Electronic Supplementary Material (ESI) for RSC Advances.

Facile "on water" domino reactions for the expedient synthesis of 2*H*-thiopyrano[2,3-*b*]quinolines

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Supporting Information

1. Experimental Section

1.1. General methods

The melting points were measured in open capillary tubes and are uncorrected. The ^{1}H NMR, ^{13}C NMR, DEPT, H,H-COSY, C,H-COSY and HMBC spectra were recorded on a Bruker (Avance) 300 MHz NMR instrument using TMS as internal standard and $CDCl_3$ as solvent. Standard Bruker software was used throughout. Chemical shifts are given in parts per million (δ-scale) and the coupling constants are given in Hertz. Silica gel-G plates (Merck) were used for TLC analysis with a mixture of petroleum ether (60–80^{o}C) and ethyl acetate as eluent. Mass spectra were recorded in LCQ Fleet mass spectrometer, Thermo Fisher Instruments Limited, US. Electrospray ionisation mass spectrometry (ESI-MS) analysis was performed in the positive ion and negative ion mode on a liquid chromatography ion trap.

General procedure for the synthesis of 3-nitro-2-aryl-2*H*-thiopyrano[2,3-*b*]quinolines 3a-o: A mixture of 2-mercaptoquinoline-3-carbaldehyde (1.0 mmol) and substituted β-nitrostyrenes (1.0 mmol) in the presence of triethylamine (TEA) (0.25 mmol) in water (10 ml) was heated under reflux at 100°C for 3-4 h. After completion of the reaction (TLC), the resulting crude product was purified by washing with cold ethanol which afforded a library of 3-nitro-2-aryl-2*H*-thiopyrano[2,3-*b*]quinolines **3** in excellent yields.

2-(4-fluorophenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3a: Yellow solid. Yield: 87%; mp. 167–168 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 5.77 (s, 1H), 6.89–6.96 (m, 2H), 7.20–7.26 (m, 2H), 7.52–7.57 (m, 1H), 7.77 (td, *J* = 8.4, 1.2 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.95 (d, *J* = 8.4 Hz, 1H), 8.20 (s, 1H), 8.31 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 41.5, 116.0 ($^{2}J_{C,F}$ = 21.7 Hz), 121.9, 126.1, 127.0, 128.1 ($^{3}J_{C,F}$ = 8.4 Hz), 128.4, 128.5, 130.9, 132.5, 136.0 ($^{4}J_{C,F}$ = 3.3 Hz), 139.4, 145.2, 149.4, 155.1, 162.6 ($^{1}J_{C,F}$ = 246.6 Hz); ESI-MS: m/z. Calcd: 338.05; Found: 339.14 (M^+).

2-(4-chlorophenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3b: Pale Yellow solid. Yield: 89%; mp. 163–164 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 5.75 (s, 1H), 7.17–7.23 (m, 4H), 7.53–7.58 (m, 1H), 7.77 (td, *J* = 8.4, 1.2 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.94 (d, *J* = 8.7 Hz, 1H), 8.21 (s, 1H), 8.32 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 41.6, 121.9, 126.1, 127.1, 127.3, 127.7, 128.5, 129.3, 131.1, 132.6, 134.5, 138.6, 139.5, 145.0, 149.4, 155.0; ESI-MS: m/z. Calcd: 354.02; Found: 355.19 (M^+).

2-(4-bromophenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3c: Pale Yellow solid. Yield: 92%; mp. 198–199 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 5.74 (s, 1H), 7.13 (d, *J* = 8.4 Hz, 2H), 7.35–7.38 (m, 2H), 7.53–7.58 (m, 1H), 7.76 (td, *J* = 7.8, 1.3 Hz, 1H), 7.85 (d, *J* = 8.4 Hz, 1H), 7.95 (d, *J* = 8.4 Hz, 1H), 8.21 (s, 1H), 8.32 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 41.7, 121.9, 122.7, 126.1, 127.1, 128.0, 128.5, 128.5, 131.1, 132.3, 132.6, 139.1, 139.5, 144.9, 149.4, 154.9; ESI-MS: m/z. Calcd: 397.97; Found: 399.06 (M^+), 401.12 (M+3).

3-nitro-2-(4-(trifluoromethyl)phenyl)-2*H*-thiopyrano[2,3-*b*]quinoline 3d: Yellow solid. Yield: 85%; mp. 160–161 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 5.82 (s, 1H), 7.38 (d, *J* = 8.1 Hz, 2H), 7.50–7.57 (m, 3H), 7.77 (t, *J* = 7.6 Hz, 1H), 7.84 (d, *J* = 7.8 Hz, 1H), 7.94 (d, *J* = 8.4 Hz, 1H), 8.29 (s, 1H), 8.35 (s, 1H) ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 41.8, 121.8, 126.1, 126.2, 126.7, 127.2, 128.5, 128.6, 130.7 ($^{2}J_{C,F}$ = 32.9 Hz), 131.5, 132.7, 139.7, 143.8, 144.5, 149.4, 154.7; ESI-MS: m/z. Calcd: 388.05; Found: 389.20 (M^+).

3-nitro-2-phenyl-2*H*-thiopyrano[2,3-*b*]quinoline 3e: Pale Yellow solid. Yield: 94%; mp. 206–207 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 5.78 (s,1H), 7.21–7.24 (m, 5H), 7.50–7.56 (m,1H), 7.75 (td, *J* = 8.4, 1.2 Hz, 1H), 7.83 (d, J = 8.1 Hz, 1H), 7.93 (d, *J* = 8.4 Hz, 1H), 8.19 (s, 1H), 8.31 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 42.2, 122.2, 126.4, 126.3, 126.9, 128.4, 128.5, 128.6, 129.1,

130.9, 132.4, 139.3, 140.0, 145.3, 149.3, 155.5; ESI-MS: m/z. Calcd: 320.06; Found: 321.21 (M^+).

3-nitro-2-(*p*-tolyl)-2*H*-thiopyrano[2,3-*b*]quinoline 3f: Yellow solid. Yield: 95%; mp. 214–215 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.26 (s, 3H), 5.76 (s, 1H), 7.03 (d, *J* = 8.4 Hz, 2H), 7.13 (d, *J* = 8.1 Hz, 2H), 7.53 (t, *J* = 7.5 Hz, 1H), 7.75 (td, *J* = 7.8, 1.5 Hz, 1H), 7.83 (d, *J* = 8.4 Hz, 1H), 7.93 (d, *J* = 8.7 Hz, 1H), 8.18 (s, 1H), 8.30 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.0, 42.1, 122.2, 126.2, 126.3, 126.8, 128.4, 128.5, 129.8, 130.5, 132.2, 137.2, 138.5, 139.0, 145.7, 149.4, 155.7; ESI-MS: m/z. Calcd: 334.08; Found: 335.18 (M^+).

2-(4-ethylphenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3g: Pale Yellow solid. Yield: 93%; mp. 217–218 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.14 (t, *J* = 7.5 Hz, 3H), 2.55 (q, *J* = 7.6 Hz, 2H), 5.76 (s, 1H), 7.05 (d, *J* = 8.1 Hz, 2H), 7.15 (d, *J* = 8.4 Hz, 2H), 7.50–7.55 (m, 1H), 7.75 (td, *J* = 7.7, 1.4 Hz, 1H), 7.83 (d, *J* = 7.8 Hz, 1H), 7.93 (d, *J* = 8.4 Hz, 1H), 8.18 (s, 1H), 8.30 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 15.3, 28.4, 42.0, 122.2, 126.1, 126.2, 126.9, 128.4, 128.5, 128.6, 130.6, 132.3, 137.3, 139.2, 144.8, 145.5, 149.3, 155.6; ESI-MS: m/z. Calcd: 348.09; Found: 349.22 (M^+).

2-(4-*(tert*-butyl)phenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3h: Pale Yellow solid. Yield: 92%; mp. 252–253 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.22 (s, 9H), 5.77 (s, 1H), 7.16 (d, *J* = 8.4 Hz, 2H), 7.24 (d, *J* = 8.4 Hz, 2H), 7.53 (t, *J* = 7.5 Hz, 1H), 7.73–7.78 (m, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.94 (d, *J* = 8.4 Hz, 1H), 8.19 (s, 1H), 8.31 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 31.1, 34.5, 41.9, 122.3, 125.9, 126.0, 126.1, 126.9, 128.4, 128.5, 130.6, 132.3, 136.9, 139.1, 145.6, 149.3, 151.6, 155.6; ESI-MS: m/z. Calcd: 376.12; Found: 377.21 (M^+).

2-(4-methoxyphenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3i: Yellow solid. Yield: 96%; mp. 208–209 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 3.72 (s, 3H), 5.75 (s, 1H), 6.73–6.76 (m, 2H), 7.15–7.18 (m, 2H), 7.51–7.56 (m, 1H), 7.76(td, *J* = 7.7, 1.4 Hz, 1H), 7.83 (d, *J* = 8.1 Hz, 1H), 7.94 (d, *J* = 8.4 Hz, 1H), 8.19 (s, 1H), 8.28 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 41.8, 55.2, 114.4, 122.2, 126.1, 126.9, 127.6, 128.4, 128.5, 130.4, 132.2, 132.3, 145.6, 149.3, 155.6, 159.7; ESI-MS: m/z. Calcd: 350.07; Found: 351.21 (M^+).

2-(2-fluorophenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3j: Pale Yellow solid. Yield: 90%; mp. 216–217 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 6.10 (s, 1H), 6.94 (t, *J* = 7.5 Hz, 1H),

7.01–7.11 (m, 2H), 7.19–7.24 (m, 1H) 7.54 (t, *J* = 7.5 Hz, 1H), 7.73–7.78 (m, 1H), 7.84 (d, *J* = 7.8 Hz, 1H), 7.93 (d, *J* = 8.4 Hz, 1H), 8.21 (s, 1H), 8.40 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 35.9 ($^3J_{C,F}$ = 3.7 Hz), 116.3 ($^2J_{C,F}$ = 21.2 Hz), 122.0, 124.5 ($^3J_{C,F}$ = 3.5 Hz), 126.2, 127.0, 127.1 ($^4J_{C,F}$ = 2.7 Hz), 127.3, 128.5, 130.3 ($^3J_{C,F}$ = 8.3 Hz), 132.0, 132.4, 139.4, 143.8, 149.4, 155.4, 159.2 ($^1J_{C,F}$ = 248.2 Hz); ESI-MS: m/z. Calcd: 338.05; Found: 339.18 (M^+).

2-(2-methoxyphenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3k: Yellow solid. Yield: 94%; mp. 199–200 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H:3.86, (s, 3H), 6.19 (s, 1H), 6.72 (t, *J* = 7.5 Hz, 1H), 6.89 (d, *J* = 8.4 Hz, 1H), 6.94 (dd, *J* = 7.5, 1.5 Hz, 1H), 7.17–7.23 (m, 1H), 7.51 (t, *J* = 7.5 Hz, 1H), 7.72 (td, *J* = 7.7, 1.3 Hz, 1H), 7.82 (d, *J* = 8.1 Hz, 1H), 7.89 (d, *J* = 8.4 Hz, 1H), 8.18 (s, 1H), 8.40 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 36.4, 55.6, 111.3, 120.5, 122.5, 126.0, 126.1, 126.7, 127.4, 128.3, 128.4, 129.7, 132.0, 132.1, 139.0, 144.4, 149.2, 155.7, 156.7; ESI-MS: m/z. Calcd: 350.07; Found: 351.18 (M^+).

2-(3-fluorophenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3l: Yellow solid. Yield: 92%; mp. 210–211 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 5.77 (s, 1H), 6.94 (d, *J* = 9.3 Hz, 2H), 7.05 (d, *J* = 7.8 Hz, 1H), 7.19–7.23 (m, 1H), 7.55 (t, *J* = 7.5 Hz, 1H), 7.75 (m, 1H), 7.85 (d, *J* = 8.1 Hz, 1H), 7.95 (d, *J* = 8.1 Hz, 1H), 8.22 (s, 1H), 8.34 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 39.3, 111.5 ($^2J_{C,F}$ = 22.3 Hz), 113.4 ($^2J_{C,F}$ = 20.8 Hz), 120.3 ($^4J_{C,F}$ = 2.8 Hz), 120.4, 124.4, 125.1, 126.1, 127.3, 129.2 ($^3J_{C,F}$ = 8.1 Hz), 130.6, 130.7, 138.9, 141.6 ($^3J_{C,F}$ = 6.7 Hz), 142.4, 147.1, 153.0, 160.7 ($^1J_{C,F}$ = 241.0 Hz); ESI-MS: m/z. Calcd: 338.05; Found: 339.2 (M^+).

2-(3-methoxyphenyl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3m: Pale Yellow solid. Yield: 95%; mp. 152–153 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 3.71 (s, 3H), 5.75 (s, 1H), 6.74–6.83 (m, 3H), 7.15 (t, *J* = 7.6 Hz, 1H), 7.53 (t, *J* = 7.5 Hz, 1H), 7.72–7.78 (m, 1H), 7.82 (d, *J* = 8.1 Hz, 1H), 7.93 (d, *J* = 8.7 Hz, 1H), 8.18 (s, 1H), 8.32 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 42.1, 55.2, 112.5, 113.5,118.5, 122.1, 126.1, 126.9, 128.4, 128.5, 130.2, 131.0, 132.3, 139.3, 141.4, 145.1, 149.3, 155.4, 159.9; ESI-MS: m/z. Calcd: 350.07 Found: 351.20 (M^+).

2-(naphthalen-1-yl)-3-nitro-2*H*-thiopyrano[2,3-*b*]quinoline 3n: Yellow solid. Yield: 91%; mp. 287–288 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 6.62 (s, 1H), 7.14–7.22 (m, 2H), 7.49–7.59 (m, 2H), 7.66–7.75 (m, 3H), 7.86 (t, *J* = 7.9 Hz, 3H), 8.20 (d, *J* = 8.7 Hz, 1H), 8.26 (s, 1H), 8.55 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 37.9, 122.2, 122.7, 123.2, 125.0, 126.1, 126.2, 127.0,

127.1, 128.5, 129.1, 129.2, 129.4, 132.3, 132.4, 134.2, 134.5, 139.5, 144.7, 149.3, 155.5; ESI-MS: m/z. Calcd: 370.08; Found: 371.19 (M^+).

3-nitro-2-(thiophen-2-yl)-2*H*-thiopyrano[2,3-*b*]quinoline 3o: Green solid. Yield: 94%; mp. 201–202 °C; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 6.06 (s, 1H), 6.82 (dd, *J* = 5.1, 3.6 Hz, 1H), 6.95 (dt, *J* = 3.6, 1.0 Hz, 1H), 7.11 (dd, *J* = 5.1, 1.2 Hz, 1H), 7.55 (ddd, *J* = 8.1, 6.9, 1.2 Hz, 1H), 7.78 (ddd, *J* = 8.4, 6.9, 1.5 Hz, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.98 (d, *J* = 8.1 Hz, 1H), 8.22 (s, 1H), 8.25 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 37.6, 122.1, 125.5, 125.9, 126.2, 127.0, 127.1, 128.5, 130.4, 132.5, 139.5, 143.0, 145.5, 149.4, 155.0, 166.1; ESI-MS: m/z. Calcd: 326.02; Found: 327.14 (M^+).

2-(4-chlorophenyl)-7-methyl-3-nitro-2H-thiopyrano[2,3-b]quinoline 3p: Yellow solid. Yield: 90% mp. 251-252; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.54 (s, 3H), 5.73 (s, 1H), 7.16–7.22 (m, 4H), 7.59–7.61 (m, 2H), 7.84 (d, *J* = 9.3 Hz, 1H), 8.11 (s, 1H), 8.31 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.4, 41.5, 121.8, 126.2, 127.3, 127.7, 128.1, 129.2, 131.3, 134.4, 134.8, 137.2, 138.6, 138.9, 144.8, 148.0, 153.7; ESI-MS: m/z. Calcd: 368.04; Found: 369.06 (M^+).

7-methyl-3-nitro-2-(p-tolyl)-2H-thiopyrano[2,3-b]quinoline 3q: Light yellow solid. Yield: 93% mp. 238-239; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.25 (s, 3H), 2.53 (s, 3H), 5.74 (s, 1H), 7.02 (d, *J* = 8.1 Hz, 2H), 7.12 (d, *J* = 7.8 Hz, 2H), 7.56–7.58 (m, 2H), 7.83 (d, *J* = 9.0 Hz, 1H), 8.09 (s, 1H), 8.28 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.0, 21.4, 41.9, 122.1, 126.2, 127.3, 128.1, 129.7, 130.9, 134.6, 137.0, 137.1, 138.4, 138.6, 145.3, 148.0, 154.3; ESI-MS: m/z. Calcd: 348.09; Found: 349.12 (M^+).

7-methoxy-3-nitro-2-(p-tolyl)-2H-thiopyrano[2,3-b]quinoline 3r: orange solid. Yield: 91% mp. 197-198; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.25 (s, 3H), 3.94 (s, 3H), 5.72 (s, 1H), 7.00–7.13 (m, 5H), 7.39 (dd, *J* = 9.1, 2.8 Hz, 1H), 7.83 (d, *J* = 9.3 Hz, 1H), 8.01 (s, 1H), 8.27 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.0, 41.8, 55.6, 105.8, 122.4, 124.8, 126.1, 127.1, 129.7, 129.8, 130.8, 137.0, 137.9, 138.4, 145.5, 152.2, 157.9; ESI-MS: m/z. Calcd: 364.09; Found: 365.08 (M^+).

Structure determination using NMR spectroscopic data of 3f:

The structures of 3-nitro-2-(*p*-tolyl)-2*H*-thiopyrano[2,3-*b*]quinoline **3f** were deduced from one- and two-dimensional NMR spectroscopic data. The structural elucidation using NMR spectroscopy is discussed below.

In the ^{1}H NMR spectrum of **3f**, the H-2 appears as a singlet at 5.76 ppm and shows HMBCs with C-3, C-4, C-10a and C-2' at 145.7, 126.3, 155.7 and 138.5 ppm respectively. The H-4 gives a singlet at 8.18 ppm which shows HMBCs with C-3, C-5, and C-10a appearing at 145.7, 139.0, and 155.7 respectively. The H-5 appears as a singlet at 8.30 ppm and shows HMBCs with C-10a at 155.7 ppm. The H-6 gives a doublet at 7.83 ppm (J = 8.4 Hz) which shows HMBCs with C-5 and C-9a at 139.0 and 149.4 ppm respectively. The H-8 appearing as a triplet of doublets at 7.75 ppm (J = 7.8, 1.5 Hz) shows HMBC with C-9a at 149.4 ppm. Likewise, the methyl protons appearing as a singlet at 2.26 ppm shows HMBC with C-4' at 129.8 ppm.

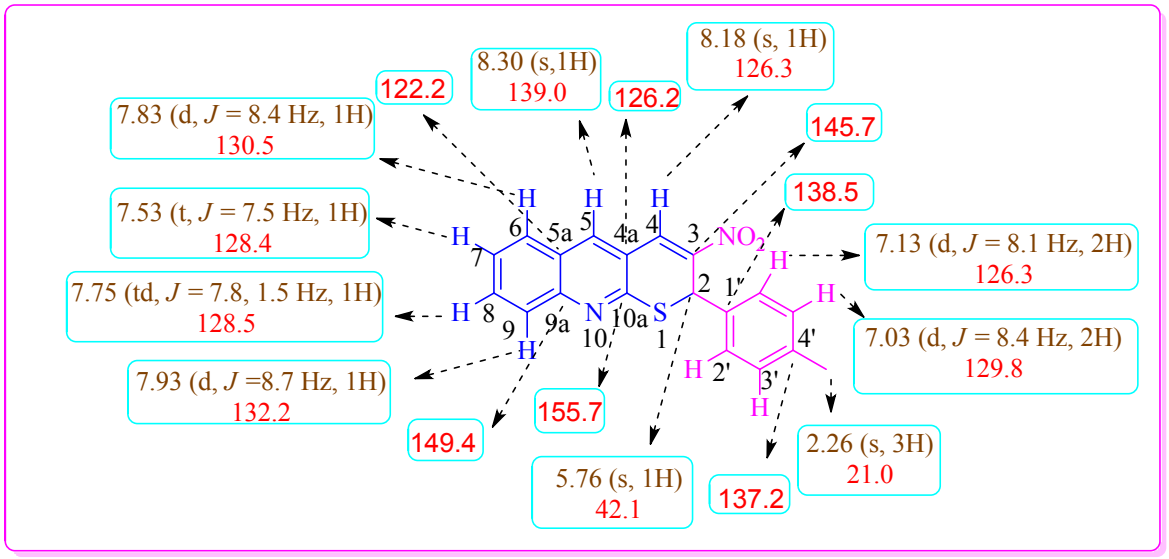

Figure 1. Selected ^{1}H and ^{13}C Chemical shifts and HMB correlations of **3f**.

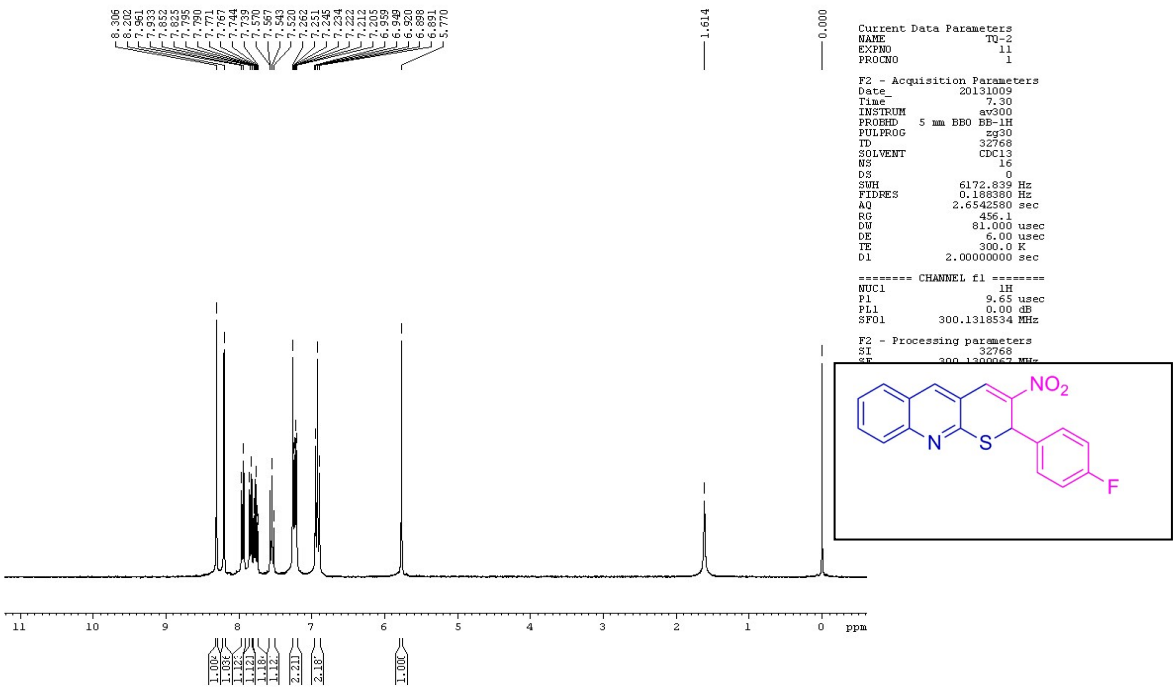

Figure. 1 ^{1}H NMR Spectrum **3a** ($CDCl_3$)

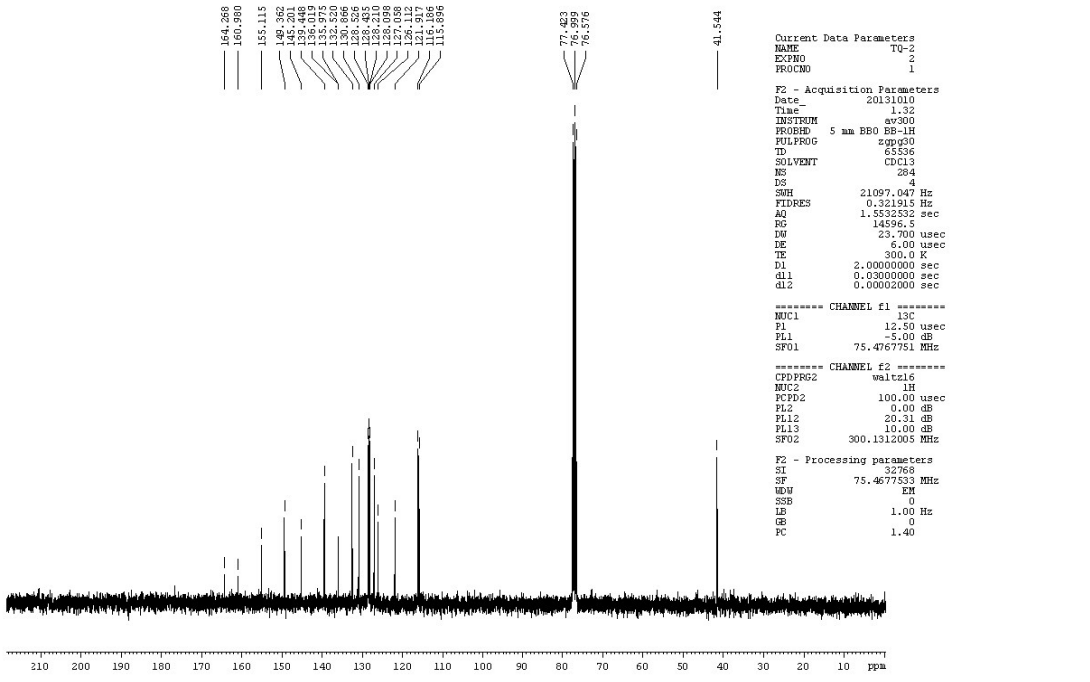

Figure. 2 ^{13}C NMR Spectrum of **3a** **(**$CDCl_3$)

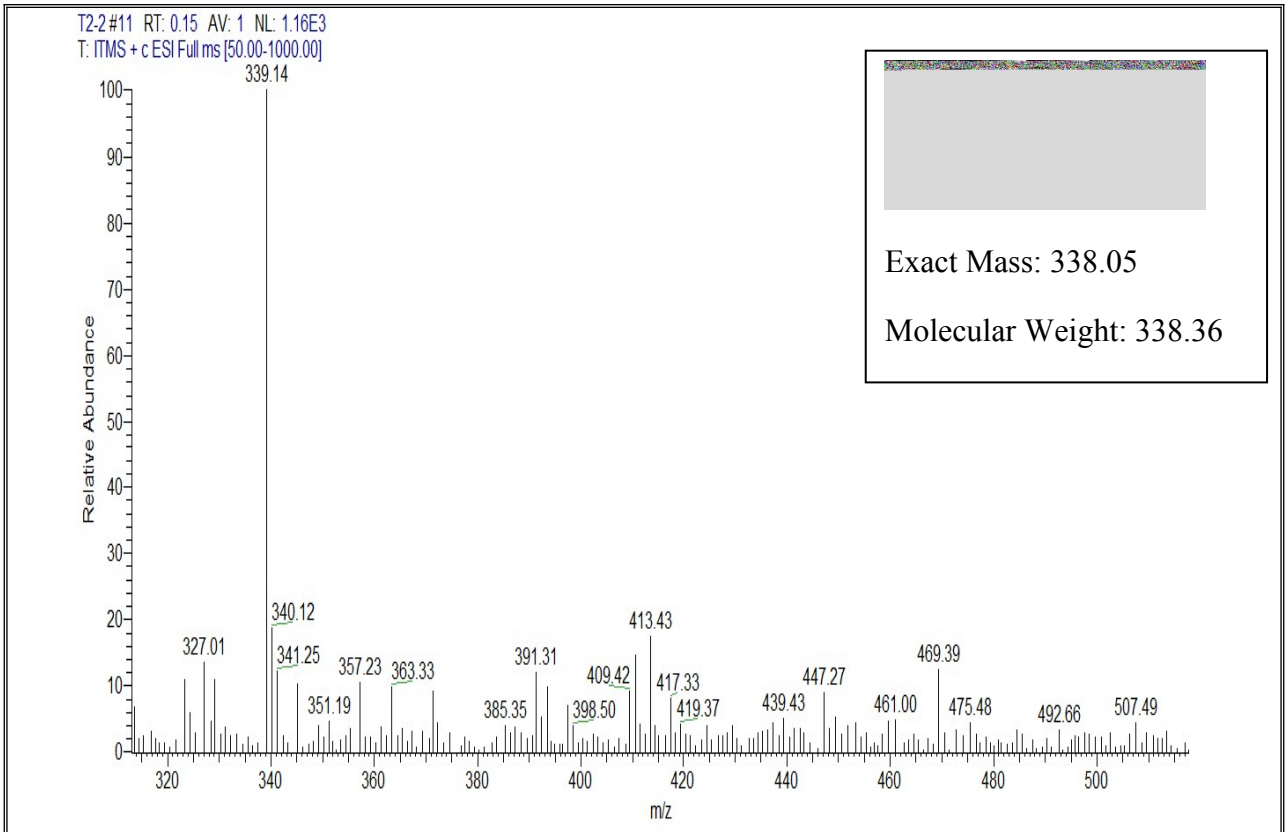

Figure. 3 ESI mass spectrum of Spectrum of **3a**

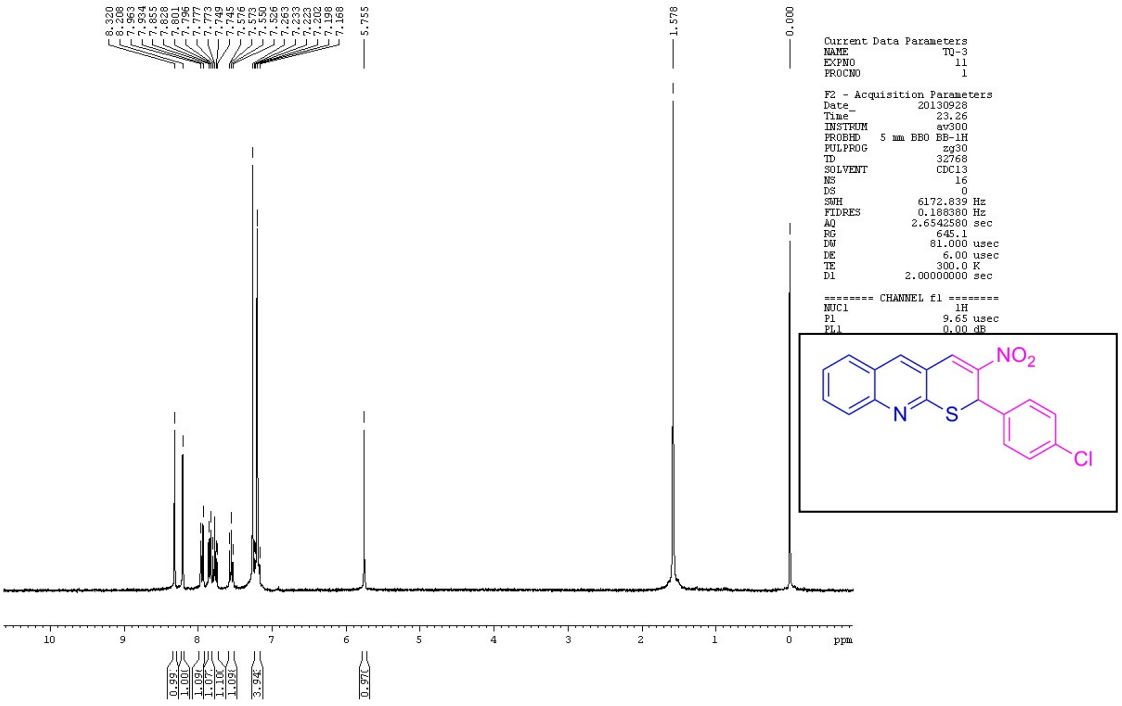

Figure. 4 ^{1}H NMR Spectrum **3b** ($CDCl_3$)

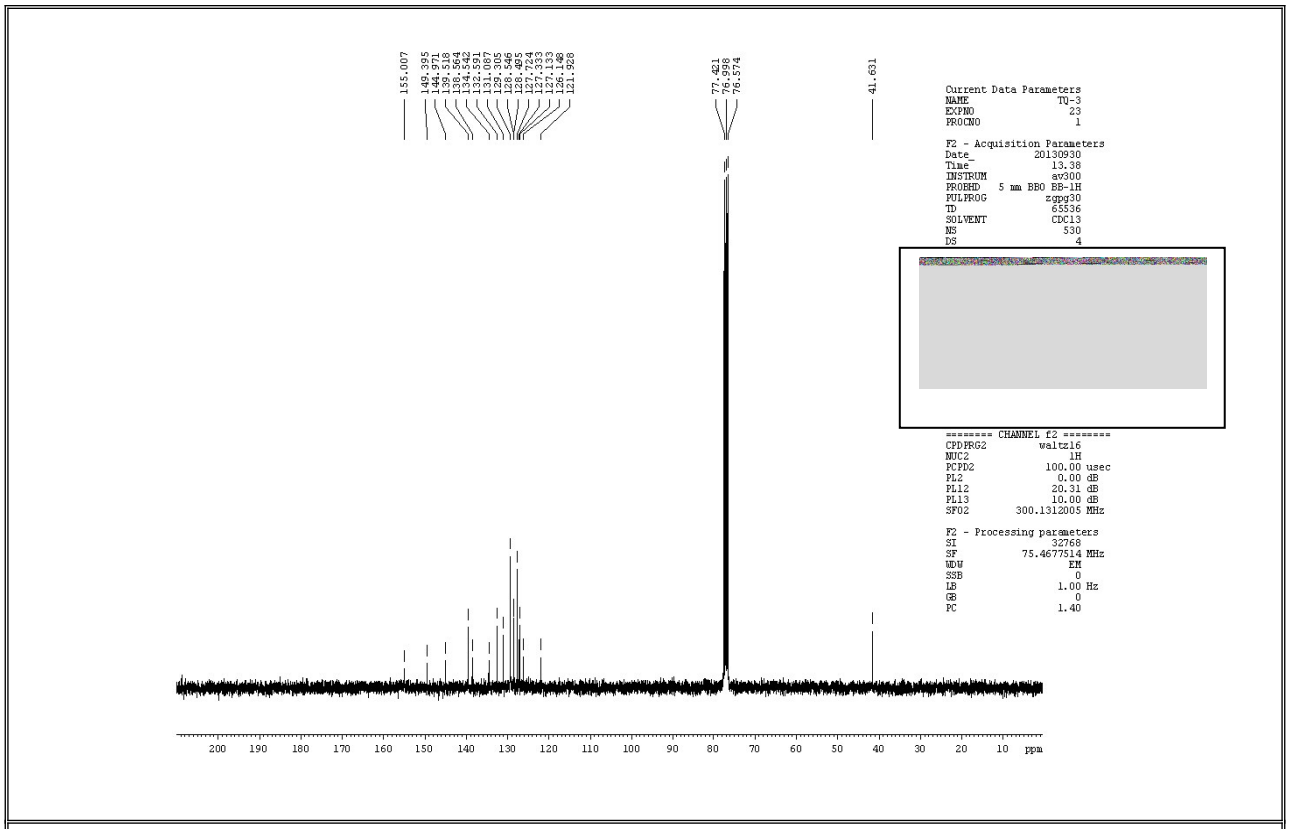

Figure. 5 ^{13}C NMR Spectrum of **3b** **(**$CDCl_3$)

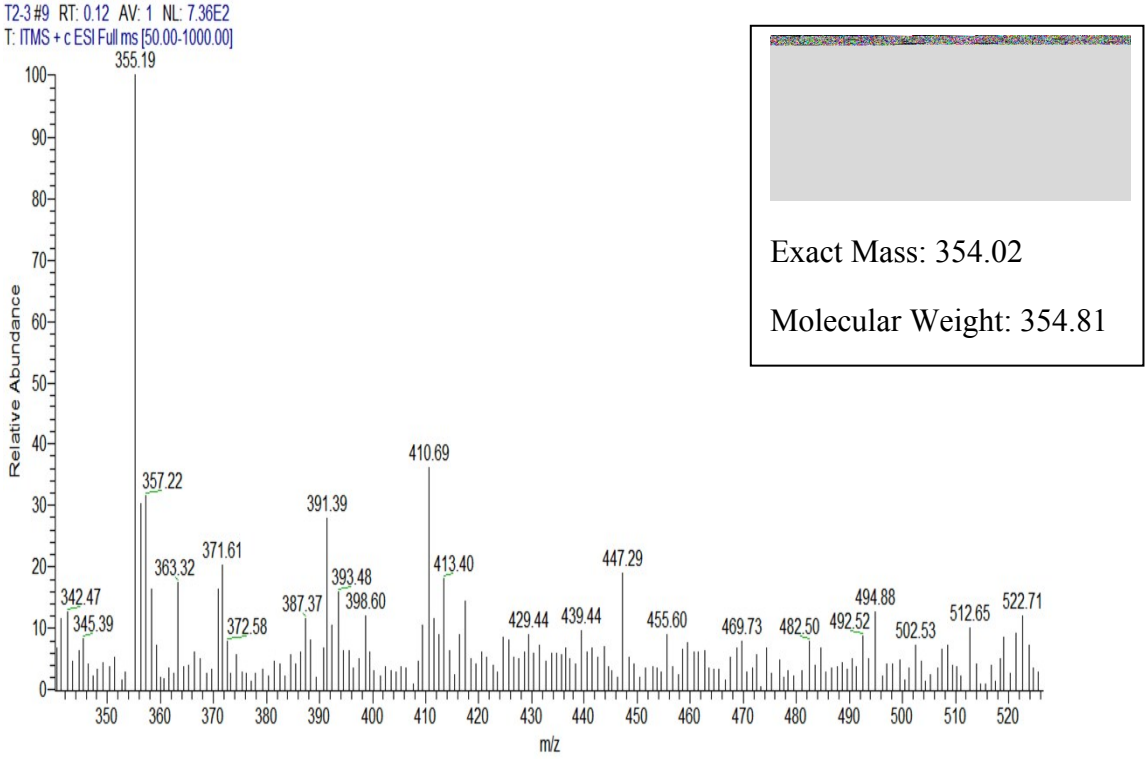

Figure. 6 ESI mass spectrum of Spectrum of **3b**

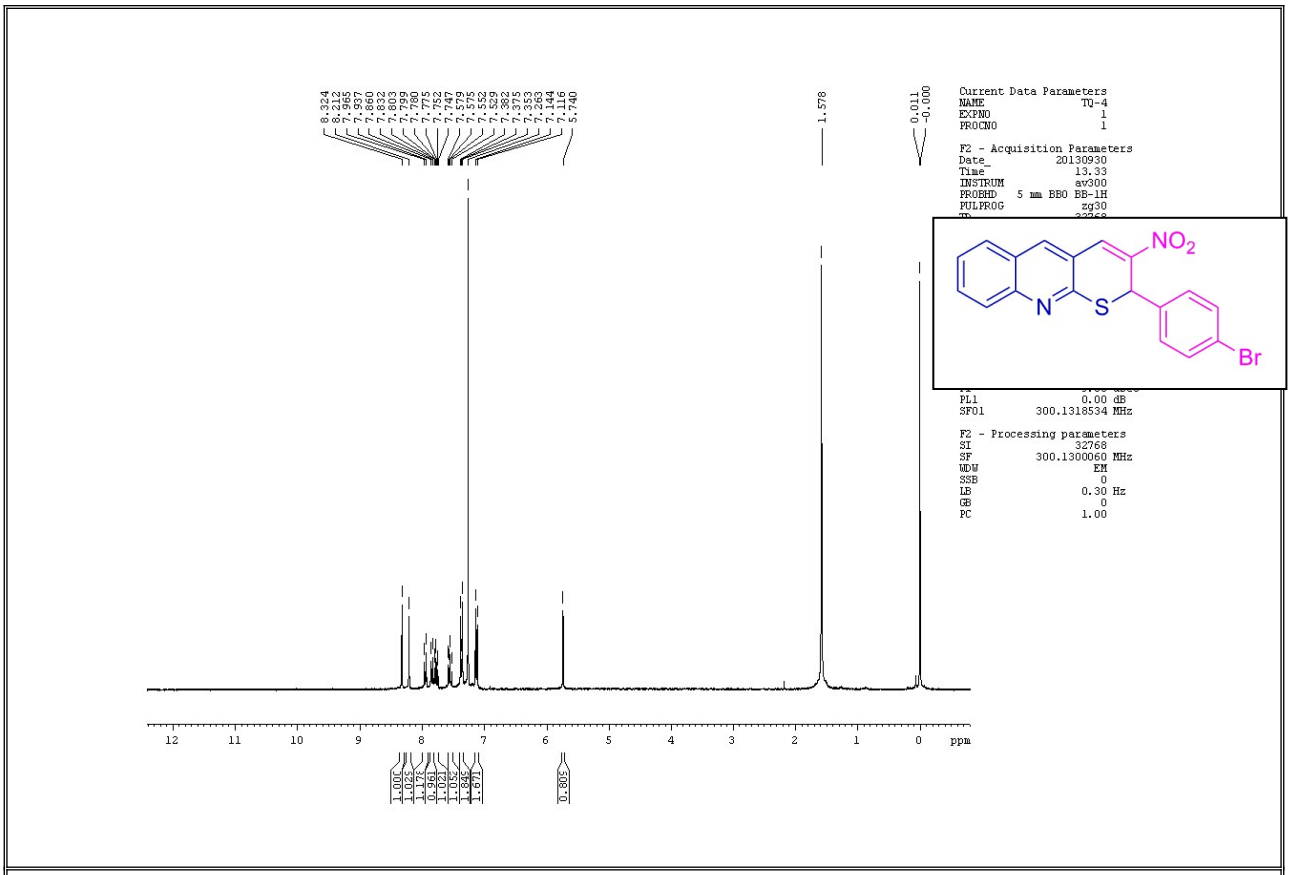

Figure. 7 ^{1}H NMR Spectrum **3c** ($CDCl_3$)

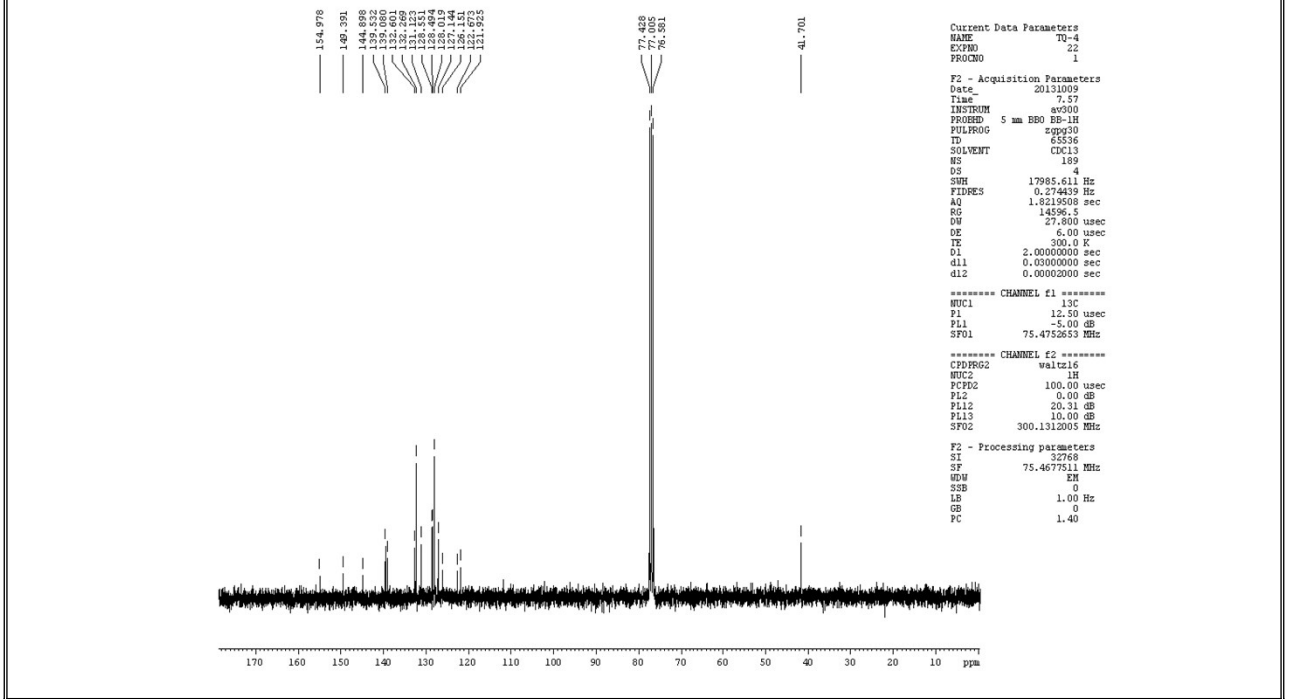

Figure. 8 ^{13}C NMR Spectrum of **3c** **(**$CDCl_3$)

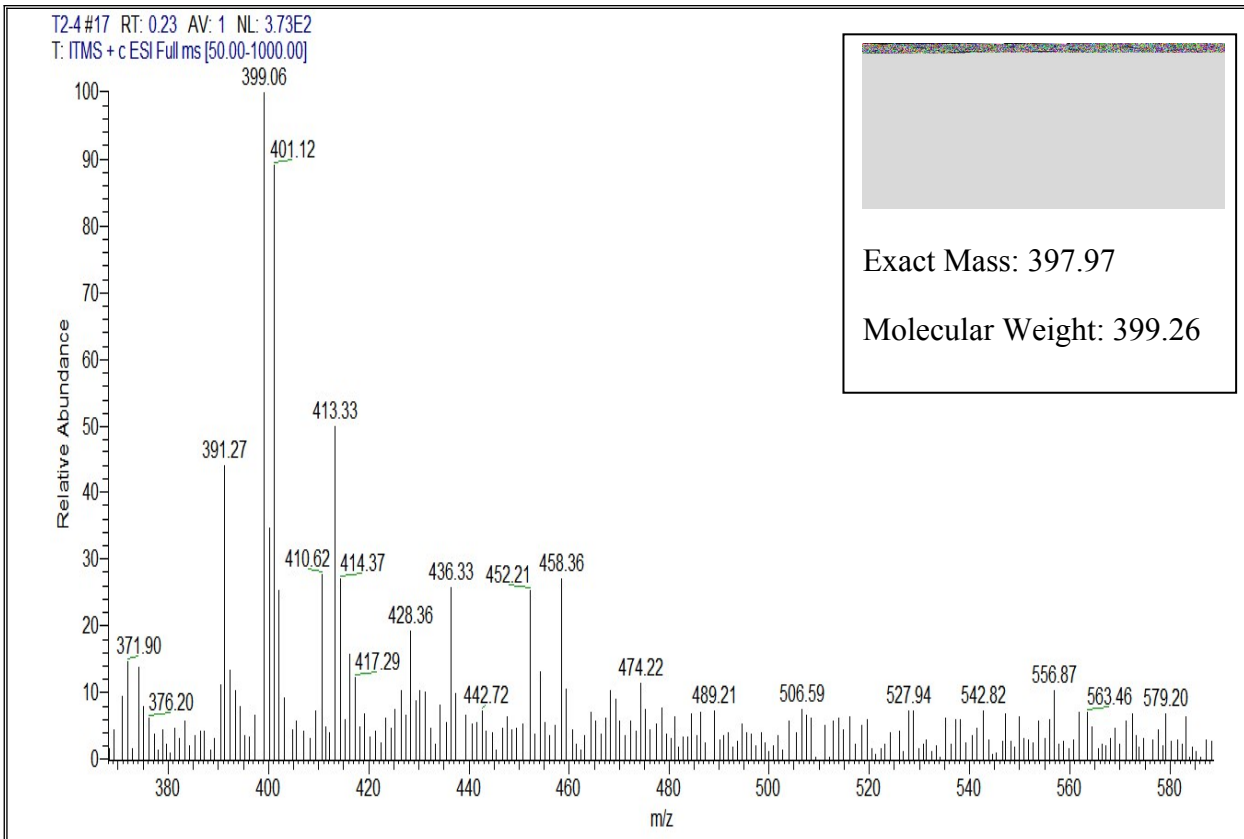

Figure. 9 ESI mass spectrum of Spectrum of **3c**

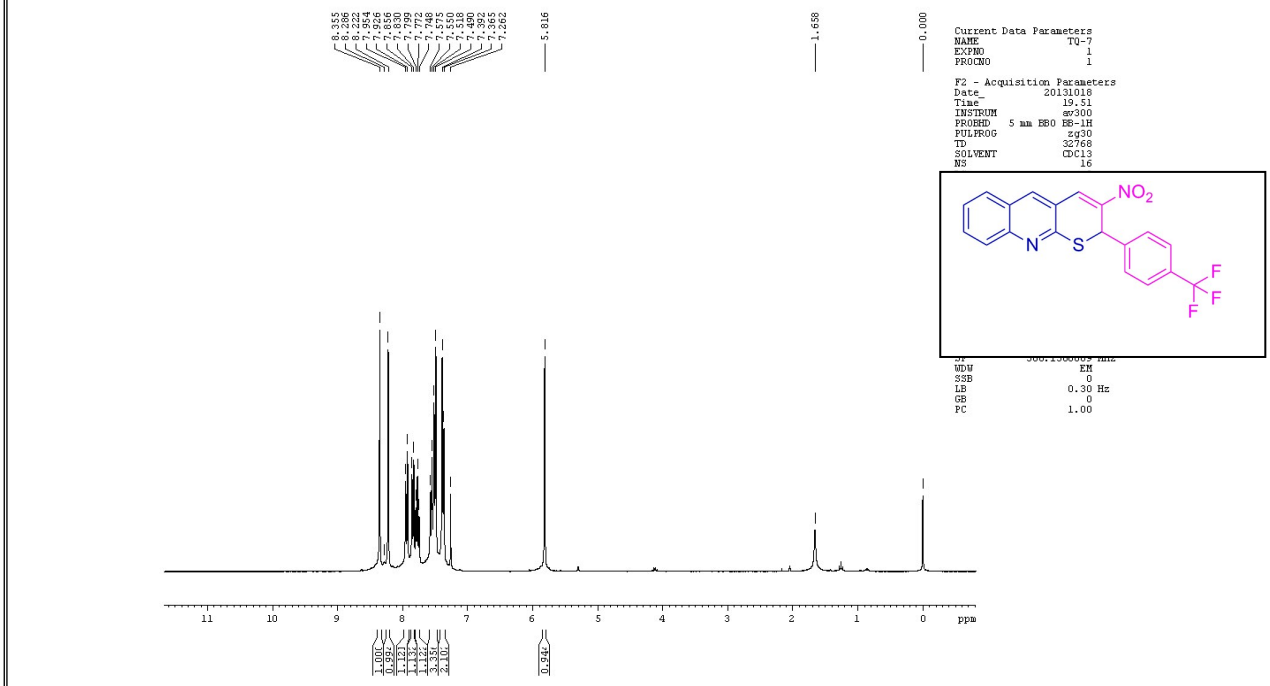

Figure. 10 ^{1}H NMR Spectrum **3d** ($CDCl_3$)

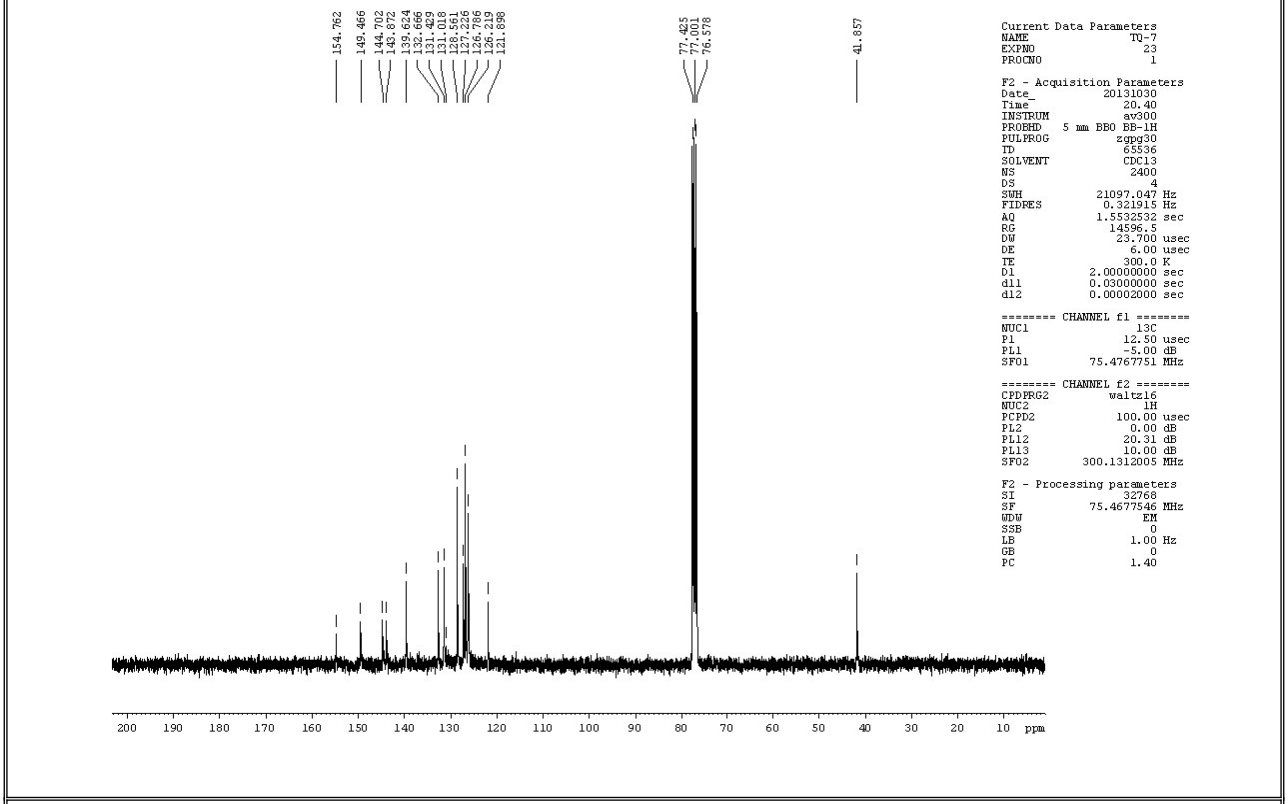

Figure. 11 ^{13}C NMR Spectrum of **3d** **(**$CDCl_3$)

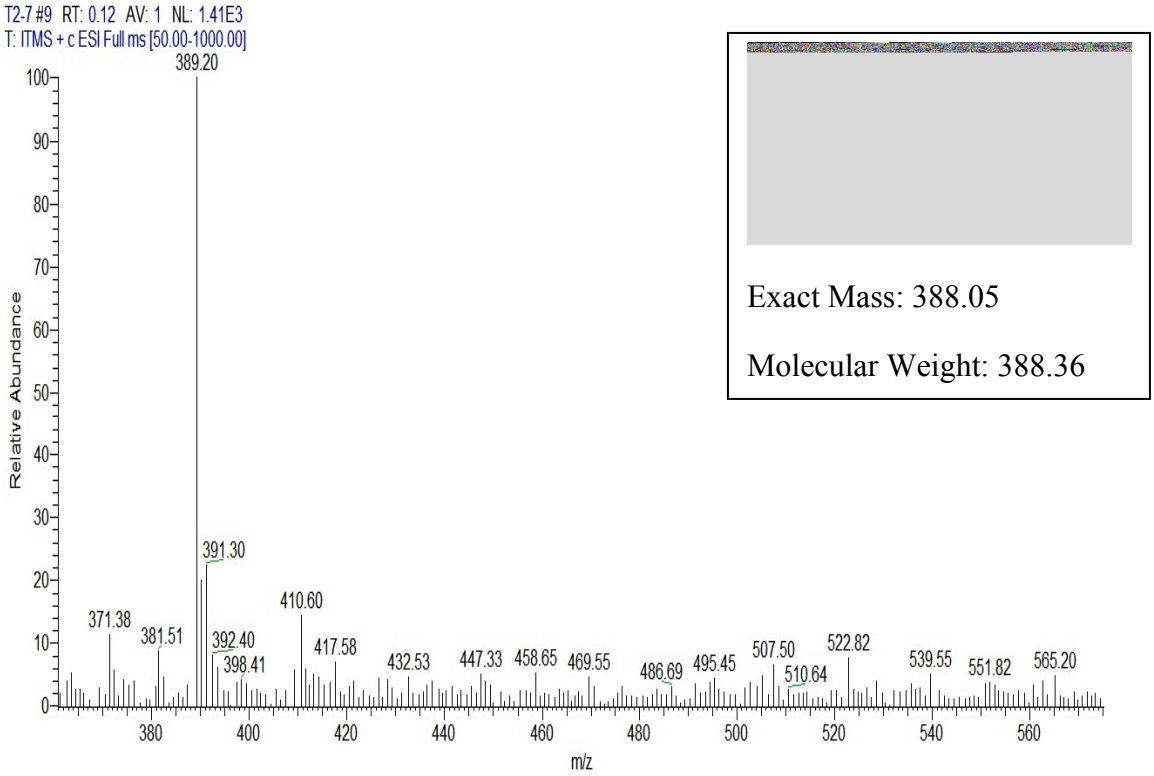

Figure. 12 ESI mass spectrum of Spectrum of **3d**

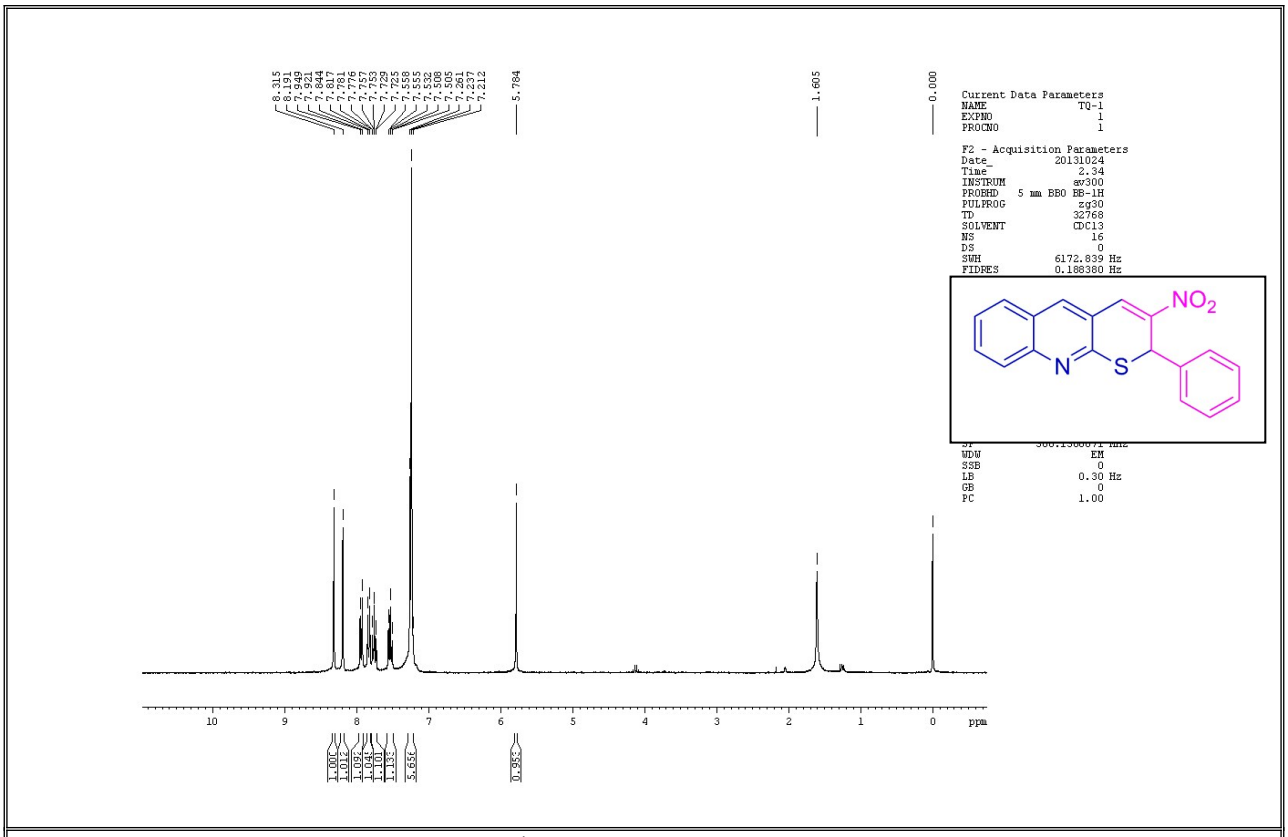

Figure. 13 ^{1}H NMR Spectrum **3e** ($CDCl_3$)

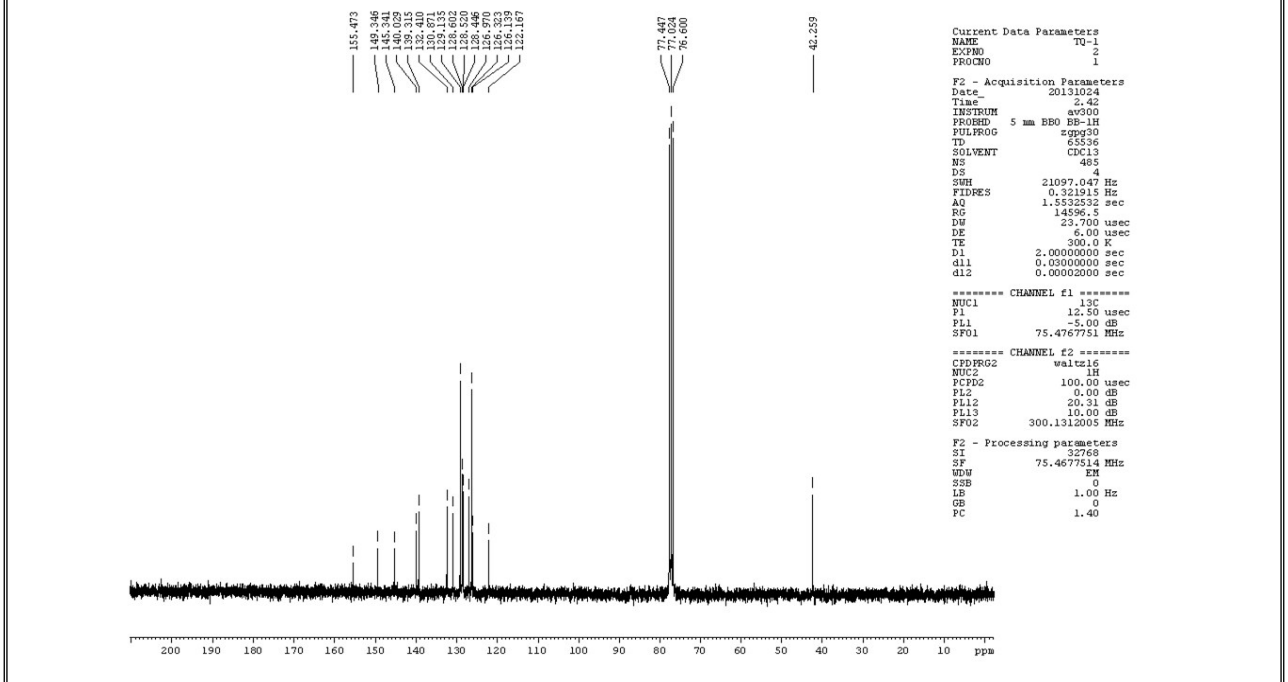

Figure. 14 ^{13}C NMR Spectrum of **3e** ($CDCl_3$)

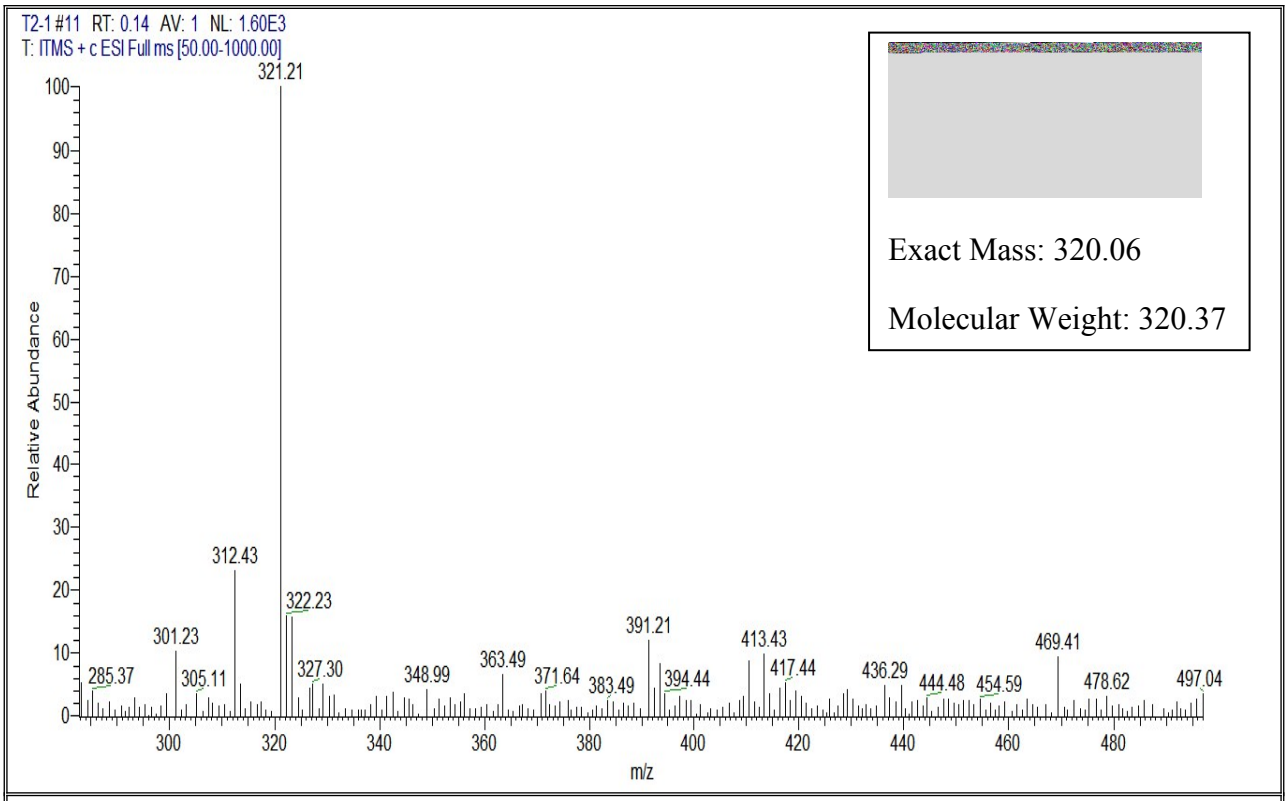

Figure. 15 ESI mass spectrum of Spectrum of **3e**

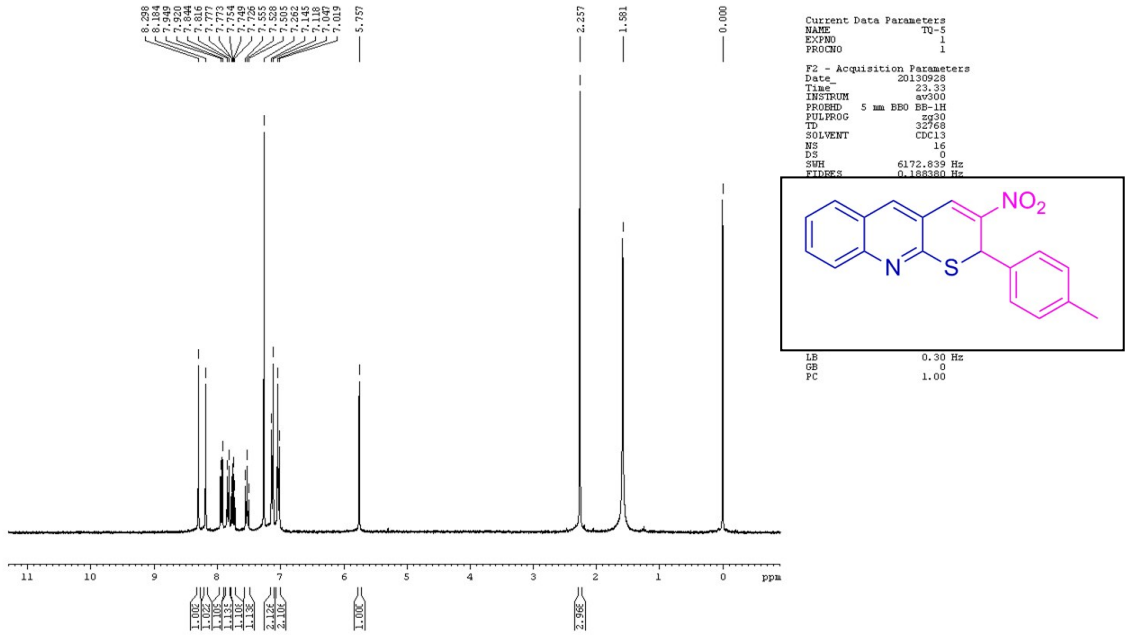

Figure. 16 ^{1}H NMR Spectrum **3f** ($CDCl_3$)

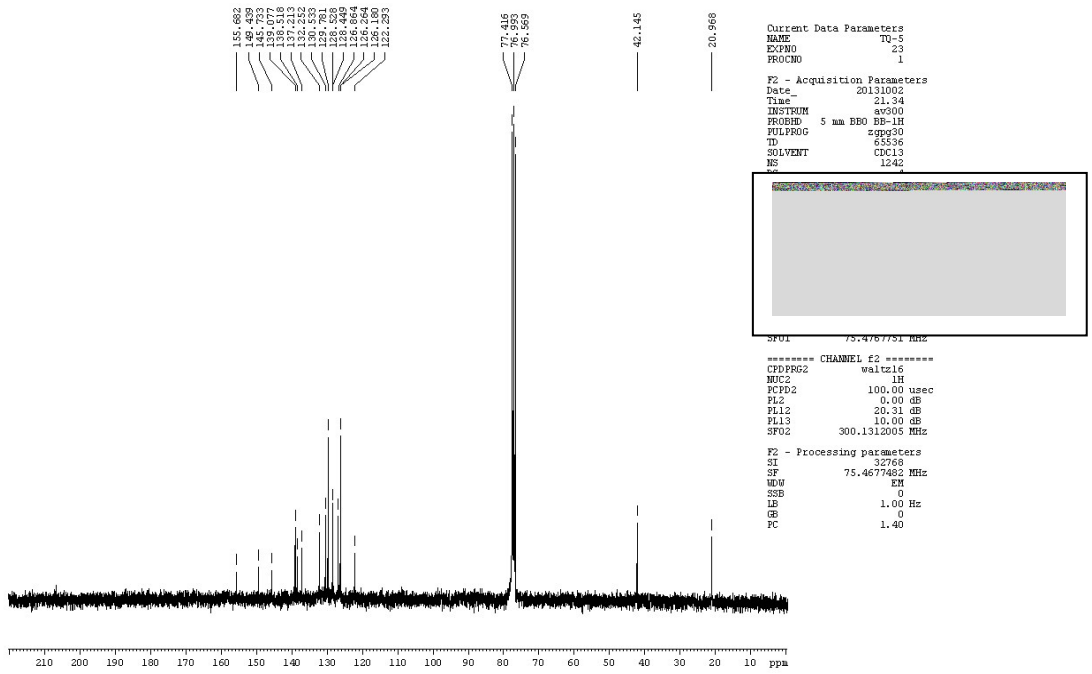

Figure. 17 ^{13}C NMR Spectrum of **3f** ($CDCl_3$)

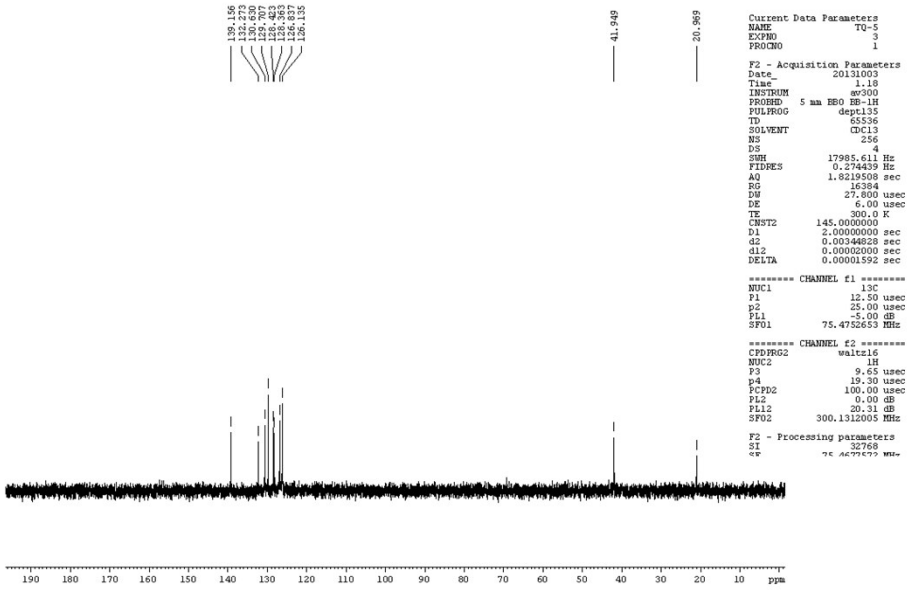

Figure. 18 DEPT-135 Spectrum of **3f** ($CDCl_3$)

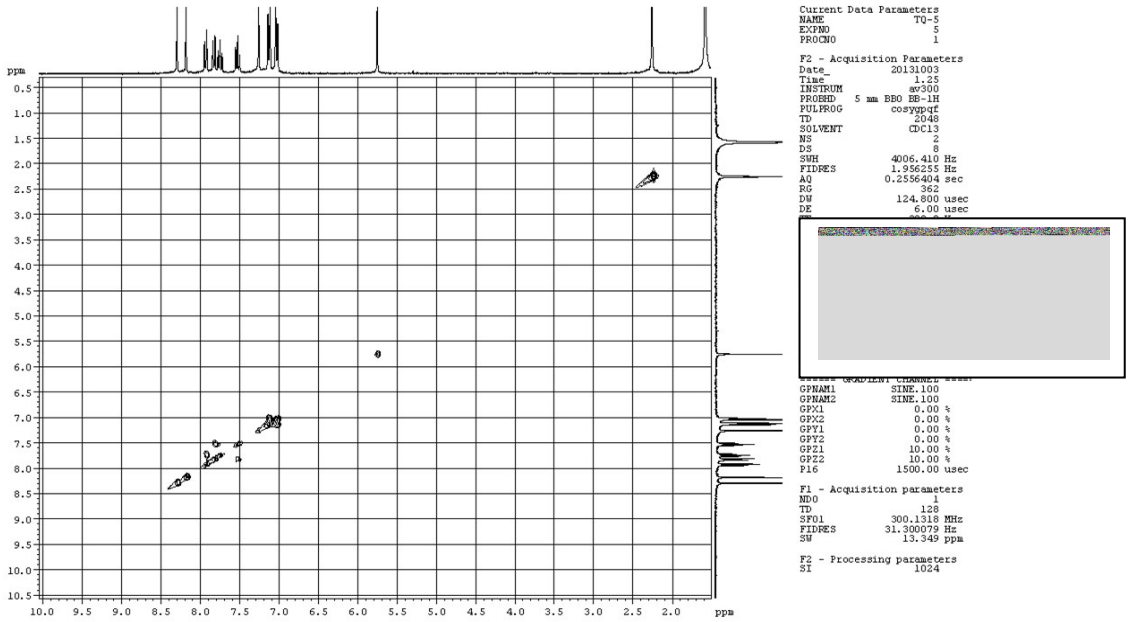

Figure. 19 H,H-COSY Spectrum of **3f** (CDCl$_3$)

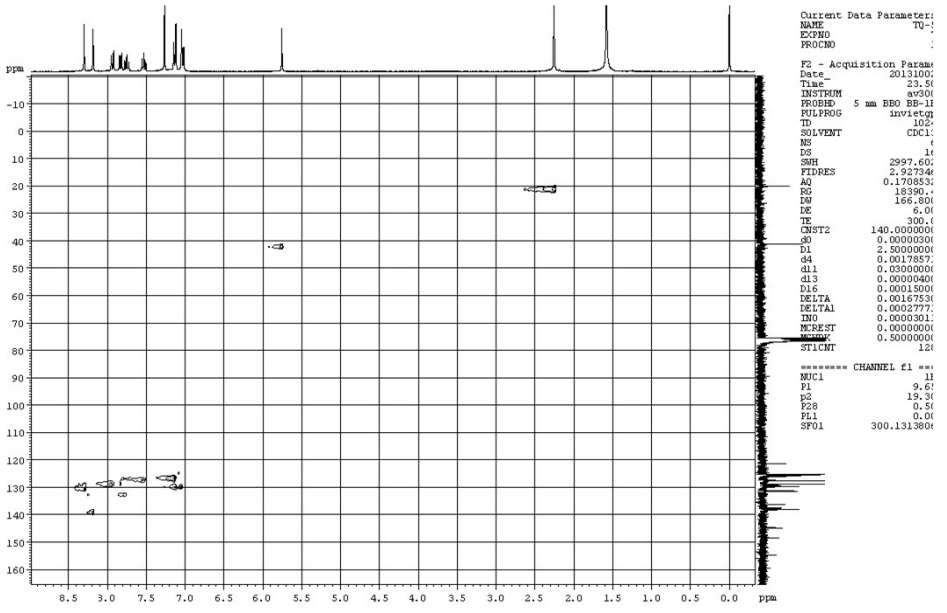

Figure. 20 C,H-COSY Spectrum of **3f** (CDCl$_3$)

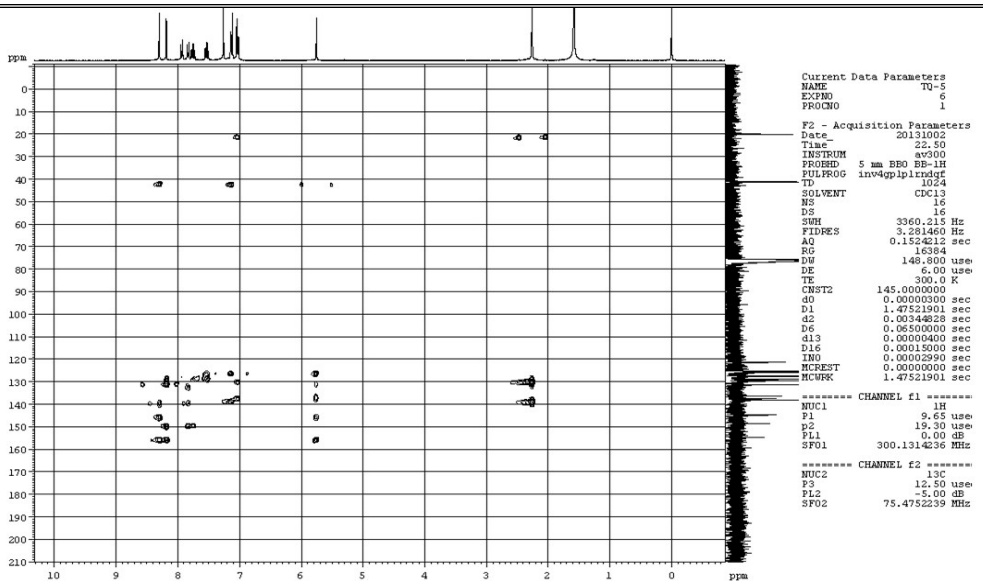

Figure. 21 HMBC Spectrum of **3f (**$CDCl_3$)

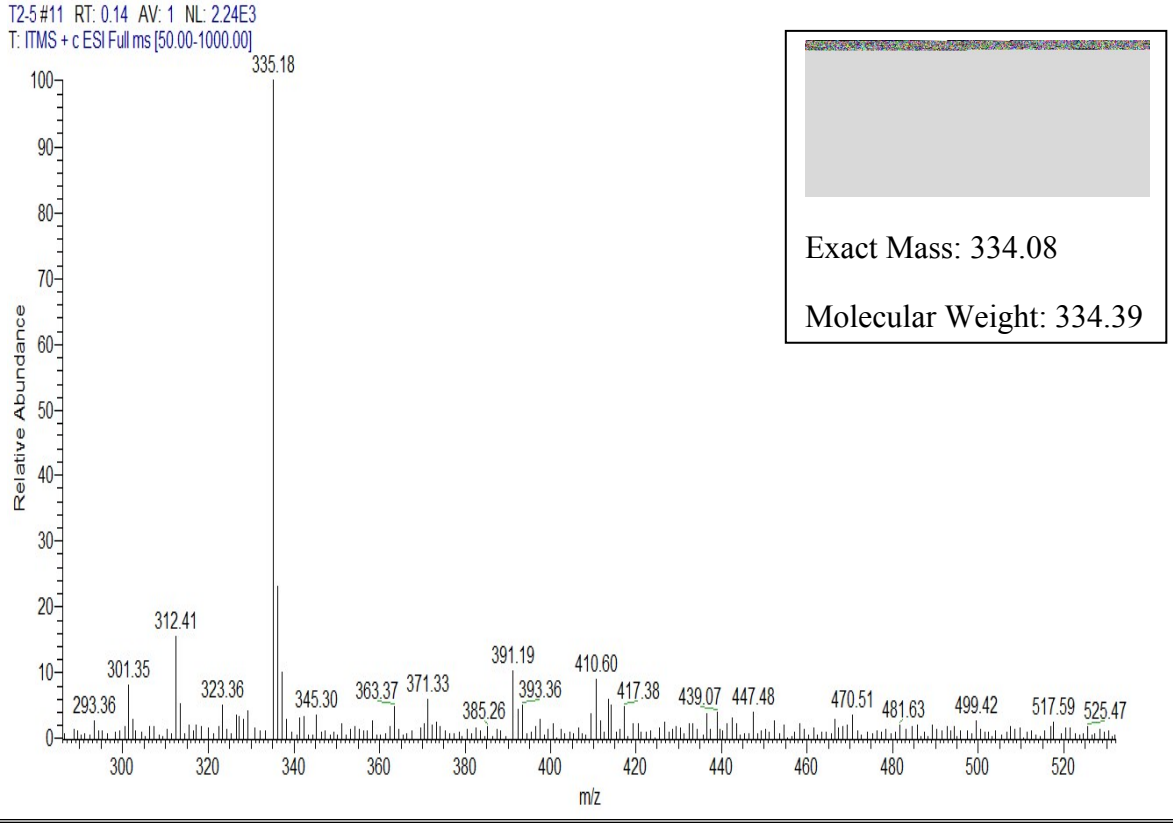

Figure. 22 ESI mass spectrum of Spectrum of **3f**

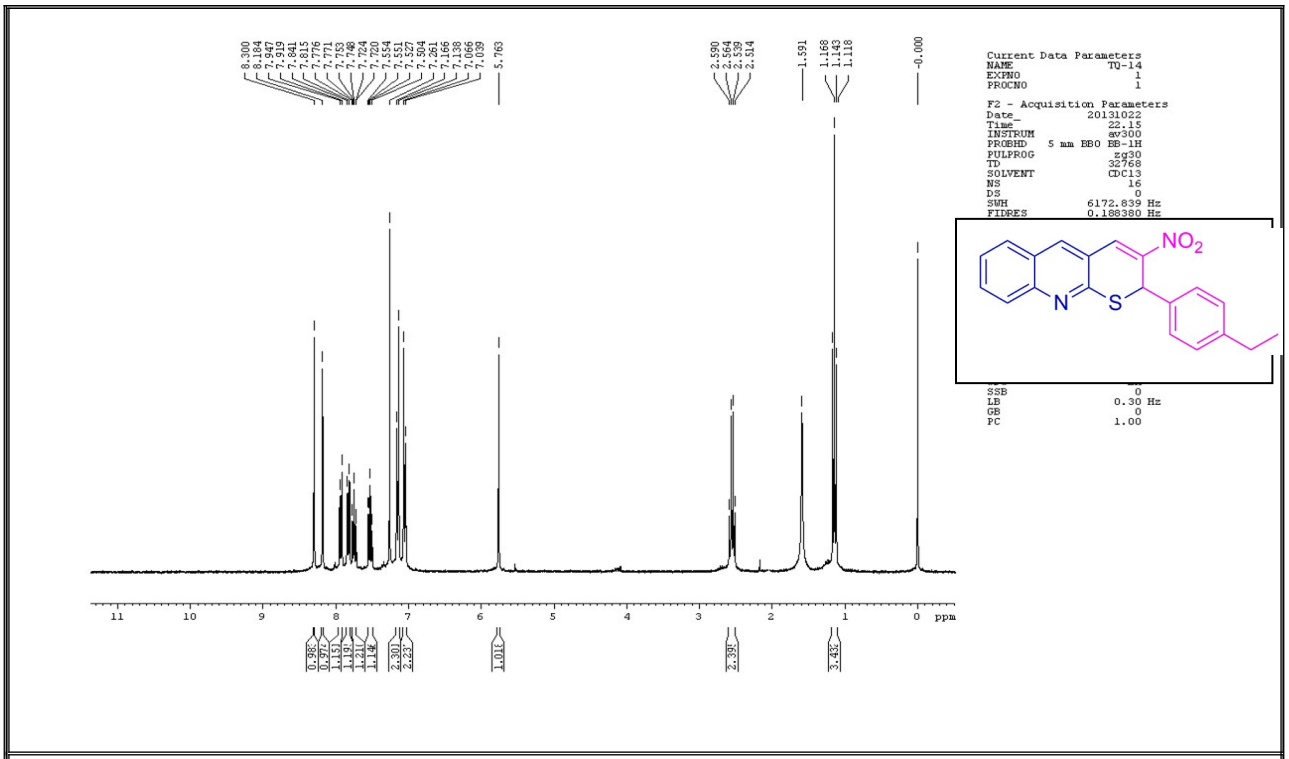

Figure. 23 ^{1}H NMR Spectrum **3g** ($CDCl_3$)

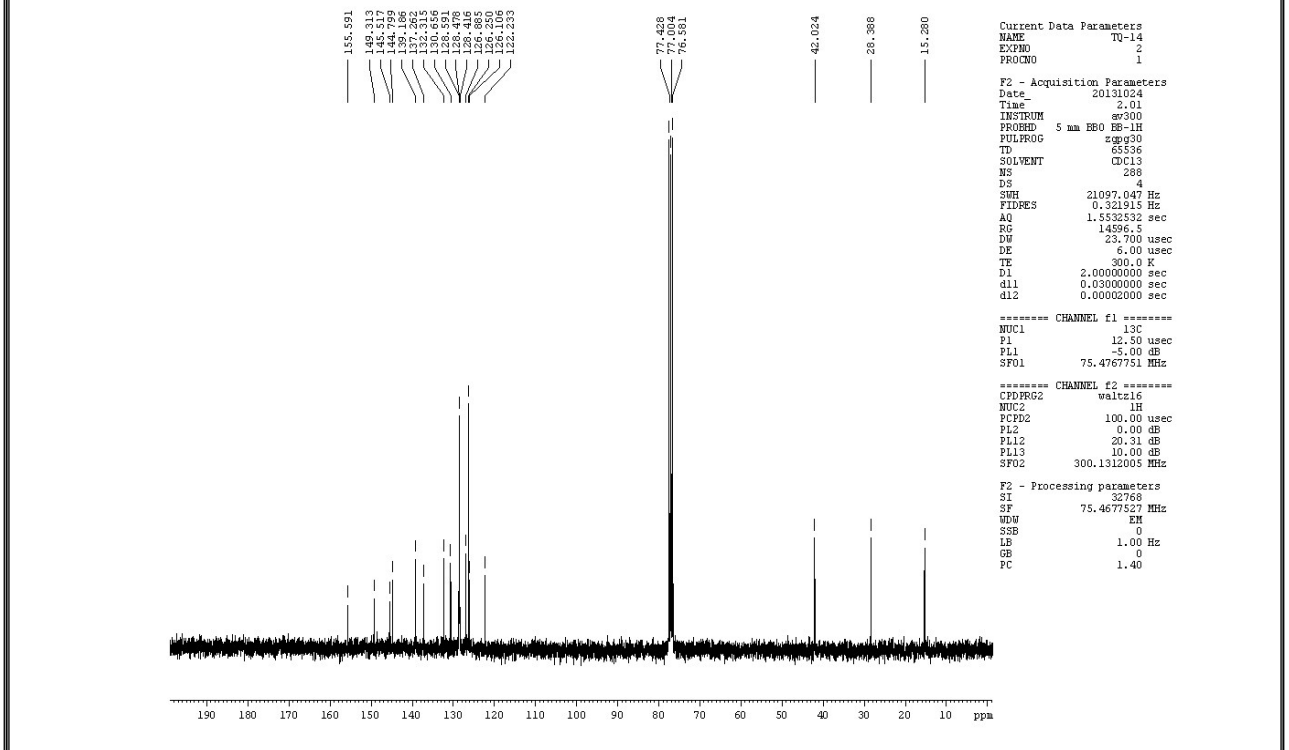

Figure. 24 ^{13}C NMR Spectrum of **3g** **(**$CDCl_3$)

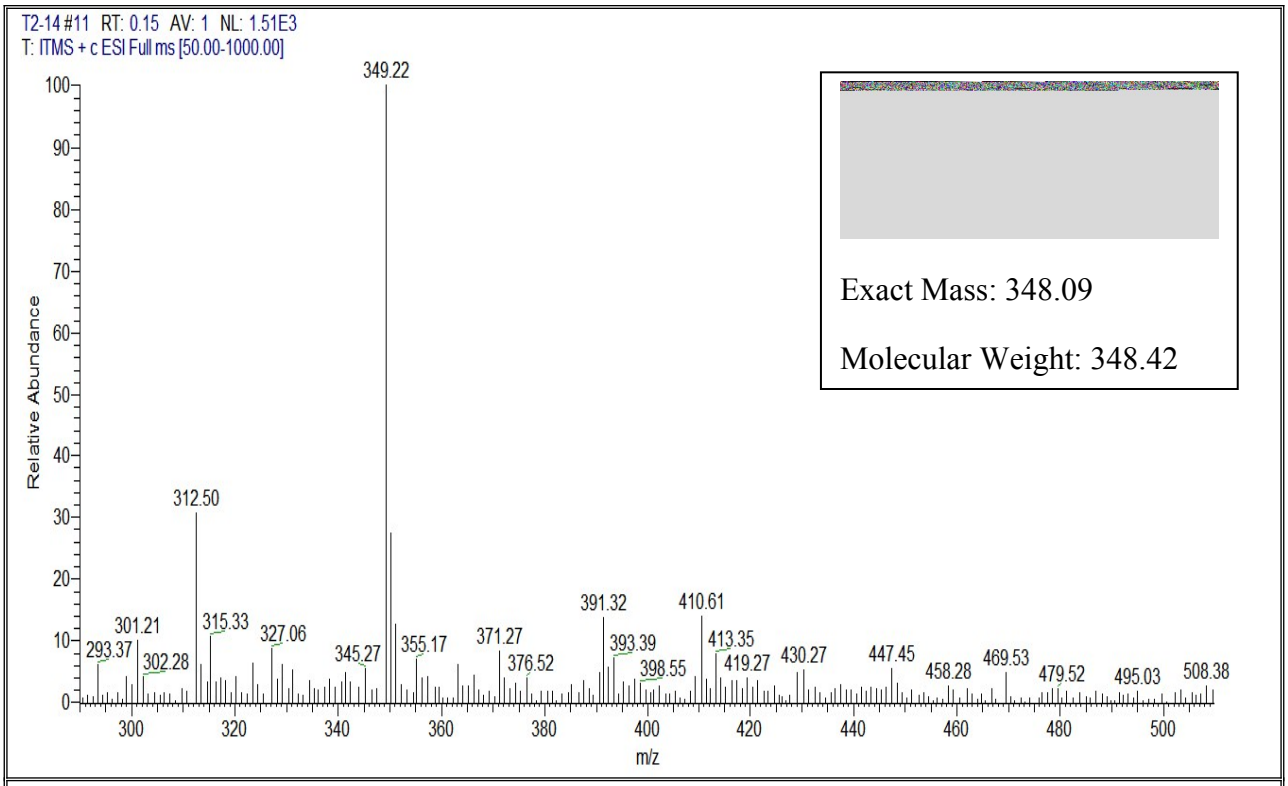

Figure. 25 ESI mass spectrum of Spectrum of **3g**

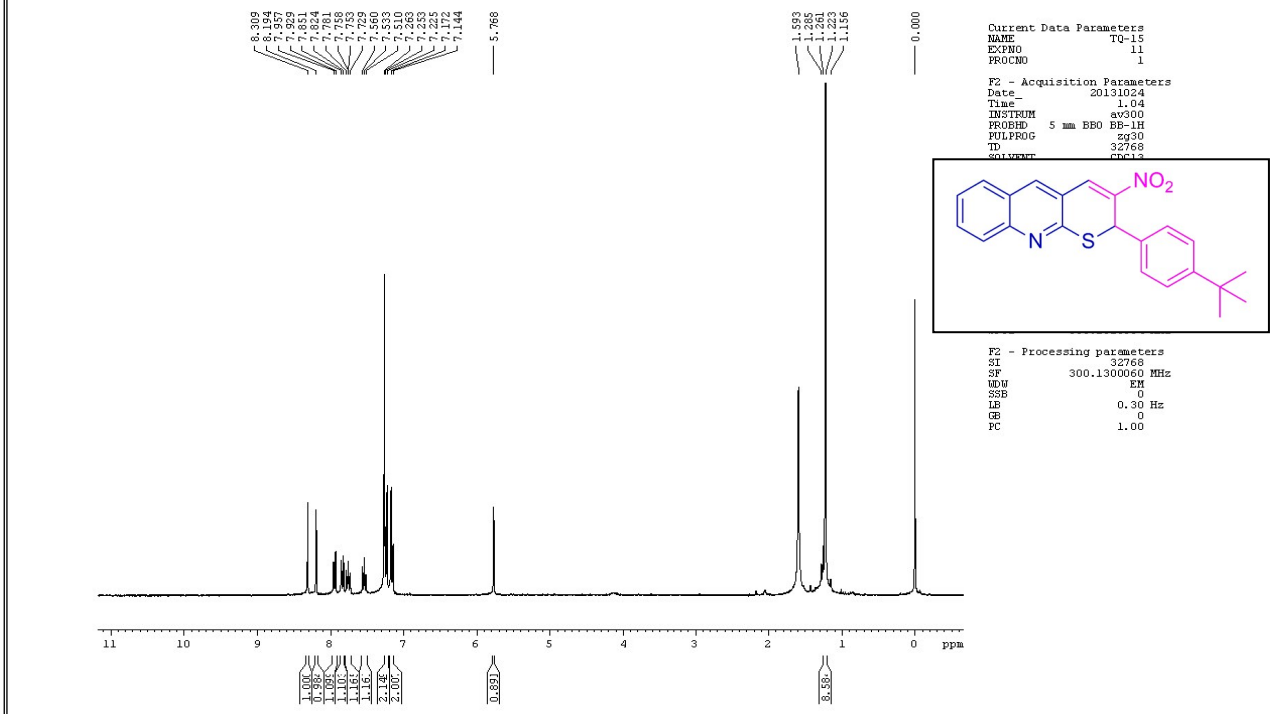

Figure. 26 ^{1}H NMR Spectrum **3h** ($CDCl_3$)

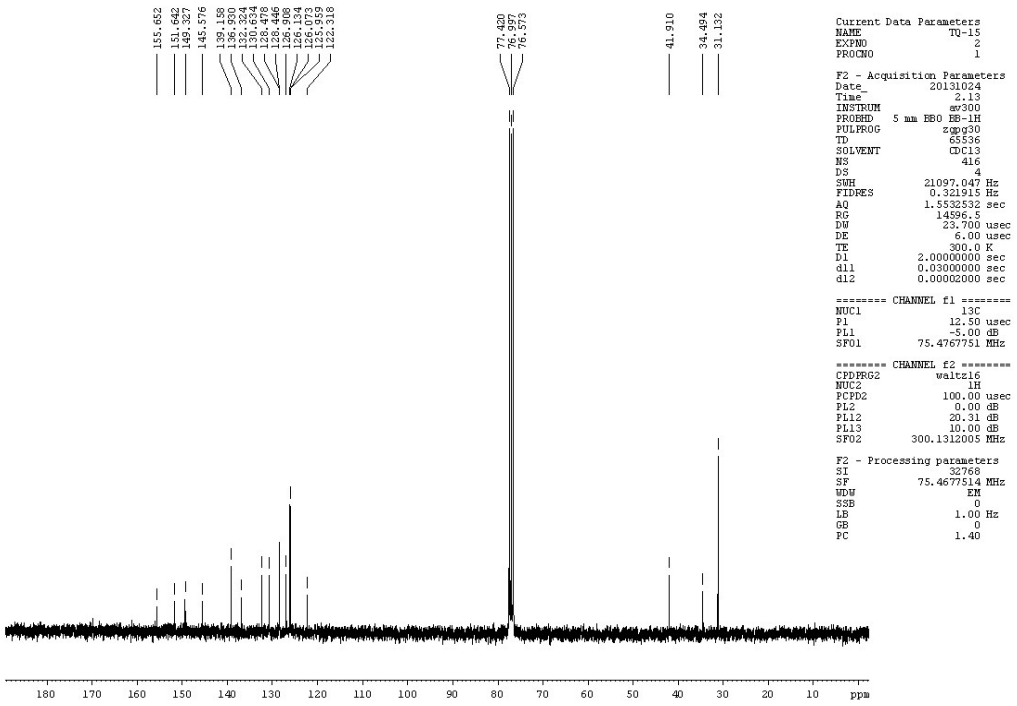

Figure. 27 ^{13}C NMR Spectrum of **3h** **(**$CDCl_3$)

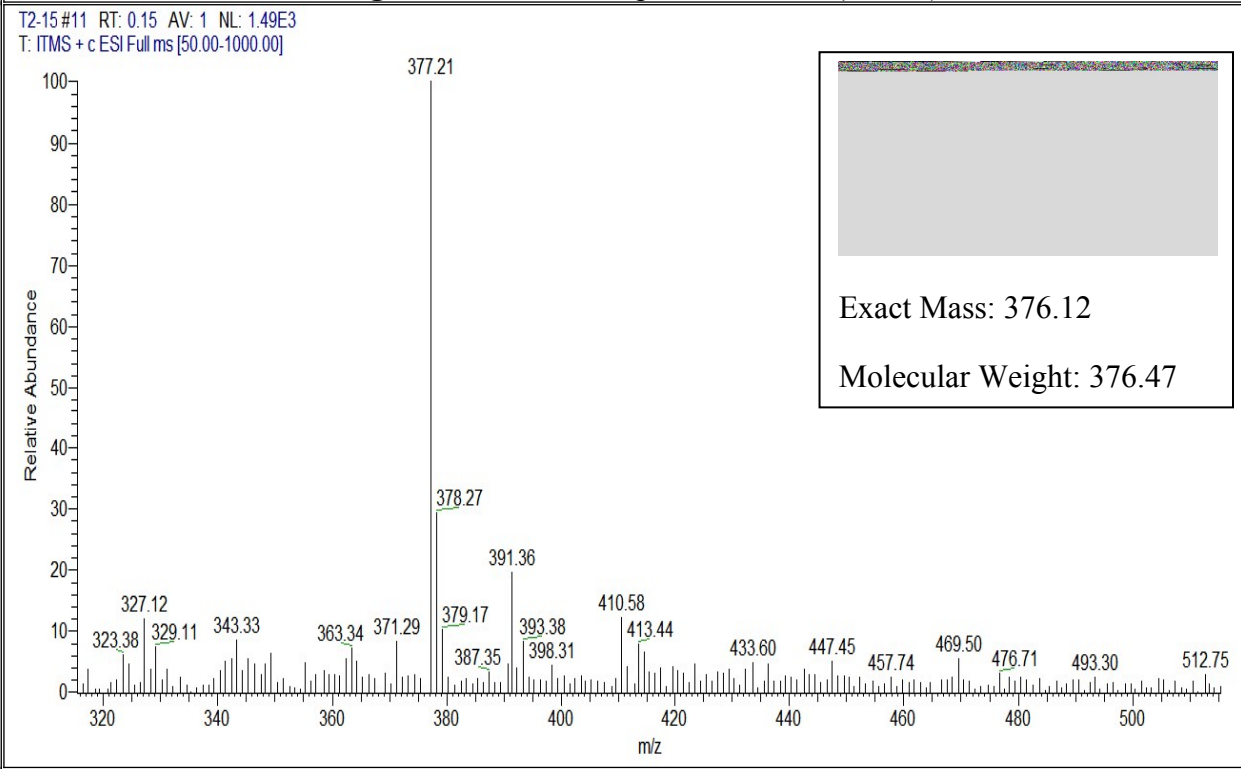

Figure. 28 ESI mass spectrum of Spectrum of **3h**

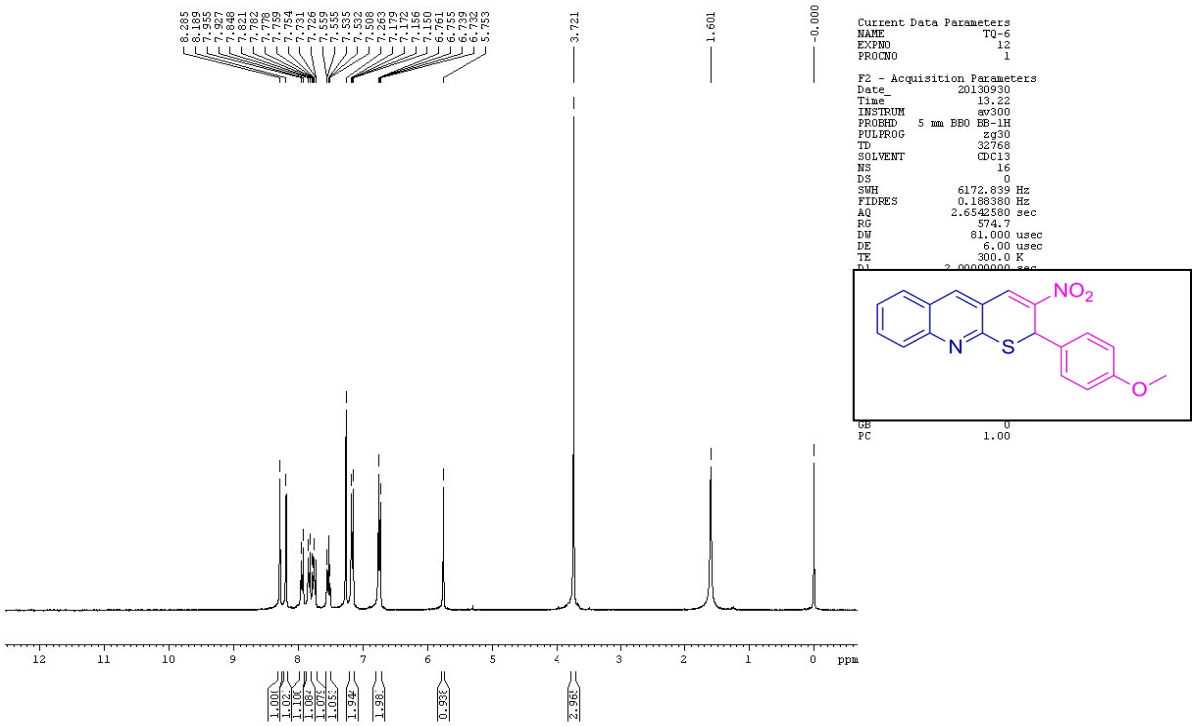

Figure. 29 ^{1}H NMR Spectrum **3i** ($CDCl_3$)

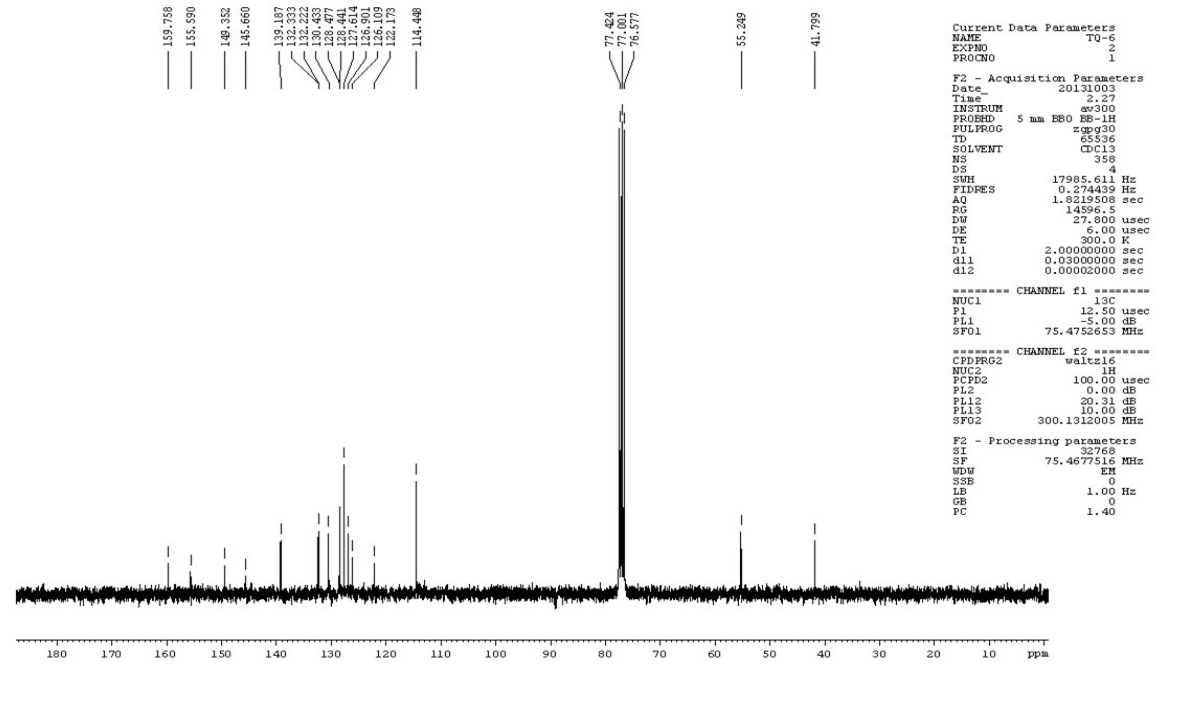

Figure. 30 ^{13}C NMR Spectrum of **3i** ($CDCl_3$)

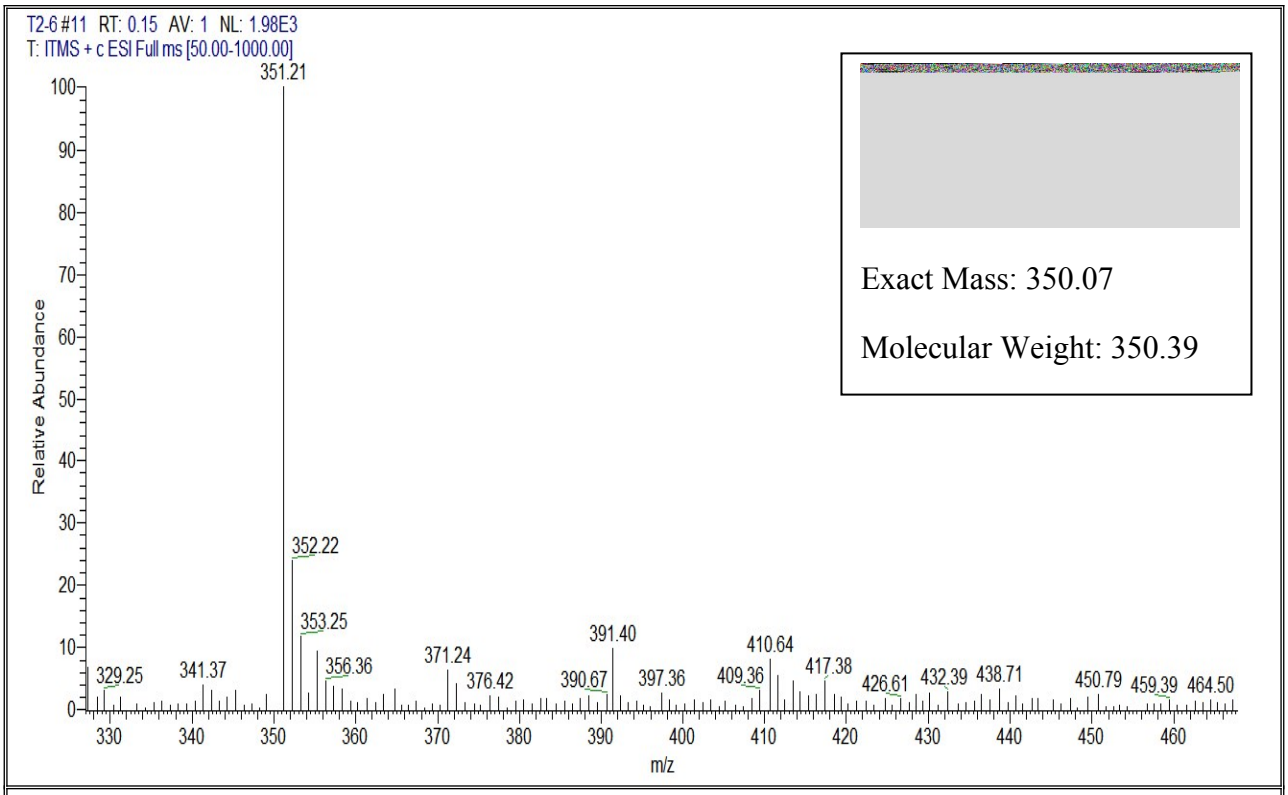

Figure. 31 ESI mass spectrum of Spectrum of **3i**

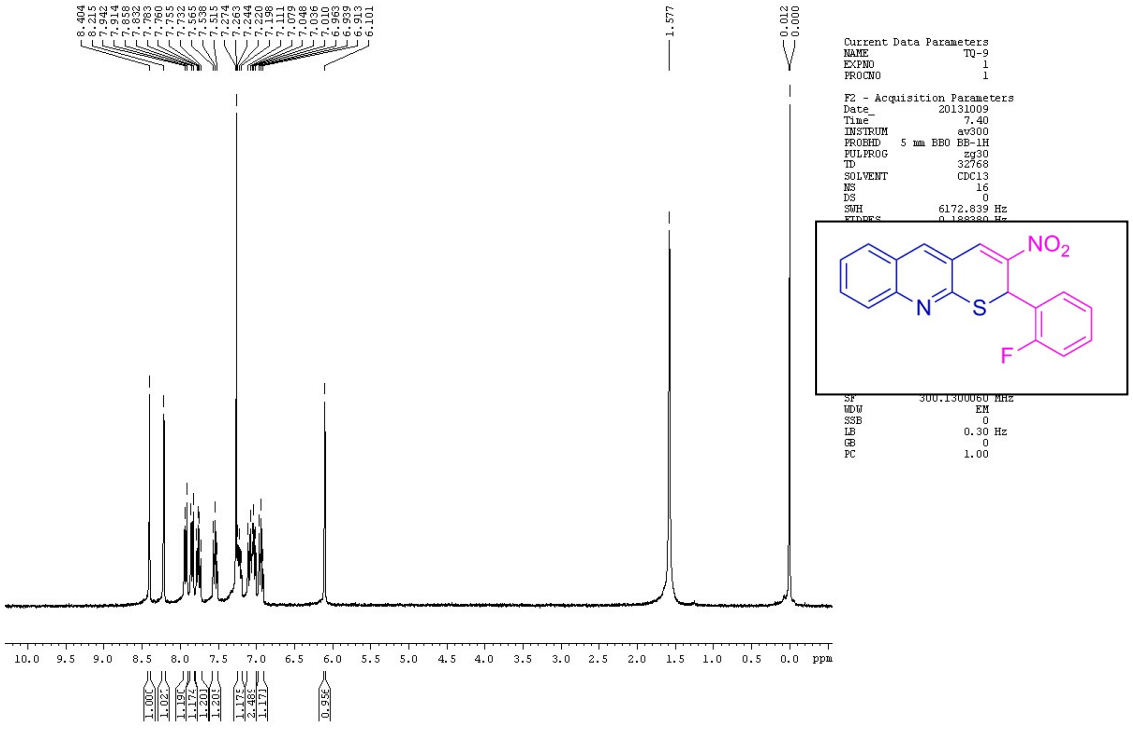

Figure. 32 ^{1}H NMR Spectrum **3j** ($CDCl_3$)

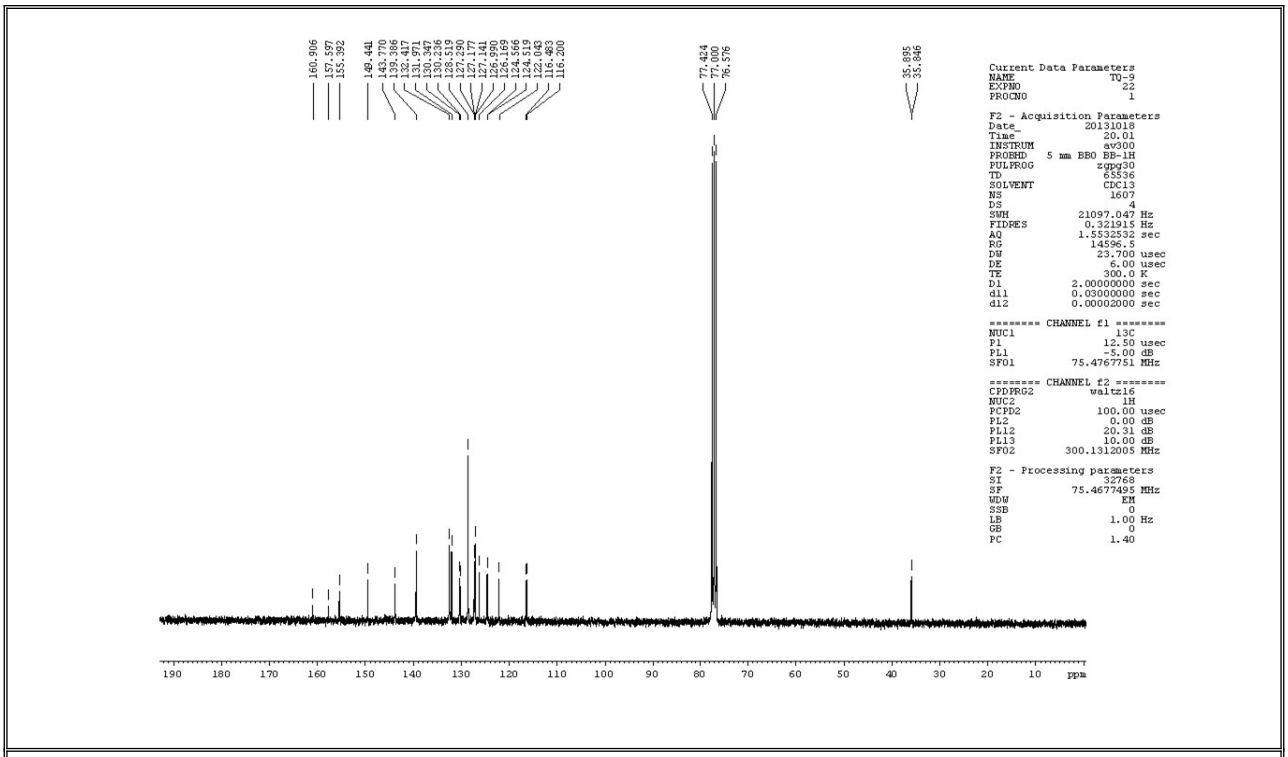

Figure. 33 ^{13}C NMR Spectrum of **3j** **(**$CDCl_3$)

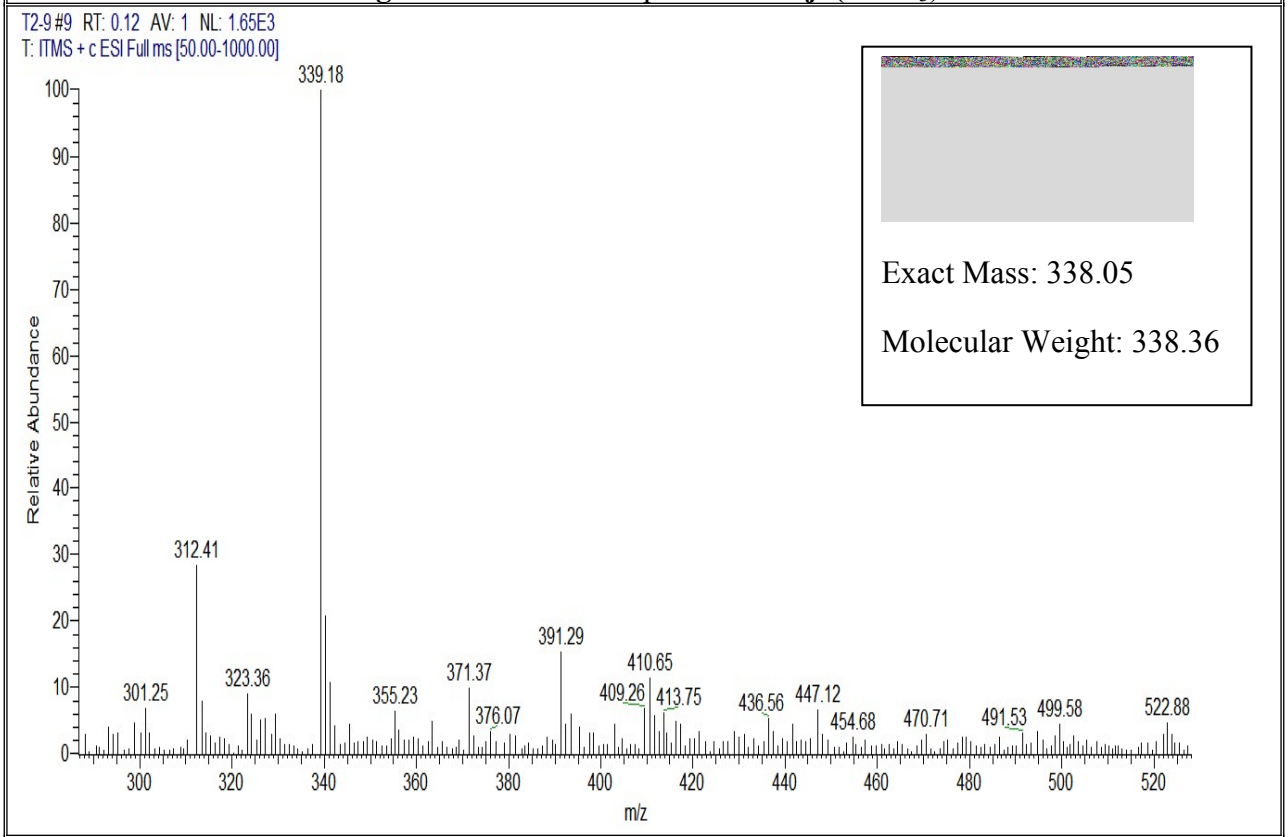

Figure. 34 ESI mass spectrum of Spectrum of **3j**

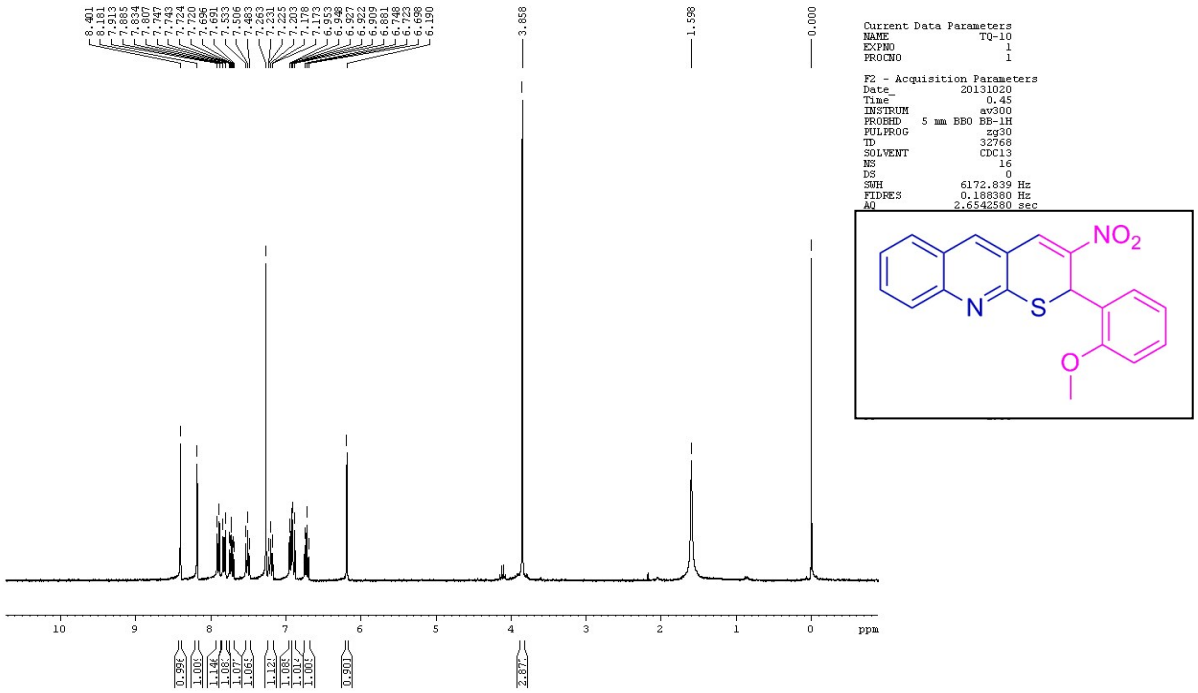

Figure. 35 ^{1}H NMR Spectrum **3k** ($CDCl_3$)

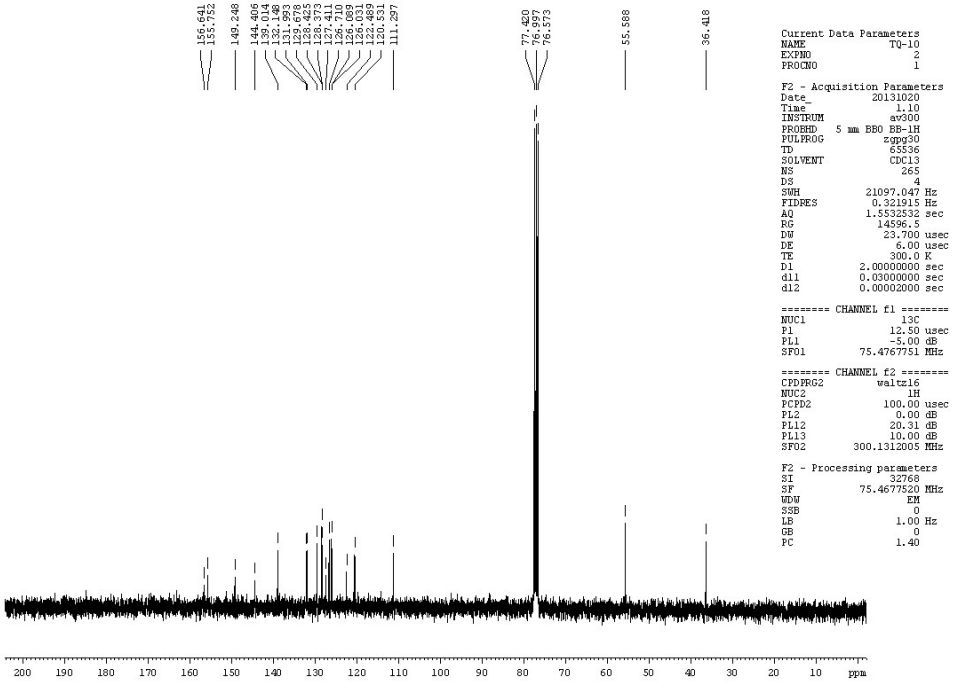

Figure. 36 ^{13}C NMR Spectrum of **3k** ($CDCl_3$)

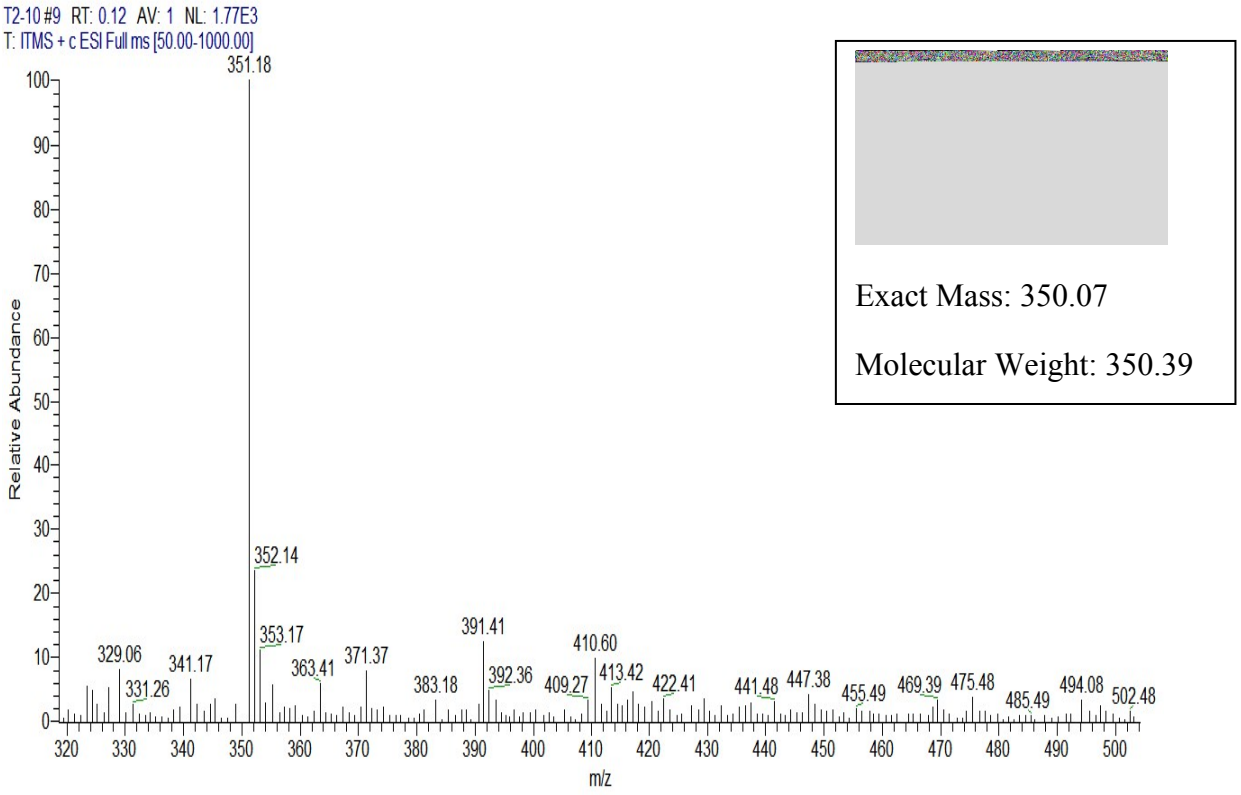

Figure. 37 ESI mass spectrum of Spectrum of **3k**

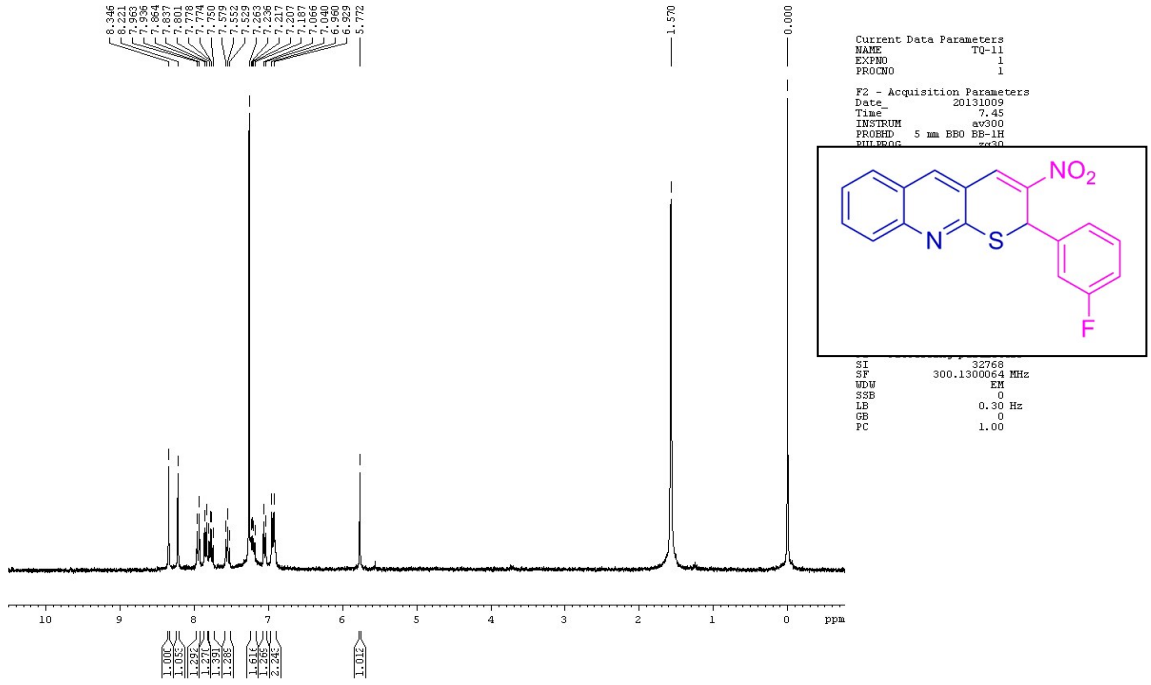

Figure. 38 ^{1}H NMR Spectrum **3l** ($CDCl_3$)

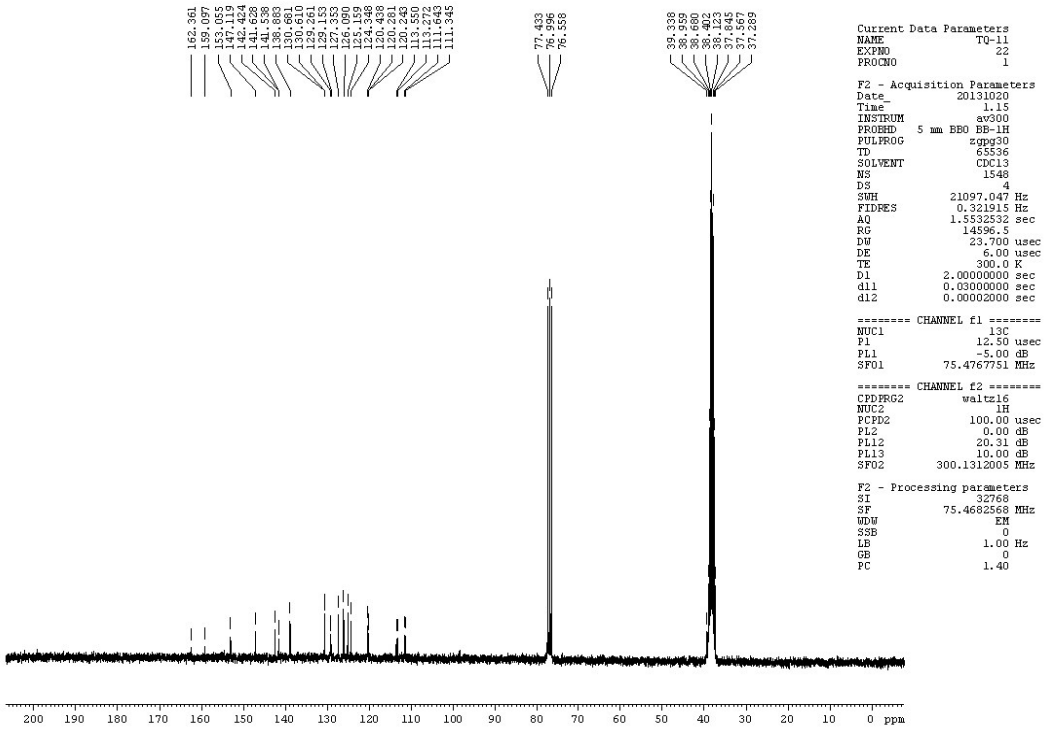

Figure. 39 ^{13}C NMR Spectrum of **3l** ($CDCl_3$+DMSO-d^6))

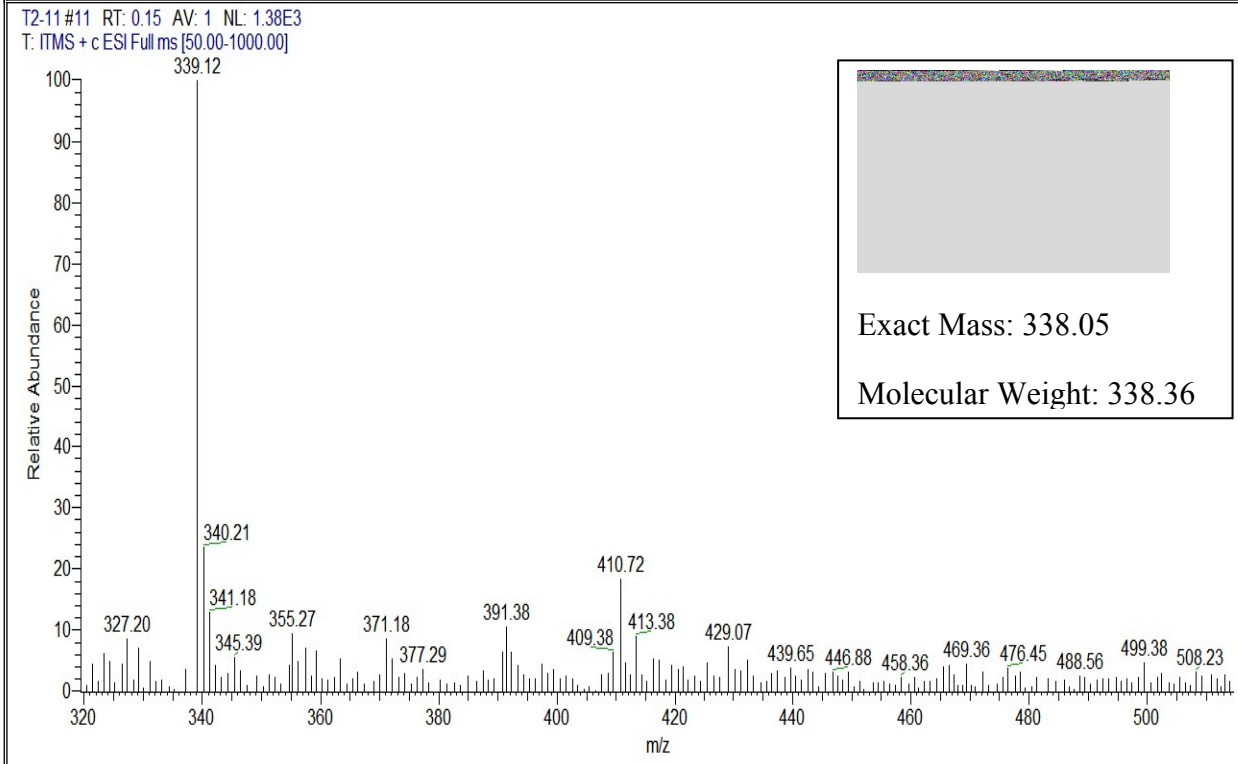

Figure. 40 ESI mass spectrum of Spectrum of **3l**

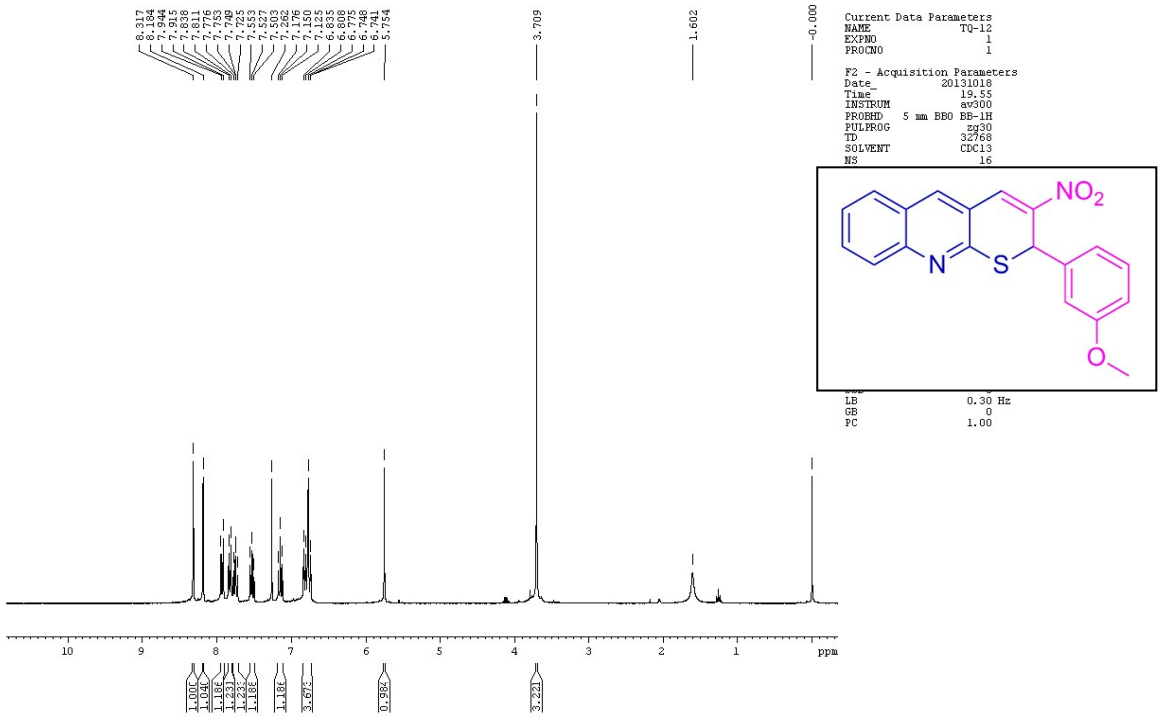

Figure. 41 ^{1}H NMR Spectrum **3m** ($CDCl_3$)

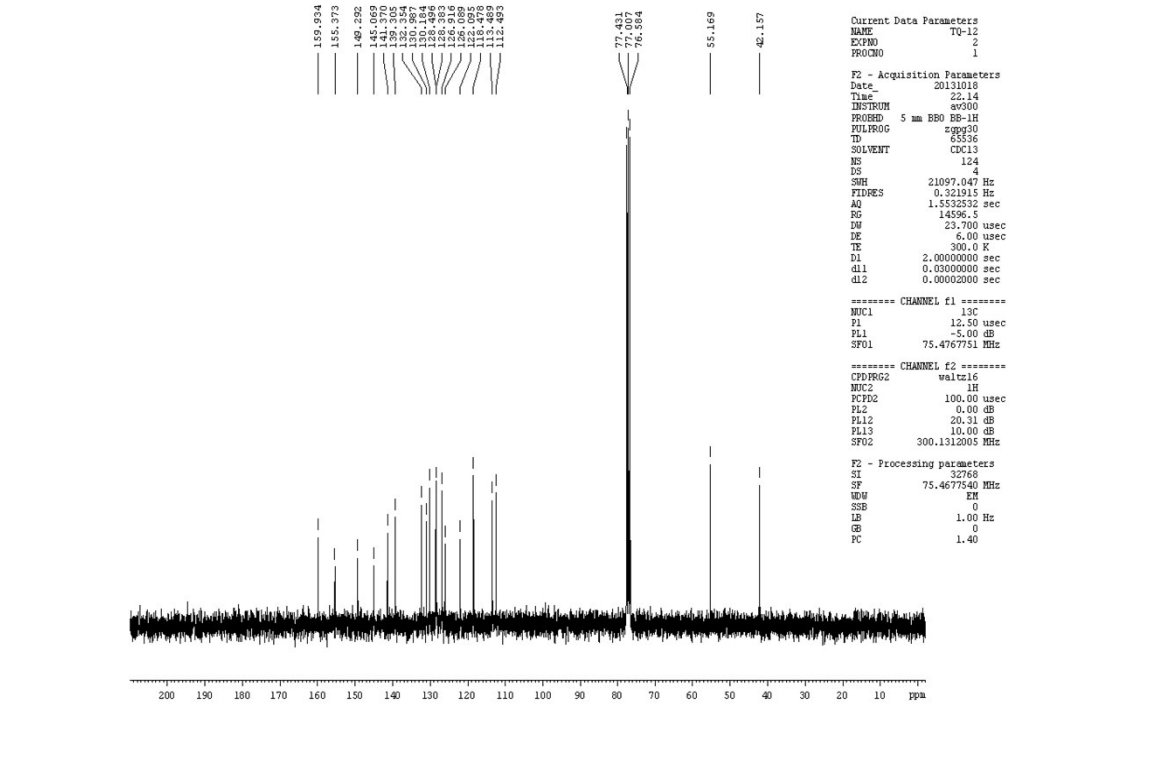

Figure. 42 ^{13}C NMR Spectrum of **3m** ($CDCl_3$)

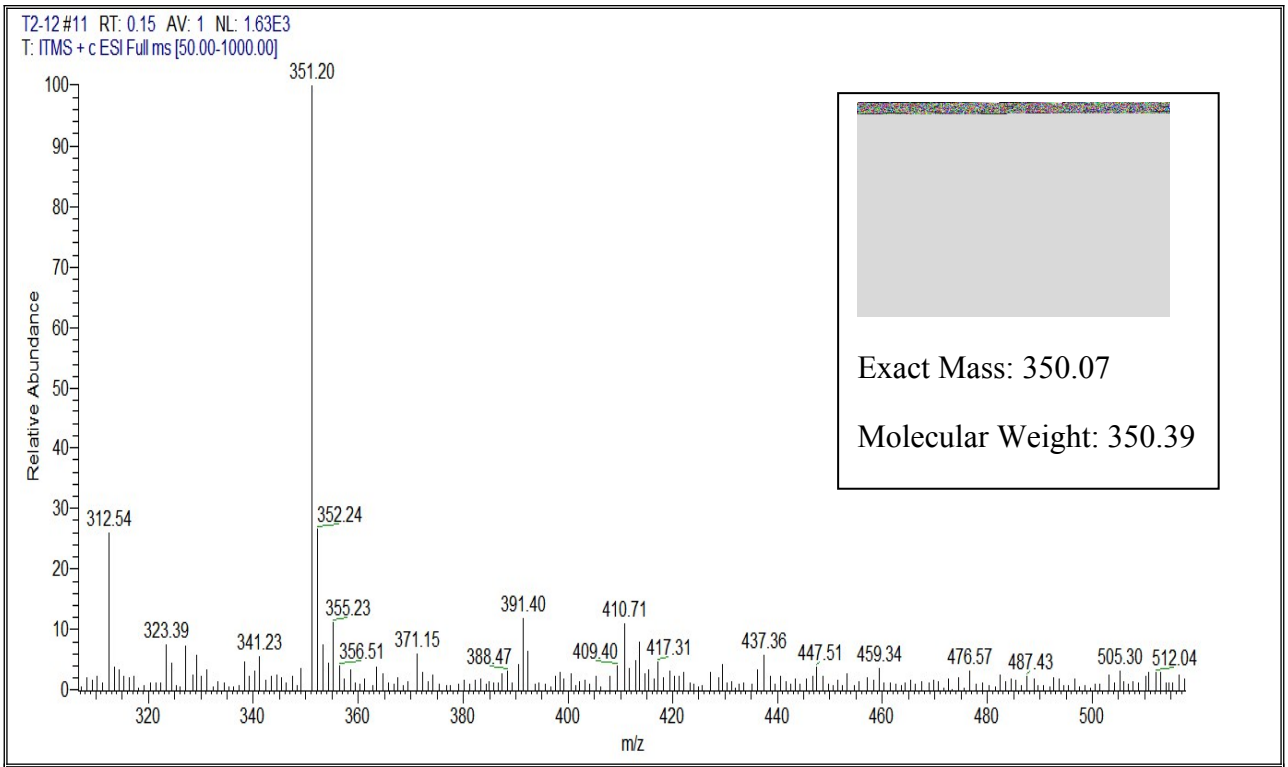

Figure. 43 ESI mass spectrum of Spectrum of **3m**

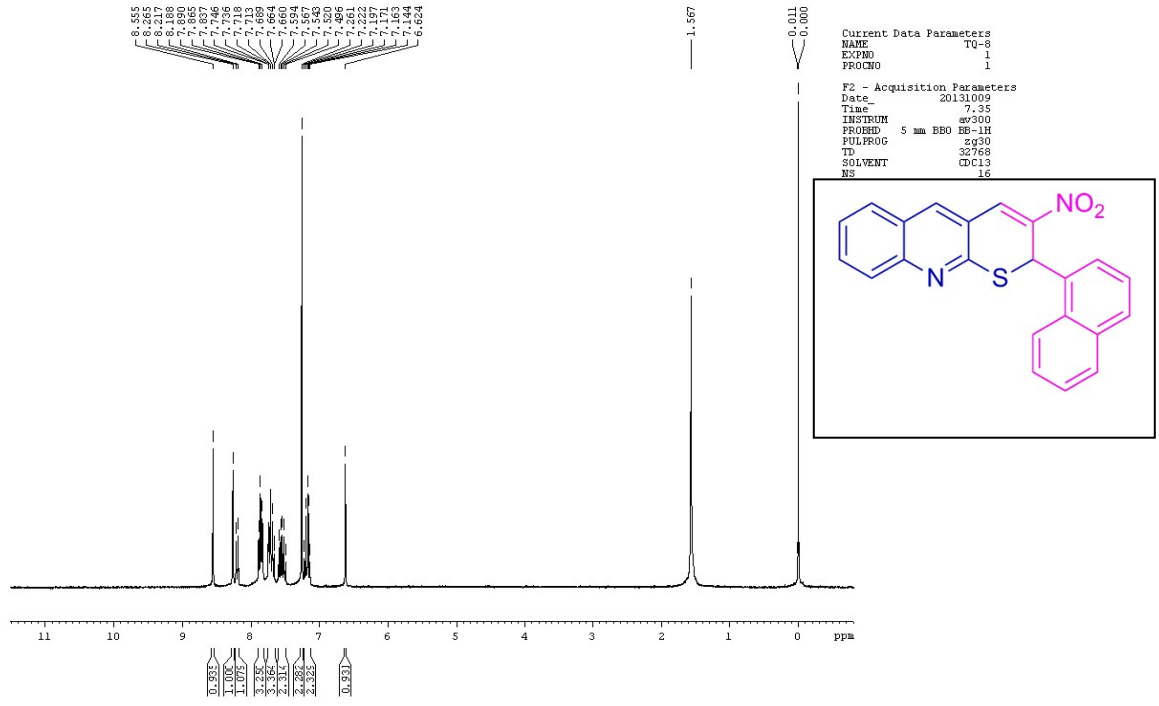

Figure. 44 ^{1}H NMR Spectrum **3n** ($CDCl_3$)

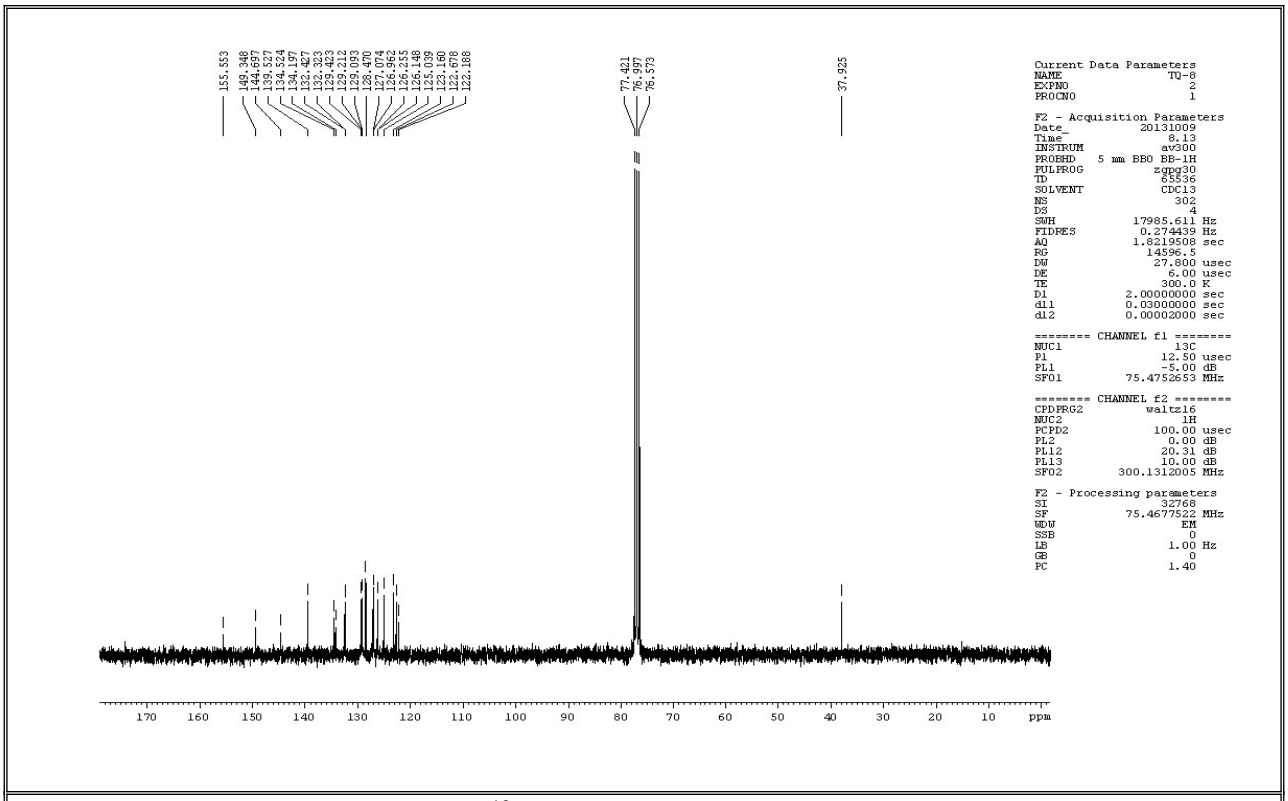

Figure. 45 ^{13}C NMR Spectrum of **3n** **(**$CDCl_3$)

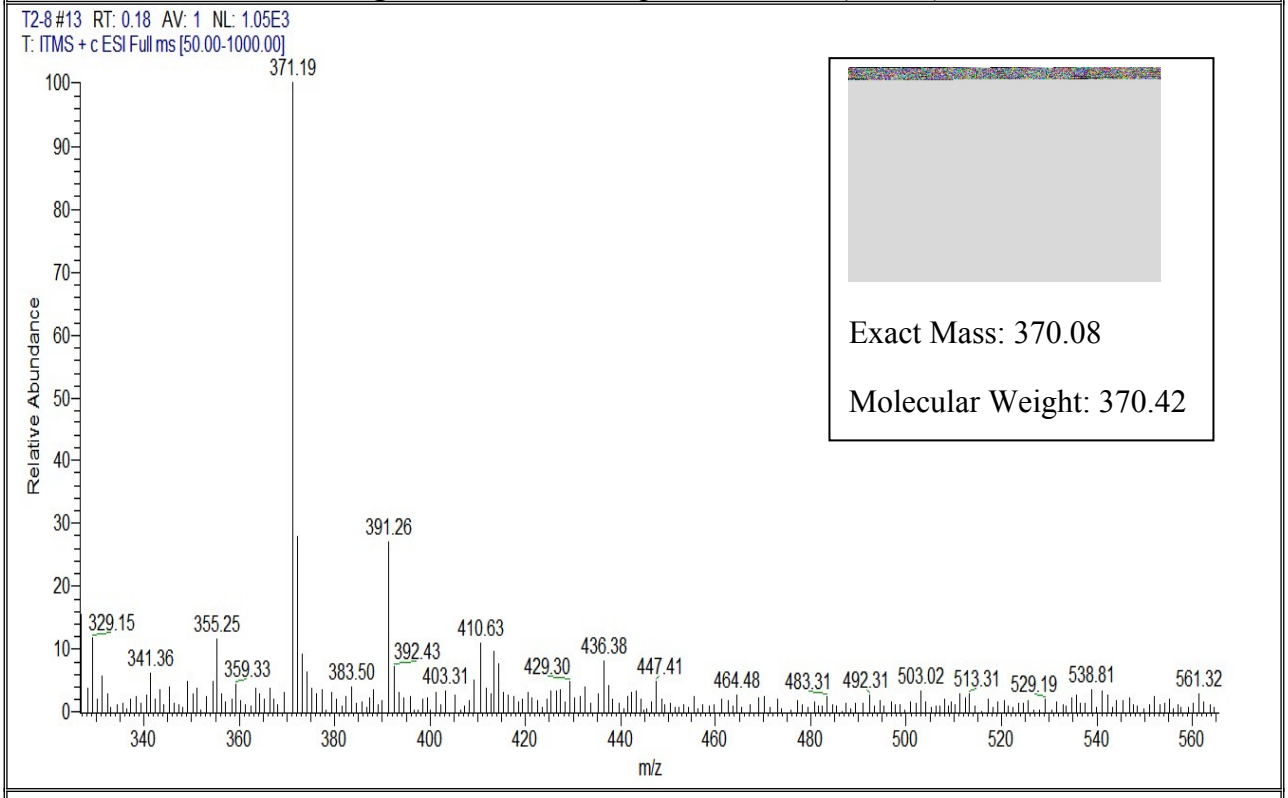

Figure. 46 ESI mass spectrum of Spectrum of **3n**

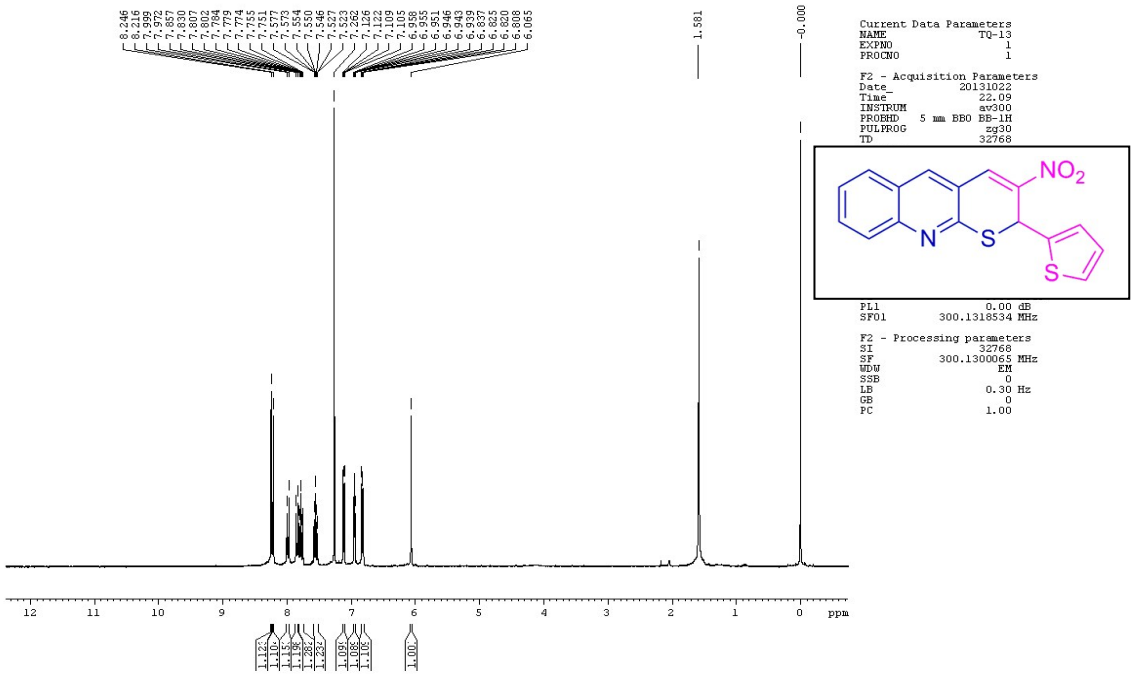

Figure. 47 ^{1}H NMR Spectrum **3o** ($CDCl_3$)

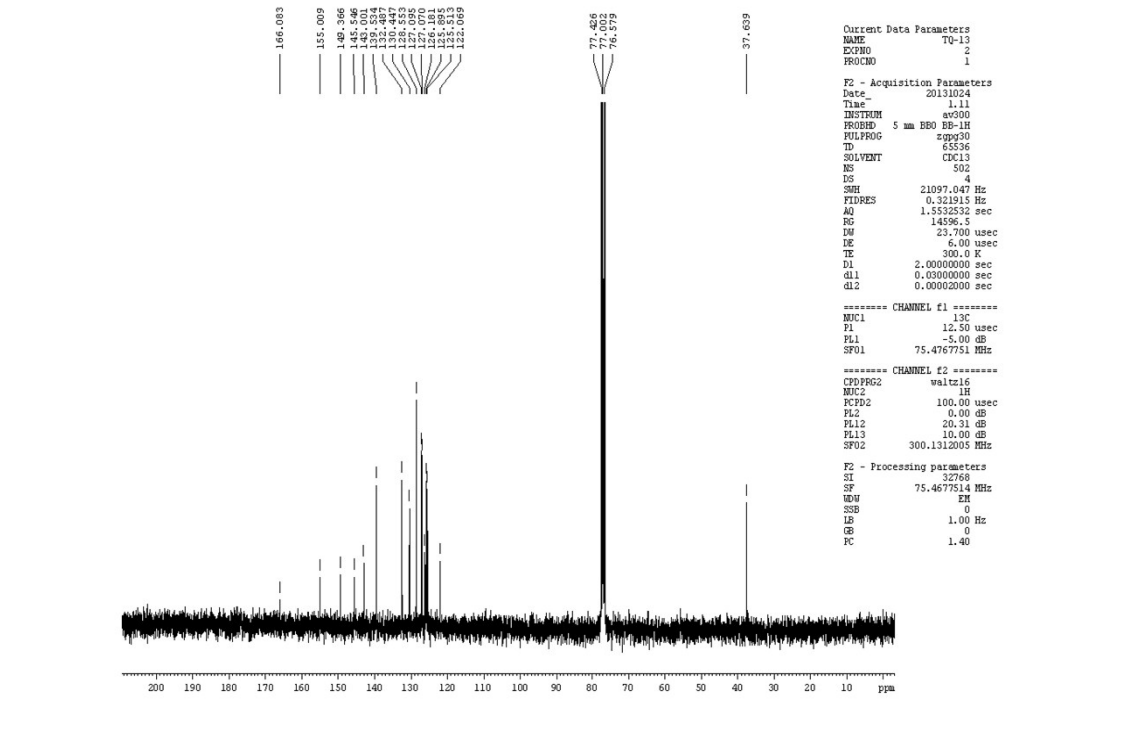

Figure. 48 ^{13}C NMR Spectrum of **3o** **(**$CDCl_3$)

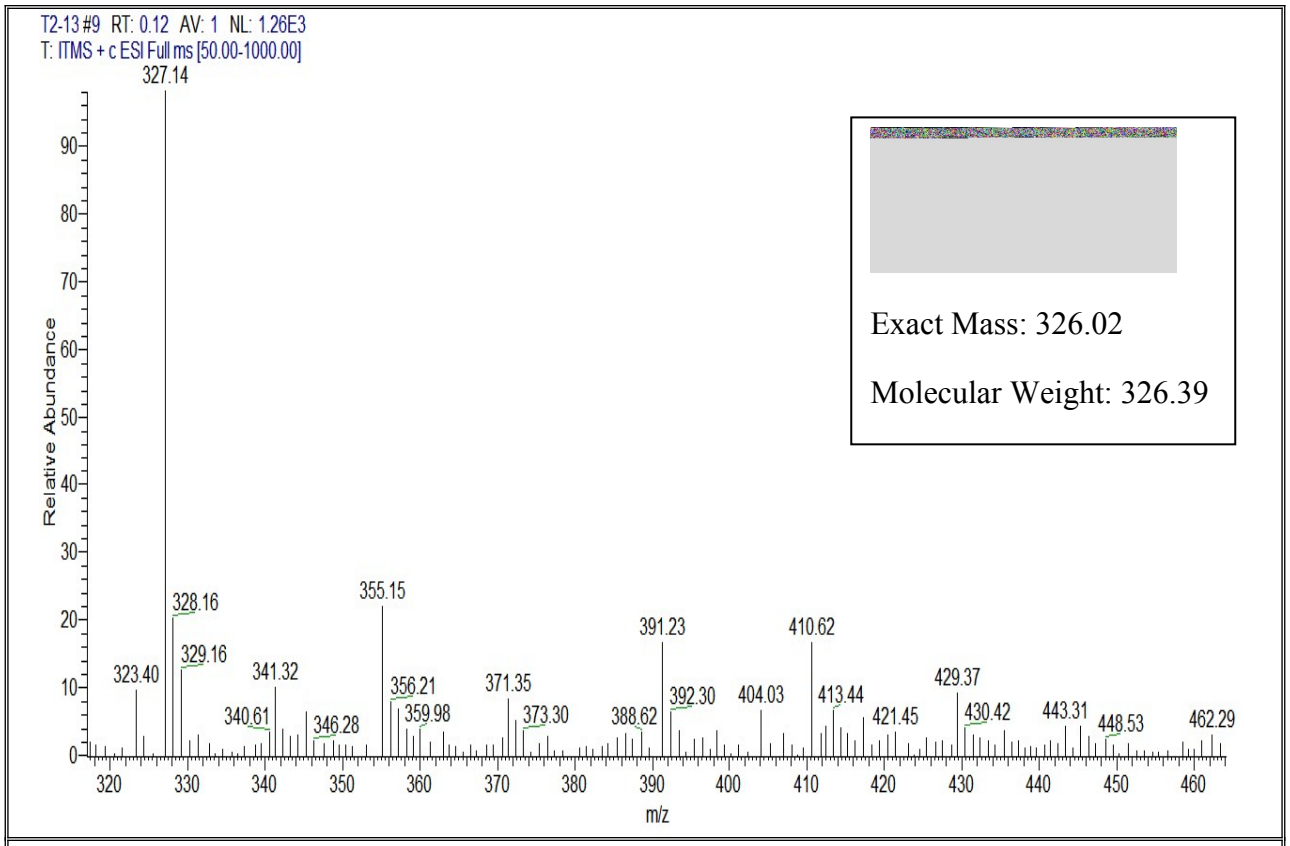

Figure. 49 ESI mass spectrum of Spectrum of **3o**

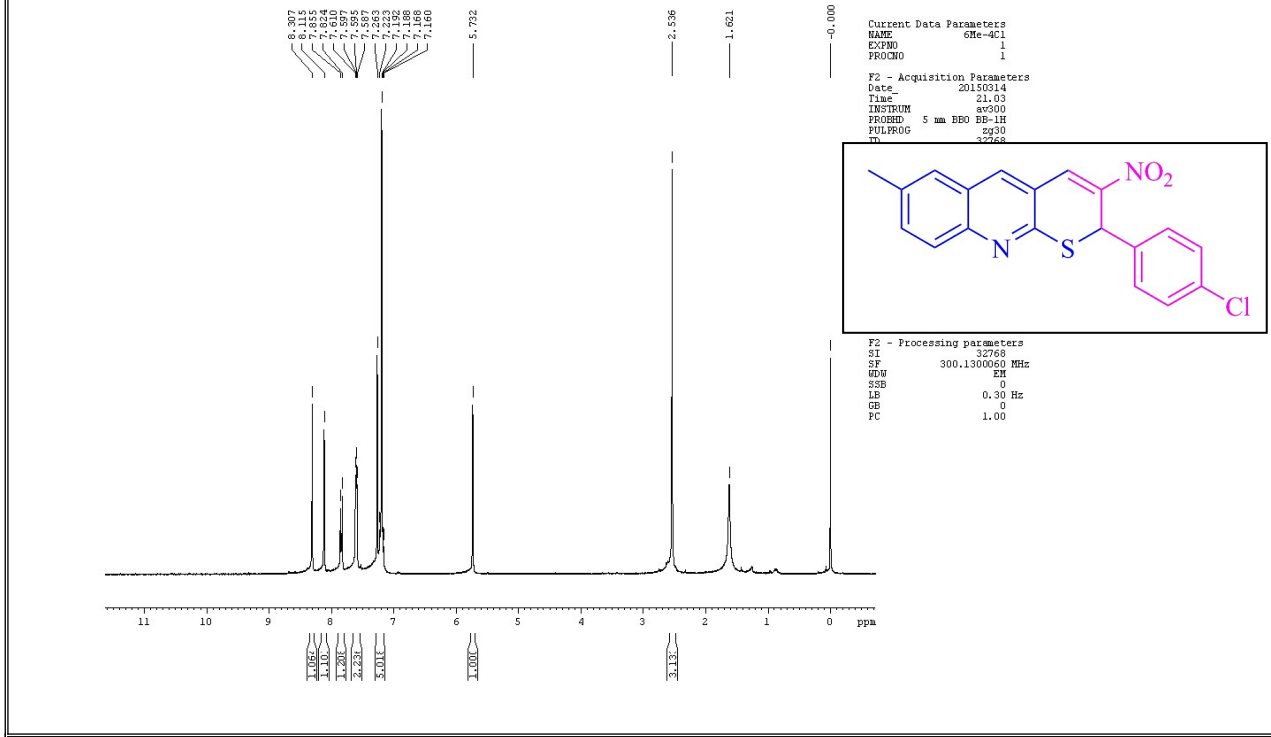

Figure. 50 ^{1}H NMR Spectrum **3p** ($CDCl_3$)

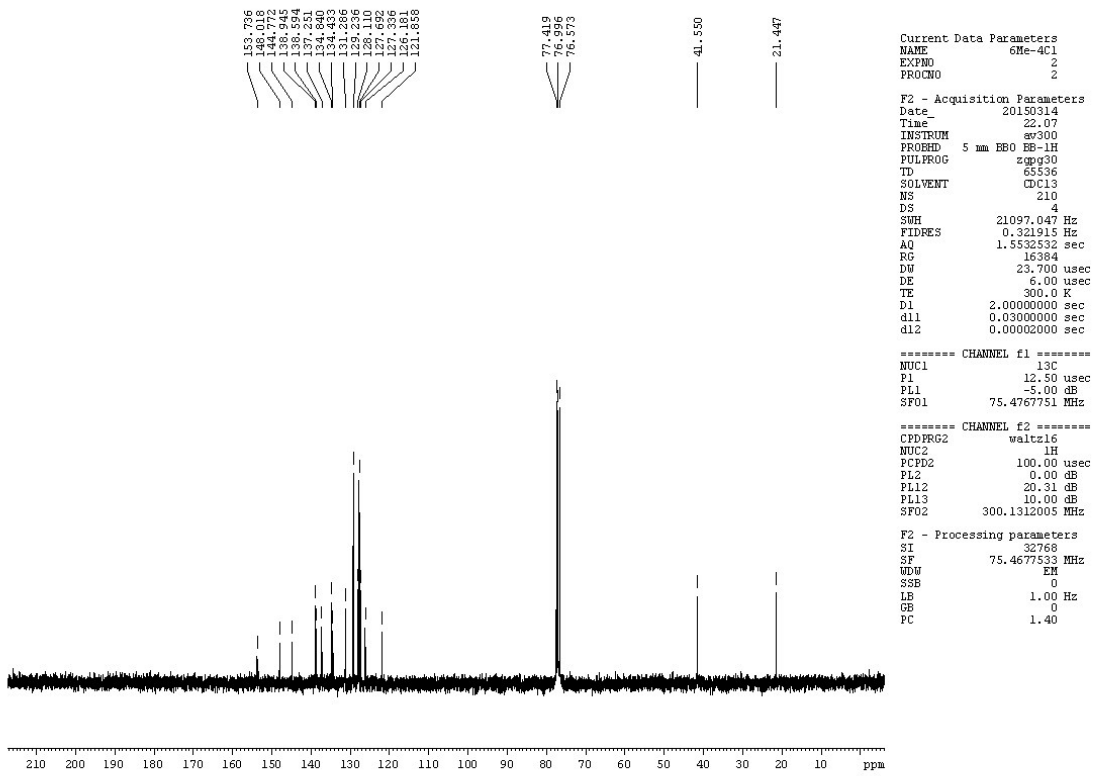

Figure. 51^{13}C NMR Spectrum of **3p** ($CDCl_3$)

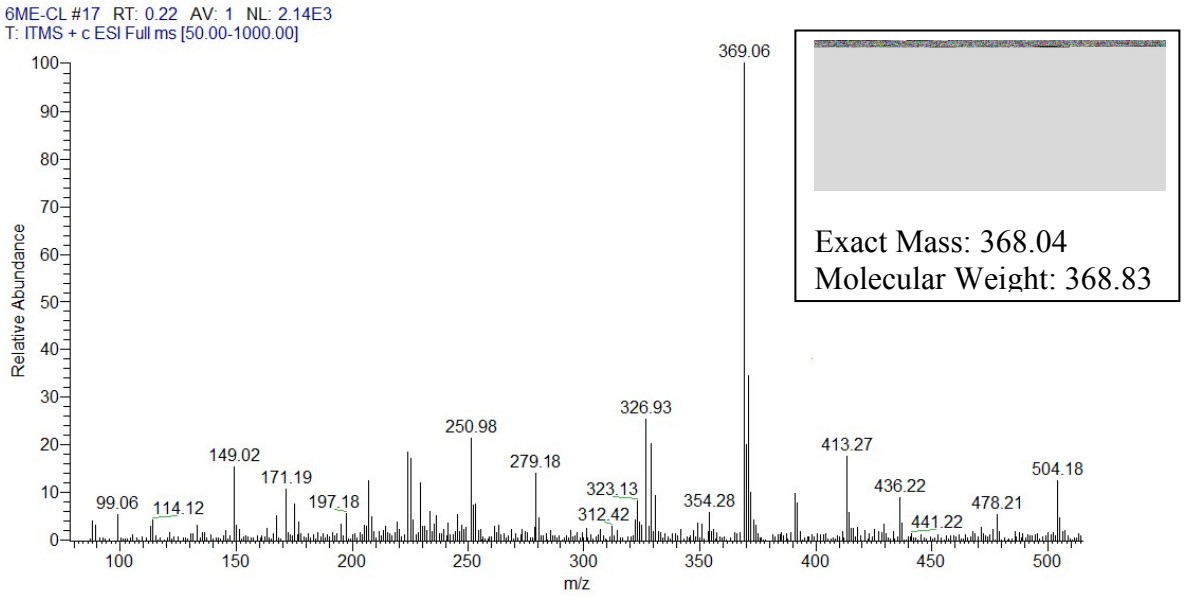

Figure. 52 ESI mass spectrum of Spectrum of **3p**

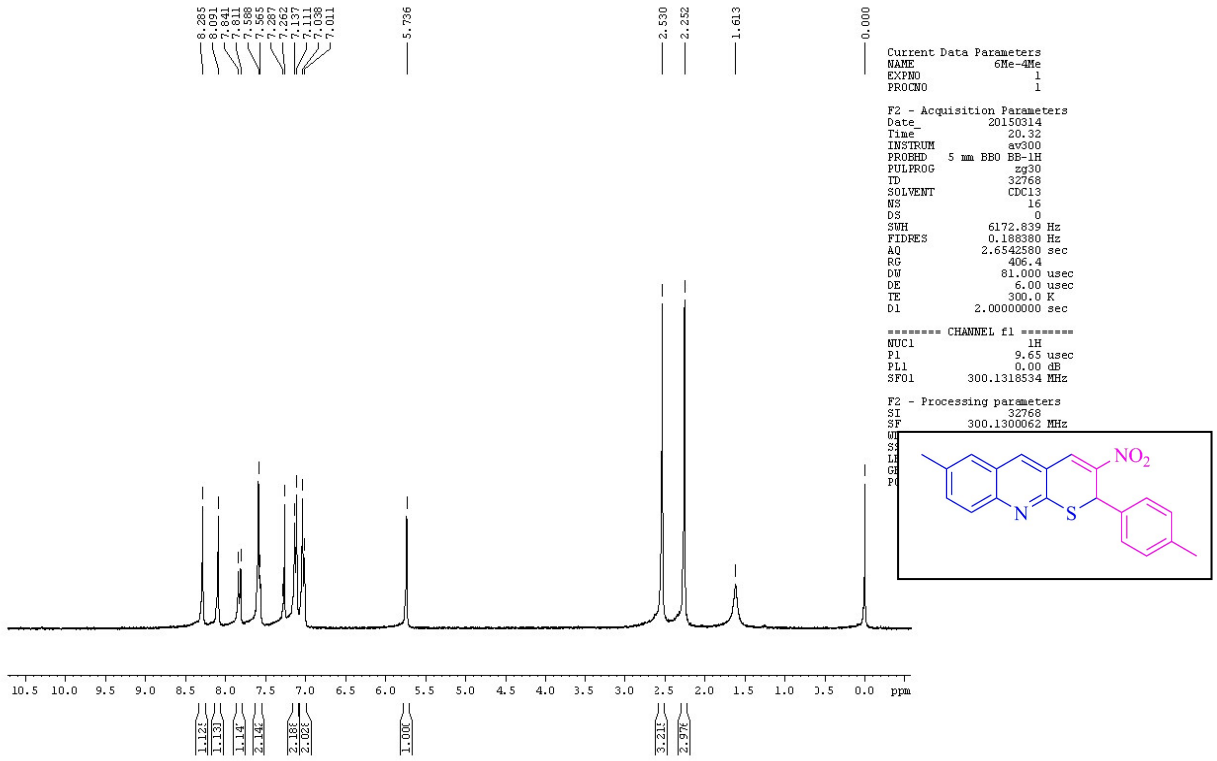

Figure. 53 ^{1}H NMR Spectrum **3q** ($CDCl_3$)

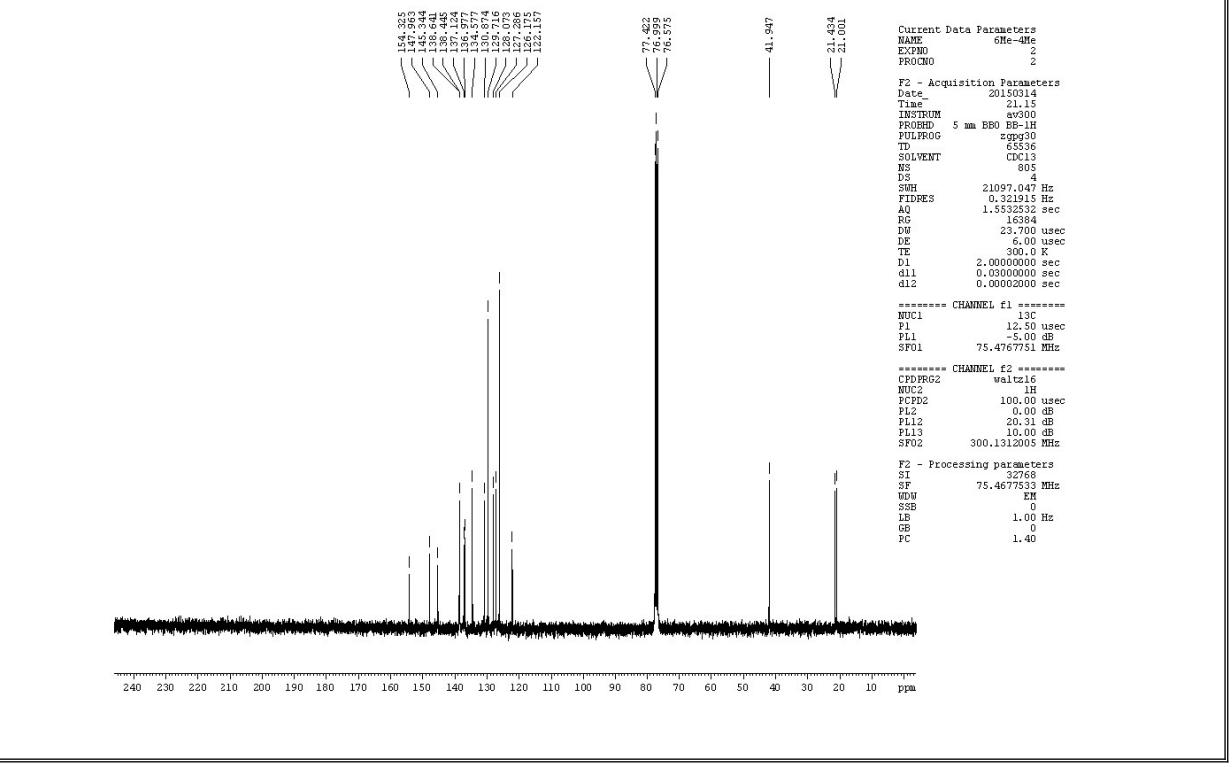

Figure. 54 ^{13}C NMR Spectrum of **3q** ($CDCl_3$)

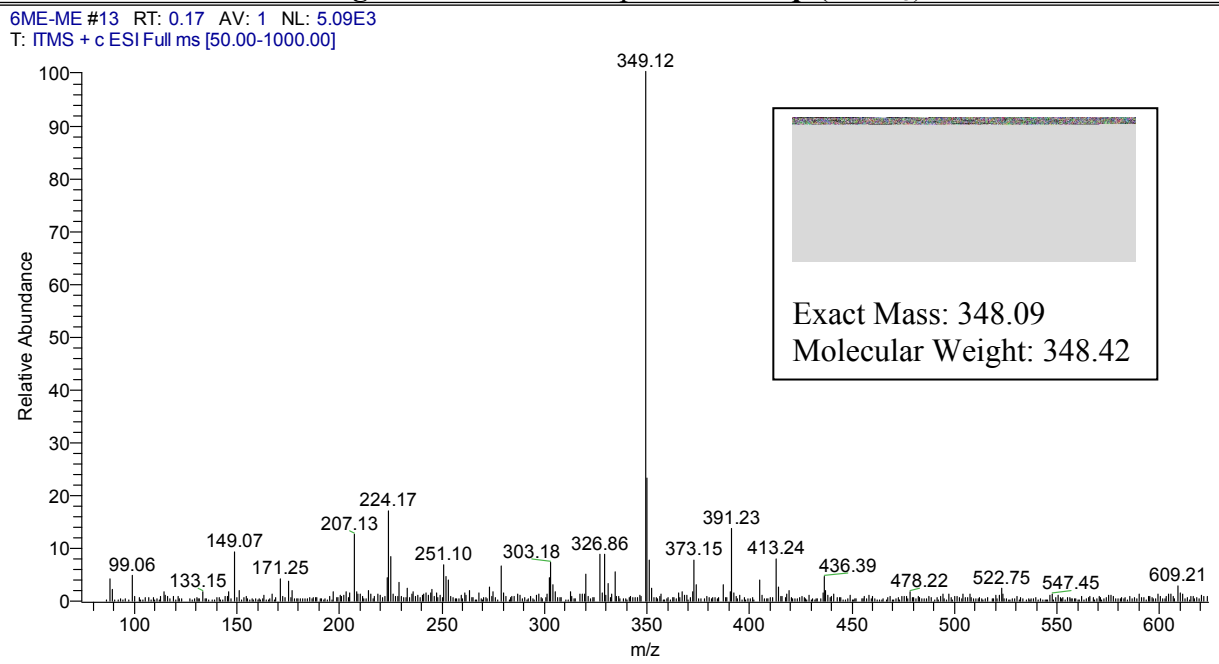

Figure. 55 ESI mass spectrum of Spectrum of **3q**

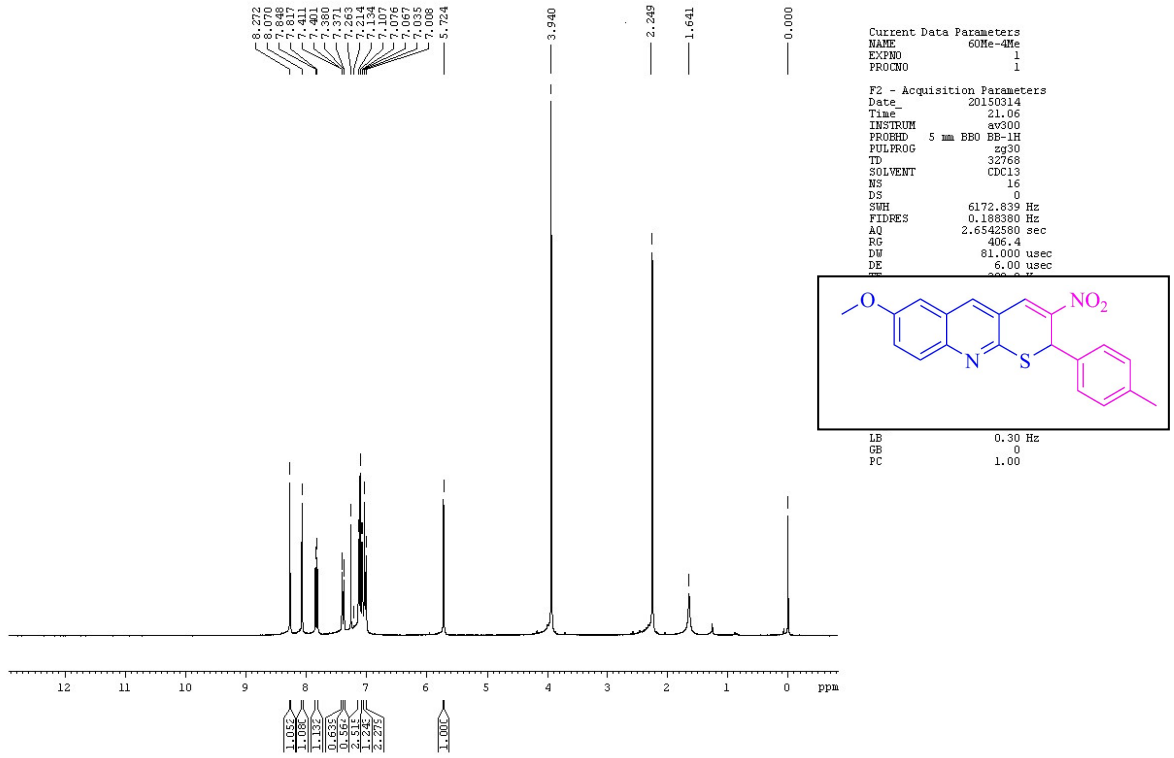

Figure. 56 ^{1}H NMR Spectrum **3r** ($CDCl_3$)

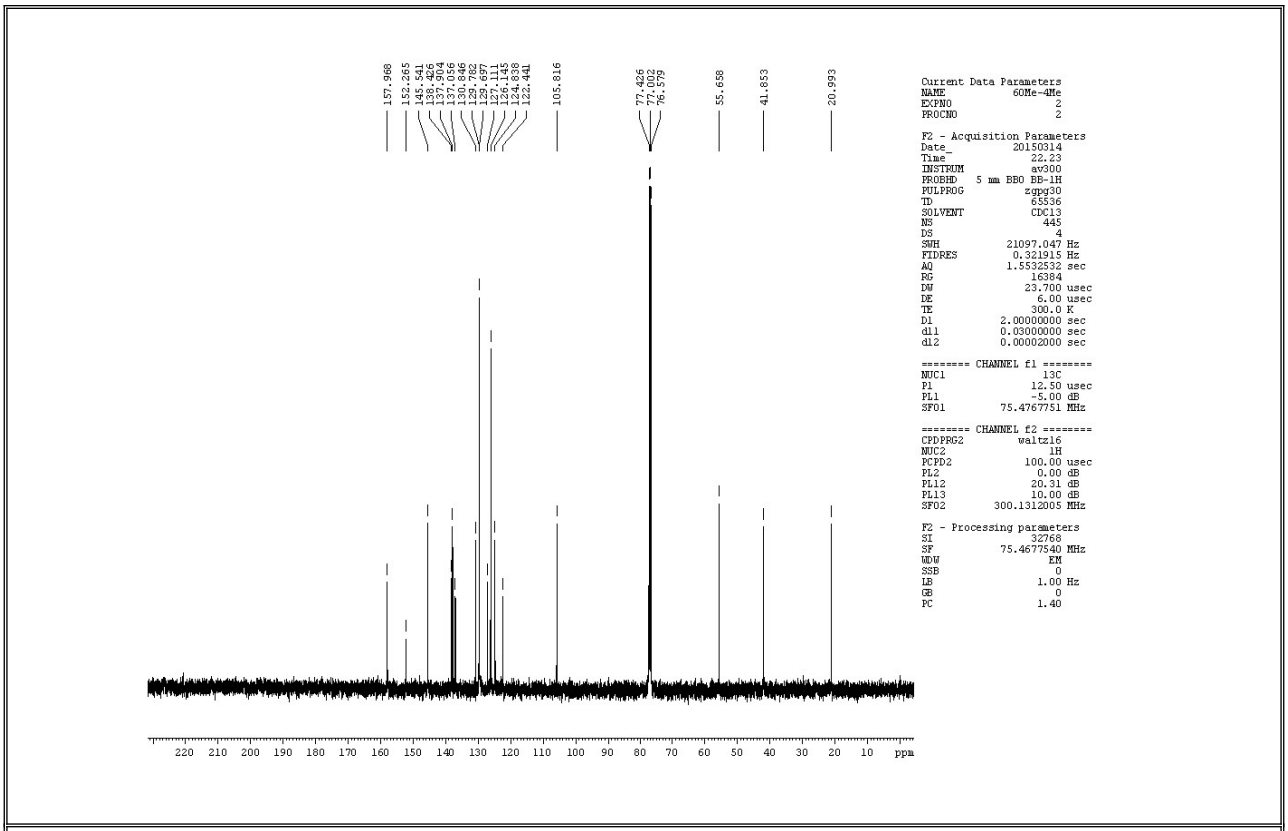

Figure. 57 ^{13}C NMR Spectrum of **3r** **(**$CDCl_3$)

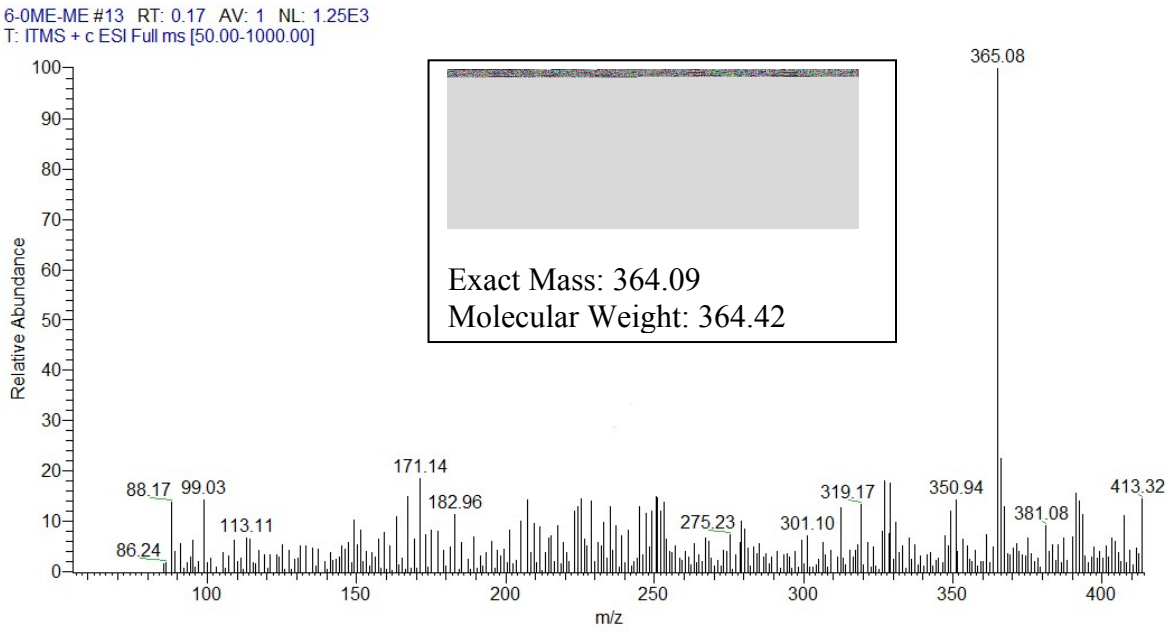

Figure. 58 ESI mass spectrum of Spectrum of **3r**