Electronic Supporting Information (ESI)

for

Facile Synthesis of Functionalized Quinolinones in Greener Reaction Medium and Their Photophysical Properties

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1. General Information

All the reagents and chemicals were purchased from common commercial suppliers like Sigma-Aldrich, Merck, and SRL and directly used as received without any further purification unless otherwise mentioned. All the reactions were carried out under oven-dried glass containers in parallel synthesizer unless otherwise mentioned. Completion of reactions was examined by thin layer chromatography carried out on pre-coated Merck silica gel-60 F254 aluminium plates with ultraviolet light (UV) or iodine as visualizing agents. Merck silica gel 60 - 120 was used for column chromatography. ^{1}H and ^{13}C NMR spectra were recorded at Bruker Advance III (^{1}H at 400 MHz and ^{13}C at 101 MHz) using $CDCl_3$ as a solvent. The Chemical shifts, δ (in ppm), are reported relative to TMS δ (^{1}H) 0.0 ppm, δ (^{13}C) 0.0 ppm, which was used as the internal reference. Otherwise, the solvents residual proton resonance and carbon resonance ($CHCl_3$, δ (^{1}H) 7.26 ppm, δ (^{13}C) 77.16 ppm, were also used for calibration. Chemical shifts (δ) values were reported in ppm and spin-spin coupling constant (J) was expressed in Hz, and the following abbreviations are used to describe multiplicity: s = singlet, d = doublet, dd = doublet of doublet, dt = doublet of triplet, t = triplet, m = multiplet, q = quartet, pent = pentate, sext = sextet. Melting points were determined using the Electrothermal IA 9200 apparatus. IR spectra were recorded on Thermo Nicolet iS50 with an inbuilt ATR (Shimadzu IR Tracer-100) spectrometer. Mass spectra were recorded on WATERS-XEVO G2-XS-QToF (A positive electrospray ionization (ESI^+) mode). Single-crystal X-ray diffraction was recorded using a D8-QUEST single-crystal XRD diffractometer; all data calculations were executed using the APEX2 program package on the PC version. The UV–vis and emission spectra were recorded with a Hitachi U-2900 apparatus JASCO V-670 PC spectrophotometer.

2. Experimental Procedure

2.1 General procedure for the synthesis of K_2CO_3:Ethylene glycol (DES-1) and DMU:Tartaric acid (7:3) (DES-2)

A mixture of K_2CO_3 and ethylene glycol was added to an oven-dried reaction vial and heated at 100 ^{O}C for 5 mins to form the K_2CO_3:Ethylene glycol deep Eutectic Solvent (DES-1).

Similarly, the synthesis of the DMU:Tartaric acid (7:3) DES (DES-2) was carried out as per the procedure in prior literature.[1]

2.2 General procedure for the synthesis of compounds 5a-5l

A mixture of substituted 2-amino benzhydrol **1**[2] (0.5 mmol, 1.0 equiv.), $Ni(OAc)_2.4H_2O$ (10 mol%), 2,2'-bipyridyl (15 mol%), KO^{t}Bu (1.0 equiv.) and K_2CO_3:Ethylene glycol (1:5) (500 mg) were added and the reaction was conducted at 100 ^{O}C for 4 h to form the benzophenone **1a**. Then, ethyl acetoacetate **2** (0.5 mmol, 1.0 equiv.) was added, and the reaction mixture was heated at 100 ^{O}C for 3 h to form the intermediate **A**. Subsequently, K_2CO_3:Ethylene glycol (1:5) (500 mg) and phenacyl bromide **3** (0.5 mmol, 1.0 equiv.) were added and continued at 100 ^{O}C for an additional 3 h to form the N-alkylated intermediate **B**. After that, DMU:Tartaric acid (7:3) (300 mg) and alcohol **4 (**0.6 mmol, 1.2 equiv.) were sequentially added, and the reaction was continued at 100 ^{O}C for 4 h. The entire reaction process was monitored by TLC. Upon completion of the reaction, the reaction mixture was cooled to RT, quenched with water (50 ml), and extracted with ethyl acetate (40 ml x 2). The combined organic layer was dried over anhydrous Na_2SO_4, and the crude reaction mixture was purified by silica gel column chromatography using 10-25% EtOAc/Pet ether as eluent, yielding a 68-81% of the desired products (**5a-5l**).

2.3 General procedure for the synthesis of compounds 6a-6p

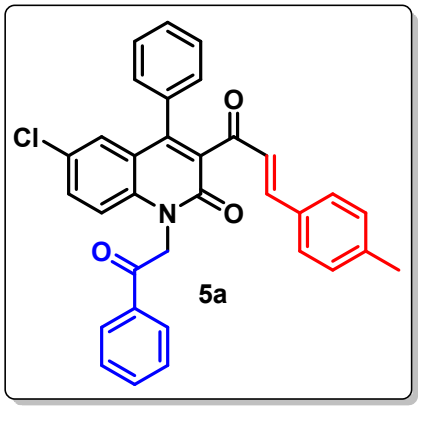
A mixture of substituted 2-amino benzhydrol **1**[2] (0.5 mmol, 1.0 equiv.), $Ni(OAc)_2.4H_2O$ (10 mol%), 2,2'-bipyridyl (15 mol%), KO^{t}Bu (1.0 equiv.) and K_2CO_3:Ethylene glycol (1:5) (500 mg) were added and the reaction was conducted at 100 ^{O}C for 4 h to form the benzophenone **1a**. Then, ethyl acetoacetate **2** (0.5 mmol, 1.0 equiv.) was added, and the reaction mixture was heated at 100 ^{O}C for 3 h to produce intermediate **A**. Subsequently, K_2CO_3:Ethylene glycol (1:5) (500 mg) and phenacyl bromide **3** (0.5 mmol, 1.0 equiv.) were added and continued at 100 ^{O}C for an additional 3 h to form the N-alkylated intermediate **B**. After that, DMU:Tartaric acid (7:3) (300 mg) and alcohol **4 (**1.5 mmol, 3.0 equiv.) were sequentially added, and the reaction was continued at 100 ^{O}C for 7 h. The entire reaction process was monitored by TLC. Upon completion of the reaction, the reaction mixture was cooled to RT, quenched with water (50 ml), and extracted with ethyl acetate (40 ml x 2). The combined organic layer was dried over anhydrous Na_2SO_4, and the crude reaction mixture was purified by silica gel column chromatography using 10-20% EtOAc/Pet ether as eluent, yielding 69-84% of the desired products (**6a-6p**).

2.4 The gram-scale synthesis of 6a

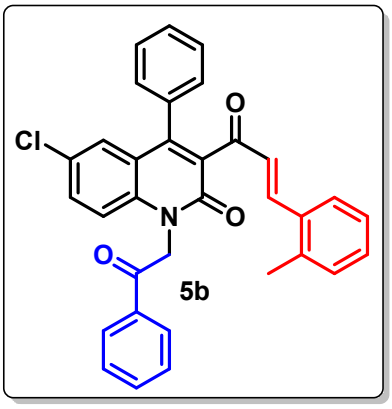
A mixture of substituted 2-amino-5-chloro benzhydrol **1a** (2.33 g, 10.0 mmol, 1.0 equiv.), $Ni(OAc)_2.4H_2O$ (249 mg, 10 mol%), 2,2'-bipyridyl (234 mg, 15 mol%), KO^{t}Bu (1.12 g, 10.0 mmol, 1.0 equiv.), and K_2CO_3:Ethylene glycol (1:5) (10.0 g) were added and the reaction was conducted at 100 ^{O}C for 4 h to form the benzophenone **1a**. Then, ethyl acetoacetate **2a** (1.30 g, 10.0 mmol, 1.0 equiv.) was added, and the reaction mixture was heated at 100 ^{O}C for 3 h to produce intermediate **A**. Subsequently, K_2CO_3:Ethylene glycol (1:5) (10.0 g) and phenacyl bromide **3a** (1.99 g, 10.0 mmol, 1.0 equiv.) were added and continued at 100 ^{O}C for an additional 3 h to form the N-alkylated intermediate **B**. After that, DMU:Tartaric acid (7:3) (300 mg) and alcohol **4a** (4.14 g, 30.0 mmol, 1.0 equiv.) were sequentially added, and the reaction was continued at 100 ^{O}C for 7 h. The entire reaction process was monitored by TLC. Upon completion of the reaction, the reaction mixture was cooled to RT, quenched with water (500 ml), and extracted with ethyl acetate (300 ml x 2). The combined organic layer was dried over anhydrous Na_2SO_4, and the crude reaction mixture was purified by silica gel column chromatography using 15% EtOAc/Pet ether as eluent, yielding 78% of the desired products (**6a**).

3. Spectral Data for the Synthesized Compounds

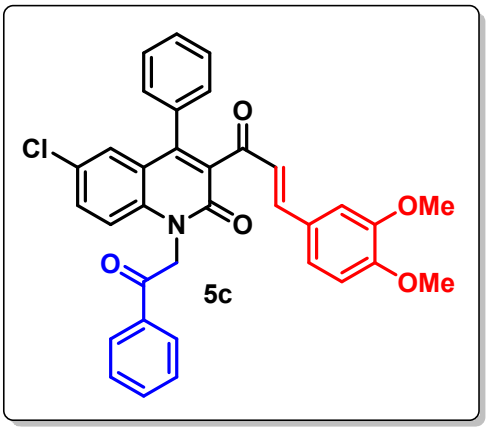
(*E*)-6-Chloro-1-(2-oxo-2-phenylethyl)-4-phenyl-3-(3-(*p*-tolyl)acryloyl)quinolin-2(1H)-one (5a). Purification was carried out by column chromatography on silica gel using a 13% ethyl acetate/Pet ether mixture, resulting in the isolation of **5a** as a Pale yellow solid (81% yield) mp: 265-267 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.14 – 8.08 (m, 2H), 7.68 (t, *J* = 7.4 Hz, 1H), 7.56 (t, *J* = 7.7 Hz, 2H), 7.49 – 7.40 (m, 4H), 7.36 – 7.31 (m, 6H), 7.26 (s, 2H), 7.13 (d, *J* = 7.9 Hz, 1H), 7.03 (d, *J* = 9.0 Hz, 1H), 6.67 (d, *J* = 16.2 Hz, 1H), 5.88 (s, 2H), 2.34 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.1, 192.1, 159.4, 147.6, 146.0, 141.3, 138.1, 134.7, 134.3, 133.5, 131.9, 131.6, 131.4, 129.6, 129.2, 129.1, 128.7, 128.6, 128.3, 128.2,



128.0, 126.2, 122.1, 115.9, 48.9, 21.5. **FT-IR**: ν = 3057, 2918, 1698, 1641, 1554, 1420, 1223, 1065, 962, 812, 754, 710, 553 cm^{-1}. **HRMS (ESI)** calcd for $C_{33}H_{24}ClNO_3Na$ requires $(M + Na)^+$ 540.1342; found: 540.1345.



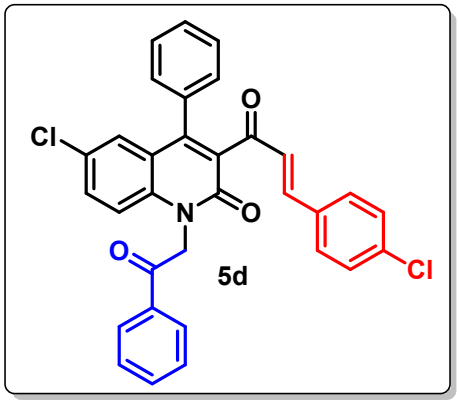
(*E*)-6-Chloro-1-(2-oxo-2-phenylethyl)-4-phenyl-3-(3-(*o*-tolyl)acryloyl)quinolin-2(1H)-one (5b). Purification was carried out by column chromatography on silica gel using a 14% ethyl acetate/Pet ether mixture, resulting in the isolation of **5b** as a Pale yellow solid (76% yield) mp: 263-265 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.10 (d, *J* = 7.6 Hz, 2H), 7.71 – 7.63 (m, 2H), 7.55 (t, *J* = 7.5 Hz, 2H), 7.43 (d, *J* = 12.1 Hz, 5H), 7.34 (d, *J* = 5.2 Hz, 3H), 7.22 (d, *J* = 7.4 Hz, 1H), 7.13 (d, *J* = 6.9 Hz, 2H), 7.03 (d, *J* = 9.0 Hz, 1H), 6.63 (d, *J* = 16.1 Hz, 1H), 5.88 (s, 2H), 2.32 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.1, 191.9, 159.4, 147.7, 143.2, 138.2, 138.1, 134.7, 134.3, 133.5, 133.3, 131.9, 131.5, 130.7, 130.4, 129.3, 129.2, 129.1, 128.7, 128.3, 128.2, 128.1, 128.0, 126.8, 126.3, 122.1, 120.9, 115.8, 48.9, 19.8. **FT-IR**: ν = 1696, 1637, 1555, 1427, 1225, 1067, 960, 821, 752, 688, 541 cm^{-1}. **HRMS (ESI)** calcd for $C_{33}H_{24}ClNO_3Na$ requires $(M + Na)^+$ 540.1342; found: 540.1370.



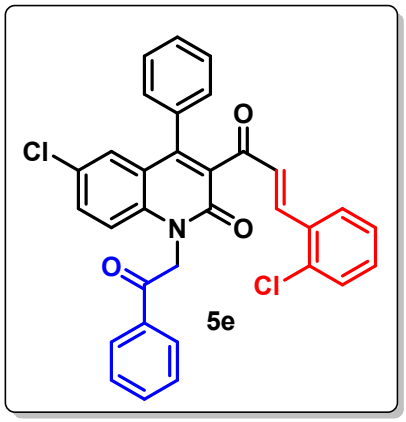
(*E*)-6-Chloro-3-(3-(3,4-dimethoxyphenyl)acryloyl)-1-(2-oxo-2-phenylethyl)-4-phenylquinolin-2(1H)-one (5c). Purification was carried out by column chromatography on silica gel using a 17% ethyl acetate/Pet ether mixture, resulting in the isolation of **5c** as a Pale yellow solid (79% yield) mp: 272-274 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.03 (d, *J* = 7.6 Hz, 2H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.49 (t, *J* = 7.5 Hz, 3H), 7.41 – 7.34 (m, 4H), 7.25 (dd, *J* = 10.7, 8.1 Hz, 4H), 6.95 (d, *J* = 8.3 Hz, 2H), 6.88 (s, 1H), 6.74 (d, *J* = 8.3 Hz, 1H), 6.53 (d, *J* = 16.1 Hz, 1H), 5.82 (s, 2H), 3.82 (s, 3H), 3.79 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.0, 192.1, 151.6, 149.1, 147.6, 146.1, 138.1, 134.7, 134.4, 133.6, 131.9, 131.9, 131.4, 129.2, 129.1, 128.7, 128.3, 128.2, 128.0, 127.3, 125.2, 123.5, 122.2, 115.9, 110.9, 110.0, 56.0, 55.9, 48.9. **FT-IR**: ν = 1715, 1639, 1594, 1483,

1246, 1109, 1019, 945, 750, 707, 546 cm^{-1}. **HRMS (ESI)** calcd for $C_{34}H_{26}ClNO_5Na$ requires $(M + Na)^+$ 586.1397; found: 586.1397.

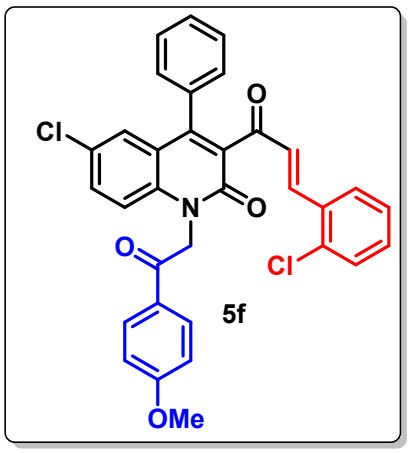
(*E*)-6-Chloro-3-(3-(4-chlorophenyl)acryloyl)-1-(2-oxo-2-phenylethyl)-4-phenylquinolin-2(1H)-one (5d). Purification was carried out by column chromatography on silica gel using a 12% ethyl acetate/Pet ether mixture, resulting in the isolation of **5d** as a Colourless solid (77% yield) mp: 245-247 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.11 (d, *J* = 7.5 Hz, 2H), 7.67 (t, *J* = 7.2 Hz, 1H), 7.55 (t, *J* = 7.3 Hz, 2H), 7.43 (d, *J* = 5.1 Hz, 4H), 7.33 (dd, *J* = 14.7, 8.2 Hz, 8H), 7.03 (d, *J* = 8.9 Hz, 1H), 6.68 (d, *J* = 16.2 Hz, 1H), 5.87 (s, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.6, 192.0, 159.4, 148.0, 143.8, 138.1, 136.6, 134.7, 134.3, 133.5, 132.9, 131.6, 131.6, 129.6, 129.2, 129.1, 129.1, 129.1, 128.7, 128.4, 128.2, 128.1, 127.4, 122.1, 115.9, 48.9. **FT-IR**: ν = 1637, 1489, 1367, 1226, 1089, 958, 753, 685, 518 cm^{-1}. **HRMS (ESI)** calcd for $C_{32}H_{21}Cl_2NO_3Na$ requires $(M + Na)^+$ 560.0796; found: 560.0796.



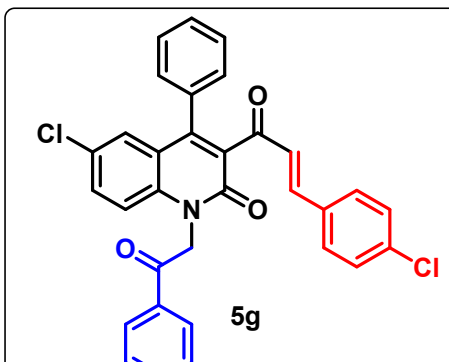
(*E*)-6-Chloro-3-(3-(2-chlorophenyl)acryloyl)-1-(2-oxo-2-phenylethyl)-4-phenylquinolin-2(1H)-one (5e). Purification was carried out by column chromatography on silica gel using an 11% ethyl acetate/Pet ether mixture, resulting in the isolation of **5e** as a Colourless solid (73% yield) mp: 243-245 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.10 (d, *J* = 7.7 Hz, 2H), 7.77 (d, *J* = 16.3 Hz, 1H), 7.66 (t, *J* = 7.3 Hz, 1H), 7.53 (dd, *J* = 13.0, 5.2 Hz, 3H), 7.46 (dd, *J* = 14.8, 8.3 Hz, 5H), 7.38 – 7.31 (m, 4H), 7.23 (dt, *J* = 14.8, 7.9 Hz, 3H), 7.04 (d, *J* = 9.0 Hz, 1H), 6.67 (d, *J* = 16.2 Hz, 1H), 5.87 (s, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.0, 191.9, 159.4, 148.0, 141.3, 138.2, 135.3, 134.7, 134.3, 133.4, 132.6, 131.6, 131.4, 131.3, 130.1, 129.4, 129.3, 129.2, 129.0, 128.7, 128.3, 128.2, 128.1, 127.9, 127.0, 122.0, 116.0, 48.9. **FT-IR**: ν = 1642, 1555, 1419, 1224, 1087, 959, 754, 687, 552 cm^{-1}. **HRMS (ESI)** calcd for $C_{32}H_{21}Cl_2NO_3Na$ requires $(M + Na)^+$ 560.0796; found: 560.0797.



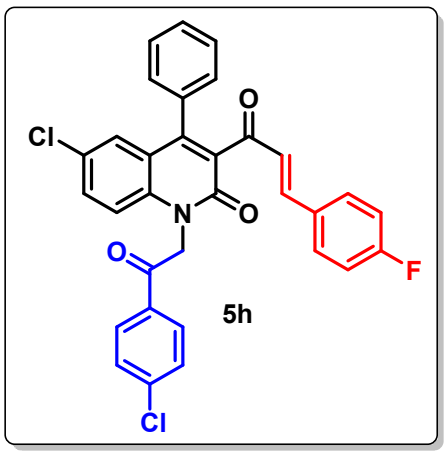
(*E*)-6-Chloro-3-(3-(2-chlorophenyl)acryloyl)-1-(2-(4-methoxyphenyl)-2-oxoethyl)-4-phenylquinolin-2(1H)-one (5f). Purification was carried out by column chromatography on silica gel using an 11% ethyl acetate/Pet ether mixture, resulting in the isolation of **5f** as a Colourless solid (75% yield) mp: 240-242 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.08 (d, *J* = 8.5 Hz, 2H), 7.77 (d, *J* = 16.2 Hz, 1H), 7.51 (d, *J* = 7.3 Hz, 1H), 7.48 – 7.41 (m, 4H), 7.39 – 7.31 (m, 4H), 7.25 – 7.18 (m, 2H), 7.03 (dd, *J* = 17.0, 8.8 Hz, 3H), 6.68 (d, *J* = 16.2 Hz, 1H), 5.83 (s, 2H), 3.90 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.0, 190.2, 164.4, 159.4, 147.9, 141.2, 138.8, 135.2, 133.4, 132.6, 131.6, 131.3, 130.6, 130.0, 129.6, 129.4, 129.2, 128.7, 128.4, 128.3, 128.0, 127.9, 127.7, 127.2, 127.0, 122.0, 116.1, 114.2, 55.6, 48.6. **FT-IR**: ν = 1700, 1633, 1488, 1369, 1224, 1089, 960, 752, 687, 544 cm^{-1}. **HRMS (ESI)** calcd for $C_{33}H_{23}Cl_2NO_4Na$ requires $(M + Na)^+$ 590.0902; found: 590.0903.



(*E*)-6-Chloro-1-(2-(4-chlorophenyl)-2-oxoethyl)-3-(3-(4-chlorophenyl)acryloyl)-4-phenylquinolin-2(1H)-one (5g). Purification was carried out by column chromatography on silica gel using a 12% ethyl acetate/Pet ether mixture, resulting in the isolation of **5g** as a Colourless solid (78% yield) mp: 237-239 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.08 (s, 2H), 7.55 (d, *J* = 5.9 Hz, 2H), 7.46 (d, *J* = 3.9 Hz, 4H), 7.39 – 7.34 (m, 4H), 7.34 – 7.30 (m, 4H), 7.28 (s, 2H), 6.69 (d, *J* = 16.2 Hz, 1H), 5.85 (s, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.7, 7191.1, 159.4, 148.1, 144.0, 141.0, 138.0, 136.7, 133.4, 132.9, 132.8, 131.7, 131.5, 129.7, 129.5, 129.3, 129.1, 129.1, 128.7, 128.5, 128.2, 127.31, 122.1, 115.8, 48.8. **FT-IR**: ν = 1700, 1637, 1594, 1427, 1366, 1224, 1085, 956, 752, 686, 550 cm^{-1}. **HRMS (ESI)** calcd for $C_{32}H_{20}Cl_3NO_3Na$ requires $(M + Na)^+$ 594.0406; found: 594.0408.

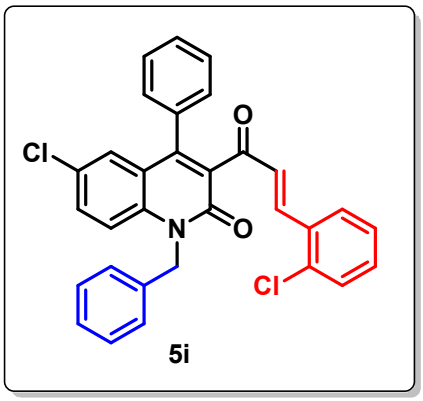


(*E*)-6-Chloro-1-(2-(4-chlorophenyl)-2-oxoethyl)-3-(3-(4-fluorophenyl)acryloyl)-4-phenylquinolin-2(1H)-one (5h). Purification was carried out by column chromatography on



silica gel using an 11% ethyl acetate/Pet ether mixture, resulting in the isolation of **5h** as a Pale yellow solid (74% yield) mp: 230-232 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.05 (d, *J* = 8.4 Hz, 2H), 7.53 (d, *J* = 8.4 Hz, 2H), 7.48 (dd, *J* = 9.0, 2.3 Hz, 2H), 7.45 – 7.39 (m, 5H), 7.35 – 7.29 (m, 4H), 7.02 (t, *J* = 8.5 Hz, 3H), 6.63 (d, *J* = 16.2 Hz, 1H), 5.83 (s, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.7, 191.1, 159.4, 148.0, 144.3, 138.0 (d, *J* = 29.8 Hz), 132.9 (d, *J* = 46.8 Hz), 131.6, 130.5, 130.4, 129.6, 129.5, 129.3, 129.1 (d, *J* = 14.1 Hz),128.5, 128.2, 126.7, 122.1, 116.15, 116.1 (d, *J* = 22.2 Hz), 115.8, 48.8. **^{19}F NMR (377 MHz, $CDCl_3$) δ** -108.7 (s, 1F). **HRMS (ESI)** calcd for $C_{32}H_{20}Cl_2FNO_3Na$ requires $(M + Na)^+$ 578.0702; found: 578.0703.

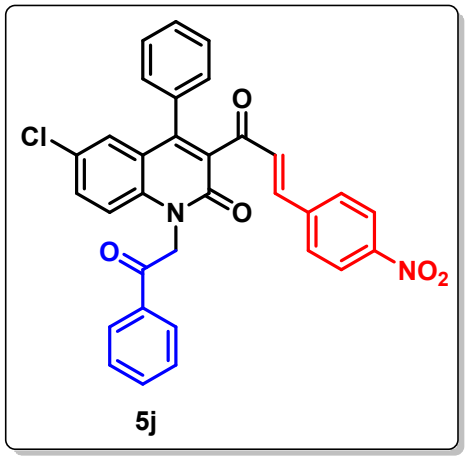
(*E*)-1-benzyl-6-chloro-3-(3-(2-chlorophenyl)acryloyl)-4-phenylquinolin-2(1H)-one (5i). Purification



5i

was carried out by column chromatography on silica gel using a 13% ethyl acetate/Pet ether mixture, resulting in the isolation of **5i** as a Colourless solid (79% yield) mp: 241-243 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.39 – 8.32 (m, 2H), 8.13 (d, *J* = 7.4 Hz, 2H), 7.81 (d, *J* = 16.3 Hz, 1H), 7.72 (t, *J* = 7.4 Hz, 1H), 7.59 (t, *J* = 7.7 Hz, 2H), 7.51 (dd, *J* = 7.3, 3.9 Hz, 4H), 7.40 (dd, *J* = 11.6, 6.1 Hz, 3H), 7.33 – 7.30 (m, 1H), 7.23 (dd, *J* = 17.3, 8.4 Hz, 2H), 6.68 (d, *J* = 16.3 Hz, 1H), 5.96 (s, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.4, 191.2, 159.5, 148.6, 143.5, 142.6, 141.8, 135.3, 134.6, 134.4, 132.6, 132.4, 132.1, 131.6, 130.1, 129.8, 129.3, 129.2, 129.0, 128.9, 128.3, 127.9, 127.1, 126.0, 124.9, 120.7, 115.5, 49.2. **FT-IR**: ν = 3060, 2931, 1697, 1637, 1553, 1485, 1418, 1227, 1090, 958, 753, 687, 548 cm^{-1}. **HRMS (ESI)** calcd for $C_{31}H_{22}Cl_2NO_2K$ requires $(M + K)^+$ 549.0665; found: 549.0667.

(*E*)-6-Chloro-3-(3-(4-nitrophenyl)acryloyl)-1-(2-oxo-2-phenylethyl)-4-phenylquinolin-

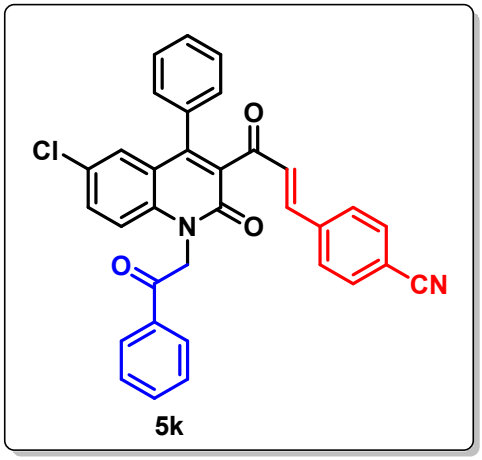


5j

2(1H)-one (5j). Purification was carried out by column chromatography on silica gel using a 15% ethyl acetate/Pet ether mixture, resulting in the isolation of **5j** as a Yellow solid (71% yield) mp: 267-269 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.17 (d, *J* = 8.4 Hz, 2H), 8.11 (d, *J* = 7.6 Hz, 2H), 7.70 (dd, *J* = 14.2, 7.0 Hz, 1H), 7.59 – 7.54 (m, 4H), 7.49 – 7.42 (m, 5H), 7.38 (s, 1H), 7.33 (d, *J* = 7.4

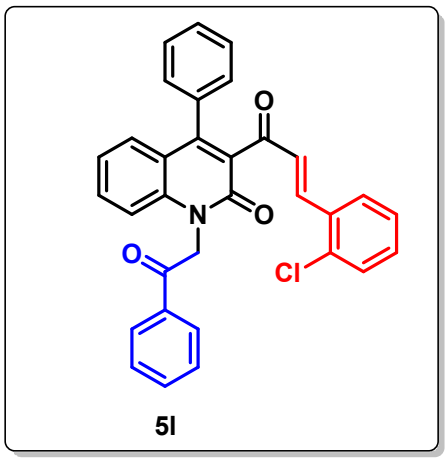
Hz, 3H), 6.84 (d, *J* = 16.2 Hz, 1H), 5.89 (s, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.2, 191.9, 159.5, 148.7, 148.6, 141.5, 140.6, 138.2, 134.5, 134.5, 133.4, 131.9, 131.2, 130.2, 129.4, 129.1, 129.1, 129.0, 128.8, 128.5, 128.2, 124.0, 122.0, 115.9, 48.9. **FT-IR**: ν = 2938, 1711, 1639, 1596, 1459, 1243, 1105, 1019, 948, 754, 709, 546 cm^{-1}. **HRMS (ESI)** calcd for $C_{32}H_{22}ClN_2O_5$ requires $(M + H)^+$ 549.1217; found: 549.1219.

(*E*)-4-(3-(6-Chloro-2-oxo-1-(2-oxo-2-phenylethyl)-4-phenyl-1,2-dihydroquinolin-3-yl)-3-oxoprop-1-en-1-yl)benzonitrile (5k). Purification was carried out by column chromatography on silica gel using a 15% ethyl acetate/Pet ether mixture, resulting in the isolation of **5k** as a Yellow solid (68% yield) mp: 254-256 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.62 (d, 2H), 7.60 (d, 1H), 7.56 (d, *J* = 4.5 Hz, 2H), 7.53 (d, *J* = 6.7 Hz, 1H), 7.49 (d, *J* = 5.5 Hz, 1H), 7.45 (d, *J* = 1.9 Hz, 2H), 7.38 (d, *J* = 8.4 Hz, 2H), 7.33 (d, *J* = 2.1 Hz, 2H), 7.31 (d, *J* = 2.3 Hz, 1H), 7.08 – 7.03 (m, 3H), 6.83 – 6.79 (m, 1H), 6.78 (d, *J* = 2.2 Hz, 1H), 5.88 (s, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.3, 191.9, 159.4, 150.0, 148.6, 142.8, 142.2, 138.8, 138.2, 137.1, 136.6, 136.1, 135.1, 134.5, 133.4, 132.8, 132.5, 130.1, 129.6, 129.3, 129.1, 128.8, 128.2, 122.0, 118.4, 115.9, 113.5, 48.9. **FT-IR**: ν = 3372, 2227, 1696, 1634, 1447, 1366, 1227, 1073, 988, 752 cm^{-1}. **HRMS (ESI)** calcd for $C_{33}H_{22}ClN_2O_3$ requires $(M + H)^+$ 529.1319; found: 529.1319.



5k

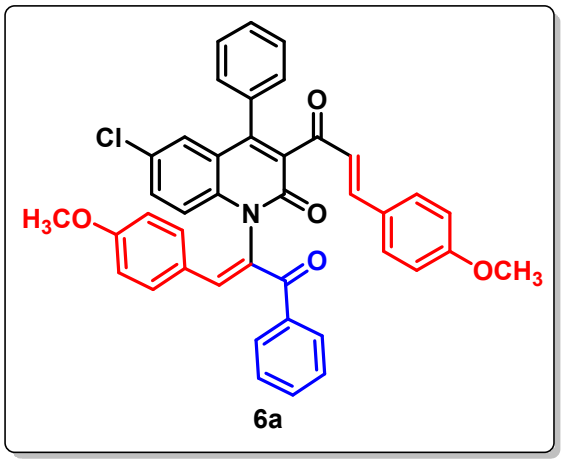
(*E*)-3-(3-(2-Chlorophenyl)acryloyl)-1-(2-oxo-2-phenylethyl)-4-phenylquinolin-2(1H)-one (5l). Purification was carried out by column chromatography on silica gel using a 13% ethyl acetate/Pet ether mixture, resulting in the isolation of **5l** as a Colourless solid (79% yield) mp: 215-217 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.12 (d, *J* = 7.4 Hz, 2H), 7.79 (d, *J* = 16.2 Hz, 1H), 7.66 (t, *J* = 7.4 Hz, 1H), 7.53 (dd, *J* = 16.3, 8.4 Hz, 4H), 7.38 (ddd, *J* = 16.2, 11.8, 7.9 Hz, 7H), 7.25 – 7.14 (m, 3H), 7.10 (d, *J* = 8.5 Hz, 1H), 6.70 (d, *J* = 16.2 Hz, 1H), 5.91 (s, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.5, 192.2,



5l

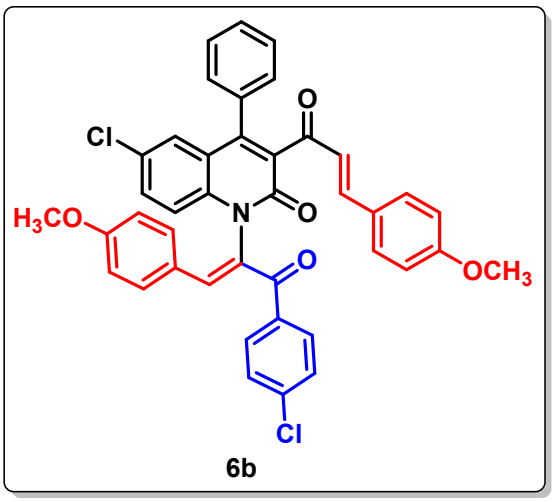
159.7, 149.2, 141.0, 139.6, 135.2, 134.8, 134.2, 134.1, 132.8, 131.6, 131.2, 130.3, 130.0, 129.5, 129.5, 129.1, 129.0, 128.9, 128.5, 128.2, 127.9, 127.0, 122.6, 120.8, 114.4, 48.8. **FT-IR**: ν = 1700, 1647, 1598, 1518, 1339, 1228, 1107, 849, 829, 750, 702, 537 cm^{-1}. **HRMS (ESI)** calcd for $C_{32}H_{23}ClNO_3$ requires $(M + H)^+$ 504.1366; found: 504.1369.

6-Chloro-1-((*Z*)-1-(4-methoxyphenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(4 methoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6a). Purification was carried out by column chromatography on silica gel using a 12% ethyl acetate/Pet ether mixture, resulting in the isolation of **6a** as a Pale yellow solid (81% yield) mp: 270-272 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.92 (d, *J* = 7.6 Hz, 2H), 7.55 – 7.49 (m, 2H), 7.43 (d, *J* = 7.5 Hz, 2H), 7.38 – 7.34 (m, 4H), 7.29 (d, *J* = 8.9 Hz, 3H), 7.25 (s, 1H), 7.13 (d, *J* = 8.5 Hz, 2H), 7.06 (d, *J* = 9.6 Hz, 1H), 6.75 (dd, *J* = 19.4, 9.5 Hz, 5H), 6.50 (d, *J* = 16.2 Hz, 1H), 3.72 (s, 3H), 3.71 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.1, 192.8, 161.9, 161.7, 159.4, 148.5, 146.0, 142.5, 137.8, 137.4, 133.7, 132.4, 132.0, 131.6, 130.6, 130.4, 130.0, 129.6, 129.2, 128.8, 128.7, 128.5, 128.5, 127.8, 127.1, 125.0, 124.3, 122.1, 116.8, 114.7, 114.2, 55.4, 55.4. **FT-IR**: ν = 1638, 1599, 1509, 1422, 1248, 1174, 1019, 826, 709, 545 cm^{-1}. **HRMS (ESI)** calcd for $C_{41}H_{30}ClNO_5Na$ requires $(M + Na)^+$ 674.1710; found: 674.1715.



6a

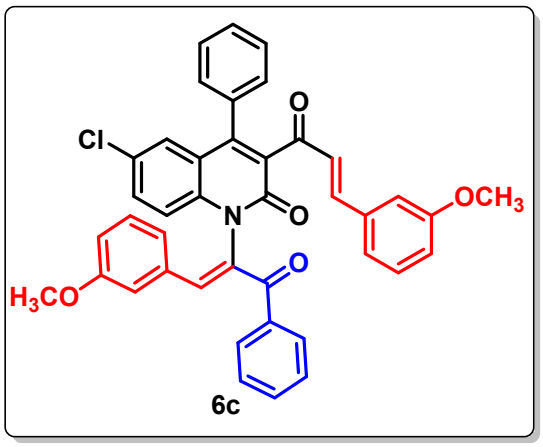
6-Chloro-1-((*Z*)-3-(4-chlorophenyl)-1-(4-methoxyphenyl)-3-oxoprop-1-en-2-yl)-3-((*E*)-3-(4-methoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6b). Purification was carried out by column chromatography on silica gel using a 14% ethyl acetate/Pet ether mixture, resulting in the isolation of **6b** as a Pale yellow solid (79% yield) mp: 275-277 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.88 (d, *J* = 8.3 Hz, 2H), 7.47 (s, 1H), 7.38 (dd, *J* = 10.4, 5.8 Hz, 6H), 7.30 – 7.23 (m, 6H), 7.12 (d, *J* = 8.7 Hz, 2H), 7.04 (d, *J* = 9.6 Hz, 1H), 6.73 (t, *J* = 9.4 Hz, 4H), 6.48 (d, *J* = 16.2 Hz, 1H), 3.72 (s, 3H), 3.70 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.6,



6b

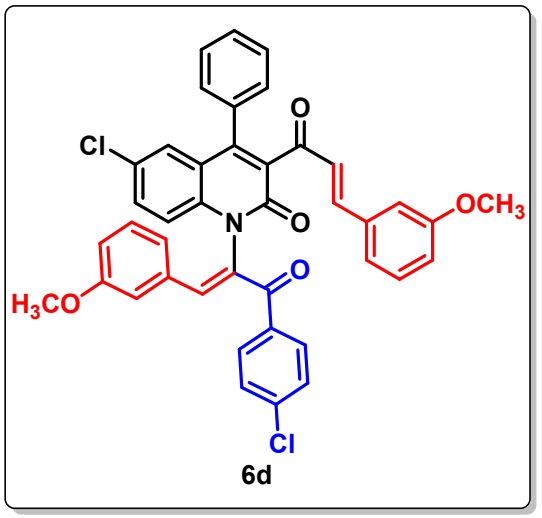
192.1, 162.0, 161.9, 159.4, 148.6, 146.1, 142.1, 138.8, 137.3, 136.1, 133.6, 132.6, 132.0, 131.7, 131.4, 130.4, 129.5, 129.2, 128.8, 128.8, 128.7, 128.7, 127.9, 127.1, 125.0, 124.1, 122.1, 116.8, 114.8, 114.3, 55.4, 55.4. **FT-IR**: ν = 1640, 1599, 1445, 1245, 1174, 1024, 753, 710, 549 cm^{-1}. **HRMS (ESI)** calcd for $C_{41}H_{29}Cl_2NO_5Na$ requires $(M + Na)^+$ 708.1320; found: 708.1321.

6-Chloro-1-((*Z*)-1-(3-methoxyphenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(3-methoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6c). Purification was carried out by column chromatography on silica gel using a 17% ethyl acetate/Pet ether mixture, resulting in the isolation of **6c** as a Pale yellow solid (80% yield) mp: 258-260 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 78.08 (d, *J* = 7.4 Hz, 2H), 7.92 (s, 1H), 7.70 (d, *J* = 16.4 Hz, 1H), 7.58 (t, *J* = 7.4 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 2H), 7.42 – 7.33 (m, 5H), 7.28 (d, *J* = 9.1 Hz, 2H), 7.23 (d, *J* = 2.2 Hz, 2H), 7.13 (d, *J* = 9.0 Hz, 1H), 6.87 (t, *J* = 7.6 Hz, 1H), 6.79 (ddd, *J* = 35.3, 17.9, 9.7 Hz, 4H), 3.80 (d, *J* = 1.4 Hz, 5H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.5, 193.0, 159.8, 158.5, 157.4, 148.4, 141.9, 137.5, 133.7, 133.0, 132.7, 132.2, 132.1, 131.9, 131.3, 130.4, 129.5, 129.1, 129.1, 128.6, 128.5, 128.3, 128.2, 127.8, 127.6, 123.5, 121.9, 121.1, 121.0, 120.6, 117.0, 111.0, 110.7, 55.6, 55.4. **FT-IR**: ν = 1707, 1638, 1484, 1240, 1110, 1018, 943, 755, 709, 541 cm^{-1}. **HRMS (ESI)**: $C_{41}H_{30}ClNO_5Na$ requires 674.1710 $(M + Na)^+$; found: 674.1739.



6c

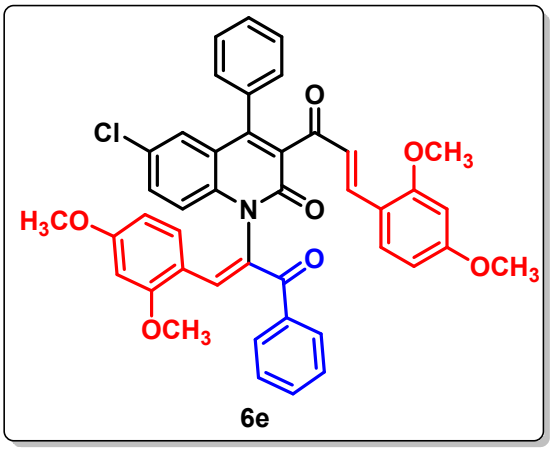
6-Chloro-1-((*Z*)-3-(4-chlorophenyl)-1-(3-methoxyphenyl)-3-oxoprop-1-en-2-yl)-3-((*E*)-3-(3-methoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6d). Purification was carried out by column chromatography on silica gel using a 16% ethyl acetate/Pet ether mixture, resulting in the isolation of **6d** as a Pale yellow solid (76% yield) mp: 262-264 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.94 (d, *J* = 8.5 Hz, 2H), 7.47 (s, 1H), 7.41 (d, *J* = 8.5 Hz, 2H), 7.36 (dd, *J* = 4.8, 3.5 Hz, 2H), 7.28 – 7.23 (m, 4H), 7.18 (s, 1H), 7.14 (td, *J* = 7.9, 4.8 Hz, 2H), 7.05 (d, *J* = 8.9 Hz, 1H), 6.91 (d, *J* = 7.7 Hz, 1H), 6.80 (ddd, *J* = 12.6, 7.8, 5.5 Hz, 4H), 6.68 (s,



6d

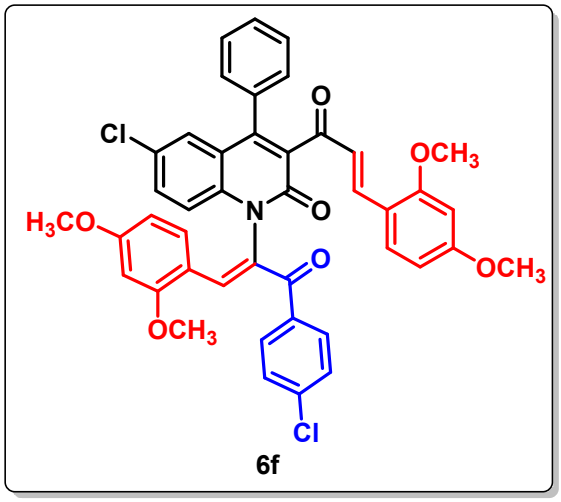
1H), 6.57 (d, *J* = 16.2 Hz, 1H), 3.69 (s, 3H), 3.58 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.6, 192.1, 159.9, 159.8, 159.5, 148.9, 146.1, 141.7, 139.3, 137.3, 135.7, 135.6, 133.4, 132.7, 132.6, 132.2, 131.8, 131.6, 130.2, 129.7, 129.4, 129.3, 128.9, 128.8, 128.8, 128.8, 127.8, 127.3, 122.7, 121.9, 121.3, 117.6, 116.8, 116.8, 113.5, 113.2, 55.3, 55.2. **FT-IR**: ν = 1705, 1639, 1595, 1447, 1247, 1173, 1025, 830, 755, 709, 550 cm^{-1}. **HRMS (ESI)** calcd for $C_{41}H_{29}Cl_2NO_5Na$ requires $(M + Na)^+$ 708.1320; found: 708.1351.

6-Chloro-1-((*Z*)-1-(2,4-dimethoxyphenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(2,4-dimethoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6e). Purification was carried out by column chromatography on silica gel using a 18% ethyl acetate/Pet ether mixture, resulting in the isolation of **6e** as a Pale yellow solid (78% yield) mp: 280-282 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.06 (dd, *J* = 29.3, 7.3 Hz, 3H), 7.95 (s, 1H), 7.65 (d, *J* = 3.3 Hz, 1H), 7.63 – 7.54 (m, 2H), 7.48 (d, *J* = 7.7 Hz, 2H), 7.40 (dd, *J* = 7.7, 4.6 Hz, 4H), 7.35 – 7.28 (m, 4H), 7.13 (dd, *J* = 8.7, 6.2 Hz, 2H), 6.66 (d, *J* = 16.3 Hz, 1H), 6.43 – 6.30 (m, 4H), 3.77 (t, *J* = 7.7 Hz, 12H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.5, 193.1, 163.3, 163.2, 160.1, 159.7, 159.4, 159.42, 148.0, 142.1, 138.0, 137.5, 137.1, 133.9, 132.7, 132.3, 131.3, 130.7, 130.2, 130.0, 129.6, 129.3, 128.9, 128.5, 128.4, 128.2, 128.1, 127.6, 125.7, 122.1, 117.0, 116.8, 113.9, 105.8, 105.3, 98.3, 98.2, 55.7, 55.5, 55.4, 55.4. **FT-IR**: ν = 1637, 1597, 1415, 1263, 1206, 1155, 1030, 822, 701, 554 cm^{-1}. **HRMS (ESI)** calcd for $C_{43}H_{34}ClNO_7Na$ requires $(M + Na)^+$ 734.1921; found: 734.1949.



6e

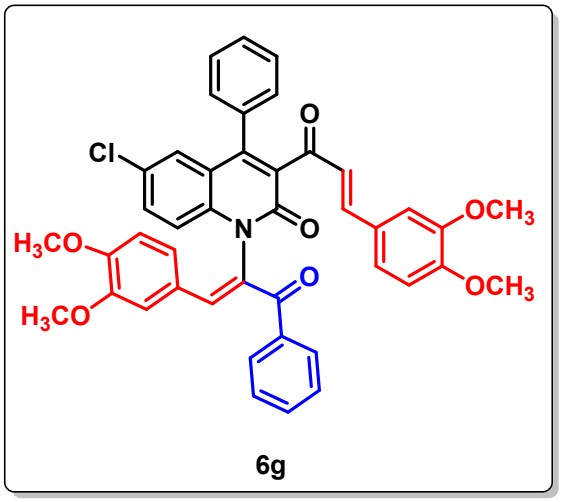
6-Chloro-1-((*Z*)-3-(4-chlorophenyl)-1-(2,4-dimethoxyphenyl)-3-oxoprop-1-en-2-yl)-3-((*E*)-3-(2,4-dimethoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6f). Purification was carried out by column chromatography on silica gel using a 17% ethyl acetate/Pet ether mixture, resulting in the isolation of **6f** as a Pale yellow solid (75% yield) mp: 284-286 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.98 (d, *J* = 8.4 Hz, 2H), 7.89 (s, 1H), 7.62 (d, *J* = 16.3 Hz, 1H), 7.45 (d, *J* = 8.4 Hz, 3H), 7.43 – 7.38 (m, 4H), 7.35 – 7.28 (m, 3H), 7.10 (dd,



6f

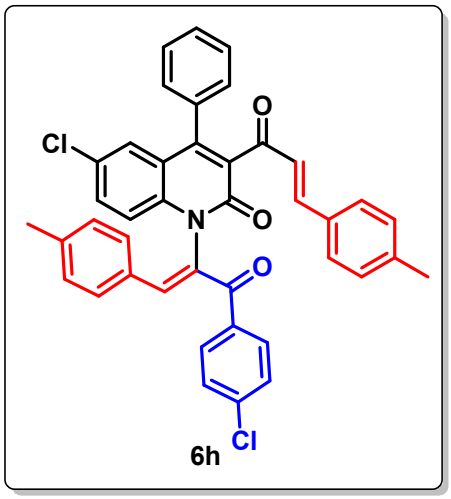
J = 8.8, 5.5 Hz, 2H), 6.66 (d, J = 16.3 Hz, 1H), 6.42 (dd, J = 8.6, 2.1 Hz, 1H), 6.36 (s, 2H), 6.31 (dd, J = 8.7, 2.1 Hz, 1H), 3.79 (d, J = 2.6 Hz, 6H), 3.77 (s, 3H), 3.76 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.4, 192.1, 163.4, 163.2, 160.1, 159.5, 148.1, 142.1, 138.7, 137.3, 136.6, 136.3, 133.8, 132.7, 131.7, 131.3, 130.7, 130.5, 130.0, 129.6, 129.1, 128.6, 128.2, 127.6, 125.6, 122.1, 117.0, 116.7, 113.7, 105.9, 105.3, 98.3, 98.2, 55.7, 55.5, 55.4. **FT-IR**: ν = 1713, 1633, 1595, 1461, 1243, 1109, 1018, 840, 754, 545 cm^{-1}. **HRMS (ESI)** calcd for $C_{43}H_{33}Cl_2NO_7K$ requires $(M + K)^+$ 784.1271; found: 784.1273.

6-Chloro-1-((*Z*)-1-(3,4-dimethoxyphenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(3,4-dimethoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6g). Purification was carried out by column chromatography on silica gel using a 20% ethyl acetate/Pet ether mixture, resulting in the isolation of **6g** as a Yellow solid (80% yield) mp: 271-273 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.05 (d, J = 7.3 Hz, 2H), 7.64 (d, J = 10.1 Hz, 2H), 7.53 (t, J = 7.6 Hz, 2H), 7.50 – 7.43 (m, 3H), 7.36 (dd, J = 7.7, 5.5 Hz, 3H), 7.31 (d, J = 3.9 Hz, 2H), 7.18 (d, J = 8.9 Hz, 1H), 7.02 (d, J = 8.2 Hz, 1H), 6.93 (d, J = 9.7 Hz, 2H), 6.80 (dd, J = 8.3, 3.5 Hz, 3H), 6.59 (d, J = 16.1 Hz, 1H), 3.88 (d, J = 6.4 Hz, 6H), 3.85 (s, 3H), 3.67 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.2, 192.6, 159.4, 151.6, 151.5, 149.1, 149.1, 148.3, 146.5, 142.6, 137.7, 137.5, 133.5, 132.8, 132.5, 131.8, 130.6, 130.1, 129.3, 129.2, 128.8, 128.7, 128.7, 128.5, 127.6, 127.3, 125.5, 125.1, 124.4, 123.5, 121.9, 116.9, 111.0, 110.9, 110.9, 110.1, 56.0, 55.9, 55.9, 55.6. **FT-IR**: ν = 2932, 2831, 1676, 1607, 1509, 1242, 1174, 1142, 1032, 827, 706, 542 cm^{-1}. **HRMS (ESI)** calcd for $C_{43}H_{35}ClNO_7$ requires $(M + H)^+$ 712.2102; found: 712.2104.



6g

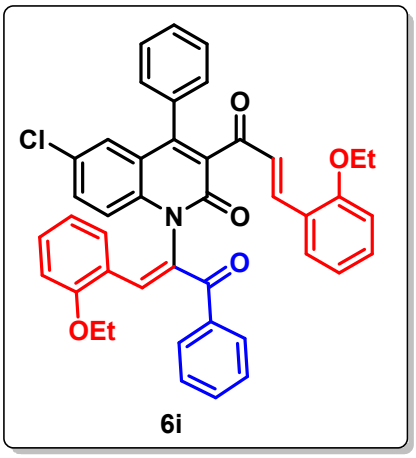
6-Chloro-1-((*Z*)-3-(4-chlorophenyl)-3-oxo-1-(*p*-tolyl)prop-1-en-2-yl)-4-phenyl-3-((*E*)-3-(*p*-tolyl)acryloyl)quinolin-2(1H)-one (6h). Purification was carried out by column chromatography on silica gel using a 12% ethyl acetate/Pet ether mixture, resulting in the isolation of **6h** as a Pale-yellow solid (78% yield) mp: 245-247 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.01 (d, J = 8.3 Hz, 2H), 7.59 (s, 1H), 7.48 (dd, J = 16.3, 5.3 Hz, 6H), 7.36 –



6h

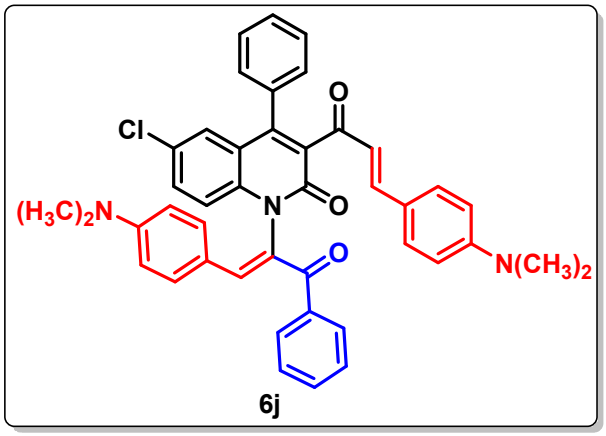
7.28 (m, 6H), 7.19 – 7.11 (m, 7H), 6.66 (d, J = 16.2 Hz, 1H), 2.35 (s, 3H), 2.33 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.7, 192.2, 159.4, 148.8, 146.3, 142.2, 142.0, 141.3, 139.0, 137.3, 135.9, 133.5, 132.4, 131.7, 131.7, 131.5, 130.0, 129.9, 129.5, 129.5, 129.2, 128.9, 128.8, 128.8, 128.7, 128.6, 127.9, 126.2, 122.0, 116.8, 21.5, 21.5. **FT-IR**: ν = 3059, 2926, 1698, 1635, 1554, 1420, 1367, 1225, 1070, 961, 751, 709, 553 cm^{-1}. **HRMS (ESI)** calcd for $C_{41}H_{29}Cl_2NO_3Na$ requires $(M + Na)^+$ 676.1422; found: 676.1424.

6-Chloro-1-((Z)-1-(2-ethoxyphenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((E)-3-(2-ethoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6i). Purification was carried out by column chromatography on silica gel using a 11% ethyl acetate/Pet ether mixture, resulting in the isolation of **6i** as a Dark brown solid (76% yield) mp: 271-273 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.11 – 8.01 (m, 3H), 7.70 (d, J = 16.4 Hz, 1H), 7.58 (t, J = 7.4 Hz, 1H), 7.48 (t, J = 7.6 Hz, 2H), 7.43 – 7.33 (m, 5H), 7.31 (d, J = 2.2 Hz, 1H), 7.28 – 7.21 (m, 4H), 7.19 (dd, J = 13.1, 6.0 Hz, 2H), 6.89 – 6.78 (m, 4H), 6.74 (t, J = 7.5 Hz, 1H), 4.09 – 3.98 (m, 4H), 1.33 (dt, J = 18.3, 6.9 Hz, 6H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.2, 192.9, 159.7, 158.0, 157.0, 148.3, 141.8, 138.0, 137.6, 133.8, 132.6, 132.4, 132.1, 131.7, 131.2, 130.3, 129.7, 129.5, 129.2, 129.0, 128.6, 128.5, 128.4, 128.2, 128.2, 127.9, 127.6, 123.7, 121.9, 121.3, 120.9, 120.5, 117.0, 112.0, 111.7, 64.1, 64.0, 14.7, 14.6. **FT-IR**: ν = 1639, 1594, 1451, 1367, 1302, 1246, 1037, 923, 751, 711, 545 cm^{-1}. **HRMS (ESI)** calcd for $C_{43}H_{34}ClNO_5Na$ requires $(M + Na)^+$ 702.2023; found: 702.2048.



6i

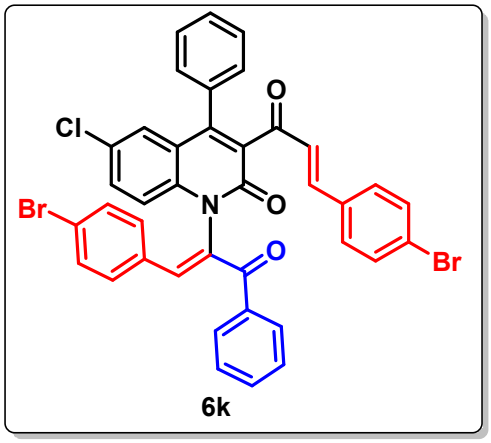
6-Chloro-1-((*Z*)-1-(4-(dimethylamino)phenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(4-(dimethylamino)phenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6j). Purification was carried out by column chromatography on silica gel using a 10% ethyl acetate/Pet ether mixture, resulting in the isolation of **6j** as a Dark brown solid (84% yield) mp: 265-267 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.87 (d, J = 7.1 Hz, 2H), 7.53 (s, 1H), 7.50 – 7.44 (m, 1H), 7.39 (t, J = 7.4 Hz, 4H), 7.33 (dd, J = 5.4, 2.6 Hz, 2H), 7.29 – 7.25 (m, 2H), 7.23 (dd, J = 9.4, 2.2 Hz,



6j

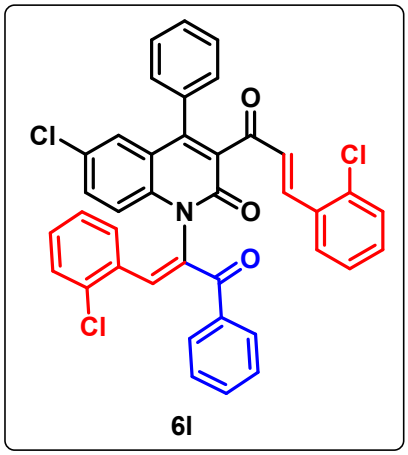
4H), 7.11 (d, *J* = 9.6 Hz, 1H), 7.02 (d, *J* = 8.9 Hz, 2H), 6.52 – 6.40 (m, 5H), 2.89 (s, 12H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.0, 192.9, 159.3, 152.1, 152.1, 147.8, 147.4, 144.0, 138.6, 137.8, 134.0, 133.3, 132.5, 131.7, 131.4, 130.6, 129.7, 129.6, 129.0, 128.9, 128.6, 128.5, 128.3, 128.1, 127.9, 127.6, 122.6, 122.3, 122.2, 119.0, 117.0, 111.9, 111.6, 40.0, 39.9. **FT-IR**: ν = 1693, 1641, 1523, 1359, 1161, 1112, 1061, 945, 812, 701, 543 cm^{-1}. **HRMS (ESI)** calcd for $C_{43}H_{36}ClN_3O_3Na$ requires $(M + Na)^+$ 700.2343; found: 700.2371.

1-((*Z*)-1-(4-Bromophenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(4-bromophenyl)acryloyl)-6-chloro-4-phenylquinolin-2(1H)-one (6k). Purification was carried out by column chromatography on silica gel using a 11% ethyl acetate/Pet ether mixture, resulting in the isolation of **6k** as a Colourless solid (75% yield) mp: 255-257 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.98 – 7.91 (m, 2H), 7.54 (d, *J* = 8.4 Hz, 2H), 7.44 (t, *J* = 7.6 Hz, 3H), 7.38 – 7.34 (m, 6H), 7.29 – 7.23 (m, 3H), 7.19 (t, *J* = 8.4 Hz, 4H), 7.04 (dd, *J* = 13.4, 8.7 Hz, 3H), 6.57 (d, *J* = 16.2 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.8, 192.2, 159.4, 149.2, 144.3, 141.1, 137.2, 137.1, 133.3, 133.3, 133.2, 132.9, 132.5, 132.1, 131.9, 130.9, 130.7, 130.0, 129.9, 129.5, 129.4, 128.9, 128.7, 128.6, 128.1, 127.4, 125.6, 125.0, 121.9, 116.6. **FT-IR**: ν = 1701, 1637, 1418, 1370, 1227, 1064, 964, 814, 690, 553 cm^{-1}. **HRMS (ESI)** calcd for $C_{39}H_{24}Br_2ClNO_3Na$ requires $(M + Na)^+$ 769.9709; found: 769.9709.



6k

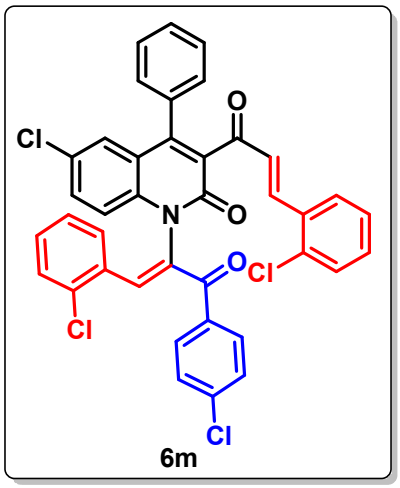
6-Chloro-1-((*Z*)-1-(2-chlorophenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(2-chlorophenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6l). Purification was carried out by column chromatography on silica gel using a 12% ethyl acetate/Pet ether mixture, resulting in the isolation of **6l** as a Colourless solid (71% yield) mp: 267-269 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.10 (d, *J* = 7.6 Hz, 2H), 7.85 (s, 1H), 7.74 (d, *J* = 16.3 Hz, 1H), 7.50 (t, *J* = 7.9 Hz, 3H), 7.45 – 7.36 (m, 5H), 7.35 (s, 4H), 7.28 – 7.23 (m, 3H), 7.19 (s, 1H), 7.14 (s, 1H), 6.62 (d, *J* = 16.3 Hz, 2H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.6, 192.3, 159.9, 149.1, 141.5, 138.6, 137.5, 136.8, 135.1, 134.9, 133.9, 133.3, 133.1, 132.6, 131.7, 131.4, 131.3, 130.8, 130.3,



6l

130.0, 129.7, 129.5, 129.4, 129.3, 128.9, 128.8, 128.6, 128.5, 128.0, 127.8, 127.4, 127.1, 121.6, 116.8. **FT-IR**: ν = 1637, 1489, 1367, 1226, 1089, 958, 753, 685, 518 cm^{-1}. **HRMS (ESI)** calcd for $C_{39}H_{24}Cl_3NO_3Na$ requires $(M + Na)^+$ 682.0719; found: 682.0748.

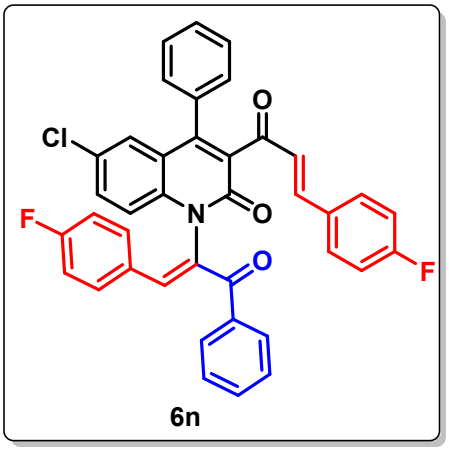
6-Chloro-1-((*Z*)-1-(2-chlorophenyl)-3-(4-chlorophenyl)-3-oxoprop-1-en-2-yl)-3-((*E*)-3-(2-chlorophenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6m).



6m

Purification was carried out by column chromatography on silica gel using a 10% ethyl acetate/Pet ether mixture, resulting in the isolation of **6m** as a Colourless solid (69% yield) mp: 271-273 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.98 (d, *J* = 8.5 Hz, 2H), 7.75 – 7.63 (m, 2H), 7.41 (d, *J* = 8.5 Hz, 3H), 7.37 – 7.32 (m, 3H), 7.30 – 7.24 (m, 6H), 7.21 (dd, *J* = 7.4, 1.5 Hz, 1H), 7.18 – 7.13 (m, 3H), 7.06 (dd, *J* = 14.0, 8.2 Hz, 2H), 6.54 (d, *J* = 16.3 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.6, 191.3, 159.9, 149.2, 141.7, 139.7, 138.1, 137.3, 135.1, 134.6, 133.9, 133.2, 132.5, 131.8, 131.6, 131.5, 131.2, 130.6, 130.1, 129.8, 129.4, 129.4, 129.3, 128.9, 128.8, 128.8, 128.6, 128.0, 127.8, 127.5, 127.1, 121.6, 116.7. **FT-IR**: ν = 1693, 1636, 1593, 1555, 1365, 1224, 1088, 752, 686, 553 cm^{-1}. **HRMS (ESI)** calcd for $C_{39}H_{23}Cl_4NO_3Na$ requires $(M + Na)^+$ 716.0303; found: 716.0305.

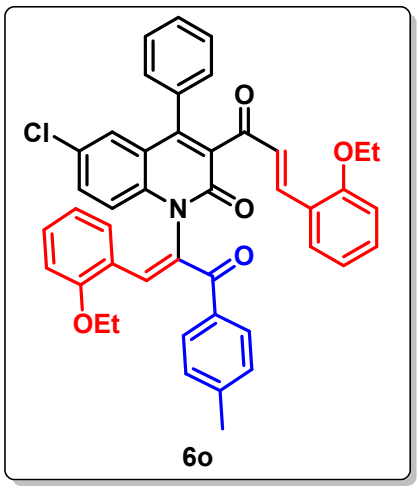
6-Chloro-1-((*Z*)-1-(4-fluorophenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(4-fluorophenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6n). Purification was carried out by column chromatography on silica gel using a 11% ethyl acetate/Pet ether mixture, resulting in the isolation of **6n** as a Colourless solid (73% yield) mp: 280-282 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.02 (d, *J* = 7.6 Hz, 2H), 7.67 – 7.60 (m, 2H), 7.50 (dd, *J* = 15.5, 7.8 Hz, 4H), 7.40 (dd, *J* = 15.0, 8.9 Hz, 5H), 7.35 – 7.25 (m, 6H), 7.10 (d, *J* = 8.7 Hz, 1H), 7.02 – 6.96 (m, 3H), 6.60 (d, *J* = 16.2 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.9, 192.4, 165.2, 162.7, 162.07, 159.4, 149.1,1 141.2 (d, *J* = 336.3 Hz), 137.2 (d, *J* = 4.0 Hz), 133.4, 132.8 (d, *J* = 91.9 Hz), 132.5, 132.2, 131.8 (d, *J* = 2.0 Hz), 130.6, 130.5, 130.0, 129.8, 129.3 (d, *J* =25.2 Hz), 128.8, 128.7 (d, *J* =2.0 Hz), 128.6, 128.0, 126.7, 126.37, 122.0, 116.7, 116.4, 115.9 (d, *J* =21.2 Hz). **^{19}F NMR (377 MHz, $CDCl_3$) δ** -107.0 (s, 1F), -108.7 (s, 1F). **FT-IR**: ν = 1693, 1641, 1555, 1420,



6n

1365, 1223, 1063, 960, 827, 687, 550 cm^{-1}. **HRMS (ESI)** calcd for $C_{39}H_{24}ClF_2NO_3Na$ requires $(M + Na)^+$ 650.1310; found: 650.1337.

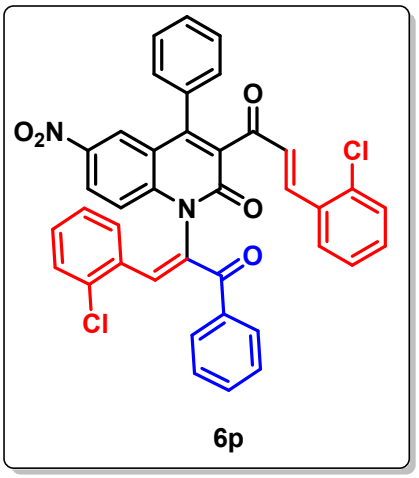
6-Chloro-1-((*Z*)-1-(2-ethoxyphenyl)-3-oxo-3-(*p*-tolyl)prop-1-en-2-yl)-3-((*E*)-3-(2-ethoxyphenyl)acryloyl)-4-phenylquinolin-2(1H)-one (6o).



6o

Purification was carried out by column chromatography on silica gel using a 15% ethyl acetate/Pet ether mixture, resulting in the isolation of **6o** as a Colourless solid (79% yield) mp: 268-270 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.03 – 7.99 (m, 3H), 7.72 (d, *J* = 16.4 Hz, 1H), 7.55 – 7.50 (m, 1H), 7.43 (dt, *J* = 6.4, 3.3 Hz, 2H), 7.41 – 7.36 (m, 3H), 7.34 – 7.29 (m, 4H), 7.28 (s, 1H), 7.25 (d, *J* = 3.9 Hz, 1H), 7.21 (dd, *J* = 10.5, 5.1 Hz, 2H), 6.92 – 6.80 (m, 4H), 6.76 (t, *J* = 7.6 Hz, 1H), 4.06 (ddd, *J* = 11.8, 9.5, 4.0 Hz, 4H), 2.46 (s, 3H), 1.40 (t, *J* = 7.0 Hz, 3H), 1.32 (dd, *J* = 18.0, 11.0 Hz, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 193.3, 192.6, 159.7, 158.0, 156.9, 148.3, 143.3, 141.8, 137.8, 137.6, 134.8, 133.8, 132.7, 132.4, 131.9, 131.8, 131.2, 130.6, 129.7, 129.5, 129.2, 129.1, 129.0, 128.6, 128.5, 128.4, 128.1, 127.9, 127.5, 123.6, 121.8, 121.3, 120.9, 120.4, 117.0, 111.9, 111.6, 64.0, 64.0, 21.7, 14.8, 14.6. **FT-IR**: ν = 2921, 2832, 1685, 1608, 1508, 1392, 1240, 1182, 1119, 997, 802, 702, 547, 492 cm^{-1}. **HRMS (ESI)** calcd for $C_{44}H_{37}ClNO_5$ requires $(M + H)^+$ 694.2360; found: 694.2362.

1-((*Z*)-1-(2-Chlorophenyl)-3-oxo-3-phenylprop-1-en-2-yl)-3-((*E*)-3-(2-chlorophenyl)acryloyl)-6-nitro-4-phenylquinolin-2(1H)-one (6p).

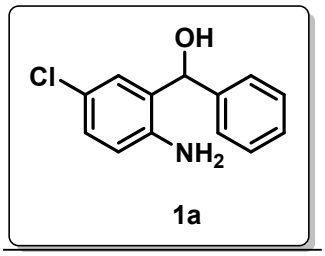


6p

Purification was carried out by column chromatography on silica gel using a 13% ethyl acetate/Pet ether mixture, resulting in the isolation of **6p** as a Colourless solid (73% yield) mp: 245-247 °C; **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.28 – 8.22 (m, 2H), 8.14 (d, *J* = 7.4 Hz, 2H), 7.92 (s, 1H), 7.78 (d, *J* = 16.3 Hz, 1H), 7.67 (t, *J* = 7.4 Hz, 1H), 7.59 – 7.48 (m, 6H), 7.36 (dd, *J* = 17.8, 8.3 Hz, 6H), 7.32 – 7.29 (m, 1H), 7.26 (dd, *J* = 14.0, 6.5 Hz, 2H), 7.17 (t, *J* = 7.5 Hz, 1H), 6.65 (d, *J* = 16.3 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 192.0, 191.9, 190.3, 160.1, 149.6, 143.0,

142.8, 142.0, 139.1, 136.5, 135.2, 134.6, 133.8, 133.4, 132.5, 132.3, 132.0, 131.7, 131.7, 130.5, 130.4, 130.1, 129.9, 129.9, 129.4, 129.2, 129.1, 129.1, 128.9, 128.7, 128.6, 128.0, 127.6, 127.2, 126.0, 124.8, 120.3, 116.3. **FT-IR**: ν = 1700, 1641, 1557, 1420, 1374, 1226, 1089, 958, 755, 689, 553 cm^{-1}. **HRMS (ESI)** calcd for $C_{39}H_{25}Cl_2N_2O_5$ requires $(M + H)^+$ 671.1141; found: 671.1145.

(2-amino-5-chlorophenyl) (phenyl)methanol (1a). Colourless solid (96% yield); **^{1}H NMR (400 MHz, $CDCl_3$) δ** 7.43 – 7.34 (m, 5H), 7.13 – 7.04 (m, 2H), 6.59 (d, *J* = 8.4 Hz, 1H), 5.76 (d, *J* = 3.1 Hz, 1H), 3.95 (s, 2H), 2.91 (d, *J* = 3.5 Hz, 1H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 143.2, 141.1, 129.0, 128.7, 128.6, 128.2, 128.0, 126.6, 123.1, 118.1, 74.3.

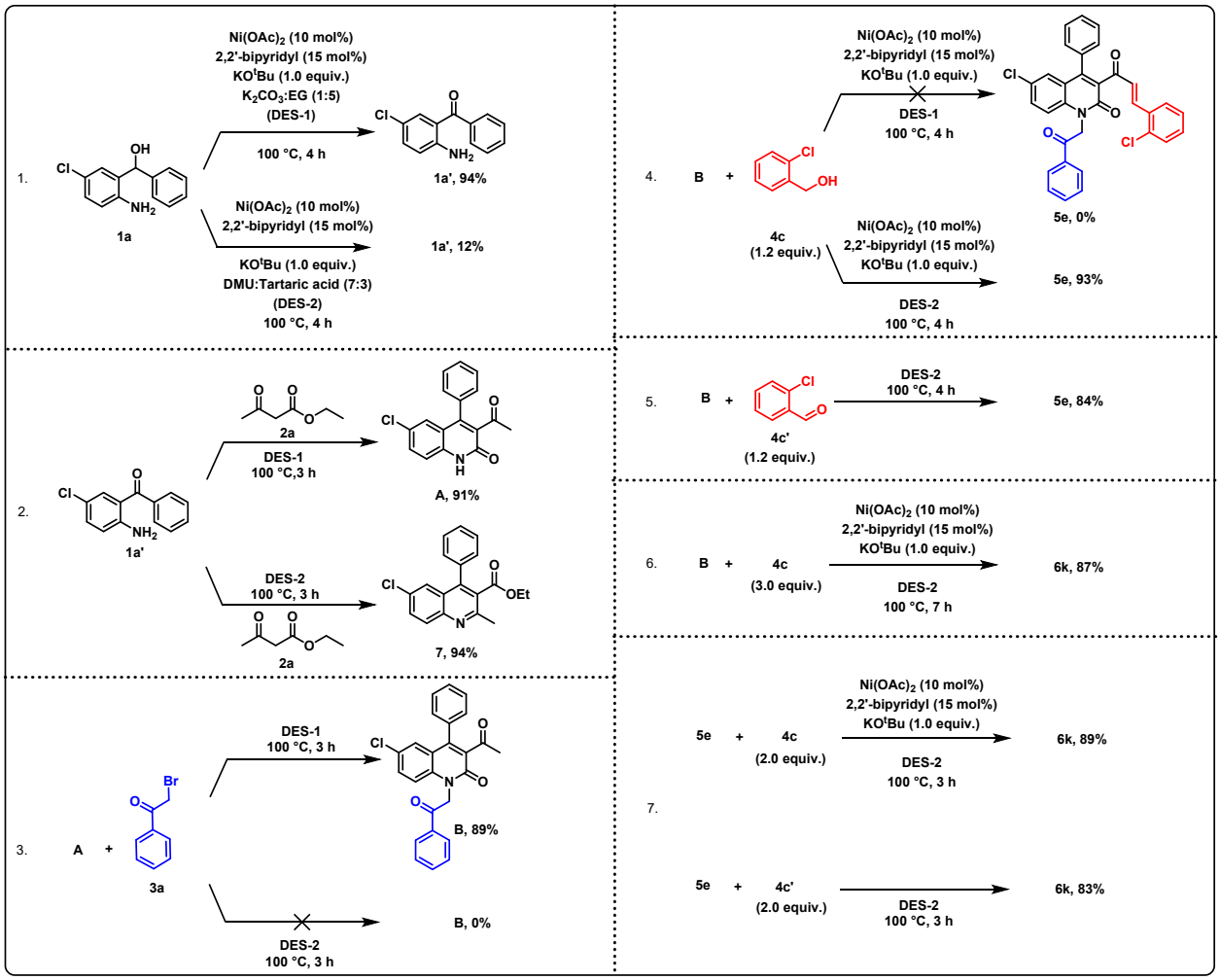


1a

4. Mechanistic Investigations

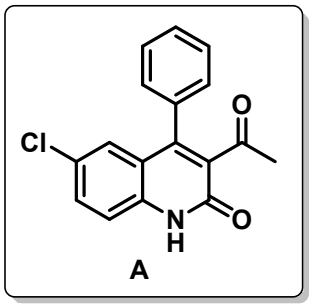
4.1 Control experiment study

As illustrated in Scheme S1, a model reaction was performed using the starting materials **1a**, **2a**, **3a** and **4c**. The formation of the intermediates **A**, **7,** and **B** was successfully isolated and characterized by ^{1}H and ^{13}C NMR analysis and the spectra are given below.

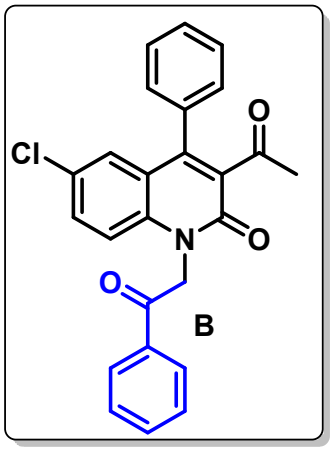


Scheme S1. Control experiment study

3-Acetyl-6-chloro-4-phenylquinolin-2(1H)-one (A). Colourless solid (93% yield); **^{1}H NMR (400 MHz, $CDCl_3$) δ** 13.20 (s, 1H), 7.52 (dd, *J* = 4.8, 1.5 Hz, 3H), 7.47 (dd, *J* = 13.0, 5.4 Hz, 2H), 7.32 (dd, *J* = 6.5, 2.9 Hz, 2H), 7.24 (d, *J* = 2.0 Hz, 1H), 2.29 (s, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 201.5, 161.5, 148.0, 136.7, 133.7, 133.5, 131.8, 129.4, 129.0, 128.9, 128.6, 126.7, 120.9, 118.2, 31.7.

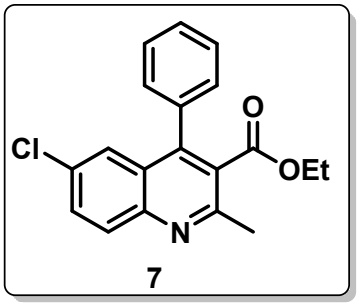


3-Acetyl-6-chloro-1-(2-oxo-2-phenylethyl)-4-phenylquinolin-2(1H)-one (B). Colourless solid (93% yield); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 – 8.09 (m, 2H), 7.69 (t, *J* = 7.4 Hz, 1H), 7.57 (t, *J* = 7.7 Hz, 2H), 7.51 (dd, *J* = 5.0, 1.8 Hz, 3H), 7.43 (dd, *J* = 9.0, 2.4 Hz, 1H), 7.33 (dd, *J* = 6.4, 3.1 Hz, 2H), 7.27 – 7.26 (m, 1H), 6.98 (d, *J* =



9.0 Hz, 1H), 5.85 (s, 2H), 2.23 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 201.0, 191.9, 159.1, 146.3, 137.8, 134.6, 134.4, 133.6, 133.4, 131.5, 129.3, 129.1, 129.1, 128.8, 128.3, 128.2, 128.1, 122.0, 115.8, 48.9, 31.4.

Ethyl 6-chloro-2-methyl-4-phenylquinoline-3-carboxylate (7).



7

Colourless solid (93% yield); **^{1}H NMR (400 MHz, $CDCl_3$) δ** 8.01 (d, *J* = 8.9 Hz, 1H), 7.65 (dd, *J* = 8.9, 0.9 Hz, 1H), 7.55 – 7.53 (m, 1H), 7.52 – 7.48 (m, 3H), 7.37 – 7.32 (m, 2H), 4.07 (q, *J* = 7.1 Hz, 2H), 2.77 (s, 3H), 0.95 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, $CDCl_3$) δ** 168.1, 155.0, 146.1, 145.4, 135.0, 132.4, 131.2, 130.5, 129.3, 128.8, 128.5, 128.2, 126.0, 125.2, 61.5, 23.7, 13.6.

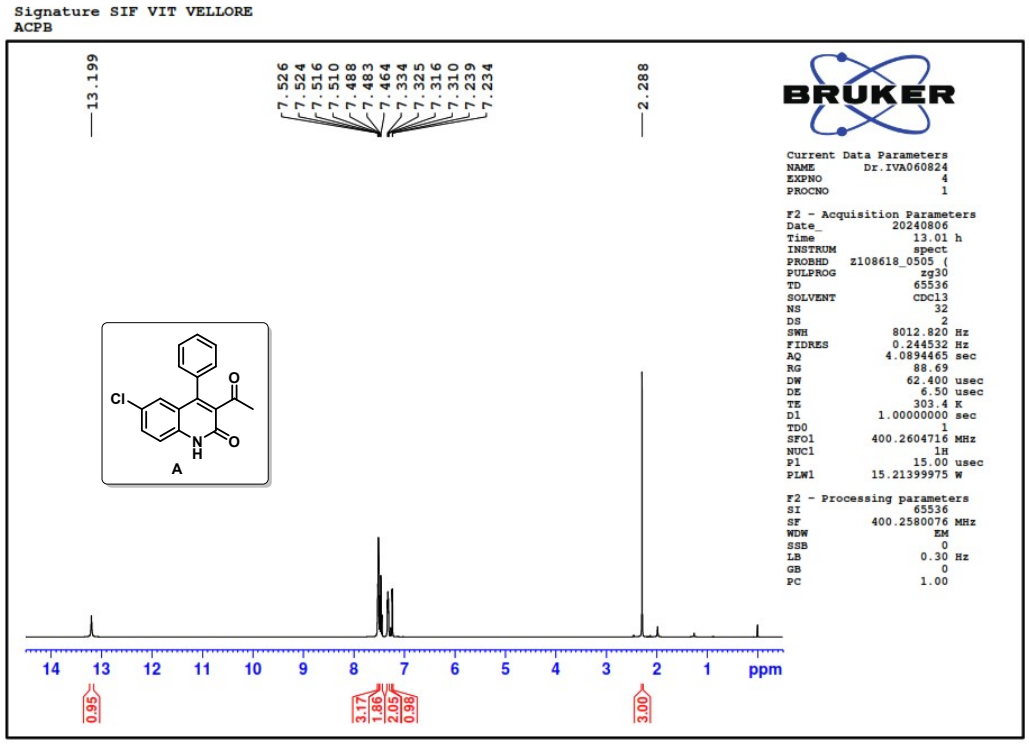


Fig. S1. ^{1}H NMR spectrum of **A** ($CDCl_3$, 400 MHz)

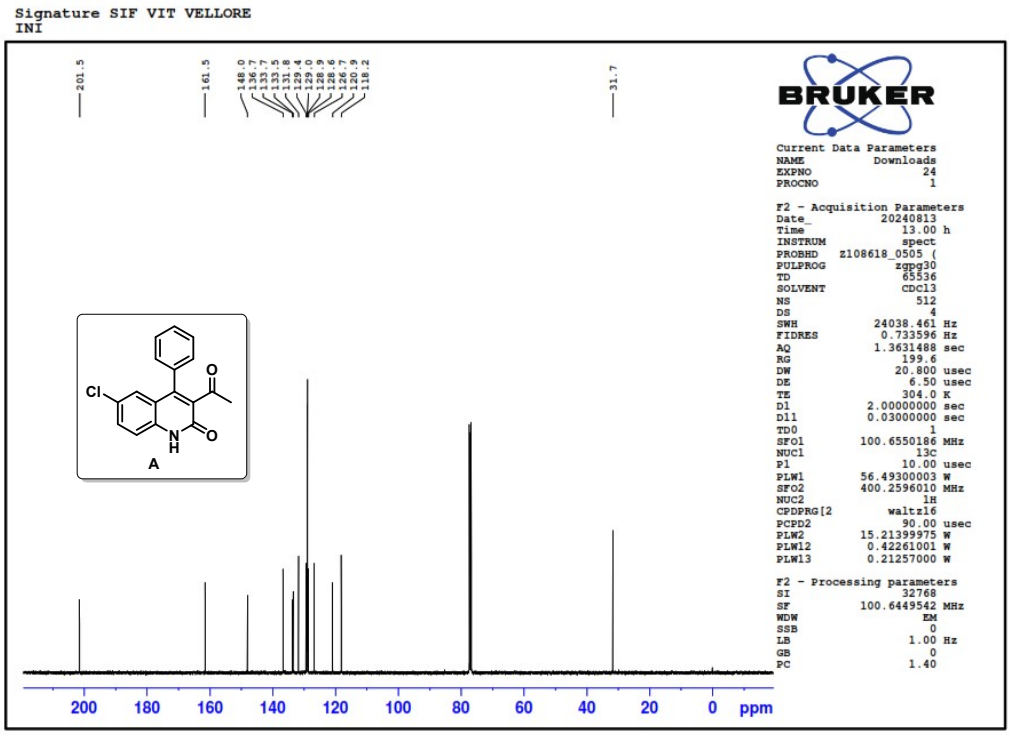


Fig. S2. ^{13}C NMR spectrum of **A** ($CDCl_3$, 101 MHz)

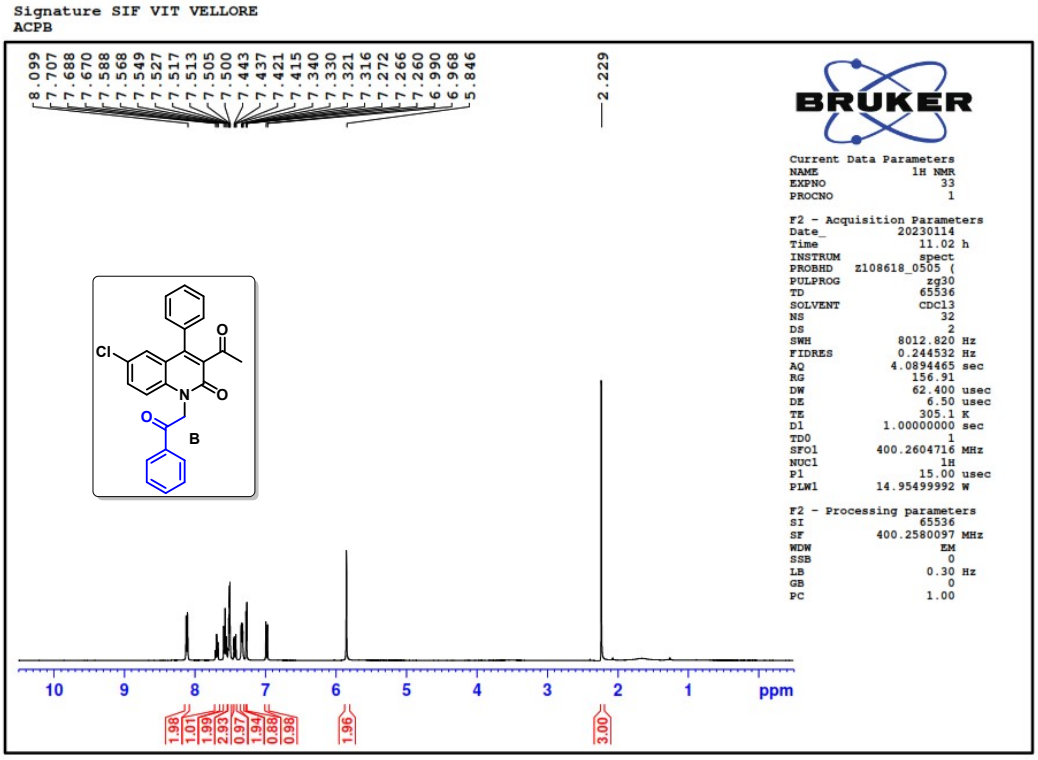


Fig. S3. ^{1}H NMR spectrum of **B** ($CDCl_3$, 400 MHz)

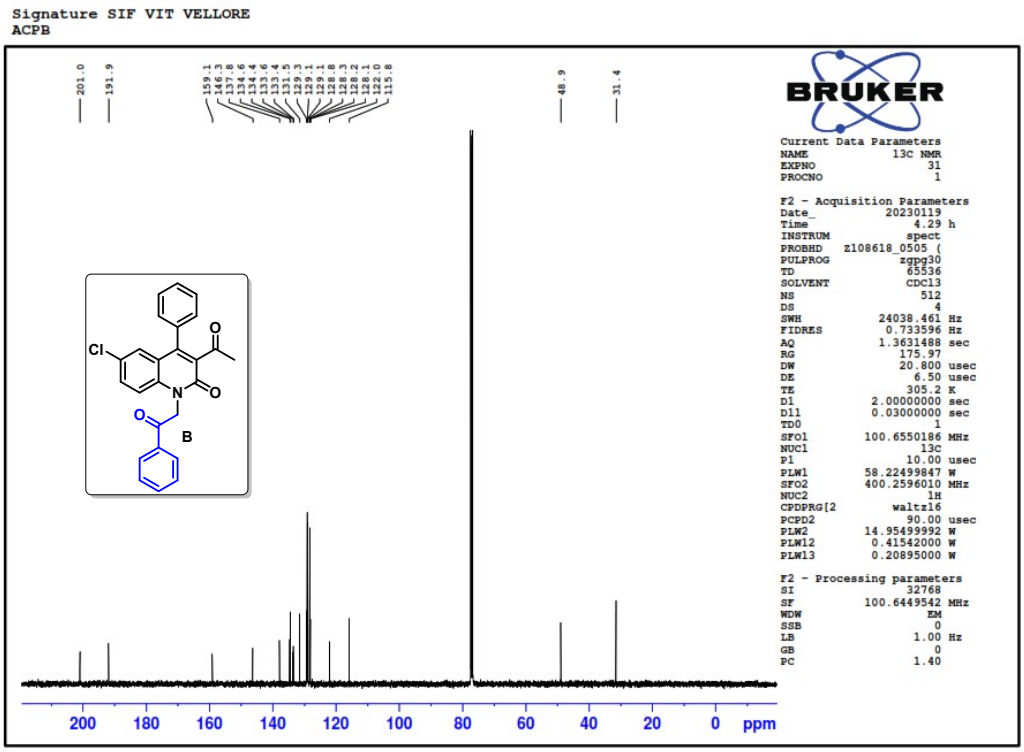


Fig S4. ^{13}C NMR spectrum of **B** ($CDCl_3$, 101 MHz)

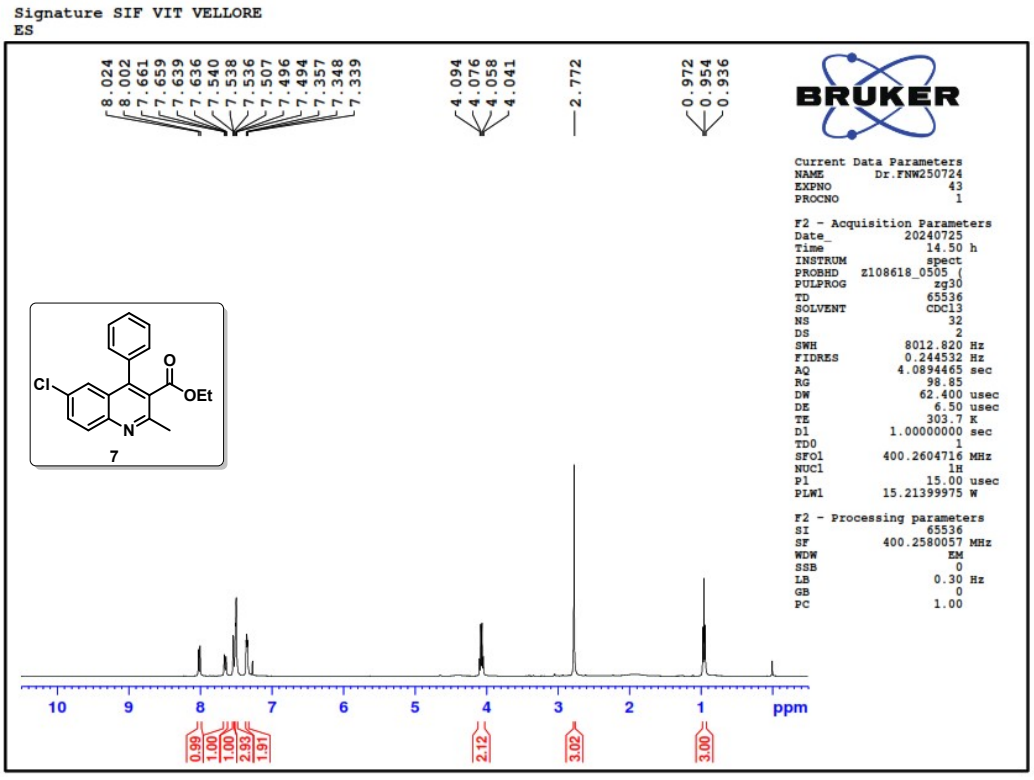


Fig. S5. ^{1}H NMR spectrum of **7** ($CDCl_3$, 400 MHz)

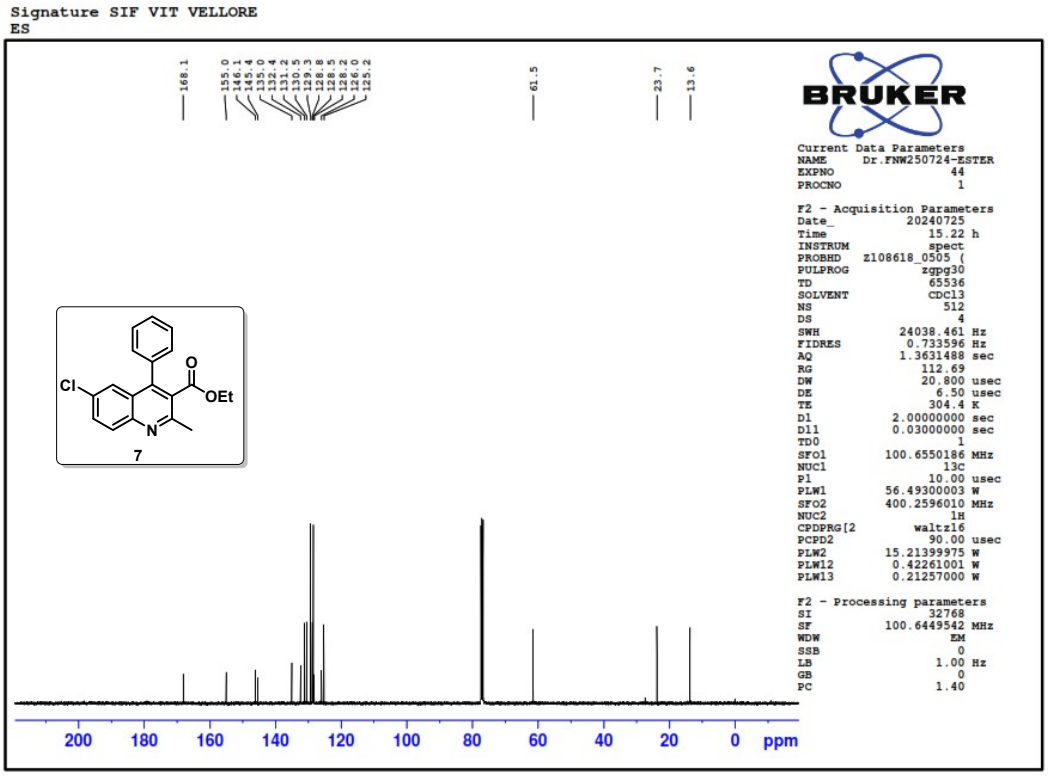
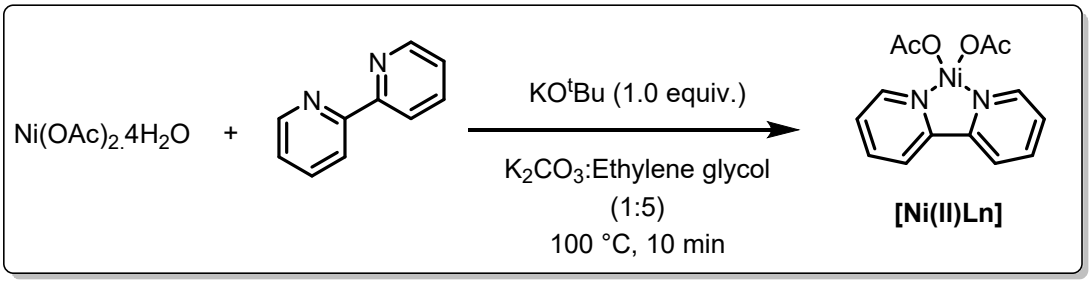


Fig. S6. ^{13}C NMR spectrum of **7** ($CDCl_3$, 101 MHz)

4.2 Mass spectroscopic Studies for the intermediate detection

4.2.1 Stoichiometric studies

A mixture of $Ni(OAc)_2.4H_2O$ (1.0 mmol), 2,2'-bipyridyl (1.5 mmol), KO^{t}Bu (1.0 equiv.) and K_2CO_3:Ethylene glycol (1:5) DES-1 were heated at 100 °C for 10 min. The reaction mixture was analyzed by HRMS (ESI) spectroscopy. The calculated mass for $C_{14}H_{14}KN_2NiO_4$ $(M + K)^+$ is 370.9944; found: 370.9945. Based on the HRMS result, we concluded that a nickel complex forms during the catalytic cycle. The HRMS spectrum of complex **[Ni(ll)L_n]** is shown in Fig.S7



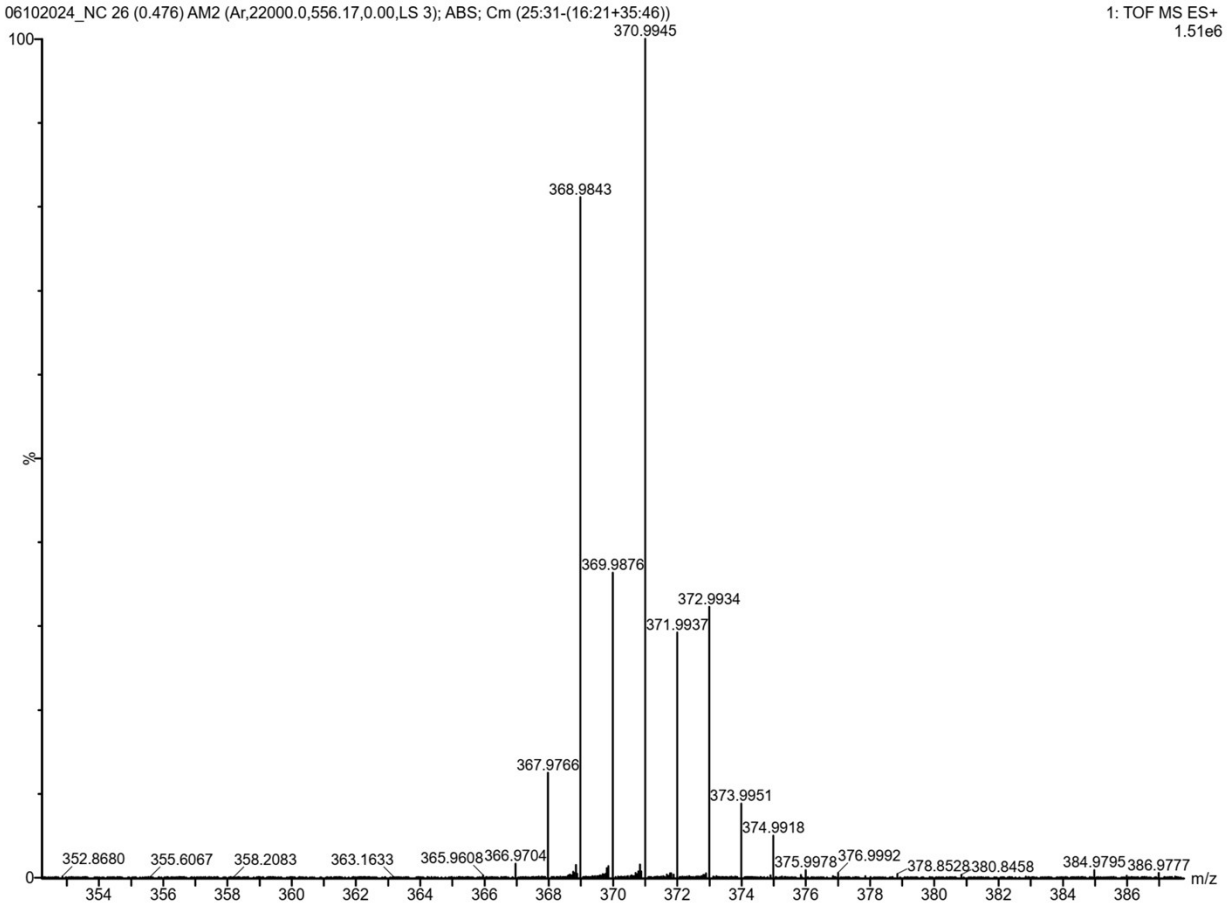
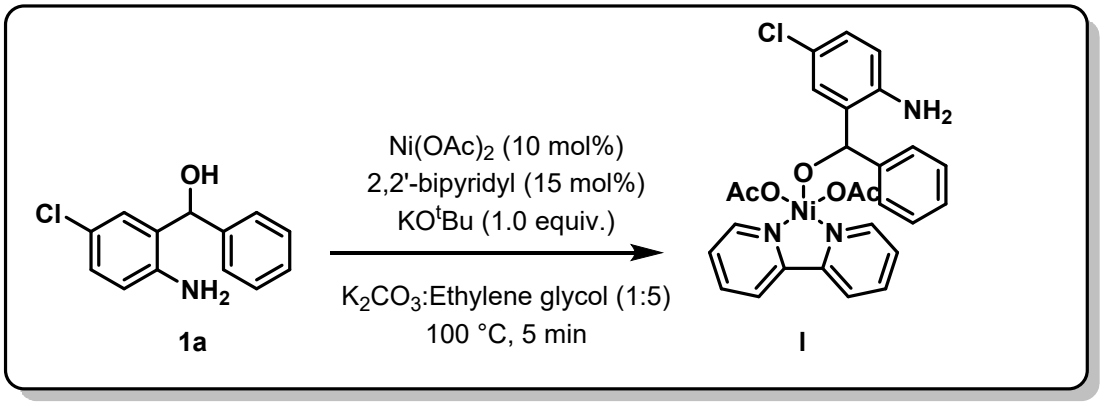


Fig. S7. HRMS spectrum of **[Ni(II)L_n]**

4.2.2 Nickel enolate intermediate identification study



A mixture of 2-amino benzhydrol (0.5 mmol), $Ni(OAc)_2.4H_2O$ (10 mol%), 2,2'-bipyridyl (15 mol%), KO^tBu (1.0 equiv.) and K_2CO_3:Ethylene glycol (1:5) DES-1 were heated at 100 °C for 5 min. The reaction mixture was analyzed by HRMS (ESI) spectroscopy. The calculated mass for $C_{27}H_{26}ClN_3NiO_5$ $(M + H)^+$ is 565.0914; found: 565.0915.

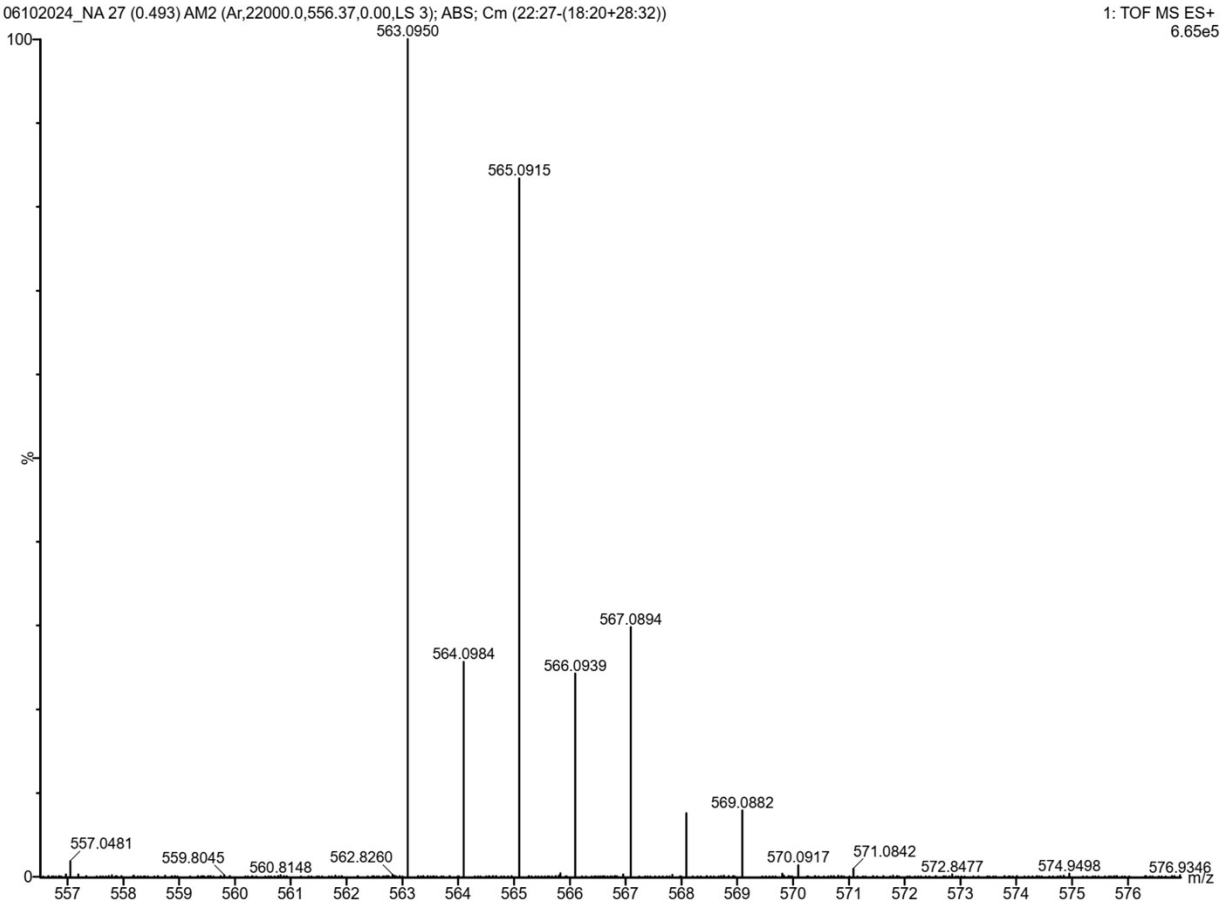
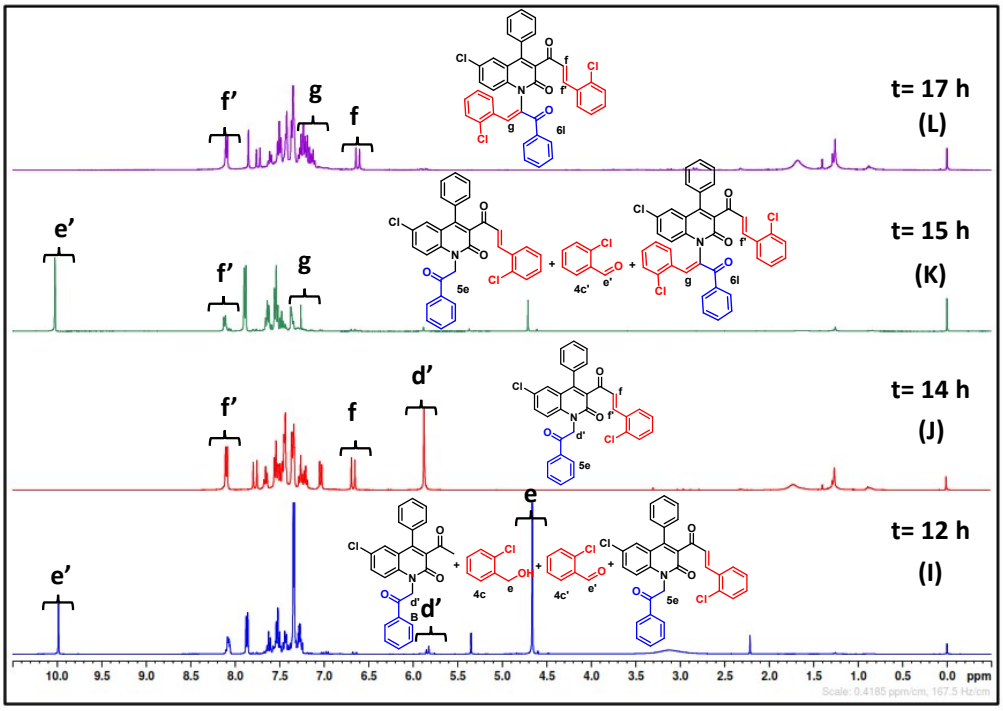
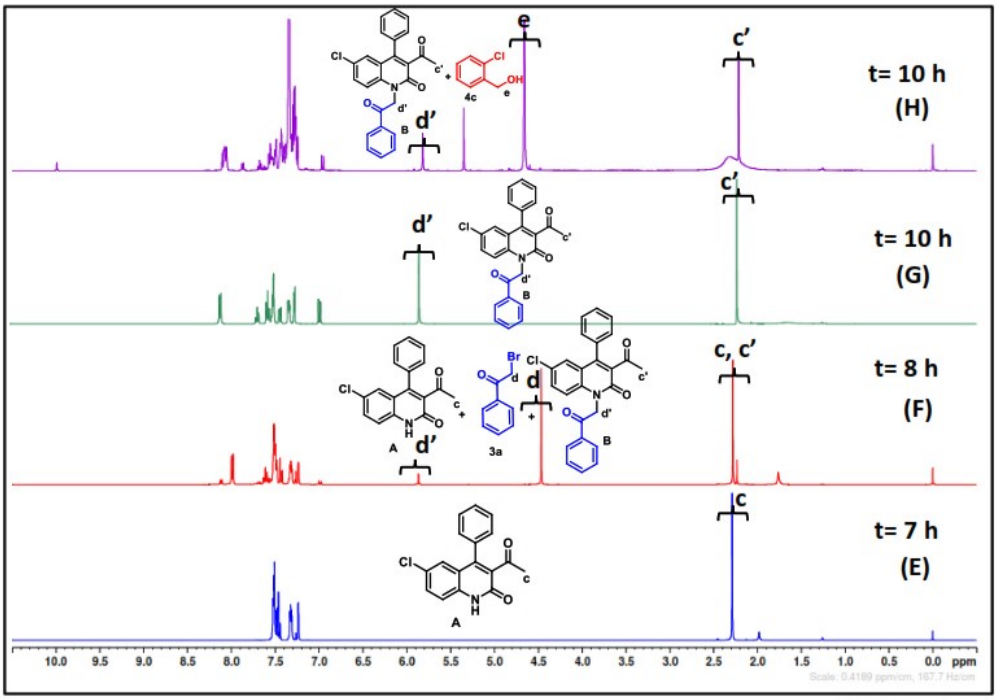


Fig. S8. HRMS spectrum of intermediate **I**

Based on the HRMS result, the reaction proceeds *via* metal alkoxide formation followed by a β-hydride elimination mechanism. The HRMS spectrum of intermediate I is shown in Fig. S8.

4.3 Reaction monitoring by ^{1}H NMR analysis for the synthesis of 5e & 6l





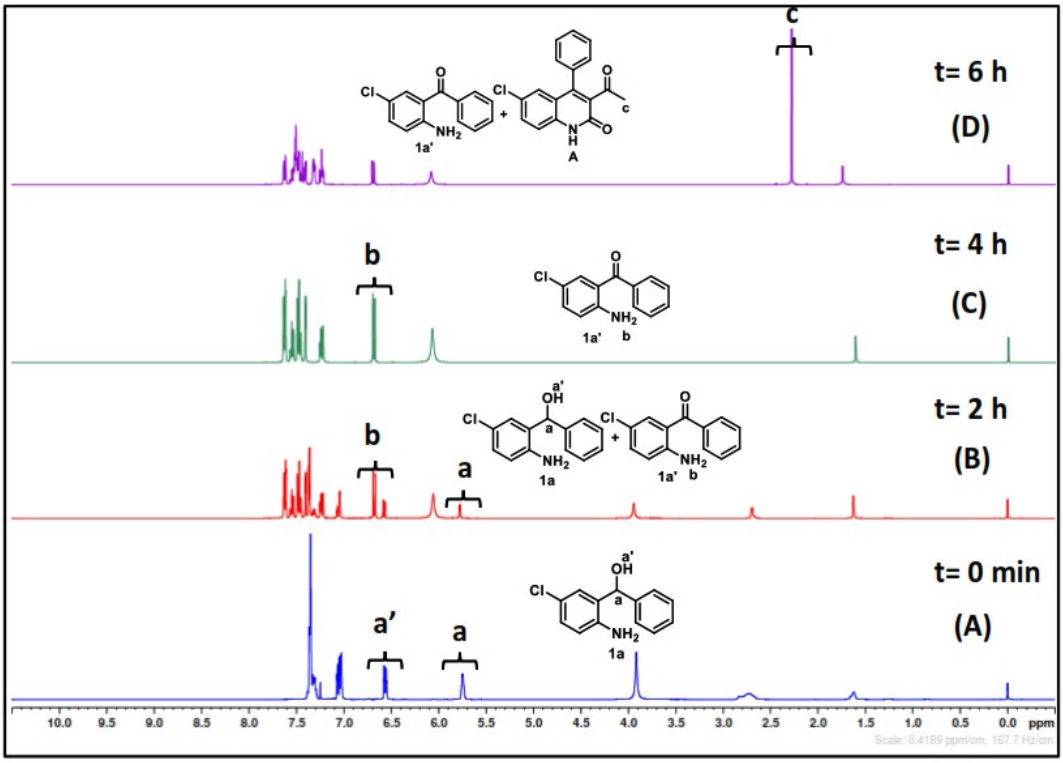


Fig. S9. Reaction monitoring by ^{1}H NMR analysis in different time intervals for the synthesis of **5e** & **6l**

The ^{1}H NMR studies were performed to propose the plausible reaction mechanism involved in the sequential synthesis of compounds **5e** and **6l**. Initially, the ^{1}H NMR spectrum of **A** was taken for the benzhydrol **1a**, before initiation of the reaction, showing the signal for its benzylic and alcoholic -OH protons at 5.8 ppm and 6.5 ppm respectively. Spectrum **B** was recorded after 2 h, indicating the formation of the benzophenone intermediate **1a'** along with benzhydrol **1a,** as shown by the appearance of NH_2 protons at 6.8 ppm. The Spectrum **C,** recorded after 4 h, demonstrated the exclusive formation of the benzophenone intermediate **1a'**, confirmed by the disappearance of the benzylic proton signal at 5.8 ppm. Spectrum **D** and Spectrum **E** were recorded at 6-hour and 7-hour intervals, respectively, indicating the formation of intermediate **A**, as shown by the presence of aliphatic CH_3 peaks in the range of 2.3-2.4 ppm. Spectrum **F** was recorded after the addition of phenacyl bromide **3a** to the reaction mixture, indicating the presence of benzylic CH_2 at 4.5 ppm. The spectrum **G** was recorded after 10 h, showing the formation of intermediate **B** which is confirmed by its methyl and benzylic protons appearing in 2.4 and 6.0 ppm respectively. Spectrum **H** was recorded after the addition of 2-chloro benzyl

alcohol **4c** into the reaction mixture, represented by the alcohol benzylic CH_2 appearing at 4.6 ppm. The spectrum **I** was recorded after 12 h, indicating the formation of aldehyde **4c'**, as evidenced by the appearance of -CHO proton at 10 ppm along with the formation of mono-alkenylated quinolinone **5e**. Spectrum **J** was recorded over a period of 14 h, showing that the reaction was completed with the formation of mono-alkenylated quinolinone **5e** which was confirmed by the disappearance of intermediate **B** aliphatic methyl protons in 2.4 ppm and the appearance of **5e** olefinic protons at 6.7 and 8.1 ppm. Similarly, by adding an excess of alcohol (3.0 mmol) **4c** and continuing the reaction for 17 h, the formation of the bi-alkenylated quinolinone **6l** was observed (Spectrum K and L). This was confirmed by the disappearance of the mono-alkenylated quinolinone **5e** benzylic CH_2 and the appearance of **6l** methine proton at 7.2 ppm. All spectra (**Fig. S9**) were recorded by conducting the reactions according to the standard reaction procedure.

5. X-Ray Crystallography Data

Crystallographic data and structure determination details are compiled in Table S1. The crystals were obtained by slow evaporation of compounds **B (CCDC: 2374871)** and **6m (CCDC: 2388694)** in a solution consisting of $CDCl_3$ and DCM at r.t. The structure was determined using direct methods employed in ShelXT,[1] OleX[2] and refinement was carried out using least-square minimization implemented in ShelXL.[3] All nonhydrogen atoms were refined with anisotropic displacement parameters. Hydrogen atom positions were fixed geometrically in idealized positions and were refined using a riding model.

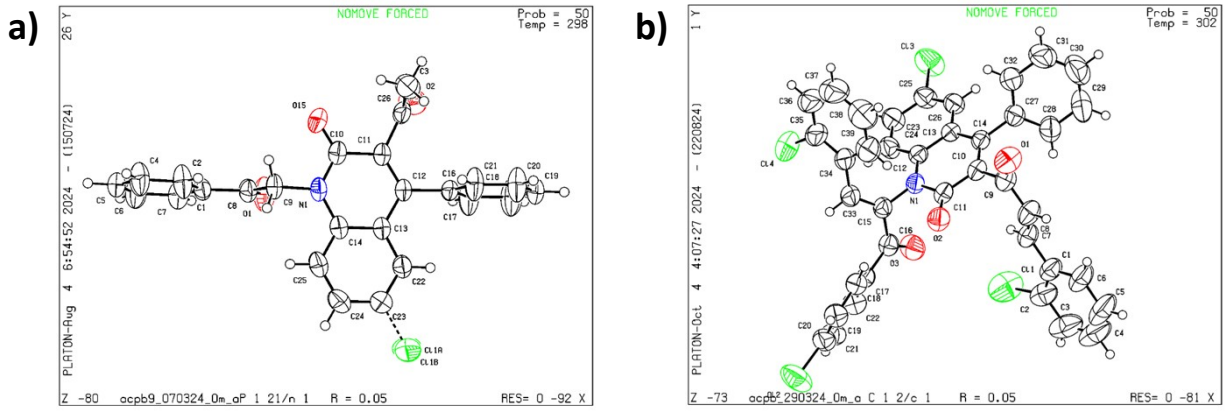
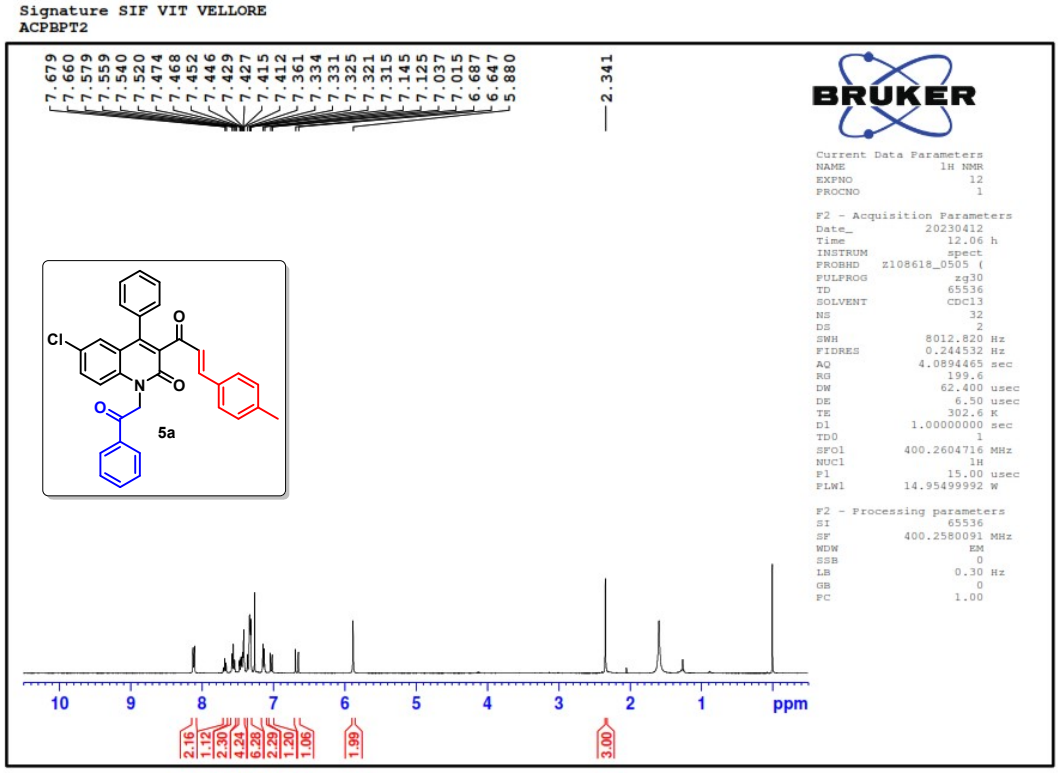


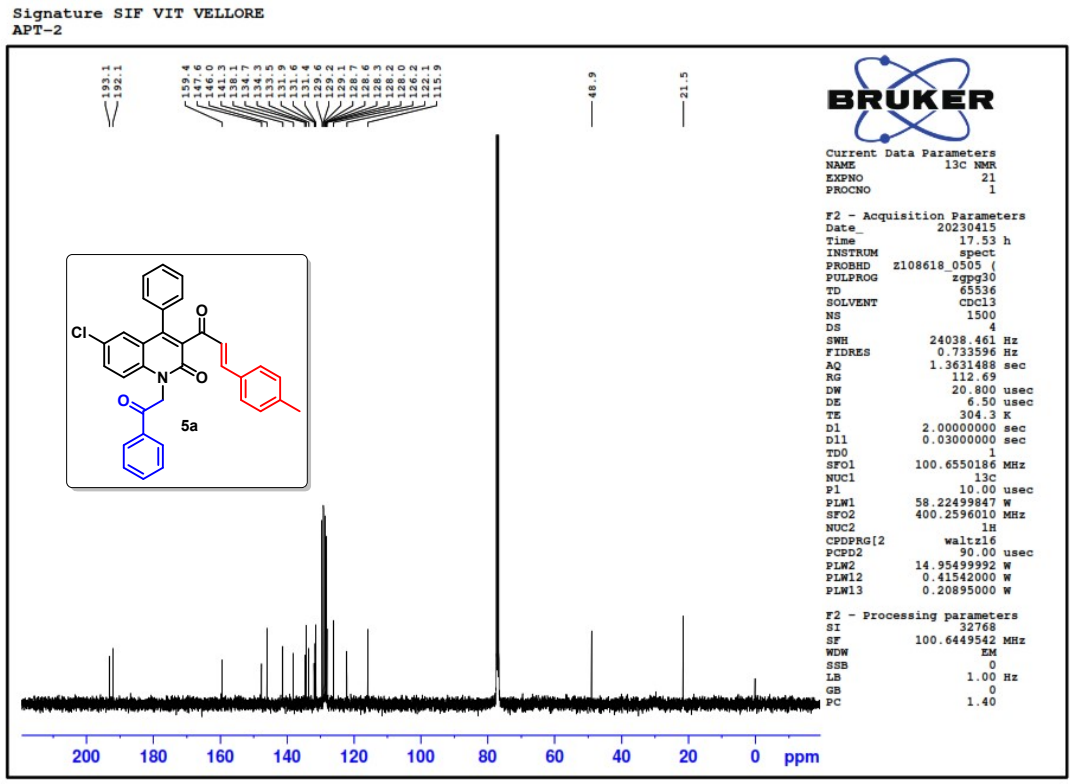
Fig 10. a) Eclipsed diagram of the compound **B**. b) Eclipsed diagram of the compound **6m**

Table S1 Crystal data and structure refinement for compounds **B (CCDC: 2374871)** and **6m (CCDC: 2388694)**

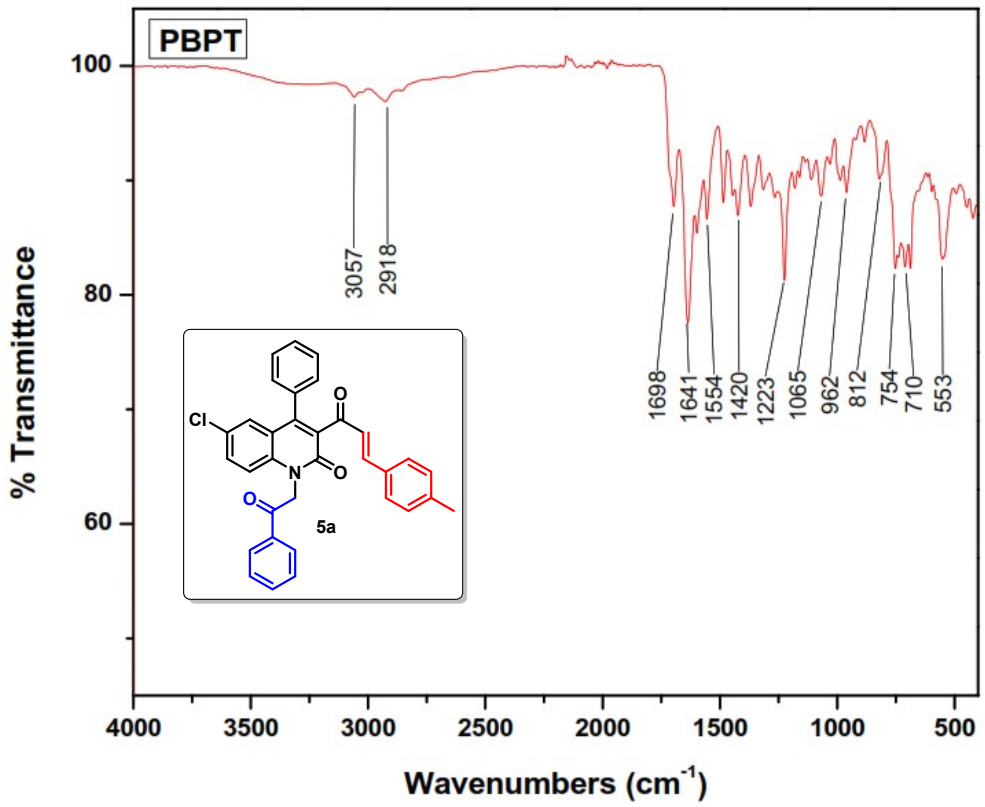
Compound number	**B**	**6m**
Empirical formula	$C_{25}H_{18}ClNO_3$	$C_{39}H_{25.5}Cl_4NO_{4.25}$
Formula weight	415.85	717.90
Temperature/K	298.00	302.00
Crystal system	monoclinic	monoclinic
Space group	$P2_1/n$	C2/c
a/Å	16.624(2)	31.3651(17)
b/Å	5.2910(8)	11.6284(6)
c/Å	23.770(3)	20.2570(11)
α/°	90	90
β/°	102.602(5)	97.297(2)
γ/°	90	90
Volume/Å^3	2040.4(5)	7328.4(7)
Z	4	8
ρ_{calc}g/cm^3	1.354	1.301
μ/mm^{-1}	0.214	0.364
F(000)	864.0	2948.0
Crystal size/mm^3	0.173 × 0.168 × 0.144	0.241 × 0.179 × 0.149
Radiation	MoKα (λ = 0.71073)	MoKα (λ = 0.71073)
2Θ range for data collection/°	3.362 to 56.562	4.054 to 56.61
Index ranges	$-21 \le h \le 22$, $-6 \le k \le 7$, $-31 \le l \le 31$	$-31 \le h \le 41$, $-15 \le k \le 15$, $-27 \le l \le 27$
Reflections collected	28713	71644
Independent reflections	5037 [R_{int} = 0.0512, R_{sigma} = 0.0431]	9085 [Rint = 0.0547, Rsigma = 0.0393]
Data/restraints/parameters	5037/0/282	9085/0/448
Goodness-of-fit on F^2	1.033	1.013
Final R indexes [I>=2σ (I)]	R_1 = 0.0540, wR_2 = 0.1314	R1 = 0.0541, wR2 = 0.1272
Final R indexes [all data]	R_1 = 0.1107, wR_2 = 0.1742	R1 = 0.1141, wR2 = 0.1662
Largest diff. peak/hole / e Å^{-3}	0.21/-0.21	0.30/-0.41

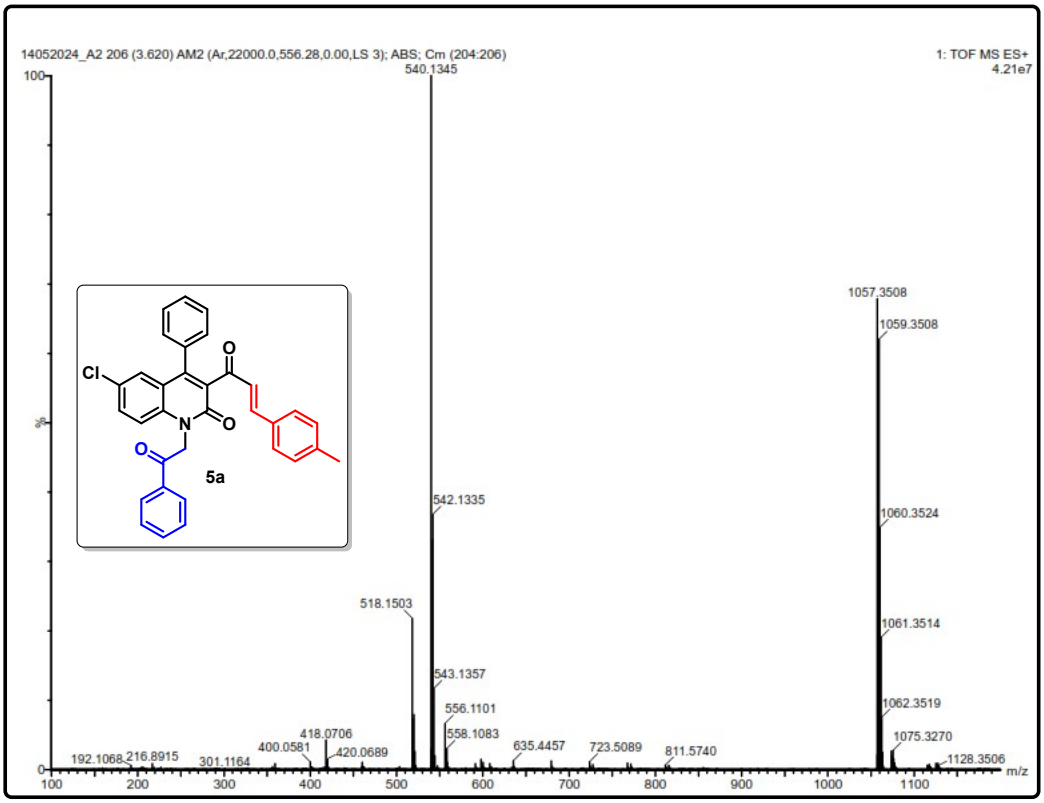
6. Copies of NMR (^{1}H & ^{13}C), FT-IR and HRMS Spectra



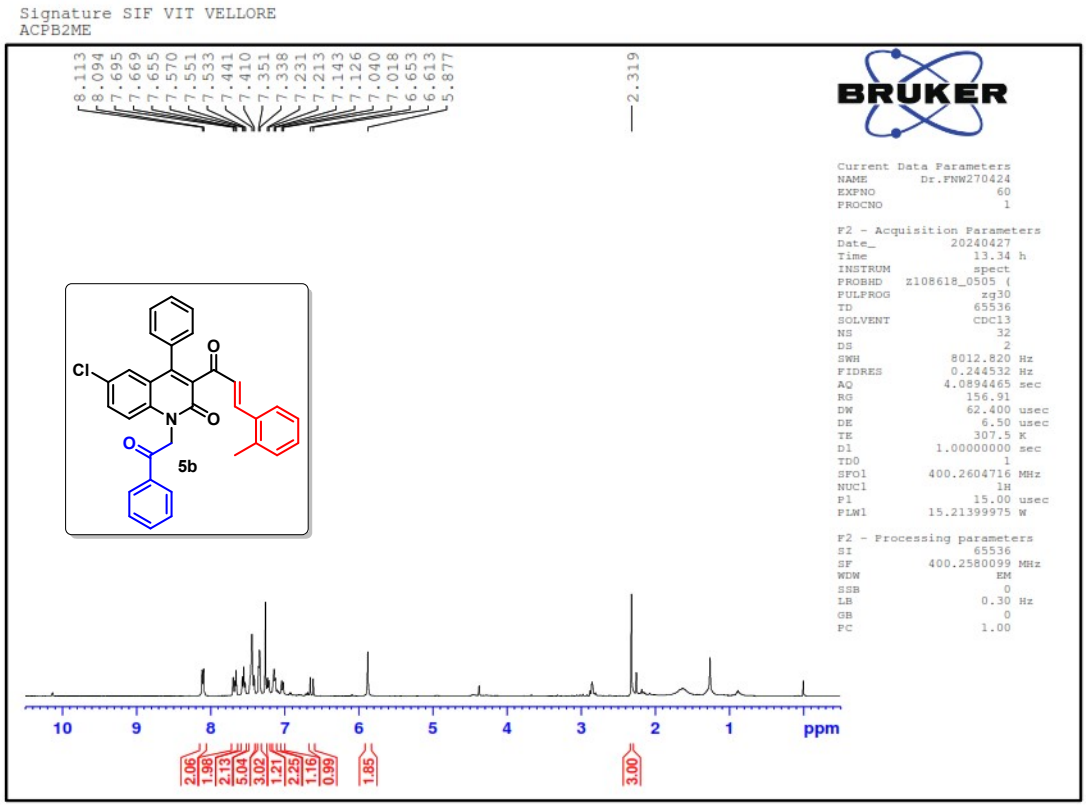


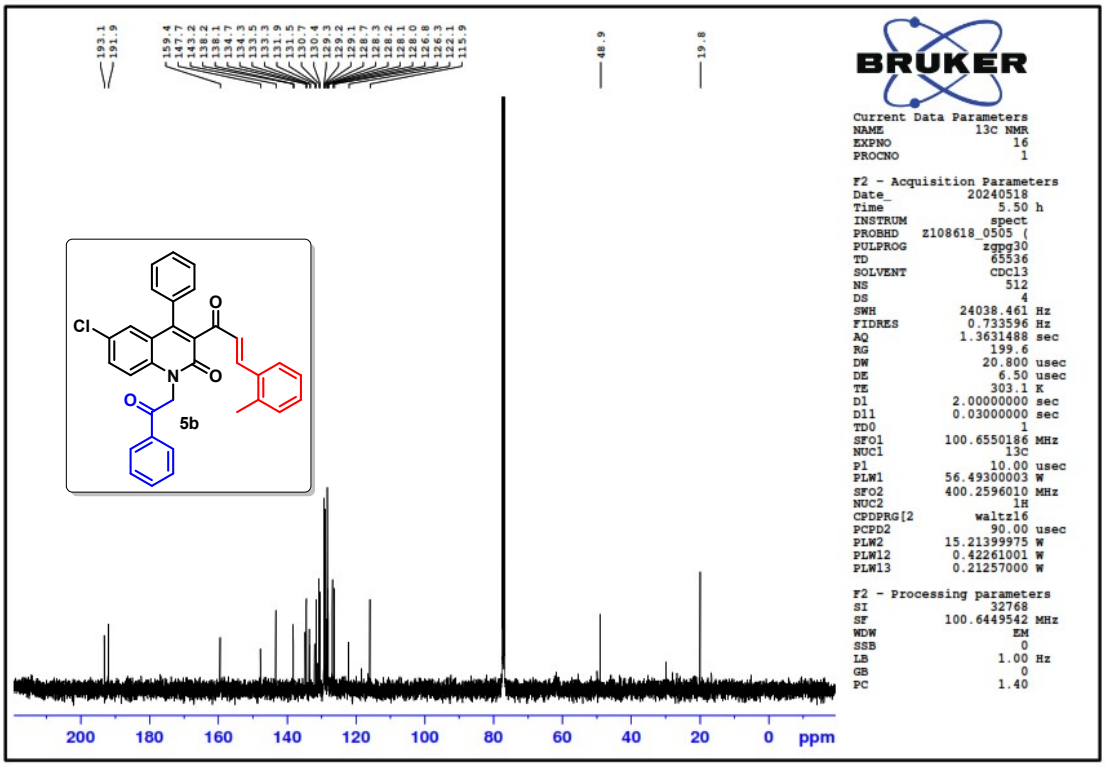
^{1}H and ^{13}C NMR spectra of compound **5a** in $CDCl_3$



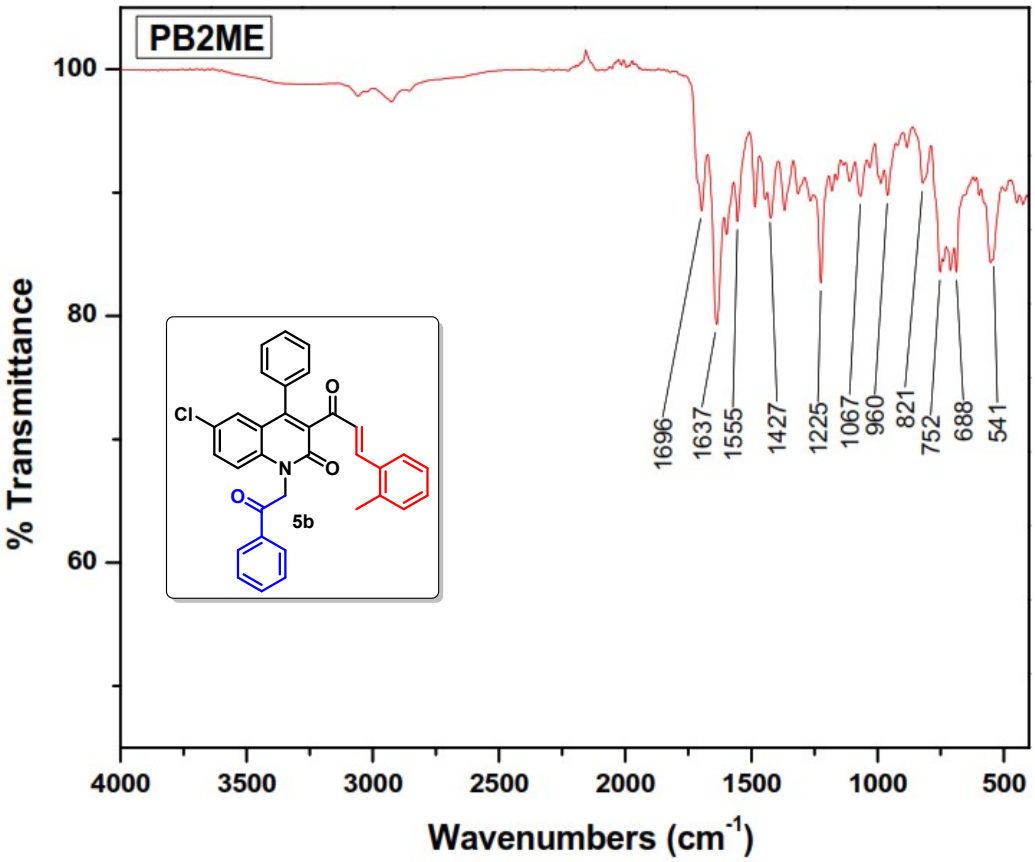


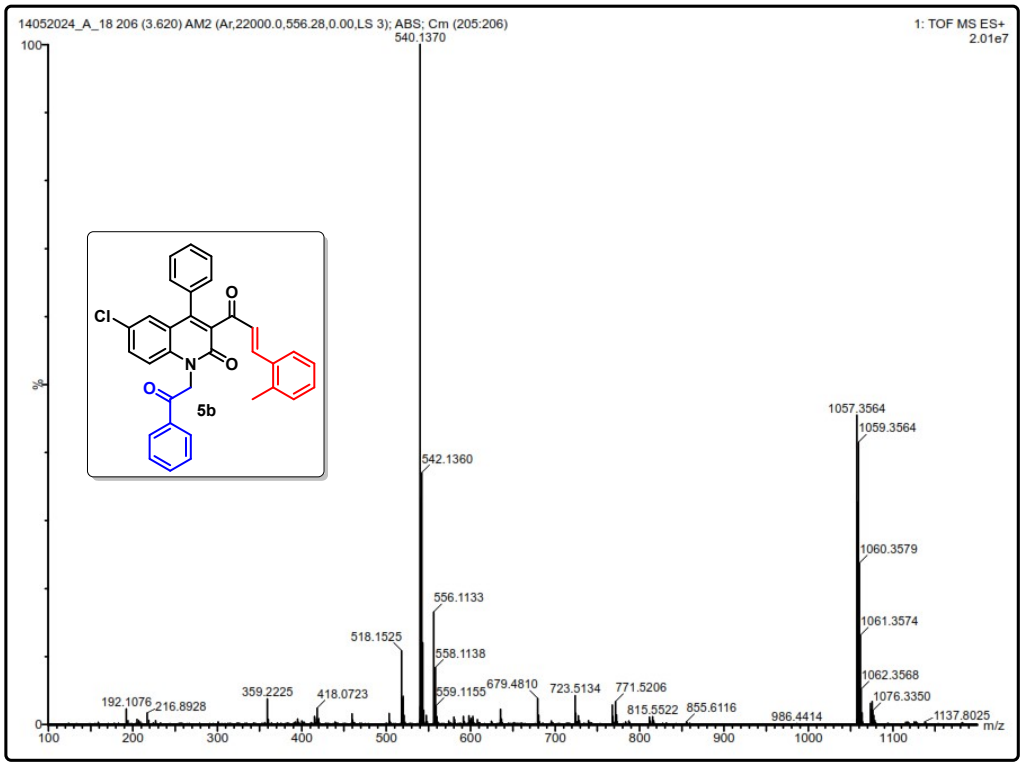
IR and HRMS spectra of compound **5a**



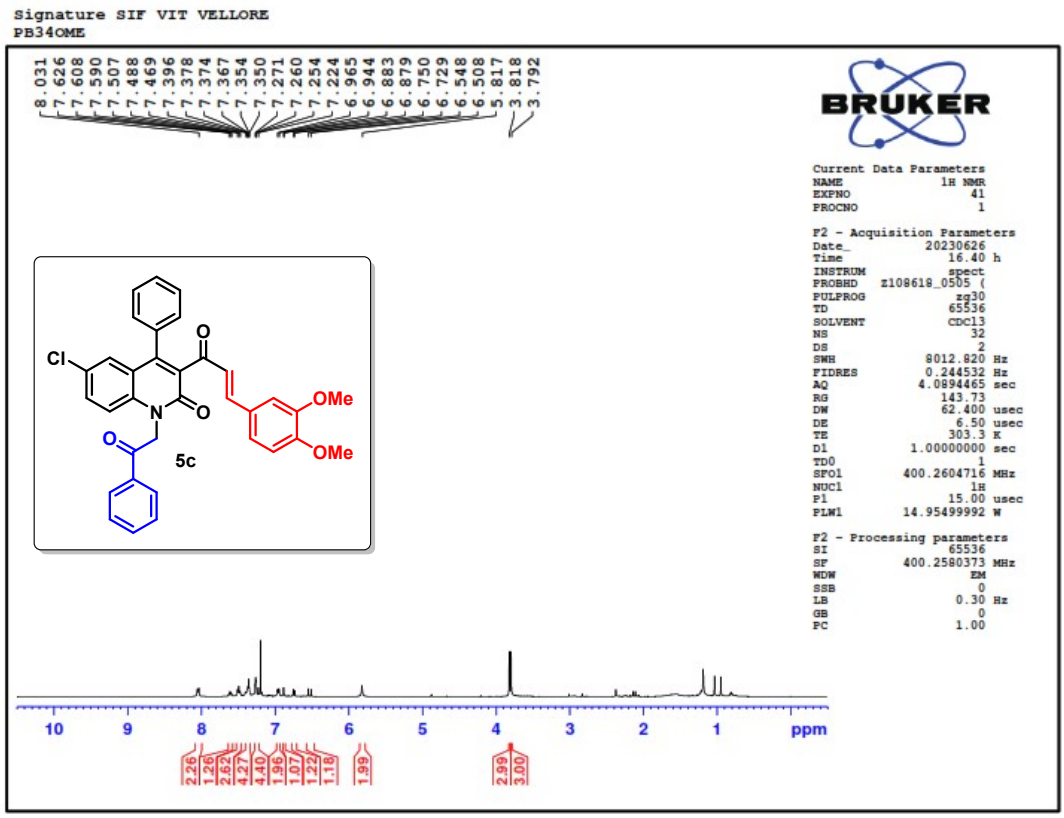


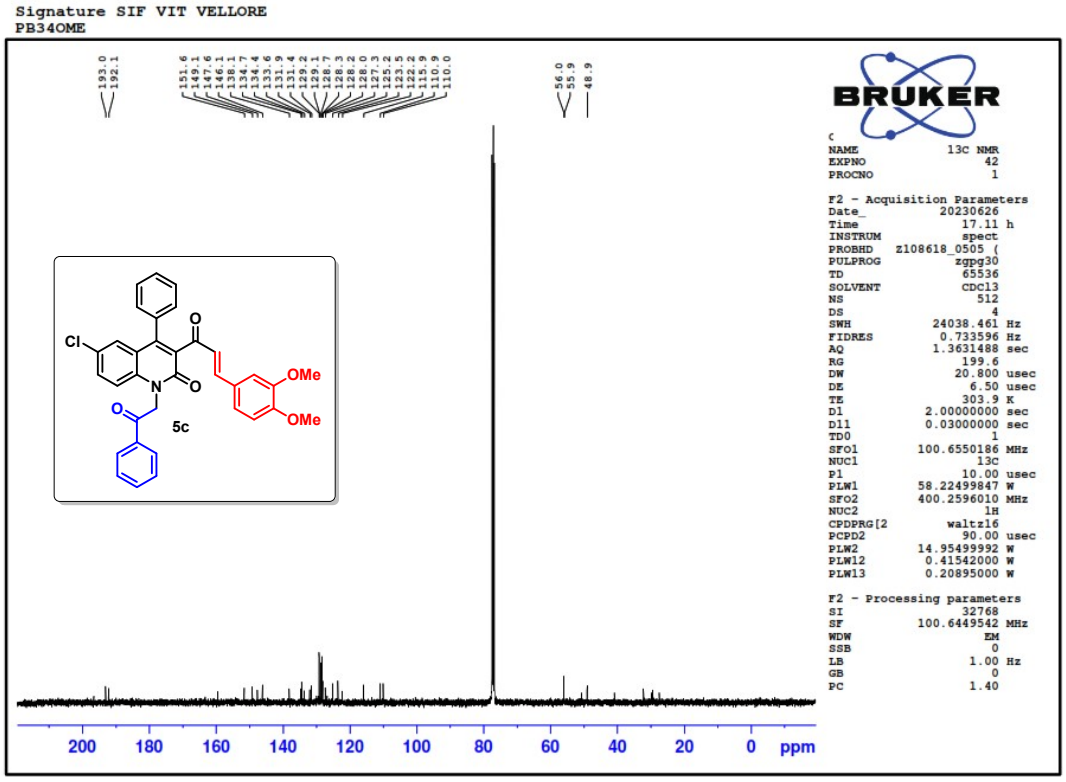
^{1}H and ^{13}C NMR spectra of compound **5b** in $CDCl_3$



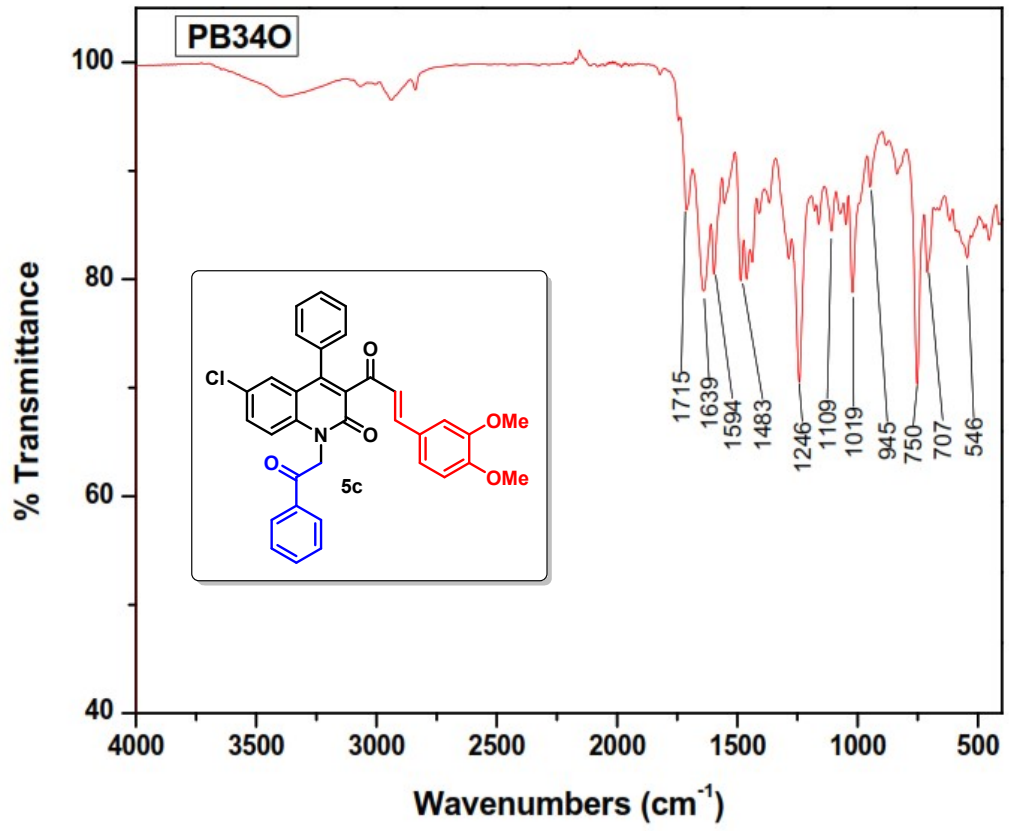


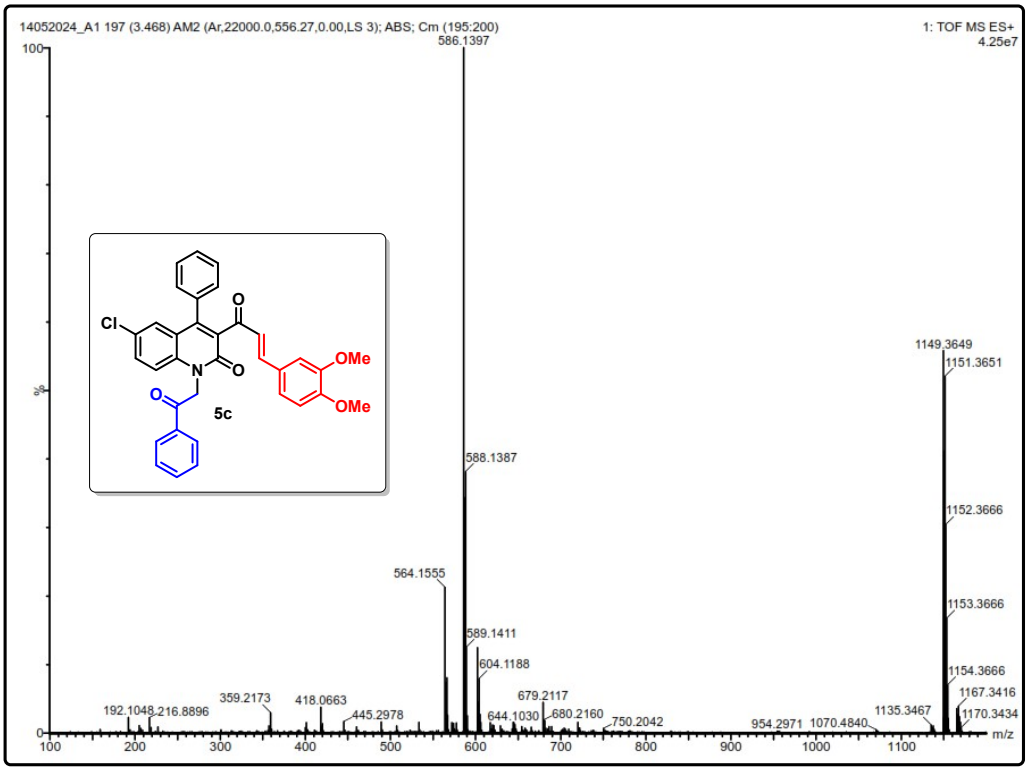
IR and HRMS spectra of compound **5b**



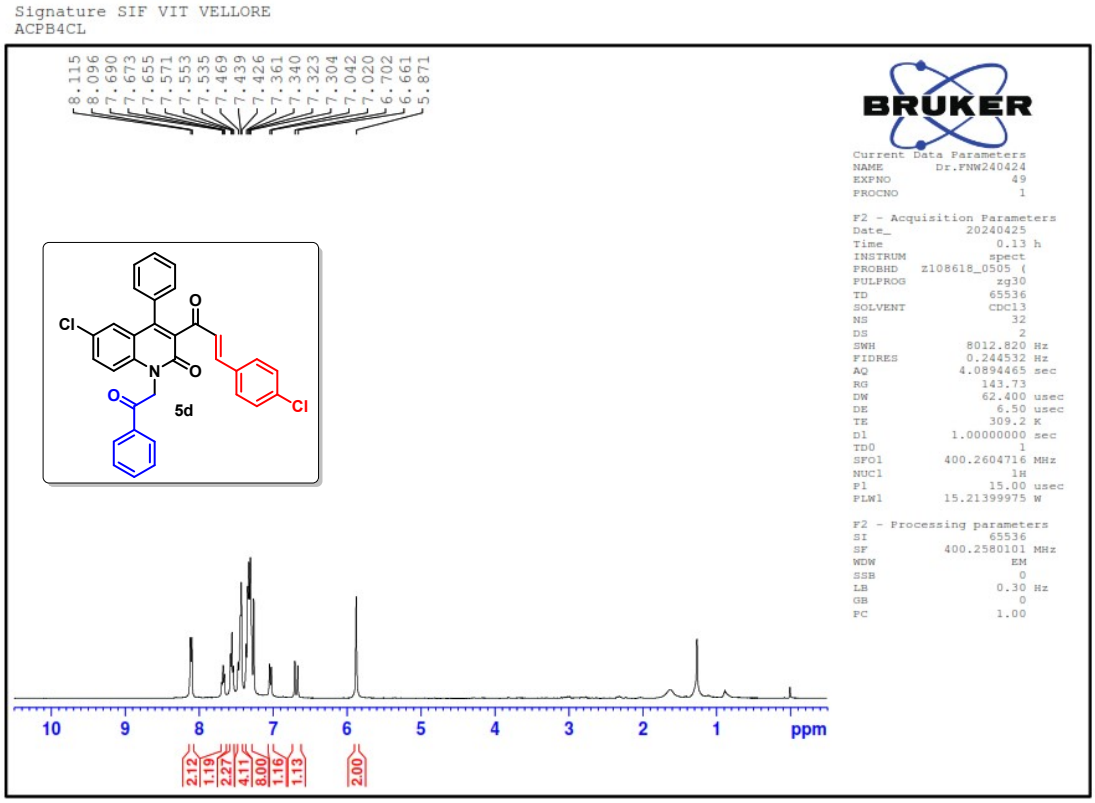


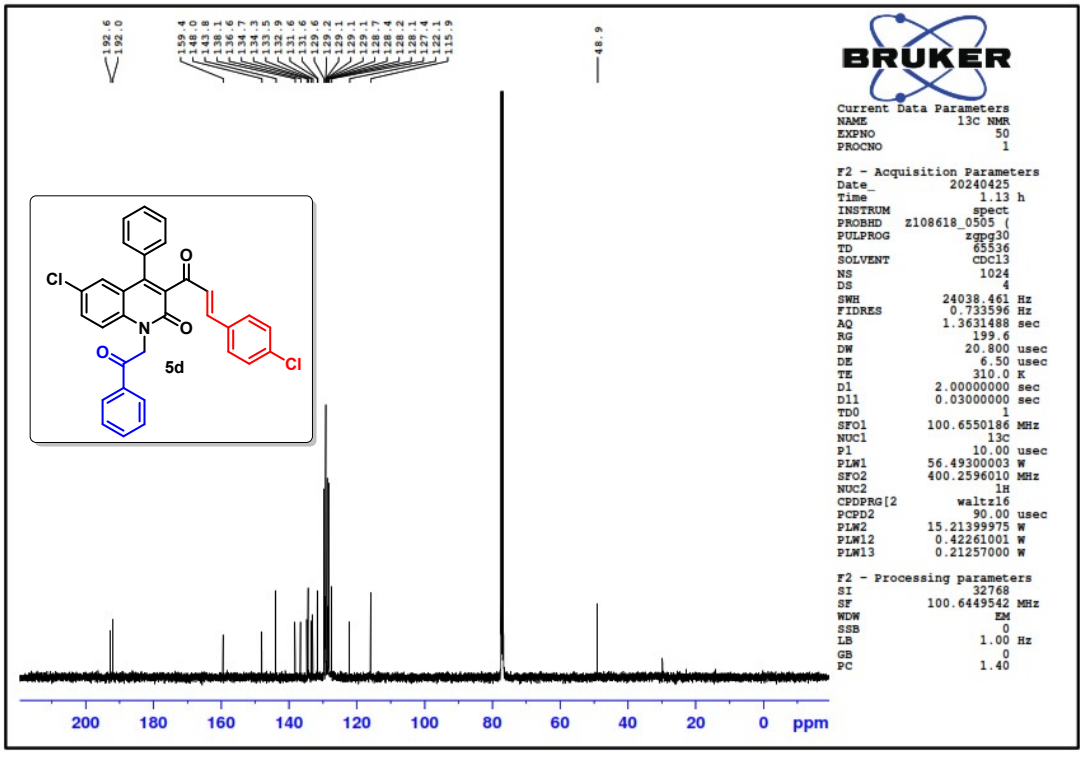
^{1}H and ^{13}C NMR spectra of compound **5c** in $CDCl_3$



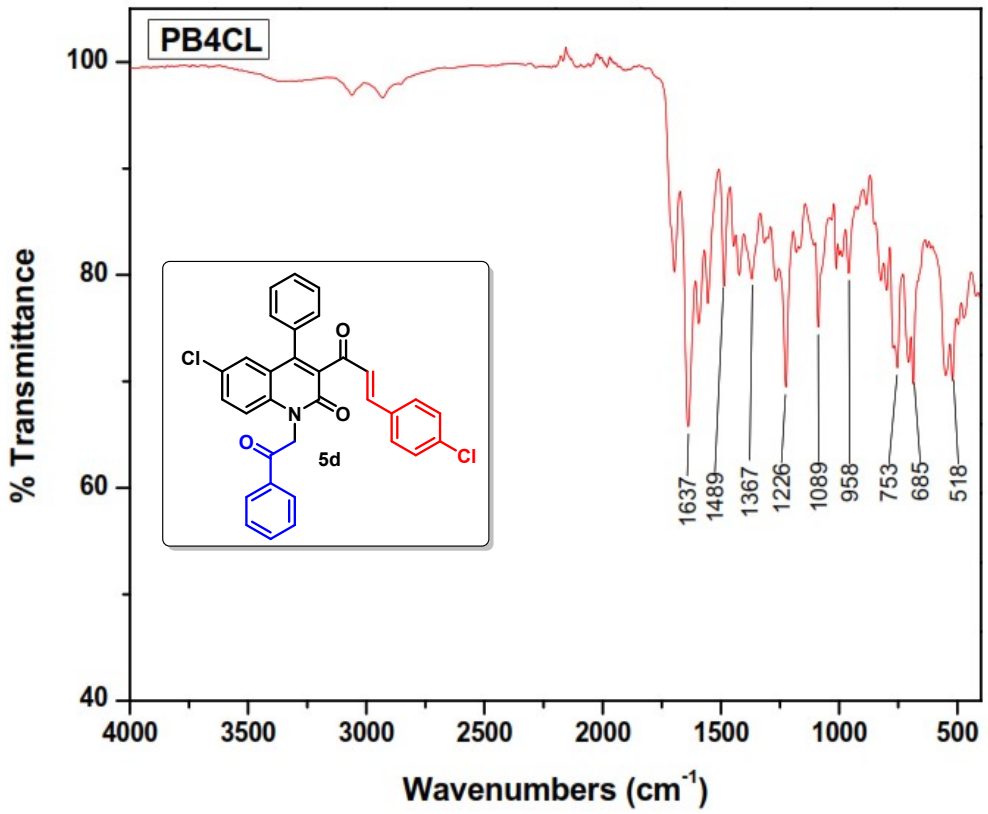


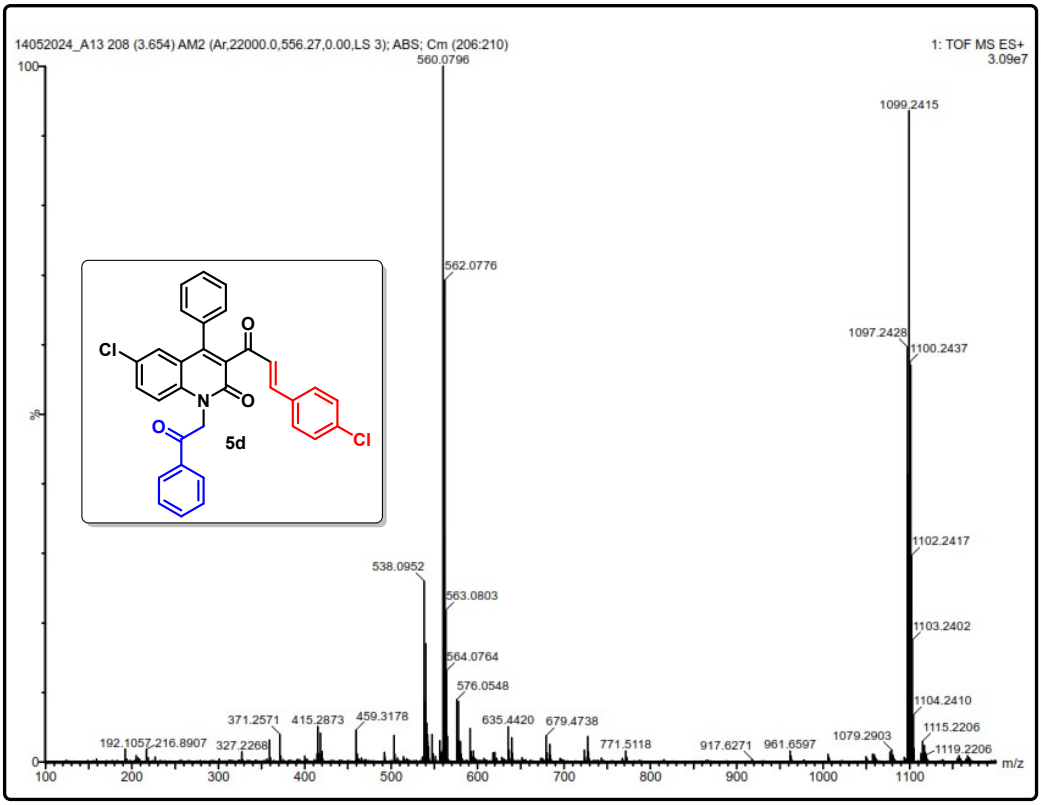
IR and HRMS spectra of compound **5c**



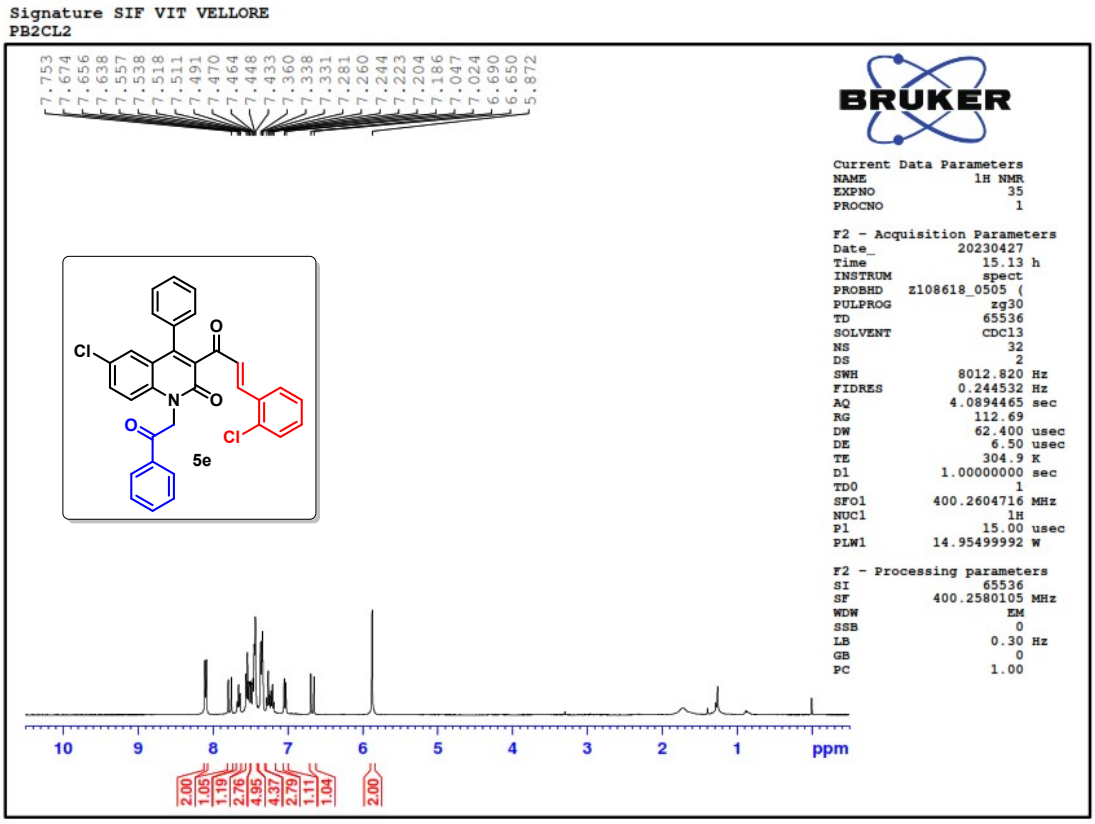


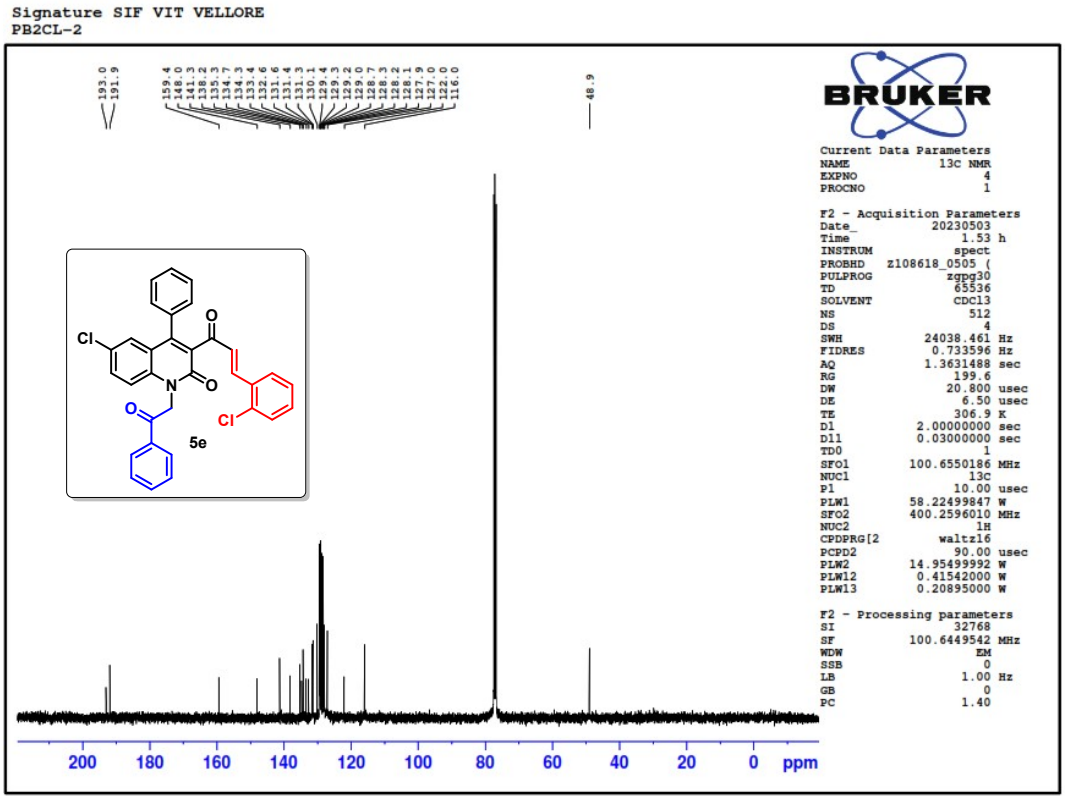
^{1}H and ^{13}C NMR spectra of compound **5d** in $CDCl_3$





IR and HRMS spectra of compound **5d**





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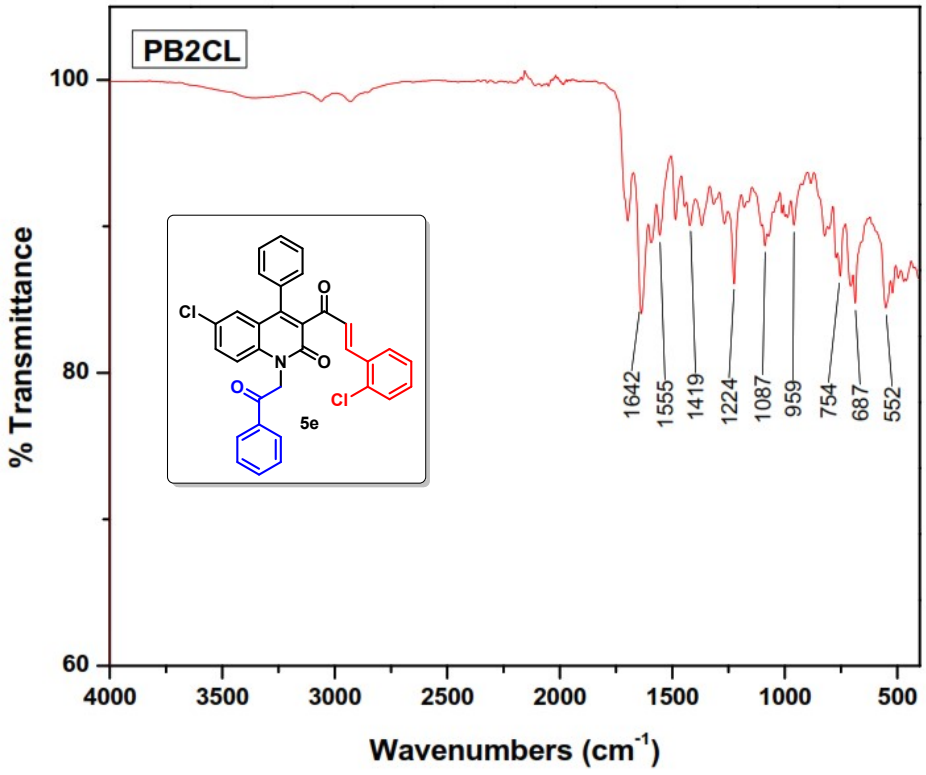
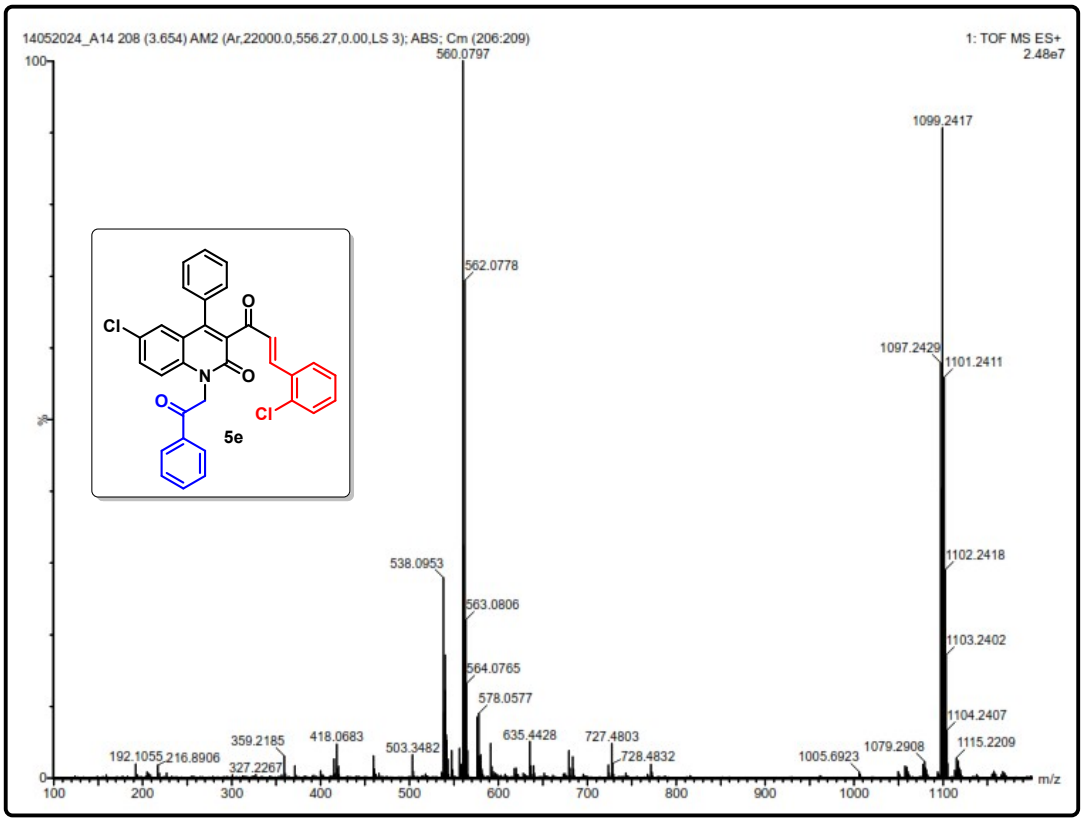
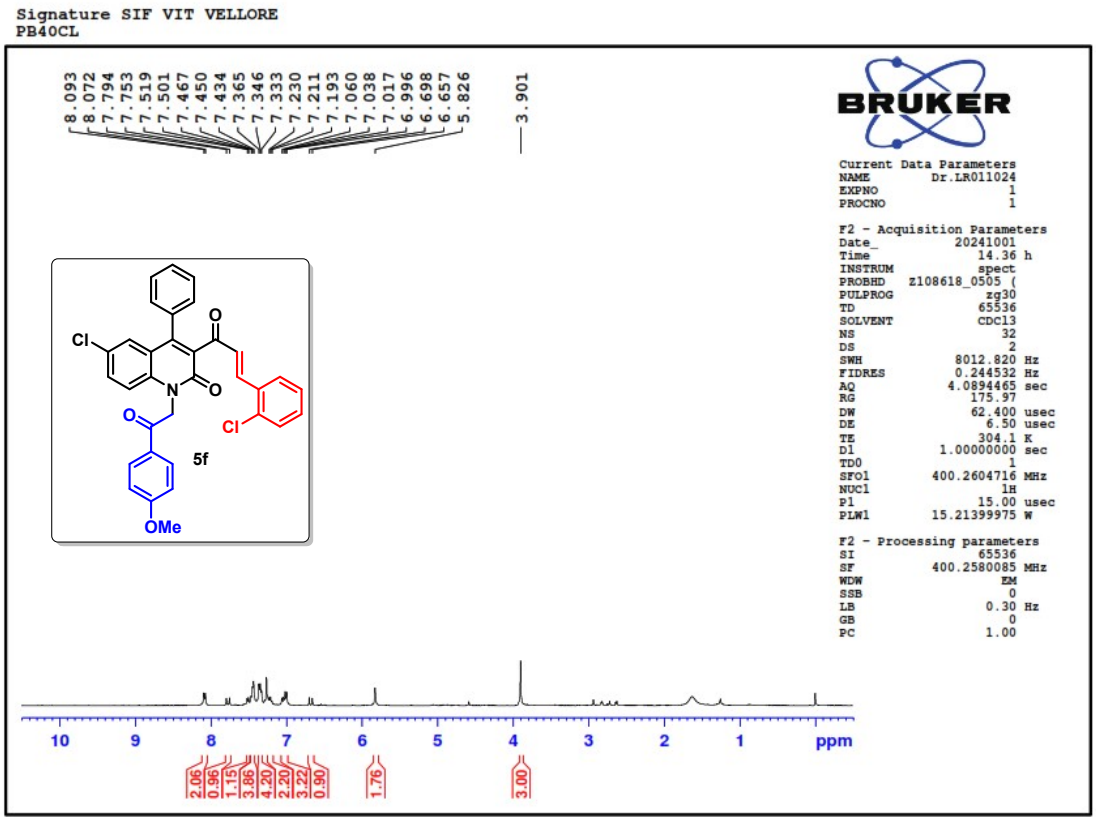
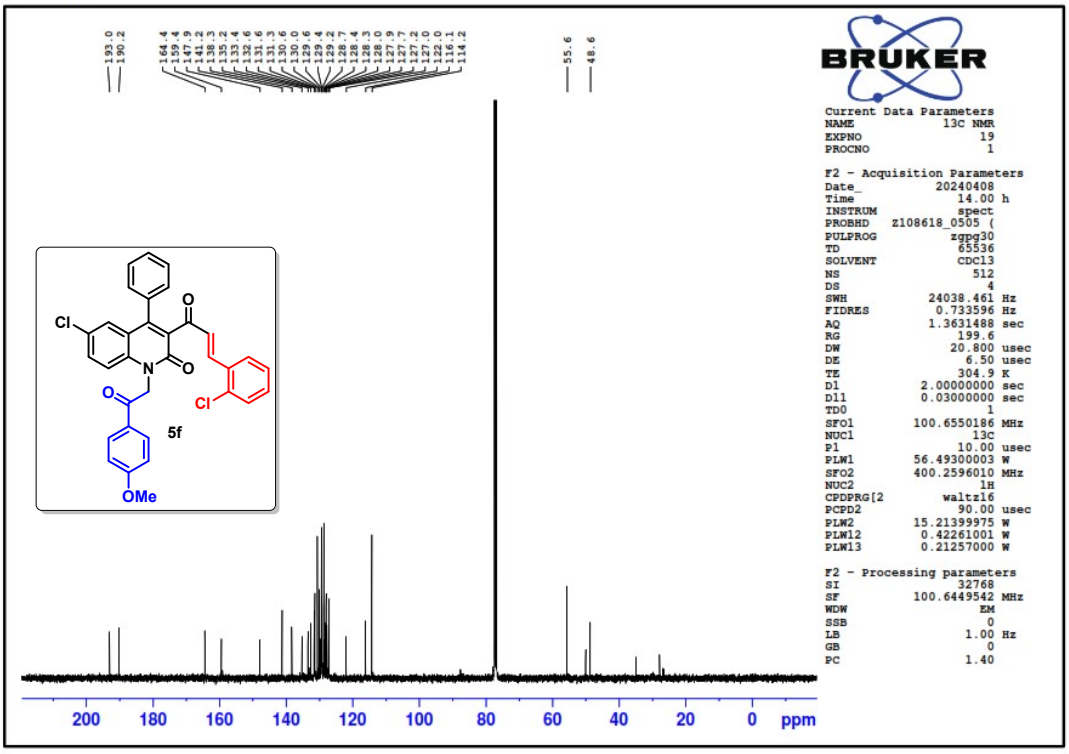


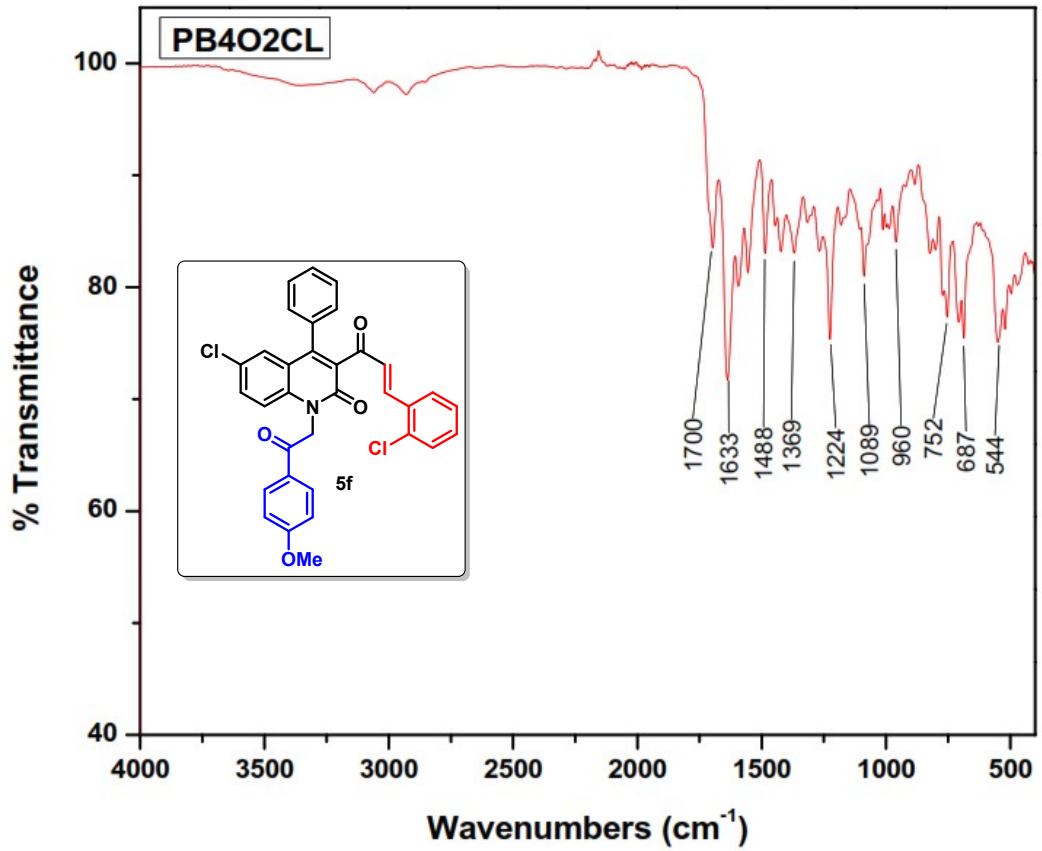


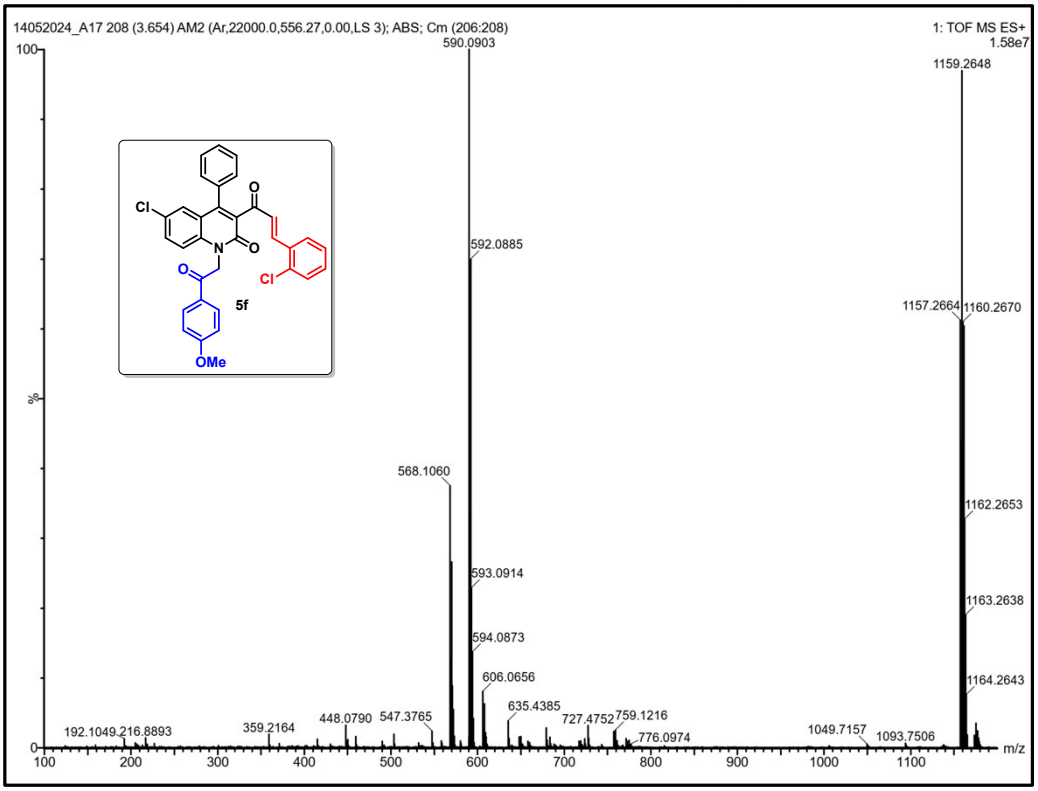
IR and HRMS spectra of compound **5e**



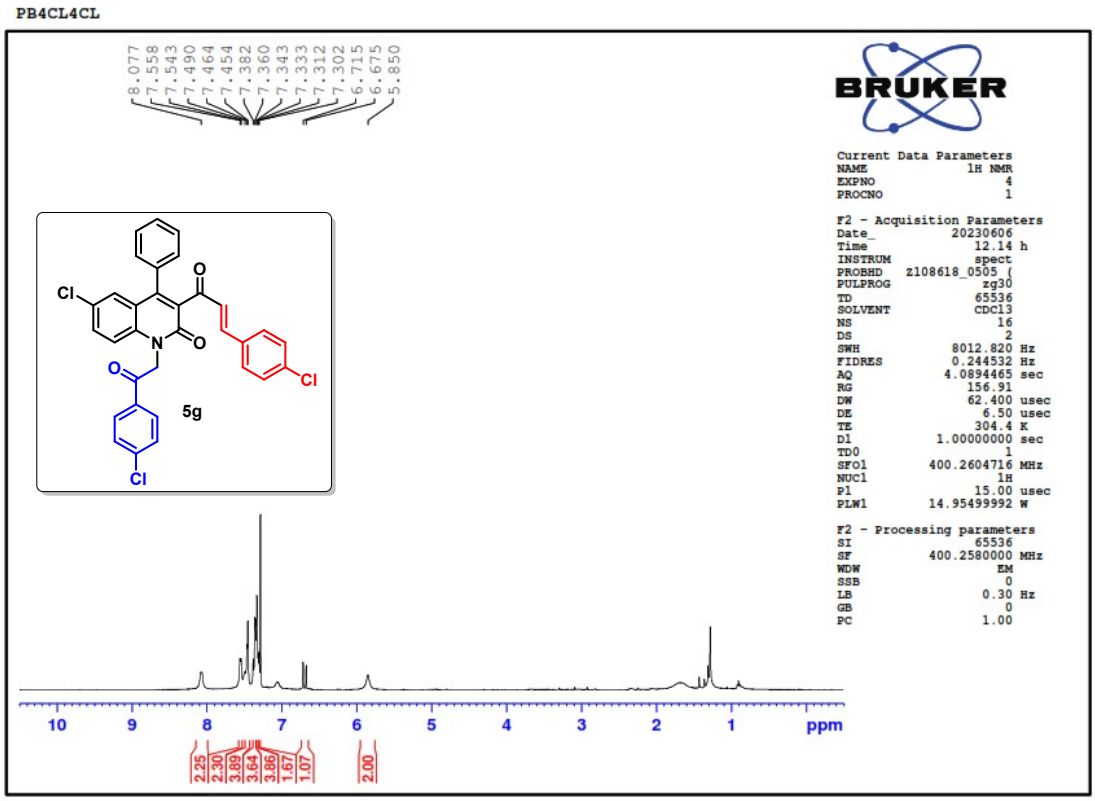


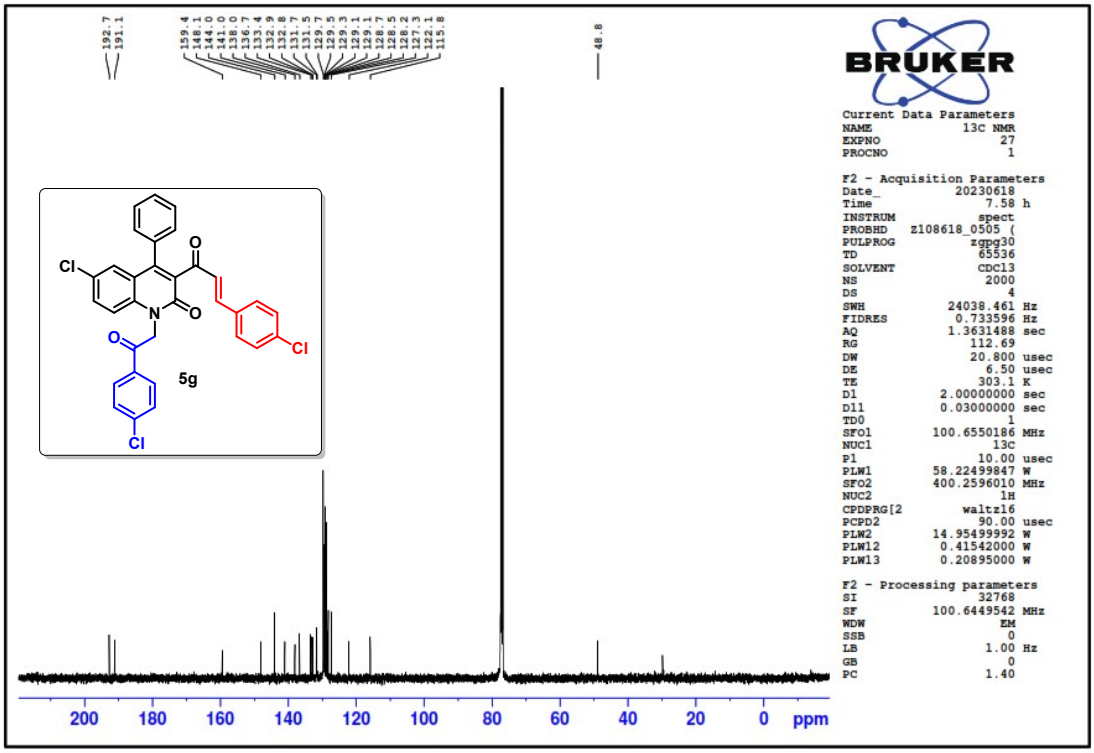
^{1}H and ^{13}C NMR spectra of compound **5f** in $CDCl_3$



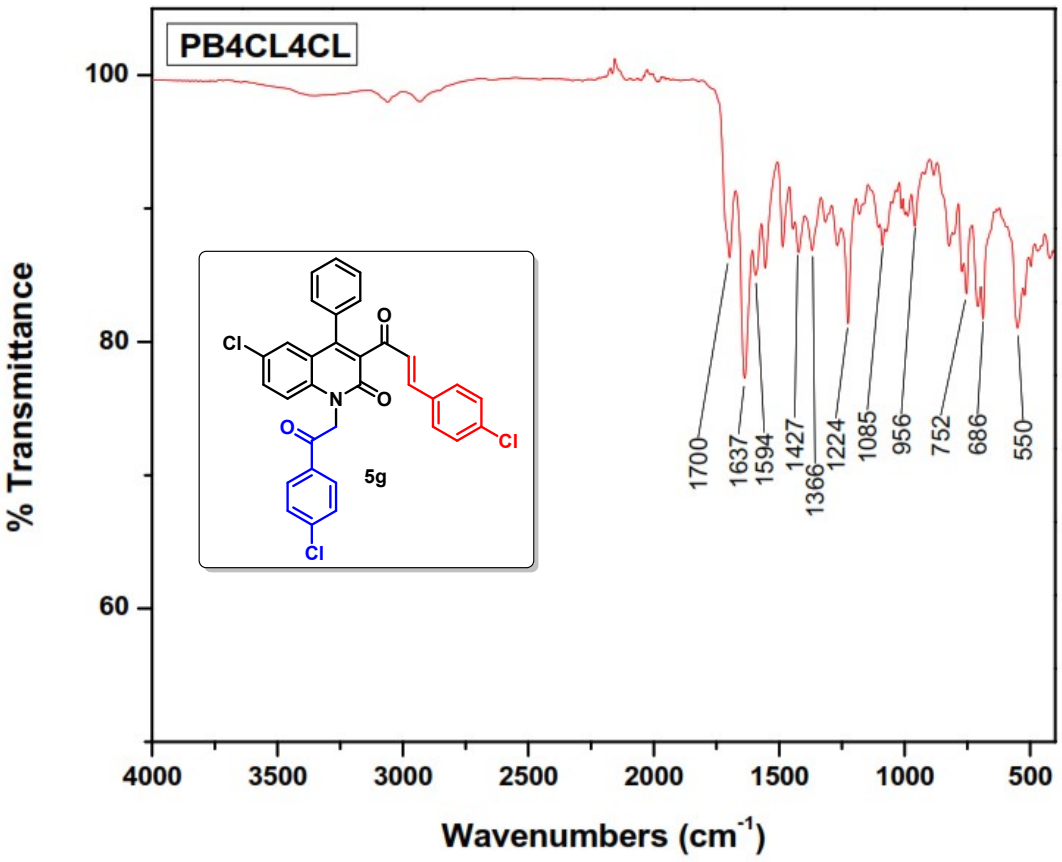


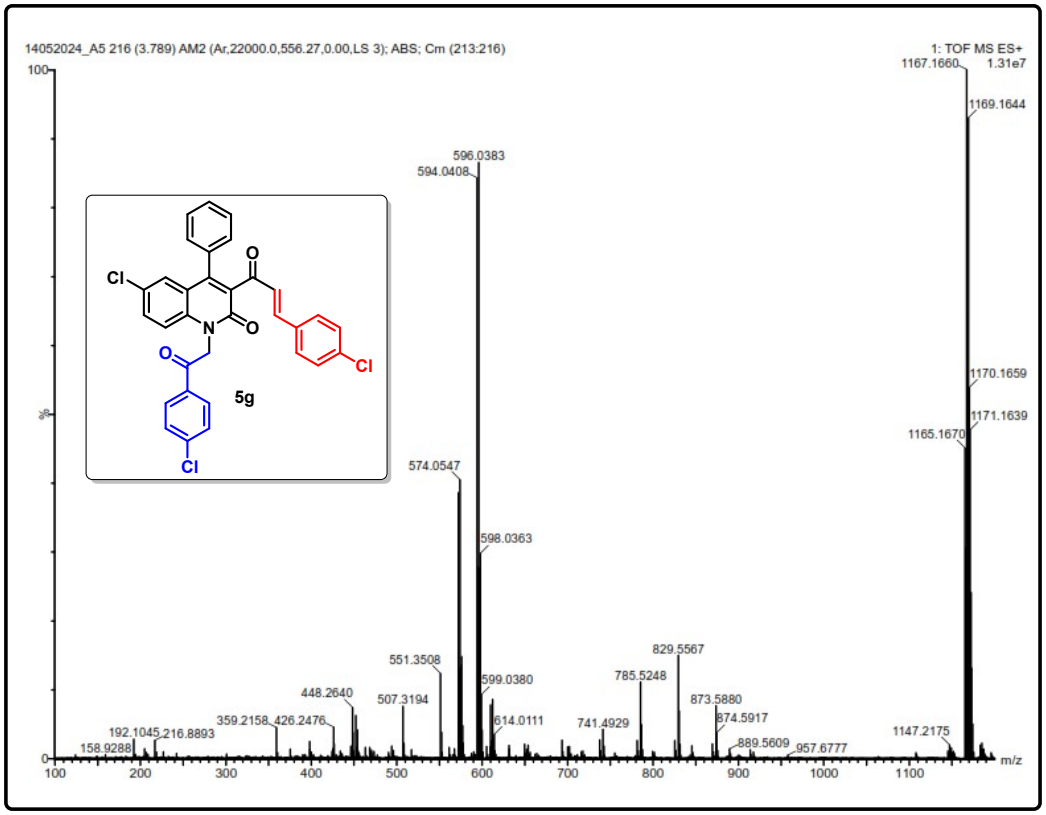
IR and HRMS spectra of compound **5f**



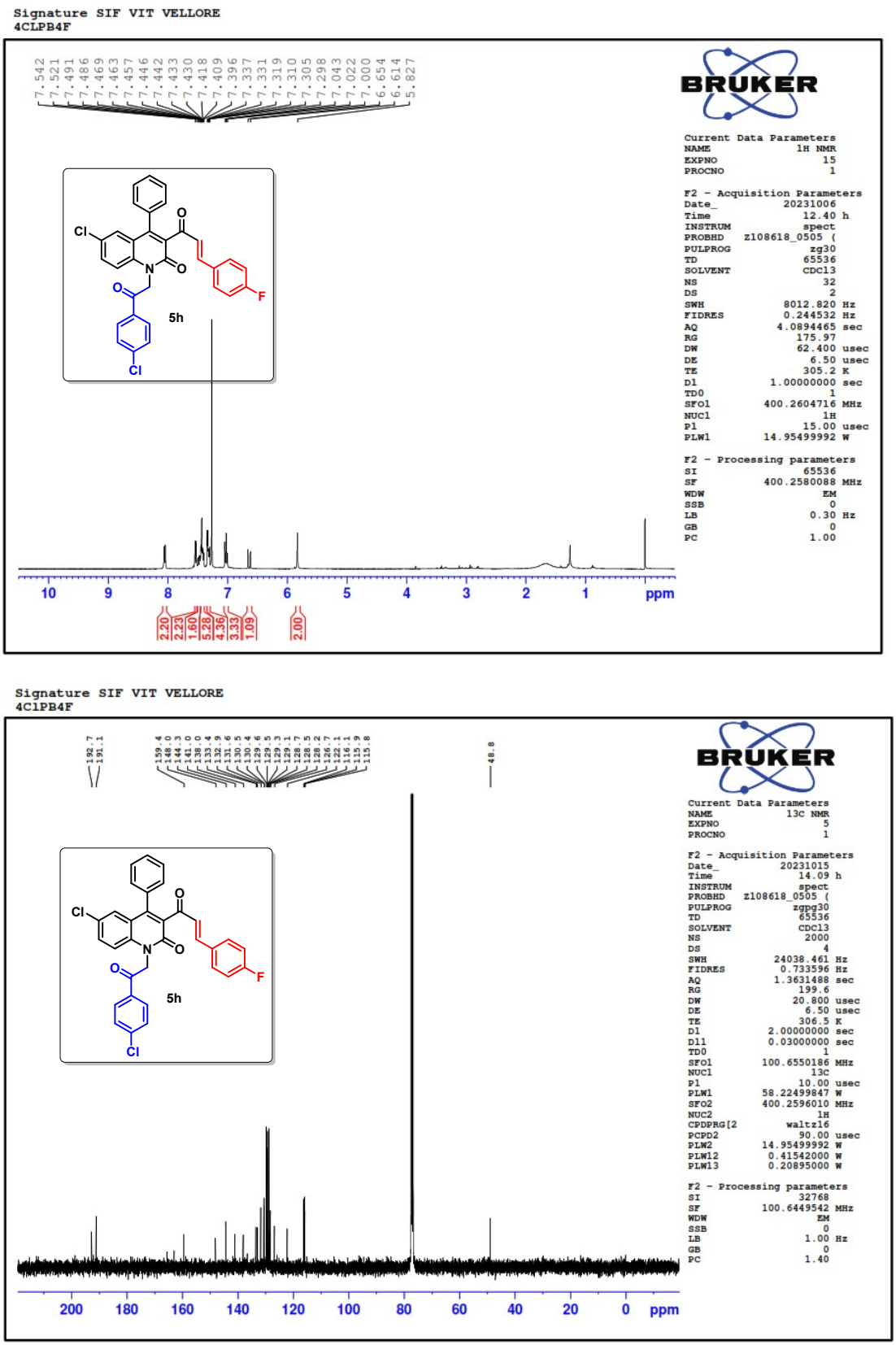


^{1}H and ^{13}C NMR spectra of compound **5g** in $CDCl_3$

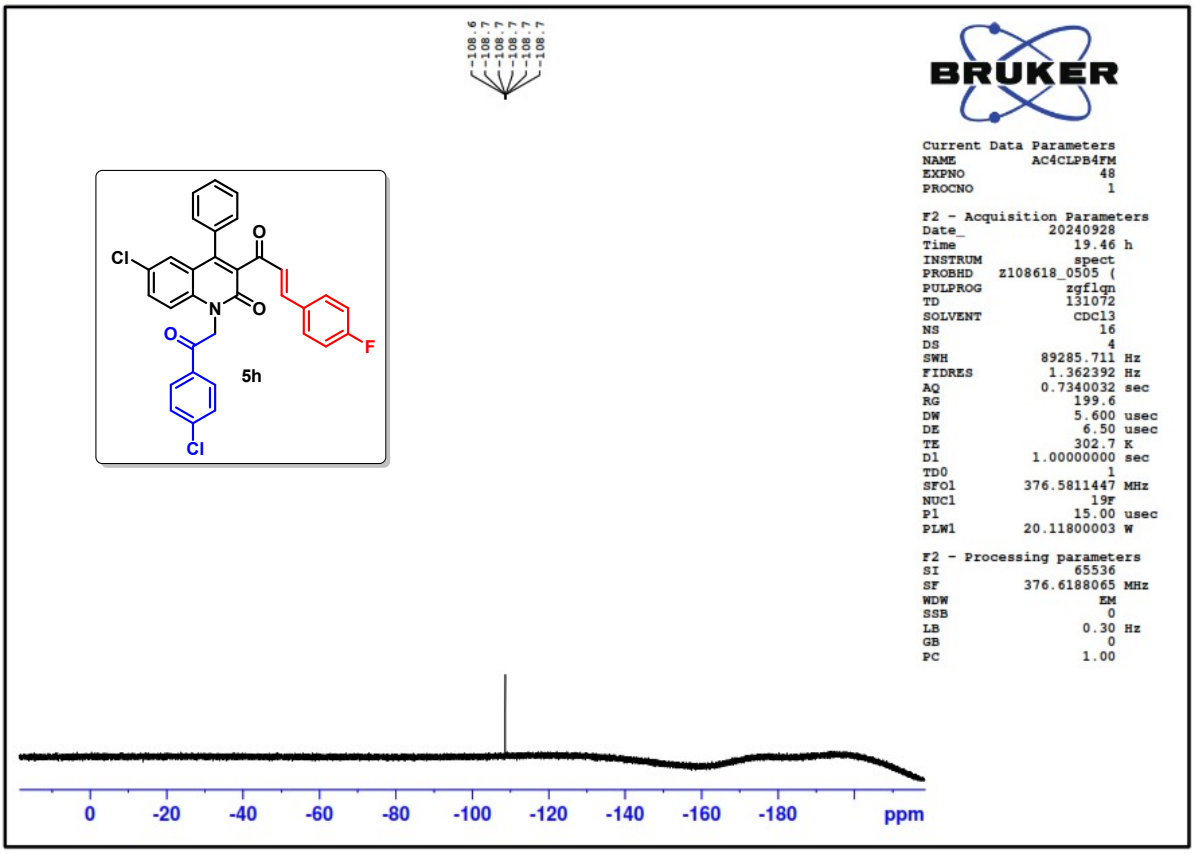




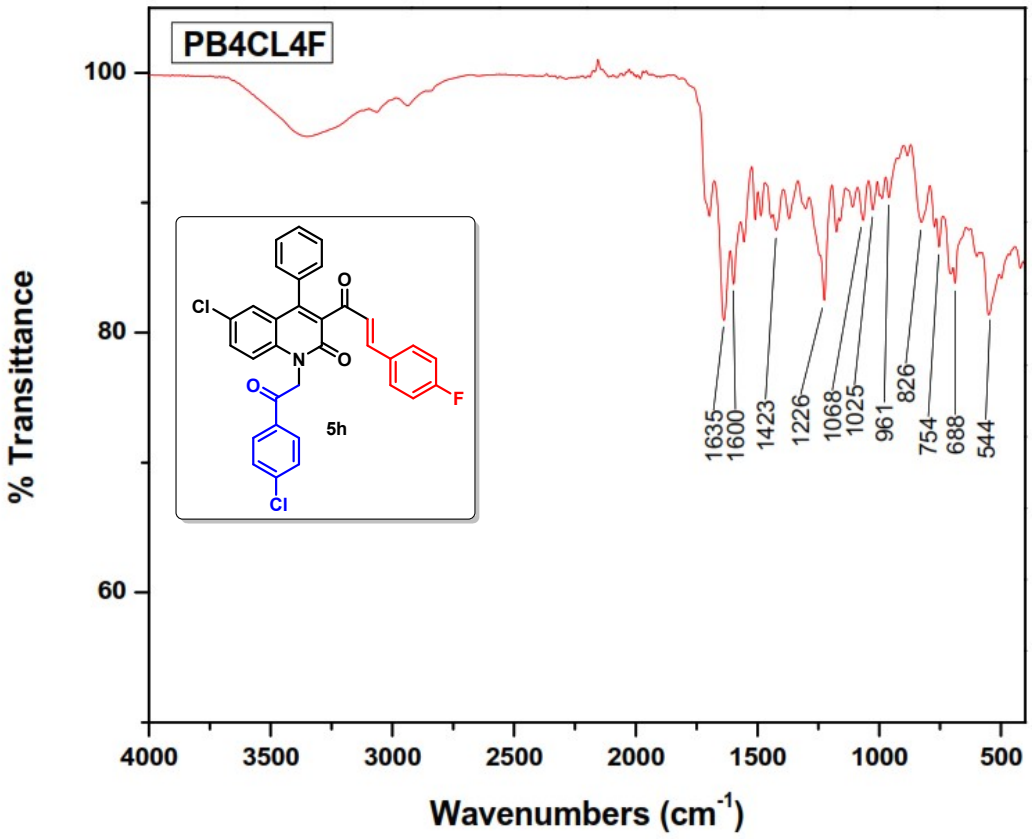
IR and HRMS spectra of compound **5g**

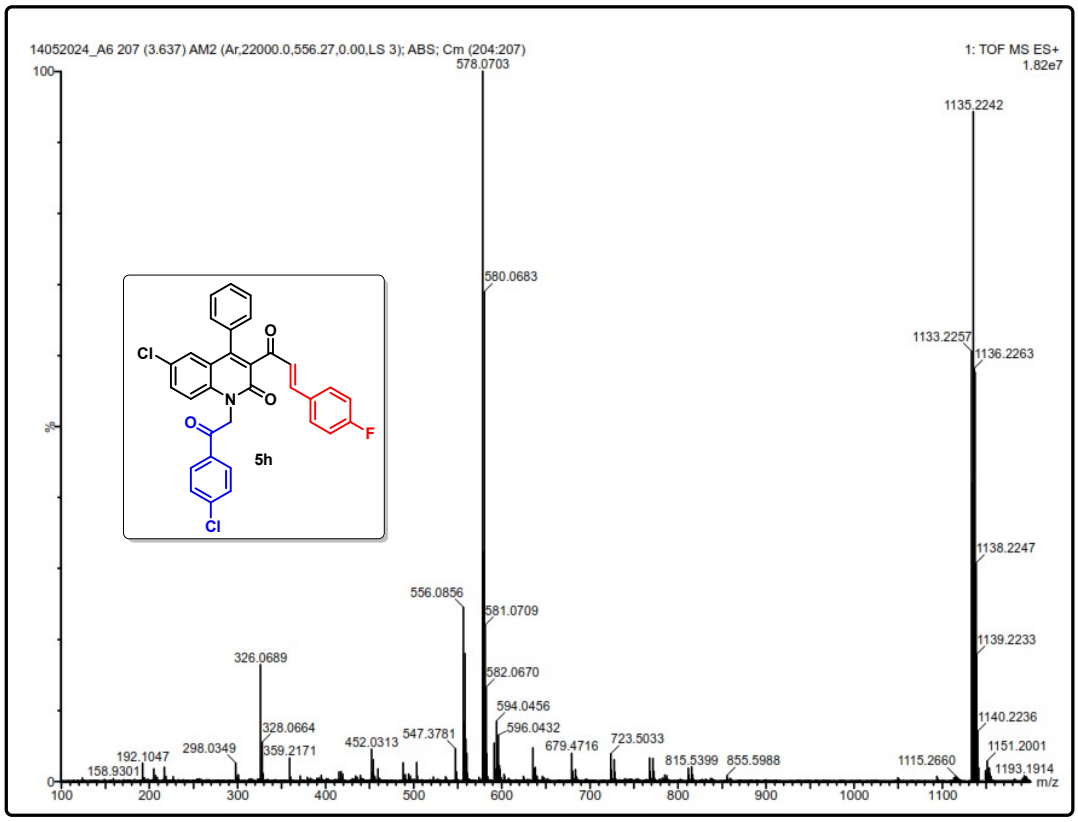


^{1}H and ^{13}C NMR spectra of compound **5h** in $CDCl_3$

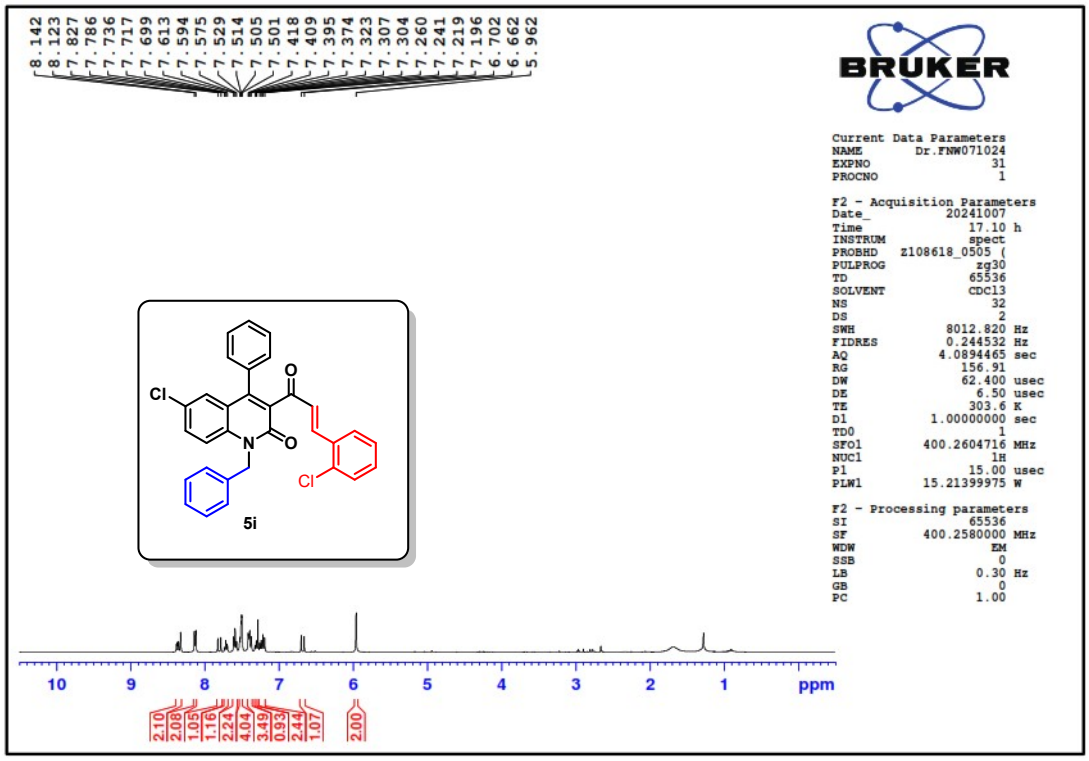


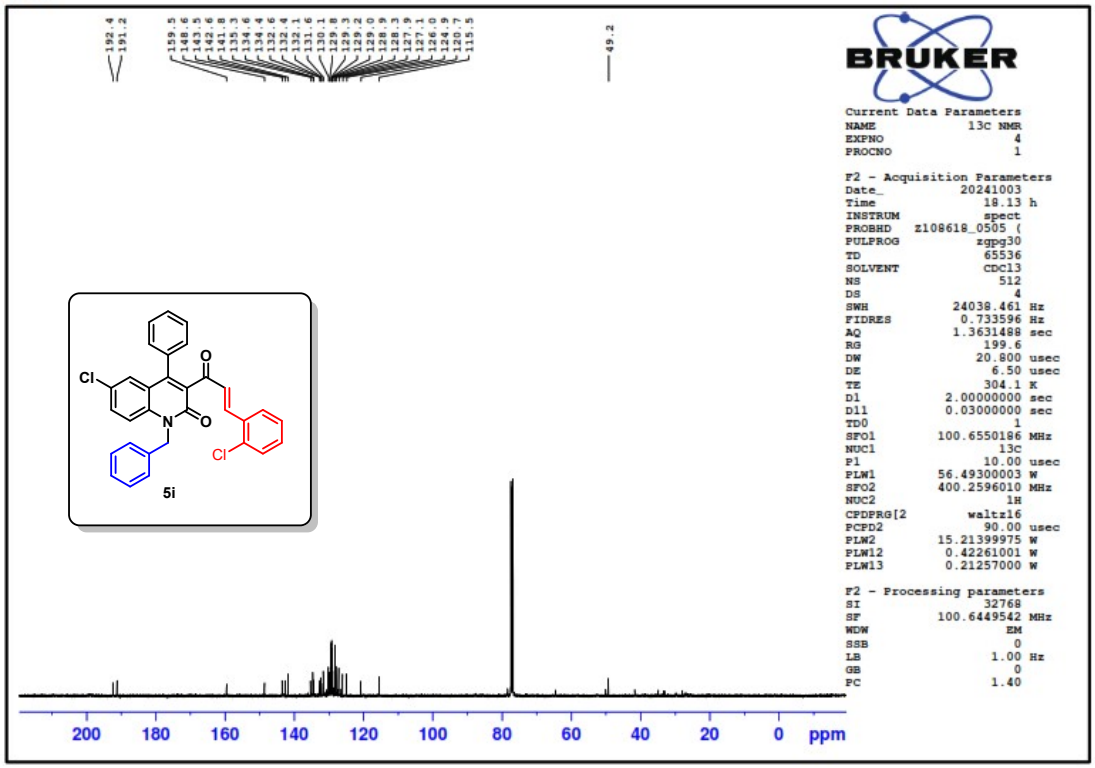
^{19}F spectra of compound **5h**



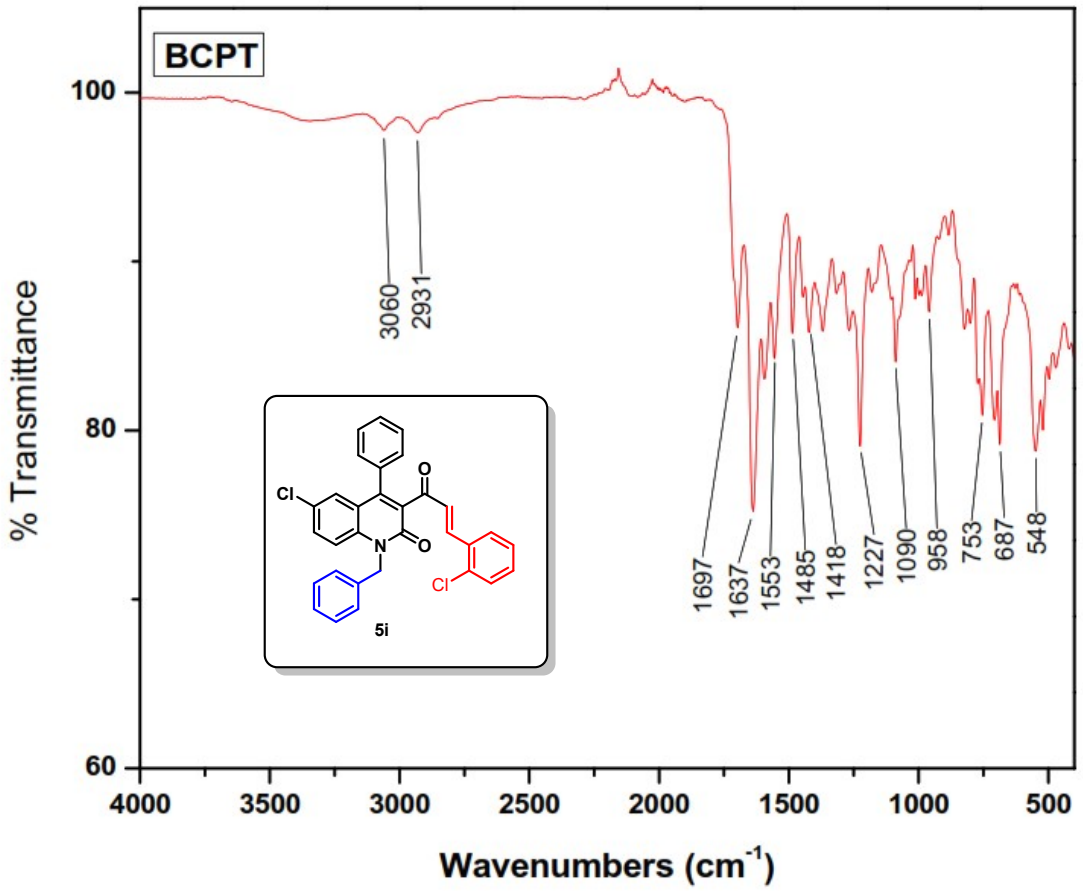


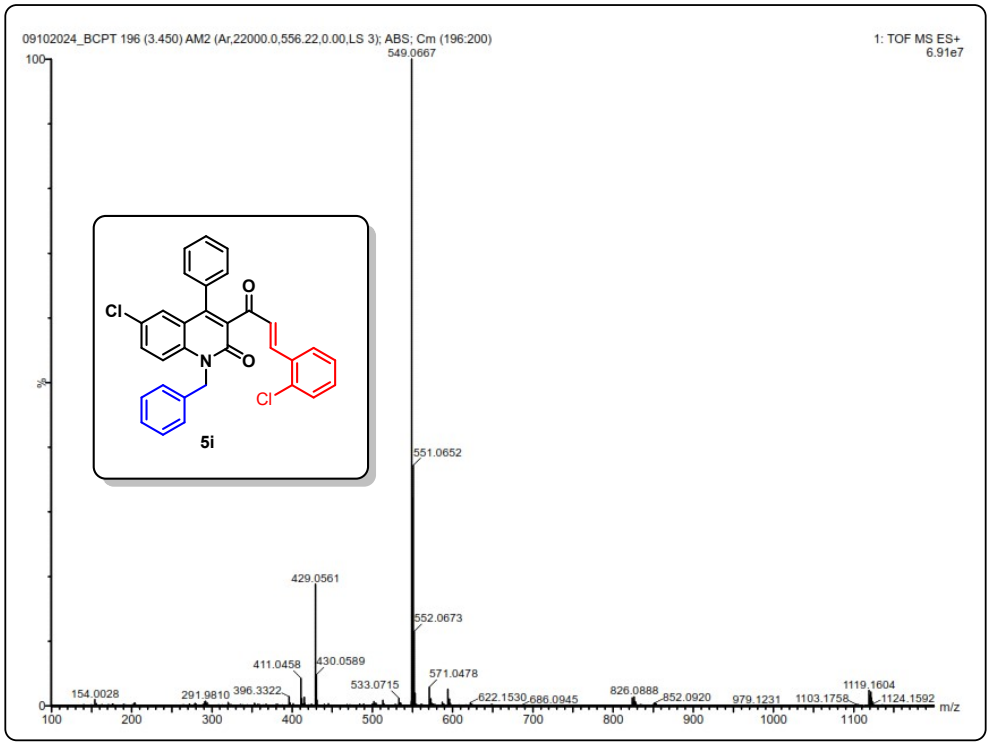
IR and HRMS spectra of compound **5h**



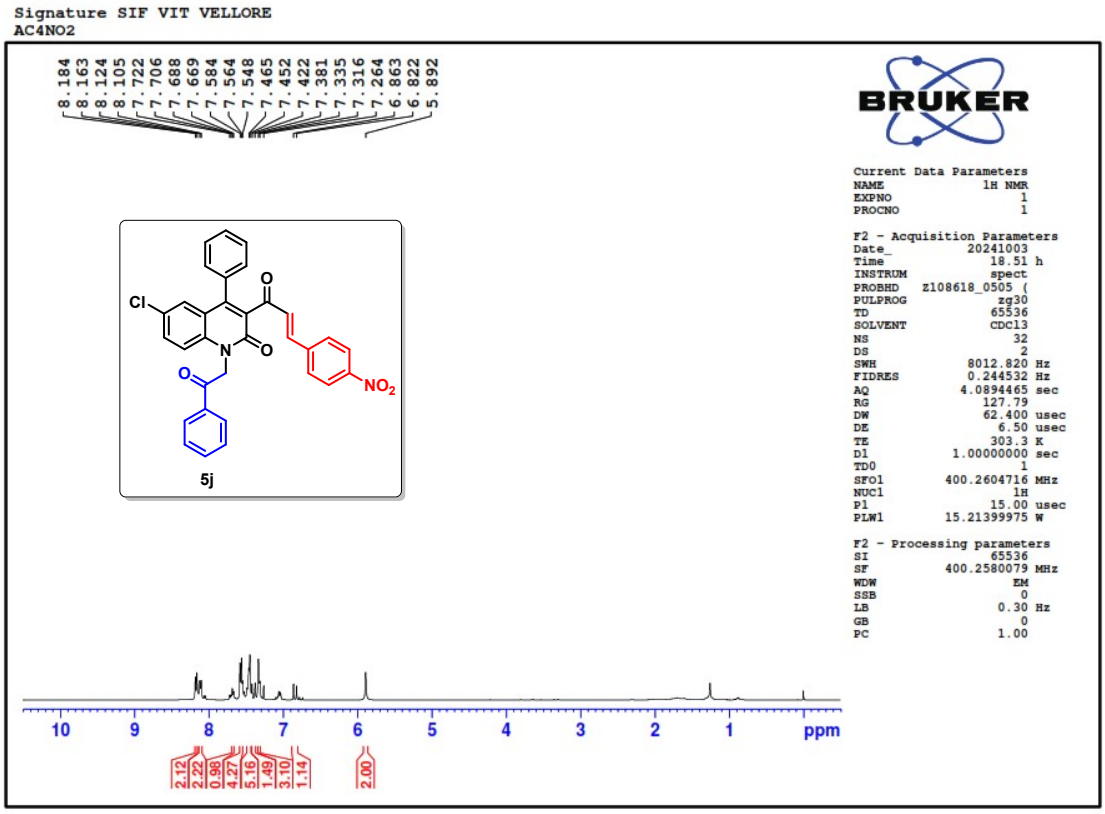


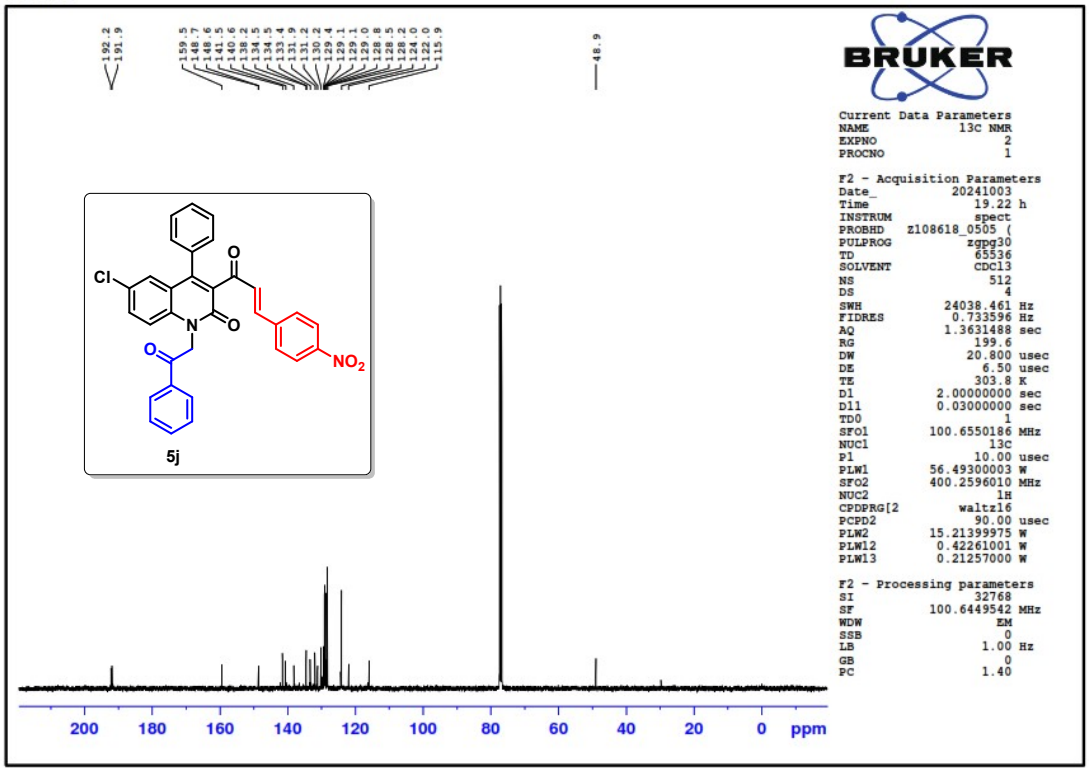
^{1}H and ^{13}C NMR spectra of compound **5i** in $CDCl_3$



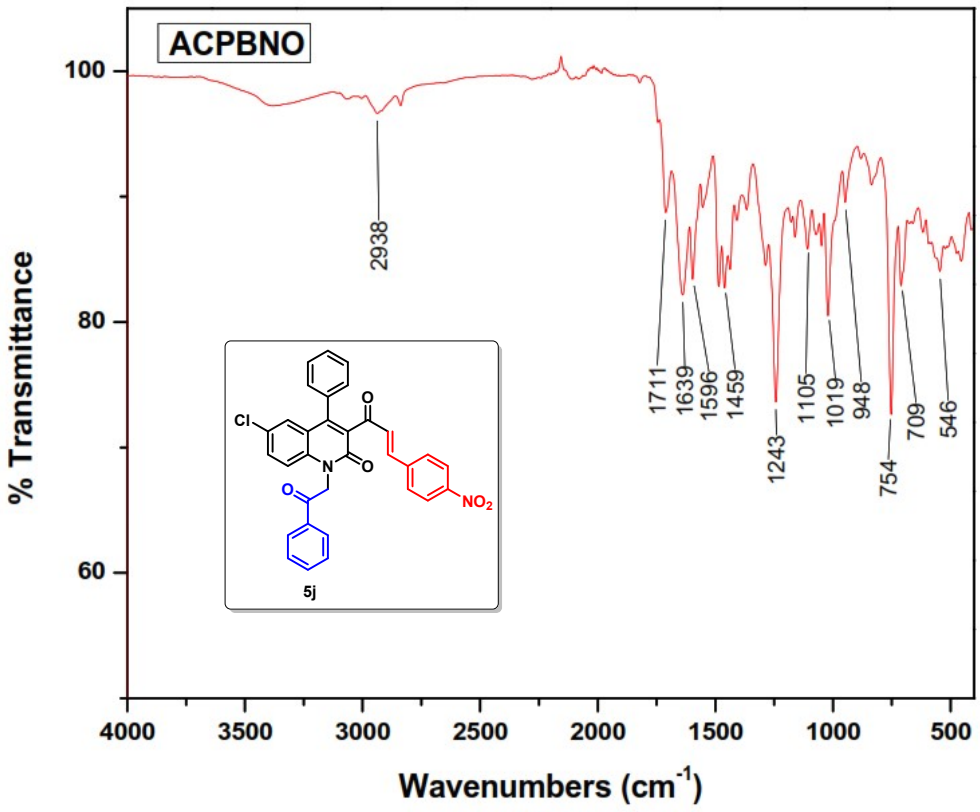


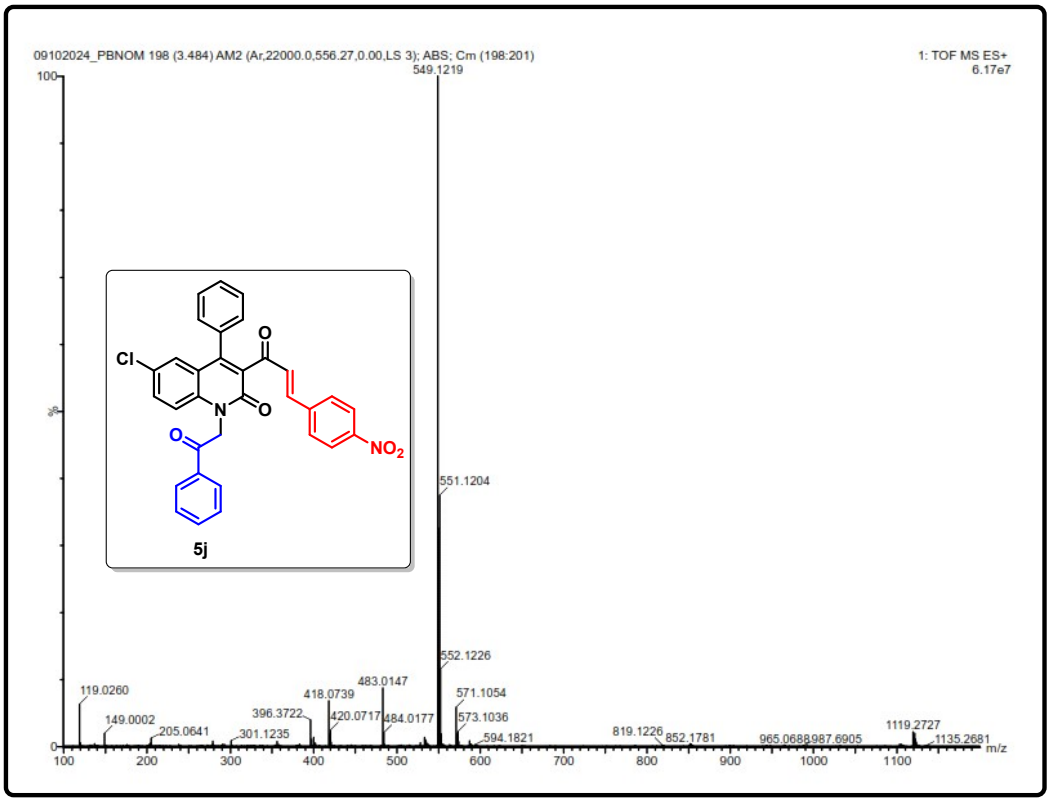
IR and HRMS spectra of compound **5i**



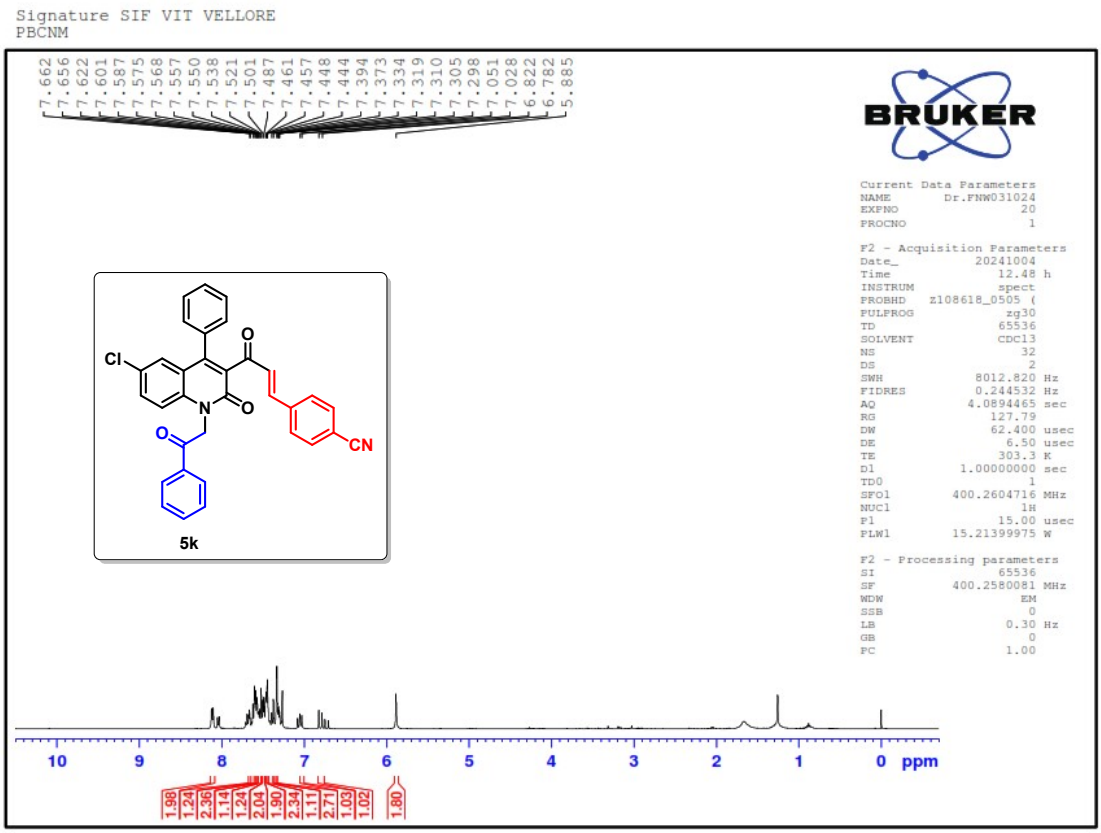


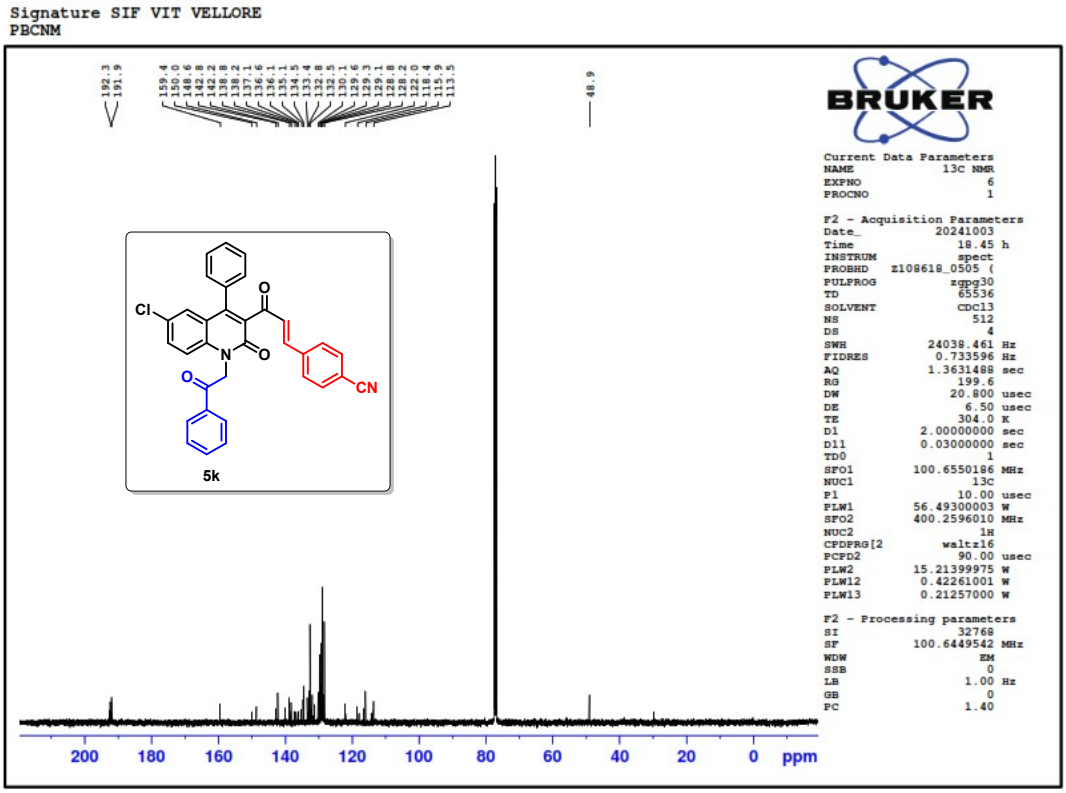
^{1}H and ^{13}C NMR spectra of compound **5j** in $CDCl_3$



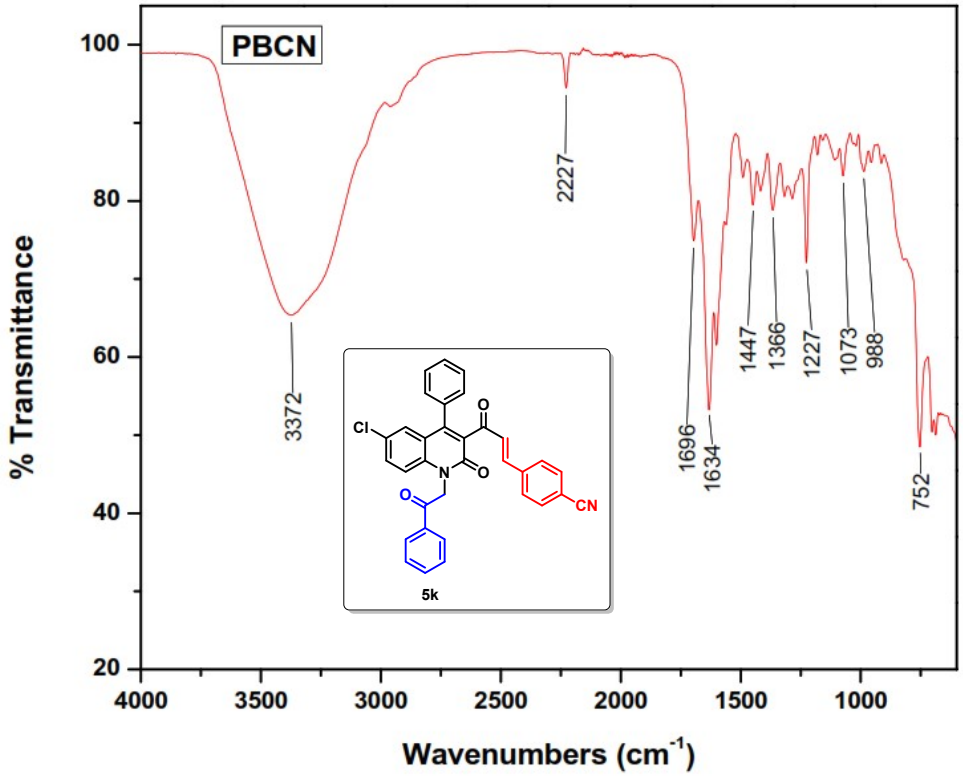


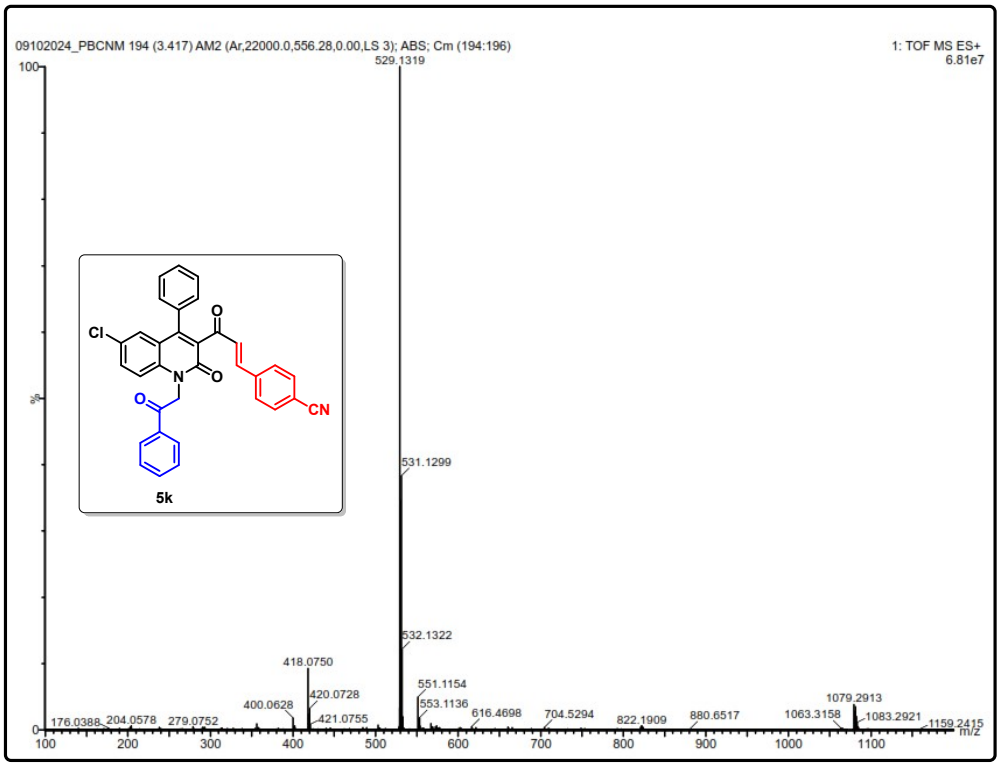
IR and HRMS spectra of compound **5j**



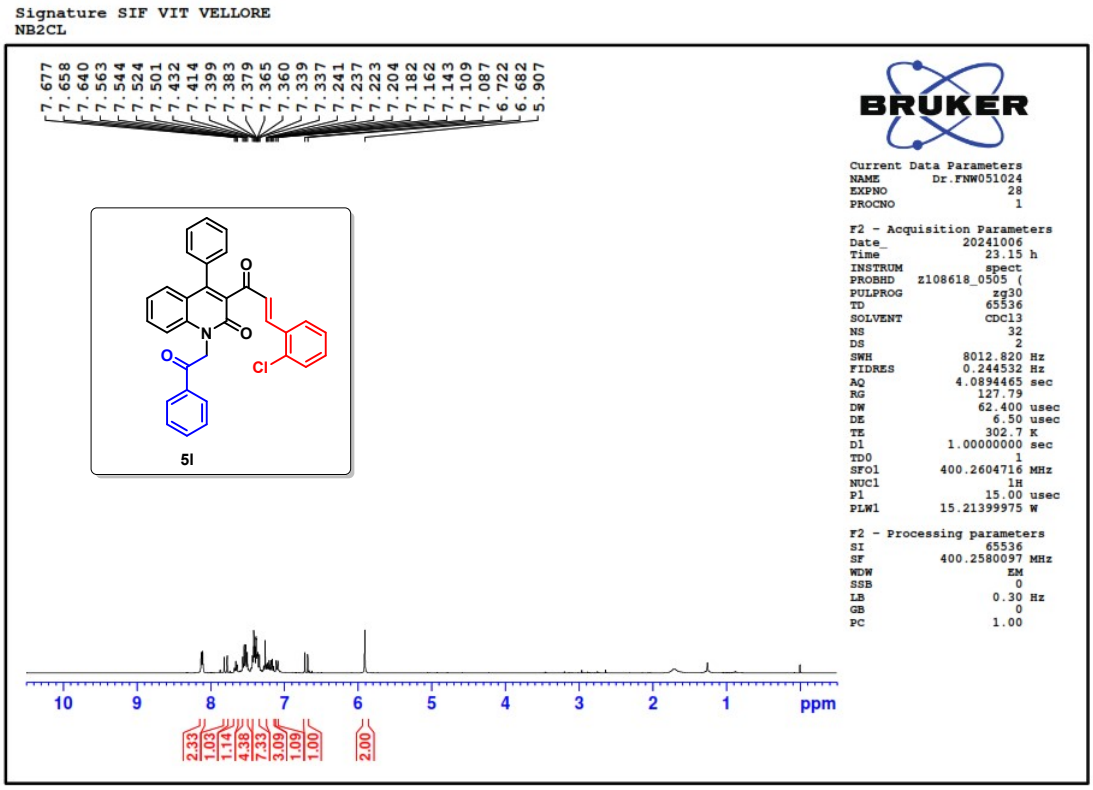


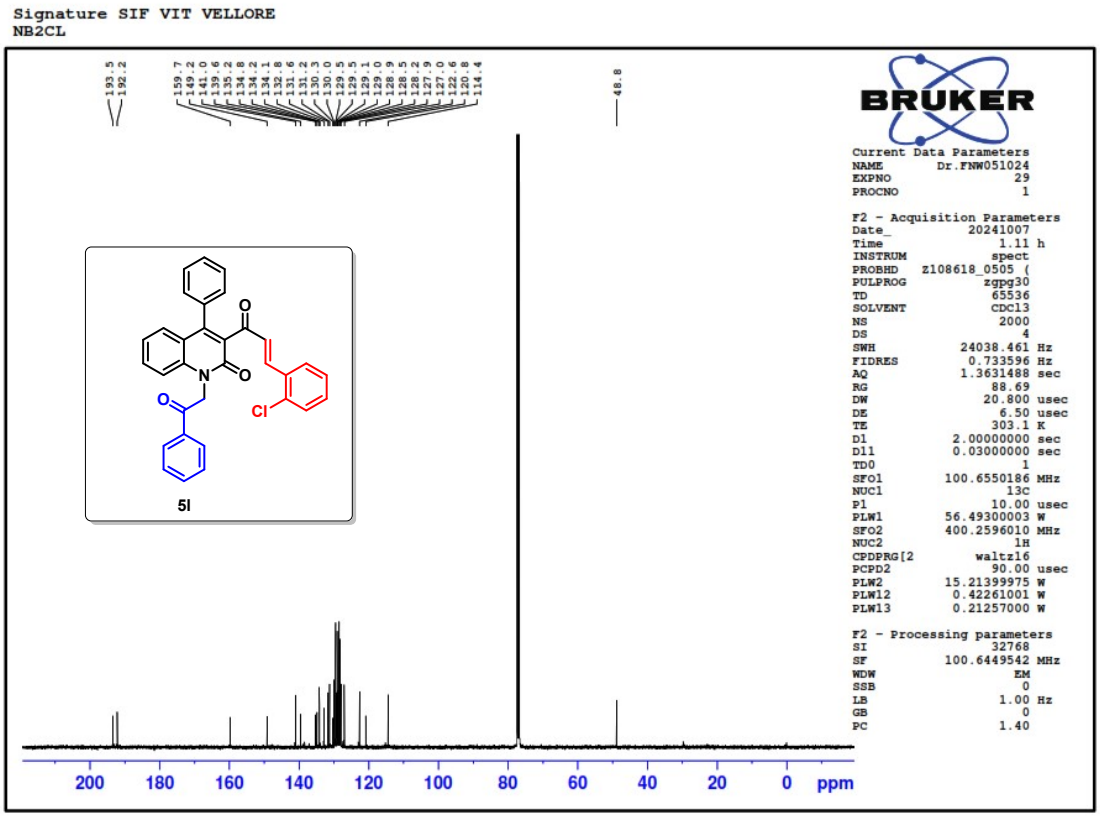
^{1}H and ^{13}C NMR spectra of compound **5k** in $CDCl_3$



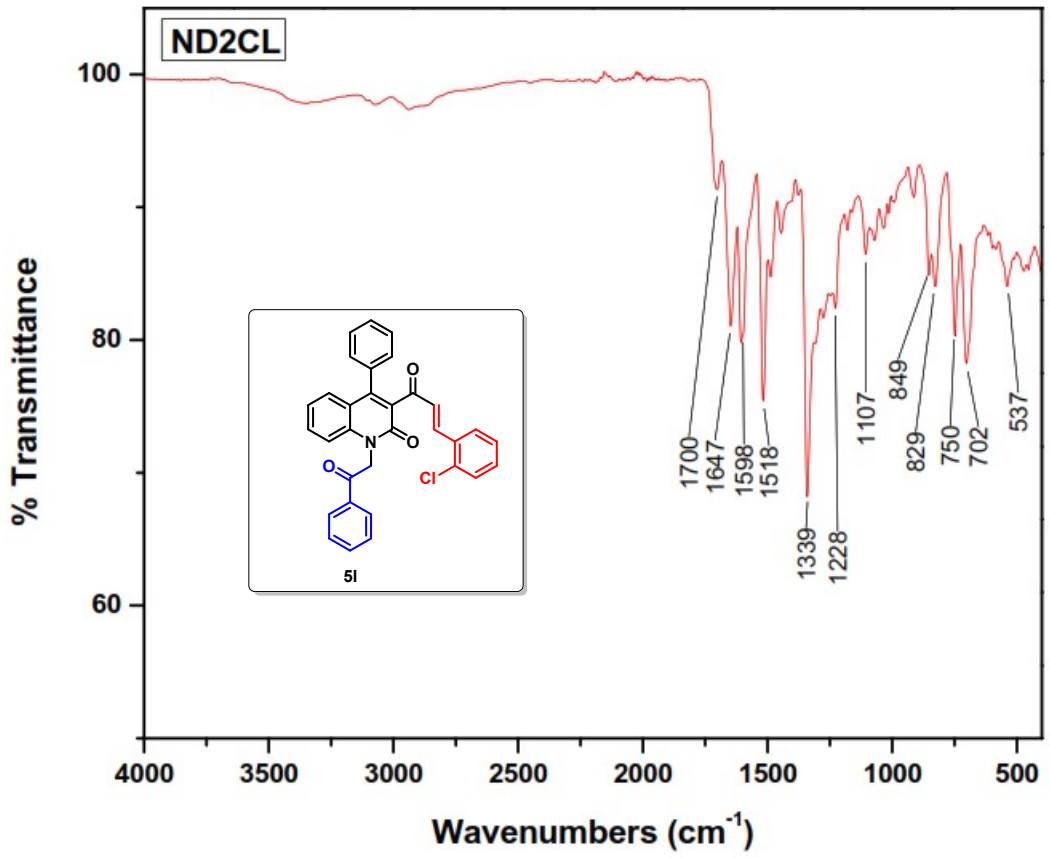


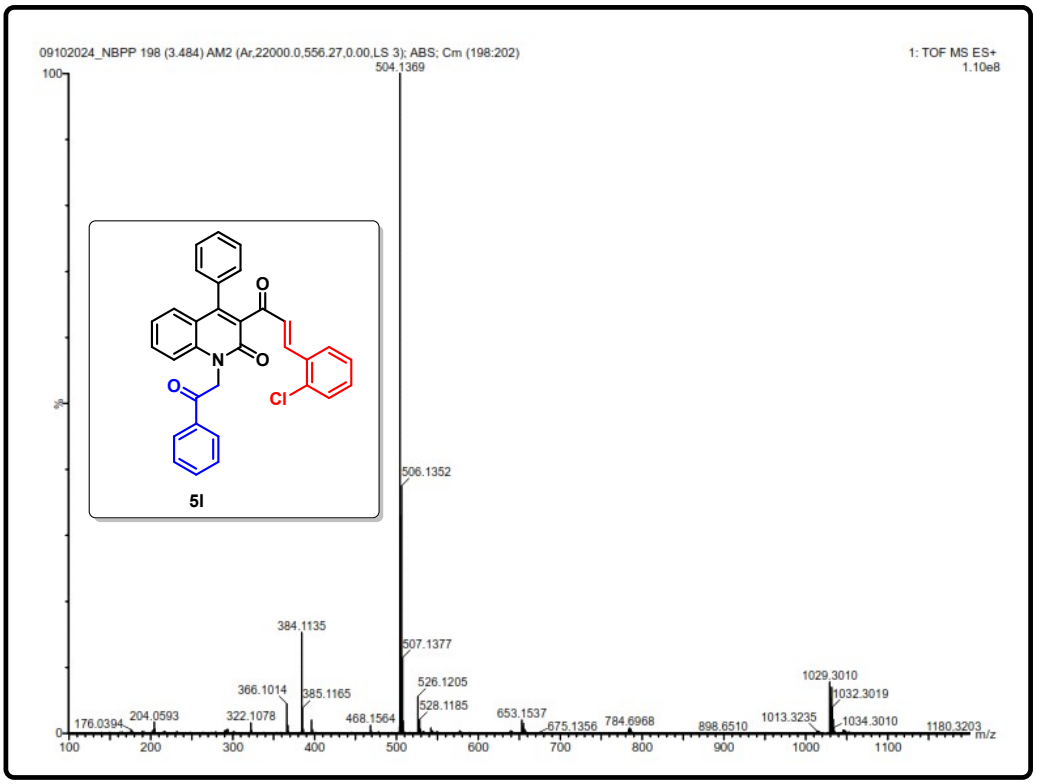
IR and HRMS spectra of compound **5k**



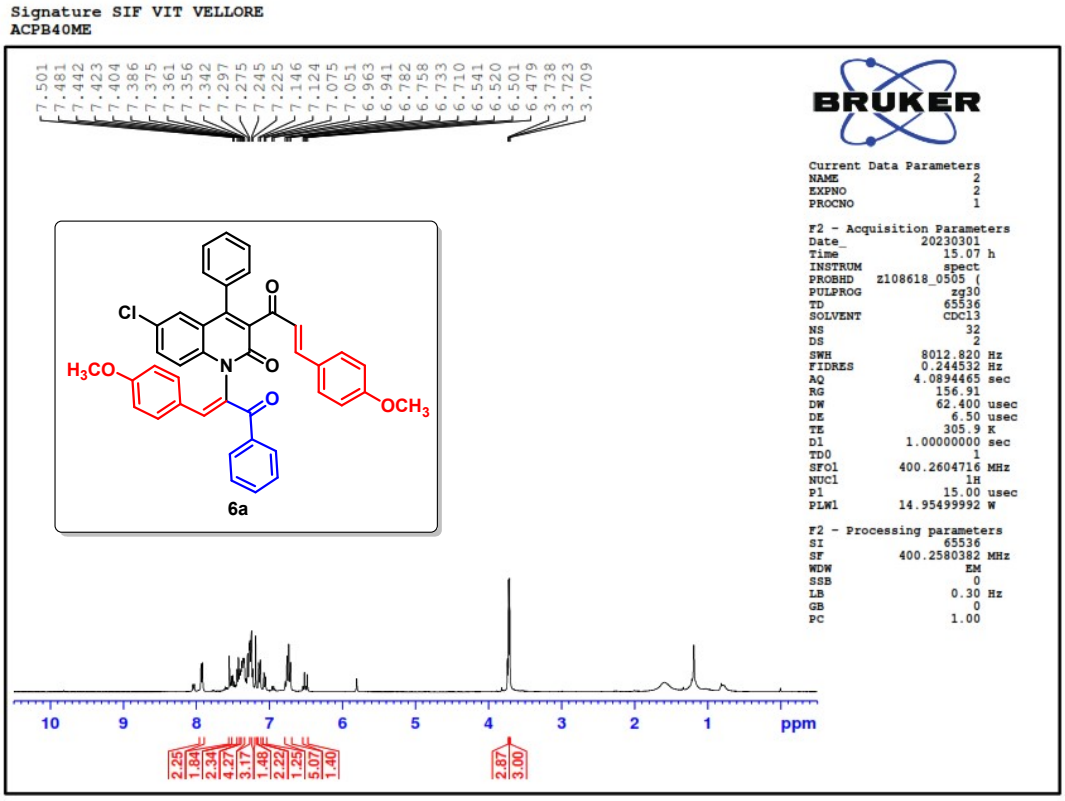


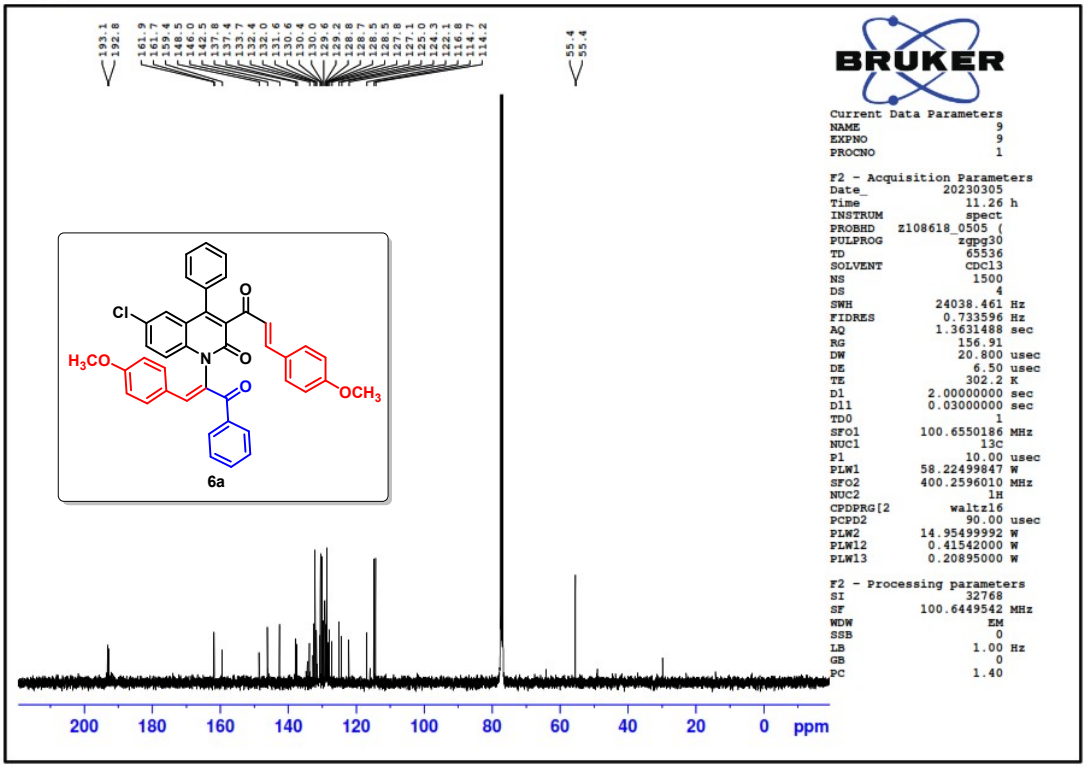
^{1}H and ^{13}C NMR spectra of compound **5l** in $CDCl_3$



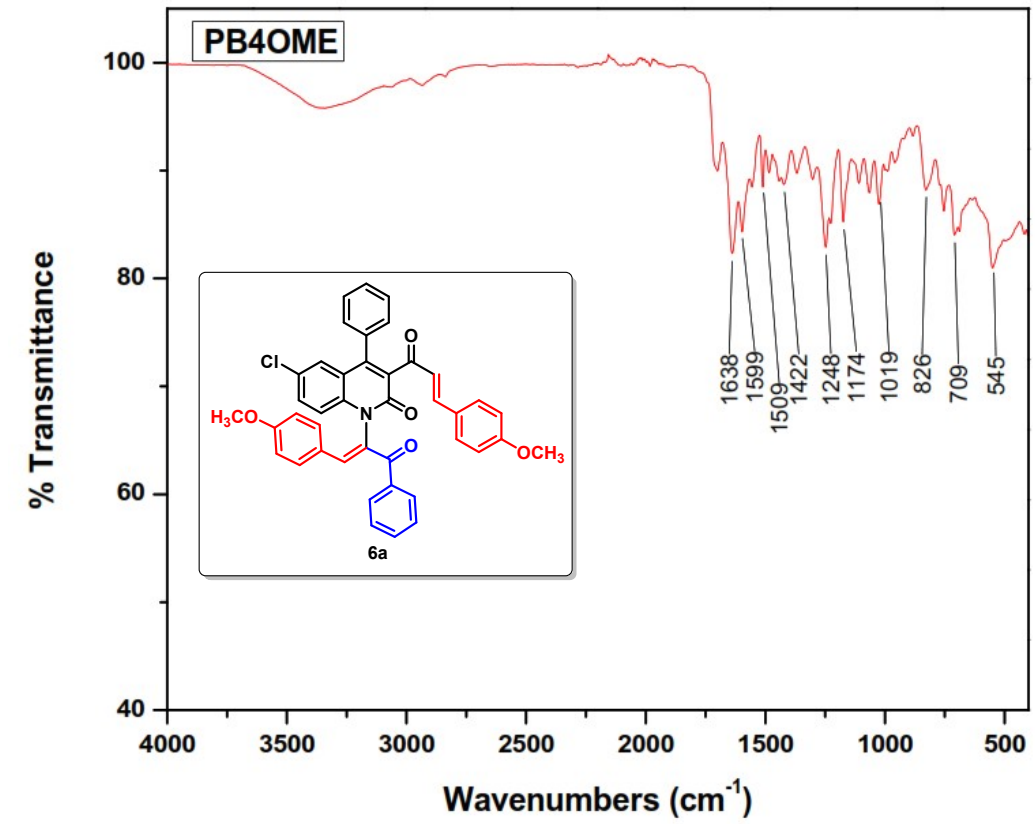


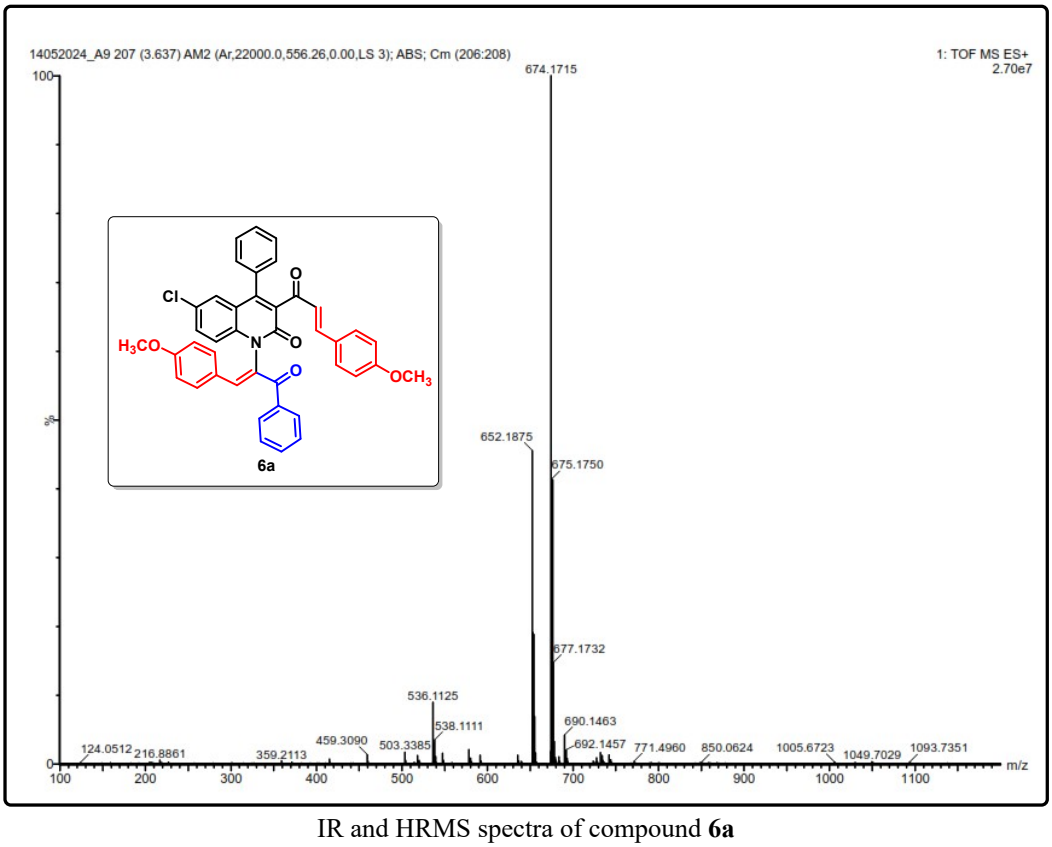
IR and HRMS spectra of compound **5l**



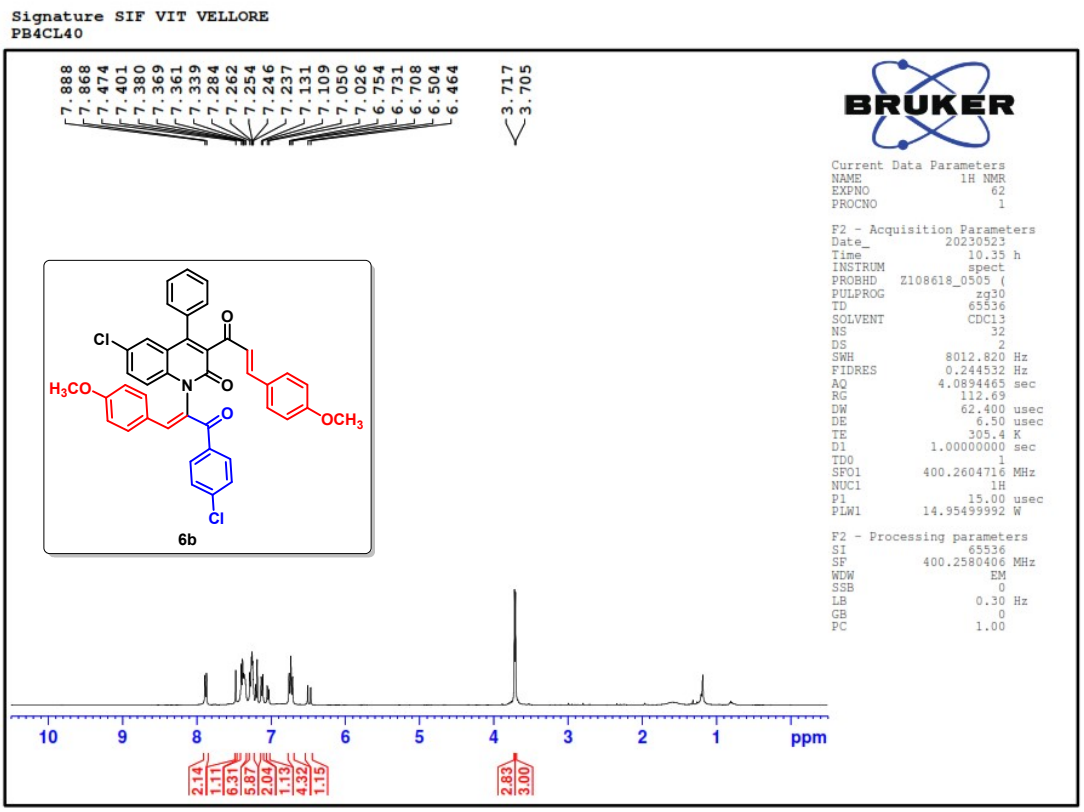


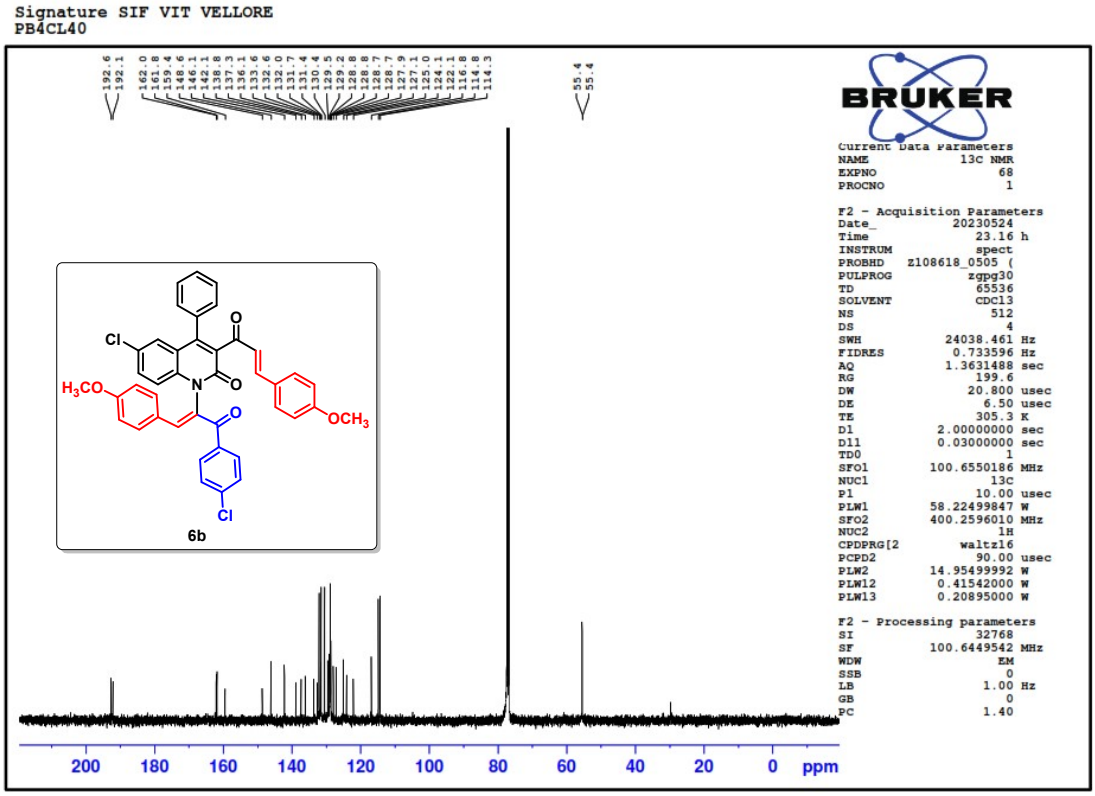
^{1}H and ^{13}C NMR spectra of compound **6a** in $CDCl_3$



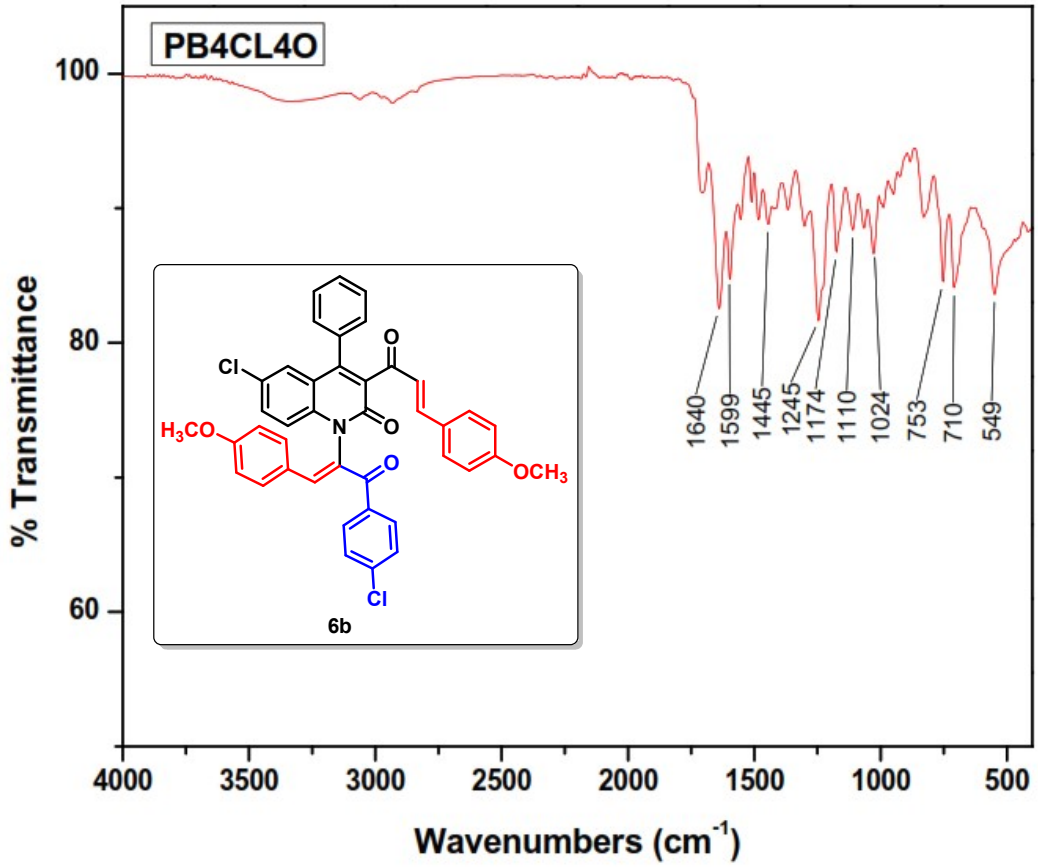


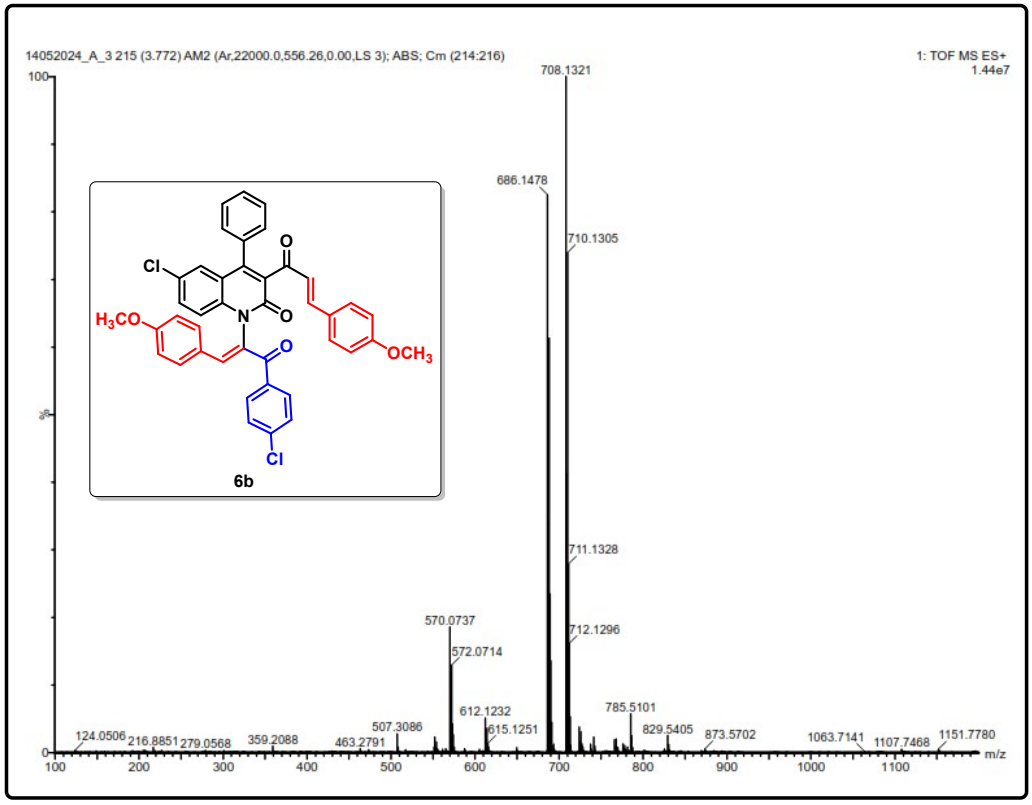
IR and HRMS spectra of compound **6a**



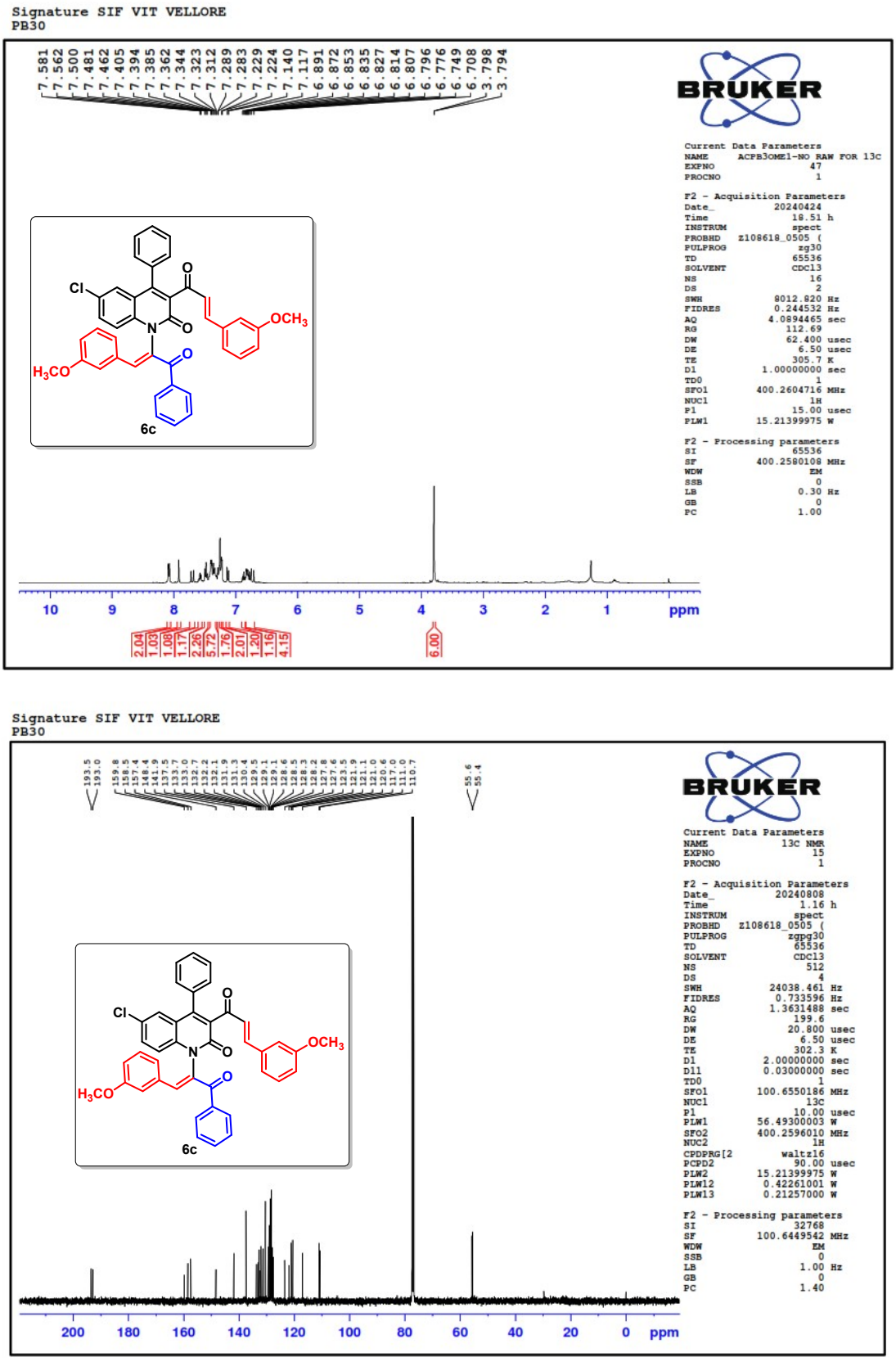


^{1}H and ^{13}C NMR spectra of compound **6b** in $CDCl_3$

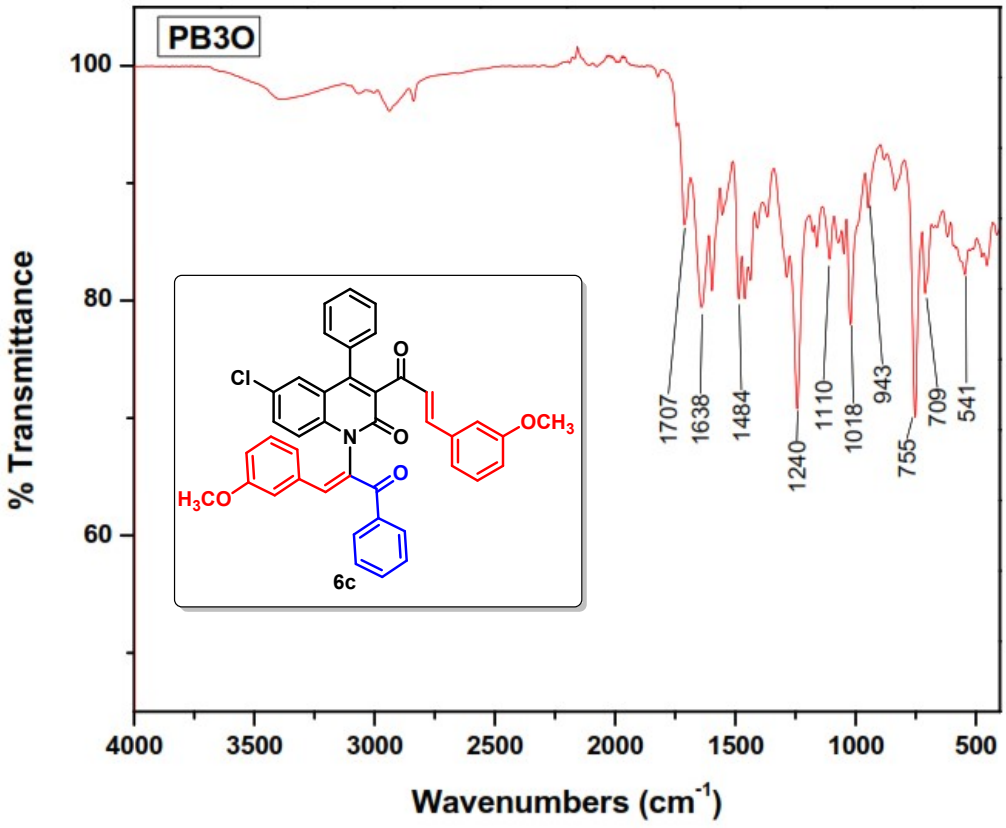


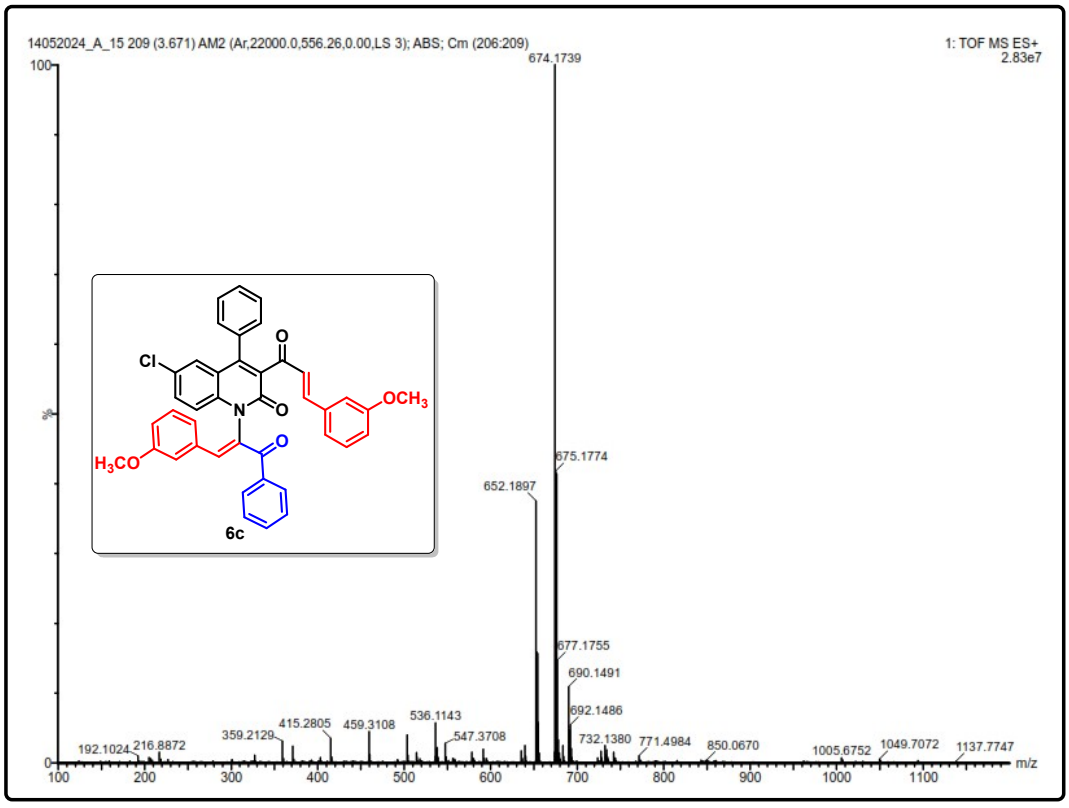


IR and HRMS spectra of compound **6b**

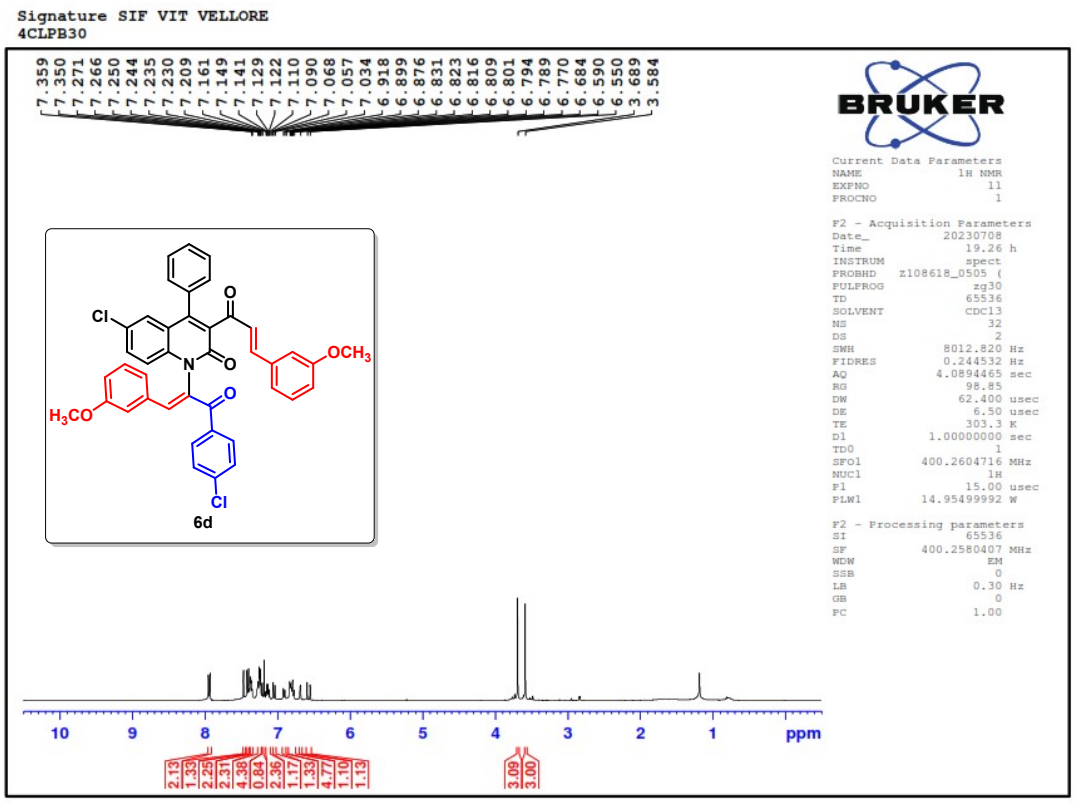


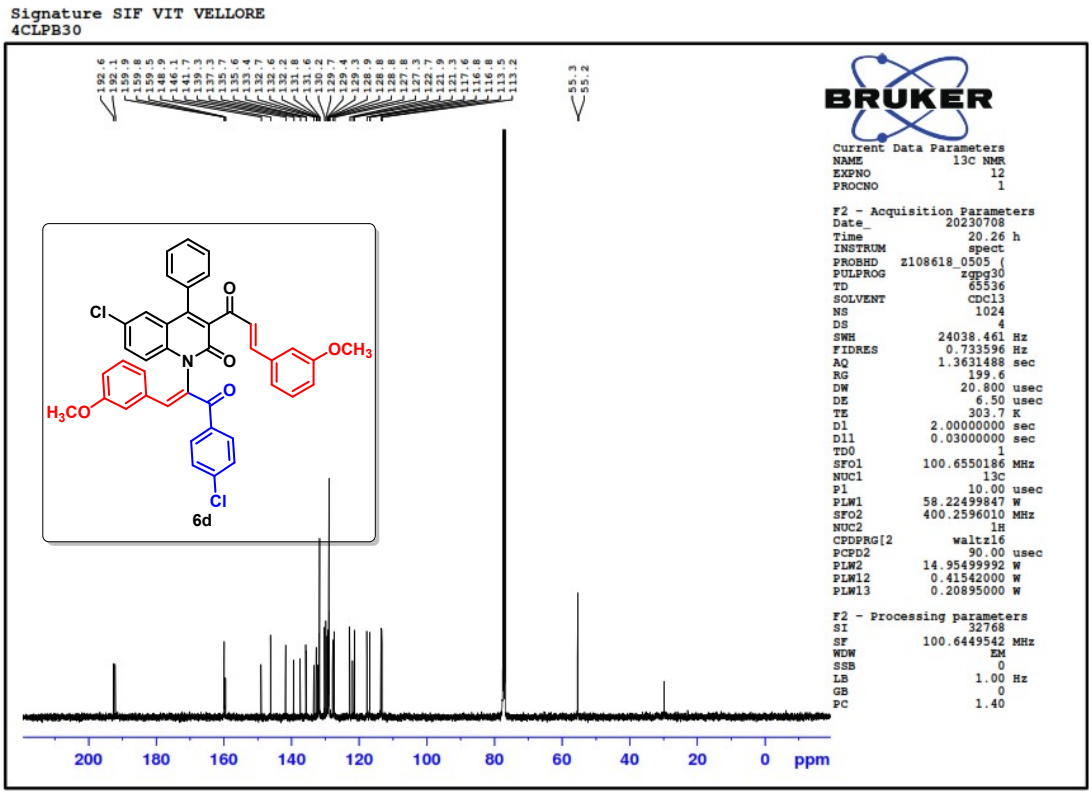
^{1}H and ^{13}C NMR spectra of compound **6c** in $CDCl_3$



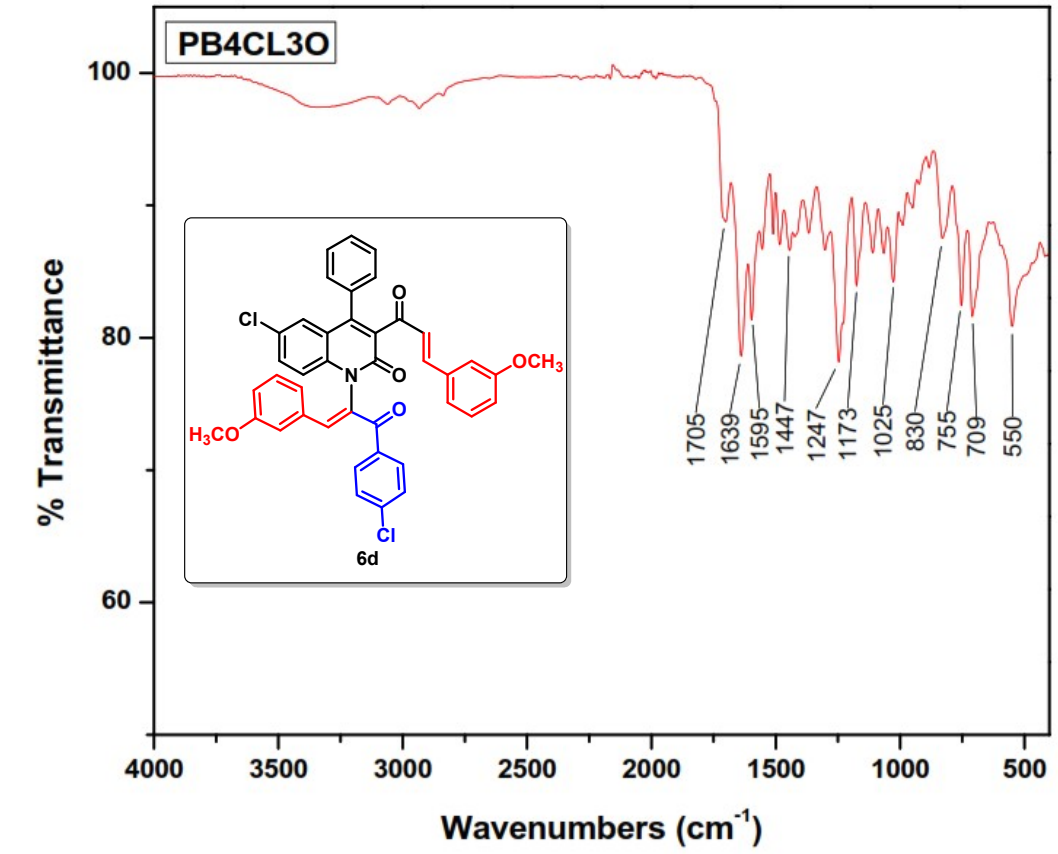


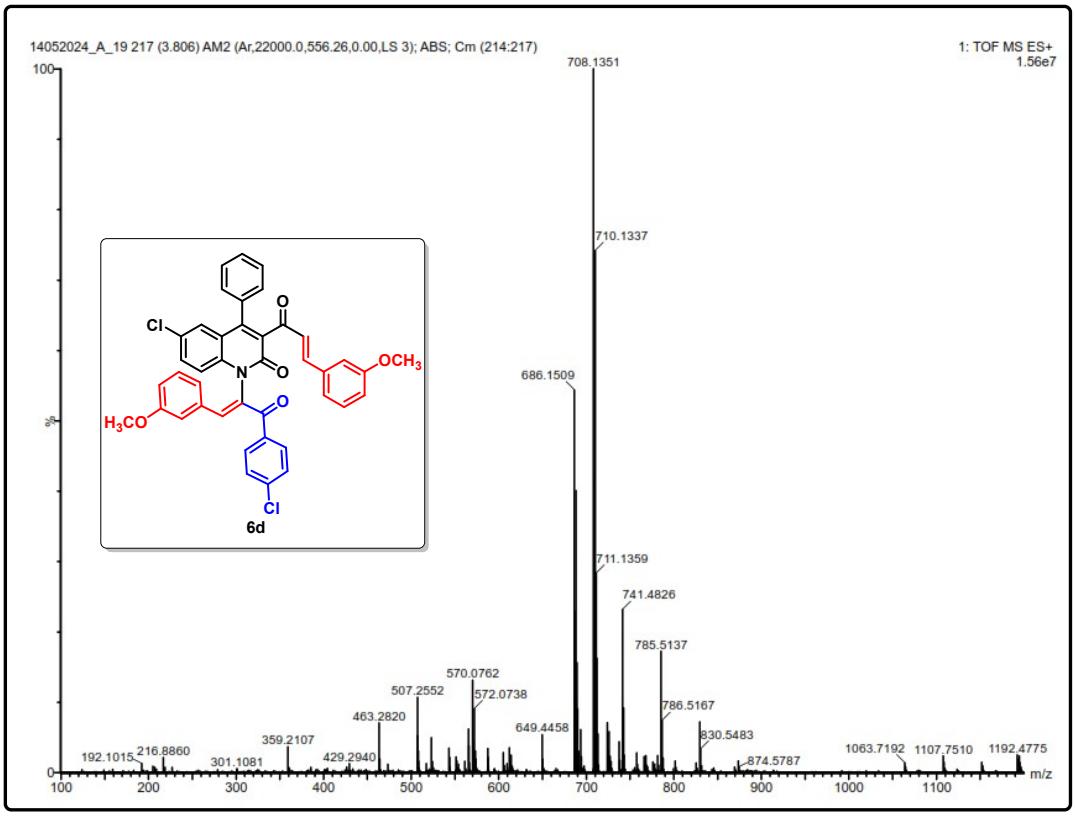
IR and HRMS spectra of compound **6c**



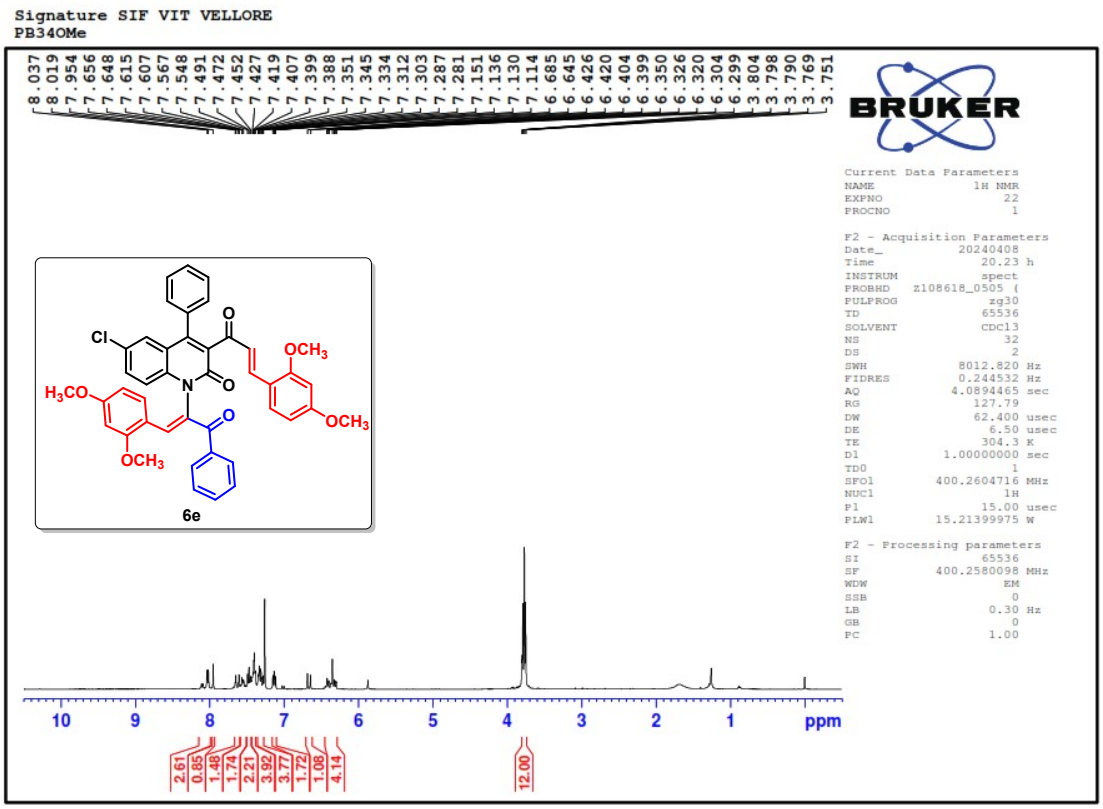


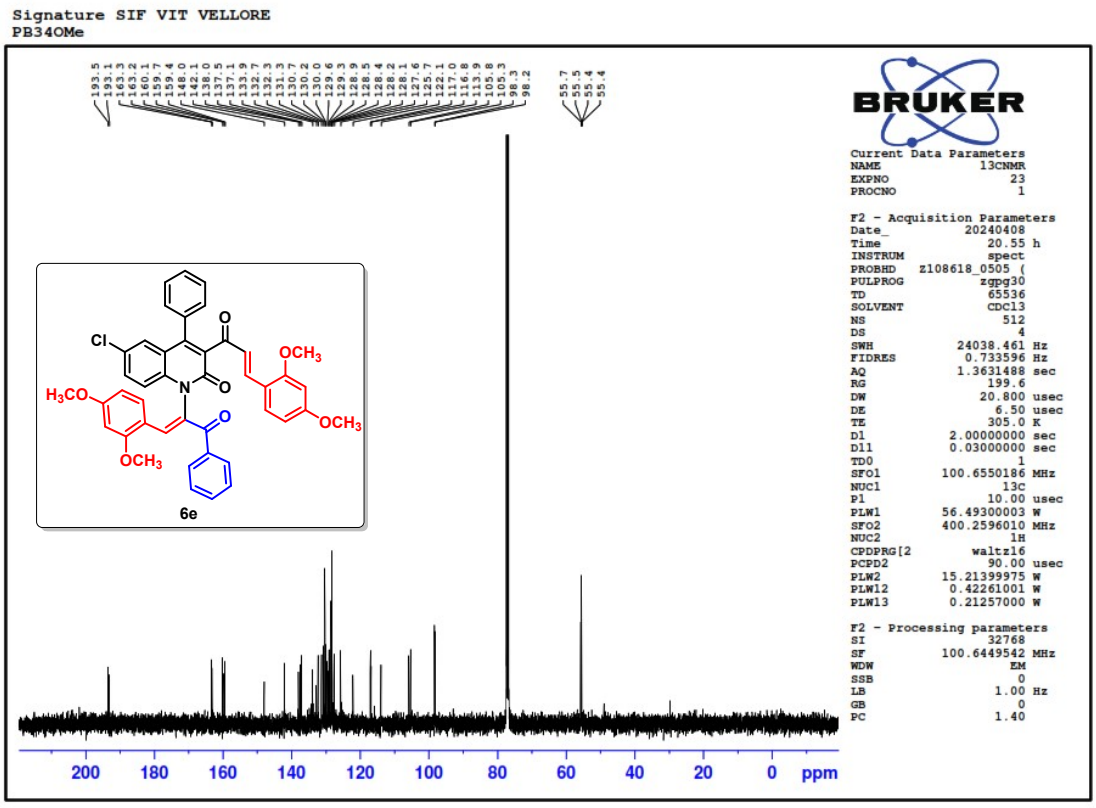
^{1}H and ^{13}C NMR spectra of compound **6d** in $CDCl_3$



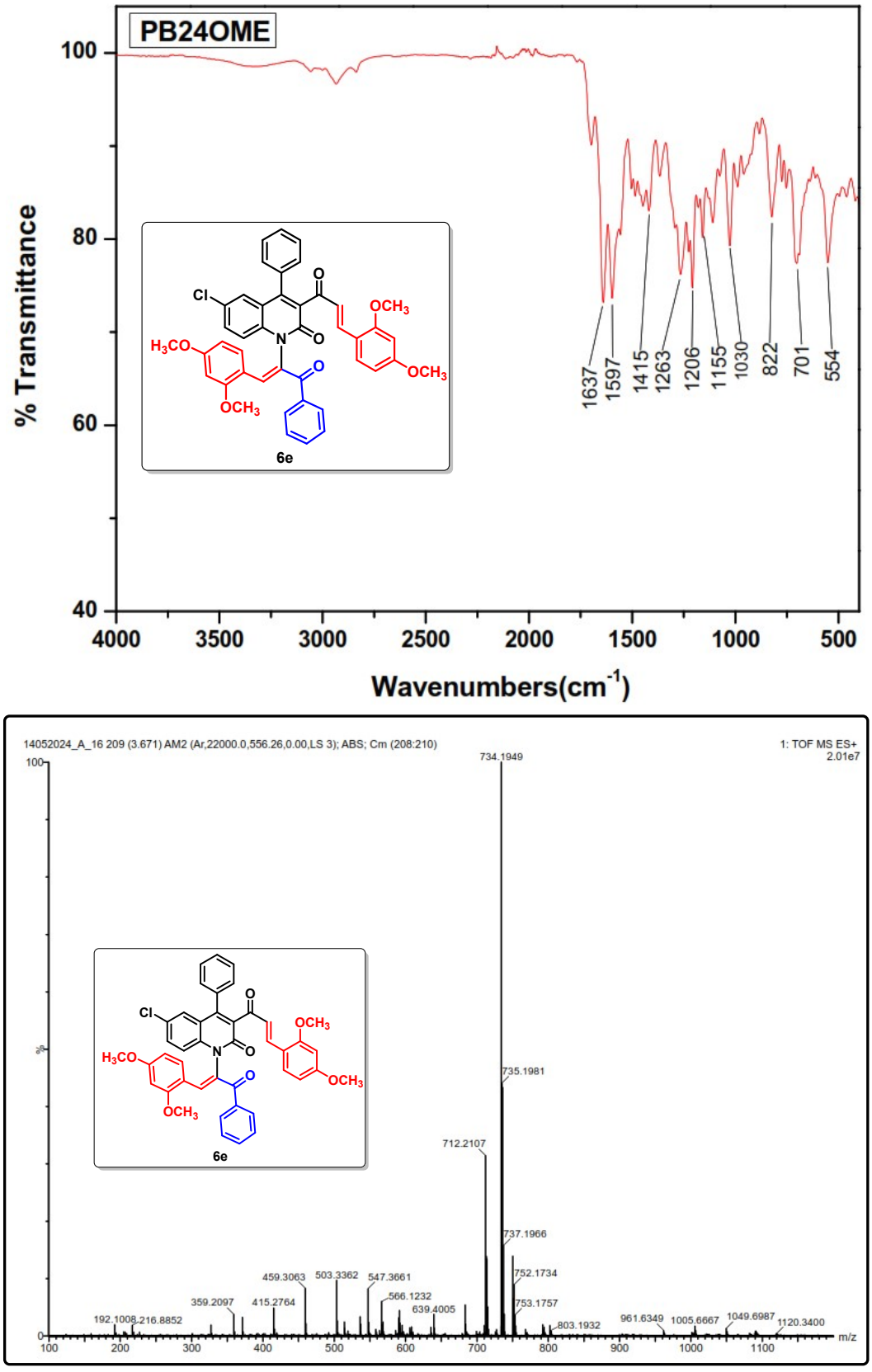


IR and HRMS spectra of compound **6d**

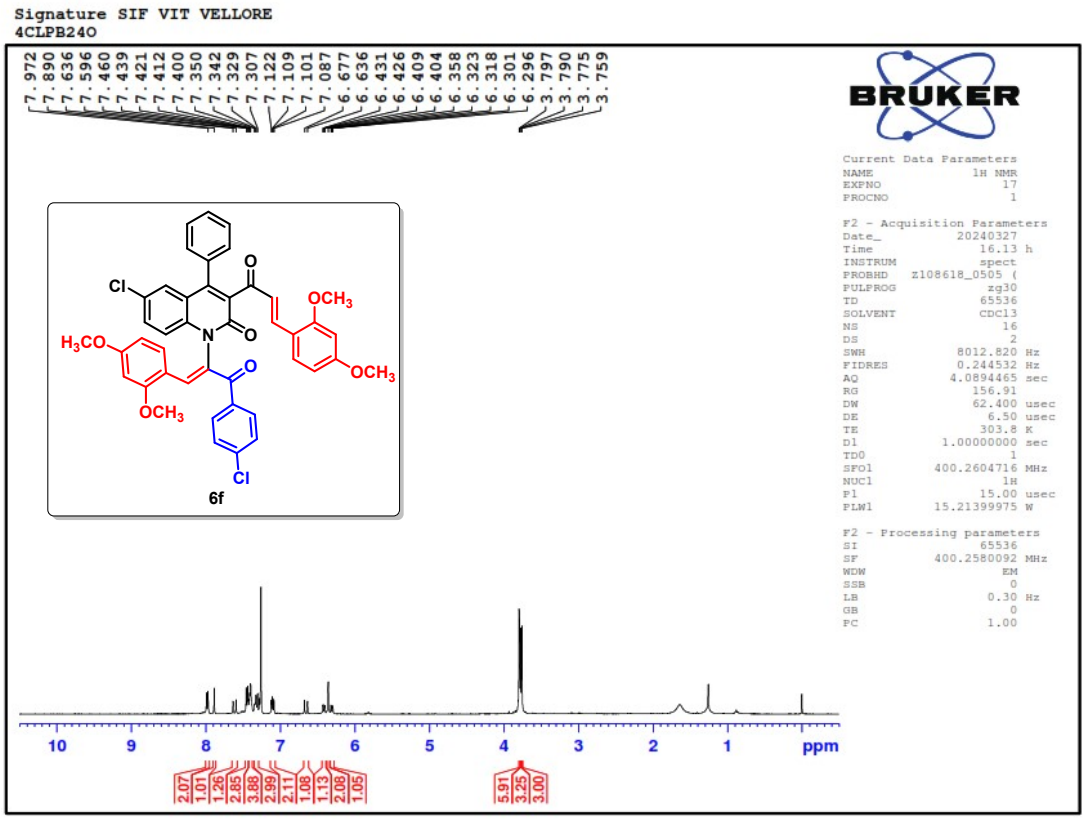


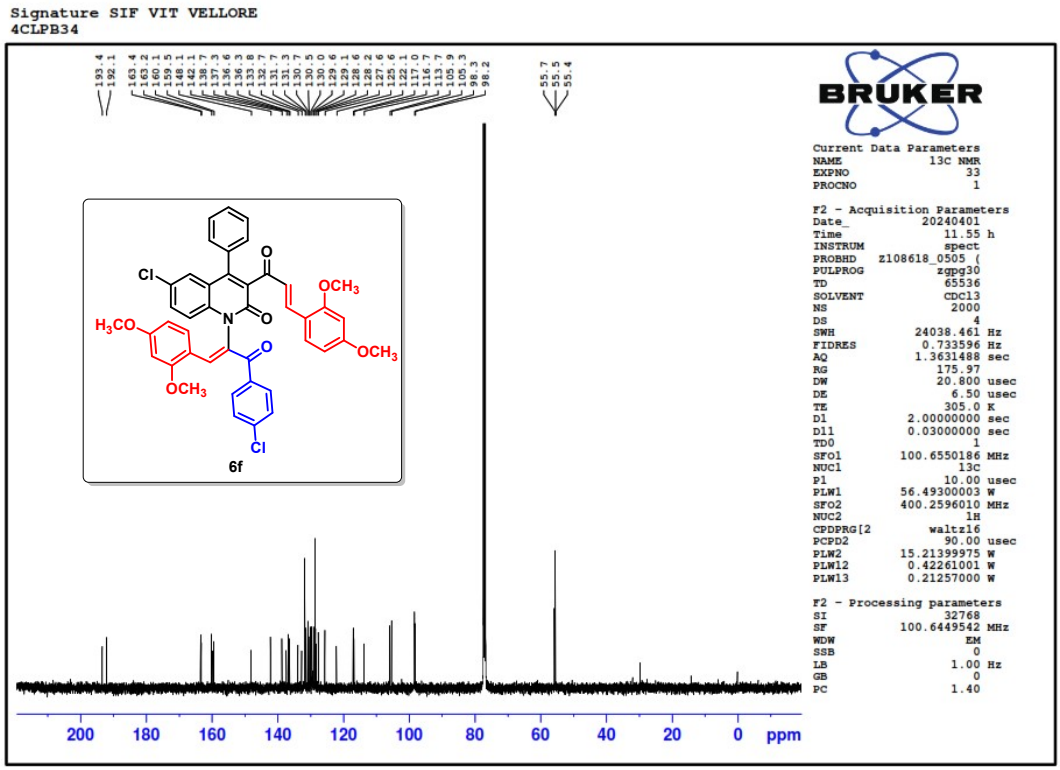


^{1}H and ^{13}C NMR spectra of compound **6e** in $CDCl_3$

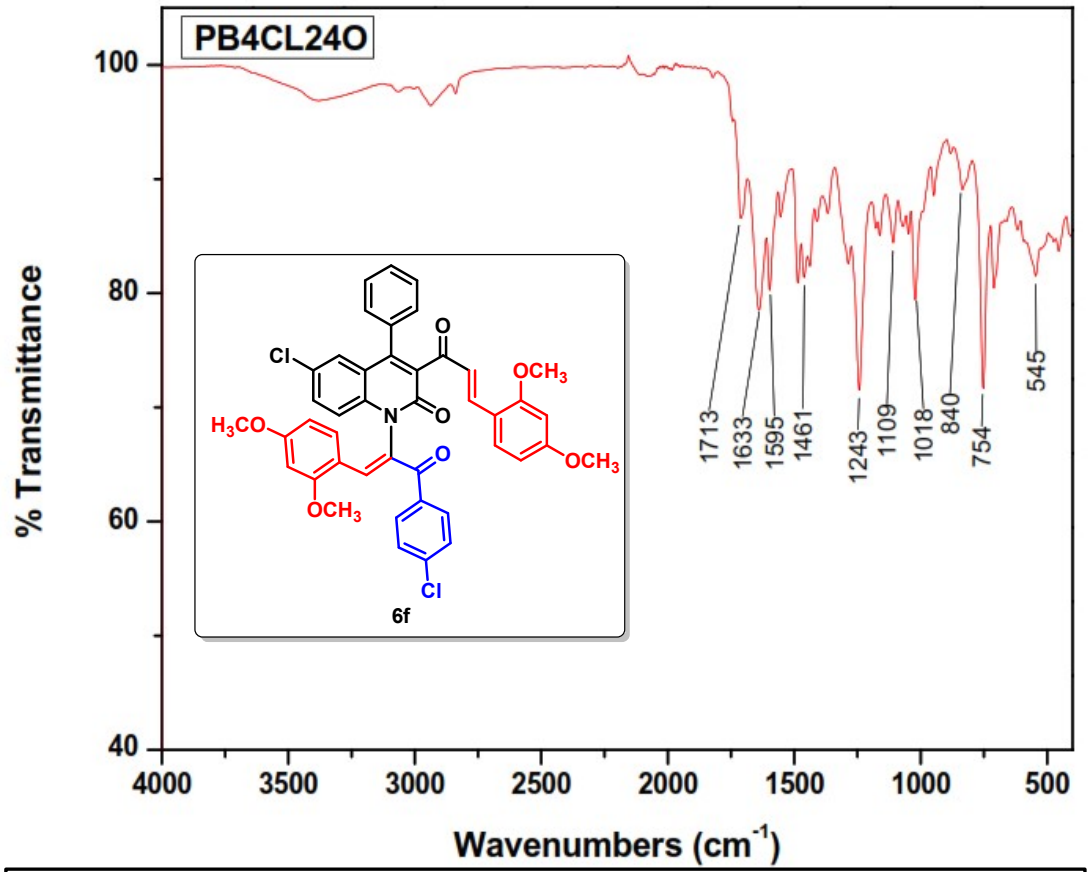


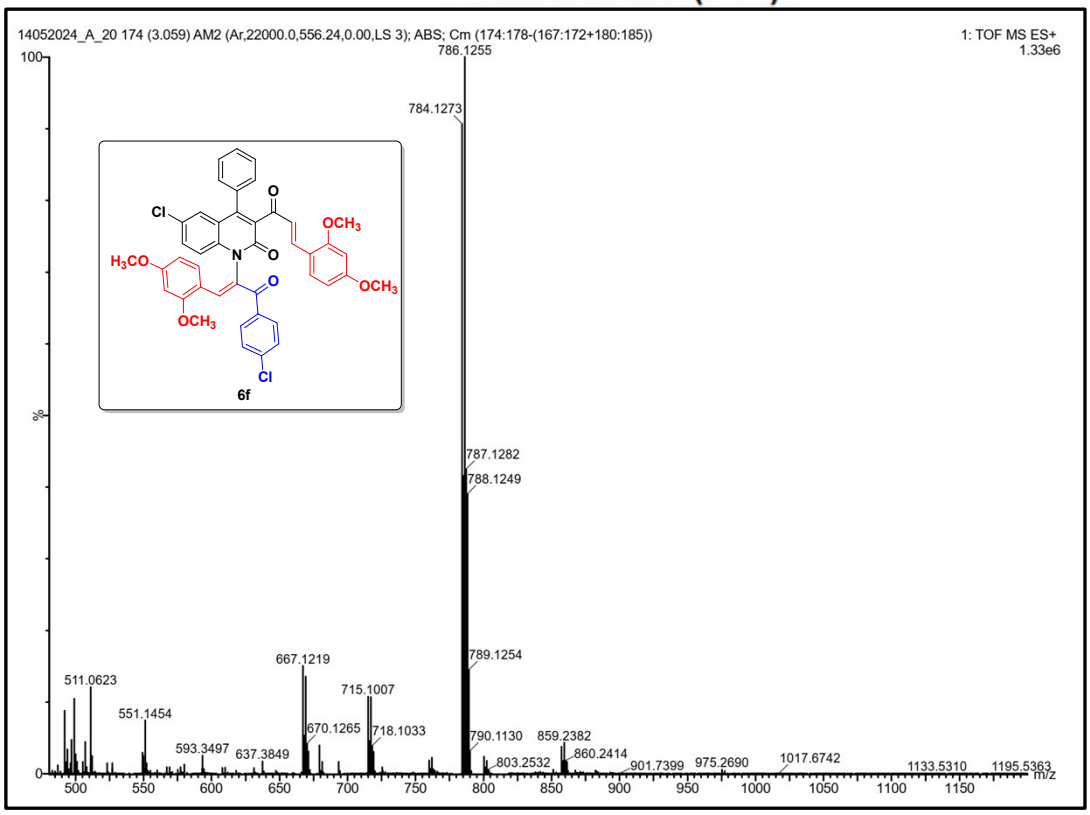
IR and HRMS spectra of compound **6e**



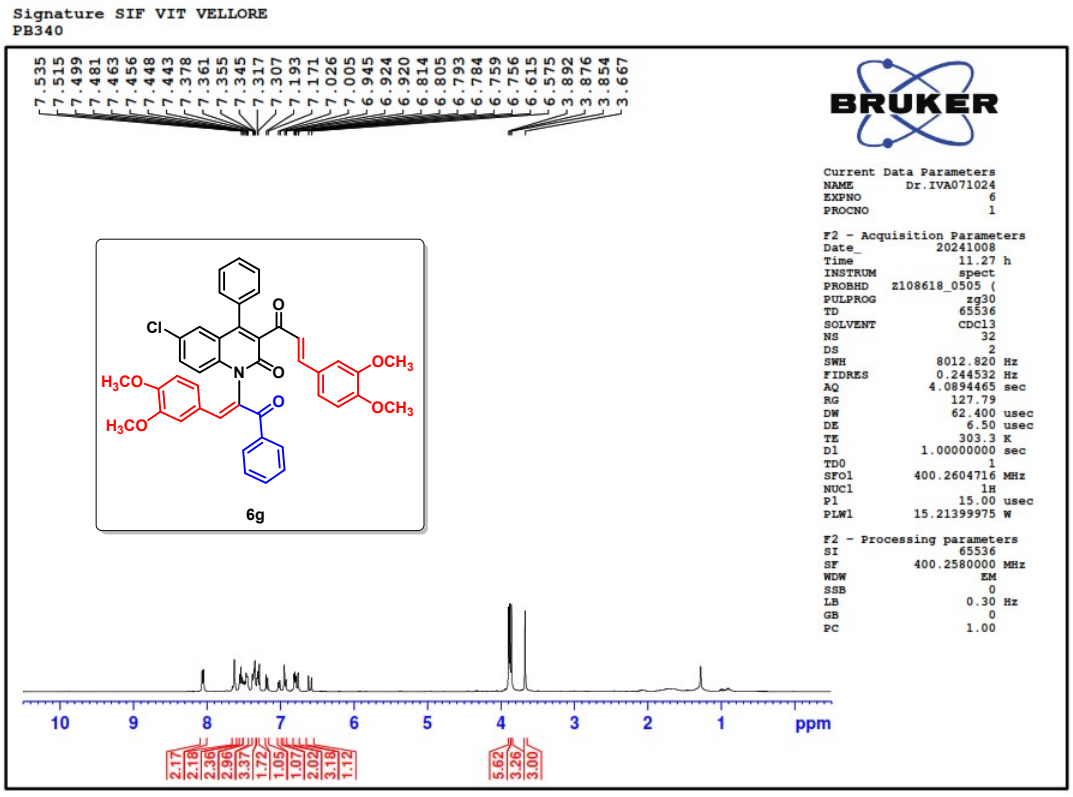


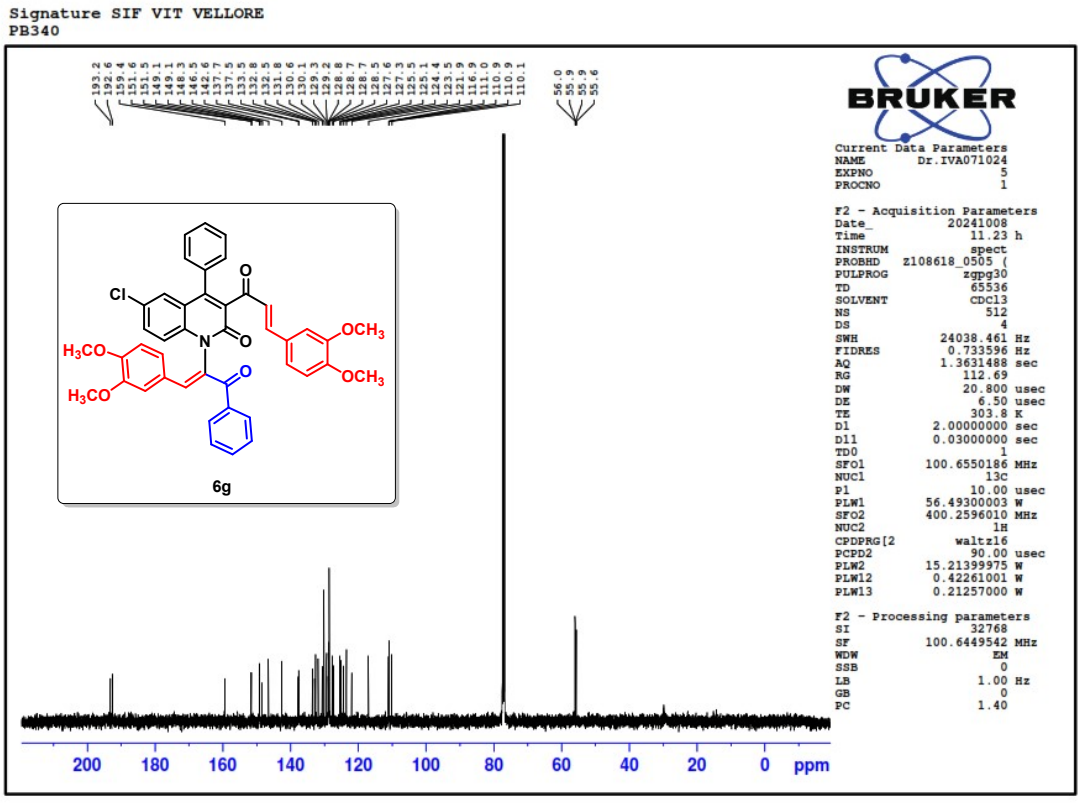
^{1}H and ^{13}C NMR spectra of compound **6f** in $CDCl_3$



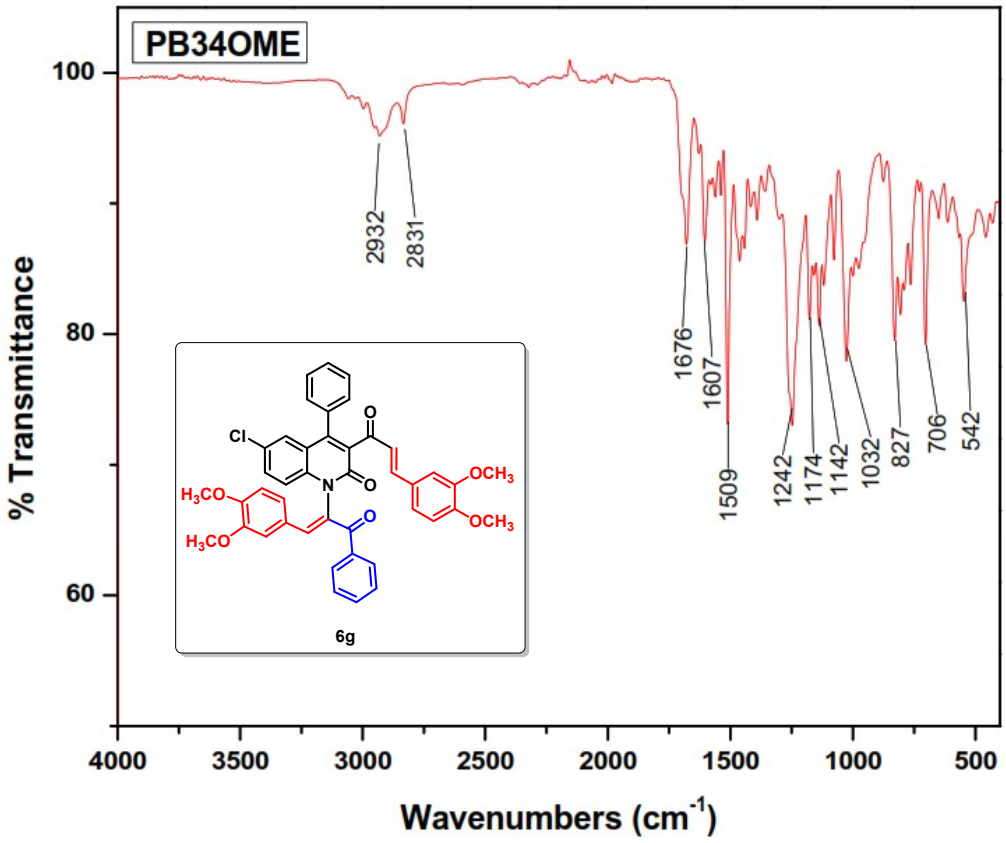


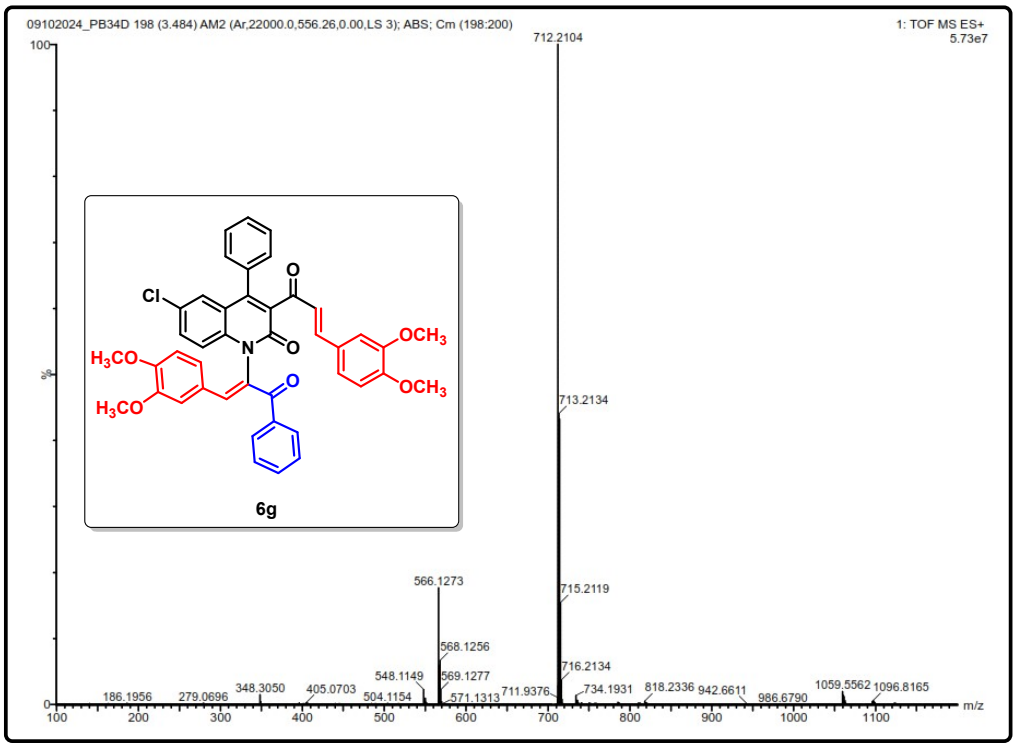
IR and HRMS spectra of compound **6f**



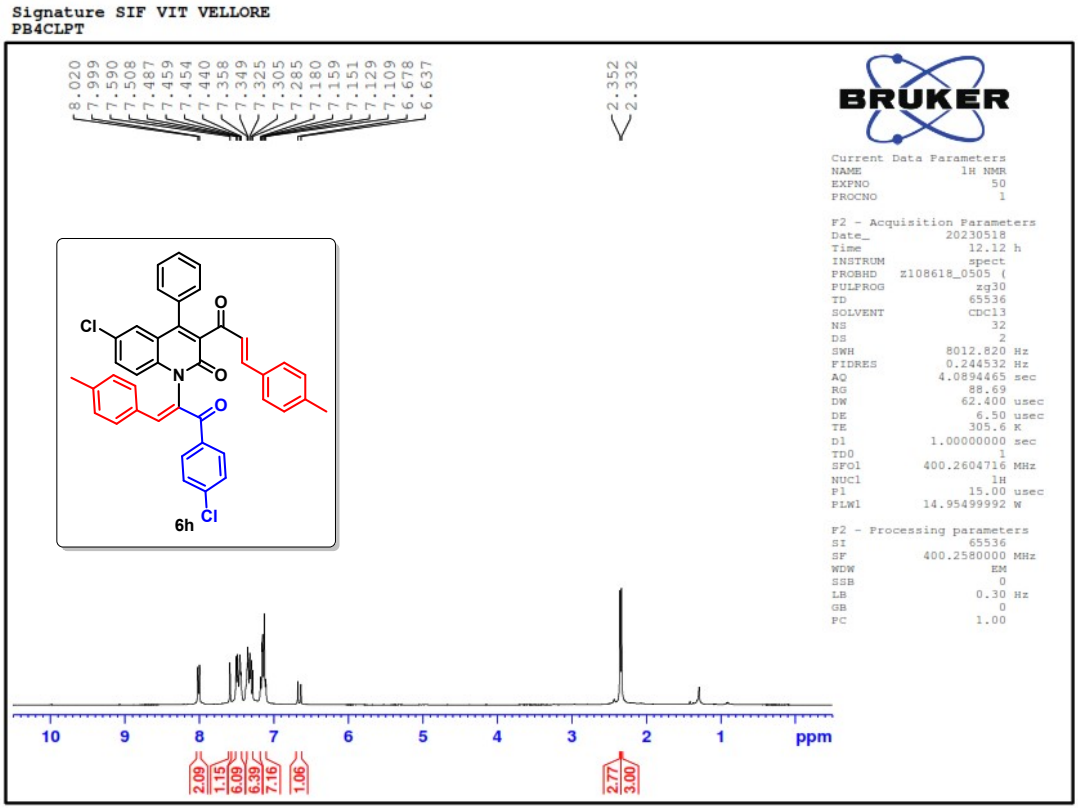


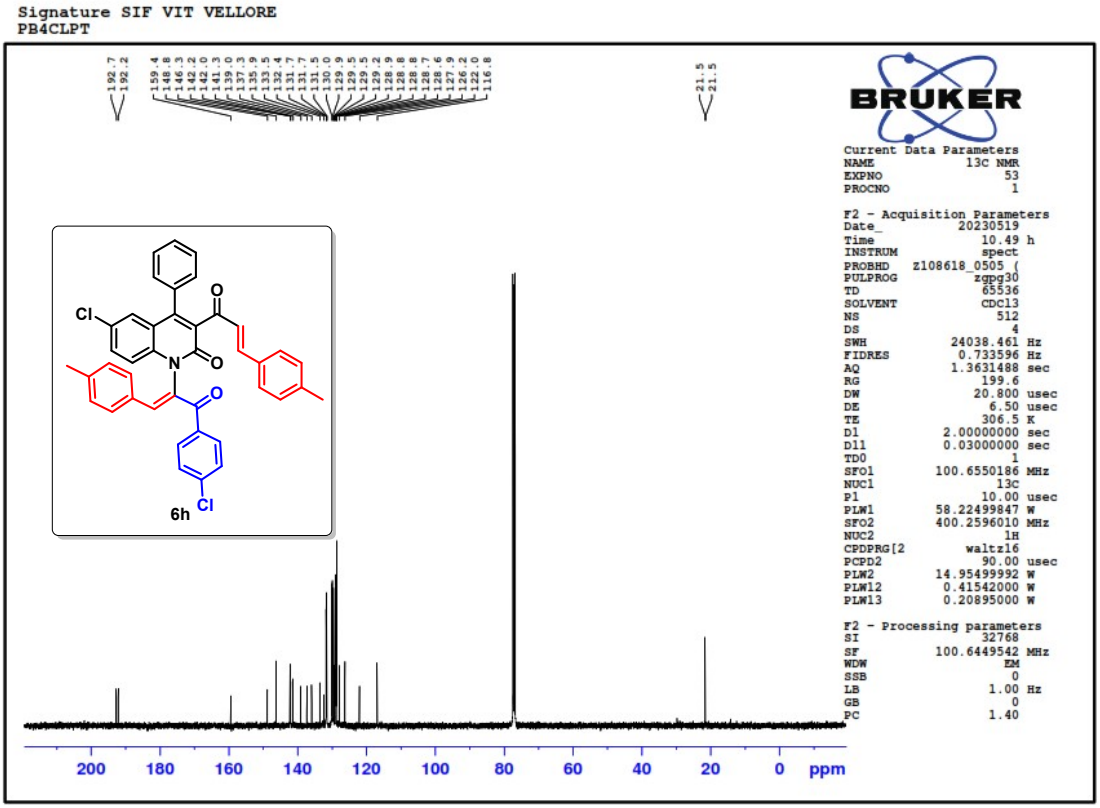
^{1}H and ^{13}C NMR spectra of compound **6g** in $CDCl_3$



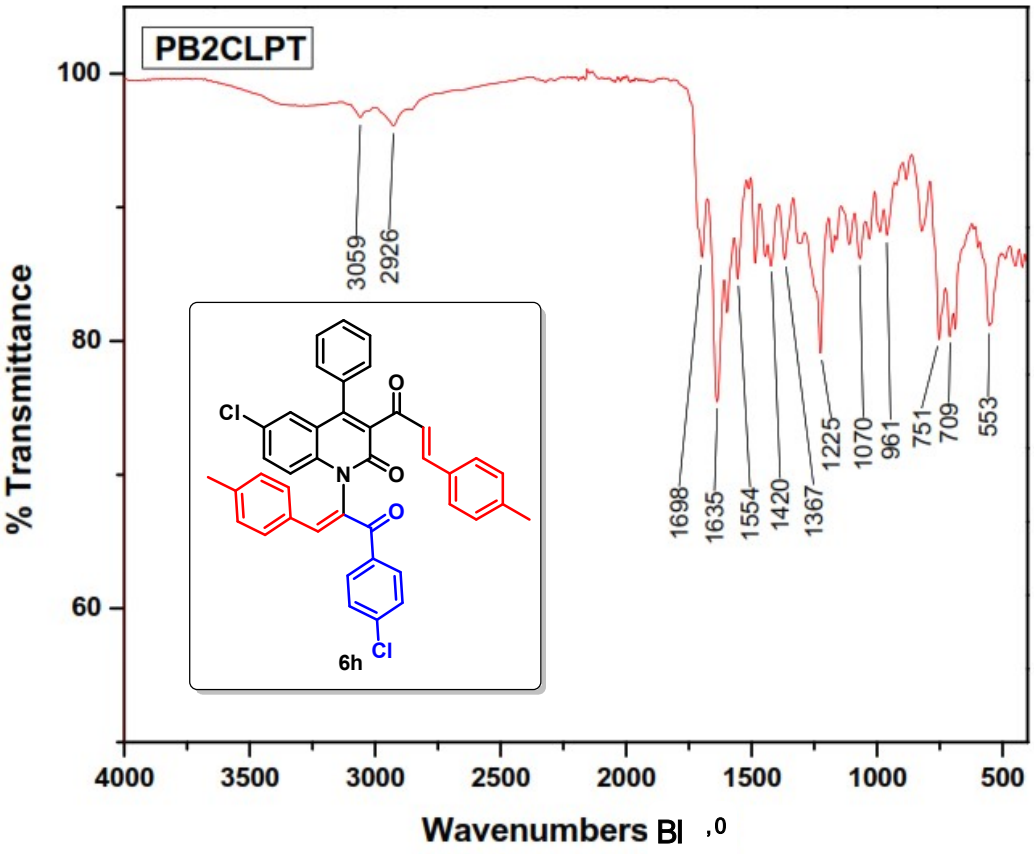


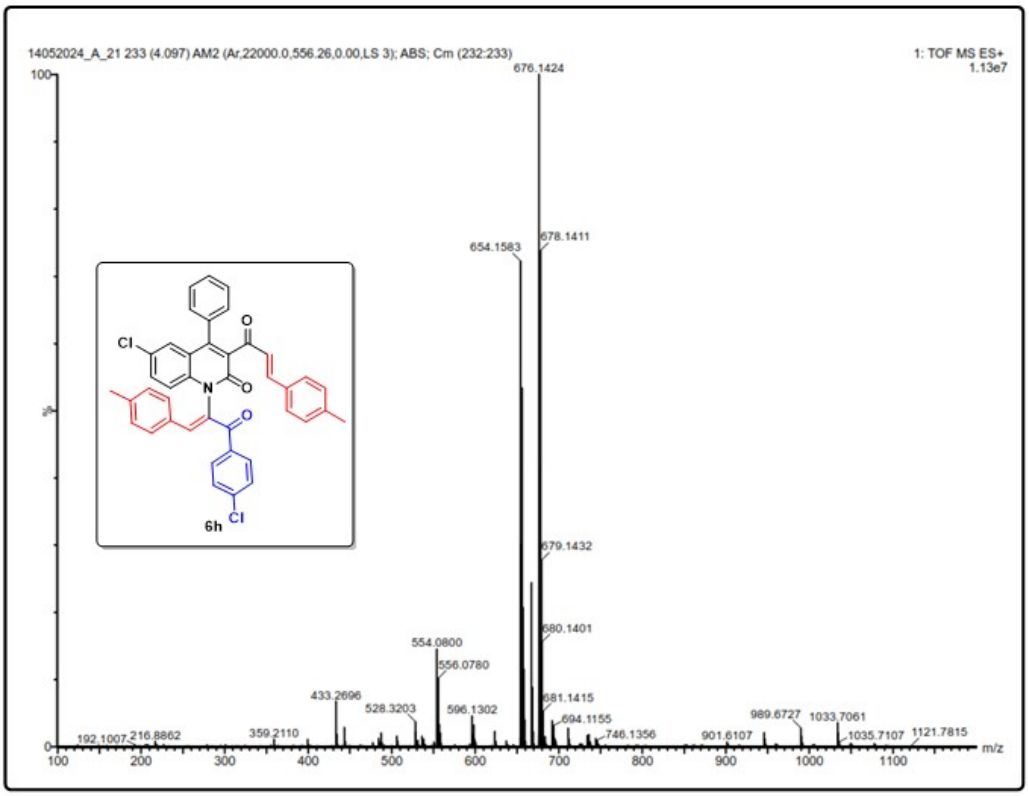
IR and HRMS spectra of compound **6g**



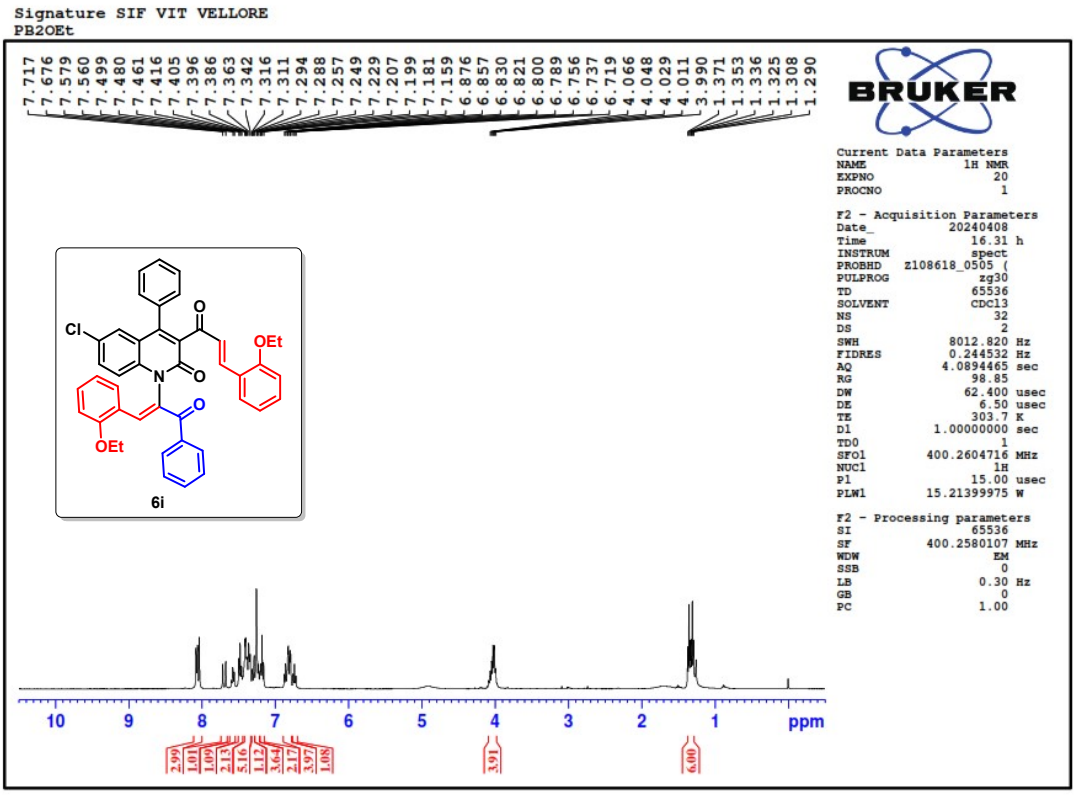


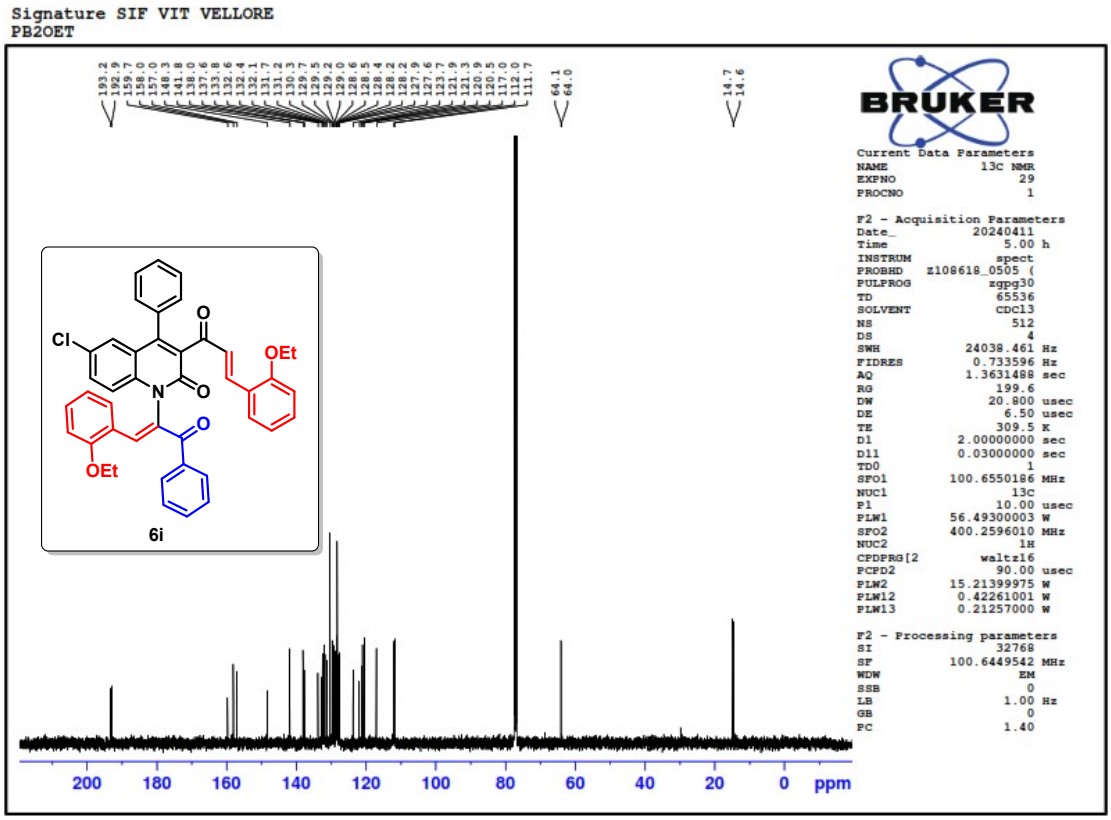
^{1}H and ^{13}C NMR spectra of compound **6h** in $CDCl_3$





IR and HRMS spectra of compound **6h**





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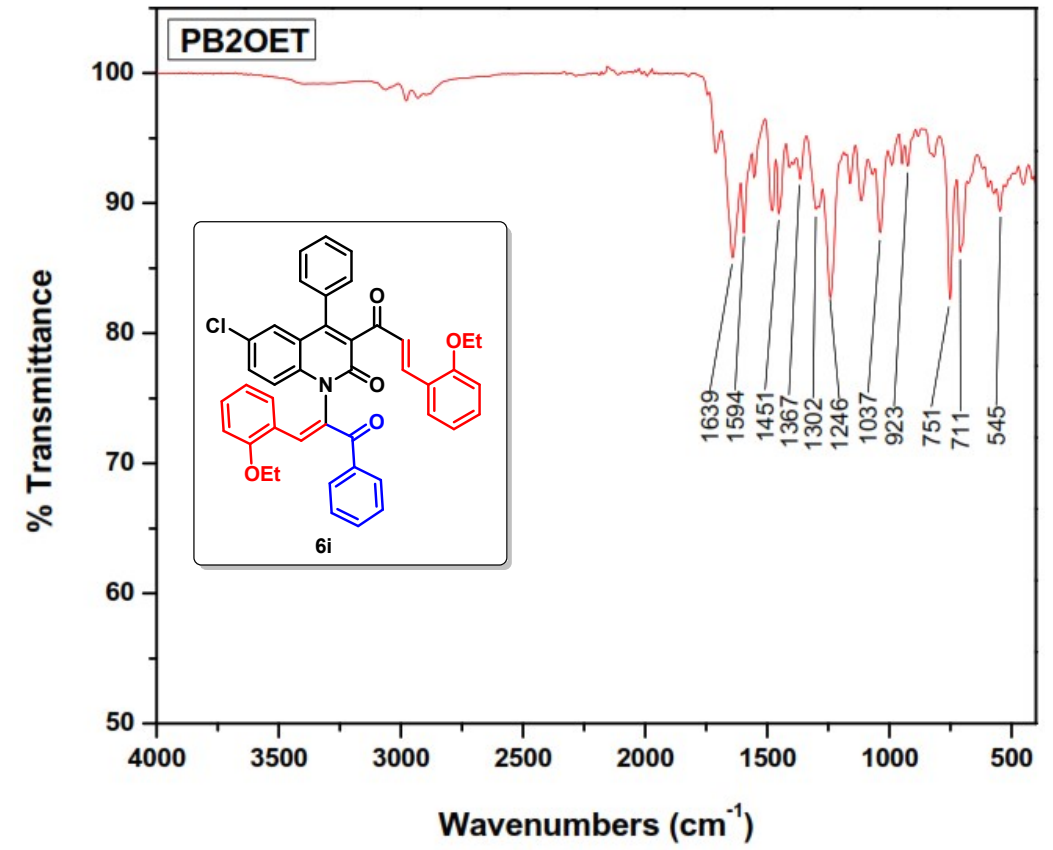
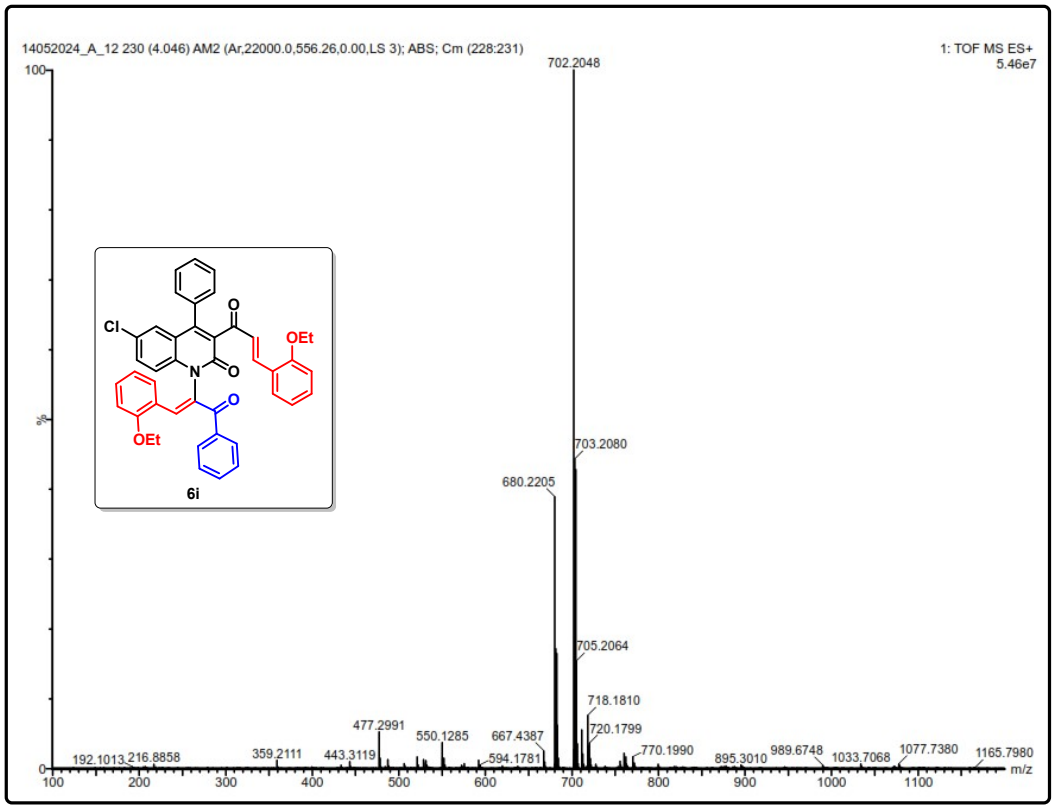
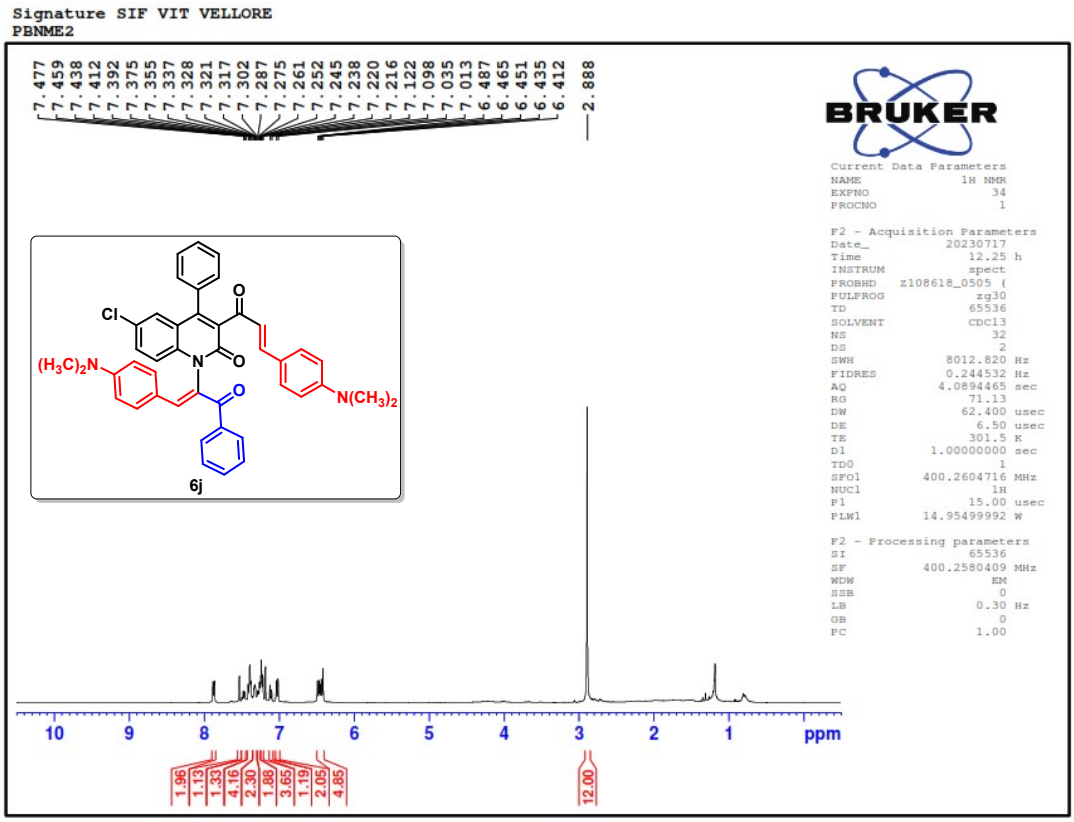
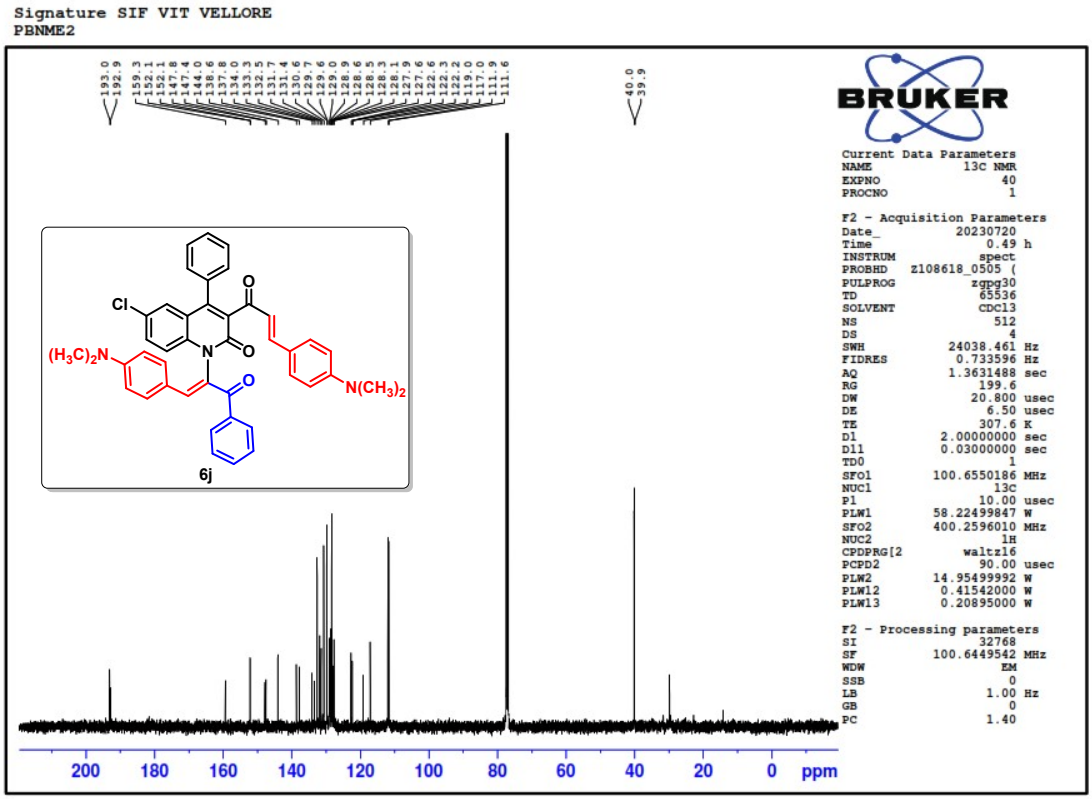
H and ^{13}C NMR spectra of compound **6i** in $CDCl_3$



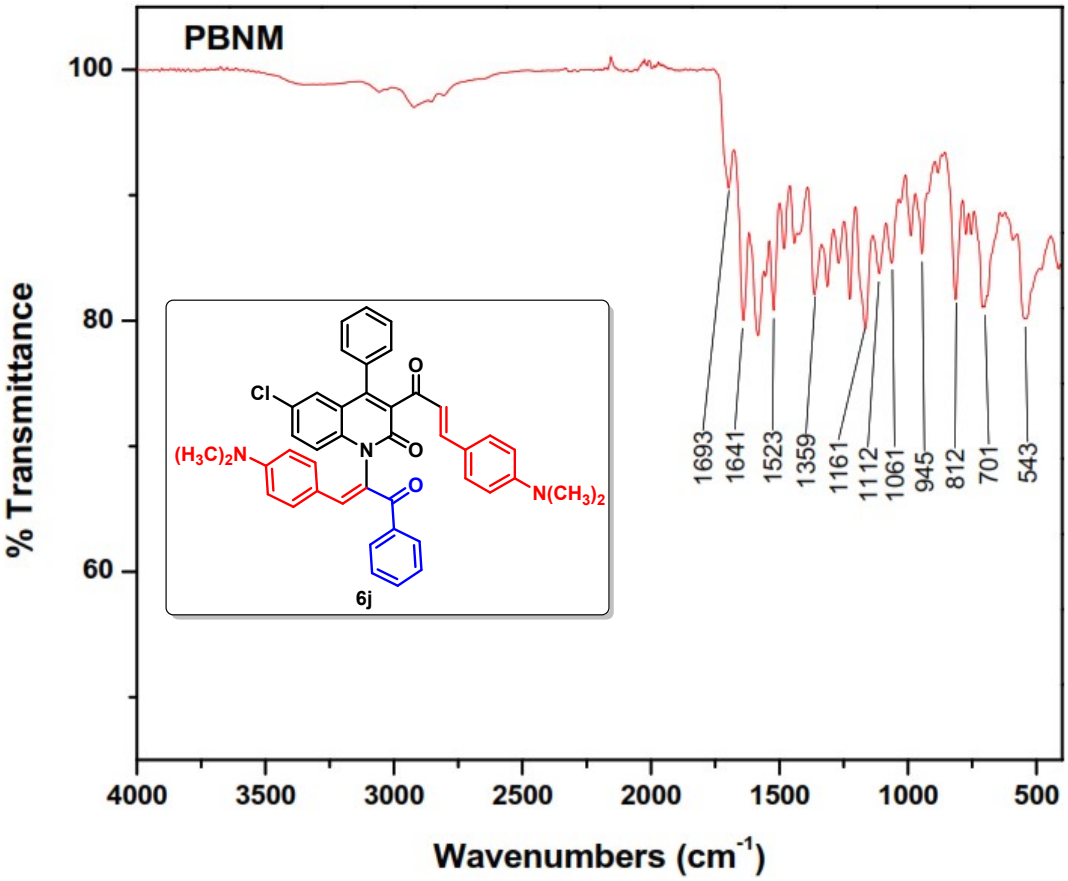


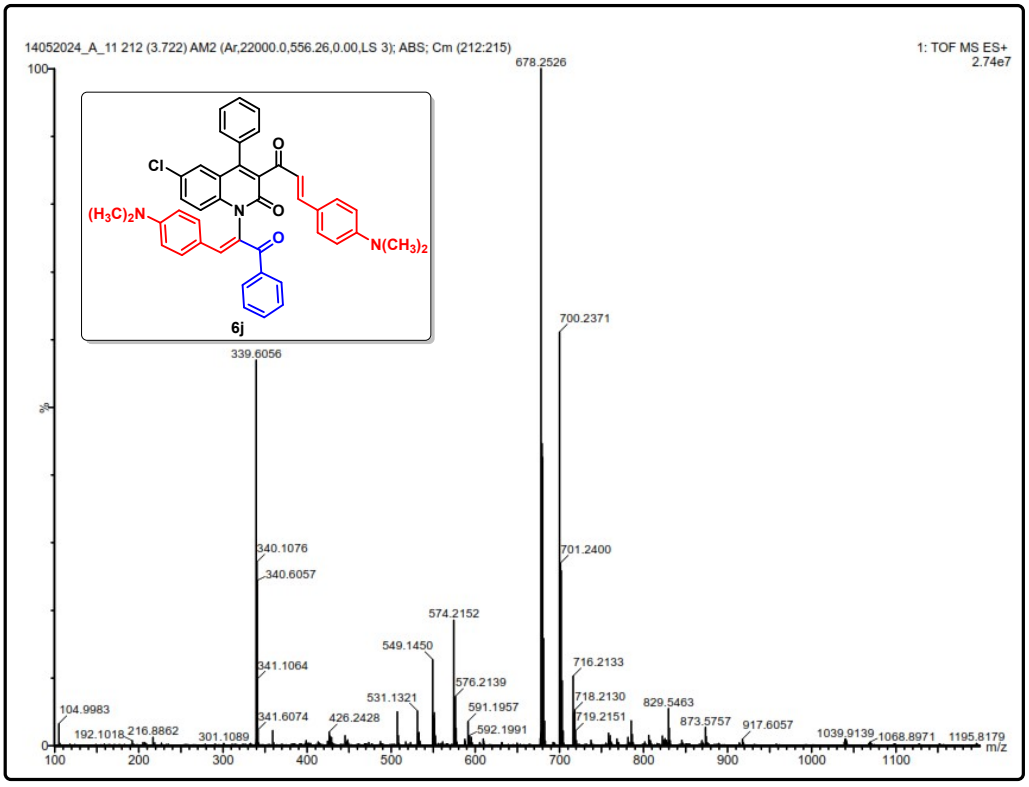
IR and HRMS spectra of compound **6i**



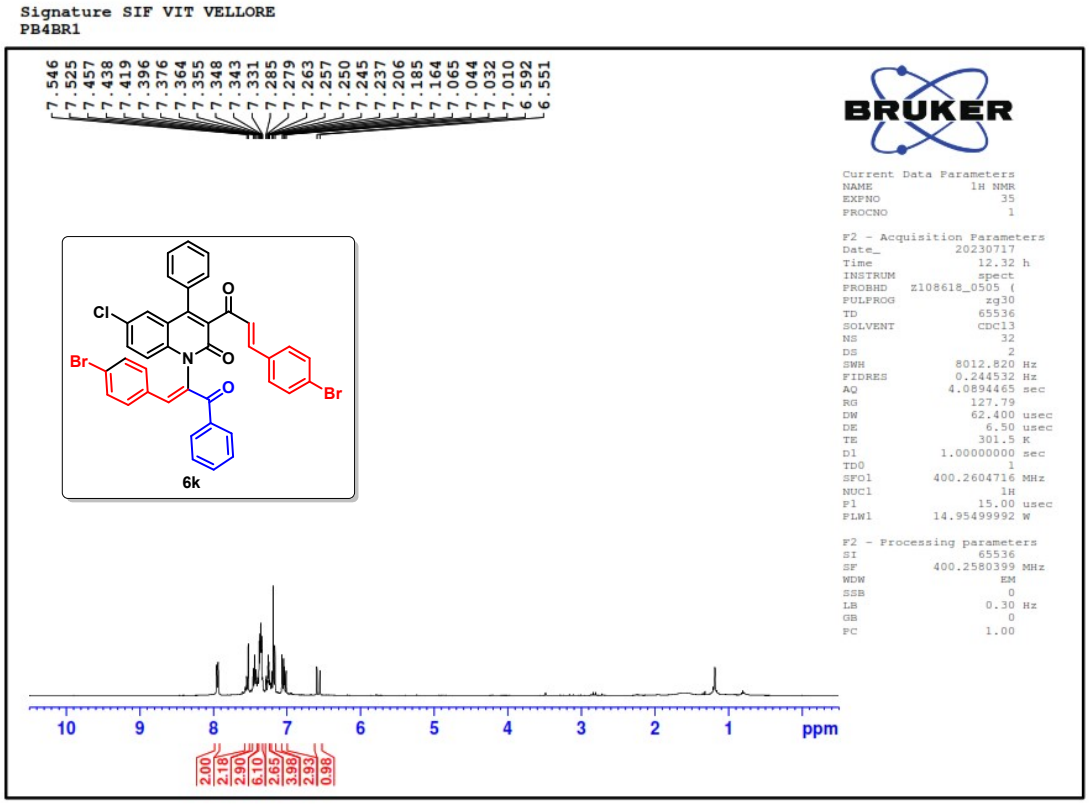


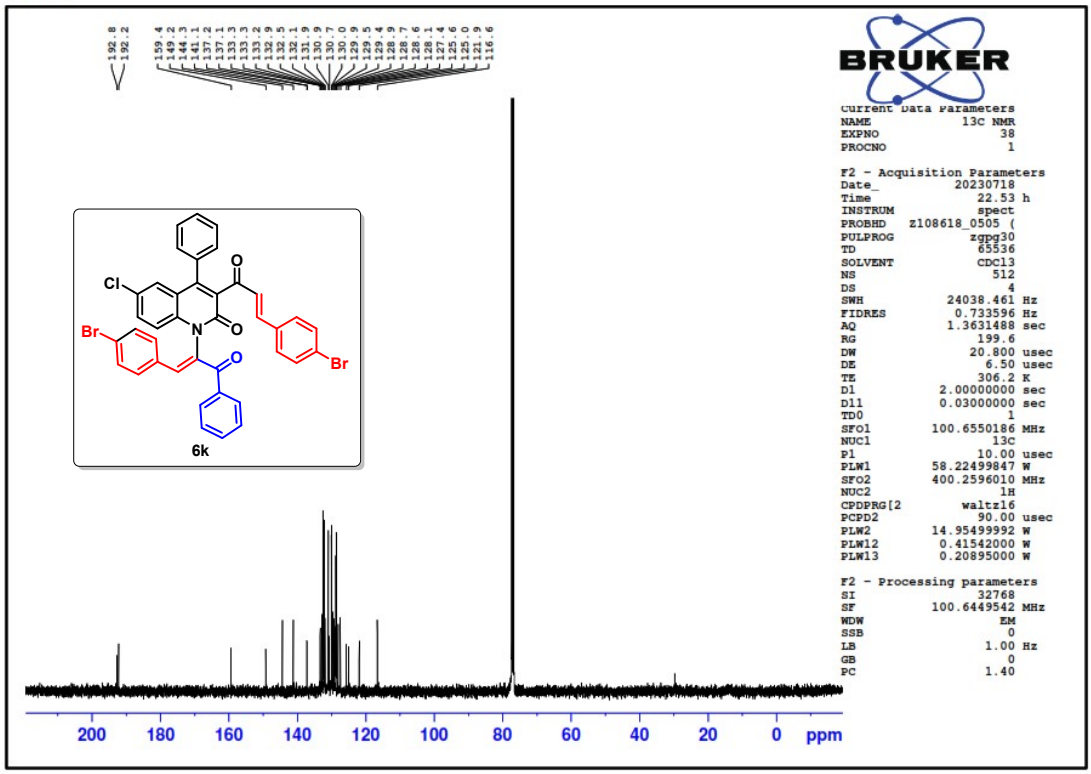
^{1}H and ^{13}C NMR spectra of compound **6j** in $CDCl_3$



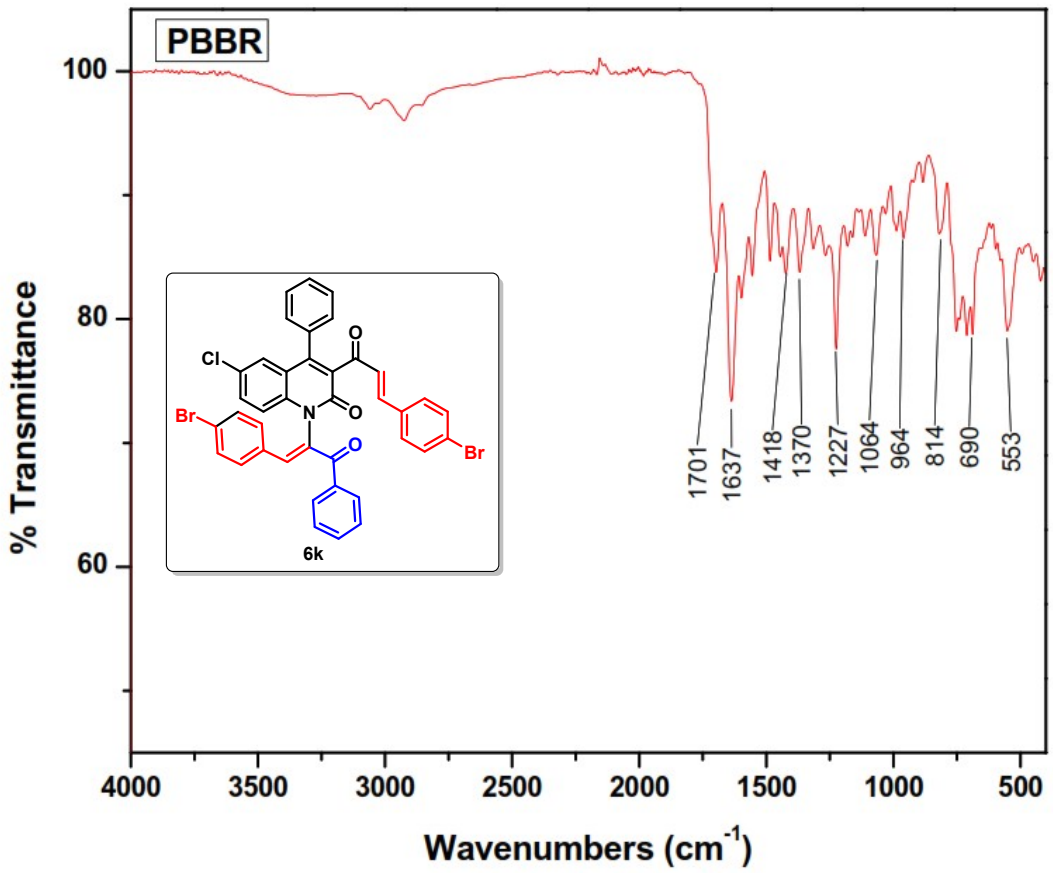


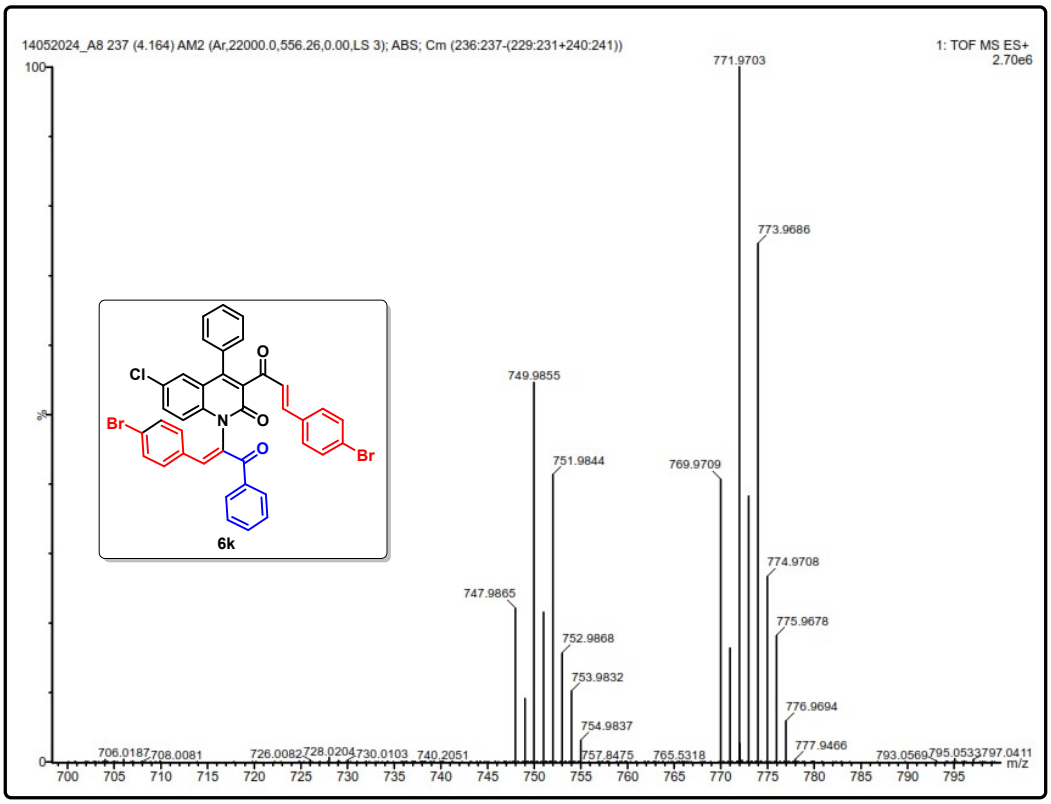
IR and HRMS spectra of compound **6j**



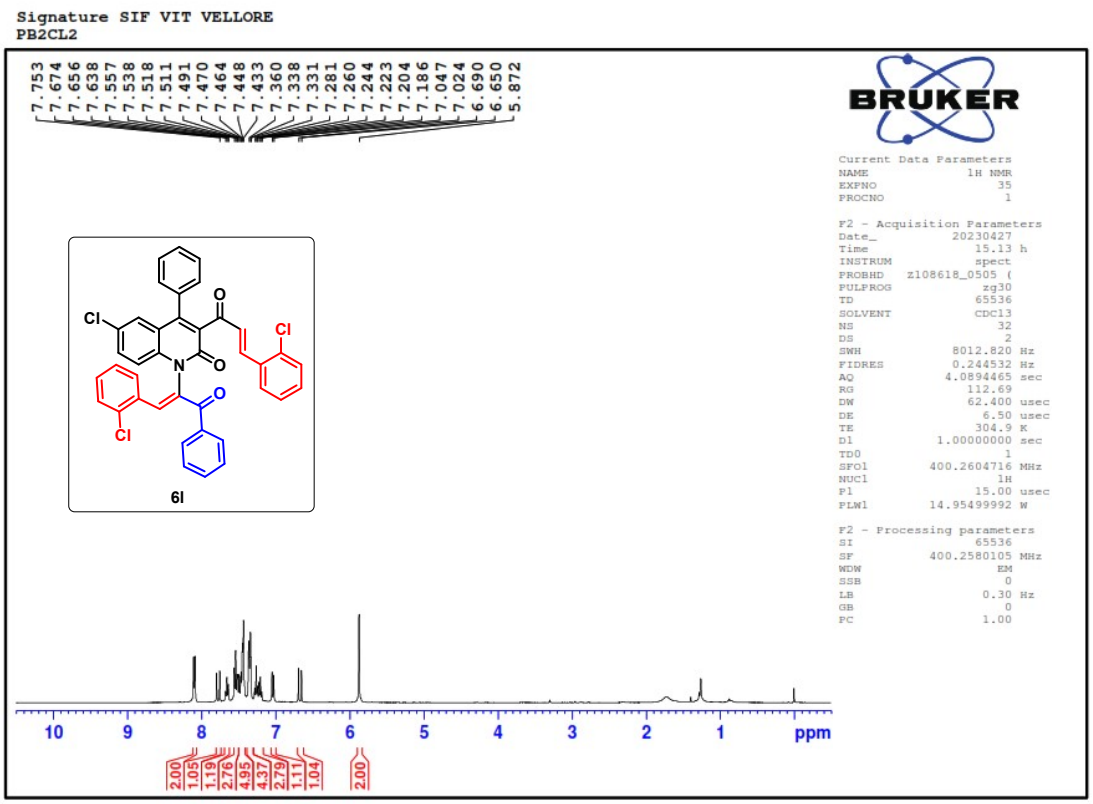


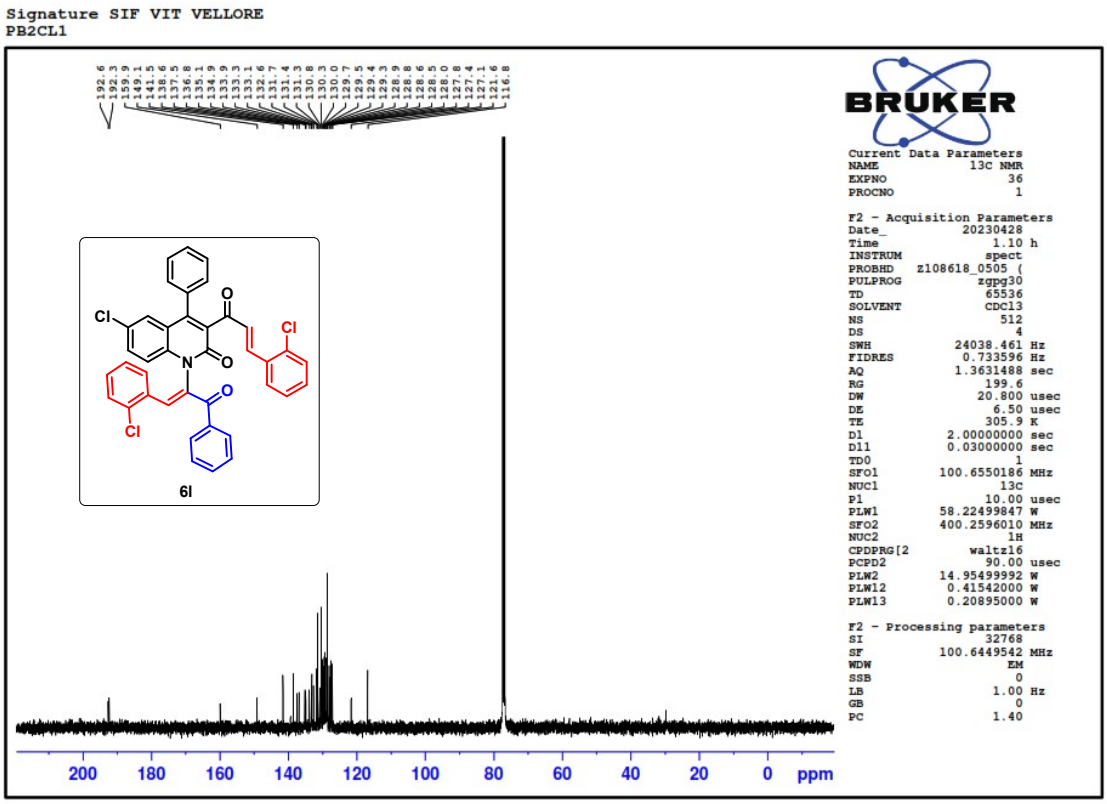
^{1}H and ^{13}C NMR spectra of compound **6k** in $CDCl_3$



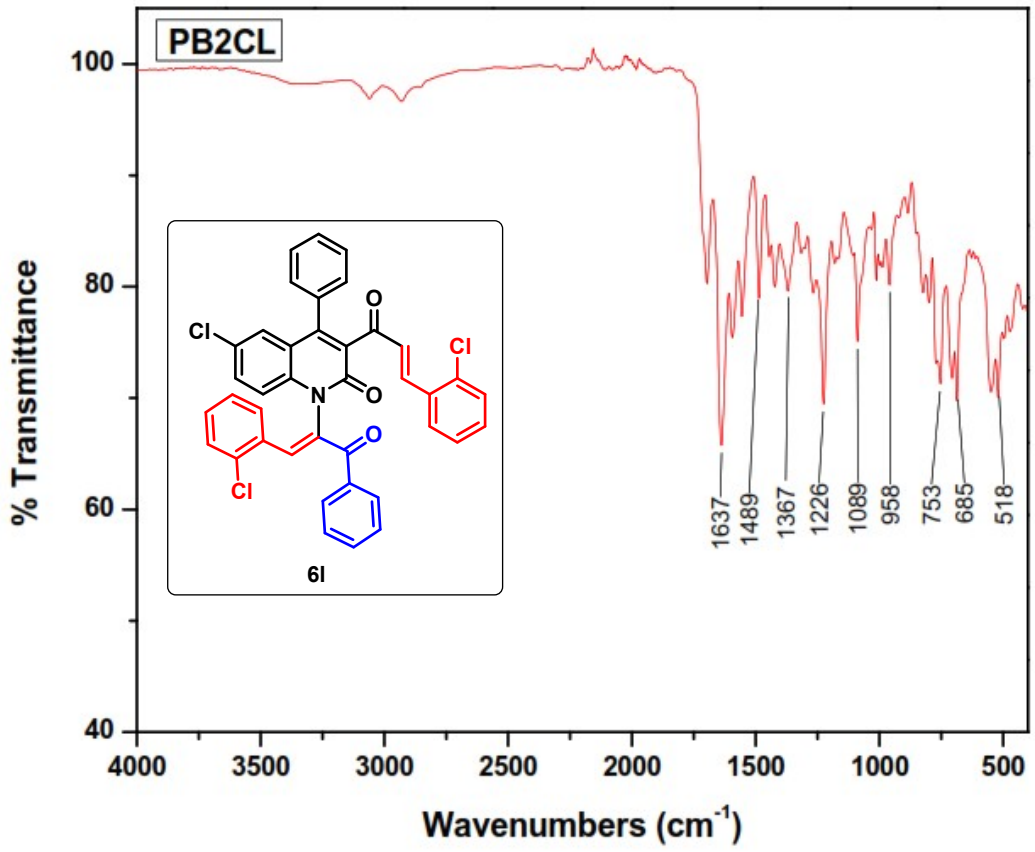


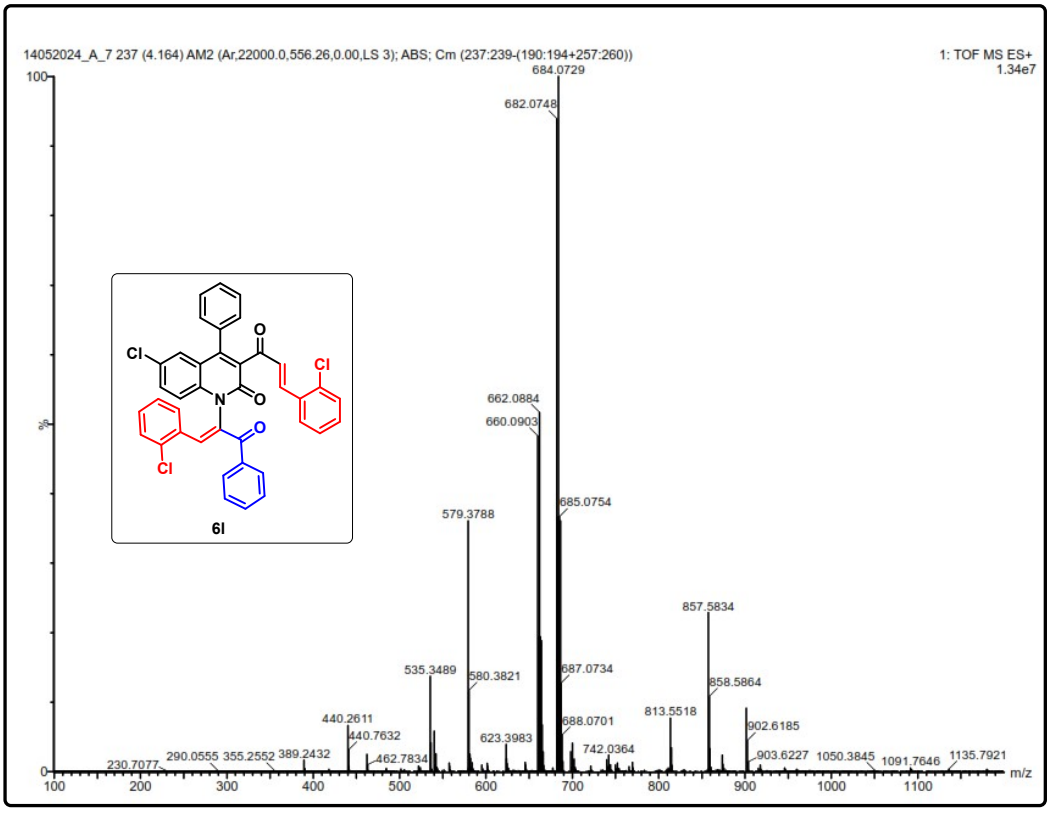
IR and HRMS spectra of compound **6k**



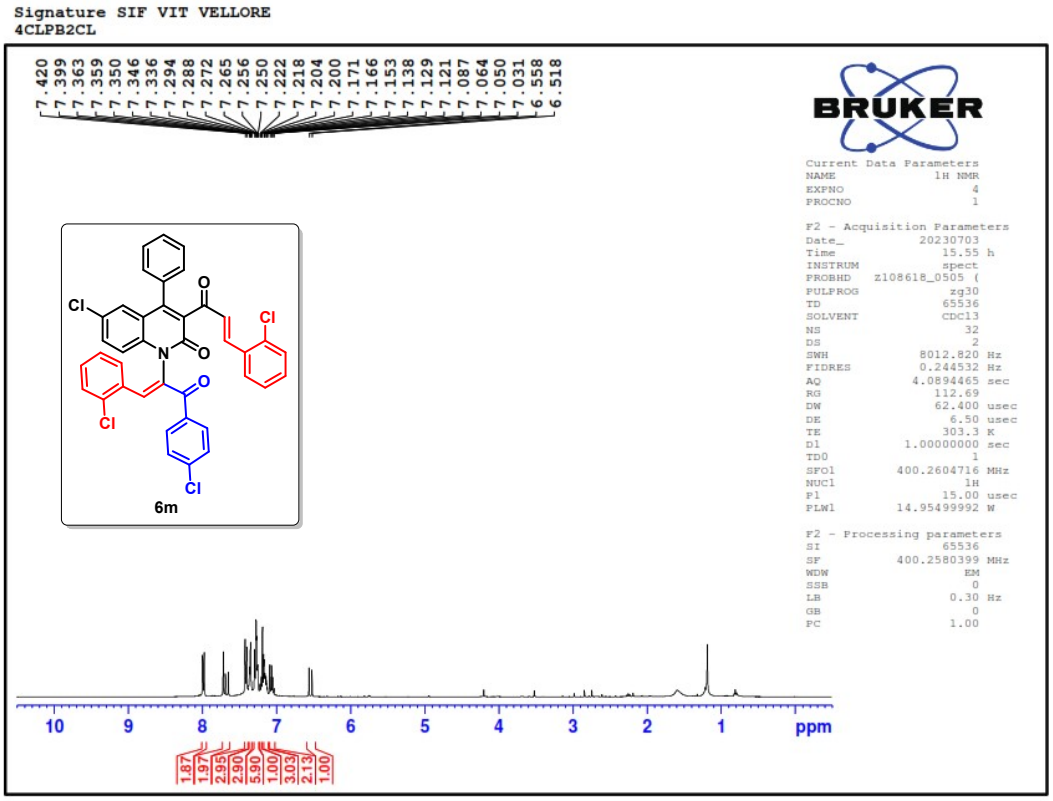


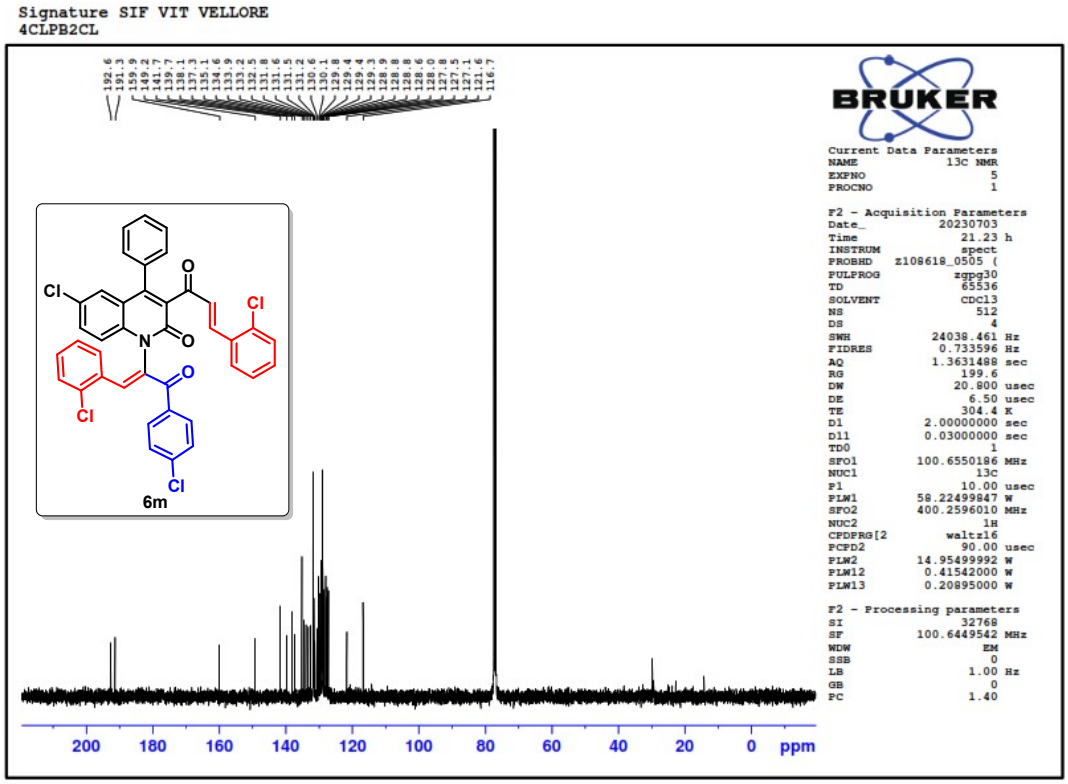
^{1}H and ^{13}C NMR spectra of compound **6l** in $CDCl_3$



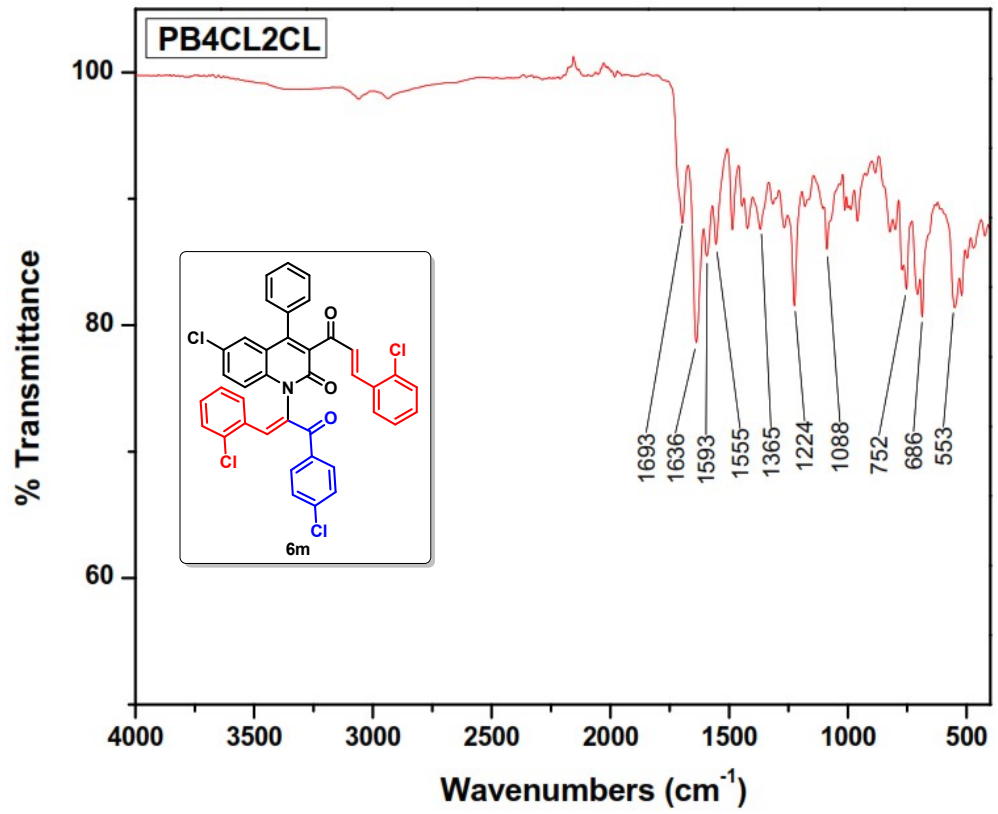


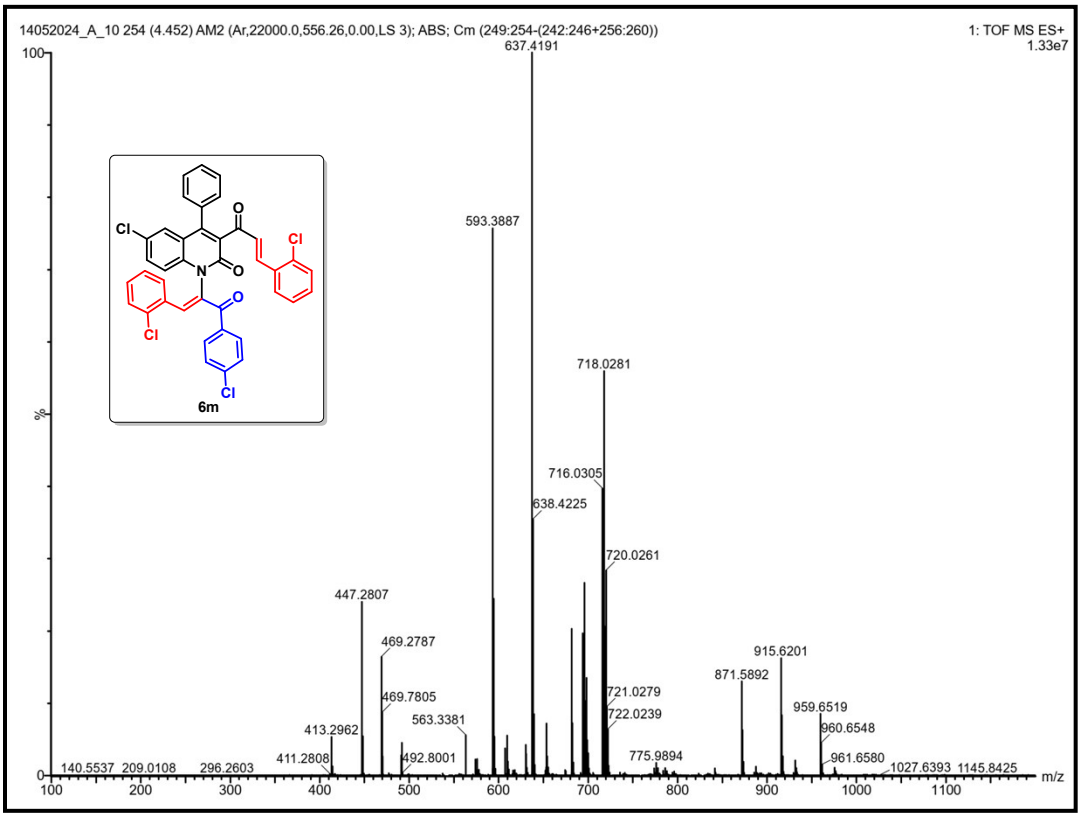
IR and HRMS spectra of compound **6l**



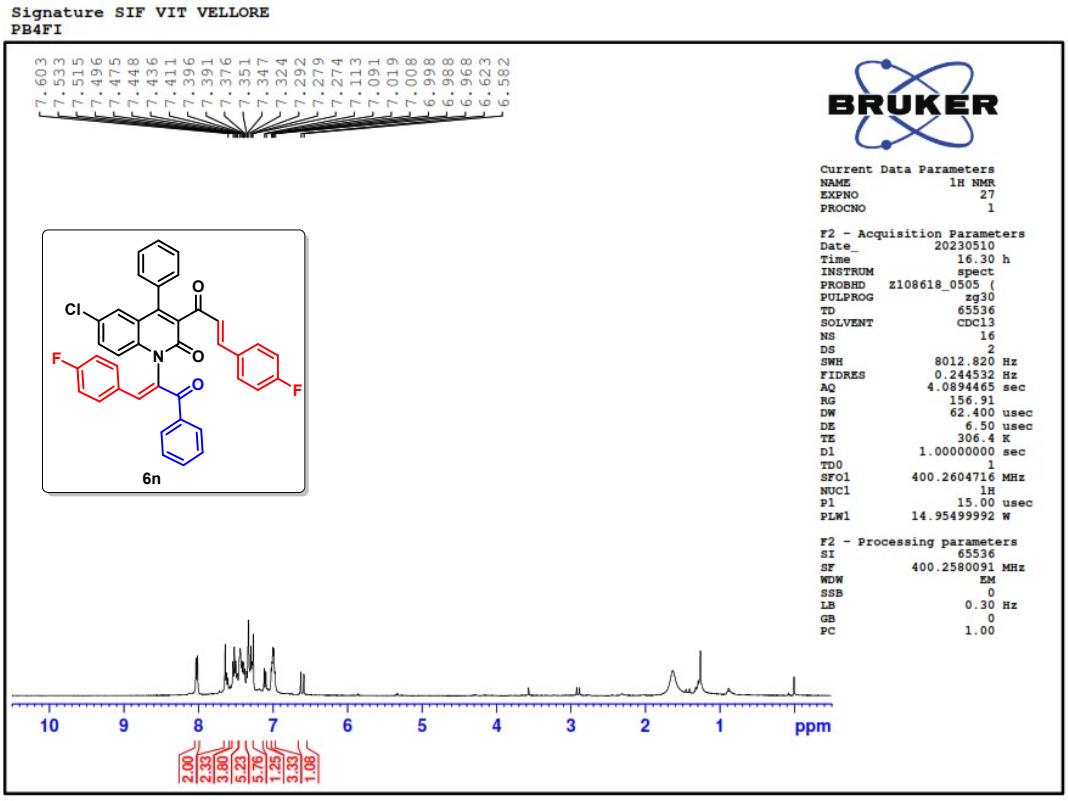


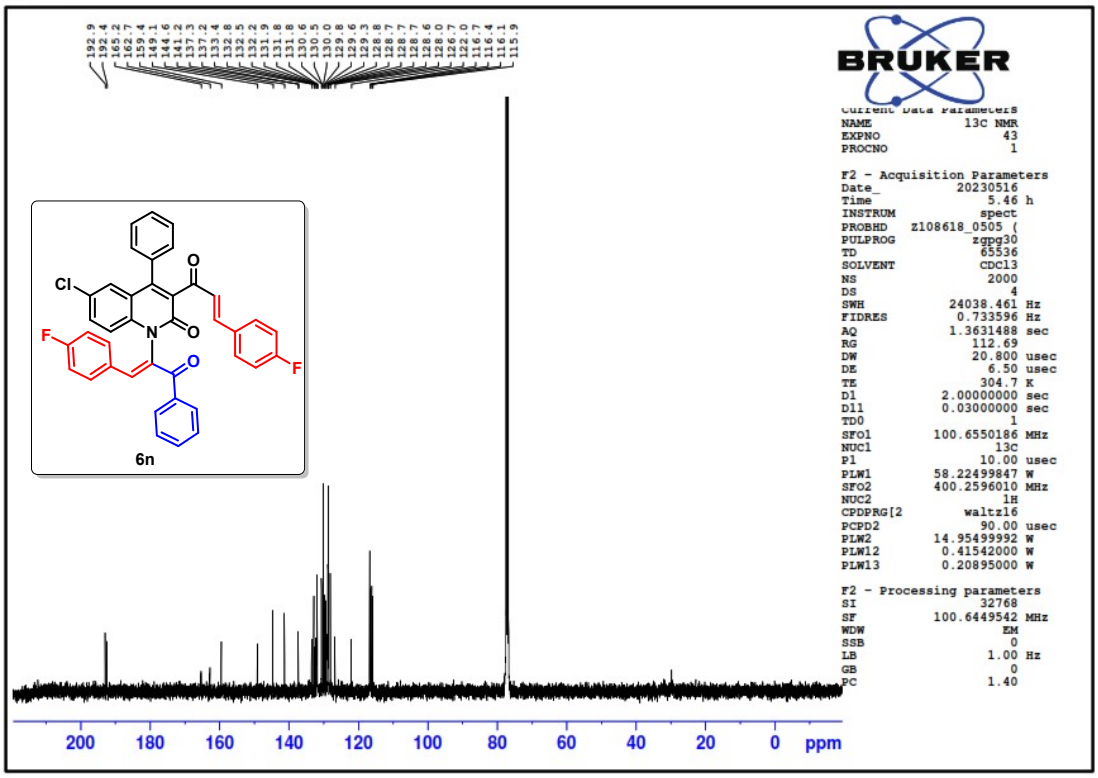
^{1}H and ^{13}C NMR spectra of compound **6m** in $CDCl_3$



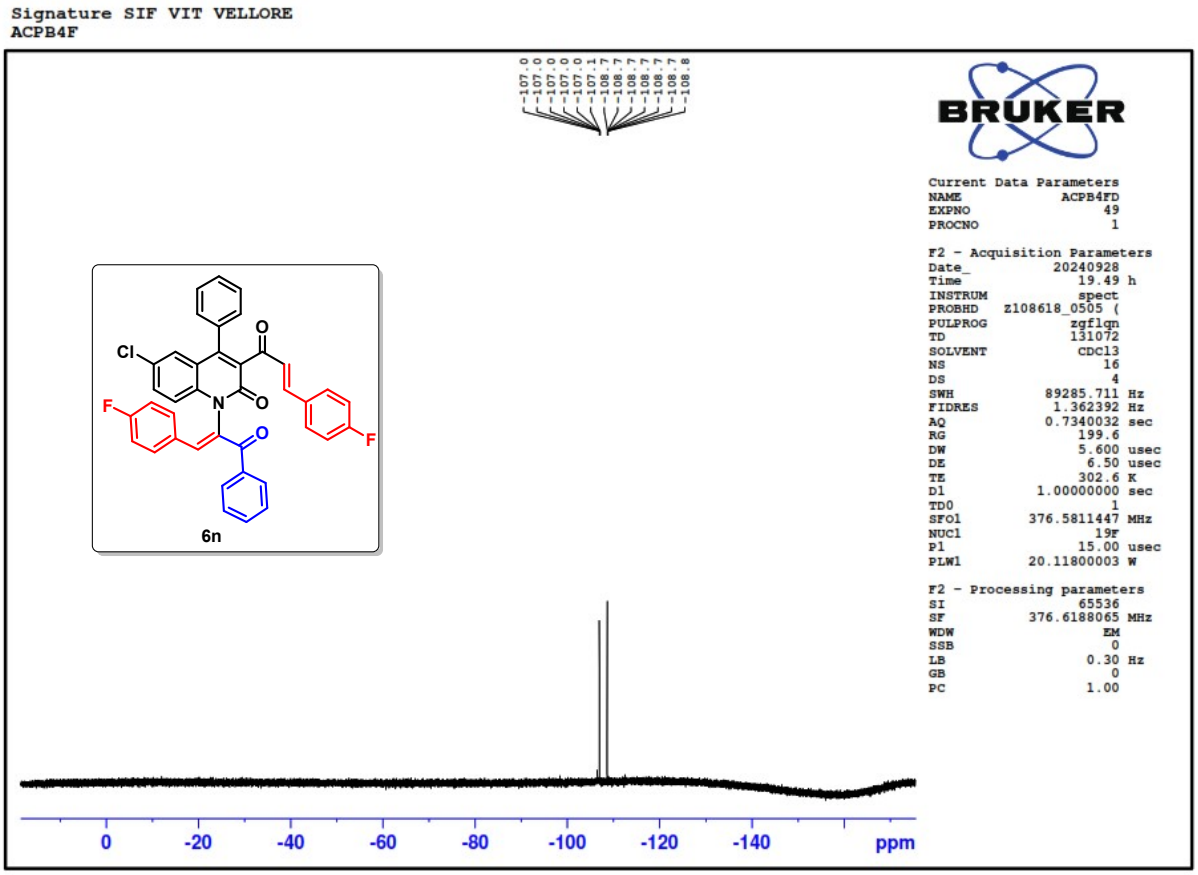


IR and HRMS spectra of compound **6m**

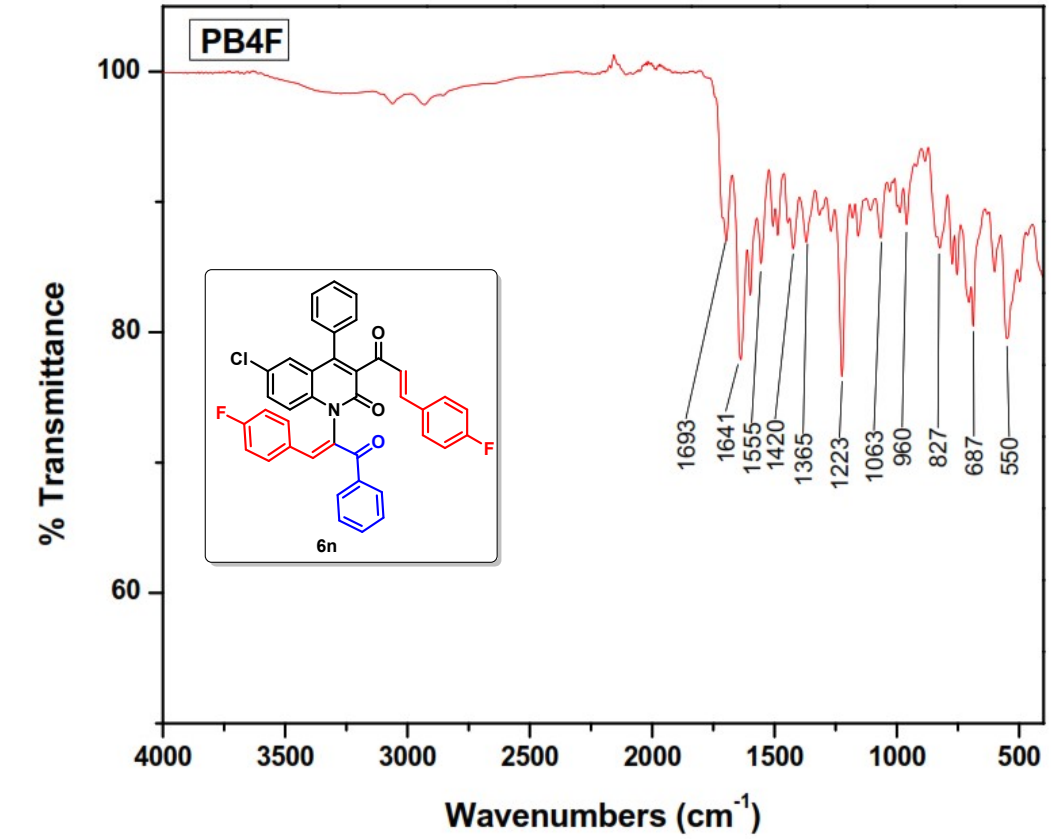


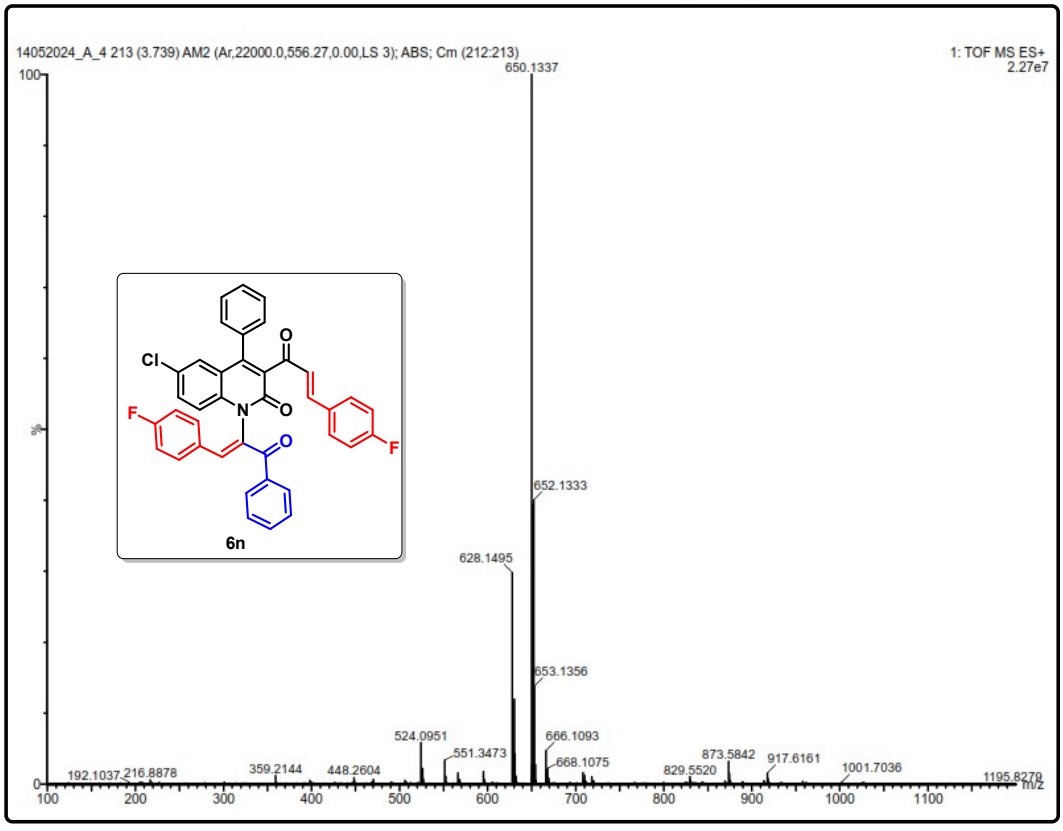


^{1}H and ^{13}C NMR spectra of compound **6n** in $CDCl_3$

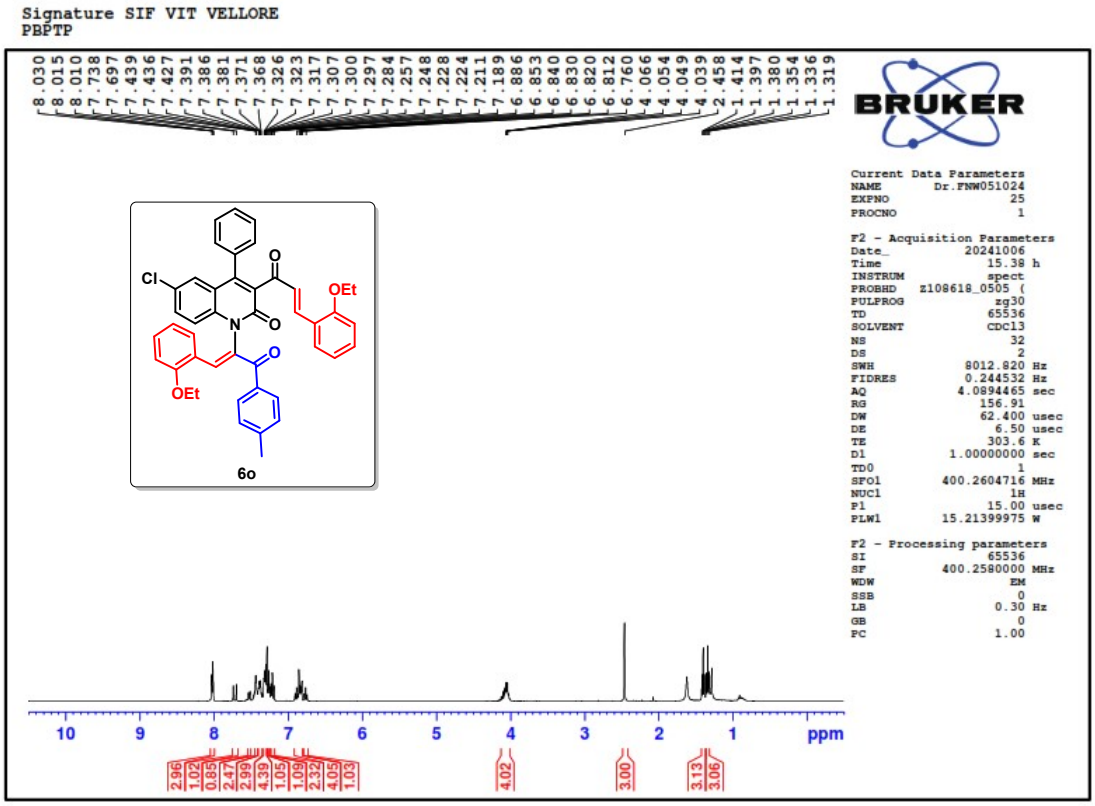


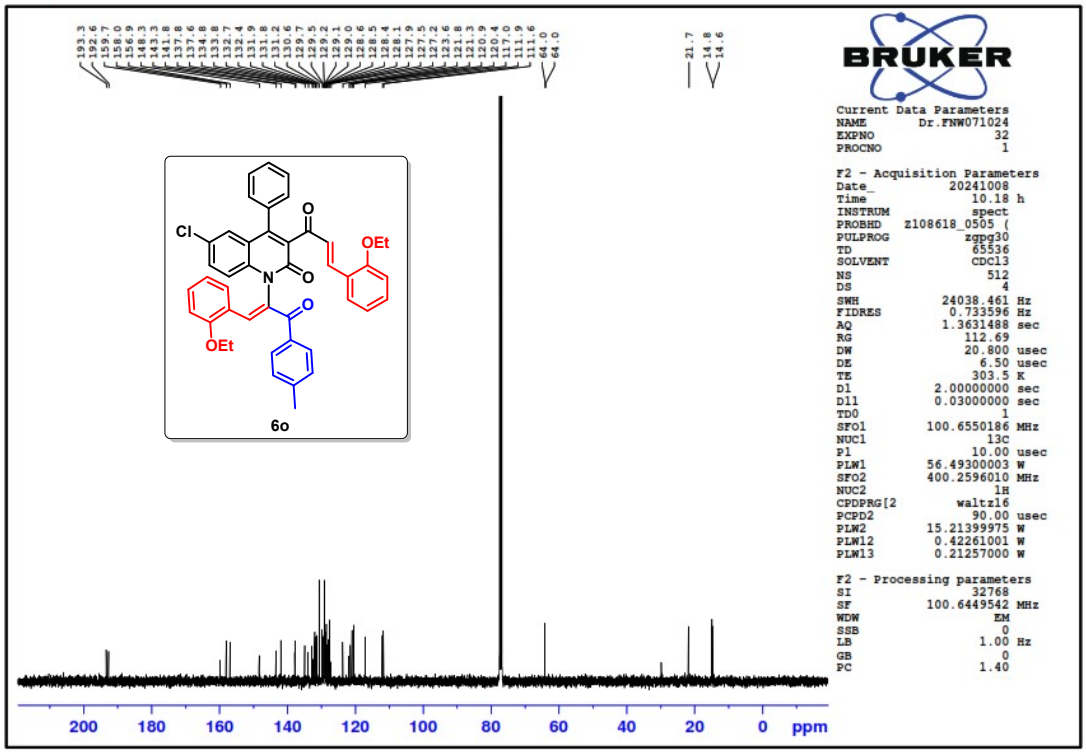
^{19}F spectra of compound **6n**



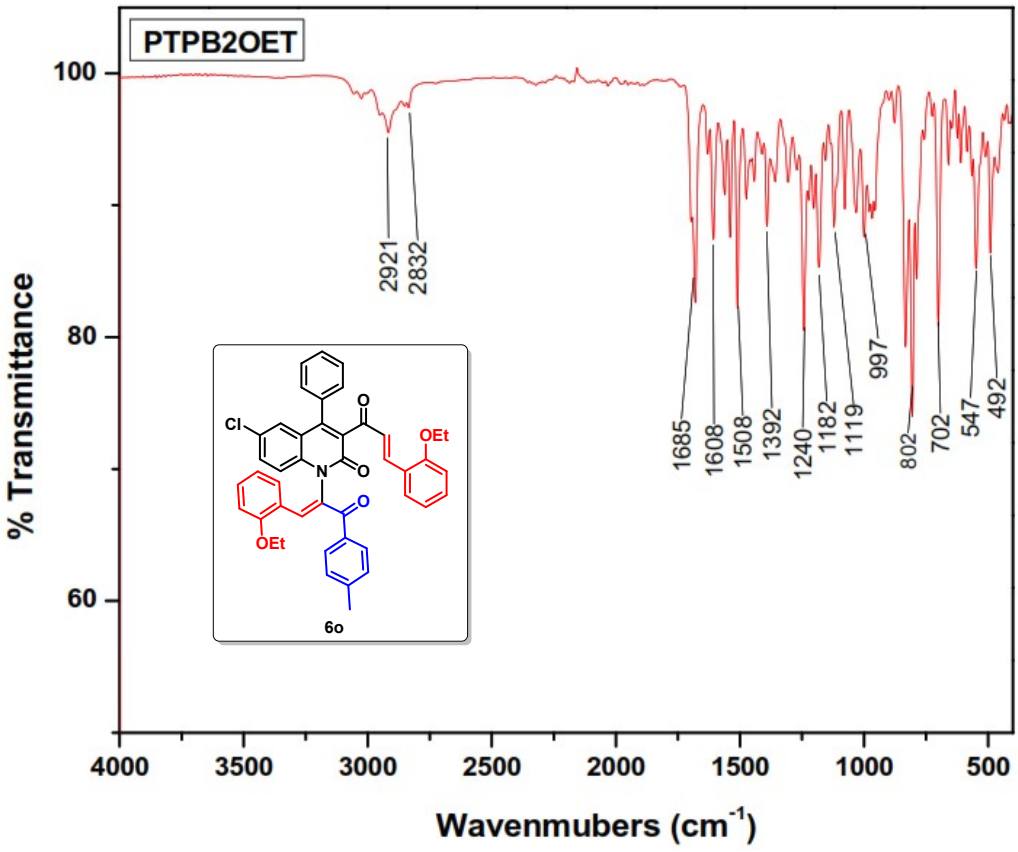


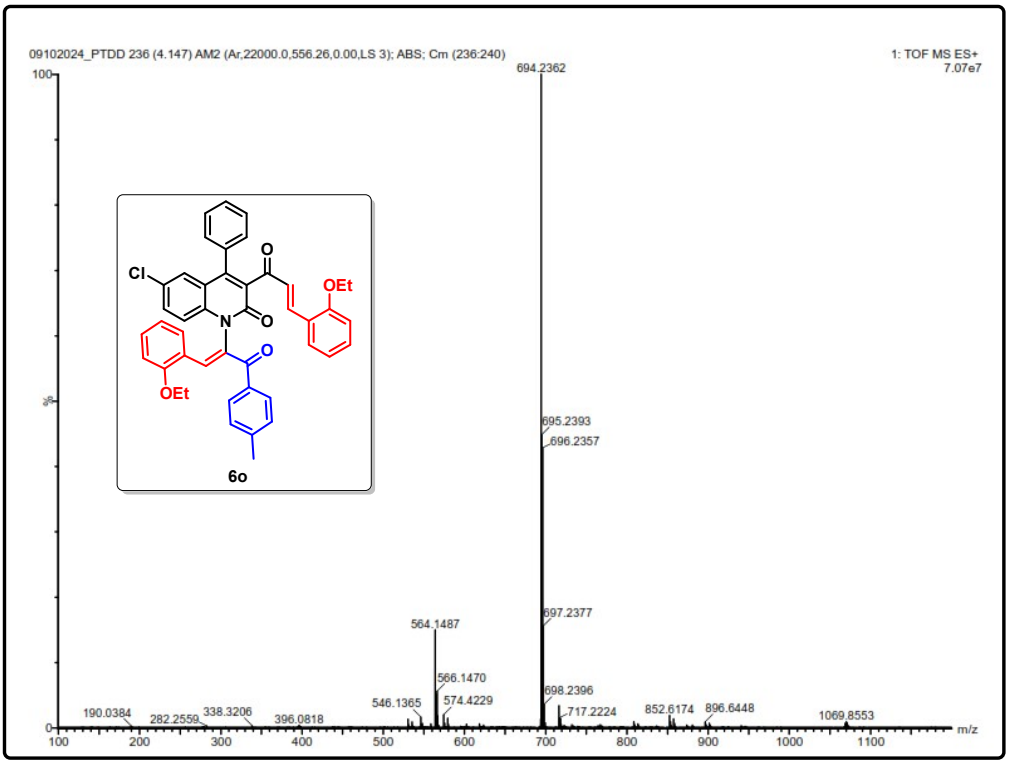
IR and HRMS spectra of compound **6n**



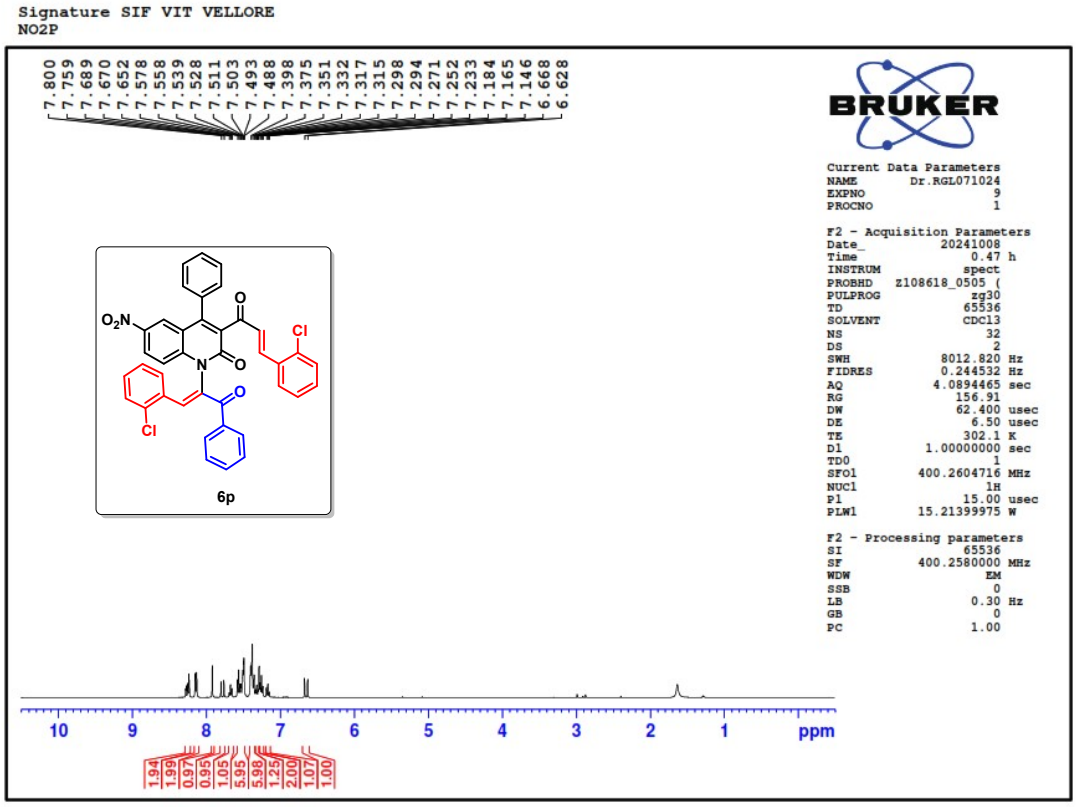


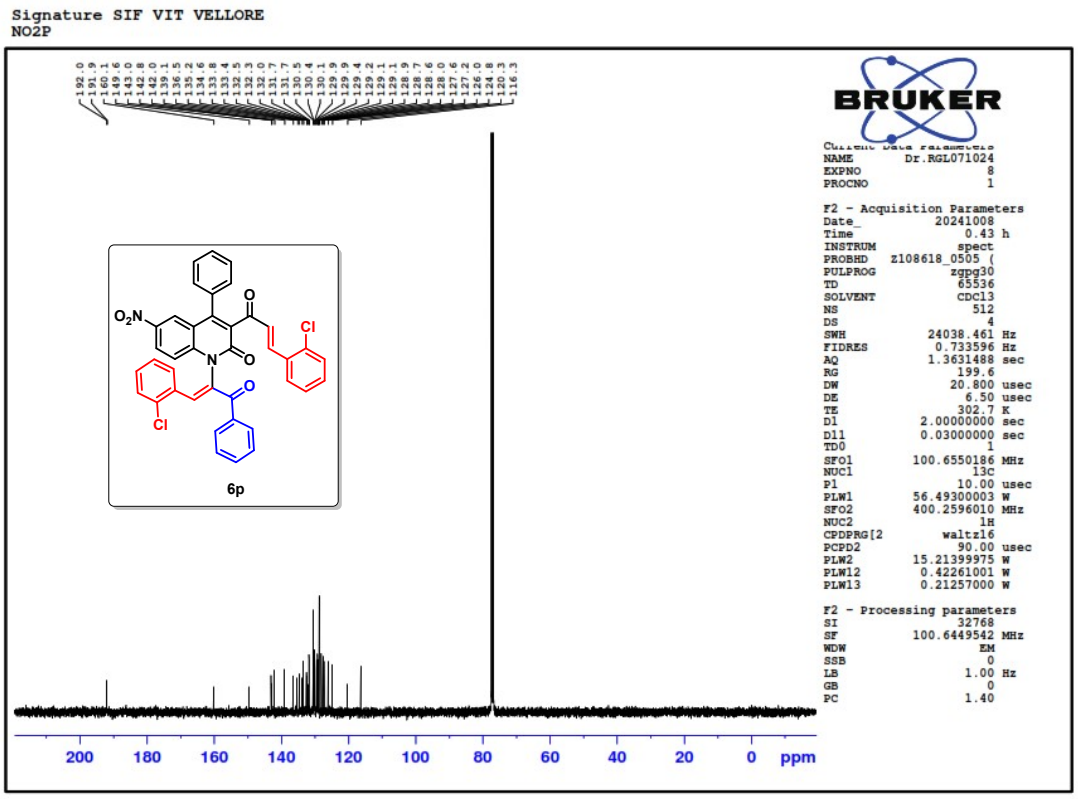
^{1}H and ^{13}C NMR spectra of compound **6o** in $CDCl_3$



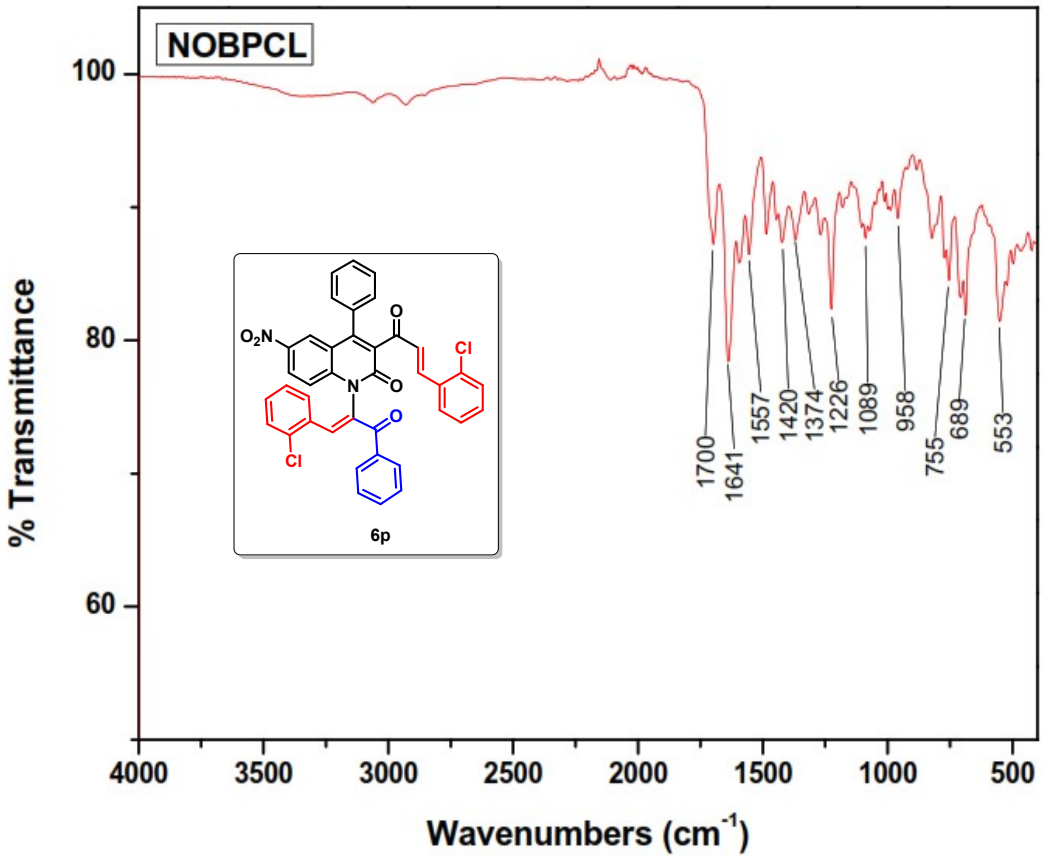


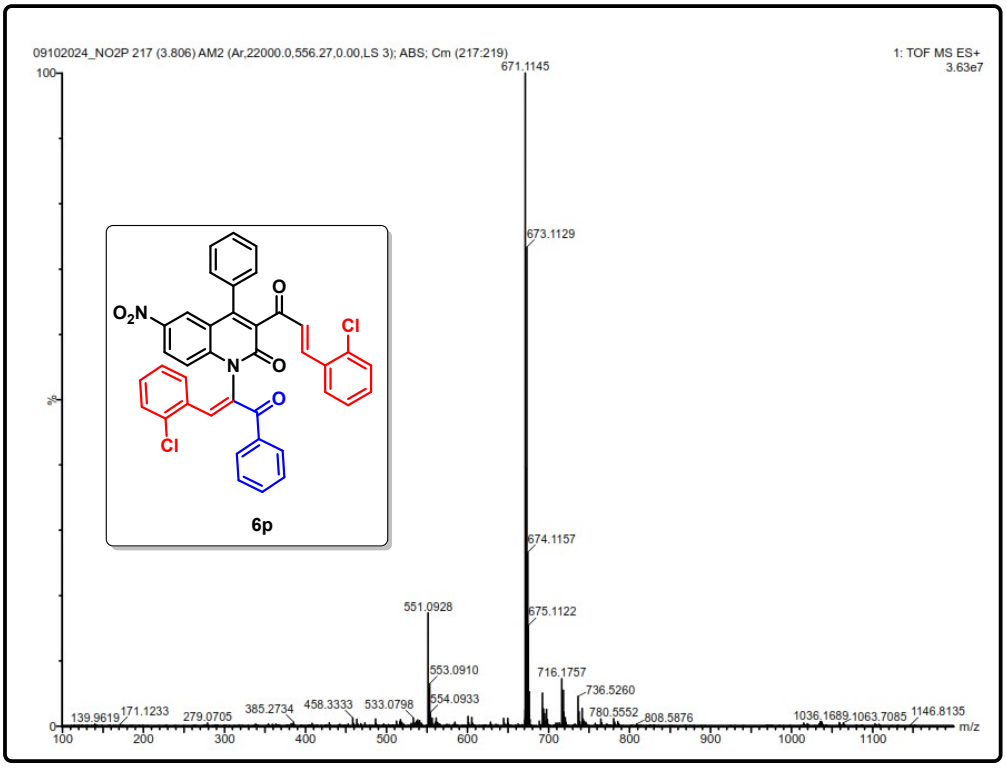
IR and HRMS spectra of compound **6o**



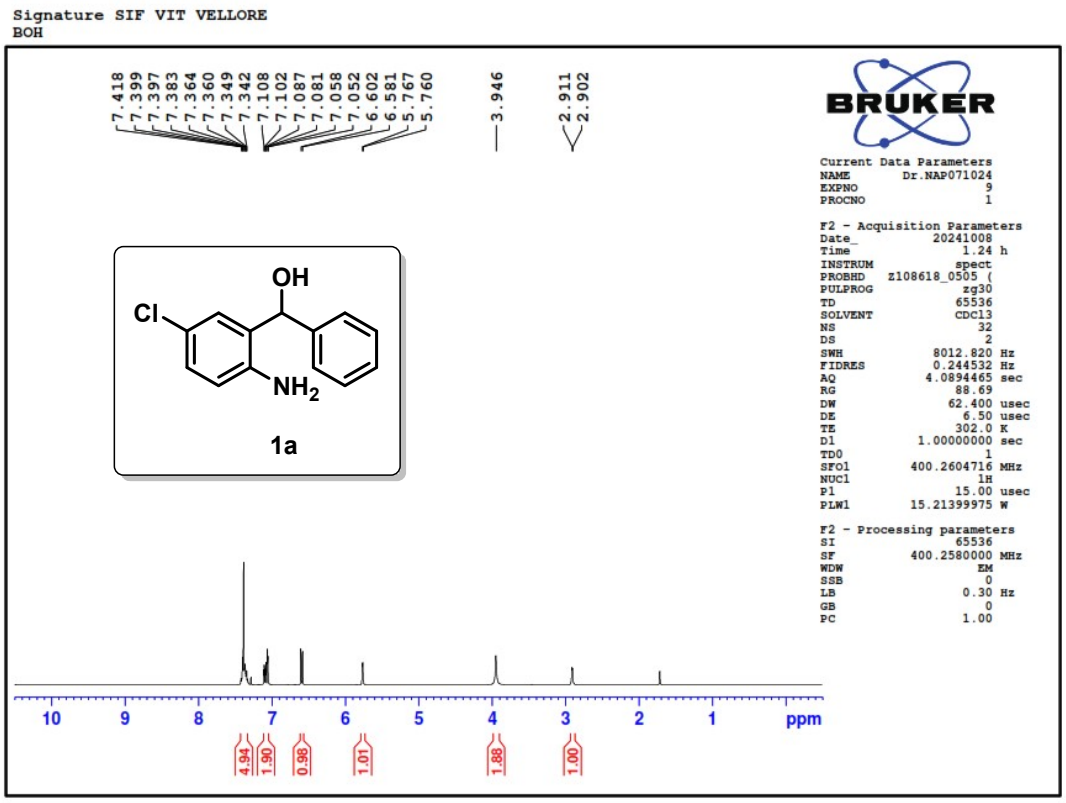


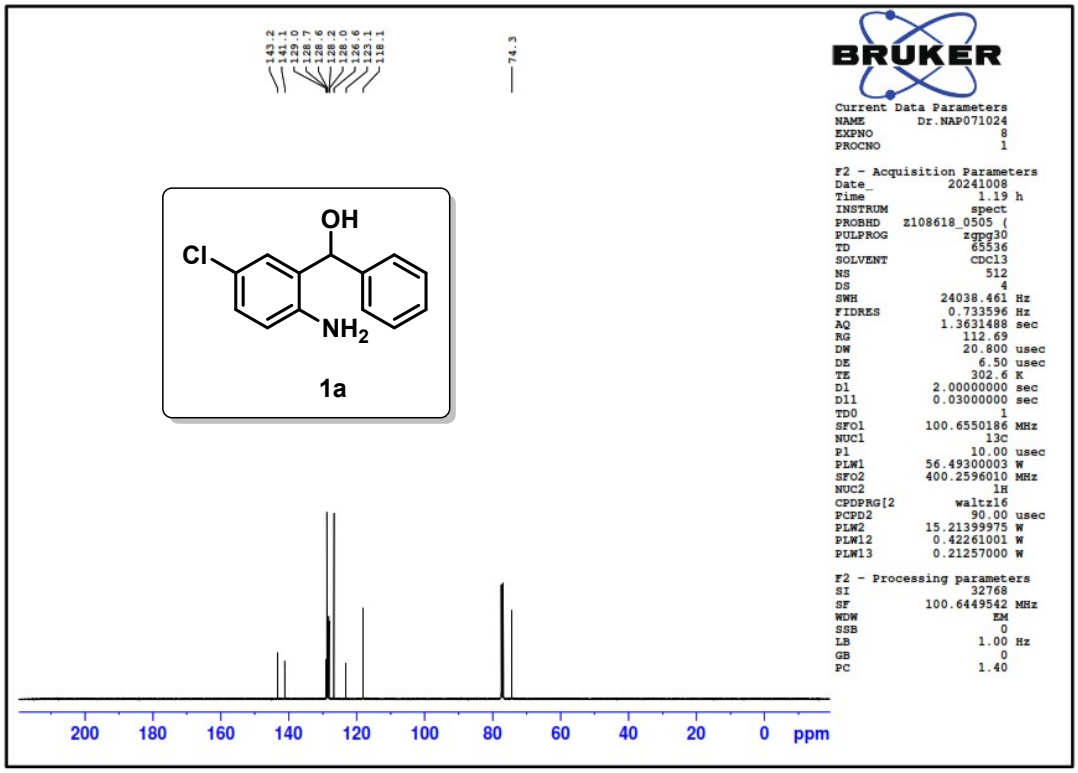
^{1}H and ^{13}C NMR spectra of compound **6p** in $CDCl_3$





IR and HRMS spectra of compound **6p**





^{1}H and ^{13}C NMR spectra of compound **1a** in $CDCl_3$

7. References:

1. V. Krishnakumar, N. G. Vindhya, B. K. Mandal and F.-R. Nawaz Khan, *Ind. Eng. Chem. Res.*, 2014, **53**, 10814–10819.
2. J.-C. Yang, M.-L. Liao, P.-G. Li and L.-H. Zou, *Green Chem.*, 2024, **26**, 9295–9299.