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Supporting Information

Base catalyzed *one-pot* thia-Michael addition-oxidation reaction of hetero-aromatic thiols to 2-aryl-3-nitro-2*H*-chromenes and their antibacterial evaluation

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1. General information

All reagents and solvents were purchased from commercial suppliers. DABCO, salicylaldehyde, trans-*β*-nitro styrene, triethylamine, pyrimidine-2-thiol, pyridine-2-thiol, and thiophenol were purchased from Sigma-Aldrich and used without further purification. The progress of the reaction was monitored by Thin Layer Chromatography (TLC) performed on silica gel aluminium plates and visualization was done by UV light. ^{1}H NMR and ^{13}C NMR Spectrum were recorded at 400 MHz and 100 MHz respectively, with TMS as an internal standard. Chemical shifts (δ) are reported in parts per million (ppm), downfield from the internal standard (TMS, δ = 0.00 ppm) relative to residual $CHCl_3$ (^{1}H: δ = 7.26 ppm, ^{20}C: δ = 77.00 ppm) as an internal reference. Coupling constants (*J*) are reported in Hertz (Hz). Peak multiplicity is indicated as follows: s-singlet, d-doublet, t-triplet, q-quartet, m-multiplets, and dd-doublet of doublet. High-resolution mass Spectra (HRMS) were recorded using the Bruker microTOF-QII mass spectrometer model at the laboratory of IISER, Berhampur.

2. Experimental procedure

2.1. Experimental procedure for the synthesis of 2-aryl-3-nitro-2H-chromene-based heteroaromatic thiols 17(a-t)

A mixture of substituted 2-aryl-3-nitro-2*H*-chromene derivatives [**15(a-q)**,1.0 mmol], pyrimidine-2-thiol/thiophenol/pyridine-2-thiol [**16(a-c)**,1.0 mmol], and Et_3N (1.0 mmol) was taken in a clean, oven-dried seal tube, along with ethanol. This mixture was subjected to an environment of 90°C for two hours. Using the TLC, the progress of the reaction was monitored. The reaction mixture was diluted with water upon completion, and the product was extracted with ethyl acetate. The organic layer was separated, dried over anhydrous Na_2SO_4, and evaporated under reduced pressure. The impure product was then refined via standard silica gel (100–200 mesh) column chromatography, employing a mixture of ethyl acetate and hexane, generating the desired heteroaromatic thiol-based 2-aryl-3-nitro-2*H*-chromene derivatives **17(a-t)** with a good to excellent yields (59%–94%).

2.2.1. *2-((2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17a**)

Reddish-yellow gum (85%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.49(d, *J*= 5.2 Hz, 2H), 7.57-7.55(m, 2H), 7.40-7.34(m, 4H), 7.15-7.11(m, 1H), 6.98(t, *J*= 5.2 Hz, 1H), 6.84-6.80(m,

2H), 6.47(d, *J*= 4 Hz, 1H), 6.04(d, *J*= 3.6 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.8, 157.6, 153.2, 139.4, 134.8, 130.1, 128.9, 128.7, 127.4, 125.6, 125.3, 121.3, 121.2, 117.2, 116.3, 77.5; HRMS (ESI) calculated for $C_{19}H_{14}N_2OS$ $[M+H]^+$ 319.0905, found 319.0915

2.2.2. *2-((6-chloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17b**)

Reddish-brown gum (87%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.51(d, *J*=5.2 Hz, 2H), 7.55-7.52(m, 2H), 7.39-7.32(m, 4H), 7.07(dd, J_{12} = 2.4 Hz, J_{13} = 8.8 Hz, 1H), 7.01(t, *J*= 4.4 Hz, 1H), 6.75(d, *J*= 8.4 Hz, 1H), 6.51 (d, *J*= 4 Hz, 1H), 6.02(d, *J*= 3.6 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.4, 157.7, 151.7, 138.9, 136.1, 129.7, 128.9, 128.7, 127.5, 126.2, 125.3, 124.6, 122.9, 117.7, 117.4, 77.7; HRMS (ESI) calculated for $C_{19}H_{13}ClN_2OS$ $[M+H]^+$ 353.0517, found 353.0505 and $[M+H+2]^+$ 355.0491

2.2.3. *2-((6-bromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17c**)

Reddish-yellow gum (86%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.52(d, *J*=5.2 Hz, 2H), 7.56-7.52(m, 2H),7.41-7.33(m, 4H), 7.22 (dd, J_{12} = 2.4 Hz, J_{13} = 8.8 Hz, 1H), 7.02 (t, *J*= 4.4 Hz, 1H), 6.71 (d, *J*= 8.4 Hz, 1H), 6.51 (d, *J*= 4 Hz, 1H), 6.03 (d, *J*= 4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 157.8, 152.2, 138.8, 136.0, 132.7, 131.1, 128.9, 128.8, 128.2, 127.5, 124.5, 123.4, 118.2, 117.4, 113.5, 77.6; HRMS (ESI) calculated for $C_{19}H_{13}BrN_2OS$ $[M+H]^+$ 397.0012, found 397.0019 and $[M+H+2]^+$ 398.9984

2.2.4. *2-((7-bromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17d**)

Reddish-yellow gum (78%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.42(d, *J*=4.8 Hz, 2H), 7.48-7.45(m, 3H), 7.33-7.28(m, 3H), 7.16(d, *J*= 8.4 Hz, 1H), 6.94-6.91(m, 1H), 6.86(dd, J_{12} =2.4 Hz, J_{13} =8 Hz, 1H), 6.41(d, *J*=3.6 Hz, 1H), 5.95(d, *J*=3.6 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 157.7, 153.8, 138.9, 134.8, 129.1, 128.9, 128.8, 127.4, 126.8, 124.8, 124.3, 123.0, 120.4, 119.6, 117.3, 77.9; HRMS (ESI) calculated for $C_{19}H_{13}BrN_2OS$ $[M+H]^+$ 397.0012, found 397.0009 and $[M+H+2]^+$ 399.0011

2.2.5. *2-((8-chloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17e**).

Reddish-brown gum (62%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.48(d, *J*= 4.4 Hz, 2H), 7.58-7.55(m, 2H), 7.40-7.29(m, 4H), 7.19(dd, J_{12}= 1.6 Hz, J_{13}= 8 Hz, 1H), 6.98(t, *J*= 4.8 Hz, 1H), 6.73(t, *J*= 8 Hz, 1H), 6.58(d, *J*= 4 Hz, 1H), 6.14(d, *J*= 4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.5, 157.6, 149.0, 138.9, 135.3, 130.5, 128.9, 128.7, 127.1, 125.2, 124.1, 123.0, 121.4, 121.2, 117.3, 77.5; HRMS (ESI) calculated for $C_{19}H_{13}ClN_2OS$ $[M+H]^+$ 353.0517, found 353.0547 and $[M+H+2]^+$ 355.0529

2.2.6. *2-((8-bromo-6-chloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17f**)

Yellow gum (77%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.53(d, *J*= 4.4Hz, 2H), 7.49-7.45(m, 2H), 7.34-7.25(m, 5H), 6.96(t, *J*= 4.8 Hz, 1H), 6.56(d, *J*= 4.4 Hz, 1H), 6.08(d, *J*= 4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.0, 157.8, 148.7, 138.3, 136.6, 132.6, 128.9, 128.7, 127.1, 126.4, 124.7, 124.4, 124.0, 117.5, 110.9, 77.6; HRMS (ESI) calculated for $C_{19}H_{12}BrClN_2OS$ $[M+H]^+$ 430.9620, found 430.9664 and $[M+H+2]^+$ 432.9652, $[M+H+4]^+$ 434.9643

2.2.7. *2-((6,8-dibromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17g**)

Reddish-yellow gum (80%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.52(d, *J*= 4.8Hz, 2H), 7.57-7.54(m, 2H), 7.49(s, 2H), 7.42-7.34(m, 3H), 7.03(t, *J*=4.8 Hz, 1H), 6.62(d, *J*= 4 Hz, 1H), 6.16(d, *J*=4.8 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.0, 157.8, 149.1, 138.3, 136.5, 135.4, 128.9, 128.7, 127.5, 127.1, 124.5, 124.3, 117.5, 113.3, 111.3, 77.6; HRMS (ESI) calculated for $C_{19}H_{12}Br_2N_2OS$ $[M+H]^+$ 476.9097, found 476.9070 and $[M+H+2]^+$ 478.9077, $[M+H+4]^+$ 480.9071

2.2.8. *2-((6,8-dichloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17h**)

Reddish-yellow gum (82%); ^{1}H NMR (400 MHz, $CDCl_3$): 8.44 (d, *J* = 5.0 Hz, 2H), 7.48-7.46 (m, 2H), 7.34-7.23 (m, 4H), 7.12 (d, *J* = 2.7 Hz, 1H), 6.95 (t, *J* = 4.8 Hz, 1H), 6.56 (d, *J* = 4.1 Hz, 1H), 6.07 (d, *J* = 4.1 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm); 171.2, 157.9, 147.8, 138.5, 136.7, 130.0, 129.1, 128.9, 127.3, 126.0, 124.5, 124.2, 124.1, 122.3, 117.6, 77.7; HRMS (ESI) calculated for $C_{19}H_{12}Cl_2N_2OS$ $[M+H]^+$ 387.0127, found 387.0146 and $[M+H+2]^+$ 389.0137

2.2.9. *2-((6-bromo-8-methoxy-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* (**17i**)

Reddish-yellow gum (59%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.51(d, *J*= 5.2 Hz, 2H), 7.57-7.52(m, 3H), 7.37-7.31(m, 2H), 7.20(d, *J*= 2 Hz, 1H), 7.01(t, *J*= 4.4 Hz, 1H), 6.89(d, *J*= 2 Hz, 1H), 6.54(d, *J*= 4.4 Hz, 1H), 6.07(d, *J*= 4.4 Hz, 1H), 3.80(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.4, 158.1, 157.7, 148.8, 138.7, 136.1, 128.8, 128.7, 127.4, 124.3, 123.6, 120.3, 117.3, 116.2, 112.8, 77.4, 56.4; HRMS (ESI) calculated for $C_{20}H_{15}BrN_2O_2S$ $[M+H]^+$ 427.0118, found 427.0089

2.2.10. *2-((6-chloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* (**17j**)

Reddish-yellow gum (78%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.52(d, *J*= 4.4 Hz, 2H), 7.51-7.46(m, 2H), 7.38(d, *J*=2.4, 1H), 7.07-7.01(m, 2H), 6.91-6.87(m, 2H), 6.71(d, *J*= 8.8 Hz, 1H), 6.50(d, *J*= 3.6 Hz, 1H), 5.96(d, *J*= 4 Hz, 1H), 3.80(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.5, 160.1, 157.7, 151.6, 136.2, 130.8, 129.7, 129.2, 126.0, 125.2, 124.4, 122.9, 117.8, 117.4, 114.1, 77.3, 55.3; HRMS (ESI) calculated for $C_{20}H_{15}ClN_2O_2S$ $[M+H]^+$ 383.0623, found 383.0638 and $[M+H+2]^+$ 385.0608

2.2.11. *2-((6,8-dichloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* (**17k**)

Red gum (91%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.52(d, *J*= 4.4 Hz, 2H), 7.50-7.47(m, 2H), 7.31(d, *J*= 2.4 Hz, 1H), 7.17(d, *J*= 2.4 Hz, 1H), 7.03(t, *J*= 4.4 Hz, 1H), 6.91-6.87(m, 2H), 6.60(d, *J*= 4.4 Hz, 1H), 6.08(d, *J*= 4 Hz, 1H), 3.80(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.2, 160.1, 157.8, 147.6, 136. 8, 130.2, 129.8, 129.0, 125.7, 124.2, 124.1, 123.9, 122.2, 117.5, 114.1, 77.3, 55.3; HRMS (ESI) calculated for $C_{20}H_{14}Cl_2N_2O_2S$ $[M+H]^+$ 417.0233, found 417.0250 and $[M+H+2]^+$ 419.0247

2.2.12. *2-((6,8-dibromo-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* (**17l**)

Reddish yellow gum (83%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.51(d, *J*= 5.2 Hz, 2H), 7.50-7.46(m, 4H), 7.03(t, *J*= 5.2 Hz, 1H), 6.90-6.88(m, 2H), 6.59(d, *J*= 4 Hz, 1H), 6.08(d, *J*= 4.8 Hz, 1H), 3.80(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.1, 160.1, 157.8, 149.1, 136.7, 135.3, 132.3, 130.2, 129.0, 127.4, 124.5, 124.2, 117.5, 114.0, 113.2, 77.3, 55.3; HRMS (ESI) calculated for $C_{20}H_{14}Br_2N_2O_2S$ $[M+H]^+$ 506.9202, found 506.9201 and $[M+H+2]^+$ 508.9183, $[M+H+4]^+$ 510.9181

2.2.13. *2-((8-bromo-6-chloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* (**17m**)

Brownish-yellow gum (88%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.51(d, *J*=4.8 Hz, 2H), 7.52-7.47(m, 2H), 7.35-7.32(m, 2H), 7.03(t, *J*=4.4 Hz, 1H), 6.91-6.87(m, 2H), 6.60(d, *J*= 4 Hz, 1H), 6.08(d, *J*= 4.4 Hz, 1H), 3.8(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.2, 160.1, 157.8, 148.6, 136.7, 132.6, 130.2, 128.9, 126.2, 124.6, 124.3, 124.1, 117.5, 114.0, 110.9, 77.3, 55.3; HRMS (ESI) calculated for $C_{20}H_{14}BrClN_2O_2S$ $[M+H]^+$ 460.9728, found 460.9724 and $[M+H+2]^+$ 462.9716, $[M+H+4]^+$ 464.9698

2.2.14. *2-((6-bromo-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* (**17n**)

Reddish yellow gum (89%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.52(d, *J*=4.4 Hz, 2H), 7.52-7.45(m, 3H), 7.20(dd, J_{12} =2.4 Hz, J_{13} =8.4 Hz, 1H), 7.03(t, *J*=5.2 Hz, 1H), 6.90-6.88(m, 2H), 6.66(d, *J*=8.8 Hz, 1H), 6.49(d, *J*= 4Hz, 1H), 5.96(d, *J*=4.4 Hz, 1H), 3.80(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 160.1, 157.7, 152.1, 136.3, 132.7, 130.8, 129.2, 128.1, 128.1, 124.2, 123.4, 118.3, 117.4, 114.1, 113.3, 77.3, 55.3; HRMS (ESI) calculated for $C_{20}H_{15}BrN_2O_2S$ $[M+H]^+$ 427.0118, found 427.0121 and $[M+H+2]^+$ 429.0106

2.2.15. *2-((6-bromo-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyrimidine* (**17o**)

Yellow gum (69%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.51(d, *J*= 5.2 Hz, 2H), 7.52-7.48(m, 2H), 7.36-7.33(m, 3H), 7.22(dd, J_{12}= 2.8 Hz, J_{13}= 8.8 Hz, 1H), 7.03(t, *J*= 4.8 Hz, 1H), 6.69(d, *J*= 8 Hz, 1H), 6.48(d, *J*= 3.6 Hz, 1H), 5.98(d, *J*= 4.4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.3, 157.8, 151.9, 137.2, 135.3, 134.8, 132.8, 130.9, 129.0, 128.9, 128.8, 128.2, 124.9, 123.3, 118.2, 117.4, 113.7, 77.3; HRMS (ESI) calculated for $C_{19}H_{12}BrClN_2OS$ $[M+H]^+$ 430.9622, found 430.9619 and $[M+H+2]^+$ 432.9621, $[M+H+4]^+$ 434.9583

2.2.16. *2-((6-chloro-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyrimidine* (**17p**)

Reddish yellow gum (74%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.52(d, *J*= 5.2 Hz, 2H), 7.52-7.49(m, 2H), 7.38-7.34(m, 3H), 7.08(dd, J_{12}= 2.8 Hz, J_{13}= 8.8 Hz, 1H), 7.03(t, *J*= 4.4 Hz, 1H), 6.74(d, *J*= 8.8 Hz, 1H), 6.48(d, *J*= 3.6 Hz, 1H), 5.98(d, *J*= 4 Hz, 1H), ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 171.3, 157.8, 151.4, 137.2, 135.4, 134.8, 130.9, 129.9, 129.0, 128.9, 128.8, 126.4, 125.4, 125.0, 122.8, 117.8, 117.4, 77.3; HRMS (ESI) calculated for $C_{19}H_{12}Cl_2N_2OS$ $[M+H]^+$ 387.0127, found 387.0145 and $[M+H+2]^+$ 389.0150

2.2.17. *8-methoxy-2-phenyl-4-(phenylthio)-2H-chromene* (**17q**)

Reddish-yellow gum (81%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 7.44-7.41(m, 2H), 7.39-7.26(m, 7H), 7.24-7.19(m, 1H), 7.14-7.08(m, 1H), 6.83- 6.78(m, 2H), 5.98(d, *J*= 3.6 Hz, 1H), 5.94(d, *J*= 3.6 Hz, 1H), 3.82(s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 148.1, 142.3, 139.9, 133.6, 130.6, 129.6, 129.2, 128.6, 128.4, 127.7, 127.1, 126.9, 121.8, 120.7, 117.3, 113.1, 77.3, 56.2; HRMS (ESI) calculated for $C_{22}H_{18}O_2S$ $[M+H]^+$ 347.1108, found 347.1136

2.2.18. *2-((6-bromo-2-phenyl-2H-chromen-4-yl)thio)pyridine* (**17r**)

Brownish-yellow gum (86%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.45- 8.43 (m, 1H), 7.56-7.45 (m, 4H), 7.41-7.33 (m, 3H), 7.23 (dd, J_{12} = 8.7, J_{13} =2.3 Hz, 1H), 7.12-7.08 (m, 1H), 7.06-7.02 (m, 1H), 6.74 (d, J = 8.7 Hz, 1H), 6.52 (d, J = 4.1 Hz, 1H), 6.00 (d, J = 3.7 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 158.6, 152.5, 149.9, 138.9, 136.9, 135.5, 133.0, 128.9, 128.8, 128.3, 127.1, 125.5, 122.9, 121.6, 120.4, 118.3, 113.7, 77.6; HRMS (ESI) calculated for $C_{20}H_{14}BrNOS$ $[M+H]^+$ 396.0059, found 396.0067 and $[M+H+2]^+$ 398.0126

2.2.19. *2-((6-chloro-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyridine* (**17s**)

Reddish yellow gum (82%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.44-8.42 (m, 1H), 7.53-7.48 (m, 1H), 7.42 (dd, J_{12} = 9.1, J_{13}= 2.3 Hz, 3H), 7.35 (dd, J = 6.6, 2.1 Hz, 2H), 7.12-7.02 (m, 3H), 6.79-6.75 (m, 1H), 6.47 (d, J = 3.7 Hz, 1H), 5.96 (d, J = 4.1 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 158.2, 151.6, 149.9, 137.3, 136.9, 134.7, 134.6, 130.1, 129.0, 128.5, 126.6, 126.1, 125.5, 122.4, 121.8, 120.5, 117.8, 76.7; HRMS (ESI) calculated for $C_{20}H_{13}Cl_2NOS$ $[M+H]^+$ 386.0175, found 386.0143 and $[M+H+2]^+$ 388.0123, $[M+H+4]^+$ 390.000

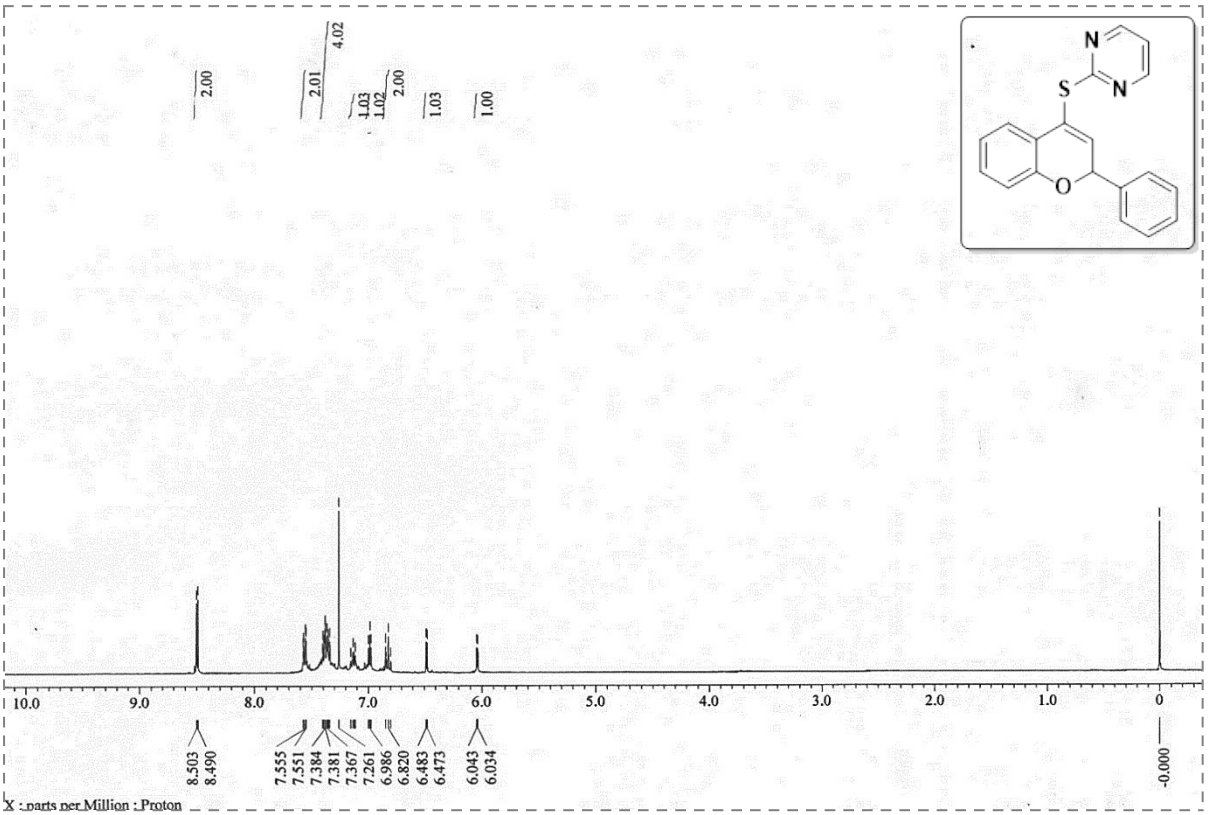
2.2.20. *2-((8-bromo-6-chloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyridine* (**17t**)

Red thick gum (94%); ^{1}H NMR (400 MHz, $CDCl_3$): δ_H (ppm) 8.43-8.42 (m, 1H), 7.50 (td, J_{12} = 7.7, J_{13}=1.8 Hz, 1H), 7.42-7.38 (m, 2H), 7.38 (d, J = 2.7 Hz, 1H), 7.32 (d, J = 2.7 Hz, 1H), 7.09 (d, J = 8.2 Hz, 1H), 7.05-7.02 (m, 1H), 6.90-6.87 (m, 2H), 6.62 (d, J = 4.6 Hz, 1H), 6.06 (d, J = 4.1 Hz, 1H), 3.79 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ_C (ppm) 160.0, 158.1, 149.9, 148.7, 137.0, 136.2, 132.8, 130.2, 128.6, 126.5, 125.3, 124.7, 123.6, 121.6, 120.5, 114.1, 111.1, 77.3, 55.2; HRMS (ESI) calculated for $C_{21}H_{15}BrClNO_2S$ $[M+H]^+$ 459.9775, found 459.9814 and $[M+H+2]^+$ 461.9772, $[M+H+4]^+$ 463.9774

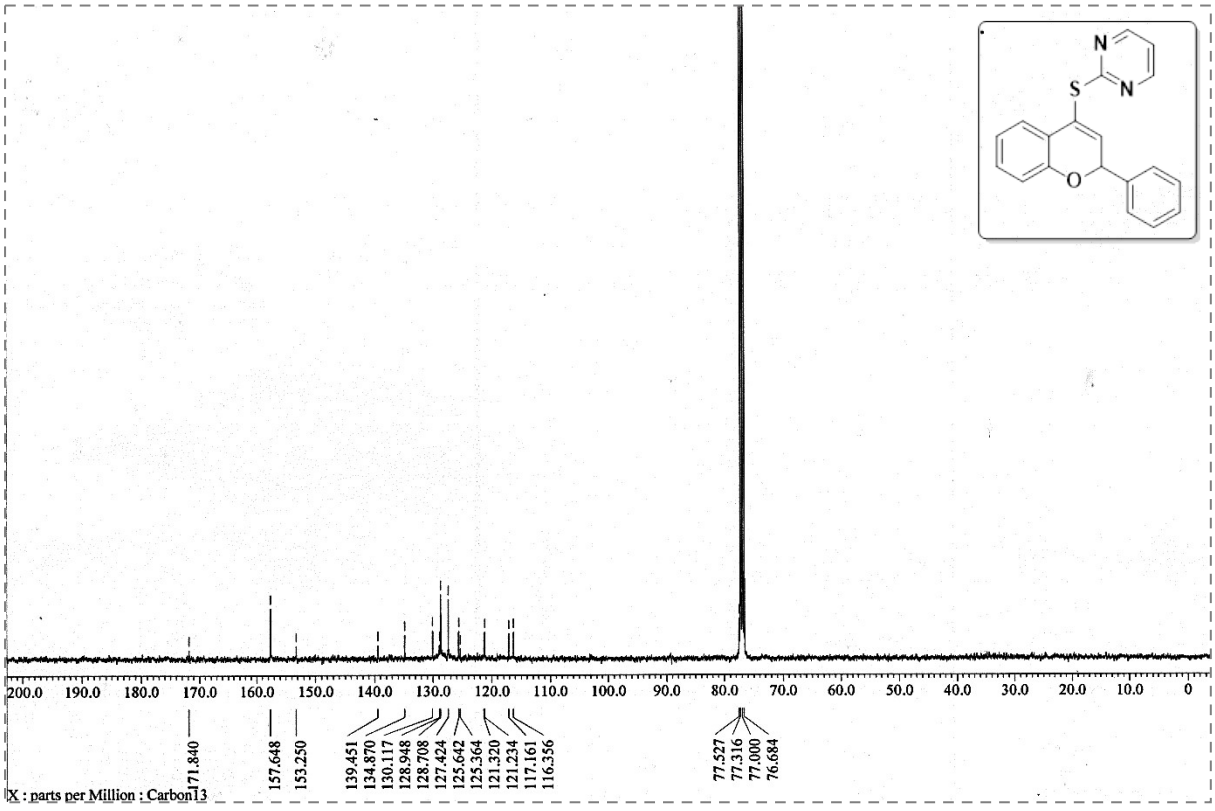
3. ^{1}H NMR Spectra, ^{13}C NMR Spectra, and HRMS Spectra of Heteroaromatic-2-thiol based-3-nitro-2*H*-Chromene derivatives 17(a-t).

3.1. *2-((2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17a)**:

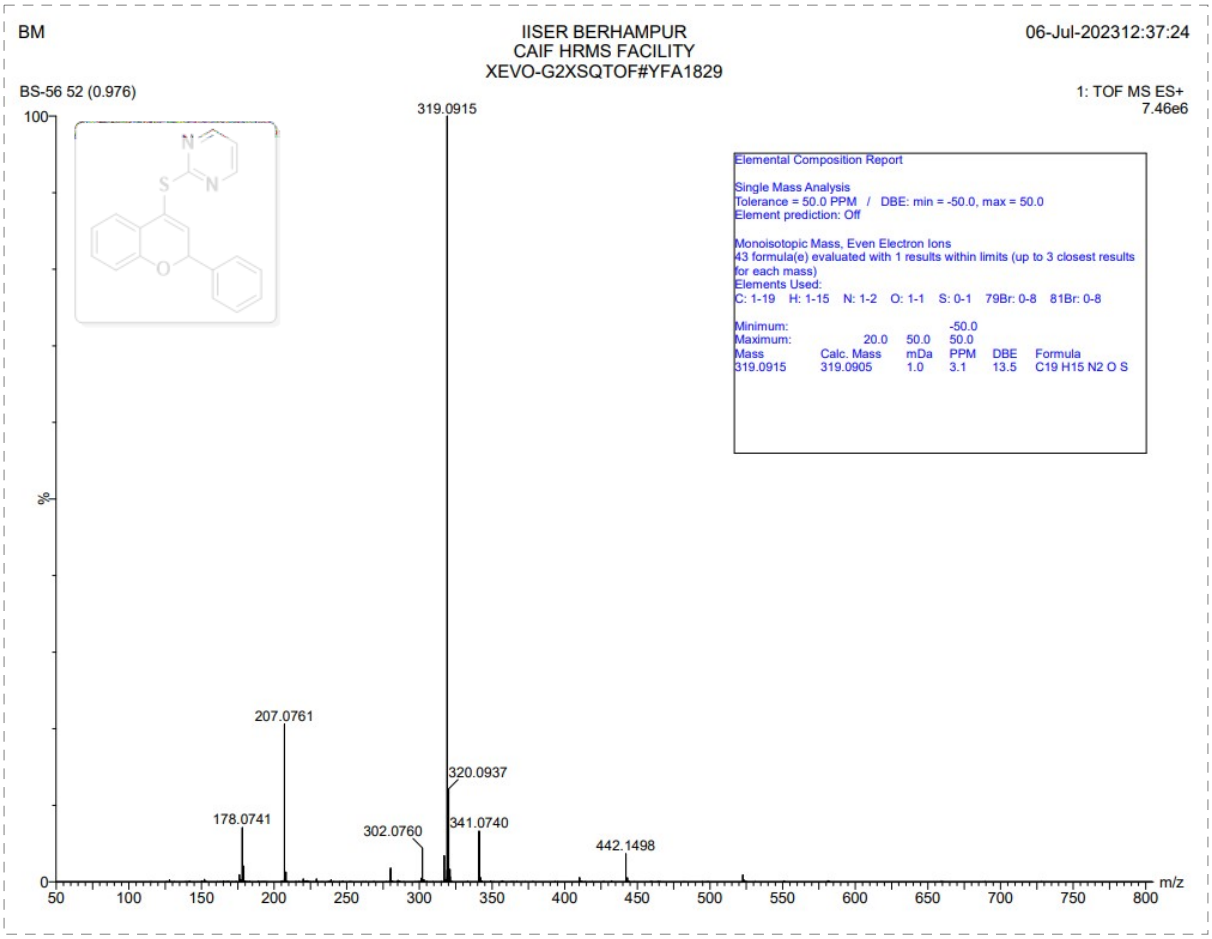
^{1}H NMR Spectrum of **(17a)**



^{13}C NMR Spectrum of **(17a)**

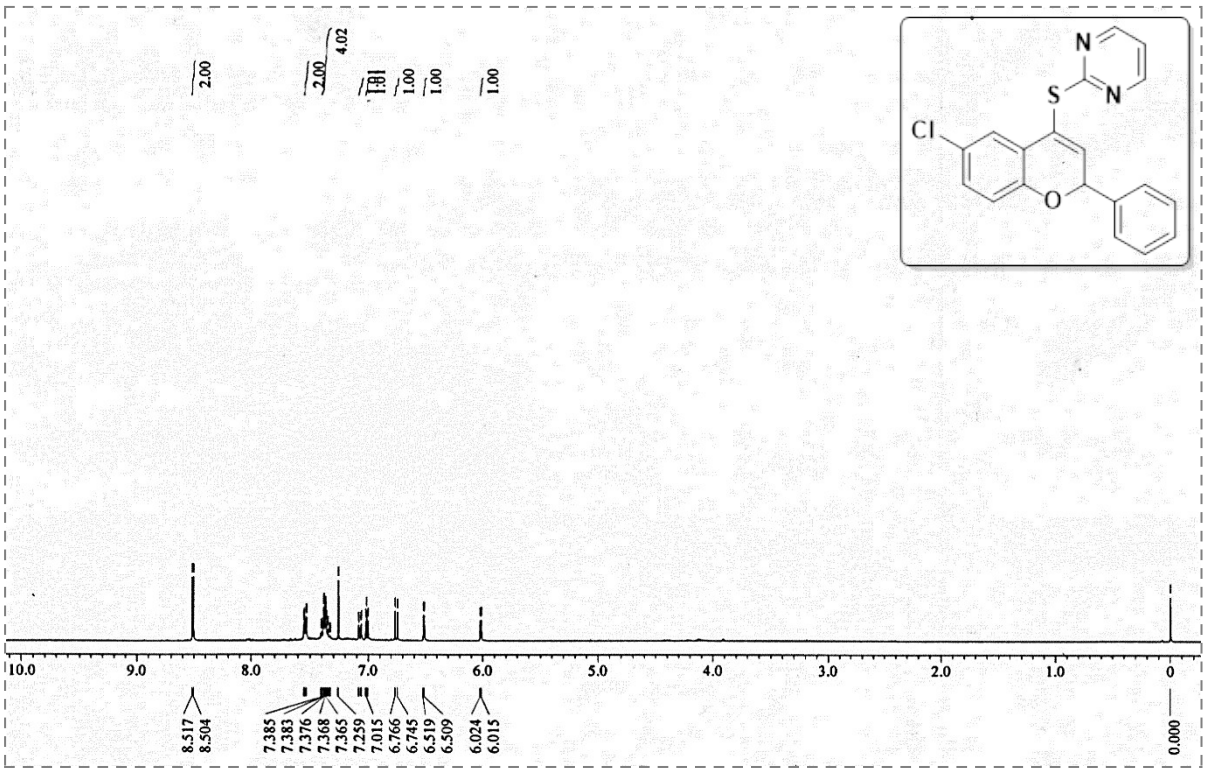


HRMS Spectrum of **(17a)**

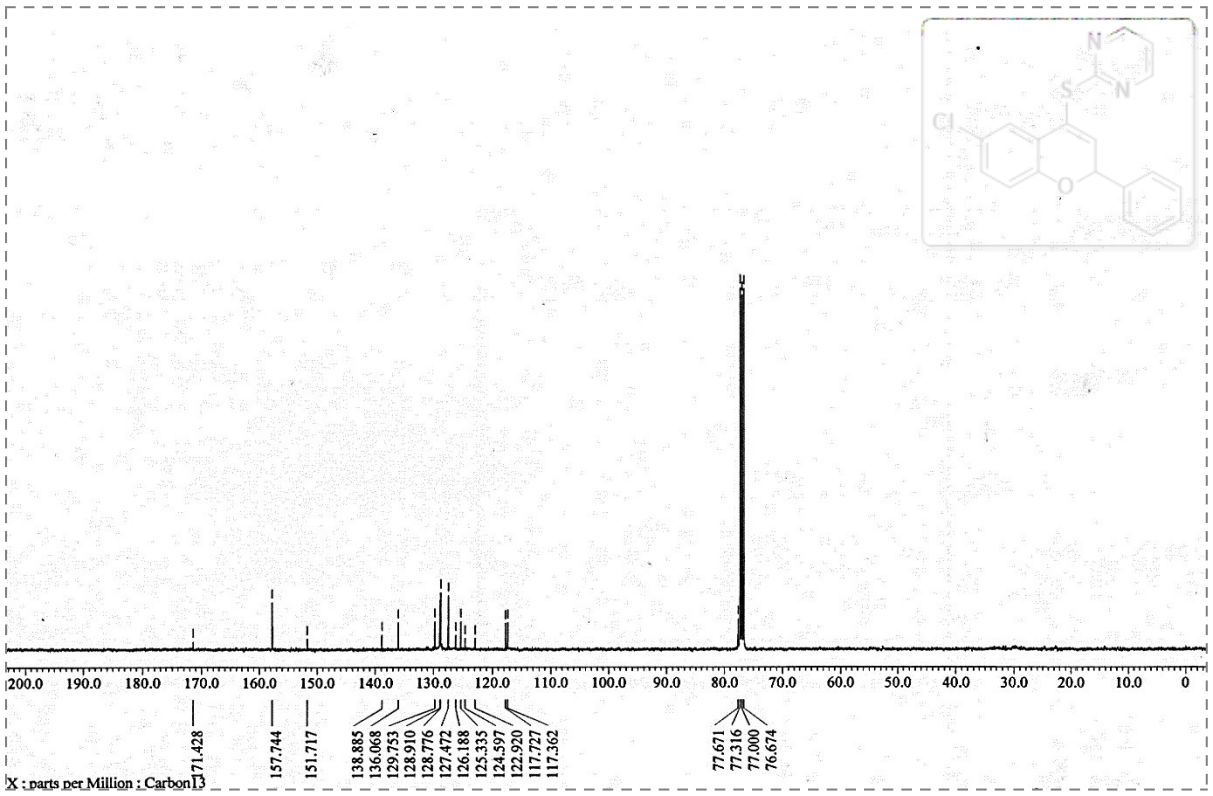


3.2. *2-((6-chloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17b)**:

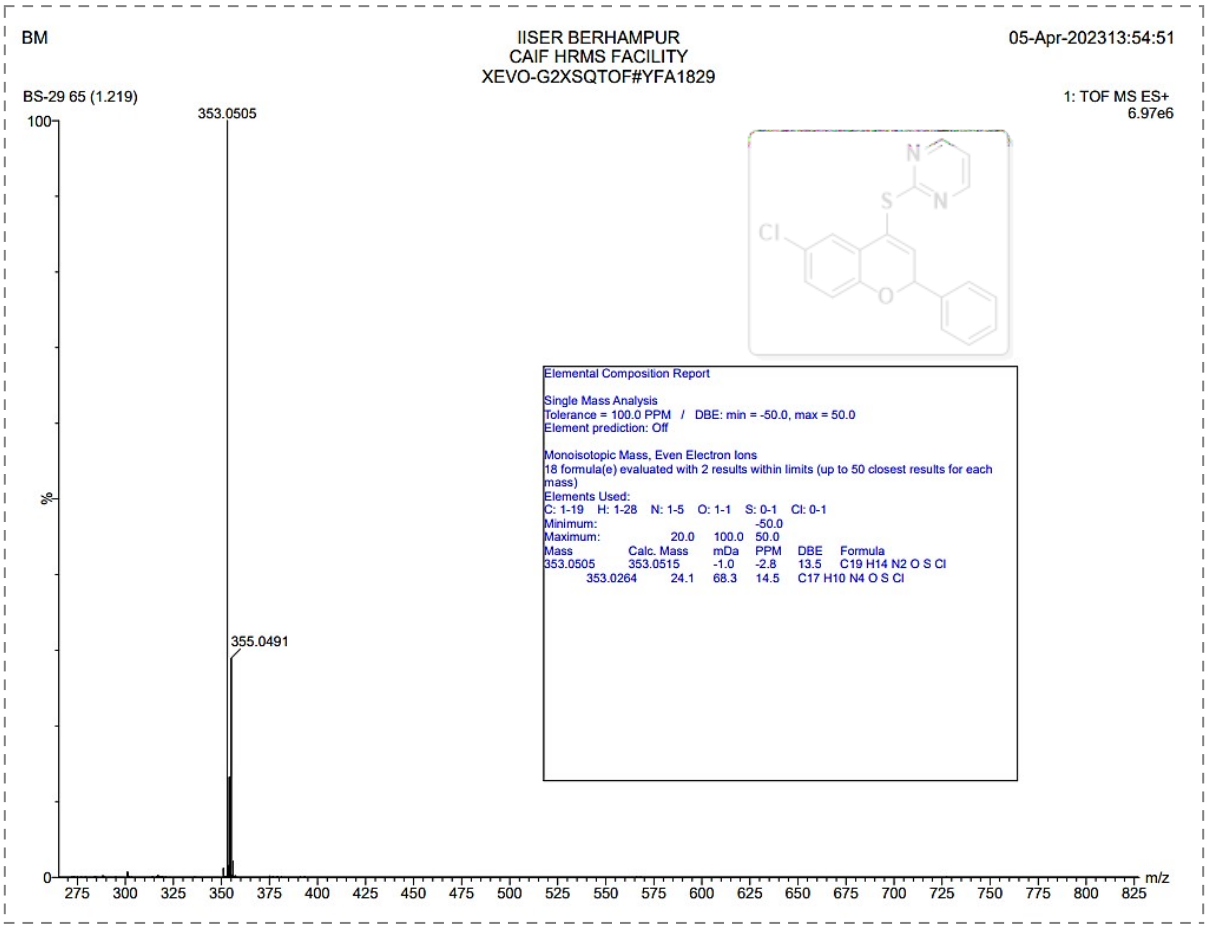
^{1}H NMR Spectrum of **(17b)**



^{13}C NMR Spectrum of **(17b)**

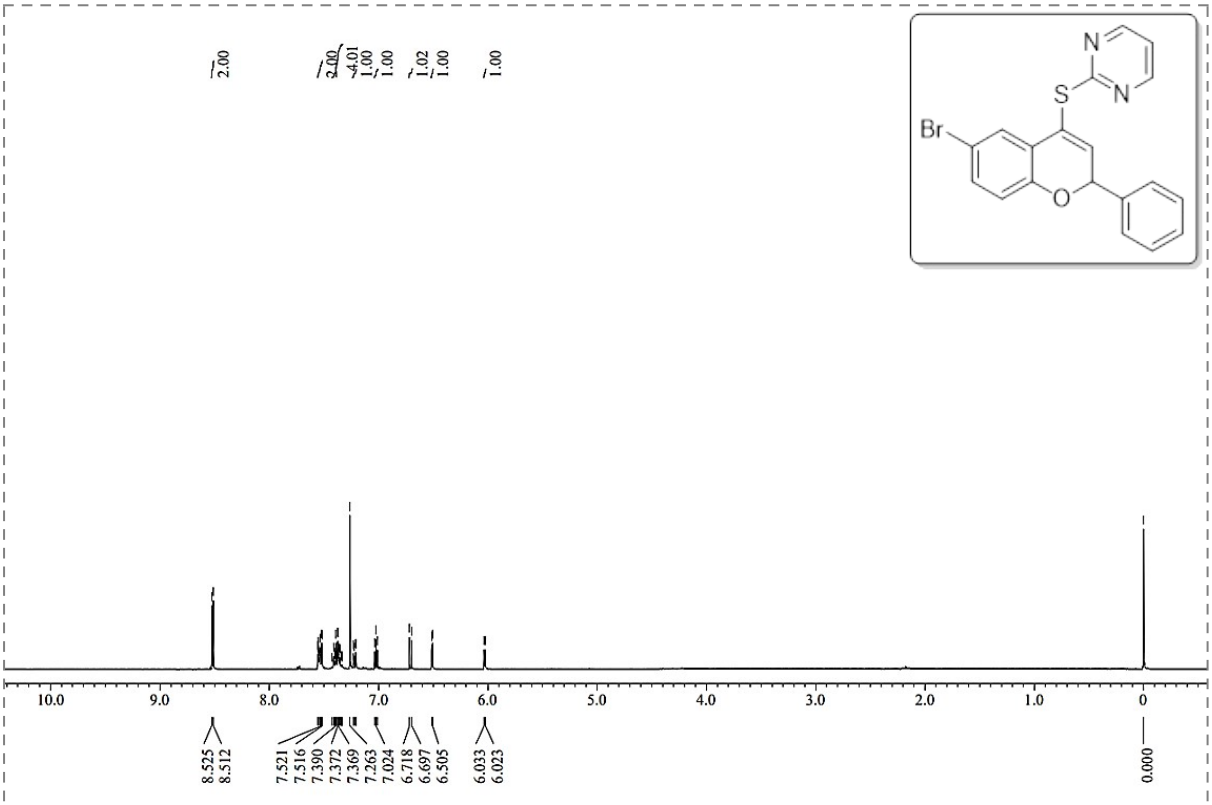


HRMS Spectrum of **(17b)**

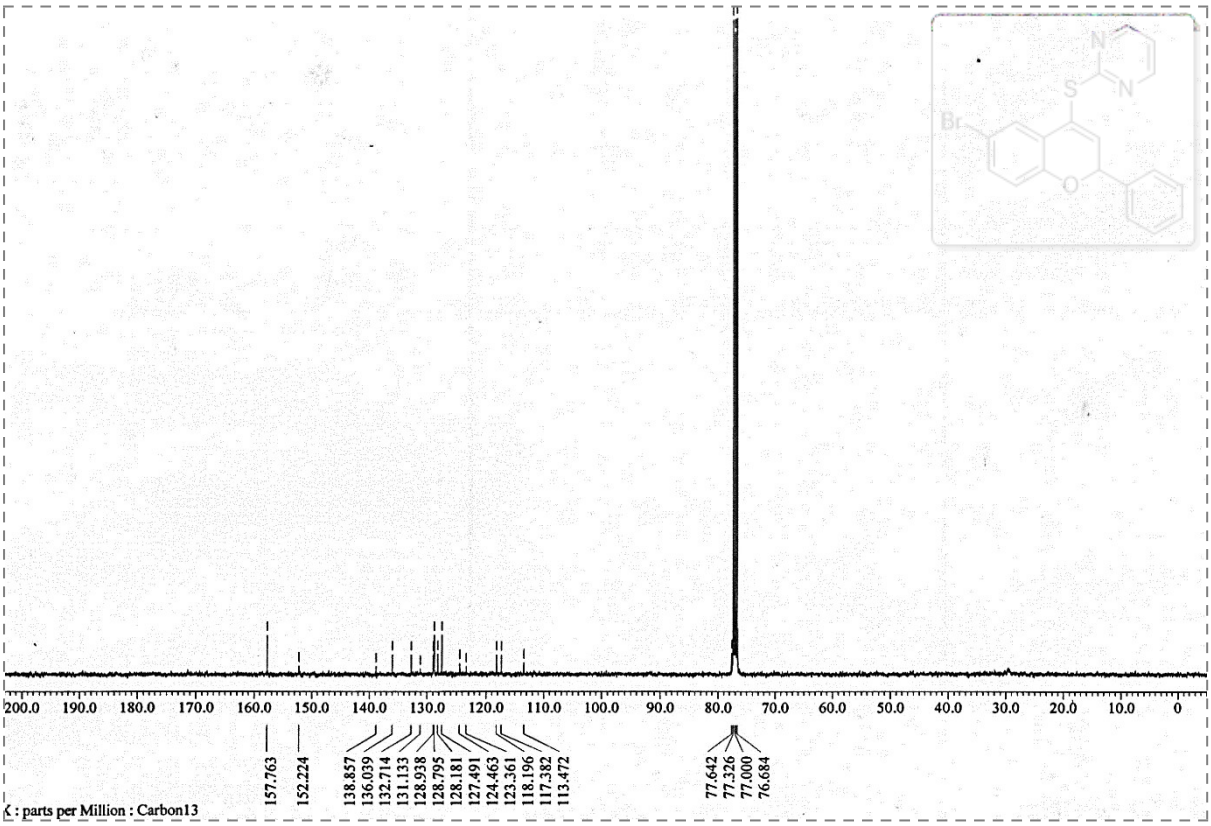


3.3. *2-((6-bromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17c)**:

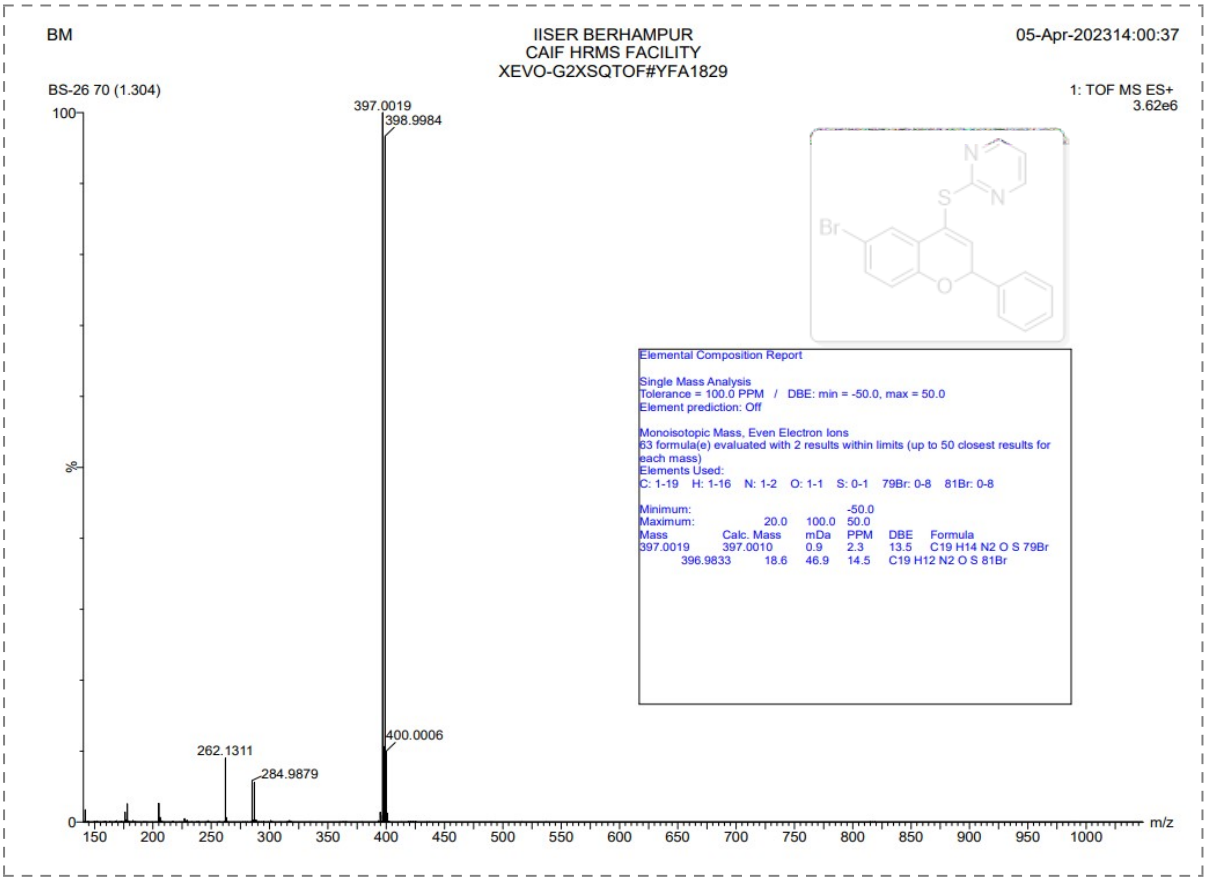
^{1}H NMR Spectrum of **(17c)**



^{13}C NMR Spectrum of **(17c)**

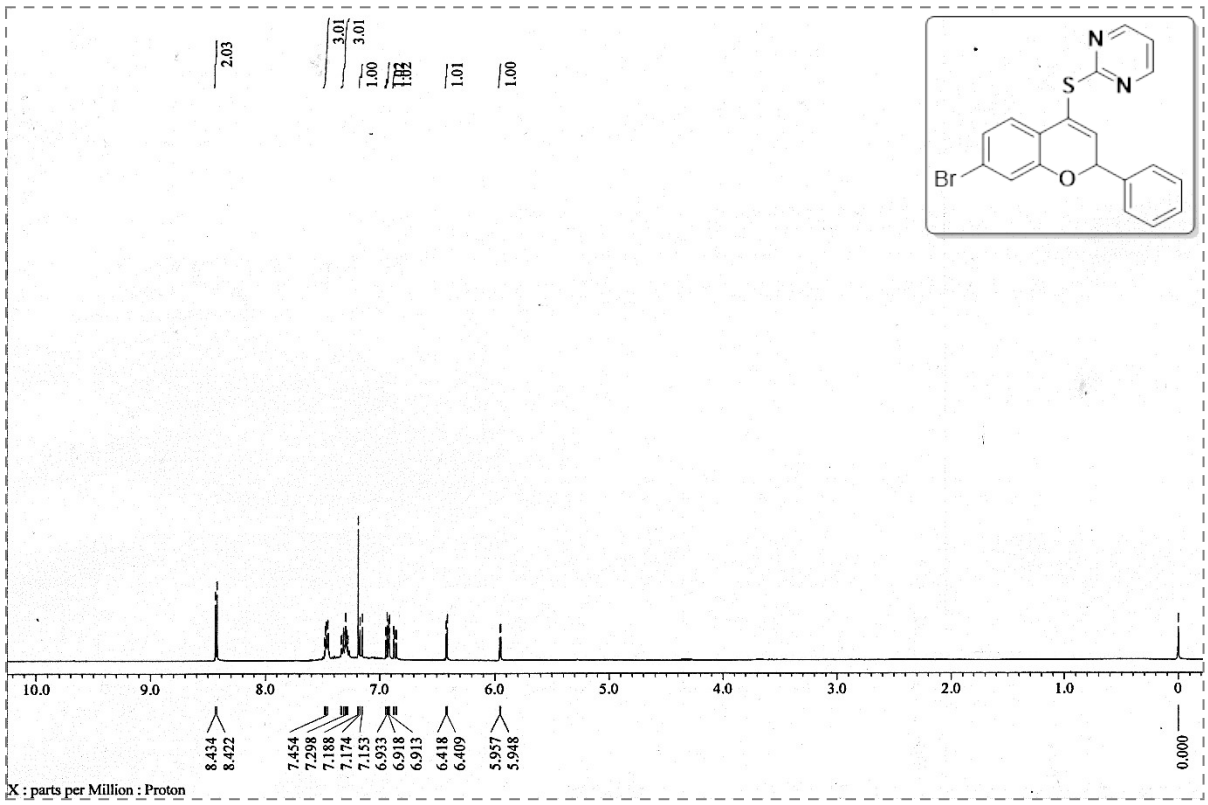


HRMS Spectrum of **(17c)**

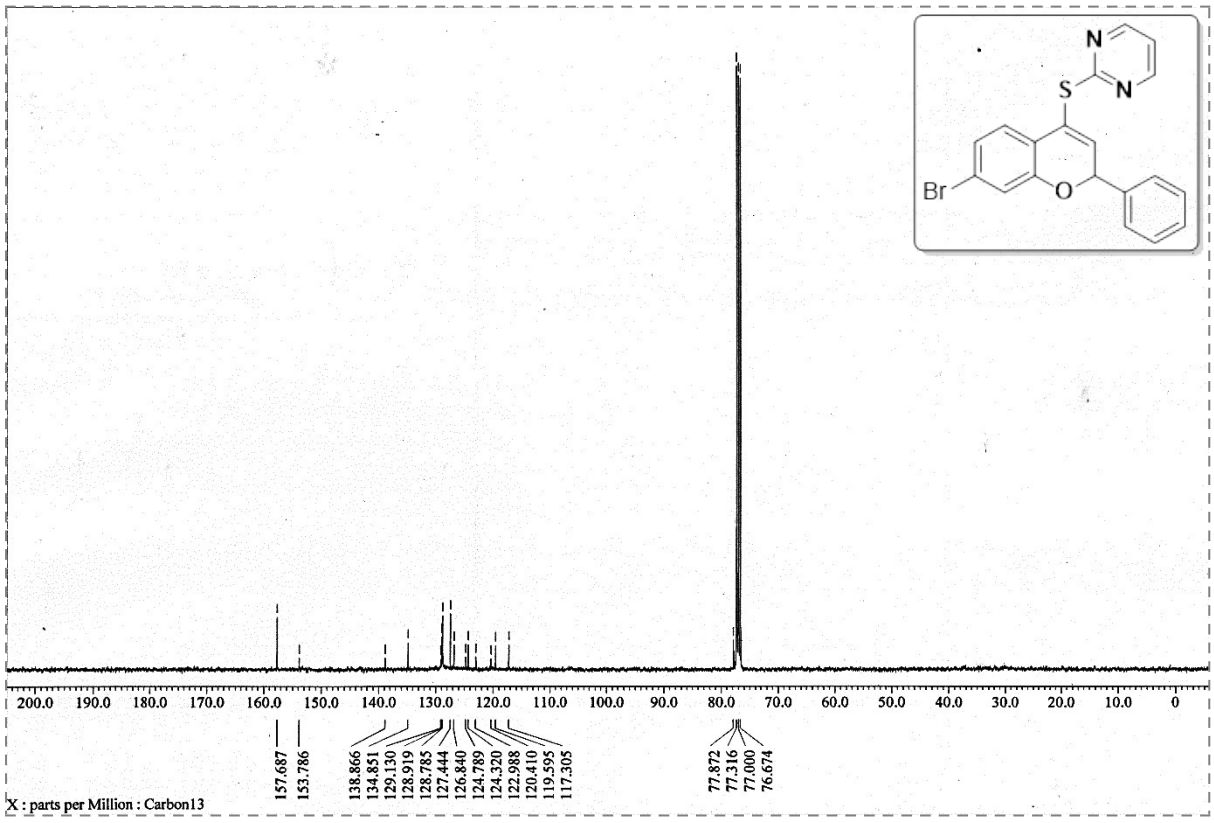


3.4. *2-((7-bromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17d)**:

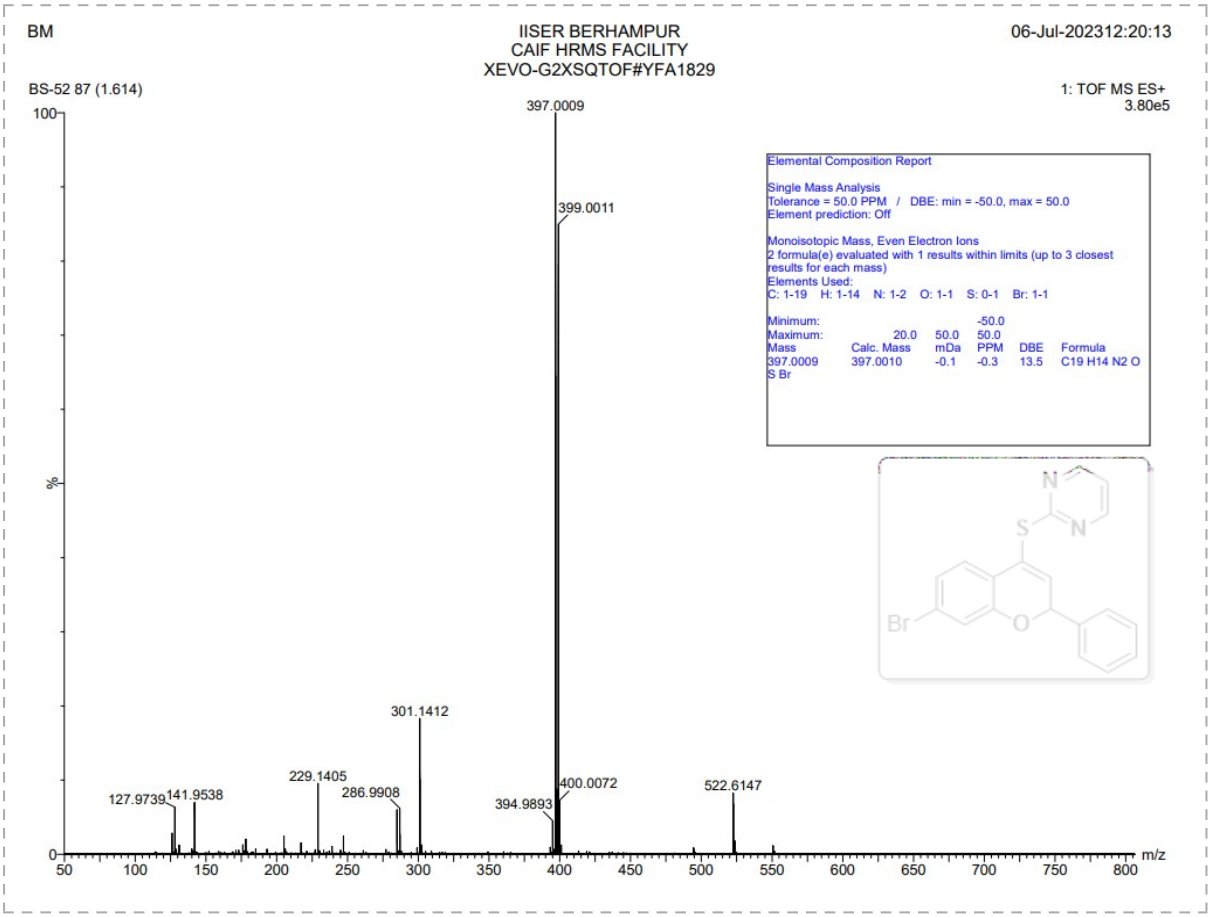
^{1}H NMR Spectrum of **(17d)**



^{13}C NMR Spectrum of **(17d)**

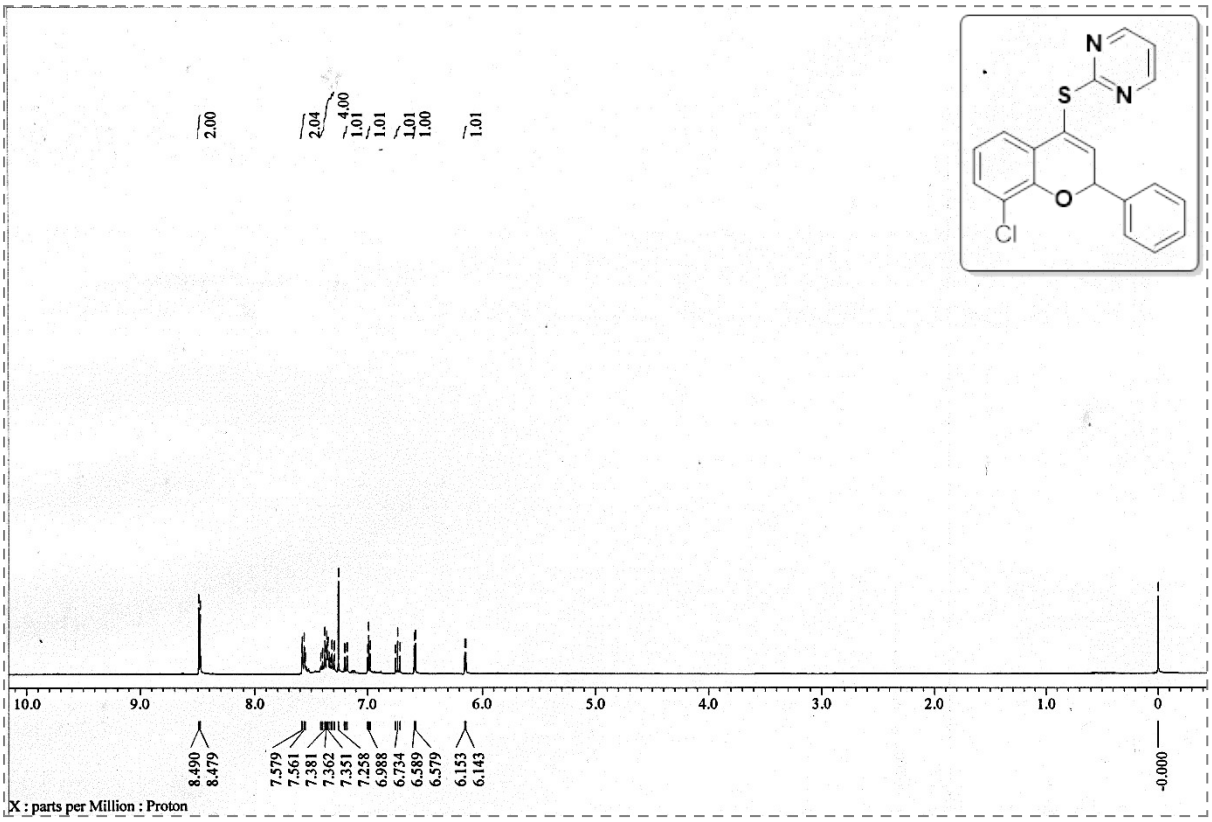


HRMS Spectrum of **(17d)**

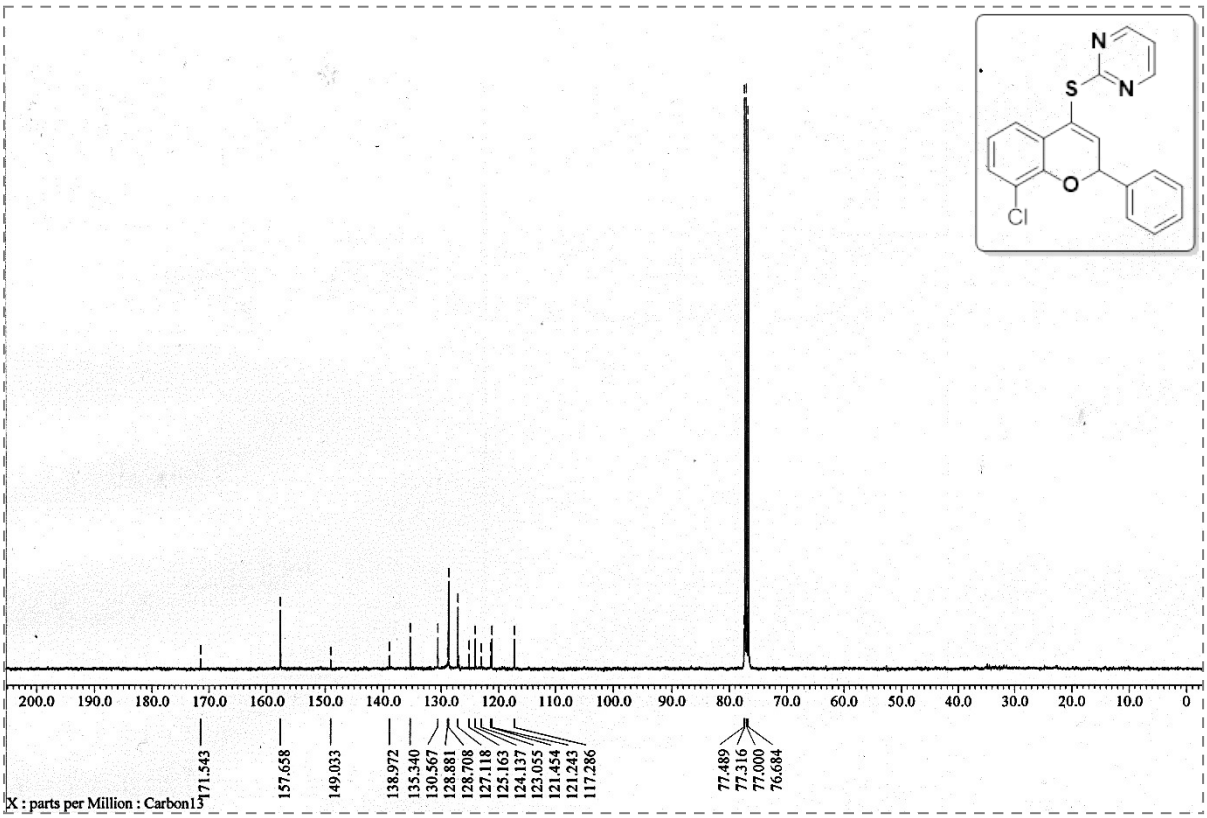


3.5. *2-((8-chloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17e)**:

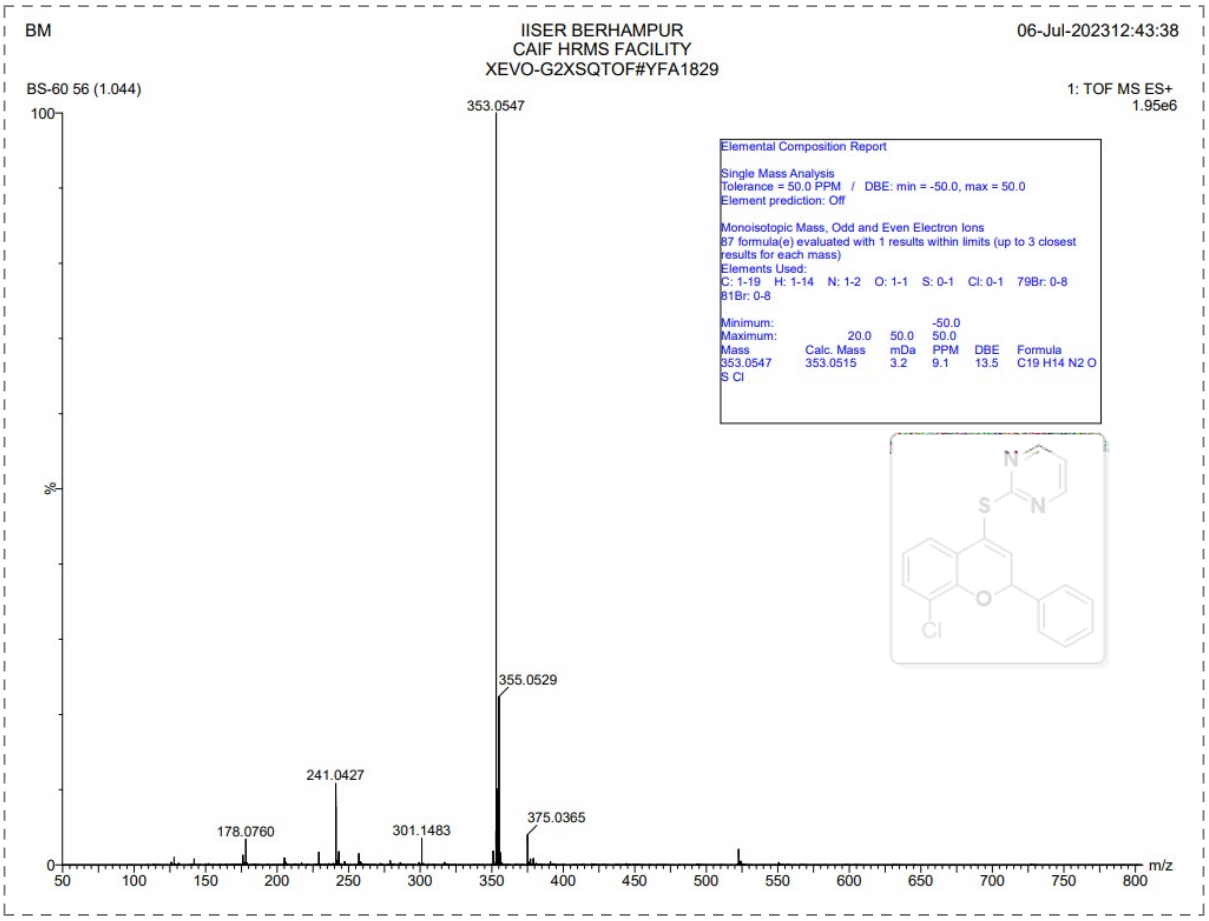
^{1}H NMR Spectrum of **(17e)**



^{13}C NMR Spectrum of **(17e)**

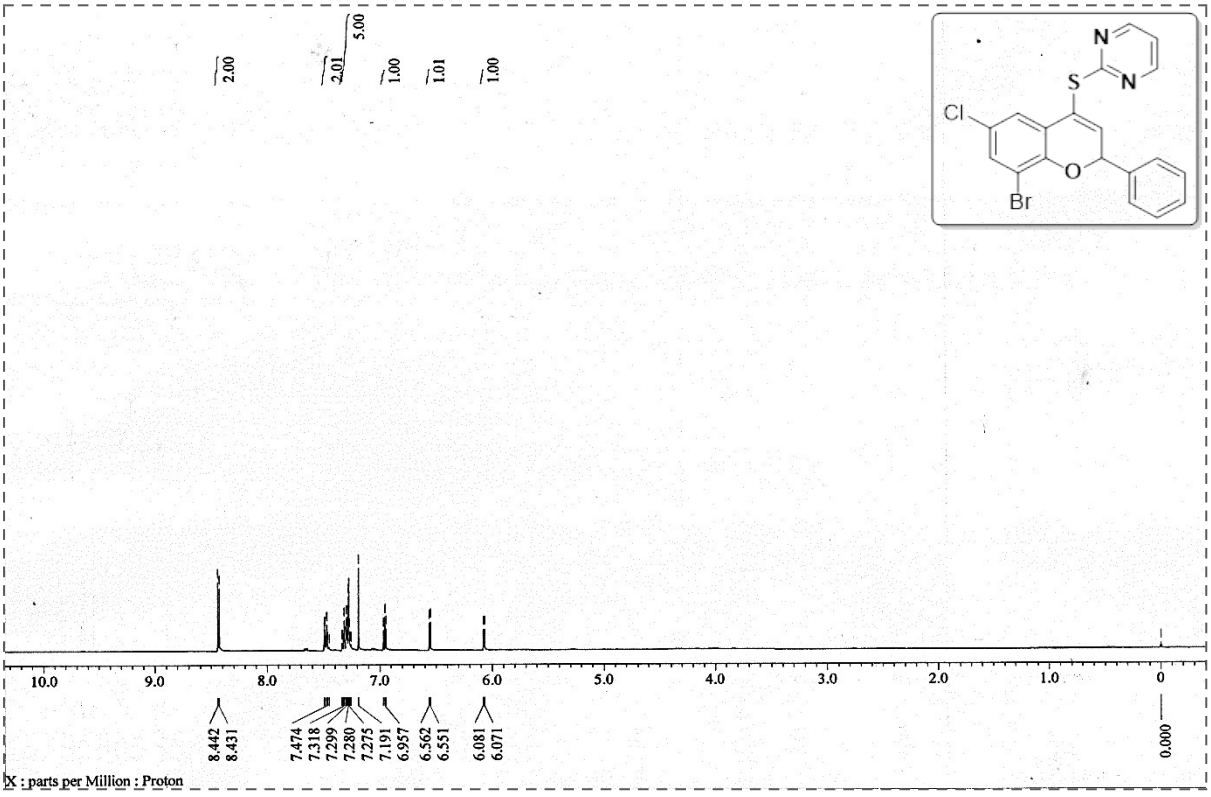


HRMS Spectrum of **(17e)**

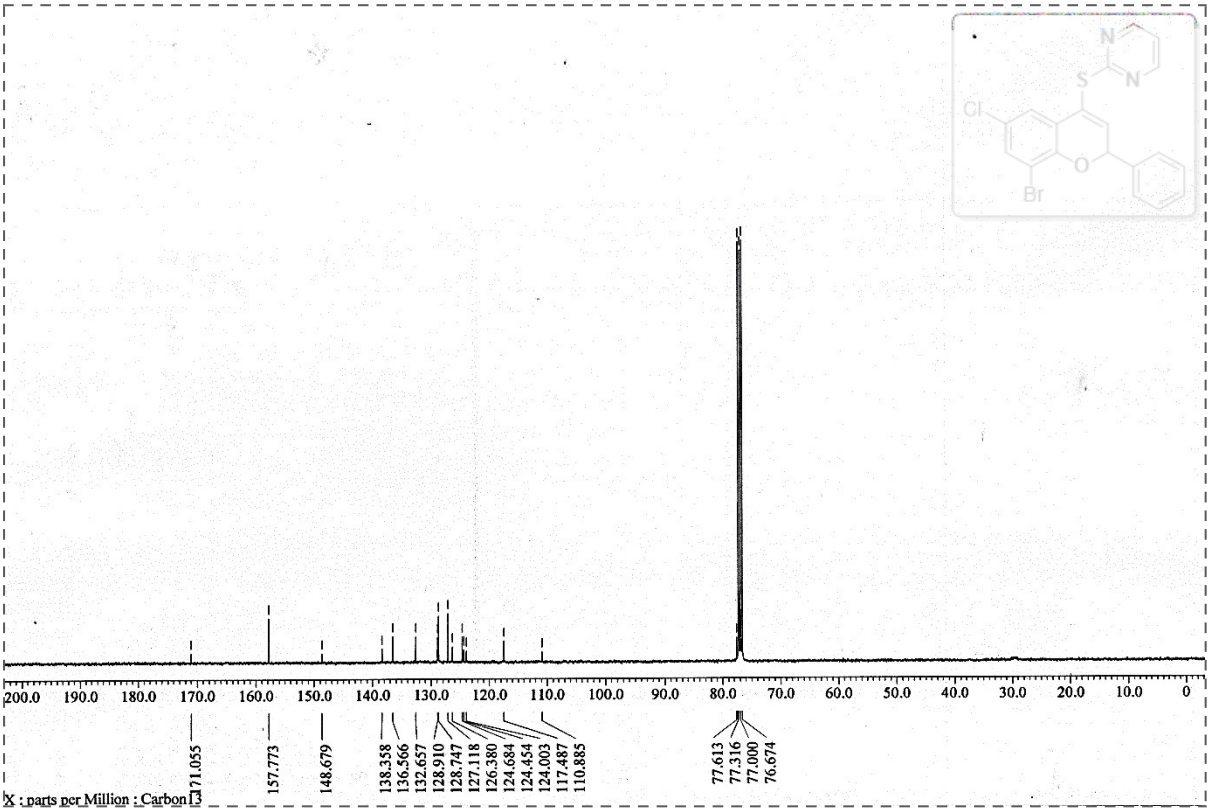


3.6. *2-((8-bromo-6-chloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17f)**:

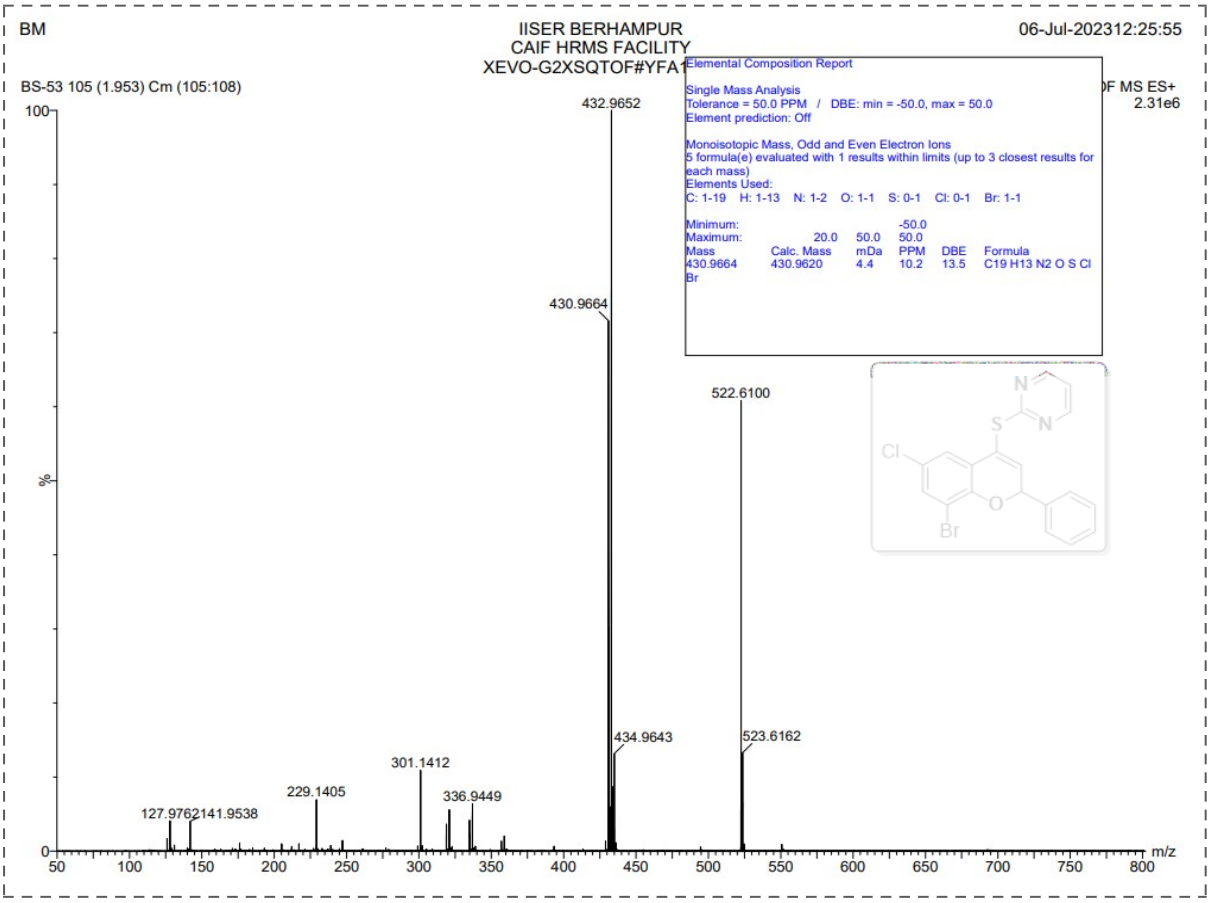
^{1}H NMR Spectrum of **(17f)**



^{13}C NMR Spectrum of **(17f)**

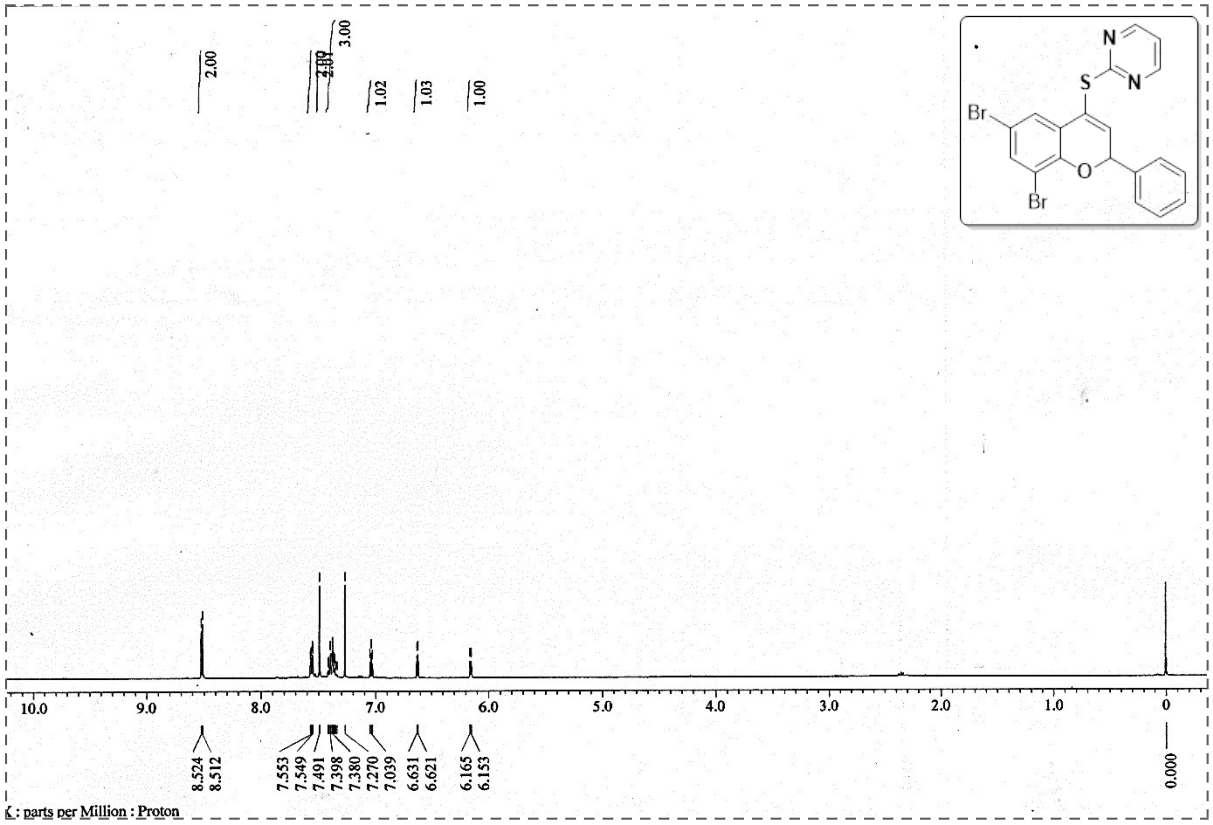


HRMS Spectrum of **(17f)**

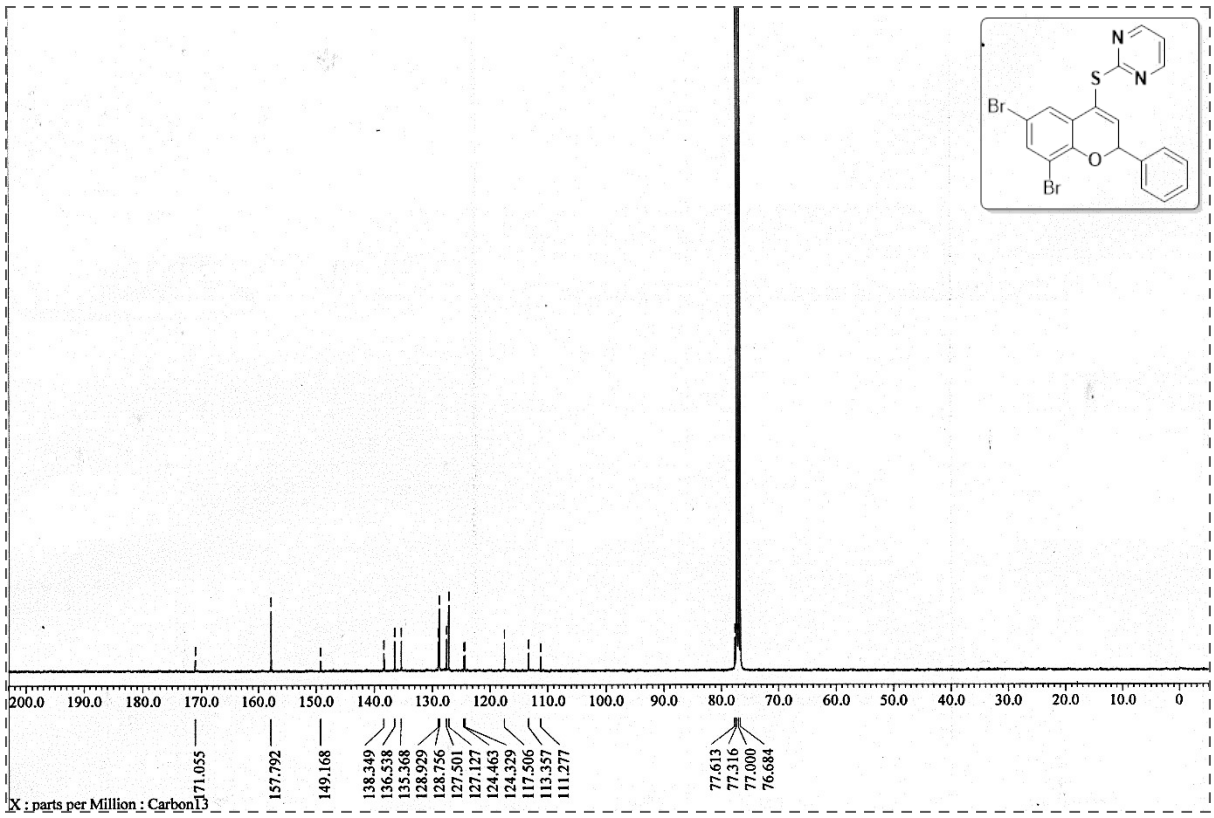


3.7. *2-((6,8-dibromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17g)**:

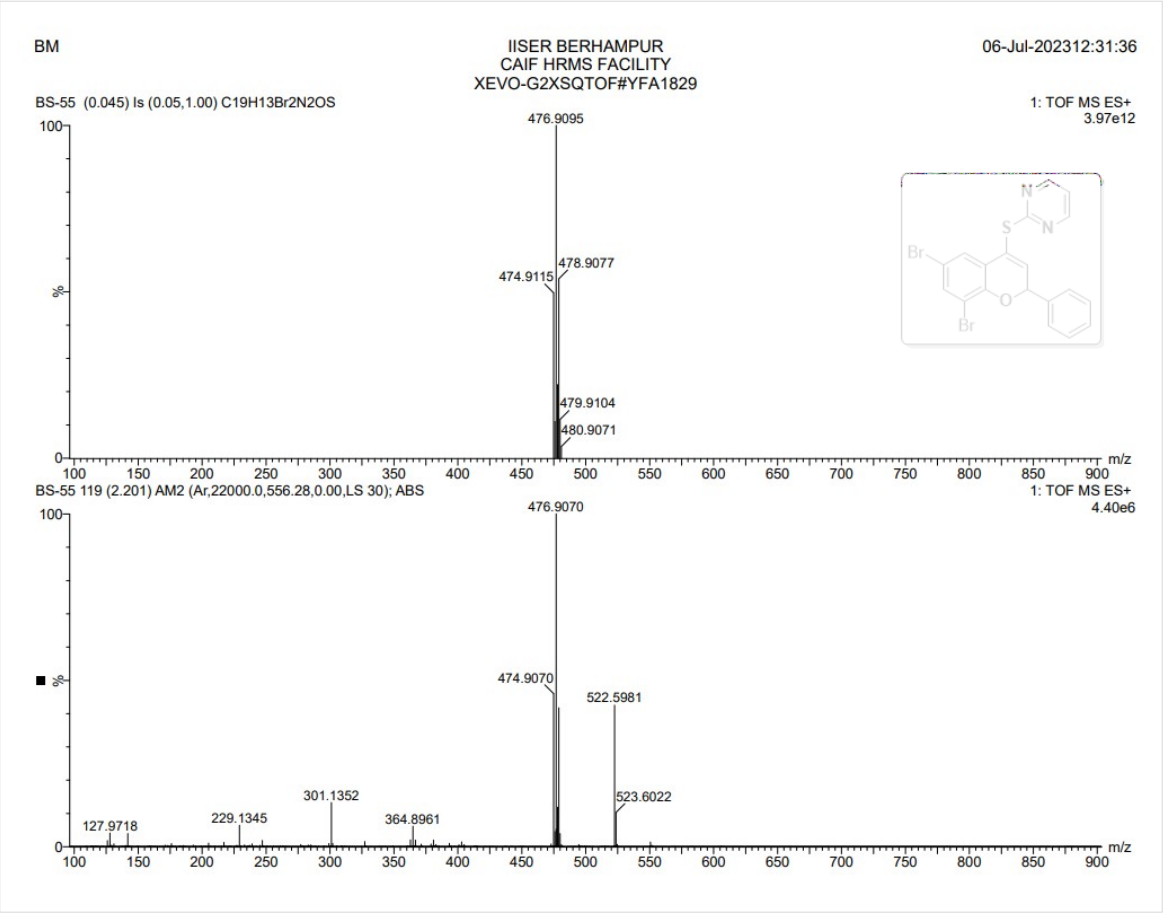
^{1}H NMR Spectrum of **(17g)**



^{13}C NMR Spectrum of **(17g)**

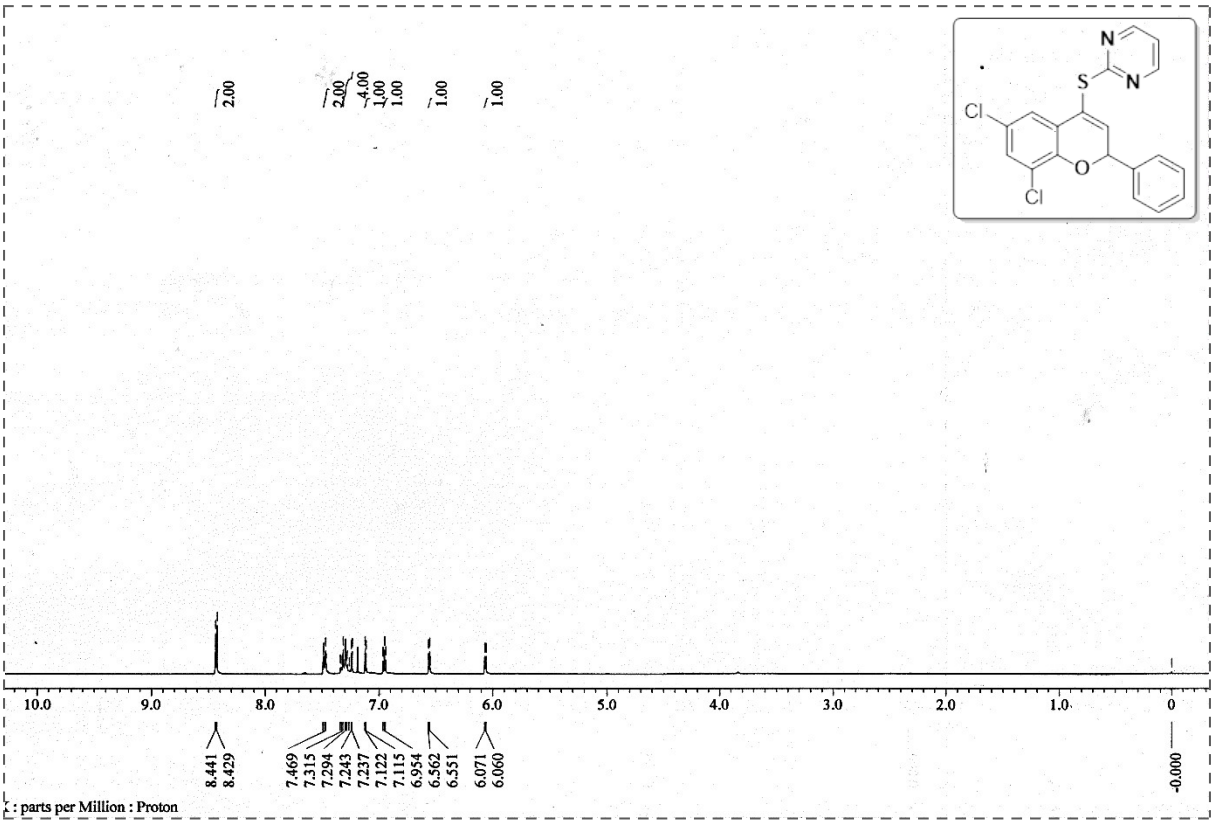


HRMS Spectrum of **(17g)**

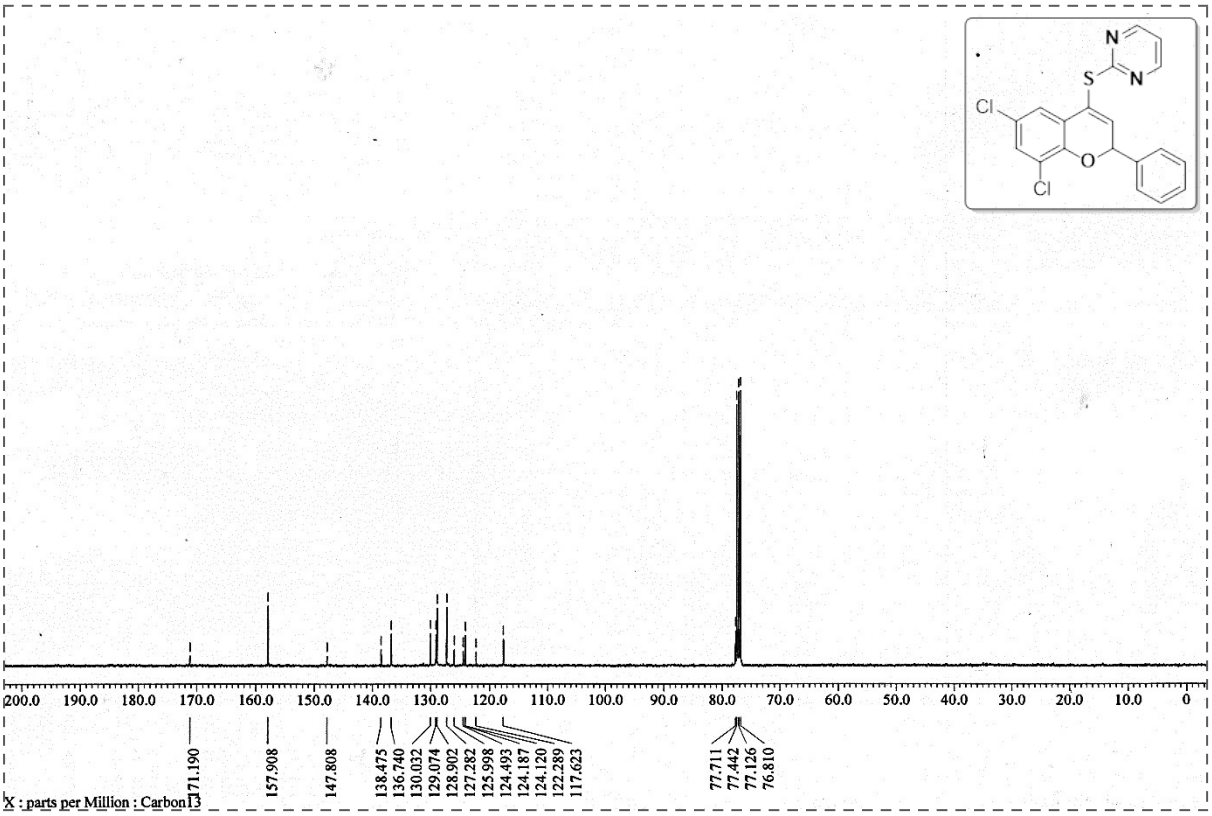


3.8. *2-((6,8-dichloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17h)**:

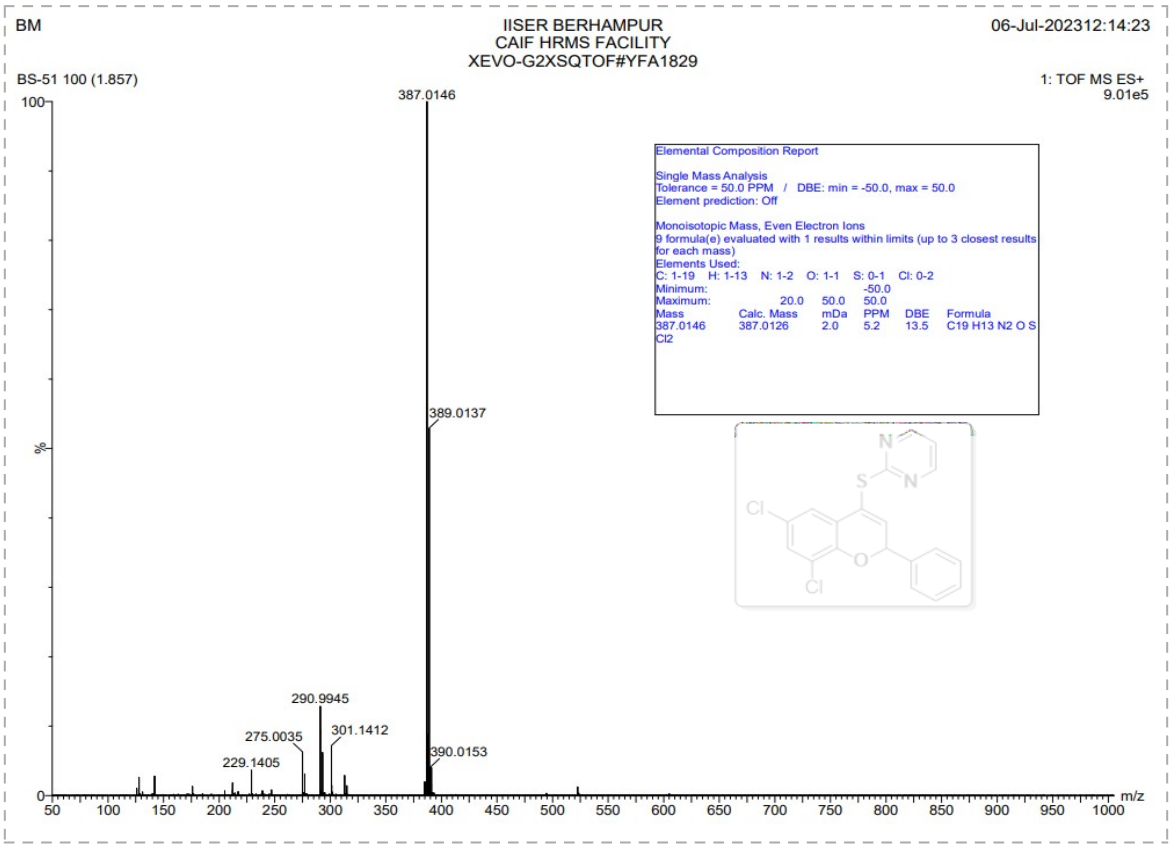
^{1}H NMR Spectrum of **(17h)**



^{13}C NMR Spectrum of **(17h)**

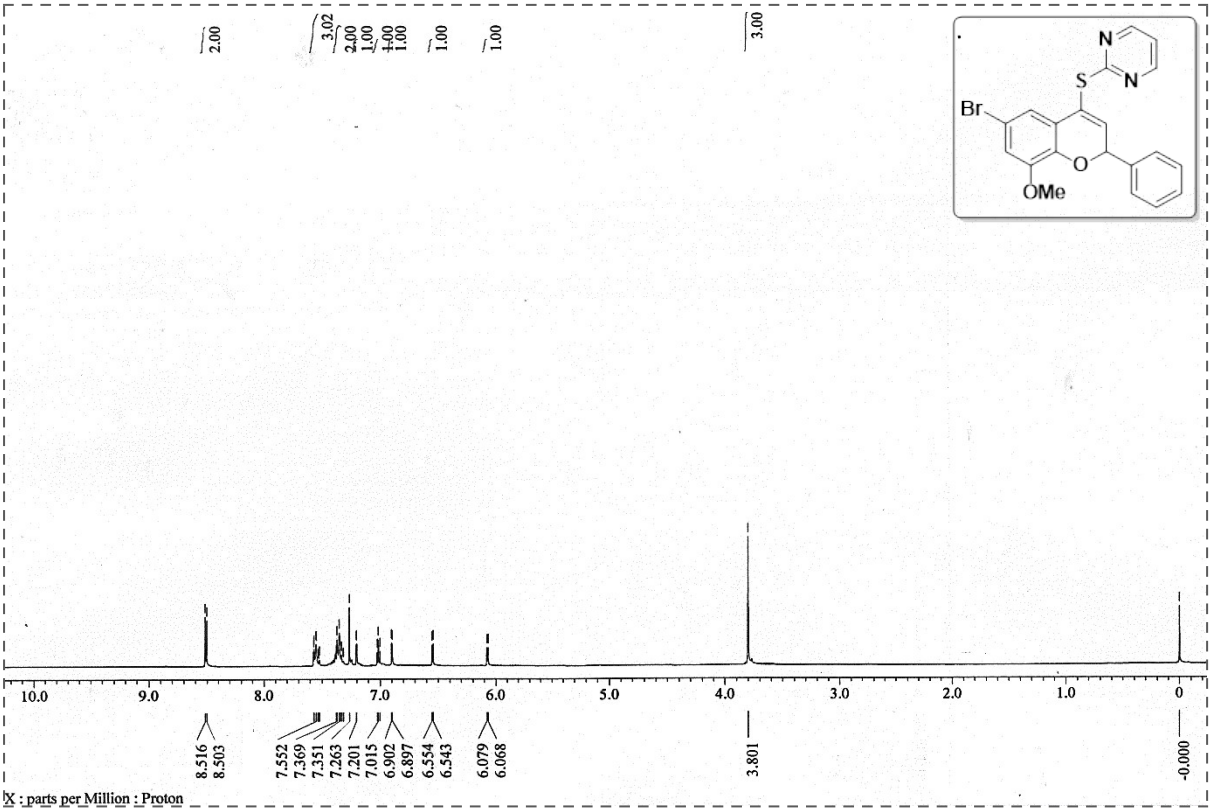


HRMS Spectrum of **(17h)**

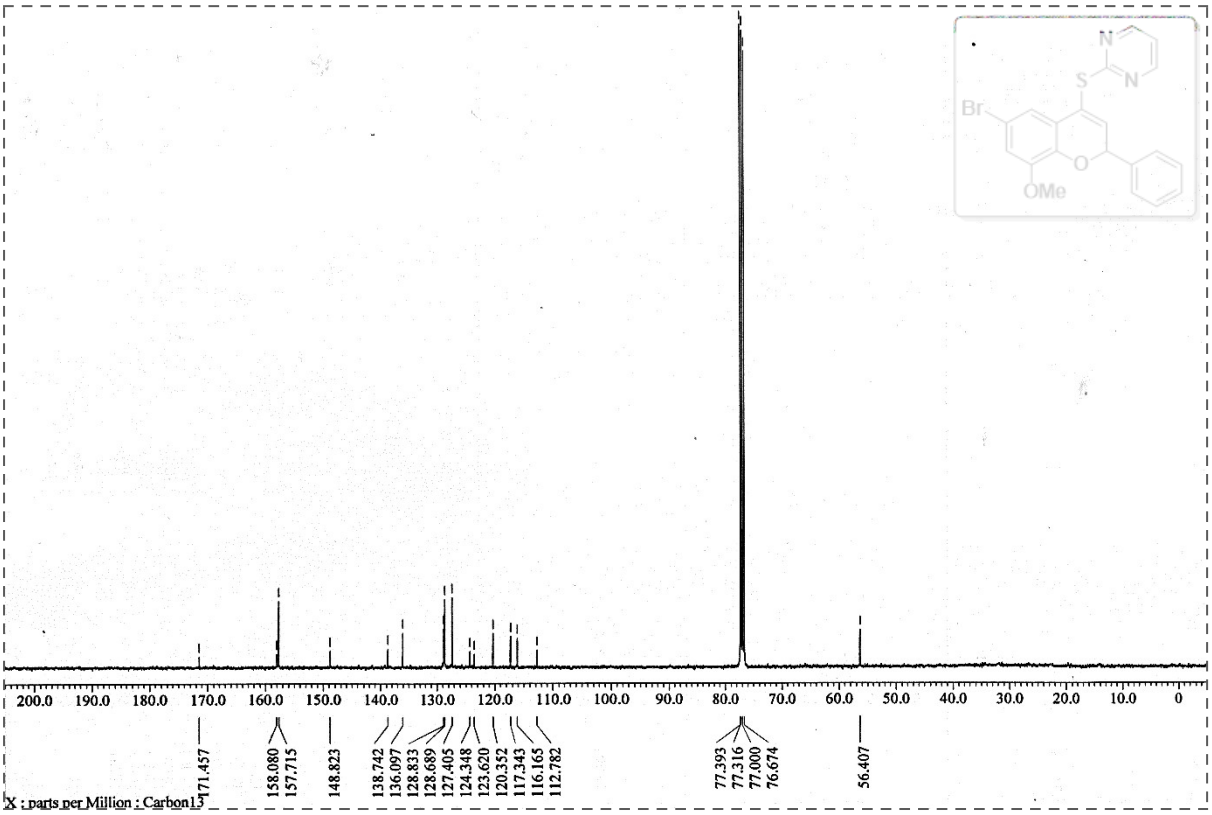


3.9. *2-((6-bromo-8-methoxy-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17i)**:

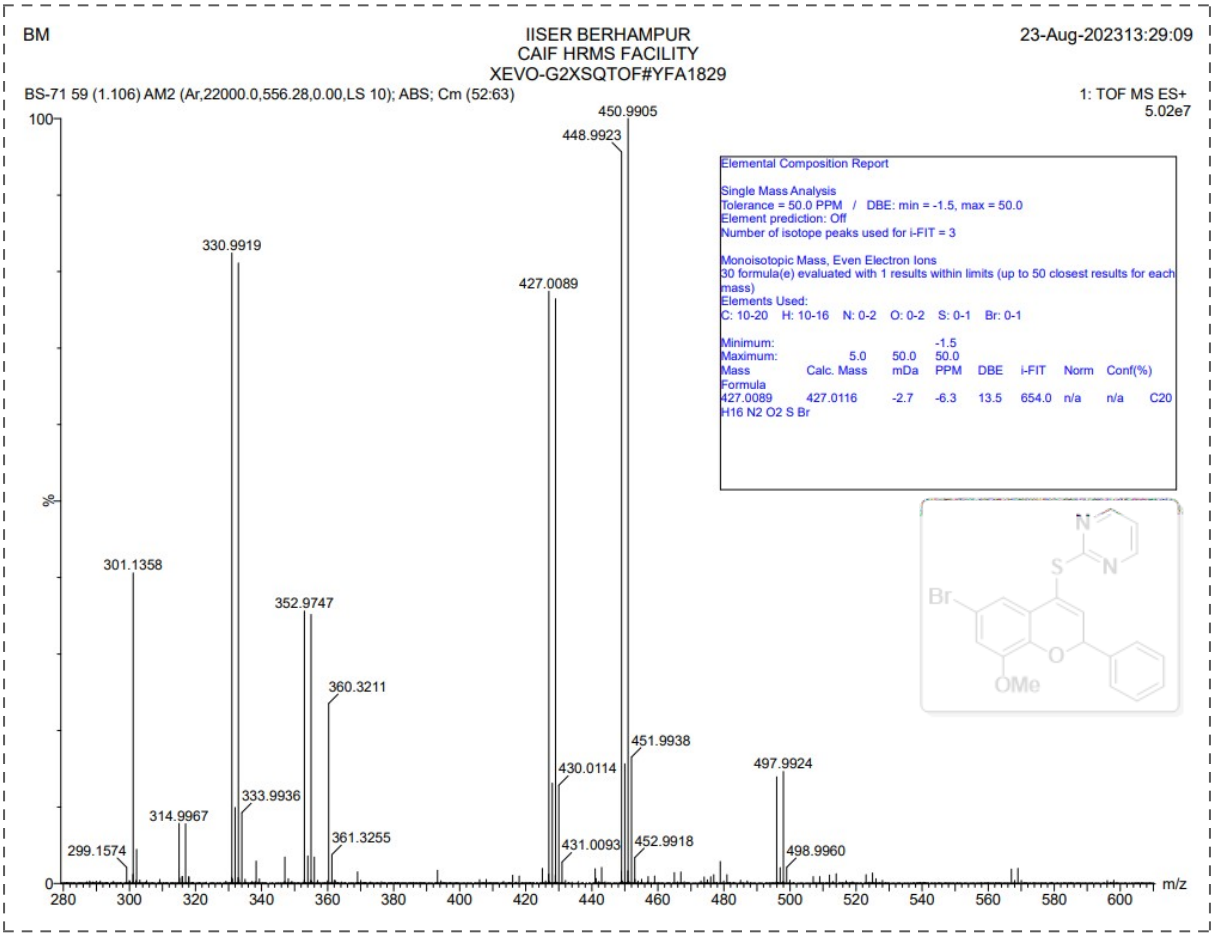
^{1}H NMR Spectrum of **(17i)**



^{13}C NMR Spectrum of **(17i)**

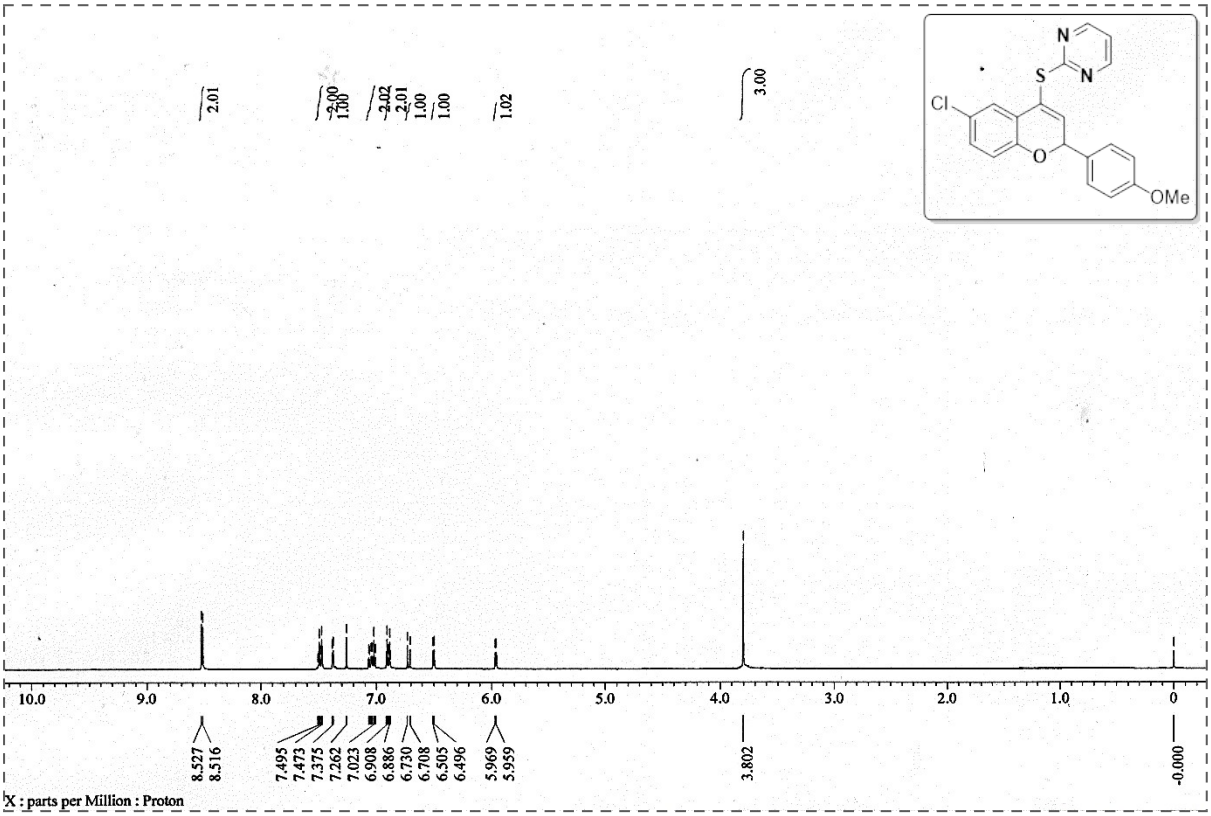


HRMS Spectrum of **(17i)**

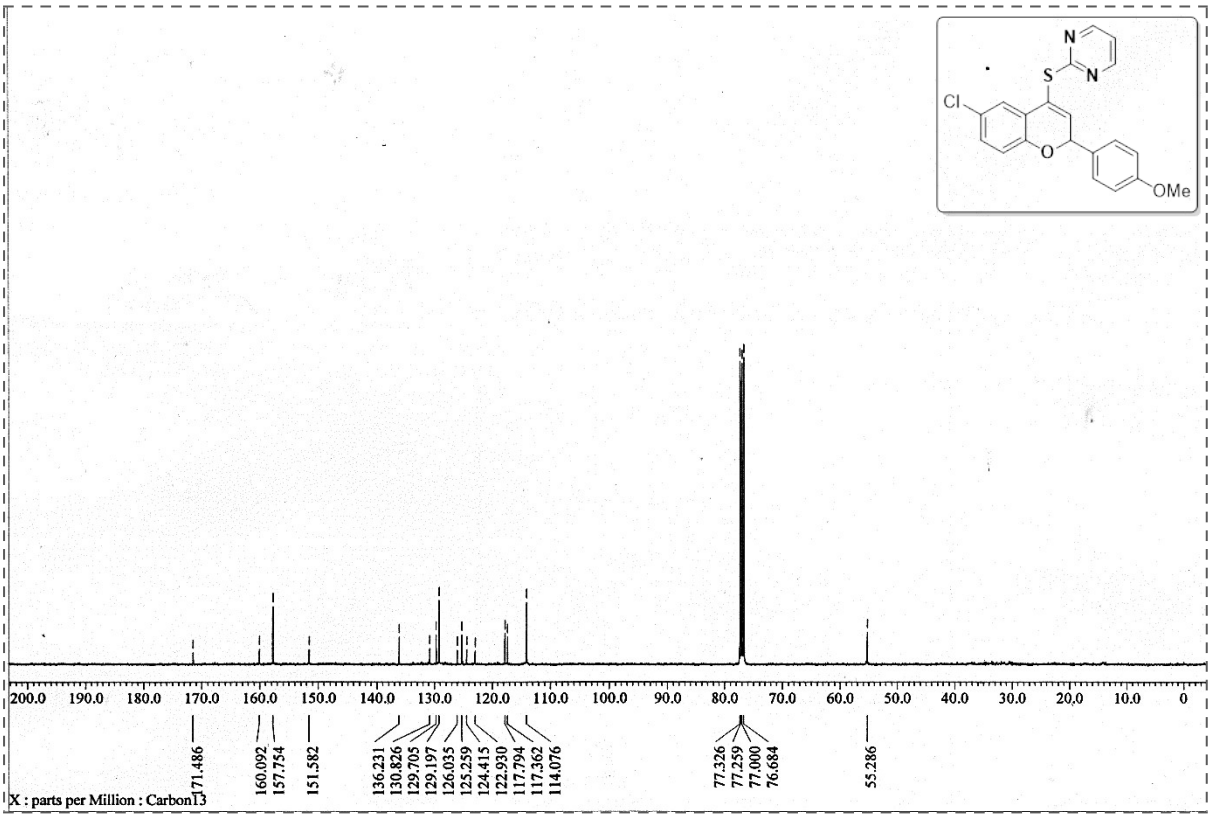


3.10. *2-((6-chloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* **(17j)**:

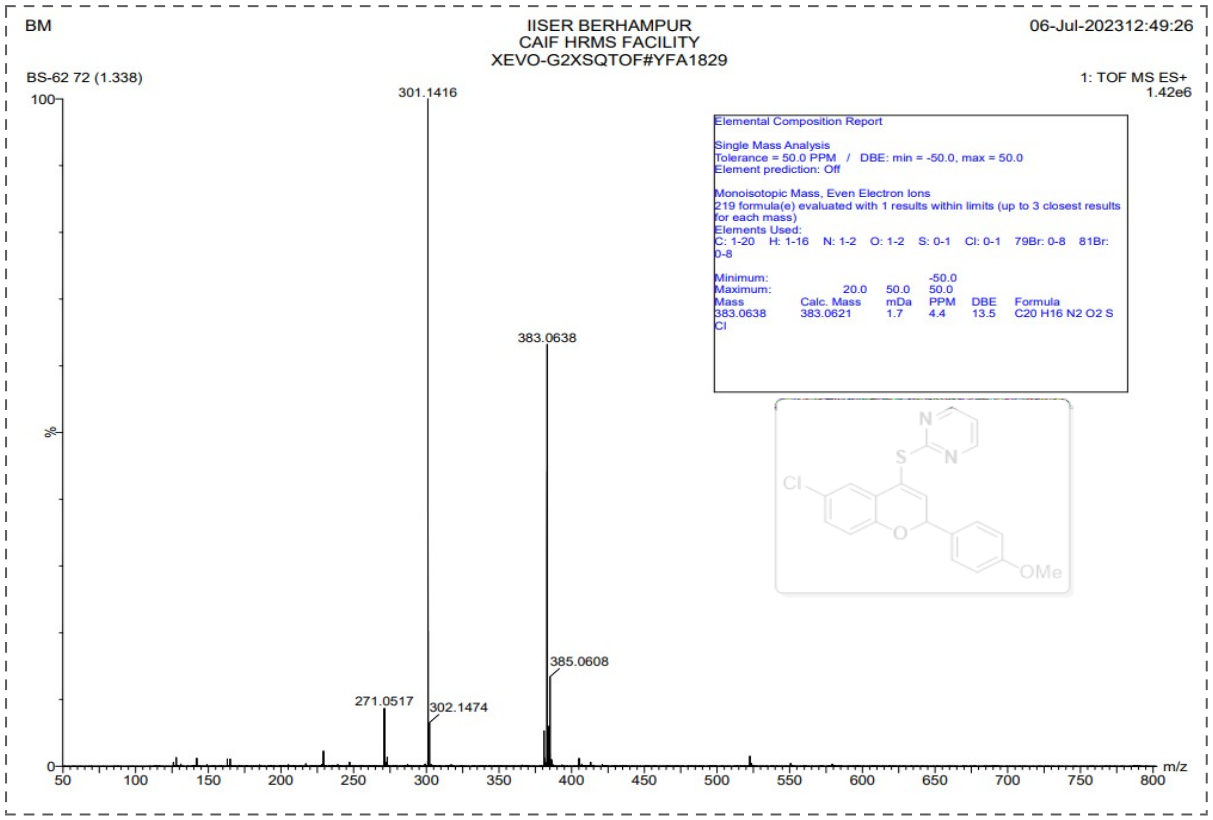
^{1}H NMR Spectrum of **(17j)**



^{13}C NMR Spectrum of **(17j)**

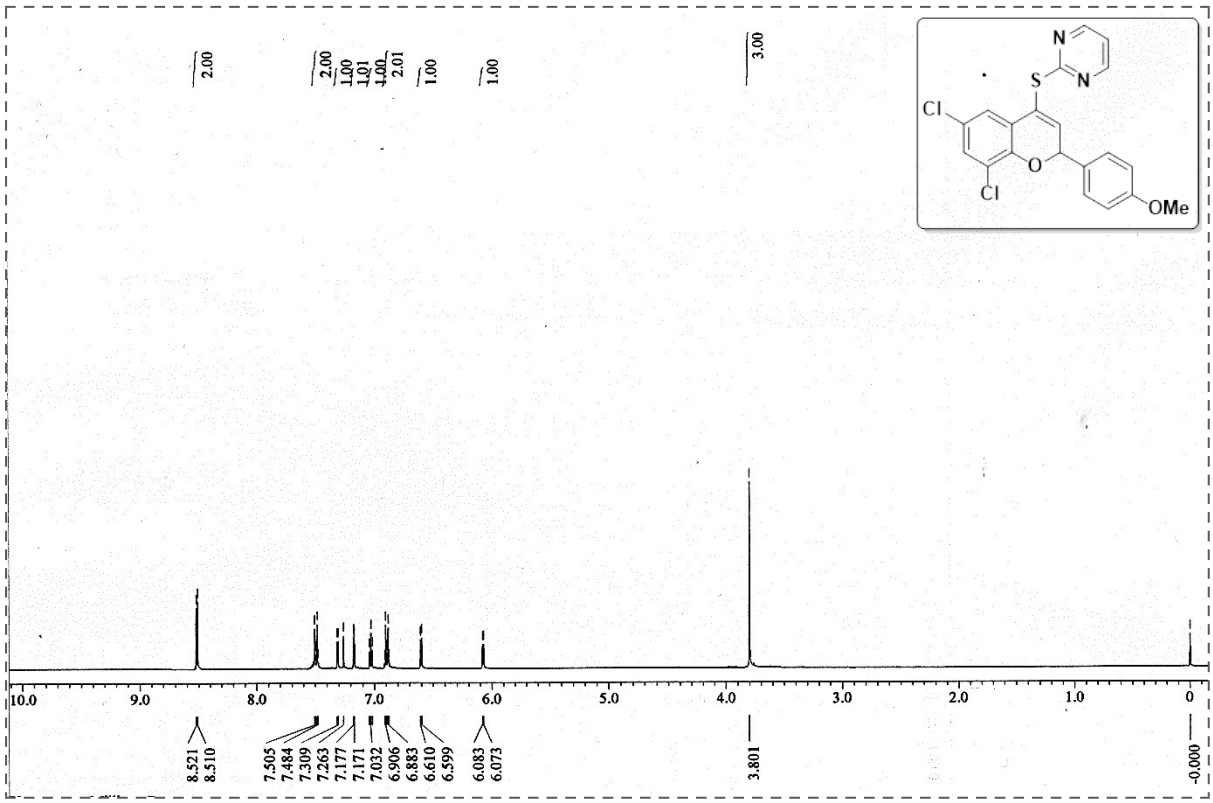


HRMS Spectrum of **(17j)**

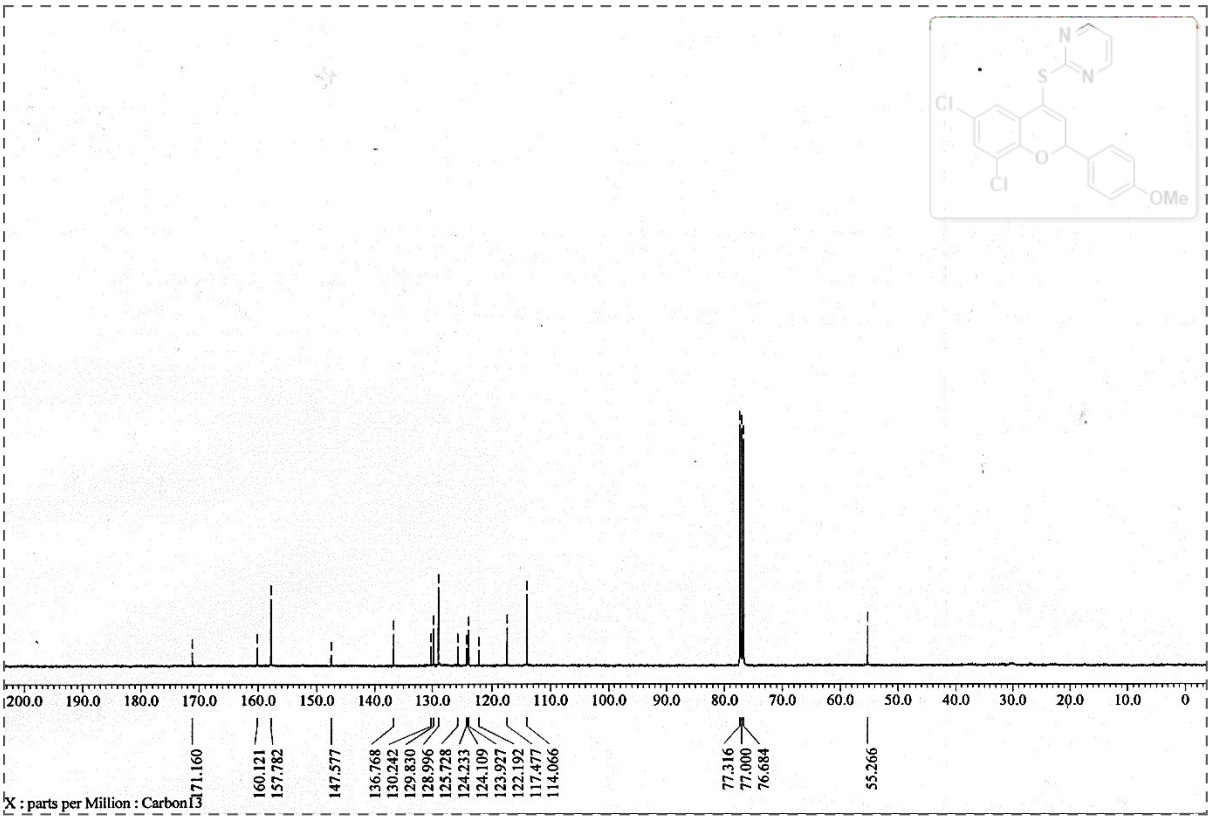


3.11. *2-((6,8-dichloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* **(17k)**:

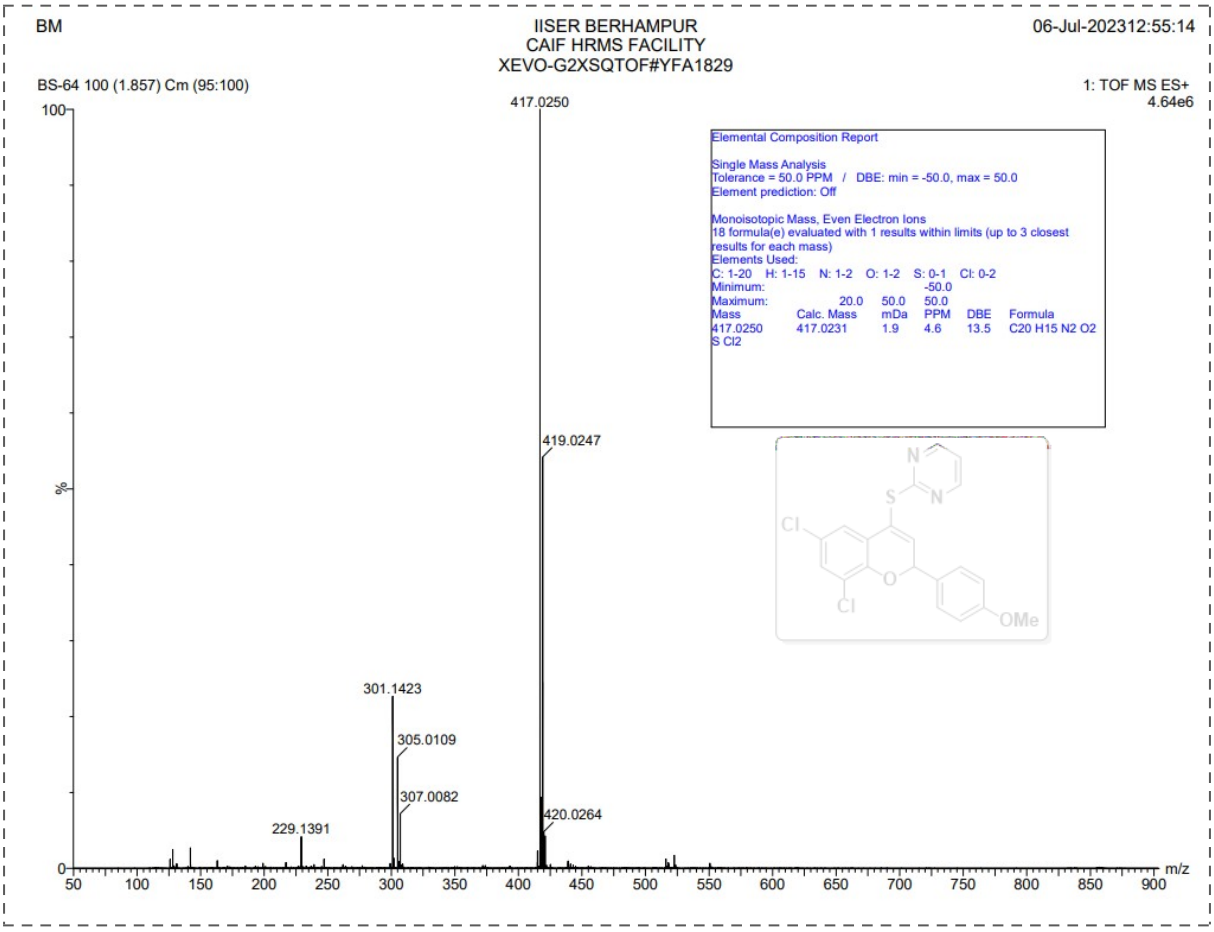
^{1}H NMR Spectrum of **(17k)**



^{13}C NMR Spectrum of **(17k)**

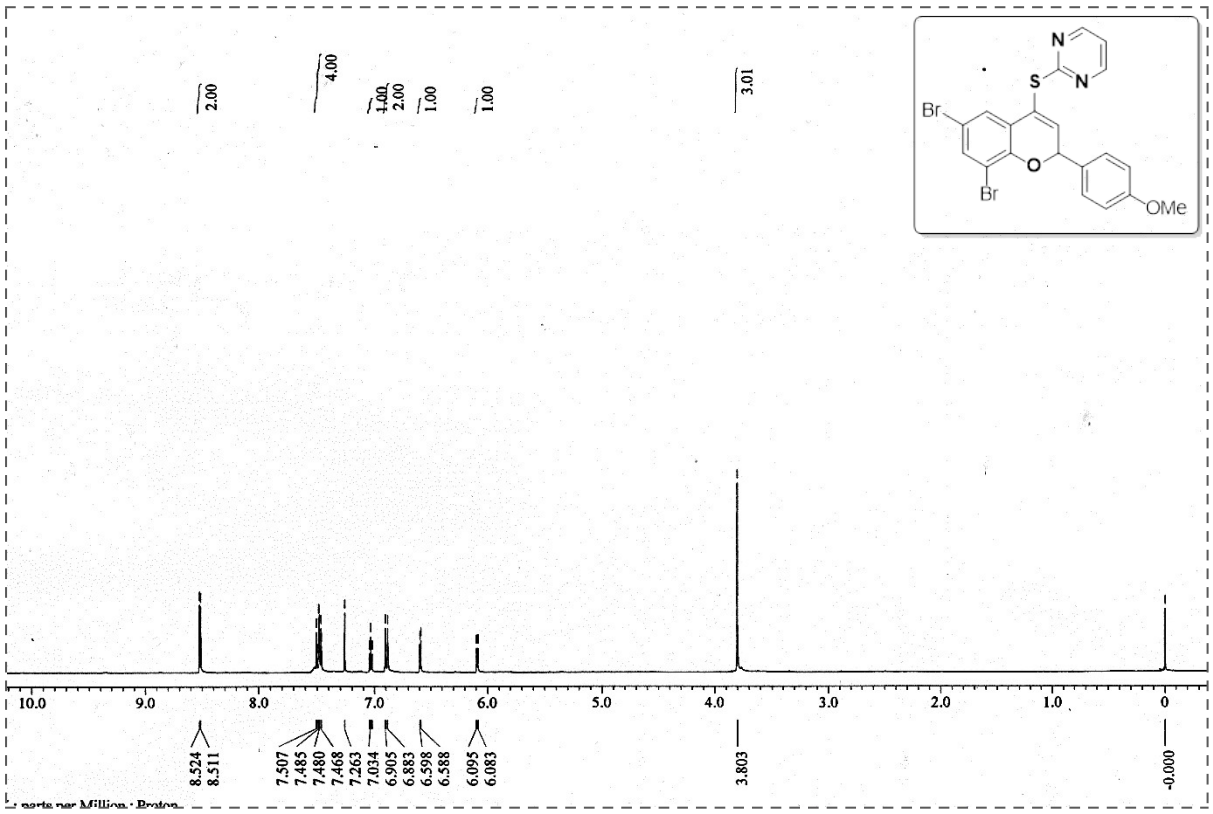


HRMS Spectrum of **(17k)**

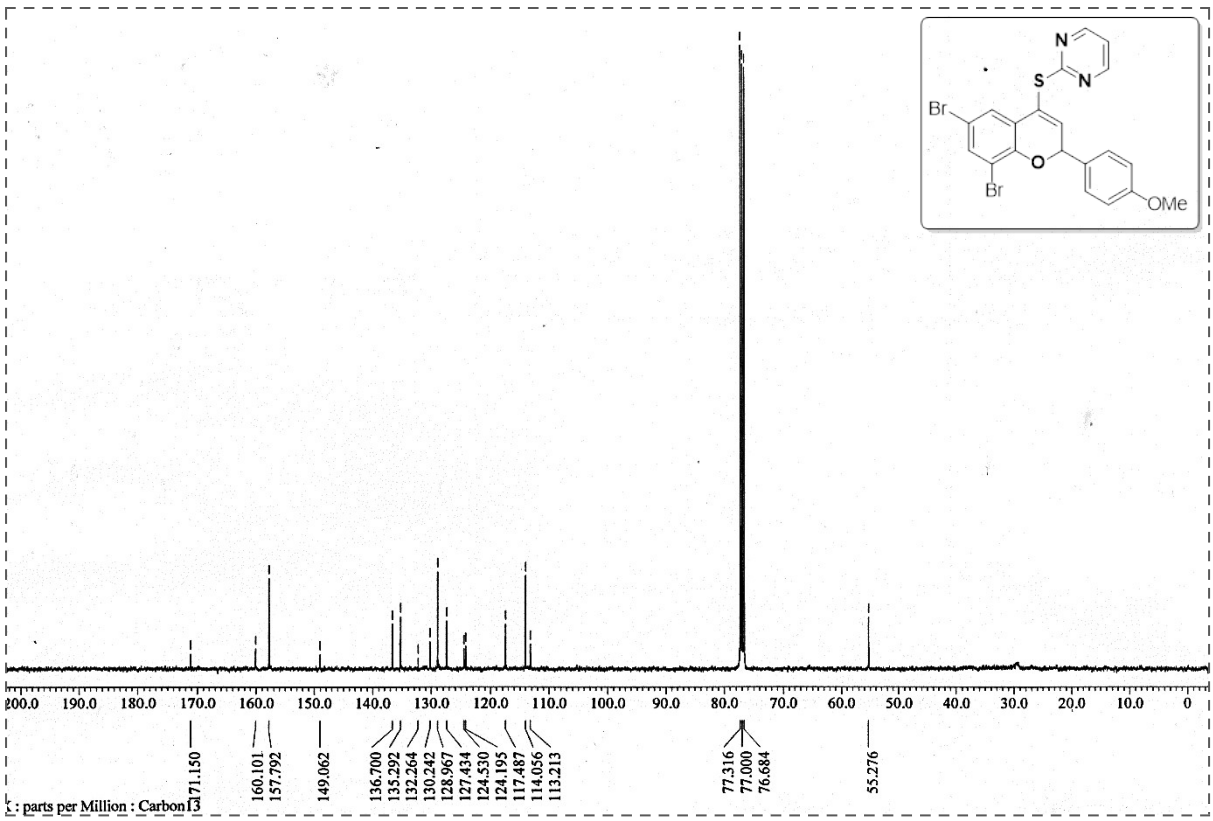


3.12. *2-((6,8-dibromo-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* **(17l)**:

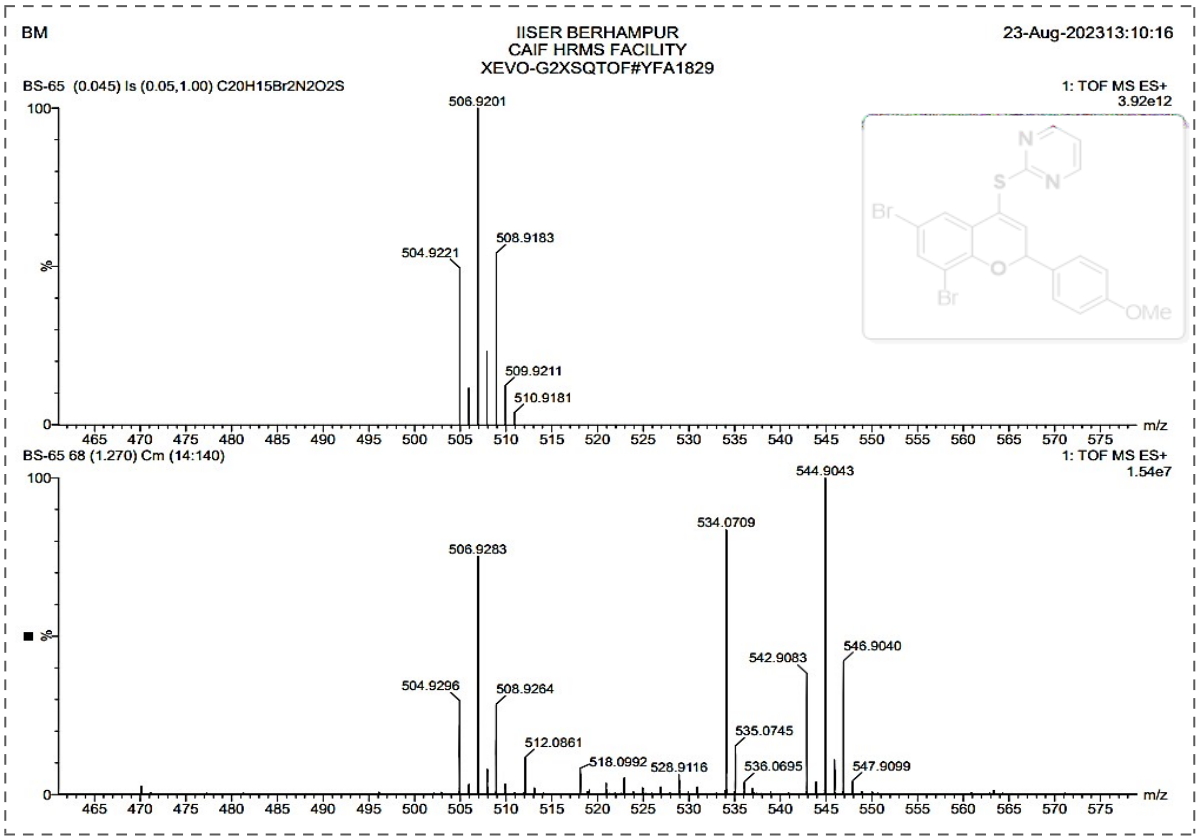
^{1}H NMR Spectrum of **(17l)**



^{13}C NMR Spectrum of **(17l)**

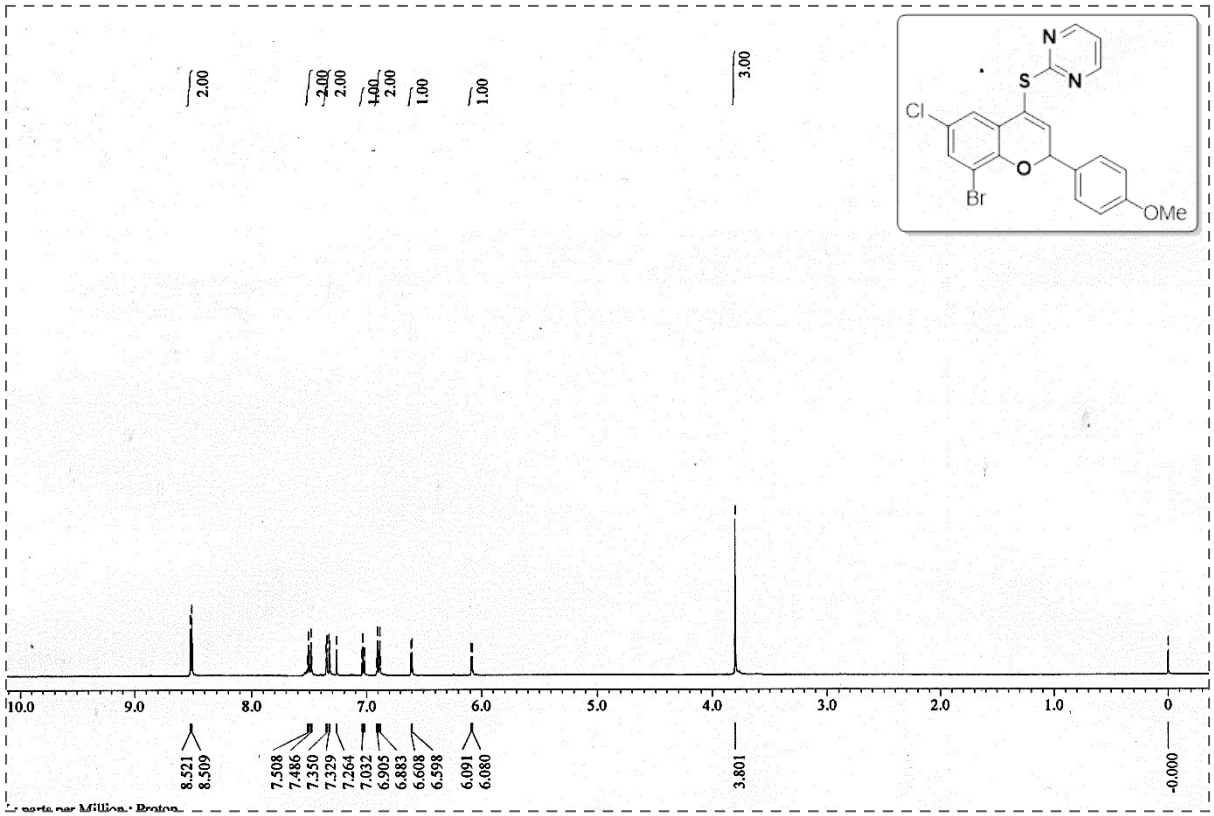


HRMS Spectrum of **(17l)**

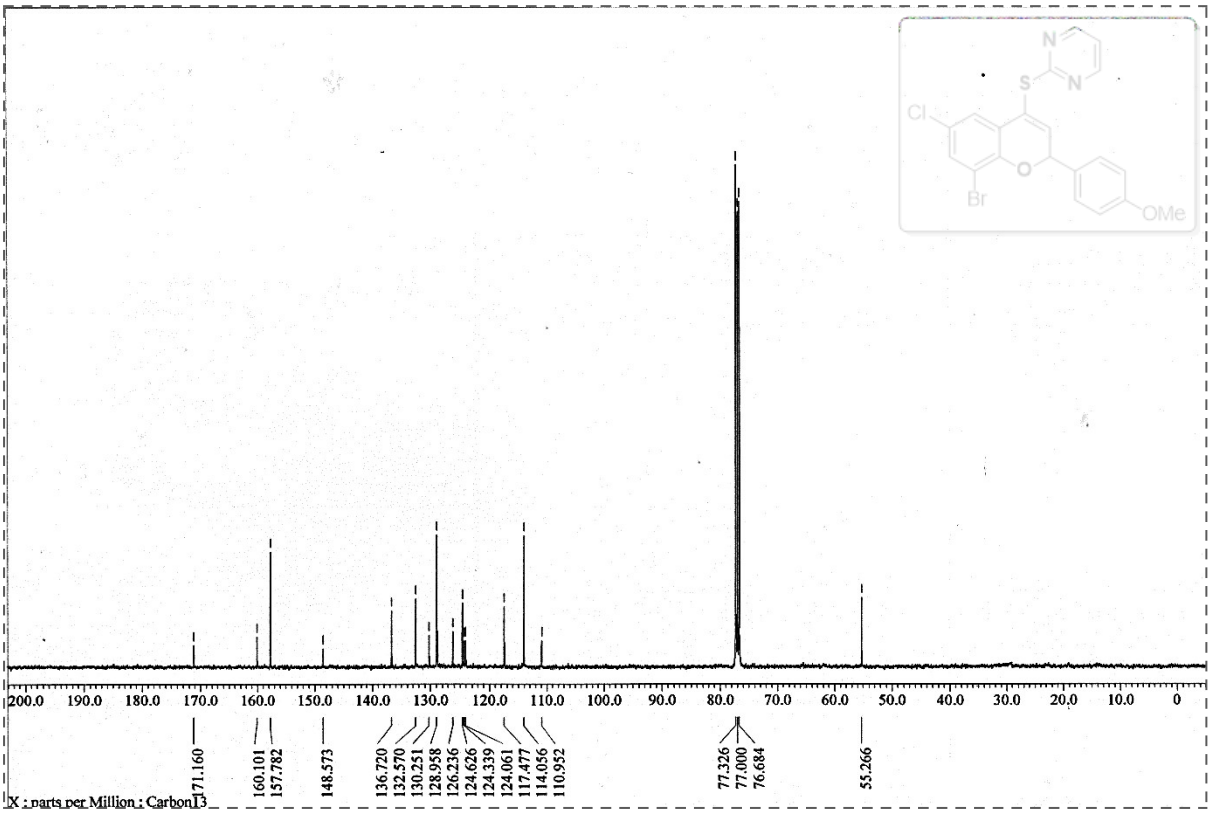


3.13. *2-((8-bromo-6-chloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* **(17m)**:

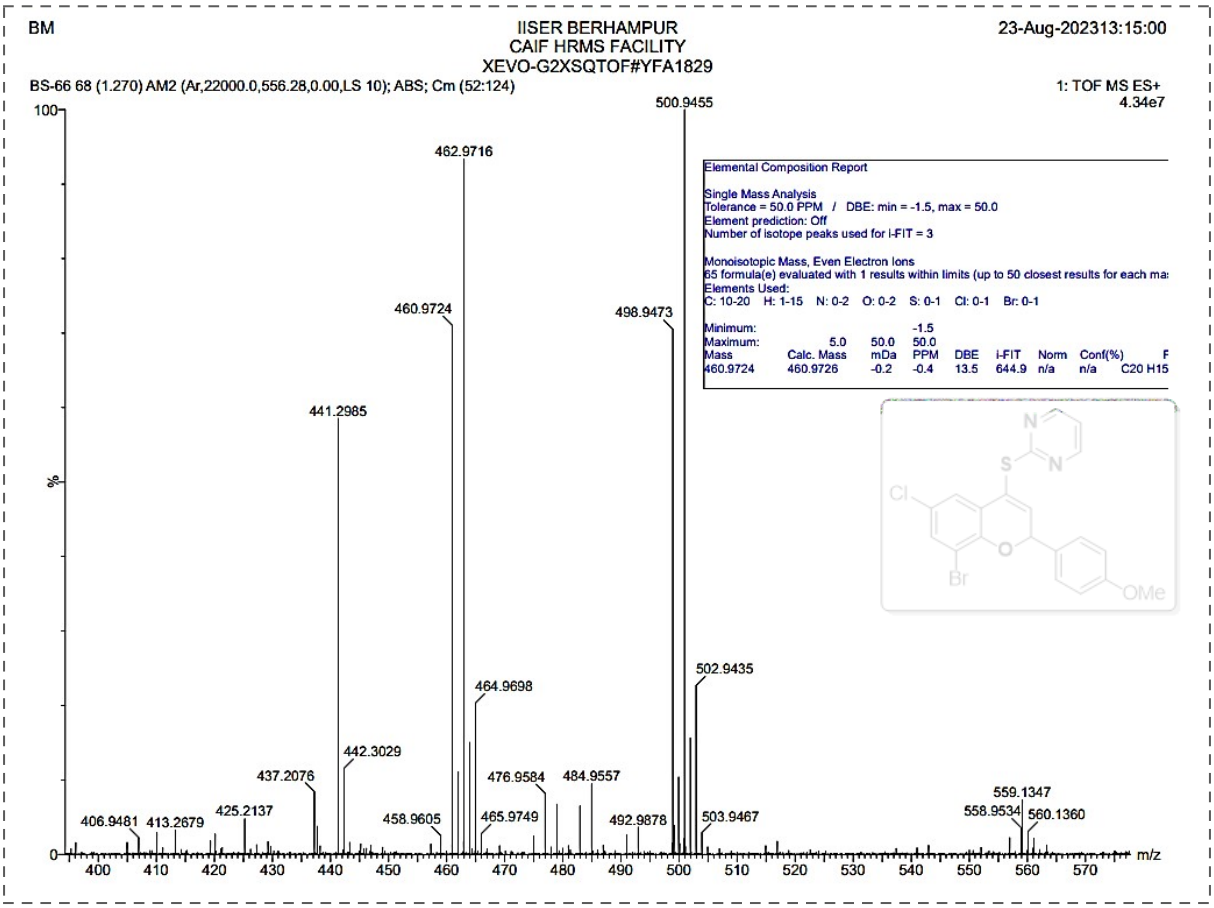
^{1}H NMR Spectrum of **(17m)**



^{13}C NMR Spectrum of **(17m)**

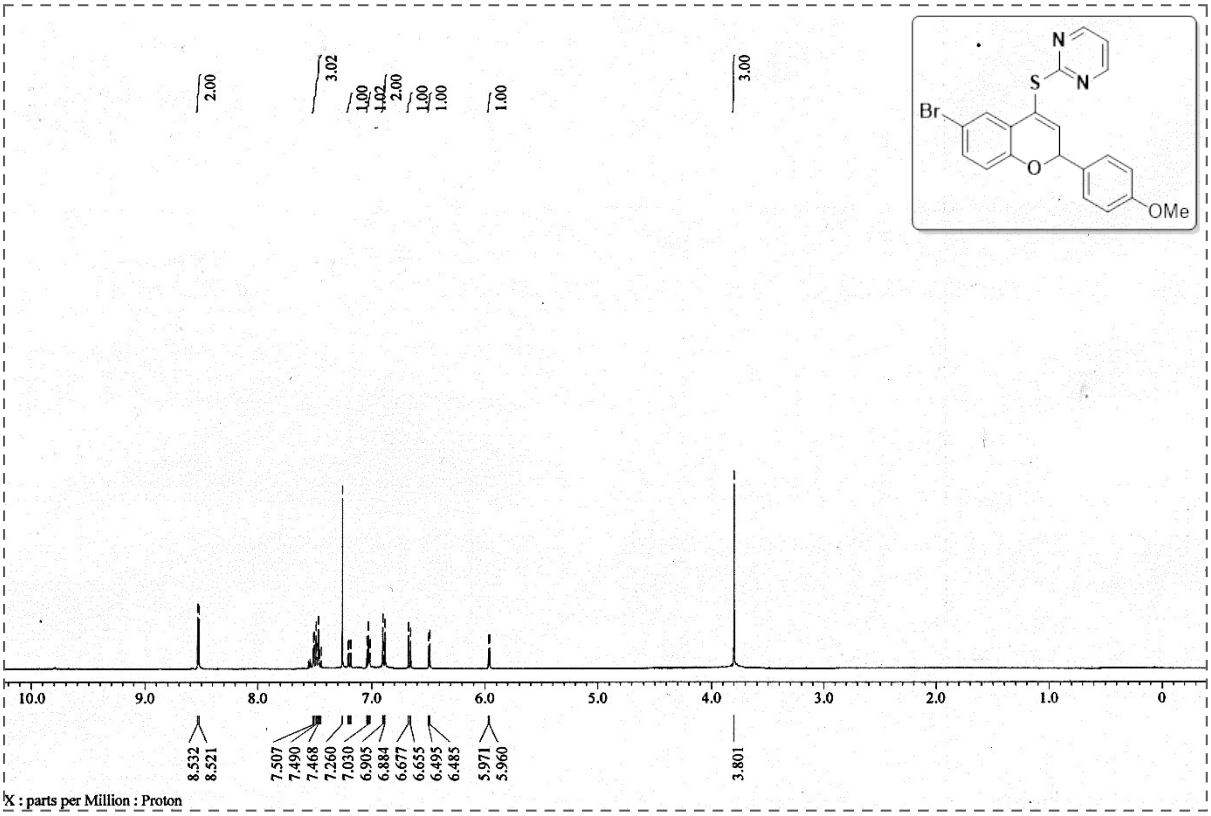


HRMS Spectrum of **(17m)**

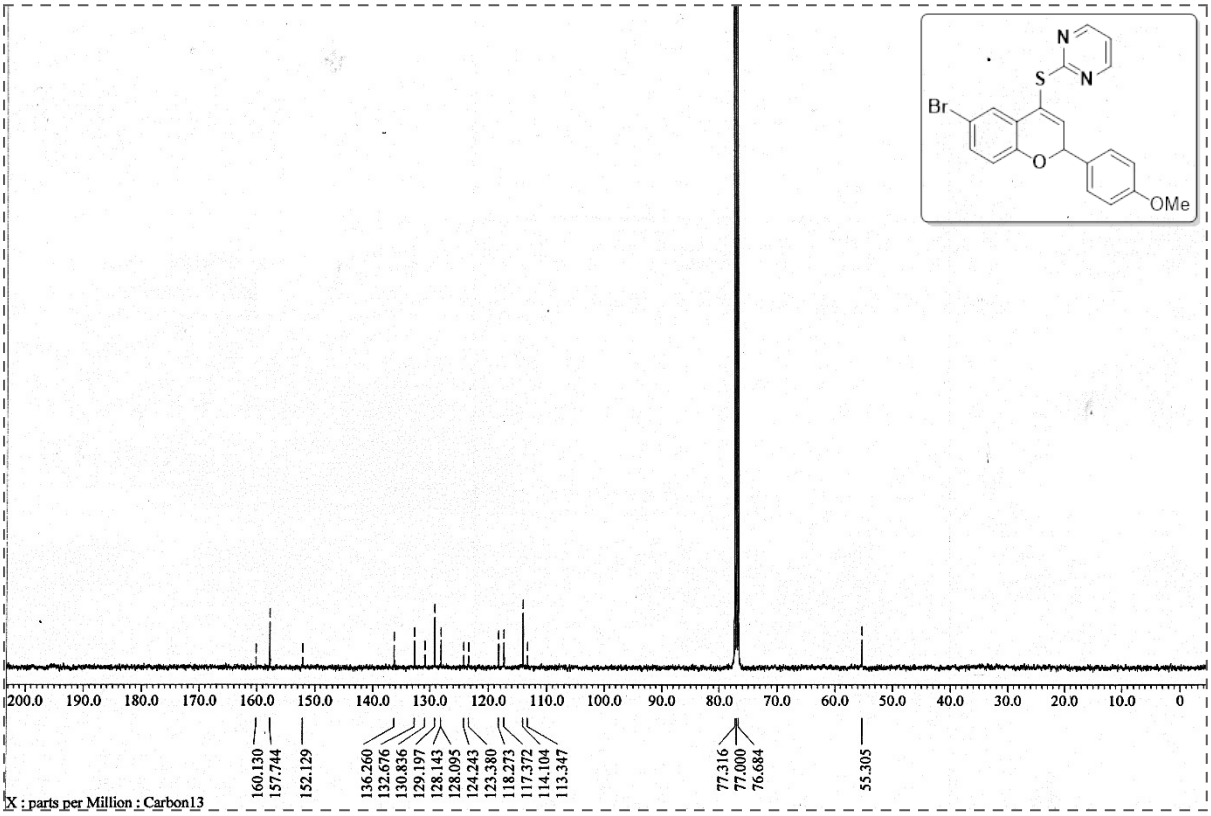


3.14. *2-((6-bromo-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine* **(17n)**:

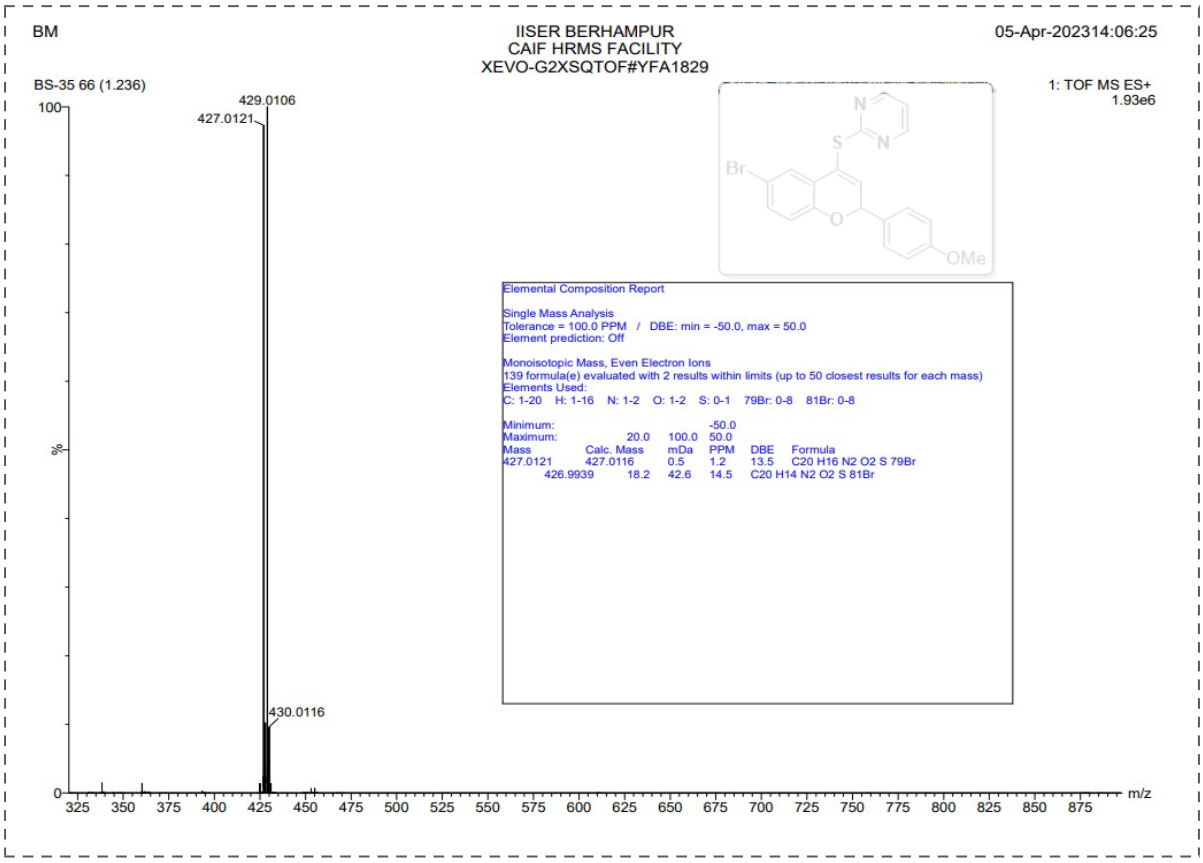
^{1}H NMR Spectrum of **(17n)**



^{13}C NMR Spectrum of **(17n)**

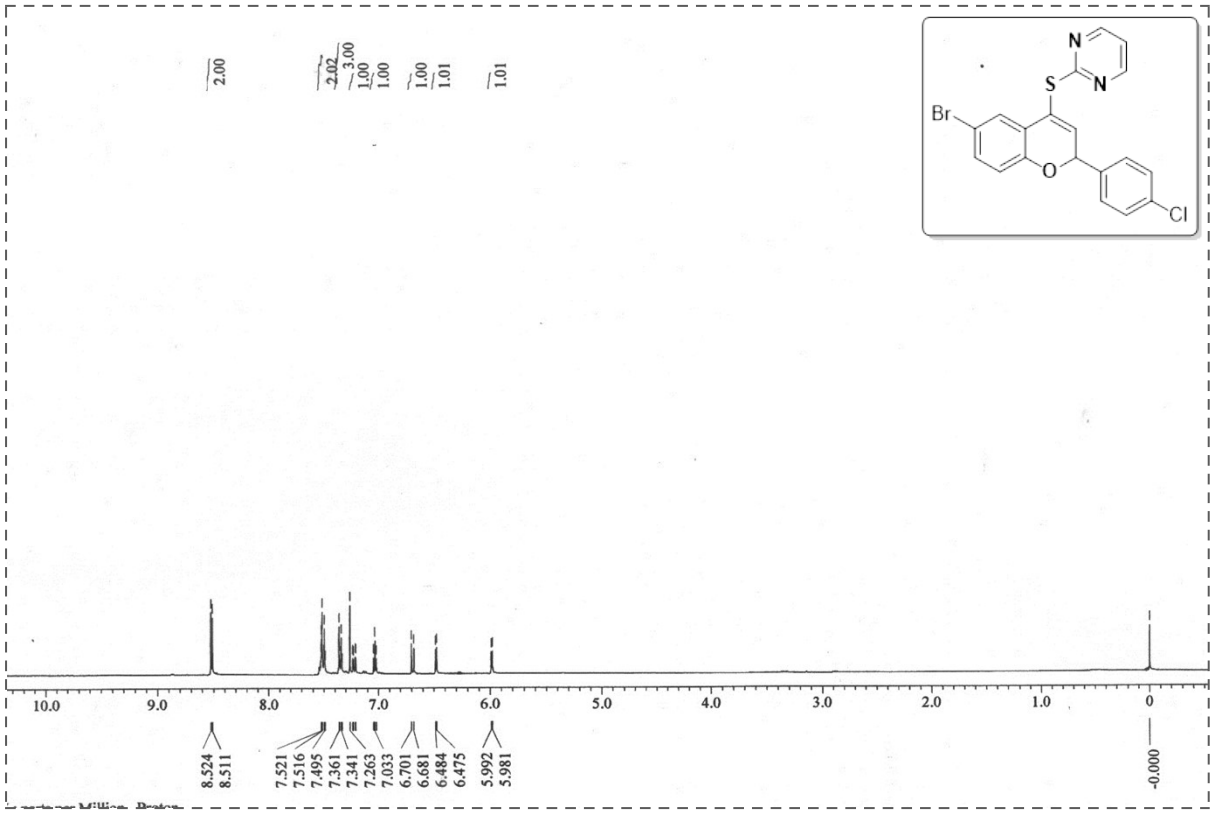


HRMS Spectrum of **(17n)**

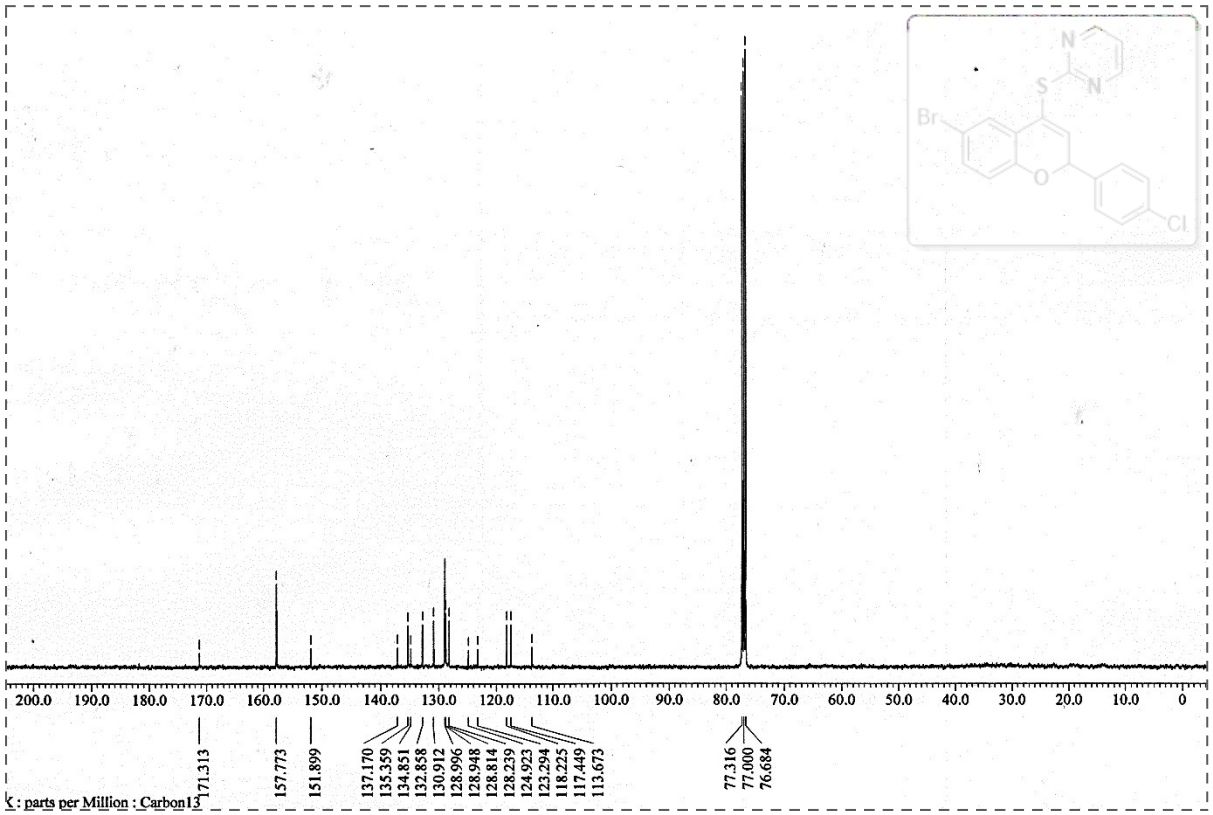


3.15. *2-((6-bromo-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyrimidine* **(17o)**:

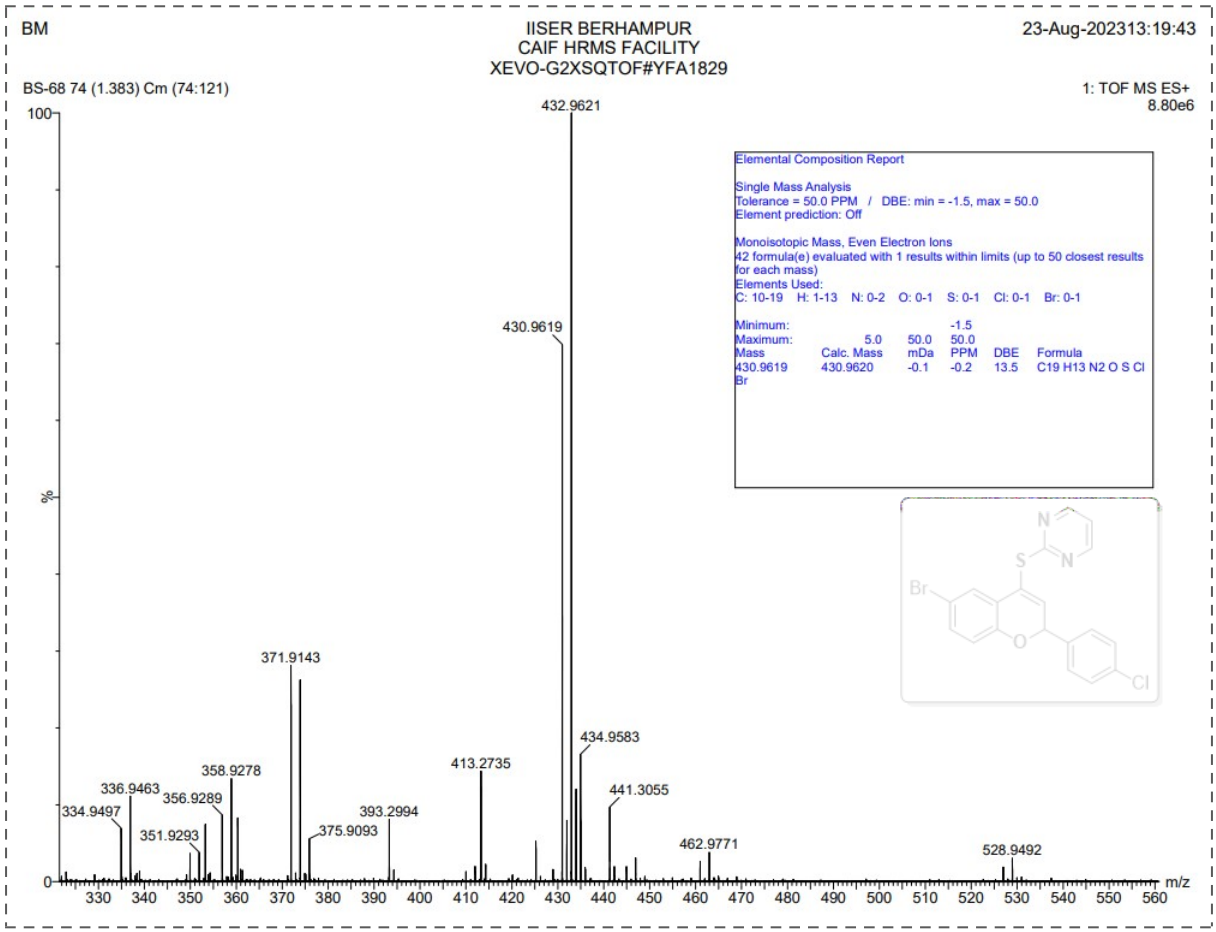
^{1}H NMR Spectrum of **(17o)**



^{13}C NMR Spectrum of **(17o)**

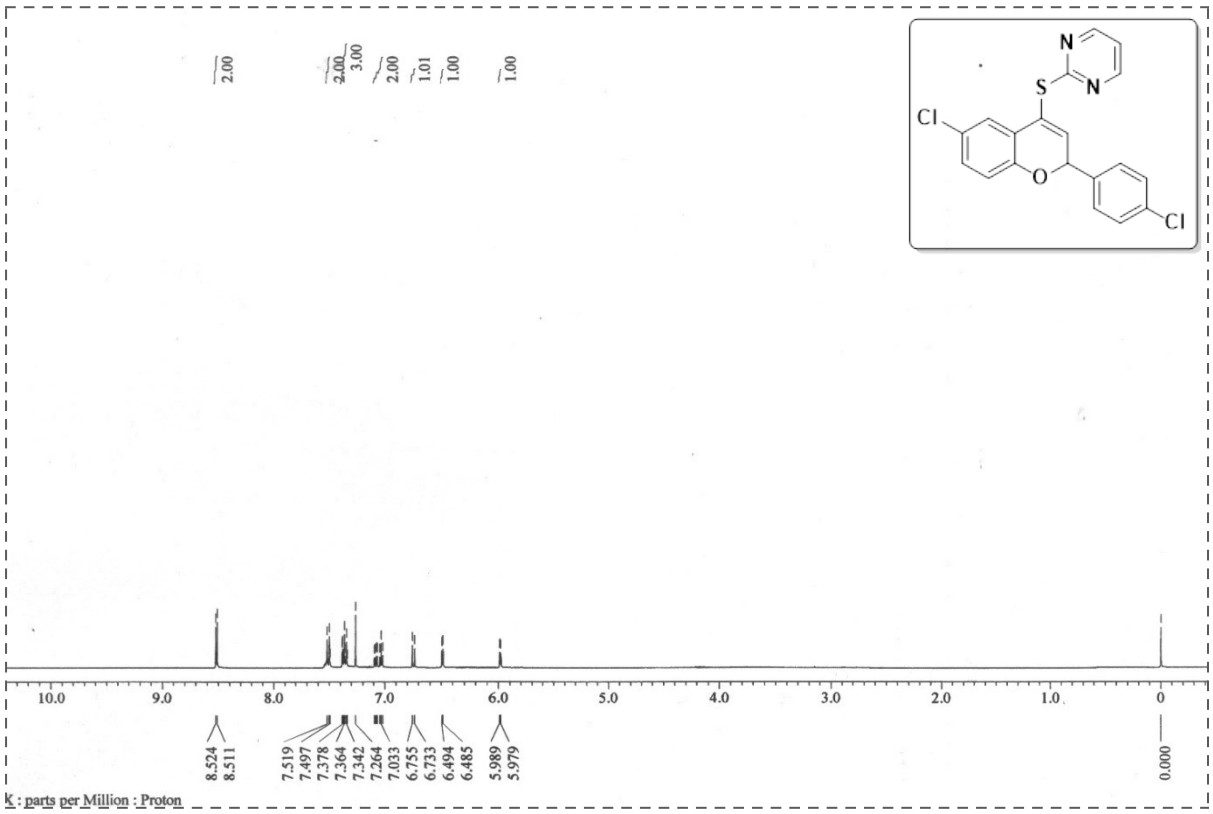


HRMS Spectrum of **(17o)**

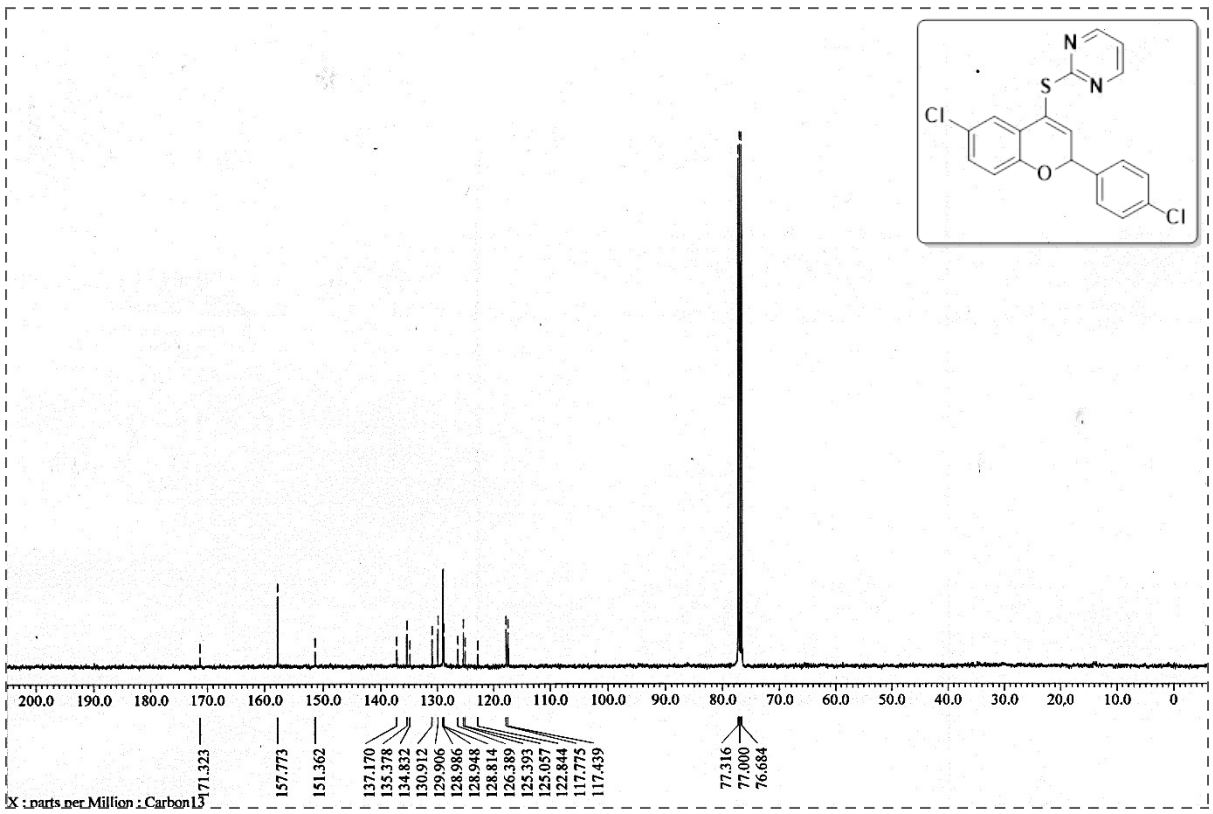


3.16. *2-((6-chloro-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyrimidine* **(17p)**:

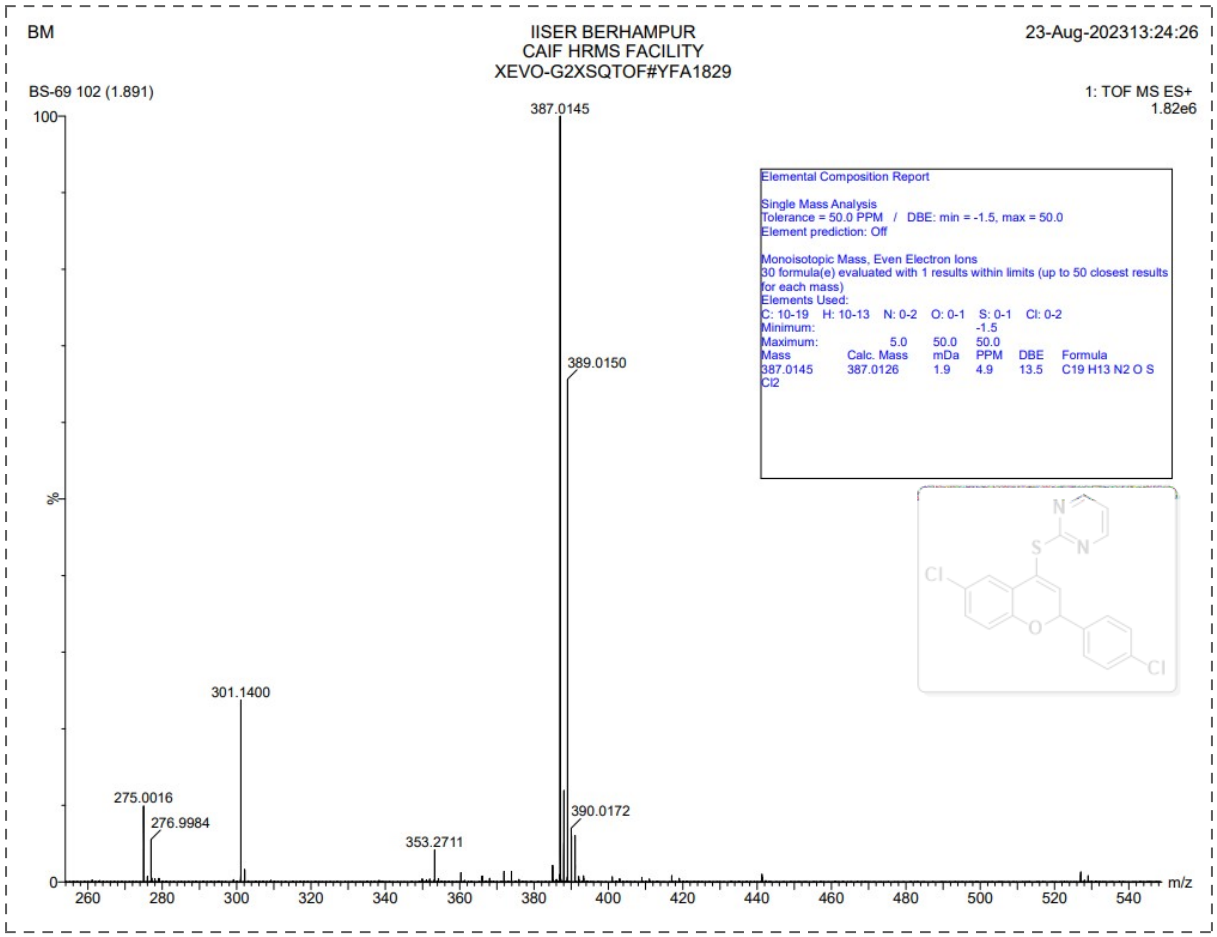
^{1}H NMR Spectrum of **(17p)**



^{13}C NMR Spectrum of **(17p)**

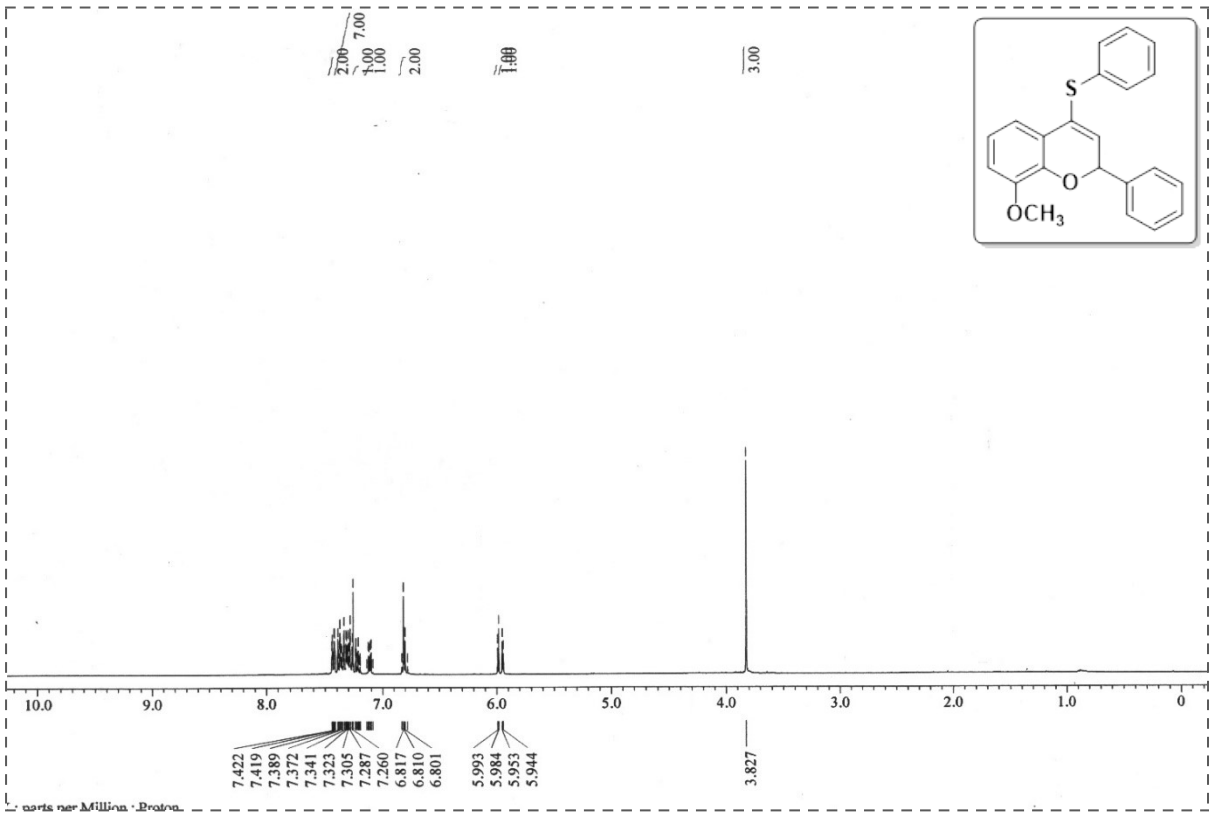


HRMS Spectrum of **(17p)**

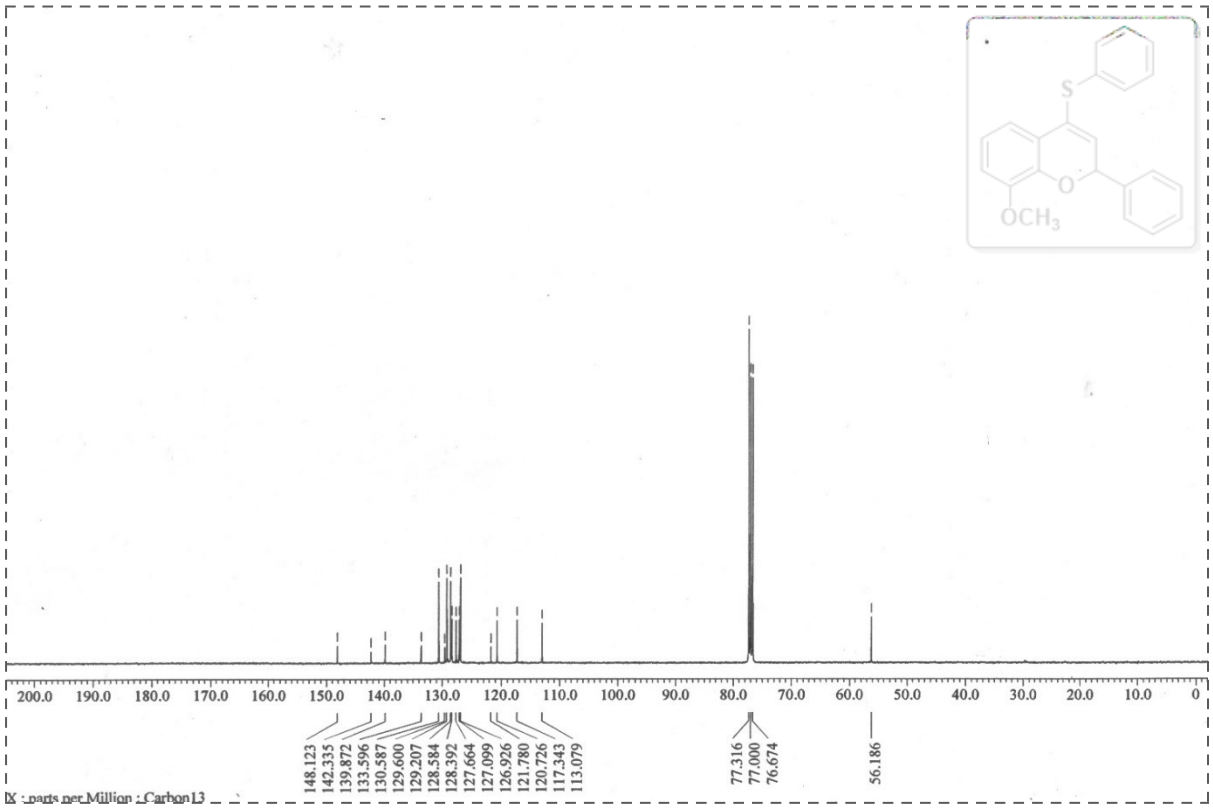


3.17. *8-methoxy-2-phenyl-4-(phenylthio)-2H-chromene* **(17q)**:

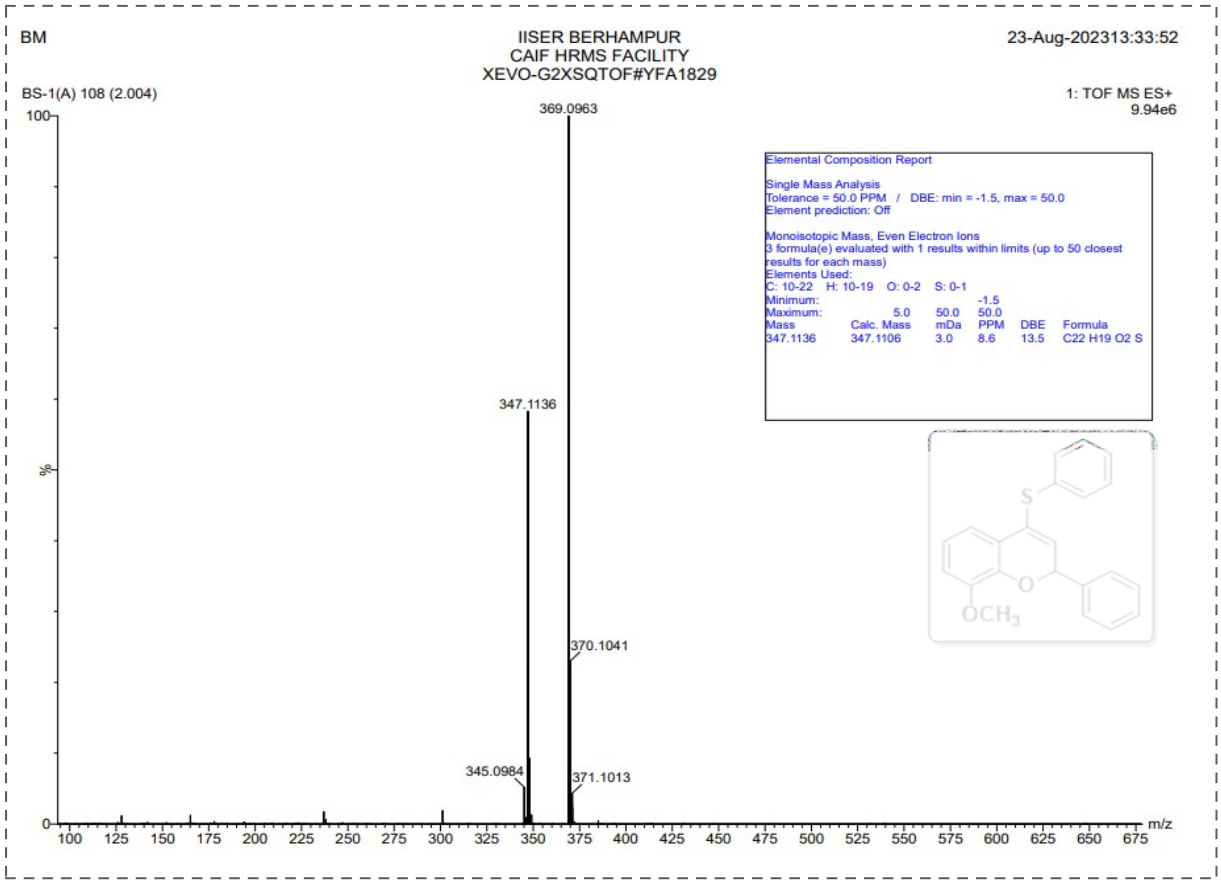
^{1}H NMR Spectrum of **(17q)**



^{13}C NMR Spectrum of **(17q)**

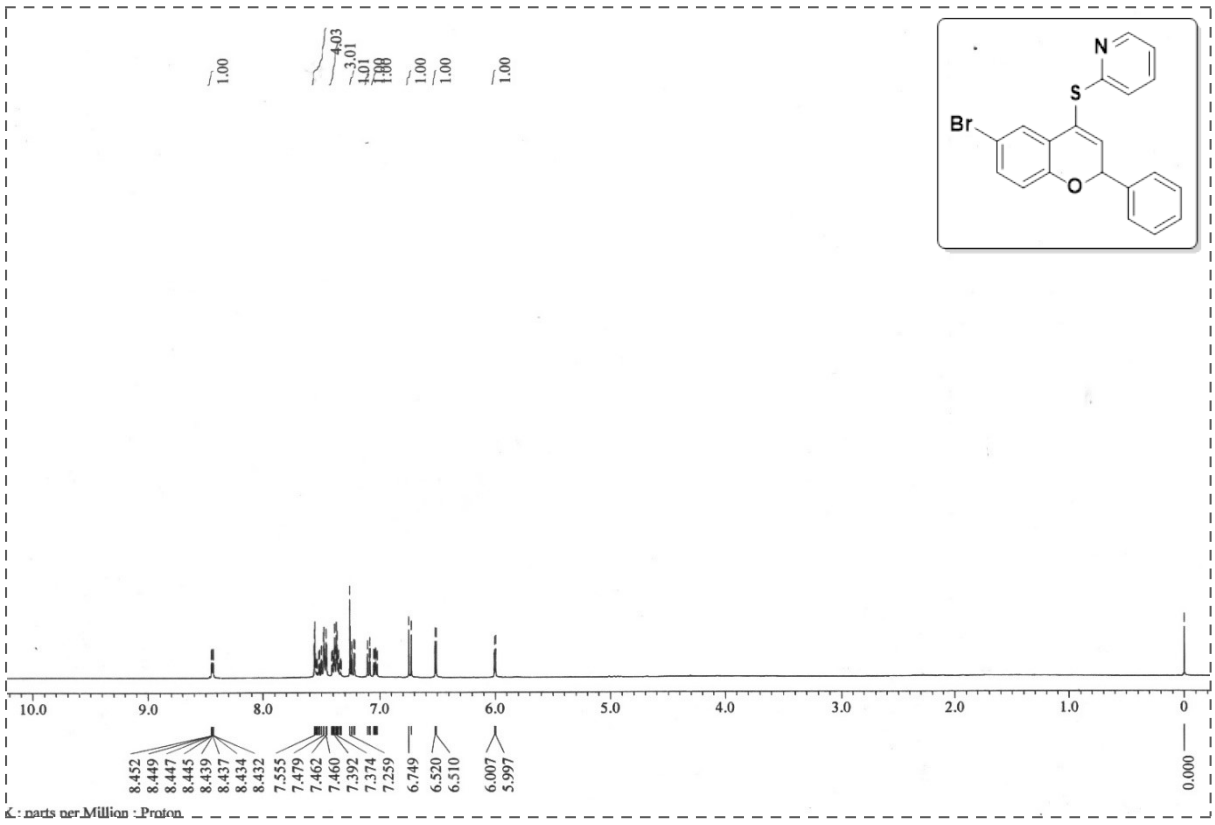


HRMS Spectrum of **(17q)**

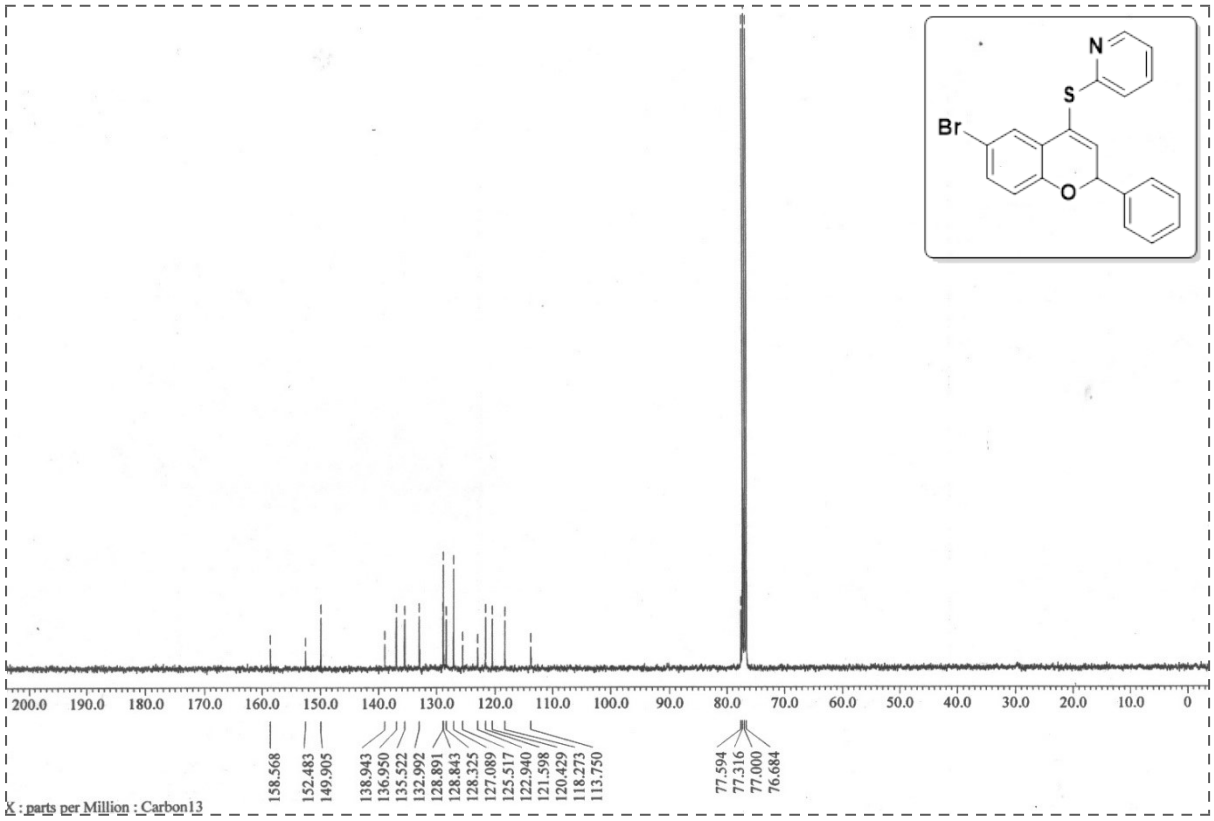


3.18. *2-((6-bromo-2-phenyl-2H-chromen-4-yl)thio)pyridine* **(17r)**:

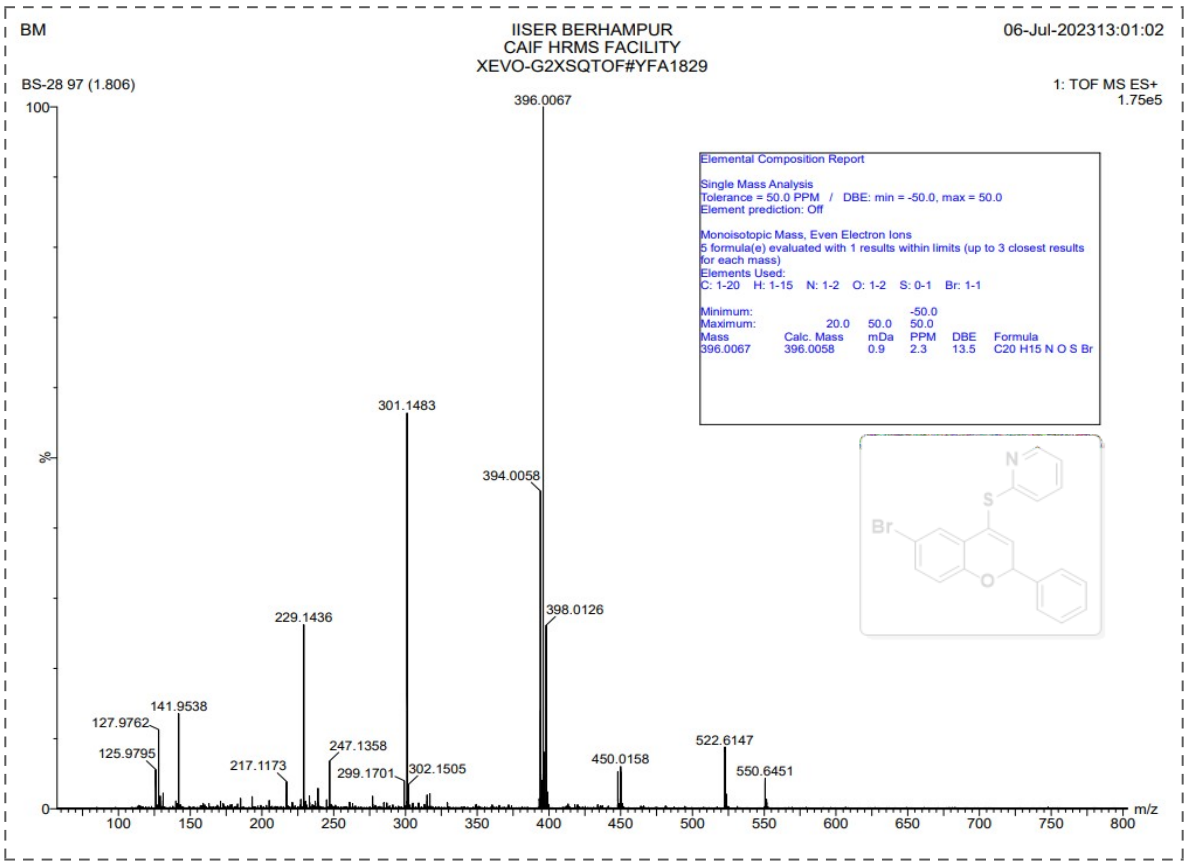
^{1}H NMR Spectrum of **(17r)**



^{13}C NMR Spectrum of **(17r)**

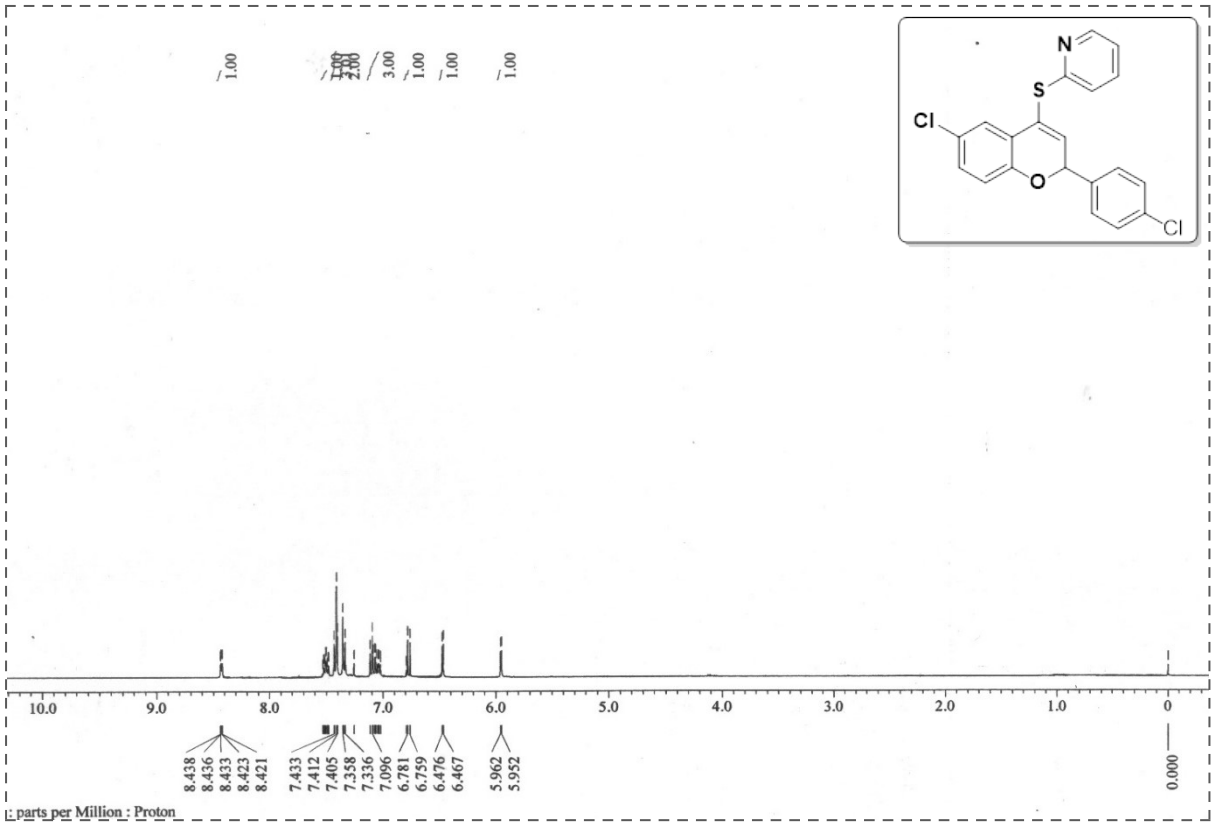


HRMS Spectrum of **(17r)**

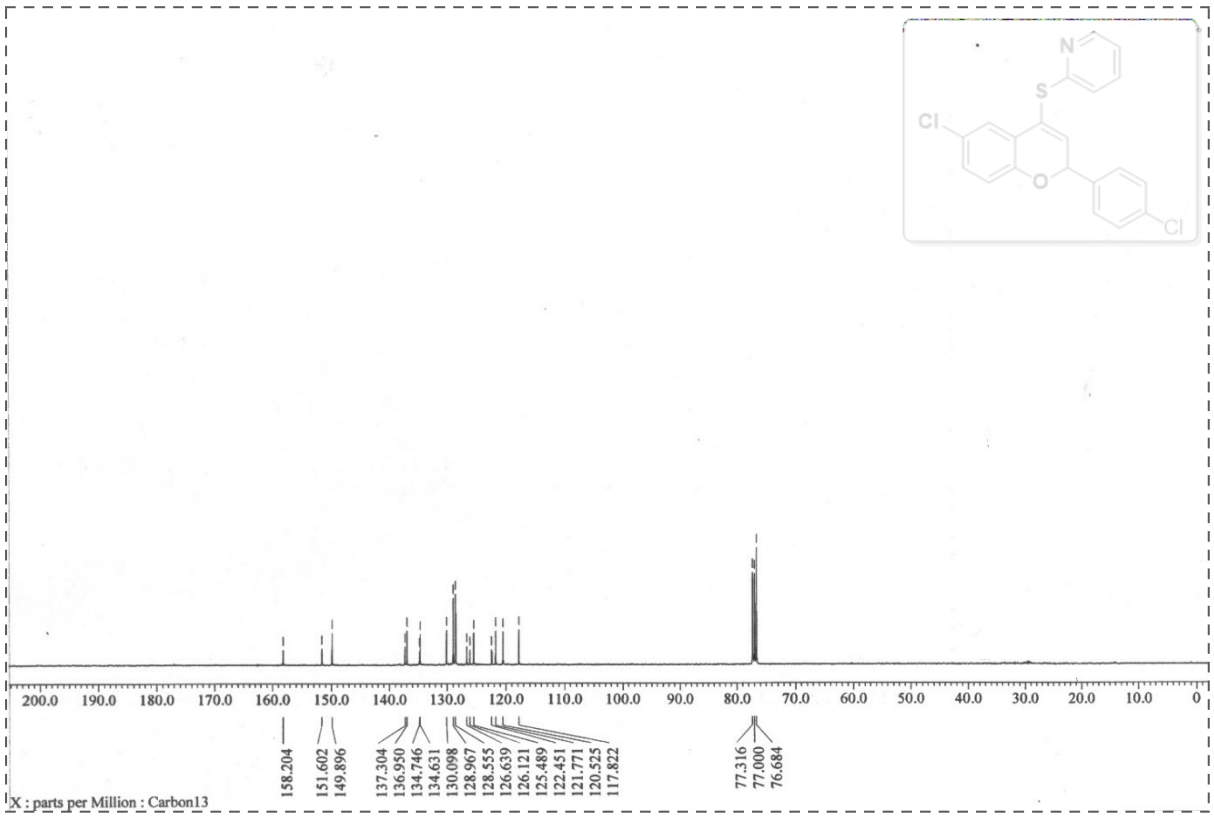


3.19. *2-((6-chloro-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyridine* **(17s)**:

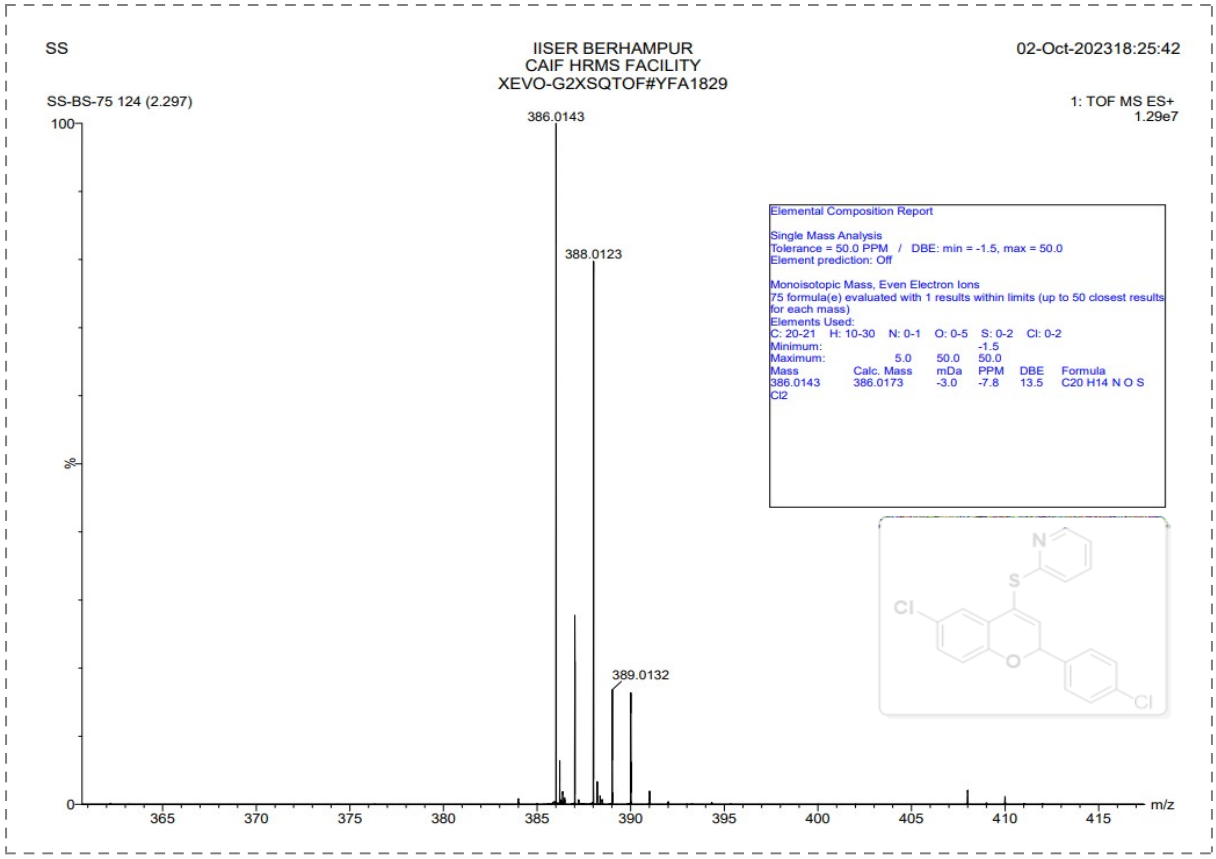
^{1}H NMR Spectrum of **(17s)**



^{13}C NMR Spectrum of **(17s)**

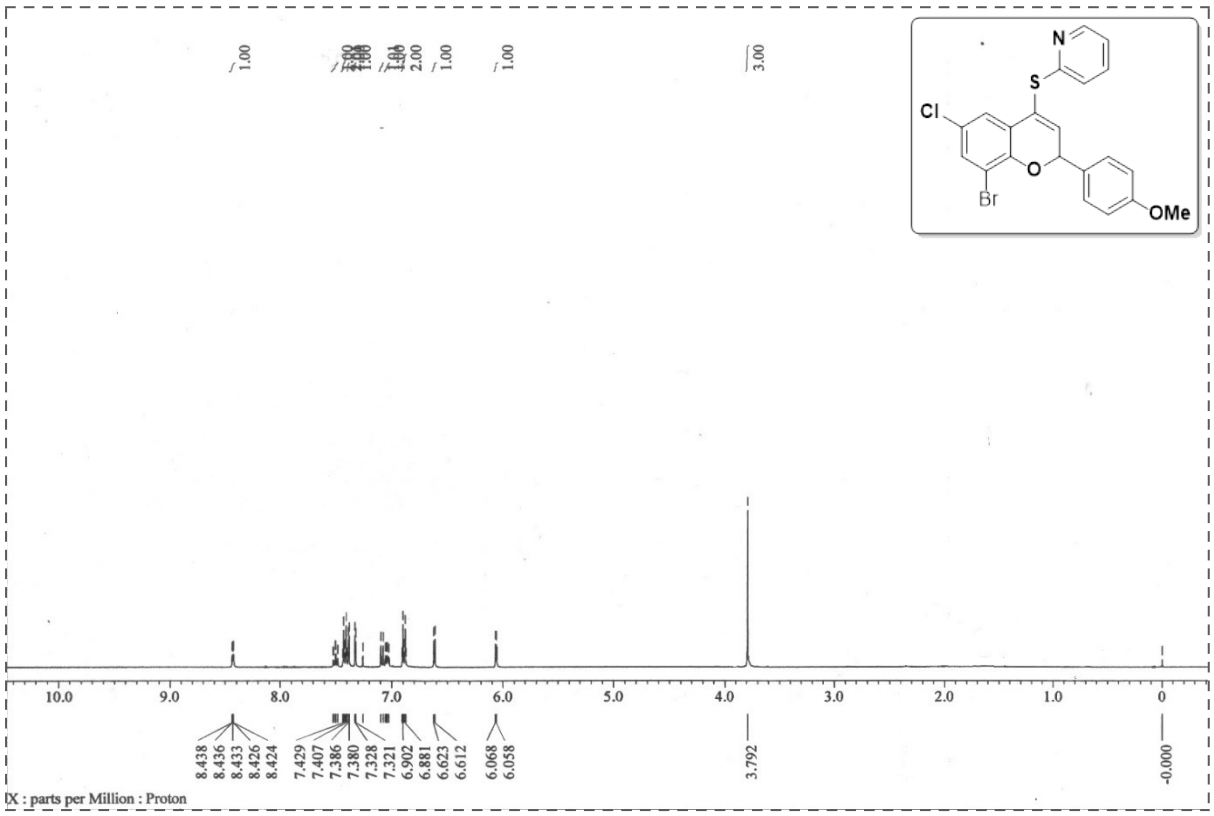


HRMS Spectrum of **(17s)**

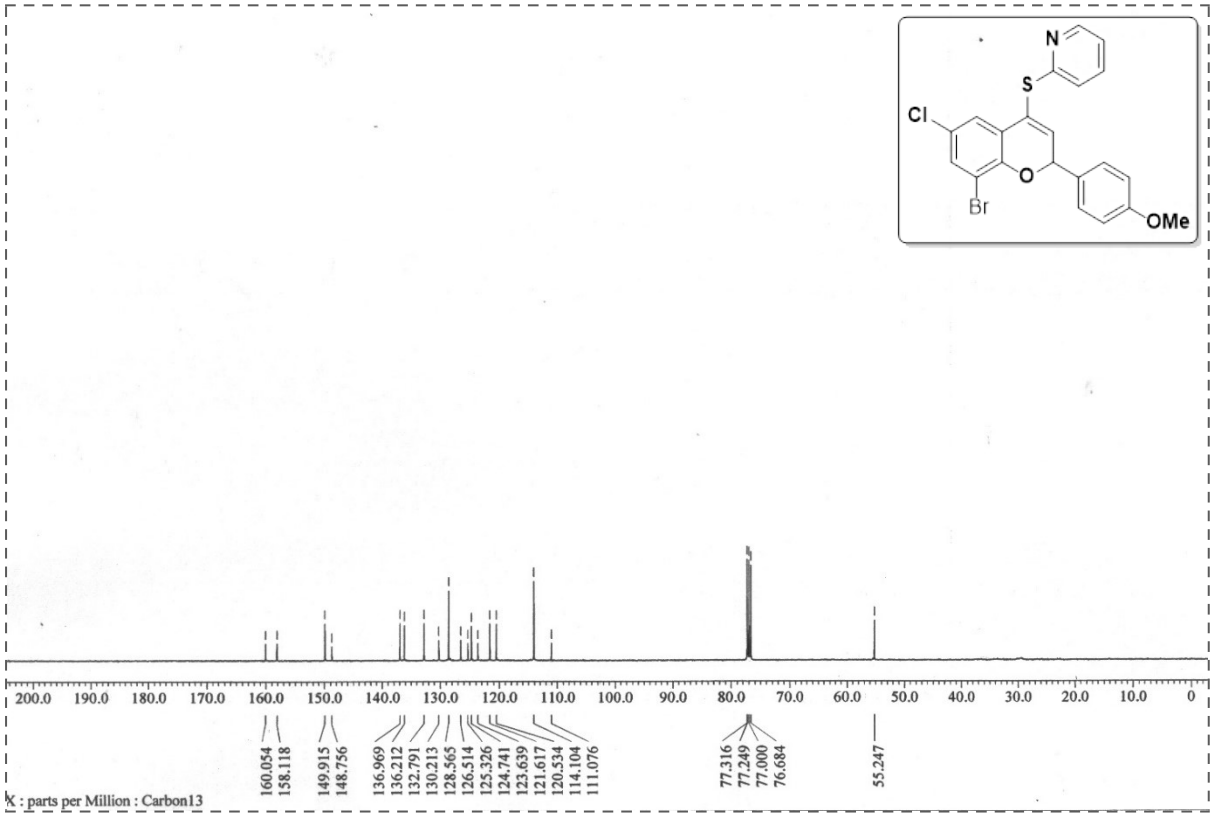


3.20. *2-((8-bromo-6-chloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyridine* **(17t)**:

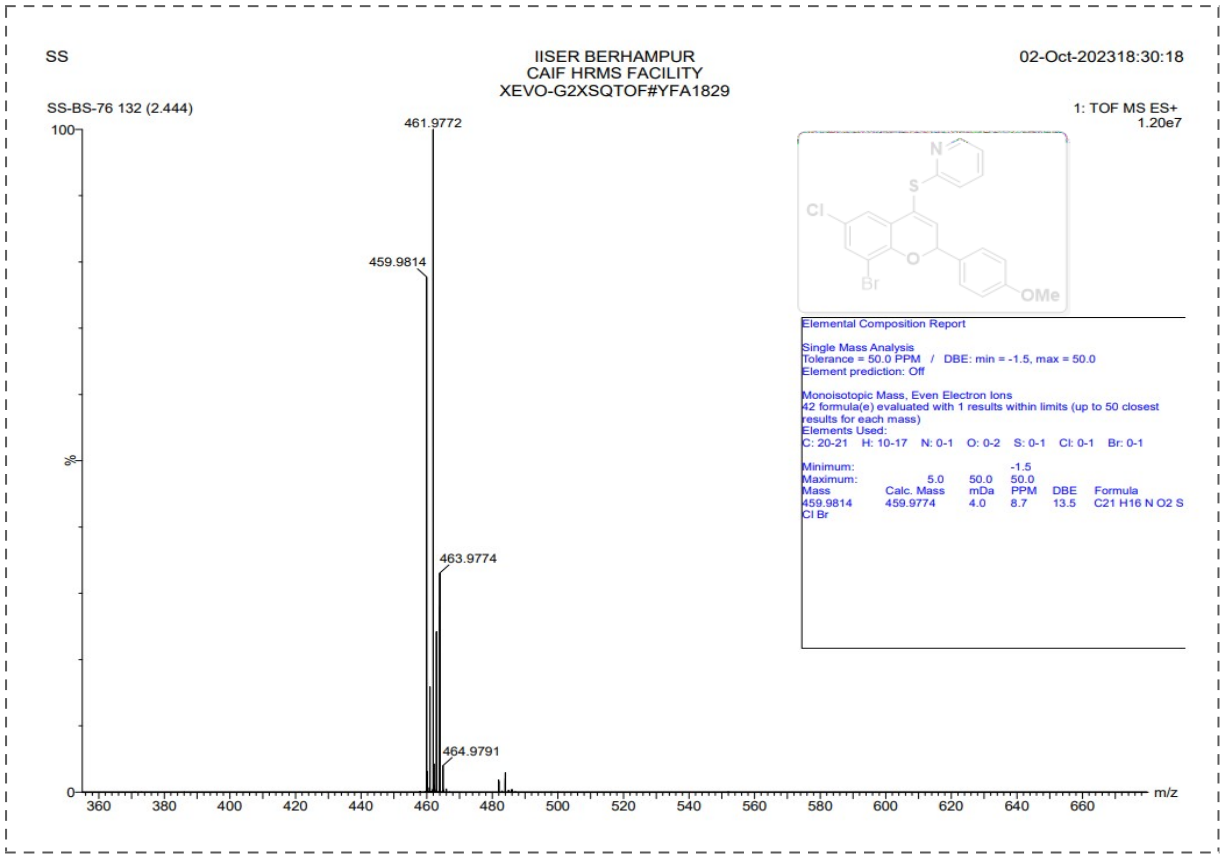
^{1}H NMR Spectrum of **(17t)**



^{13}C NMR Spectrum of **(17t)**



HRMS Spectrum of **(17t)**



4. **Molecular docking table and studies of compound (17a-e and 17g-s) against bacterial DNA gyrase of *E. coli* and *S. aureus***

The docking calculation of compounds **17(a-t)** was carried out by using AutoDock Tools version v4.2. Crystal structure of the *E. coli* protein, bacterial DNA gyrase (PDBID: 3G7E), and *S. aureus* protein, bacterial DNA gyrase (PDBID: 3G7B), was retrieved from Protein Data Bank (https://www. rcsb.org/), and 3D structures of the synthesized ligands were prepared by ChemDraw Ultra 12.0. Initially, during the molecular docking procedure, polar H-bonds were added, bounded ligands with water molecules were eliminated and other default parameters were employed. The 2D illustration of the docked complex of ligand-receptor was visualized by PyMOL (www.pymol.org) and BIOVIA Discovery Studio R2 2017. Subsequently, the top docking score was selected for further assessment of antibacterial properties.

Table **S1**. Docking score and binding interactions of synthesized heteroaromatic thiol-based 2-aryl-3-nitro-2*H*-chromene derivatives **17(a-t)** with amino acid residues of DNA gyrase.

Compounds	*E. coli*		*S. aureus*	
	Docking score (kCal/mol)	Residues showing interaction	Docking score (kCal/mol)	Residues showing interaction
17a	-8.6	GLY88, ASP35, LYS89,	-7.2	GLU35, ASN31, ILE79,

		ALA39, ARG62, ILE80, PHE90, PRO65, ALA76, ILE64, ASN32		THR127, ILE63, ILE129, SER32, ILE28
17b	-8.2	ILE64, LYS89, ALA39, ARG62, GLU36, PRO65	-7.3	ARG61, GLU35, VAL56, ILE129, SER32, ILE28, ILE63, ASN31
17c	-8.5	ILE64, GLY88, LYS89, ALA39, PHE90, ARG62, GLU36	-7.1	ARG61, GLU35, VAL56, ILE28, ILE129, SER32, ILE63, ASN31
17d	**-7.7**	LYS89, GLU36, ARG62, ILE64, VAL29, ASN32, ALA33, ILE80, PHE90	**-7.7**	PRO64, ASN31, GLU35, ARG61, ILE63, ILE28, THR127, ILE129,
17e	-8.0	ILE64, GLY88, LYS89, ALA39, GLU36, PRO65, ARG62, PHE90	-7.3	GLU35, ARG61, ILE63, ILE129, ILE28, ASN31
17f	**-8.7**	ILE80, ASN32, PRO65, GLU36, ARG62, LYS89, ALA39, PHE90	**-7.7**	ILE63, THR127, GLU35, ASN31, ILE28
17g	-8.3	ILE64, GLY88, ARG62, LYS89, ALA39, GLU36, PRO65	-7.5	LEU80, ILE129, ILE28, ILE63, GLU35, PRO64, GLY62, ASN31
17h	-7.1	ASP35, LYS89, GLU36, PHE90, PRO65, ALA76, ILE80, ILE64, ASN32, GLY88	-7.1	ILE28, ILE63, ILE129, VAL56, GLU35
17i	-7.0	LYS89, ASP35, ALA39, VAL97, ARG62, GLY88	-6.5	ILE63, ILE28, ASN31, ILE129, LEU80, GLU35, ARG61,
17j	-8.4	PHE90, PRO65, LYS89, ASP35, GLY88, ASP59, ALA33, ILE64	-6.7	ILE79, ASN31, ILE63, ILE28, ILE129, SER32, ASP58
17k	-8.1	LYS89, ASP35, GLY88, PHE90, PRO65, ILE80, ALA76, ILE64	-6.9	ILE79, PRO64, ILE63, ILE28, ILE129, VAL56, SER32, ASP58, ASN31
17l	-7.3	LYS89, ASP35, GLY88, GLU36, PHE90, PRO65, ILE80, ALA76, ILE64, ASP59, ASN32	-6.6	PRO64, ARG61, ILE63, ALA38, GLU35, GLY62, ILE79, ASN31
17m	-7.7	LYS89, ASP35, GLY88, GLU36, PHE90, PRO65, ILE80, ALA76, ILE64, ASN32	-6.6	ARG61, GLU35, ASP34, ILE63, ILE28, ILE79, ASN31, LEU80
17n	-8.4	LYS89, ASP35, PRO65, PHE90, ILE64, ALA33, ASP59	-6.4	ILE79, ILE63, ILE28, ILE29, SER32, ASP58
17o	-7.4	LYS89, ASP35, GLY88, ARG62, ALA39, VAL97, HIS102	-7.4	ARG61, GLU35, ILE63, VAL56, ILE129, SER32, ILE28, ASN31
17p	-8.6	LYS89, ASP35, ALA39, VAL97, ARG62, GLU36, PRO65, PHE90	-7.2	ARG61, GLU35, ILE79, ILE63, ILE129, ILE28, SER32, ASN31
17q	-8.5	LYS89, ALA39, ARG62, GLU36, PHE90, PRO65, ILE64	-7.5	ILE79, ILE63, GLY62, GLU35, PRO64
17r	-8.4	LYS89, ALA39, ARG62, GLU36, PHE90, PRO65, ILE64	-7.4	ASN31, ILE63, GLU35, ILE79, PRO64, GLY62

17s	-7.8	LYS89, ASP35, ALA39, ARG62, GLU36, PHE90, PRO65, ILE64, ILE80	-6.9	ILE63, ILE28, SER32, ASN31, ILE79, GLU35, PRO64, GLY62, ARG61
17t	**-8.8**	PHE90, ARG62, GLU36, ILE64, LYS89, ILE80, GLY88, ASN32, HIS102, LEU101	**-7.9**	ILE79, ILE63, PRO64, ILE28, ILE129, VAL56, SER32, ASN31, ASP58

a) *2-((2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17a)**

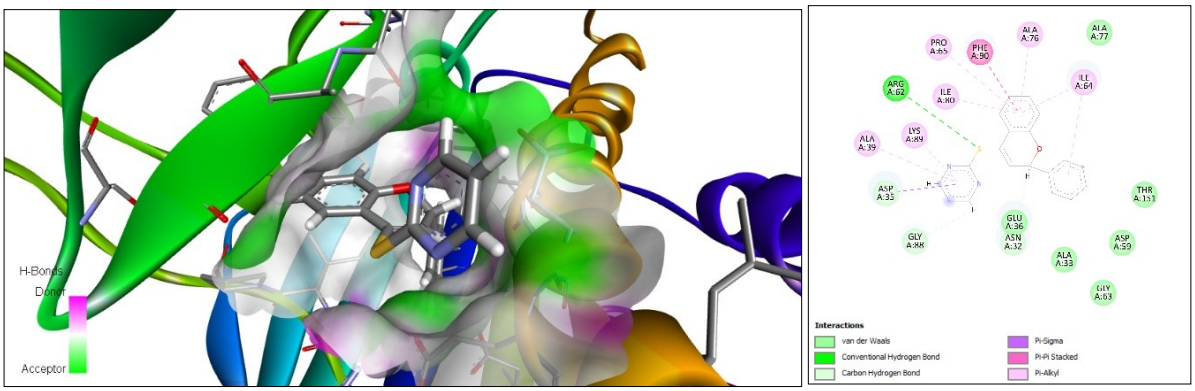


Figure S1(i). Binding interaction of compound **17a** with *E. coli* DNA gyrase (PDBID:3G7E)

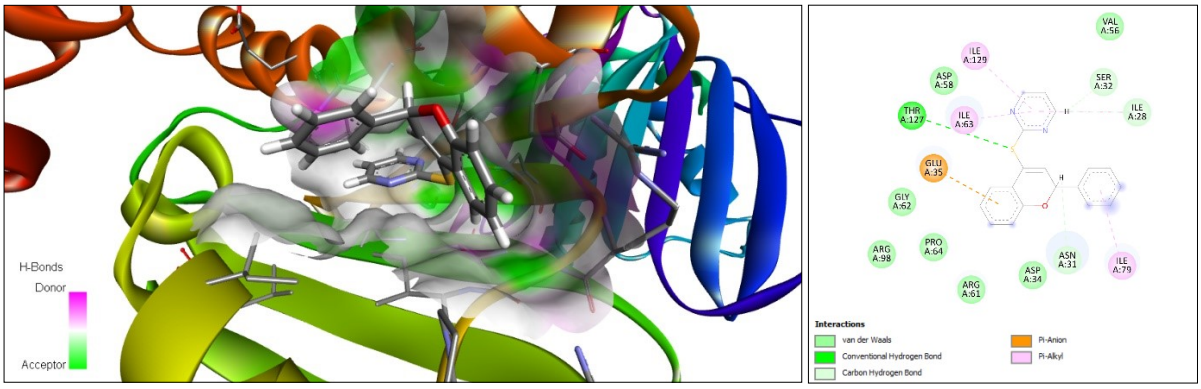


Figure S1(ii). Binding interaction of compound **17a** with *S. aureus* DNA gyrase (PDBID:3G7B)

b) *2-((6-chloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17b)**

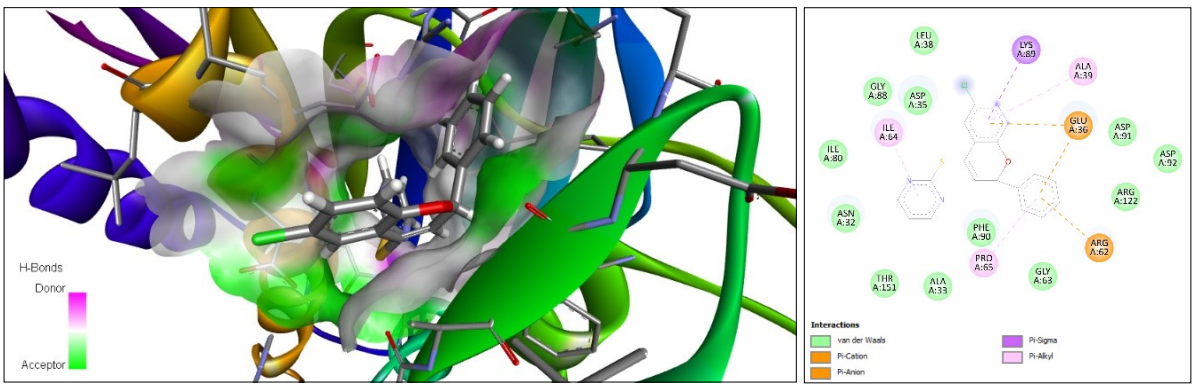


Figure S2(i). Binding interaction of compound **17b** with *E. coli* DNA gyrase (PDBID:3G7E)

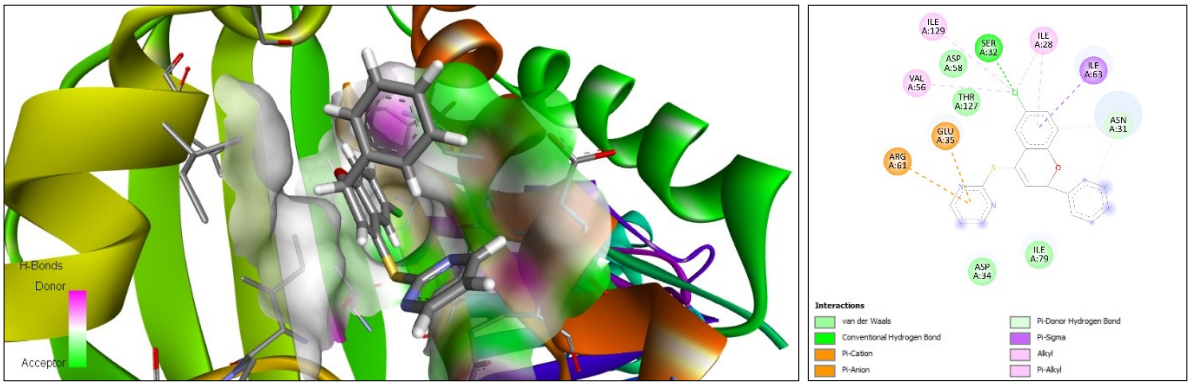


Figure S2(ii). Binding interaction of compound **17b** with *S. aureus* DNA gyrase (PDBID:3G7B)

c) *2-((6-bromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17c)**

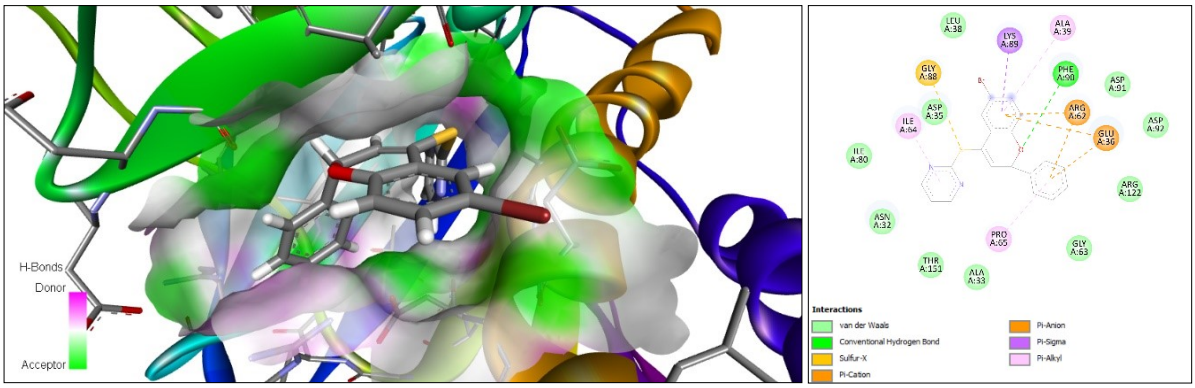


Figure S3(i). Binding interaction of compound **17c** with *E. coli* DNA gyrase (PDBID:3G7E)

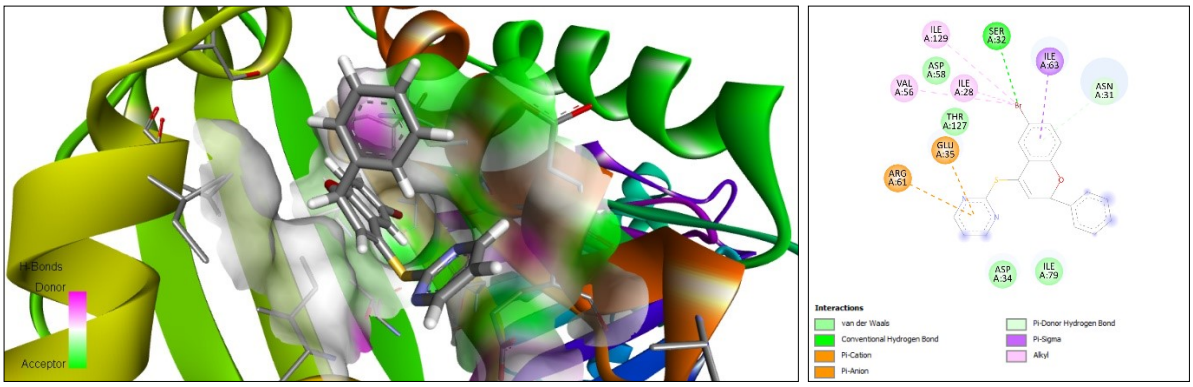


Figure S3(ii). Binding interaction of compound **17c** with *S. aureus* DNA gyrase (PDBID:3G7B)

d) *2-((7-bromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine* **(17d)**

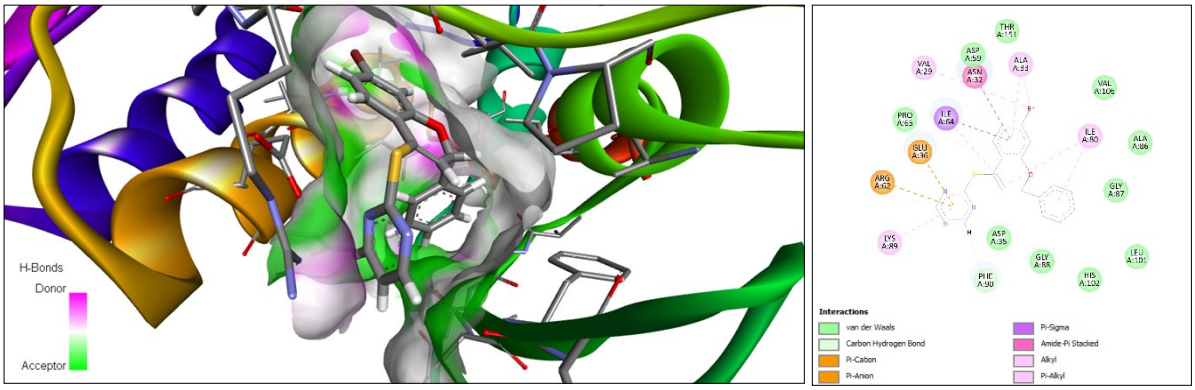


Figure S4(i). Binding interaction of compound **17d** with *E. coli* DNA gyrase (PDBID:3G7E)

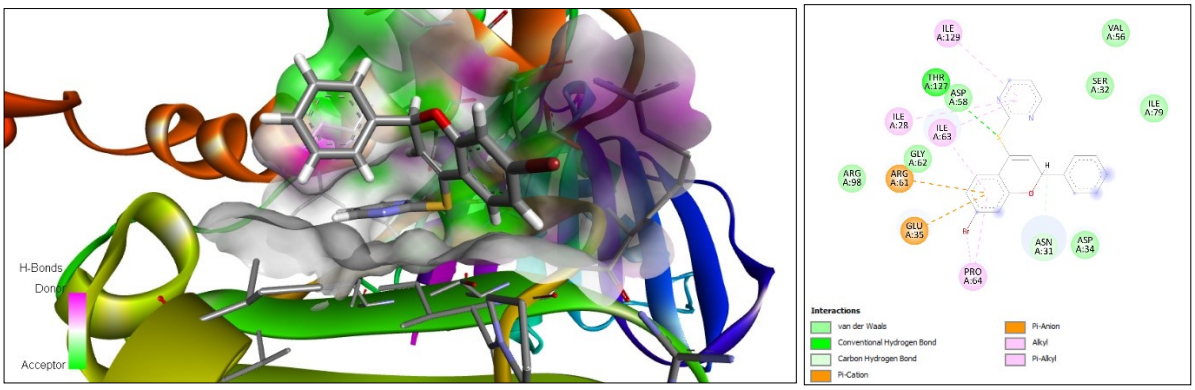


Figure S4(ii). Binding interaction of compound **17d** with *S. aureus* DNA gyrase (PDBID:3G7B)

e) 2-((8-chloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine **(17e)**

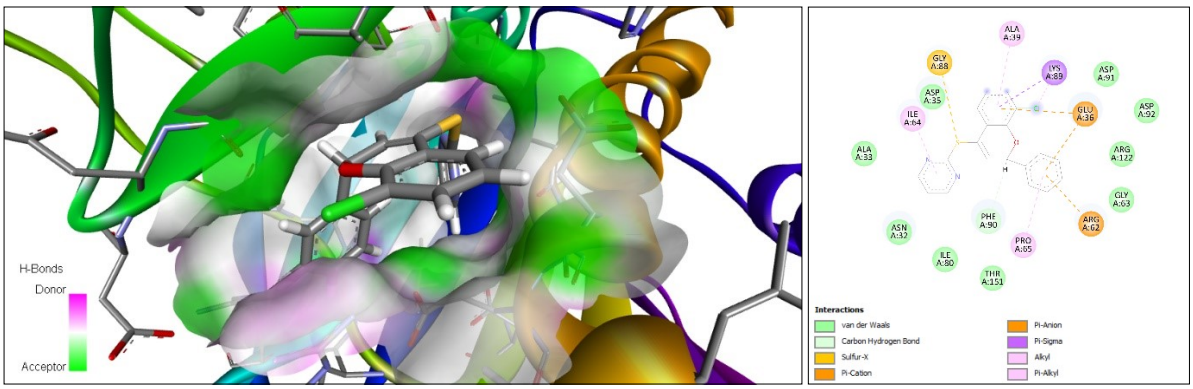


Figure S5(i). Binding interaction of compound **17e** with *E. coli* DNA gyrase (PDBID:3G7E)

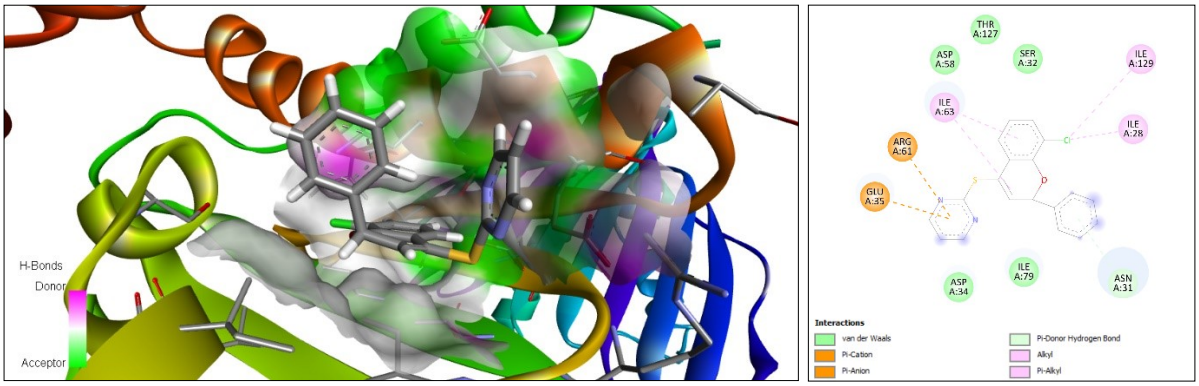


Figure S5(ii). Binding interaction of compound **17e** with *S. aureus* DNA gyrase (PDBID:3G7B)

g) 2-((6,8-dibromo-2-phenyl-2H-chromen-4-yl)thio)pyrimidine **(17g)**

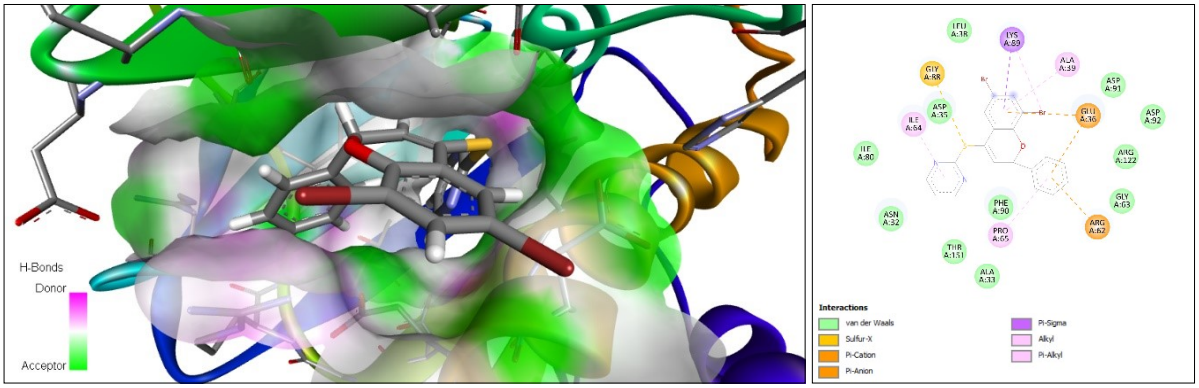


Figure S6(i). Binding interaction of compound **17g** with *E. coli* DNA gyrase (PDBID:3G7E)

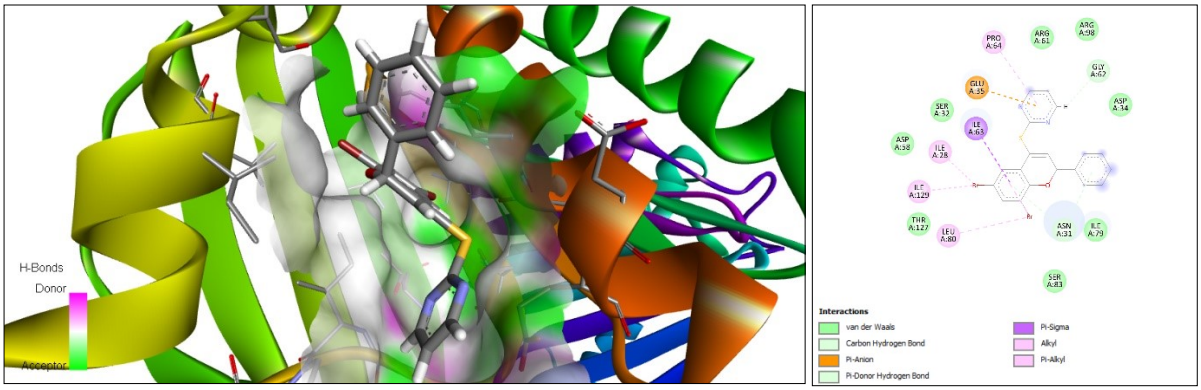


Figure S6(ii). Binding interaction of compound **17g** with *S. aureus* DNA gyrase (PDBID:3G7B)

h) 2-((6,8-dichloro-2-phenyl-2H-chromen-4-yl)thio)pyrimidine **(17h)**

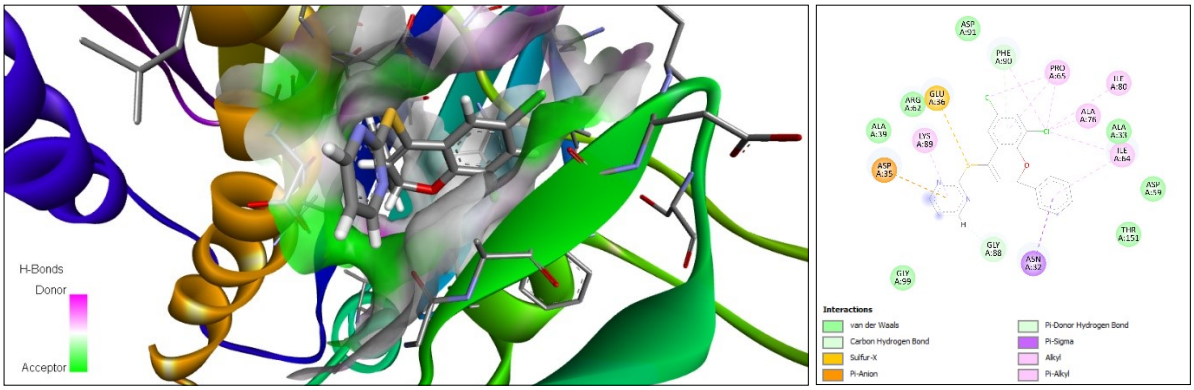


Figure S7(i). Binding interaction of compound **17h** with *E. coli* DNA gyrase (PDBID:3G7E)

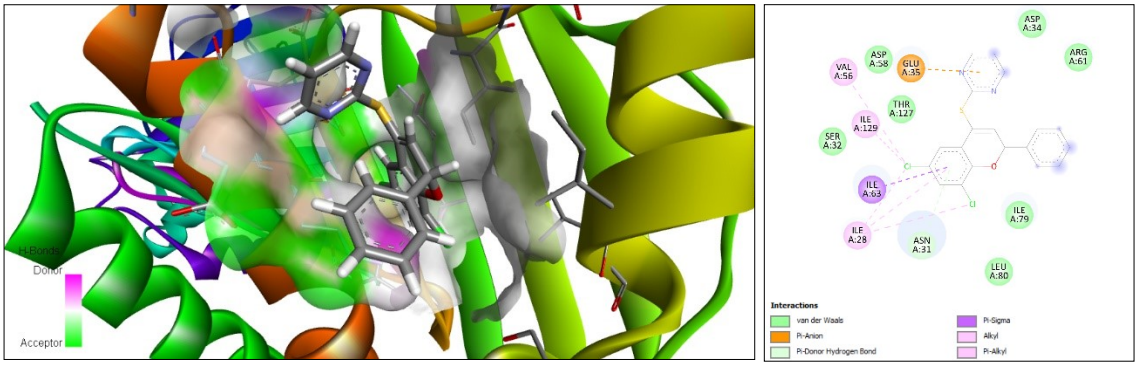


Figure S7(ii). Binding interaction of compound **17h** with *S. aureus* DNA gyrase (PDBID:3G7B)

i) 2-((6-bromo-8-methoxy-2-phenyl-2H-chromen-4-yl)thio)pyrimidine **(17i)**

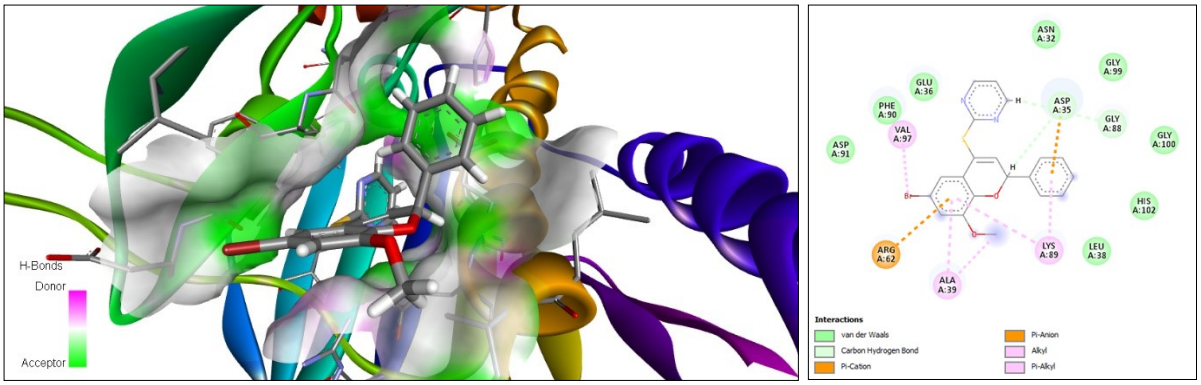


Figure S8(i). Binding interaction of compound **17i** with *E. coli* DNA gyrase (PDBID:3G7E)

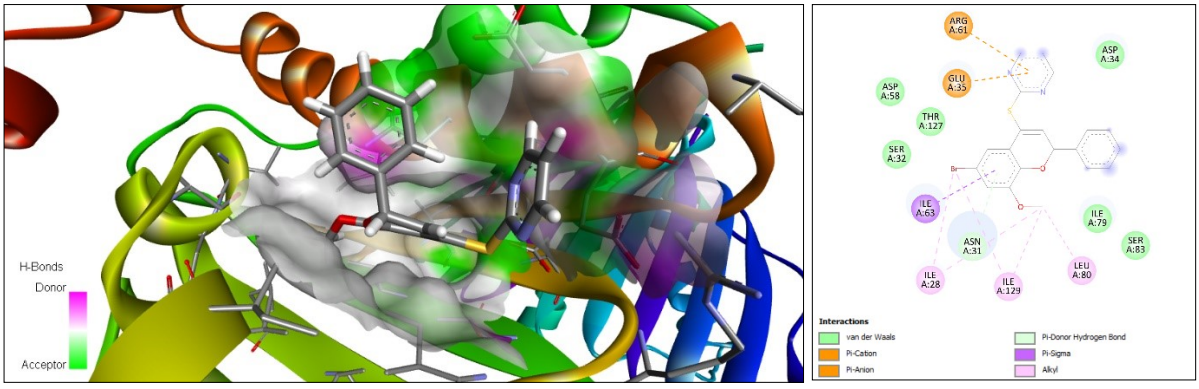


Figure S8(ii). Binding interaction of compound **17i** with *S. aureus* DNA gyrase (PDBID:3G7B)

j) 2-((6-chloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine **(17j)**

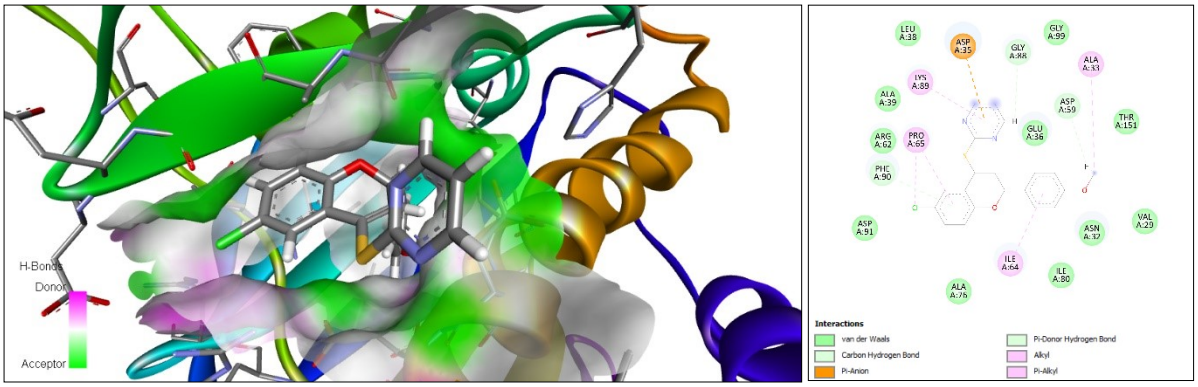


Figure S9(i). Binding interaction of compound **17j** with *E. coli* DNA gyrase (PDBID:3G7E)

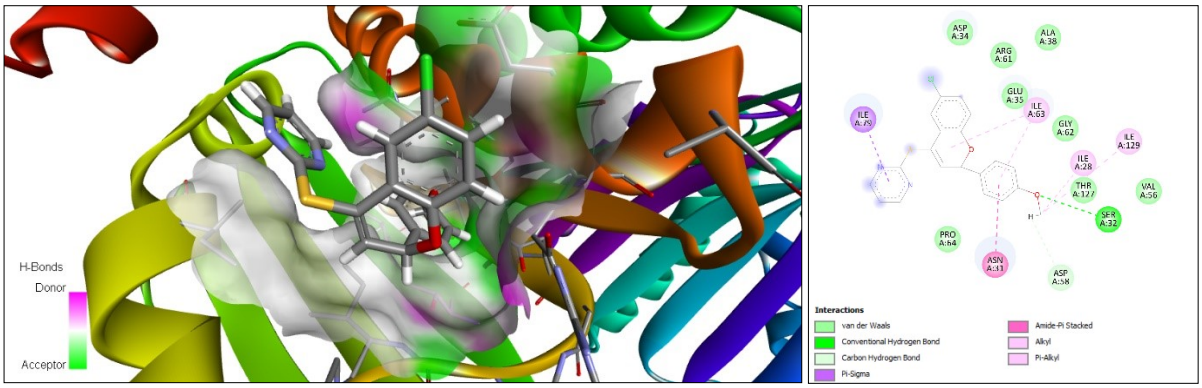


Figure S9(ii). Binding interaction of compound **17j** with *S. aureus* DNA gyrase (PDBID:3G7B)

k) 2-((6,8-dichloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine **(17k)**

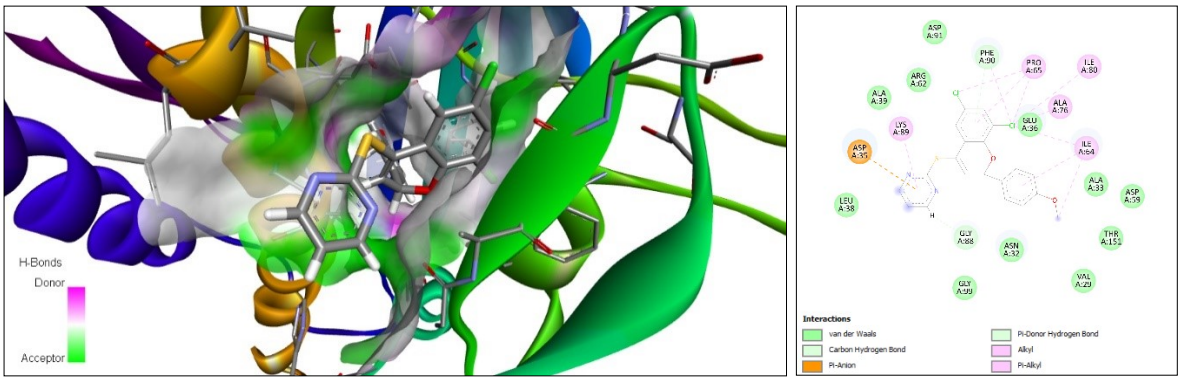


Figure S10(i). Binding interaction of compound **17k** with *E. coli* DNA gyrase (PDBID:3G7E)

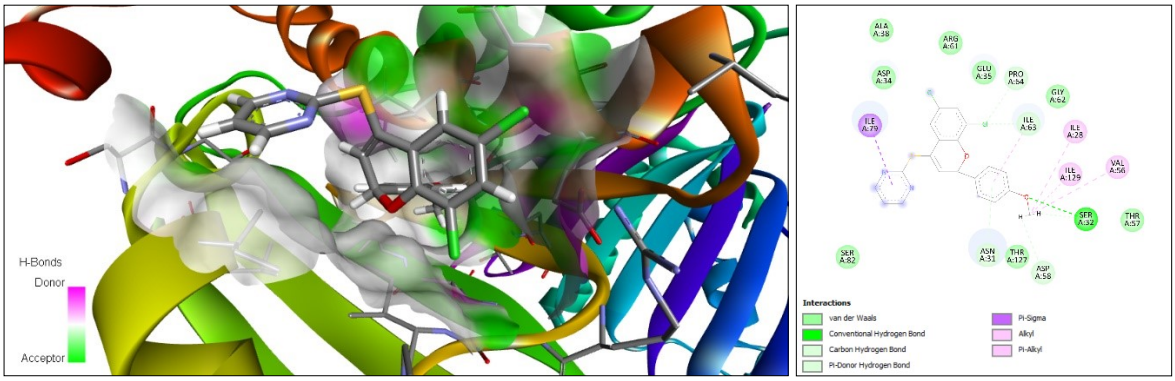


Figure S10(ii). Binding interaction of compound **17k** with *S. aureus* DNA gyrase (PDBID:3G7B)

l) 2-((6,8-dibromo-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine **(17l)**

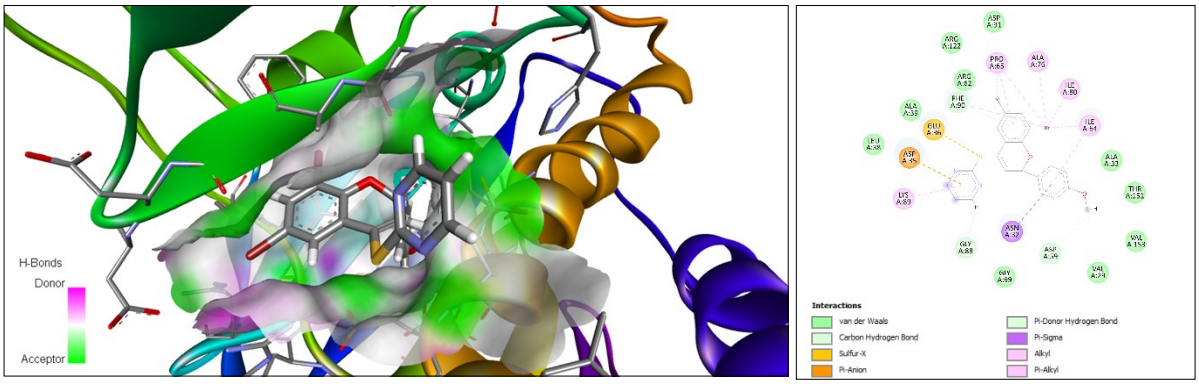


Figure S11(i). Binding interaction of compound **17l** with *E. coli* DNA gyrase (PDBID:3G7E)

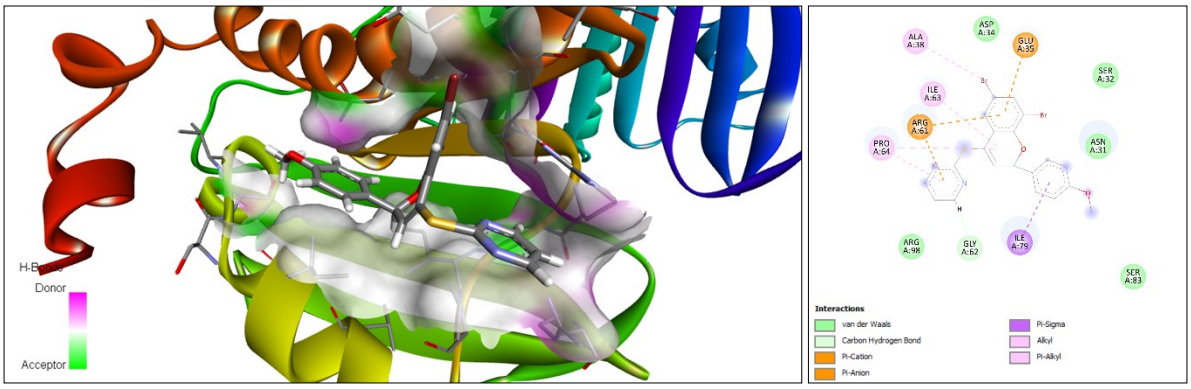


Figure S11(ii). Binding interaction of compound **17l** with *S. aureus* DNA gyrase (PDBID:3G7B)

m) 2-((8-bromo-6-chloro-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine **(17m)**

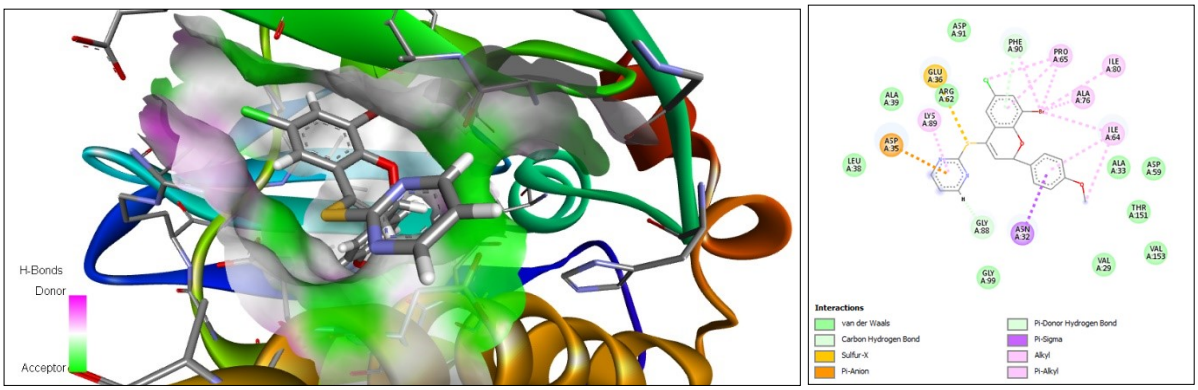


Figure S12(i). Binding interaction of compound **17m** with *E. coli* DNA gyrase (PDBID:3G7E)

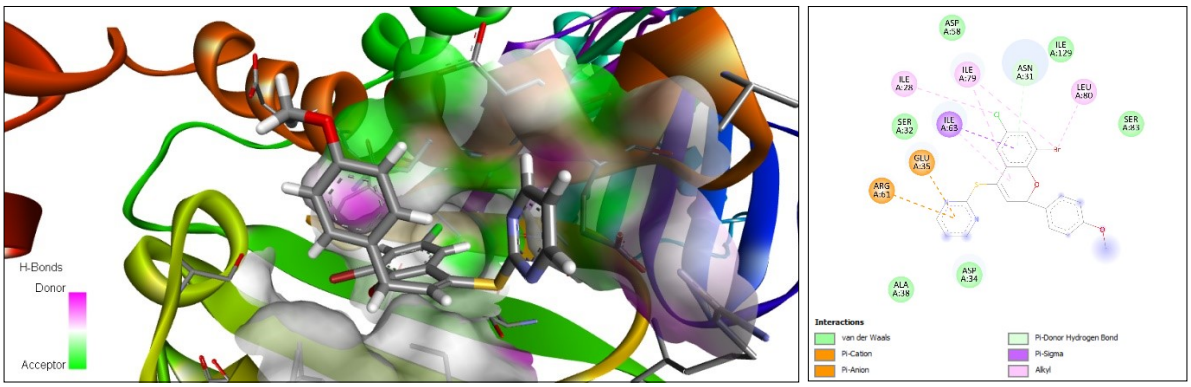


Figure S12(ii). Binding interaction of compound **17m** with *S. aureus* DNA gyrase (PDBID:3G7B)

n) 2-((6-bromo-2-(4-methoxyphenyl)-2H-chromen-4-yl)thio)pyrimidine **(17n)**

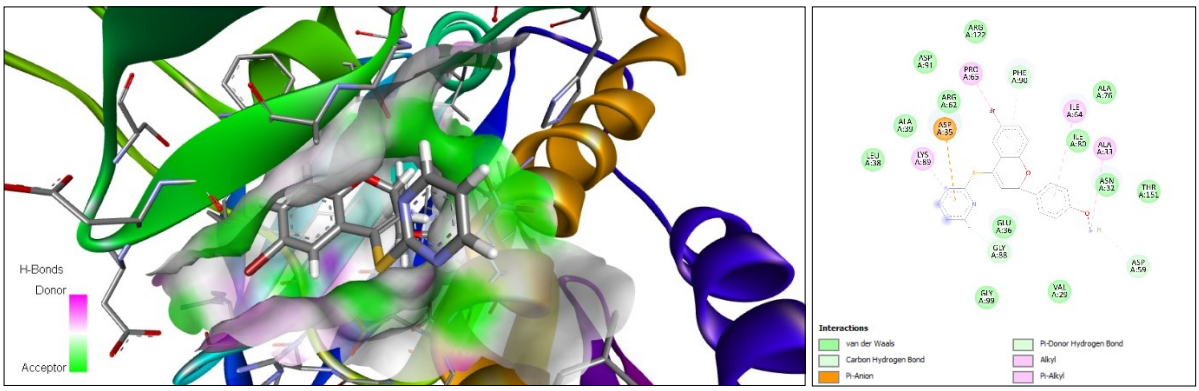


Figure S13(i). Binding interaction of compound **17n** with *E. coli* DNA gyrase (PDBID:3G7E)

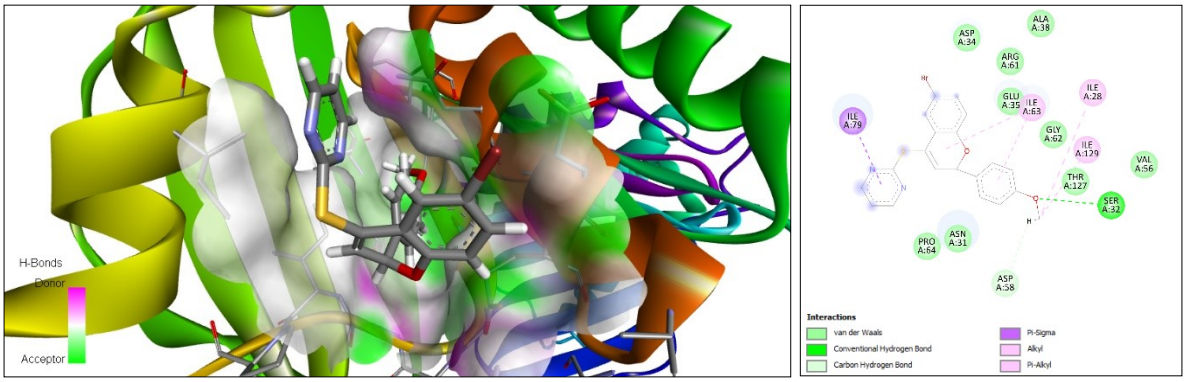


Figure S13(ii). Binding interaction of compound **17n** with *S. aureus* DNA gyrase (PDBID:3G7B)

o) 2-((6-bromo-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyrimidine **(17o)**

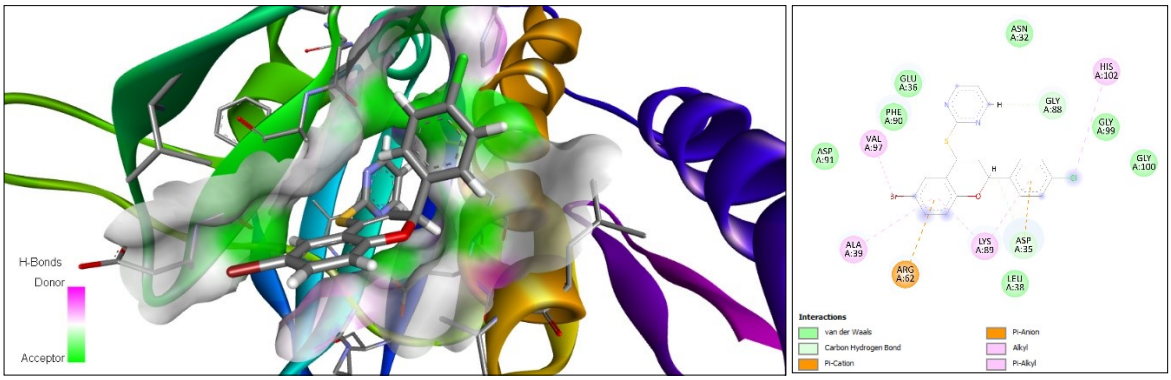


Figure S14(i). Binding interaction of compound **17o** with *E. coli* DNA gyrase (PDBID:3G7E)

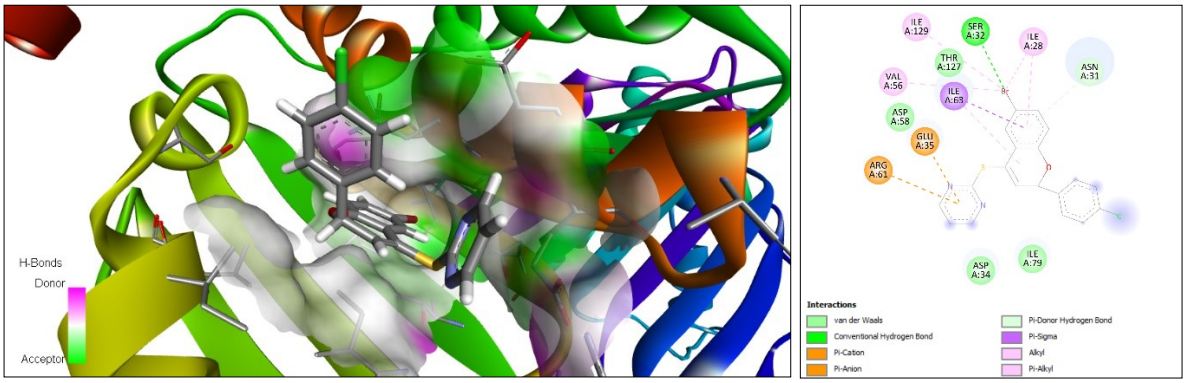


Figure S14(ii). Binding interaction of compound **17o** with *S. aureus* DNA gyrase (PDBID:3G7B)

p) 2-((6-chloro-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyrimidine **(17p)**

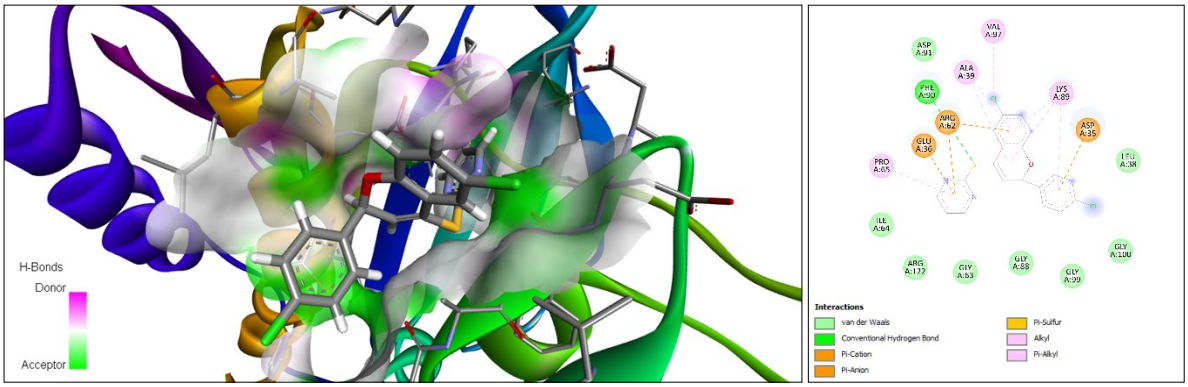


Figure S15(i). Binding interaction of compound **17p** with *E. coli* DNA gyrase (PDBID:3G7E)

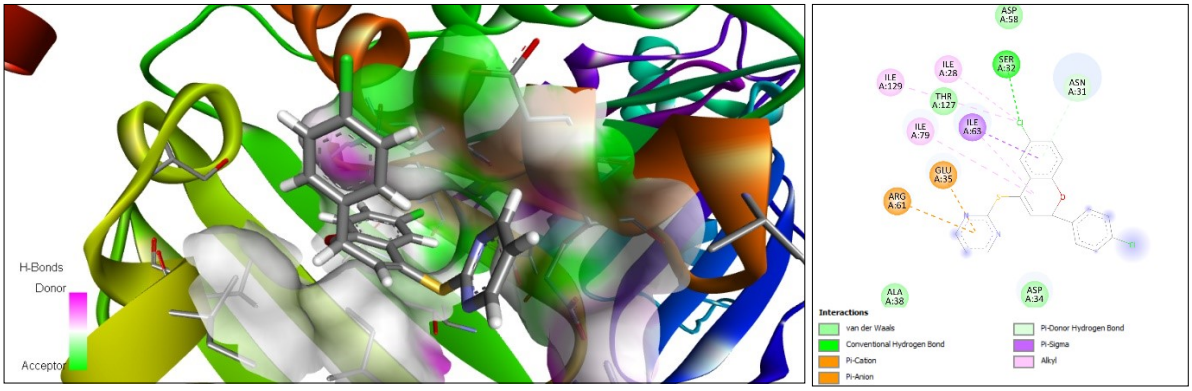


Figure S15(ii). Binding interaction of compound **17p** with *S. aureus* DNA gyrase (PDBID:3G7B)

q) 8-methoxy-2-phenyl-4-(phenylthio)-2H-chromene **(17q)**

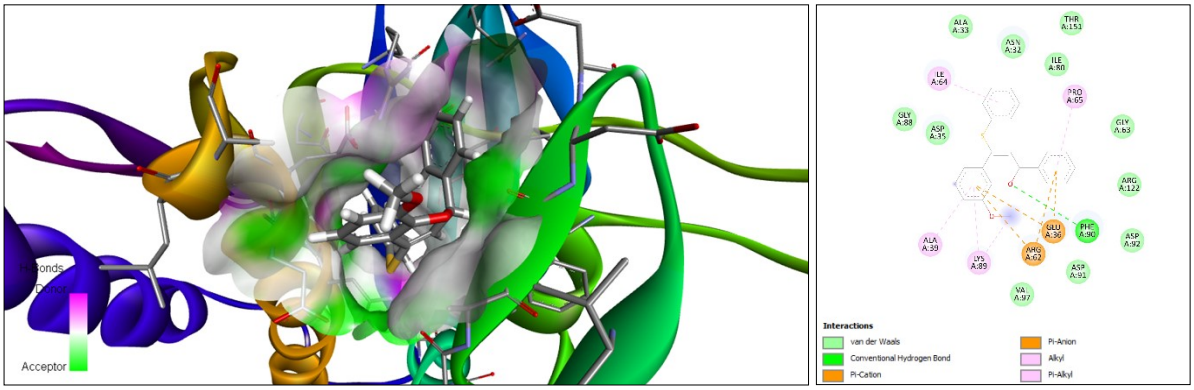


Figure S16(i). Binding interaction of compound **17q** with *E. coli* DNA gyrase (PDBID:3G7E)

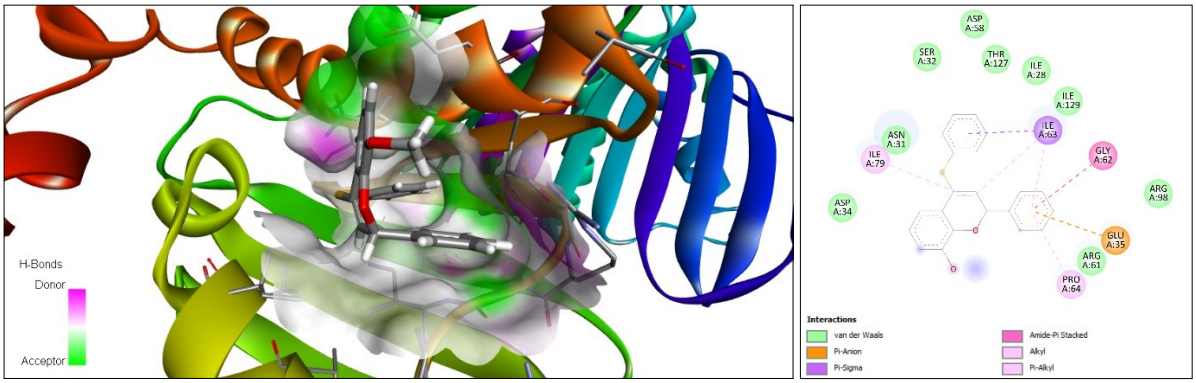


Figure S16(ii). Binding interaction of compound **17q** with *S. aureus* DNA gyrase (PDBID:3G7B)

r) 2-((6-bromo-2-phenyl-2H-chromen-4-yl)thio)pyridine **(17r)**

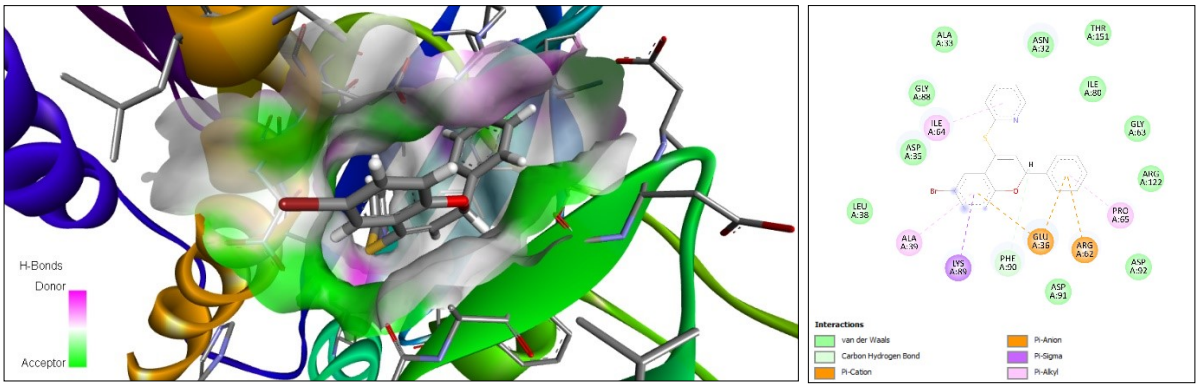


Figure S17(i). Binding interaction of compound **17r** with *E. coli* DNA gyrase (PDBID:3G7E)

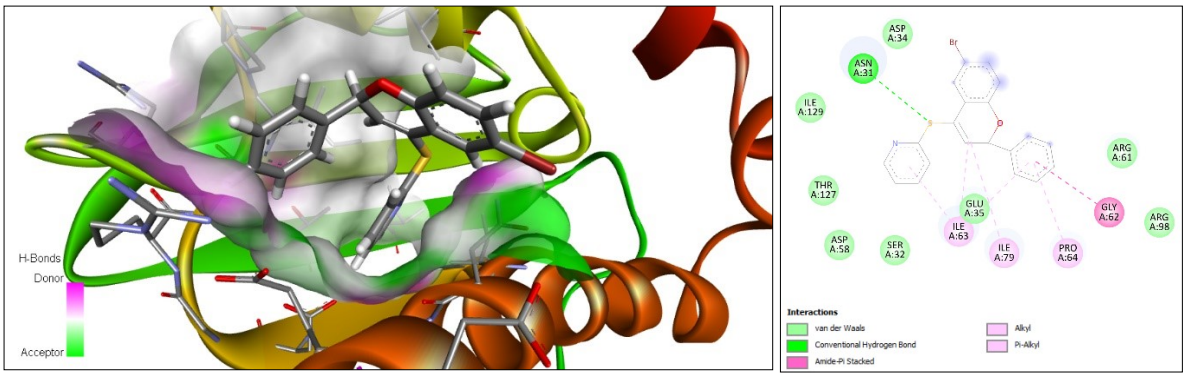


Figure S17(ii). Binding interaction of compound **17r** with *S. aureus* DNA gyrase (PDBID:3G7B)

s) 2-((6-chloro-2-(4-chlorophenyl)-2H-chromen-4-yl)thio)pyridine **(17s)**

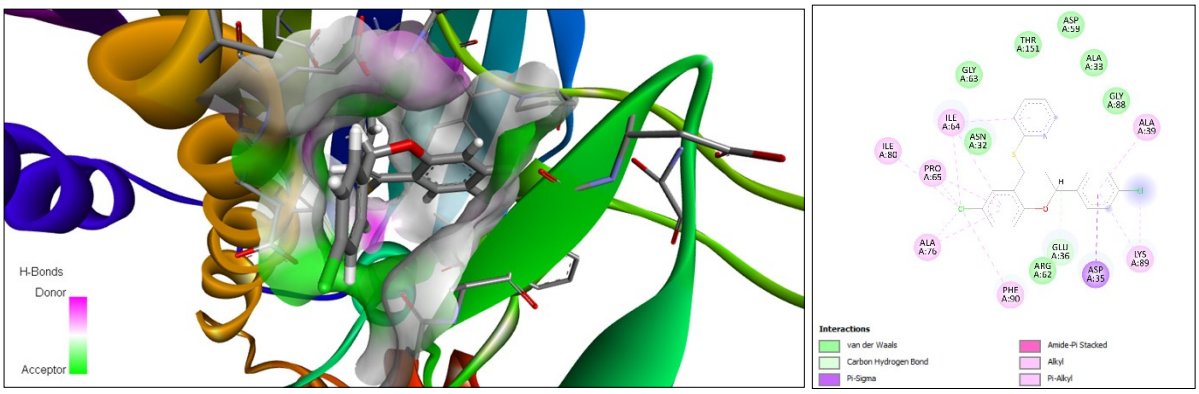


Figure S18(i). Binding interaction of compound **17s** with *E. coli* DNA gyrase (PDBID:3G7E)

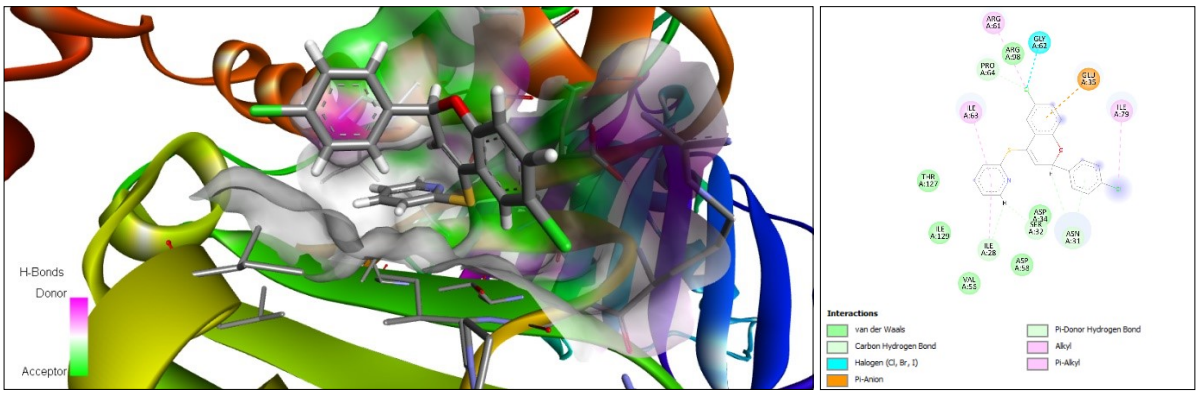


Figure S18(ii). Binding interaction of compound **17s** with *S. aureus* DNA gyrase (PDBID:3G7B)

5. Anti-bacterial evaluations Data

The *in vitro* antibacterial sensitivity assay of all the synthesized compounds was performed using agar-well diffusion methods against the test organisms namely, Gram-positive bacteria *S. aureus* and Gram-negative bacteria *E. coli*. Gentamicin was chosen as the standard drug. Preliminarily, the developed synthesized compounds were dissolved in DMSO. The Mueller-Hinton agar plates were used for the assessment of the zone of inhibition. At first, an aliquot of 25 ml of sterilized media was poured into a sterilized Petri plate; after solidification, the microbial suspension was spread over the concerning agar medium and followed to develop a well of 6 mm diameter using a sterilized cork borer. Then, each well was loaded with 80µl of test samples at concentrations of 100µg/ml for the ZI assessment. Afterward, those synthesized compounds were diluted at varying concentrations viz., 6.25, 12.5, 25, 50 µg/ml, and 100 µg/ml for the determination of MIC-assay. Then, each fractionated entity was further evaluated in a 96-plate for the determination of the rate of bacterial inhibitory efficacy.

Table S2. Antimicrobial activities of diversely substituted 3-nitro-2*H*-chromene-based heteroaromatic thiols

Compound Code	*E. coli*		*S. aureus*	
	ZI (mm)	MIC (µg/ml)	ZI (mm)	MIC (µg/ml)
17a	15	12.5	14	12.5
17b	14	12.5	20	50
17c	15	12.5	14	12.5
17d	14	25	14	12.5
17e	12	25	12	50
17f	16	12.5	15	12.5
17g	12	50	12	50
17h	20	25	12	50
17i	14	25	20	25
17j	20	25	20	25
17k	14	25	20	25
17l	12	50	11	50
17m	20	50	20	50
17n	14	12.5	14	12.5
17o	14	25	14	25
17p	16	12.5	15	12.5
17q	14	12.5	14	12.5
17r	20	25	20	50
17s	14	25	20	50
17t	17	6.25	16	12.5
Standard*	20	6.25	20	12.5

ZI: Zone of Inhibition, MIC: Minimum Inhibitory Concentration, *Standard Drug: Gentamicin