

Supplementary Information

An Efficient Synthesis of Novel Bis-Chalcones and Bis-Pyrazolines in the Presence of Cellulose Sulfuric Acid as Biodegradable Catalyst under Solvent-Free Conditions

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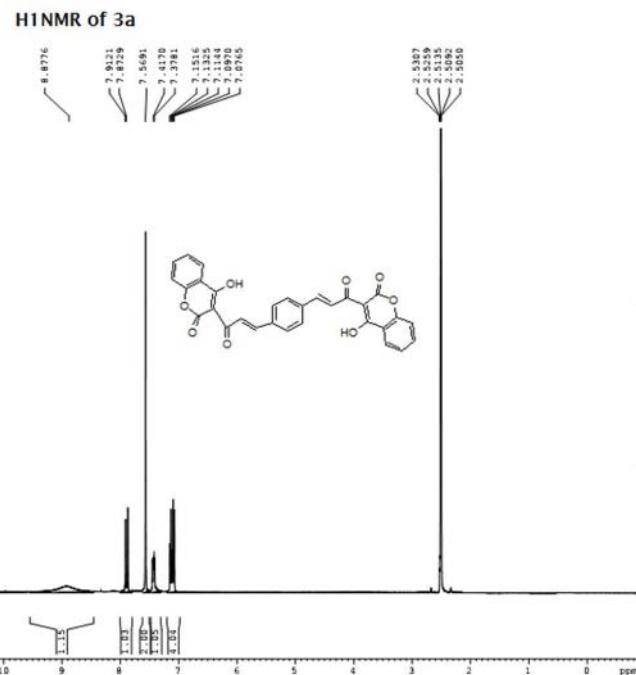
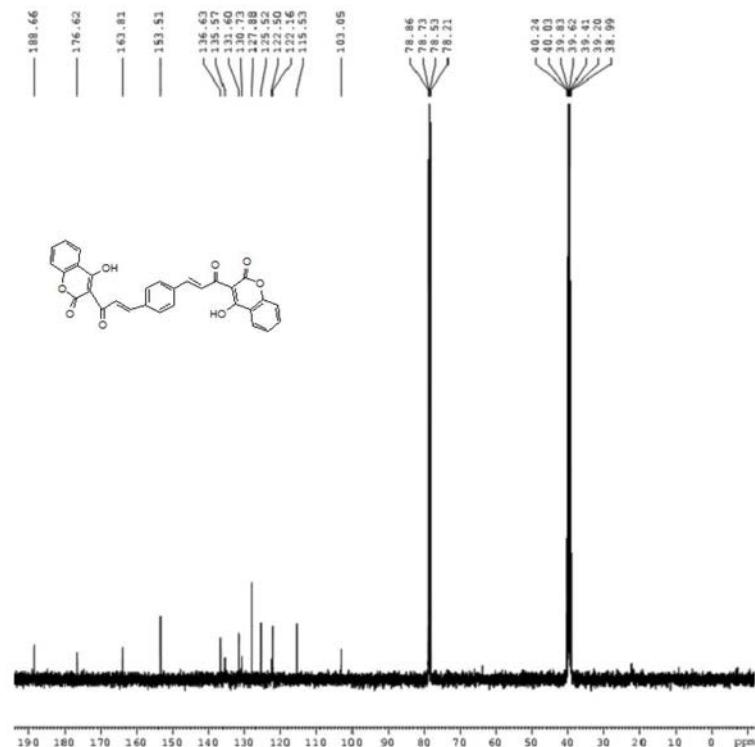
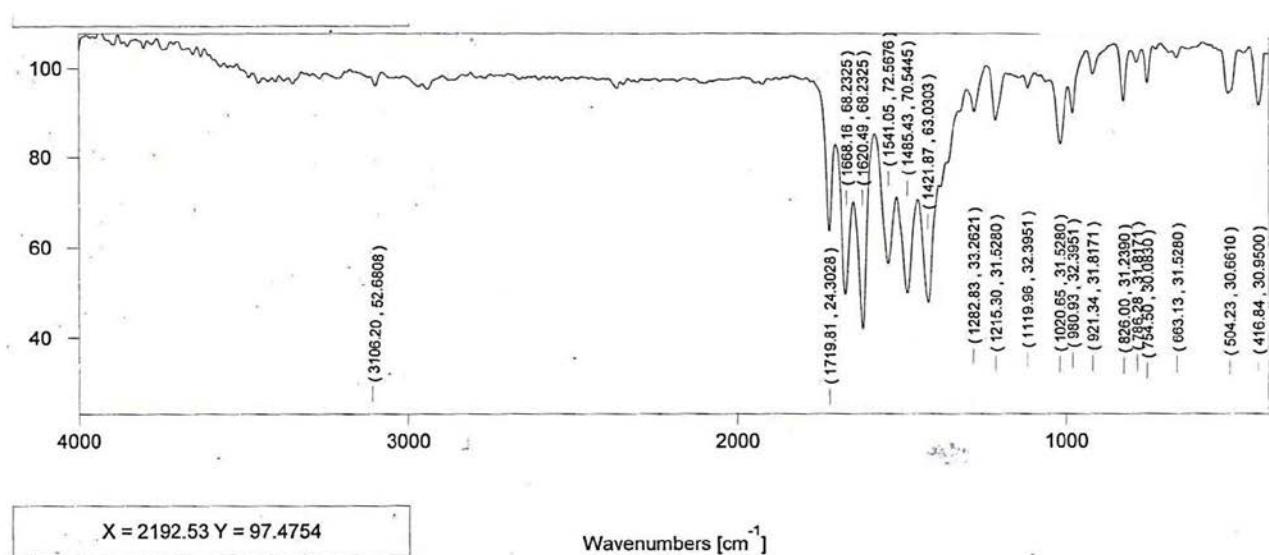


Figure S1. ¹H NMR (DMSO-*d*₆, 400 MHz) spectrum of compound 3a.

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C13NMR of 3a**Figure S2.** ^{13}C NMR (DMSO- d_6 , 100 MHz) spectrum of compound 3a.**Figure S3.** FT-IR (KBr) spectrum of compound 3a.

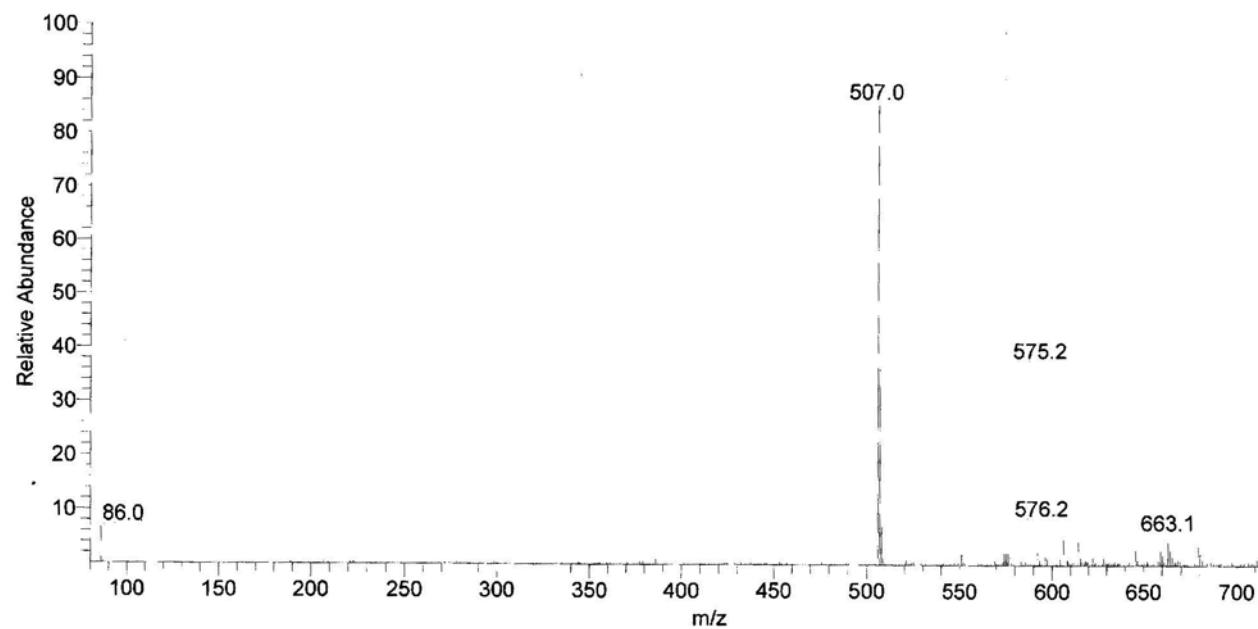


Figure S4. MS spectrum of compound 3a.

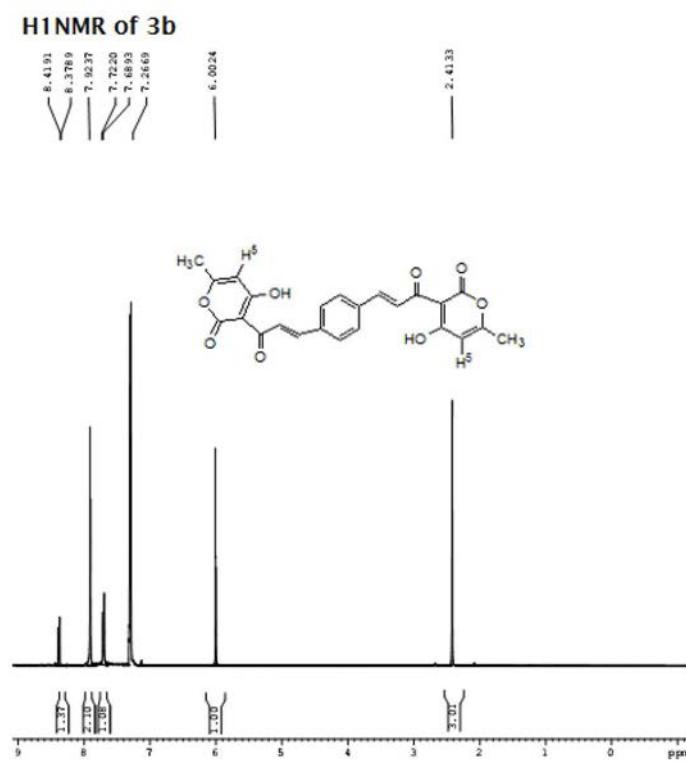


Figure S5. ¹H NMR (DMSO-d₆, 400 MHz) spectrum of compound 3b.

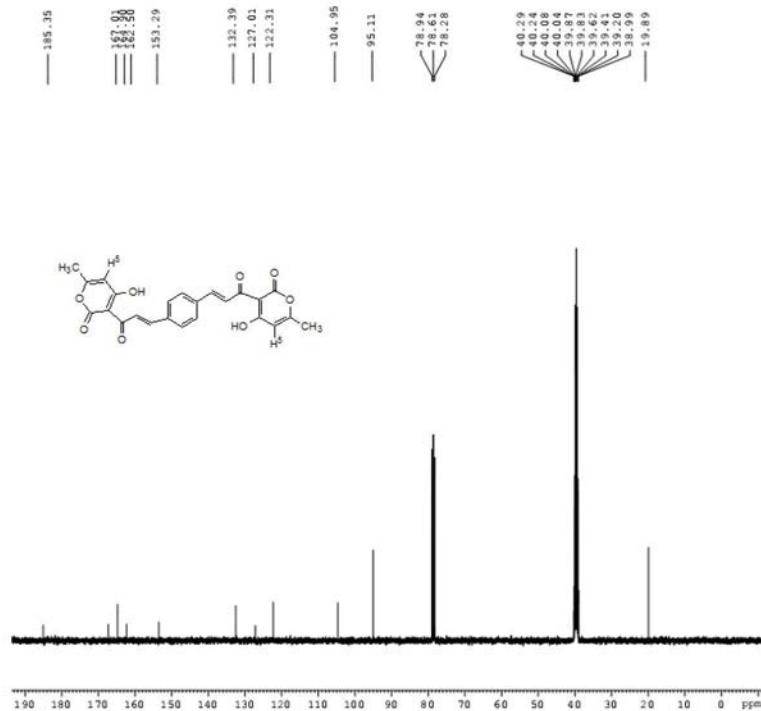
C¹³NMR of 3b

Figure S6. ¹³C NMR (DMSO-*d*₆, 100 MHz) spectrum of compound 3b.

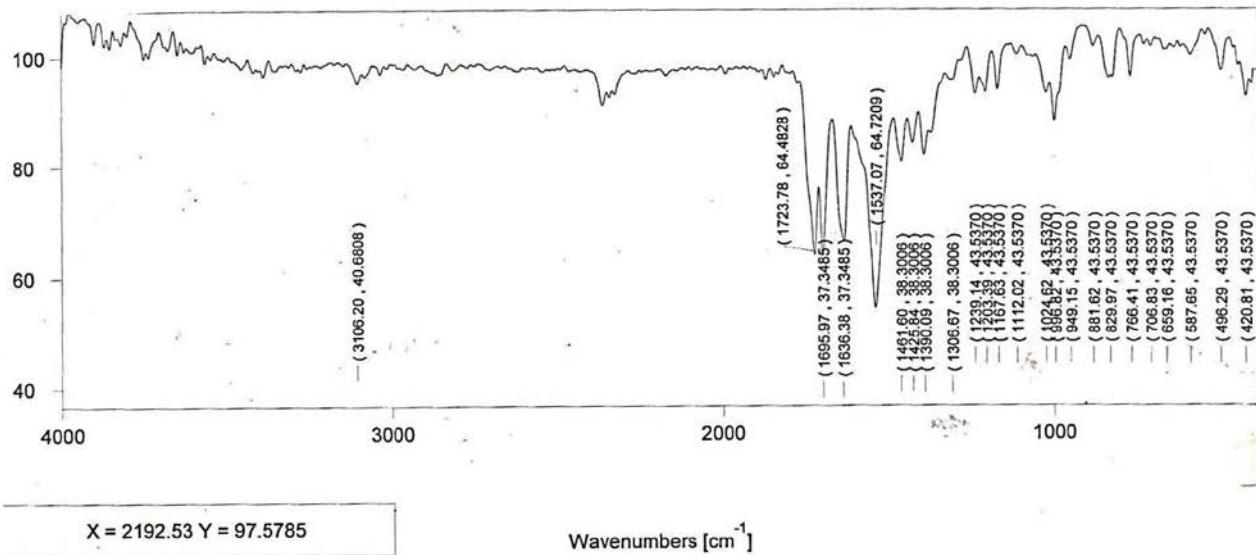


Figure S7. FT-IR spectrum of compound 3b.

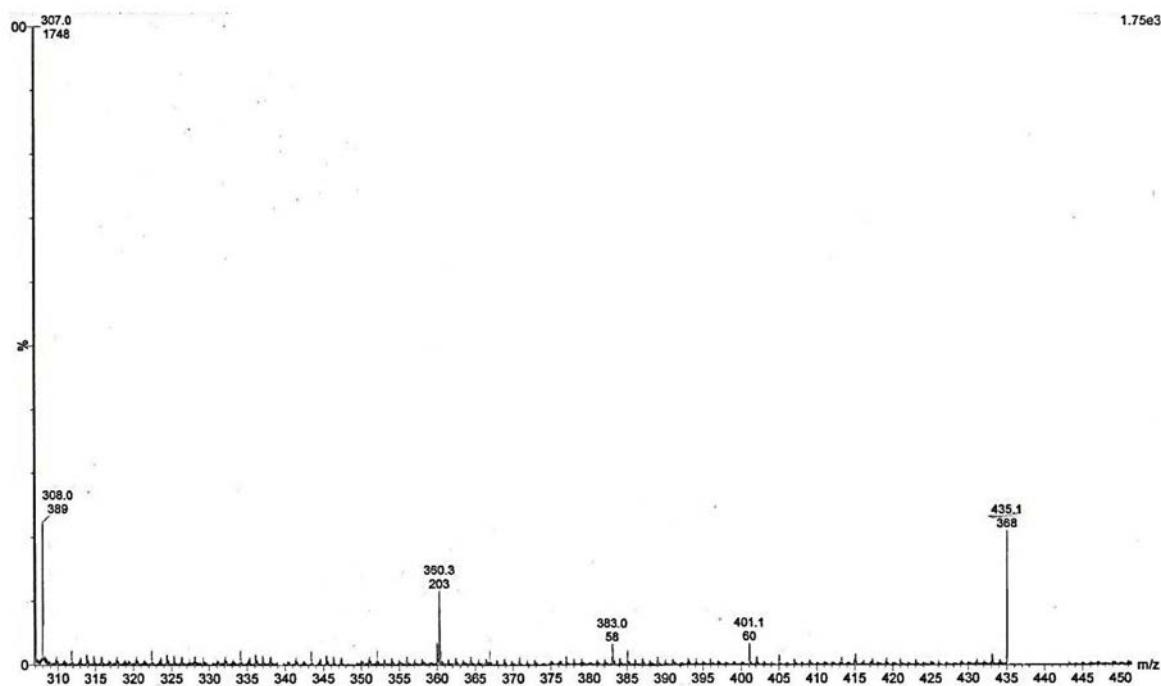


Figure S8. MS spectrum of compound **3b**.

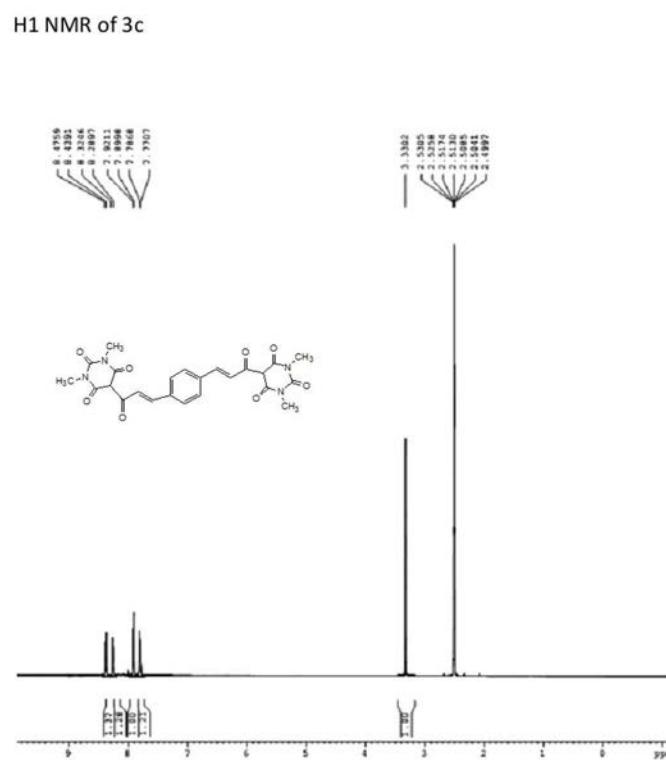


Figure S9. ¹H NMR (DMSO-*d*₆, 400 MHz) spectrum of compound **3c**.

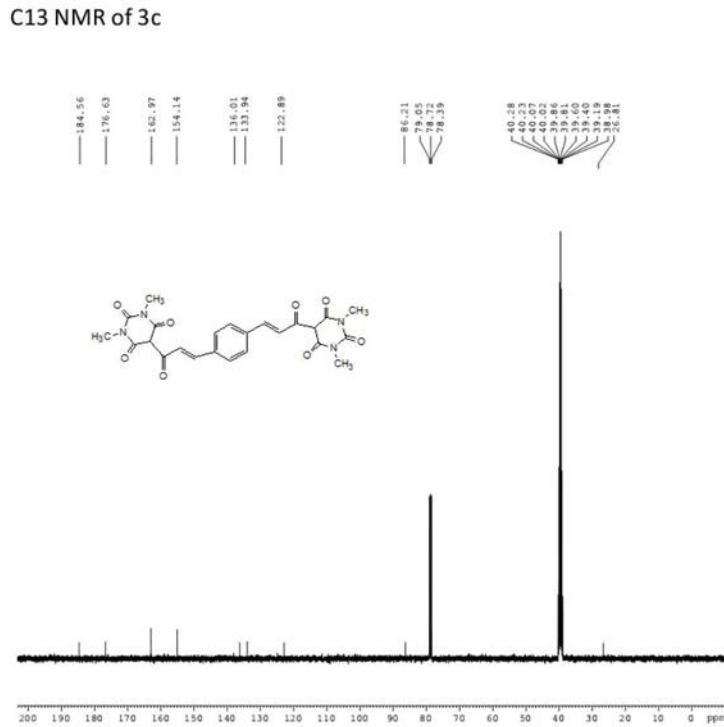


Figure S10. ^{13}C NMR (DMSO- d_6 , 100 MHz) spectrum of compound 3c.

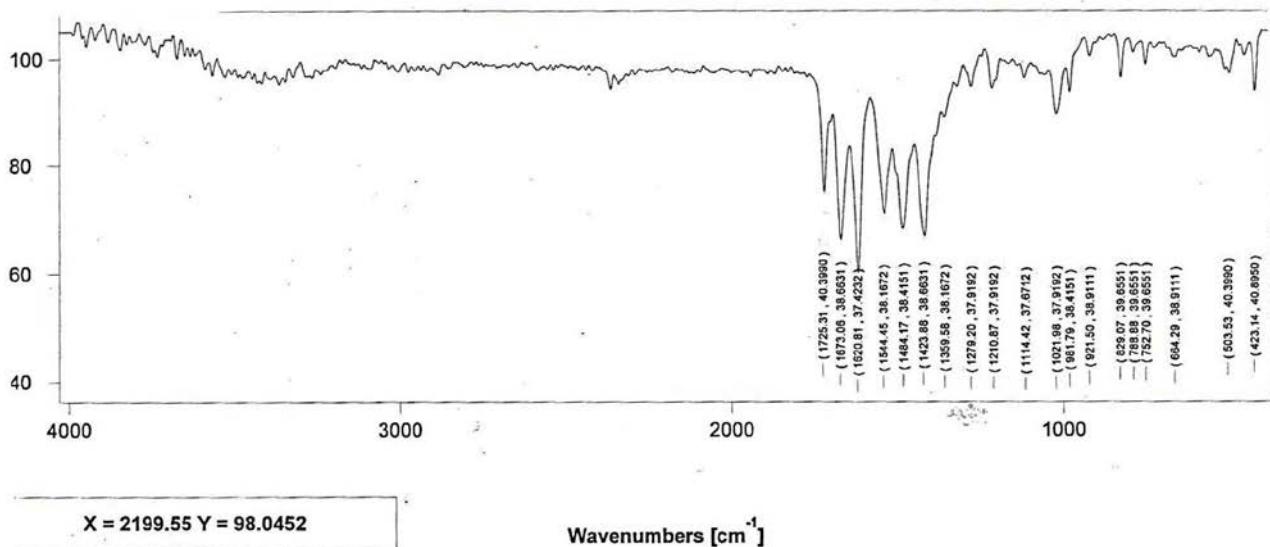


Figure S11. FT-IR (KBr) spectrum of compound **3c**.

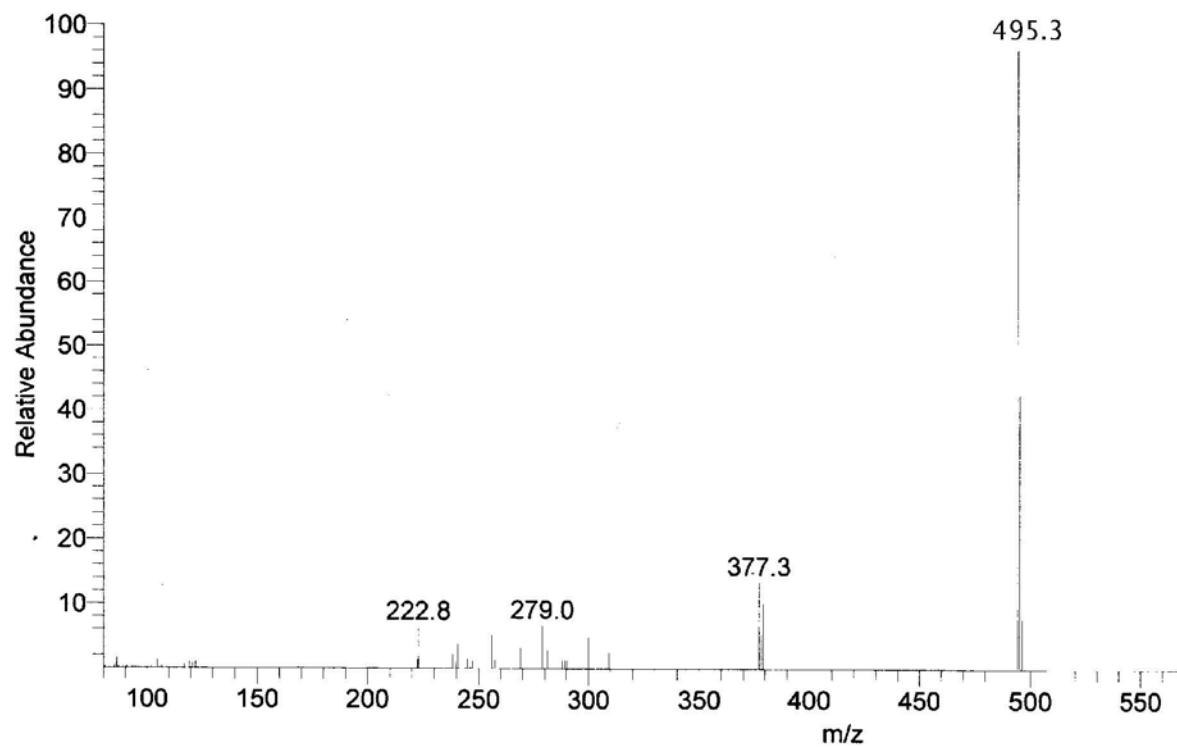


Figure S12. MS spectrum of compound 3c.

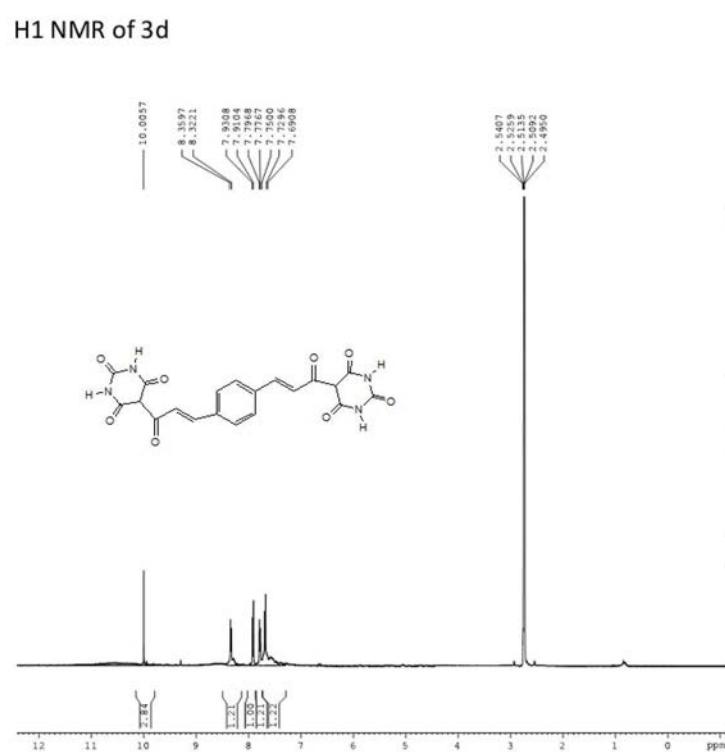
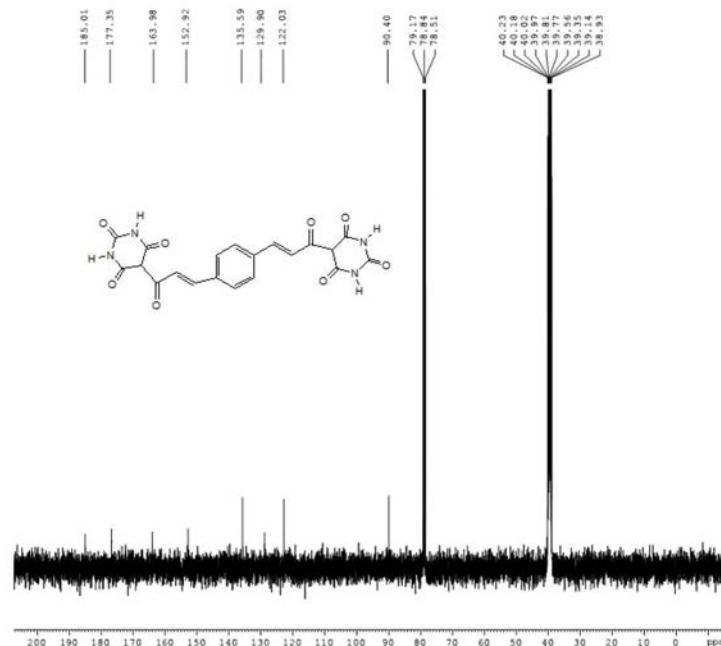
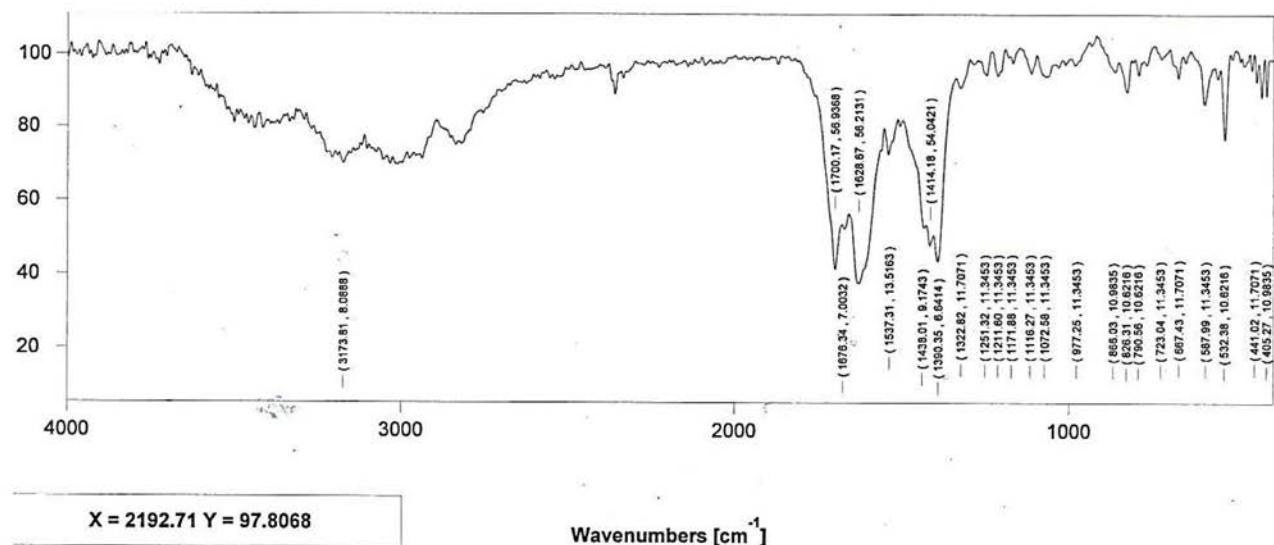


Figure S13. ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) spectrum of compound 3d.

C13 NMR of 3d**Figure S14.** ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) spectrum of compound 3d.**Figure S15.** FT-IR (KBr) spectrum of compound 3d.

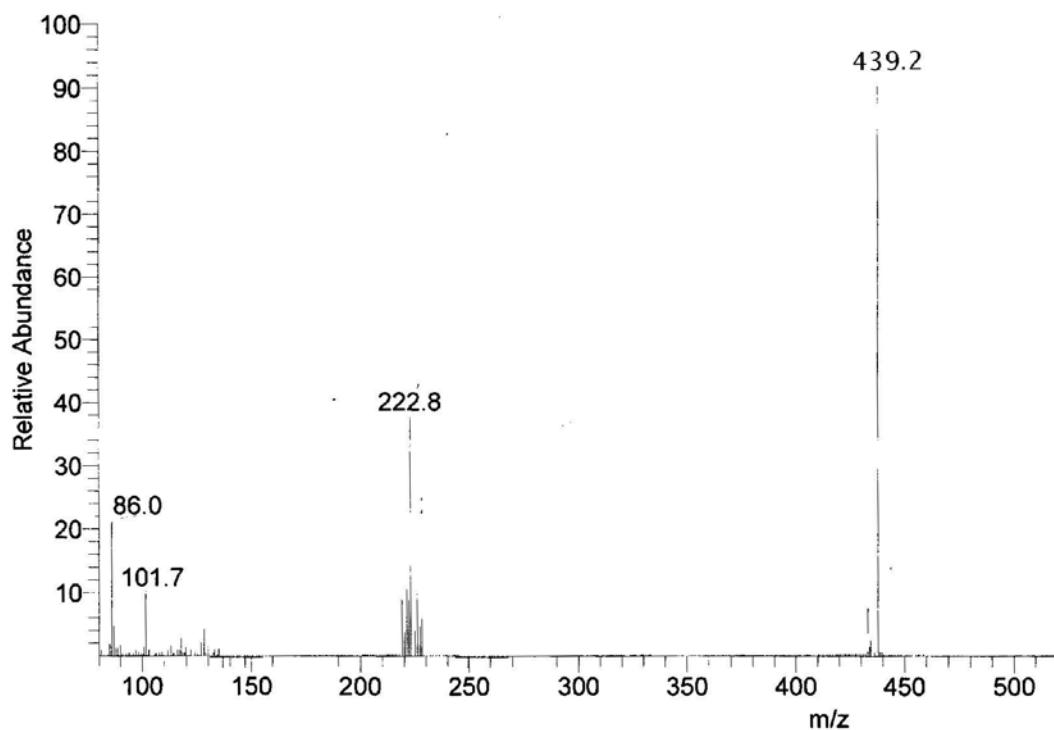


Figure S16. MS spectrum of compound **3d**.

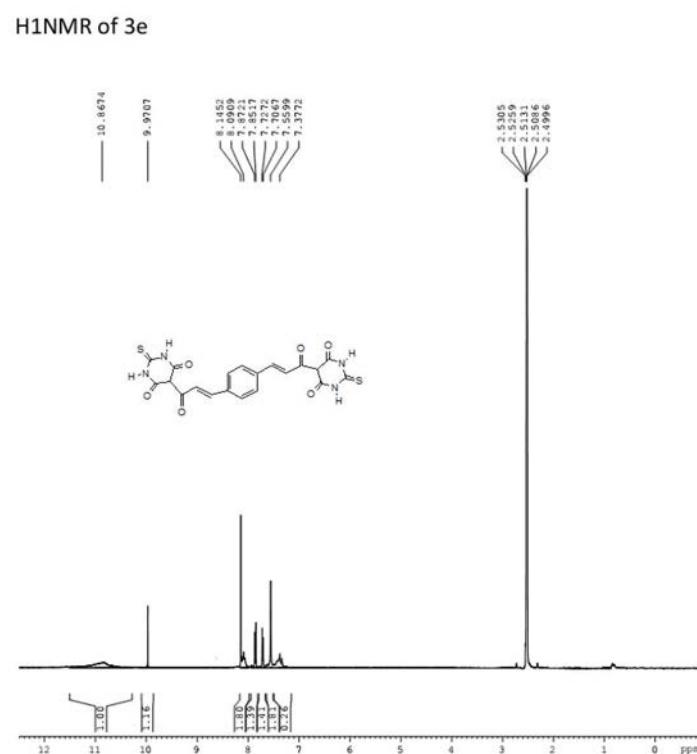
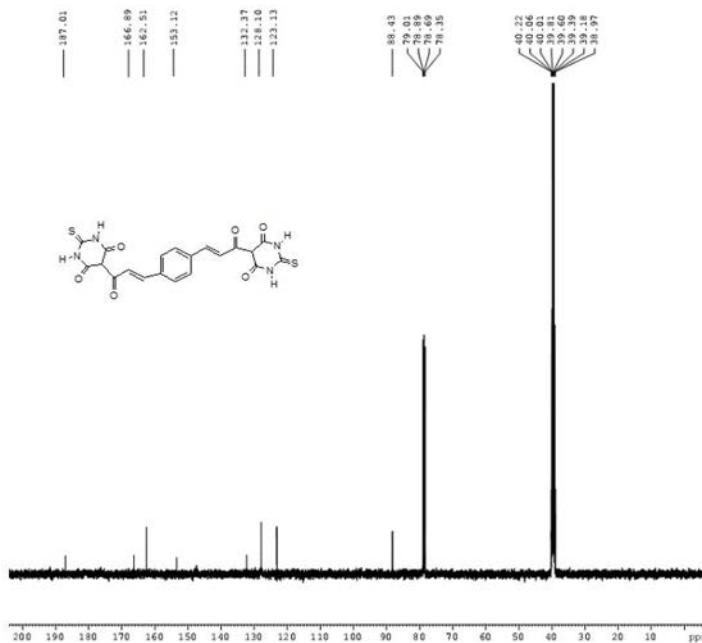
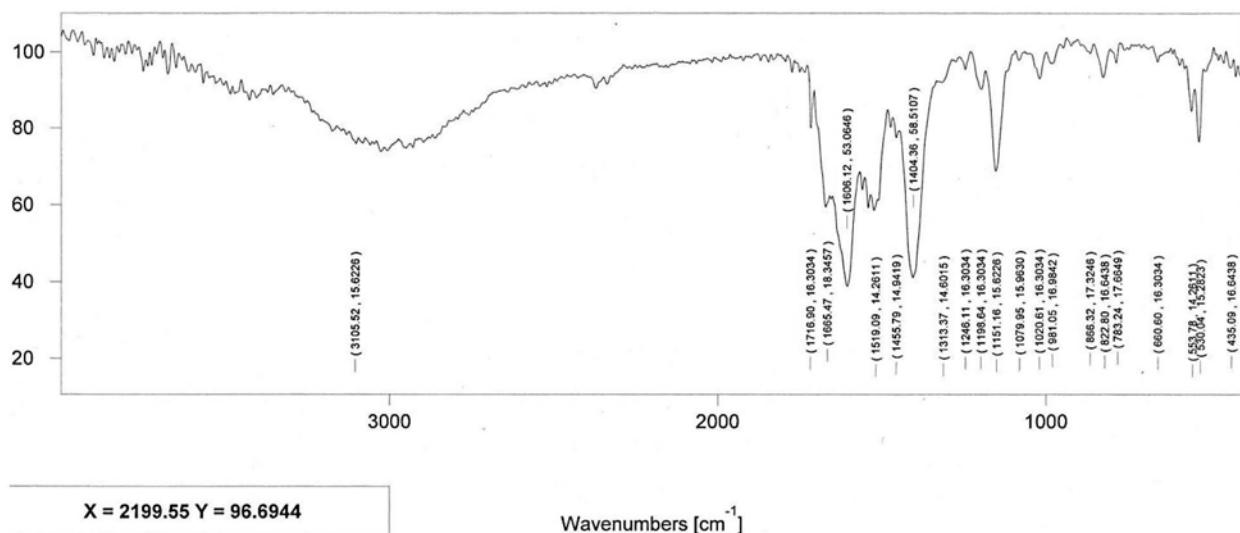


Figure S17. ¹H NMR ($\text{DMSO}-d_6$, 400 MHz) spectrum of compound **3e**.

C13NMR Of 3e**Figure S18.** ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) spectrum of compound 3e.**Figure S19.** FT-IR (KBr) spectrum of compound 3e.

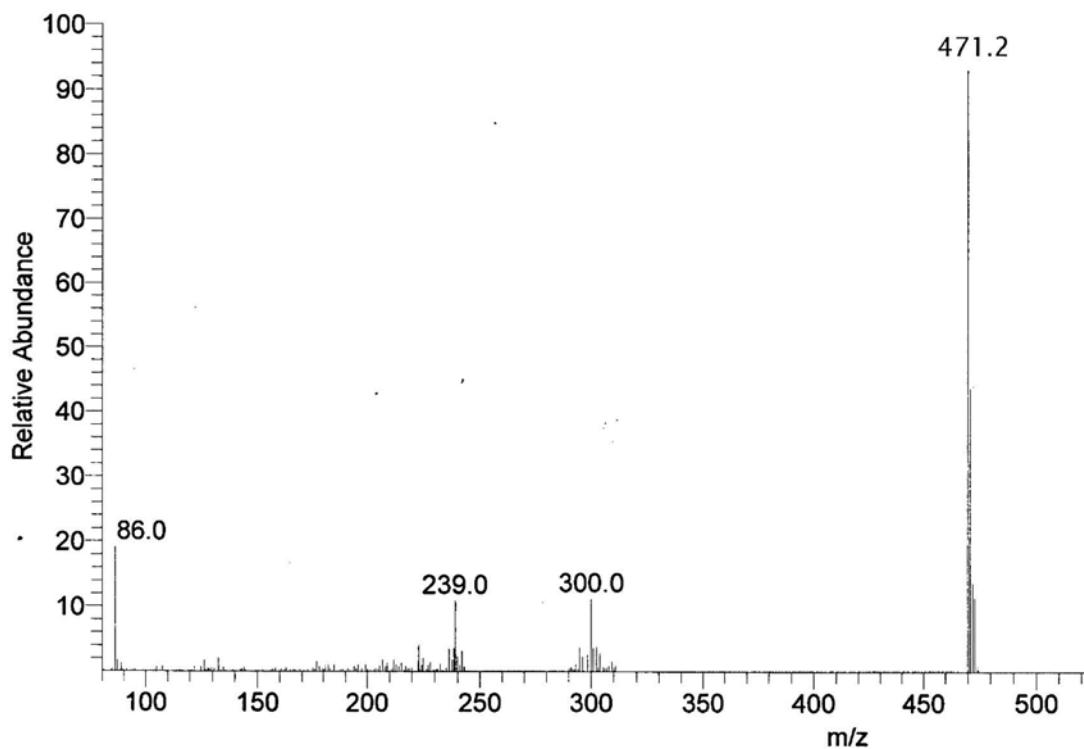


Figure S20. MS spectrum of compound **3e**.

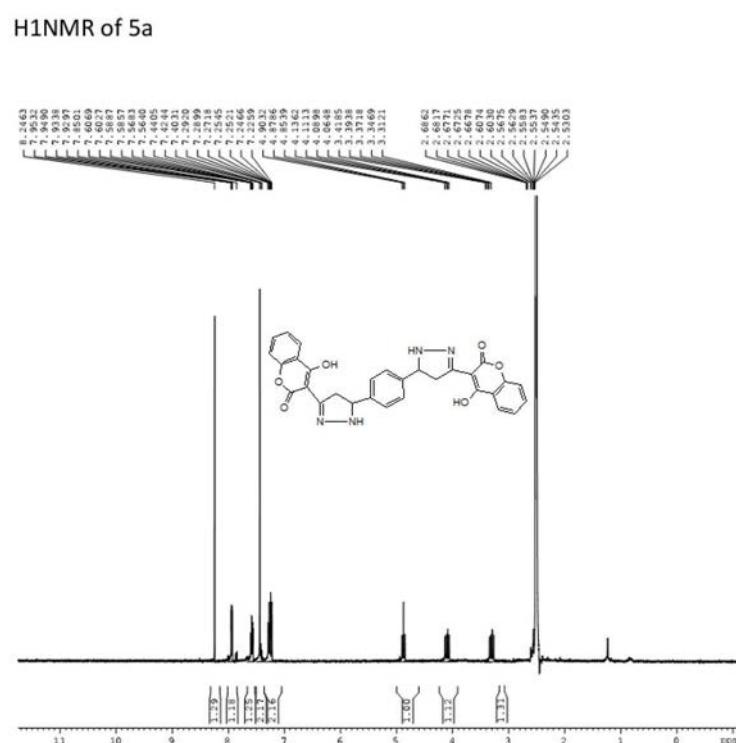


Figure S21. ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) spectrum of compound 5a.

C13NMR of 5a

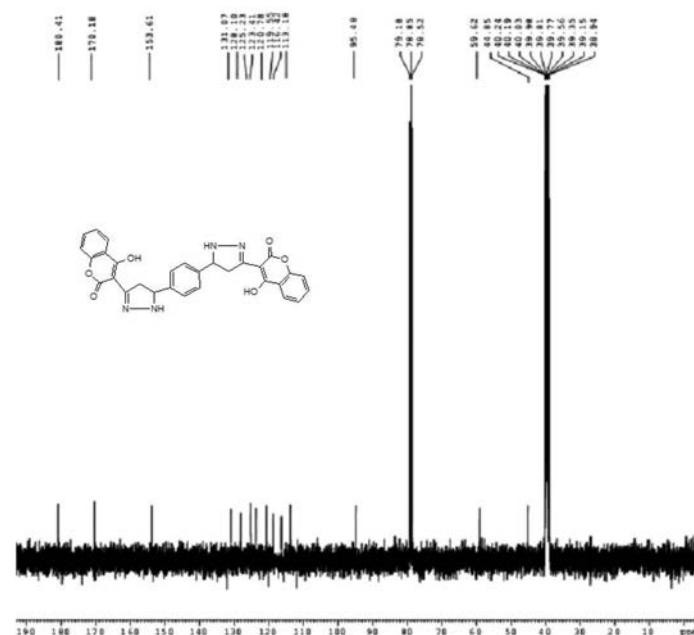


Figure S22. ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) spectrum of compound **5a**.

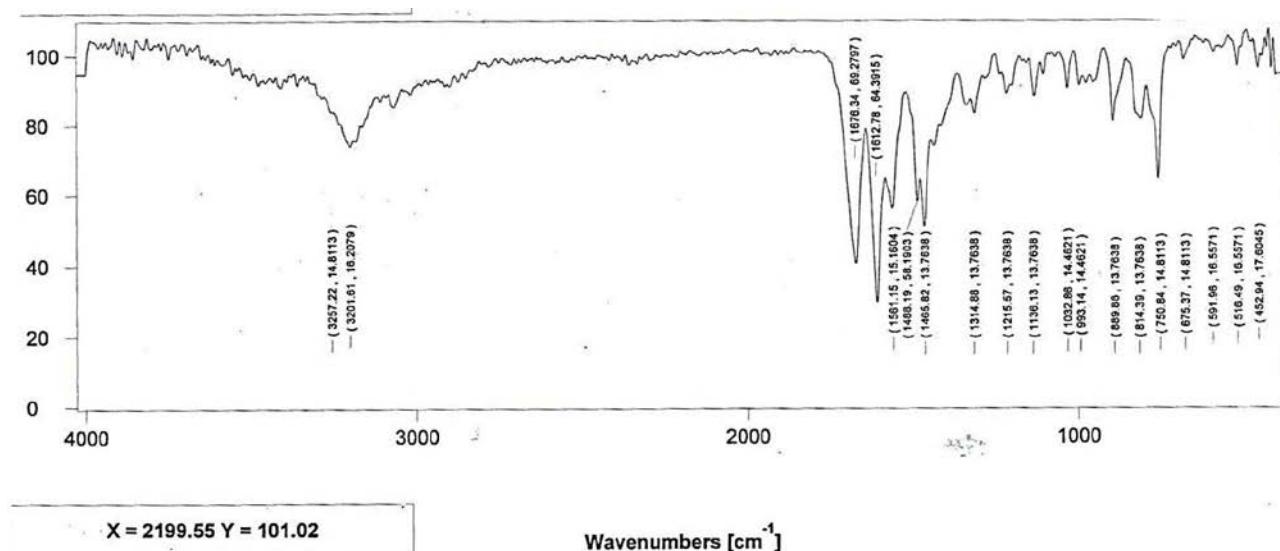


Figure S23. FT-IR (KBr) spectrum of compound **5a**.

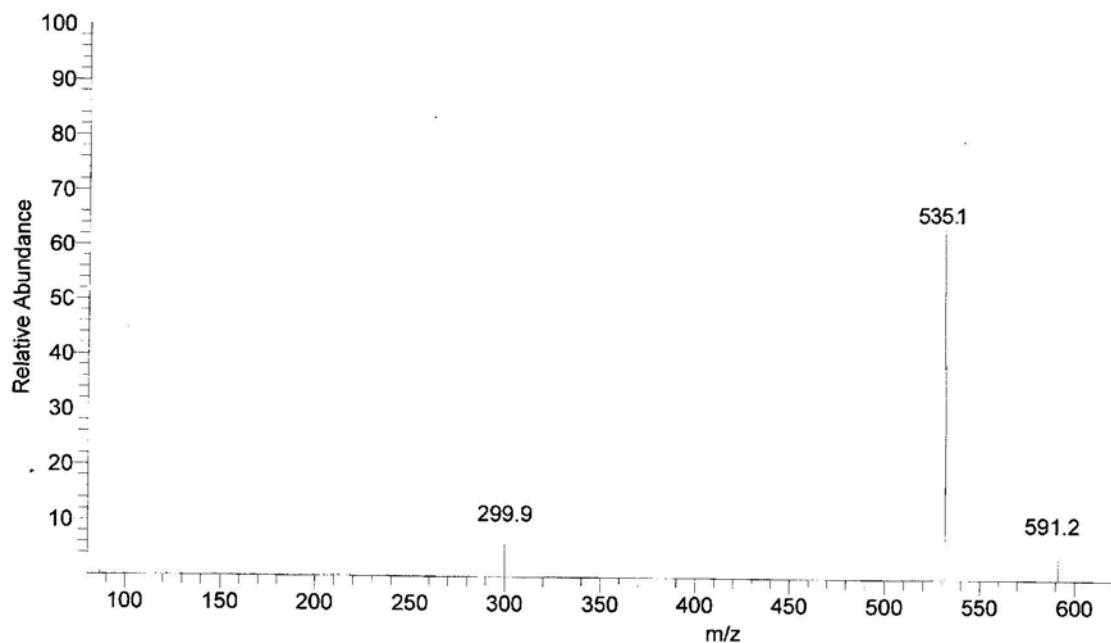


Figure S24. MS spectrum of compound **5a**.

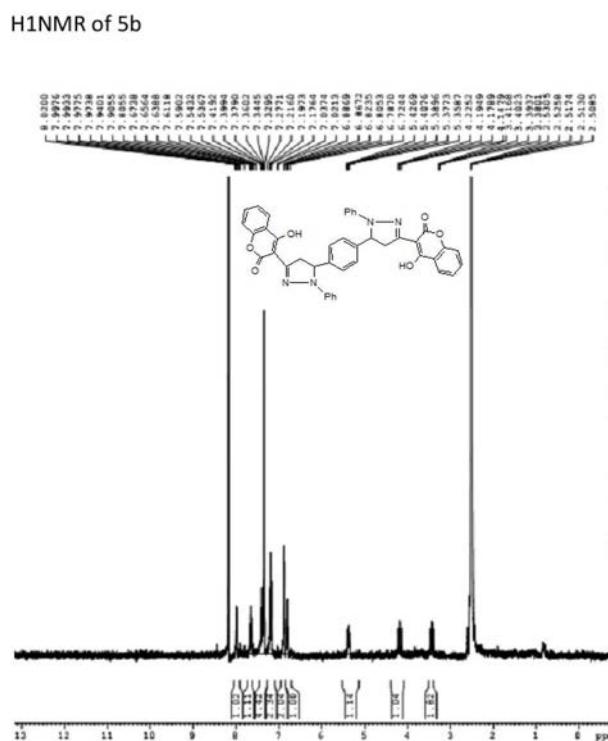


Figure S25. ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) spectrum of compound **5b**.

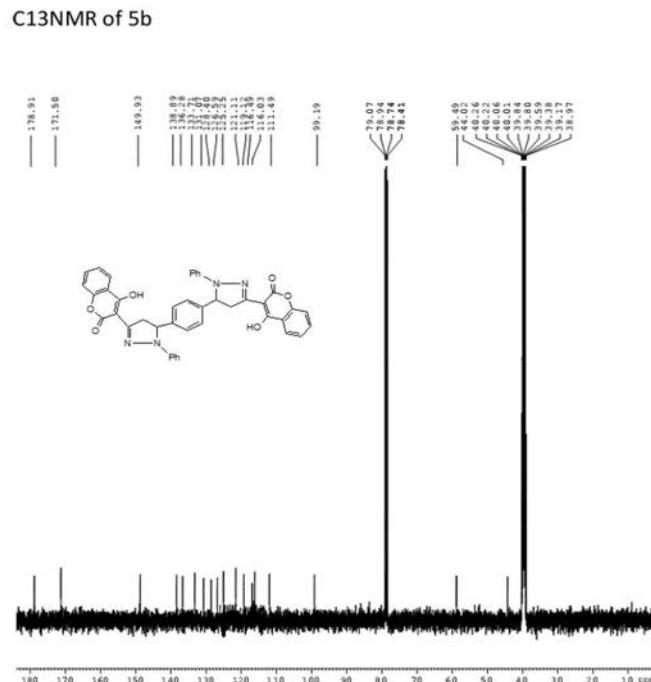


Figure S26. ^{13}C NMR (DMSO- d_6 , 100 MHz) spectrum of compound **5b**.

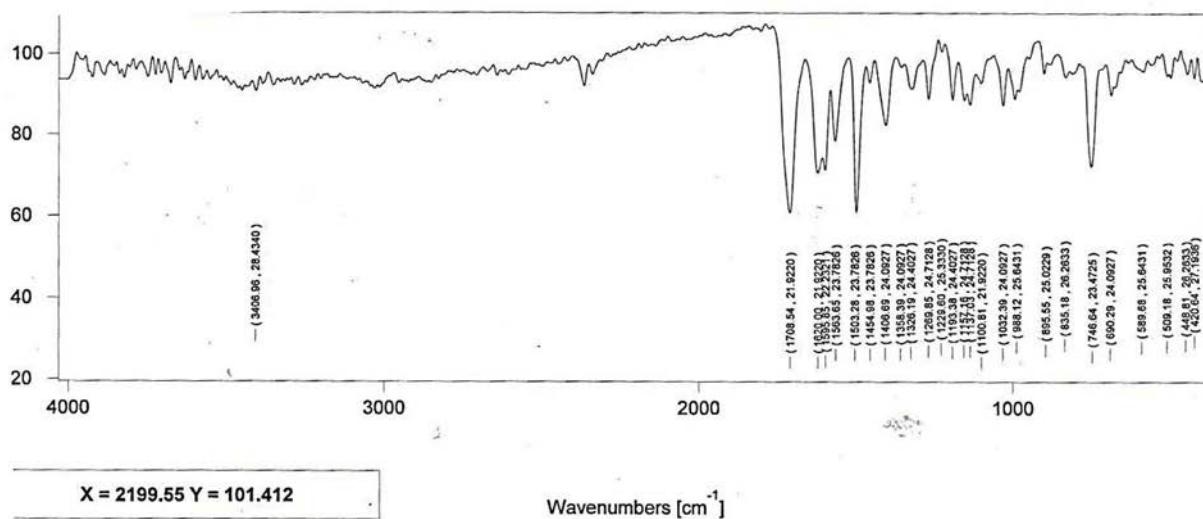


Figure S27. FT-IR (KBr) spectrum of compound **5b**.

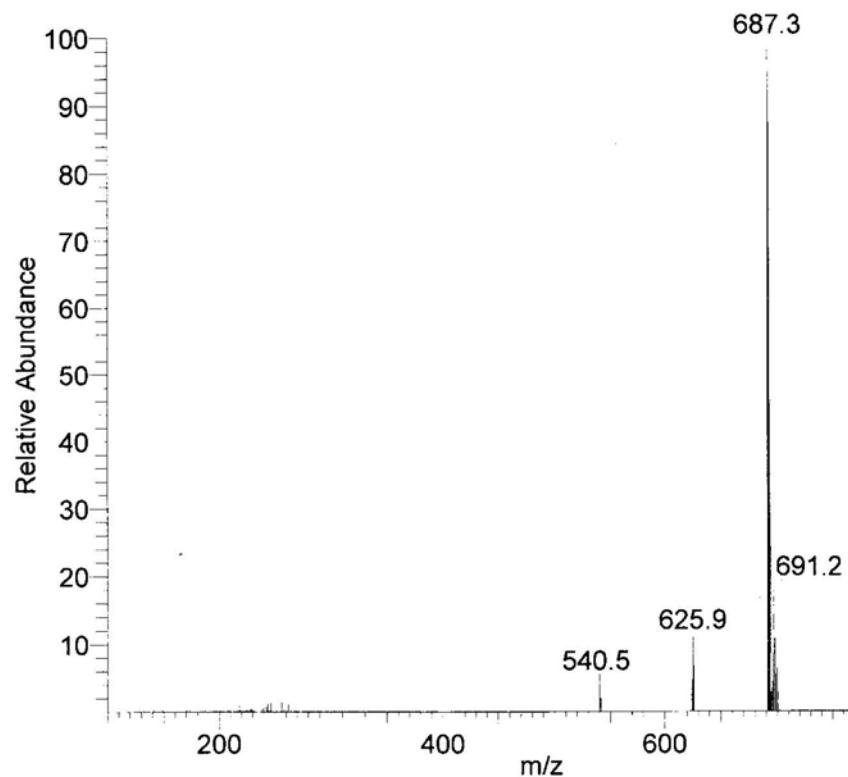
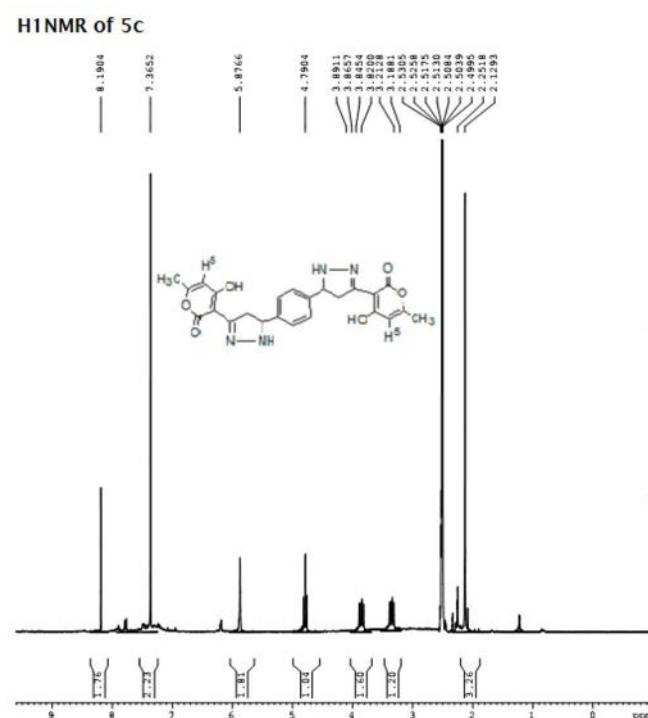
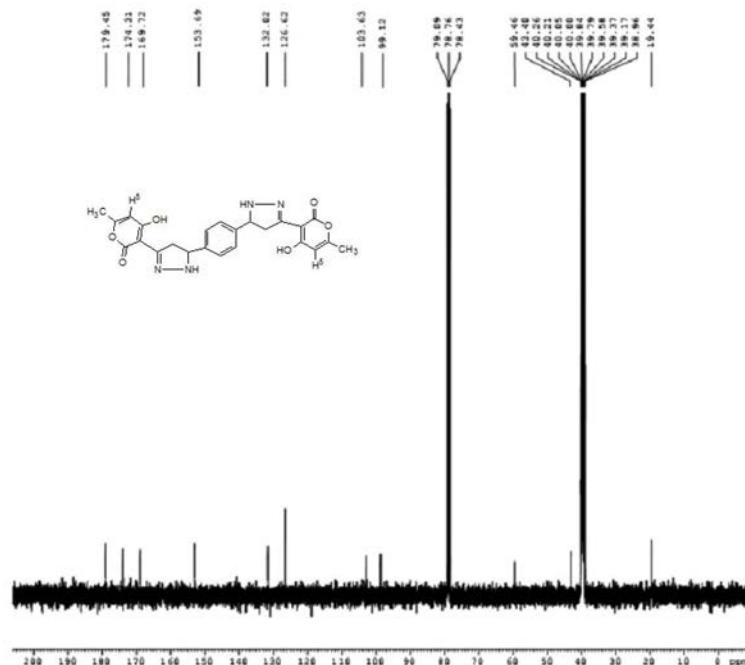
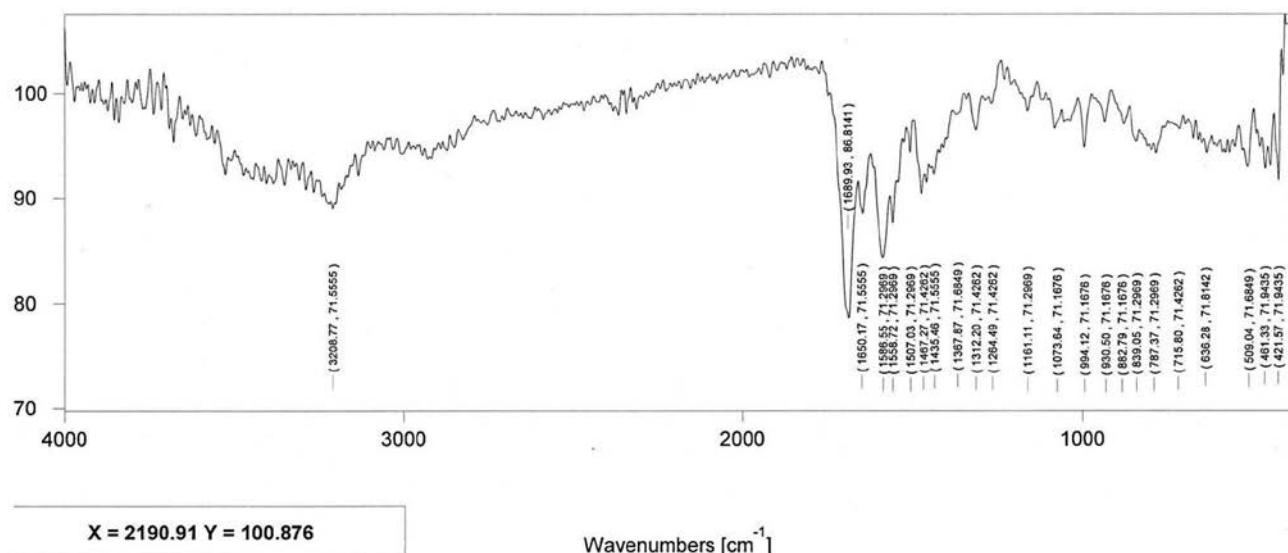


Figure S28. MS spectrum of compound **5b**.



C13NMR of 5c**Figure S30.** ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) spectrum of compound **5c**.**Figure S31.** FT-IR (KBr) spectrum of compound **5c**.

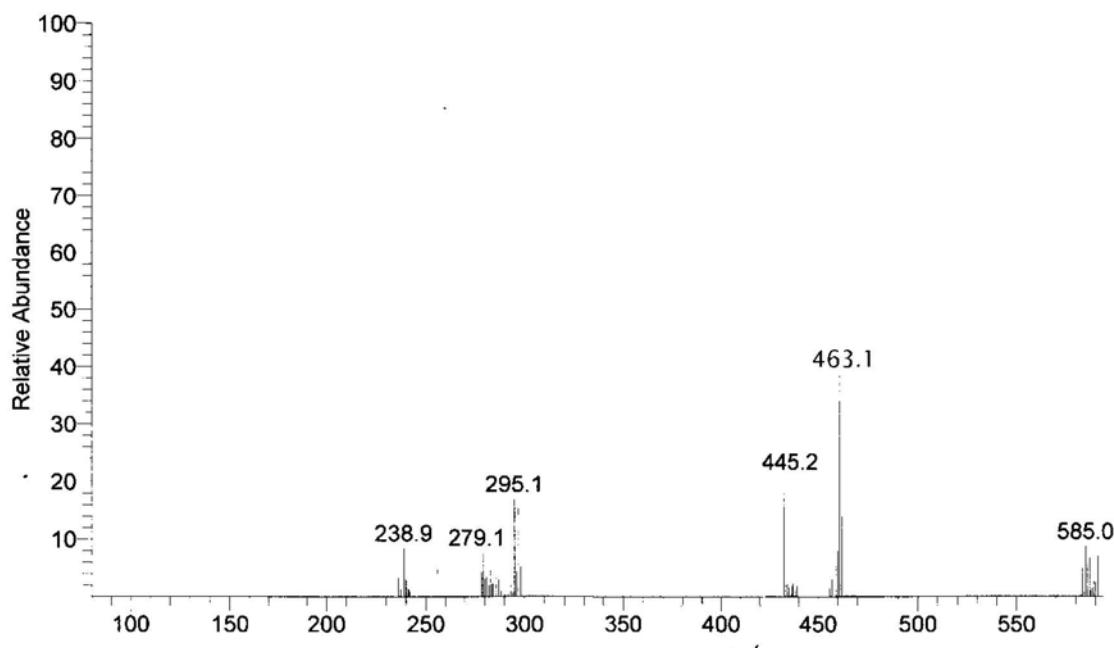


Figure S32. MS spectrum of compound 5c.

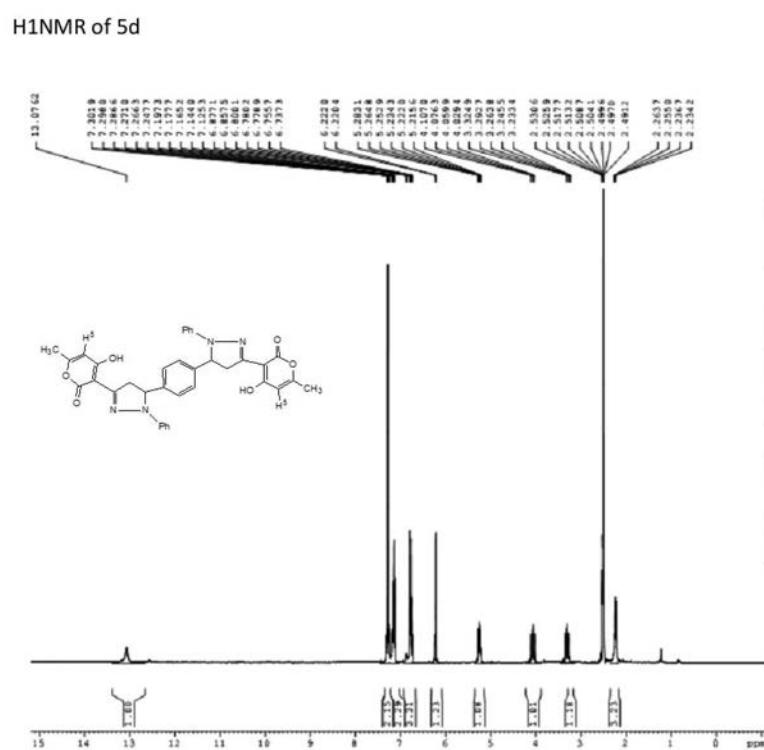


Figure S33. ¹H NMR (DMSO-*d*₆, 400 MHz) spectrum of compound 5d.

C13NMR of 5d

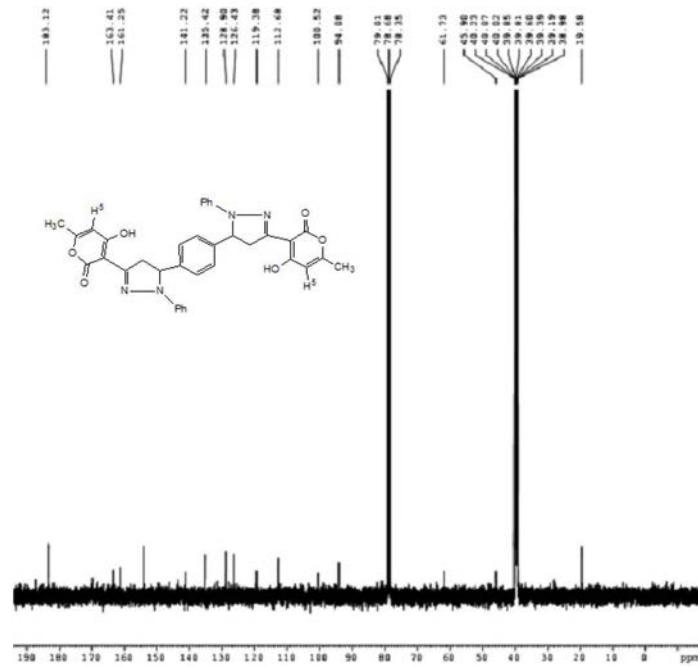


Figure S34. ^{13}C NMR (DMSO- d_6 , 100 MHz) spectrum of compound **5d**.

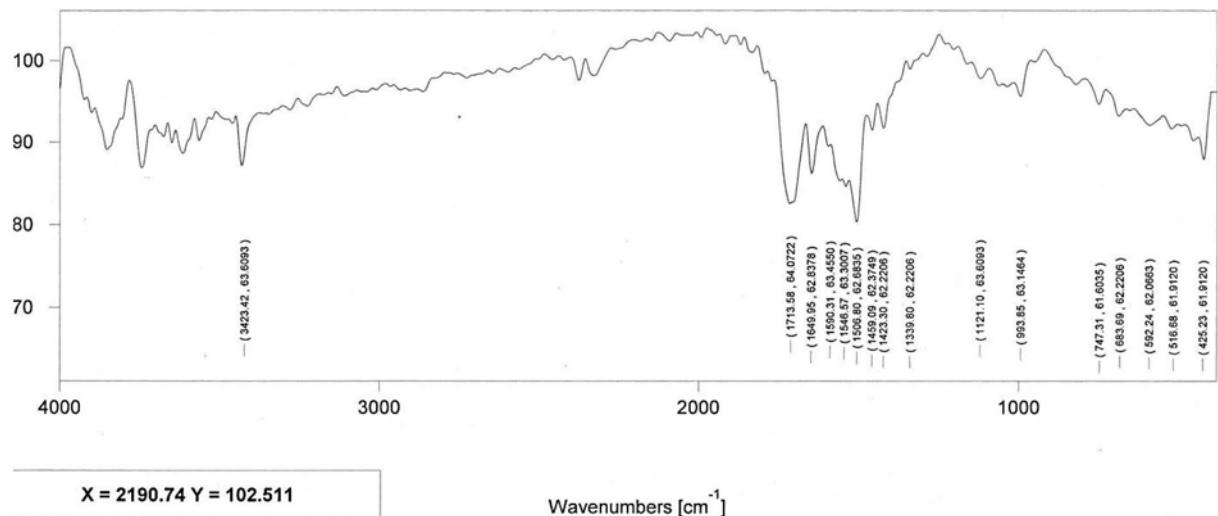


Figure S35. FT-IR (KBr) spectrum of compound **5d**.

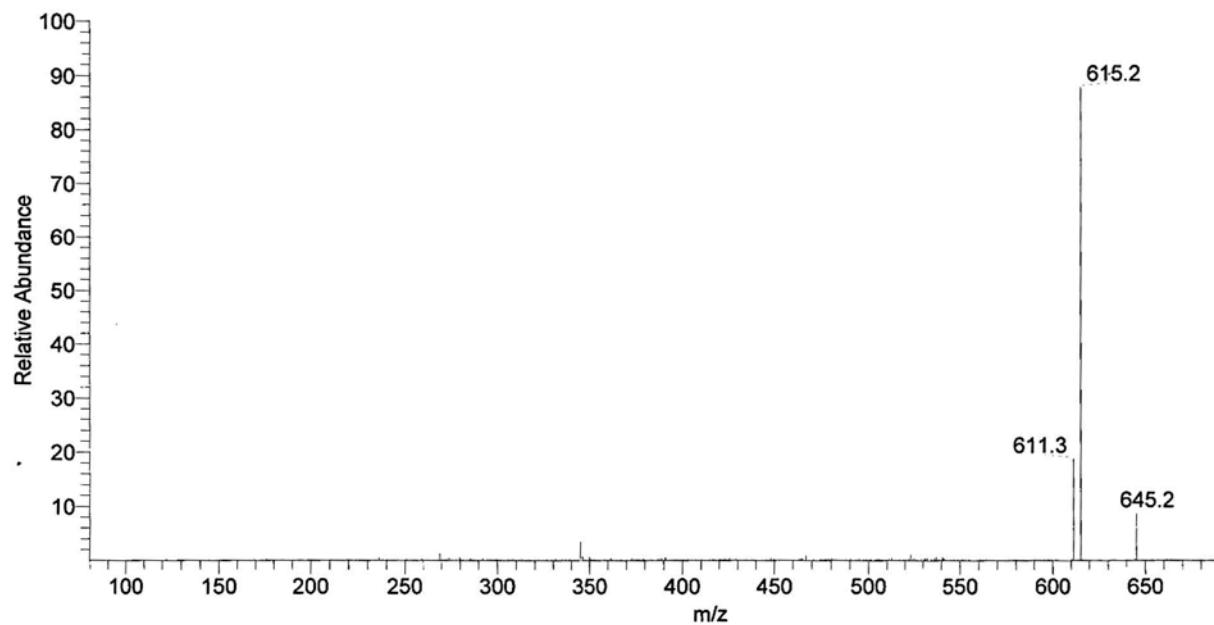


Figure S36. MS spectrum of compound **5d**.

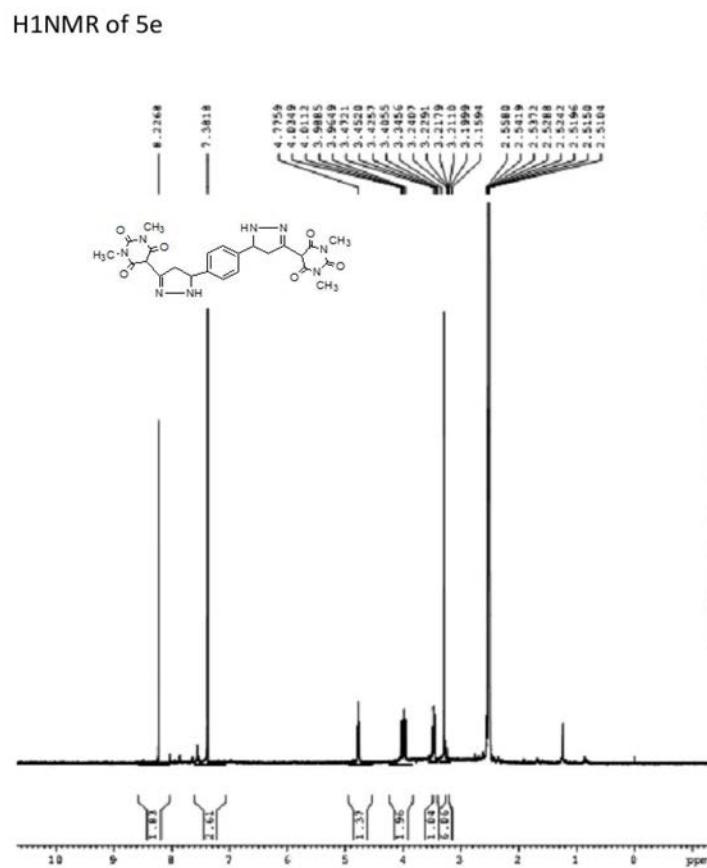
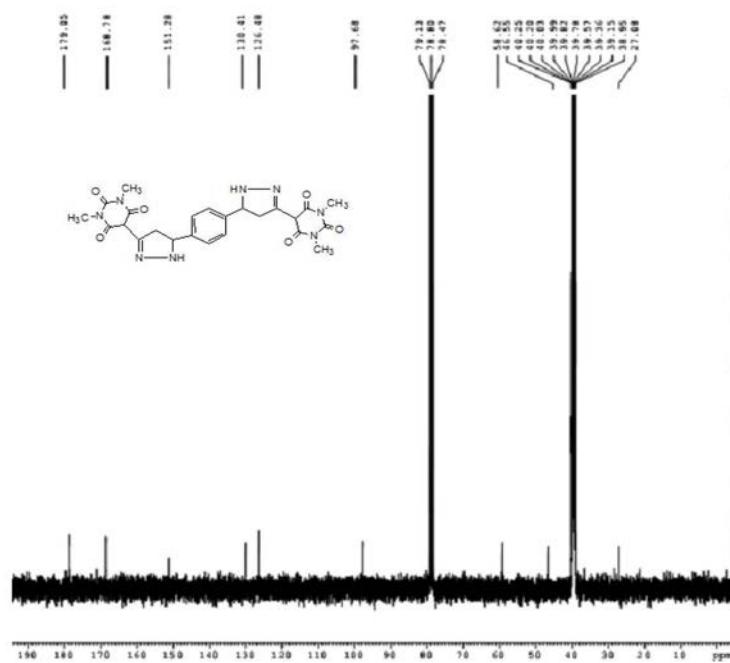
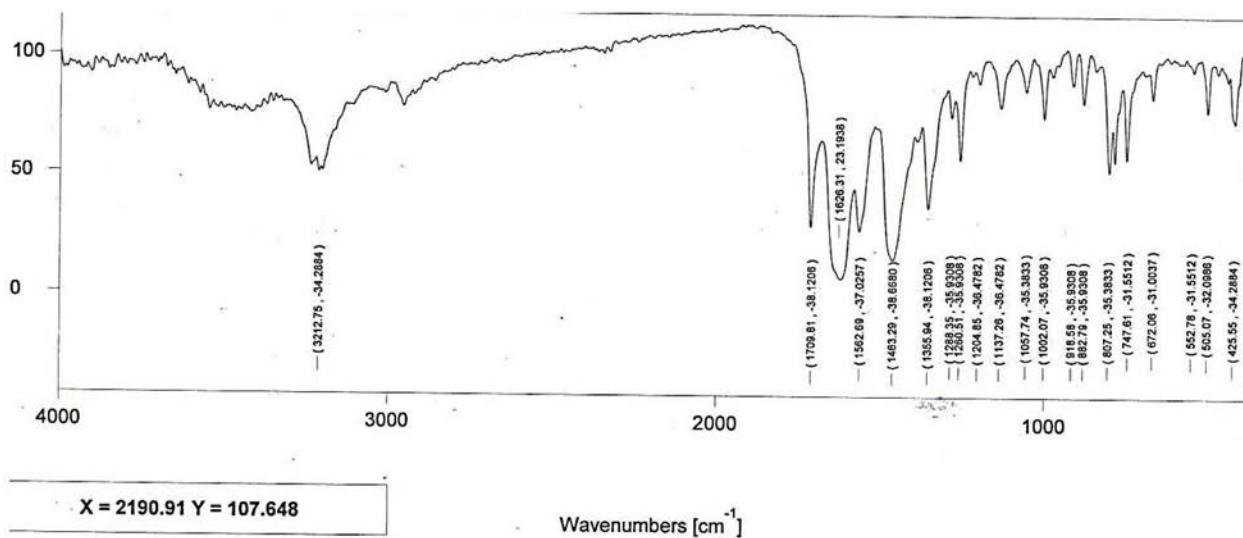


Figure S37. ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) spectrum of compound **5e**.

C₁₃NMR of 5e**Figure S38.** ¹³C NMR (DMSO-*d*₆, 100 MHz) spectrum of compound 5e.**Figure S39.** FT-IR (KBr) spectrum of compound 5e.

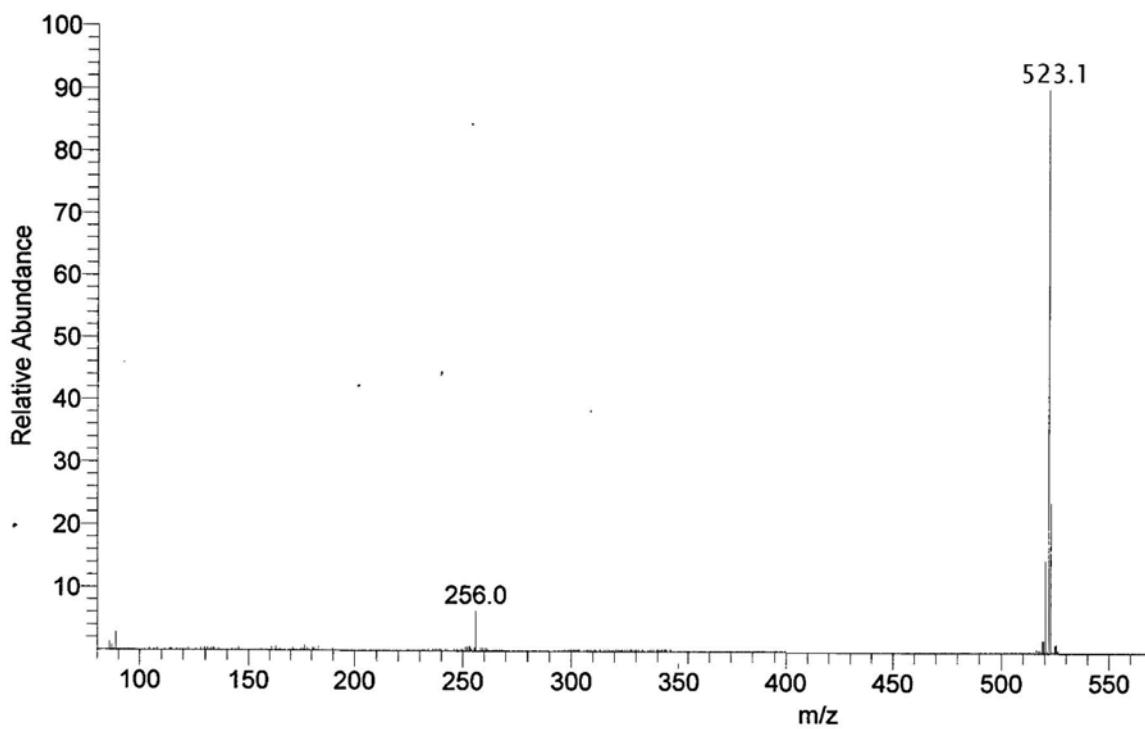


Figure S40. MS spectrum of compound **5e**.

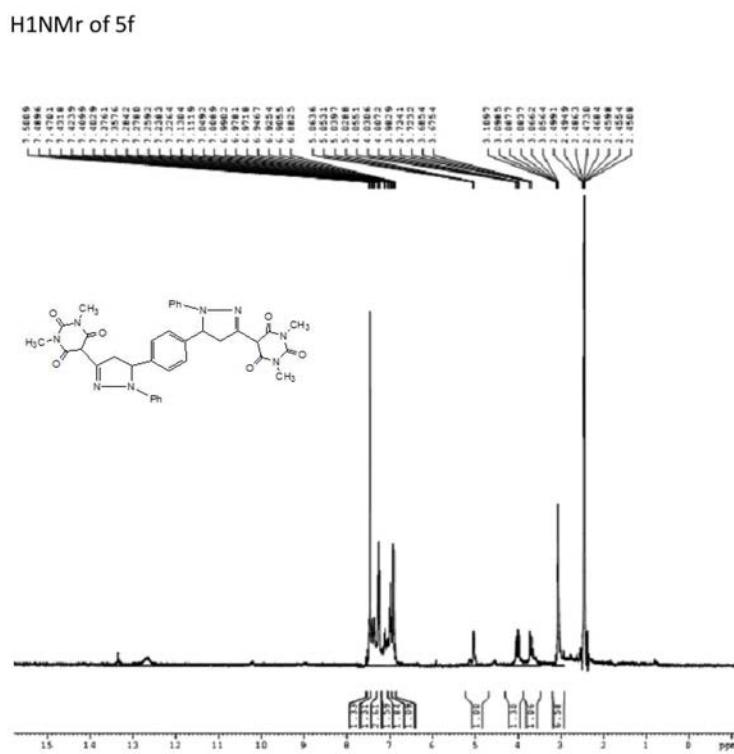


Figure S41. ^1H NMR (DMSO- d_6 , 400 MHz) spectrum of compound **5f**.

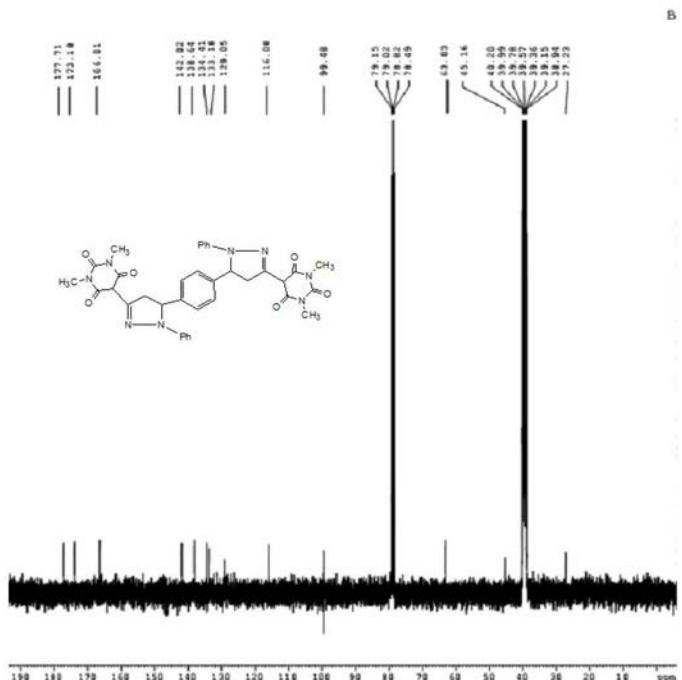
C13NMR of 5f

Figure S42. ¹³C NMR (DMSO-*d*₆, 100 MHz) spectrum of compound 5f.

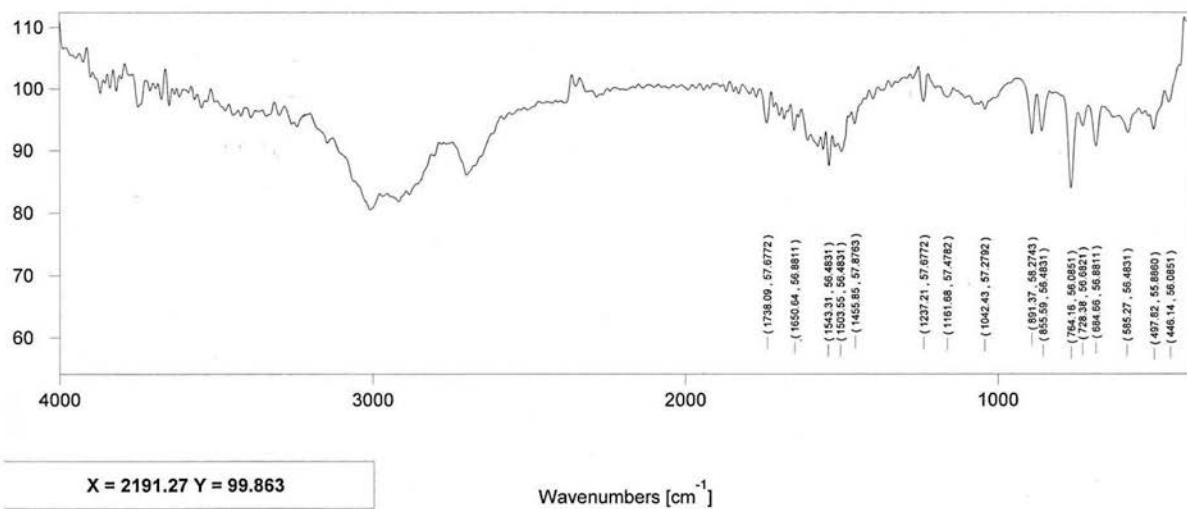


Figure S43. FT-IR (KBr) spectrum of compound 5f.

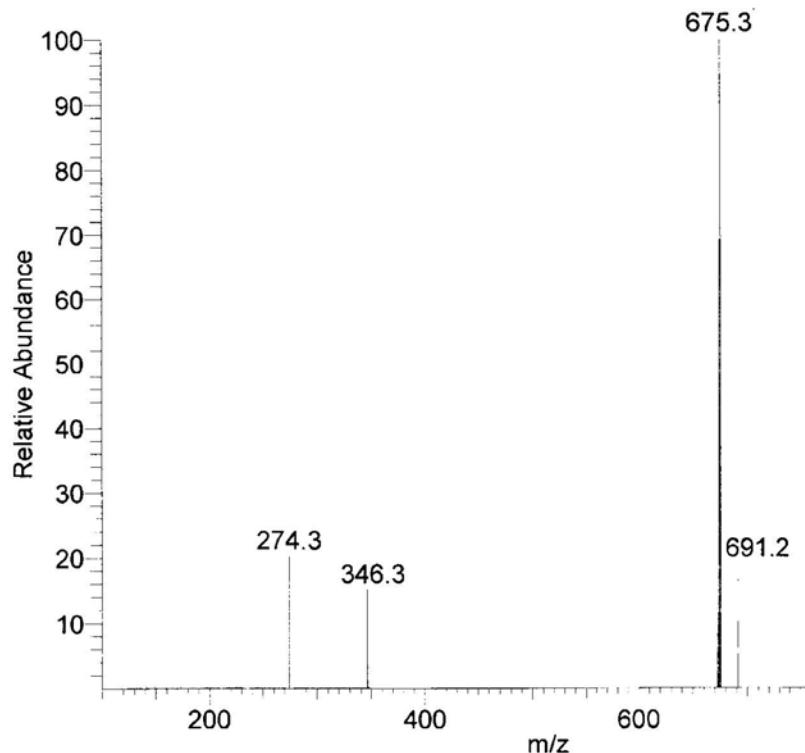


Figure S44. MS spectrum of compound **5f**.

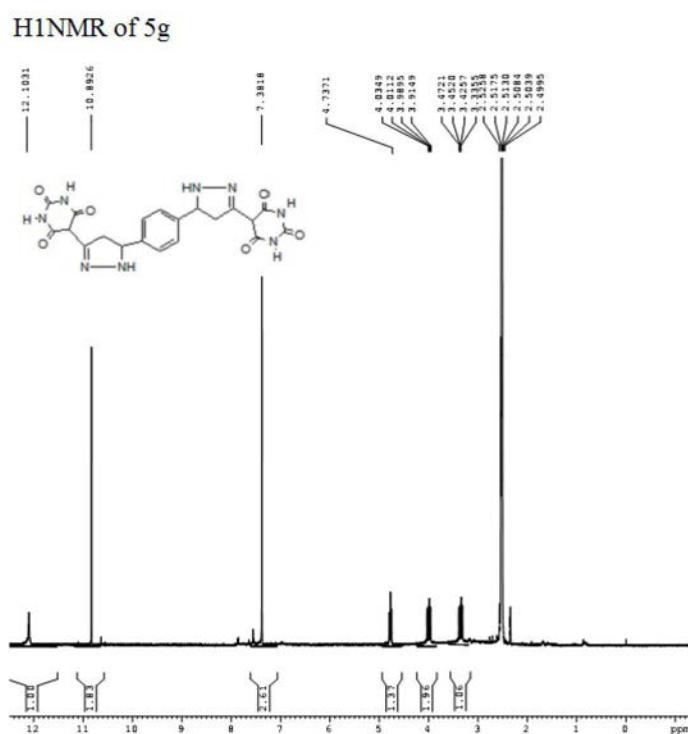


Figure S45. ^1H NMR (DMSO- d_6 , 400 MHz) spectrum of compound **5g**.

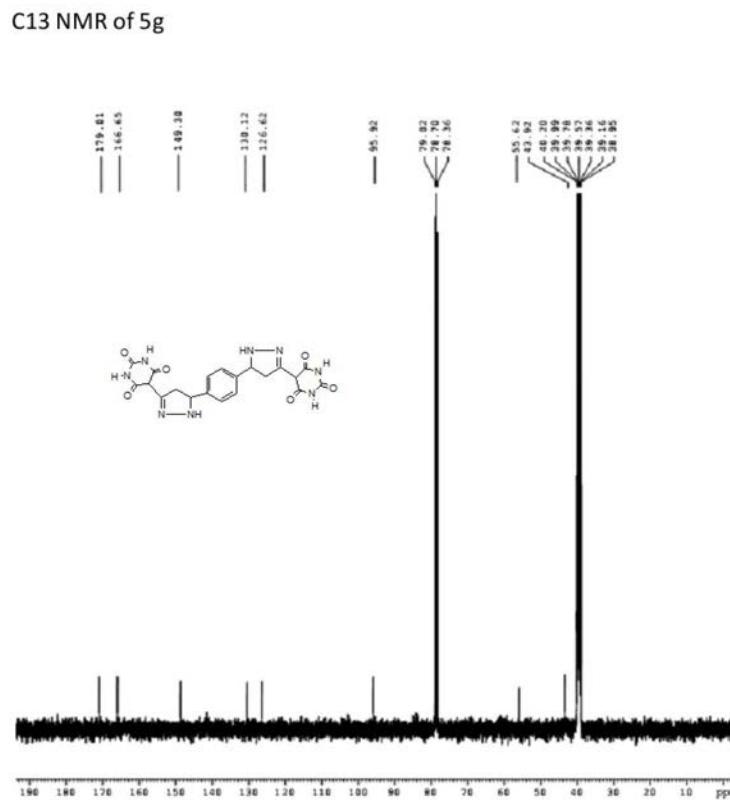


Figure S46. ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) spectrum of compound **5g**.

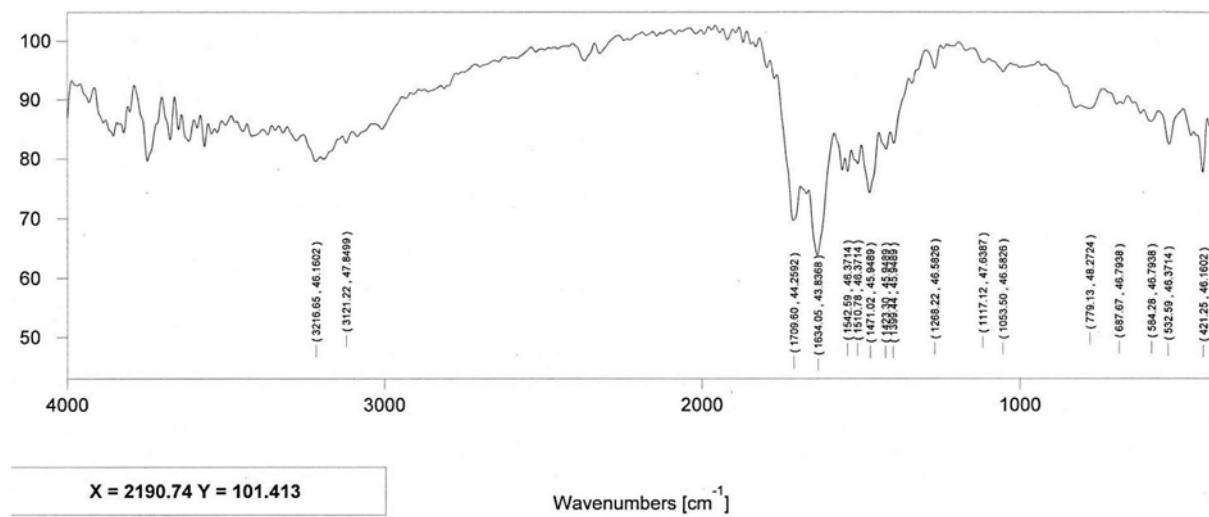
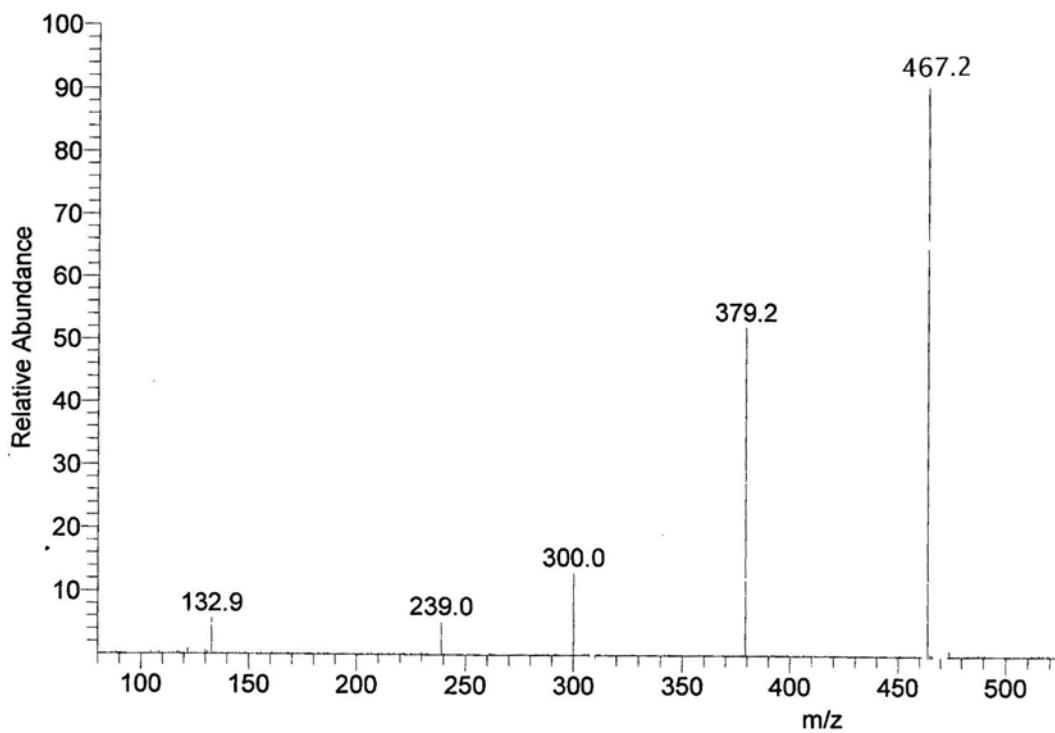
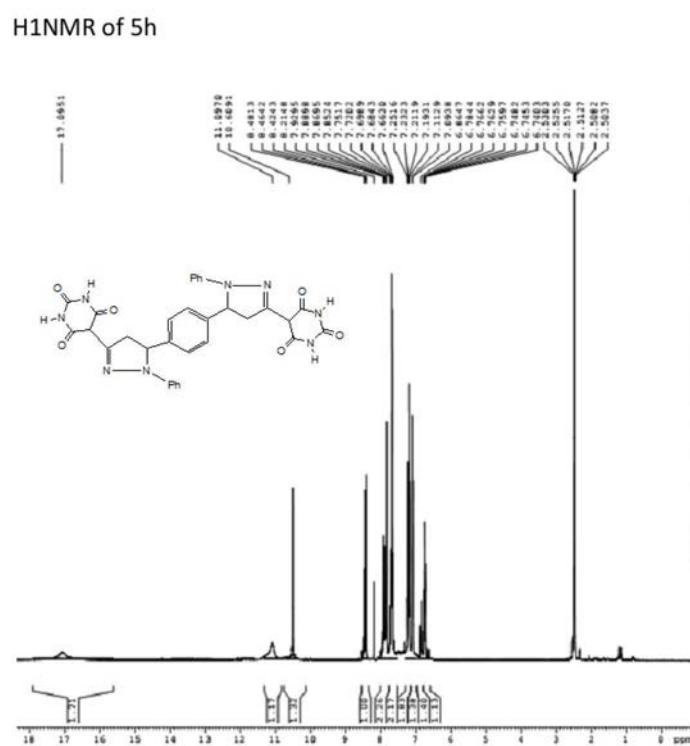
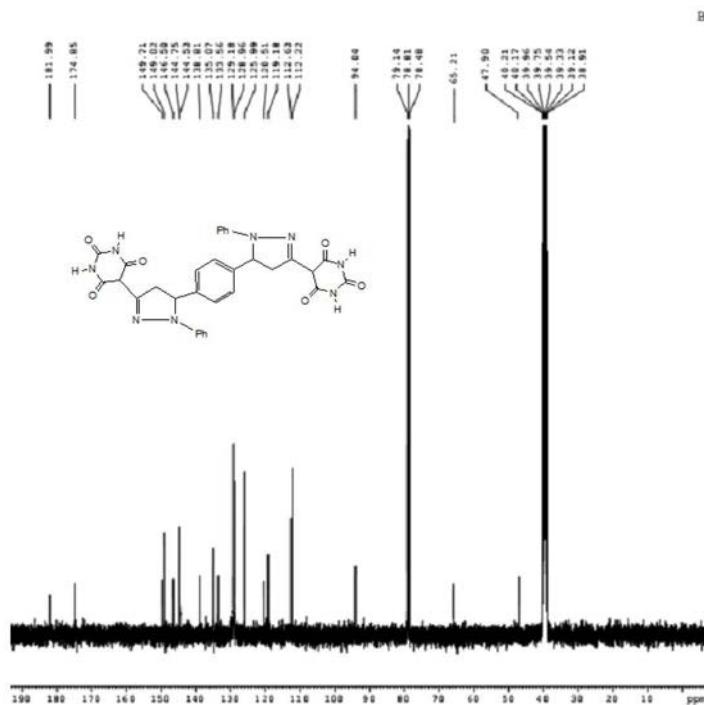
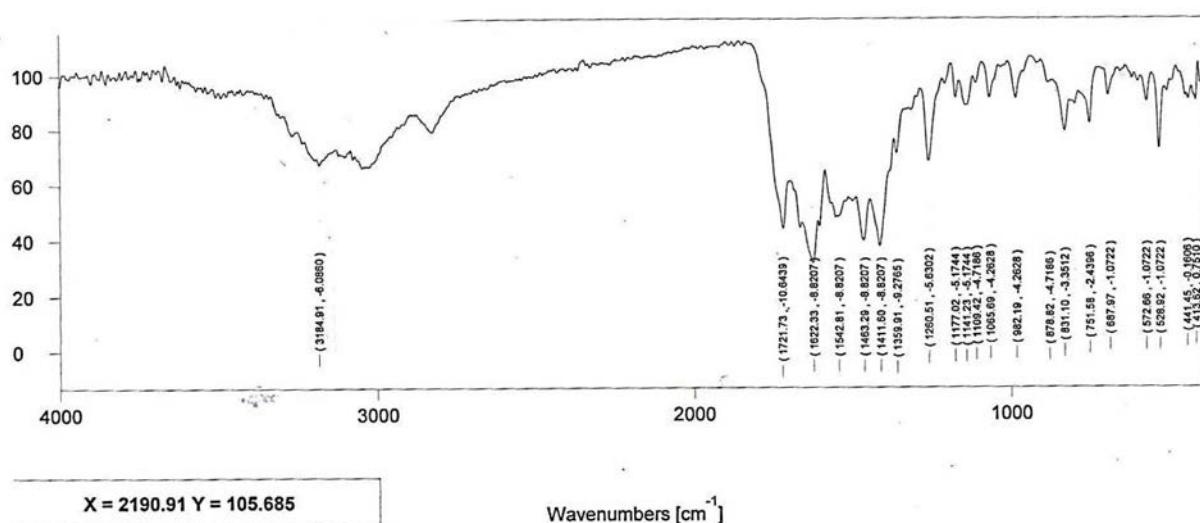


Figure S47. FT-IR (KBr) spectrum of compound 5g.

**Figure S48.** MS spectrum of compound **5g**.**Figure S49.** ¹H NMR ($\text{DMSO}-d_6$, 400 MHz) spectrum of compound **5h**.

C13NMR of 5h**Figure S50.** ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) spectrum of compound **5h**.**Figure S51.** FT-IR (KBr) spectrum of compound **5h**.

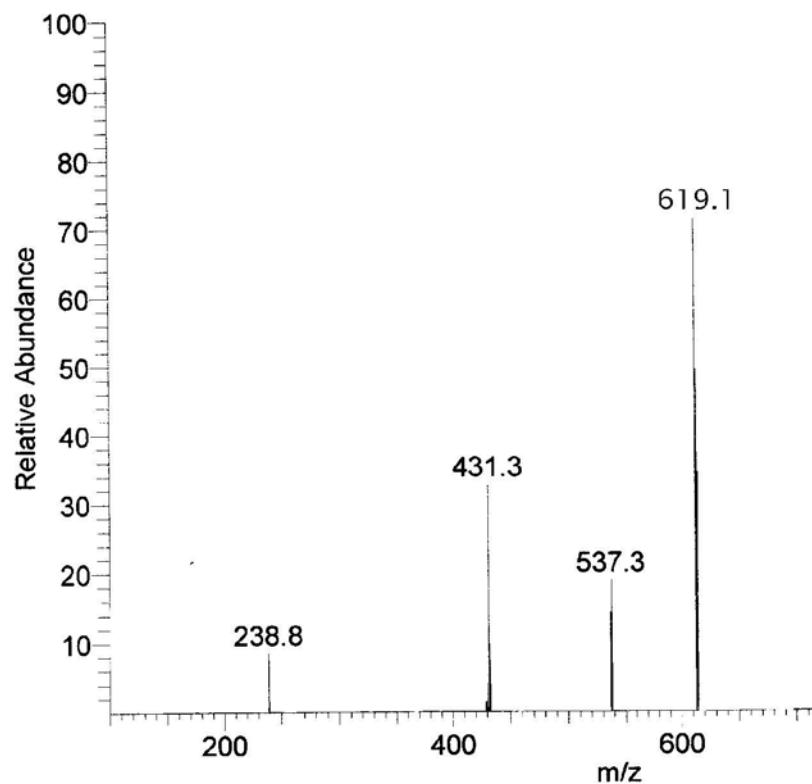


Figure S52. MS spectrum of compound **5h**.

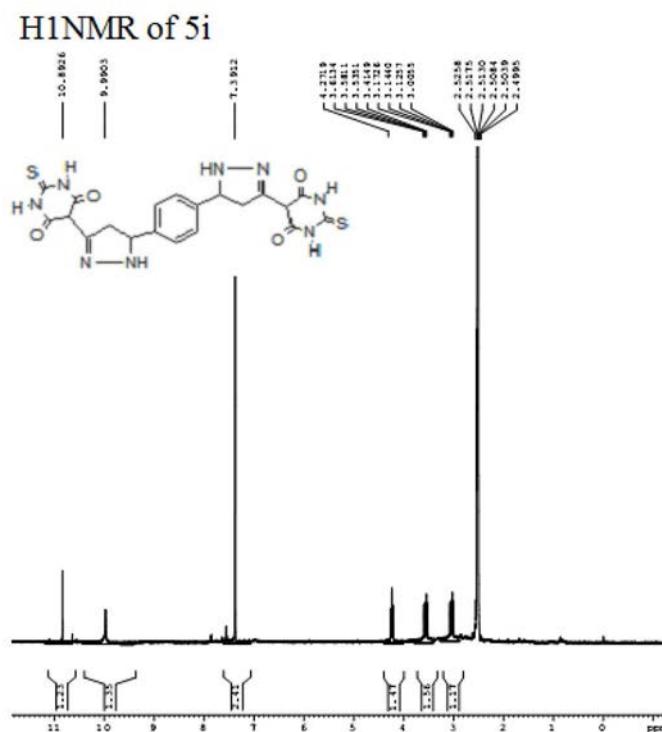


Figure S53. ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) spectrum of compound **5i**.

13 CNMR of 5i

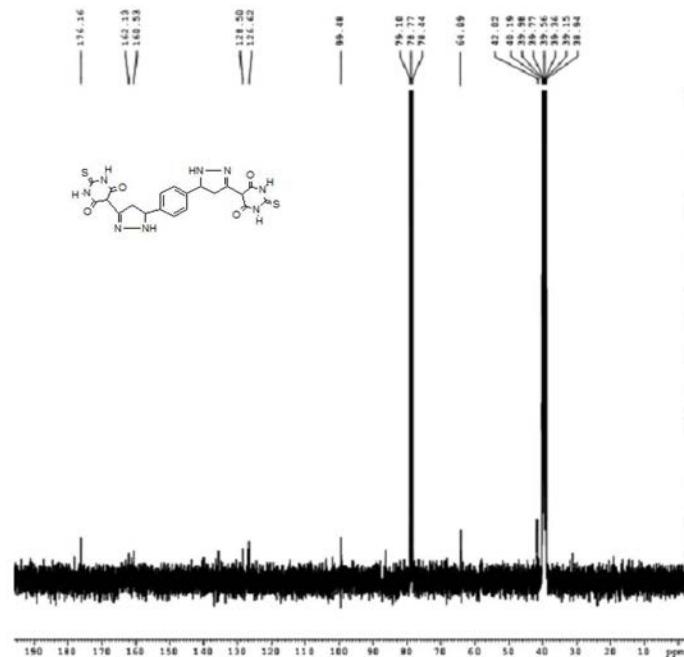


Figure S54. ¹³C NMR ($\text{DMSO}-d_6$, 100 MHz) spectrum of compound 5i.

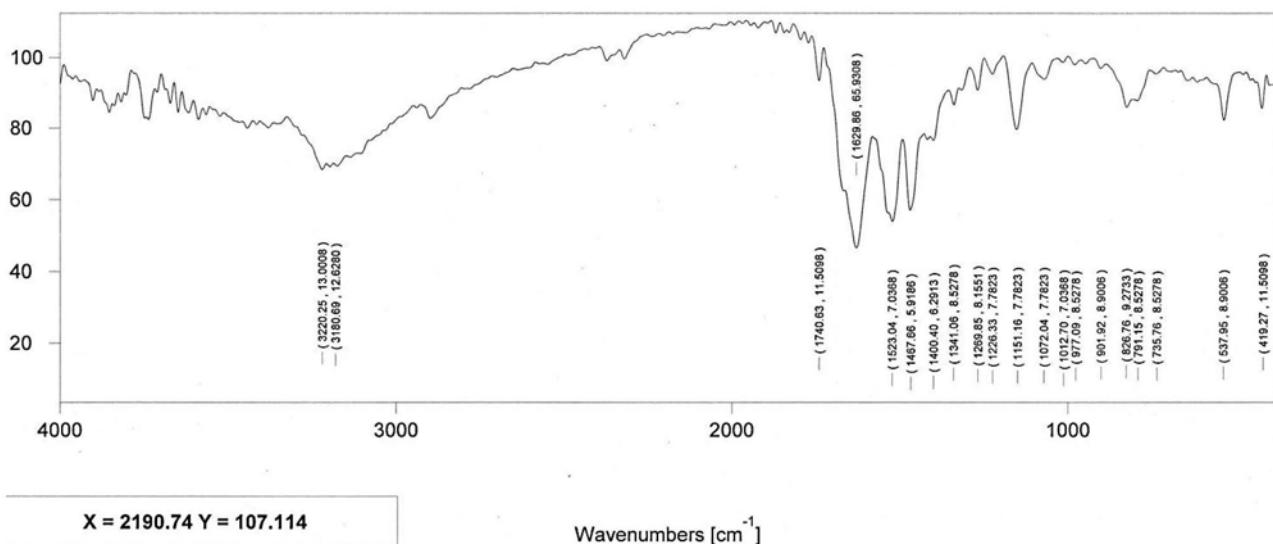


Figure S55. FT-IR (KBr) spectrum of compound 5i.

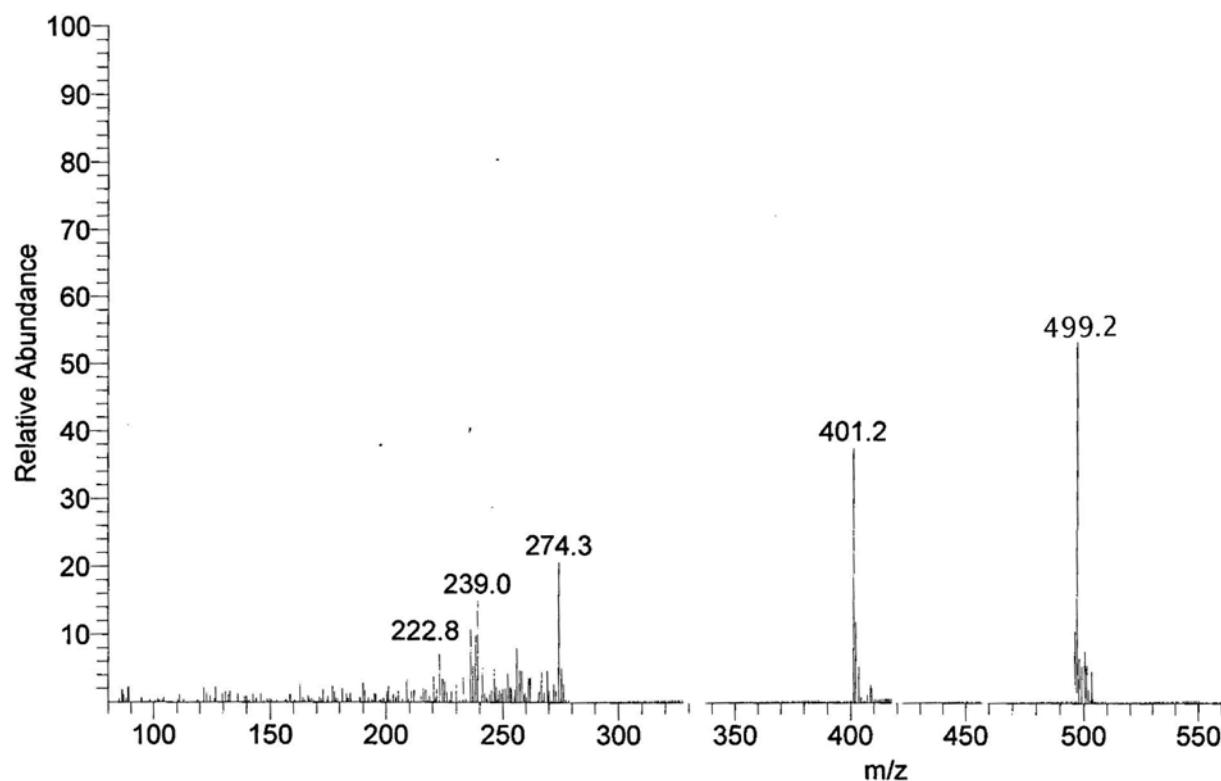


Figure S56. MS spectrum of compound **5i**.

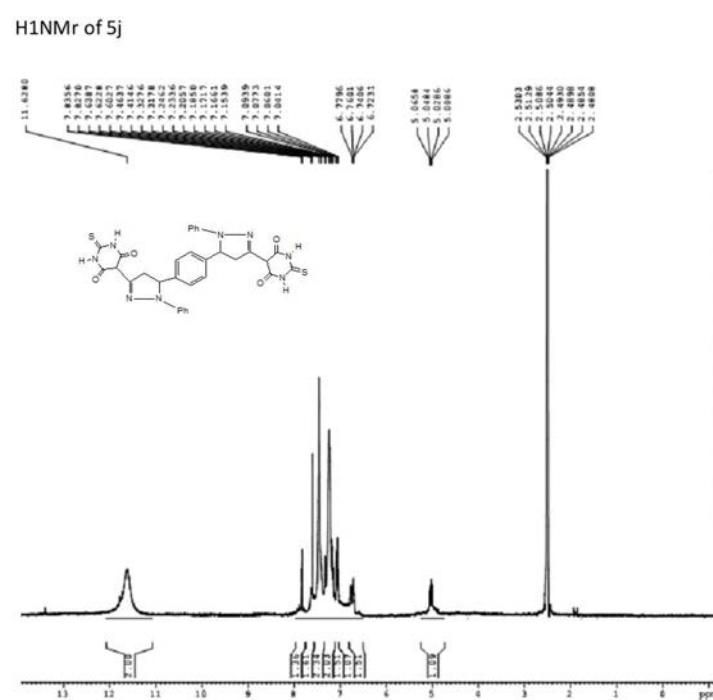


Figure S57. ^1H NMR ($\text{DMSO}-d_6$, 400 MHz) spectrum of compound **5j**.

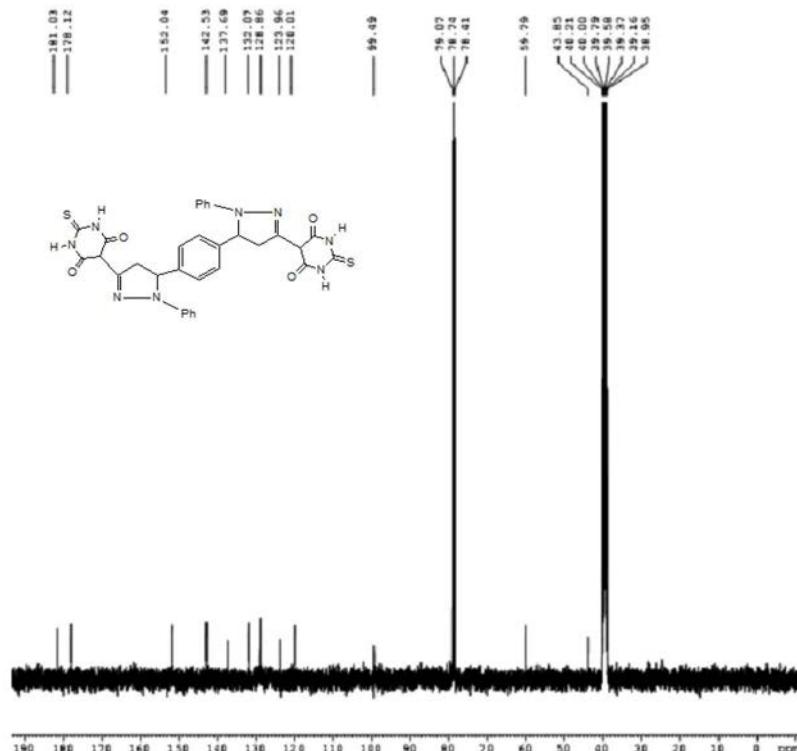
C13NMR of 5j

Figure S58. ^{13}C NMR ($\text{DMSO}-d_6$, 100 MHz) spectrum of compound **5j**.

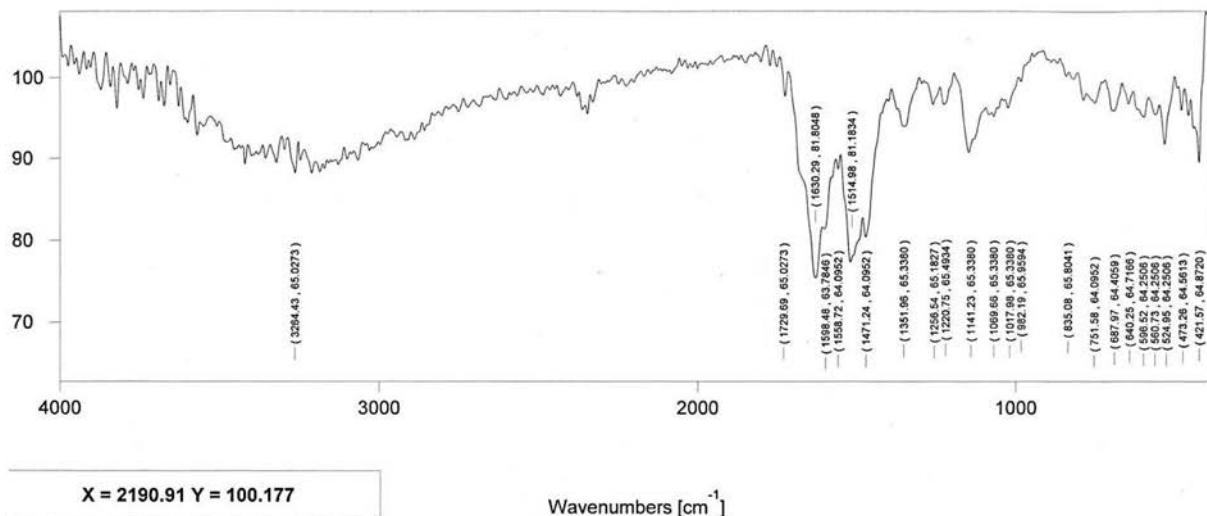


Figure S59. FT-IR (KBr) spectrum of compound **5j**.

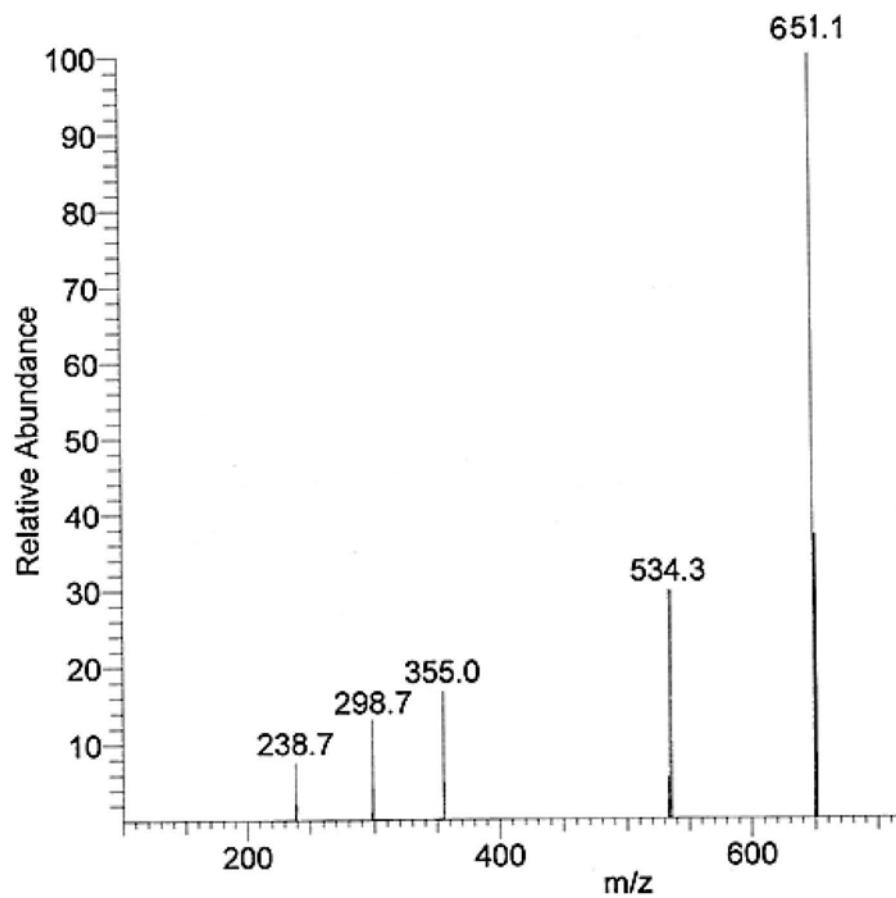


Figure S60. MS spectrum of compound **5j**.