Electronic Supplementary Material (ESI) for Organic & Biomolecular Chemistry. This journal is © The Royal Society of Chemistry 2014

An easy route to Synthetic Analogues of Radicamine B, Codonopsine and Codonopsinine from D-Mannitol

Suresh Dharuman, Ashok Kumar Palanivel and Yashwant. D. Vankar

Department of Chemistry, Indian Institute of Technology Kanpur 208 016, India

Fax: 0091-512-259 0007; E mail: vankar@iitk.ac.in

1. Scanned copy of ¹H, ¹³C and 2D-NMR Spectra......S2-S64

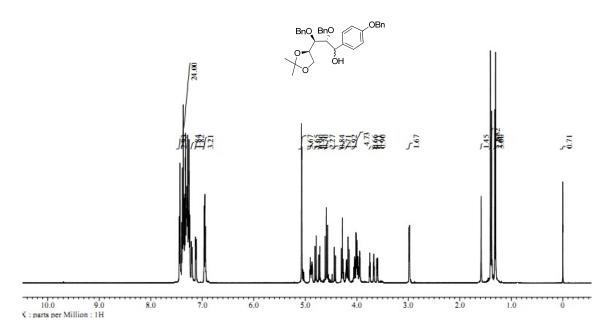


Figure 1.1: 1 H NMR (500 MHz, CDCl₃) Spectrum of Compound **7**

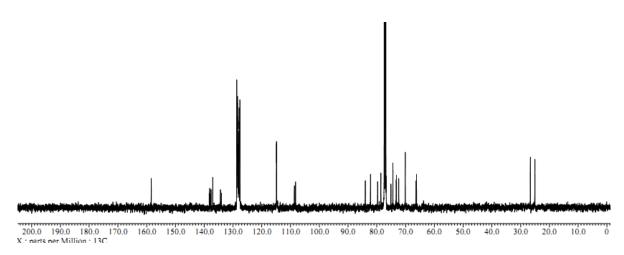


Figure 1.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 7

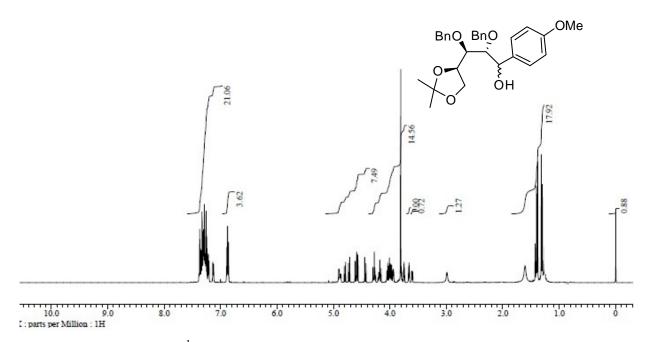


Figure 2.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 15

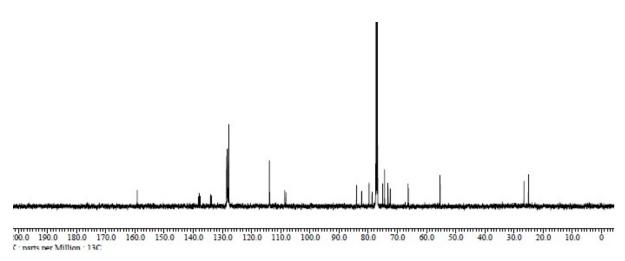


Figure 2.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound **15**

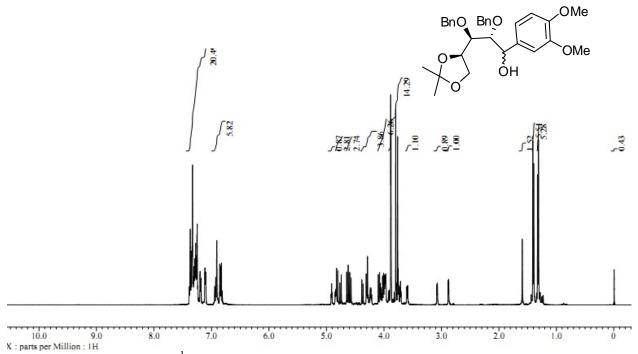


Figure 3.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 16

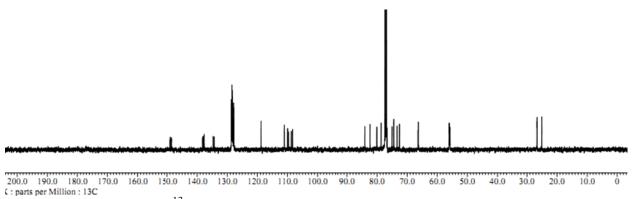


Figure 3.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 16

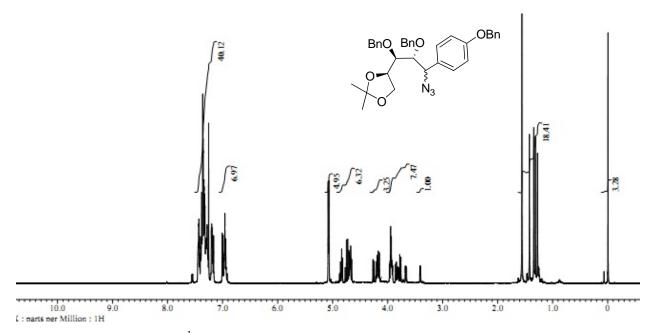


Figure 4.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 8a

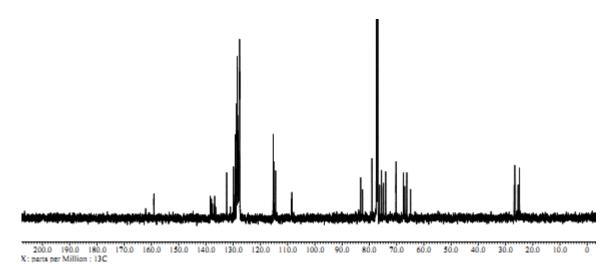


Figure 4.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 8a

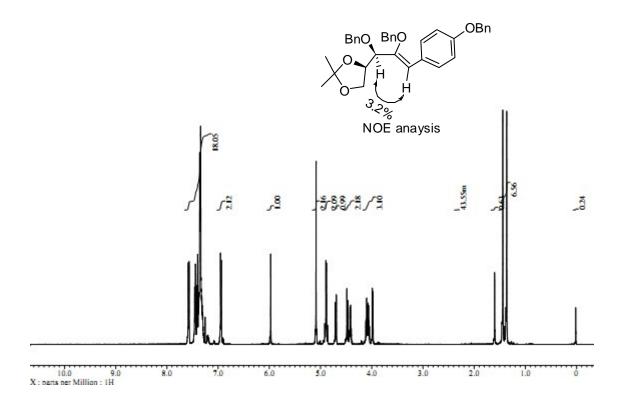


Figure 5.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound **8b**

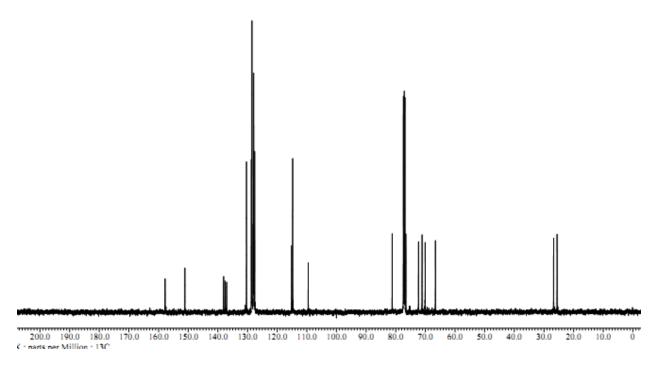


Figure 5.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 8b

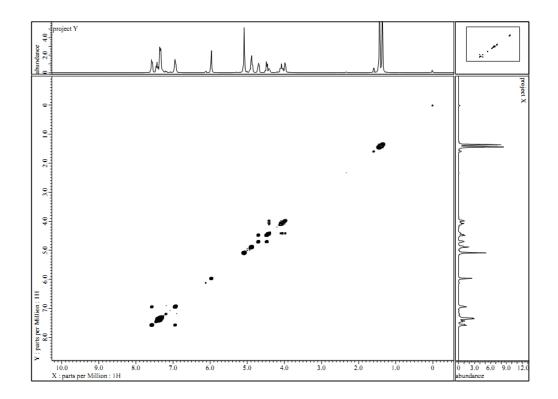


Figure 5.3: ¹H⁻¹H COSY Spectrum of Compound **8b**

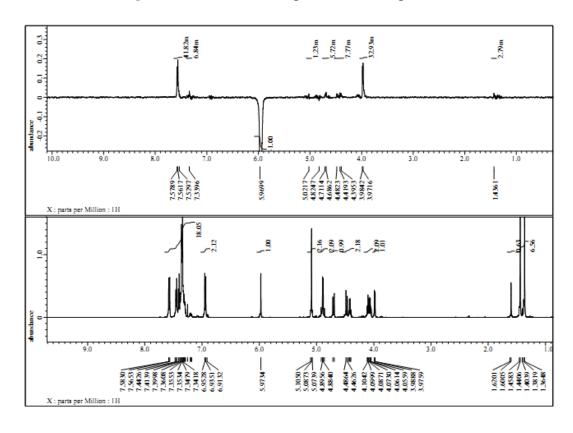


Figure 5.4: NOE irradiation of Vinylic proton of Compound 8b

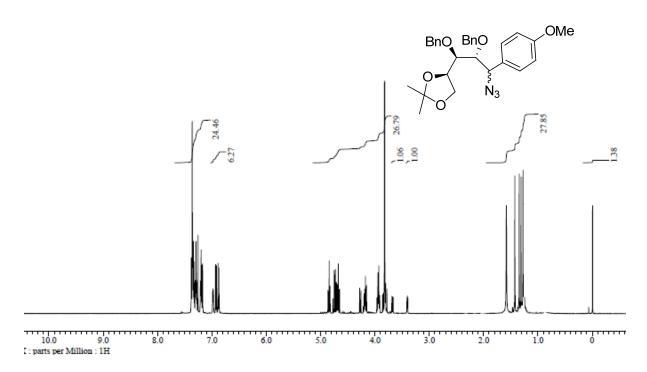


Figure 6.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 17a

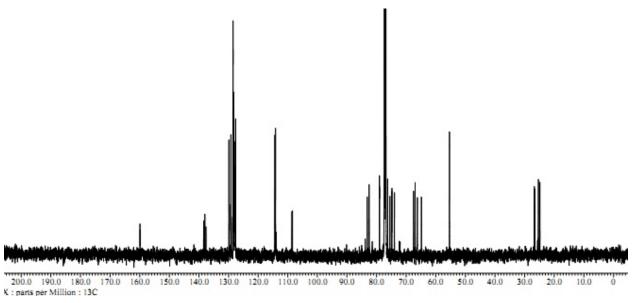


Figure 6.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 17a

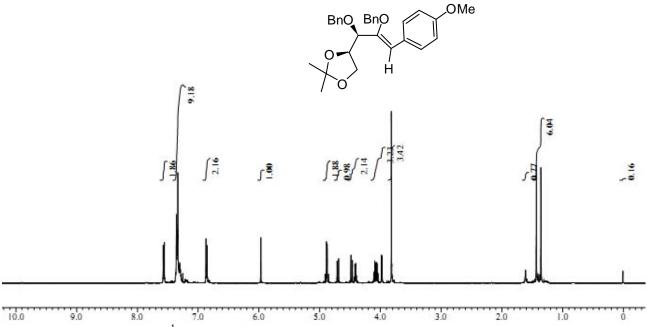


Figure 7.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 17b

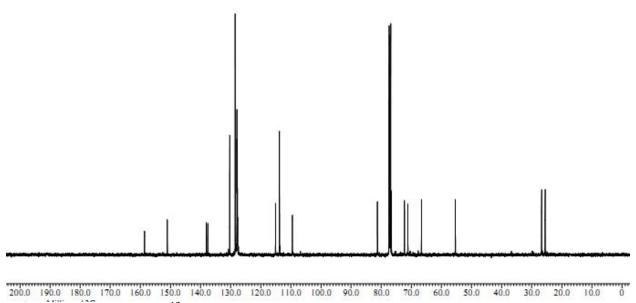


Figure 7.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 17b

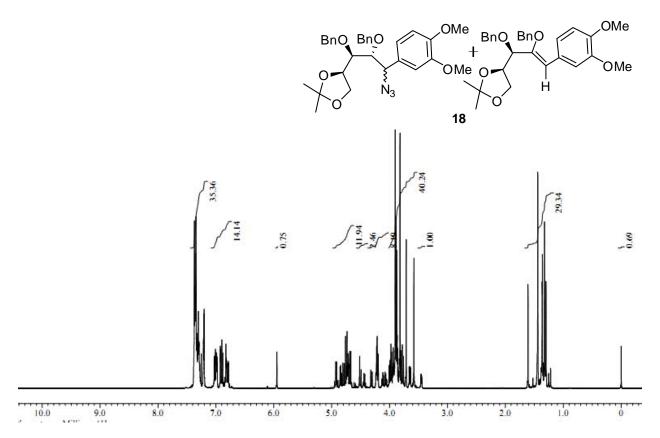


Figure 8.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 18

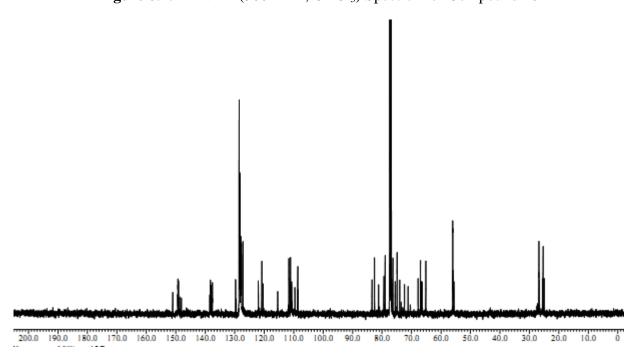


Figure 8.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 18

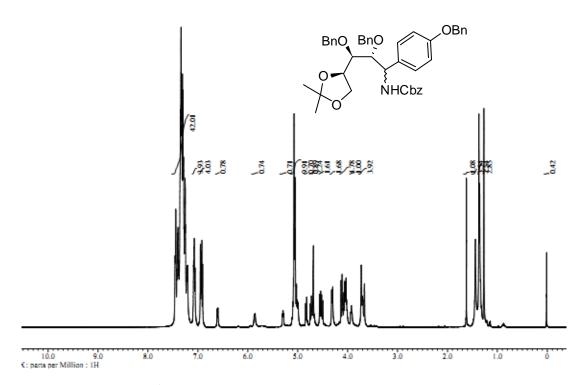


Figure 9.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 9

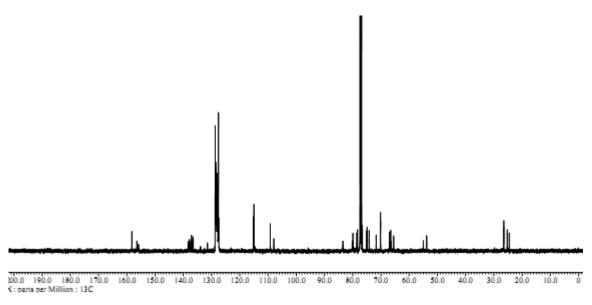


Figure 9.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 9

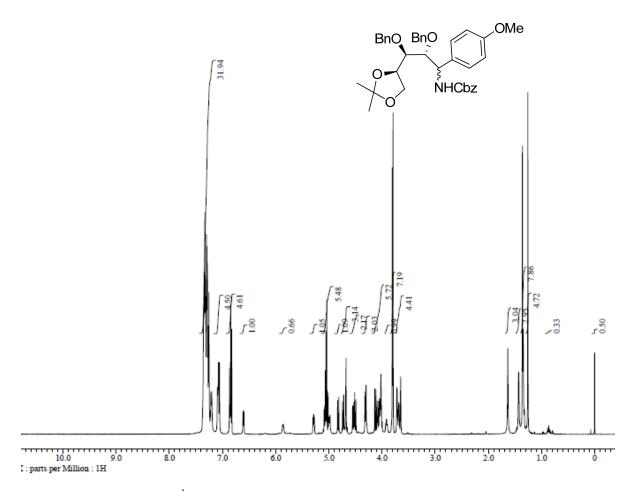


Figure 10.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 19

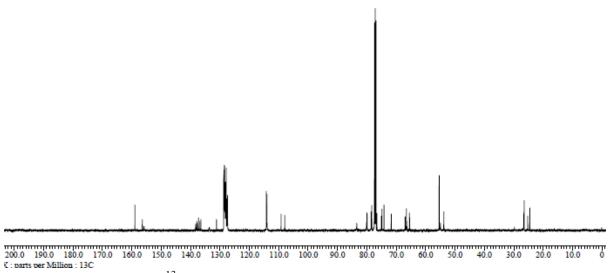


Figure 10.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 20

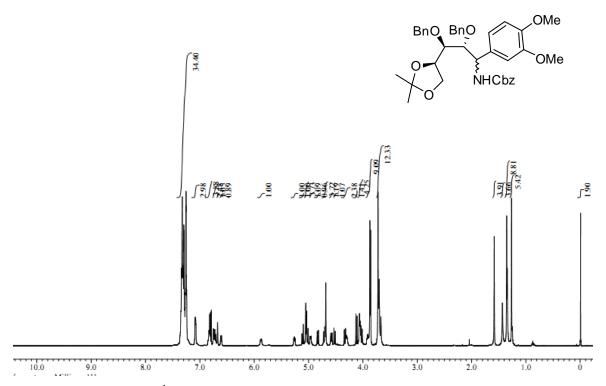


Figure 11.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 20a

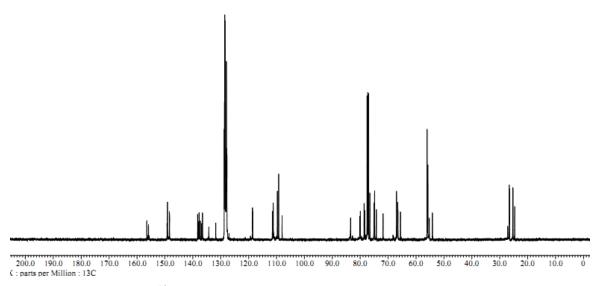


Figure 11.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 20a

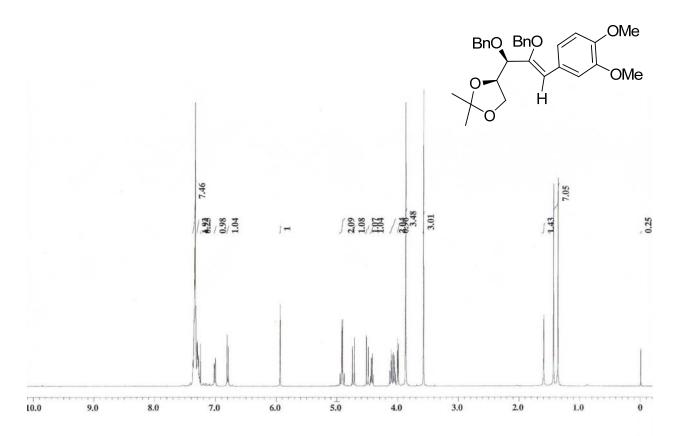
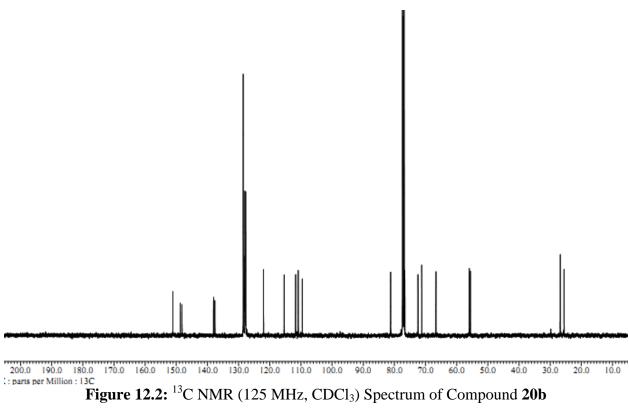


Figure 12.1: ¹H NMR (400 MHz, CDCl₃) Spectrum of Compound 20b



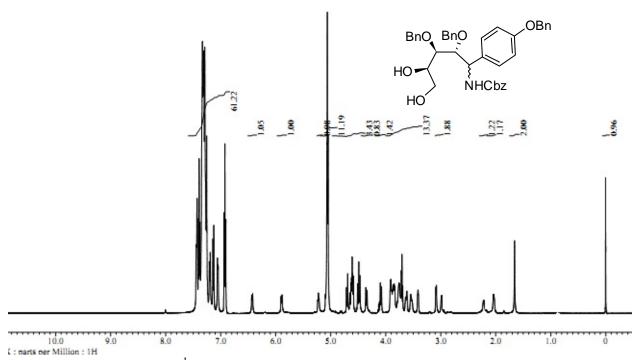


Figure 13.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound **10**

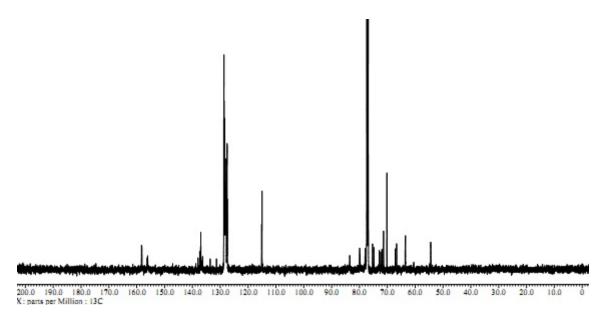


Figure 13.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 10

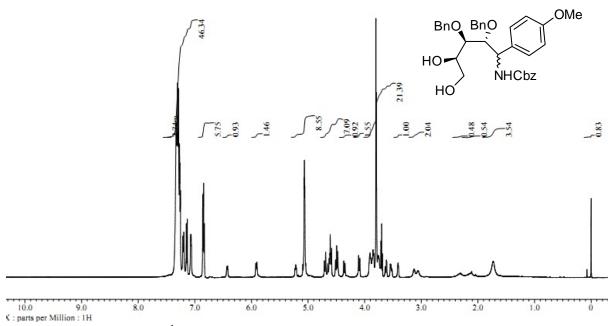


Figure 14.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 21

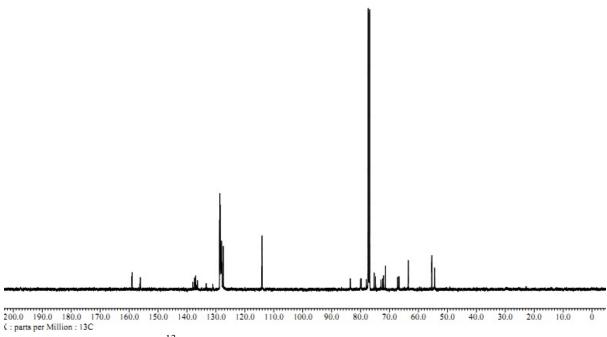


Figure 14.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 21

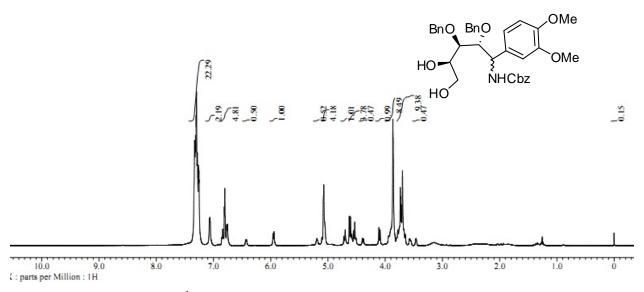


Figure 15.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 22

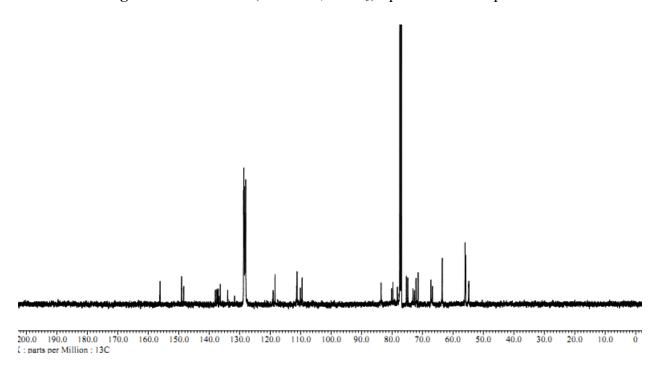


Figure 15.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 22

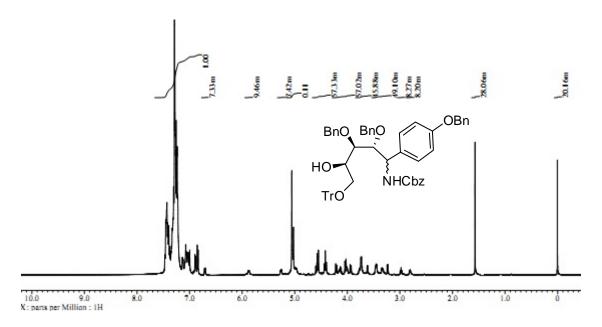


Figure 16.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 11

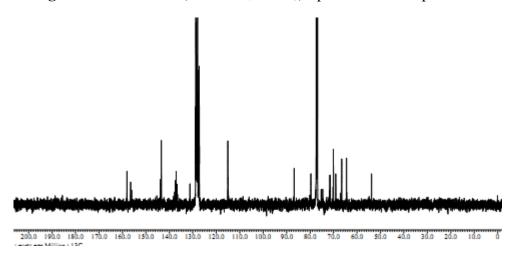


Figure 16.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 11

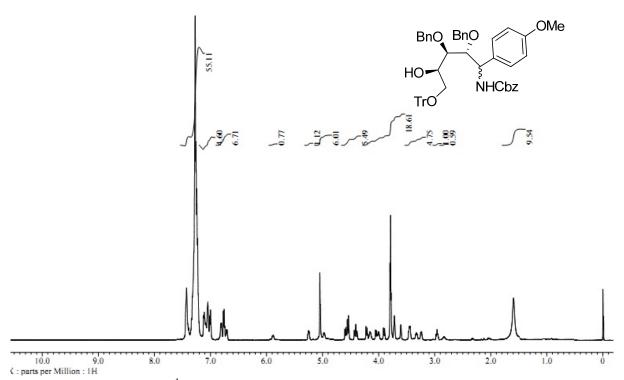


Figure 17.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 23

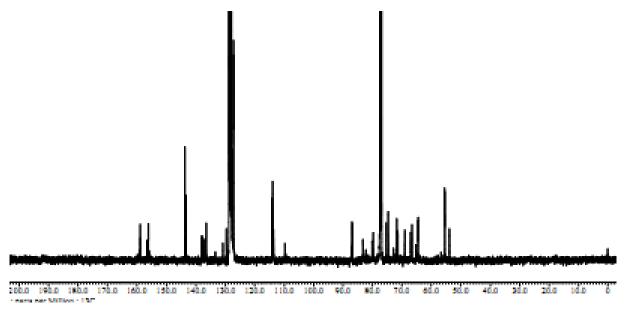


Figure 17.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 23

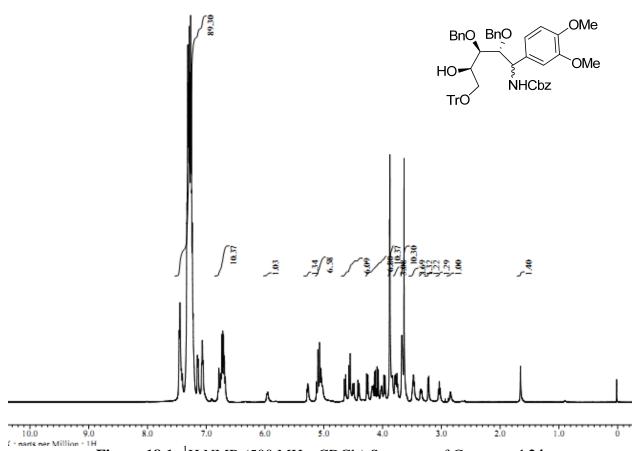


Figure 18.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 24

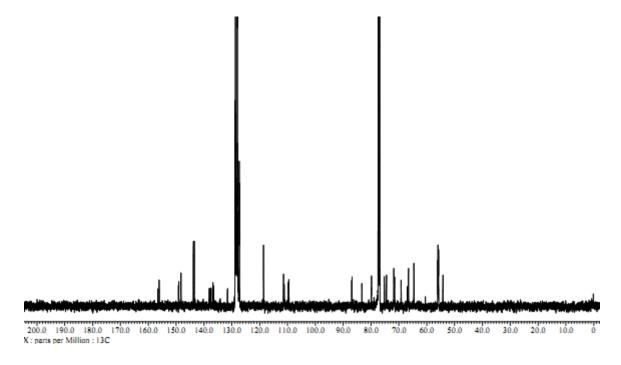


Figure 18.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 24

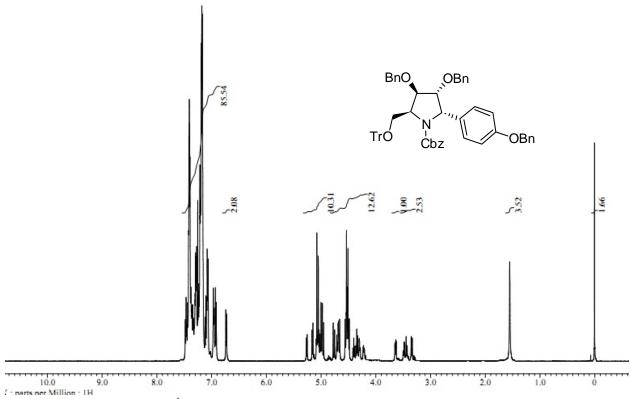


Figure 19.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 12a

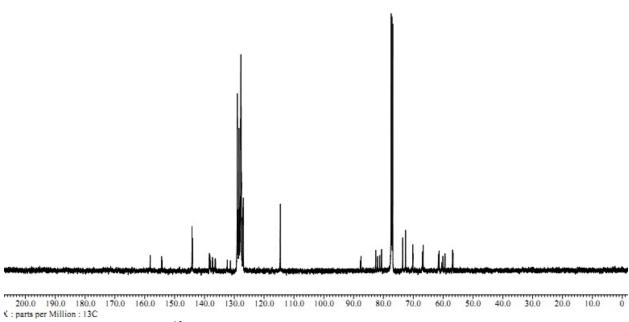


Figure 19.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 12a

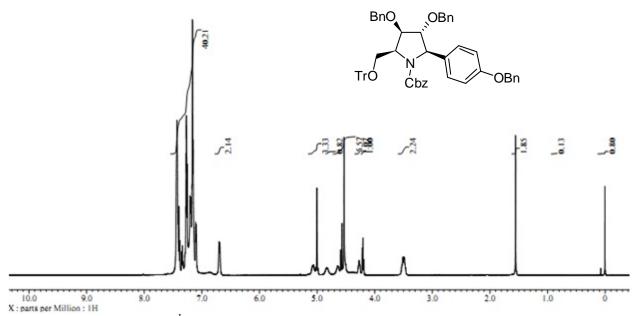


Figure 20.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 12b

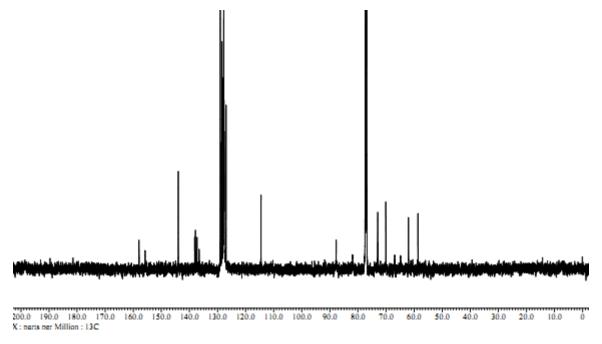


Figure 20.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 12b

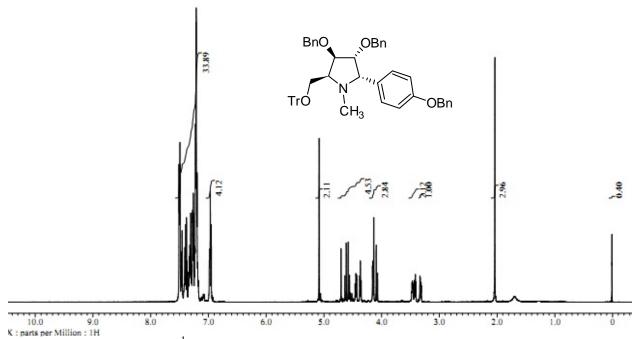


Figure 21.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound **13a**

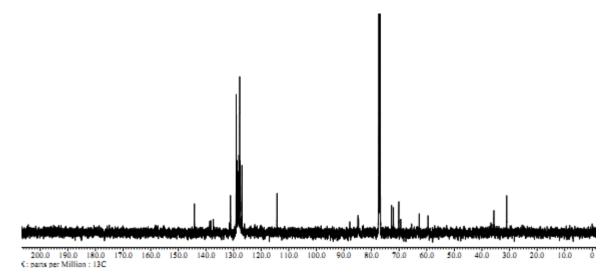


Figure 21.2: 13 C NMR (125 MHz, CDCl₃) Spectrum of Compound 13a

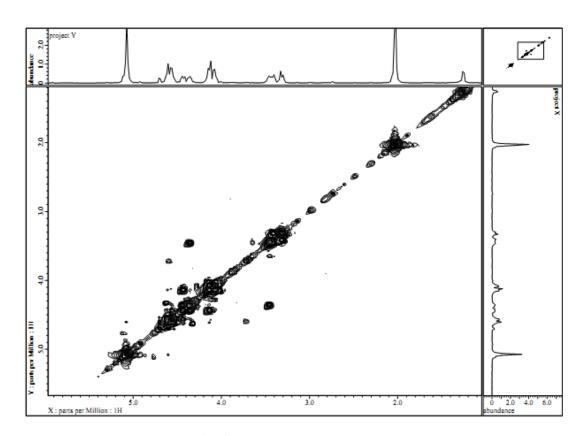


Figure 21.3: ¹H⁻¹H COSY Spectrum of Compound 13a

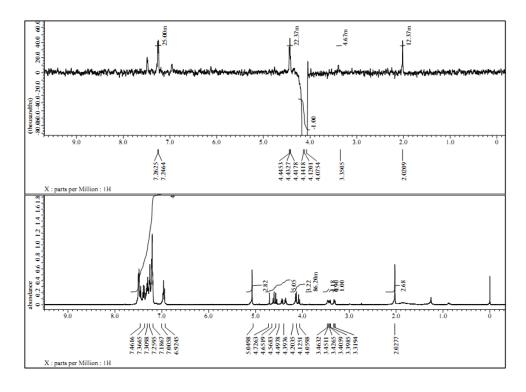


Figure 21.4: NOE irradiation of H-2 proton Spectrum of Compound 13a

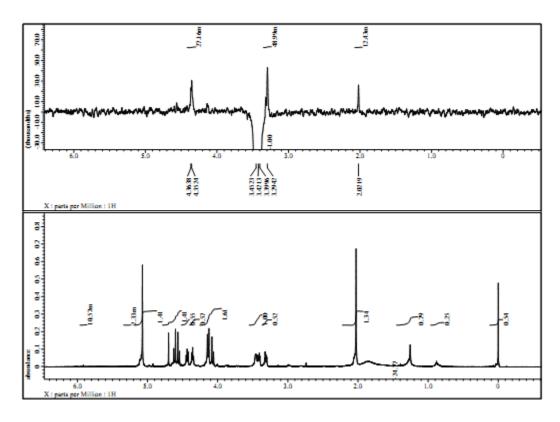


Figure 21.5: NOE irradiation of H-5 proton Spectrum of Compound 13a

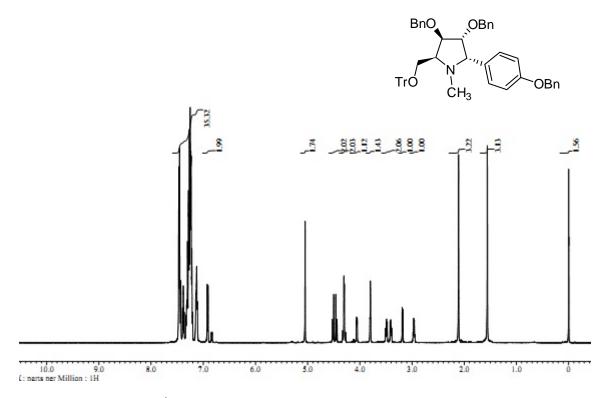


Figure 22.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 13b

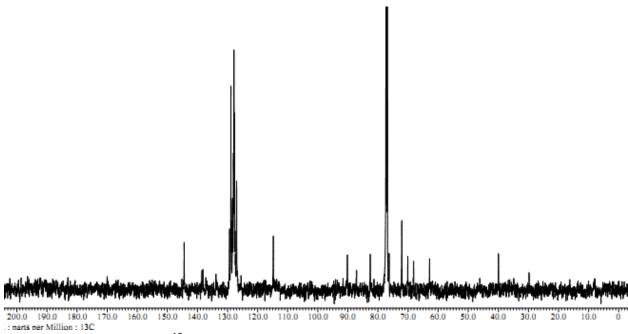


Figure 22.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 13b

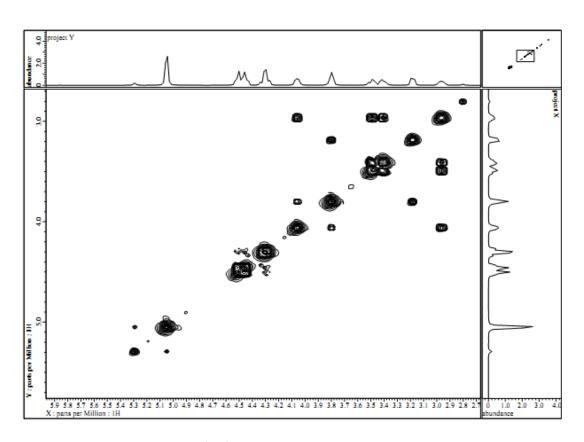


Figure 22.3: ¹H⁻¹H COSY Spectrum of Compound 13b

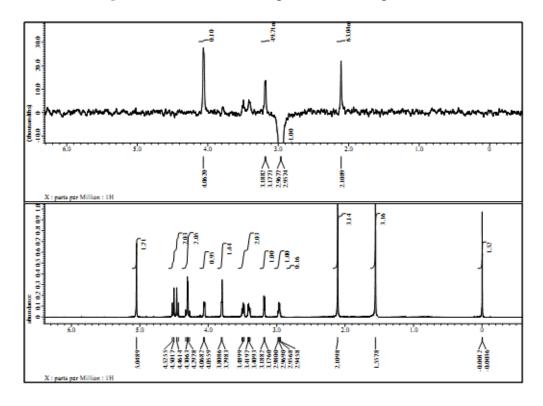


Figure 22.4: NOE irradiation of H-5 proton Spectrum of Compound 13b

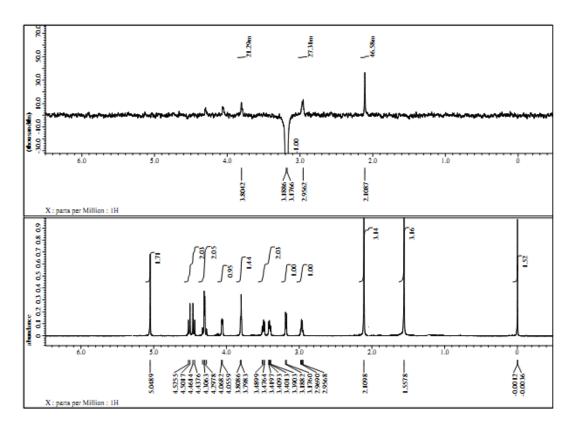


Figure 22.5: NOE irradiation of H-2 proton Spectrum of Compound 13b

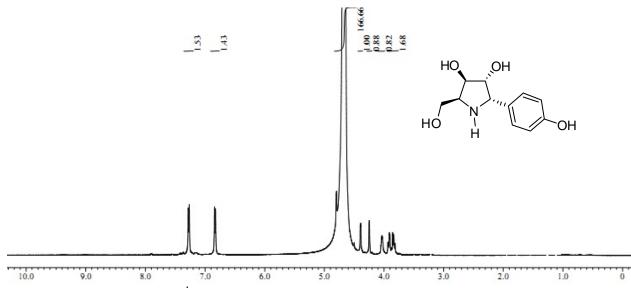


Figure 23.1: ¹H NMR (500 MHz, D₂O) Spectrum of Compound 14a

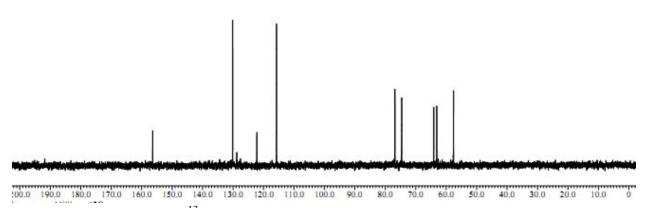


Figure 23.2: ¹³C NMR (125 MHz, D₂O) Spectrum of Compound 14a

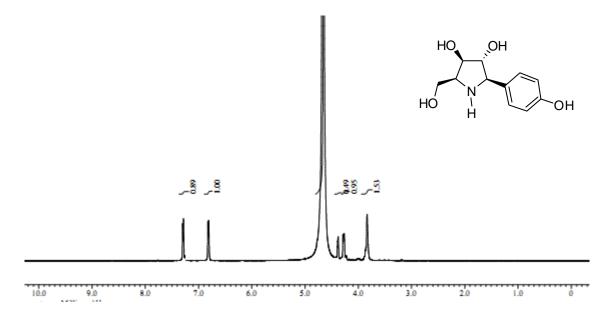


Figure 24.1: ¹H NMR (500 MHz, D₂O) Spectrum of Compound 14b

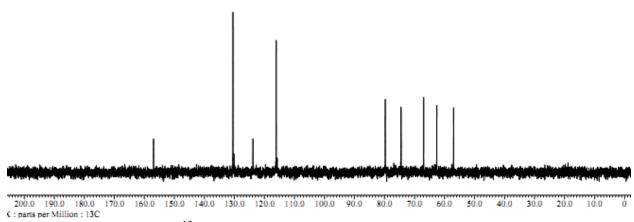


Figure 24.2: ¹³C NMR (125 MHz, D₂O) Spectrum of Compound 14b

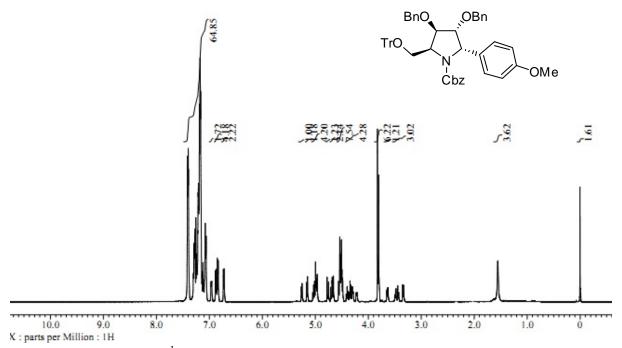


Figure 25.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 25a

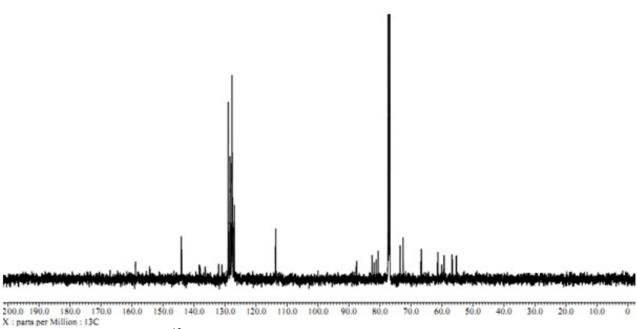


Figure 25.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 25a

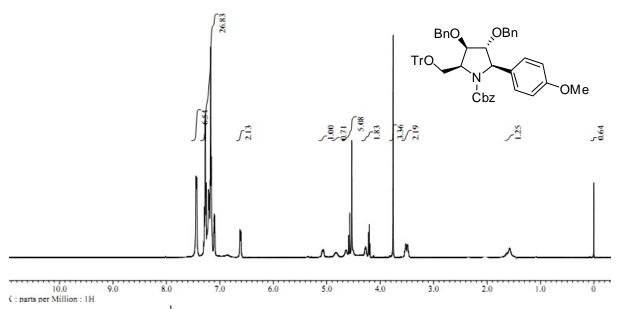


Figure 26.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 25b

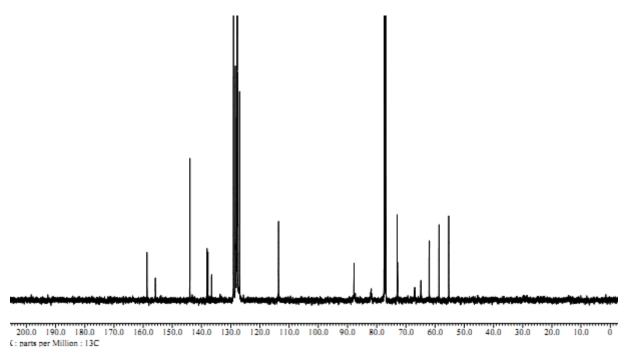


Figure 26.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 25b

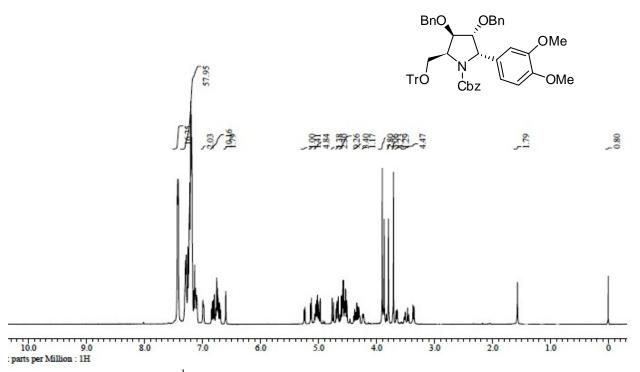


Figure 27.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 26a

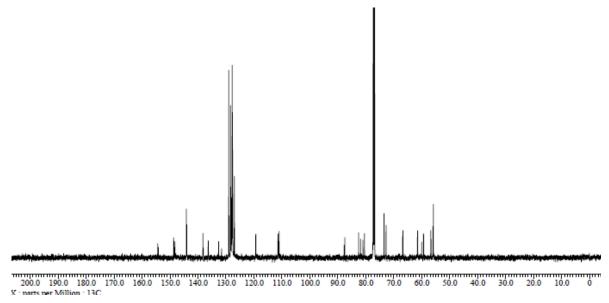


Figure 27.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 26a

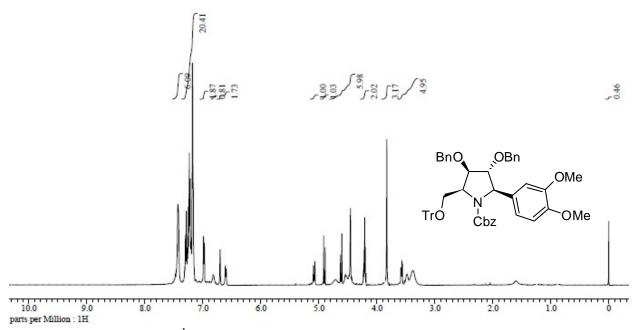
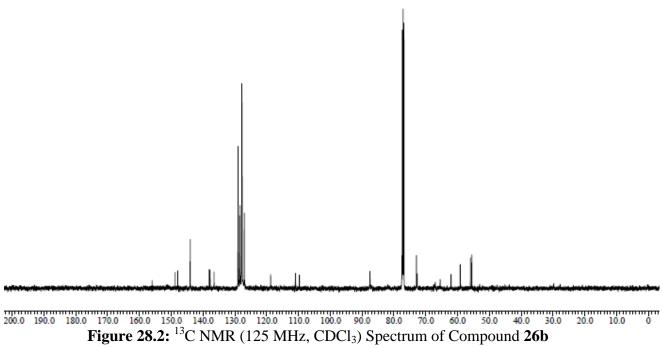


Figure 28.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 26b



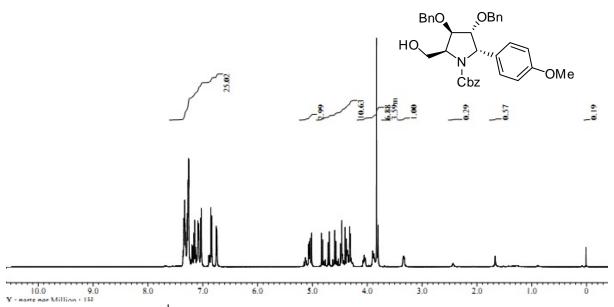


Figure 29.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 27a

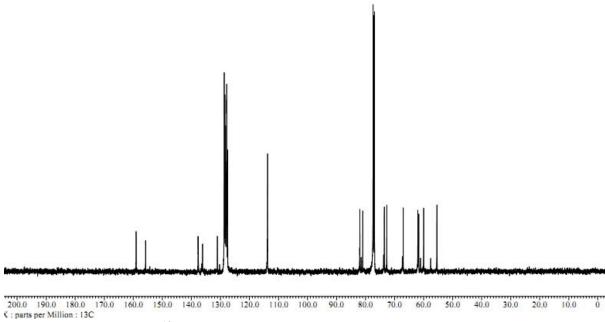
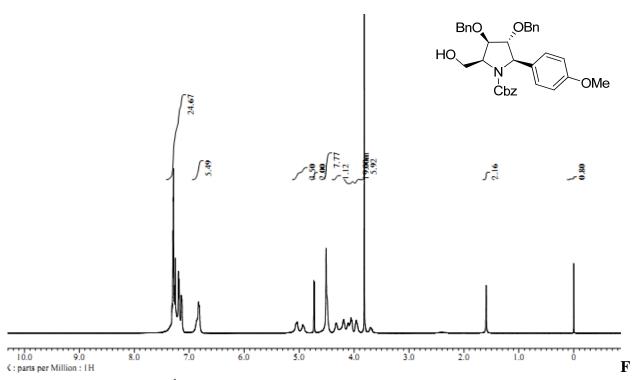


Figure 29.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 27a



igure 30.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 27b

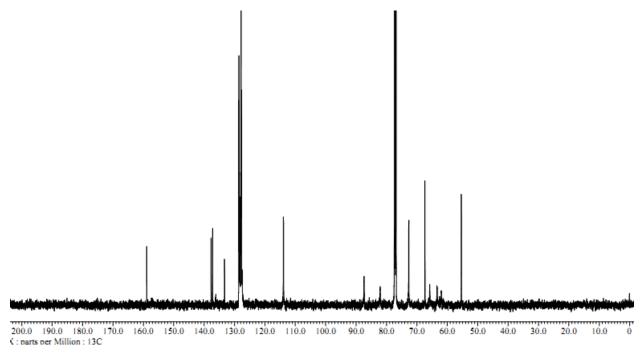


Figure 30.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 27b

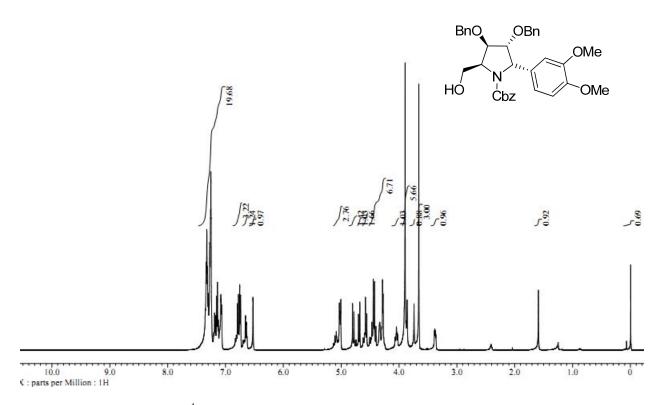


Figure 31.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 28a

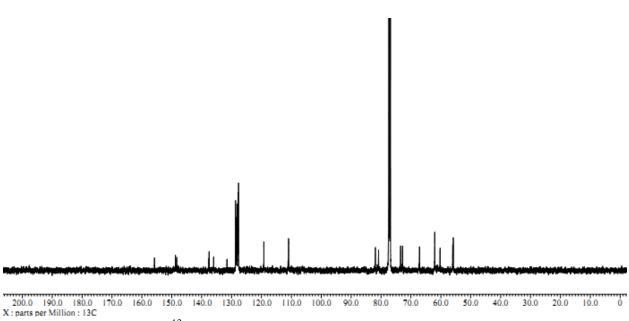


Figure 31.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 28a

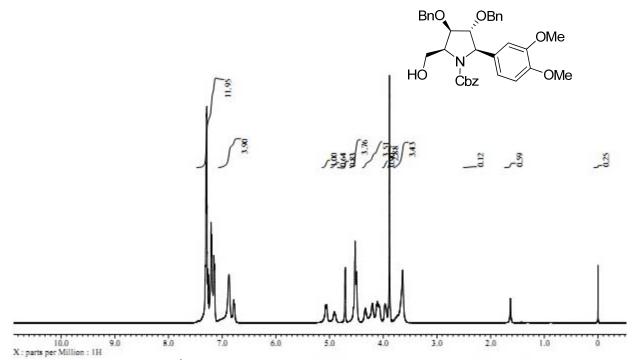


Figure 32.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 28b

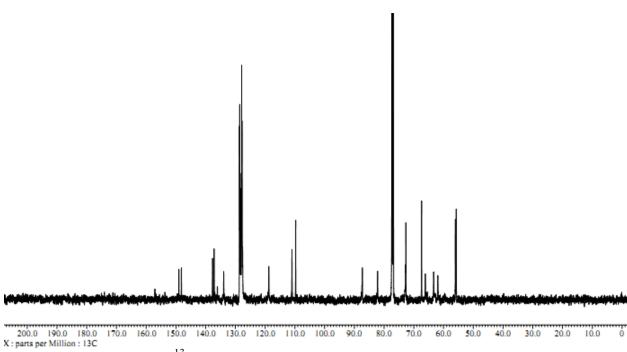


Figure 32.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 28b

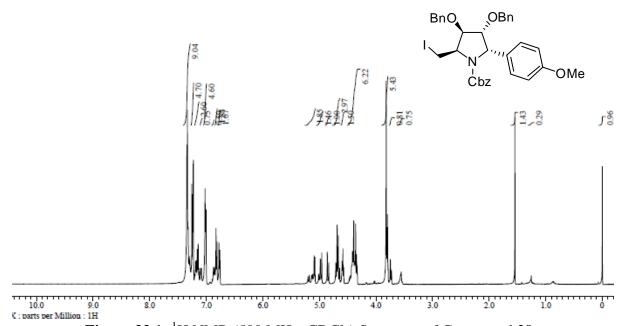


Figure 33.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 29a

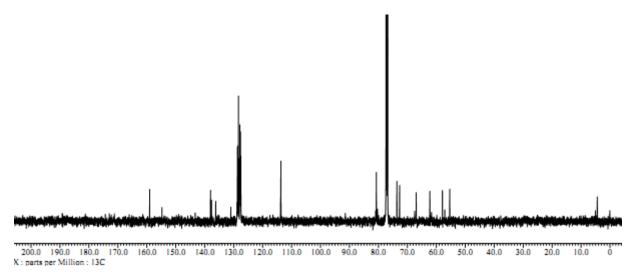


Figure 33.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 29a

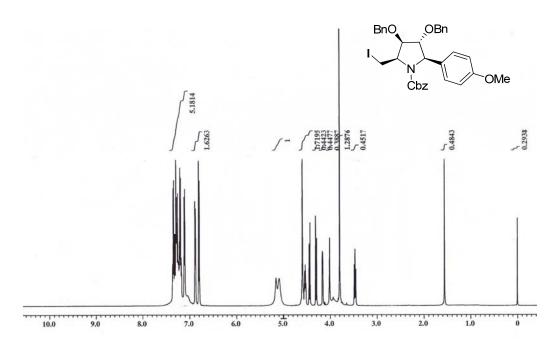


Figure 34.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 29b

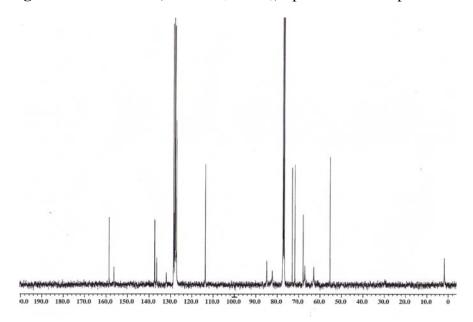


Figure 34.2: ¹³C NMR (100 MHz, CDCl₃) Spectrum of Compound 29b

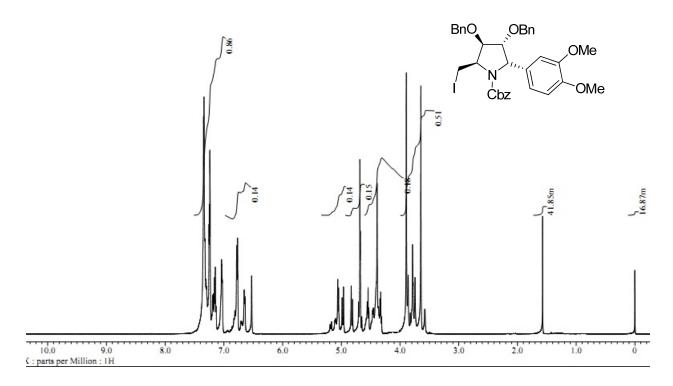


Figure 35.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 30a

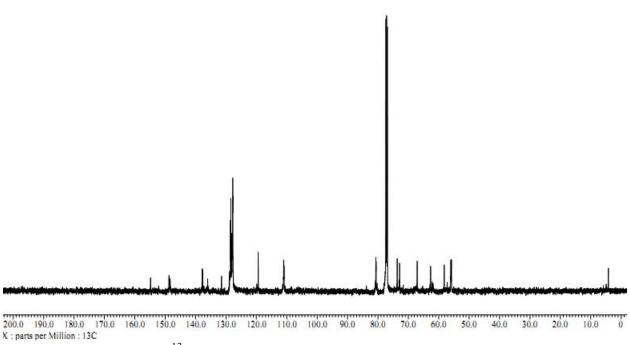


Figure 35.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 30a

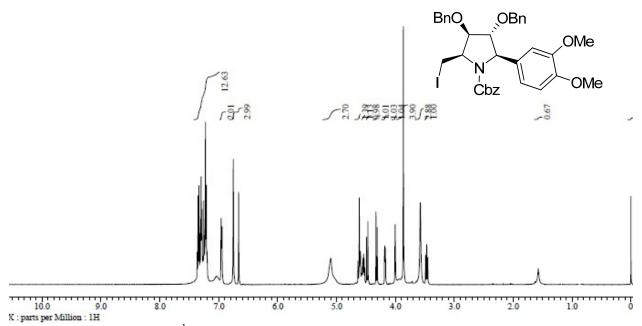
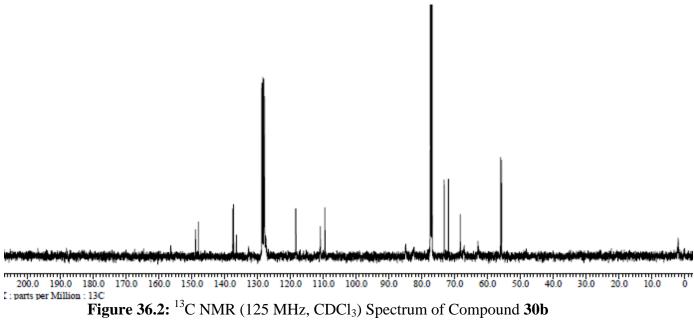


Figure 36.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound **30b**



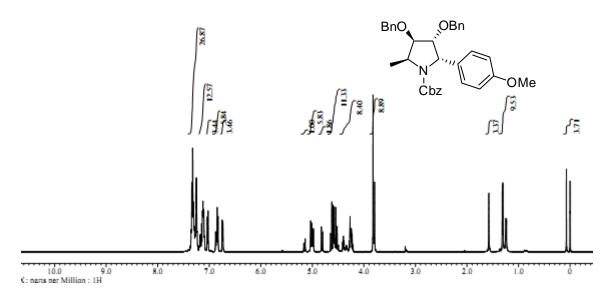


Figure 37.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 31a

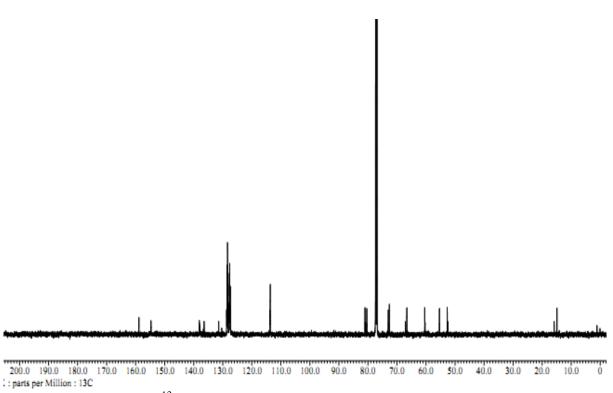


Figure 37.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 31a

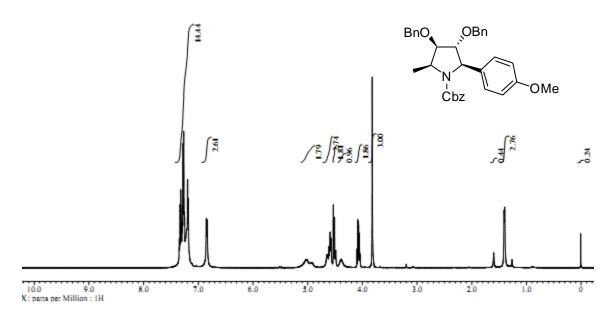


Figure 38.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 31b

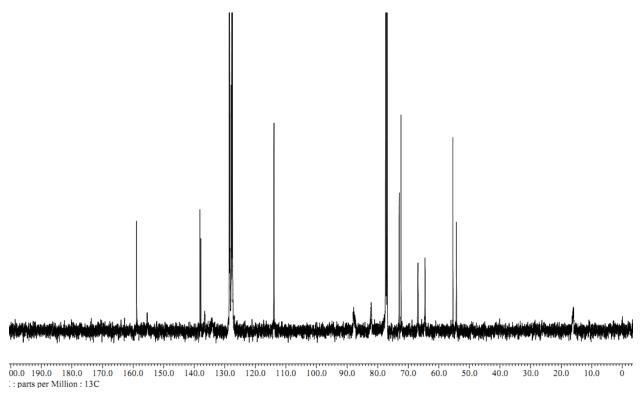


Figure 38.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 31b

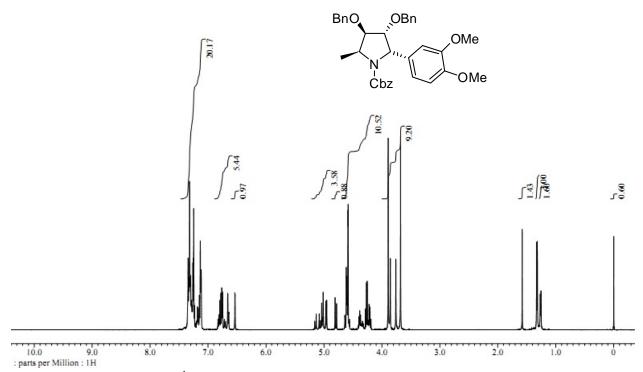


Figure 39.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 32a

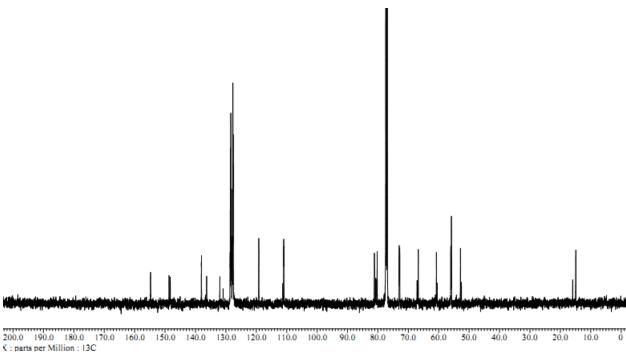


Figure 39.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 32a

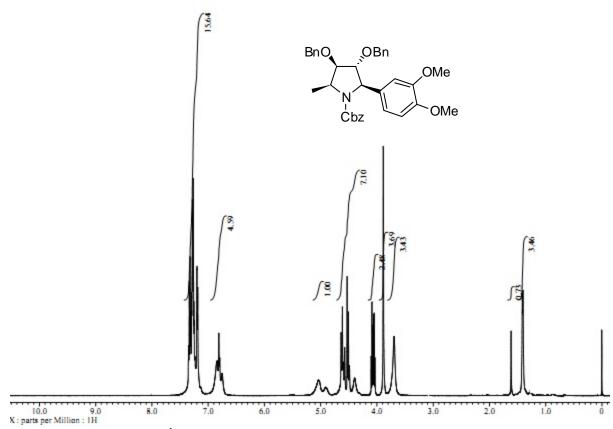


Figure 40.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 32b

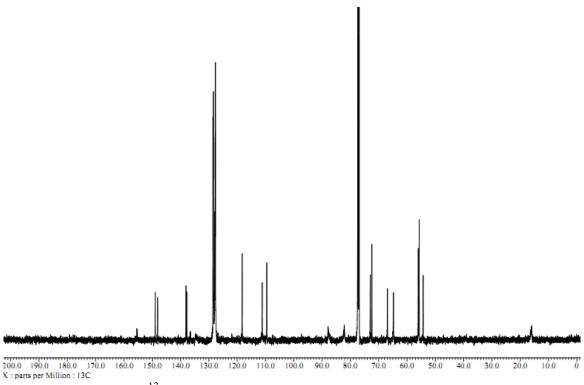


Figure 40.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 32b

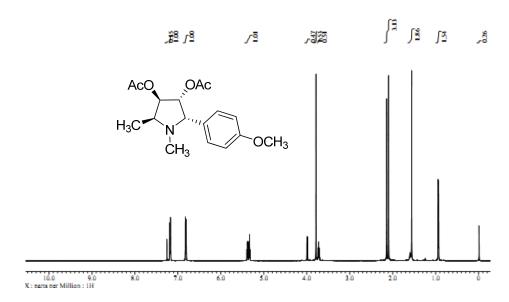


Figure 41.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 33a

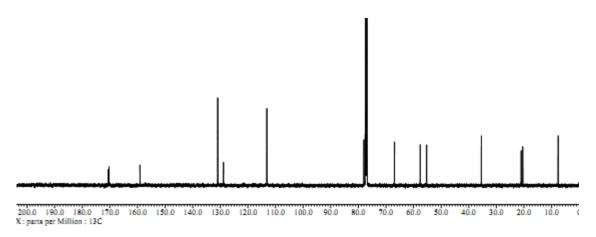


Figure 41.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 33a

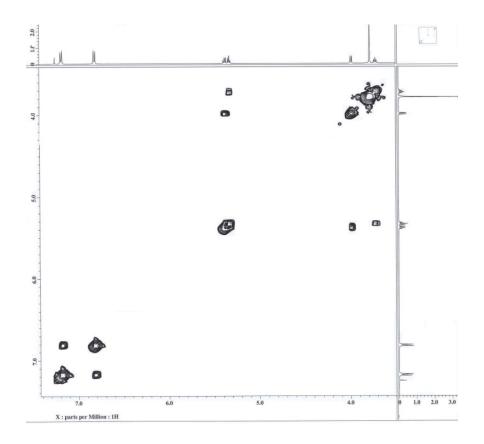


Figure 41.3: ¹H-¹H COSY Spectrum of Compound 33a

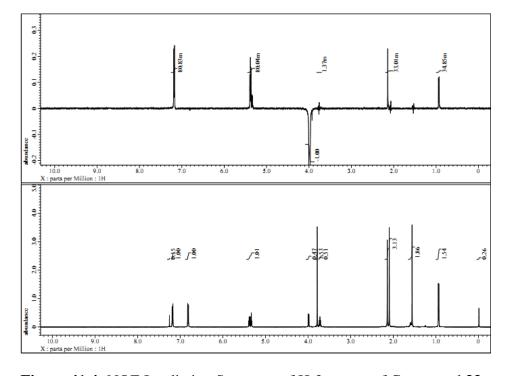


Figure 41.4: NOE Irradiation Spectrum of H-2 proton of Compound 33a

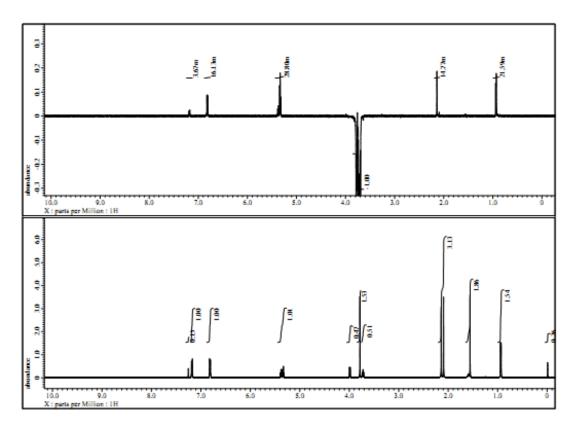


Figure 41.5: NOE Irradiation Spectrum of H-5 proton of Compound 33a

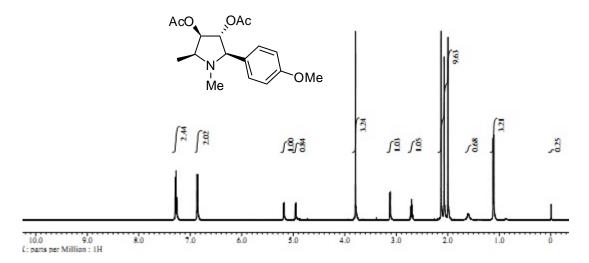


Figure 42.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 33b

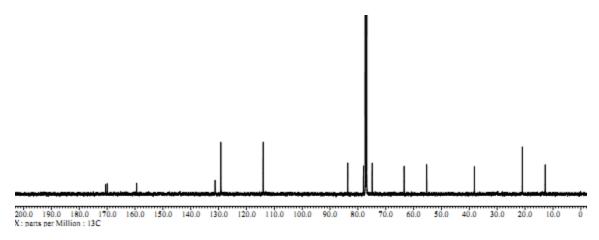


Figure 42.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 33b

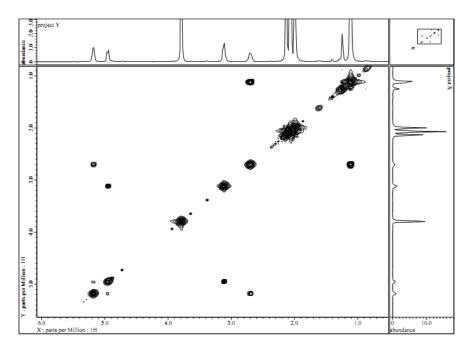


Figure 42.3: ¹H-¹H COSY Spectrum of Compound 33b

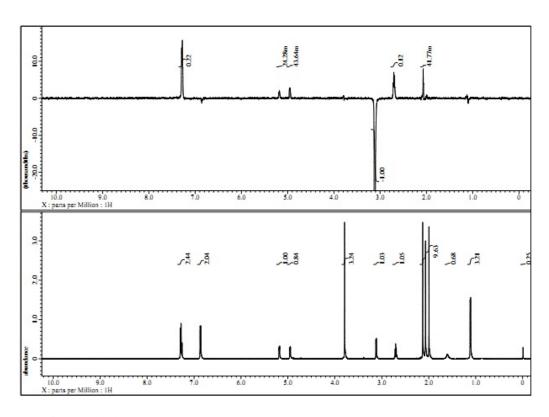


Figure 42.4: NOE Irradiation Spectrum of H-2 proton of Compound 33b

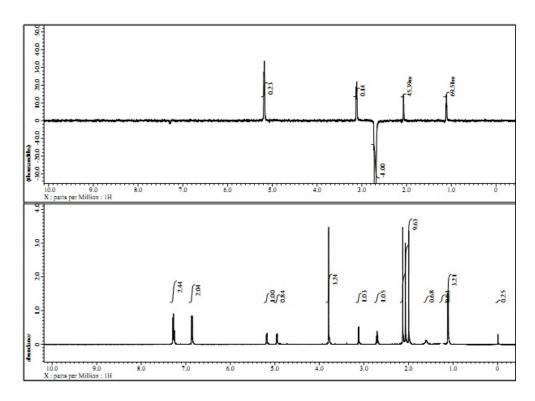


Figure 42.5: NOE Irradiation Spectrum of H-2 proton of Compound 33b

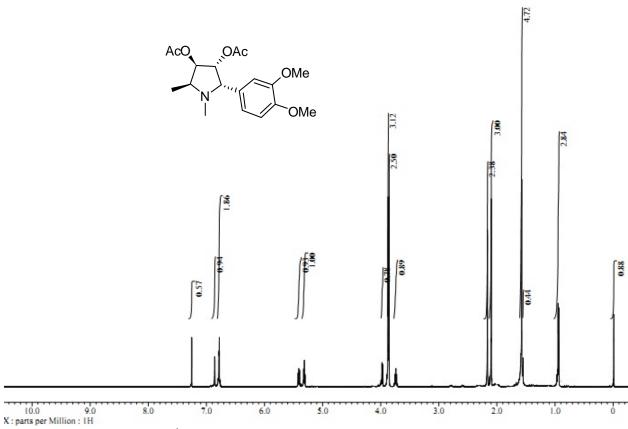


Figure 43.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 34a

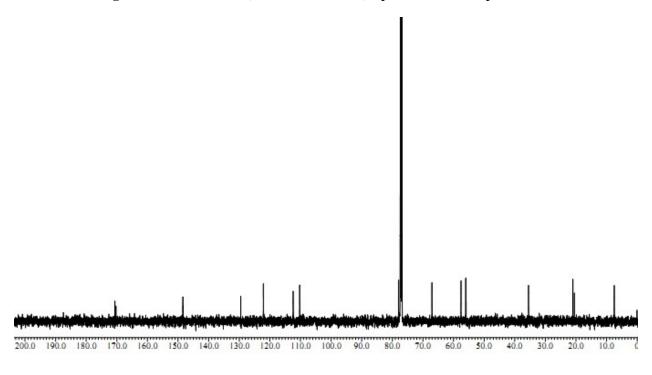


Figure 43.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 34a

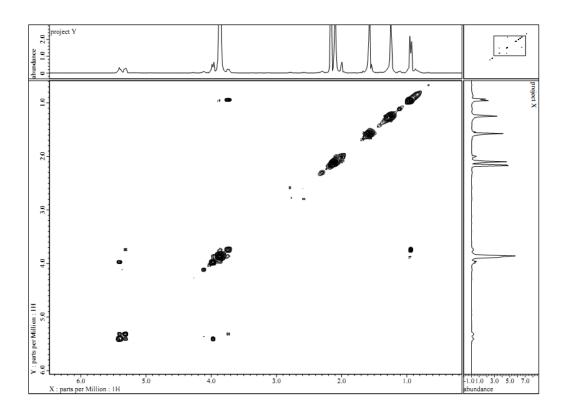


Figure 43.3: ¹H-¹H COSY Spectrum of Compound 34a

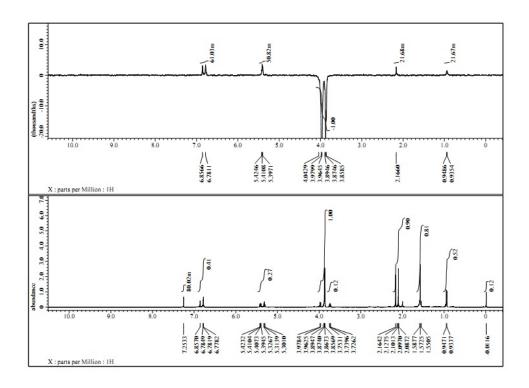


Figure 43.4: NOE irradiation of H-2 proton Spectrum of Compound 34a

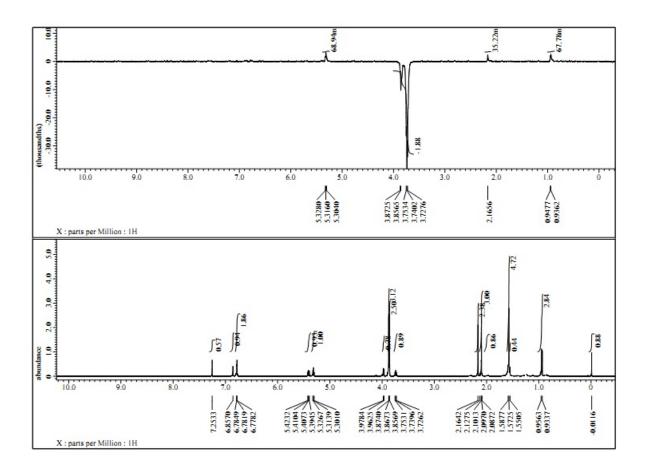


Figure 43.5: NOE irradiation of H-5 proton Spectrum of Compound 34a

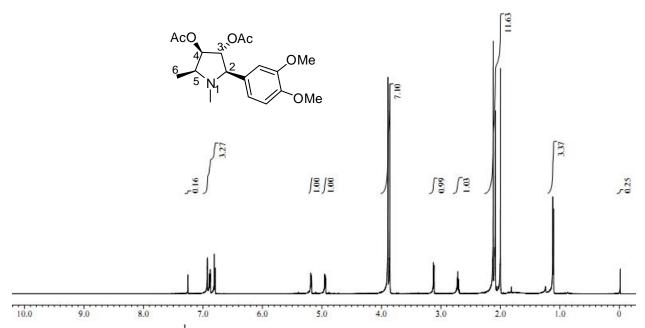


Figure 44.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 34b

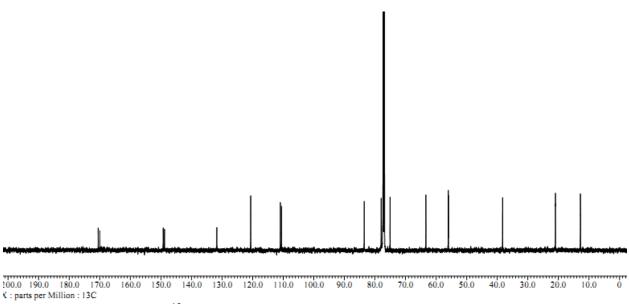


Figure 44.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 34b

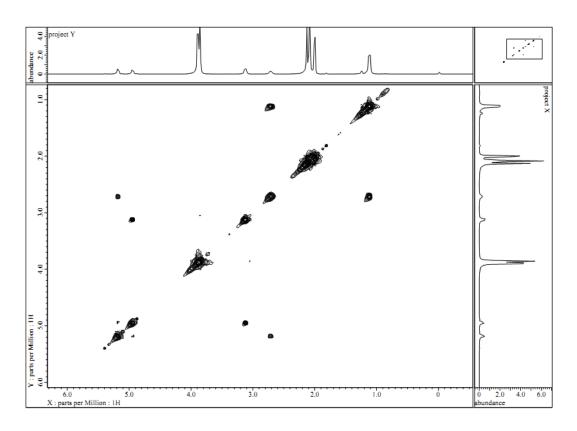


Figure 44.3: ¹H-¹H COSY Spectrum of Compound 34b

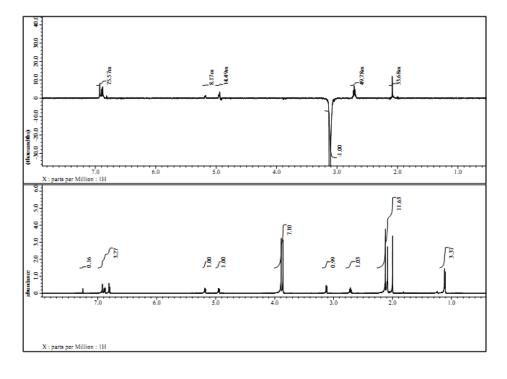


Figure 44.4: NOE irradiation of H-2 proton Spectrum of Compound 34b

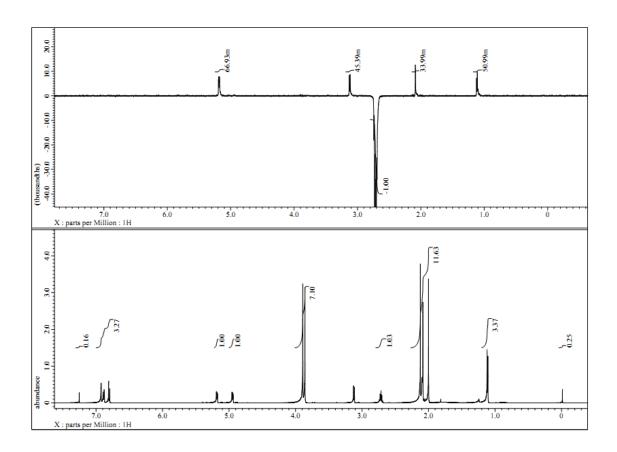
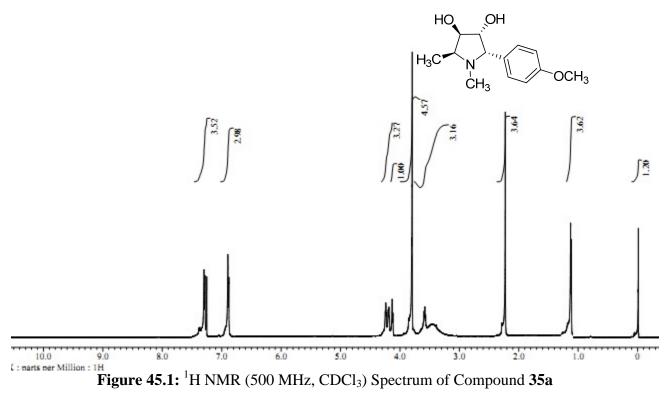


Figure 44.5: NOE irradiation of H-5 proton Spectrum of Compound 34b



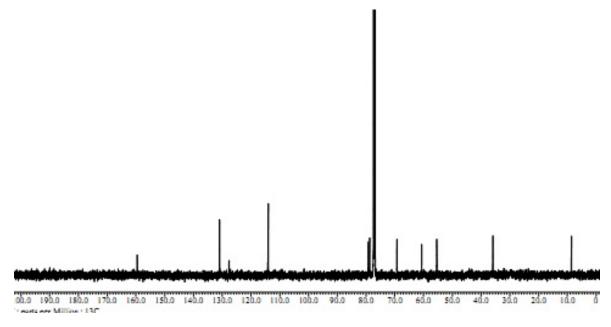
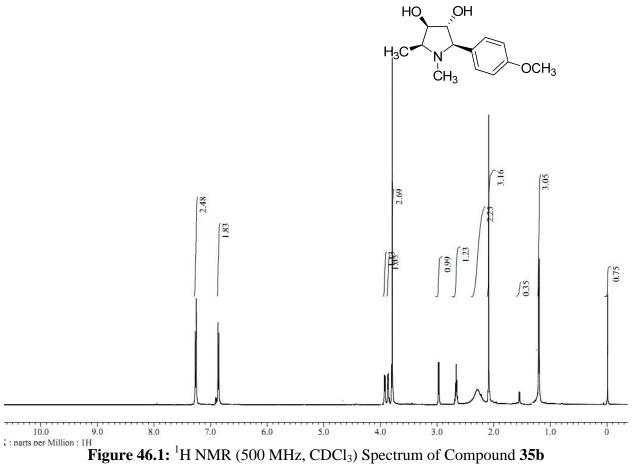
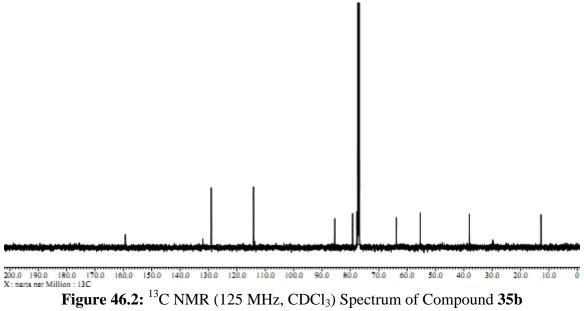


Figure 45.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 35a





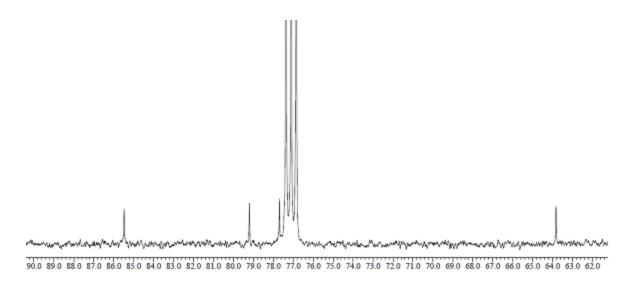


Figure 46.3: Expansion of ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 35b

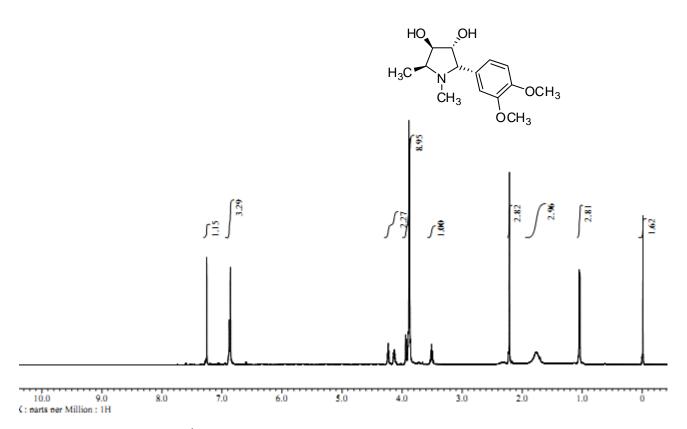


Figure 47.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 36a

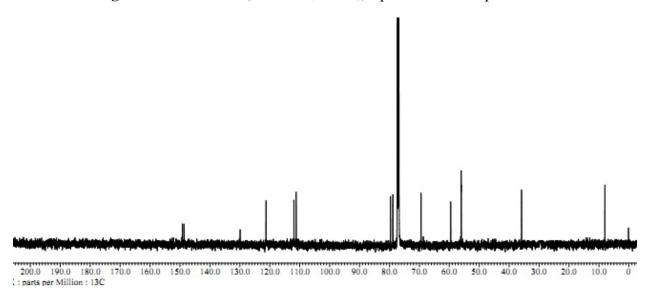


Figure 47.2: ¹³C NMR (125 MHz, CDCl₃) Spectrum of Compound 36a

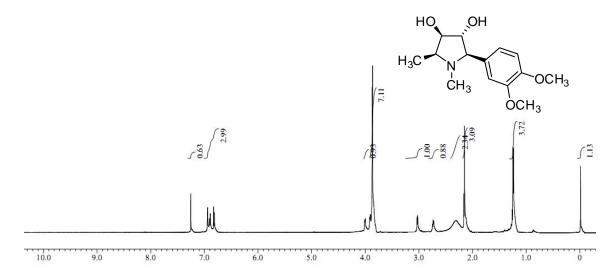
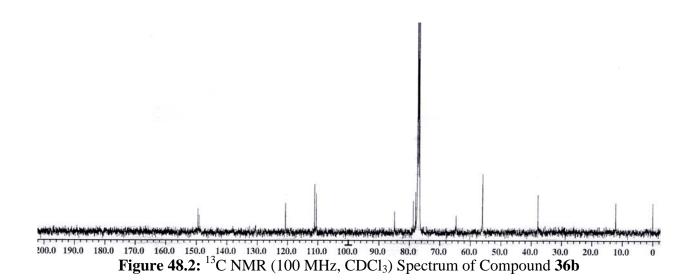


Figure 48.1: ¹H NMR (500 MHz, CDCl₃) Spectrum of Compound 36b



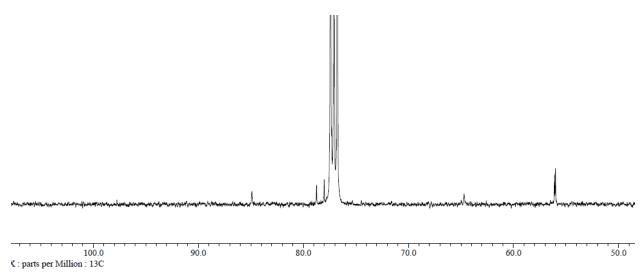


Figure 48.3: Expansion of ¹³C NMR (100 MHz, CDCl₃) Spectrum of Compound 36b