

Ce-Zr/SiO₂: A versatile reusable heterogeneous catalyst for three-component synthesis of 2-amino-4*H*-pyranoquinoline derivatives

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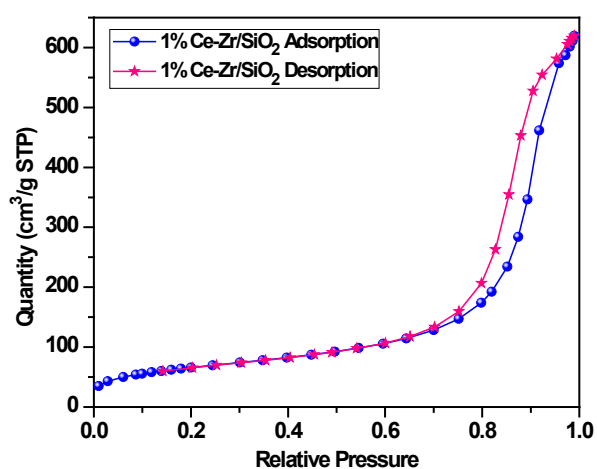


Fig 1. BET surface area and pore size of Ce-Zr/SiO₂

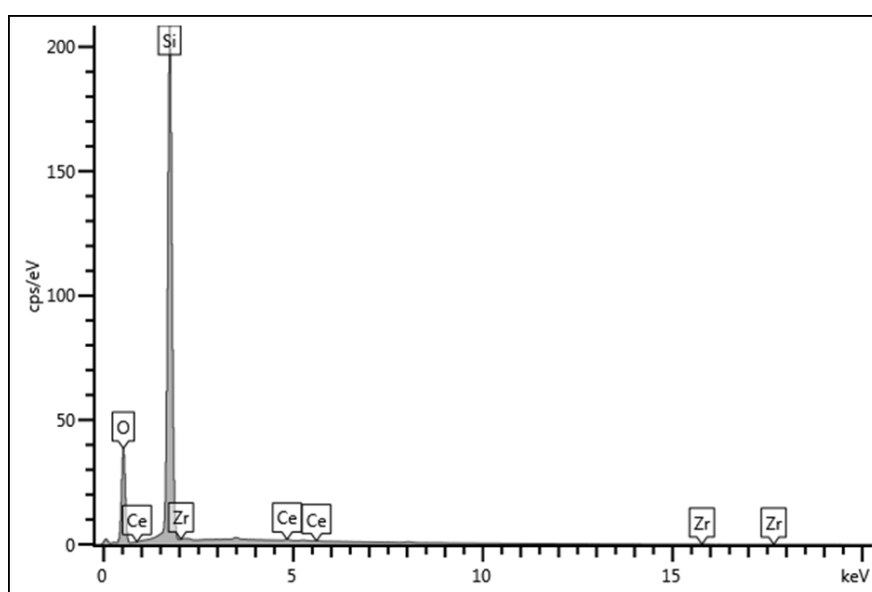
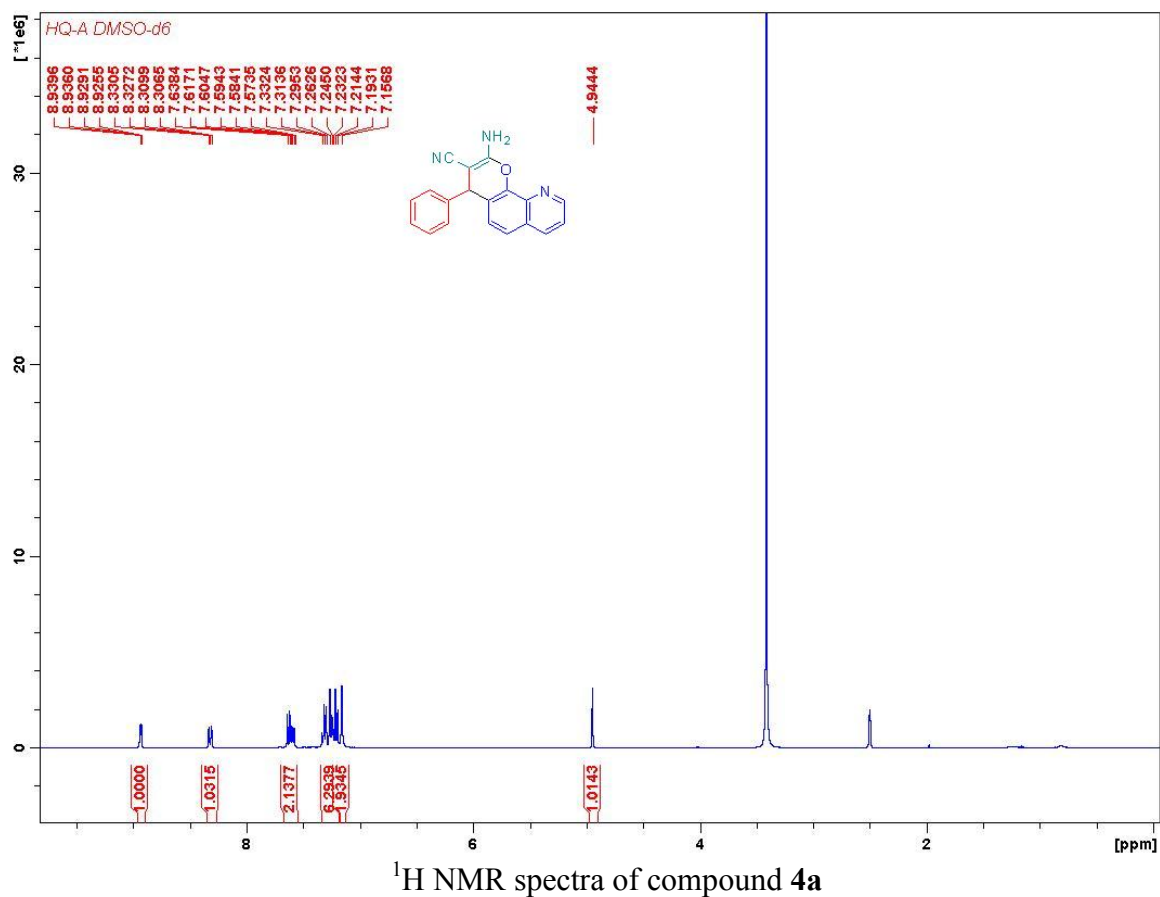
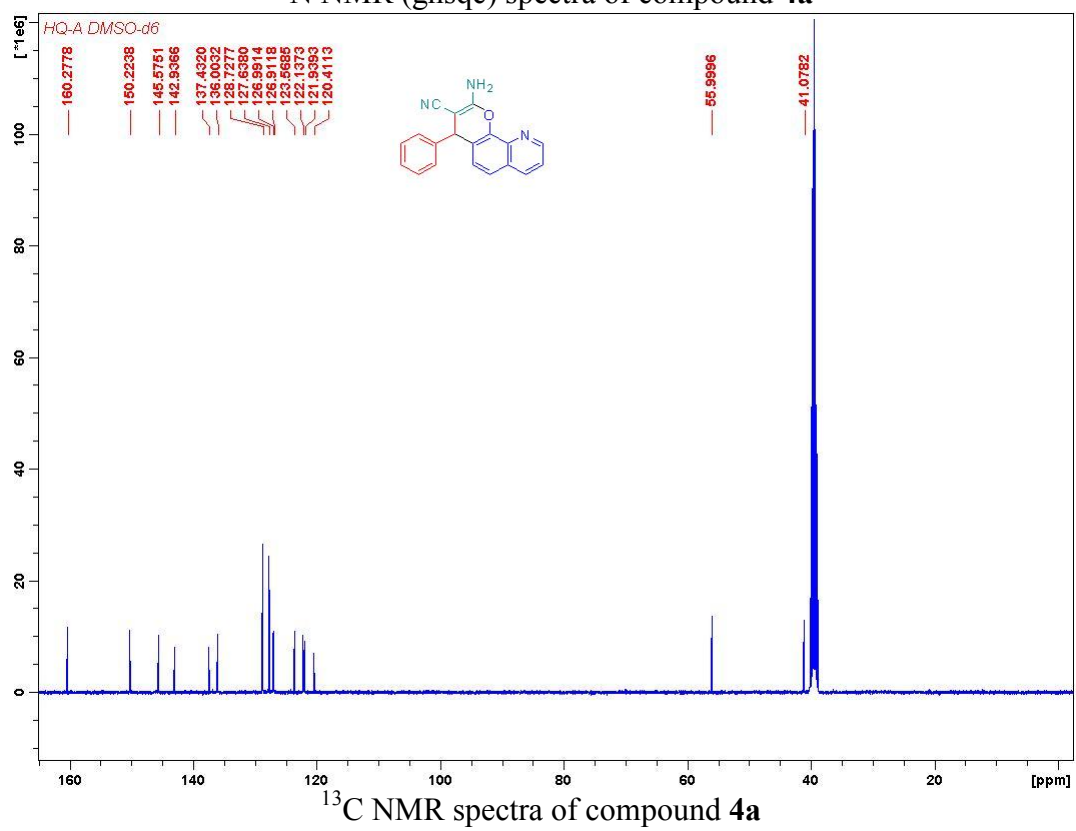
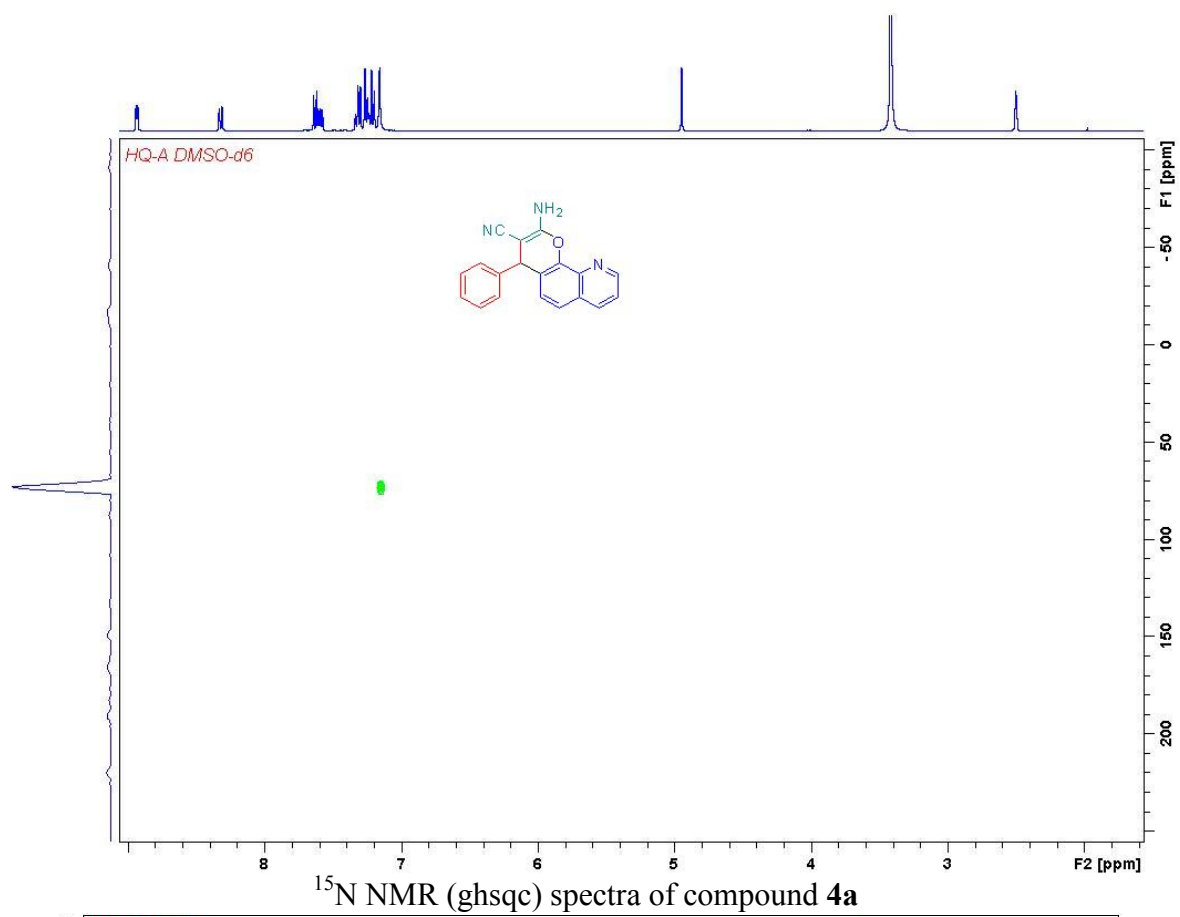


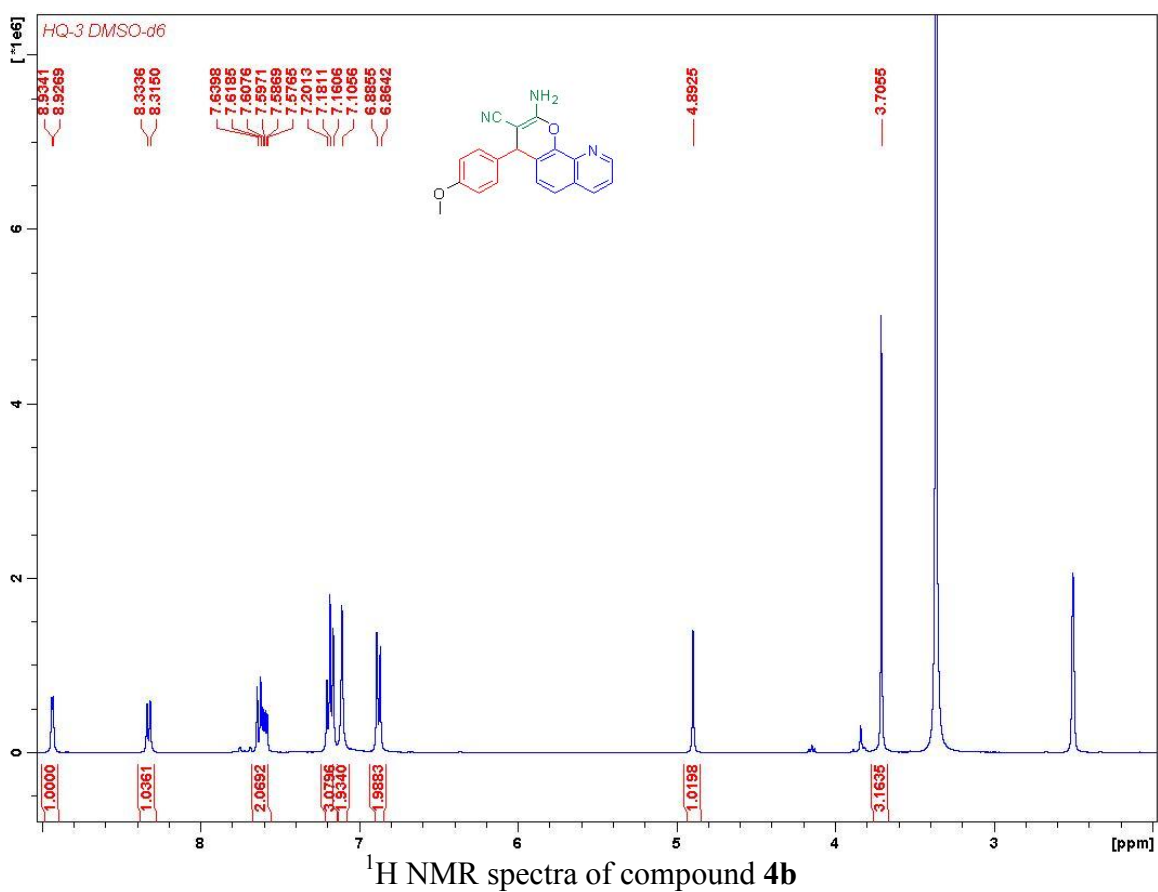
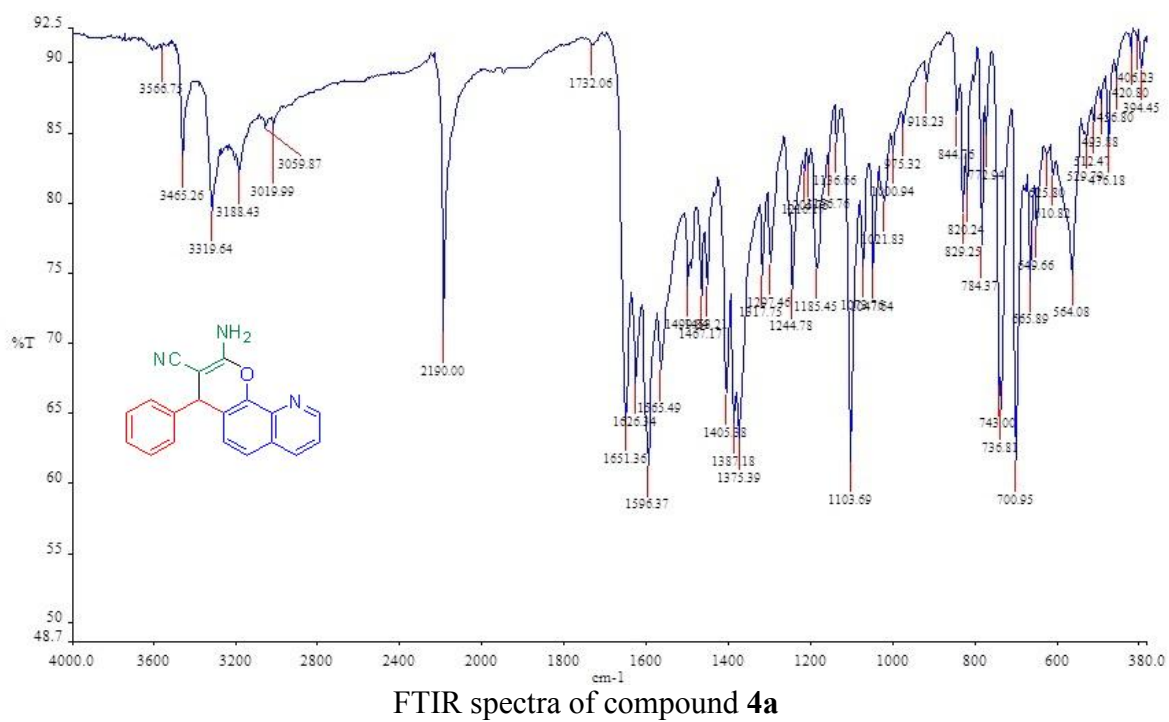
Fig 2. SEM-EDX of Ce-Zr/SiO₂

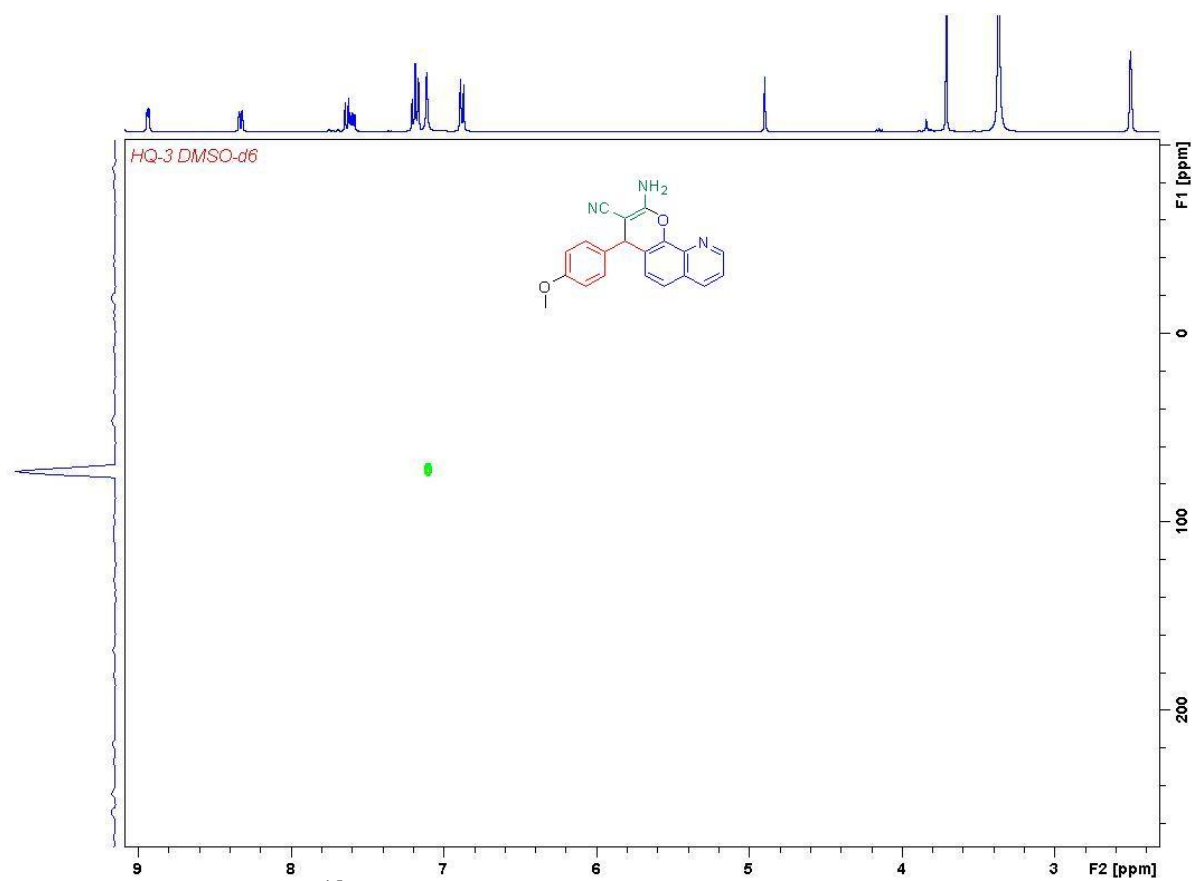
Apparatus and analysis

All chemicals used were reagent grade and were used as received without further purification. ^1H NMR and ^{13}C NMR spectra were recorded at 25 °C at 400 MHz and 100 MHz (Bruker Avance) instrument respectively, using TMS as internal standard. Chemical shifts are given in parts per million (ppm). The FT-IR spectroscopy of samples was carried out on a Perkin Elmer Precisely 100 FT-IR spectrometer in the 400-4000 cm^{-1} region. LCMS mass spectra were recorded on a MASPEC low resolution mass spectrometer operating at 70 eV. Elemental analyses were carried out using a Perkin-Elmer CHNS Elemental Analyzer model 2400. Reactions were monitored and the purity of products was checked out on thin layer chromatography (TLC) on aluminium-backed plates coated with Merck Kieselgel 60 F254 silica gel, visualizing the spots under ultraviolet light and iodine chamber. Melting points are uncorrected and were recorded on a hot stage melting point apparatus Ernst Leitz Wetzlar, Germany.

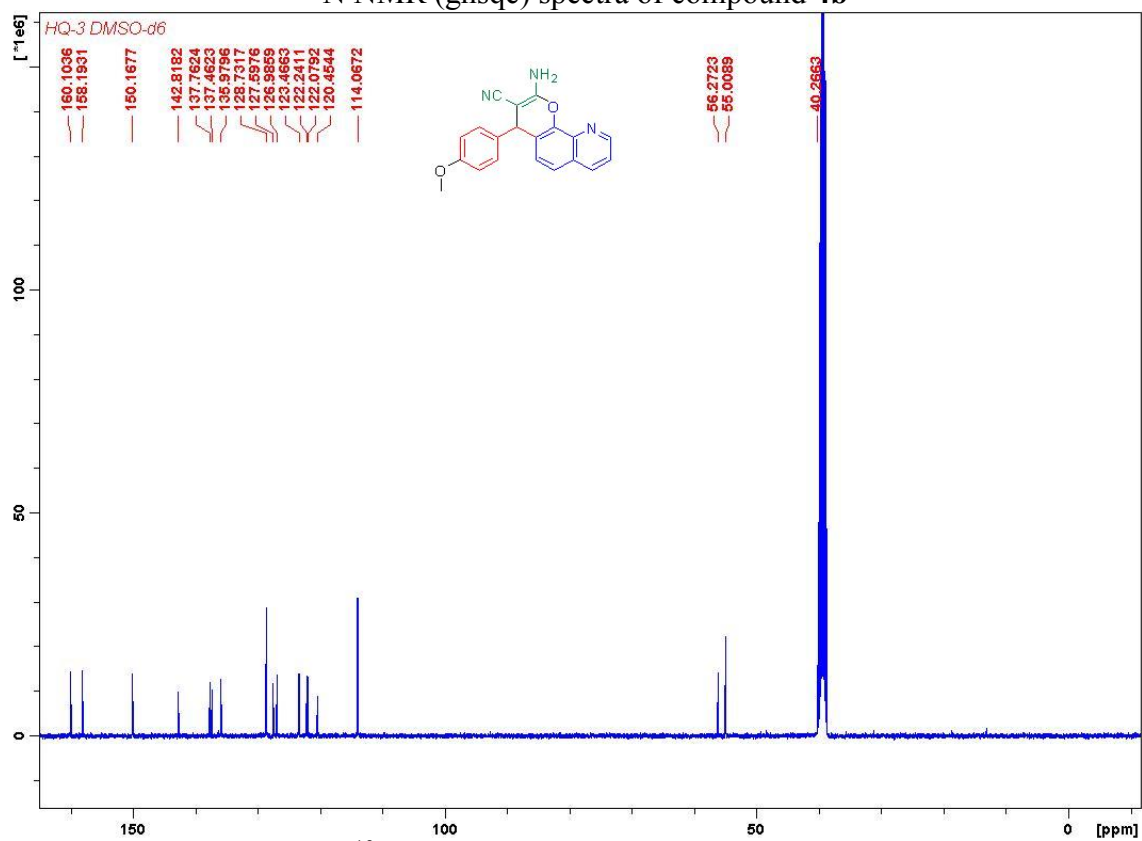




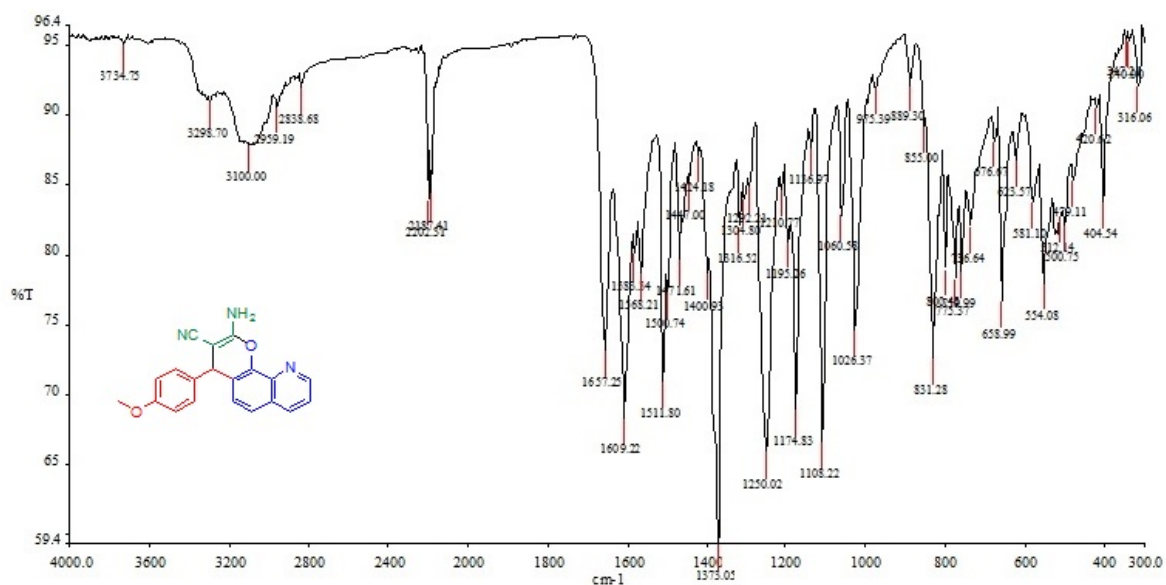




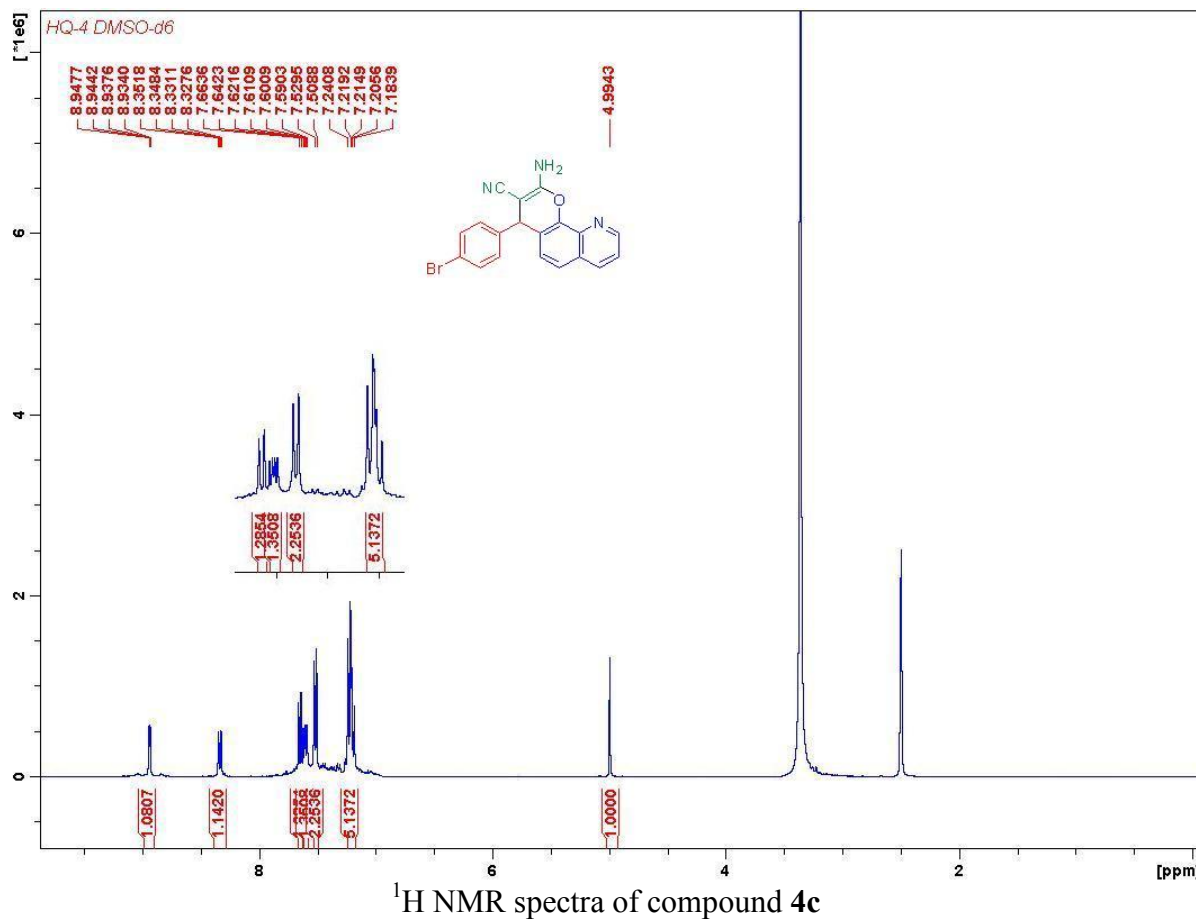
¹⁵N NMR (ghsqc) spectra of compound **4b**



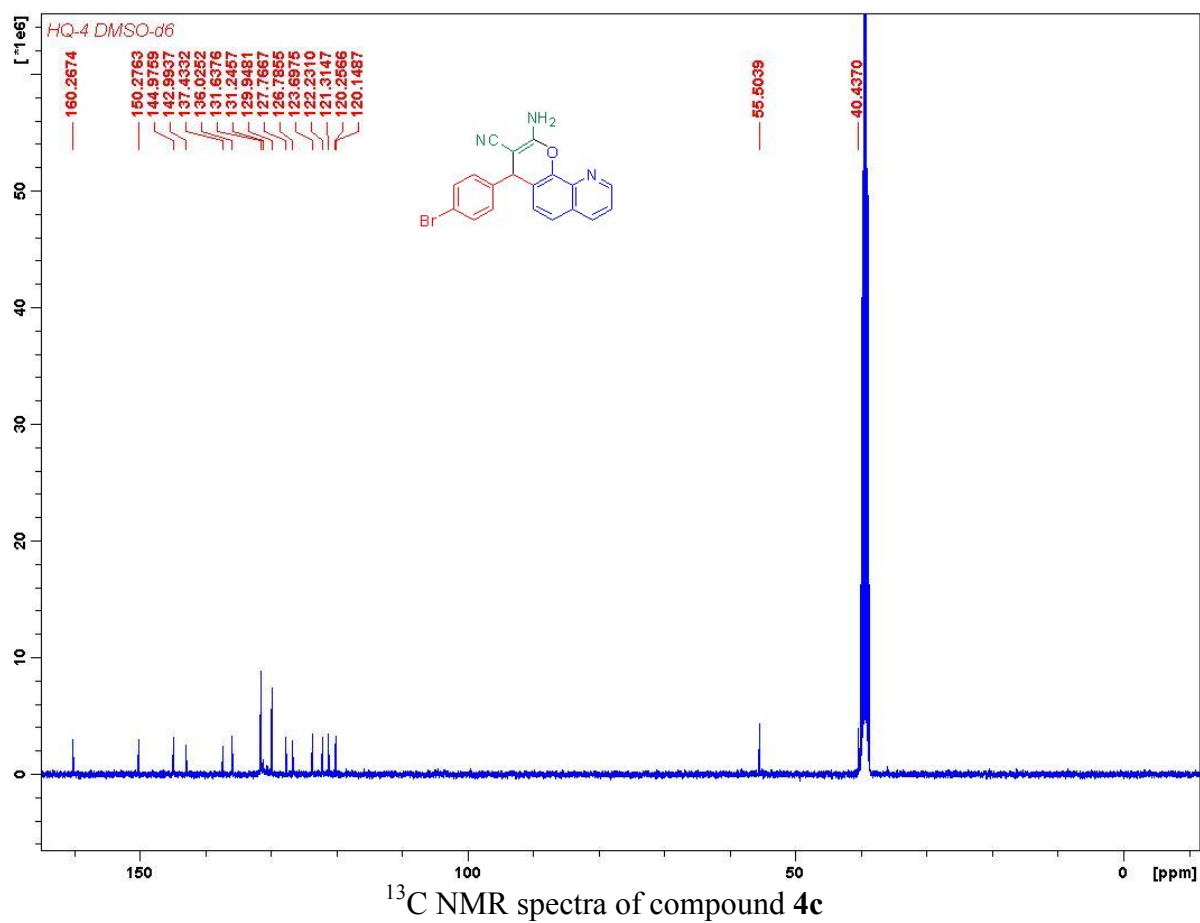
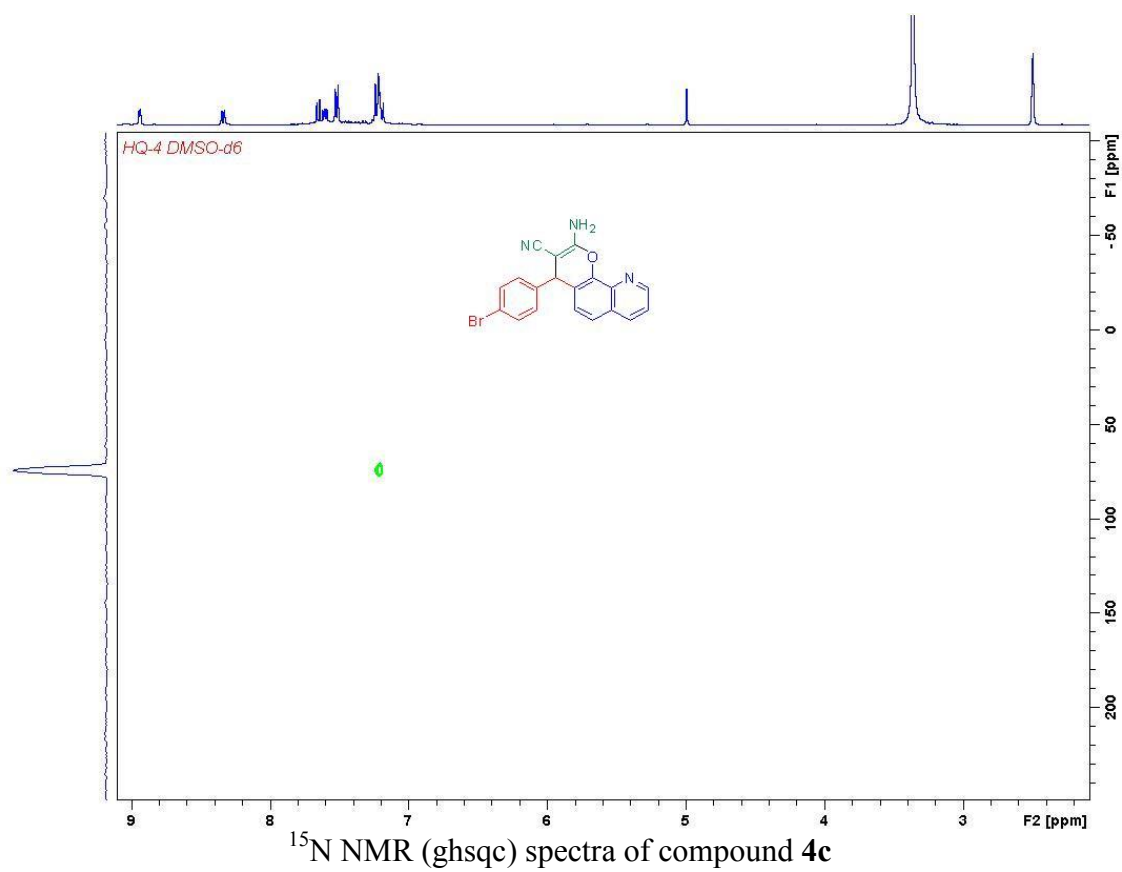
¹³C NMR spectra of compound **4b**

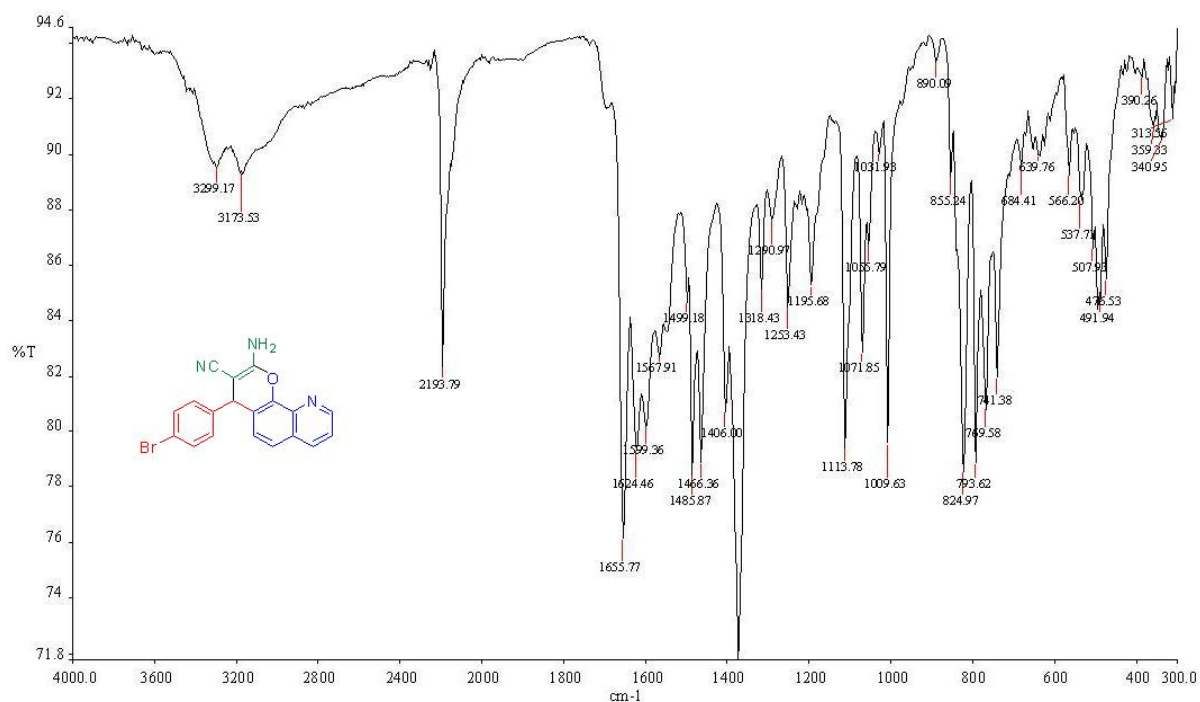


FTIR spectra of compound **4b**

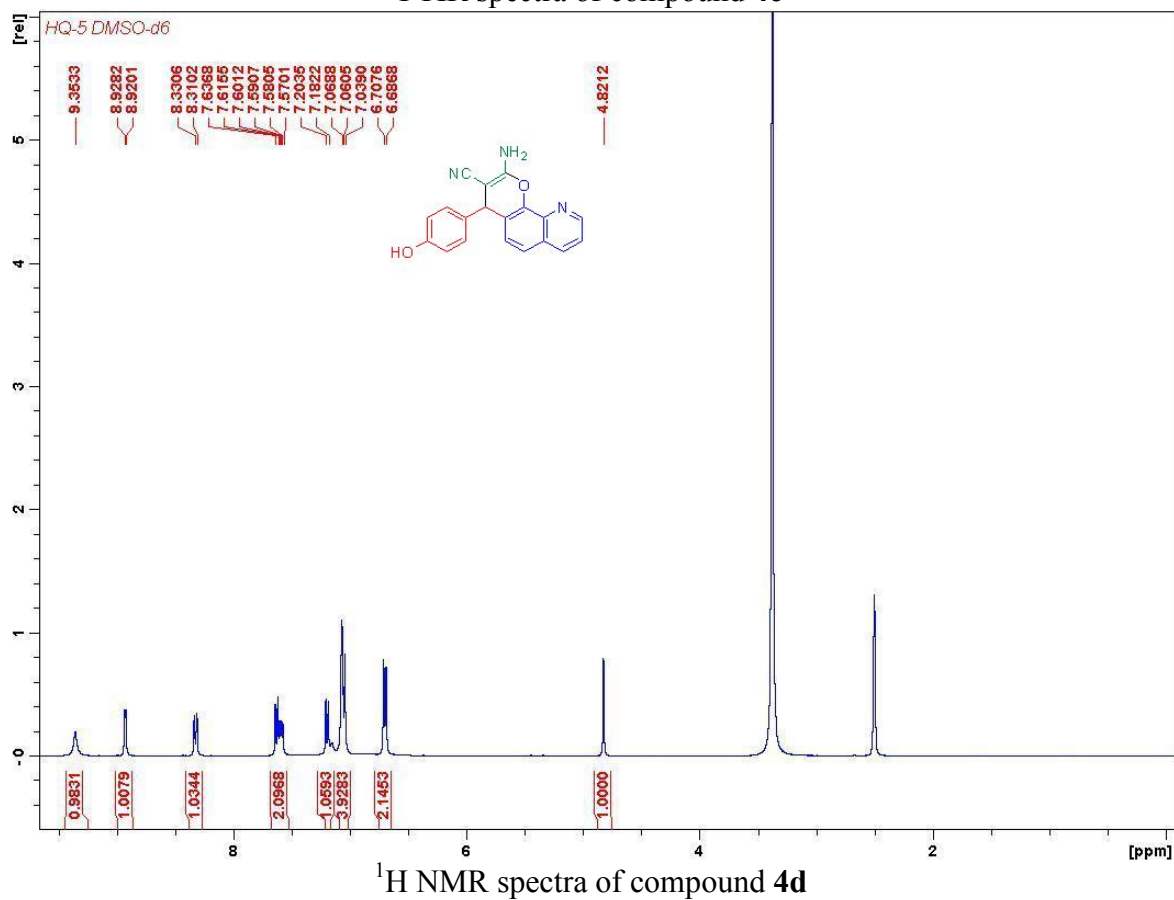


^1H NMR spectra of compound **4c**

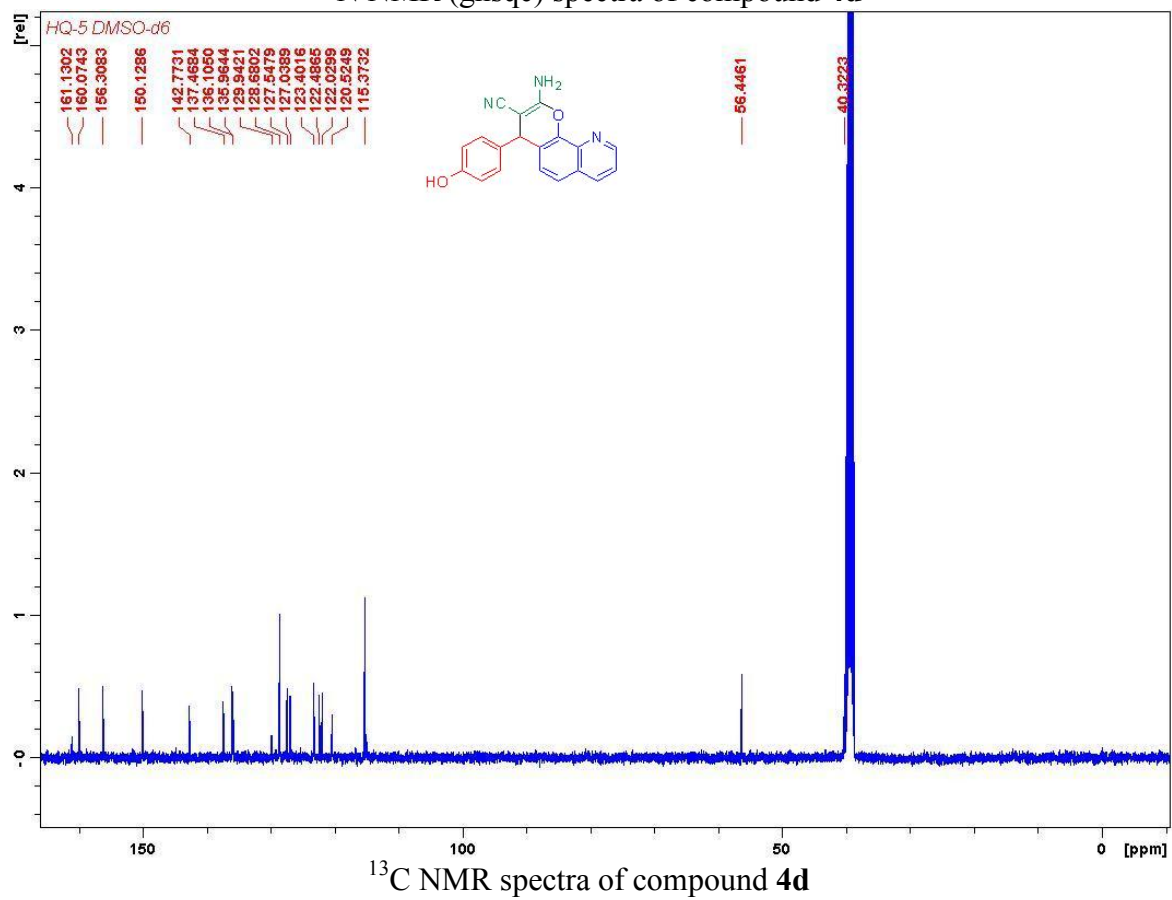
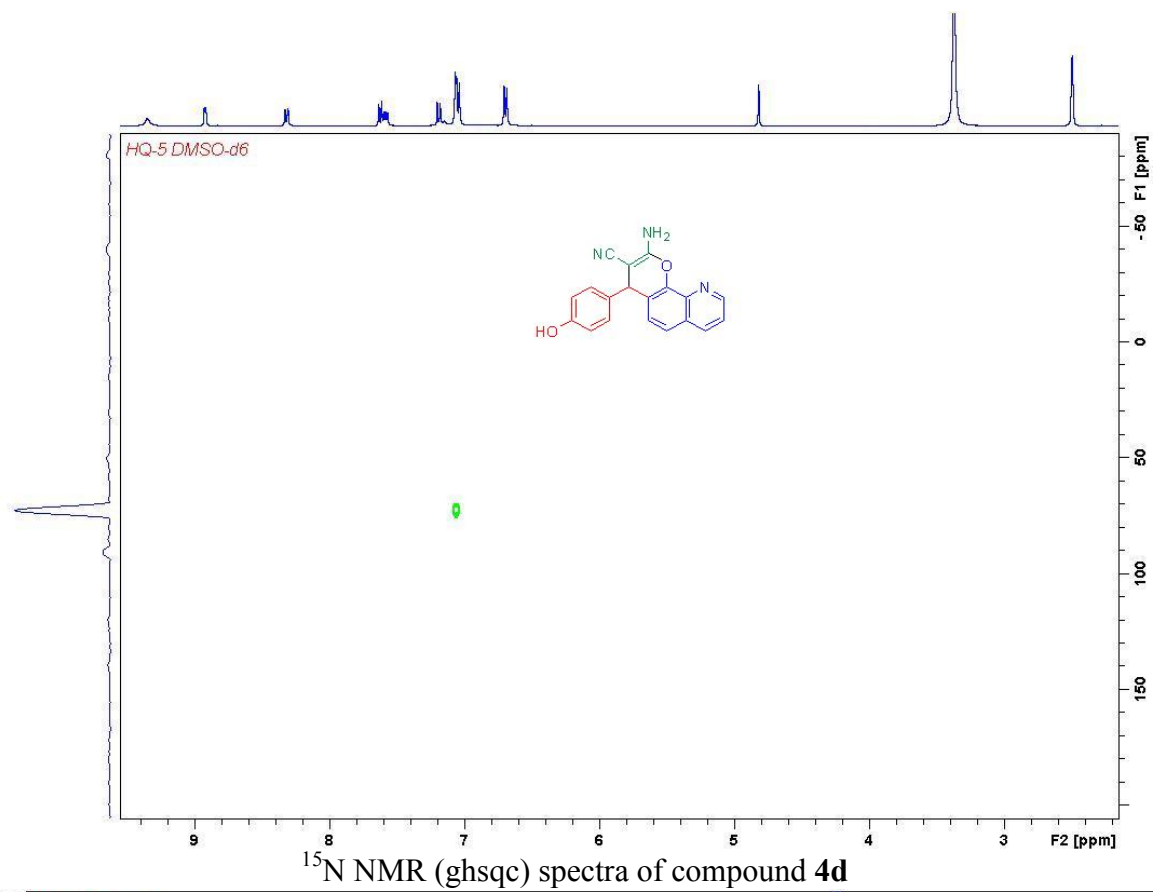


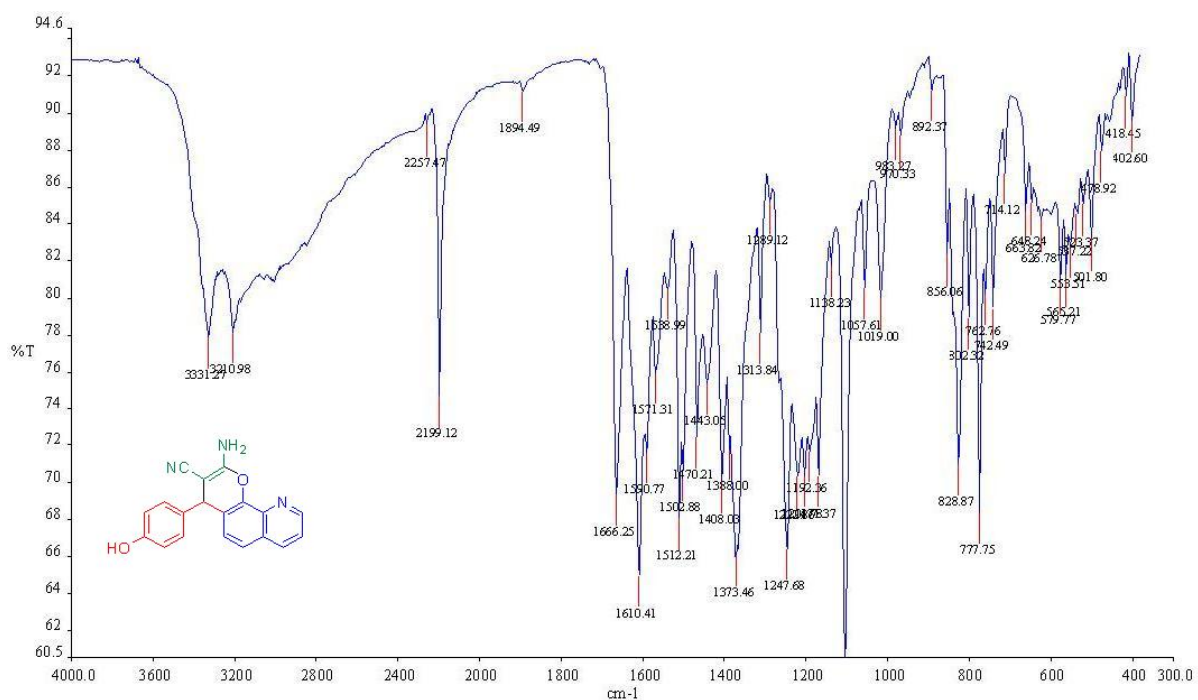


FTIR spectra of compound **4c**

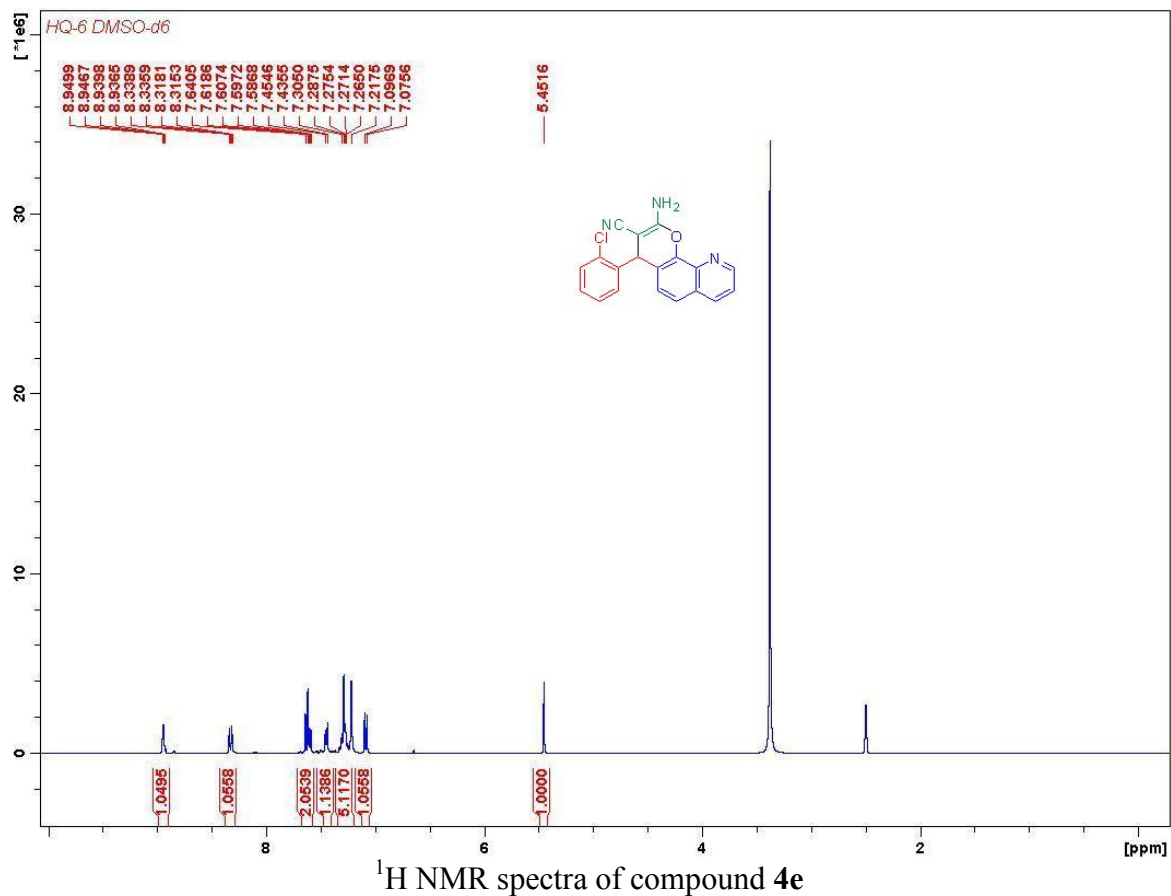


¹H NMR spectra of compound **4d**

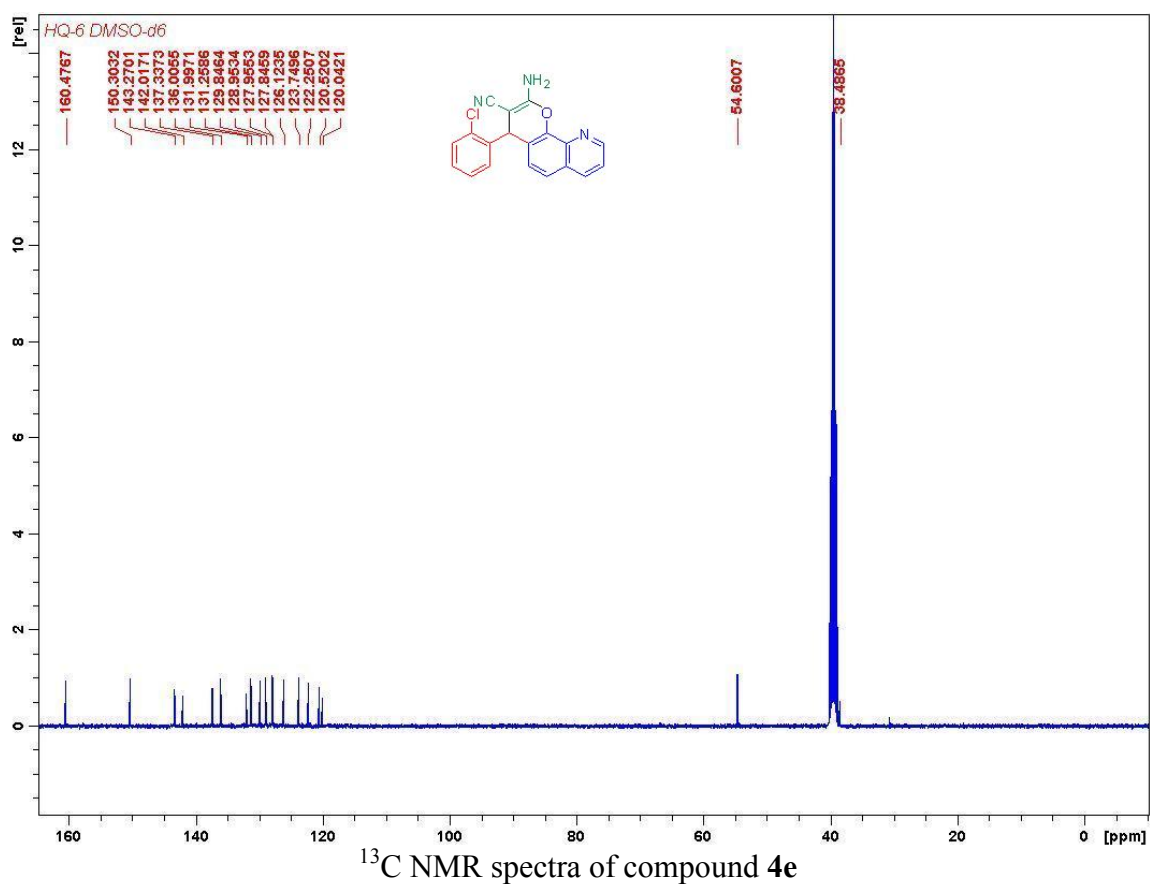
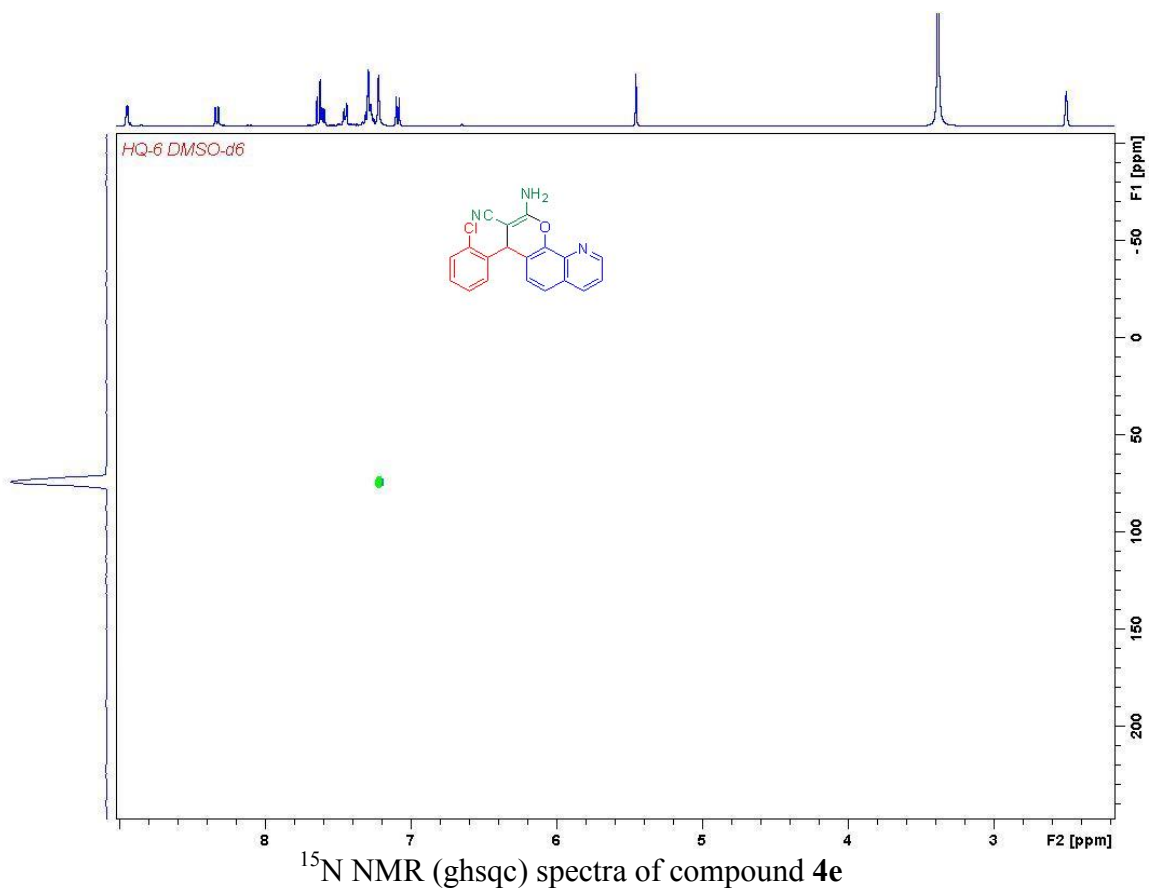


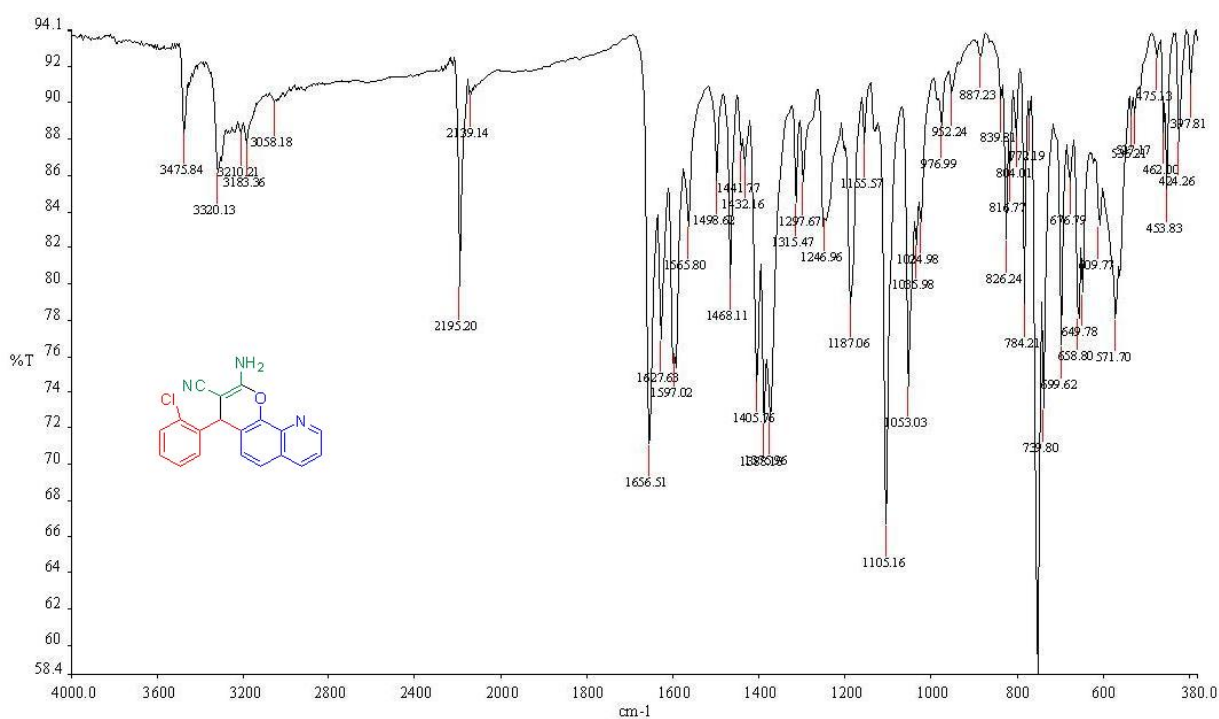


FTIR spectra of compound 4d

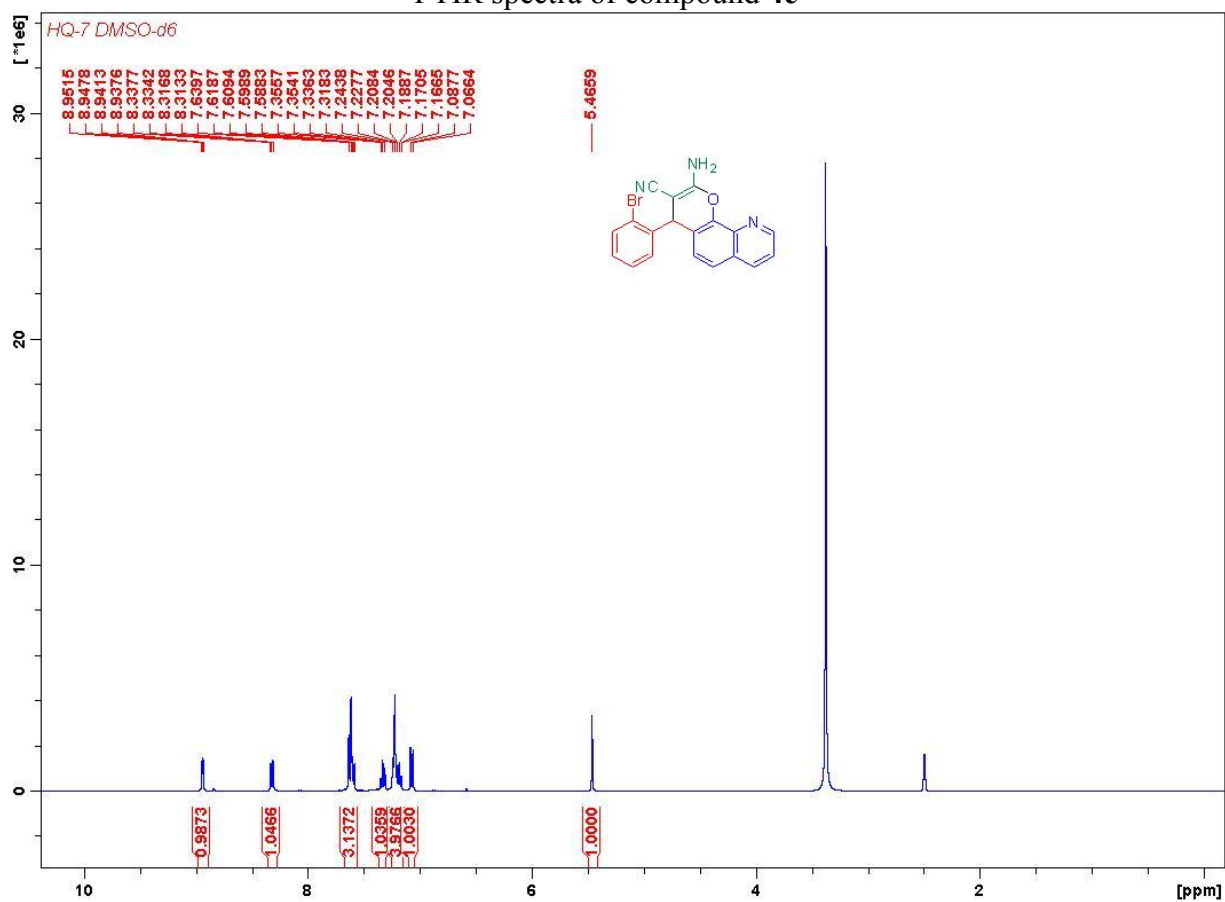


¹H NMR spectra of compound 4e

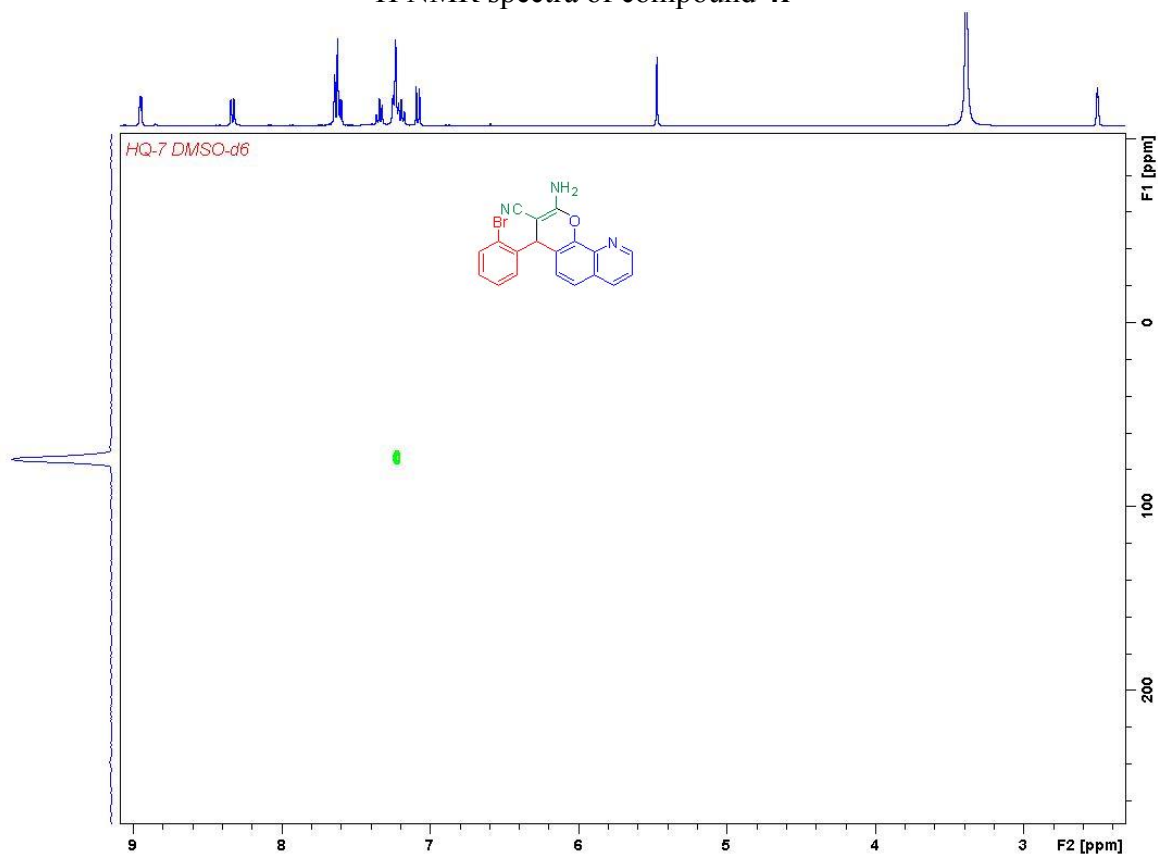




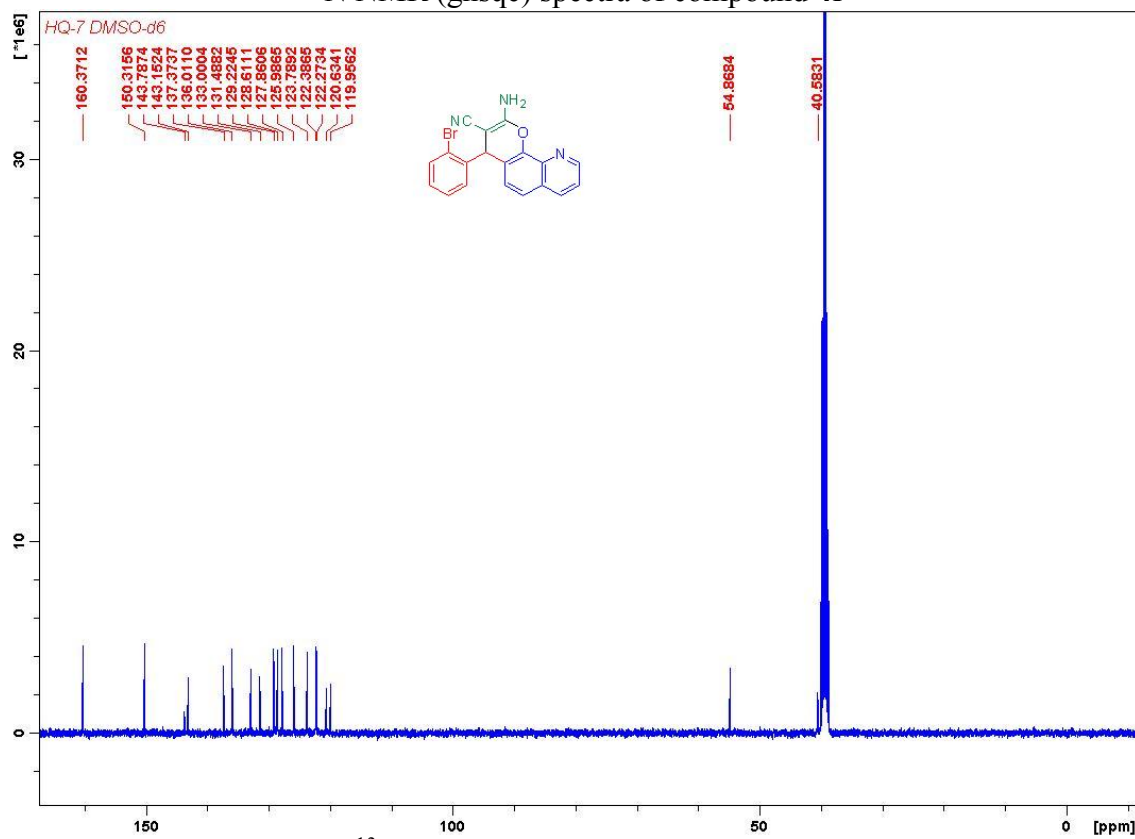
FTIR spectra of compound 4e



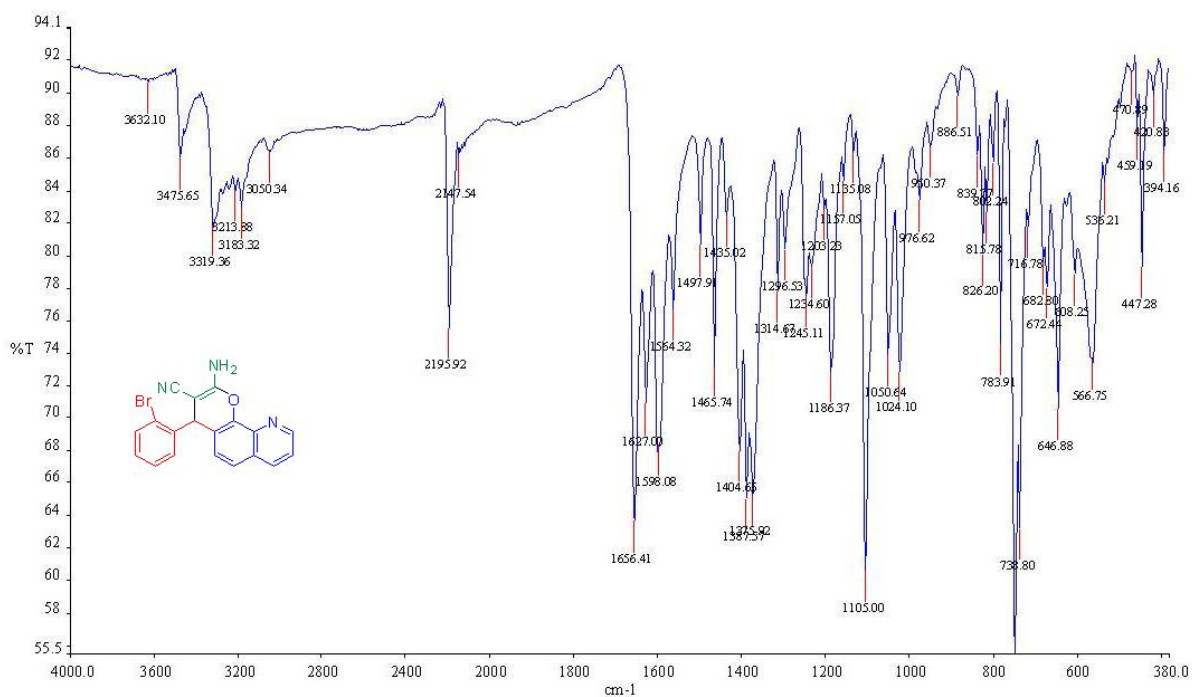
^1H NMR spectra of compound **4f**



^{15}N NMR (ghsqc) spectra of compound **4f**



^{13}C NMR spectra of compound **4f**



FTIR spectra of compound 4f