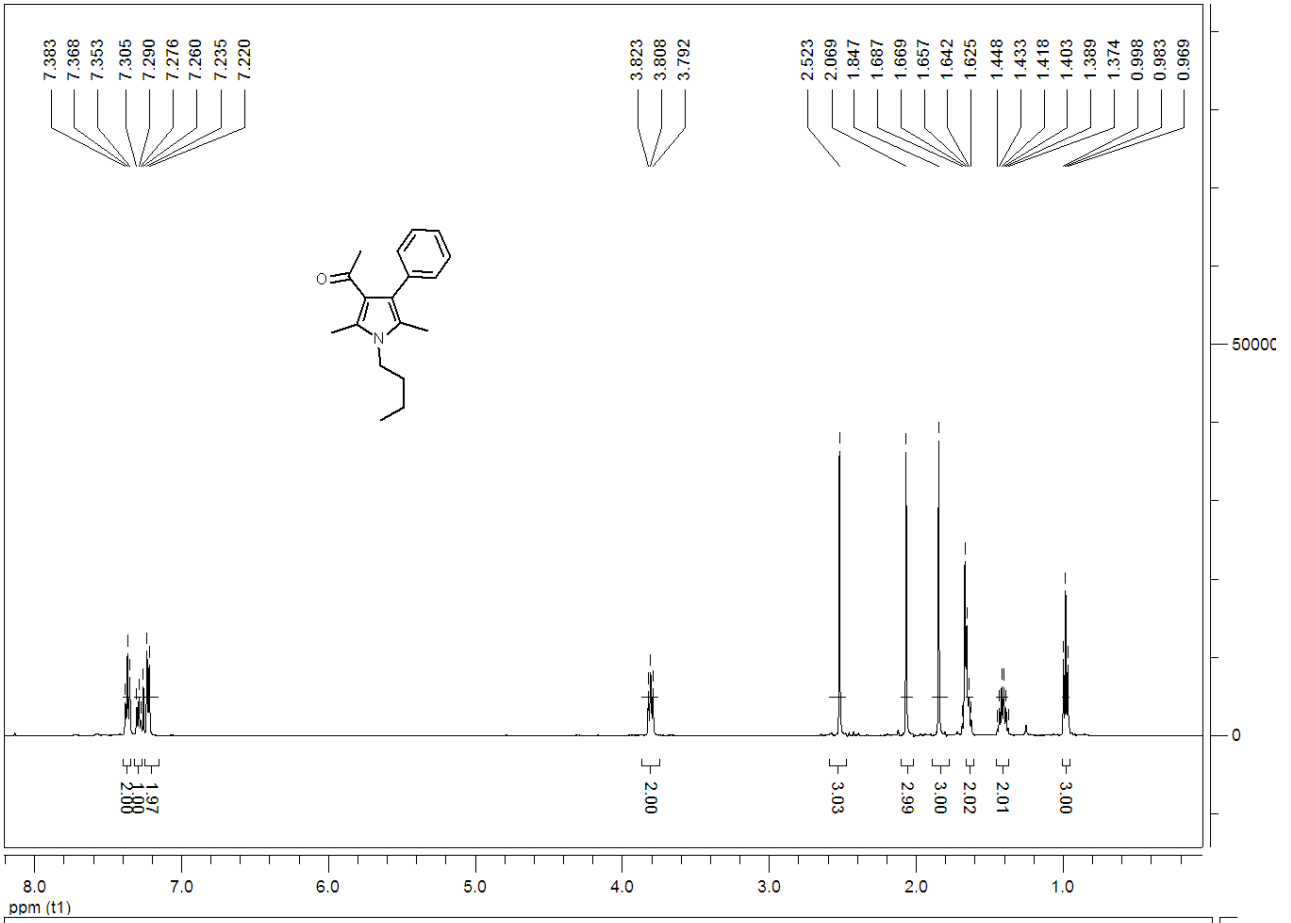


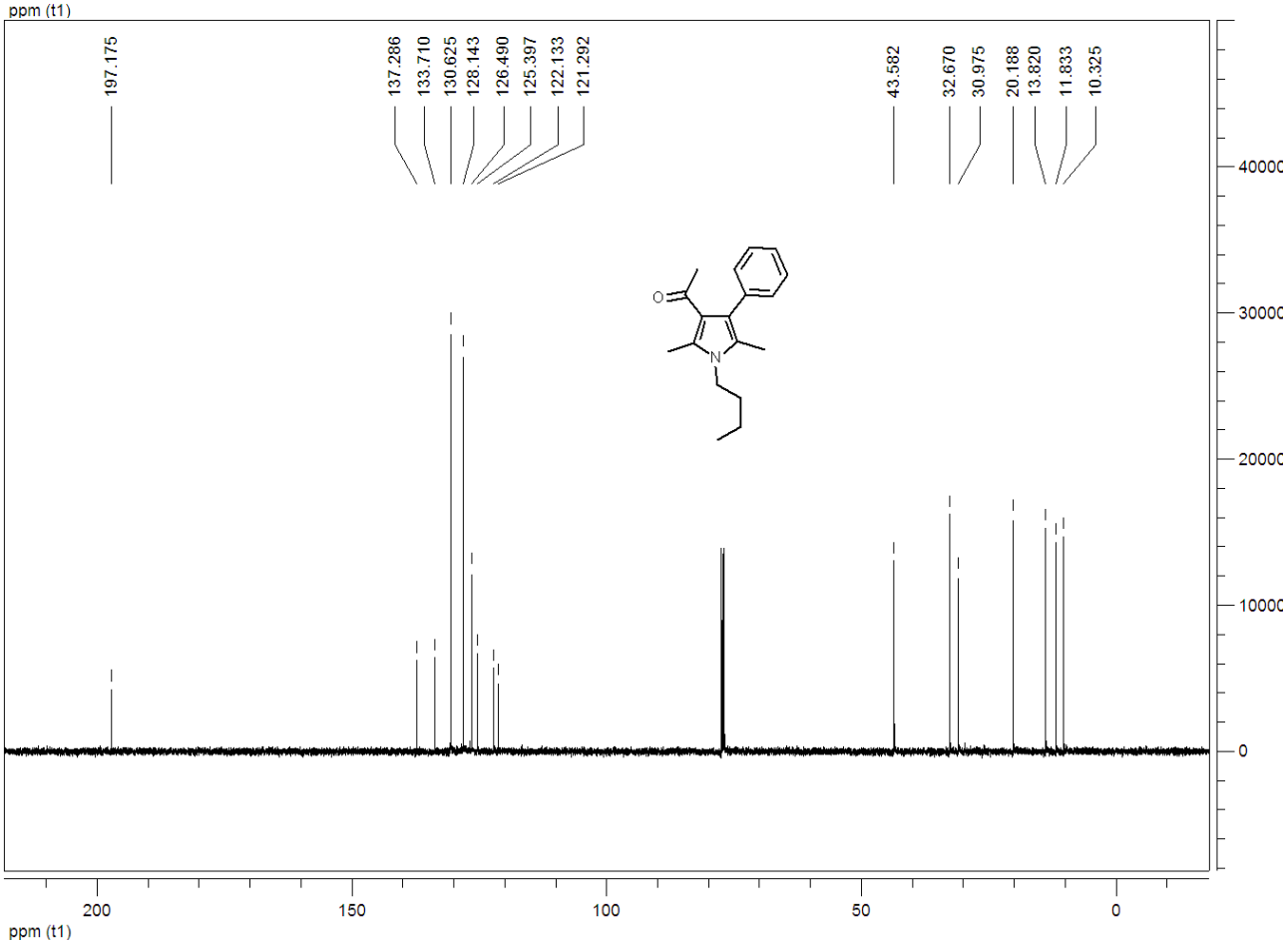
^{1}H NMR and ^{13}C NMR of compound **4aj**



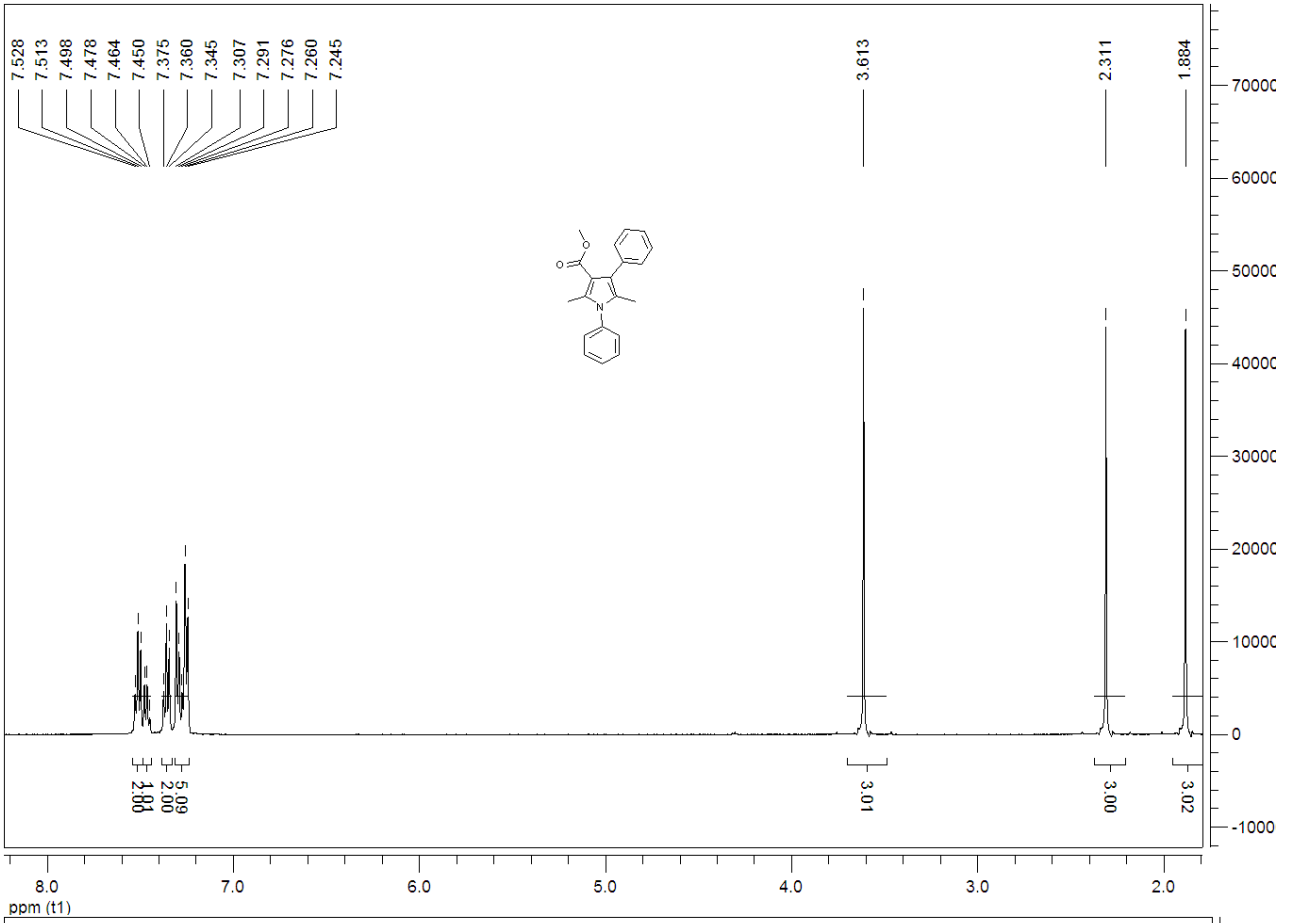


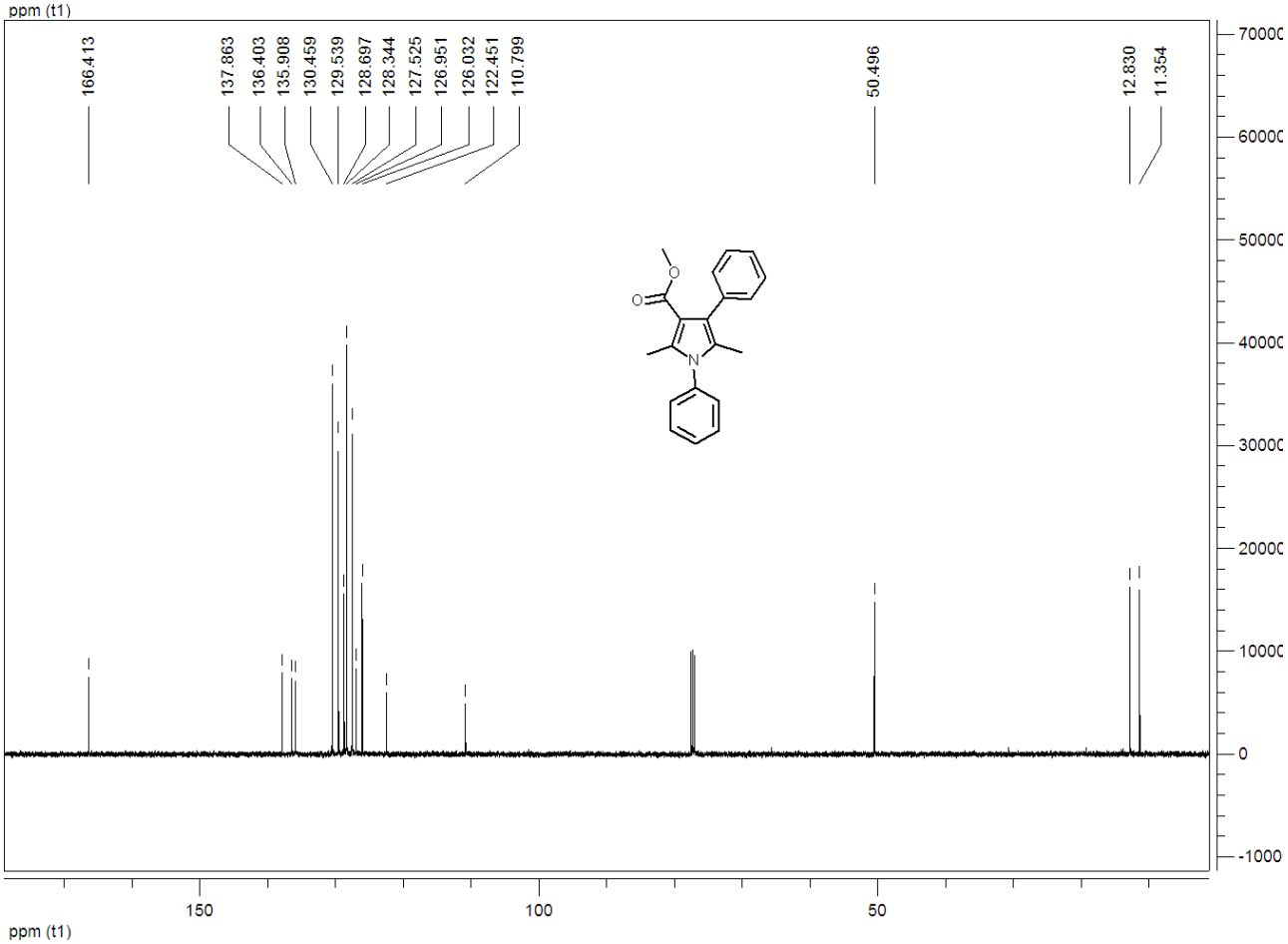
^{1}H NMR and ^{13}C NMR of compound **4ak**



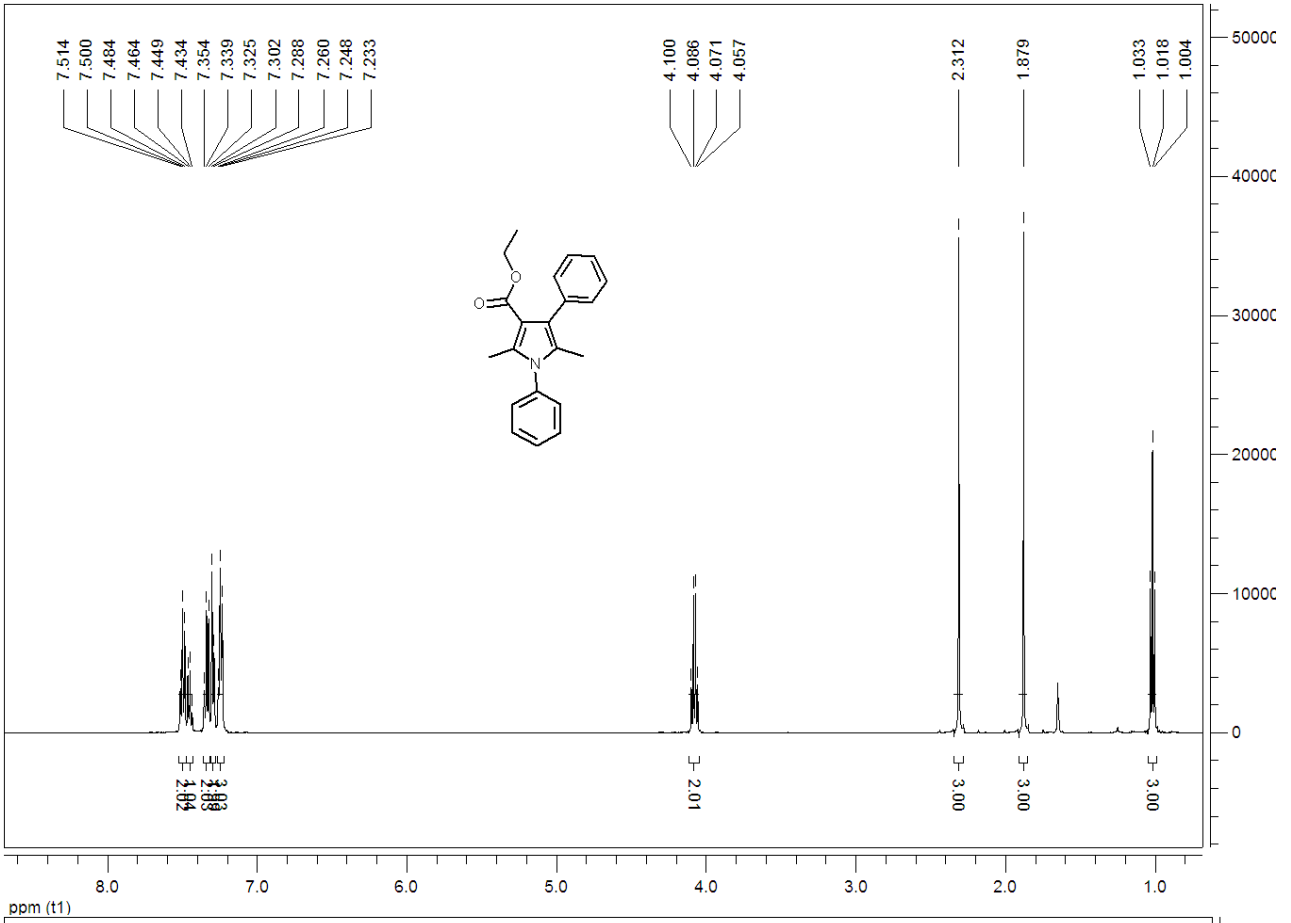


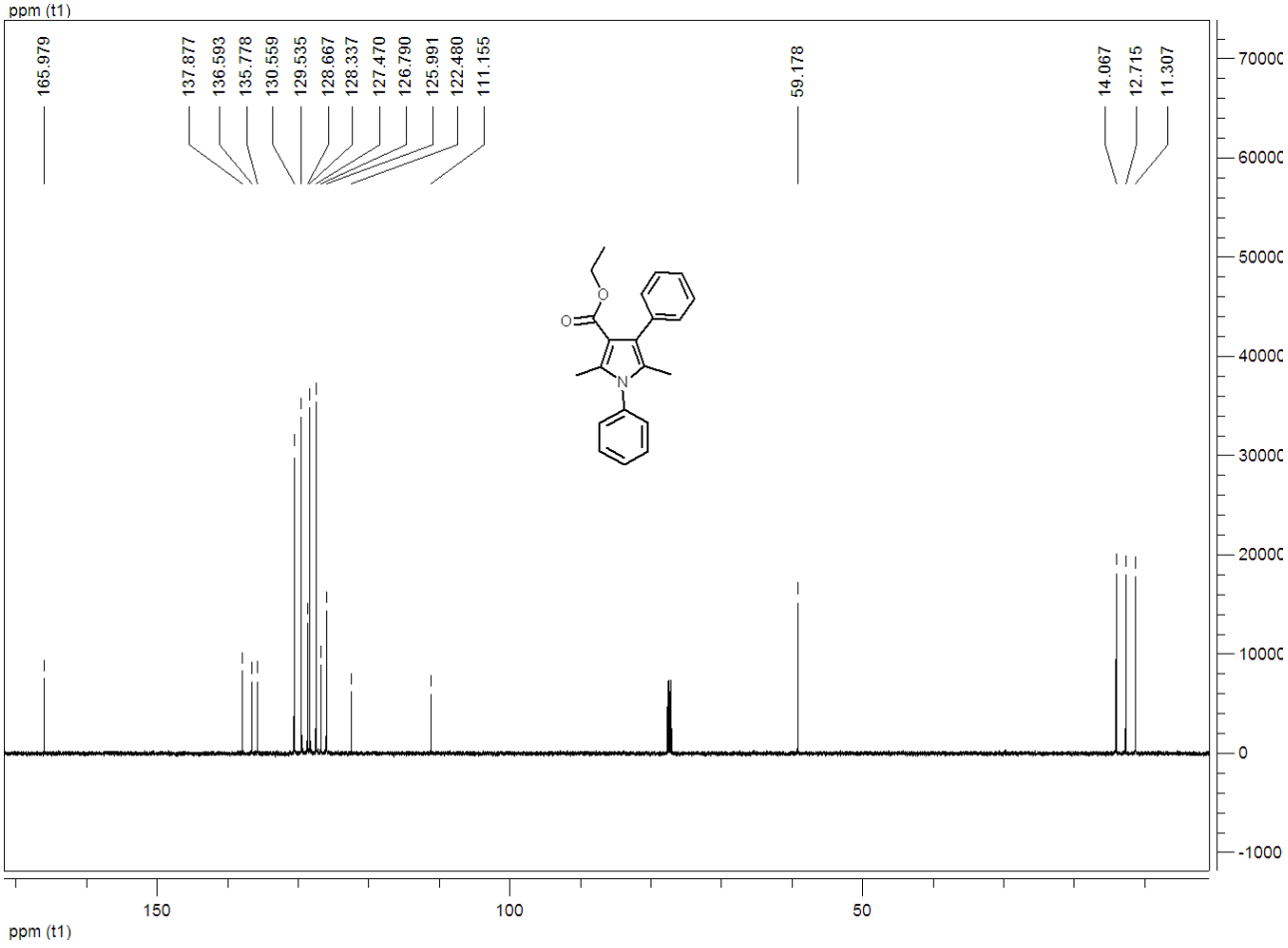
^{1}H NMR and ^{13}C NMR of compound **4al**



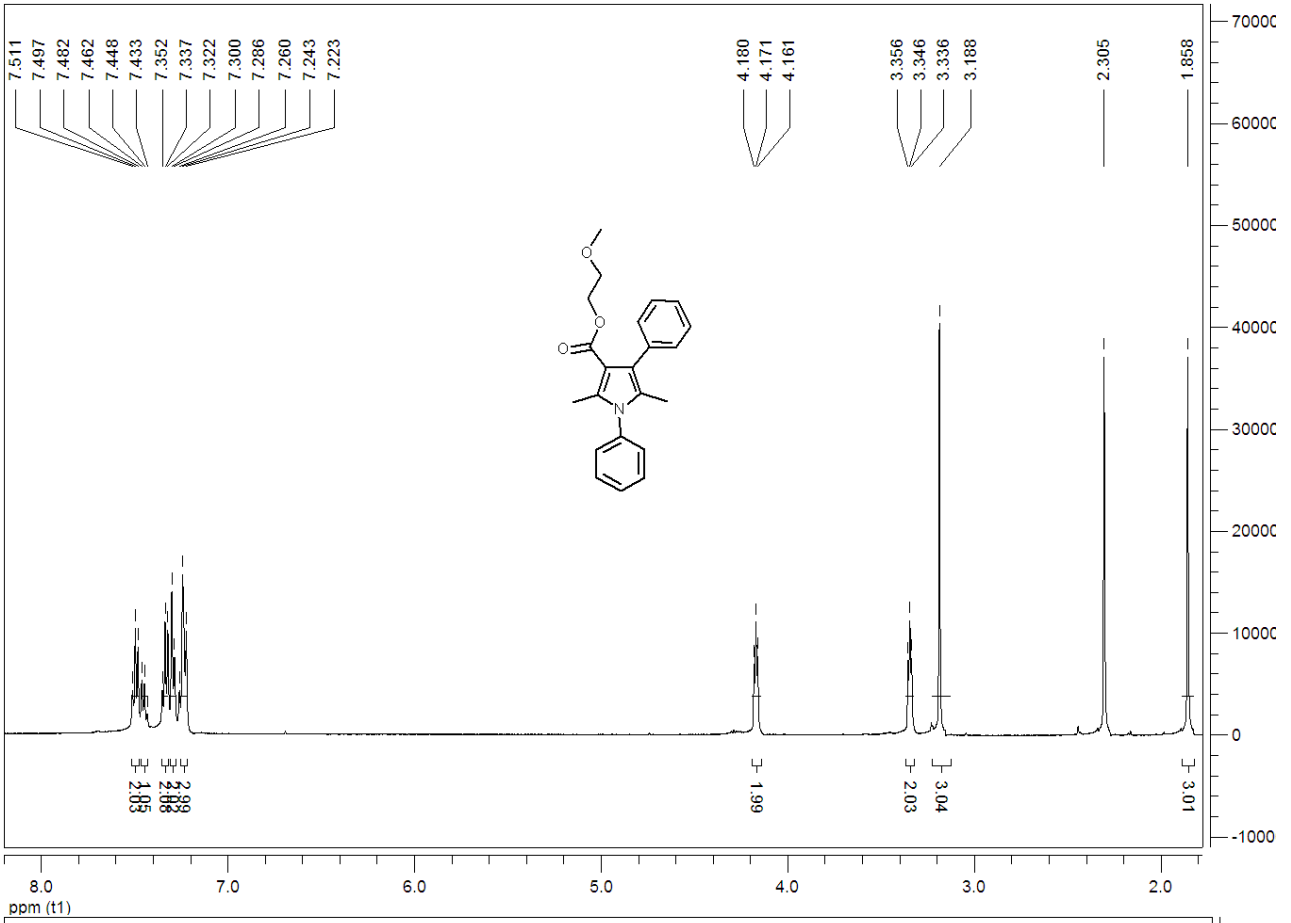


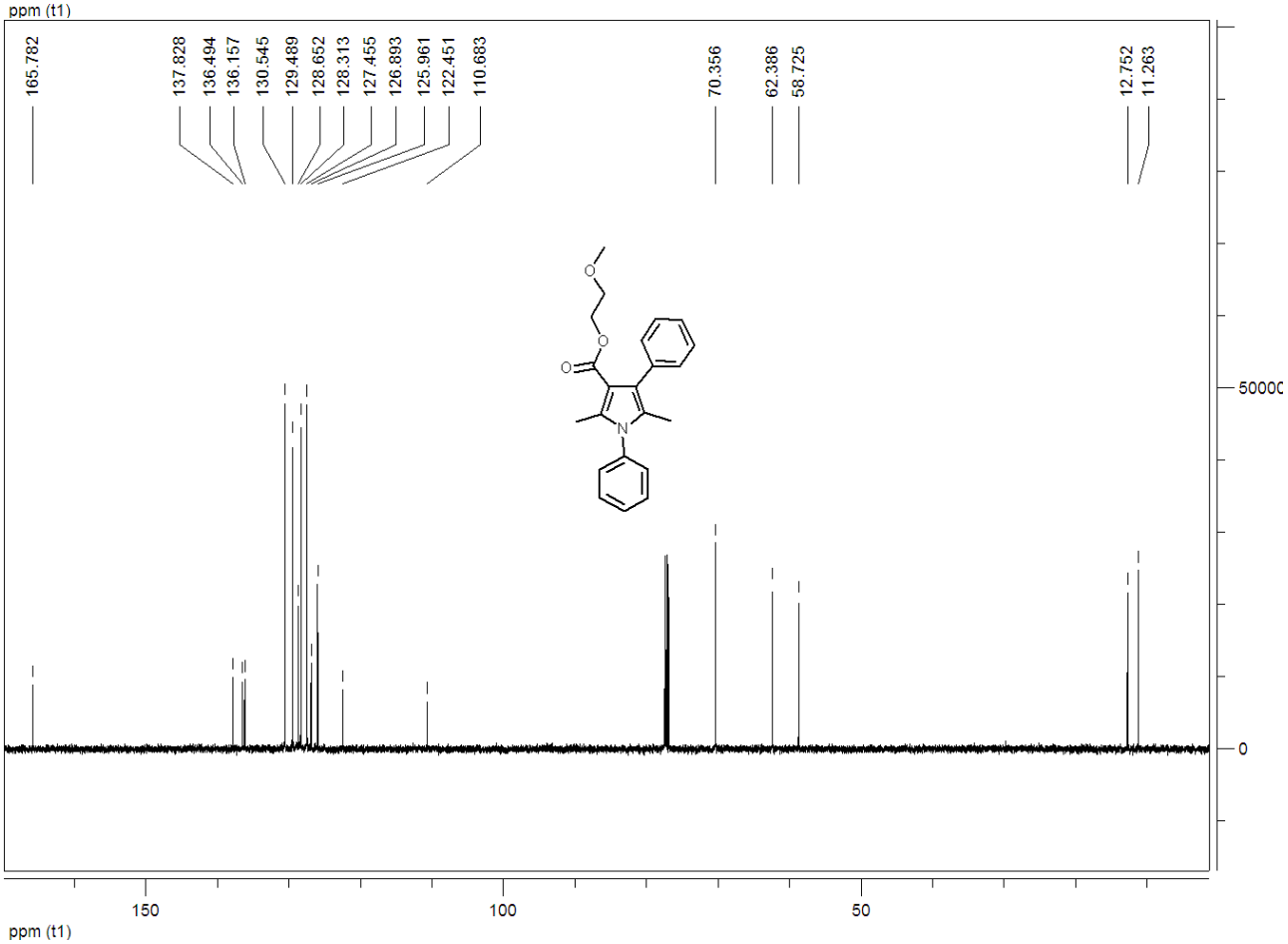
^{1}H NMR and ^{13}C NMR of compound **4am**



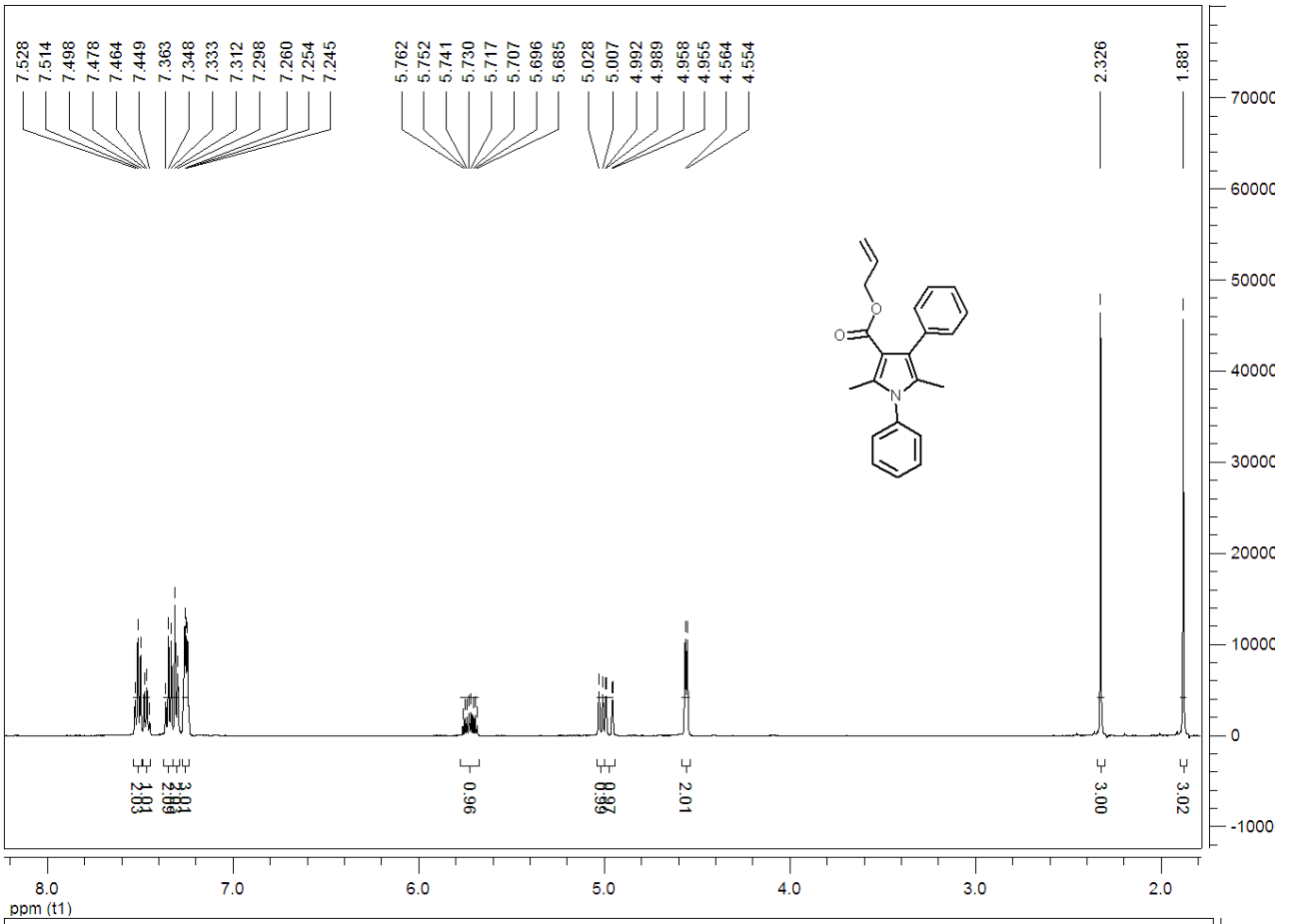


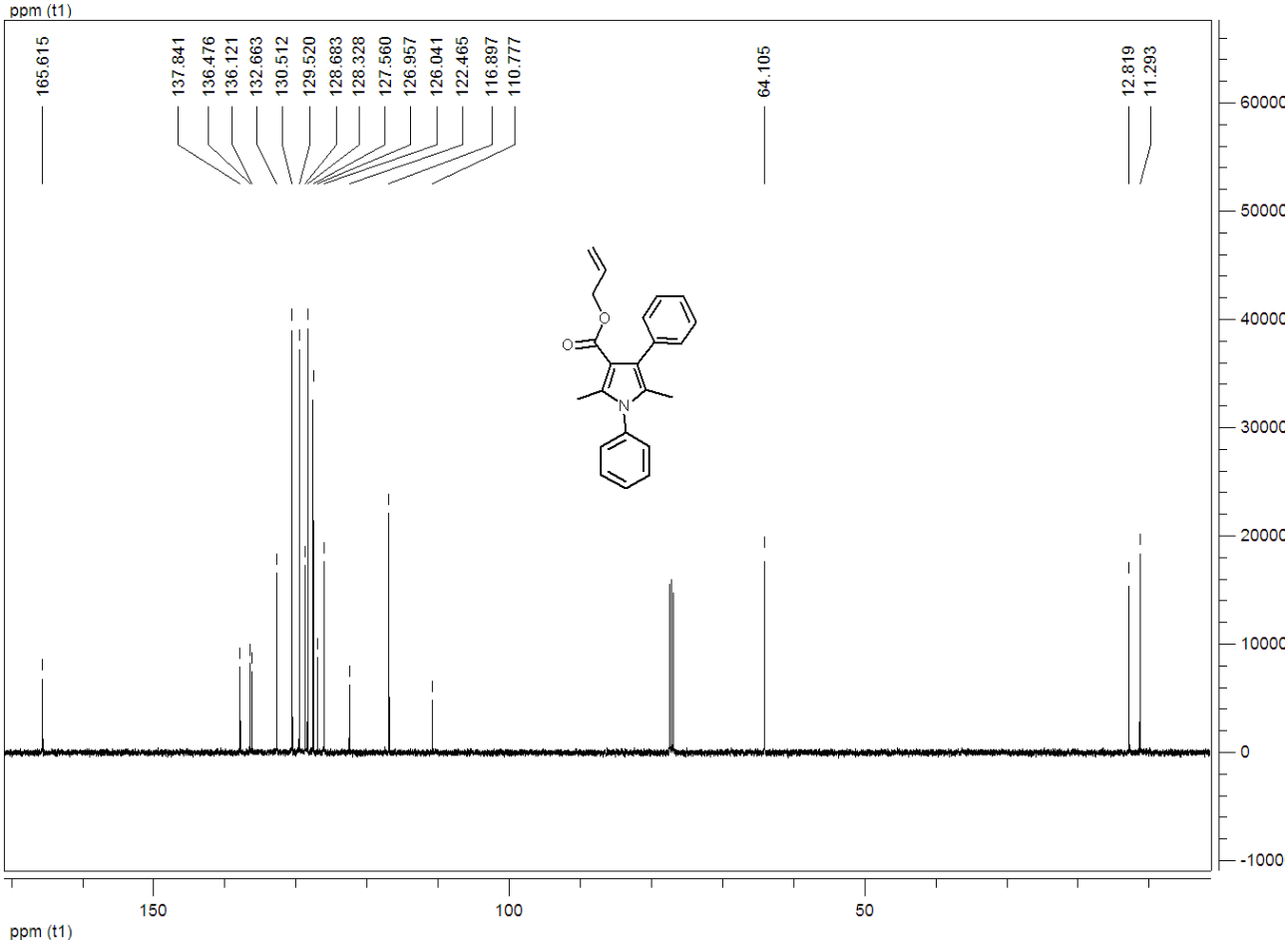
^{1}H NMR and ^{13}C NMR of compound **4an**



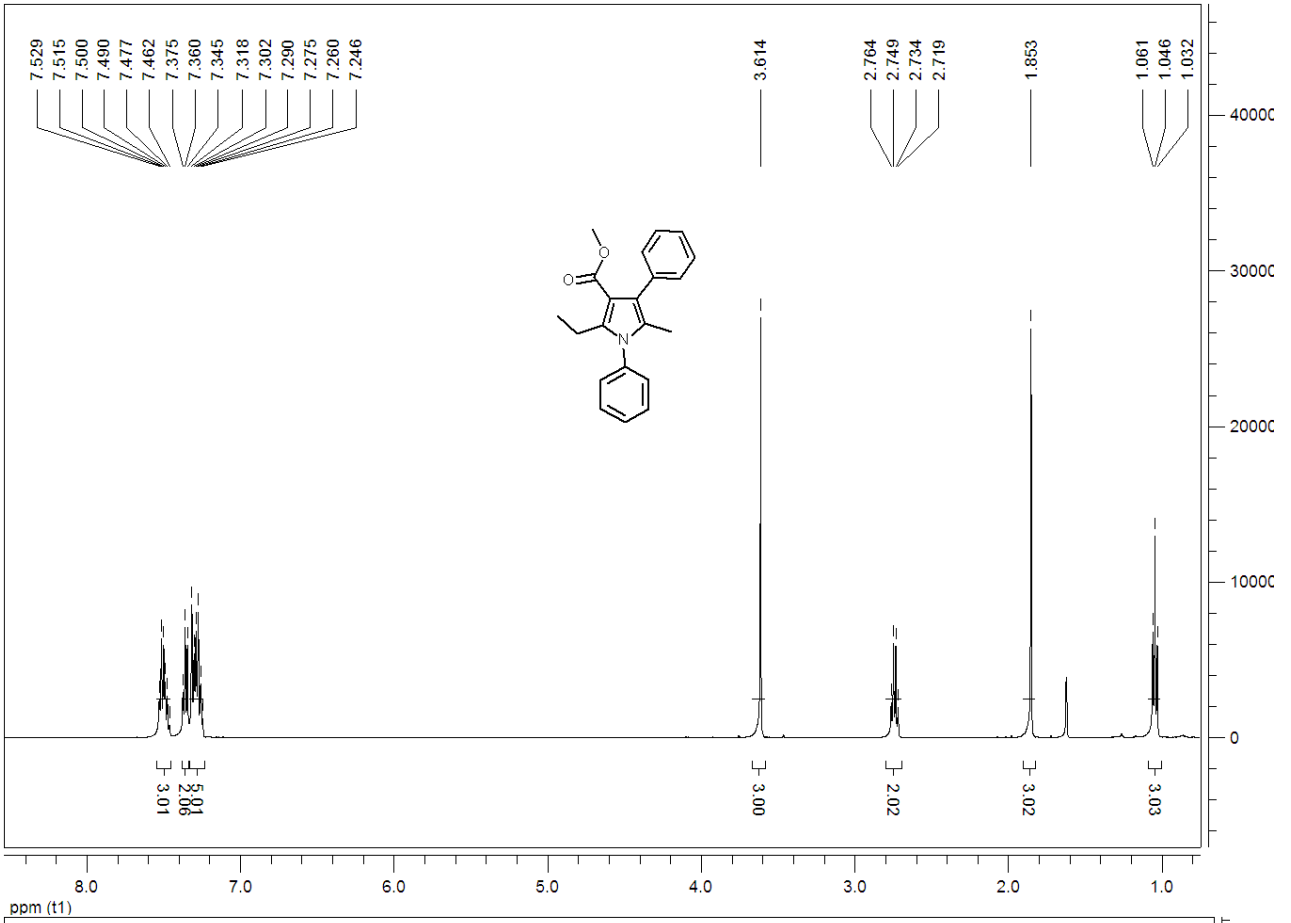


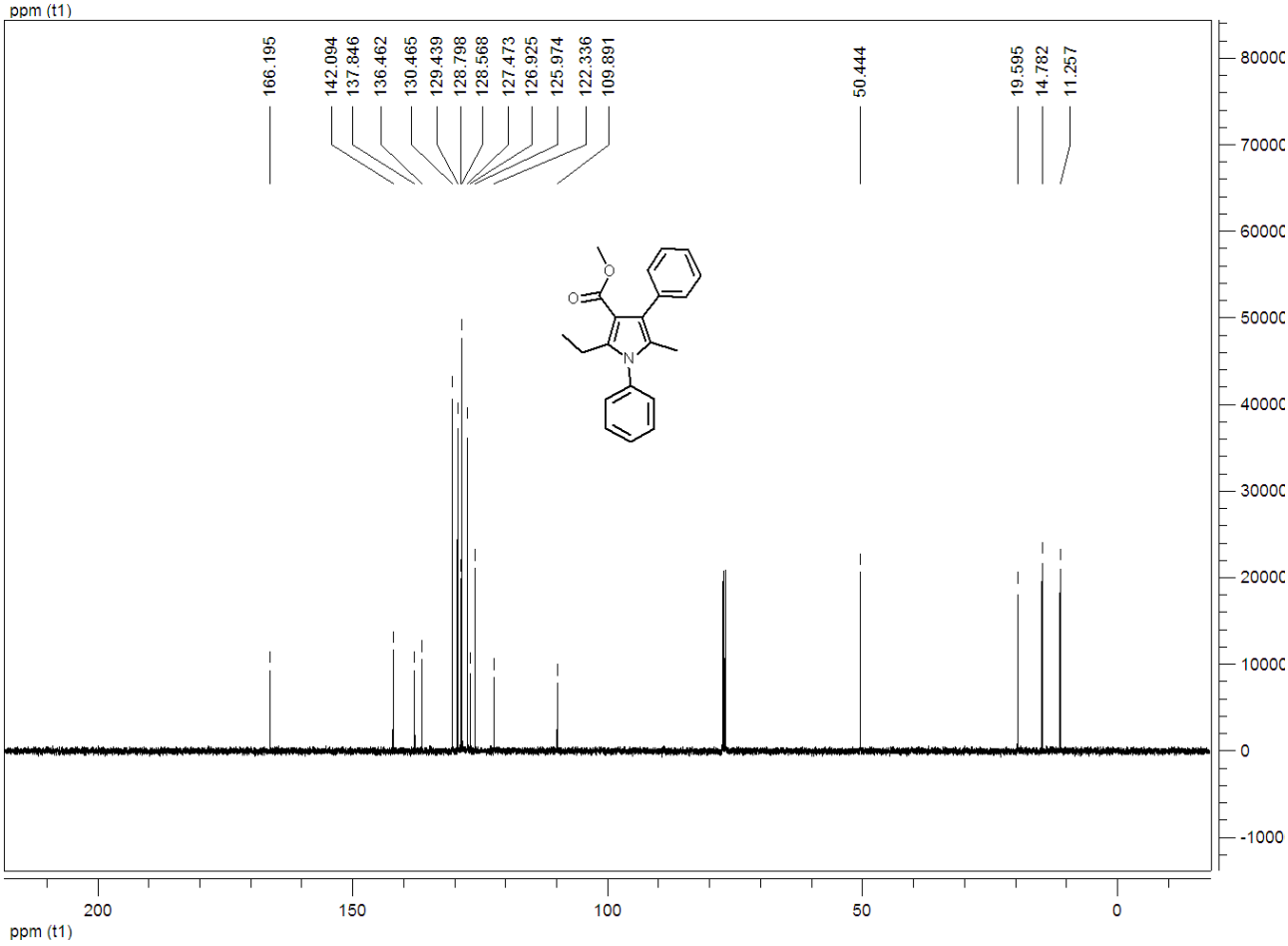
^{1}H NMR and ^{13}C NMR of compound **4ao**



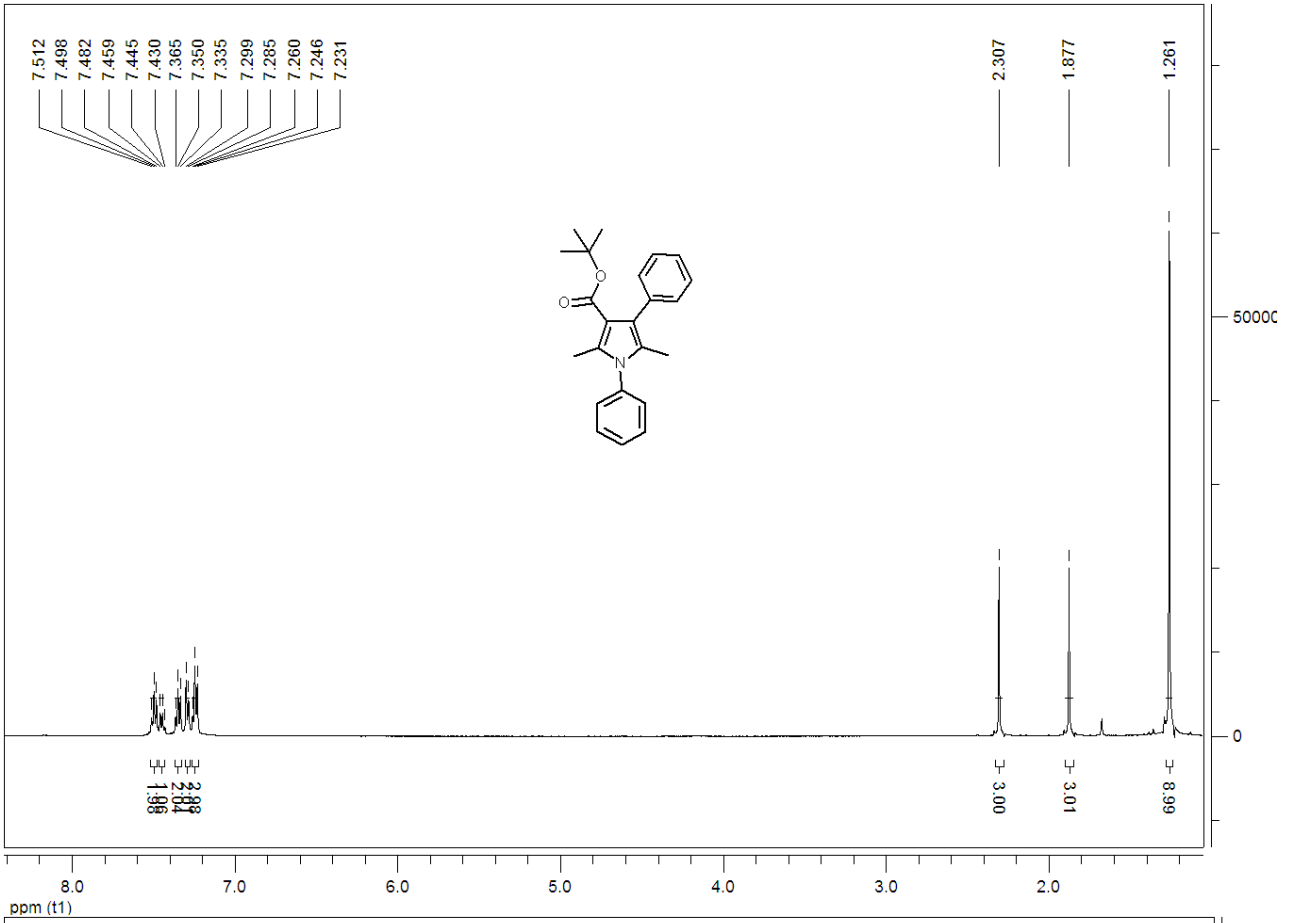


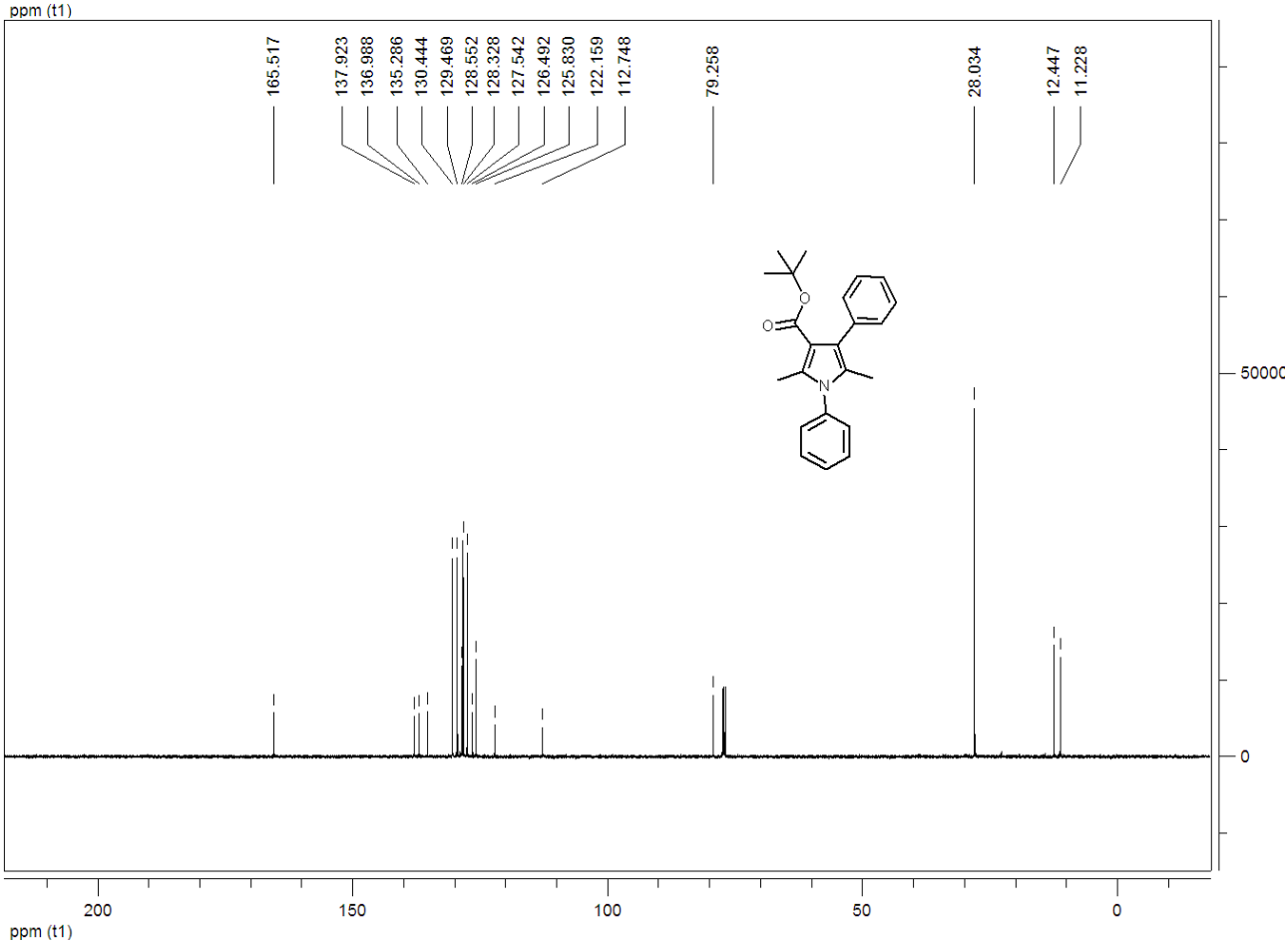
^{1}H NMR and ^{13}C NMR of compound **4ap**



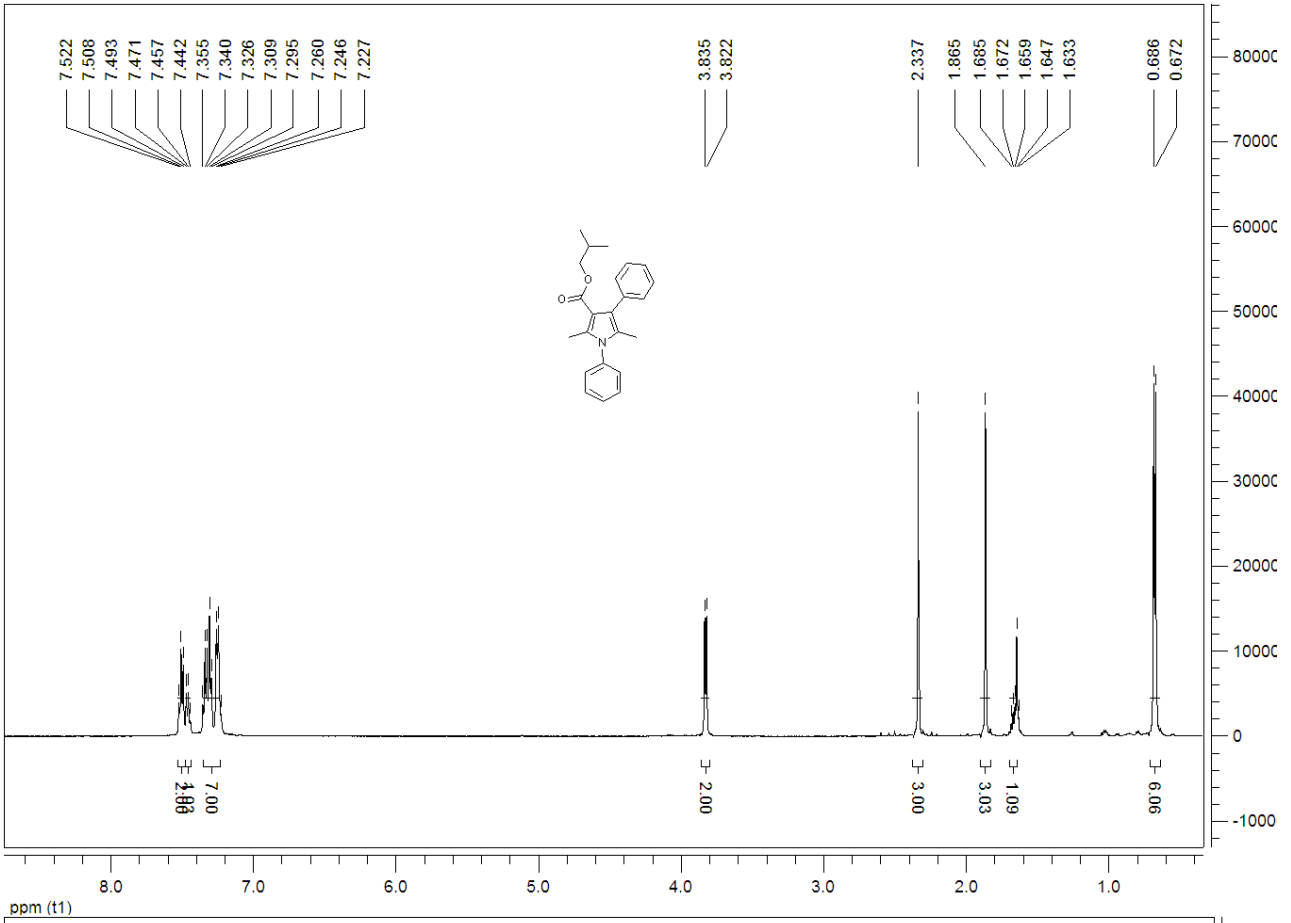


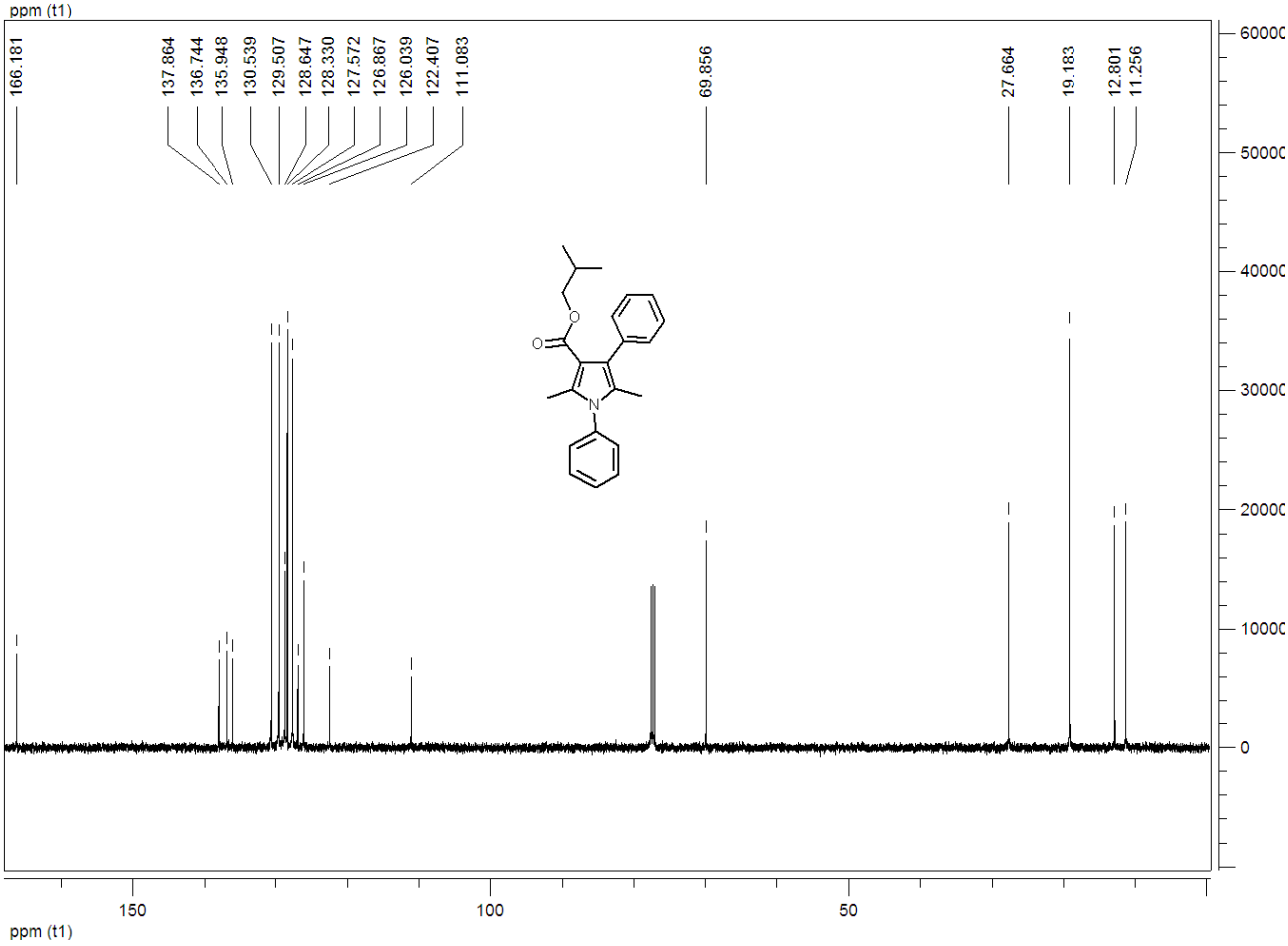
^{1}H NMR and ^{13}C NMR of compound **4aq**



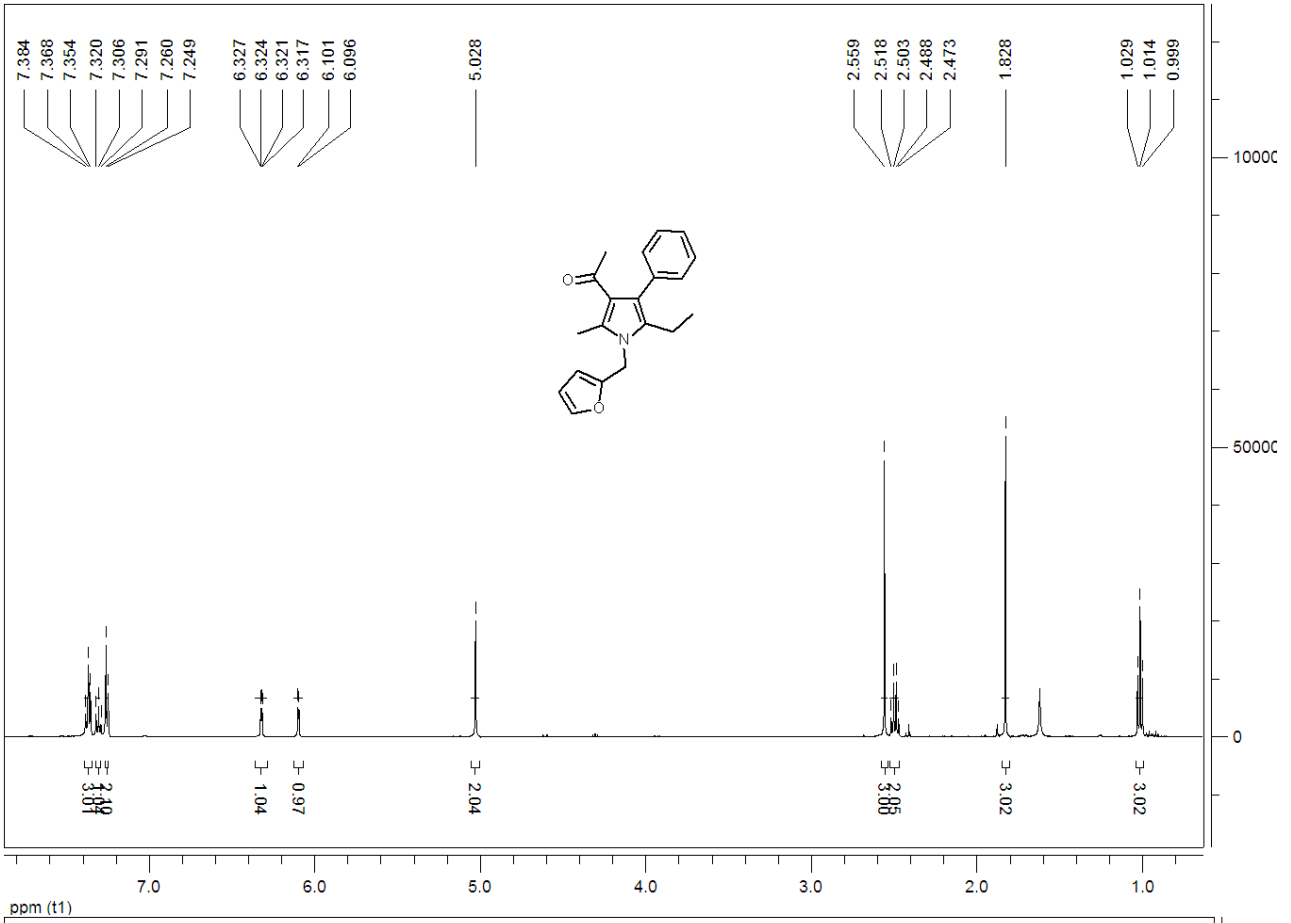


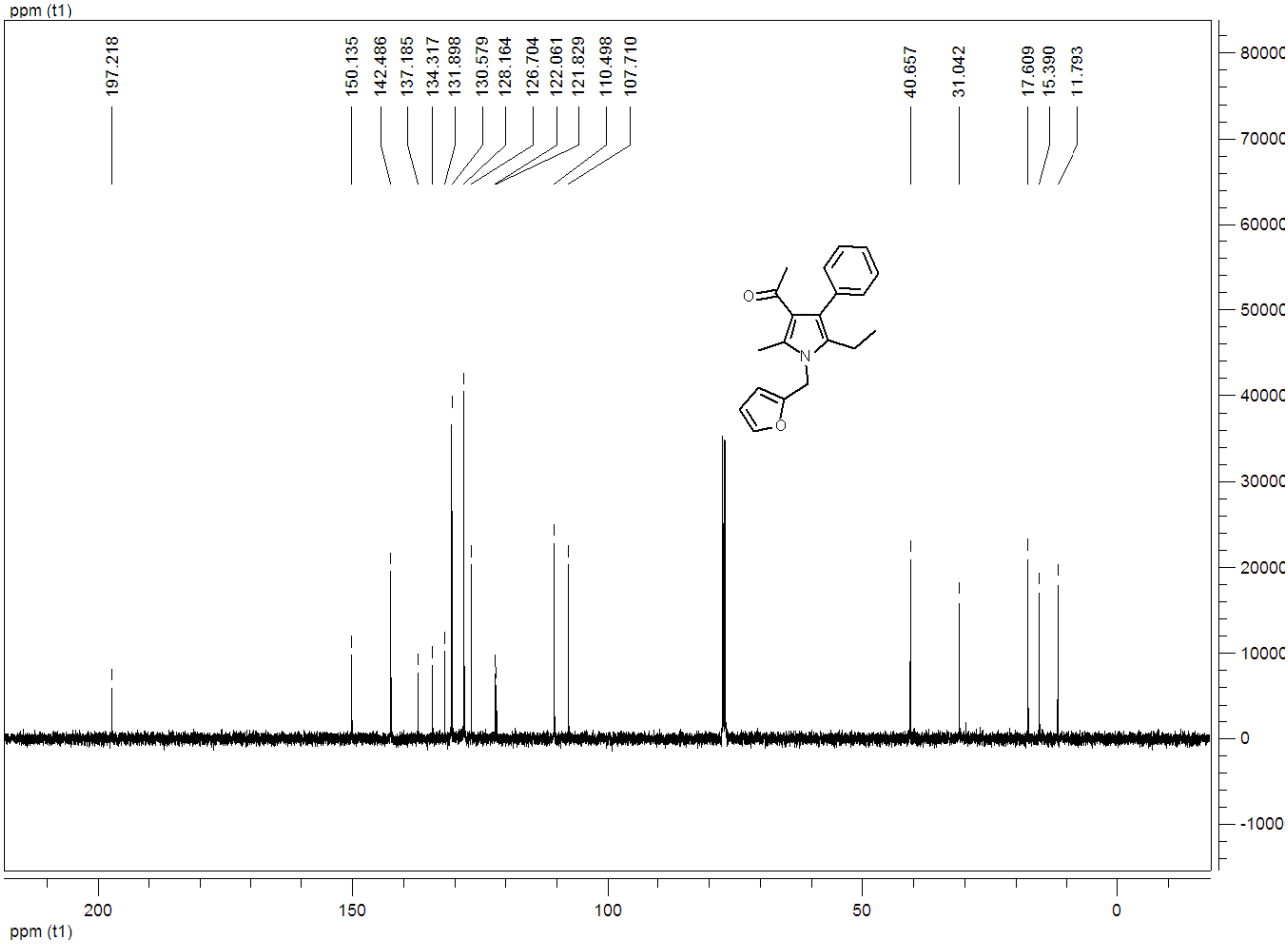
^{1}H NMR and ^{13}C NMR of compound **4ar**



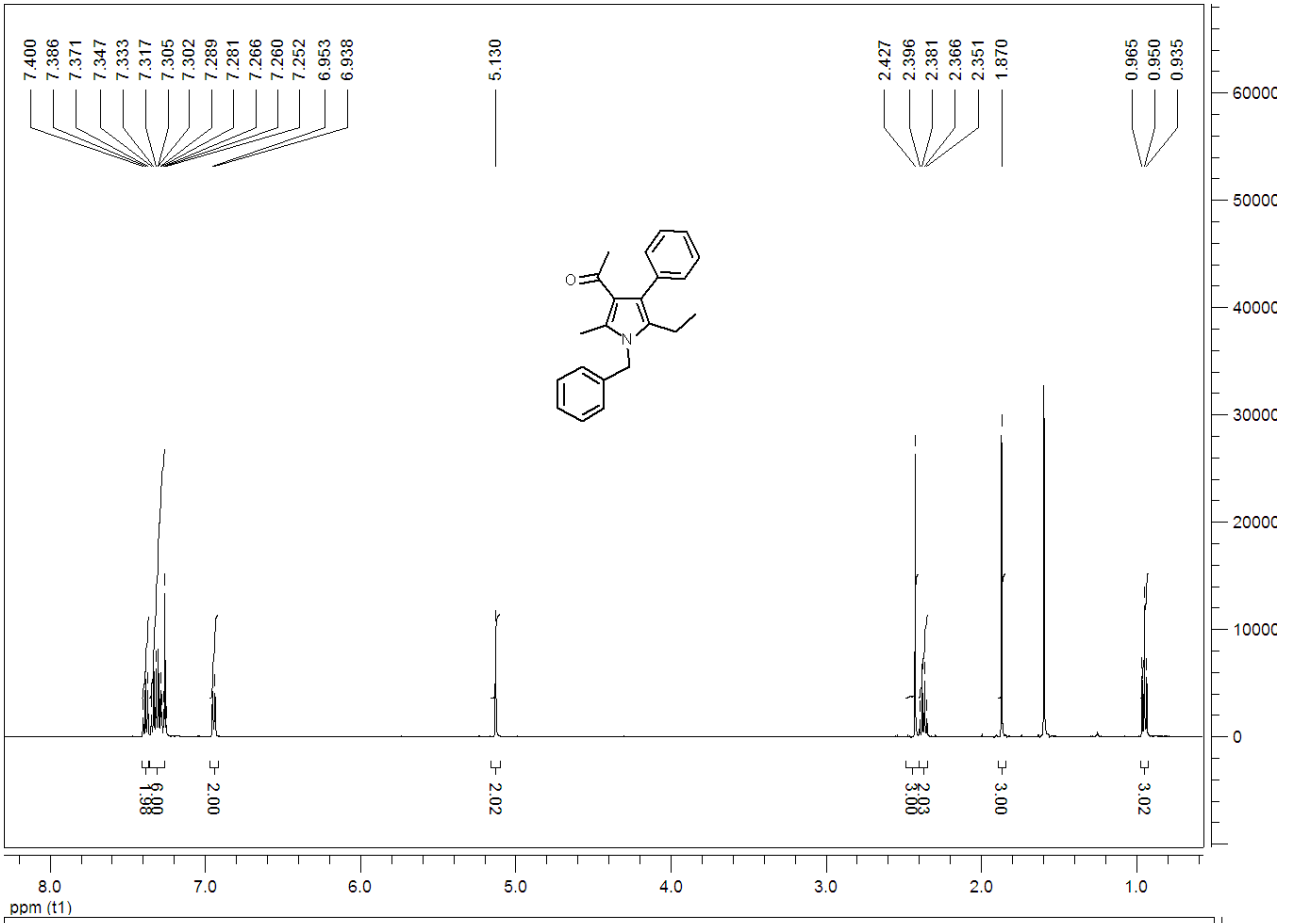


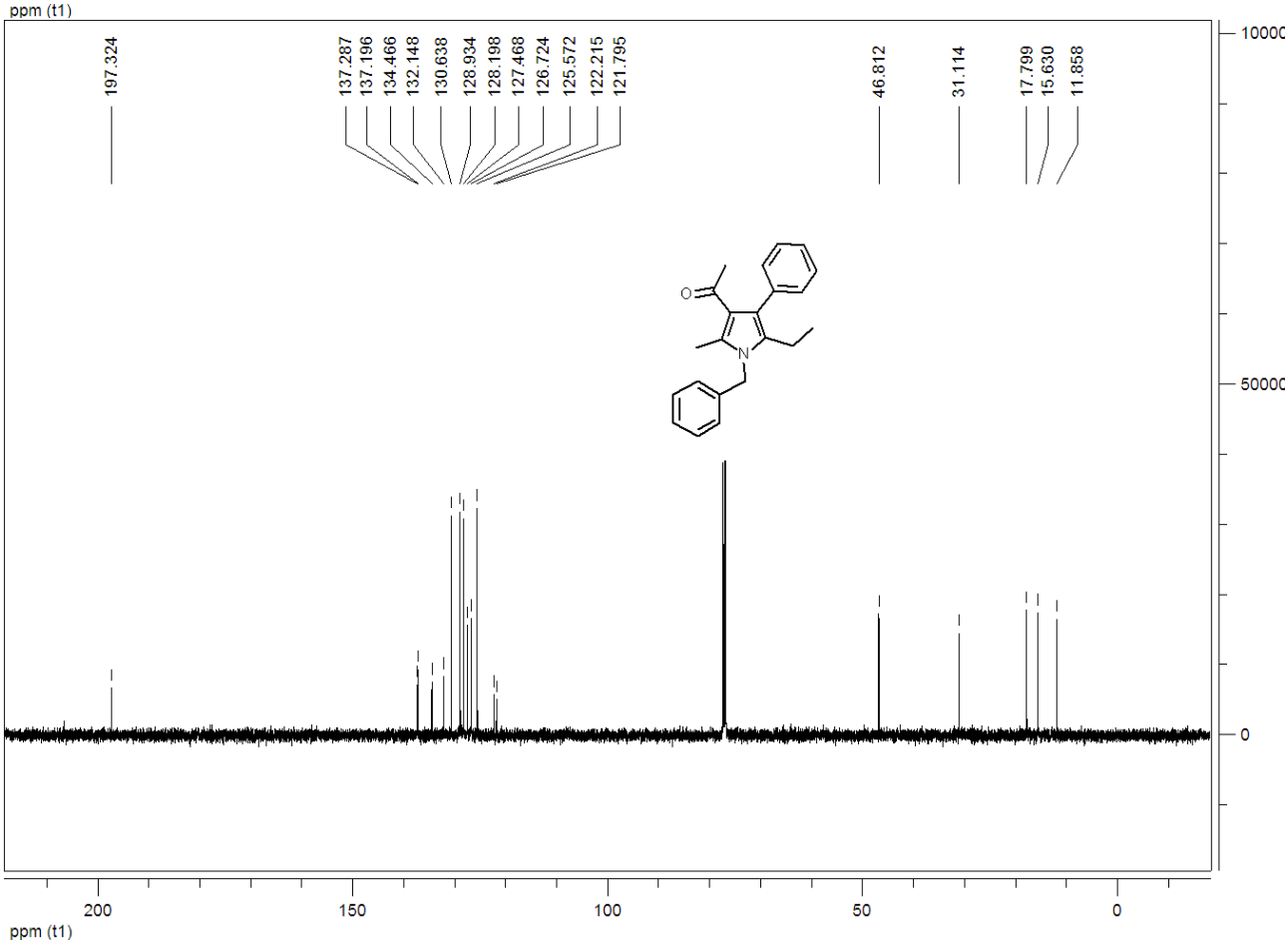
^{1}H NMR and ^{13}C NMR of compound **4as**



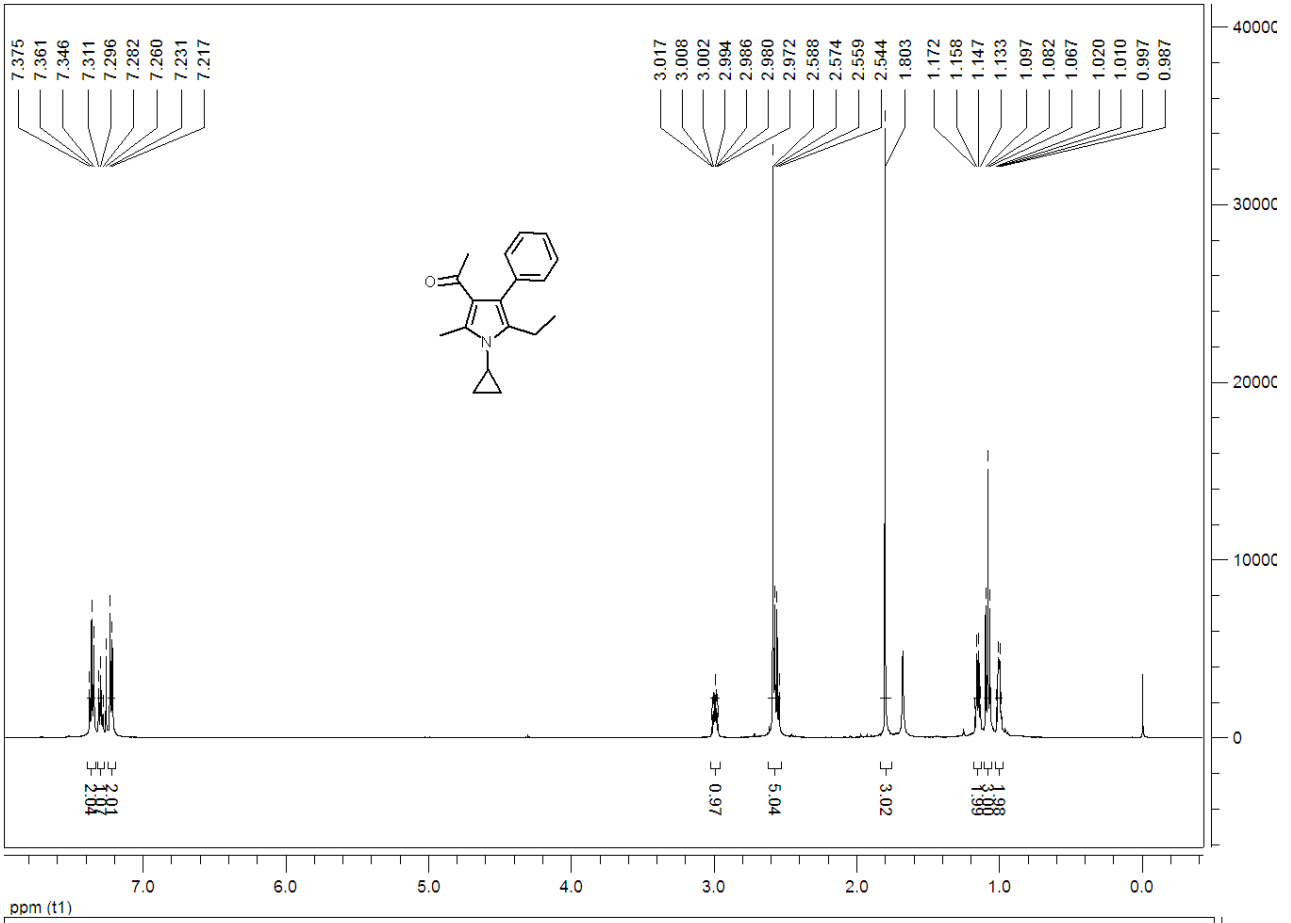


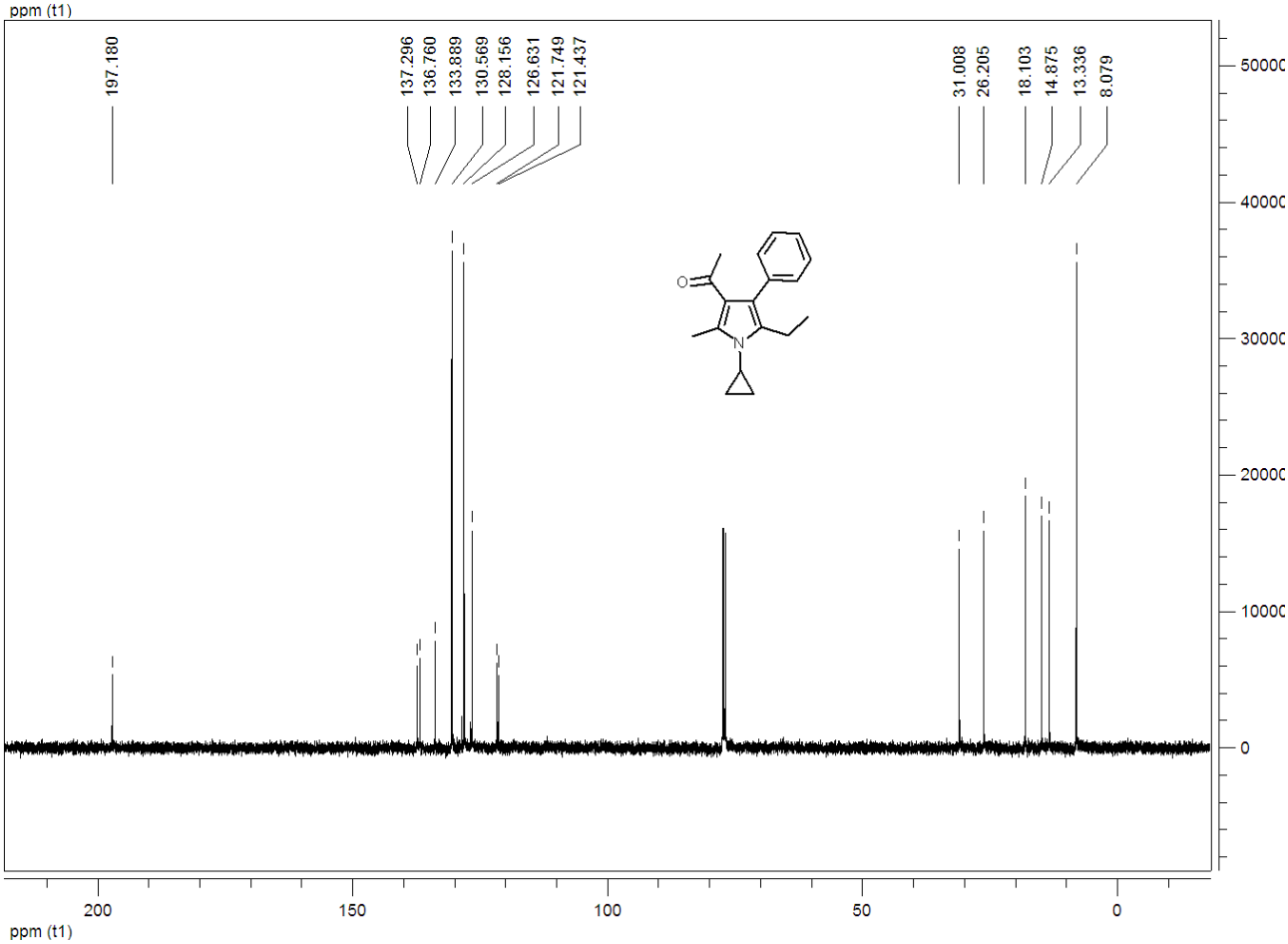
^{1}H NMR and ^{13}C NMR of compound **4at**





^{1}H NMR and ^{13}C NMR of compound **4au**





^{1}H NMR and ^{13}C NMR of compound **4av**