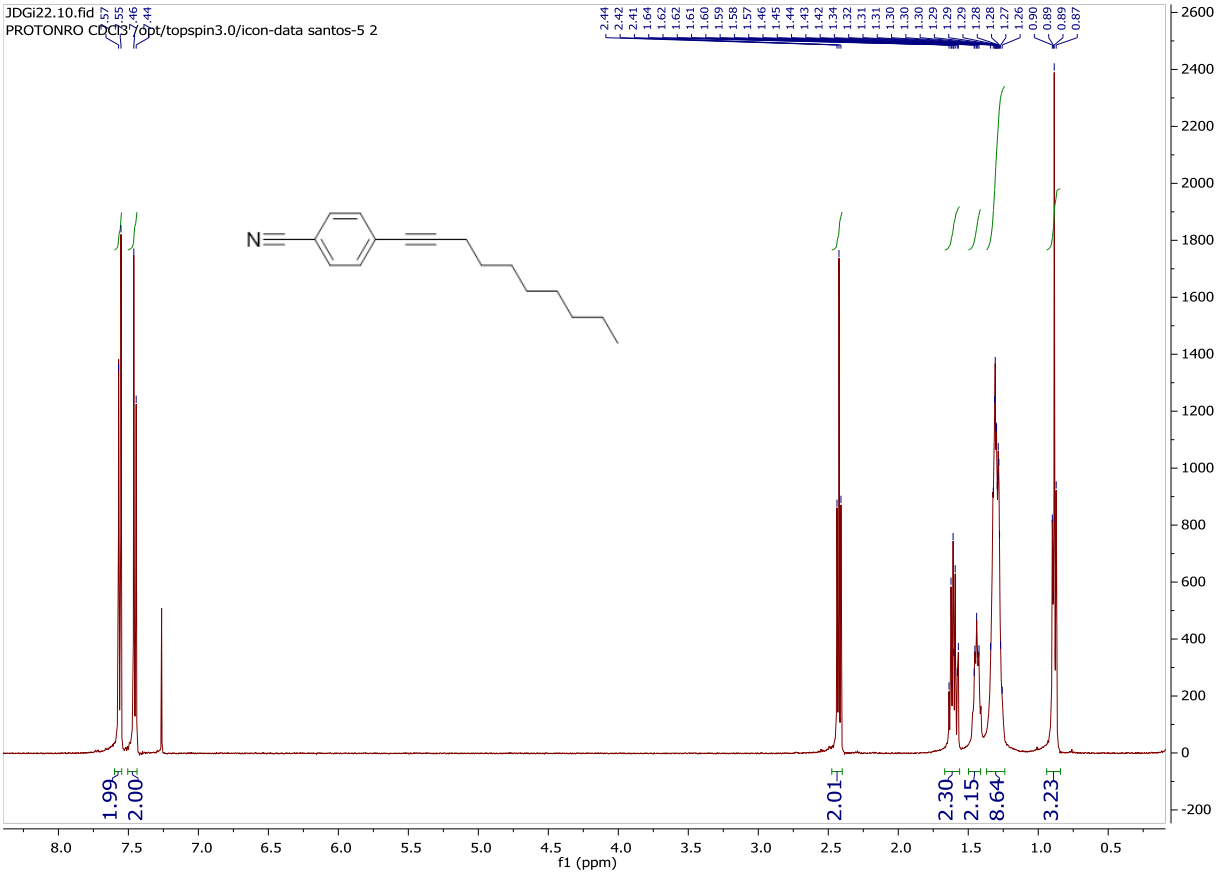
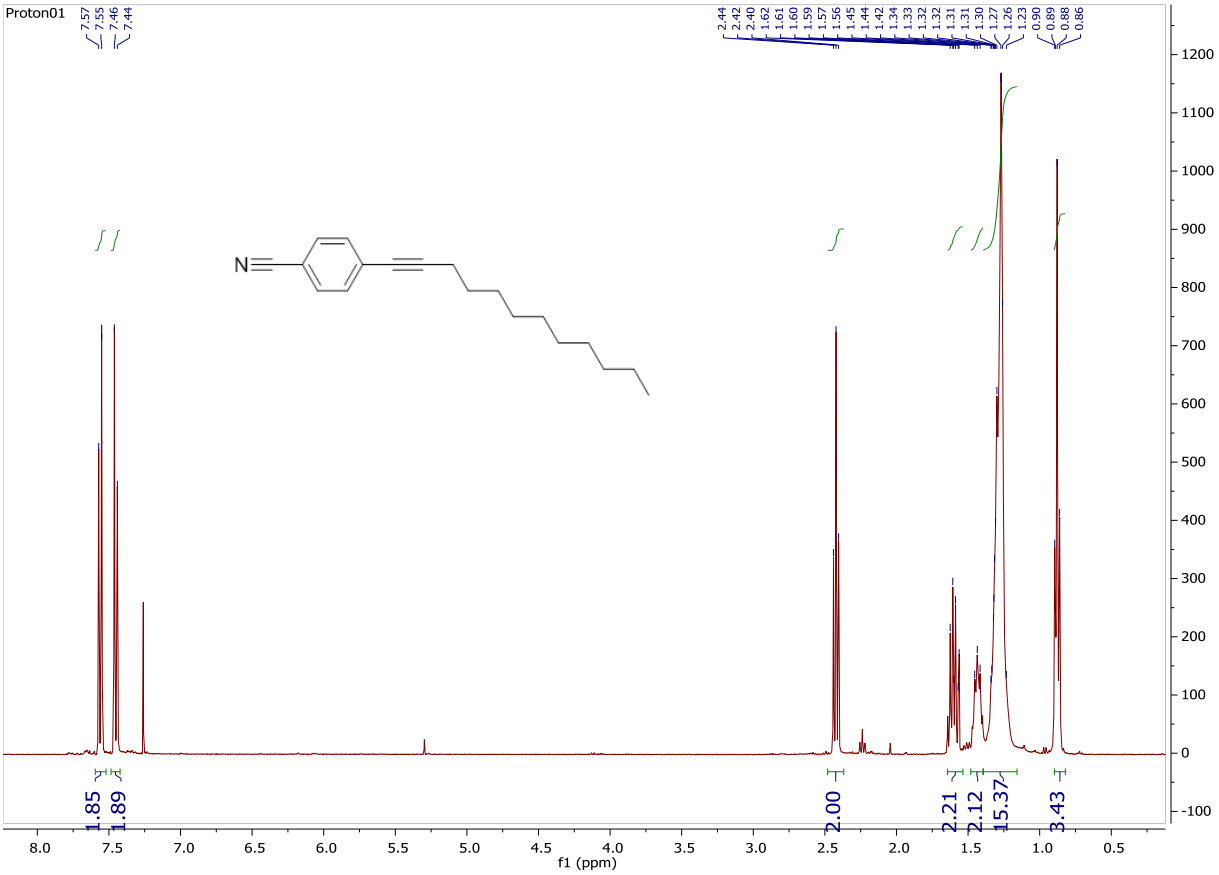
Appendix A NMR Spectra for Chapter 2

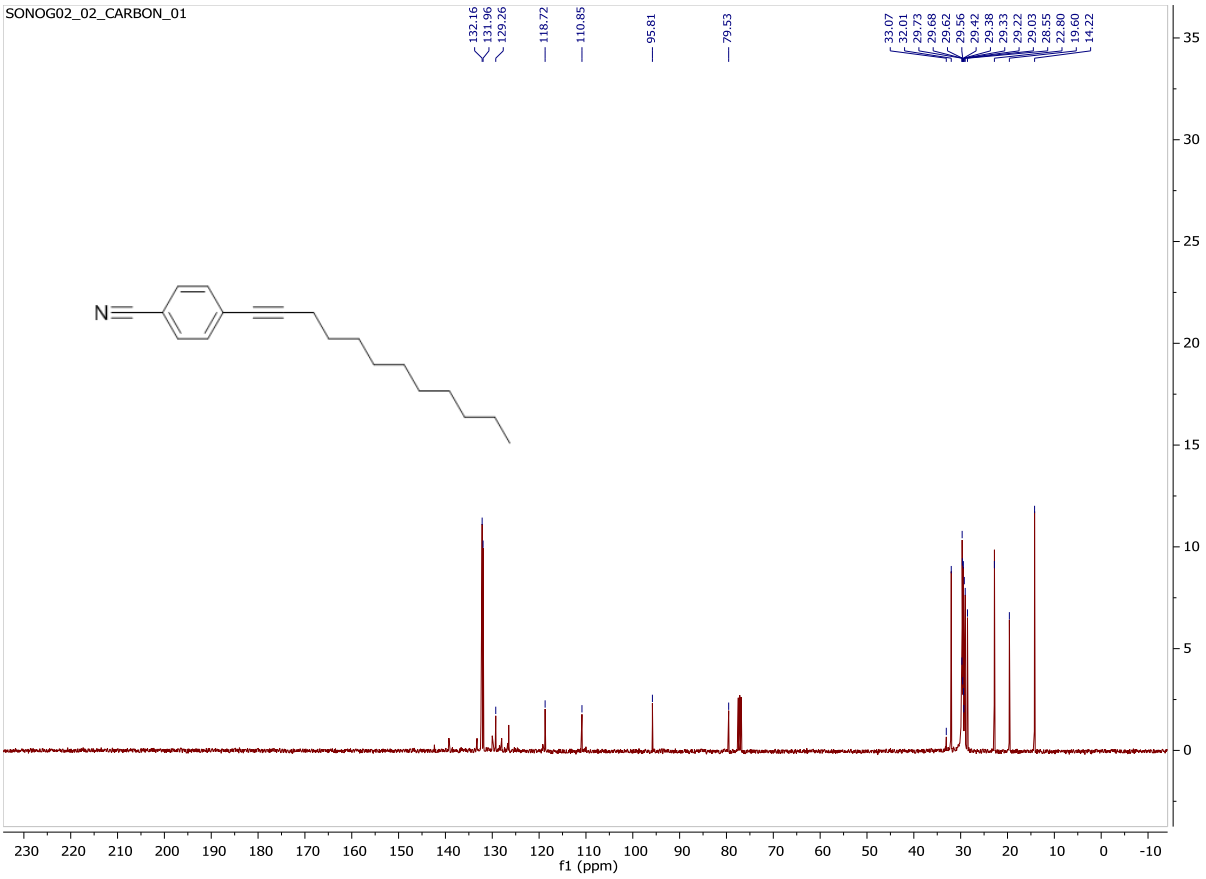
^{1}H-NMR Spectrum for Compound 2.1b:



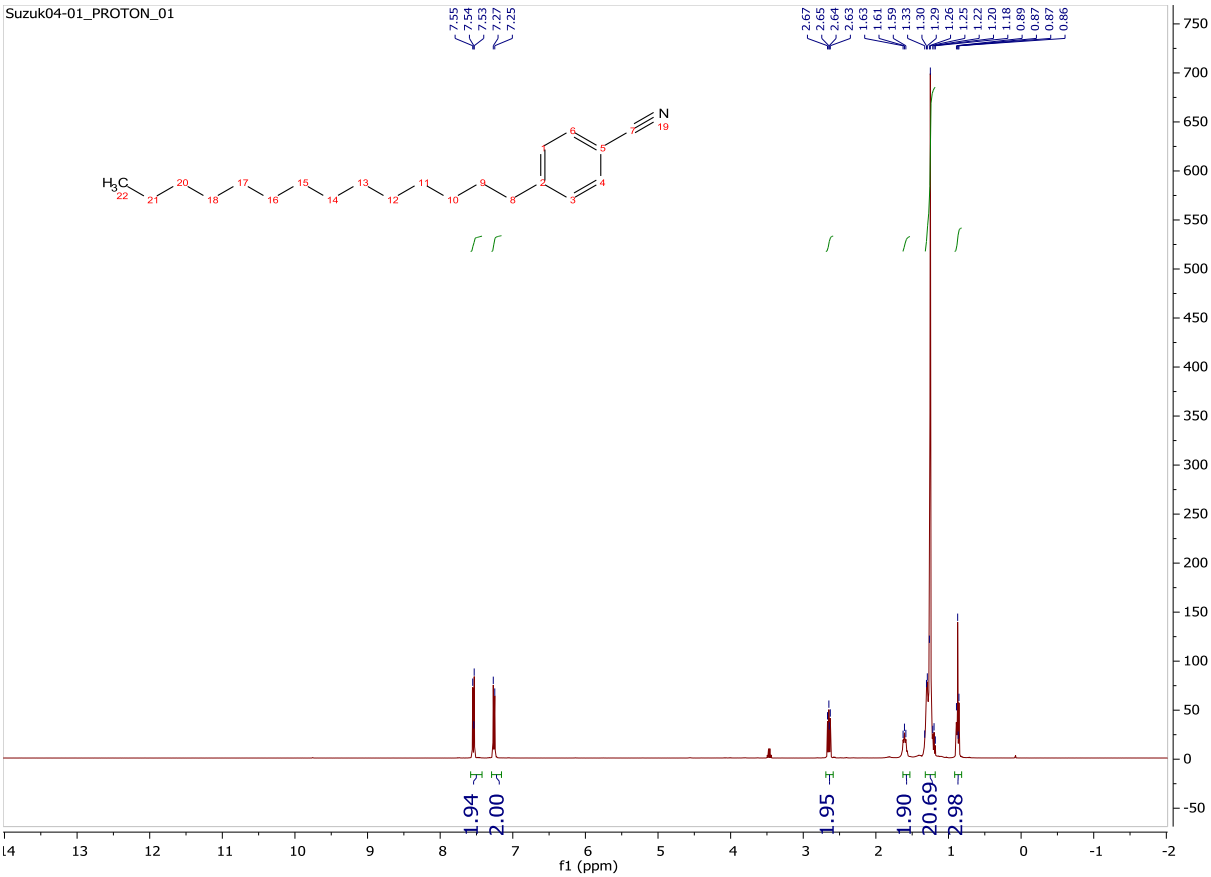
^{1}H-NMR Spectrum for Compound 2.1c:



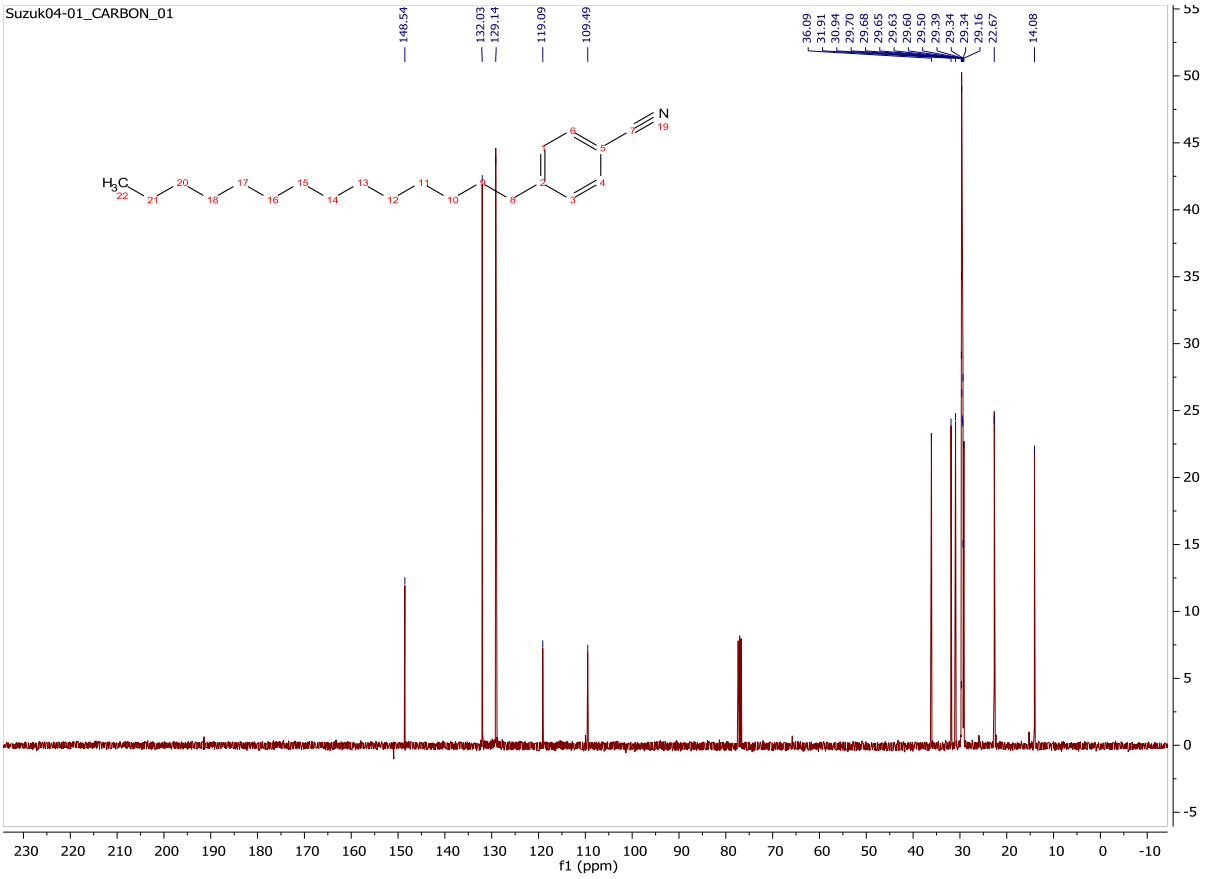
^{13}C-NMR Spectrum for Compound 2.1c



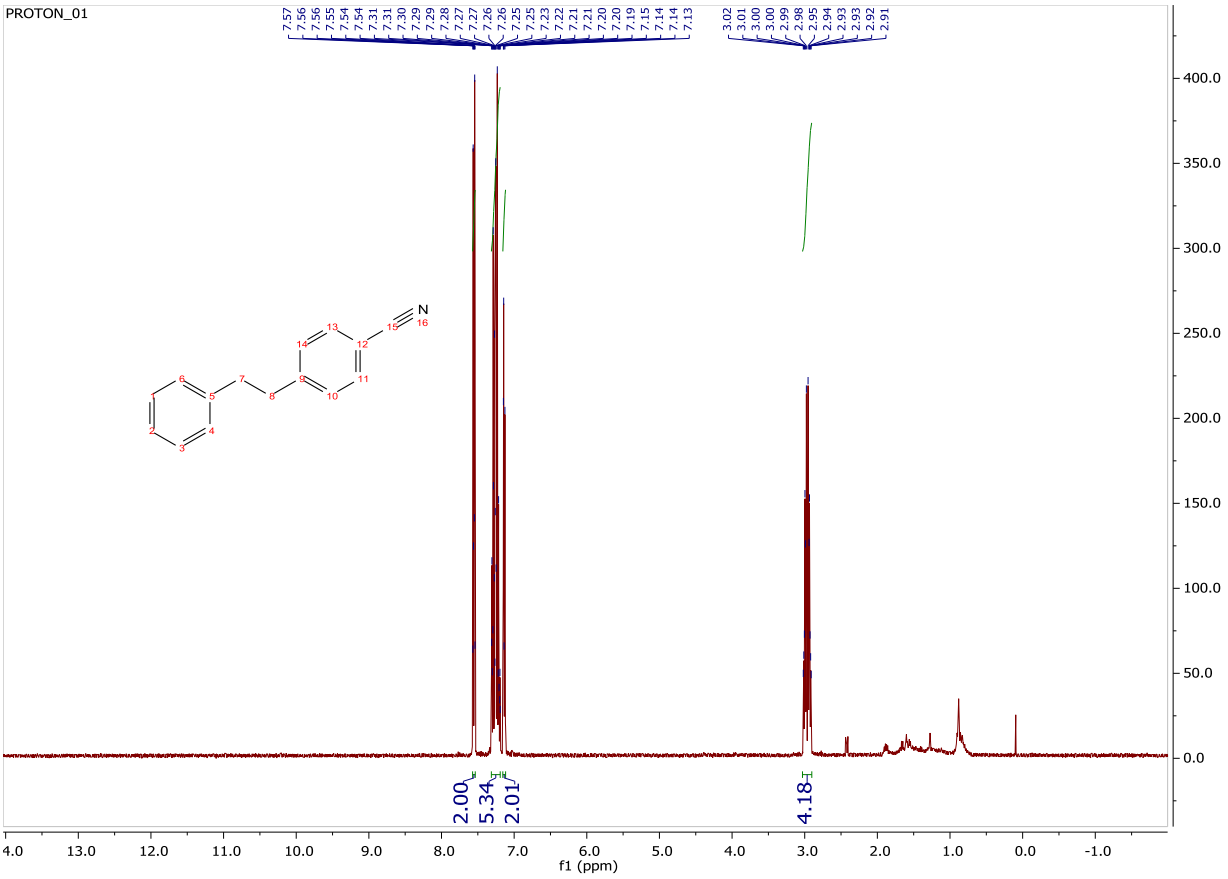
^{1}H-NMR Spectrum for Compound 2.1d



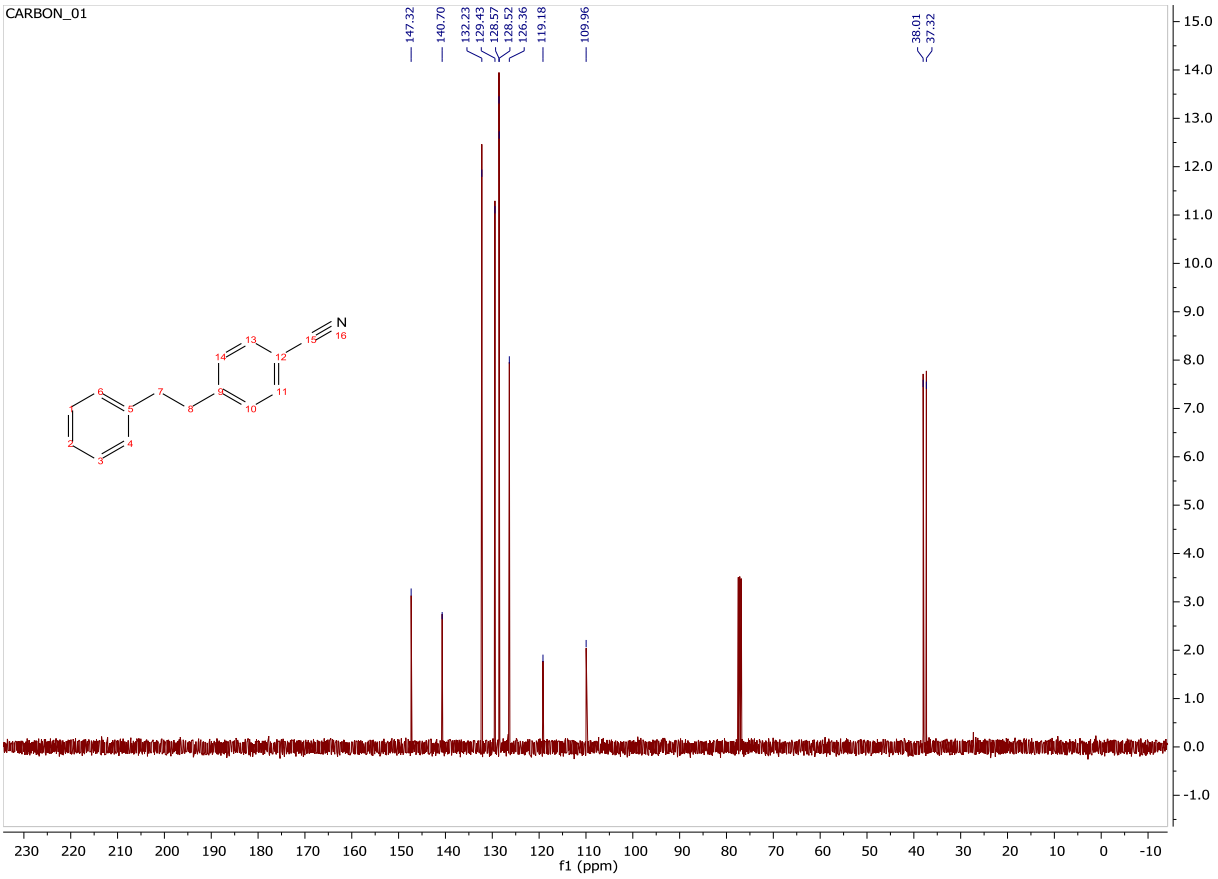
^{13}C-NMR Spectrum for Compound 2.1d



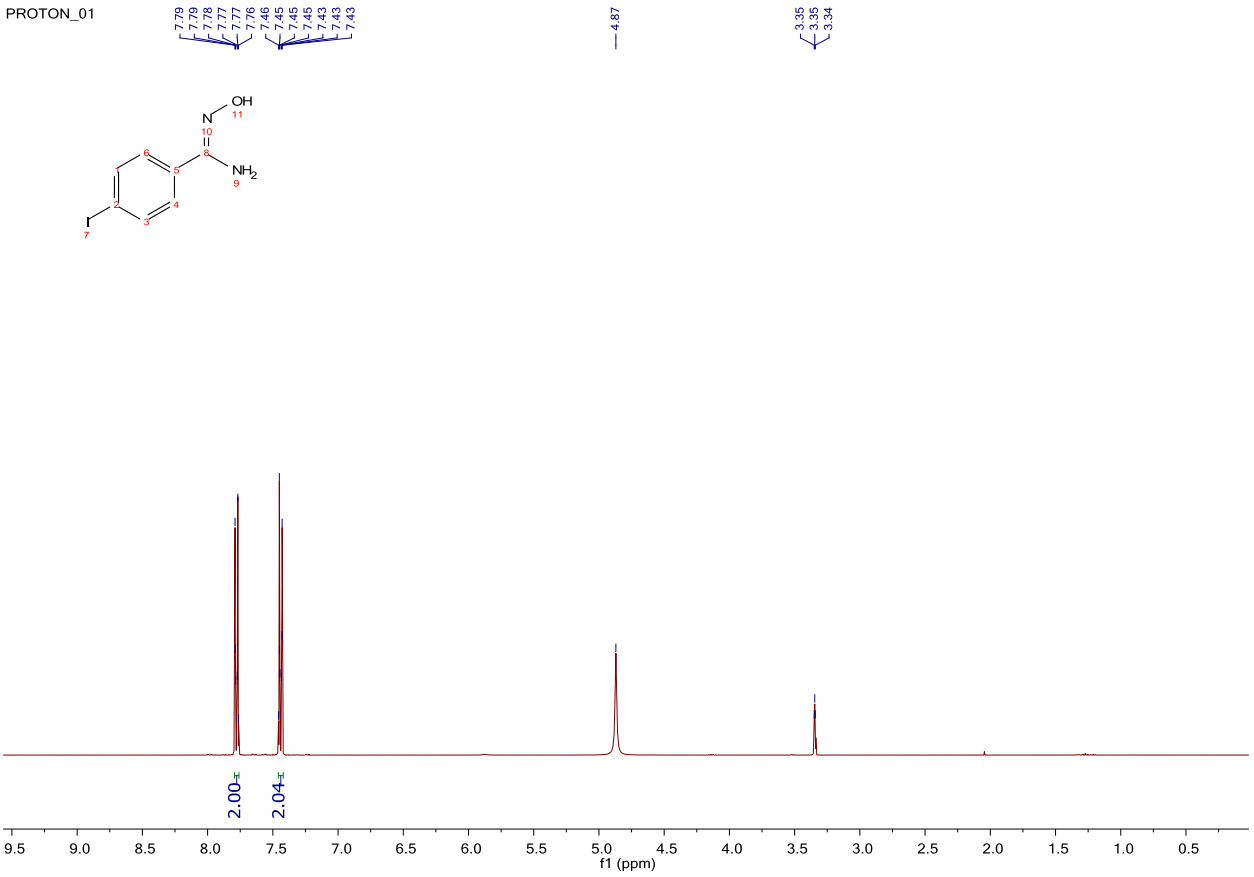
^{1}H-NMR Spectrum for Compound 2.1e



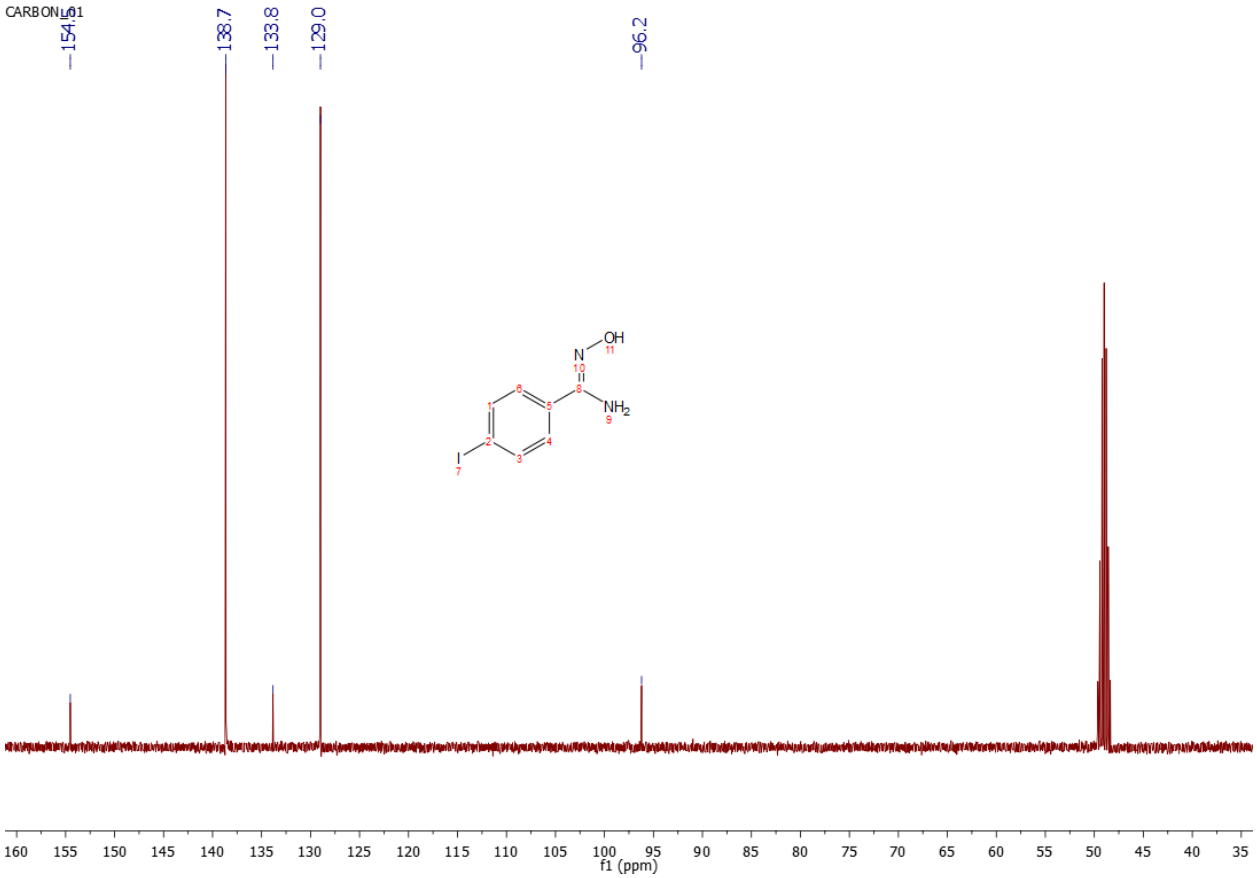
^{13}C-NMR Spectrum for Compound 2.1e



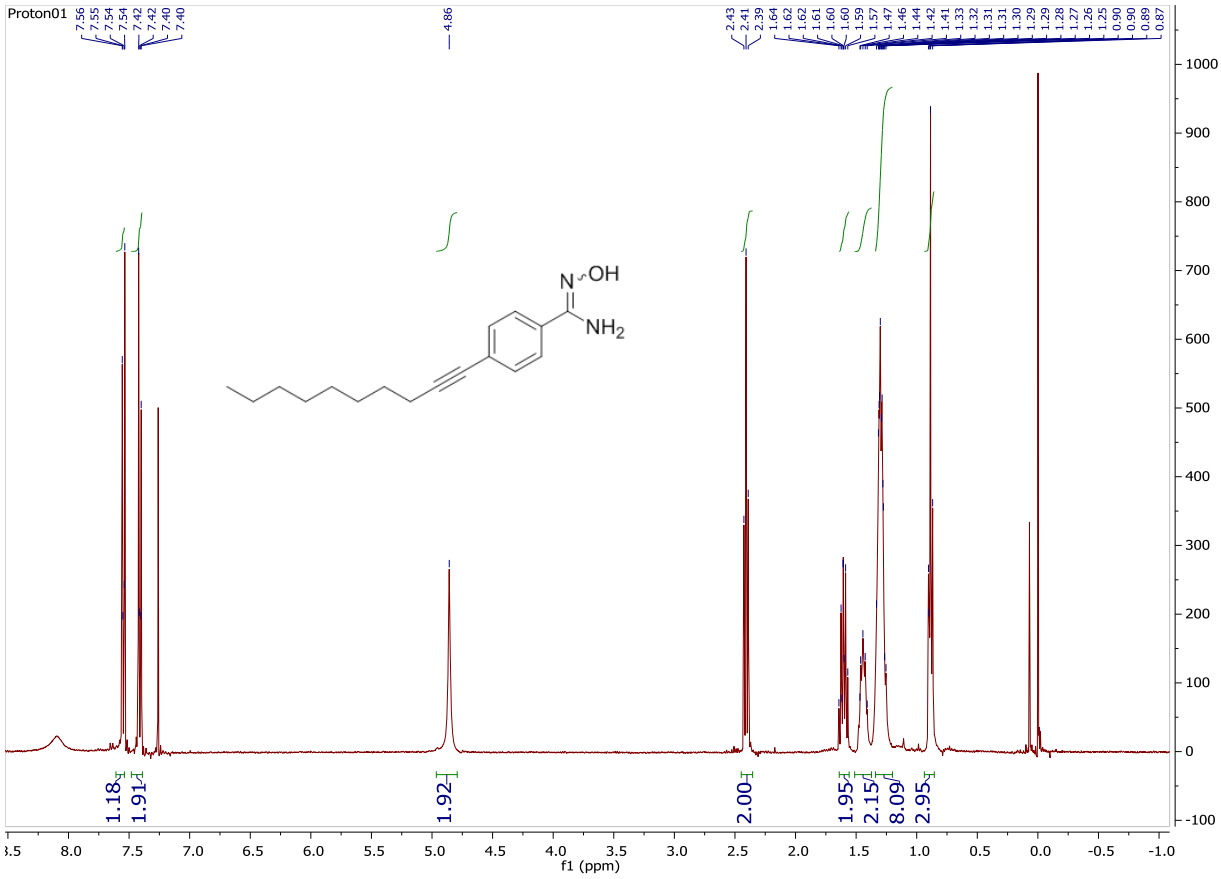
^{1}H-NMR Spectrum for Compound 2.2a:



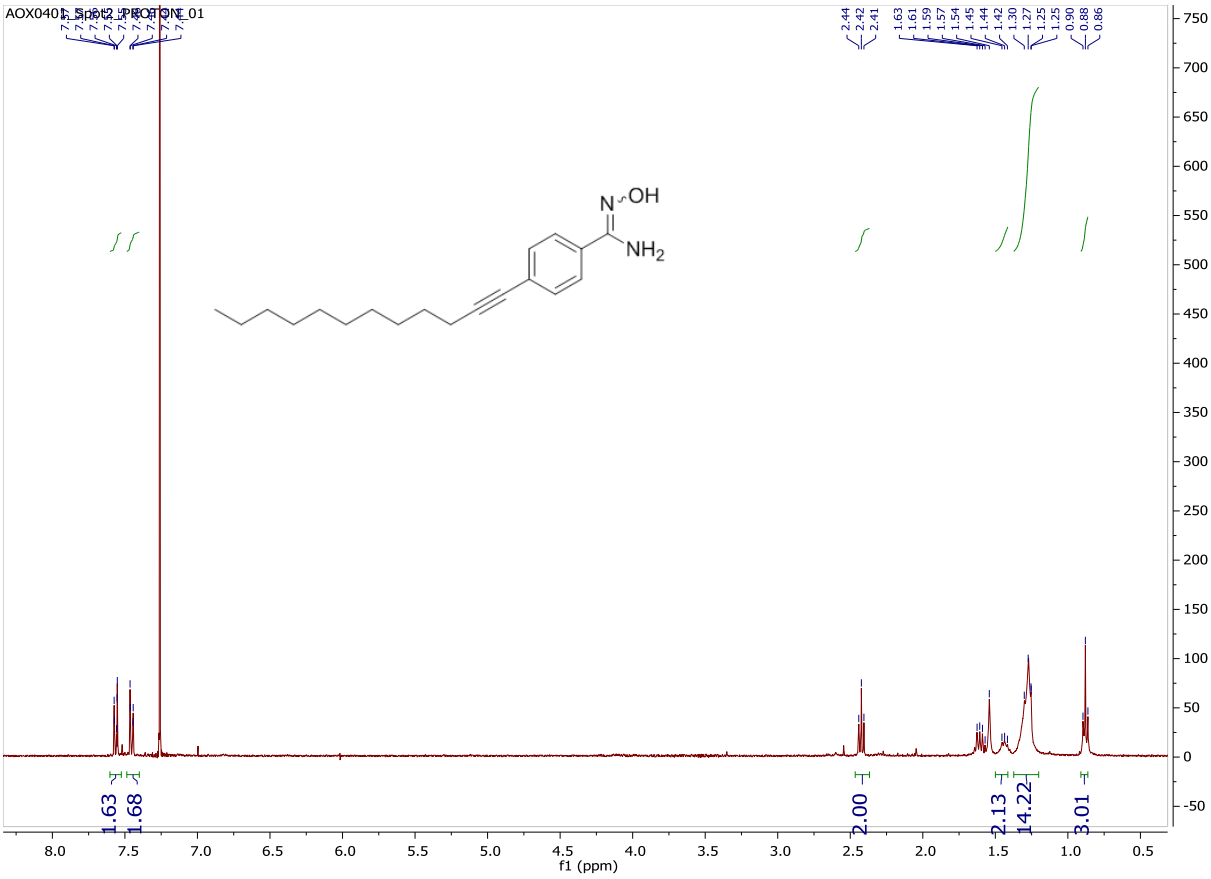
^{13}C-NMR Spectrum for Compound 2.2a



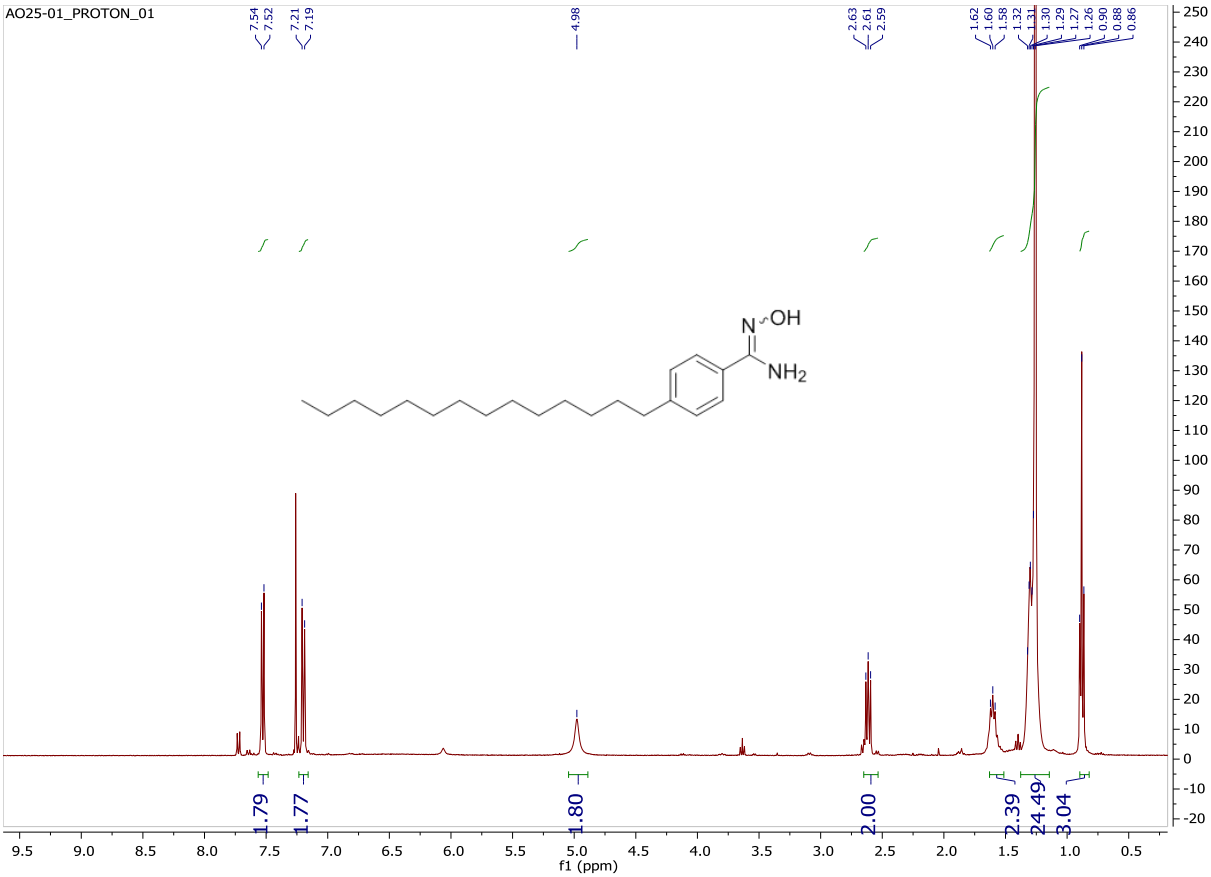
^{1}H-NMR Spectrum for Compound 2.2b



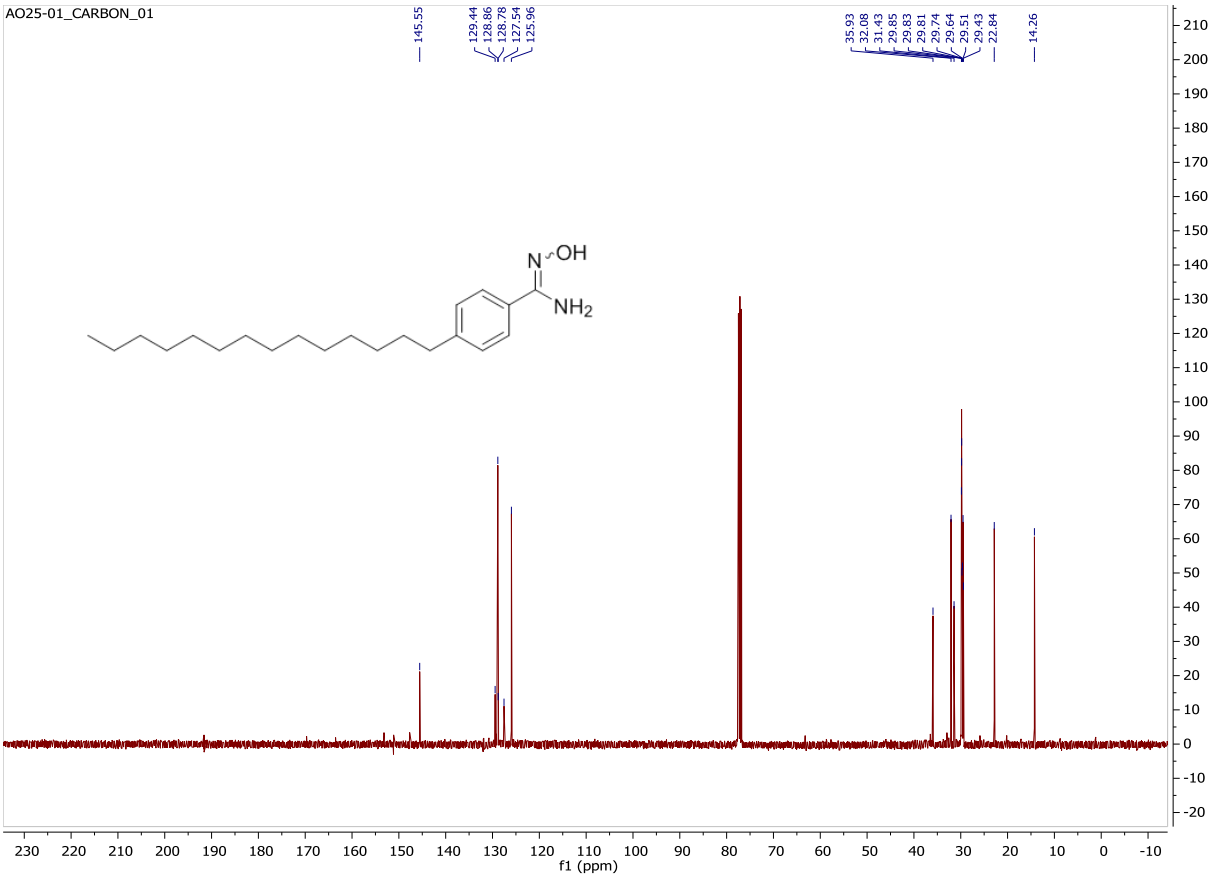
^{1}H-NMR Spectrum for Compound 2.2c



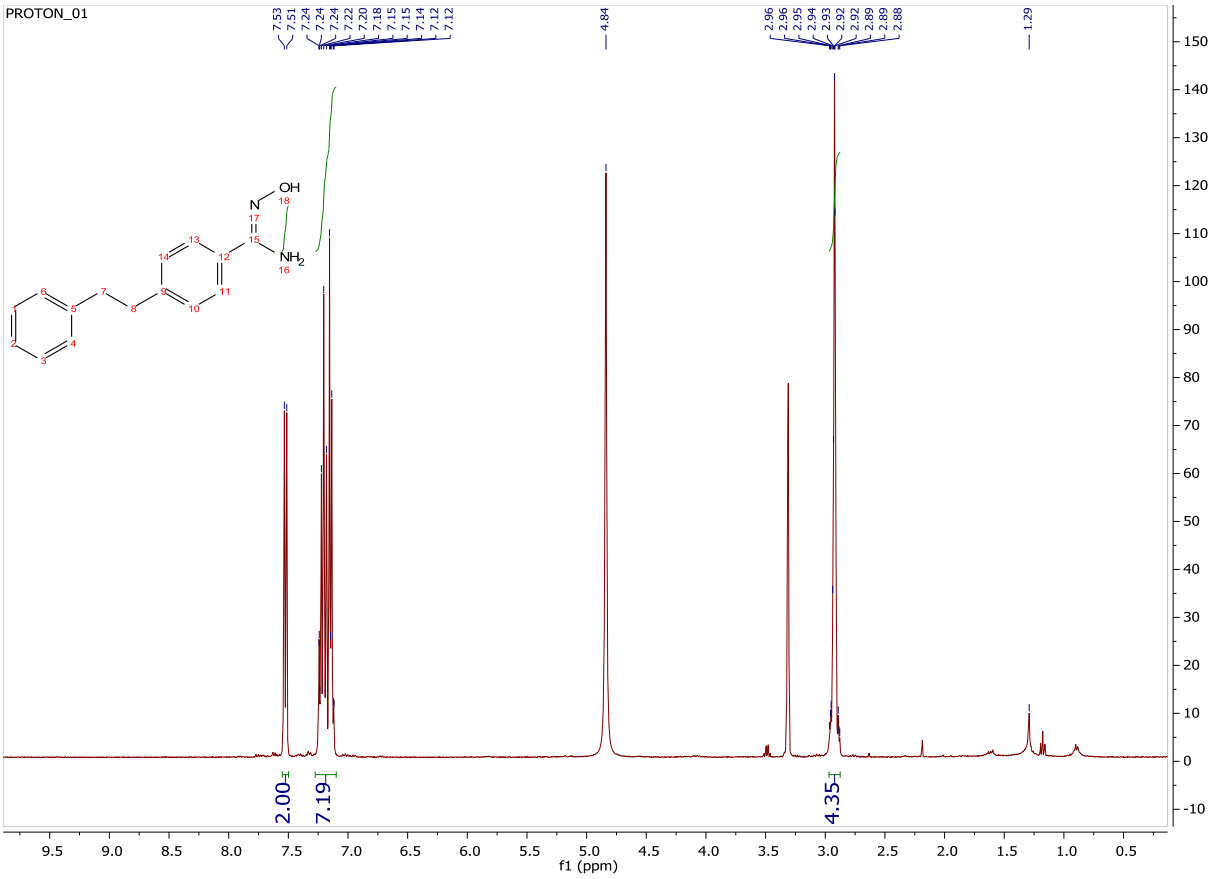
^{1}H-NMR Spectrum for Compound 2.2d



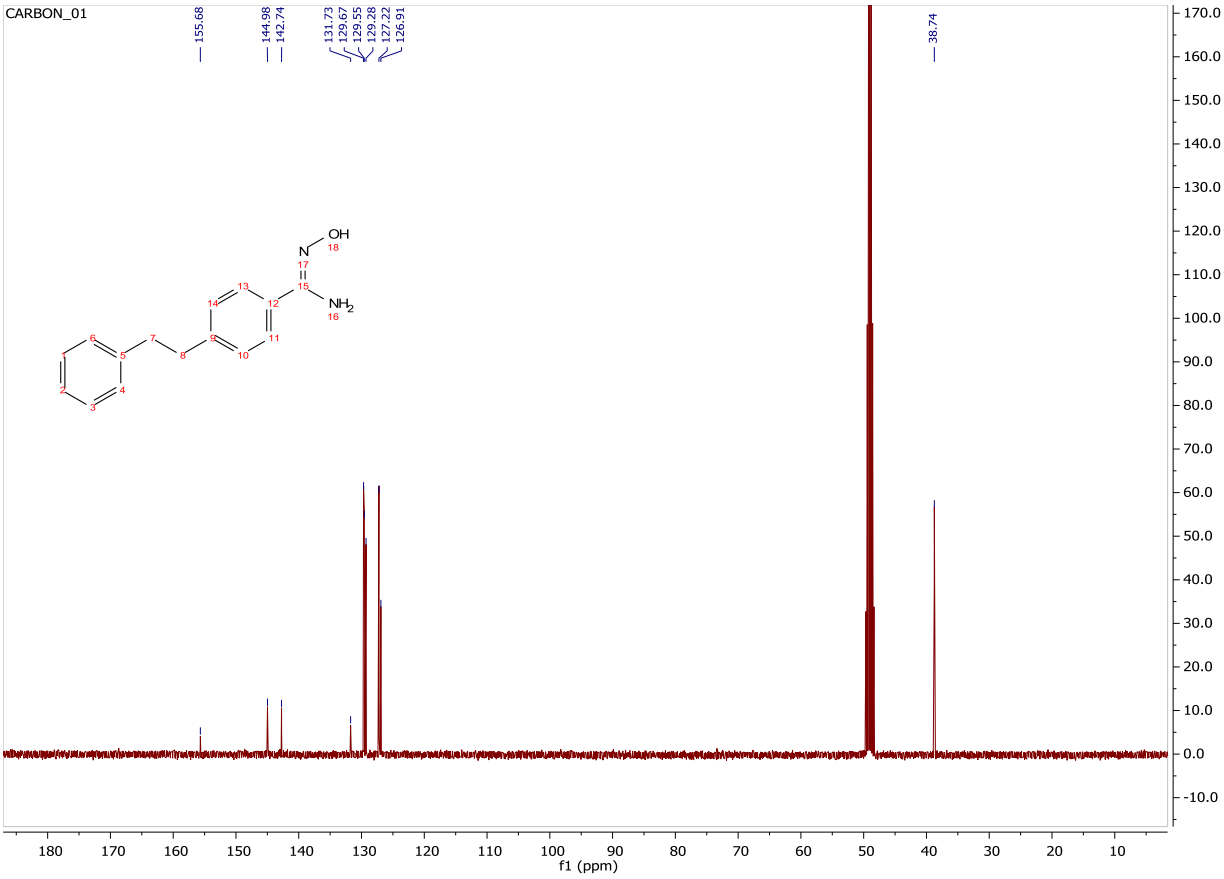
^{13}C-NMR Spectrum for Compound 2.2d



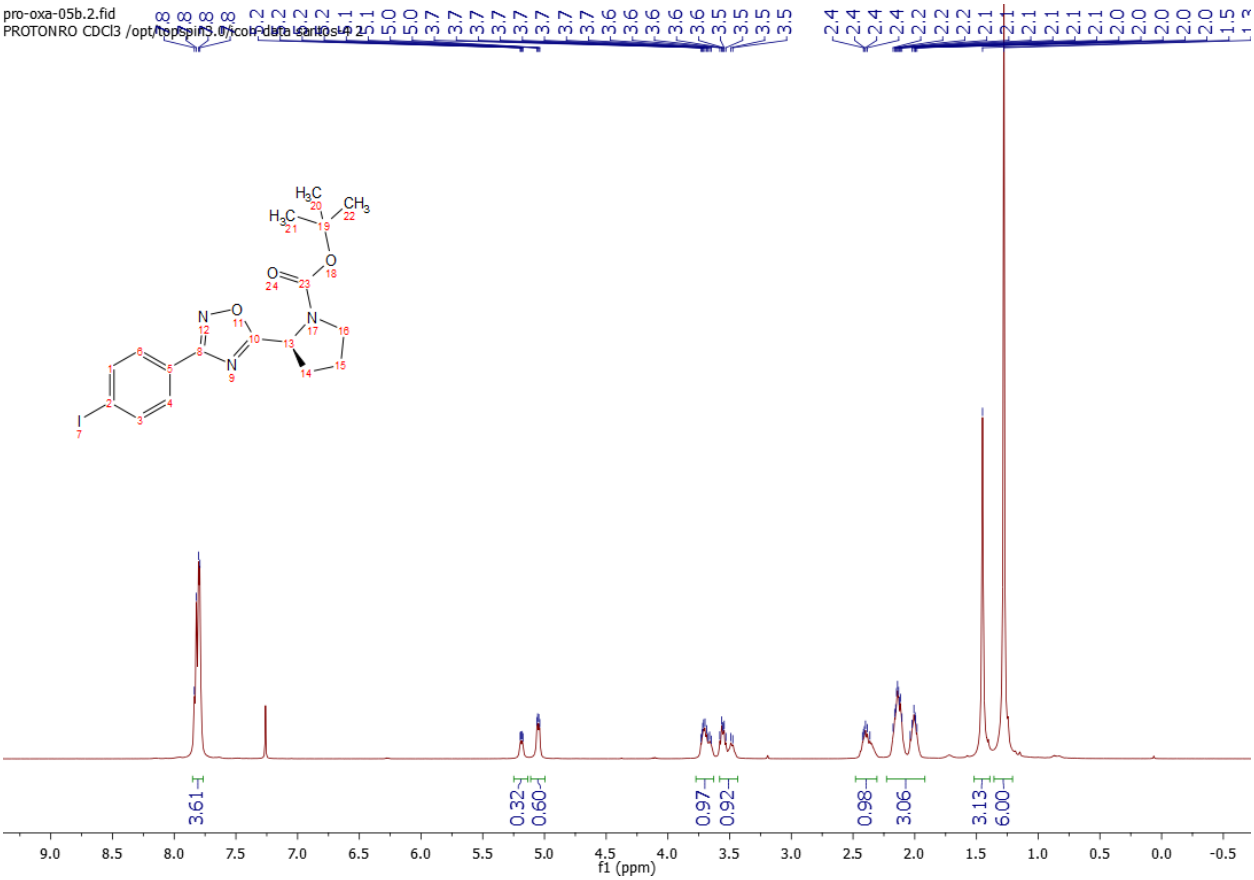
^{1}H-NMR Spectrum for Compound 2.2e



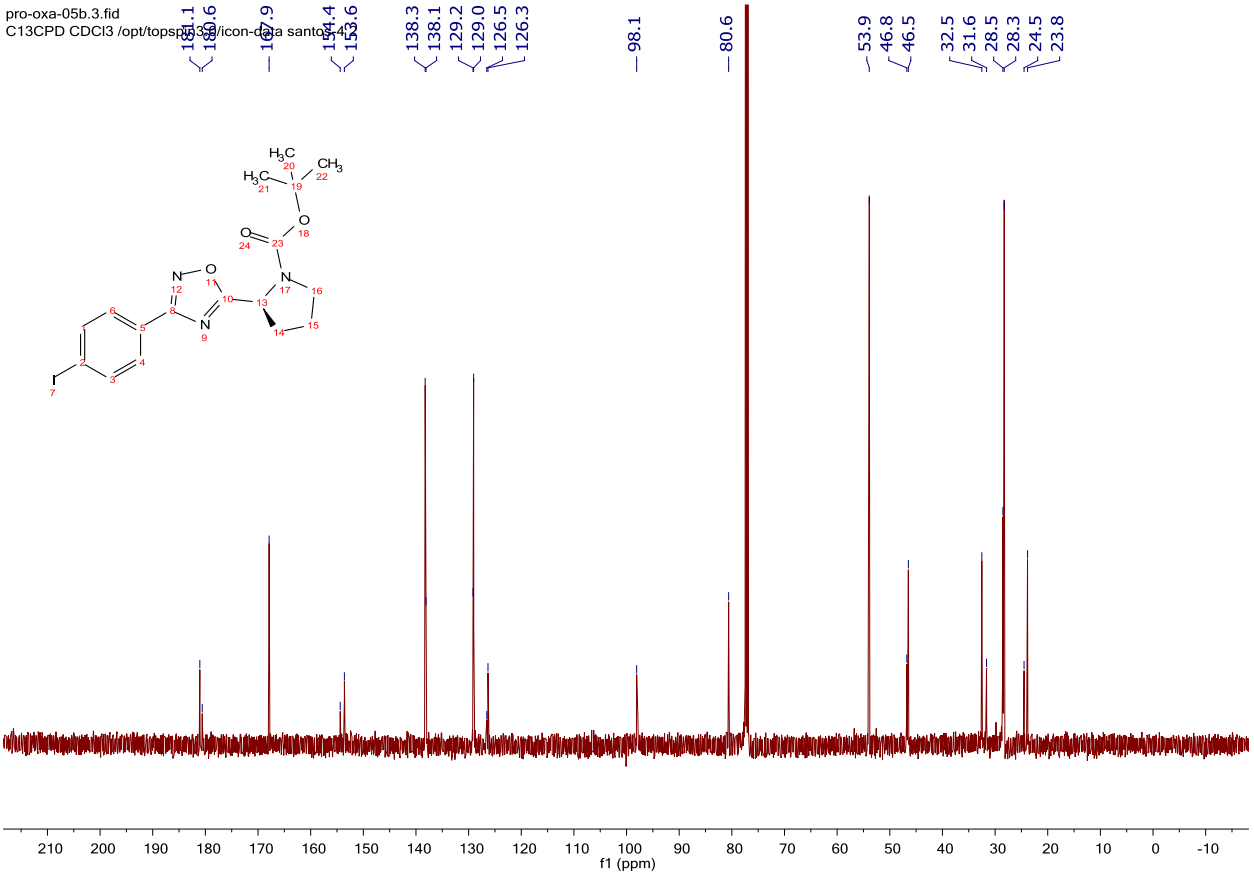
^{13}C-NMR Spectrum for Compound 2.2e



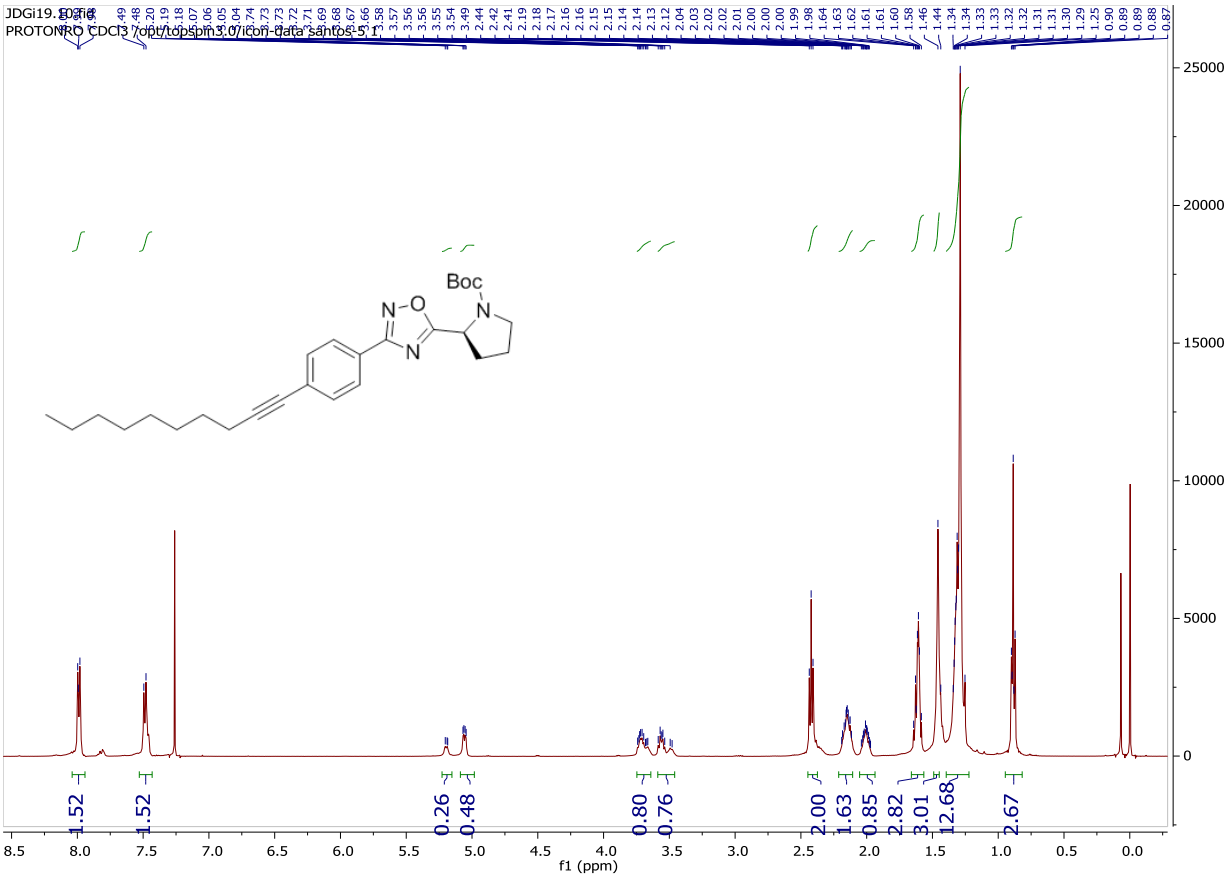
^{1}H-NMR Spectrum for Compound 2.3a



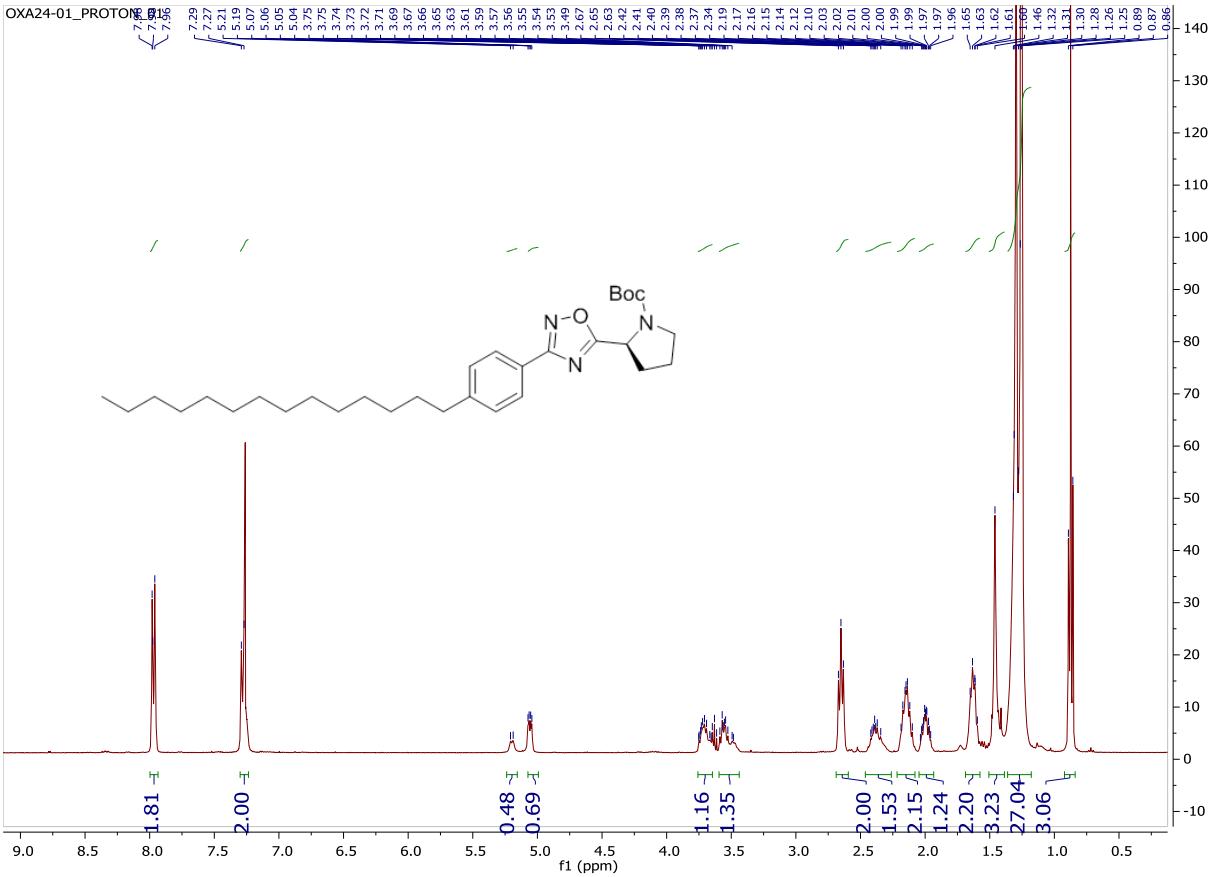
^{13}C-NMR Spectrum for Compound 2.3a



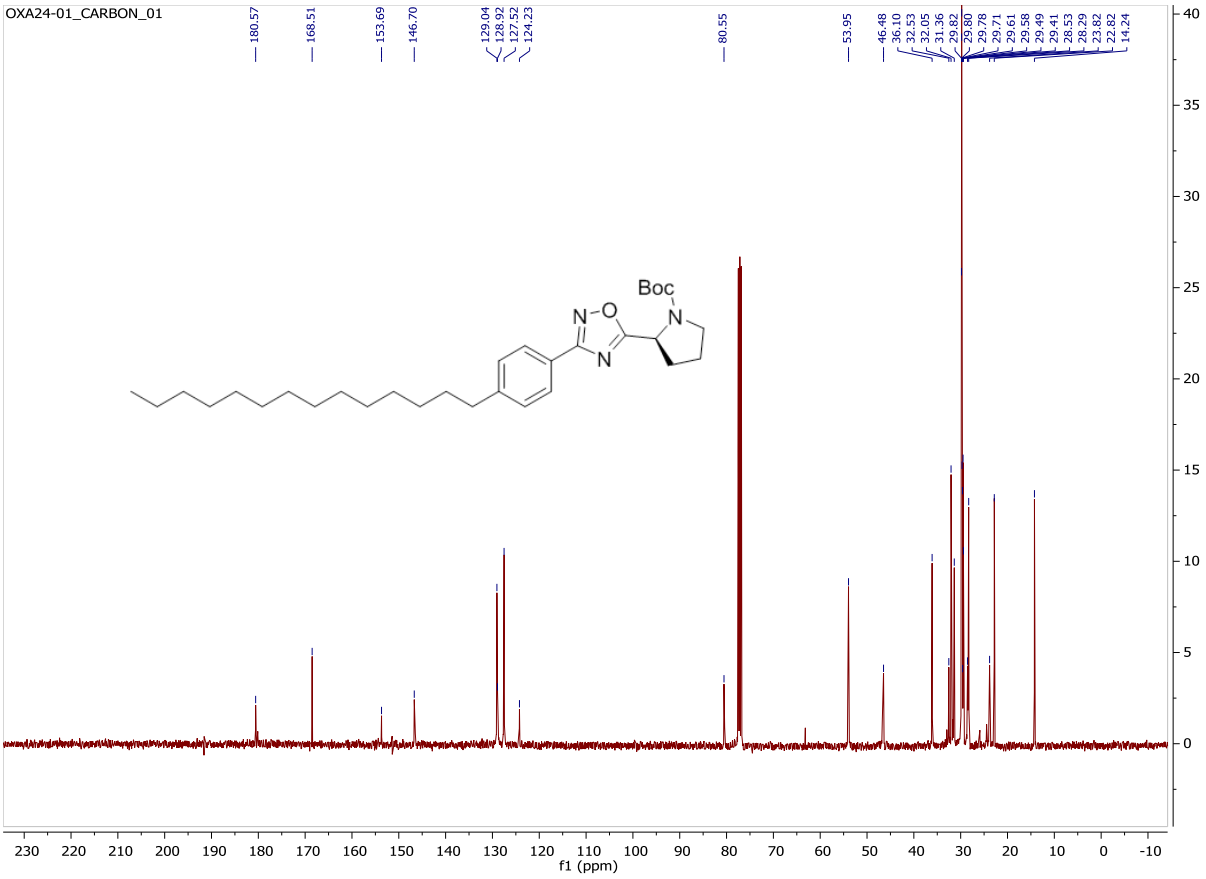
^{1}H-NMR Spectrum for Compound 2.3b



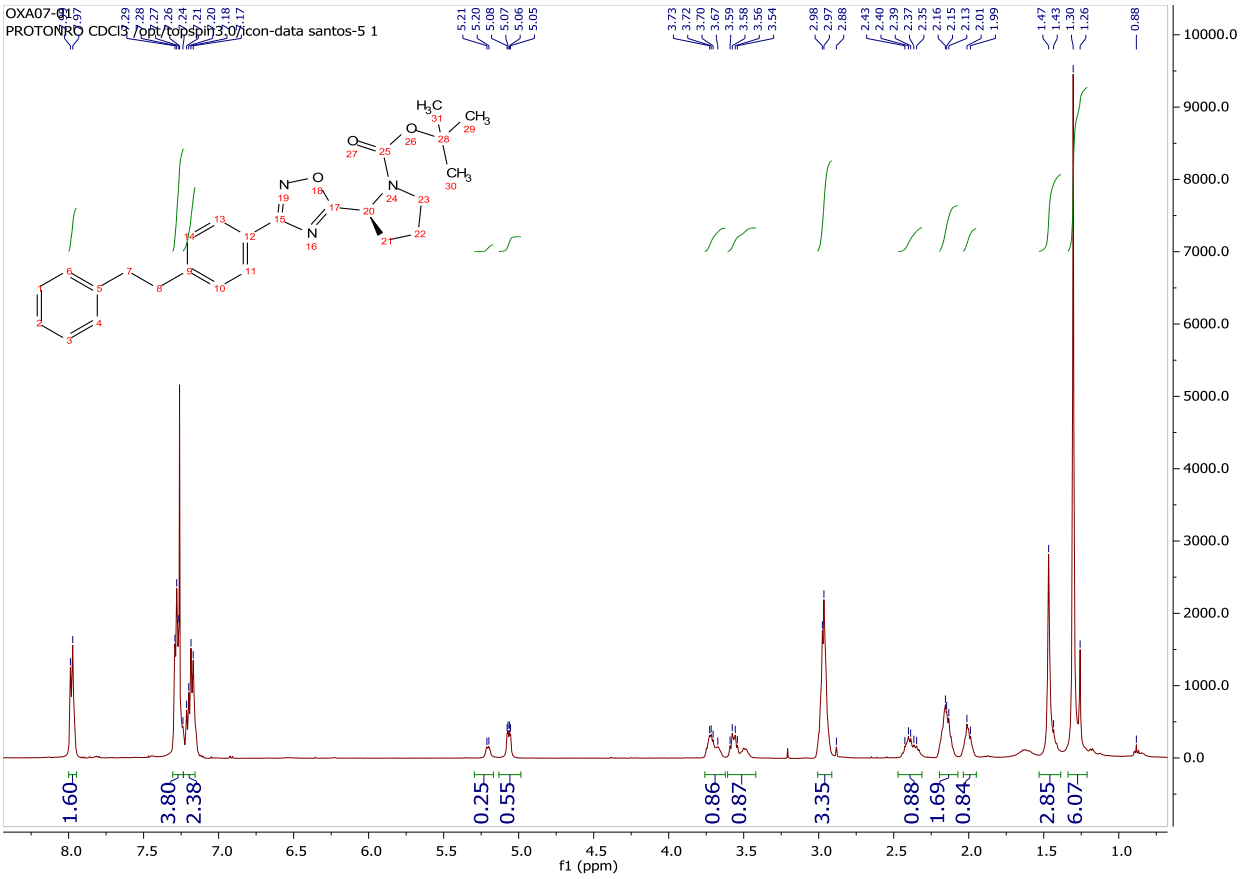
^{1}H-NMR Spectrum for Compound 2.3d



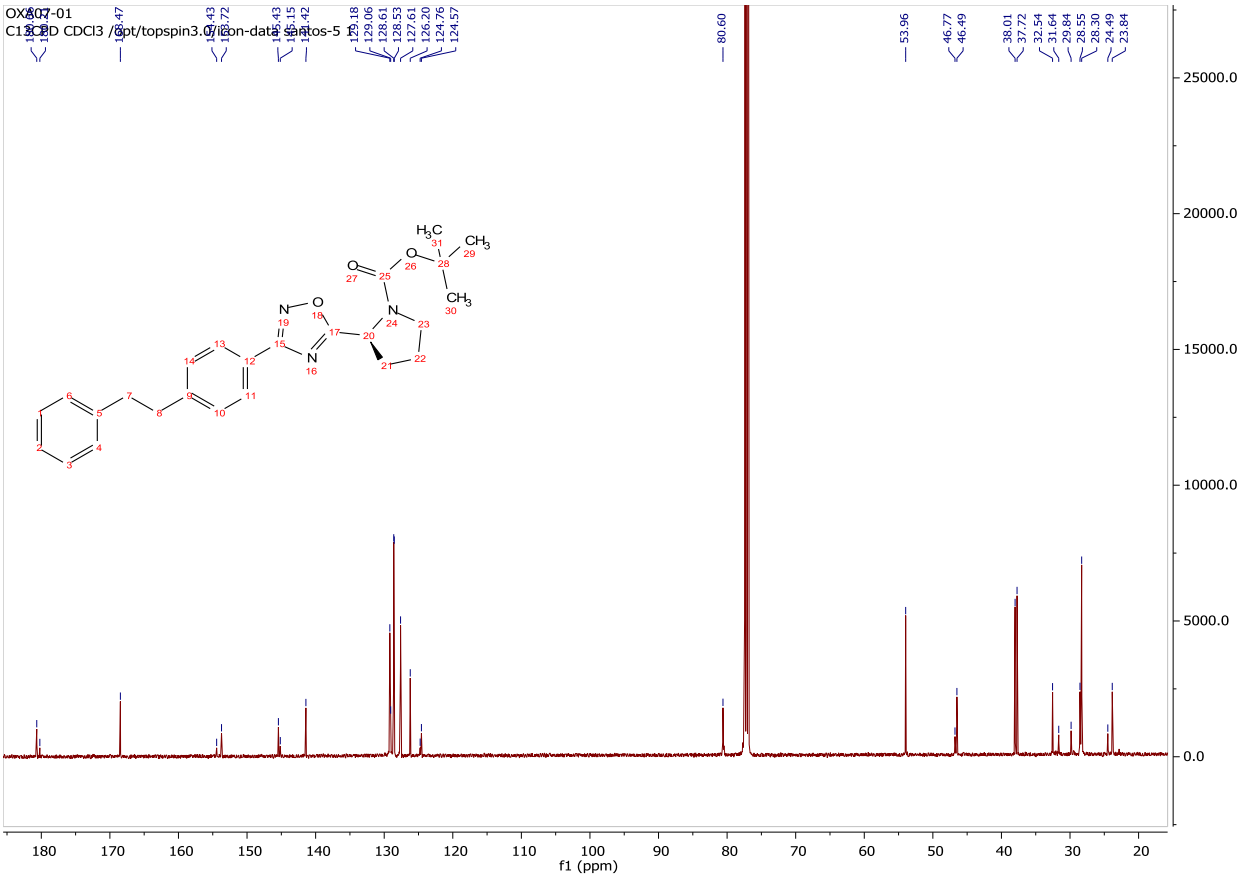
^{13}C-NMR Spectrum for Compound 2.3d



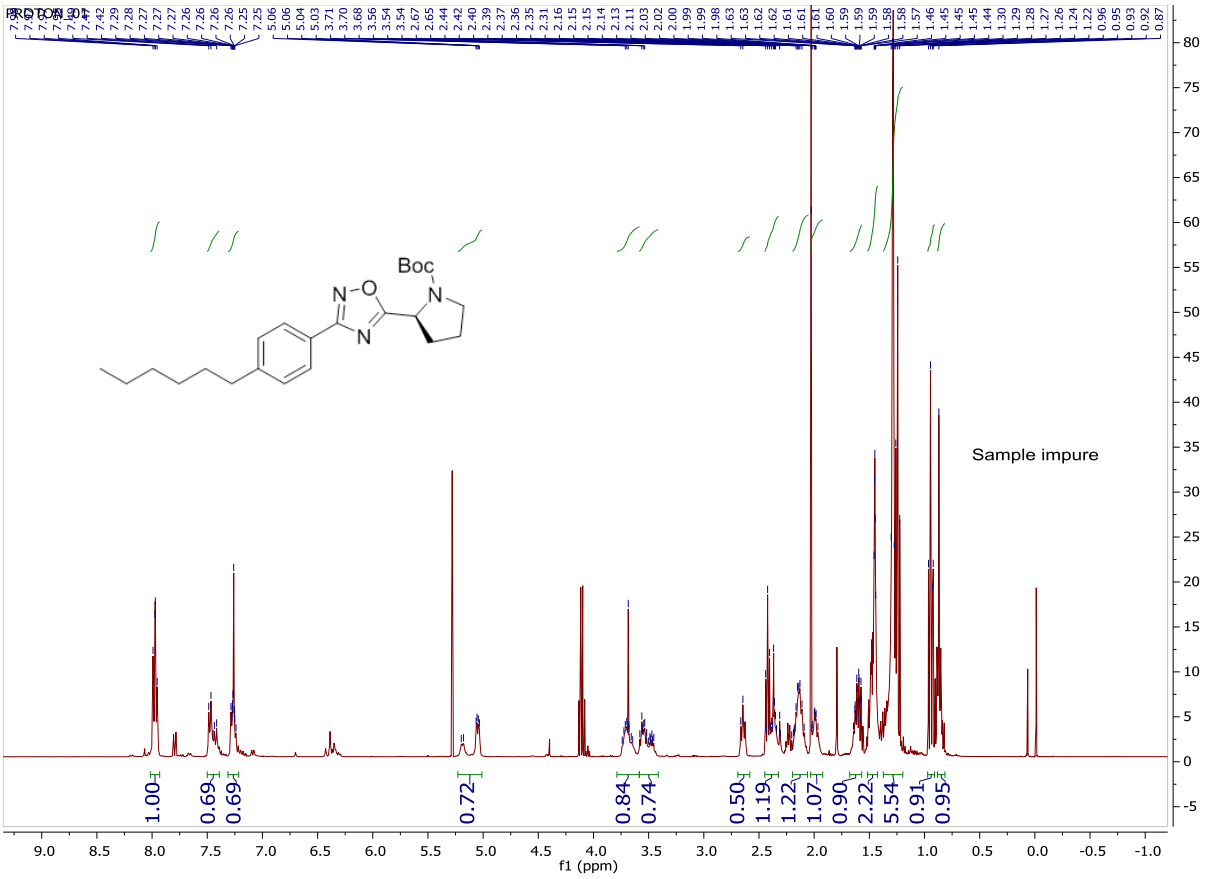
^{1}H-NMR Spectrum for Compound 2.3e



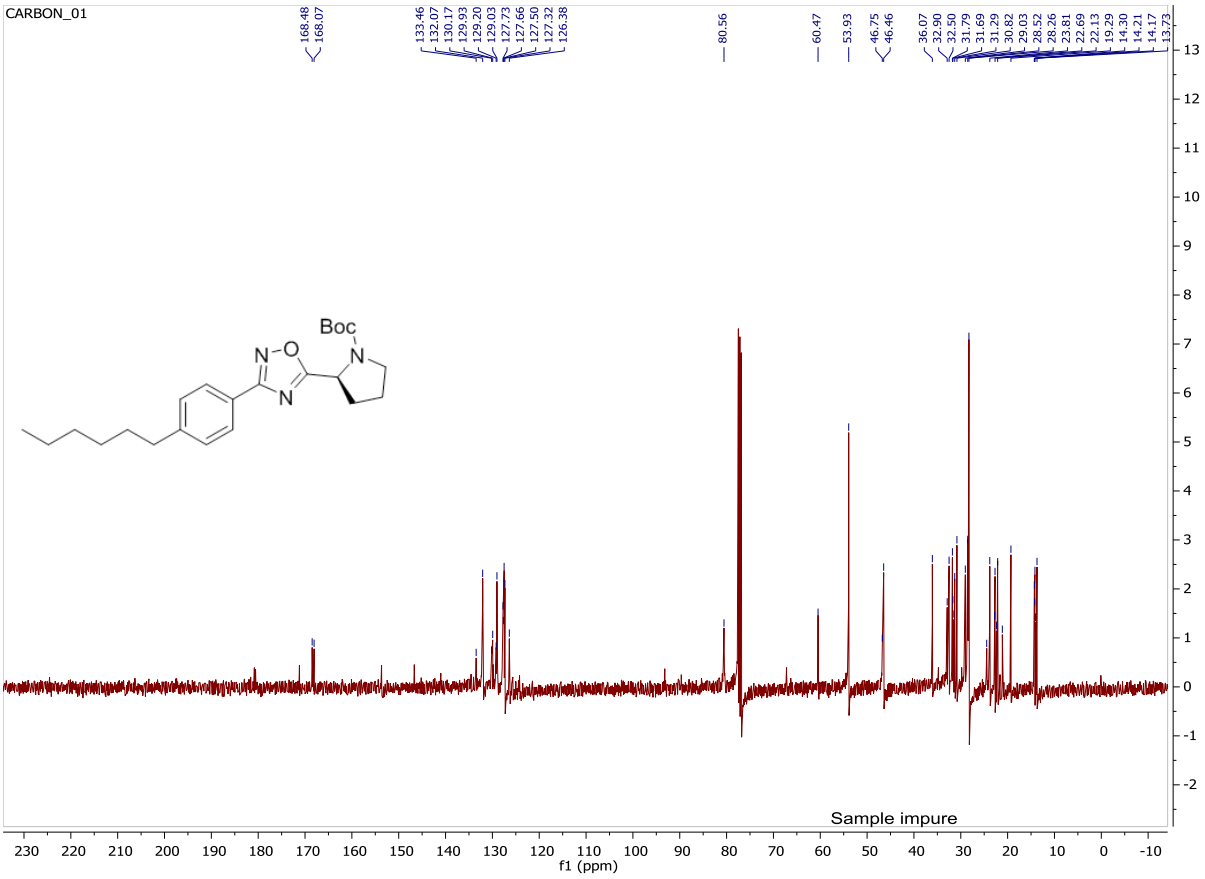
^{13}C-NMR Spectrum for Compound 2.3e



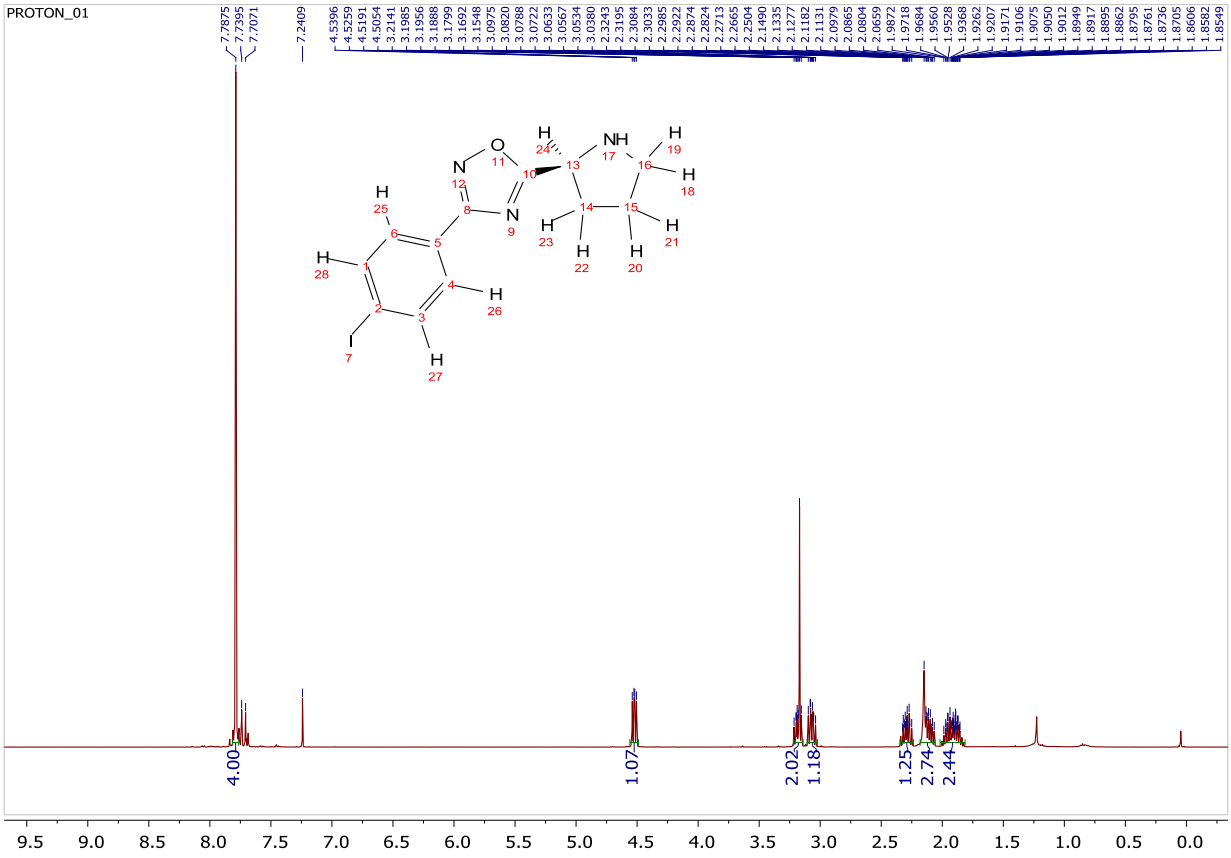
^{1}H-NMR Spectrum for Compound 2.3f



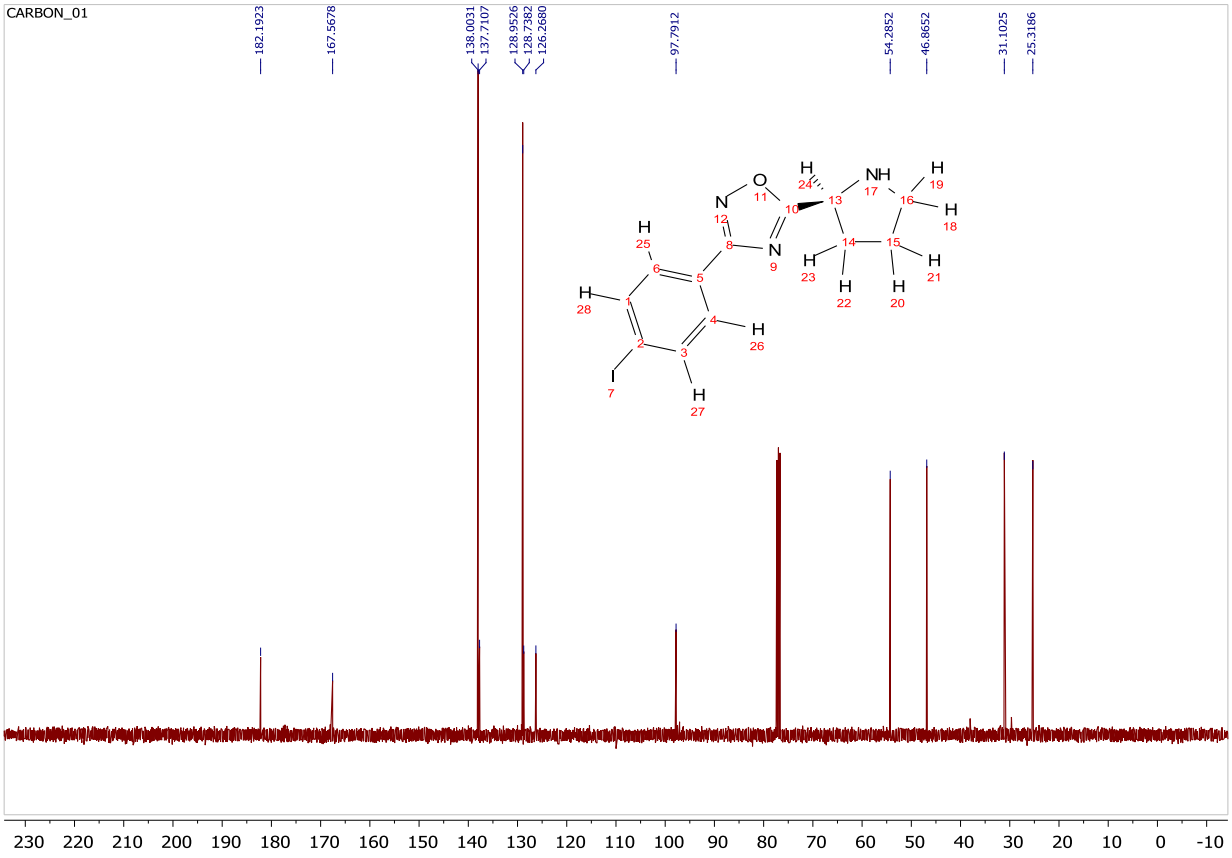
^{13}C-NMR Spectrum for Compound 2.3f



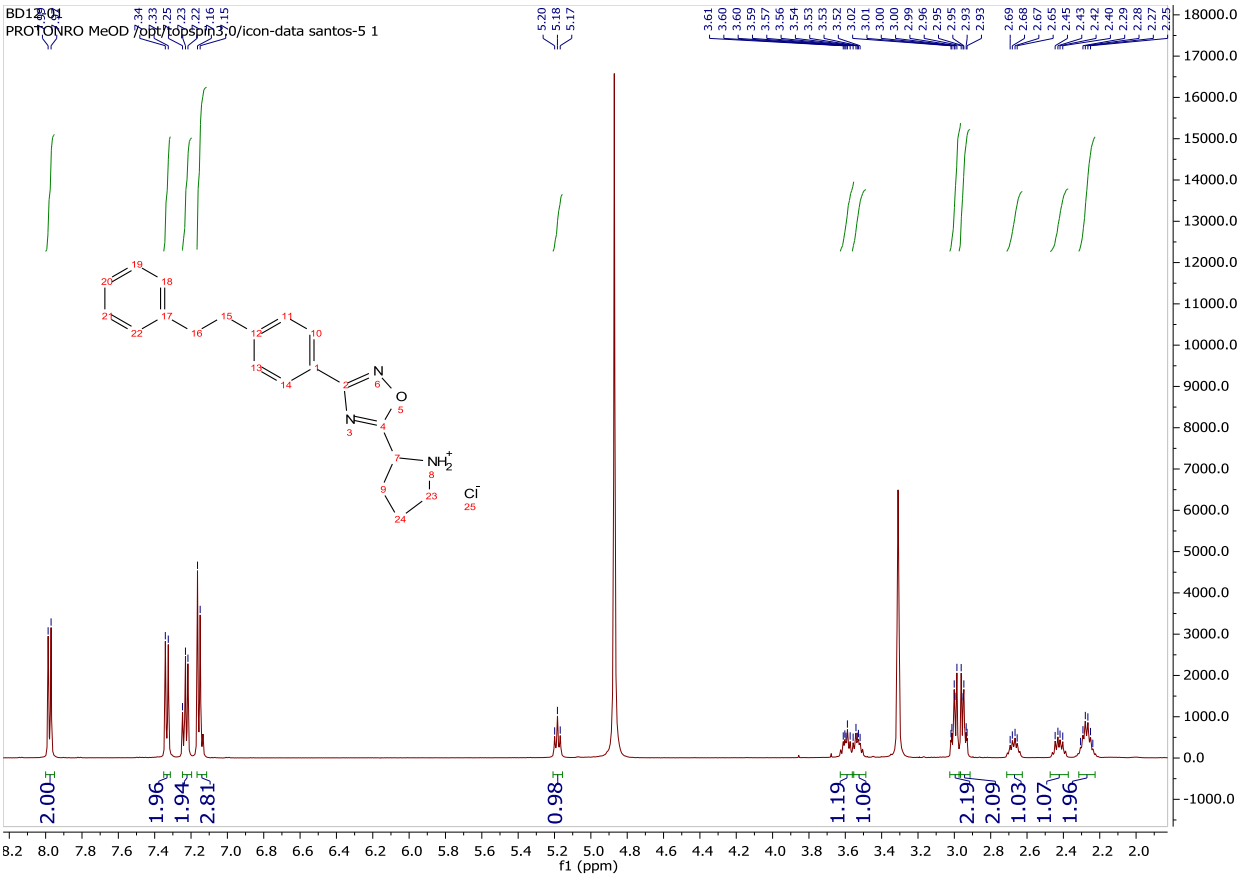
^{1}H-NMR Spectrum for Compound 2.4a



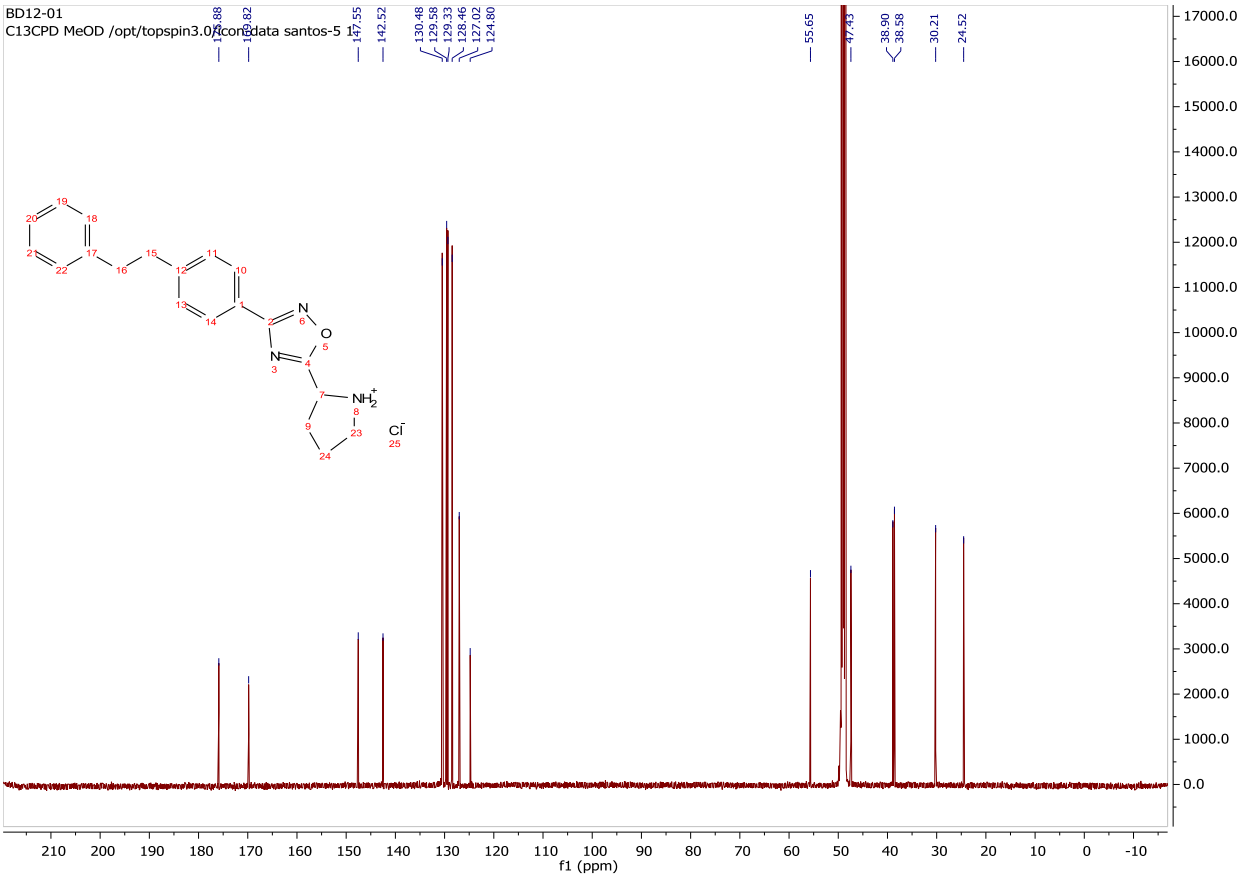
^{13}C-NMR Spectrum for Compound 2.4a



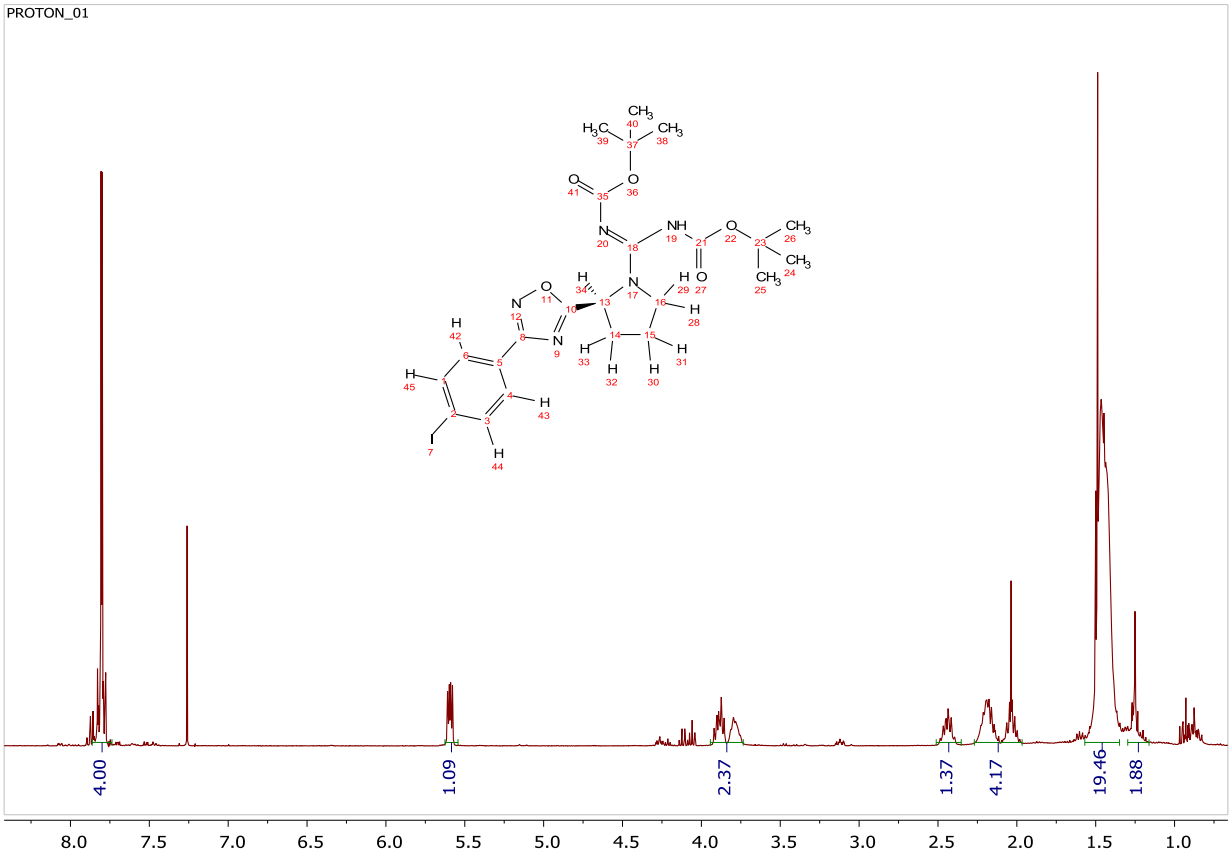
^{1}H-NMR Spectrum for Compound 2.4e



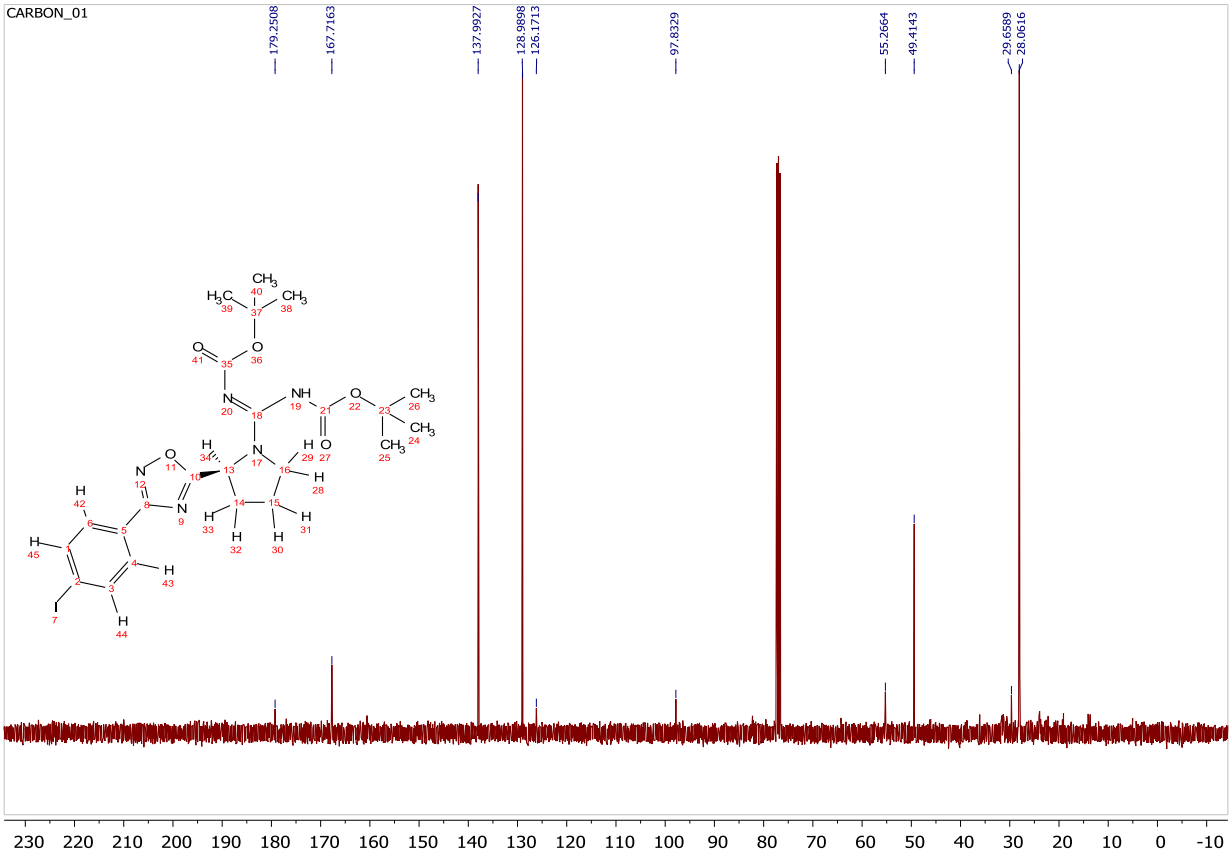
^{13}C-NMR Spectrum for Compound 2.4e



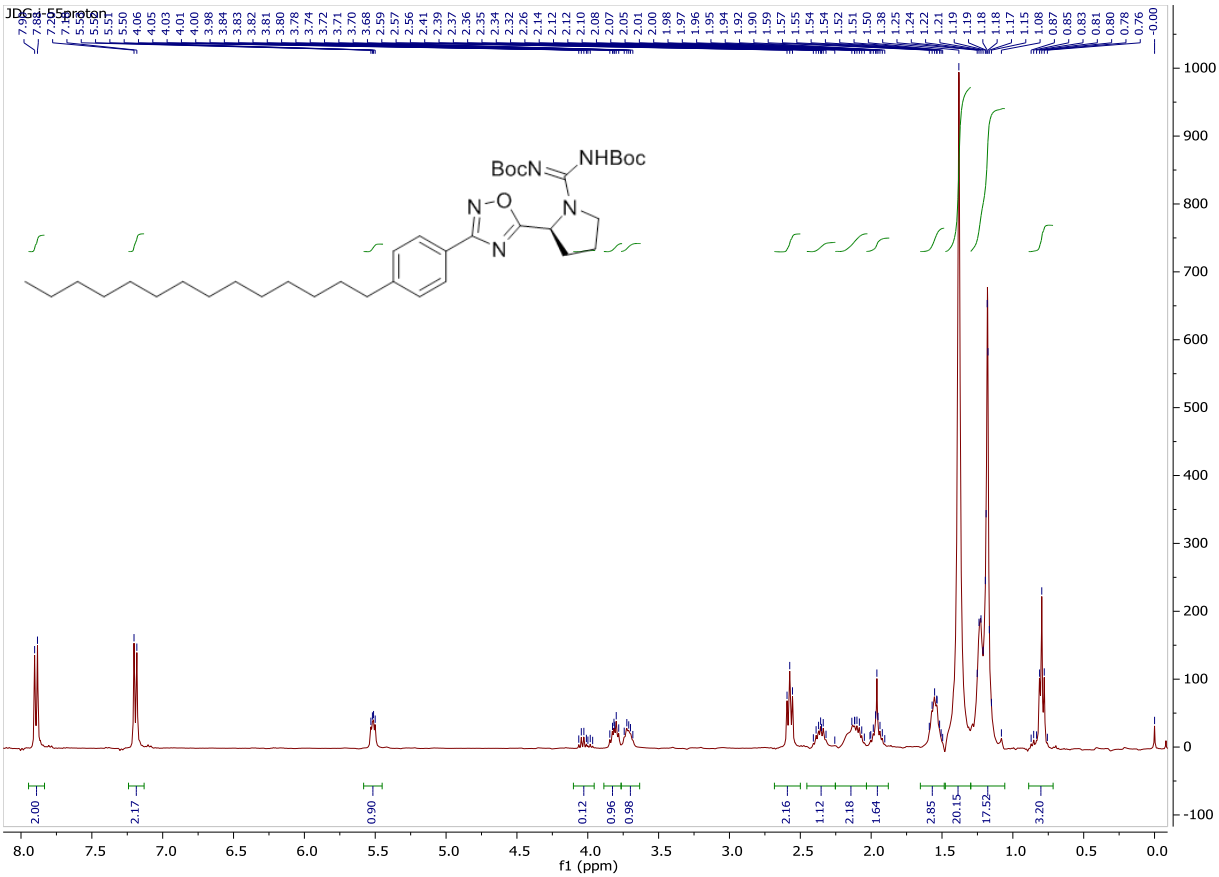
^{1}H-NMR Spectrum for Compound 2.5a



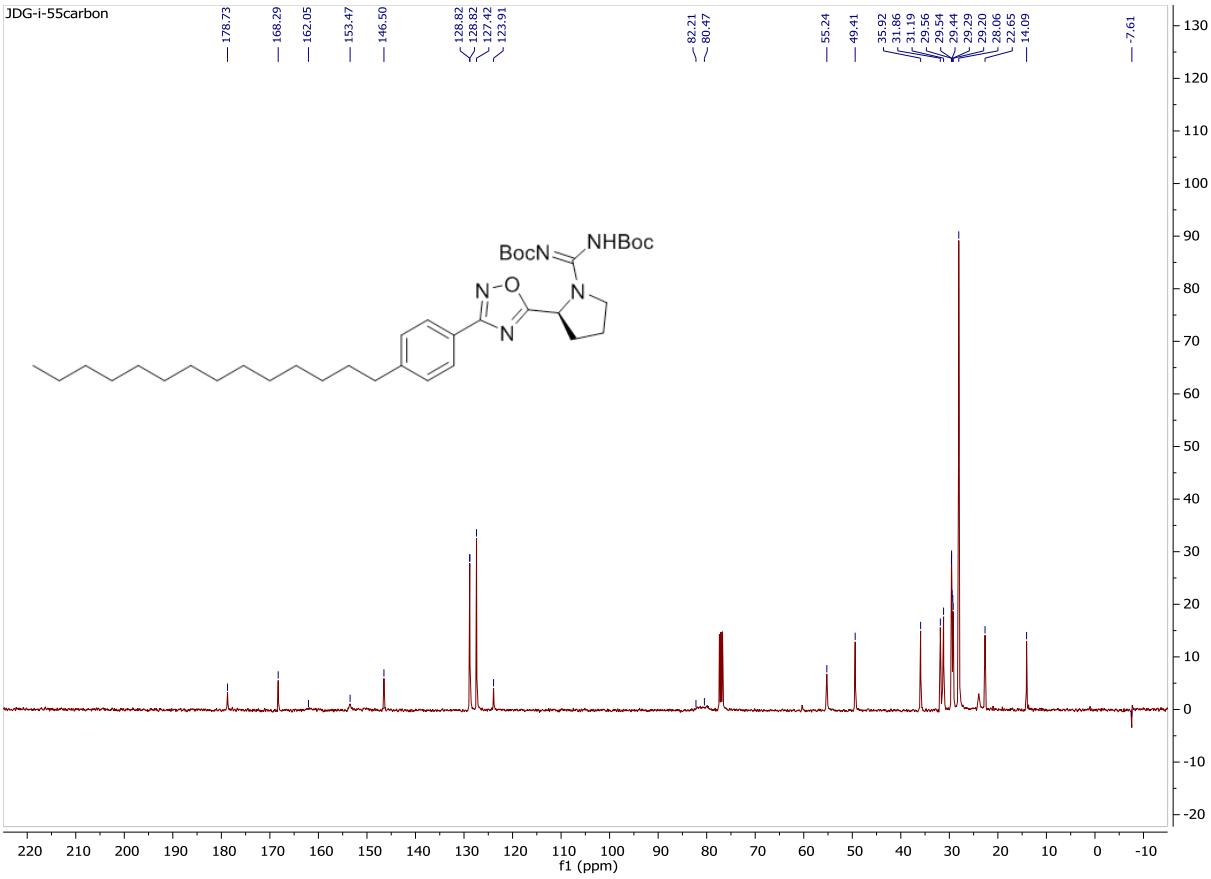
^{13}C-NMR Spectrum for Compound 2.5a



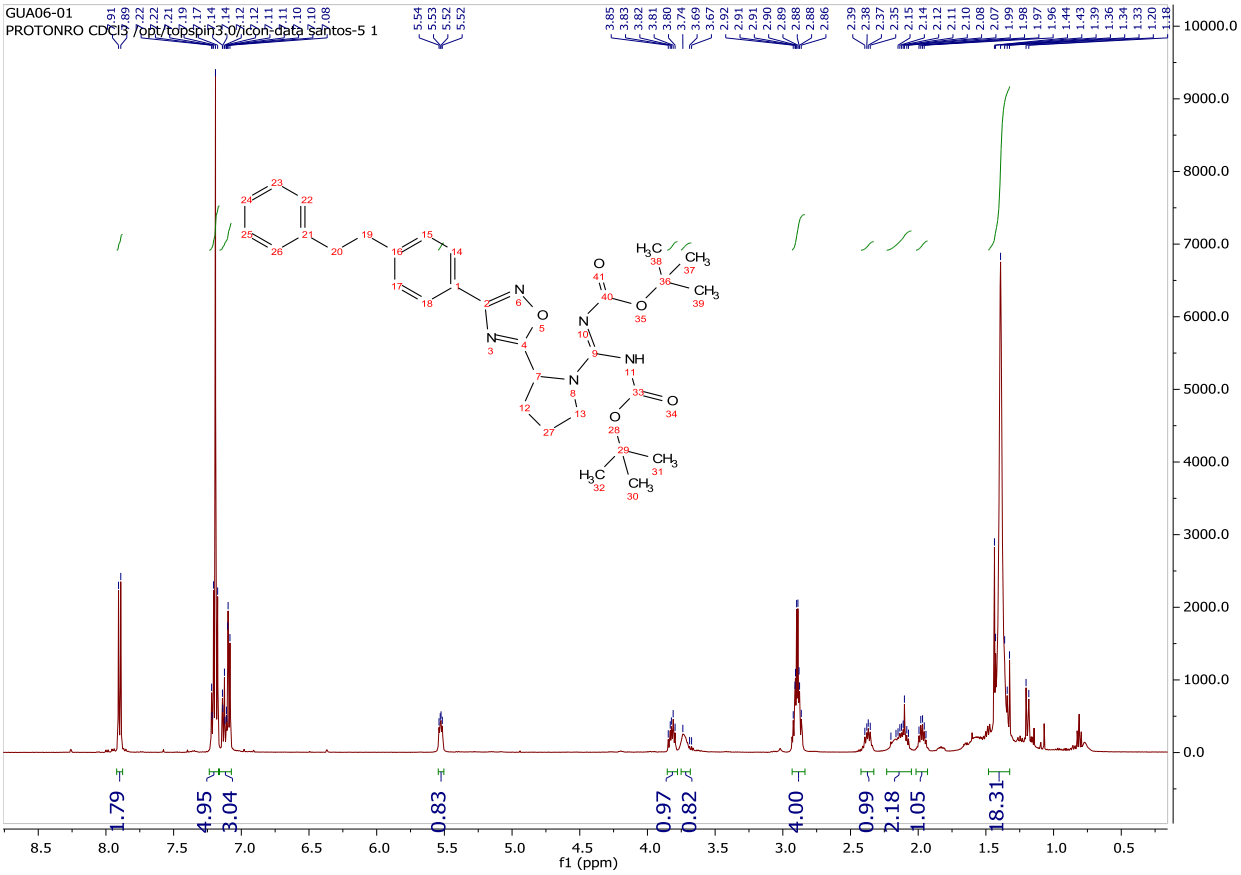
^{1}H-NMR Spectrum for Compound 2.5d



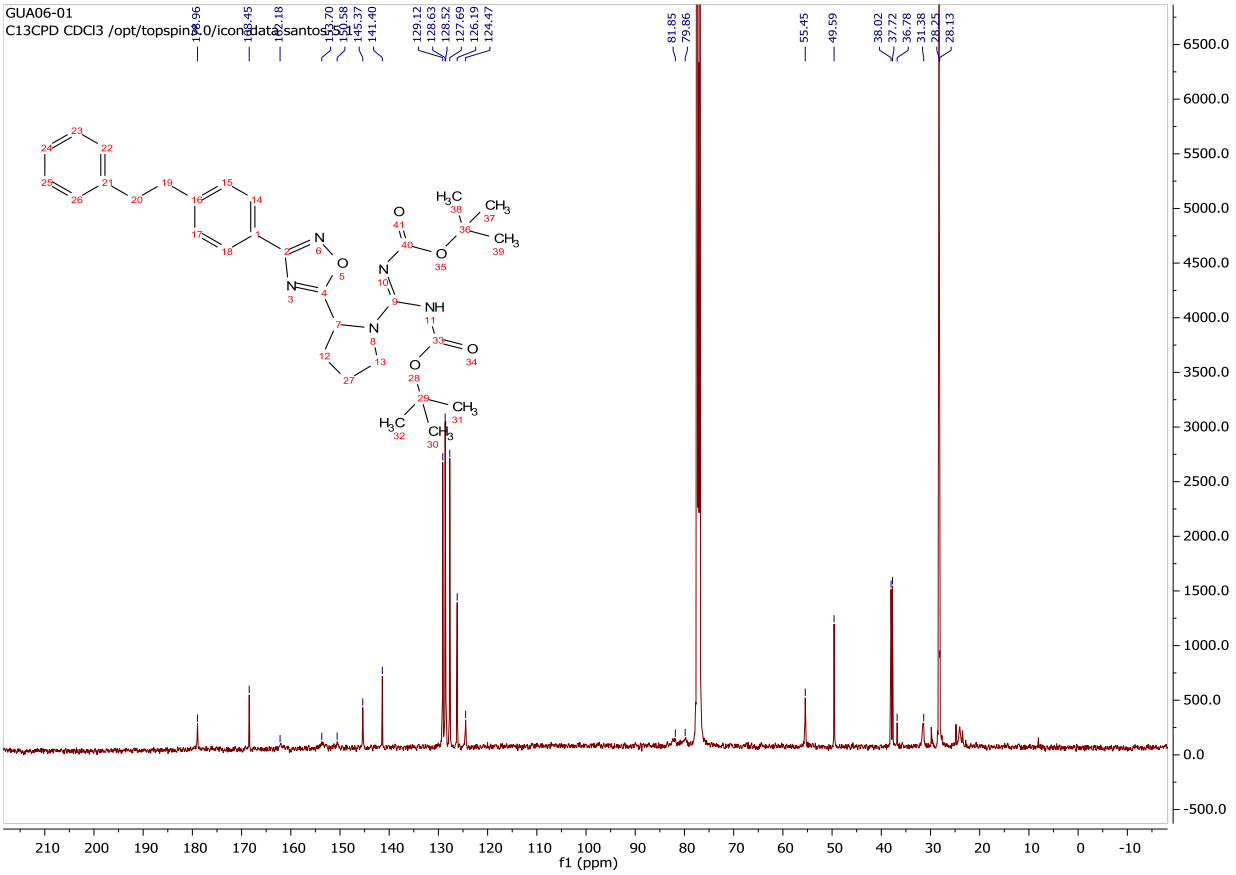
^{13}C-NMR Spectrum for Compound 2.5d



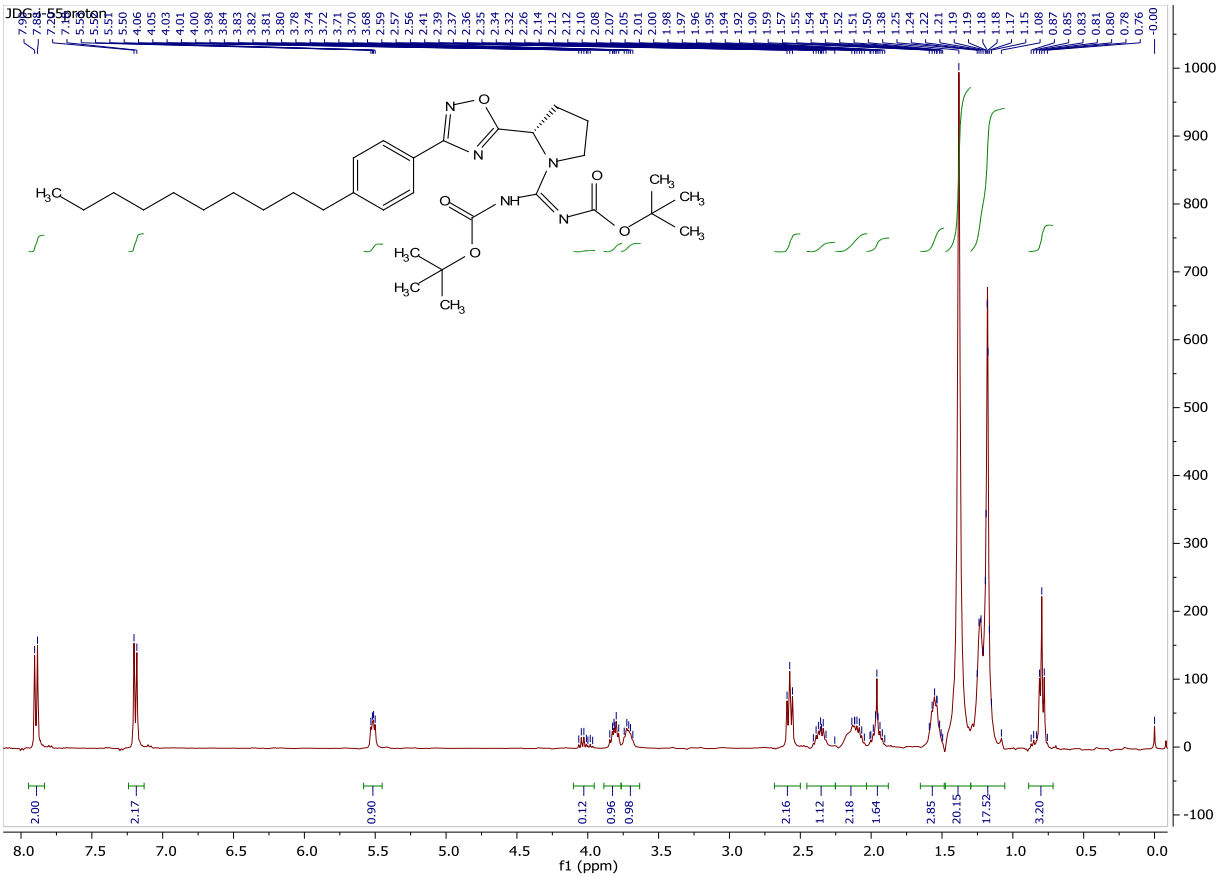
^{1}H-NMR Spectrum for Compound 2.5e



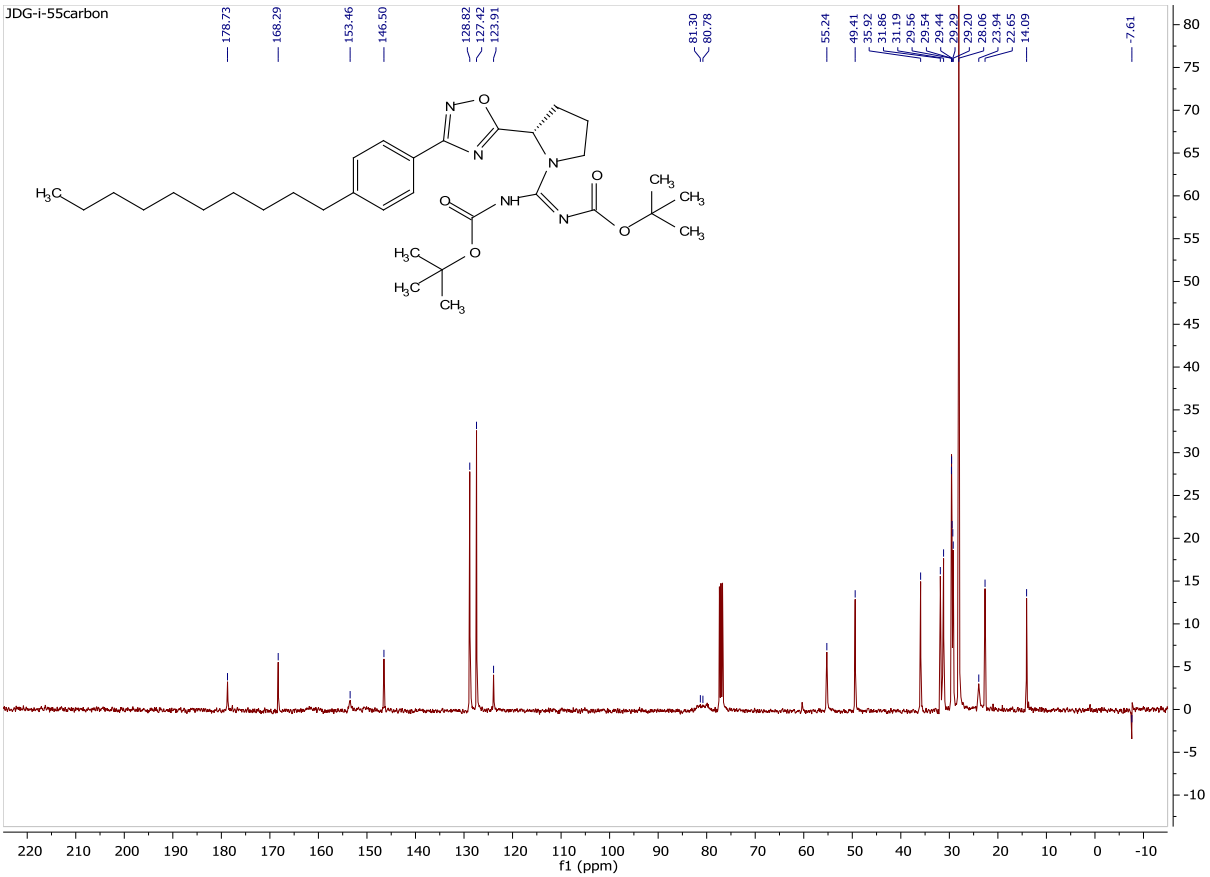
^{13}C-NMR Spectrum for Compound 2.5e



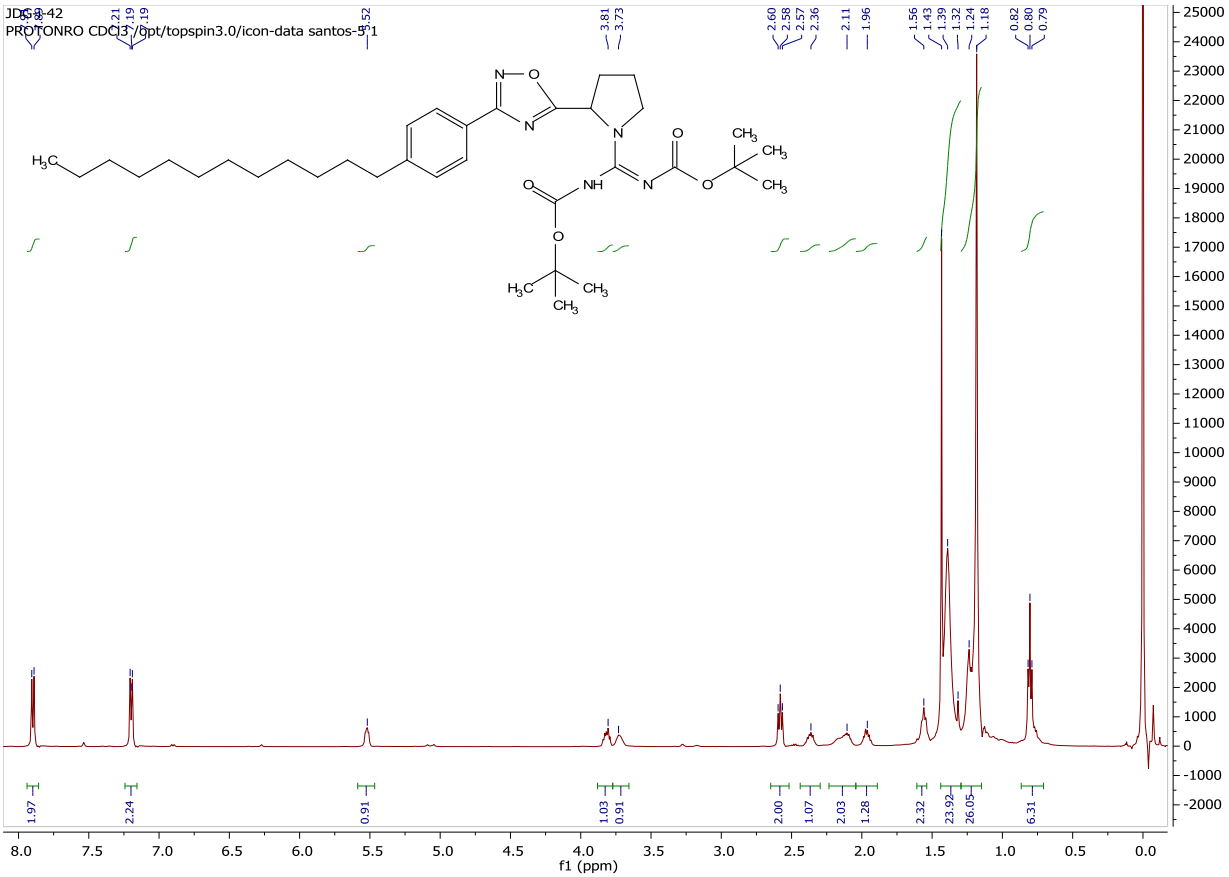
^{1}H-NMR Spectrum for Compound 2.5g



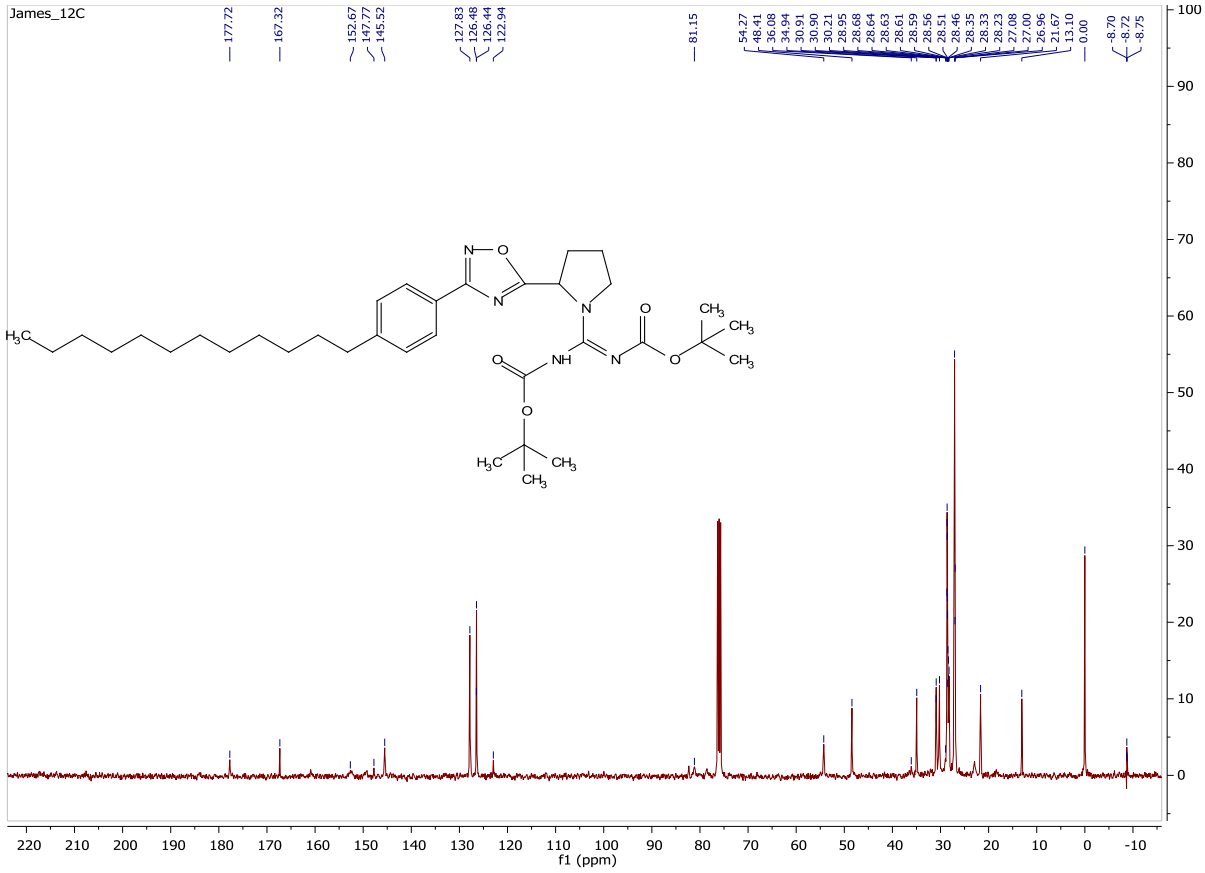
^{13}C-NMR Spectrum for Compound 2.5g



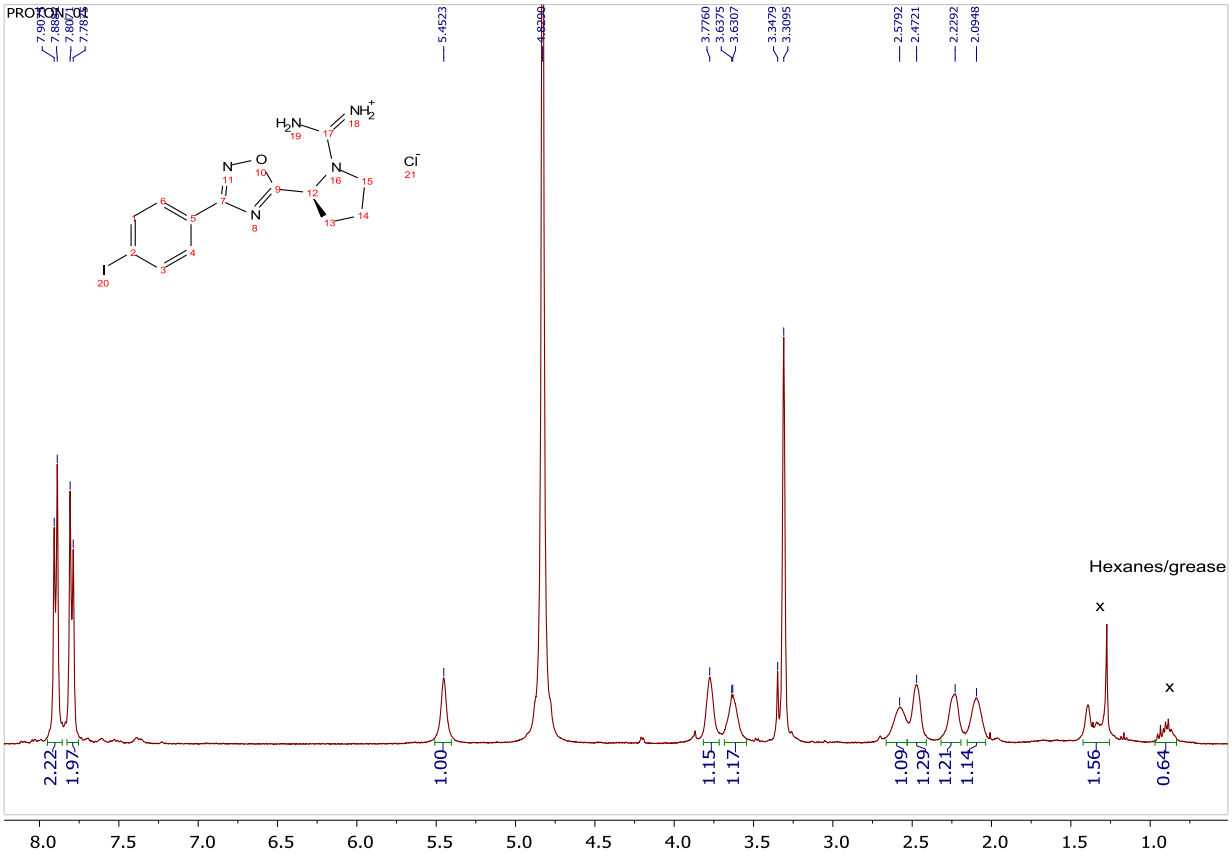
^{1}H-NMR Spectrum for Compound 2.5h



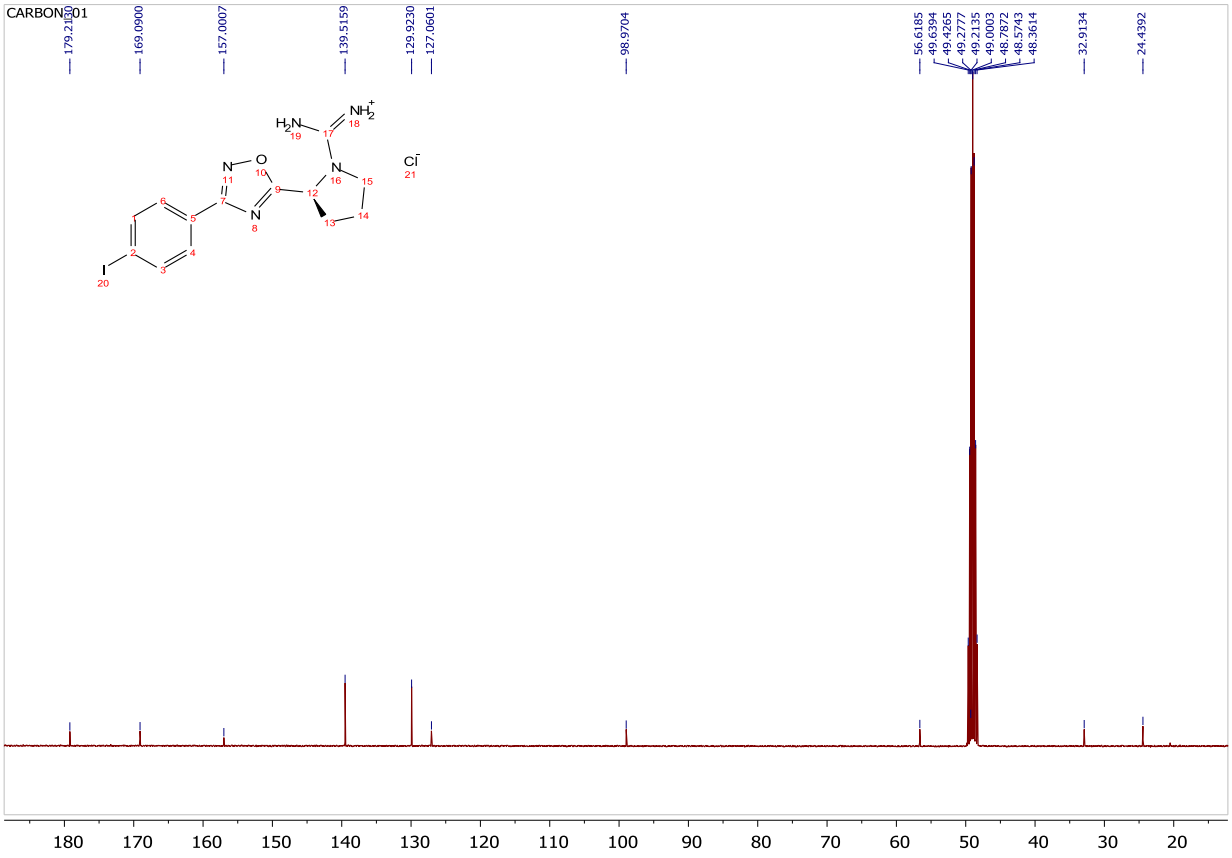
^{13}C-NMR Spectrum for Compound 2.5h



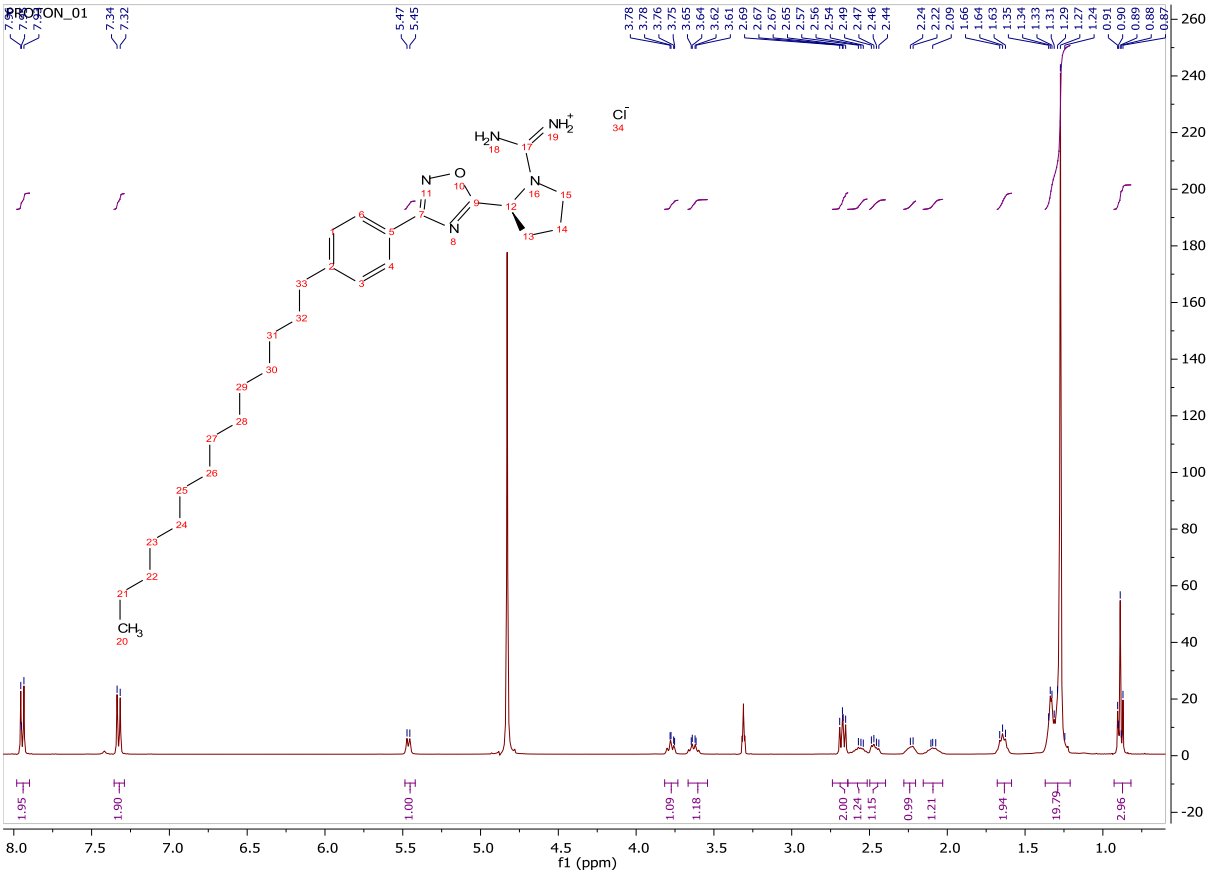
^{1}H-NMR Spectrum for Compound 2.6a



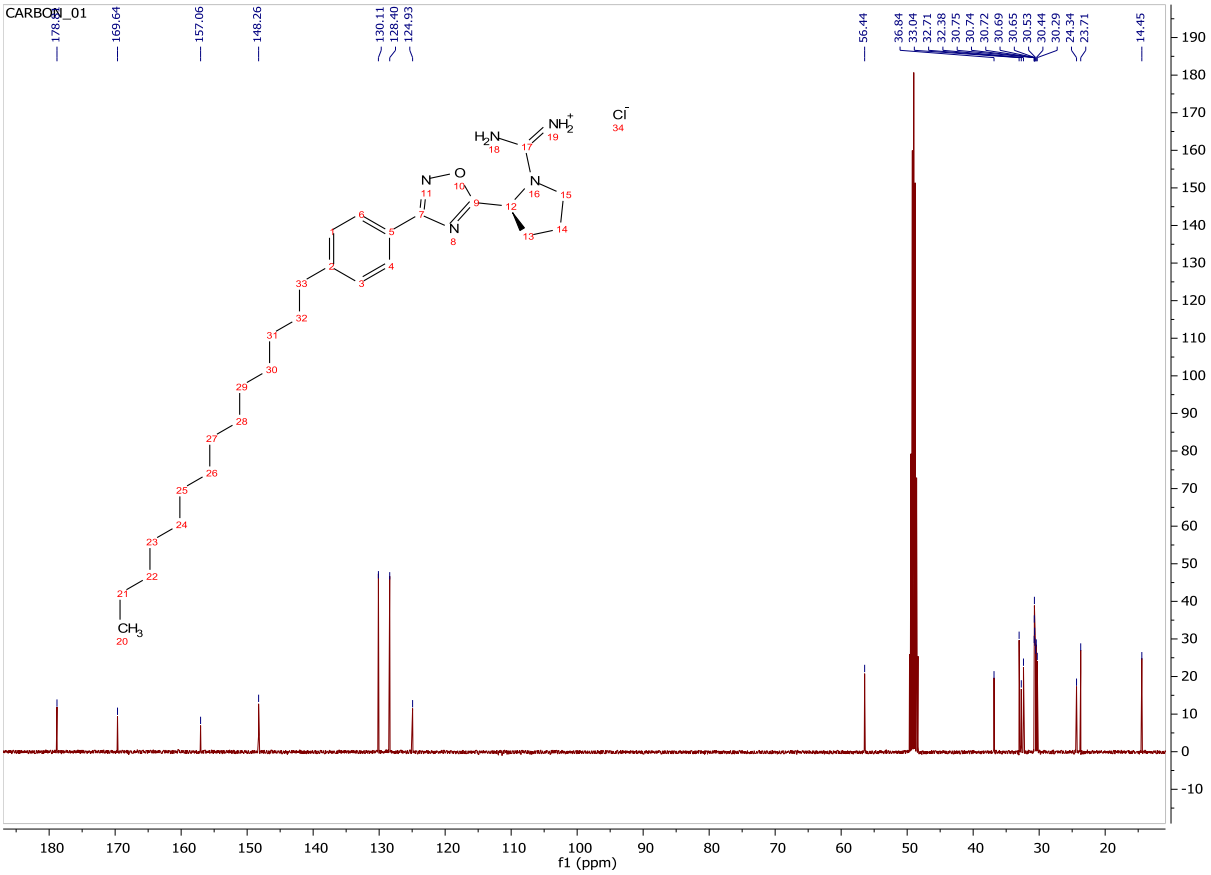
^{13}C-NMR Spectrum for Compound 2.6a



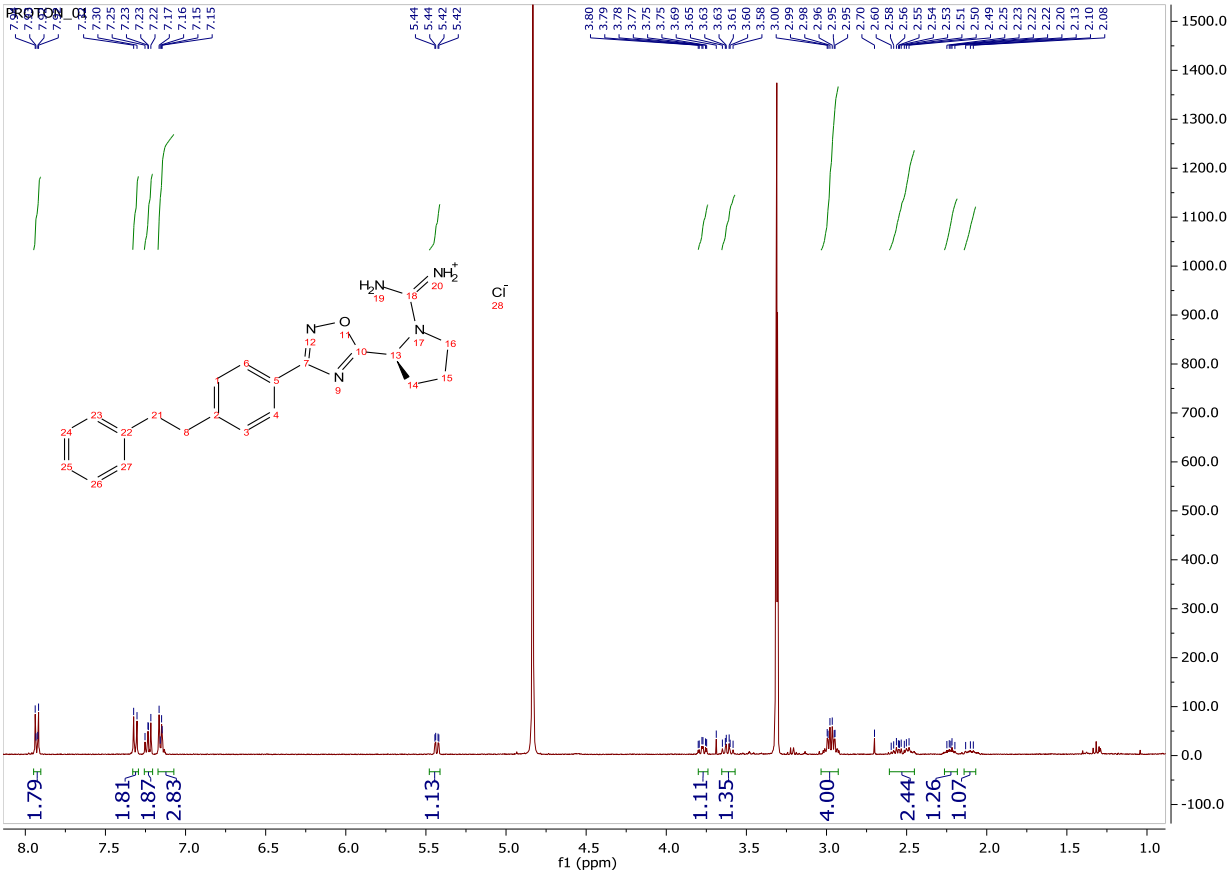
^{1}H-NMR Spectrum for Compound 2.6d



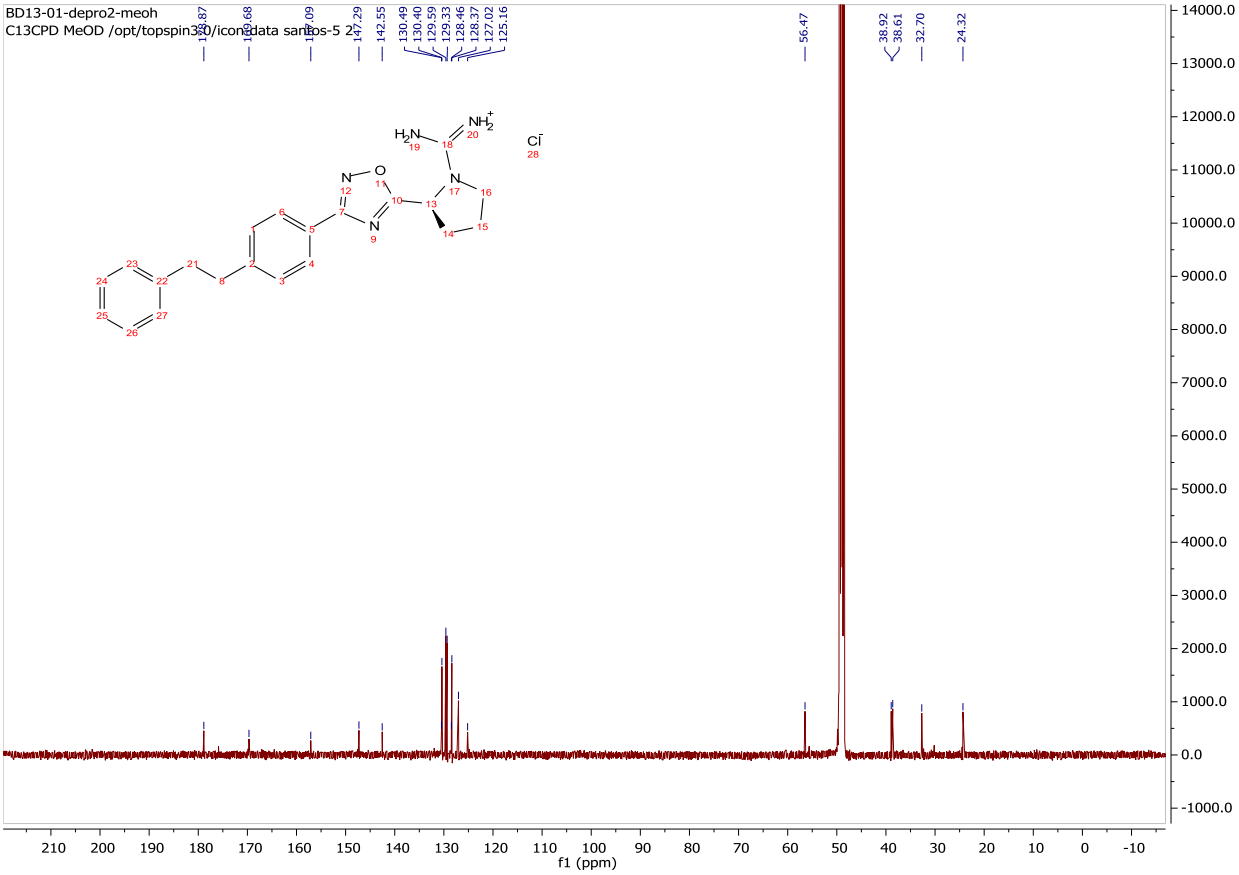
^{13}C-NMR Spectrum for Compound 2.6d



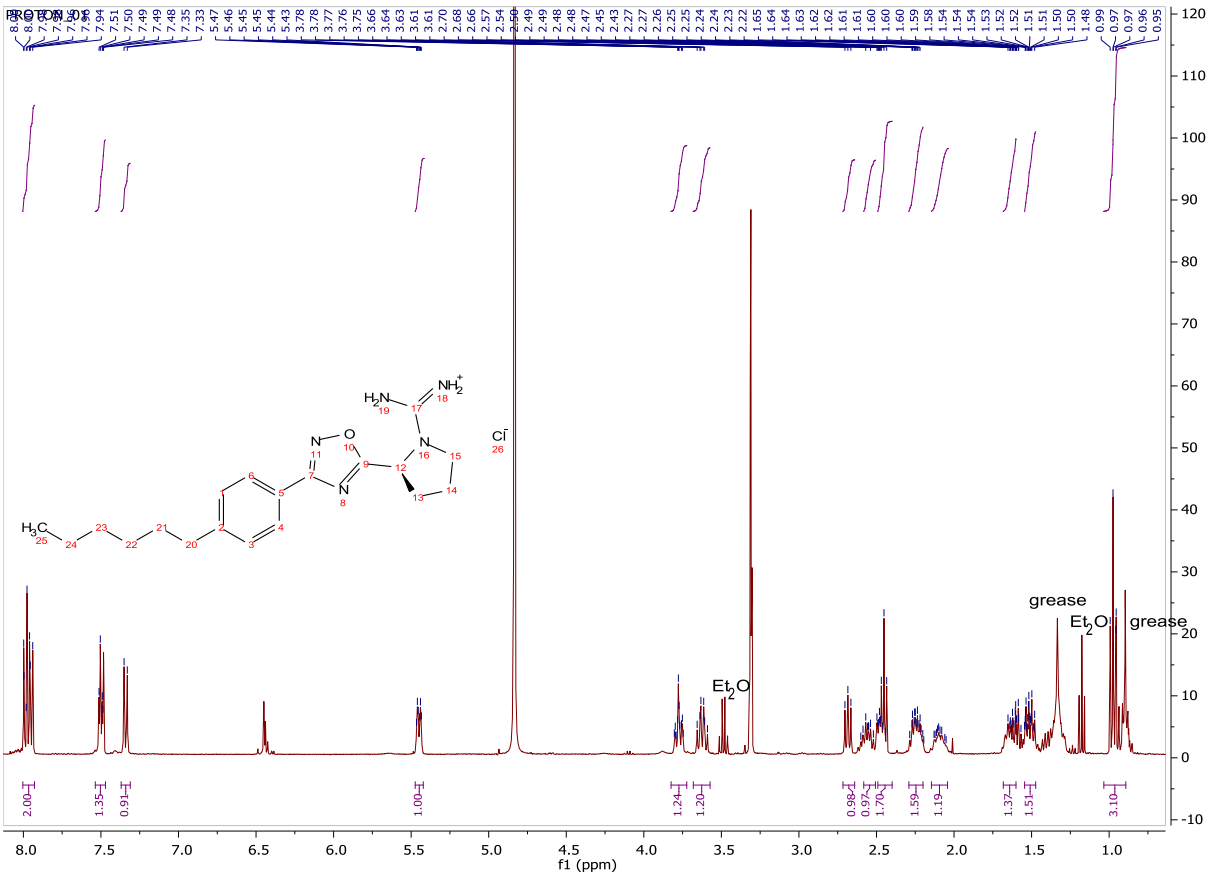
^{1}H-NMR Spectrum for Compound 2.6e



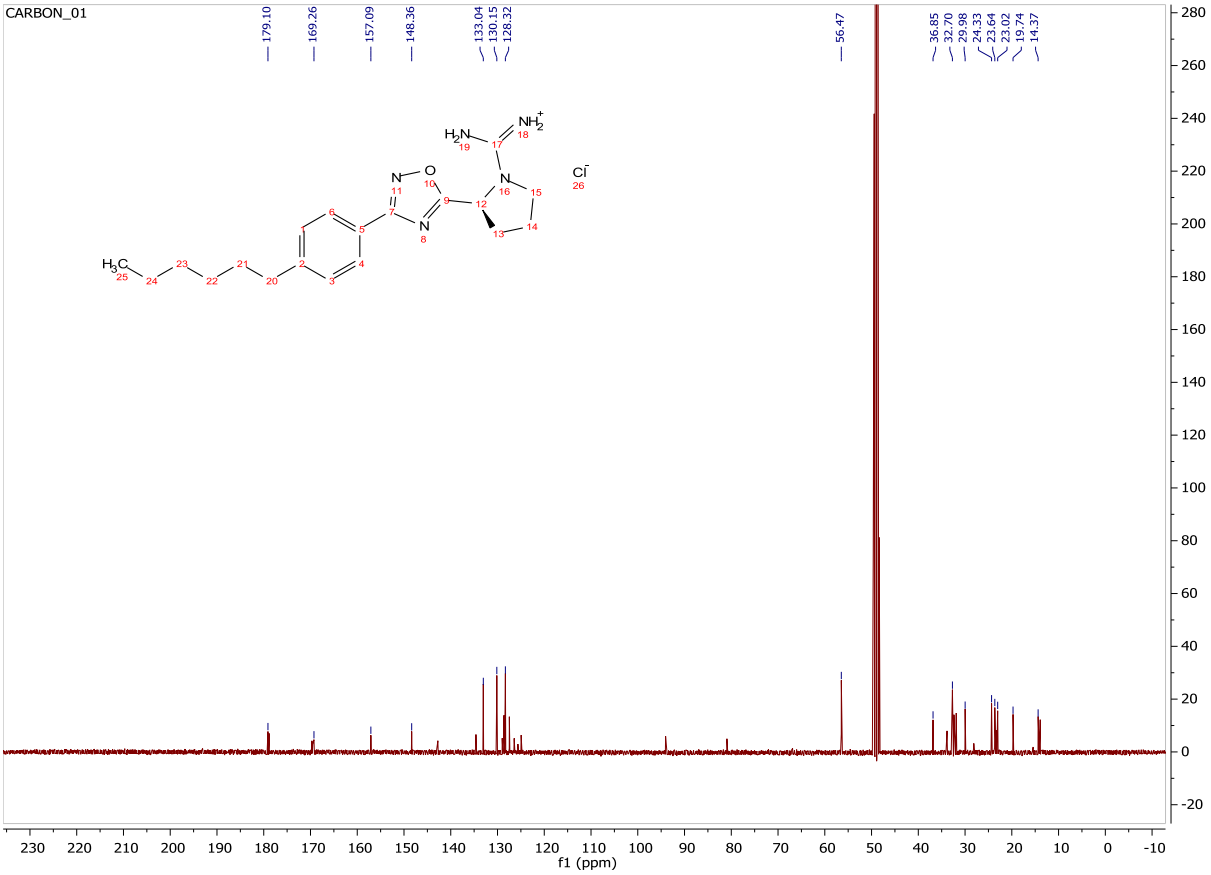
^{13}C-NMR Spectrum for Compound 2.6e



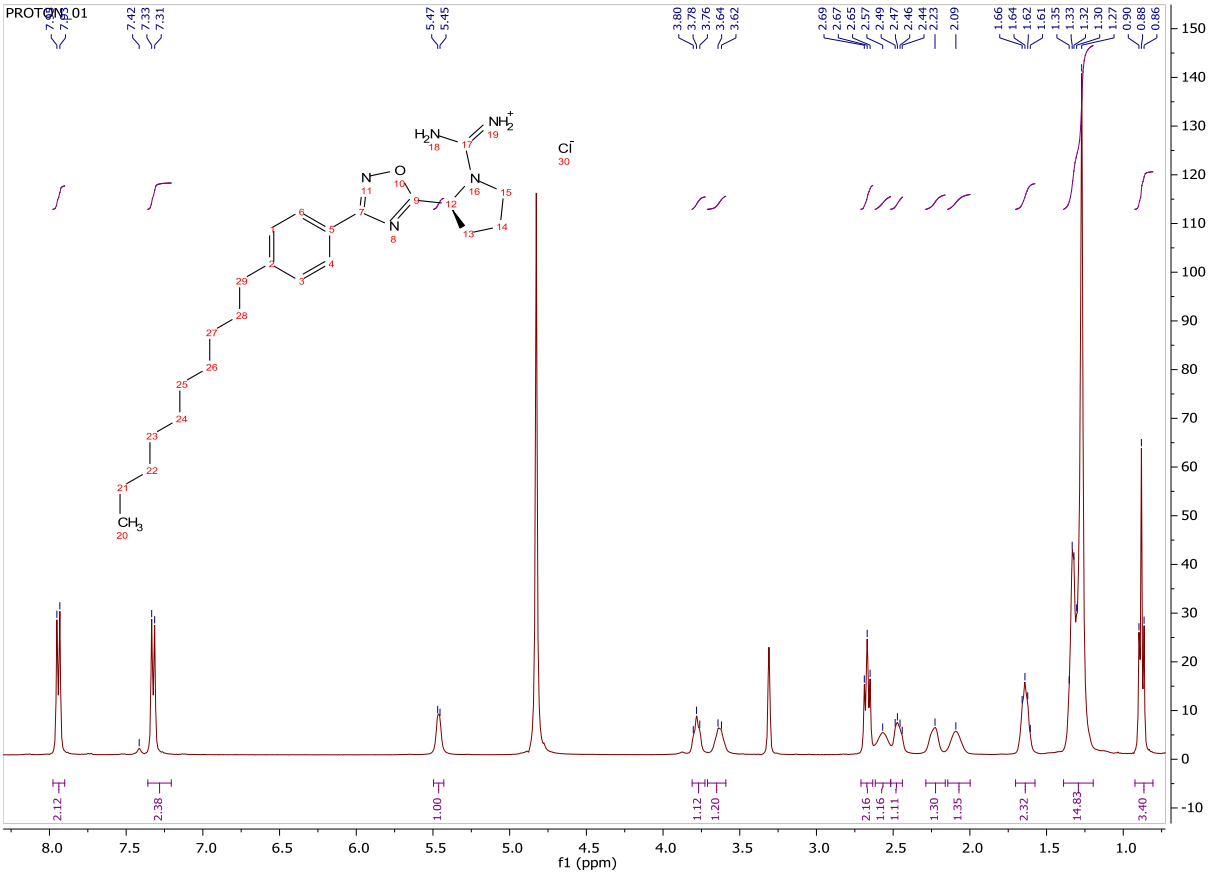
^{1}H-NMR Spectrum for Compound 2.6f



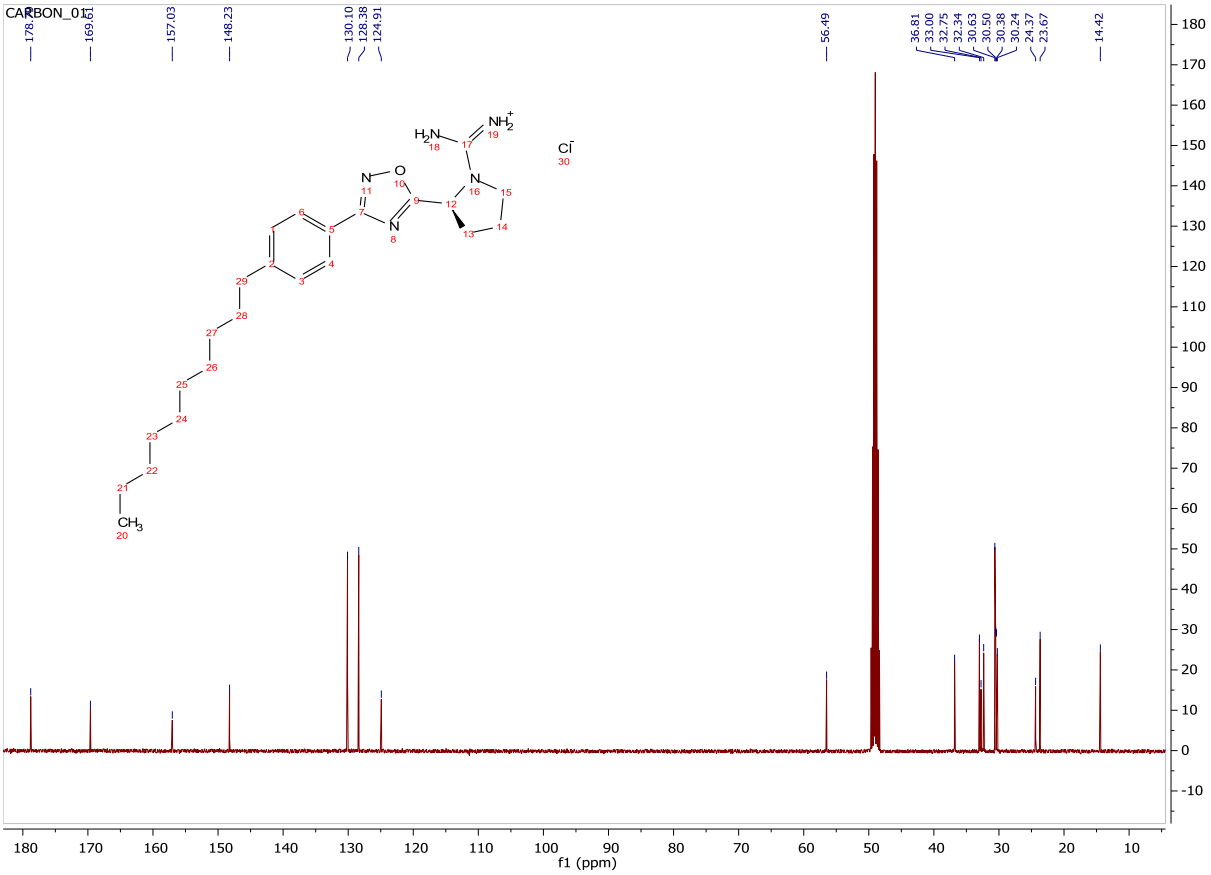
^{13}C-NMR Spectrum for Compound 2.6f



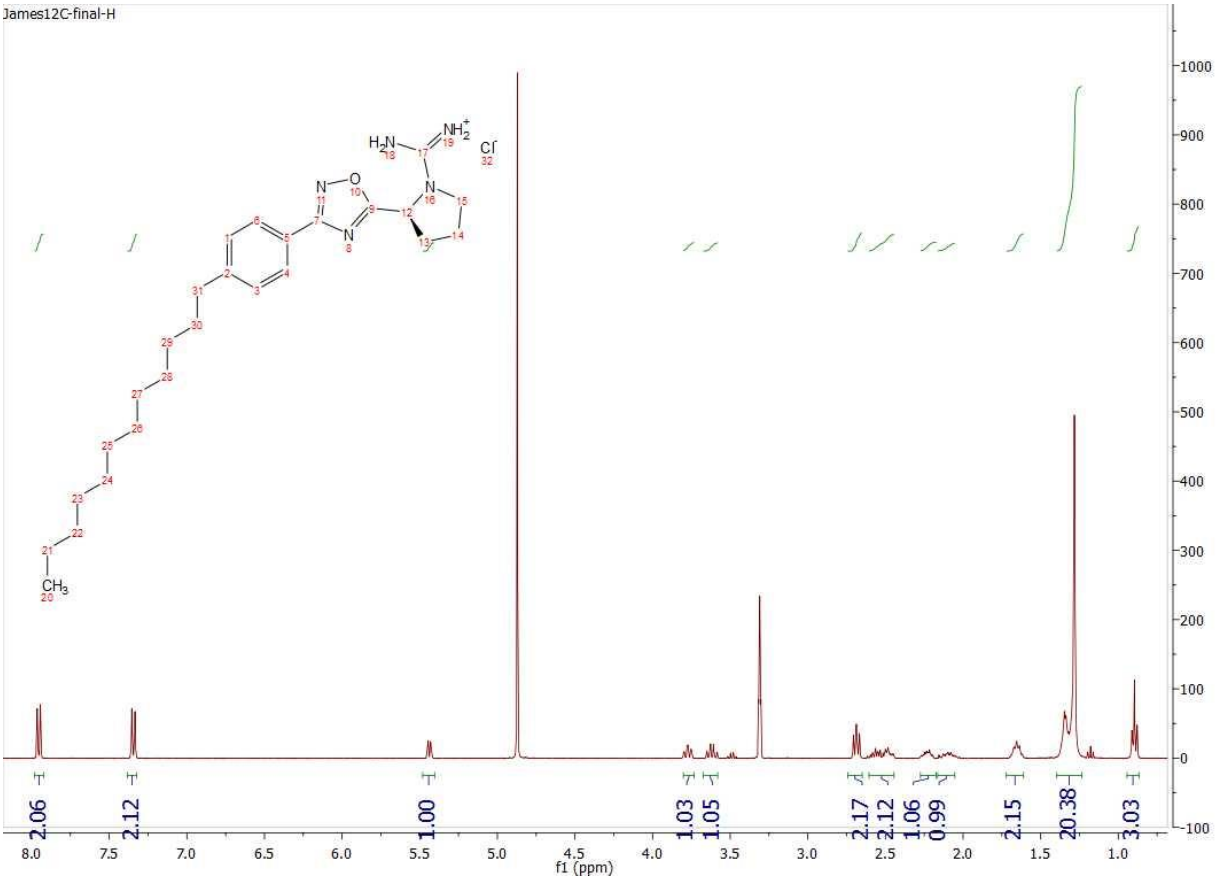
^{1}H-NMR Spectrum for Compound 2.6g



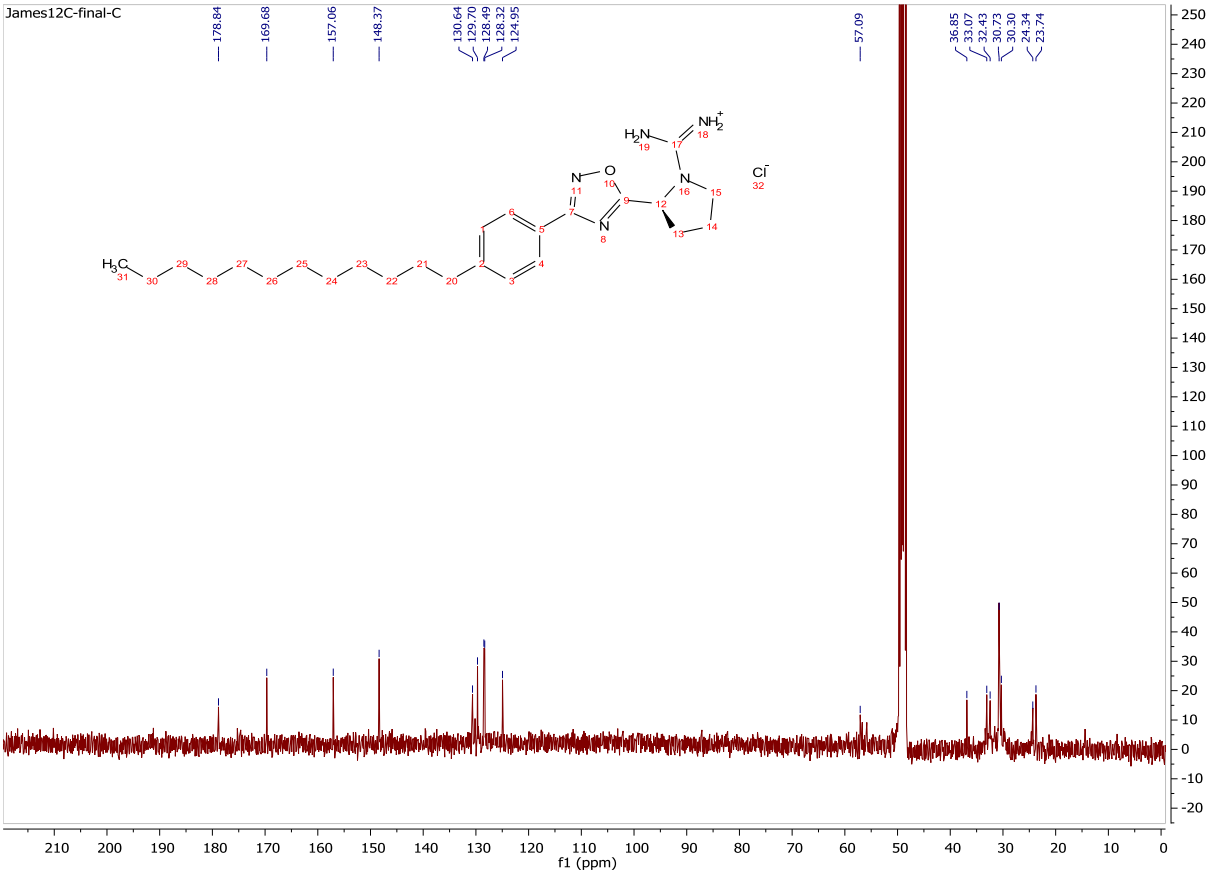
^{13}C-NMR Spectrum for Compound 2.6g



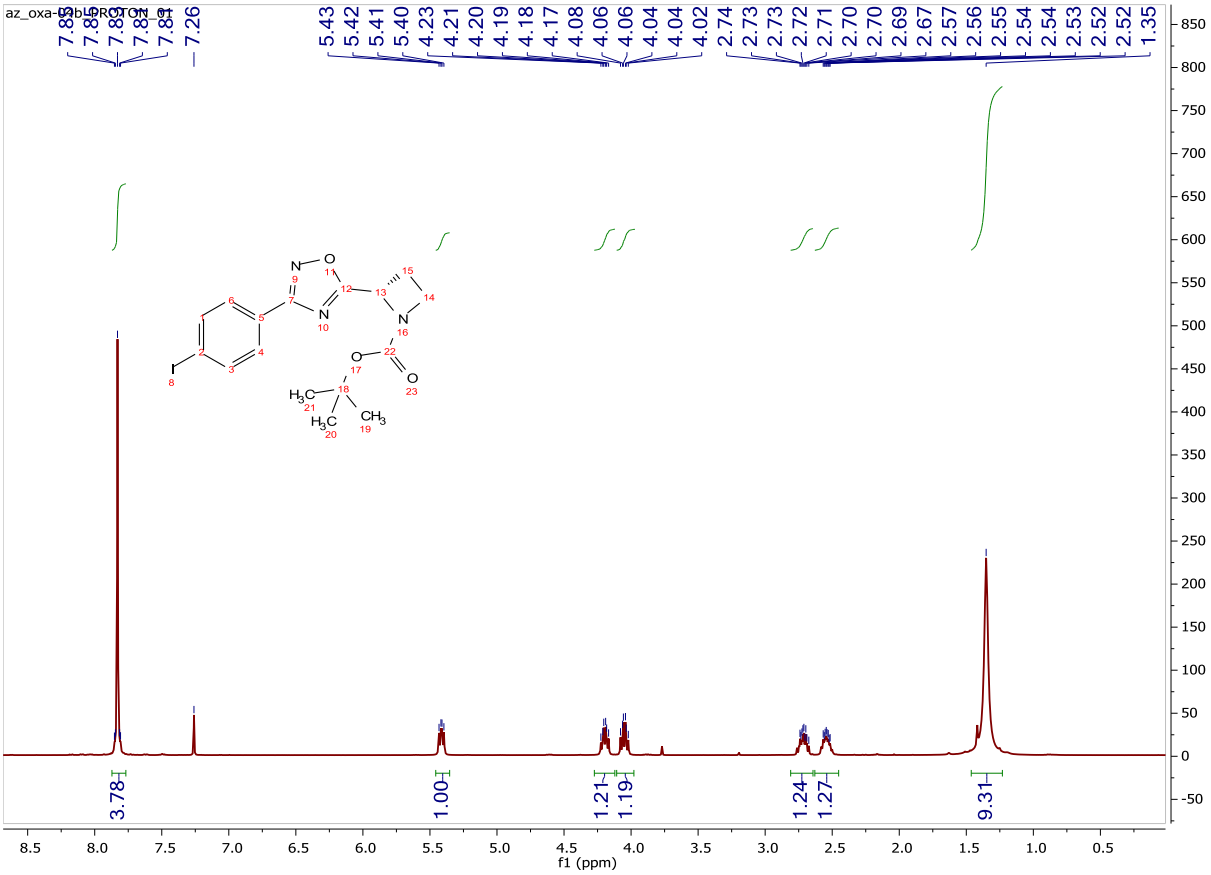
^{1}H-NMR Spectrum for Compound 2.6h



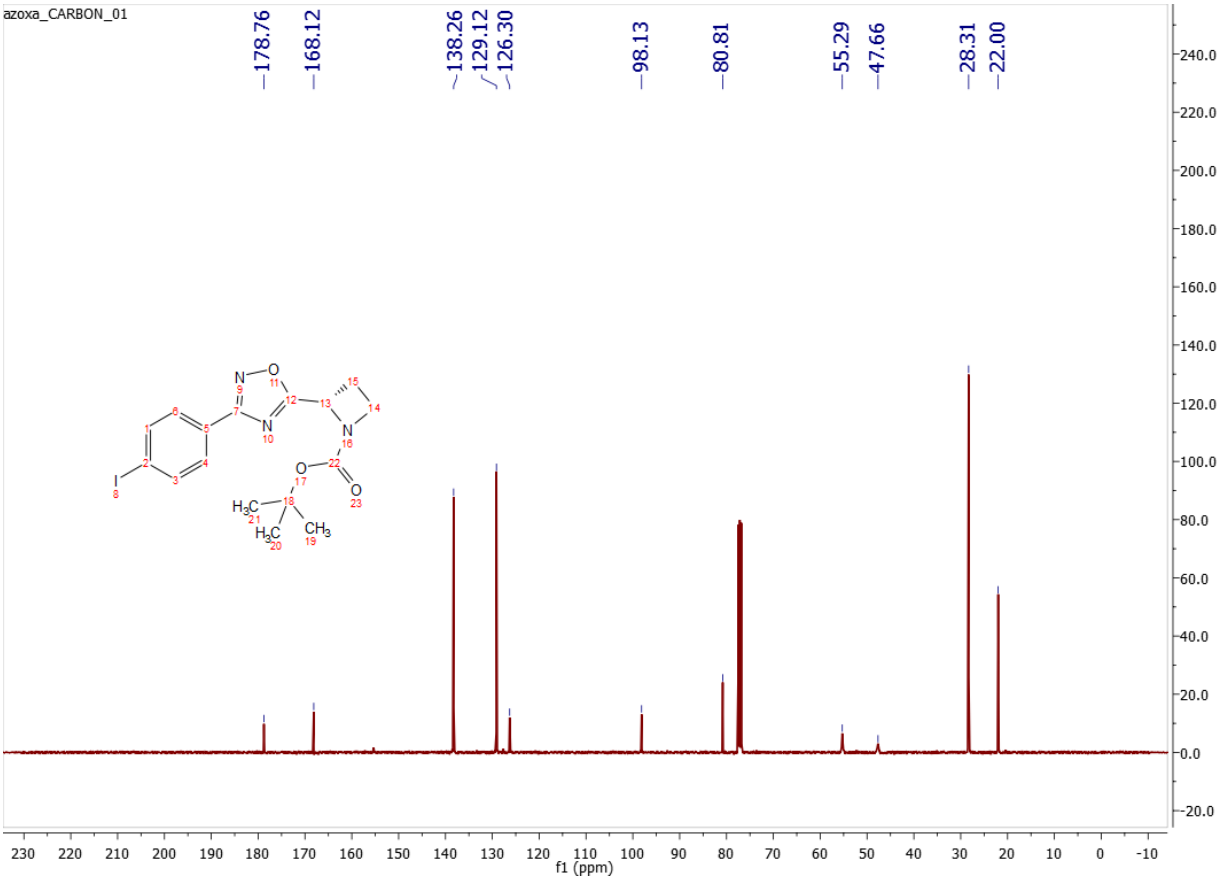
^{13}C-NMR Spectrum for Compound 2.6h



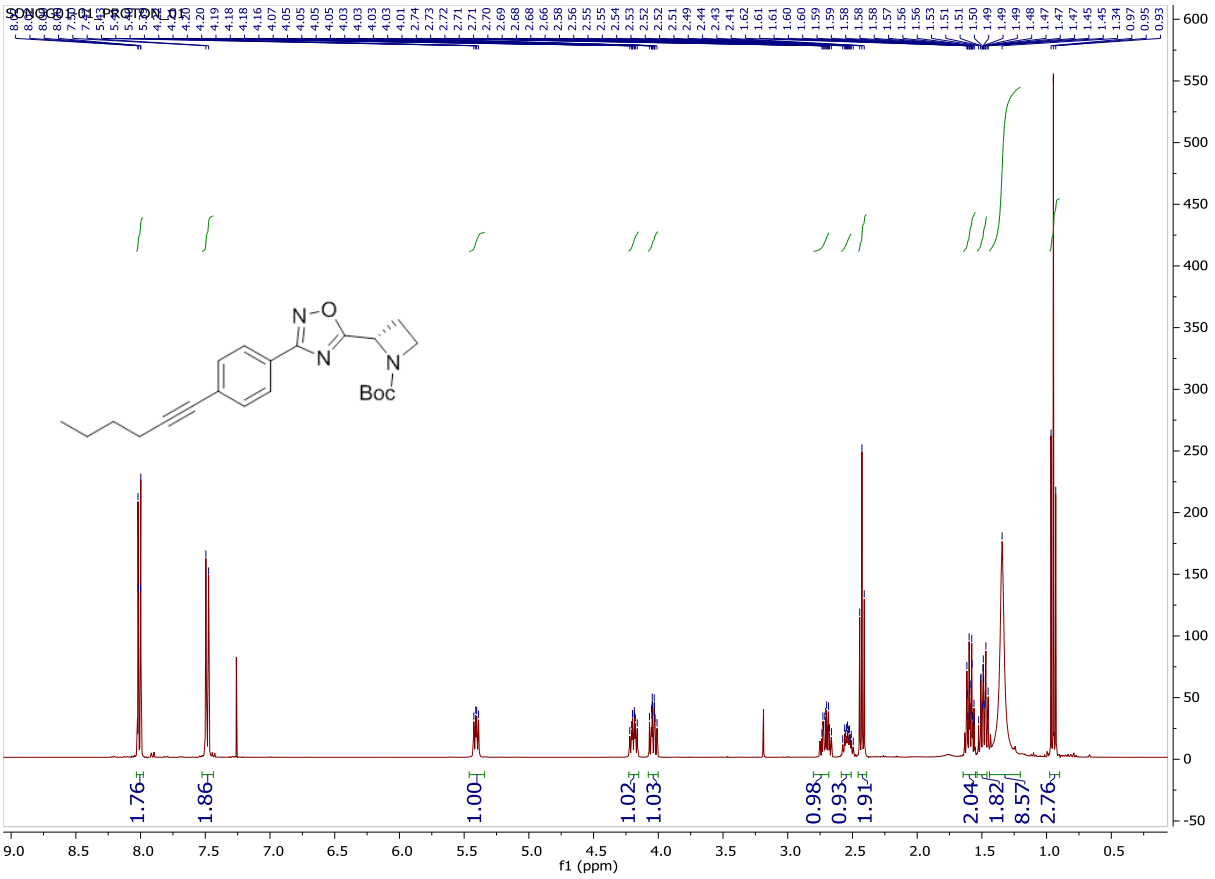
^{1}H-NMR Spectrum for Compound 2.8



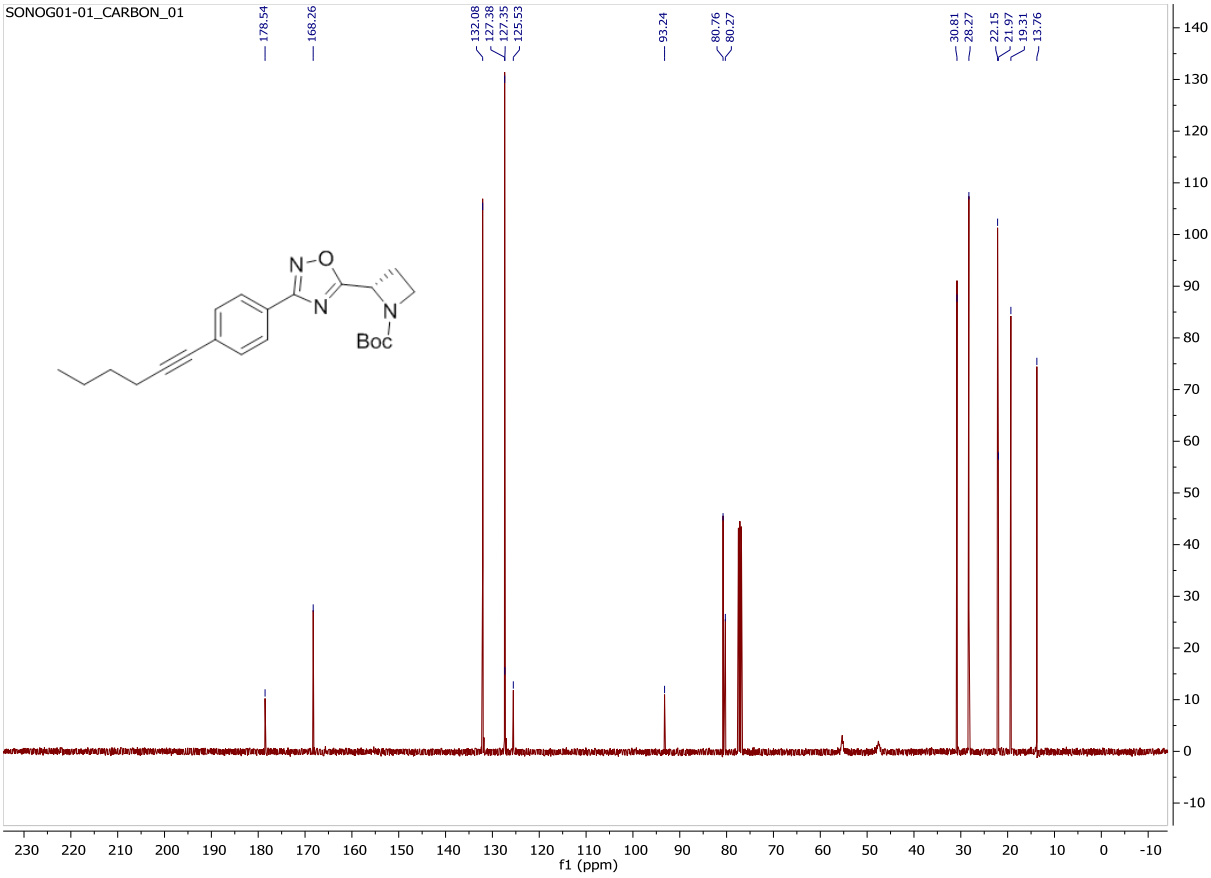
^{13}C-NMR Spectrum for Compound 2.8



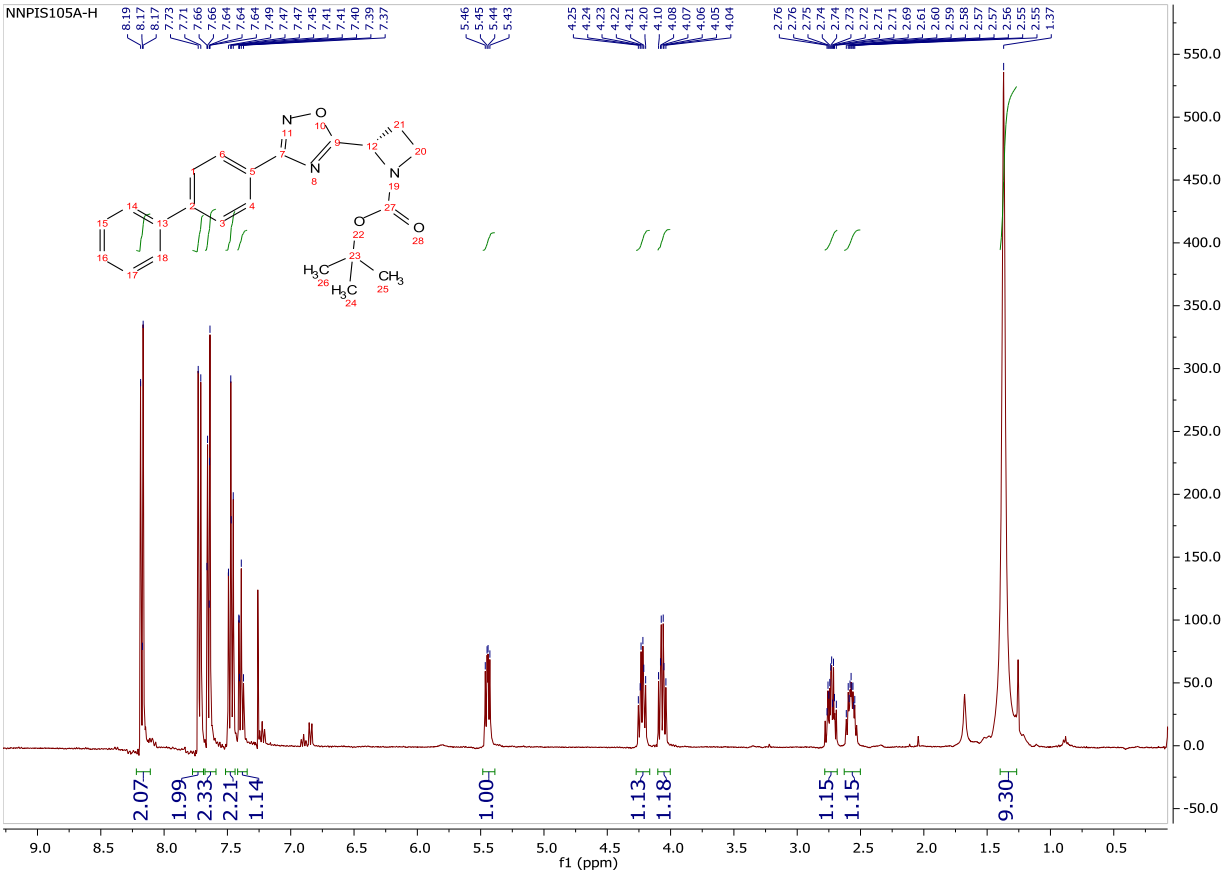
^{1}H-NMR Spectrum for Compound 2.9a



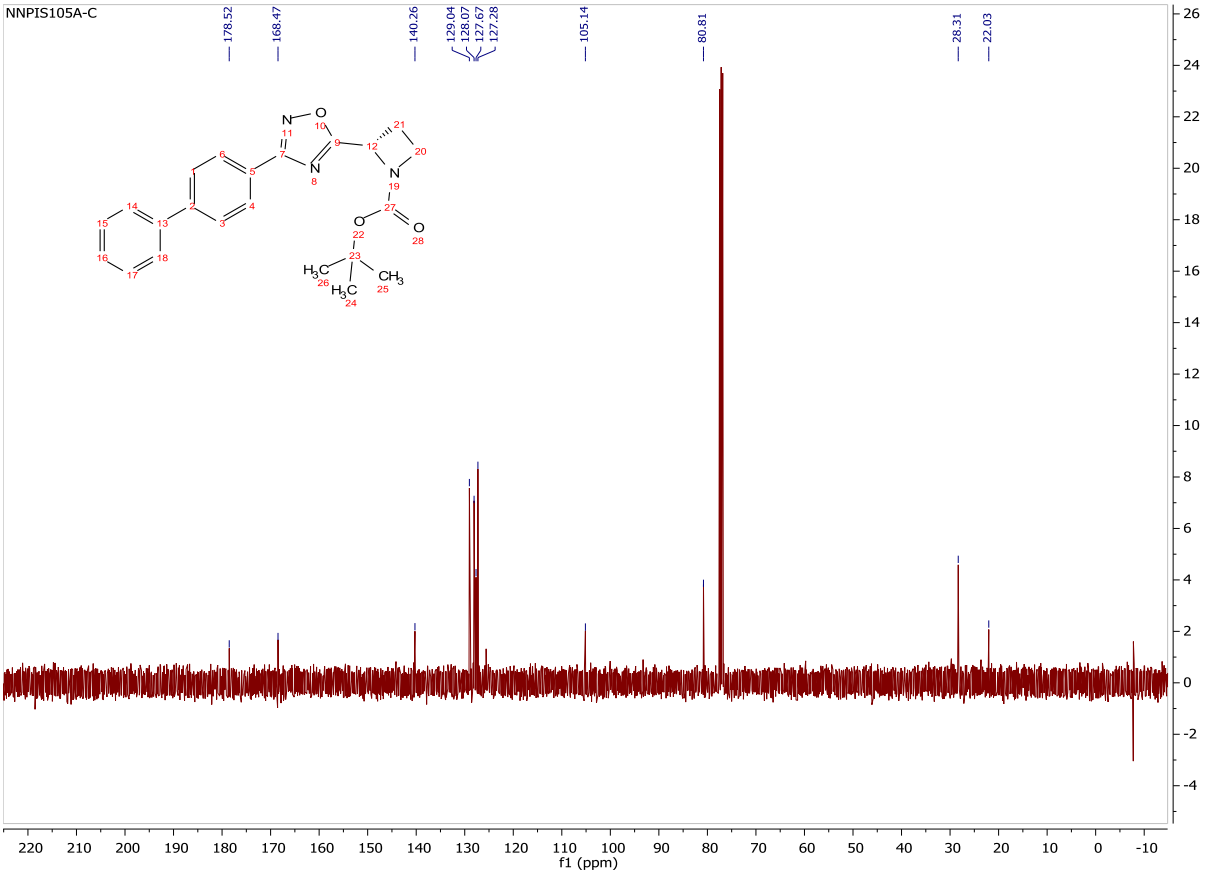
^{13}C-NMR Spectrum for Compound 2.9a



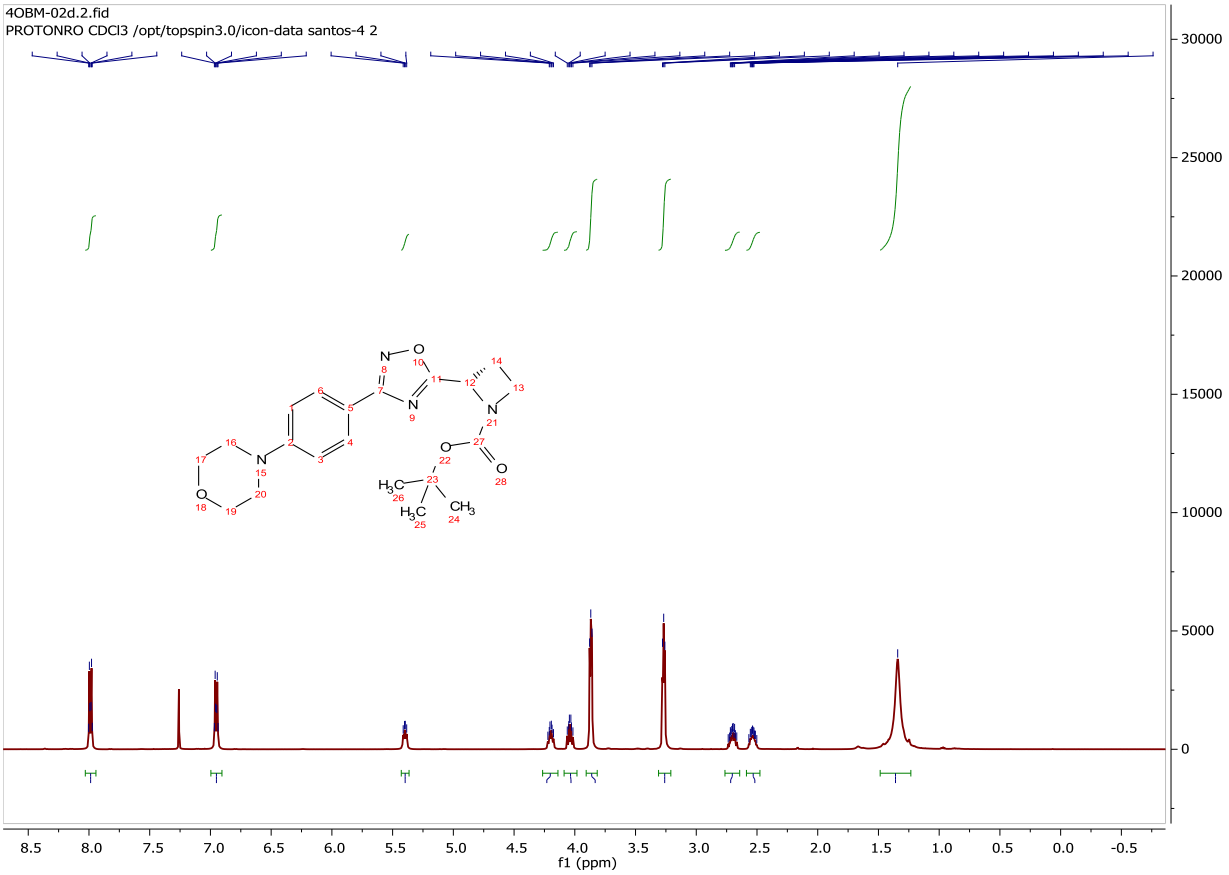
^{1}H-NMR Spectrum for Compound 2.9c



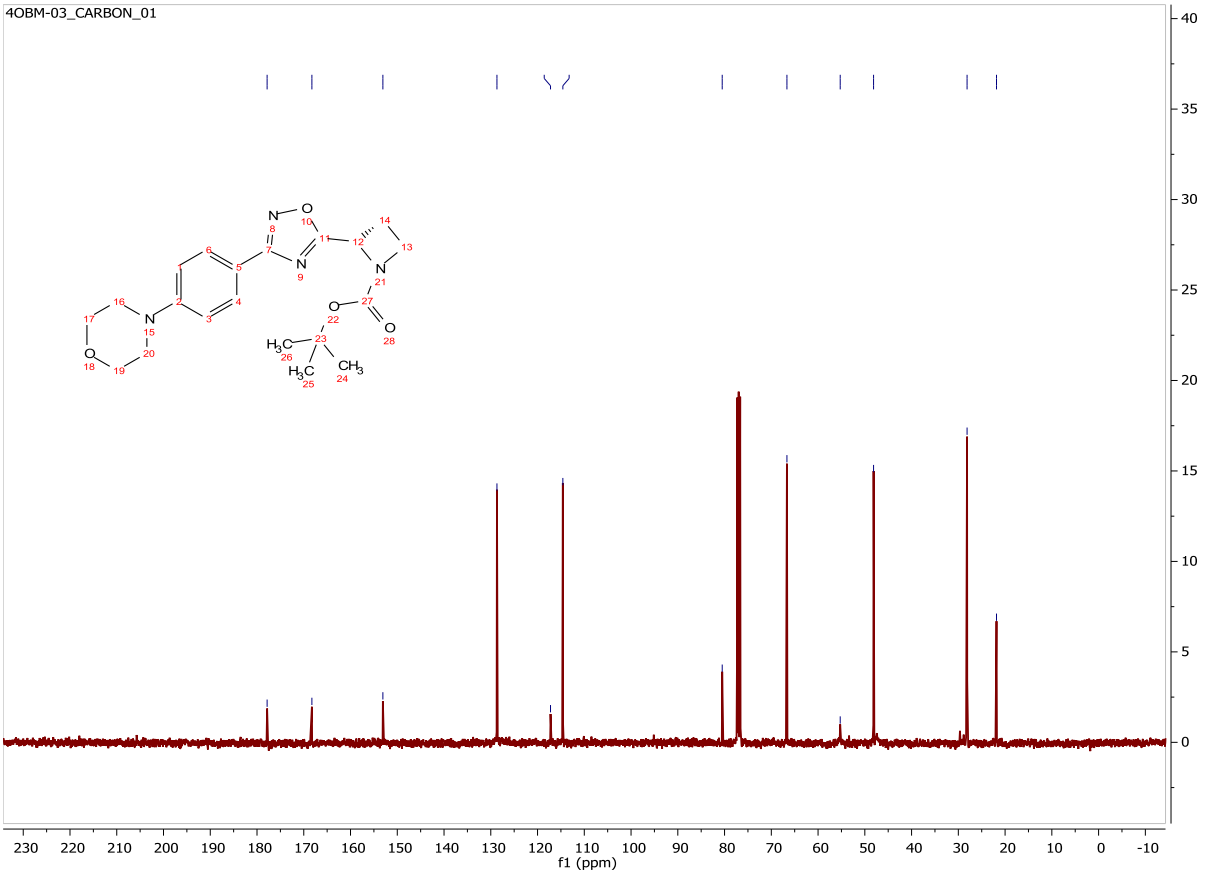
^{13}C-NMR Spectrum for Compound 2.9c



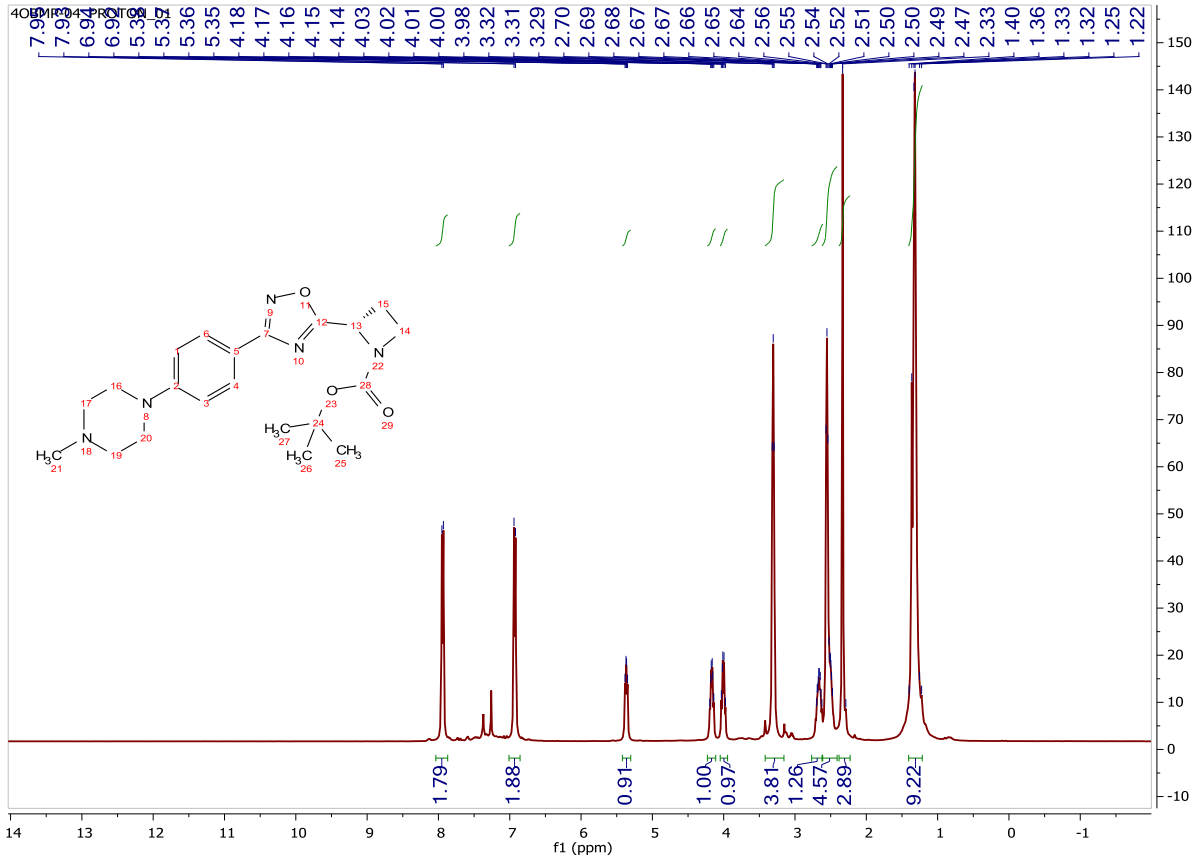
^{1}H-NMR Spectrum for Compound 2.9d



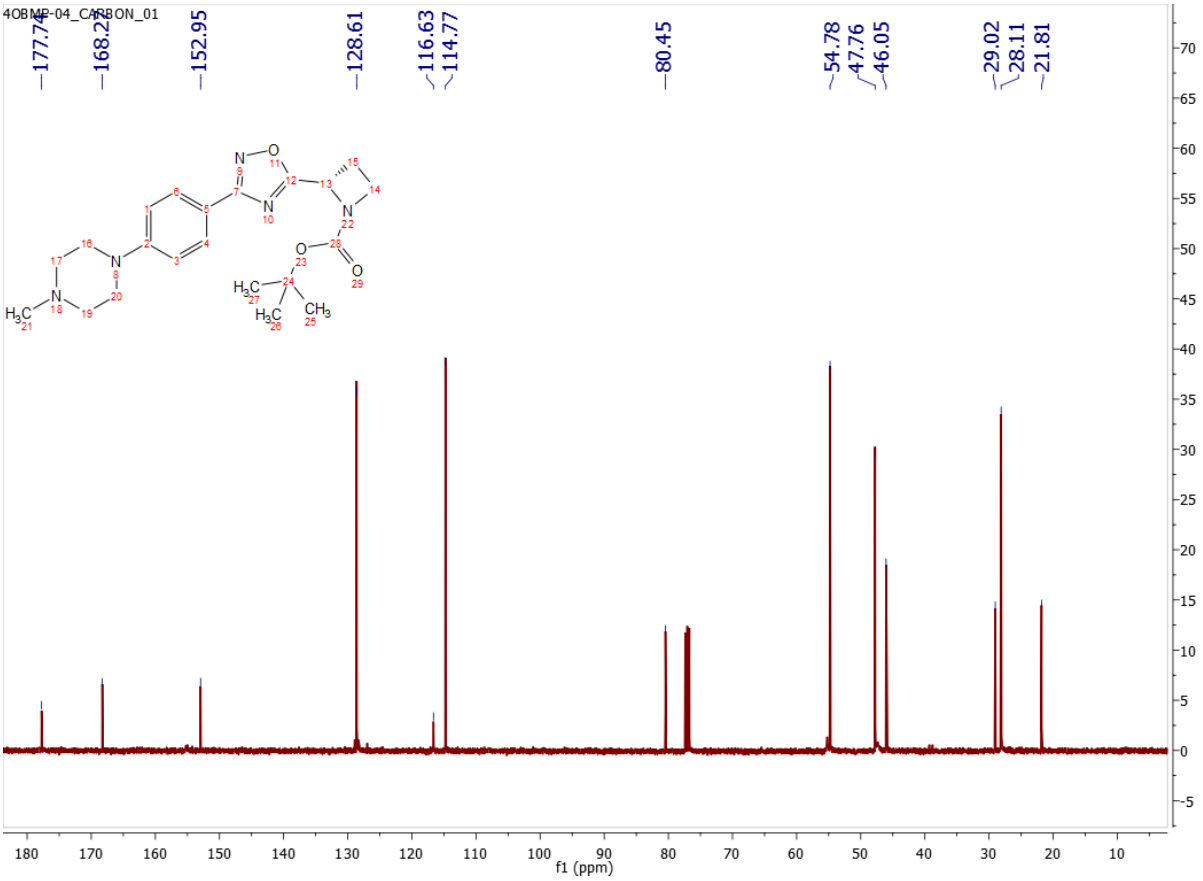
^{13}C-NMR Spectrum for Compound 2.9d



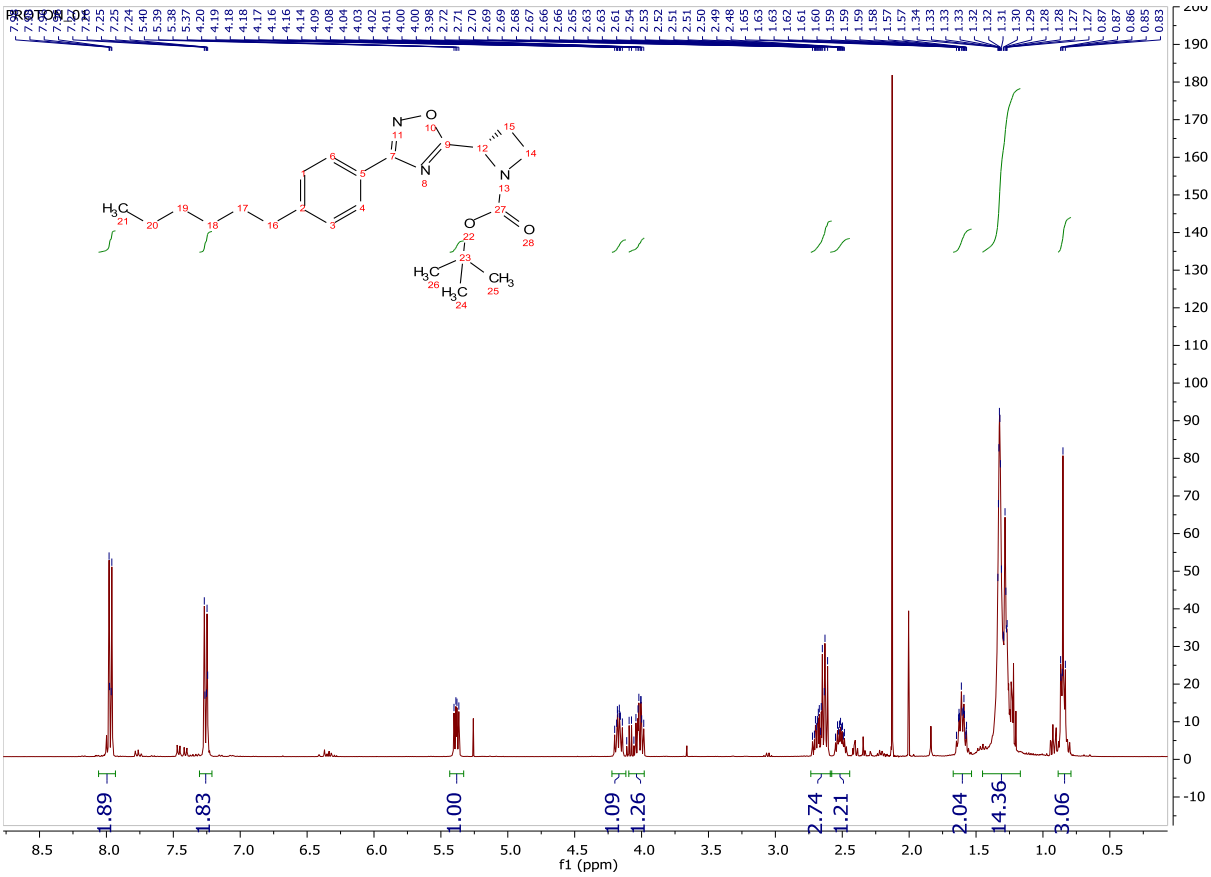
^{1}H-NMR Spectrum for Compound 2.9e



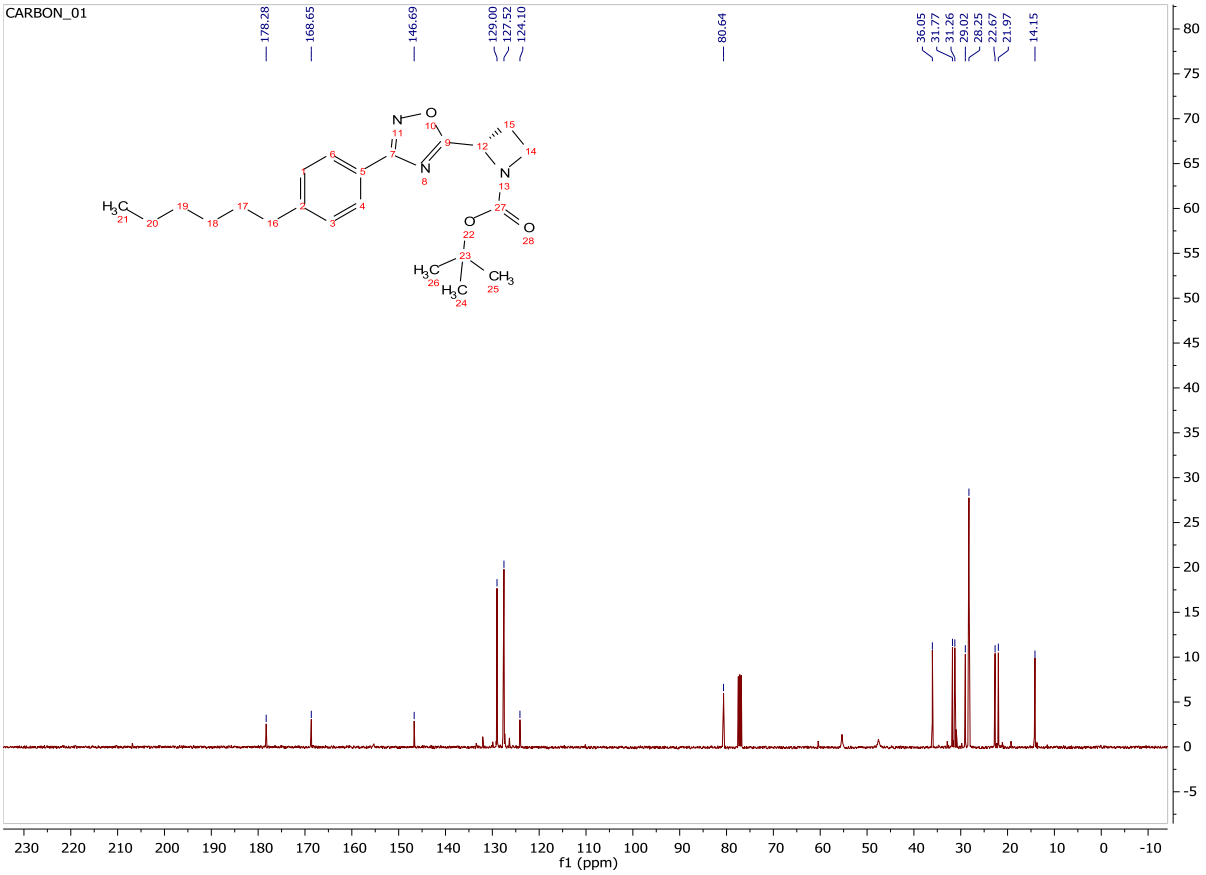
^{13}C-NMR Spectrum for Compound 2.9e



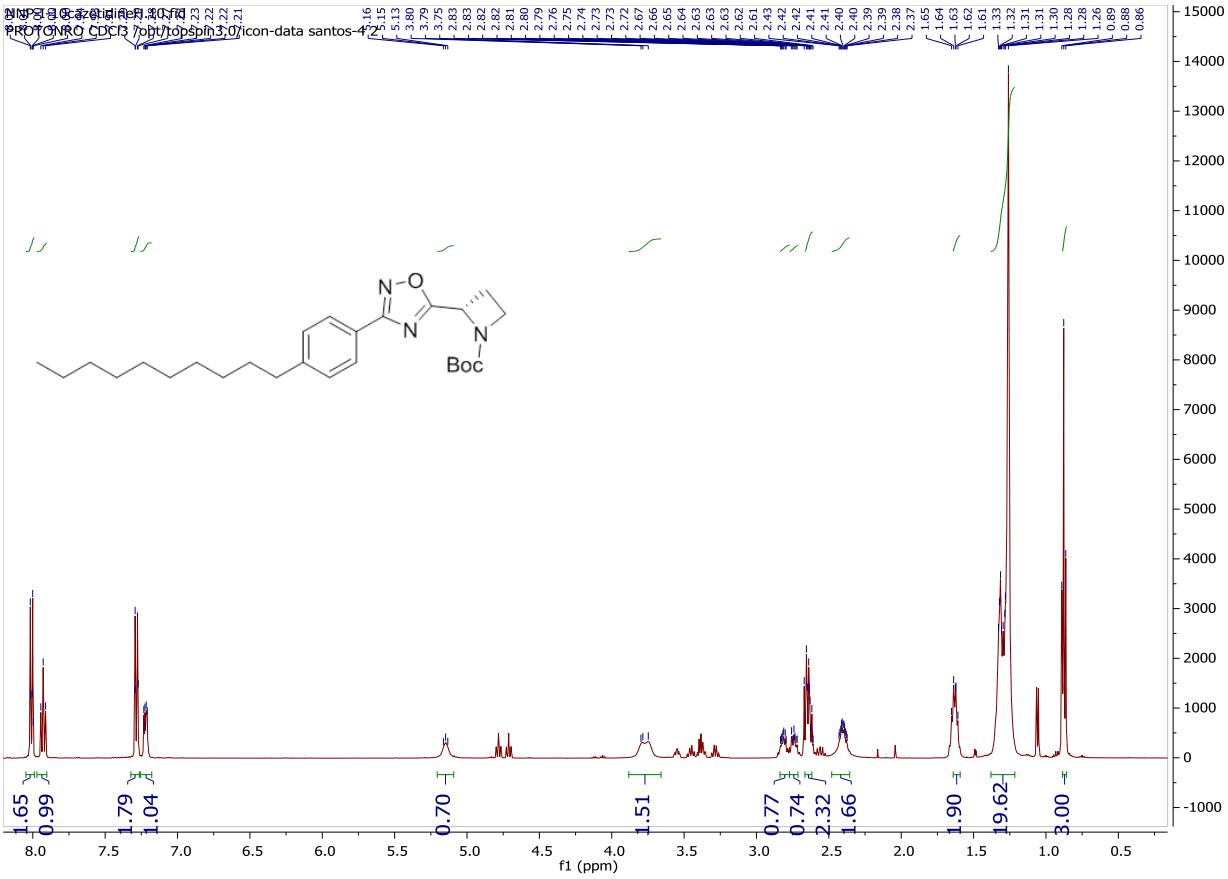
^{1}H-NMR Spectrum for Compound 2.9f



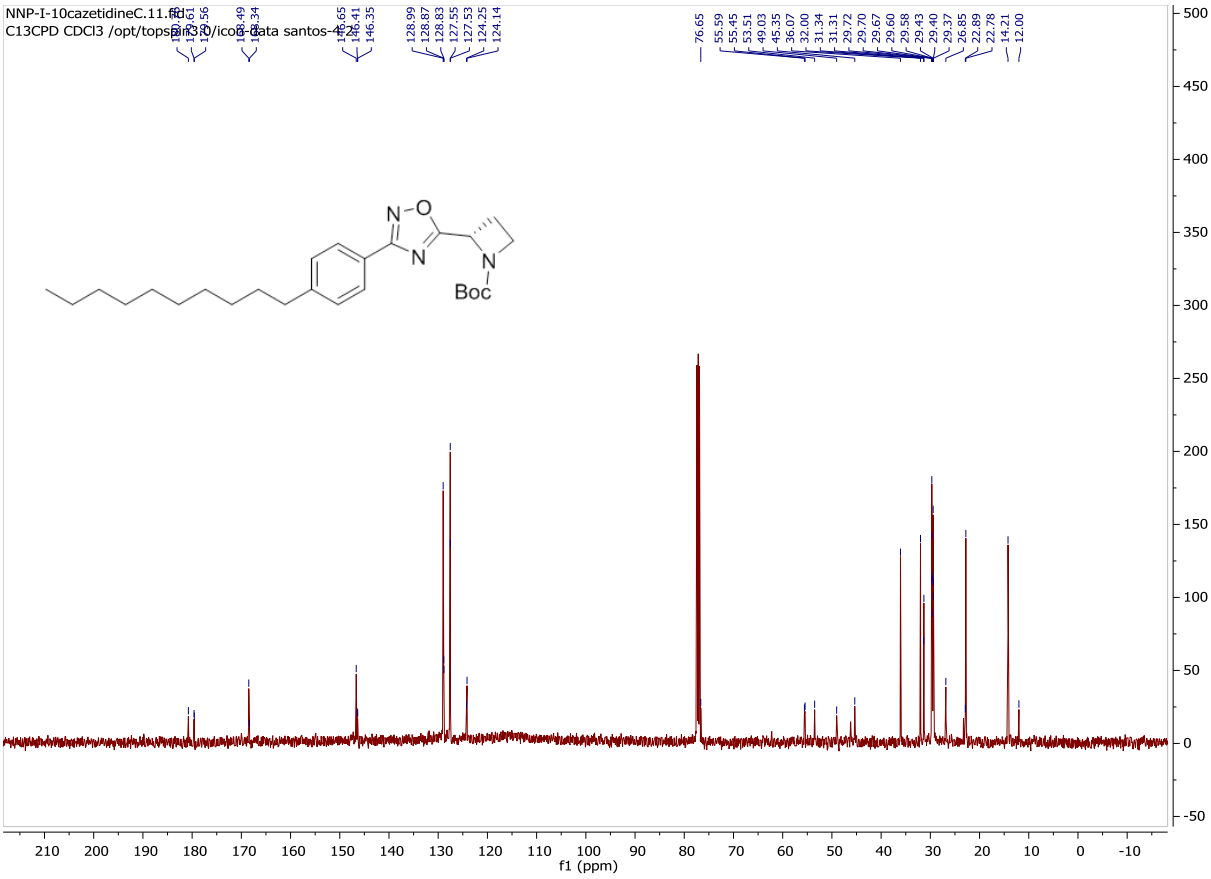
^{13}C-NMR Spectrum for Compound 2.9f



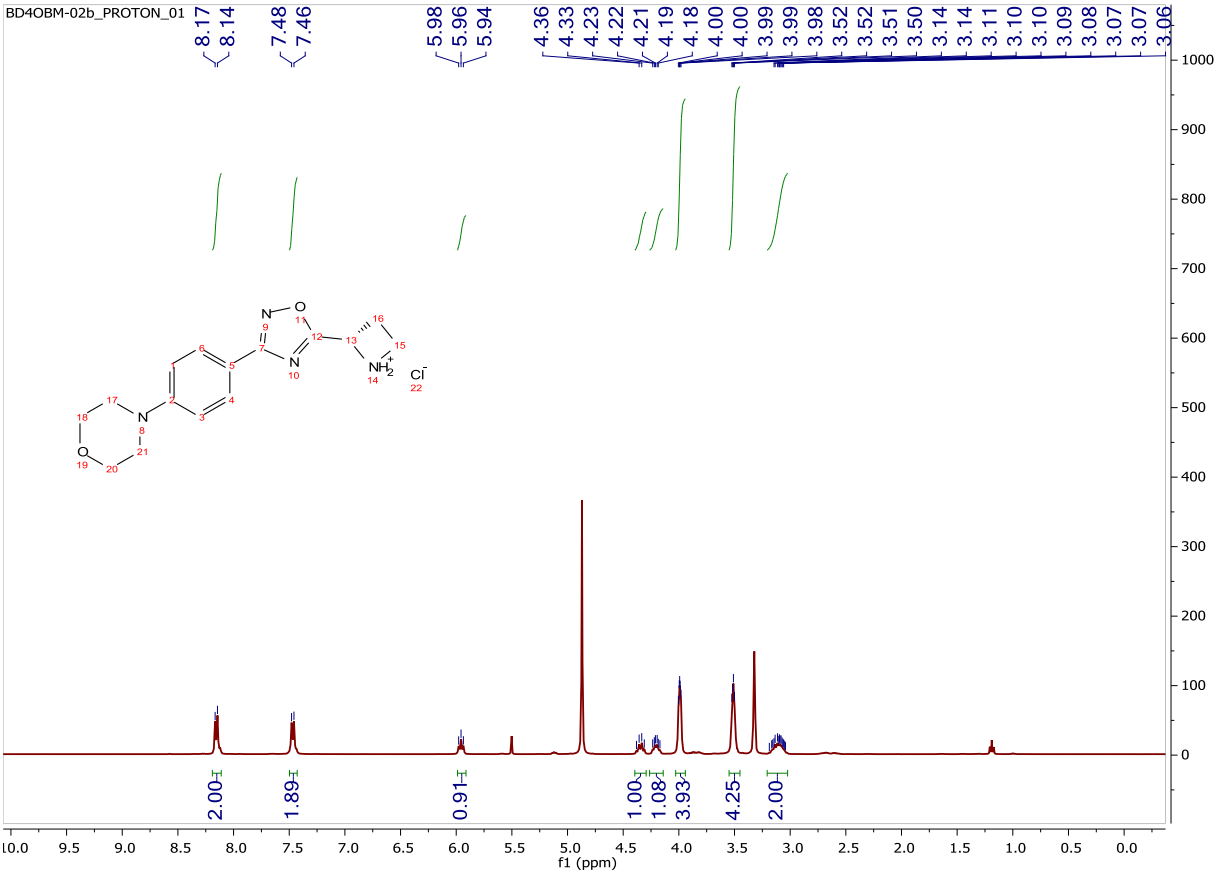
^{1}H-NMR Spectrum for Compound 2.9g



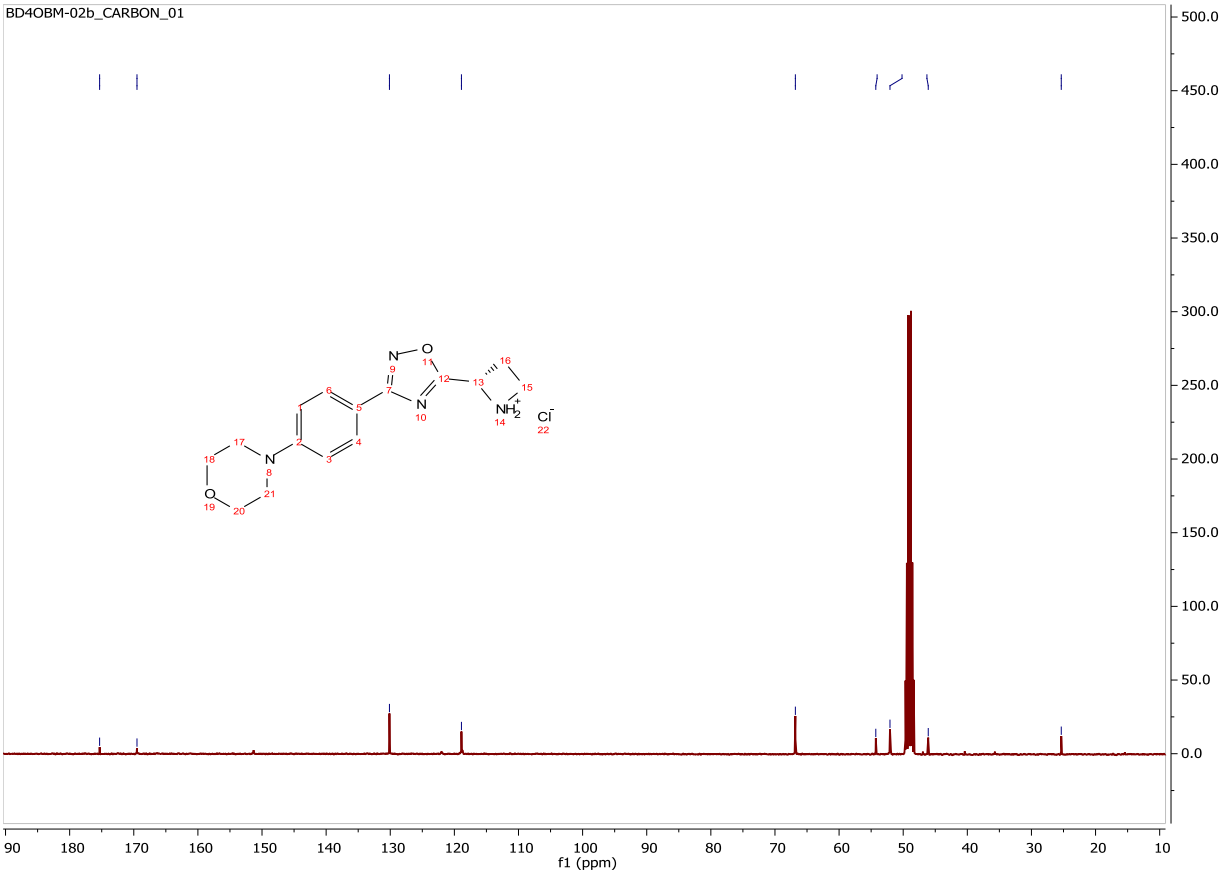
^{13}C-NMR Spectrum for Compound 2.9g



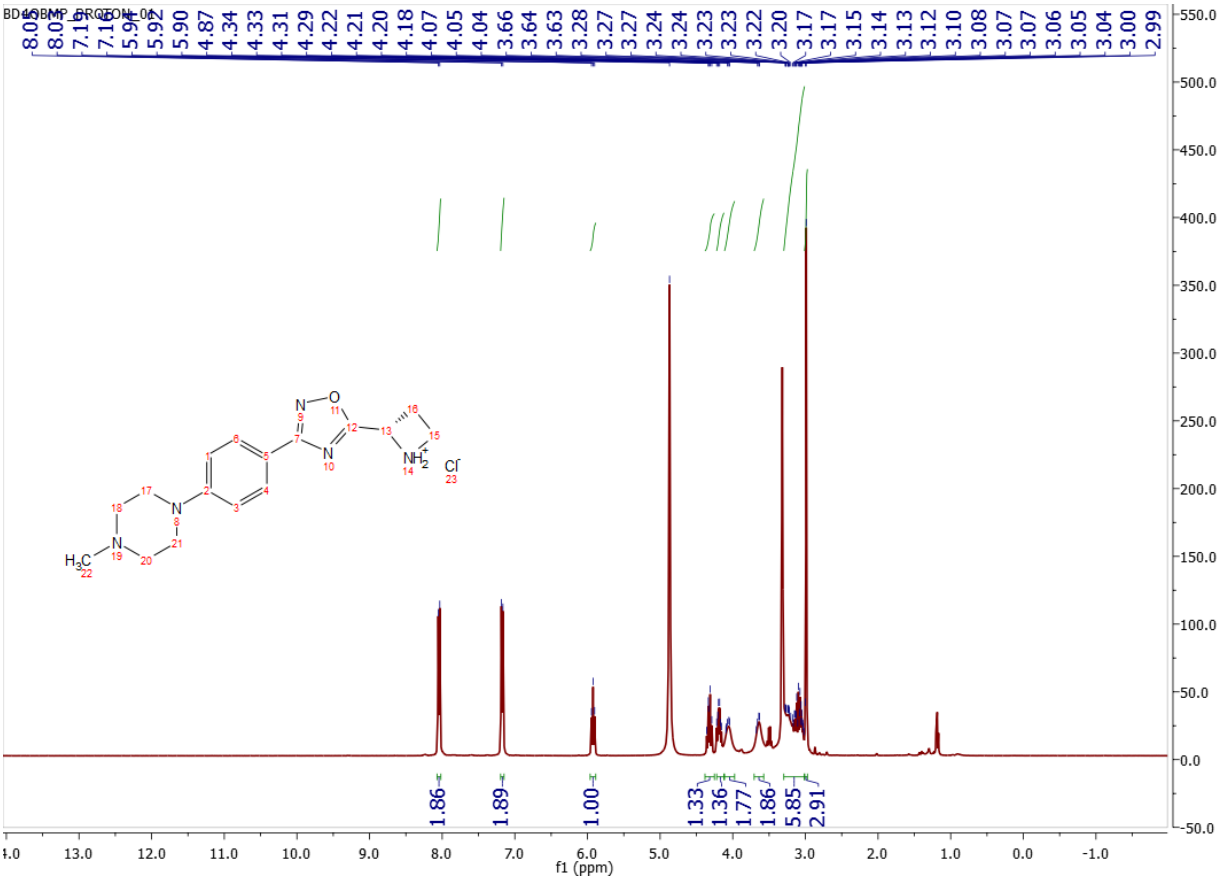
^{1}H-NMR Spectrum for Compound 2.10d



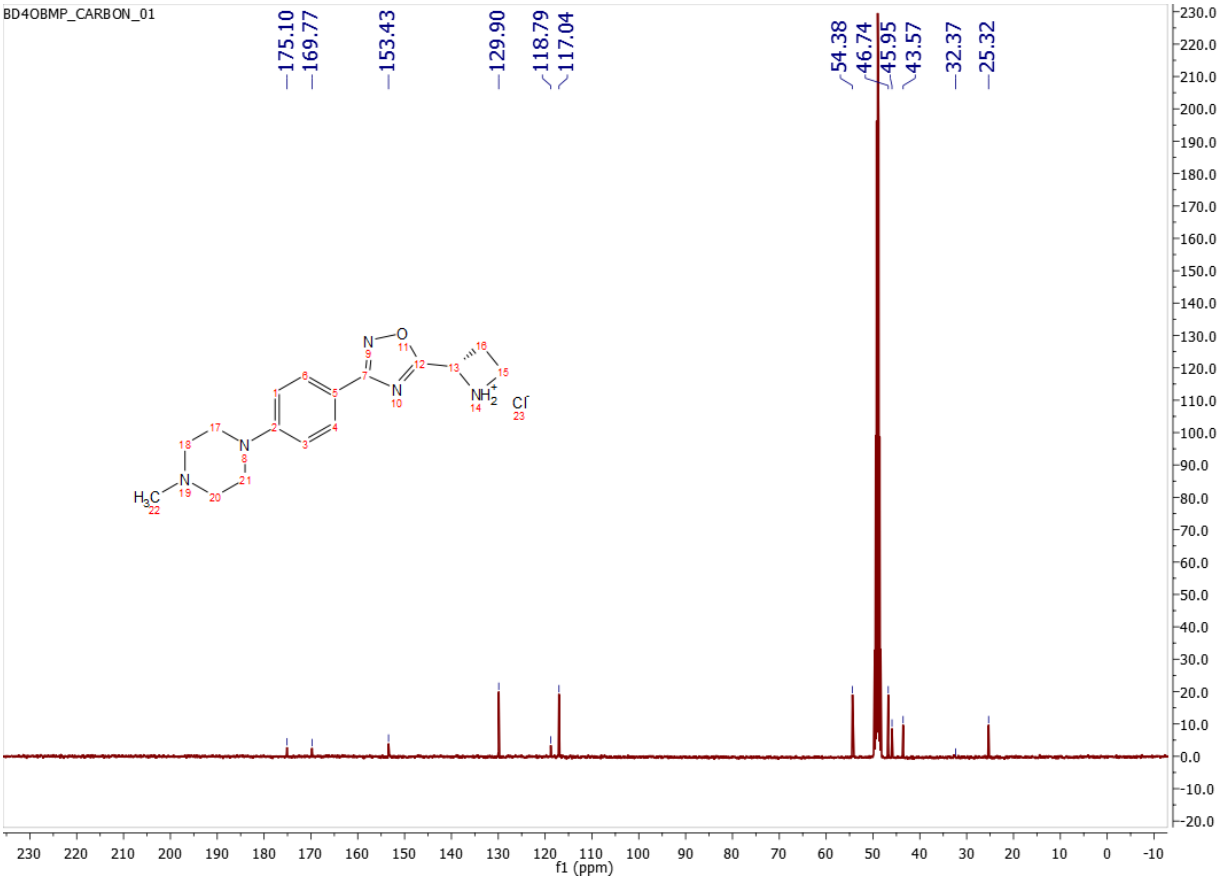
^{13}C-NMR Spectrum for Compound 2.10d



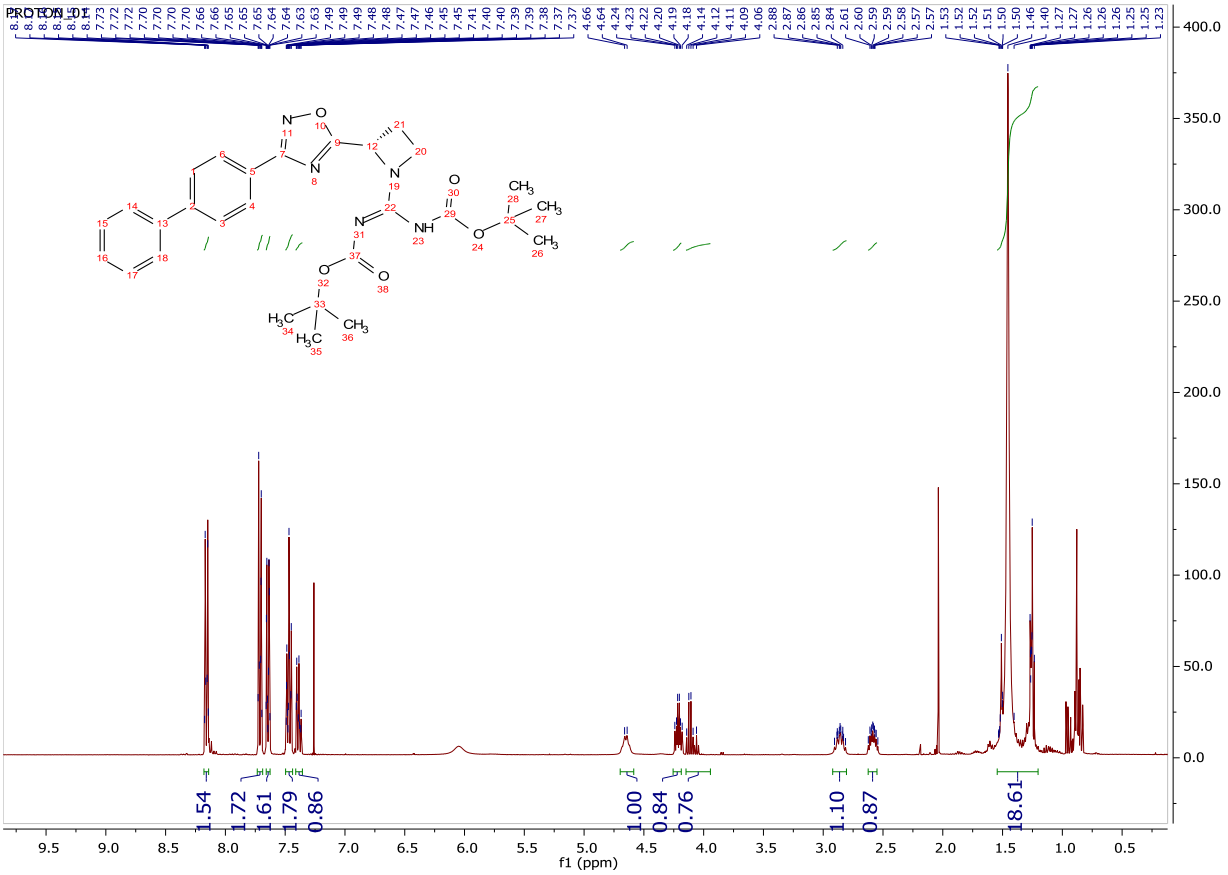
^{1}H-NMR Spectrum for Compound 2.10e



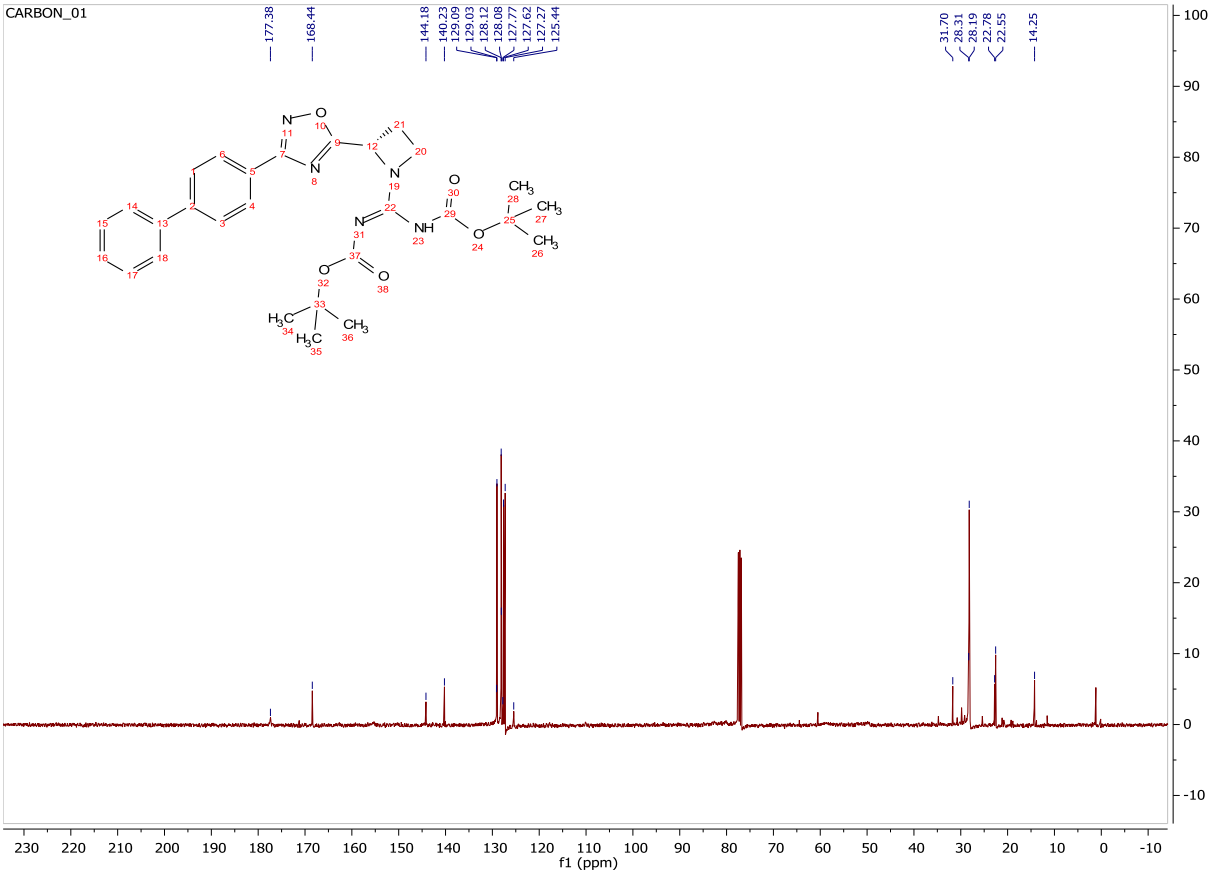
^{13}C-NMR Spectrum for Compound 2.10e



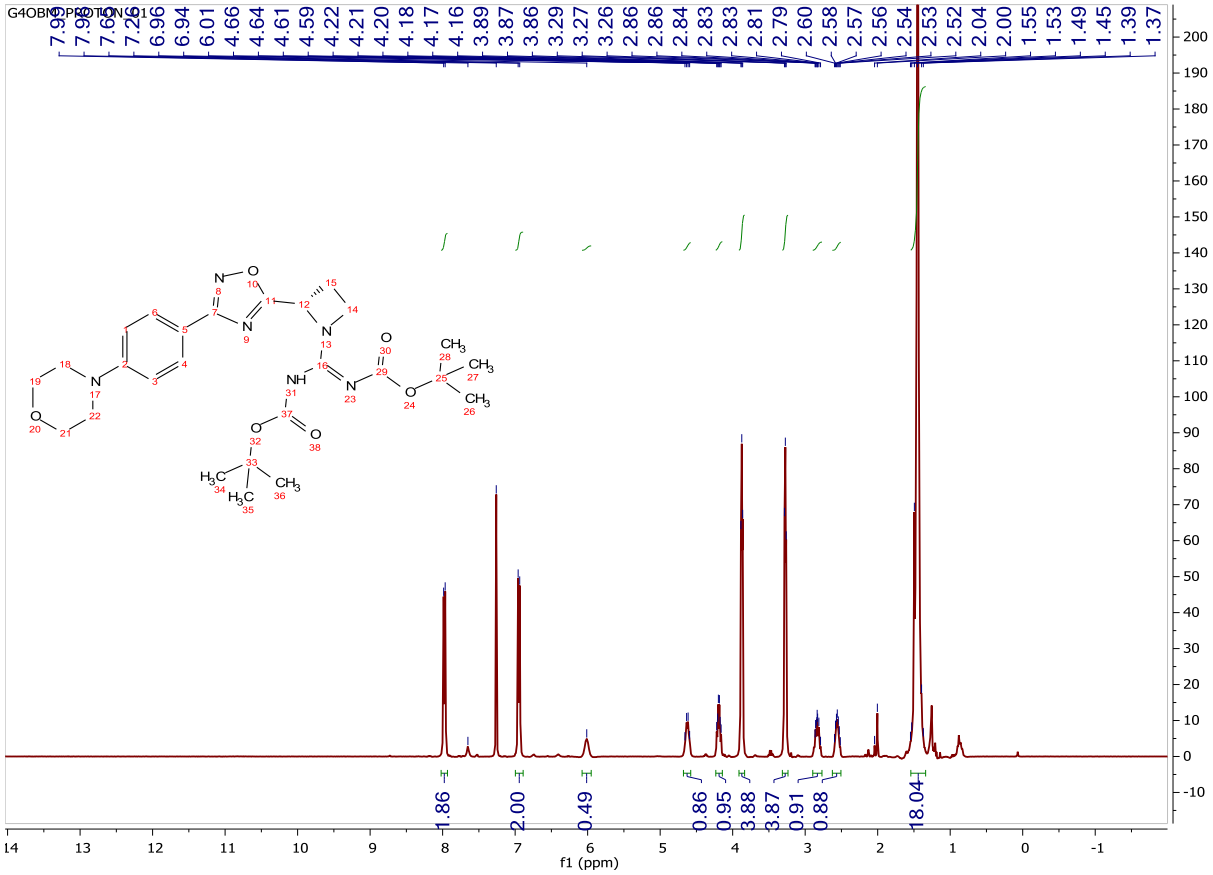
^{1}H-NMR Spectrum for Compound 2.11c



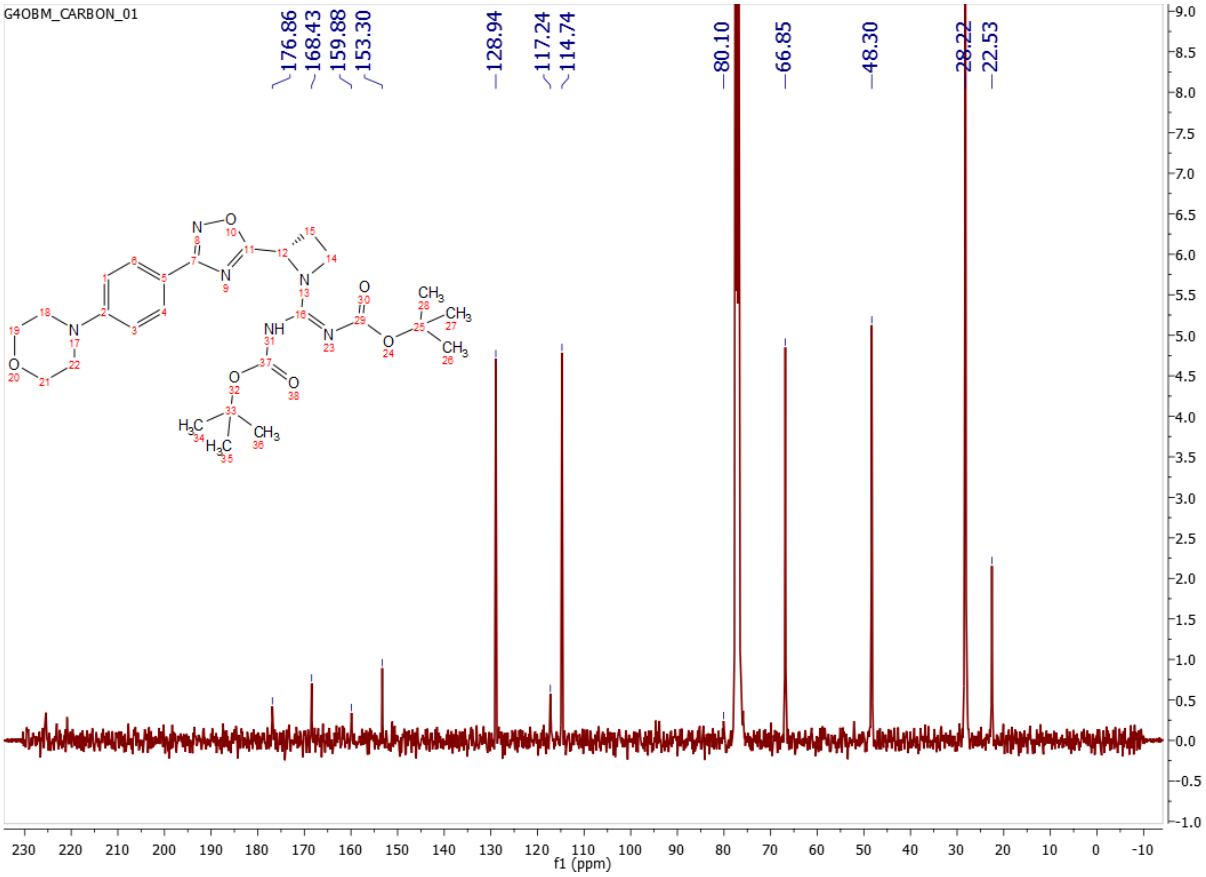
^{13}C-NMR Spectrum for Compound 2.11c



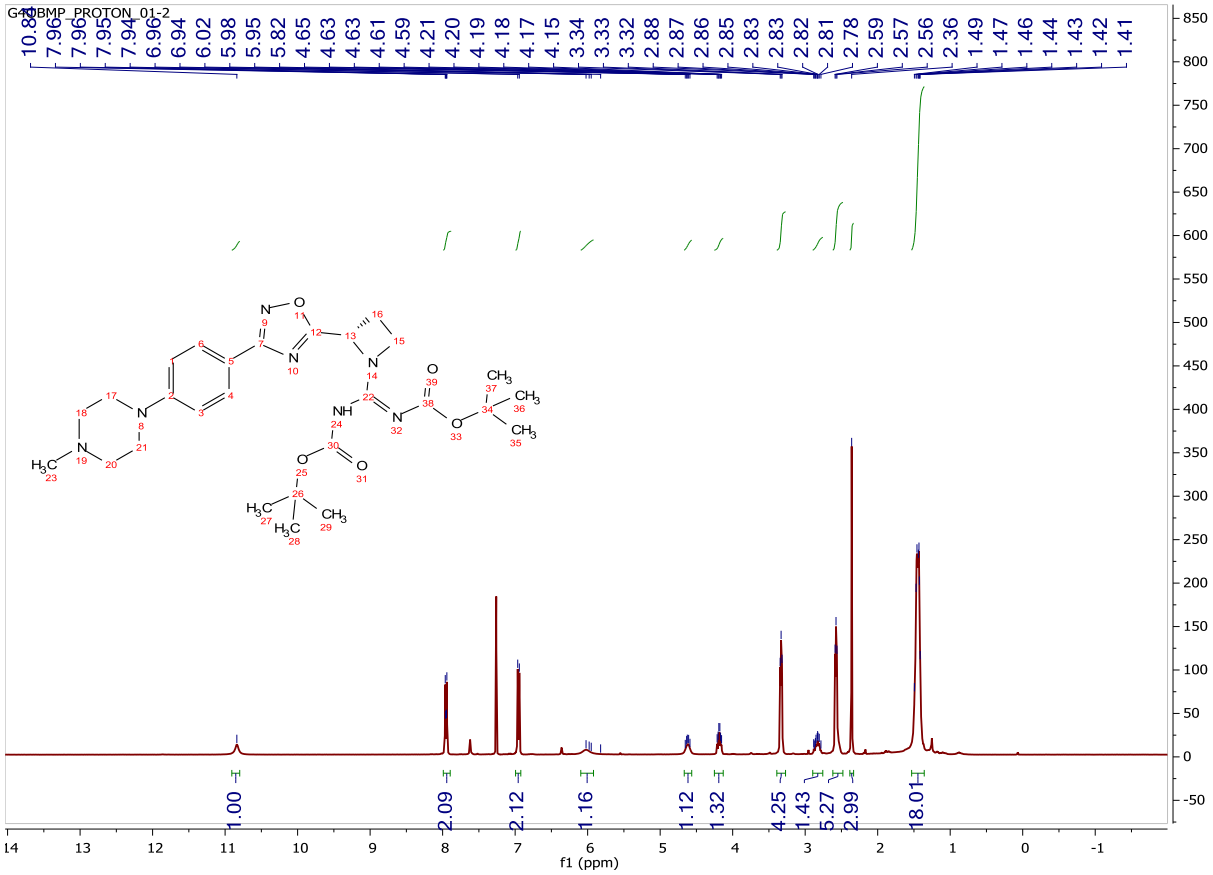
^{1}H-NMR Spectrum for Compound 2.11d



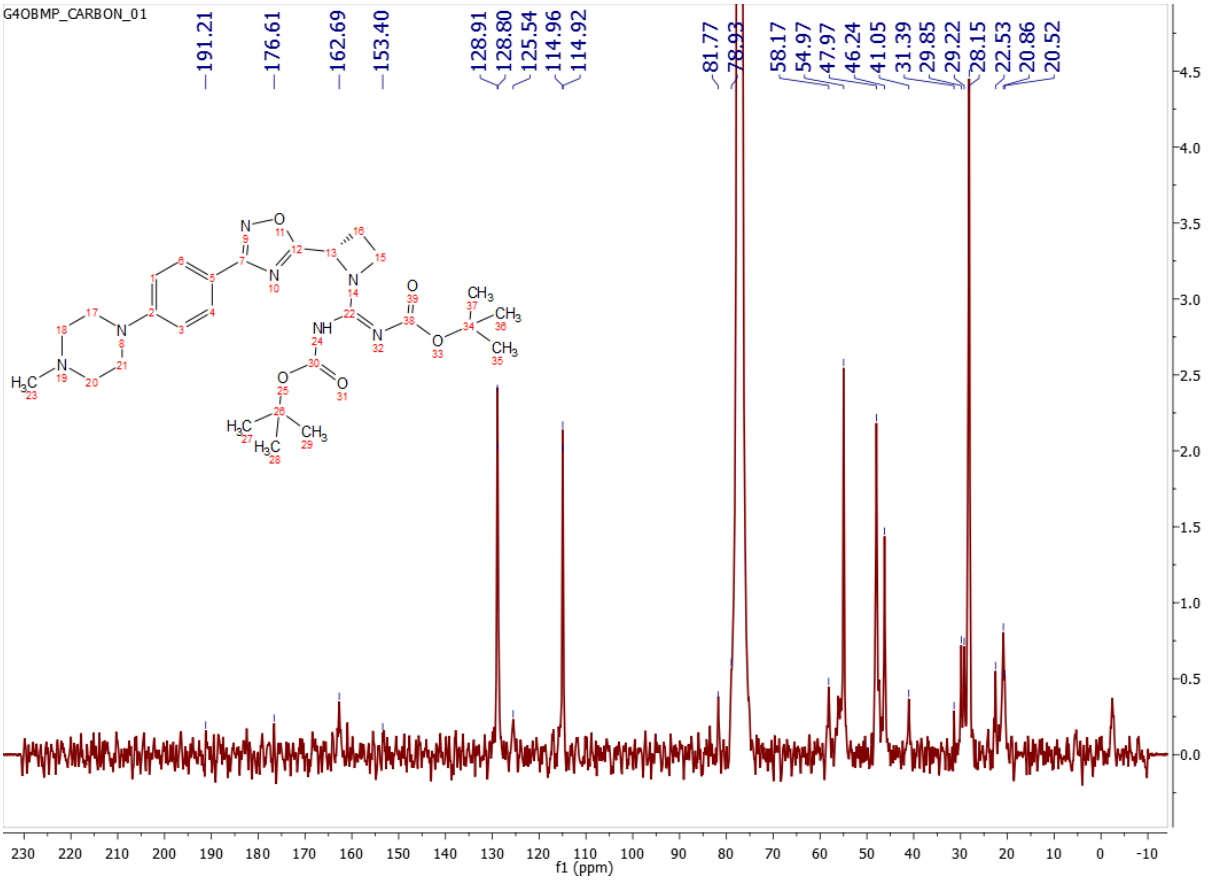
^{13}C-NMR Spectrum for Compound 2.11d



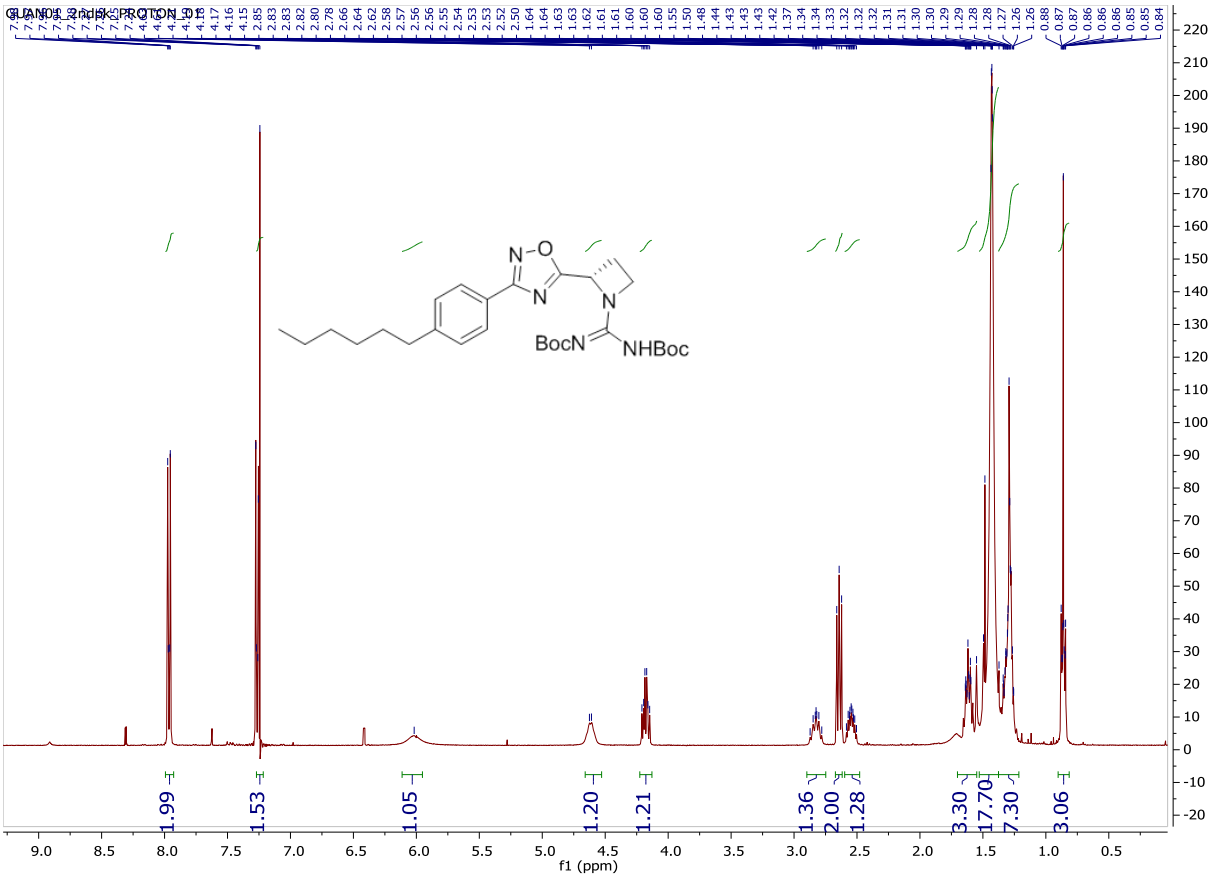
^{1}H-NMR Spectrum for Compound 2.11e



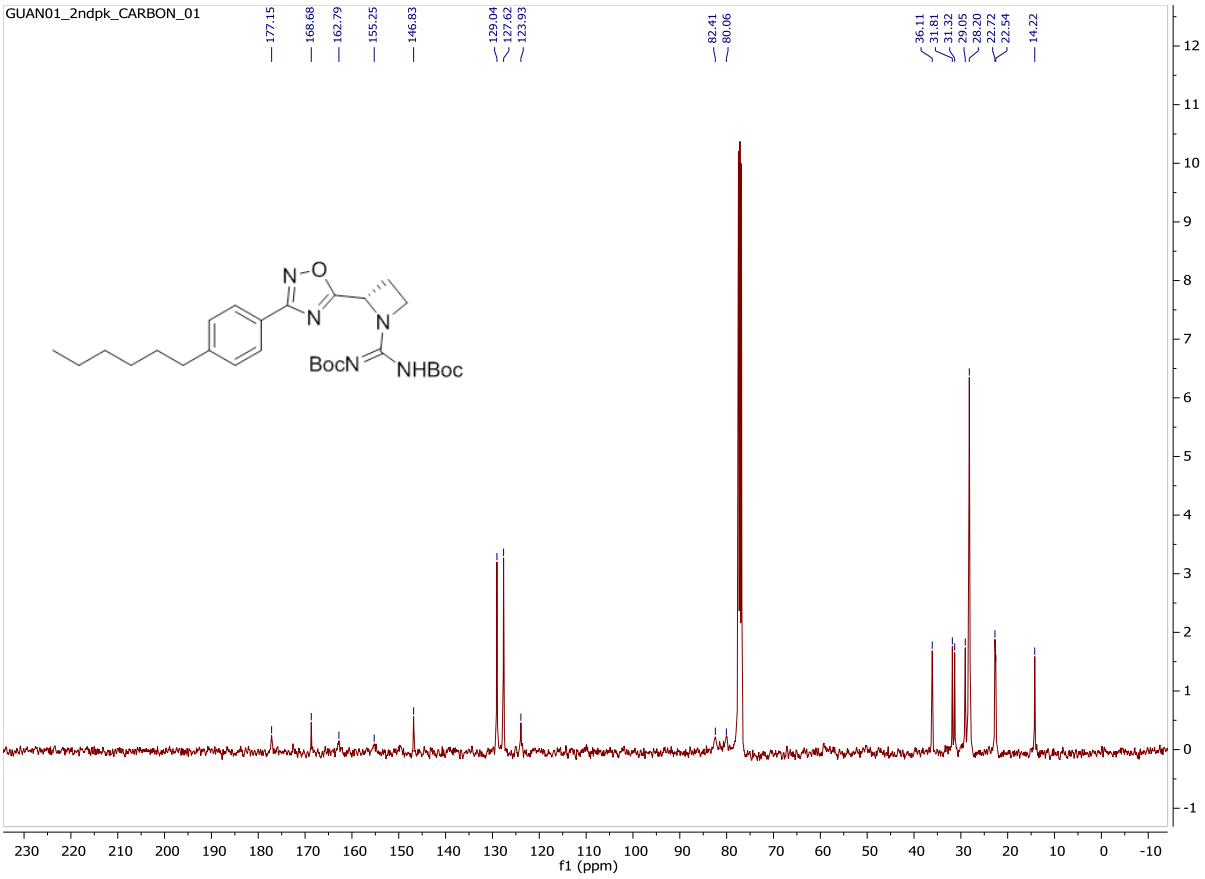
^{13}C-NMR Spectrum for Compound 2.11e



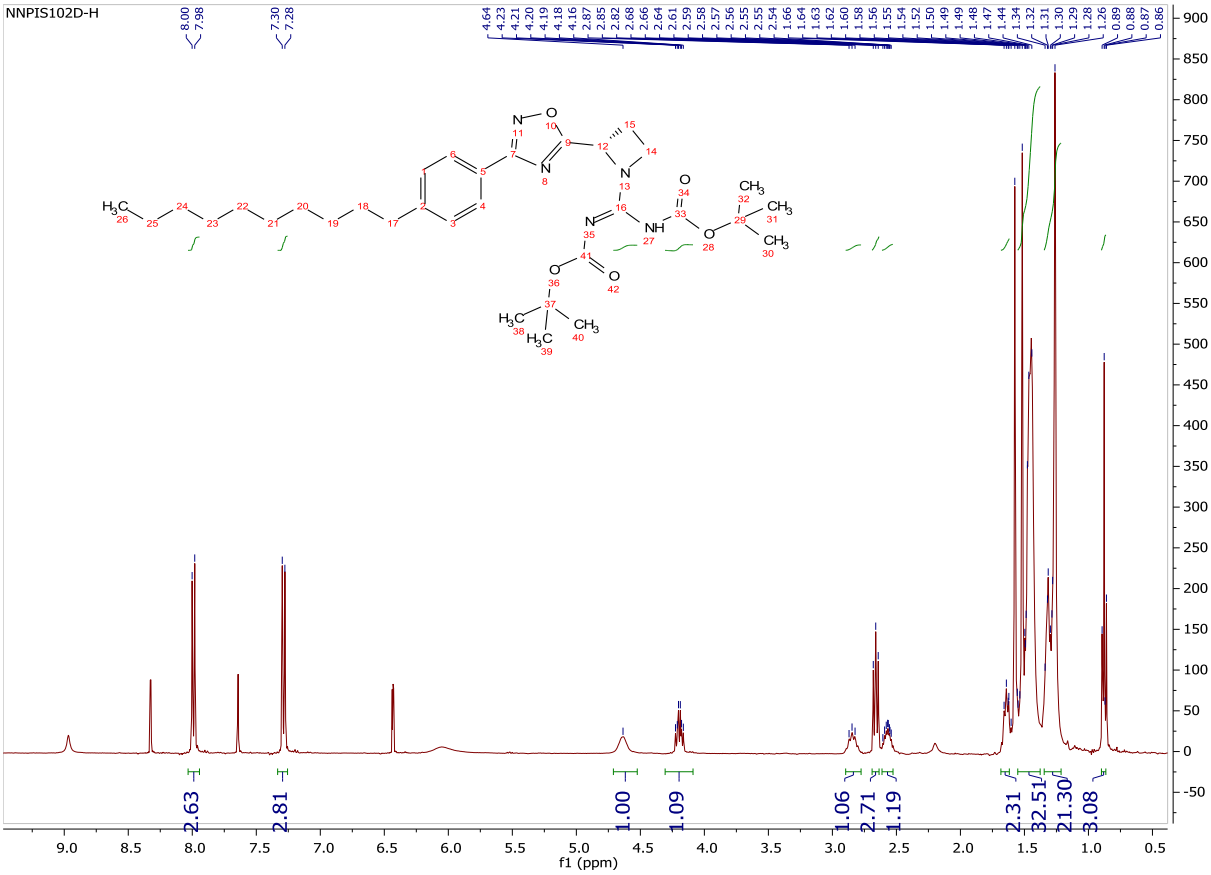
^{1}H-NMR Spectrum for Compound 2.11f



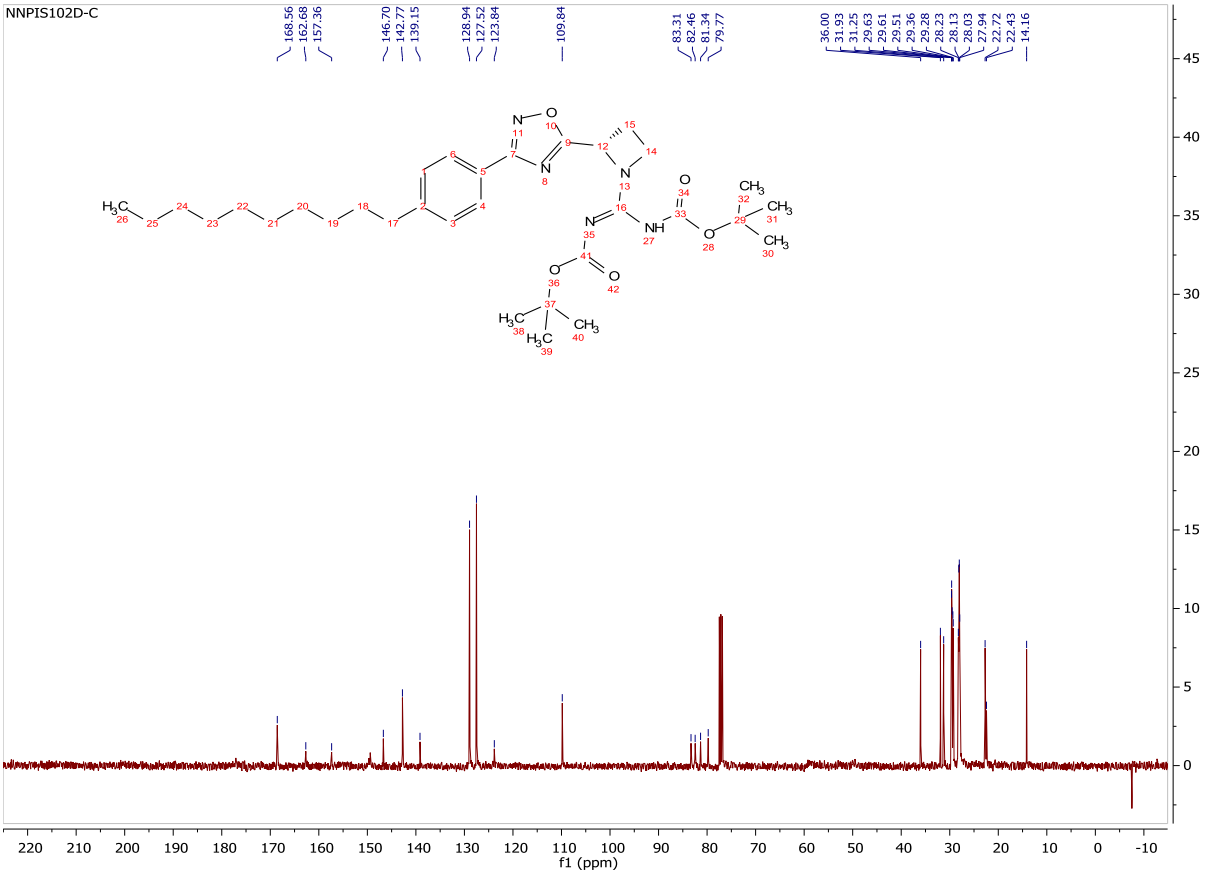
^{13}C-NMR Spectrum for Compound 2.11f



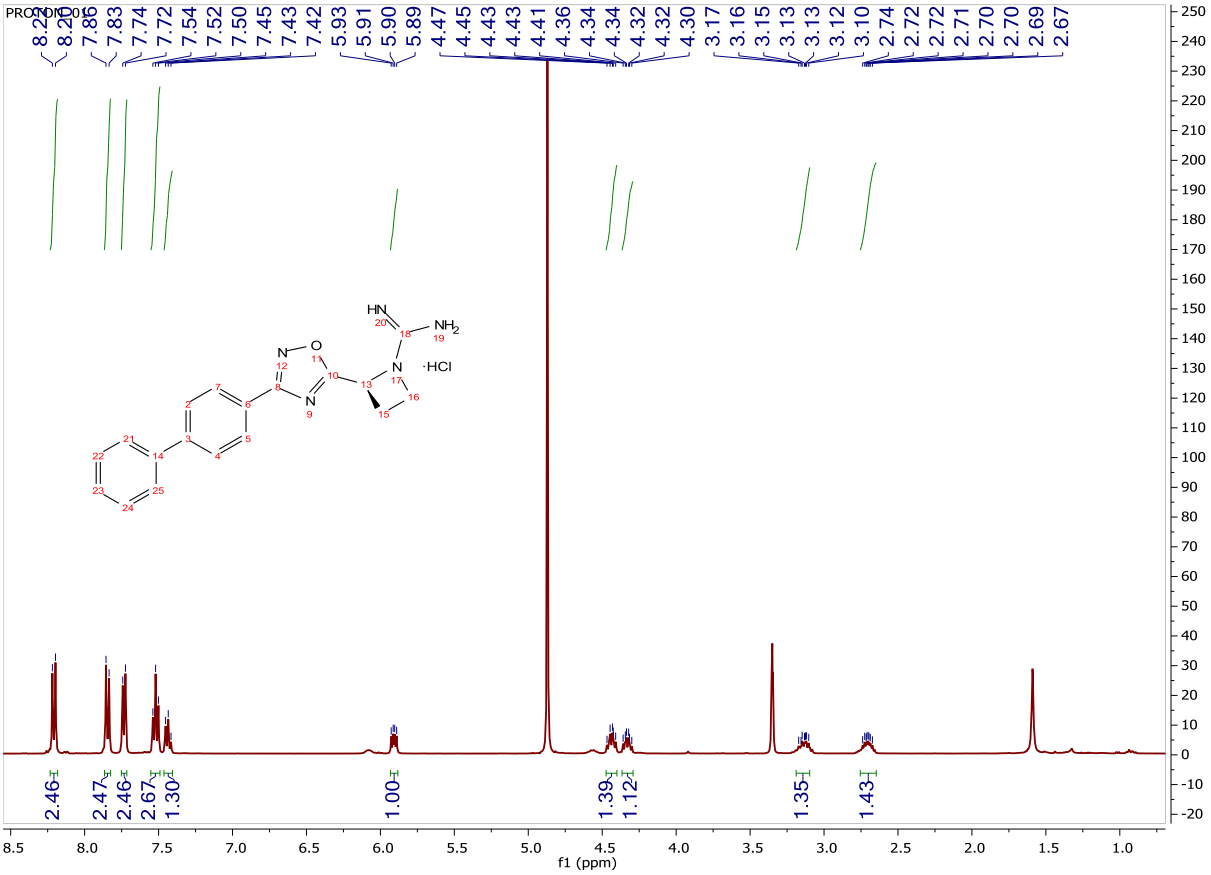
^{1}H-NMR Spectrum for Compound 2.11g



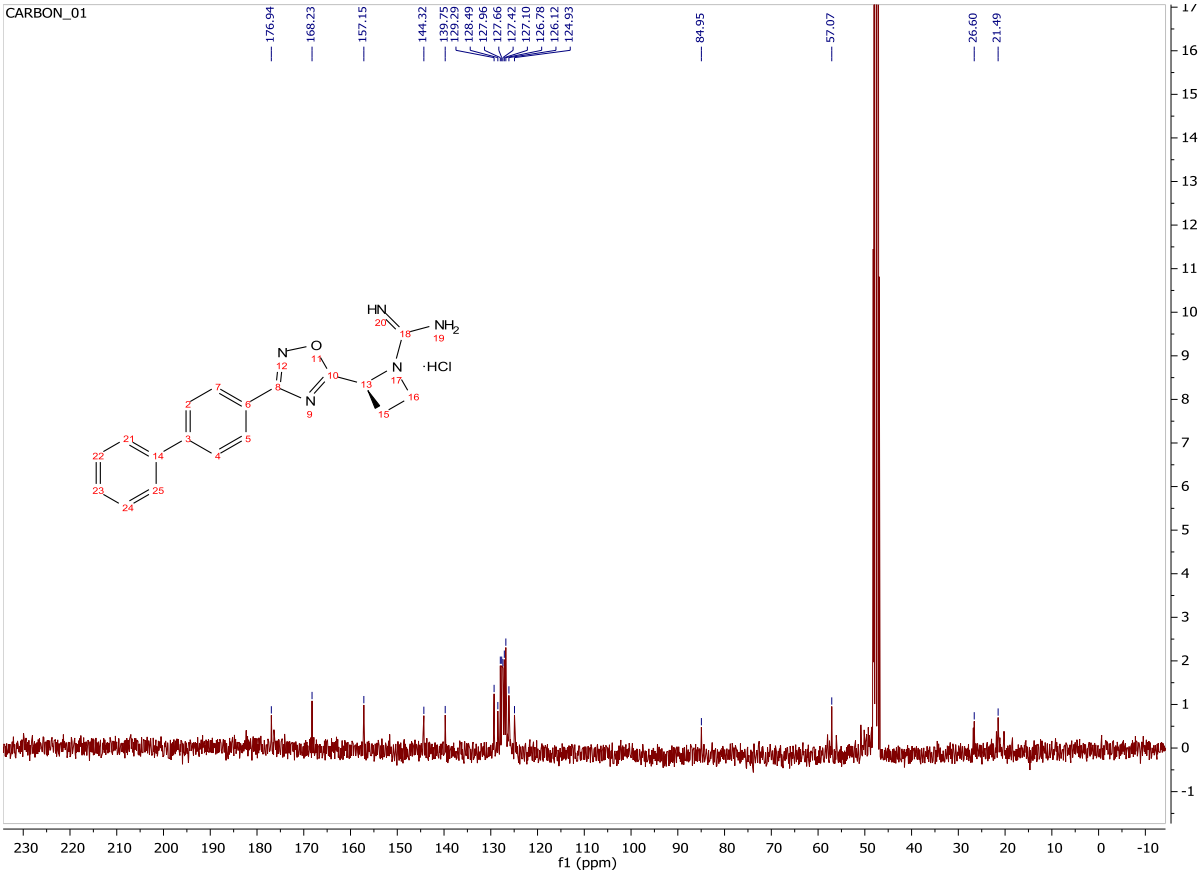
^{13}C-NMR Spectrum for Compound 2.11g



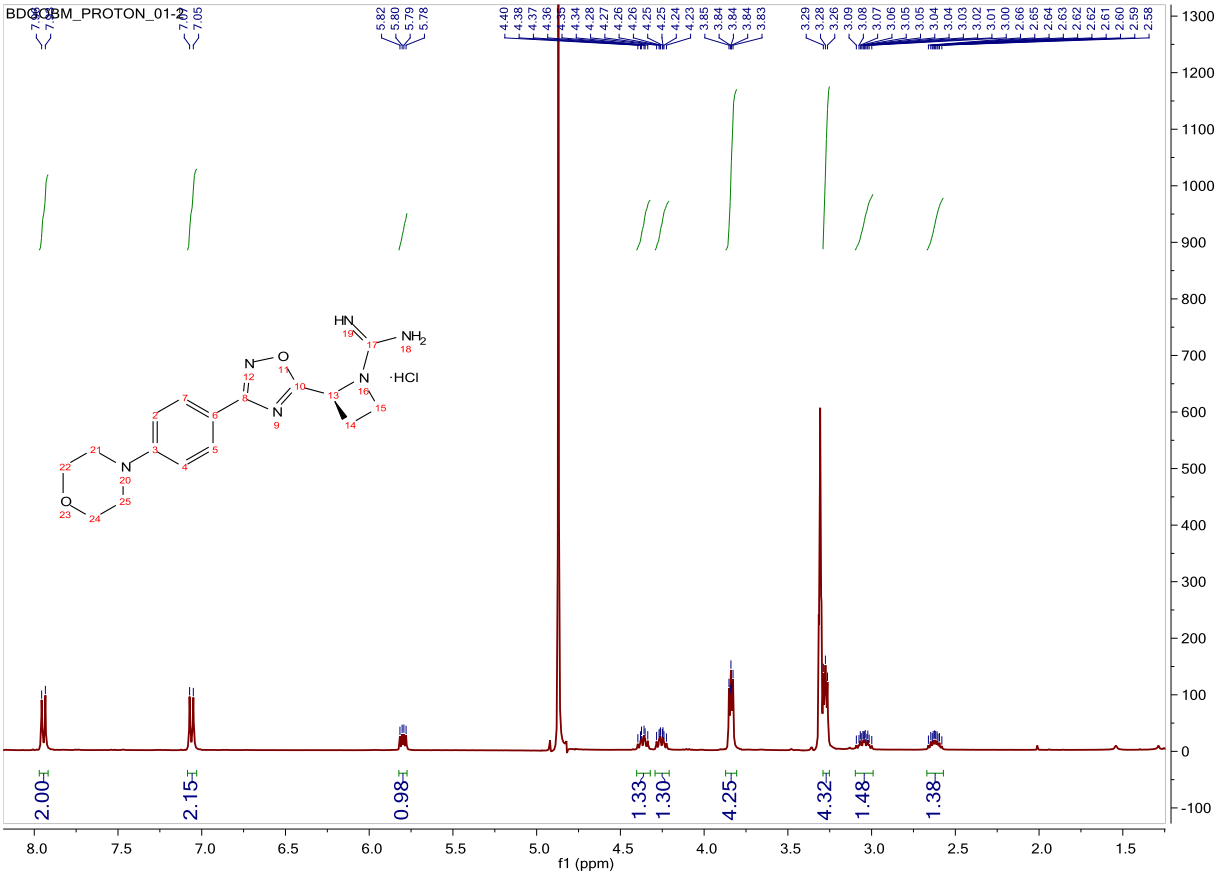
^{1}H-NMR Spectrum for Compound 2.12c



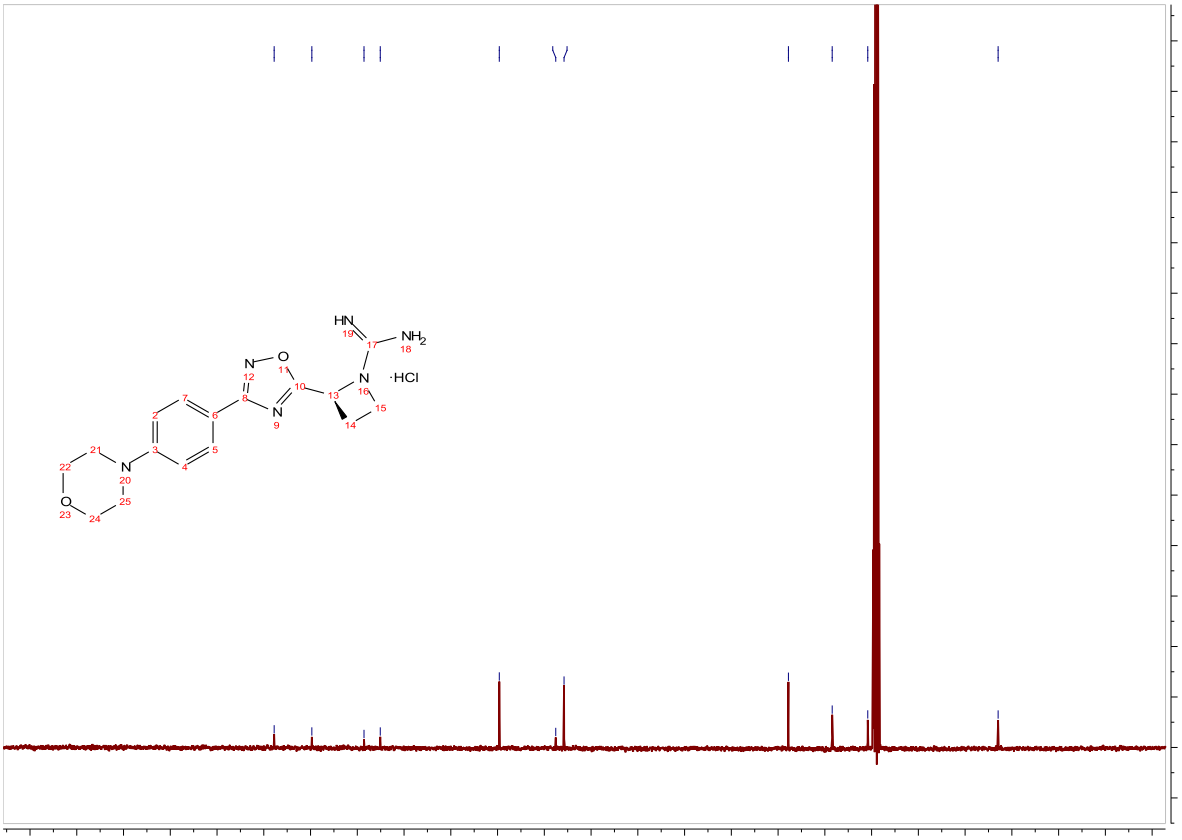
^{13}C-NMR Spectrum for Compound 2.12c



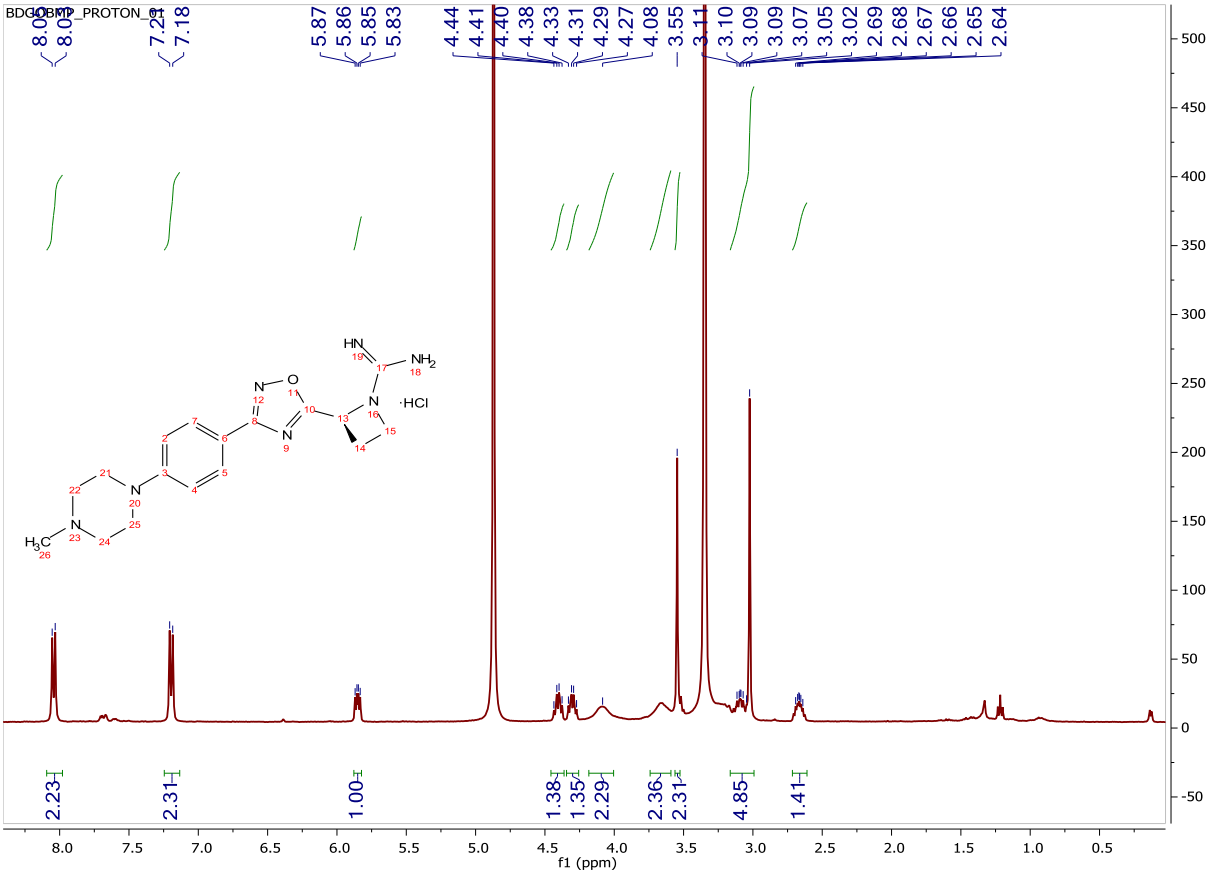
^{1}H-NMR Spectrum for Compound 2.12d



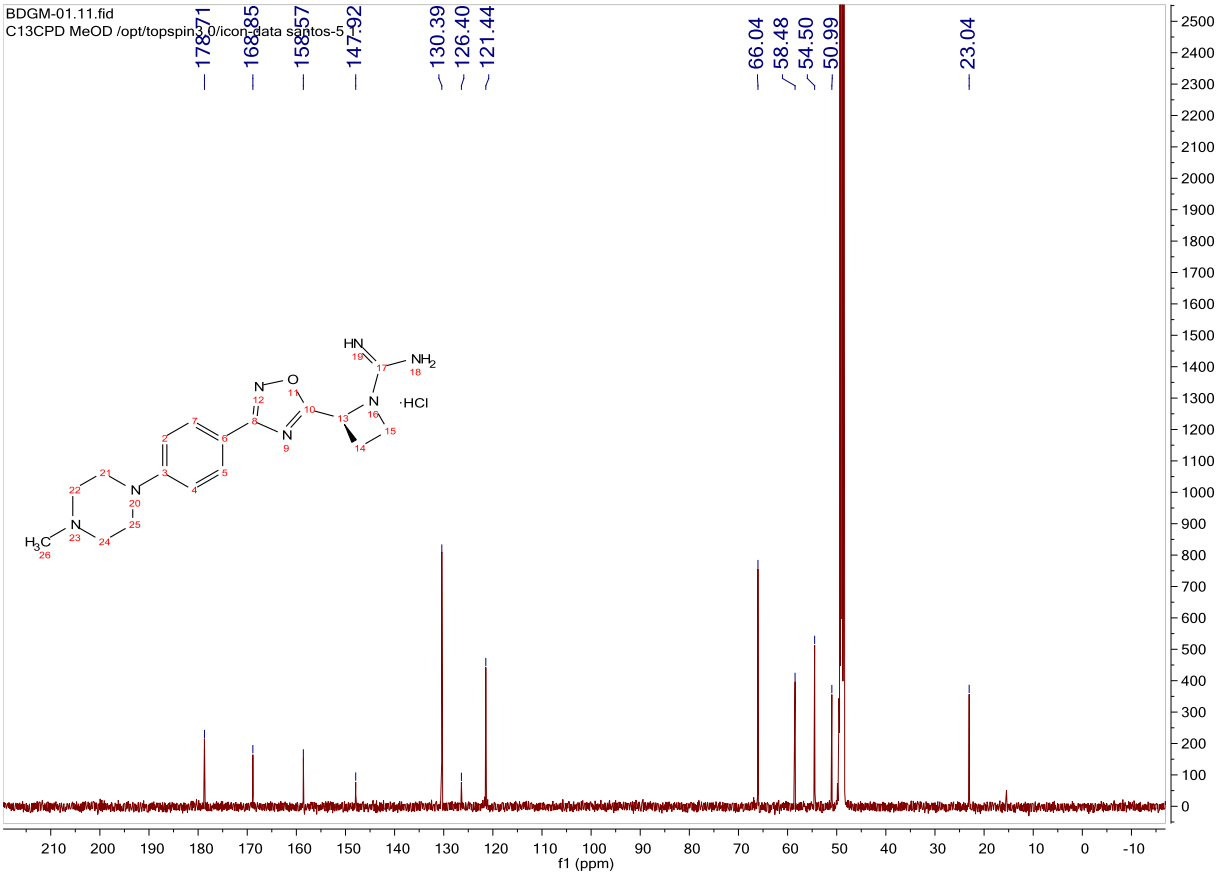
^{13}C-NMR Spectrum for Compound 2.12d



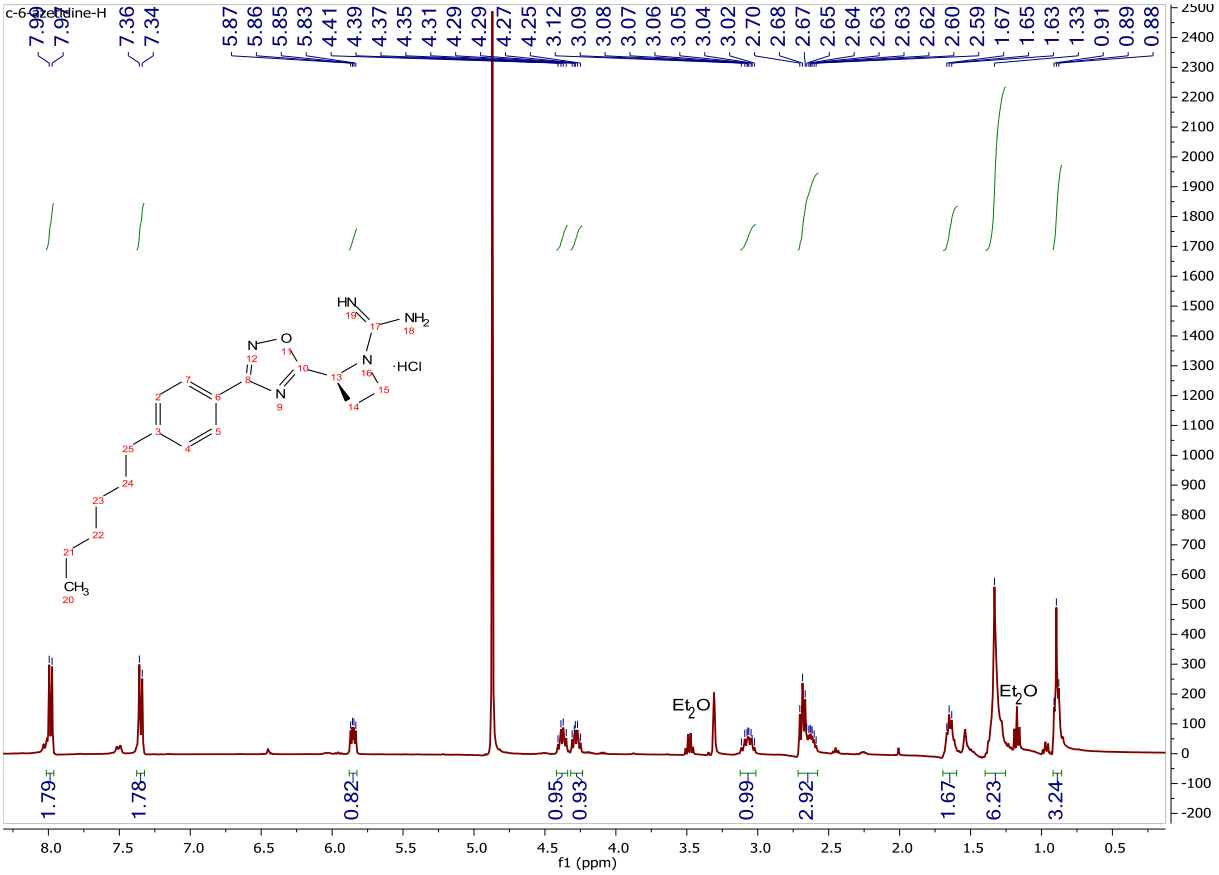
^{1}H-NMR Spectrum for Compound 2.12e



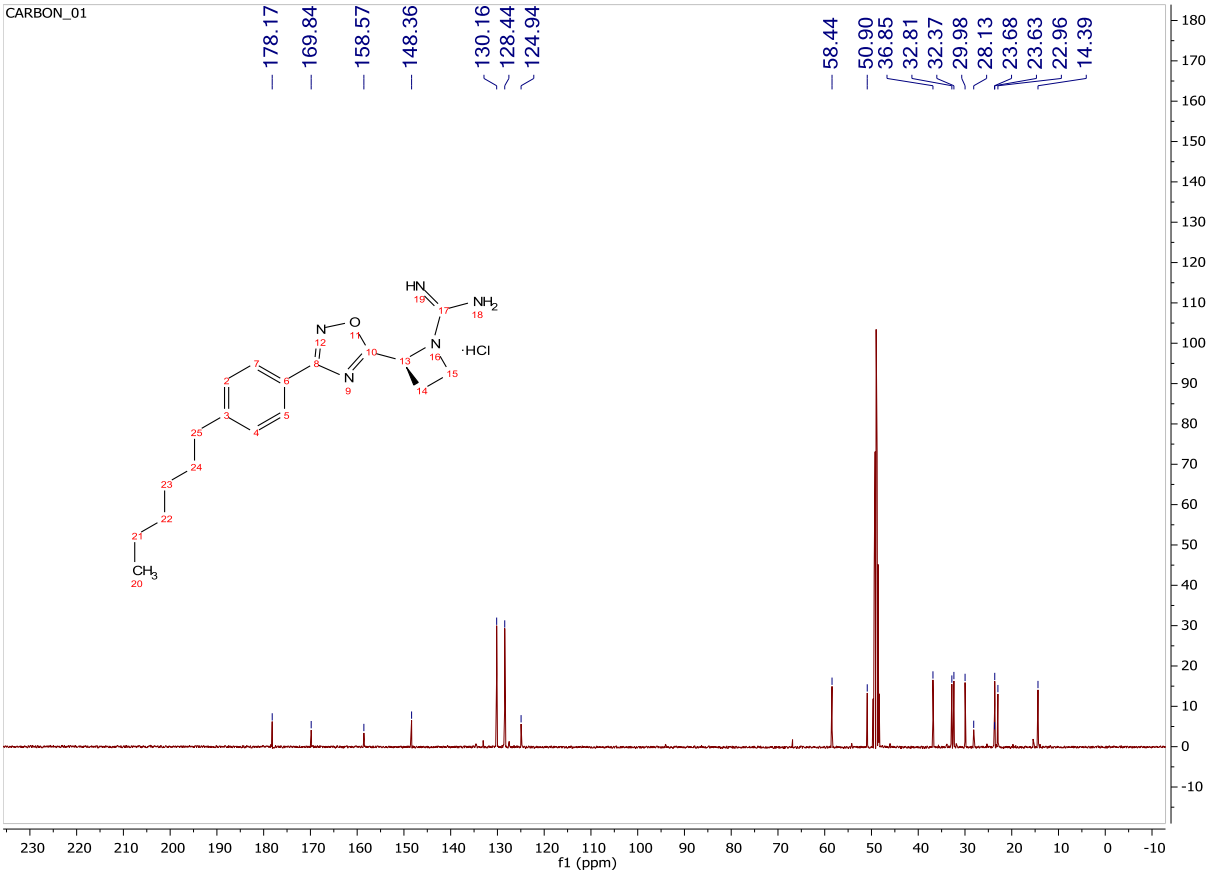
^{13}C-NMR Spectrum for Compound 2.12e



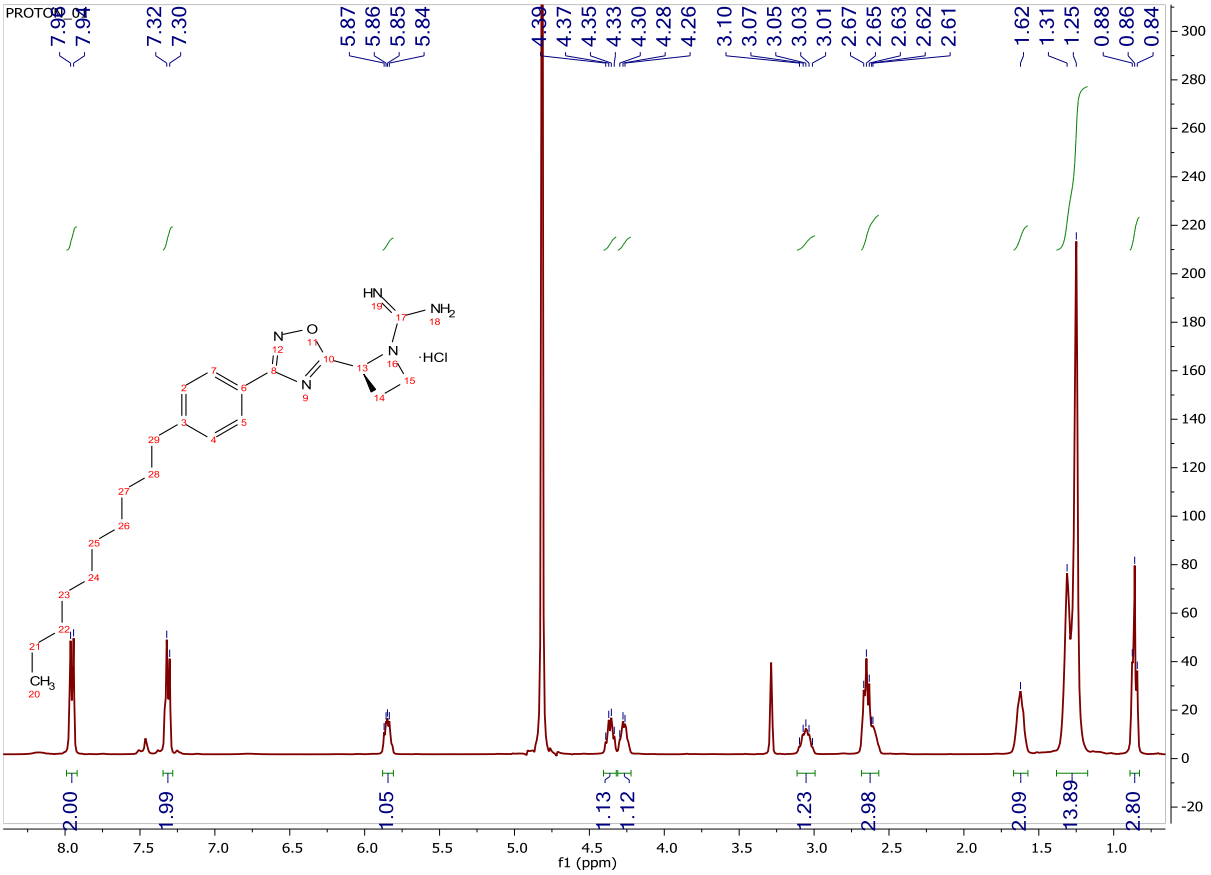
^{1}H-NMR Spectrum for Compound 2.12f



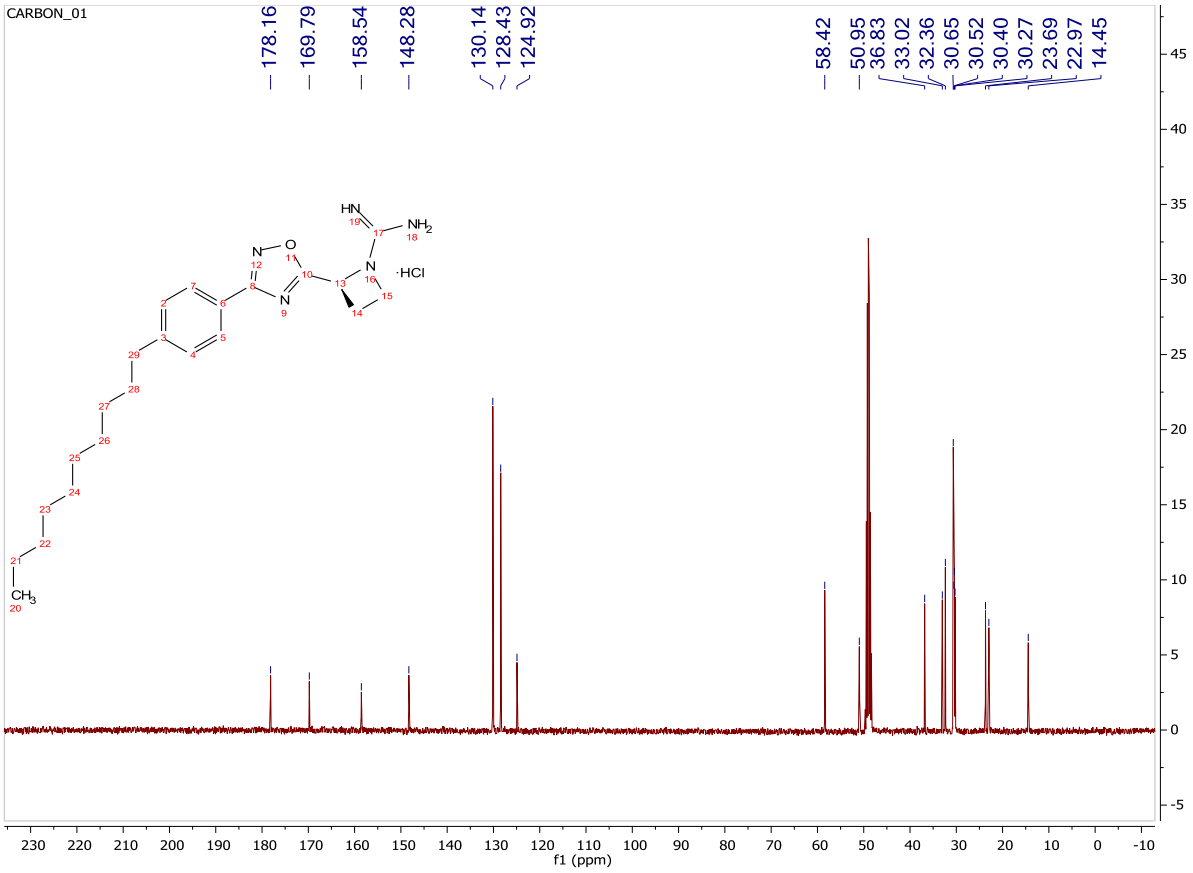
^{13}C-NMR Spectrum for Compound 2.12f



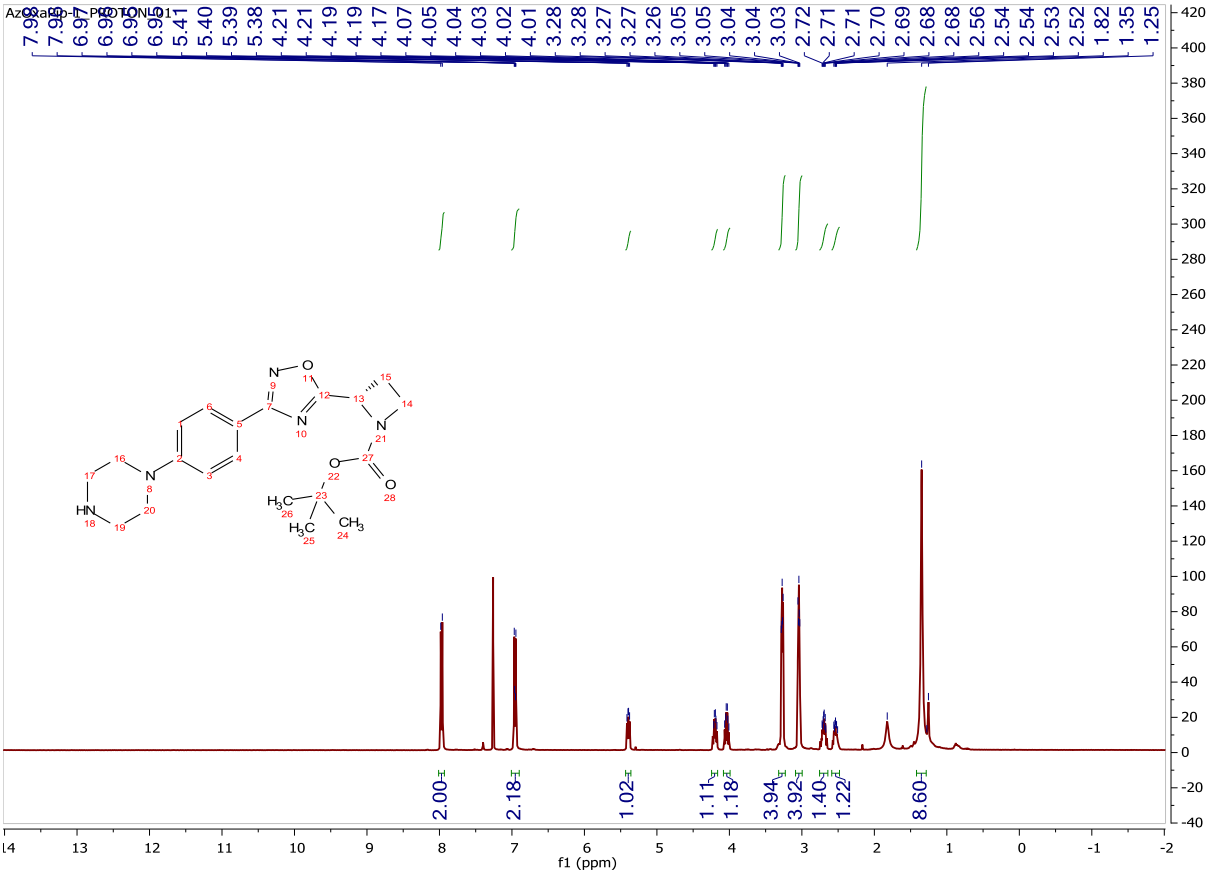
^{1}H-NMR Spectrum for Compound 2.12g



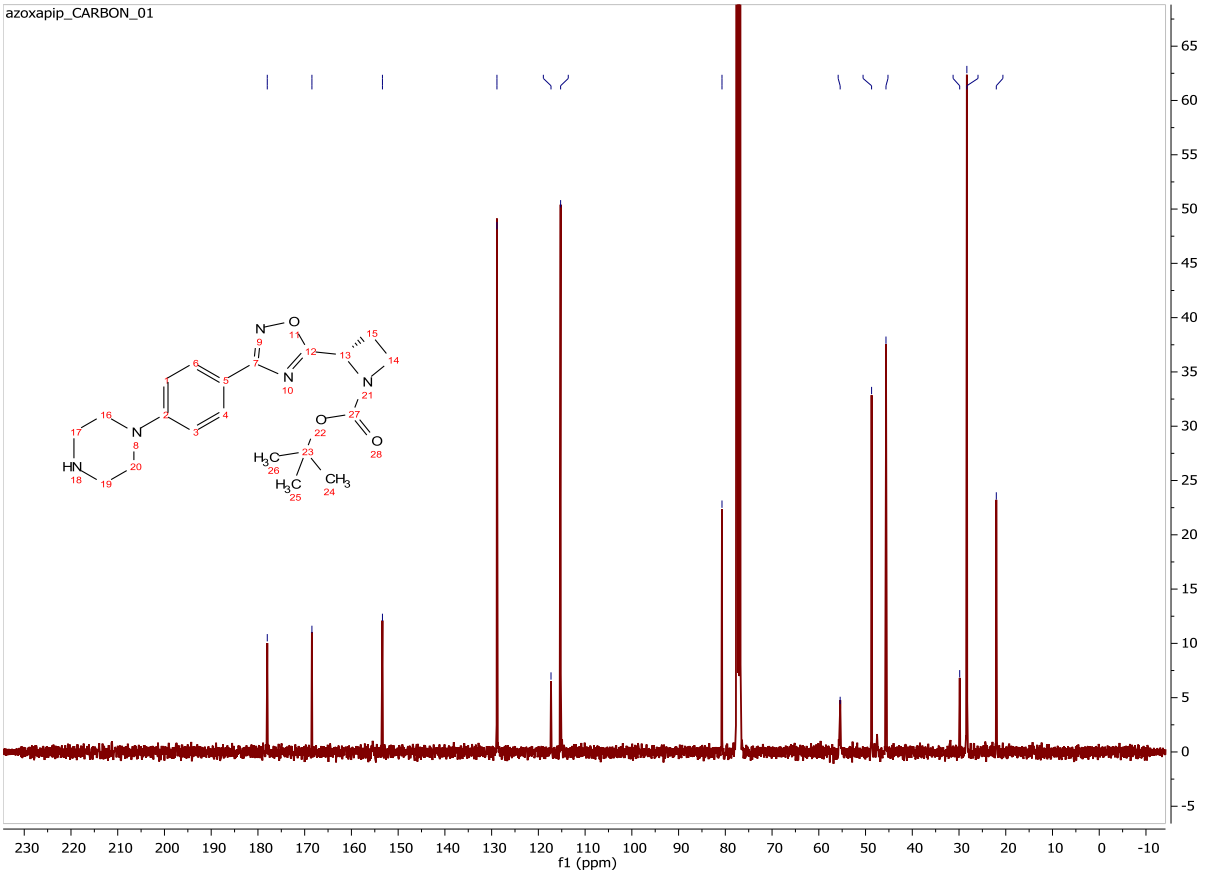
^{13}C-NMR Spectrum for Compound 2.12g



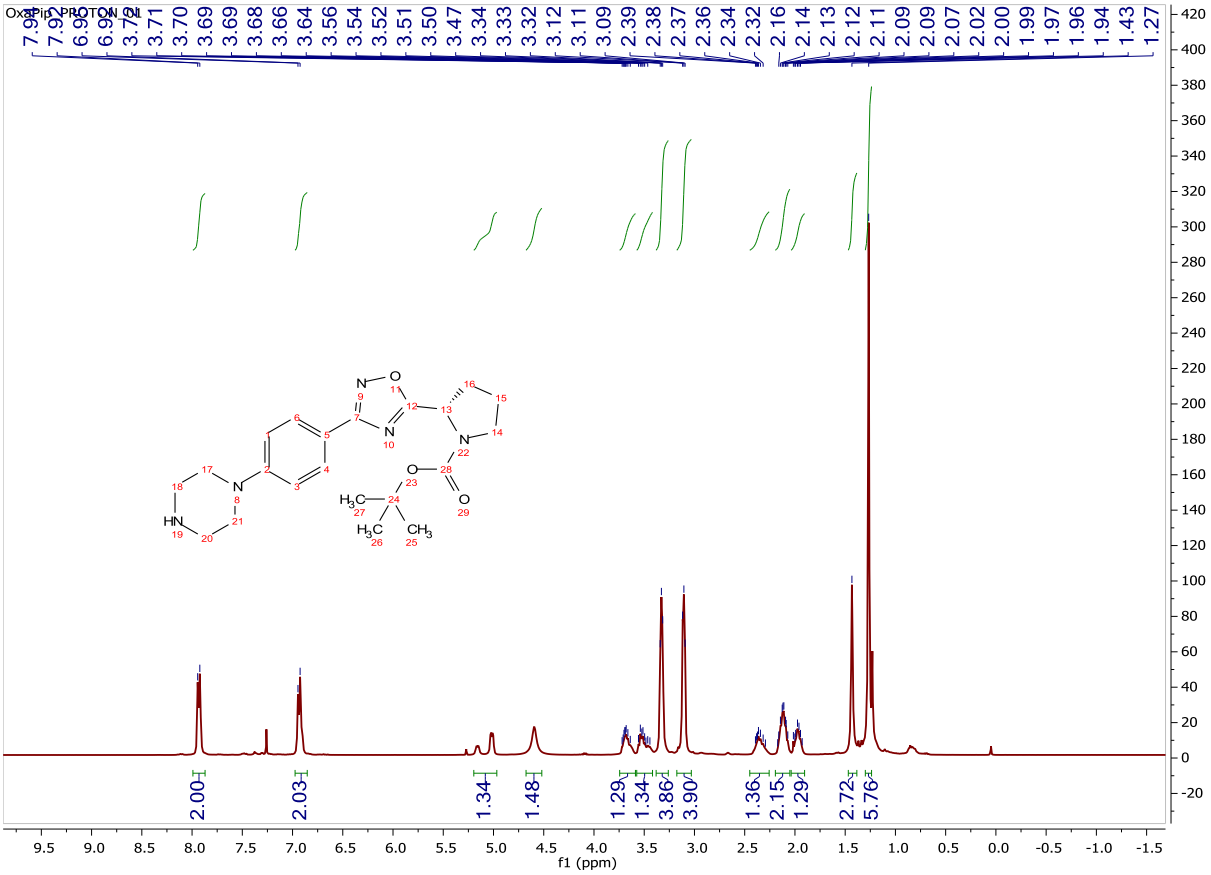
^{1}H-NMR Spectrum for Compound 2.13a



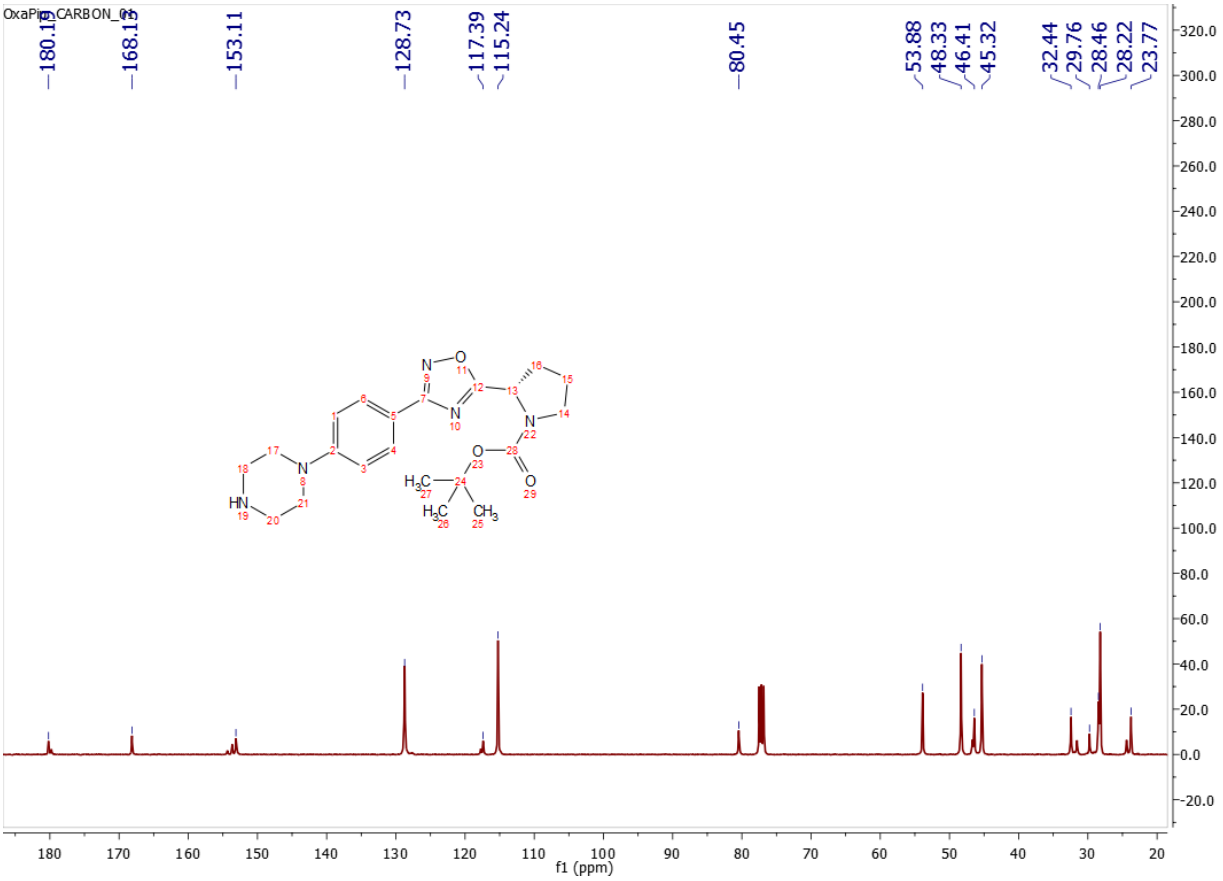
^{13}C-NMR Spectrum for Compound 2.13a



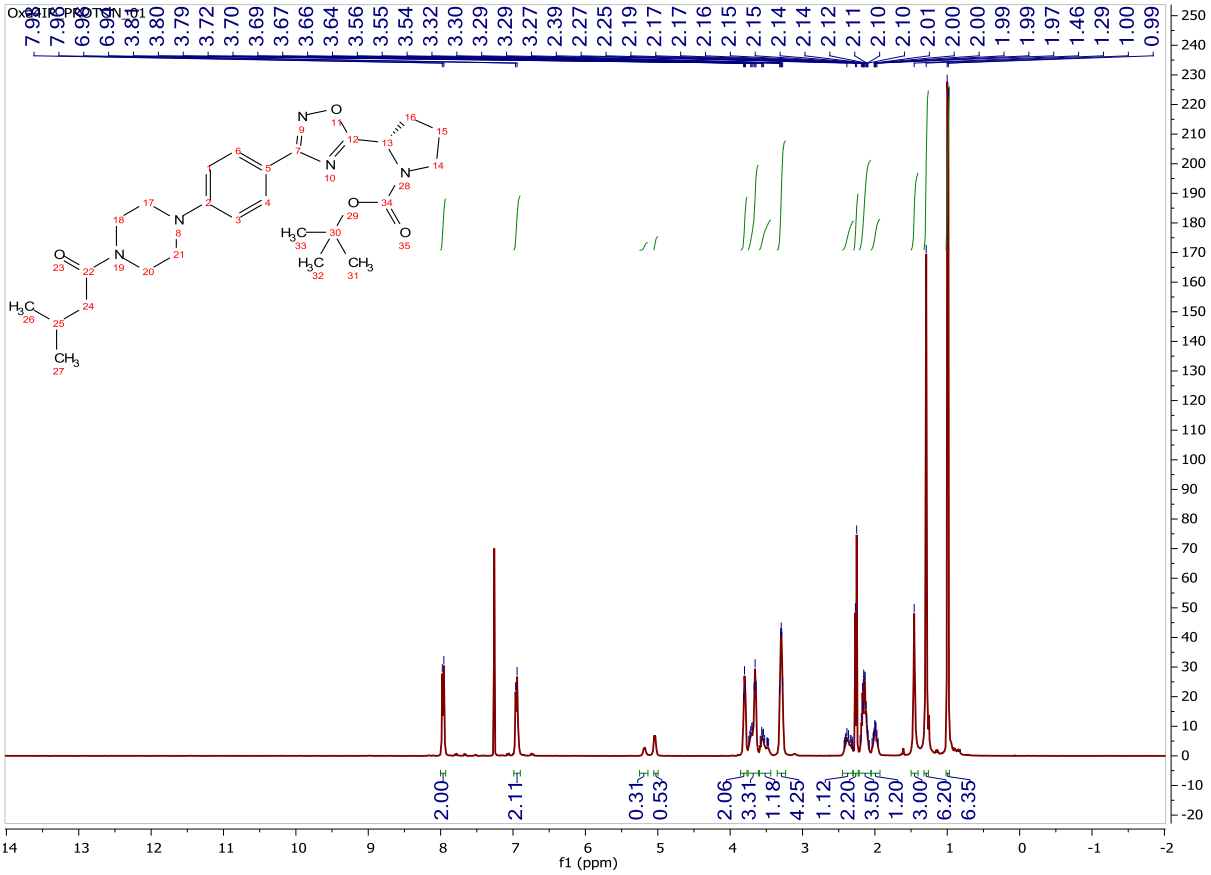
^{1}H-NMR Spectrum for Compound 2.13b



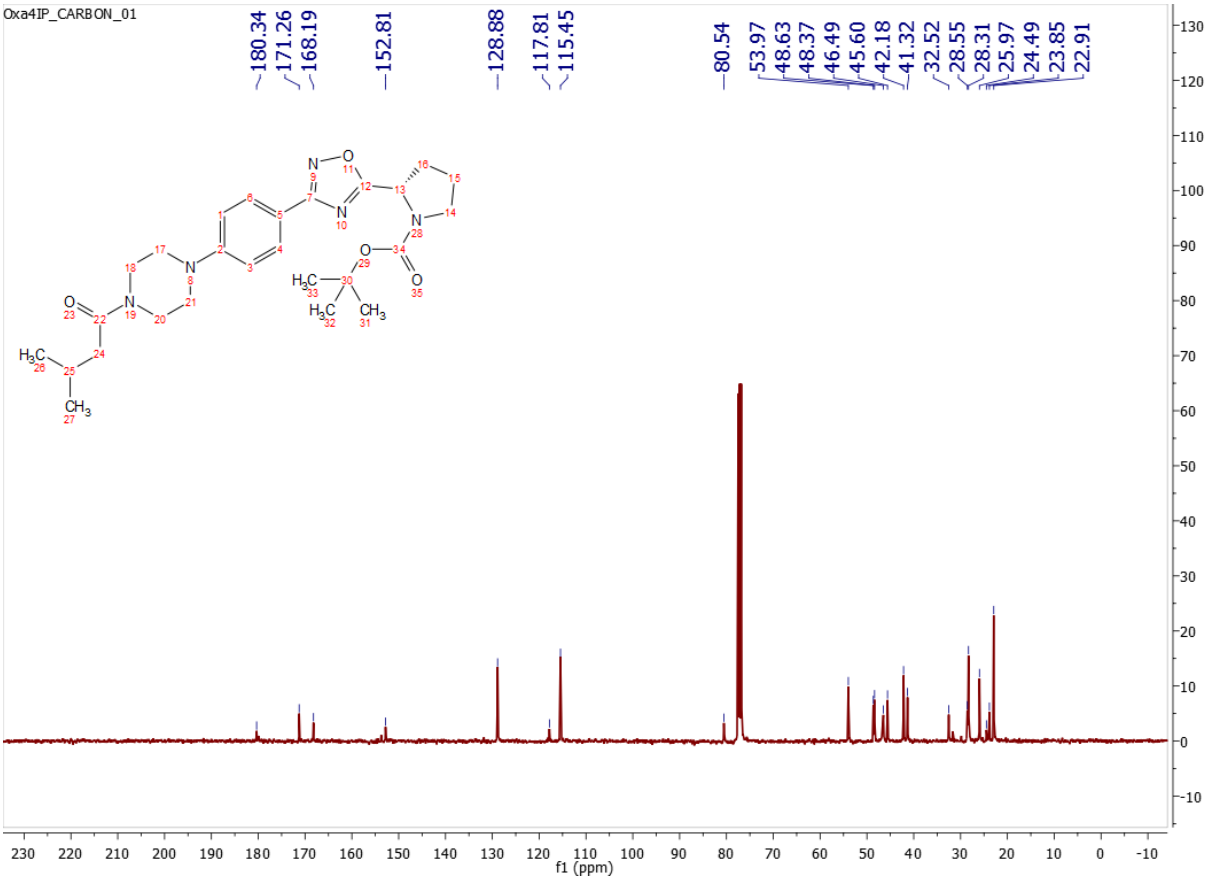
^{13}C-NMR Spectrum for Compound 2.13b



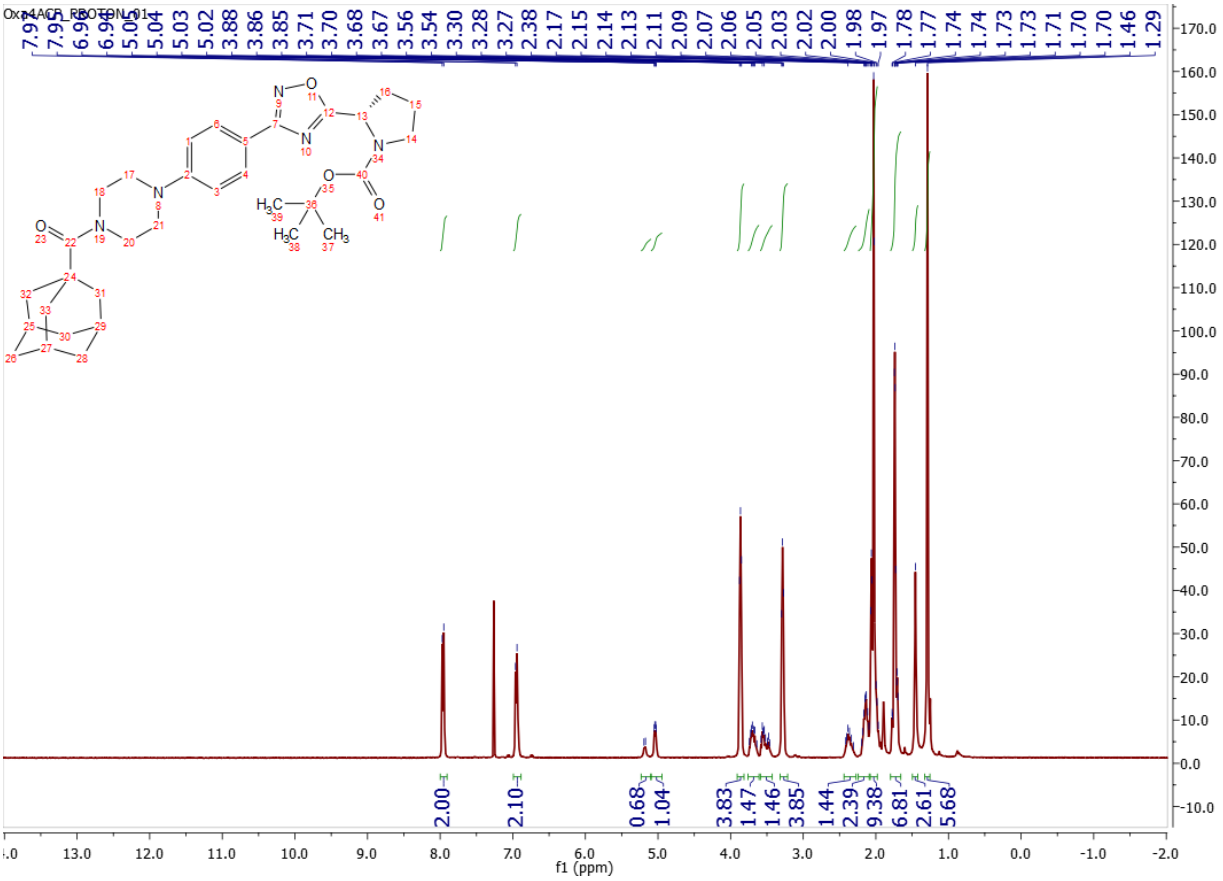
^{1}H-NMR Spectrum for Compound 2.14a



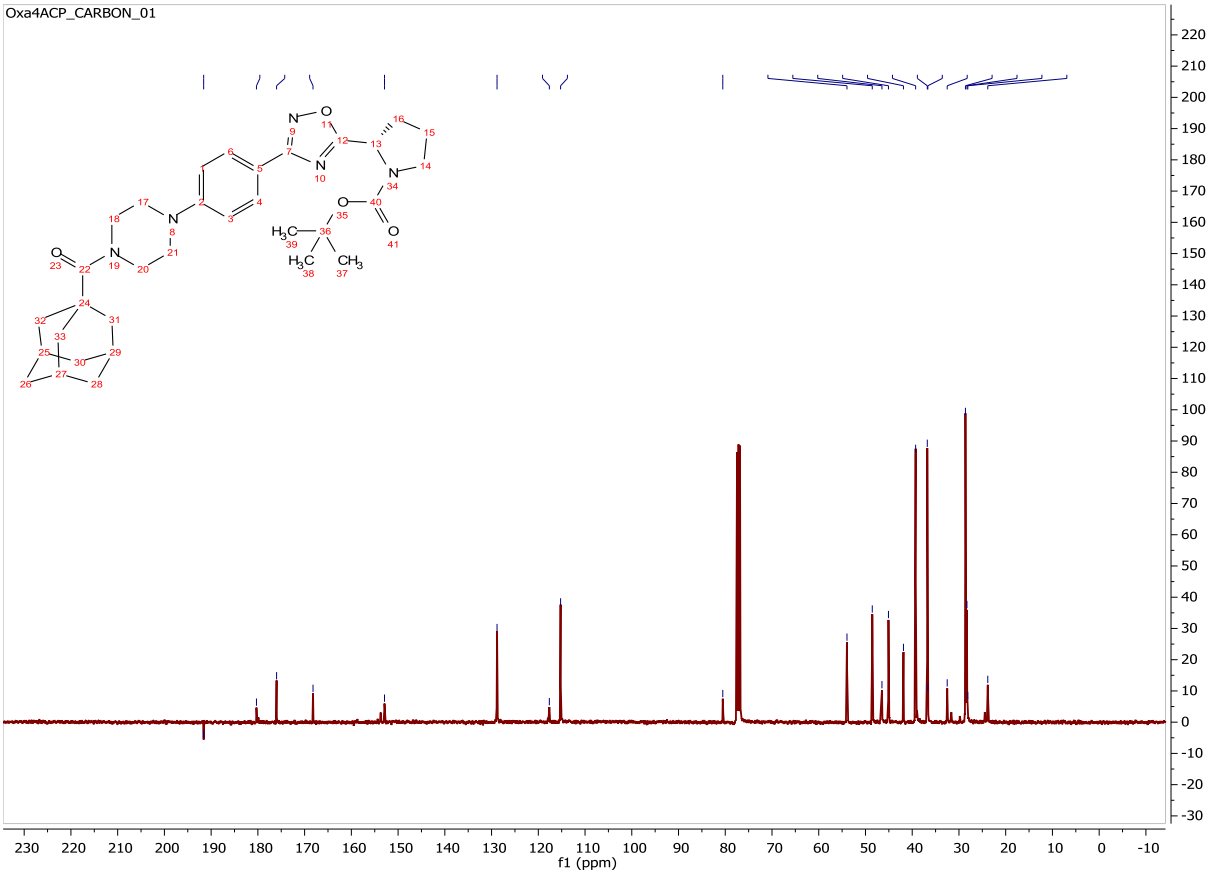
^{13}C-NMR Spectrum for Compound 2.14a



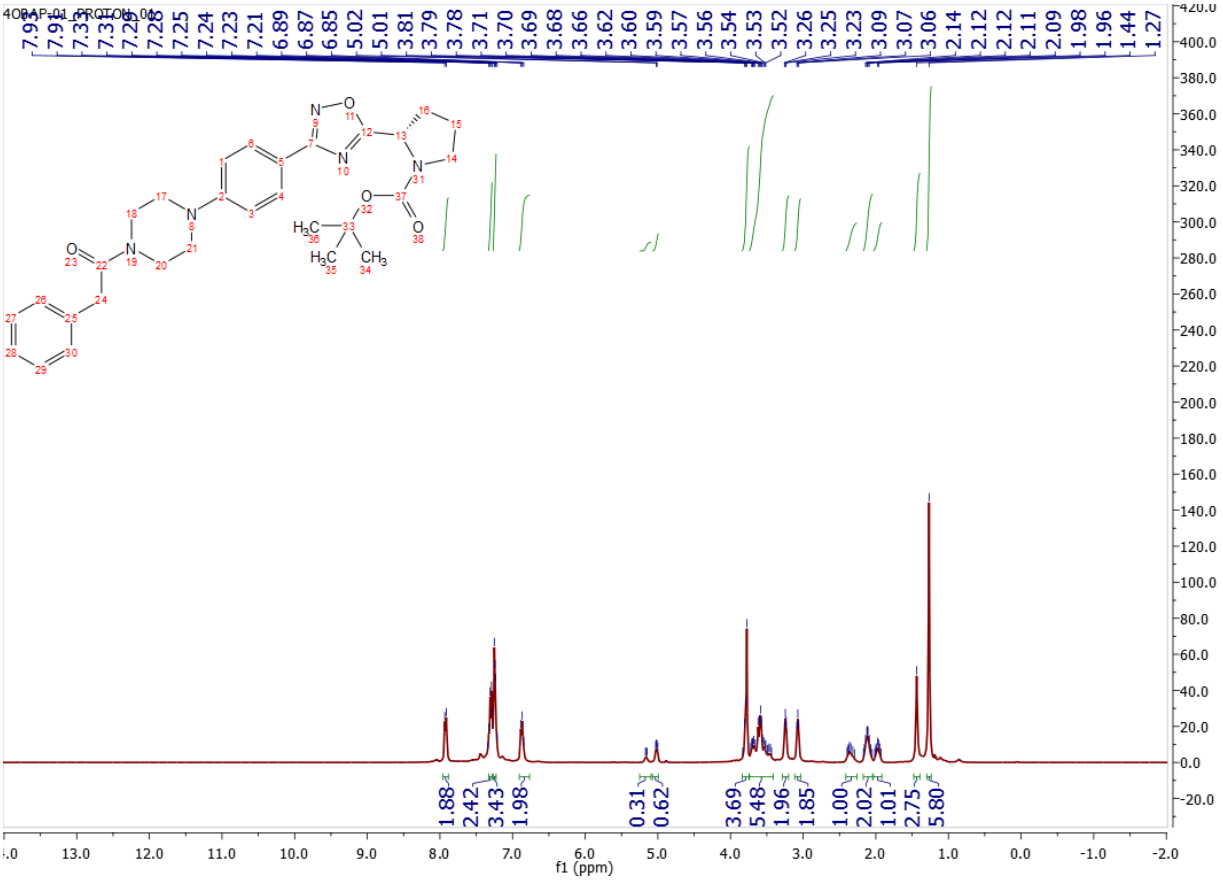
^{1}H-NMR Spectrum for Compound 2.14b



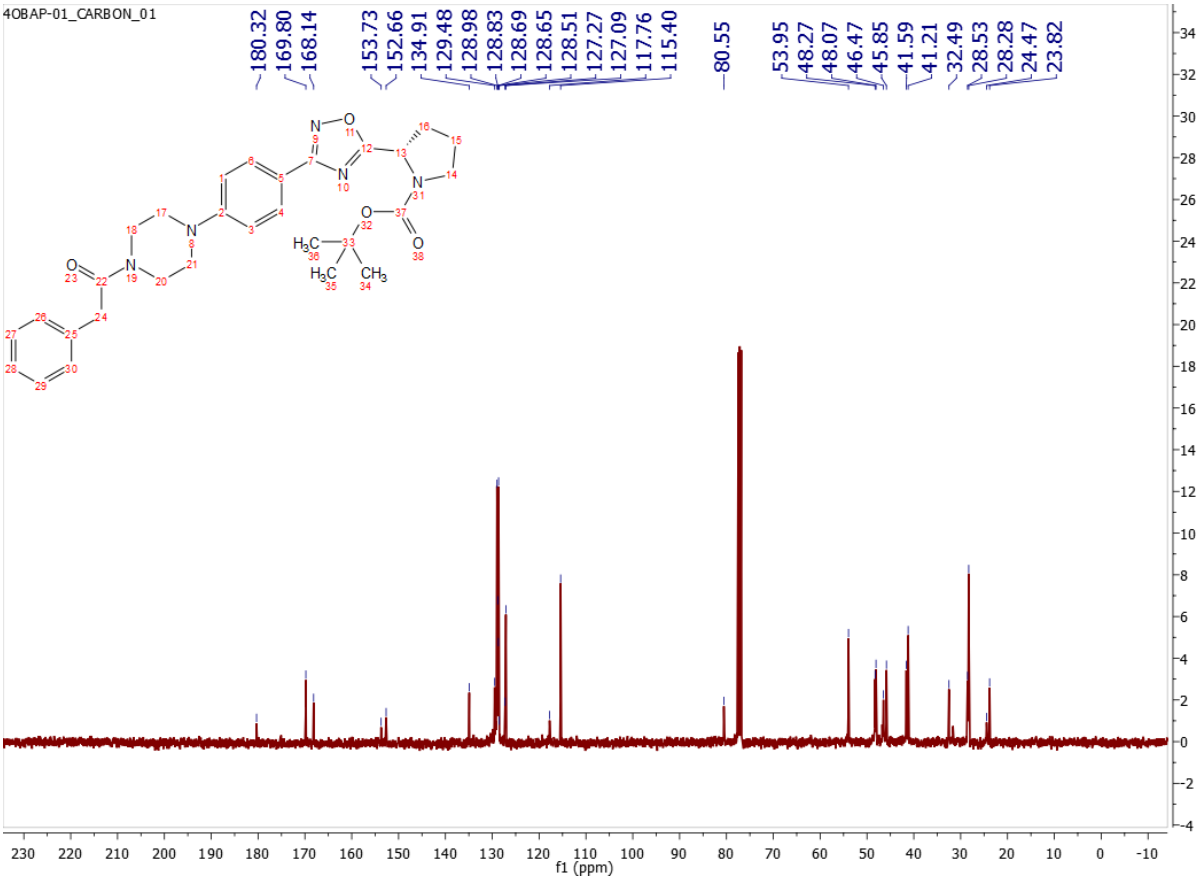
^{13}C-NMR Spectrum for Compound 2.14b



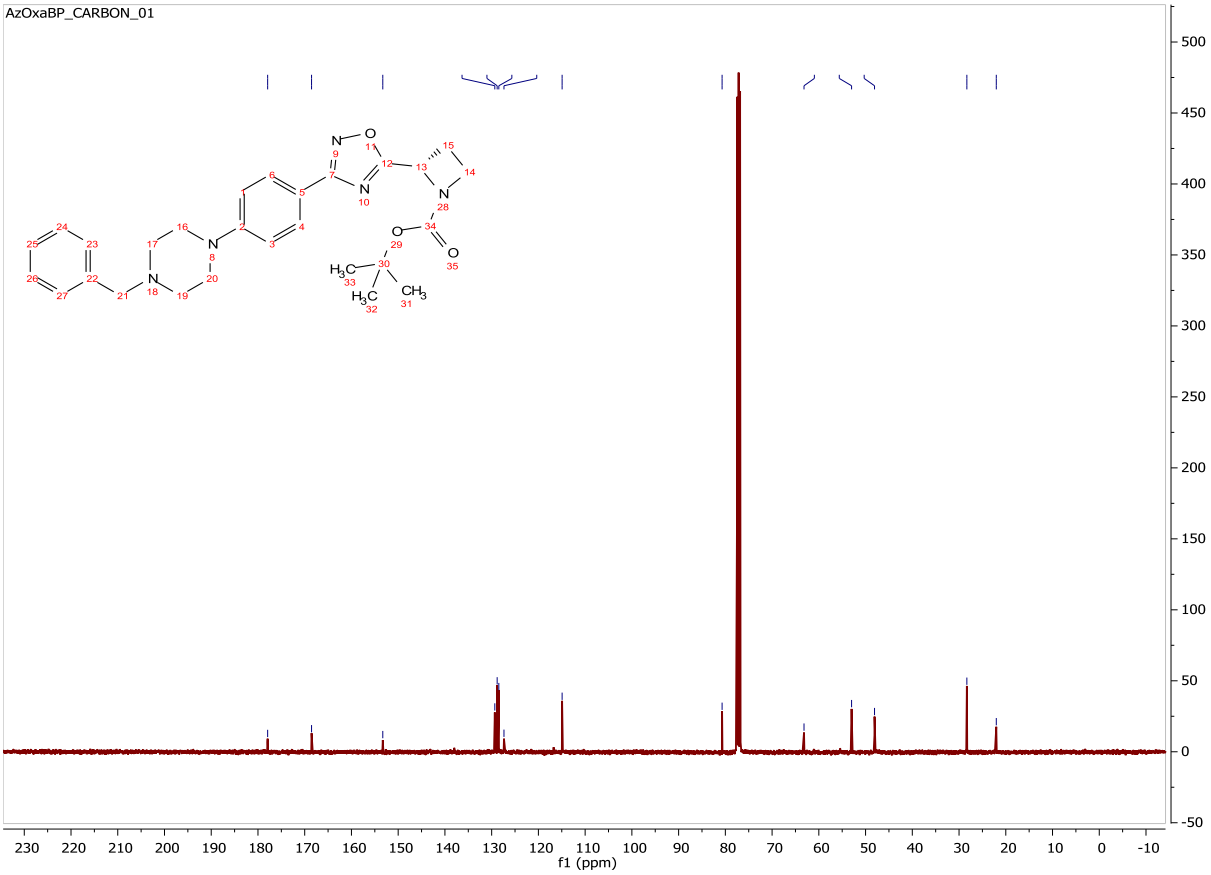
^{1}H-NMR Spectrum for Compound 2.14c



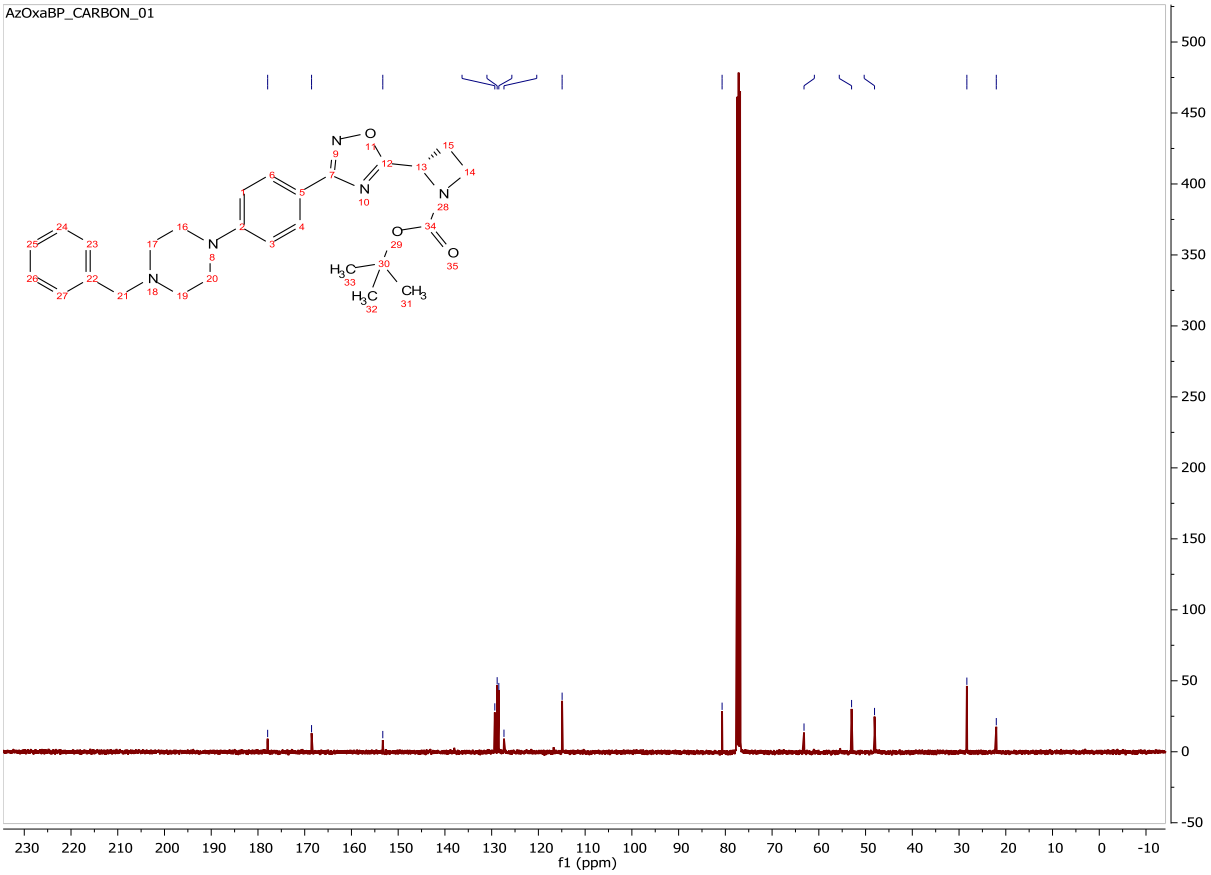
^{13}C-NMR Spectrum for Compound 2.14c



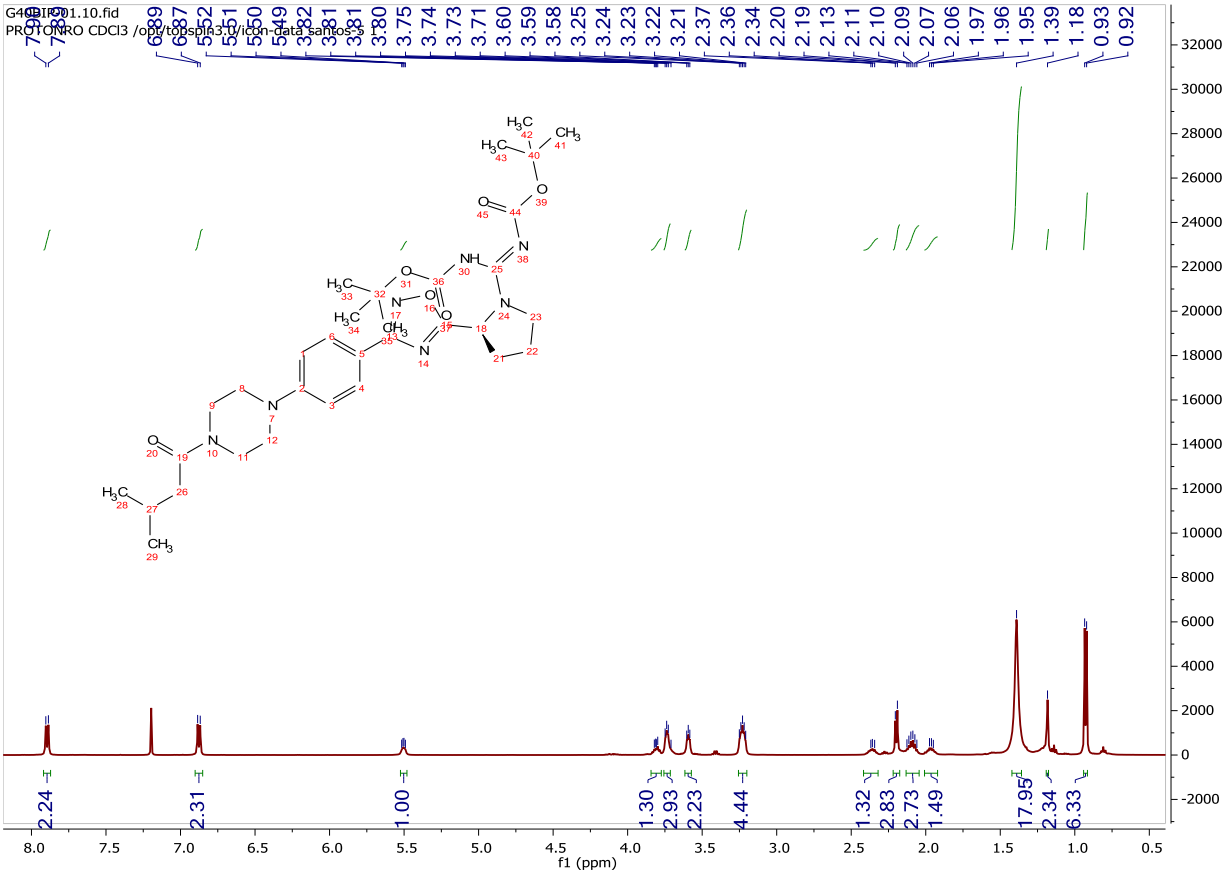
^{1}H-NMR Spectrum for Compound 2.14d



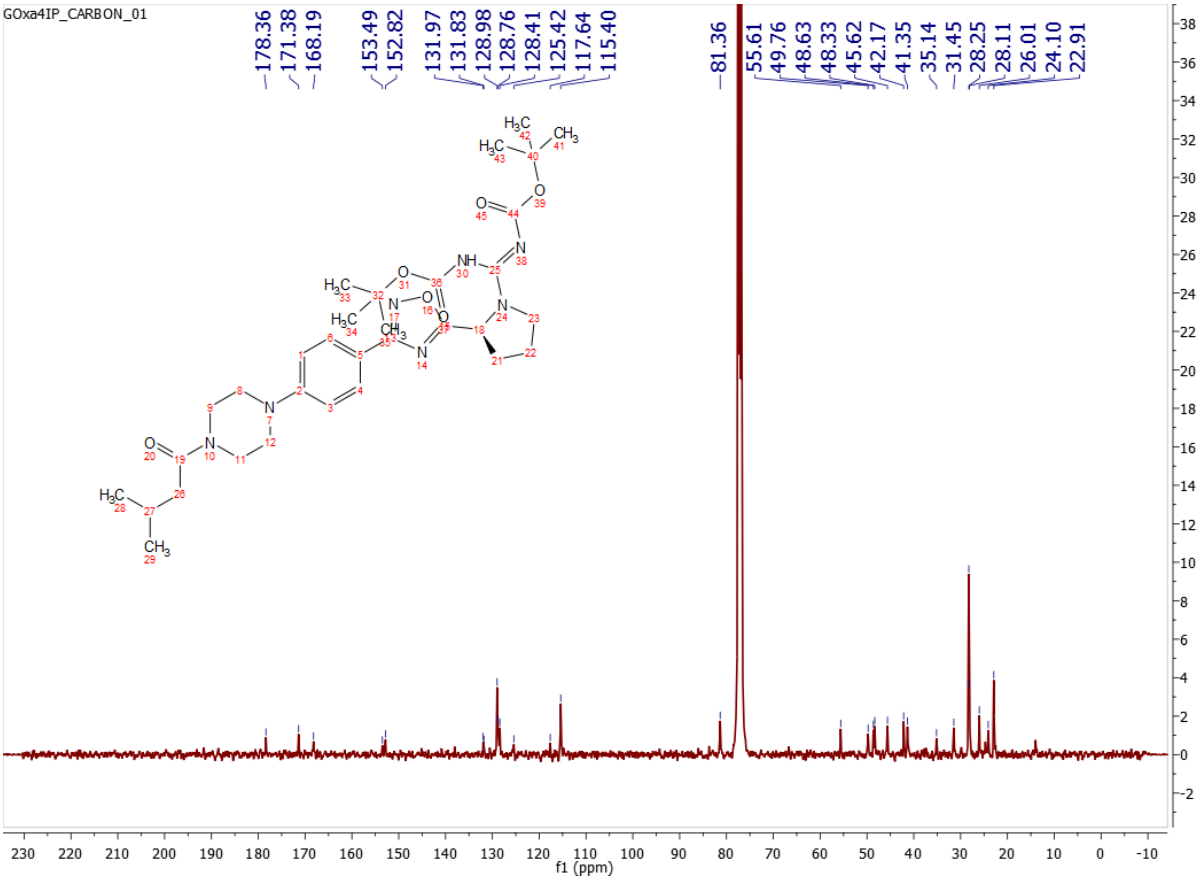
^{13}C-NMR Spectrum for Compound 2.14d



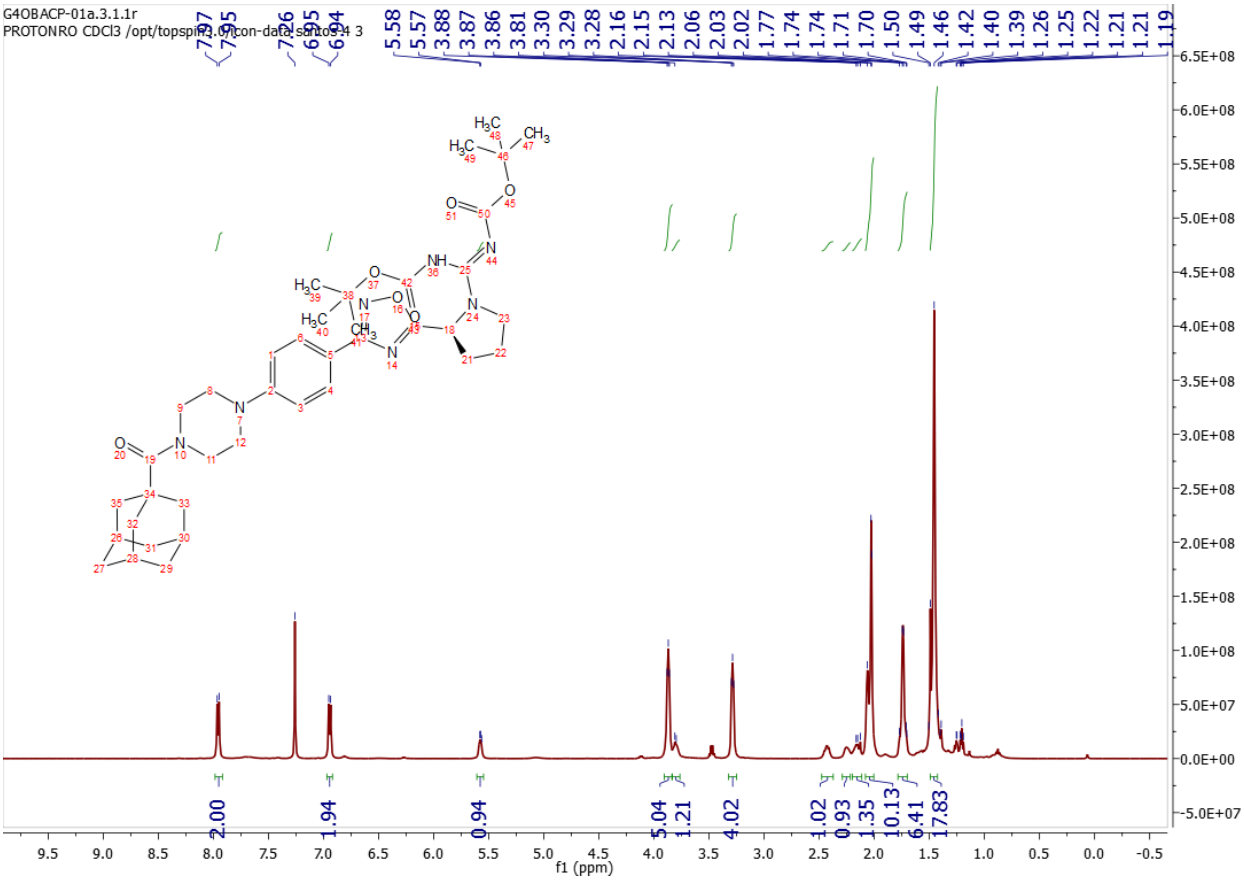
^{1}H-NMR Spectrum for Compound 2.16a



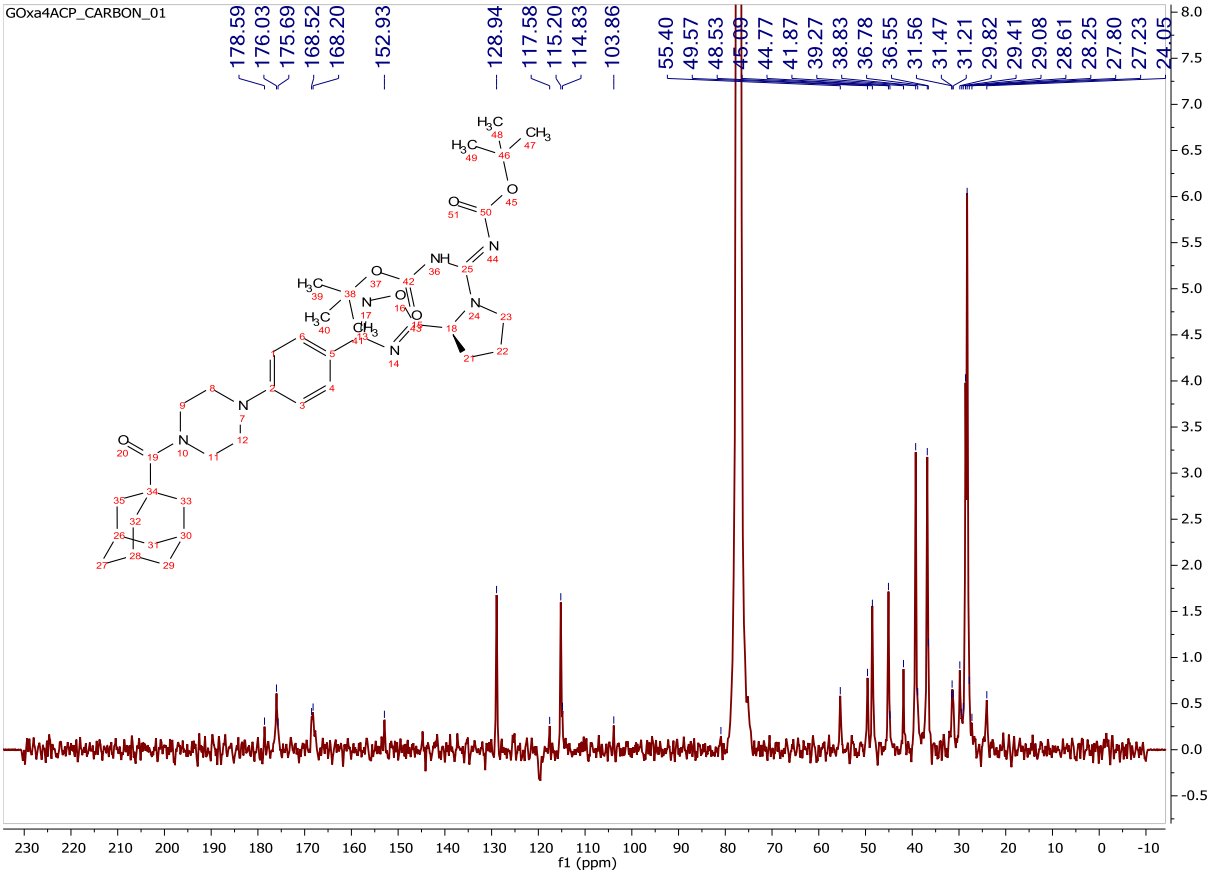
^{13}C-NMR Spectrum for Compound 2.16a



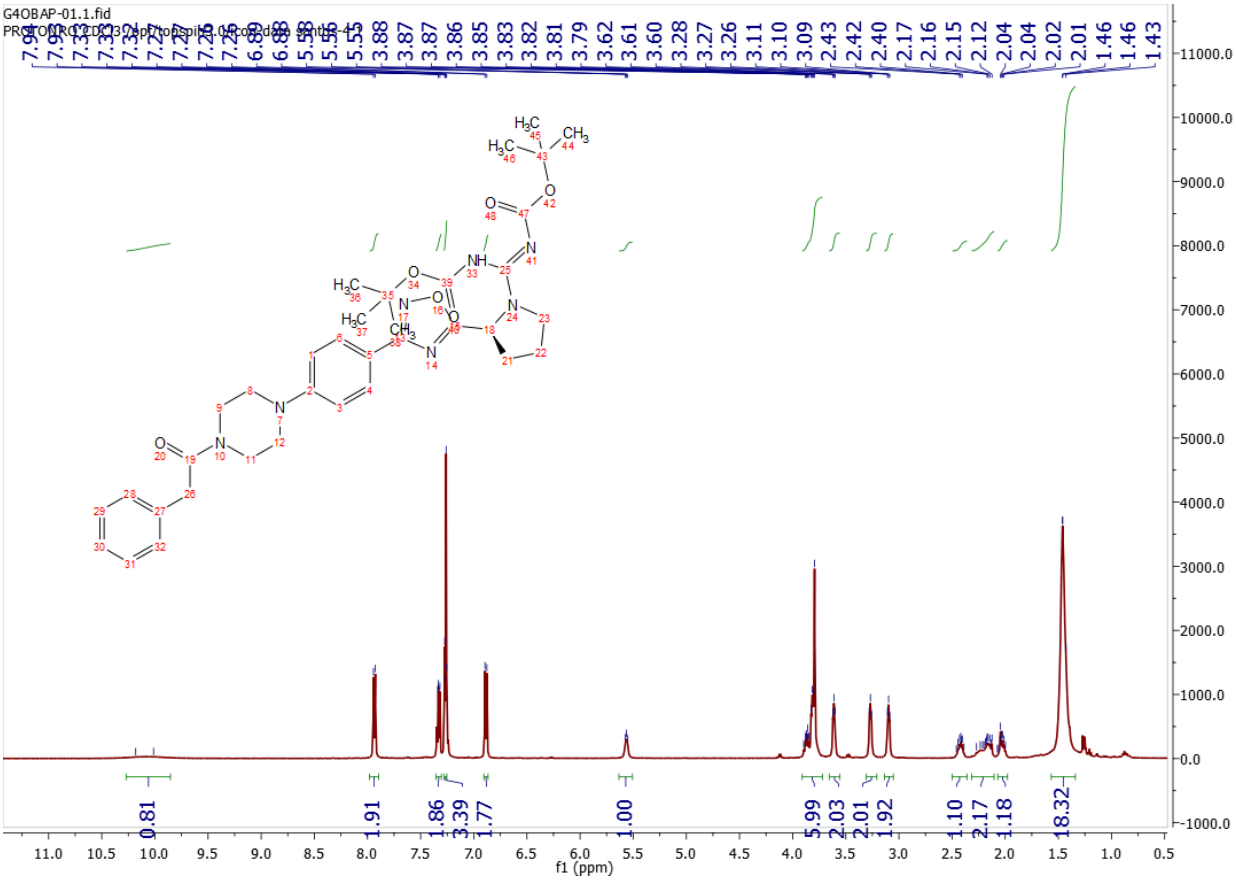
^{1}H-NMR Spectrum for Compound 2.16b



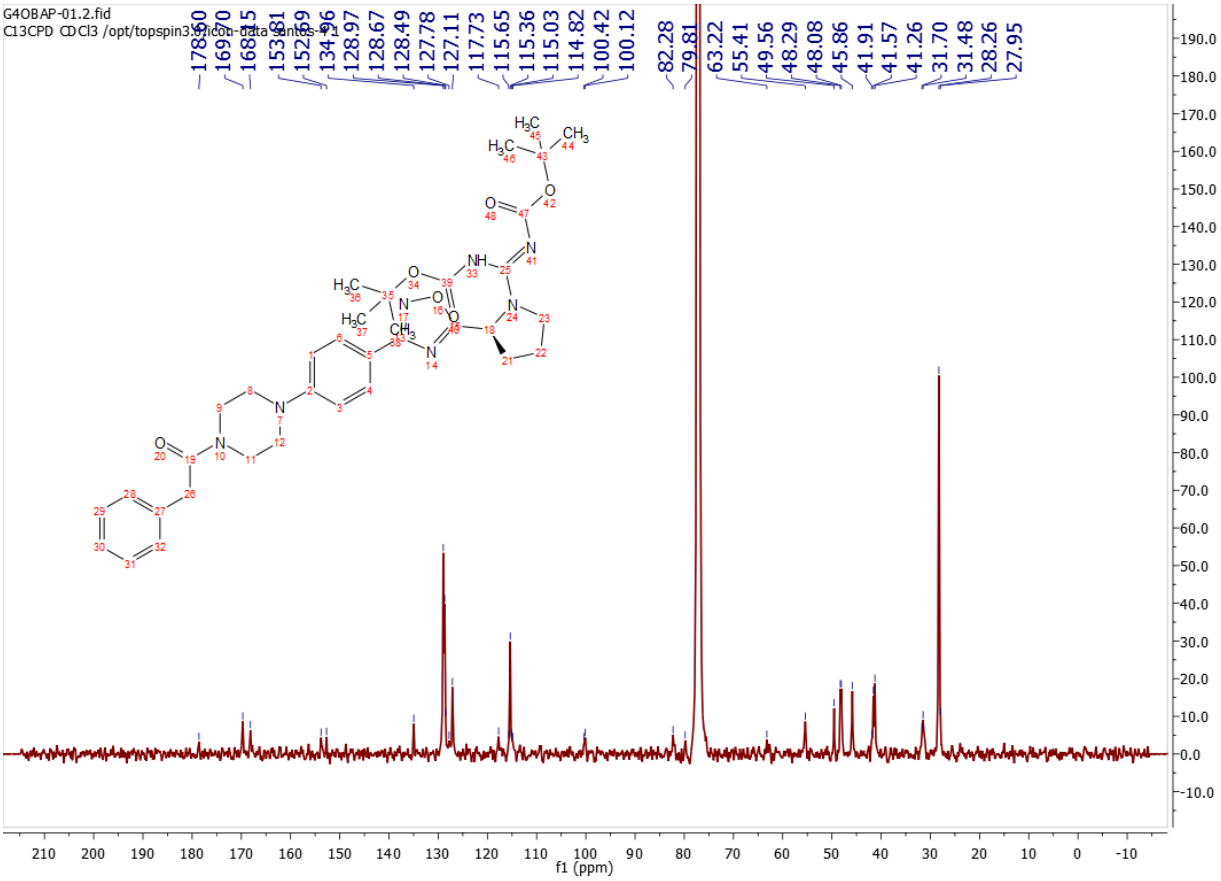
^{13}C-NMR Spectrum for Compound 2.16b



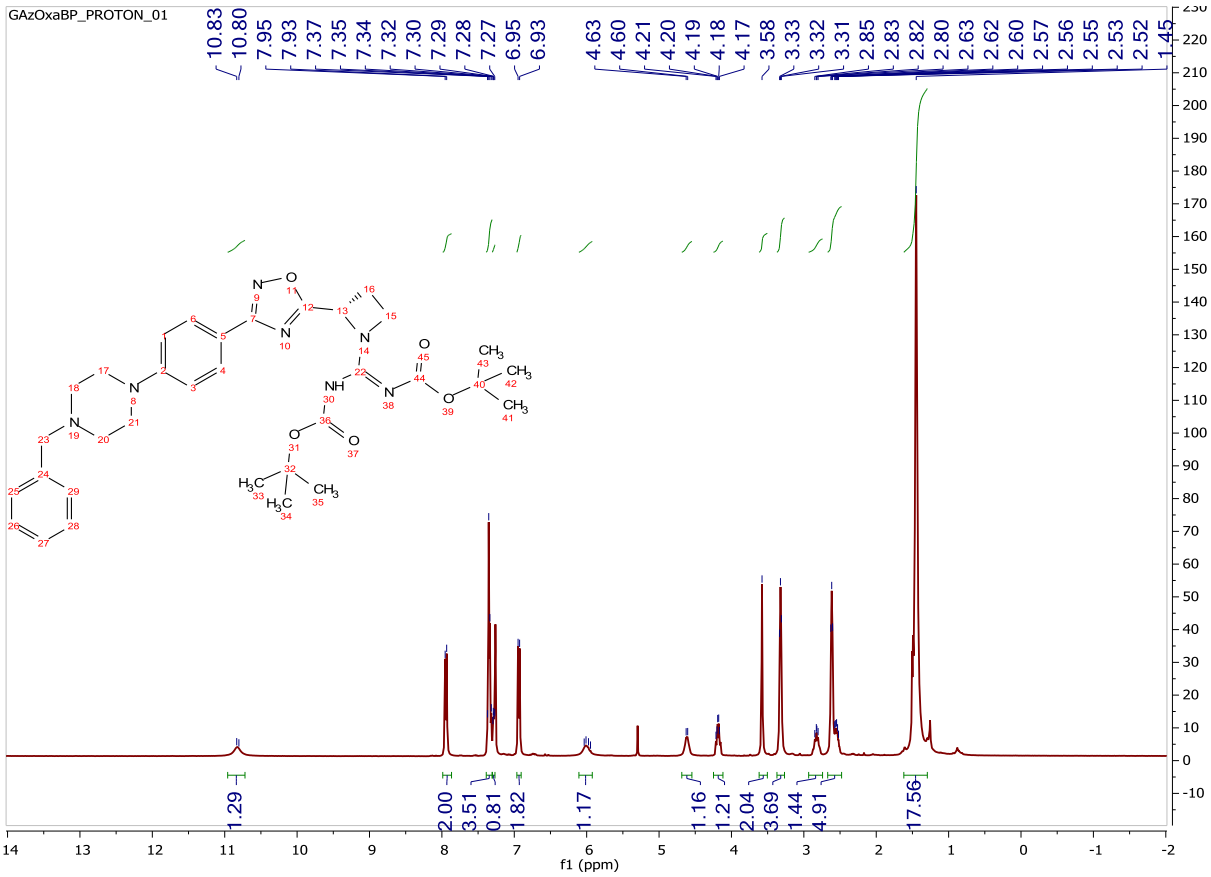
^{1}H-NMR Spectrum for Compound 2.16c



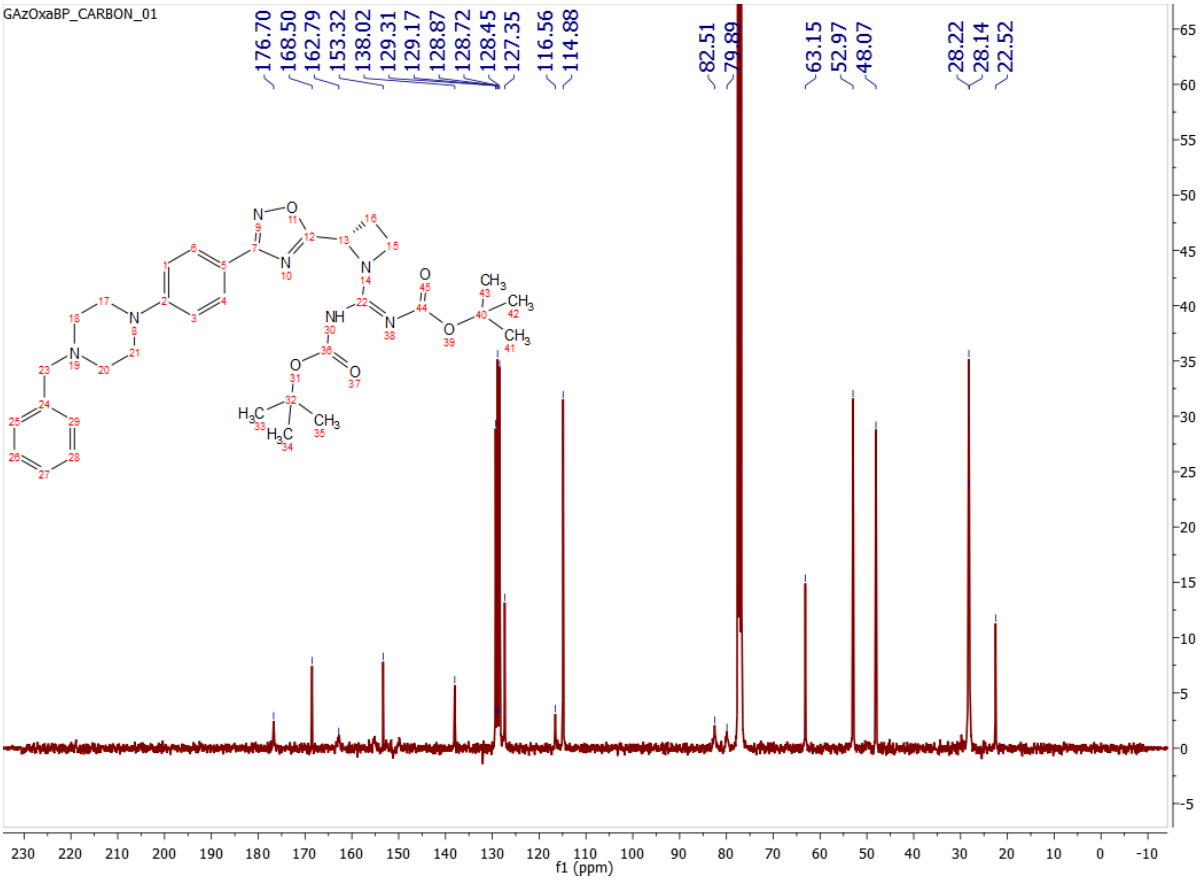
^{13}C-NMR Spectrum for Compound 2.16c



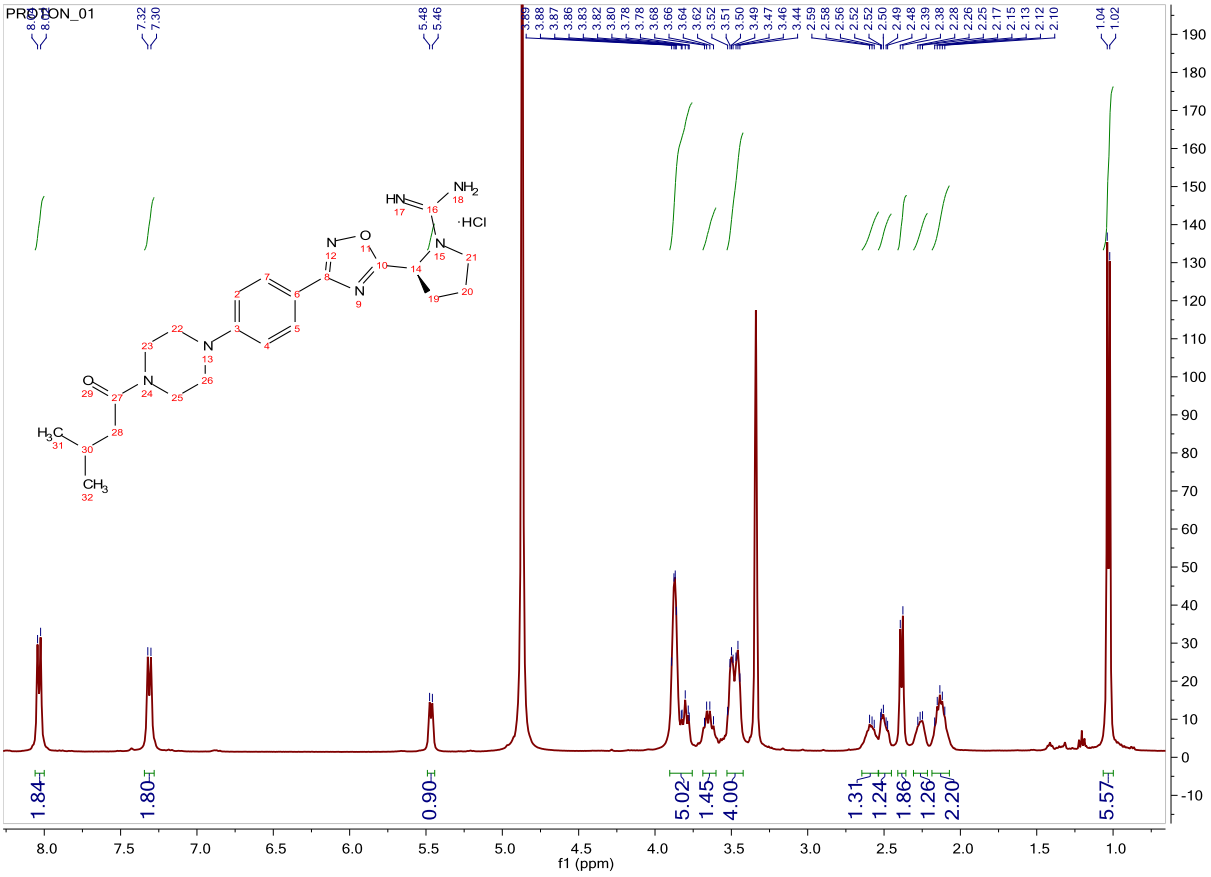
^{1}H-NMR Spectrum for Compound 2.16d



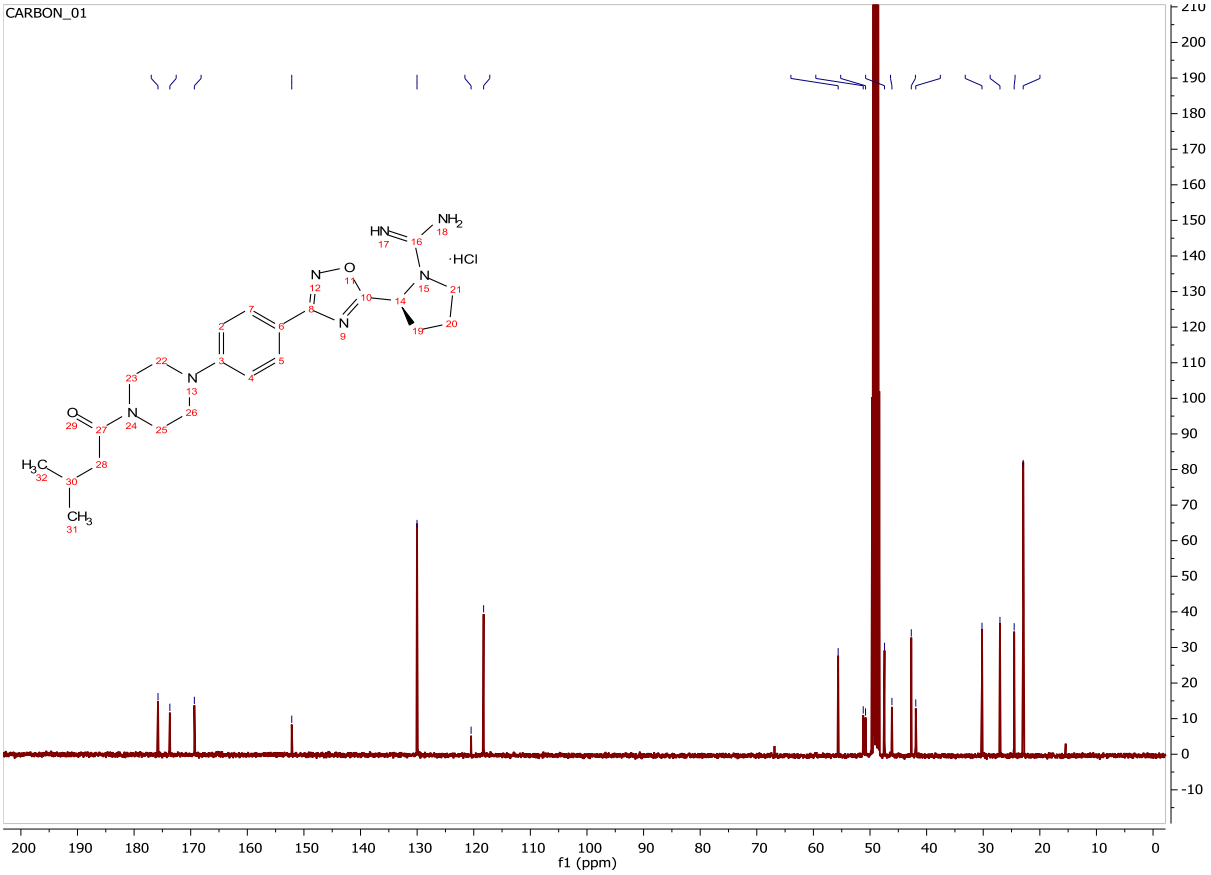
^{13}C-NMR Spectrum for Compound 2.16d



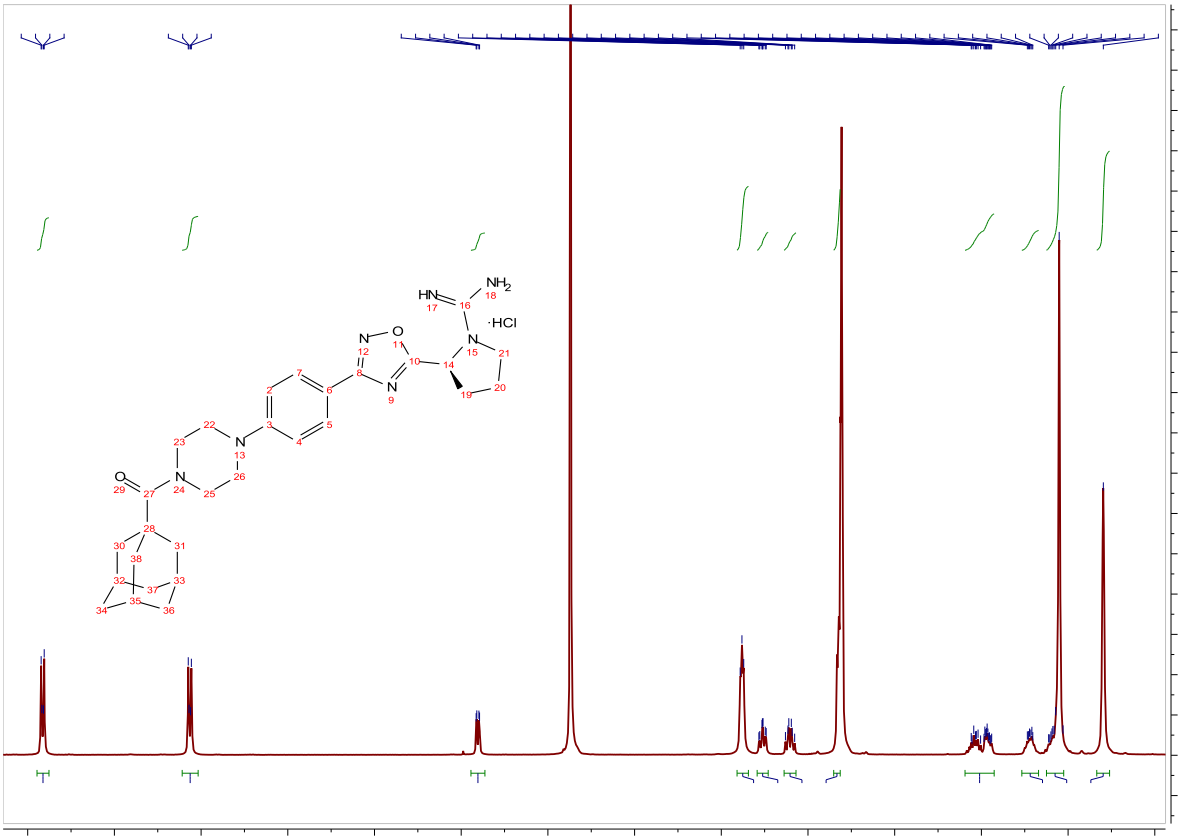
^{1}H-NMR Spectrum for Compound 2.17a



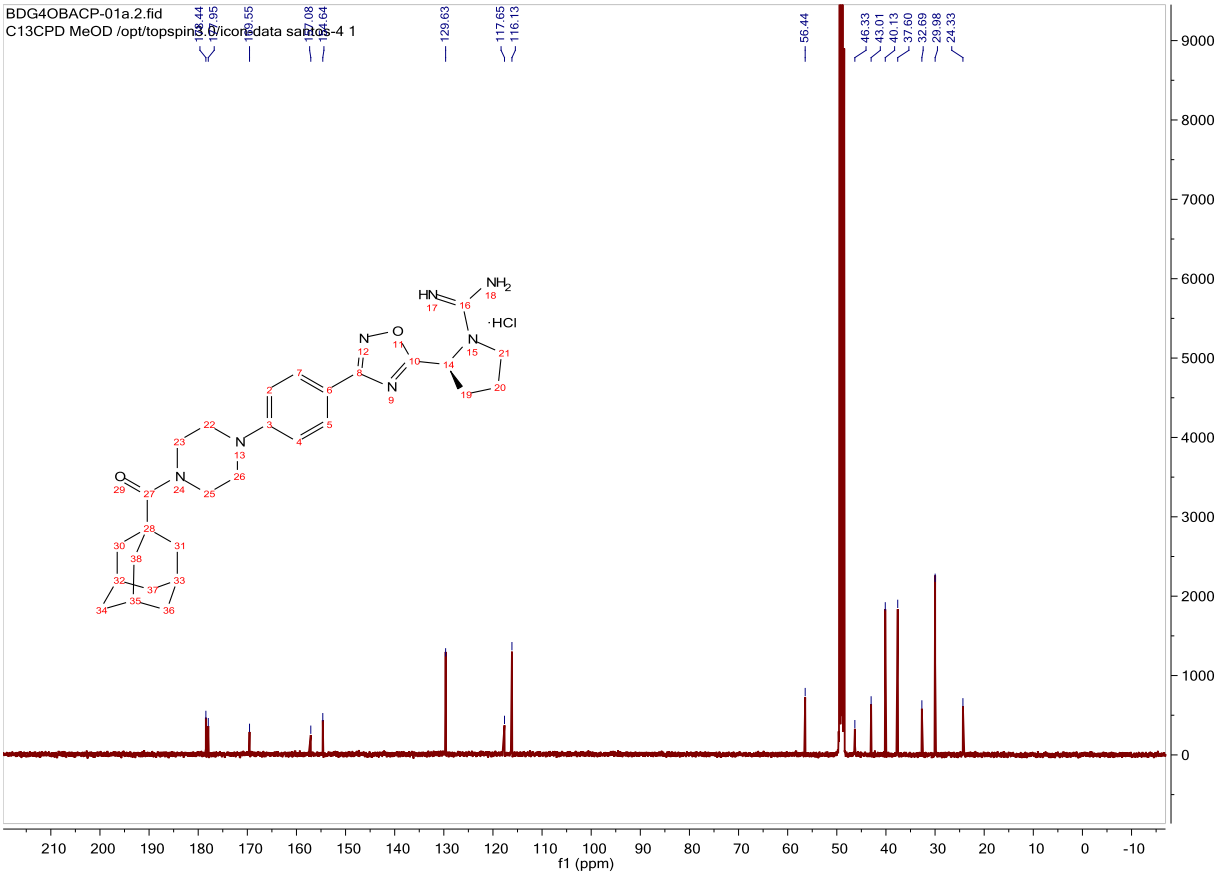
^{13}C-NMR Spectrum for Compound 2.17a



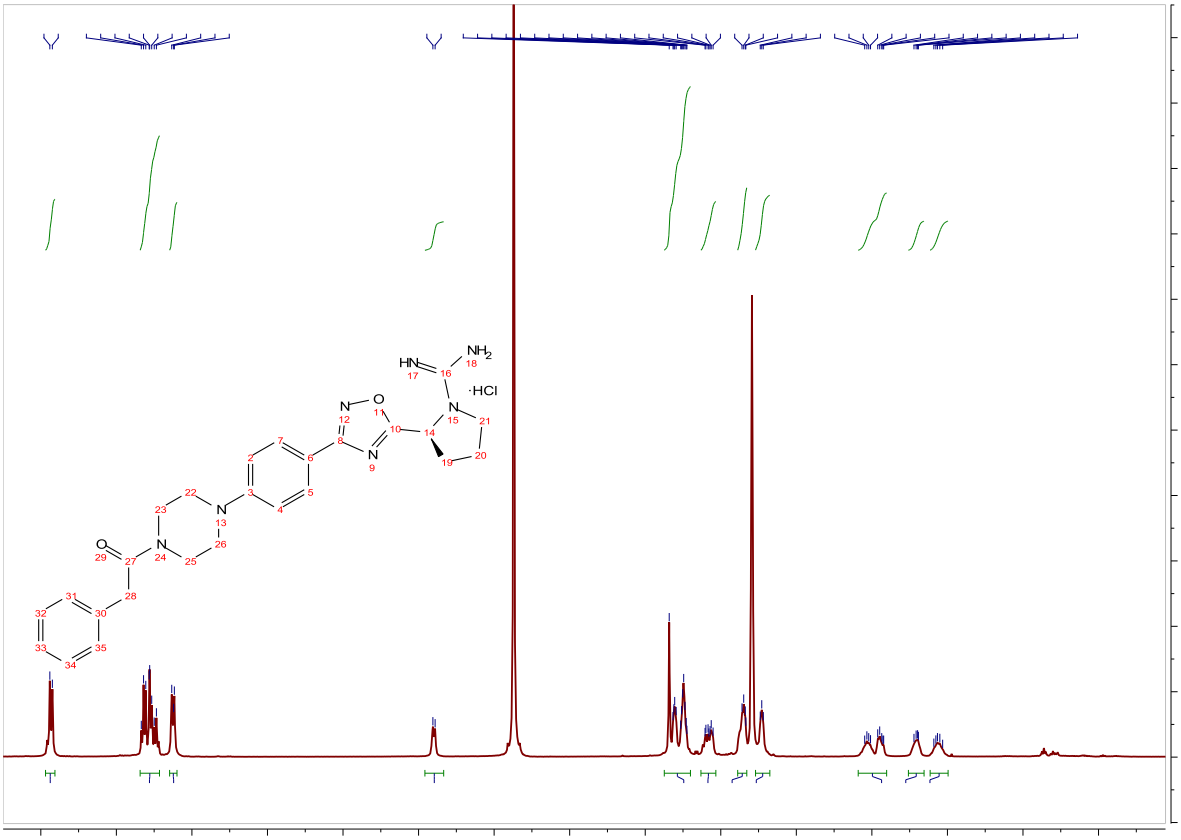
^{1}H-NMR Spectrum for Compound 2.17b



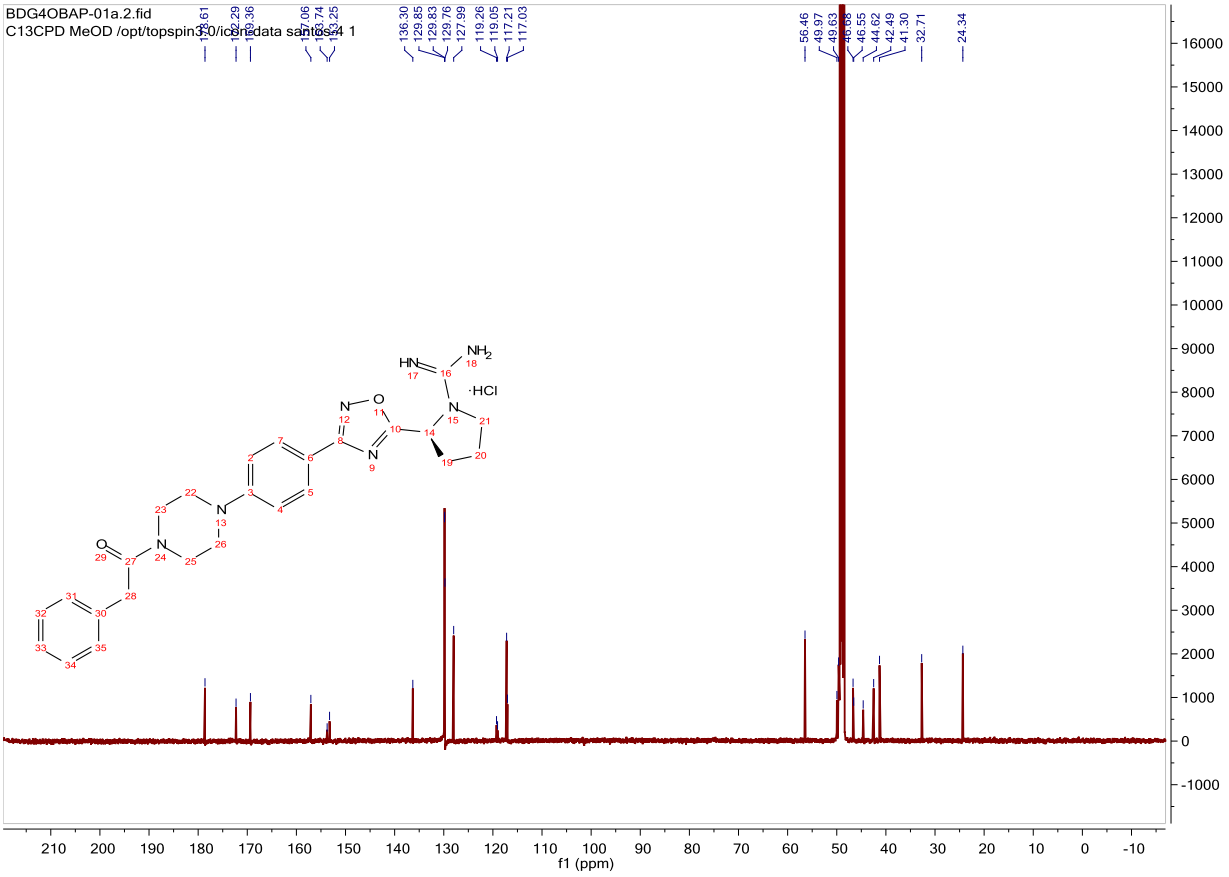
^{13}C-NMR Spectrum for Compound 2.17b



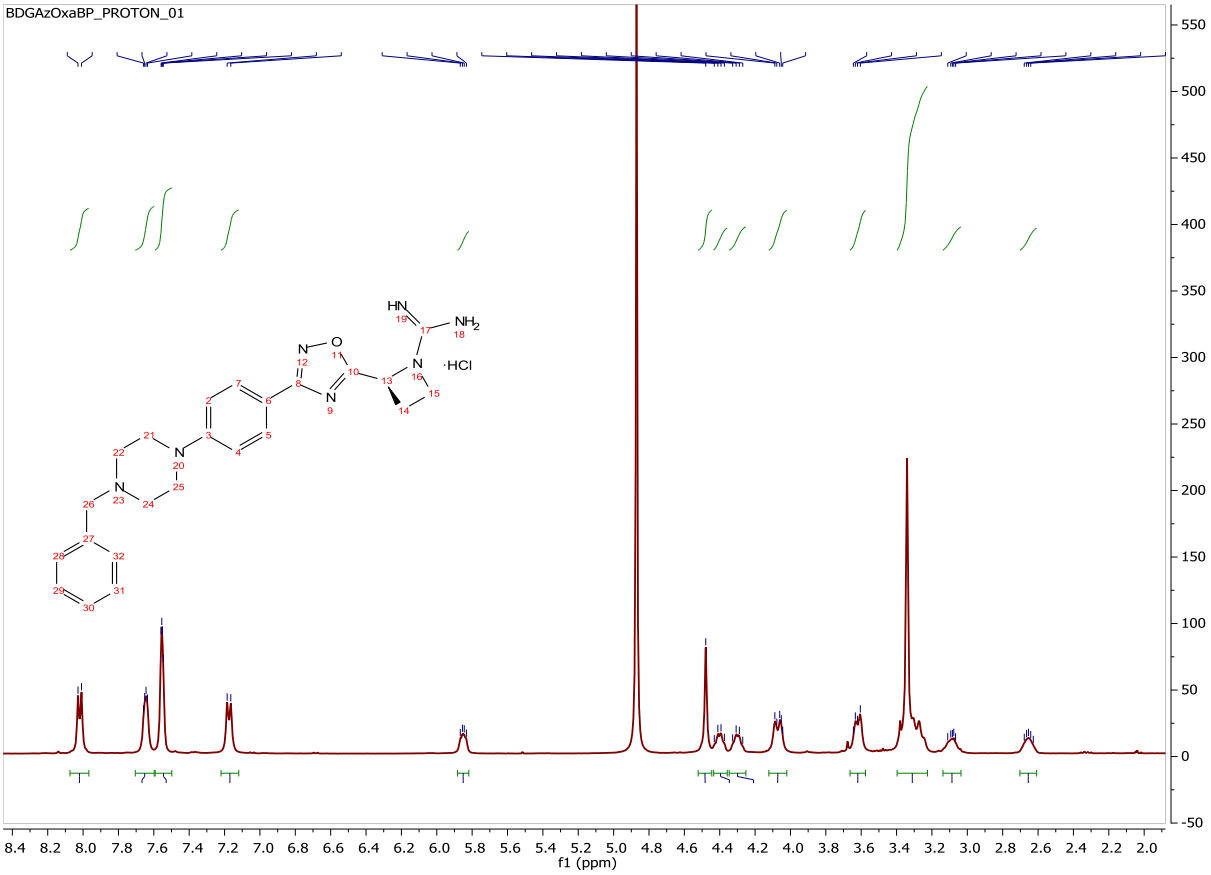
^{1}H-NMR Spectrum for Compound 2.17c



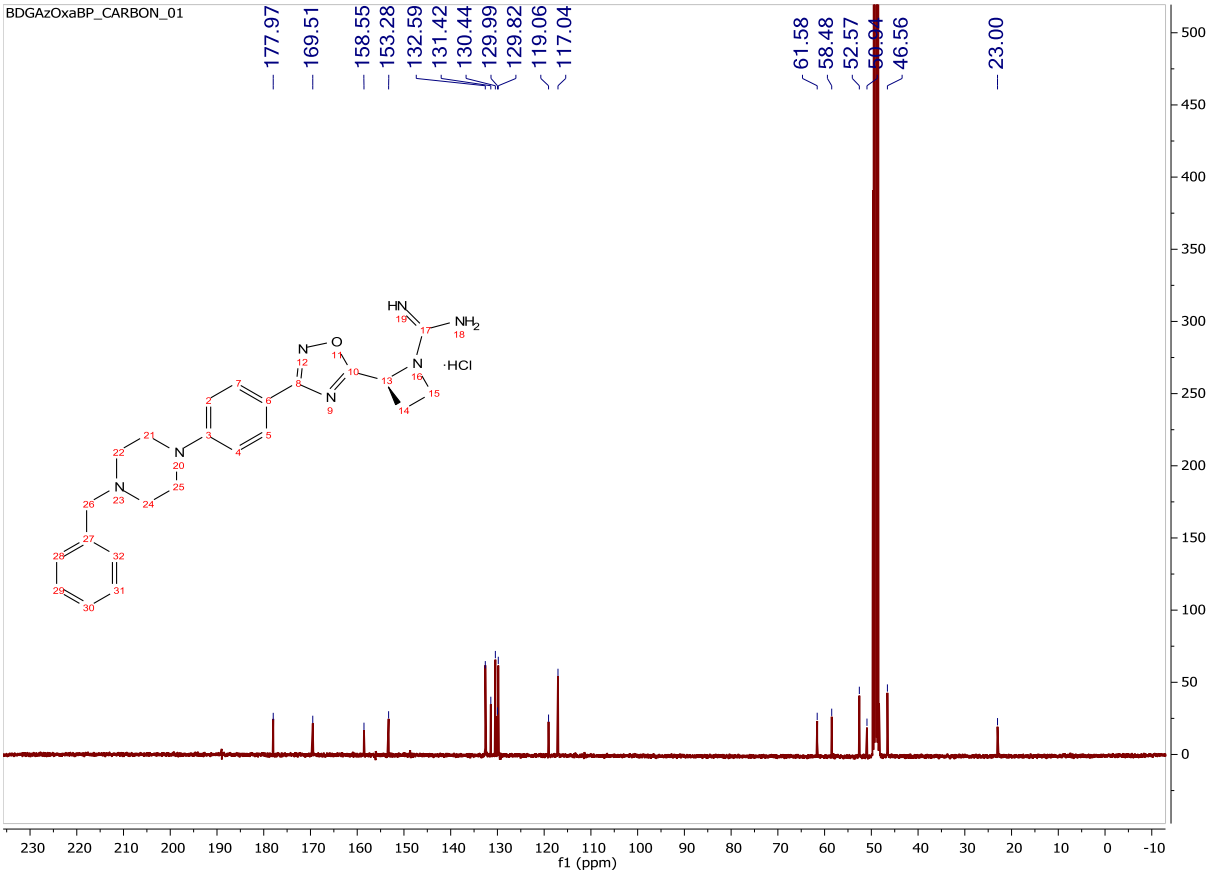
^{13}C-NMR Spectrum for Compound 2.17c



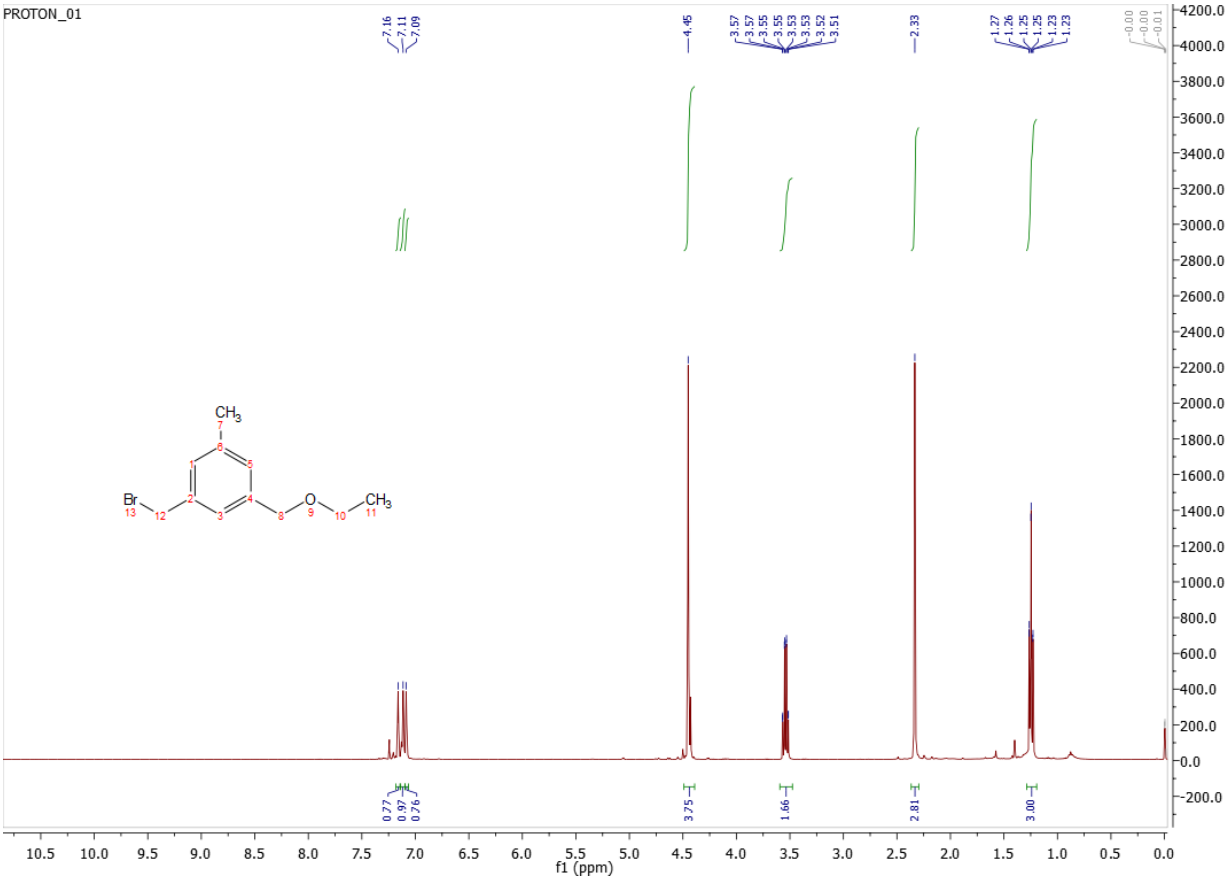
^{1}H-NMR Spectrum for Compound 2.17d



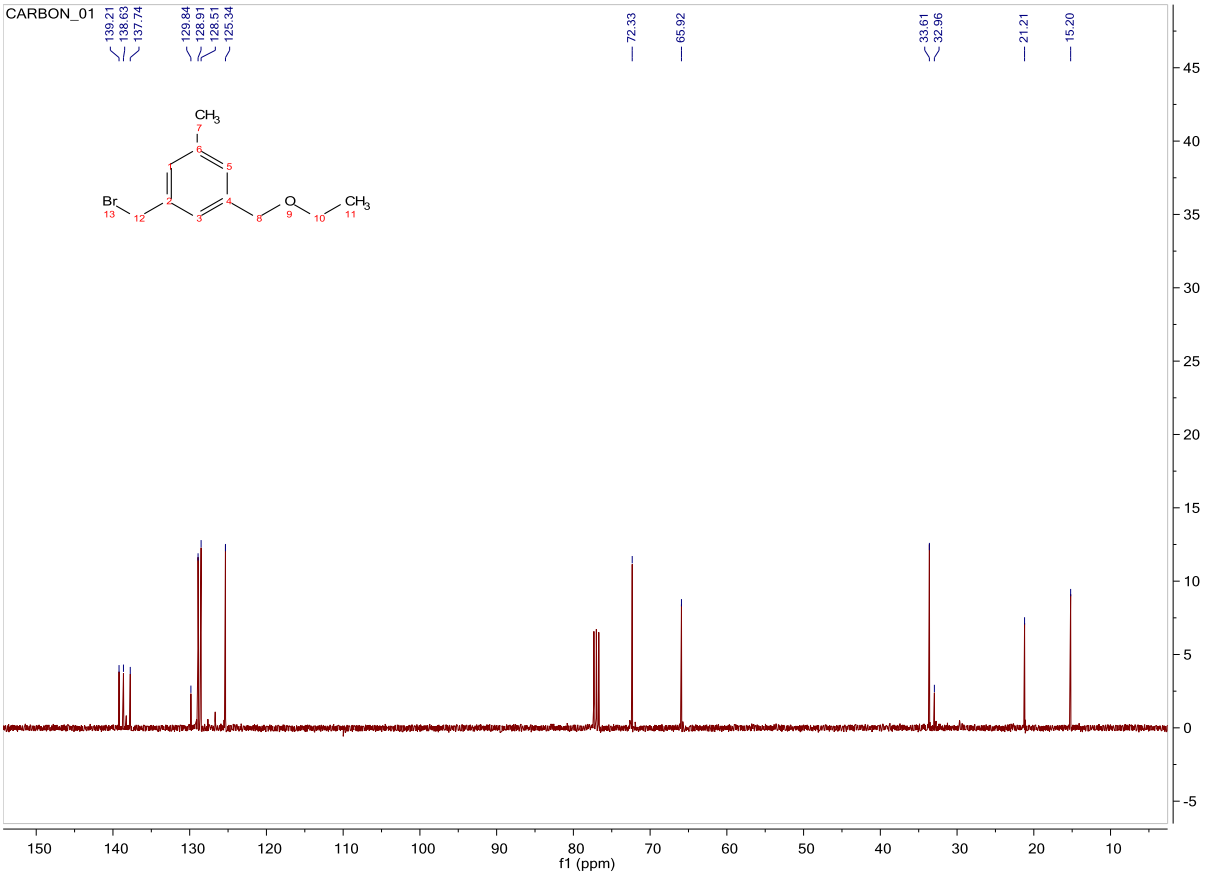
^{13}C-NMR Spectrum for Compound 2.17d



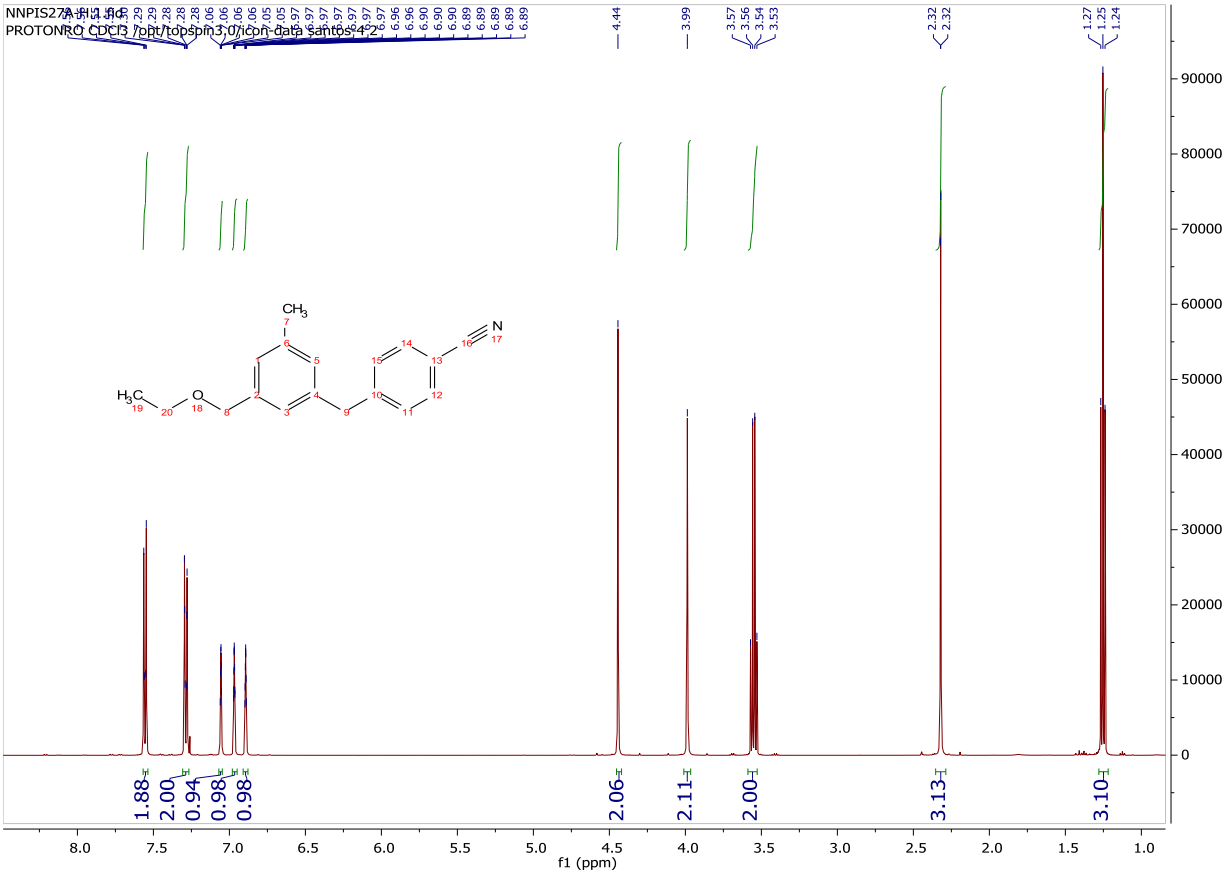
^{1}H-NMR Spectrum for Compound 2.19



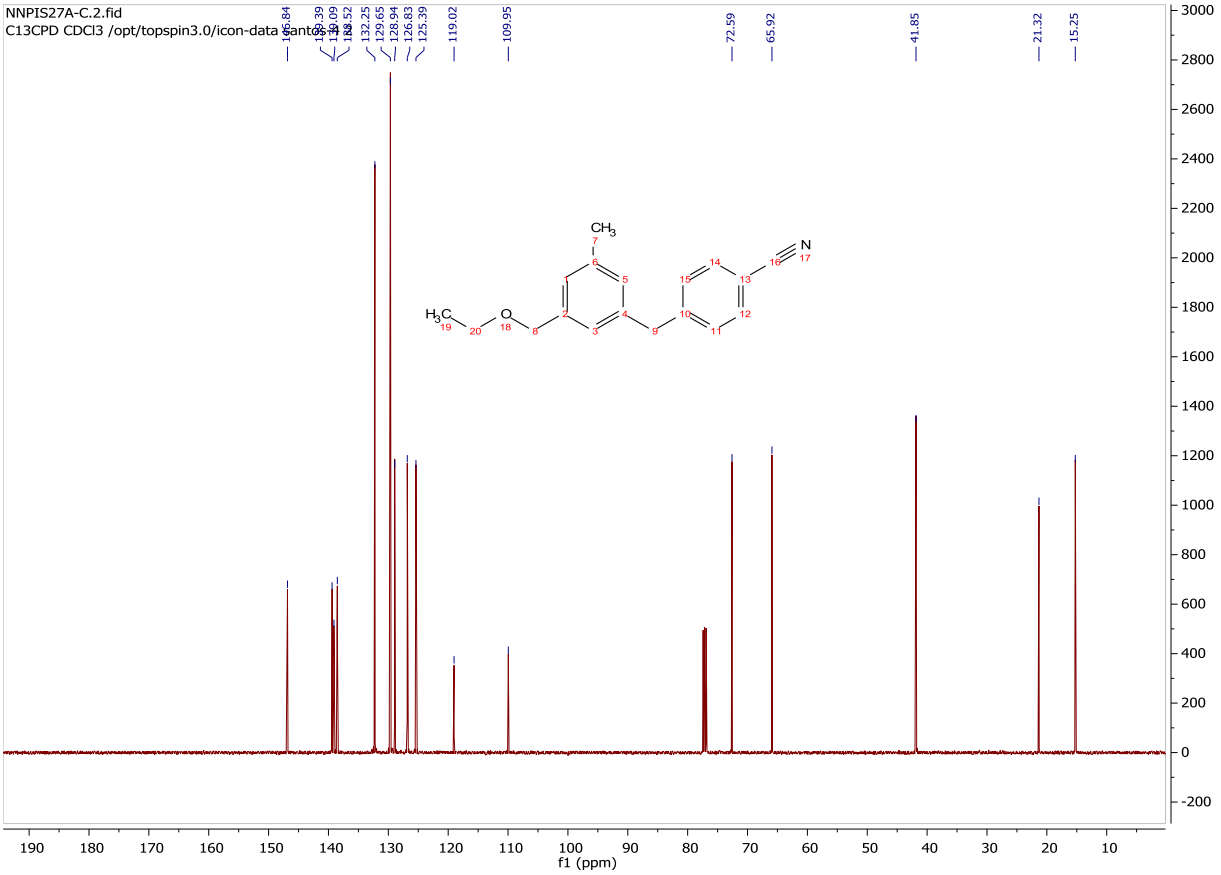
^{13}C-NMR Spectrum for Compound 2.19



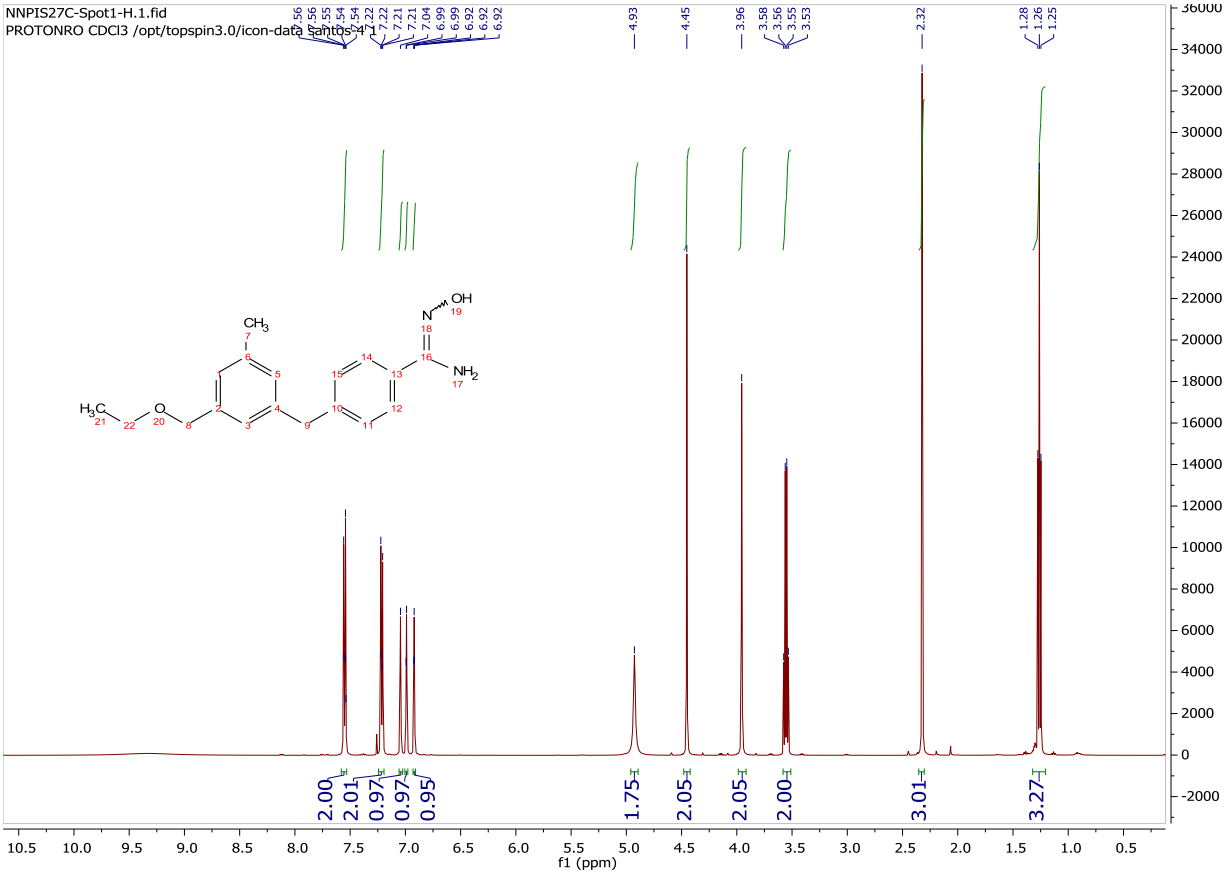
^{1}H-NMR Spectrum for Compound 2.20



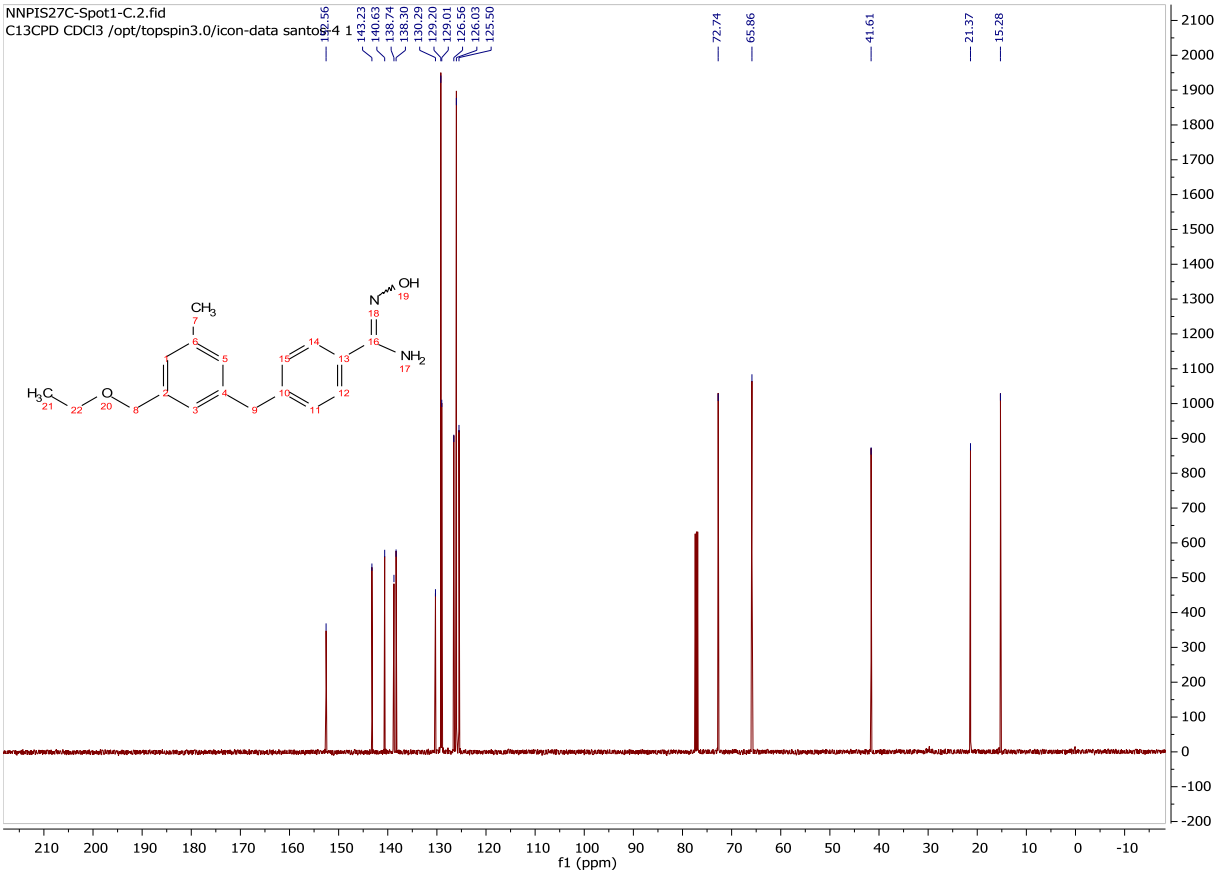
^{13}C-NMR Spectrum for Compound 2.20



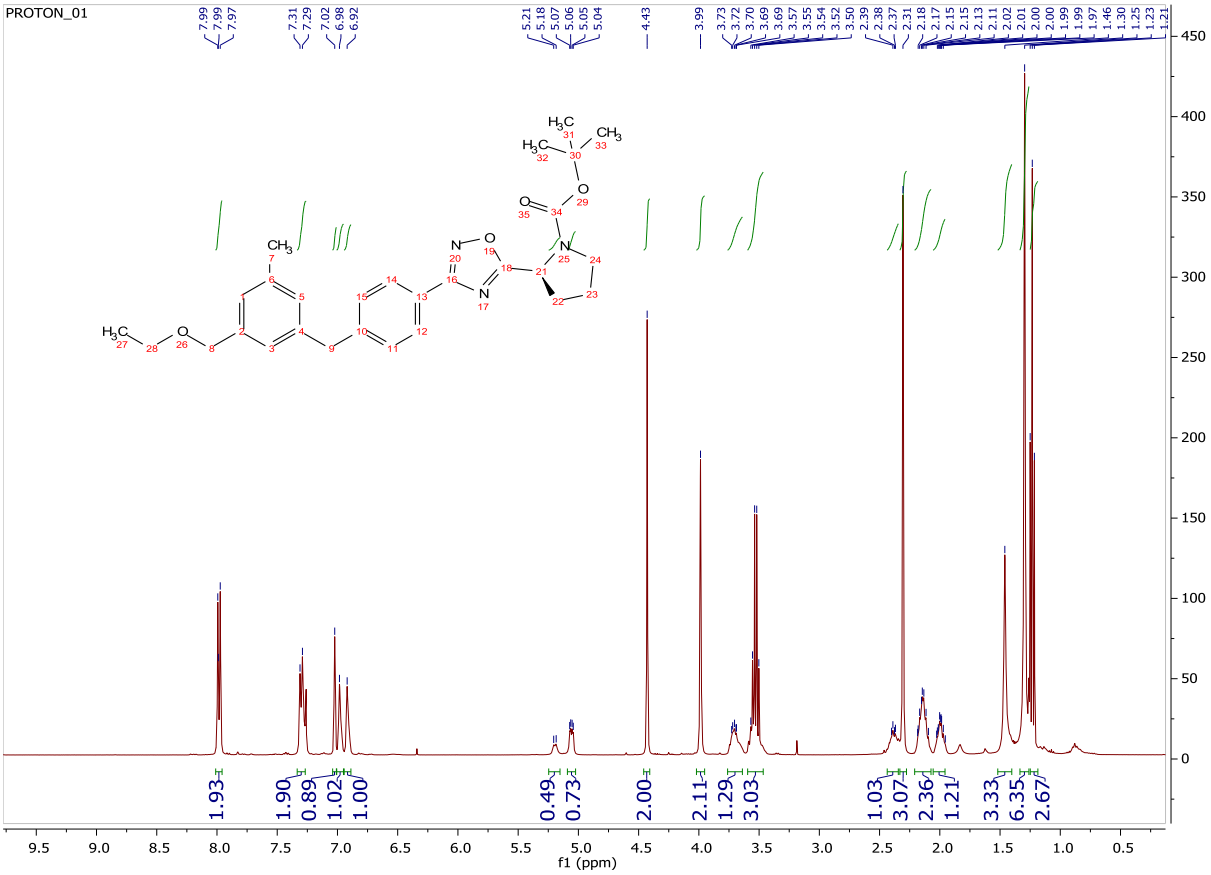
^{1}H-NMR Spectrum for Compound 2.21



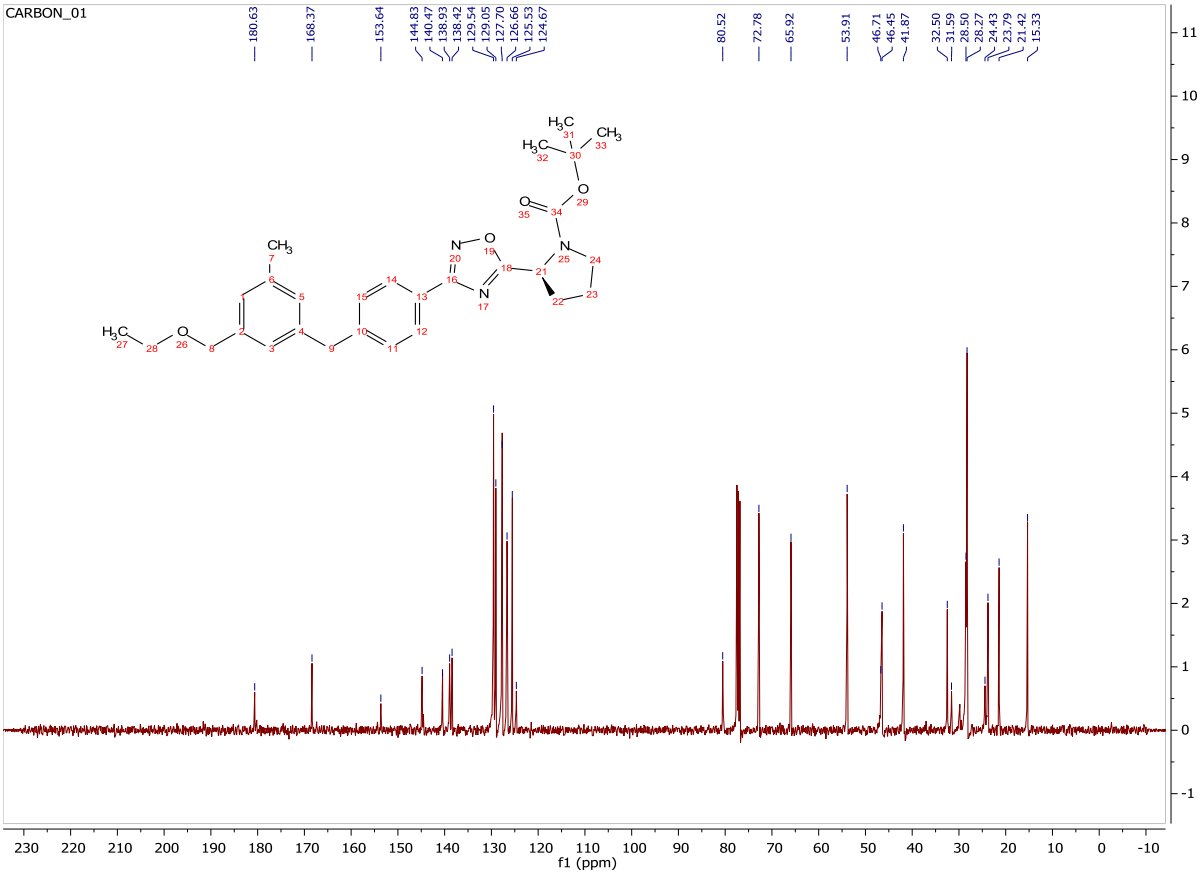
^{13}C-NMR Spectrum for Compound 2.21



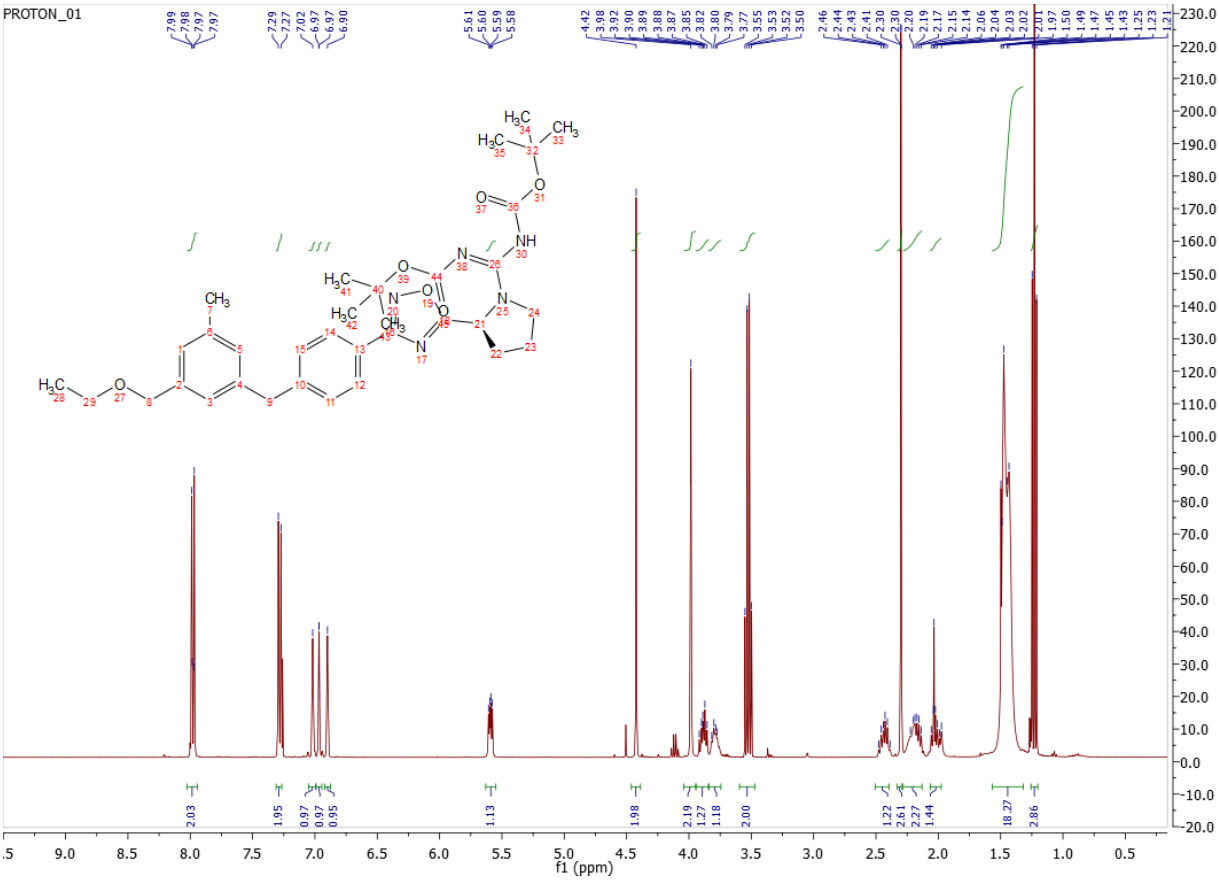
^{1}H-NMR Spectrum for Compound 2.22



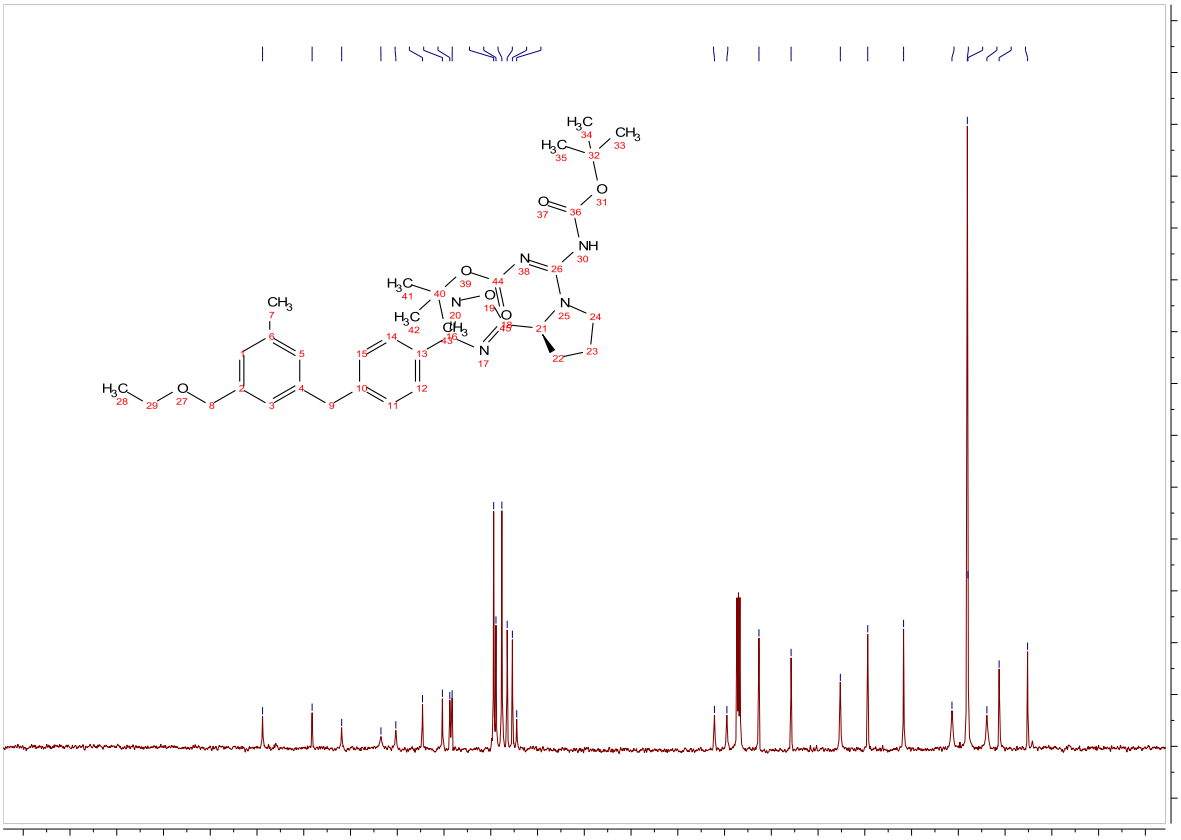
^{13}C-NMR Spectrum for Compound 2.22



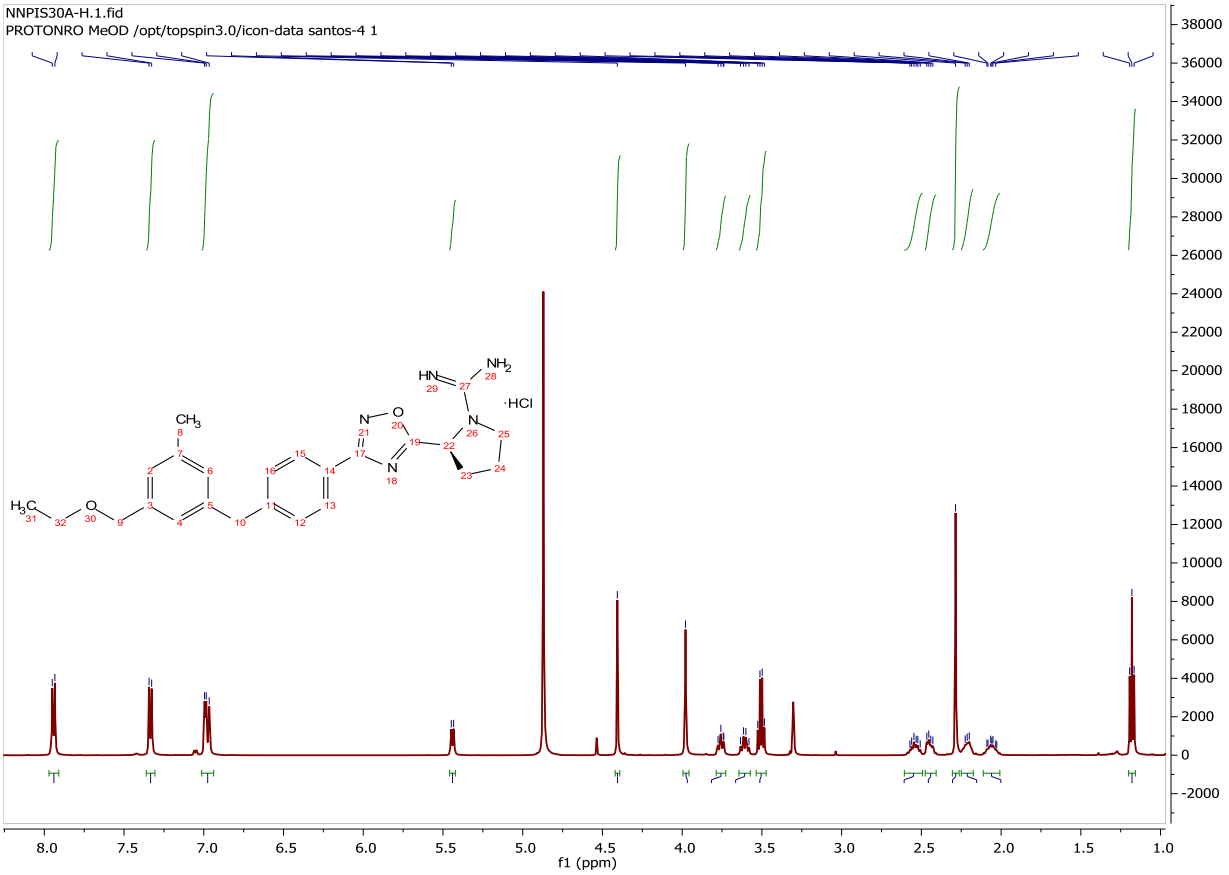
^{1}H-NMR Spectrum for Compound 2.24



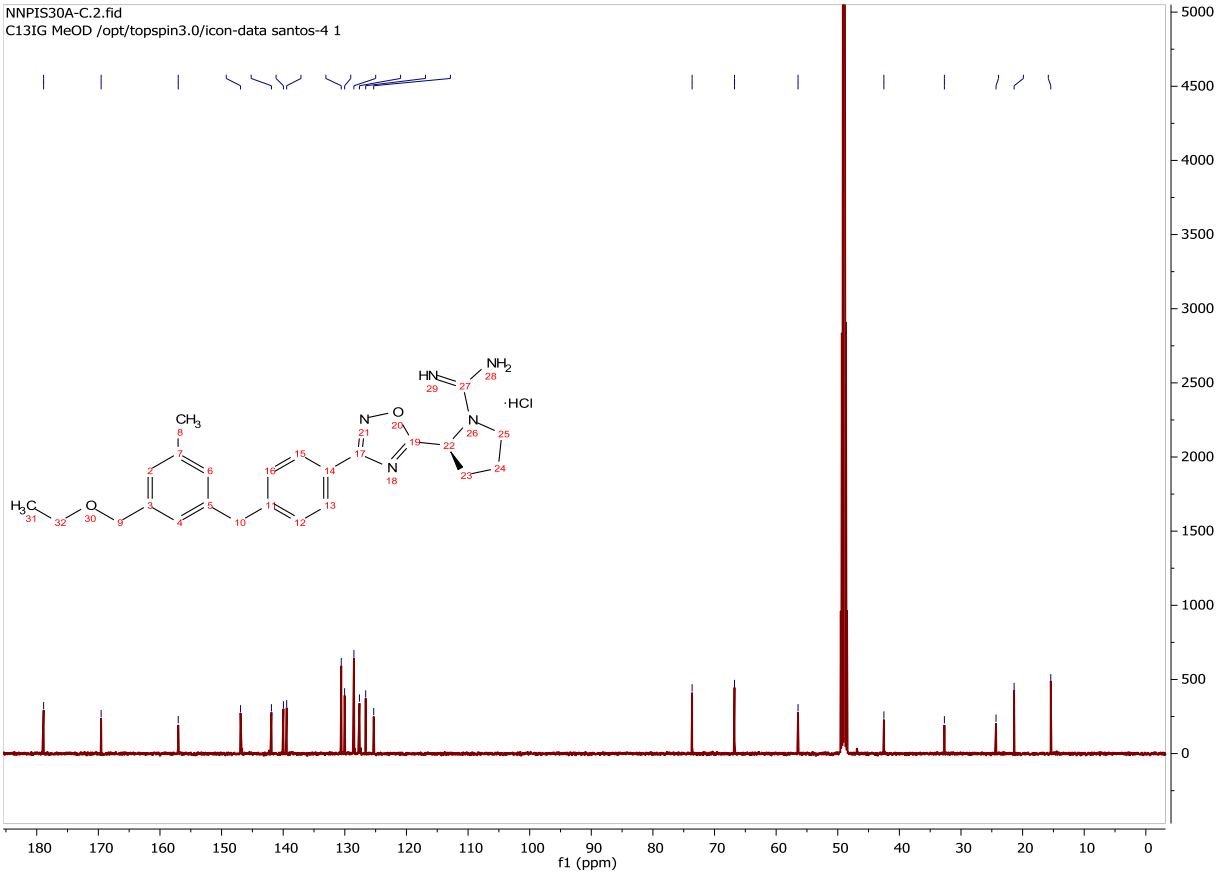
^{13}C-NMR Spectrum for Compound 2.24



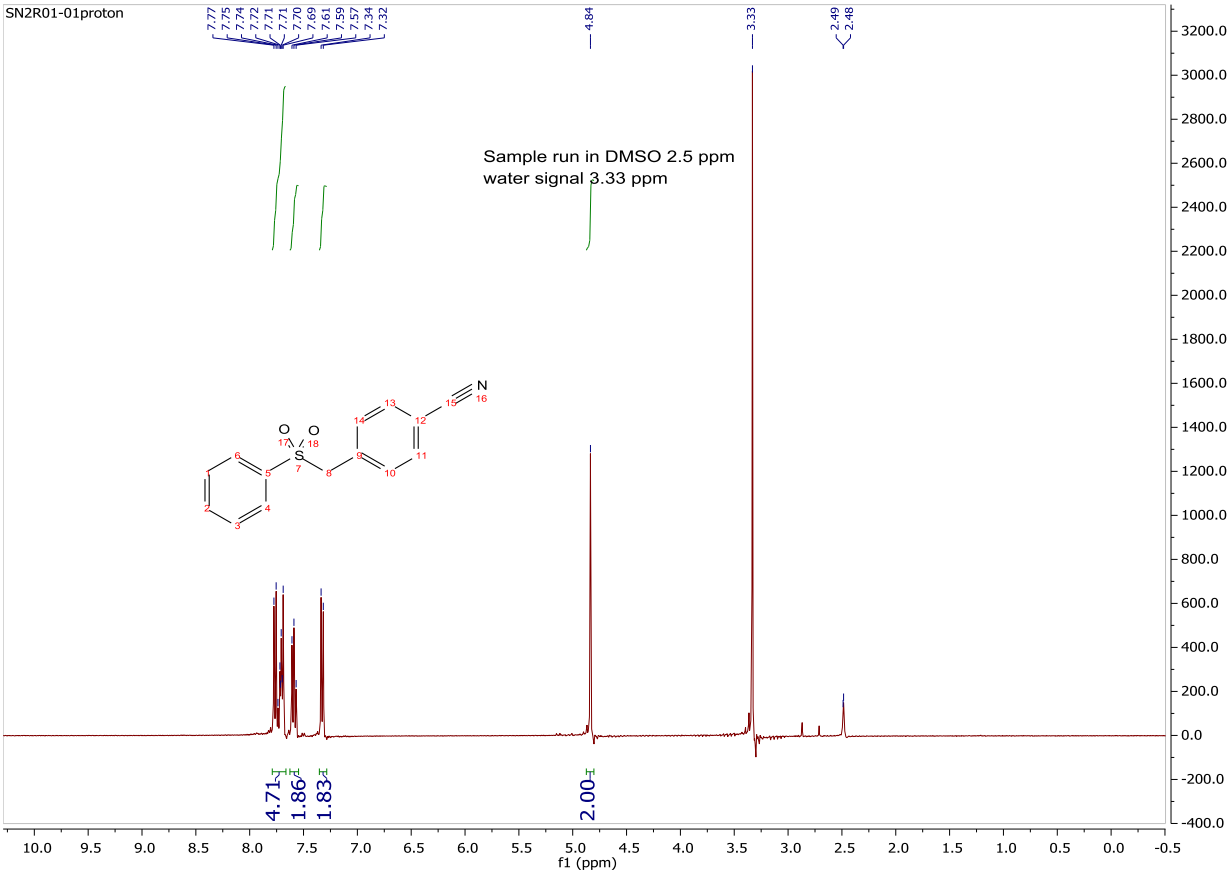
^{1}H-NMR Spectrum for Compound 2.25



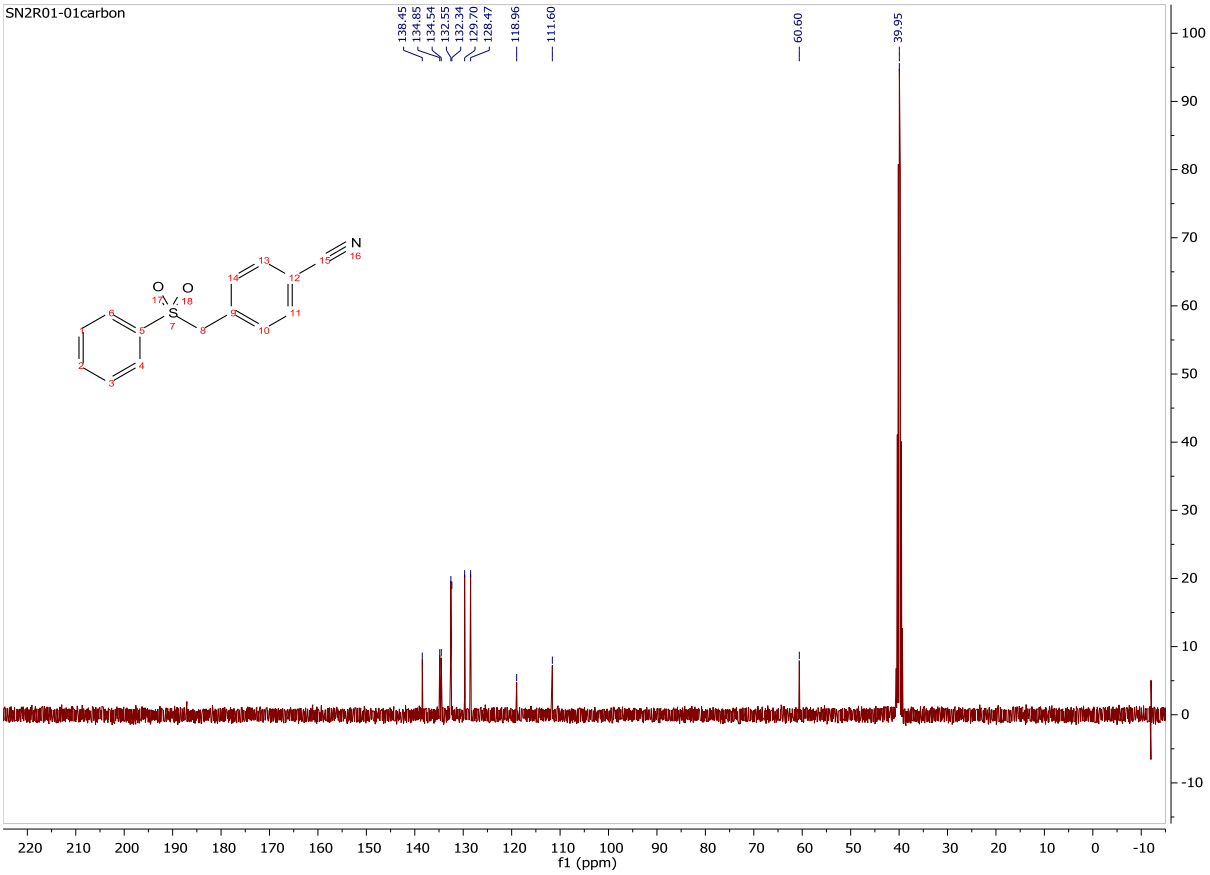
^{13}C-NMR Spectrum for Compound 2.25



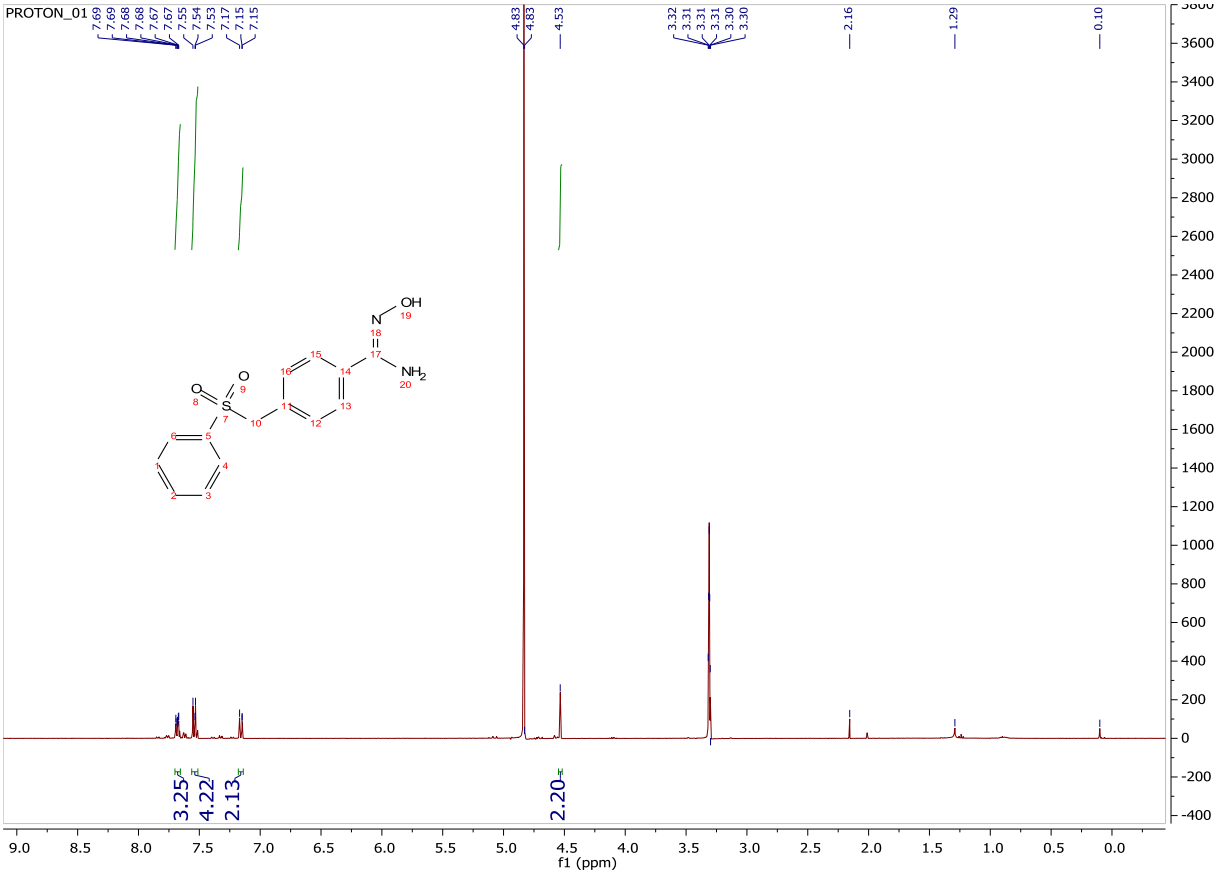
^{1}H-NMR Spectrum for Compound 2.27



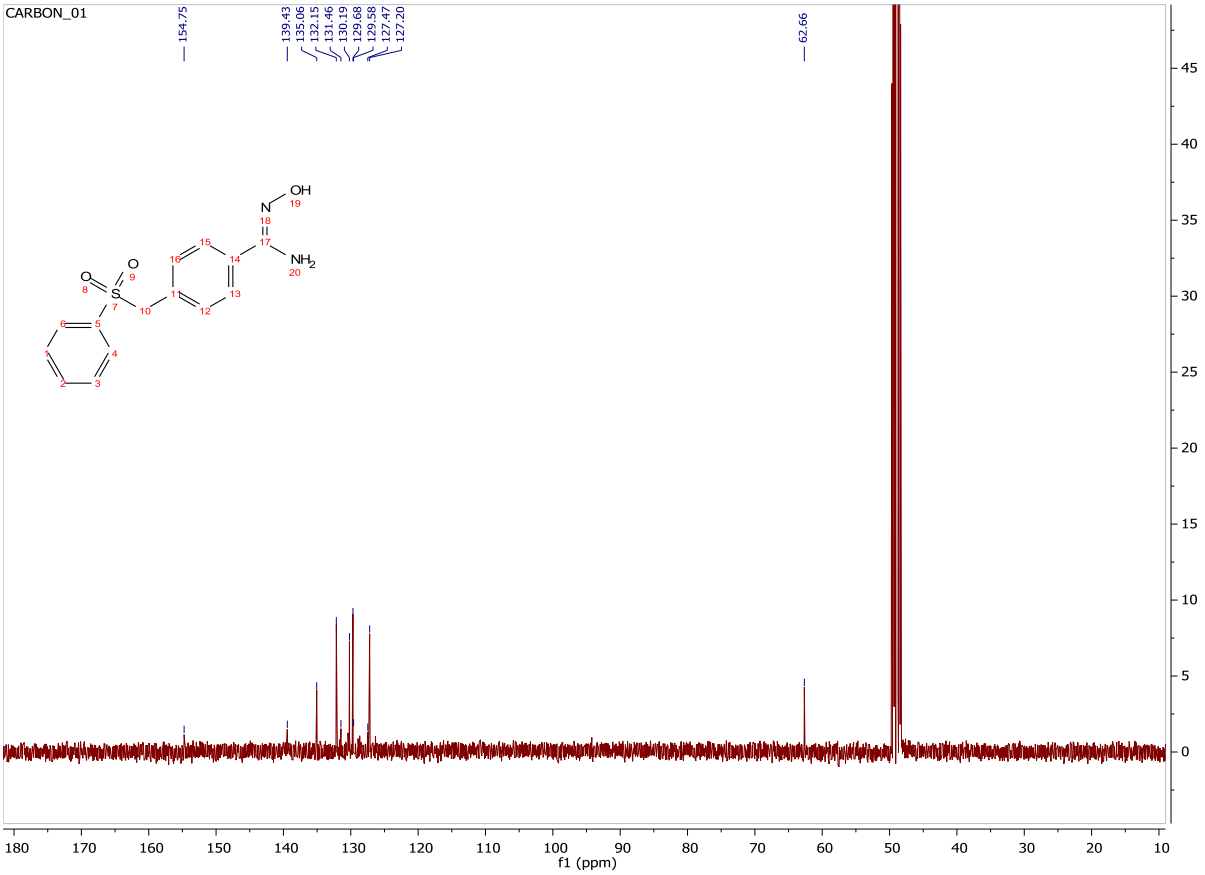
^{13}C-NMR Spectrum for Compound 2.27



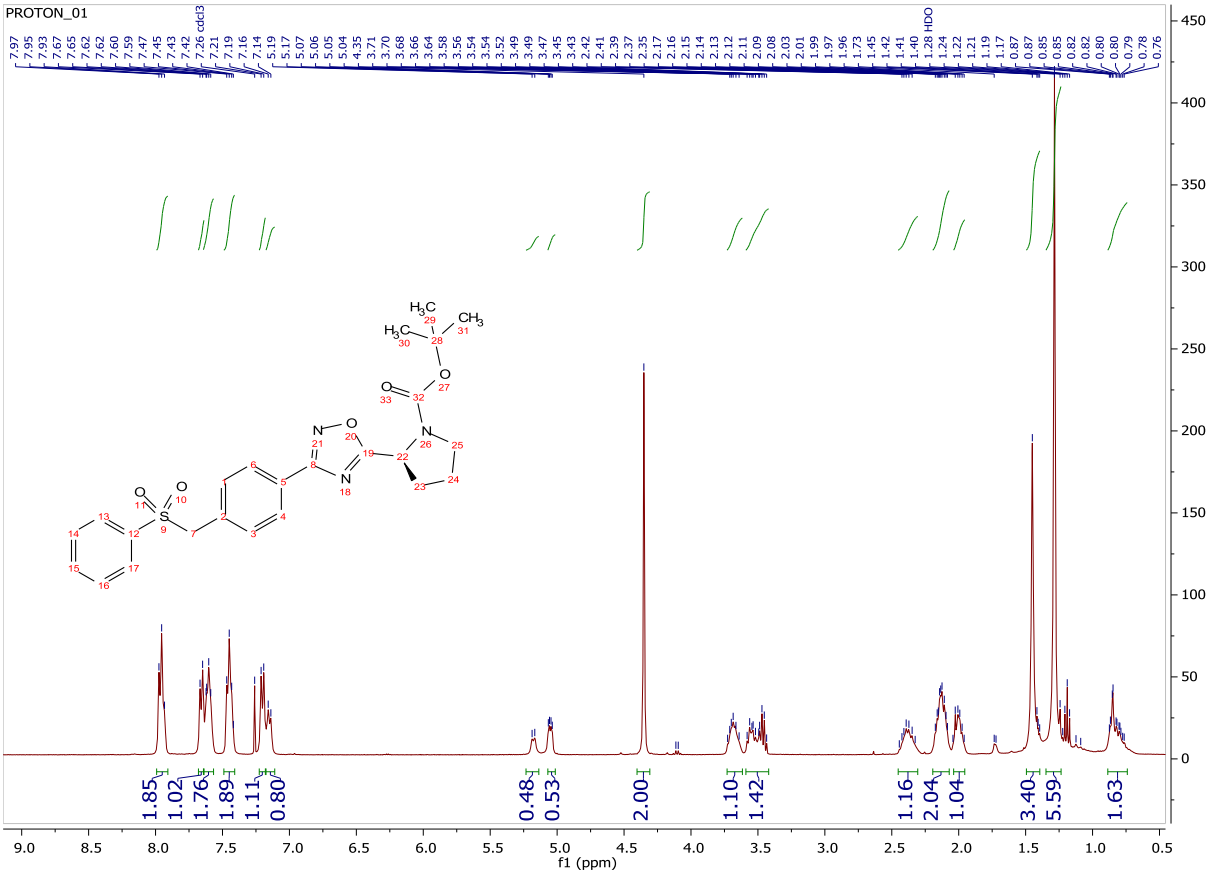
^{1}H-NMR Spectrum for Compound 2.28



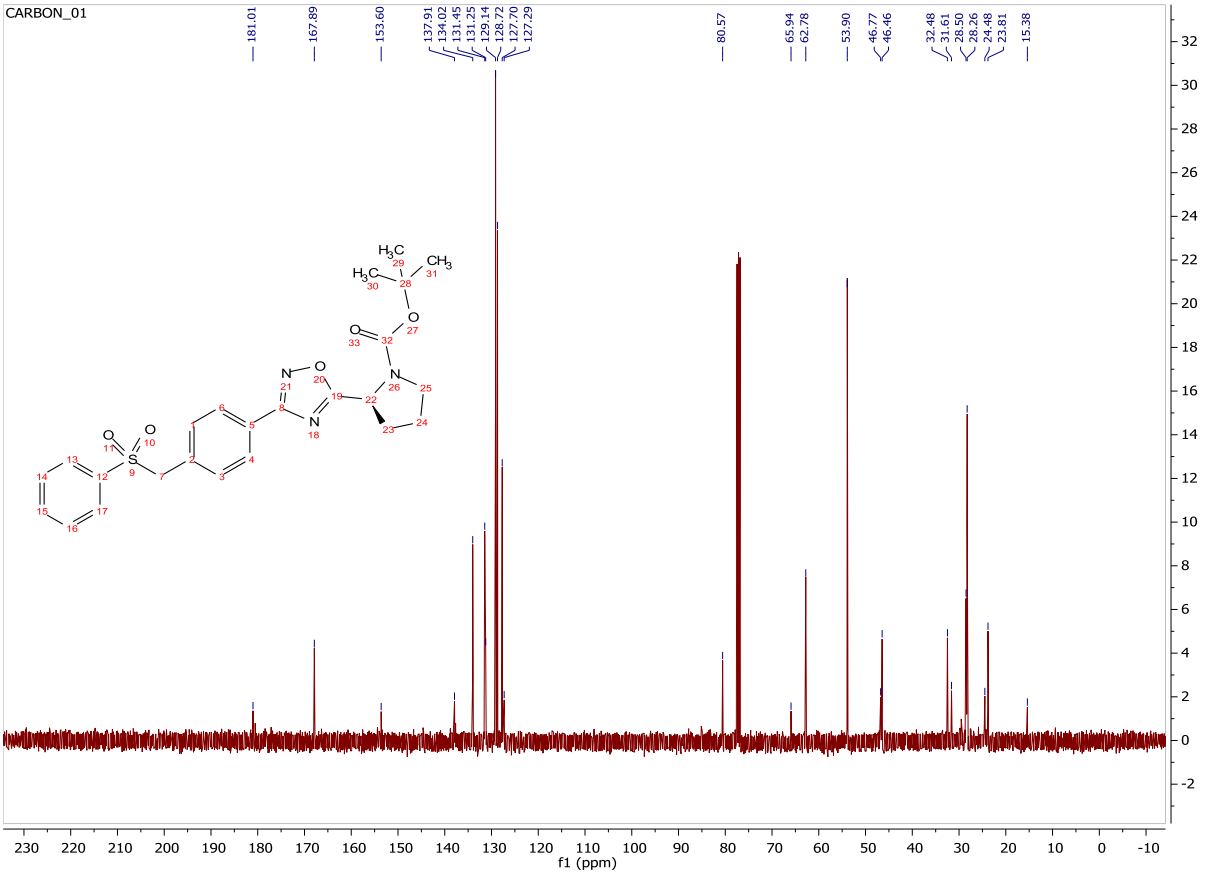
^{13}C-NMR Spectrum for Compound 2.28



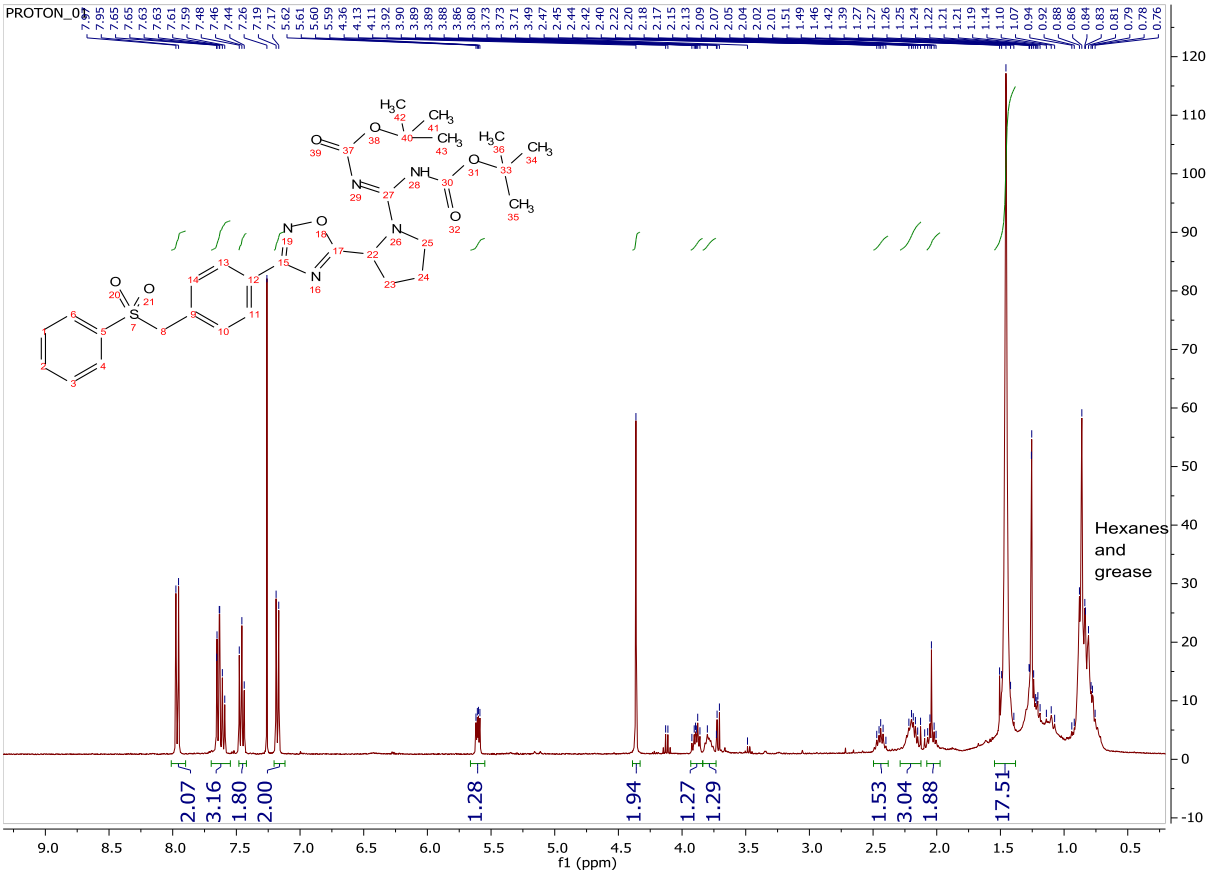
^{1}H-NMR Spectrum for Compound 2.29



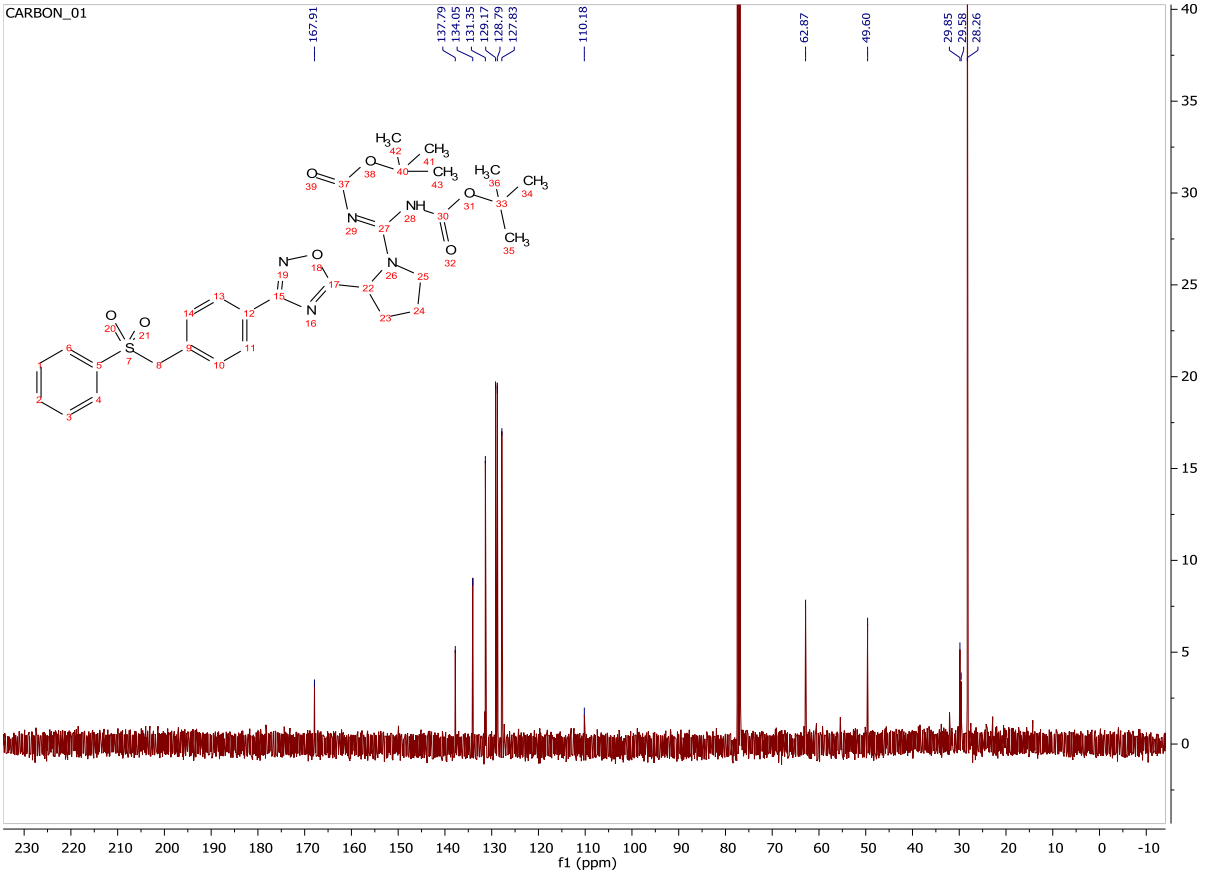
^{13}C-NMR Spectrum for Compound 2.29



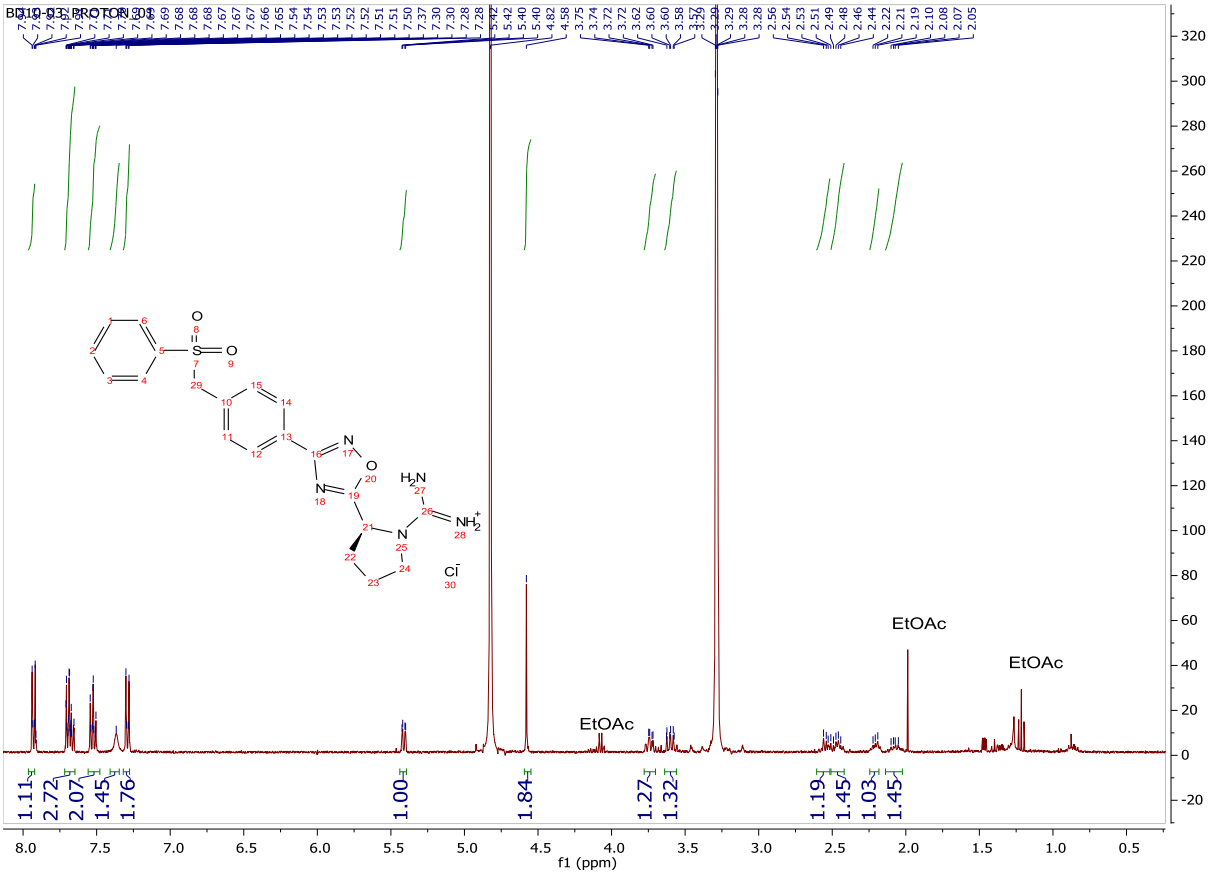
^{1}H-NMR Spectrum for Compound 2.31



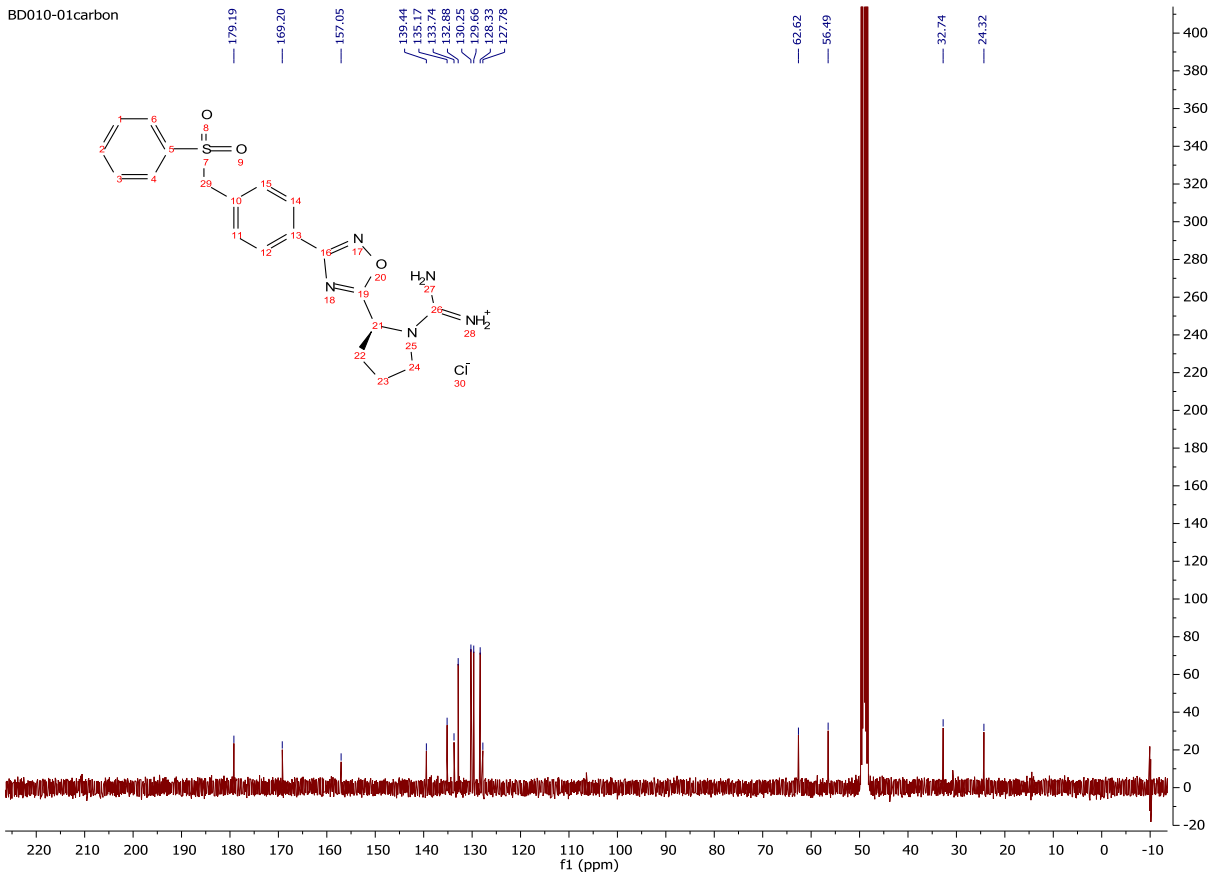
^{13}C-NMR Spectrum for Compound 2.31



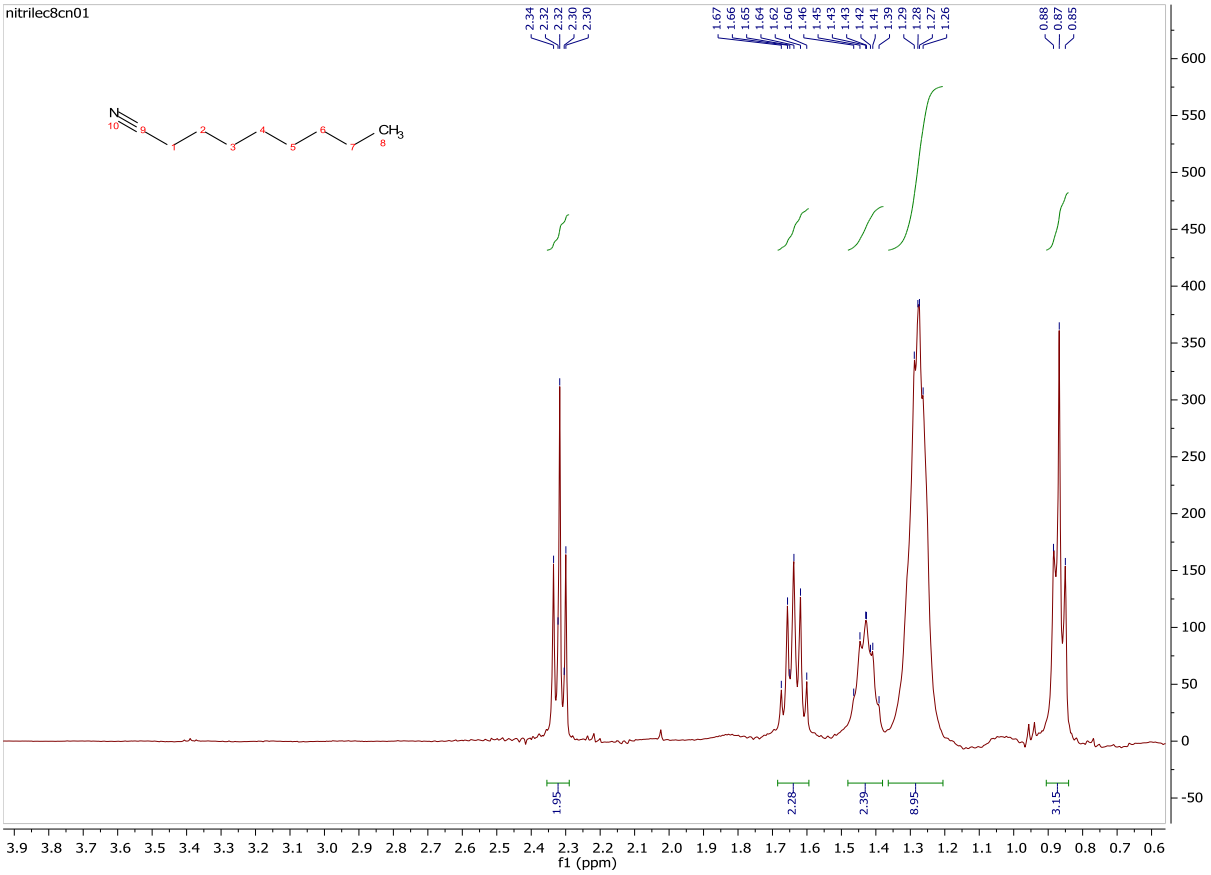
^{1}H-NMR Spectrum for Compound 2.32



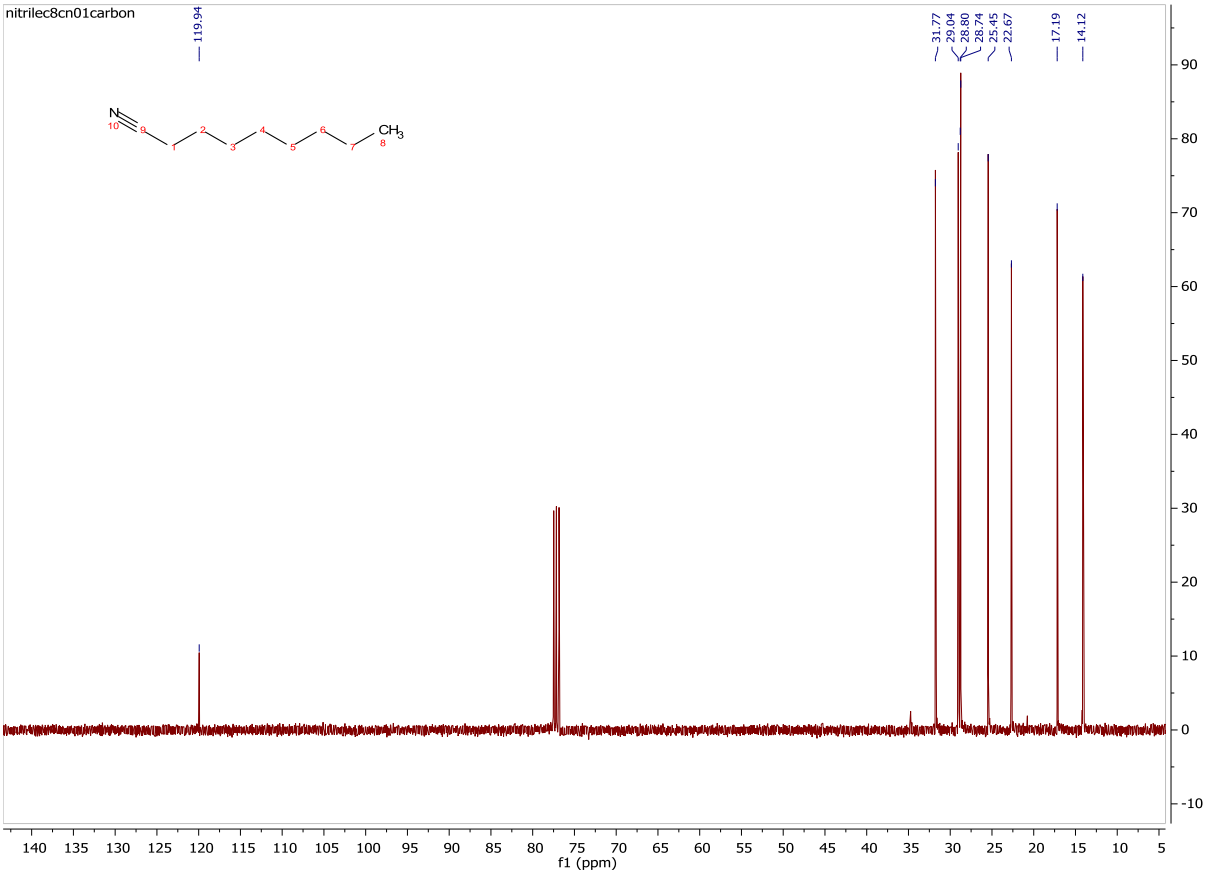
^{13}C-NMR Spectrum for Compound 2.32



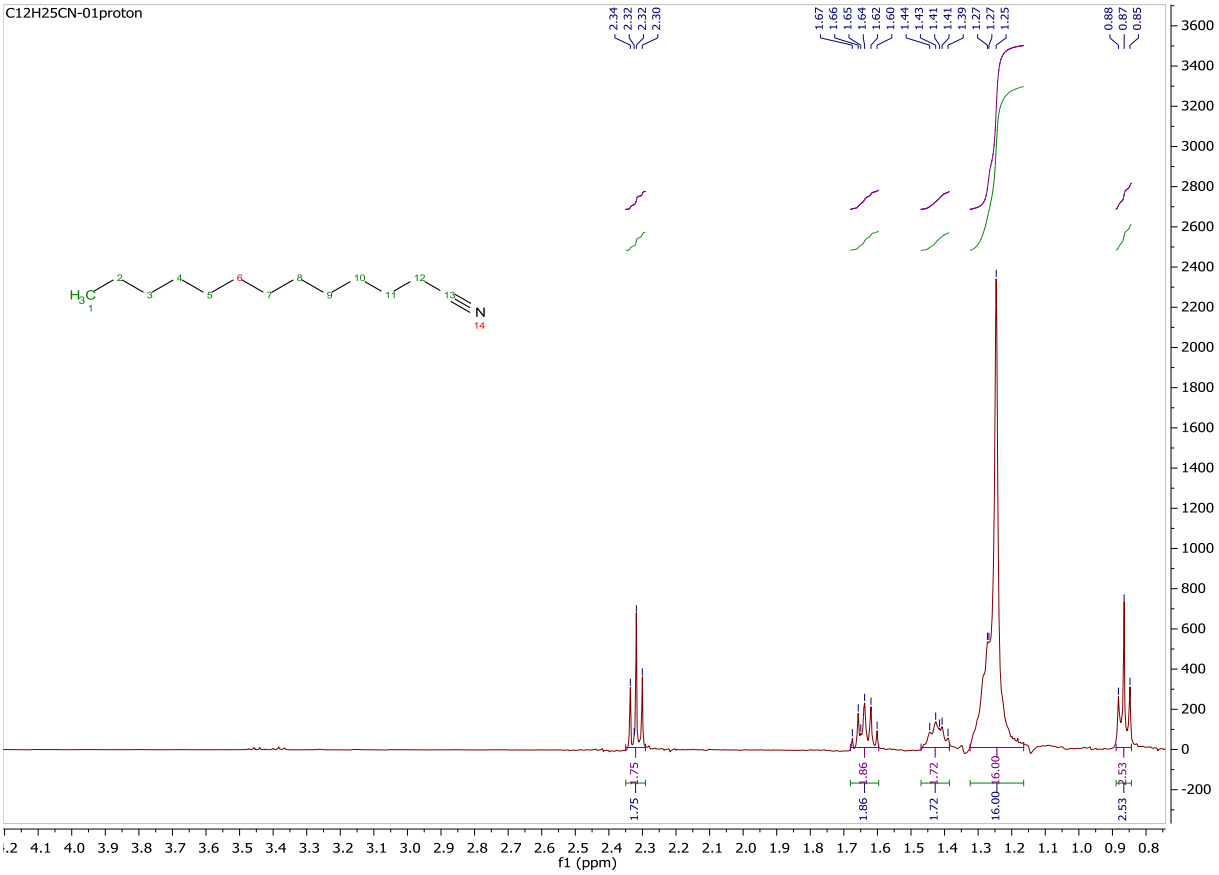
^{1}H-NMR Spectrum for Compound 2.34a



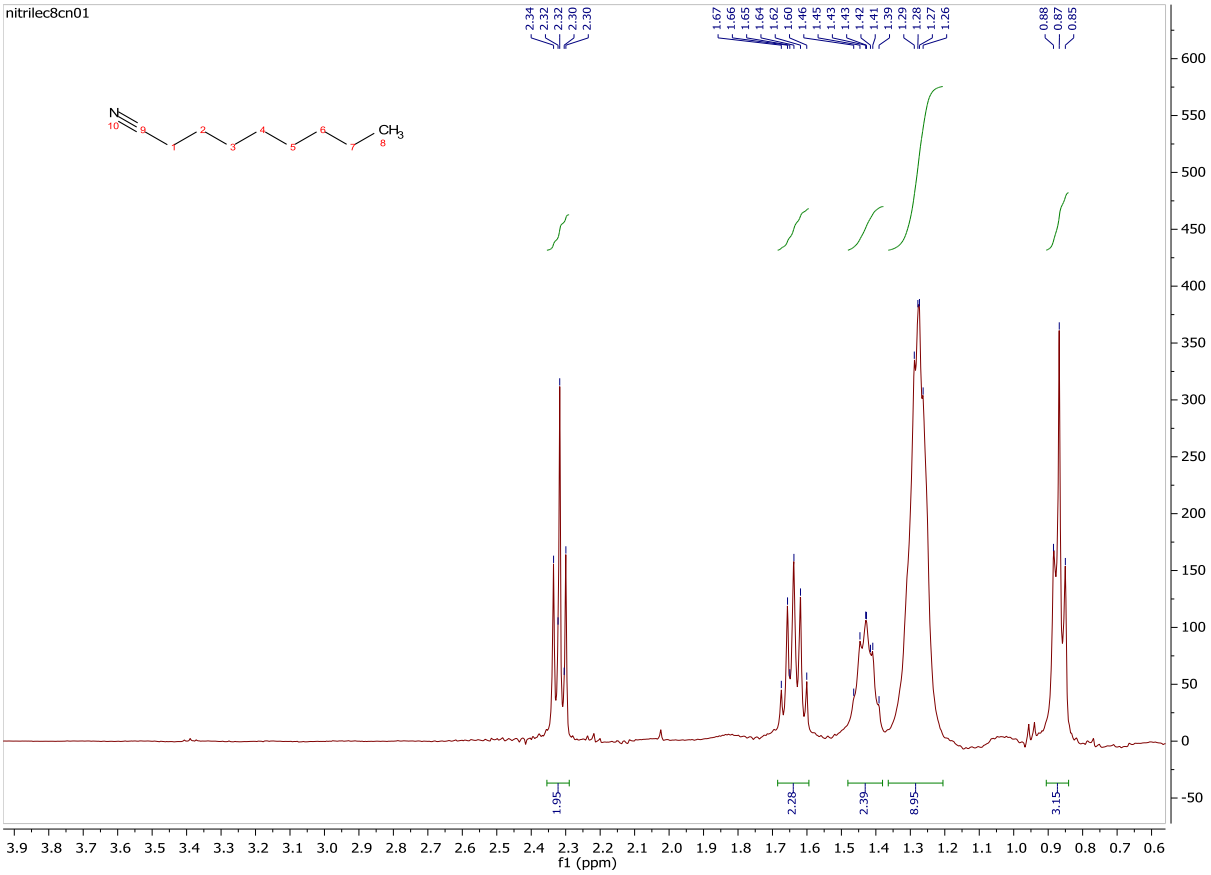
^{13}C-NMR Spectrum for Compound 2.34a



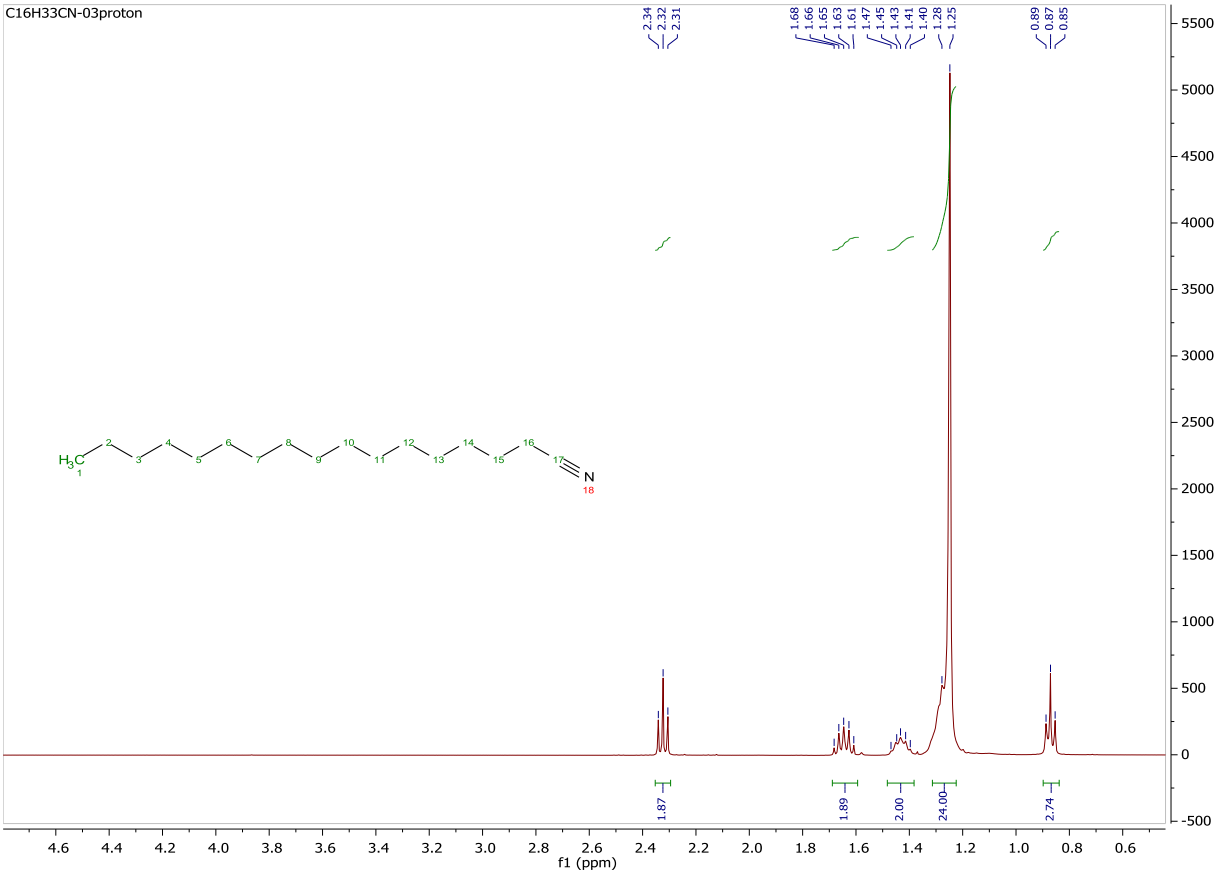
^{1}H-NMR Spectrum for Compound 2.34b



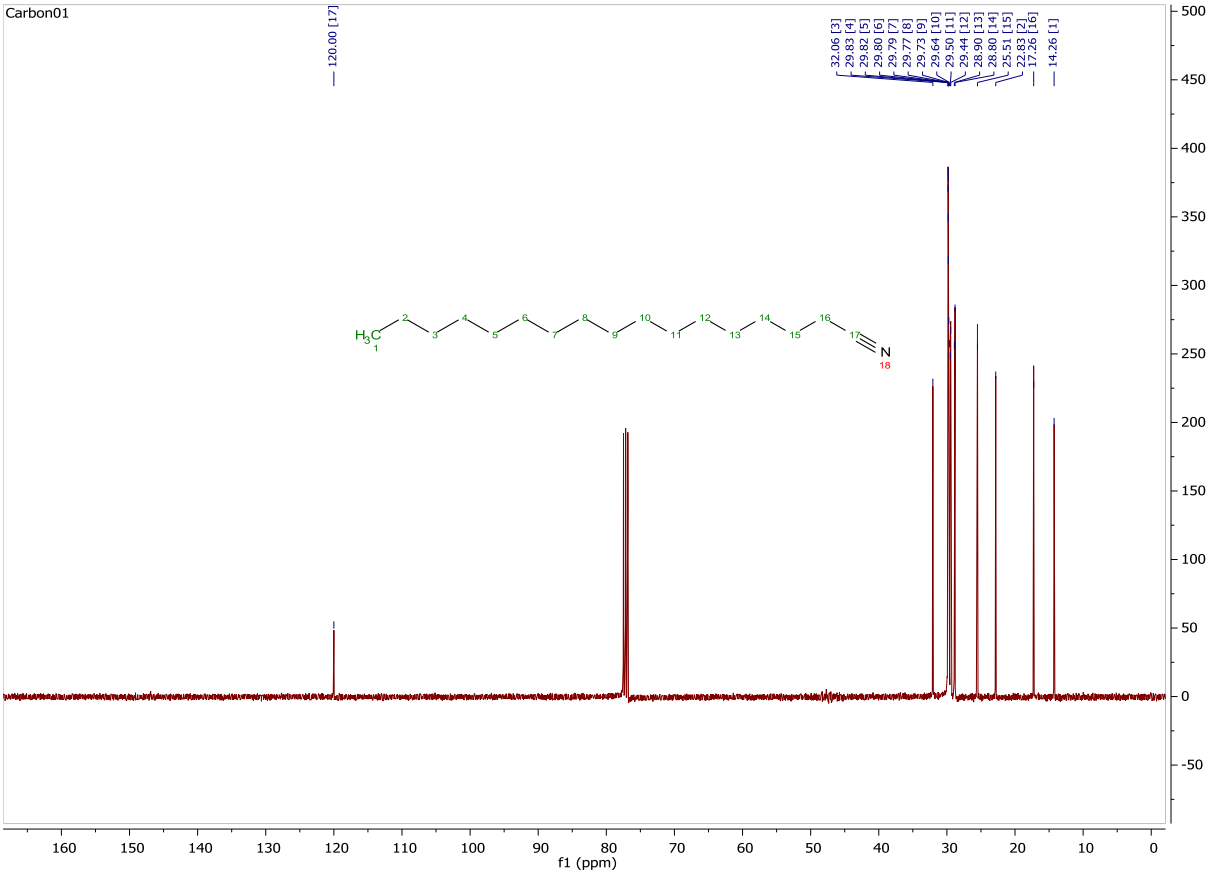
^{13}C-NMR Spectrum for Compound 2.34b



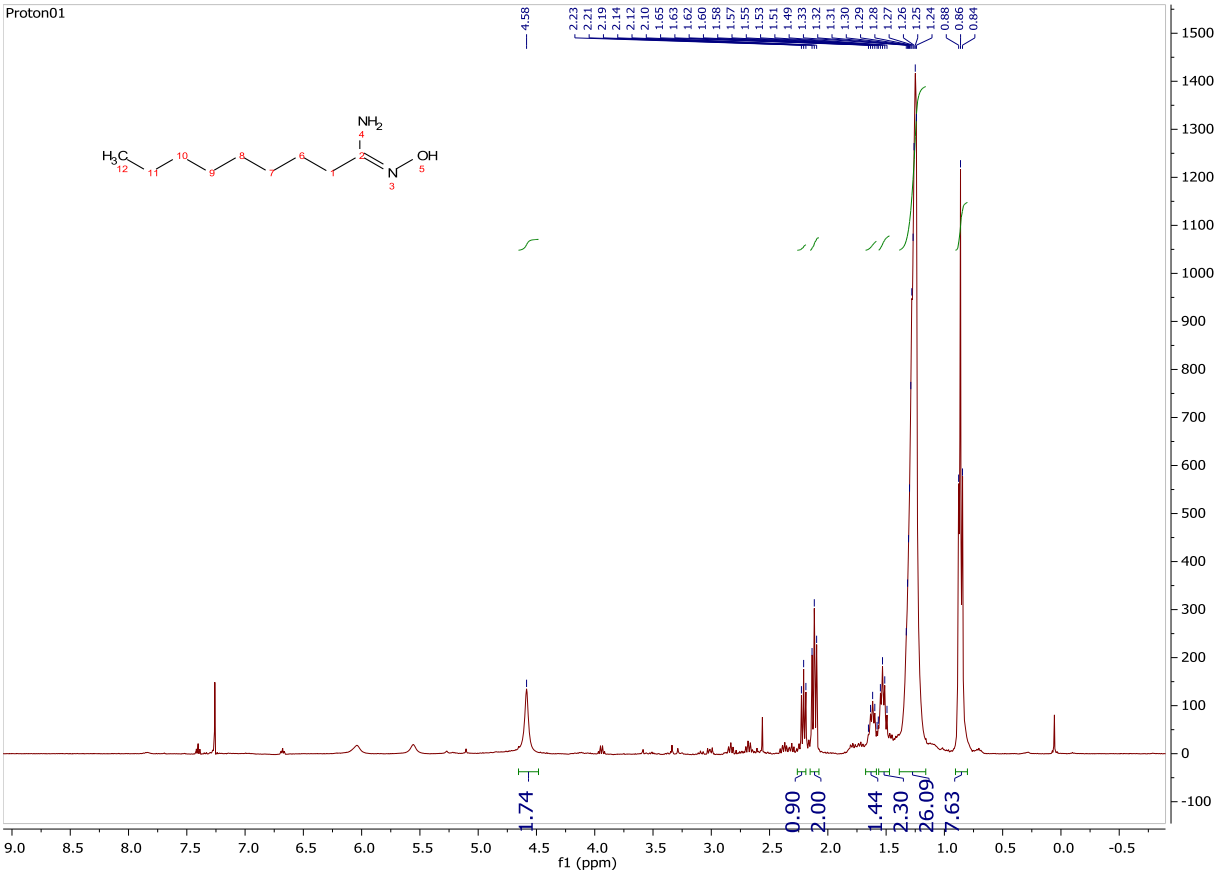
^{1}H-NMR Spectrum for Compound 2.34c



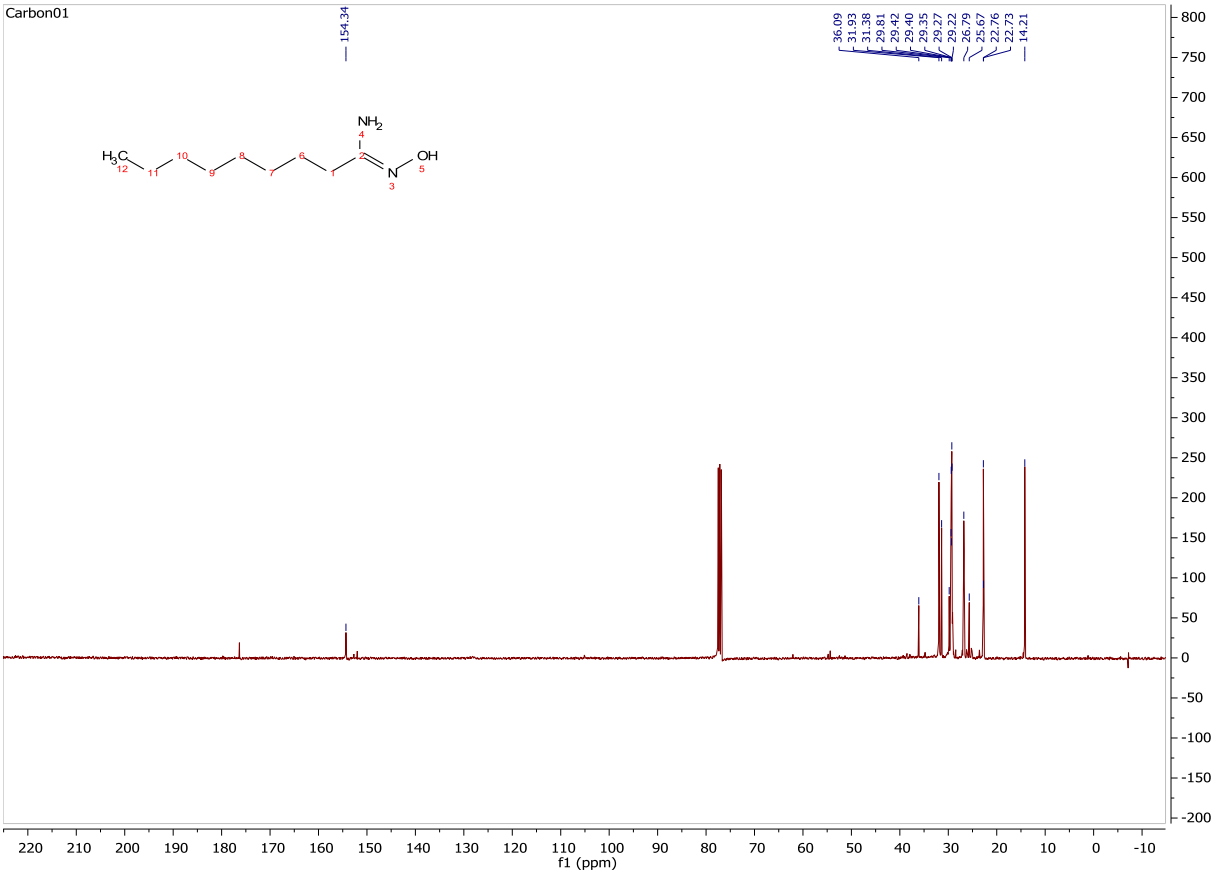
^{13}C-NMR Spectrum for Compound 2.34c



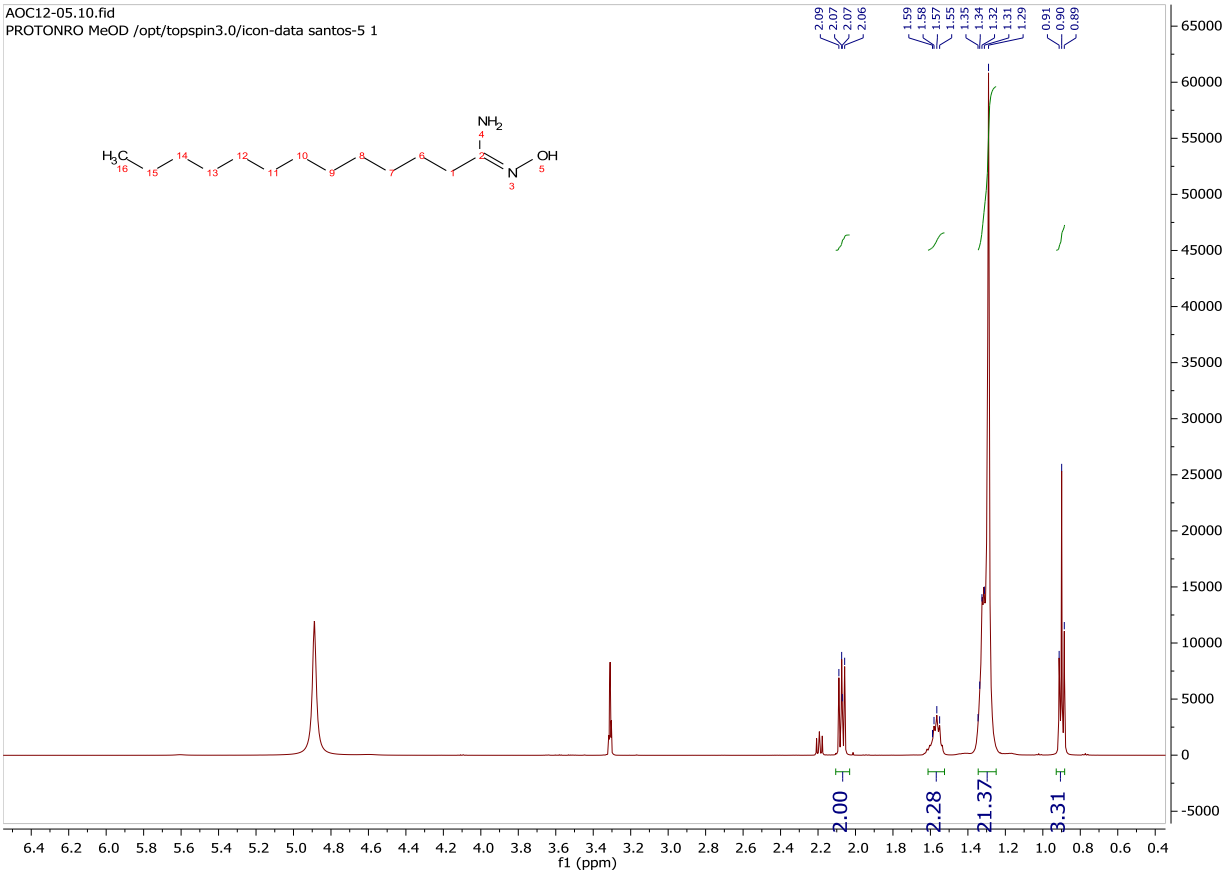
^{1}H-NMR Spectrum for Compound 2.35a



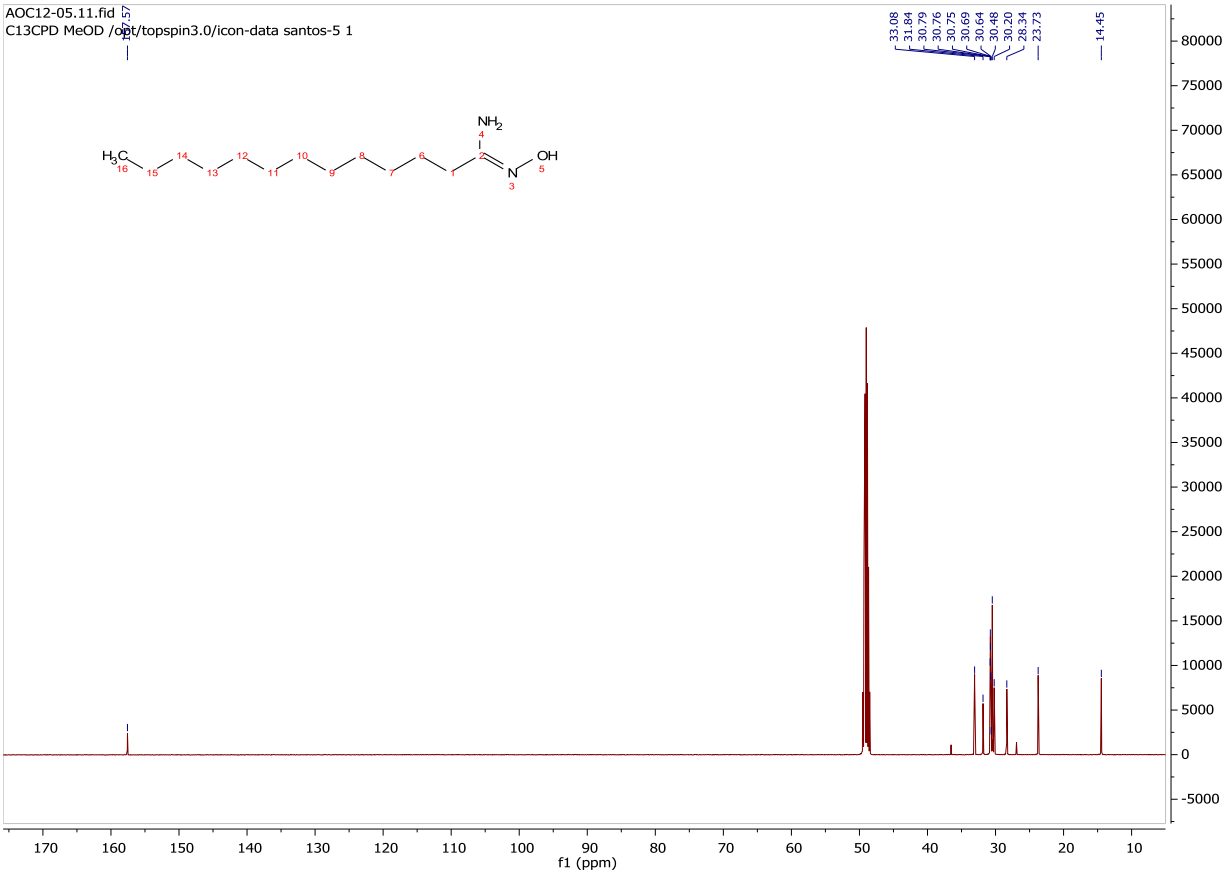
^{13}C-NMR Spectrum for Compound 2.35a



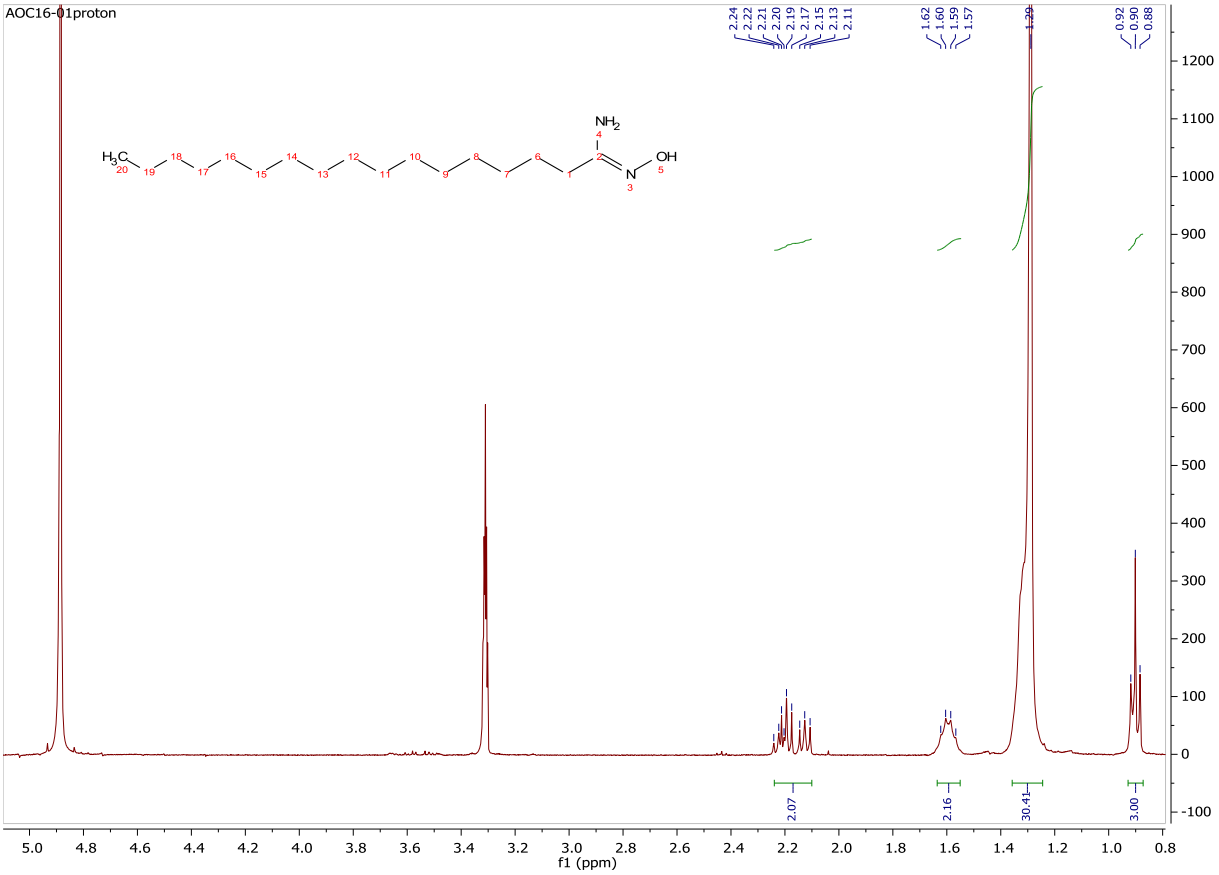
^{1}H-NMR Spectrum for Compound 2.35b



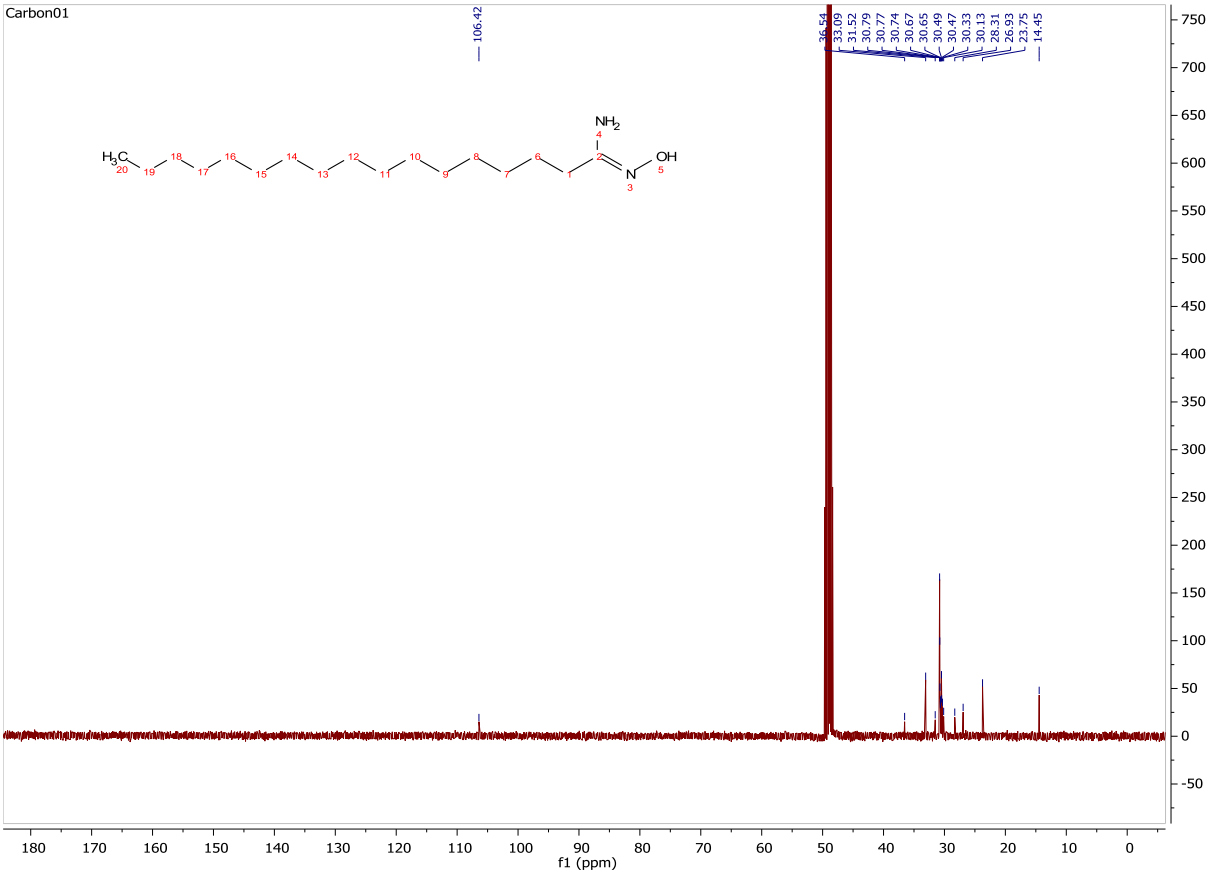
^{13}C-NMR Spectrum for Compound 2.35b



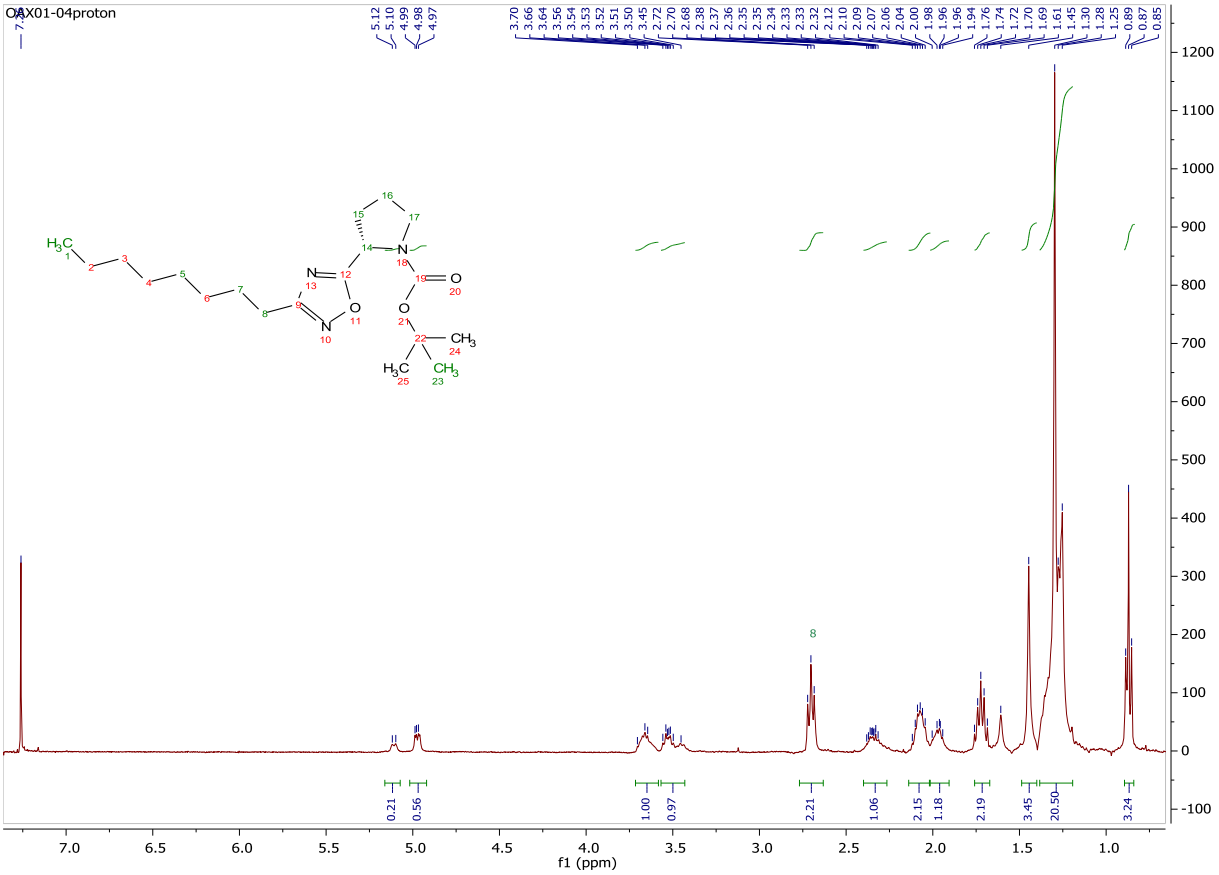
^{1}H-NMR Spectrum for Compound 2.35c



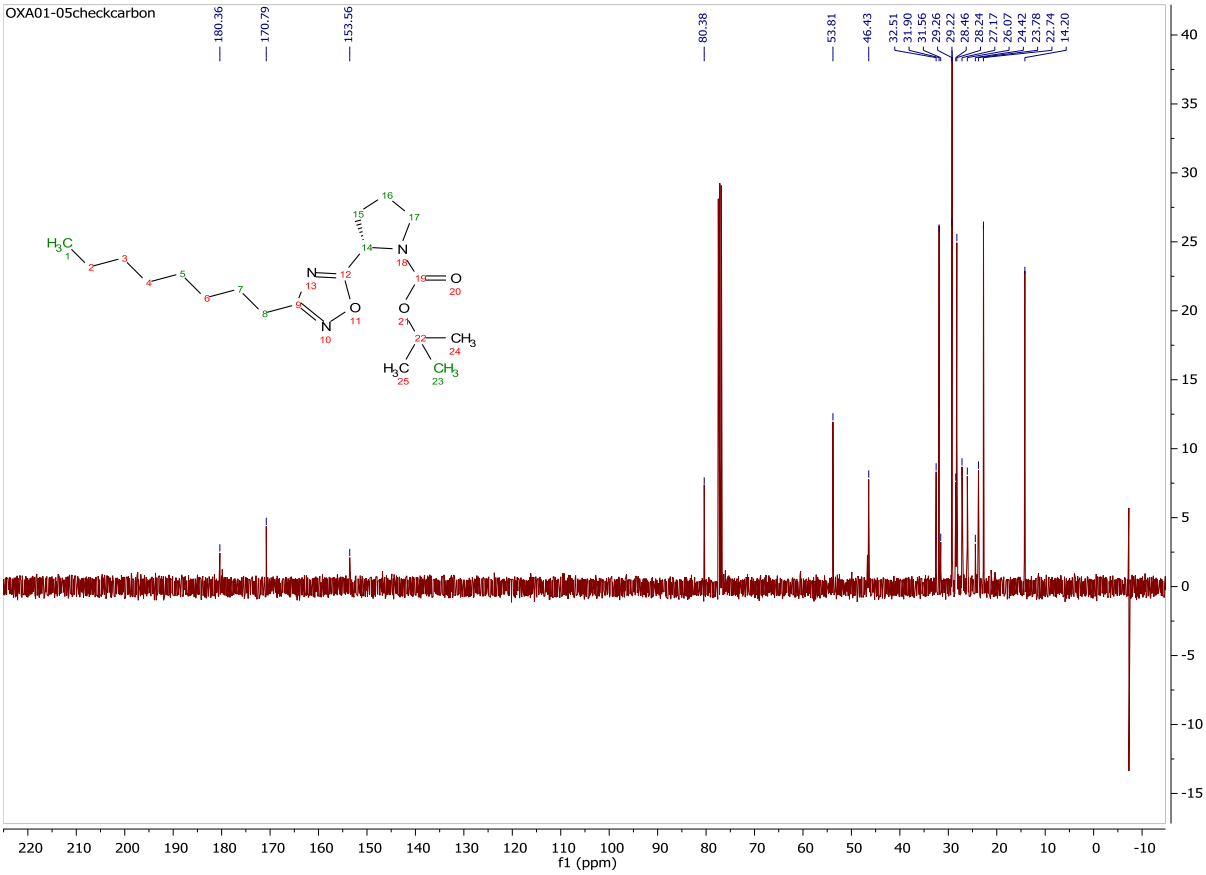
^{13}C-NMR Spectrum for Compound 2.35c



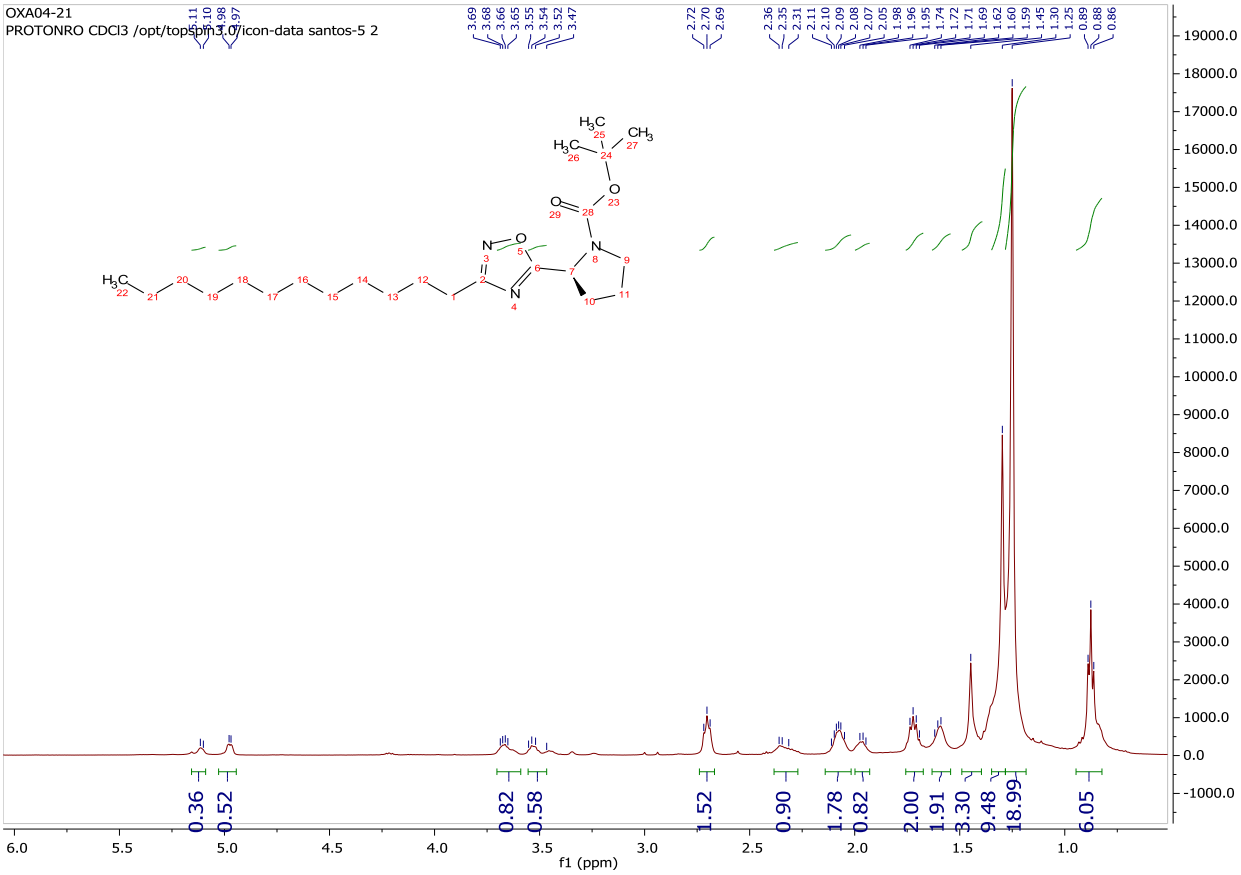
^{1}H-NMR Spectrum for Compound 2.36a



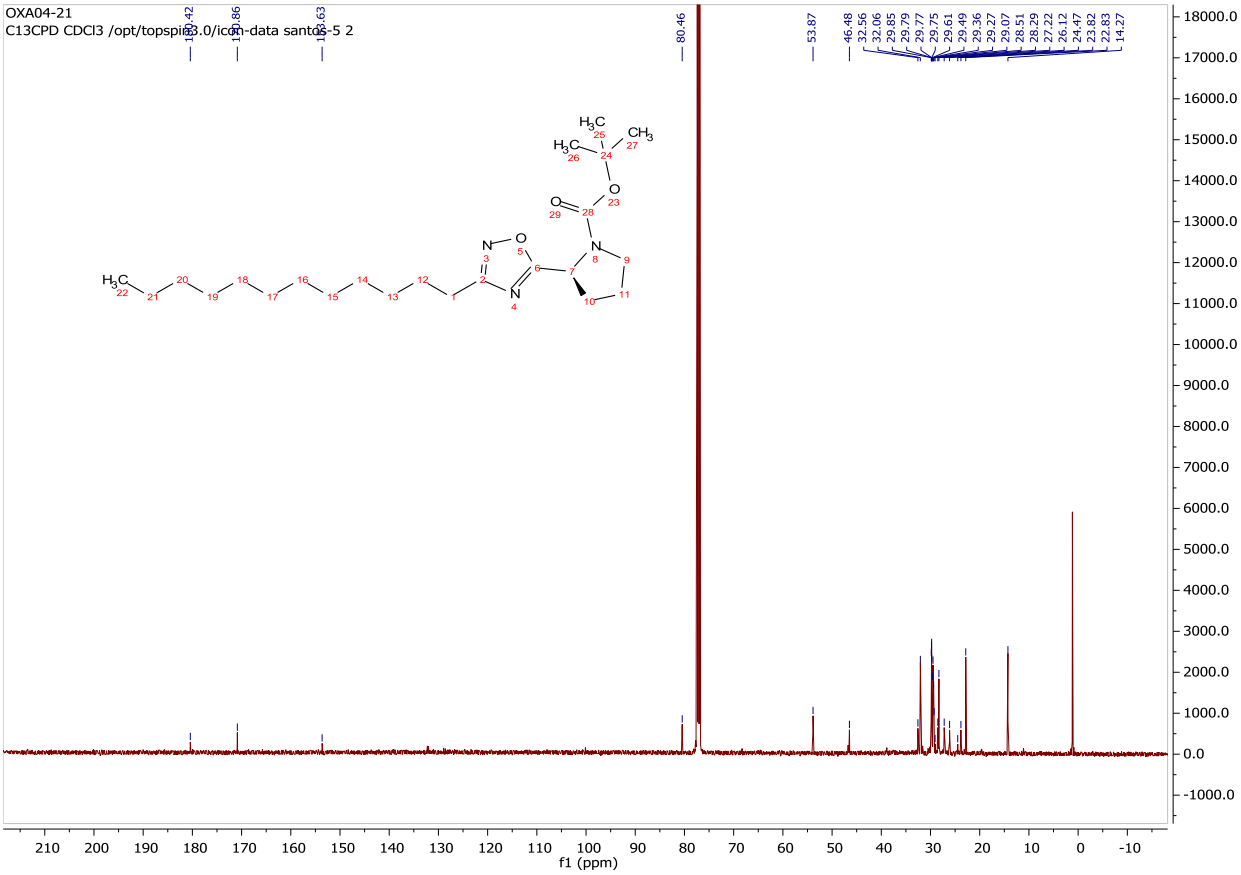
^{13}C-NMR Spectrum for Compound 2.36a



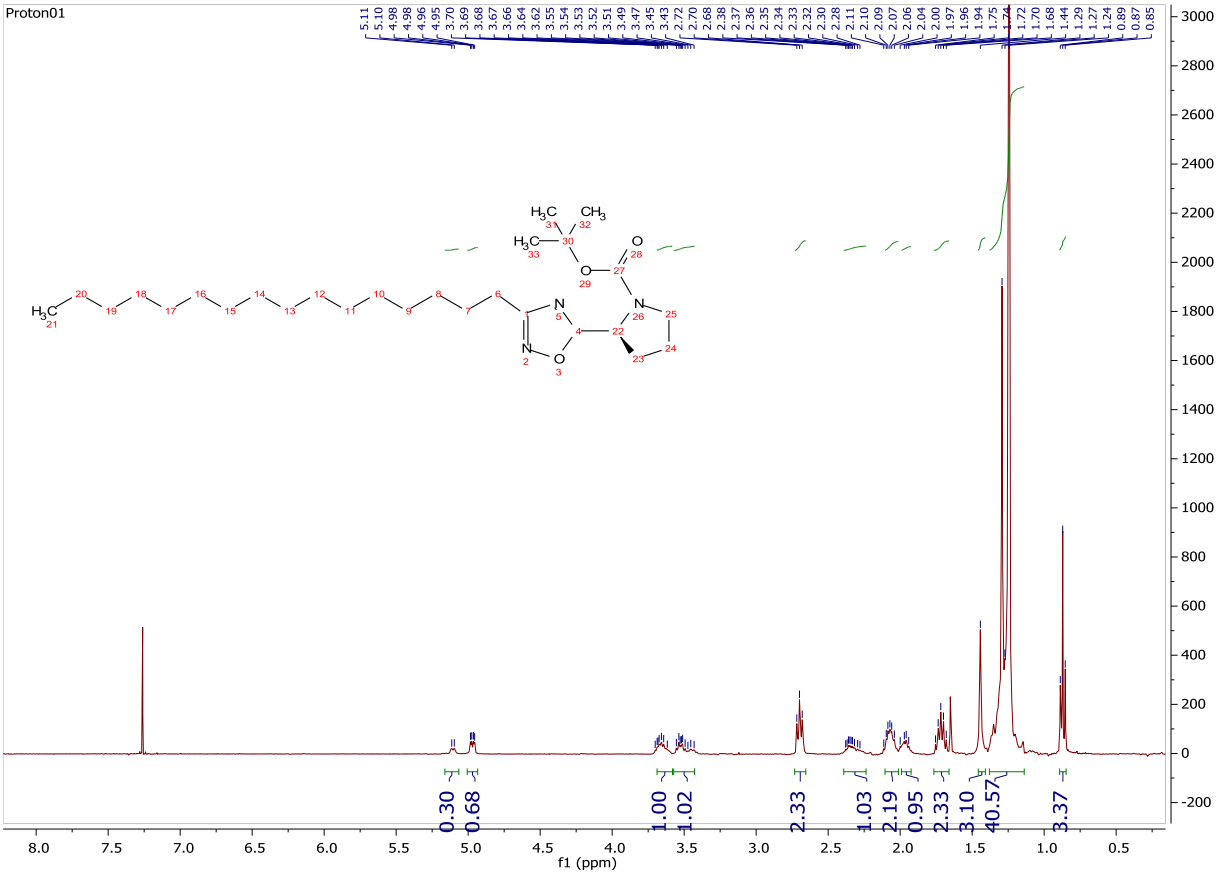
^{1}H-NMR Spectrum for Compound 2.36b



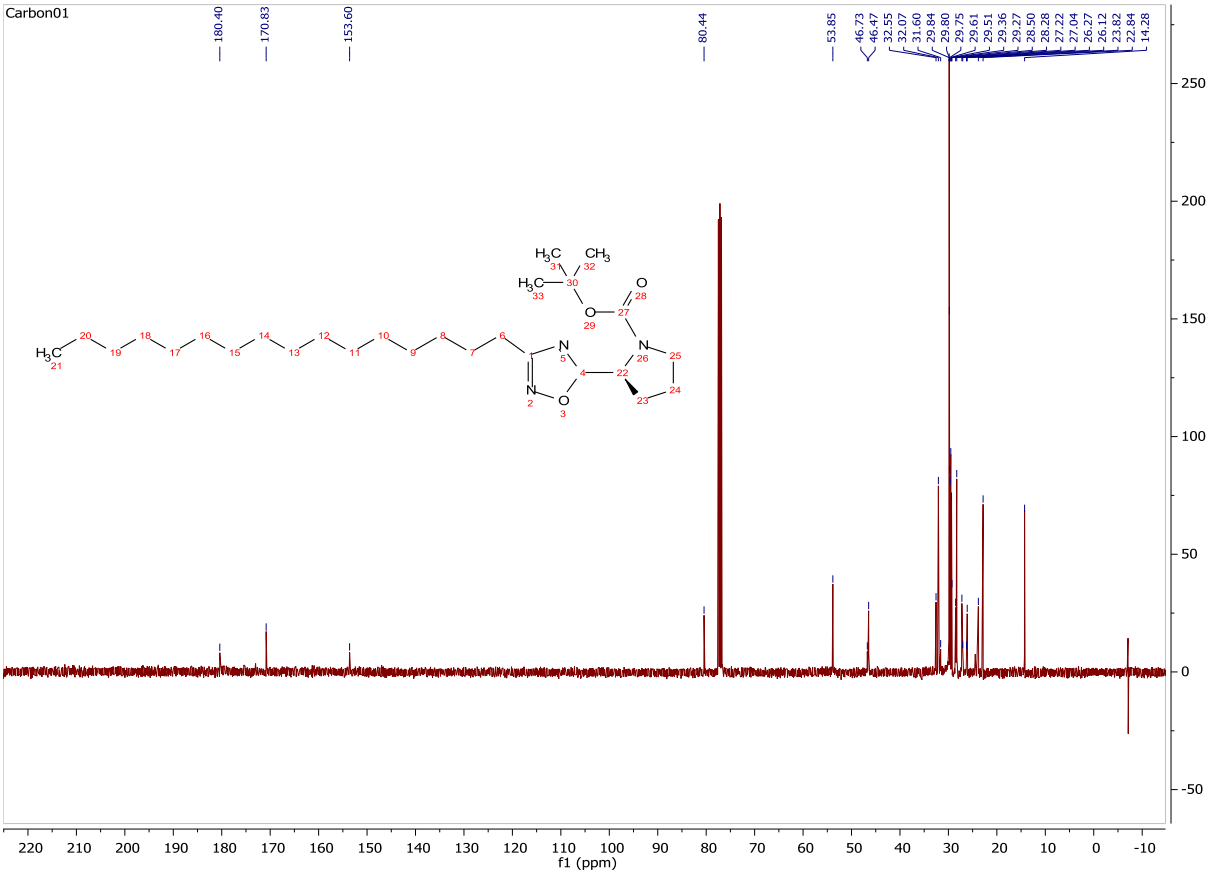
^{13}C-NMR Spectrum for Compound 2.36b



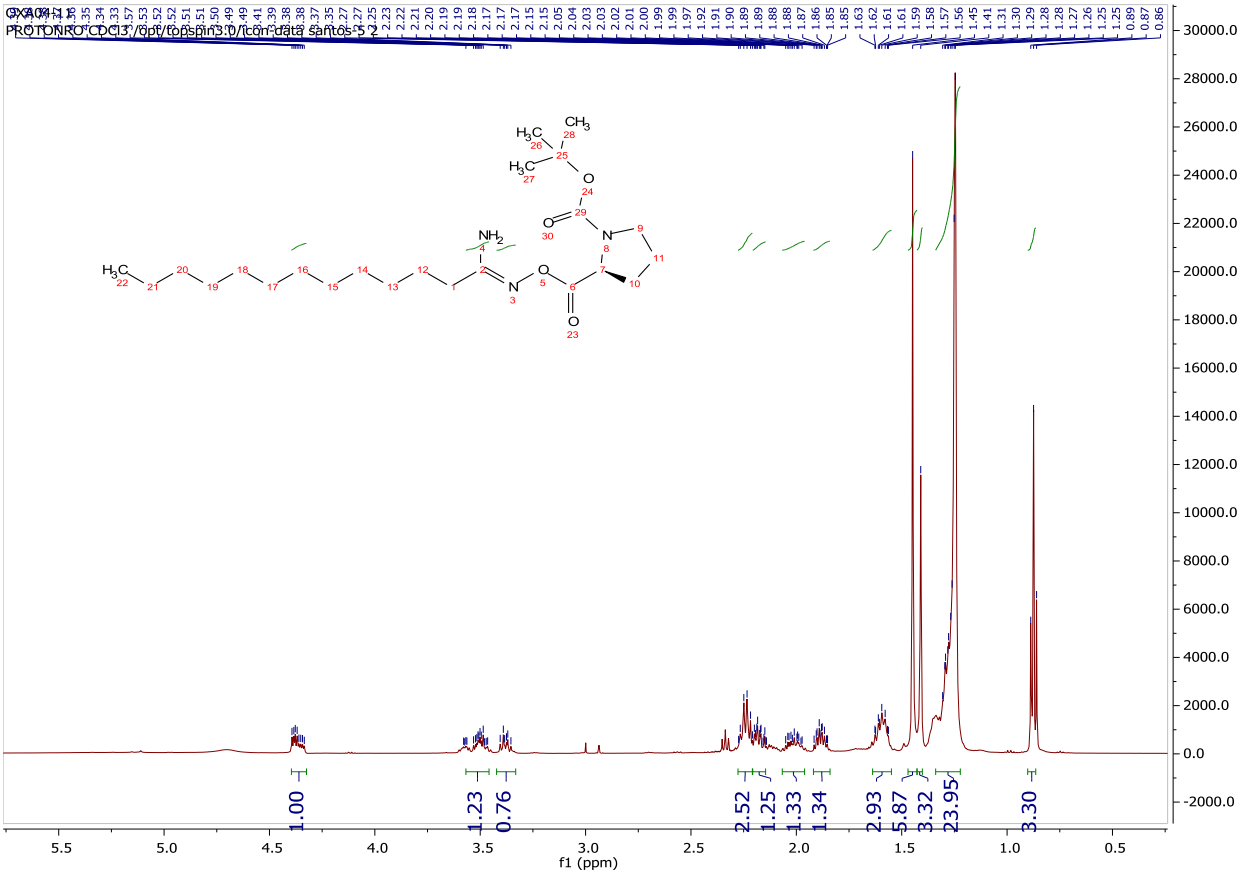
^{1}H-NMR Spectrum for Compound 2.36c



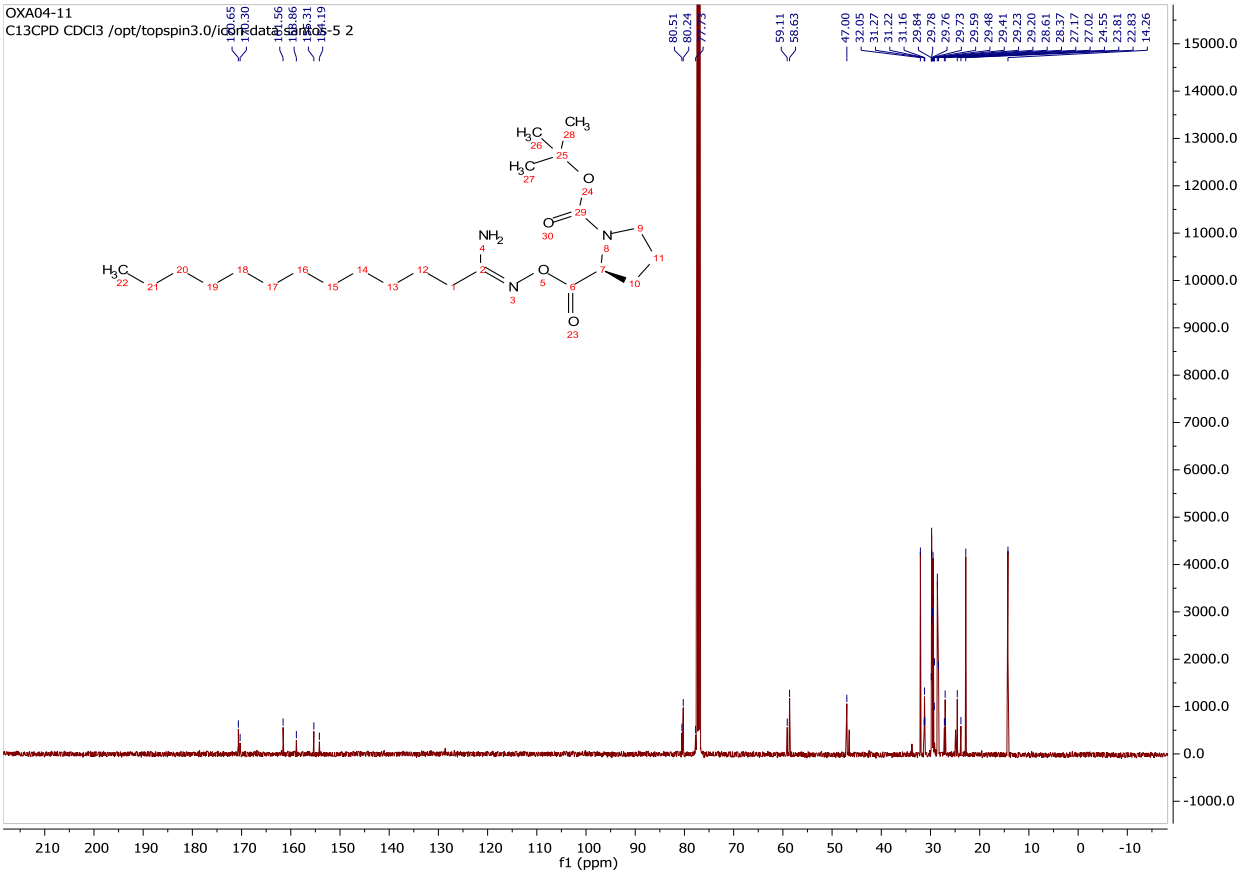
^{13}C-NMR Spectrum for Compound 2.36c



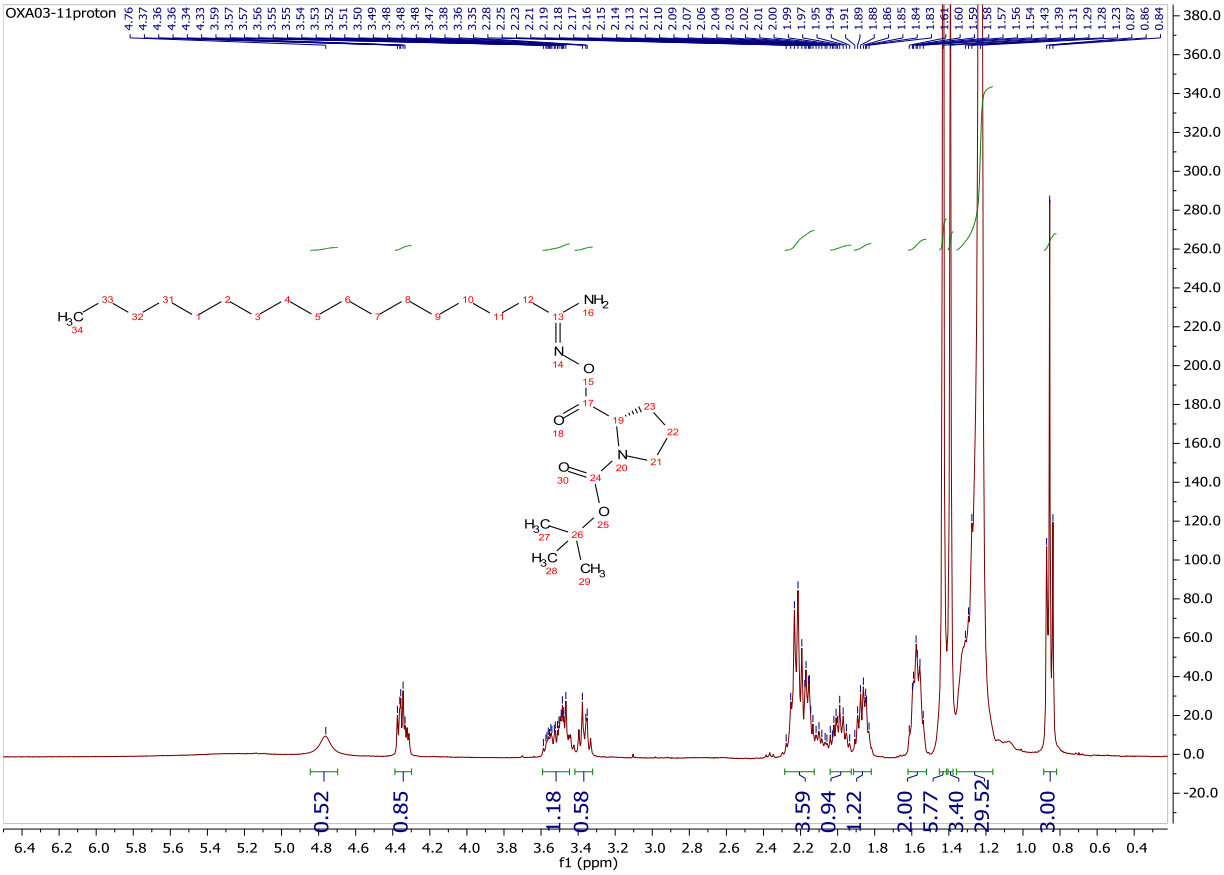
^{1}H-NMR Spectrum for Compound 2.37b



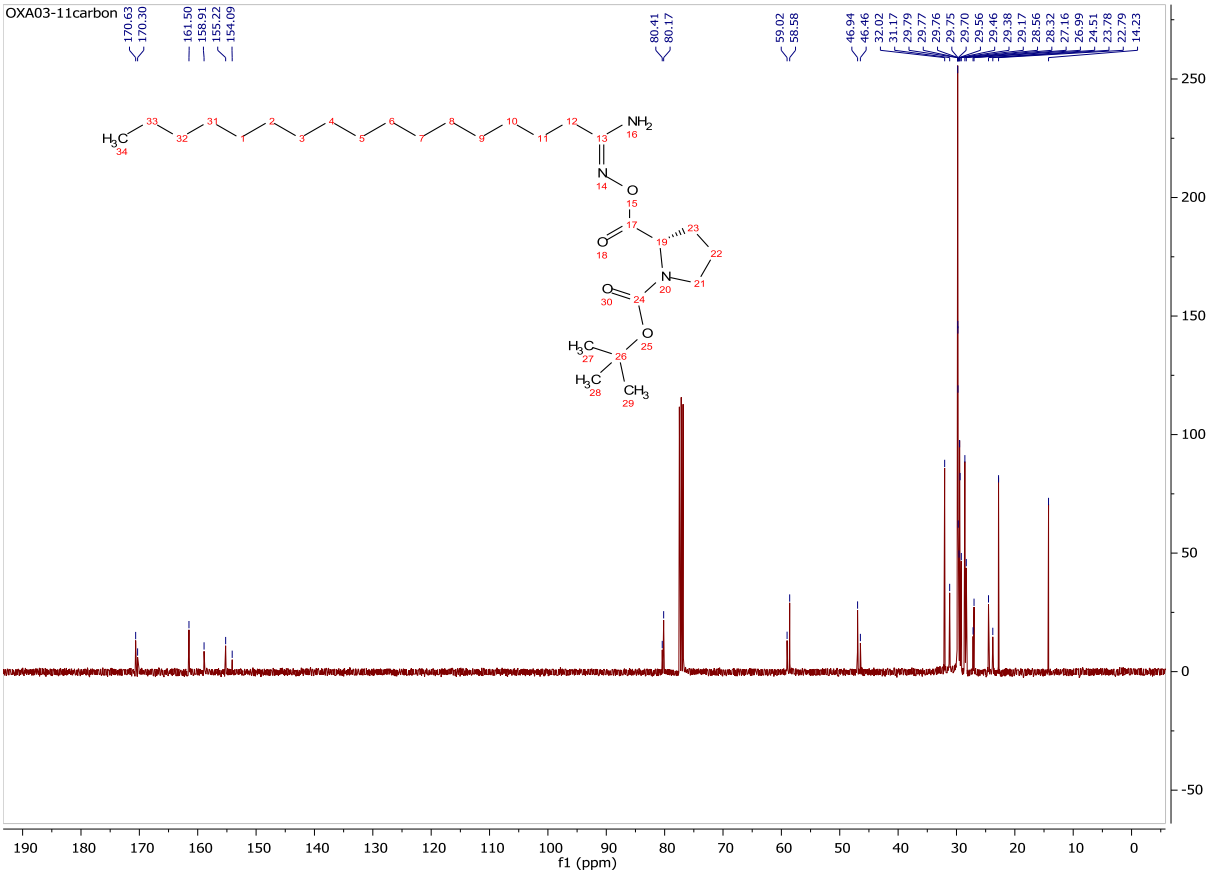
^{13}C-NMR Spectrum for Compound 2.37b



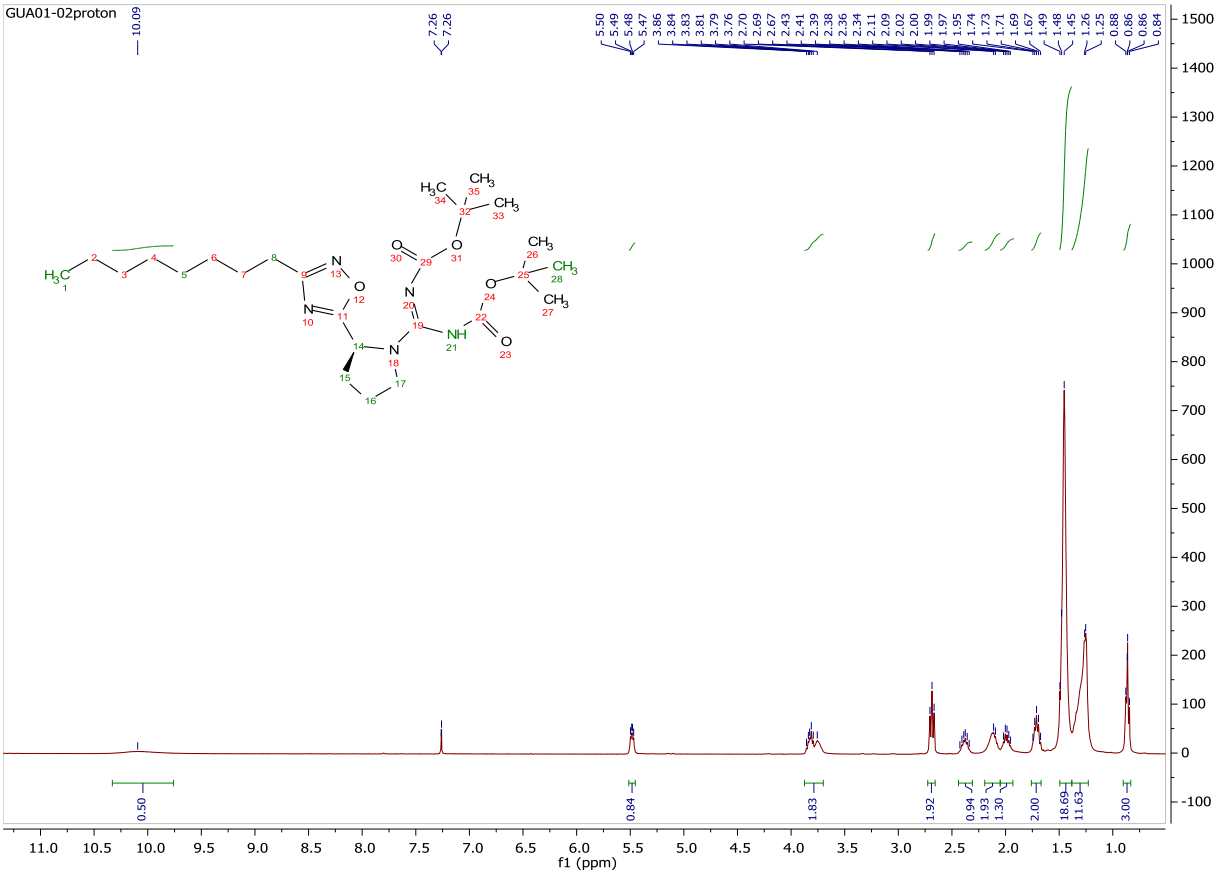
^{1}H-NMR Spectrum for Compound 2.37c



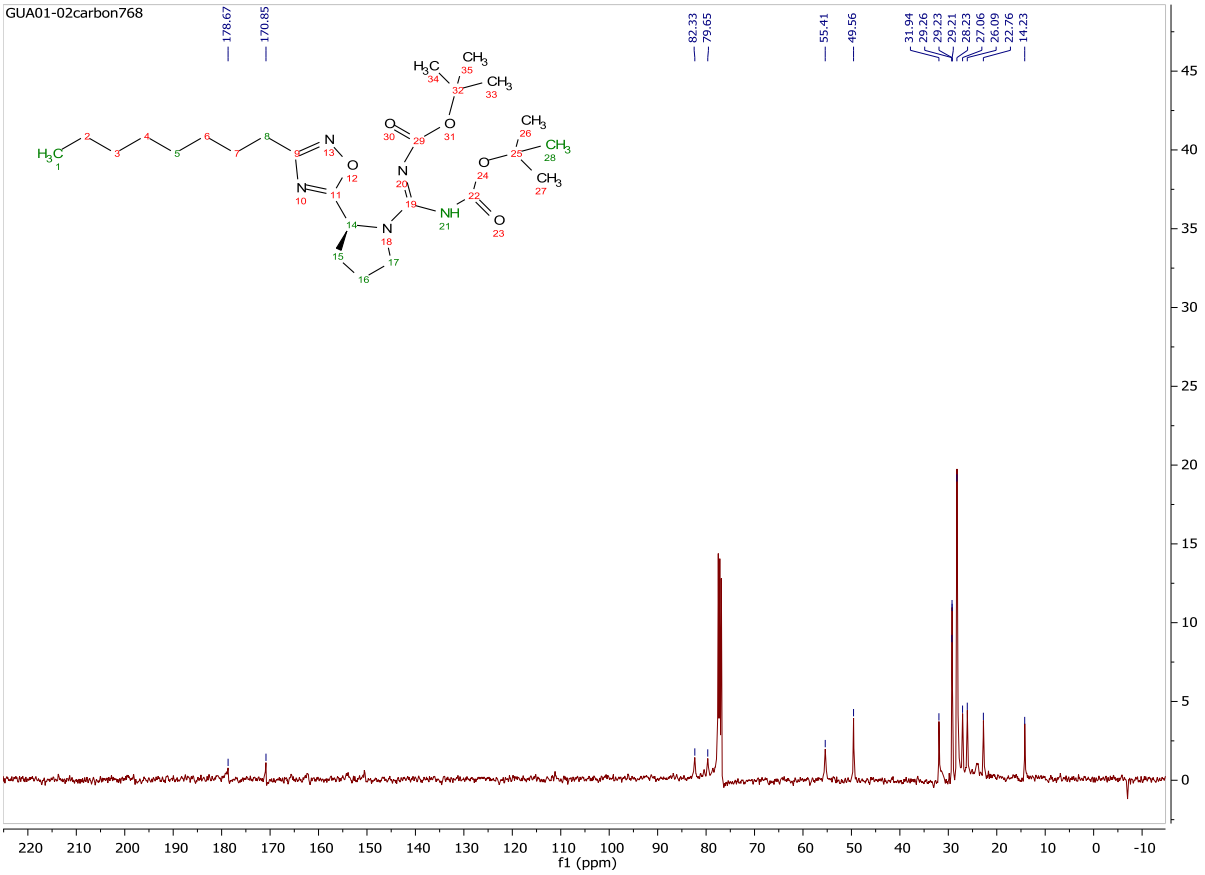
^{13}C-NMR Spectrum for Compound 2.37c



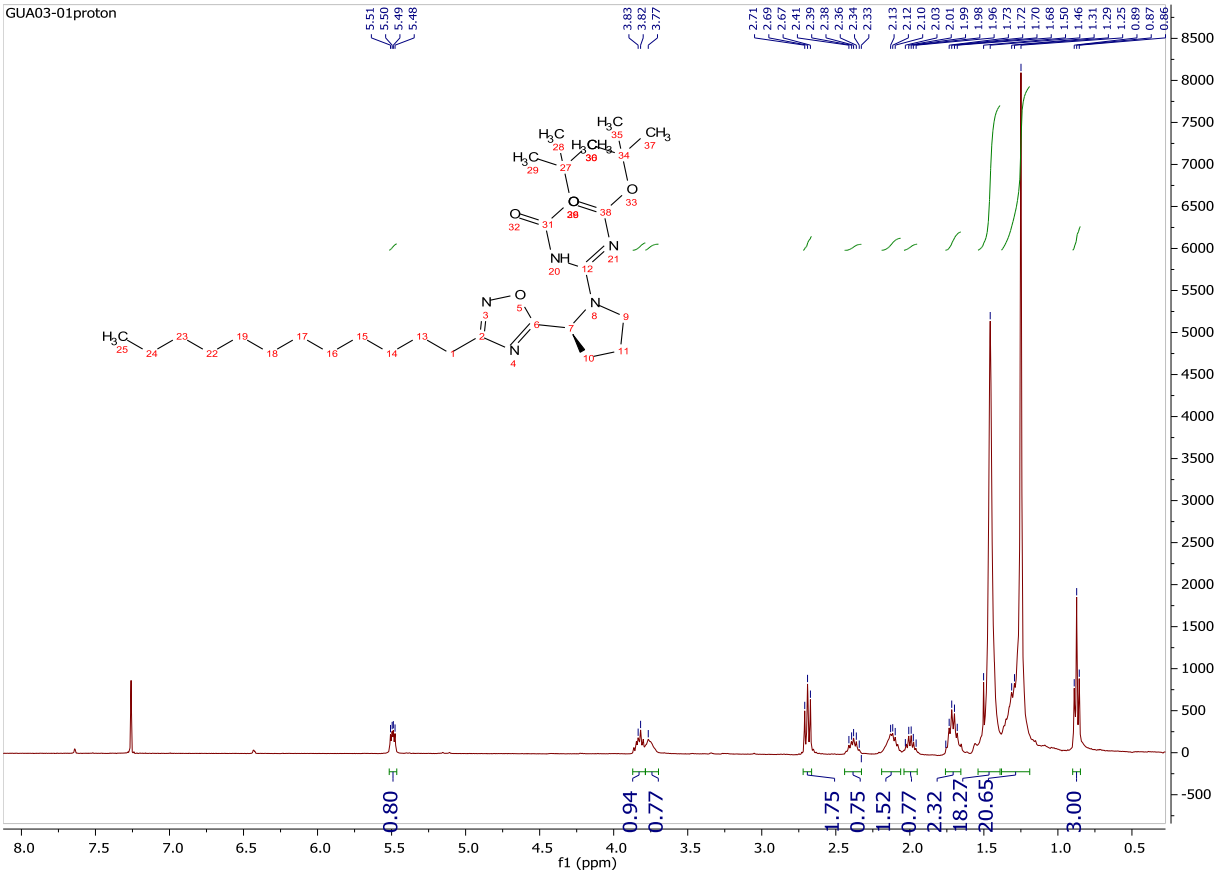
^{1}H-NMR Spectrum for Compound 2.39a



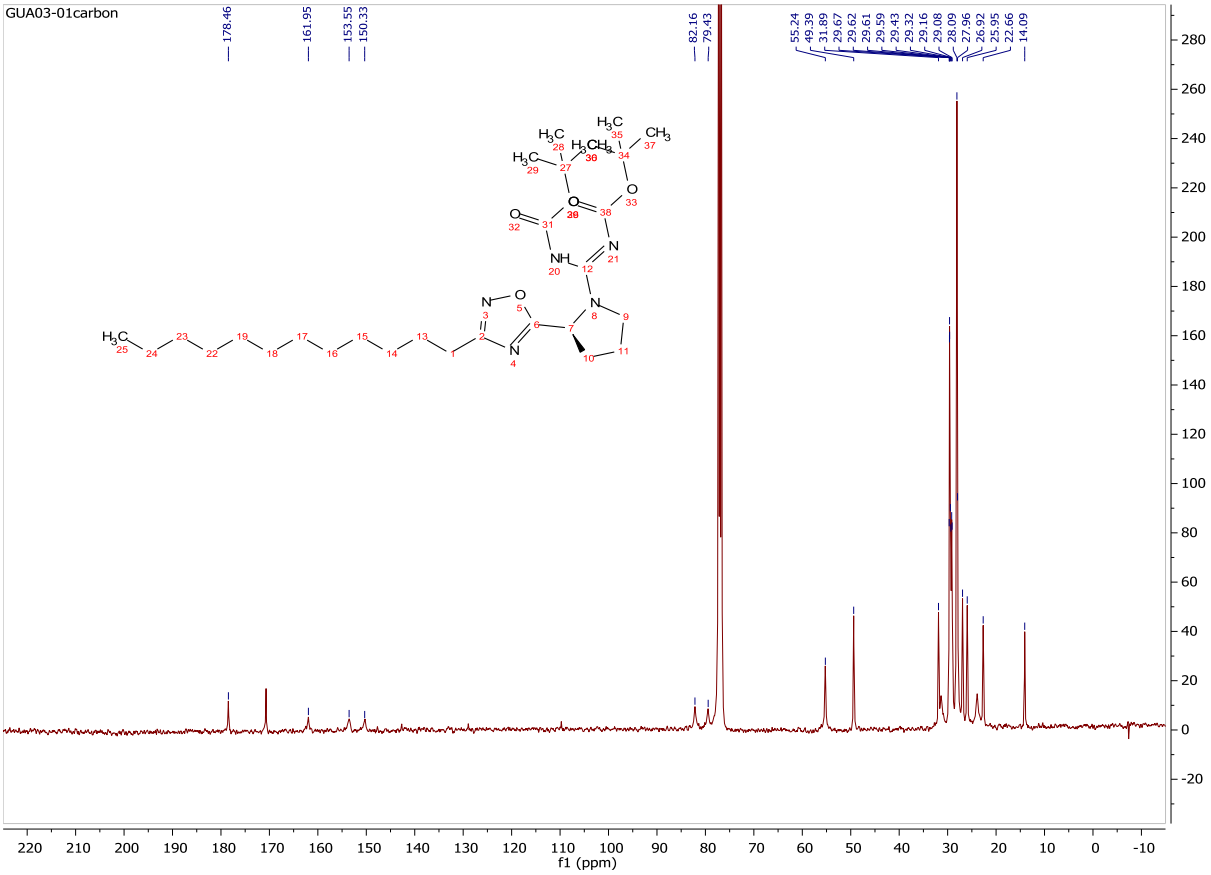
^{13}C-NMR Spectrum for Compound 2.39a



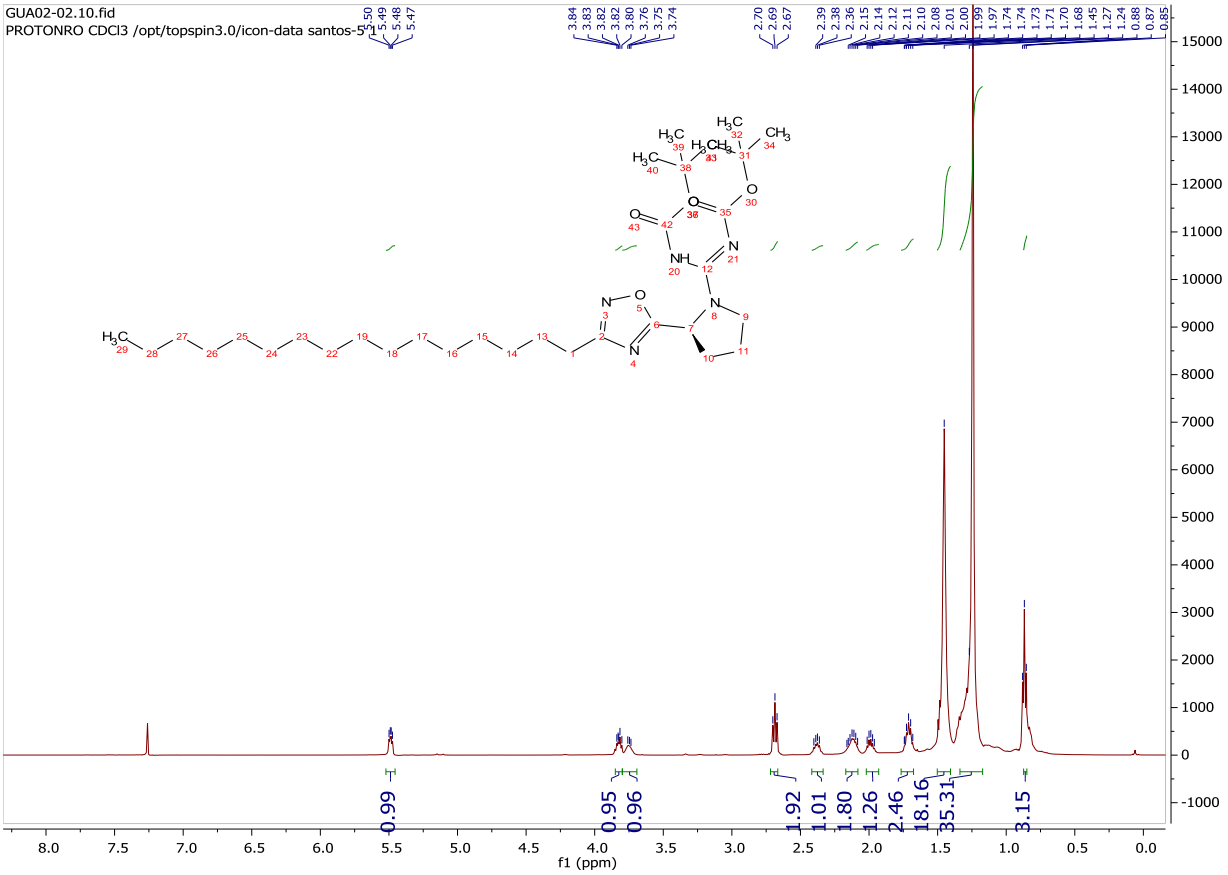
^{1}H-NMR Spectrum for Compound 2.39b



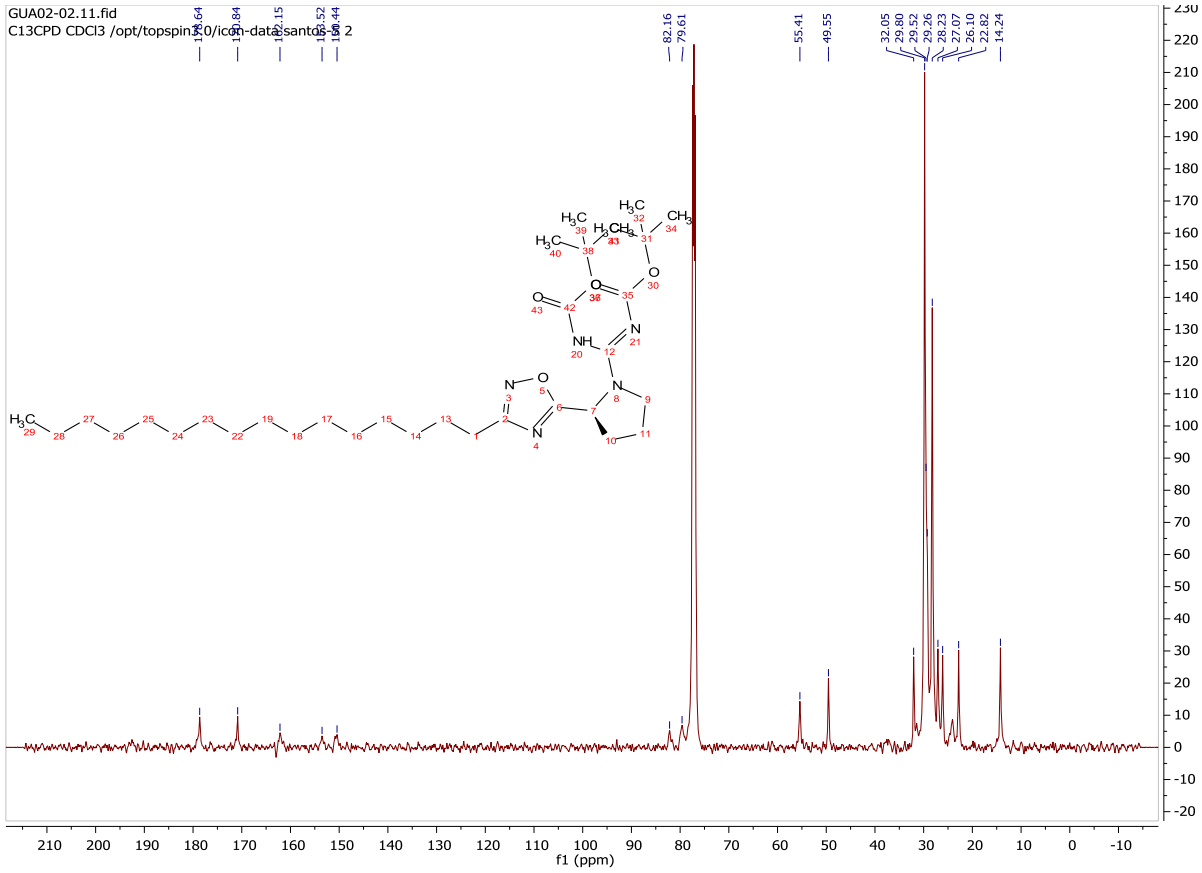
^{13}C-NMR Spectrum for Compound 2.39b



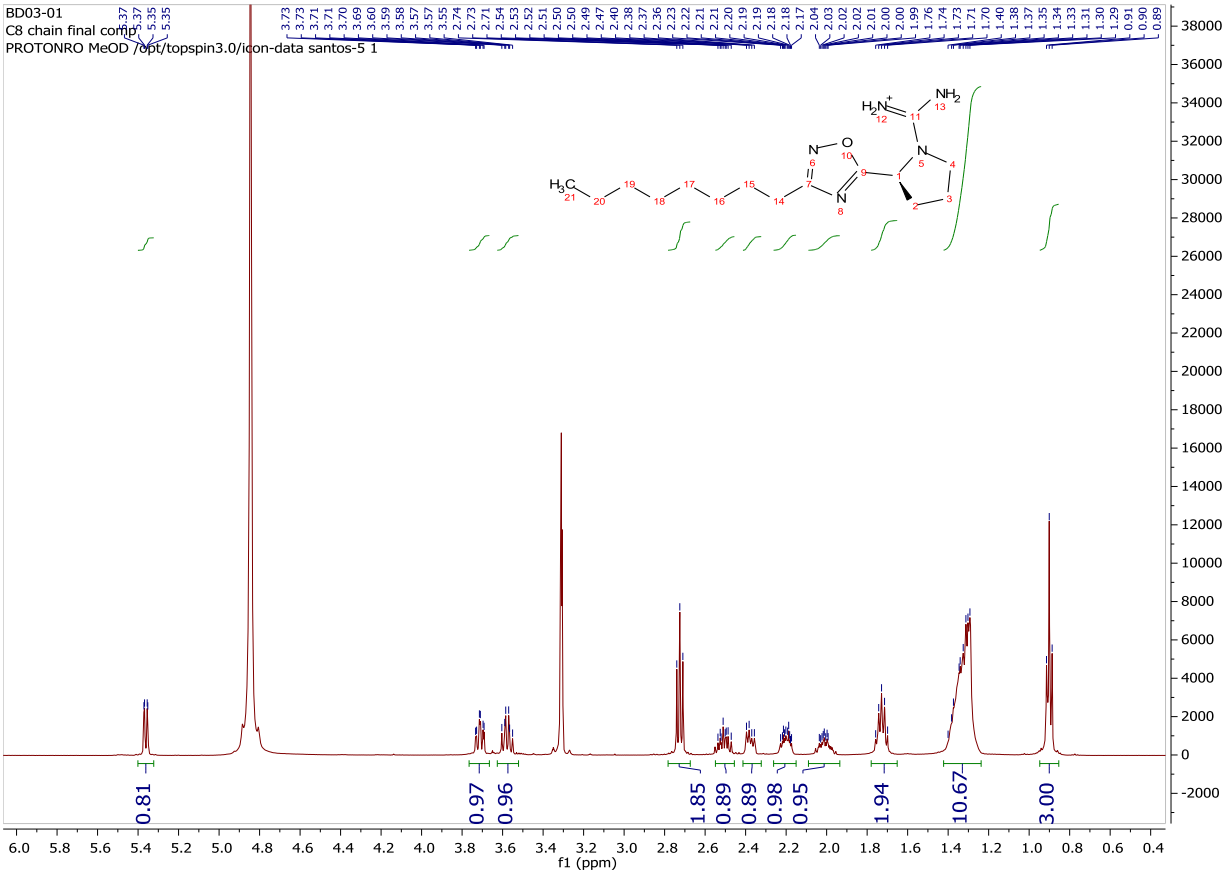
^{1}H-NMR Spectrum for Compound 2.39c



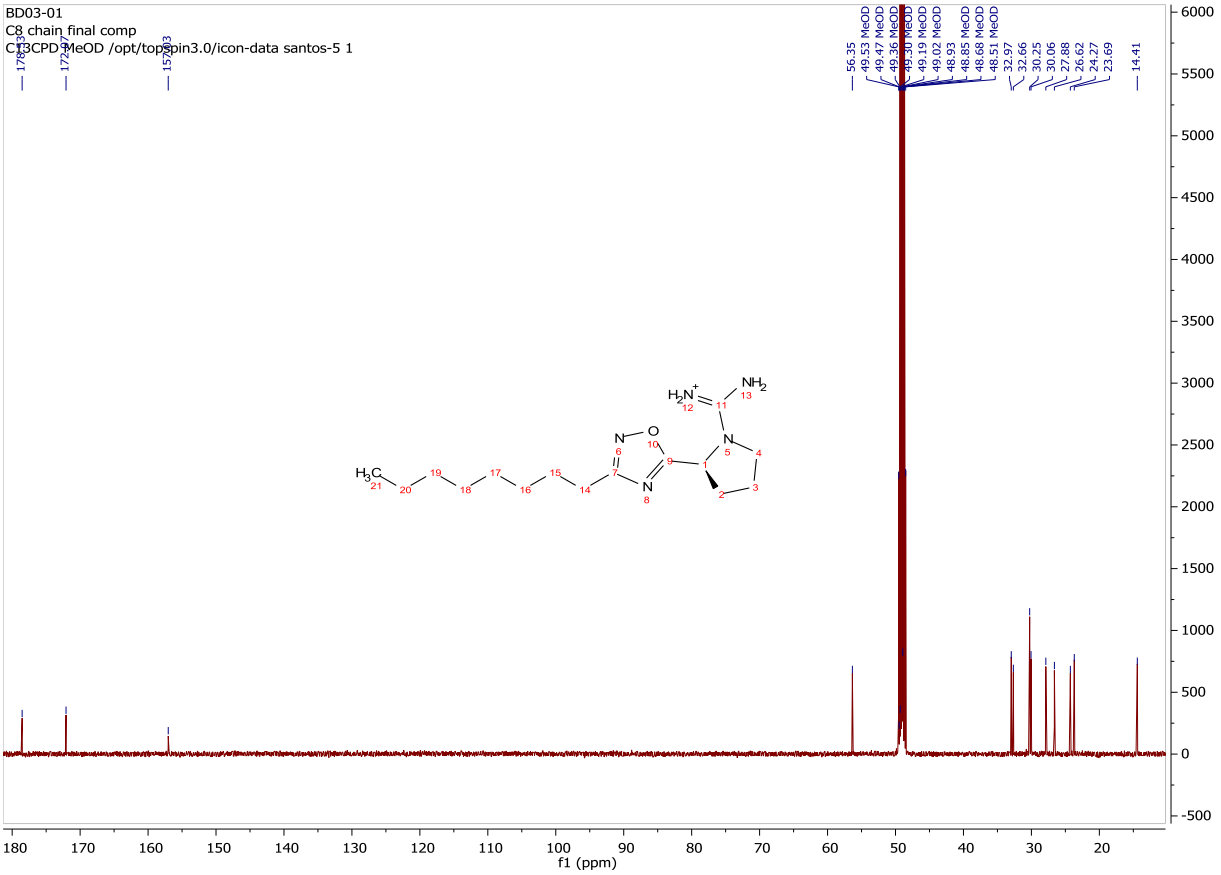
^{13}C-NMR Spectrum for Compound 2.39c



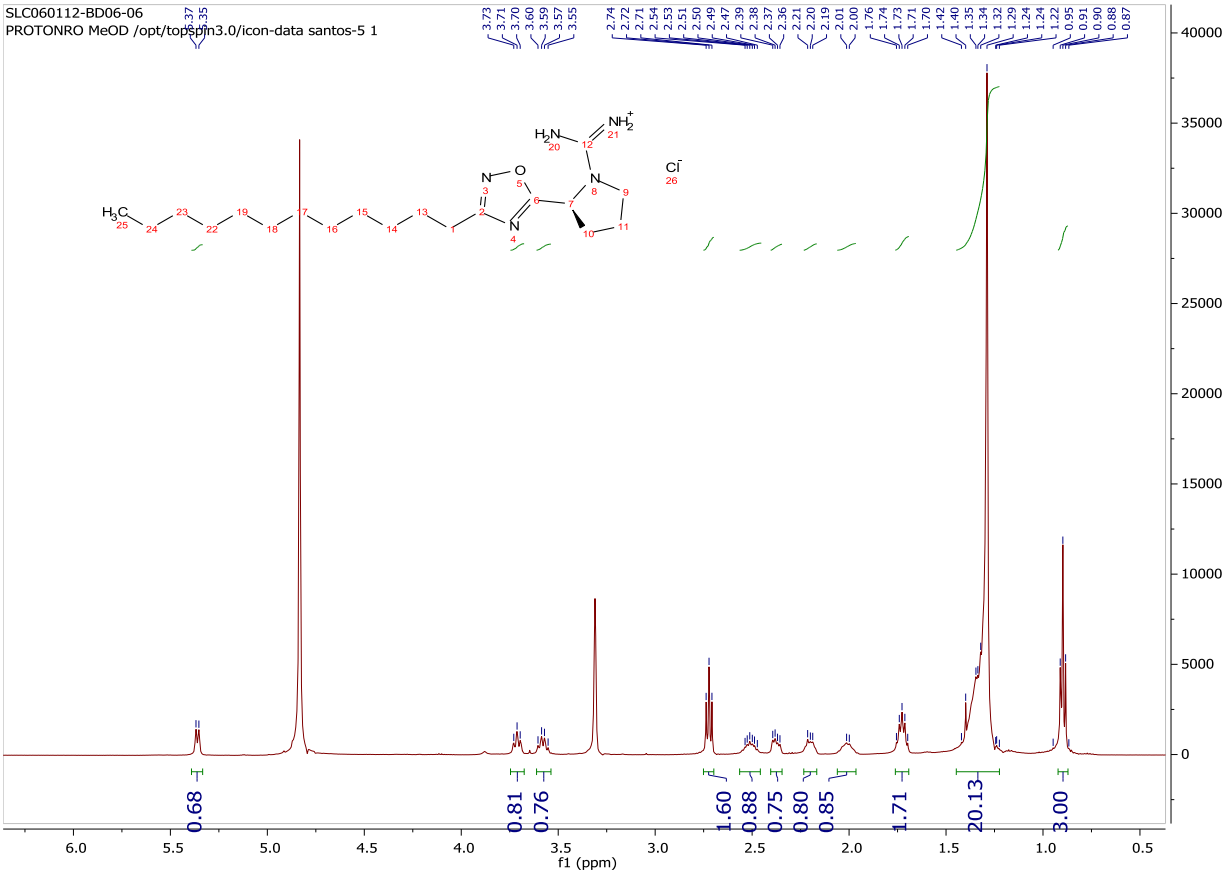
^{1}H-NMR Spectrum for Compound 2.40a



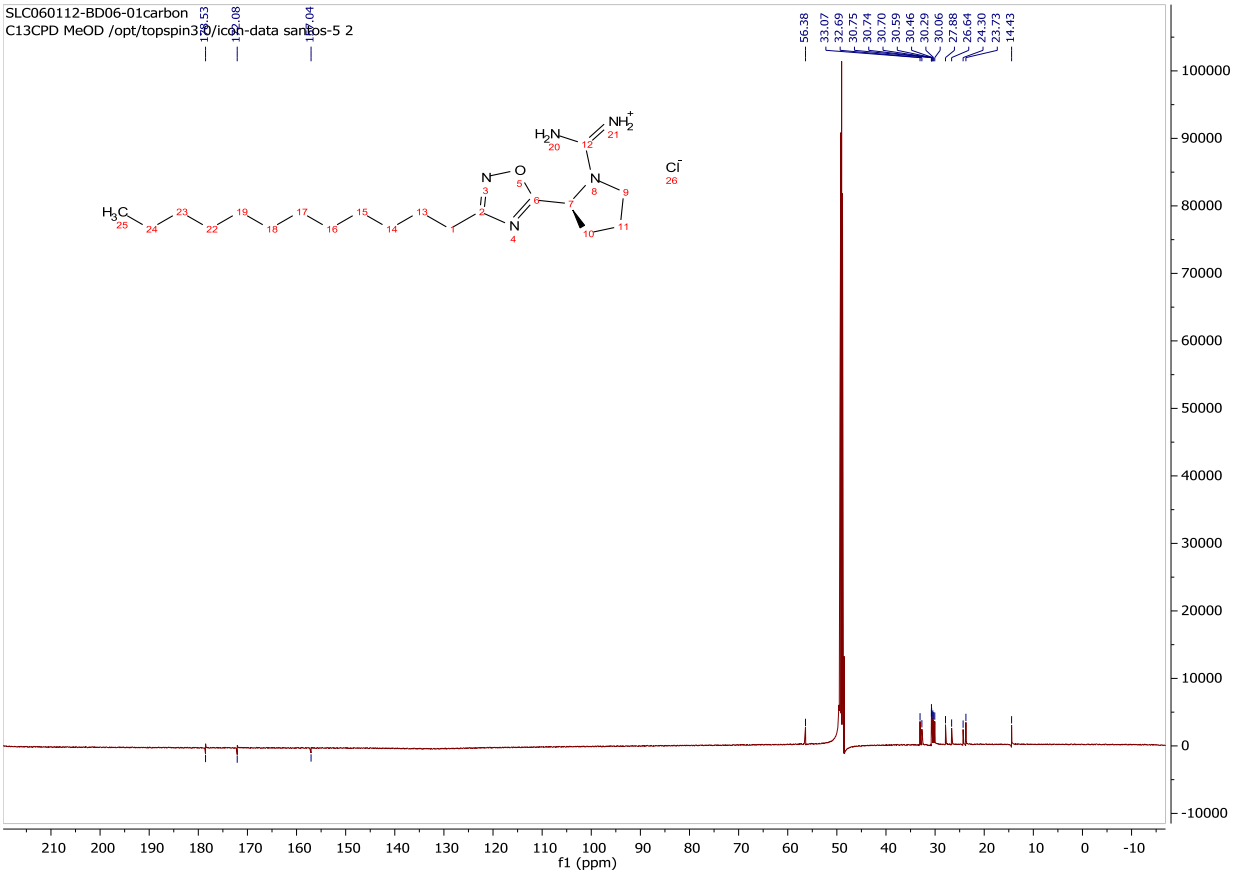
^{13}C-NMR Spectrum for Compound 2.40a



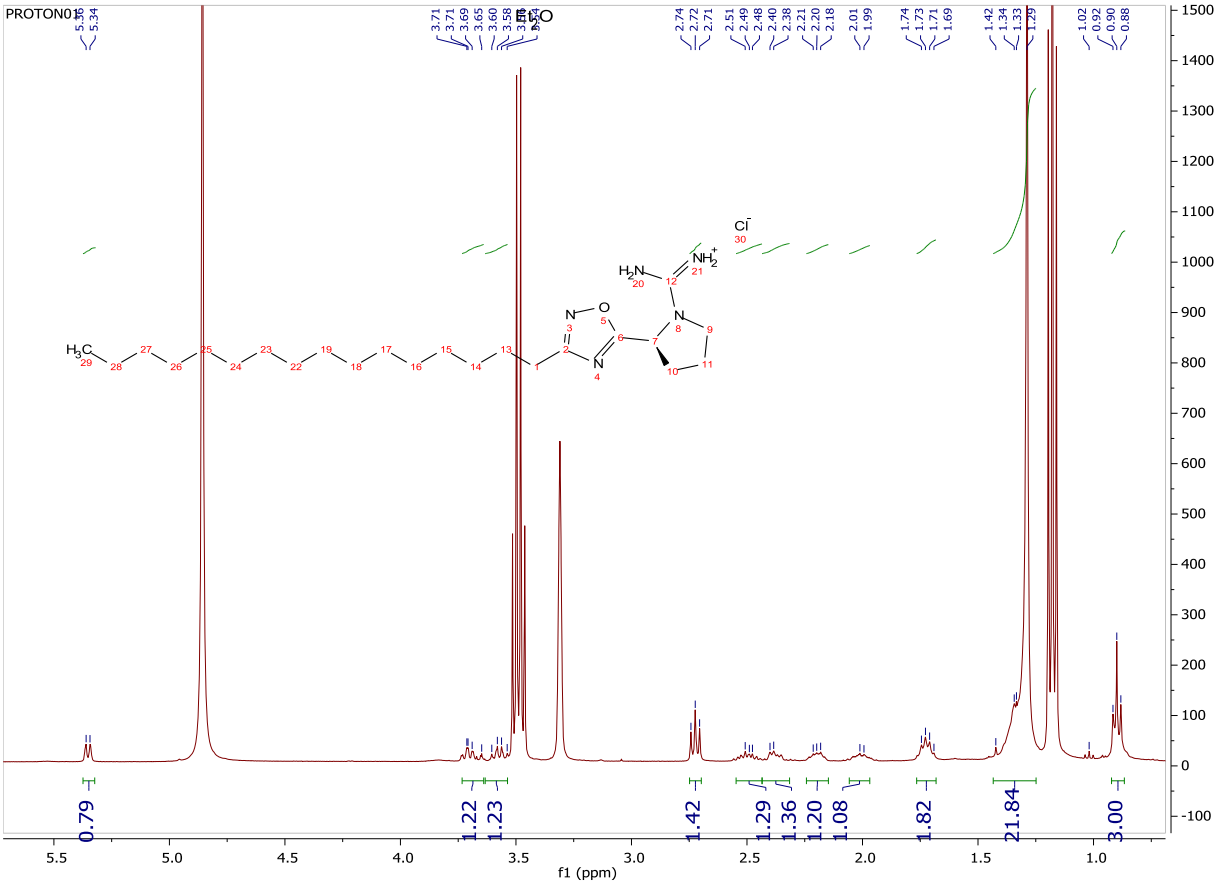
^{1}H-NMR Spectrum for Compound 2.40b



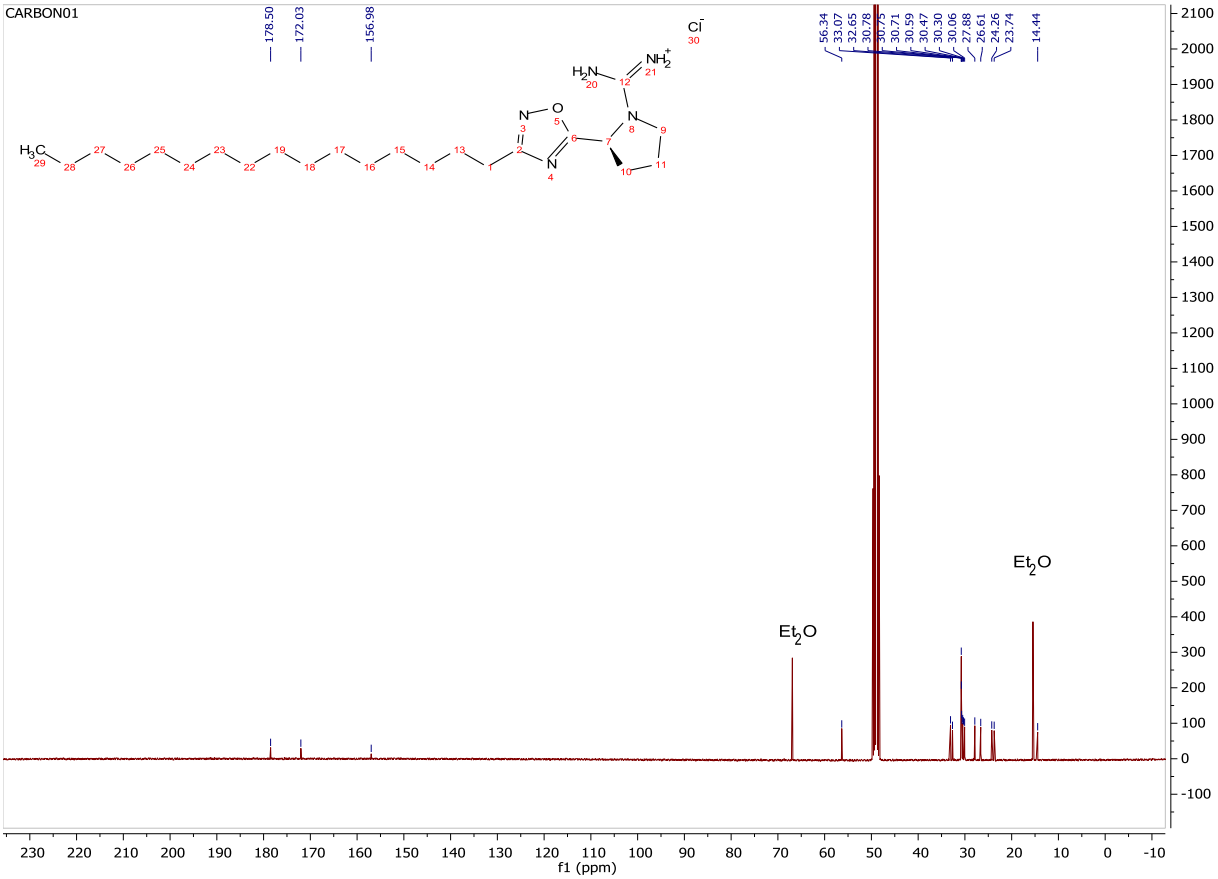
^{13}C-NMR Spectrum for Compound 2.40b



^{1}H-NMR Spectrum for Compound 2.40c

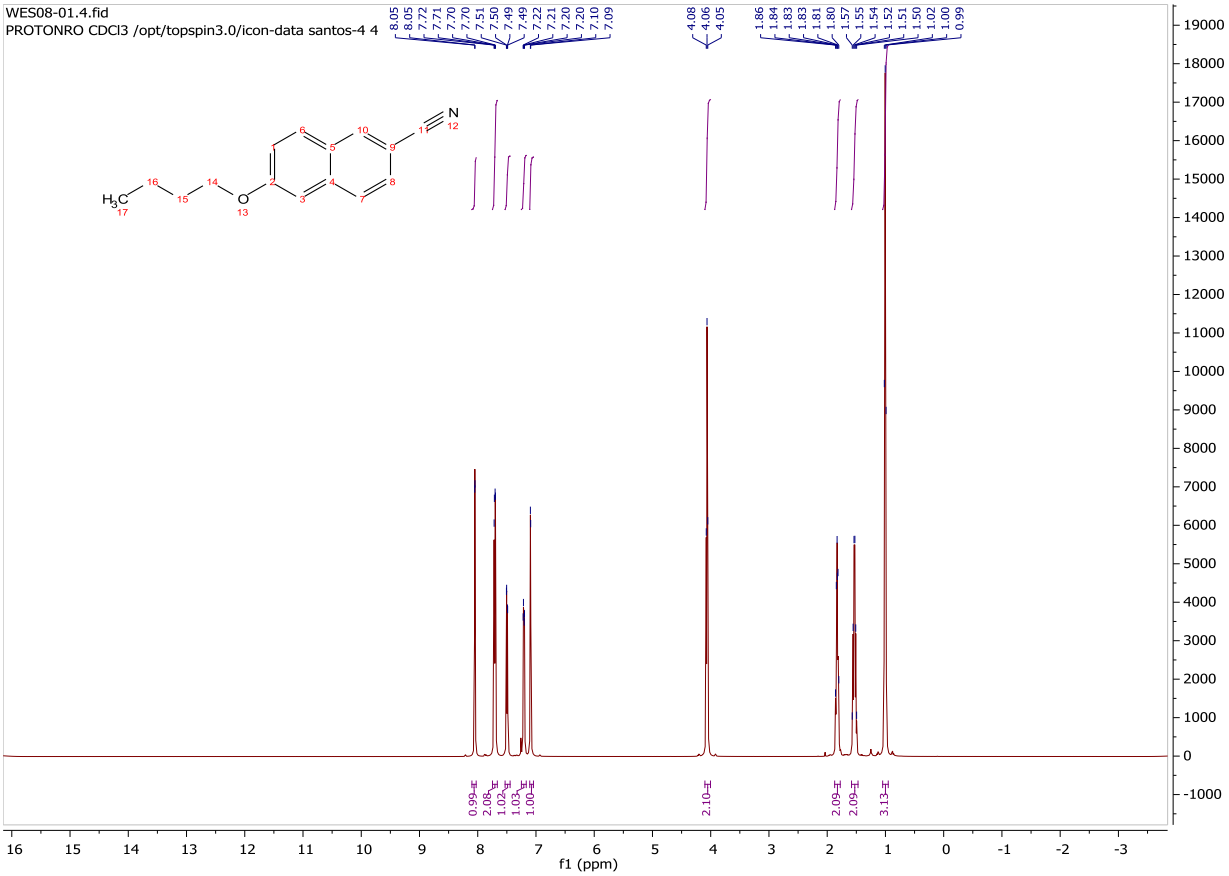


^{13}C-NMR Spectrum for Compound 2.40c

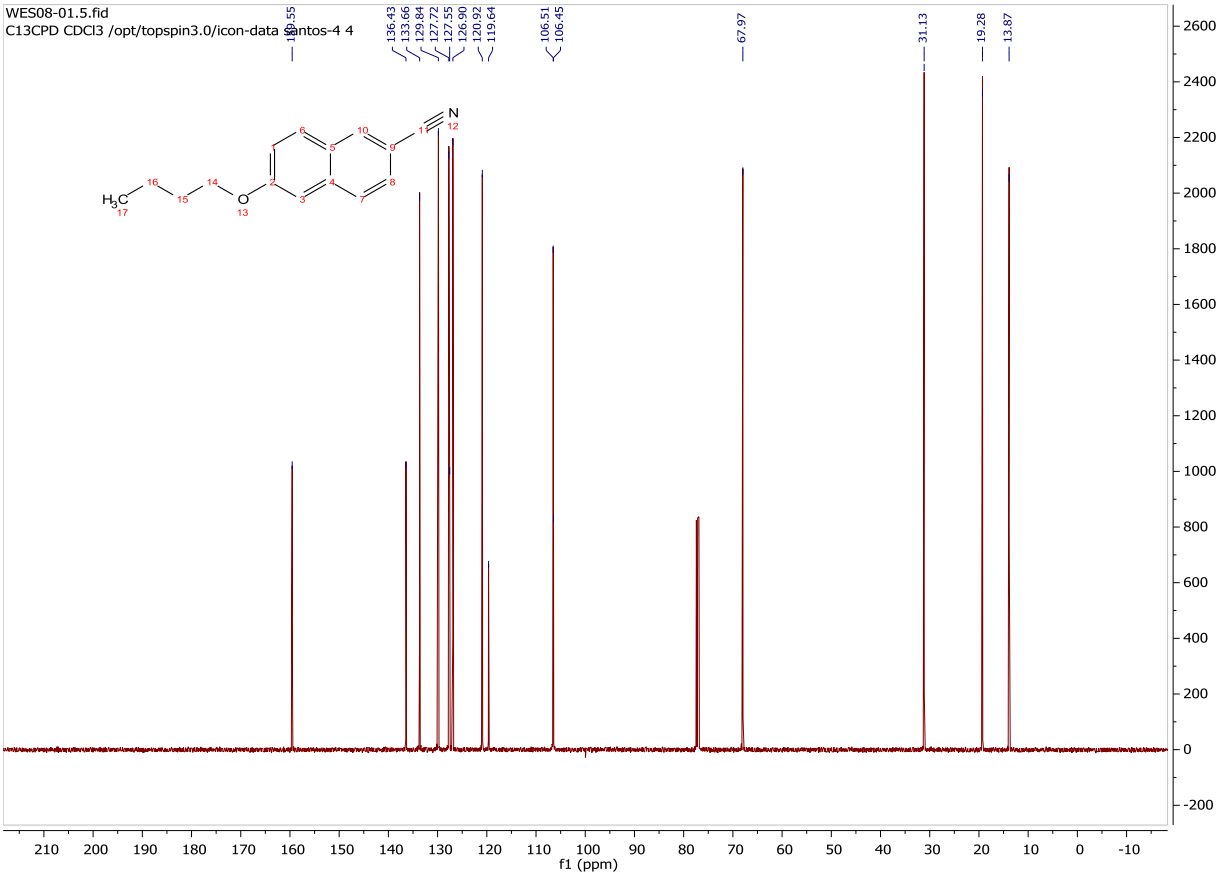


Appendix B NMR Spectra for Chapter 3

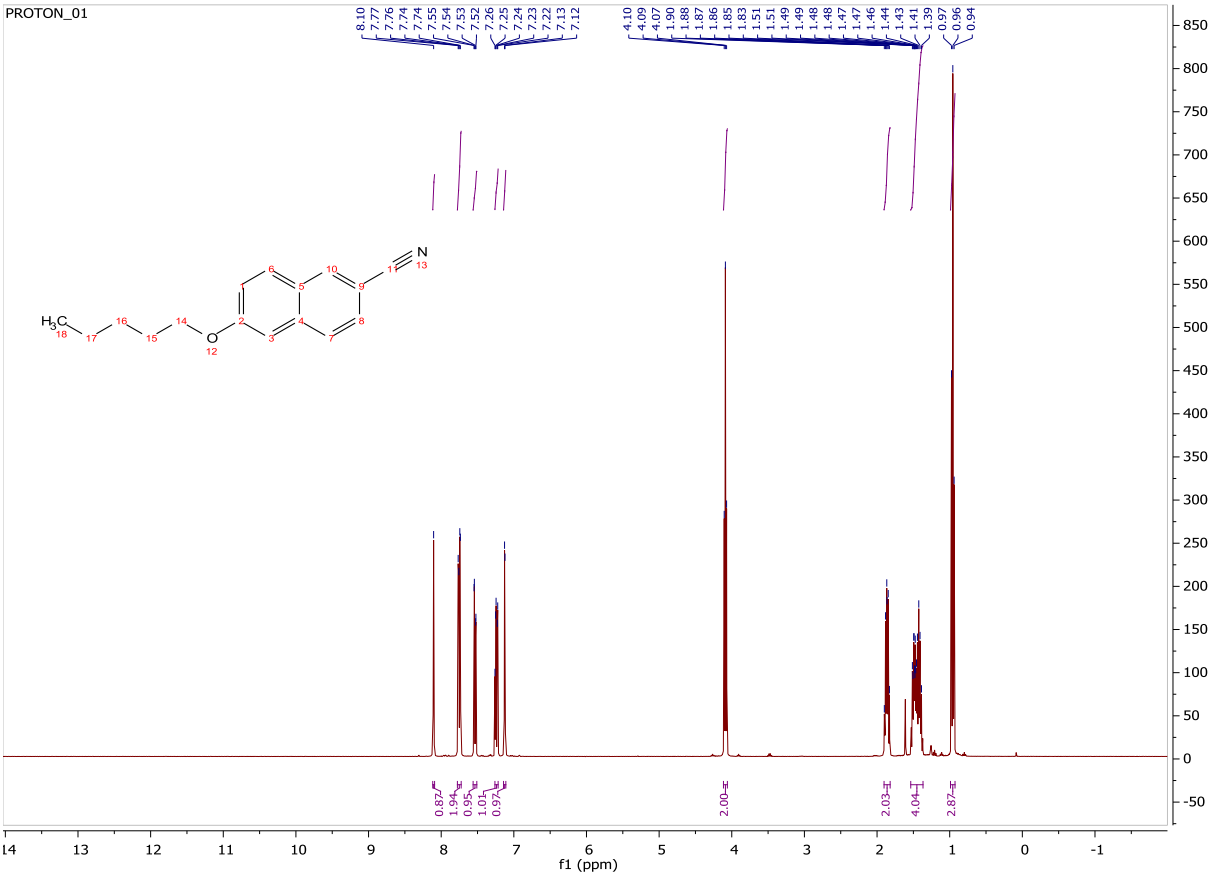
^{1}H-NMR Spectrum for 3.2a:



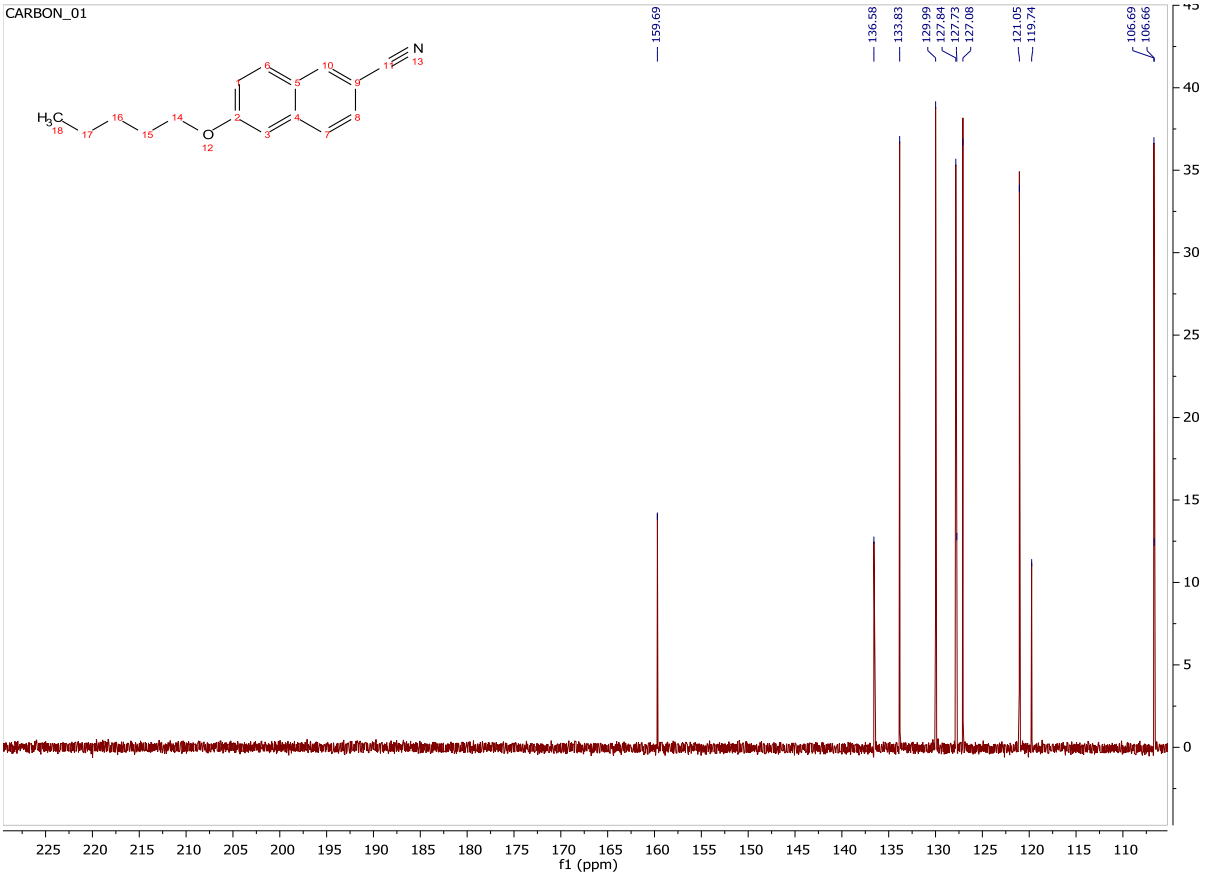
^{13}C-NMR Spectrum for 3.2a:



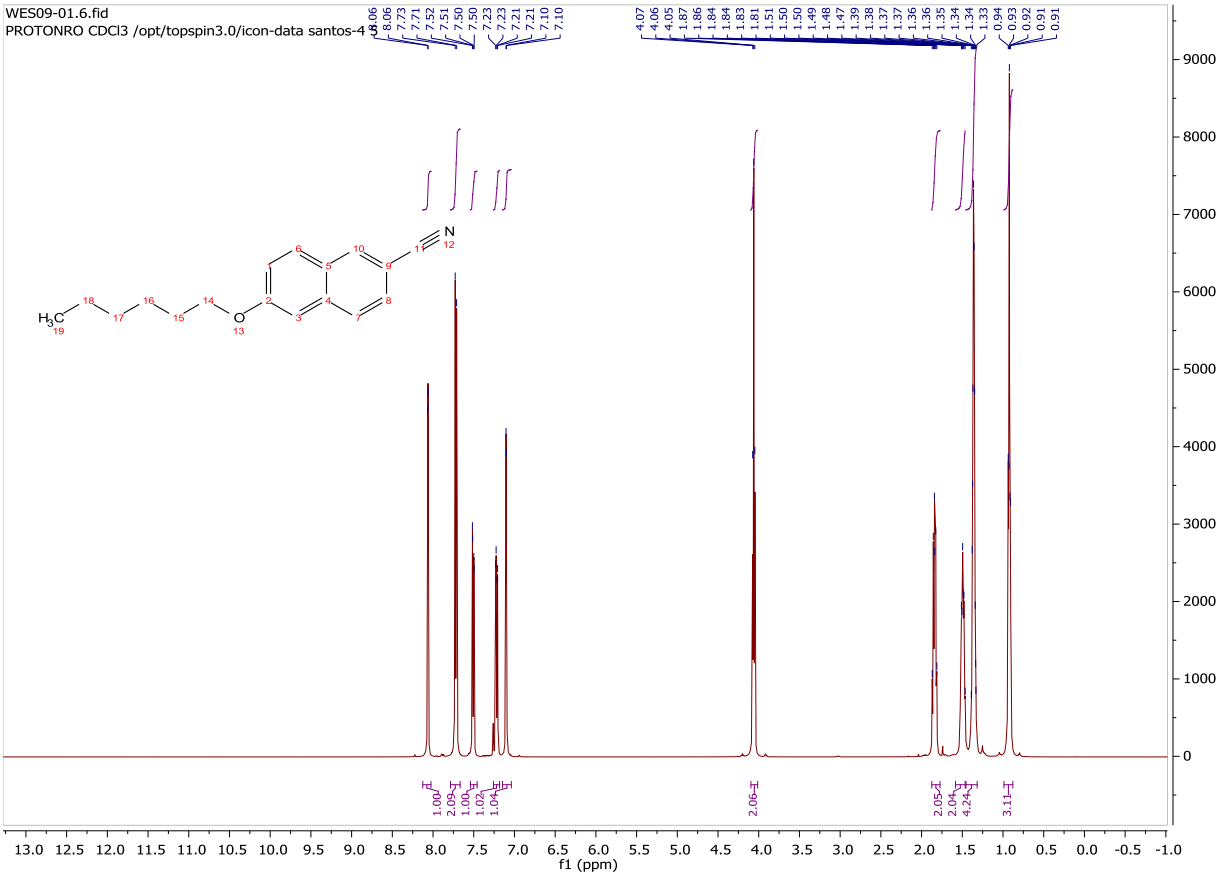
^{1}H-NMR Spectrum for 3.2b:



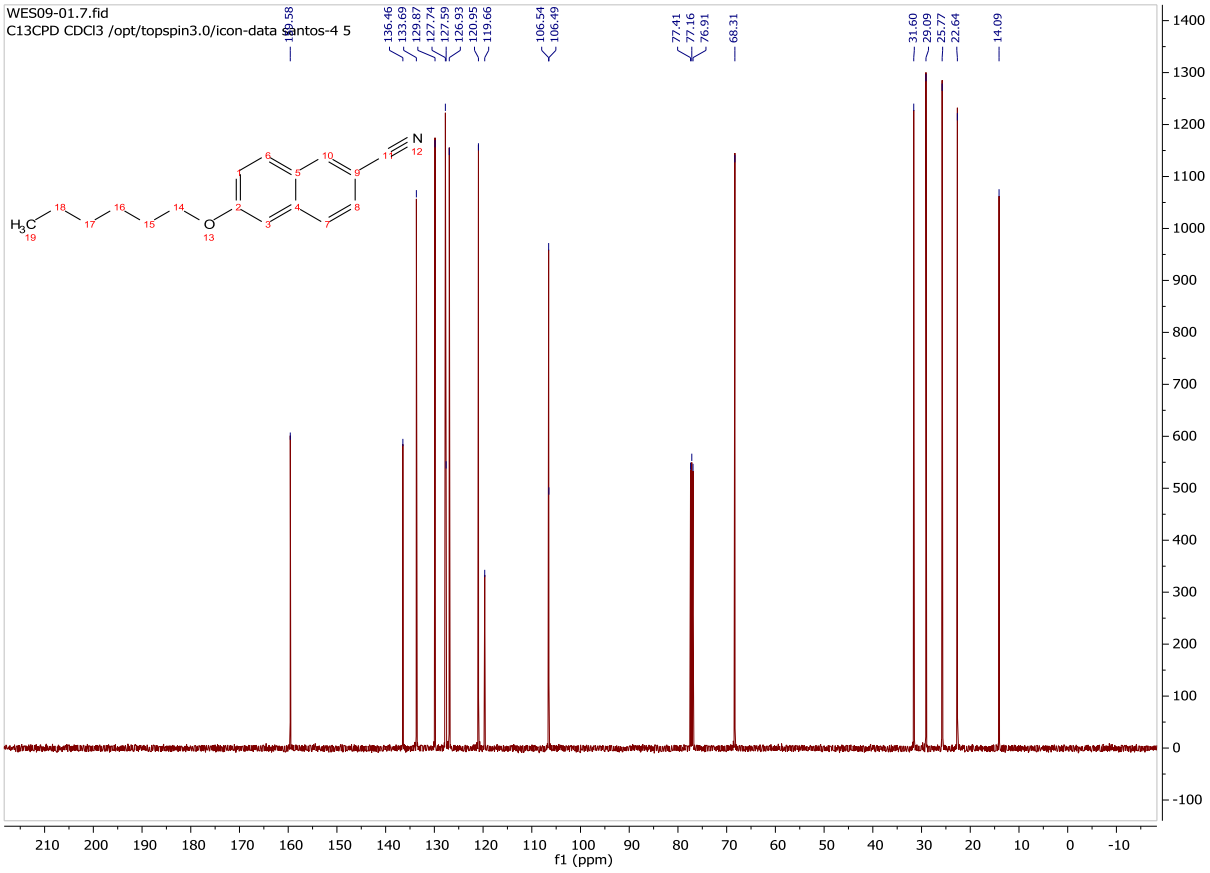
^{13}C-NMR Spectrum for 3.2b:



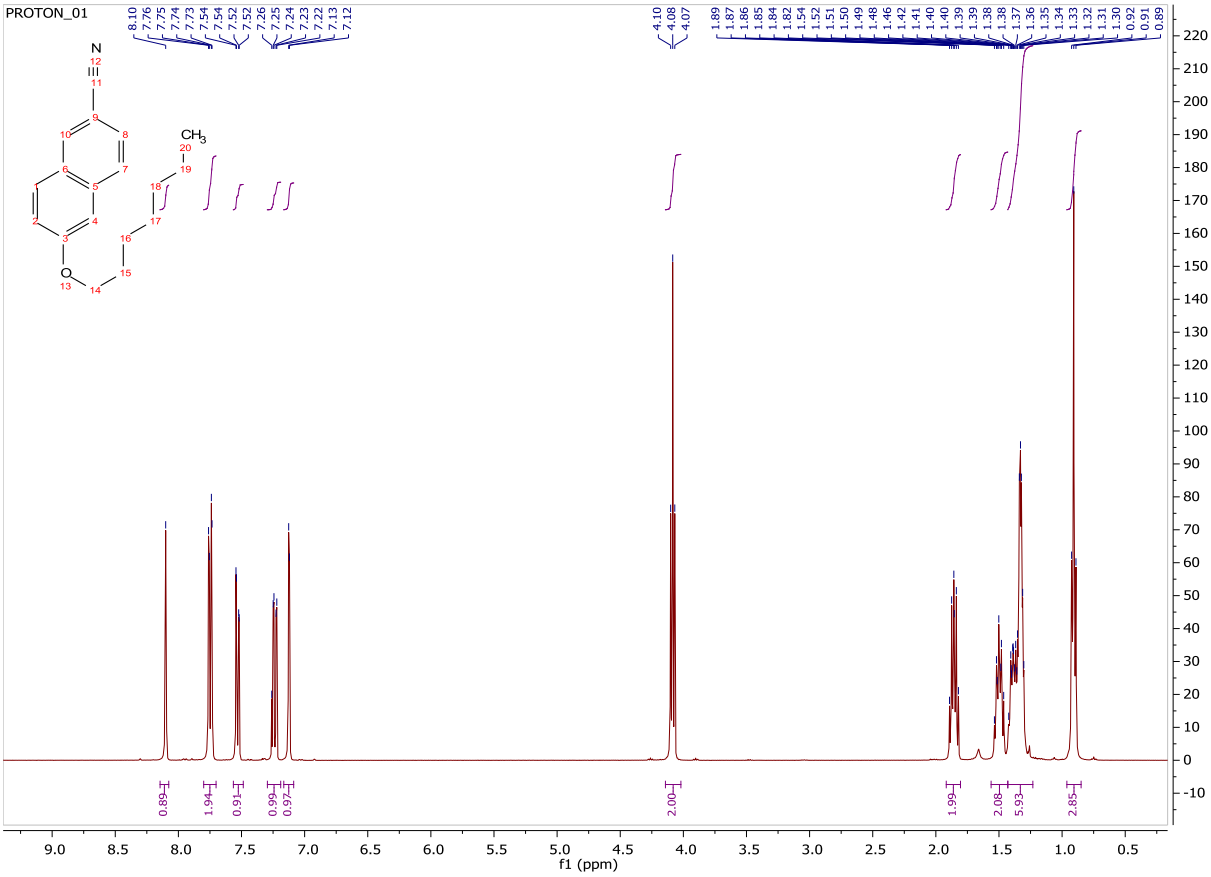
^{1}H-NMR Spectrum for 3.2c:



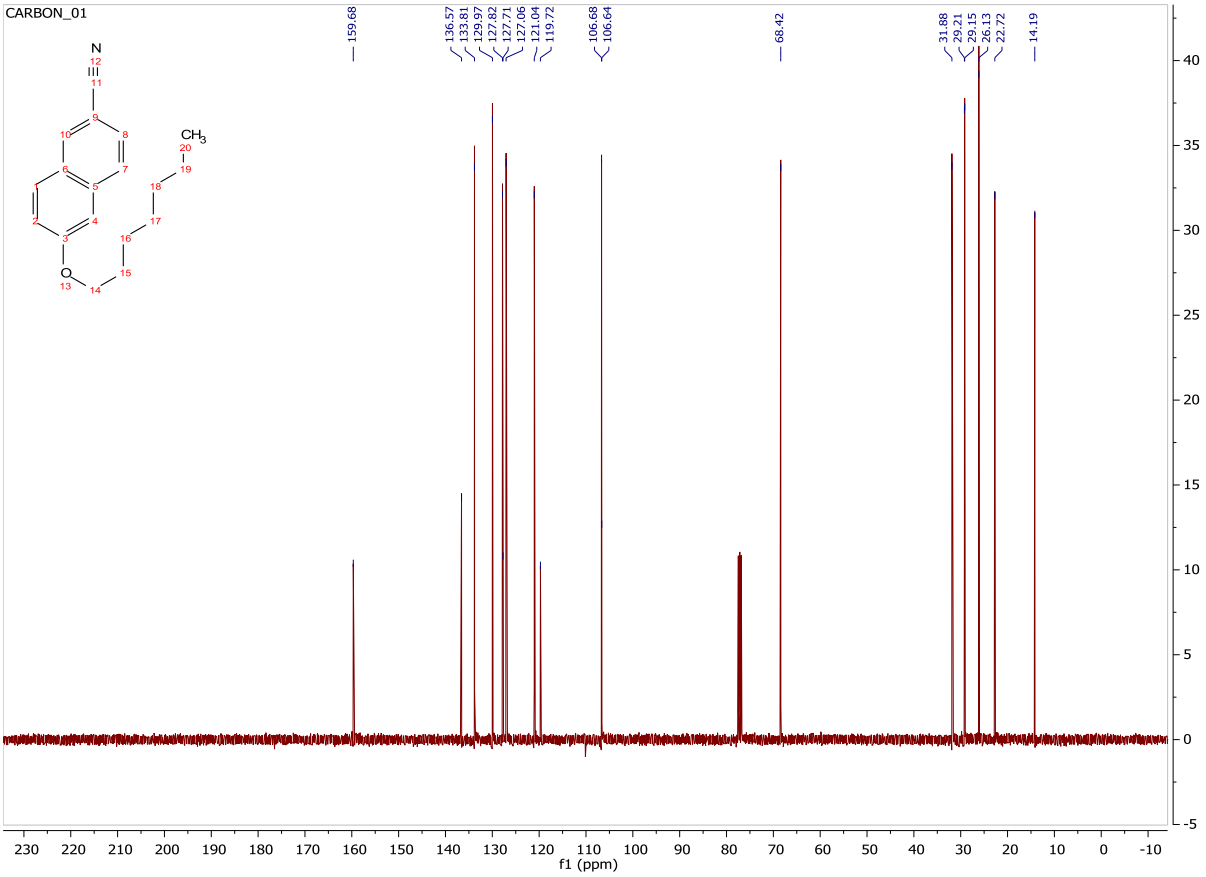
^{13}C-NMR Spectrum for 3.2c:



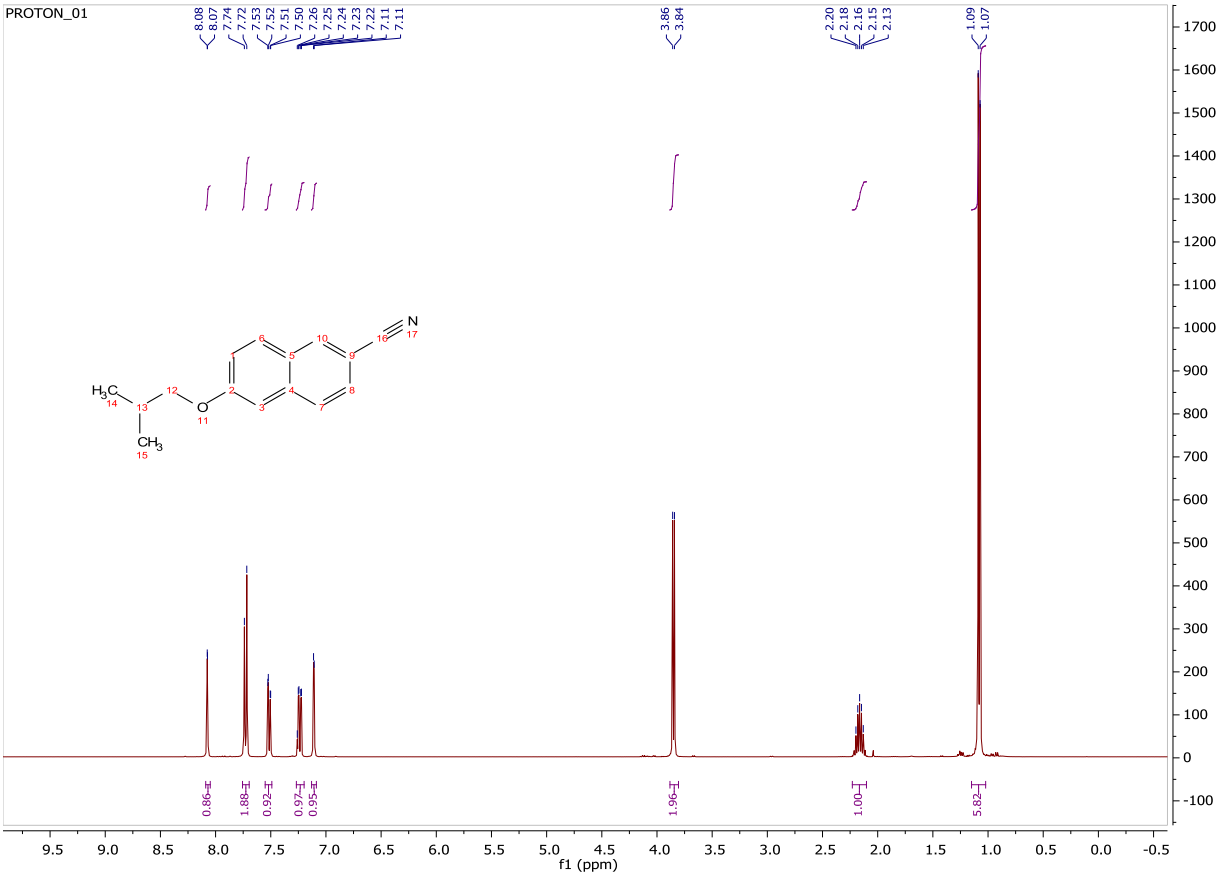
^{1}H-NMR Spectrum for 3.2d:



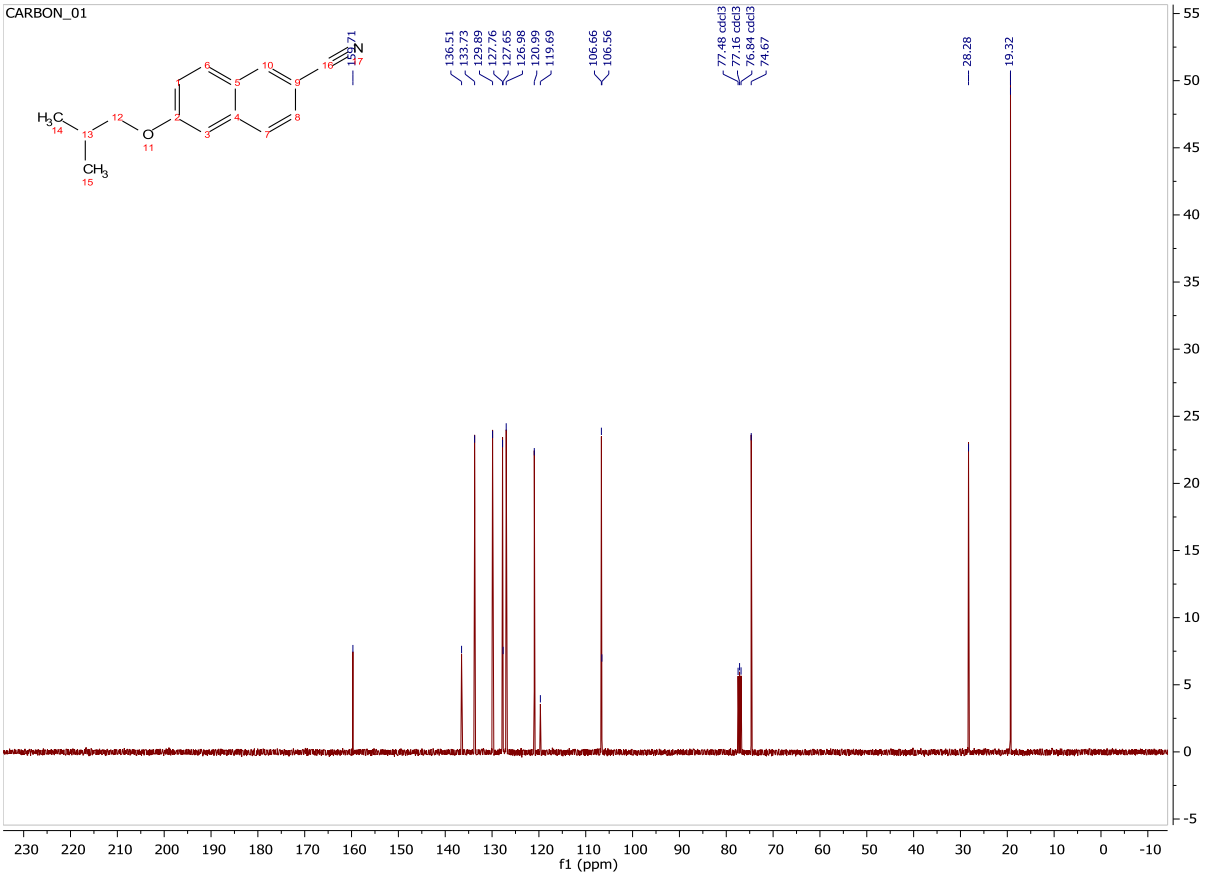
^{13}C-NMR Spectrum for 3.2d:



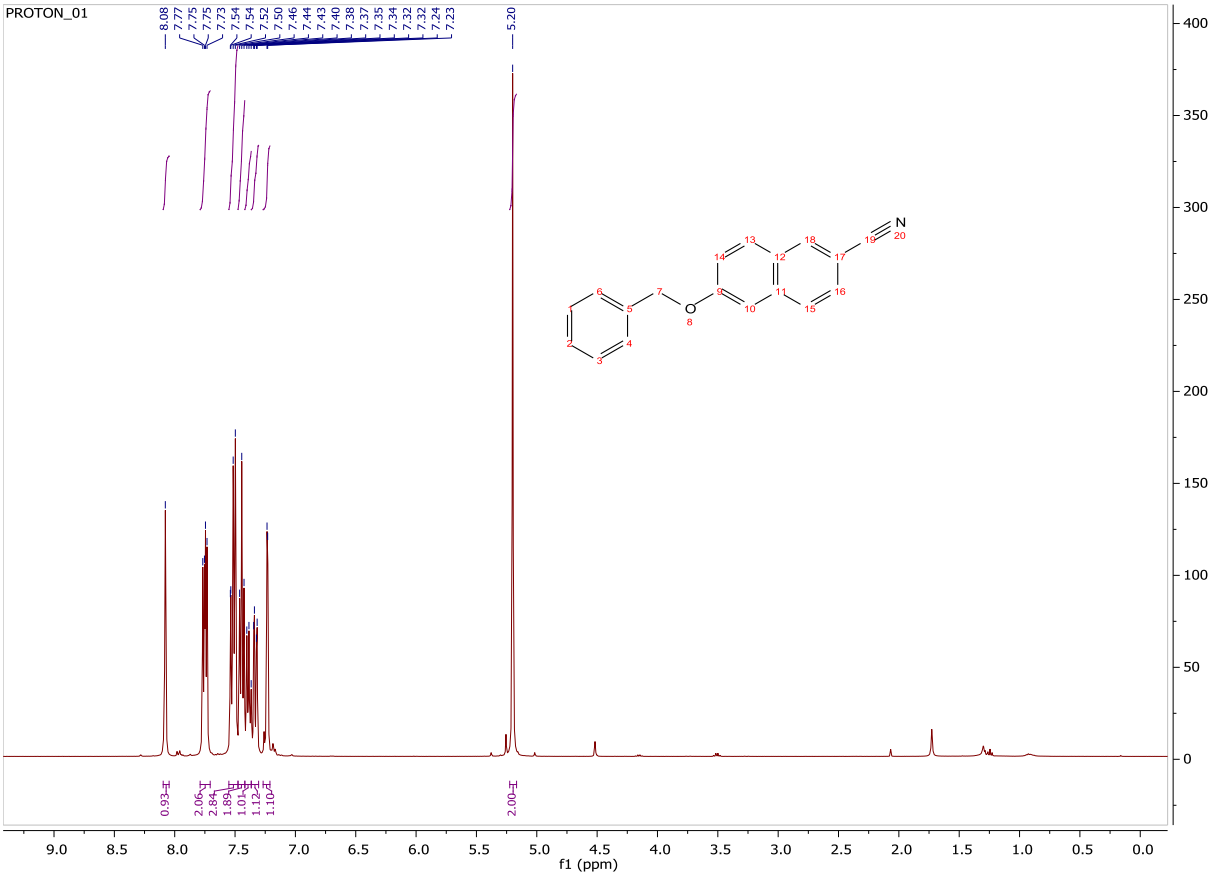
^{1}H-NMR Spectrum for 3.2e:



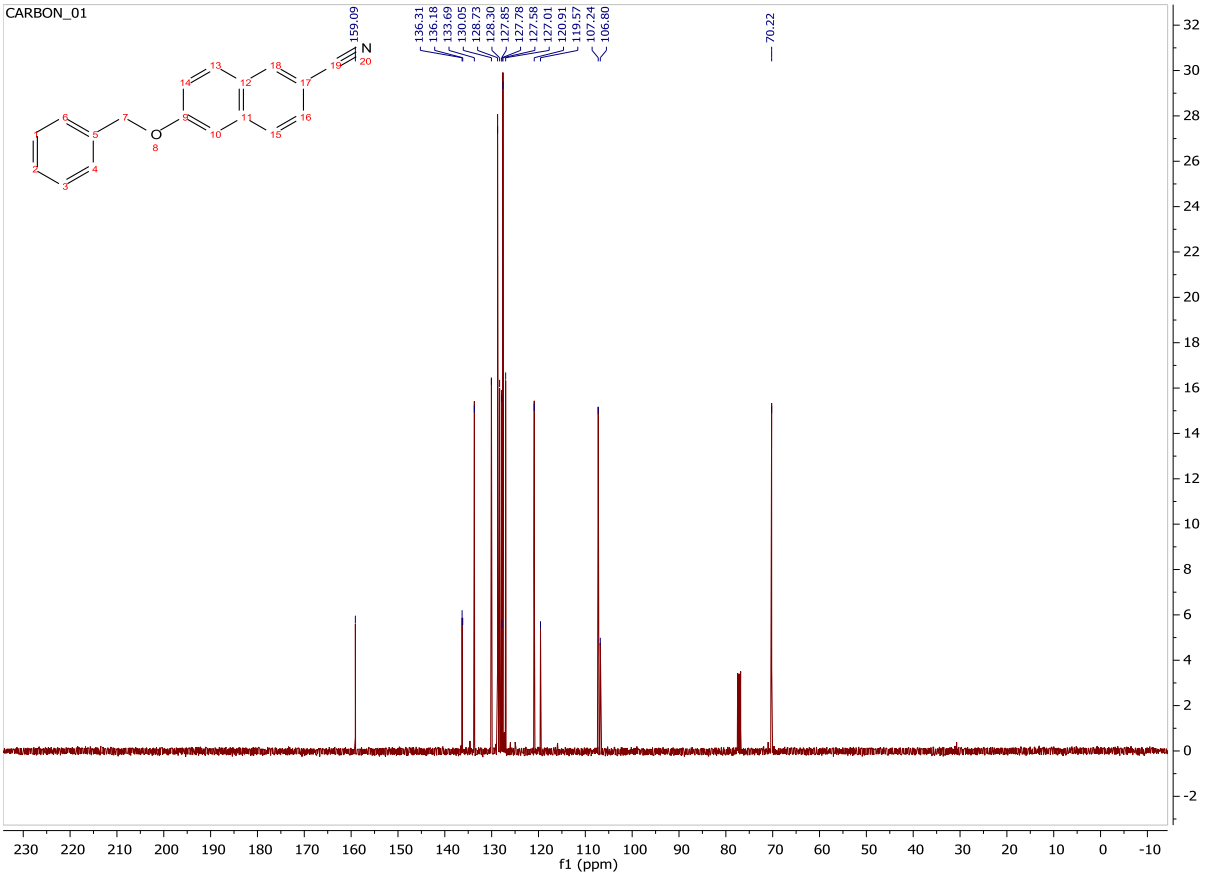
^{13}C-NMR Spectrum for 3.2e:



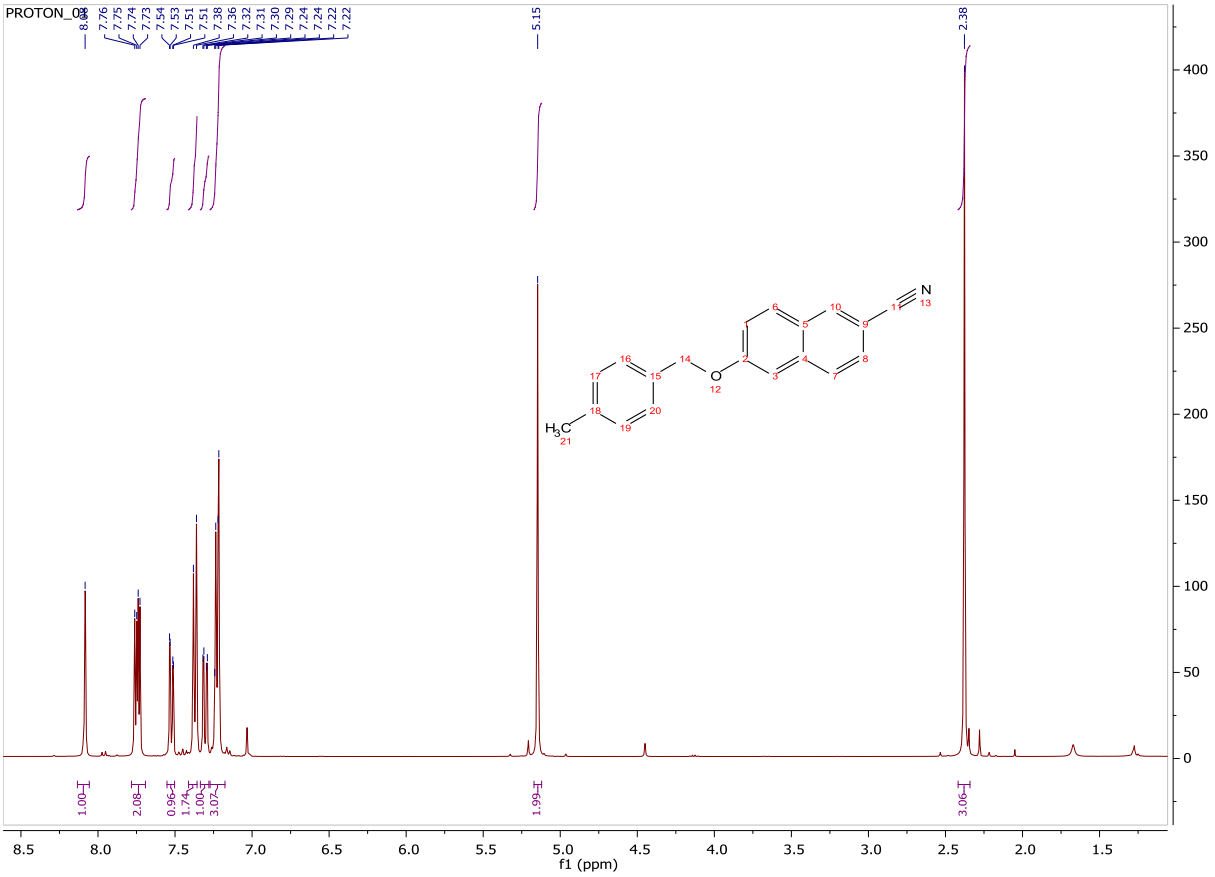
^{1}H-NMR Spectrum for 3.2f:



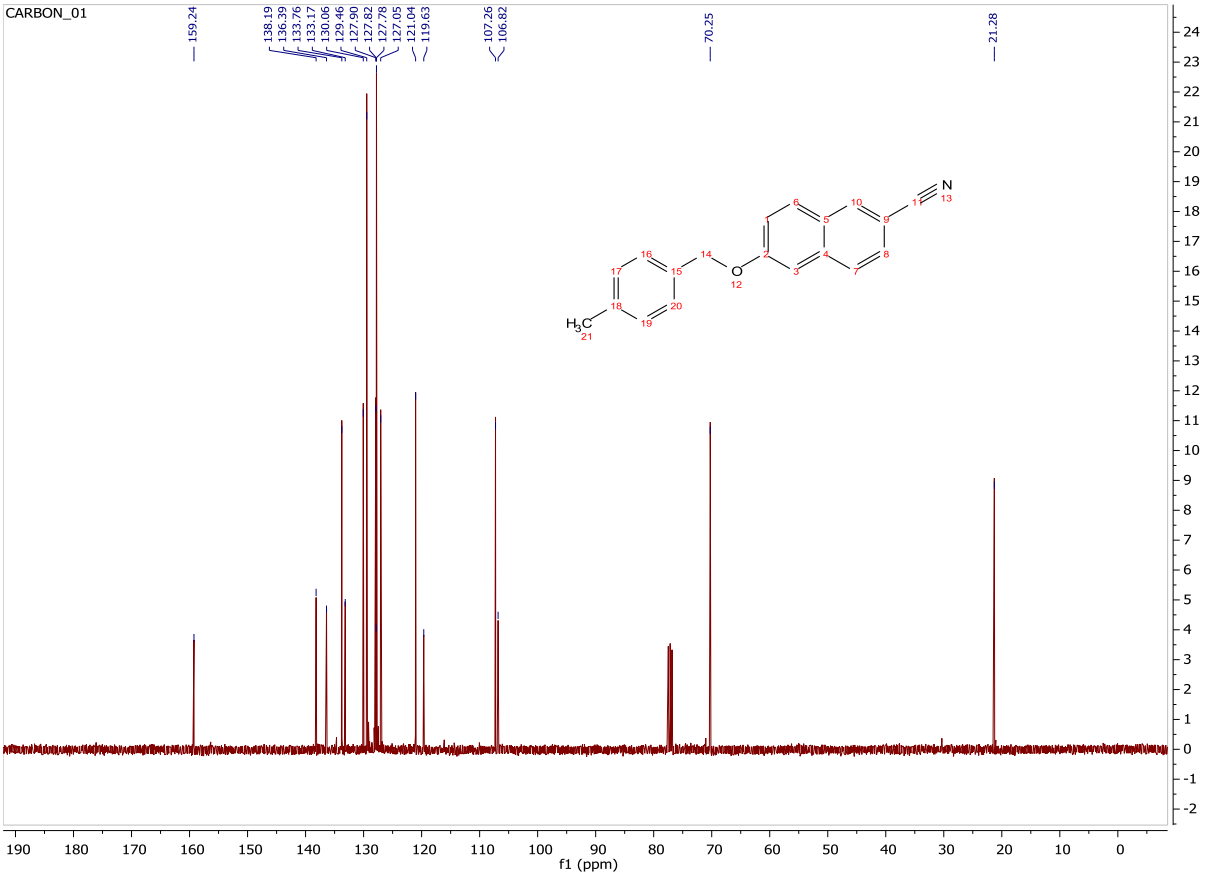
^{13}C-NMR Spectrum for 3.2f:



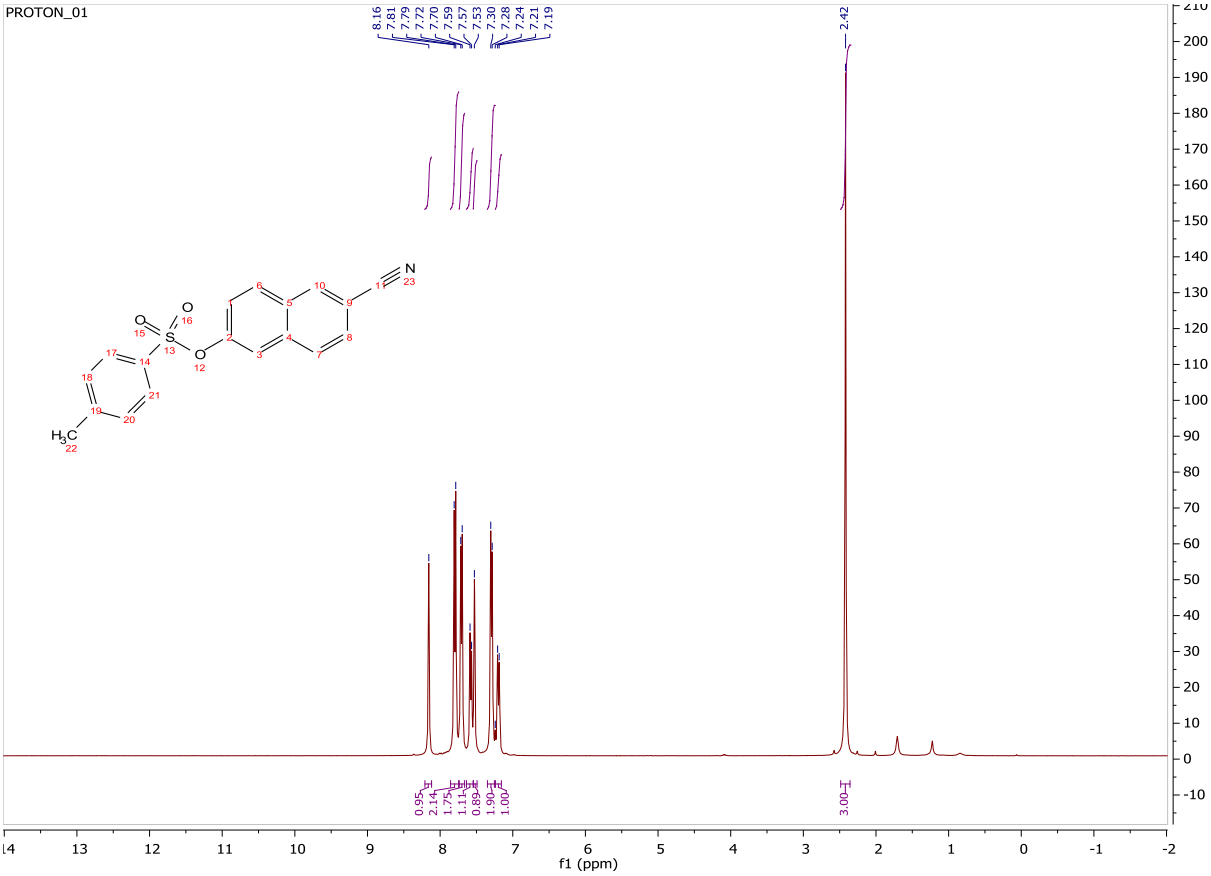
^{1}H-NMR Spectrum for 3.2g:



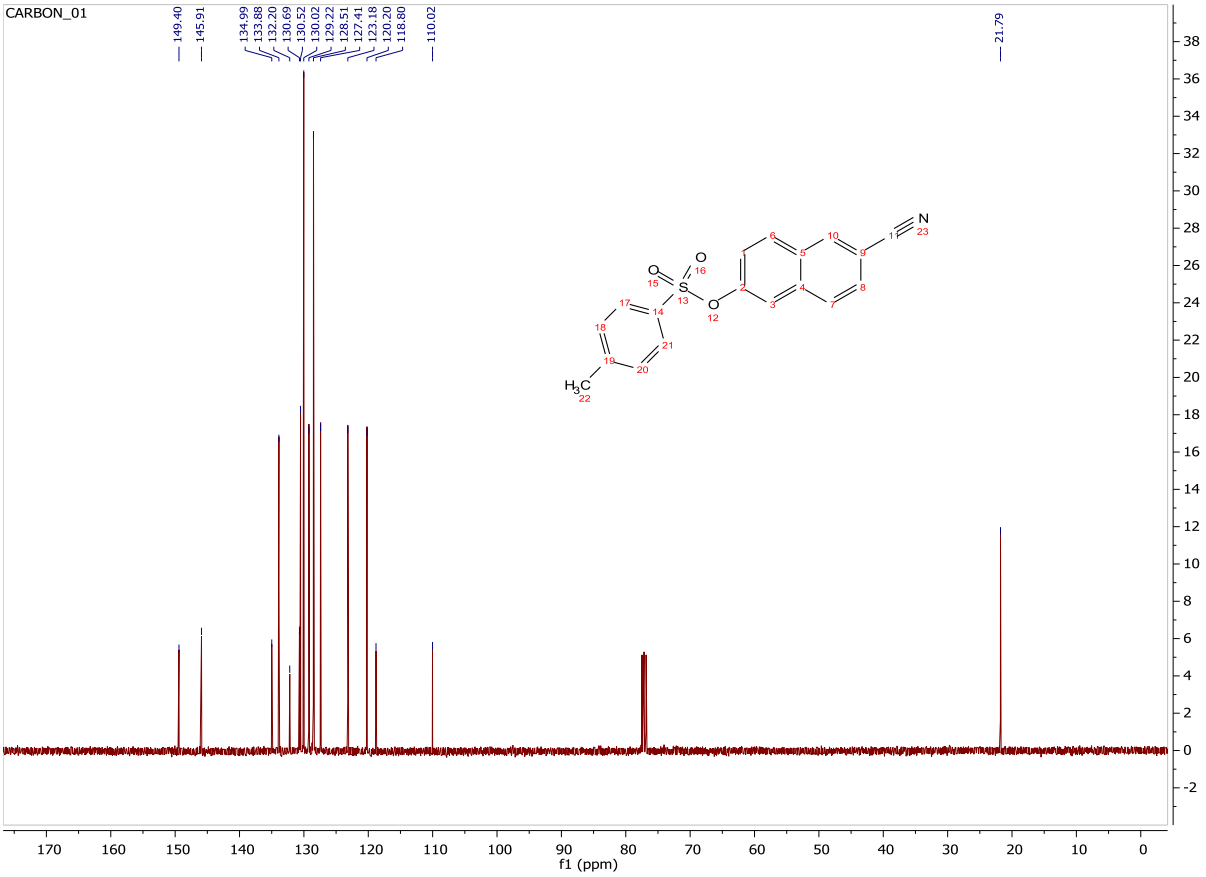
^{13}C-NMR Spectrum for 3.2g:



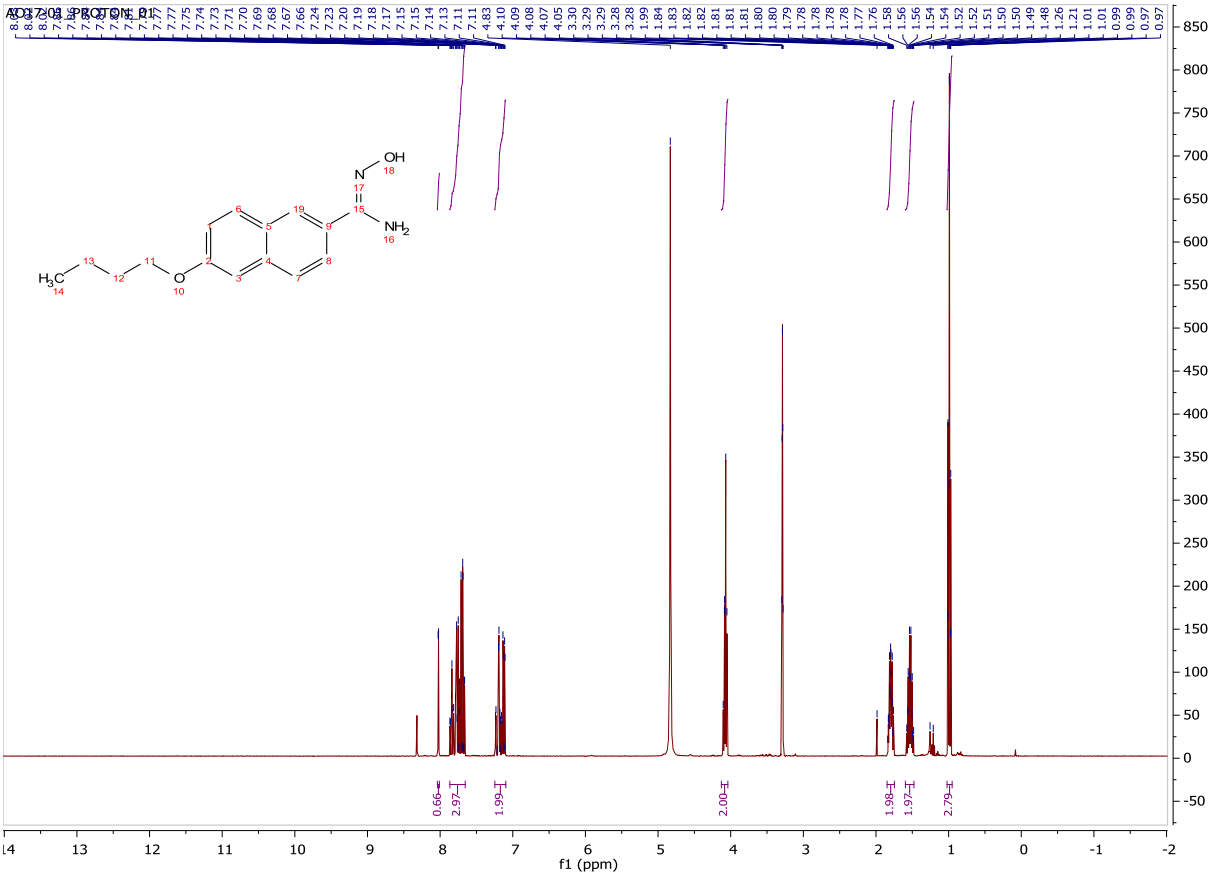
^{1}H-NMR Spectrum for 3.2h:



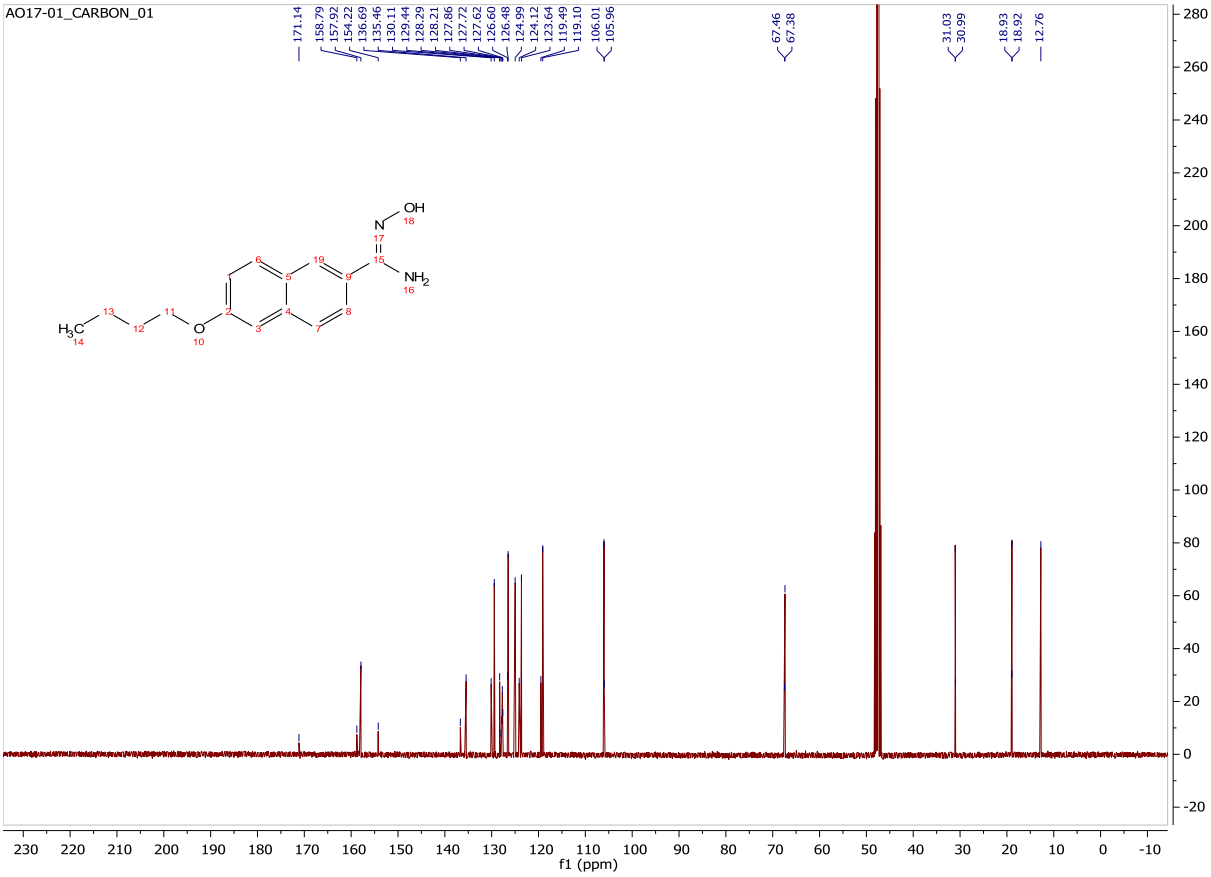
^{13}C-NMR Spectrum for 3.2h:



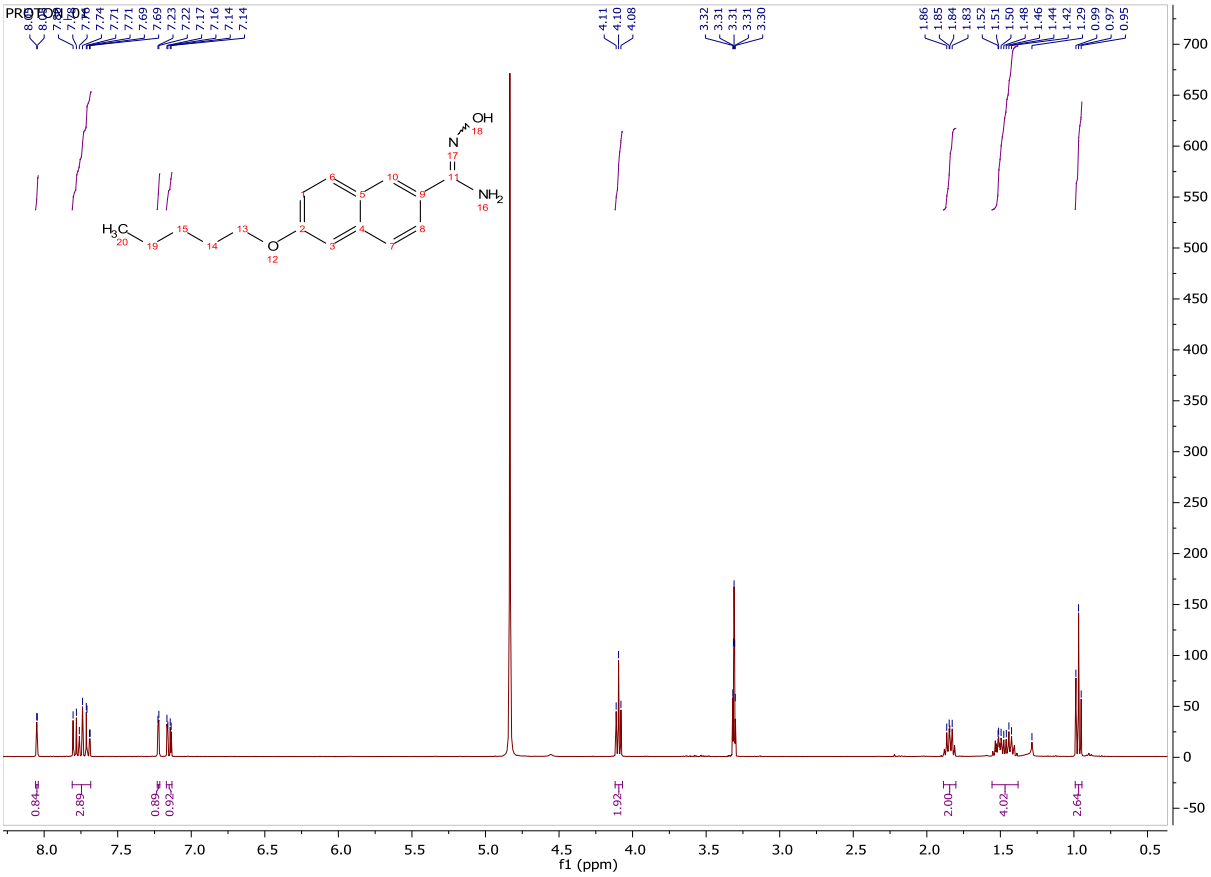
^{1}H-NMR Spectrum for 3.3a:



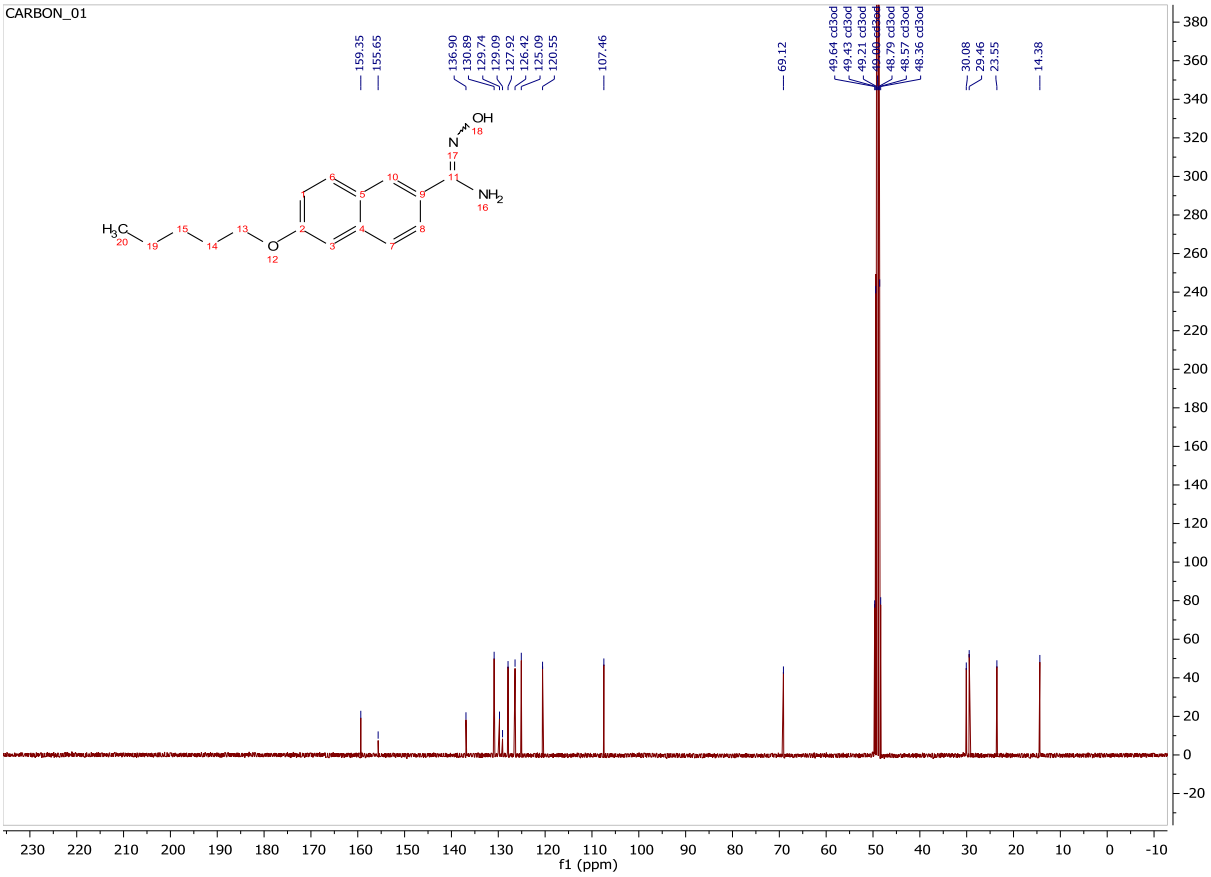
^{13}C-NMR Spectrum for 3.3a:



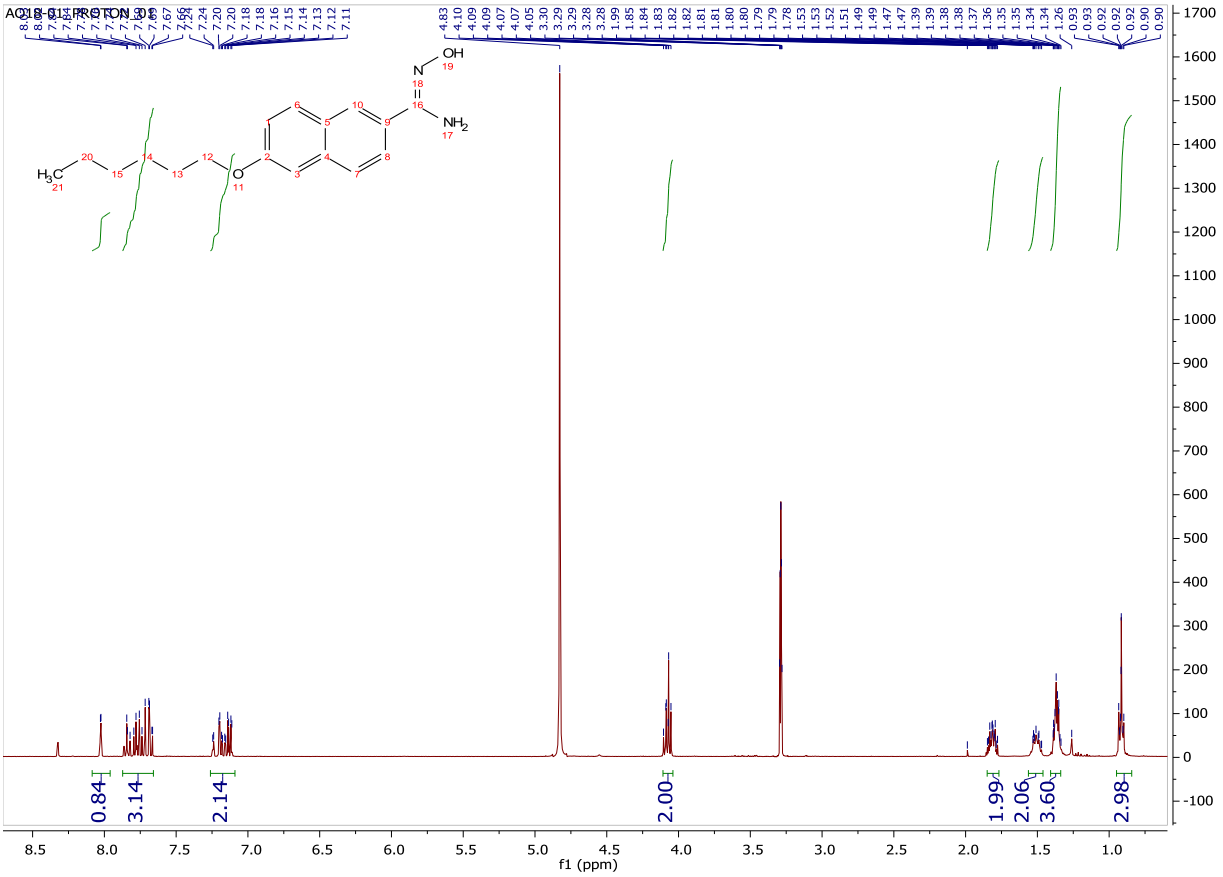
^{1}H-NMR Spectrum for 3.3b:



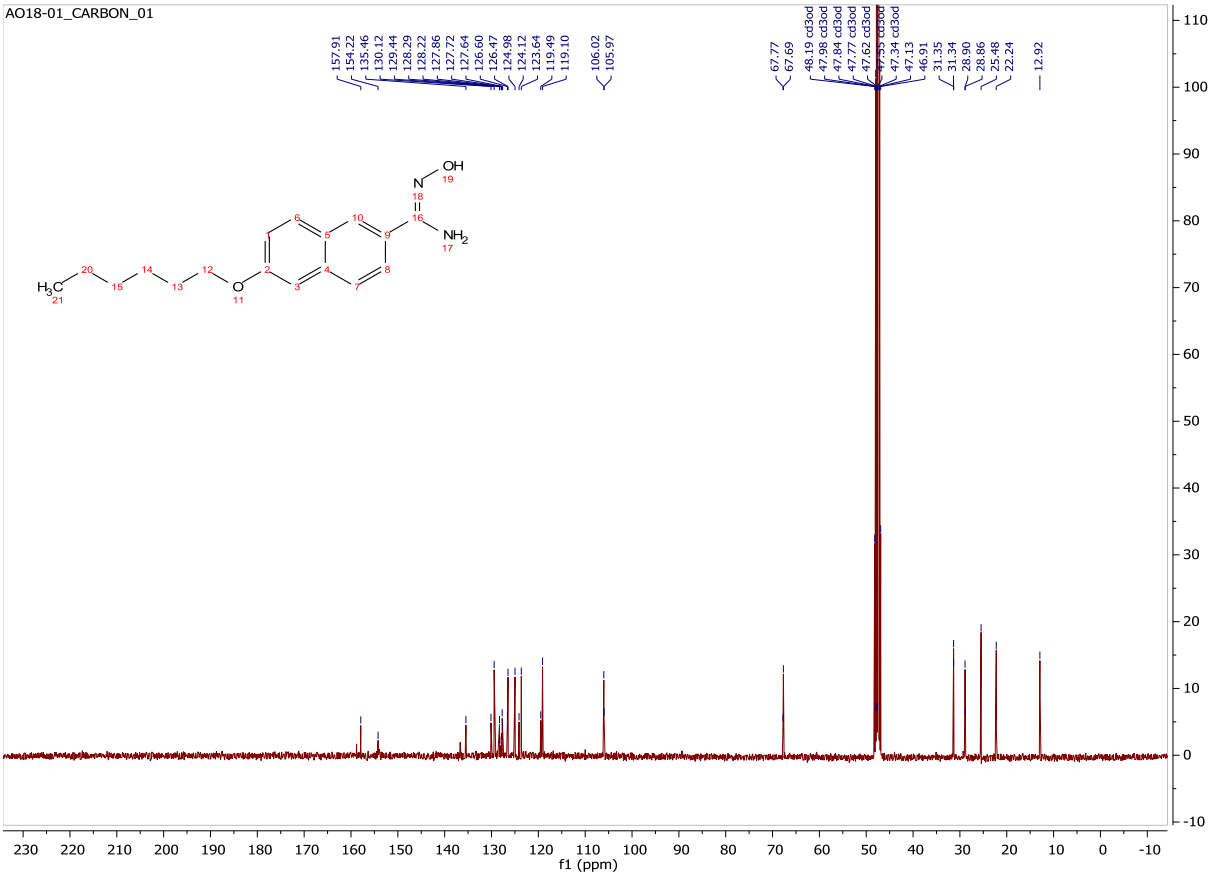
^{13}C-NMR Spectrum for 3.3b:



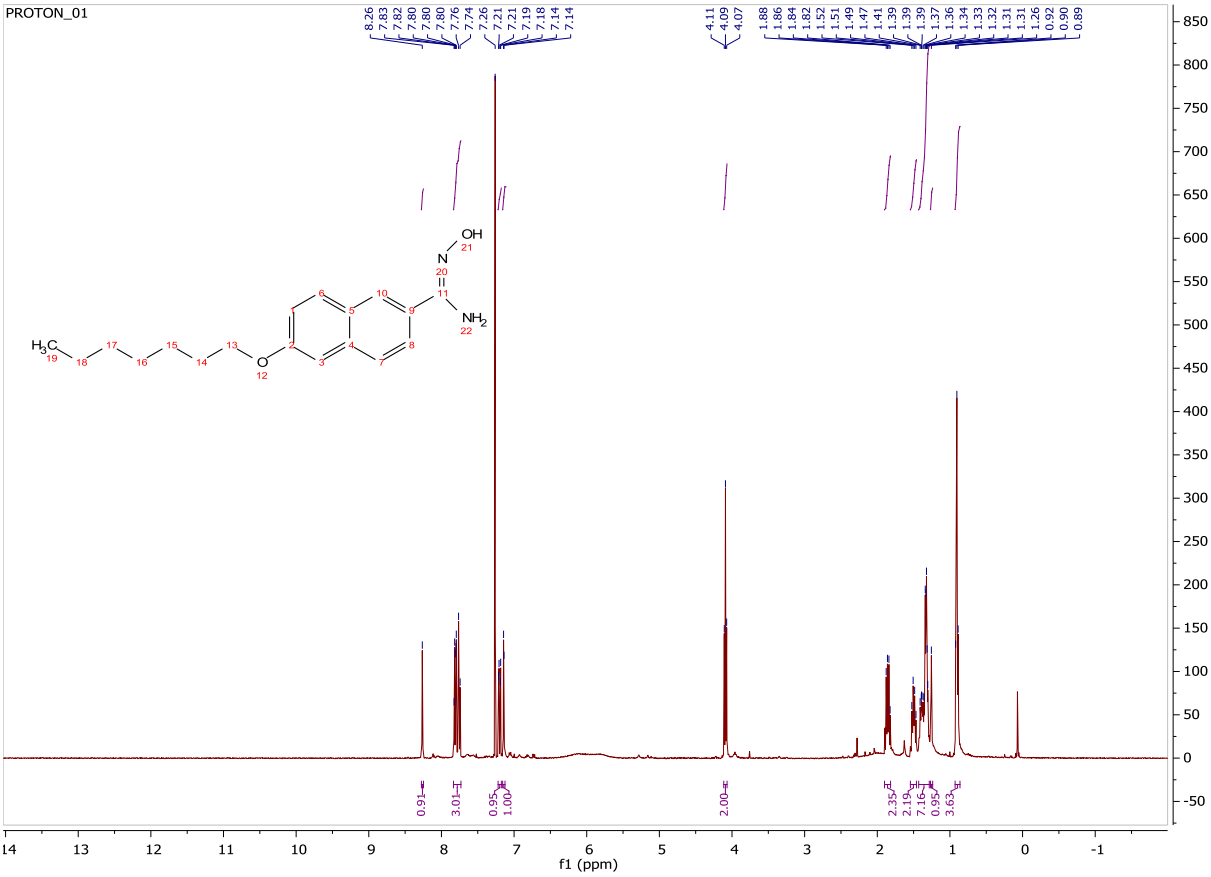
^{1}H-NMR Spectrum for 3.3c:



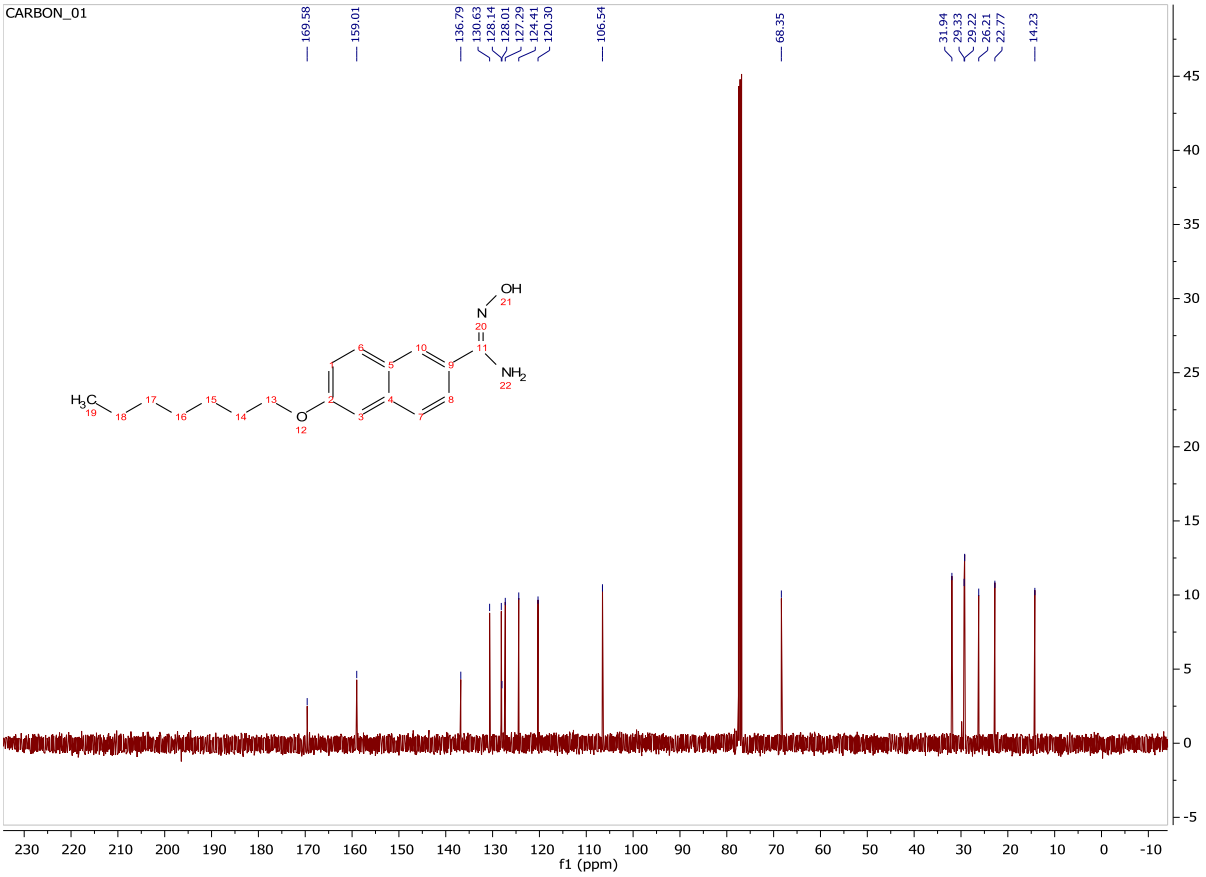
^{13}C-NMR Spectrum for 3.3c:



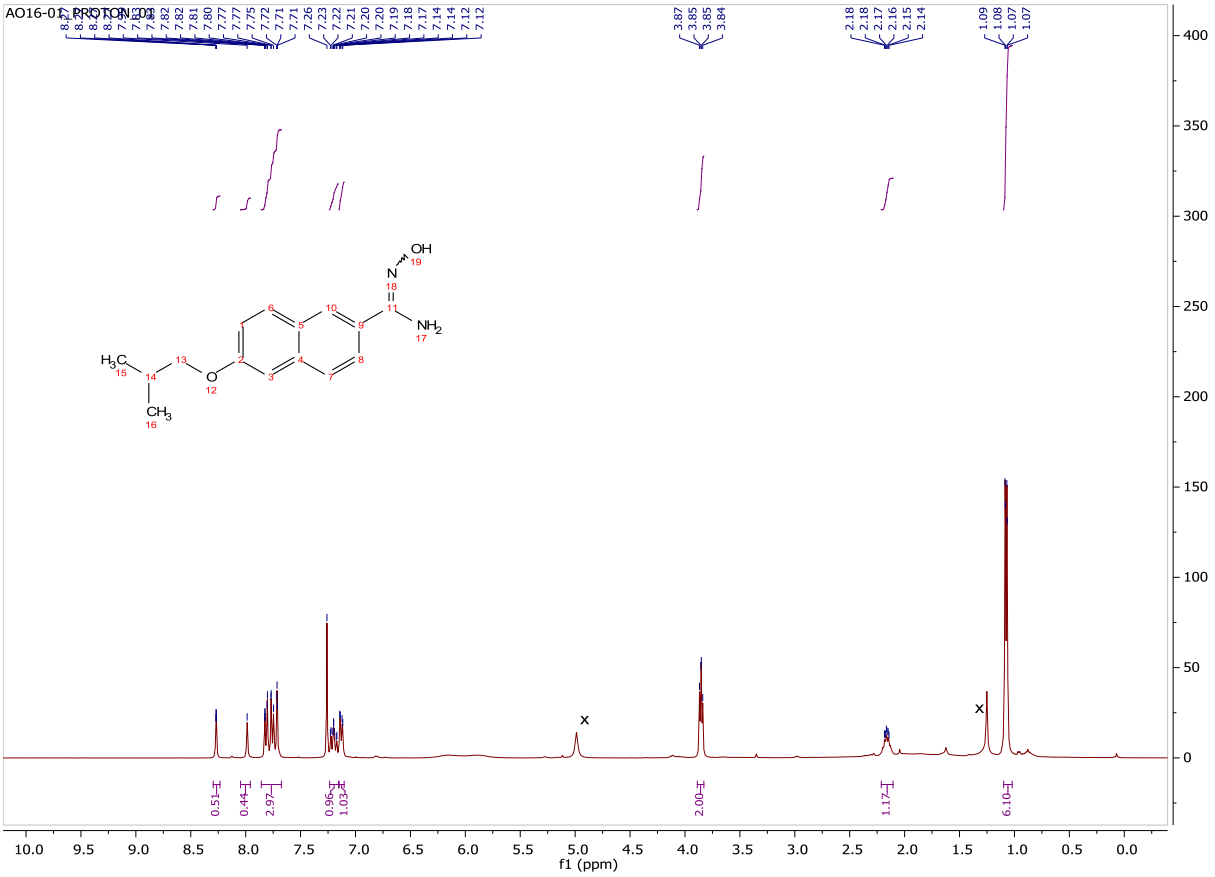
^{1}H-NMR Spectrum for 3.3d:



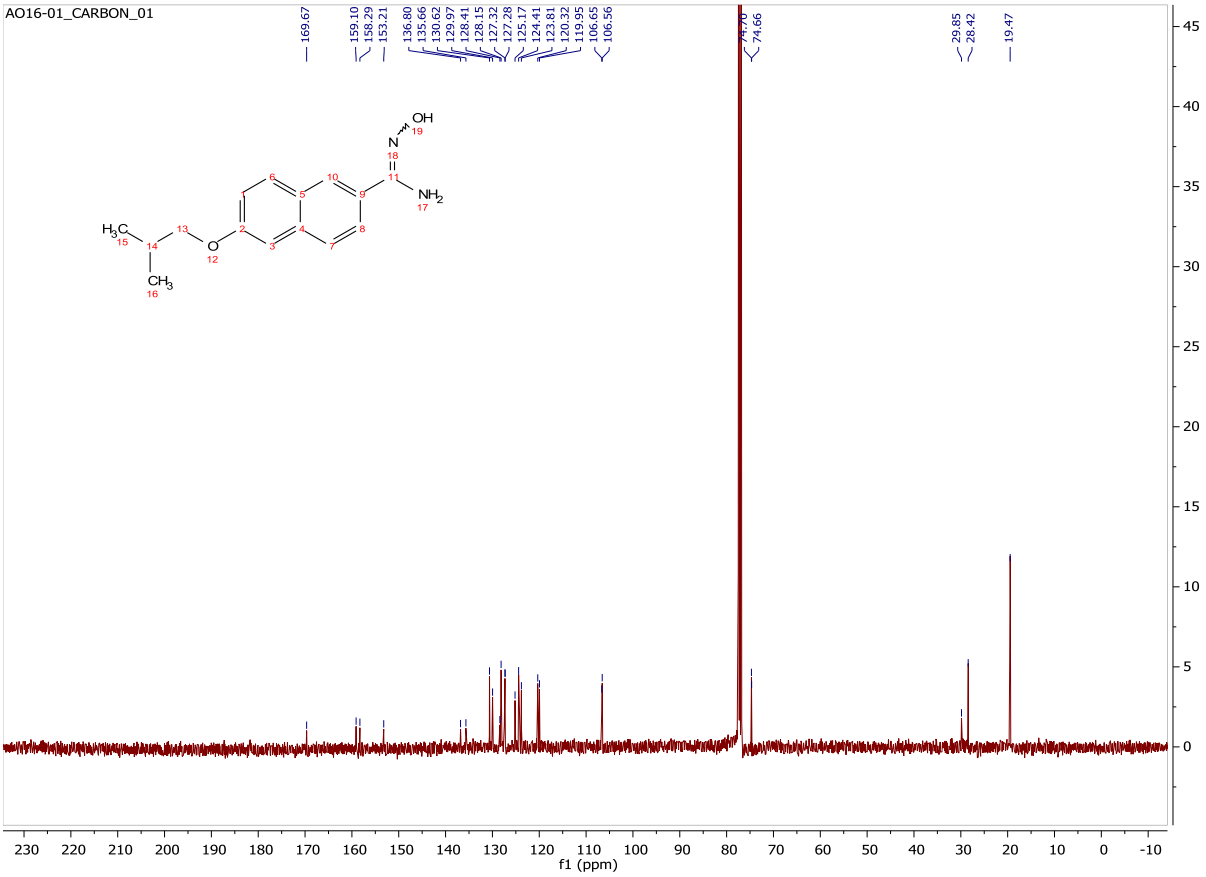
^{13}C-NMR Spectrum for 3.3d:



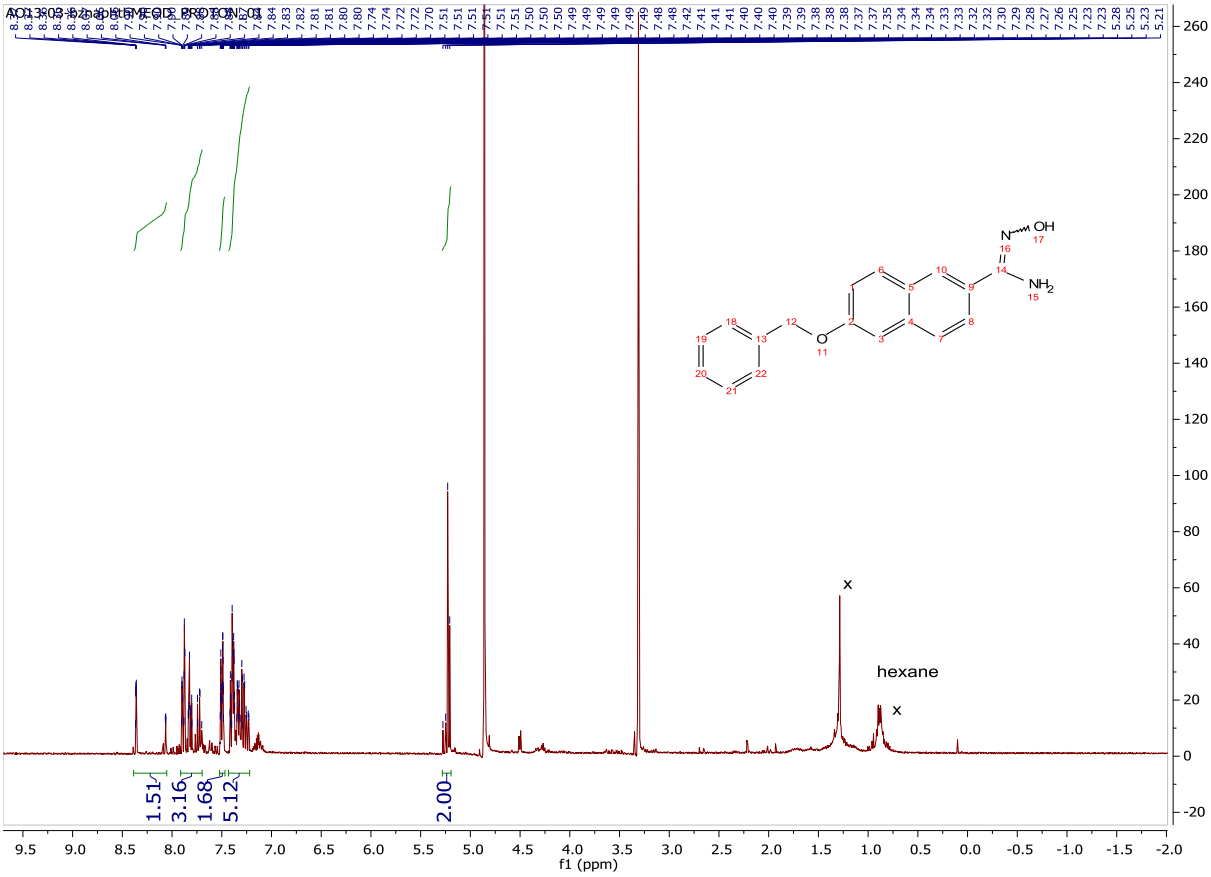
^{1}H-NMR Spectrum for 3.3e:



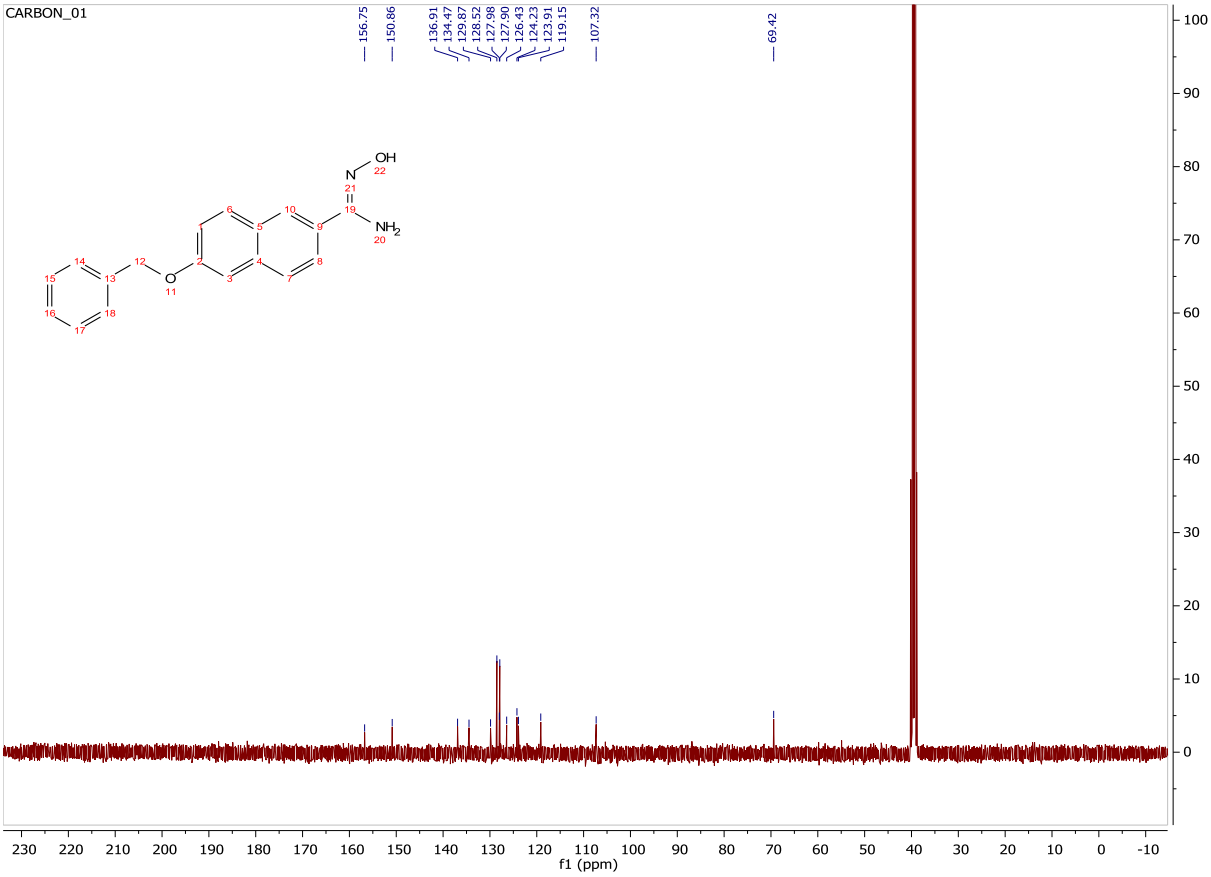
^{13}C-NMR Spectrum for 3.3e:



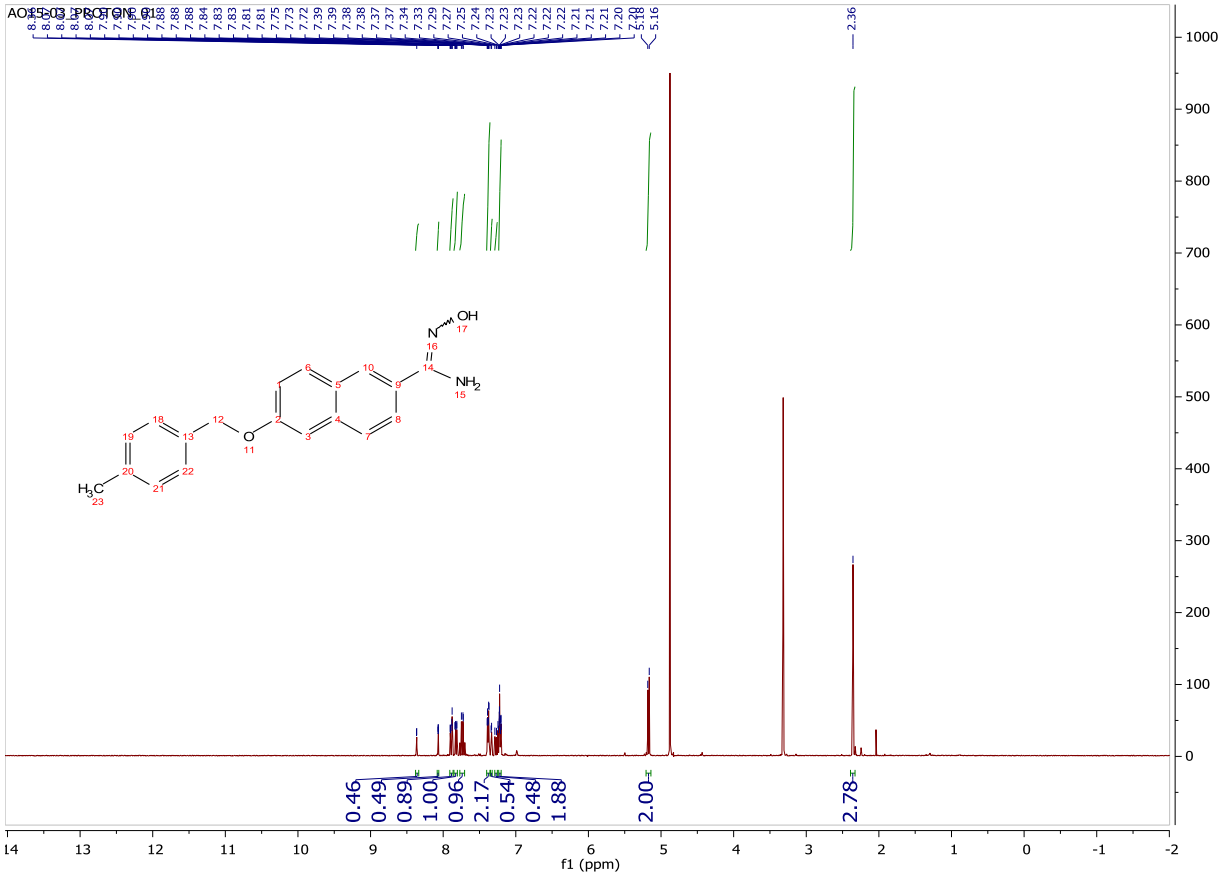
^{1}H-NMR Spectrum for 3.3f:



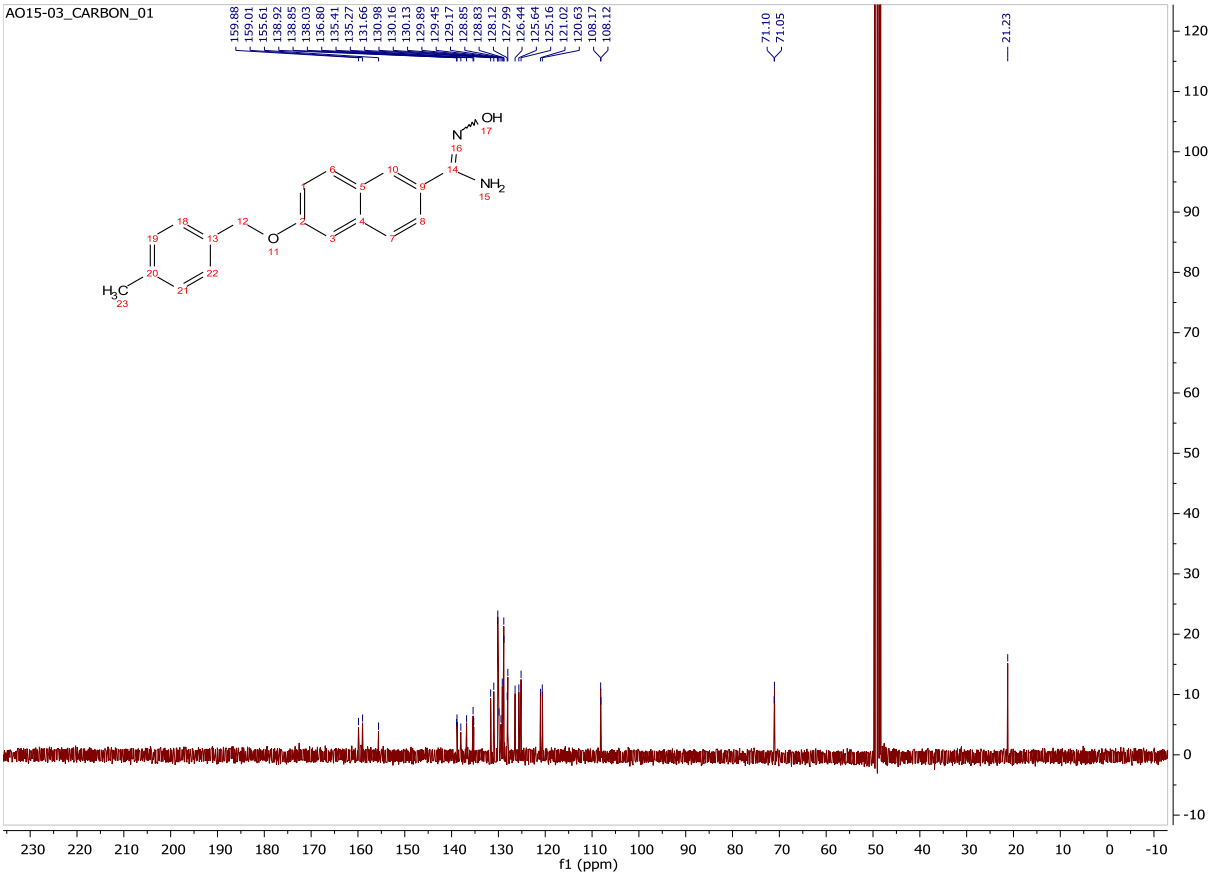
^{13}C-NMR Spectrum for 3.3f:



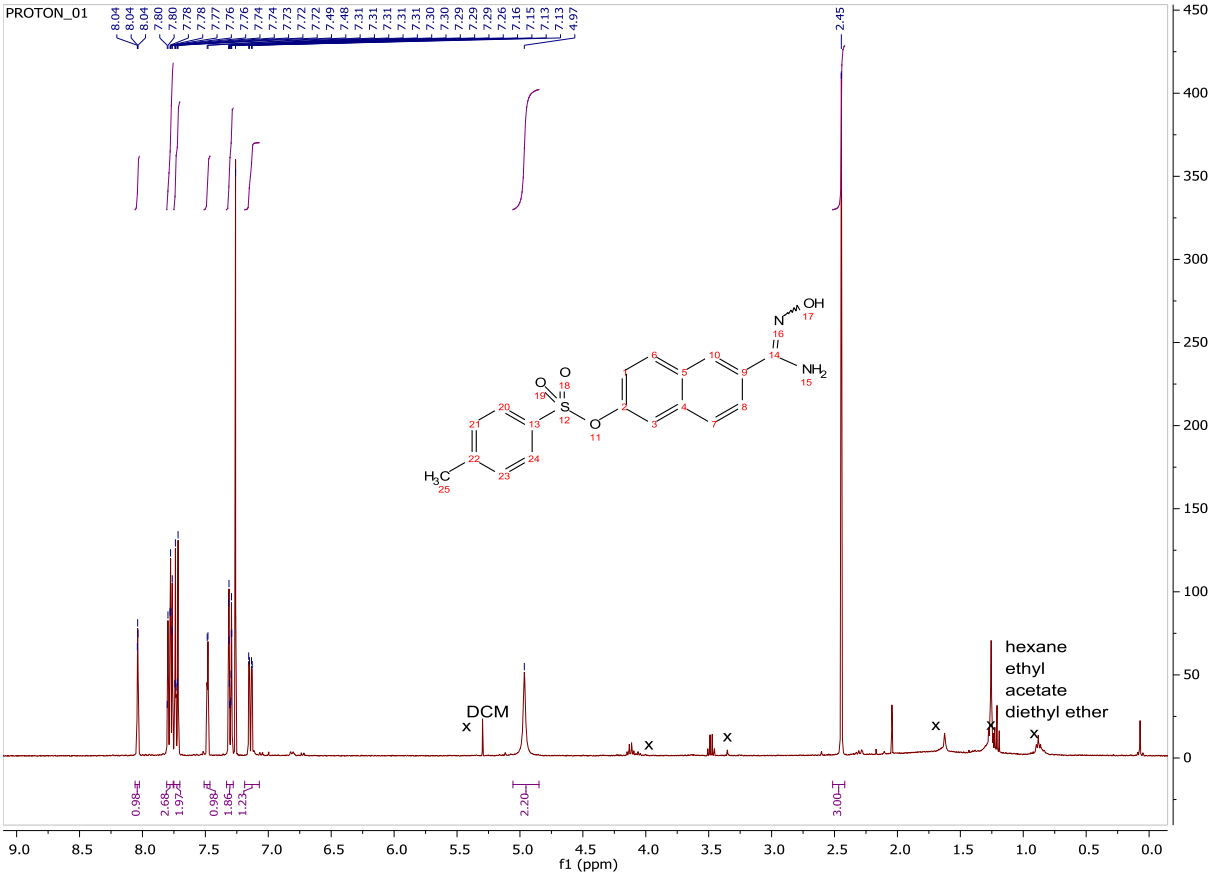
^{1}H-NMR Spectrum for 3.3g:



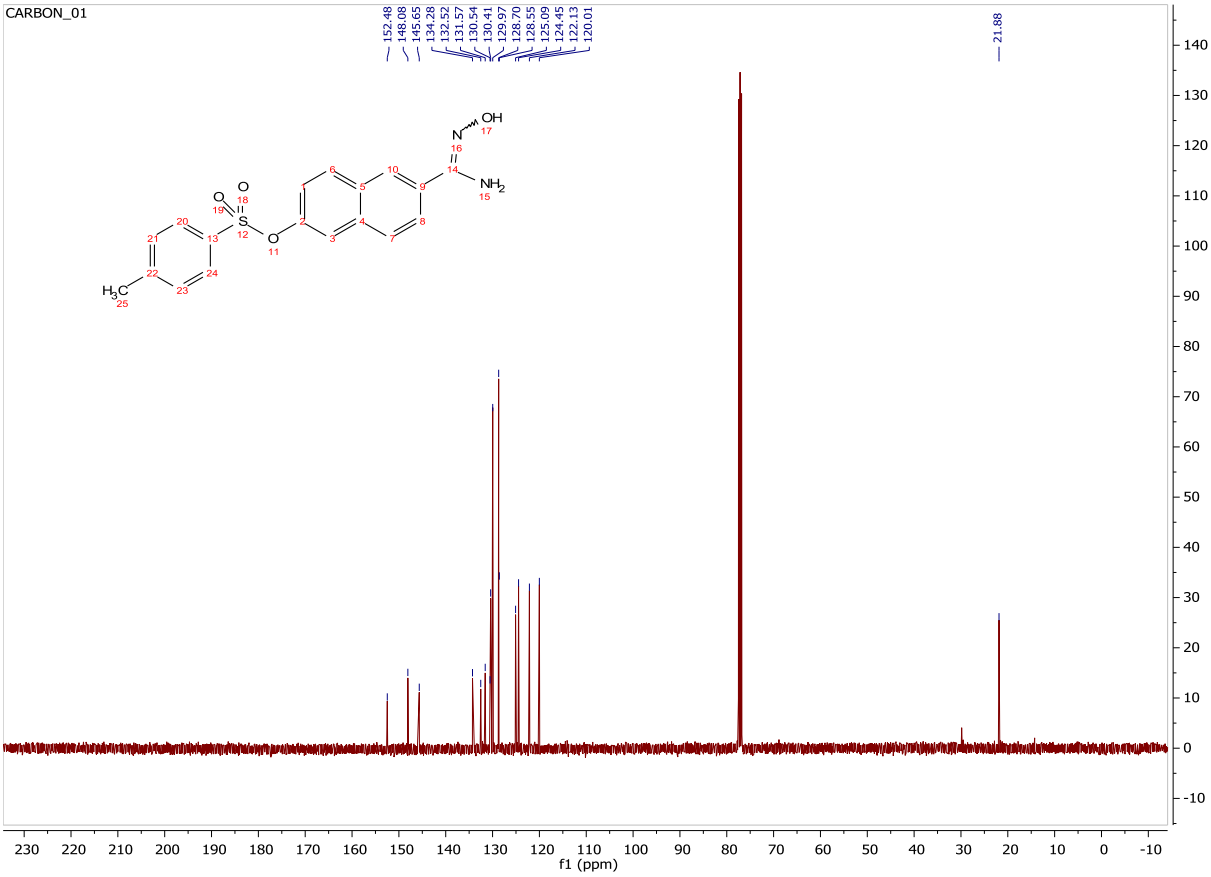
^{13}C-NMR Spectrum for 3.3g:



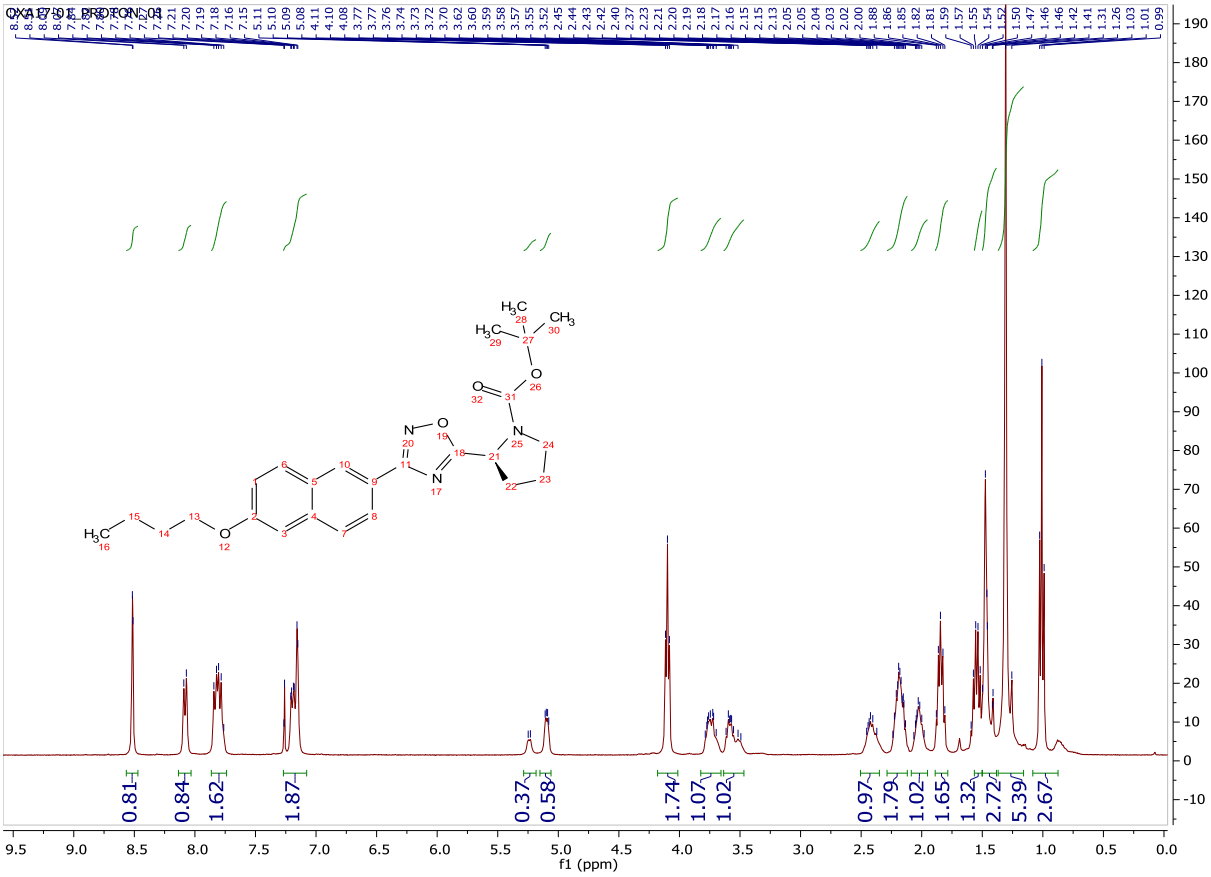
^{1}H-NMR Spectrum for 3.3h:



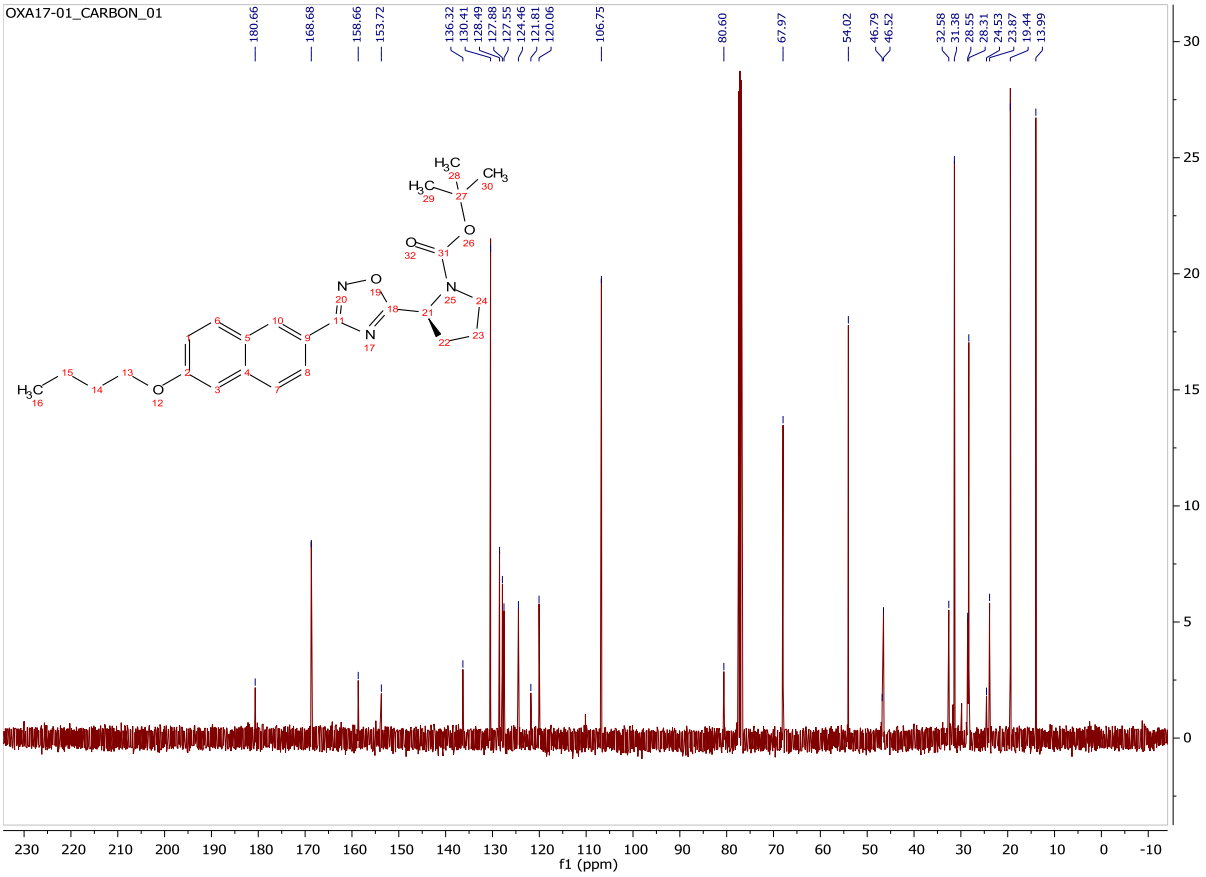
^{13}C-NMR Spectrum for 3.3h:



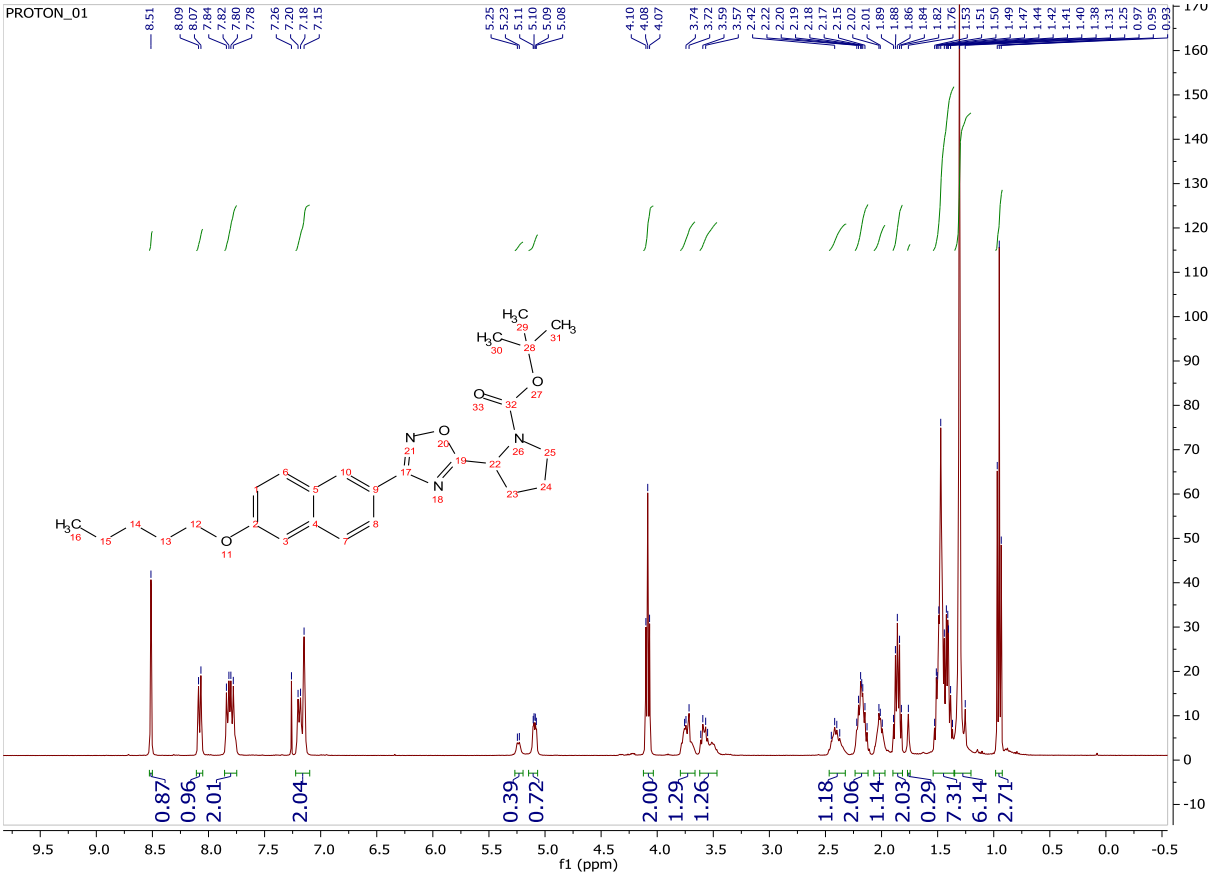
^{1}H-NMR Spectrum for 3.4a:



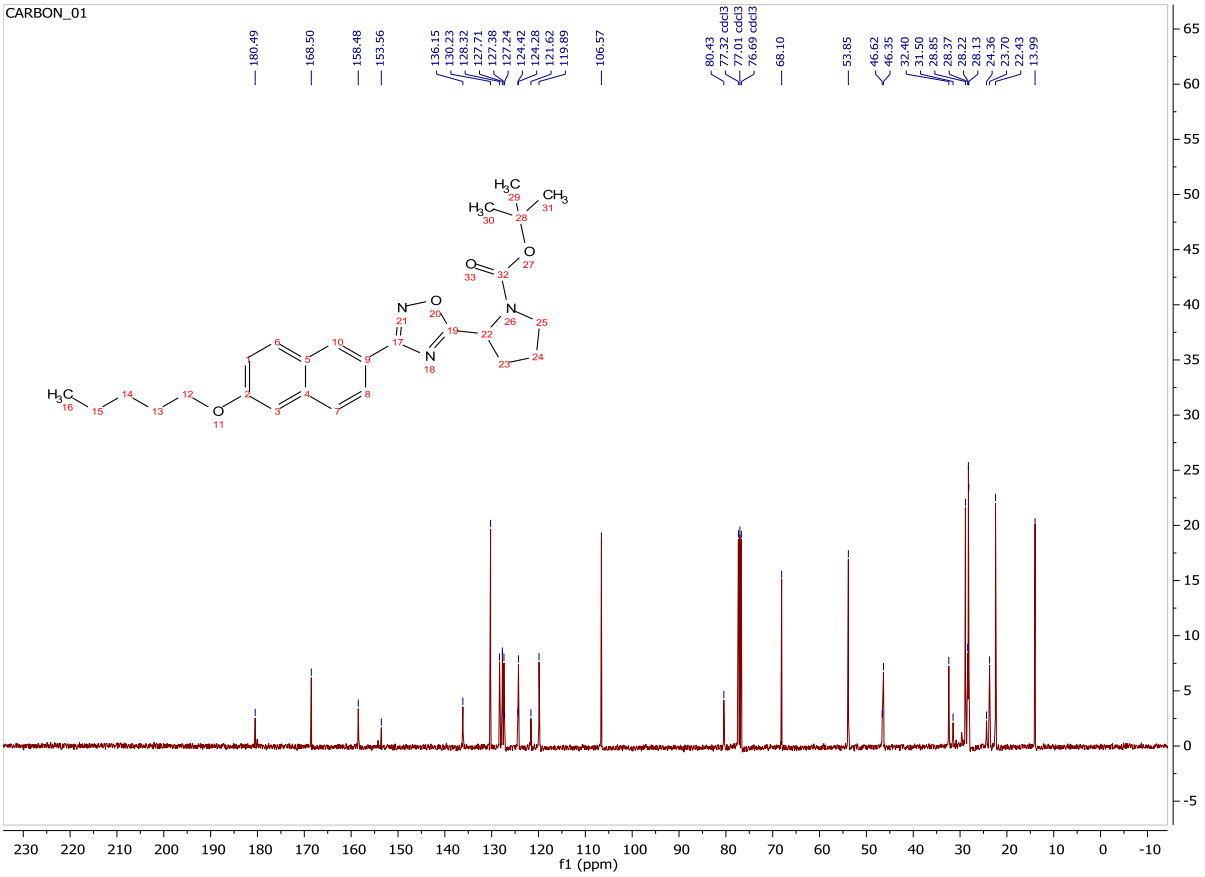
^{13}C-NMR Spectrum for 3.4a:



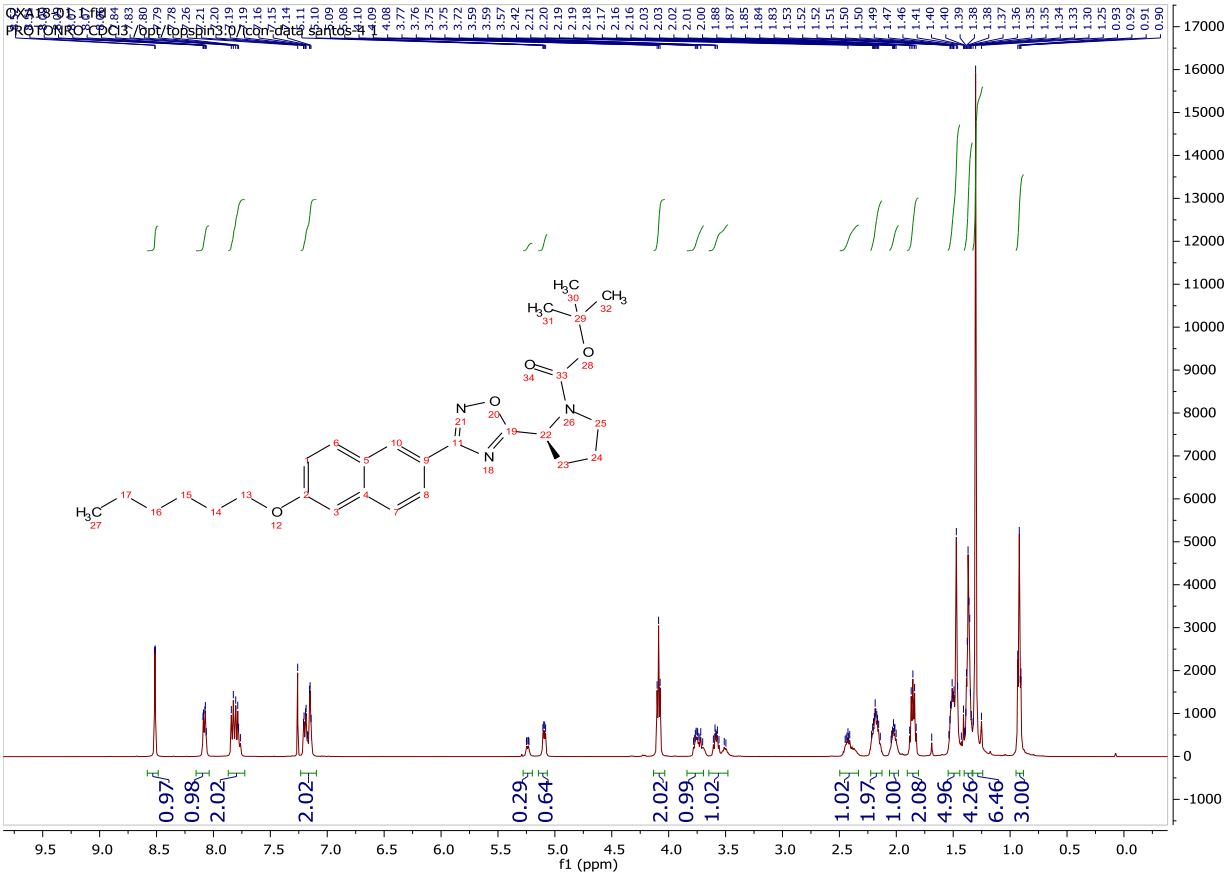
^{1}H-NMR Spectrum for 3.4b:



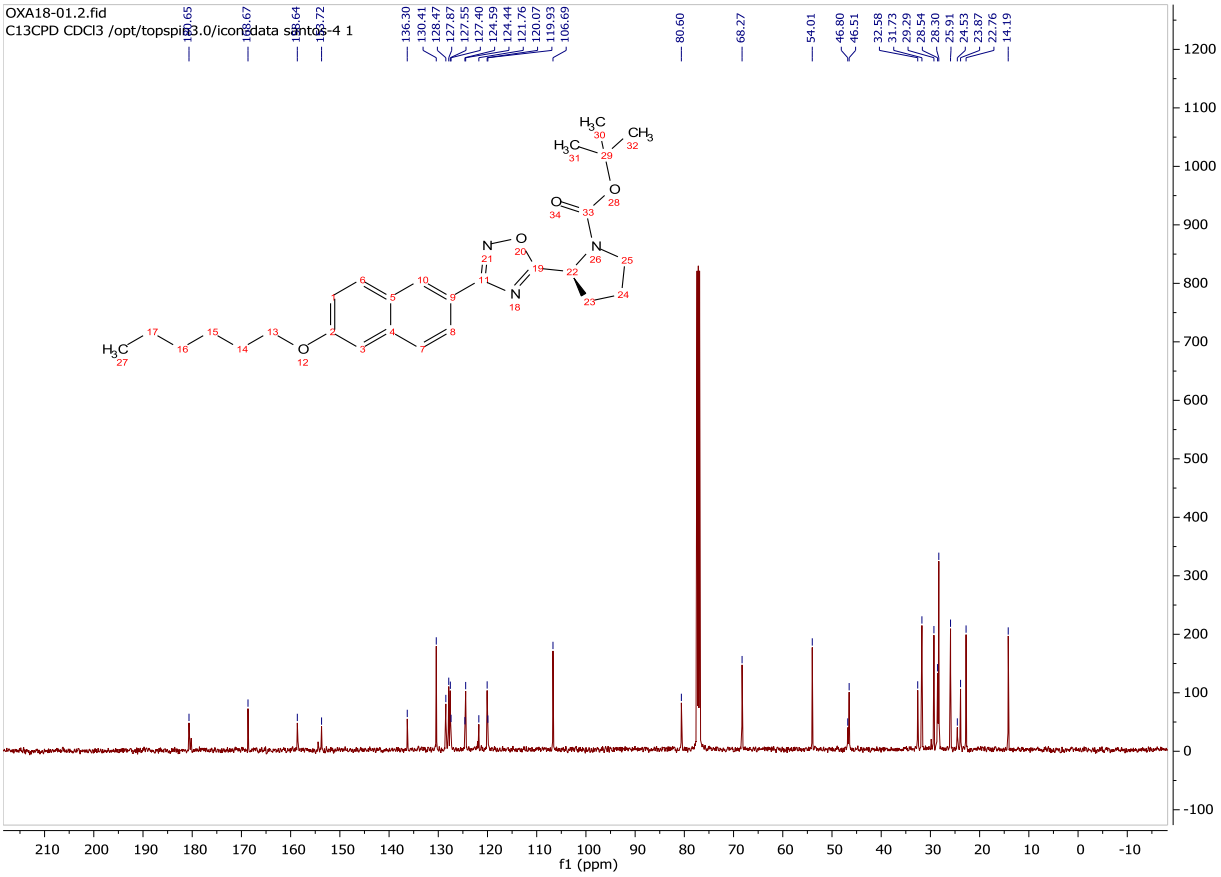
^{13}C-NMR Spectrum for 3.4b:



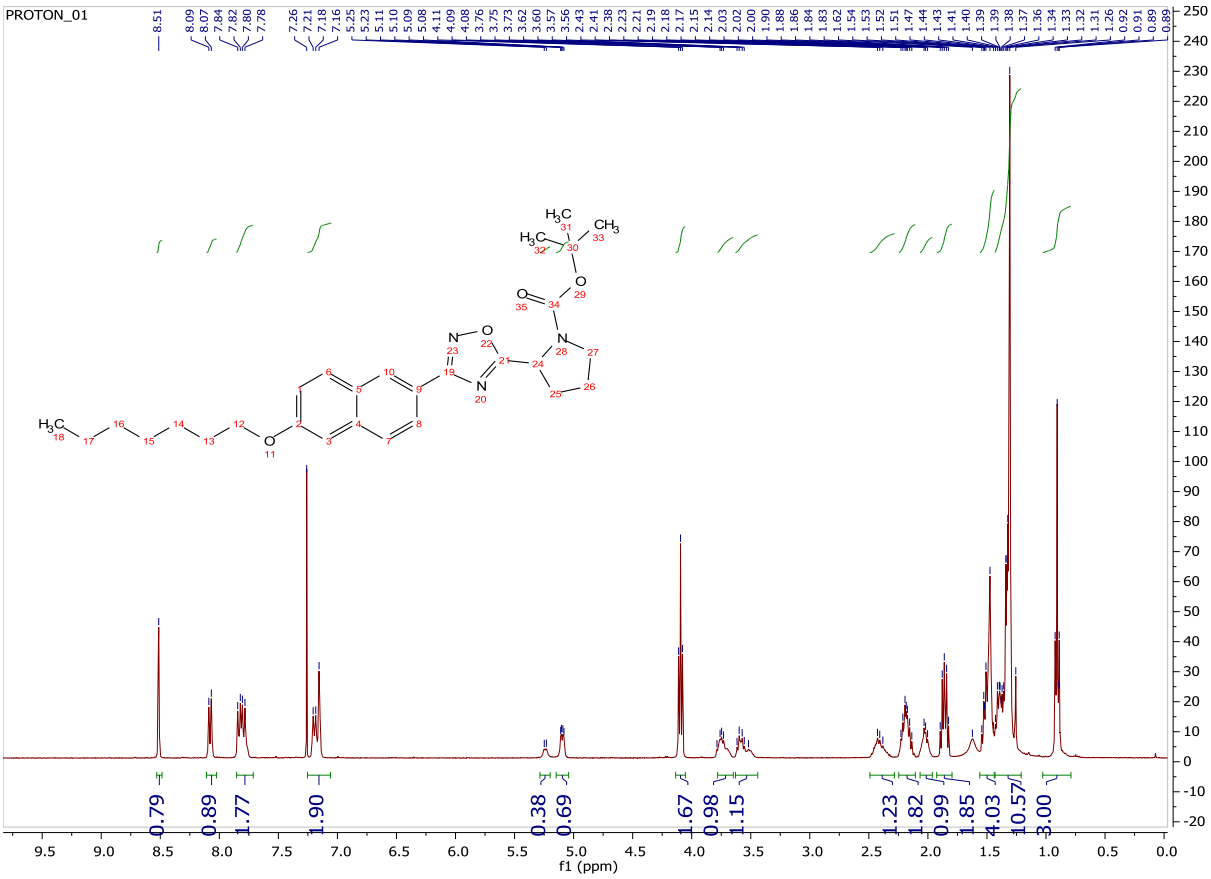
^{1}H-NMR Spectrum for 3.4c:



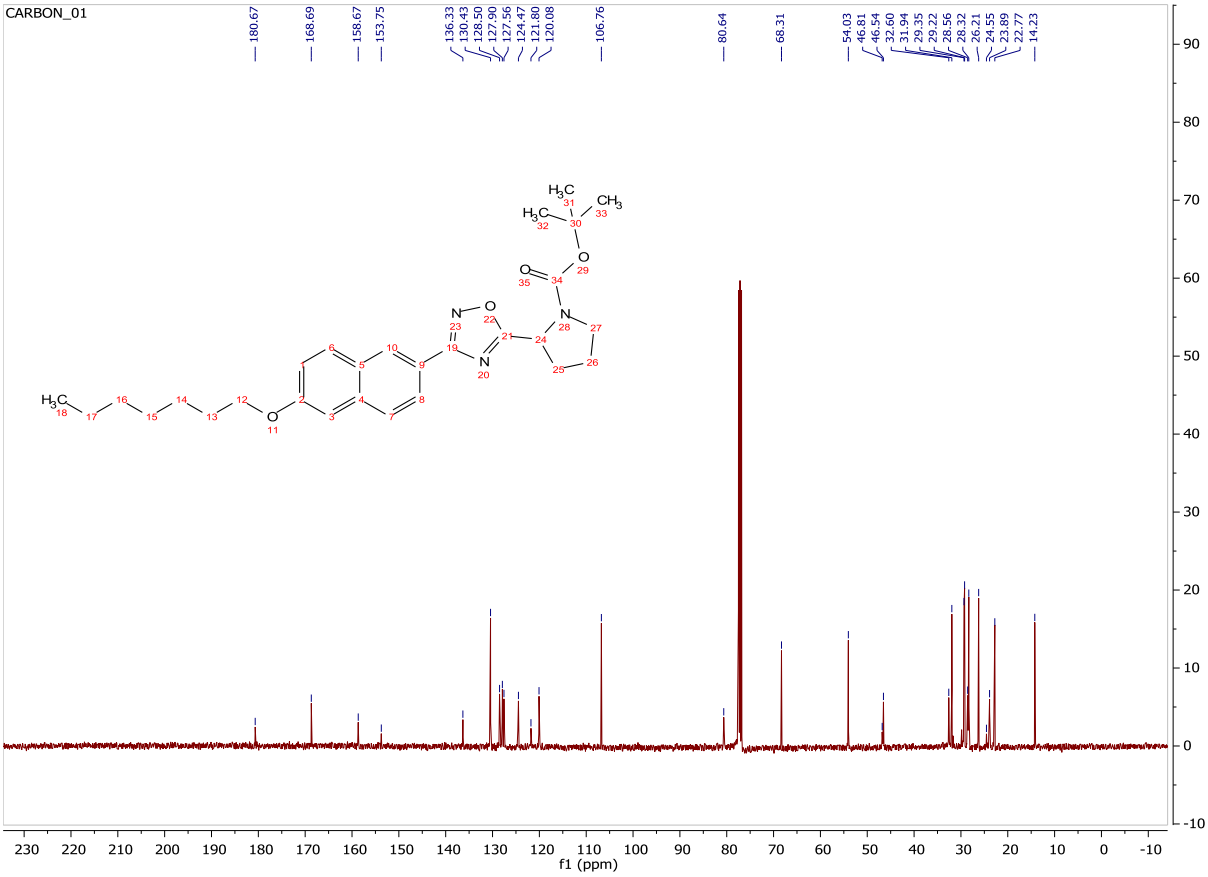
^{13}C-NMR Spectrum for 3.4c:



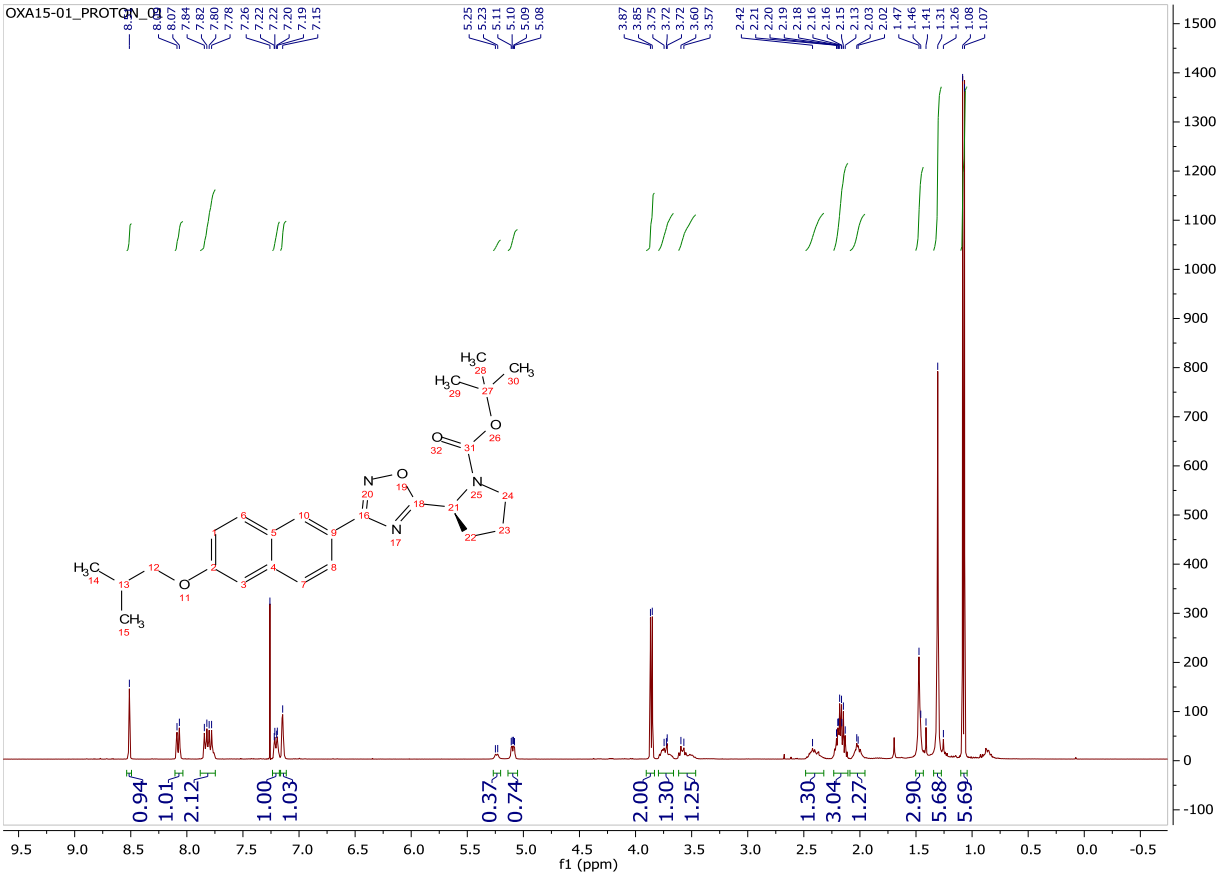
^{1}H-NMR Spectrum for 3.4d:



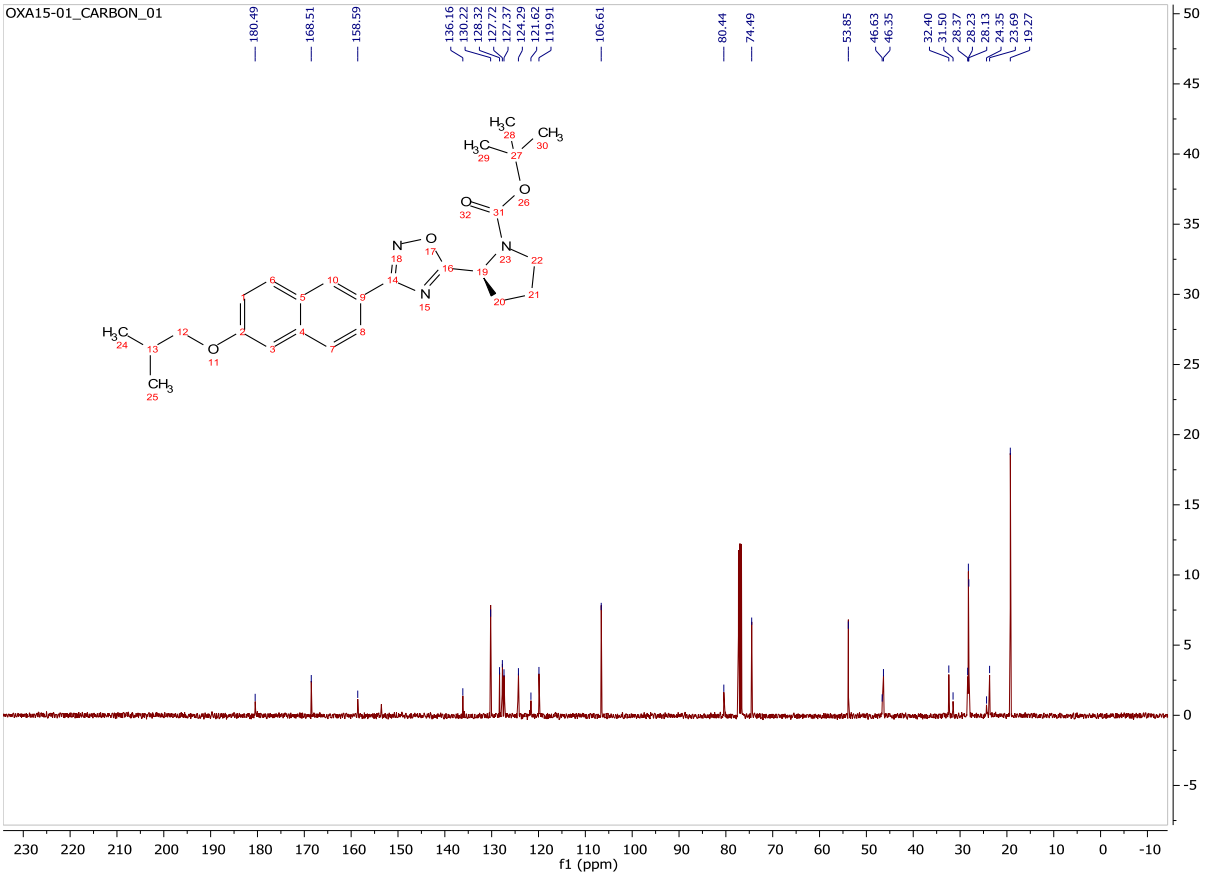
^{13}C-NMR Spectrum for 3.4d:



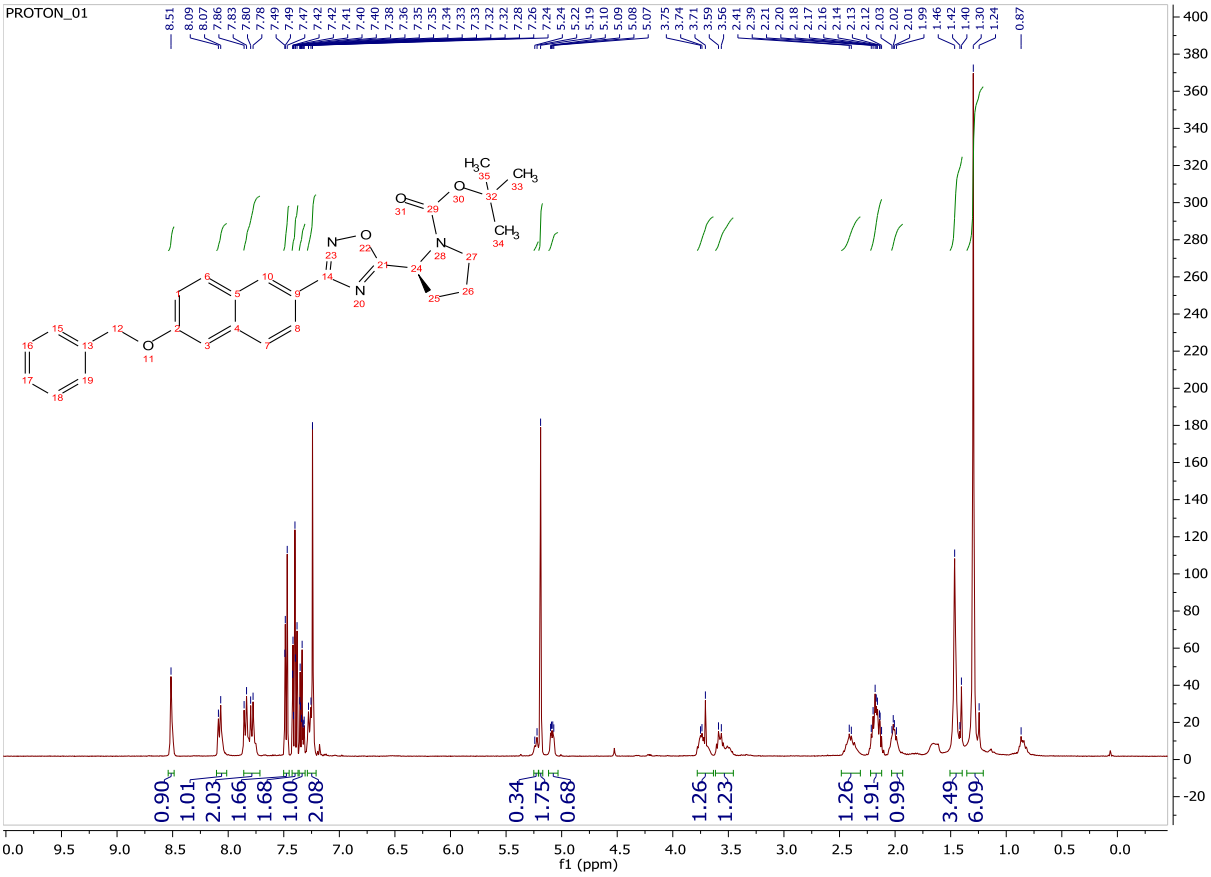
^{1}H-NMR Spectrum for 3.4e:



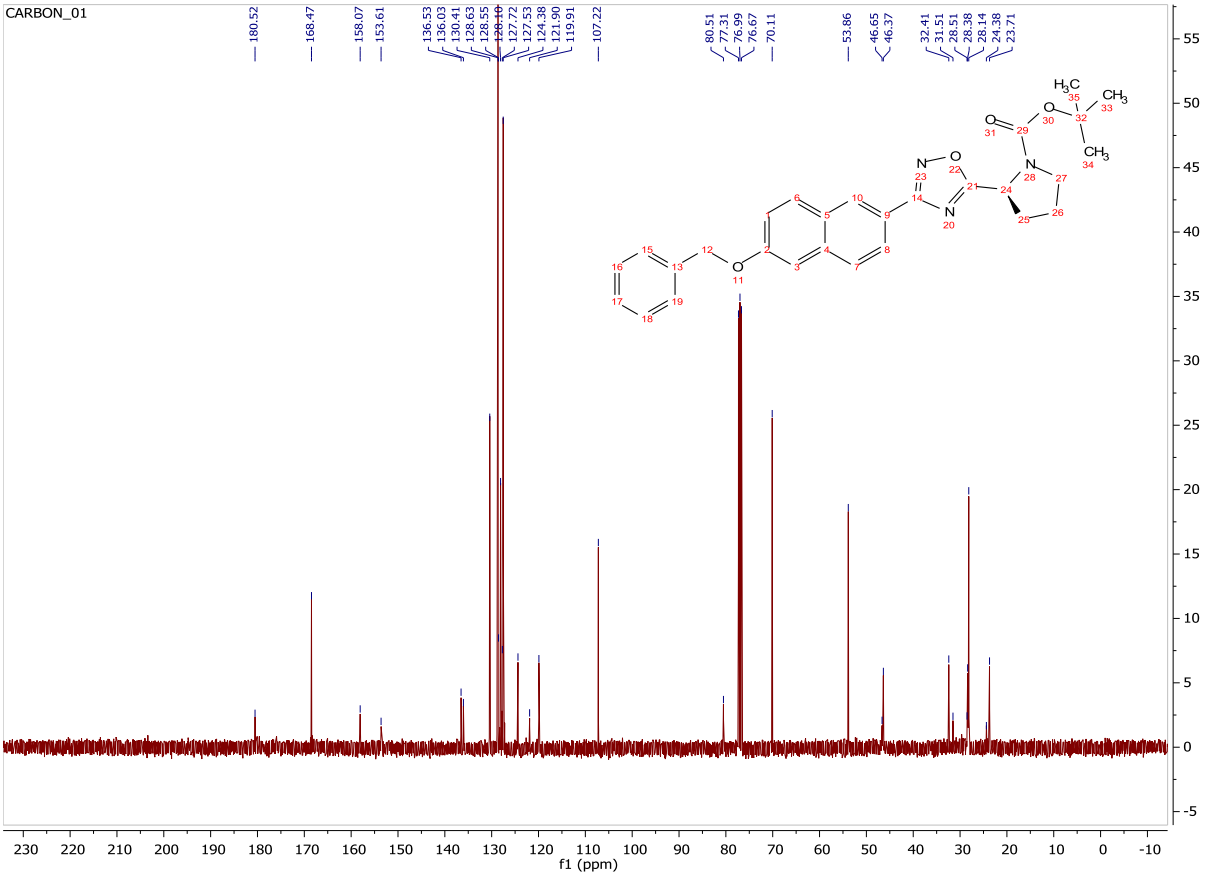
^{13}C-NMR Spectrum for 3.4e:



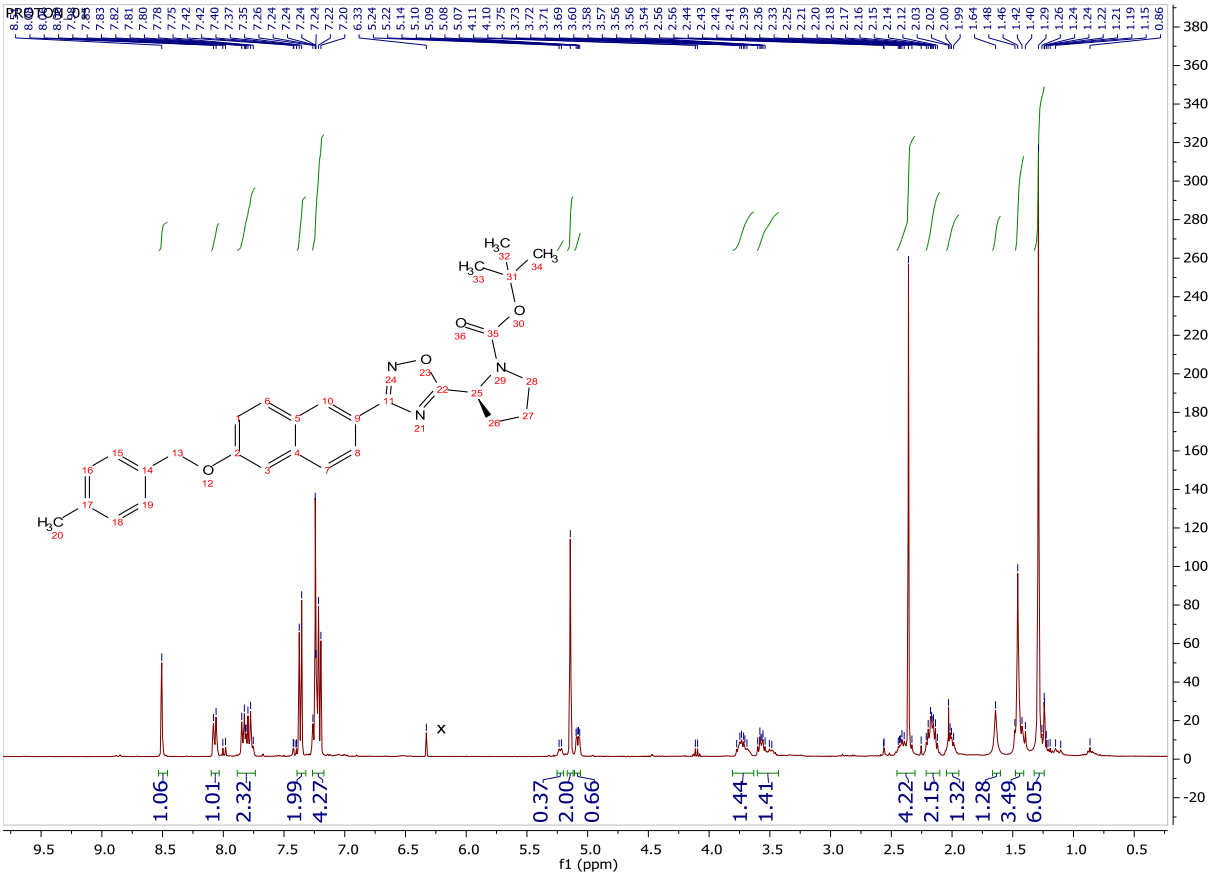
^{1}H-NMR Spectrum for 3.4f:



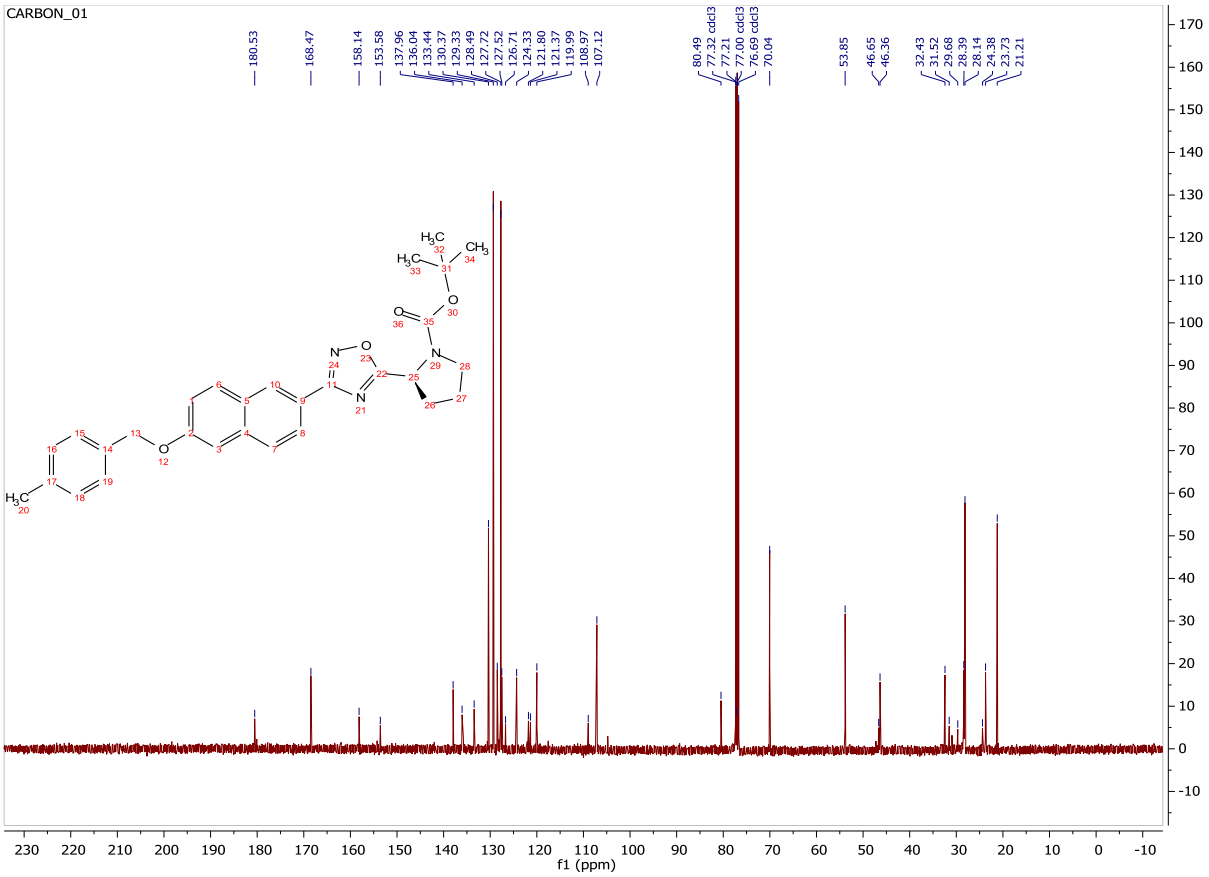
^{13}C-NMR Spectrum for 3.4f:



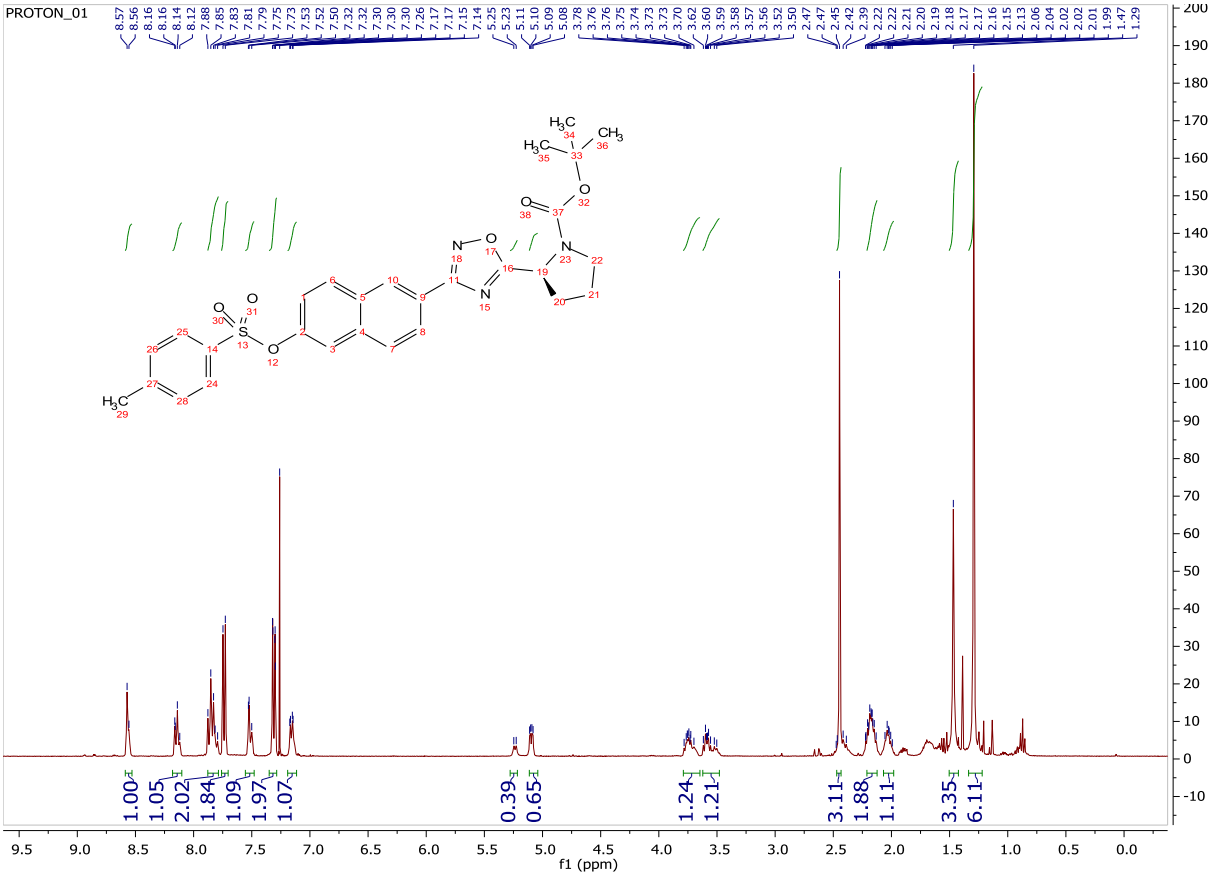
^{1}H-NMR Spectrum for 3.4g:



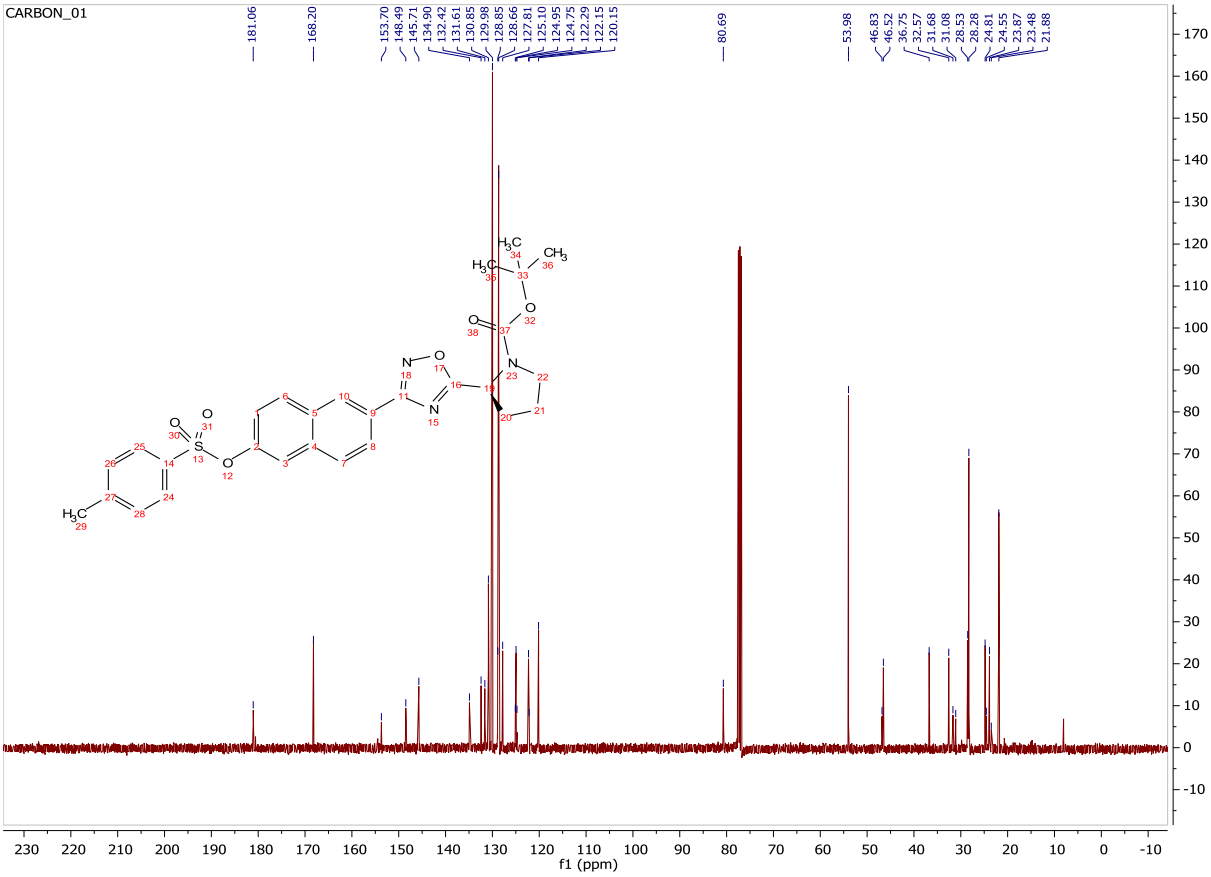
^{13}C-NMR Spectrum for 3.4g:



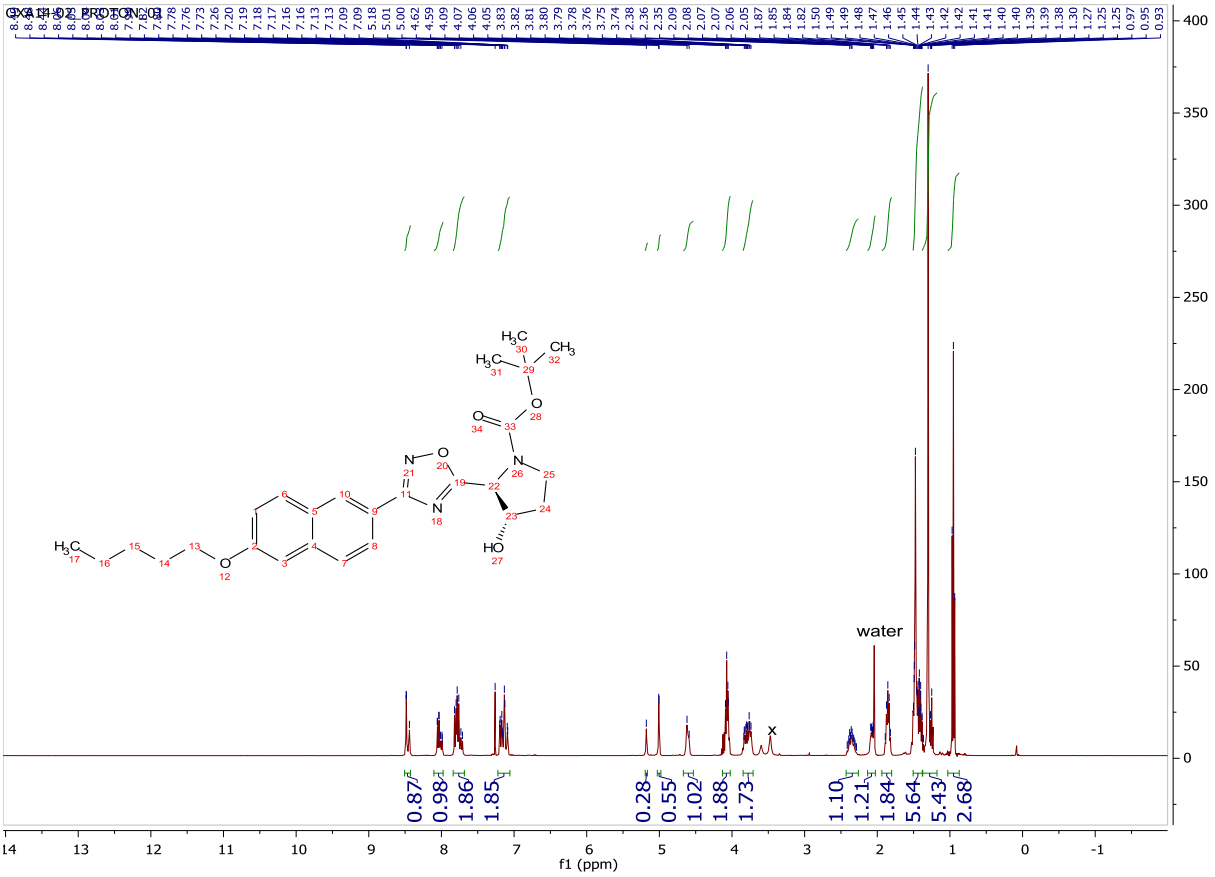
^{1}H-NMR Spectrum for 3.4h:



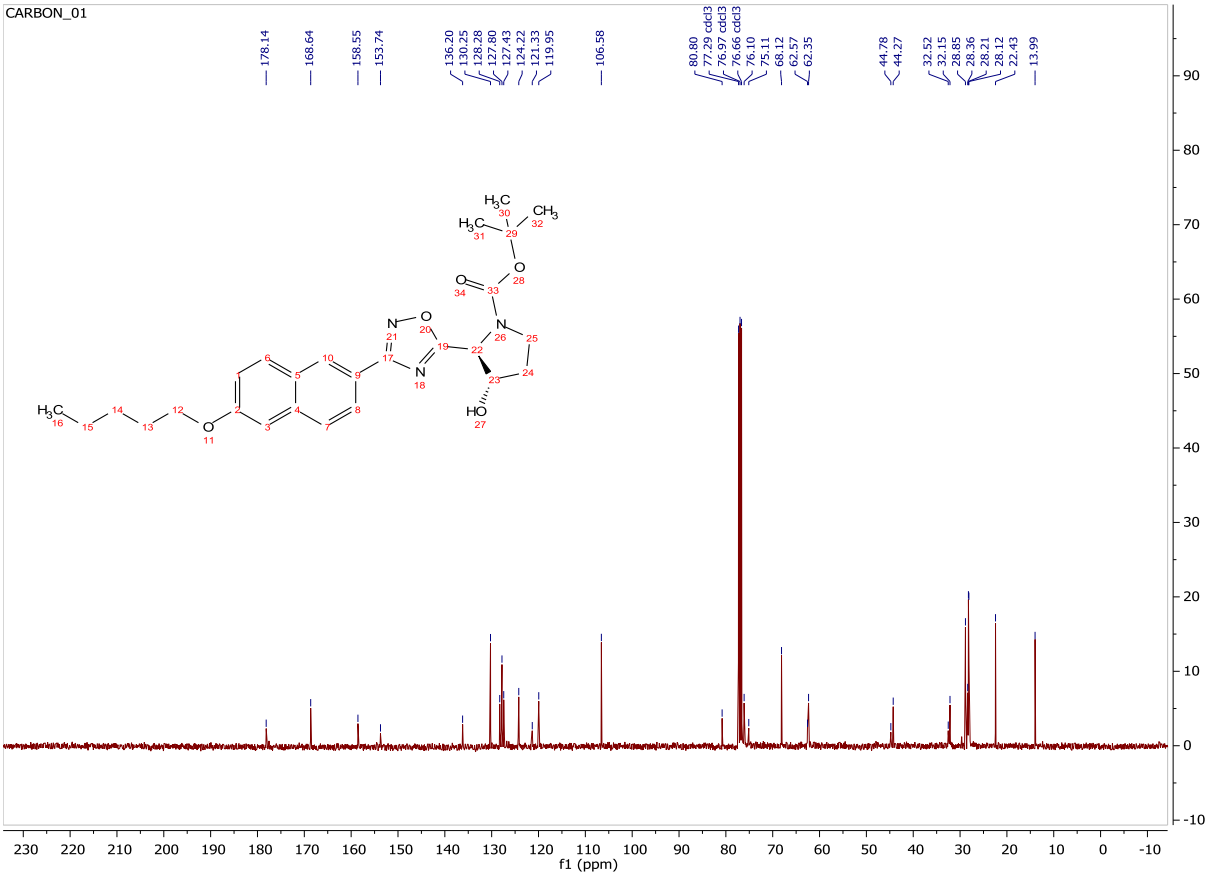
^{13}C-NMR Spectrum for 3.4h:



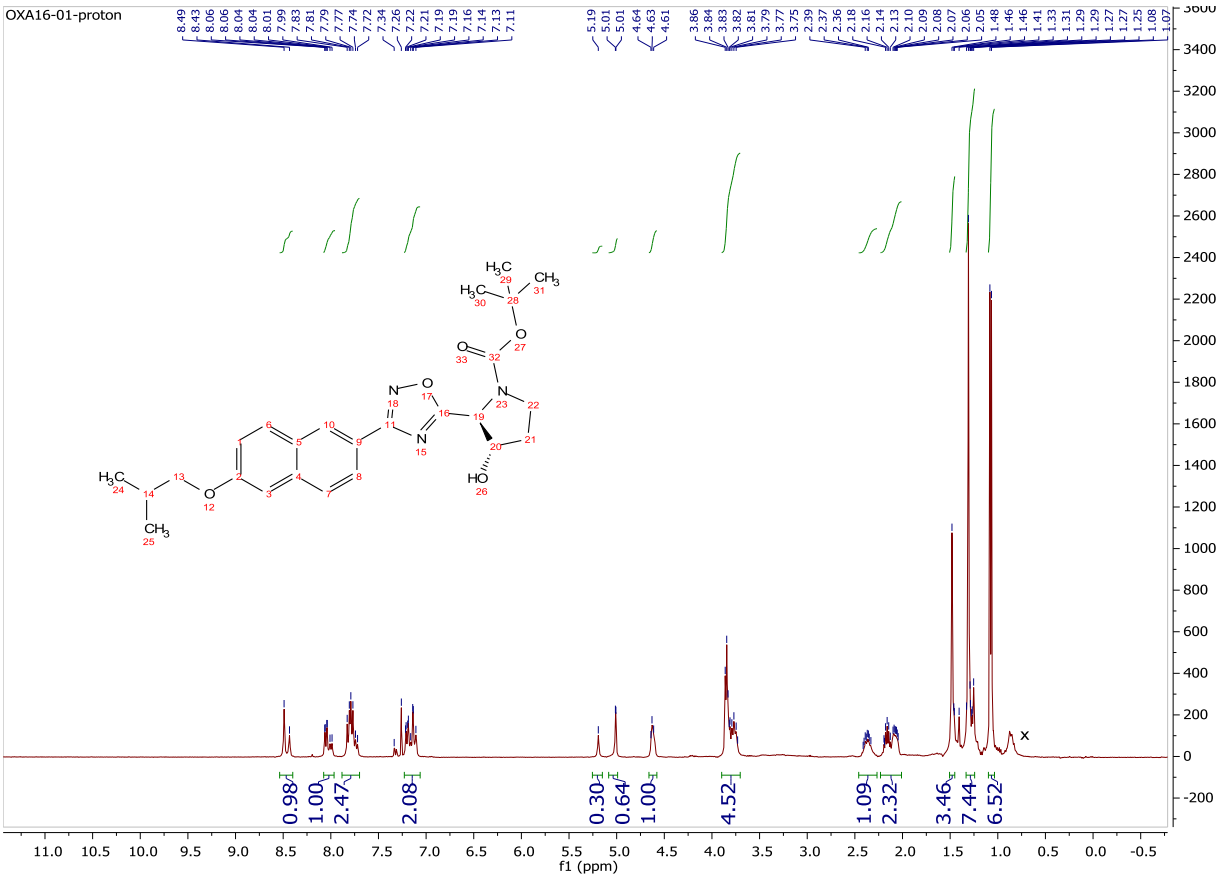
^{1}H-NMR Spectrum for 3.4i:



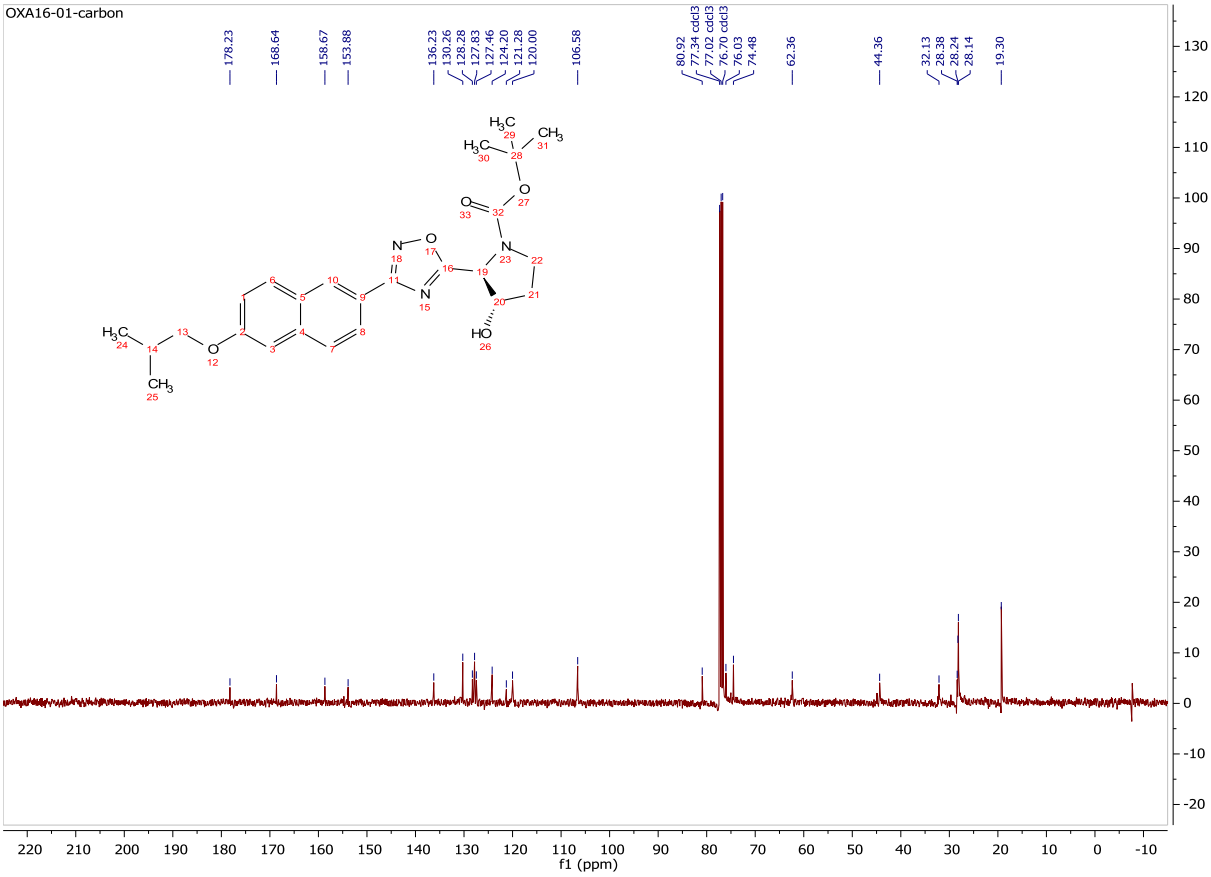
^{13}C-NMR Spectrum for 3.4i:



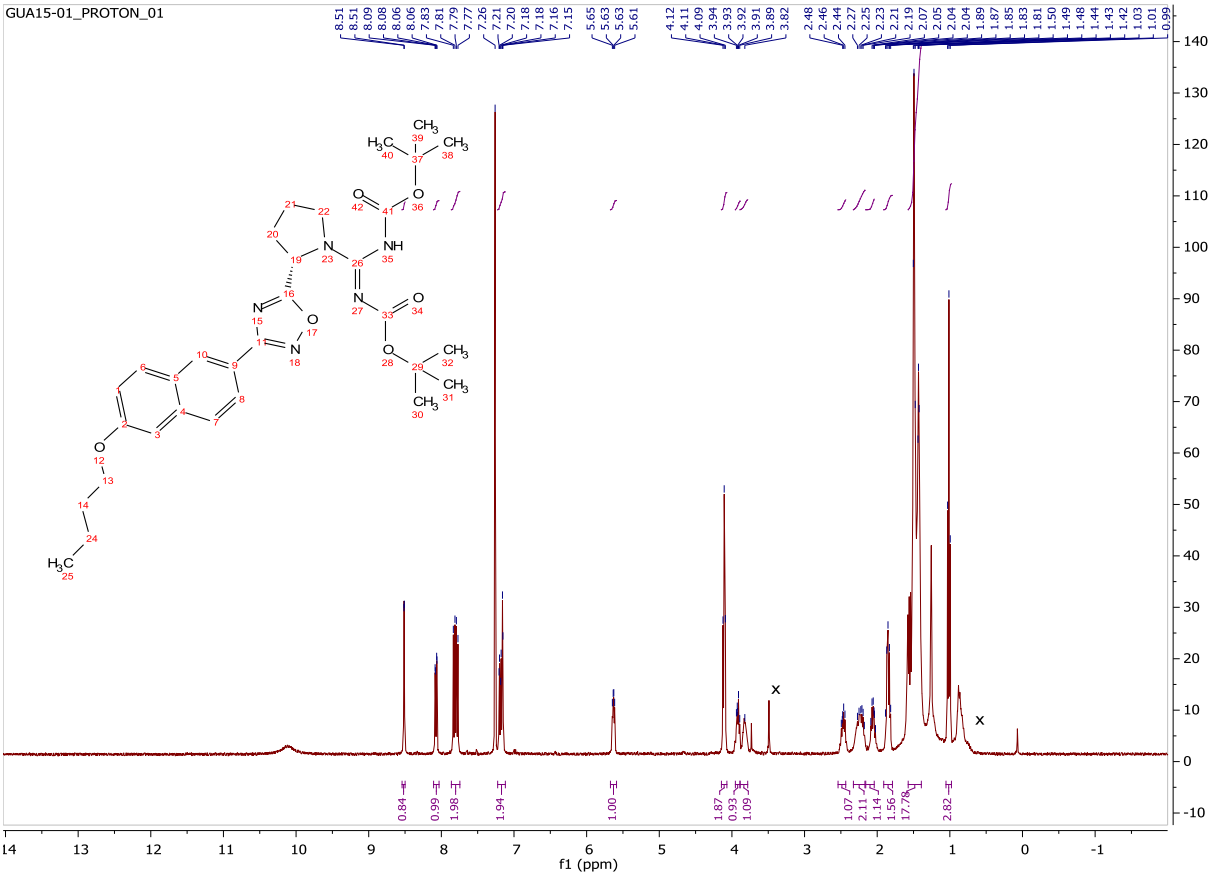
^{1}H-NMR Spectrum for 3.4j:



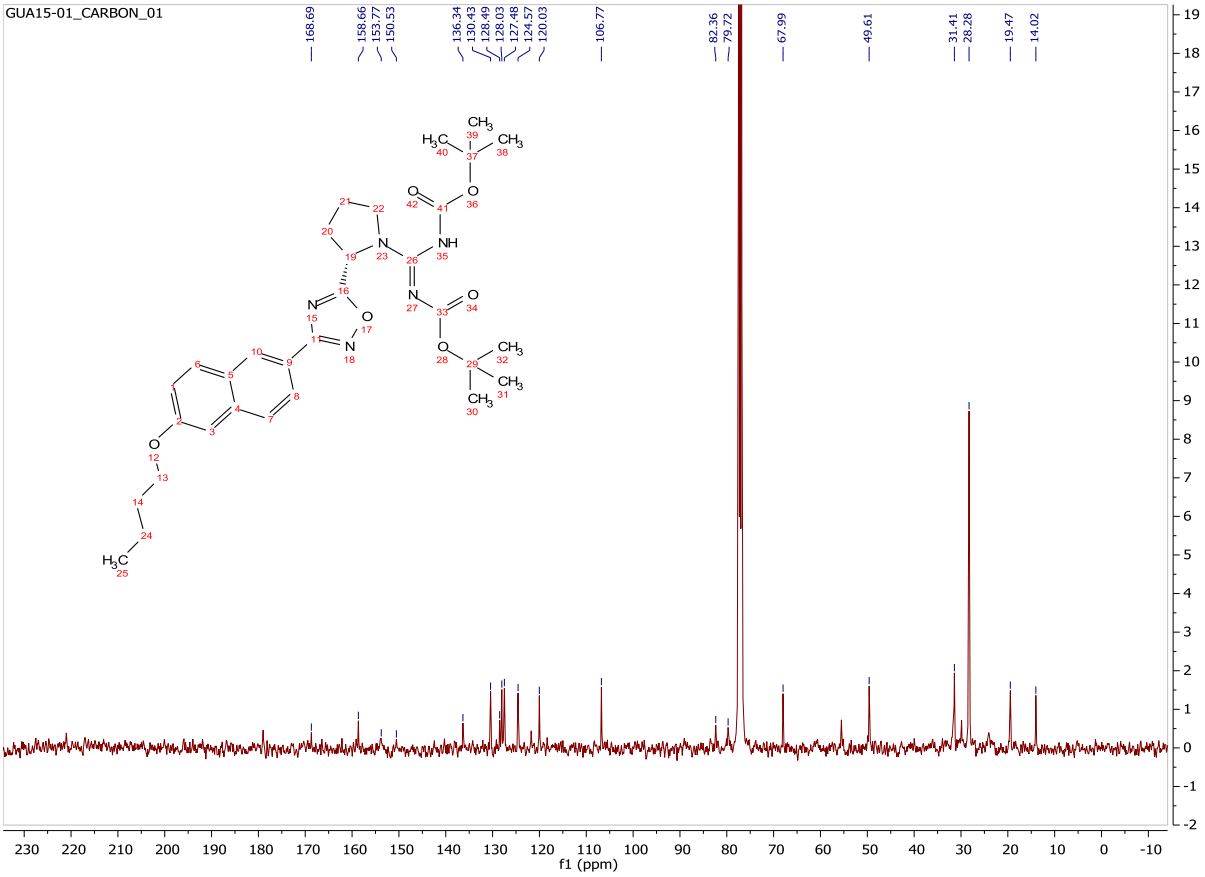
^{13}C-NMR Spectrum for 3.4j:



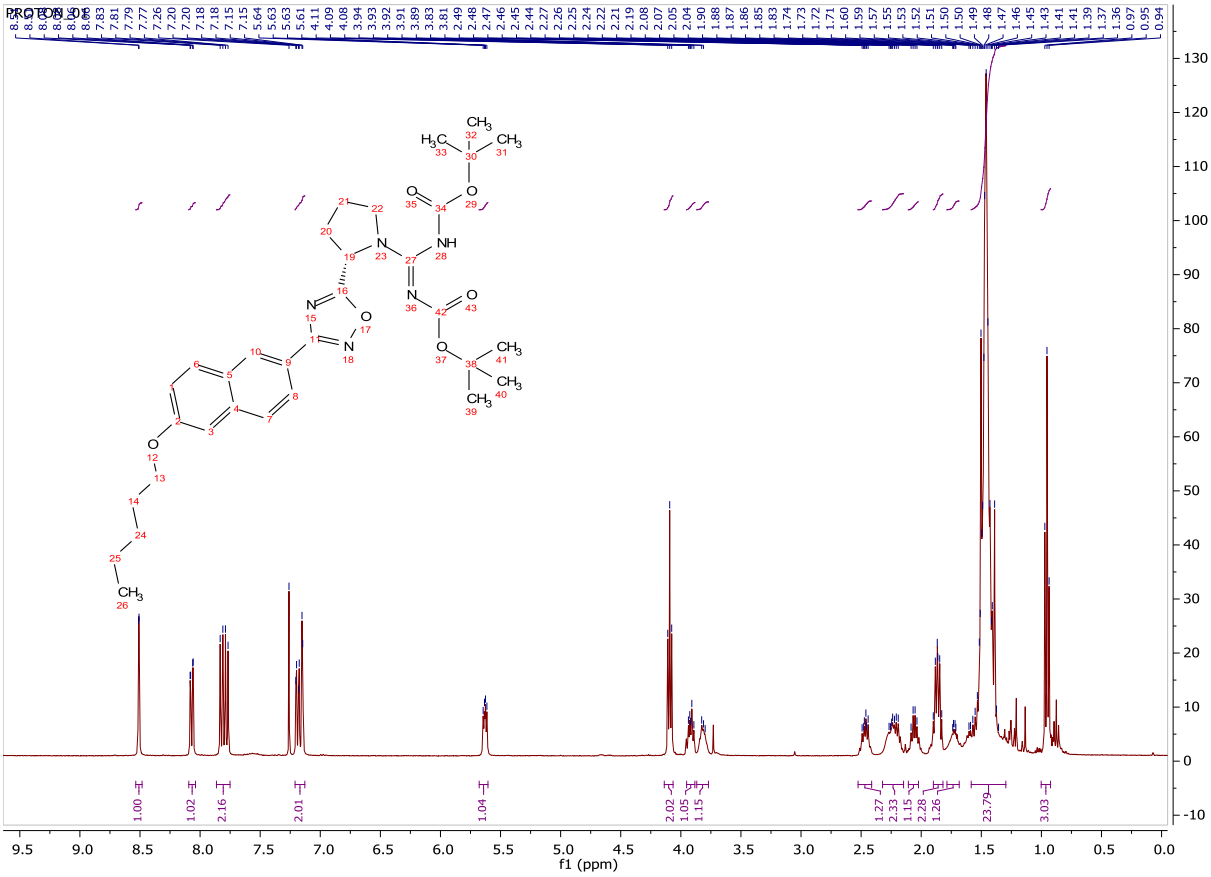
^{1}H-NMR Spectrum for 3.6a:



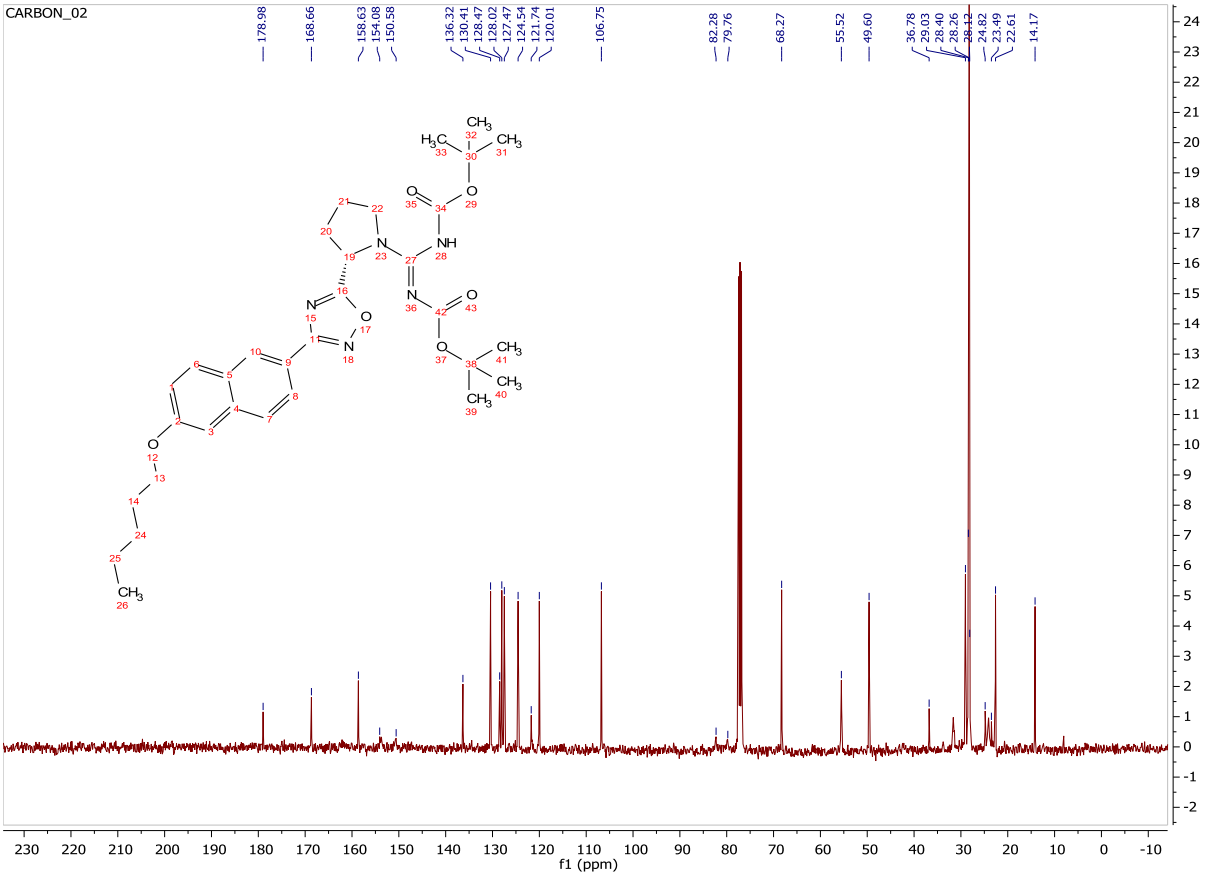
^{13}C-NMR Spectrum for 3.6a:



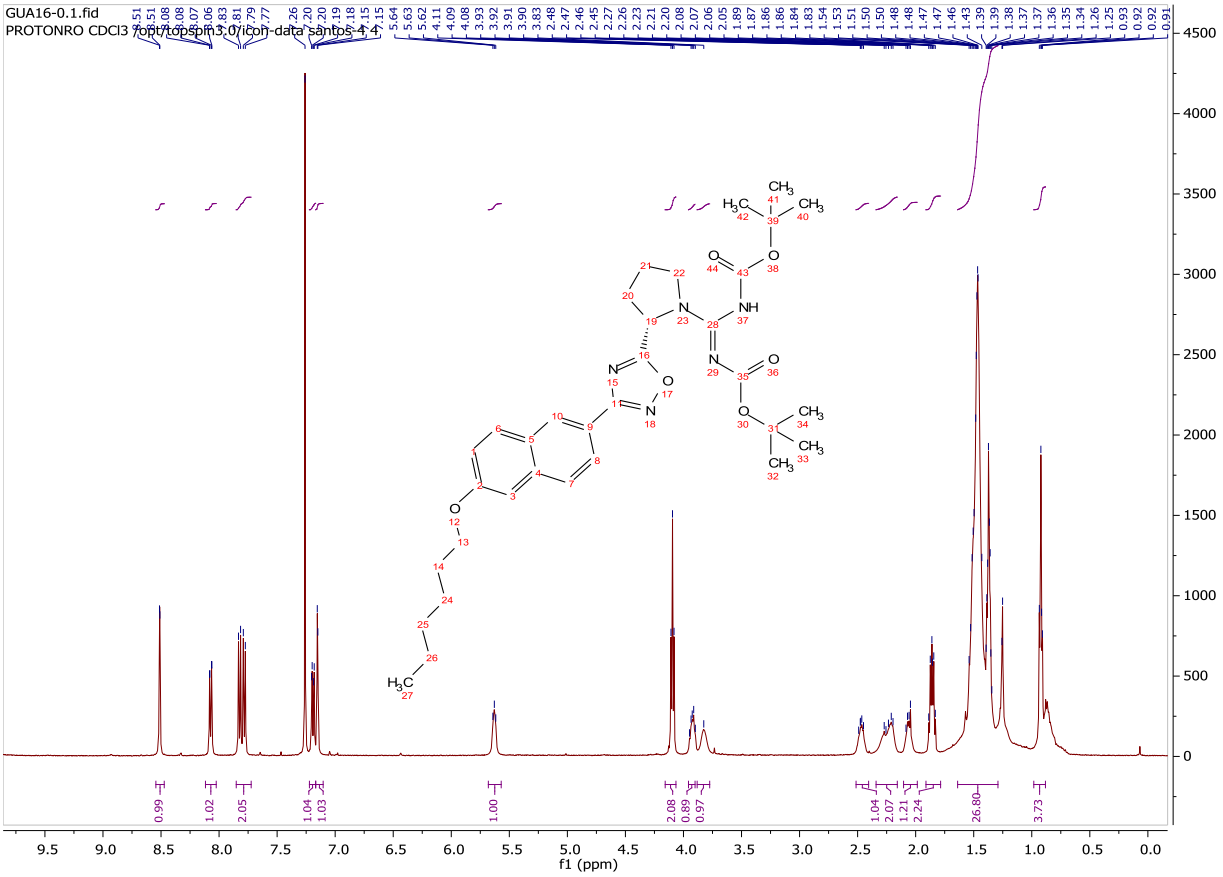
^{1}H-NMR Spectrum for 3.6b:



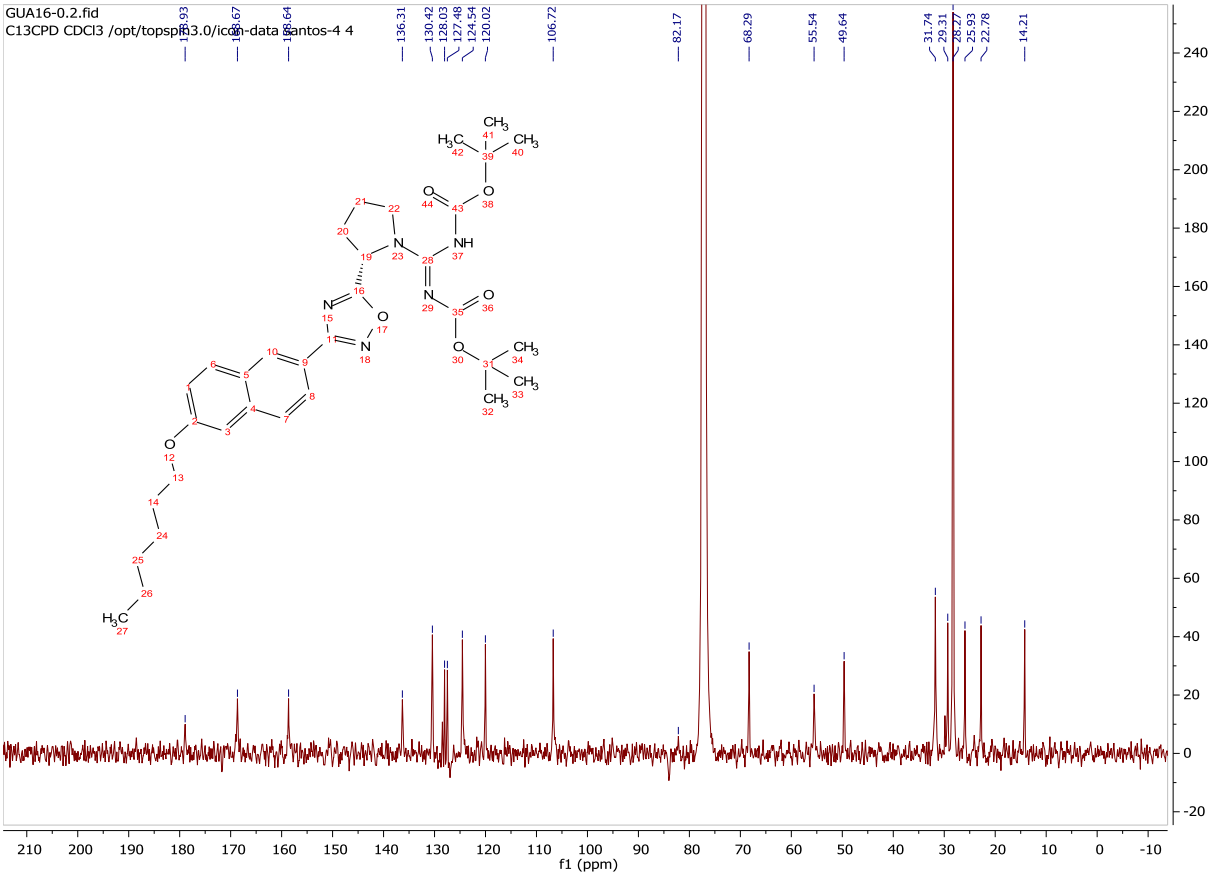
^{13}C-NMR Spectrum for 3.6b:



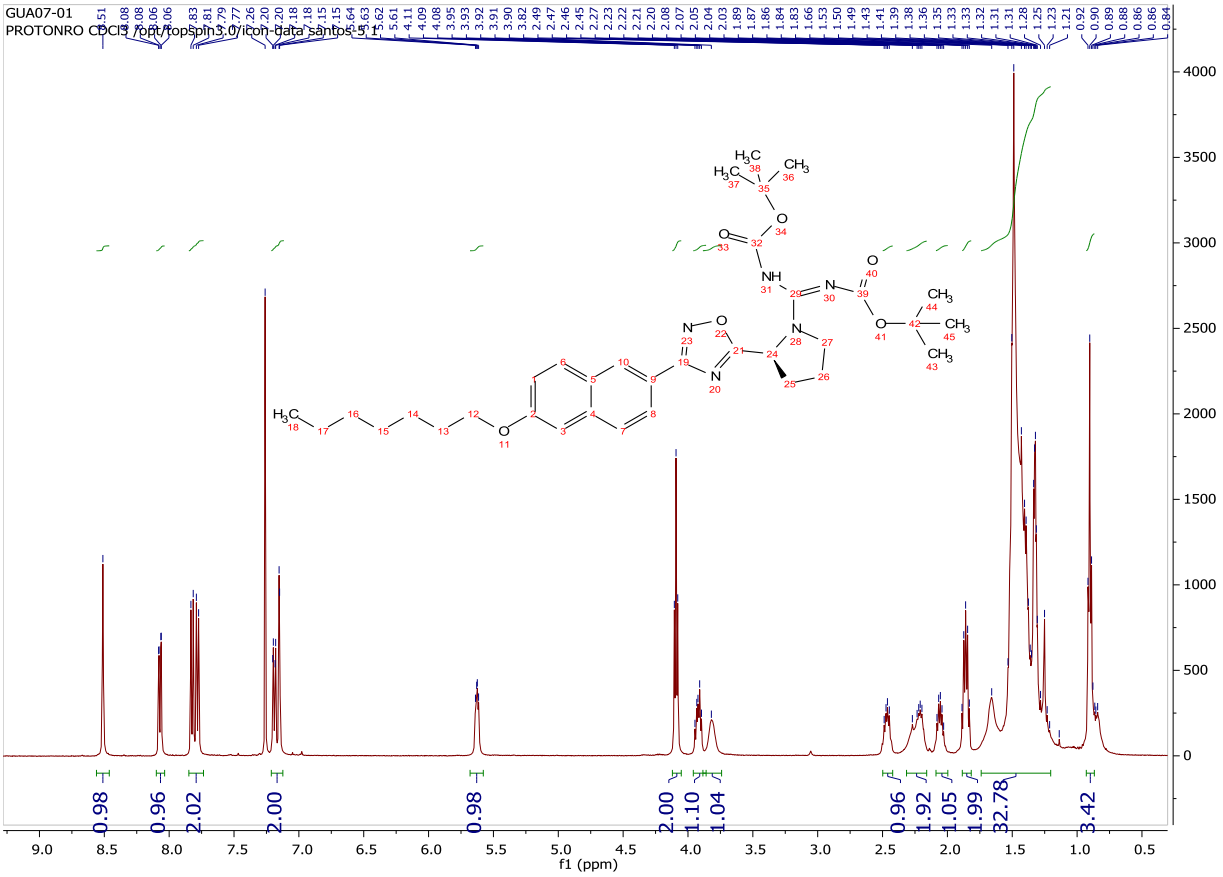
^{1}H-NMR Spectrum for 3.6c:



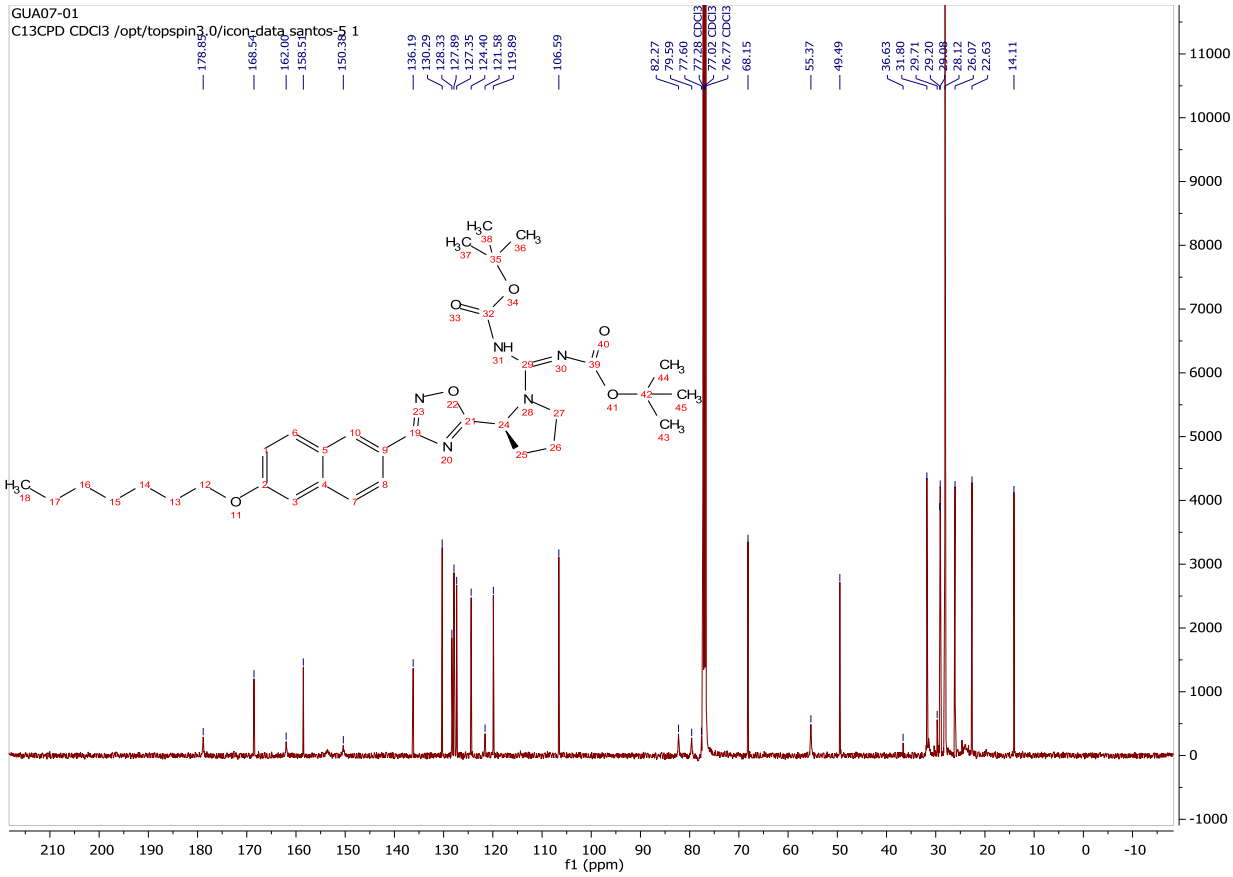
^{13}C-NMR Spectrum for 3.6c:



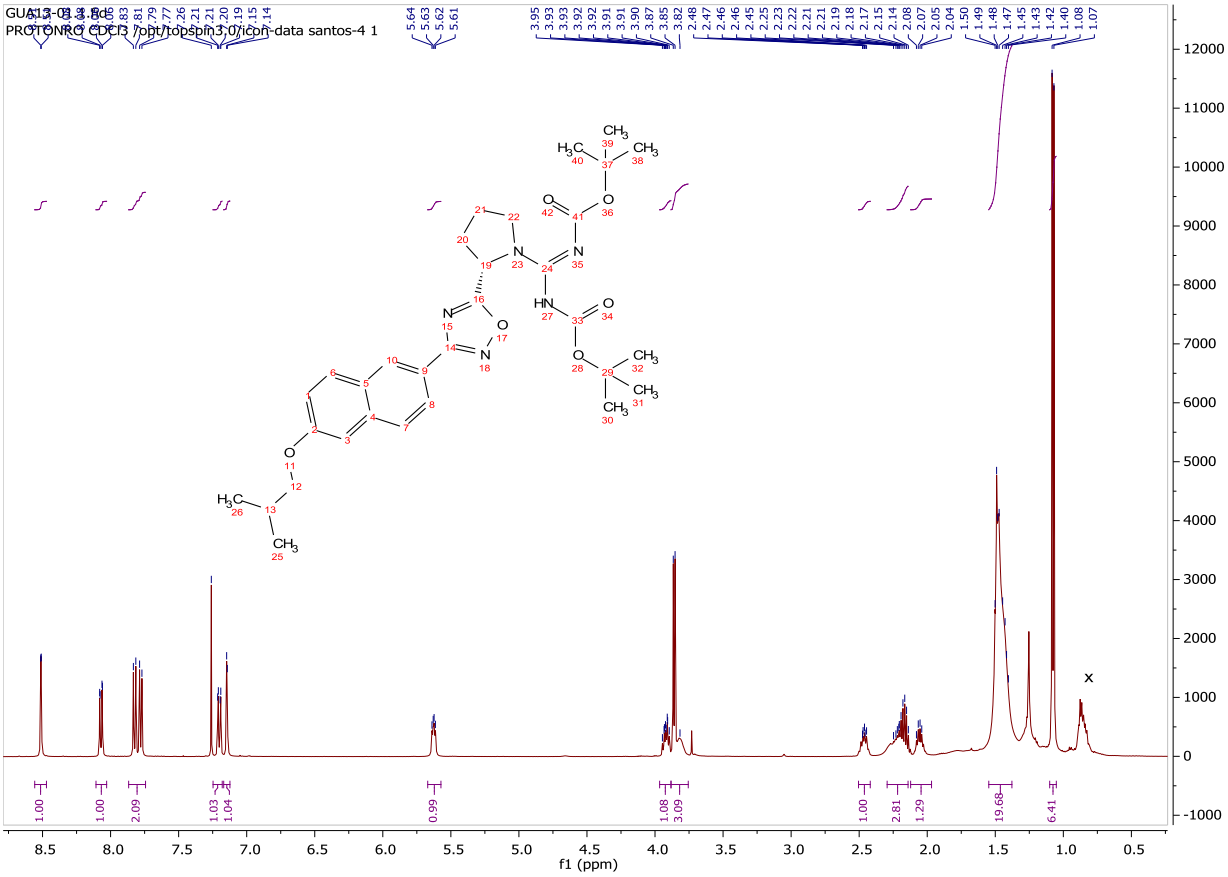
^{1}H-NMR Spectrum for 3.6d:



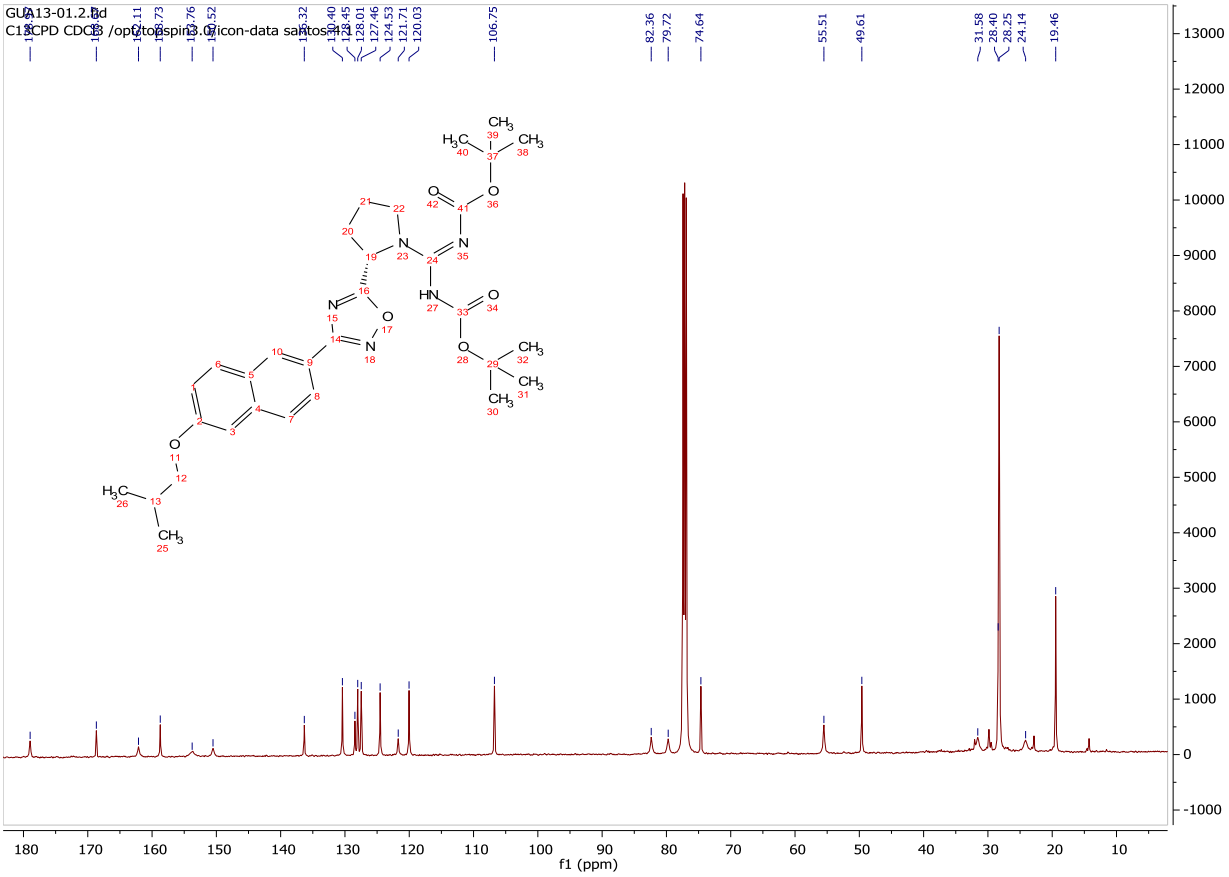
^{13}C-NMR Spectrum for 3.6d:



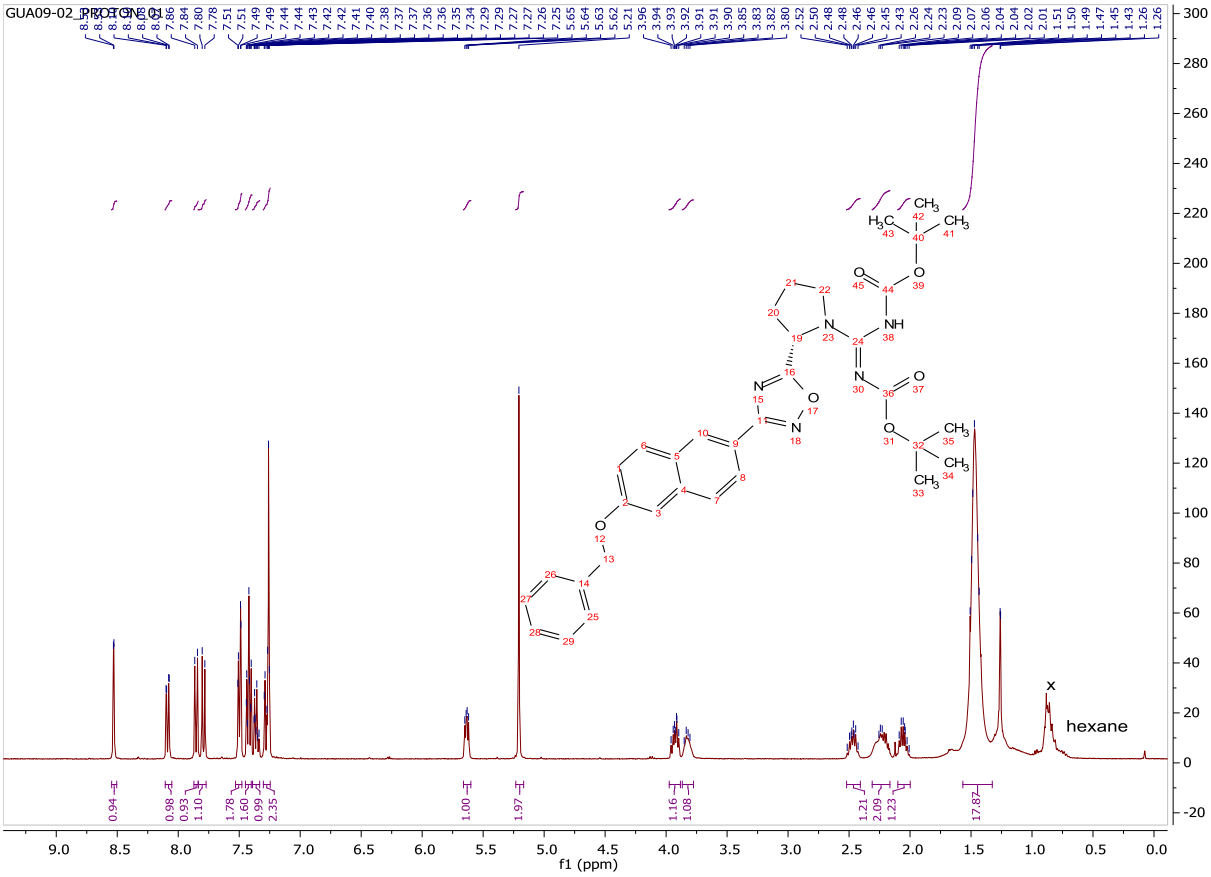
^{1}H-NMR Spectrum for 3.6e:



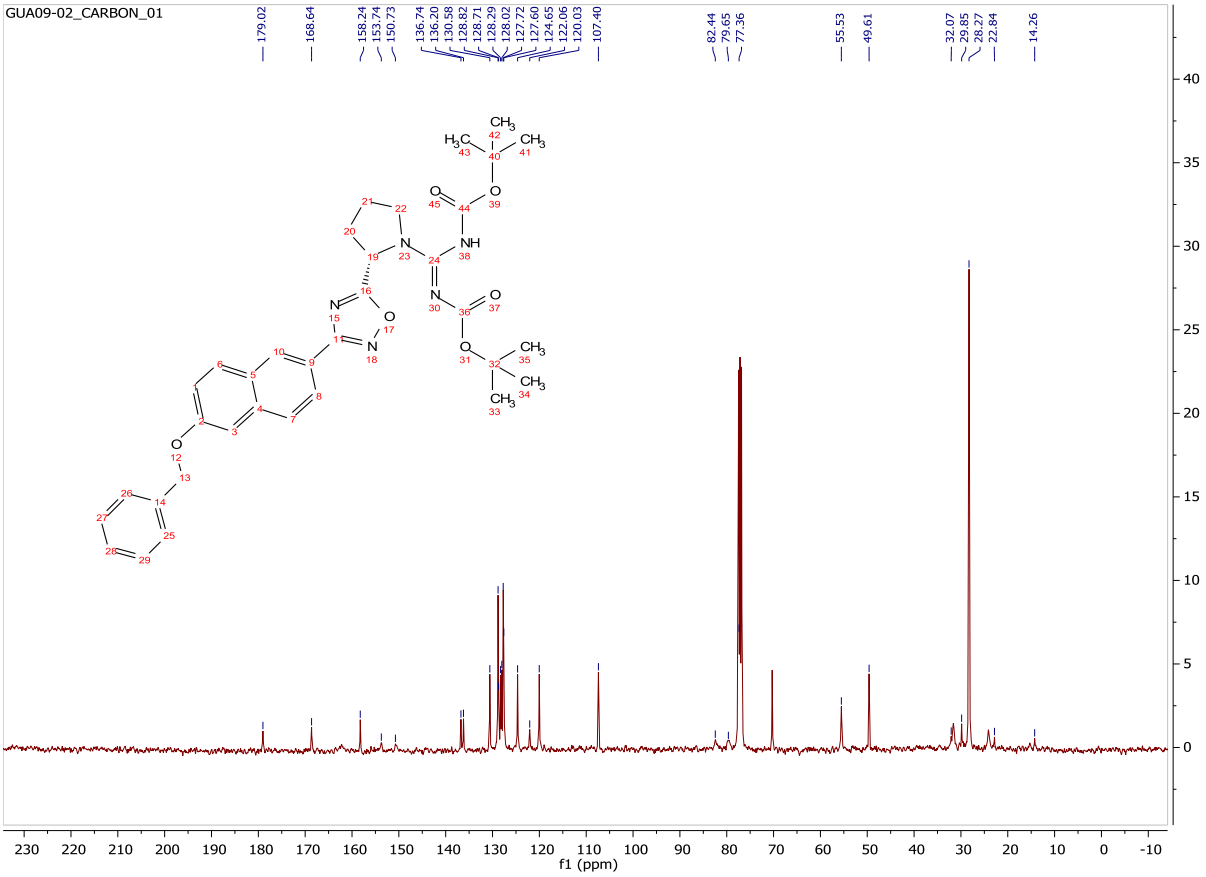
^{13}C-NMR Spectrum for 3.6e:



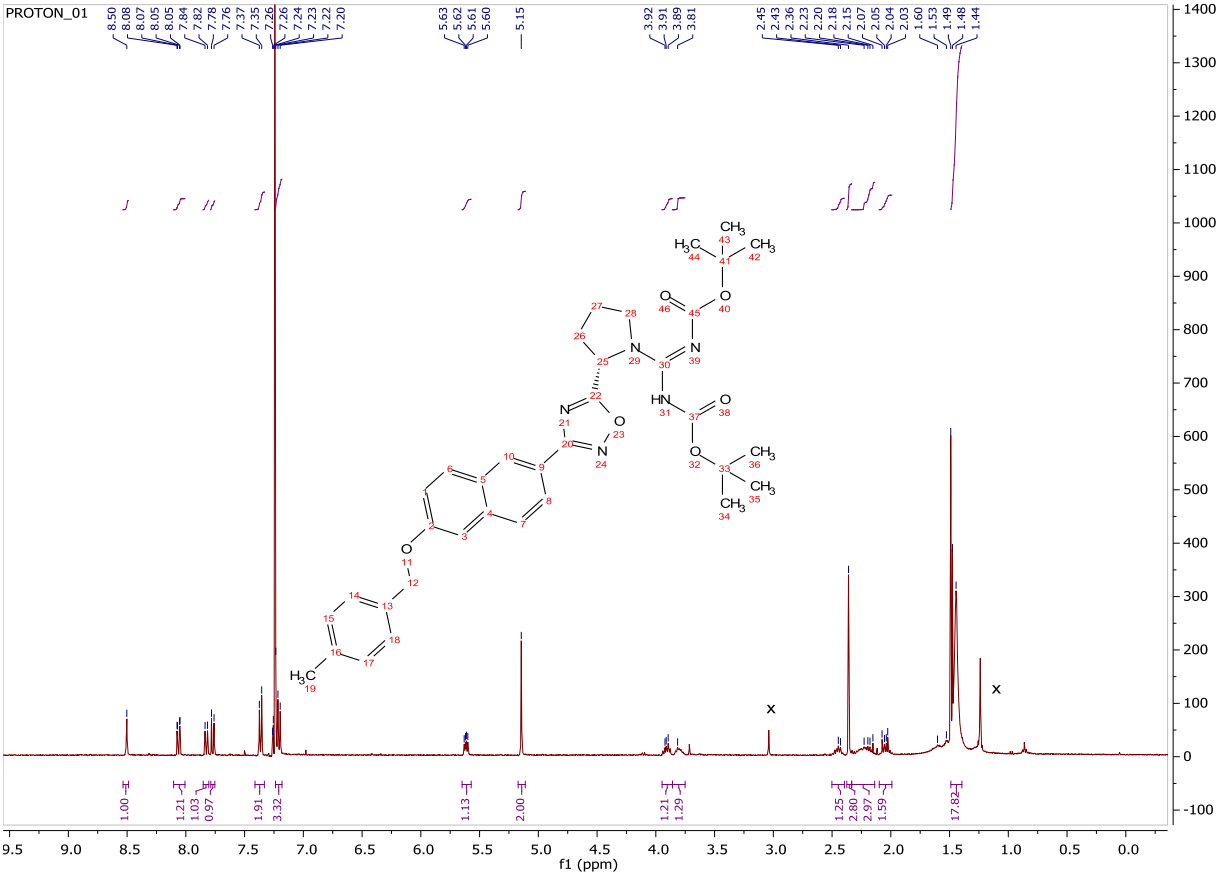
^{1}H-NMR Spectrum for 3.6f:



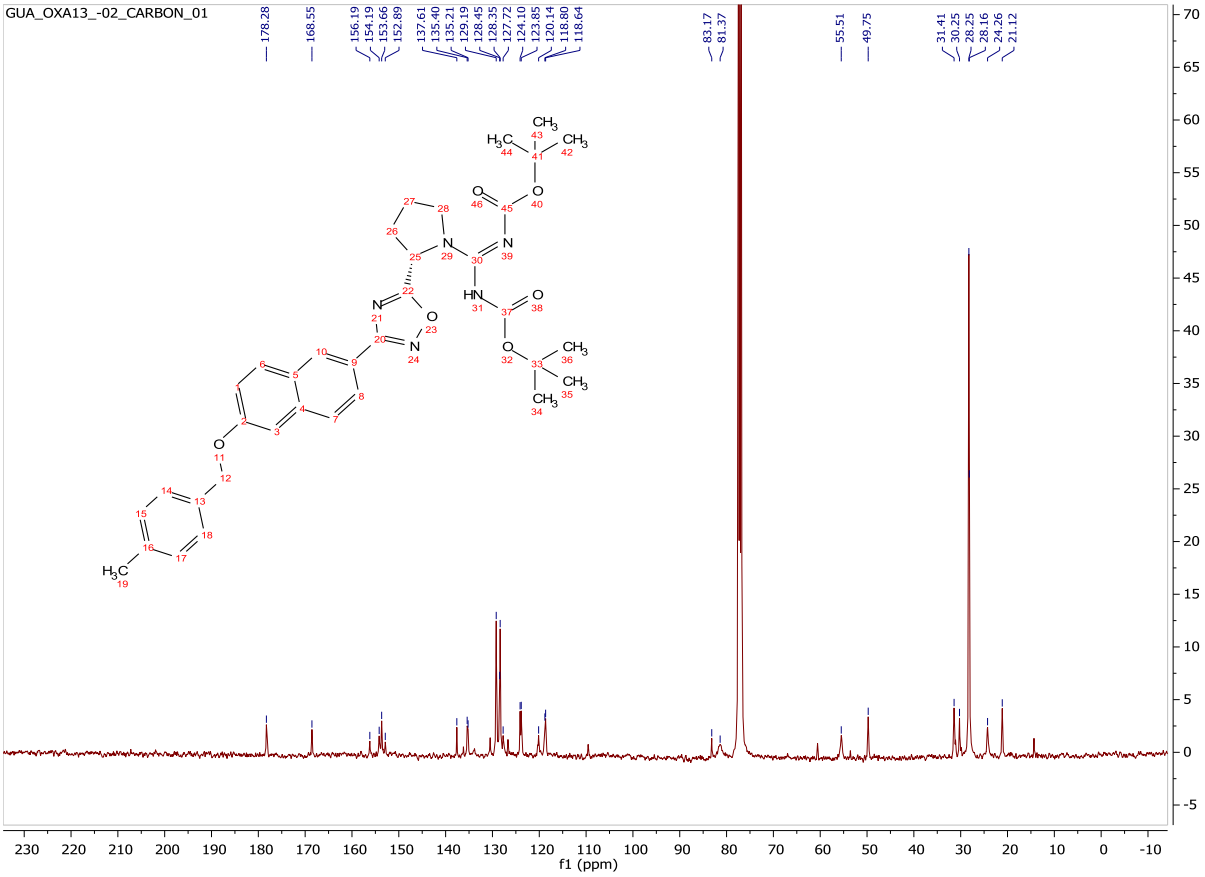
^{13}C-NMR Spectrum for 3.6f:



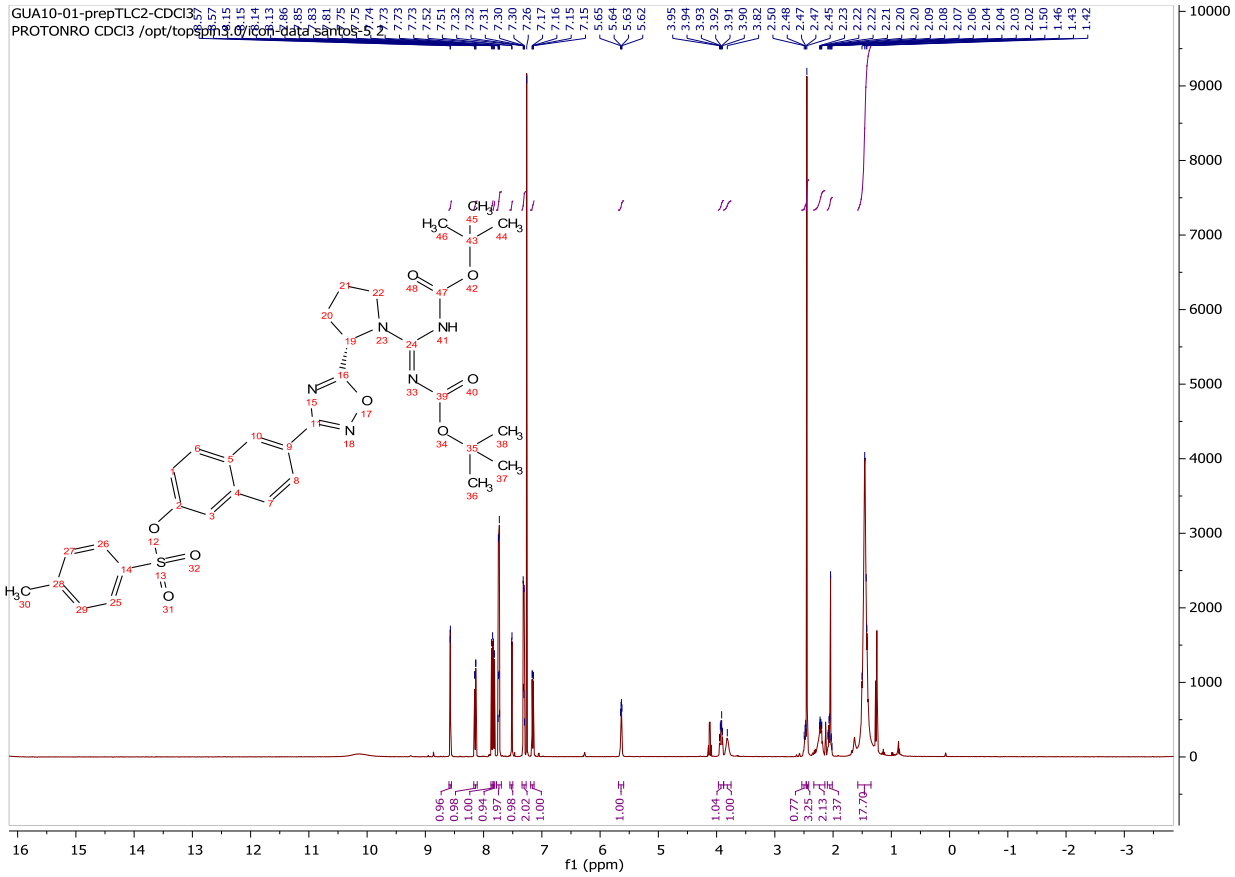
^{1}H-NMR Spectrum for 3.6g:



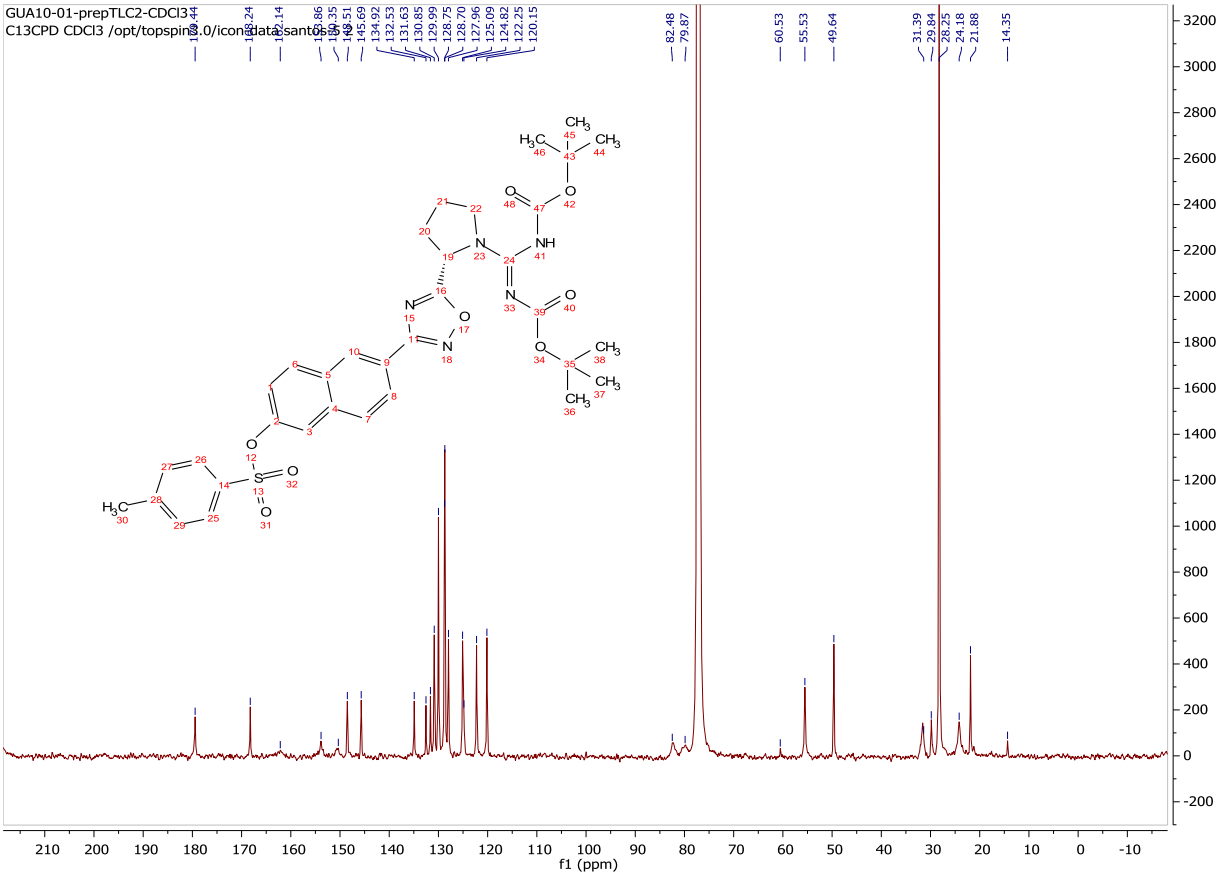
^{13}C-NMR Spectrum for 3.6g:



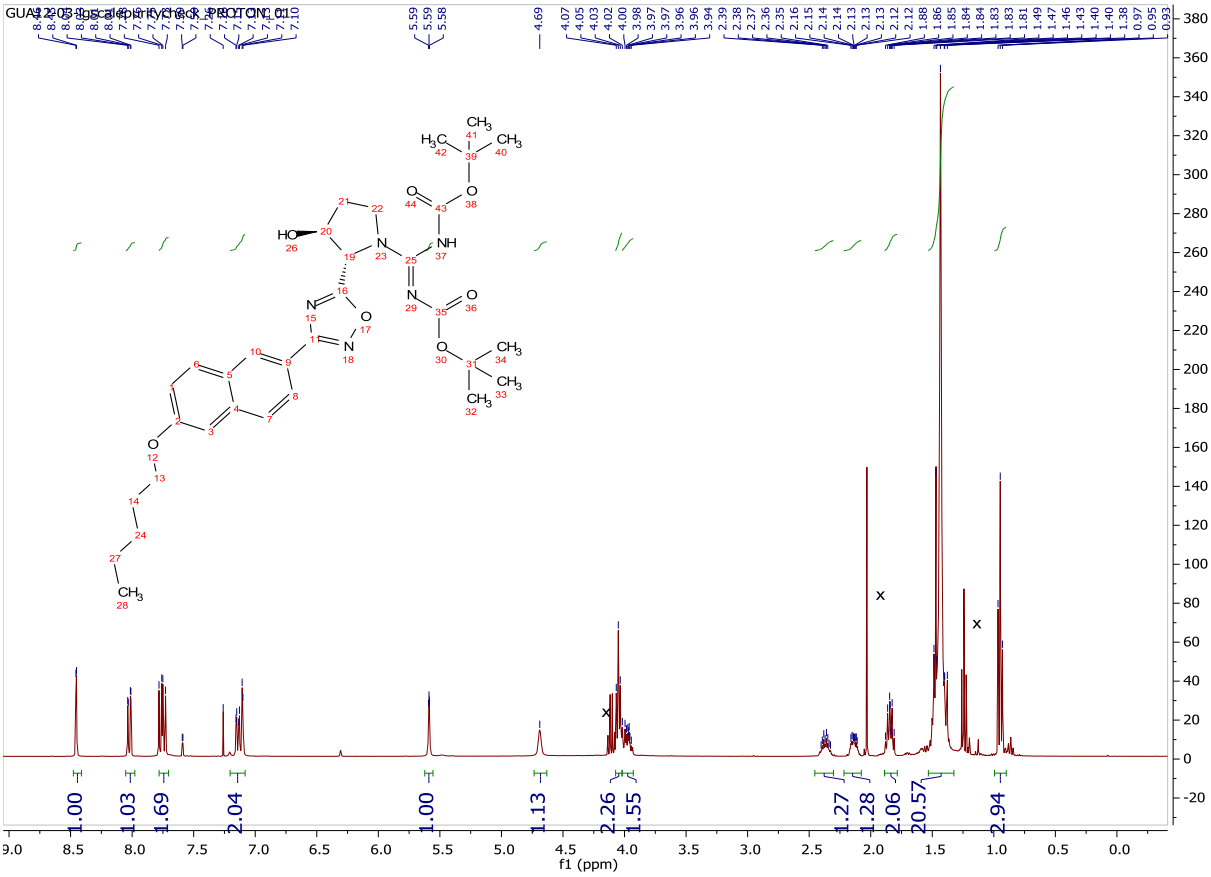
^{1}H-NMR Spectrum for 3.6h:



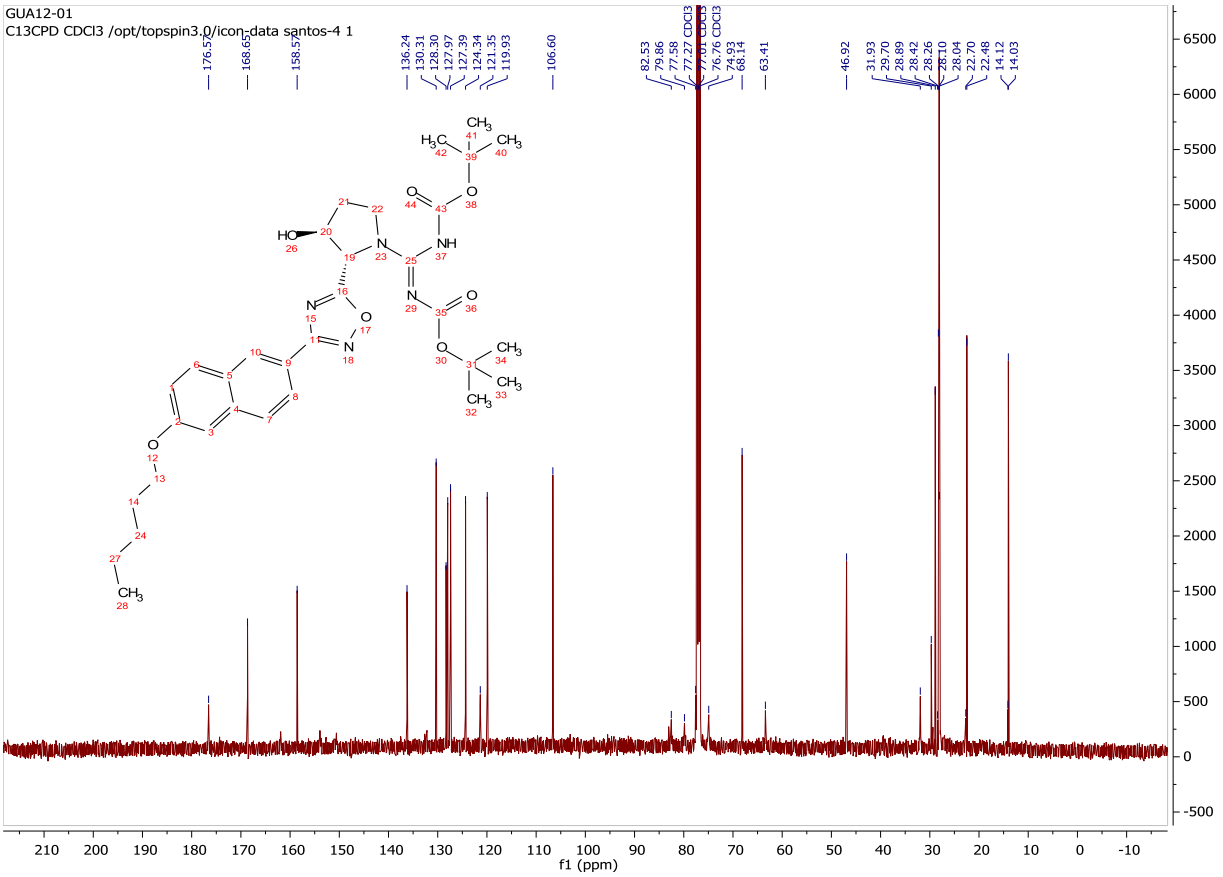
^{13}C-NMR Spectrum for 3.6h:



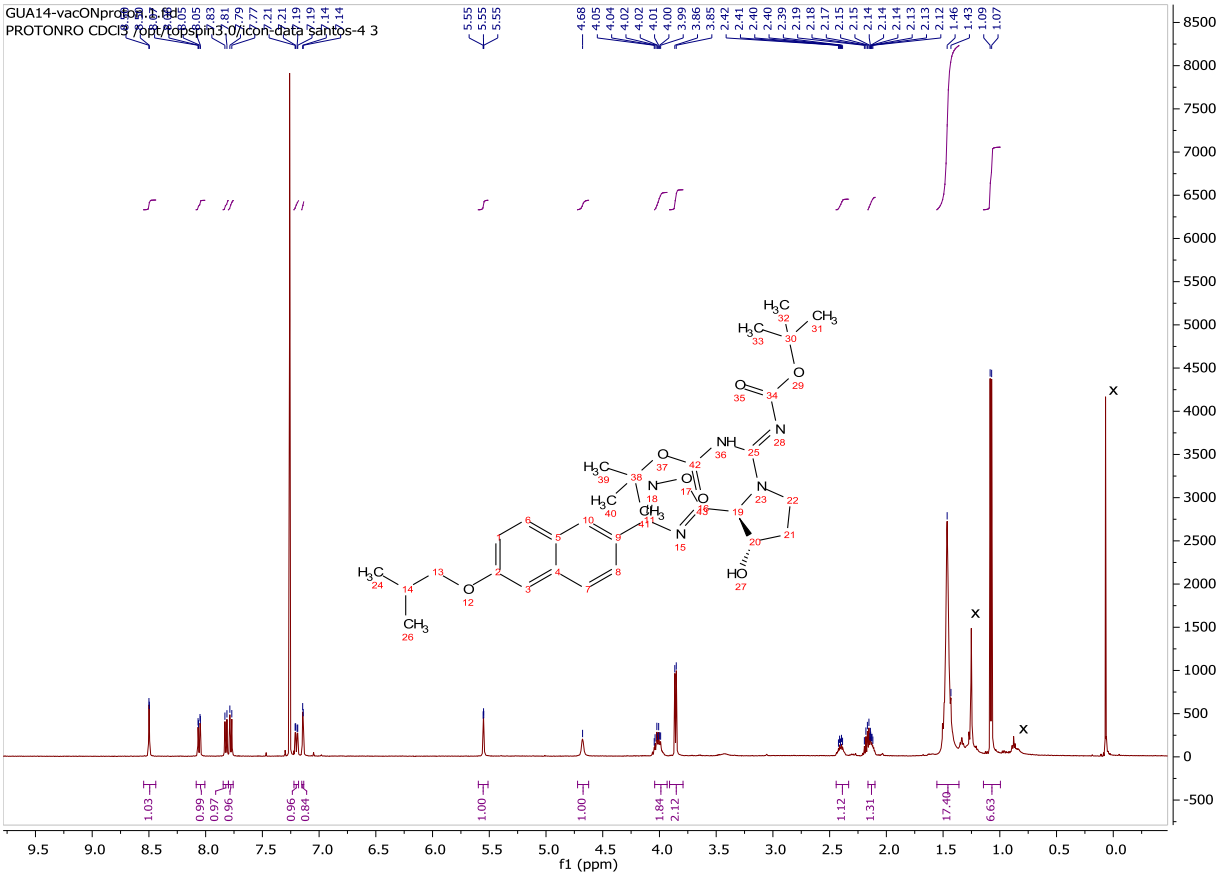
^{1}H-NMR Spectrum for 3.6i:



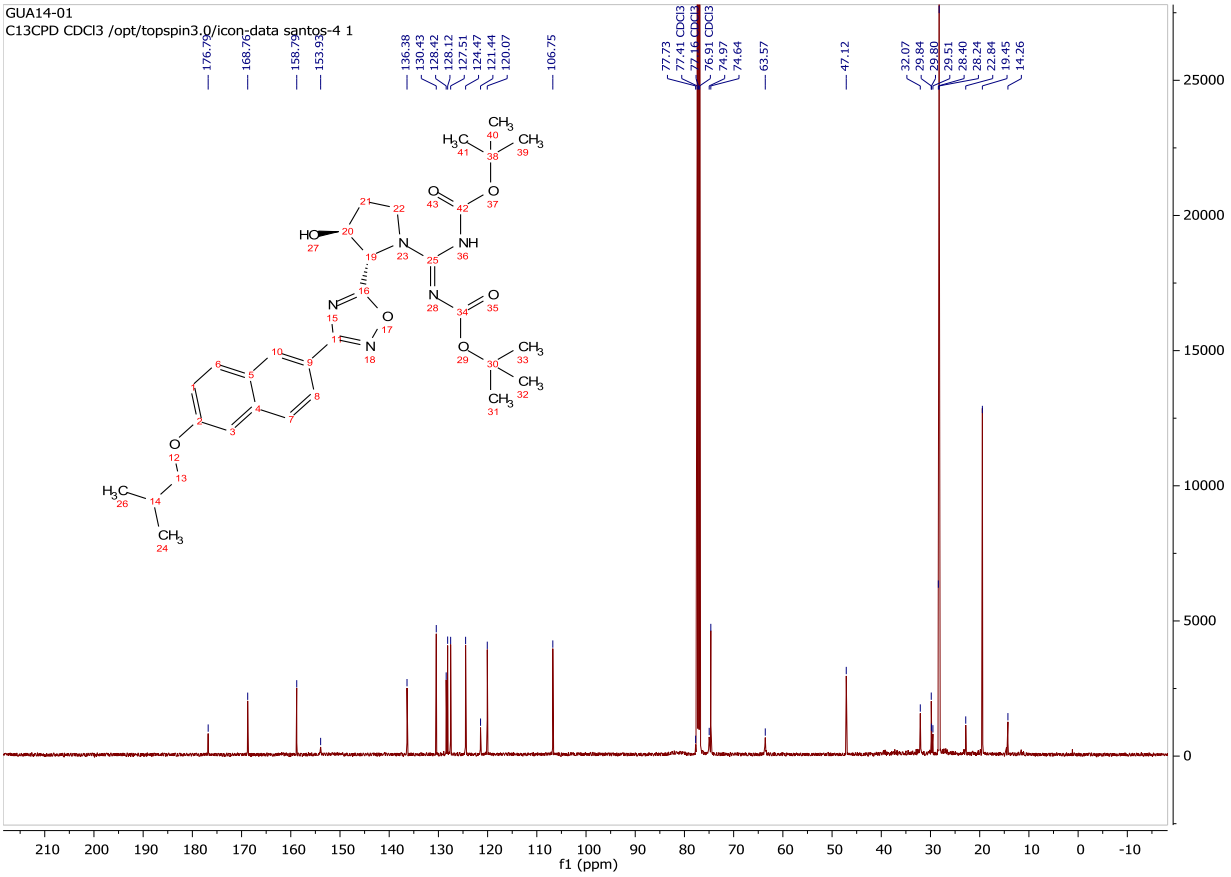
^{13}C-NMR Spectrum for 3.6i:



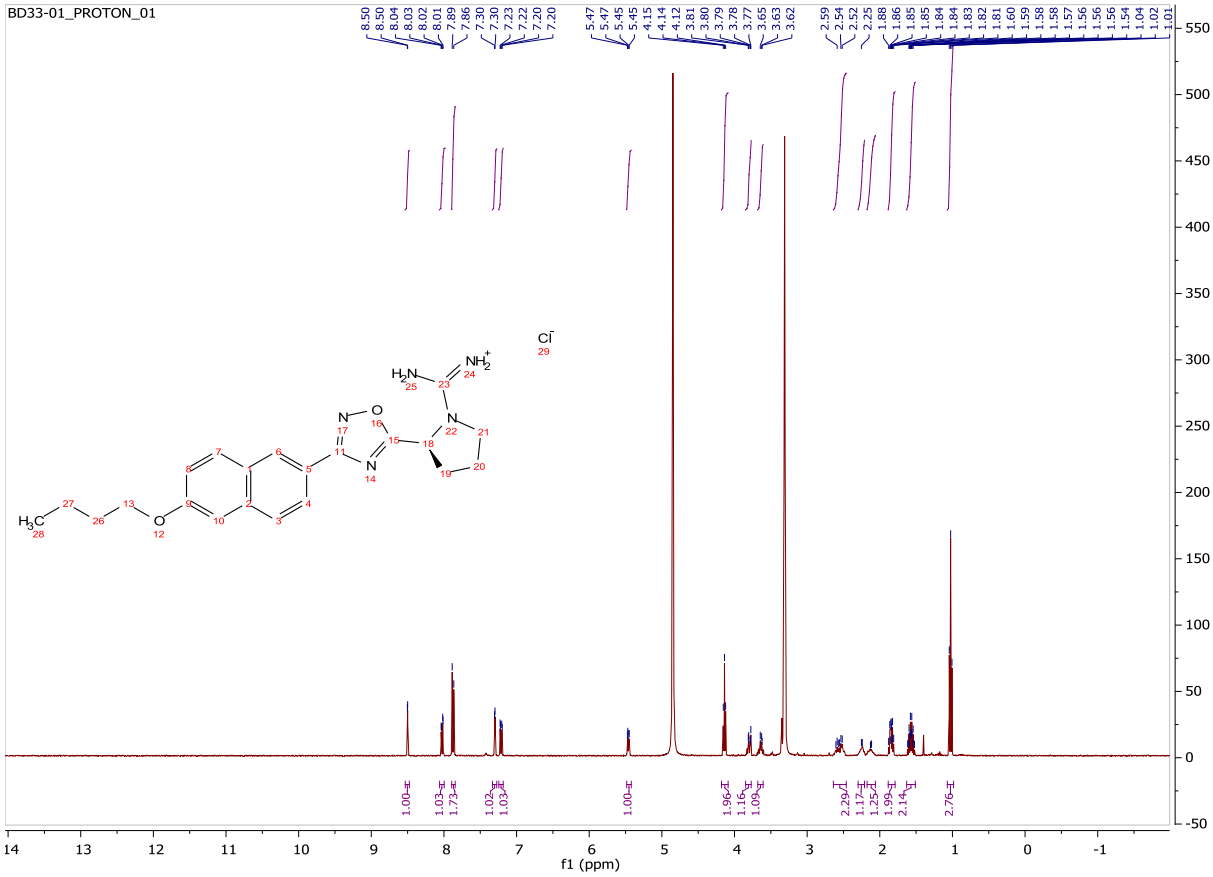
^{1}H-NMR Spectrum for 3.6j:



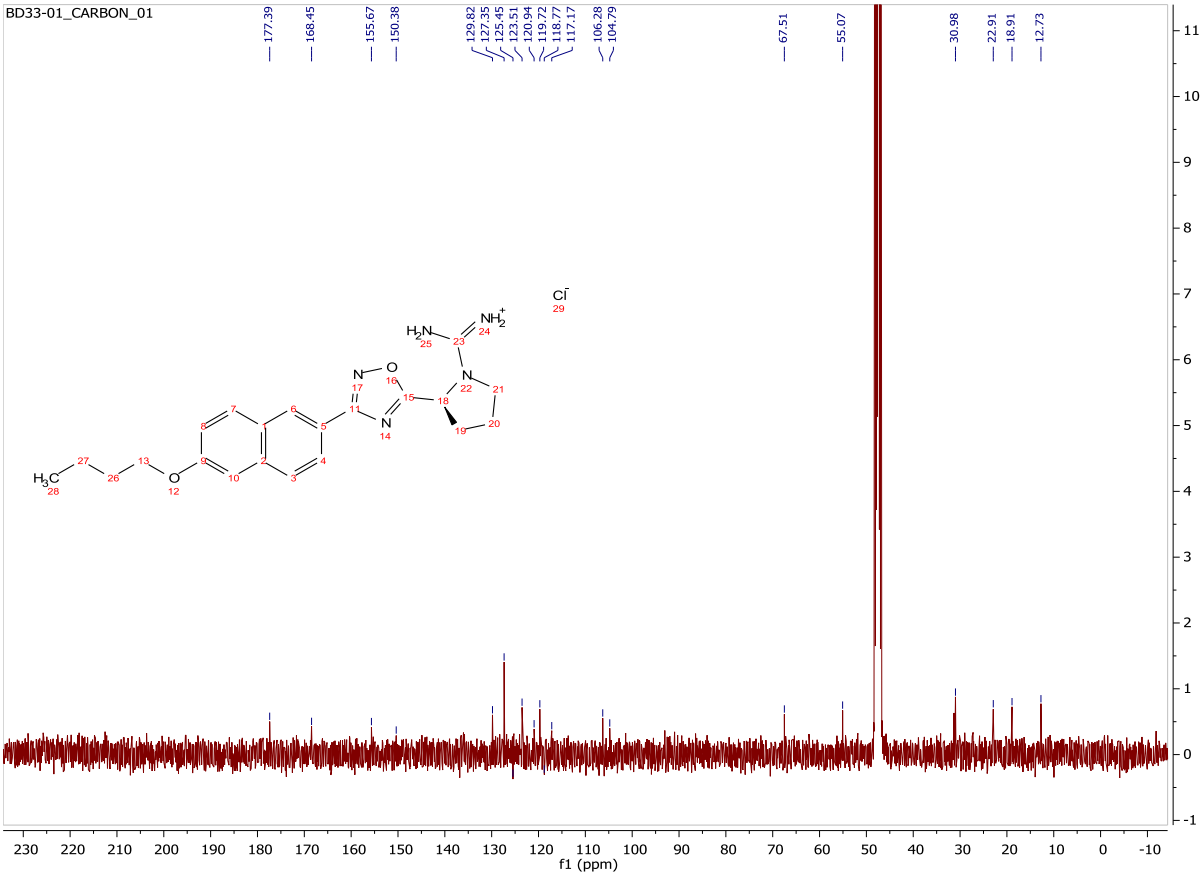
^{13}C-NMR Spectrum for 3.6j:



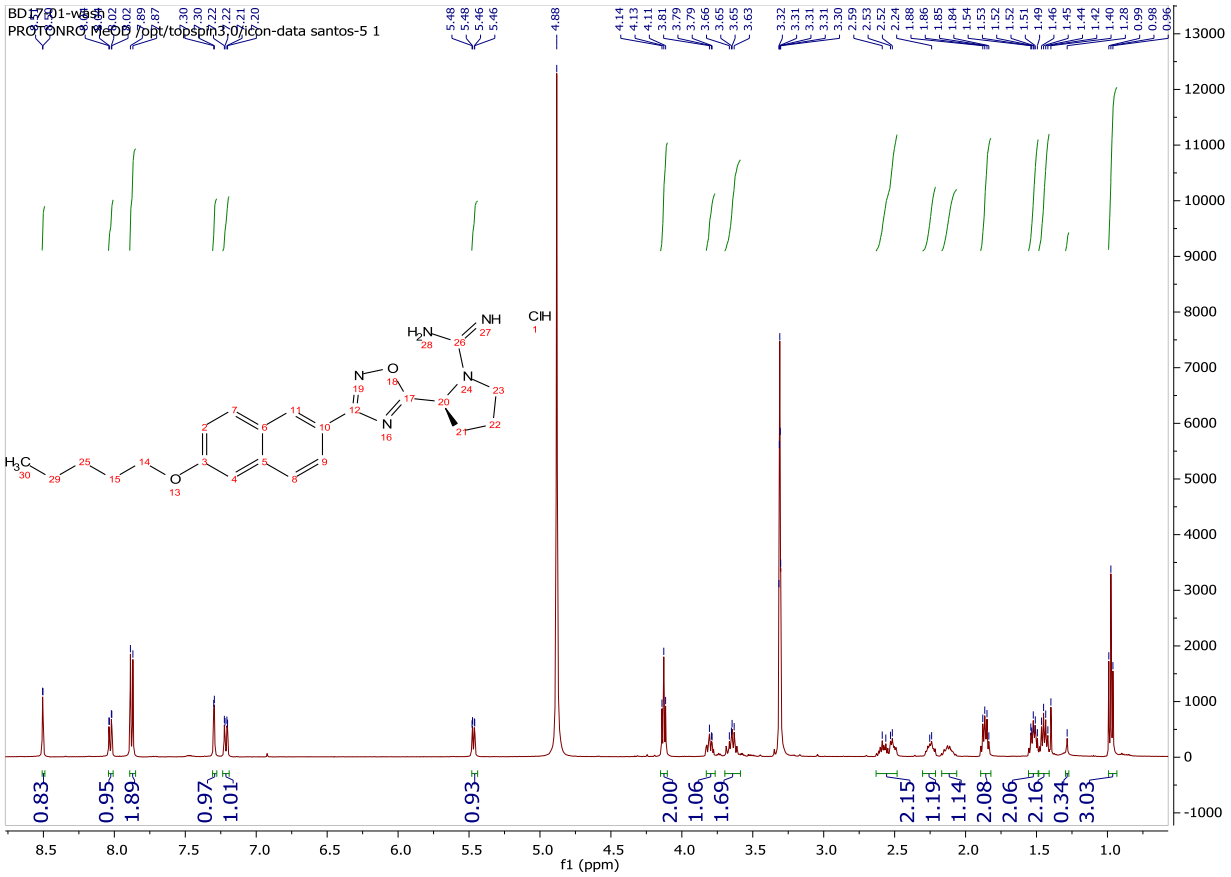
^{1}H-NMR Spectrum for 3.7a:



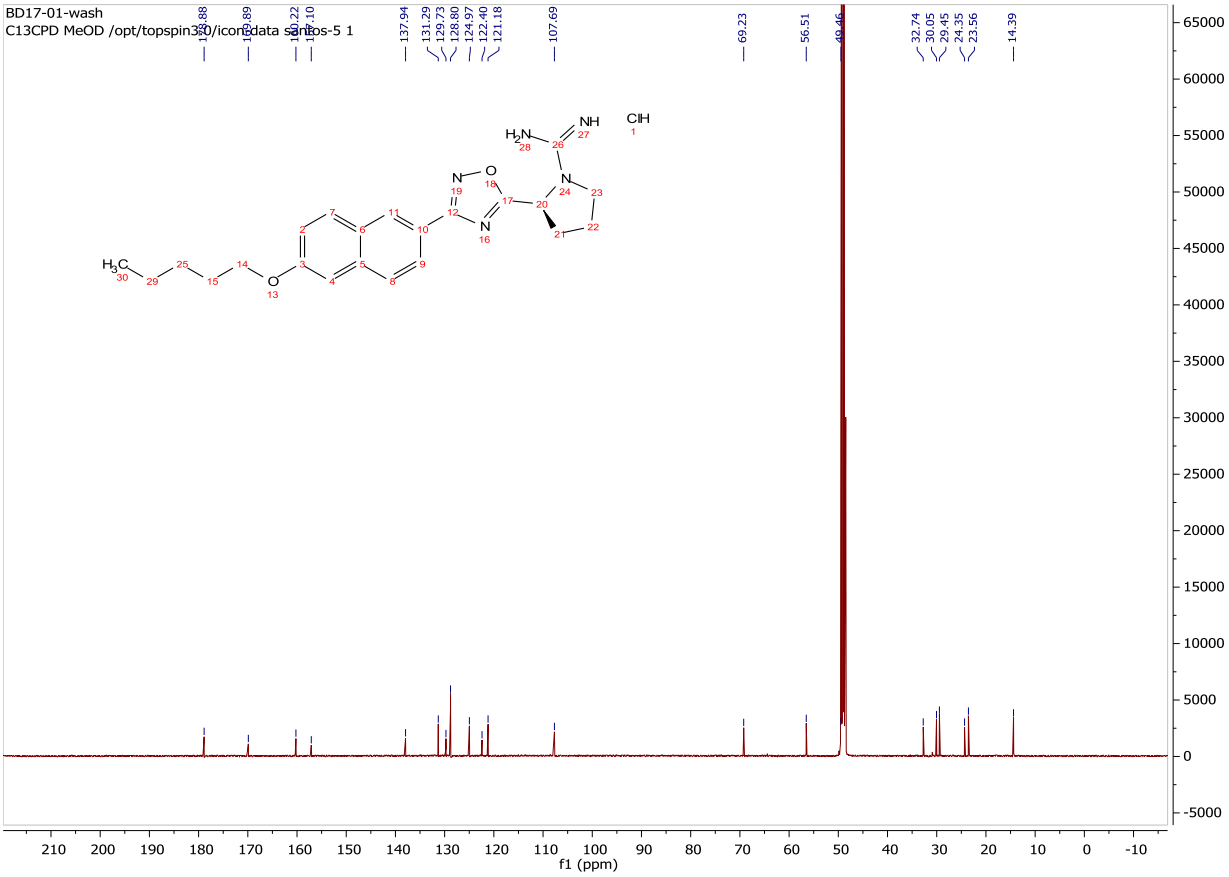
^{13}C-NMR Spectrum for 3.7a:



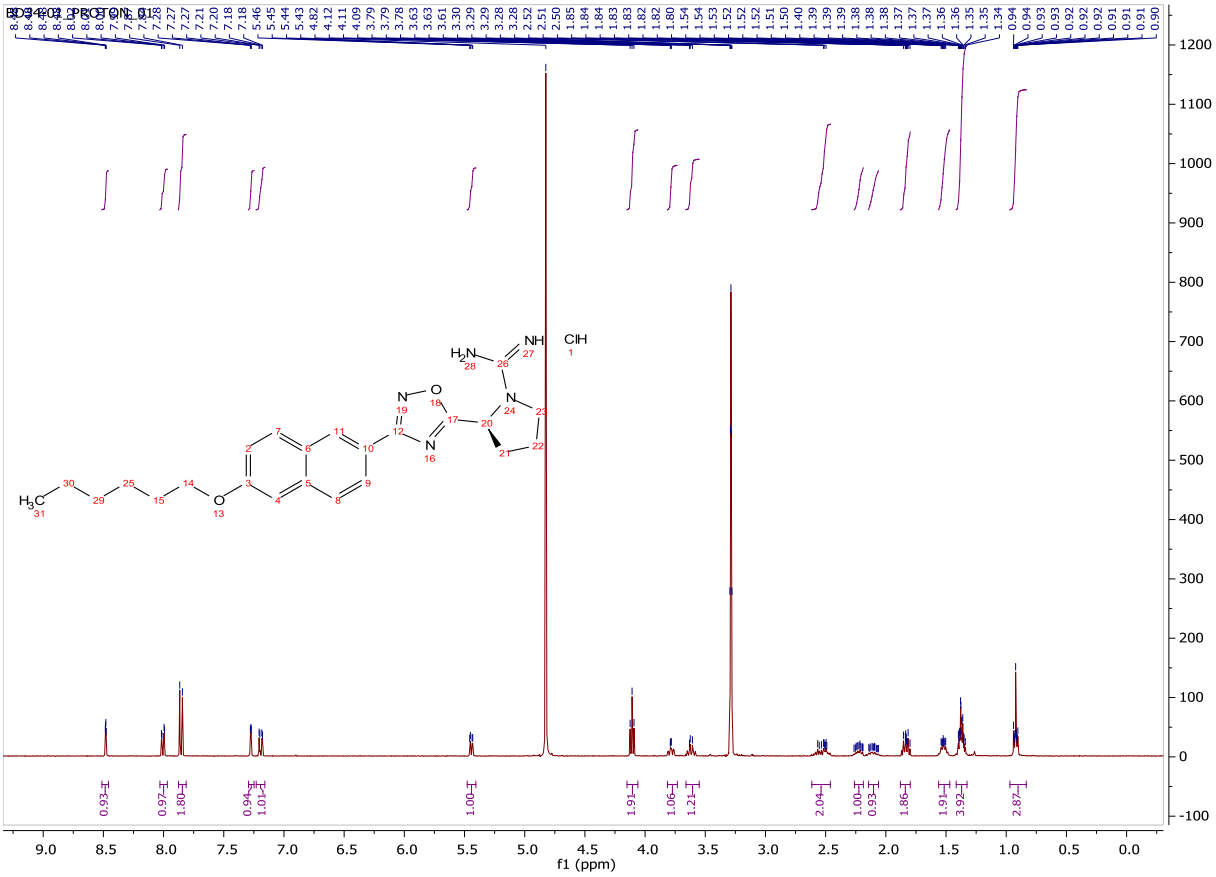
^{1}H-NMR Spectrum for 3.7b:



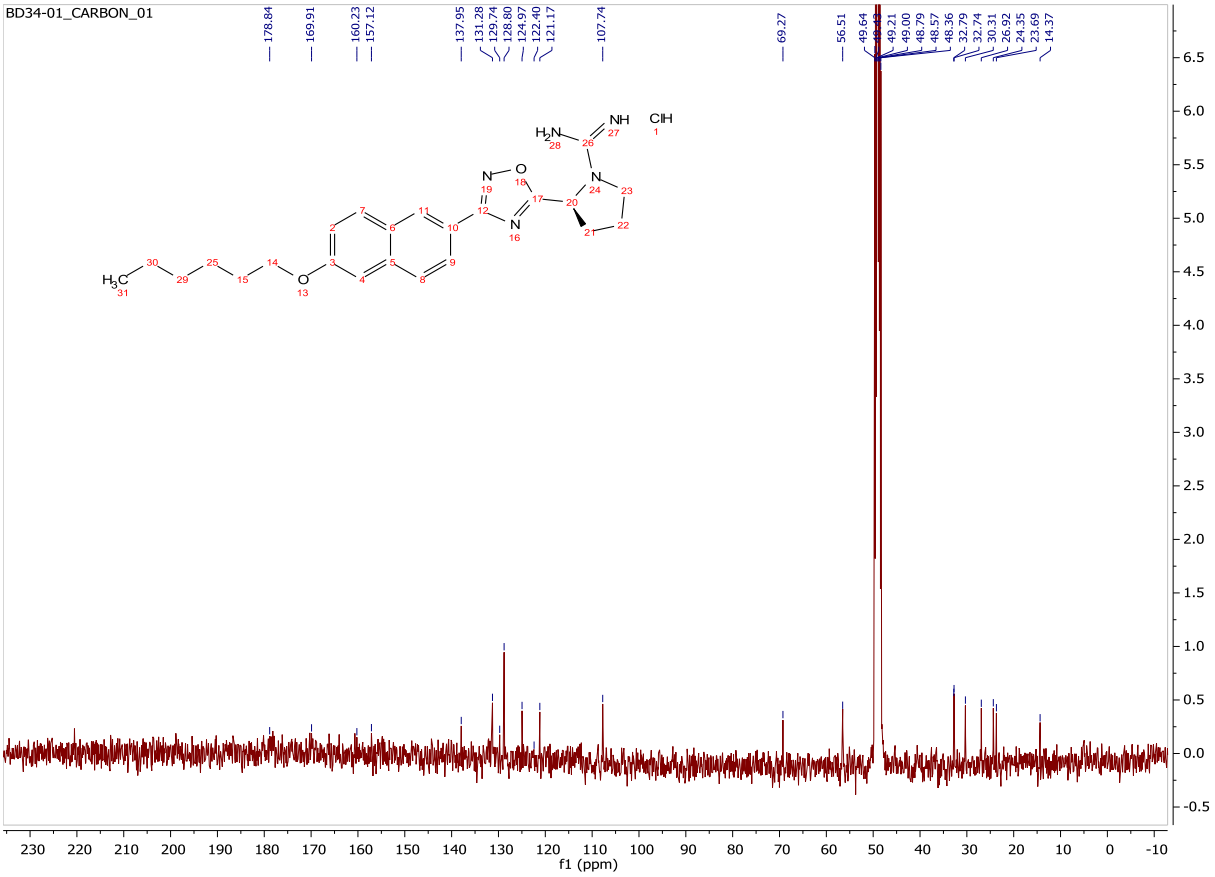
^{13}C-NMR Spectrum for 3.7b:



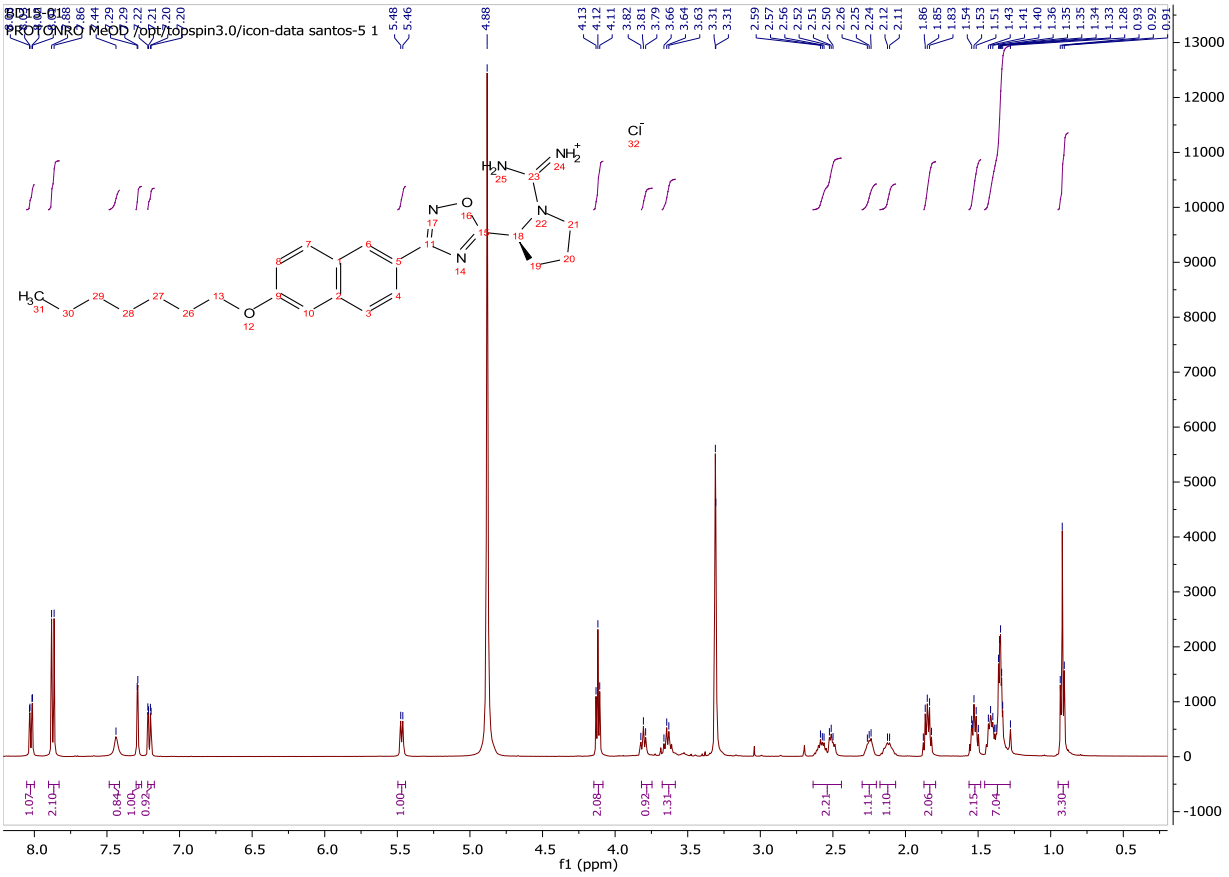
^{1}H-NMR Spectrum for 3.7c:



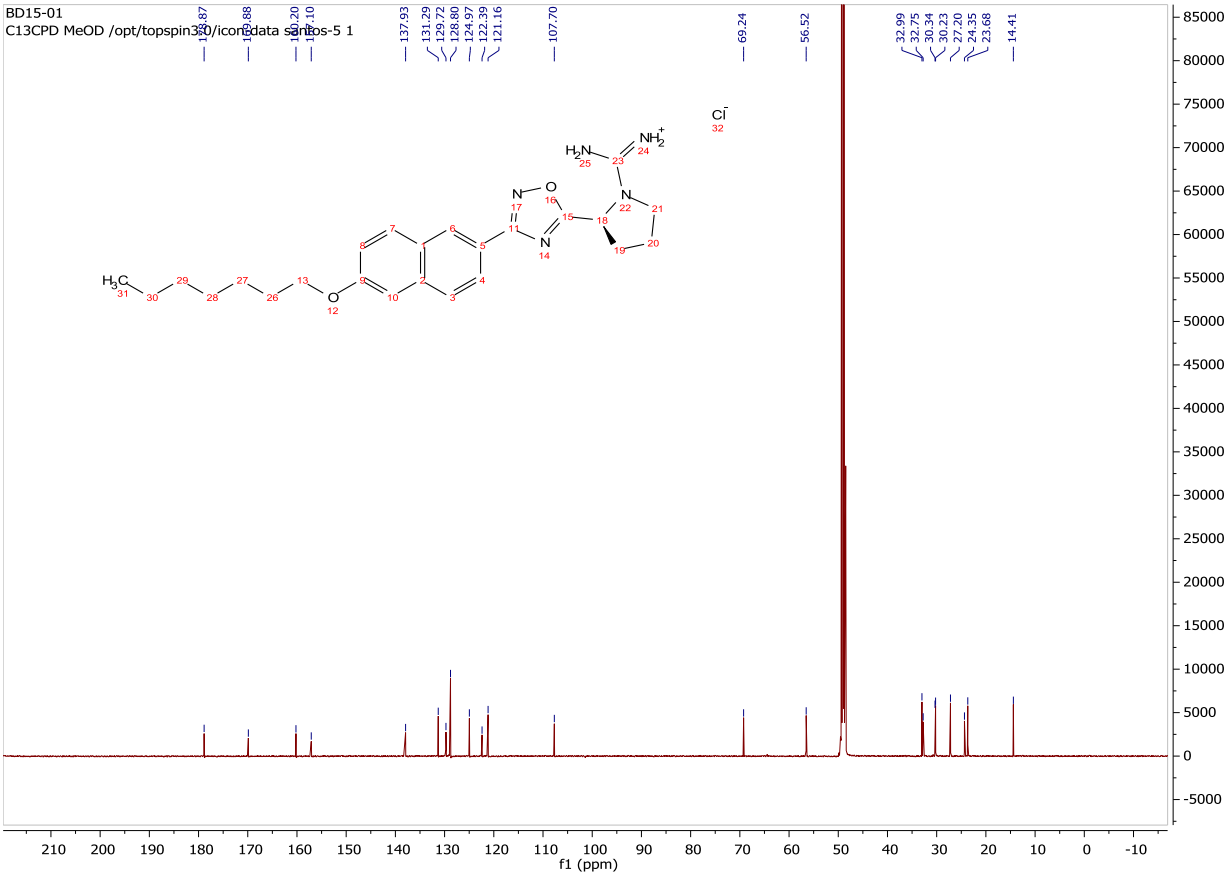
^{13}C-NMR Spectrum for 3.7c:



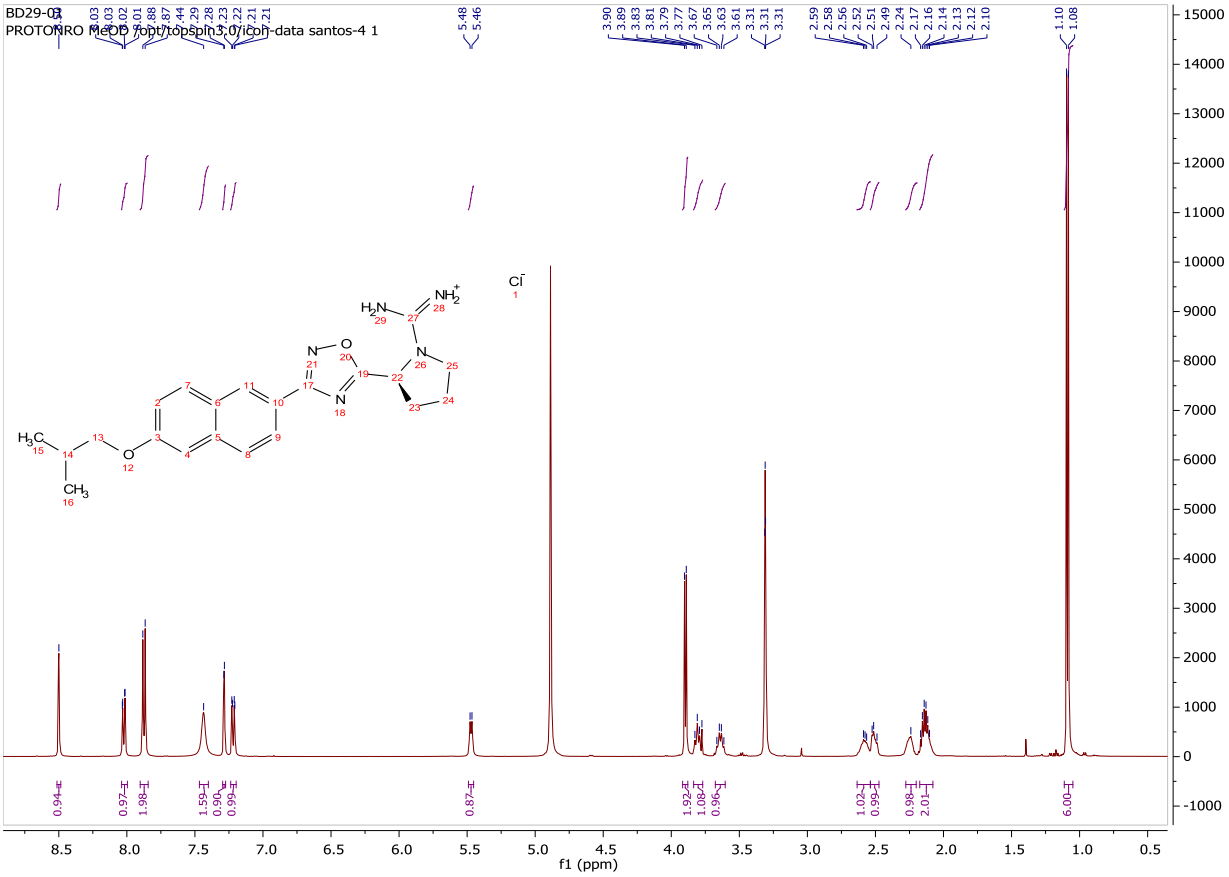
^{1}H-NMR Spectrum for 3.7d:



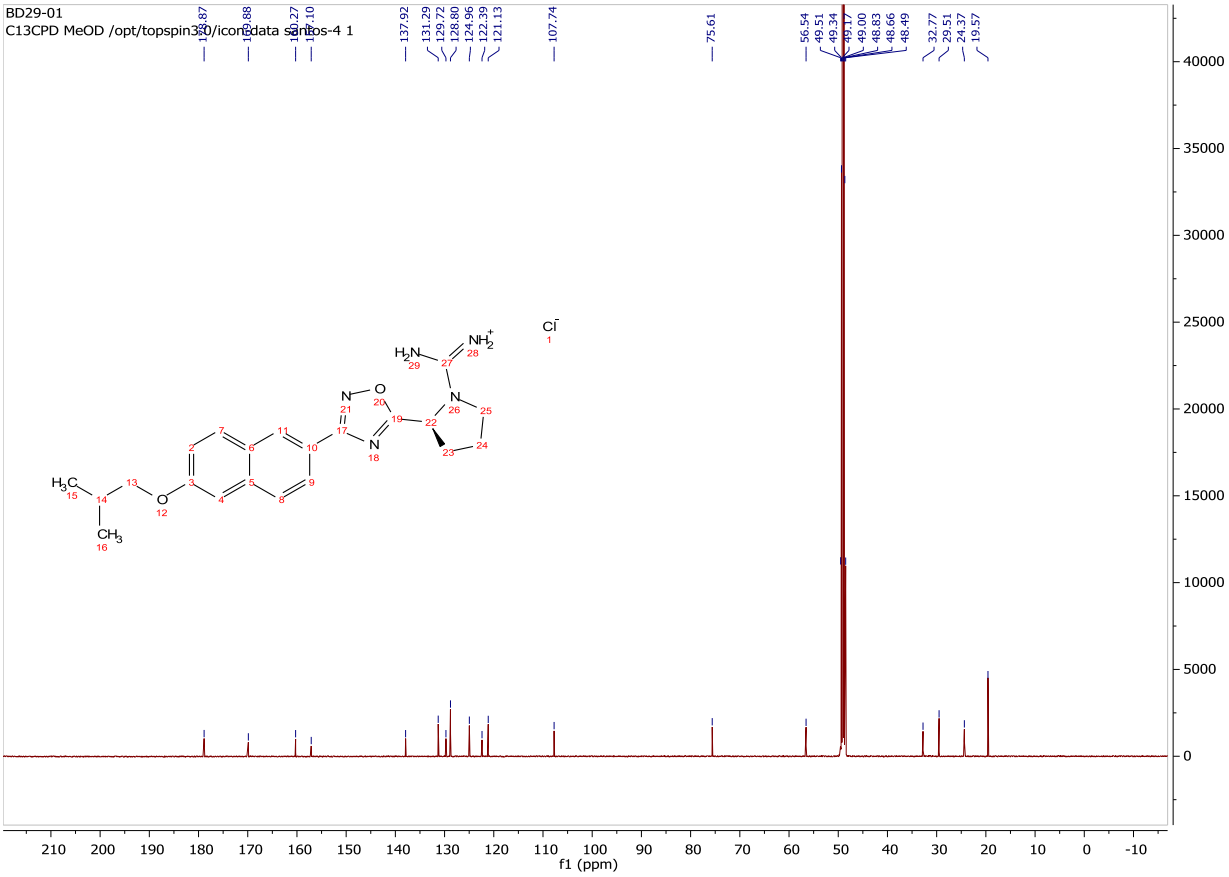
^{13}C-NMR Spectrum for 3.7d:



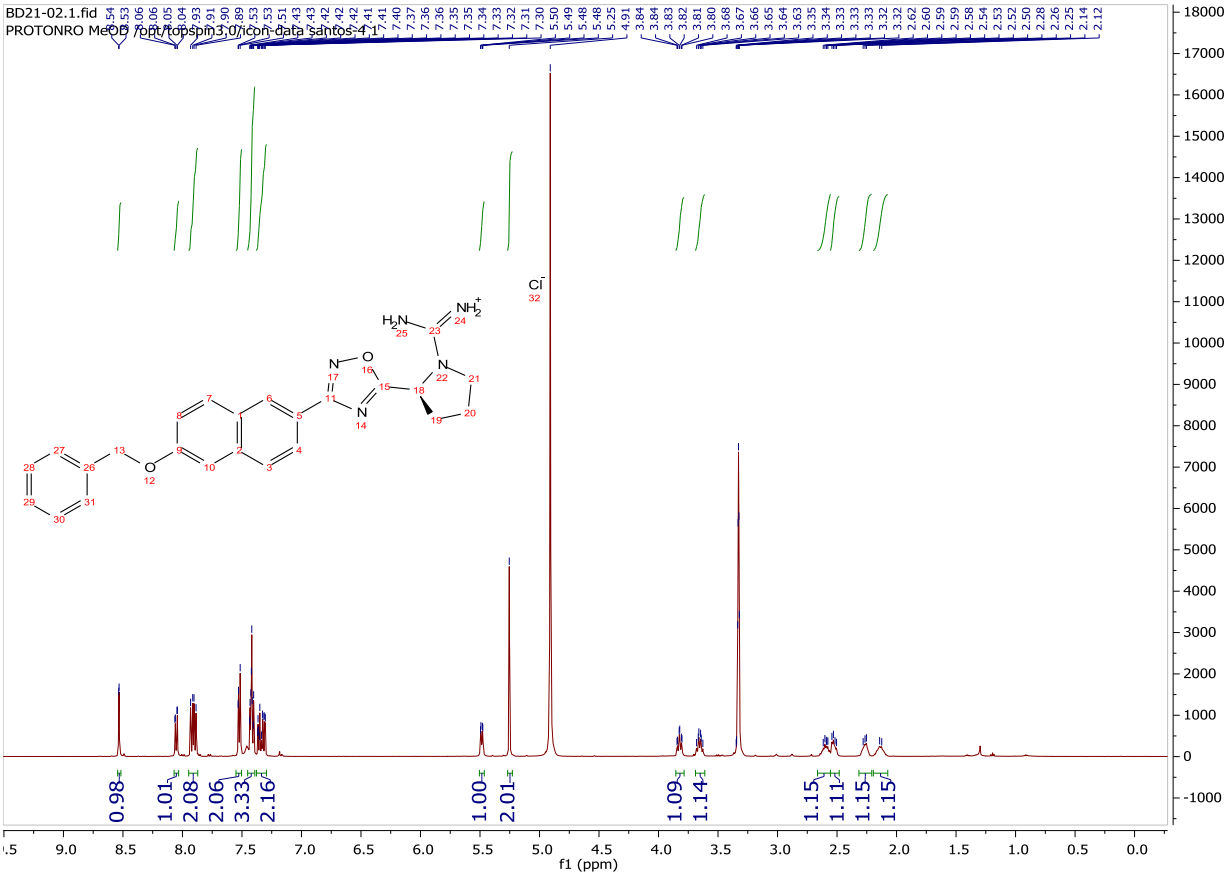
^{1}H-NMR Spectrum for 3.7e:



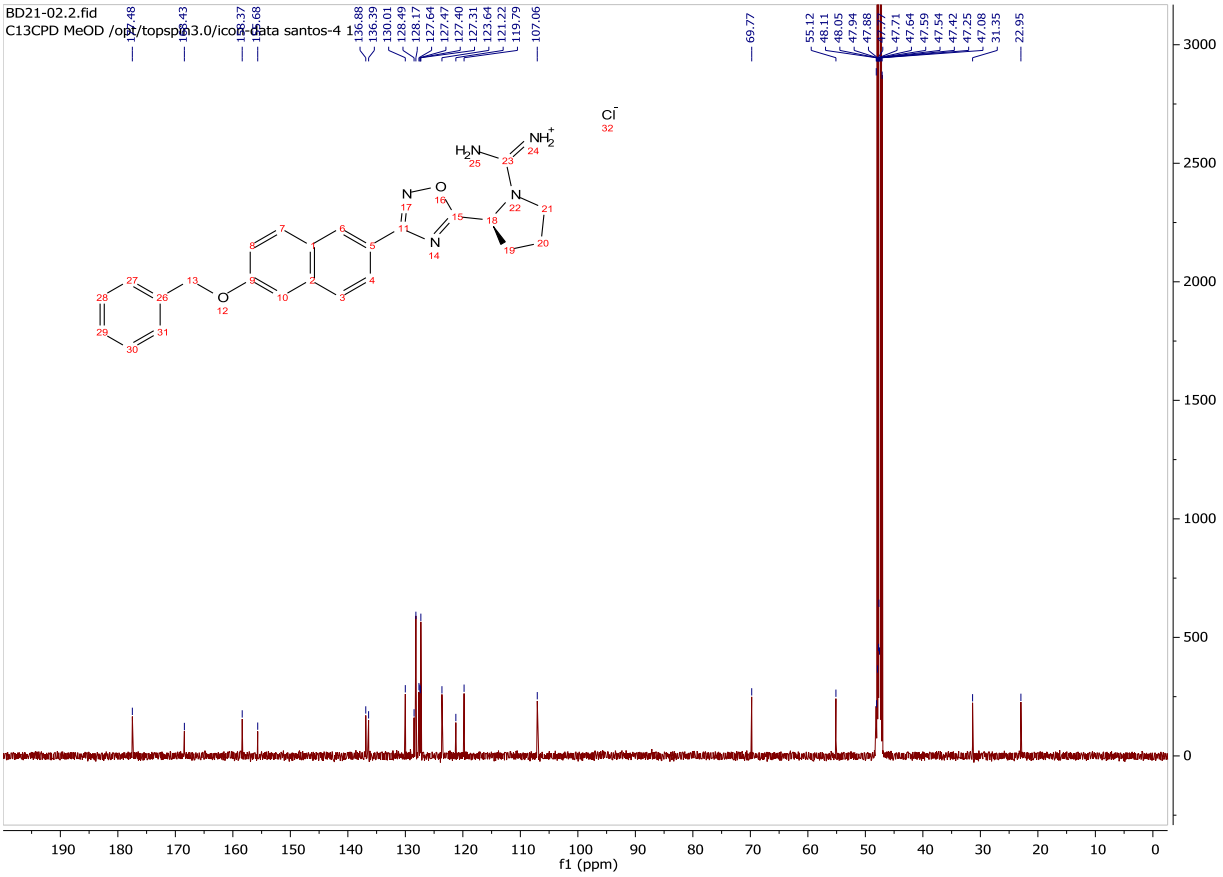
^{13}C-NMR Spectrum for 3.7e:



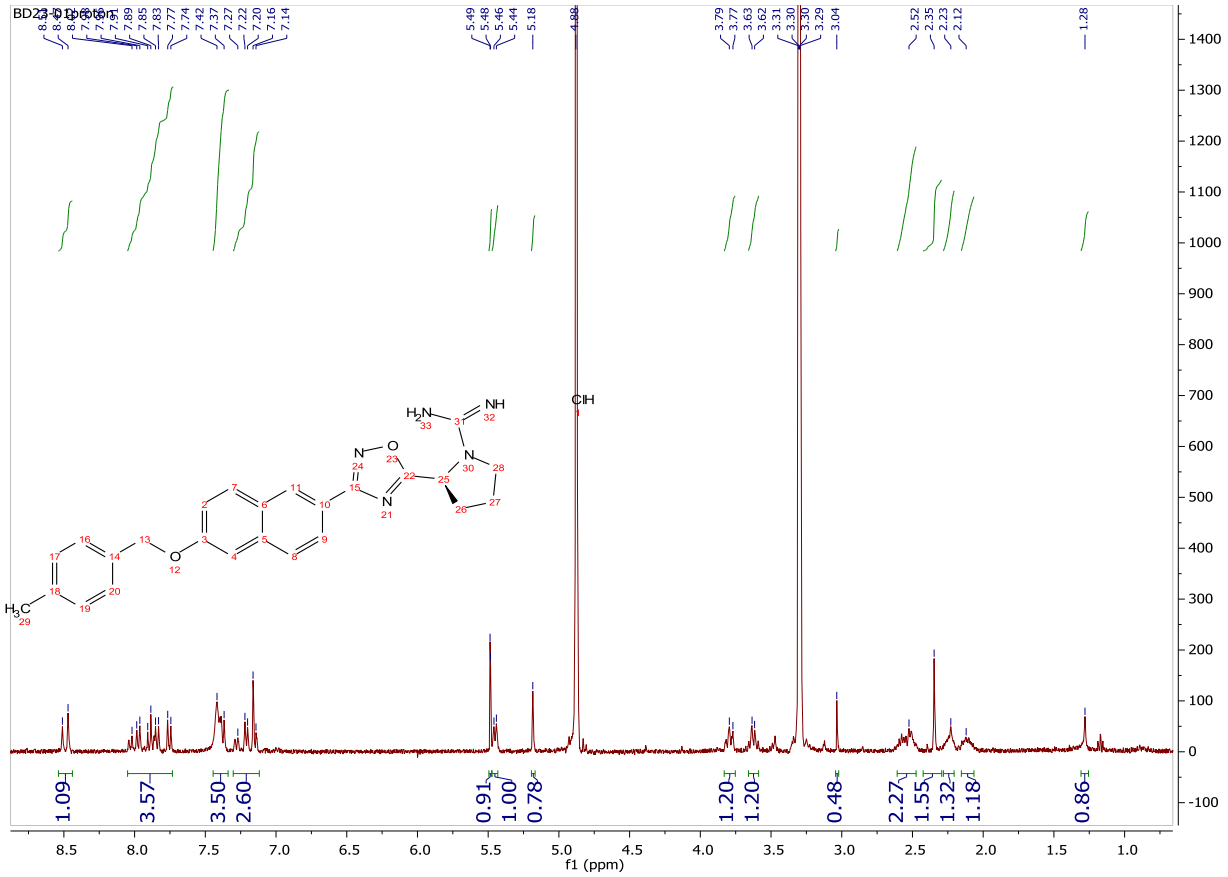
^{1}H-NMR Spectrum for 3.7f:



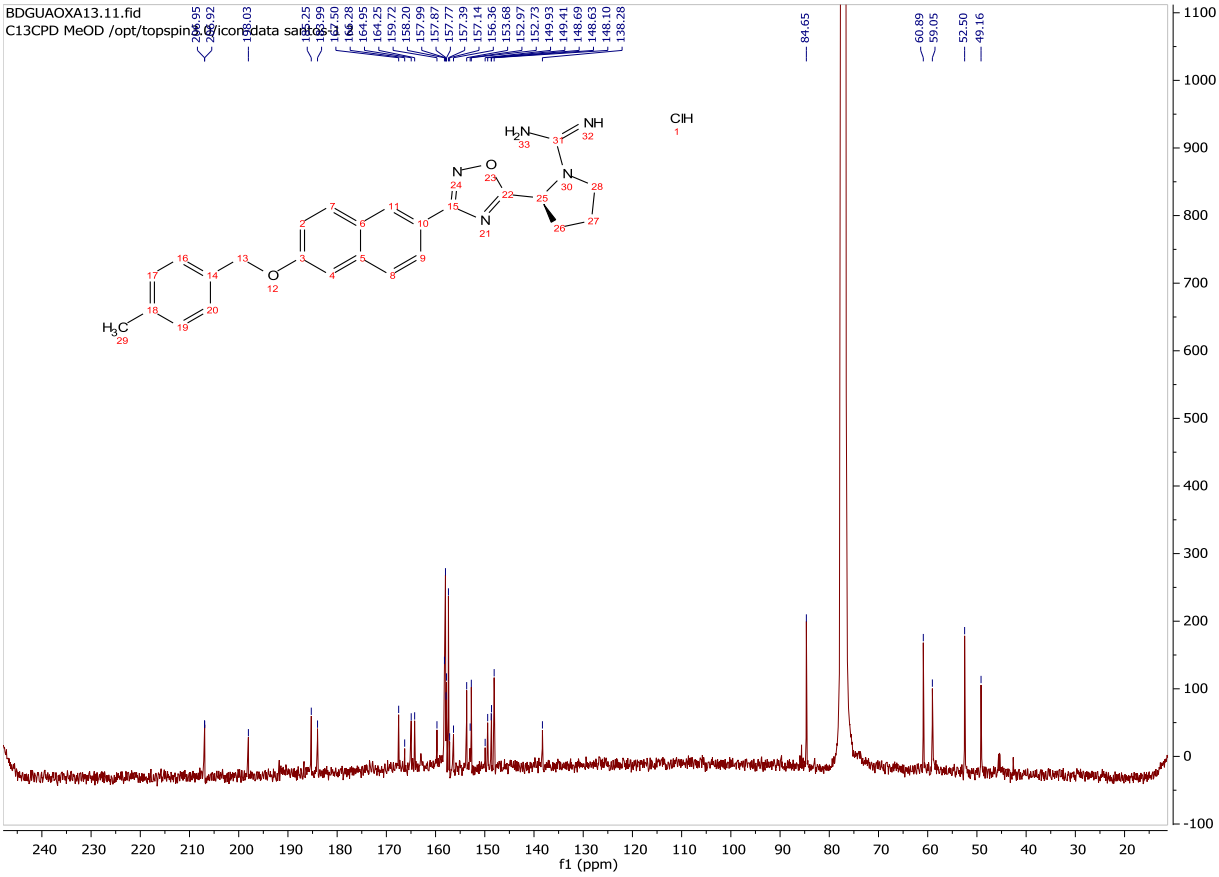
^{13}C-NMR Spectrum for 3.7f:



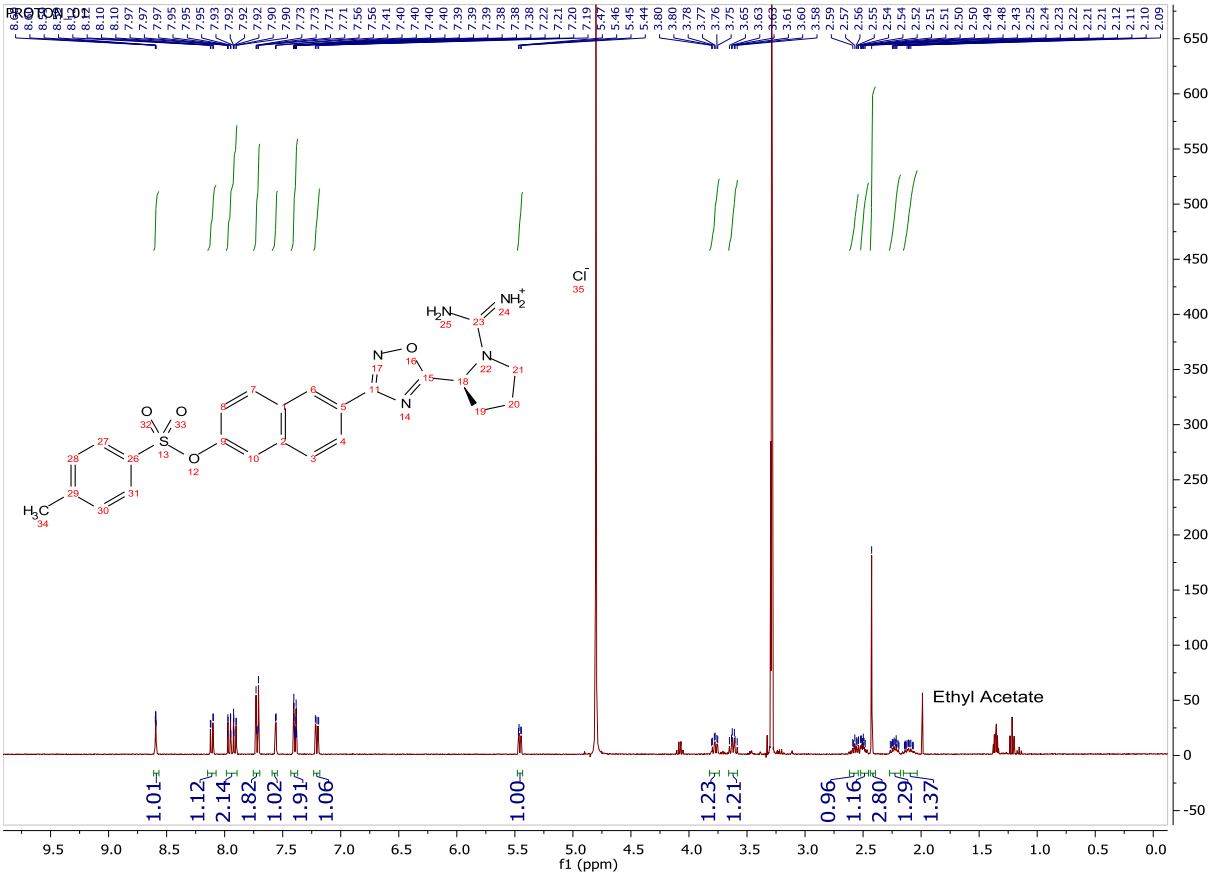
^{1}H-NMR Spectrum for 3.7g:



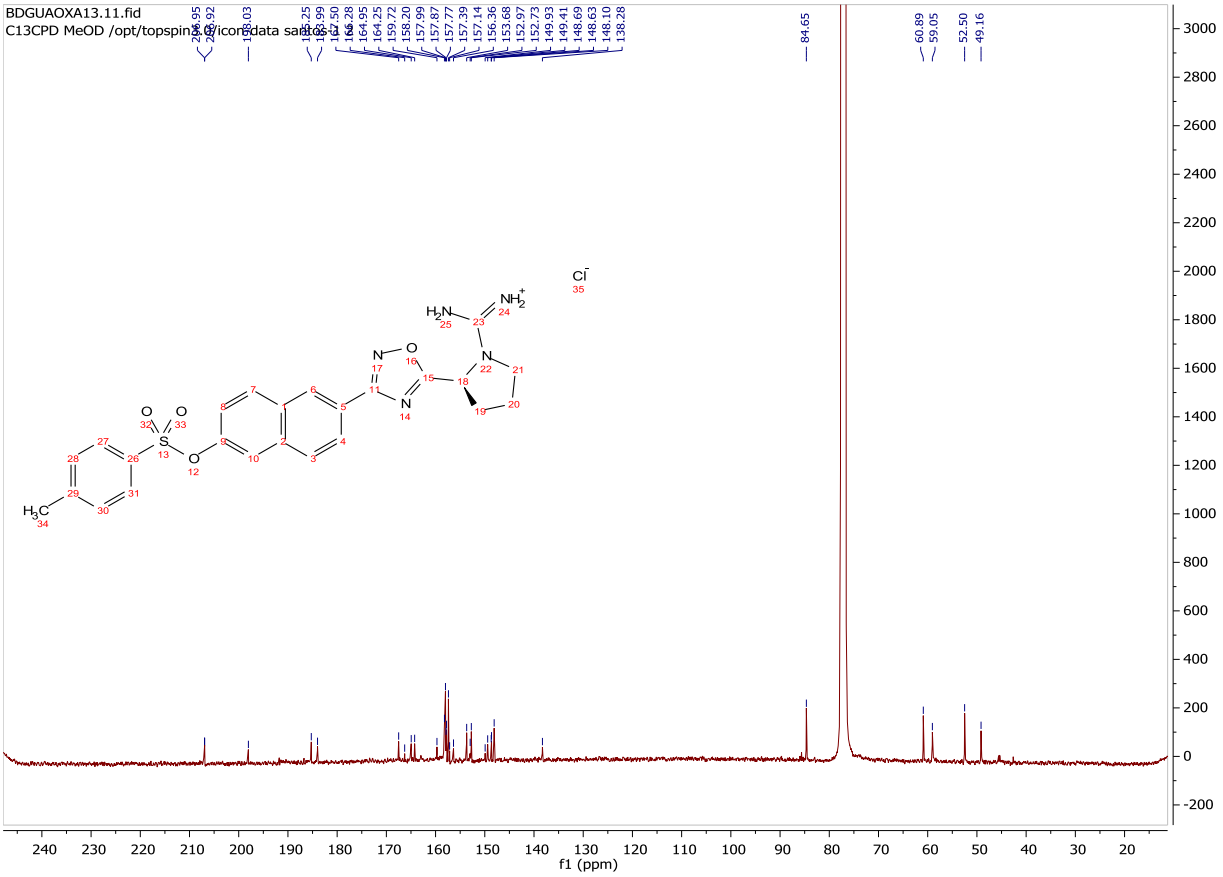
^{13}C-NMR Spectrum for 3.7g:



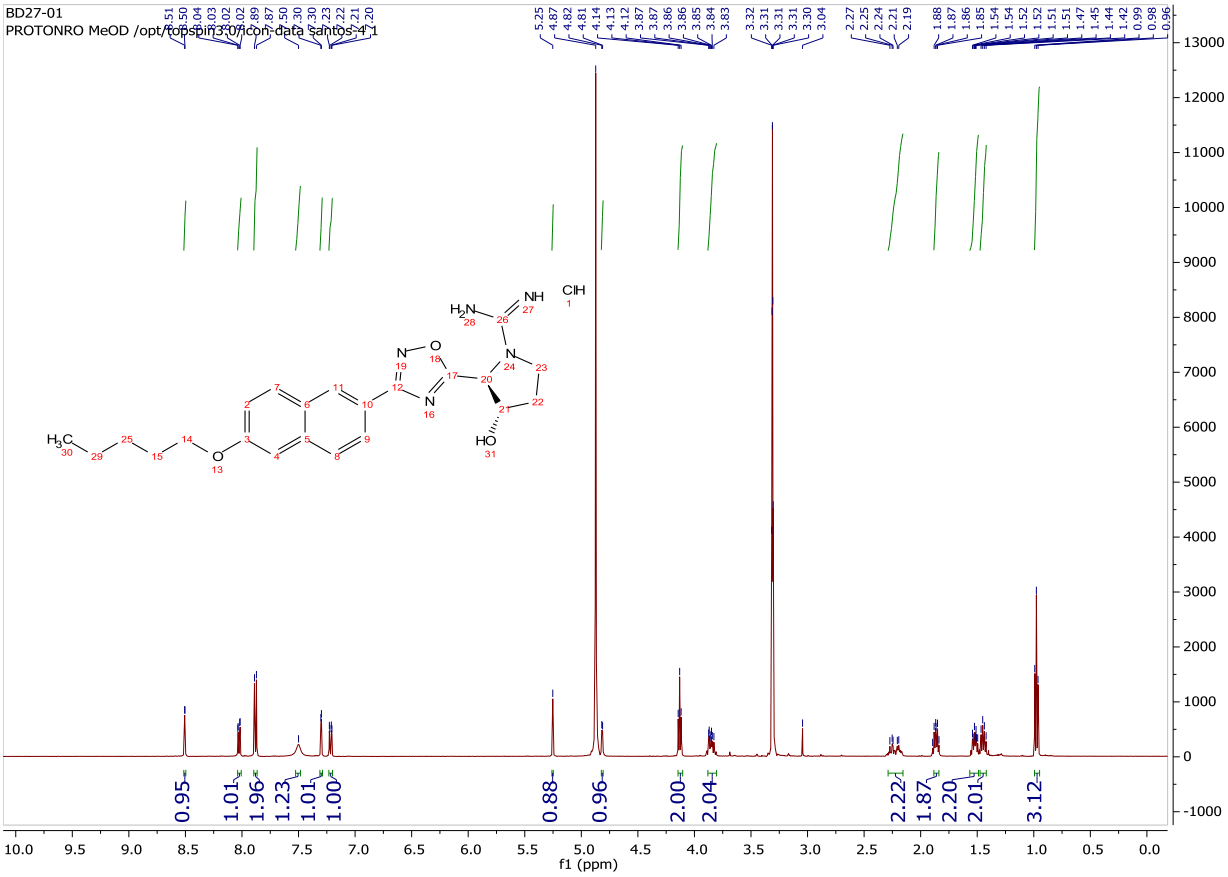
^{1}H-NMR Spectrum for 3.7h:



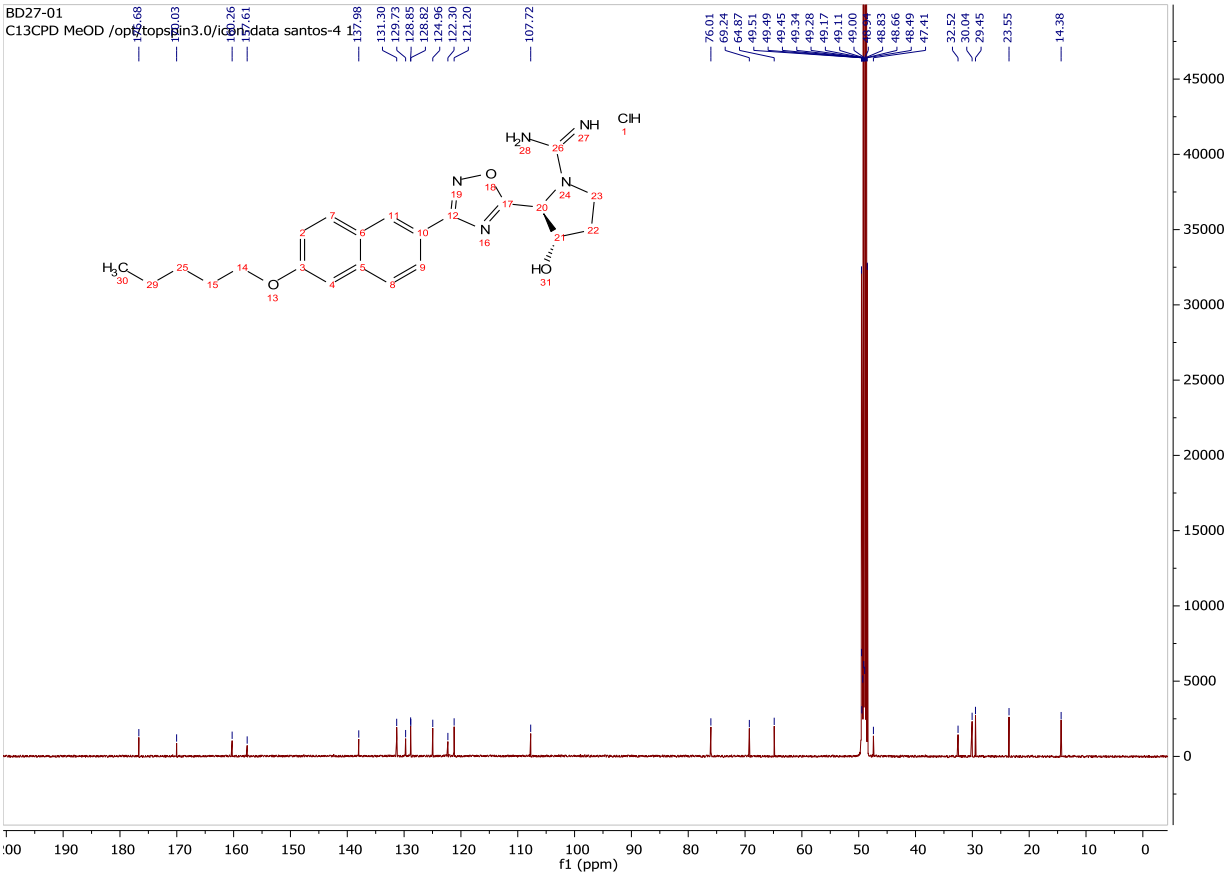
^{13}C-NMR Spectrum for 3.7h:



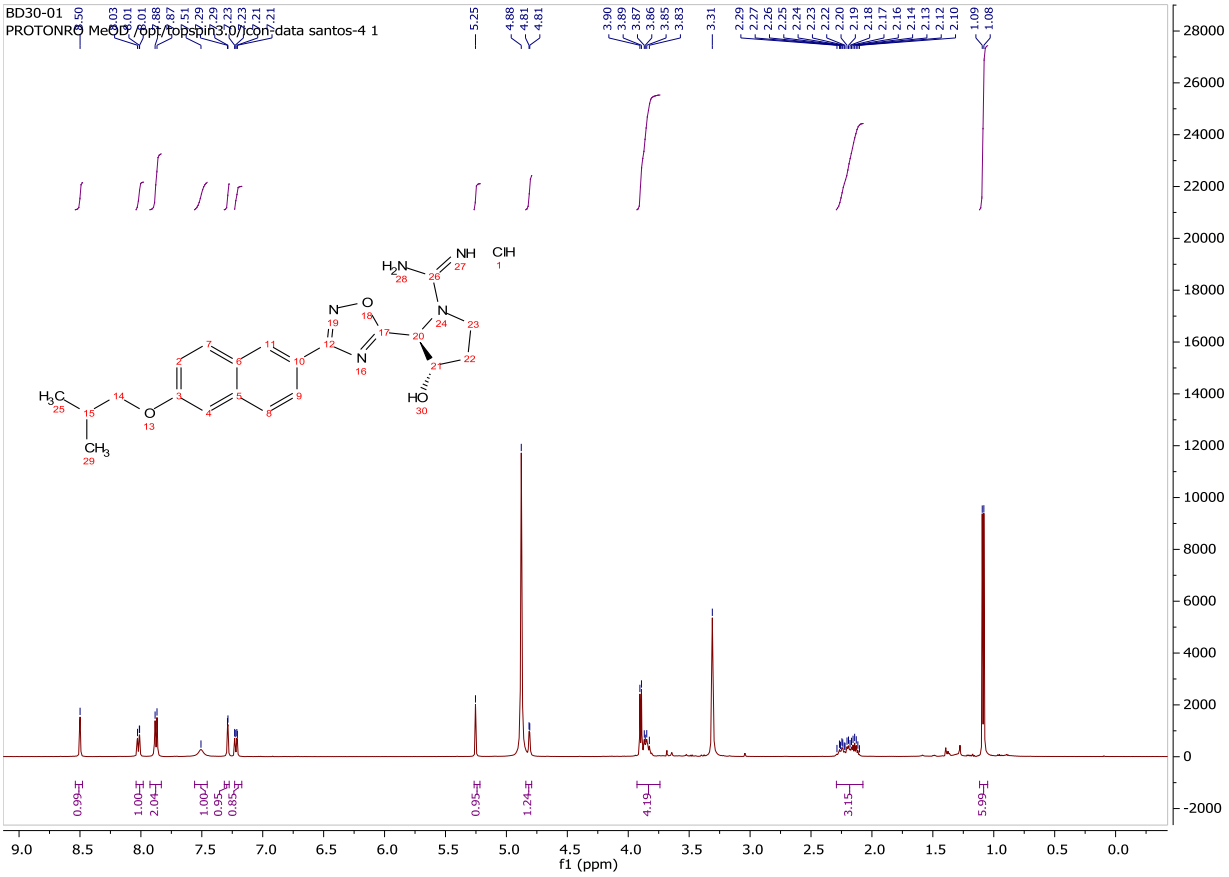
^{1}H-NMR Spectrum for 3.7i:



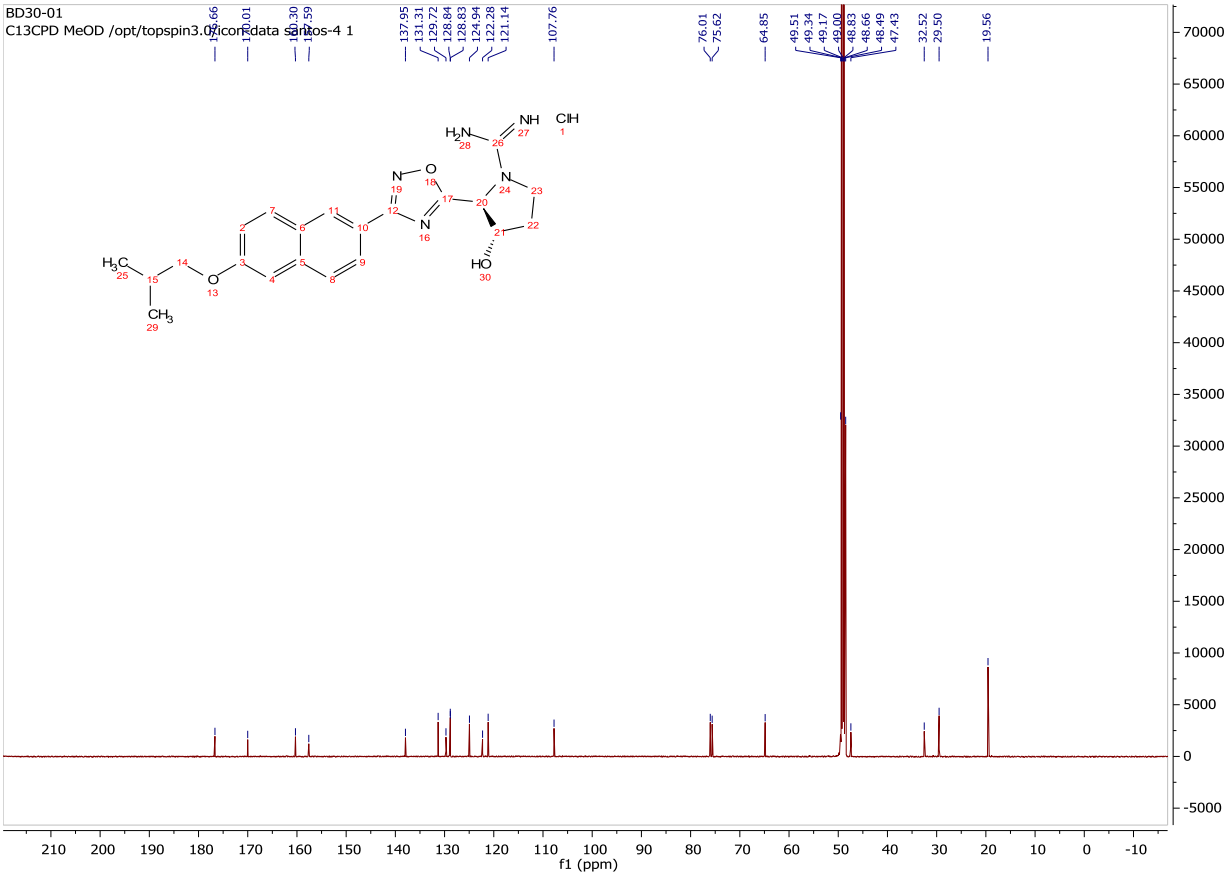
^{13}C-NMR Spectrum for 3.7i:



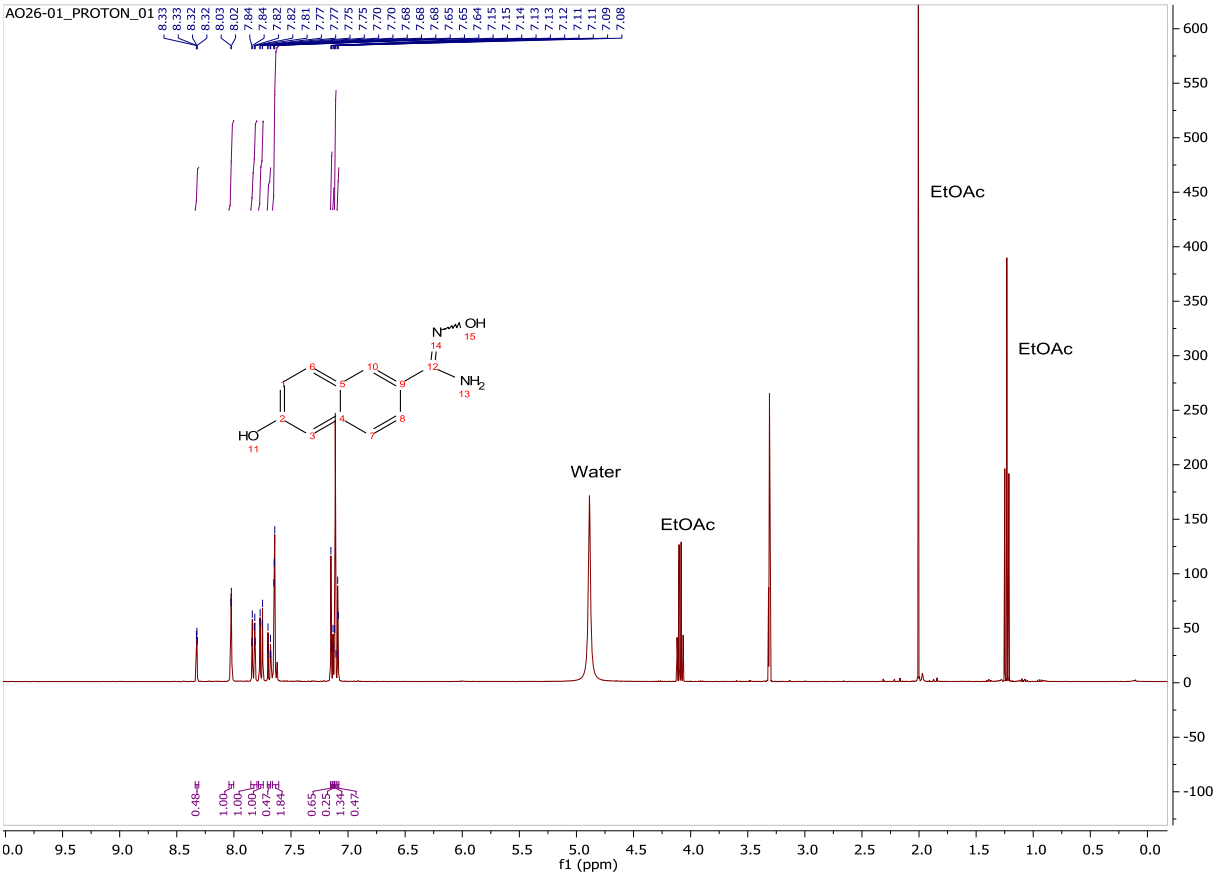
^{1}H-NMR Spectrum for 3.7j:



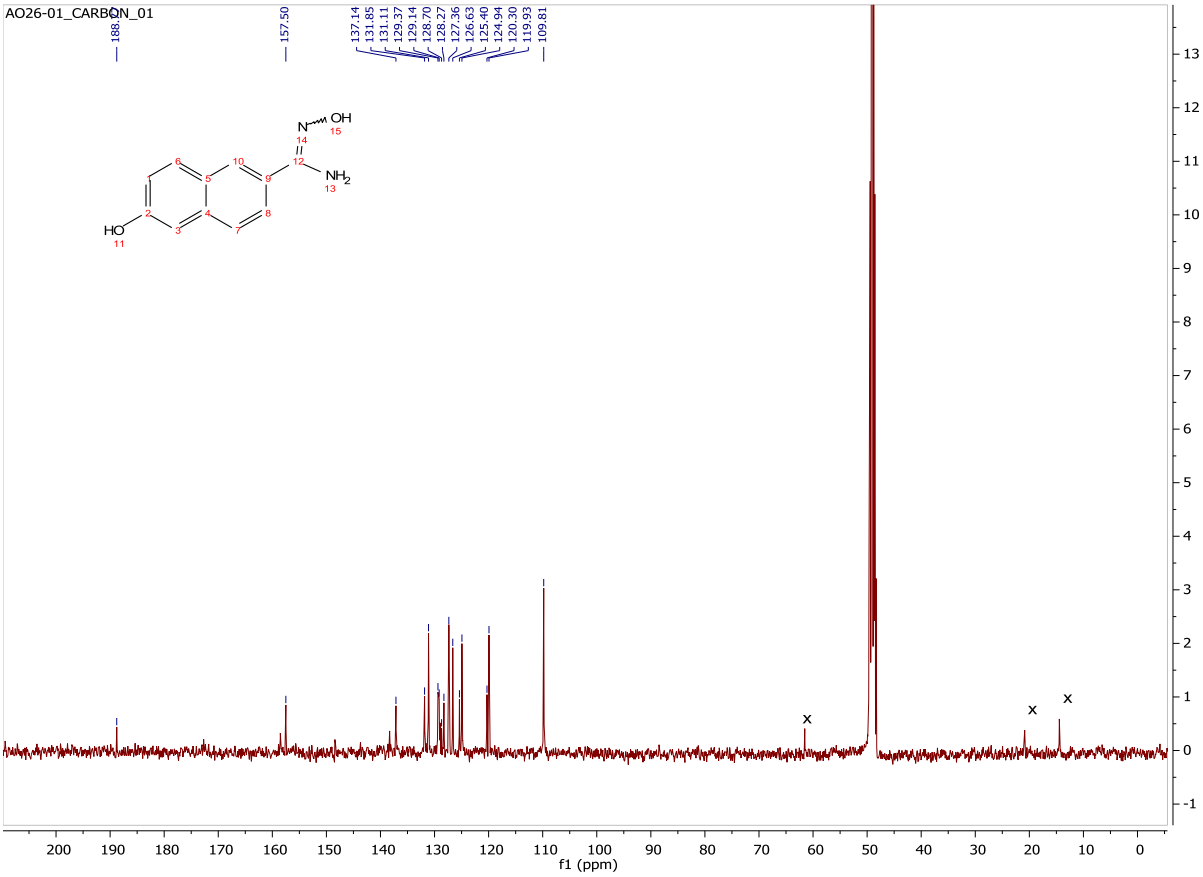
^{13}C-NMR Spectrum for 3.7j:



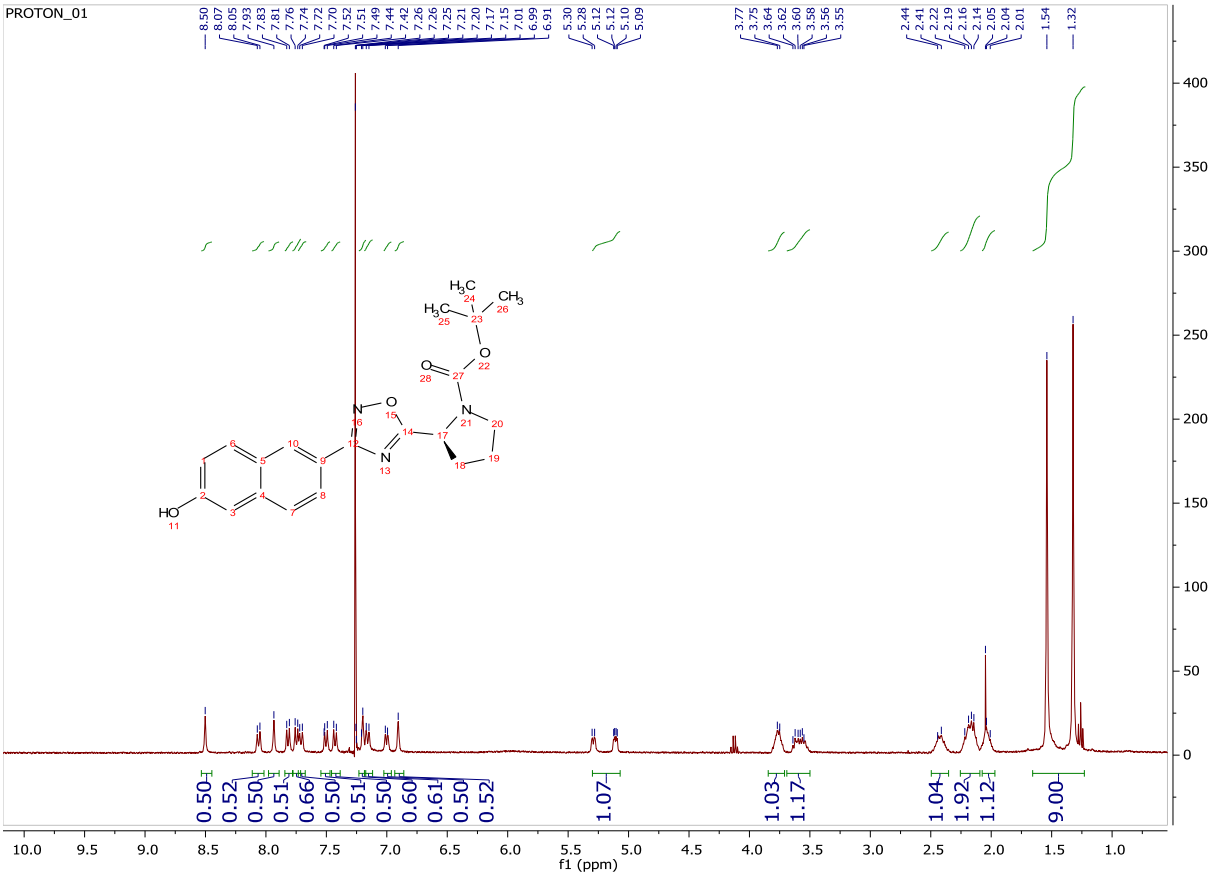
^{1}H-NMR Spectrum for 3.8:



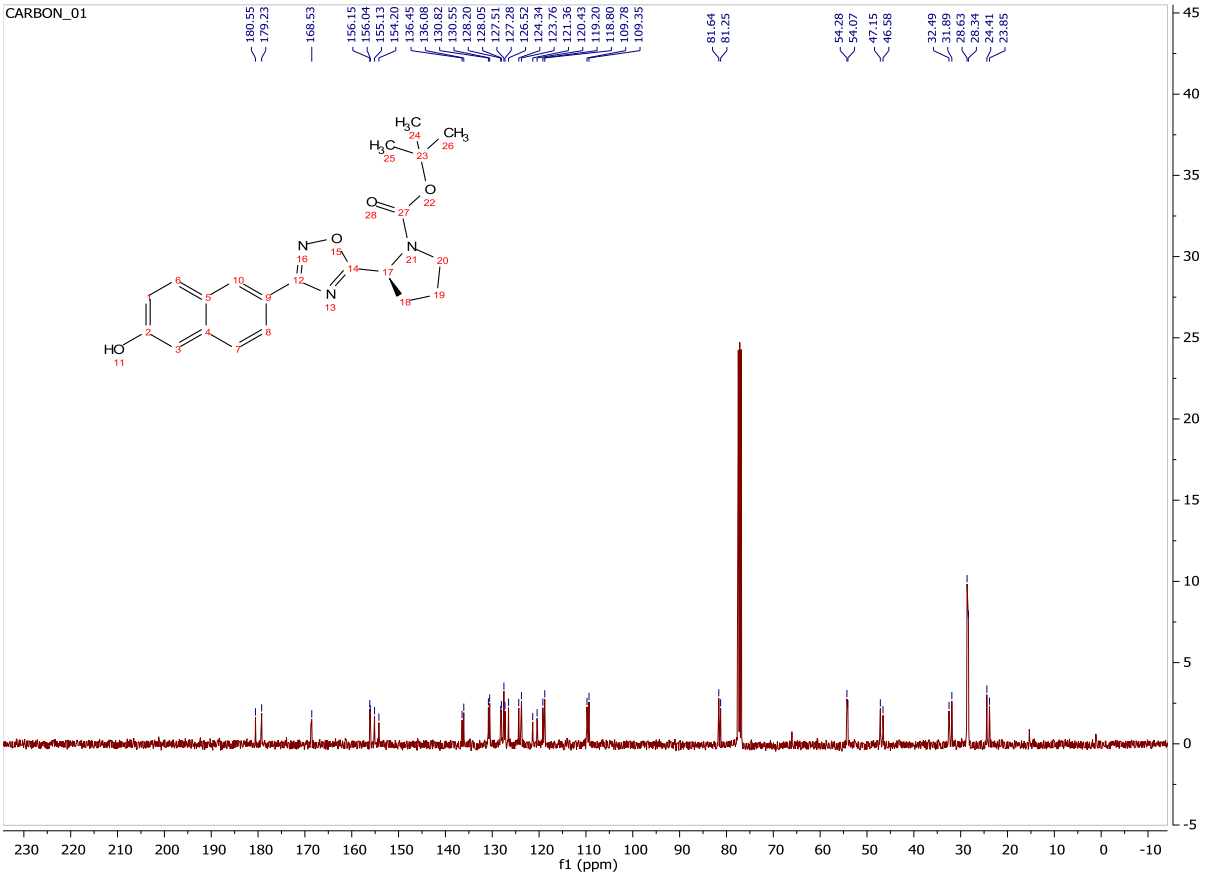
^{13}C-NMR Spectrum for 3.8:



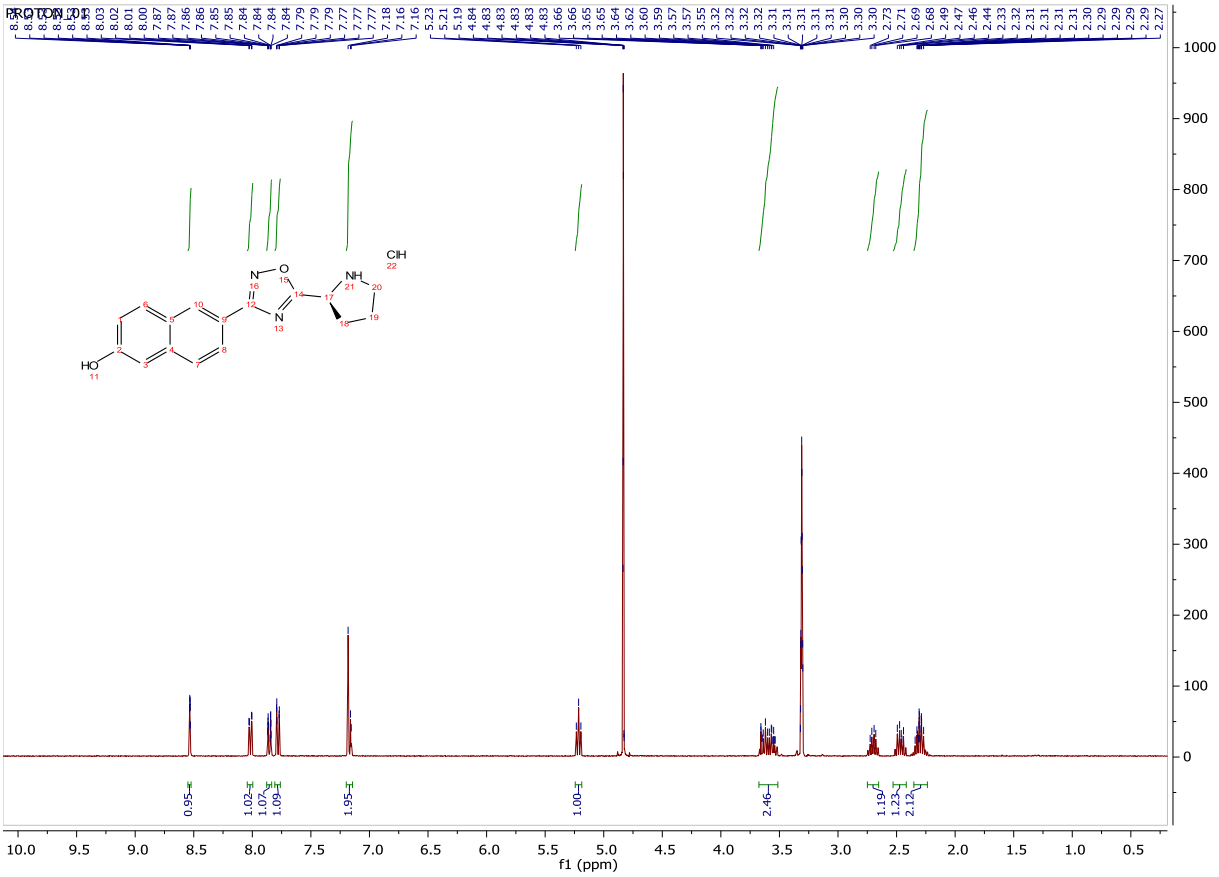
^{1}H-NMR Spectrum for 3.9:



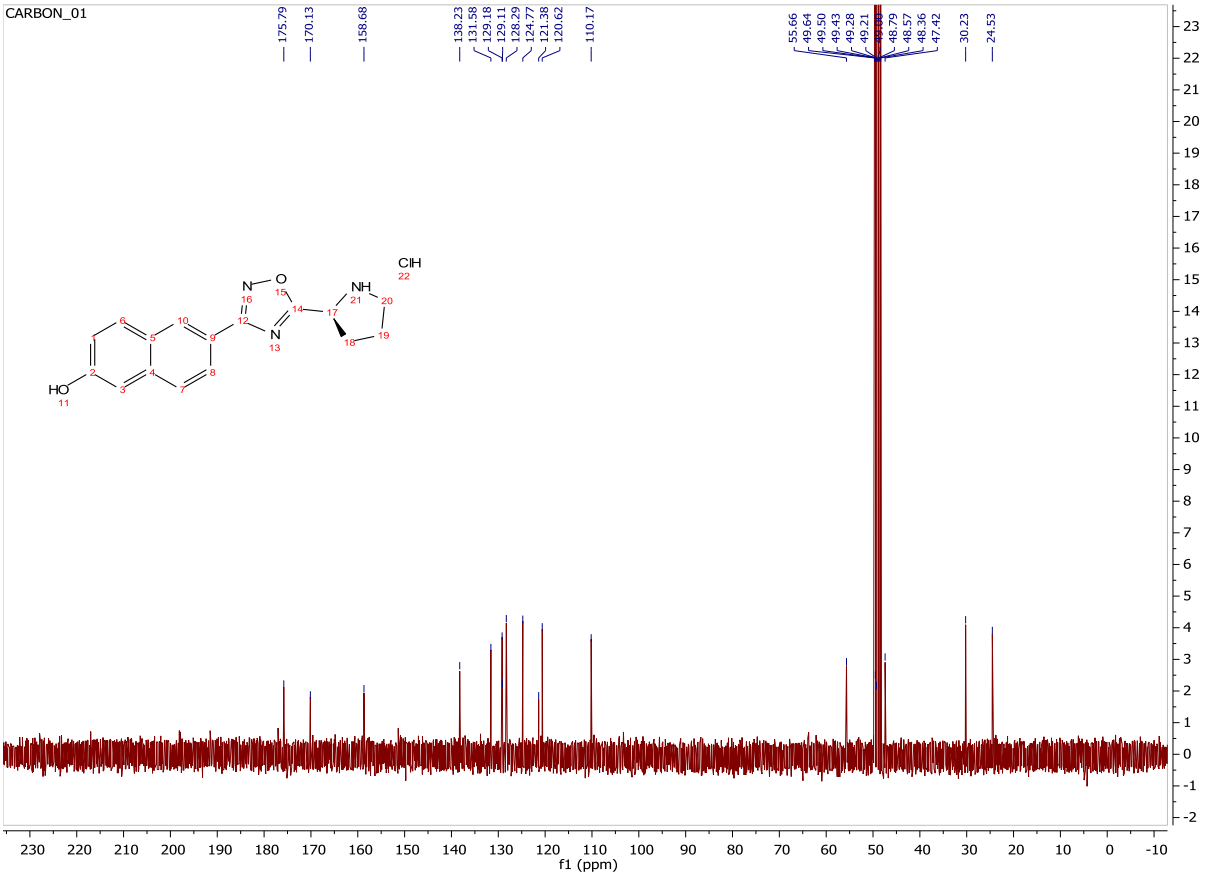
^{13}C-NMR Spectrum for 3.9:



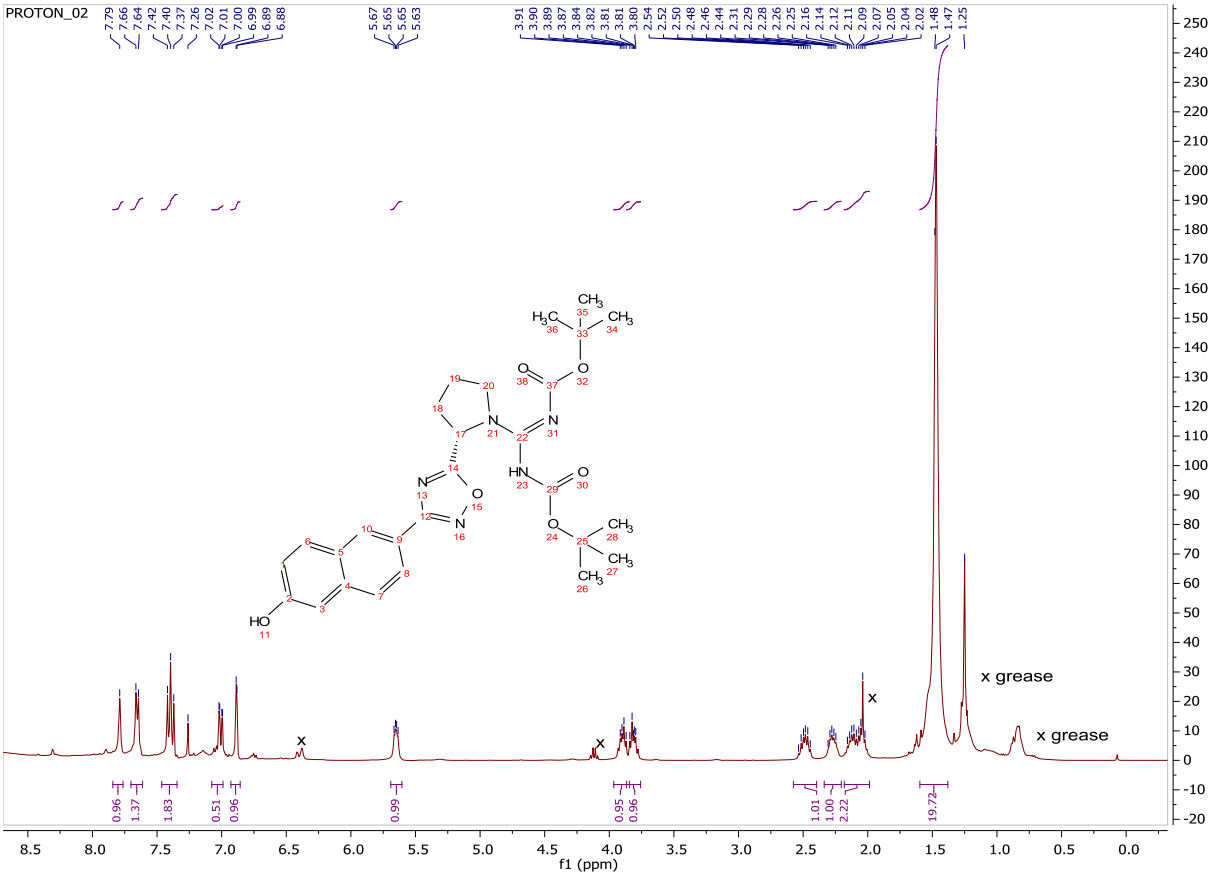
^{1}H-NMR Spectrum for 3.10:



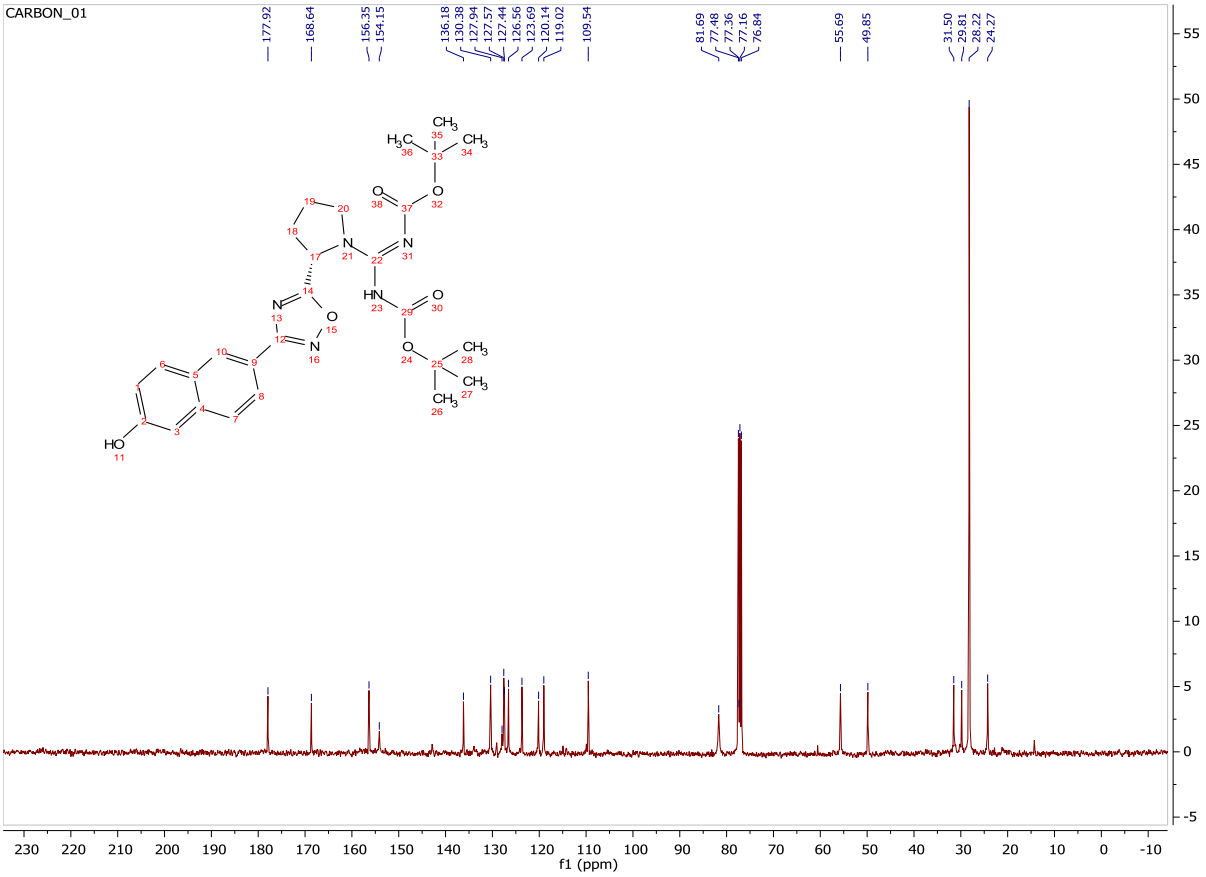
^{13}C-NMR Spectrum for 3.10:



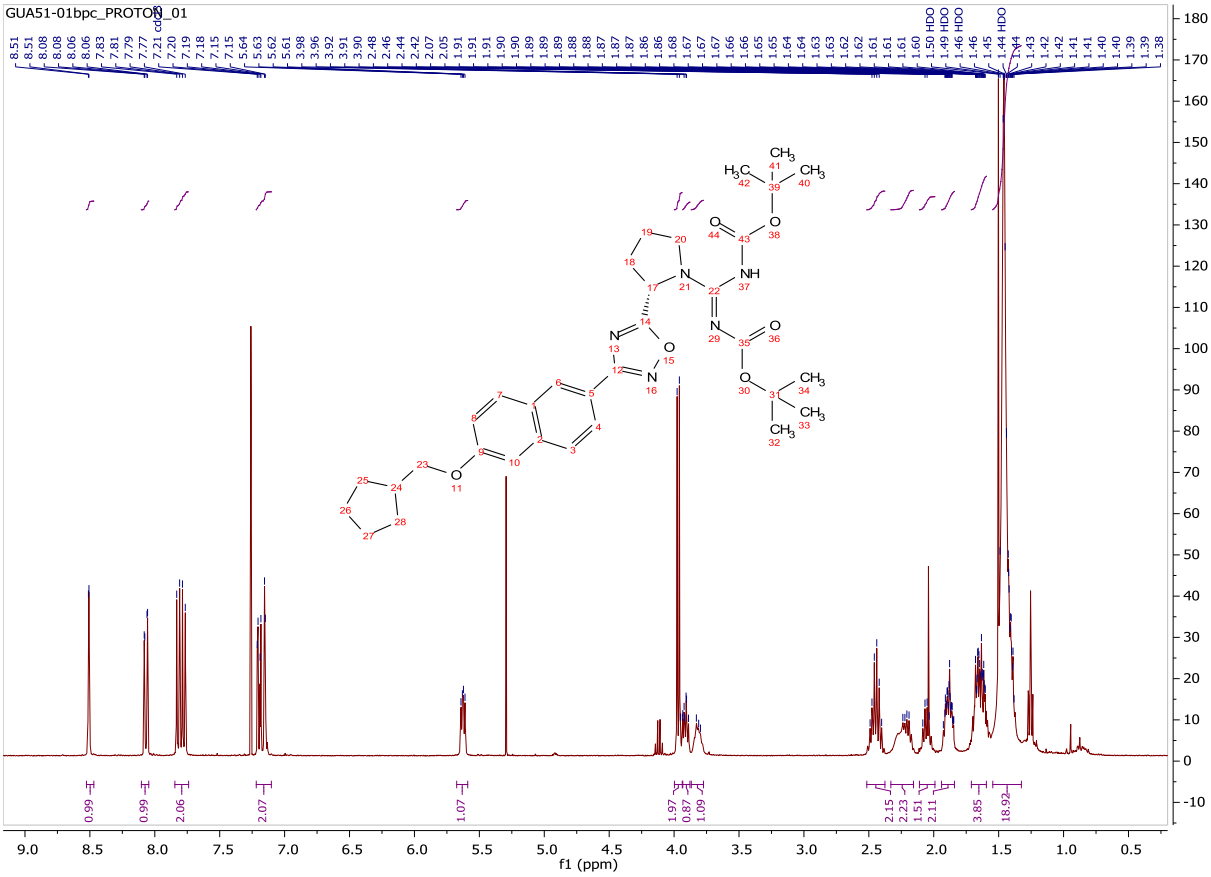
^{1}H-NMR Spectrum for 3.11:



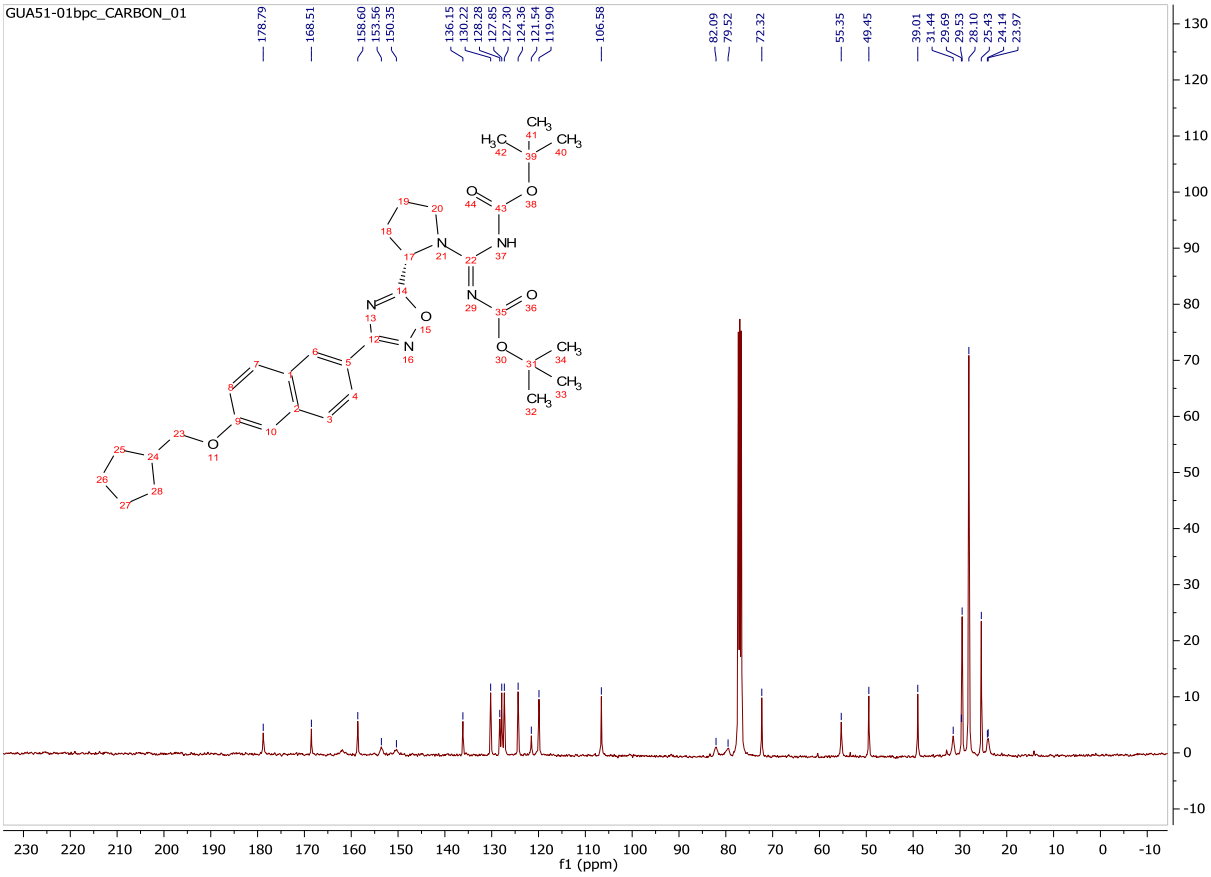
^{13}C-NMR Spectrum for 3.11:



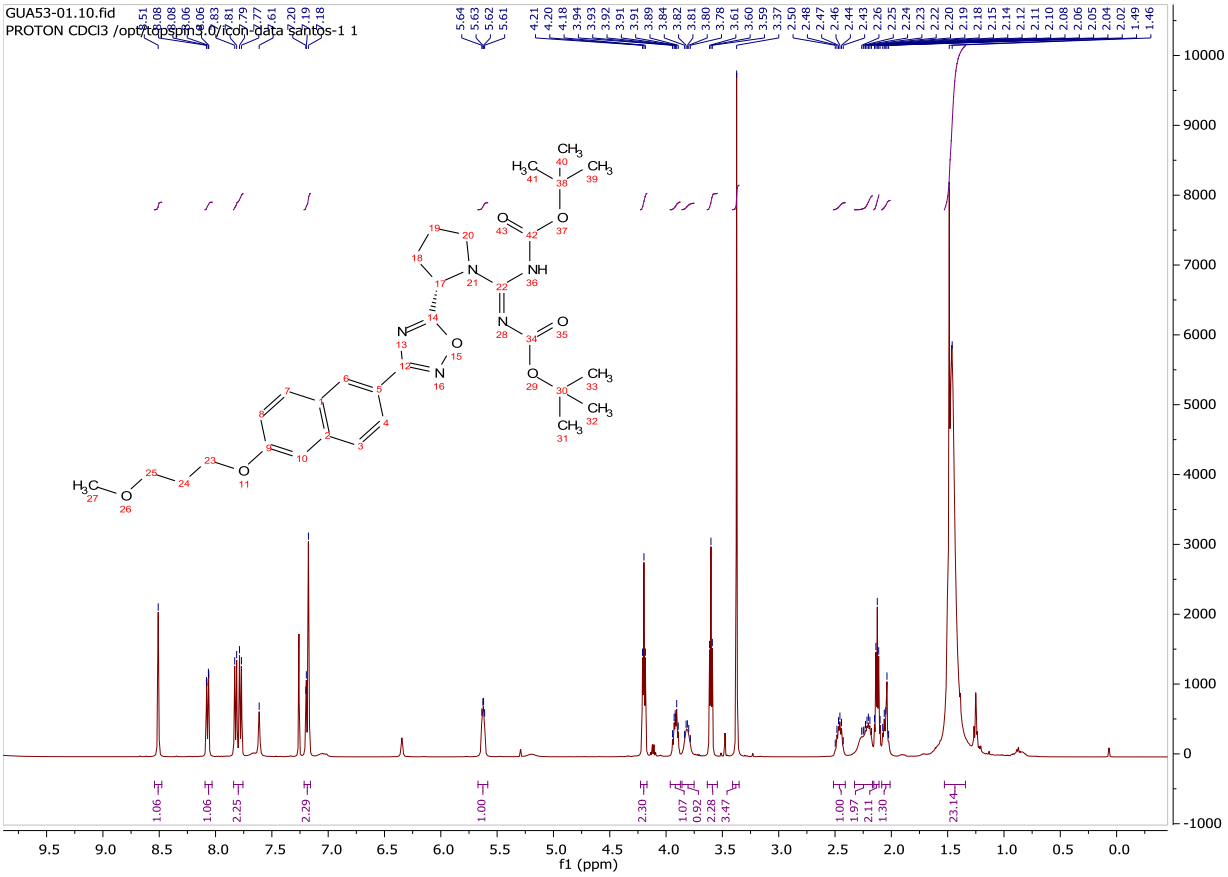
^{1}H-NMR Spectrum for 3.6k:



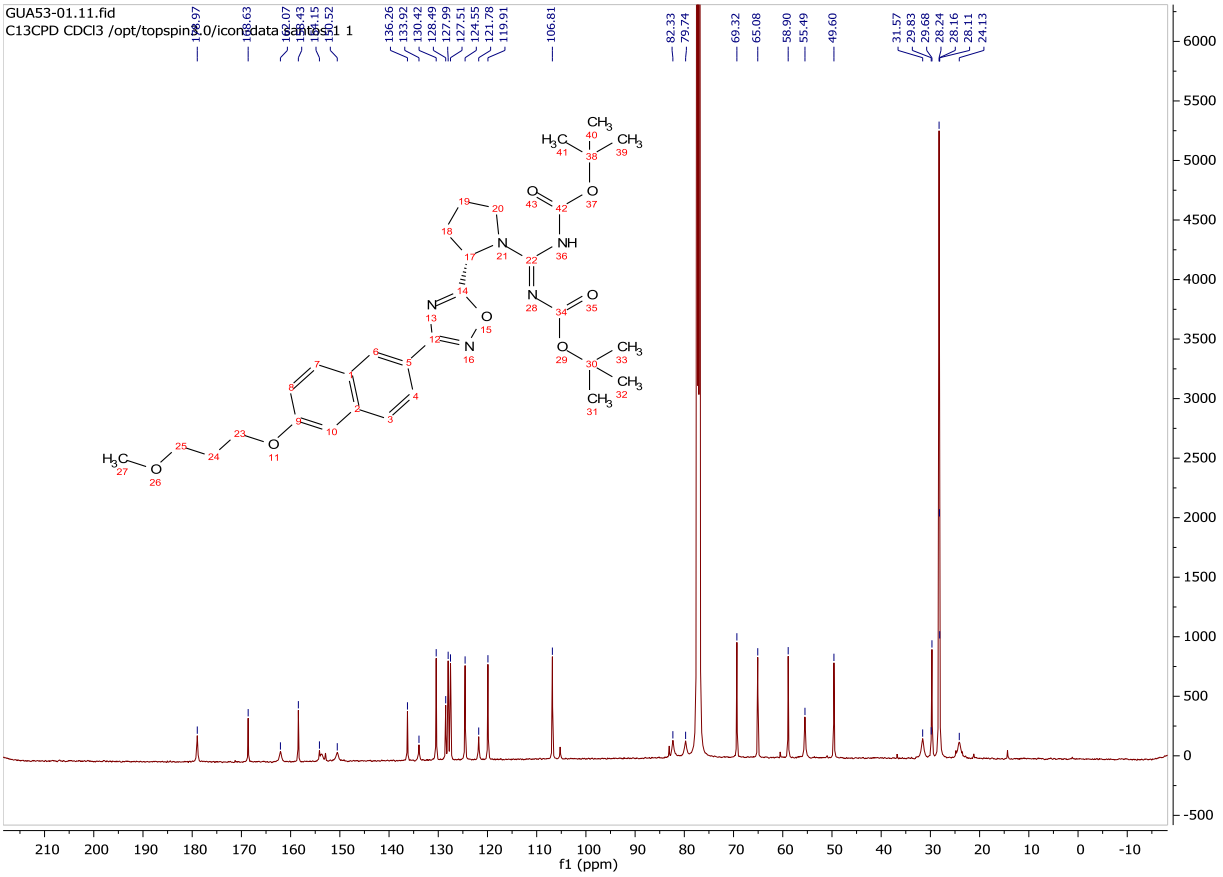
^{13}C-NMR Spectrum for 3.6k:



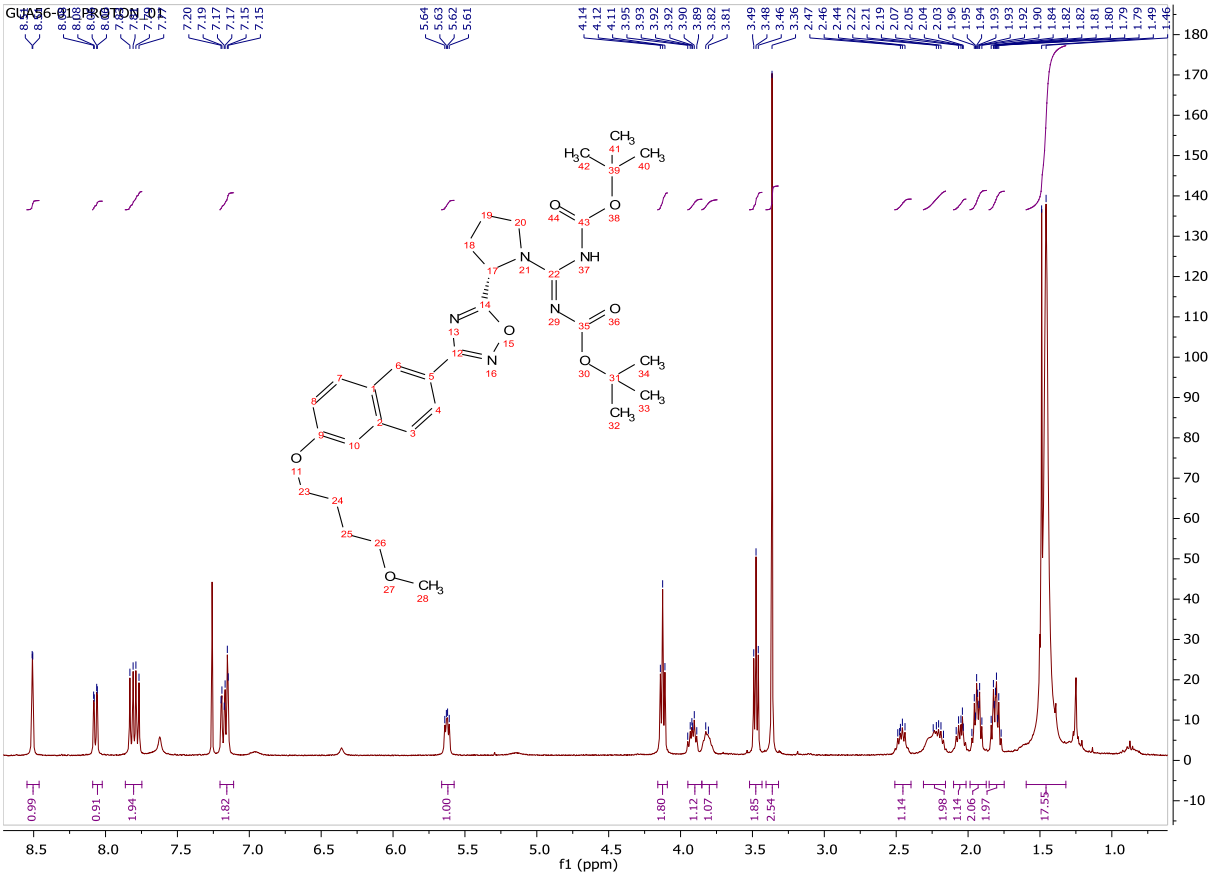
^{1}H-NMR Spectrum for 3.6l:



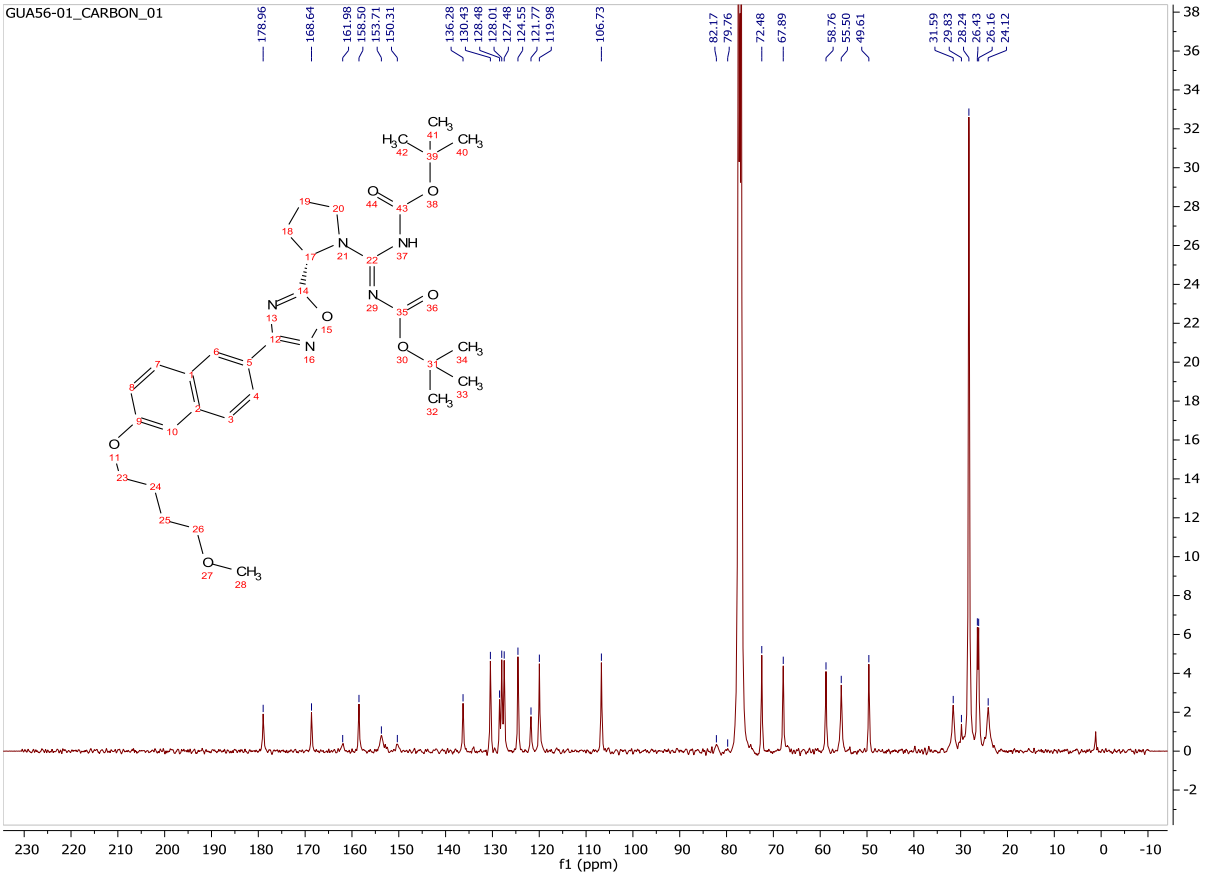
^{13}C-NMR Spectrum for 3.6l:



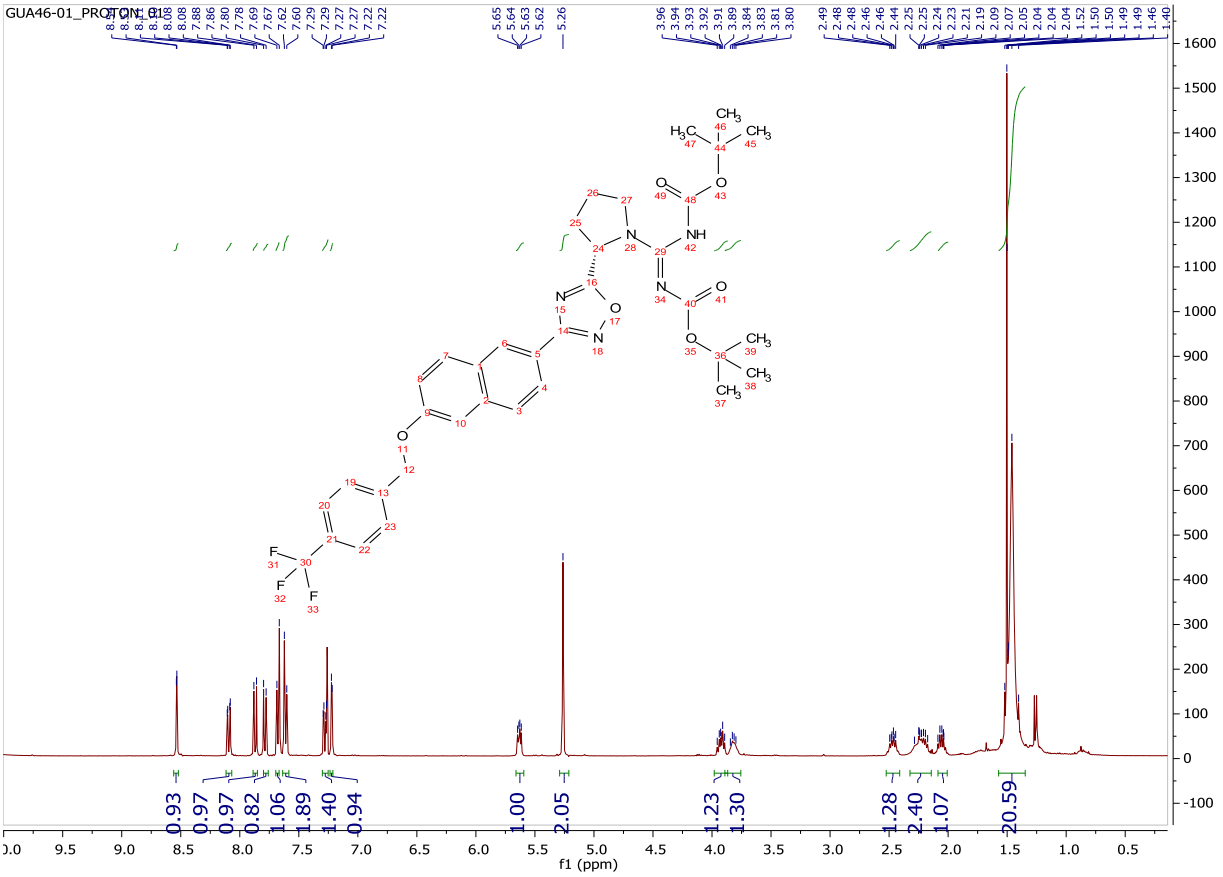
^{1}H-NMR Spectrum for 3.6m:



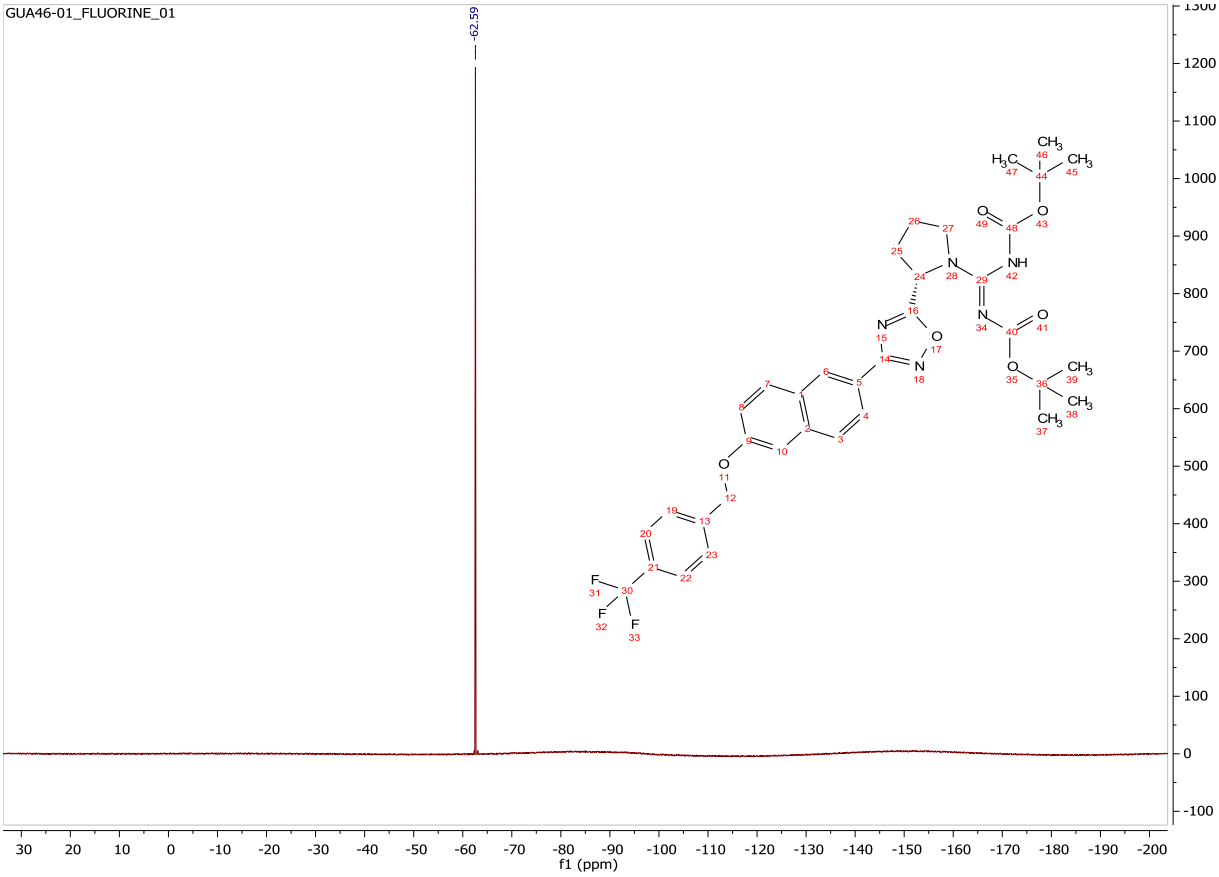
^{13}C-NMR Spectrum for 3.6m:



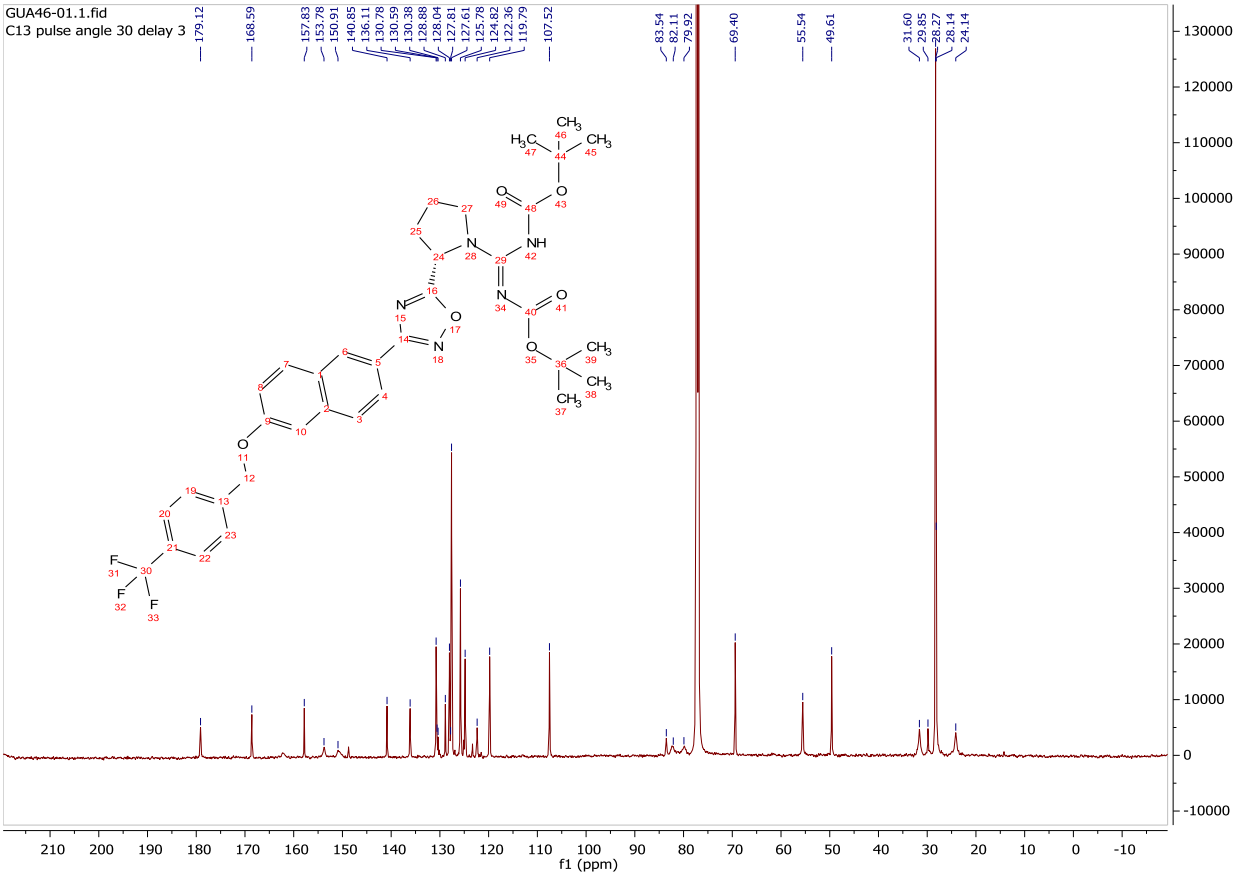
^{1}H-NMR Spectrum for 3.6n:



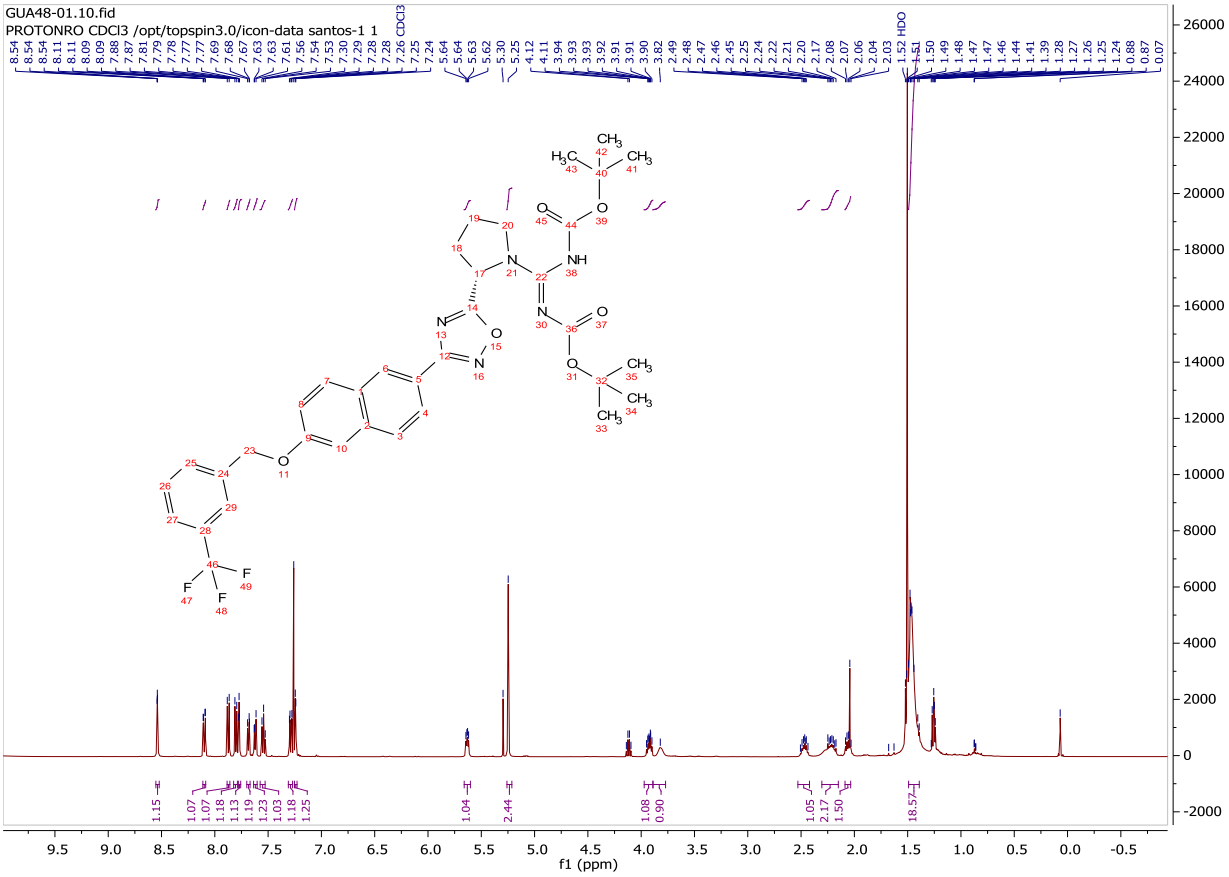
^{19}F-NMR Spectrum for 3.6n:



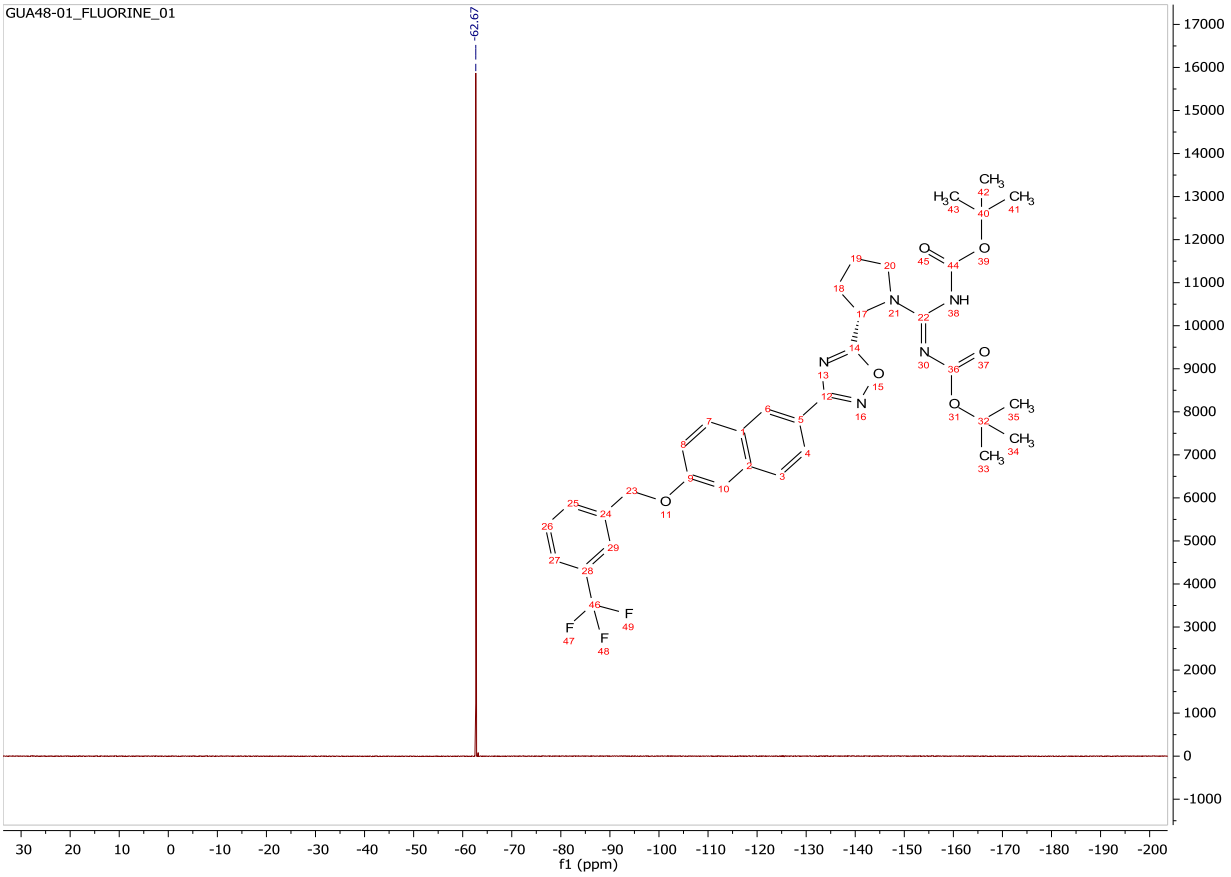
^{13}C-NMr Spectrum for 3.6n:



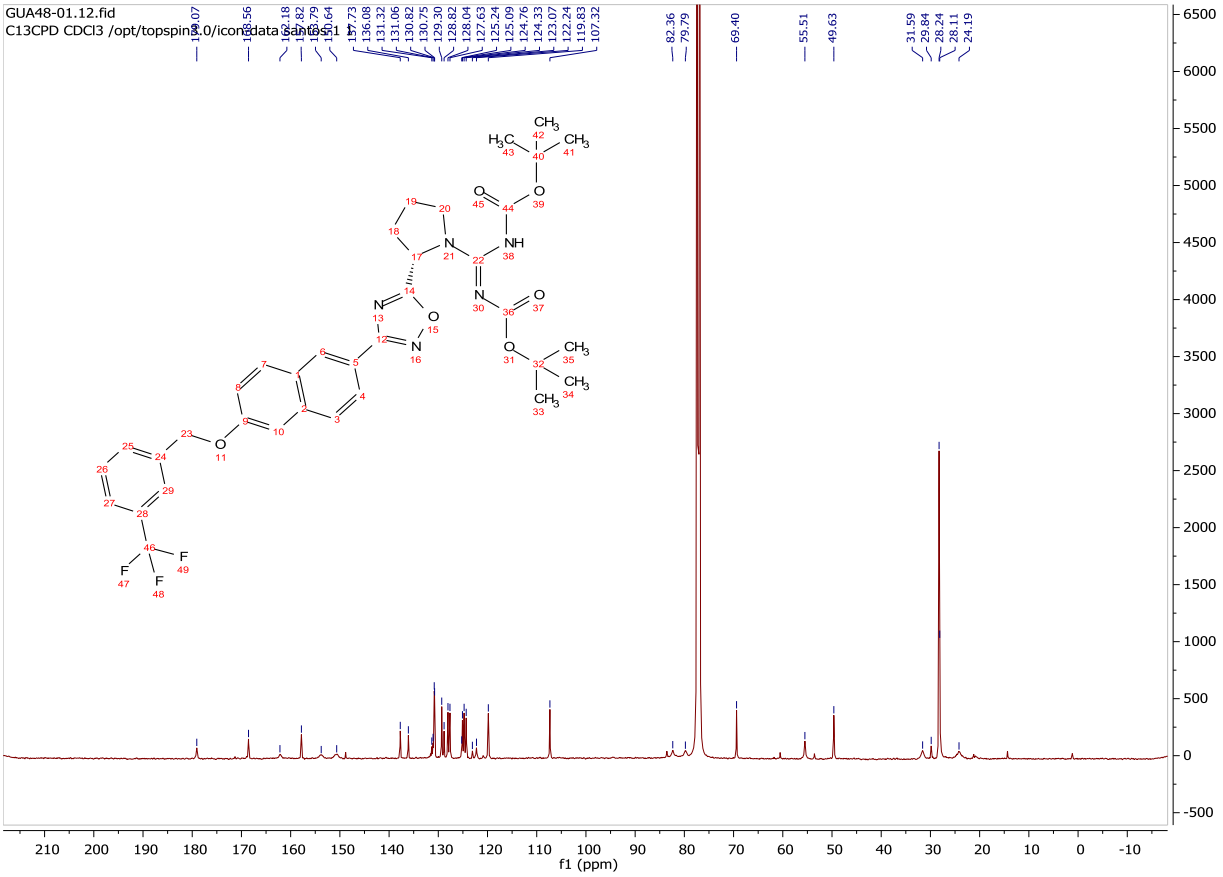
^{1}H-NMR Spectrum for 3.6o



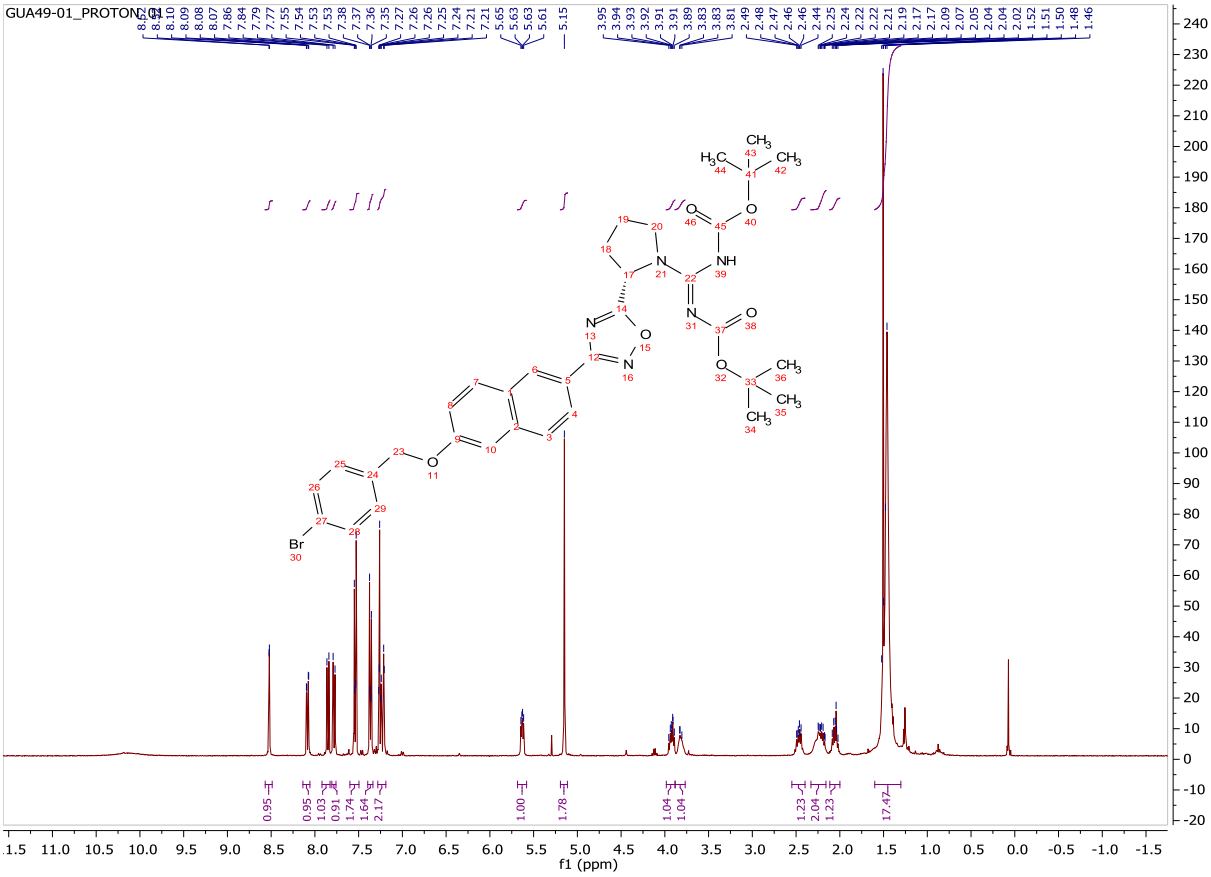
^{19}F-NMR Spectrum for 3.6o



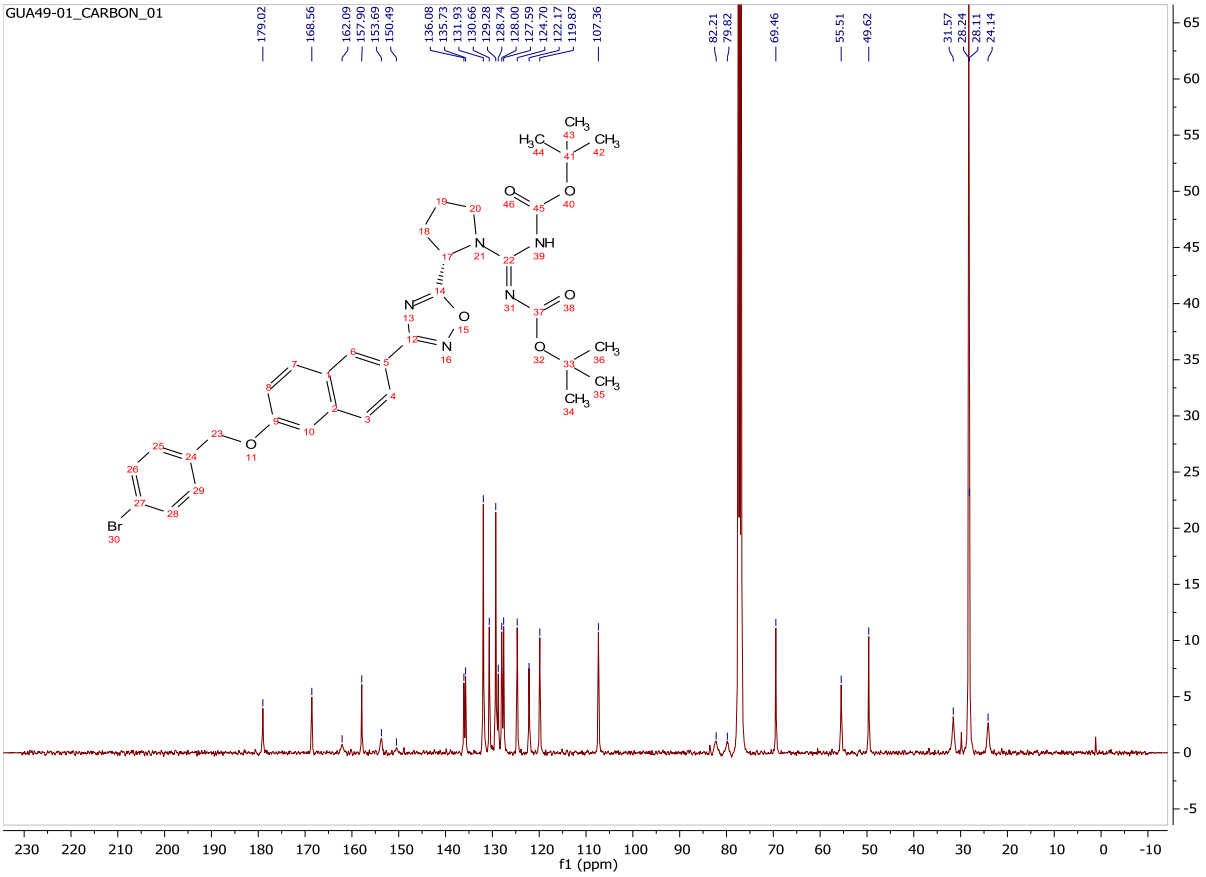
^{13}C-NMR Spectrum for 3.6o



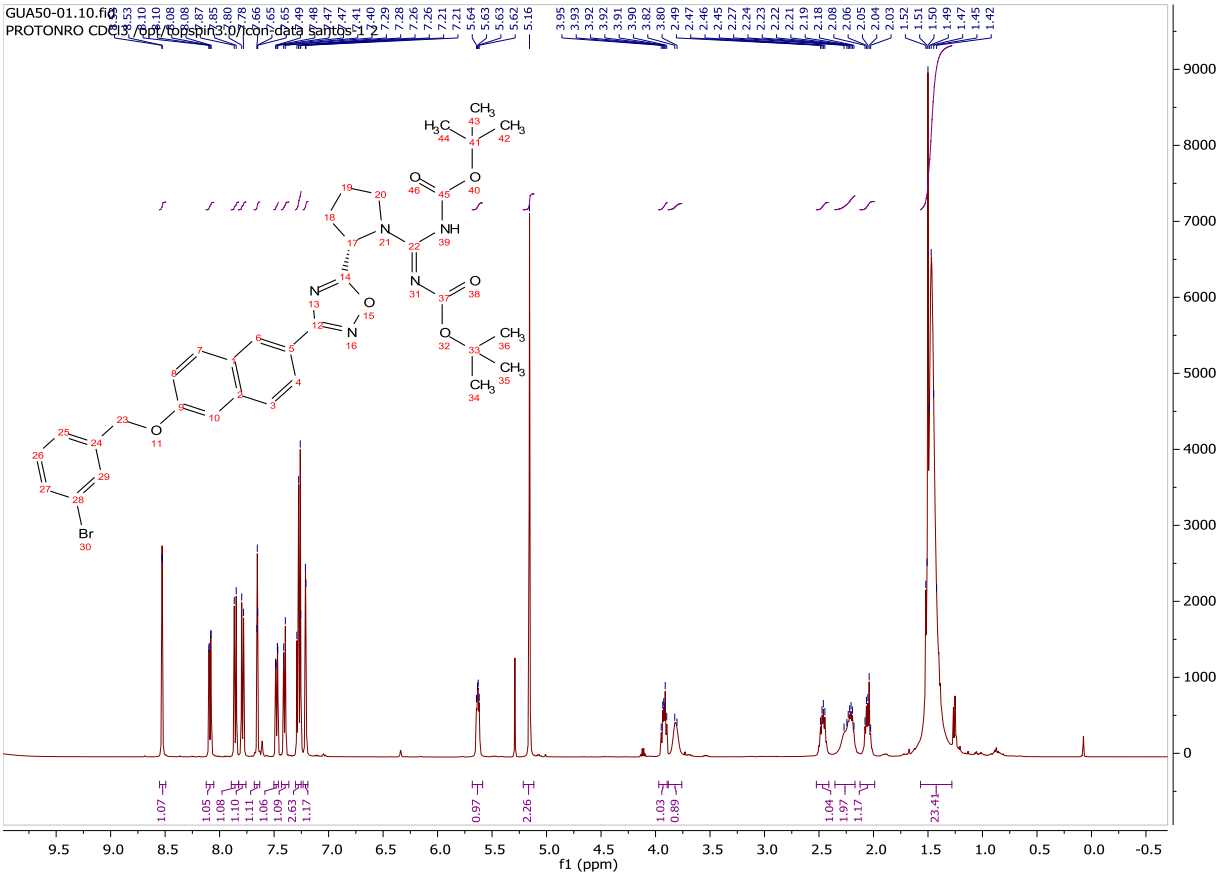
^{1}H-NMR Spectrum for 3.6p:



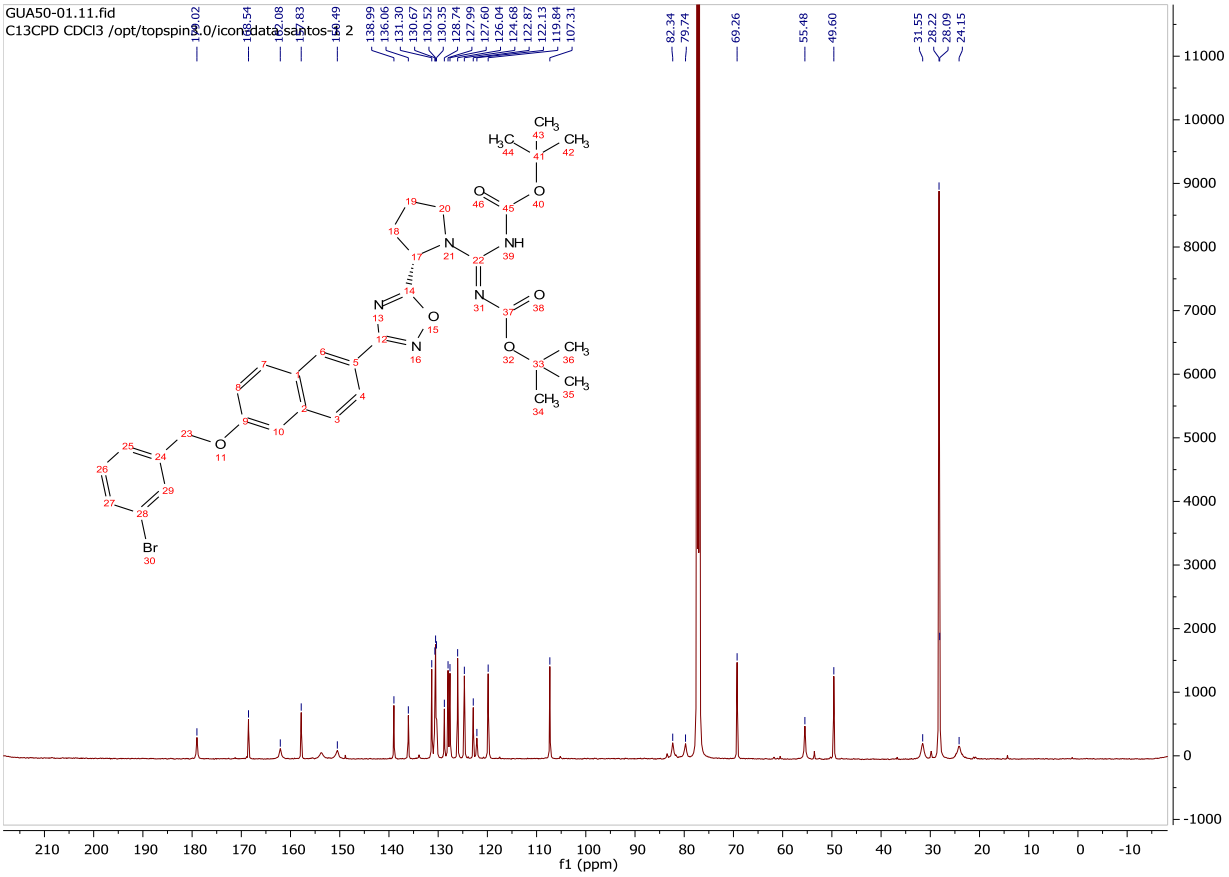
^{13}C-NMR Spectrum for 3.6p:



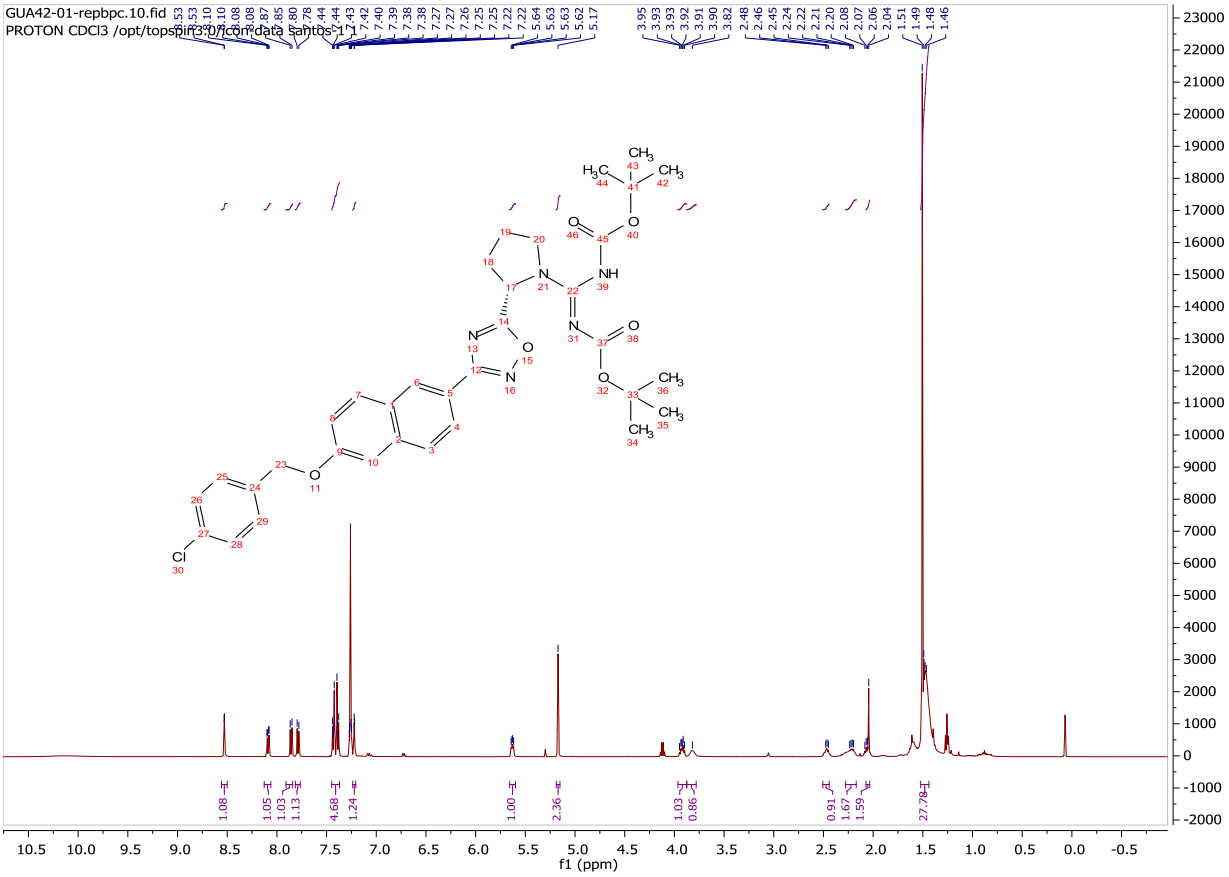
^{1}H-NMR Spectrum for 3.6q:



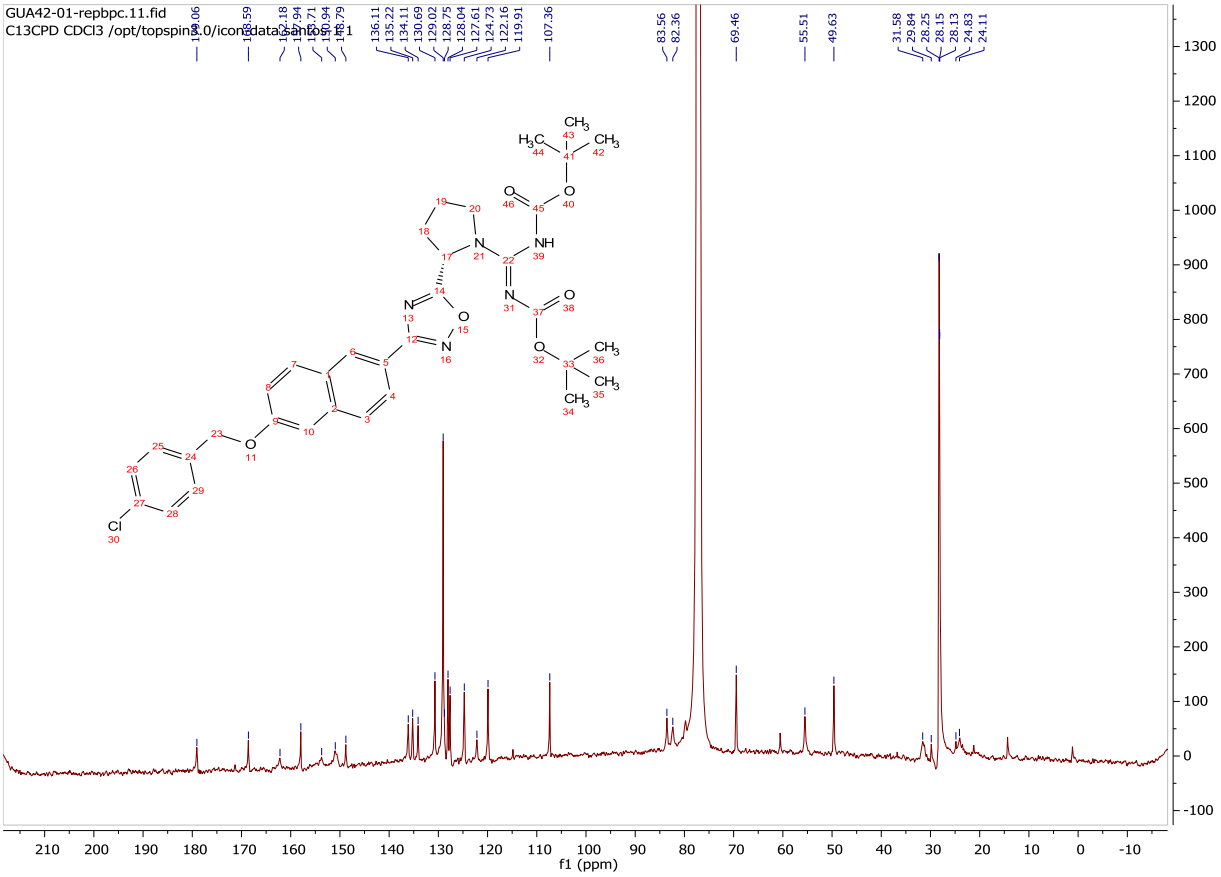
^{13}C-NMR Spectrum for 3.6q:



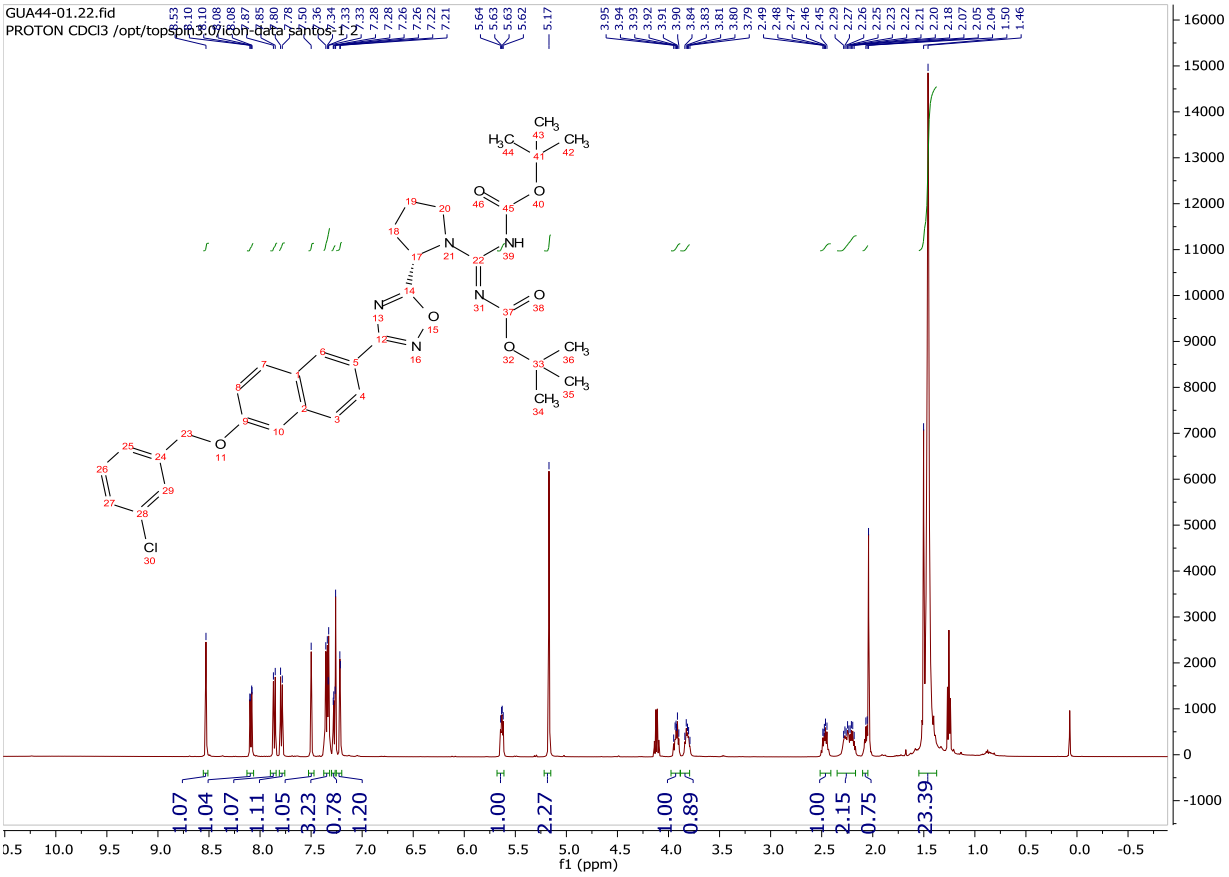
^{1}H-NMR Spectrum for 3.6r:



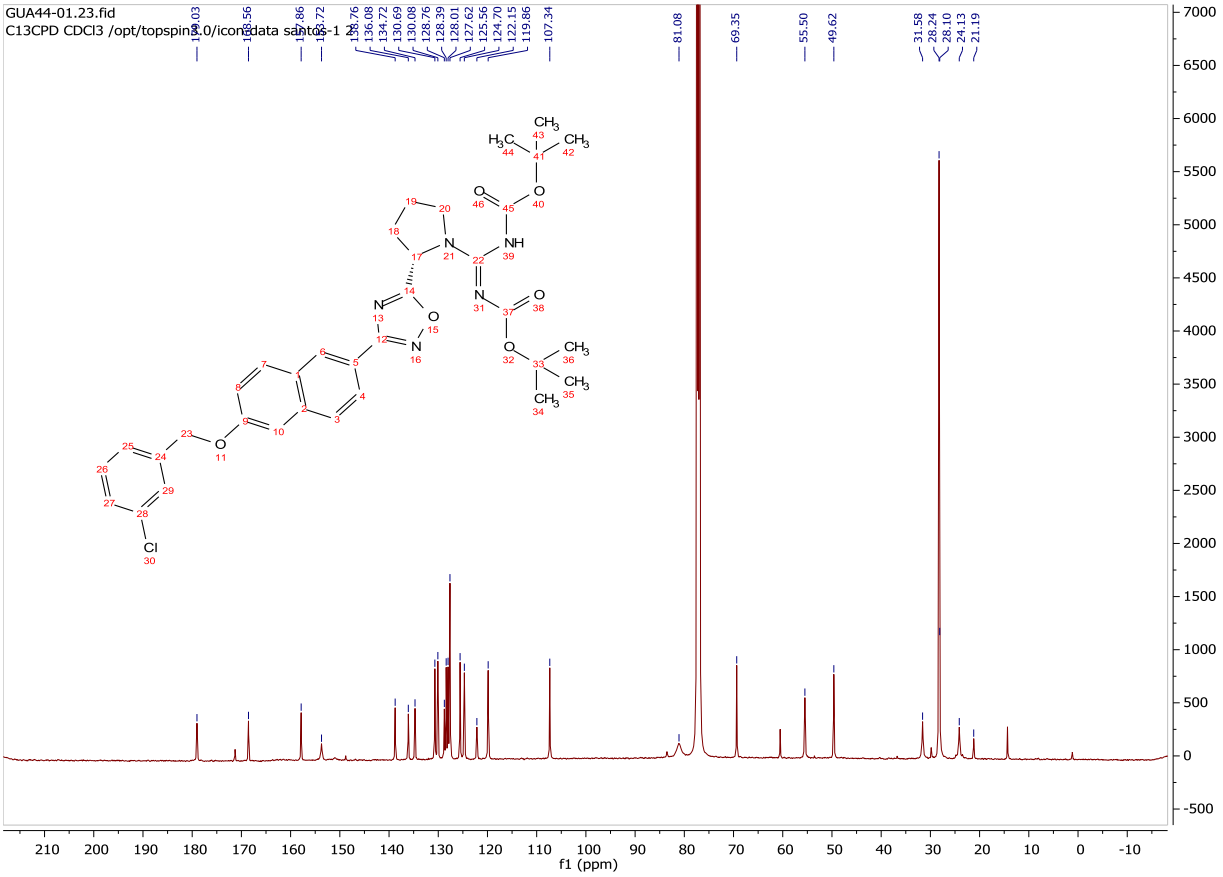
^{13}C-NMR Spectrum for 3.6r:



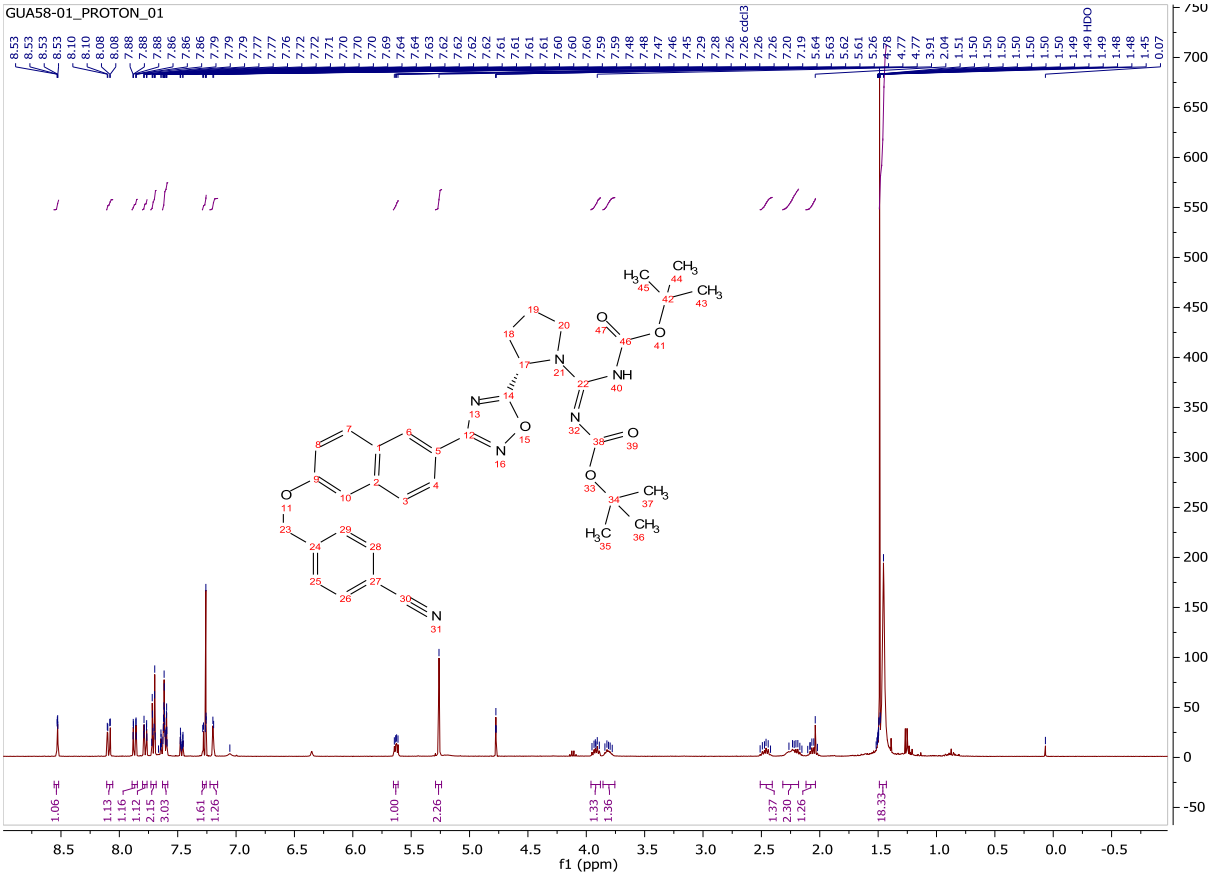
^{1}H-NMR Spectrum for 3.6s:



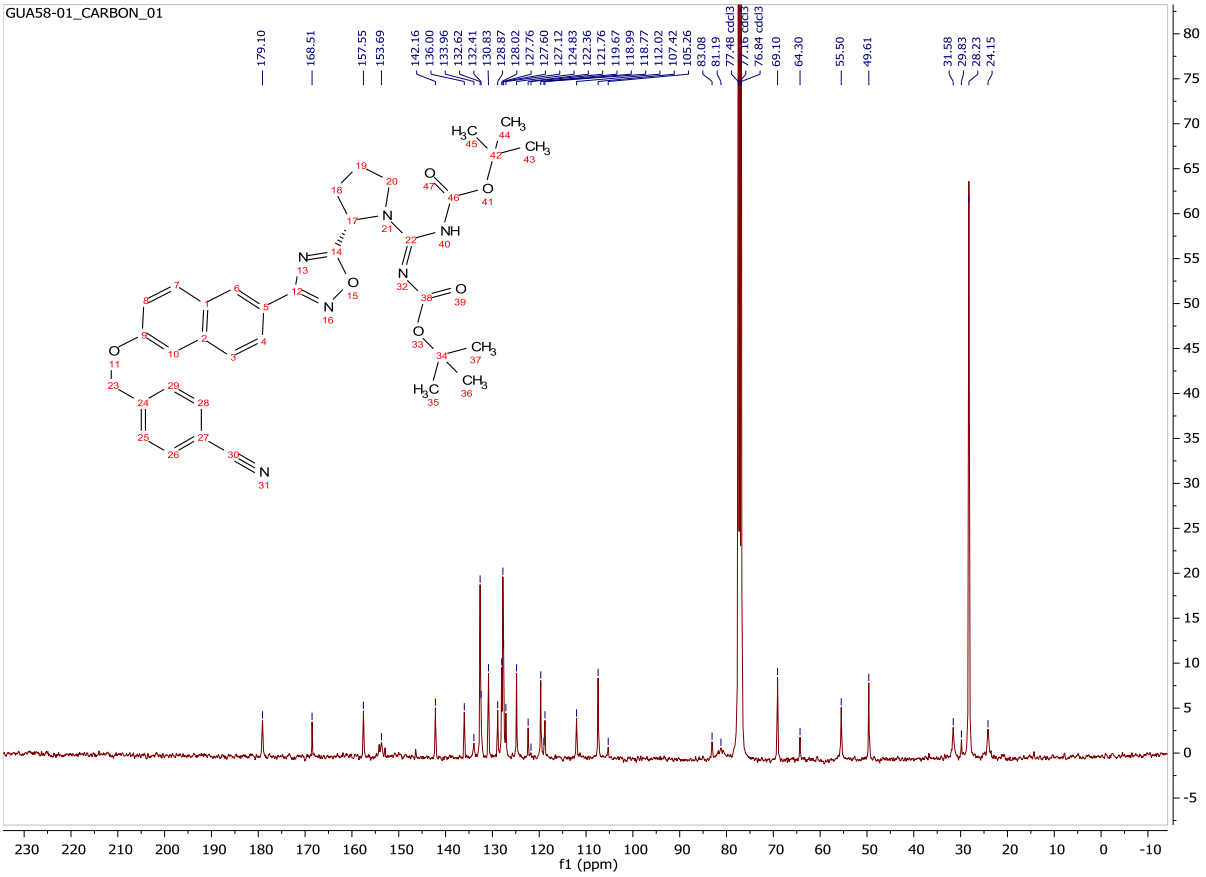
^{13}C-NMR Spectrum for 3.6s:



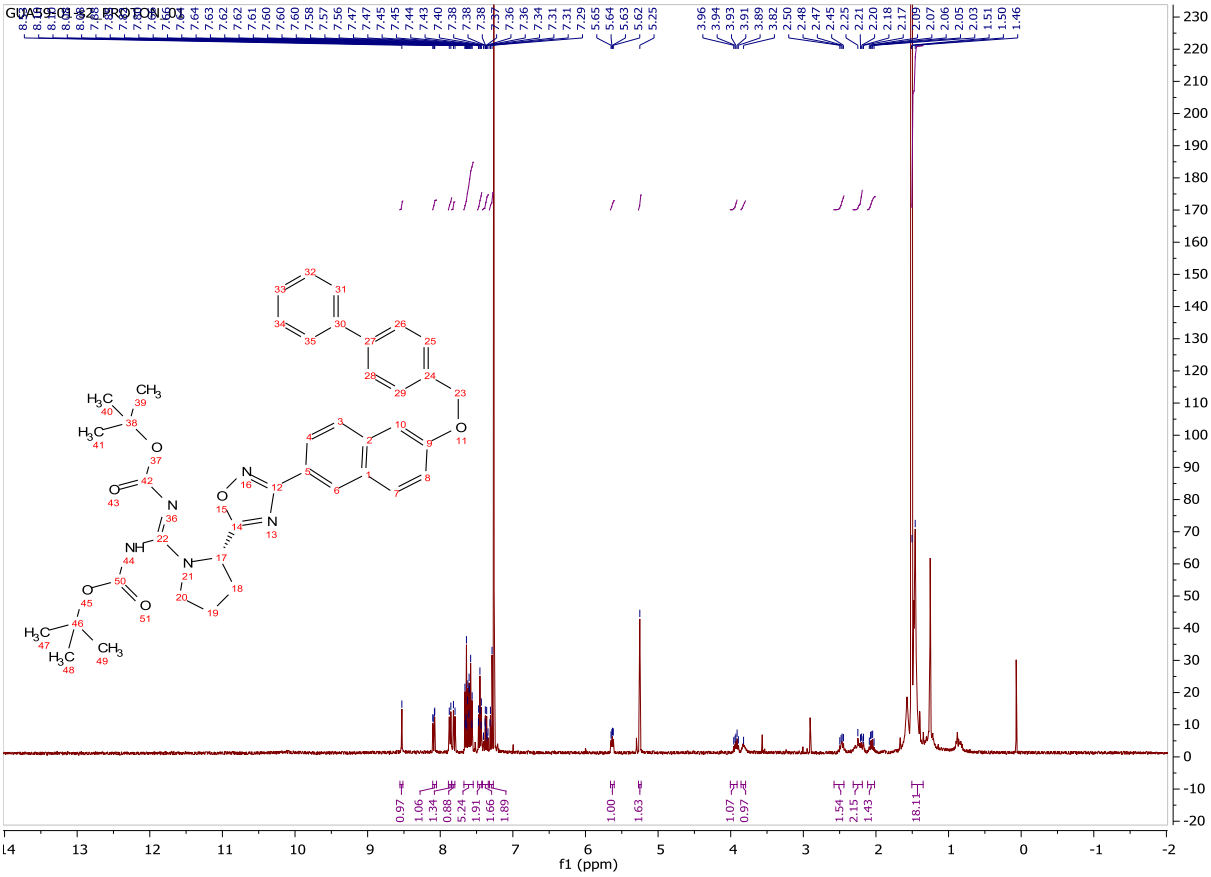
^{1}H-NMR Spectrum for 3.6t



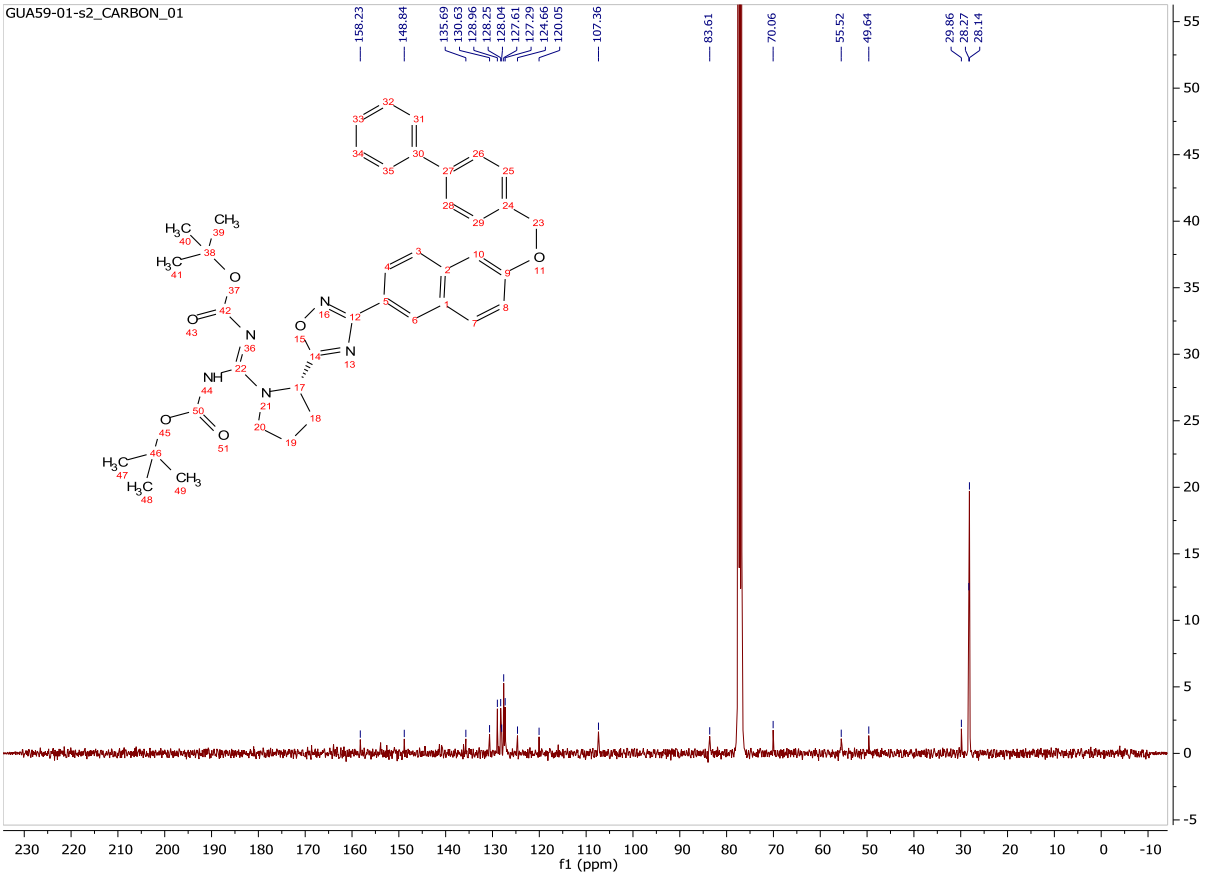
^{13}C-NMR Spectrum for 3.6t:



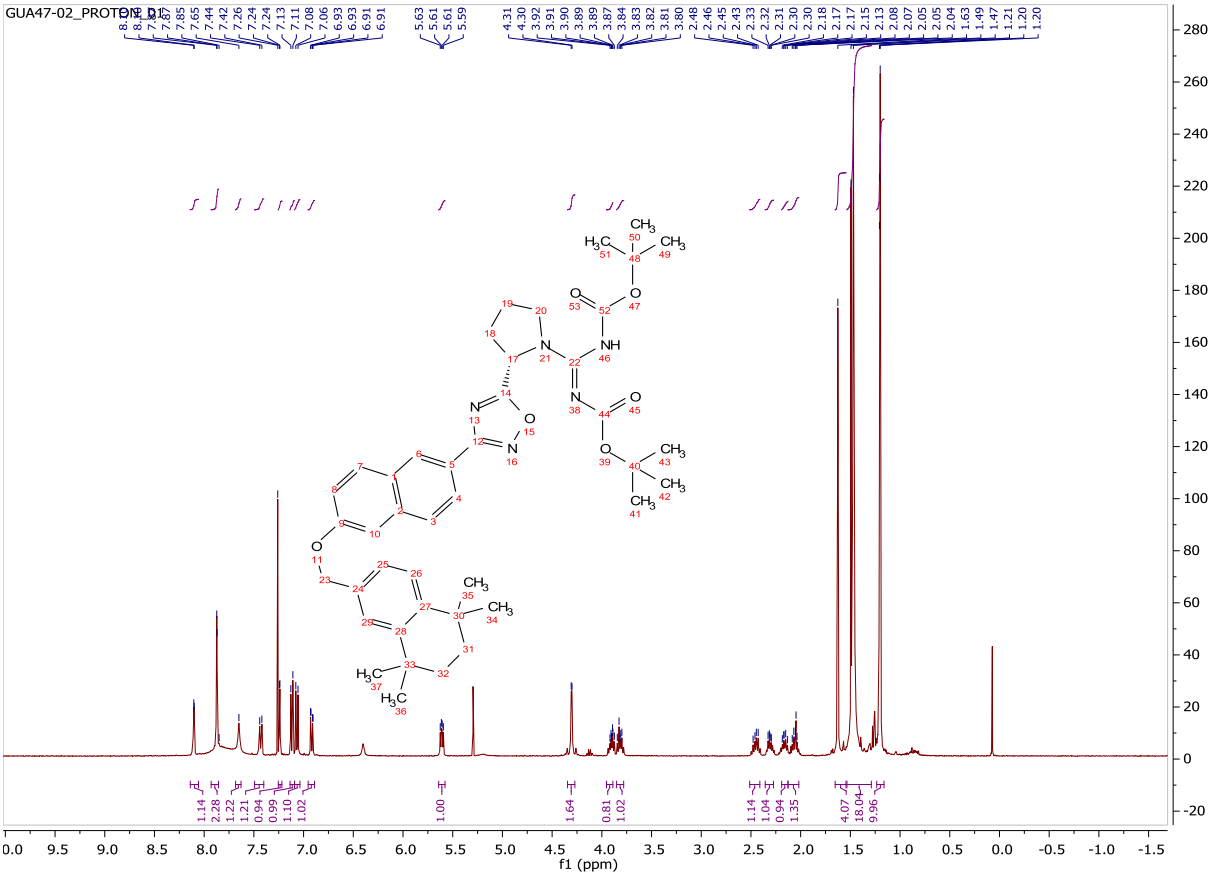
^{1}H-NMR Spectrum for 3.6u:



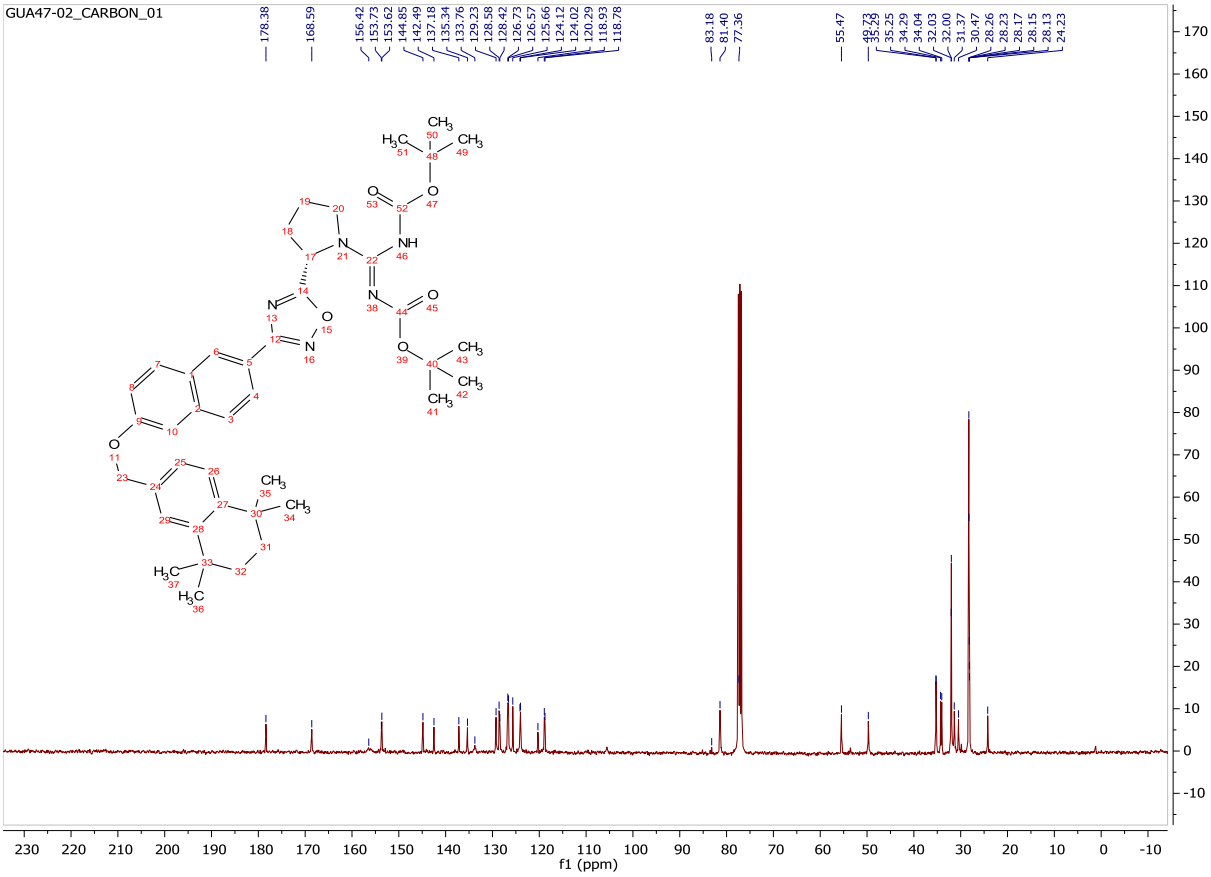
^{13}C-NMR Spectrum for 3.6u:



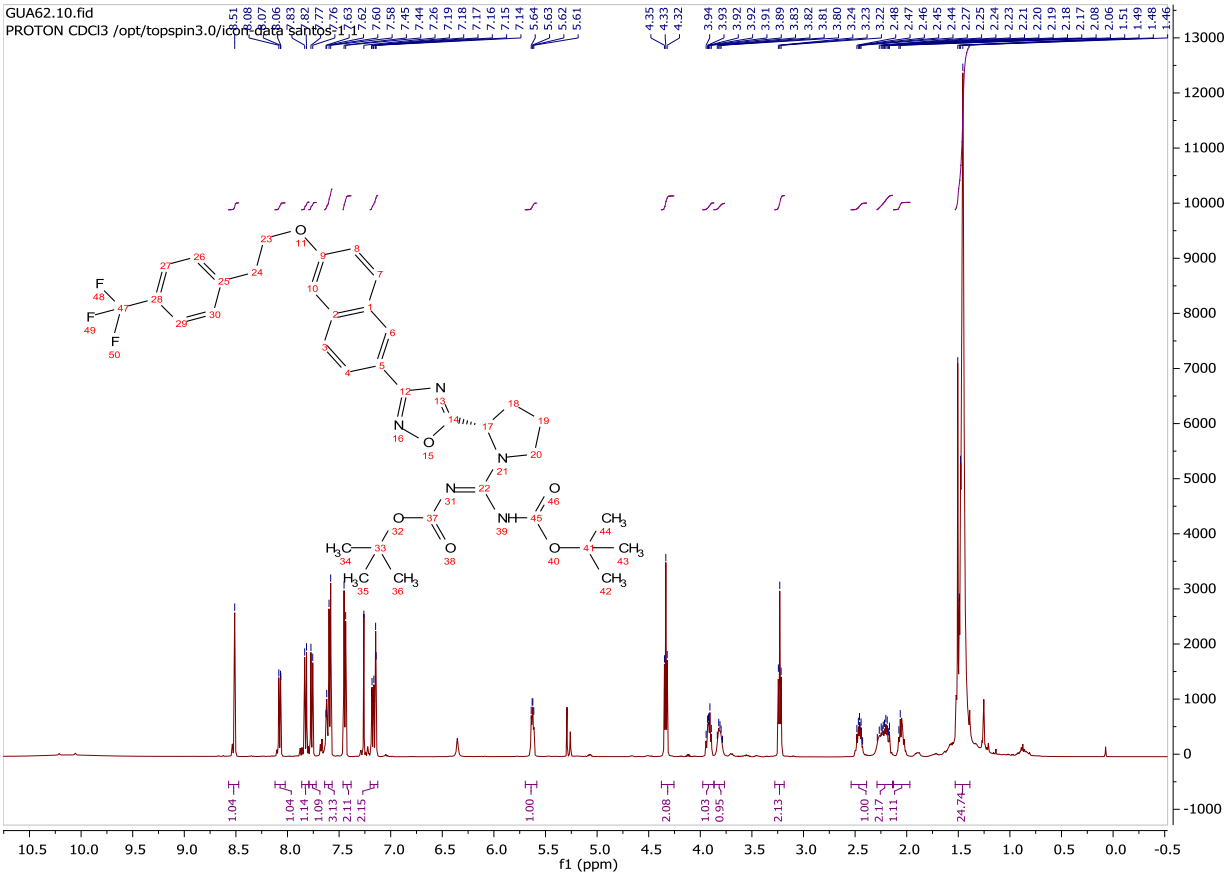
^{1}H-NMR Spectrum for 3.6v:



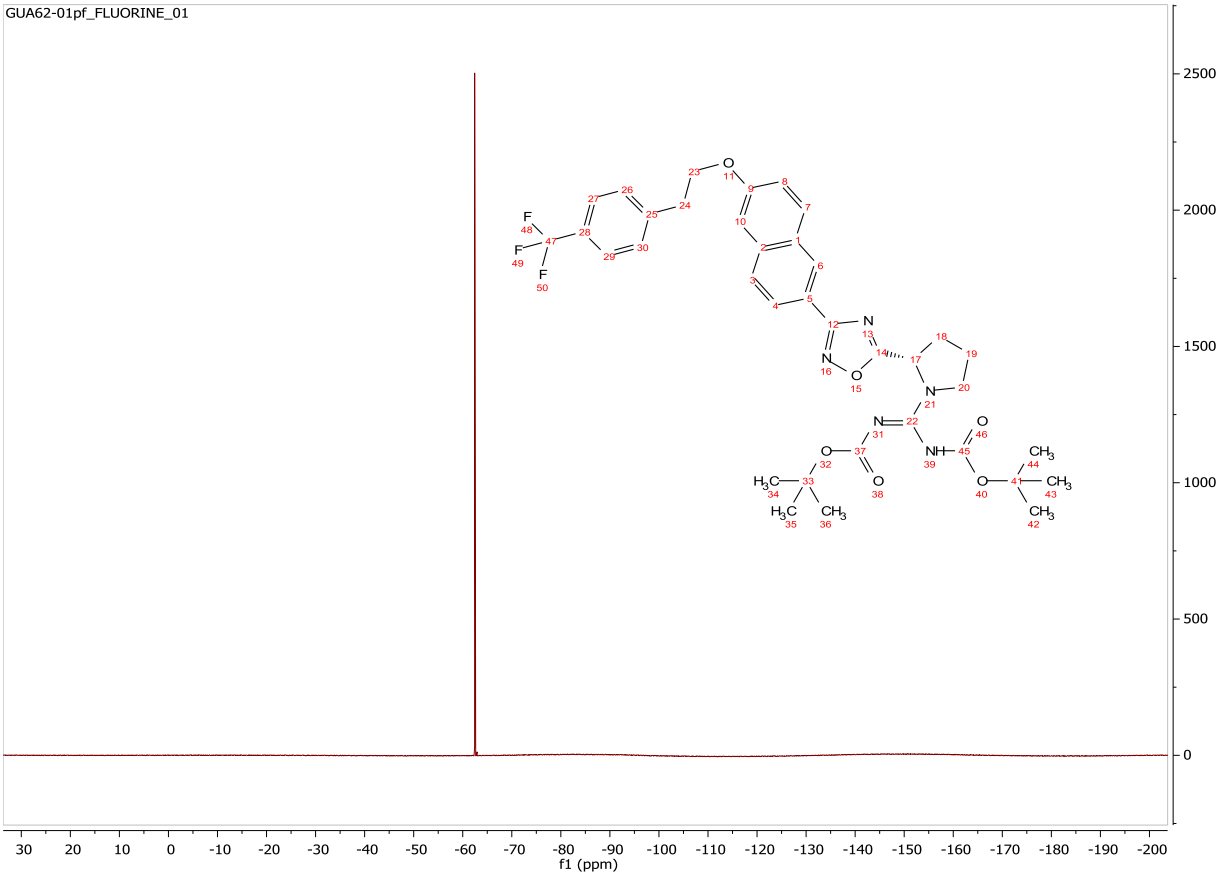
^{13}C-NMR Spectrum for 3.6v:



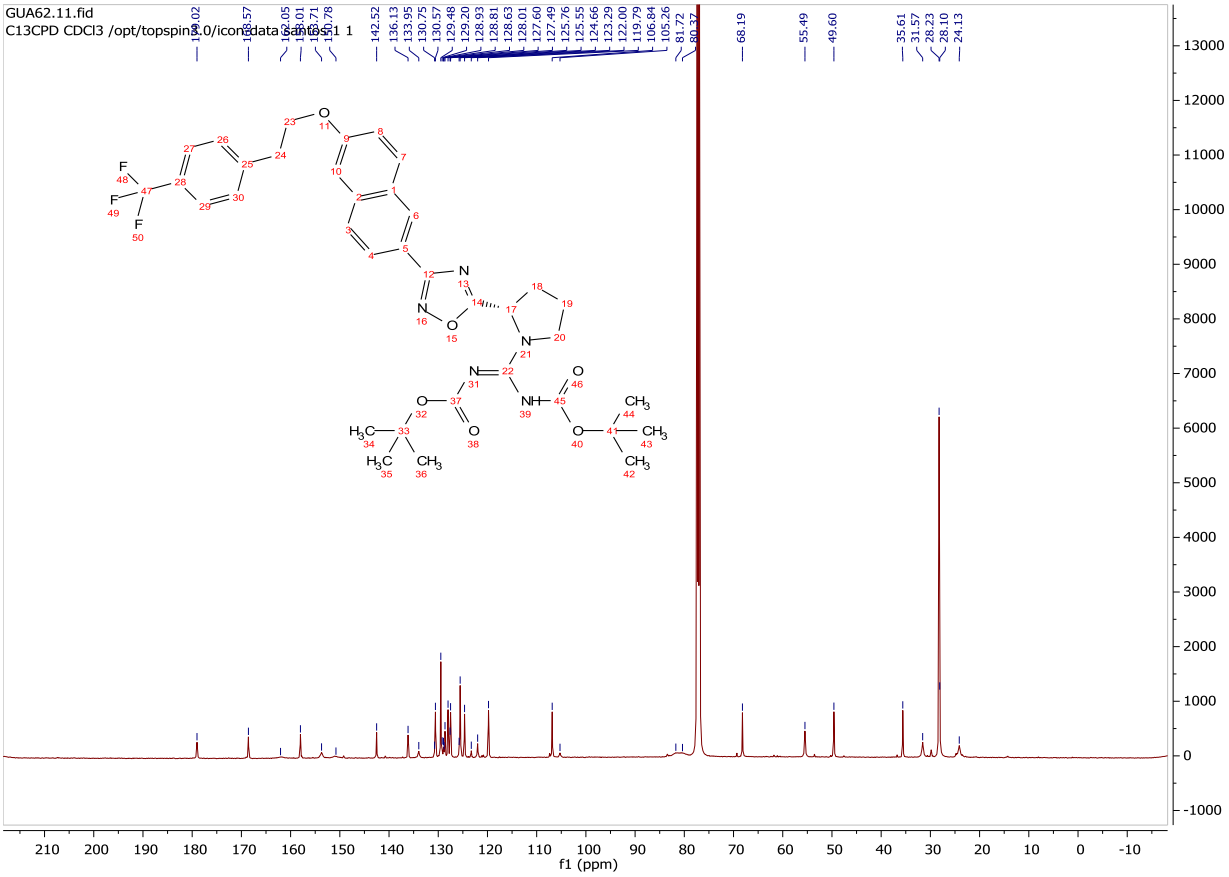
^{1}H-NMR Spectrum for 3.6w:



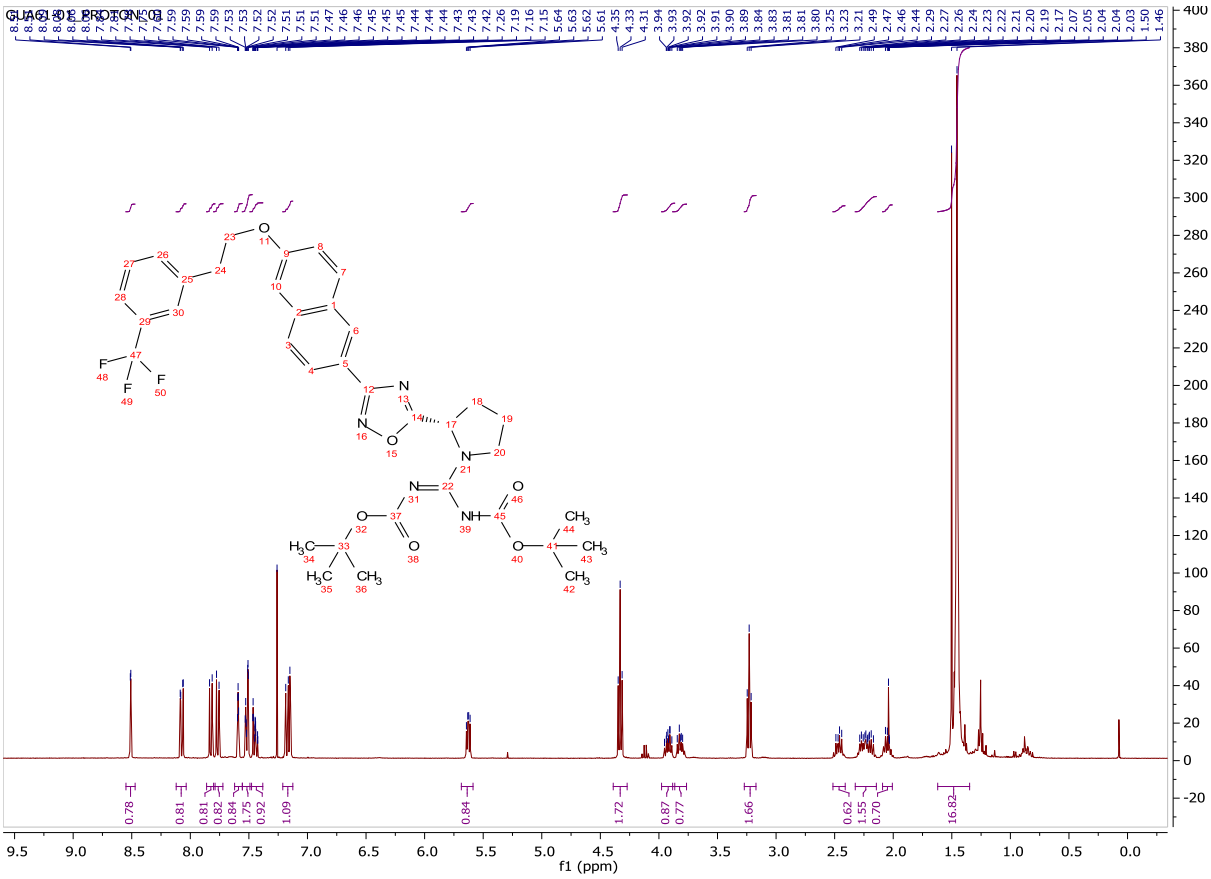
^{19}F-NMR Spectrum for 3.6w:



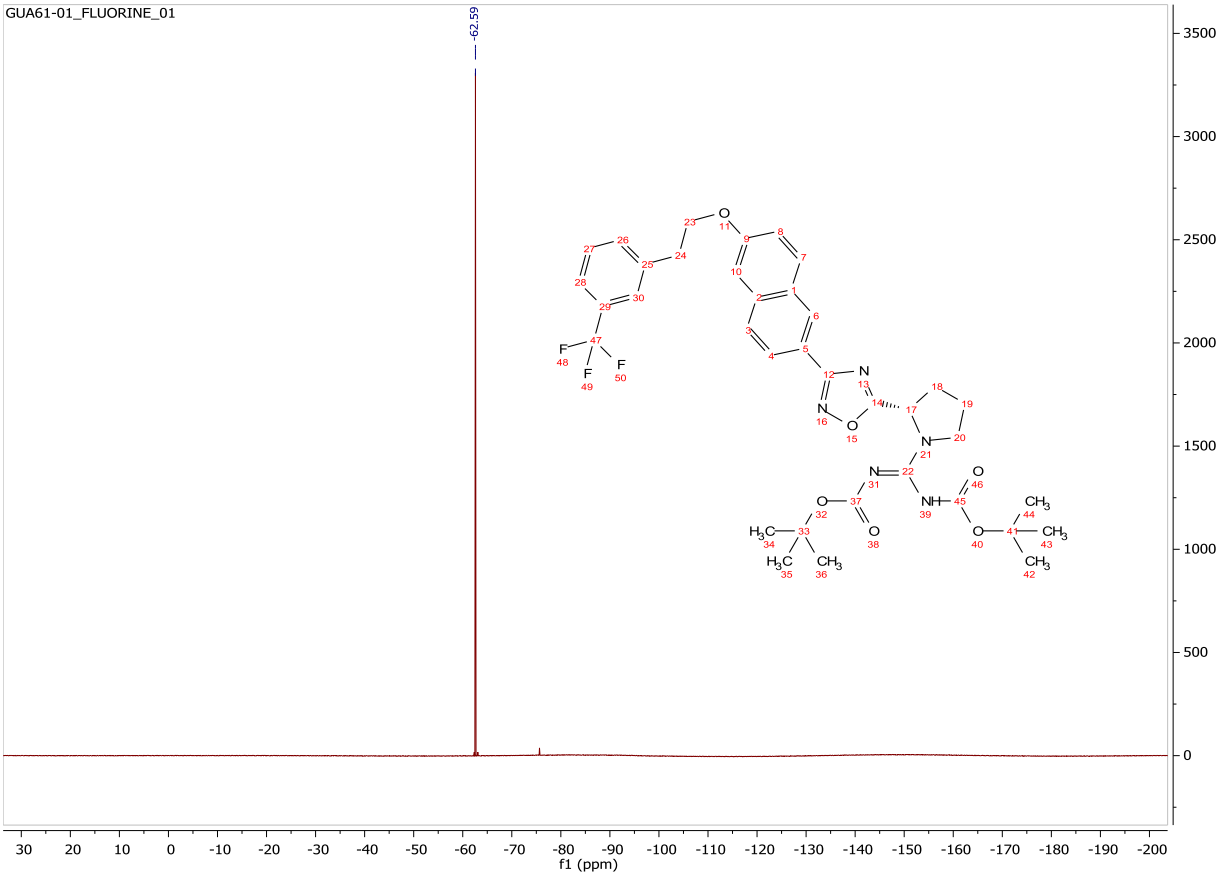
^{13}C-NMR Spectrum for 3.6w:



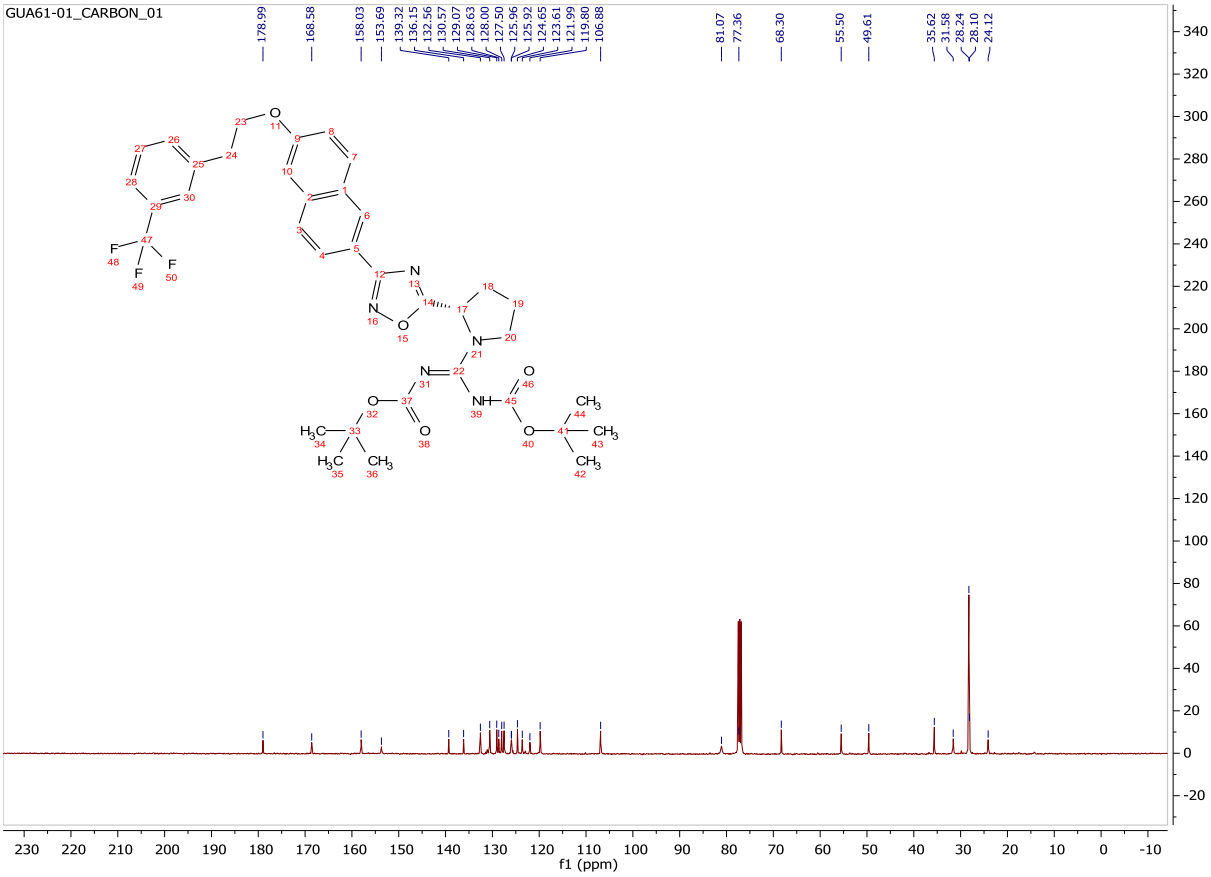
^{1}H-NMR Spectrum for 3.6x:



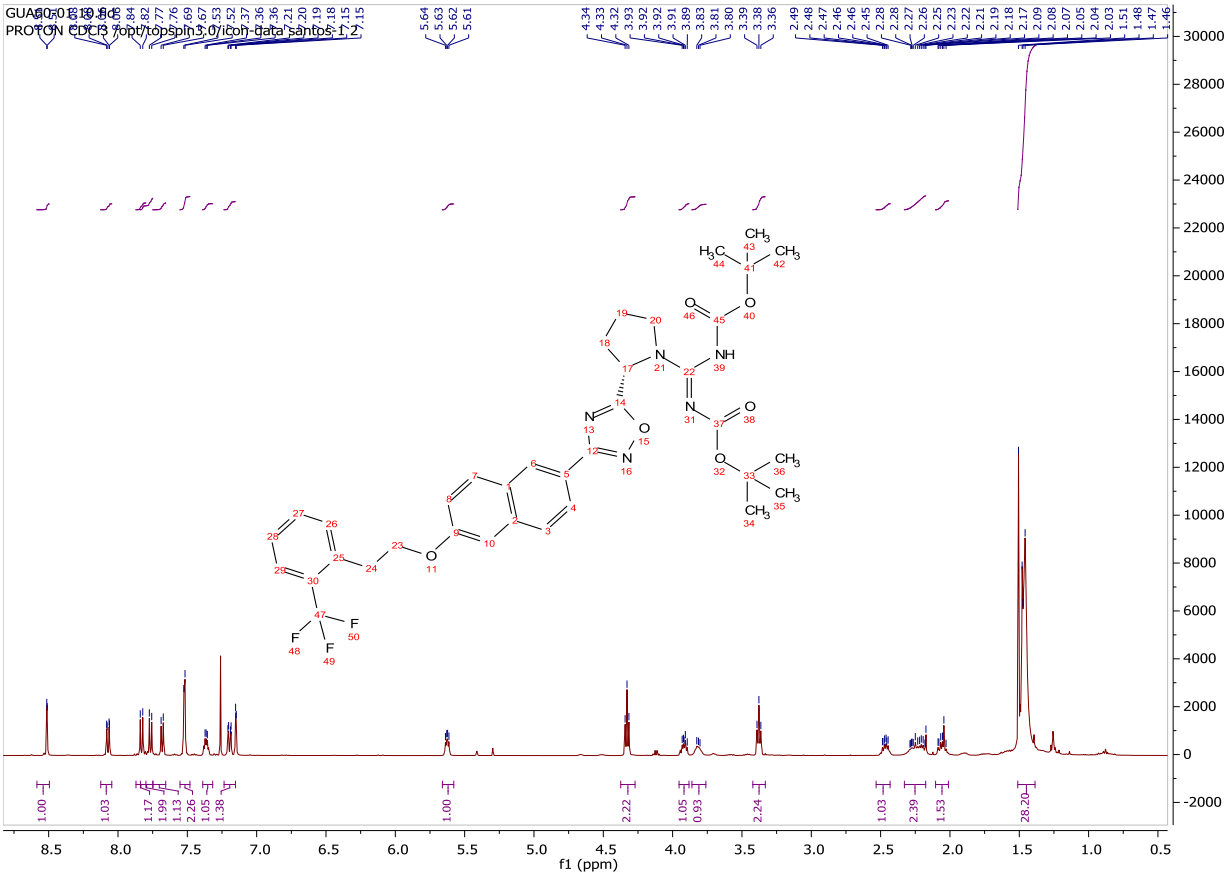
^{19}F-NMR Spectrum for 3.6x:



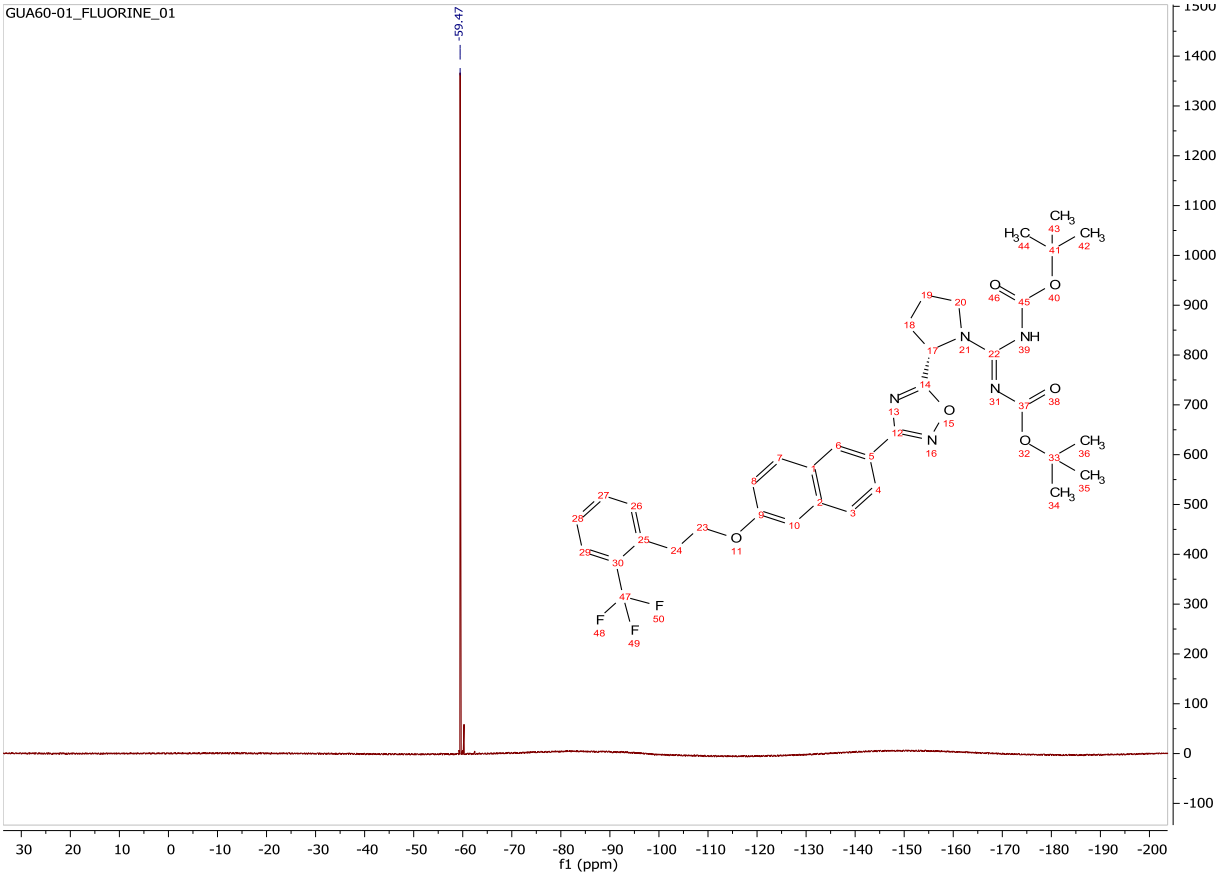
^{13}C-NMR Spectrum for 3.6x:



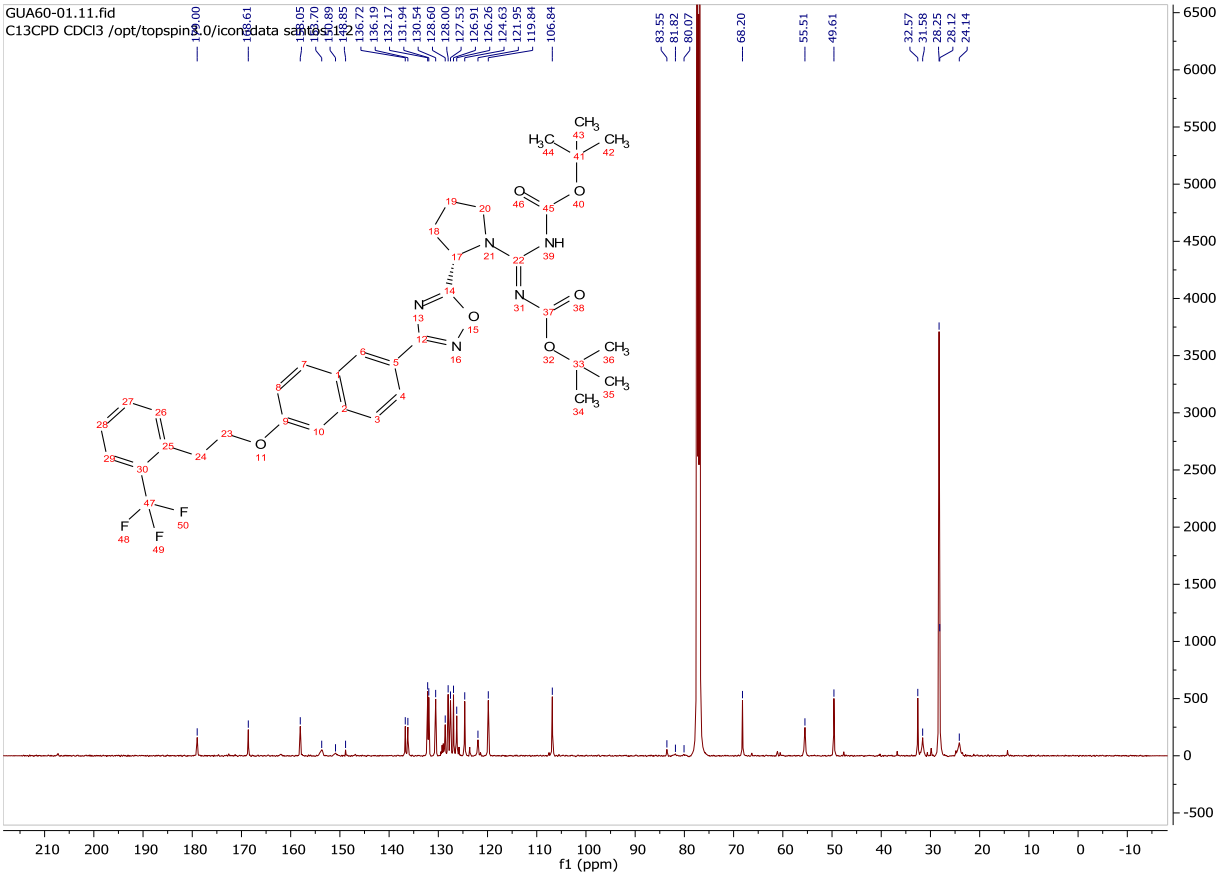
^{1}H-NMR Spectrum 3.6y:



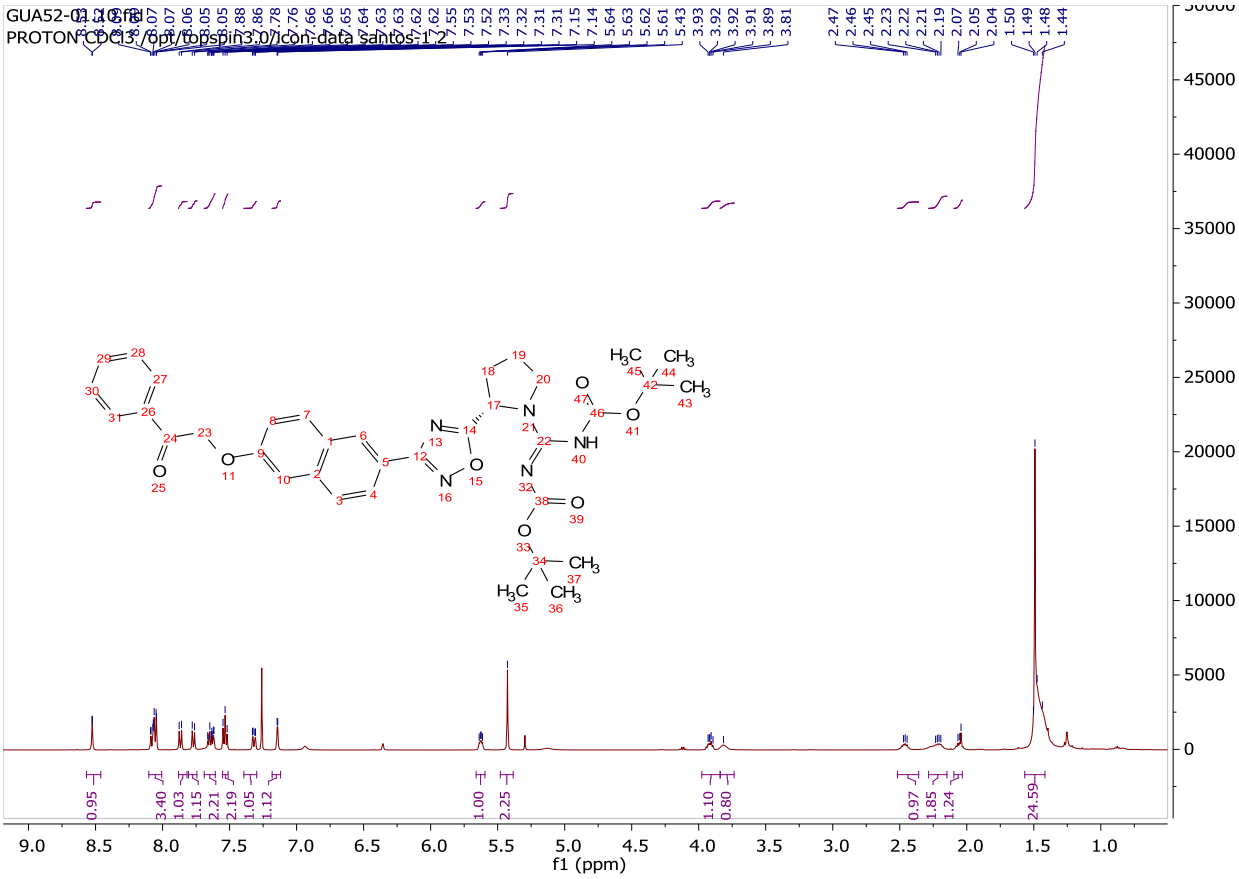
^{19}F-NMR Spectrum for 3.6y:



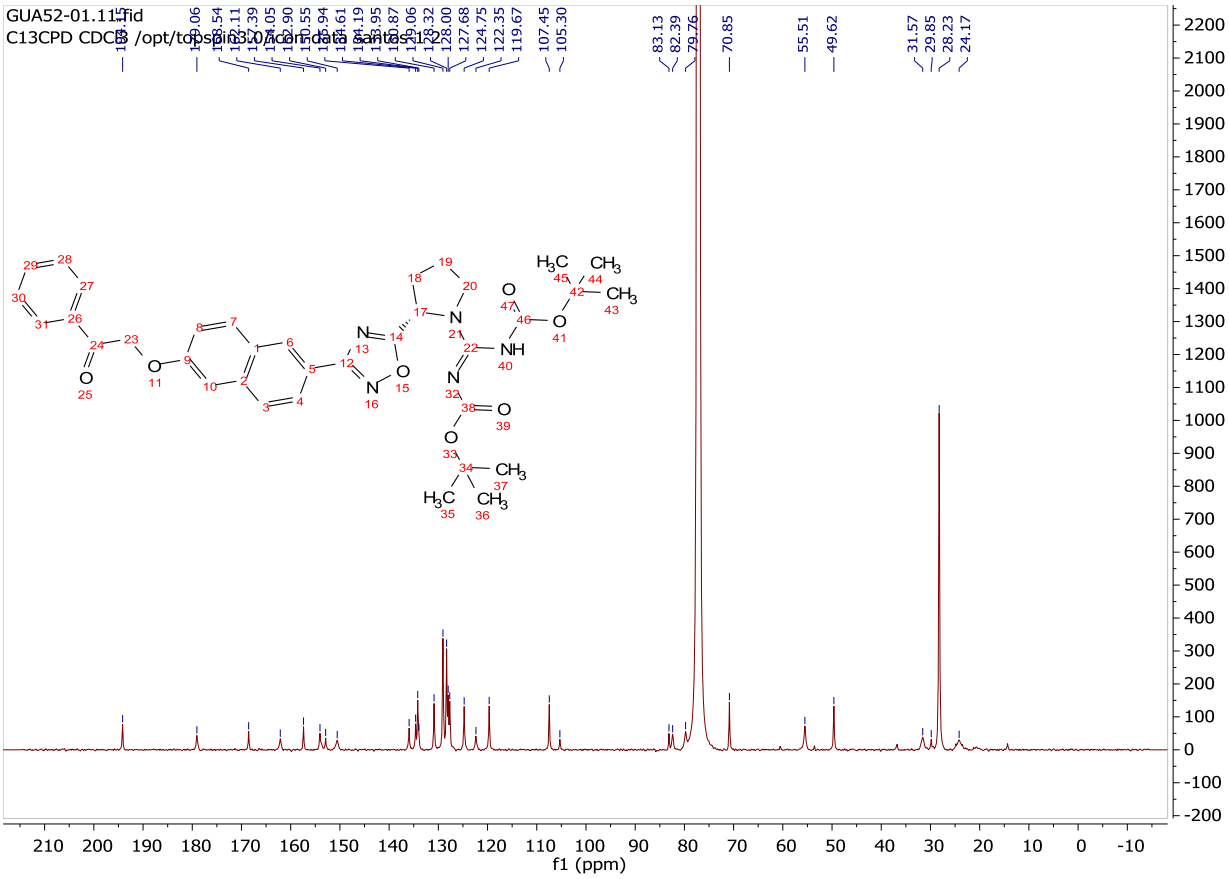
^{13}C-NMR Spectrum for 3.6y:



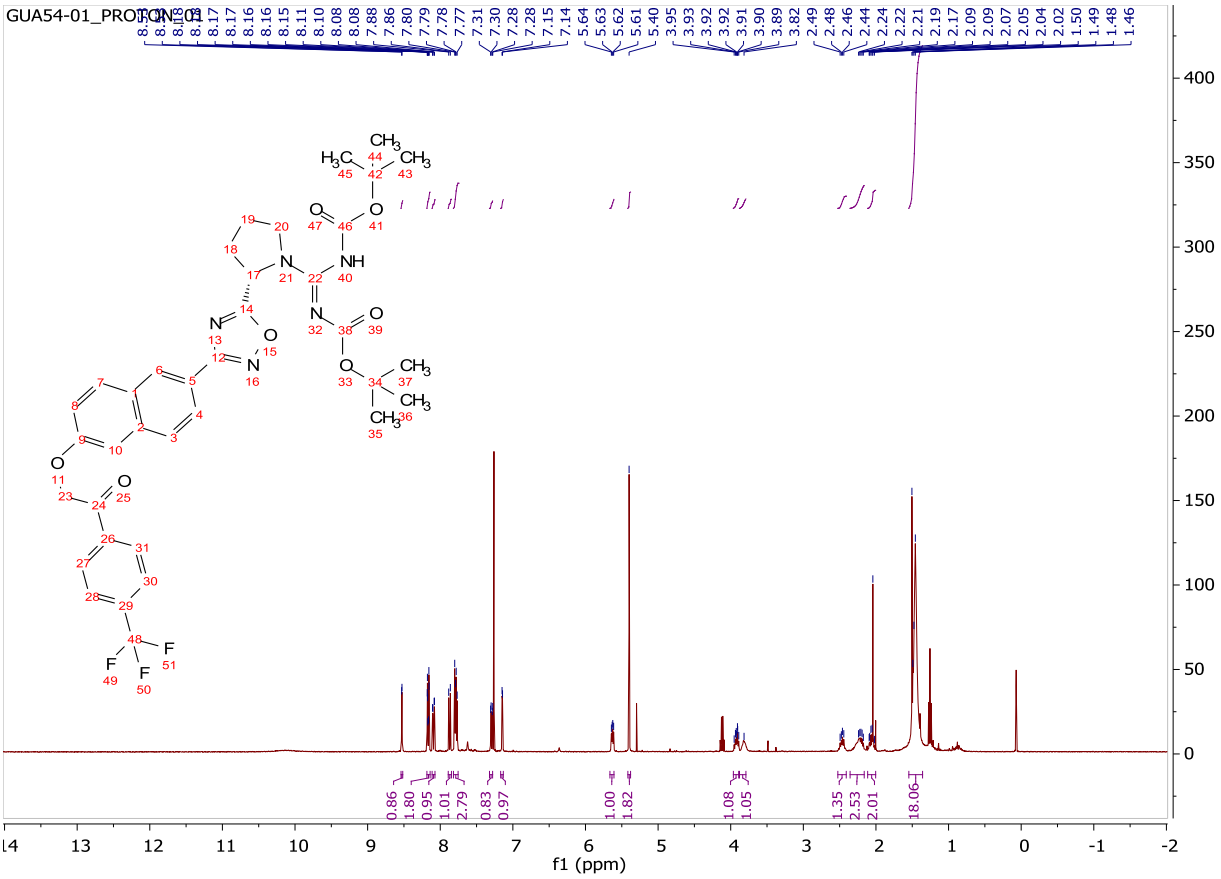
^{1}H-NMR Spectrum for 3.6z:



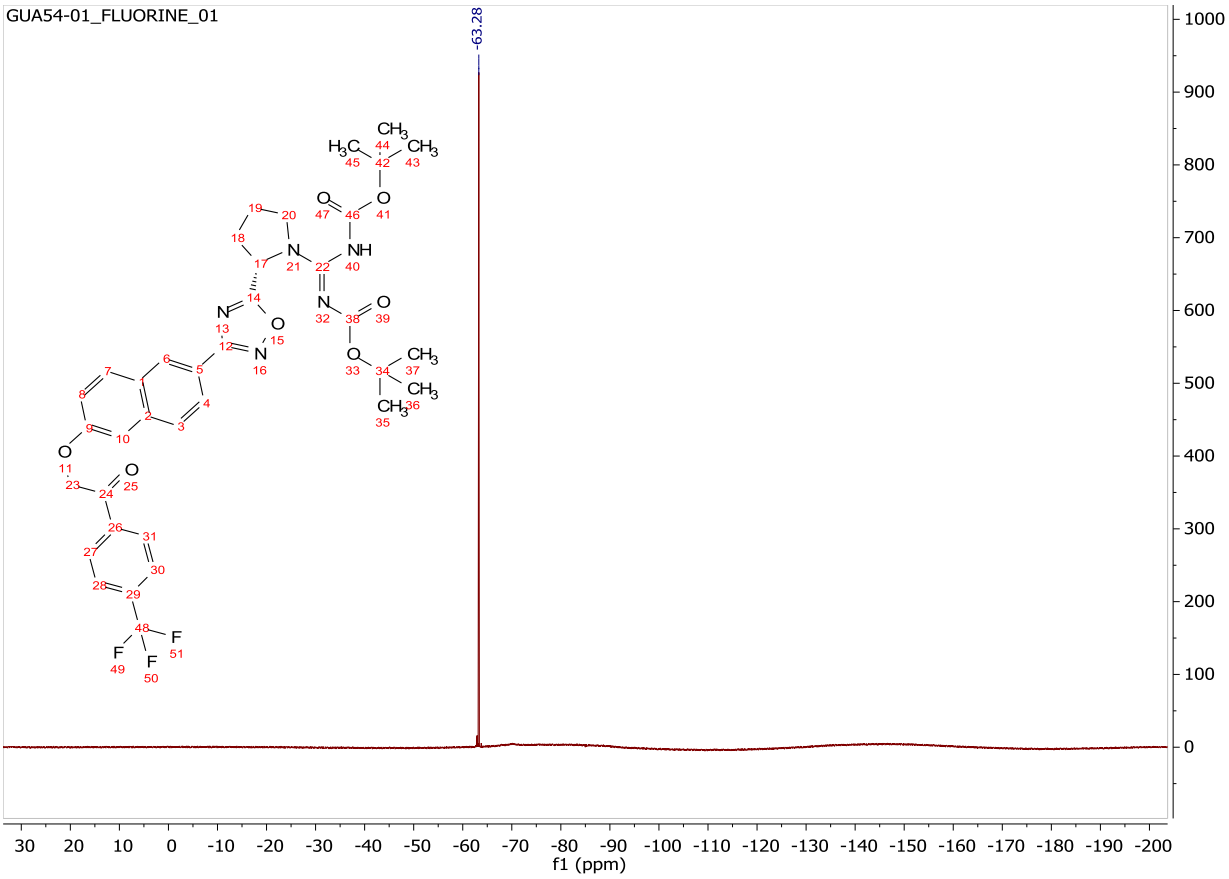
^{13}C-NMR Spectrum for 3.6z:



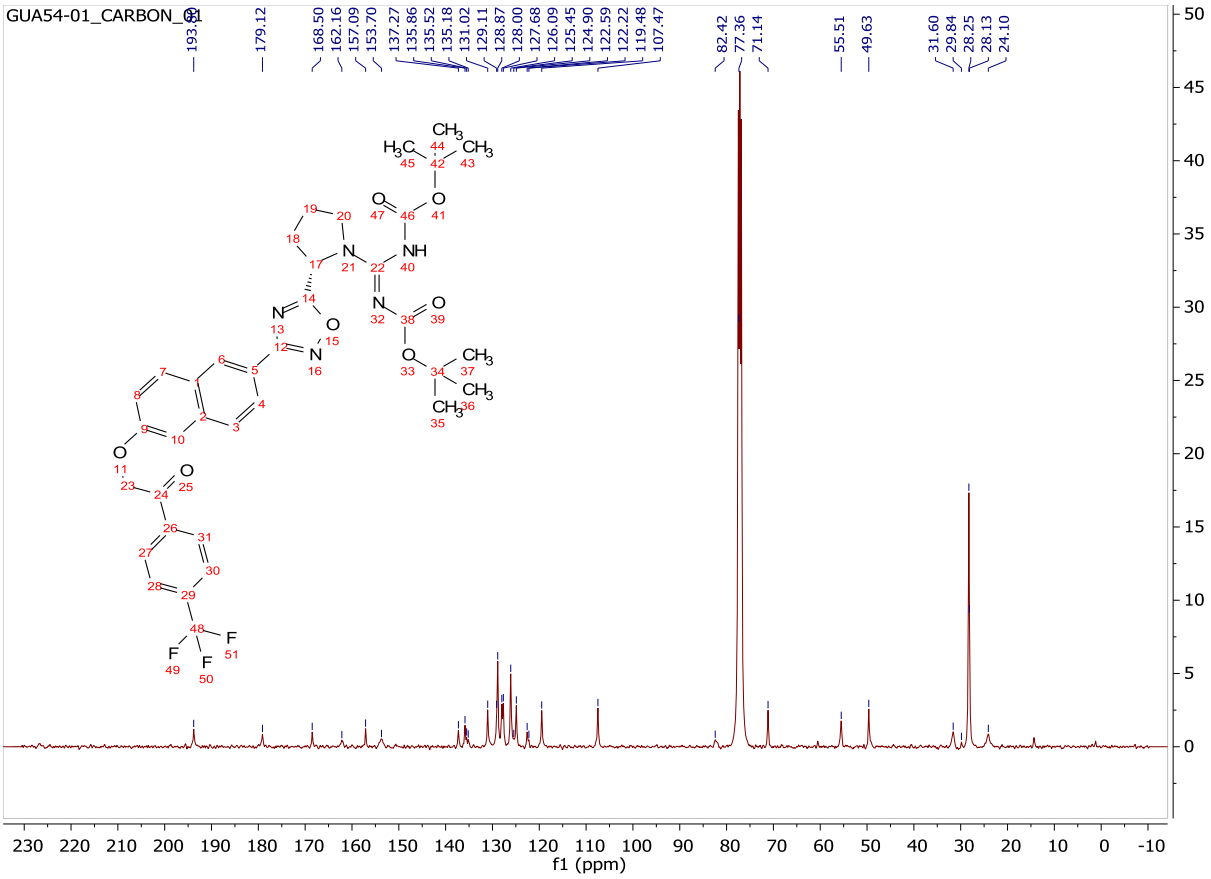
^{1}H-NMR Spectrum for 3.6aa:



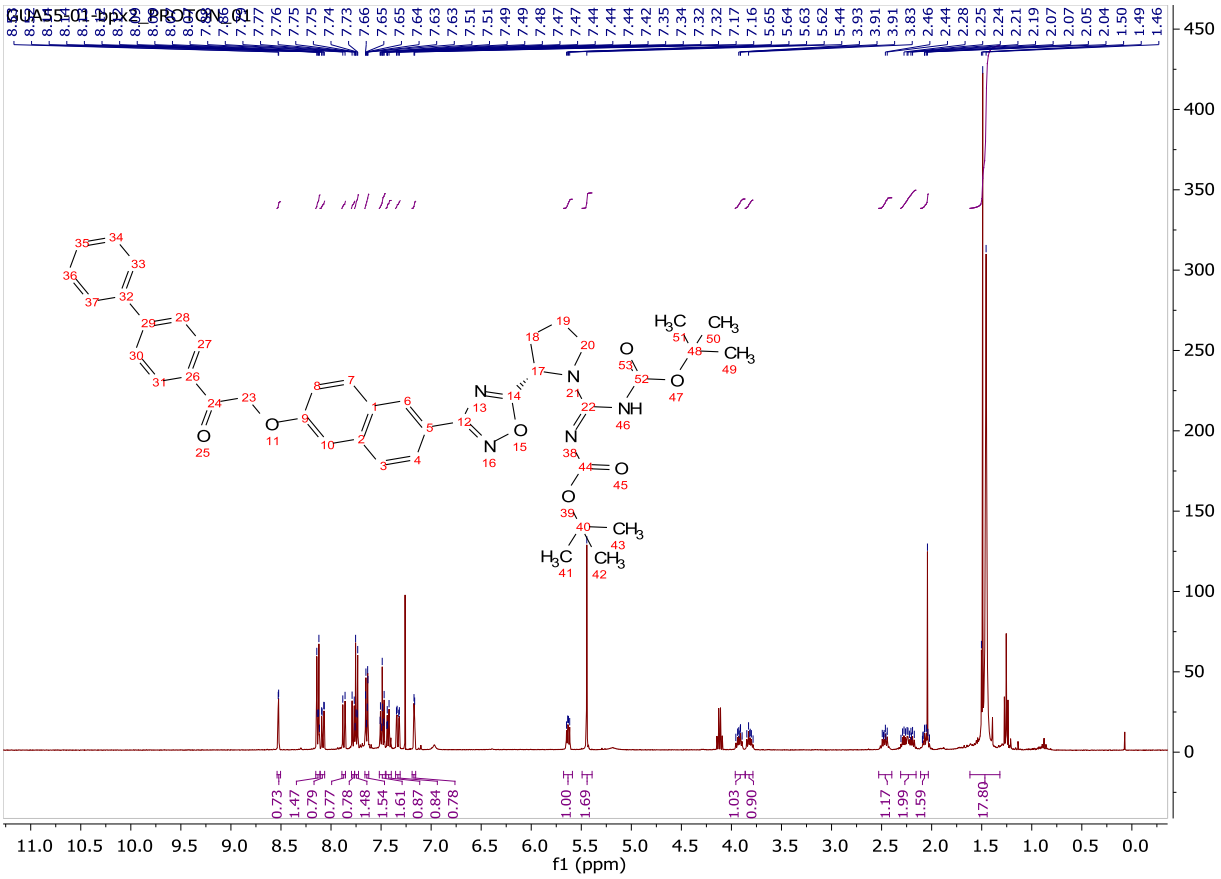
^{19}F-NMR Spectrum for 3.6aa:



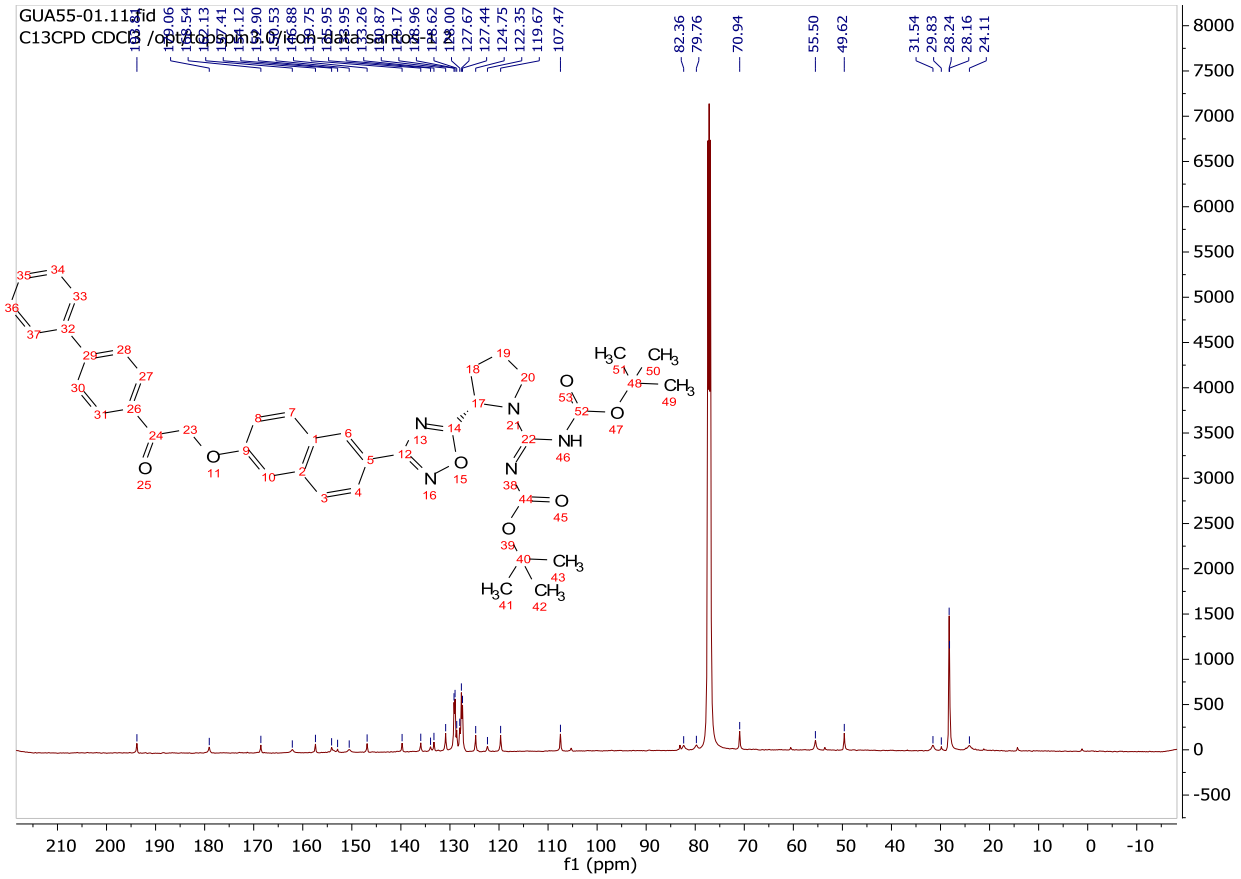
^{13}C-NMR Spectrum for 3.6aa:



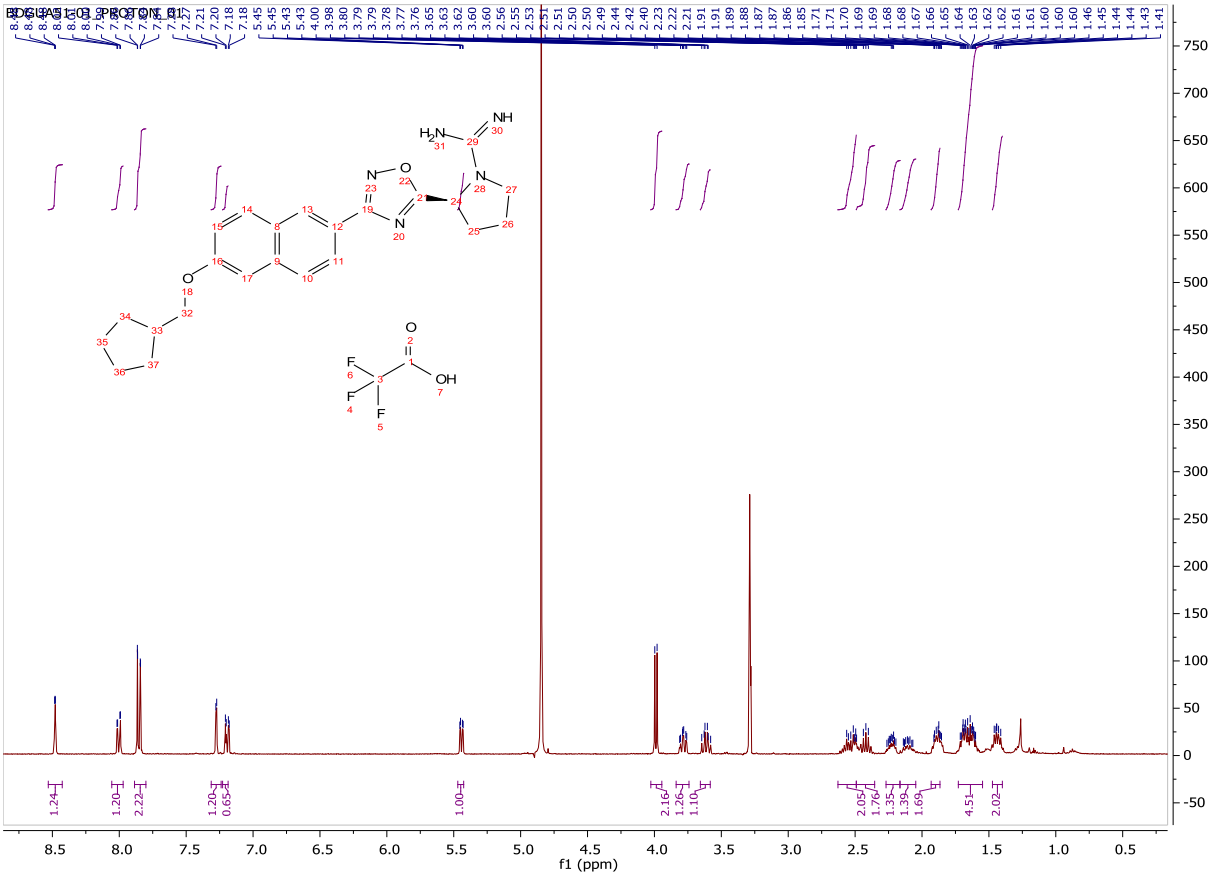
^{1}H-NMR Spectrum for 3.6ab:



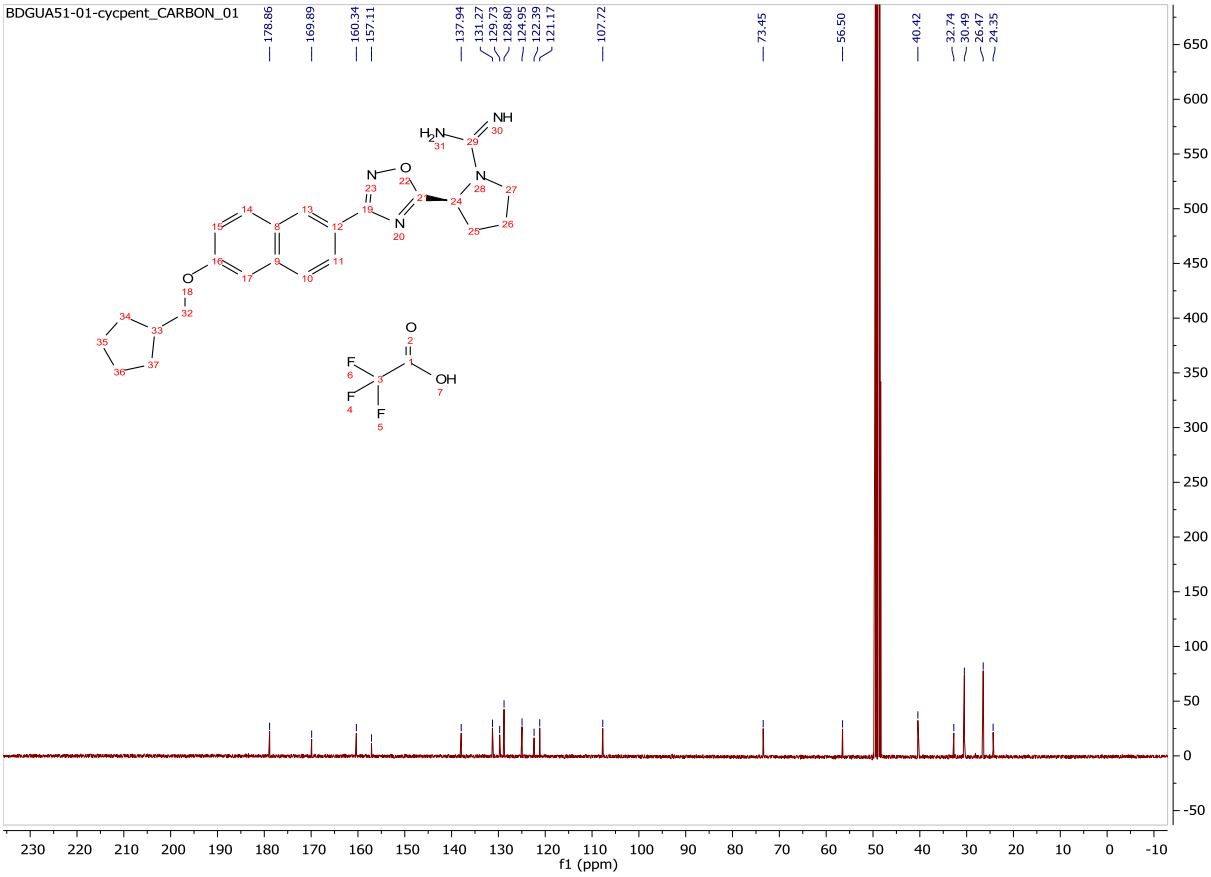
^{13}C-NMR Spectrum for 3.6ab:



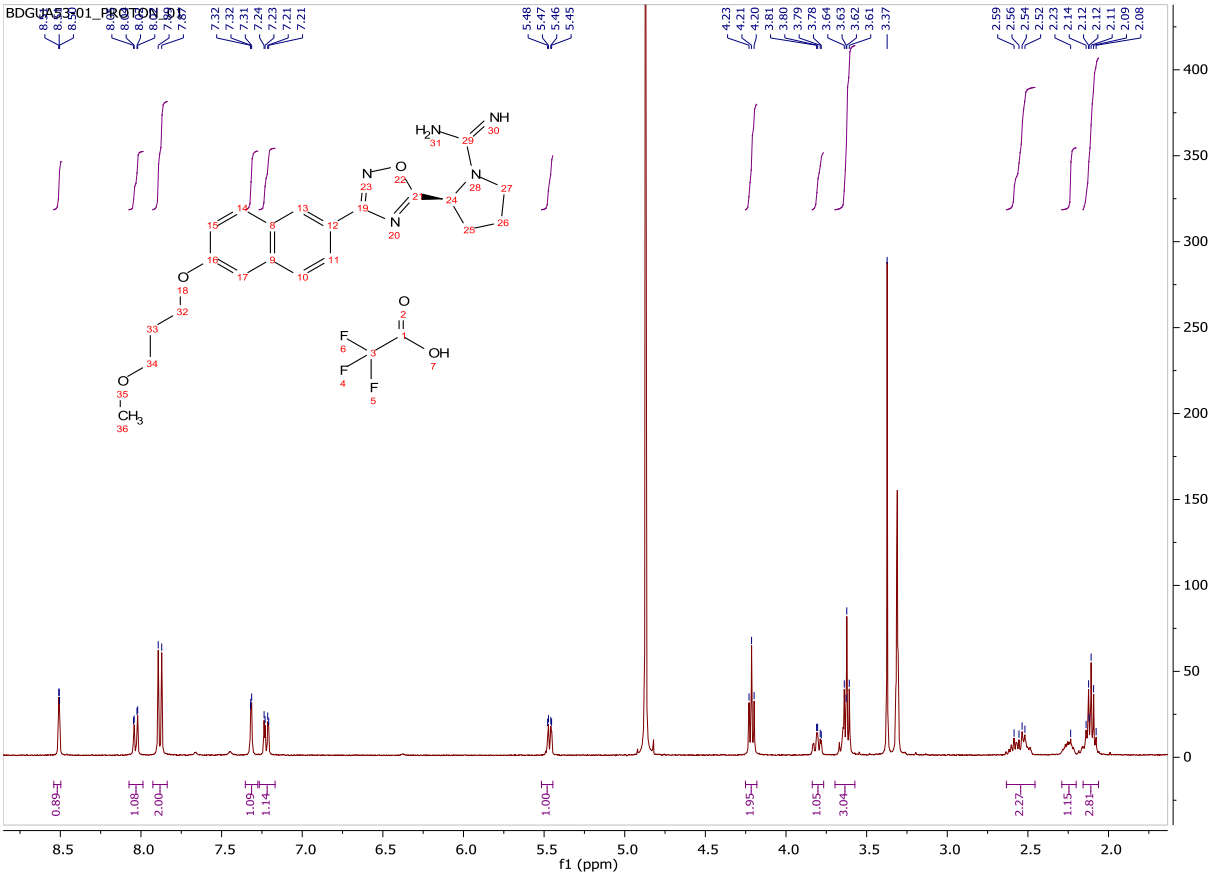
^{1}H-NMR Spectrum for 3.7k:



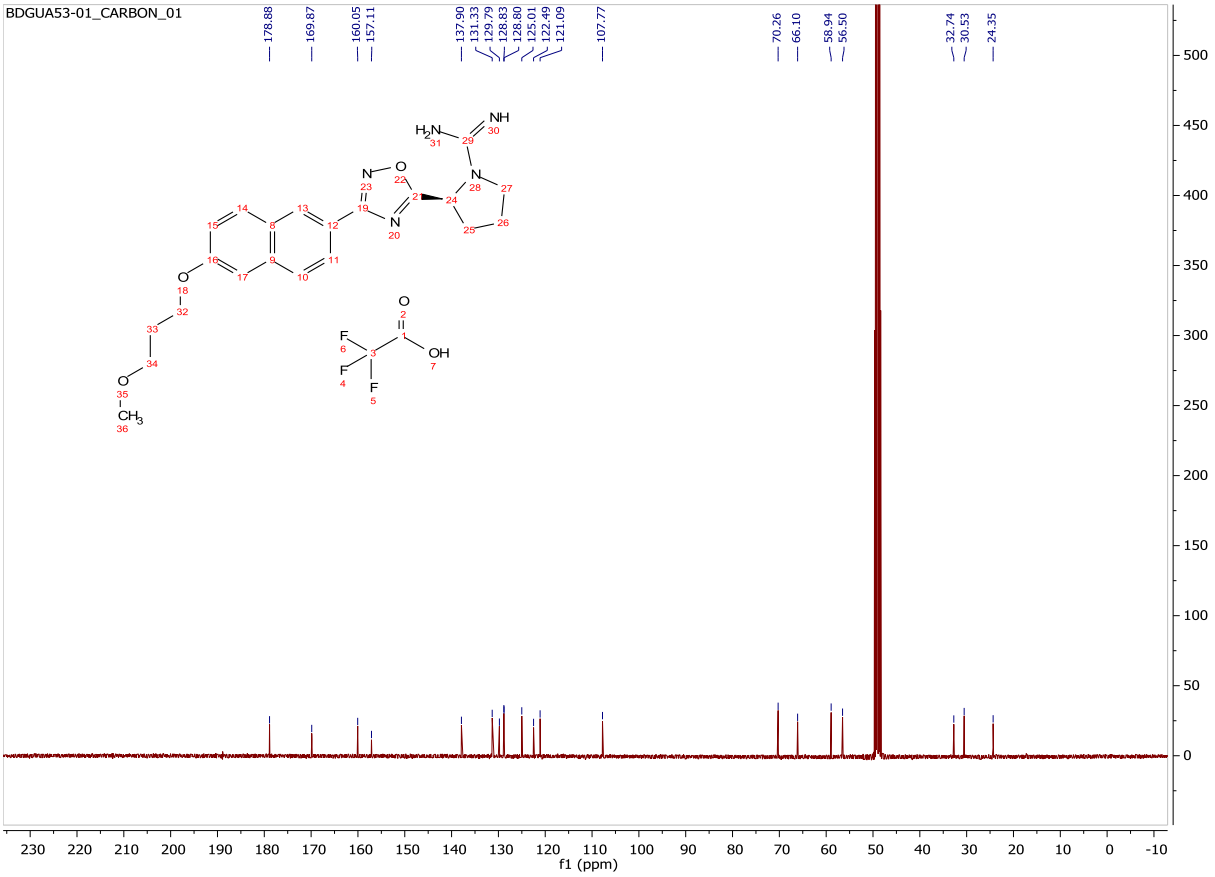
^{13}C-NMR Spectrum for 3.7k:



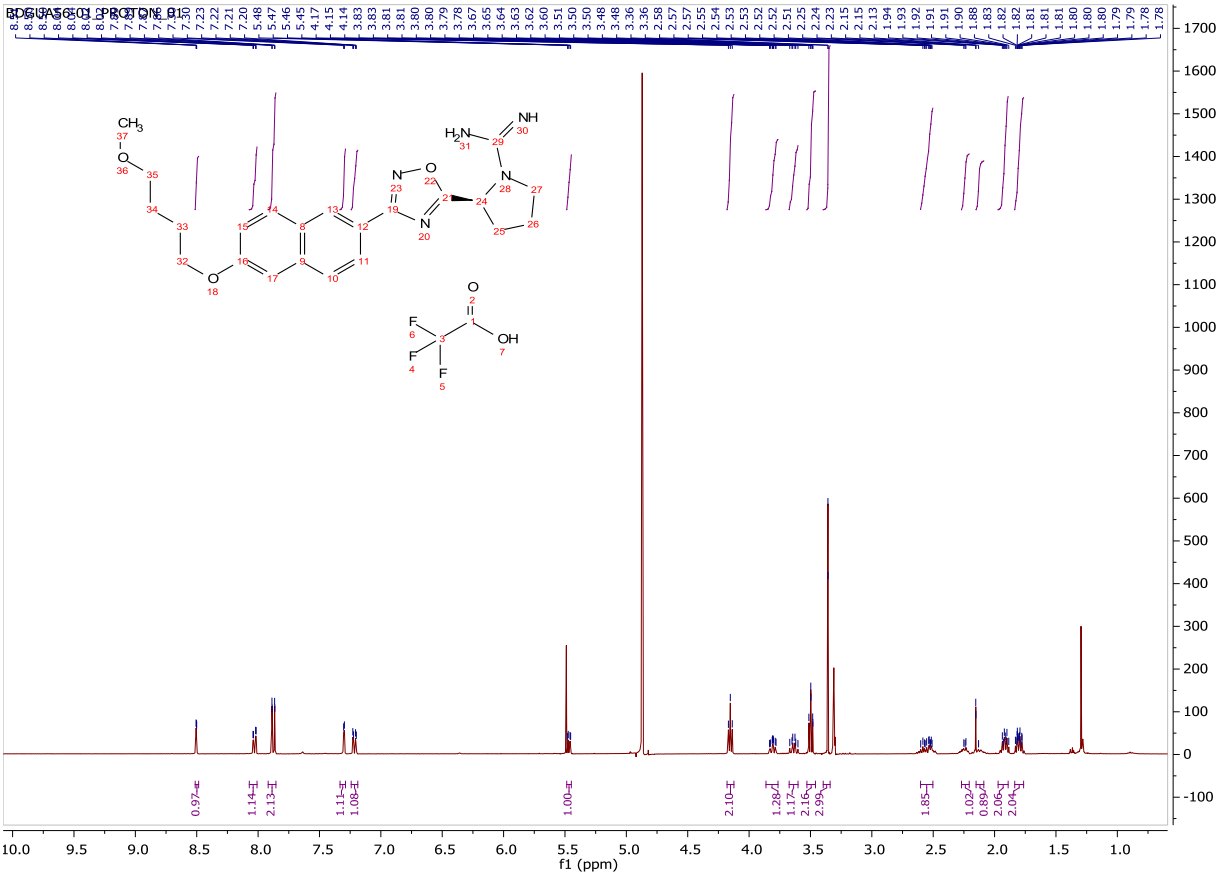
^{1}H-NMR Spectrum for 3.7l:



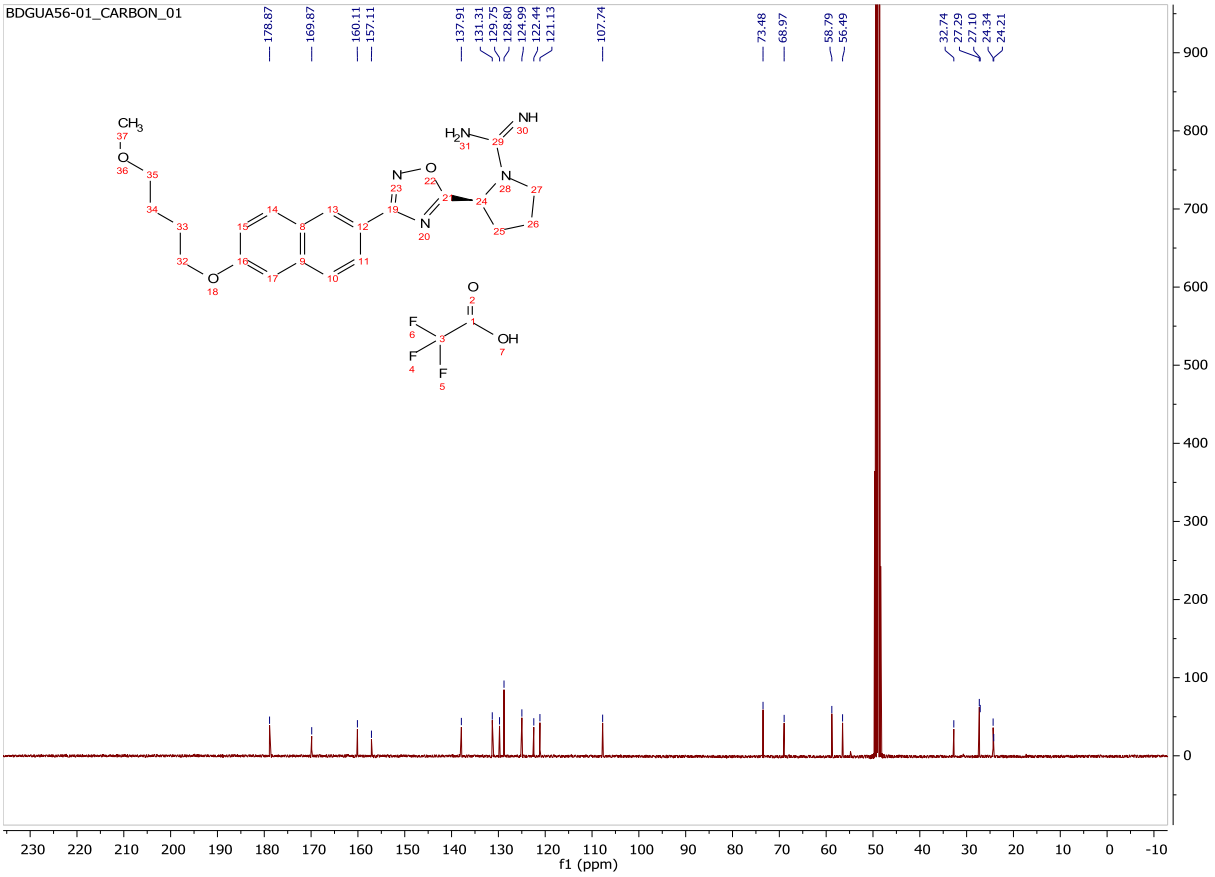
^{13}C-NMR Spectrum for 3.7l:



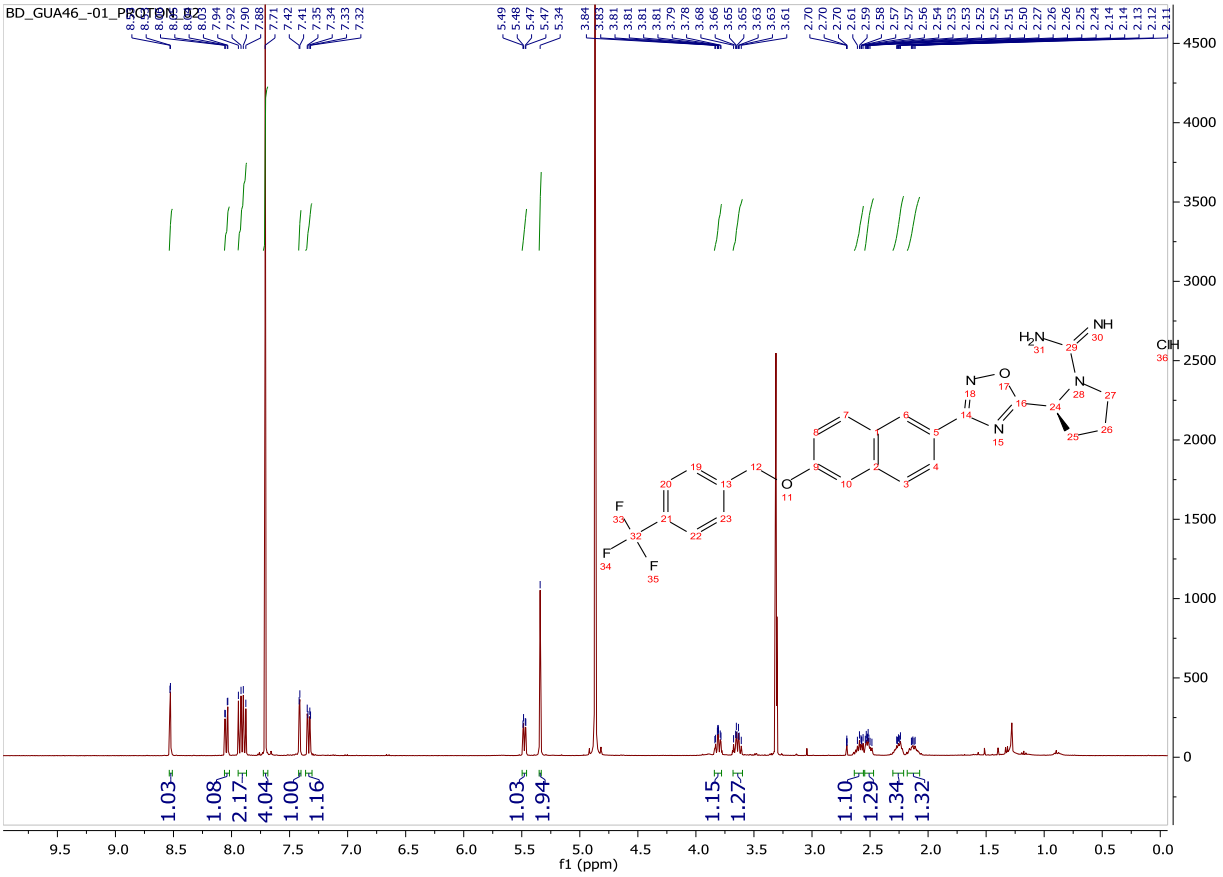
^{1}H-NMR Spectrum for 3.7m:



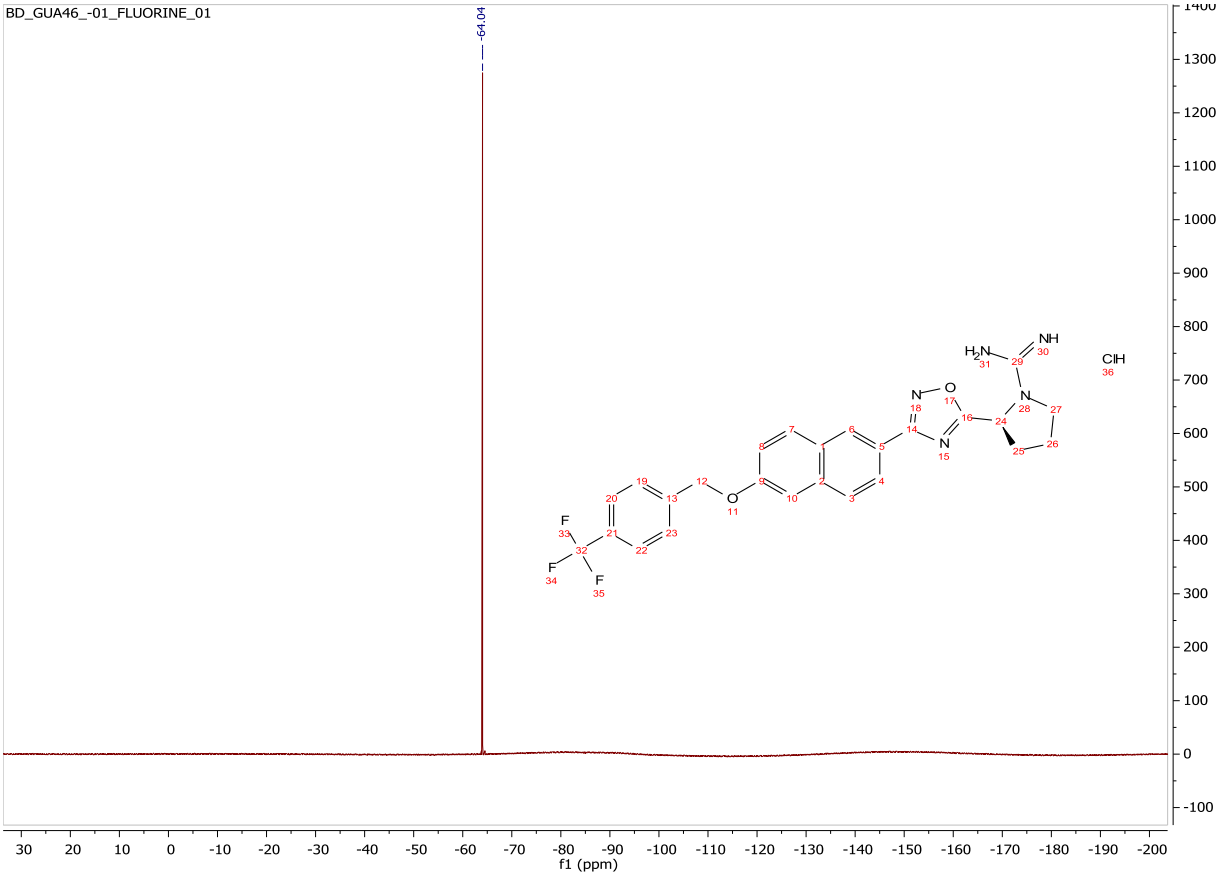
^{13}C-NMR Spectrum 3.7m:



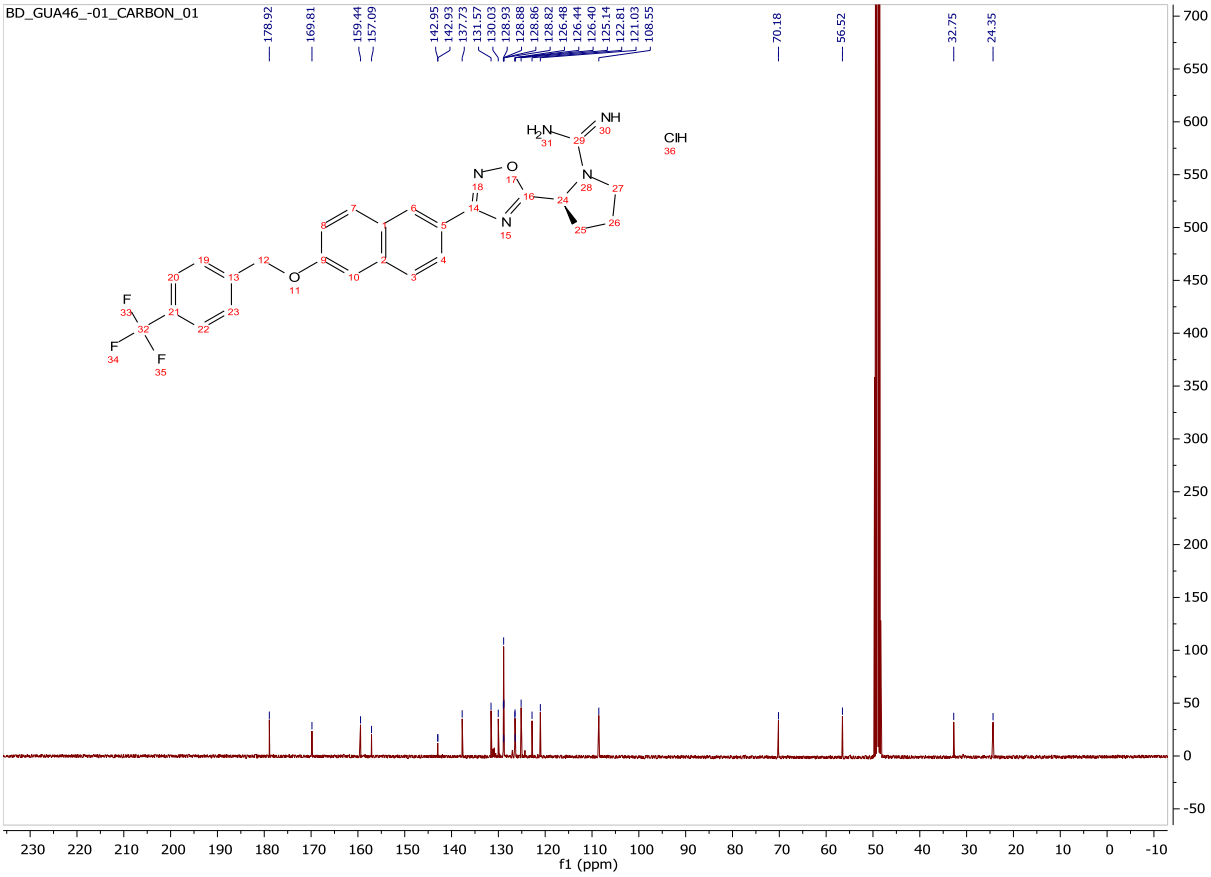
^{1}H-NMR Spectrum for 3.7n:



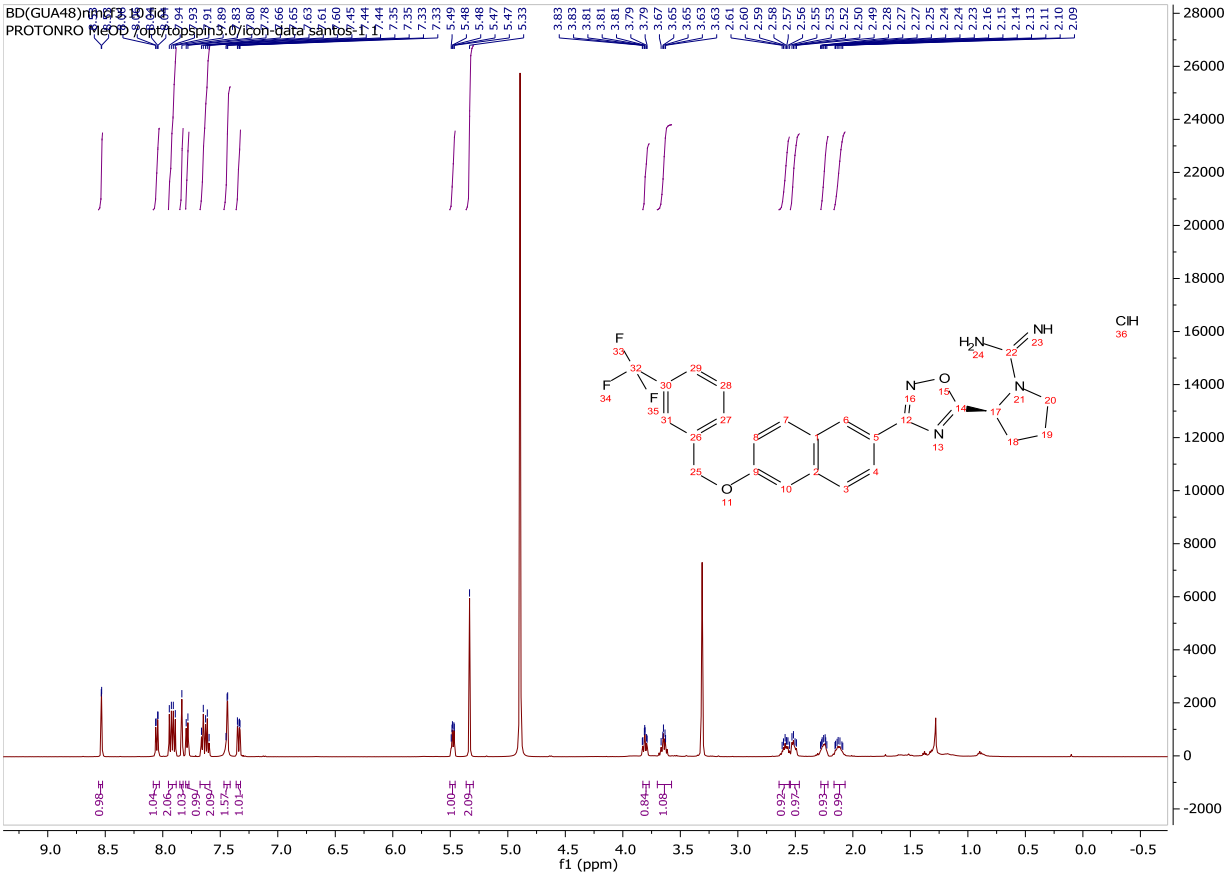
^{19}F-NMR Spectrum for 3.7n:



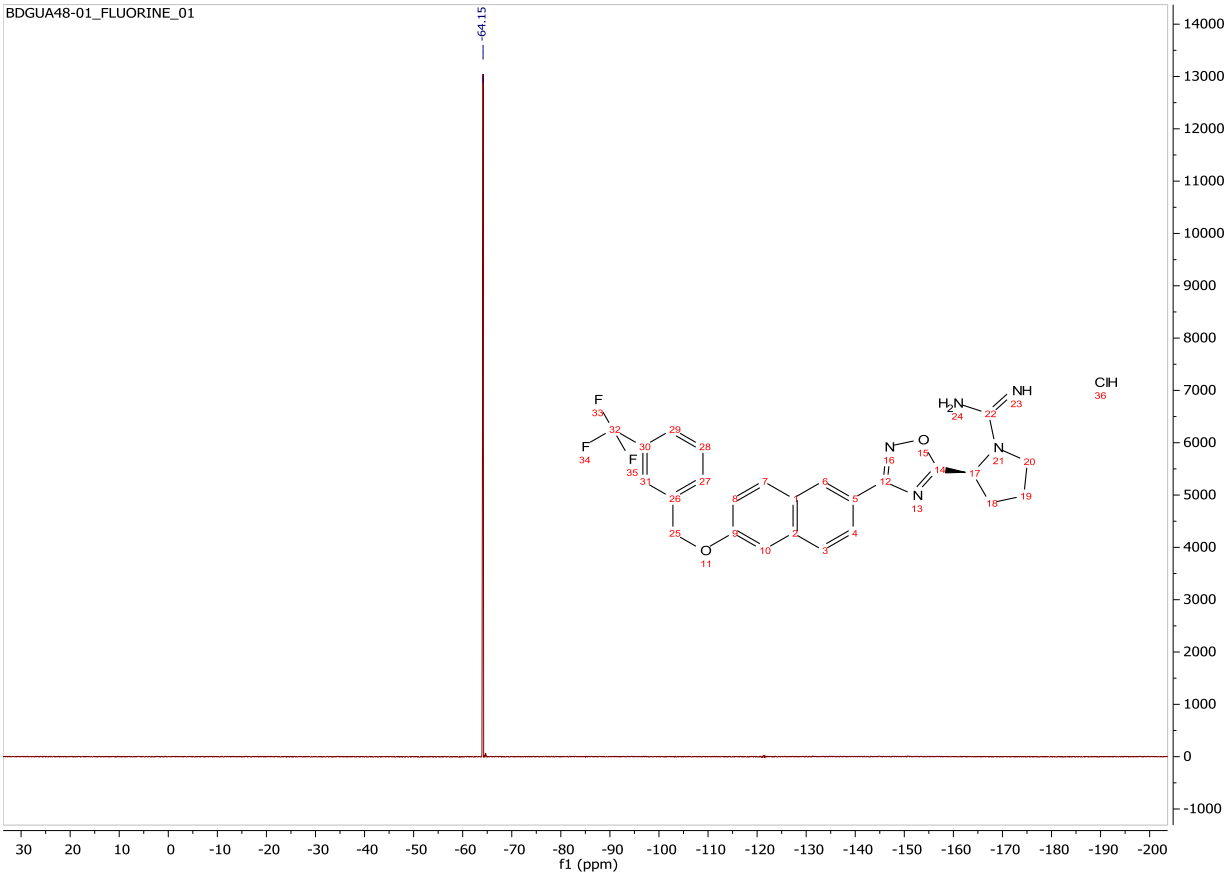
^{13}C-NMR Spectrum for 3.7n



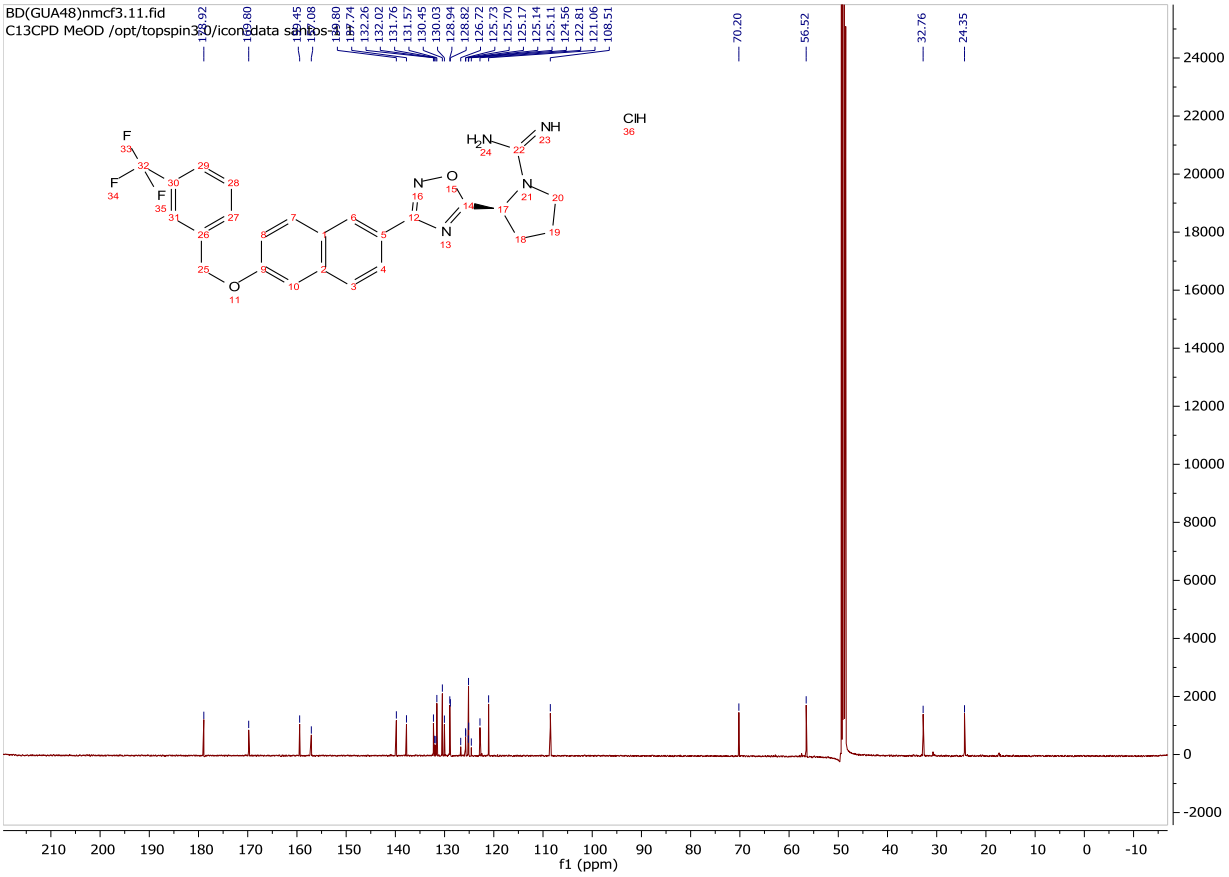
^{1}H-NMR Spectrum for 3.7o:



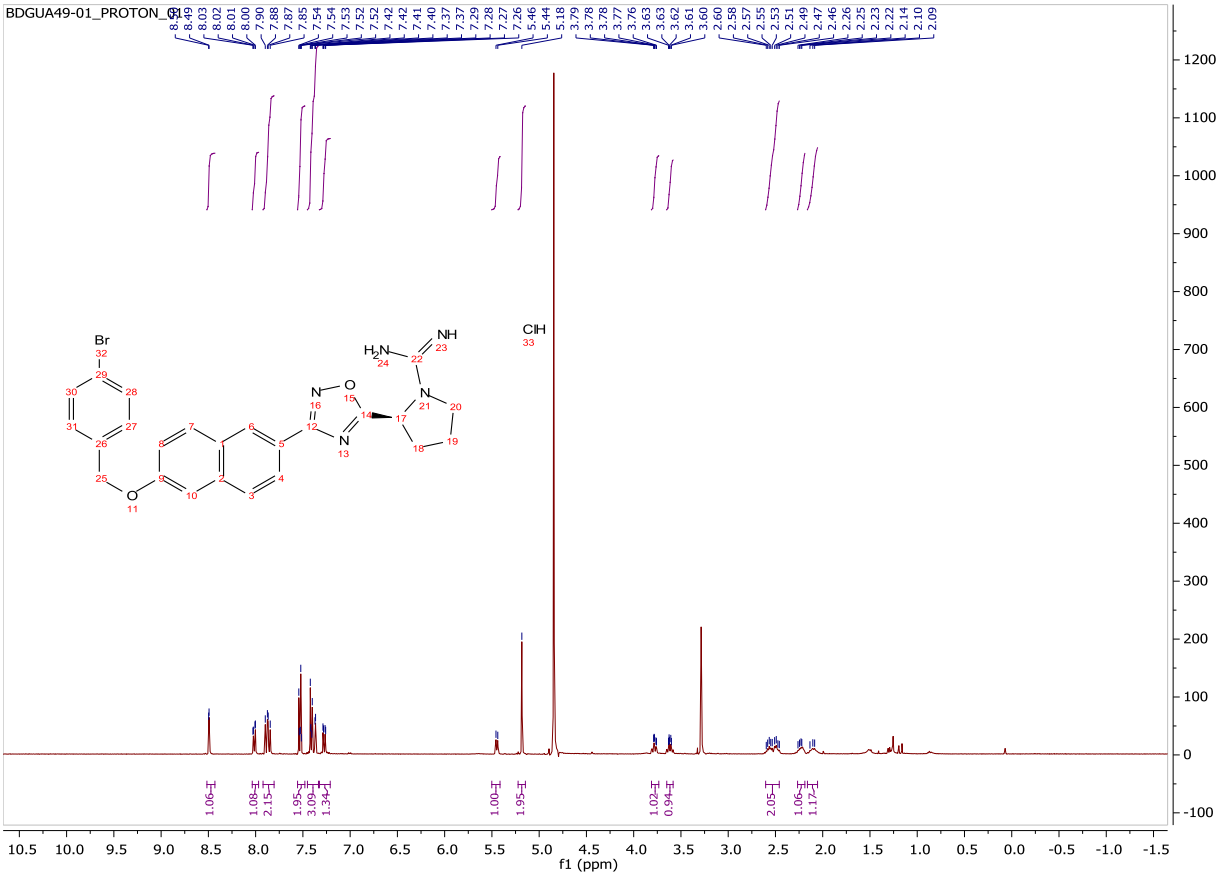
^{19}F-NMR Spectrum for 3.7o:



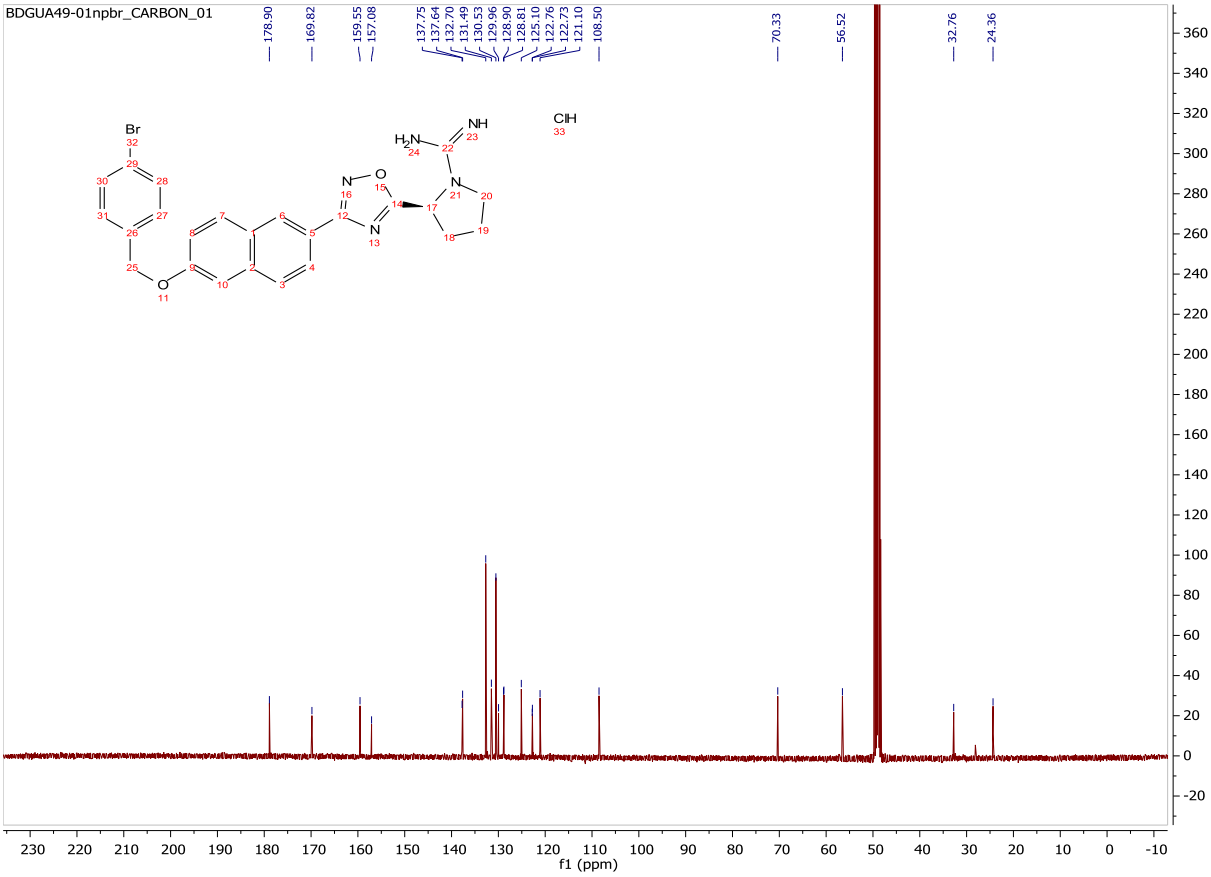
^{13}C-NMR Spectrum for 3.7o:



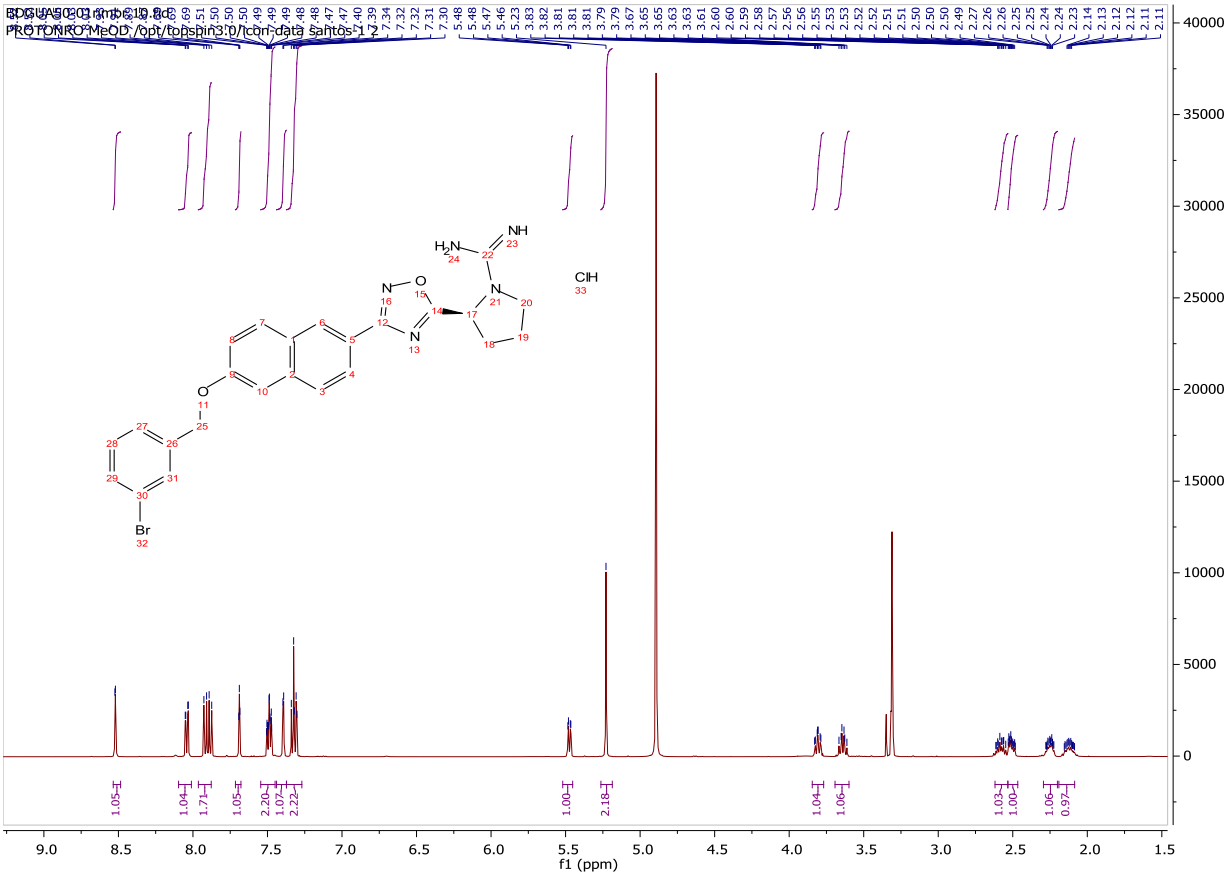
^{1}H-NMR Spectrum for 3.7p:



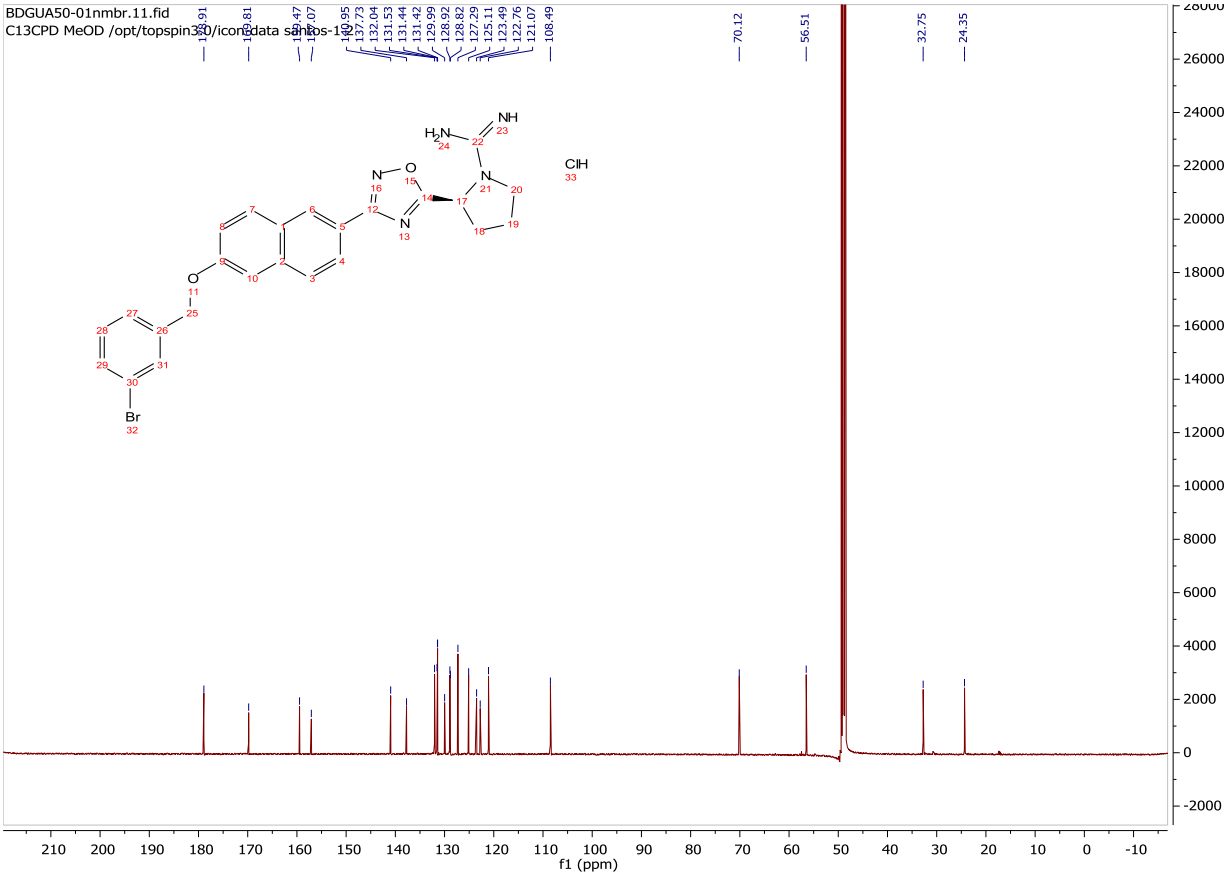
^{13}C-NMR Spectrum for 3.7p:



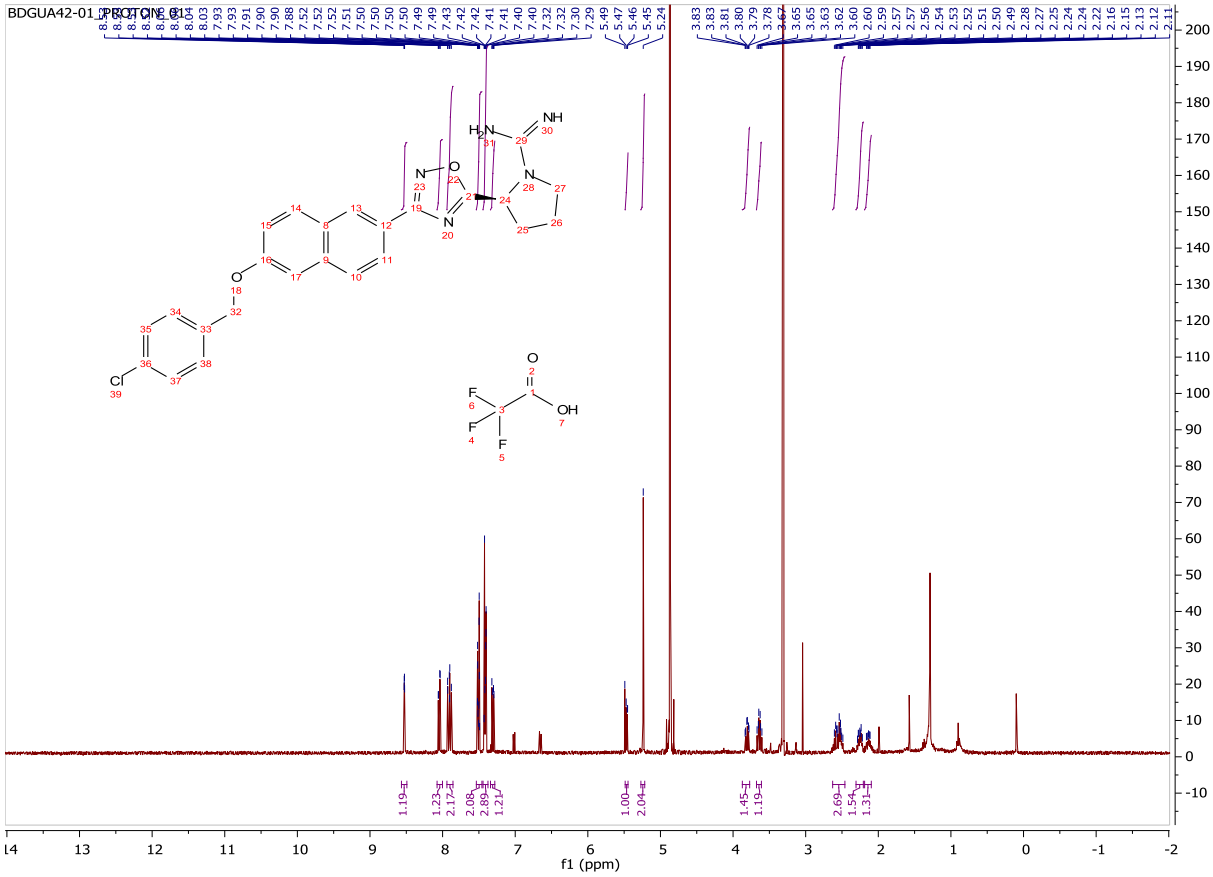
^{1}H-NMR Spectrum for 3.7q:



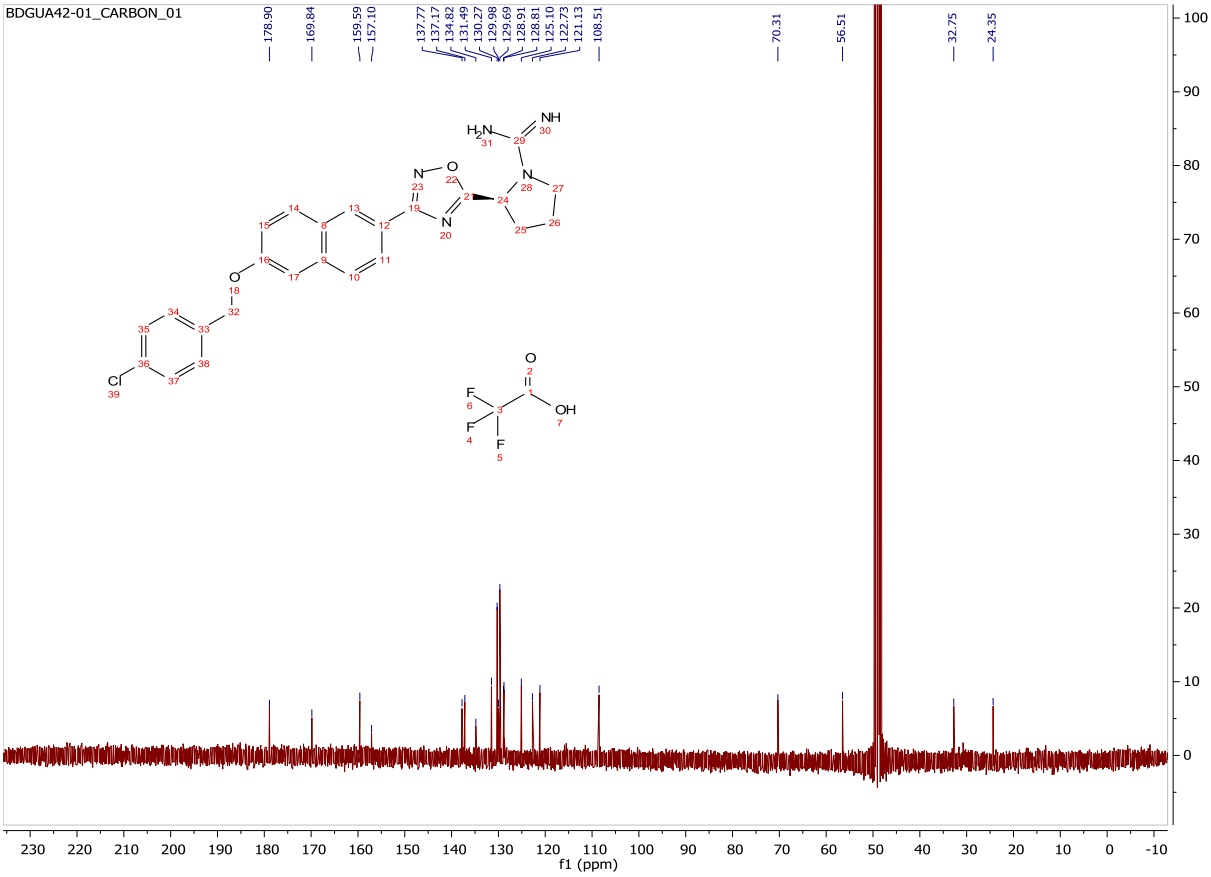
^{13}C-NMR Spectrum for 3.7q:



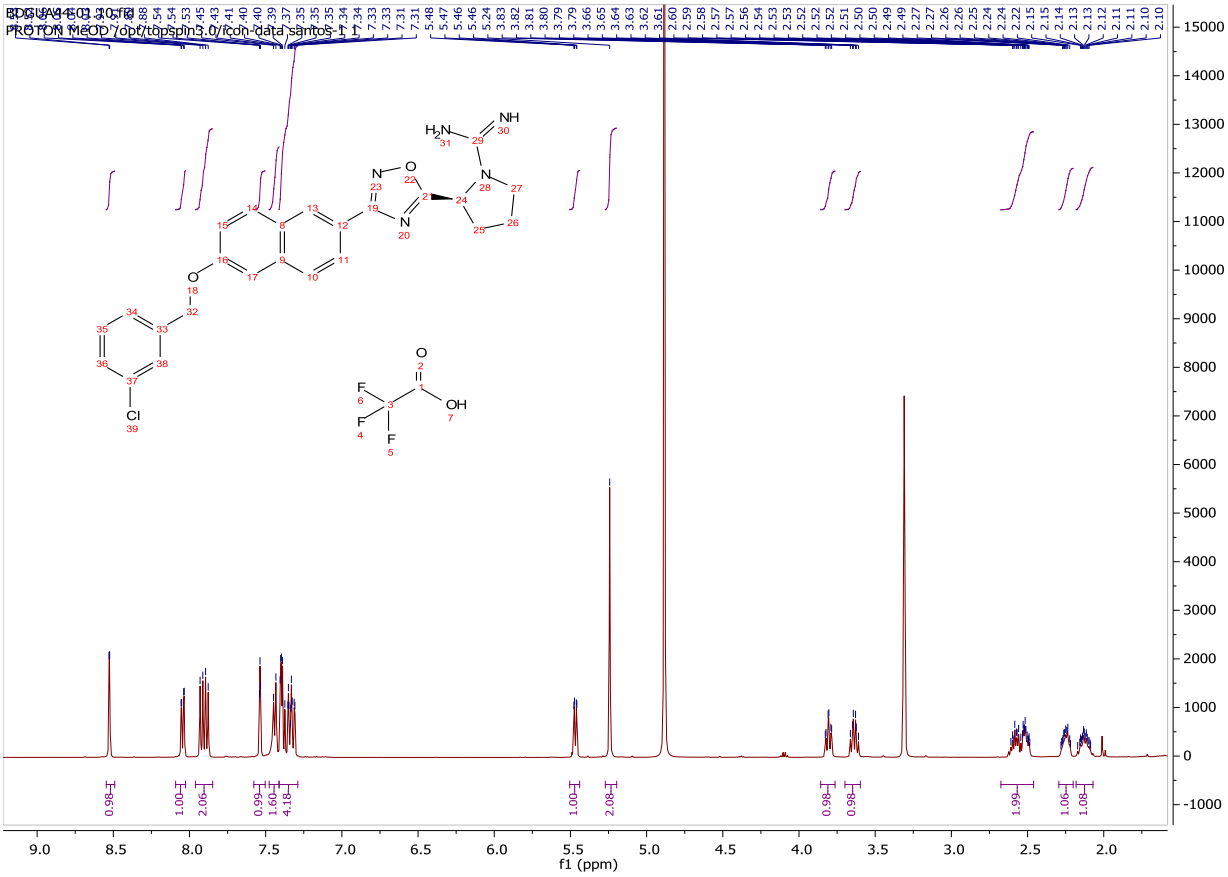
^{1}H-NMR Spectrum for 3.7r:



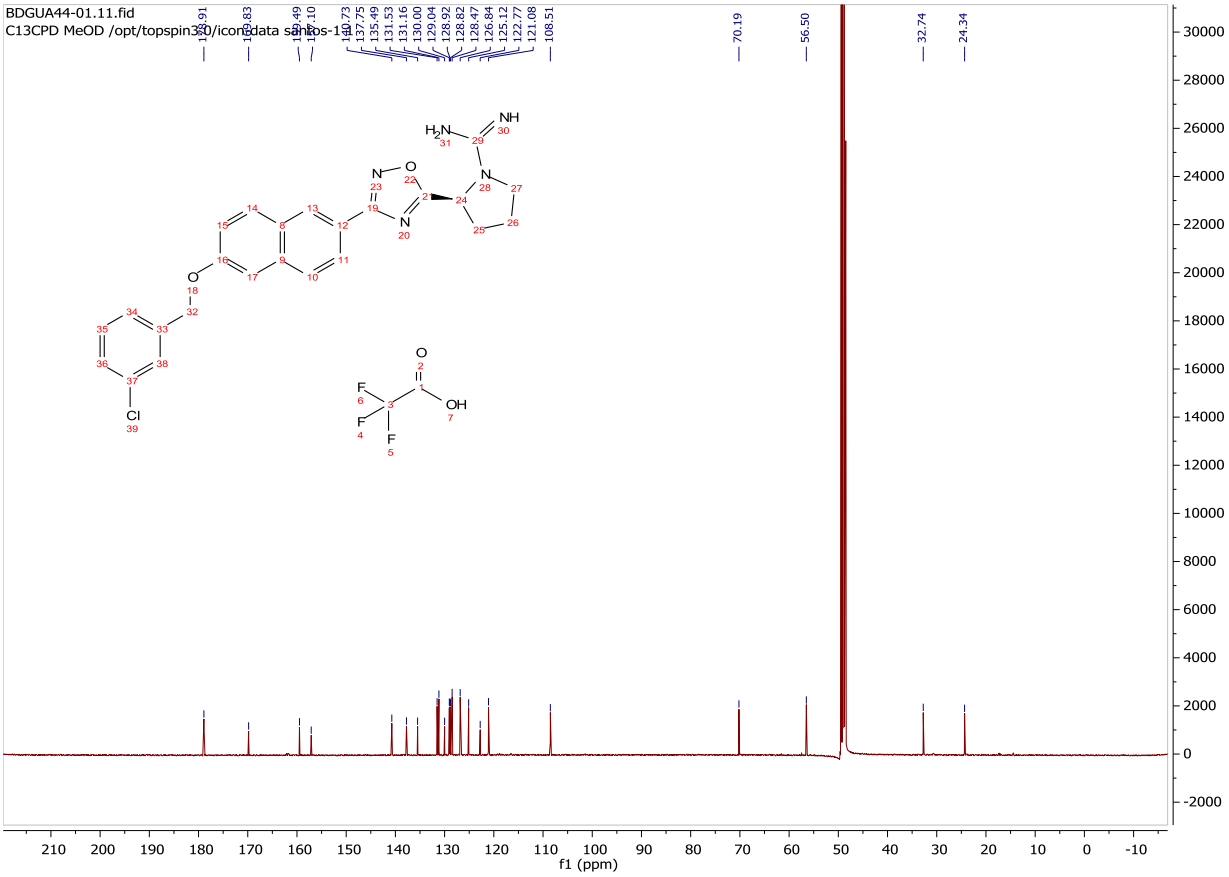
^{13}C-NMR Spectrum for 3.7r:



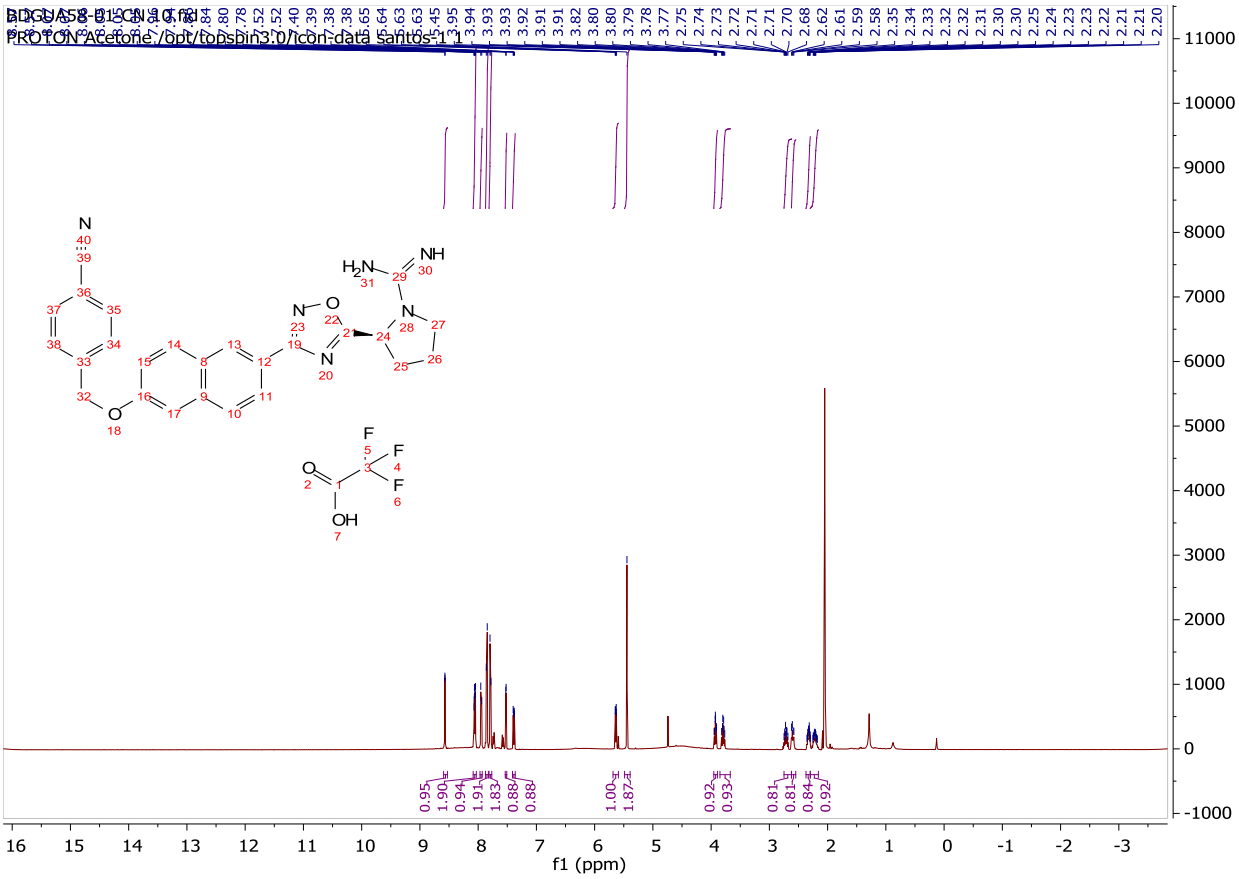
^{1}H-NMR Spectrum for 3.7s:



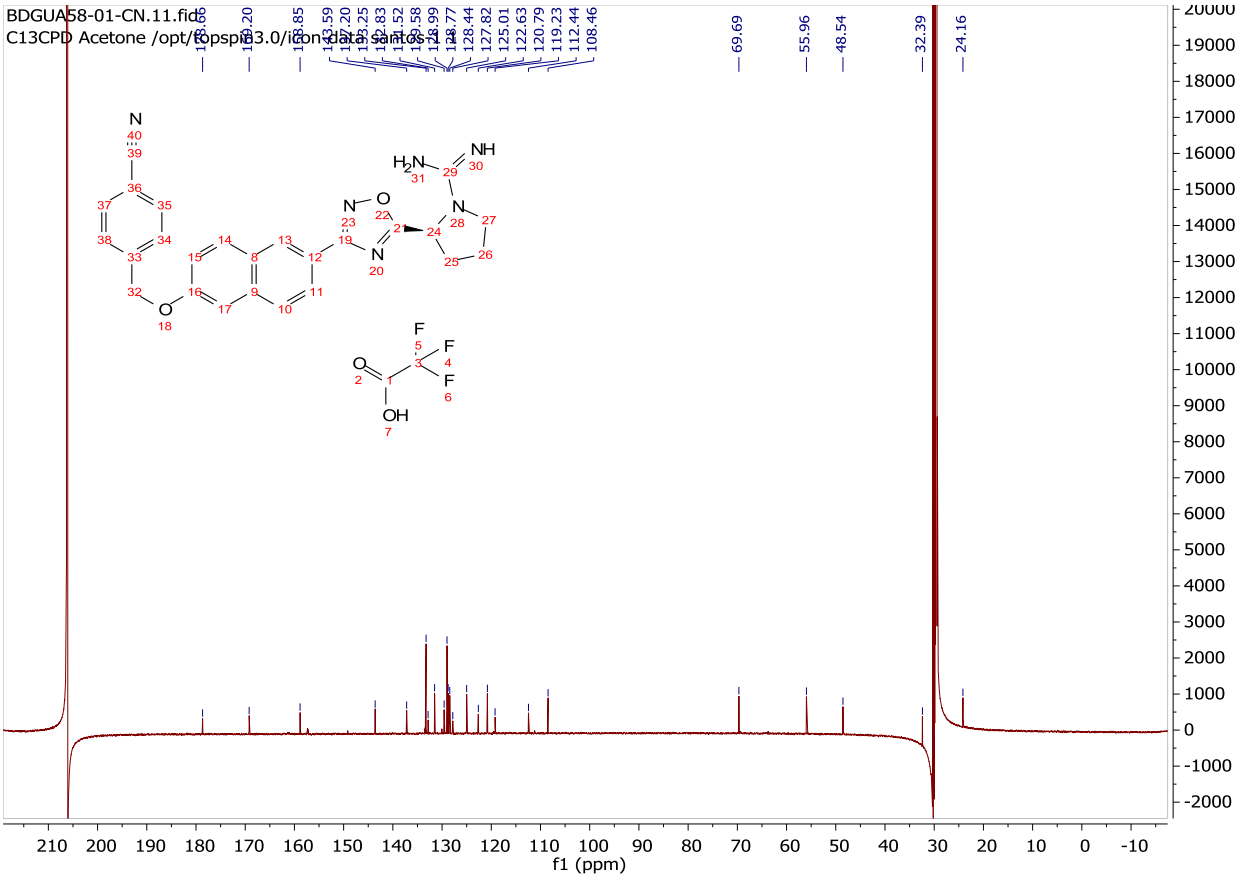
^{13}C-NMR Spectrum for 3.7s:



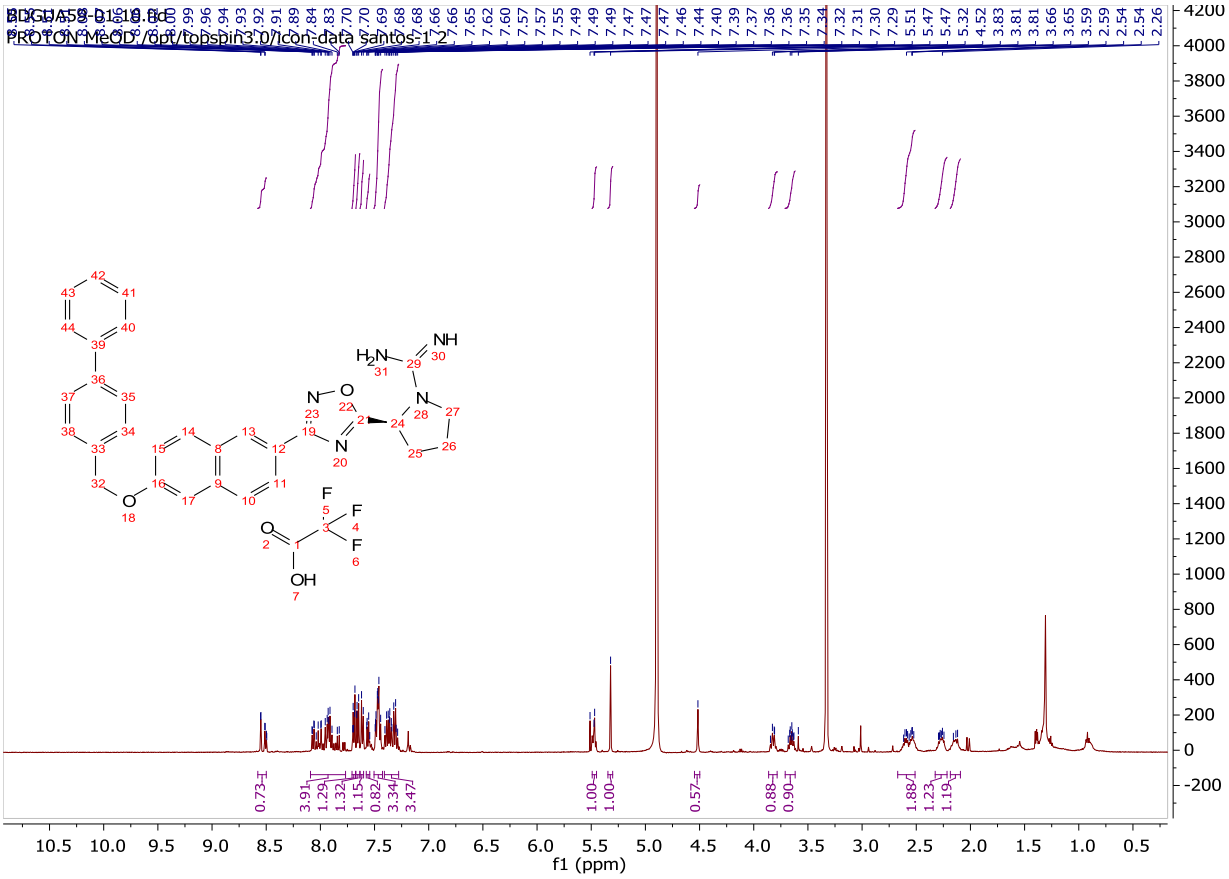
^{1}H-NMR Spectrum for 3.7t:



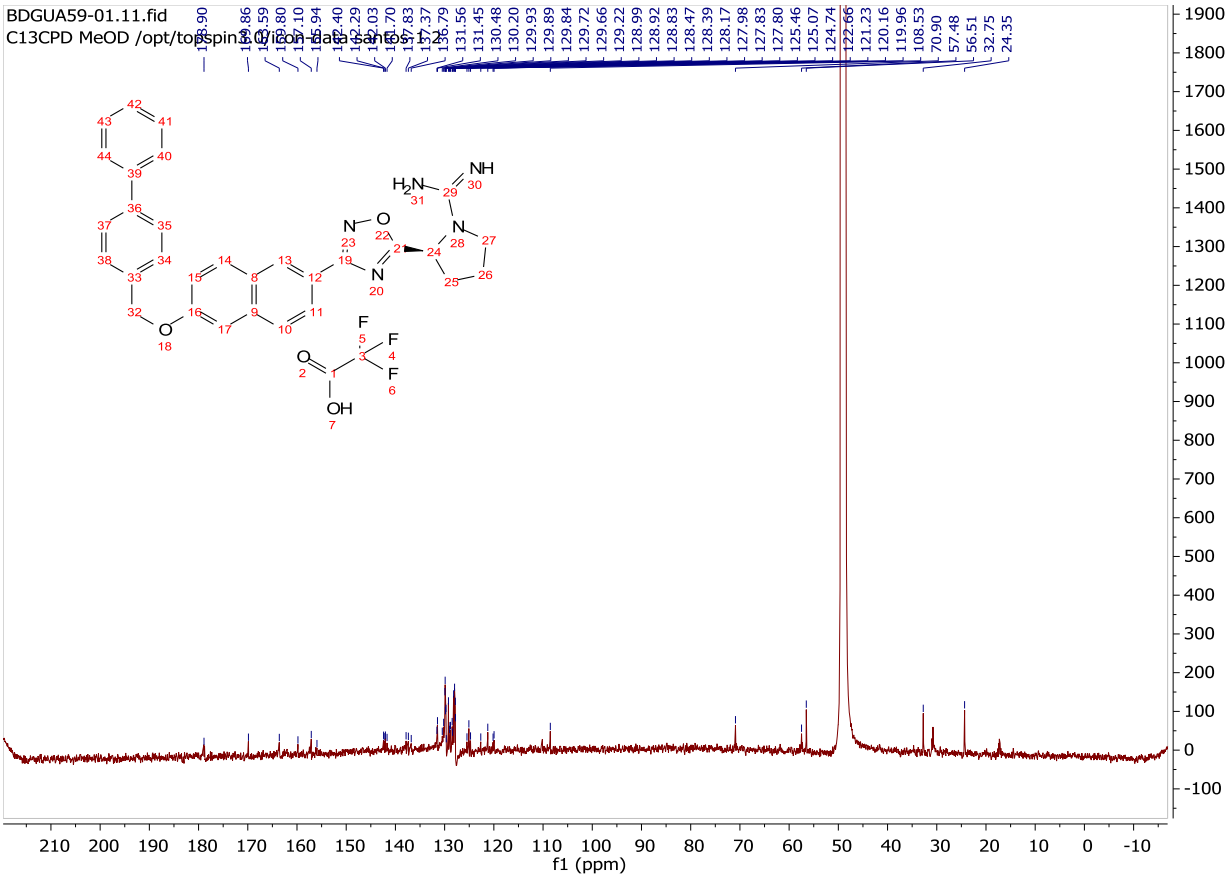
^{13}C-NMR Spectrum for 3.7t:



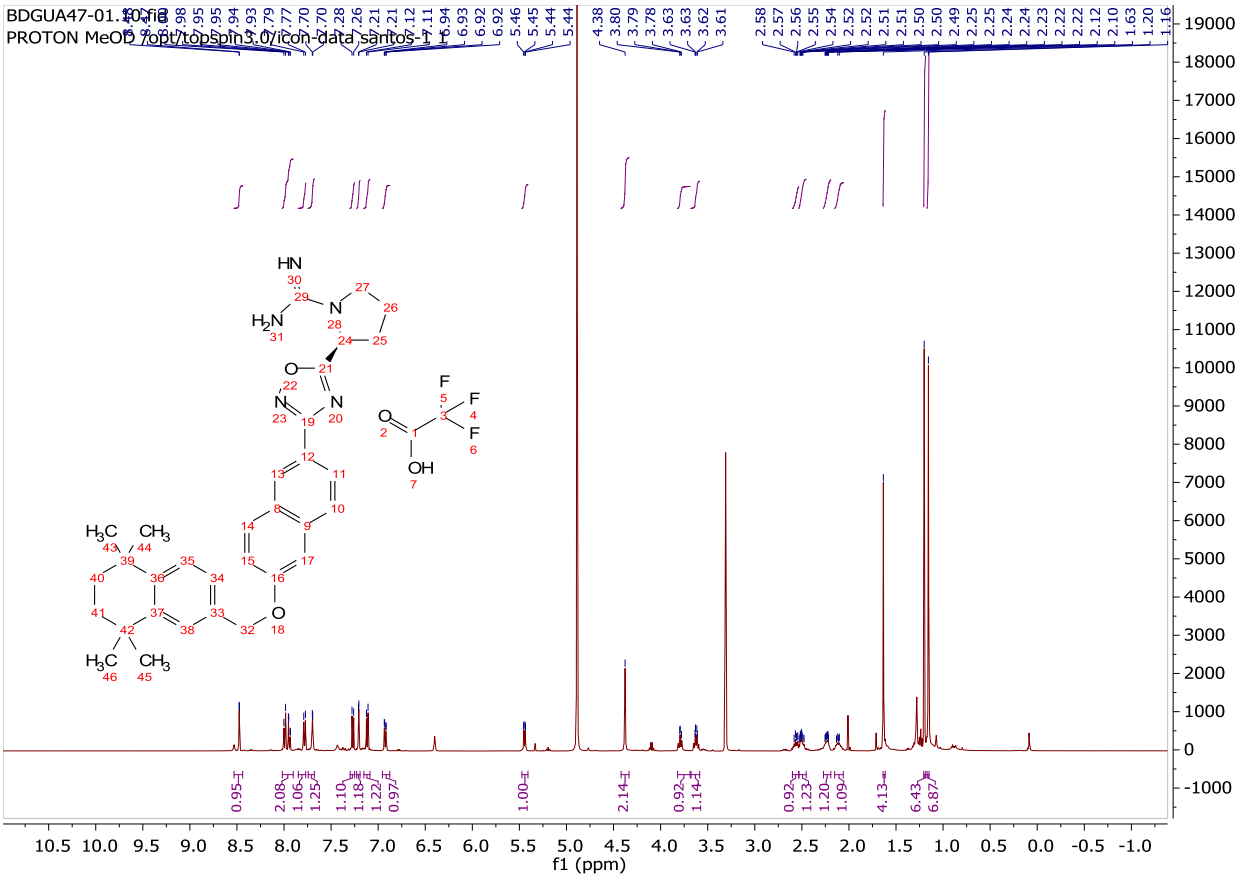
^{1}H-NMR Spectrum for 3.7u:



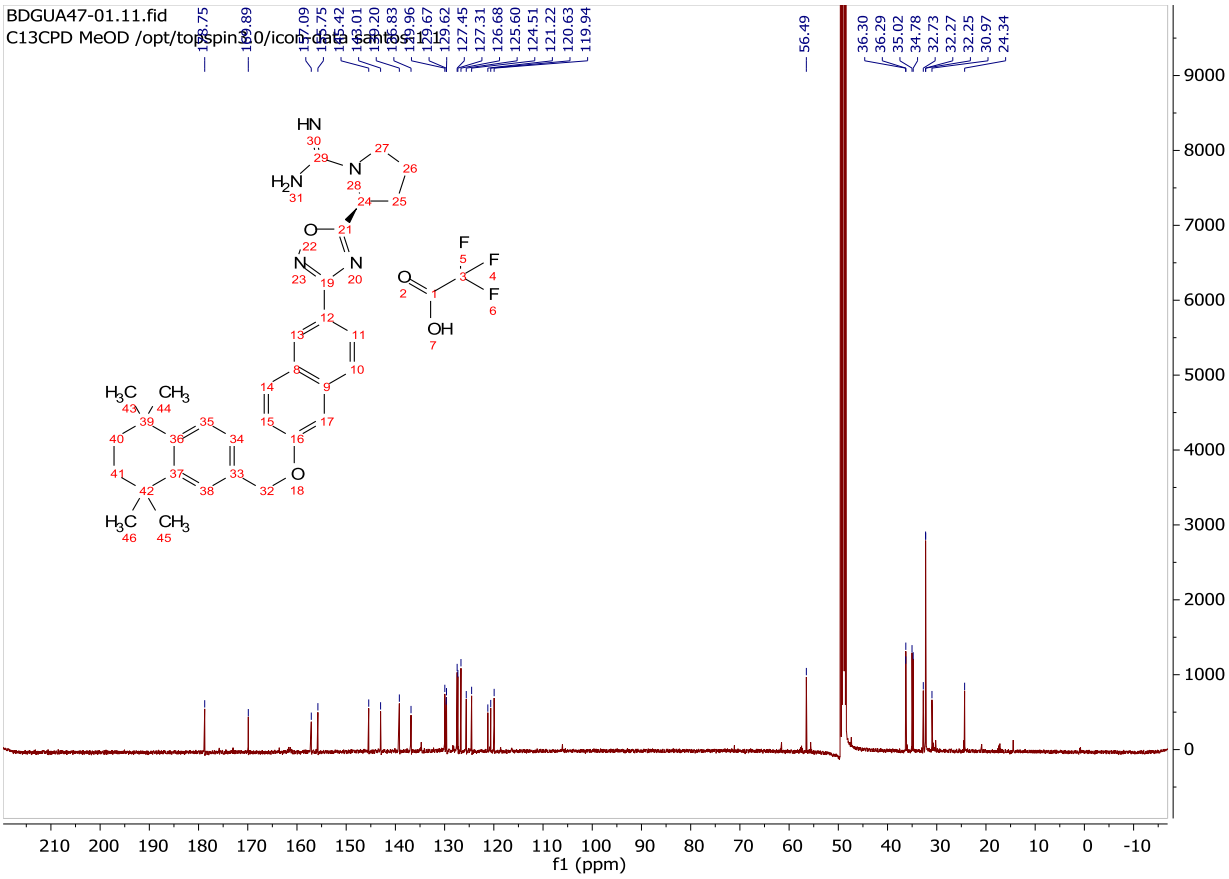
^{13}C-NMR Spectrum for 3.7u:



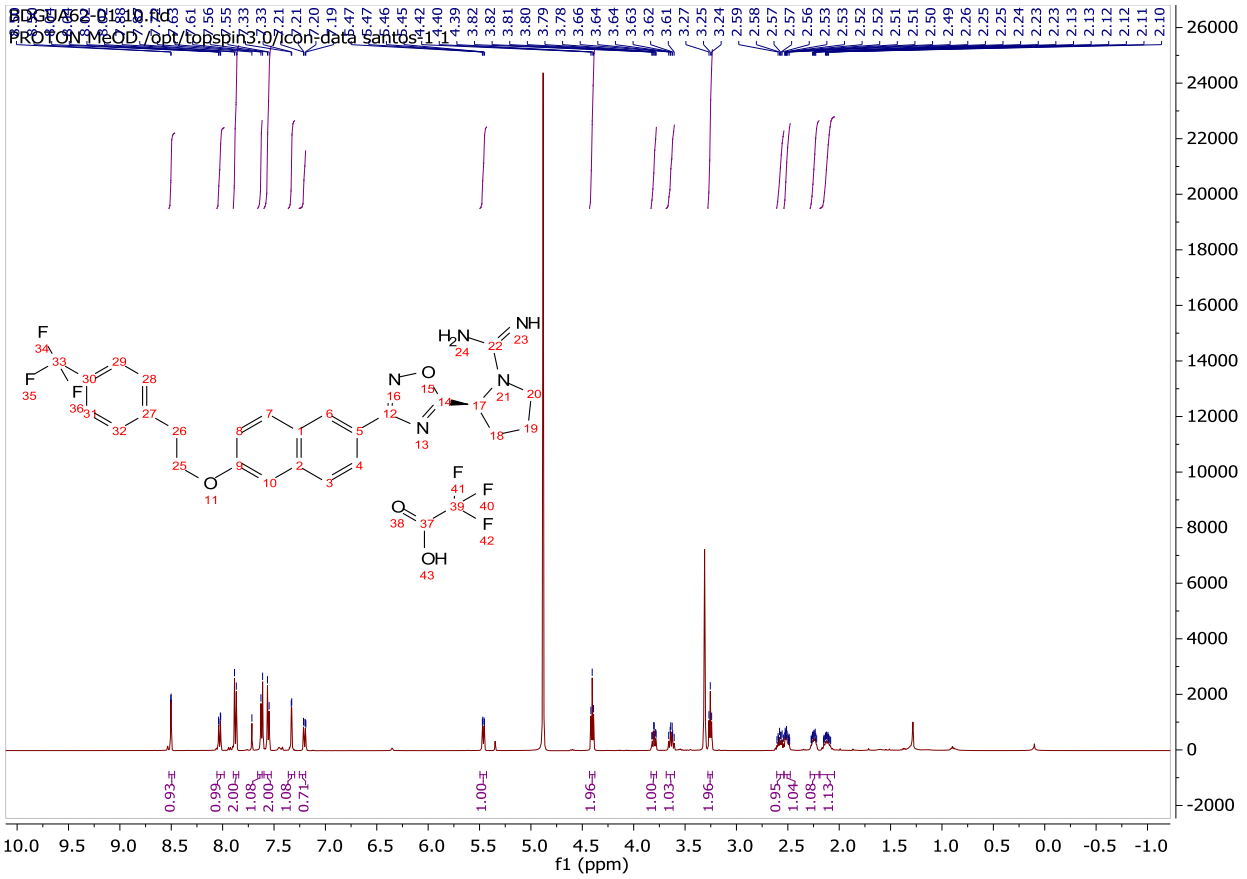
^{1}H-NMR Spectrum for 3.7v:



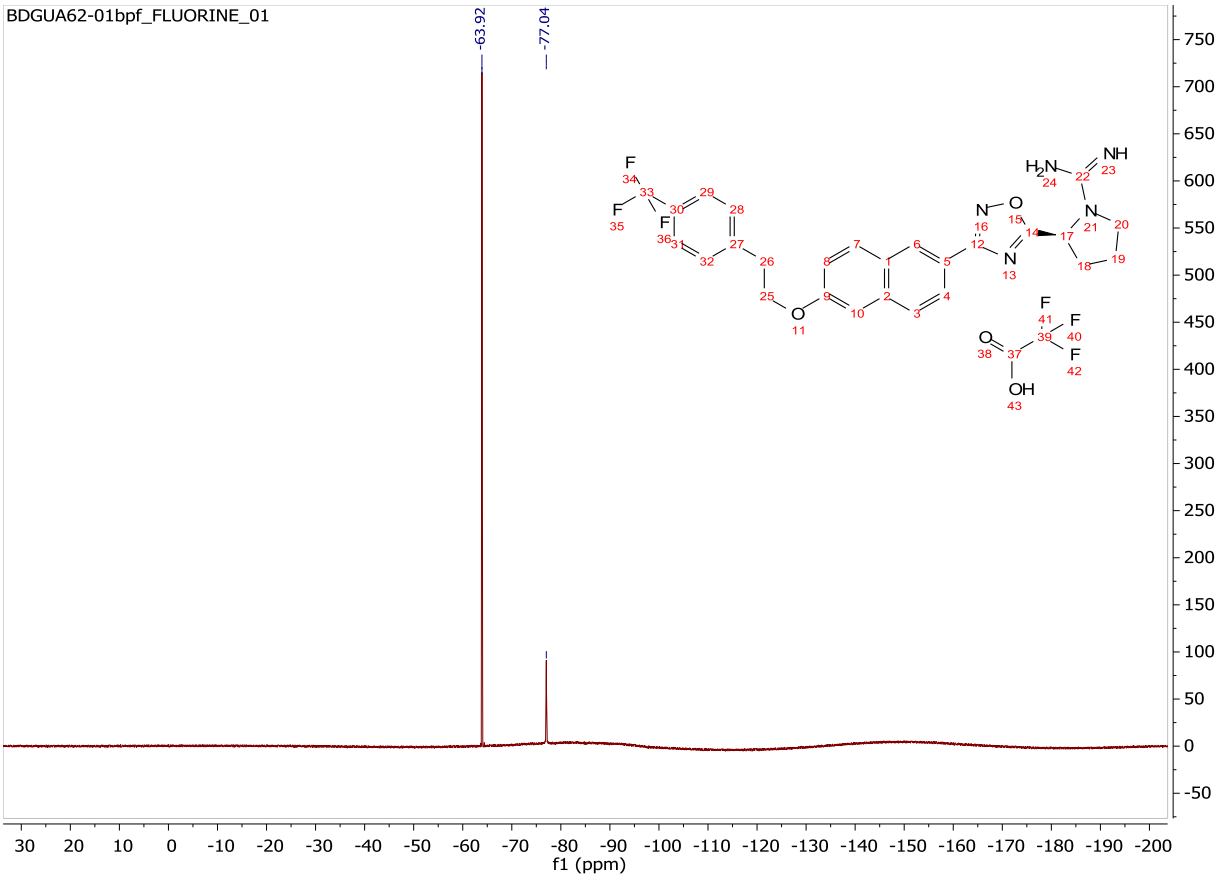
^{13}C-NMR Spectrum for 3.7v:



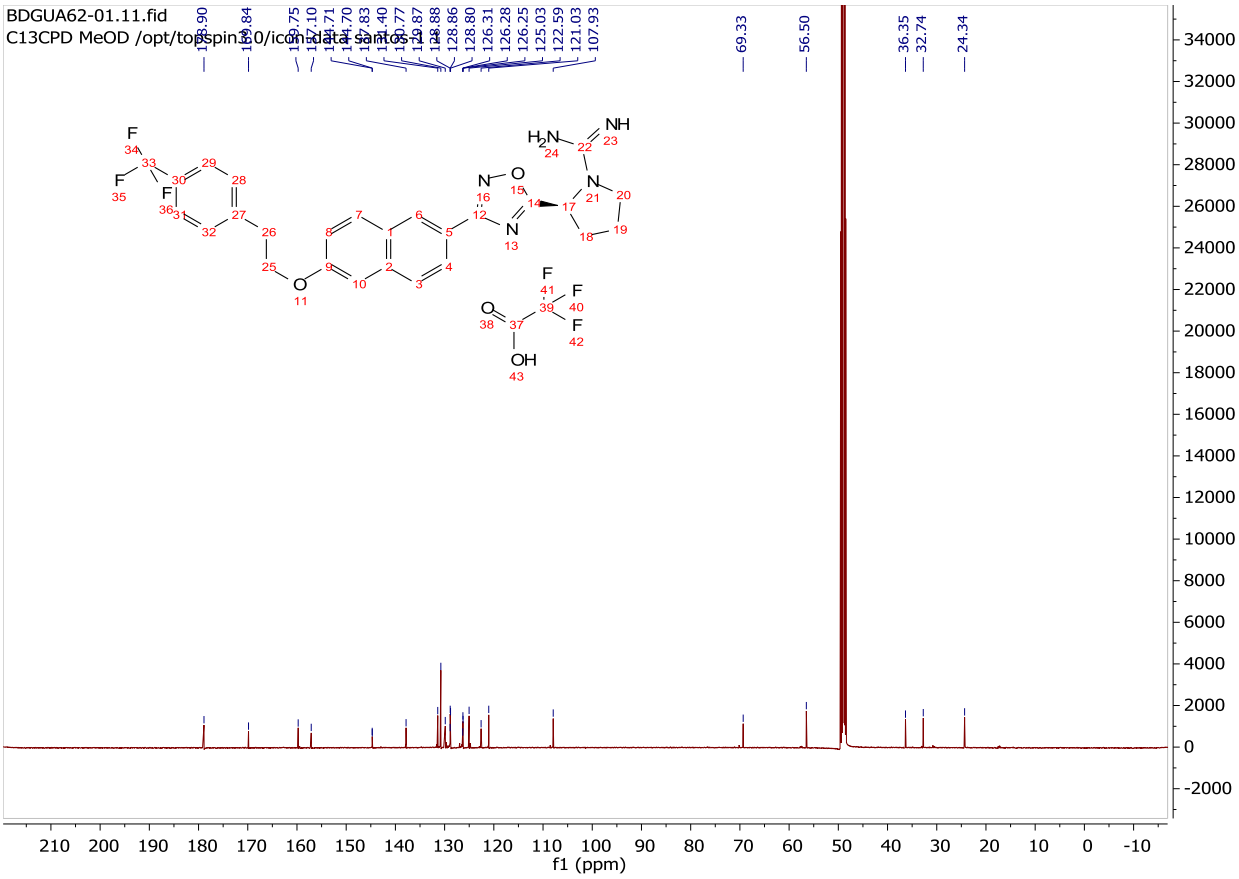
^{1}H-NMR Spectrum for 3.7w:



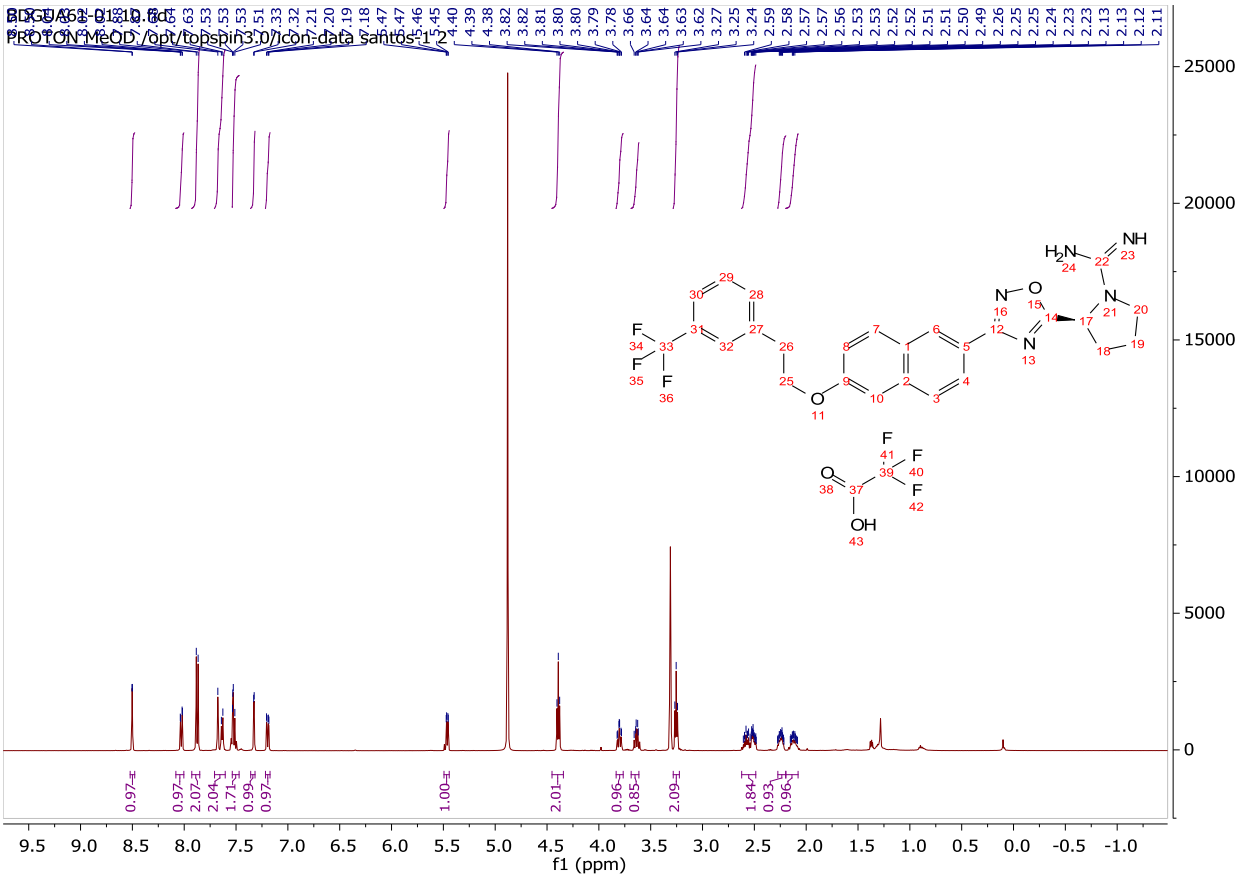
^{19}F-NMR Spectrum for 3.7w:



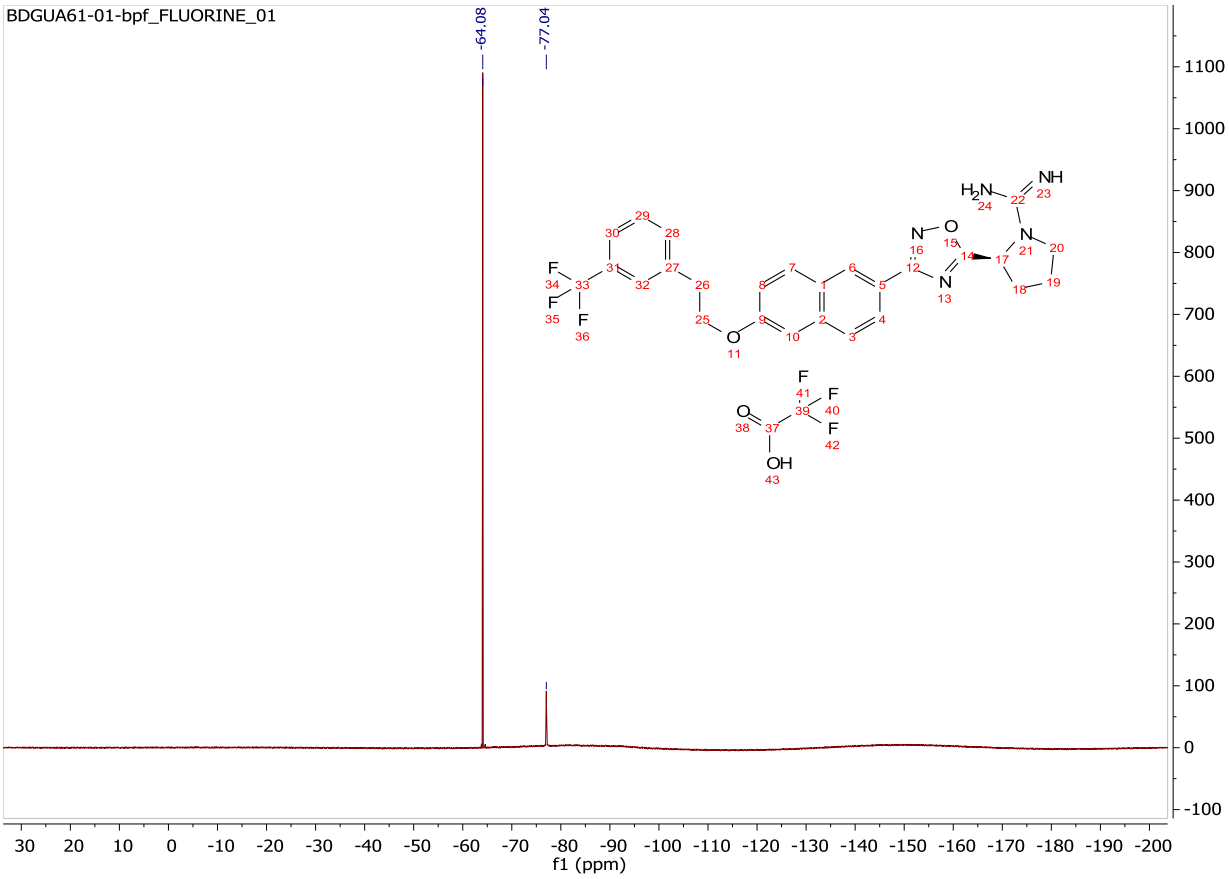
^{13}C-NMR Spectrum for 3.7w:



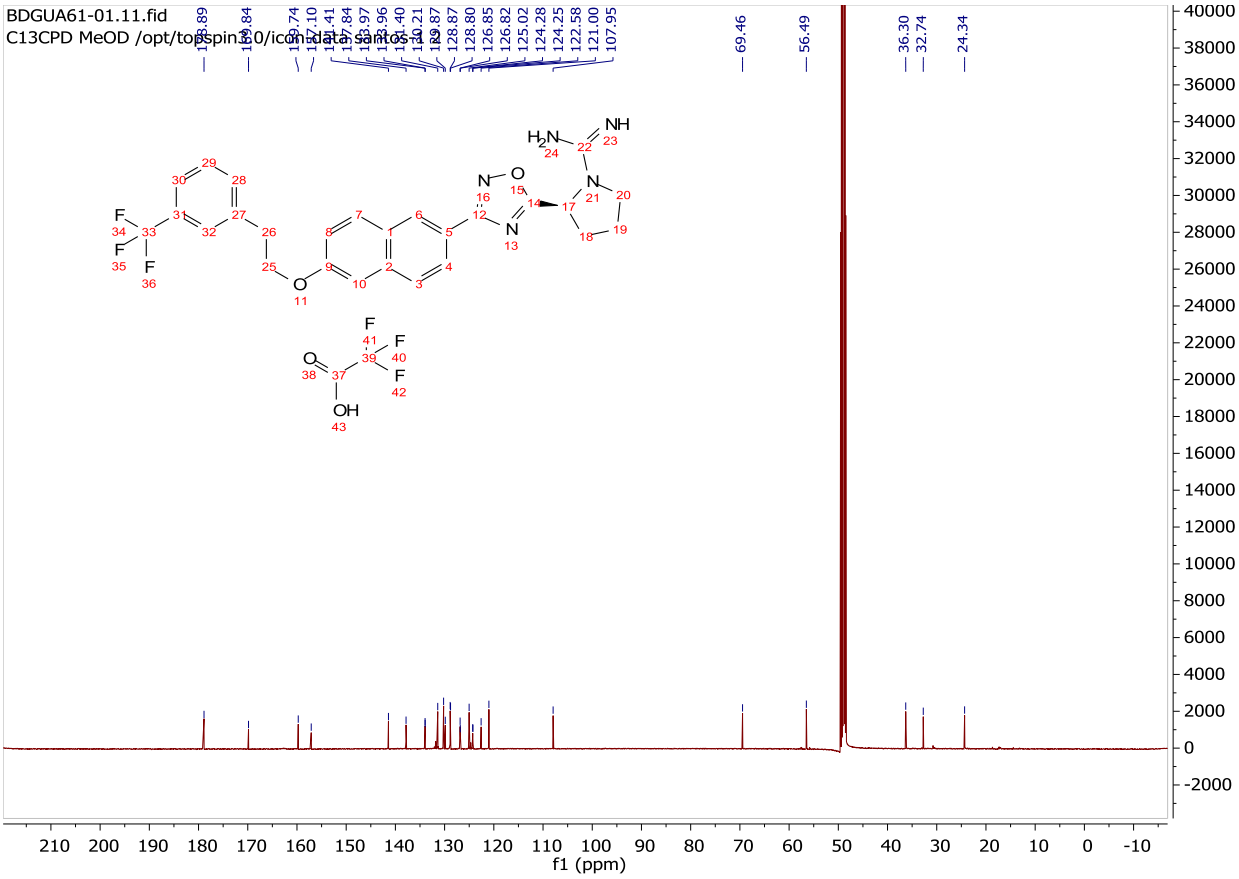
^{1}H-NMR Spectrum for 3.7x:



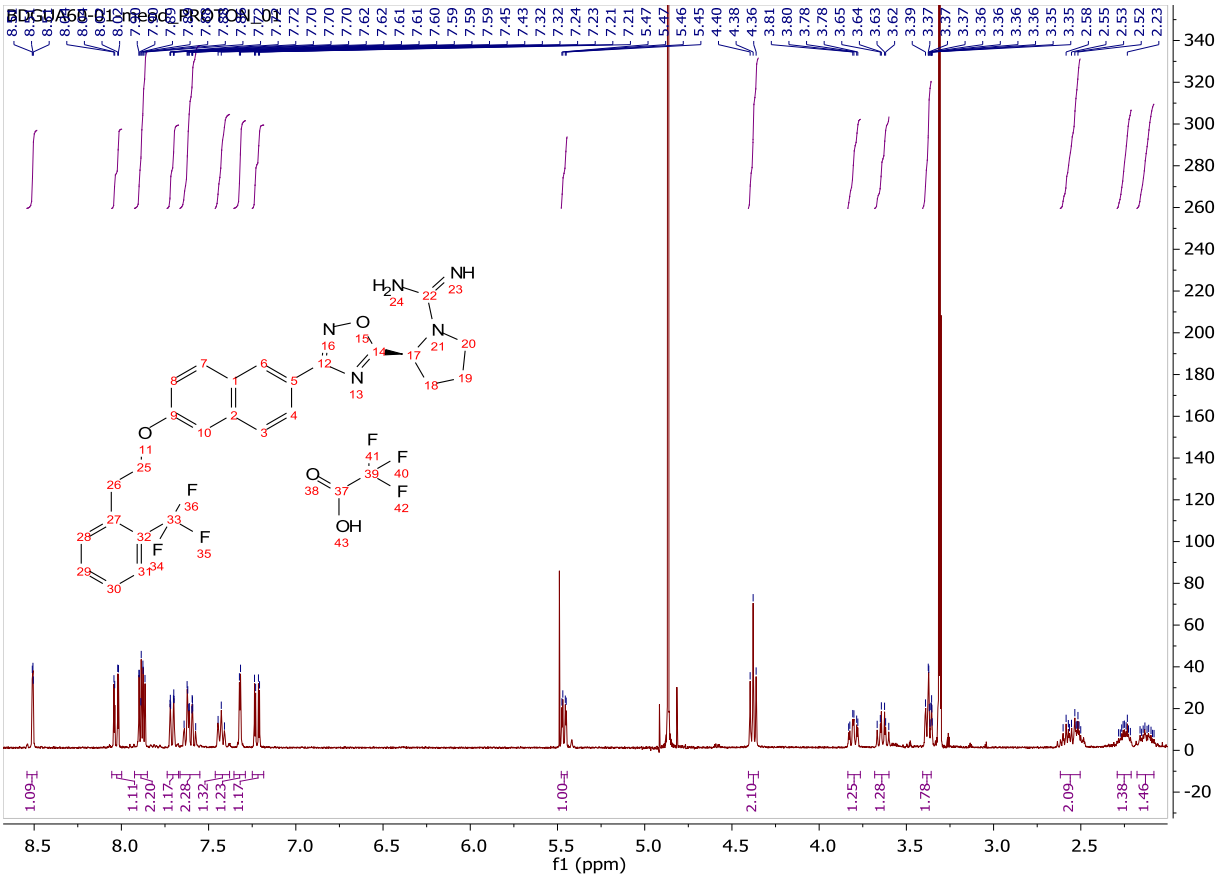
^{19}F-NMR Spectrum for 3.7x:



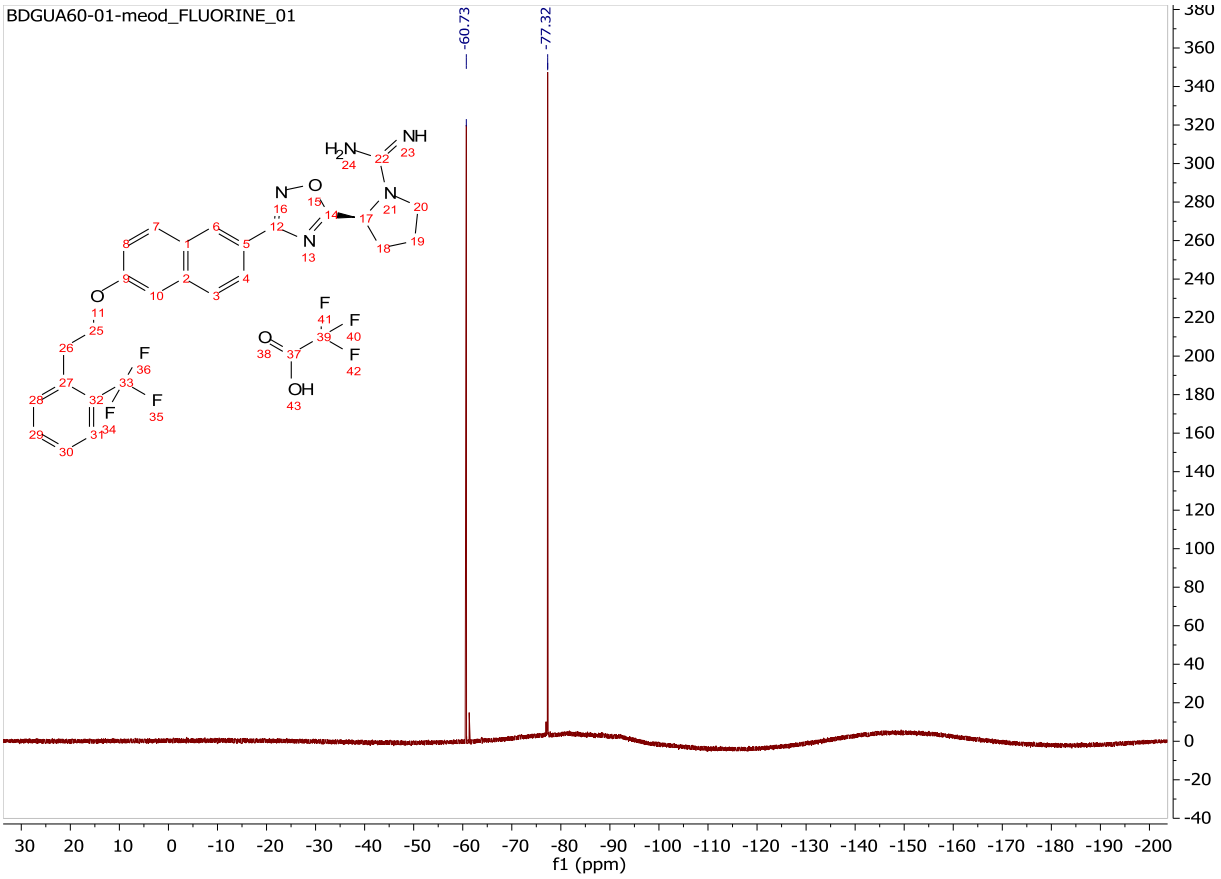
^{13}C-NMR Spectrum for 3.7x:



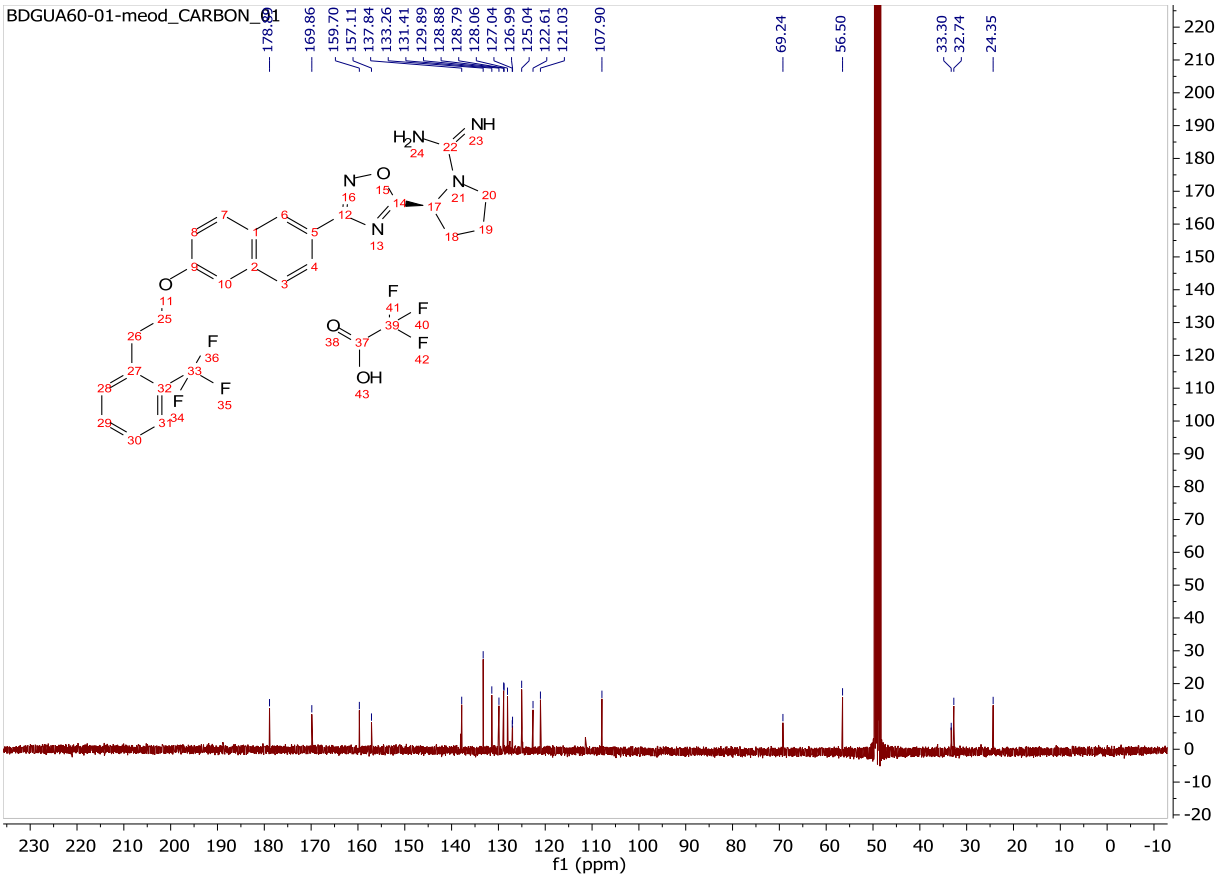
^{1}H-NMR Spectrum for 3.7y



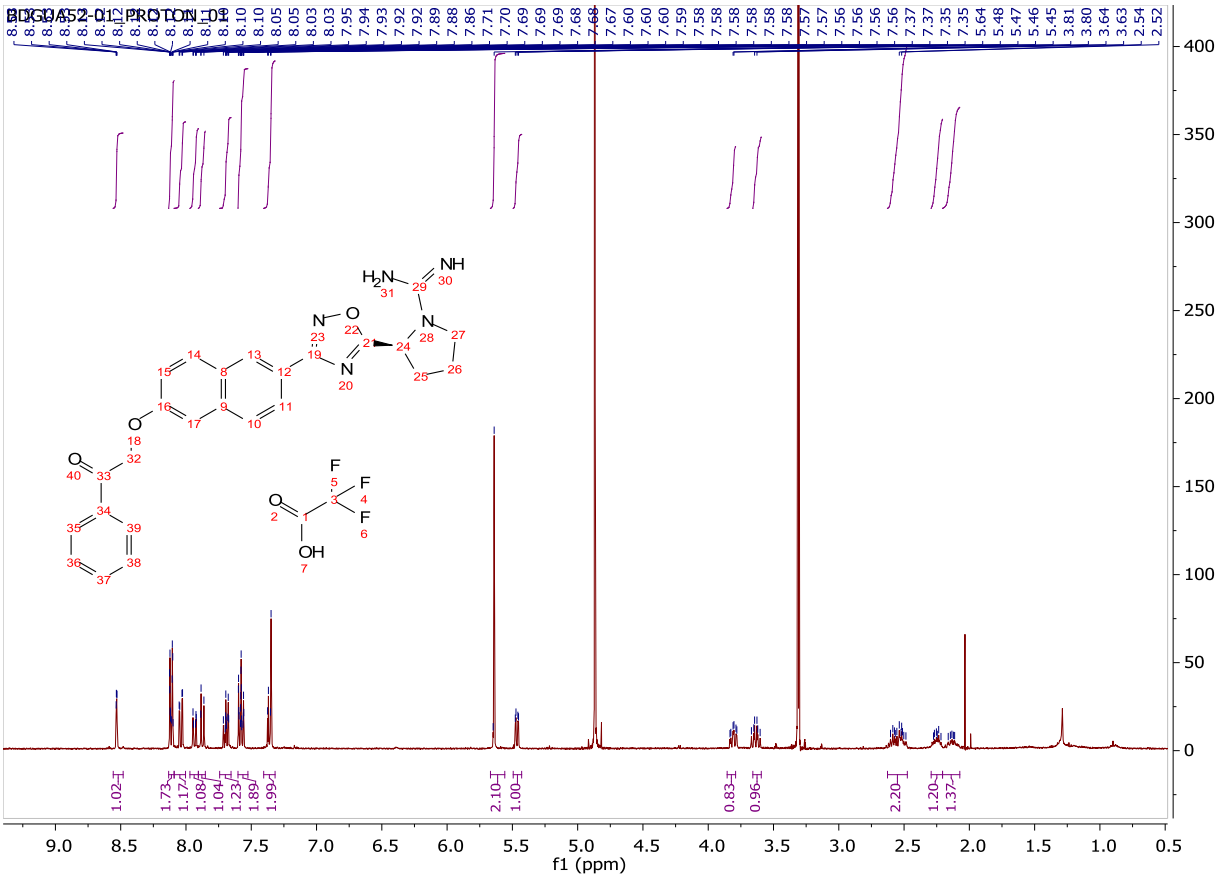
^{19}F-NMR Spectrum for 3.7y:



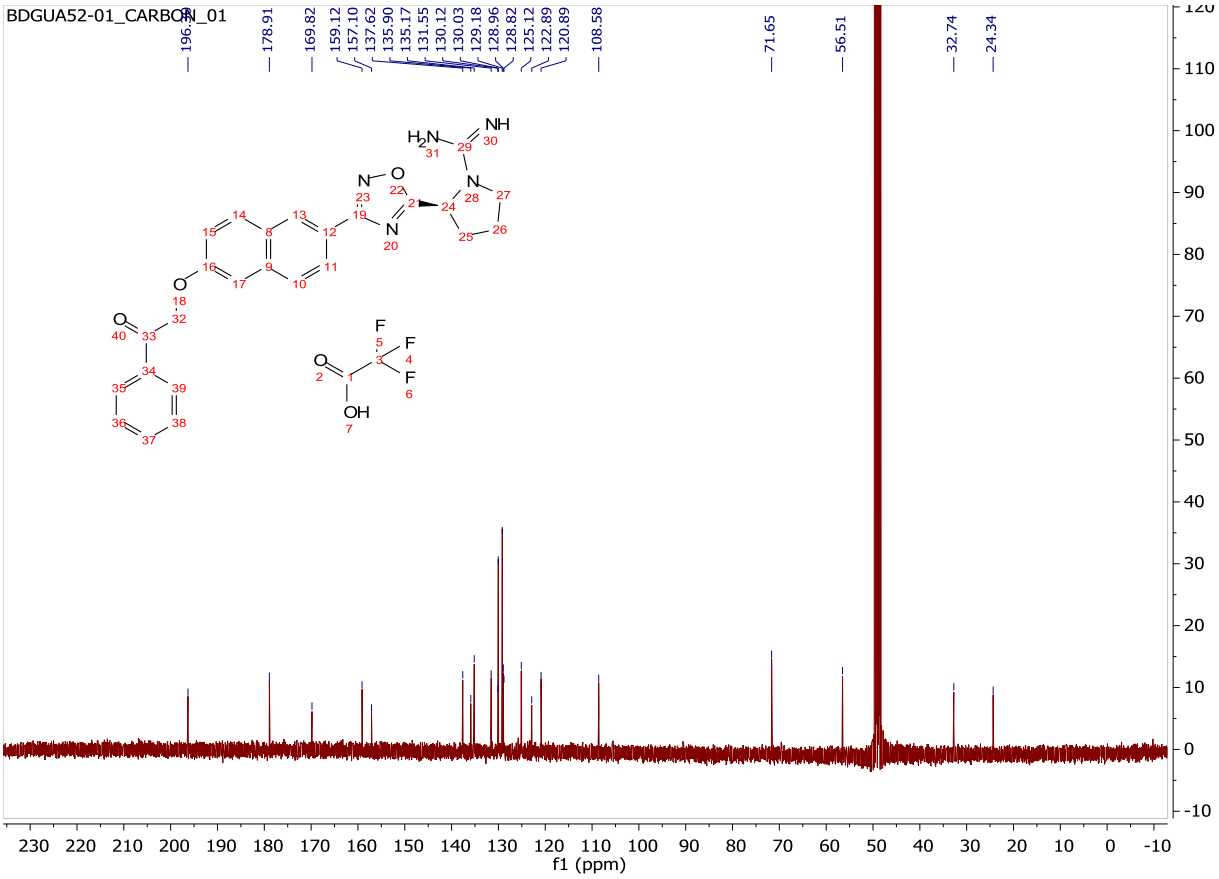
^{13}C-NMR Spectrum for 3.7y:



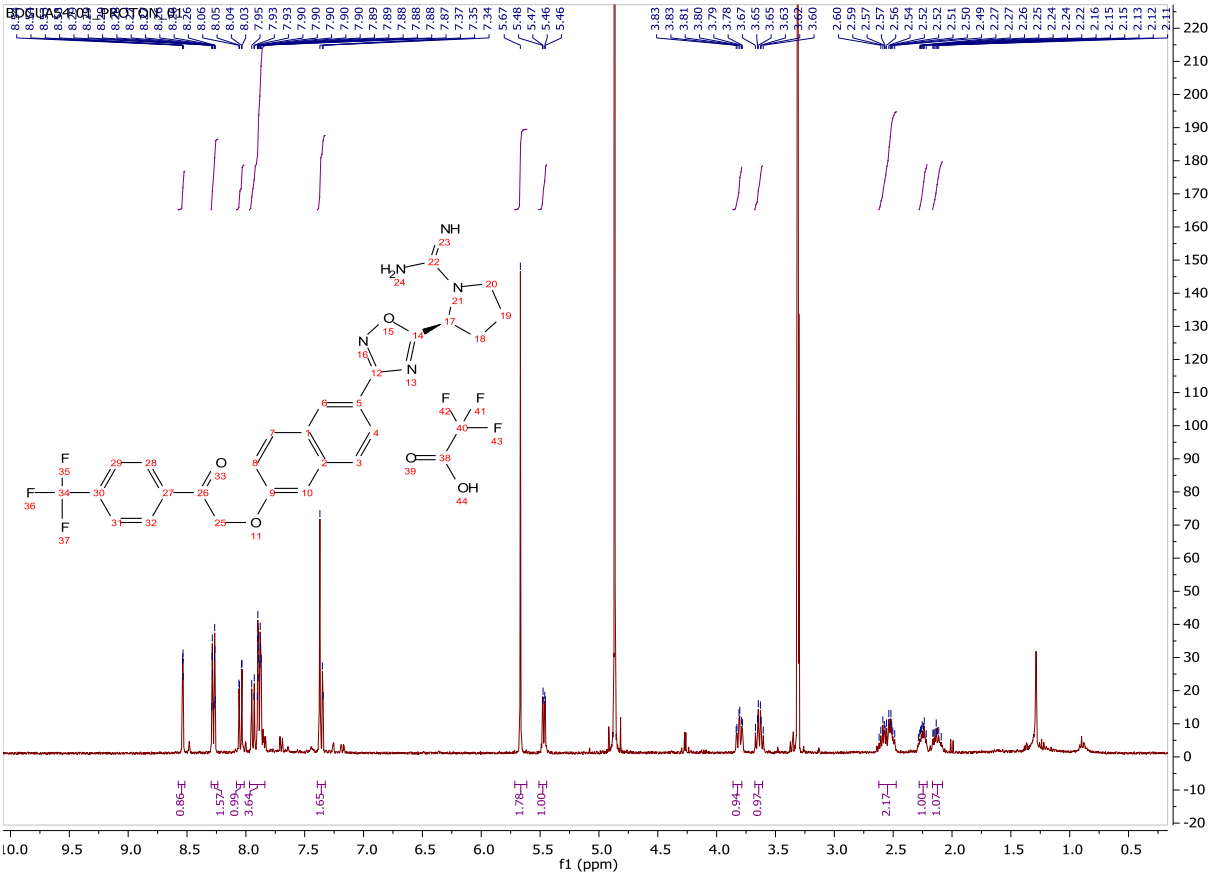
^{1}H-NMR Spectrum for 3.7z:



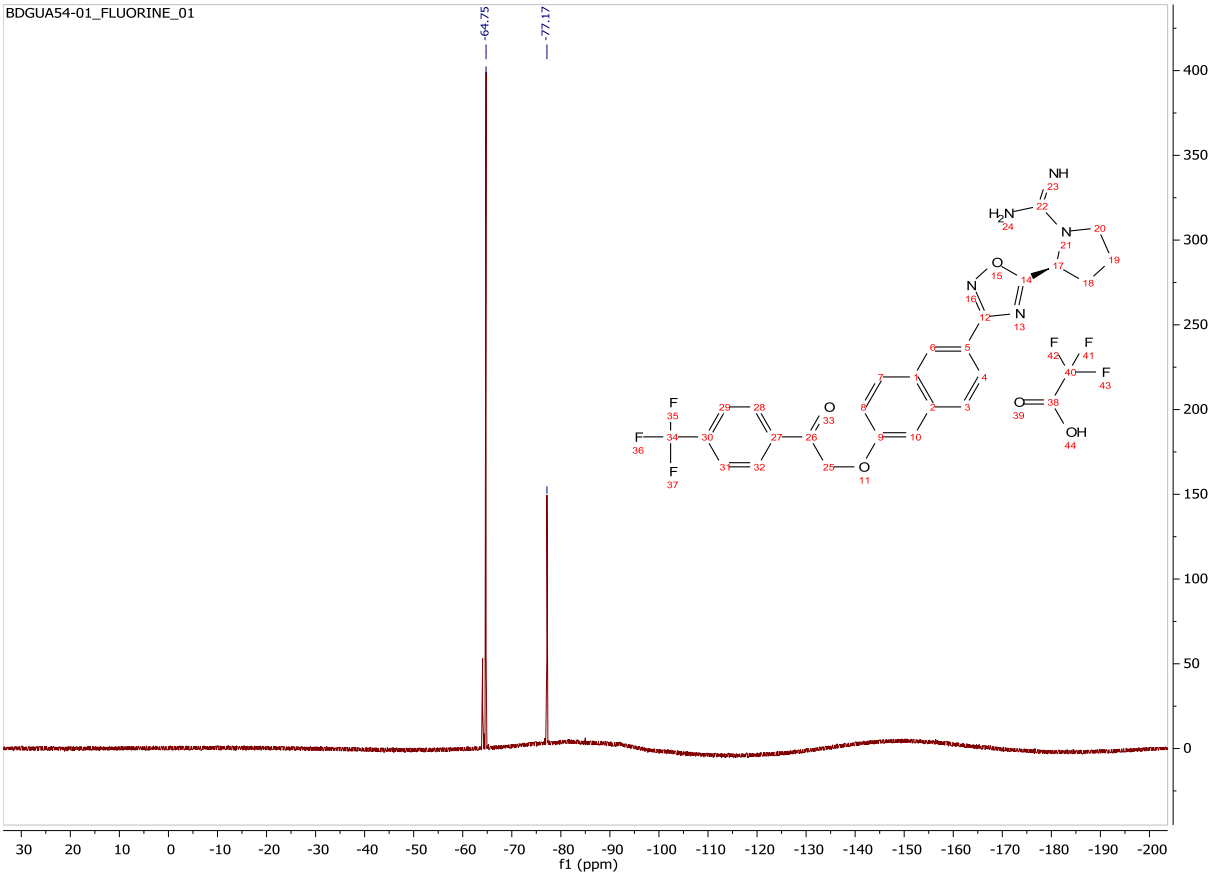
^{13}C-NMR Spectrum for 3.7z:



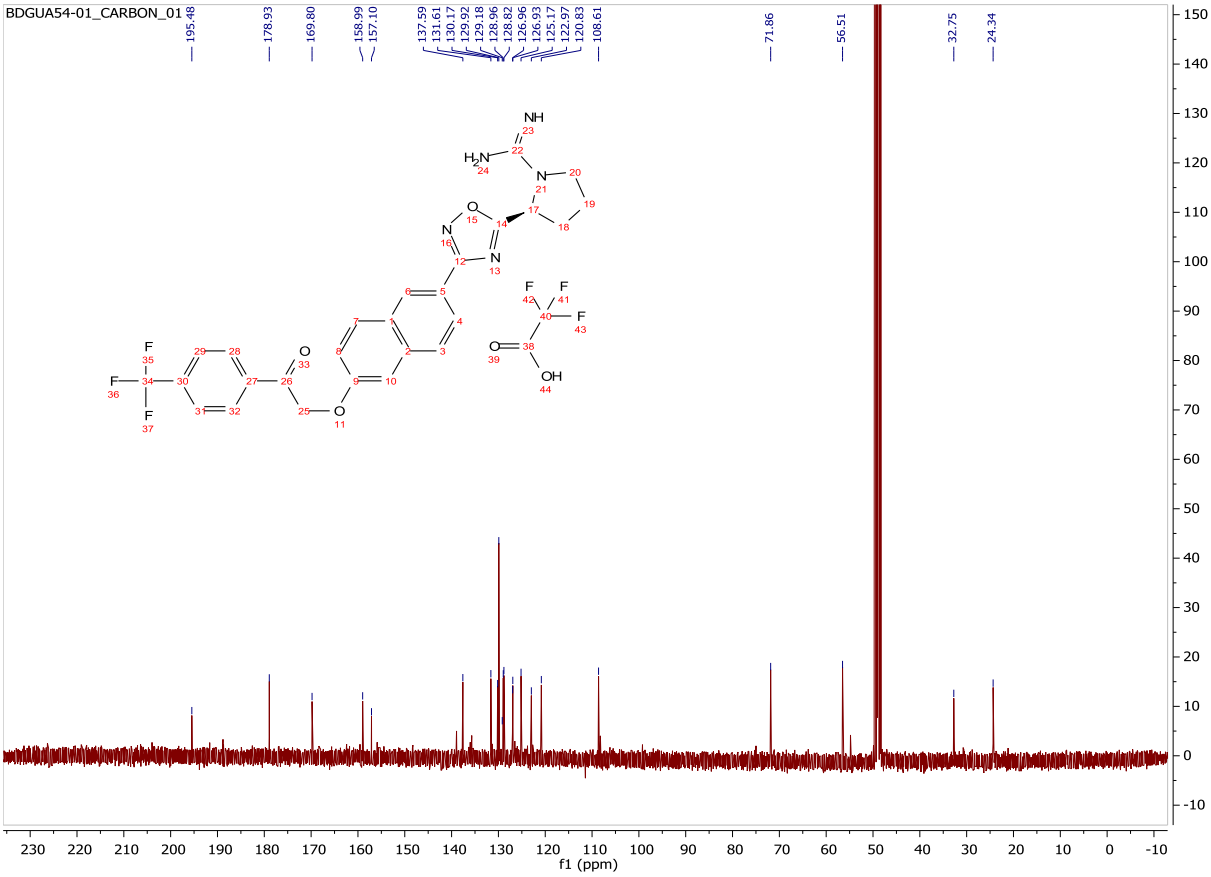
^{1}H-NMR Spectrum for 3.7aa:



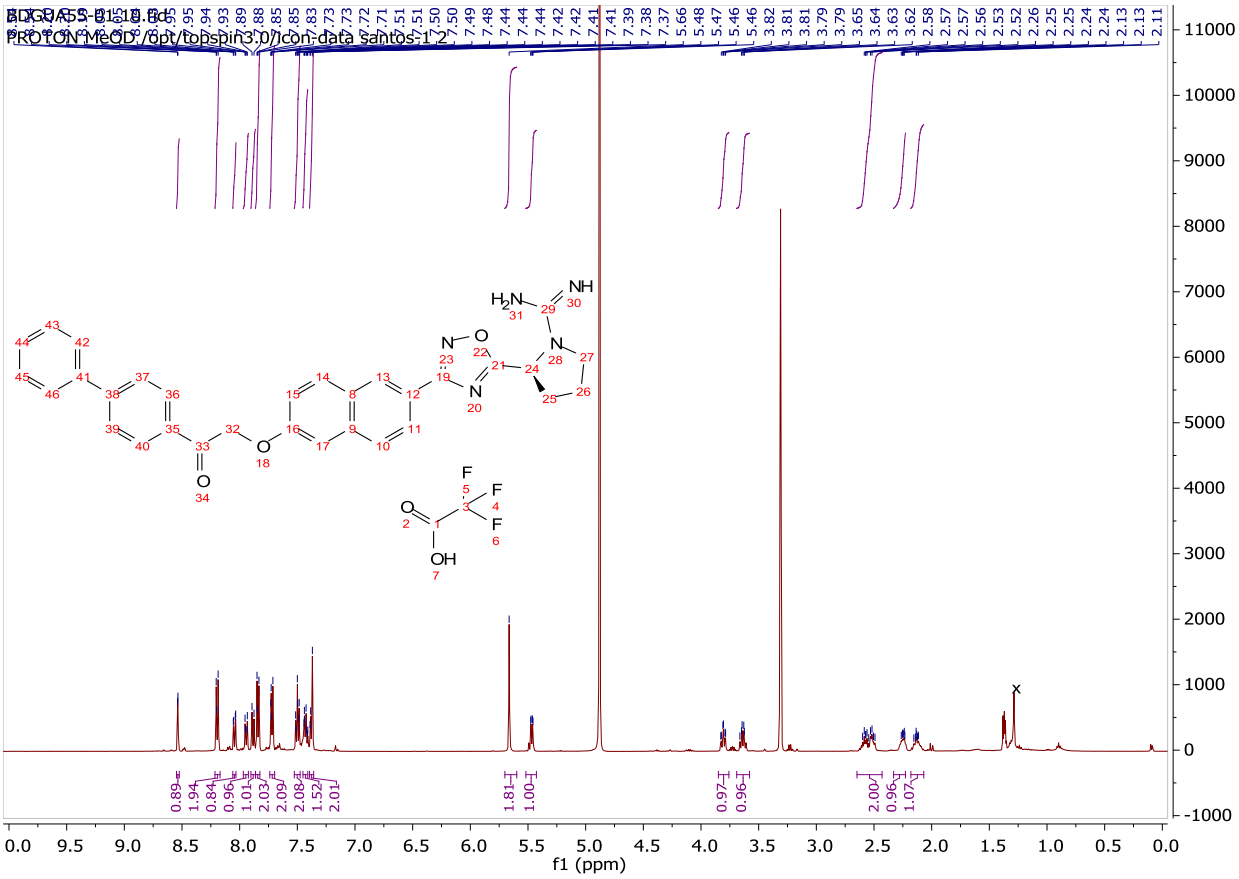
^{19}F-NMR Spectrum for 3.7aa:



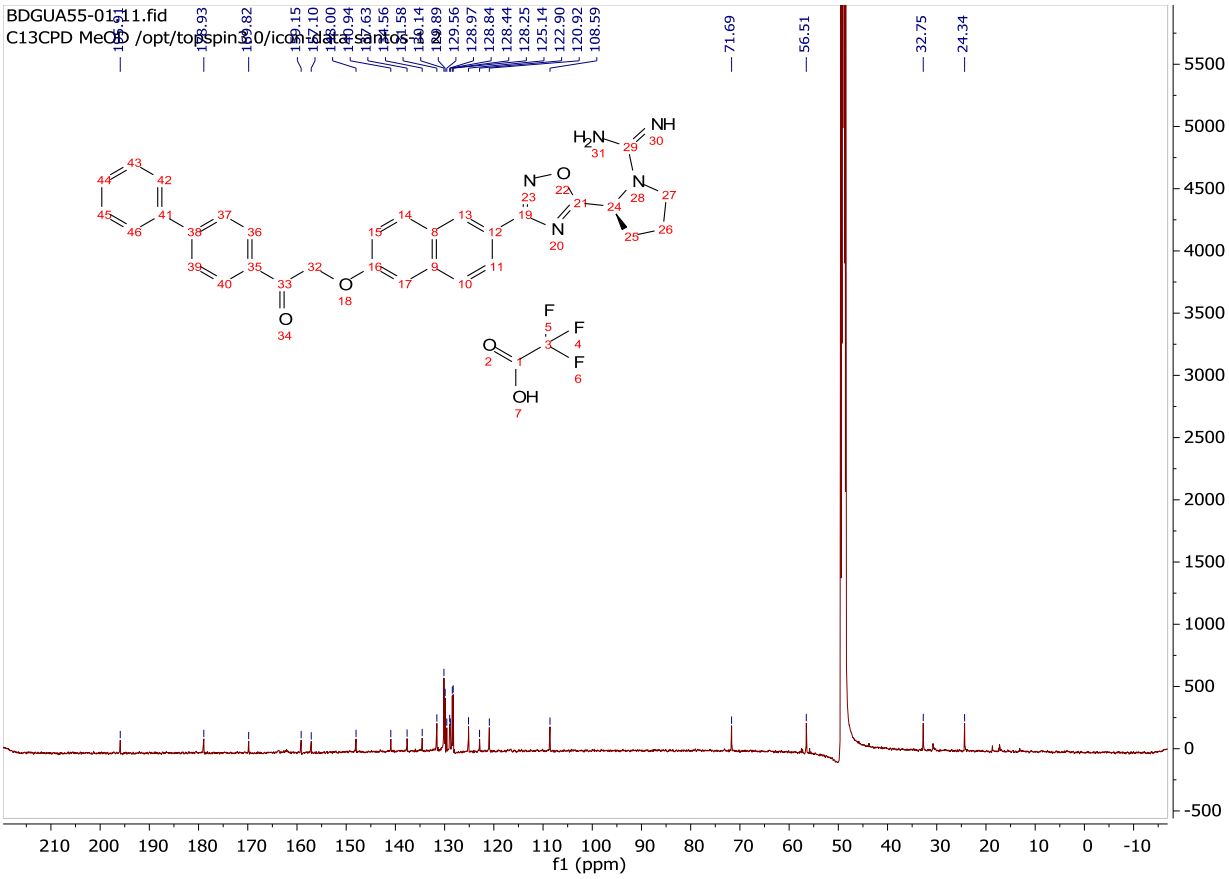
^{13}C-NMR Spectrum for 3.7aa:



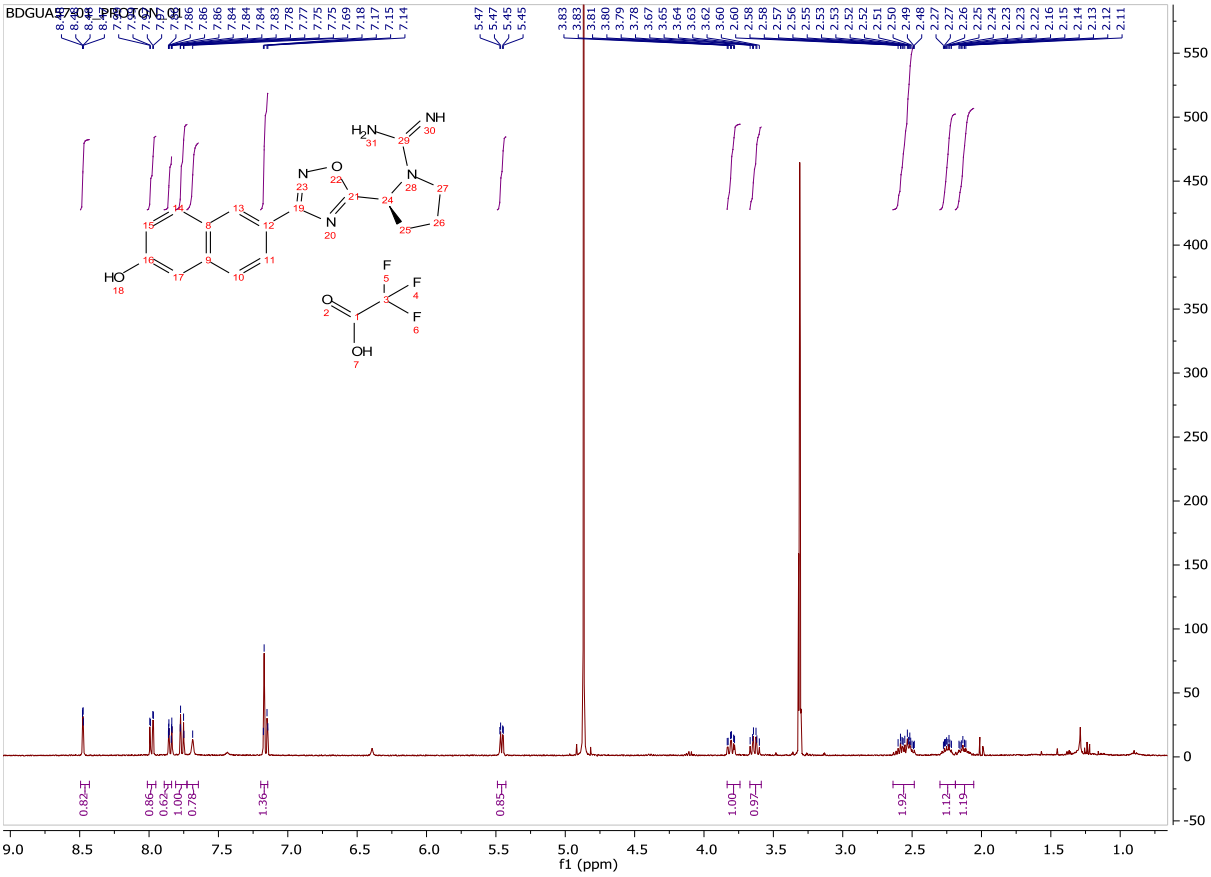
^{1}H-NMR Spectrum for 3.7ab:



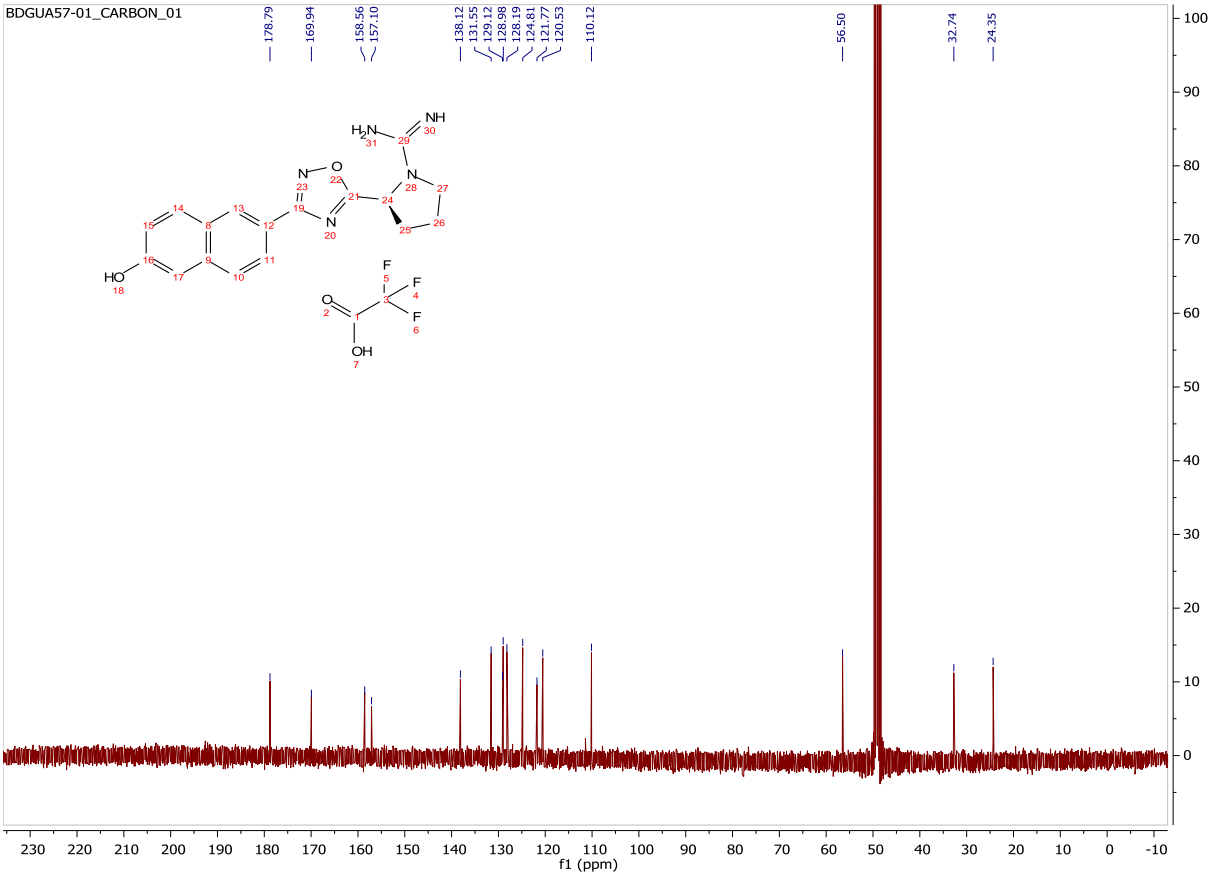
^{13}C-NMR Spectrum for 3.7ab:



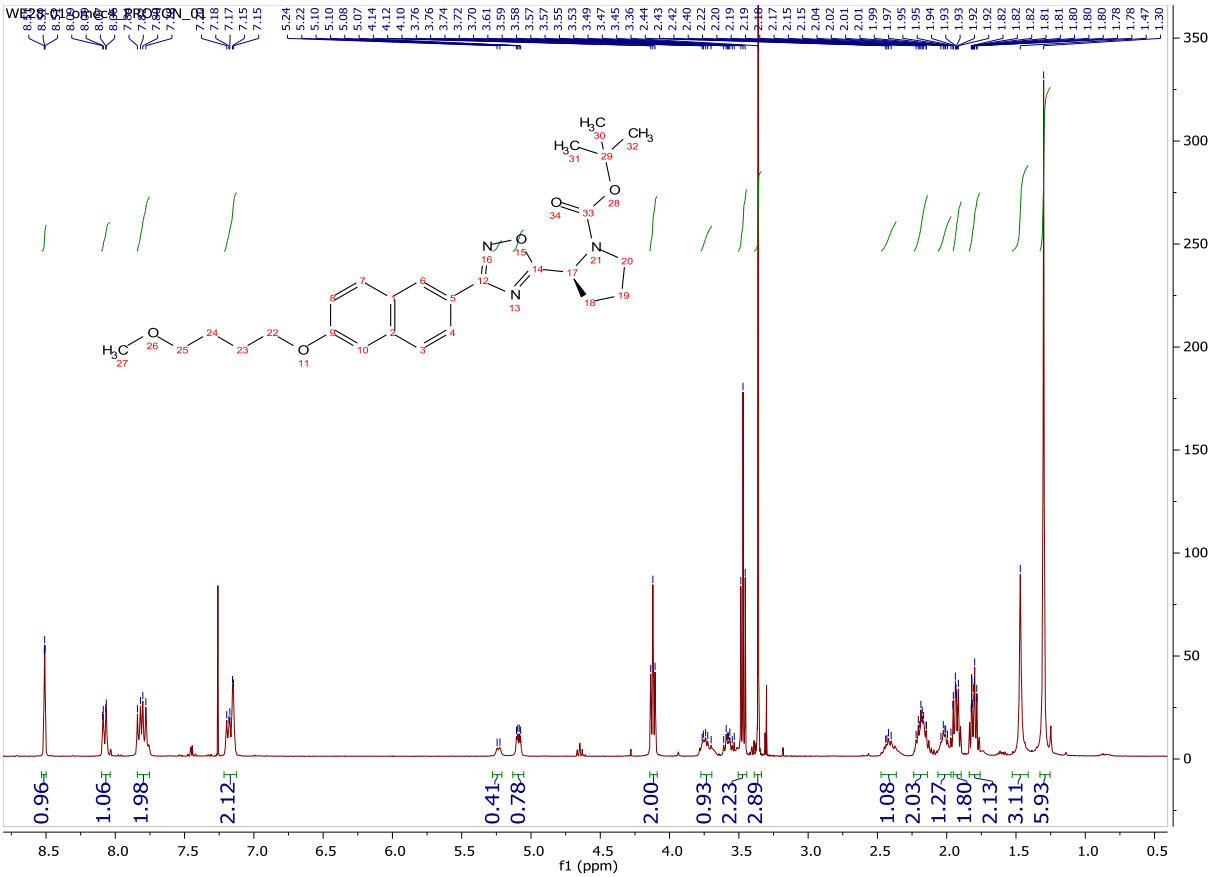
^{1}H-NMR Spectrum for 3.7ac:



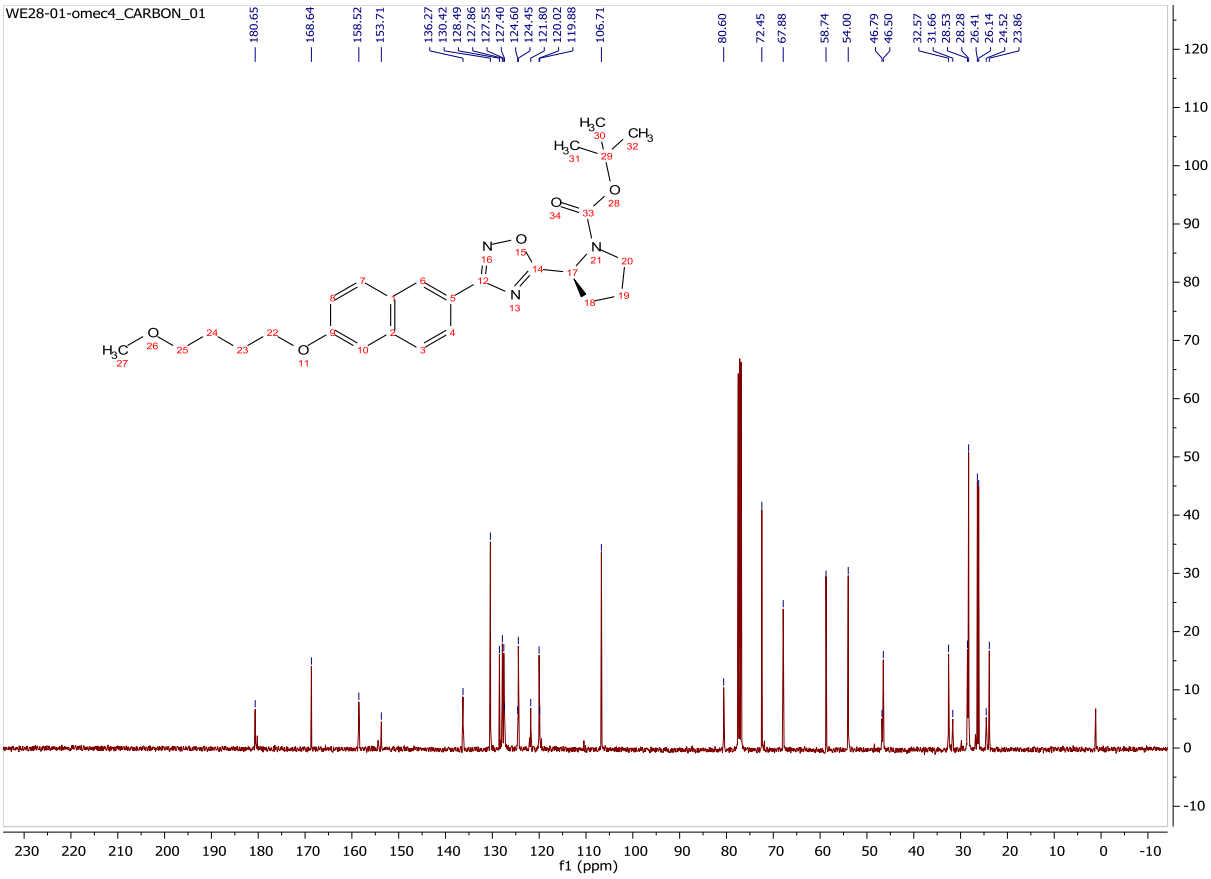
^{13}C-NMR Spectrum for 3.7ac:



^{1}H-NMR Spectrum for 3.12:

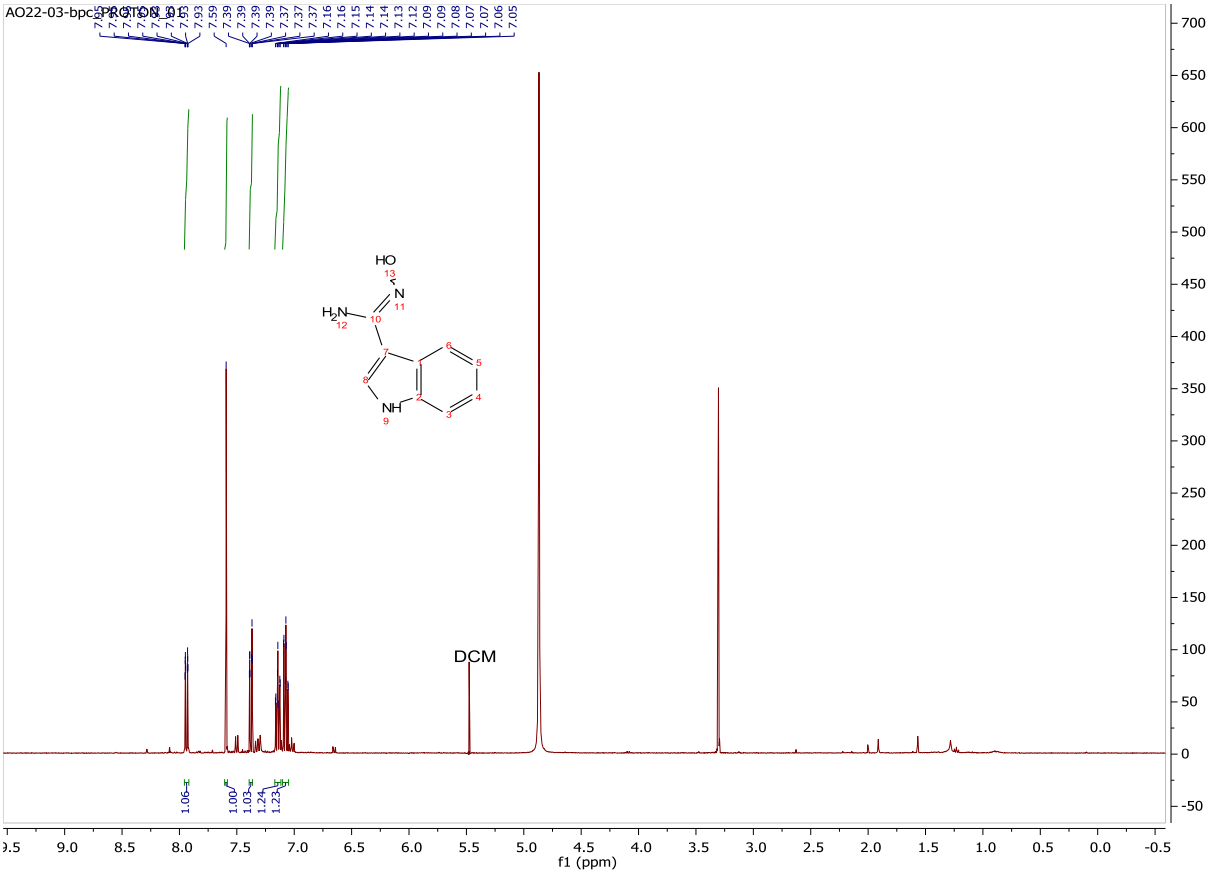


^{13}C-NMR Spectrum for 3.12:

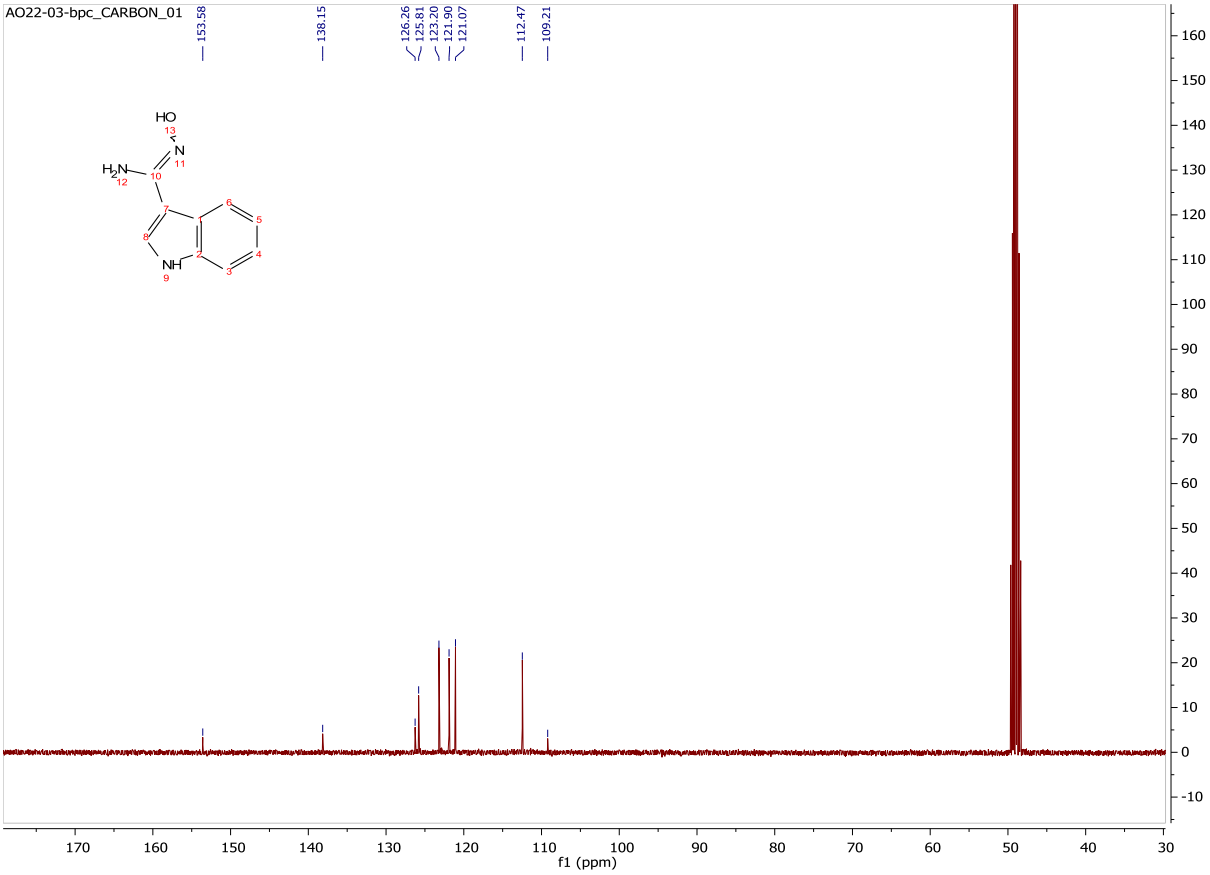


Appendix C NMR Spectra for Chapter 4

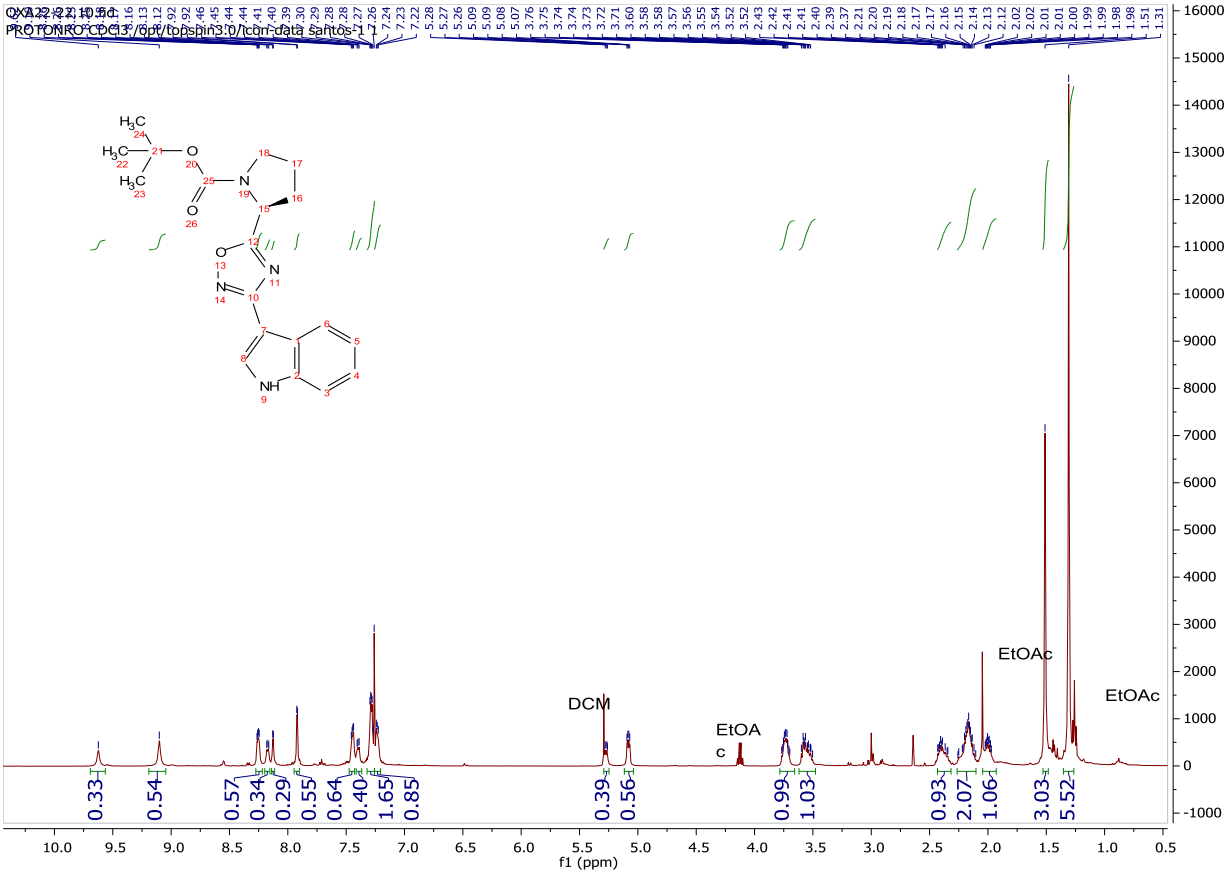
^{1}H-NMR Spectrum for Compound 4.2:



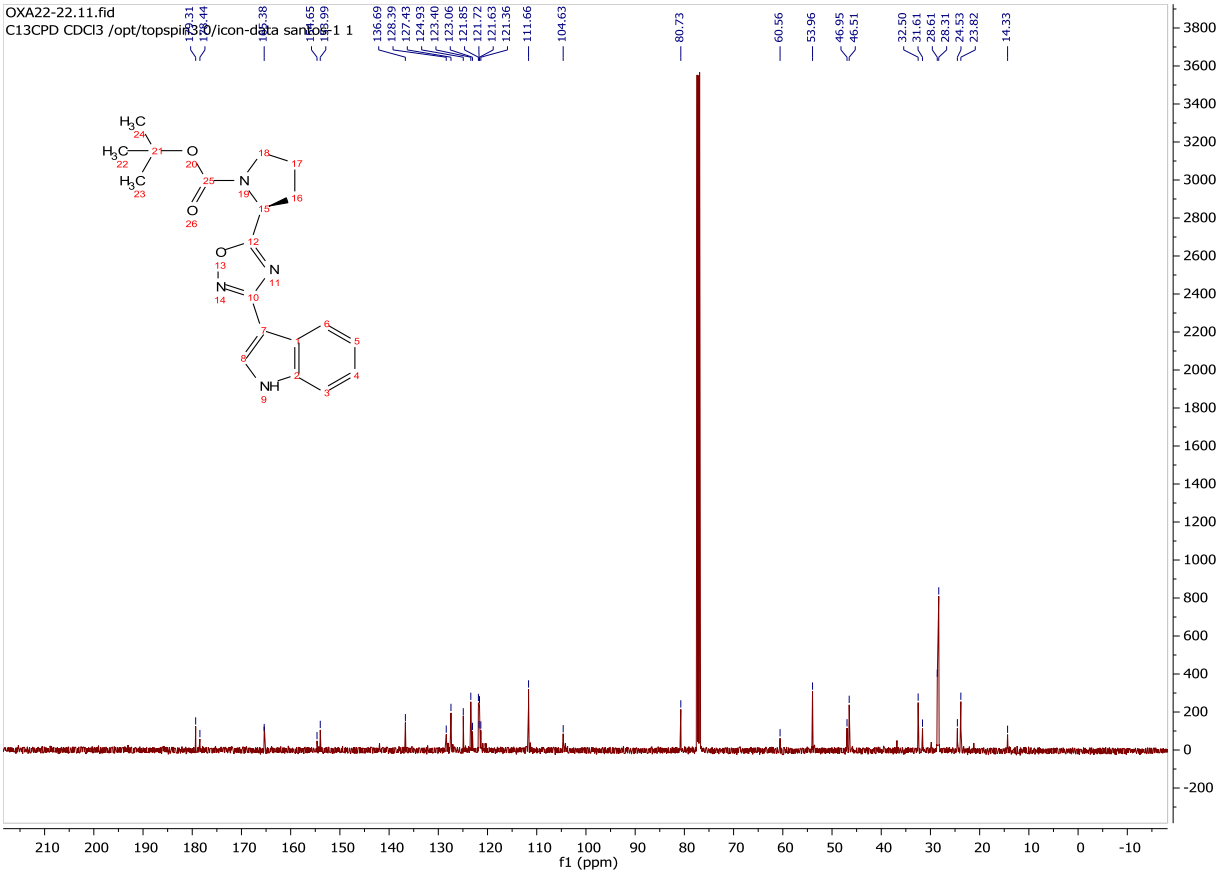
^{13}C-NMR Spectrum for Compound 4.2:



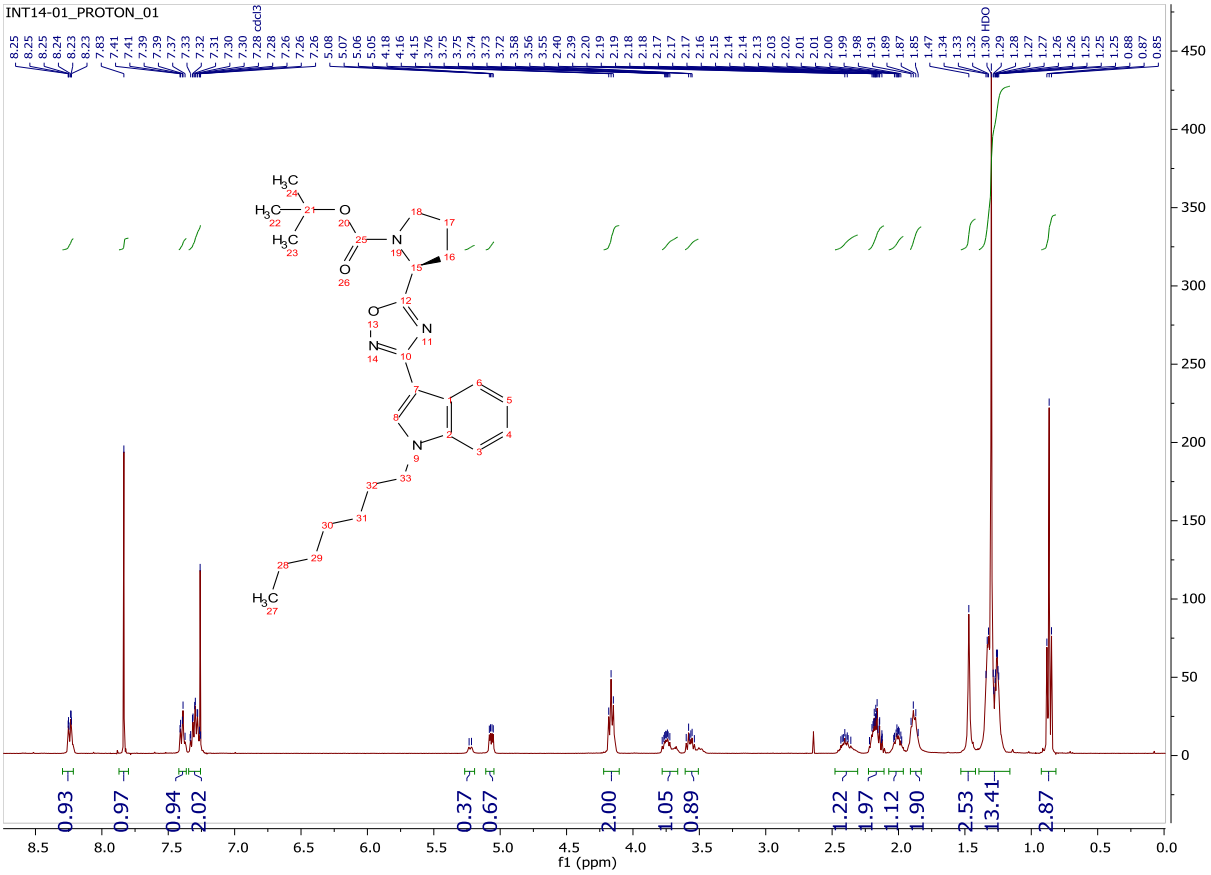
^{1}H-NMR Spectrum for Compound 4.3:



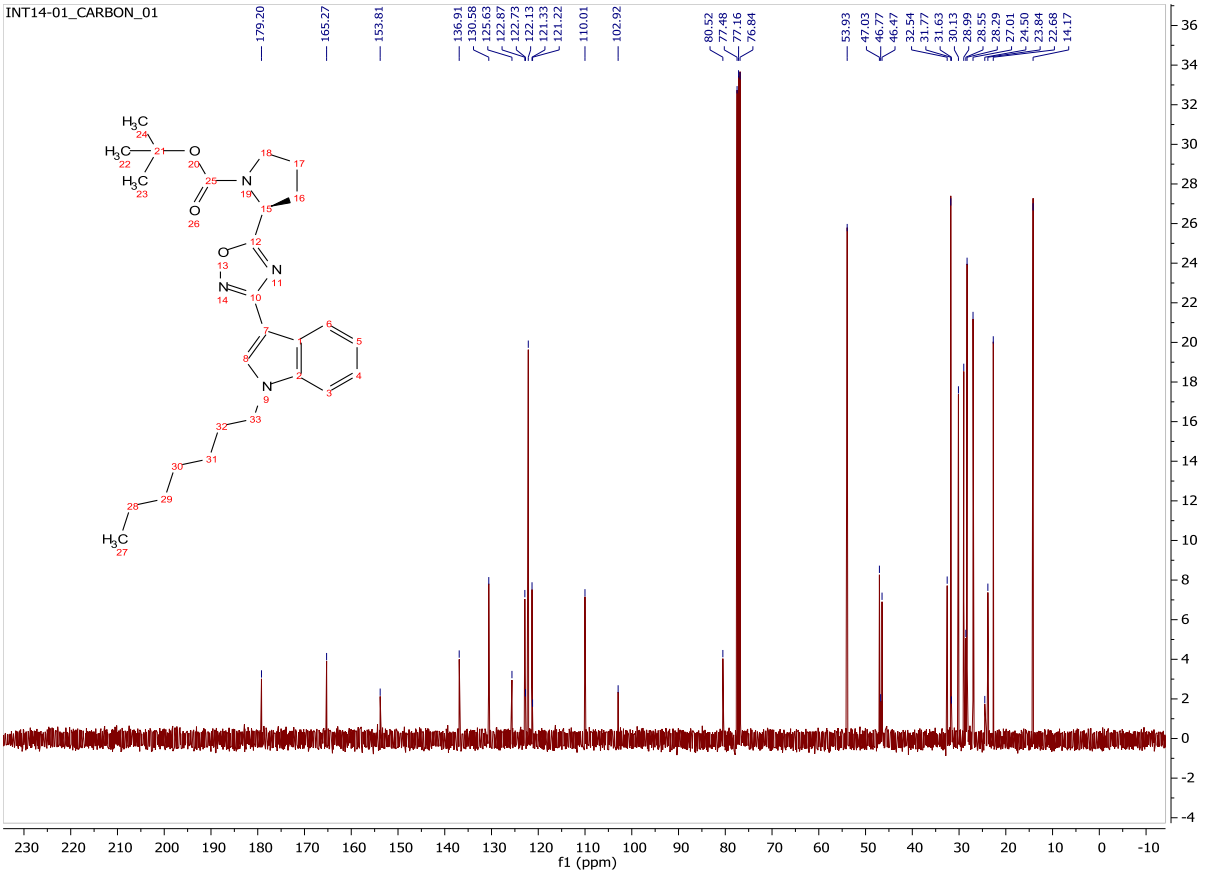
^{13}C-NMR Spectrum for Compound 4.3:



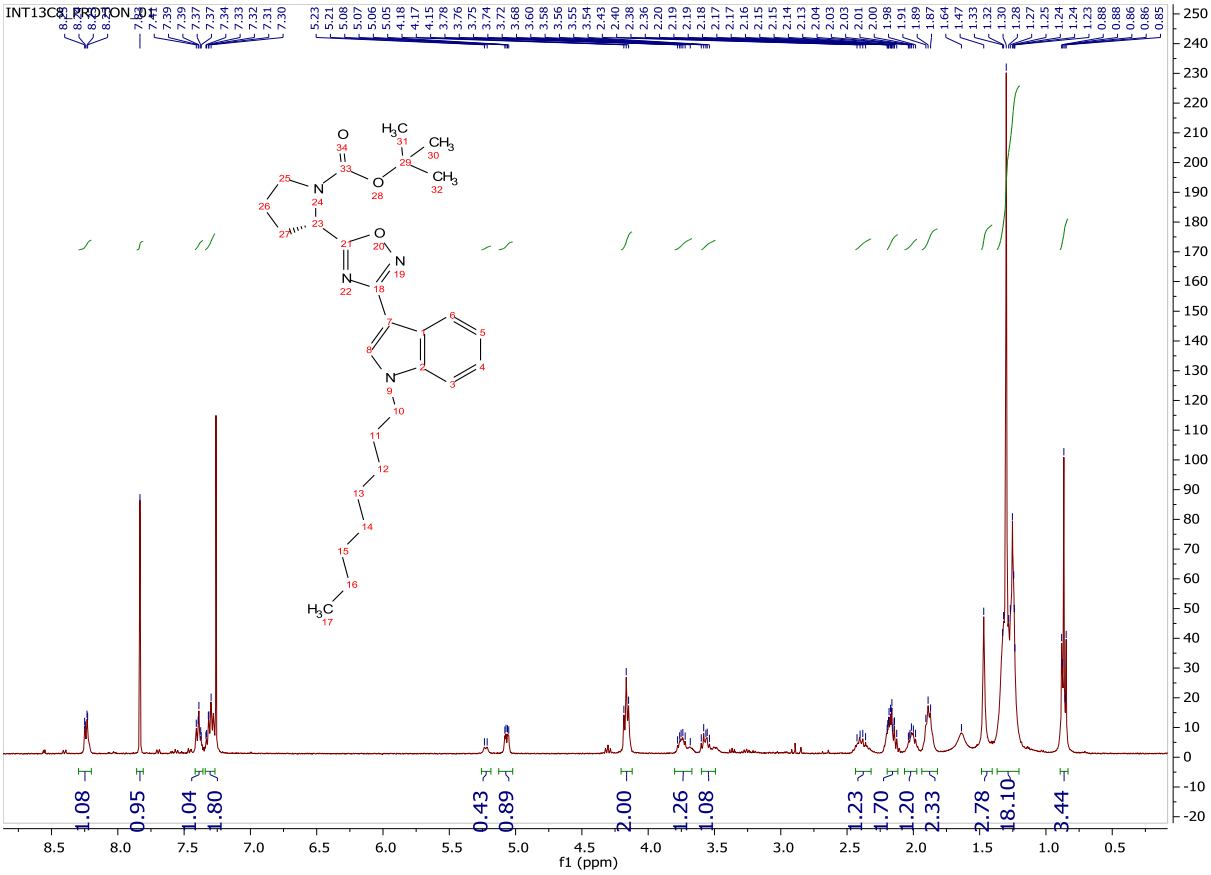
^{1}H-NMR Spectrum for Compound 4.4a:



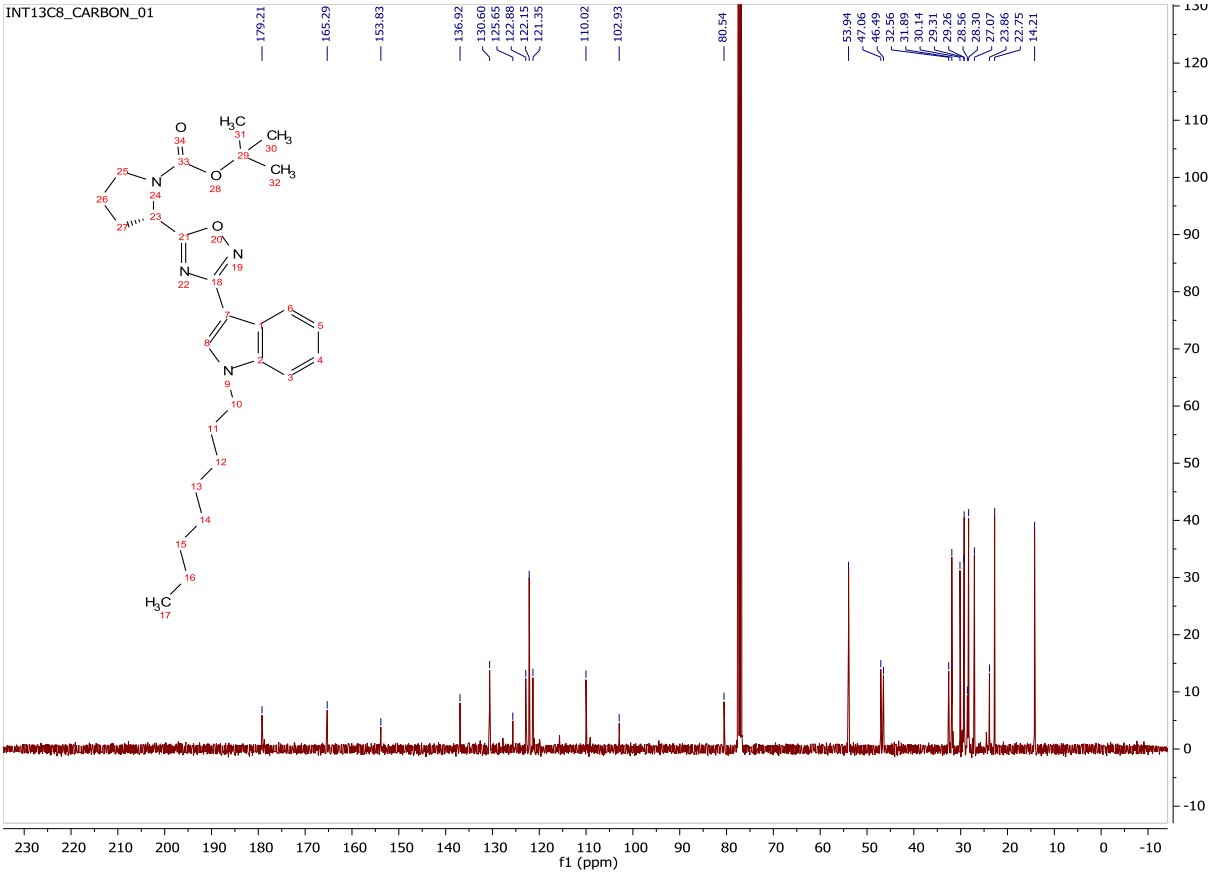
^{13}C-NMR Spectrum for Compound 4.4a:



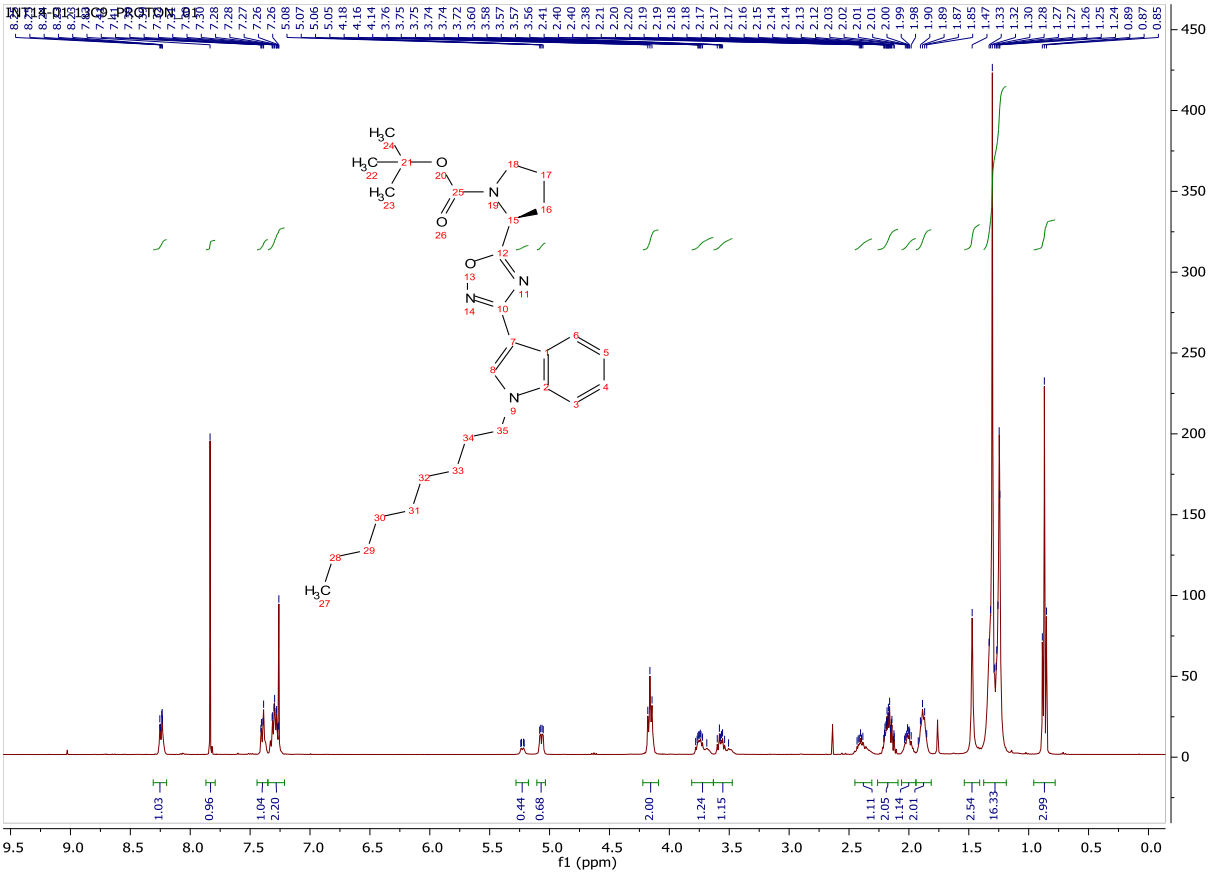
^{1}H-NMR Spectrum for Compound 4.4b:



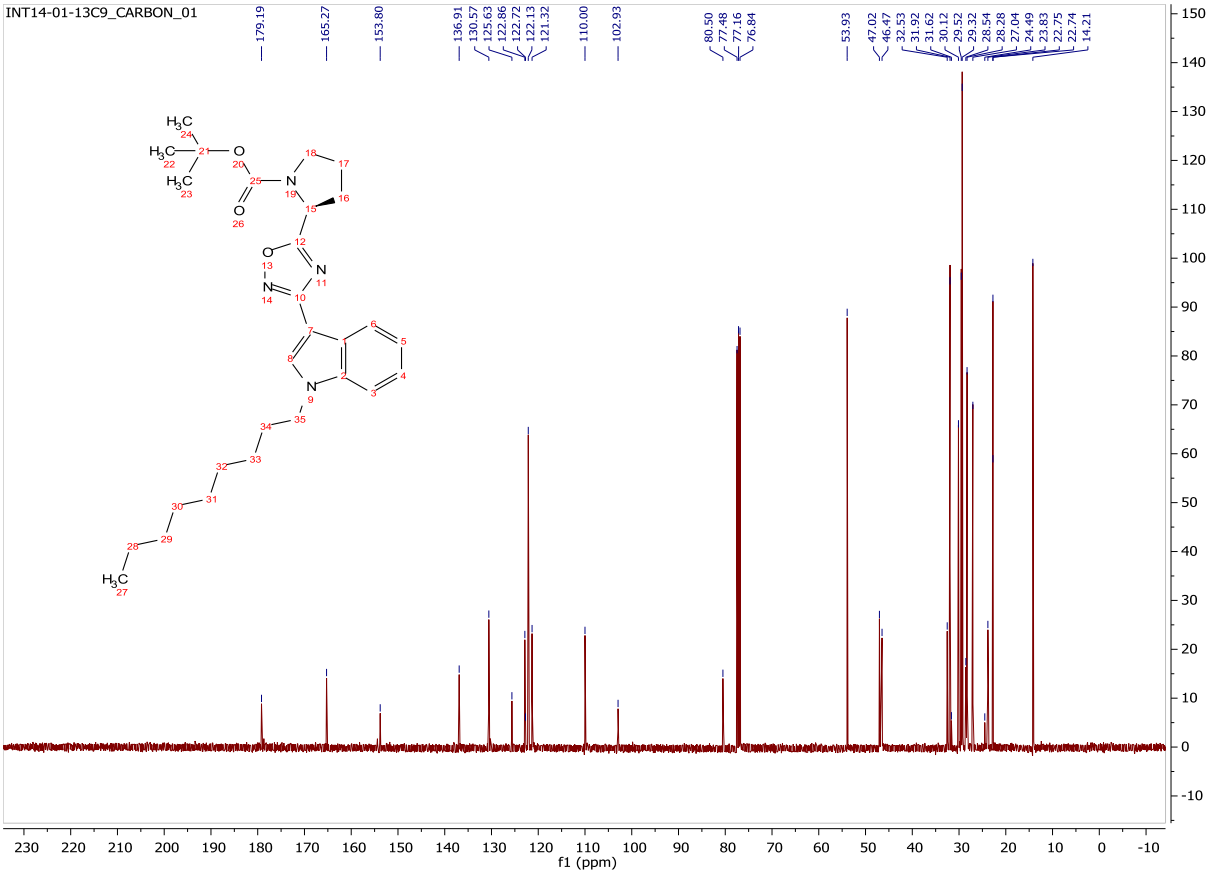
^{13}C-NMR Spectrum for Compound 4.4b:



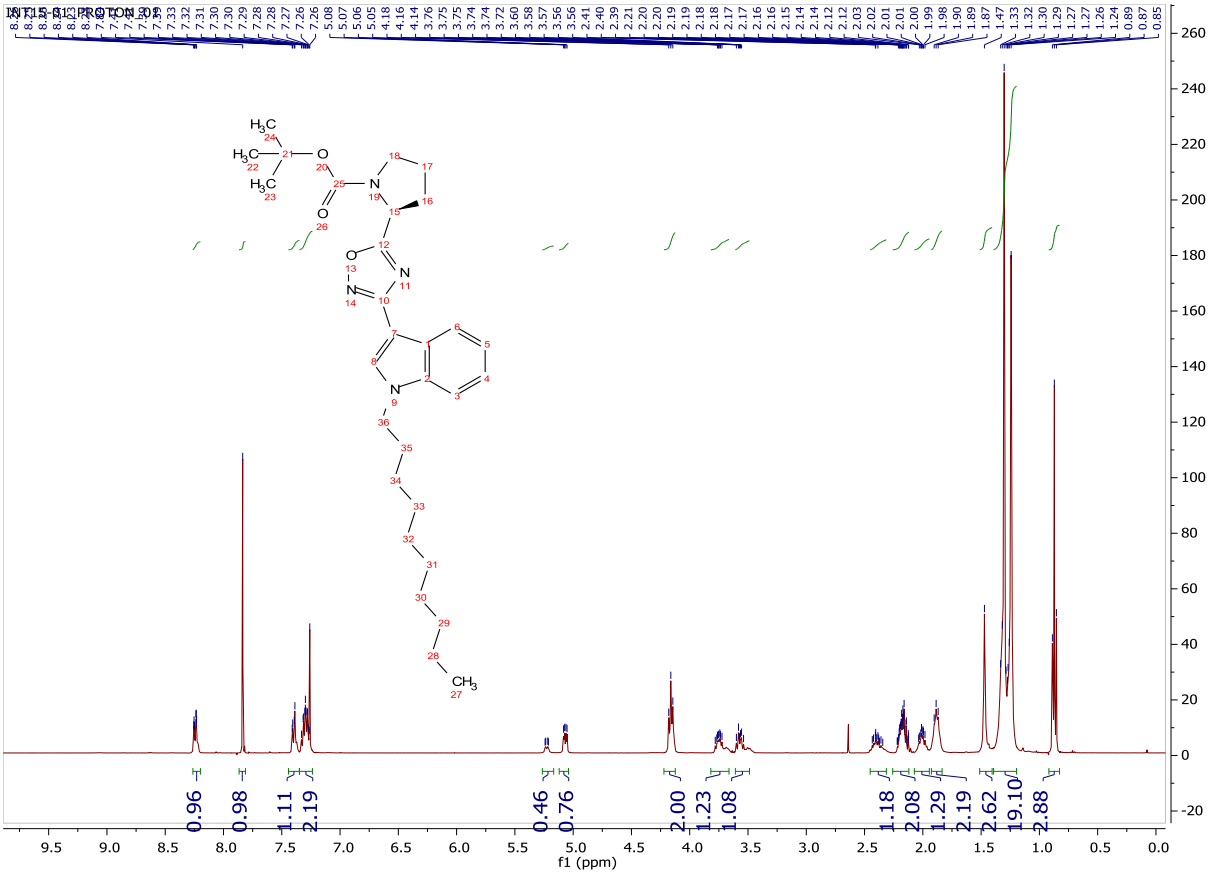
^{1}H-NMR Spectrum for Compound 4.4c:



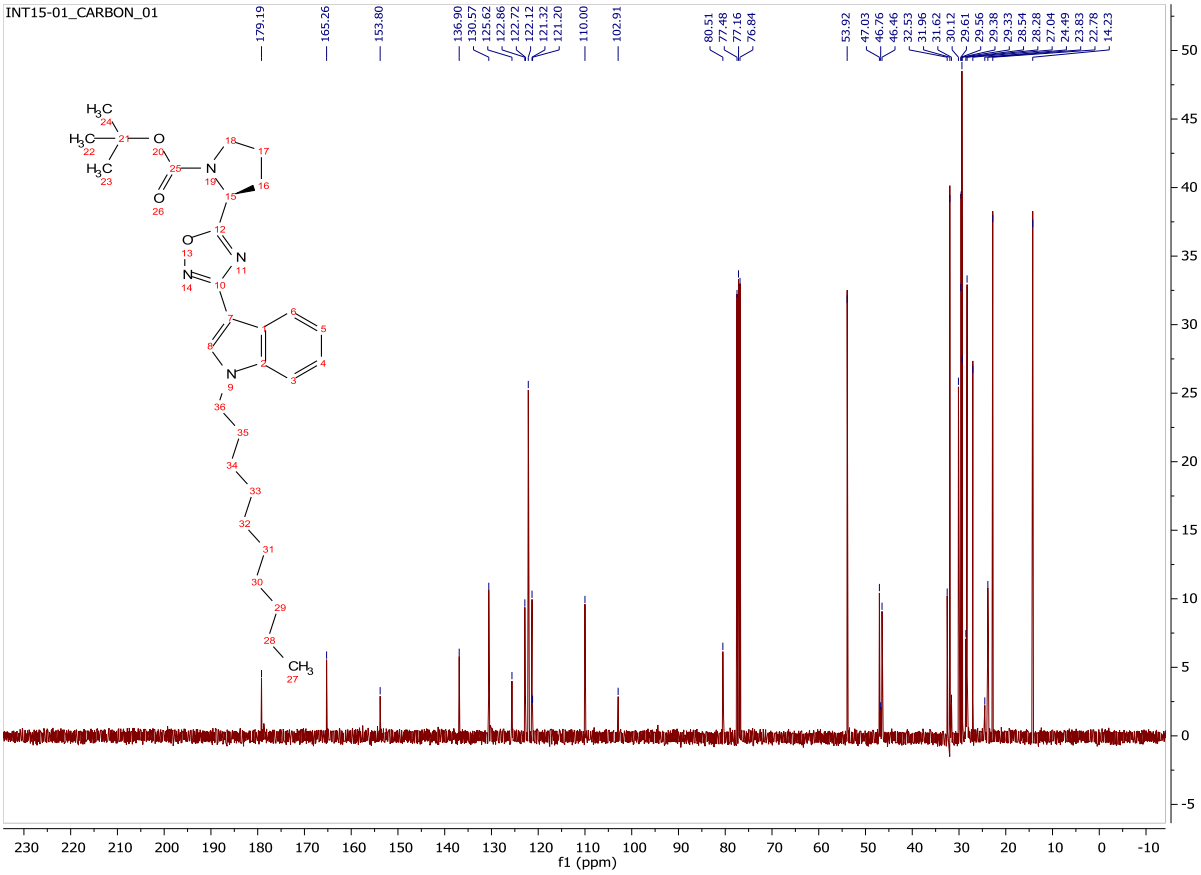
^{13}C-NMR Spectrum for Compound 4.4c:



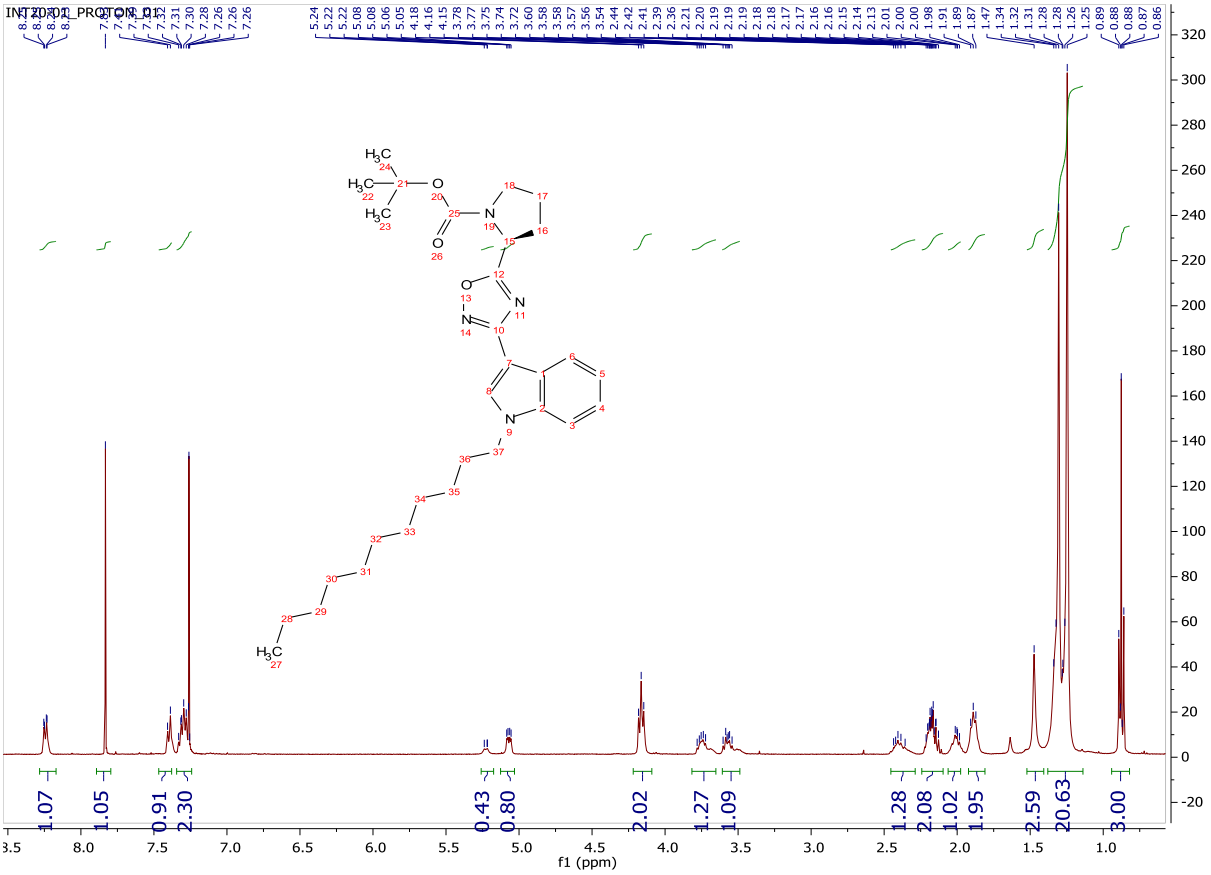
^{1}H-NMR Spectrum for Compound 4.4d:



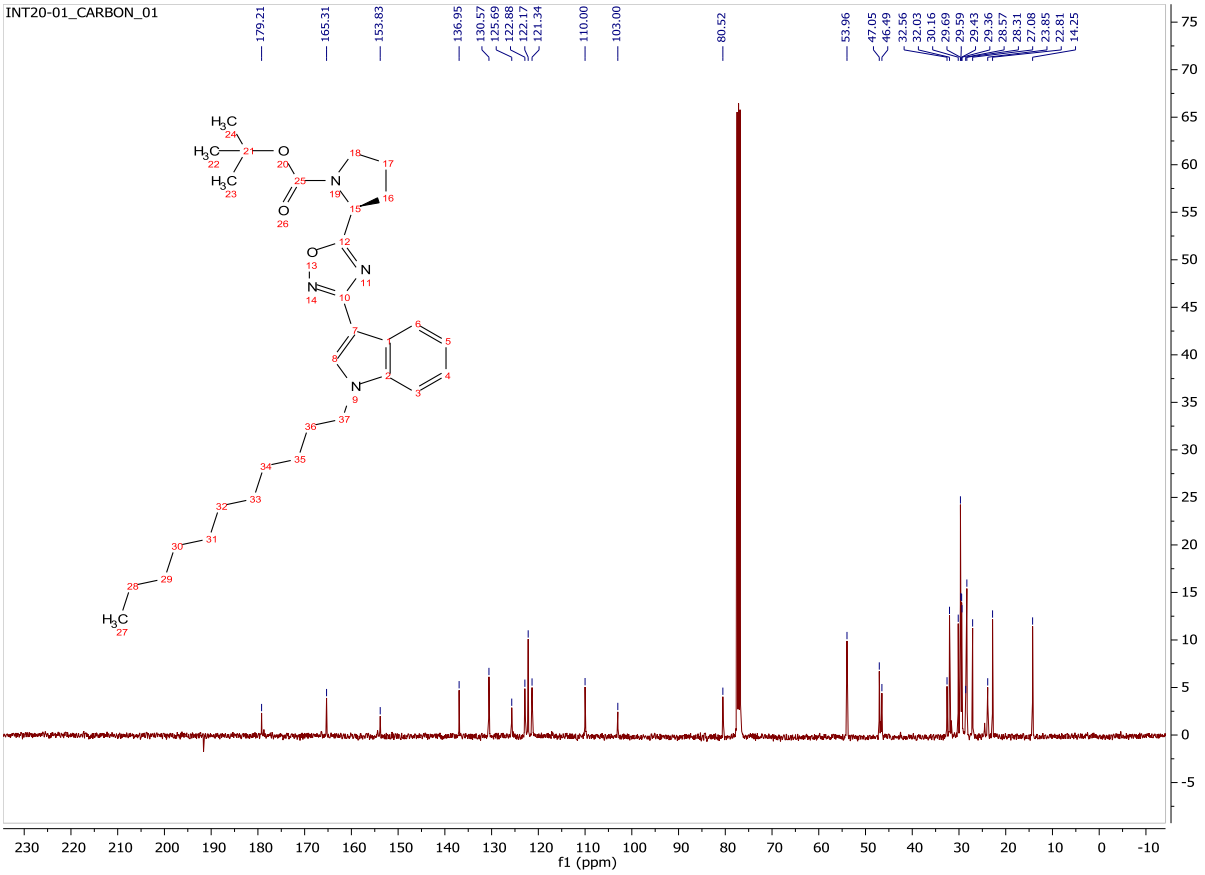
^{13}C-NMR Spectrum for Compound 4.4d:



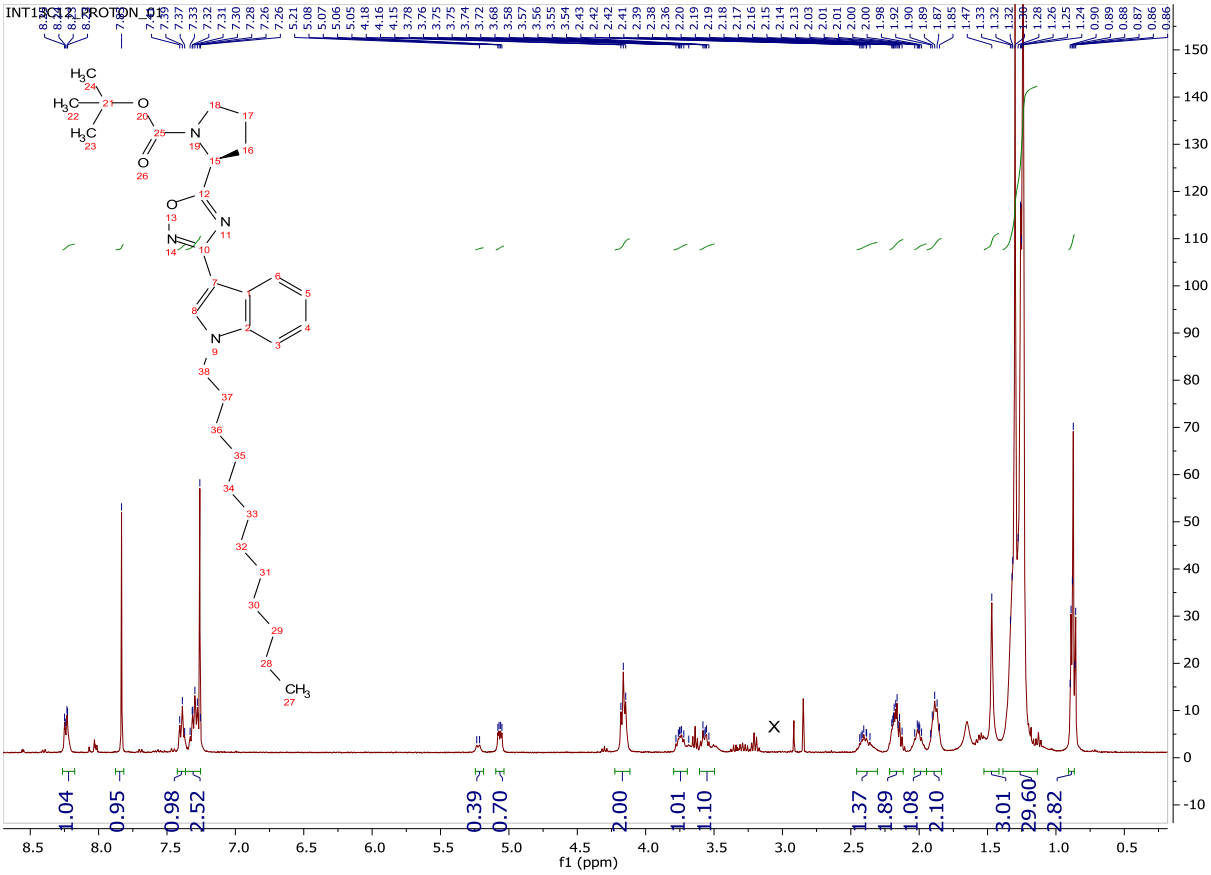
^{1}H-NMR Spectrum for Compound 4.4e:



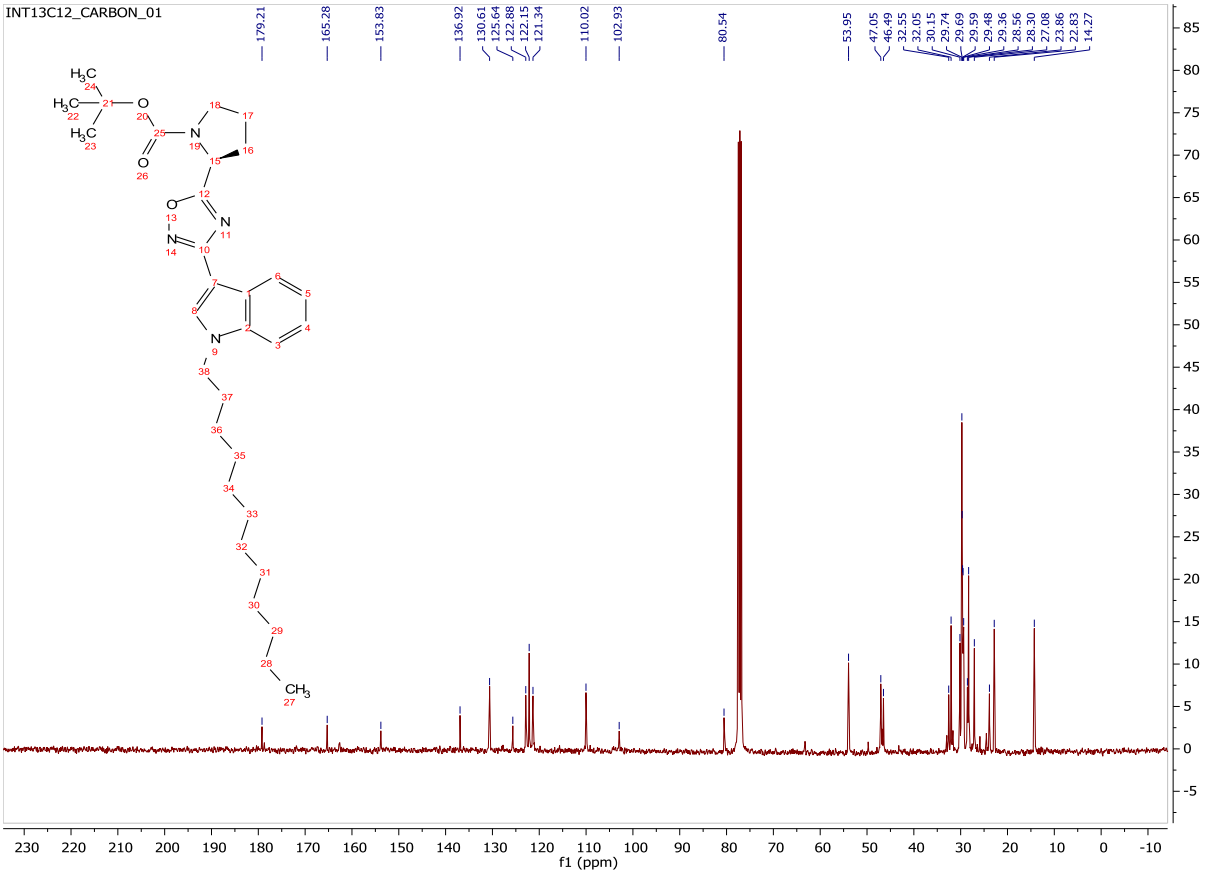
^{13}C-NMR Spectrum for Compound 4.4e:



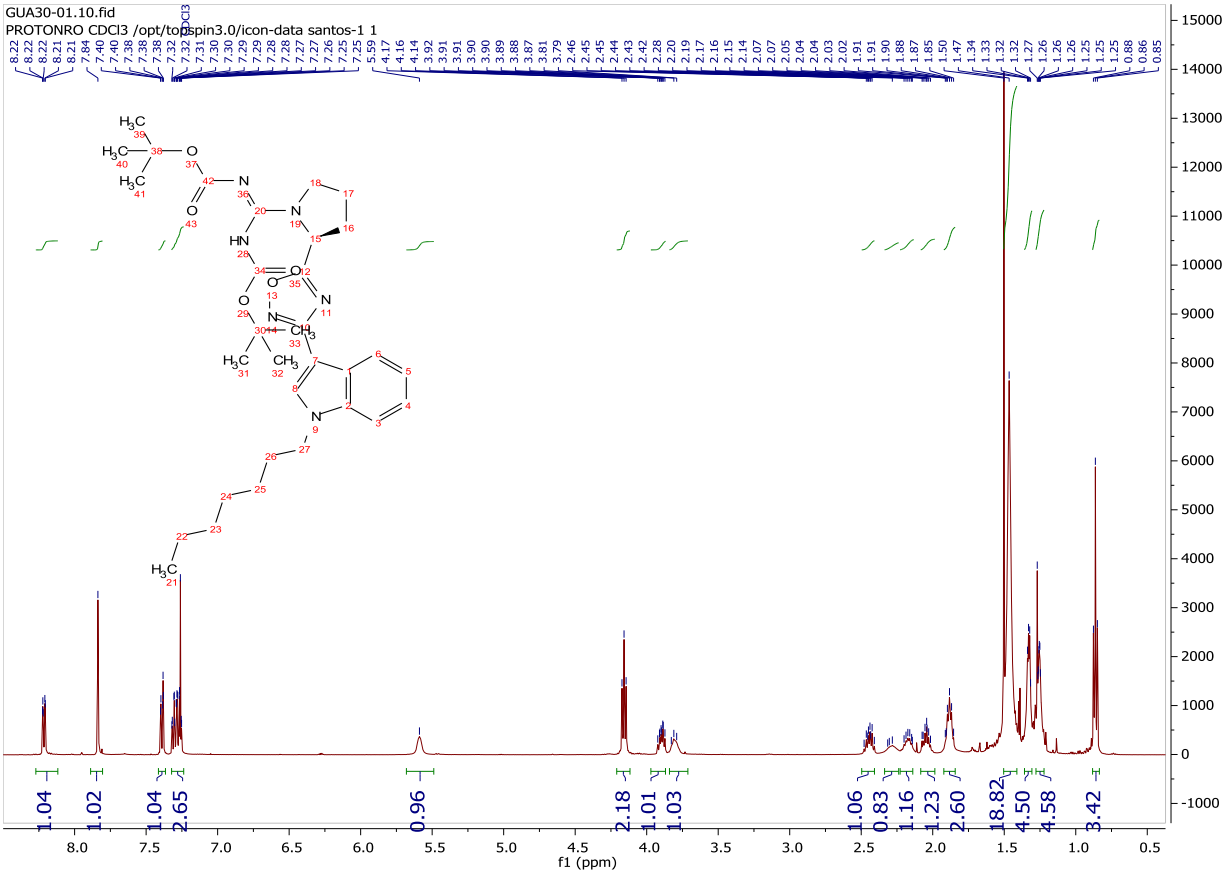
^{1}H-NMR Spectrum for Compound 4.4f:



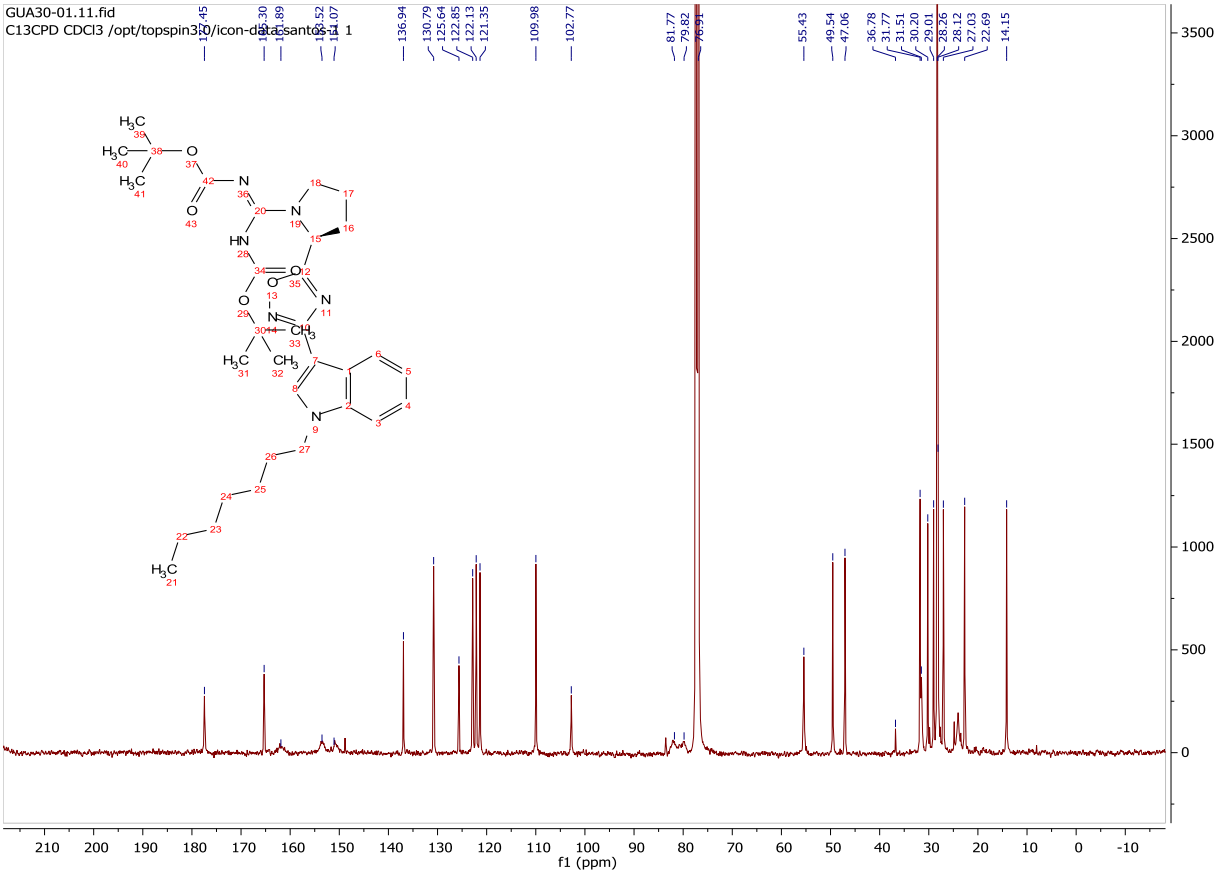
^{13}C-NMR Spectrum for Compound 4.4f:



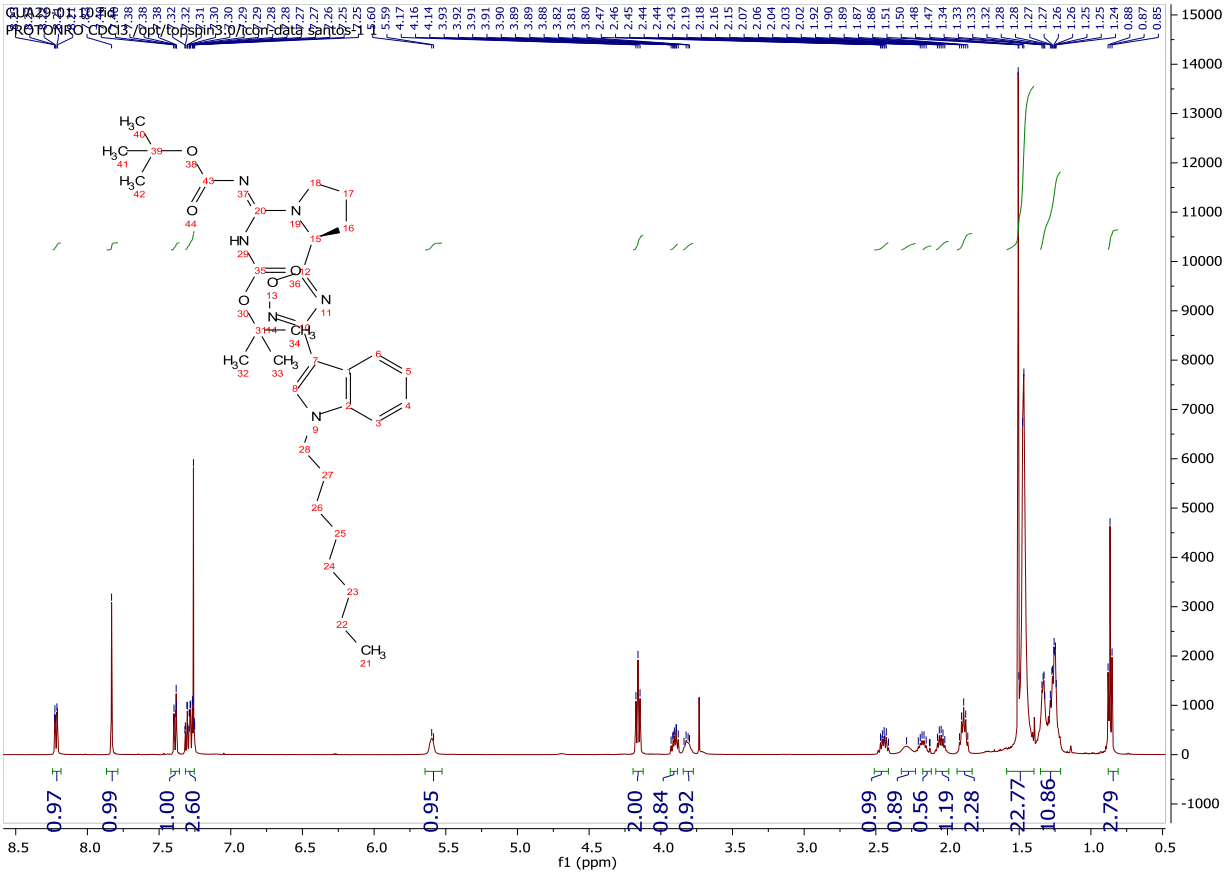
^{1}H-NMR Spectrum for Compound 4.6a:



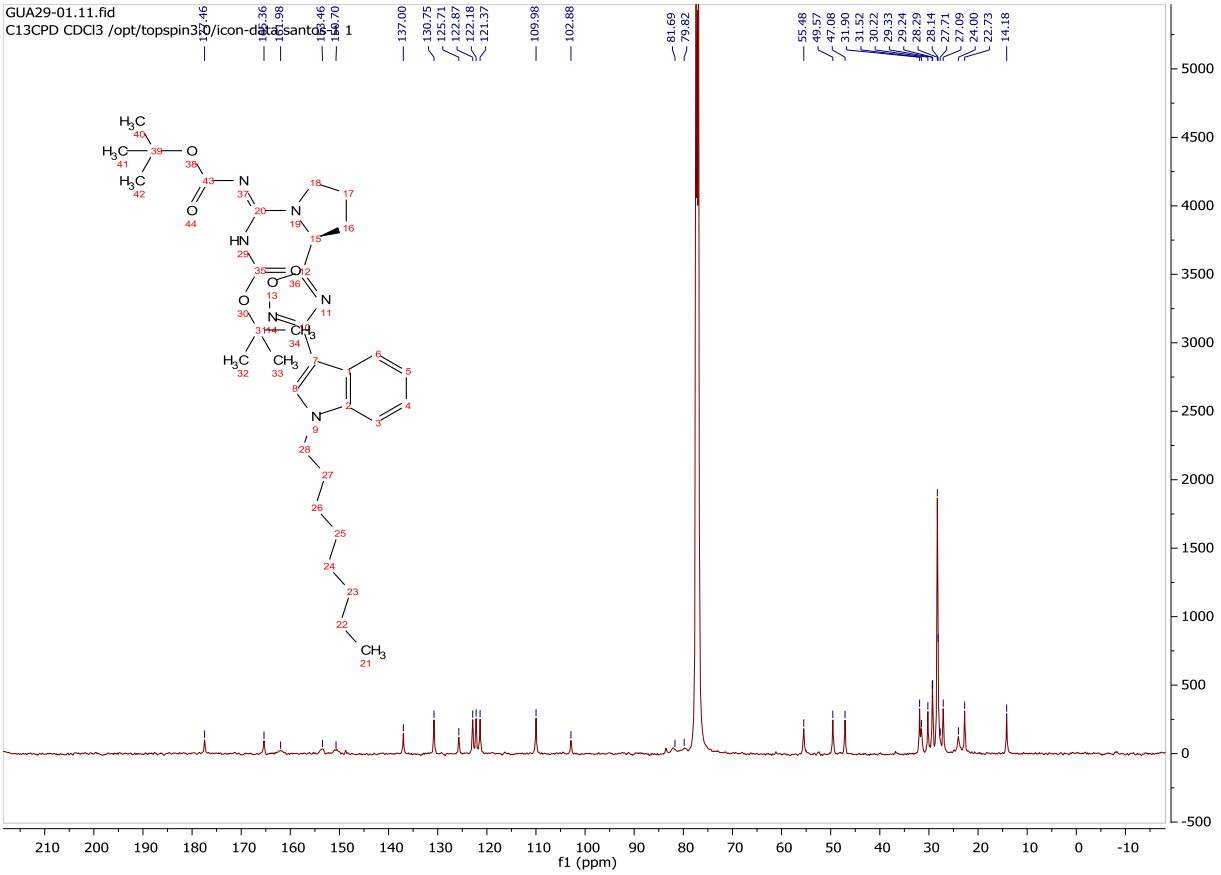
^{13}C-NMR Spectrum for Compound 4.6a:



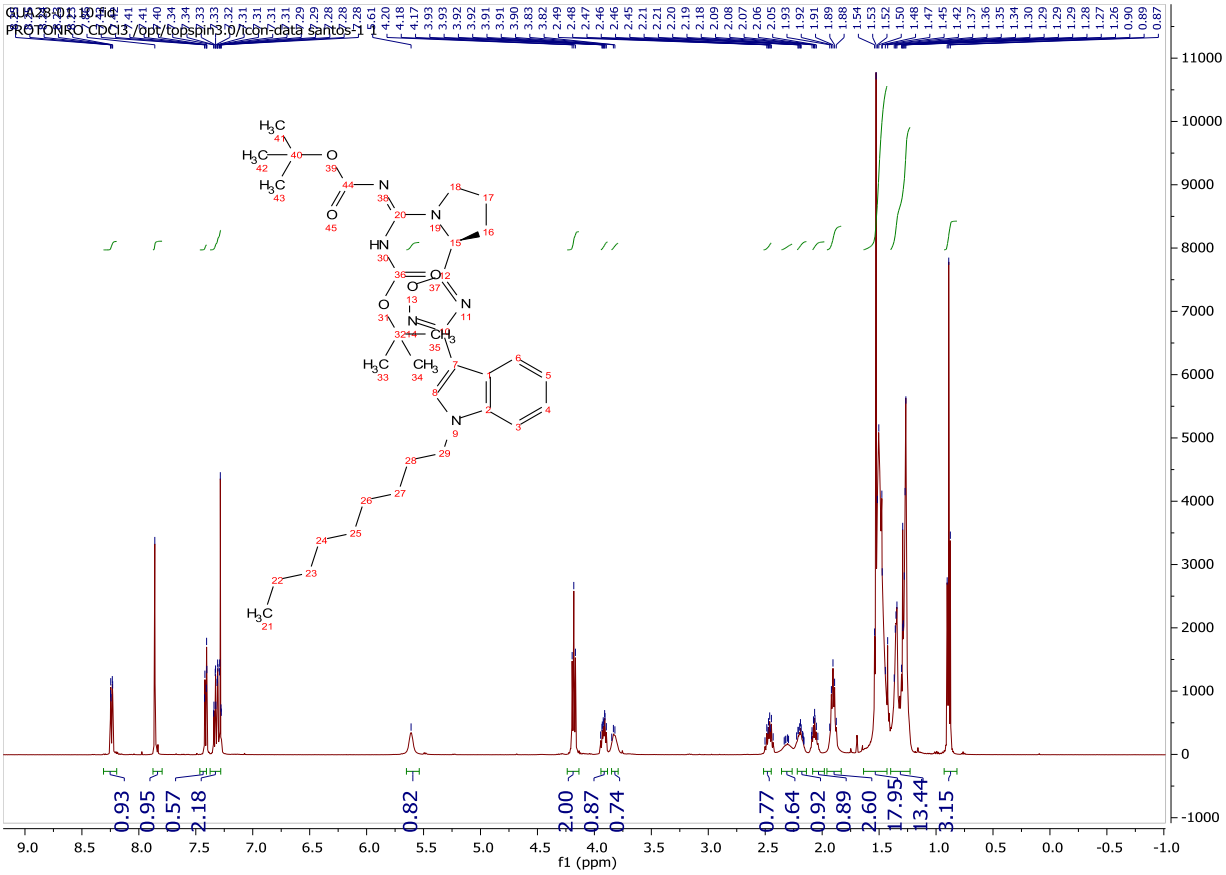
^{1}H-NMR Spectrum for Compound 4.6b:



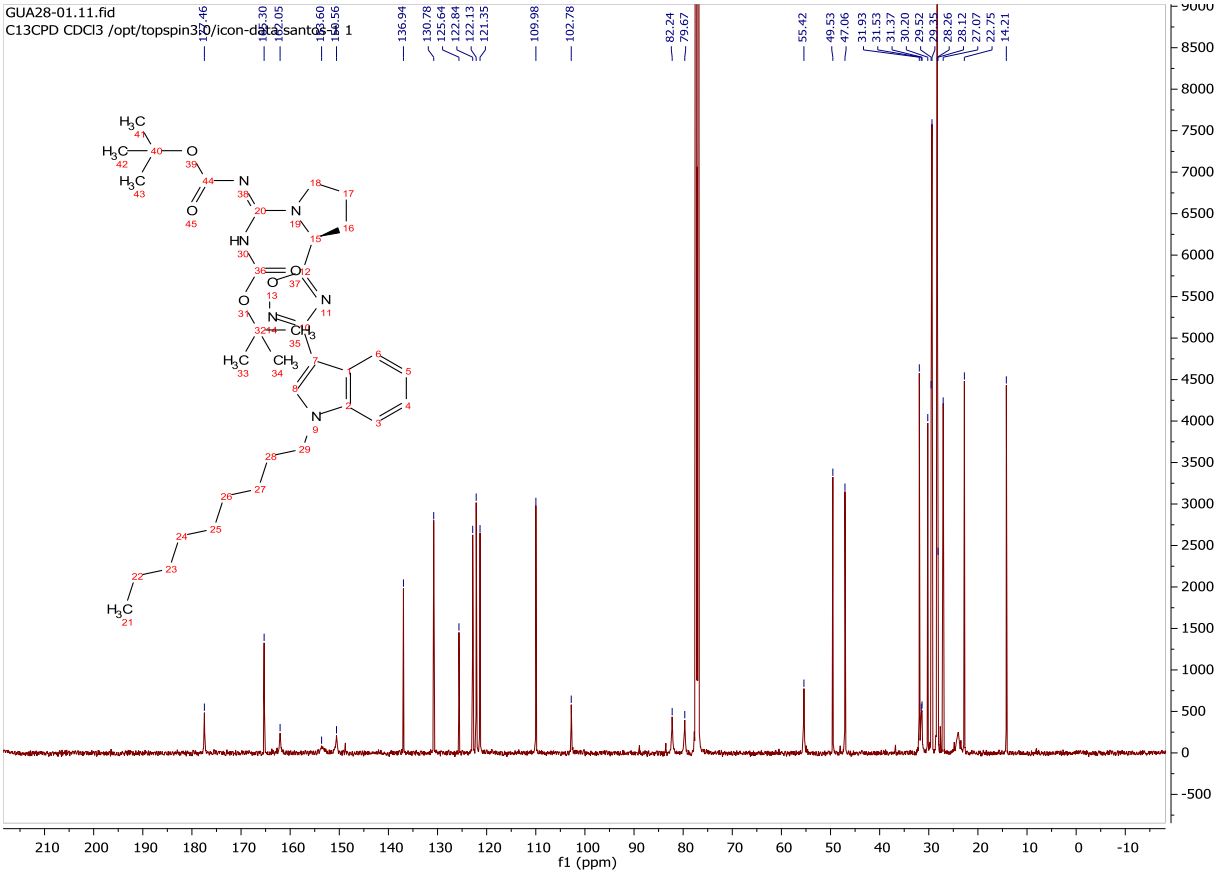
^{13}C-NMR Spectrum for Compound 4.6b:



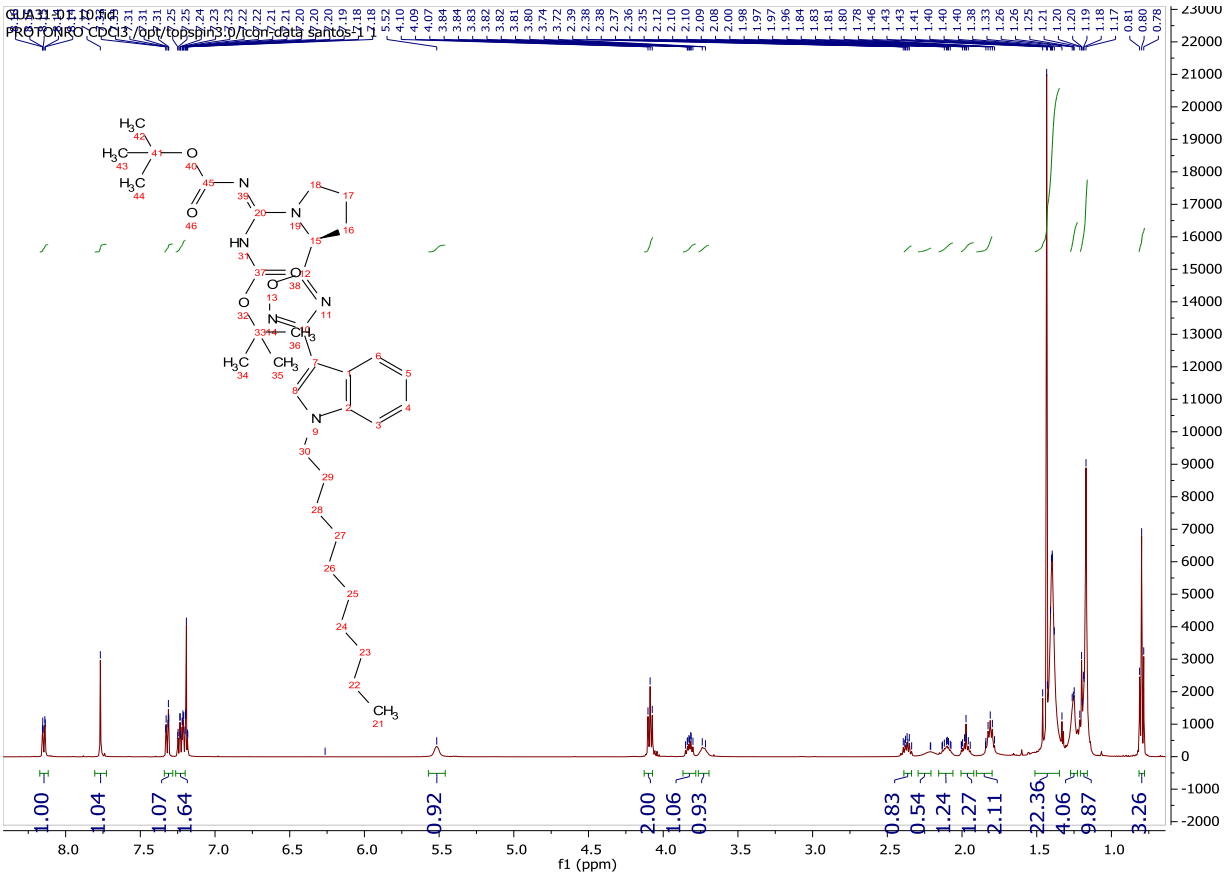
^{1}H-NMR Spectrum for Compound 4.6c:



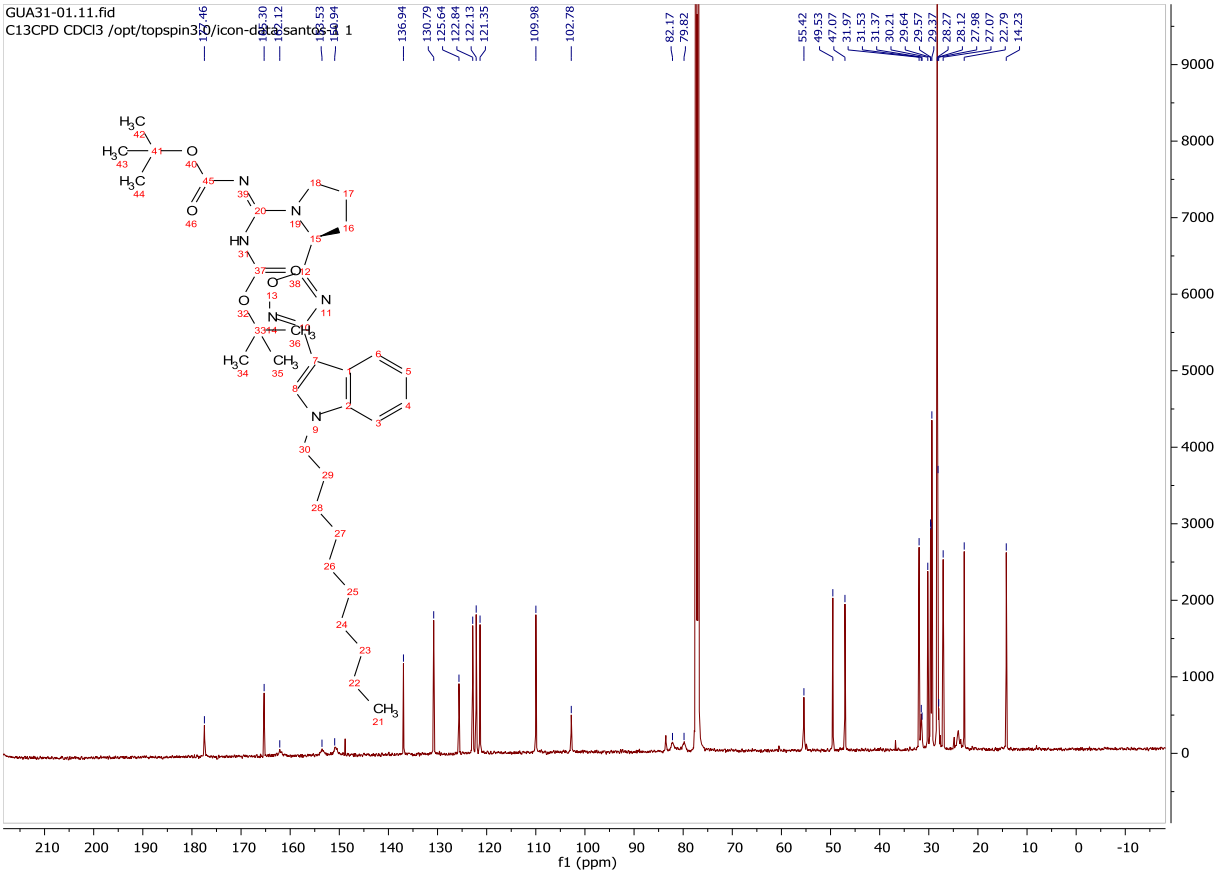
^{13}C-NMR Spectrum for Compound 4.6c:



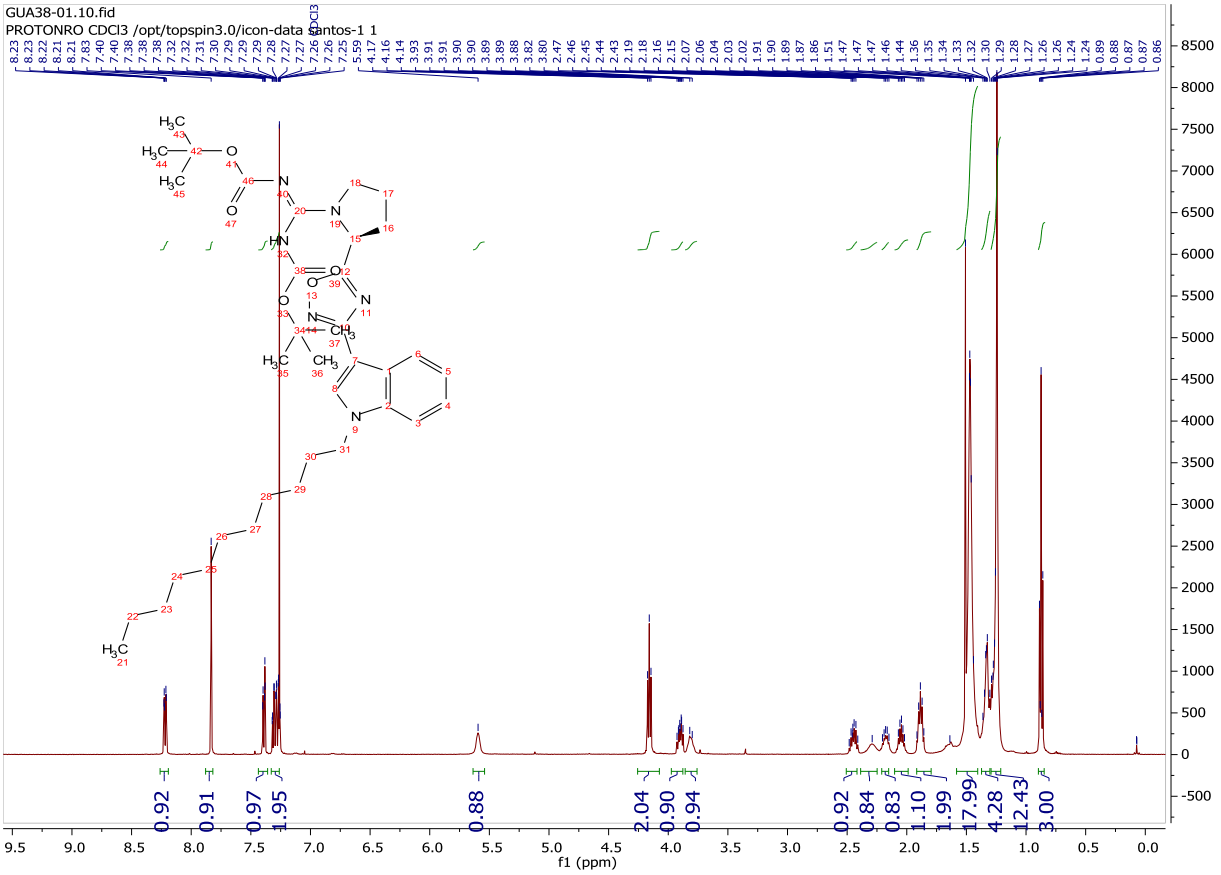
^{1}H-NMR Spectrum for Compound 4.6d:



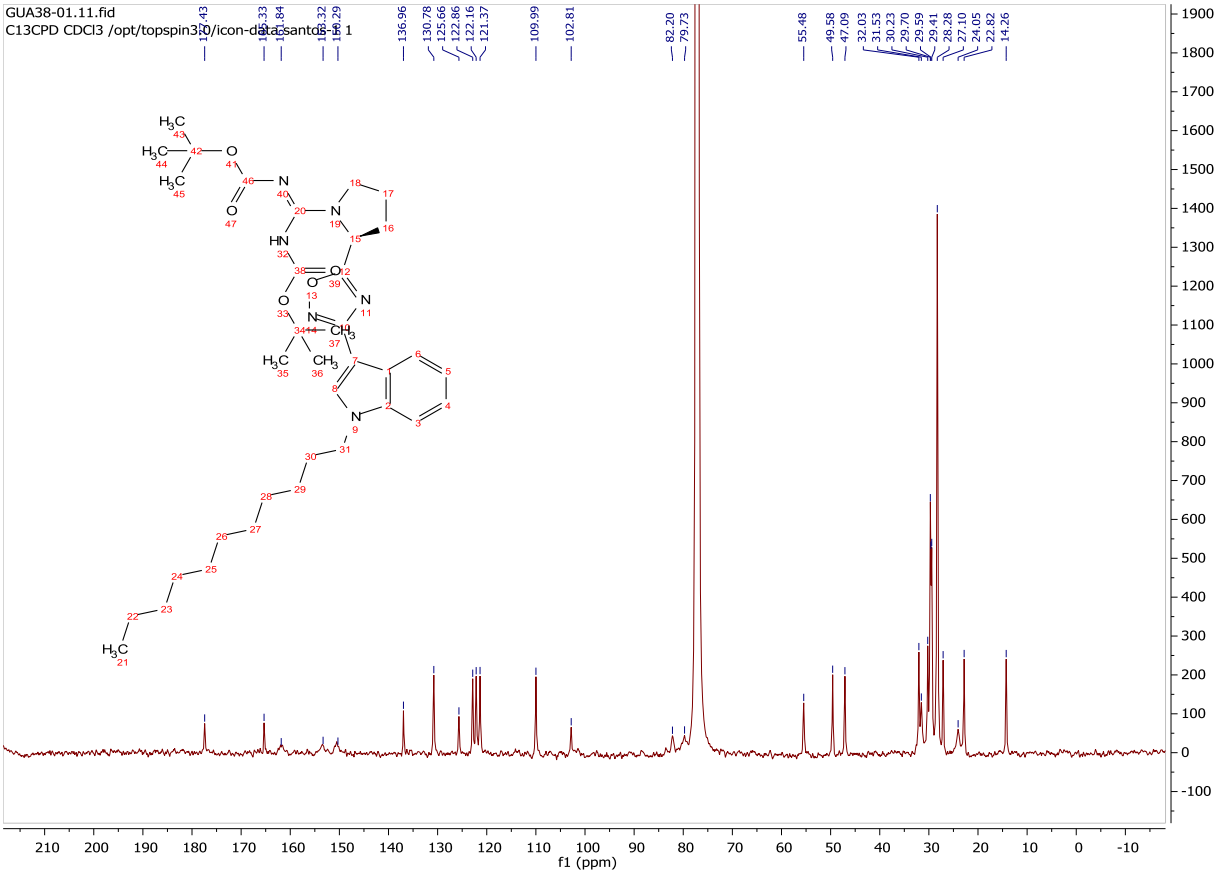
^{13}C-NMR Spectrum for Compound 4.6d:



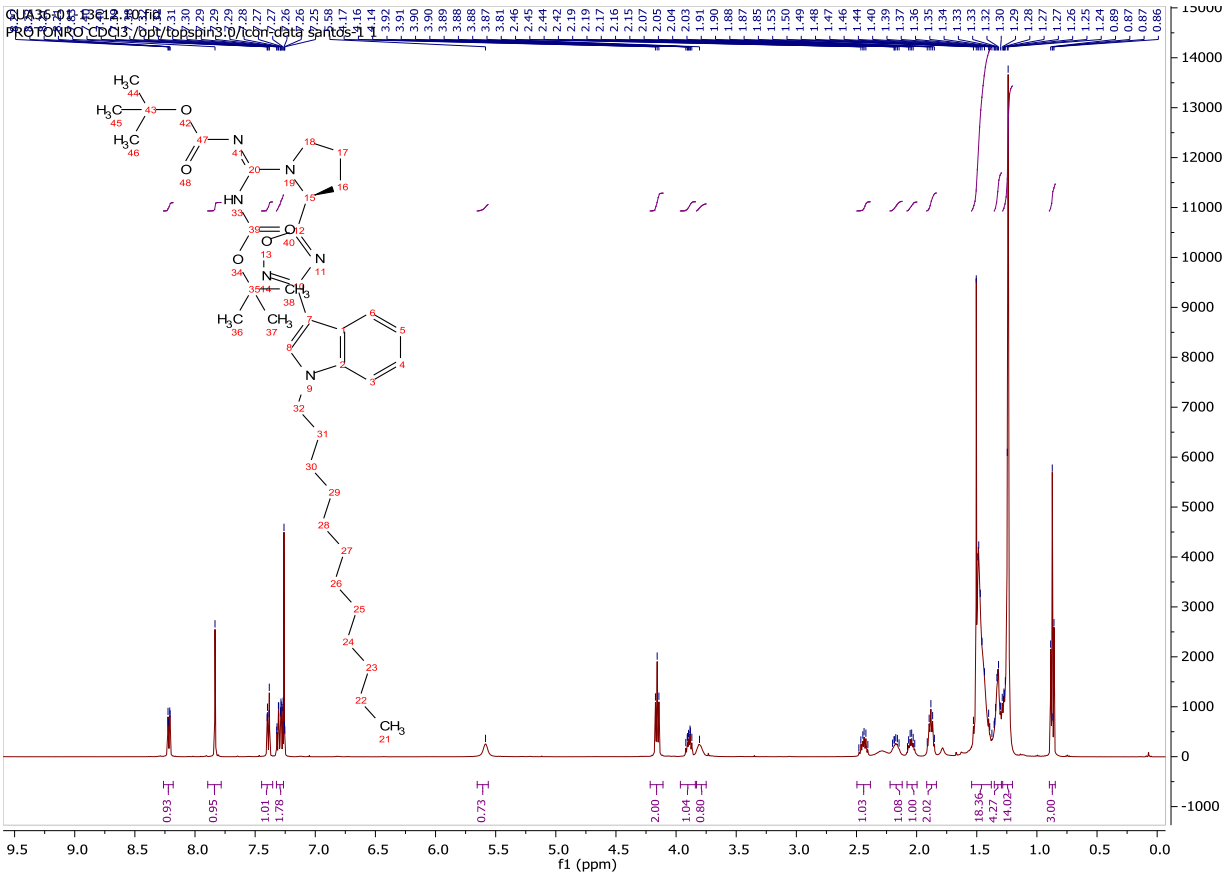
^{1}H-NMR Spectrum for Compound 4.6e:



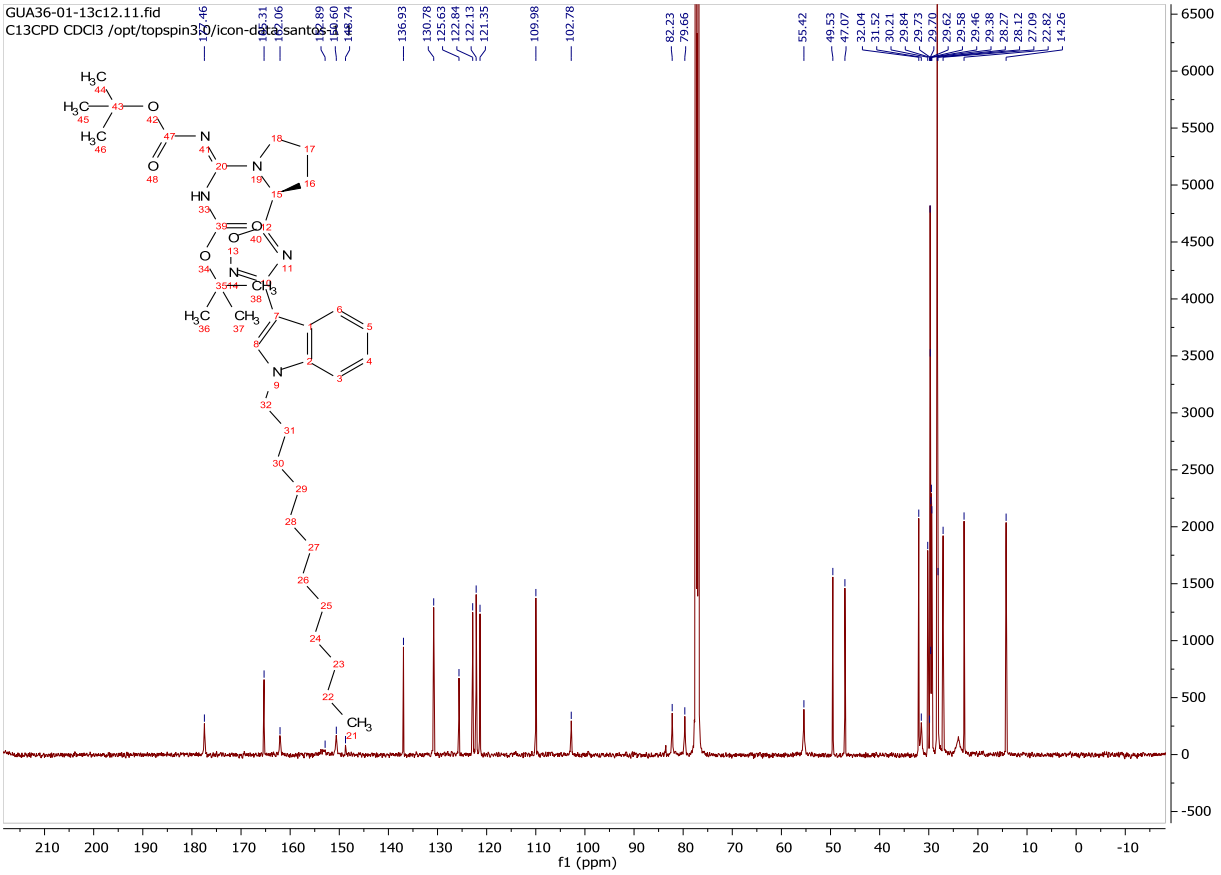
^{13}C-NMR Spectrum for Compound 4.6e:



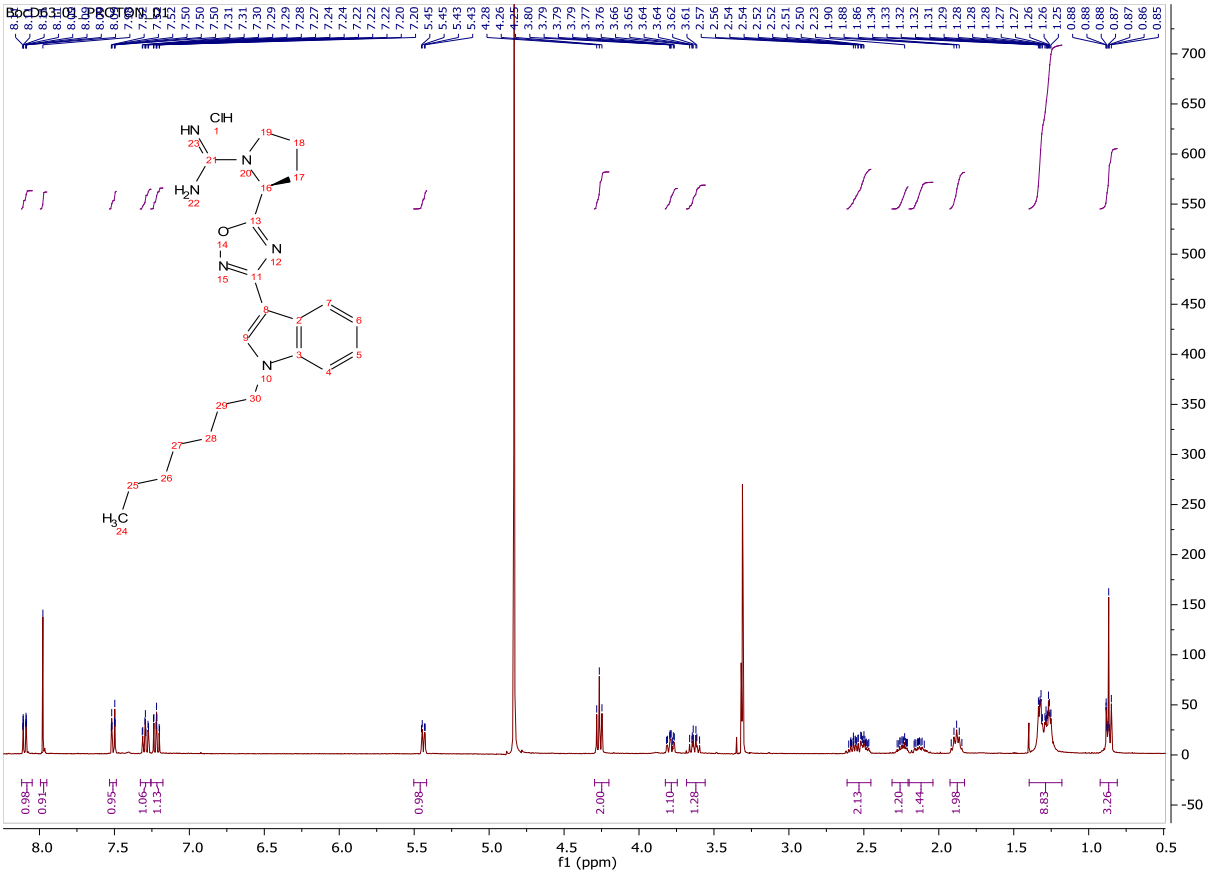
^{1}H-NMR Spectrum for Compound 4.6f:



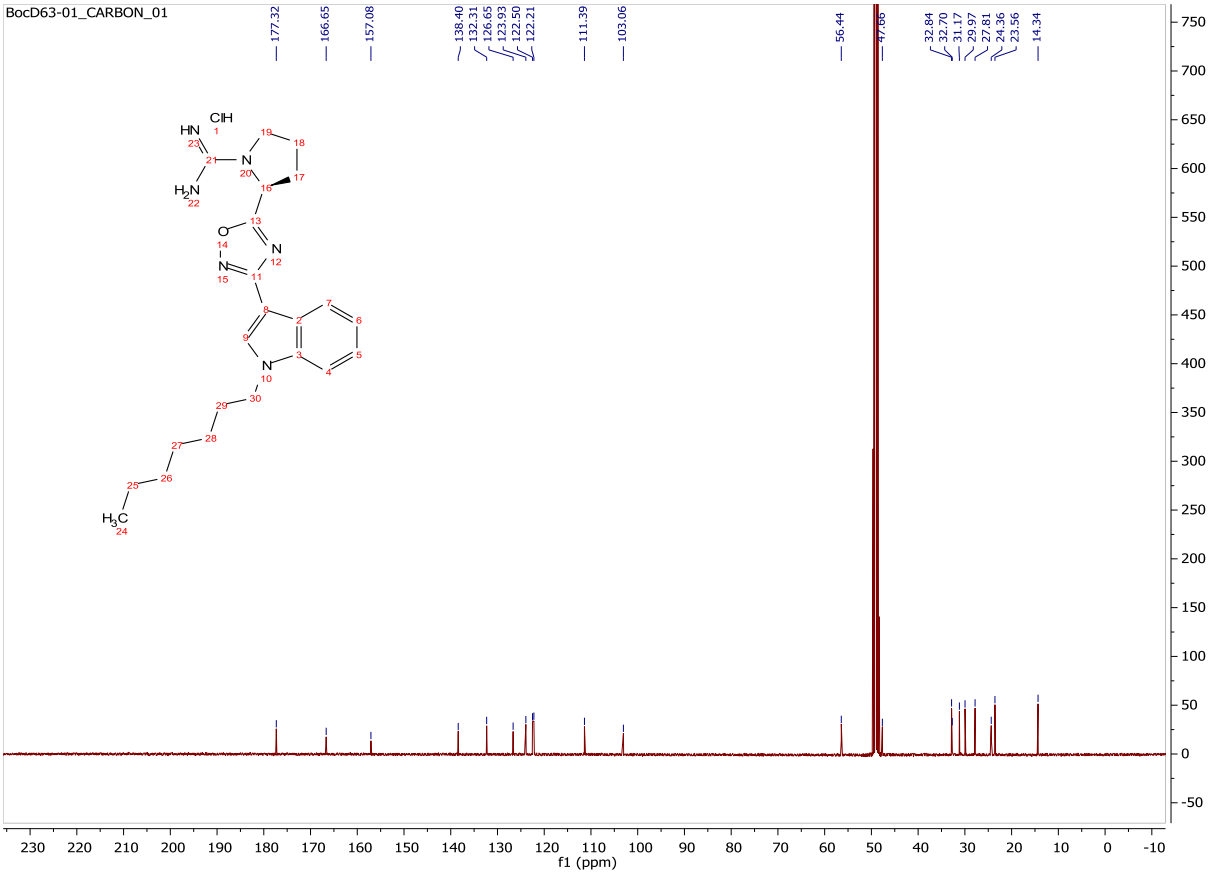
^{13}C-NMR Spectrum for Compound 4.6f:



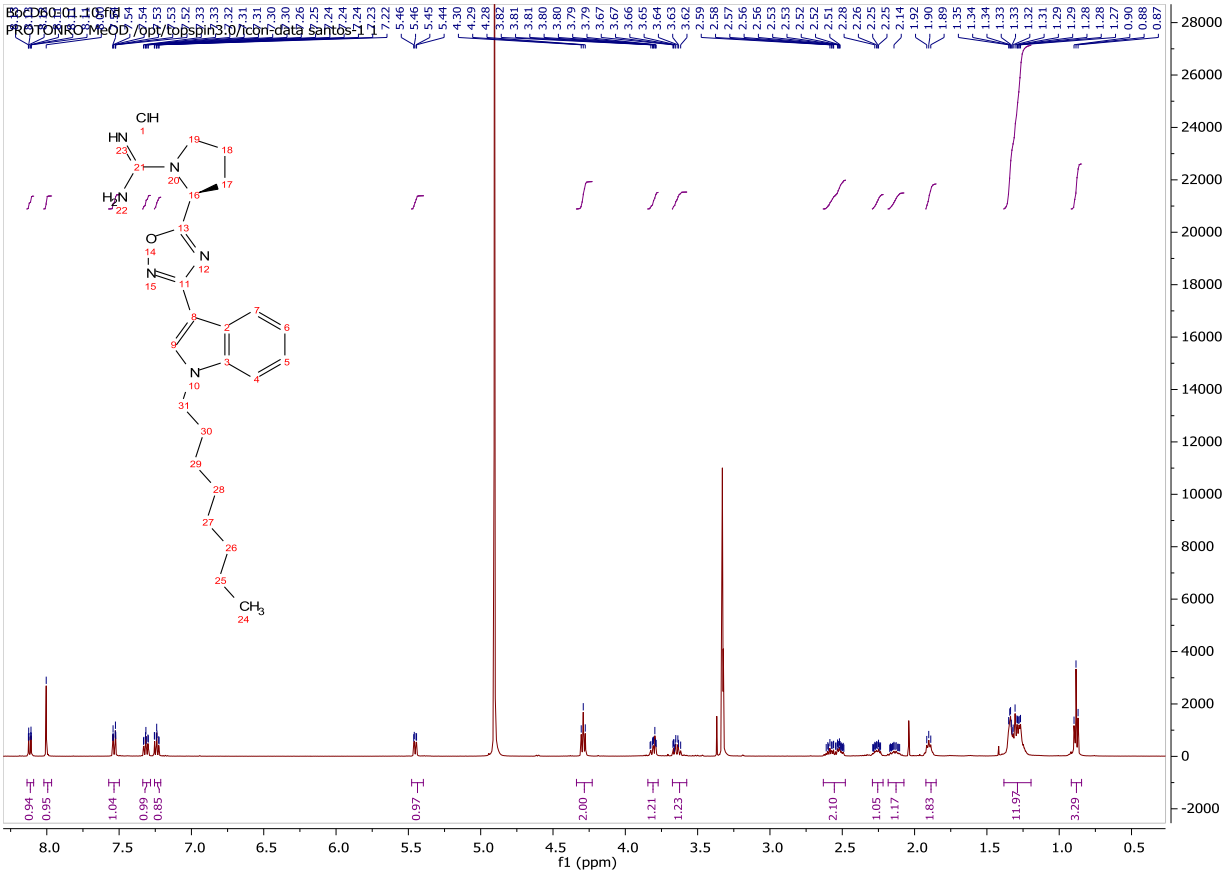
^{1}H-NMR Spectrum for Compound 4.7a:



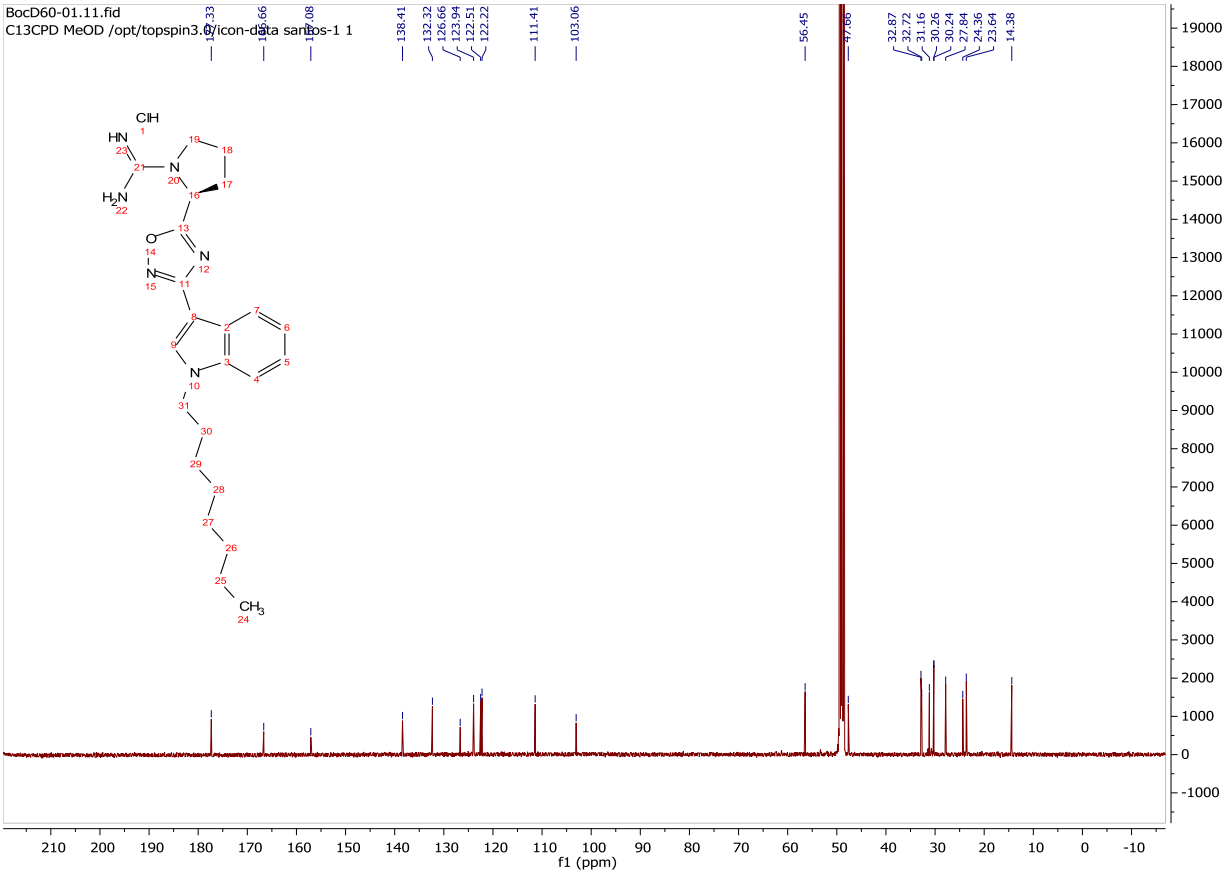
^{13}C-NMR Spectrum for Compound 4.7a:



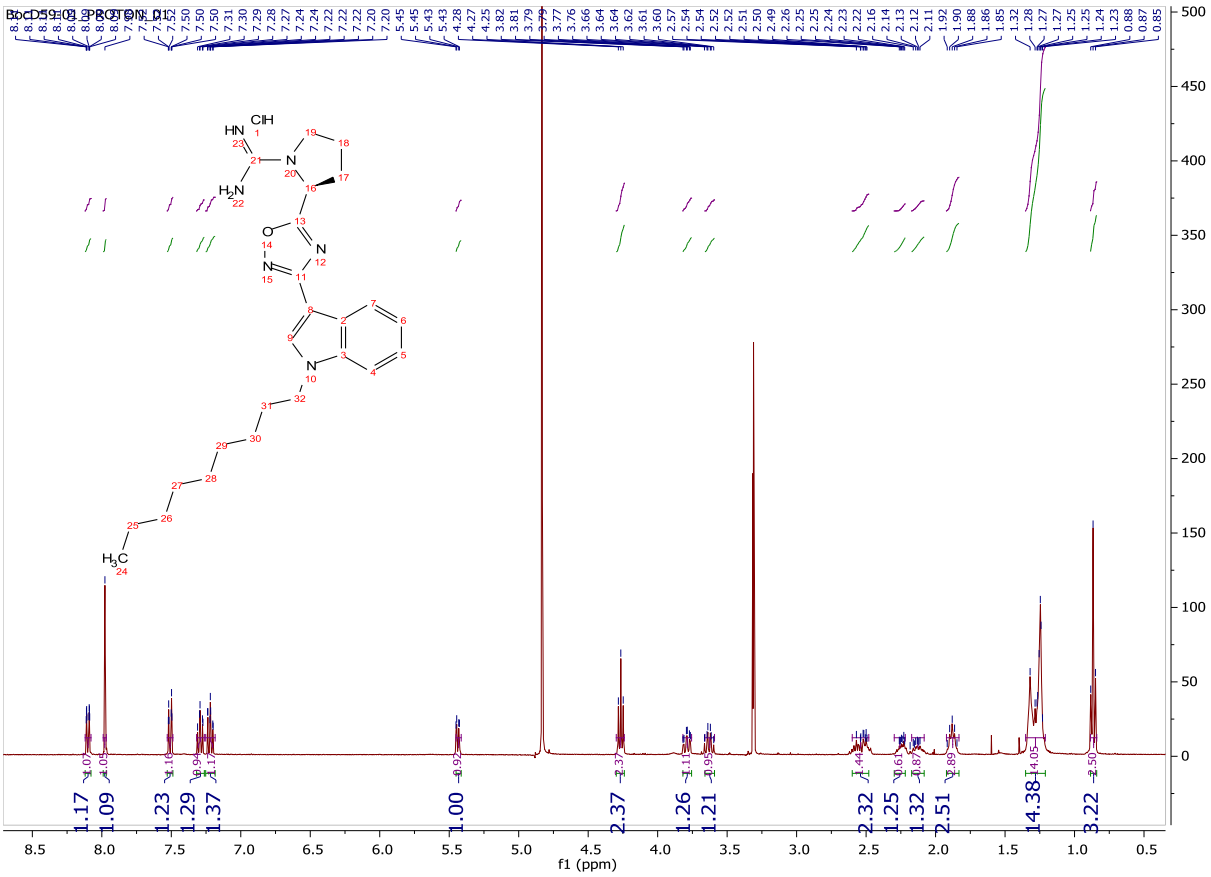
^{1}H-NMR Spectrum for Compound 4.7b:



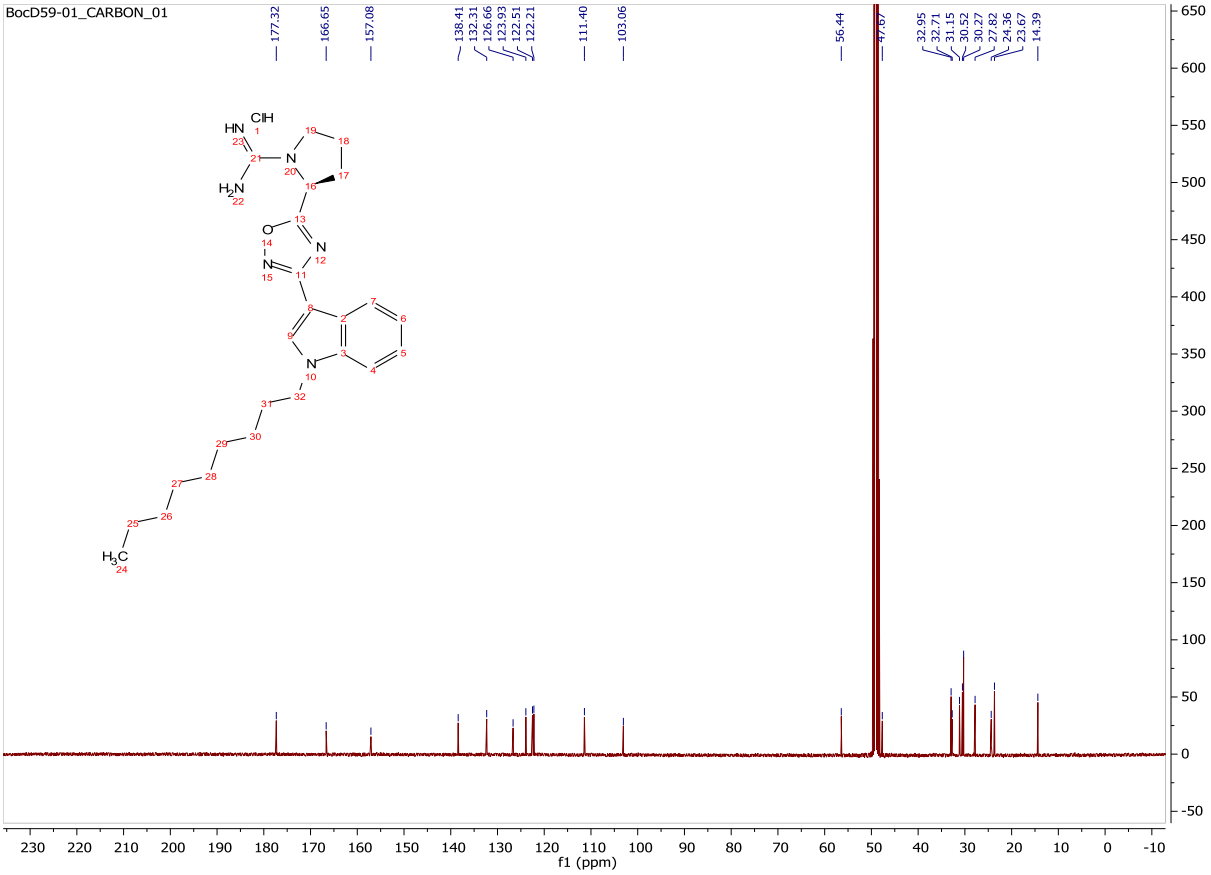
^{13}C-NMR Spectrum for Compound 4.7b:



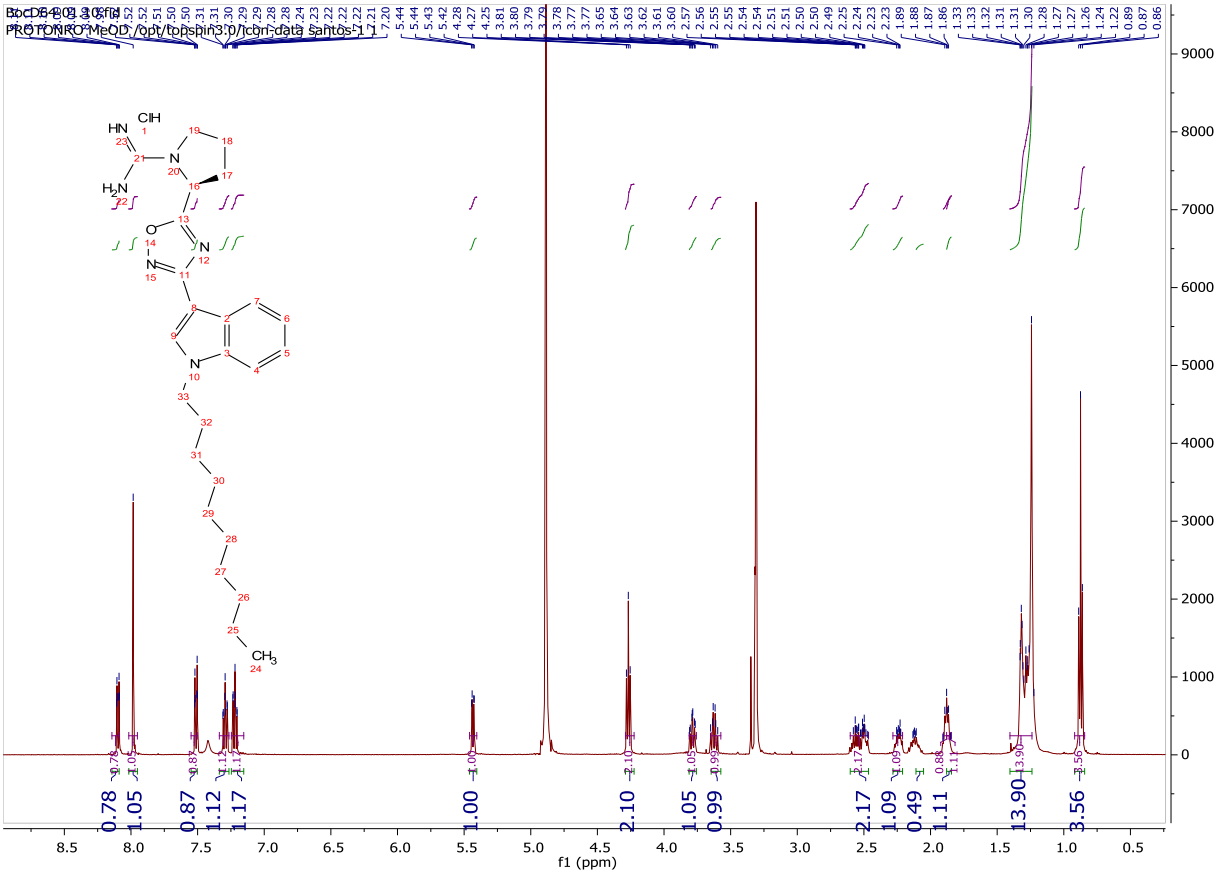
^{1}H-NMR Spectrum for Compound 4.7c:



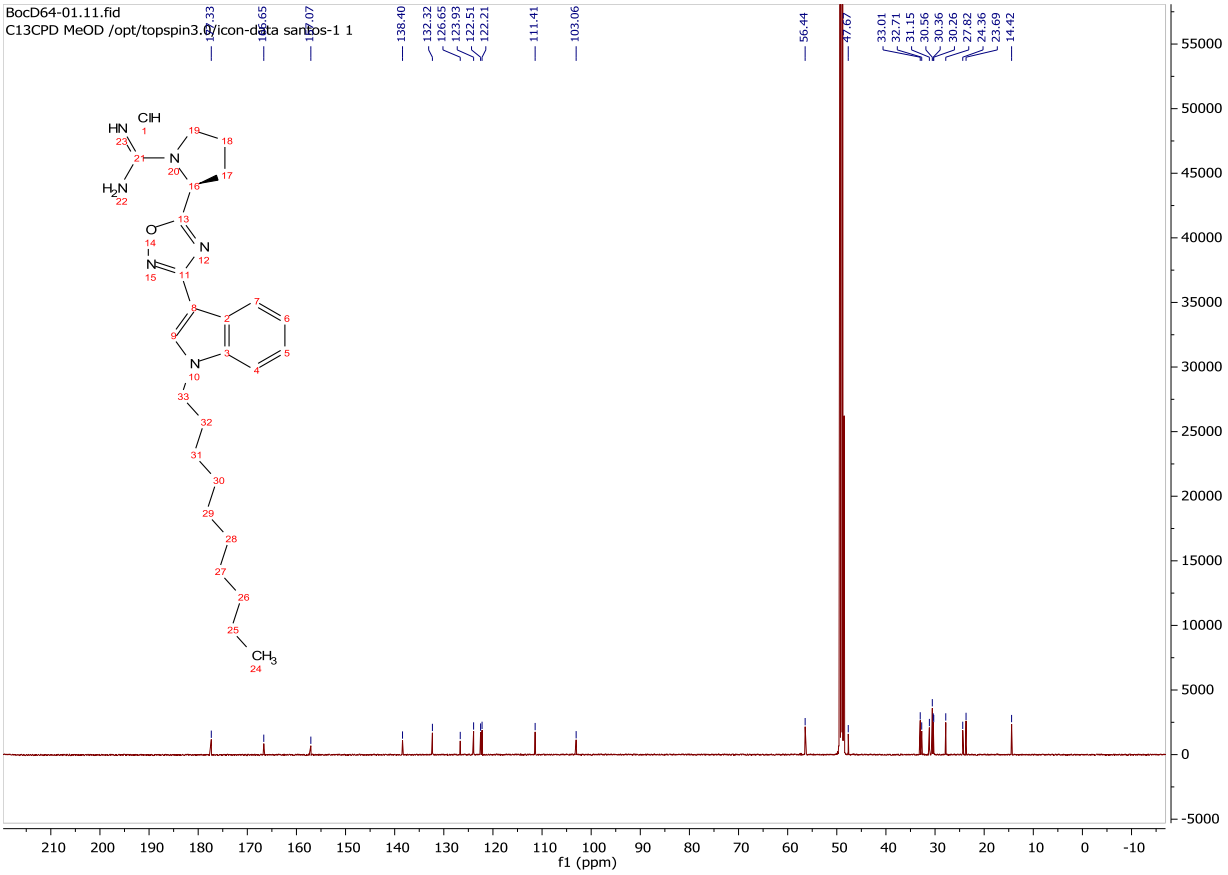
^{13}C-NMR Spectrum for Compound 4.7c:



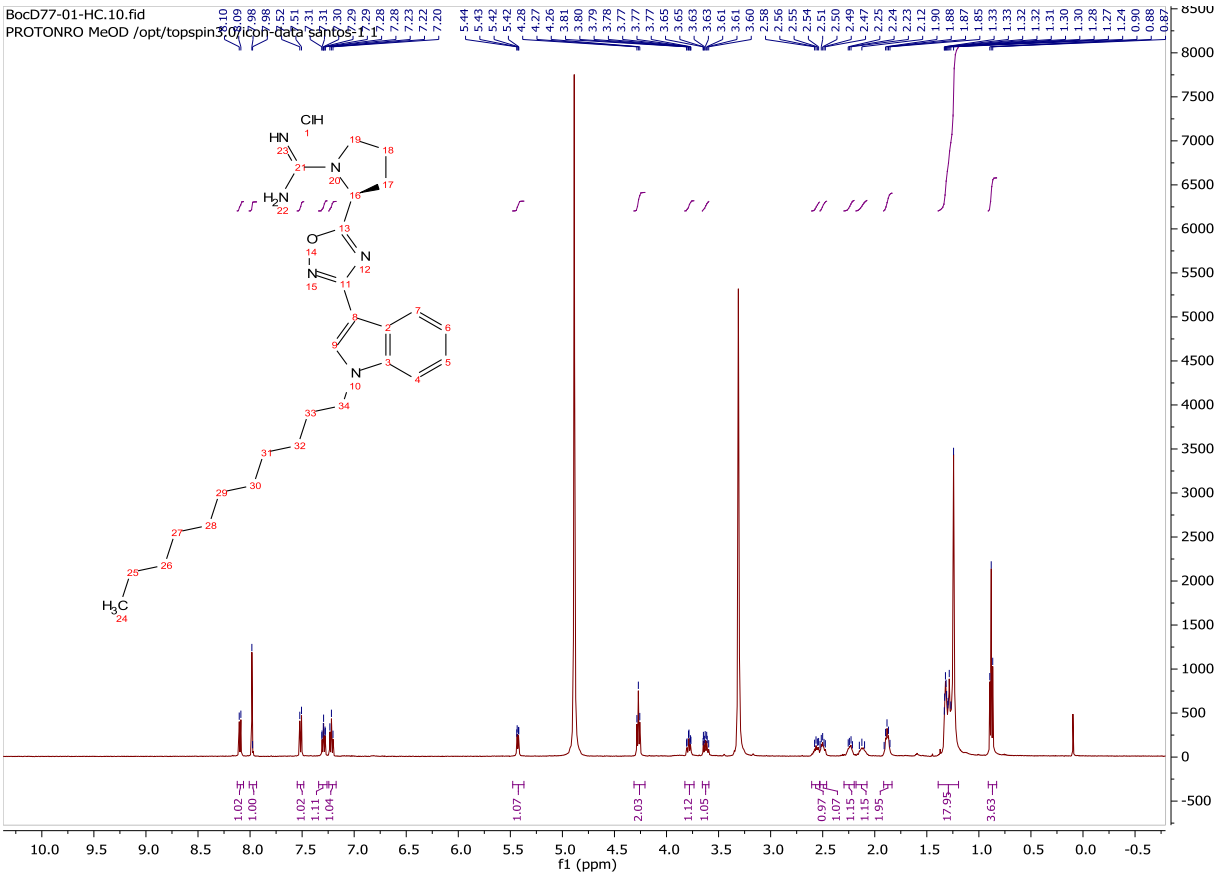
^{1}H-NMR Spectrum for Compound 4.7d:



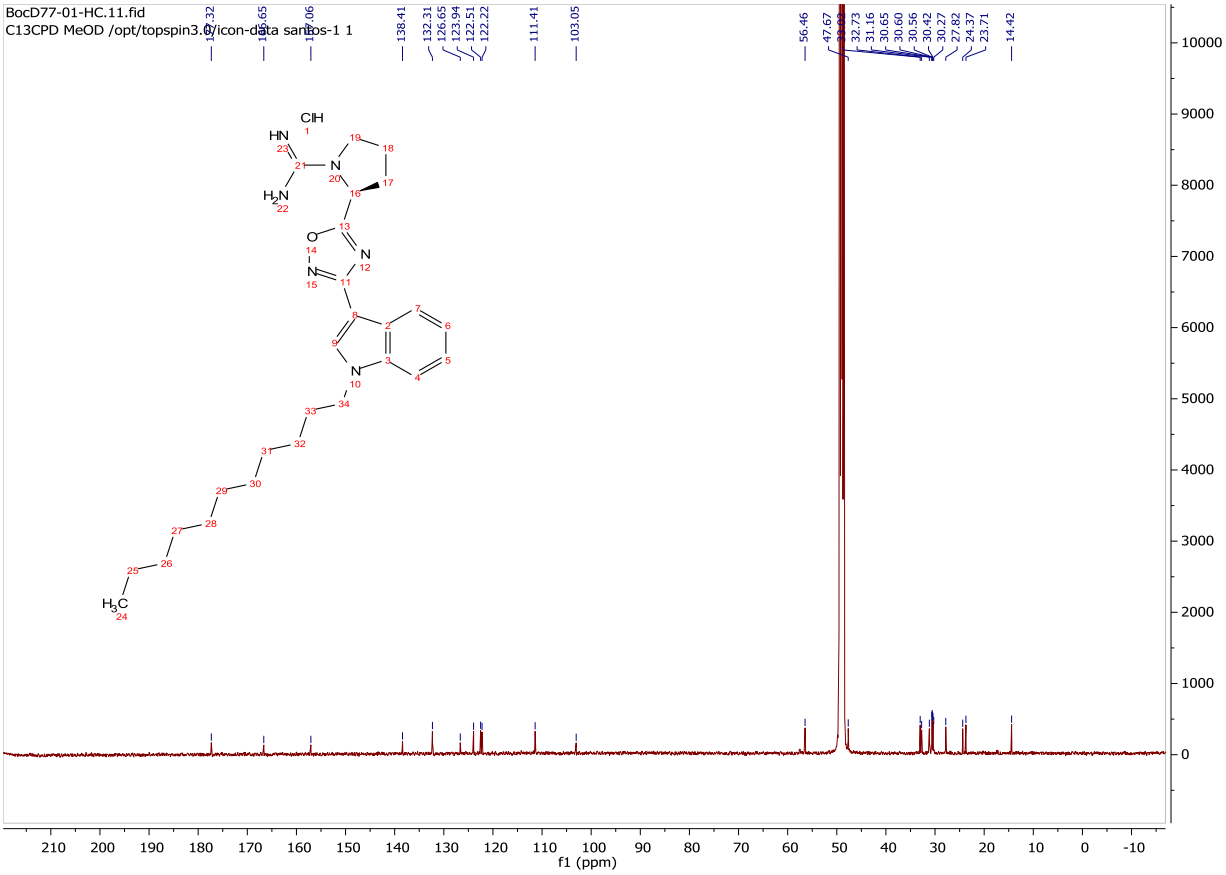
^{13}C-NMR Spectrum for Compound 4.7d:



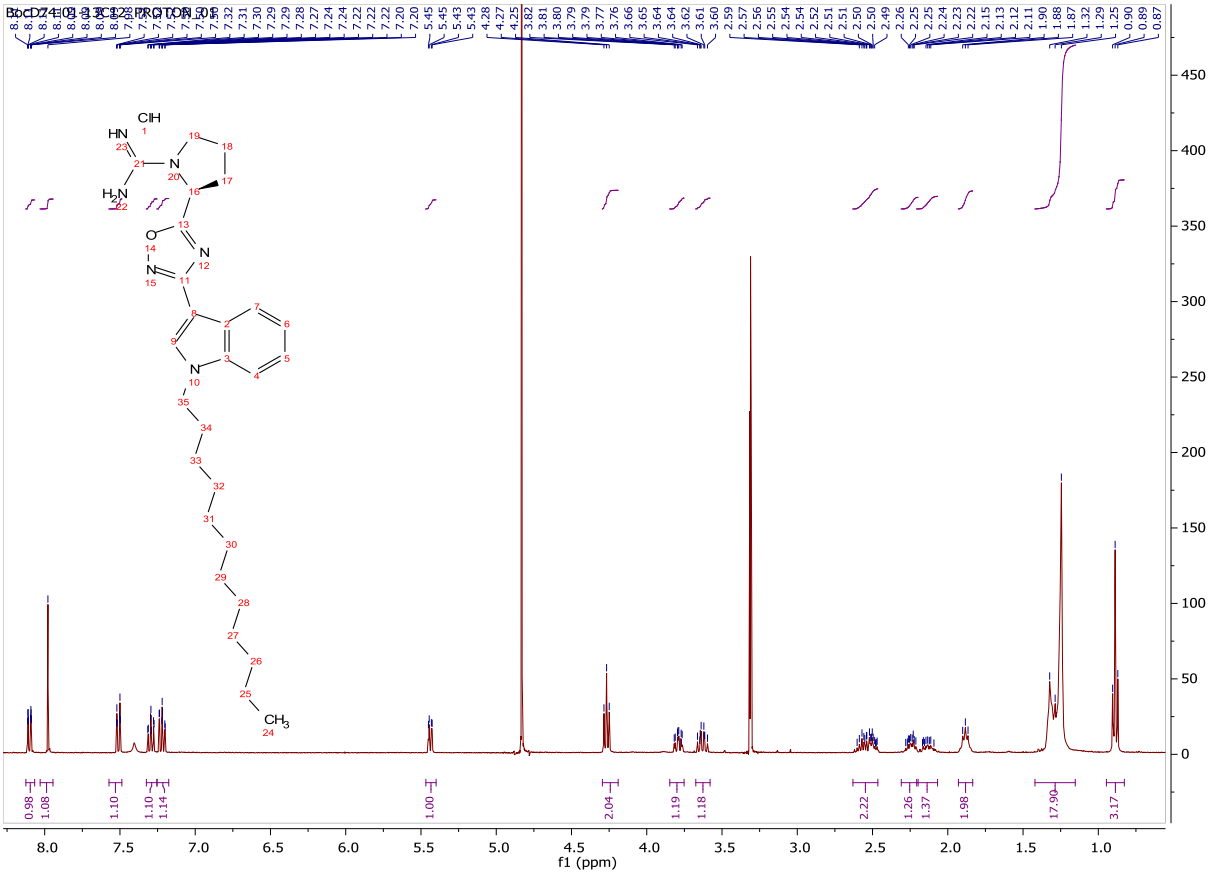
^{1}H-NMR Spectrum for Compound 4.7e:



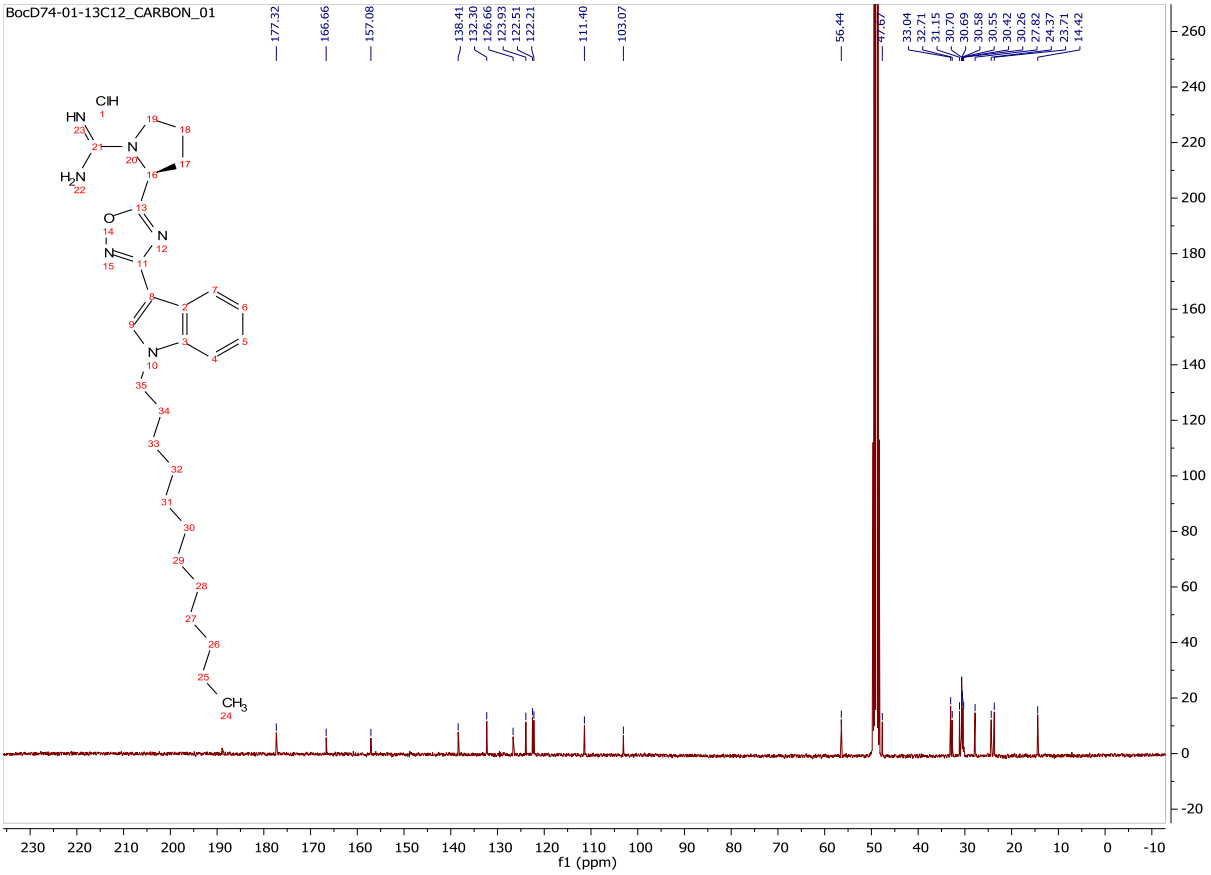
^{13}C-NMR Spectrum for Compound 4.7e:



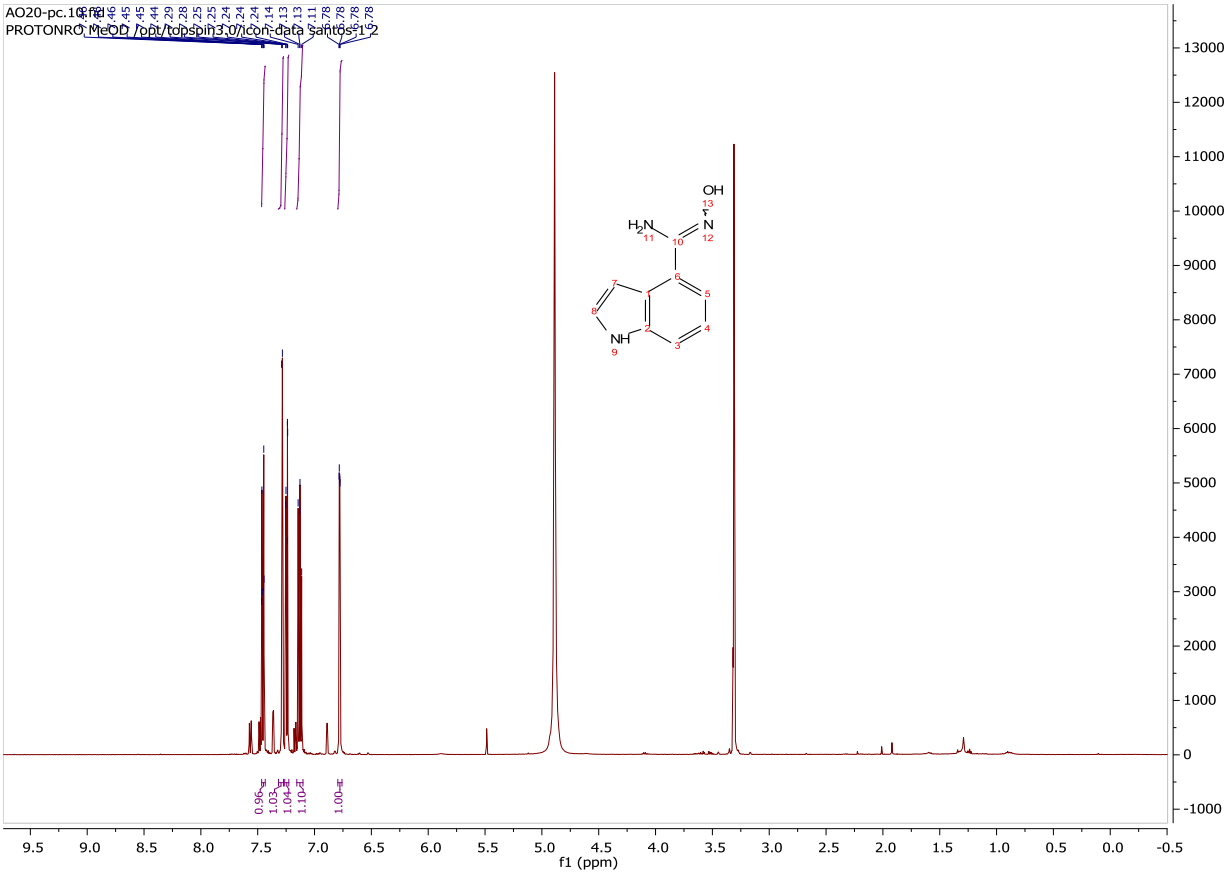
^{1}H-NMR Spectrum for Compound 4.7f:



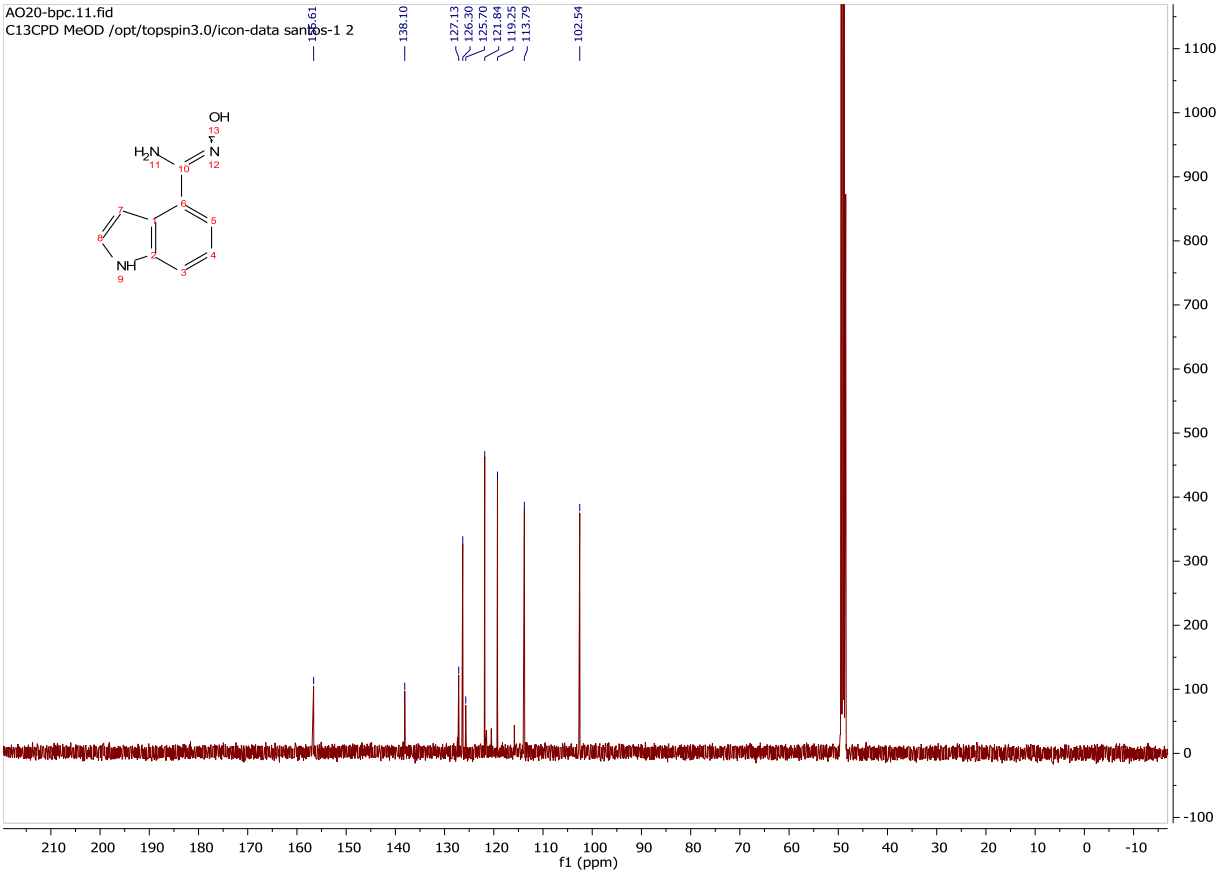
^{13}C-NMR Spectrum for Compound 4.7f:



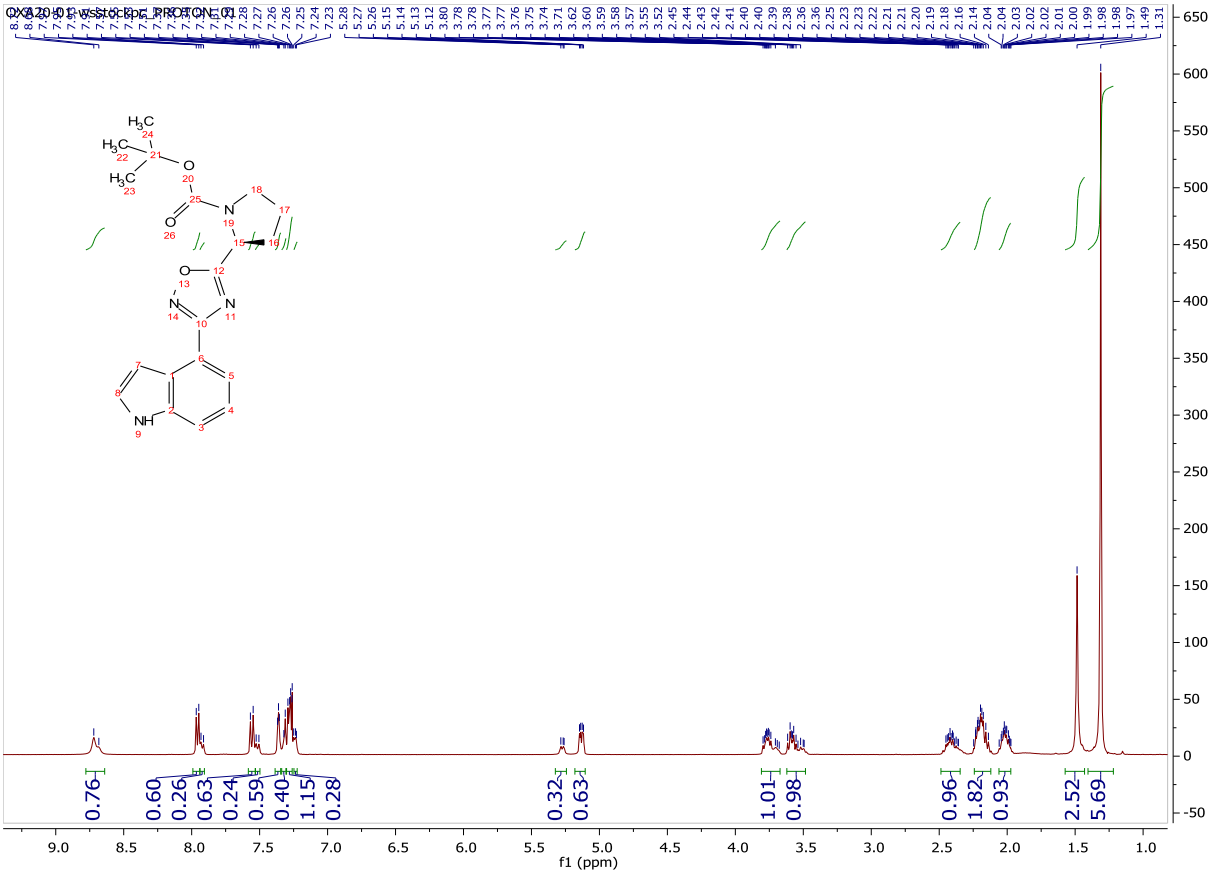
^{1}H-NMR Spectrum for Compound 4.9:



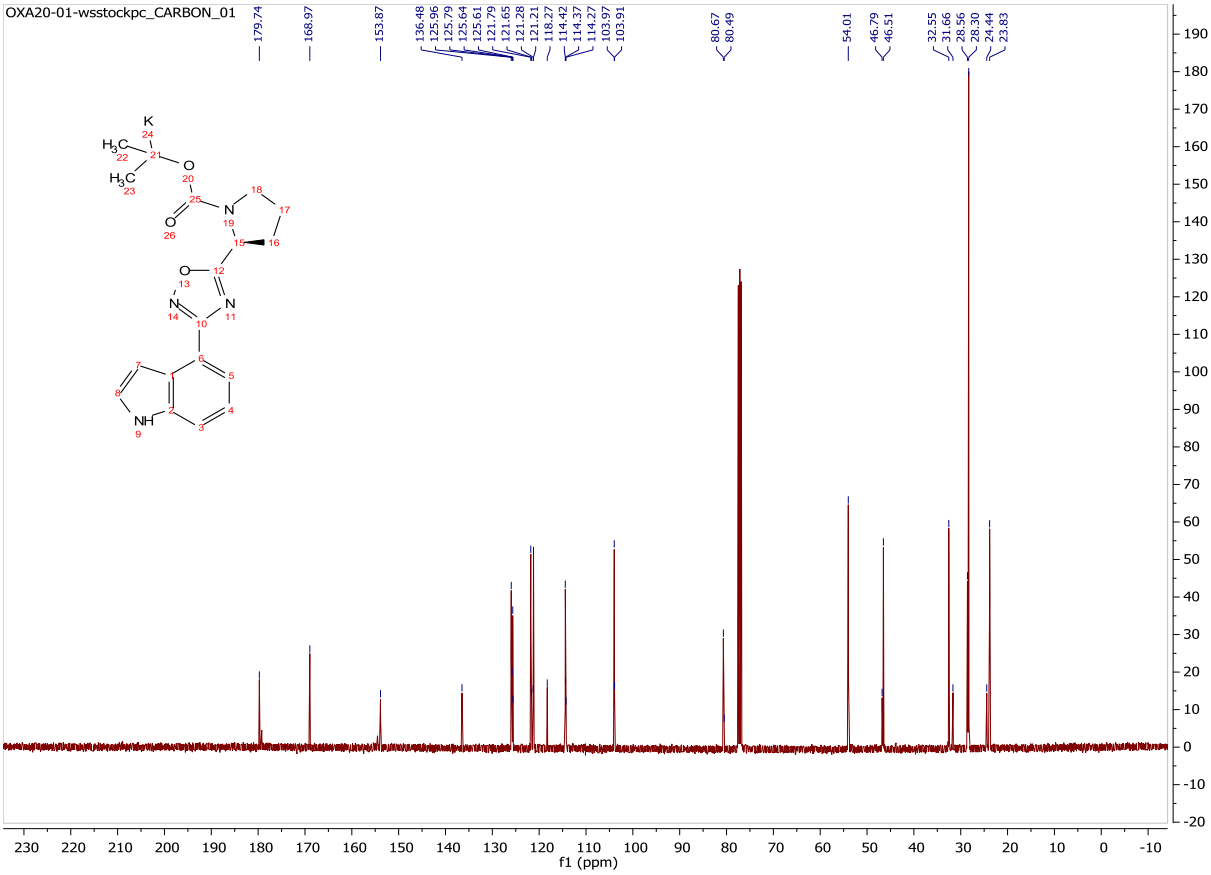
^{13}C-NMR Spectrum for Compound 4.9:



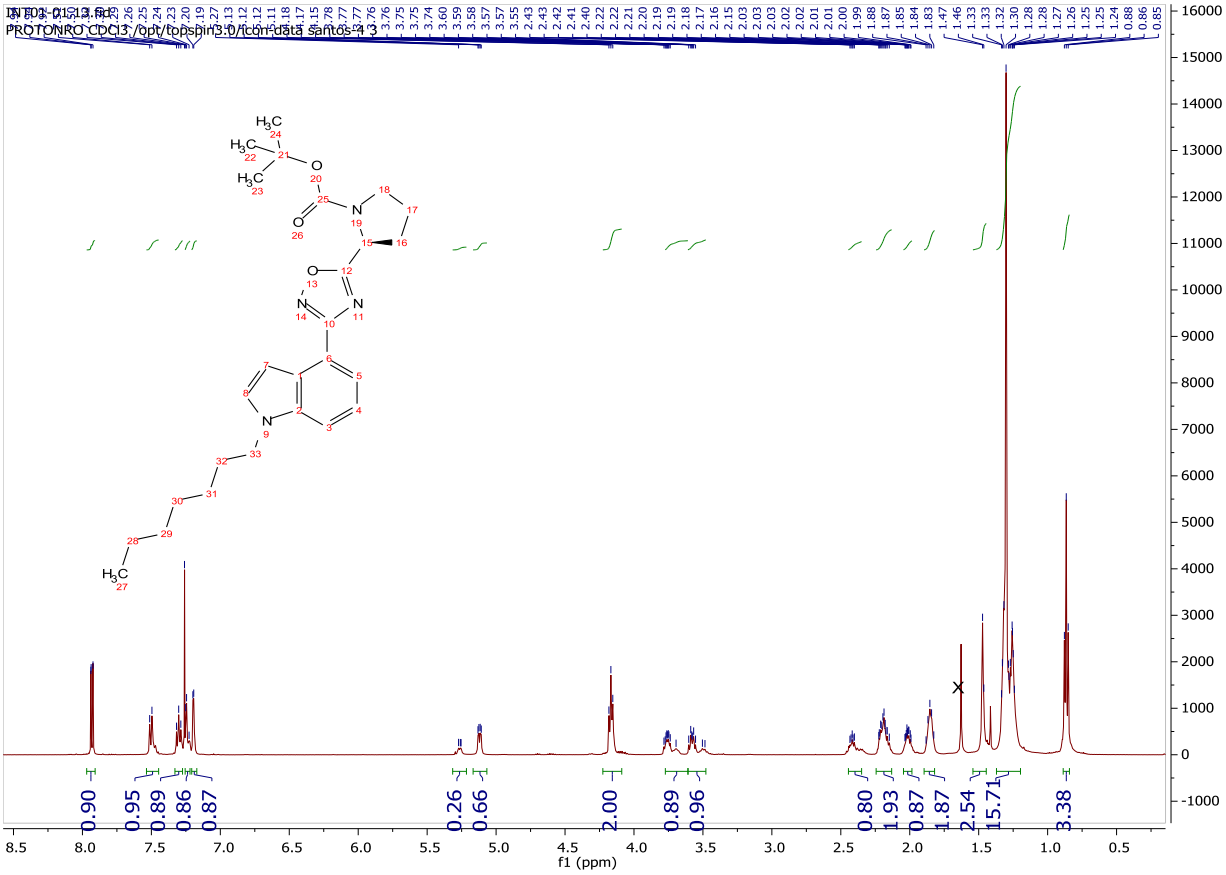
^{1}H-NMR Spectrum for Compound 4.10:



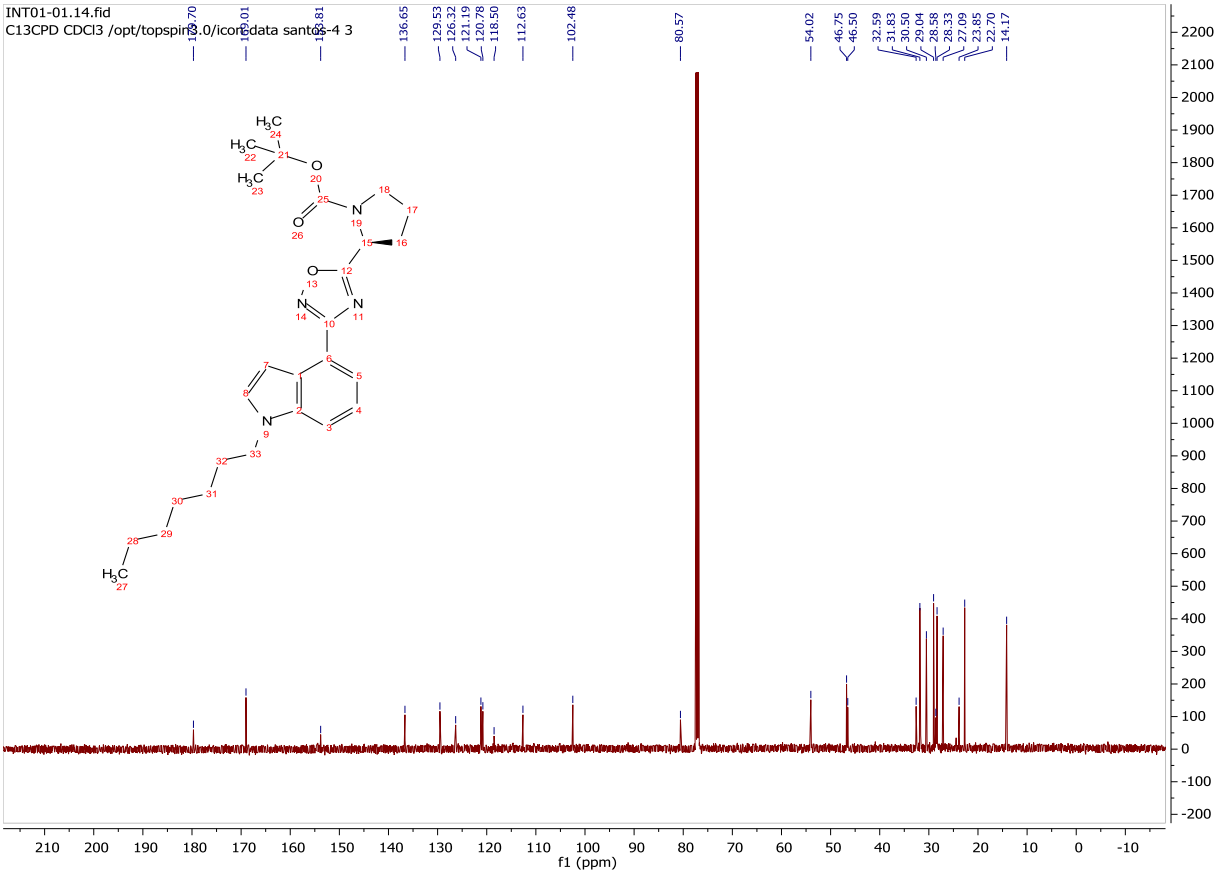
^{13}C-NMR Spectrum for Compound 4.10:



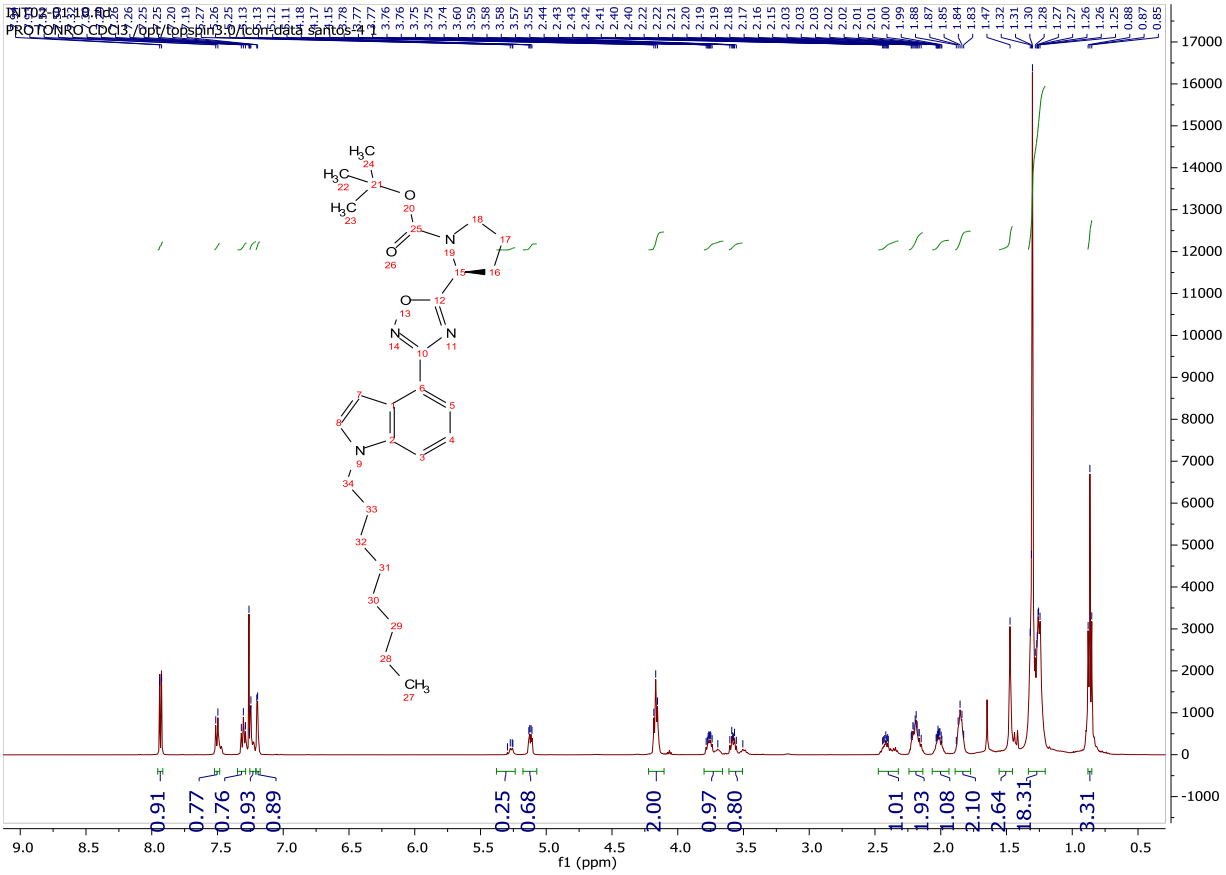
^{1}H-NMR Spectrum for Compound 4.11a:



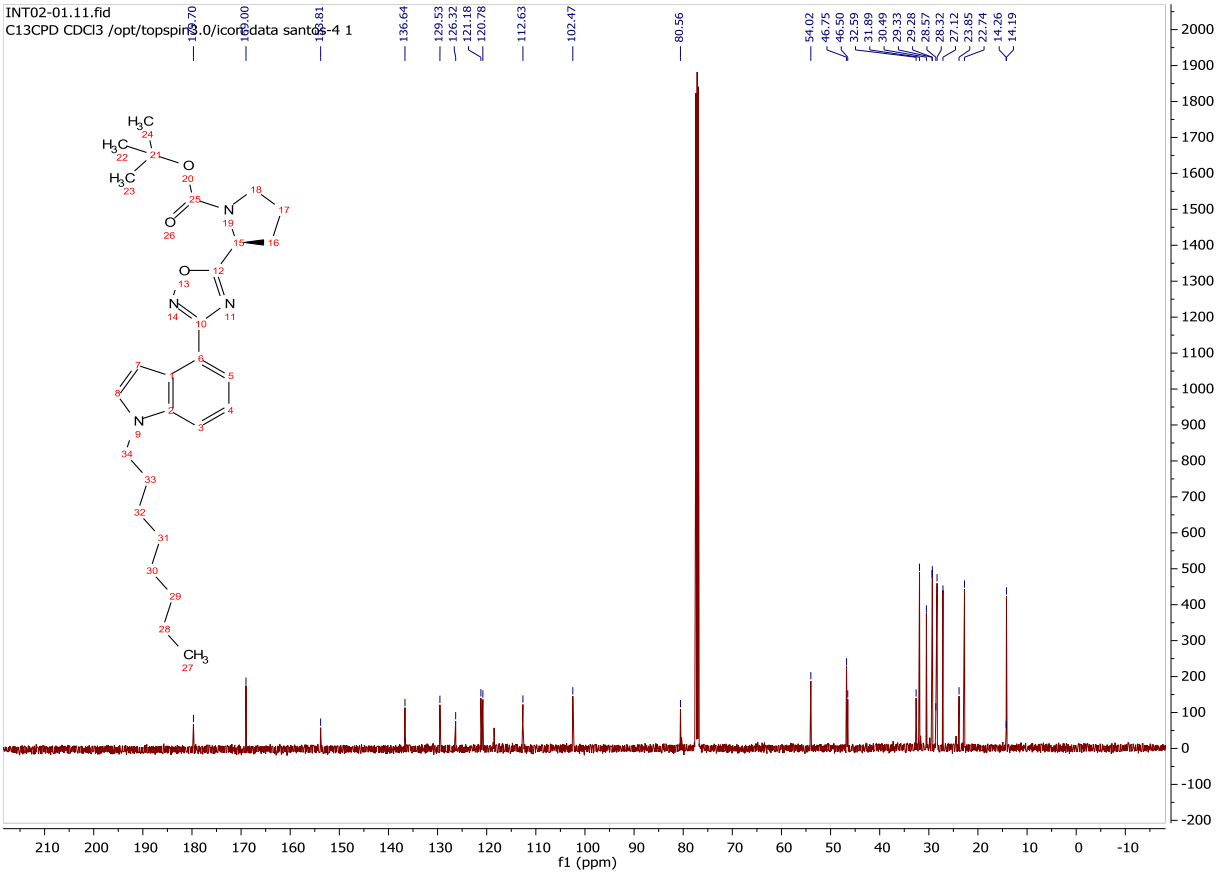
^{13}C-NMR Spectrum for Compound 4.11a:



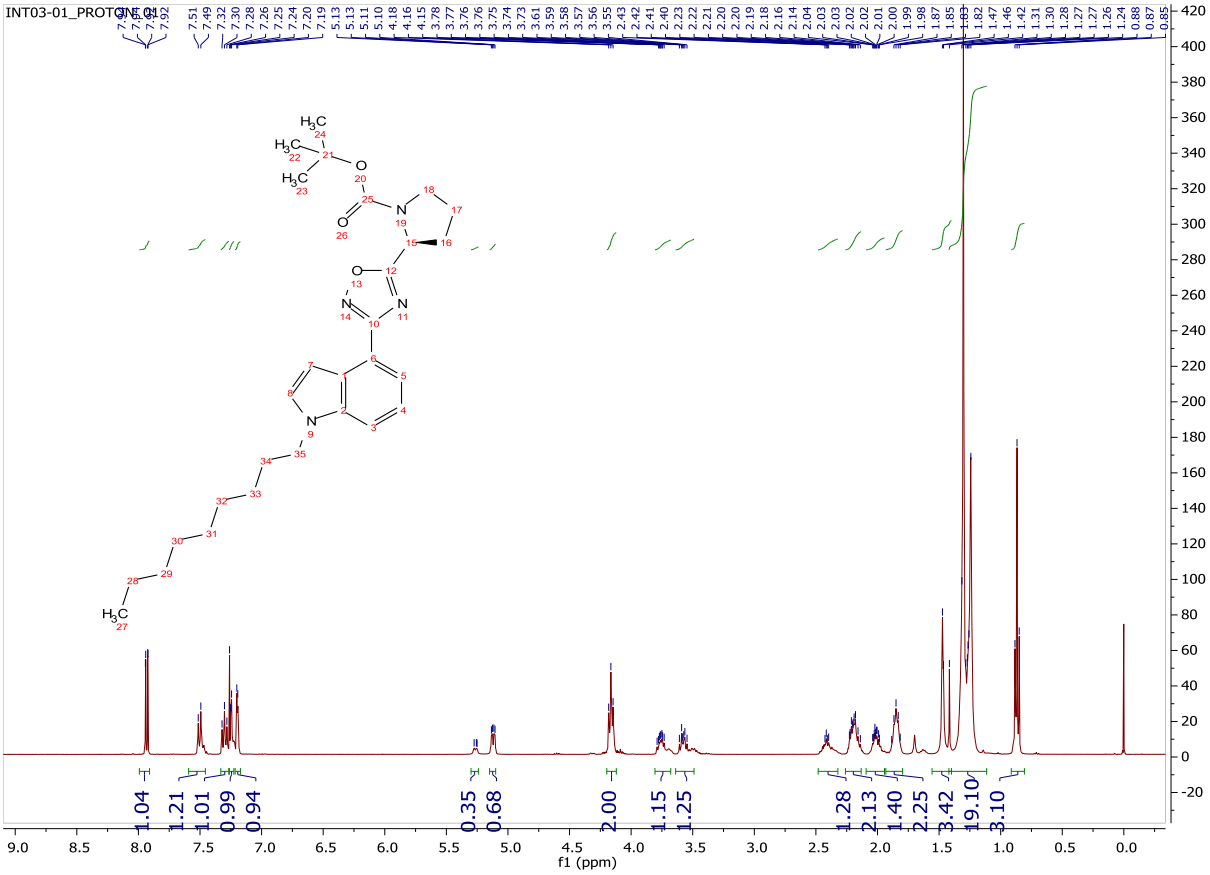
^{1}H-NMR Spectrum for Compound 4.11b:



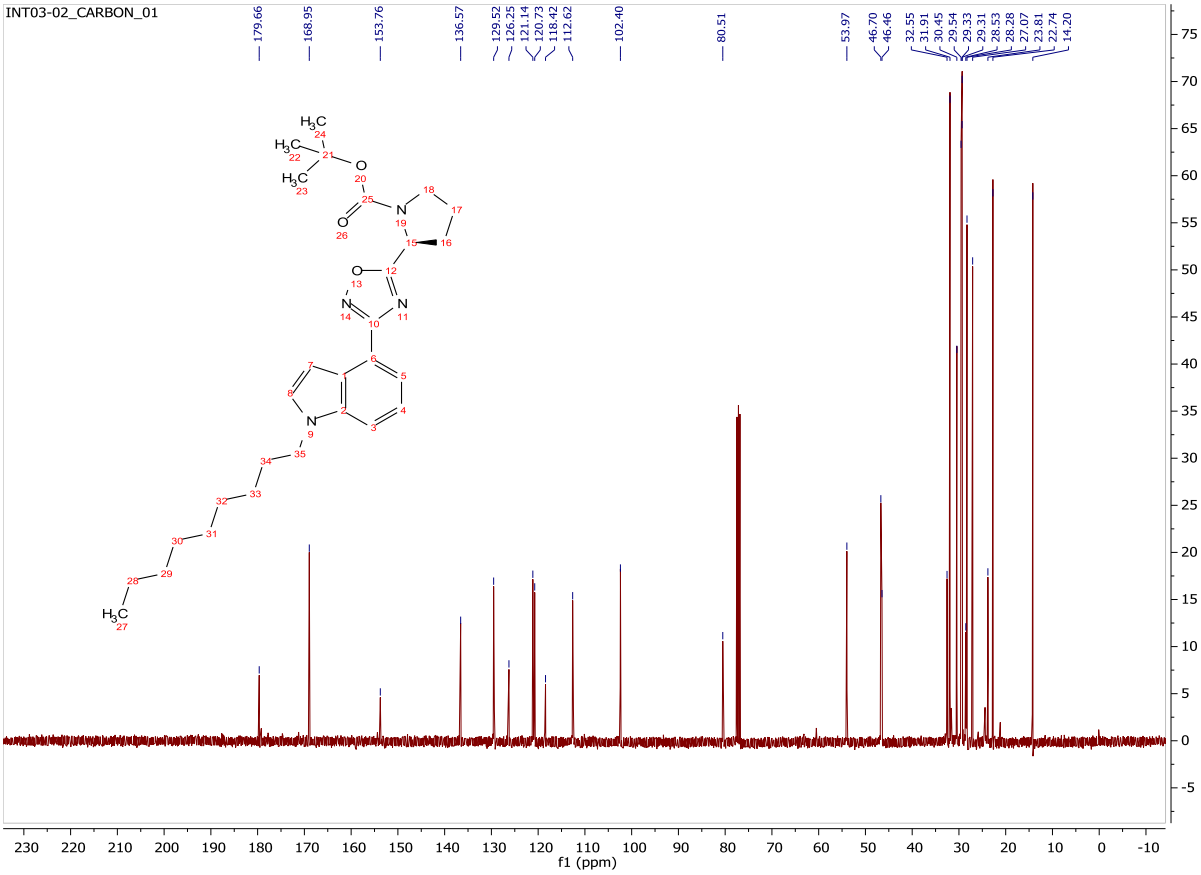
^{13}C-NMR Spectrum for Compound 4.11b:



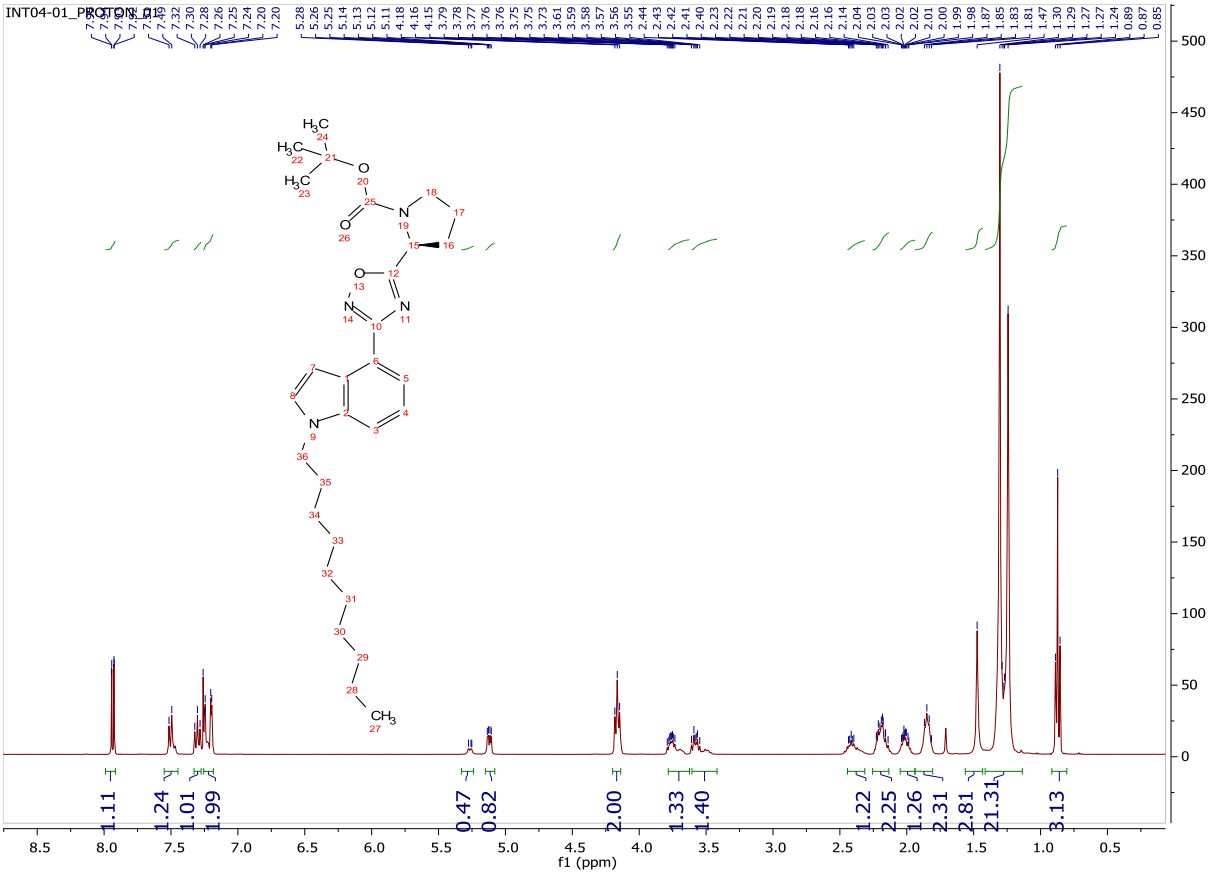
^{1}H-NMR Spectrum for Compound 4.11c:



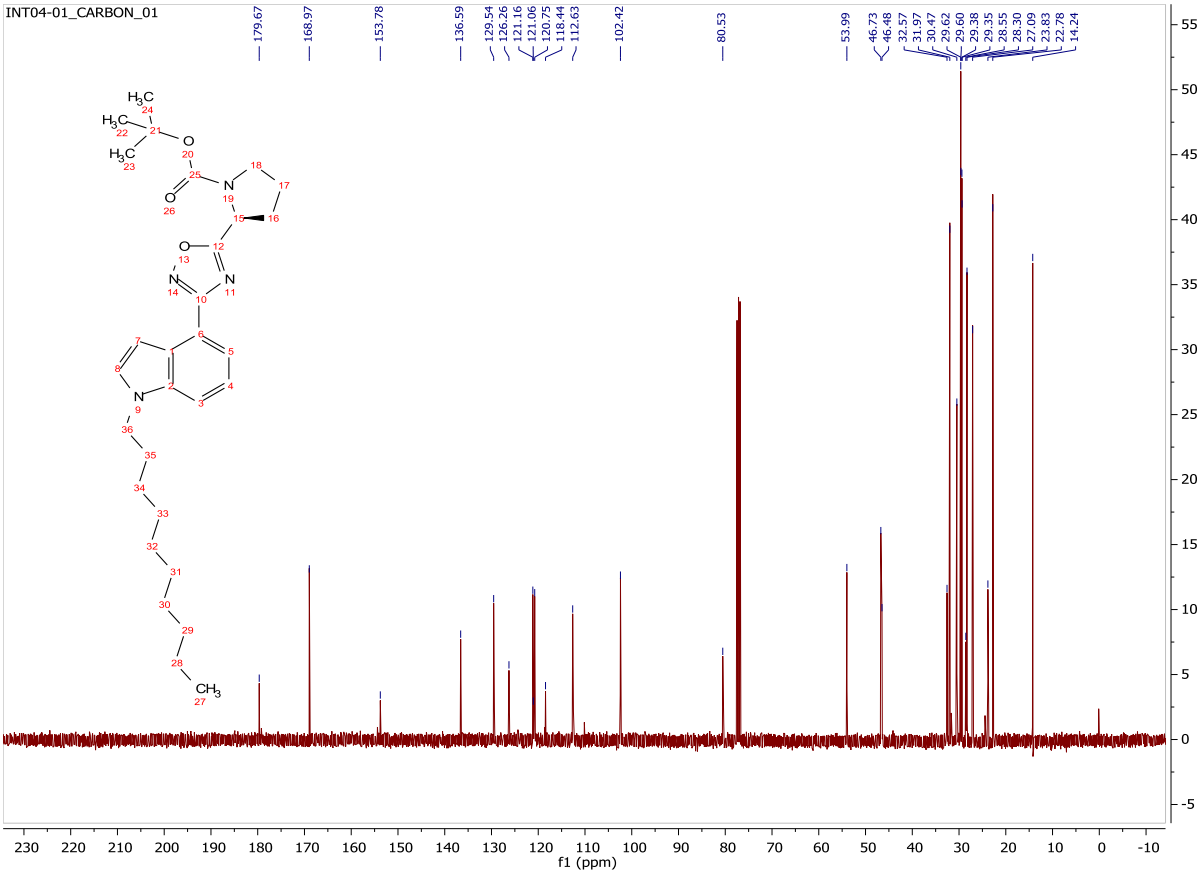
^{13}C-NMR Spectrum for Compound 4.11c:



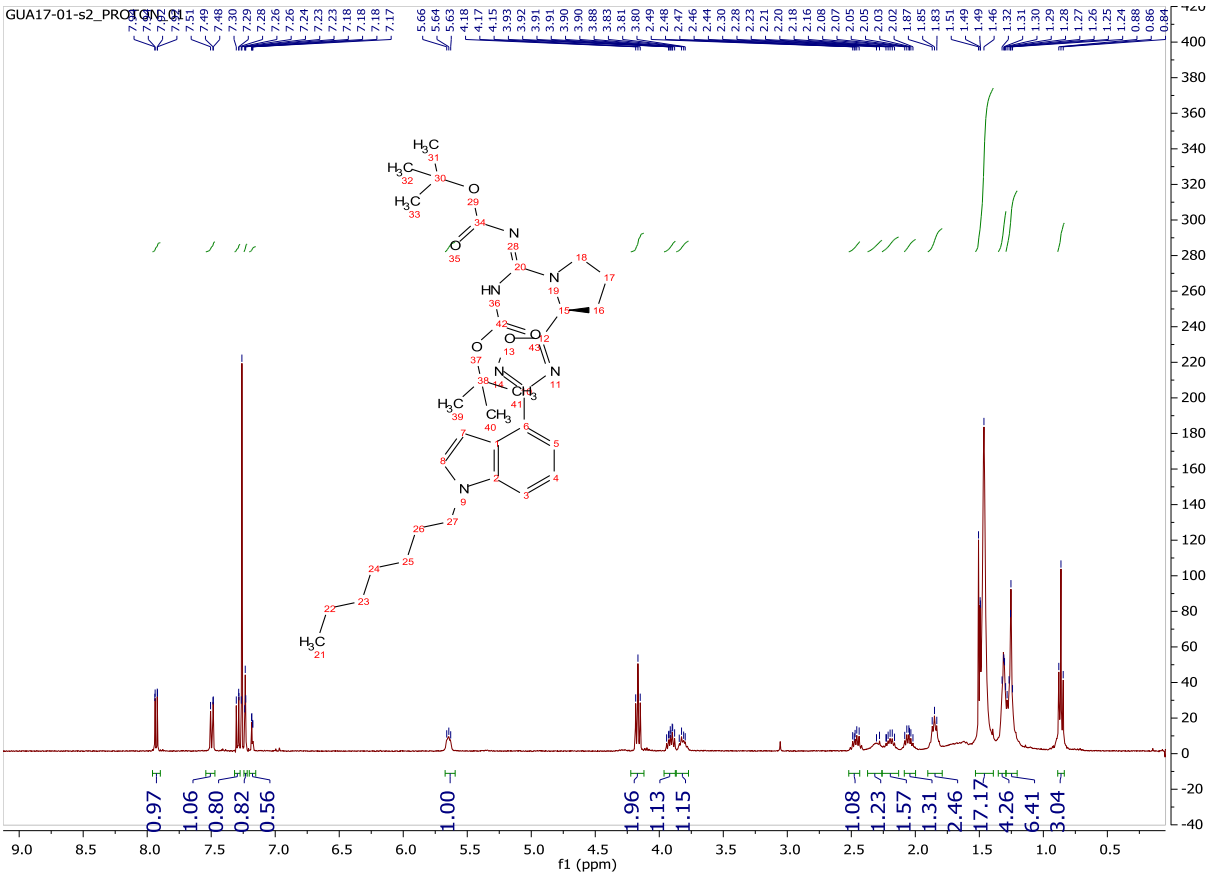
^{1}H-NMR Spectrum for Compound 4.11d:



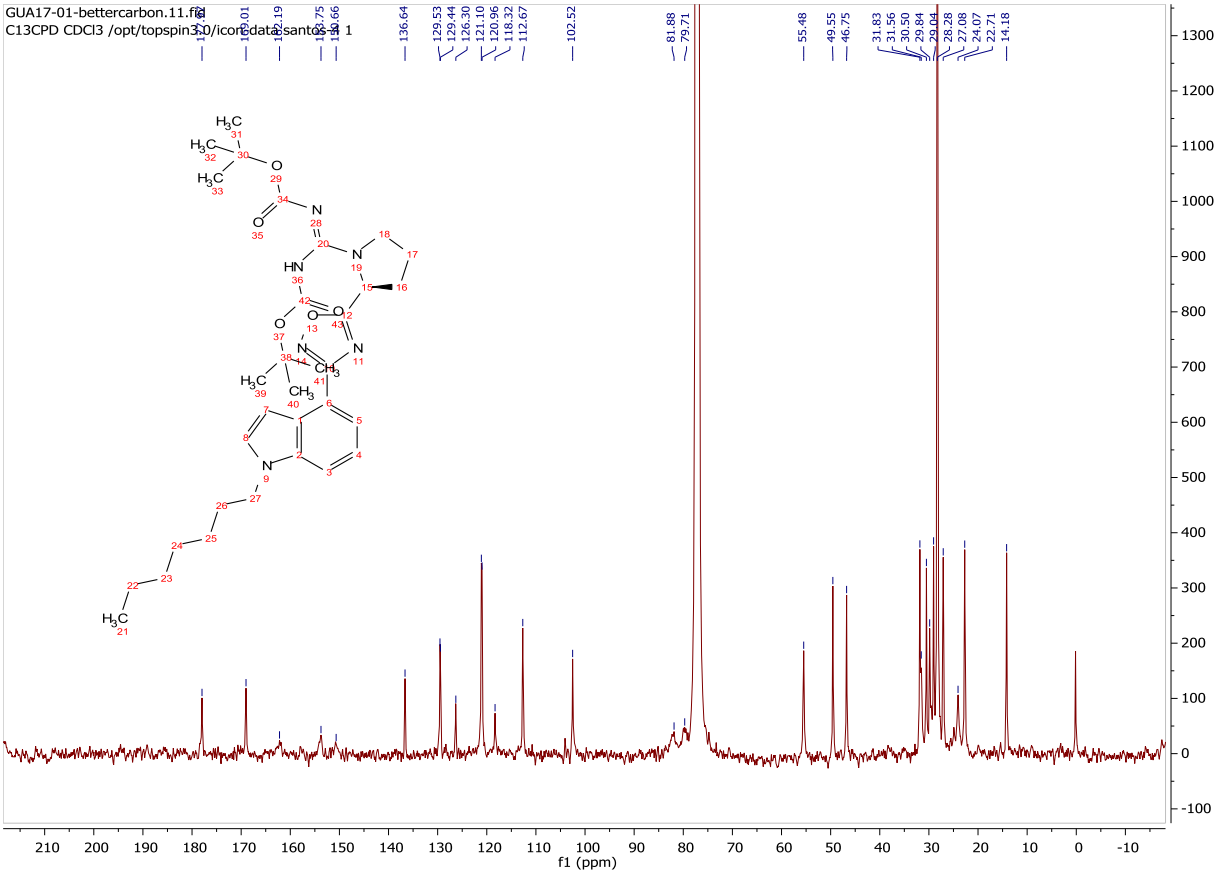
^{13}C-NMR Spectrum for Compound 4.11d:



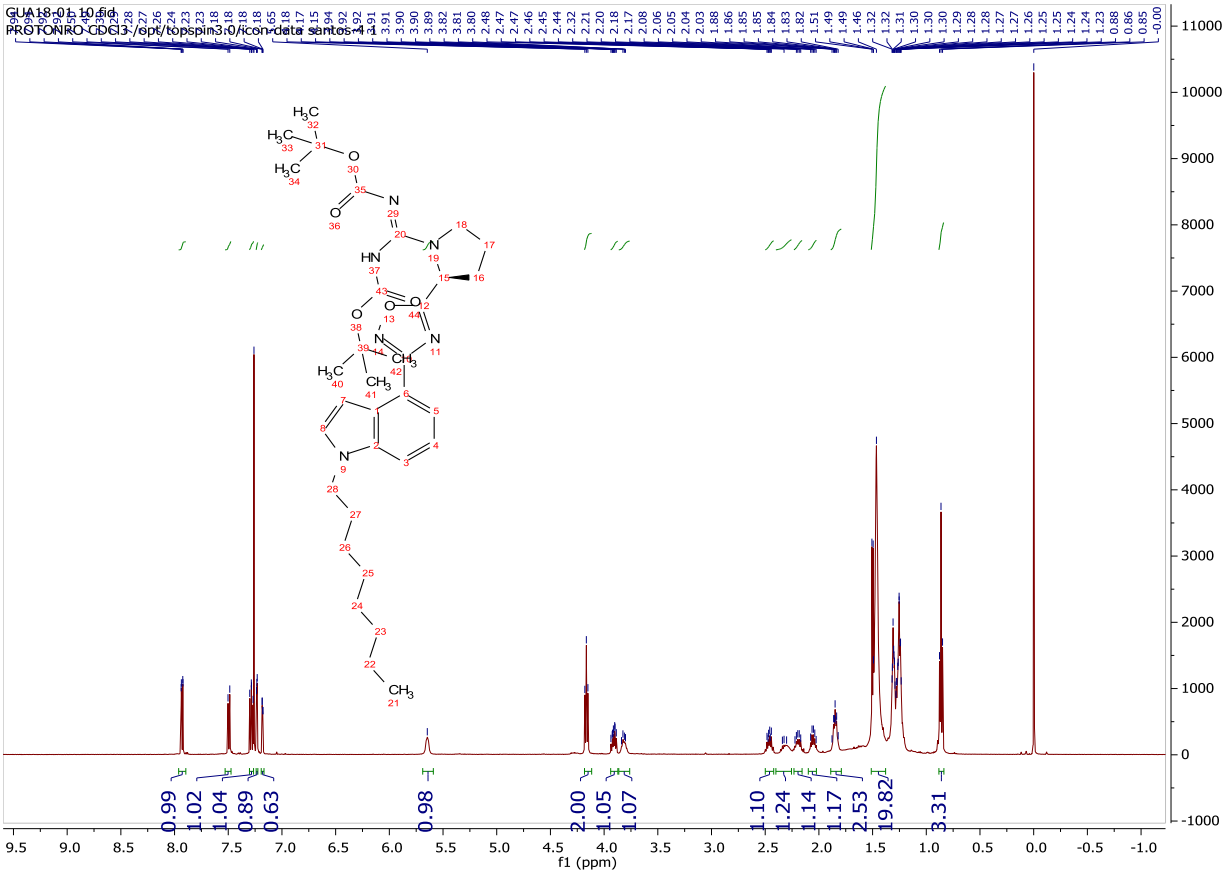
^{1}H-NMR Spectrum for Compound 4.13a:



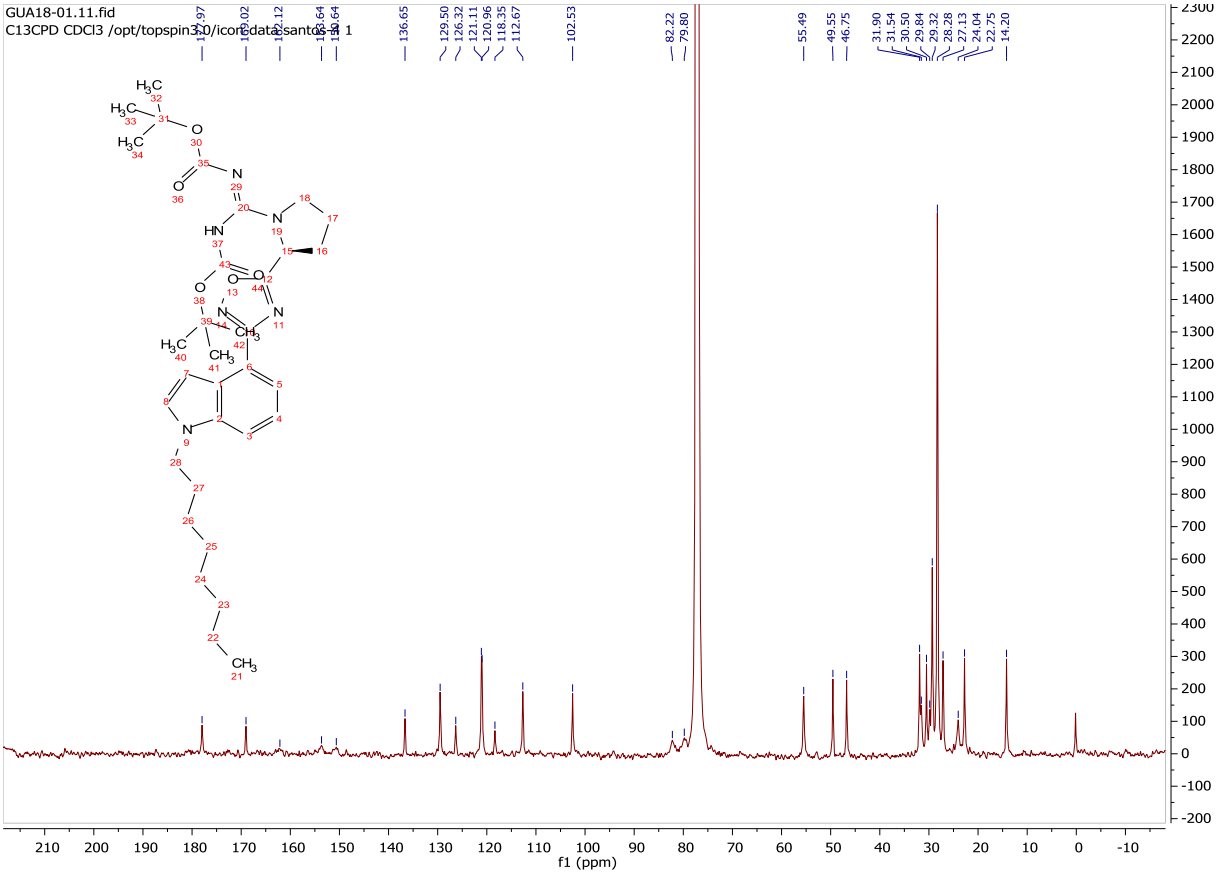
^{13}C-NMR Spectrum for Compound 4.13a:



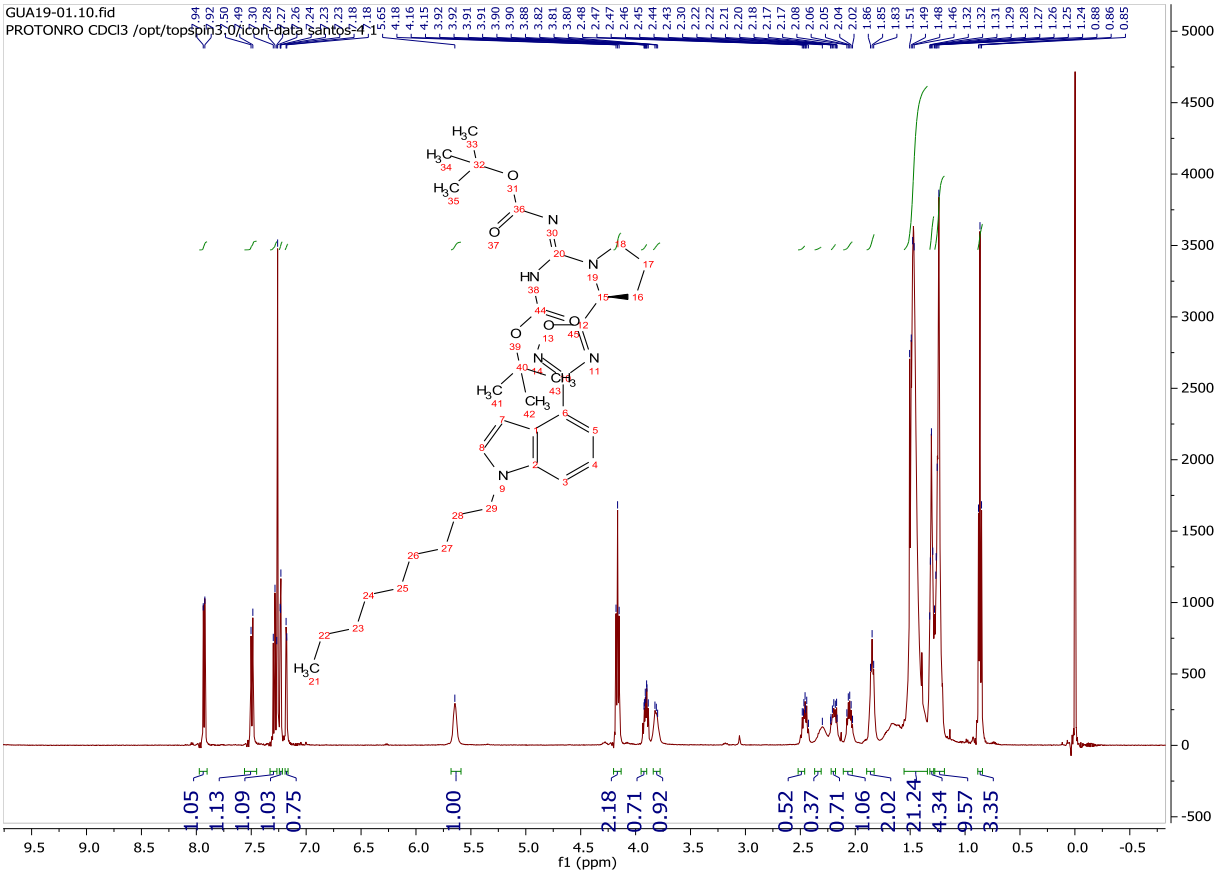
^{1}H-NMR Spectrum for Compound 4.13b:



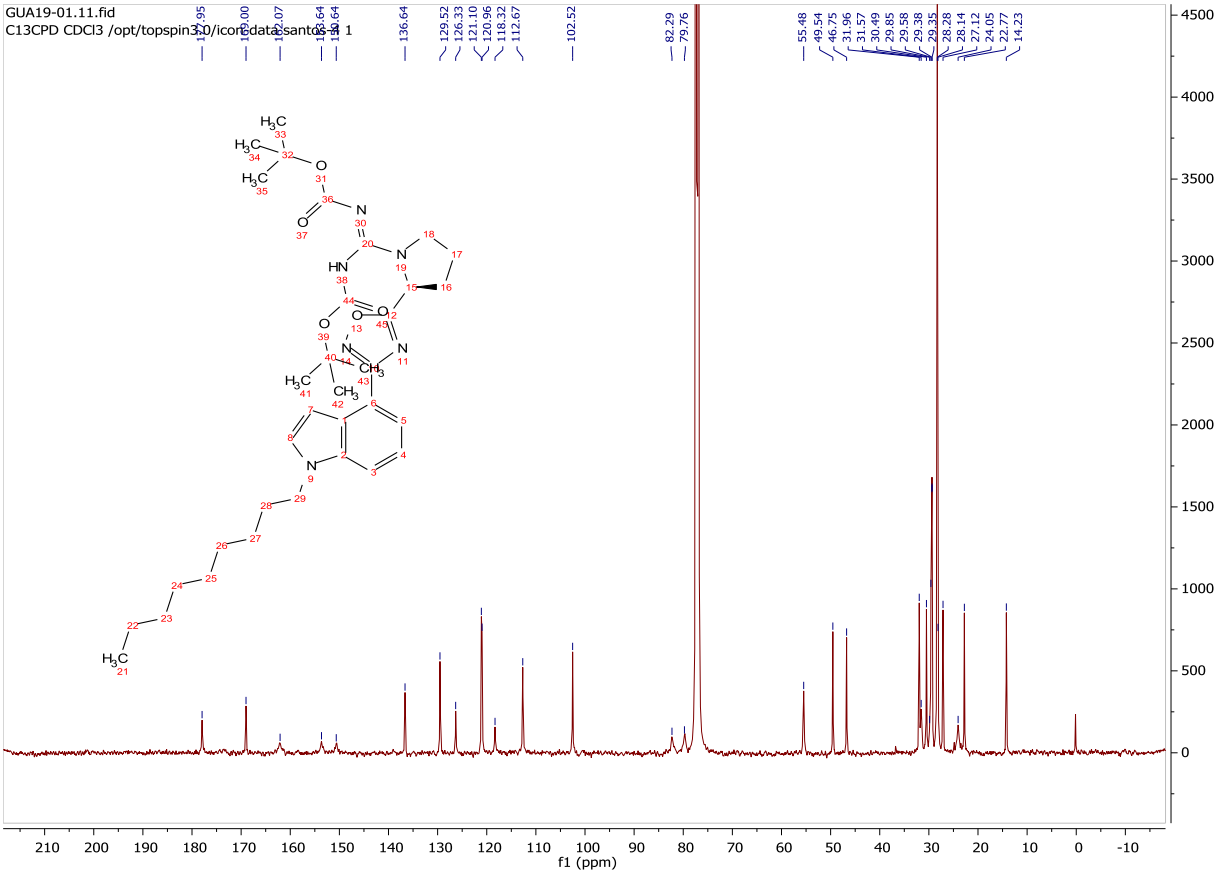
^{13}C-NMR Spectrum for Compound 4.13b:



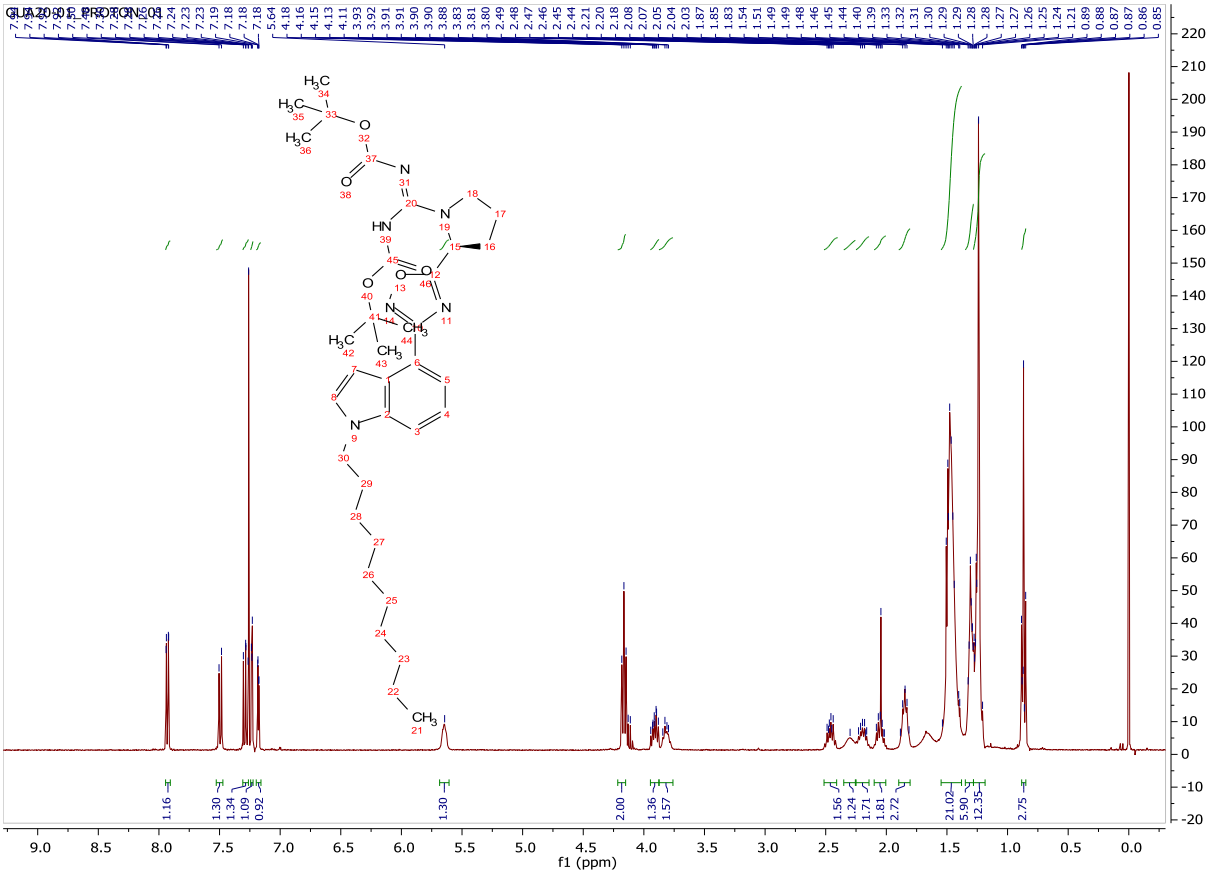
^{1}H-NMR Spectrum for Compound 4.13c:



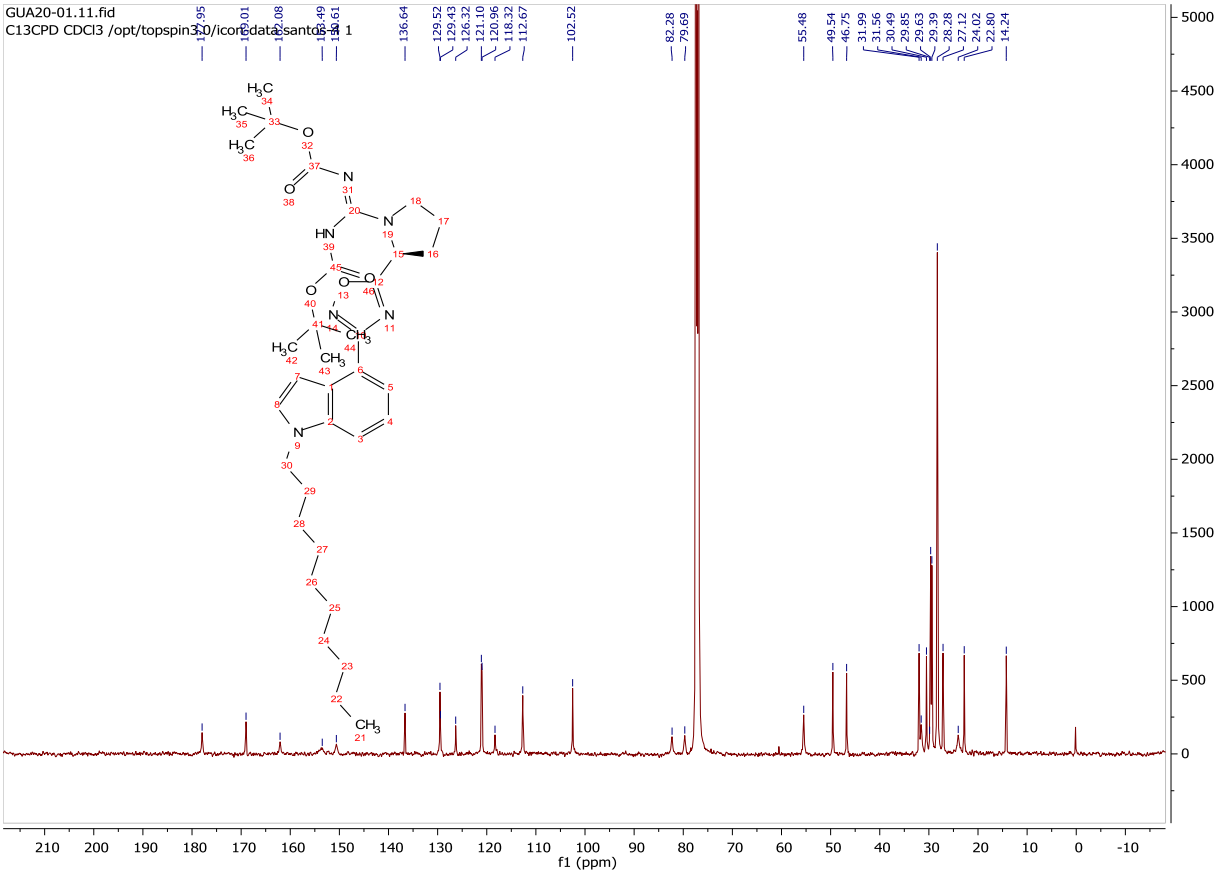
^{13}C-NMR Spectrum for Compound 4.13c:



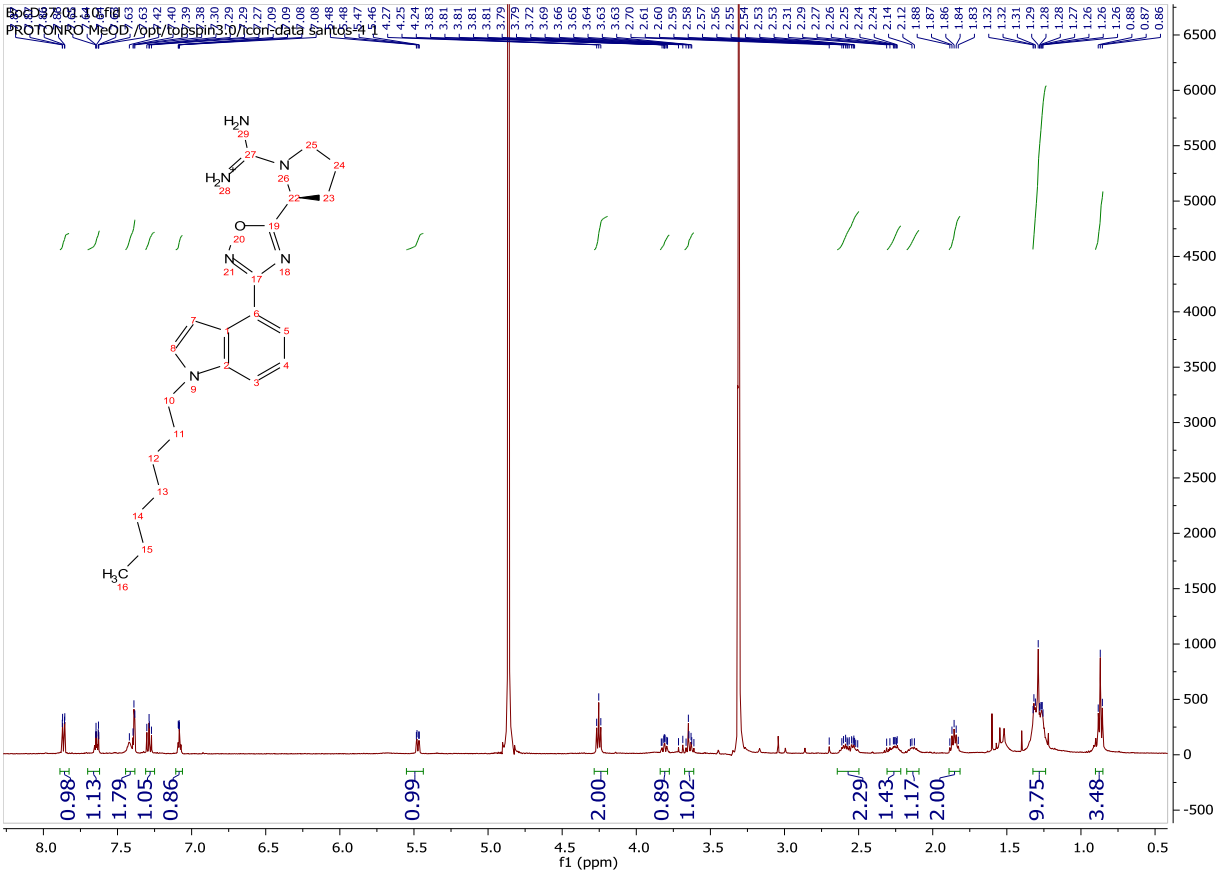
^{1}H-NMR Spectrum for Compound 4.13d:



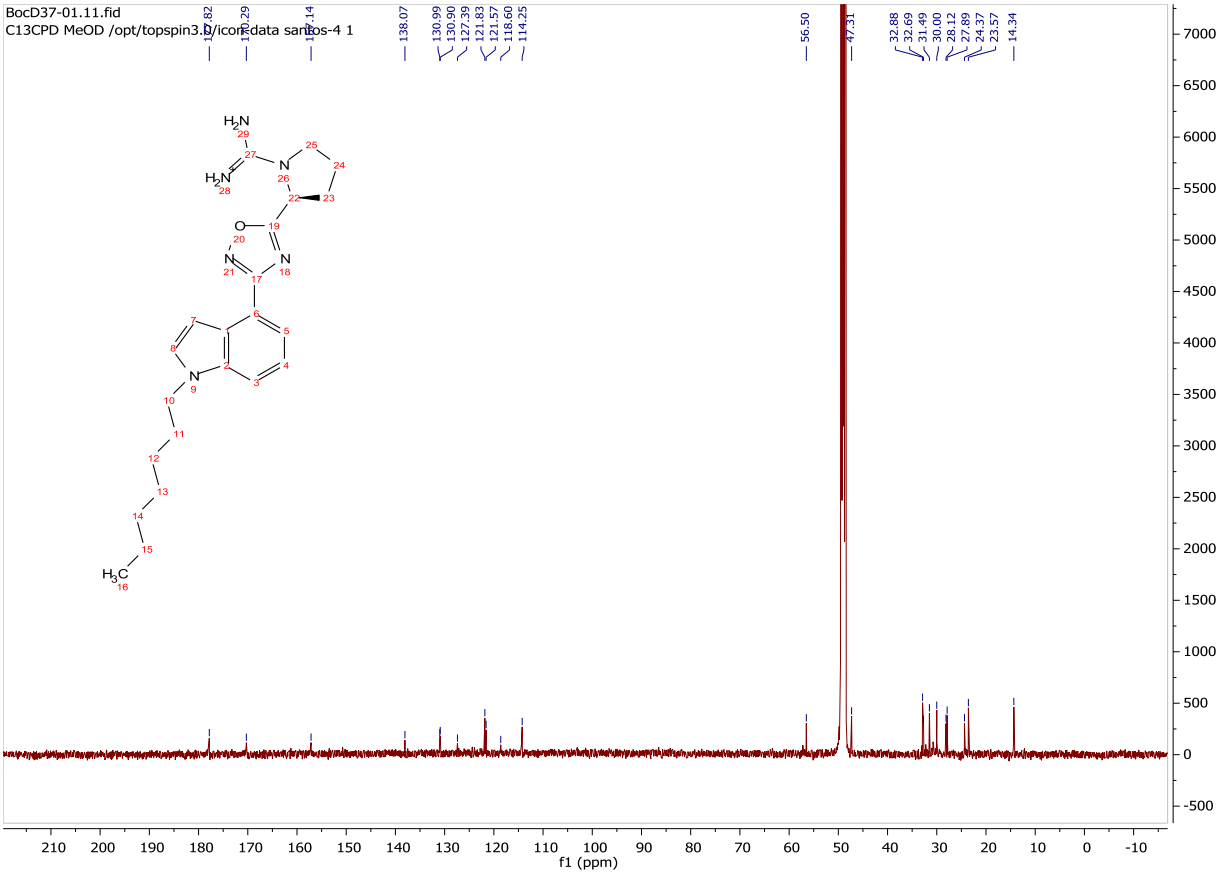
^{13}C-NMR Spectrum for Compound 4.13d:



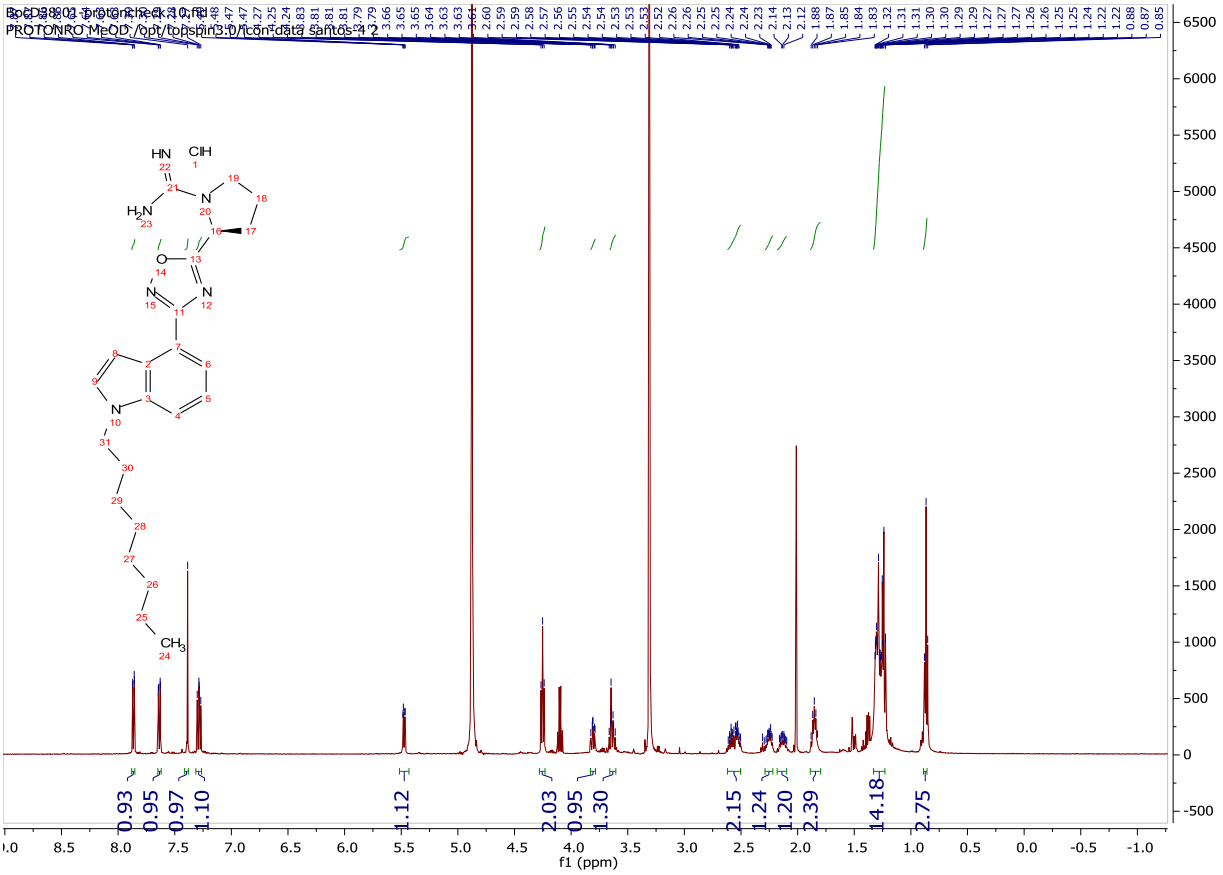
^{1}H-NMR Spectrum for Compound 4.14a:



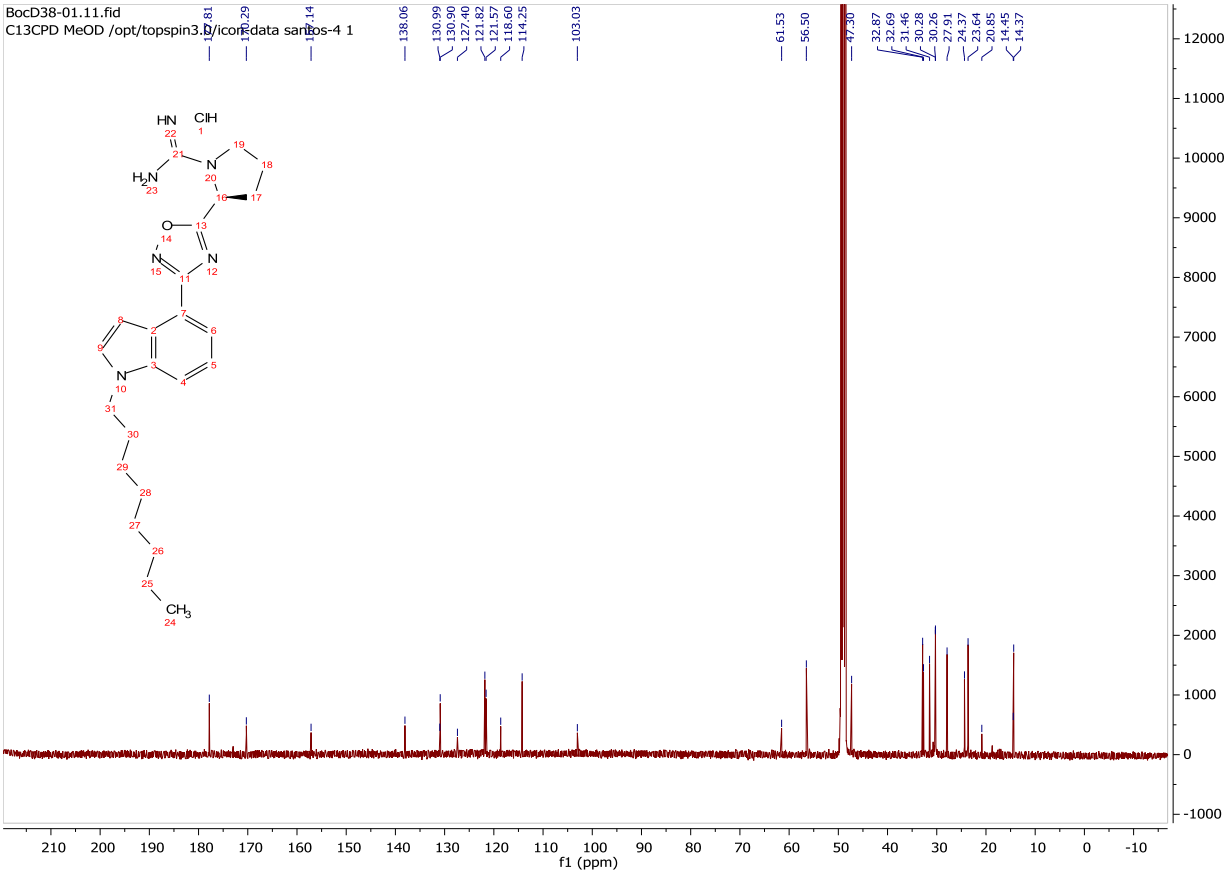
^{13}C-NMR Spectrum for Compound 4.14a:



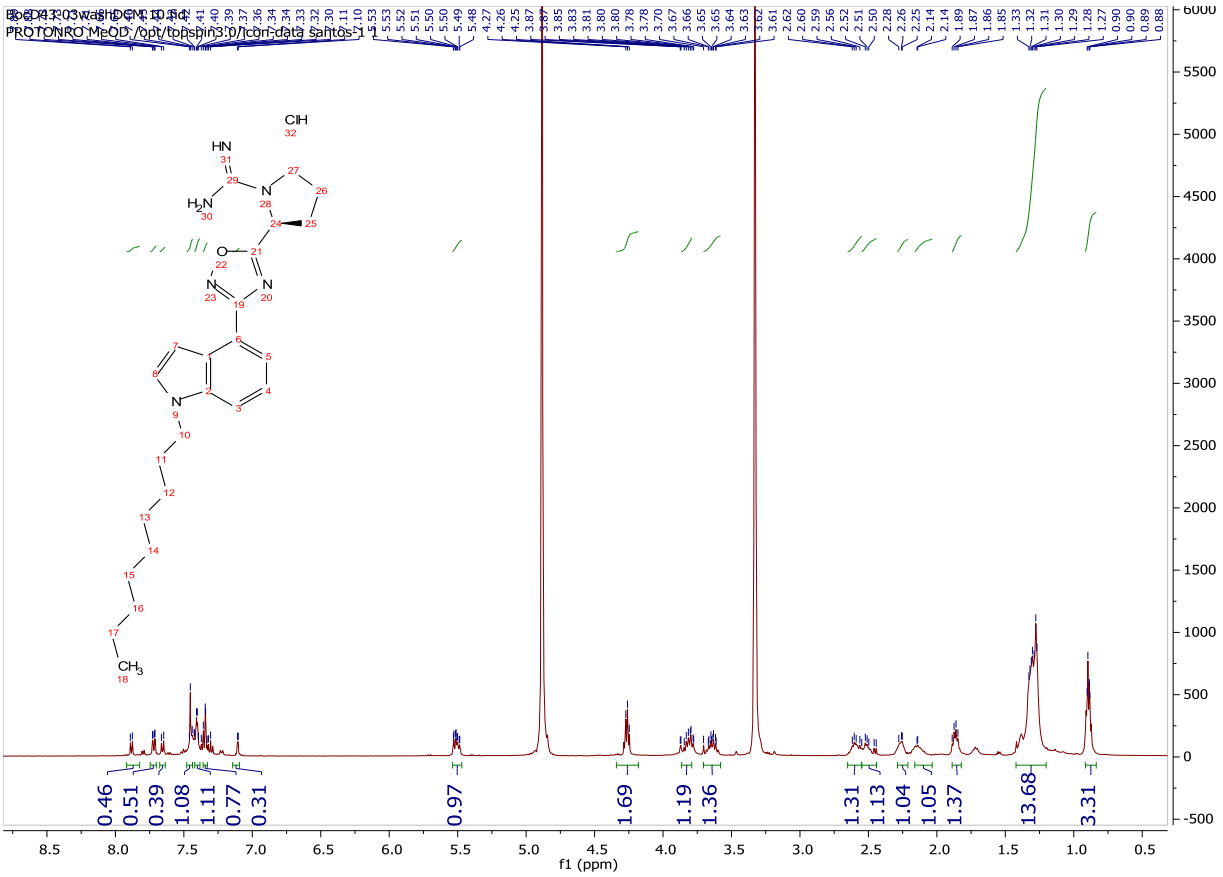
^{1}H-NMR Spectrum for Compound 4.14b:



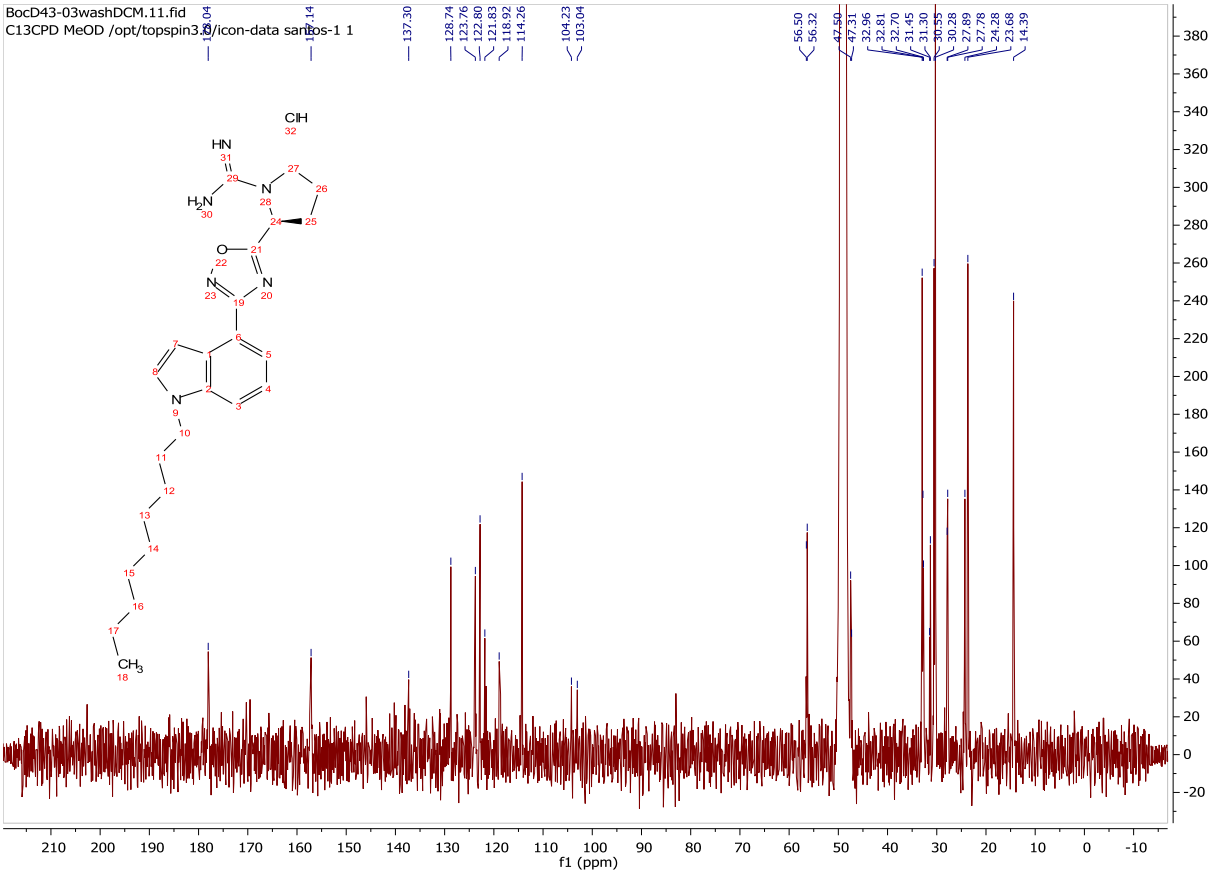
^{13}C-NMR Spectrum for Compound 4.14b:



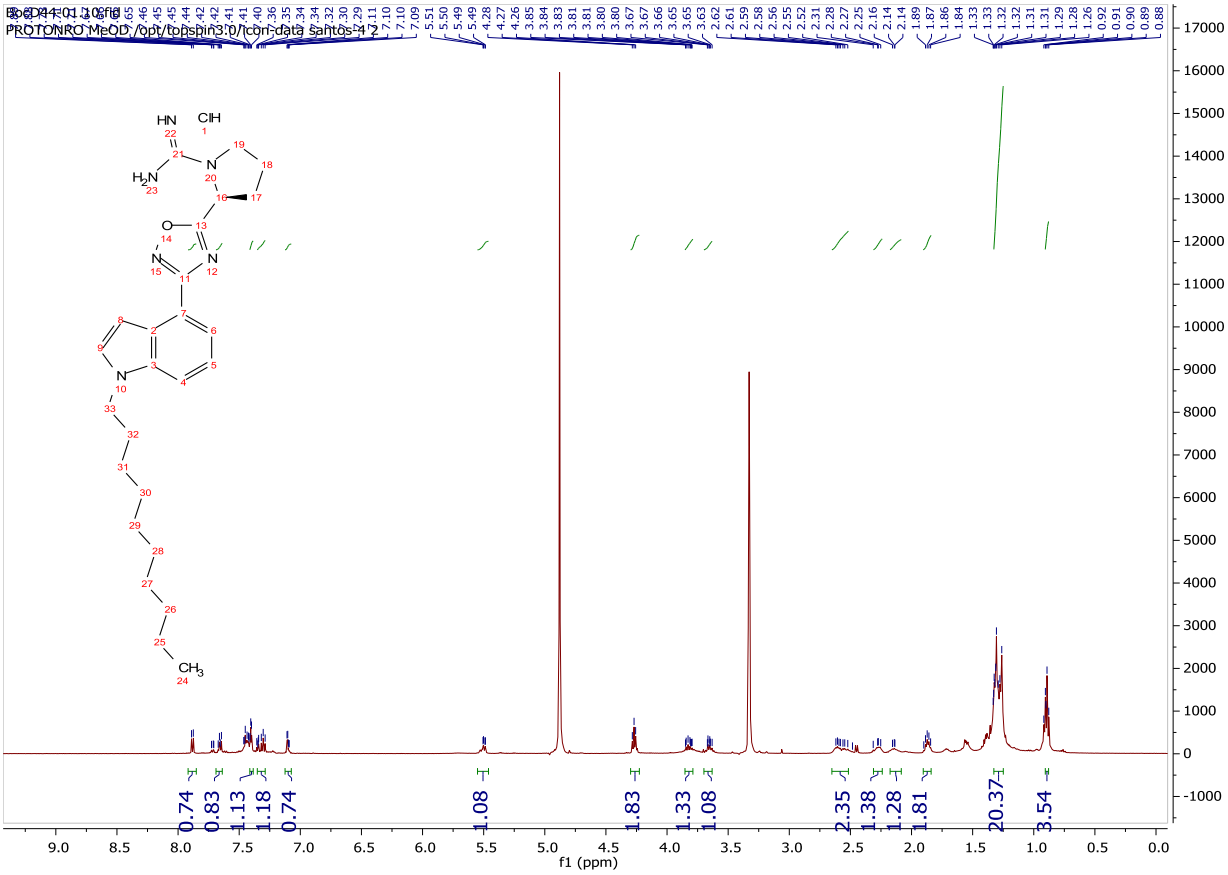
^{1}H-NMR Spectrum for Compound 4.14c:



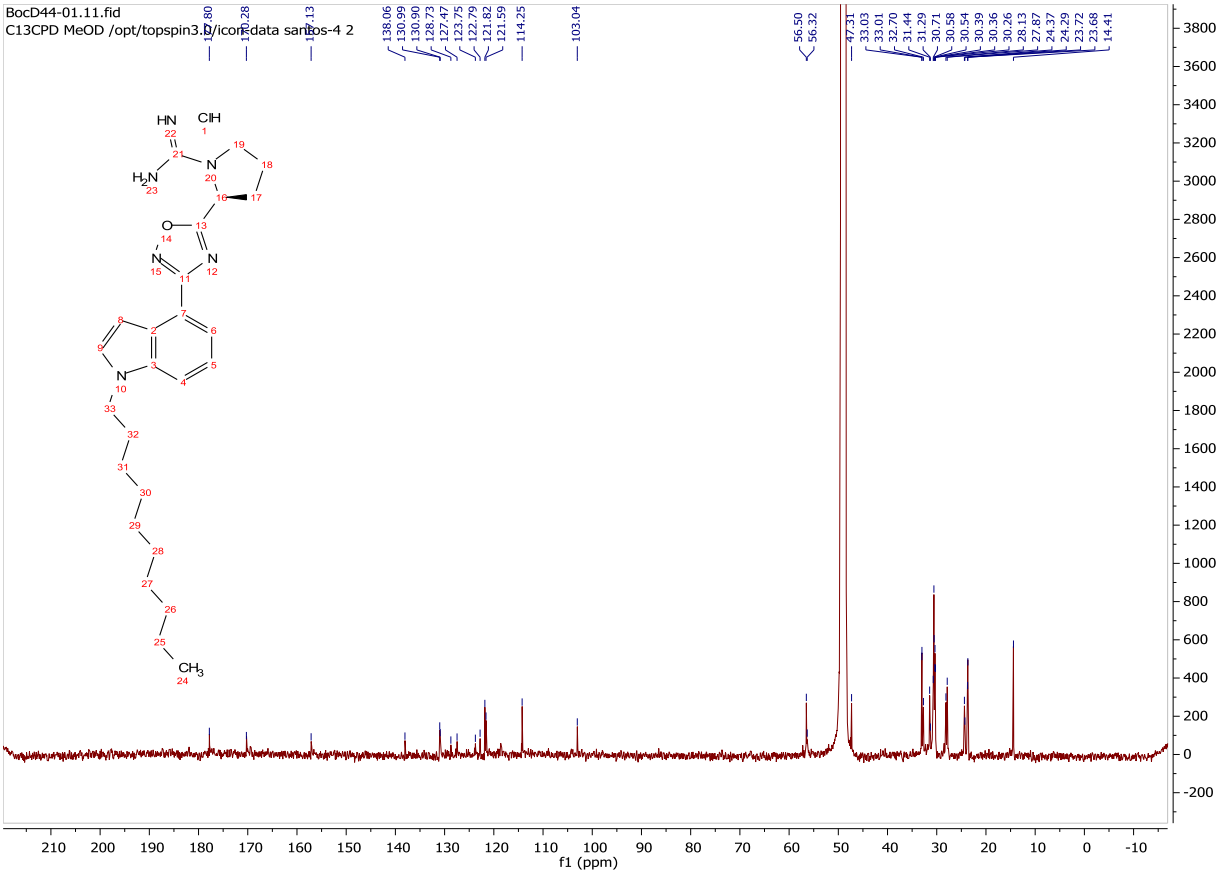
^{13}C-NMR Spectrum for Compound 4.14c:



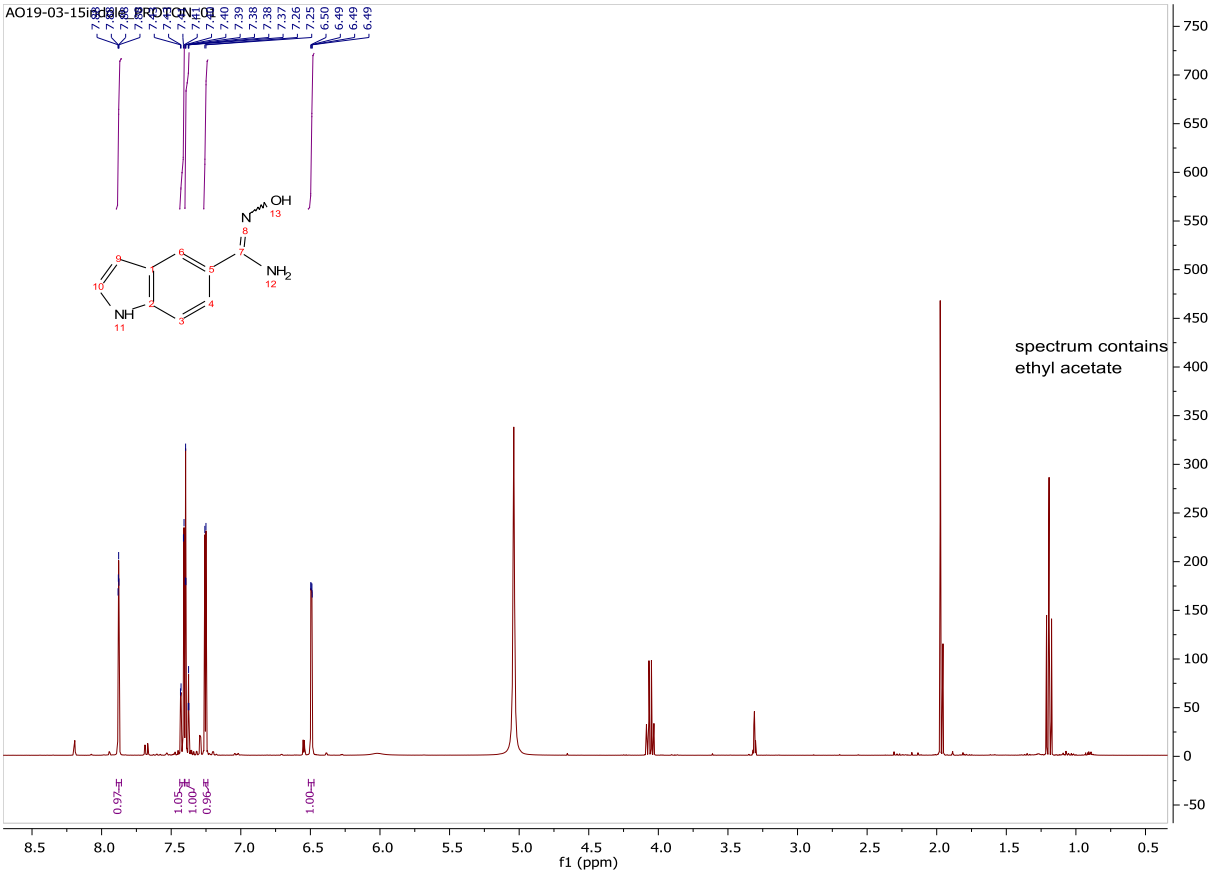
^{1}H-NMR Spectrum for Compound 4.14d:



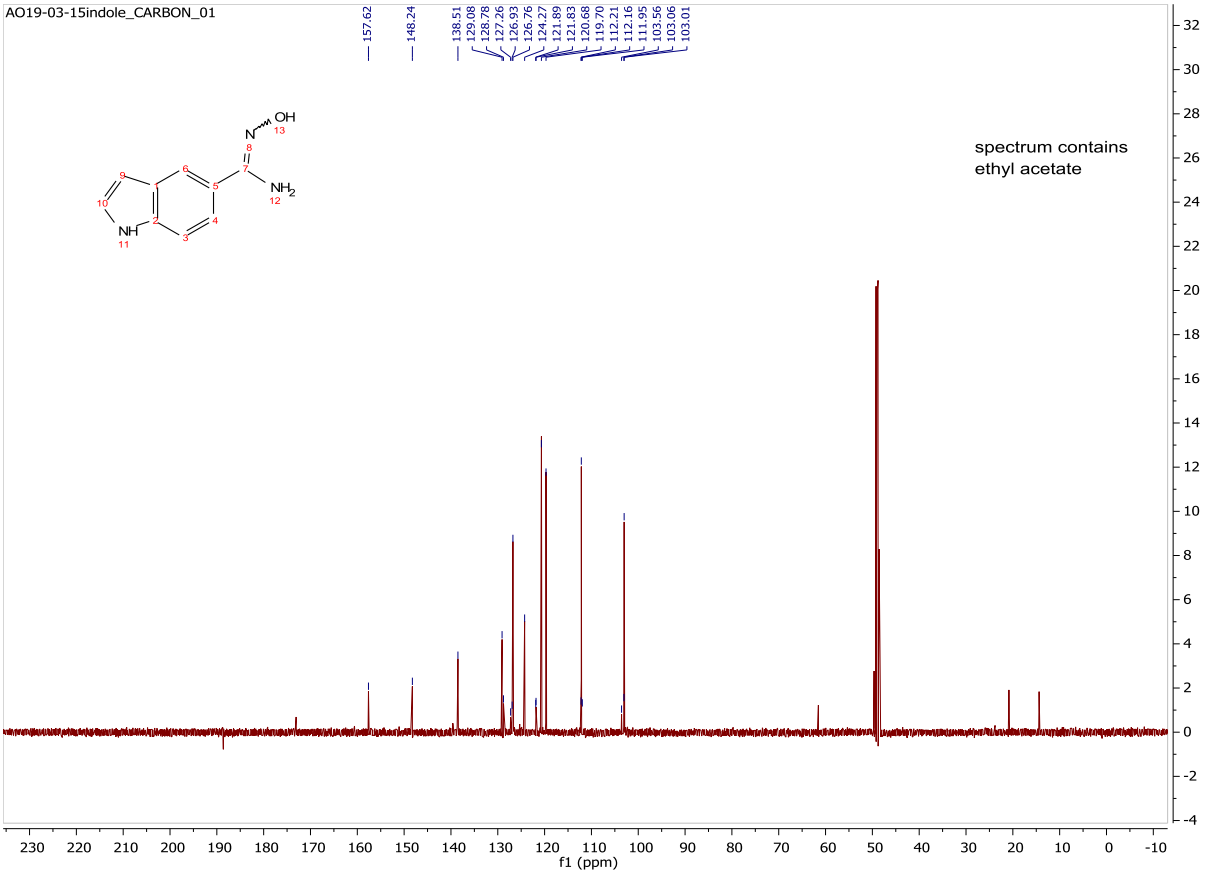
^{13}C-NMR Spectrum for Compound 4.14d:



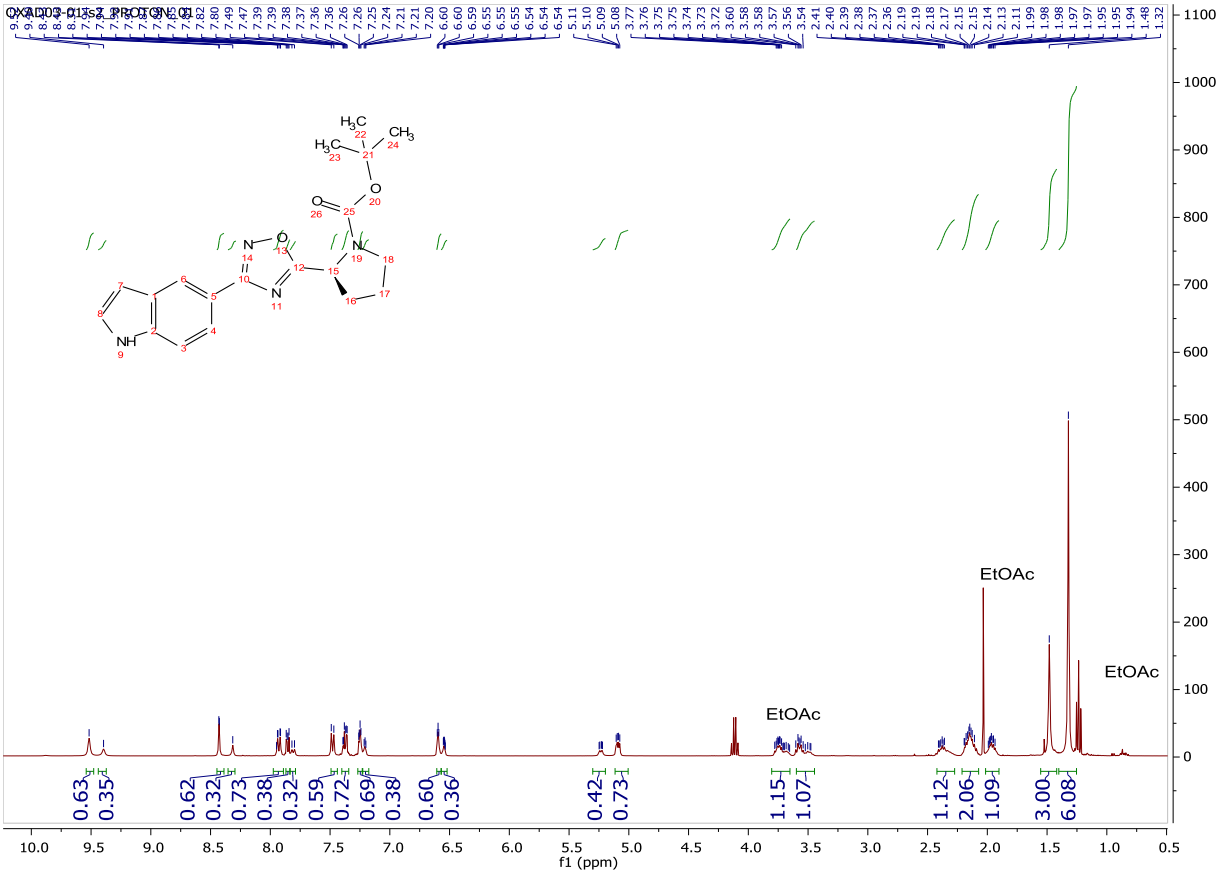
^{1}H-NMR Spectrum for Compound 4.16:



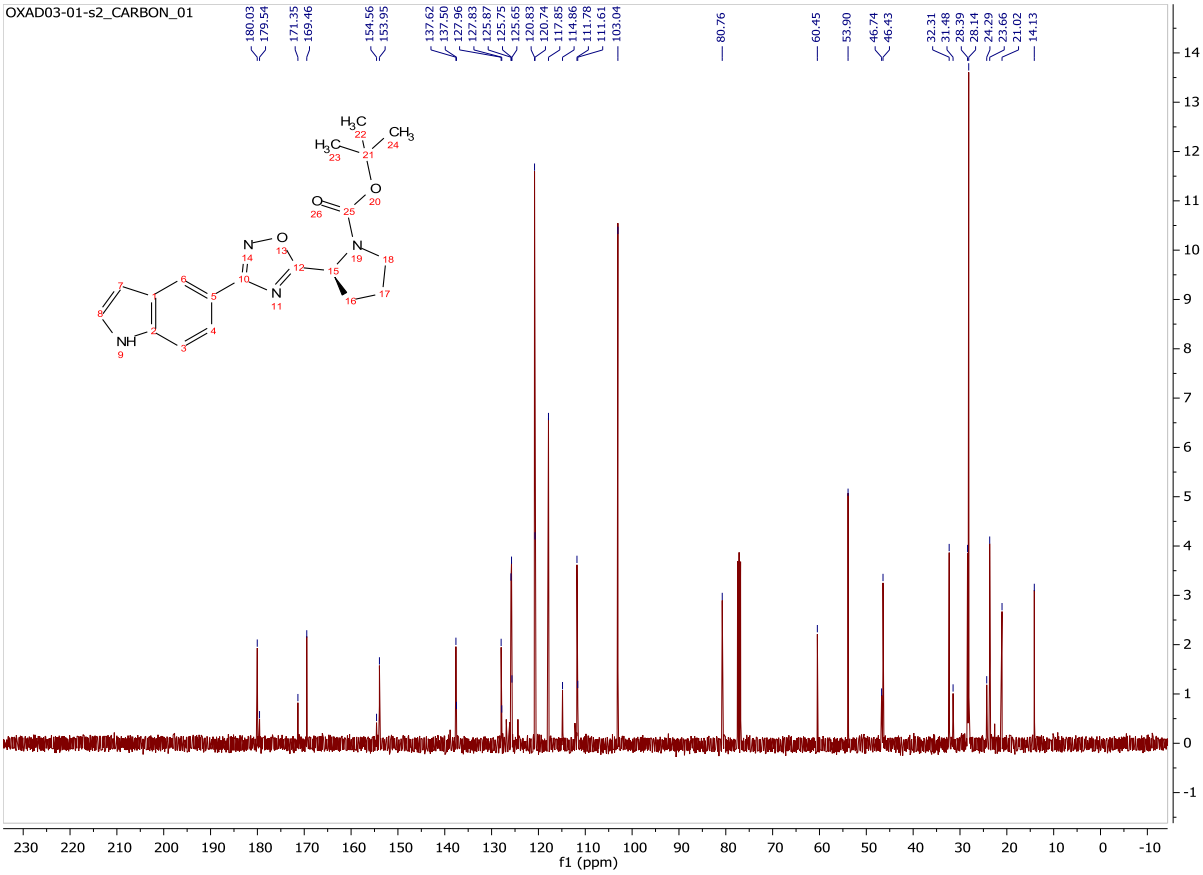
^{13}C-NMR Spectrum for Compound 4.16:



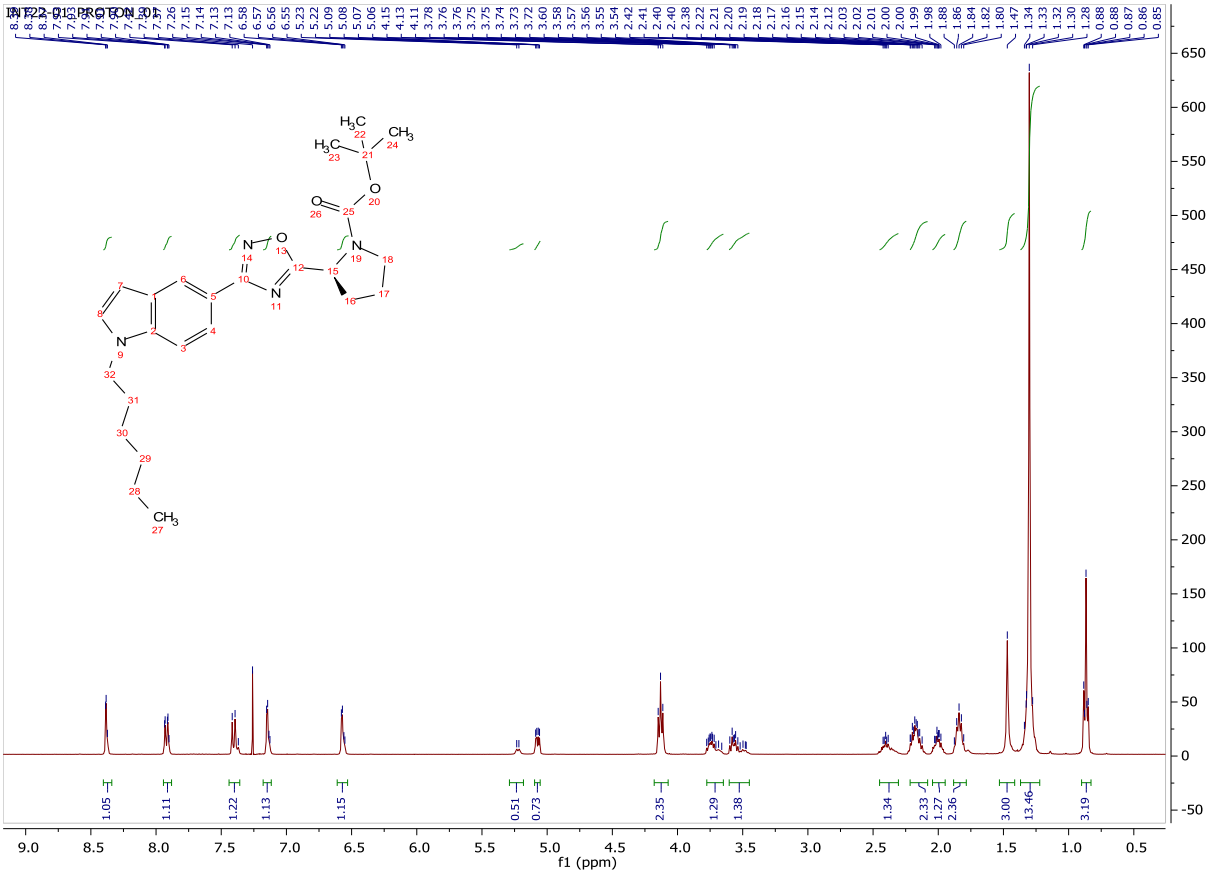
^{1}H-NMR Spectrum for Compound 4.17:



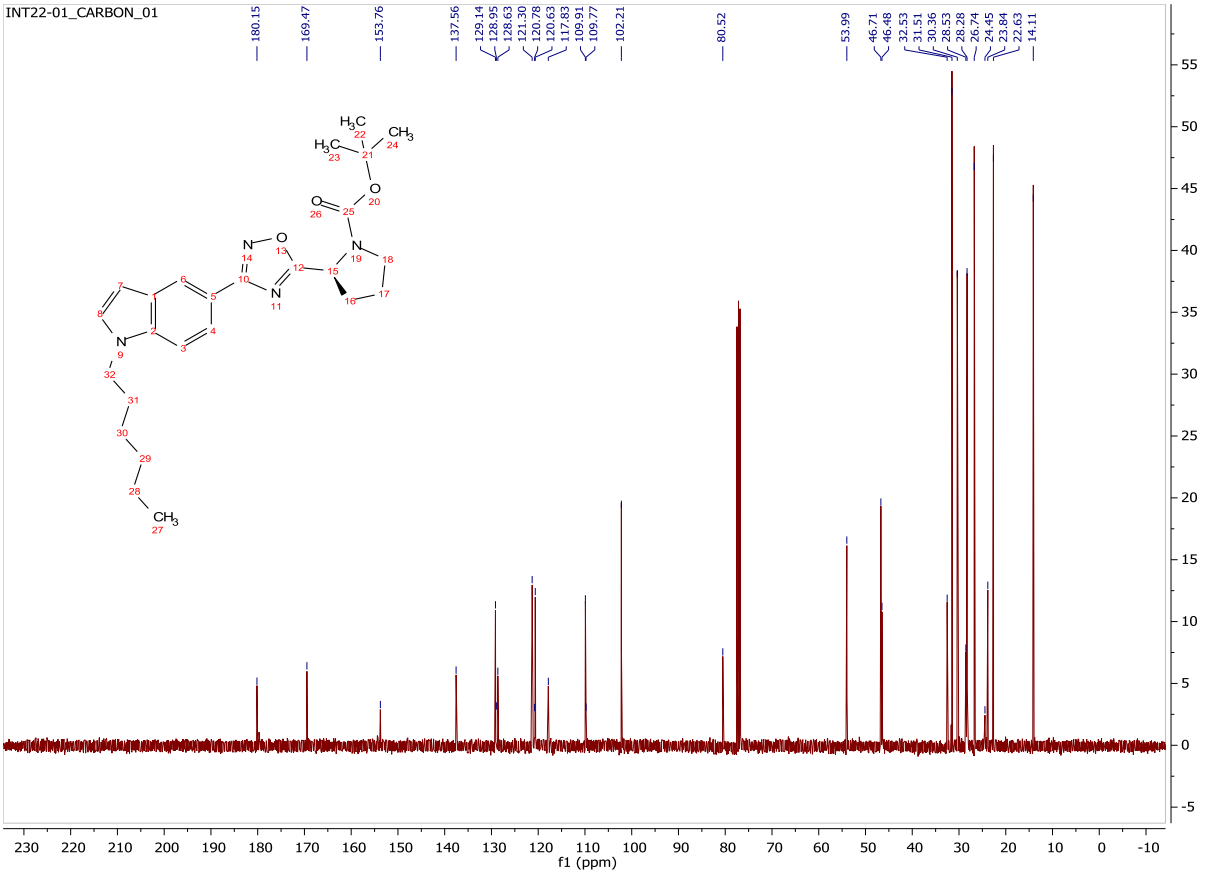
^{13}C-NMR Spectrum for Compound 4.17:



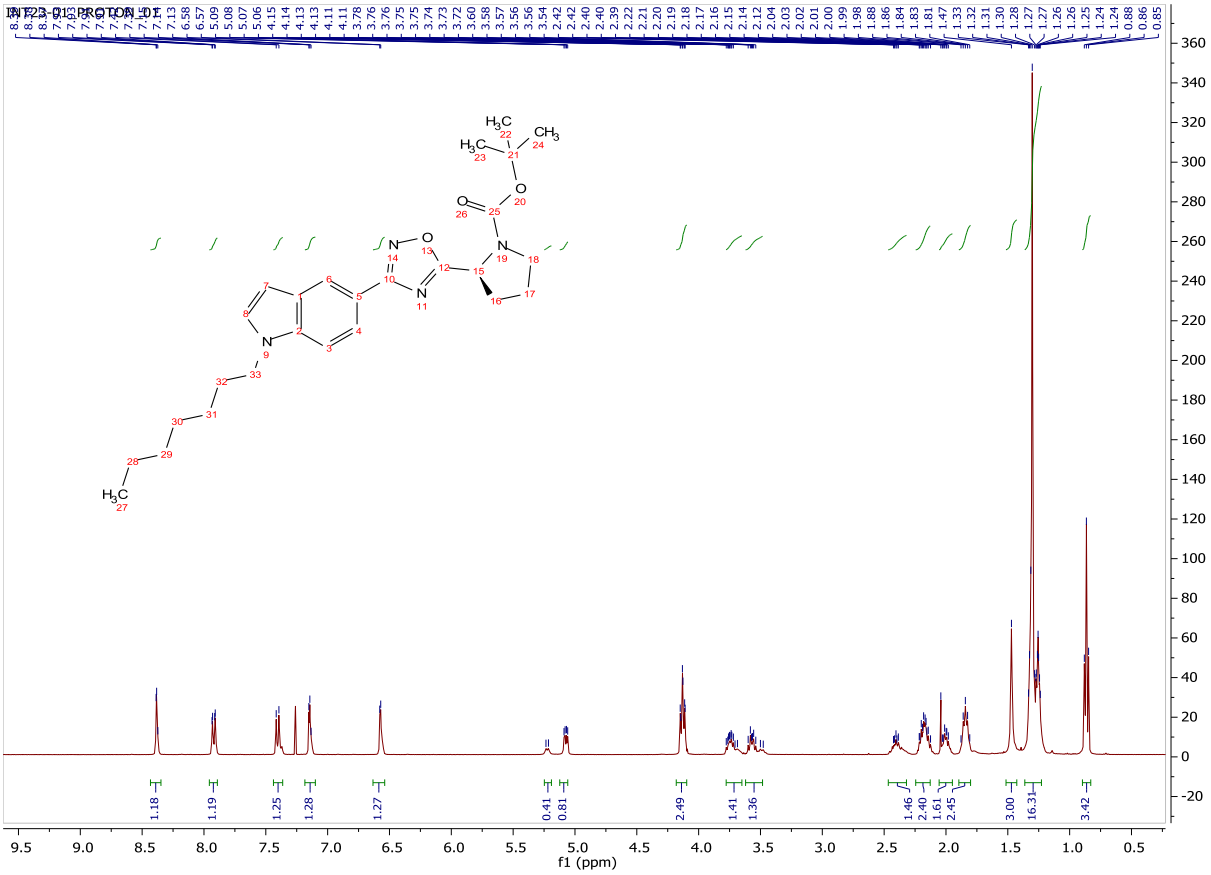
^{1}H-NMR Spectrum for Compound 4.18a:



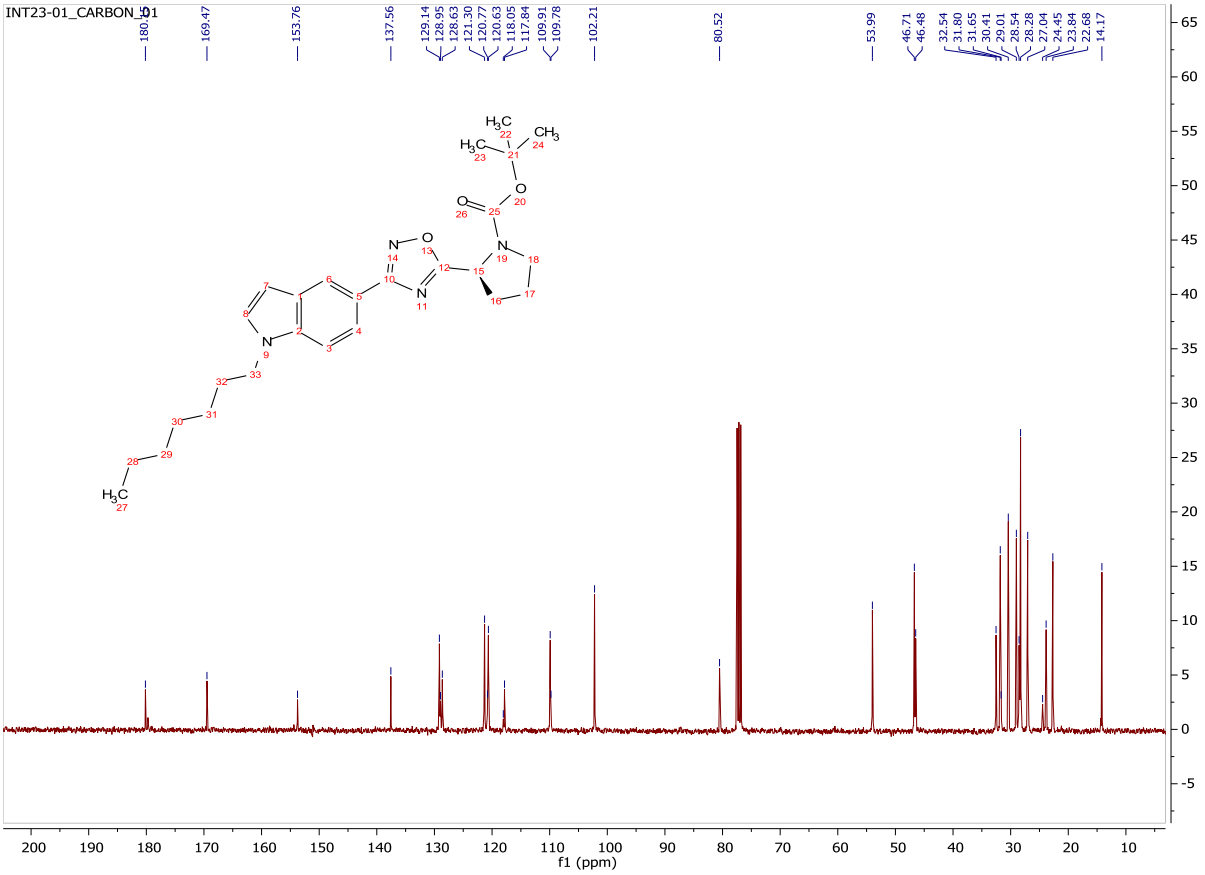
^{13}C-NMR Spectrum for Compound 4.18a:



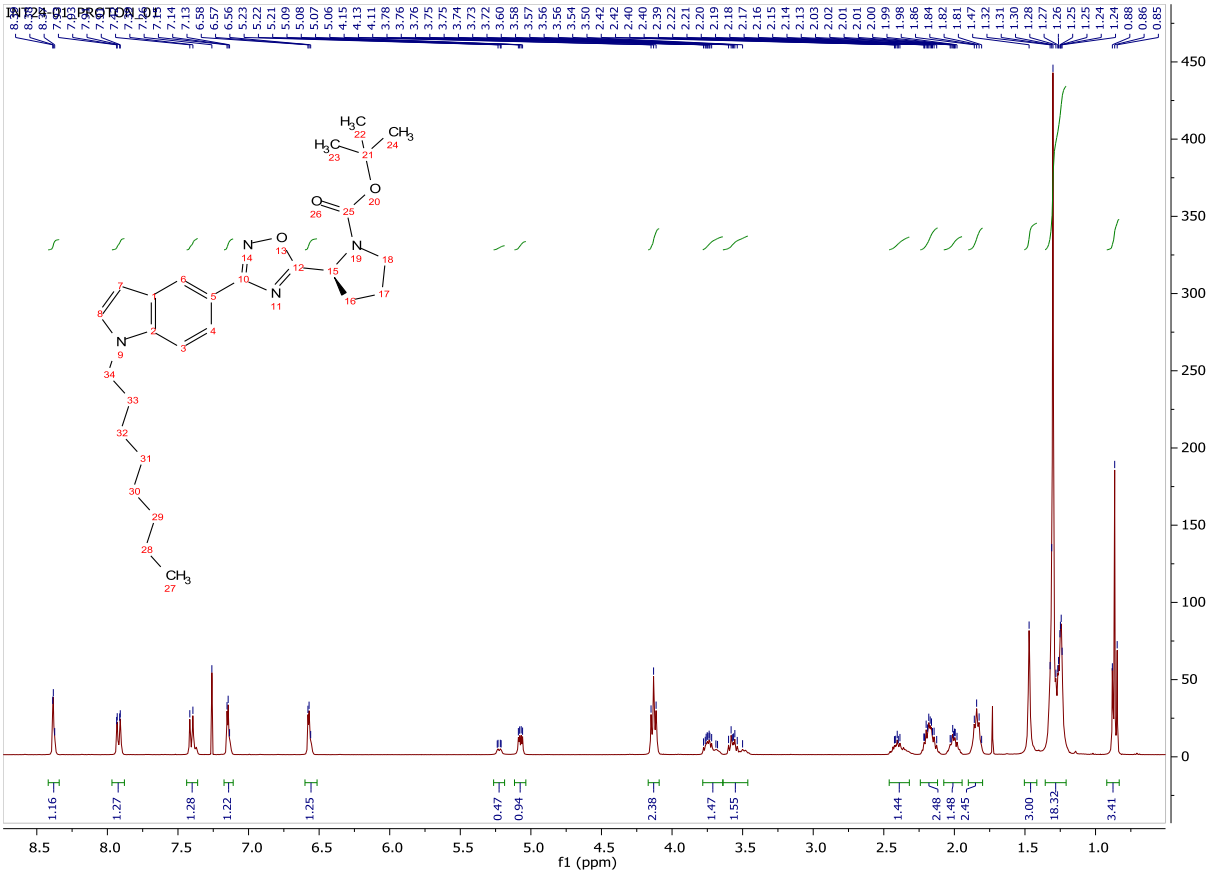
^{1}H-NMR Spectrum for Compound 4.18b:



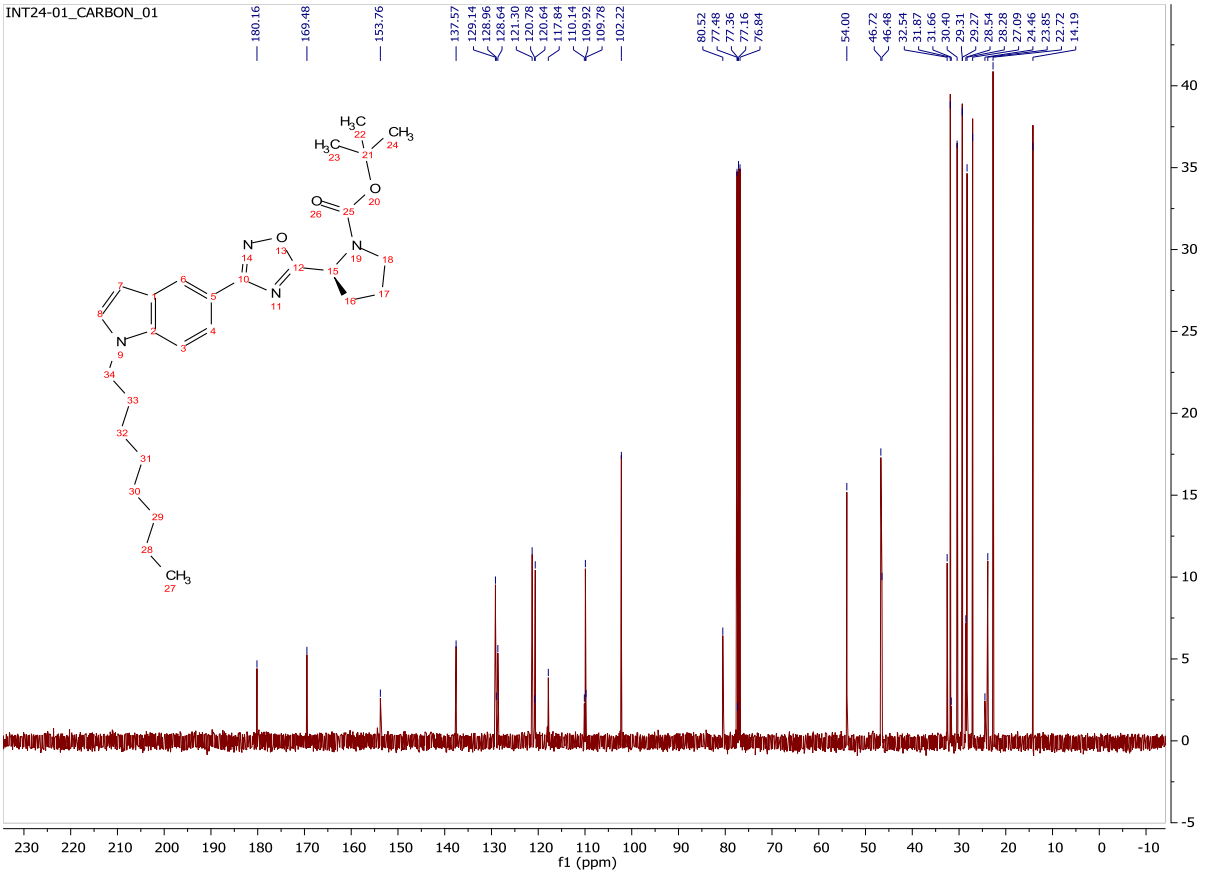
^{13}C-NMR Spectrum for Compound 4.18b:



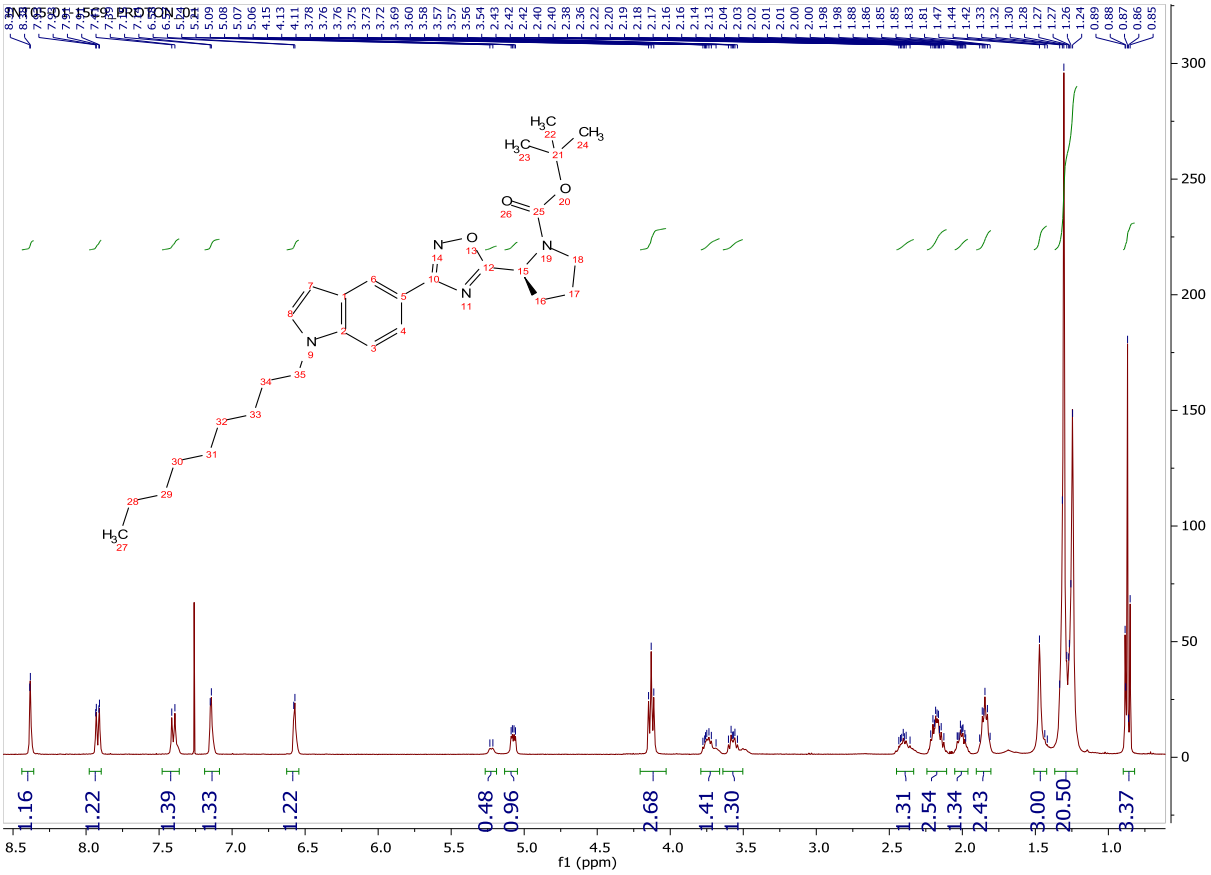
^{1}H-NMR Spectrum for Compound 4.18c:



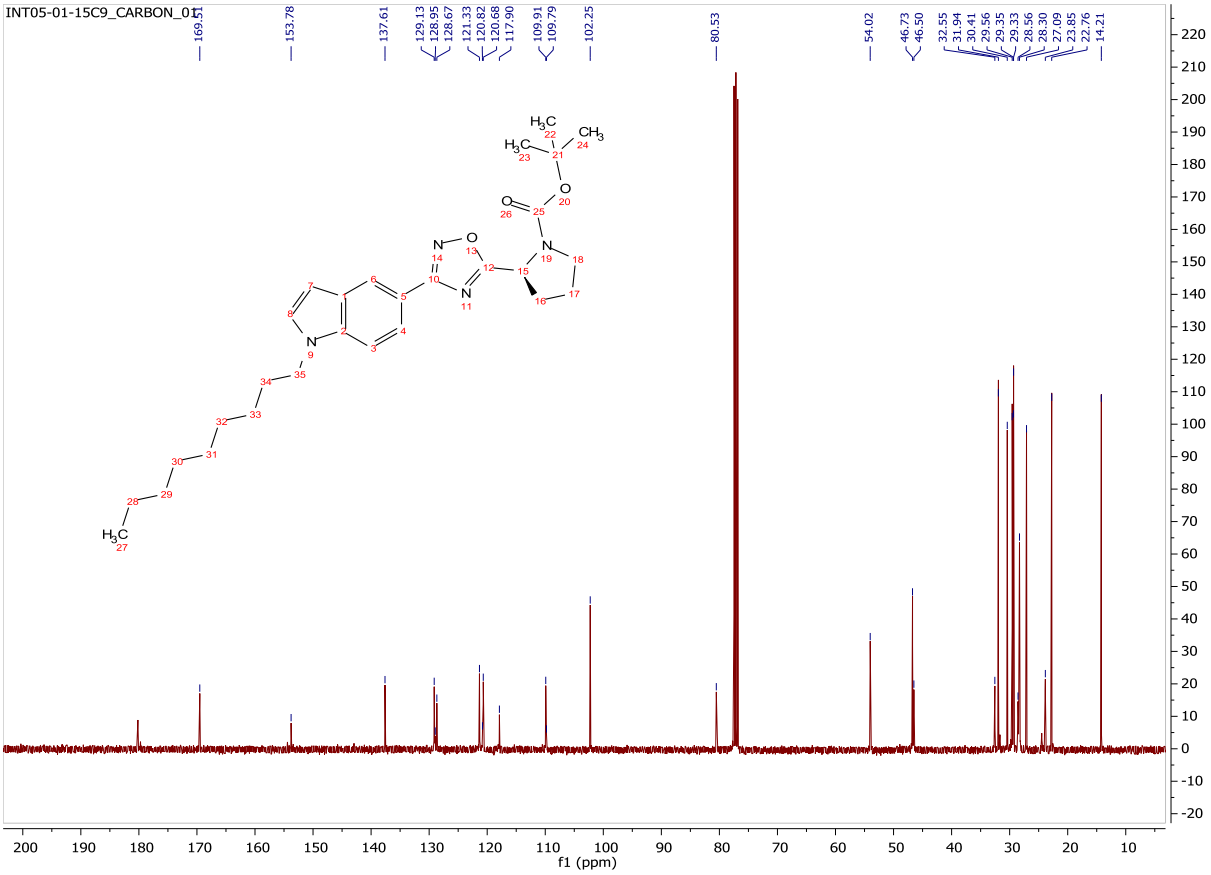
^{13}C-NMR Spectrum for Compound 4.18c:



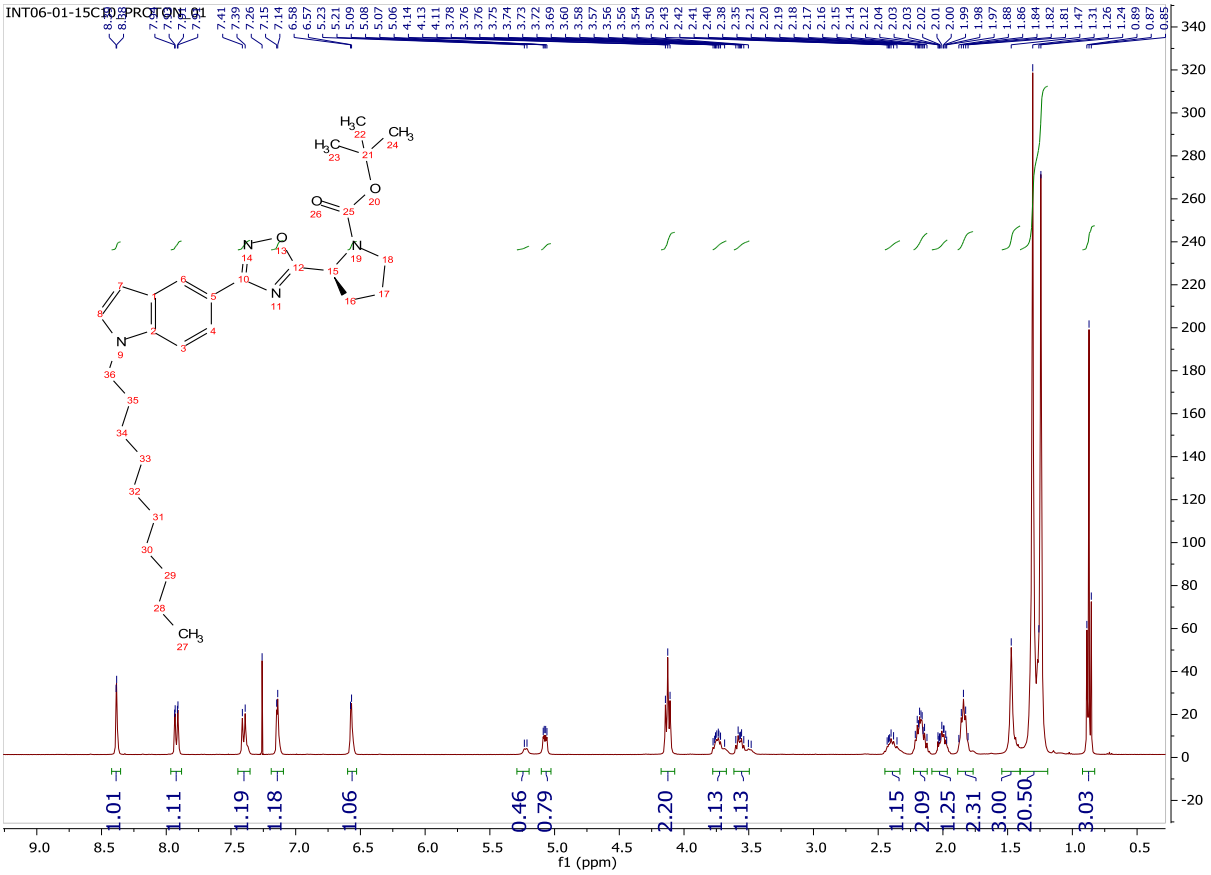
^{1}H-NMR Spectrum for Compound 4.18d:



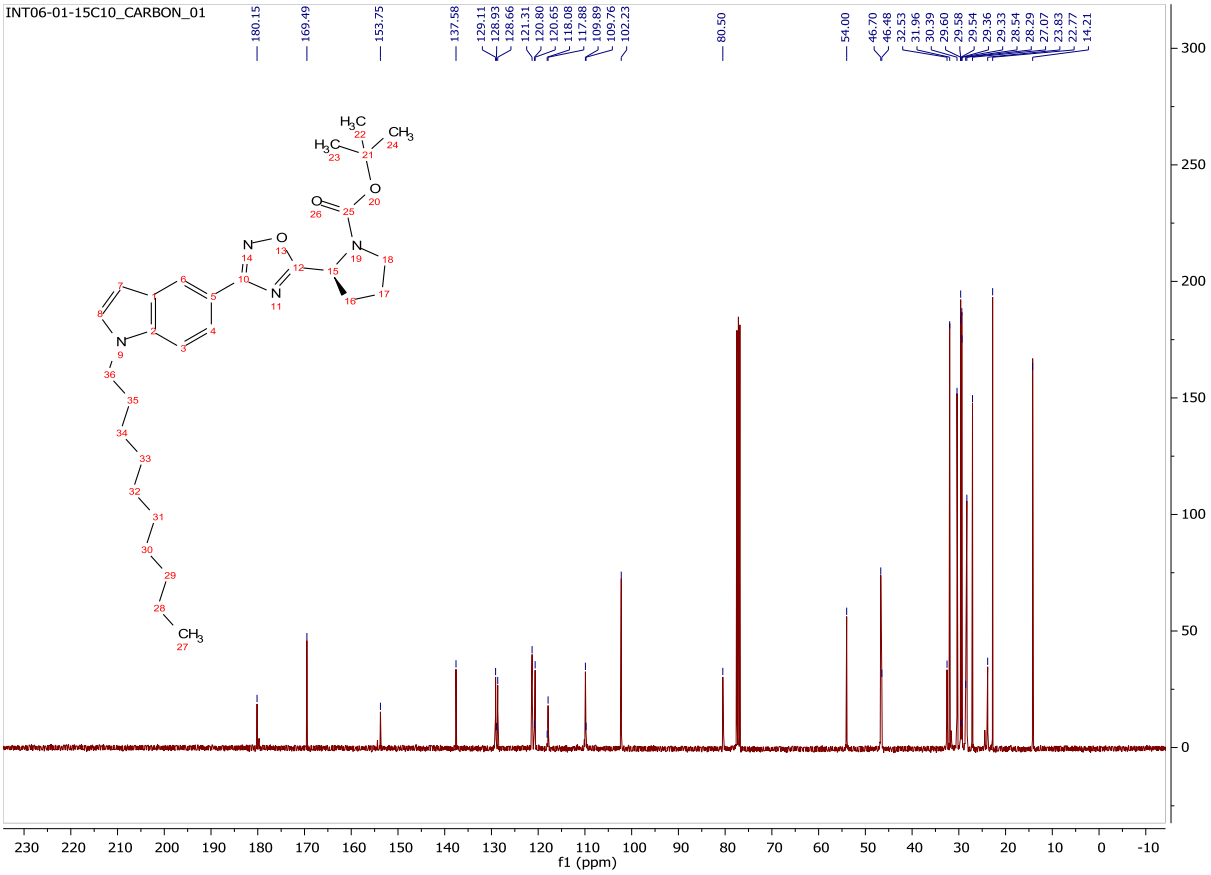
^{13}C-NMR Spectrum for Compound 4.18d:



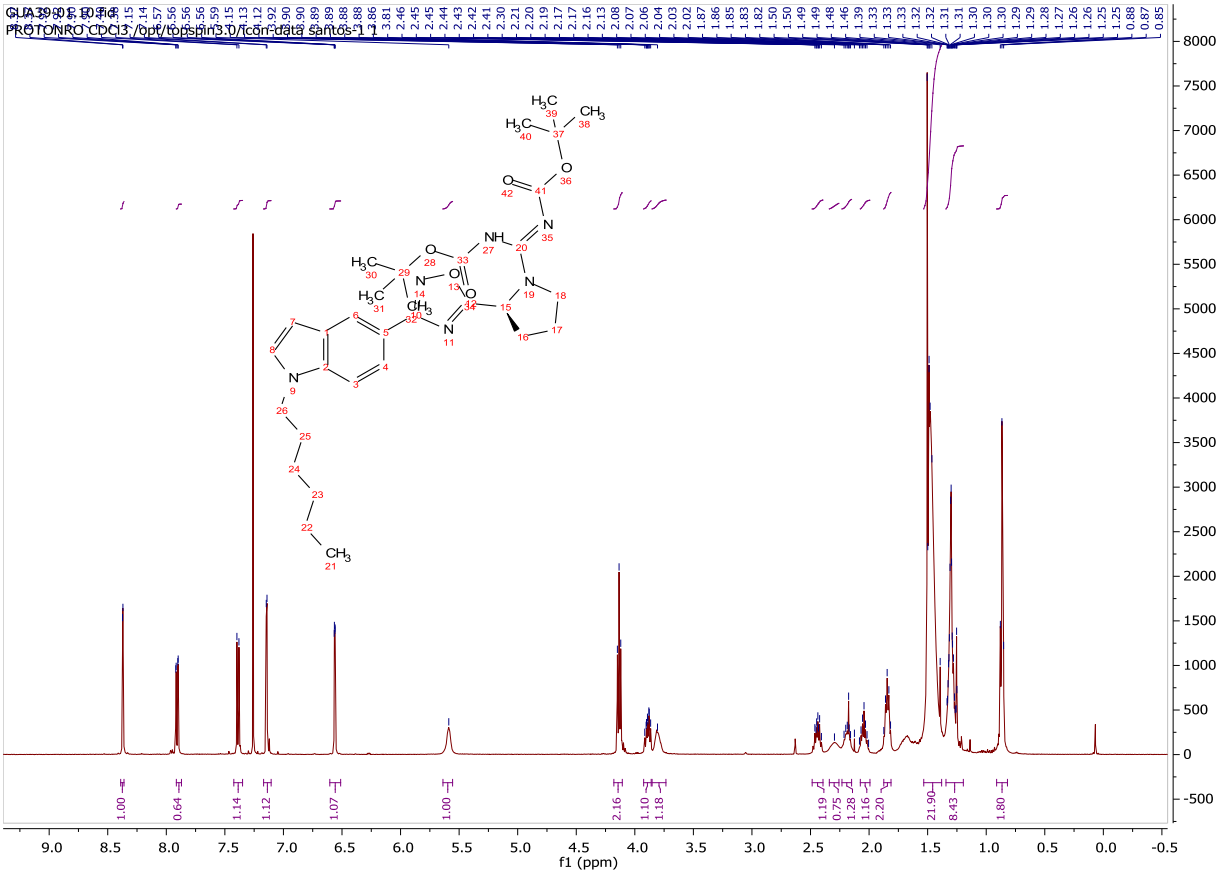
^{1}H-NMR Spectrum for Compound 4.18e:



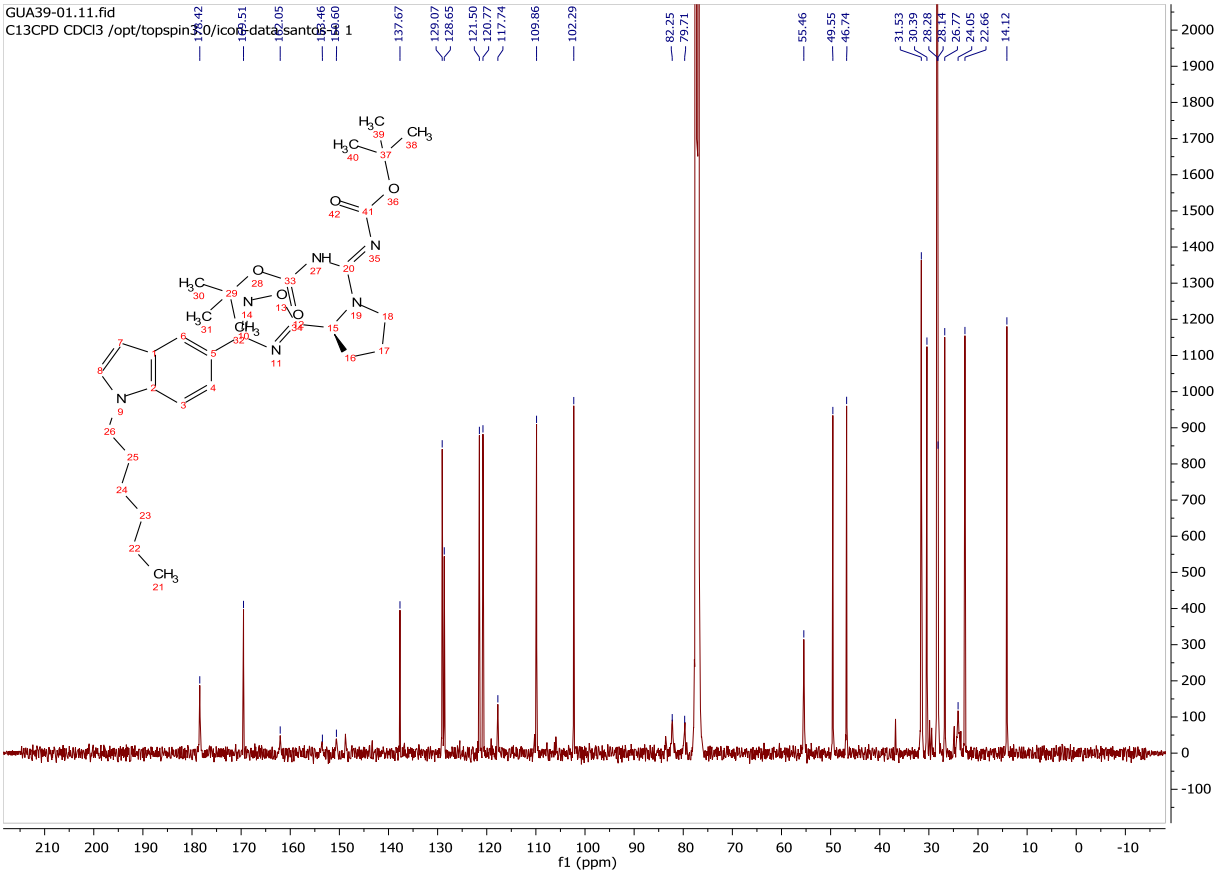
^{13}C-NMR Spectrum for Compound 4.18e:



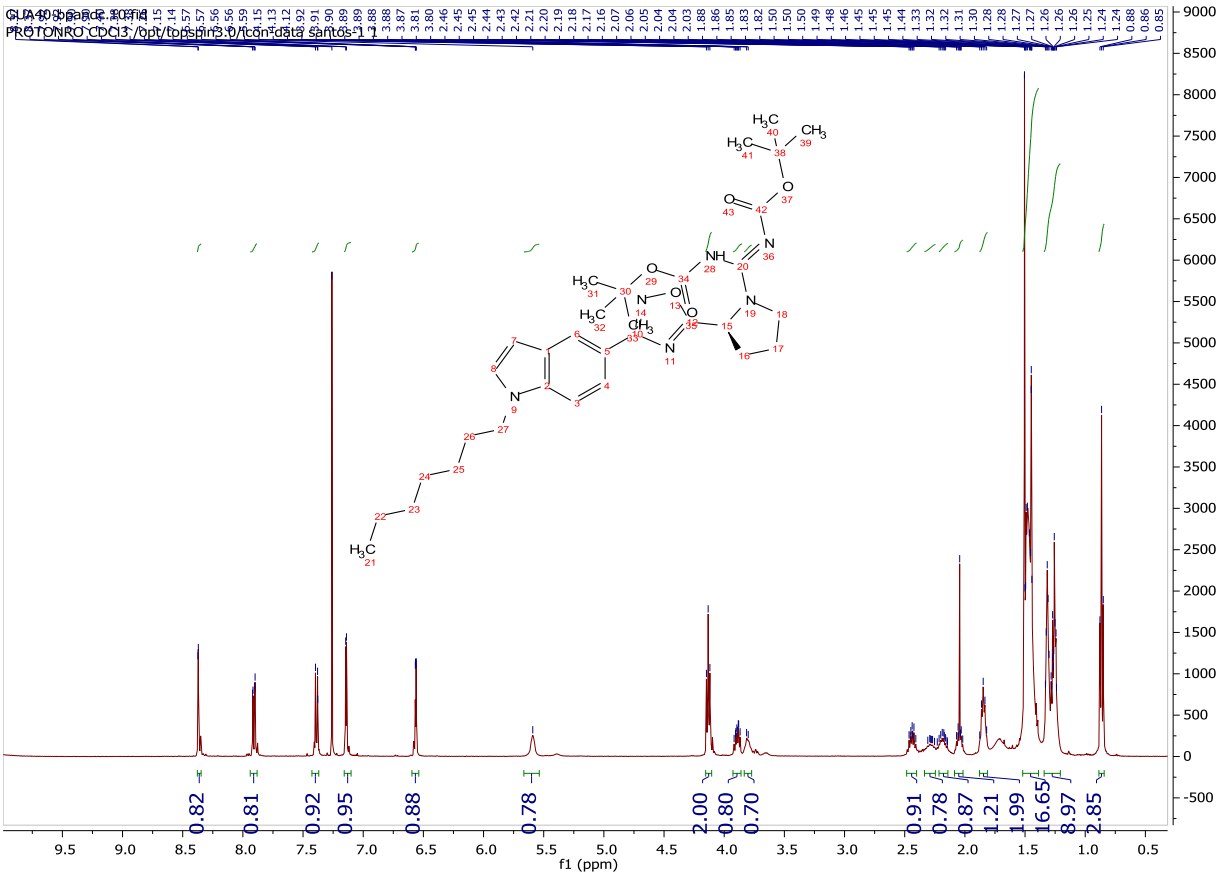
^{1}H-NMR Spectrum for Compound 4.20a:



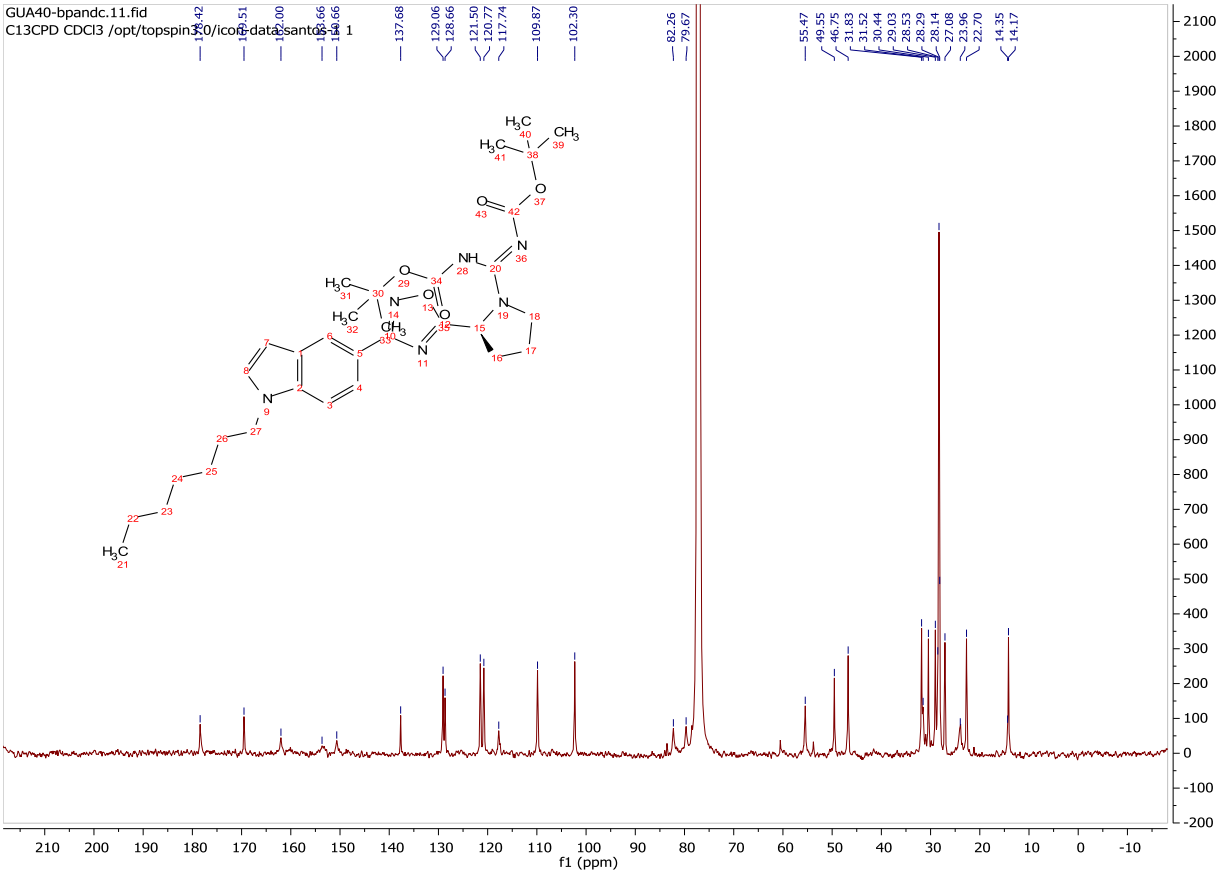
^{13}C-NMR Spectrum for Compound 4.20a:



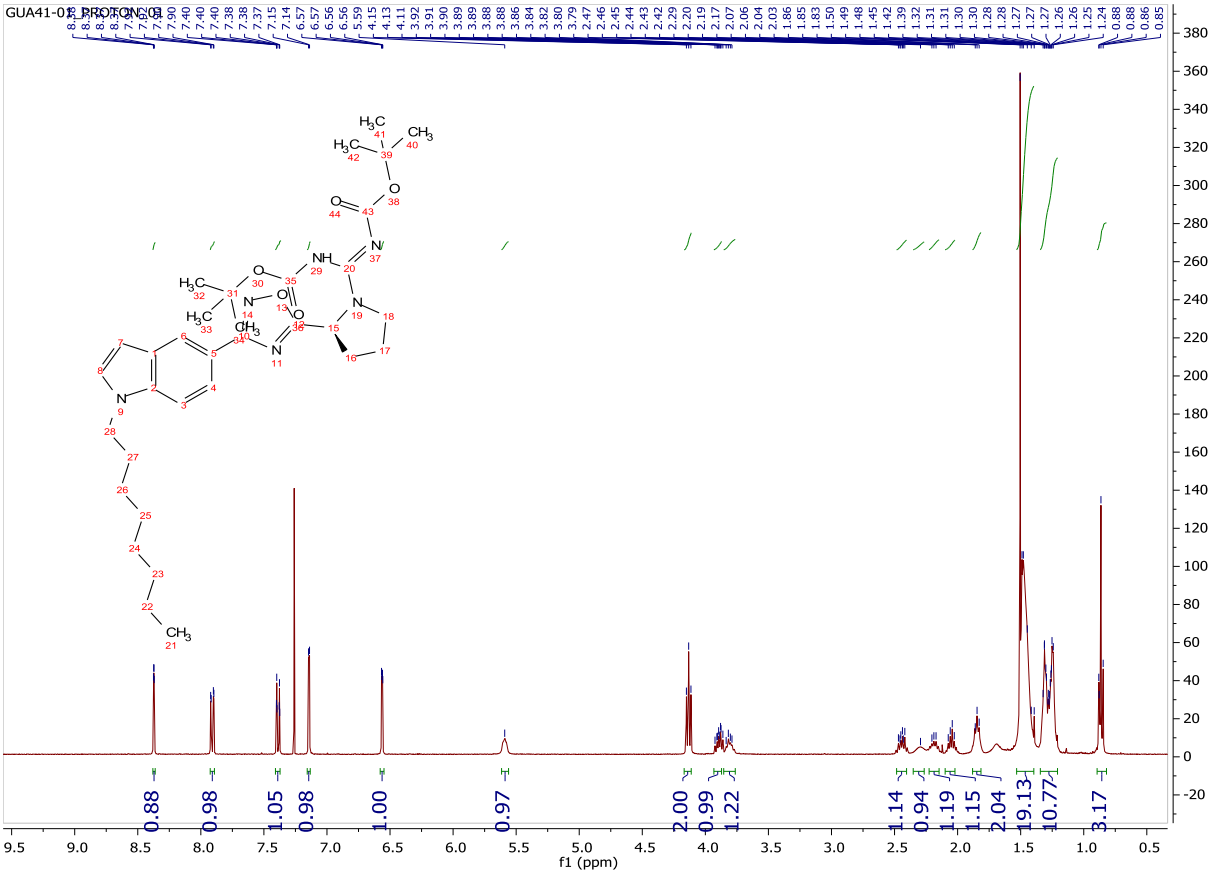
^{1}H-NMR Spectrum for Compound 4.20b:



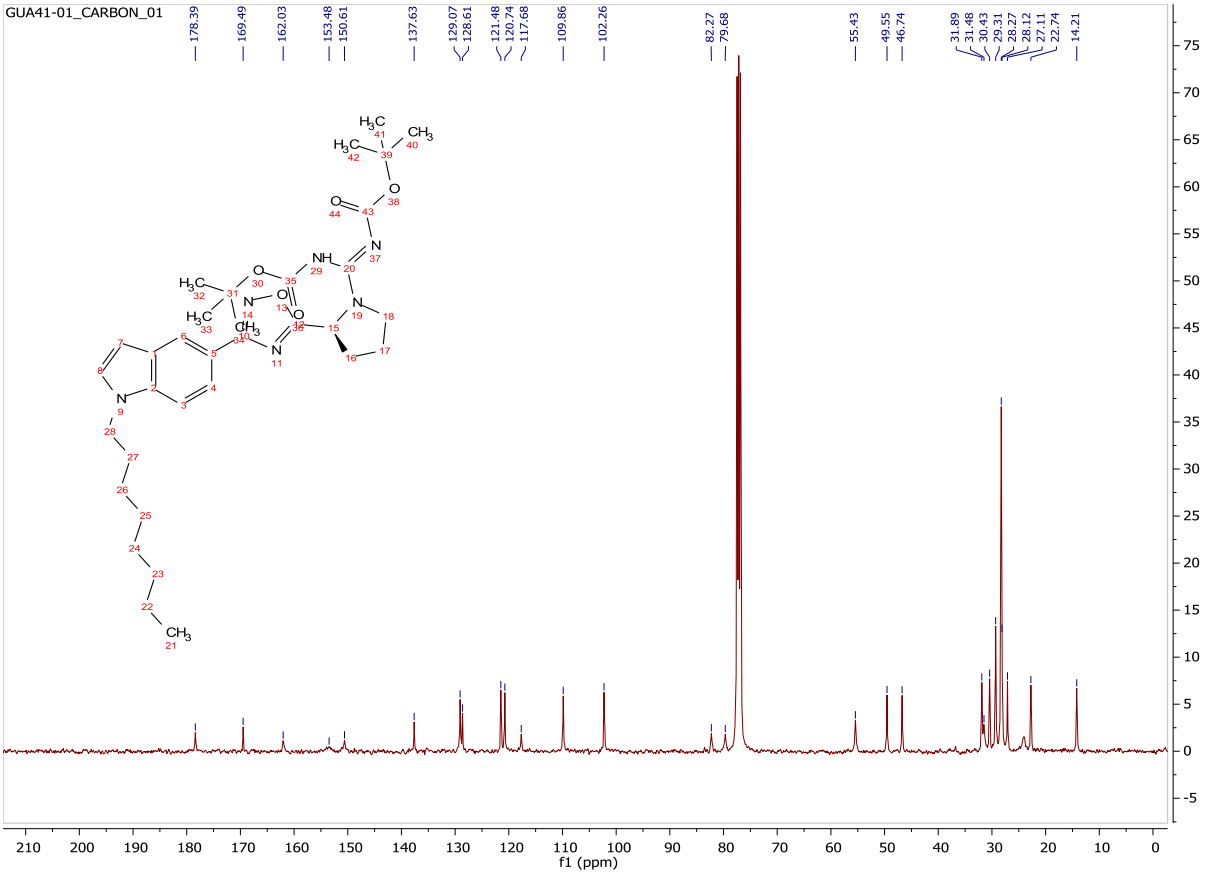
^{13}C-NMR Spectrum for Compound 4.20b:



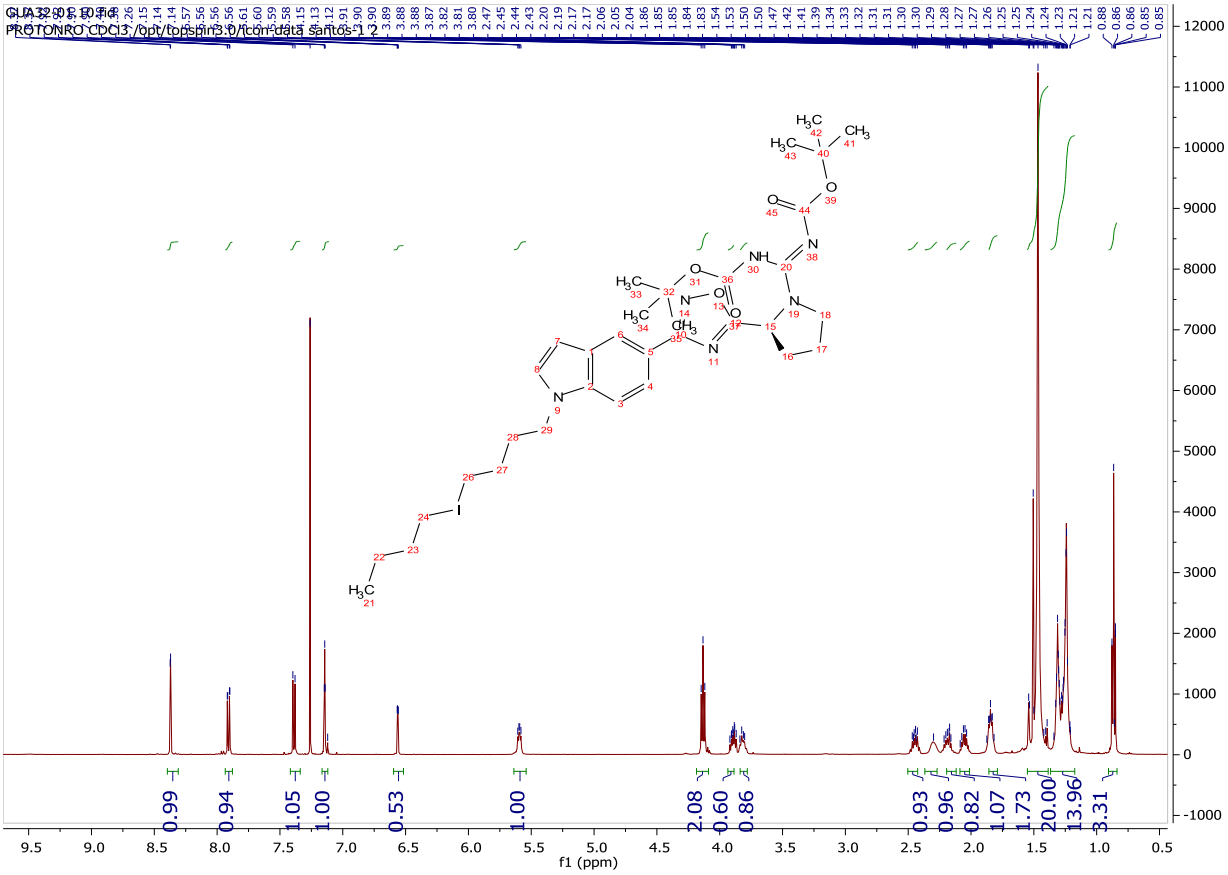
^{1}H-NMR Spectrum for Compound 4.20c:



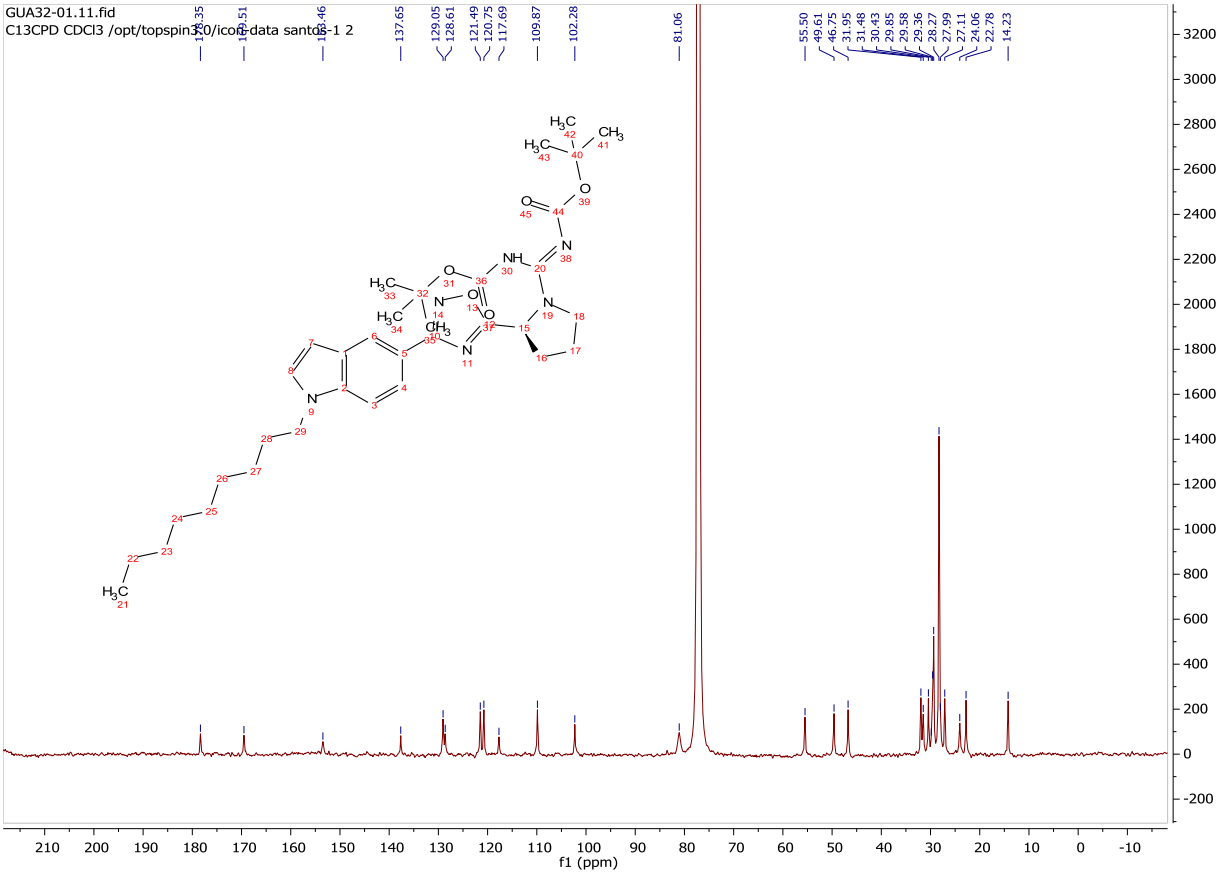
^{13}C-NMR Spectrum for Compound 4.20c:



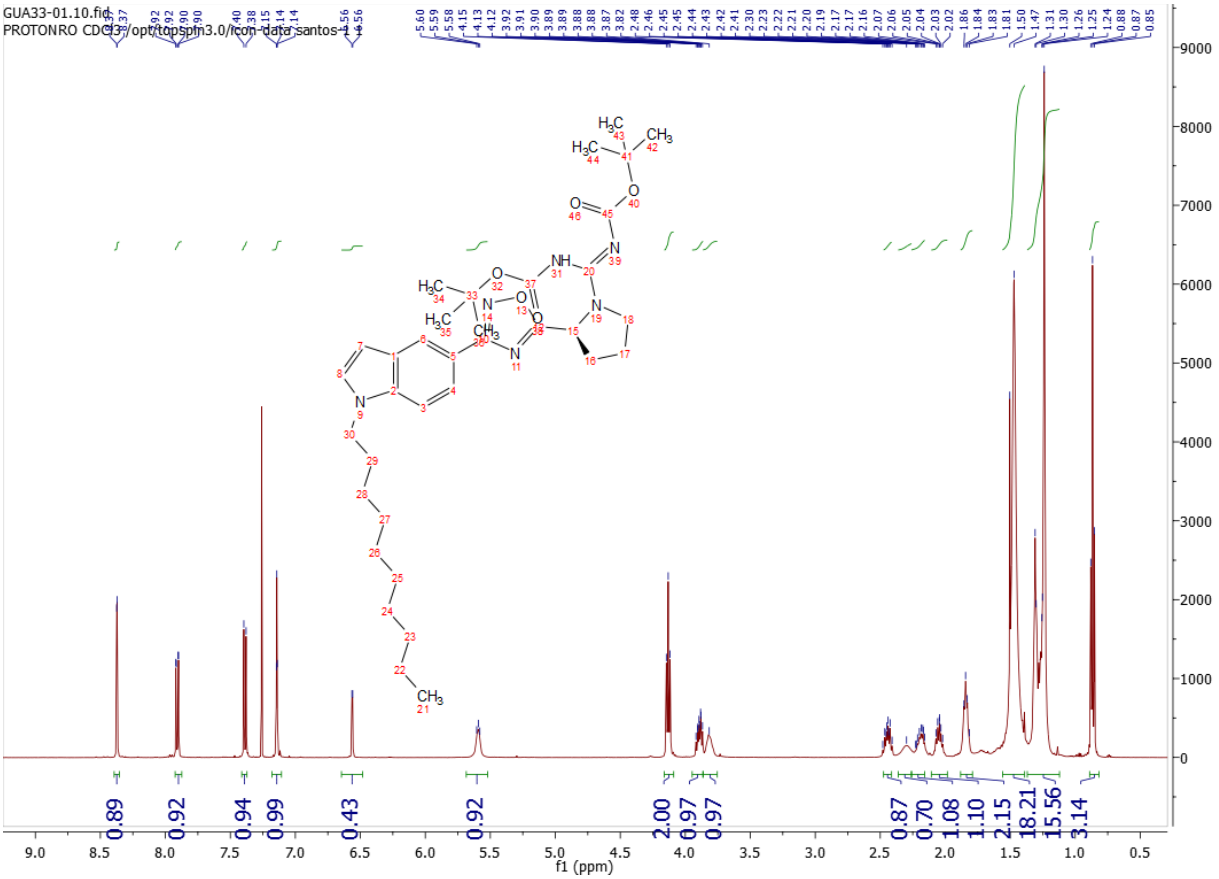
^{1}H-NMR Spectrum for Compound 4.20d:



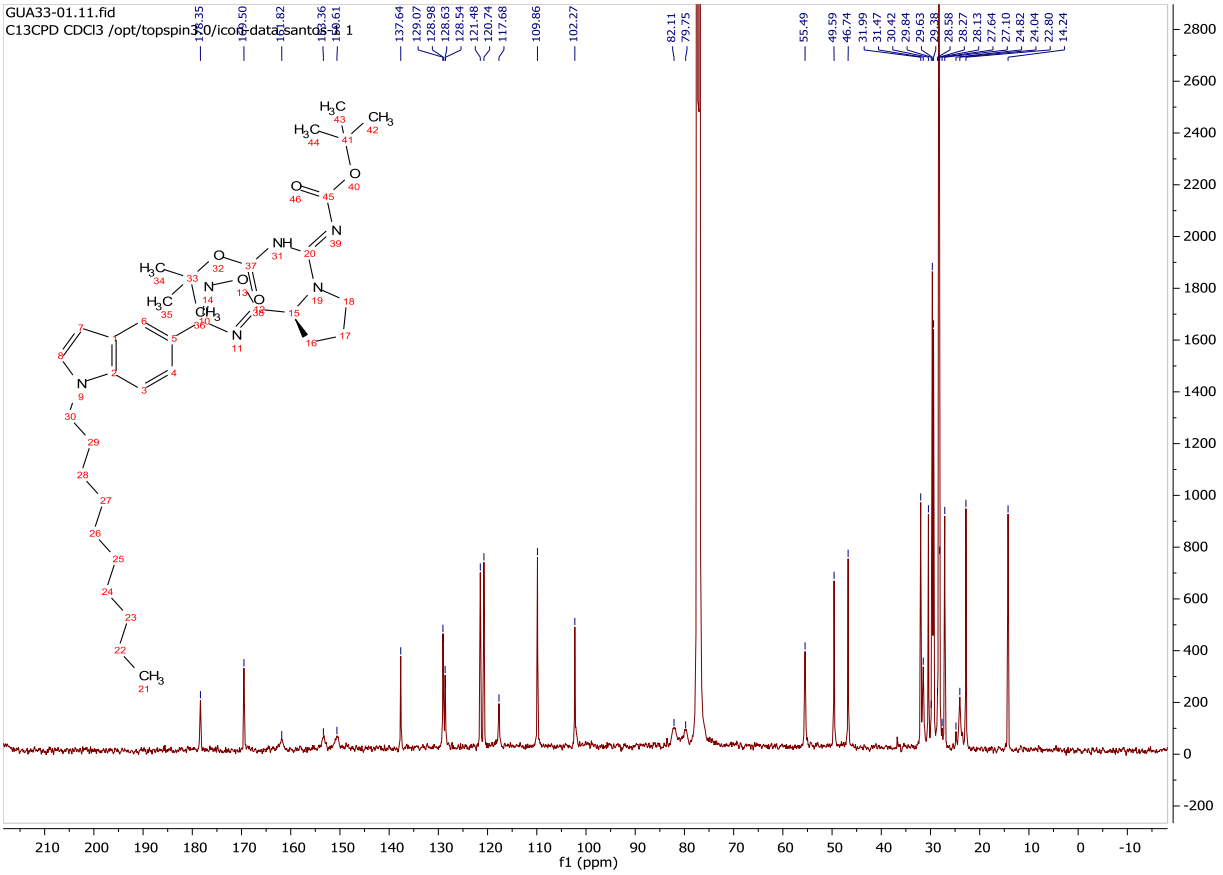
^{13}C-NMR Spectrum for Compound 4.20d:



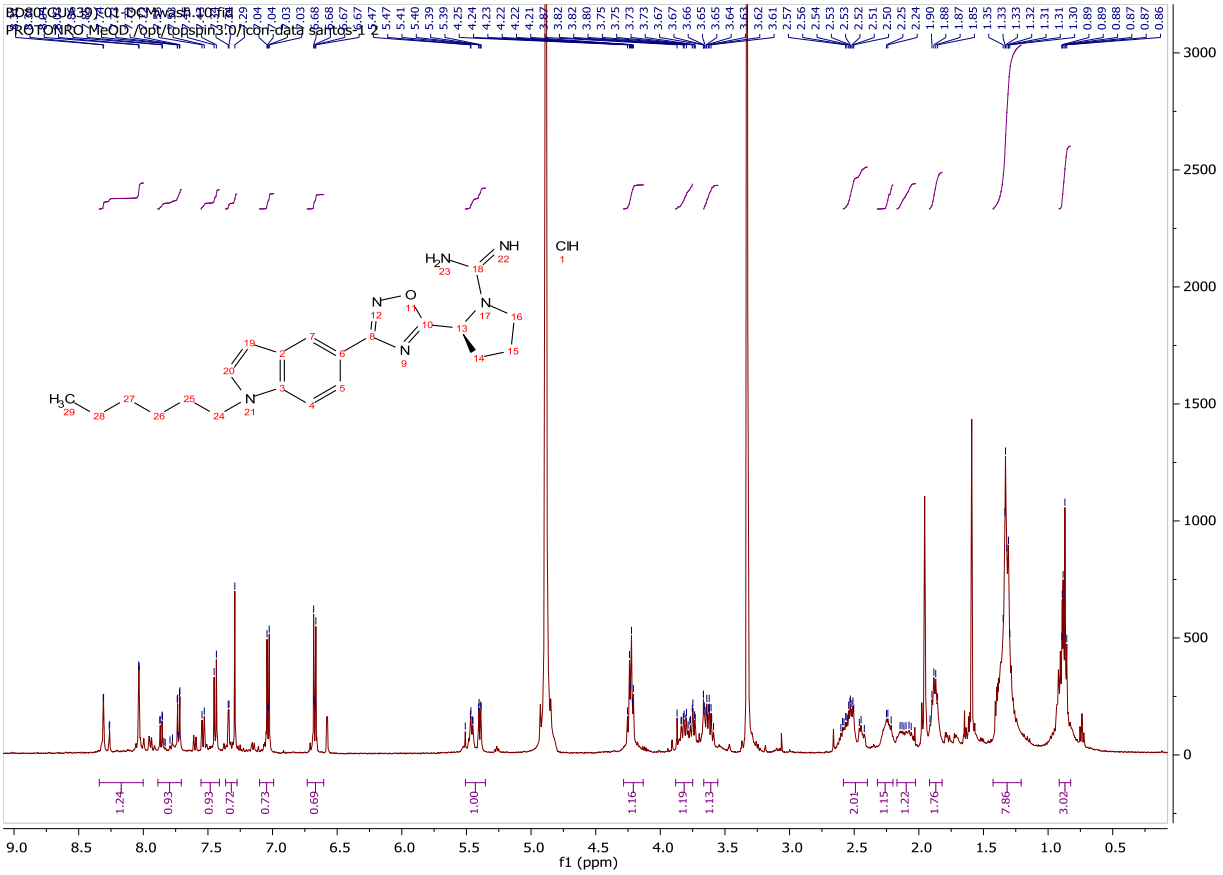
^{1}H-NMR Spectrum for Compound 4.20e:



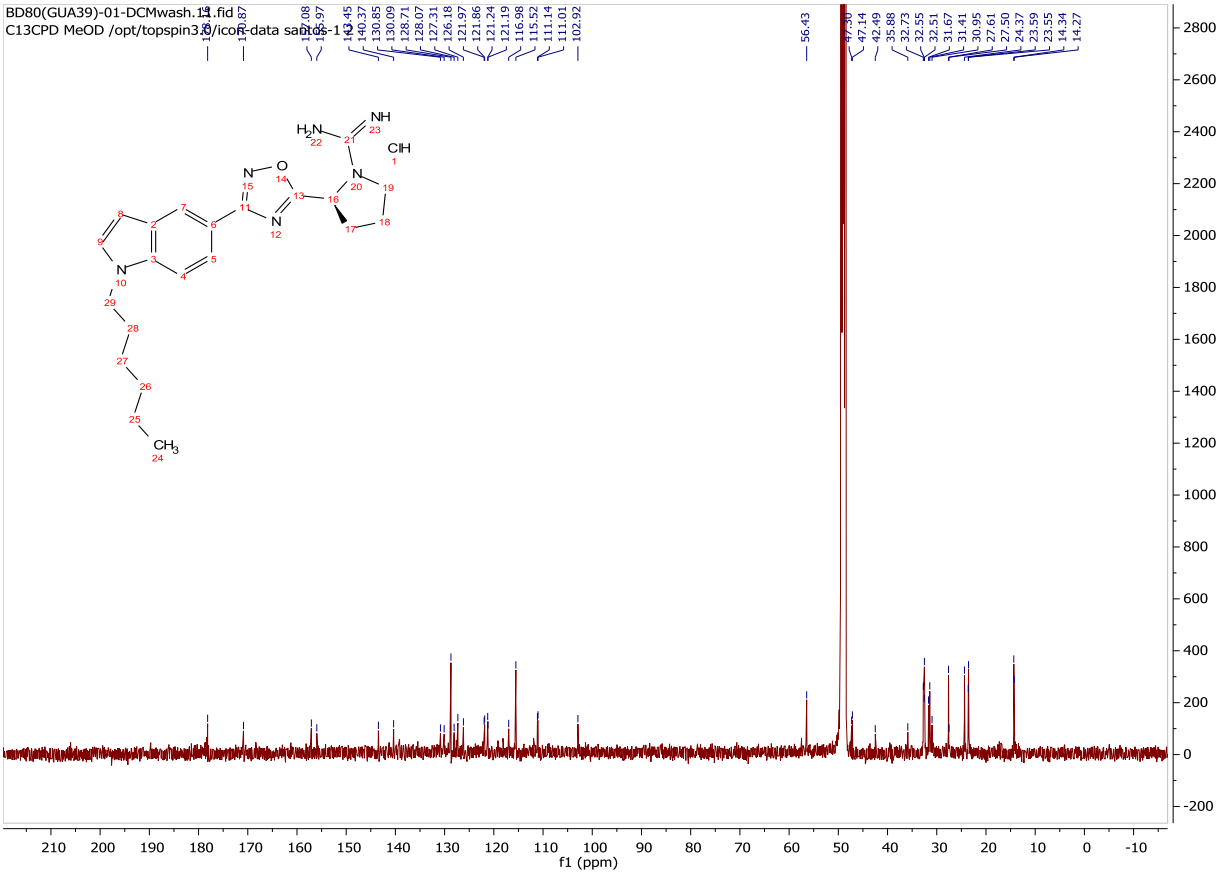
^{13}C-NMR Spectrum for Compound 4.20e:



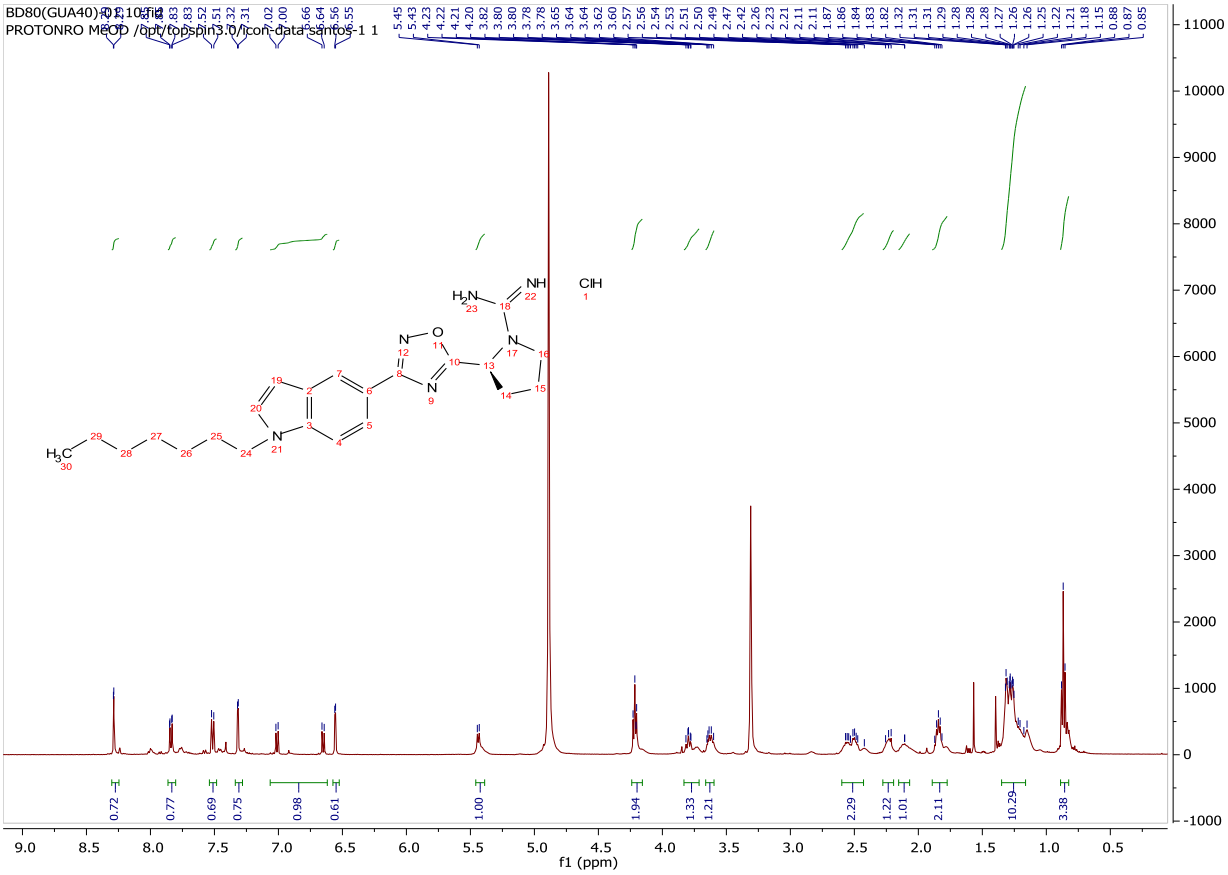
^{1}H-NMR Spectrum for Compound 4.21a:



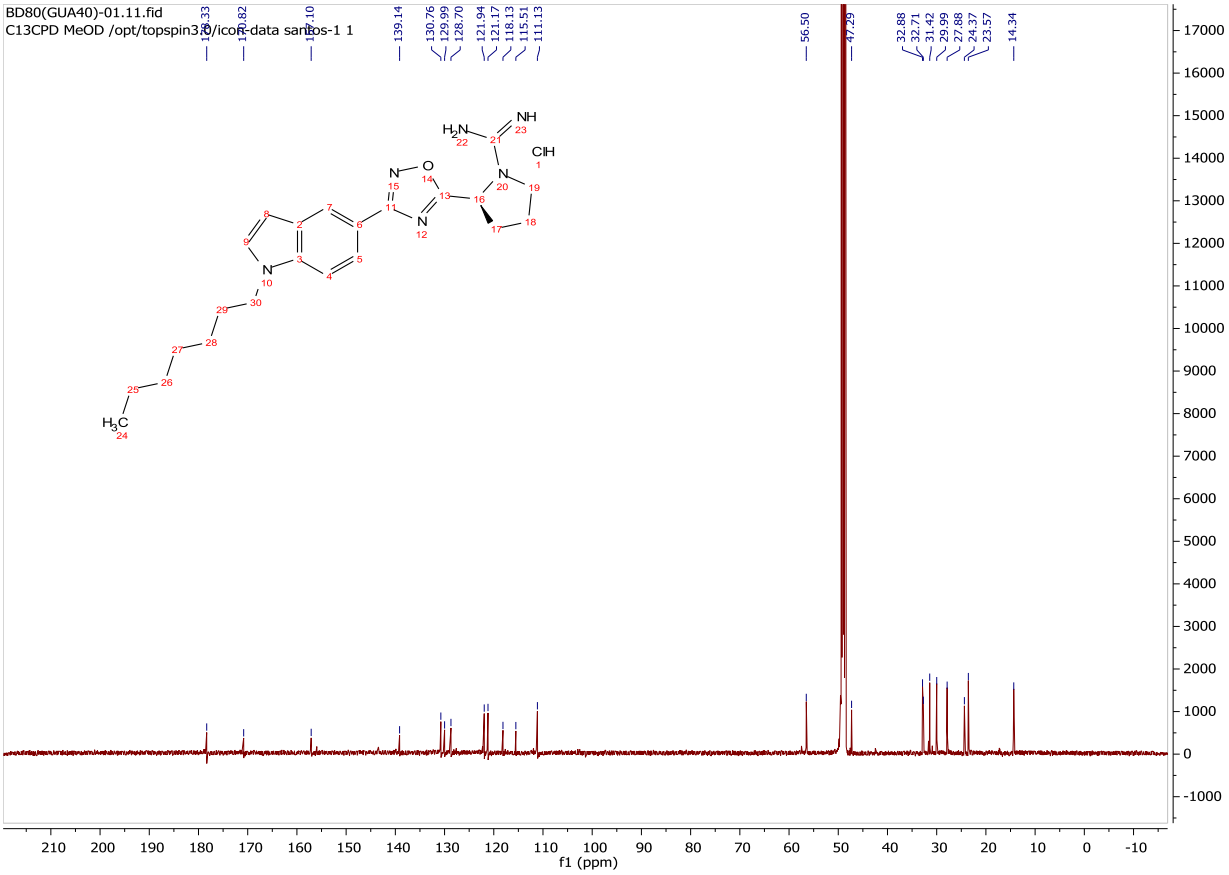
^{13}C-NMR Spectrum for Compound 4.21a:



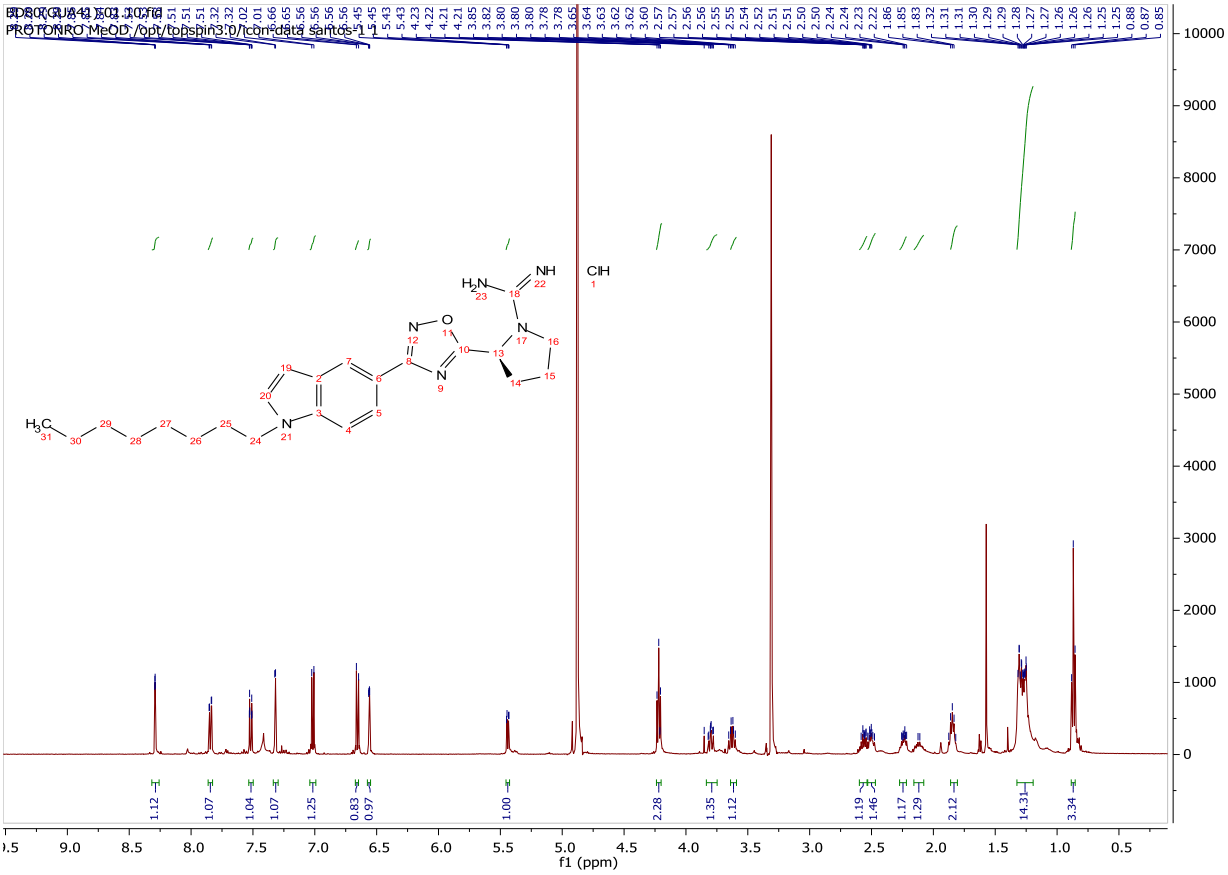
^{1}H-NMR Spectrum for Compound 4.21b:



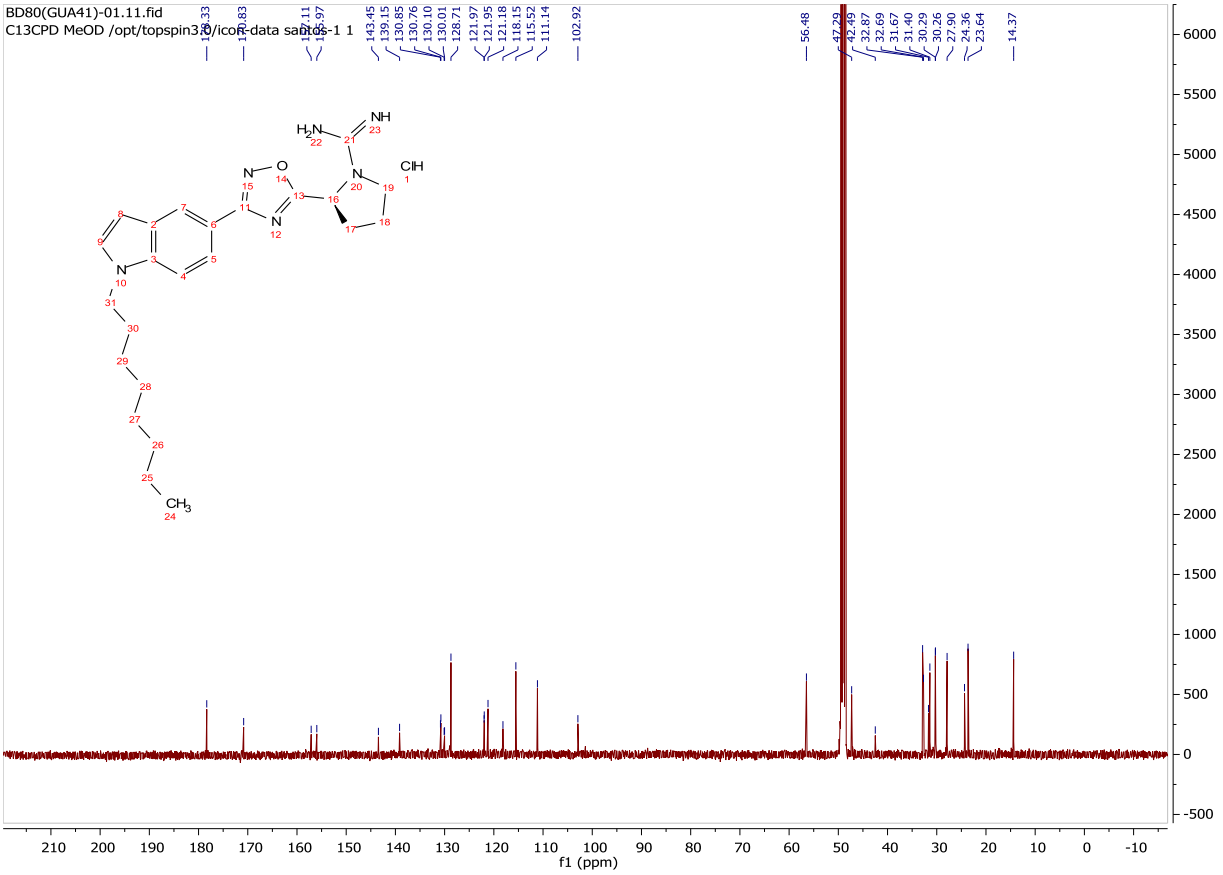
^{13}C-NMR Spectrum for Compound 4.21b:



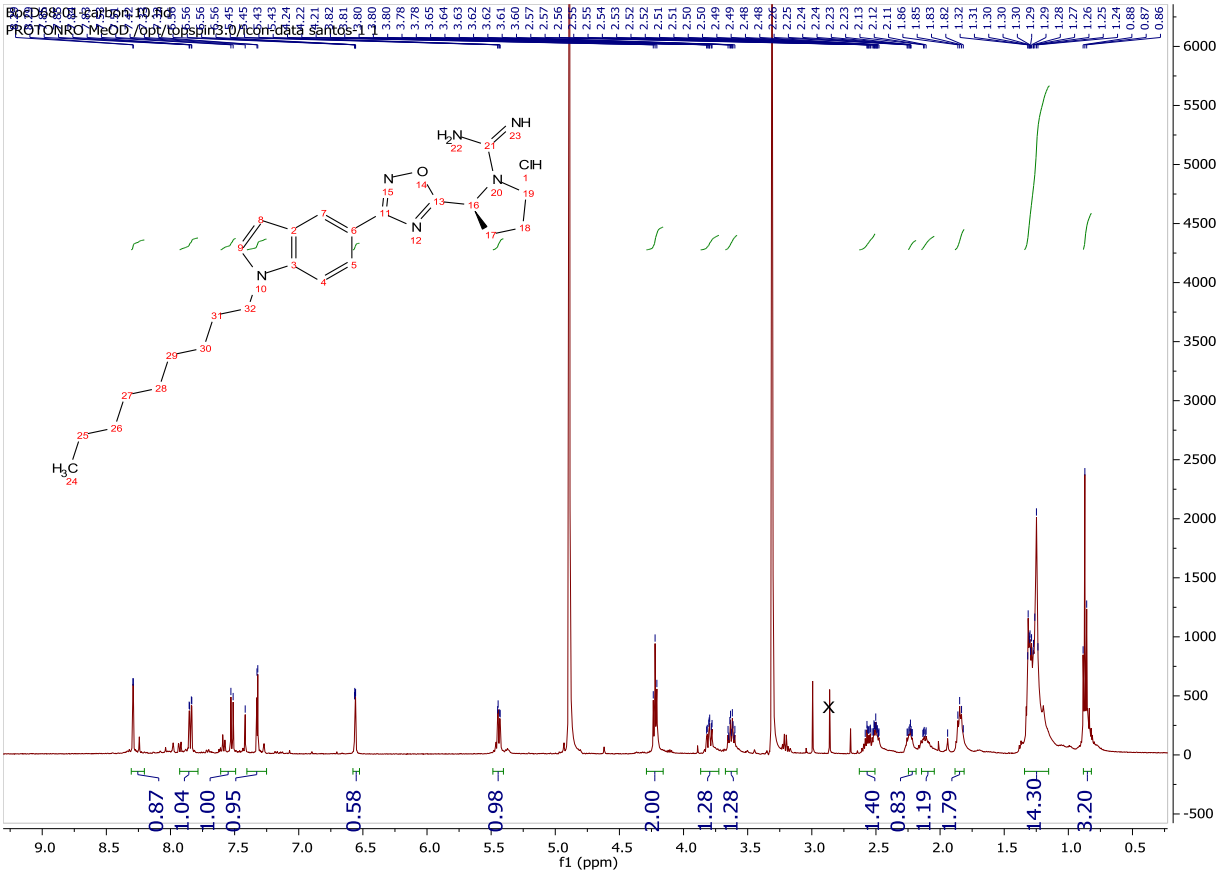
^{1}H-NMR Spectrum for Compound 4.21c:



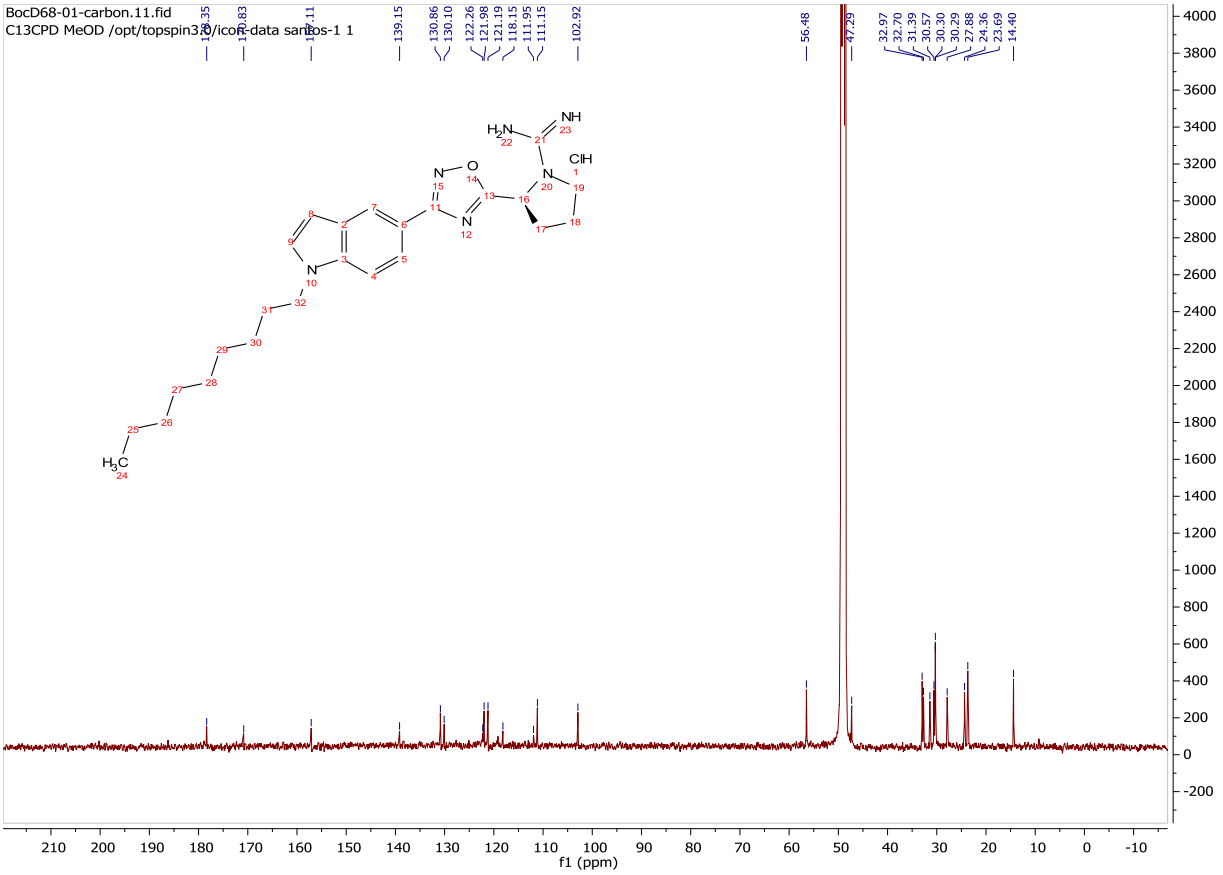
^{13}C-NMR Spectrum for Compound 4.21c:



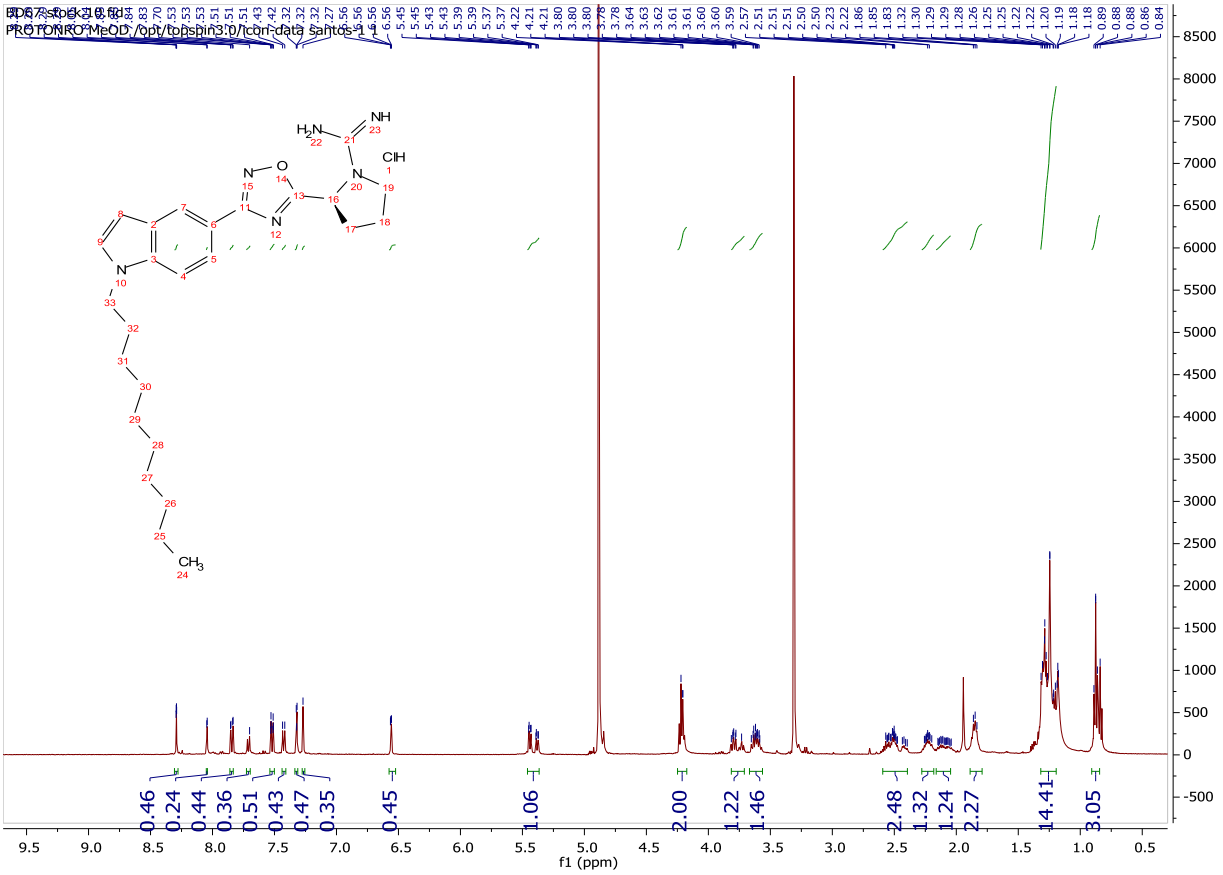
^{1}H-NMR Spectrum for Compound 4.21d:



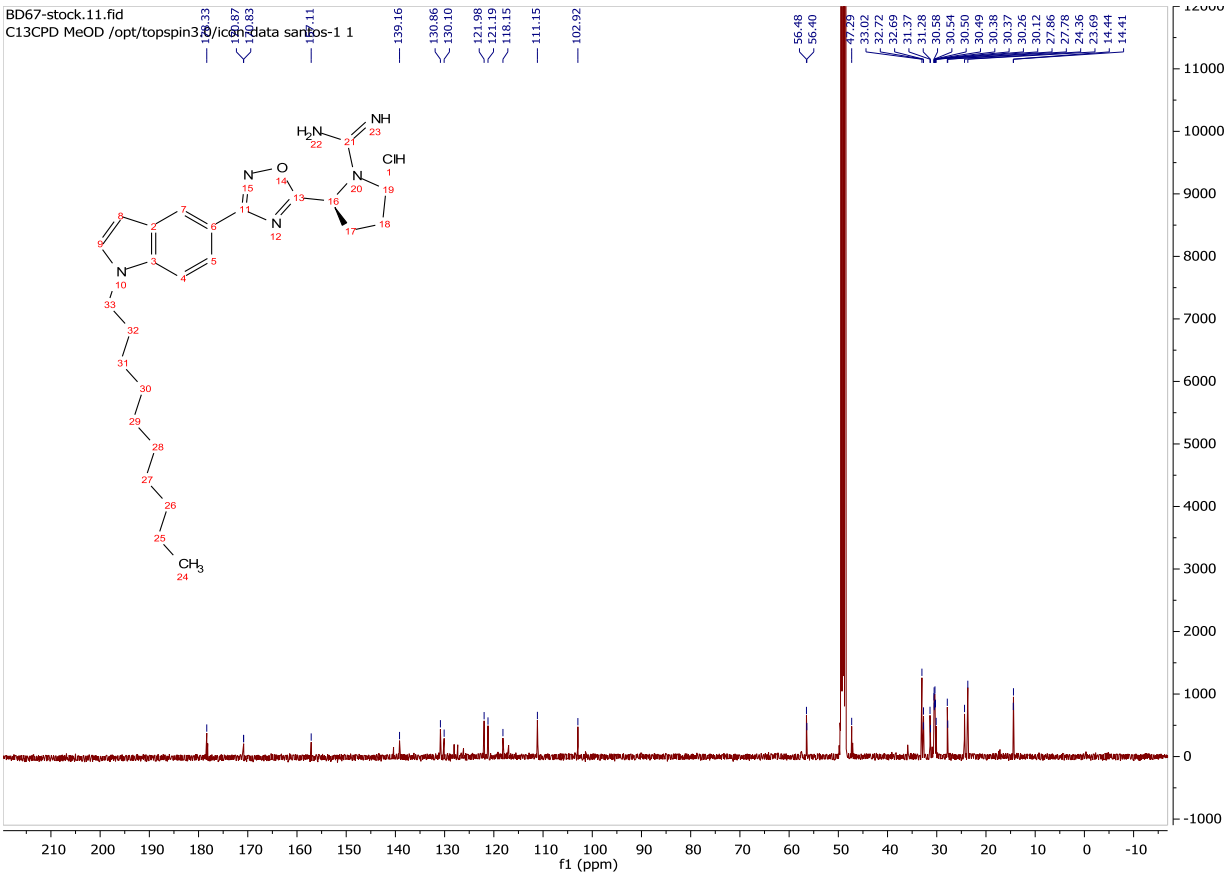
^{13}C-NMR Spectrum for Compound 4.21d:



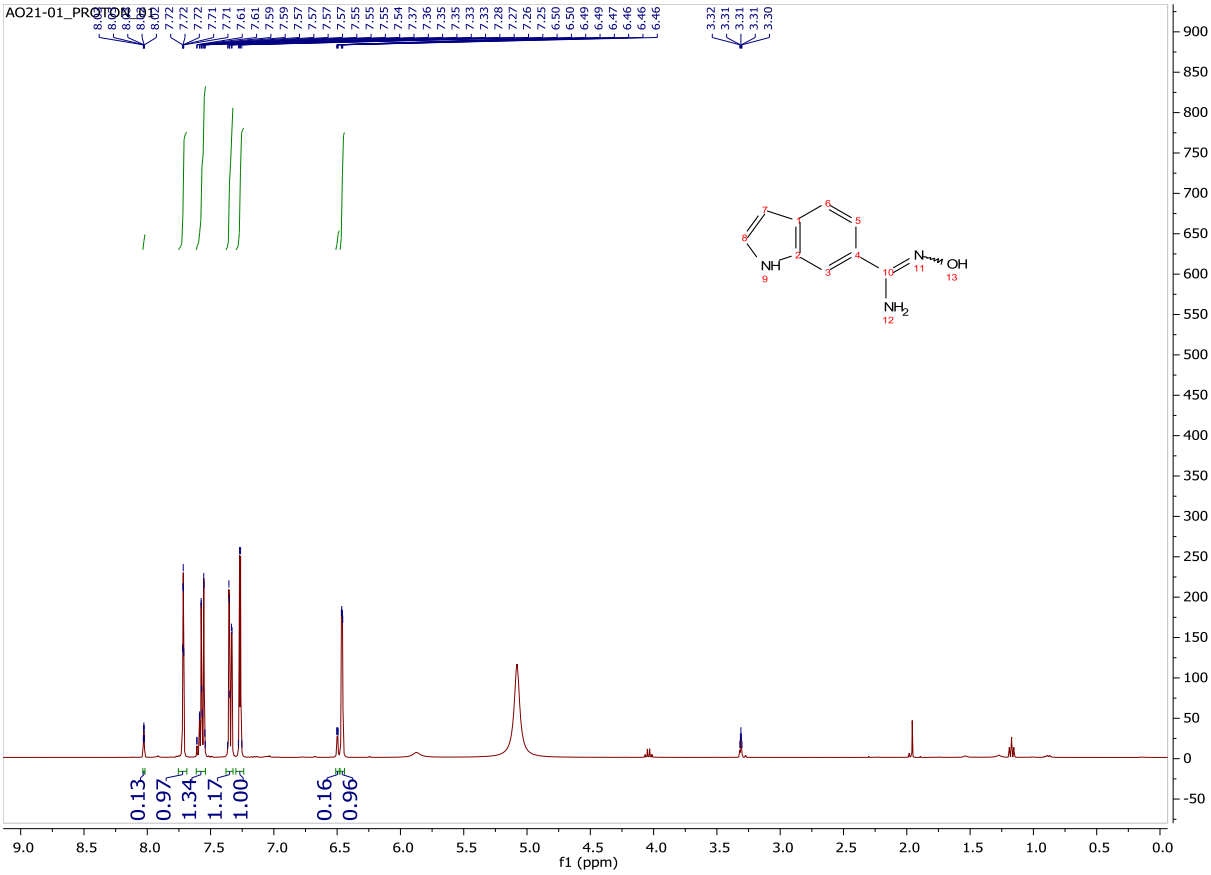
^{1}H-NMR Spectrum for Compound 4.21e:



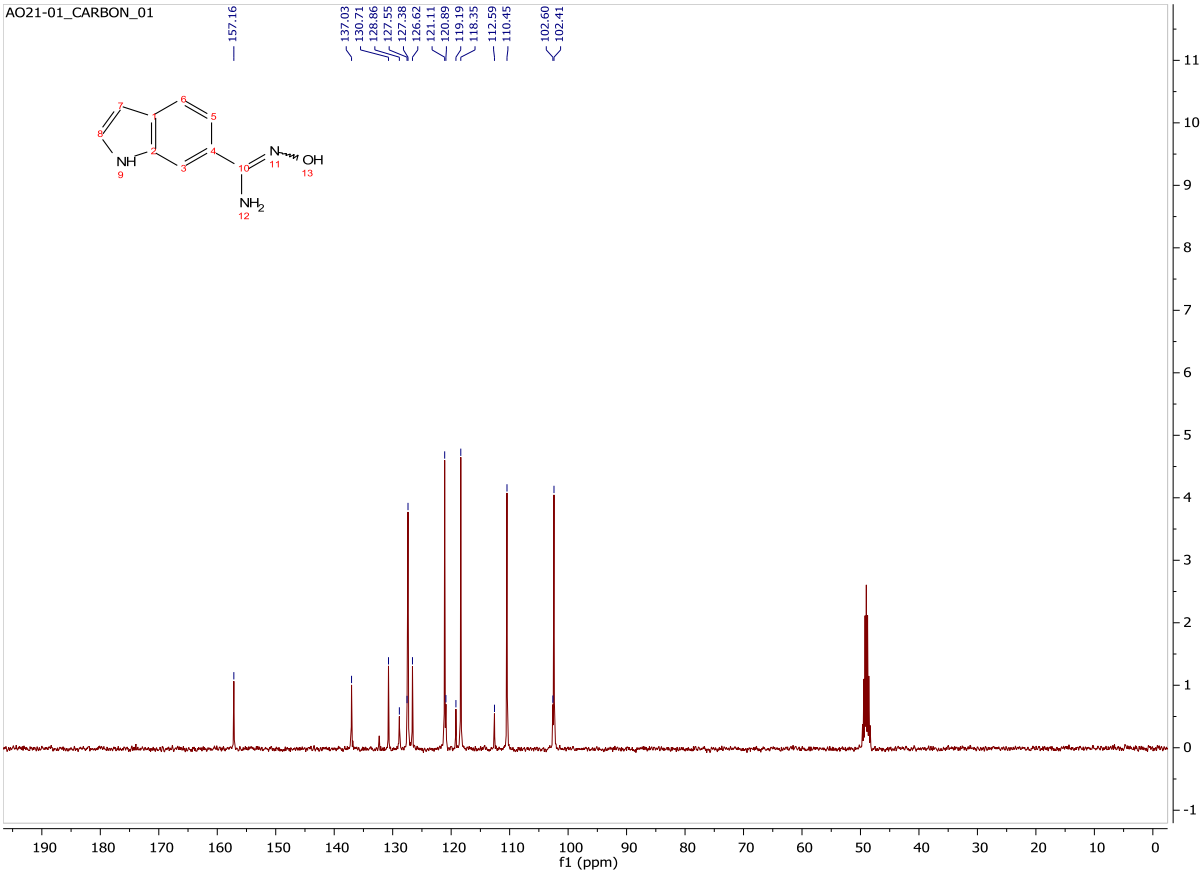
^{13}C-NMR Spectrum for Compound 4.21e:



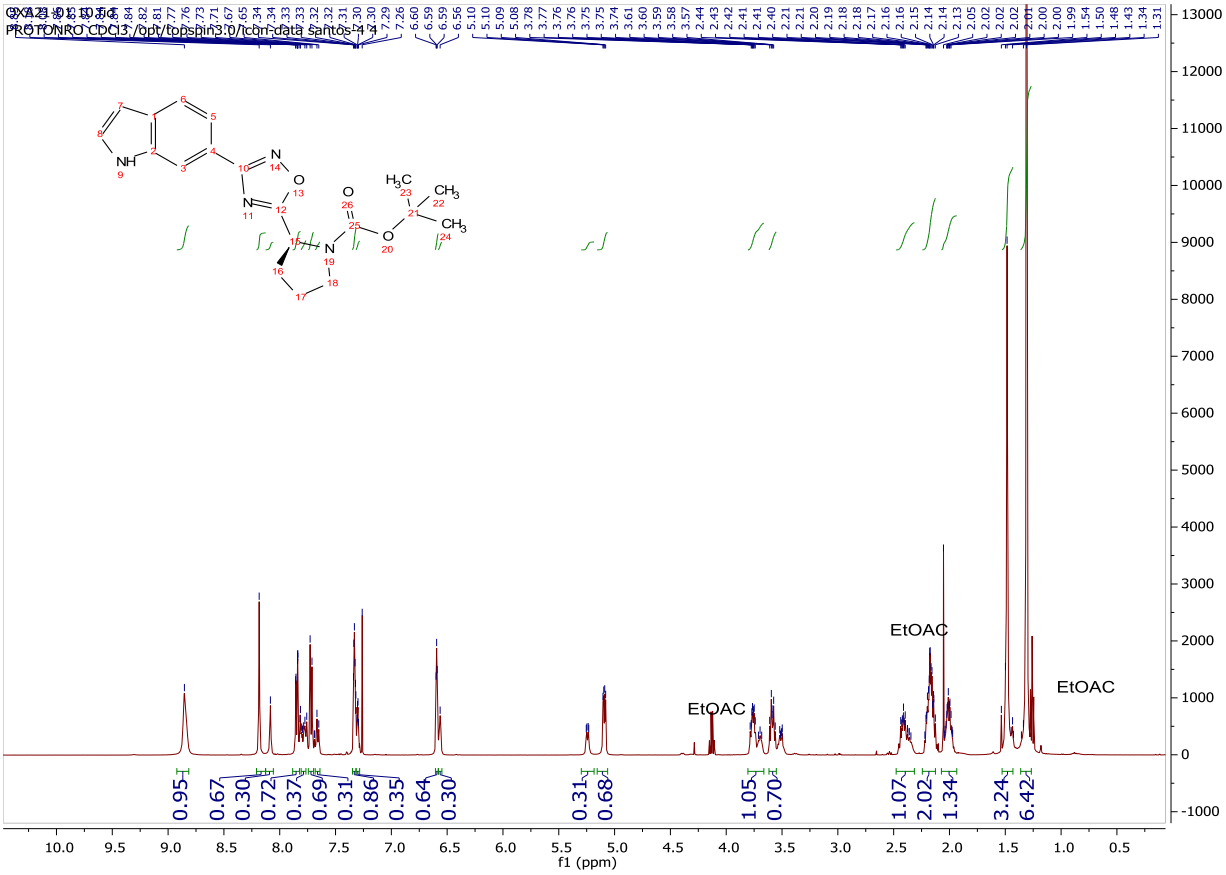
^{1}H-NMR Spectrum for Compound 4.23:



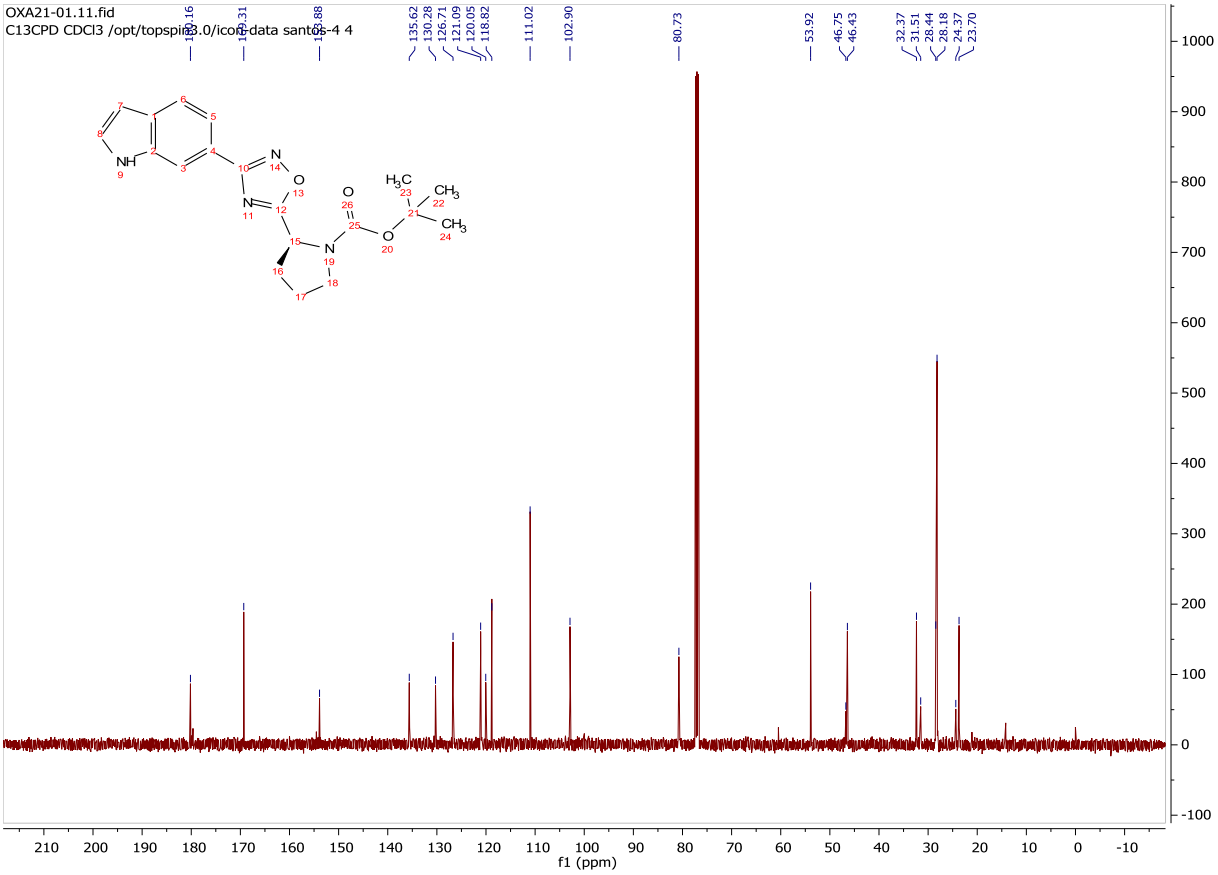
^{13}C-NMR Spectrum for Compound 4.23:



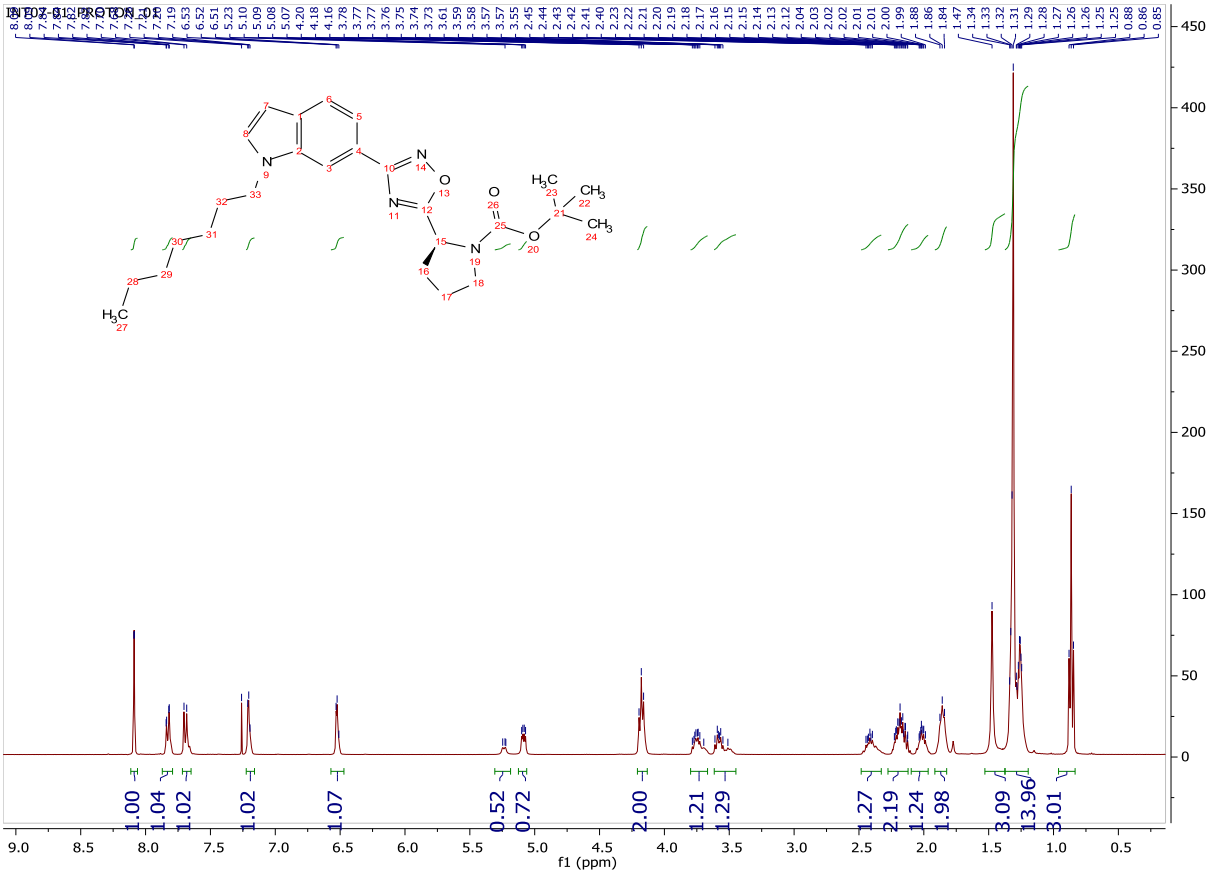
^{1}H-NMR Spectrum for Compound 4.24:



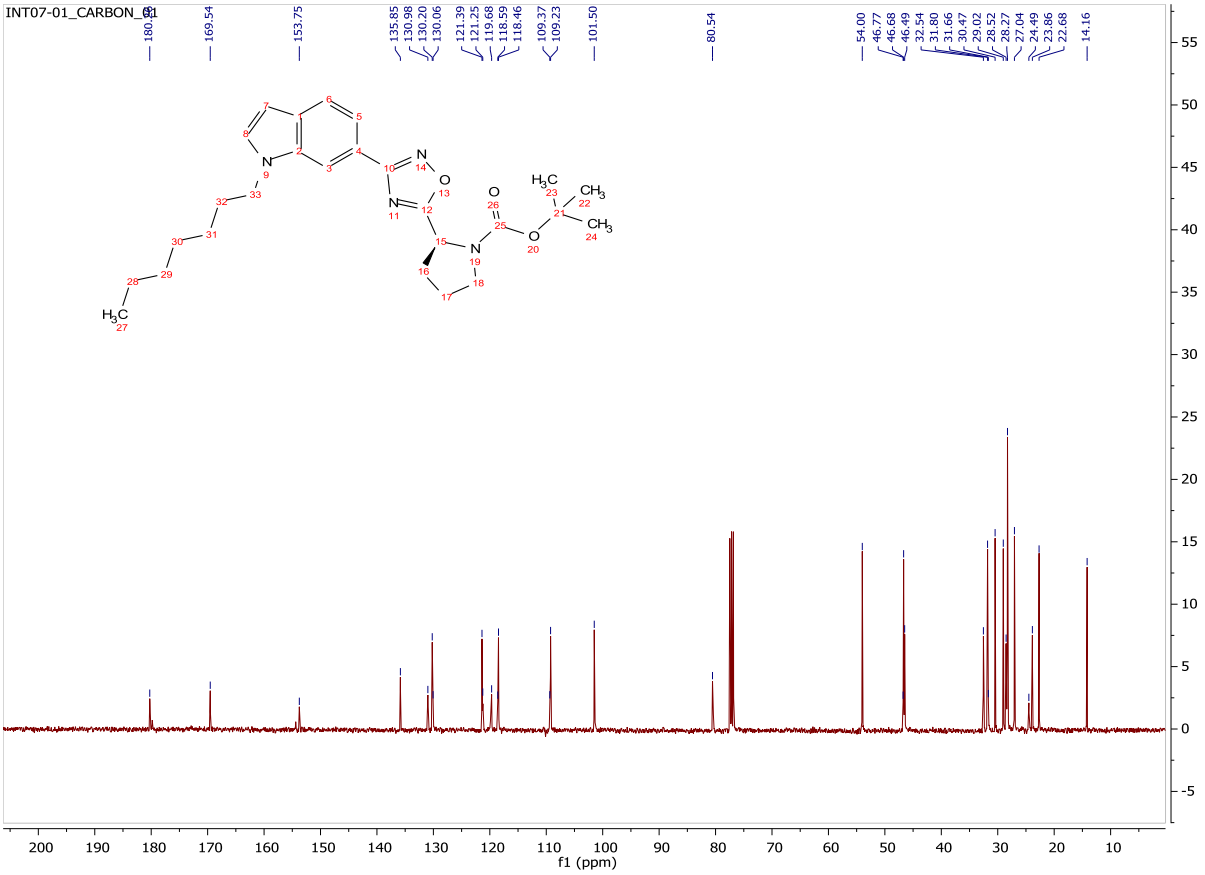
^{13}C-NMR Spectrum for Compound 4.24:



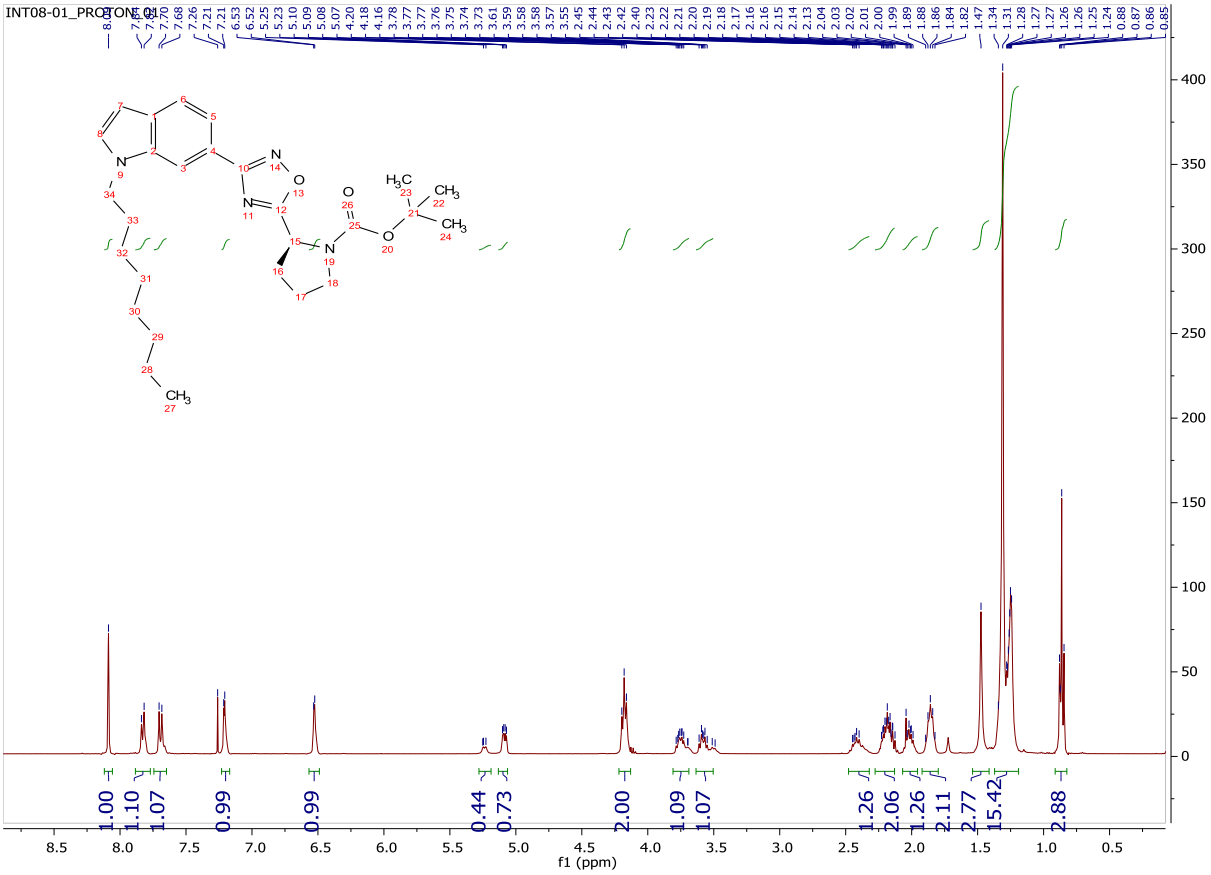
^{1}H-NMR Spectrum for Compound 4.25a:



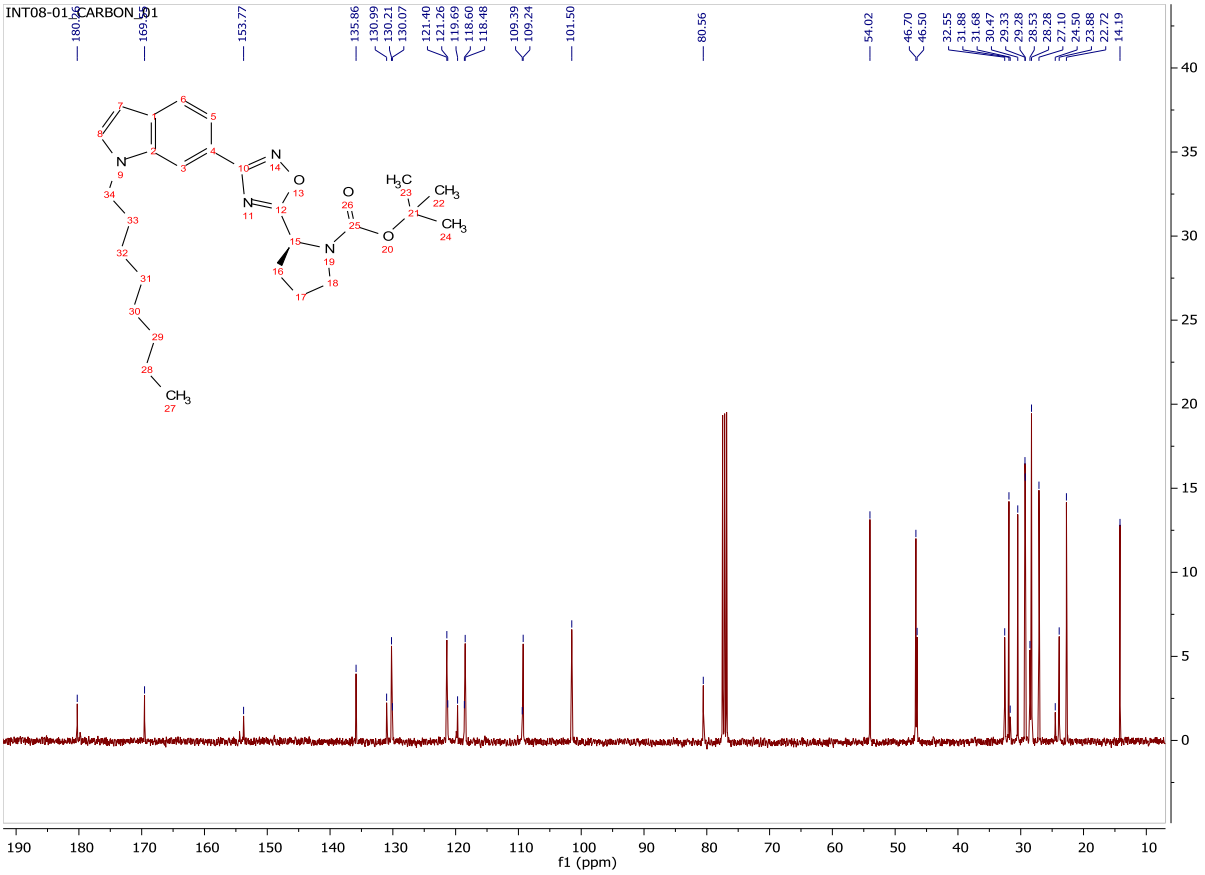
^{13}C-NMR Spectrum for Compound 4.25a:



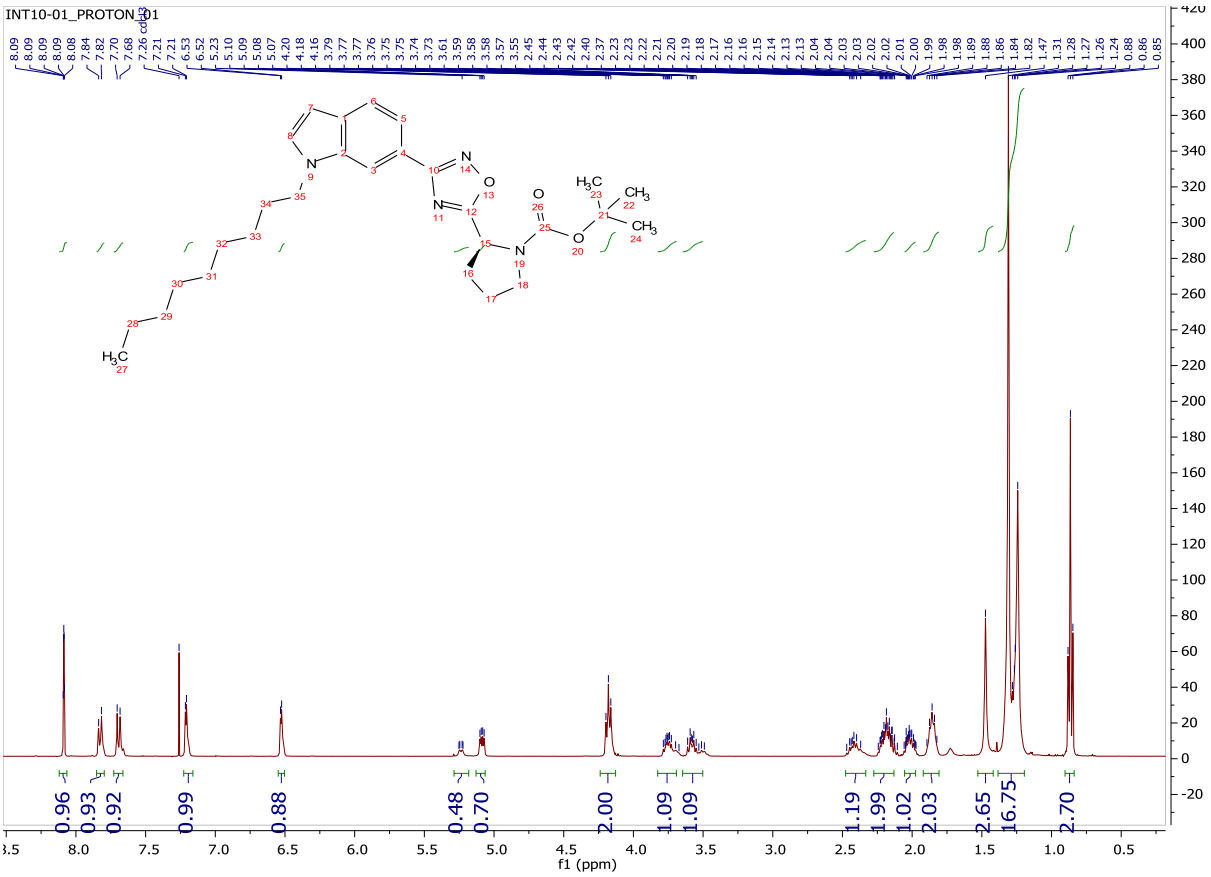
^{1}H-NMR Spectrum for Compound 4.25b:



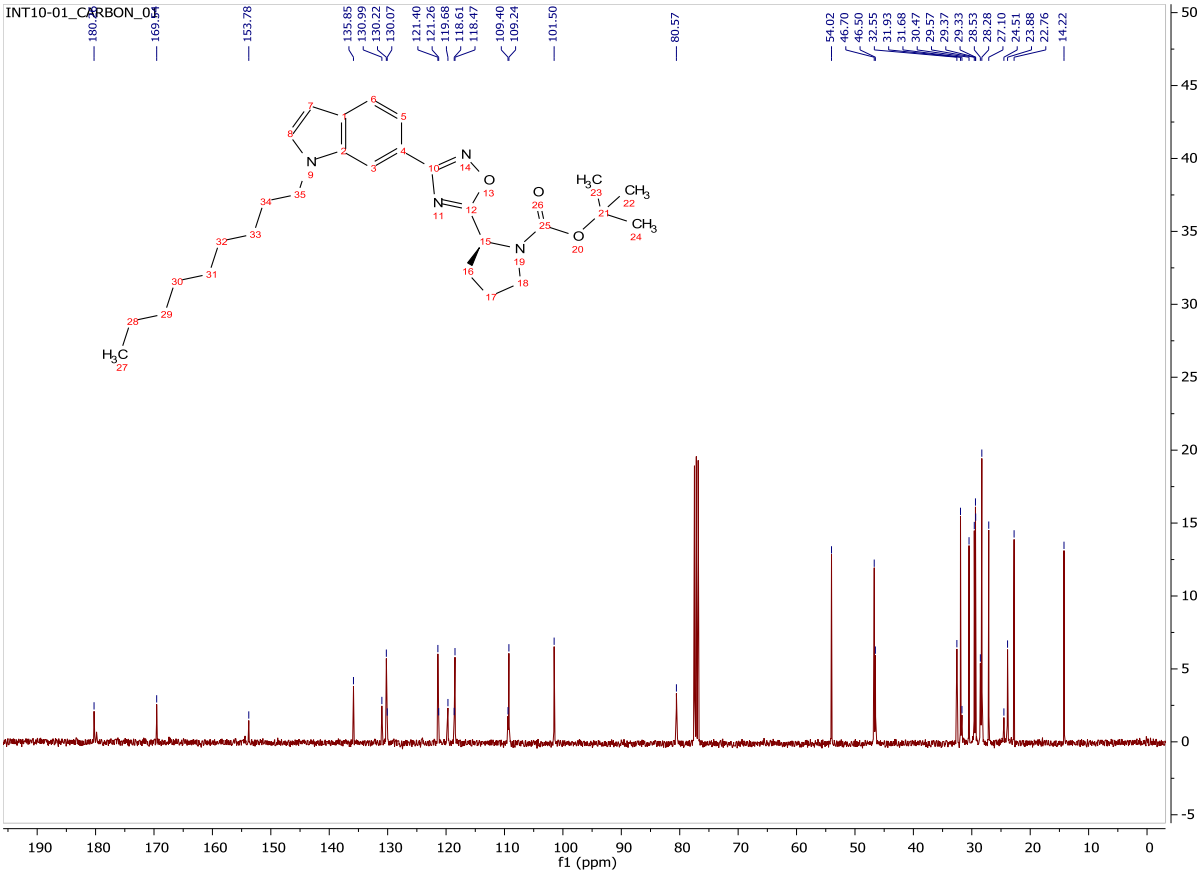
^{13}C-NMR Spectrum for Compound 4.25b:



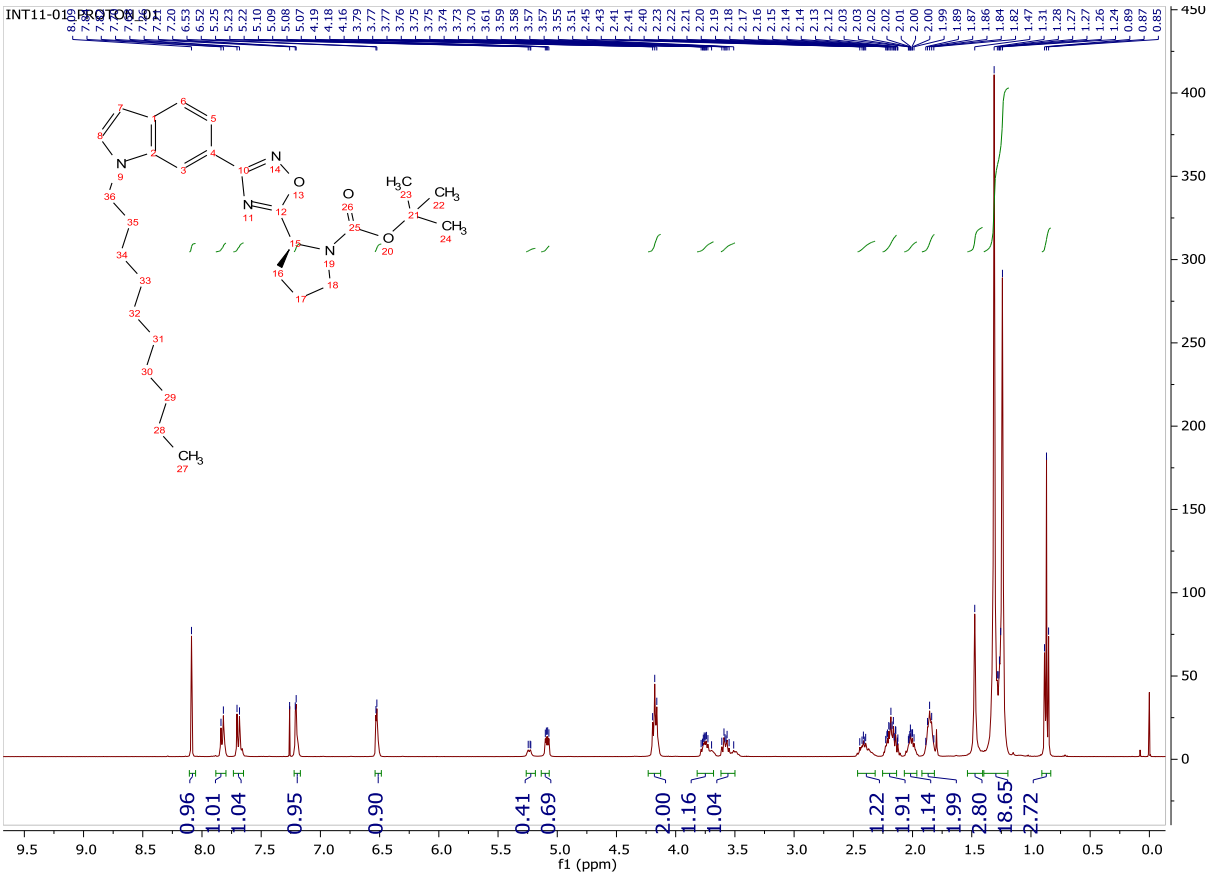
^{1}H-NMR Spectrum for Compound 4.25c:



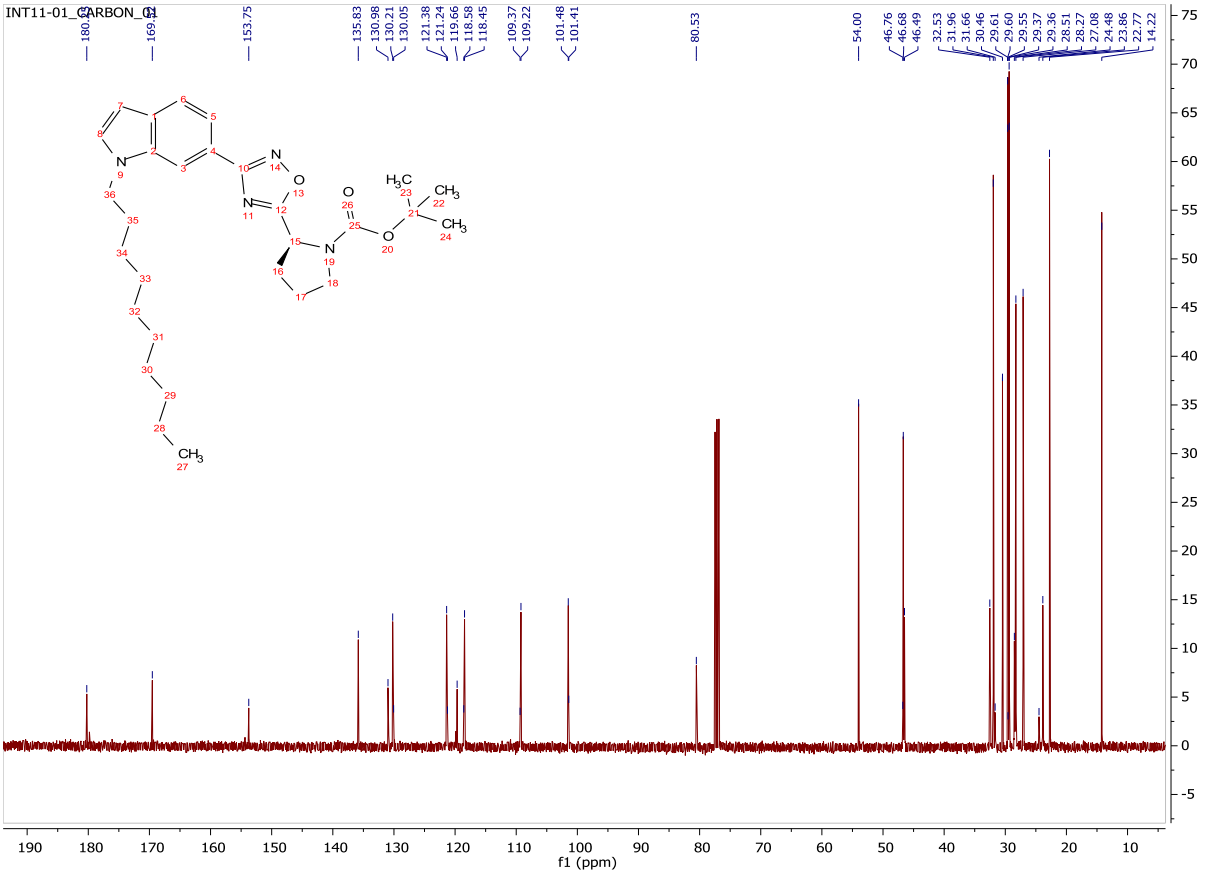
^{13}C-NMR Spectrum for Compound 4.25c:



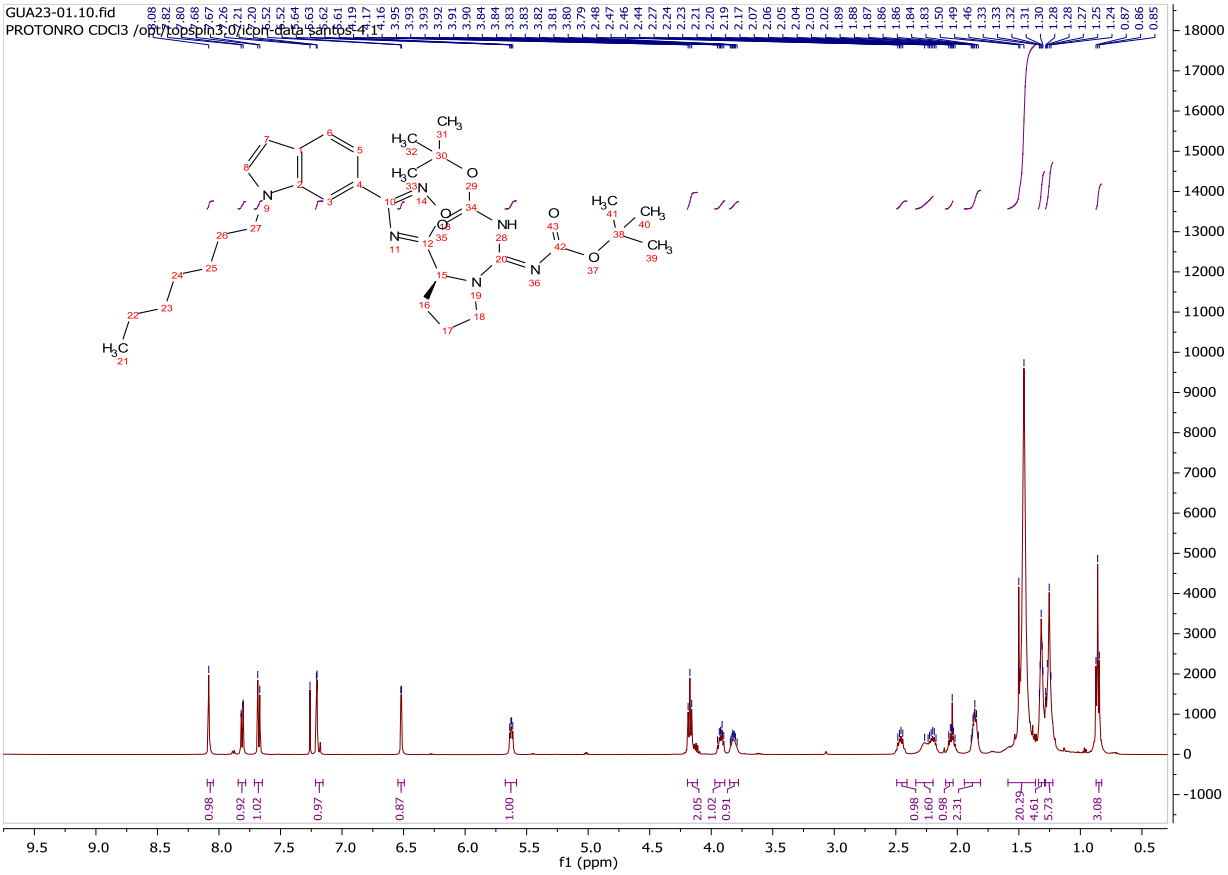
^{1}H-NMR Spectrum for Compound 4.25d:



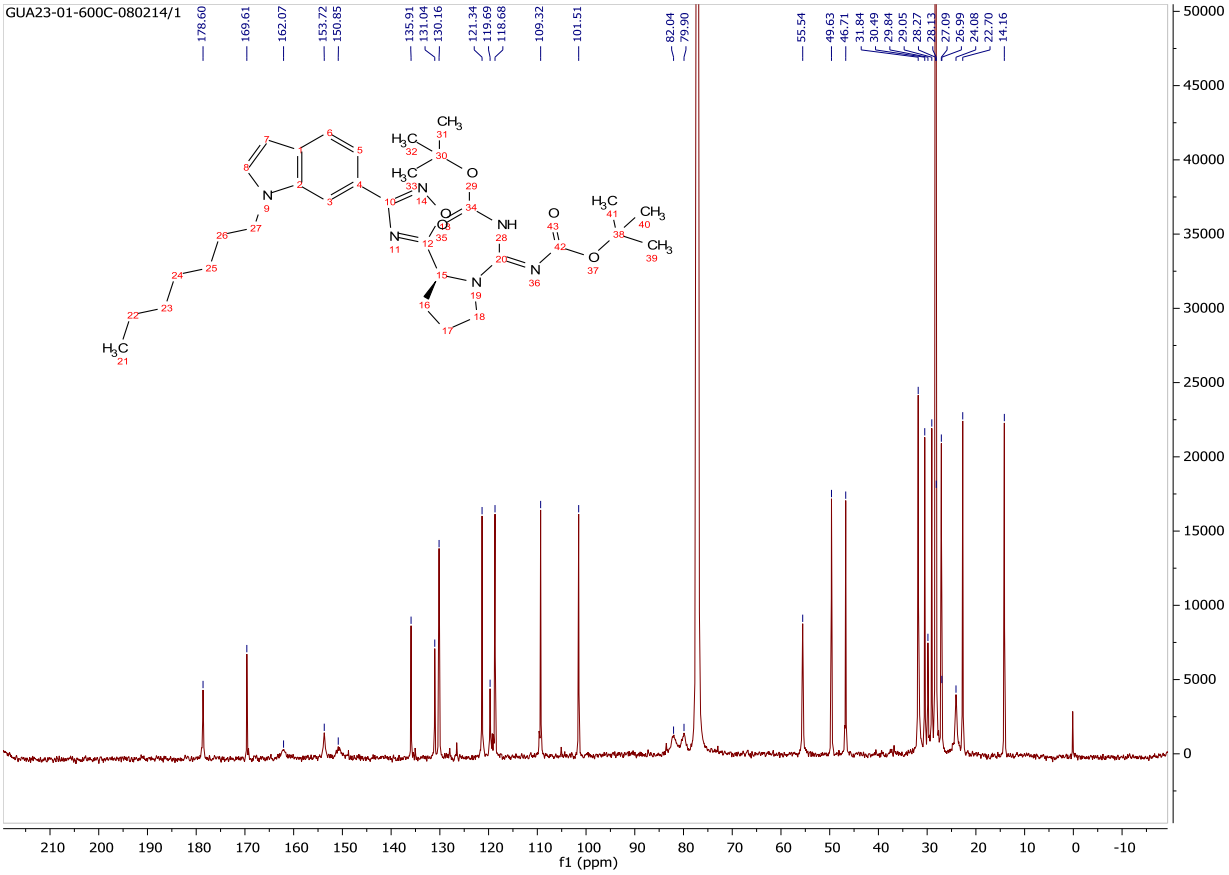
^{13}C-NMR Spectrum for Compound 4.25d:



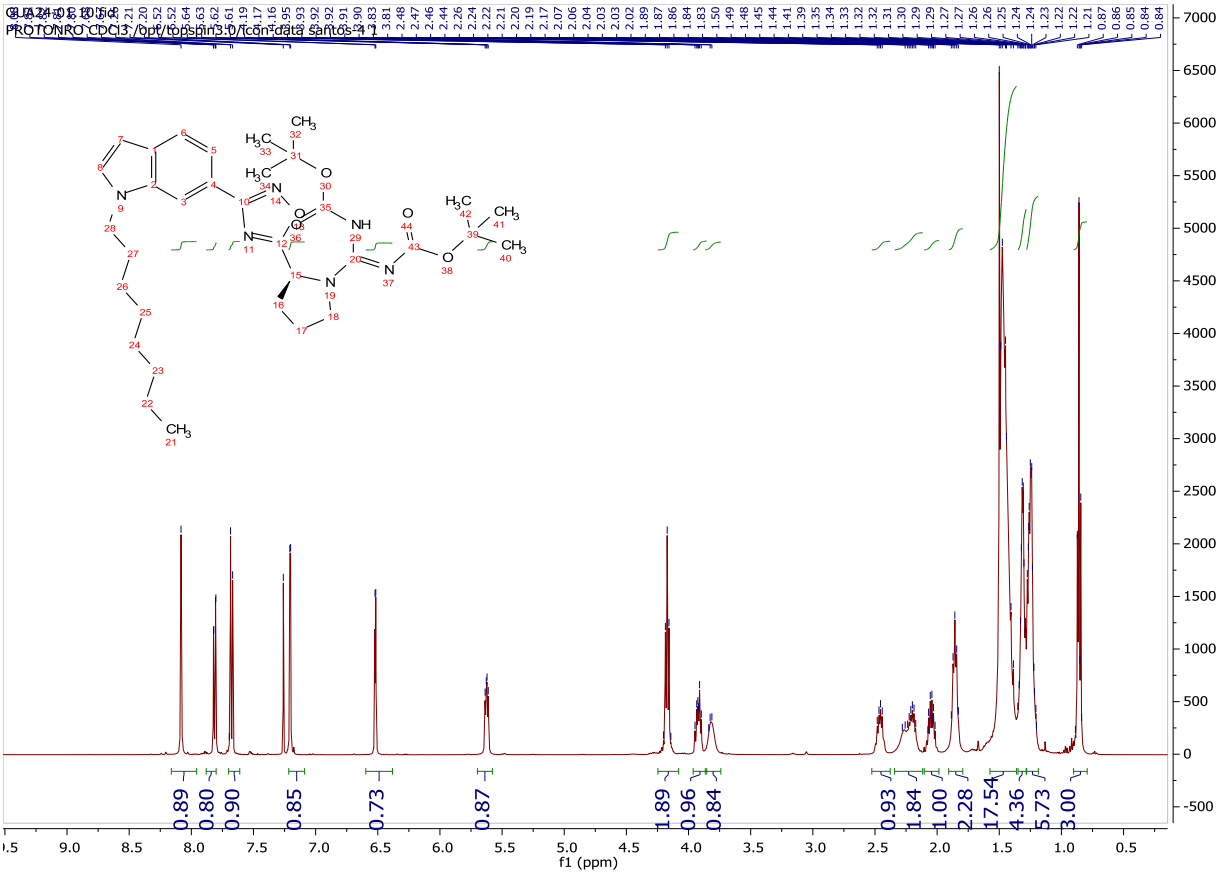
^{1}H-NMR Spectrum for Compound 4.27a:



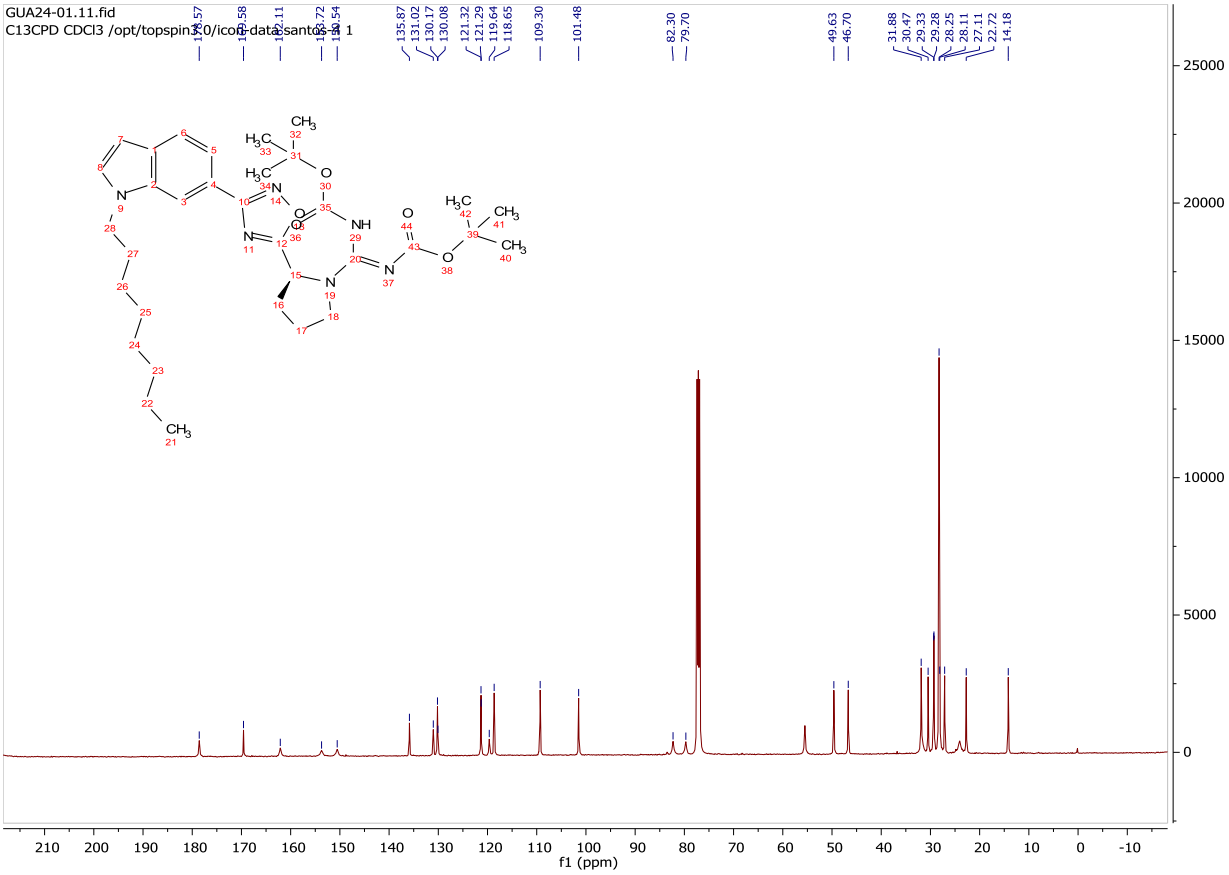
^{13}C-NMR Spectrum for Compound 4.27a:



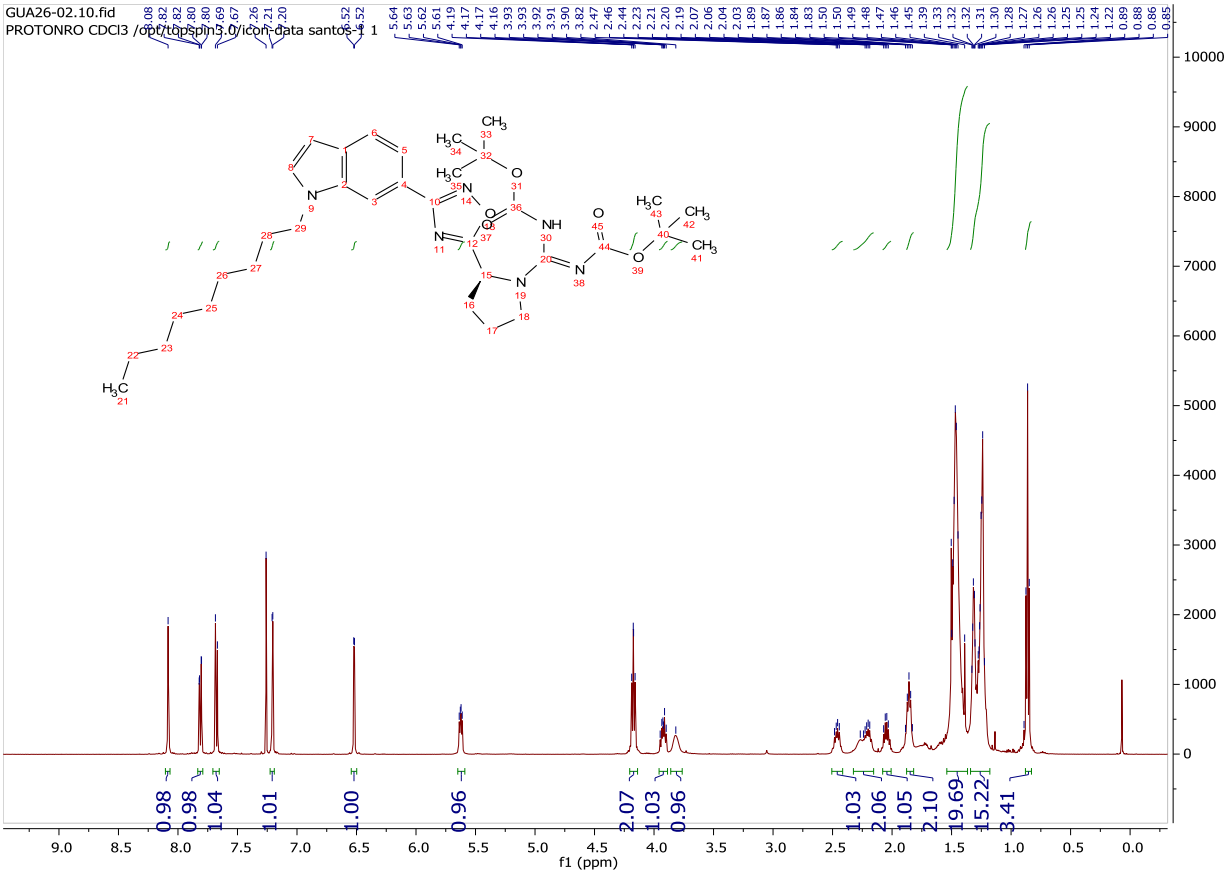
^{1}H-NMR Spectrum for Compound 4.27b:



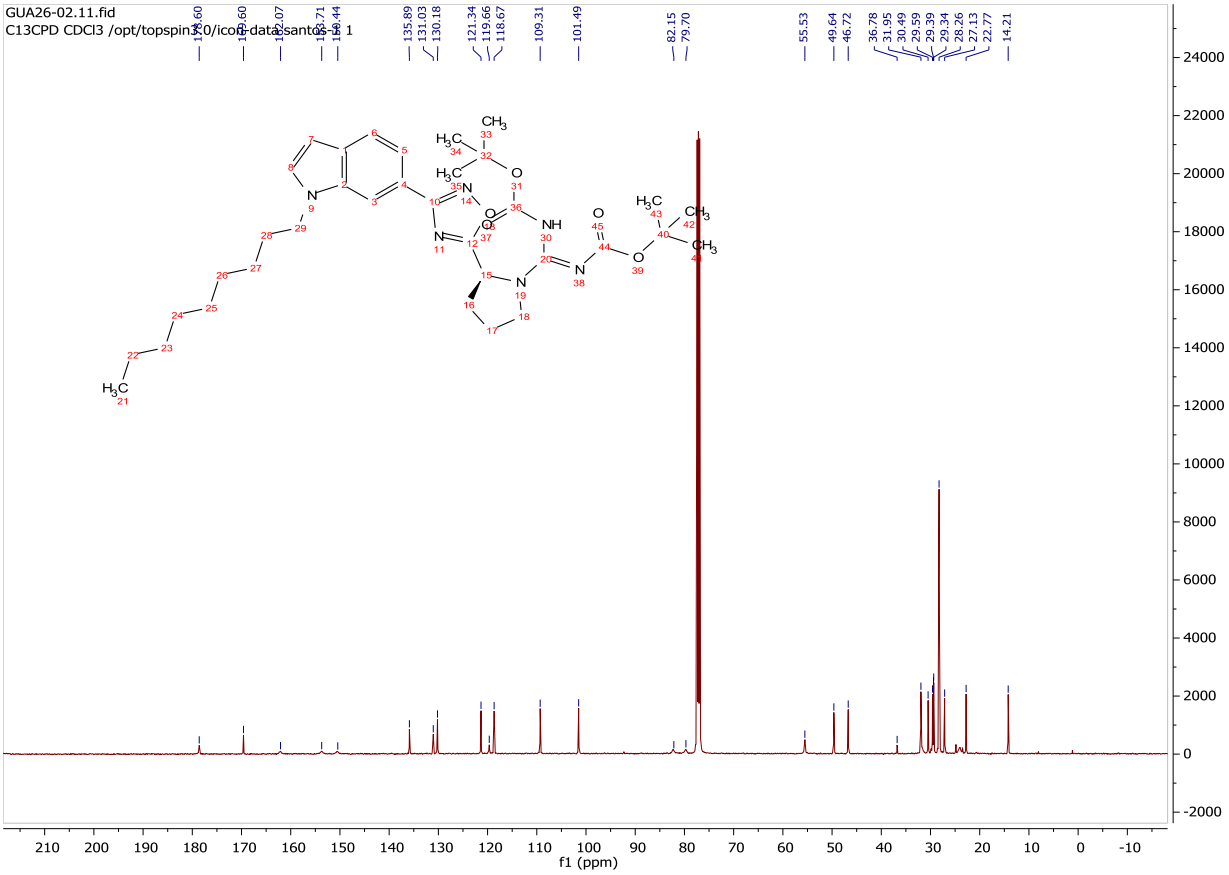
^{13}C-NMR Spectrum for Compound 4.27b:



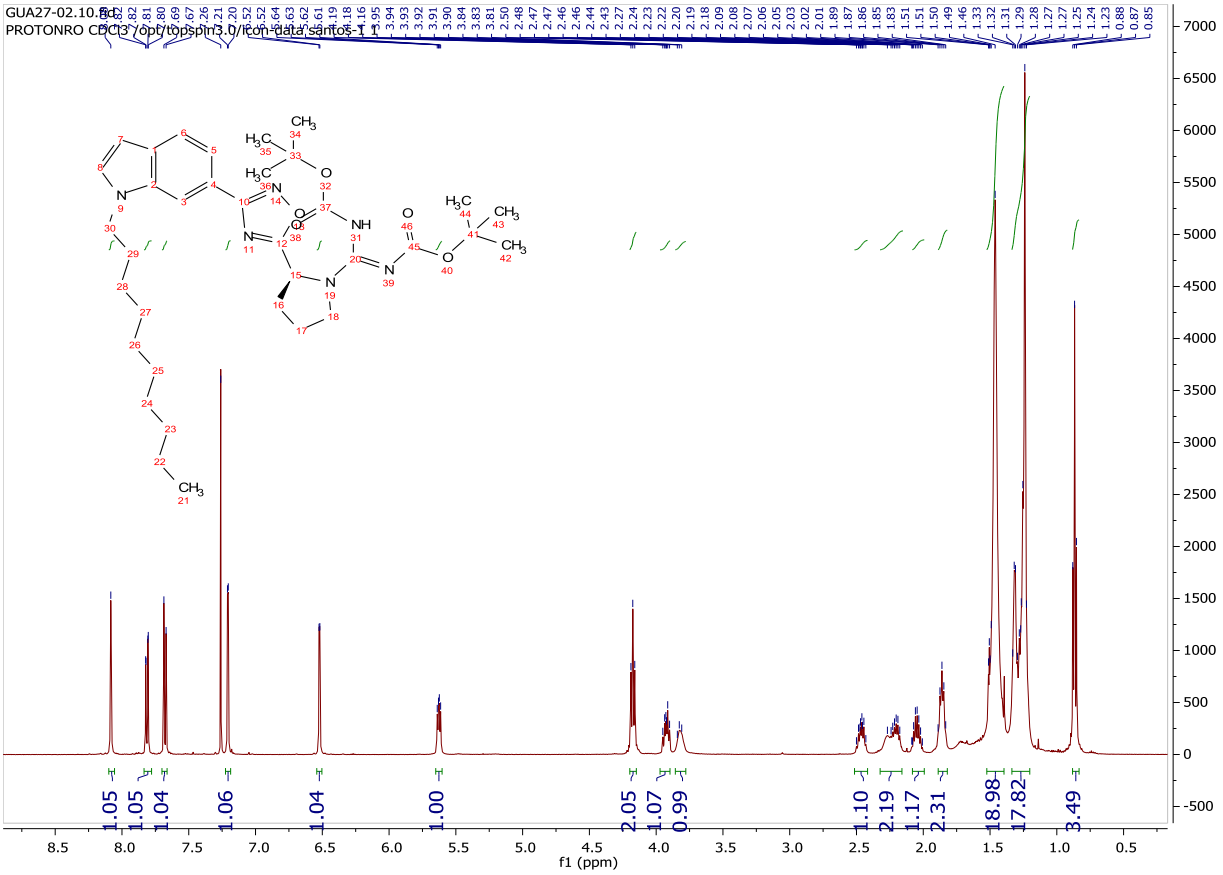
^{1}H-NMR Spectrum for Compound 4.27c:



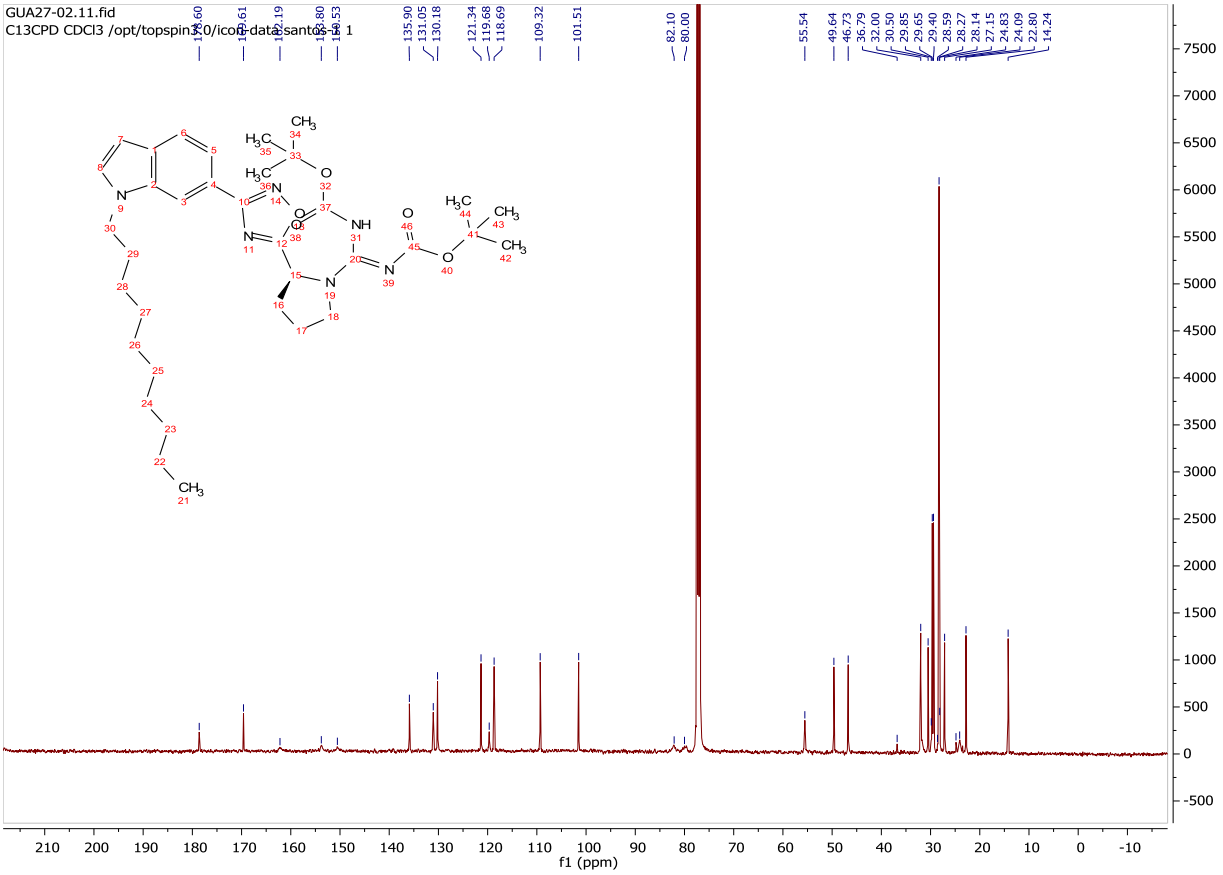
^{13}C-NMR Spectrum for Compound 4.27c:



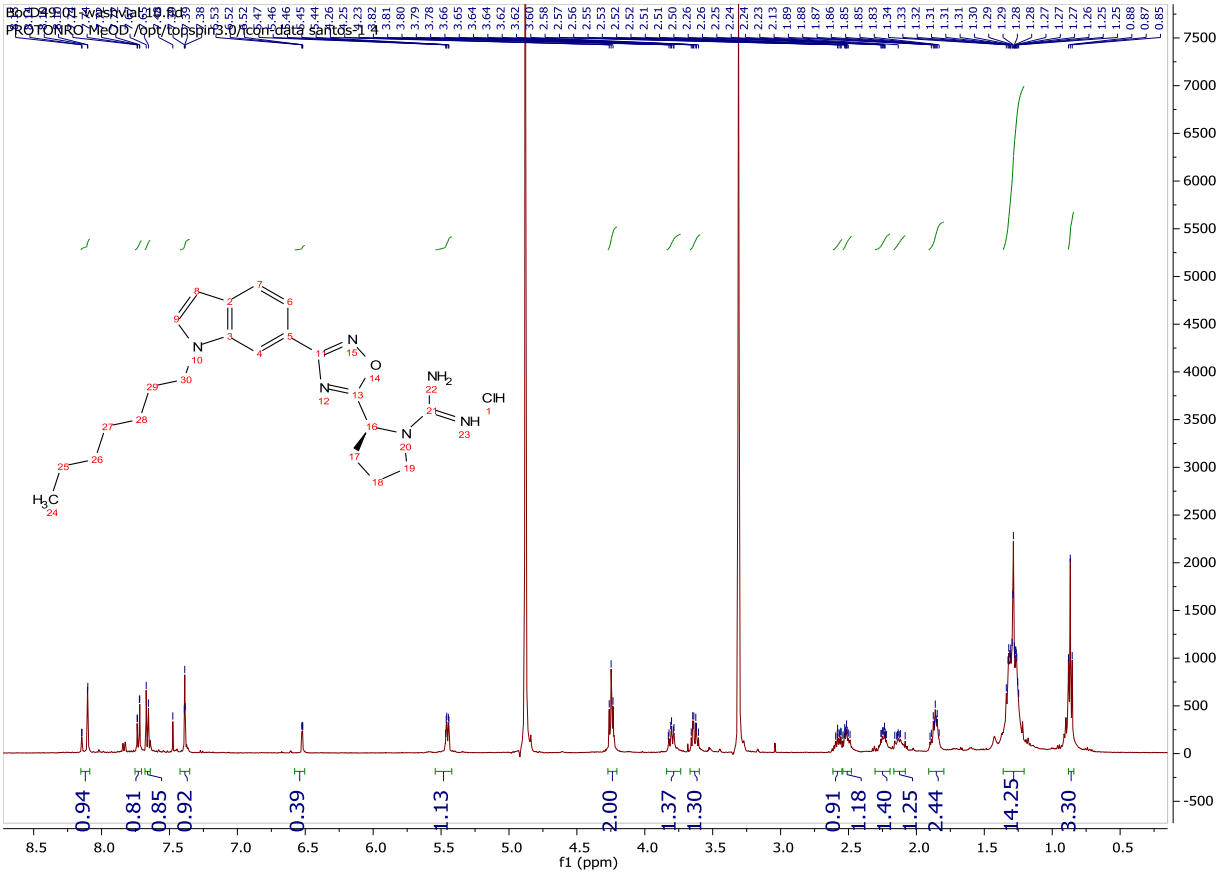
^{1}H-NMR Spectrum for Compound 4.27d:



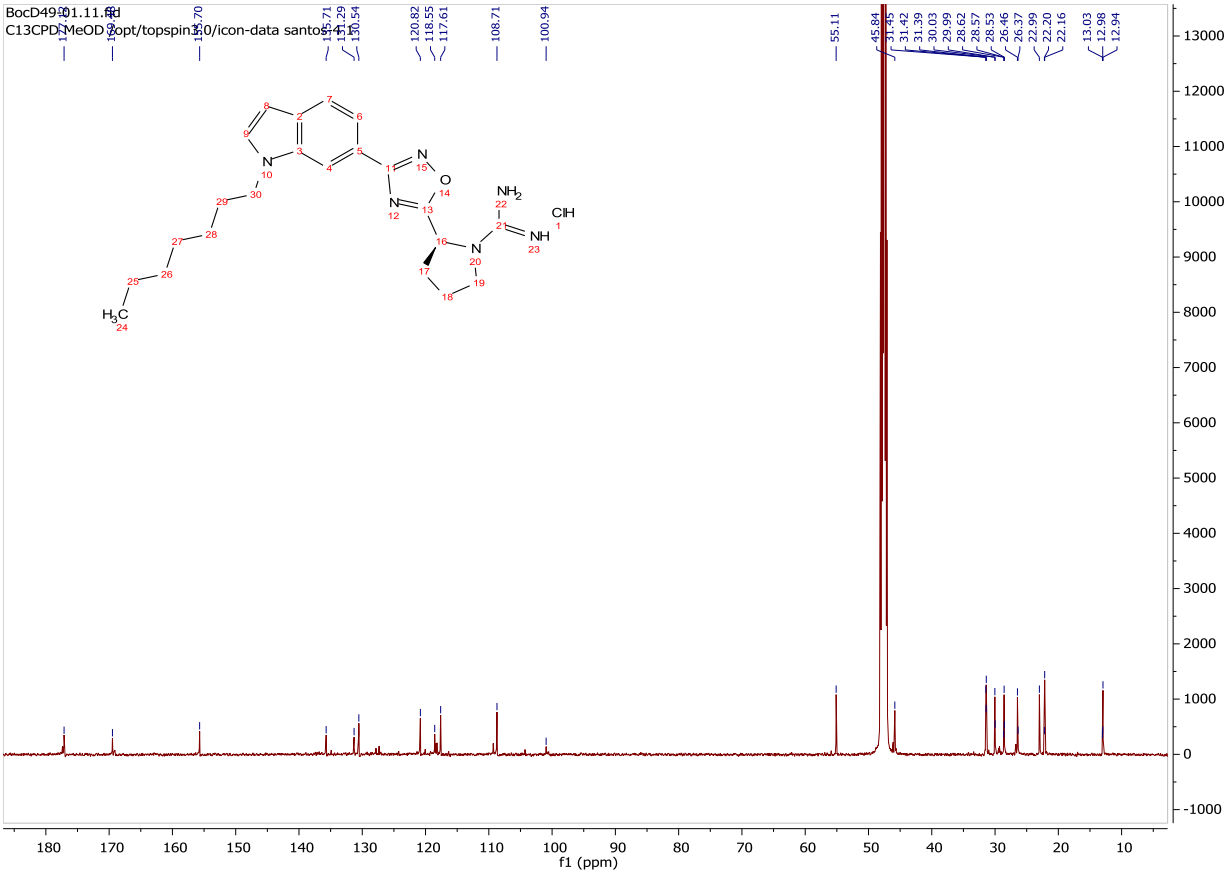
^{13}C-NMR Spectrum for Compound 4.27d:



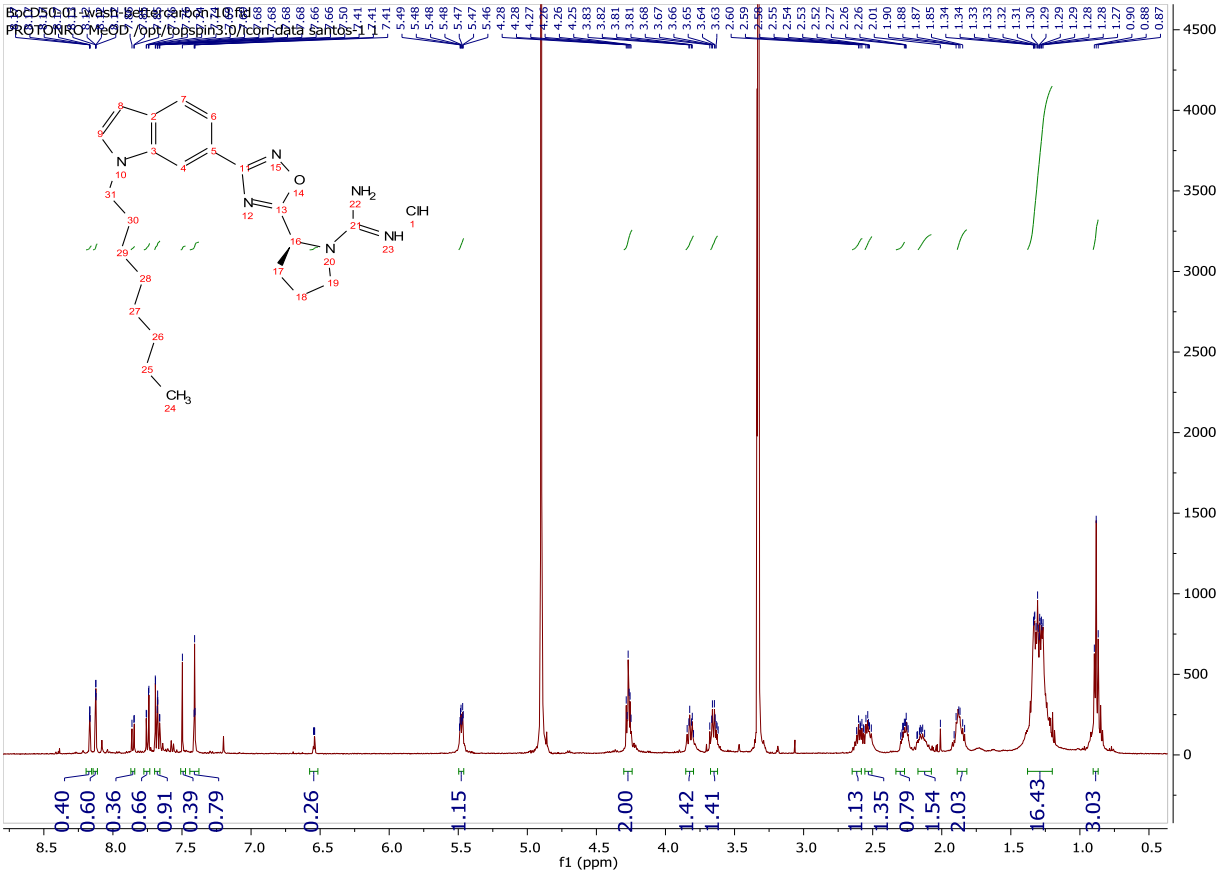
^{1}H-NMR Spectrum for Compound 4.28a:



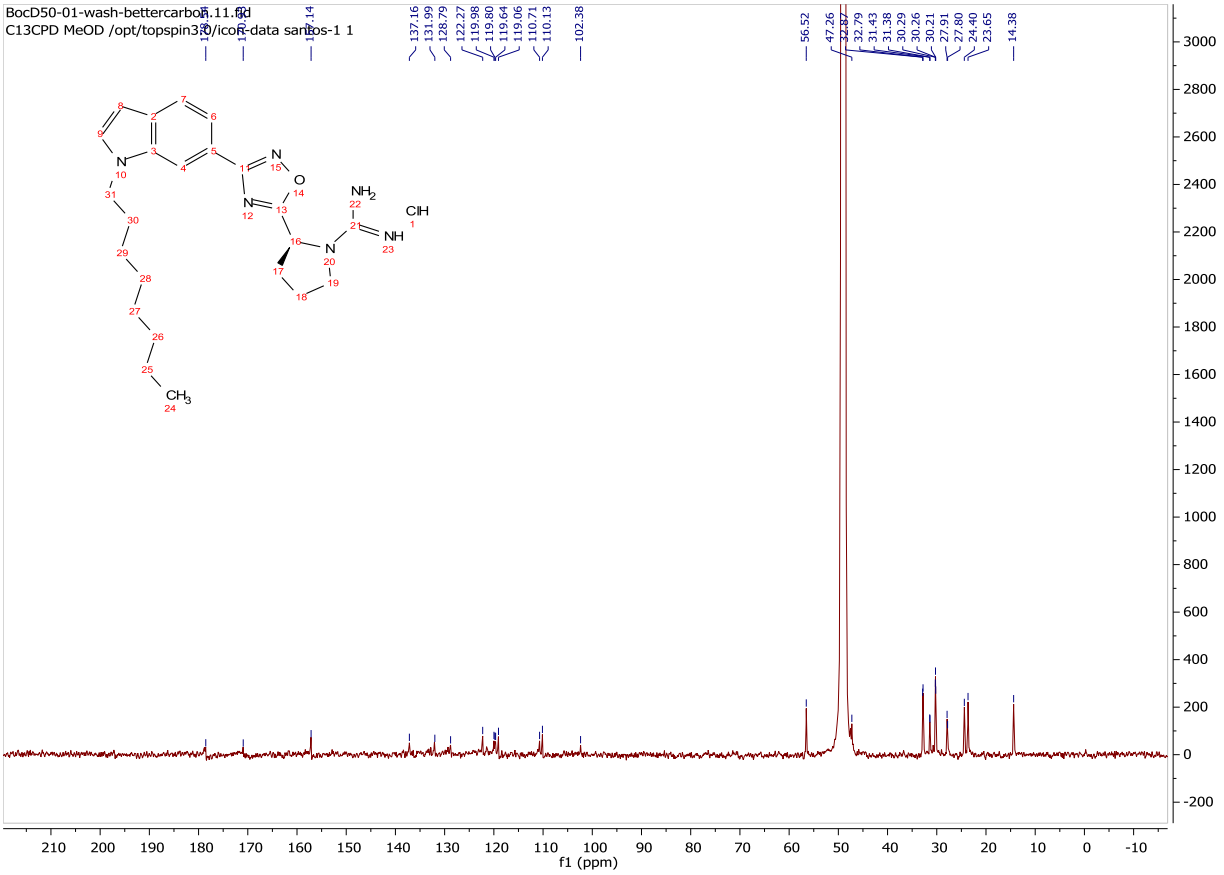
^{13}C-NMR Spectrum for Compound 4.28a:



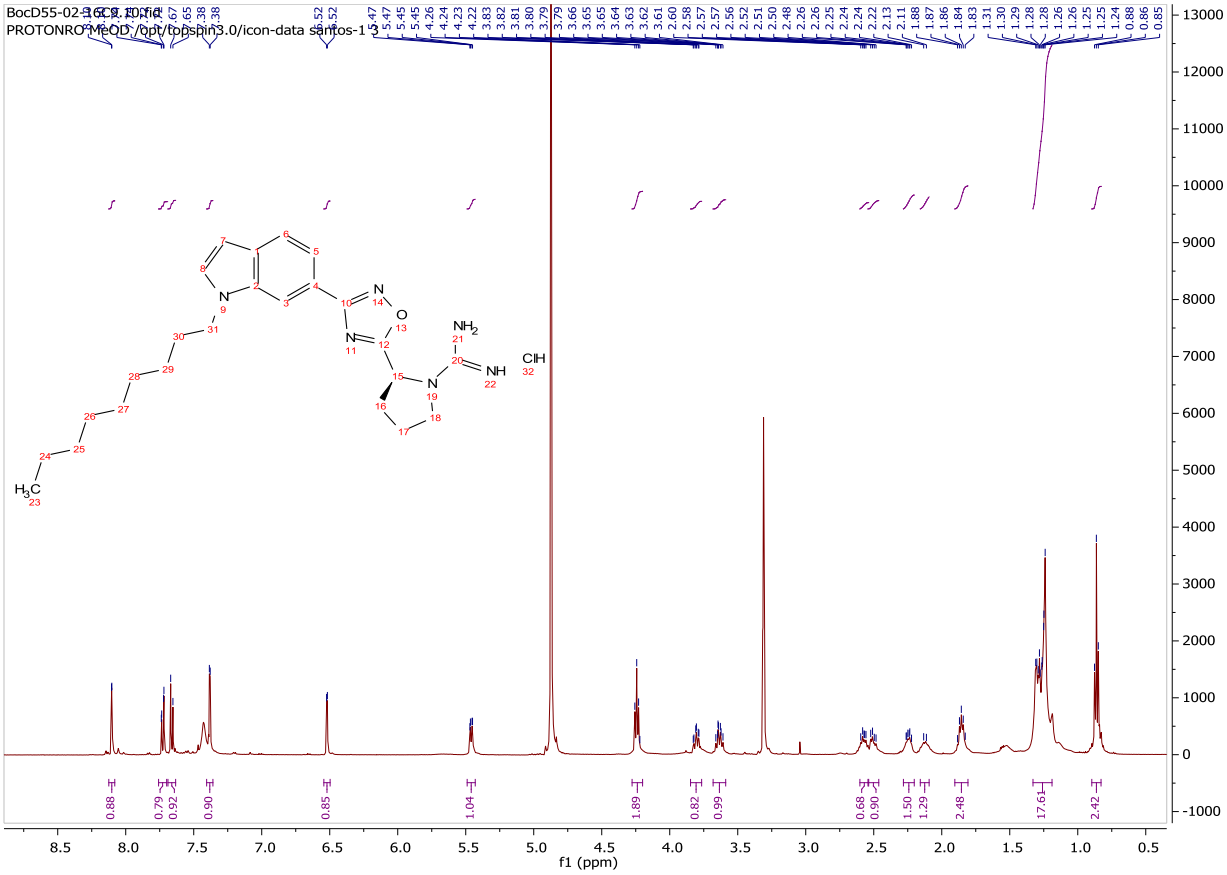
^{1}H-NMR Spectrum for Compound 4.28b:



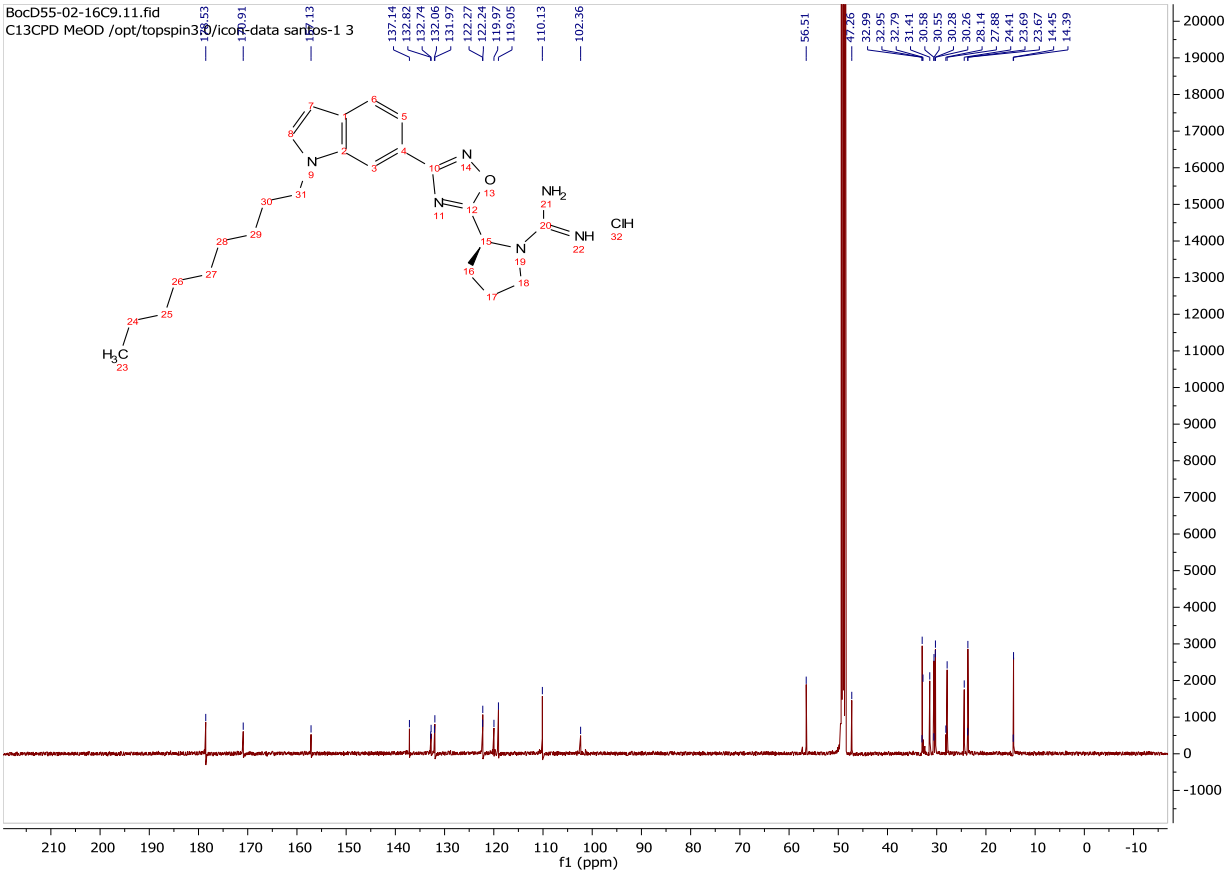
^{13}C-NMR Spectrum for Compound 4.28b:



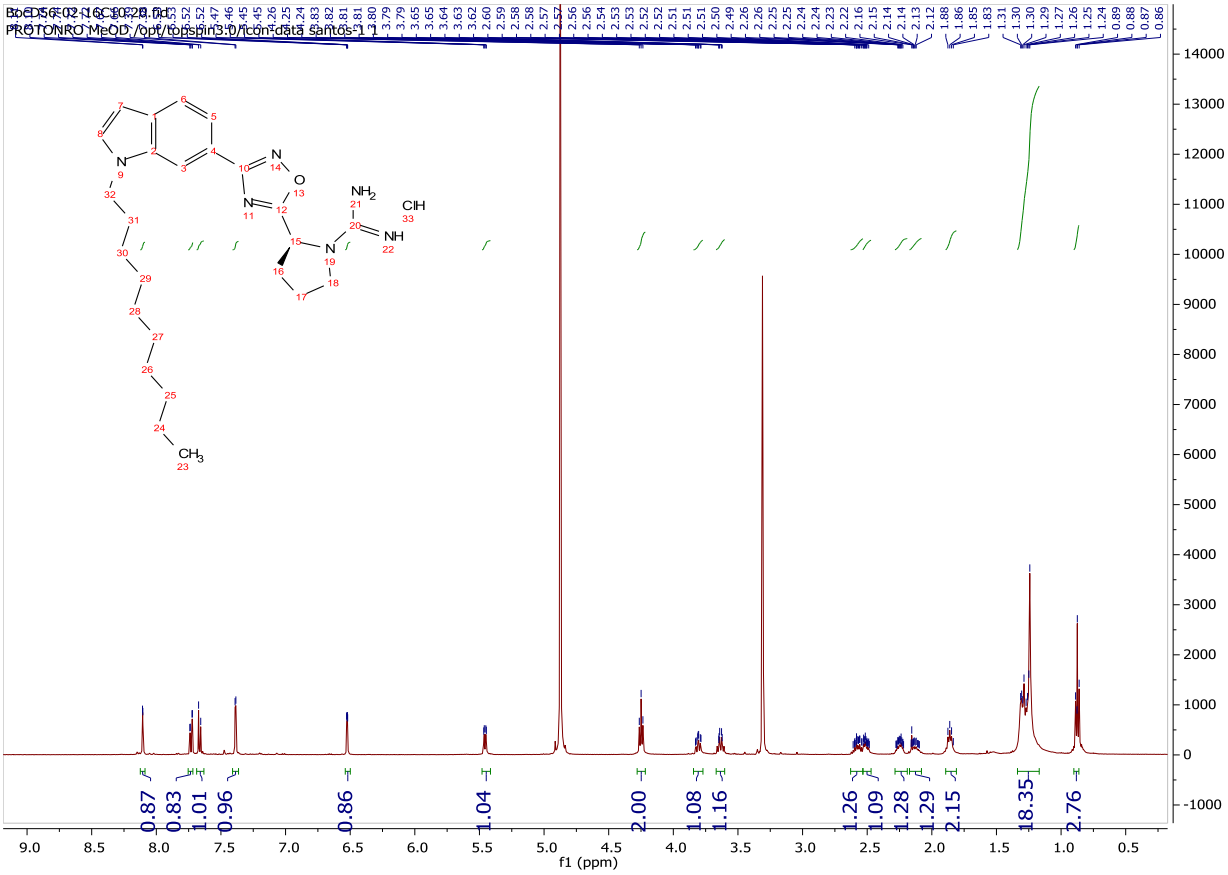
^{1}H-NMR Spectrum for Compound 4.28c:



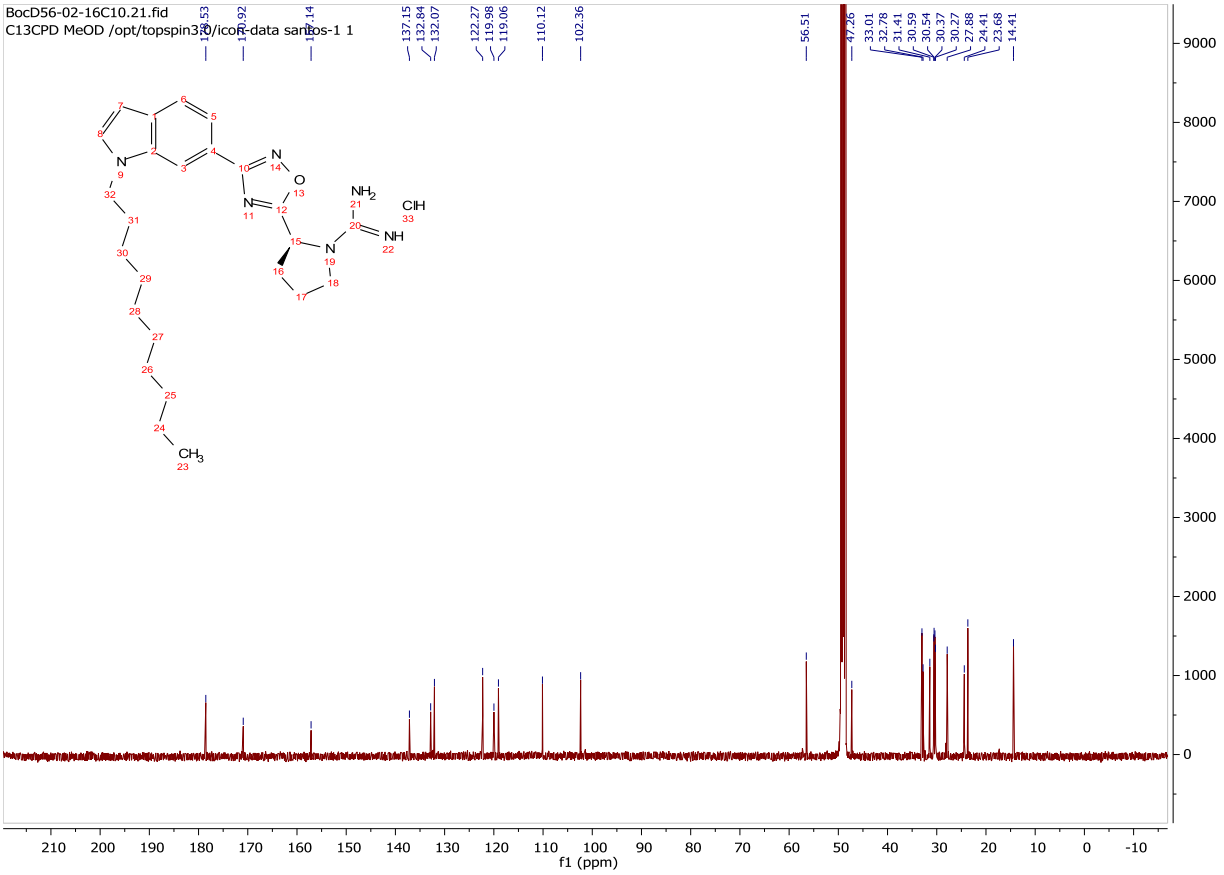
^{13}C-NMR Spectrum for Compound 4.28c:



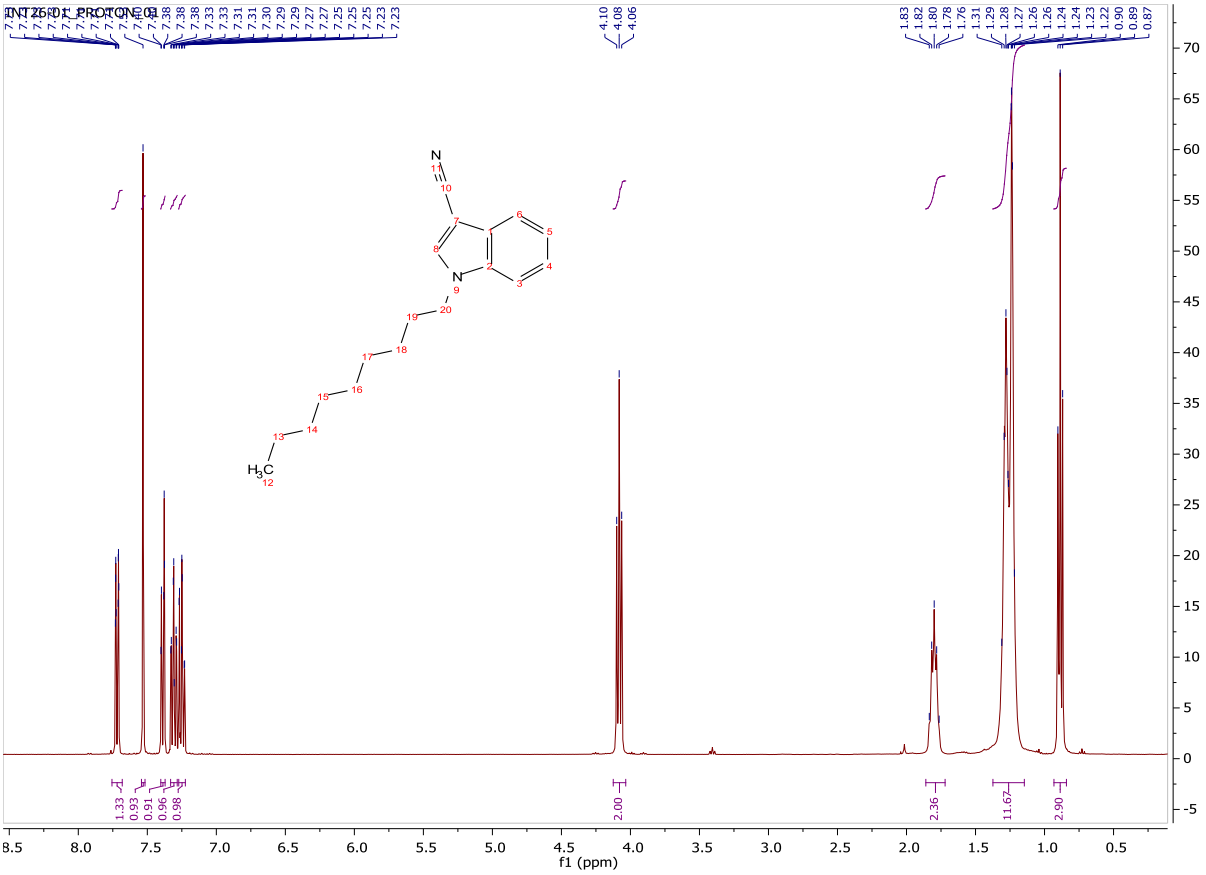
^{1}H-NMR Spectrum for Compound 4.28d:



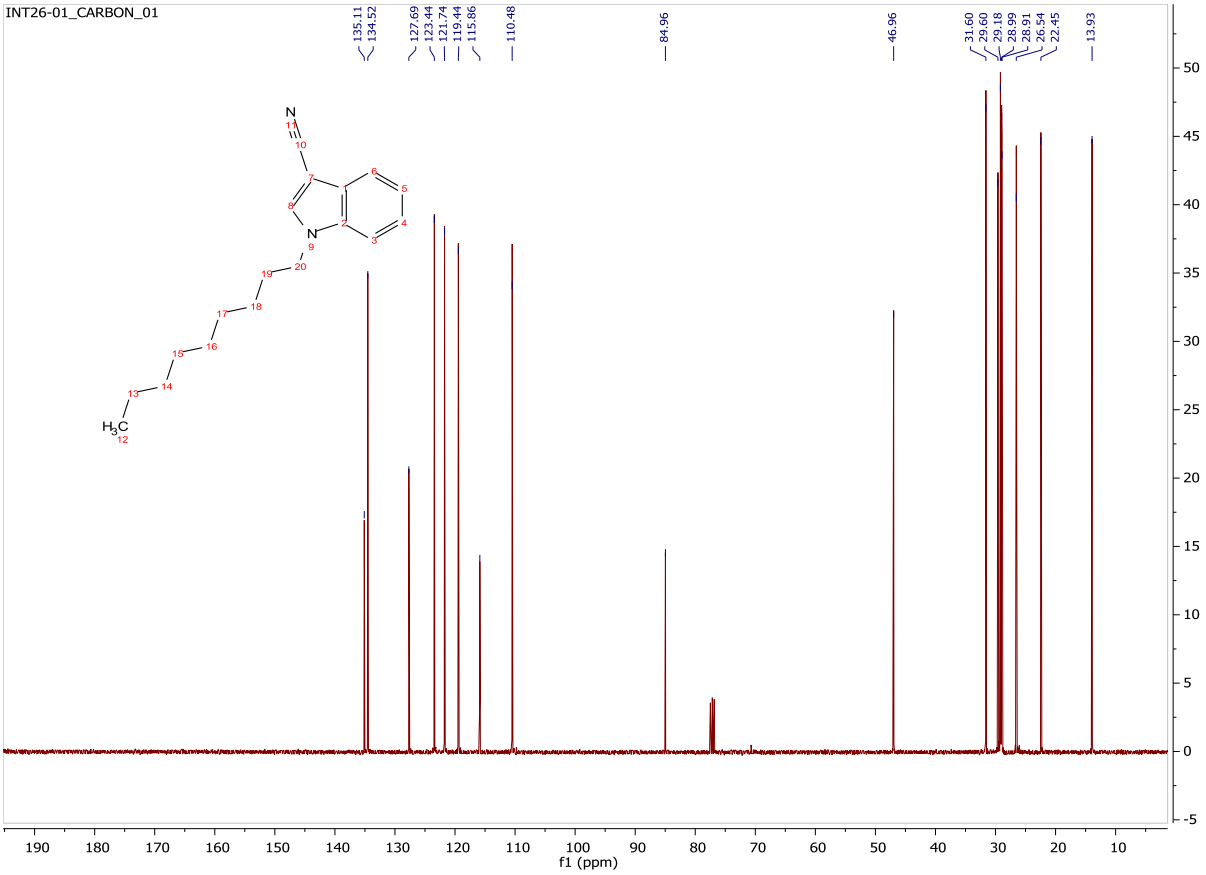
^{13}C-NMR Spectrum for Compound 4.28d:



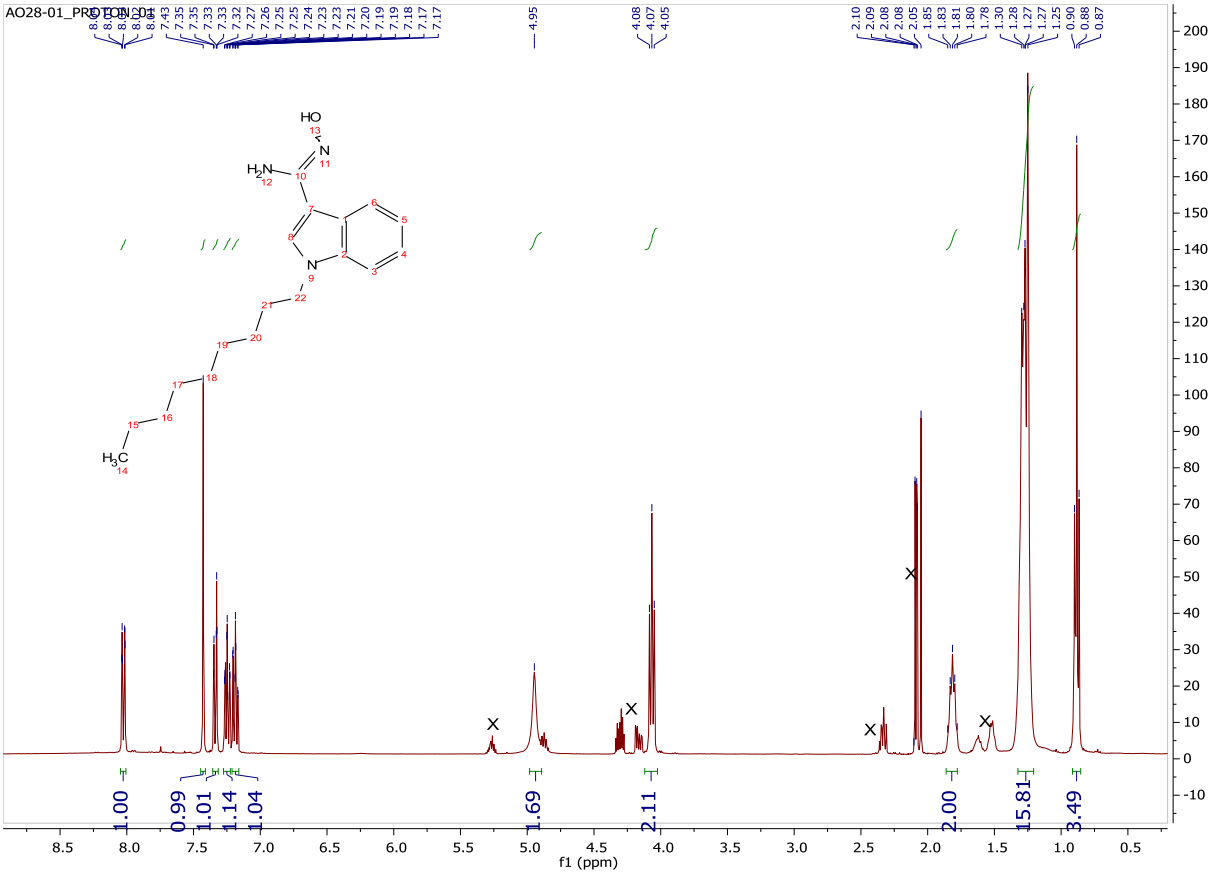
^{1}H-NMR Spectrum for Compound 4.29:



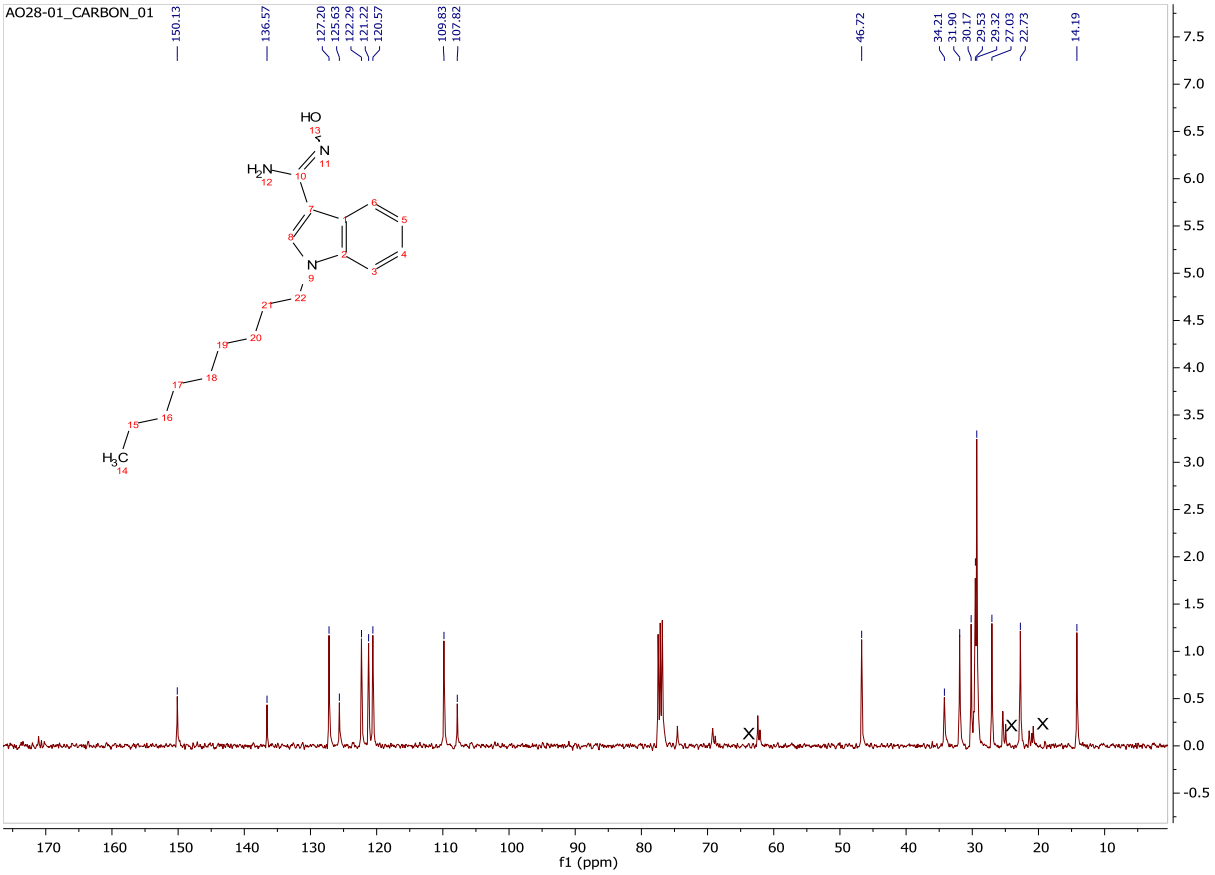
^{13}C-NMR Spectrum for Compound 4.29:



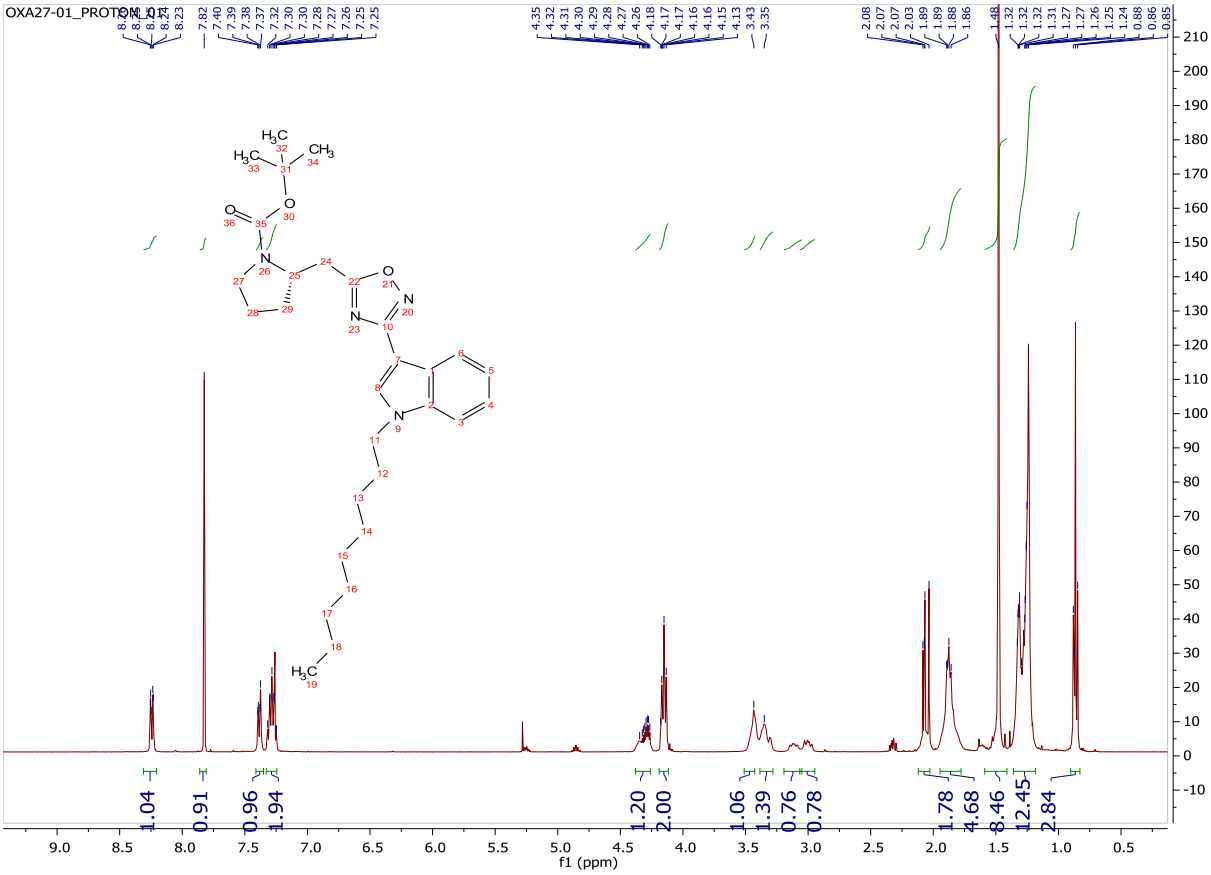
^{1}H-NMR Spectrum for Compound 4.30:



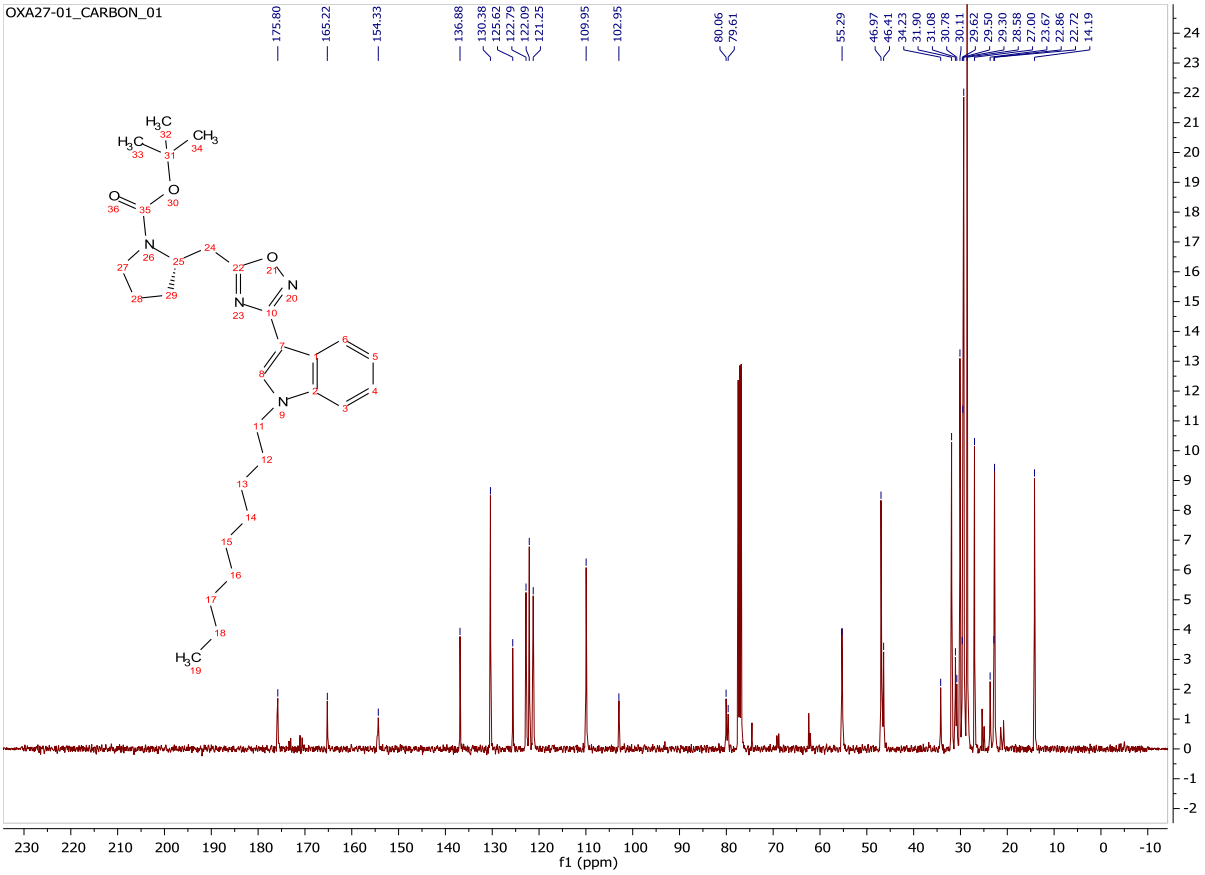
^{13}C-NMR Spectrum for Compound 4.30:



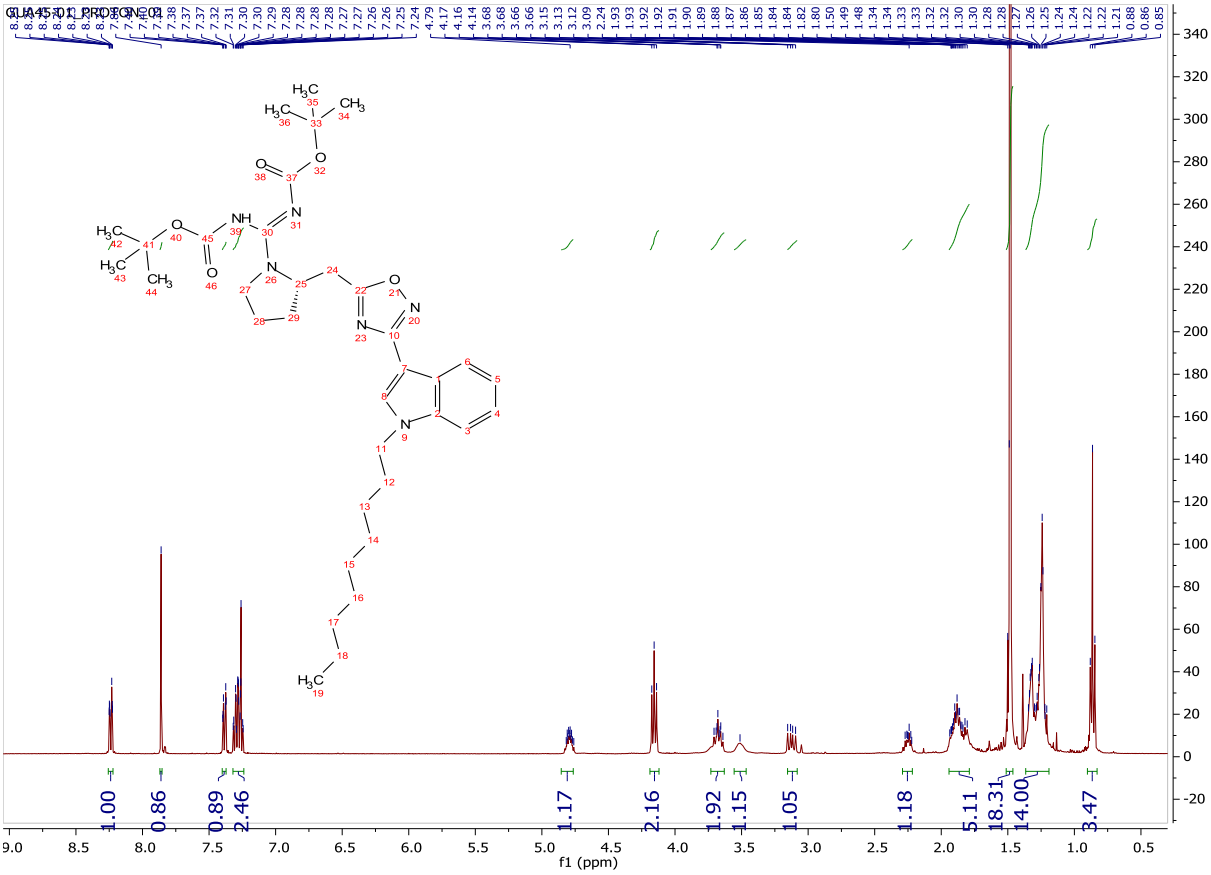
^{1}H-NMR Spectrum for Compound 4.31:



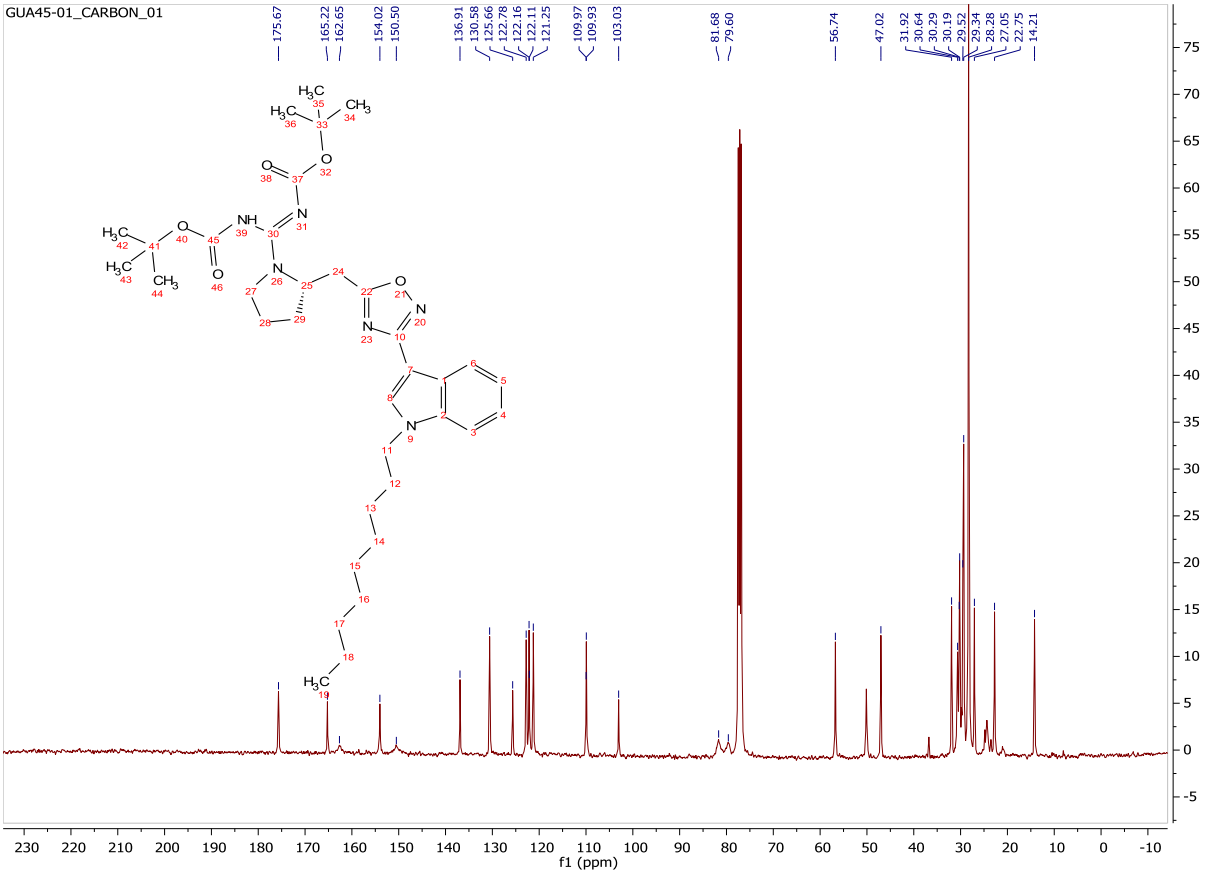
^{13}C-NMR Spectrum for Compound 4.31:



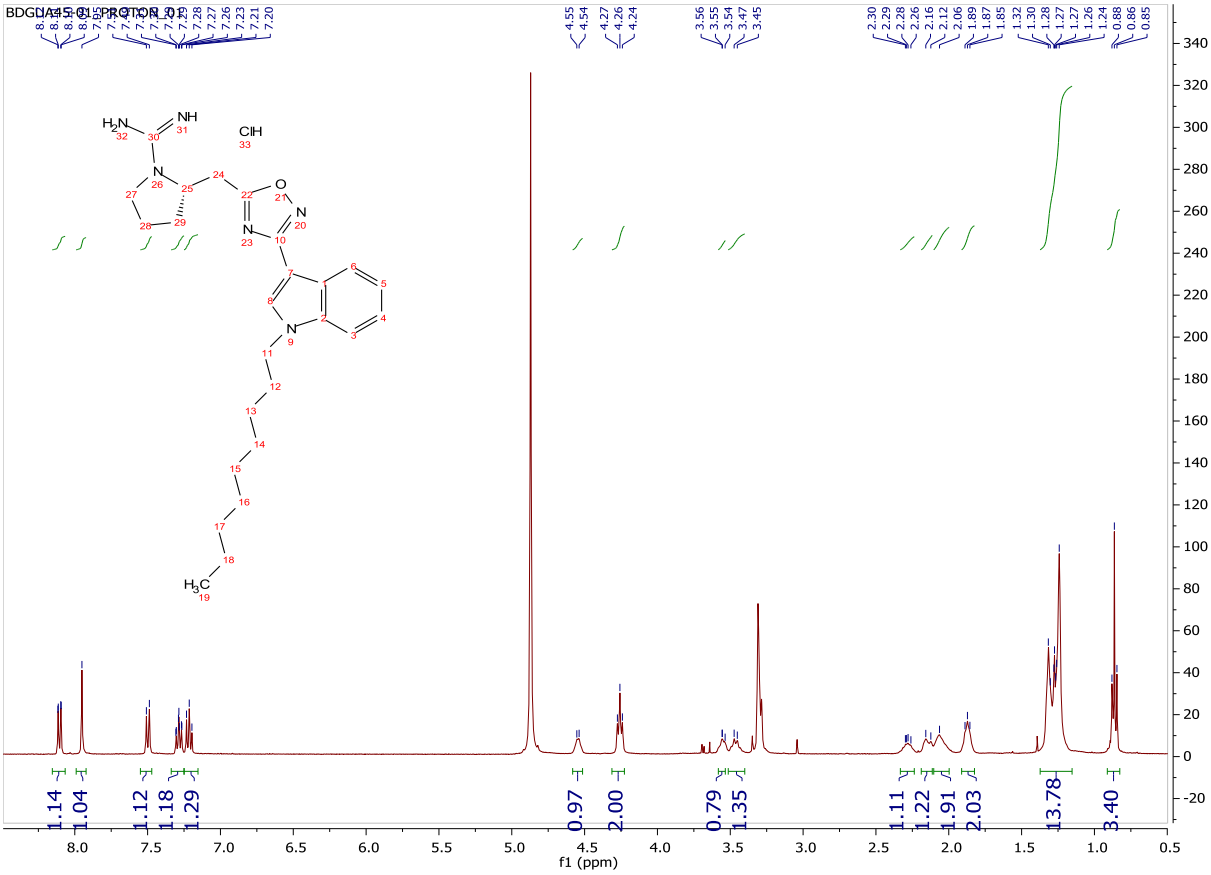
^{1}H-NMR Spectrum for Compound 4.33:



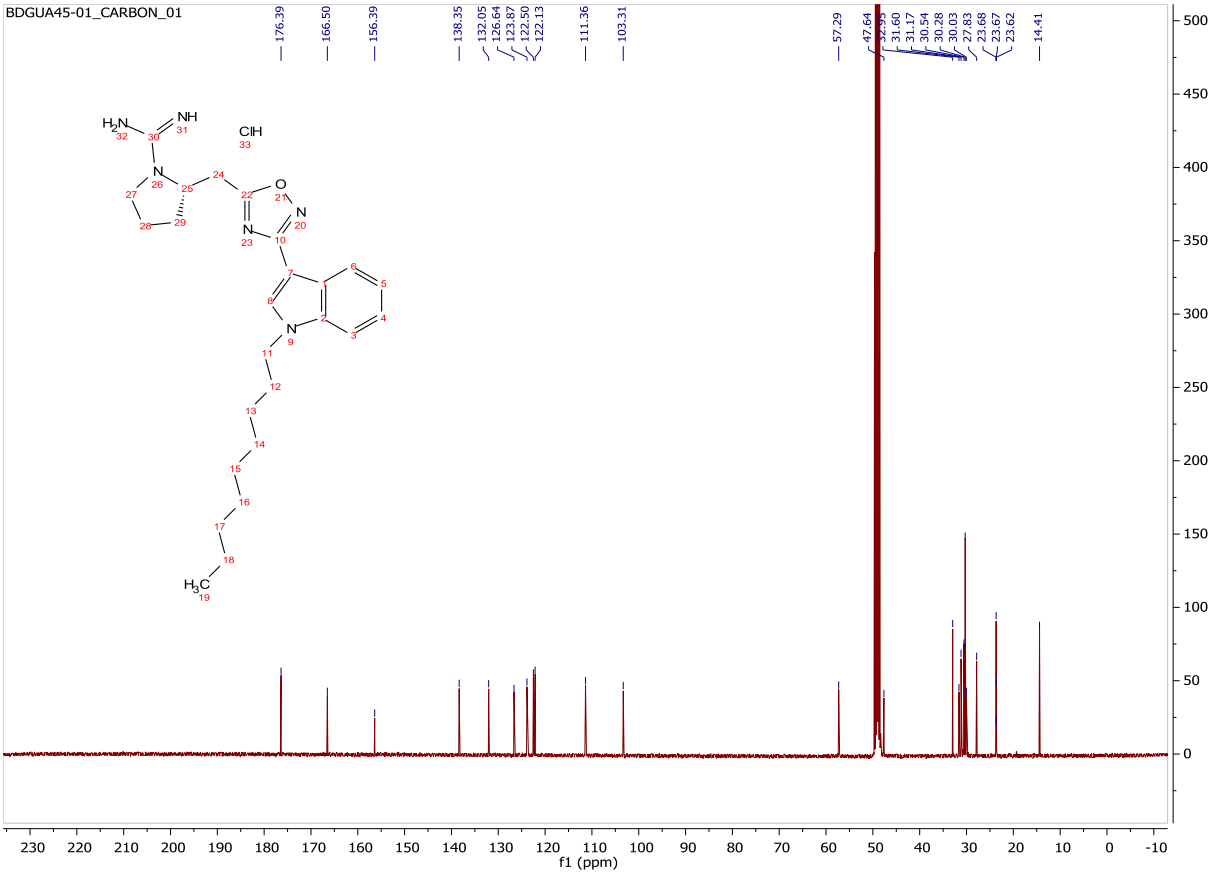
^{13}C-NMR Spectrum for Compound 4.33:



^{1}H-NMR Spectrum for Compound 4.34:

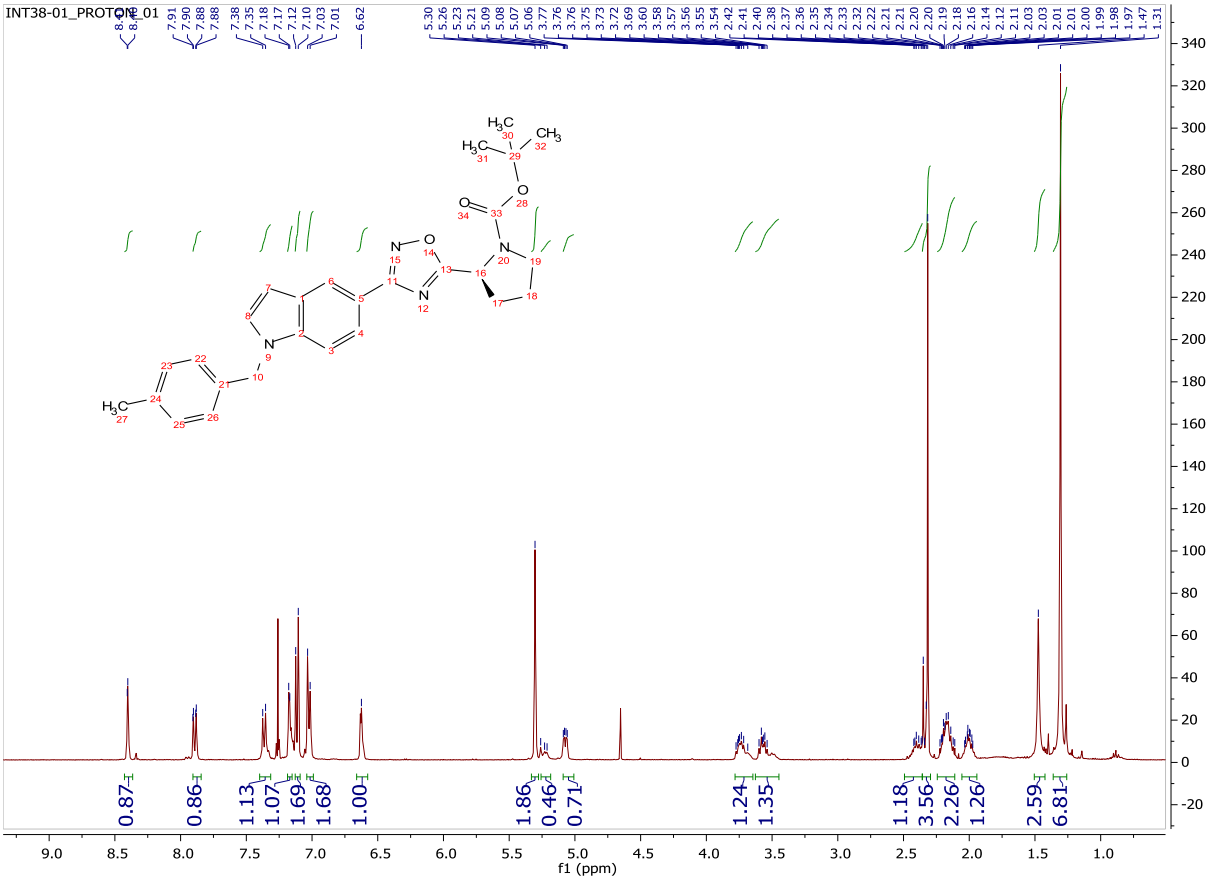


^{13}C-NMR Spectrum for Compound 4.34:

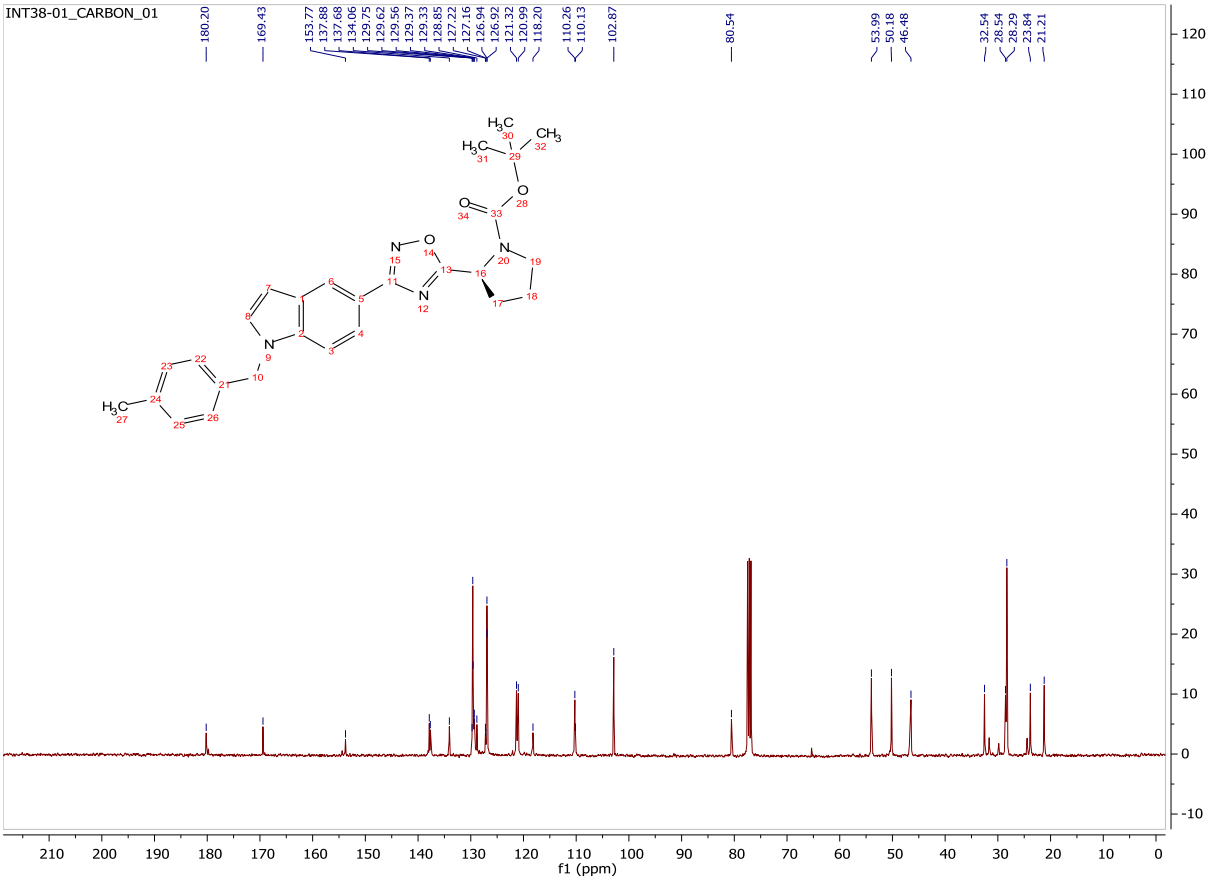


Appendix D NMR Spectra for Chapter 5

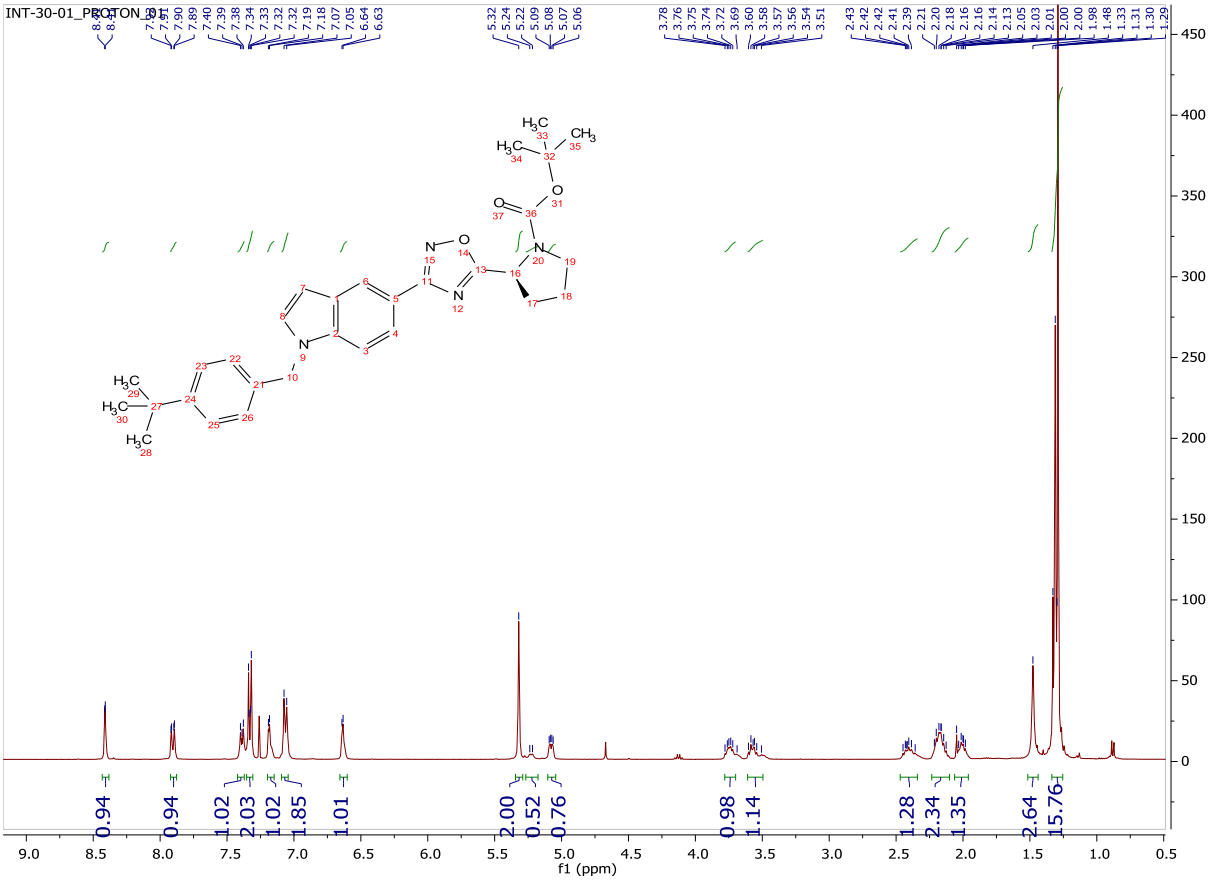
^{1}H-NMR Spectrum for Compound 5.1a:



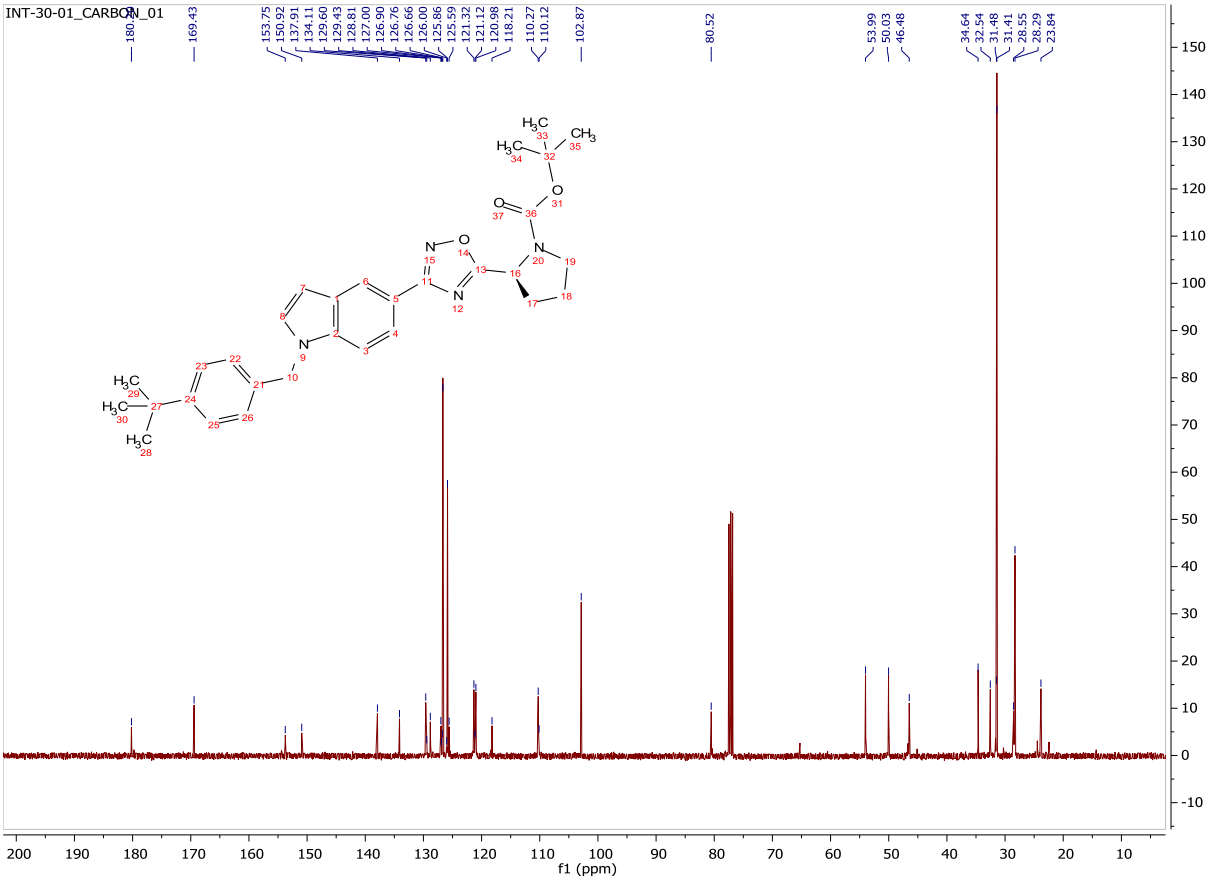
^{13}C-NMR Spectrum for Compound 5.1a:



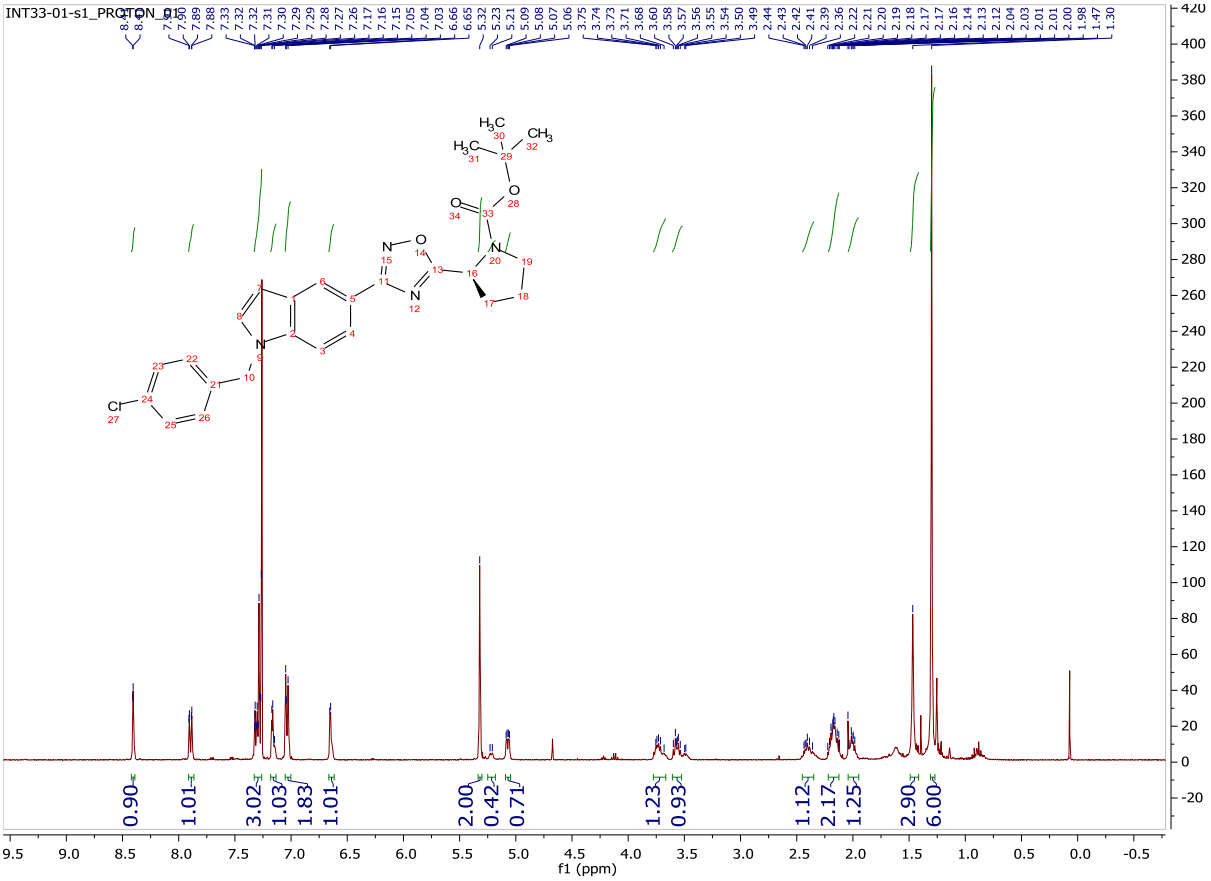
^{1}H-NMR Spectrum for Compound 5.1b:



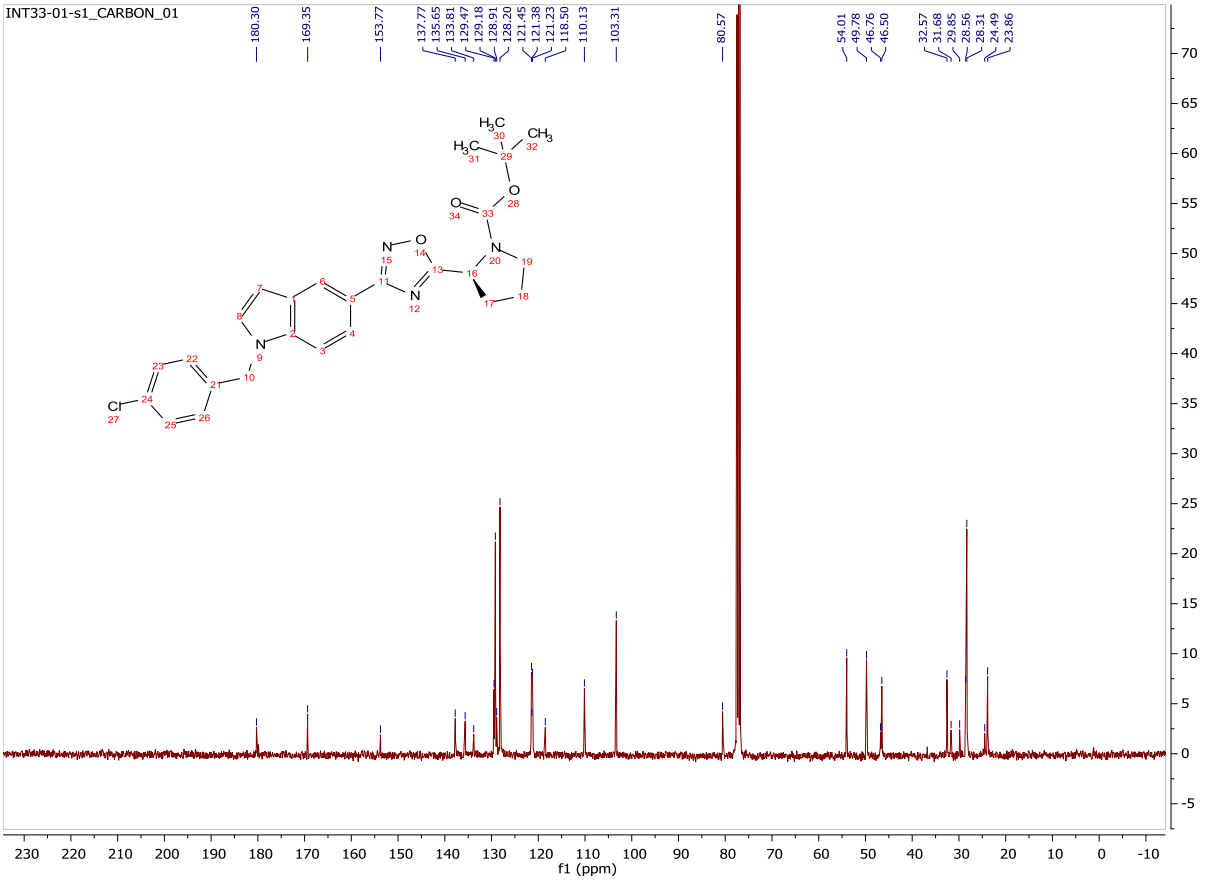
^{13}C-NMR Spectrum for Compound 5.1b:



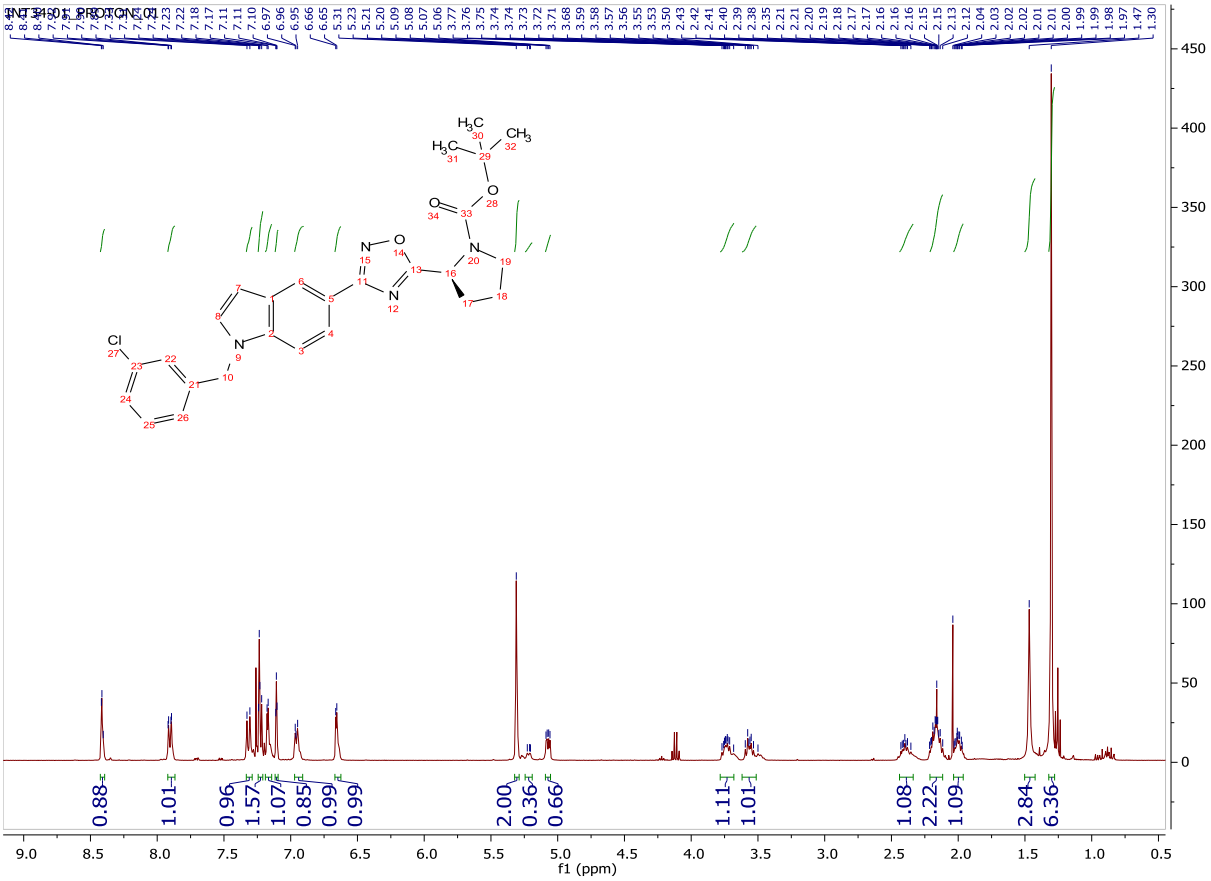
^{1}H-NMR Spectrum for Compound 5.1c:



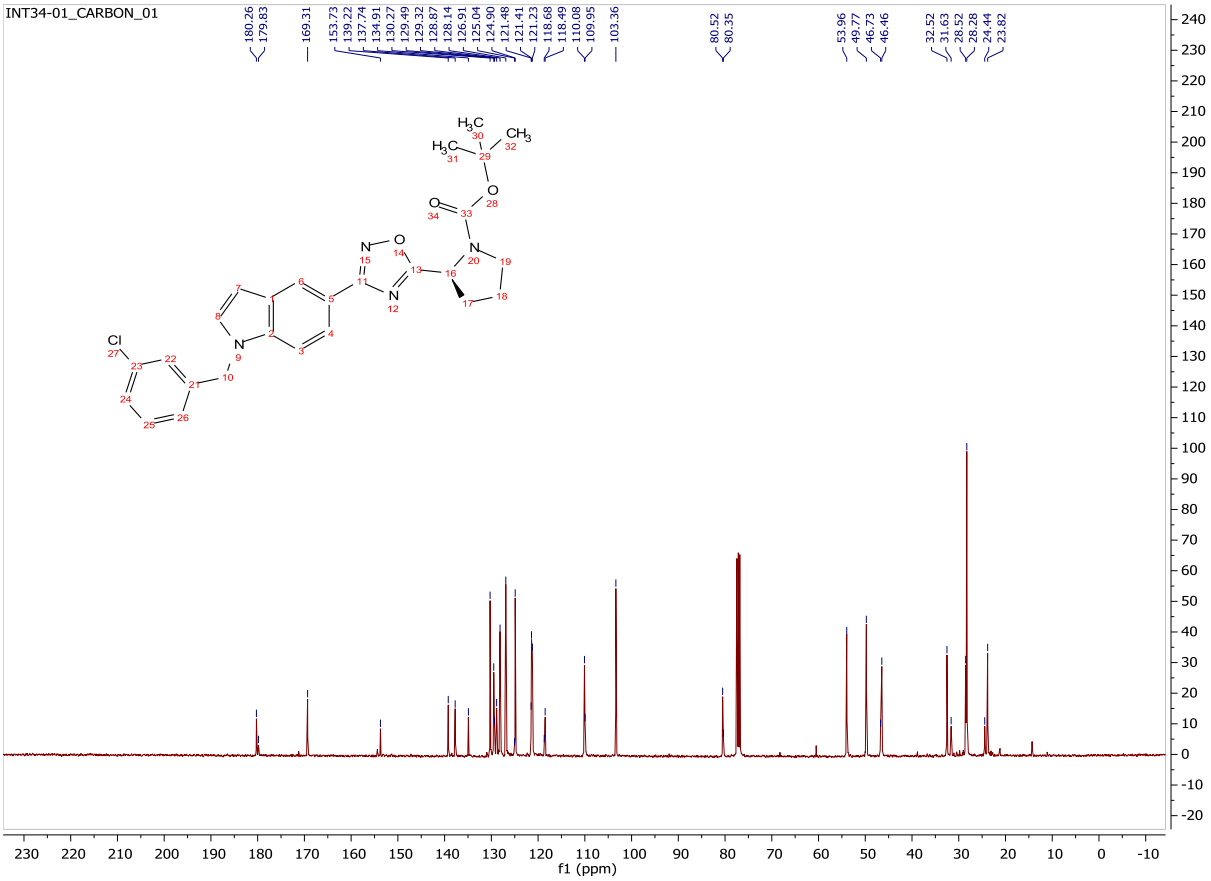
^{13}C-NMR Spectrum for Compound 5.1c:



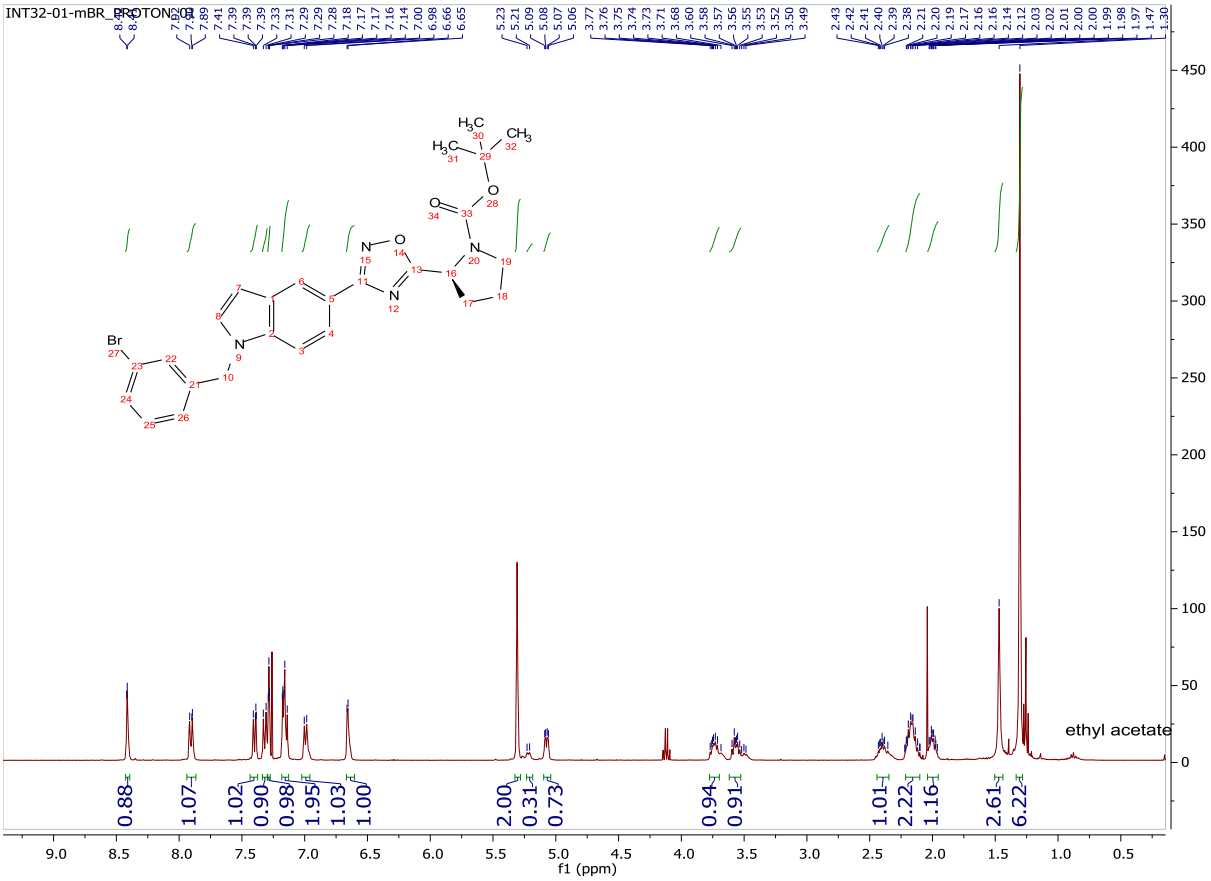
^{1}H-NMR Spectrum for Compound 5.1d:



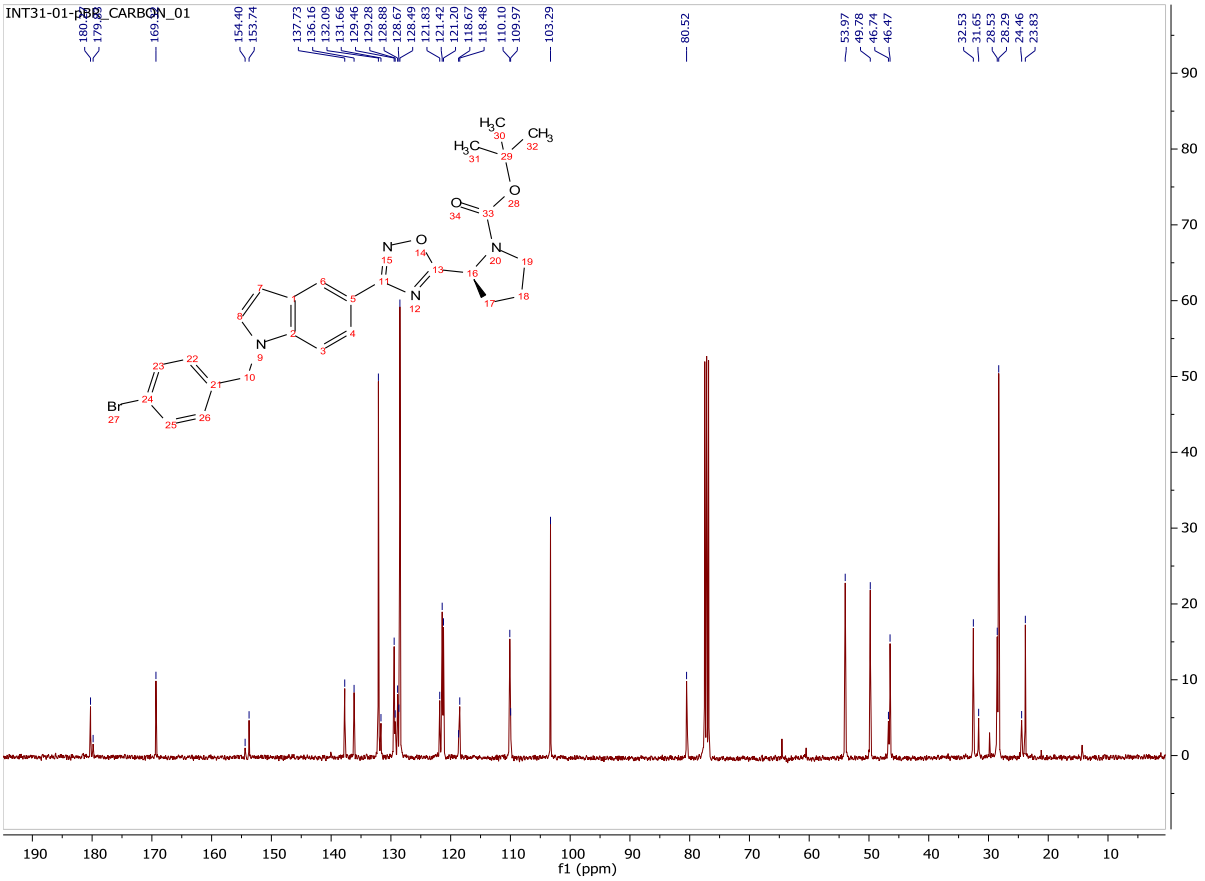
^{13}C-NMR Spectrum for Compound 5.1d:



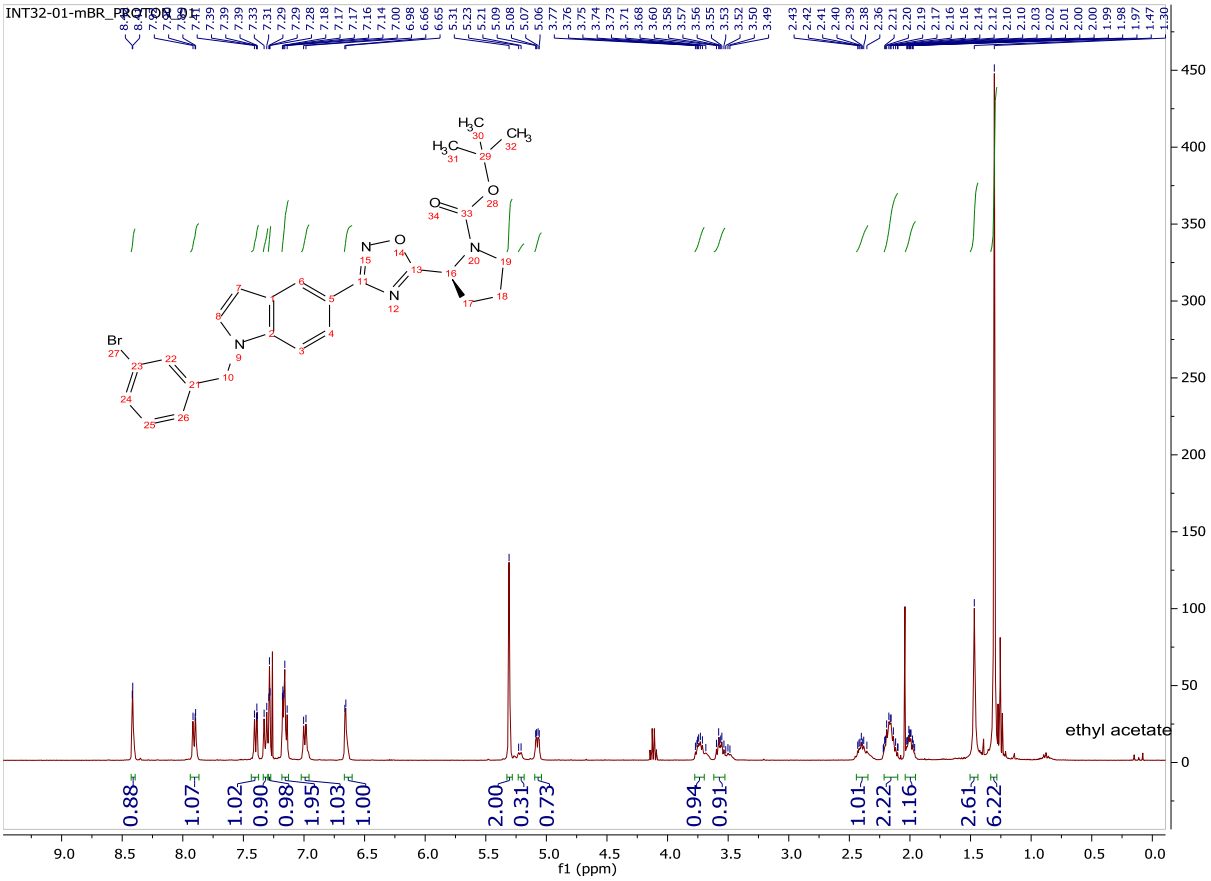
^{1}H-NMR Spectrum for Compound 5.1e:



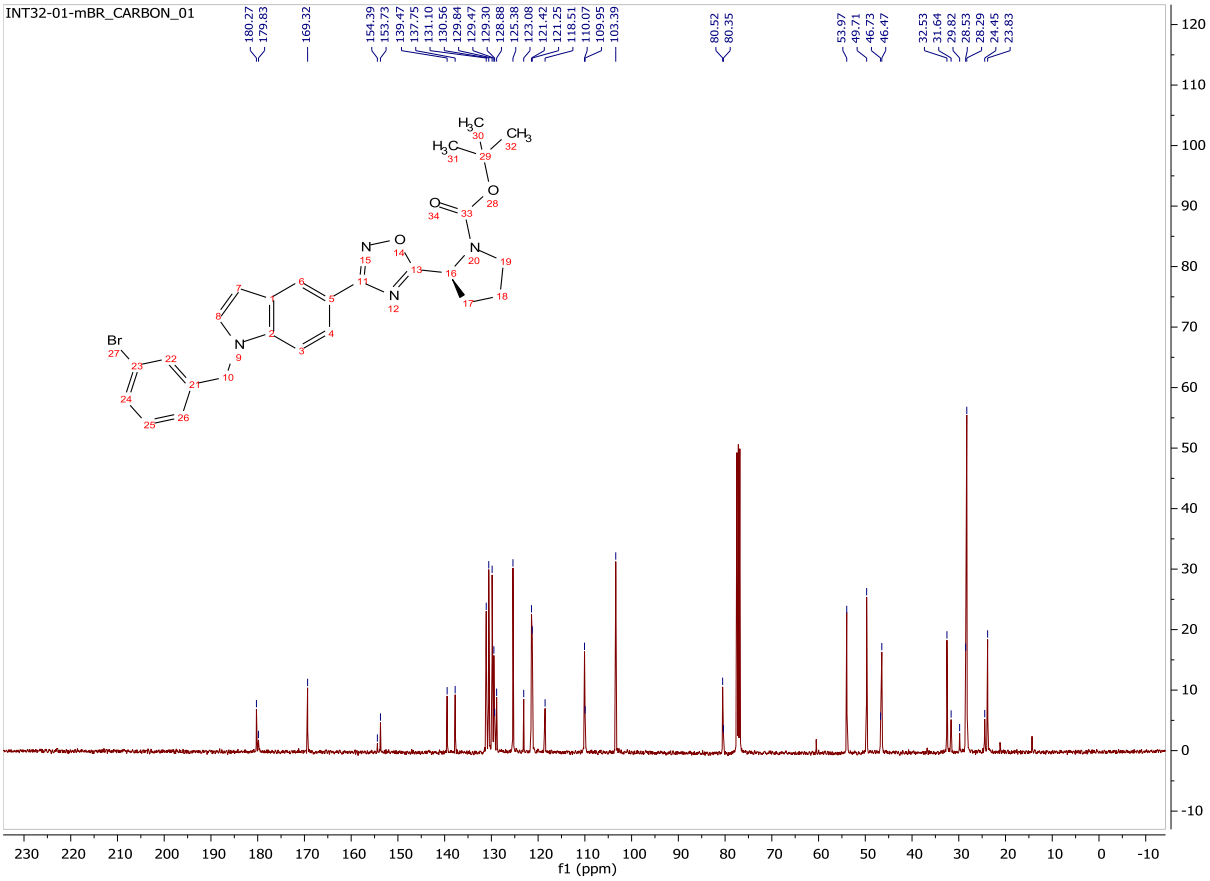
^{13}C-NMR Spectrum for Compound 5.1e:



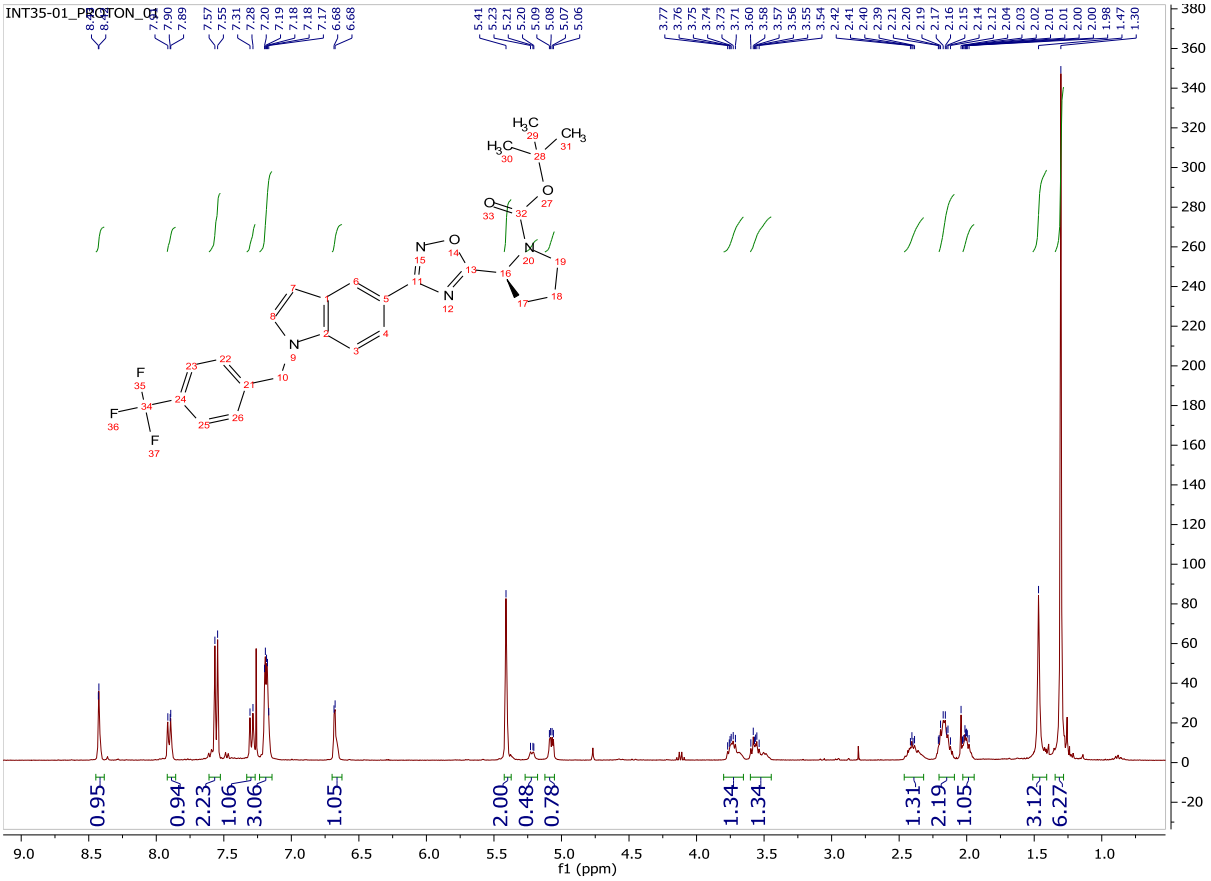
^{1}H-NMR Spectrum for Compound 5.1f:



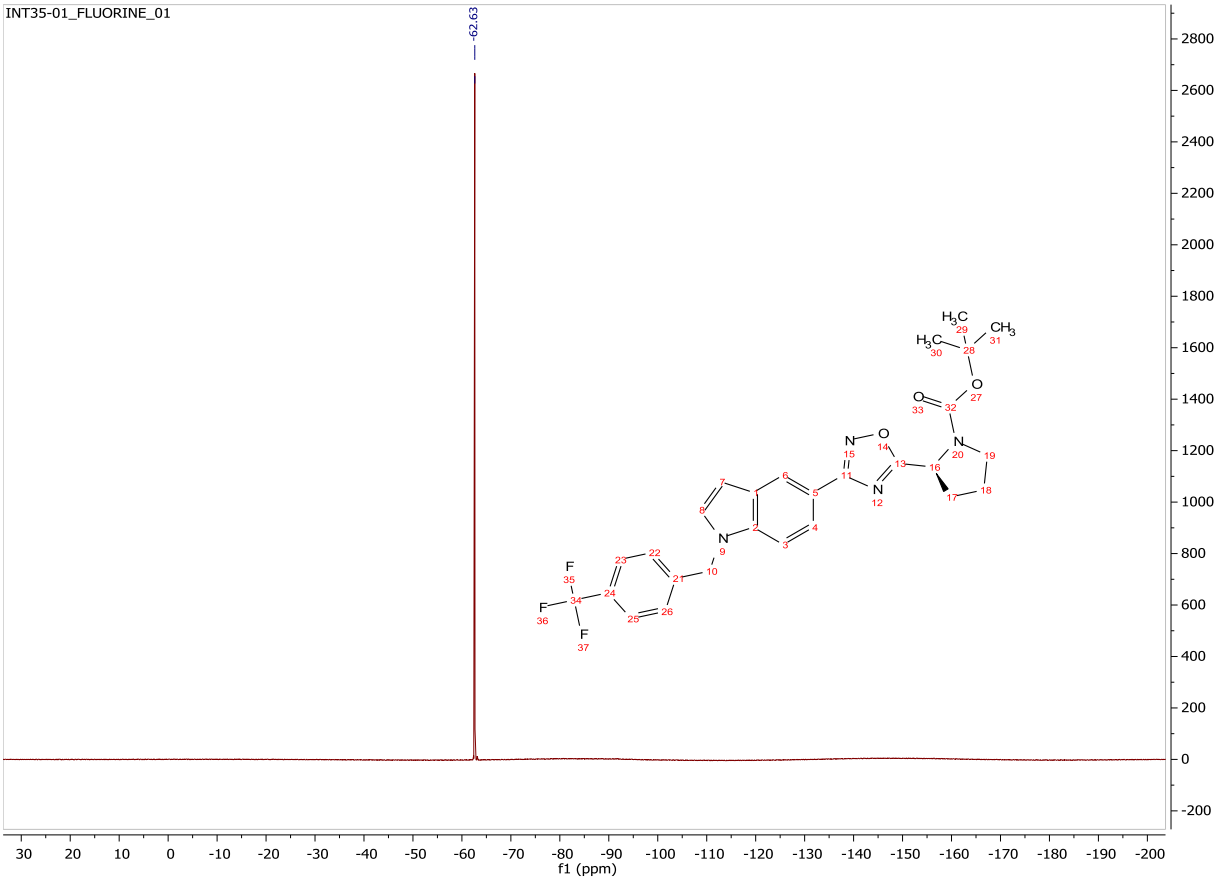
^{13}C-NMR Spectrum for Compound 5.1f:



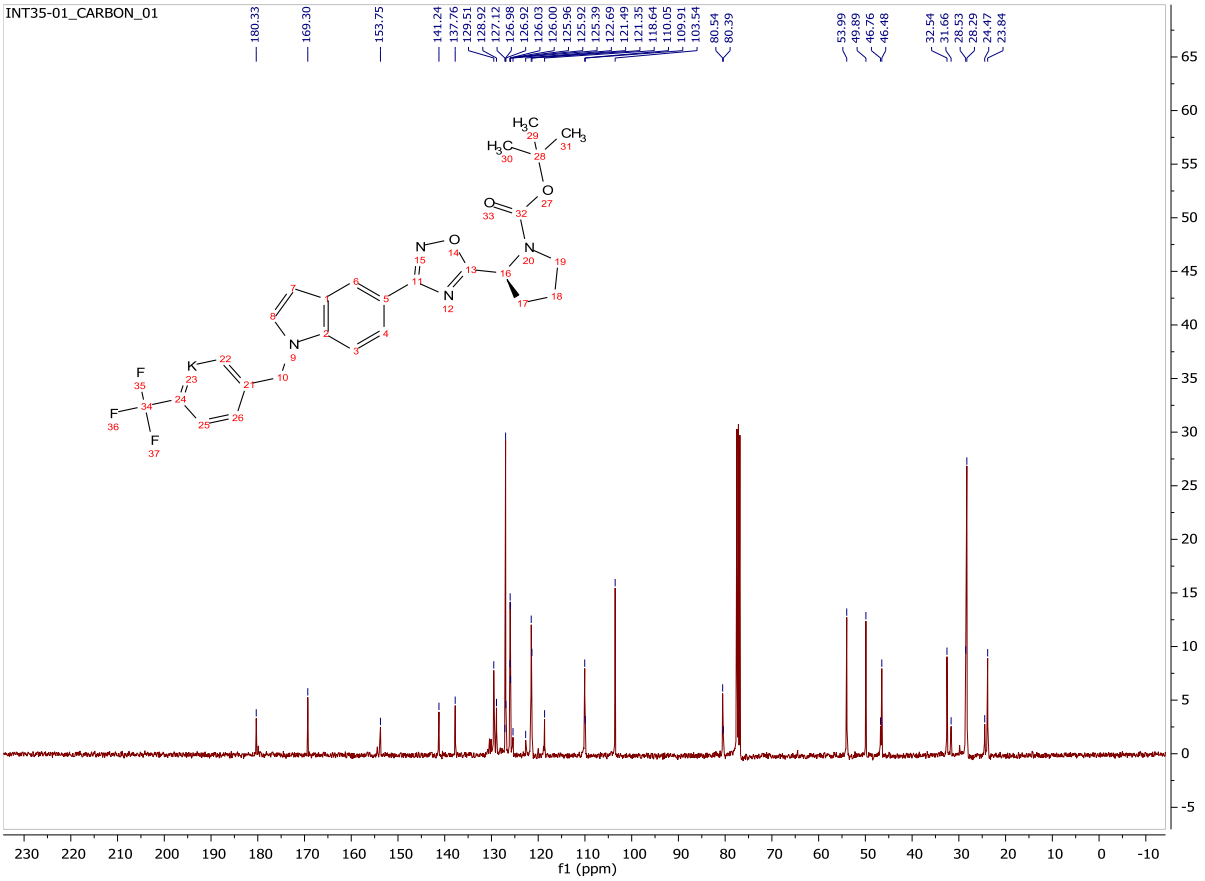
^{1}H-NMR Spectrum for Compound 5.1g:



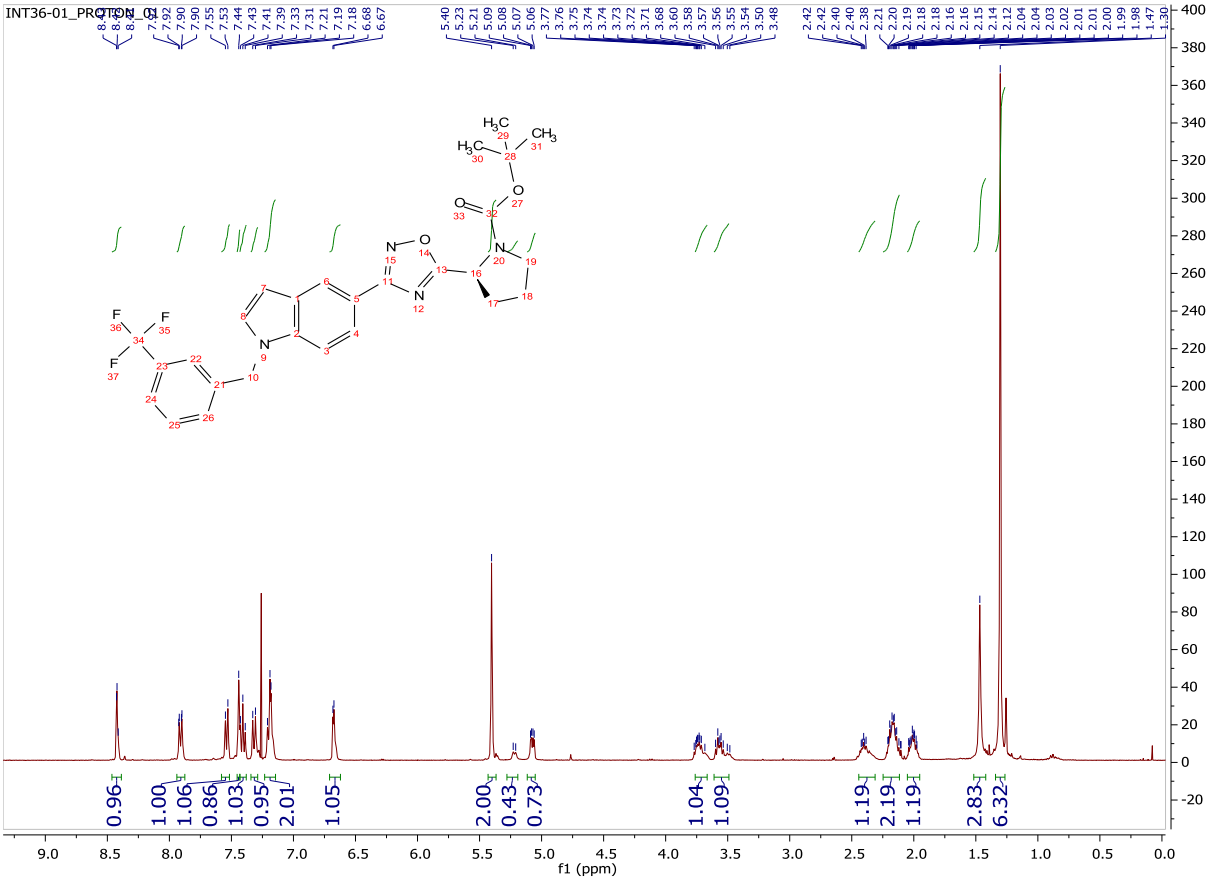
^{19}F-NMR Spectrum for Compound 5.1g:



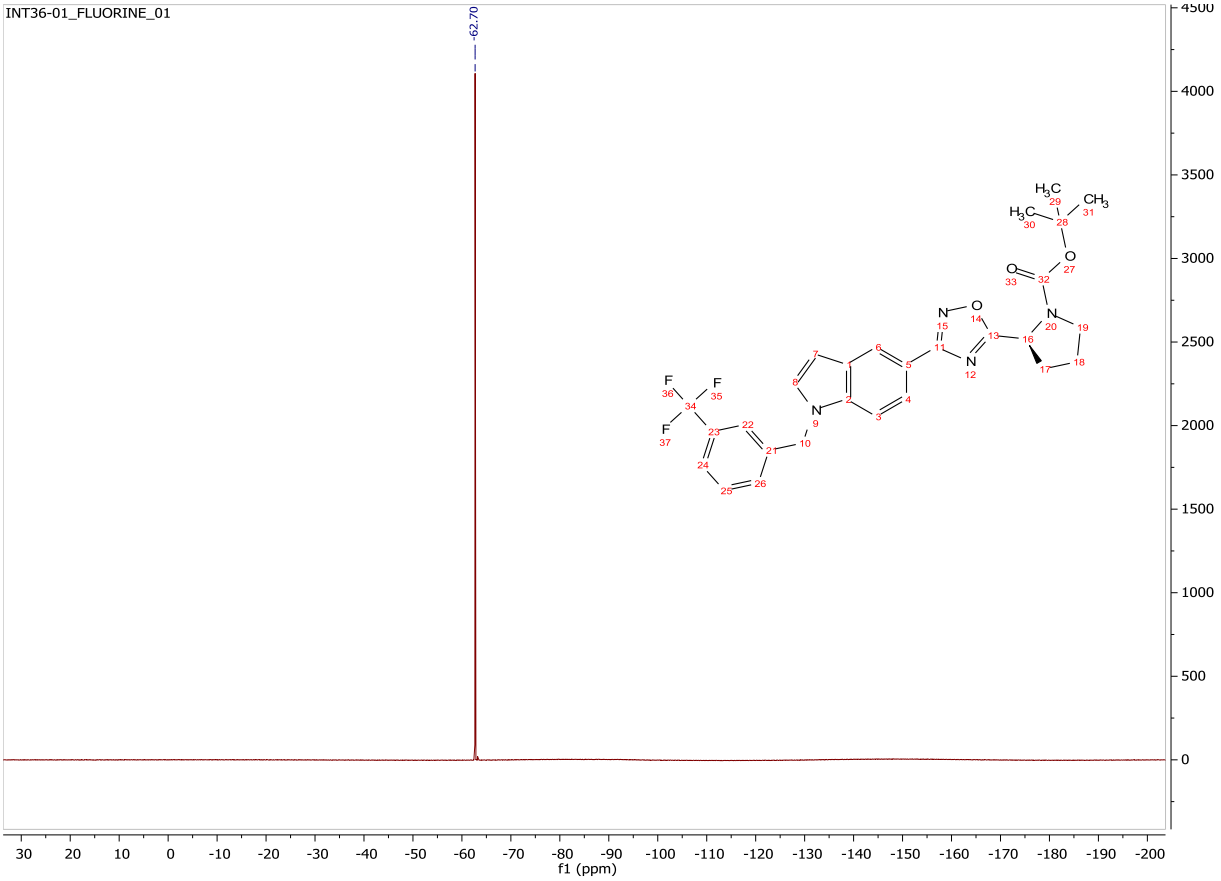
^{13}C-NMR Spectrum for Compound 5.1g:



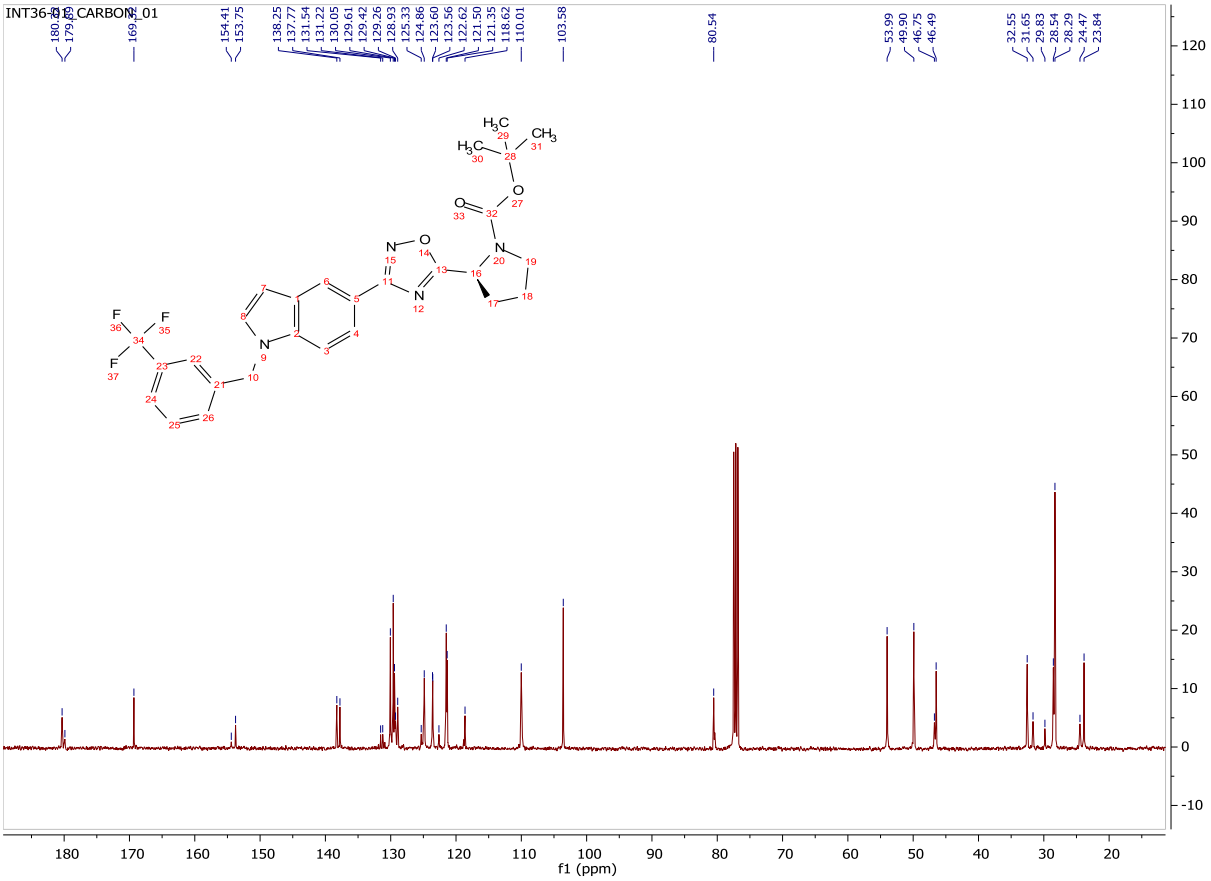
^{1}H-NMR Spectrum for Compound 5.1h:



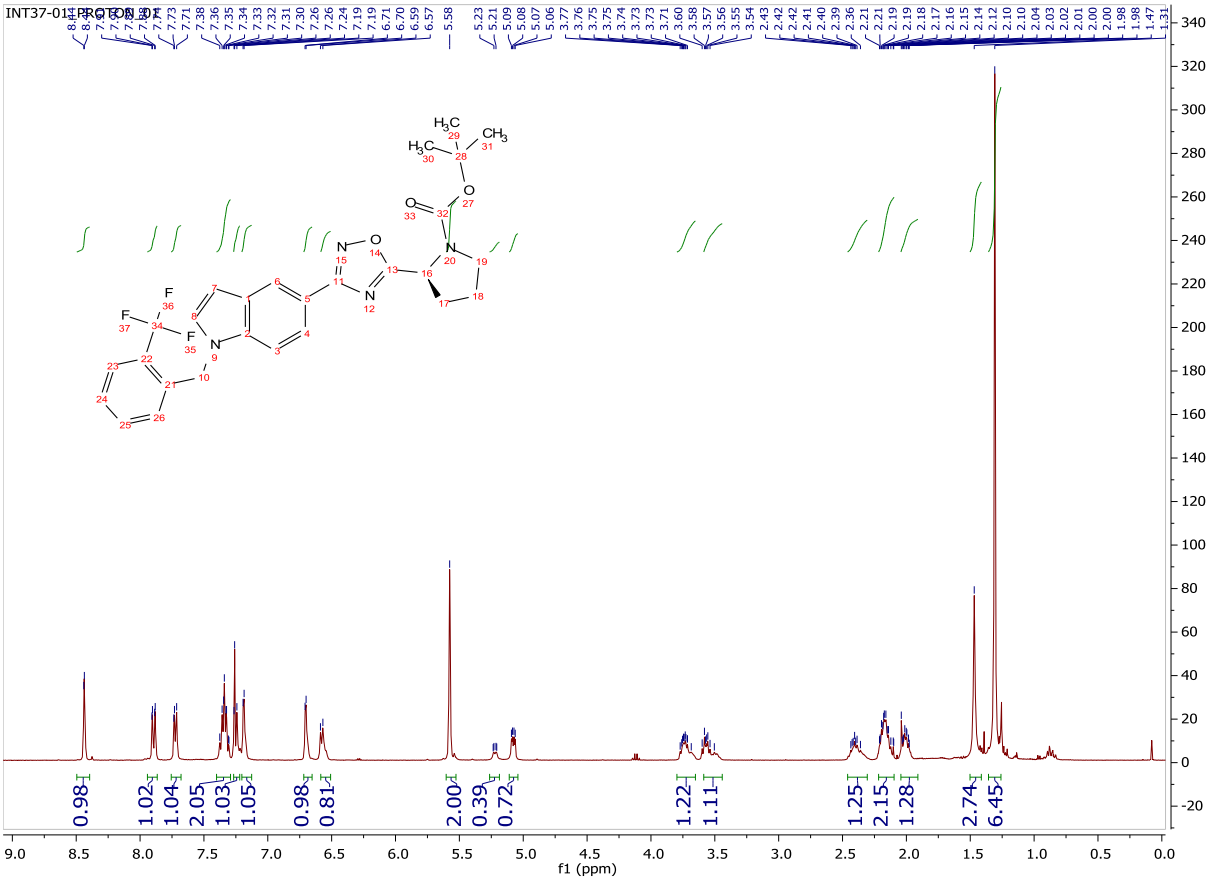
^{19}F-NMR Spectrum for Compound 5.1h:



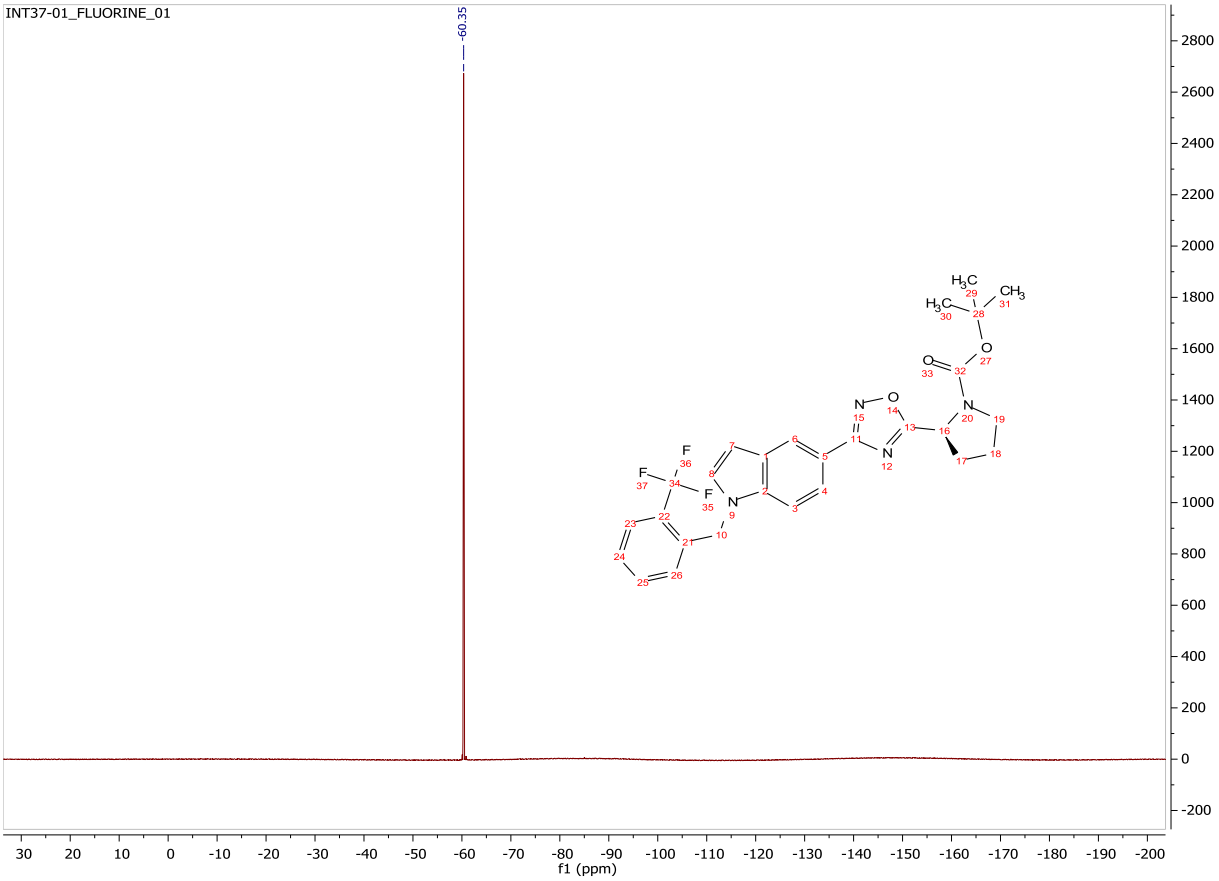
^{13}C-NMR Spectrum for Compound 5.1h:



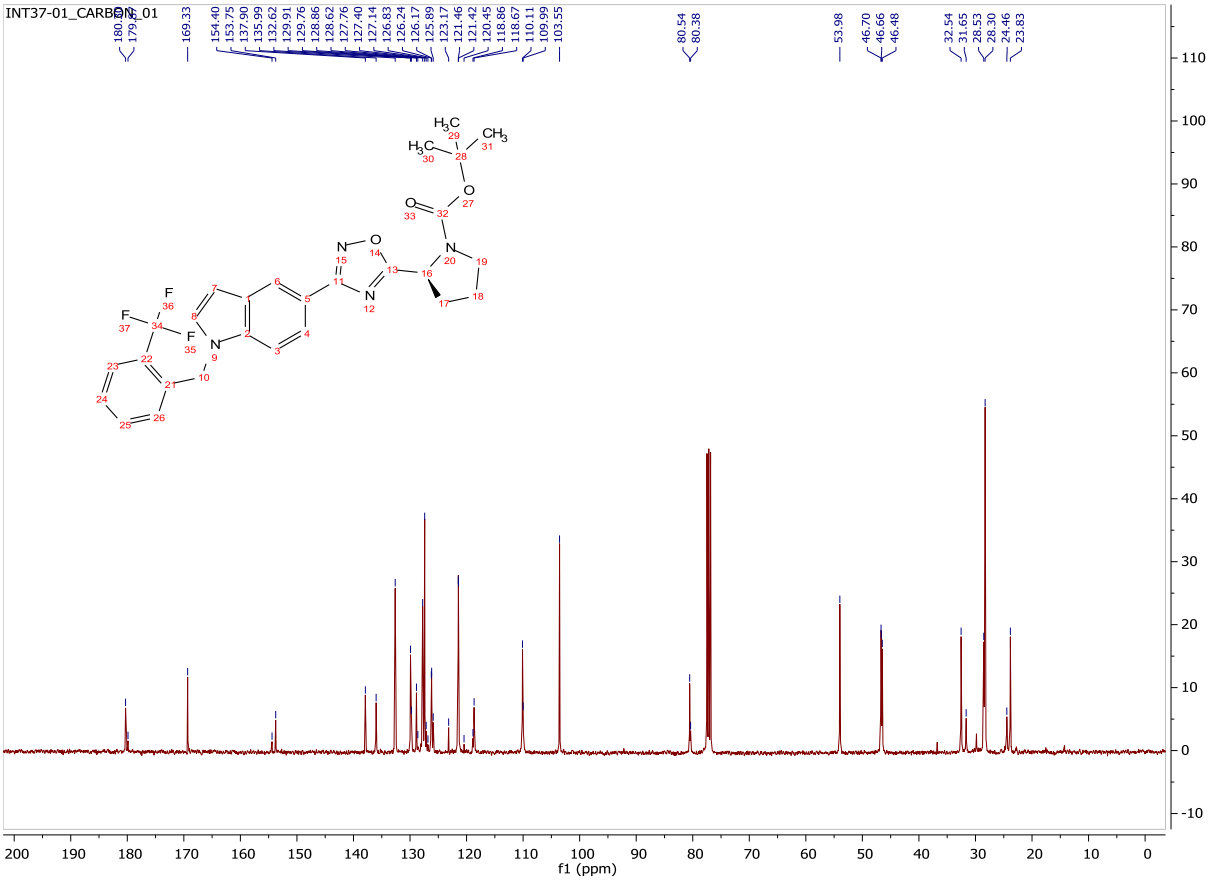
^{1}H-NMR Spectrum for Compound 5.1i:



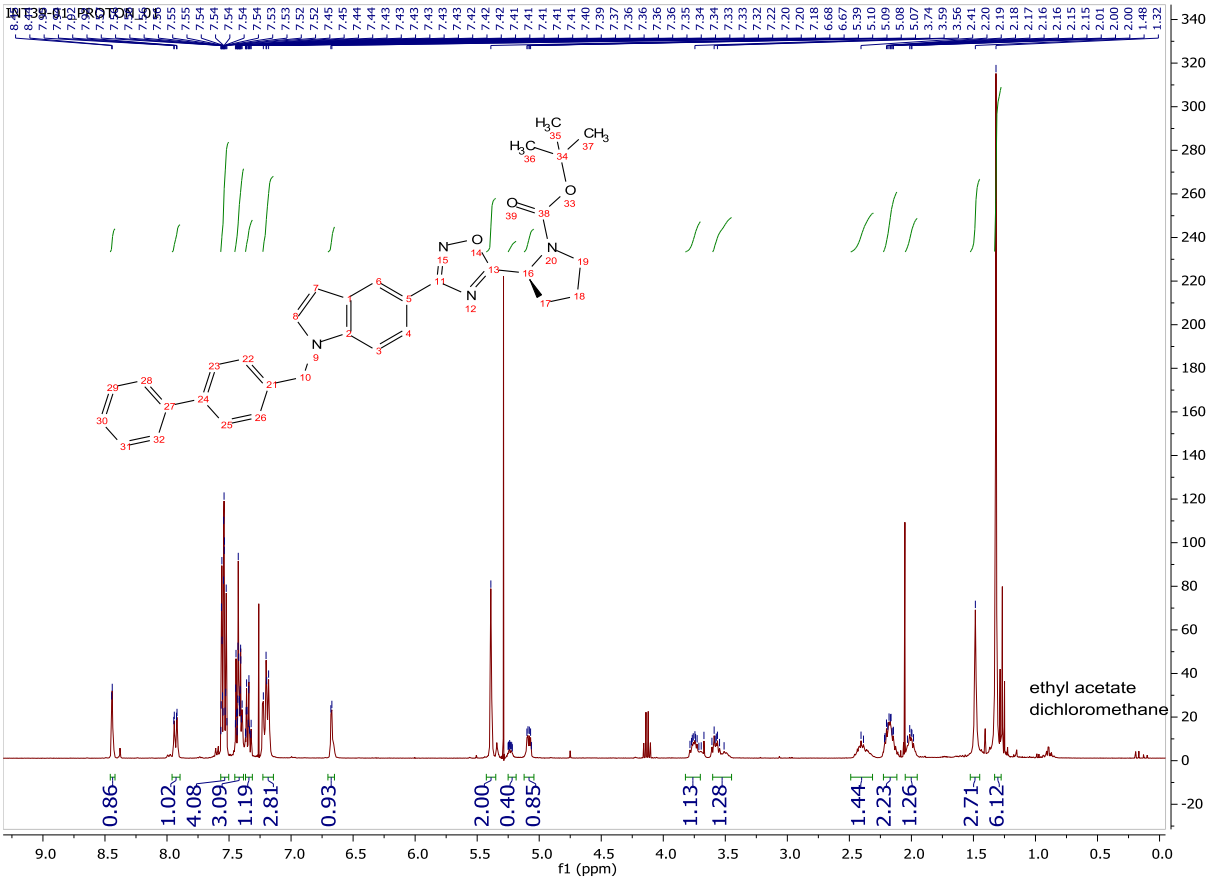
^{19}F-NMR Spectrum for Compound 5.1i:



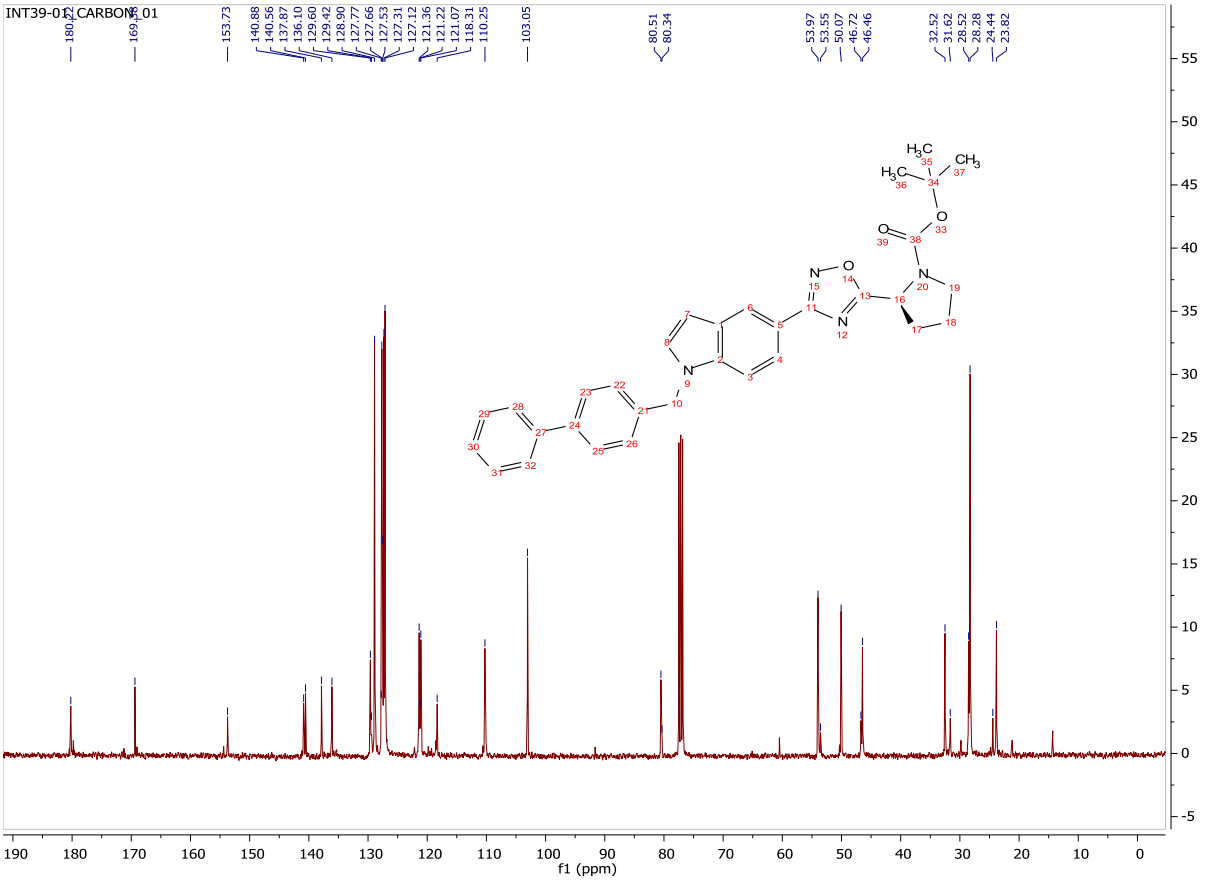
^{13}C-NMR Spectrum for Compound 5.1i:



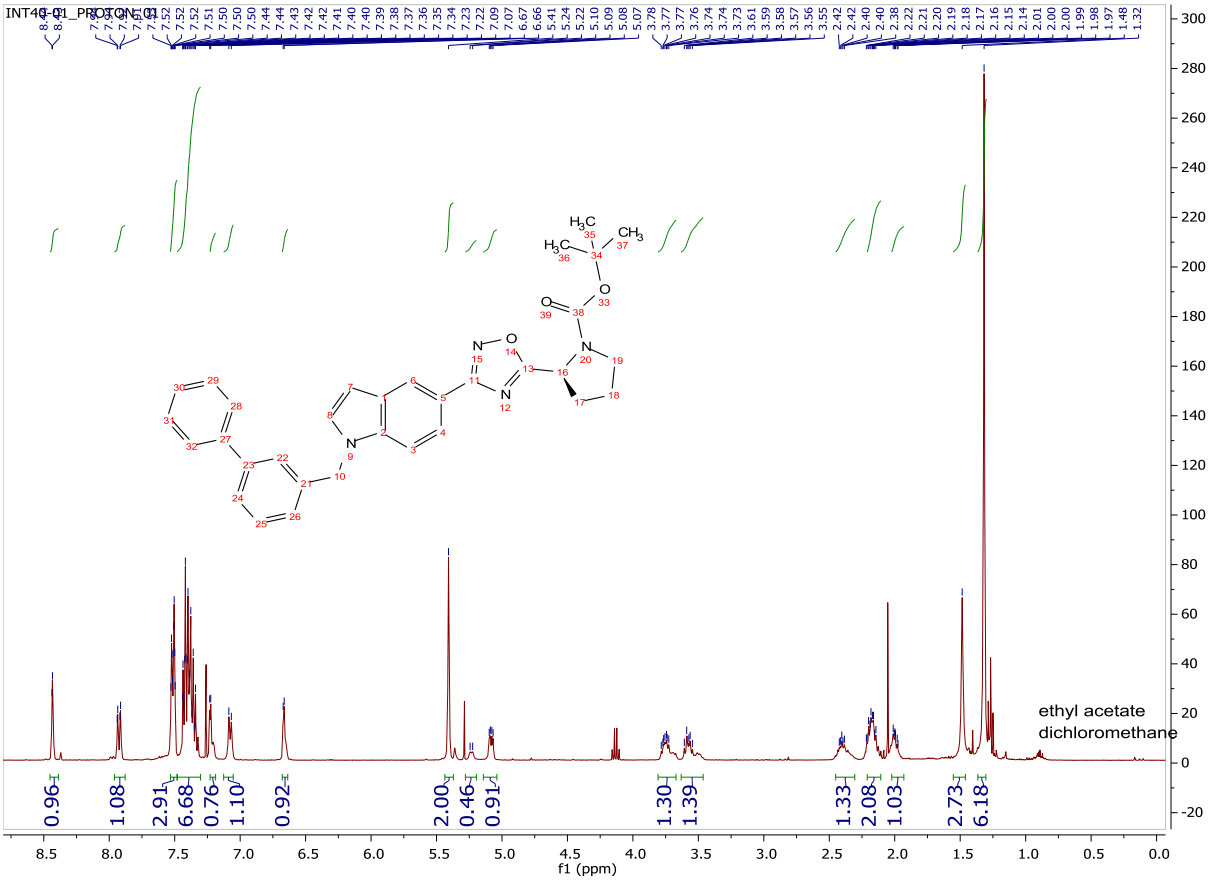
^{1}H-NMR Spectrum for Compound 5.1j:



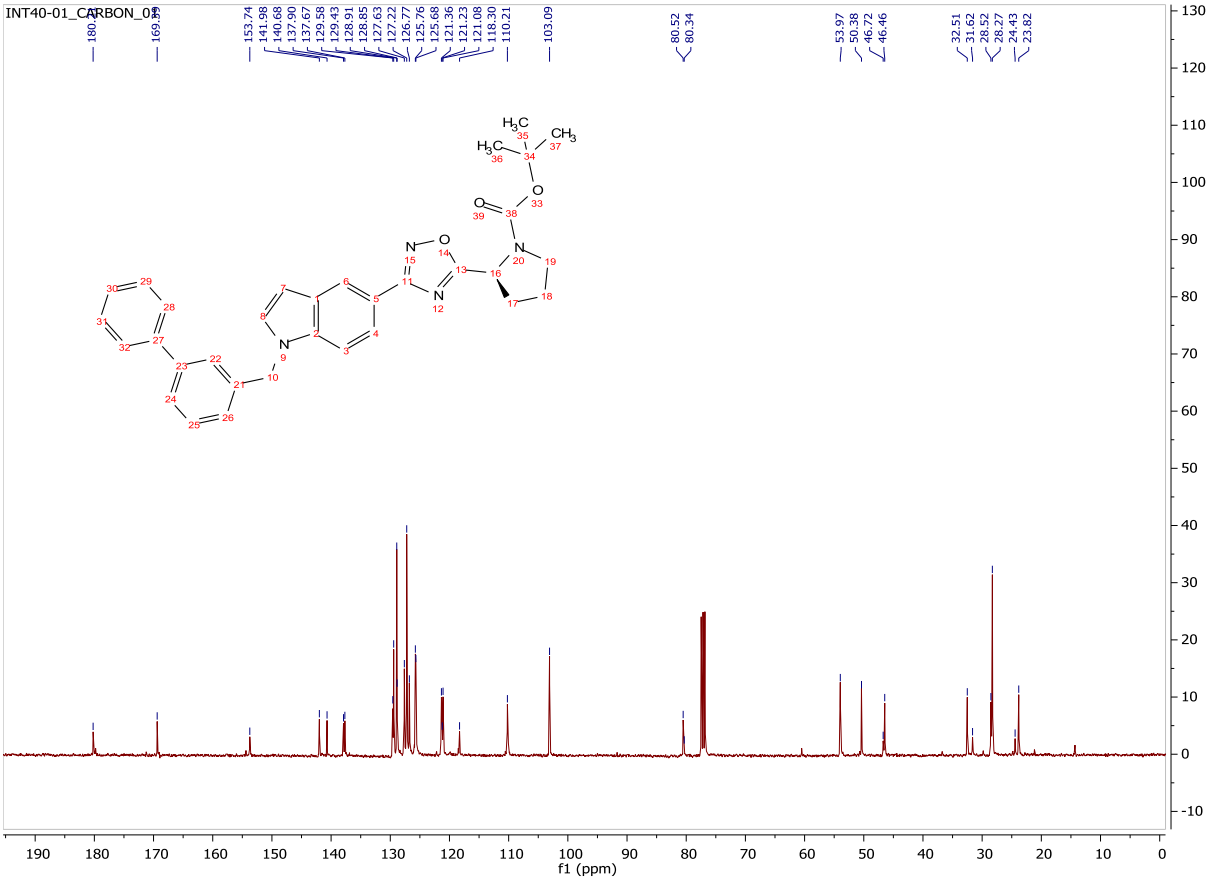
^{13}C-NMR Spectrum for Compound 5.1j:



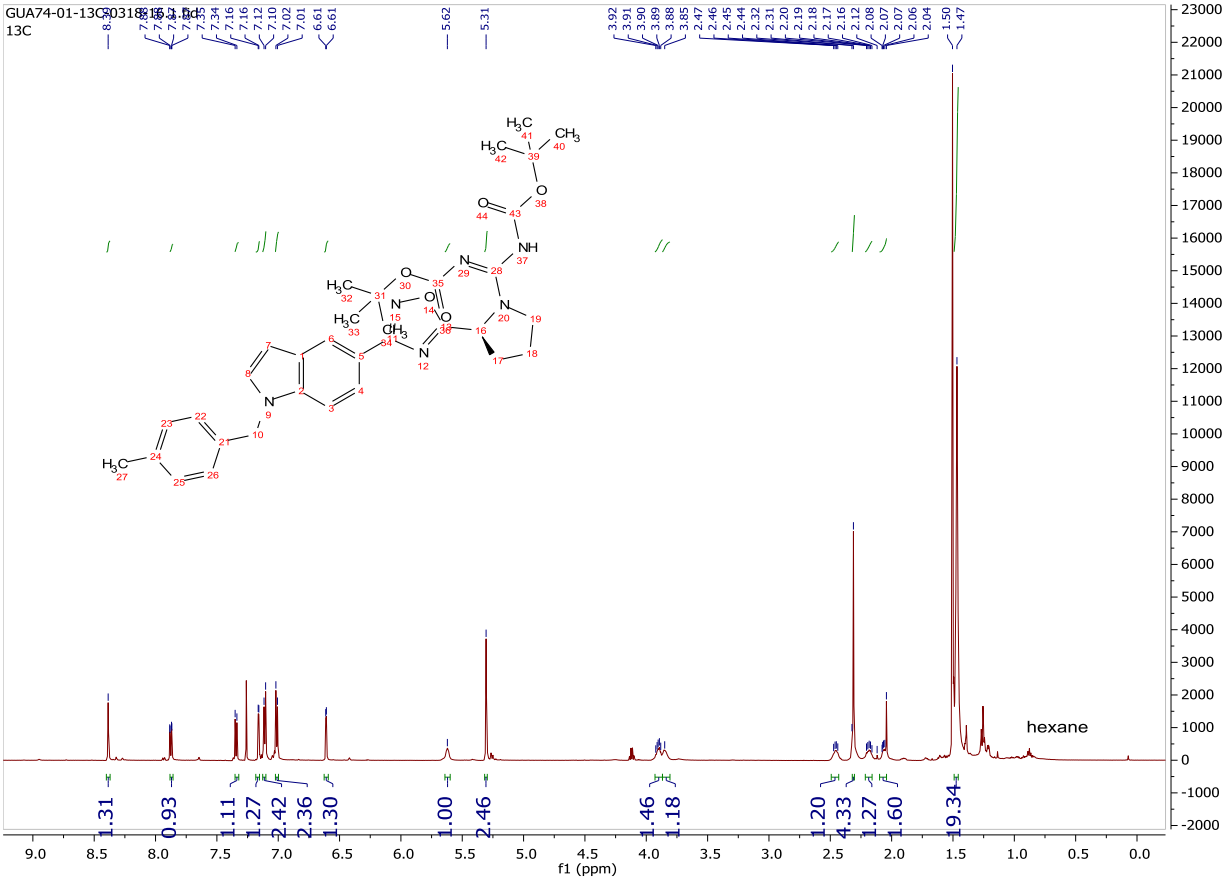
^{1}H-NMR Spectrum for Compound 5.1k:



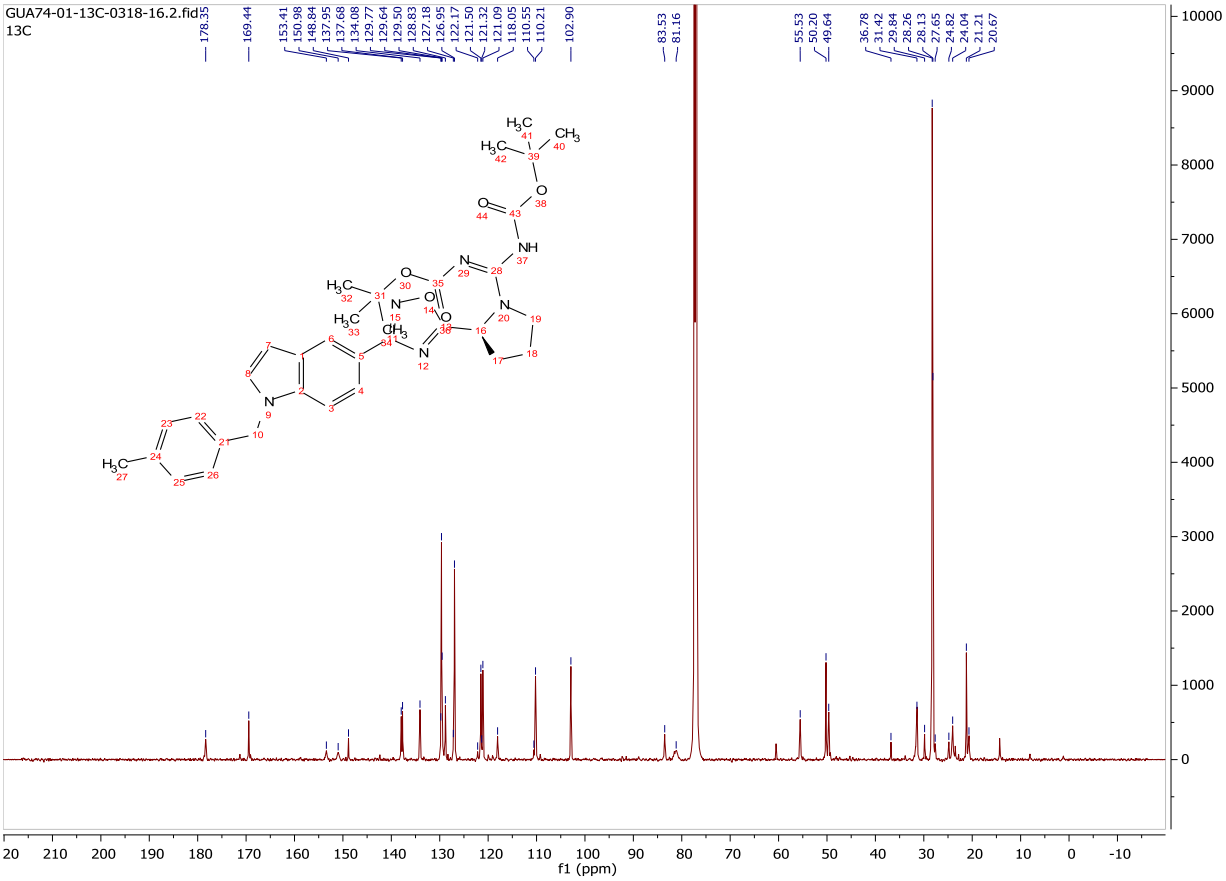
^{13}C-NMR Spectrum for Compound 5.1k:



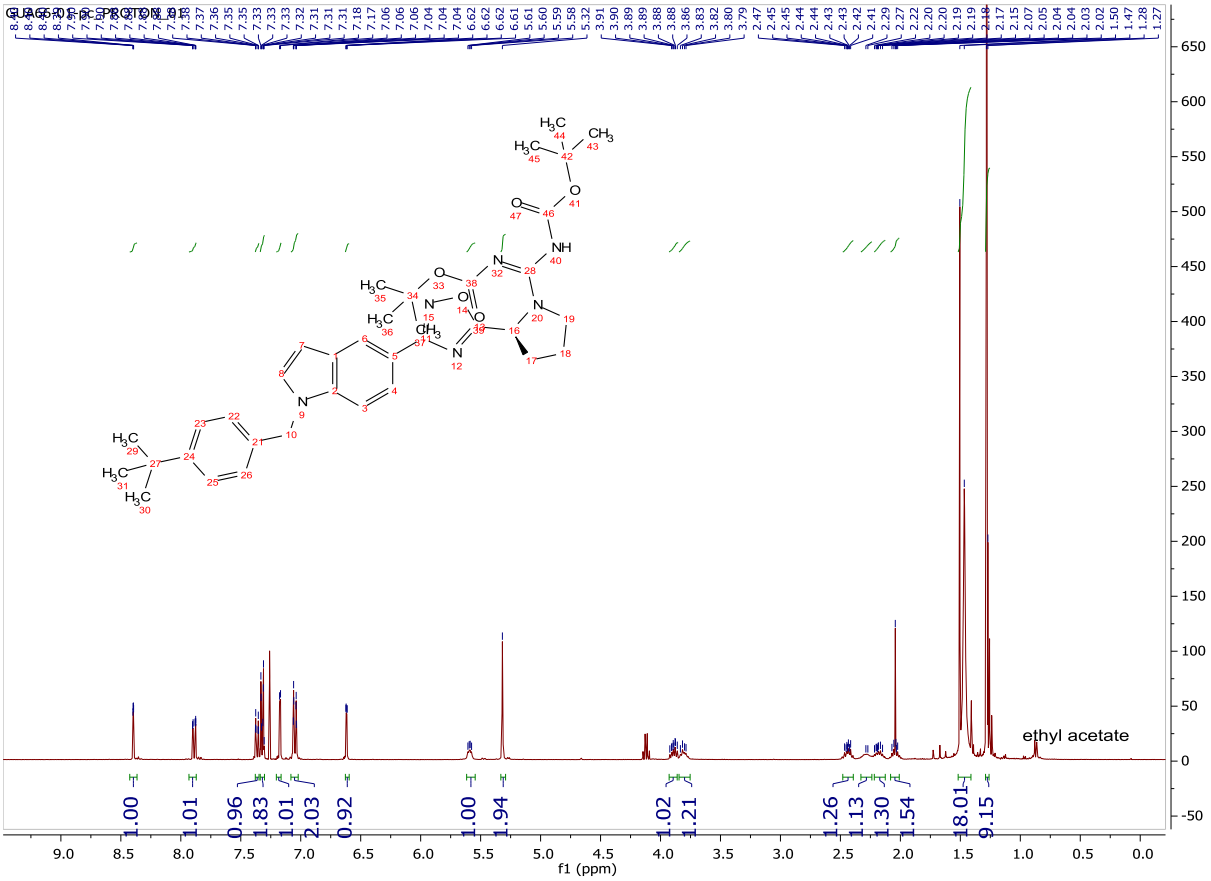
^{1}H-NMR Spectrum for Compound 5.3a:



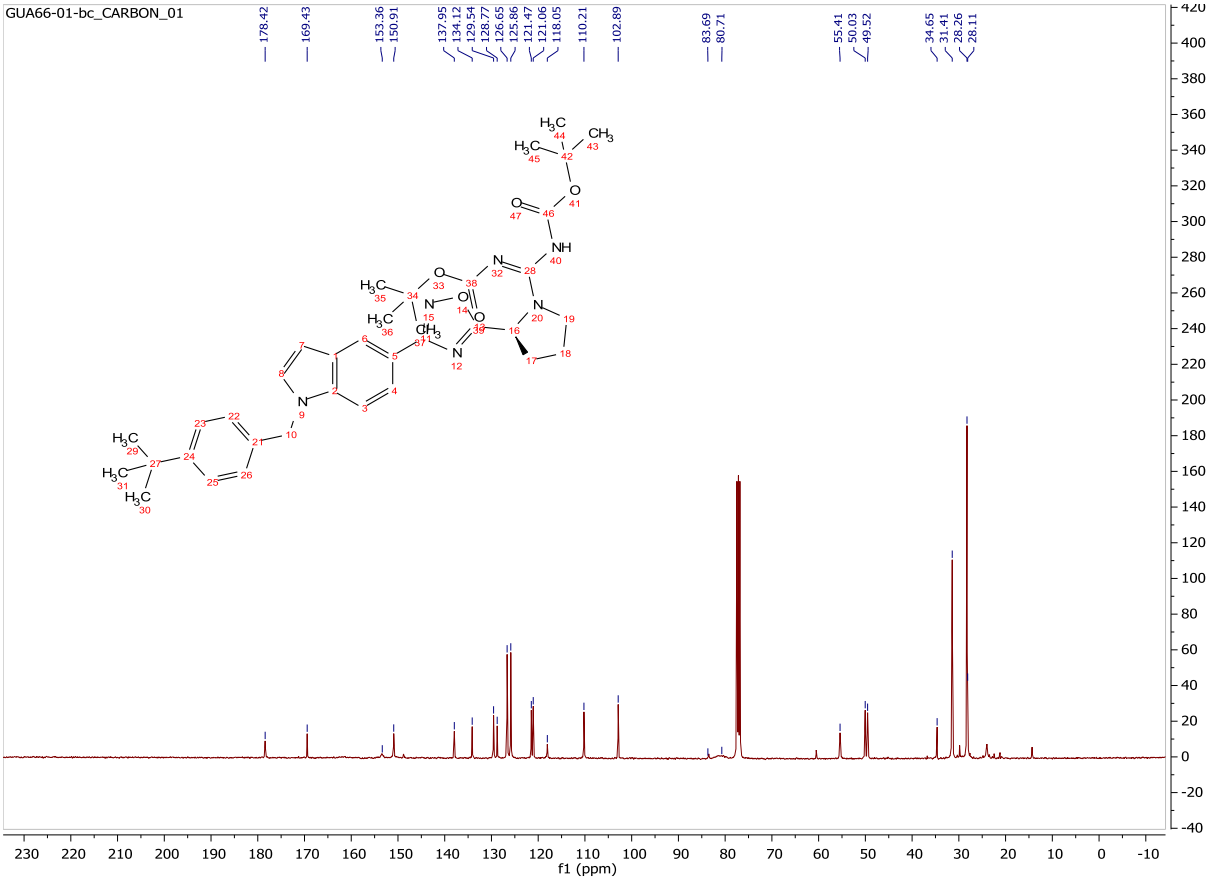
^{13}C-NMR Spectrum for Compound 5.3a:



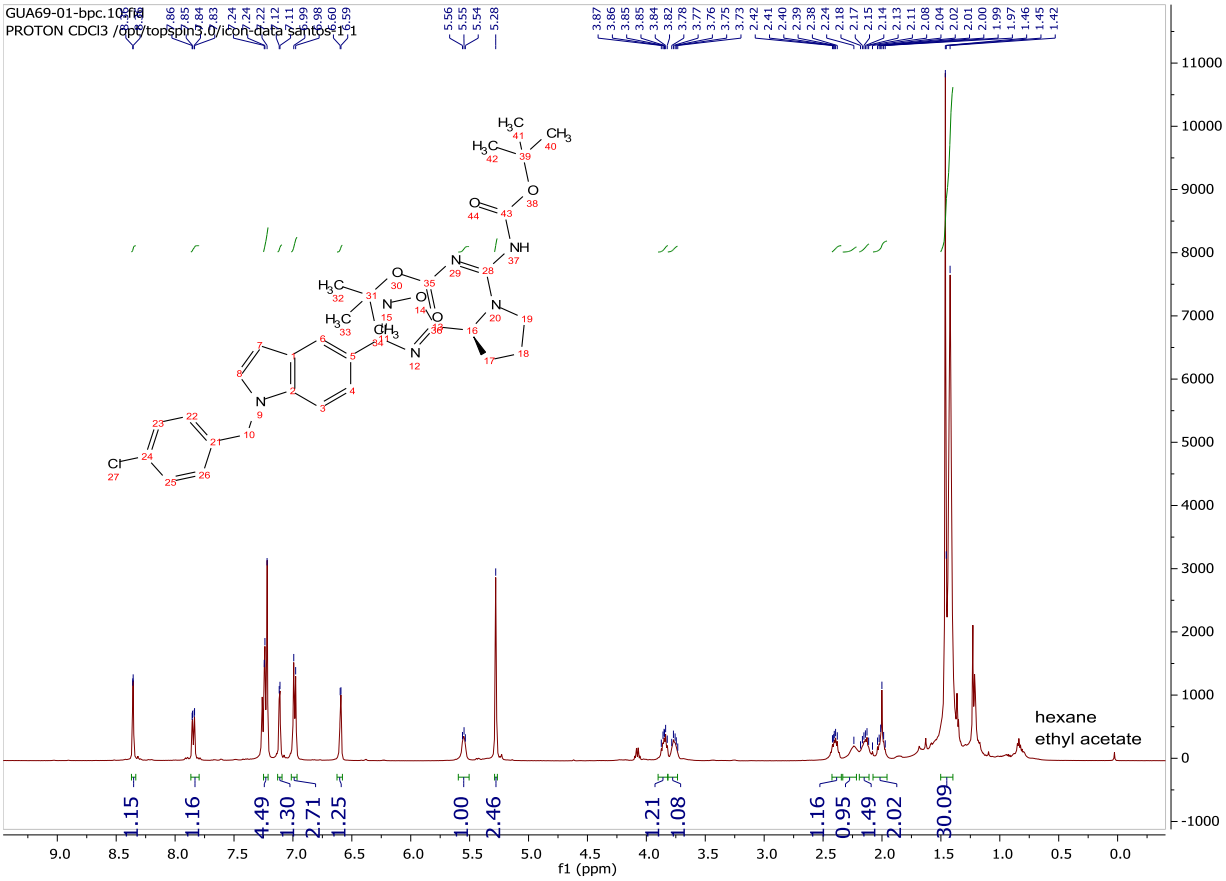
^{1}H-NMR Spectrum for Compound 5.3b:



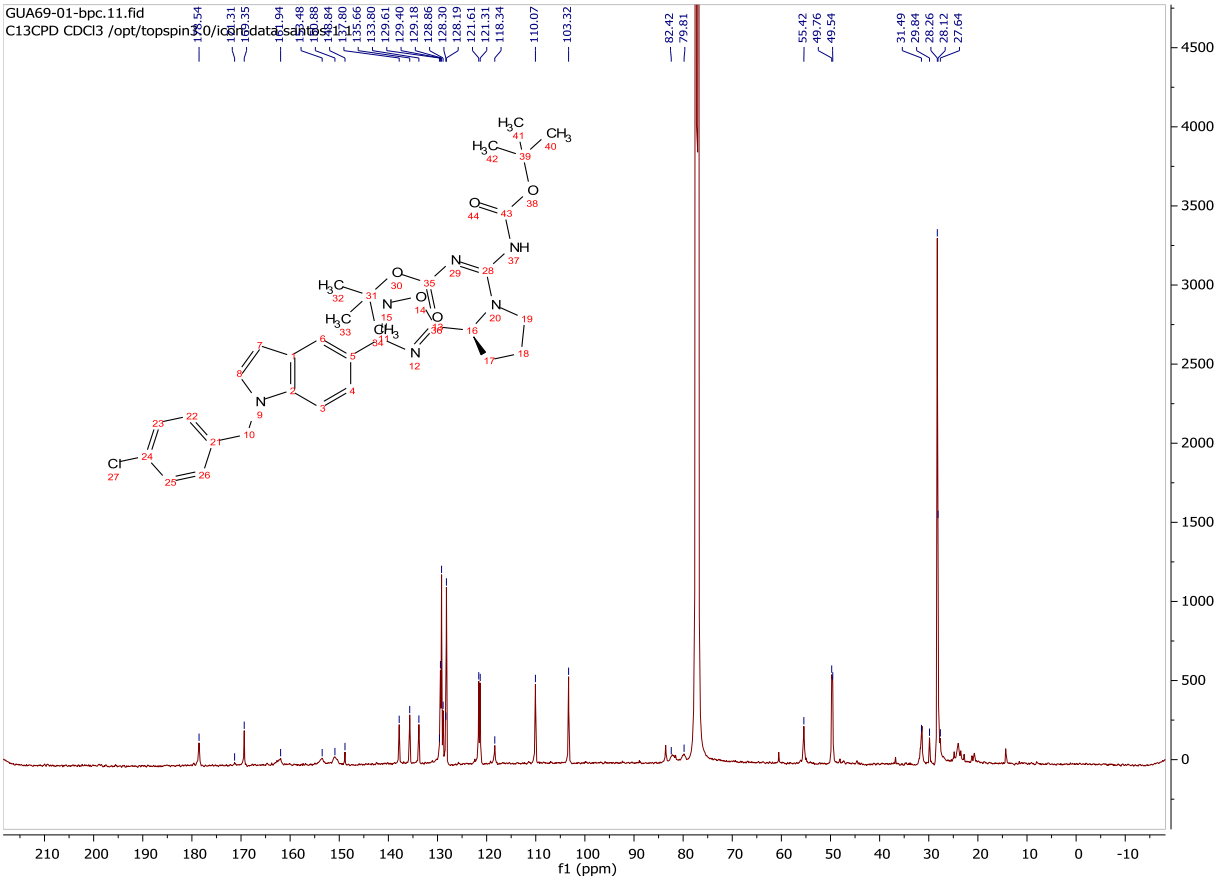
^{13}C-NMR Spectrum for Compound 5.3b:



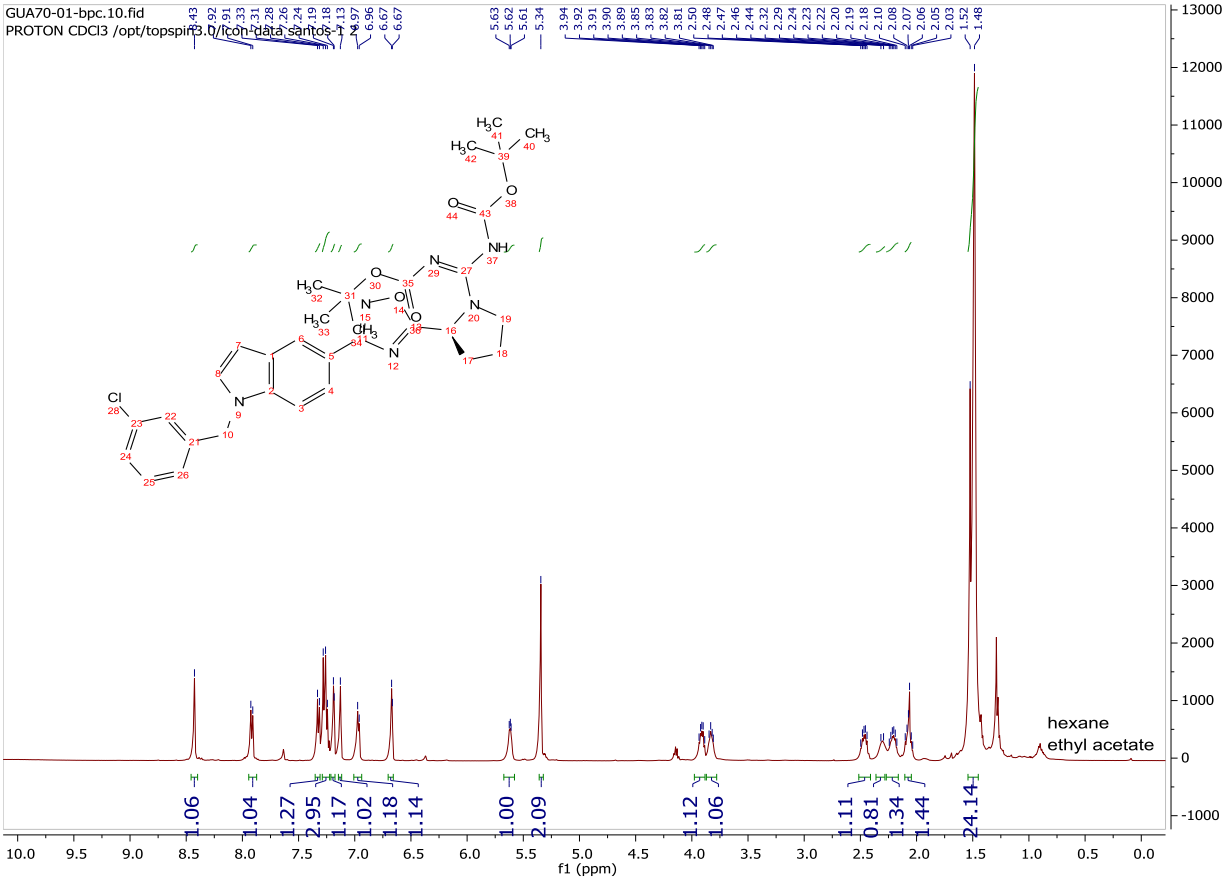
^{1}H-NMR Spectrum for Compound 5.3c:



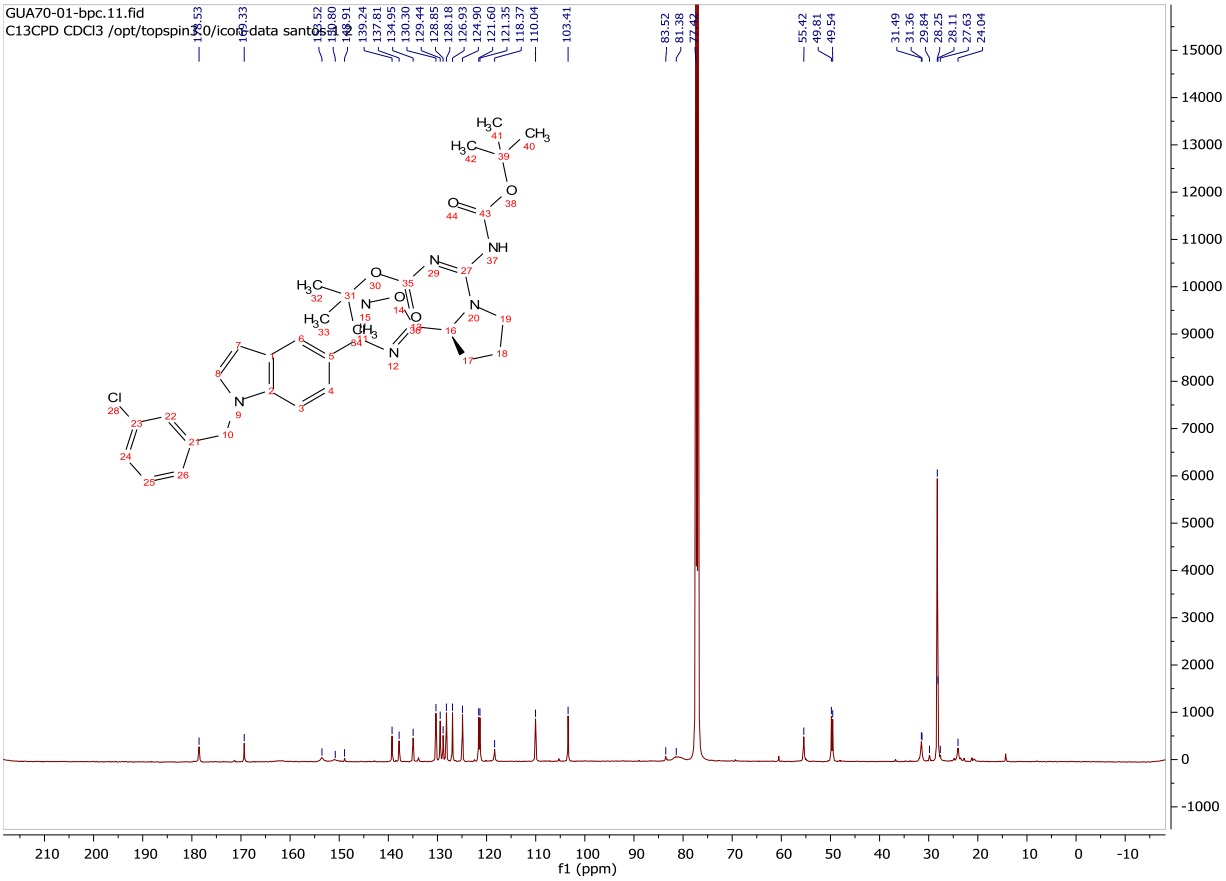
^{13}C-NMR Spectrum for Compound 5.3c:



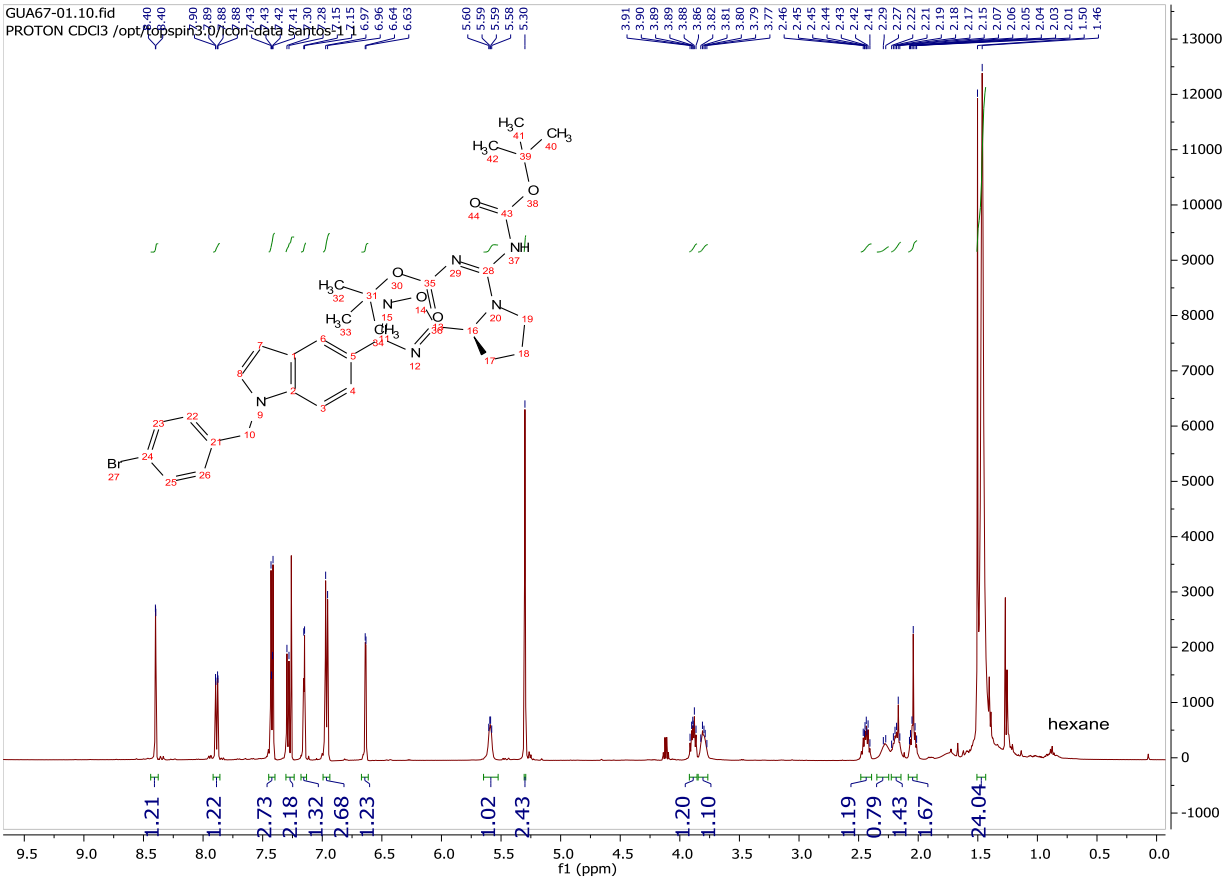
^{1}H-NMR Spectrum for Compound 5.3d:



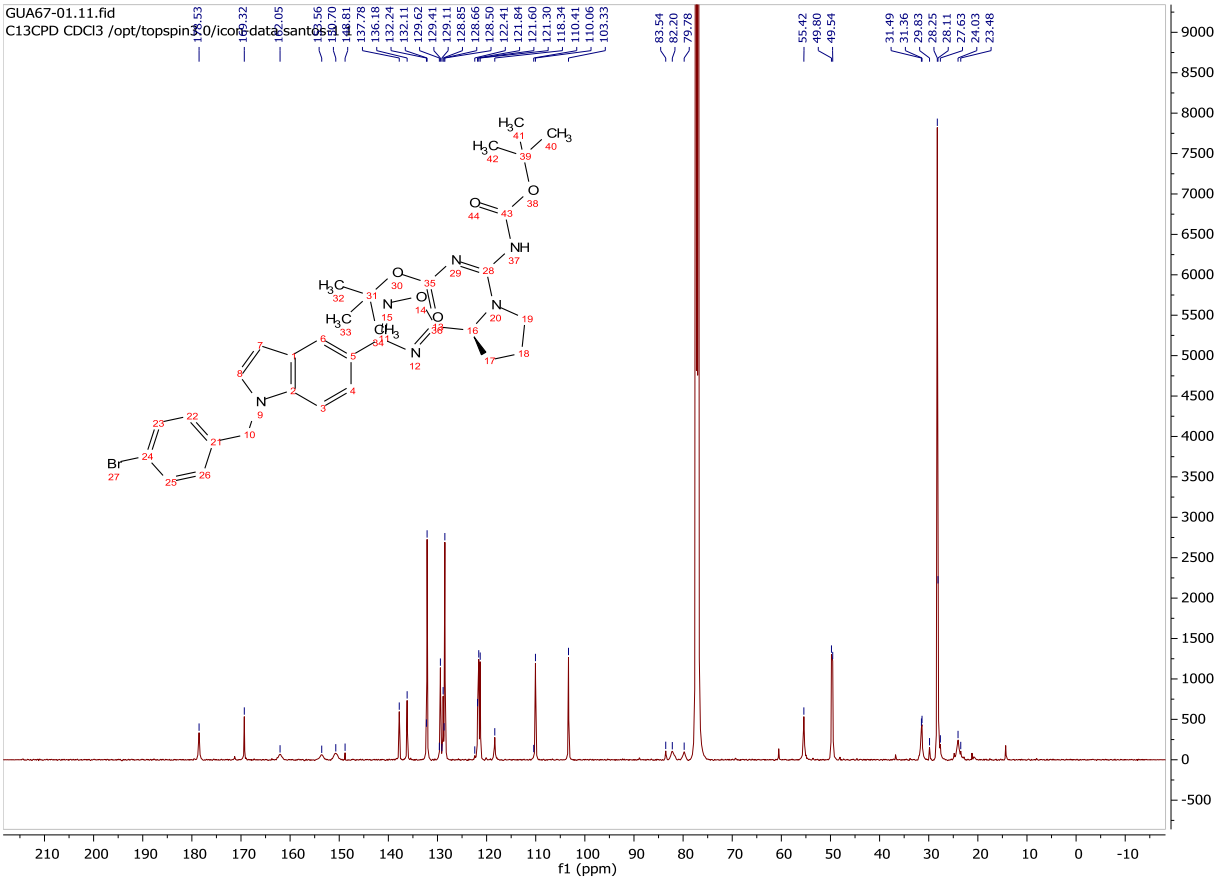
^{13}C-NMR Spectrum for Compound 5.3d:



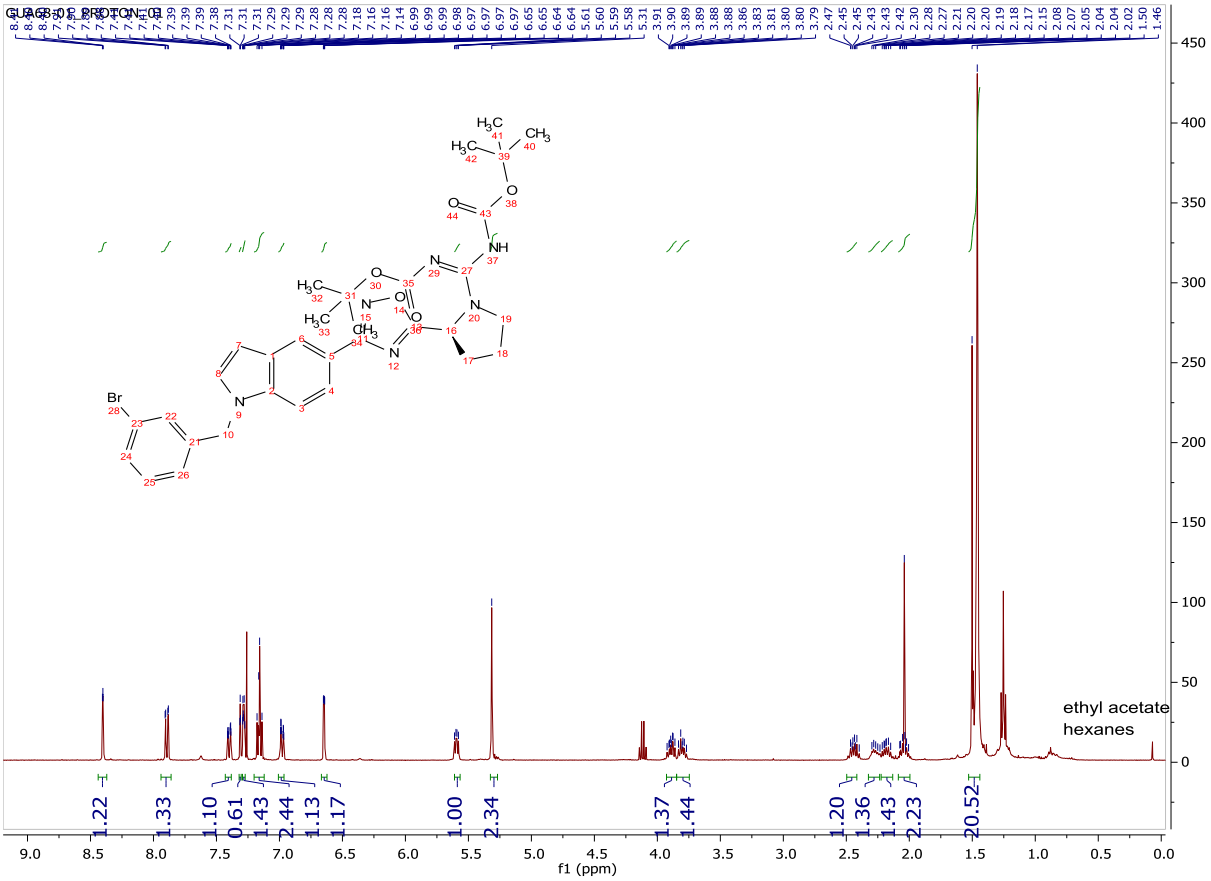
^{1}H-NMR Spectrum for Compound 5.3e:



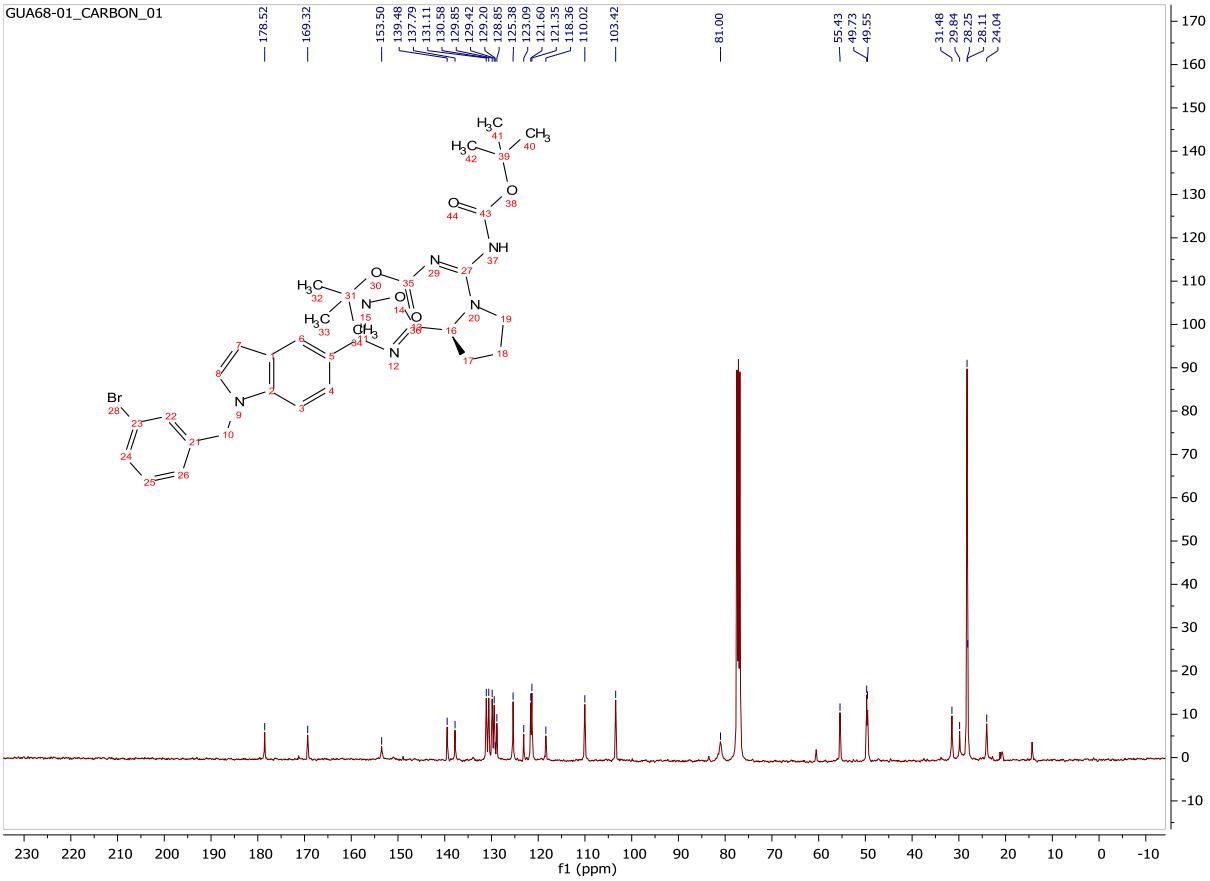
^{13}C-NMR Spectrum for Compound 5.3e:



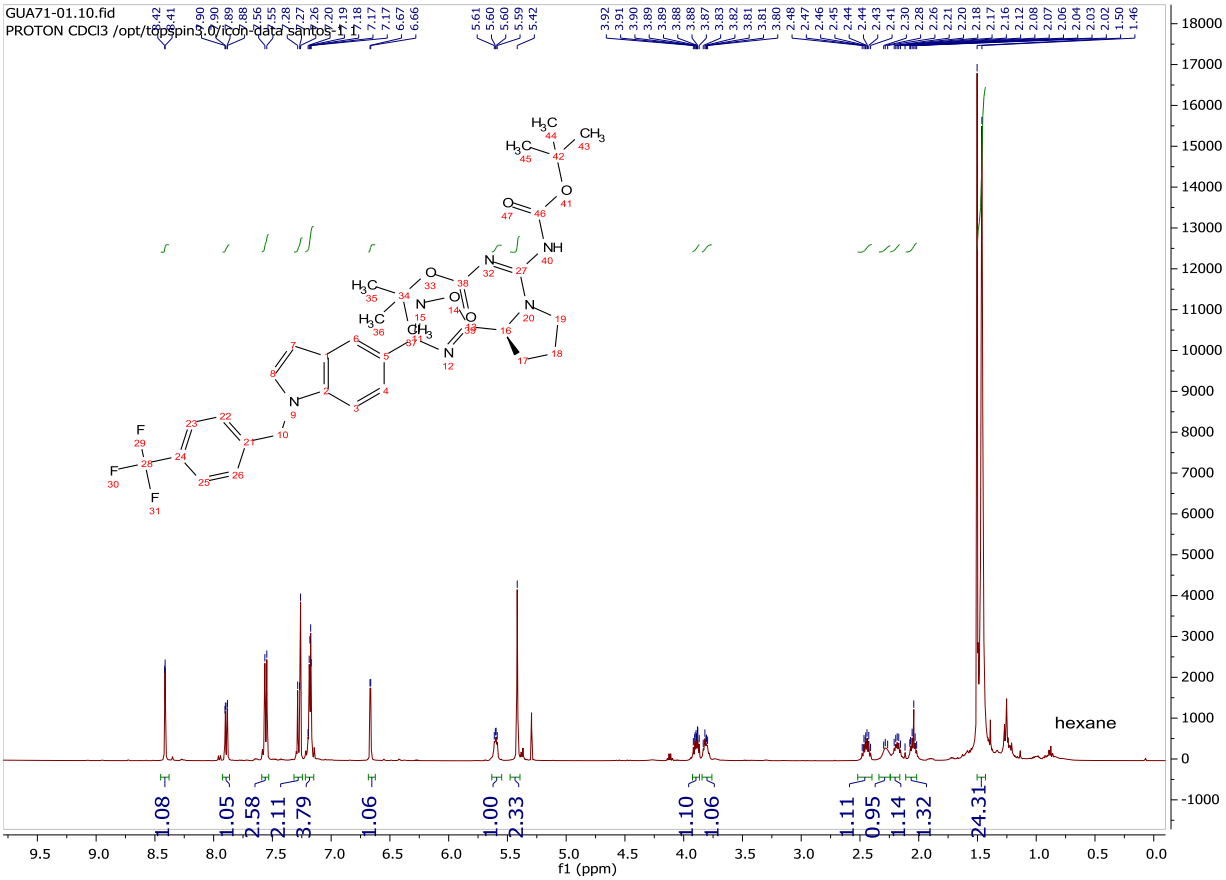
^{1}H-NMR Spectrum for Compound 5.3f:



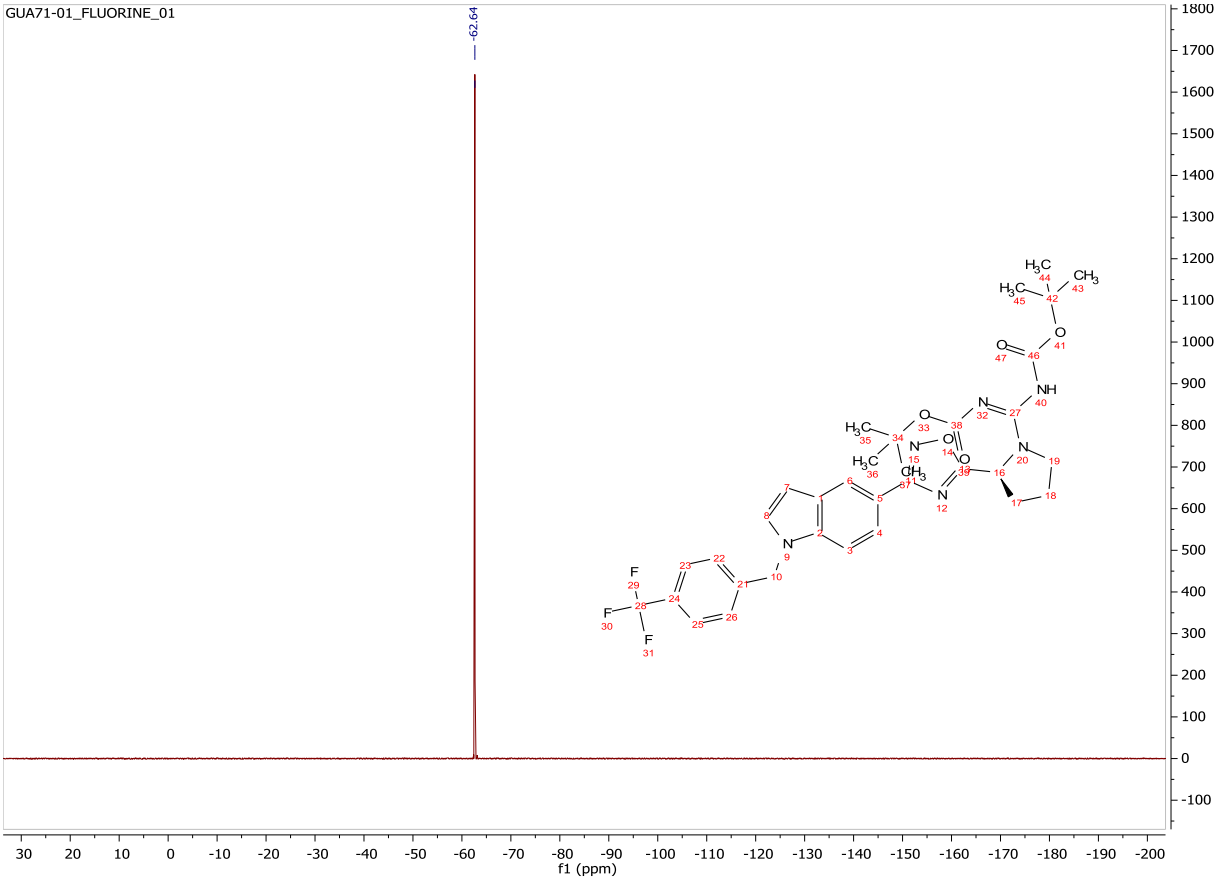
^{13}C-NMR Spectrum for Compound 5.3f:



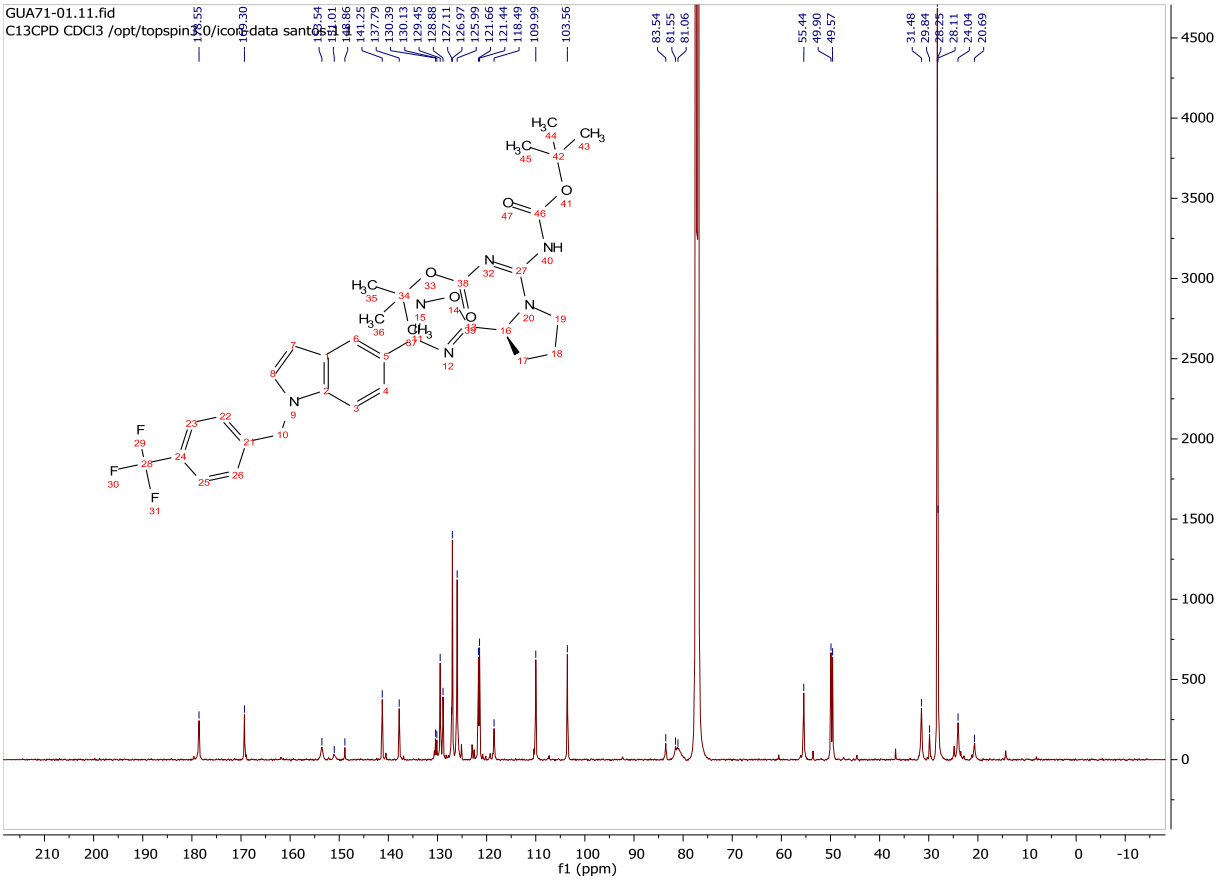
^{1}H-NMR Spectrum for Compound 5.3g:



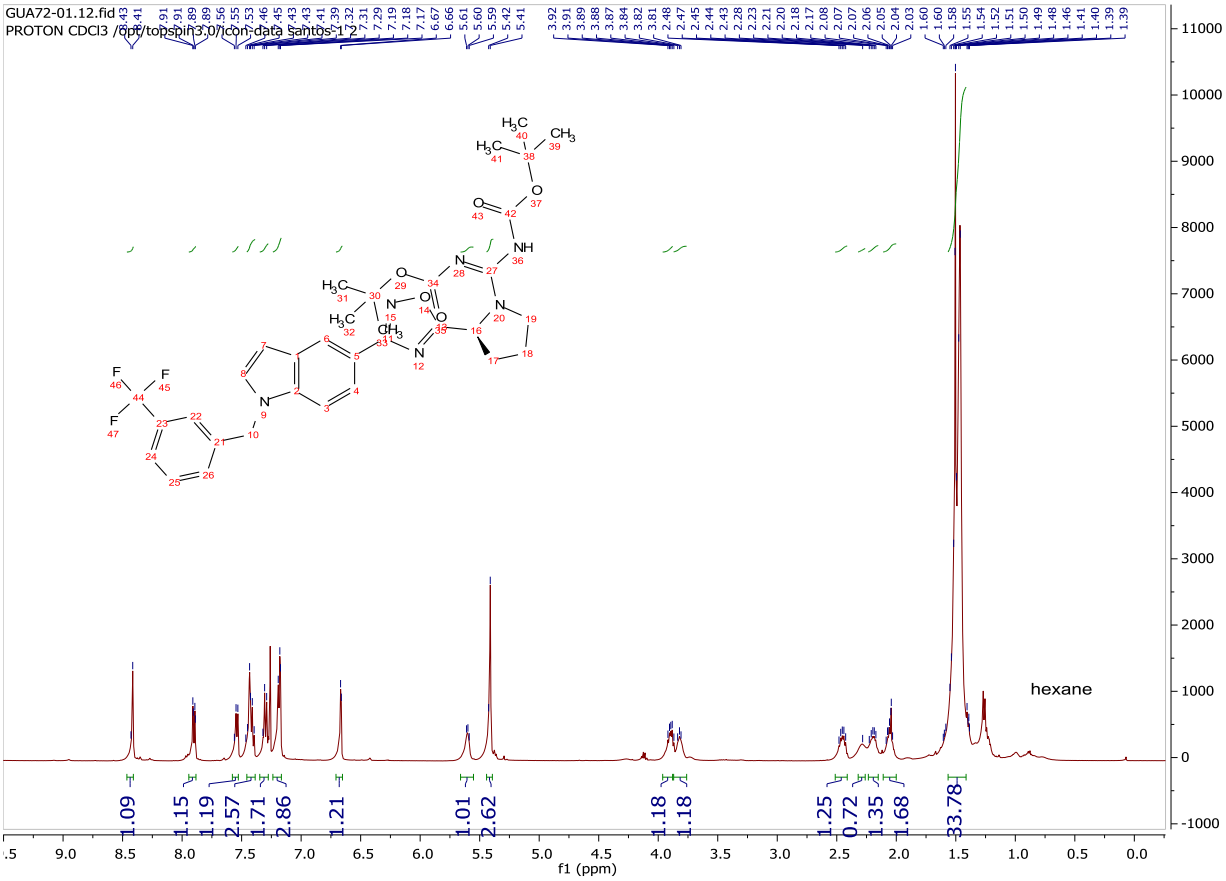
^{19}F-NMR Spectrum for Compound 5.3g:



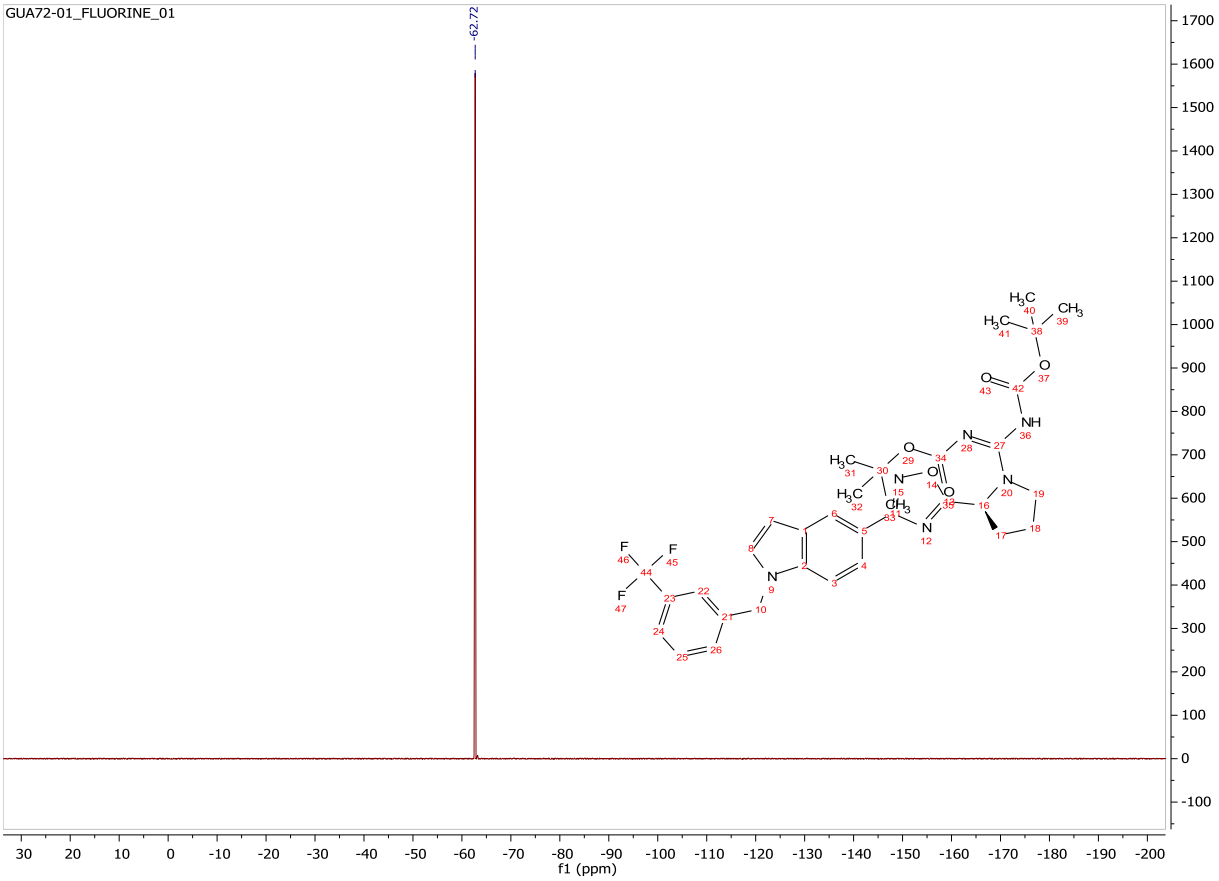
^{13}C-NMR Spectrum for Compound 5.3g:



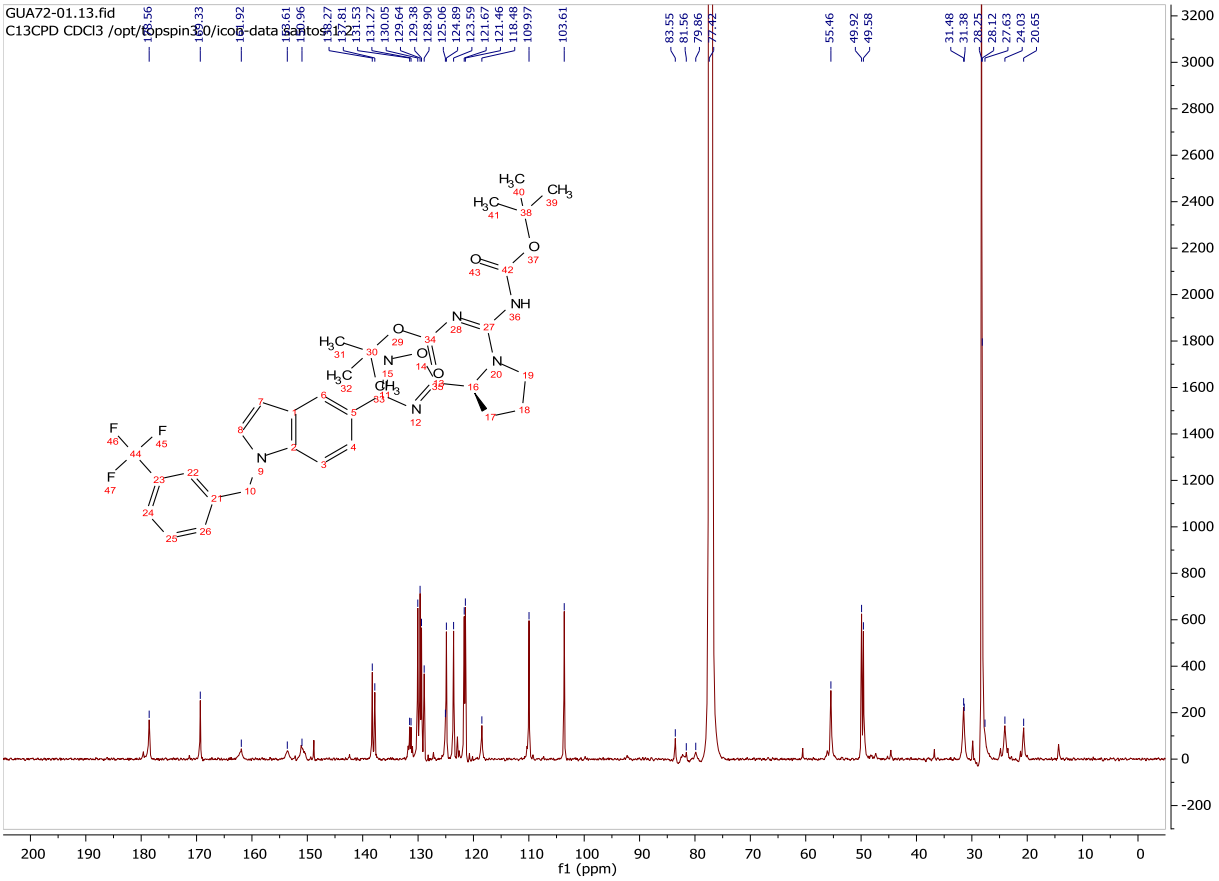
^{1}H-NMR Spectrum for Compound 5.3h:



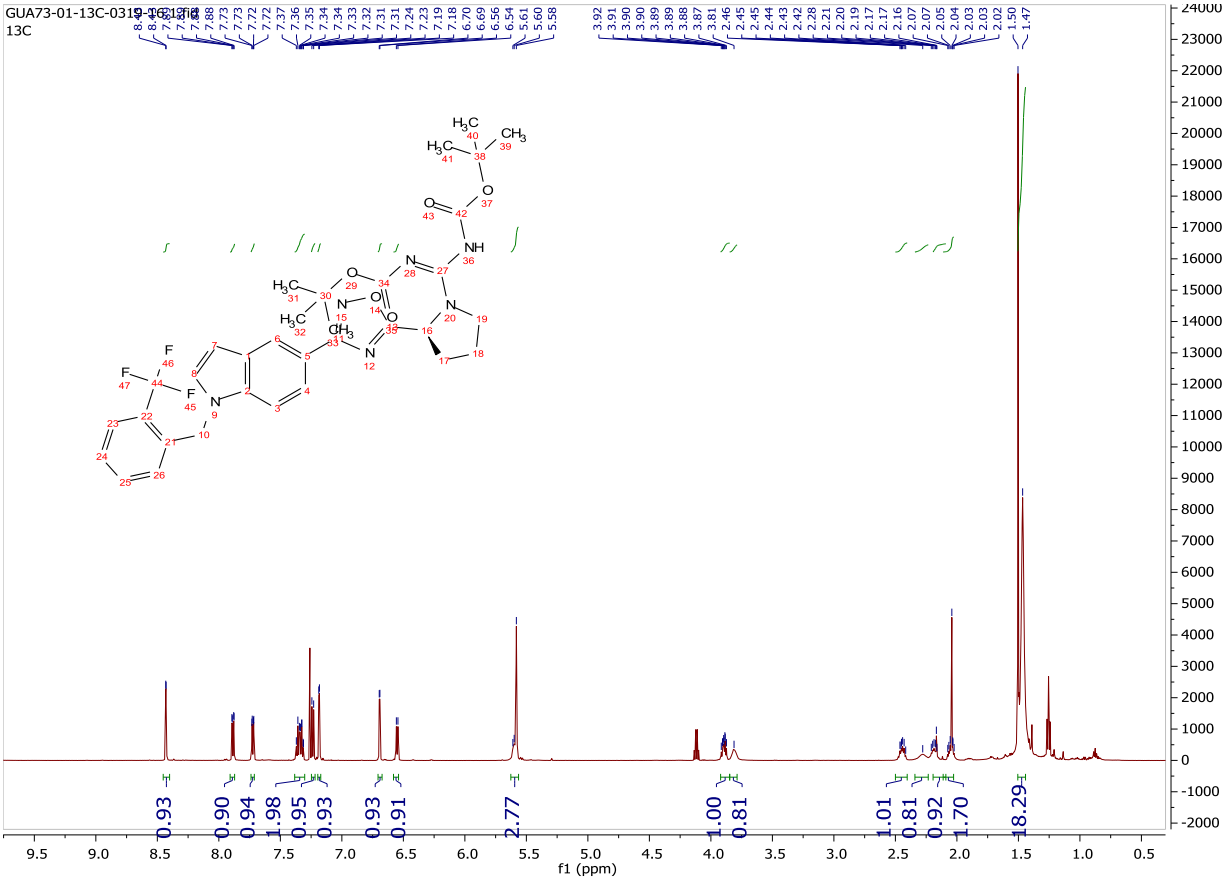
^{19}F-NMR Spectrum for Compound 5.3h:



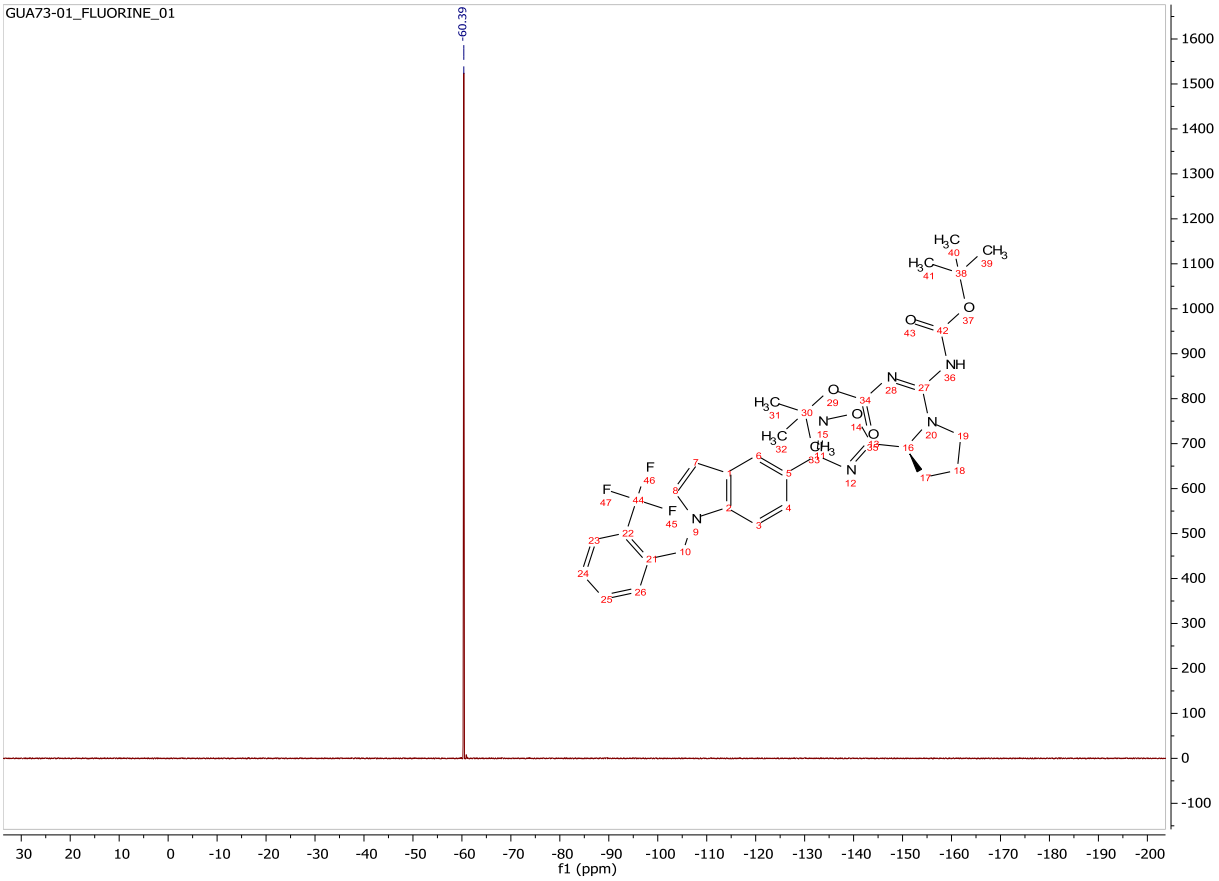
^{13}C-NMR Spectrum for Compound 5.3h:



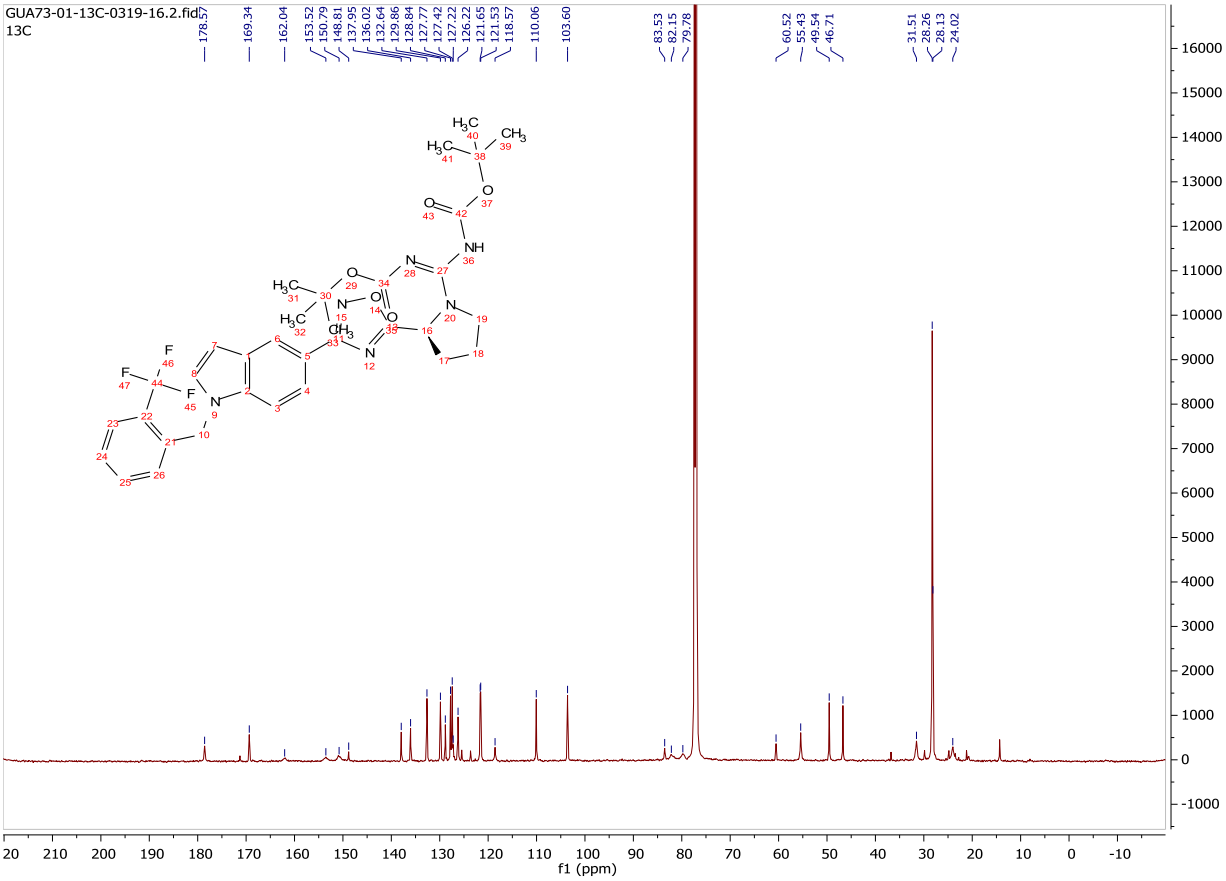
^{1}H-NMR Spectrum for Compound 5.3i:



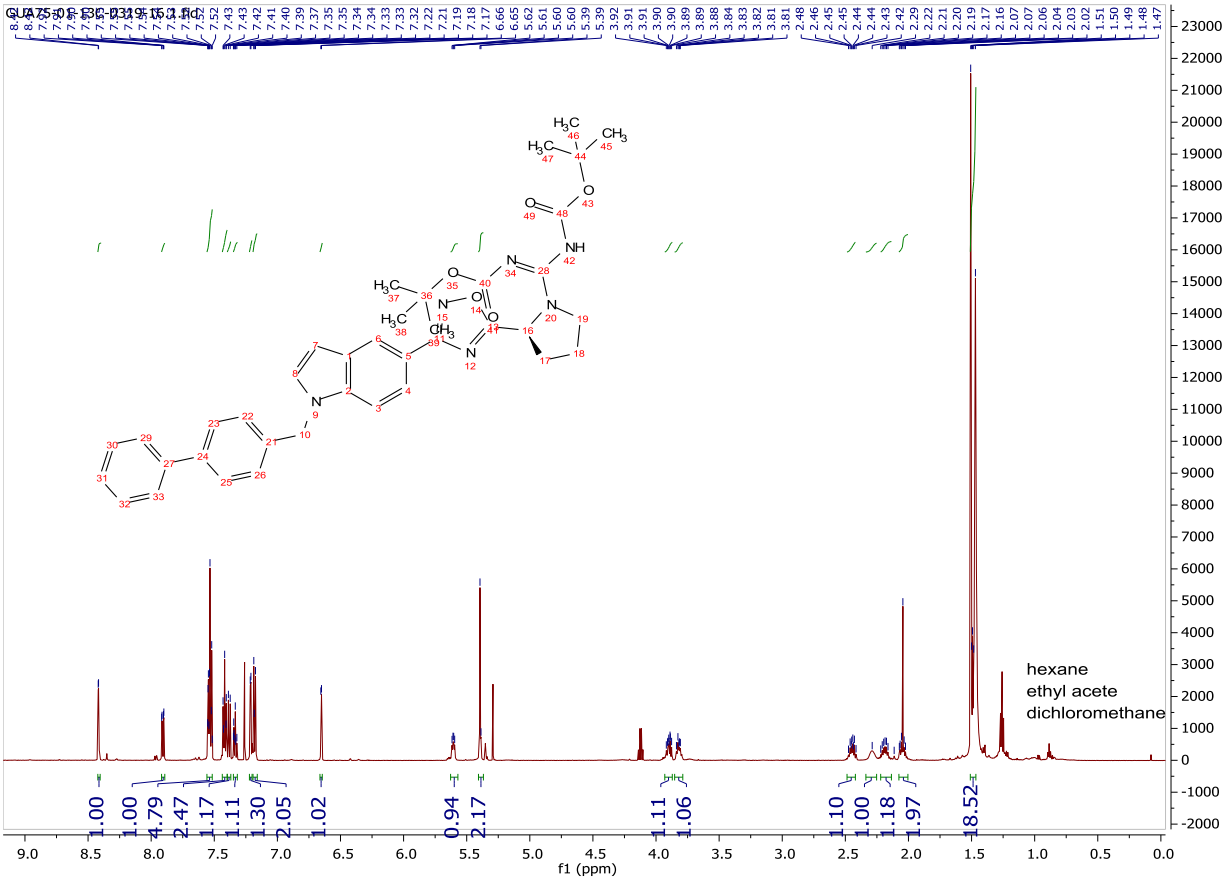
^{19}F-NMR Spectrum for Compound 5.3i:



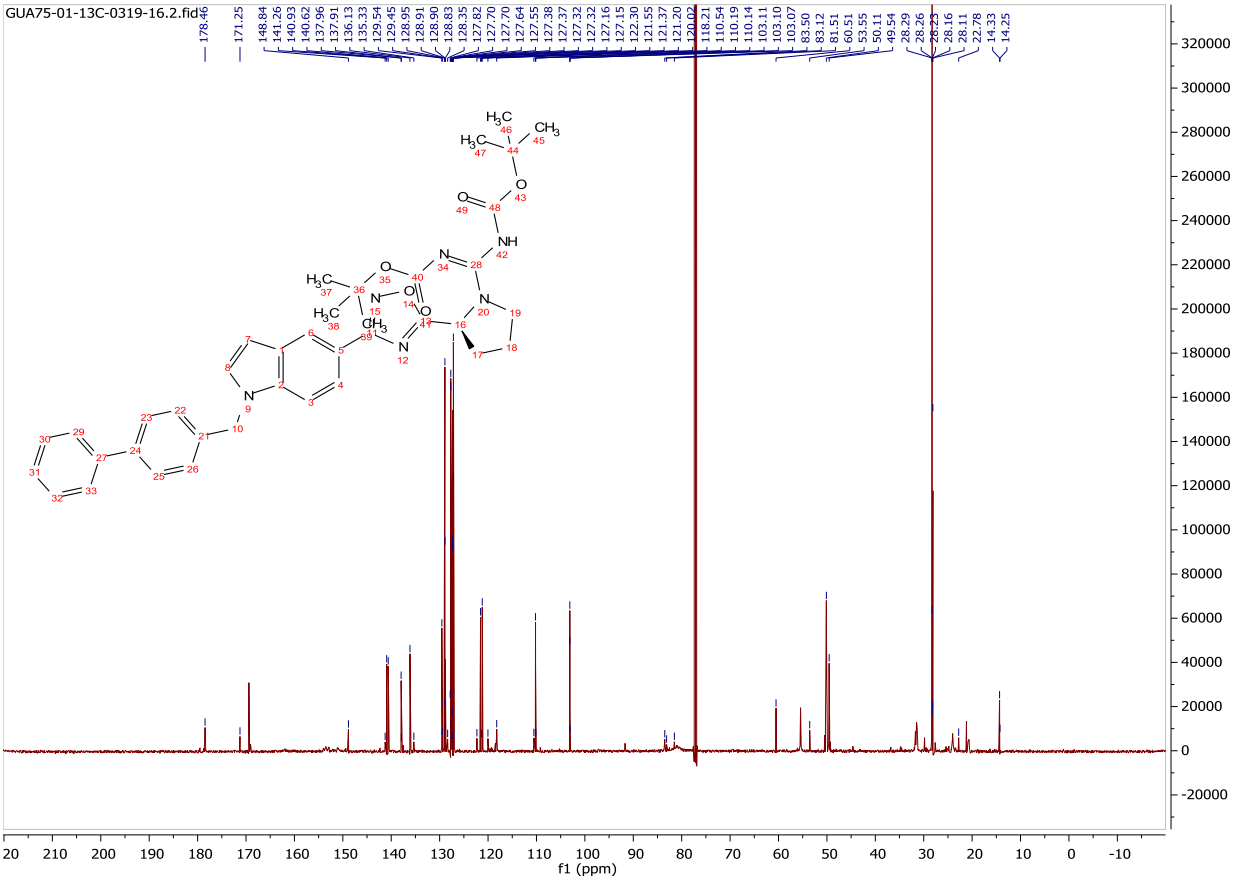
^{13}C-NMR Spectrum for Compound 5.3i:



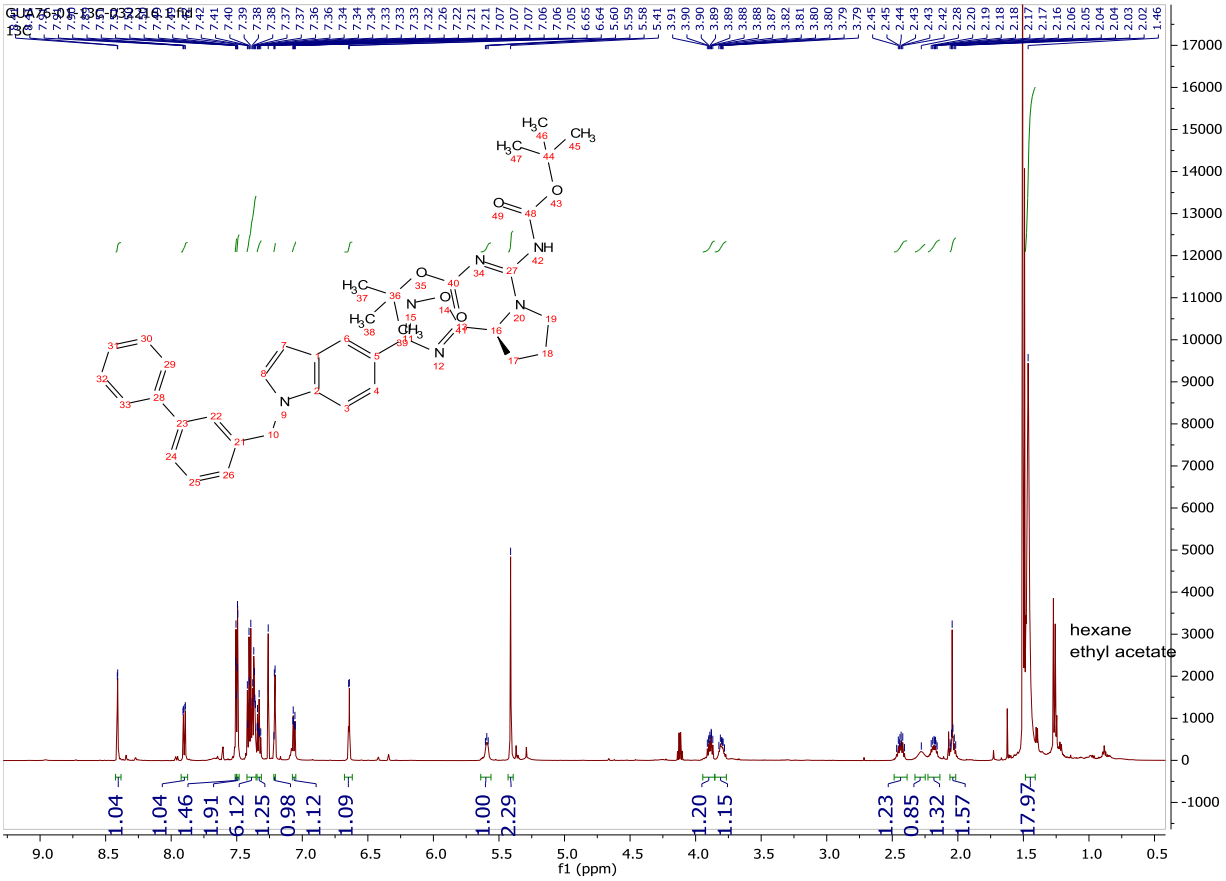
^{1}H-NMR Spectrum for Compound 5.3j:



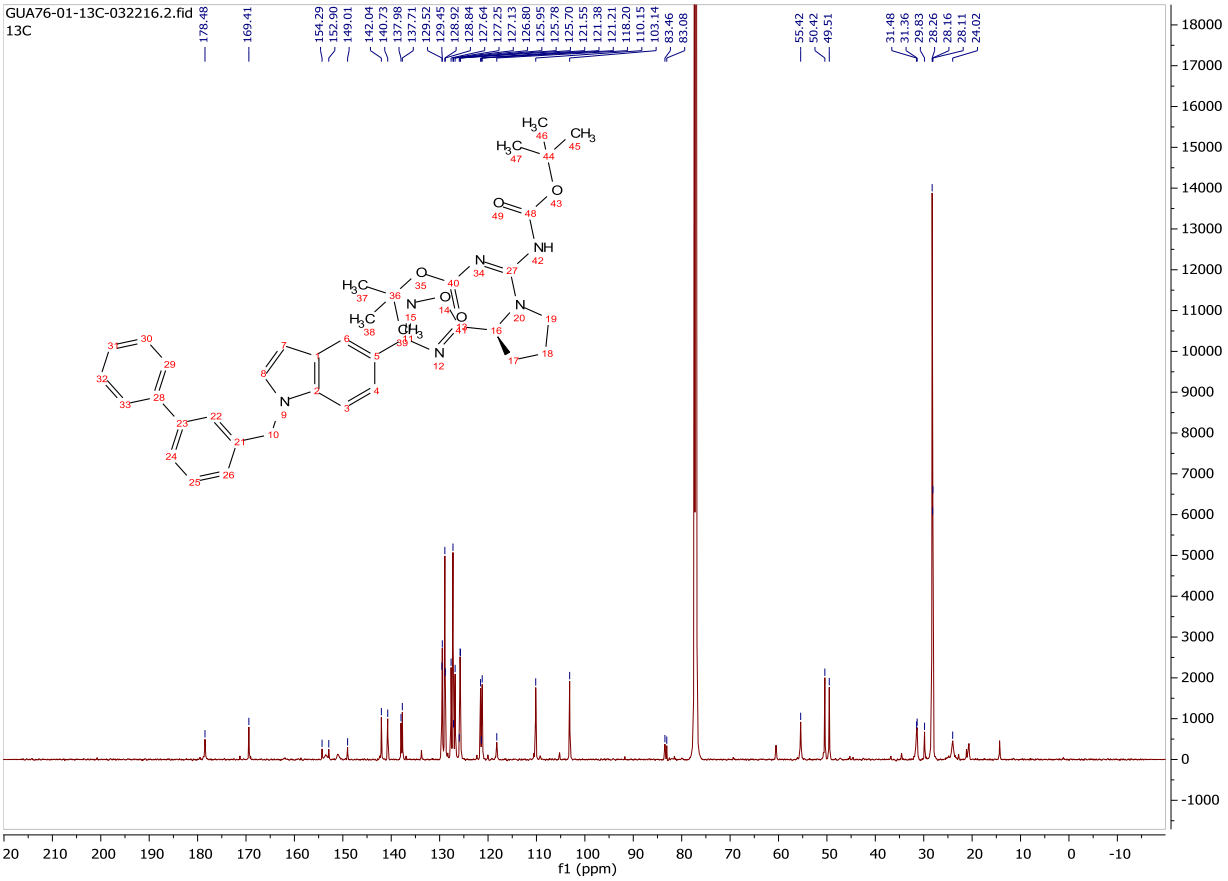
^{13}C-NMR Spectrum for Compound 5.3j:



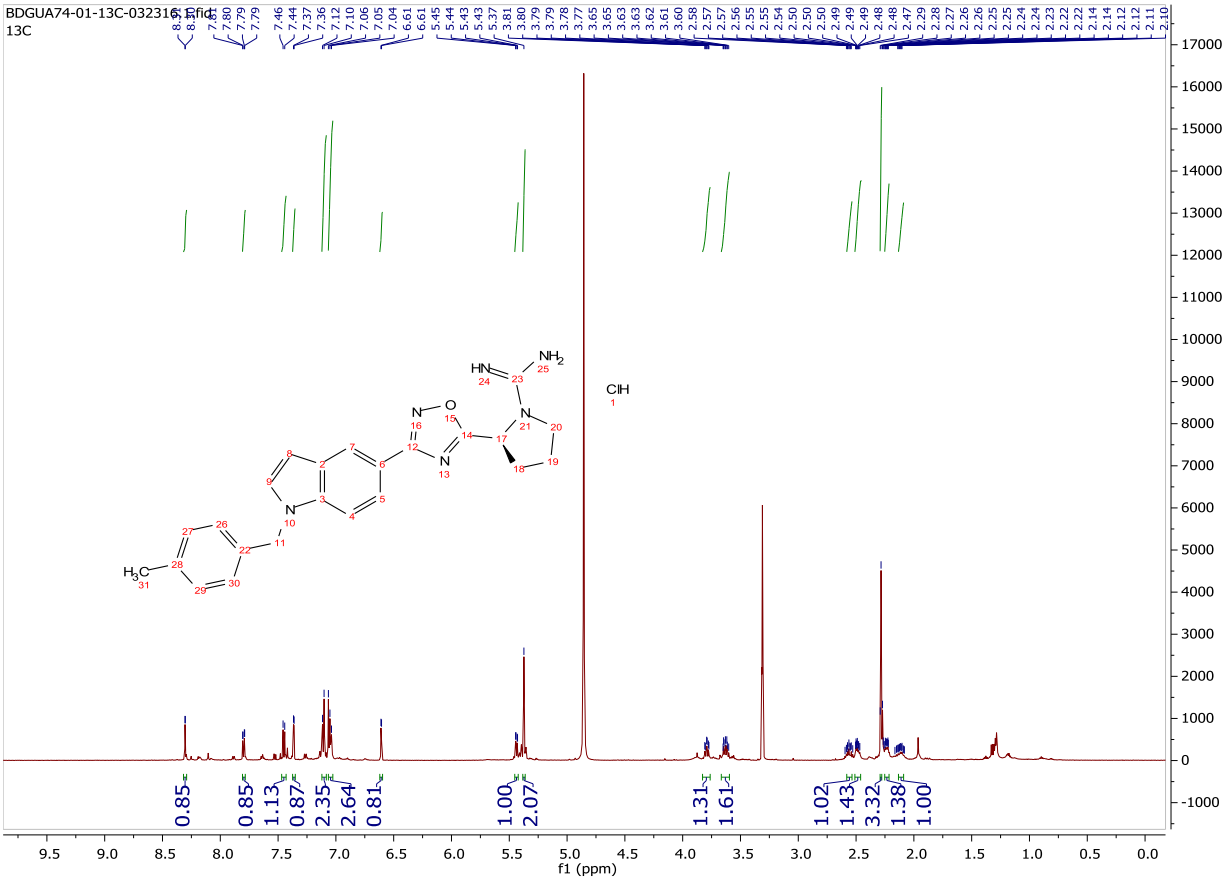
^{1}H-NMR Spectrum for Compound 5.3k:



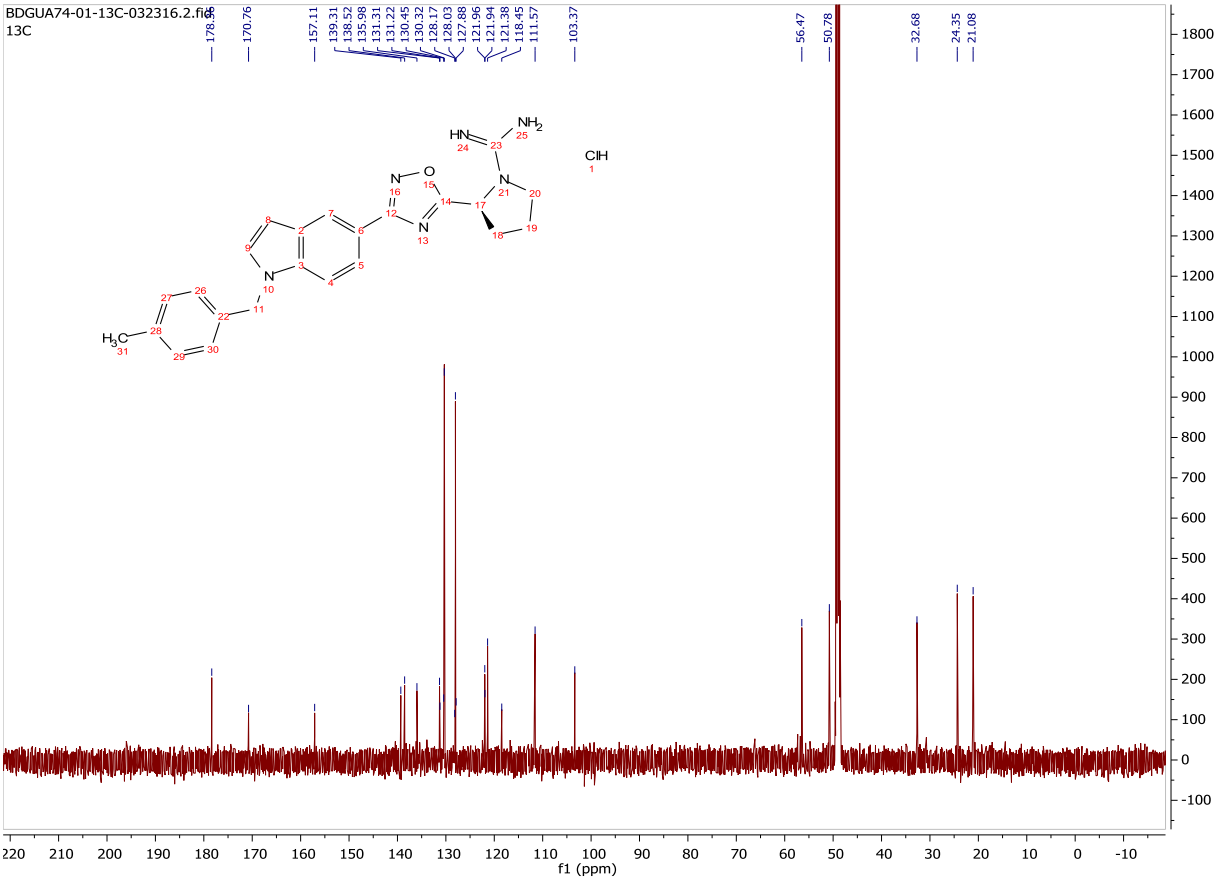
^{13}C-NMR Spectrum for Compound 5.3k:



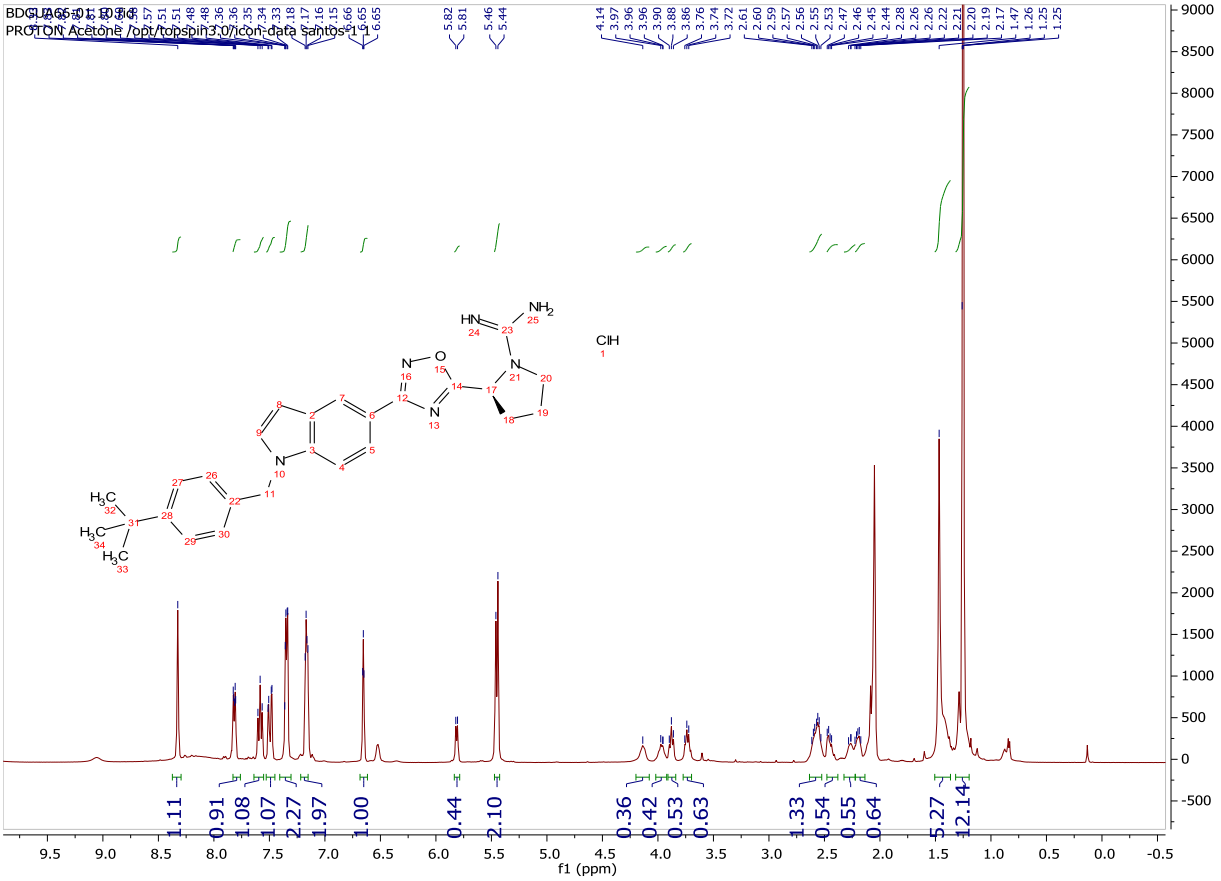
^{1}H-NMR Spectrum for Compound 5.4a:



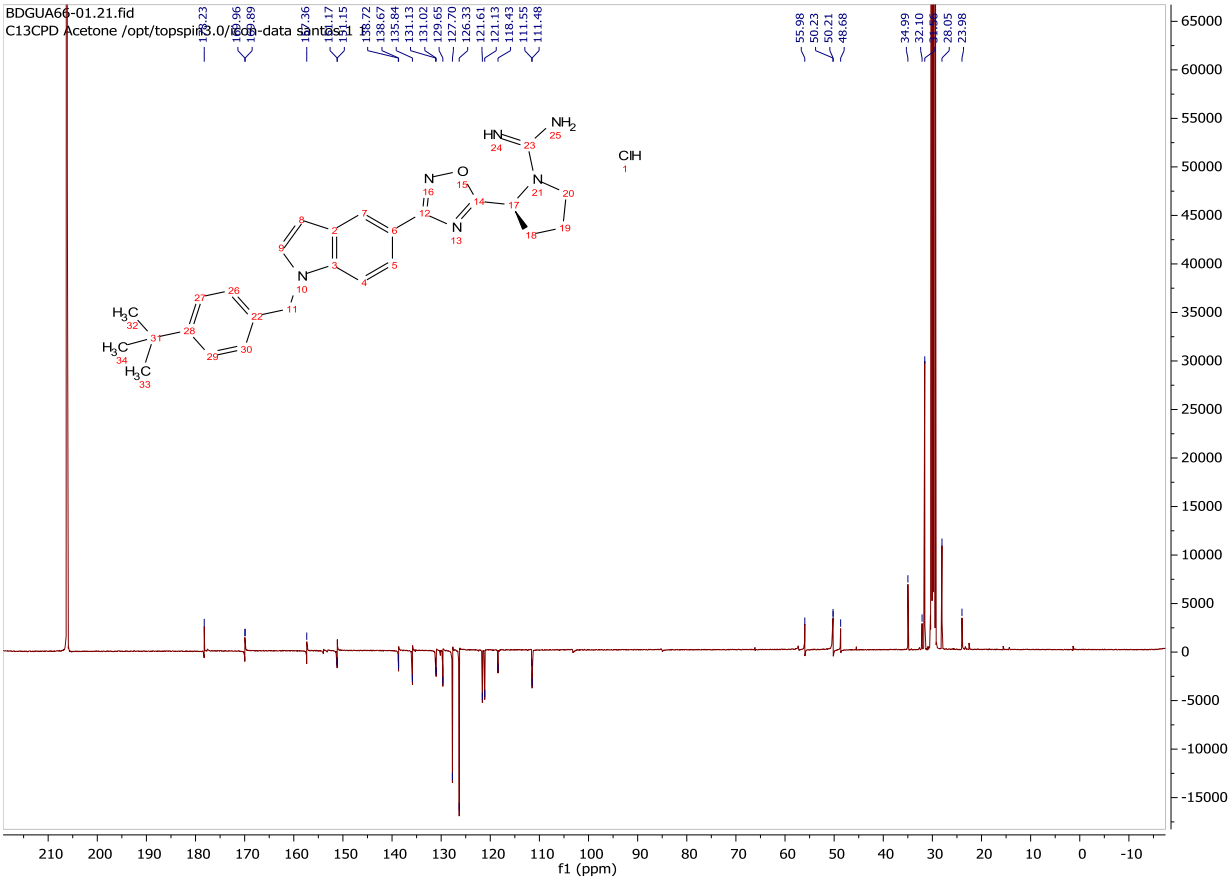
^{13}C-NMR Spectrum for Compound 5.4a:



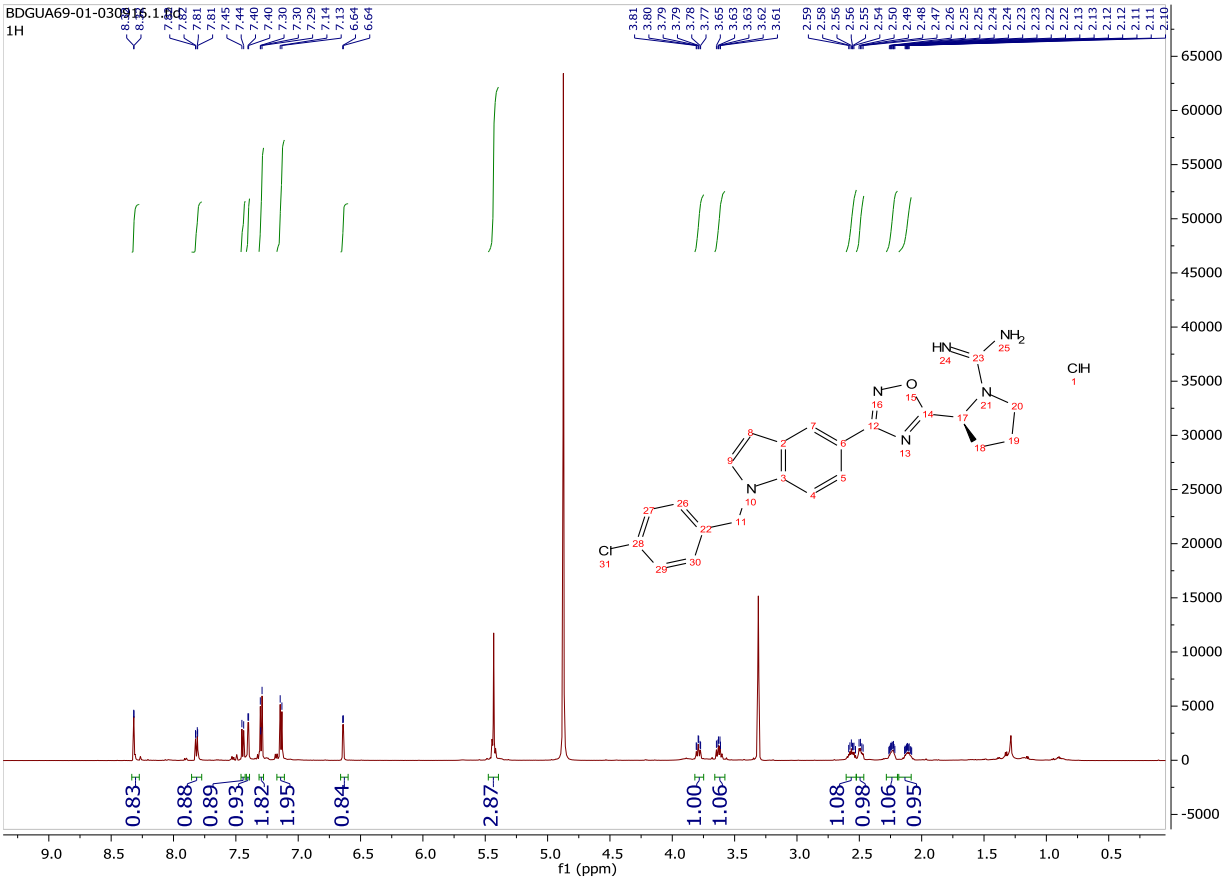
^{1}H-NMR Spectrum for Compound 5.4b:



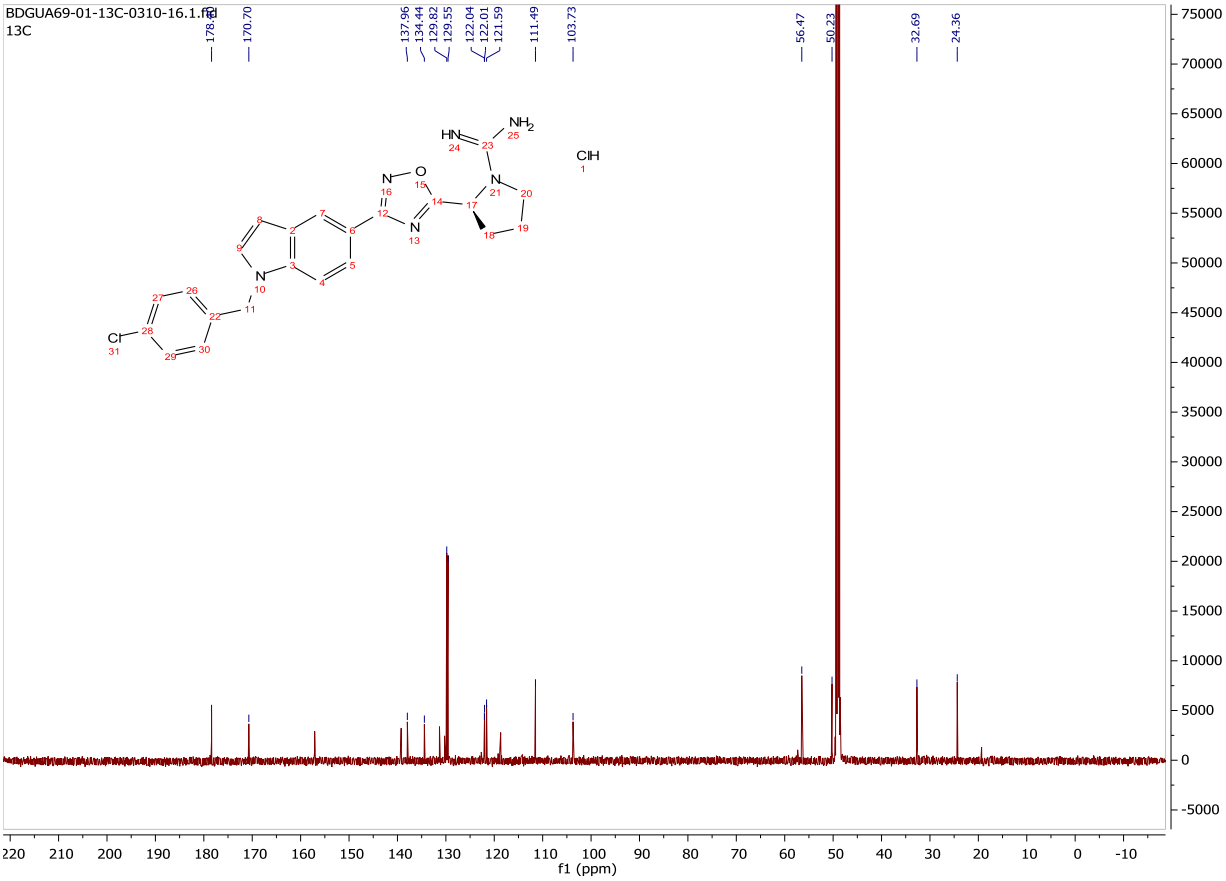
^{13}C-NMR Spectrum for Compound 5.4b:



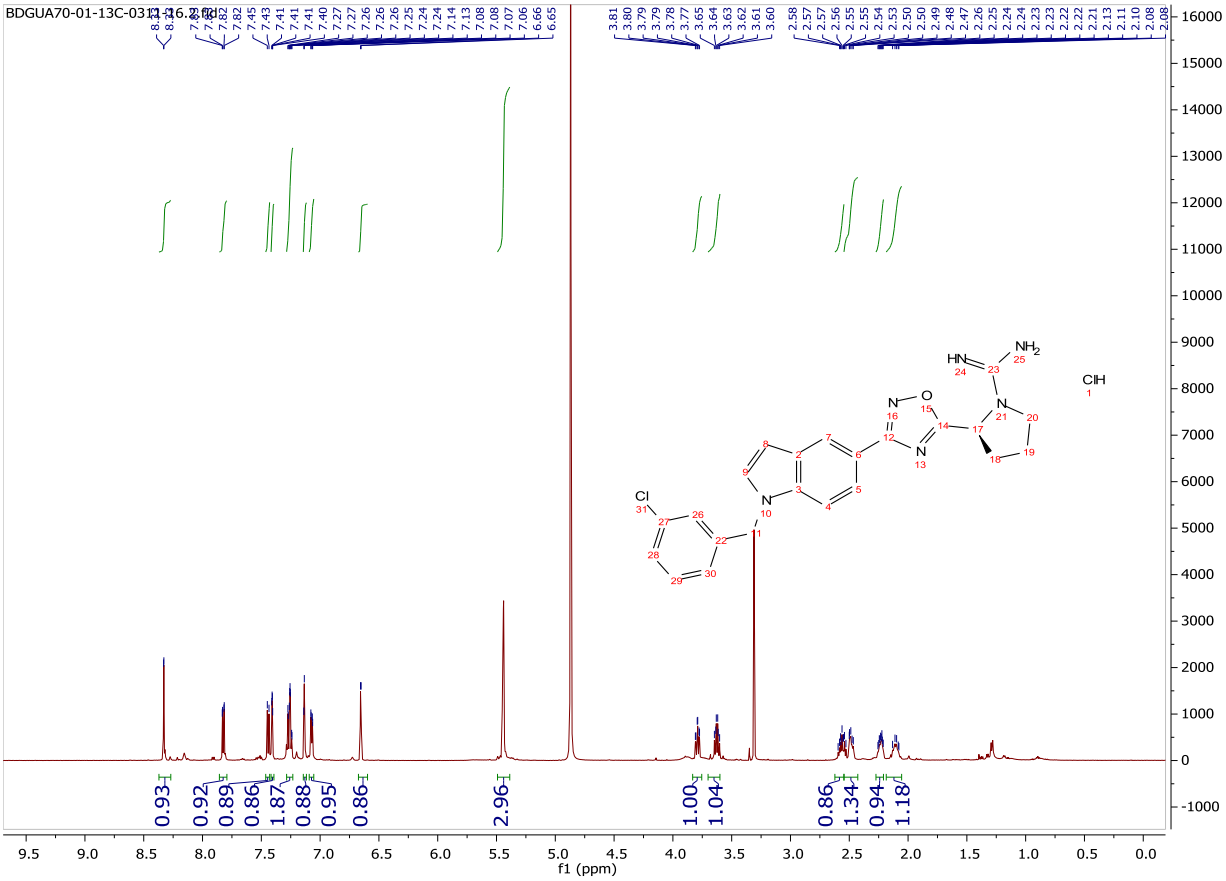
^{1}H-NMR Spectrum for Compound 5.4c:



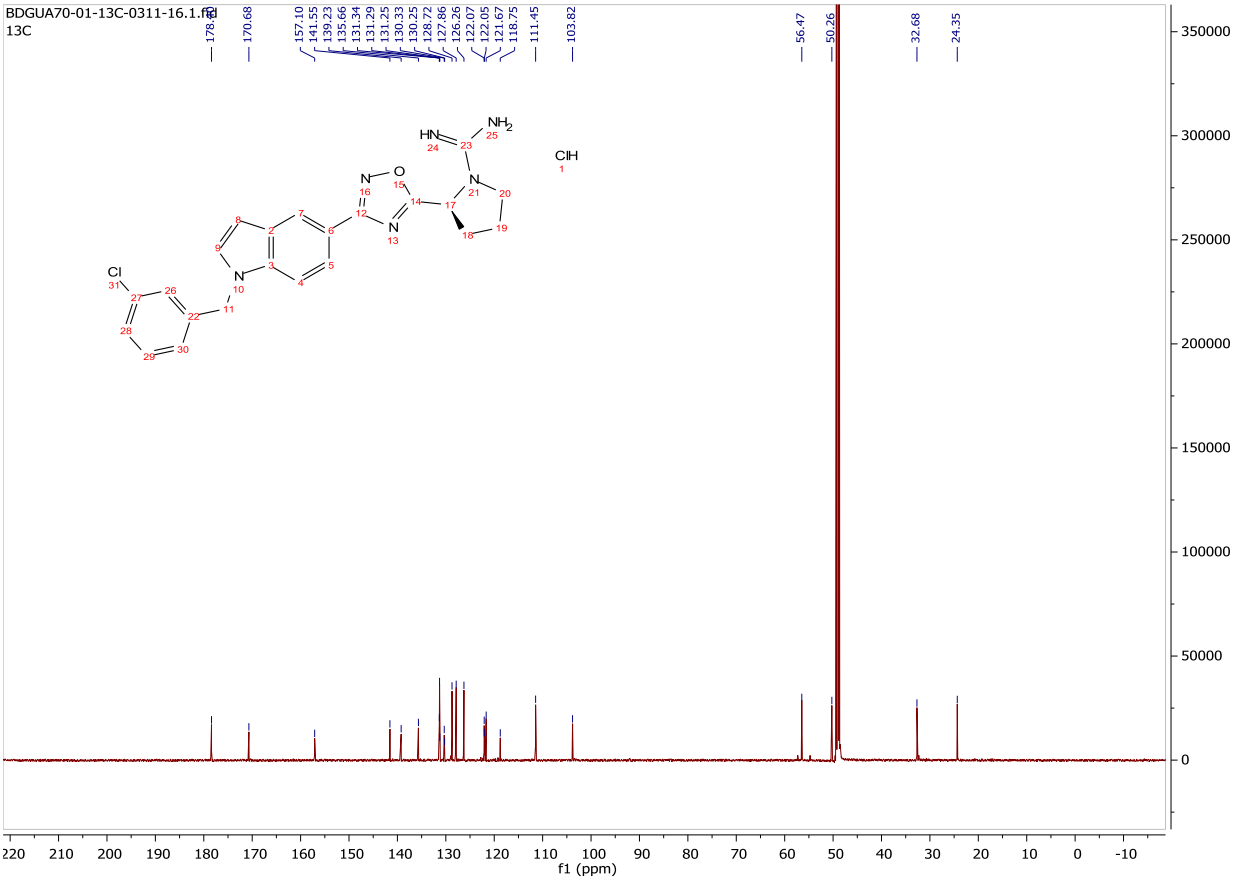
^{13}C-NMR Spectrum for Compound 5.4c:



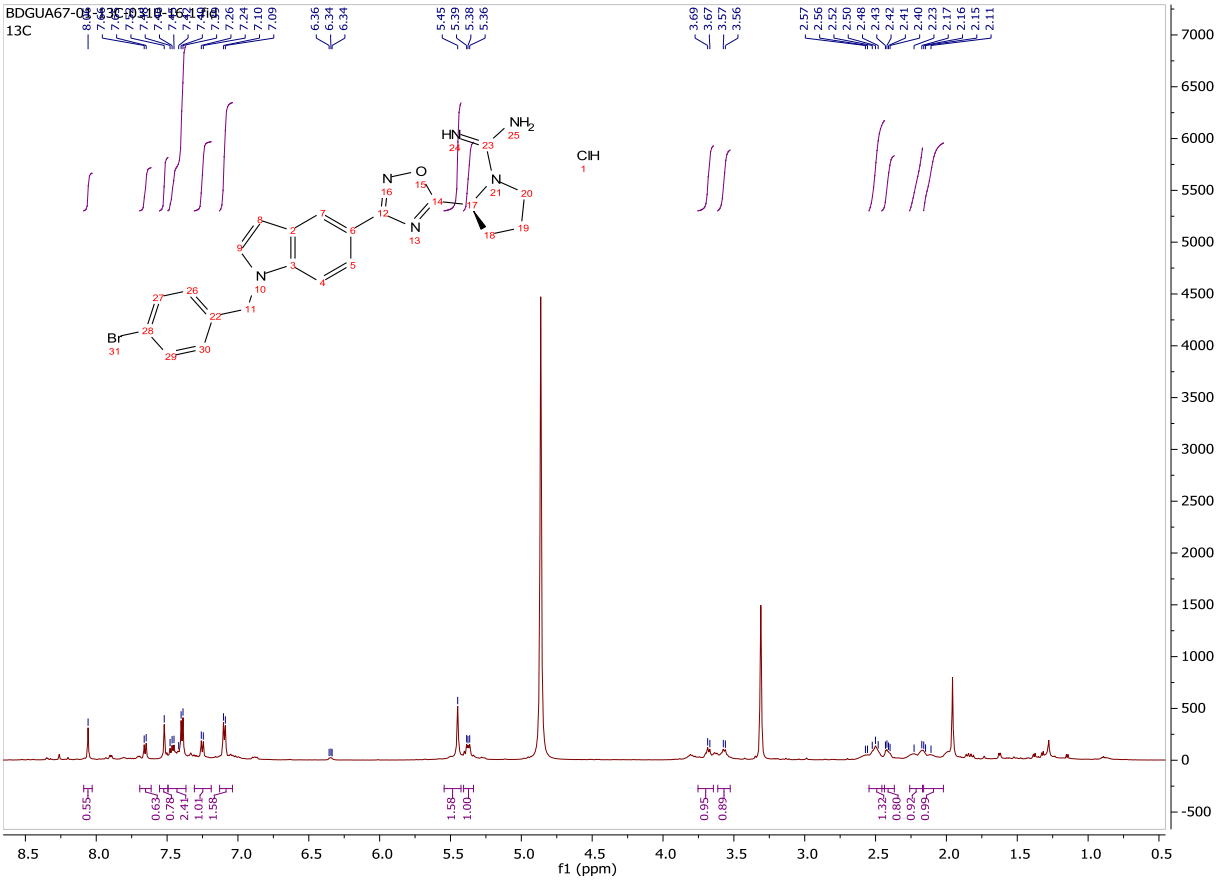
^{1}H-NMR Spectrum for Compound 5.4d:



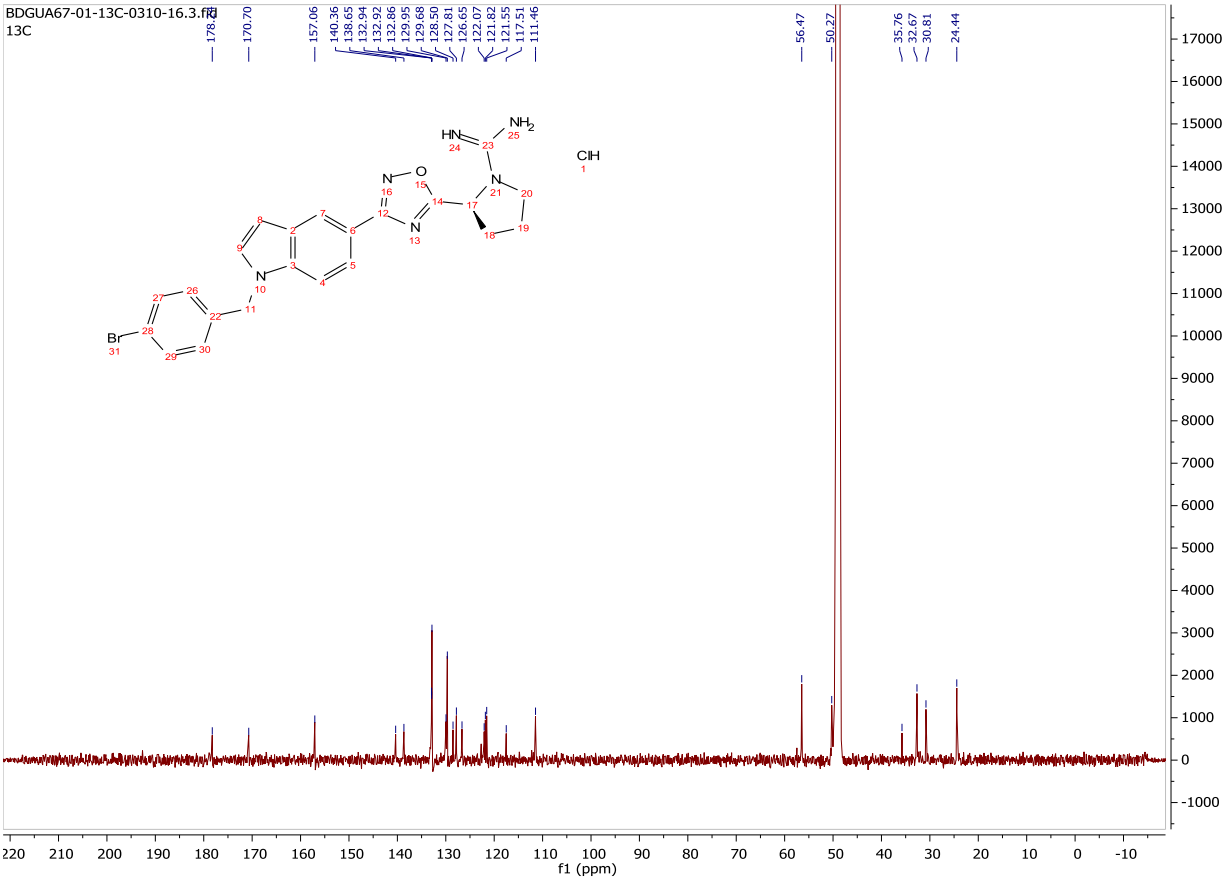
^{13}C-NMR Spectrum for Compound 5.4d:



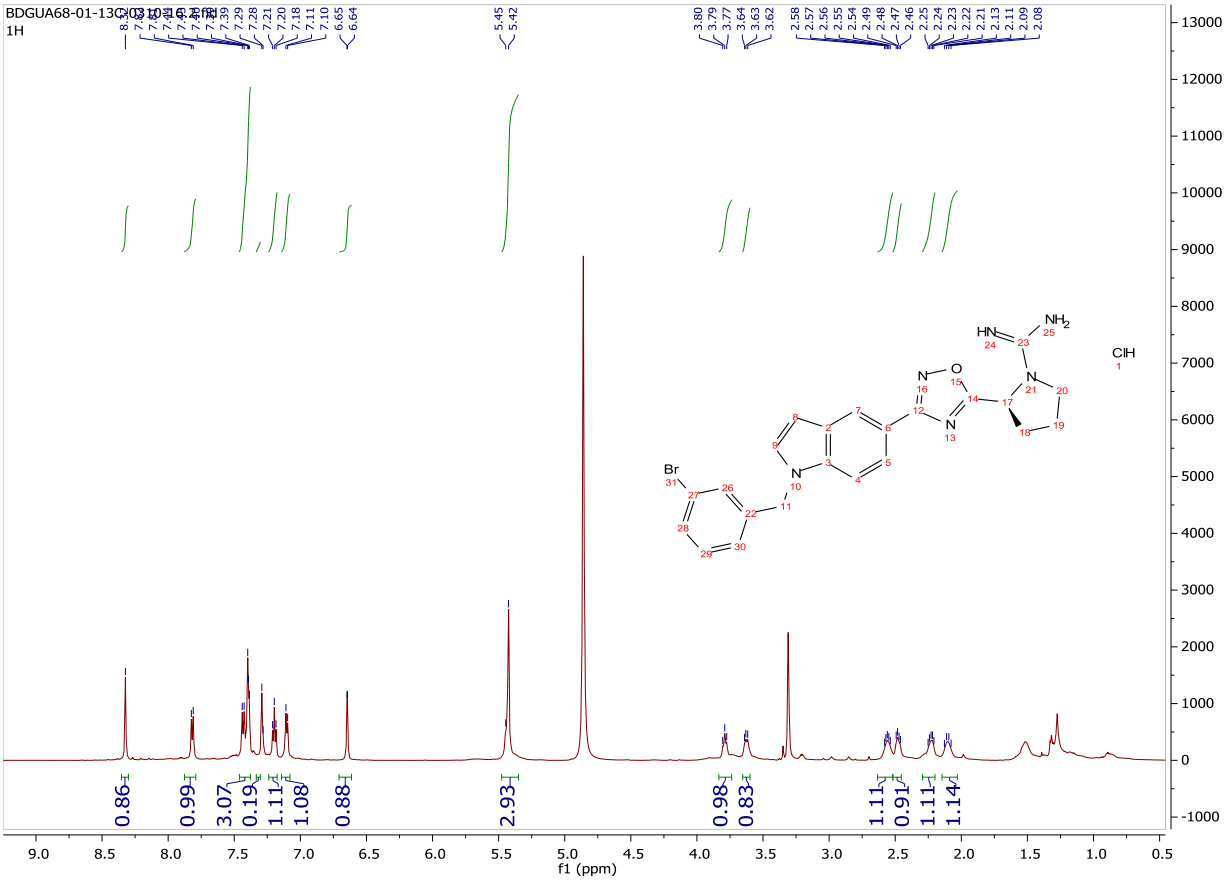
^{1}H-NMR Spectrum for Compound 5.4e:



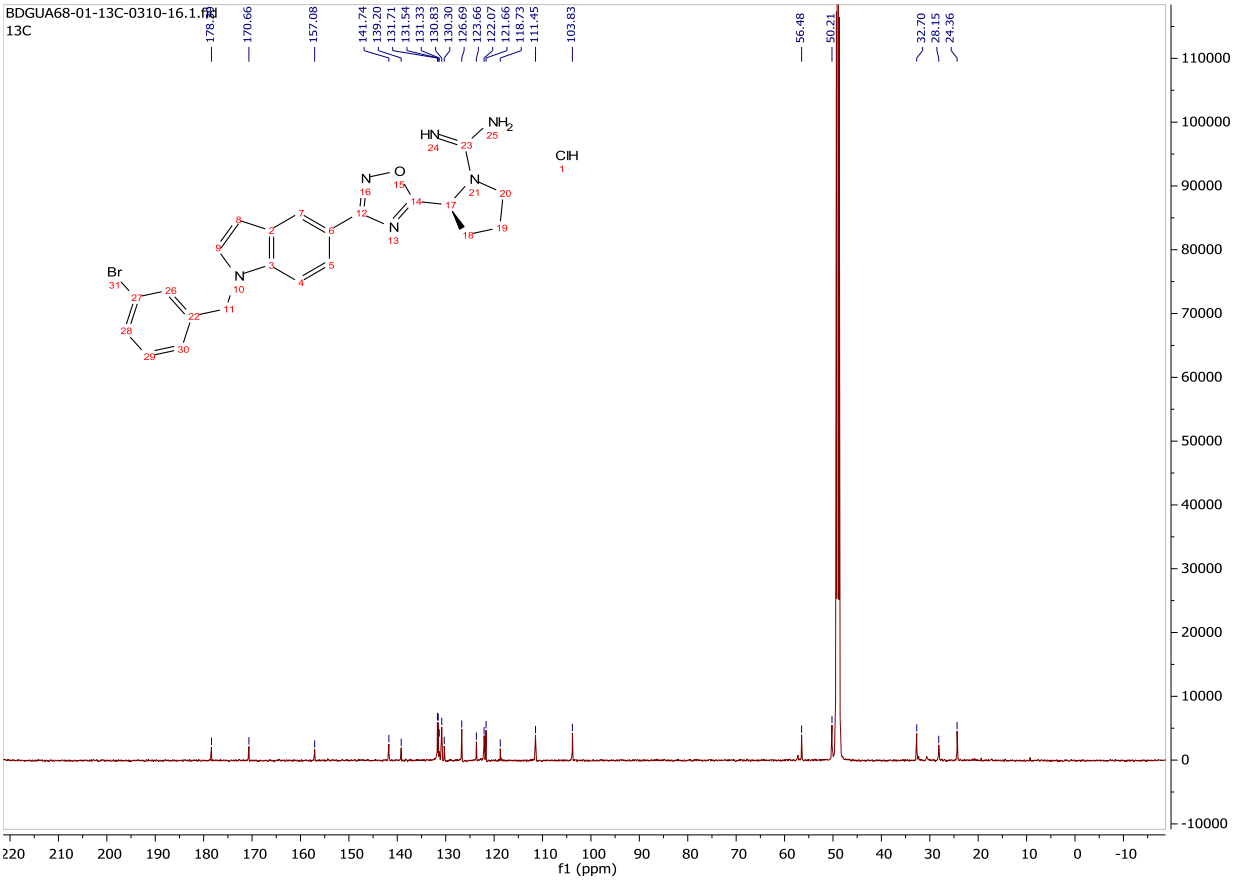
^{13}C-NMR Spectrum for Compound 5.4e:



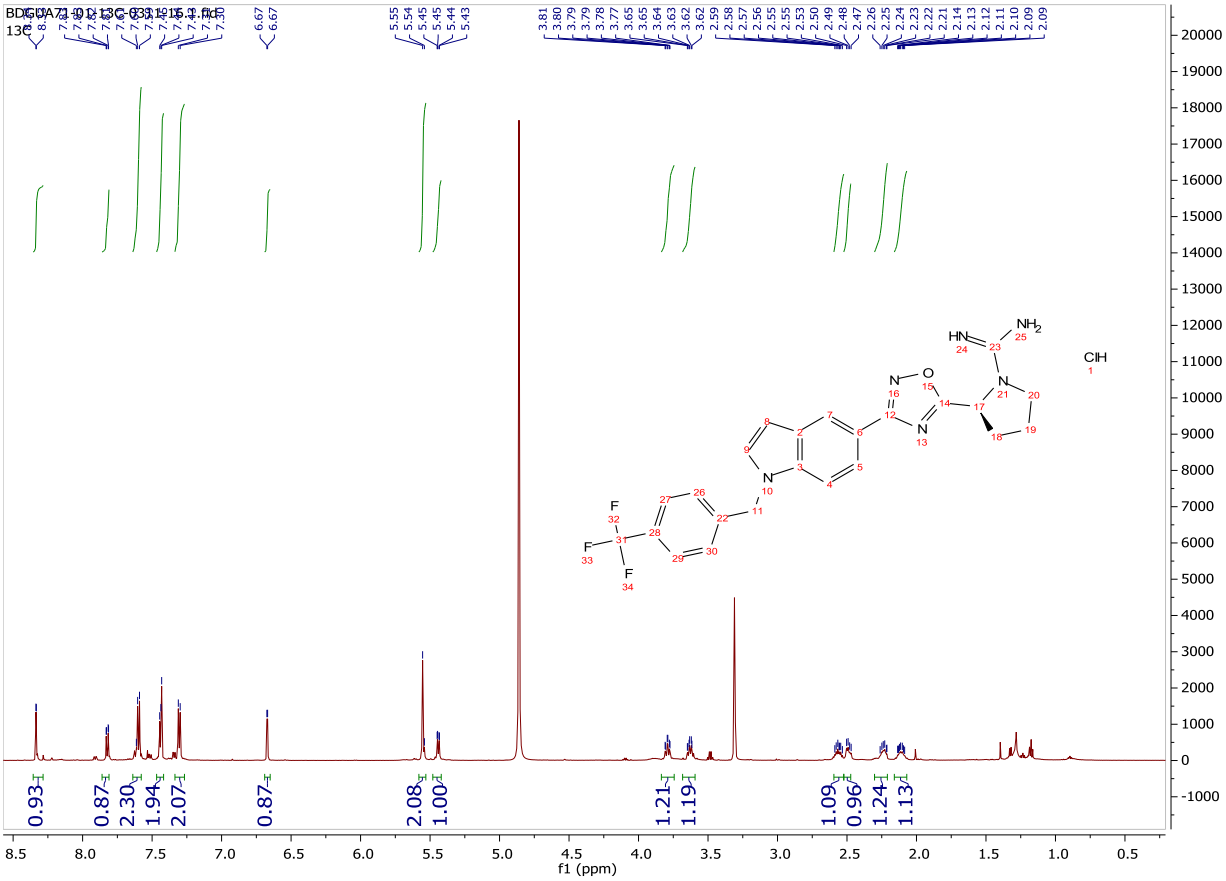
^{1}H-NMR Spectrum for Compound 5.4f:



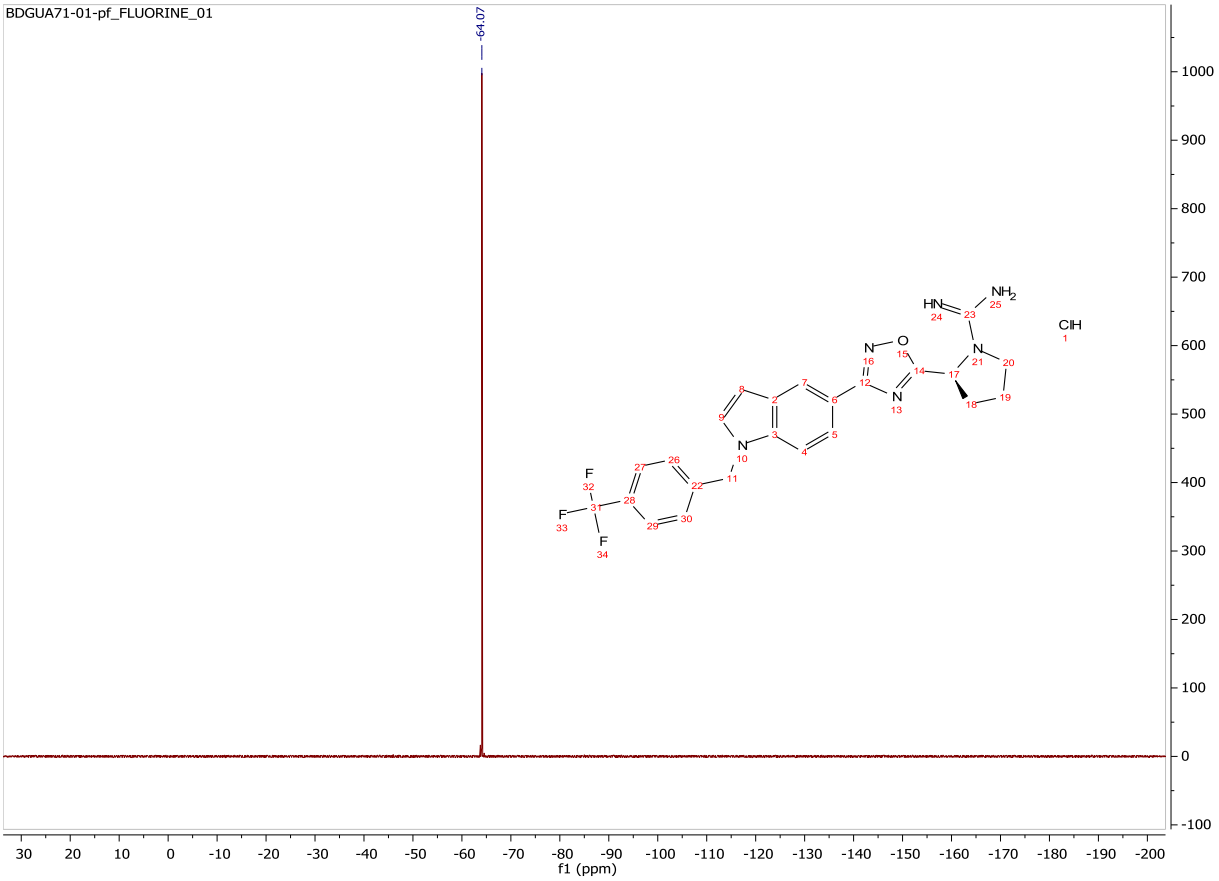
^{13}C-NMR Spectrum for Compound 5.4f:



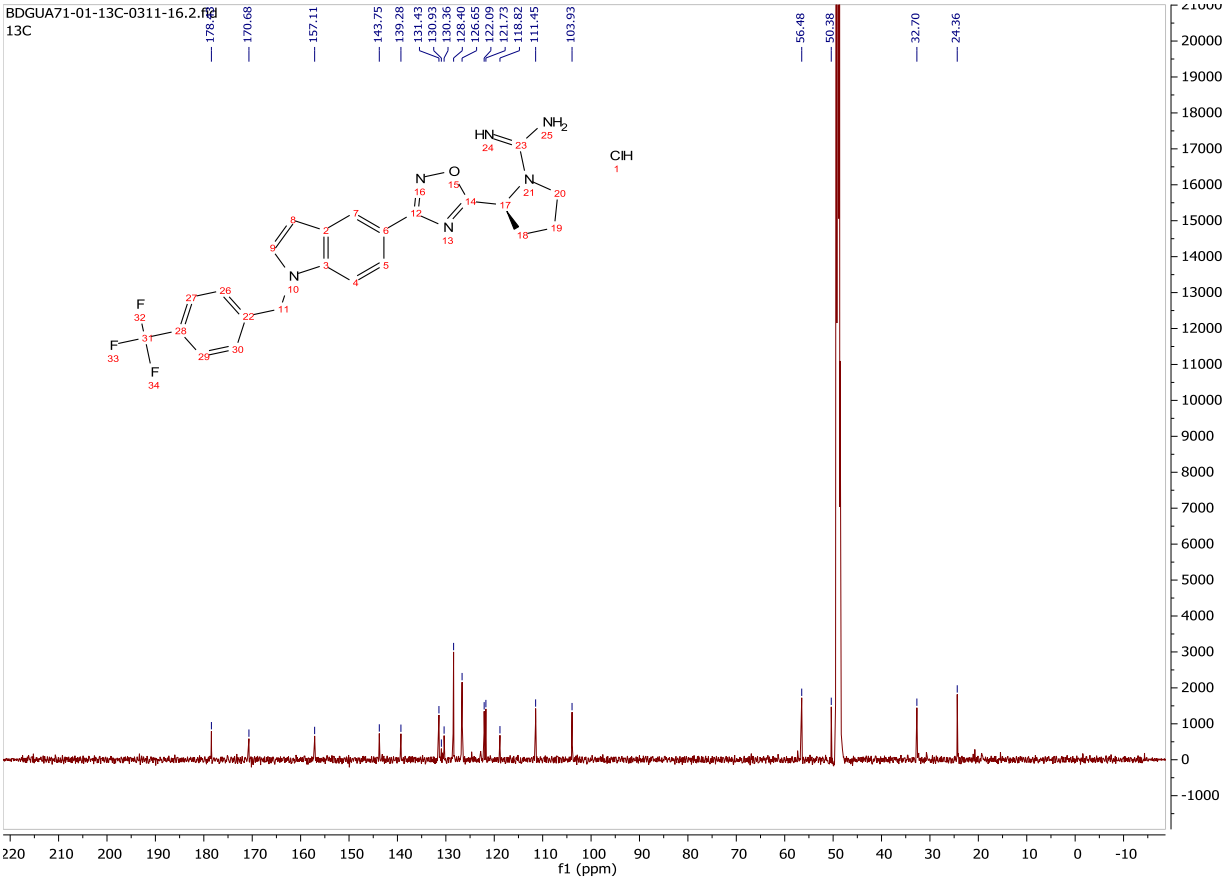
^{1}H-NMR Spectrum for Compound 5.4g:



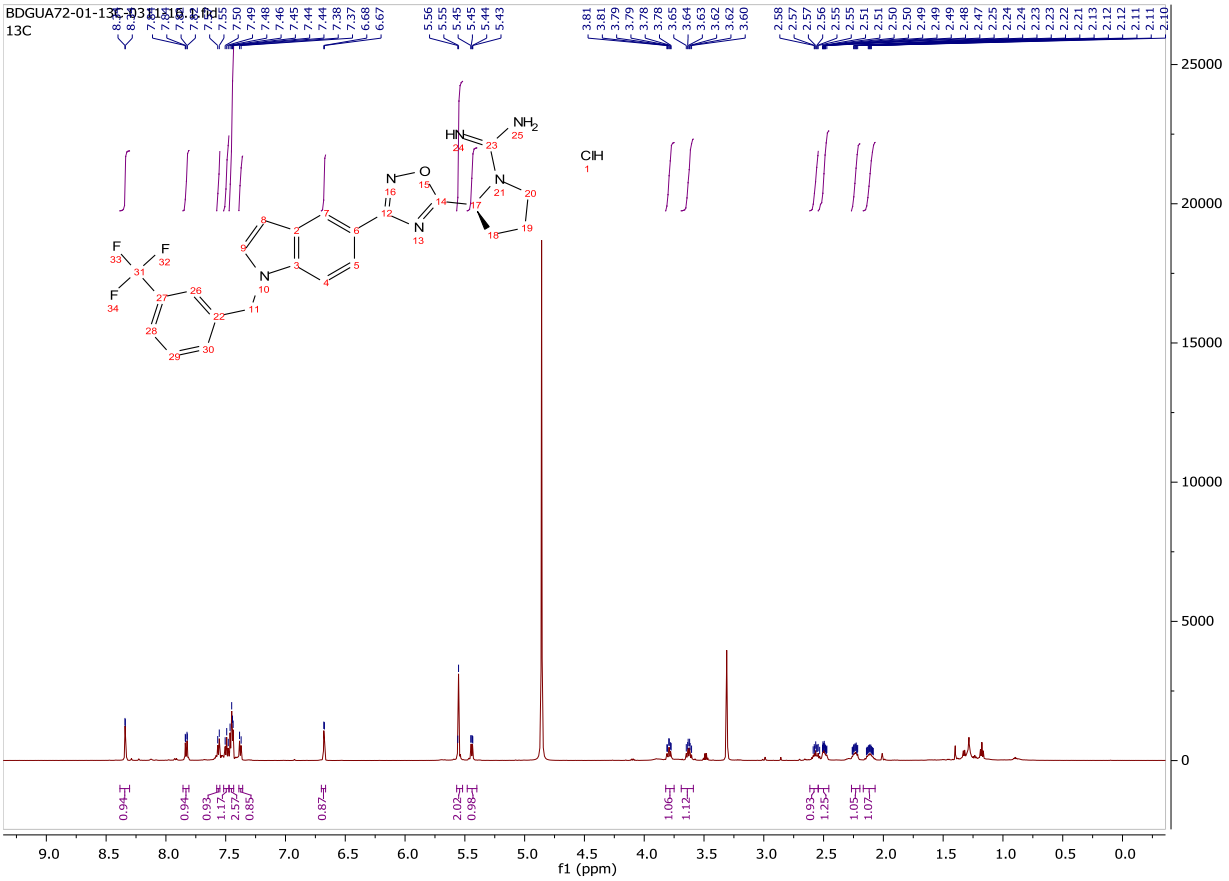
^{19}F-NMR Spectrum for Compound 5.4g:



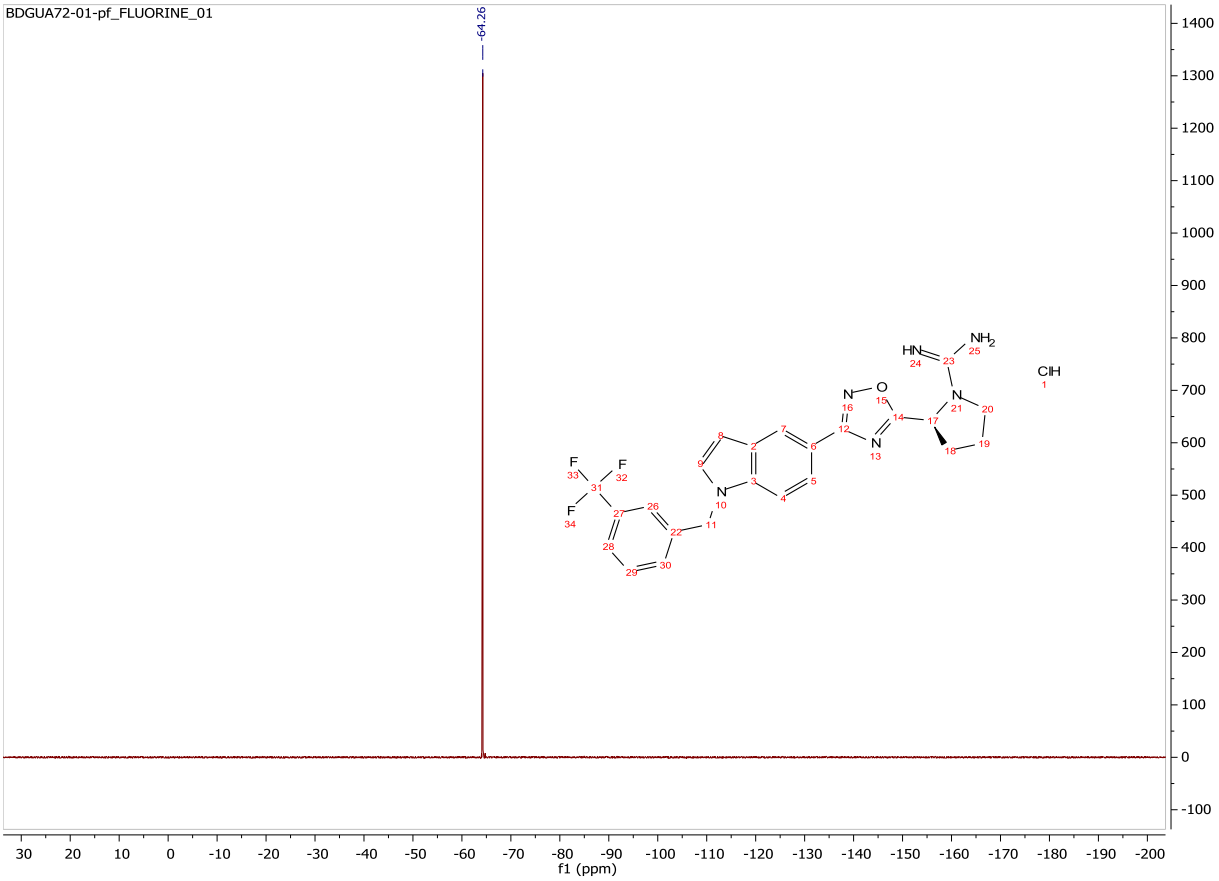
^{13}C-NMR Spectrum for Compound 5.4g:



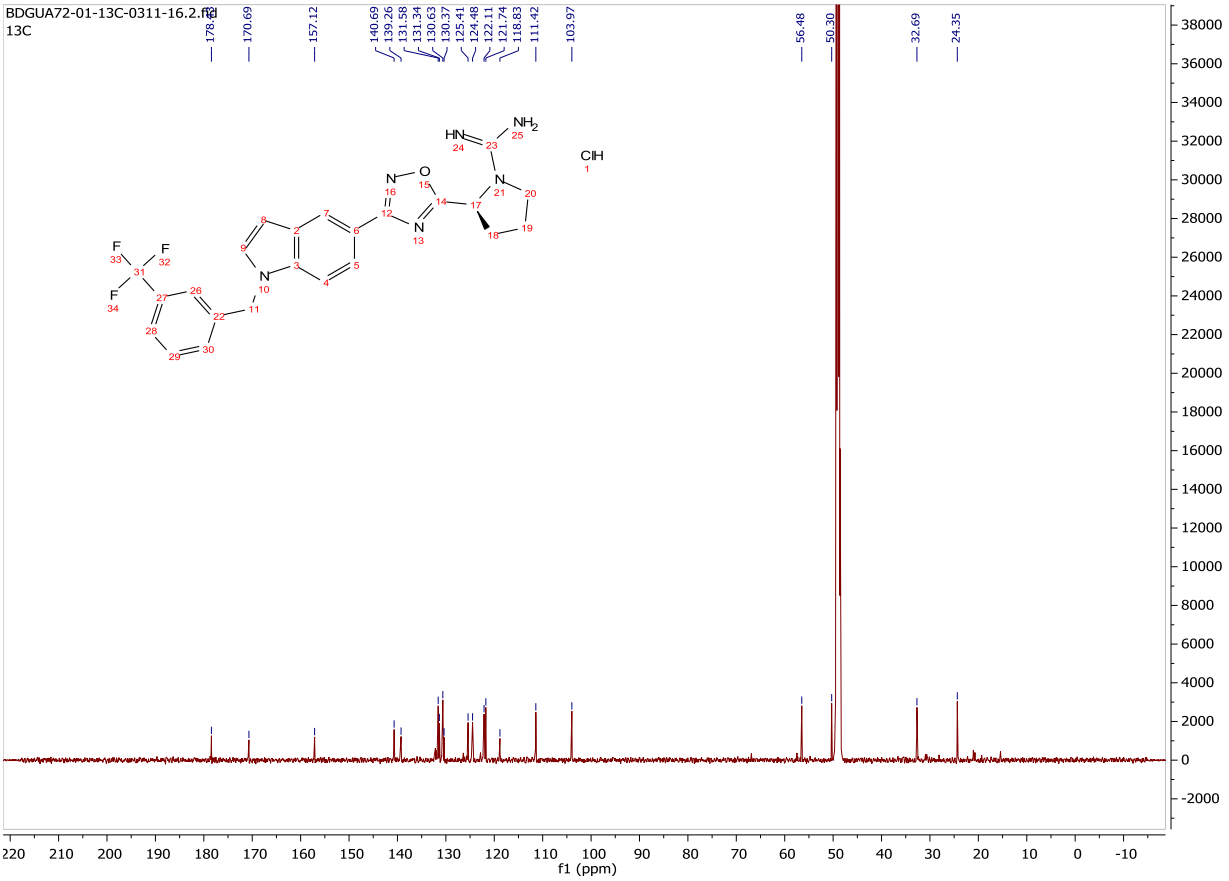
^{1}H-NMR Spectrum for Compound 5.4h:



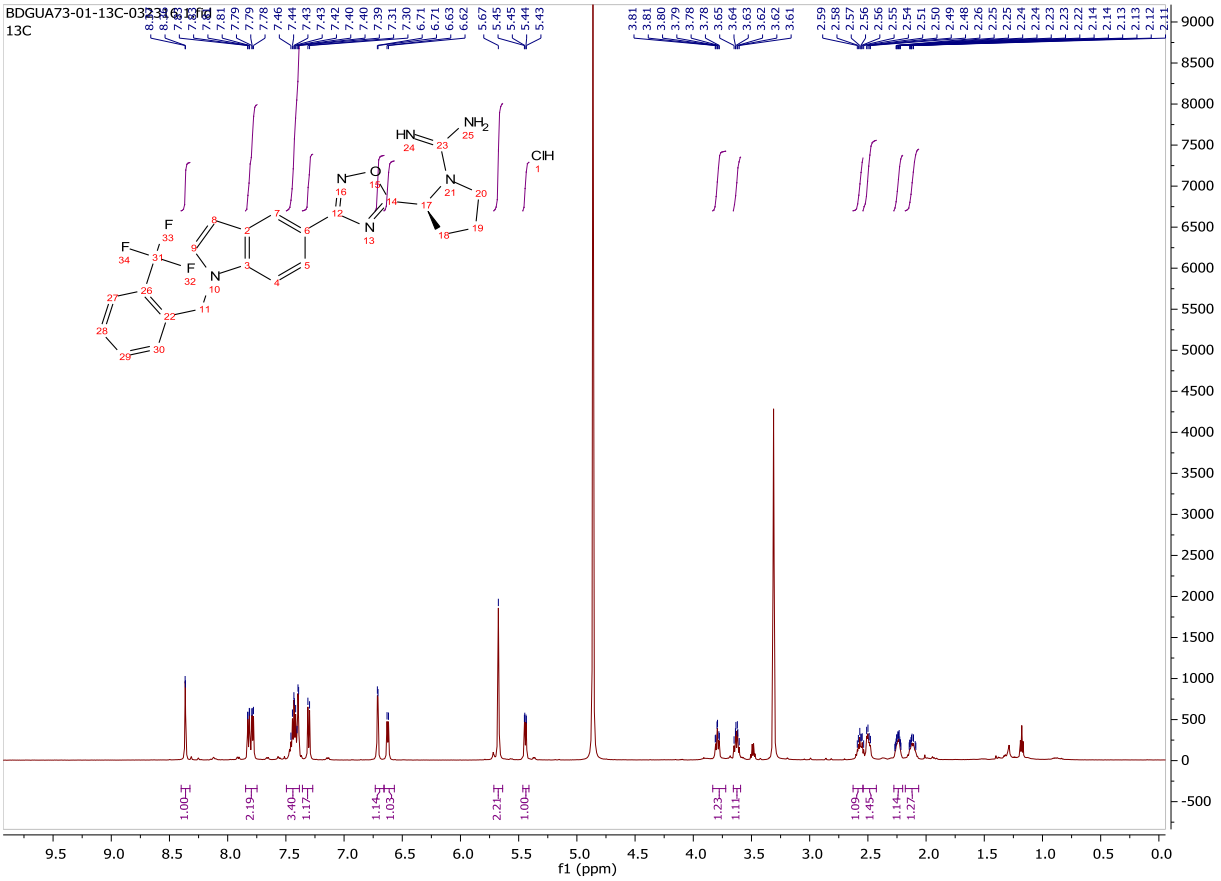
^{19}F-NMR Spectrum for Compound 5.4h:



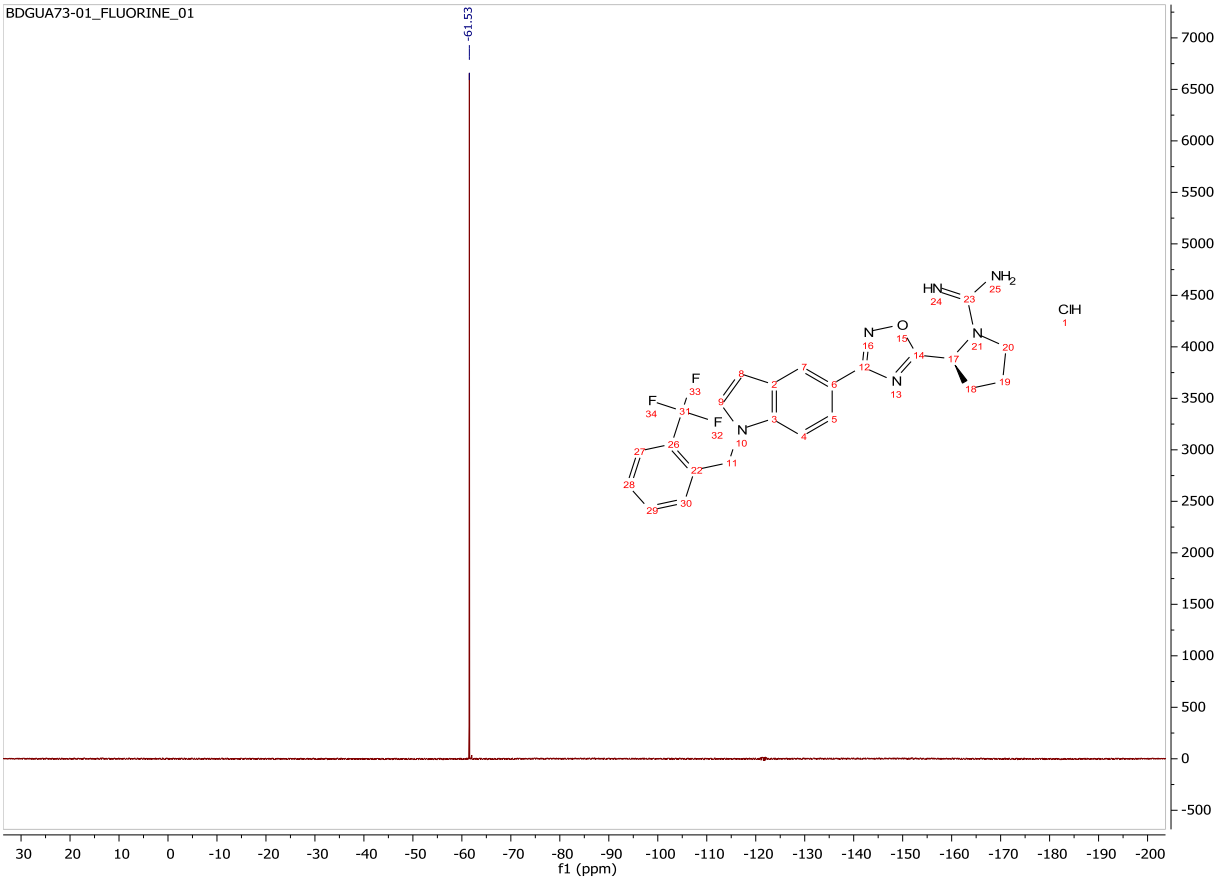
^{13}C-NMR Spectrum for Compound 5.4h:



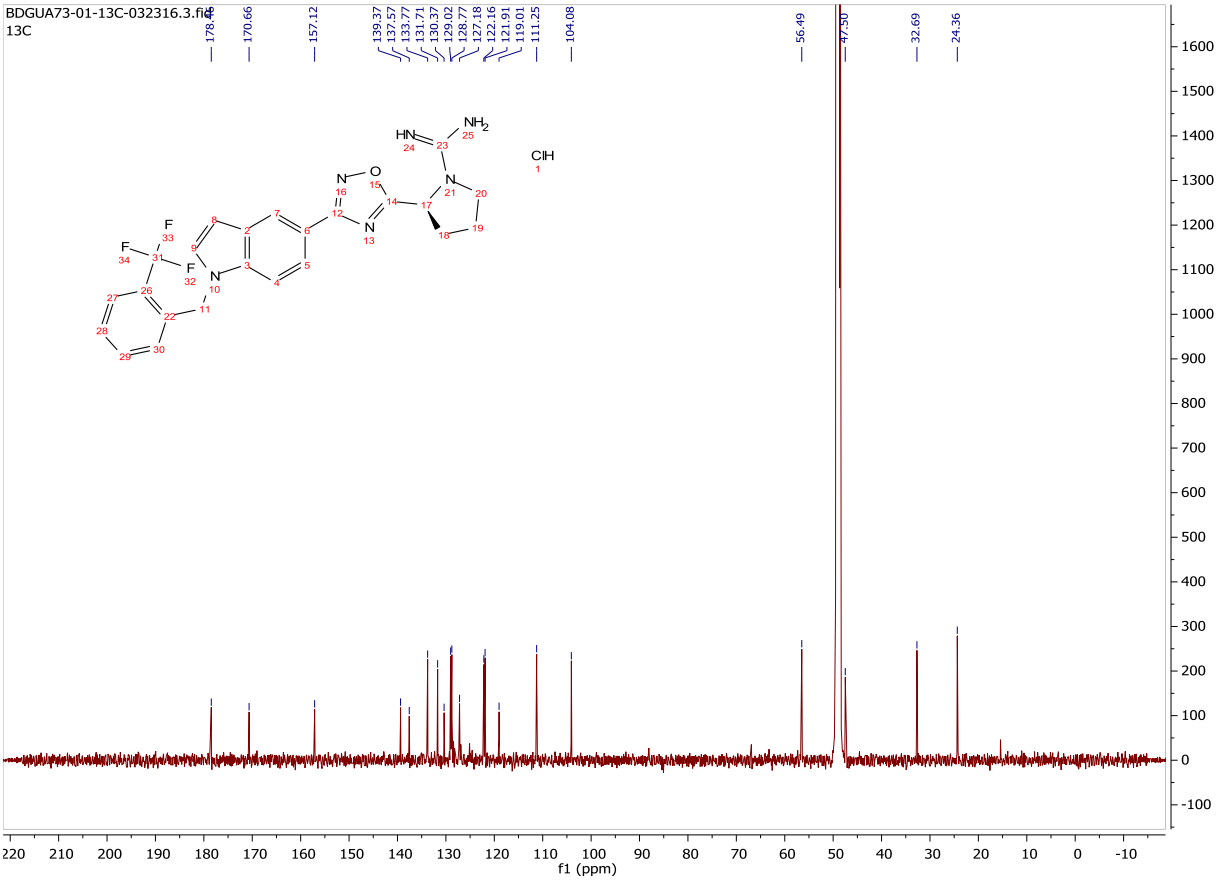
^{1}H-NMR Spectrum for Compound 5.4i:



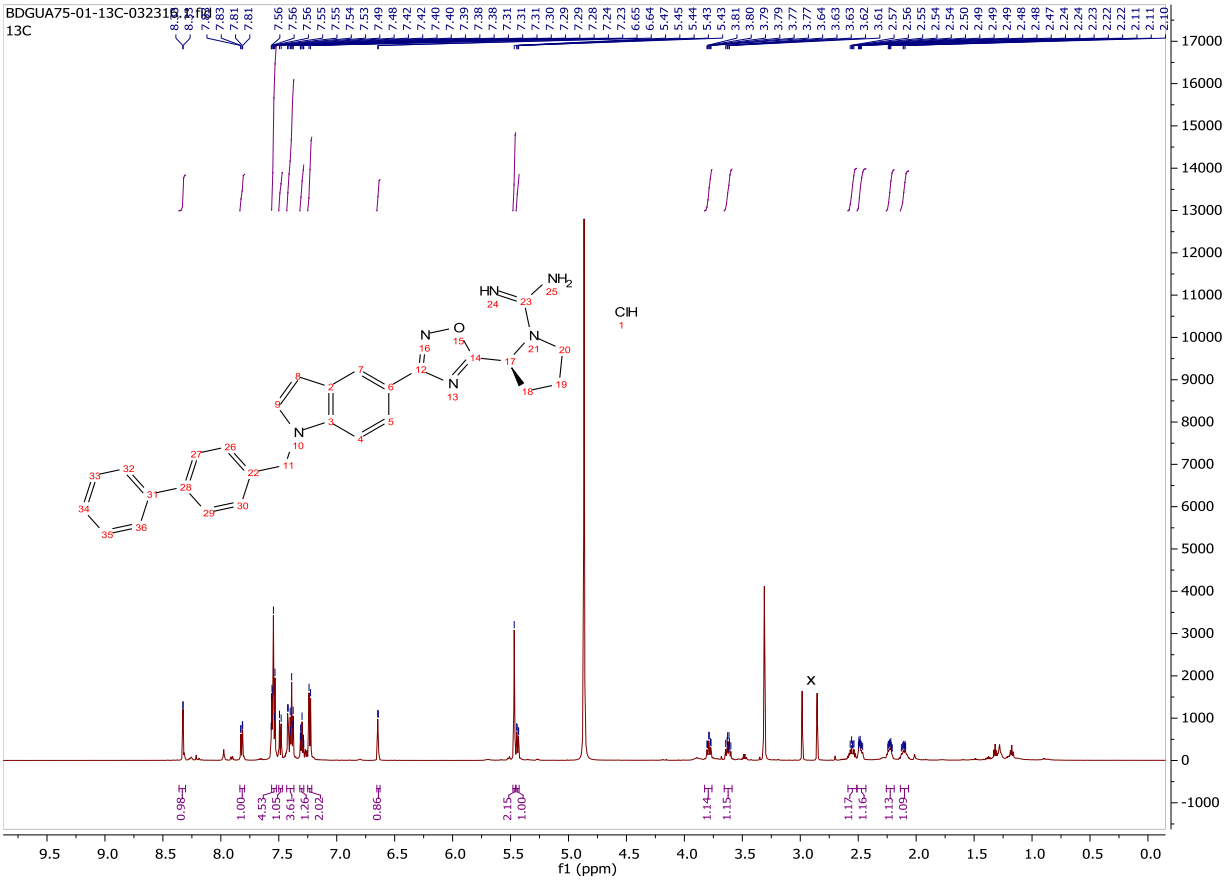
^{19}F-NMR Spectrum for Compound 5.4i:



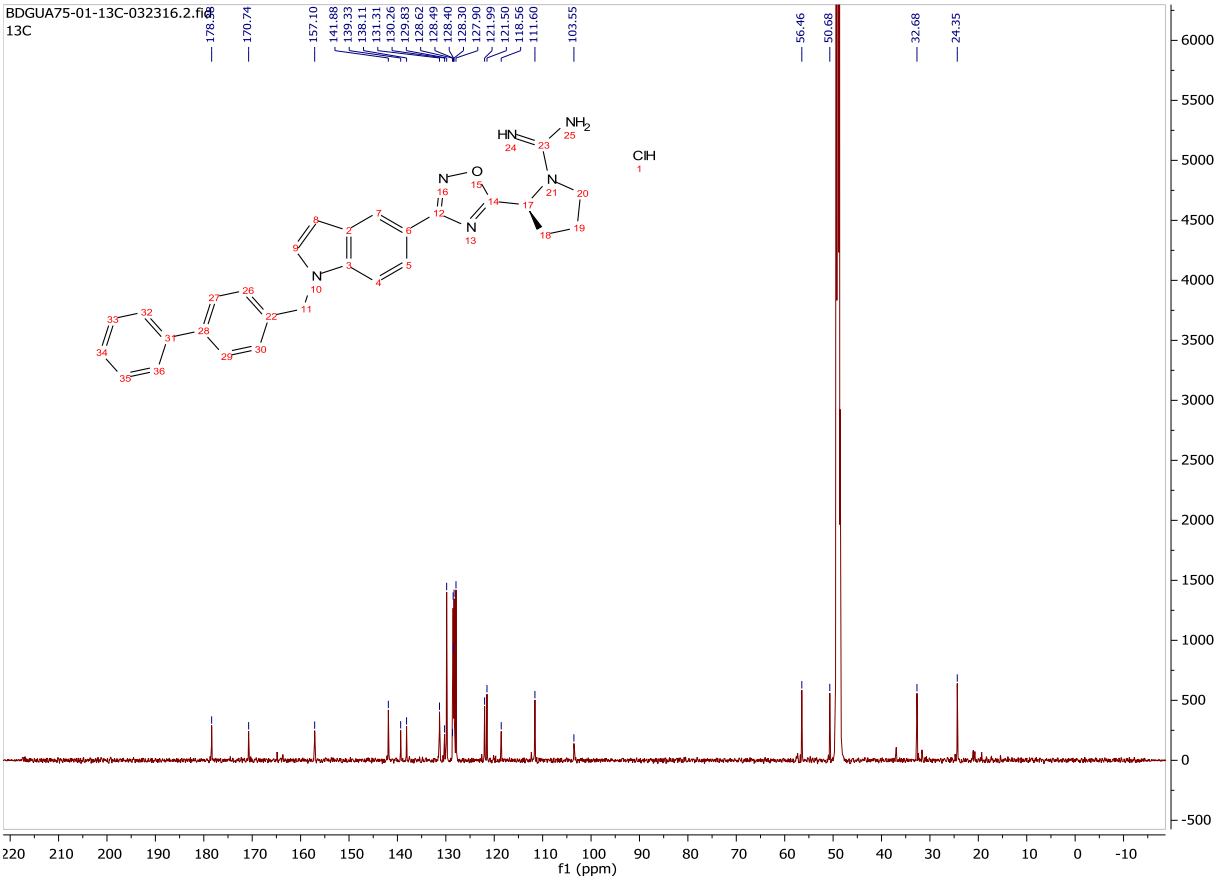
^{13}C-NMR Spectrum for Compound 5.4i:



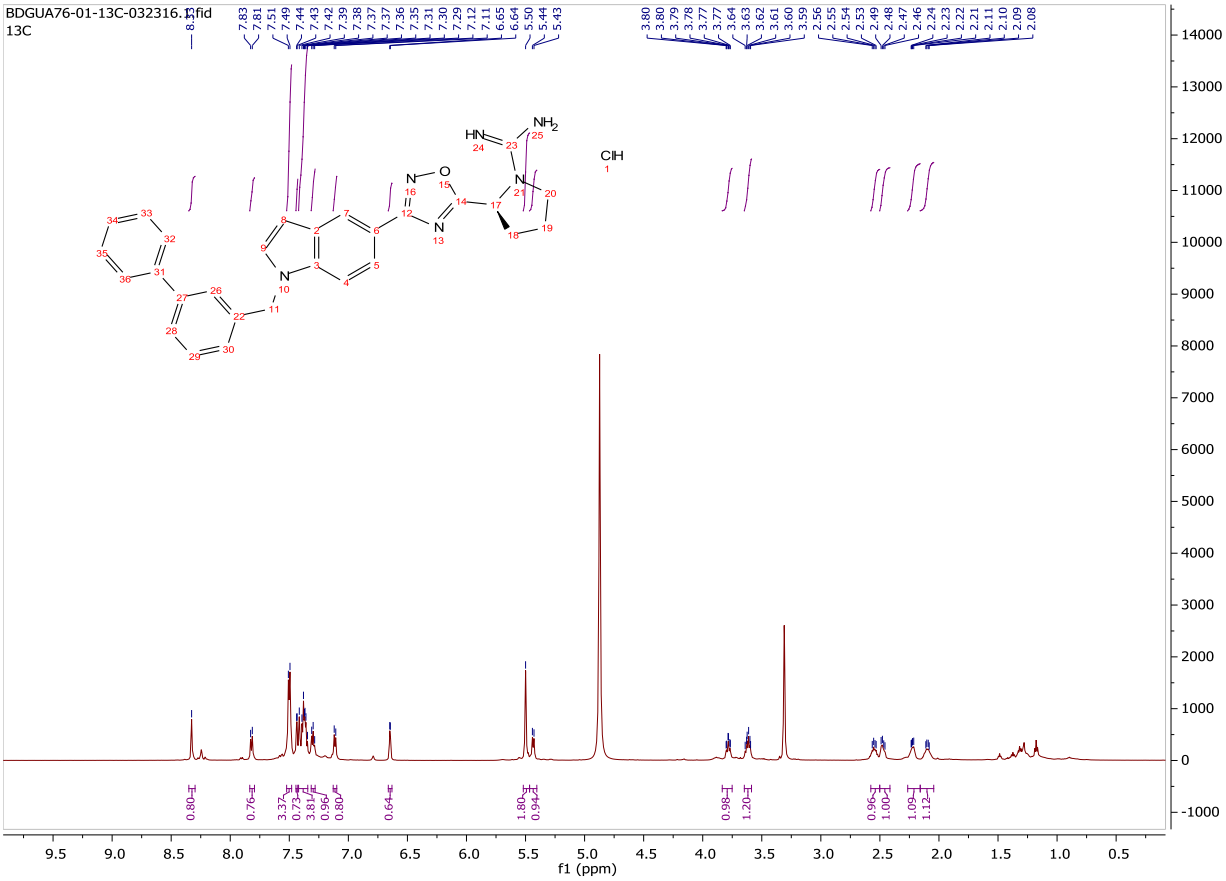
^{1}H-NMR Spectrum for Compound 5.4j:



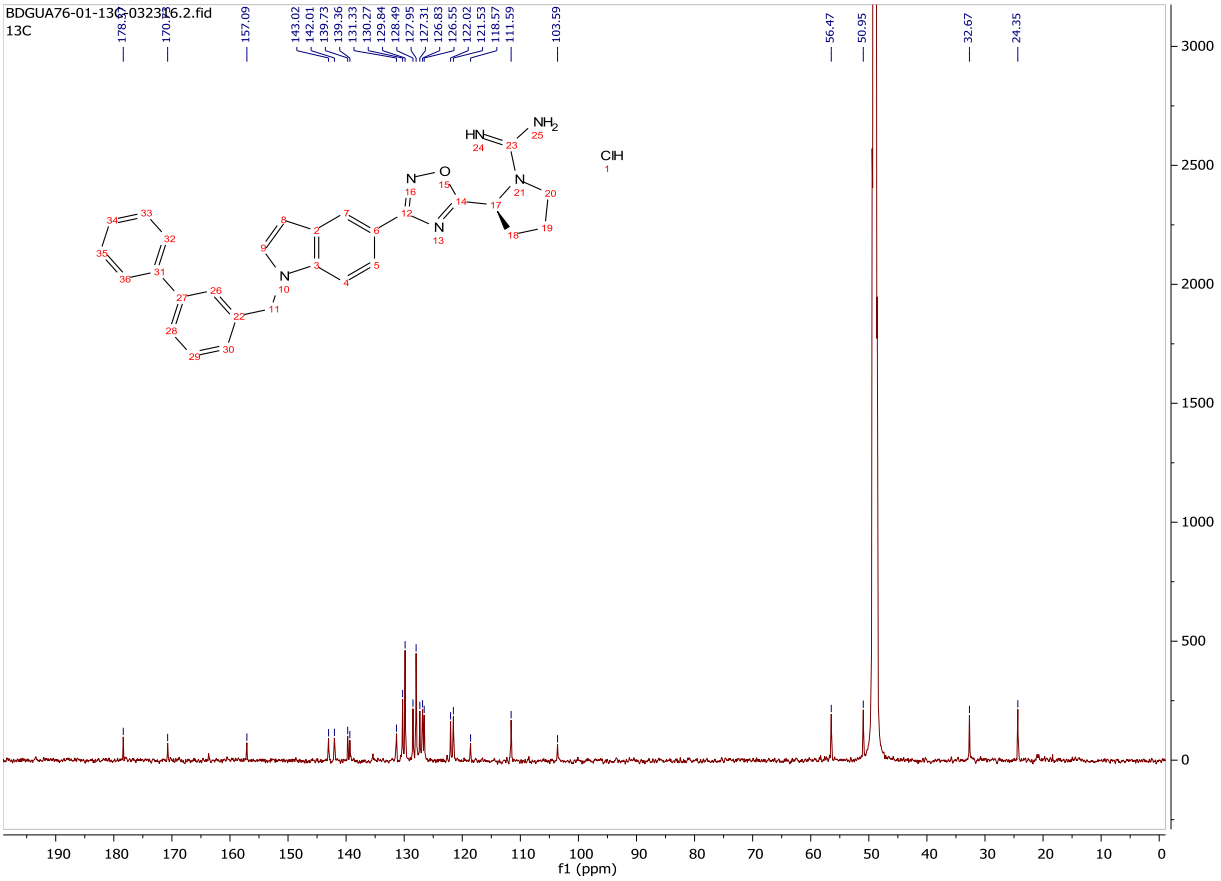
^{13}C-NMR Spectrum for Compound 5.4j:



^{1}H-NMR Spectrum for Compound 5.4k:



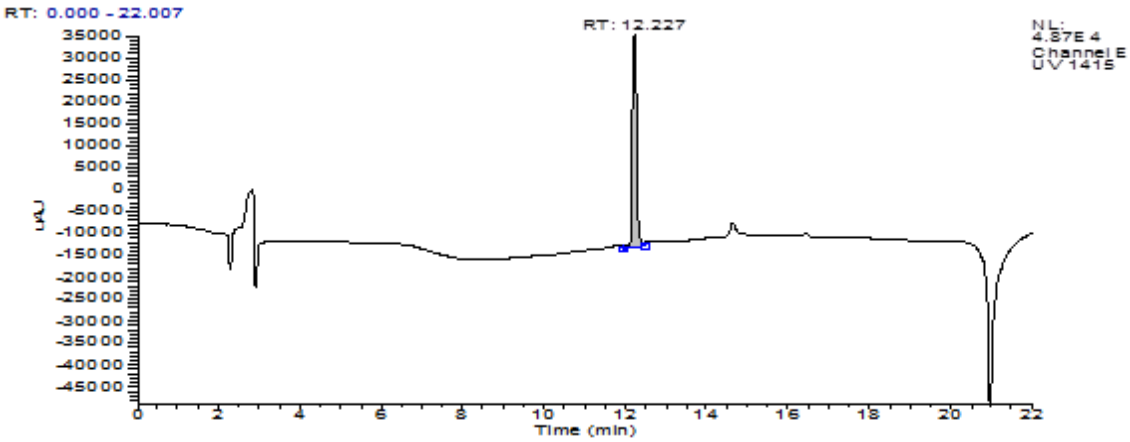
^{13}C-NMR Spectrum for Compound 5.4k:



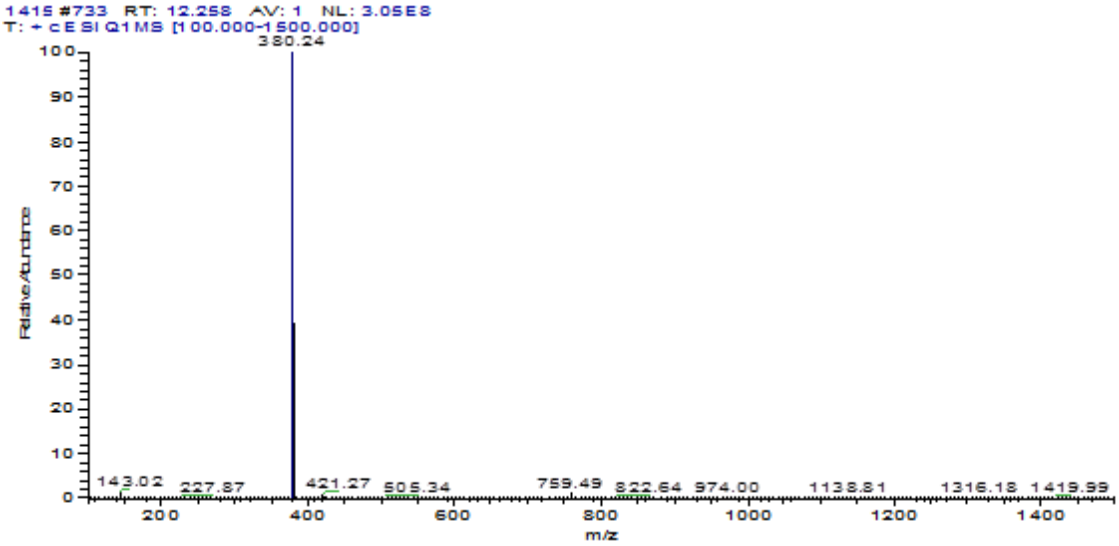
Appendix E HPLC and MS Spectra for Chapter 3

HPLC and MS Spectra for Chapter 3 Final Compounds

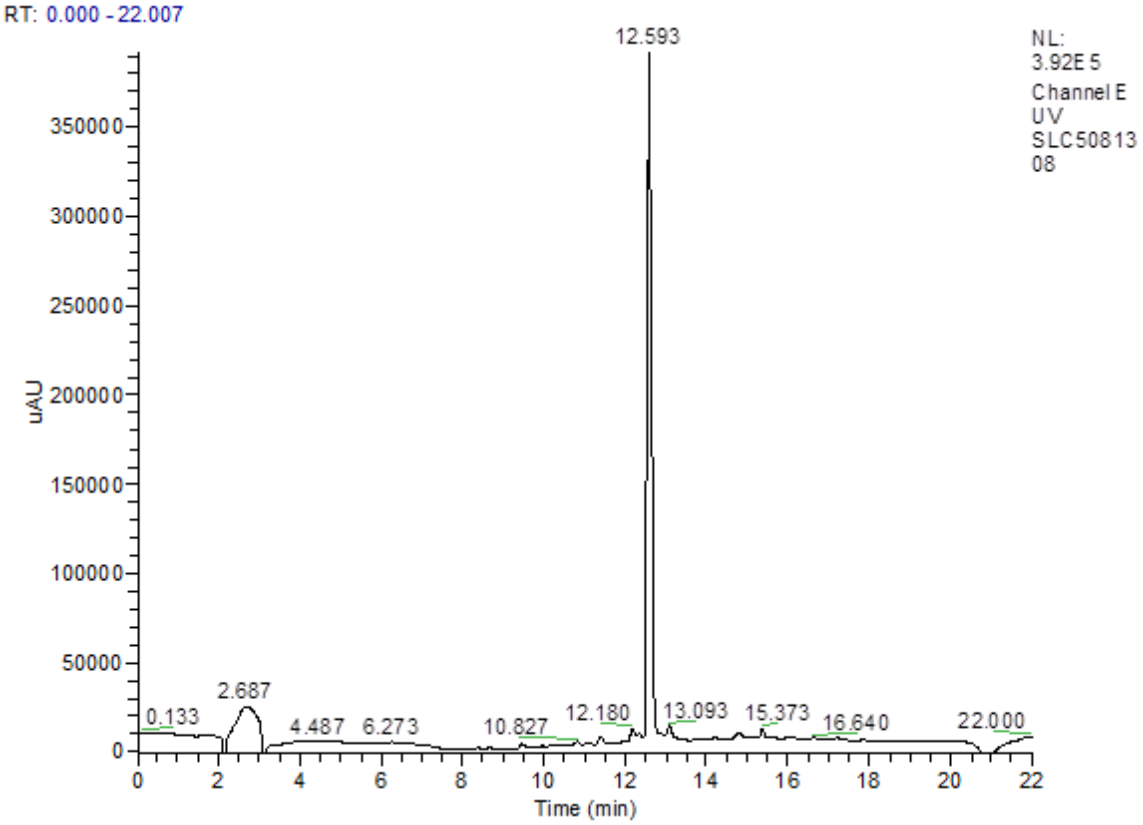
HPLC Spectrum for 3.7a:



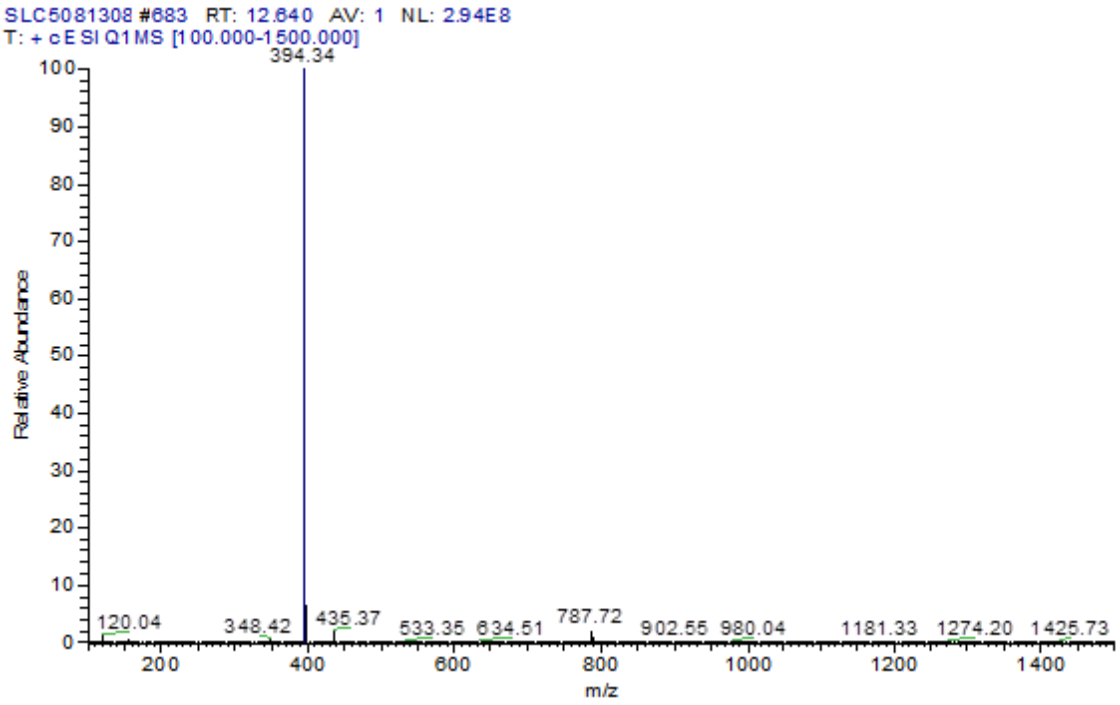
MS Spectrum for 3.7a:



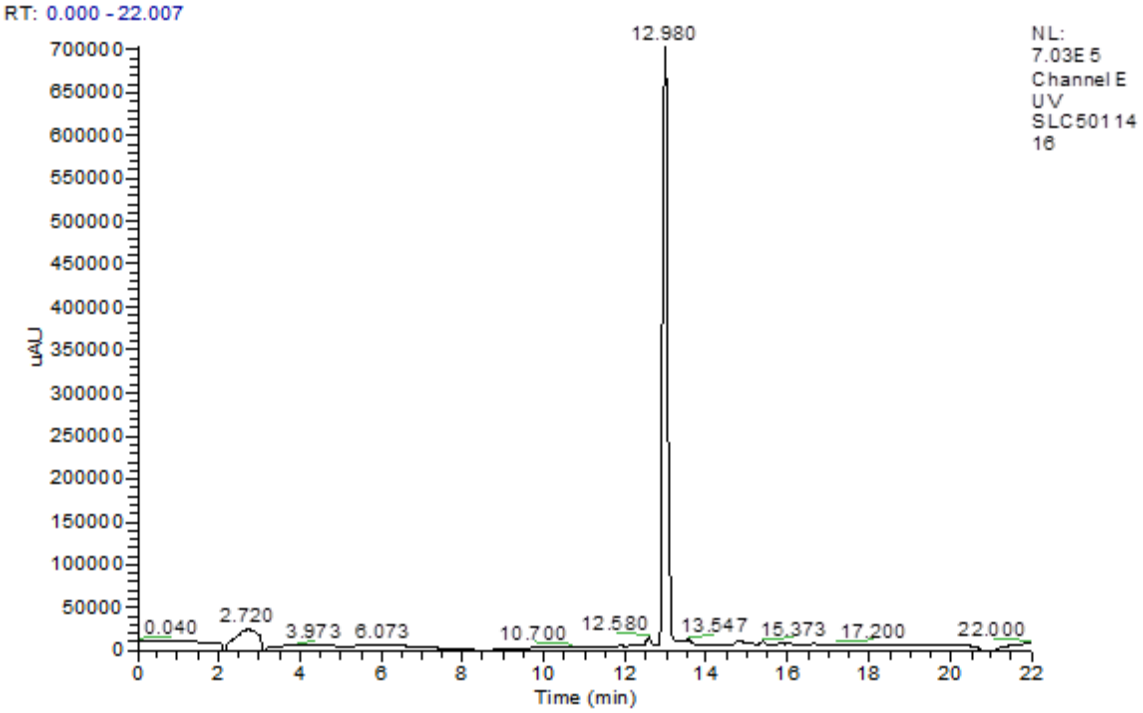
HPLC Spectrum for 3.7b:



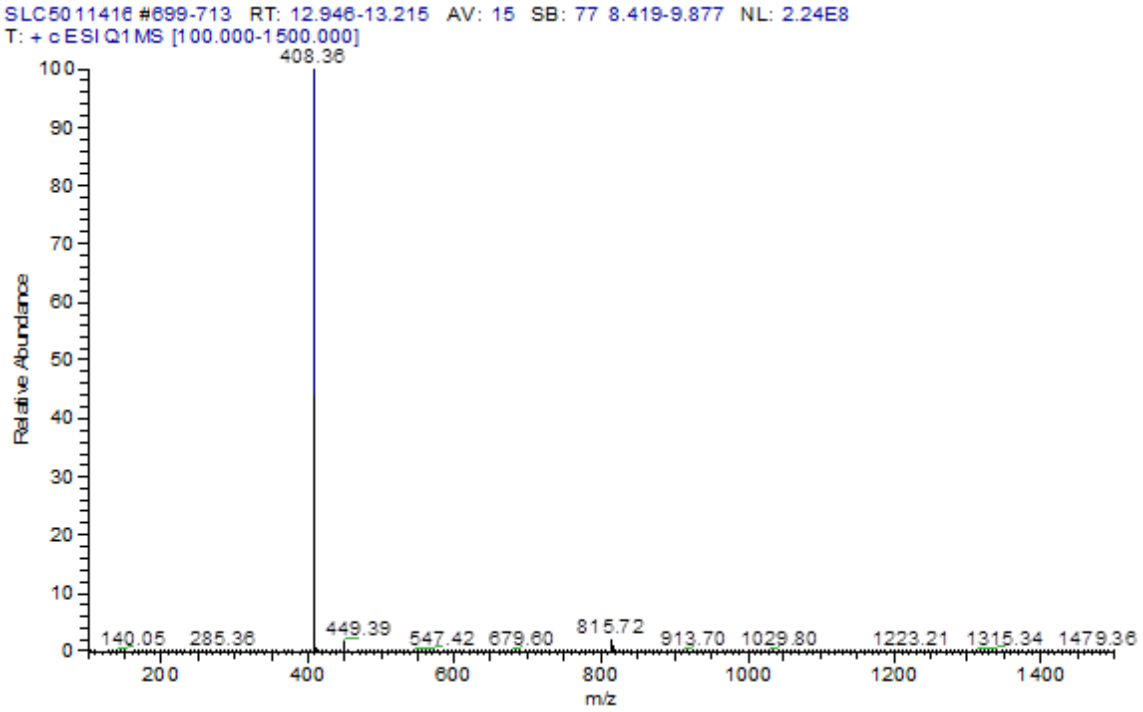
MS Spectrum for 3.7b:



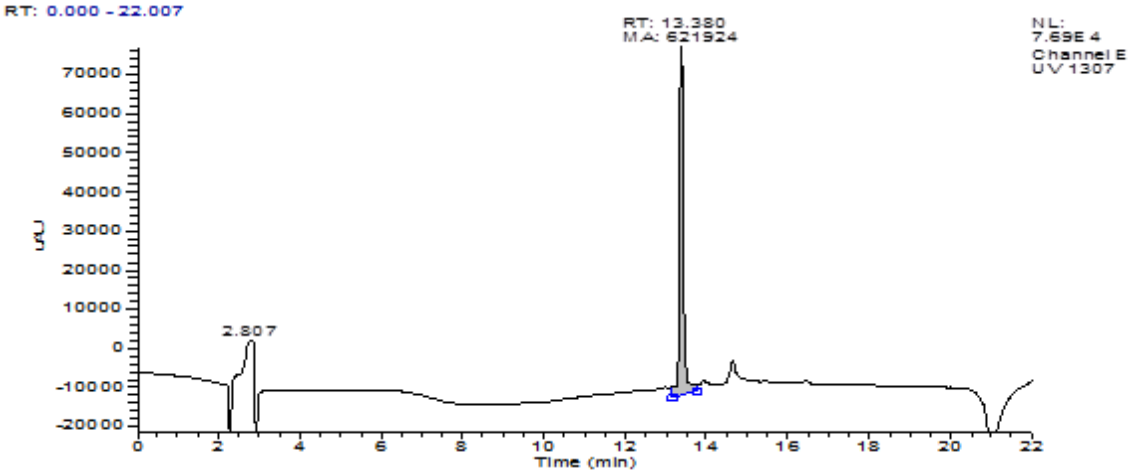
HPLC Spectrum for 3.7c:



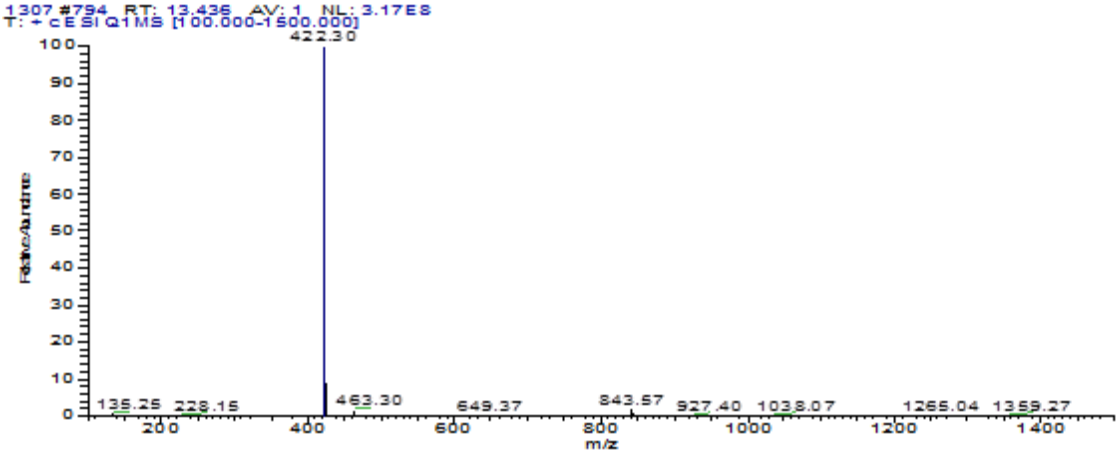
MS Spectrum for 3.7c:



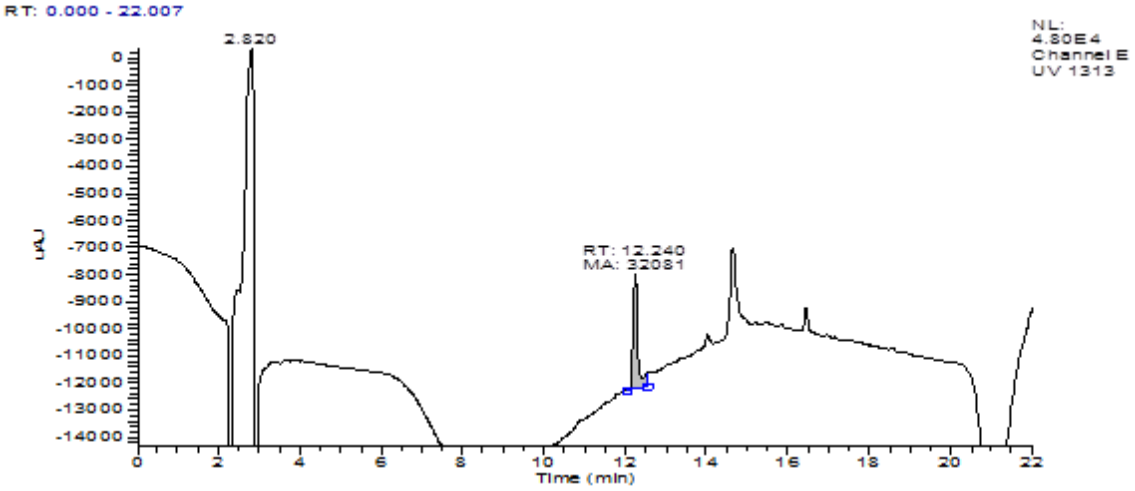
HPLC Spectrum for 3.7d:



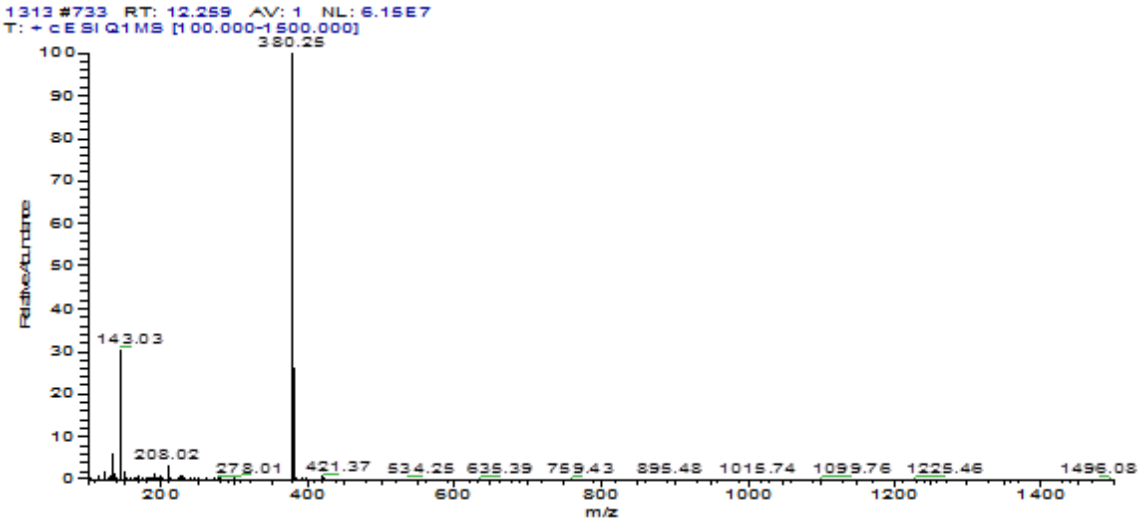
MS Spectrum for 3.7d:



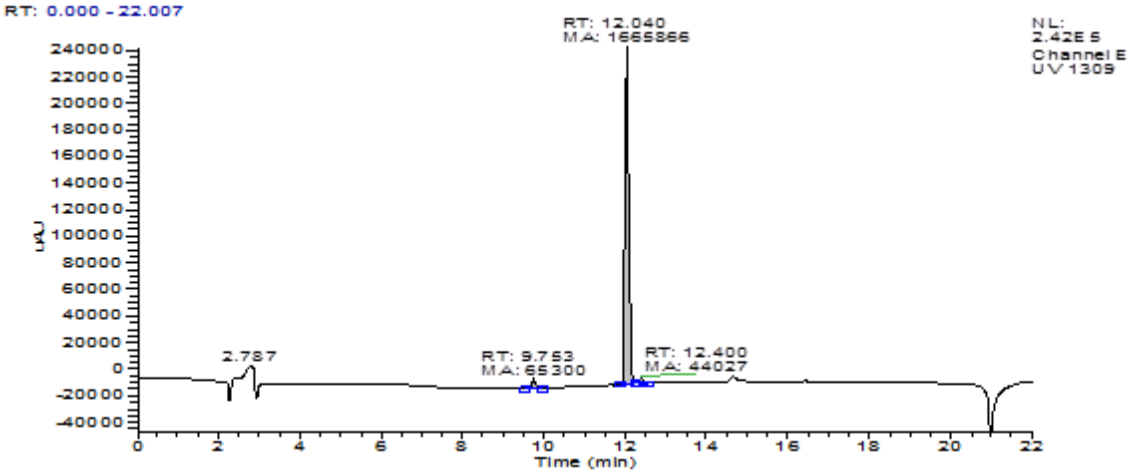
HPLC Spectrum for 3.7e:



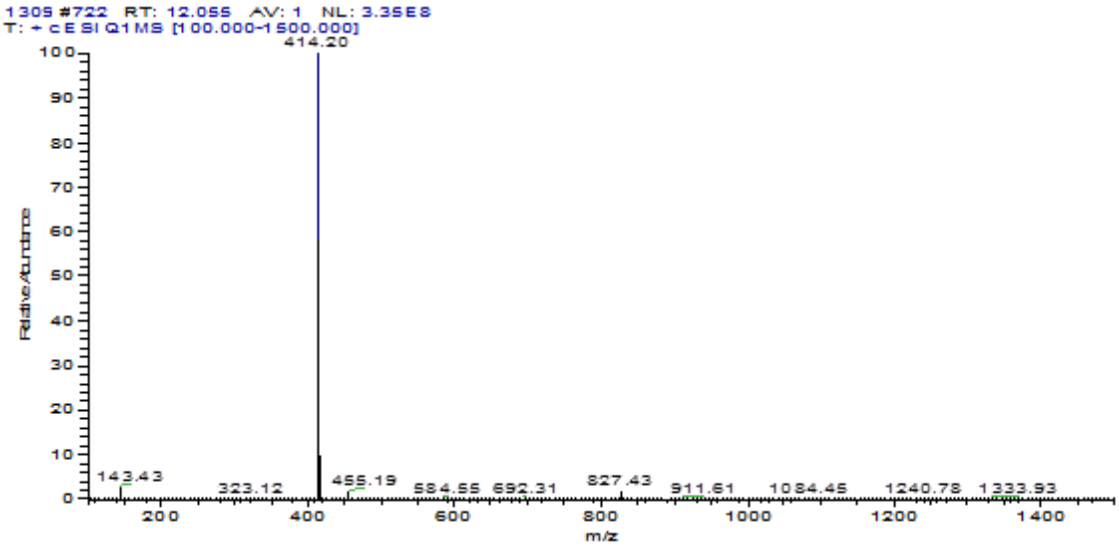
MS Spectrum for 3.7e:



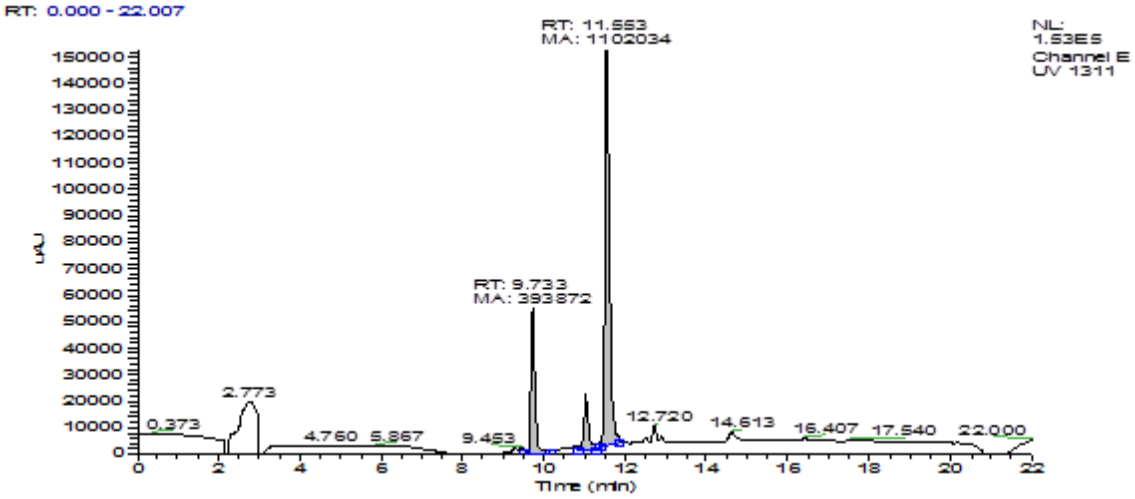
HPLC Spectrum for 3.7f:



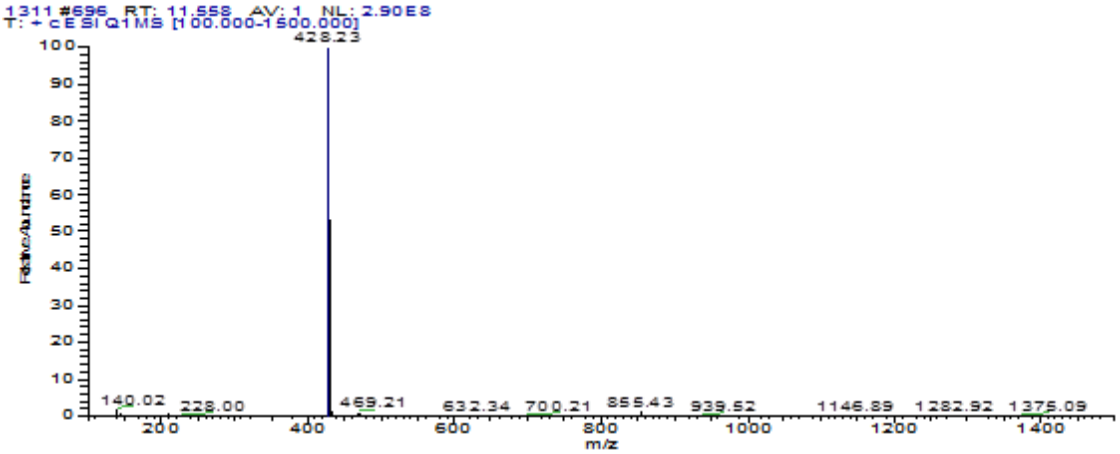
MS Spectrum for 3.7f:



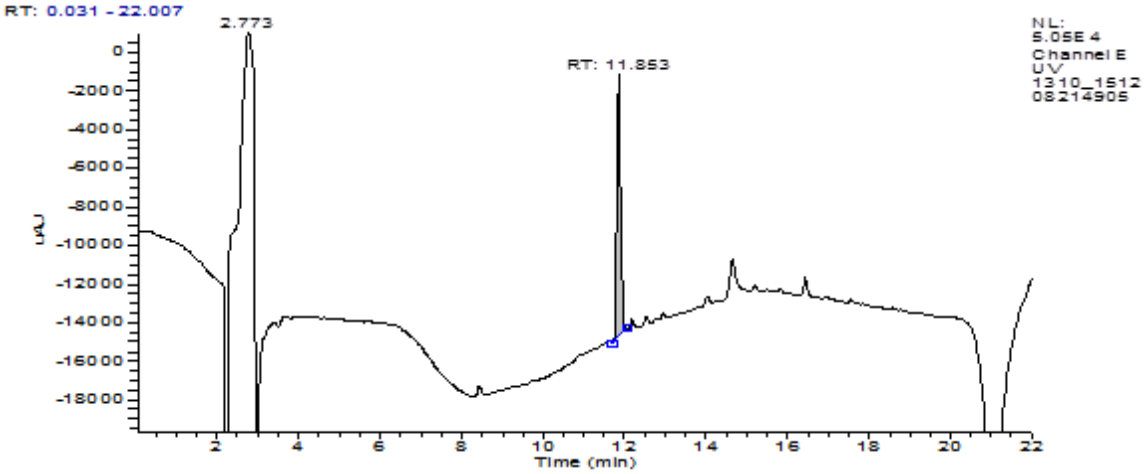
HPLC Spectrum for 3.7g:



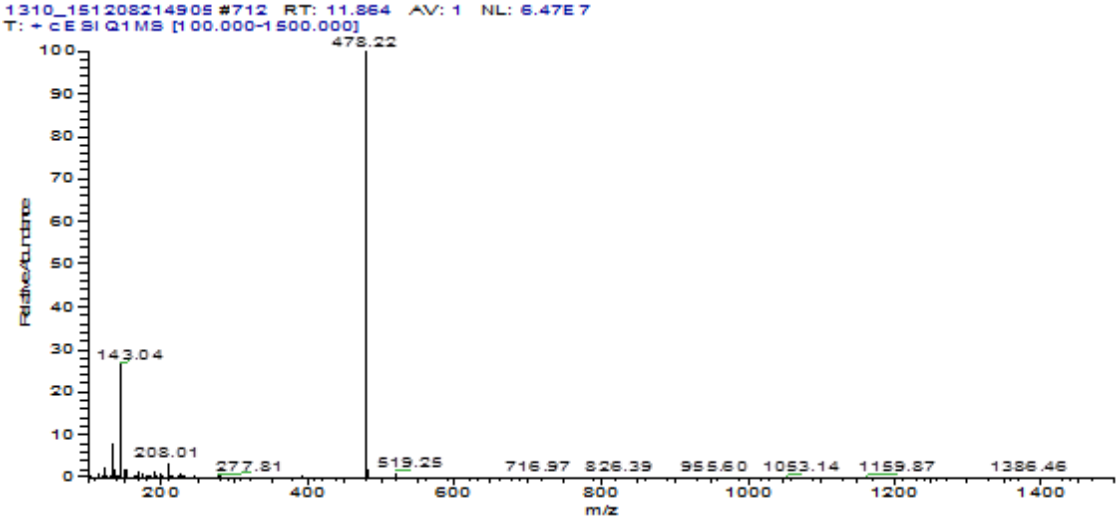
MS Spectrum for 3.7g:



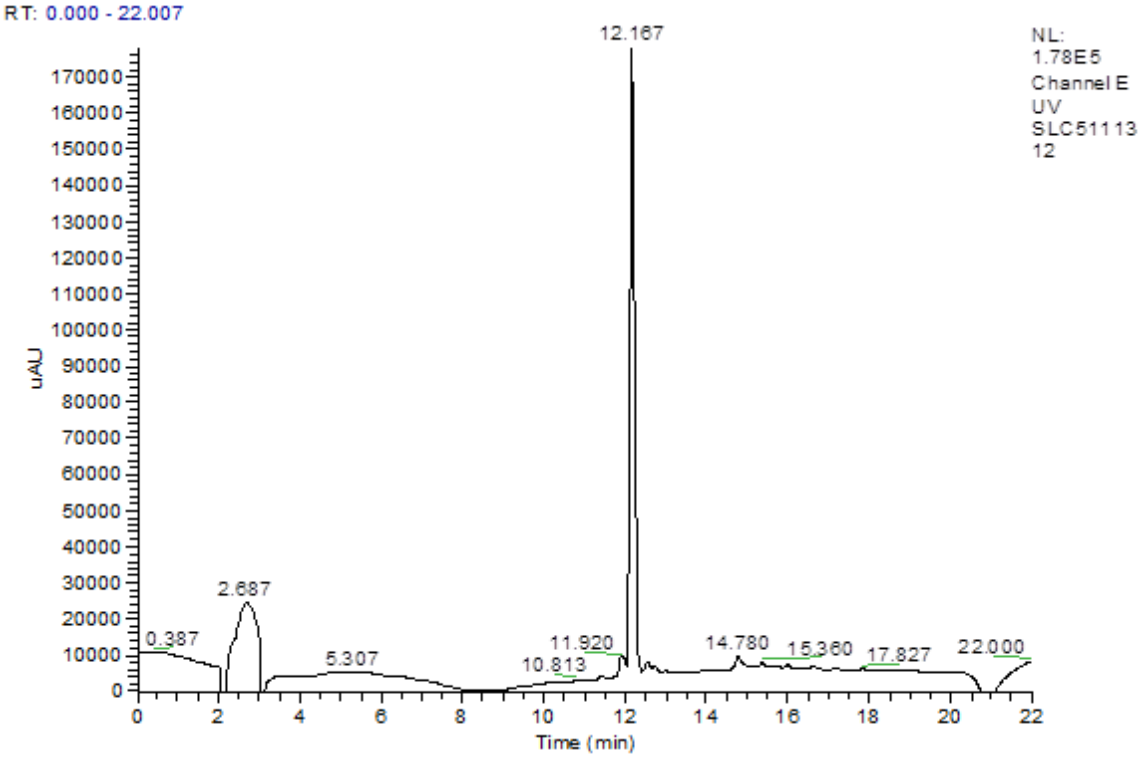
HPLC Spectrum for 3.7h:



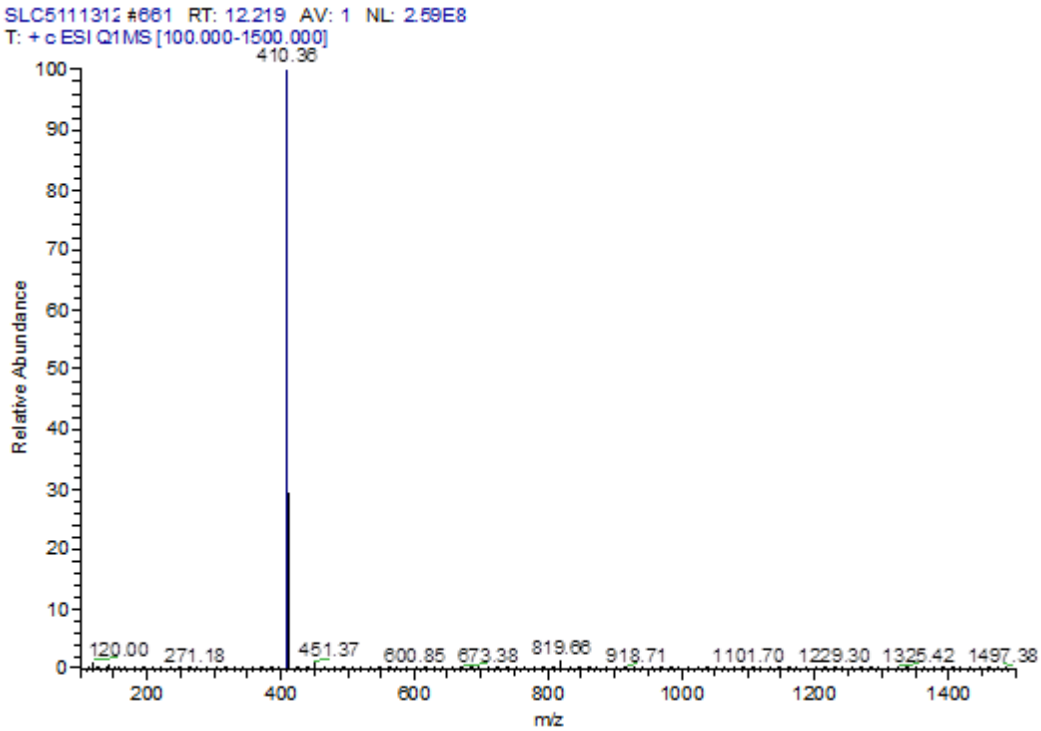
MS Spectrum for 3.7h:



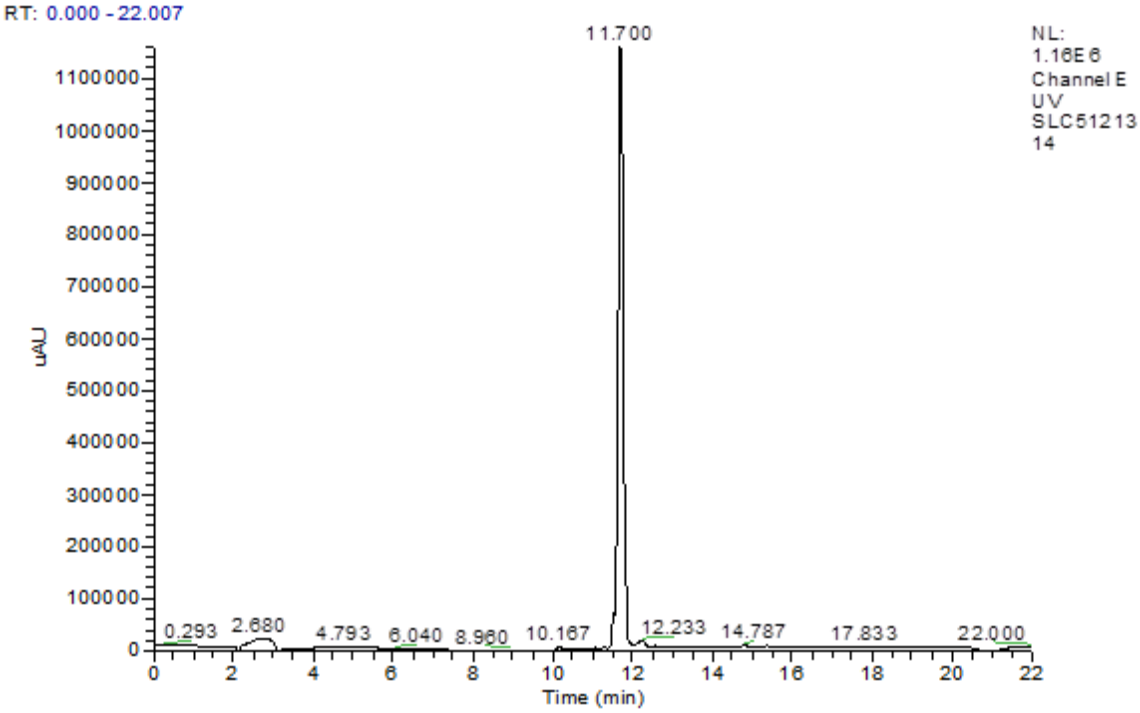
HPLC Spectrum for 3.7i:



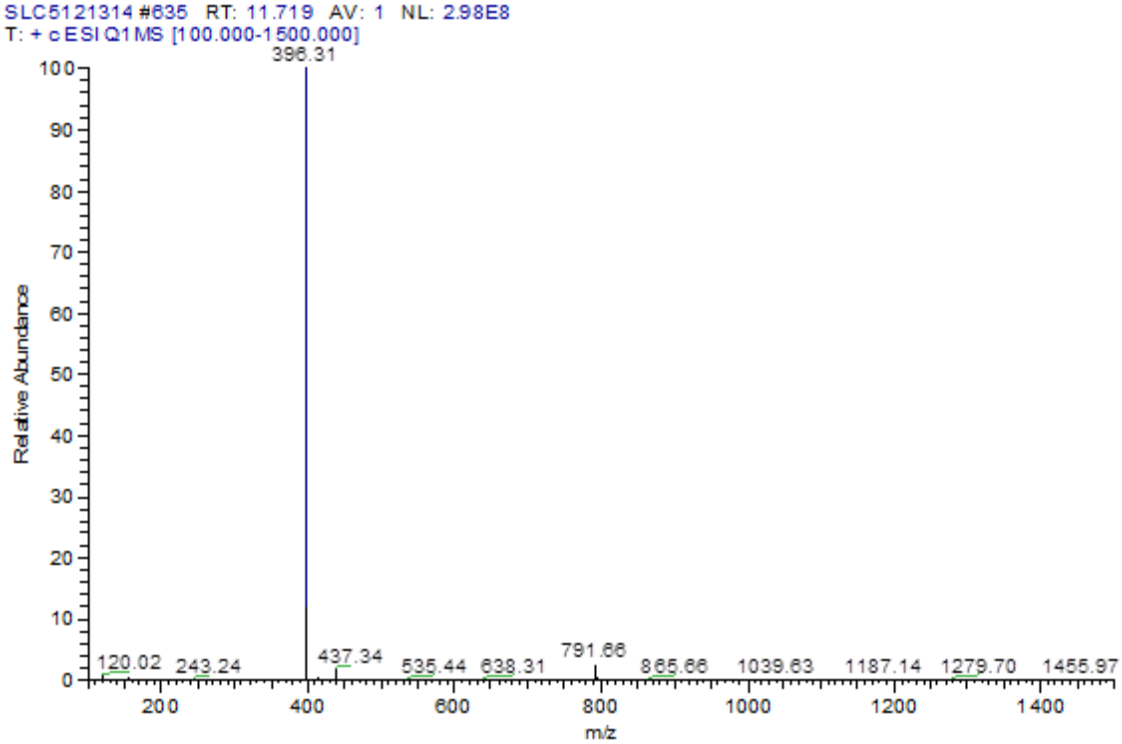
MS Spectrum for 3.7i:



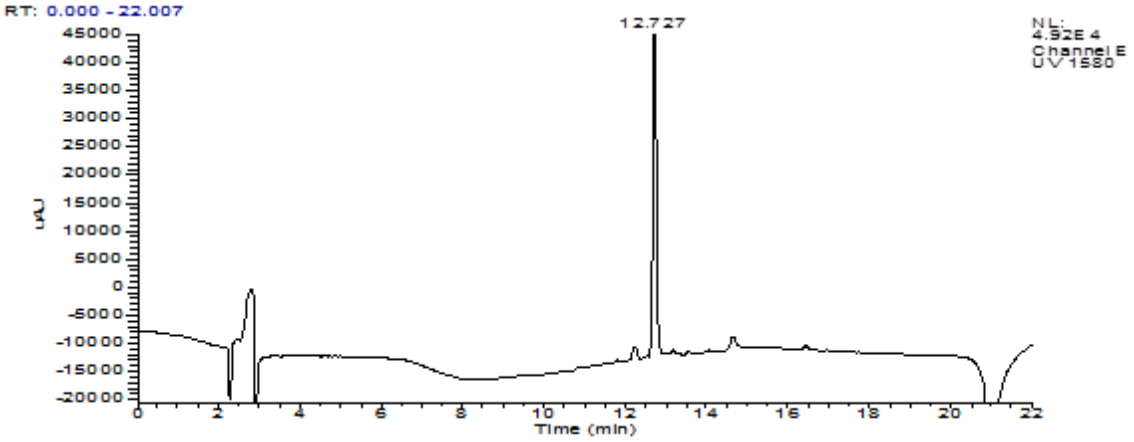
HPLC Spectrum for 3.7j:



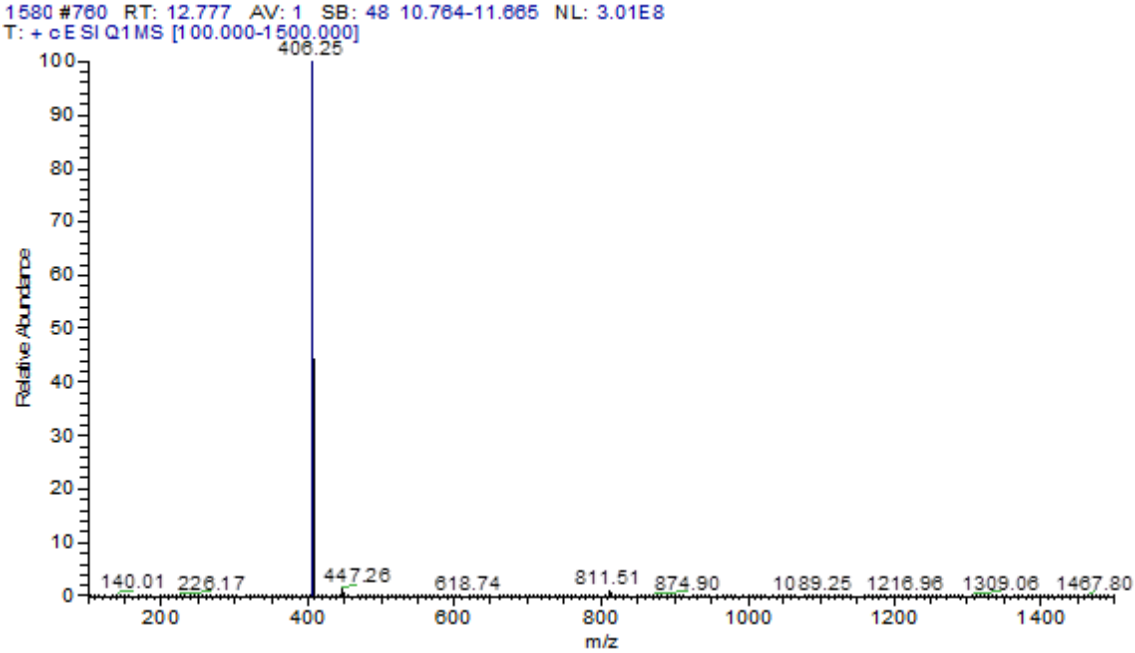
MS Spectrum for 3.7i:



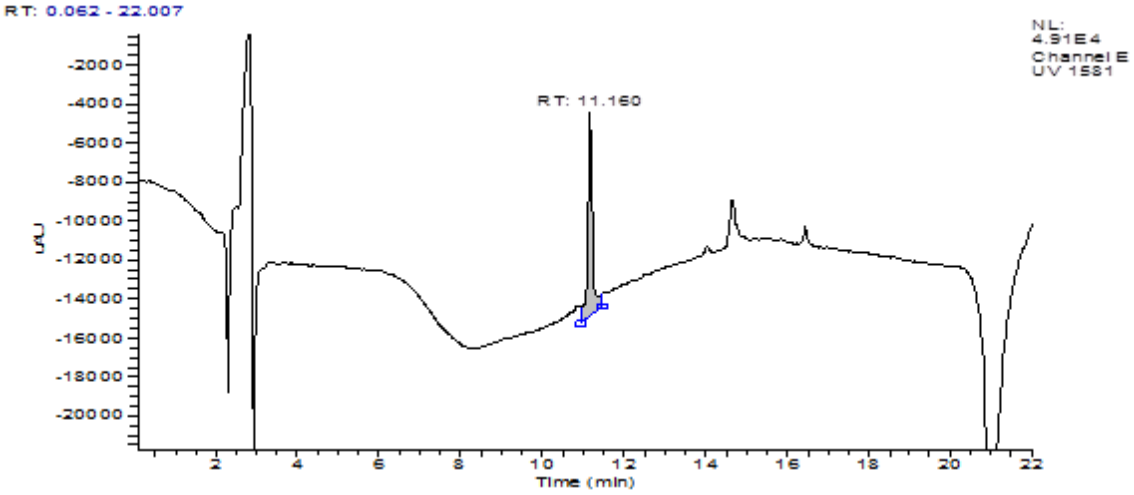
HPLC Spectrum for 3.7k:



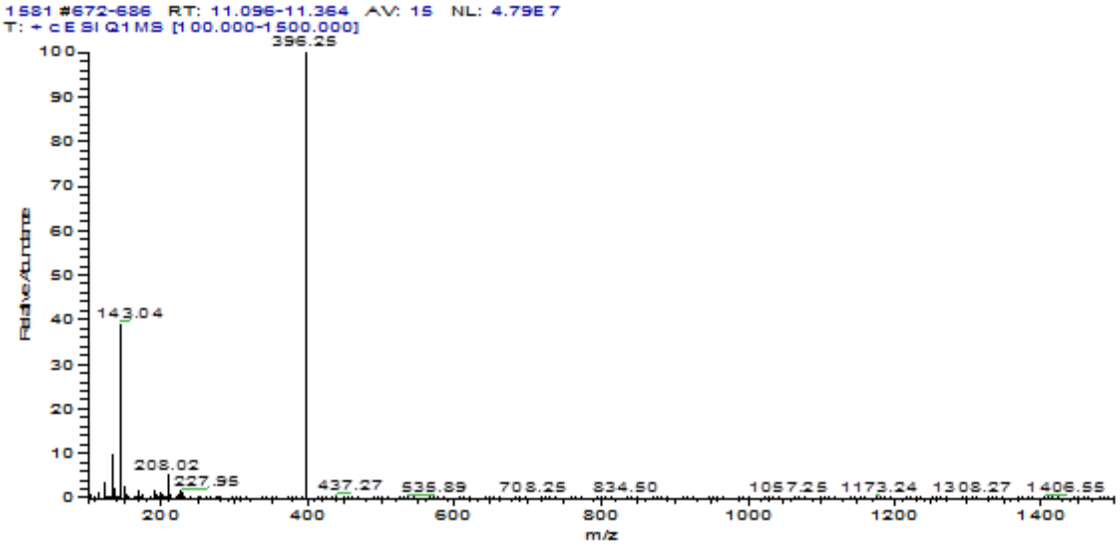
MS Spectrum for 3.7k:



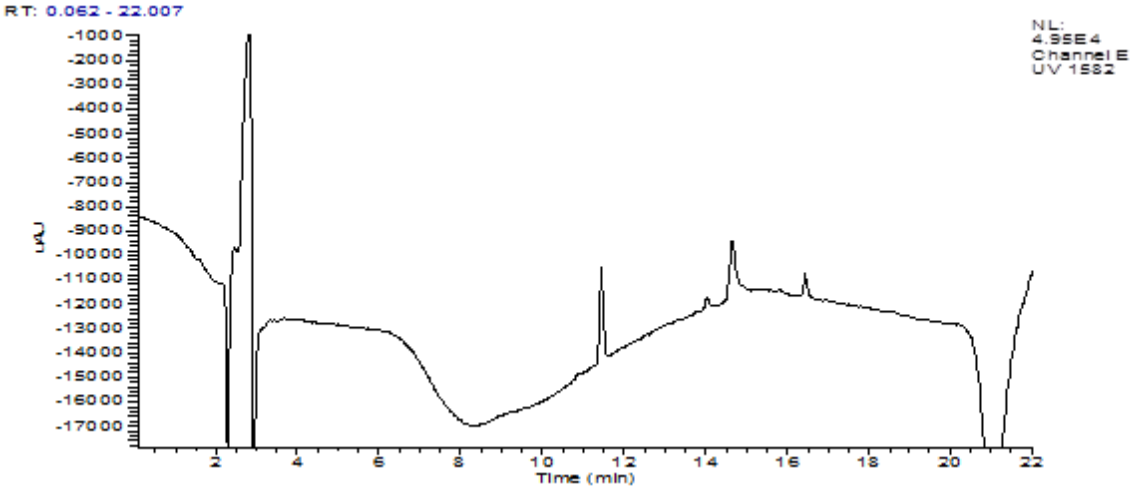
HPLC Spectrum for 3.7l:



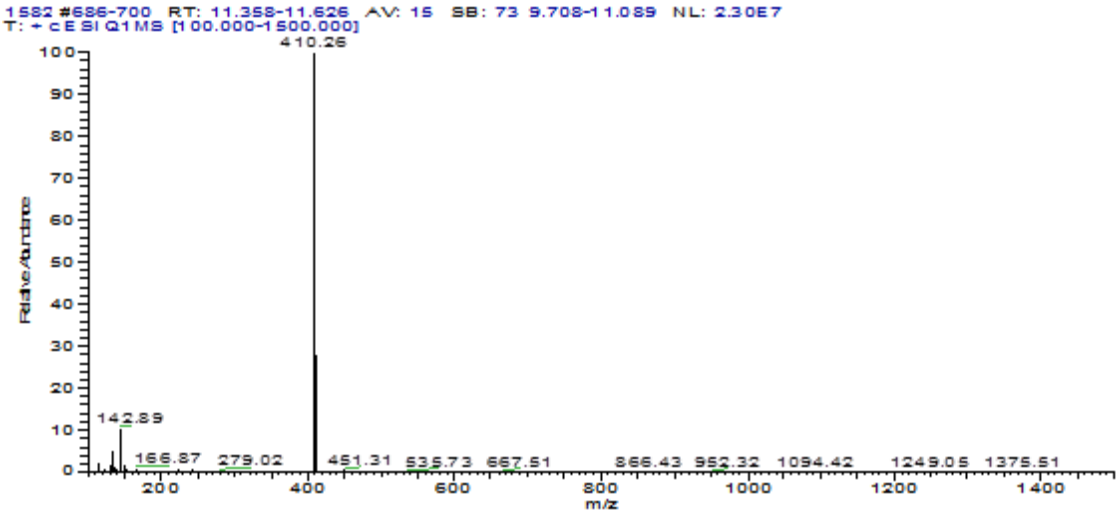
MS Spectrum for 3.7l



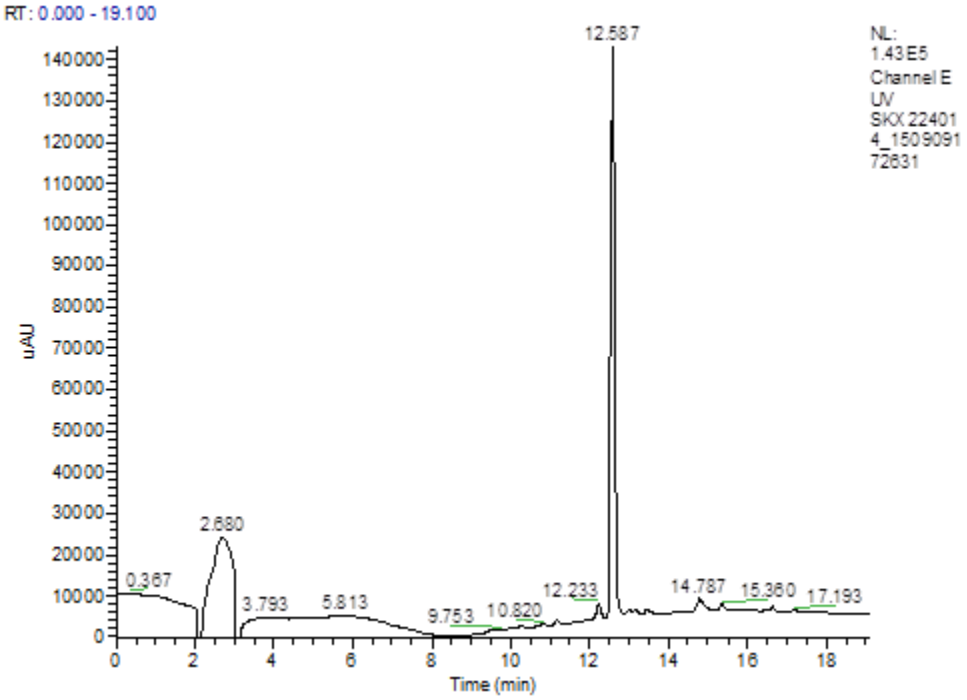
HPLC Spectrum for 3.7m:



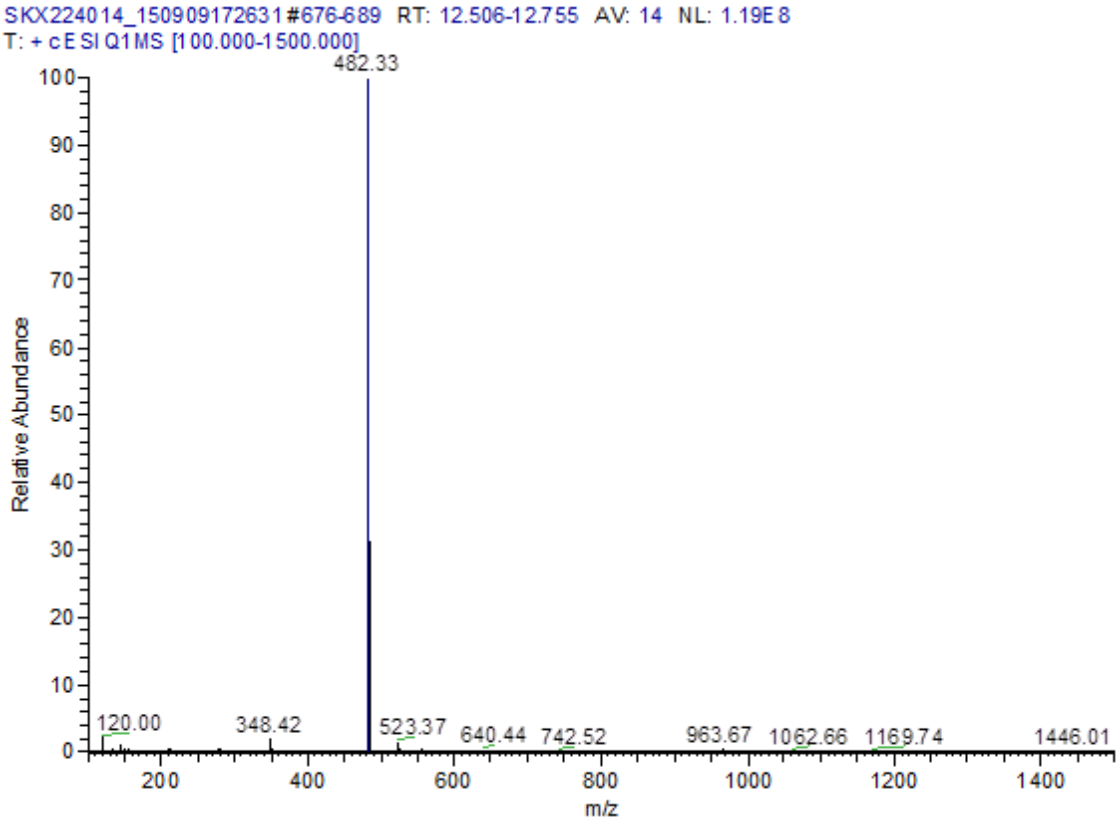
MS Spectrum for 3.7m:



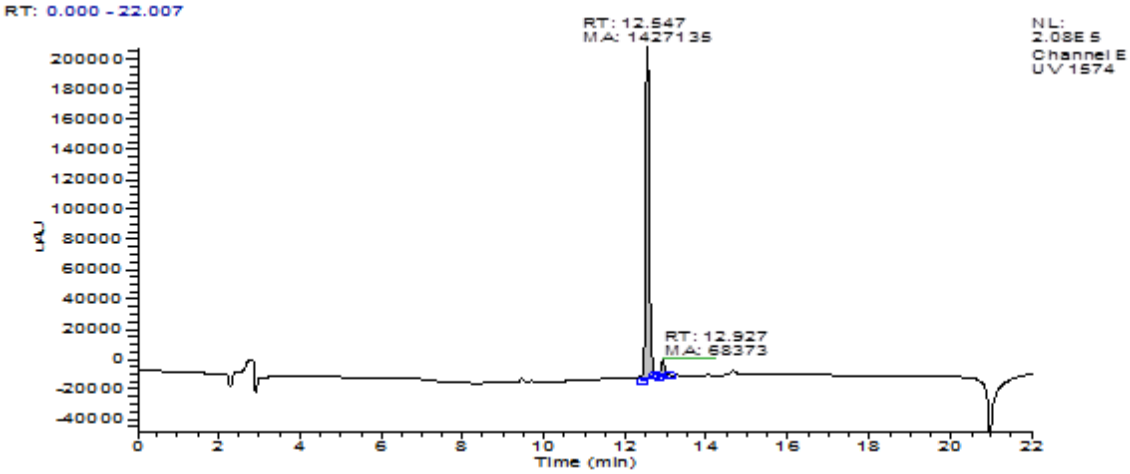
HPLC Spectrum for 3.7n:



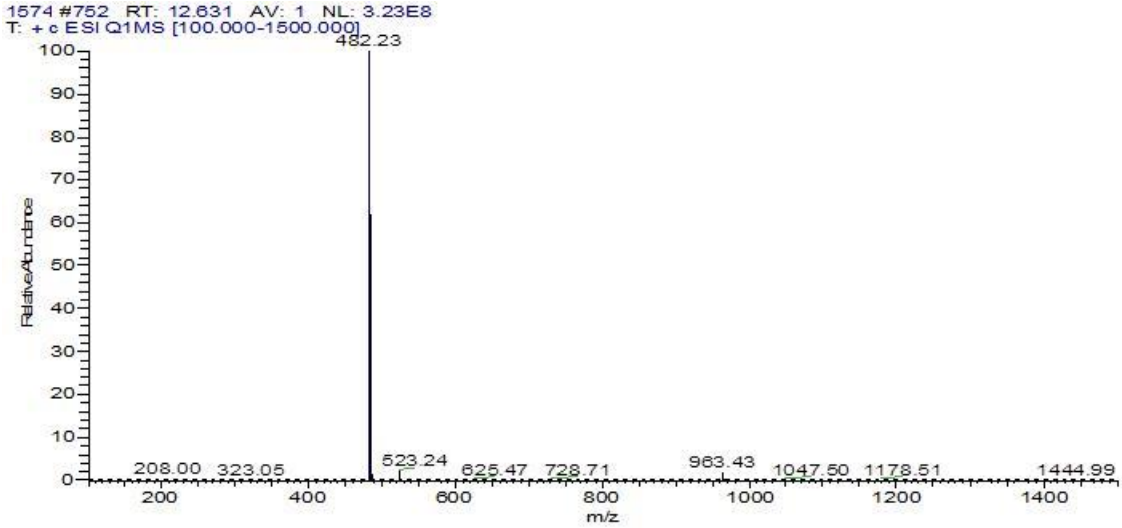
MS Spectrum for 3.7n:



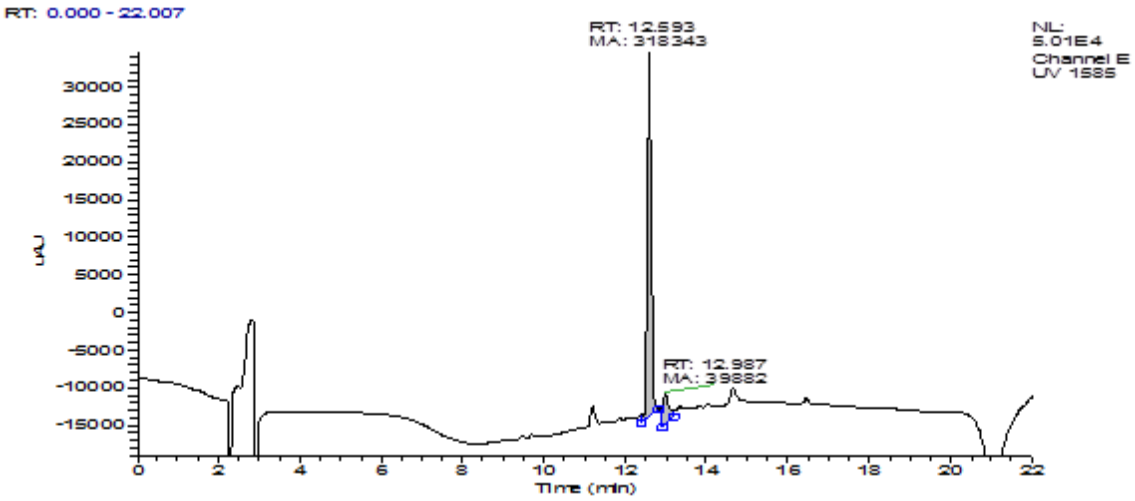
HPLC Spectrum for 3.7o:



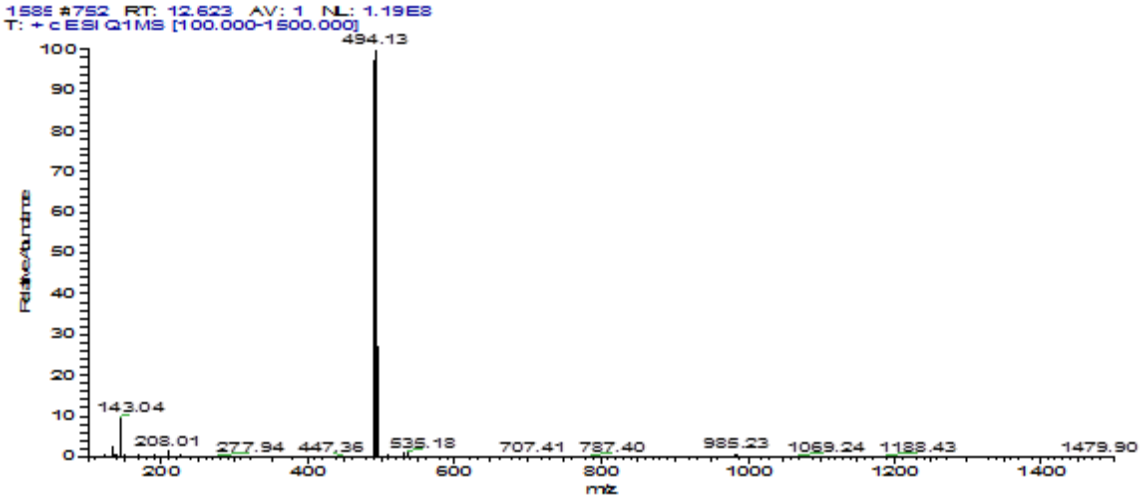
MS Spectrum for 3.7o:



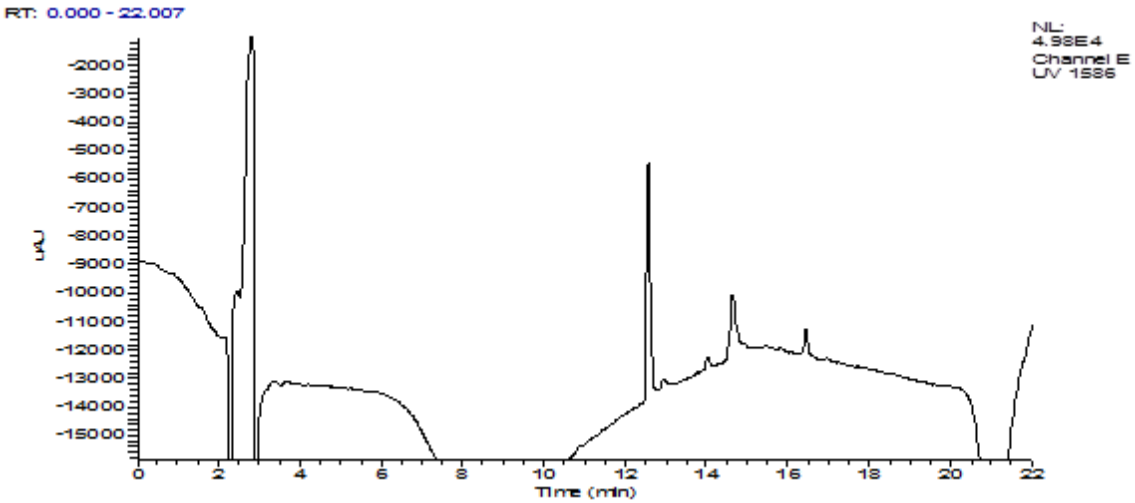
HPLC Spectrum for 3.7p:



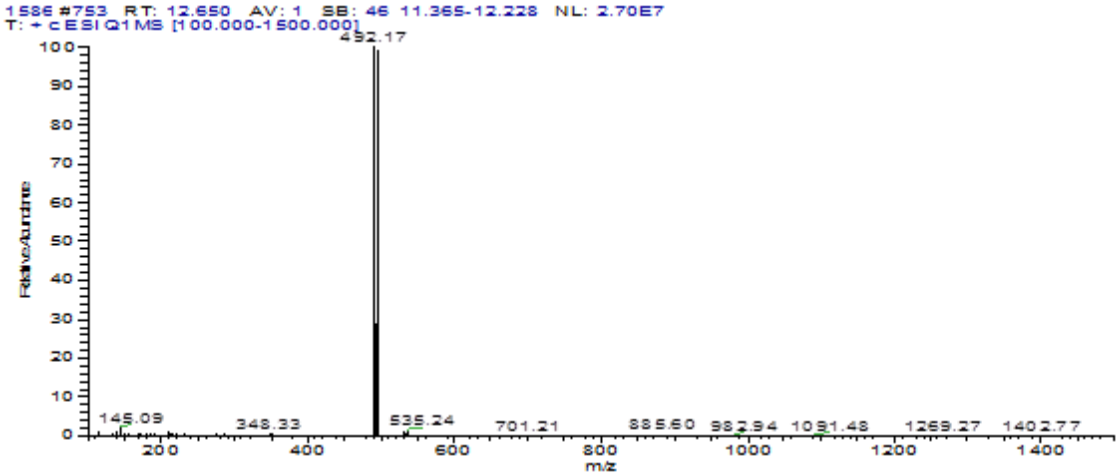
MS Spectrum for 3.7p:



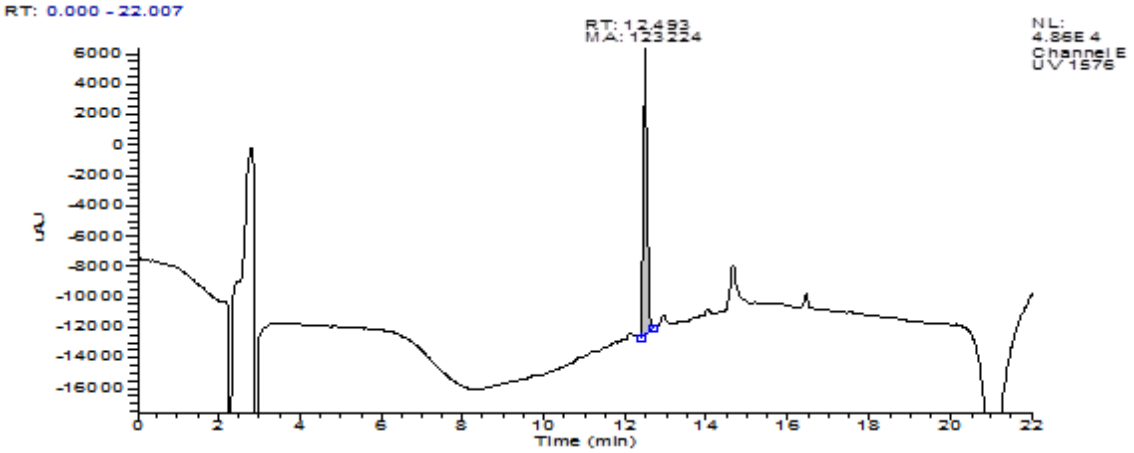
HPLC Spectrum for 3.7q:



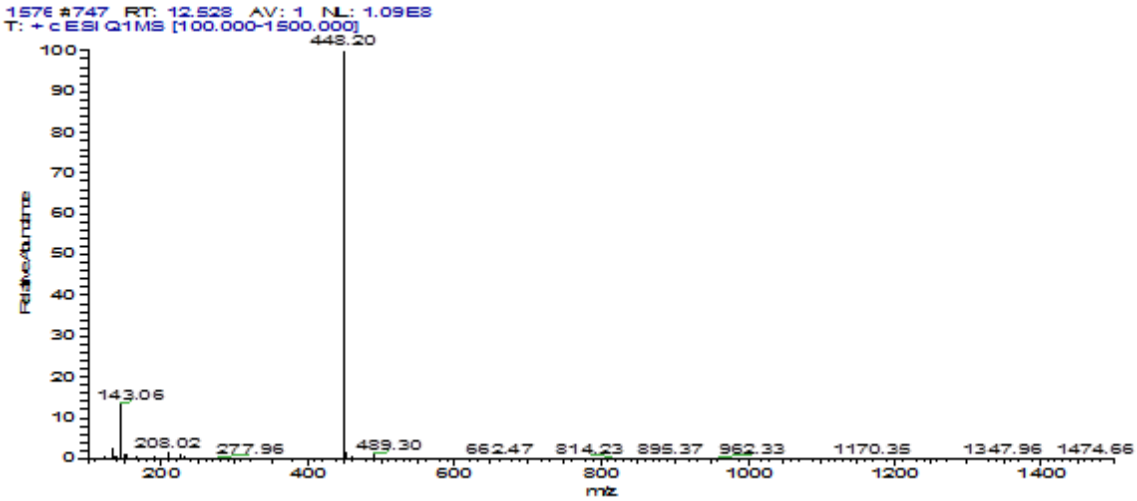
MS Spectrum for 3.7q:



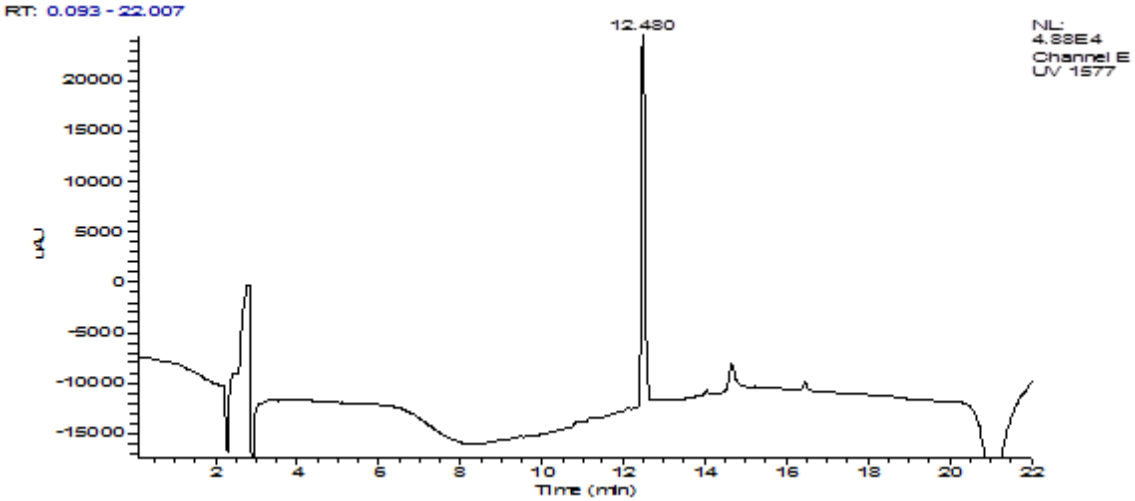
HPLC Spectrum for 3.7r:



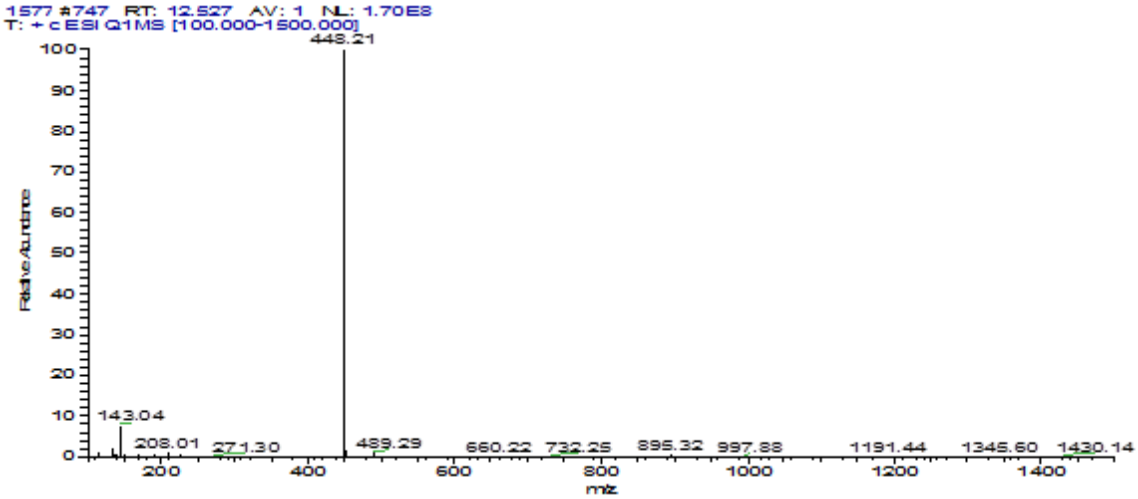
MS Spectrum for 3.7r:



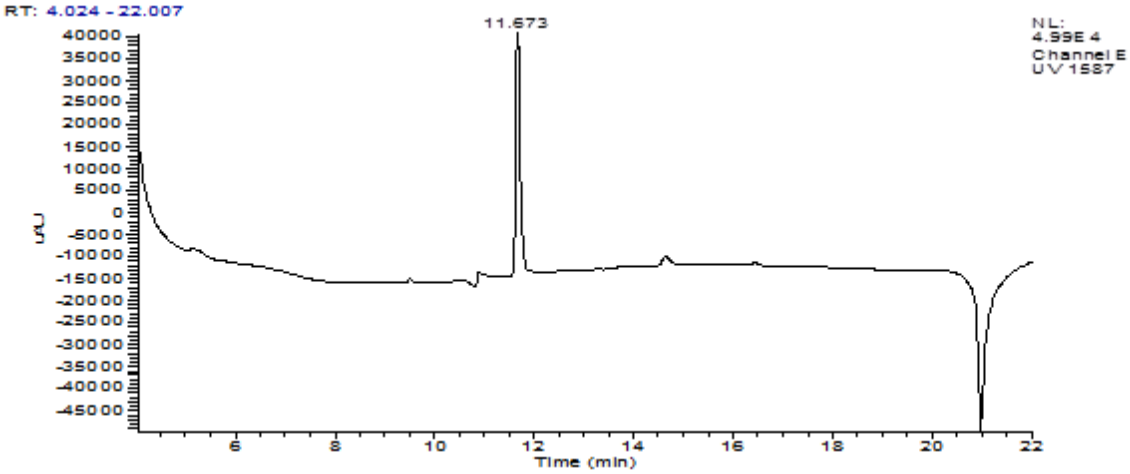
HPLC Spectrum for 3.7s:



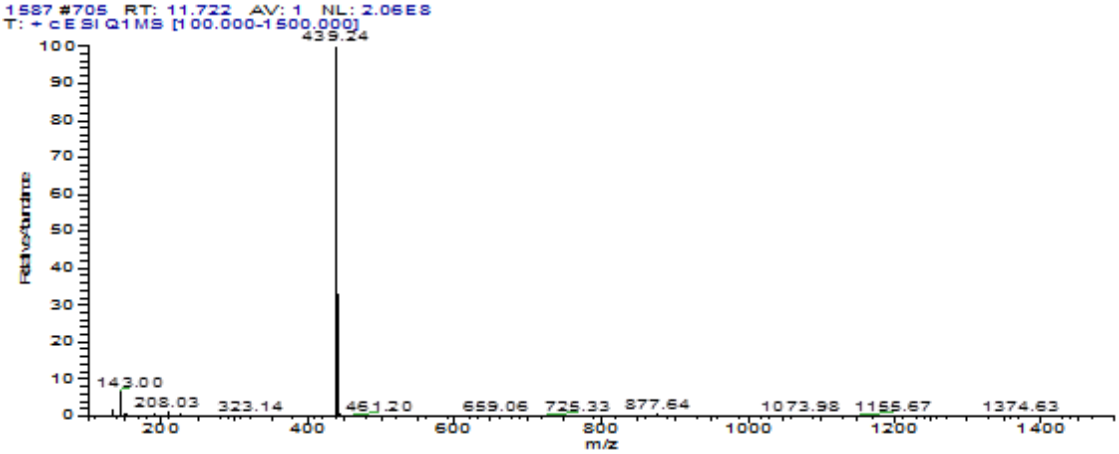
MS Spectrum for 3.7s:



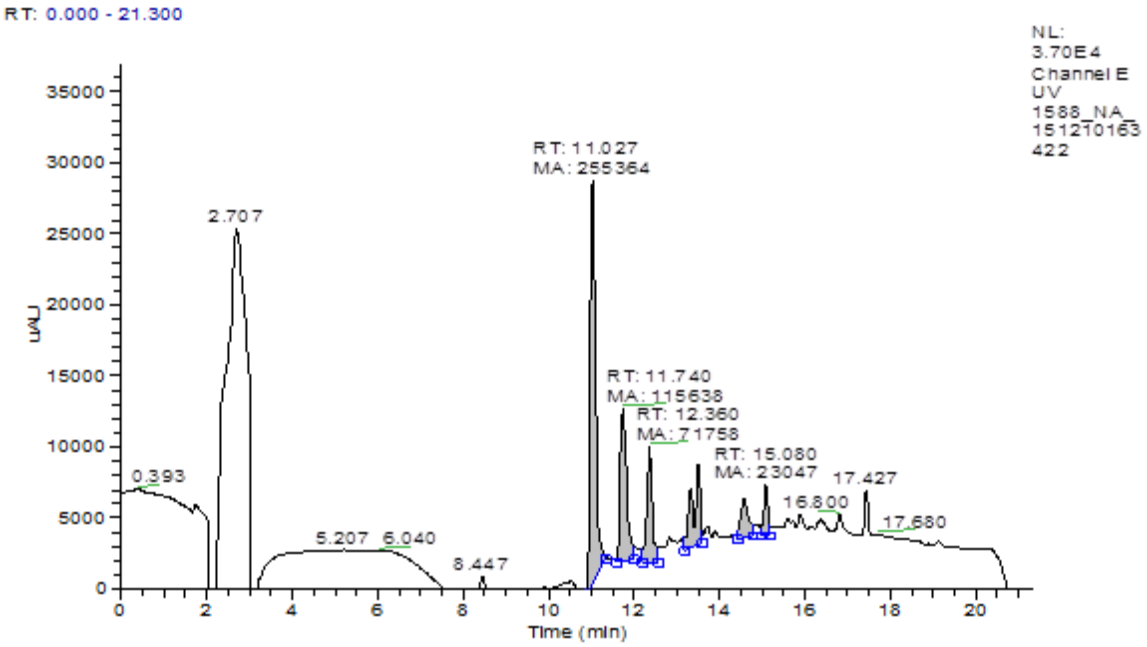
HPLC Spectrum for 3.7t:



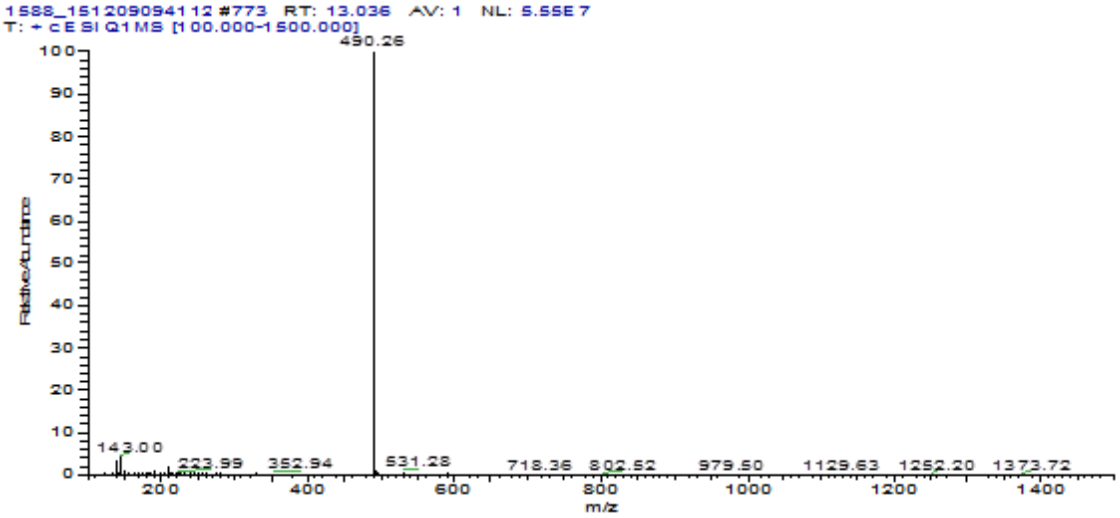
MS Spectrum for 3.7t:



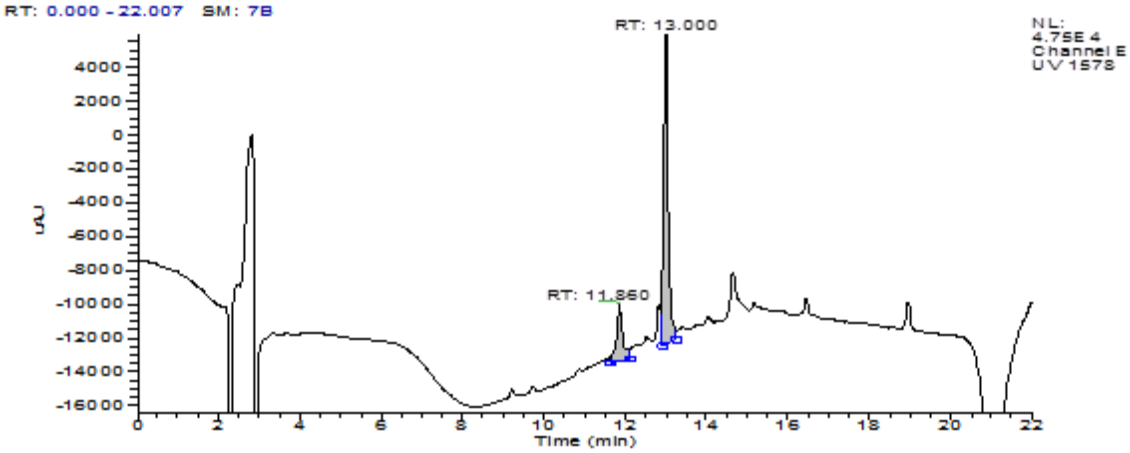
HPLC Spectrum for 3.7u:



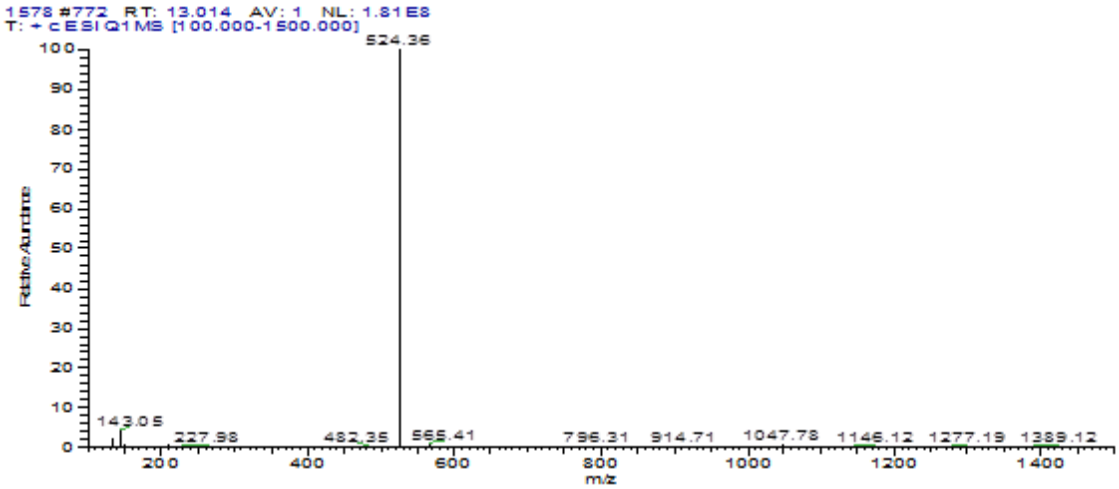
MS Spectrum for 3.7u;



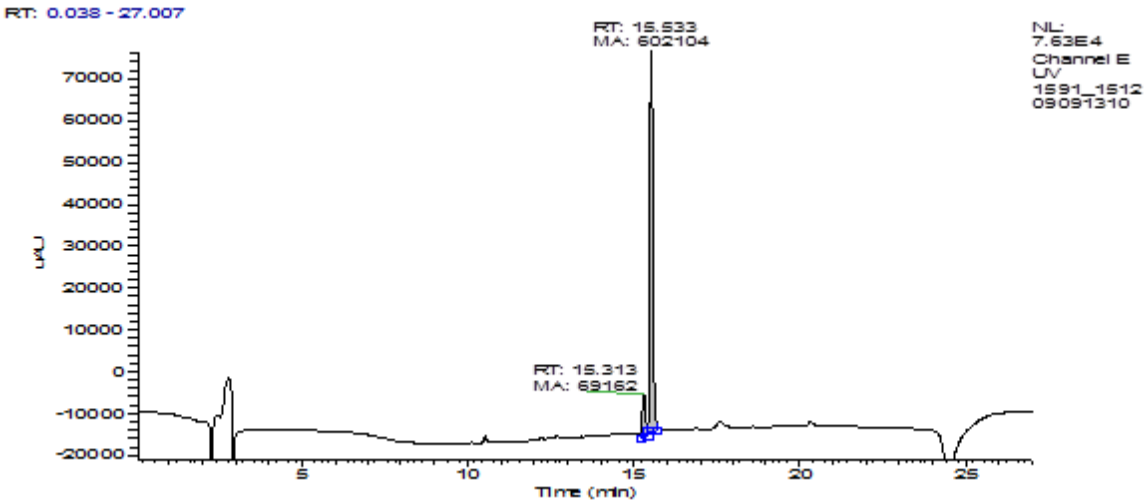
HPLC Spectrum for 3.7v:



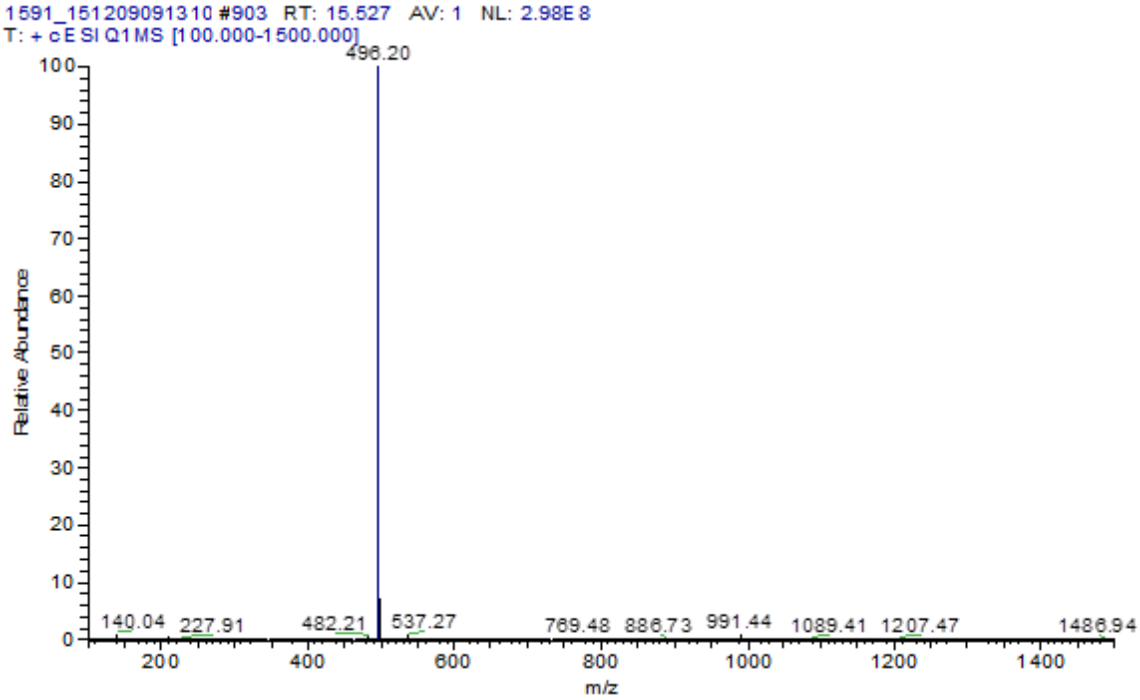
MS Spectrum for 3.7v:



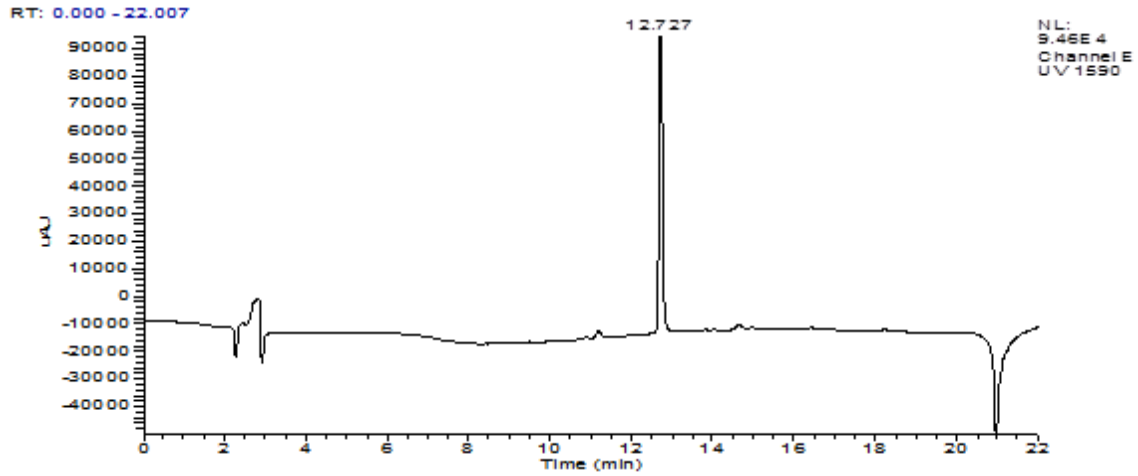
HPLC Spectrum for 3.7w:



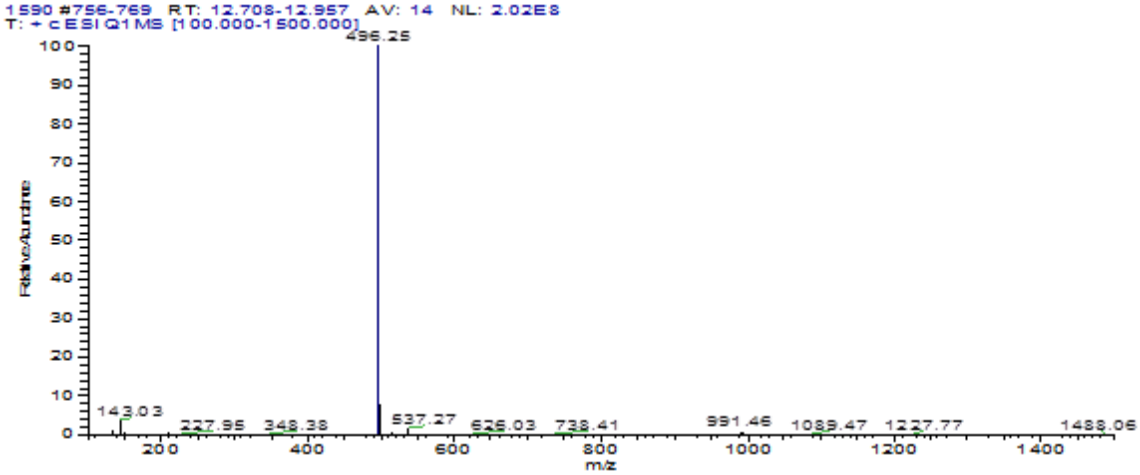
MS Spectrum for 3.7w:



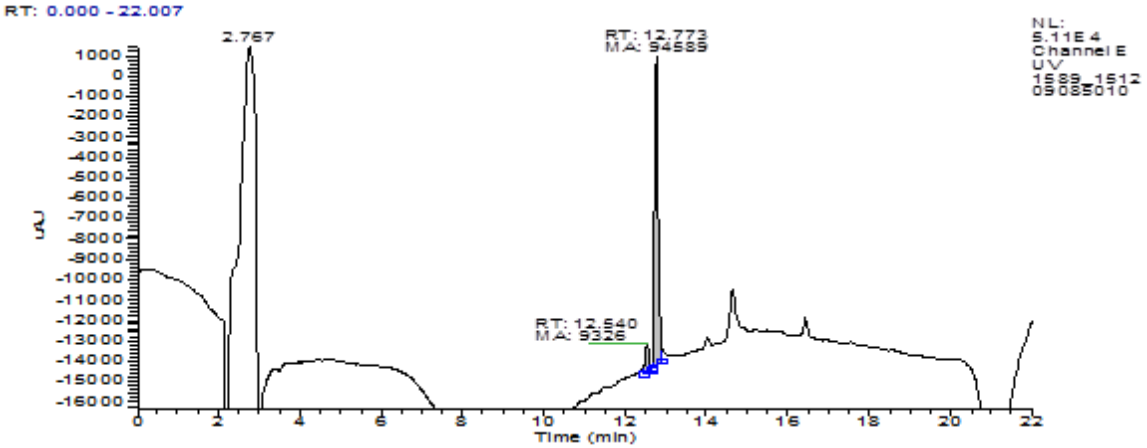
HPLC Spectrum for 3.7x:



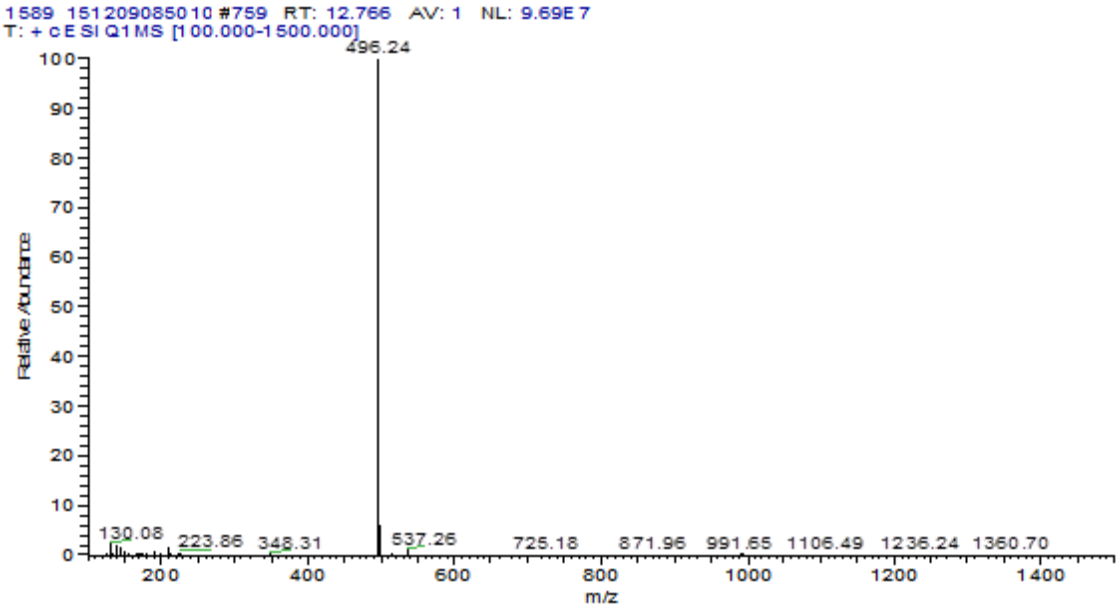
MS Spectrum for 3.7x:



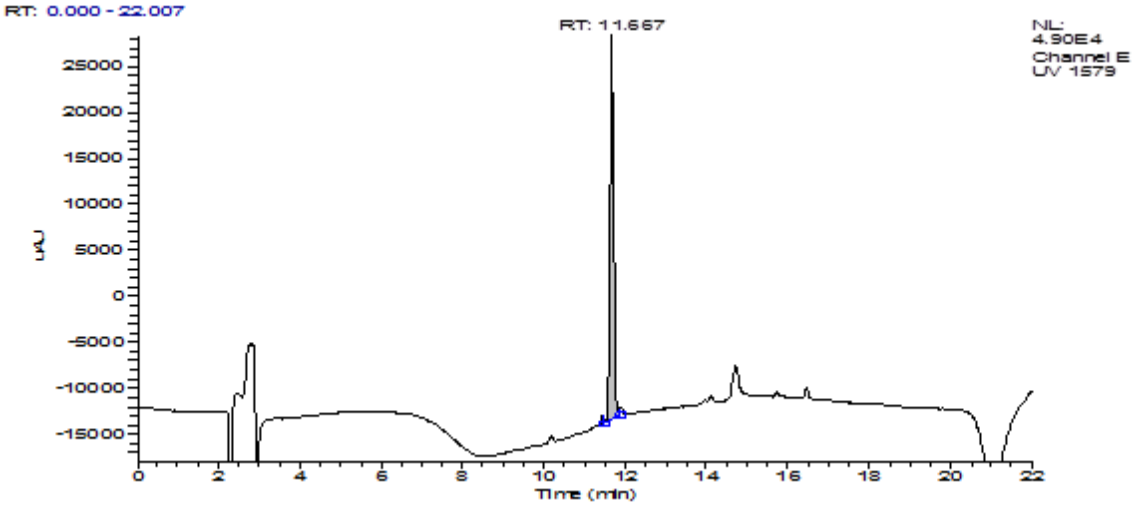
HPLC Spectrum for 3.7y:



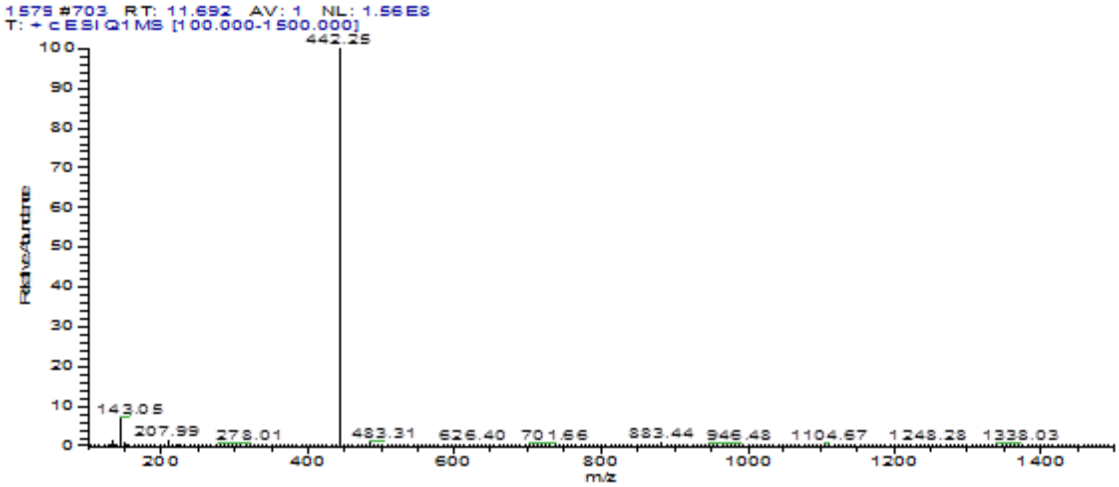
MS Spectrum for 3.7y:



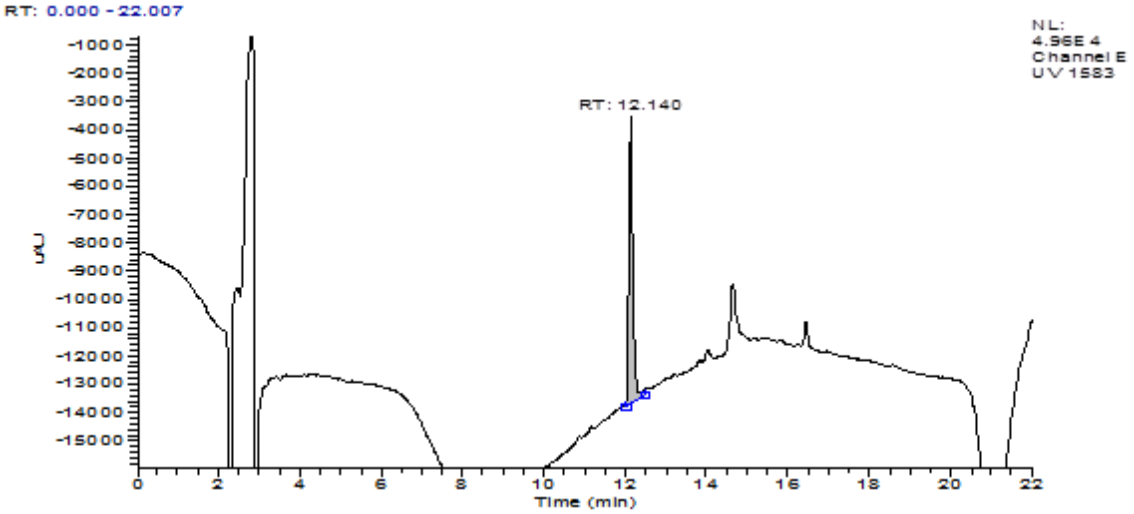
HPLC Spectrum for 3.7z:



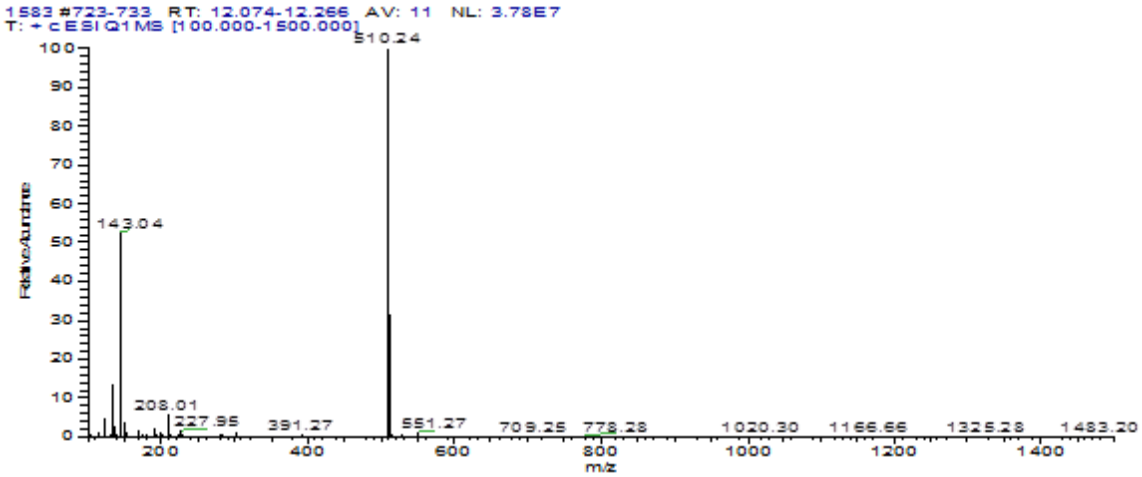
MS Spectrum for 3.7z:



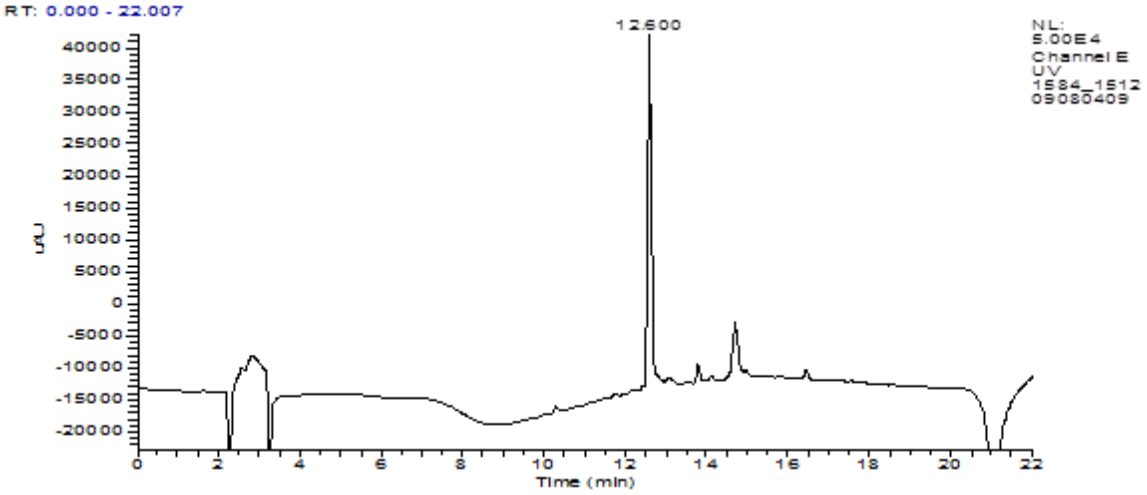
HPLC Spectrum for 3.7aa:



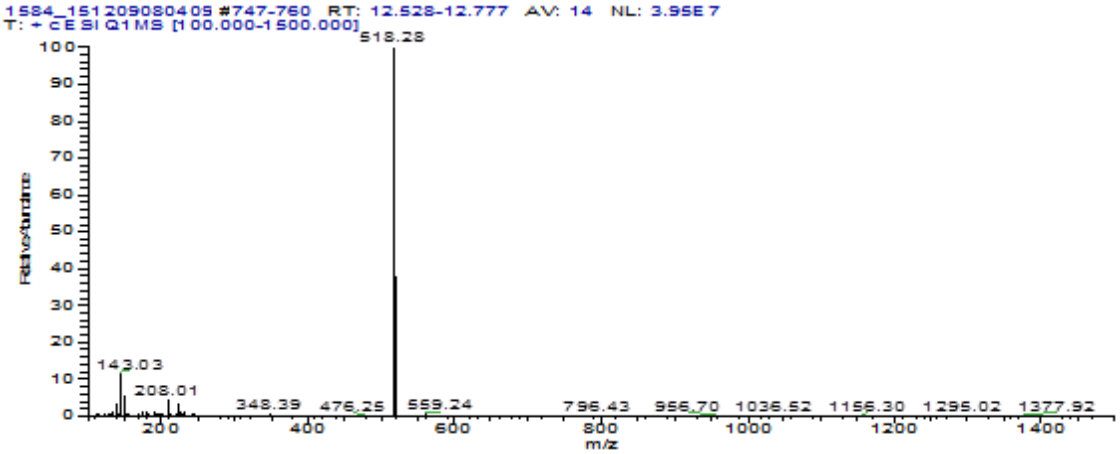
MS Spectrum for 3.7aa:



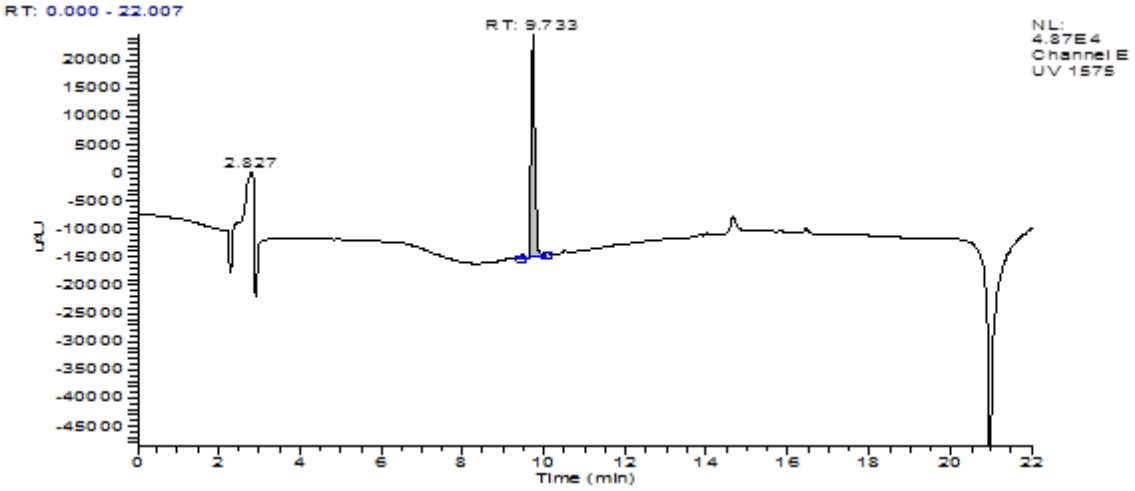
HPLC Spectrum for 3.7ab:



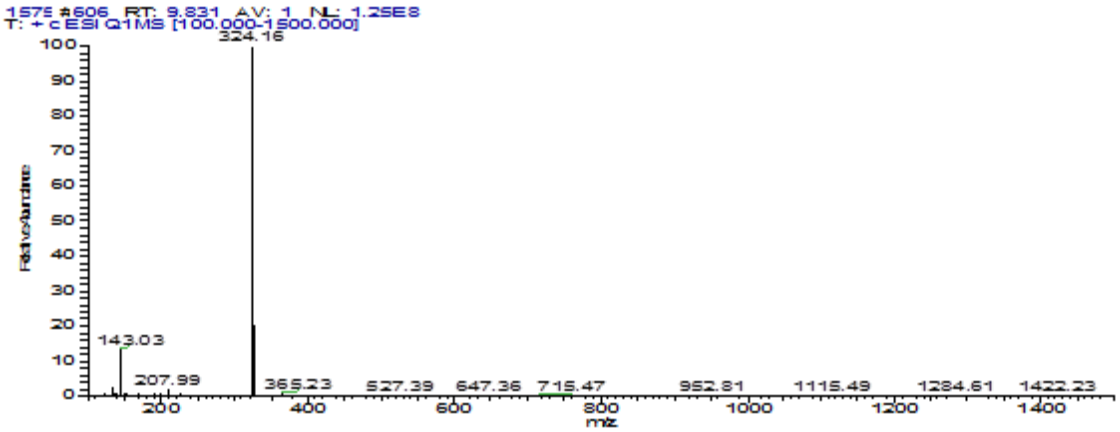
MS Spectrum for 3.7ab:



HPLC Spectrum for 3.7ac:

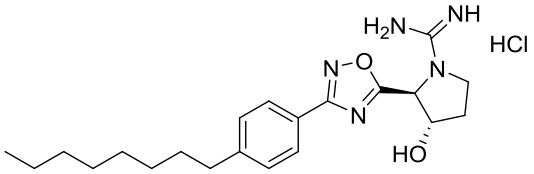


MS Spectrum for 3.7ac

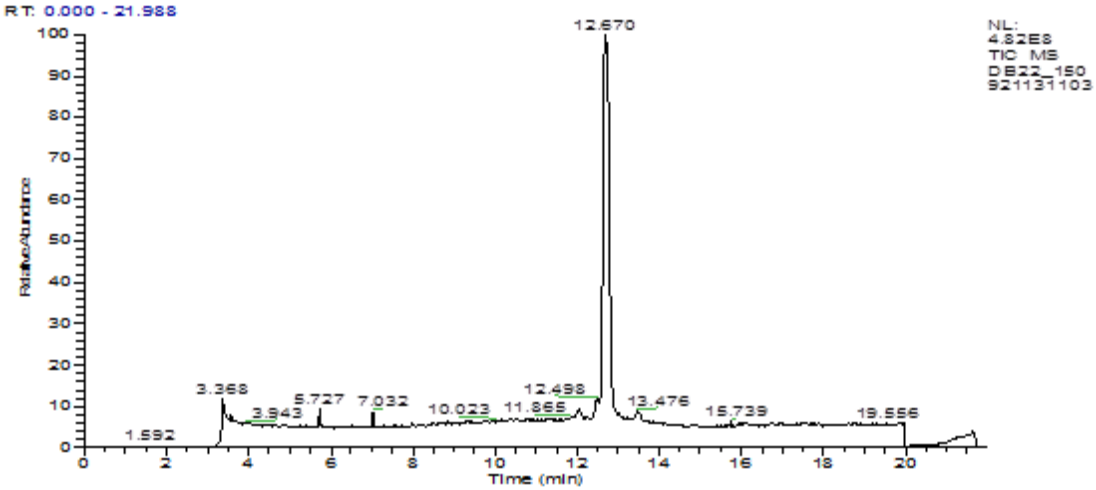


Appendix F Chiral SFC Spectra for **3.7i**, **3.7j** and Standard Compounds **BD22** and **SLM120702**

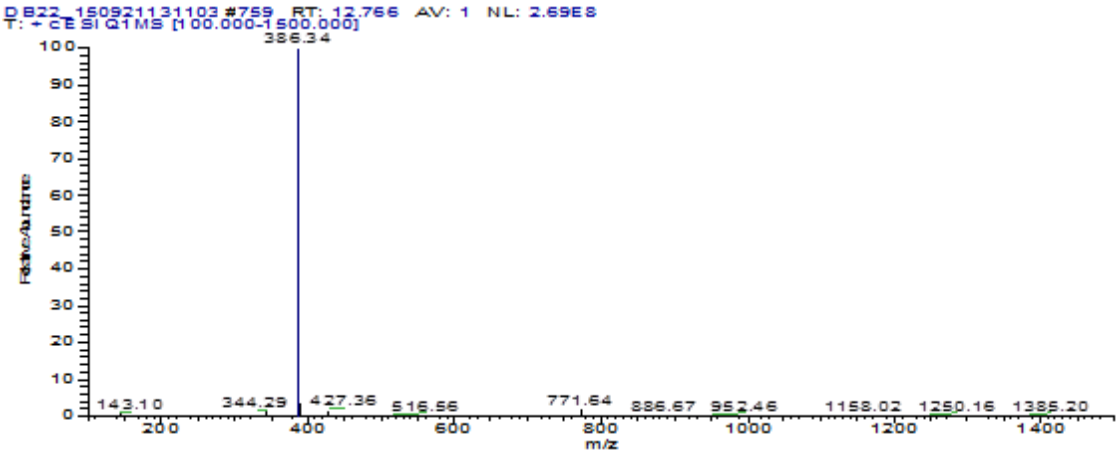
Structure of Standard BD22:



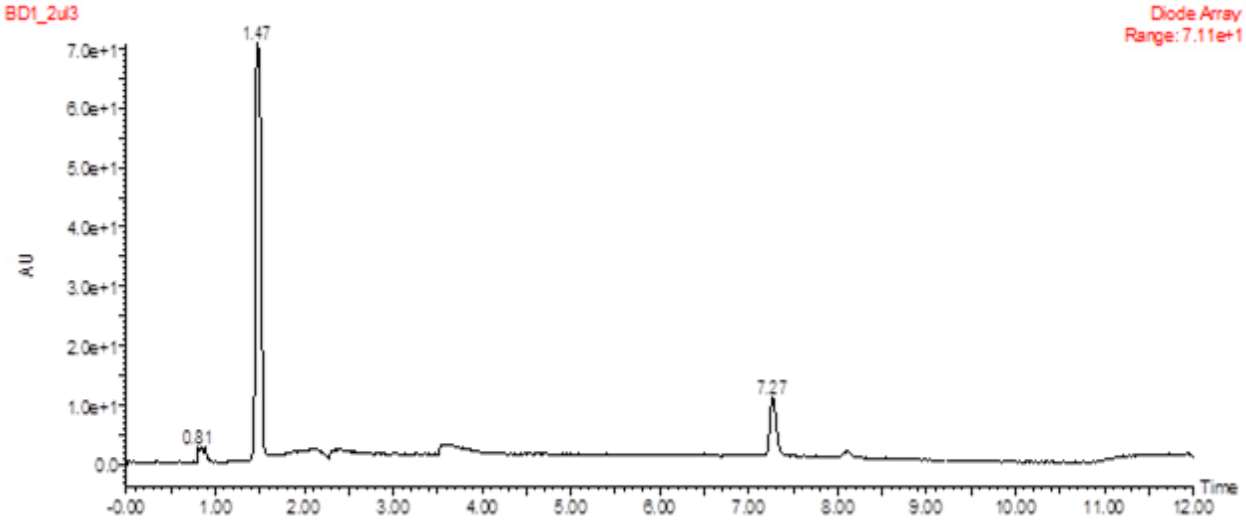
HPLC Spectrum for Standard BD22:



MS Spectrum for Standard BD22:

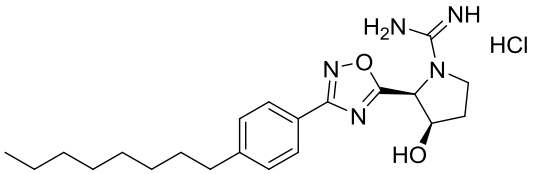


SFC Spectrum for Standard BD22:

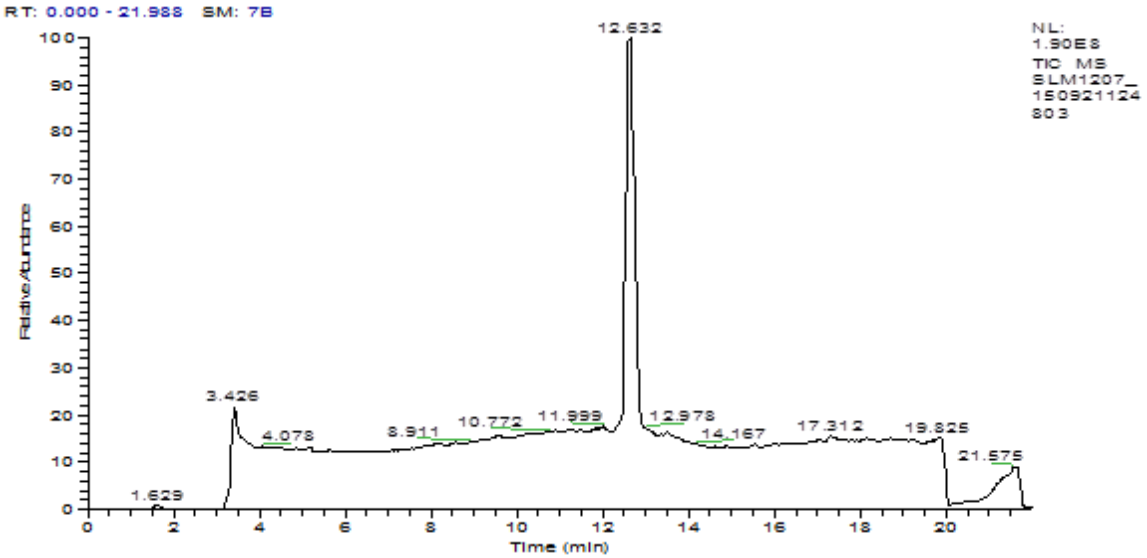


BD22 was originally synthesized by Dr. Mithun Raja using purchased (*3S*)-hydroxy-Boc-L-proline as the head group. As seen in the HPLC and MS spectra, the compound is comprised of one compound with the correct mass. The SFC spectrum indicates that the product is comprised of one diastereiomer which has a retention time of 7.27 minutes. The peak at 1.47 minutes is from DMSO solvent.

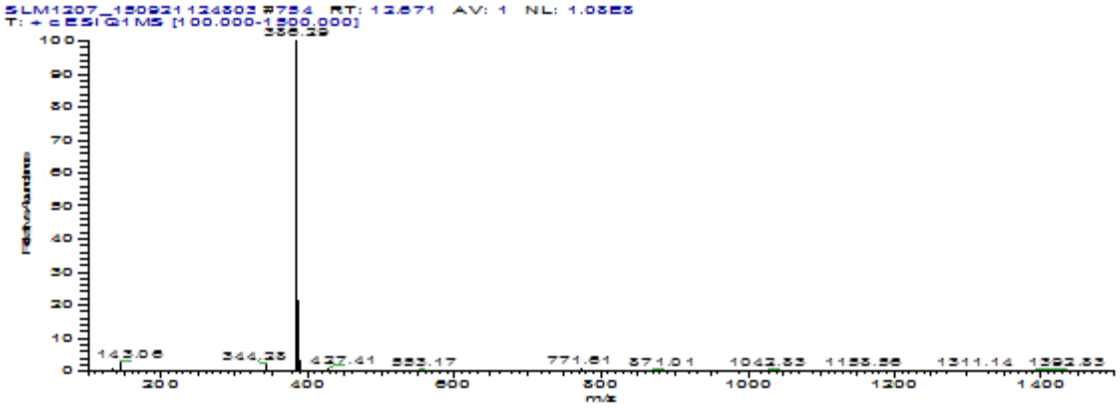
Structure of Standard SLM120702:



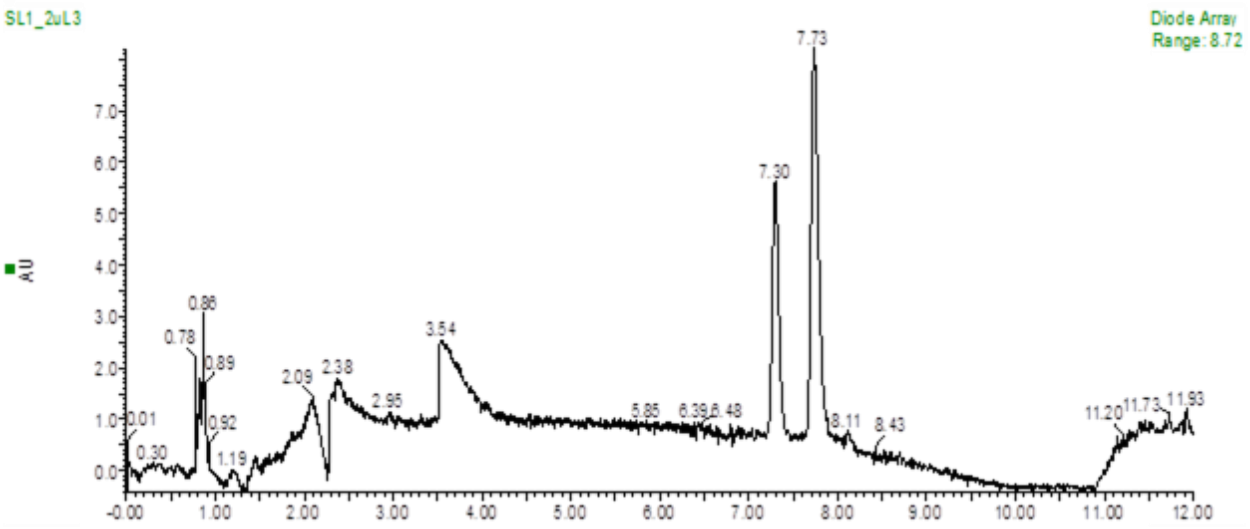
HPLC Spectrum for Standard SLM120702:



MS Spectrum for Standard SLC120702:

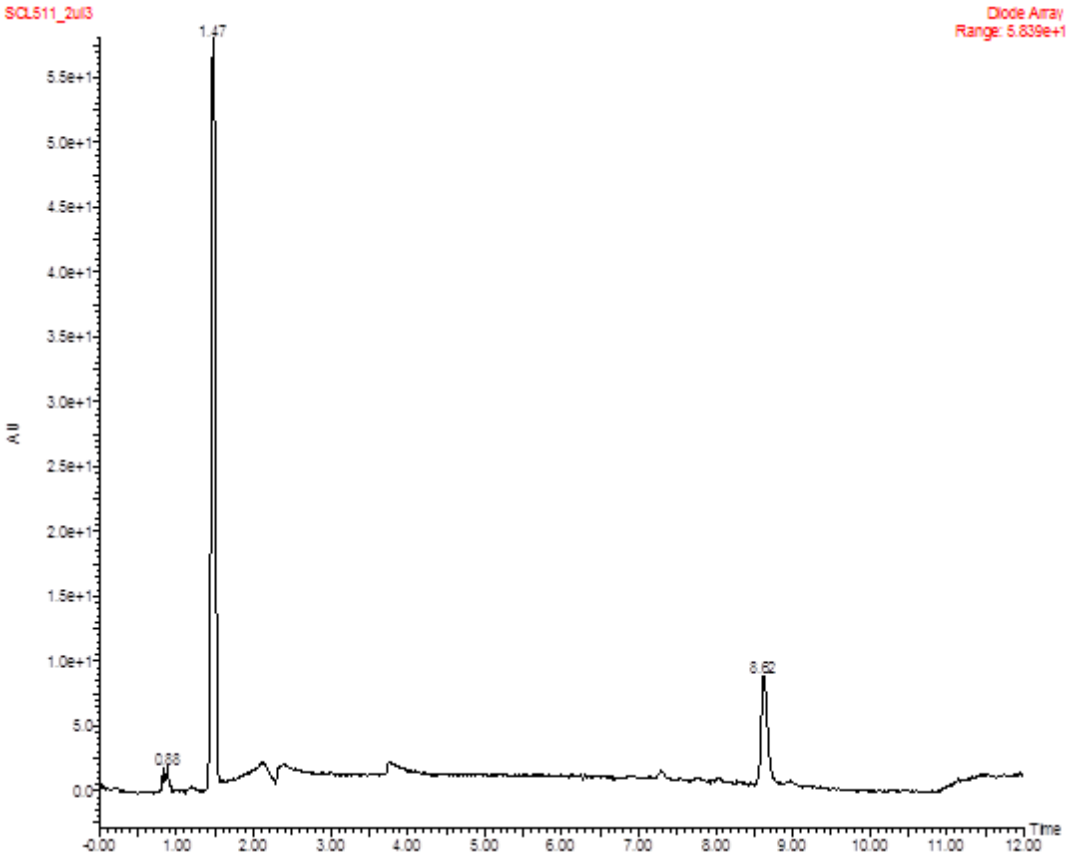


SFC Spectrum for Standard SLM120702:



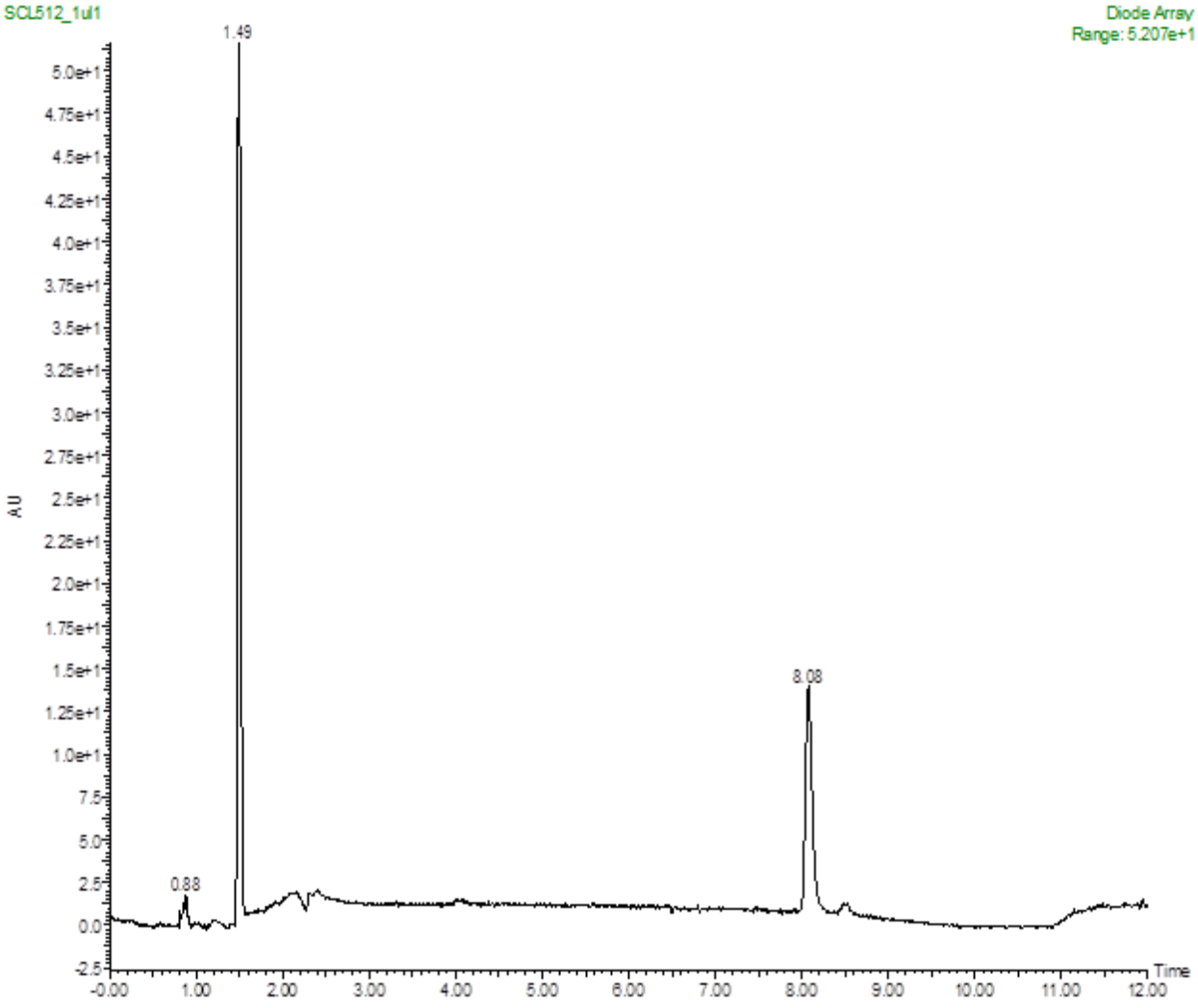
SLM120702 was originally synthesized by Emily Morris using purchased (*3S*)-hydroxy-Boc-L-proline as the head group. The chiral inversion was achieved via a Mitsunobu reaction. As seen in the HPLC and MS spectra, the compound is comprised of one compound with the correct mass. The SFC spectrum indicates that the product is comprised of a mixture of two diastereomers. The first diastereomer, which has a retention time of 7.30 minutes, matched standard **BD22** which did not undergo chemical inversion at the chiral center. The second diastereomer, **SLC120702**, has a retention time of 7.73 minutes.

SFC Spectrum for 3.7i:



As seen in the HPLC and MS spectra, the compound is comprised of one compound with the correct mass. The SFC spectrum indicates that the product is comprised of one diastereiomer which has a retention time of 8.62 minutes. The peak at 1.47 minutes is from DMSO solvent. There is a slight peak at approximately 8.9 minutes from the diastereomer of **3.7i**, indicating that the compound possesses 93% ee. This diastereomer is most likely due to impurities in the purchased starting material.

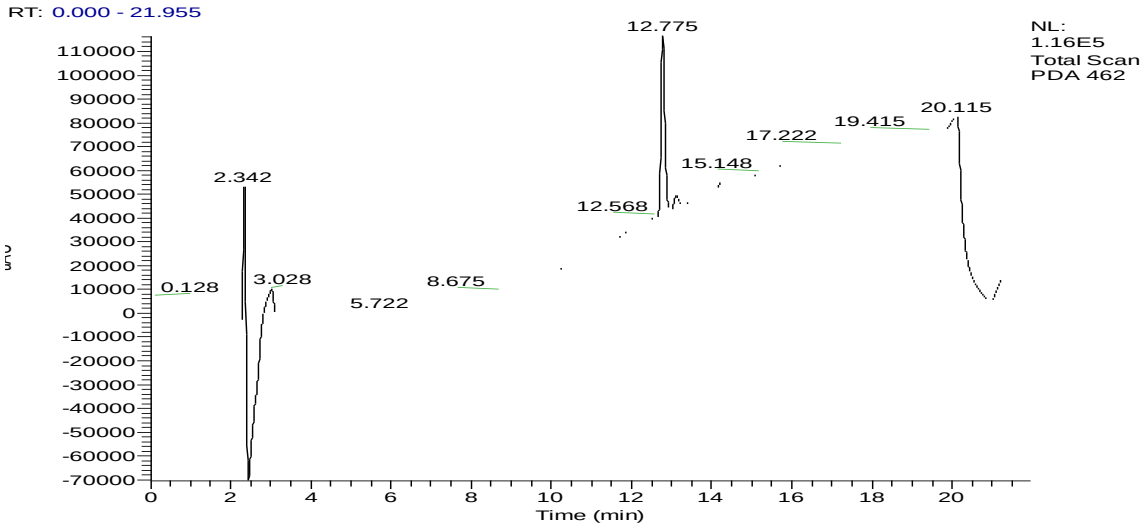
SFC Spectrum for 3.7j:



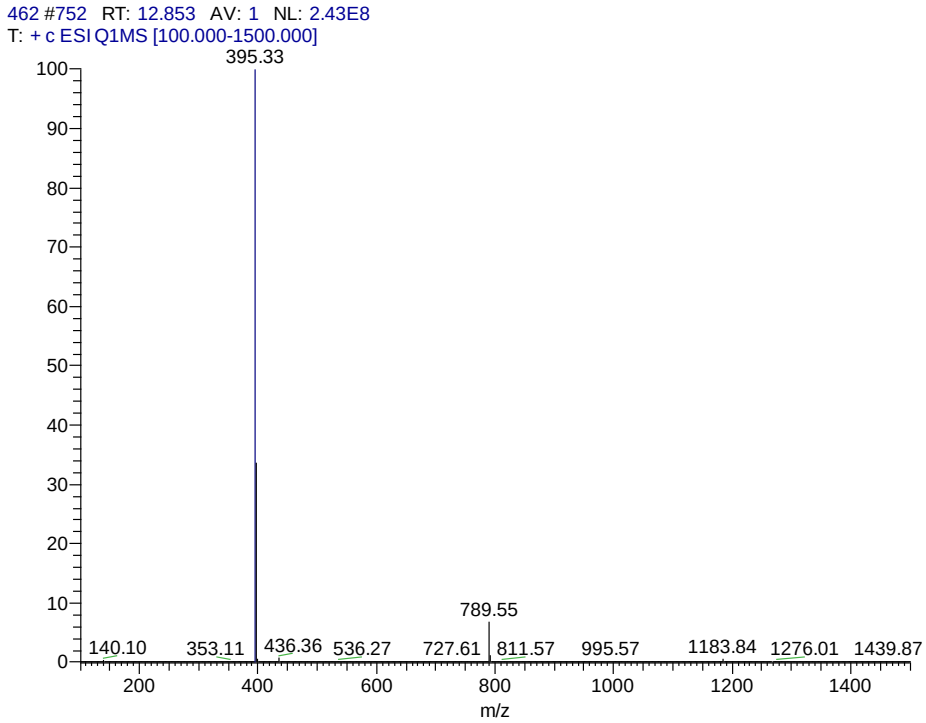
As seen in the HPLC and MS spectra, the compound is comprised of one compound with the correct mass. The SFC spectrum indicates that the product is comprised of one diastereiomer which has a retention time of 8.08 minutes. The peak at 1.47 minutes is from DMSO solvent. There is a slight peak at approximately 8.6 minutes from the diastereomer of **3.7j**, indicating that the compound possesses 92% ee. This diastereomer is most likely due to impurities in the purchased starting material.

Appendix G: HPLC and MS Spectra for Chapter 4

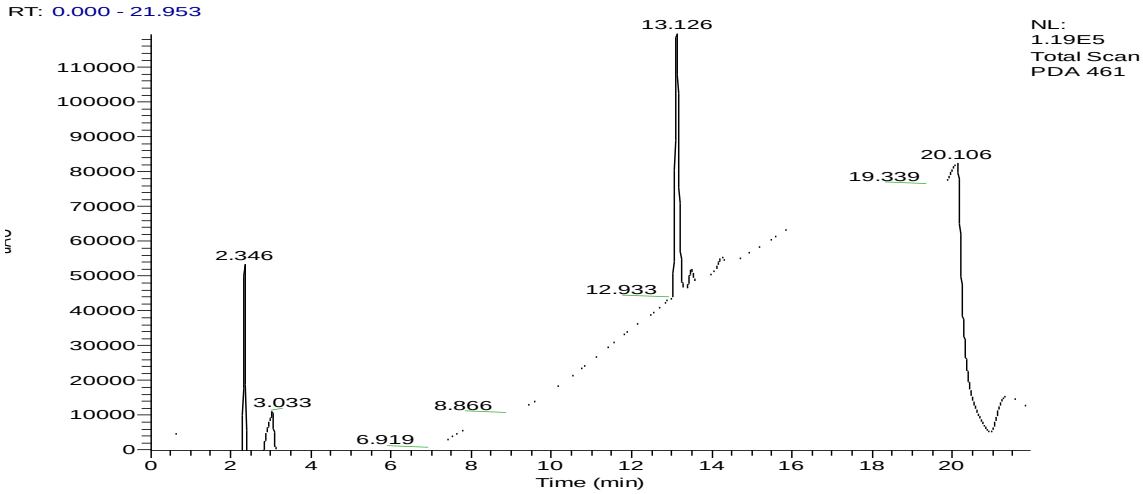
HPLC Spectrum for 4.7a:



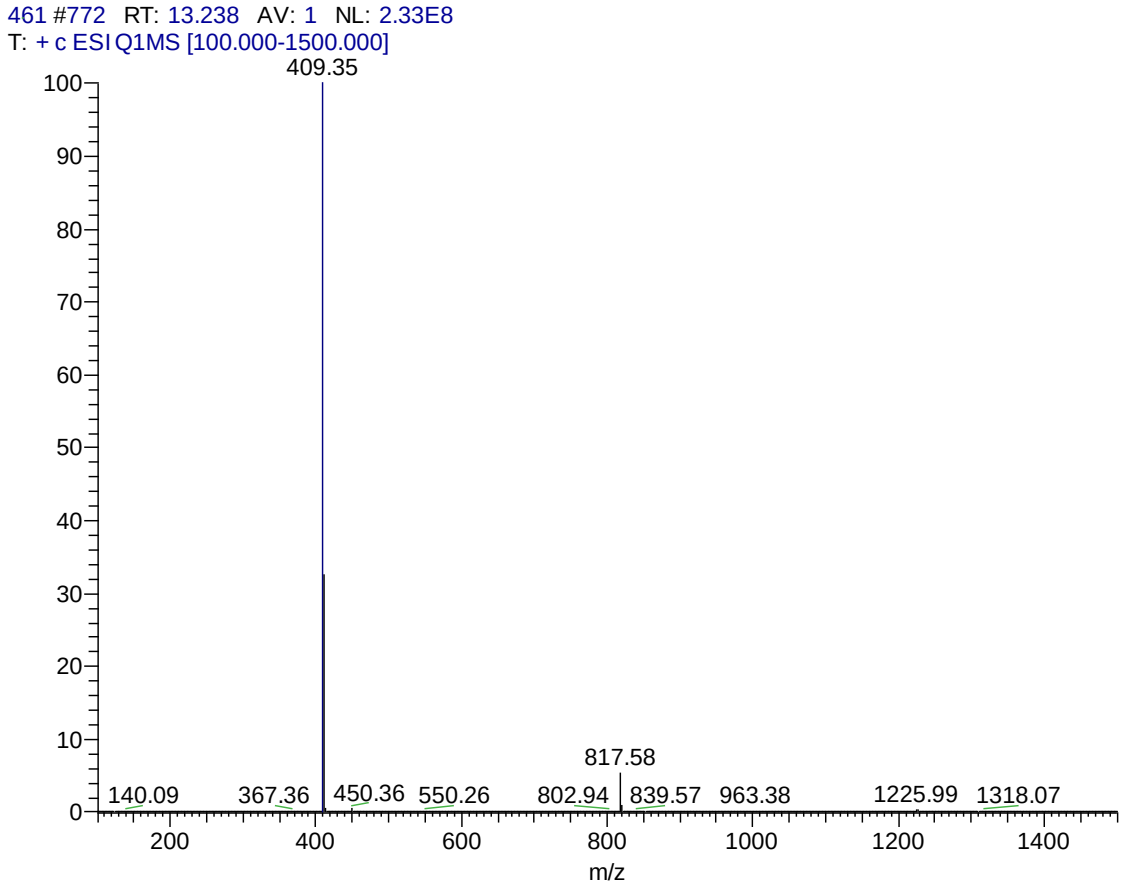
MS Spectrum for 4.7a:



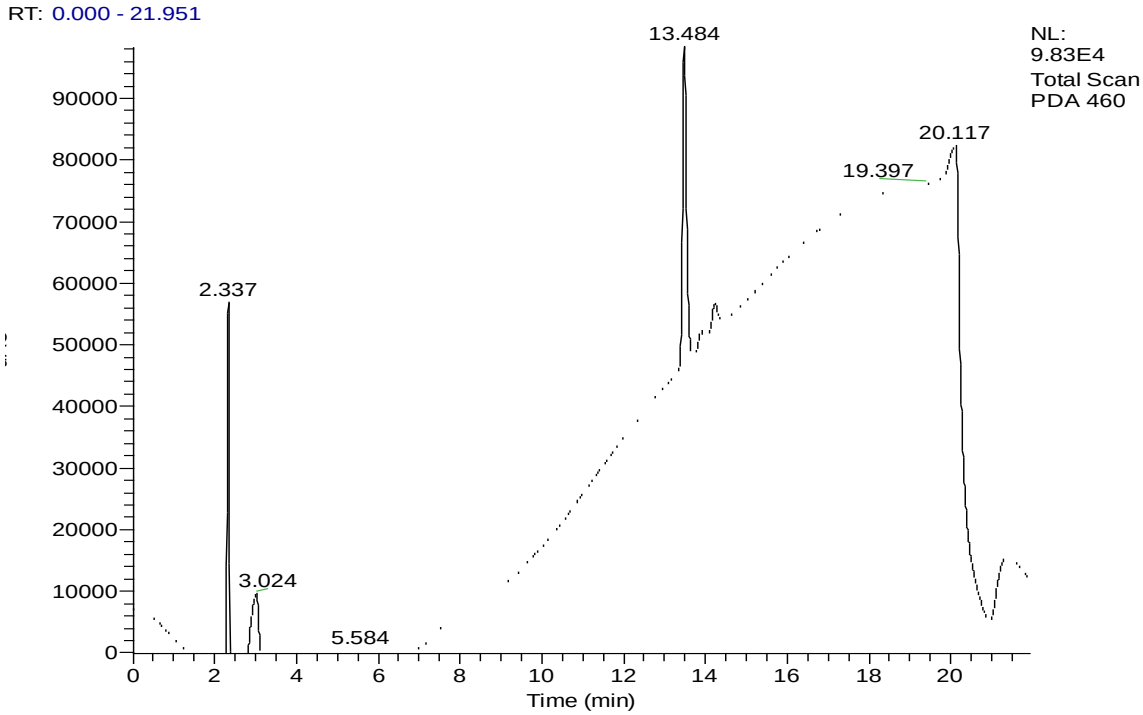
HPLC Spectrum for 4.7b:



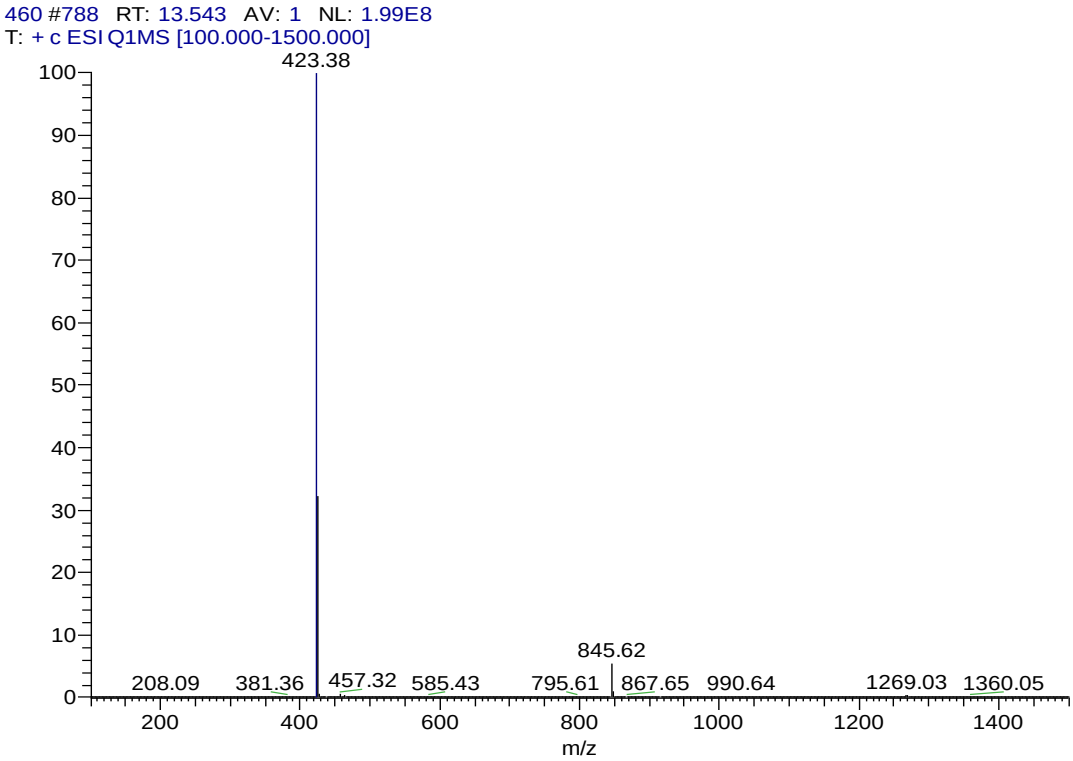
MS Spectrum for 4.7b:



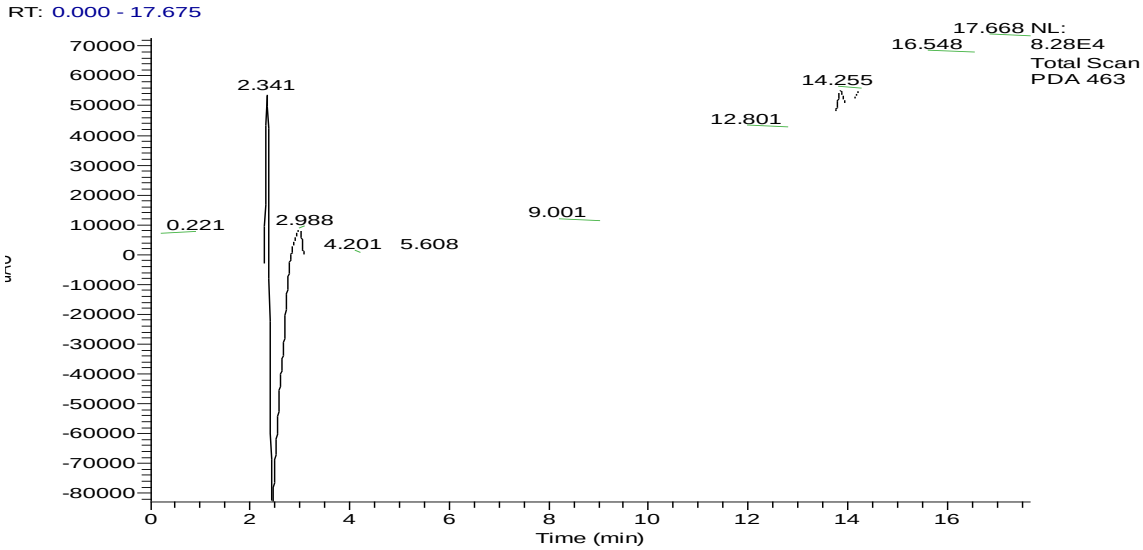
HPLC Spectrum for 4.7c:



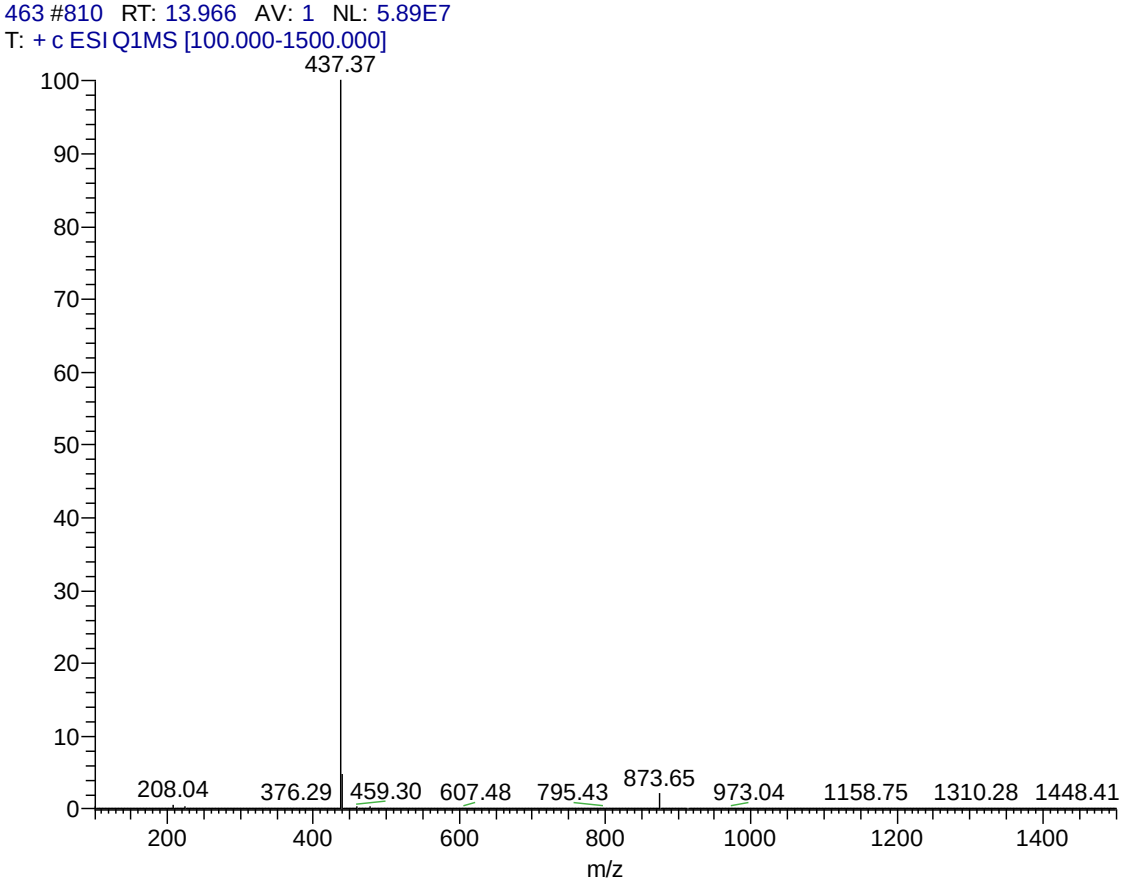
MS Spectrum for 4.7c:



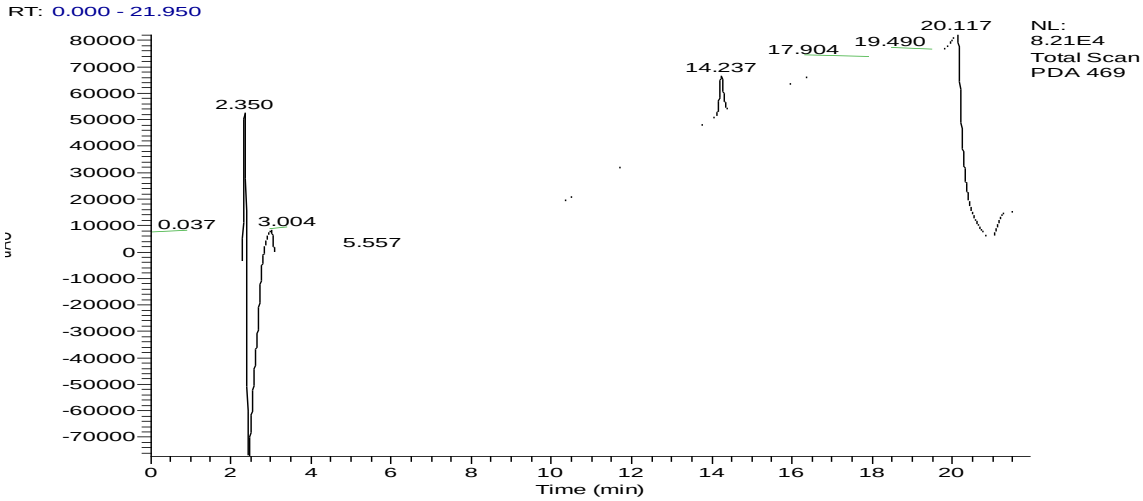
HPLC Spectrum for 4.7d:



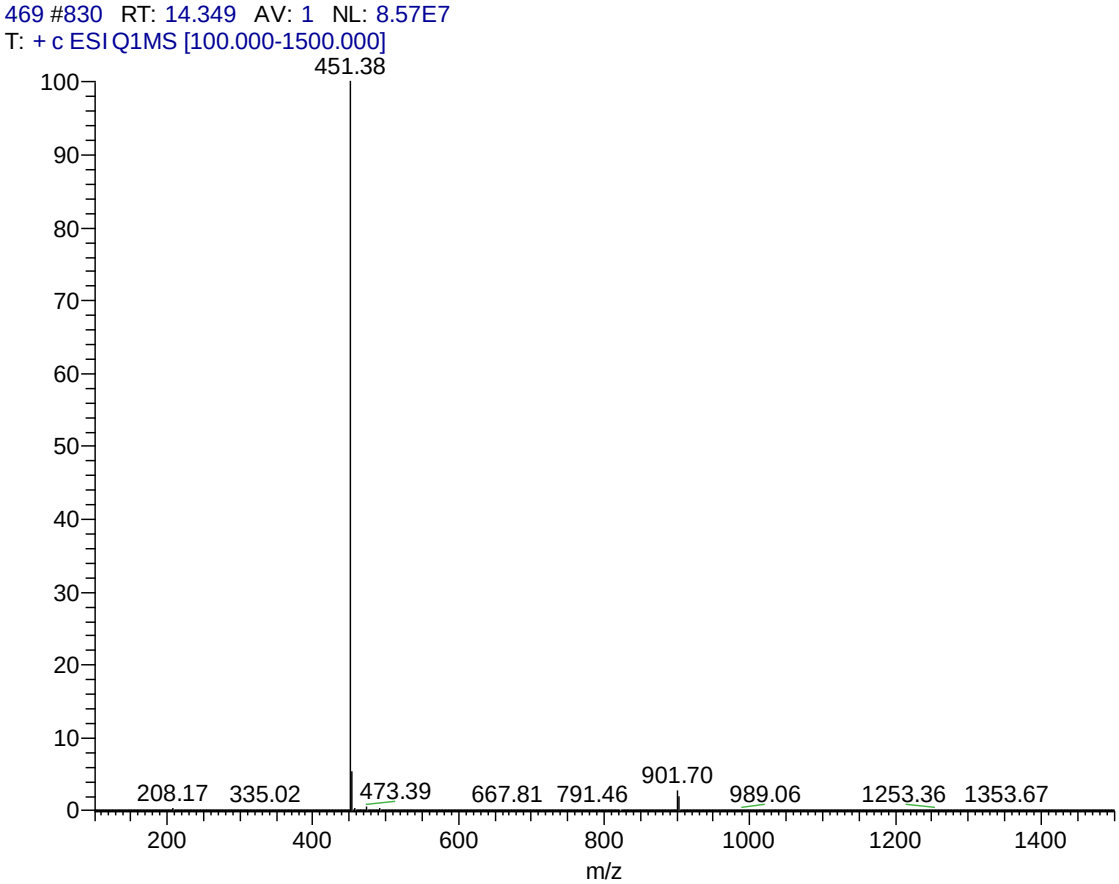
MS Spectrum for 4.7d:



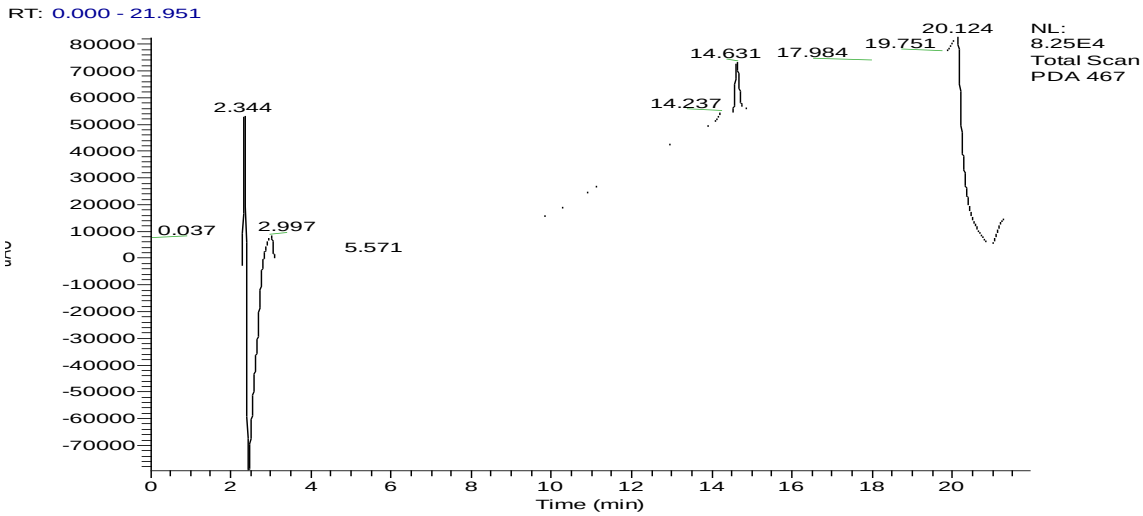
HPLC Spectrum for 4.7e:



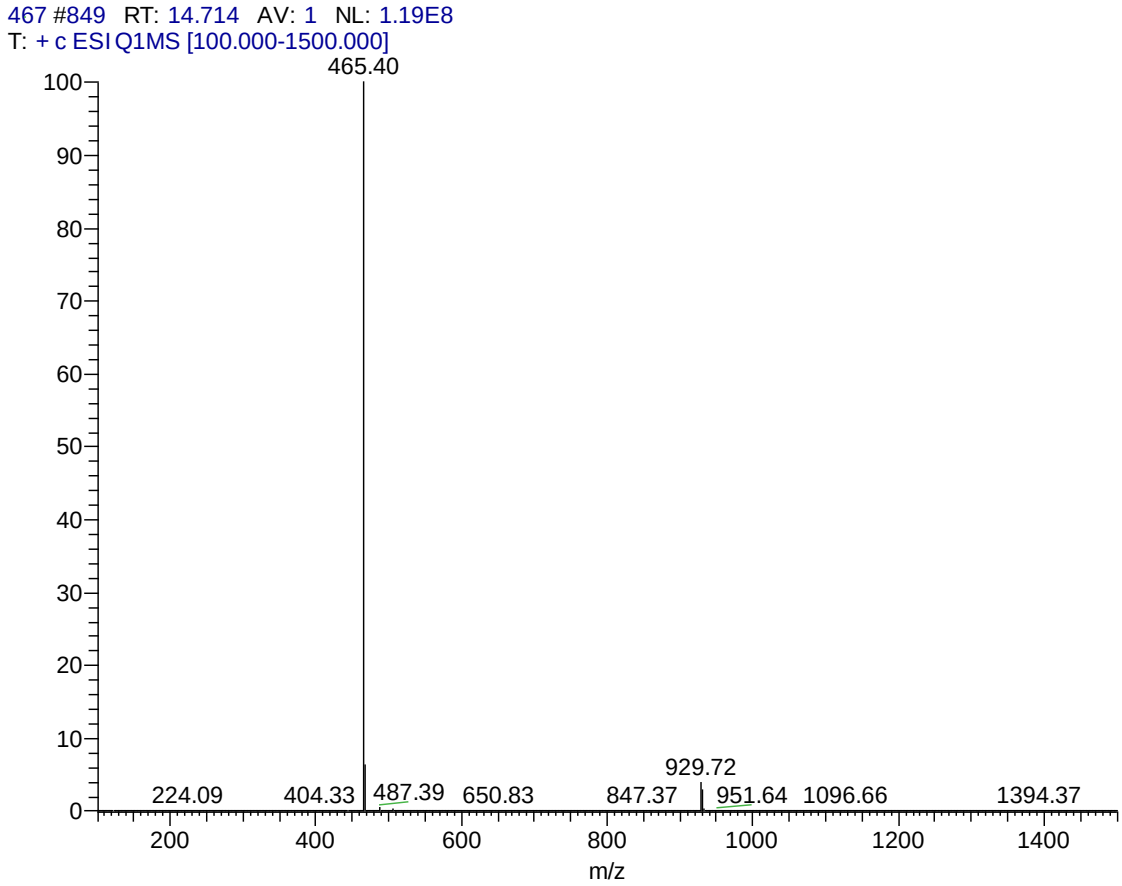
MS Spectrum for 4.7e:



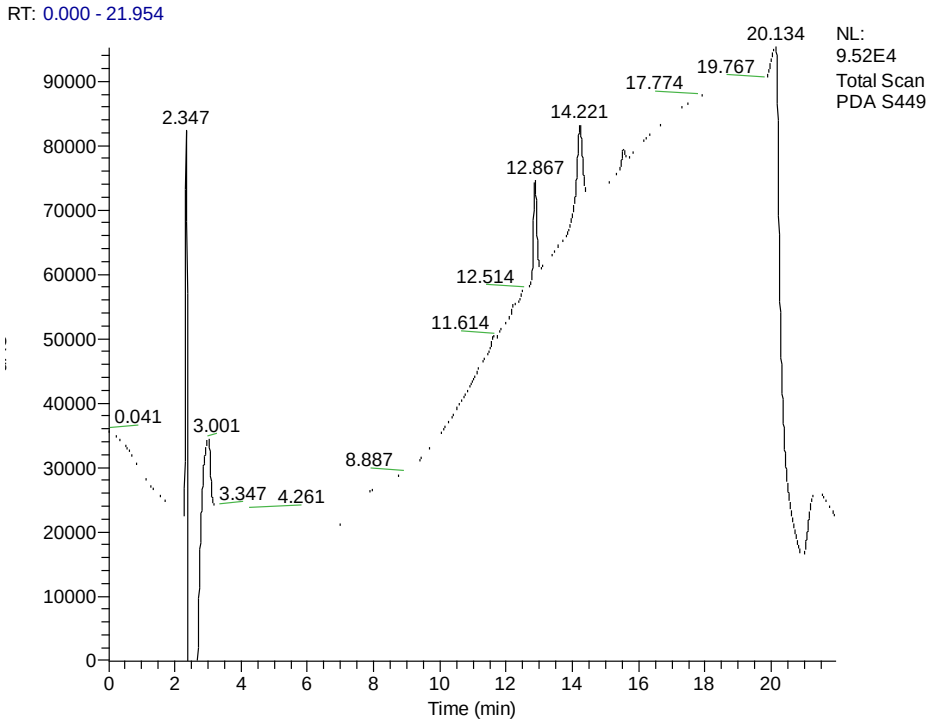
HPLC Spectrum for 4.7f:



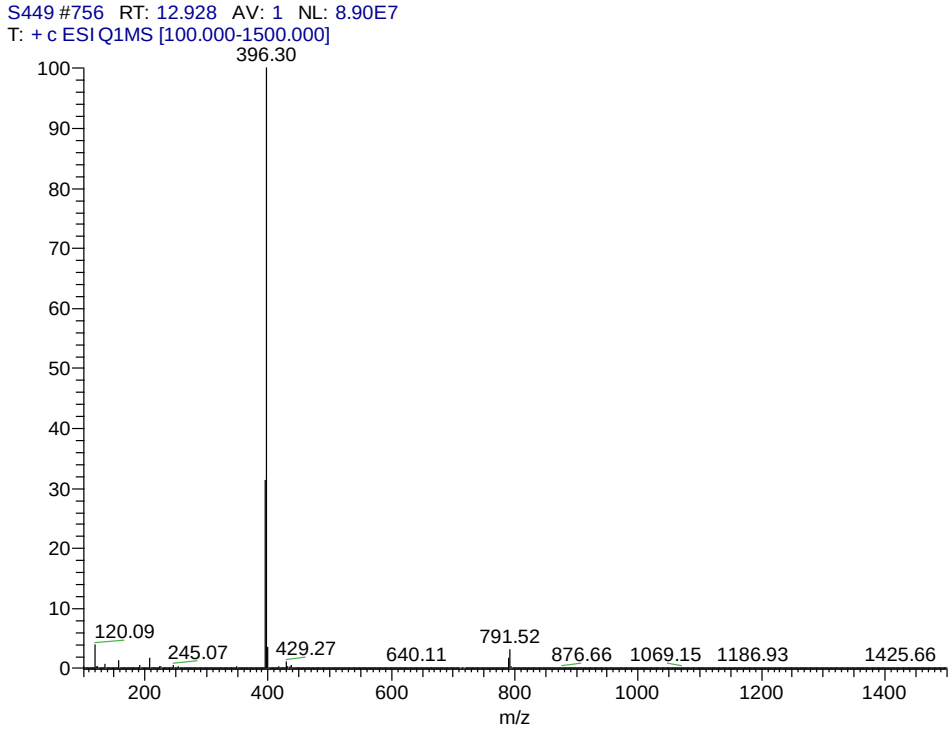
MS Spectrum for 4.7f:



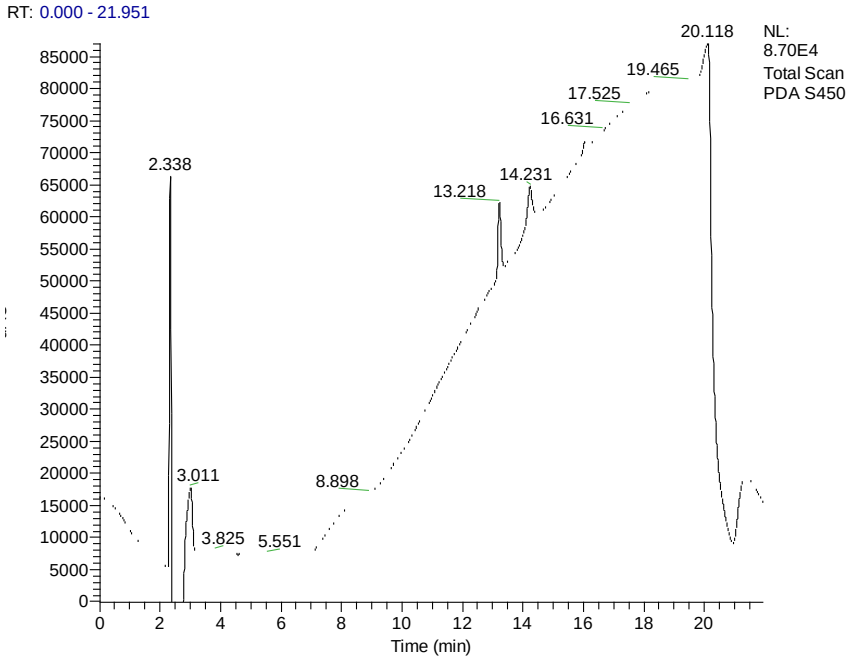
HPLC Spectrum for 4.14a:



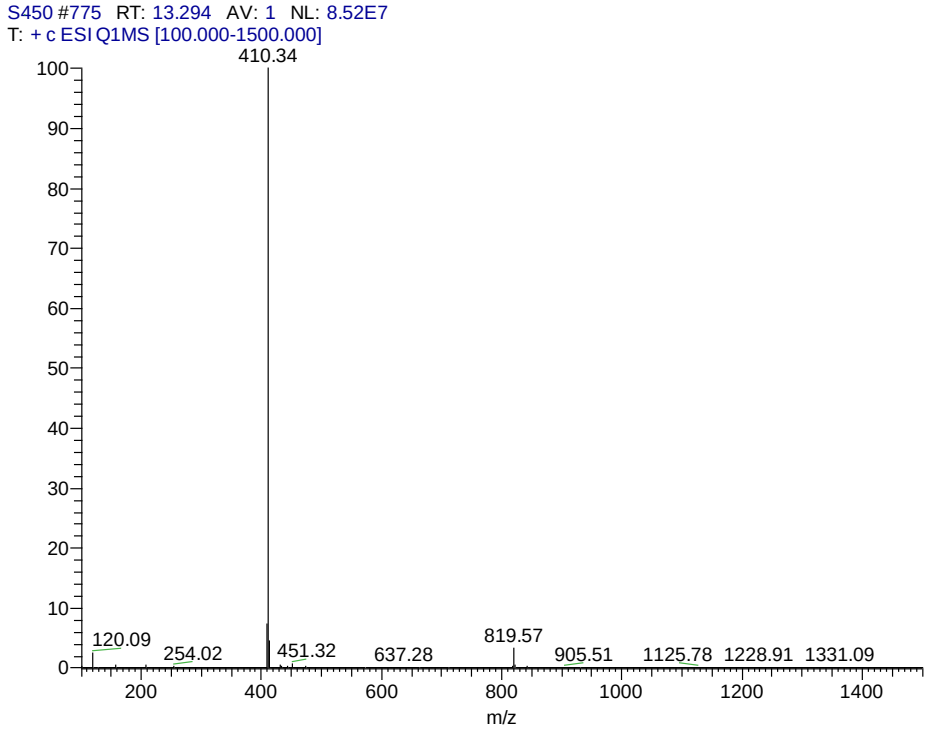
MS Spectrum for 4.14a:



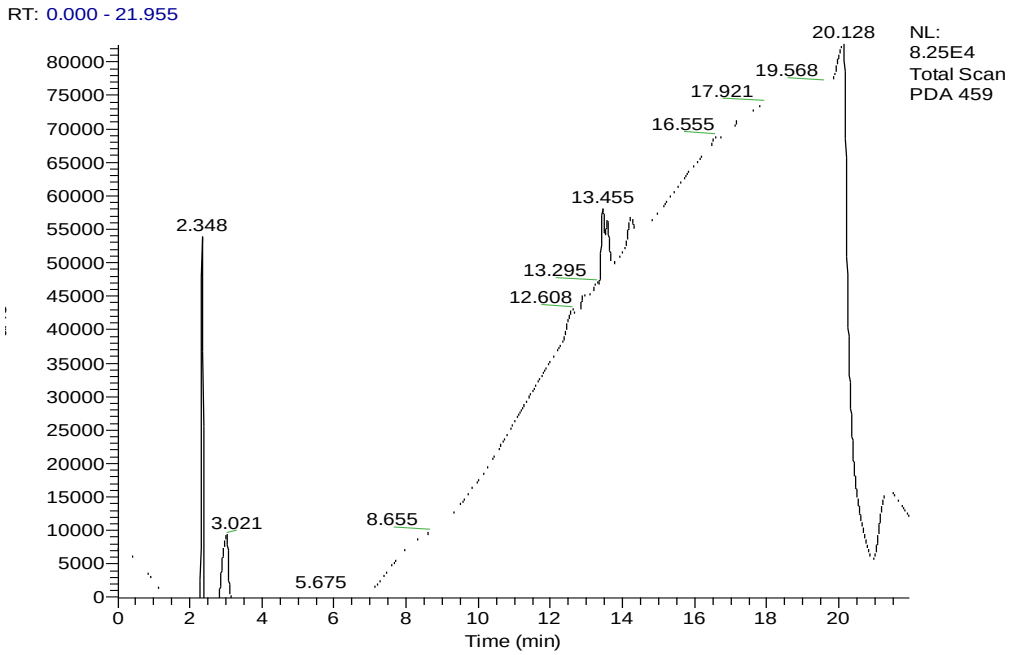
HPLC Spectrum for 4.14b:



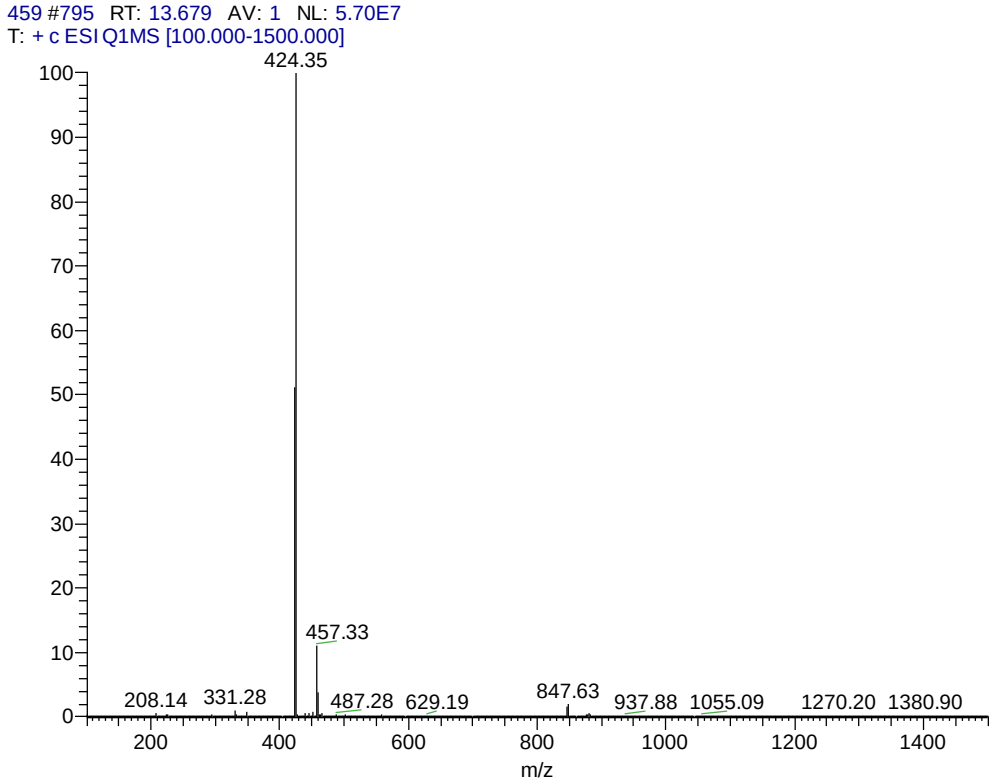
MS Spectrum for 4.14b:



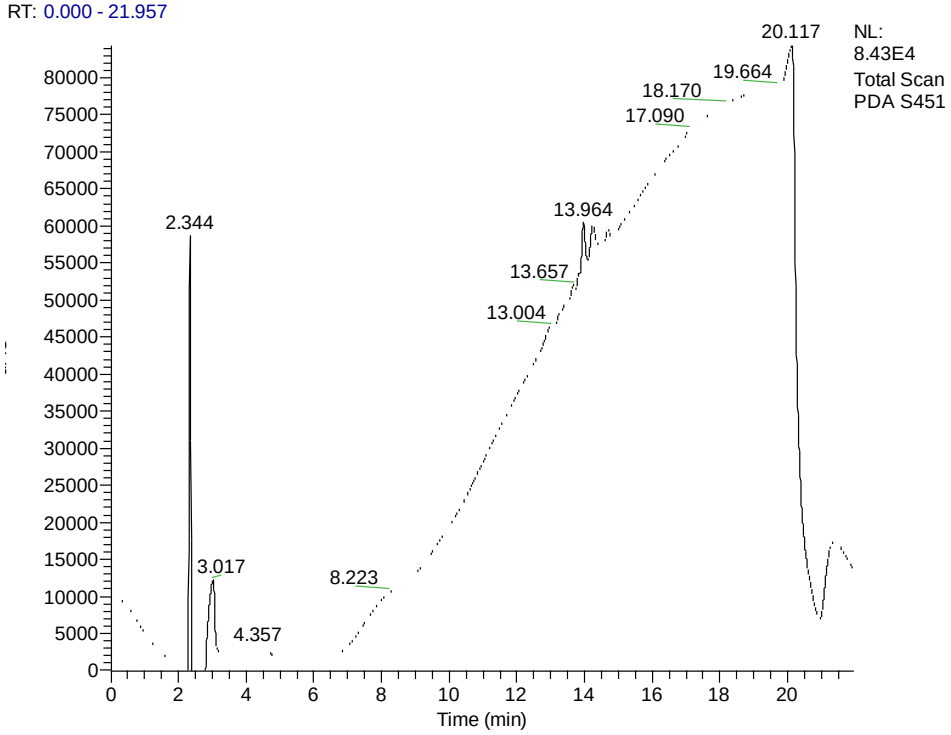
HPLC Spectrum for 4.14c:



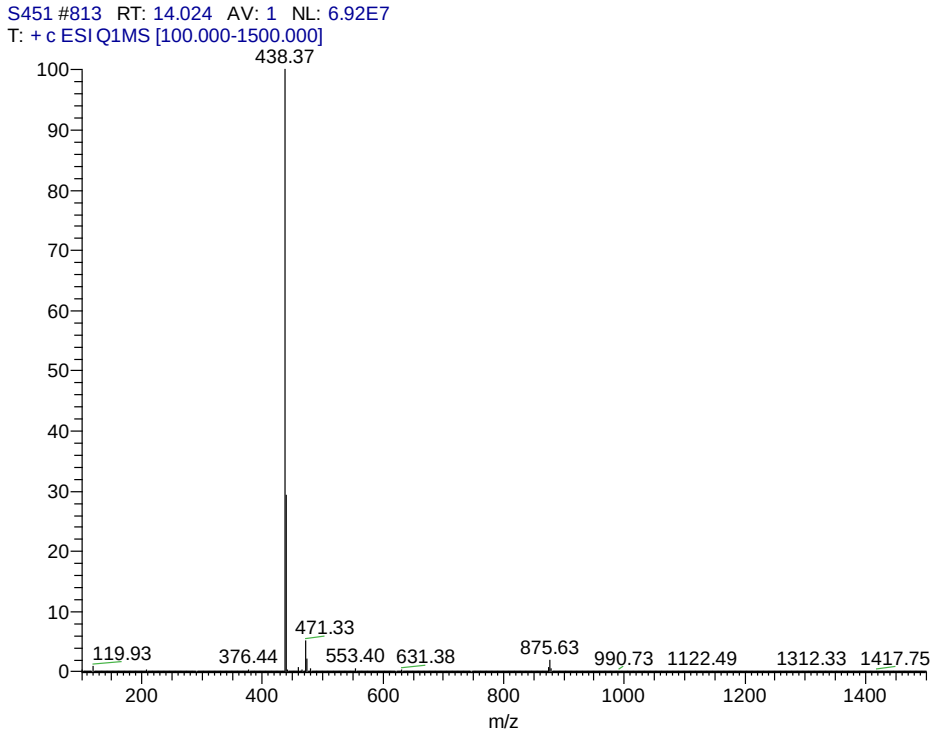
MS Spectrum for 4.14c:



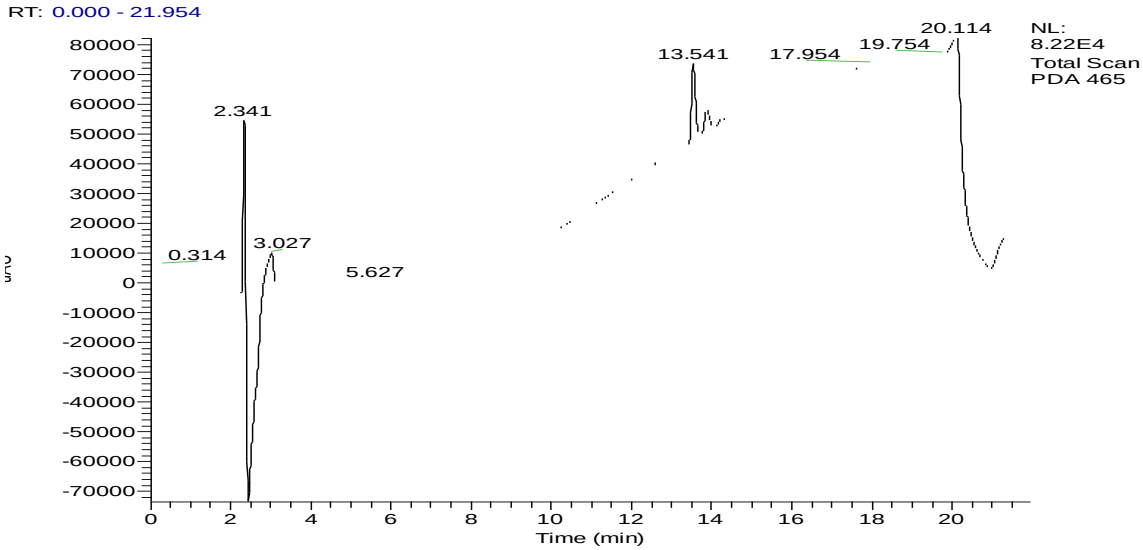
HPLC Spectrum for 4.14d:



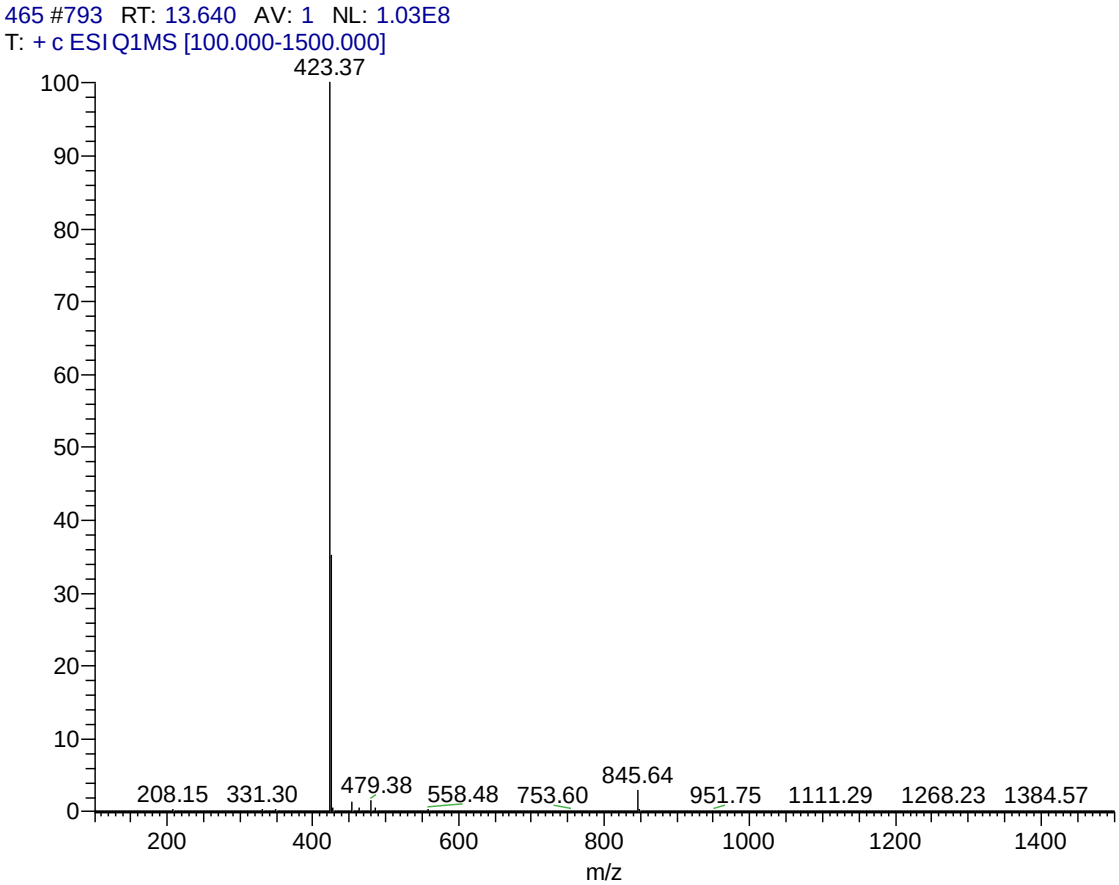
MS Spectrum for 4.14d:



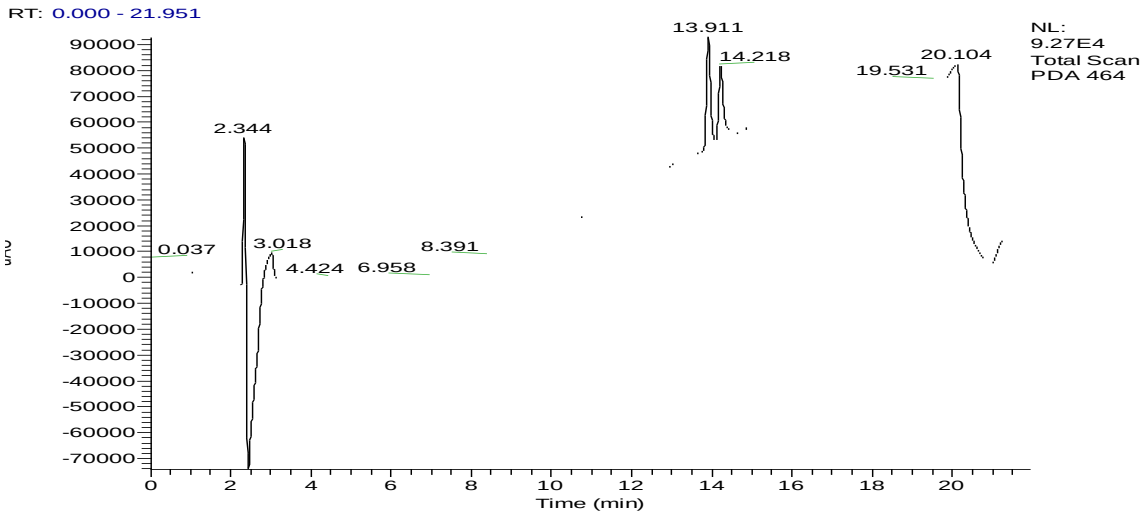
HPLC Spectrum for 4.21d:



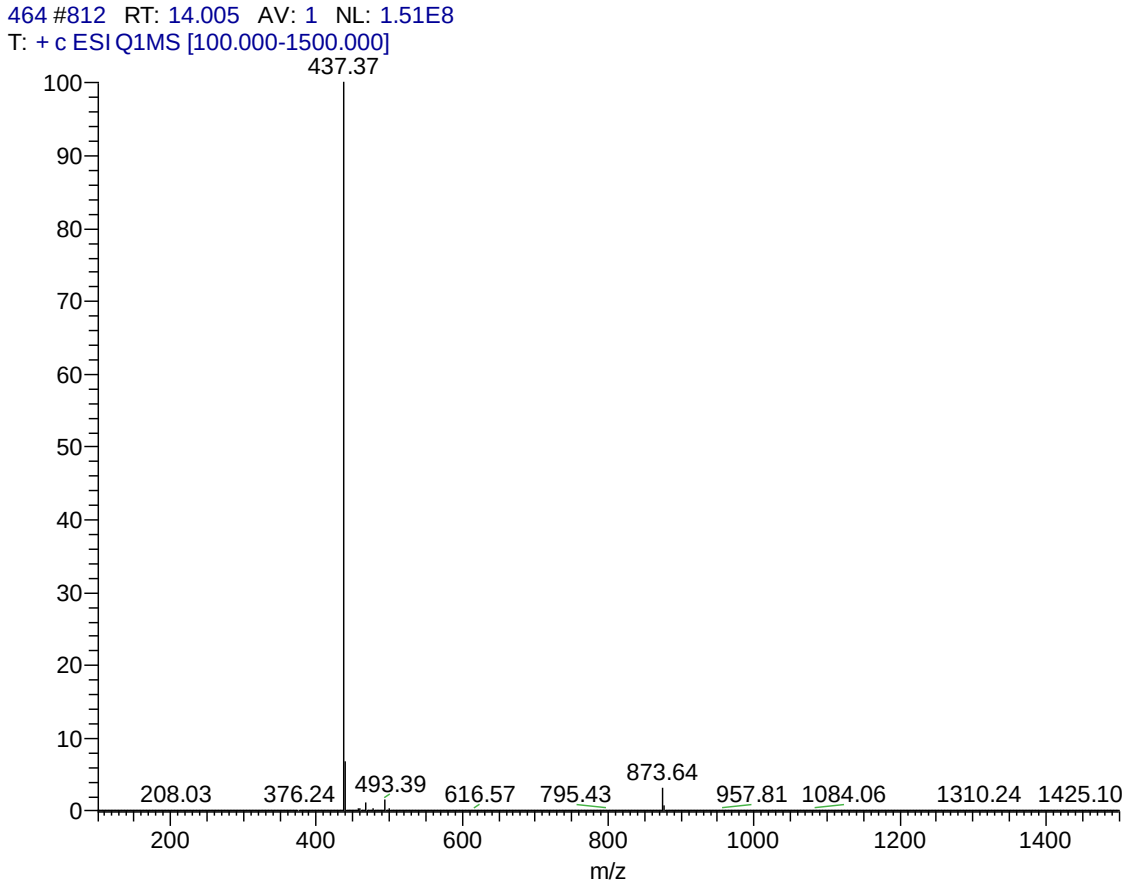
MS Spectrum for 4.21d:



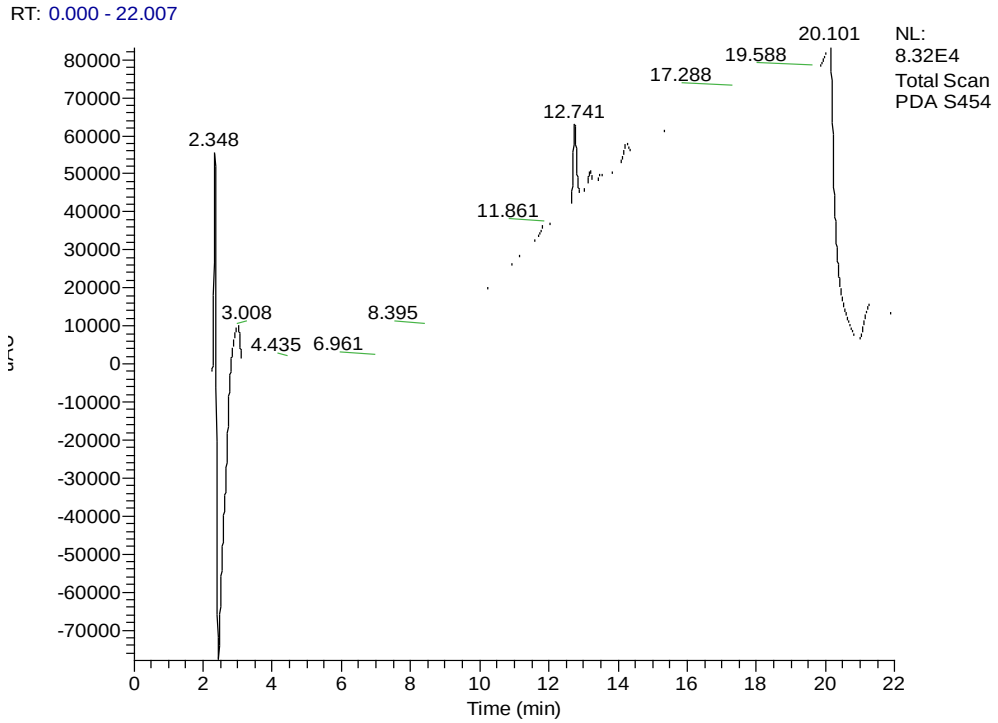
HPLC Spectrum for 4.21e:



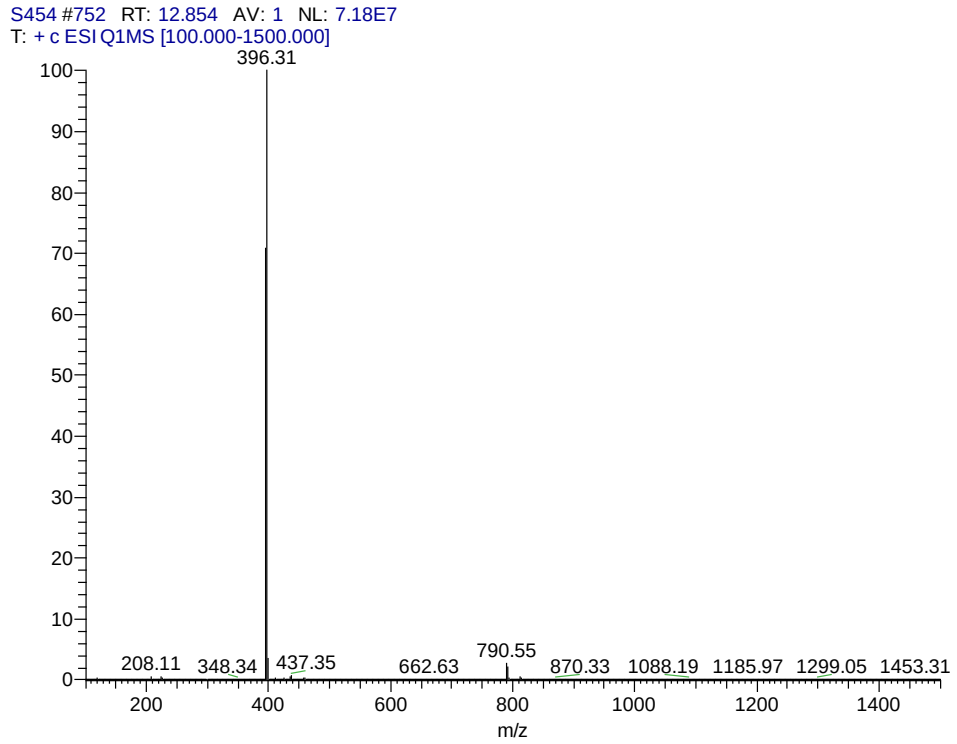
MS Spectrum for 4.21e:



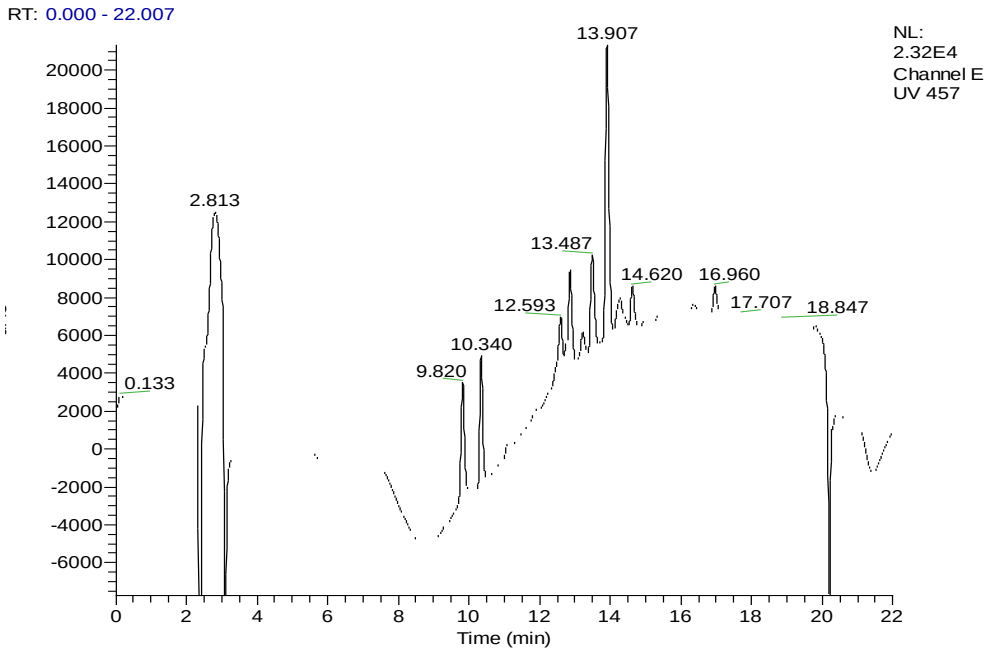
HPLC Spectrum for 4.28a:



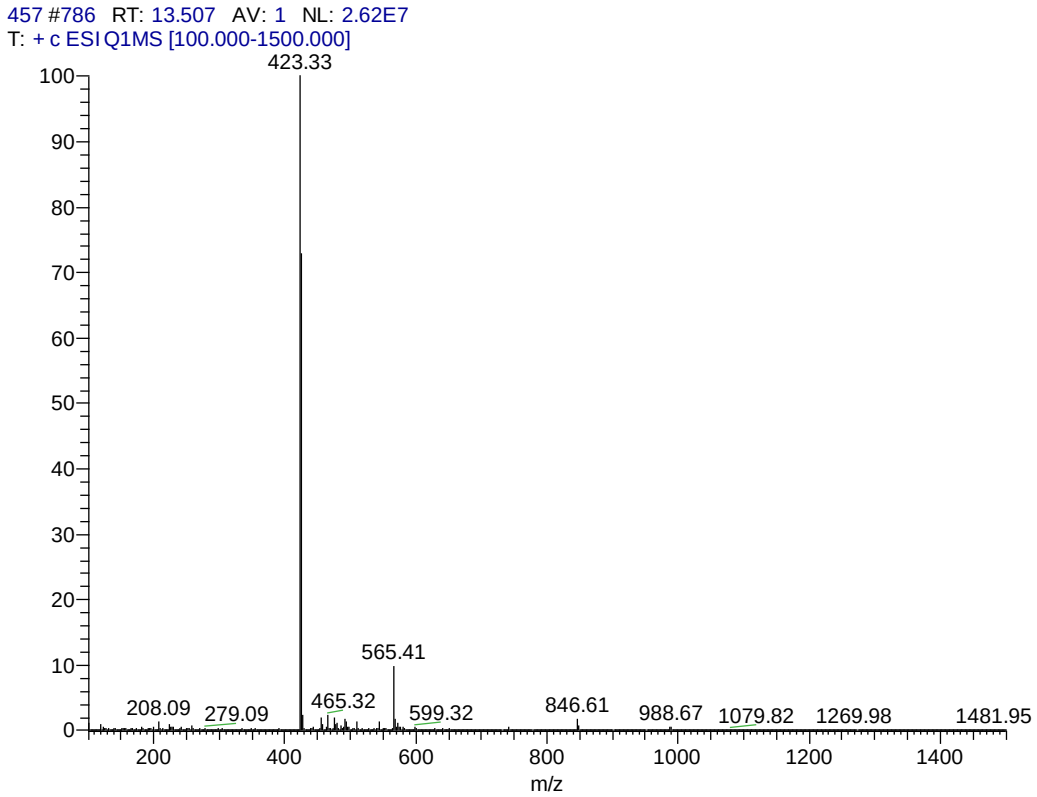
MS Spectrum for 4.28a:



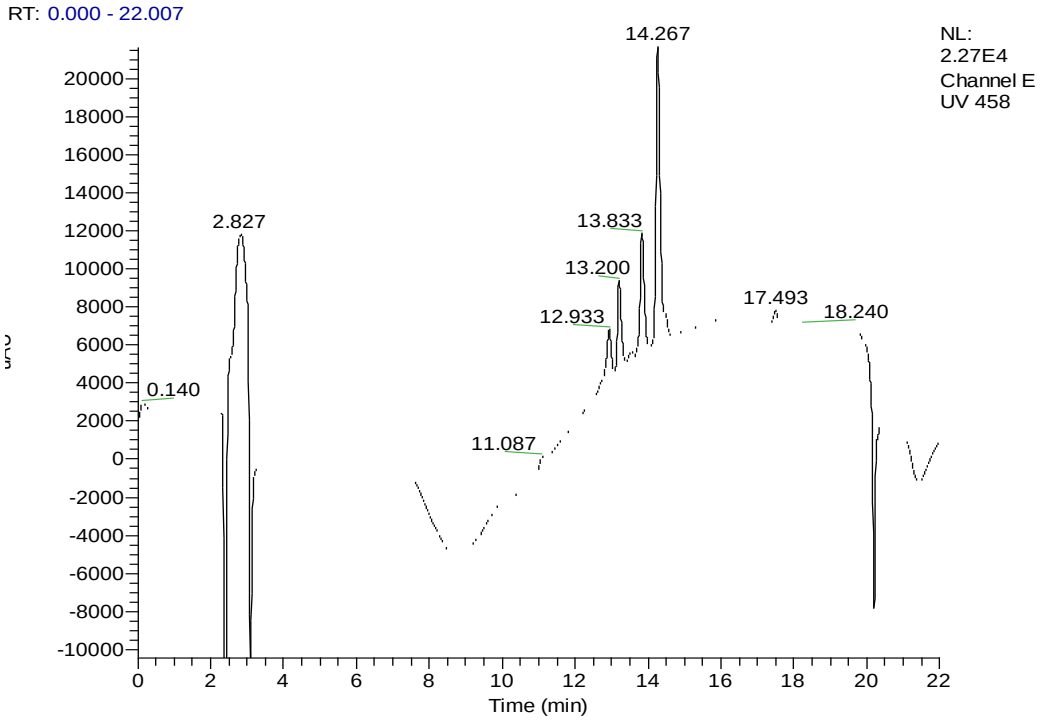
HPLC Spectrum for 4.28c:



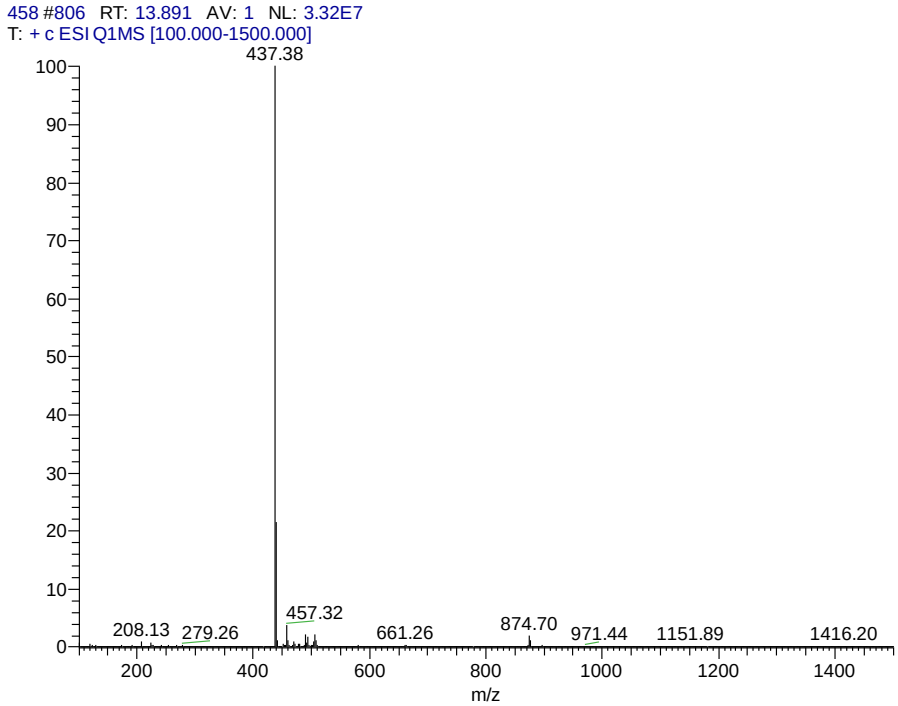
MS Spectrum for 4.28c:



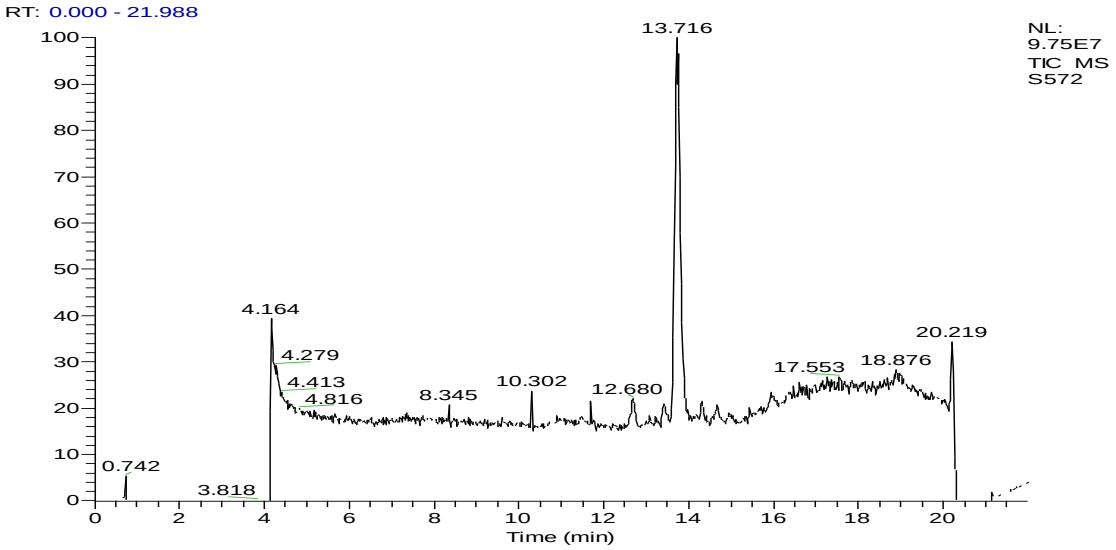
Spectrum for 4.28d:



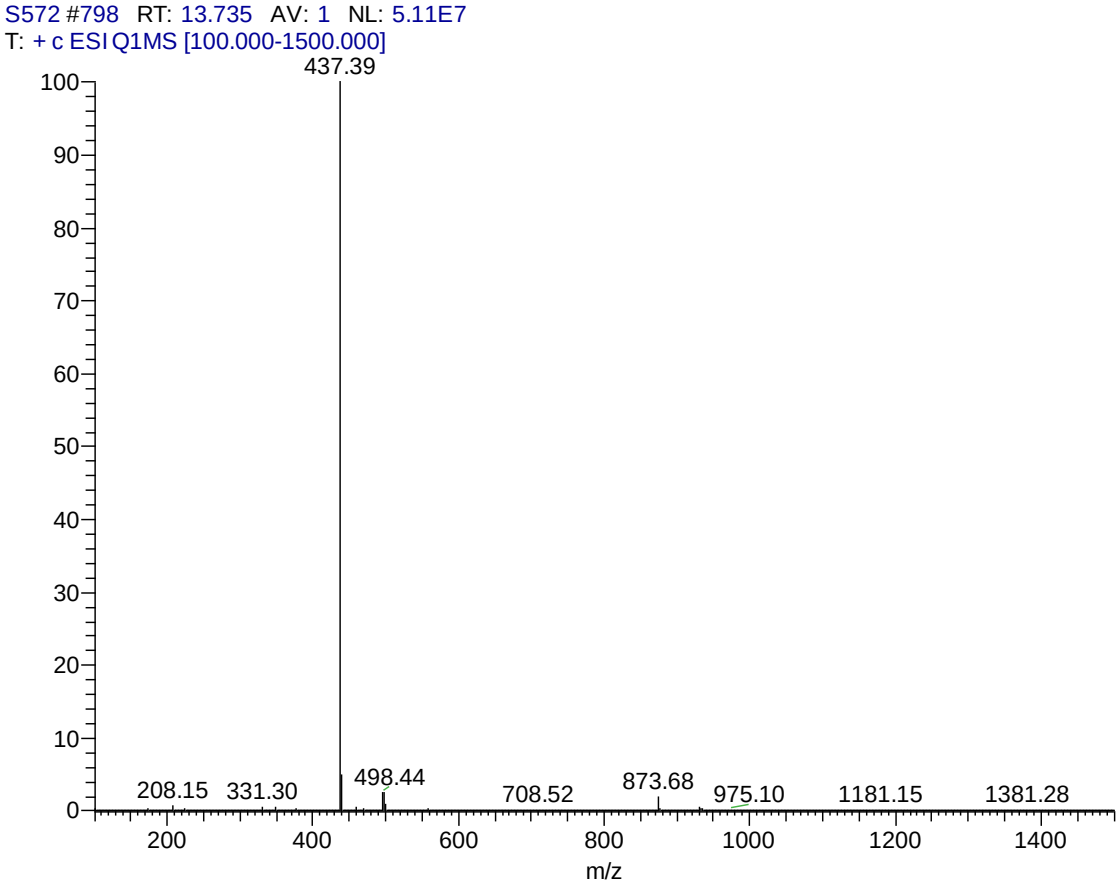
MS Spectrum for 4.28d:



HPLC Spectrum for 4.34:

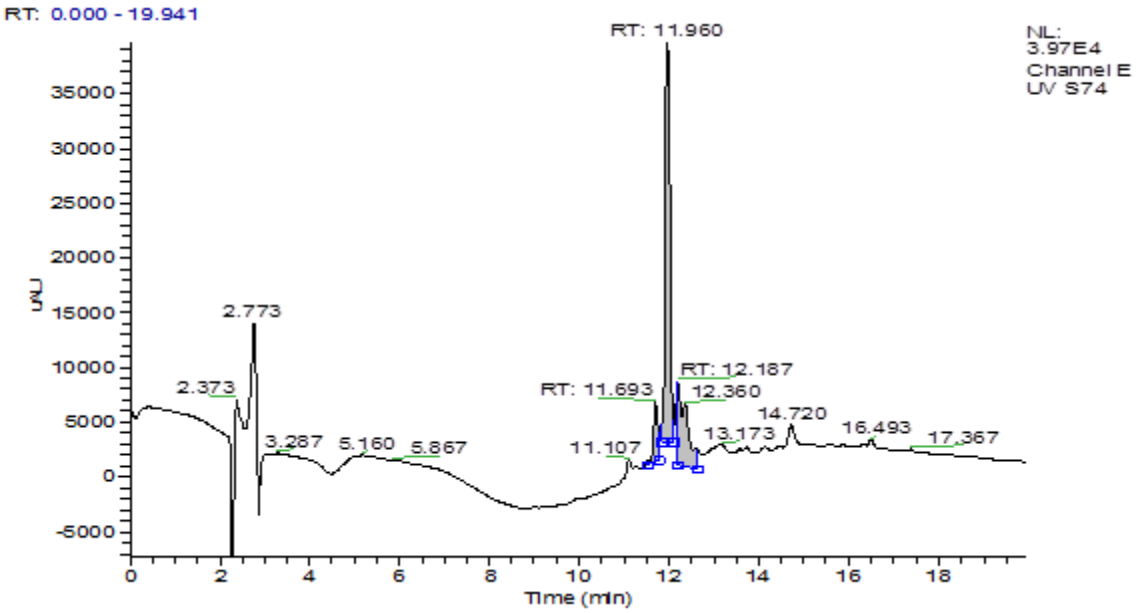


MS Spectrum for 4.34:

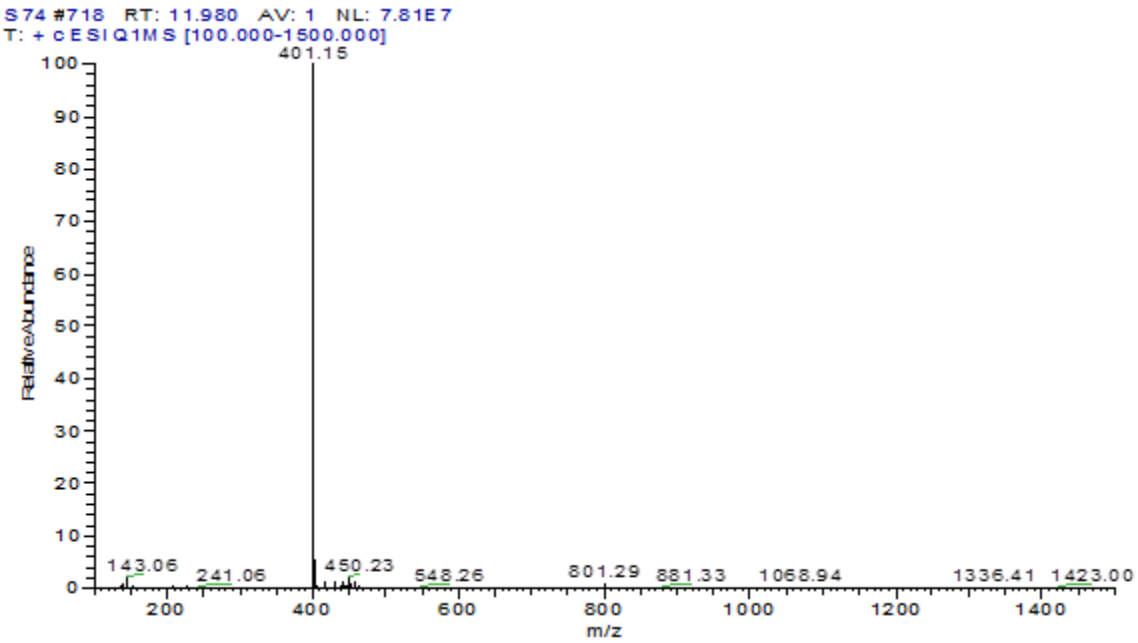


Appendix H HPLC and MS Spectra for Chapter 5

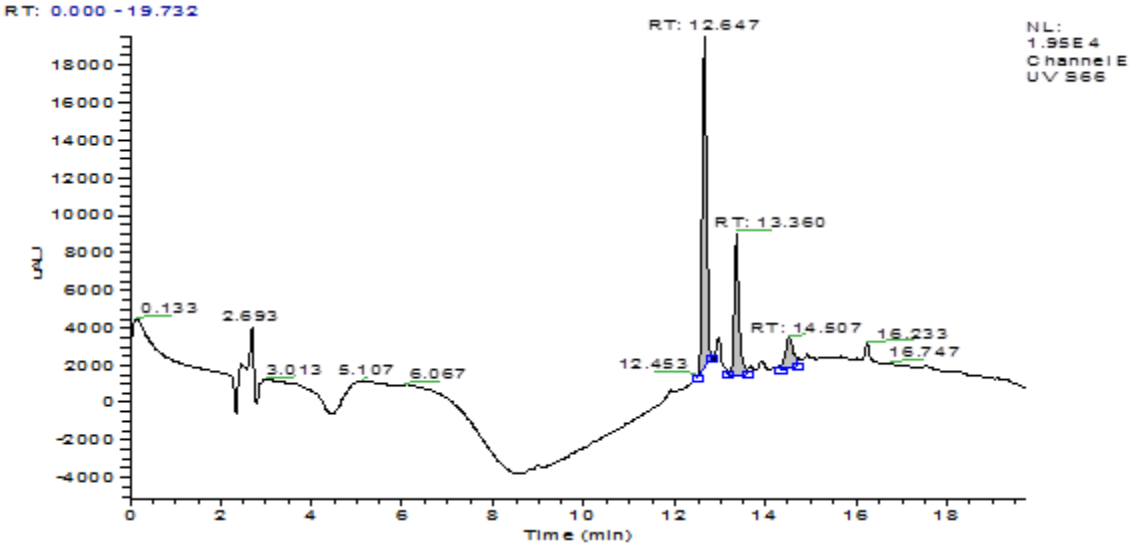
HPLC Spectrum for 5.4a:



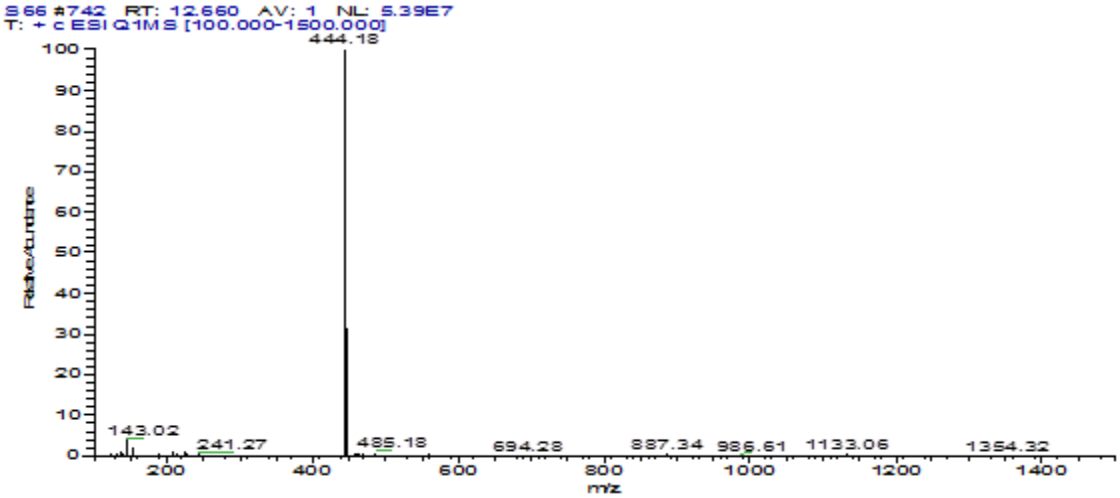
MS Spectrum for 5.4a:



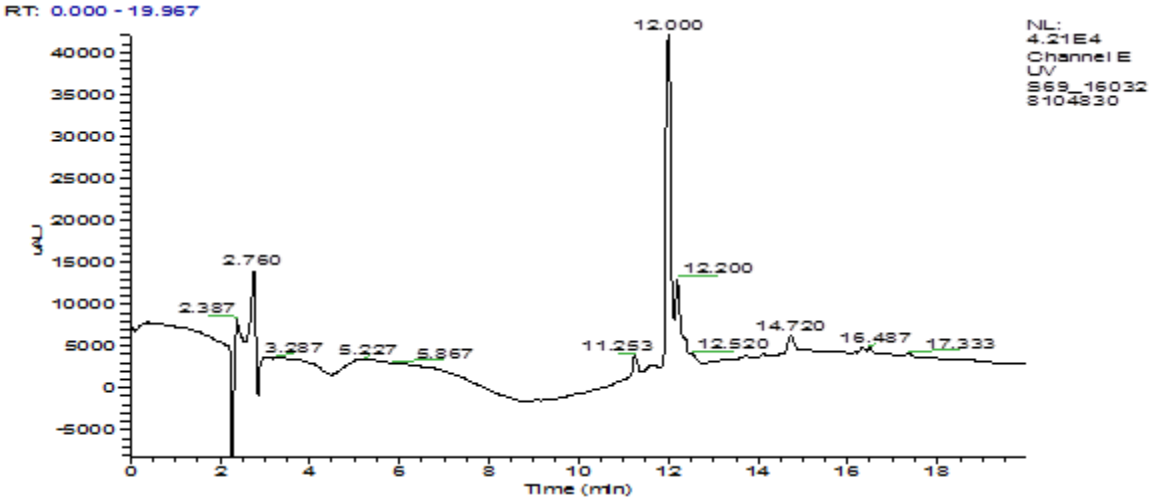
HPLC Spectrum for 5.4b:



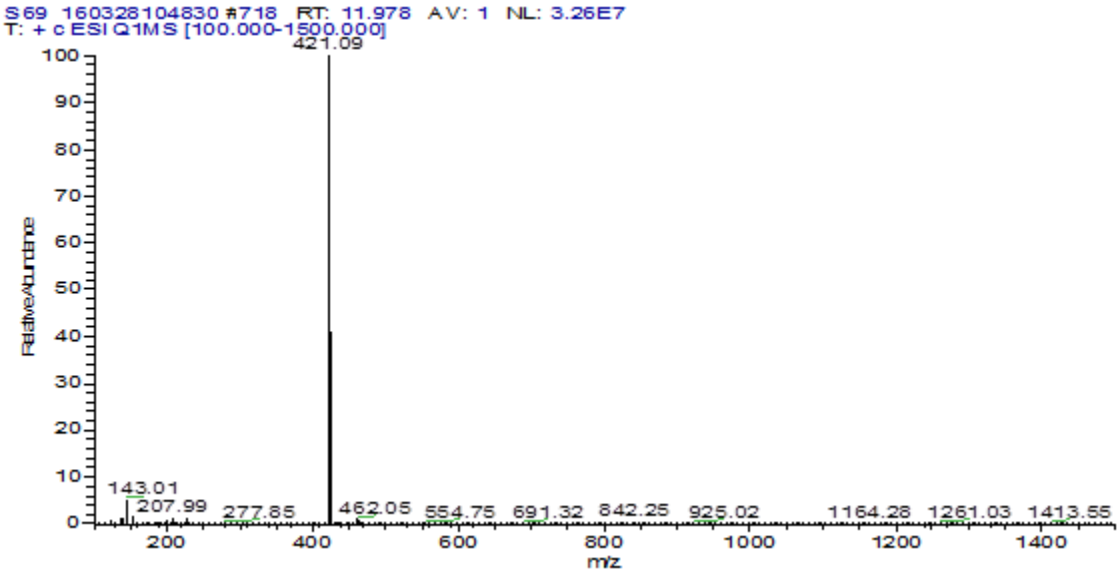
MS Spectrum for 5.4b:



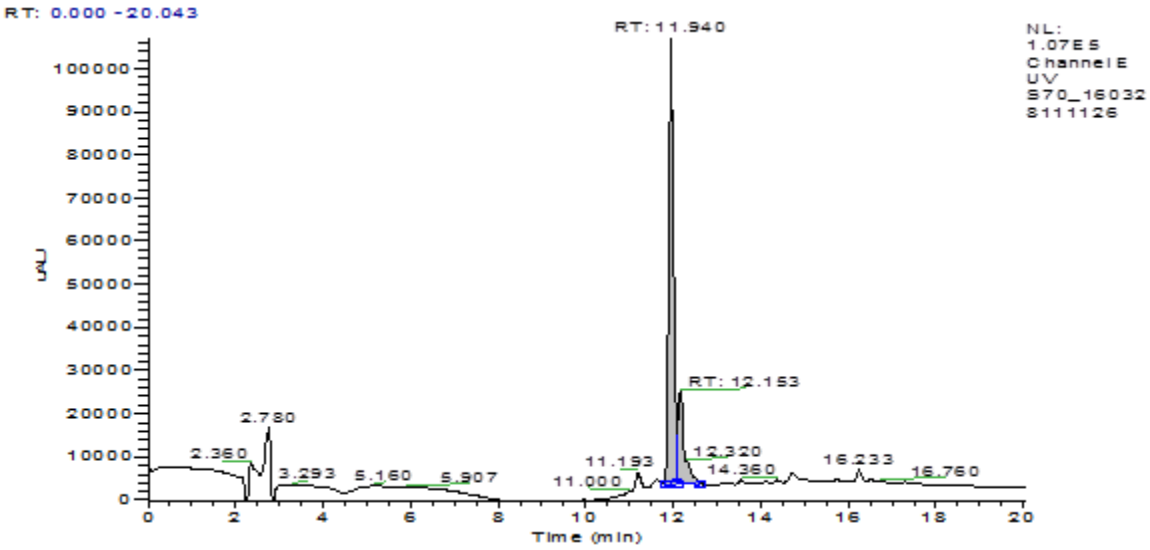
HPLC Spectrum for 5.4c:



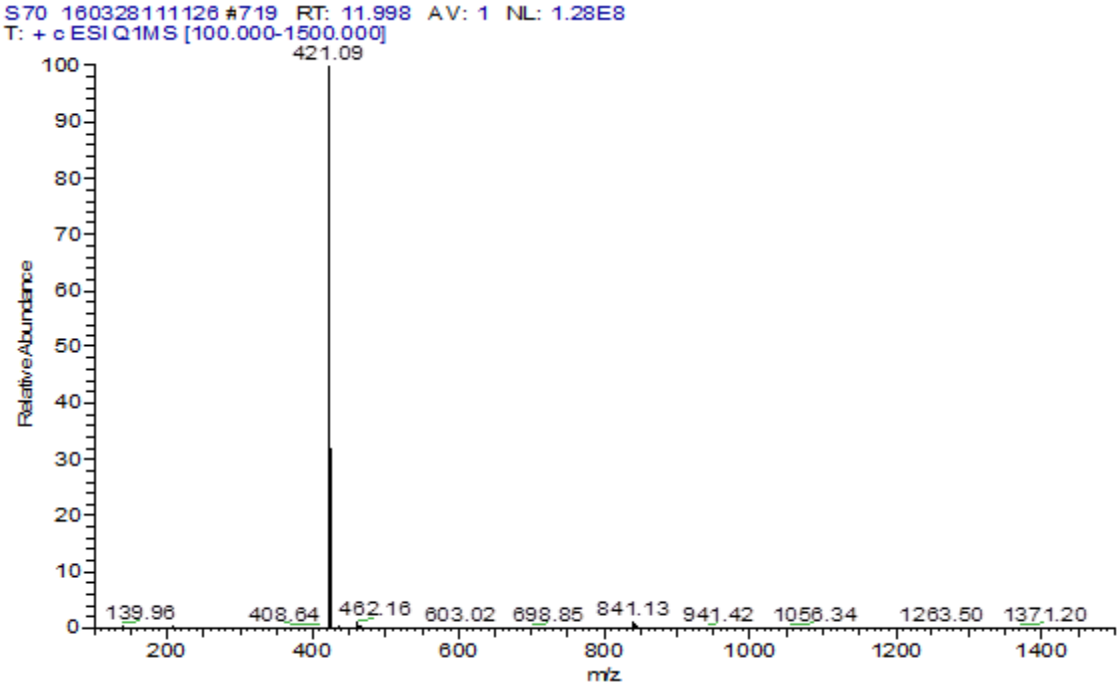
MS Spectrum for 5.4c:



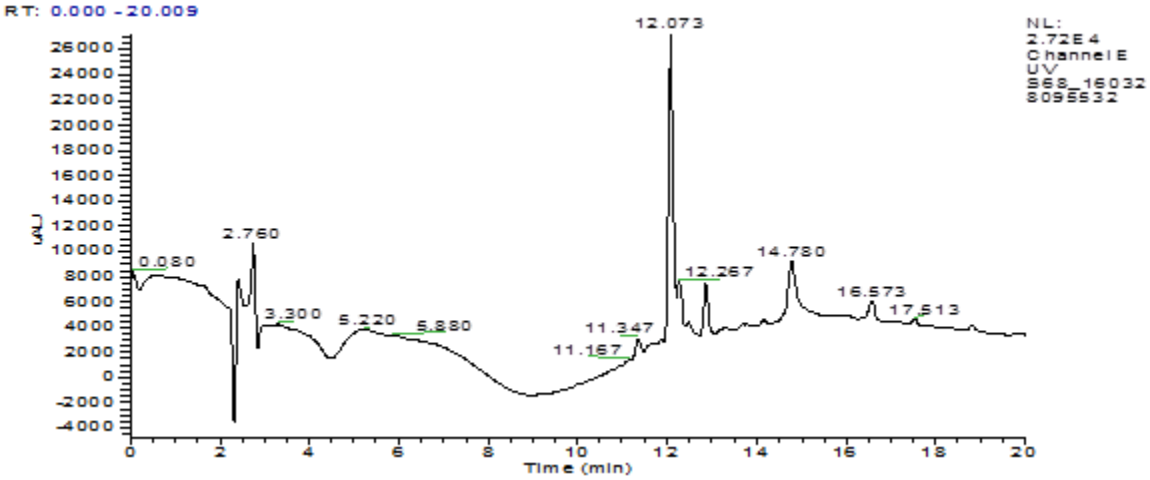
HPLC Spectrum for 5.4d:



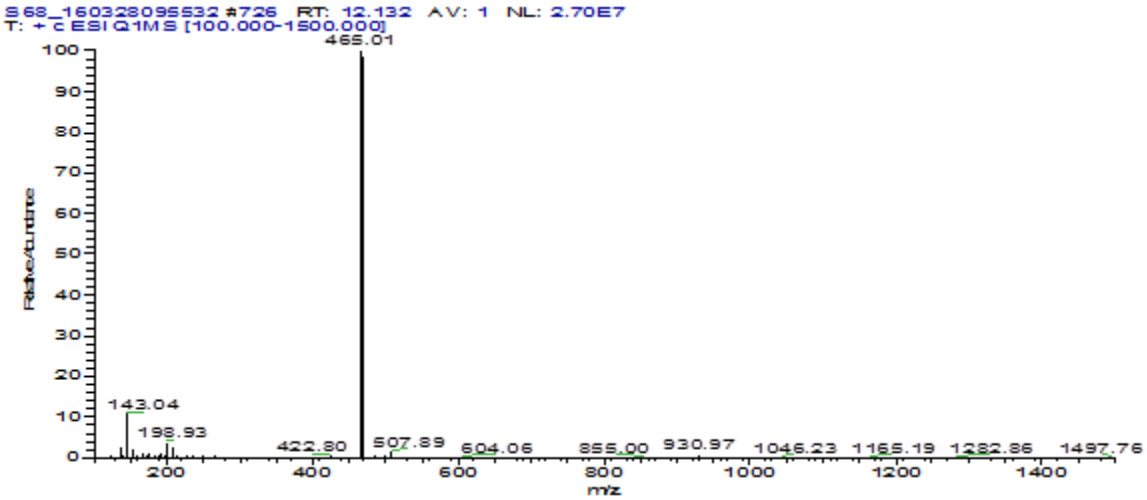
MS Spectrum for 5.4d:



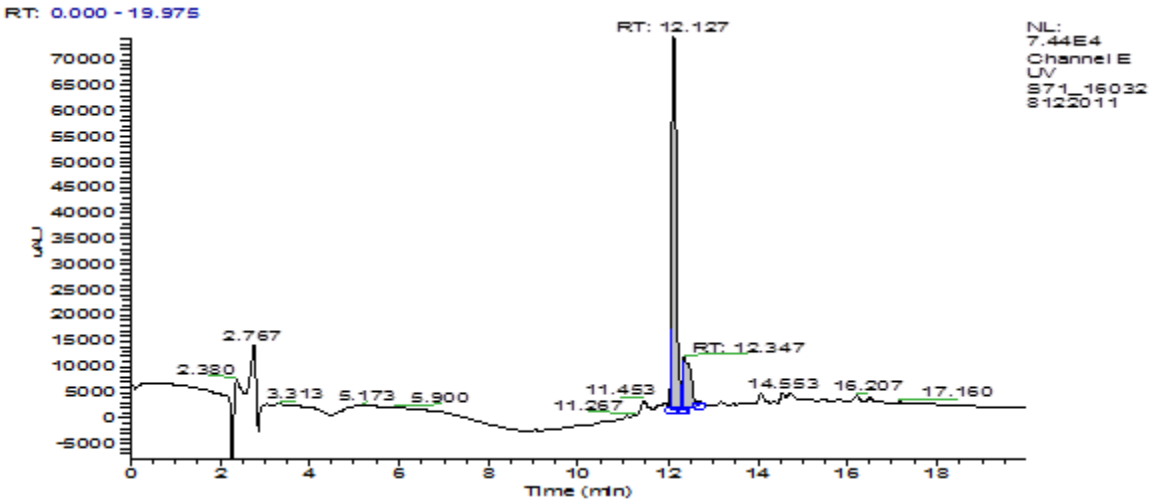
HPLC Spectrum for 5.4f:



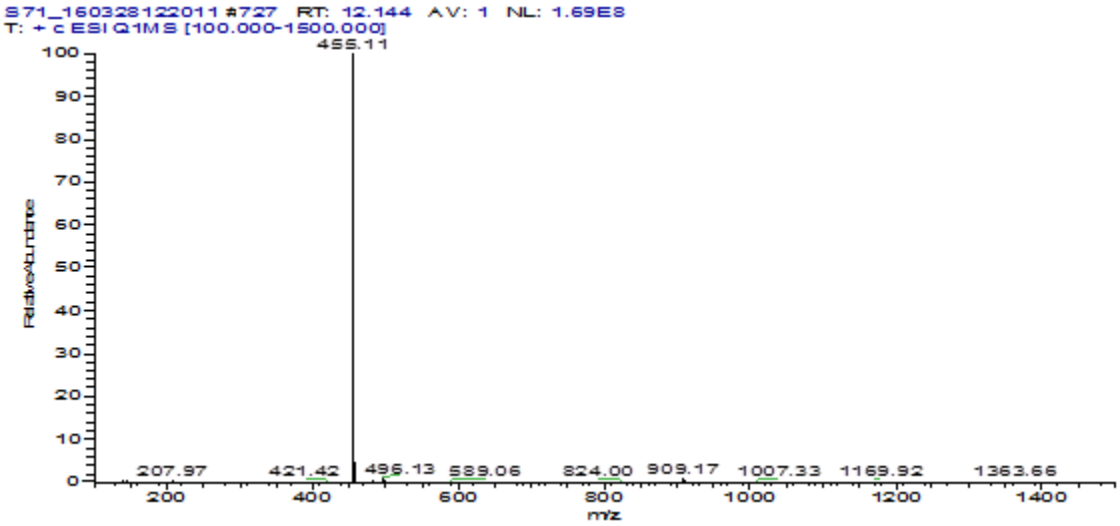
MS Spectrum for 5.4f:



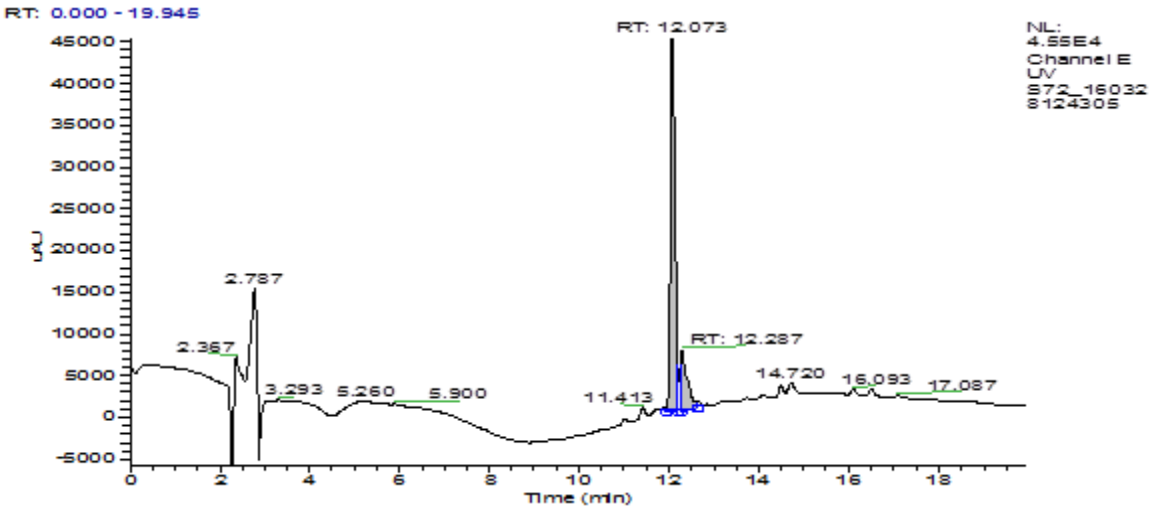
HPLC Spectrum for 5.4g:



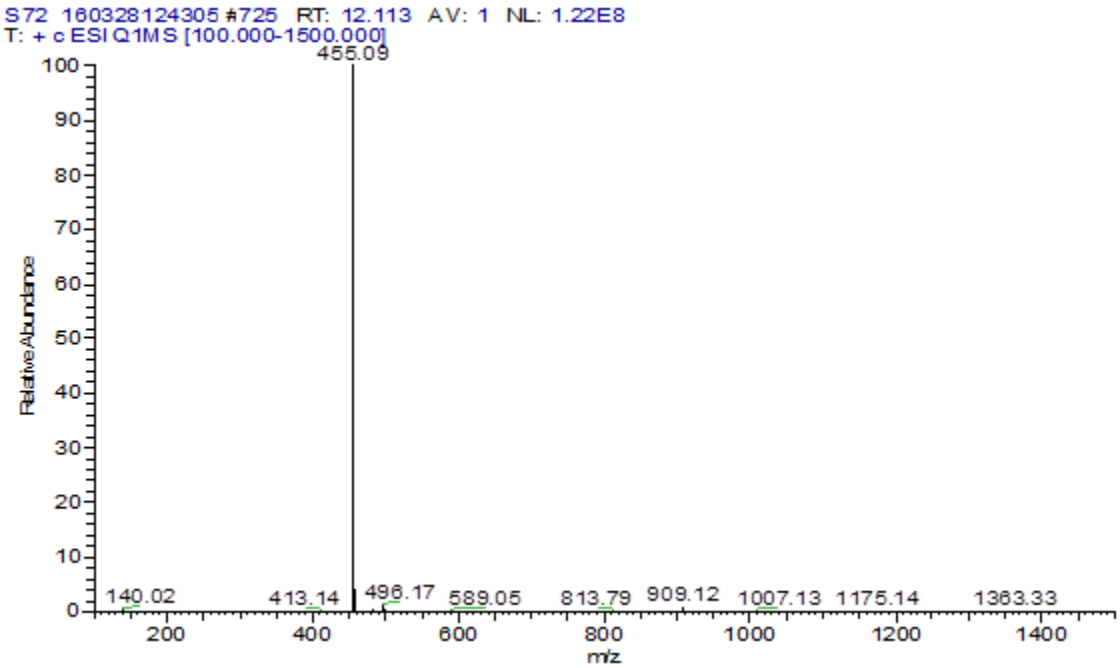
MS Spectrum for 5.4g:



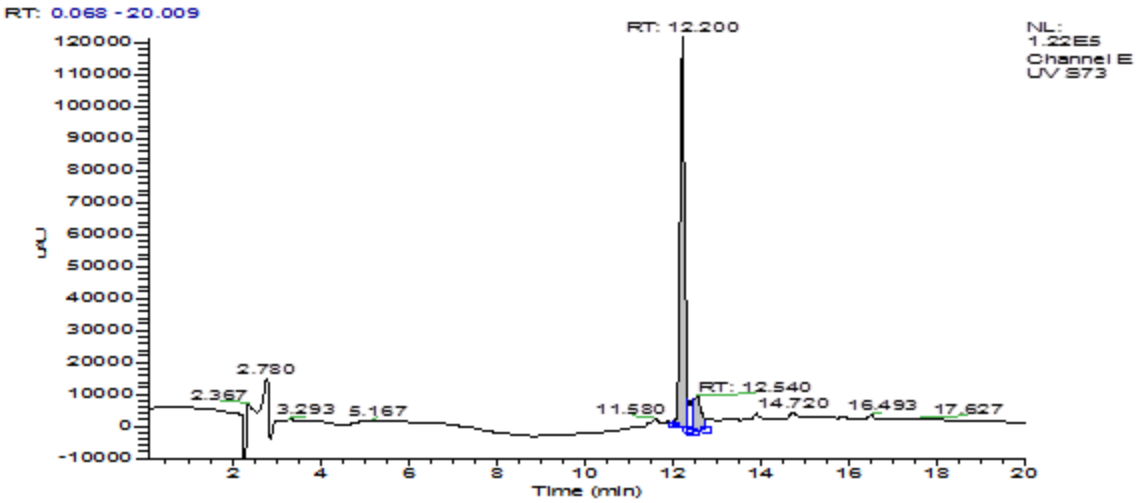
HPLC Spectrum for 5.4h:



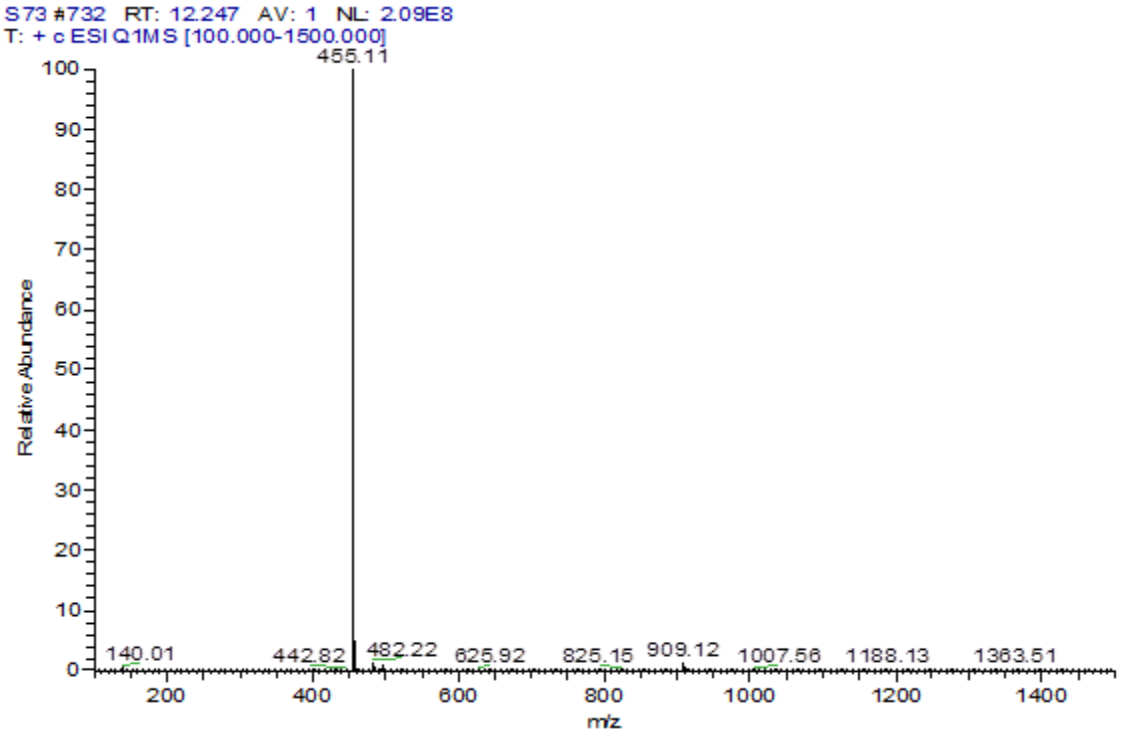
MS Spectrum for 5.4h:



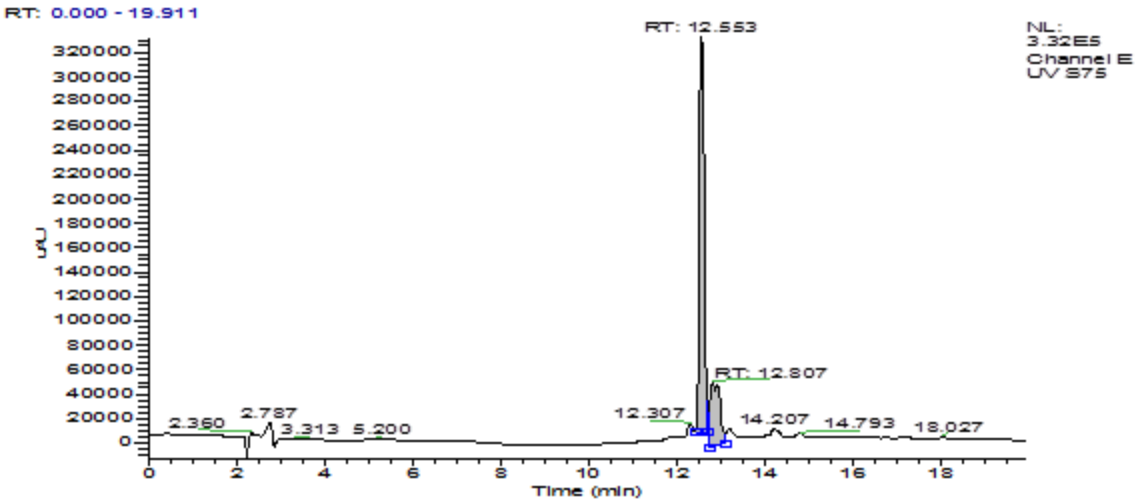
HPLC Spectrum for 5.4i:



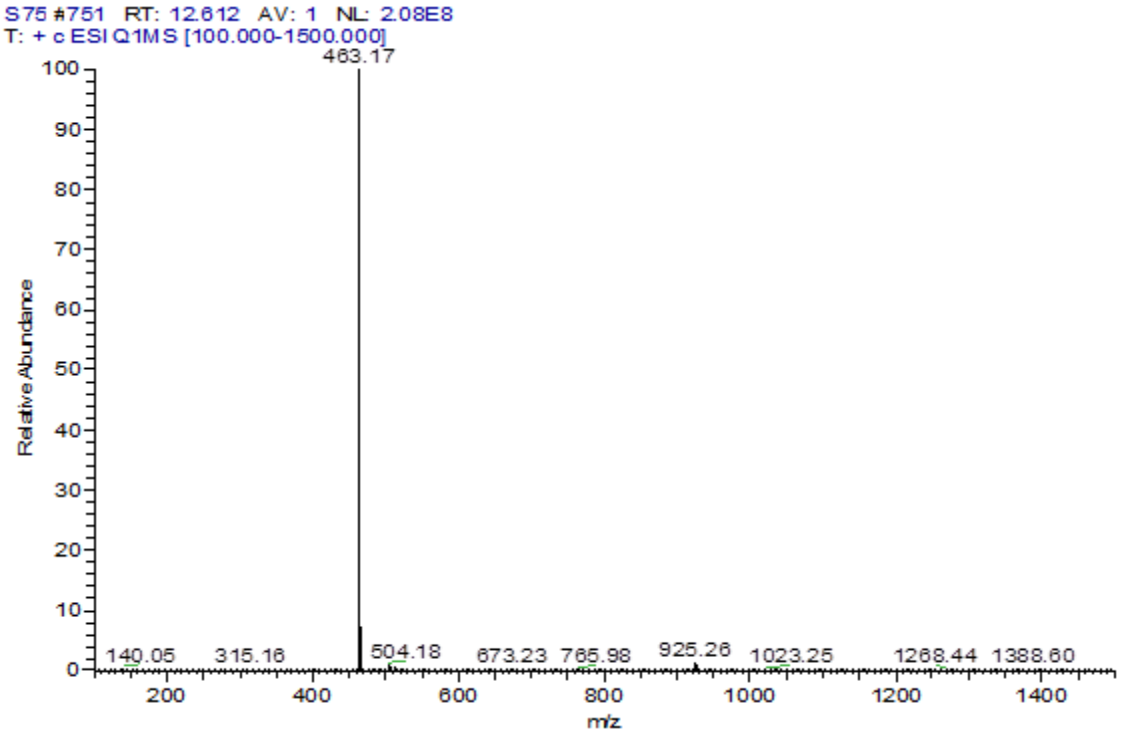
MS Spectrum for 5.4i:



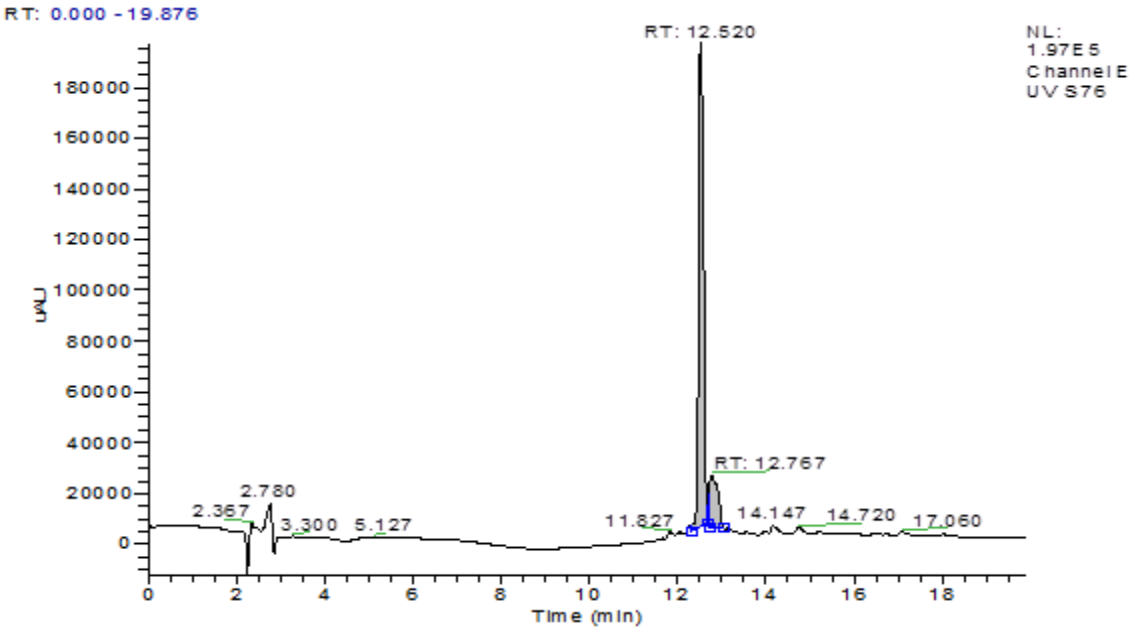
HPLC Spectrum for 5.4j:



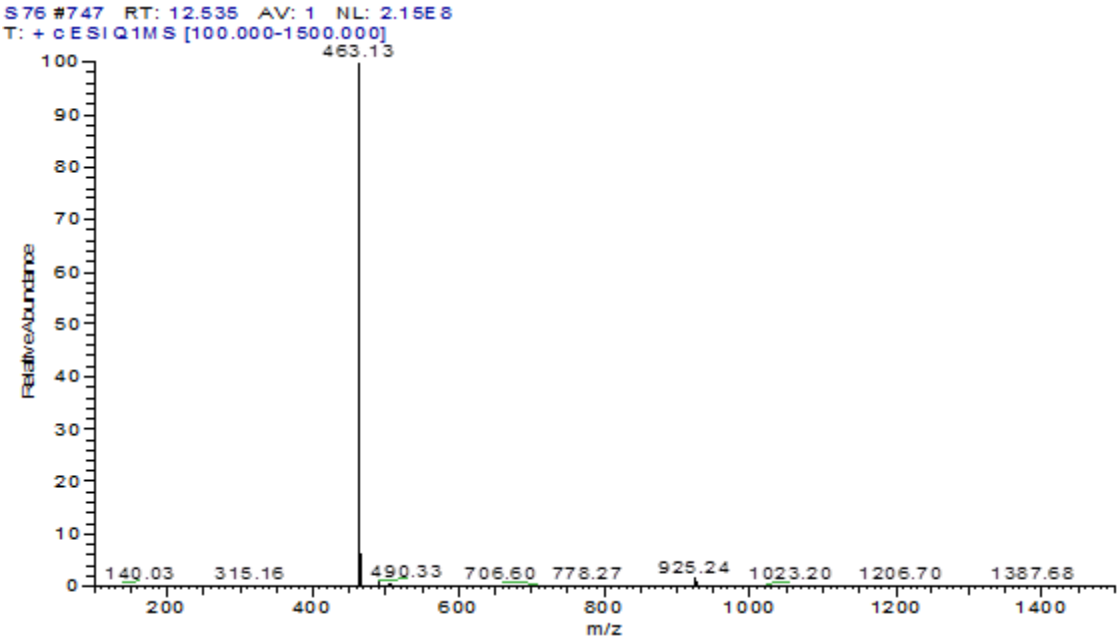
MS Spectrum for 5.4j:



HPLC Spectrum for 5.4k:



MS Spectrum for 5.4k:



Appendix I Permission Documents

Figure 1.3. Signaling and Regulation of Sphingosine Kinase 2

This Agreement between Molly D Congdon ("You") and John Wiley and Sons ("John Wiley and Sons") consists of your license details and the terms and conditions provided by John Wiley and Sons and Copyright Clearance Center.

Get the printable license.

License Number	3865510747598
License date	May 10, 2016
Licensed Content Publisher	John Wiley and Sons
Licensed Content Publication	FEBS Journal
Licensed Content Title	Roles, regulation and inhibitors of sphingosine kinase 2
Licensed Content Author	Heidi A. Neubauer,Stuart M. Pitson
Licensed Content Date	Jun 7, 2013
Licensed Content Pages	20
Type of Use	Dissertation/Thesis
Requestor type	University/Academic
Format	Print and electronic
Portion	Figure/table
Number of figures/tables	1
Original Wiley figure/table number(s)	Figure 4. Signalling and Regulation of SphK2
Will you be translating?	No
Title of your thesis / dissertation	Structure-Activity Relationship Studies and Molecular Modeling of Sphingosine Kinase 2 Inhibitors
Expected completion date	May 2016
Expected size (number of pages)	300
Requestor Location	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Publisher Tax ID	EU826007151
Billing Type	Invoice
Billing address	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Total	**0.00 USD**

Figure 1.6. Intracellular Inflammatory Pathways Involving Sphingolipids

Order Completed

Thank you for your order.

This Agreement between Molly D Congdon ("You") and John Wiley and Sons ("John Wiley and Sons") consists of your license details and the terms and conditions provided by John Wiley and Sons and Copyright Clearance Center.

Your confirmation email will contain your order number for future reference.

Get the printable license.

License Number	3921451382929
License date	Aug 03, 2016
Licensed Content Publisher	John Wiley and Sons
Licensed Content Publication	British Journal of Pharmacology
Licensed Content Title	Sphingolipids in inflammation: pathological implications and potential therapeutic targets
Licensed Content Author	Graeme F. Nixon
Licensed Content Date	Jun 25, 2009
Licensed Content Pages	12
Type of use	Dissertation/Thesis
Requestor type	University/Academic
Format	Print and electronic
Portion	Figure/table
Number of figures/tables	1
Original Wiley figure/table number(s)	Figure 2
Will you be translating?	No
Title of your thesis / dissertation	Structure-Activity Relationship Studies and Molecular Modeling of Sphingosine Kinase 2 Inhibitors
Expected completion date	May 2016
Expected size (number of pages)	300
Requestor Location	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Publisher Tax ID	EU826007151
Billing Type	Invoice
Billing address	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Total	0.00 USD

Figure 1.7. S1P and S1P1 Control Lymphocyte Trafficking and Vascular Integrity

This Agreement between Molly D Congdon ("You") and Nature Publishing Group ("Nature Publishing Group") consists of your license details and the terms and conditions provided by Nature Publishing Group and Copyright Clearance Center.

Get the printable license.

License Number	3865060332541
License date	May 09, 2016
Licensed Content Publisher	Nature Publishing Group
Licensed Content Publication	Nature
Licensed Content Title	Sphingolipid metabolites in inflammatory disease
Licensed Content Author	Michael Maceyka, Sarah Spiegel
Licensed Content Date	Jun 4, 2014
Licensed Content Volume	510
Licensed Content Issue	7503
Type of Use	reuse in a dissertation / thesis
Requestor type	academic/educational
Format	print and electronic
Portion	figures/tables/illustrations
Number of figures/tables/illustrations	1
High-res required	no
Figures	Figure 3.A
Author of this NPG article	no
Your reference number	
Title of your thesis / dissertation	Structure-Activity Relationship Studies and Molecular Modeling of Sphingosine Kinase 2 Inhibitors
Expected completion date	May 2016
Estimated size (number of pages)	300
Requestor Location	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Billing Type	Invoice
Billing address	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Total	**0.00 USD**

Figure 1.8. The Janus-faced Effects of Intracellular and Extracellular S1P on the Expression of Pro-fibrotic Connective Tissue Growth Factor

Order Completed

Thank you for your order.

This Agreement between Molly D Congdon ("You") and Elsevier ("Elsevier") consists of your license details and the terms and conditions provided by Elsevier and Copyright Clearance Center.

Your confirmation email will contain your order number for future reference.

Get the printable license.

License Number	3921460605190
License date	Aug 03, 2016
Licensed Content Publisher	Elsevier
Licensed Content Publication	Biochimica et Biophysica Acta (BBA) - Molecular and Cell Biology of Lipids
Licensed Content Title	Sphingosine-1-phosphate: A Janus-faced mediator of fibrotic diseases
Licensed Content Author	Stephanie Schwalm,Josef Pfeilschifter,Andrea Huwiler
Licensed Content Date	January 2013
Licensed Content Volume	1831
Licensed Content Issue	1
Licensed Content Pages	12
Type of Use	reuse in a thesis/dissertation
Portion	figures/tables/illustrations
Number of figures/tables/illustrations	1
Format	both print and electronic
Are you the author of this Elsevier article?	No
Will you be translating?	No
Order reference number	
Original figure numbers	Figure 1 Effects of Intracellular and Extracellular S1P
Title of your thesis/dissertation	Structure-Activity Relationship Studies and Molecular Modeling of Sphingosine Kinase 2 Inhibitors
Expected completion date	May 2016
Estimated size (number of pages)	300
Elsevier VAT number	GB 494 6272 12
Requestor Location	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Total	0.00 USD

Figure 1.9. Methods in which Infectious Pathogens Manipulate Sphingolipid Signaling

This Agreement between Molly D Congdon ("You") and Elsevier ("Elsevier") consists of your license details and the terms and conditions provided by Elsevier and Copyright Clearance Center.

Get the printable license.

License Number	3874951114633
License date	May 23, 2016
Licensed Content Publisher	Elsevier
Licensed Content Publication	Drug Discovery Today
Licensed Content Title	Sphingosine-1-phosphate signaling: unraveling its role as a drug target against infectious diseases
Licensed Content Author	Mohd Arish,Atahar Husein,Mohammad Kashif,Mohammed Saleem,Yusuf Akhter,Abdur Rub
Licensed Content Date	January 2016
Licensed Content Volume	21
Licensed Content Issue	1
Type of Use	reuse in a thesis/dissertation
Portion	figures/tables/illustrations
Number of figures/tables/illustrations	1
Format	both print and electronic
Are you the author of this Elsevier article?	No
Will you be translating?	No
Order reference number	
Original figure numbers	Figure 2
Title of your thesis/dissertation	Structure-Activity Relationship Studies and Molecular Modeling of Sphingosine Kinase 2 Inhibitors
Expected completion date	May 2016
Estimated size (number of pages)	300
Elsevier VAT number	GB 494 6272 12
Requestor Location	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Billing Type	Invoice
Billing address	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon

Figure 1.11. Complex of S1P with mAb Fab

From: PNAS Permissions <PNASPermissions@nas.edu>
Sent: May 10, 2016
To: me
Subject: Request to Reprint a Figure in a Dissertation

Permission is granted for your use of the figure as described in your message. Please cite the PNAS article in full when re-using the material. Because this material published after 2008, a copyright note is not needed. There is no charge for this material, either. Let us know if you have any questions.

Best regards,
Kay McLaughlin for
Diane Sullenberger
Executive Editor
PNAS

From: Molly Congdon [mailto:mcongdon@vt.edu]
Sent: Monday, May 09, 2016 8:22 PM
To: PNAS Permissions
Subject: Request to Reprint a Figure in a Dissertation

To Whom It May Concern,

I am interested in using a figure from Wojciak, J.M. et al., PNAS, 2009, 106 (42) for my dissertation. I have included the required information below. Please let me know if it is possible for me to use the figure and if there are any specific formatting requirements for the citation.

1. Molly D. Congdon, Virginia Tech Graduate Student, PhD. Candidate
2. Molly Congdon 2300 Foxhunt Ln. Apt D. Blacksburg VA. 24060 phone: 540-552-1572, email: mcongdon@vt.edu
3. PNAS vol. 106 no. 42 October 20, 2009
4. The crystal structure of sphingosine-1-phosphate in complex with a Fab fragment reveals metal bridging of an antibody and its antigen
5. Jonathan M. Wojciak, Norman Zhu, Karen T. Schuerenberg, Kelli Moreno, William S. Shestowsky, Masao Hiraiwa, Roger Sabbadini, and Tom Huxford
6. Page number 17719
7. Figure 2

Intended use of the Material

1. Structure-Activity Relationship Studies and Molecular Modeling of Sphingosine Kinase 2 Inhibitors
2. Molly D. Congdon
3. Molly D. Congdon
4. $0.00

5. 5 copies will be produced
6. Work is for personal use and my PhD. Committee
7. Work is a PhD. dissertation/thesis

Sincerely,
Molly D Congdon

Figure 1.15. SI-II Bound in hSphK Isoform 3

This Agreement between Molly D Congdon ("You") and Elsevier ("Elsevier") consists of your license details and the terms and conditions provided by Elsevier and Copyright Clearance Center.

Get the printable license.

License Number	3864960914703
License date	May 09, 2016
Licensed Content Publisher	Elsevier
Licensed Content Publication	Structure
Licensed Content Title	Molecular Basis of Sphingosine Kinase 1 Substrate Recognition and Catalysis
Licensed Content Author	Zhulun Wang,Xiaoshan Min,Shou-Hua Xiao,Sheree Johnstone,William Romanow,David Meininger,Haoda Xu,Jinsong Liu,Jessica Dai,Songzhu An,Stephen Thibault,Nigel Walker
Licensed Content Date	7 May 2013
Licensed Content Volume	21
Licensed Content Issue	5
Type of Use	reuse in a thesis/dissertation
Portion	figures/tables/illustrations
Number of figures/tables/illustrations	1
Format	both print and electronic
Are you the author of this Elsevier article?	No
Will you be translating?	No
Order reference number	
Original figure numbers	Figure 5.C
Title of your thesis/dissertation	Structure-Activity Relationship Studies and Molecular Modeling of Sphingosine Kinase 2 Inhibitors
Expected completion date	May 2016
Estimated size (number of pages)	300
Elsevier VAT number	GB 494 6272 12
Requestor Location	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Billing Type	Invoice
Billing address	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States

Figure 1.17 Amgen 82 Bound in hSphK1

Order Completed

Thank you for your order.

This Agreement between Molly D Congdon ("You") and Elsevier ("Elsevier") consists of your license details and the terms and conditions provided by Elsevier and Copyright Clearance Center.

Your confirmation email will contain your order number for future reference.

Get the printable license.

License Number	3921461039078
License date	Aug 03, 2016
Licensed Content Publisher	Elsevier
Licensed Content Publication	Bioorganic & Medicinal Chemistry Letters
Licensed Content Title	Structure guided design of a series of sphingosine kinase (SphK) inhibitors
Licensed Content Author	Darin J. Gustin,Yihong Li,Matthew L. Brown,Xiaoshan Min,Mike J. Schmitt,Malgorzata Wanska,Xiaodong Wang,Richard Connors,Sheere Johnstone,Mario Cardozo,Alan C. Cheng,Shawn Jeffries,Brendon Franks,Shyun Li,Shanling Shen,Mariwil Wong,Holger Wesche et al.
Licensed Content Date	15 August 2013
Licensed Content Volume	23
Licensed Content Issue	16
Licensed Content Pages	9
Type of Use	reuse in a thesis/dissertation
Portion	figures/tables/illustrations
Number of figures/tables/illustrations	1
Format	both print and electronic
Are you the author of this Elsevier article?	No
Will you be translating?	No
Order reference number	
Original figure numbers	Figure 5 82 bound in SphK1
Title of your thesis/dissertation	Structure-Activity Relationship Studies and Molecular Modeling of Sphingosine Kinase 2 Inhibitors
Expected completion date	May 2016
Estimated size (number of pages)	300
Elsevier VAT number	GB 494 6272 12
Requestor Location	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Total	0.00 USD

Figure 1.18. PF543 Bound to hSphK1 Isoform 2

Letter

Crystal Structure of Sphingosine Kinase 1 with PF-543

Jing Wang[†], Stefan Knapp[†‡], Nigel J. Pyne[§], Susan Pyne[§], and Jonathan M. Elkins[*†]
[†] Structural Genomics Consortium, University of Oxford, Old Road Campus Research Building, Old Road Campus, Roosevelt Drive, Oxford OX3 7DQ, U.K.
[‡] Target Discovery Institute, University of Oxford, NDM Research Building, Old Road Campus, Roosevelt Drive, Oxford OX3 7FZ, U.K.
[§] Cell Biology Group, Strathclyde Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, Glasgow G4 0RE, U.K.

ACS Med. Chem. Lett., **2014**, *5* (12), pp 1329–1333
DOI: 10.1021/ml5004074
Publication Date (Web): October 27, 2014

*E-mail: jon.elkins@sgc.ox.ac.uk.

Chapter 2 – Complete Chapter

Order Completed

Thank you for your order.

This Agreement between ("You") and Elsevier ("Elsevier") consists of your order details and the terms and conditions provided by Elsevier and Copyright Clearance Center.

License number	Reference confirmation email for license number
License date	Sep 13, 2015
Licensed Content Publisher	Elsevier
Licensed Content Publication	Bioorganic & Medicinal Chemistry Letters
Licensed Content Title	Structure–activity relationship studies of the lipophilic tail region of sphingosine kinase 2 inhibitors
Licensed Content Author	Molly D. Congdon,Elizabeth S. Childress,Neeraj N. Patwardhan,James Gumkowski,Emily A. Morris,Yugesh Kharel,Kevin R. Lynch,Webster L. Santos
Licensed Content Date	Available online 23 March 2015
Licensed Content Volume	n/a
Licensed Content Issue	n/a
Type of Use	reuse in a thesis/dissertation
Portion	full article
Format	both print and electronic
Are you the author of this Elsevier article?	Yes
Will you be translating?	No
Order reference number	
Title of your thesis/dissertation	Structure–activity relationship studies of sphingosine kinase 2 inhibitors
Expected completion date	Dec 2015
Elsevier VAT number	GB 494 6272 12
Billing Type	Invoice
Billing address	Molly D Congdon Dept. of Chemistry Virginia Tech 306 Hahn Hall North BLACKSBURG, VA 24061 United States Attn: Molly D Congdon
Total	0.00 USD

CLOSE WINDOW

Chapter 3– SphK Isoform Selective Naphthalene SAR Portion of Chapter

Copyright Clearance Center RightsLink®

Home | Account Info | Help | Live Chat

ACS Publications
Most Trusted. Most Cited. Most Read.

Title: Structure–Activity Relationship Studies and Molecular Modeling of Naphthalene-Based Sphingosine Kinase 2 Inhibitors

Author: Molly D. Congdon, Yugesh Kharel, Anne M. Brown, et al

Publication: ACS Medicinal Chemistry Letters

Publisher: American Chemical Society

Date: Mar 1, 2016

Logged in as:
Molly Congdon
Account #:
3000945178

LOGOUT

PERMISSION/LICENSE IS GRANTED FOR YOUR ORDER AT NO CHARGE

This type of permission/license, instead of the standard Terms & Conditions, is sent to you because no fee is being charged for your order. Please note the following:

- Permission is granted for your request in both print and electronic formats, and translations.
- If figures and/or tables were requested, they may be adapted or used in part.
- Please print this page for your records and send a copy of it to your publisher/graduate school.
- Appropriate credit for the requested material should be given as follows: "Reprinted (adapted) with permission from (COMPLETE REFERENCE CITATION). Copyright (YEAR) American Chemical Society." Insert appropriate information in place of the capitalized words.
- One-time permission is granted only for the use specified in your request. No additional uses are granted (such as derivative works or other editions). For any other uses, please submit a new request.

BACK | CLOSE WINDOW

Chapter 3– Understanding the Role of S1P Portion of Chapter

ASPET
Transforming Discoveries into Therapies

September 15, 2015

Molly Congdon
Chemistry Department
Virginia Tech
900 West Campus Drive
Blacksburg, VA 24061

Email: mcongdon@vt.edu

Dear Molly Congdon:

This is to grant you permission to include the following article in your dissertation entitled "Structure-Activity Relationship Studies of Sphingosine Kinase 2 Inhibitors" for Virginia Tech:

> Yugesh Kharel, Emily A. Morris, Molly D. Congdon, Steven B. Thorpe, Jose L. Tomsig, Webster L. Santos, and Kevin R. Lynch, Sphingosine Kinase 2 Inhibition and Blood Sphingosine 1-Phosphate Levels, *J Pharmacol Exp Ther* October 2015 355:23-31

On the first page of each copy of this article, please add the following:

> Reprinted with permission of the American Society for Pharmacology and Experimental Therapeutics. All rights reserved.

In addition, the original copyright line published with the paper must be shown on the copies included with your thesis.

Sincerely yours,

Richard Dodenhoff
Journals Director