Supporting Information

Design and synthesis of highly oxygenated furo[3,2-c]pyran-4-ones and furo[3,2-c]chromen-4-ones scaffold as potential anticancer and antimicrobial agent

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Experimental and cytotoxicity and antimicrobial assay details, compound characterization and NMR spectra

Content

Experimental

Synthesis of highly oxygenated furo[3,2-c]pyran-4-one (4, 5, 8 and 9)

Dehydroacetic acid (1, 1 mmol) or its chalcone (4, 1 mmol) was dissolved in acetonitrile (15 mL) and refluxed for 3 hours after addition of α-bromoketone (2, 1 mmol) and potassium carbonate (K_2CO_3) (3 mmol). The reaction was monitored by TLC using hexane from petroleum-ethylacetate (9:1). After completion, the reaction mixture was cooled to room temperature and water was added to precipitate the desired product (4, 5). The precipitates were filtered, washed with water and crystallized from ethanol. Similarly, furo[3,2-c]chromen-4-ones (8, 9) were synthesized using the above protocols.

2-Benzoyl-3,6-dimethyl-4H-furo[3,2-c]pyran-4-one (**4a**)
Colour: White, m.p. 142°C, yield 98%, I.R. (KBr, cm^{-1}): 1756(-O-C=O), 1622(-C=O); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.93 (m, 2H, $C_{2'}$/$C_{6'}$-H), 7.60 (m, 1H, $C_{4'}$-H), 7.50 (m, 2H, $C_{3'}$/$C_{5'}$-H), 6.43 (d, 1H, C_7-H, J=0.9 Hz), 2.66 (s, 3H, C_3-CH_3), 2.37 (s, 3H, C_6-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$): 184.00 (-C=O), 163.27 (C-1a), 161.92 (C-6), 159.27 (C-2), 147.98 (C-4), 137.40 (C-1'), 132.77 (C-3), 131.37 (C-4'), 129.34 (C-2'/C-6'), 128.44 (C-3'/C-5'), 109.98 (C-3a), 95.63 (C-7), 20.58 (C-6- CH_3), 10.88 (C-3-CH_3); HRMS: m/z(M^+) calcd. for $C_{16}H_{12}O_4$: 268.0736, found: 269.0889(M^++H).

6-Dimethyl-2-(4-methylbenzoyl)-4H-furo[3,2-c]pyran-4-one (**4b**)

Colour: White, m.p. 205°C, yield 98%, I.R. (KBr,cm^{-1}): 1736 (-O-C=O), 1624 (-C=O); ^{1}H NMR (400 MHz, $CDCl_3$) δ :7.85 (d, 2H, $C_{2'}/C_{6'}$-H, *J*=8.4 Hz), 7.29 (d, 2H, $C_{3'}/C_{5'}$-H, J=8.0Hz), 6.42 (d, 1H, C_7-H, J=0.8 Hz), 2.66 (s, 3H, C_3-CH_3), 2.45 (s, 3H, C_6-CH_3), 2.37 (s, 3H, $C_{4'}$-CH_3); ^{13}C NMR (100 MHz,$CDCl_3$): 183.69 (-C=O), 163.09 (C-1a), 161.80 (C-6), 159.34 (C-2), 148.14 (C-4), 143.71 (C-4'), 134.75 (C-1'), 130.88 (C-3), 129.55 (C-2'/C-6'), 129.15 (C-3'/C-5'), 109.95 (C-3a), 95.65 (C-7), 21.73 (C-4'-CH_3), 20.57 (C-6- CH_3), 10.88 (C-3-CH_3); HRMS: m/z(M^+) calcd.for $C_{17}H_{14}O_4$: 282.0892, found: 283.1008 (M^++H).

2-(4-Methoxybenzoyl)-3,6-dimethyl-4H-furo[3,2-c]pyran-4-one (**4c**)

Colour: white, m.p. 209°C, yield 98%, I.R. (KBr,cm^{-1}): 1746 (-O-C=O), 1629 (-C=O); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.99 (d, 2H, $C_{2'}/C_{6'}$-H, J= 6.88 Hz), 6.99 (d, 2H, $C_{3'}/C_{5'}$-H, J=6.88 Hz), 6.43 (d, 1H, C_7-H, J=0.8 Hz), 3.90 (s, 3H, $C_{4'}$-OCH_3), 2.66 (s, 3H, C_3-CH_3), 2.37 (s, 3H, C_6-CH_3), ^{13}C NMR (100 MHz,$CDCl_3$): 182.41 (-C=O), 163.50 (C-1a), 162.95 (C-4'), 161.63 (C-6), 159.32 (C-2), 148.30 (C-4), 131.89 (C-2'/C-6'), 130.49 (C-1'), 130.11 (C-3), 113.78 (C-3'/C-5'), 109.96 (C-3a), 95.61 (C-7), 55.53 (C-4'-OCH_3), 20.53 (C-6-CH_3), 10.82 (C-3-CH_3); HRMS: m/z(M^+) calcd. for $C_{17}H_{14}O_5$: 298.0841, found: 299.0958 (M^++H).

(E)-2-Benzoyl-3-(2,5-dimethoxystyryl)-6-methyl-4H-furo[3,2-c]pyran-4-one(**5a**)

Colour: light yellow, m.p. 162° C, yield 95%, I.R. (KBr,cm^{-1}): 1741 (-O-C=O), 1627 (-C=O); ^{1}H NMR (400 MHz, $CDCl_3$) δ : 8.47 (d, 1H, -CH=C**H**-Ar, J=16.3 Hz), 7.91 (t, 2H, $C_{2'}/C_{6'}$-H, J=7.2, 1.6 Hz), 7.77 (d, 1H,-C**H**=CH-Ar, J=16.3 Hz), 7.62 (t, 1H, $C_{4'}$-H, J=7.6 Hz), 7.51 (t, 2H, $C_{3'}/C_{5'}$-H, J=7.6, 7.6 Hz), 7.19 (dd, 1H, $C_{4''}$, J=8.0, 1.6 Hz), 7.10 (d, 1H, $C_{6''}$, J=1.6 Hz), 6.87 (d, 1H, $C_{3''}$, J=8.4 Hz), 6.45 (s, 1H, C_7-H), 3.92 (s, 6H, $C_{3'}$-Ar-OCH_3), 2.41 (s, 3H, C_6-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$): 184.33 (-**C**=O), 163.76 (C-1a), 163.29 (C-6), 159.23 (C-5''), 149.99 (C-2''), 149.09 (C-2), 146.85 (C-4), 140.76 (C-3), 138.04 (C-1'), 132.59 (C-4'), 132.10 (-CH=**C**H-Ar), 130.12 (C-2'/,C-6'), 129.39 (C-3'/C-5'), 128.41 (-**CH**=CH-Ar), 121.49 (C-3a), 114.44 (C-1''), 111.05 (C-3''), 109.41 (C-4''), 107.41 (C-6''), 95.58 (C-7), 55.95 (C-5''-OCH_3), 55.93 (C-2''-OCH_3), 20.47 (C-6- CH_3); HRMS: m/z (M^+) calcd. for $C_{25}H_{20}O_6$: 416.1260, found: 417.1258 (M^++H).

(E)-3-(2,5-Dimethoxystyryl)-6-methyl -2-(4-methylbenzoyl)-4H-furo[3,2-c]pyran-4-one (**5b**)
Colour: light yellow, m.p. 140°C, yield 95%, I.R. (KBr,cm^{-1}): 1815 (-O-C=O), 1658 (-C=O); ^{1}H NMR (400 MHz, $CDCl_3$) δ : 8.73 (d, 1H,-CH=C**H**-Ar, J=16.6 Hz), 7.84 (d, 1H, -C**H**=CH-Ar, J= 16.5 Hz), 7.83 (d, 2H, $C_{2'}/C_{6'}$ -H, J=8.2 Hz), 7.31 (d, 2H, $C_{3'}/C_{5'}$ -H, J=8.0 Hz), 7.12 (d, 1H, $C_{4''}$ -H, J=1.5 Hz), 6.83 (s, 1H, $C_{6''}$,$C_{3''}$-H, J=1.6 Hz), 6.44 (d, 1H, C_7-H, J=0.7 Hz), 3.84 (s, 6H, $C_{2''}/C_{5''}$ -OCH_3), 2.45 (s, 3H, C_6-CH_3), 2.39 (s, 3H, $C_{4'}$-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$): 183.95 (-**C=**O), 163.53 (C-1a), 163.09 (C-6), 159.18 (C-5″), 153.74 (C-2″), 152.54 (C-2), 147.31 (C-4), 143.55 (C-4′), 135.58 (C-3a), 135.29 (C-1′), 131.70 (-CH=**C**H-Ar), 129.64 (C-2′/C-6′), 129.11 (C-3′/C-5′), 126.95 (-**C**H=CH-Ar), 117.08 (C-3a), 115.70 (C-1″), 112.74 (C-3″), 111.99 (C-4″), 107.40 (C-6″), 95.50 (C-7), 56.59 (C-5″-OCH_3), 55.81 (C-2″-OCH_3), 21.72 (C-4′-CH_3), 20.43 (C-6-CH_3); HRMS: m/z (M^+) calcd. for $C_{26}H_{22}O_6$: 430.1416, found: 431.1203 (M^++H).

(E)-3-(2,5-Dimethoxystyryl)-2-(4-methoxybenzoyl)-6-methyl-4H-furo[3,2-c]pyran-4-one(**5c**)
Colour: light yellow, m.p. 138° C, yield 95%, I.R. (KBr,cm^{-1}): 1743 (-O-C=O), 1625 (-C=O); ^{1}H NMR (400 MHz, $CDCl_3$) δ : 8.70 (d, 1H, -CH=C**H**-Ar, J=16.7 Hz), 7.96 (dd, 2H, $C_{2'}/C_{6'}$ -H, J= 6.9, 2.0 Hz), 7.82 (d, 1H, -C**H**=CH-Ar, J=16.5 Hz), 7.13 (t, 1H, $C_{4''}$ -H, J=1.3,1.5 Hz), 6.99 (dd, 2H, $C_{3'}/C_{5'}$ -H, J=6.9, 2.0 Hz), 6.83 (d, 1H, $C_{3''}/C_{6''}$ -H, J=1.6 Hz), 6.45 (d, 1H, C_7-H, J=0.8 Hz), 3.86 (s, 9H, $C_{3'}/C_{2''}/C_{5''}$ -OCH_3), 2.40 (s, 3H, C_6-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$): 182.74 (-**C**=O), 163.41 (C-1a), 163.38 (C-4′), 162.97 (C-6), 159.21 (C-5″), 153.74 (C-2″), 152.50 (C-2), 147.44 (C-4), 135.28 (C-3), 131.99 (-CH=**C**H-Ar), 131.30 (C-2′/C-6′), 130.51 (C-1′), 126.99 (-**C**H=CH-Ar), 117.14 (C-3a), 115.67 (C-1″), 113.71 (C-3″), 112.74(C-4″),111.91(C-3′/C-5′), 107.37(C-6″), 95.50(C-7), 56.59(C-5″-OCH_3), 55.82(C-2″-OCH_3),55.53(C-4′OCH_3),20.42(C-6-CH_3); HRMS:m/z(M^+) calcd.for $C_{26}H_{22}O_7$: 446.1366, found: 447.1204(M^++H).

(E)-2-Benzoyl-3-(2,4-dimethoxystyryl)-6-methyl-4H-furo[3,2-c]pyran-4-one(**5d**)
Colour: dark yellow,m.p.140°C,yield 95%, I.R.(KBr,cm^{-1}): 1739(-O-C=O),1624(-C=O);^{1}HNMR (400 MHz, $CDCl_3$) δ : 8.73(d,1H,-CH=C**H**-Ar,J= 16.6 Hz), 7.90(m,2H,$C_{2'}/C_{6'}$-H), 7.86(d,1H,-C**H**=CH-Ar,J=16.5Hz), 7.58(m,1H,$C_{4'}$-H), 7.54(m,1H,$C_{6''}$-H), 7.51(m, 2H,$C_{3'}/C_{5'}$-H,J=8.9Hz),6.50(dd,1H,$C_{5''}$-H,J=2.0,8.5Hz), 6.45(d,1H,$C_{3''}$-H,J=2.3Hz),

6.42(d,1H,C_7-H,J=0.8Hz), 3.82(s,6H, $C_{2''}/C_{4''}$–OCH_3), 2.39(s,3H,C_6-CH_3); ^{13}CNMR(100MHz,$CDCl_3$): 184.22(-**C**=O),163.58(C-1a), 163.20(C-6),161.66(C-4''),159.31(C-2),159.25(C-4), 146.68(C-2''),138.16(C-3), 136.23(C-1'),133.01(C-4'), 132.53(-CH=**C**H-Ar), 129.46(C-6''), 128.89(C-2'/C-6'),128.42(C-3'/C-5'),119.29(-**C**H=CH-Ar), 114.61(C-3a), 107.44(C-1''), 105.14(C-5''), 98.4(C-3''),95.53(C-7), 55.72(C-2''-OCH_3),55.43(C-4''-OCH_3), 20.43(C-6-CH_3); HRMS:m/z(M^+) calcd.for $C_{25}H_{20}O_6$: 416.1260, found: 417.1308(M^++H).

(E)-3-(2,4-Dimethoxystyryl)-6-methyl -2-(4-methylbenzoyl) -4H-furo[3,2-c]pyran-4-one(**5e**)
Colour: dark yellow, m.p.186°C, yield 95%, I.R.(KBr, cm^{-1}): 1741 (-O-C=O), 1627 (-C=O); ^{1}HNMR (400 MHz, $CDCl_3$) δ : 8.71(d, 1H,-CH=C**H**-Ar, J =16.6 Hz), 7.86 (d, 1H,-C**H**=CH-Ar, J =16.6 Hz), 7.84 (d, 2H, $C_{2'}/C_{6'}$-H, J= 8.2 Hz), 7.56 (d, 1H, $C_{6''}$-H, J= 8.5 Hz), 7.28 (d, 2H, $C_{3'}/C_{5'}$-H, J =7.9 Hz), 6.50 (dd, 1H, $C_{5''}$-H, J=2.0, 8.5 Hz), 6.45 (d, 1H, $C_{3''}$-H, J =2.4 Hz), 6.42 (d, 1H, C_7-H, J= 0.8 Hz), 3.89 (s, 6H, $C_{2''}/C_{4''}$-OCH_3), 2.45 (s, 3H, C_6-CH_3), 2.39 (s, 3H,$C_{4'}$-CH_3); ^{13}CNMR (100 MHz, $CDCl_3$) : 183.92 (-**C**=O), 163.41 (C-1a), 163.05 (C-6), 161.58 (C-4''), 159.27 (C-2), 146.90 (C-4), 143.31 (C-2''), 141.16 (C-4''), 135.90 (C-3), 135.46 (C-1'),132.59 (-CH=**CH**-Ar), 129.59 (C-6''), 129.05 (C-2'/C-6'), 128.85 (C-3'/C-5'), 119.37 (-**C**H=CH-Ar), 114.71 (C-3a), 107.42 (C-1''), 105.13 (C-5''), 98.46 (C-3''), 95.52 (C-7), 55.70 (C-2''-OCH_3), 55.42 (C-4''-OCH_3), 21.71 (C-4'-CH_3), 20.41 (C-6-CH_3); HRMS: m/z(M^+) calcd. for $C_{26}H_{22}O_6$: 430.1416, found: 431.1361(M^++H).

(E)-3-(2,4-Dimethoxystyryl)-2-(4-methoxybenzoyl)-6-methyl-4H-furo[3,2-c]pyran-4-one(**5f**)
Colour: dark yellow, m.p.180°C, yield 95%, I.R.(KBr, cm^{-1}): 1741 (-O-C=O),1624 (-C=O); ^{1}HNMR (400 MHz, $CDCl_3$) δ : 8.68 (d, 1H, -CH=C**H**-Ar, J =16.6 Hz), 7.97 (dd, 2H, $C_{2'}/C_{6'}$-H, J= 2.0, 6.8 Hz), 7.84 (d, 1H, -C**H**=CH-Ar, J = 16.5 Hz), 7.58 (d, 1H, $C_{6''}$-H, J = 8.6 Hz), 6.98 (dd, 2H, $C_{3'}/C_{5'}$-H, J = 2.0, 6.9 Hz), 6.51 (dd, 1H, $C_{5''}$-H, J =2.3, 8.4 Hz), 6.45 (d, 1H, C_7-H, J = 0.8 Hz), 3.82 (s, 9H, $C_{4'}/C_{2''}/C_{4''}$-OCH_3), 2.40 (s, 3H, C_6-CH_3); ^{13}CNMR (100 MHz, $CDCl_3$) :182.74 (-**C**=O), 163.30 (C-1a), 163.25 (C-4'), 162.93 (C-6), 161.53 (C-4''), 159.33 (C-2), 159.21 (C-4), 147.02 (C-2''), 135.60 (C-3), 132.21 (-CH=**C**H-Ar), 131.93 (C-2'/C-6'), 130.67 (C-1'), 128.77 (C-6''), 119.39 (-**C**H=CH-Ar), 114.75(C-3a),113.66(C-3'/C-5'), 107.39(C-1''), 105.11(C-5''), 98.45(C-3''), 95.53(C-7), 55.71(C-2''-OCH_3),55.53(C-4''-OCH_3),55.43(C-4'-OCH_3),20.42(C-6-CH_3); HRMS:m/z(M^+) calcd.for $C_{26}H_{22}O_7$: 446.1366, found:

447.1320(M^++H).

(E)-2-Benzoyl-3-(3,4-dimethoxystyryl)-6-methyl-4H-furo[3,2-c]pyran-4-one (**5g**)
Colour: yellow, m.p. 160º C,yield 95%, I.R.(KBr,cm^{-1}):1739(-O-C=O),1624(-C=O); ^{1}HNMR (400 MHz, $CDCl_3$) δ: 8.46(d,1H,-CH=C**H**-Ar,J=16.4Hz), 7.91(t,2H,$C_{2'}$/$C_{6'}$-H,J=7.2,1.4Hz), 7.76(d,1H,-C**H**=CH-Ar,J=16.4Hz),7.60(t,1H,$C_{4'}$-H,J=7.4Hz), 7.52(t,2H,$C_{3'}$/$C_{5'}$-H,J=1.3,7.4Hz), 7.19(dd,1H,$C_{6''}$-H,J=1.8,8.3Hz), 7.09(d,1H,$C_{2''}$-H,J=1.8Hz), 6.86(d,1H,$C_{5''}$–H,J=8.3Hz), 6.44(d,1H,C_7-H,J=0.8Hz), 3.92(s,6H,$C_{3''}$/$C_{4''}$-OCH_3), 2.41(s,3H,C_6-CH_3); ^{13}CNMR(100 MHz,$CDCl_3$):184.32(-**C**=O),163.75(C-1a),163.28(C-6), 159.20(C-3"), 150.01(C-4"),149.11(C-2), 146.86(C-4), 140.76(C-3) ,138.05(C-1'), 132.57(-CH=**C**H-Ar),132.09(C-4'),130.14(C-1"),129.38(C-2'/C-6'),128.40(C-3'/C-5'), 121.48(-**C**H=CH-Ar), 114.44(C-3a),111.08(C-6"),109.46(C-5"),107.40(C-2"), 95.56(C-7), 55.94(C-3"/C-4"-OCH_3), 20.45(C-3-CH_3); HRMS:m/z(M^+) calcd.for $C_{25}H_{20}O_6$: 416.1260, found: 417.1265(M^++H).

(E)-3-(3,4-Dimethoxystyryl)-6-methyl -2-(4-methylbenzoyl) -4H-furo[3,2-c]pyran-4-one(**5h**)
Colour: yellow, m.p. 134º C, yield 96%, I.R. (KBr, cm^{-1}): 1741 (-O-C=O), 1627 (-C=O); ^{1}HNMR (400 MHz, $CDCl_3$) δ : 8.46 (d, 1H,-CH=C**H**-Ar, J = 16.4 Hz), 7.85 (d, 2H, $C_{2'}$/$C_{6'}$-H, J= 8.2 Hz), 7.79 (d, 1H, -C**H**=CH-Ar, J=16.4 Hz), 7.33 (d, 2H, $C_{3'}$/$C_{5'}$-H, J= 8.0 Hz), 7.23 (dd, 1H, $C_{6''}$-H, J = 2.0, 8.4 Hz), 7.12 (d, 1H, $C_{2''}$-H, J = 2.0 Hz), 6.88 (d, 1H, $C_{5''}$-H, J = 8.4 Hz), 6.45 (d, 1H, C_7-H, J = 0.8 Hz), 3.94 (s, 6H, $C_{3''}$/$C_{4''}$-OCH_3), 2.46 (s, 3H, C_6-CH_3), 2.41 (s, 3H, $C_{4'}$-CH_3); ^{13}CNMR (100 MHz, $CDCl_3$) : 184.03 (-**C**=O), 163.61 (C-1a), 163.14 (C-6), 159.28 (C-3"), 149.93 (C-4"), 149.08 (C-2), 147.08 (C-4), 143.54 (C-4'), 140.46 (C-3), 135.34 (C-1'), 131.71 (-CH=**C**H-Ar), 130.20 (C-1"), 129.61 (C-2'/C-6'), 129.12 (C-3'/C-5'), 121.44 (-**C**H=CH-Ar), 114.55 (C-3a), 111.05 (C-6"), 109.40 (C-5"), 107.39 (C-2"), 95.58 (C-7), 55.95 (C-3"/C-4"-OCH_3), 21.74 (C-4'-CH_3), 20.46 (C-6-CH_3); HRMS :m/z (M^+) calcd.for $C_{26}H_{22}O_6$: 430.1416, found: 431.1454 (M^++H).

(E)-3-(3,4-dimethoxystyryl)-2-(4-methoxybenzoyl)-6-methyl-4H-furo[3,2-c]pyran-4-one(**5i**)
Colour: yellow, m.p. 139º C, yield 96%, I.R. (KBr, cm^{-1}): 1739 (-O-C=O), 1629 (-C=O); ^{1}HNMR (400 MHz, $CDCl_3$) δ : 8.43 (d, 1H,-CH=C**H**-Ar, J=16.4 Hz), 7.98 (d, 2H, $C_{2'}$/$C_{6'}$-H, J =

8 Hz), 7.76 (d, 1H, -C**H**=CH-Ar, J = 16.4 Hz), 7.21 (d, 1H, $C_{2''}$-H, J = 8.1 Hz), 7.12 (s, 1H, $C_{5''}$-H), 7.01 (d, 2H, $C_{3'}/C_{5'}$-H, J = 8 Hz) ,6.88 (dd, 1H, $C_{6''}$-H, J =3.6, 8.3 Hz), 6.46 (d, 1H, C_7-H, J = 2.8 Hz), 3.91 (s, 9H, $C_{3''}/C_{4''}$-OCH3, C4'-OCH_3), 2.41 (s, 3H, C_6-CH_3); ^{13}CNMR (100 MHz, $CDCl_3$): 182.82 (-**C**=O), 163.49 (C-1a), 163.37 (C-4'), 163.02 (C-6), 159.30 (C-3''), 149.87 (C-4''), 149.07 (C-2), 147.21 (C-4), 140.16 (C-3), 131.94 (-CH=**C**H-Ar), 131.33 (C-2'/C-6'), 130.57 (C-1'), 130.24 (C-1''), 121.38 (-**C**H=CH-Ar), 114.61 (C-3'/C-5'), 113.72 (C-3a), 111.05 (C-6''), 109.37 (C-5''), 107.35 (C-2''), 95.57 (C-7), 55.95 (C-3''/C-4''-OCH_3), 55.54 (C-4'-OCH_3), 20.45 (C-6-CH_3); HRMS : m/z(M^+) calcd.for $C_{26}H_{22}O_7$: 446.1366, found: 447.1381 (M^++H).

(E)-2-Benzoyl-)-6-methyl-3-(3,4,5-trimethoxystyryl-4H-furo[3,2-c]pyran-4-one (**5j**)
Colour: light yellow, m.p. 167º C, yield 95%, I.R. (KBr, cm^{-1}): 1743 (-O-C=O), 1625 (-C=O); ^{1}HNMR (400 MHz, $CDCl_3$) δ: 8.44 (d, 1H, -CH=C**H**-Ar, J= 16.3Hz), 7.92 (dd, 2H, $C_{2'}/C_{6'}$-H, J = 1.4, 8.2 Hz), 7.76 (d, 1H, -C**H**=CH-Ar, J = 16.3 Hz), 7.62 (t, 1H, $C_{4'}$-H), 7.53 (t, 2H, $C_{3'}/C_{5'}$-H, J =7.6 Hz), 6.80 (s, 2H, $C_{2''}/C_{6''}$-H), 6.46 (d, 1H, C_7-H, J = 0.8 Hz), 3.93 (s, 9H, $C_{3''}/C_{4''}/C_{5''}$-OCH_3), 2.43 (s, 3H, C_6-CH_3); ^{13}CNMR (100 MHz, $CDCl_3$) : 184.41 (-**C**=O), 163.85 (C-1a), 163.35 (C-6),159.23(C-3''/C-5''),153.36(C-2),147.08(C-4),140.70(C-3), 138.96(C-4''),138.96(C-1'),137.96(C-1''),132.70(-CH=**C**H-Ar),131.62(C-4'),129.41(C-2'/C-6'),128.45(C-3'/C-5'),115.77(-**C**H=CH-Ar),107.39(C-3a),104.49(C-2''/C-6''),95.59(C-7),60.99(C-4''-OCH_3),56.19(C-3''/C-5''-OCH_3),20.49(C-6-CH_3); HRMS:m/z(M^+) calcd.for $C_{26}H_{22}O_7$: 446.1366, found: 447.1381(M^++H).

(E)-6-Methyl-2-(4-methylbenzoyl)-3-(3,4,5-trimethoxystyryl)-4H-furo[3,2-c]pyran-4-one(**5k**)
Colour: light yellow, m.p.140º C,yield 95%, I.R.(KBr,cm^{-1}): 1737(-O-C=O),1634(-C=O); ^{1}HNMR (400 MHz, $CDCl_3$)δ : 8.42(d,1H,-CH=C**H**-Ar,J=16.3 Hz), 7.84(d,2H,$C_{2'}/C_{6'}$-H,J=8.1 Hz), 7.77(d,1H,-C**H**=CH-Ar,J=16.3Hz), 7.32(d,2H,$C_{3'}/C_{5'}$-H,J=8.1 Hz), 6.82(s,2H,$C_{2''}/C_{6''}$-H), 6.45(d,1H,C_7-H,J=0.8Hz), 3.83(s,12H,$C_{3''}/C_{4''}/C_{5''}$-OCH_3), 2.45(s,3H,C_6-CH_3), 2.41(s,3H,$C_{4'}$-CH_3);^{13}CNMR(100MHz,$CDCl_3$):184.06(-**C**=O),163.669(C-1a),159.25(C-6), 153.35(C-3''/C-5''),152.42(C-2),147.30(C-4),143.66(C-4'),140.39(C-3),138.94(C-4''),135.27(C-1''),132.77(-CH=**C**H-Ar),131.19(C-1'),129.63(C-2'/C-6'),128.99(C-3'/C-5'),115.87(-**C**H=CH-Ar),107.36(C-3a),104.51(C-2''/C-6''),95.57(C-7),60.97(C-4''-OCH_3),56.16(C-3''/C-5''-OCH_3),

21.73(C-4'-CH_3), 20.45(C-6-CH_3); HRMS:m/z(M^+) calcd.for $C_{27}H_{24}O_7$: 460.1522, found: 461.1659(M^++H).

(E)-2-(4-Methoxybenzoyl)-6-methyl-3-(3,4,5-trimethoxystyryl)-4H-furo[3,2-c]pyran-4-one(**5l**)

Colour: light yellow, m.p.143°C,yield 95%, I.R.(KBr,cm^{-1}): 1734(-O-C=O),1616(-C=O); ^{1}HNMR (400 MHz, $CDCl_3$)δ: 8.40(d,1H,-CH=C**H**-Ar,J=16.3Hz), 7.96(d,2H,77,J=8.9 Hz), 7.73(d,1H,-C**H**=CH-Ar,J=16.3Hz), 7.00(d,2H,$C_{3'}$/$C_{5'}$-H,J=8.9 Hz), 6.80(s,2H,$C_{2''}$/$C_{6''}$-H), 6.47(d,1H,C_7-H,J=0.8Hz), 3.84(s,12H,$C_{3''}$/$C_{4''}$/$C_{5''}$/OCH_3,$C_{4'}$-OCH_3), 2.41(s,3H,C_6-CH_3);^{13}CNMR(100 MHz,$CDCl_3$):182.88(-**C**=O),163.56(C-1a), 163.45(C-4'),163.08(C-6),159.30(C-3''/C-5''),153.34(C-2),147.45(C-4), 140.08(C-3),138.84(C-4''),132.82(C-1''),131.97(-CH=**C**H-Ar),130.81(C-2'/C-6'),130.50(C-1'), 115.95(-**C**H=CH-Ar), 113.75(C-3a), 107.33(C-3'/C-5'), 104.42(C-2''/C-6''),95.58(C-7),60.97(C-4''-OCH_3),56.16(C-3''/C-5''-OCH_3),55.54(C-4'-OCH_3),20.46(C-6-CH_3); HRMS:m/z(M^+) calcd.for $C_{27}H_{24}O_8$: 476.1471, found: 477.1550(M^++H).

2-Benzoyl-3-methyl-4H-furo[3,2-c]chromen-4-one (**8a**)

Colour: white, m.p. 141° C, yield 92%, IR (KBr, cm^{-1}) : 1753 (-O-C=O), 1672 (-C=O); ^{1}HNMR: (400 MHz, $CDCl_3$) δ: 8.03 (d, 2H, $C_{2'}$/$C_{6'}$-H, J = 7.08 Hz), 7.91 (dd, 1H, C_9-H, J = 7.8, 7.8 Hz), 7.60-7.65 (m, 2H, $C_{4'}$-H and C_7-H), 7.56 (t, 2H, $C_{3'}$/$C_{5'}$-H), 7.47 (d, 1H, C_6-H, J = 8.3 Hz), 7.38 (t, 1H, C_8-H, J = 6.8, 8.3 Hz), 2.76 (s, 3H, C_3-CH_3), ^{13}C NMR (100 MHz, $CDCl_3$) δ: 183.96 (-**C**=O), 157.84 (C-9b), 157.75 (C-4), 153.75 (C-5a), 149.07 (C-2), 137.33 (C-1'), 132.97 (C-4'), 132.31 (C-7), 132.01 (C-3), 129.47 (C-2'/C-6'), 128.54 (C-3'/C-5'), 124.83 (C-8), 121.75 (C-9), 117.59 (C-6), 112.20 (C-3a), 111.95 (C-9a), 10.82 (C-3-CH_3); HRMS: (m/z) M^+ calcd. for $C_{19}H_{12}O_4$: 304.0736, found: 305.0798 (M^++H).

3-Methyl-2-(4-methylbenzoyl)-4H-furo[3,2-c] chromen-4-one (**8b**)

Colour: light brown, m.p. 108° C, yield: 90%, IR(KBr, cm^{-1}) : 1726 (-O-C=O), 1656 (-C=O); ^{1}HNMR: (400 MHz, $CDCl_3$) δ: 7.95 (d, 2H, $C_{2'}$/$C_{6'}$-H, J = 8.4 Hz), 7.91 (dd, 1H, C_9-H, J = 7.8 Hz), 7.57-7.62 (m, 1H, C_7-H), 7.47 (d, 1H, C_6-H, J = 7.6 Hz), 7.35-7.39 (m, 3H, C_8-H, $C_{3'}$/$C_{5'}$-H), 2.74 (s, 3H, C_3-CH_3), 2.38 (s, 3H, $C_{4'}$-CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 183.64

(-**C**=O), 163.06 (C-9b), 161.77 (C-5a), 159.29 (C-2), 148.15 (C-4), 143.67 (C-4'), 134.77 (C-1'), 132.30 (C-7), 130.86 (C-3), 129.54 (C-2'/C-6'), 129.14 (C-3'/C-5'), 124.8(C-8), 121.7 (C-9), 117.6 (C-6), 112.2 (C-3a), 111.9 (C-9a), 21.71 (C-4'-CH_3), 10.85 (C-3-CH_3);
HRMS: (m/z) M^+ calcd. for $C_{20}H_{14}O_4$: 318.892, found: 319.0955 (M^++H).

2-(4-Methoxybenzoyl)-3-methyl-4H-furo[3,2-c] chromen-4-one (**8c**)
Colour: white, m.p. 110º C, yield 90%, IR (KBr, cm^{-1}) : 1746 (-O-C=O), 1632 (-C=O); ^{1}HNMR (400 MHz, $CDCl_3$) δ: 8.08 (d, 1H, C_9-H, J = 8.7 Hz), 7.94 (t, 1H, C_7-H, J = 8.9, 9.3 Hz), 7.75 (d, 1H, C_6-H, J = 8.4 Hz), 7.59 (t, 1H, C_8-H, J = 6.9, 7.2 Hz), 7.36 (m, 2H, $C_{2'}$/$C_{6'}$-H), 6.99-7.05 (m, 2H, $C_{3'}$/$C_{5'}$-H), 3.88-3.93 (s, 3H, $C_{4'}$-OCH_3), 2.75 (s, 3H, C_3-CH_3); ^{13}CNMR (100 MHz, $CDCl_3$) : 182.41 (-**C**=O), 163.46 (C-9b), 162.93 (C-4'), 161.62 (C-5a), 159.34 (C-2), 148.24 (C-4), 132.38 (C-7), 131.88 (C-2'/C-6'), 130.48 (C-1'), 130.04 (C-3), 124.8 (C-8), 121.7 (C-9), 117.6 (C-6), 113.75 (C-3'/C-5'), 112.2 (C-3a), 111.9 (C-9a), 55.52 (C-4'-OCH_3), 10.85 (C-3-CH_3); HRMS : m/z M^+ calcd. for $C_{20}H_{14}O_5$: 334.0841, found: 335.0901 (M^++H).

(E)-2-Benzoyl-3-(2,5-dimethoxystyryl)-4H-furo[3,2-c]chromen-4-one (**9a**)
Colour: yellow, m.p. 140º C, yield 97%, I.R. (KBr, cm^{-1}) : 1753 (-O-C=O), 1600 (-C=O); ^{1}HNMR: (400 MHz, $CDCl_3$) δ: 8.75 (d,1H, -CH=C**H**-Ar, J = 16.0 Hz), 8.00 (d, 2H, $C_{2'}$/$C_{6'}$-H, J = 8.0 Hz,), 7.93 (d, 1H, -C**H**=CH-Ar, J = 16.0 Hz), 7.90 (dd, 1H, C_9-H, J = 1.2, 8.4 Hz), 7.59-7.65 (m, 2H, C_8-H, $C_{4'}$-H), 7.55 (t, 2H, $C_{3'}$/$C_{5'}$-H, J = 8.9 Hz), 7.48 (d, 1H, C_6-H, J = 7.6 Hz), 7.37 (m, 1H, C_7-H), 7.17 (s, 1H, $C_{4''}$-H), 6.85 (s, 2H, $C_{3''}$/$C_{6''}$-H), 3.81, 3.88 (s, 6H, $C_{2''}$-OCH_3 and $C_{5''}$-OCH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 184.17(-**C**=O), 158.93 (C-9b), 157.58 (C-5''), 153.84 (C-2''), 152.67 (C-4), 148.16 (C-5a), 137.94 (C-1'), 136.28 (-CH=**C**H-Ar), 132.79 (C-4'), 132.70 (C-7), 132.54 (C-3), 129.56 (C-2'/C-6'), 128.49 (C-3'/C-5'), 126.88 (-**C**H=CH-Ar), 124.75 (C-8), 121.94 (C-9), 117.32 (C-6), 116.70 (C-3a)115.97 (C-1''), 112.84 (C-6''), 112.17 (C-3''), 111.89 (C-4''), 109.66 (C-9a), 56.64, 55.89 (C-2'',C-5''-OCH3); HRMS: (m/z) M^+ calcd. for $C_{28}H_{20}O_6$: 452.1260, found: 453.1354 (M^++H).

(E)-3-(2,5-Dimethoxystyryl)-2-(4-methylbenzoyl)-4H-furo[3,2-c]chromen-4-one (**9b**)
Colour: yellow, m.p. 146º C, yield 95%, I.R. (KBr, cm^{-1}) : 1744 (-O-C=O), 1620 (-C=O); ^{1}HNMR: (400 MHz, $CDCl_3$) δ: 8.74(d,1H, -CH=C**H**-Ar, J = 16.6 Hz), 7.89-7.93(m, 4H, -

C**H**=CH-Ar, C_9-H, $C_{2'}$/$C_{6'}$-H), 7.59-7.63 (m, 1H, C_7-H), 7.48 (d, 1H, C_6-H, J = 8.0 Hz), 7.34-7.39 (m, 1H, C_8-H, $C_{3'}$/$C_{5'}$-H), 7.17 (s, 1H, $C_{4''}$-H), 6.85 (s, 2H, $C_{3''}$/$C_{6''}$-H), 3.81, 3.88 (s, 6H, $C_{2''}$/$C_{5''}$-OCH_3), 2.47 (s, 1H, $C_{4'}$- CH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 183.95 (-**C=**O), 163.53 (C-9b), 163.09 (C-5a), 159.18 (C-5''), 153.74 (C-2''), 152.54 (C-2), 147.31 (C-4), 143.55 (C-4'), 135.58 (C-3), 135.29 (C-1'), 131.70 (-CH=**C**H-Ar), 129.64 (C-2'/C-6'), 129.11 (C-3'/C-5'), 126.95 (-**C**H=CH-Ar), 124.45 (C-8), 121.13 (C-9), 117.46 (C-6), 117.08 (C-3a), 115.70 (C-1''), 112.74 (C-6''), 111.99 (C-3''), 107.40 (C-4''), 95.50 (C-7), 56.59 (C-5''-OCH_3), 55.81 (C-2''-OCH_3), 20.43 (C-4'-CH_3); HRMS: (m/z) M^+ calcd. for $C_{29}H_{22}O_6$: 466.1416, found: 467.1518 (M^++H).

(E)-3-(2,5-Dimethoxystyryl)-2-(4-methoxybenzoyl)-4H-furo[3,2-c]chromen-4-one (**9c**)

Colour: yellow, m.p. 180º C, yield 95%, I.R. (KBr, cm^{-1}): 1754 (-O-C=O), 1627 (-C=O); ^{1}HNMR: (400 MHz, $CDCl_3$) δ: 8.71 (d, 1H, -CH=C**H**-Ar, J = 16.6 Hz), 8.05 (d, 2H, $C_{2'}$/$C_{6'}$-H, J = 8.9 Hz), 7.93 (dd, 1H, C_9-H, J = 1.2, 8.4 Hz), 7.89 (d, 1H, -C**H**=CH-Ar, J = 16.5 Hz), 7.60 -7.64 (m, 1H, C_7-H), 7.48 (d, 1H, C_6-H, J = 7.6 Hz), 7.36-7.41 (m, 1H, C_8-H), 7.17 (s, 1H, $C_{4''}$-H), 7.03 (d, 2H, $C_{3'}$/$C_{5'}$-H, J = 8.9 Hz),6.84 (s, 2H, $C_{3''}$/$C_{6''}$-H), 3.81, 3.88, 3.92(s, 9H, $C_{2''}$/$C_{5''}$, $C_{4'}$-OCH_3); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 182.69 (-**C**=O), 163.57 (C-9b), 153.79 (C-4'), 153.74 (C-5''), 152.55 (C-2''), 135.60(C-5a), 132.39(C-2), 132.10 (C-2'/C-6'), 130.48 (C-7), 126.96 (C-1'), 124.72 (C-3), 121.85(C-8), 117.30 (C-9), 116.82 (C-6), 115.77 (C-1''), 113.84 (C-3',C-5'), 112.76 (C-3''), 112.05(C-4''), 111.97 (C-6'') 56.61, 55.85, 55.56 (C-2'', C-5'',C-4'-OCH_3); HRMS: (m/z) M^+ calcd. for $C_{29}H_{22}O_7$: 482.1366, found: 483.1472 (M^++H).

(E)-2-Benzoyl-3-(3,4,5-trimethoxystyryl)-4H-furo[3,2-c]chromen-4-one (**9d**)

Colour: yellow, m.p. 191º C, yield 94%, I.R. (KBr, cm^{-1}) : 1734 (-O-C=O), 1627 (-C=O); ^{1}HNMR: (400 MHz, $CDCl_3$) δ: 8.47 (d, 1H, -CH=C**H**-Ar, J = 16.3 Hz), 8.01 (d, 2H, $C_{2'}$/$C_{6'}$-H, J = 7.6 Hz), 7.91 (dd, 1H, C_9-H, J = 7.8, 7.6 Hz), 7.83 (1H, d, C**H**=CH-Ar, J = 16.3 Hz), 7.83 (d, 1H, CH=C**H**-Ar, J = 16.3 Hz),7.62-7.67 (m, 2H, C_8-H, $C_{4'}$-H), 7.55-7.59 (m, 2H, $C_{3''}$/$C_{5''}$-H), 7.50 (d, 1H, C_6-H, J = 8.0 Hz), 7.40 (t, 1H, C_7-H, J = 5.1, 7.6 Hz), 6.84 (s, 2H, $C_{2''}$,$C_{6''}$-H)3.77-3.92 (s, 9H, $C_{3''}$,$C_{4''}$,$C_{5''}$-OCH_3); ^{13}CNMR (100 MHz, $CDCl_3$) :184.41 (-**C**=O), 163.85 (C-9b), 163.35 (C-5a), 159.23 (C-3''/C-5''), 153.36 (C-2), 147.08 (C-4), 140.70 (C-3), 138.96 (C-4''), 138.96 (C-1'), 137.96 (C-1''), 132.79 (-CH=**C**H-Ar), 132.70 (C-9a), 131.62 (C

-4'), 129.41 (C-2'/C-6'), 128.45 (C-3'/C-5'), 125.52 (C-8), 120.05 (C-9), 117.34 (C-6) 115.77 (-**C**H=CH-Ar), 107.39 (C-3a), 104.49 (C-2"/C-6"), 95.59 (C-7), 60.99 (C-4"-OCH_3), 56.19 (C-3"/C-5"-OCH_3); HRMS: (m/z) M^+ calcd. for $C_{29}H_{22}O_7$: 482.1366, found: 483.1494 (M^++H).

(E)-3-(3,4,5-Trimethoxystyryl)-2-(4-methylbenzoyl)-4H-furo[3,2-c]chromen-4-one (**9e**)
Colour: yellow, m.p. 181° C, yield 94%, I.R. (KBr, cm^{-1}) : 1724 (-O-C=O), 1629 (-C=O); ^{1}HNMR: (400 MHz, $CDCl_3$) δ: 8.45 (d, 1H, -CH=C**H**-Ar, J = 16.4Hz), 7.91-7.94 (m, 3H, -C**H**=CH-Ar, C_9-H, $C_{2'}/C_{6'}$-H), 7.83 (d, 1H,-C**H**=CH-Ar, J = 16.3 Hz), 7.63 (t, 1H, C_7-H, J = 8.4 Hz), 7.50 (d, 1H, C_6-H, J = 8.2 Hz), 7.35-7.41 (m, 3H, C_8-H, $C_{3'}/C_{5'}$-H), 6.84(s, 2H, $C_{2''}$-H and $C_{6''}$-H), 3.88, 3.92 (s, 9H, $C_{3''}$-OCH_3, $C_{4''}$-$OCH_3$and $C_{5''}$-OCH_3), 2.48 (s, 1H, $C_{4'}$- CH_3); ^{13}CNMR (100 MHz, $CDCl_3$) :183.55 (-**C**=O), 157.72 (C-9b), 153.77 (C-5", C-3"), 153.41 (C-4"), 148.36 (C-5a), 143.87 (C-4'), 140.67 (C-1"), 135.64 (C-1'), 131.77 (-CH=**C**H-Ar), 129.75 (C-2'/C-6'), 129.24 (C-3'/C-5'),128.99 (C-3), 124.82 (C-8), 121.92 (C-9), 118.92 (-**C**H=CH-Ar), 117.32 (C-6), 115.57 (C-3a), 111.89 (C-9a), 104.46 (C-2'',C-6'') 60.96 (C-4''-OCH_3), 56.21 (C-3"/C-5"-OCH_3), 21.74 (C-4'-CH_3); HRMS: (m/z) M^+ calcd. for $C_{30}H_{24}O_7$: 496.1522, found: 497.1768 (M^++H).

(E)-3-(3,4,5-Trimethoxystyryl)-2-(4-methoxybenzoyl)-4H-furo[3,2-c]chromen-4-one (**9f**)
Colour: yellow, m.p. 183° C, yield 94%, I.R. (KBr, cm^{-1}) : 1746 (-O-C=O), 1637 (-C=O); ^{1}HNMR: (400 MHz, $CDCl_3$) δ: 8.45 (d, 1H, -CH=C**H**-Ar, J = 16.4 Hz), 8.07 (d, 2H, $C_{2'}$ / $C_{6'}$-H, J = 8.8 Hz), 7.96 (d, 1H,C_9-H, J = 7.7 Hz), 7.82 (d, 1H, -C**H**=CH-Ar, J = 16.4 Hz), 7.66 (t, 1H, C_7-H, J = 7.1 Hz), 7.53 (d, 1H, C_6-H, J = 8.4 Hz), 7.42 (t, 1H, C_8-H, J = 7.6 Hz), 7.07 (d, 2H, $C_{3'}/C_{5'}$-H, J = 8.8 Hz), 6.86 (s, 2H, $C_{2''}$ and $C_{6''}$-H), 3.95, 3.94, 3.92, 3,90 (s, 12H, $C_{4'}$-OCH_3, $C_{3''}$, $C_{4''}$-OCH_3 and $C_{5''}$-OCH_3);^{13}CNMR (100 MHz, $CDCl_3$) : 183.52 (-**C**=O), 156.51 (C-3",C-5"), 153.19 (C-4"), 141.43 (C-1"), 139.66 (C-4'), 133.25 (-CH=-CH-Ar), 131.90 (C-1'), 127.57 (C-2',C-6'), 126.23 (C-3',C-5'), 123.07 (-CH=CH-Ar), 121.23 (C-9), 116.23 (C-6), 105.51 (C-2", C-6"), 60.79 (C-4"-OCH3), 56.11 (C-3", C-4', C-5"-OCH3)HRMS: (m/z) M^+ calcd. for $C_{30}H_{24}O_8$: 512.1471, found: 513.1692 (M^++H).

Pharmacological/biological assays

Anticancer activity culture

To relate the degree of propagation of a tumor cell line in the absence and presence of the test substances furo[3,2-c]pyran-4-ones (**4**, **5**) and furo[3,2-c]chromen-4-ones (**8**, **9**), generally later a listed time the sulphorhodamine B (SRB) [1] evaluation is carried out. This trusts on the uptake othe negatively charged pink aminoxanthine dye, sulphorhdamine B (SRB) using amino acids (basic) in the cells. Larger the number of cells, the more amount of dye is taken up then after fixing, the cells are lysed and the released dye will give a moreintense colour and better absorbance. Cells were cultured in a 96 well plate. Inoculation densities per well varies from cell line to cell line under investigation. 100 µL of cell suspension was plated. The cells were then treated with 50 µM concentration of test compound complete growth medium (RPMI-1640) for 48 hours. After 48 hours of incubation at 37℃, cells were washed for 1h with ice cold TCA at 4℃. After fixing the cells in fixative, the plates were rinsed with water for three times and it was further allowed to air dry. 100µL of 0.4% SRB dye was added for half an hour at room temperature after drying. 1% v/v acetic acid is then used for washing plates 3 times to remove any unbound SRB. The plates are then kept for drying at room temperature, after drying the bound dye was solubilized by adding 100 µL of 10mM TRIS buffer having pH- 10.4 to each well. The plates were shaking for 5 minutes to solubilize the dye. Finally, OD was taken at 540 nm in a microplate reader. IC_{50} was determined by plotting OD against concentration.

$$\text{The \% of cell viability} = \frac{\text{Absorbance of treated cells-Absorbance of blank}}{\text{Absorbance of control cells-Absorbance of blank}} \times 100$$

% Growth inhibition = 100- % cell viability

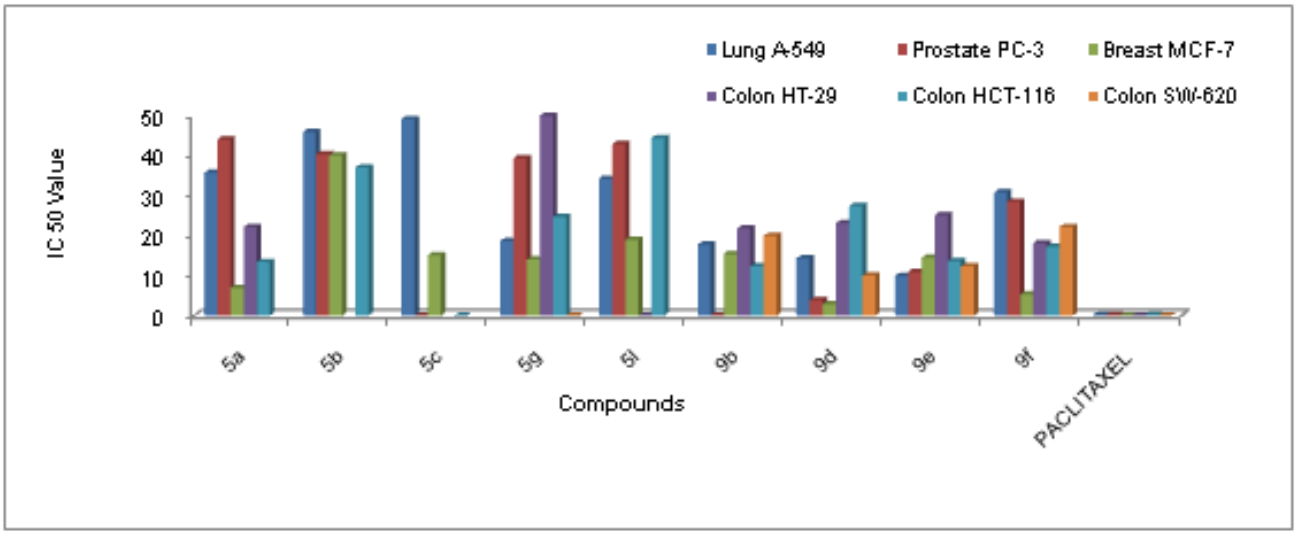

Fig.1. Graphical representation of IC_{50} value of different compound for different cancer cell lines.

4.2.2 Antimicrobial activity cultures

The antimicrobial screening of the synthesized furo[3,2-c]pyran-4-ones (**4**,**5**) and furo[3,2-c]chromen-4-ones (**8**, **9**) were carried out against three bacterial strains i.e. *Bacillus sublitis* (MTCC-441), *Staphylcococcus aureus* (MTCC 3160) and *Escherichia coli* (MTCC-443) and two fungal strains i.e. *Candida albicans* (MTCC-227) and *Aspergillus niger* (MTCC-281) employing tube dilution method [2]. Dilutions of standard and test compounds were done in double strength nutrient broth I.P. and Sabouraud dextrose broth I.P. for bacteria and fungi. The testing compounds were incubated for 24 h at 37°C±1°C for all bacteria and 25°C for seven days for fungi *A. niger* or for 48 h at 37°C±1°C for fungi *C. albicans*. Results of activities were noted in terms of MIC. Graphical representation of antibacterial study is represented in Fig. 2.

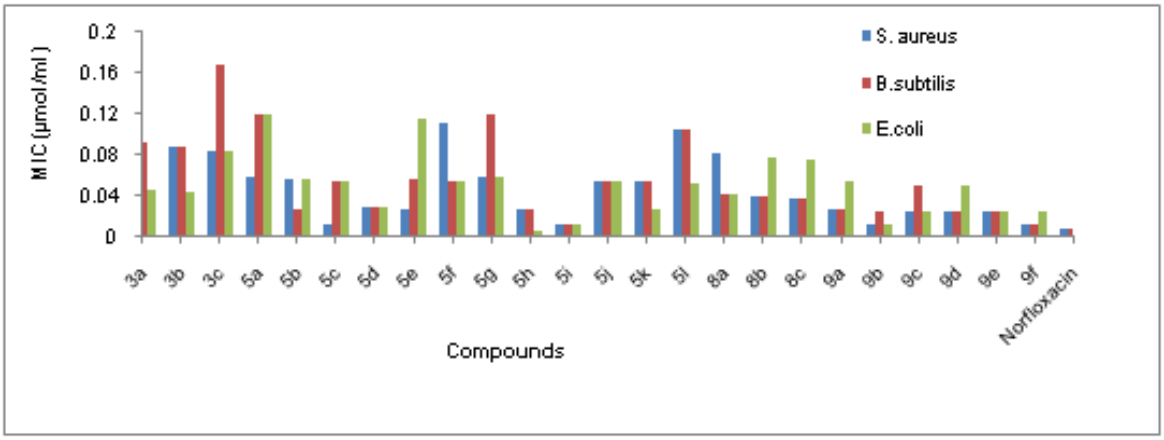

Fig. 2. Show the graphical representation of antibacterial study of synthesized compounds (**4, 5, 8 and 9**).

Graphical representation of antifungal study is represented in **Fig.3**.

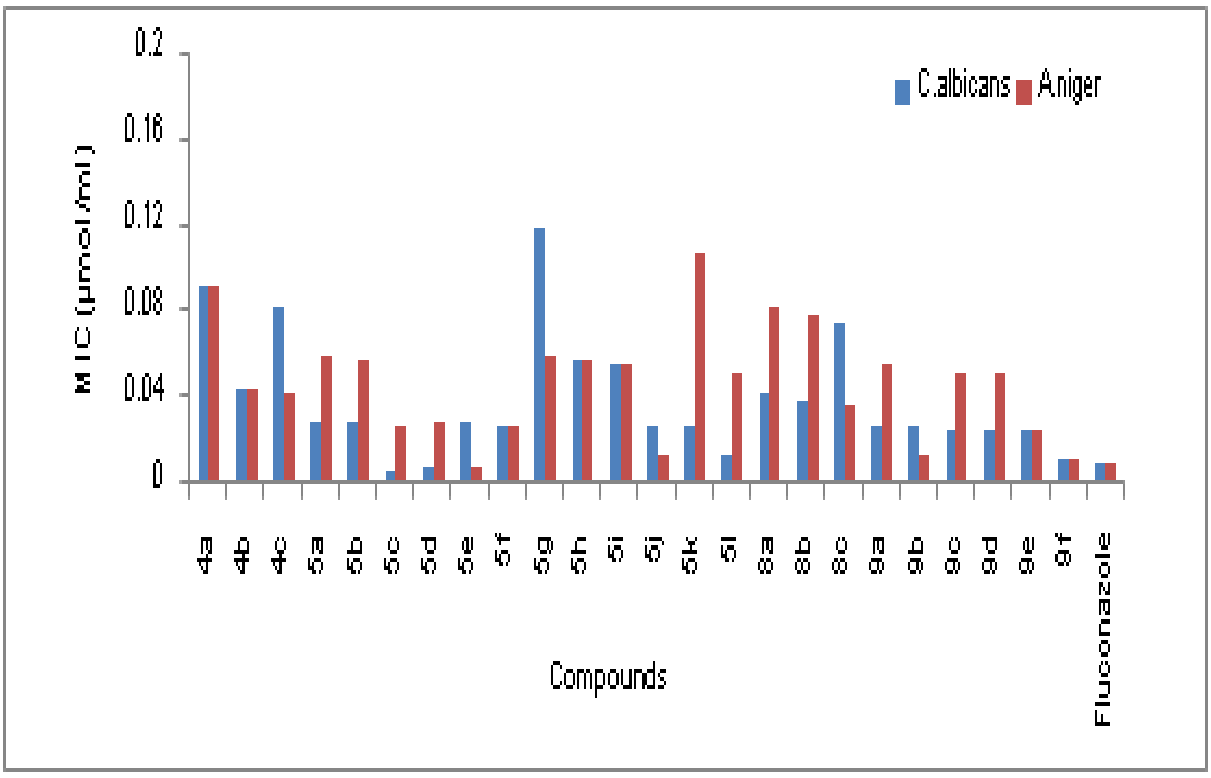

Fig. 3 The graphical representation of antifungal study of synthesized compounds (**4, 5, 8, 9)**

^{1}H, ^{13}C NMR, 2D and HRMSspectra of synthesized compounds

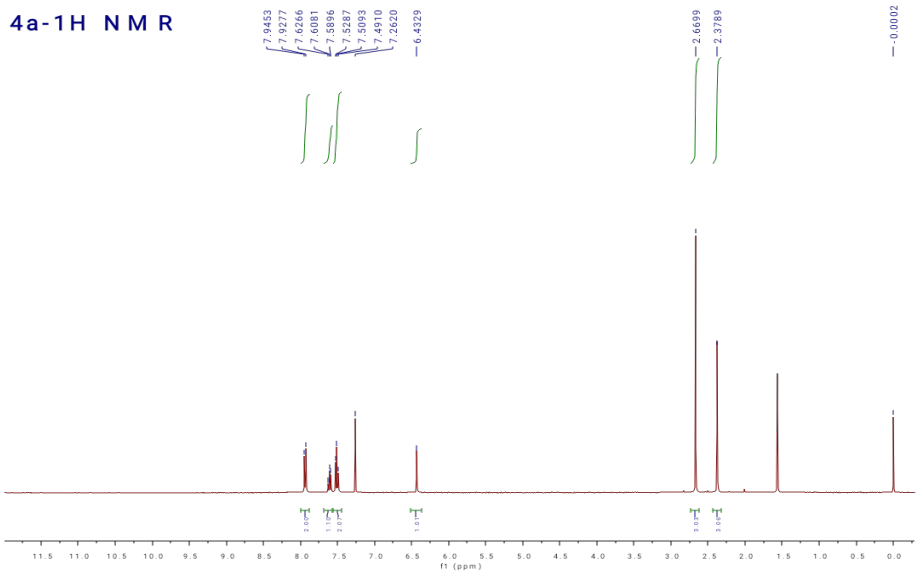

Figure S1. ^{1}H NMR of compound 4a

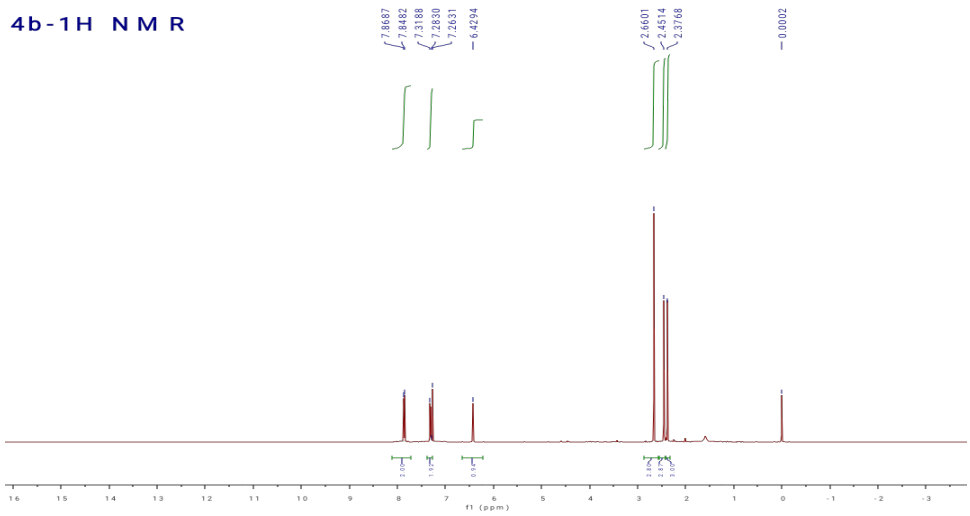

Figure S2. ^{1}H NMR of compound 4b

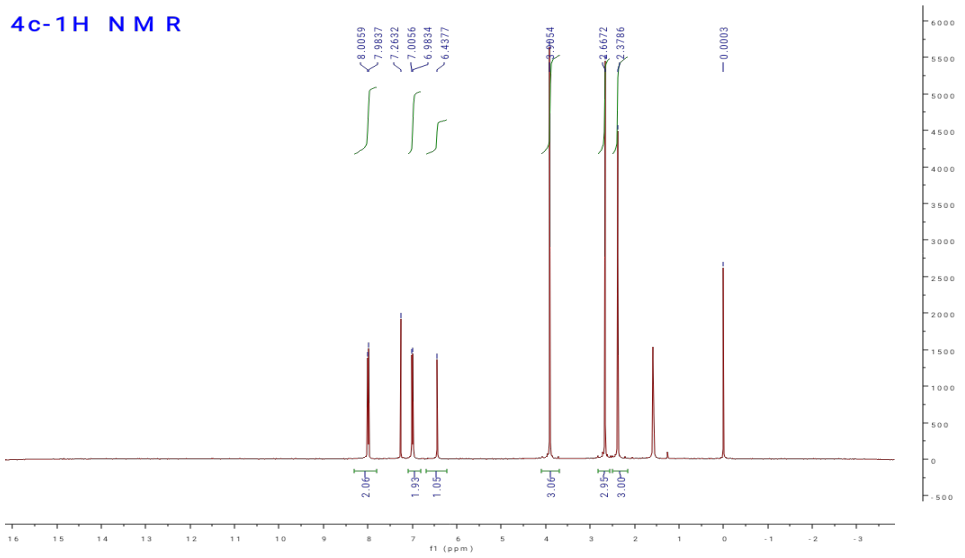

Figure S3. ^{1}H NMR of compound 4c

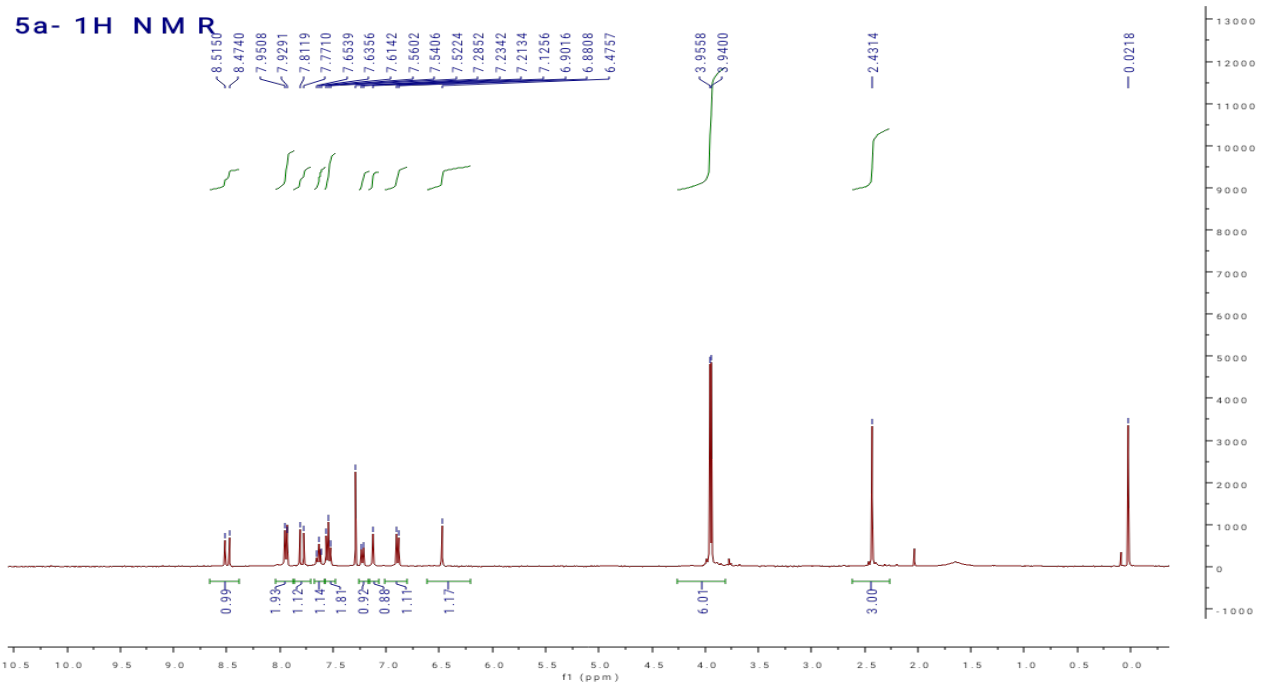

Figure S4. ^{1}H NMR of compound 5a

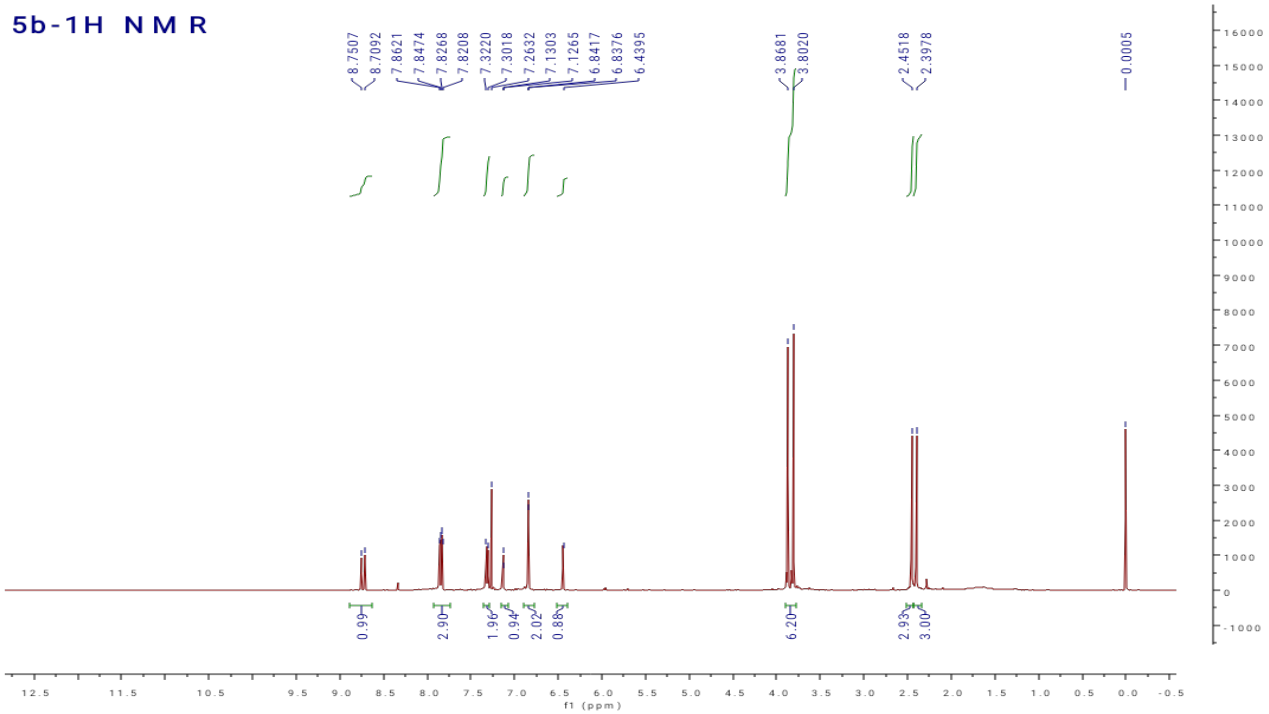

Figure S5. ^{1}H NMR of compound 5b

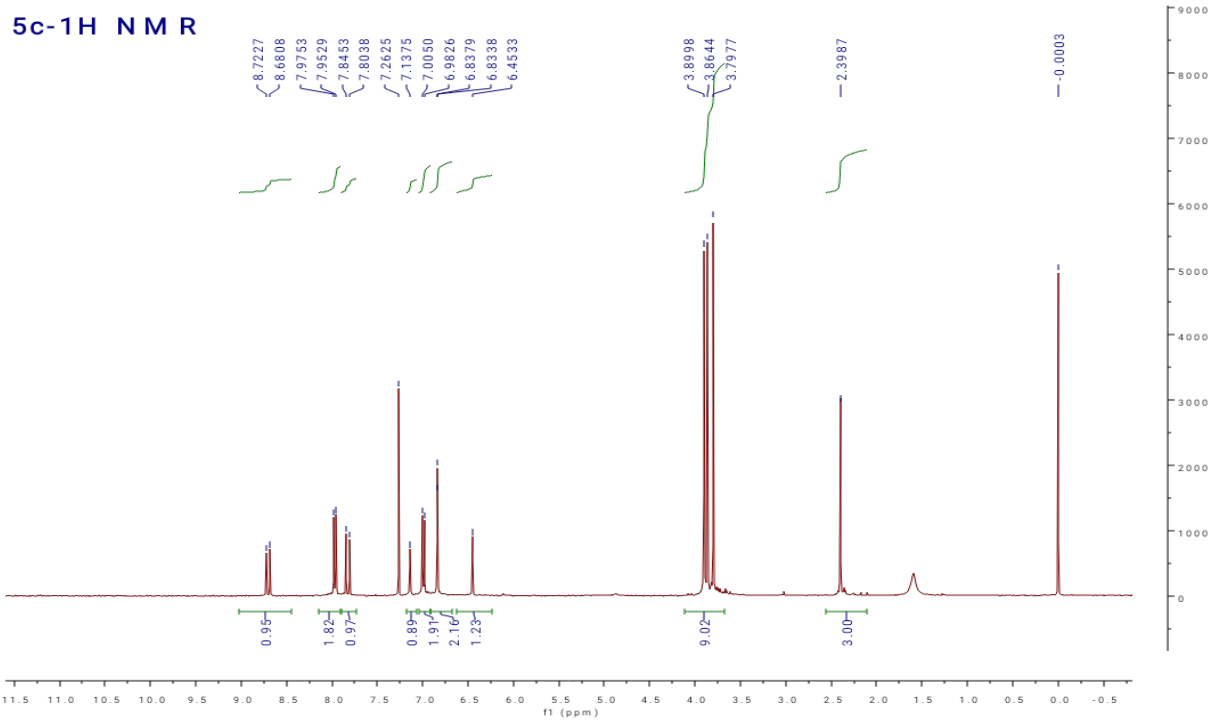

Figure S6. ^{1}H NMR of compound 5c

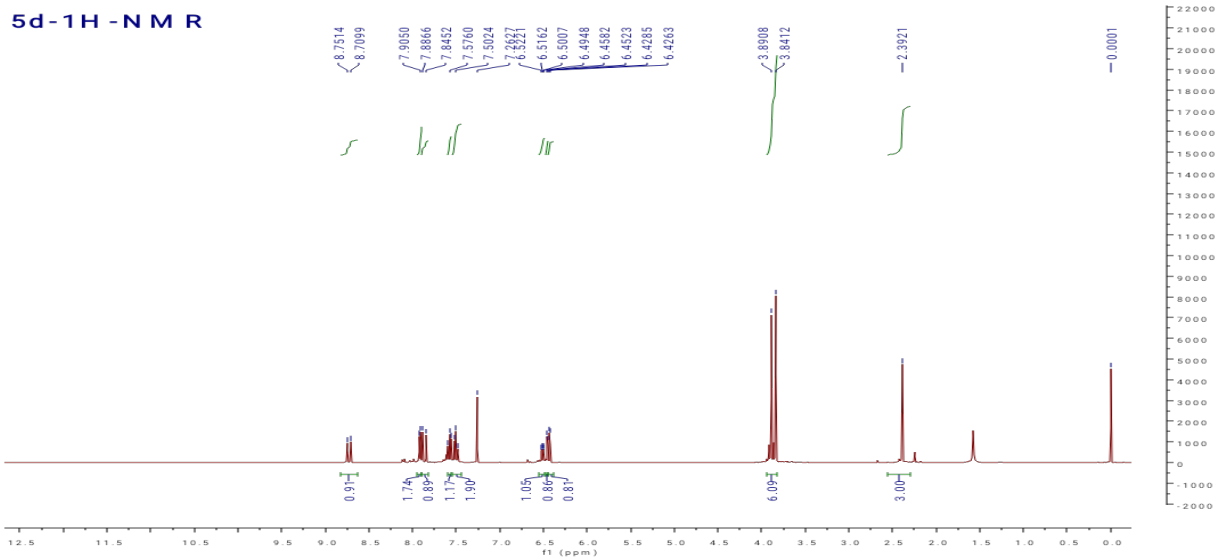

Figure S7. ^{1}H NMR of compound 5d

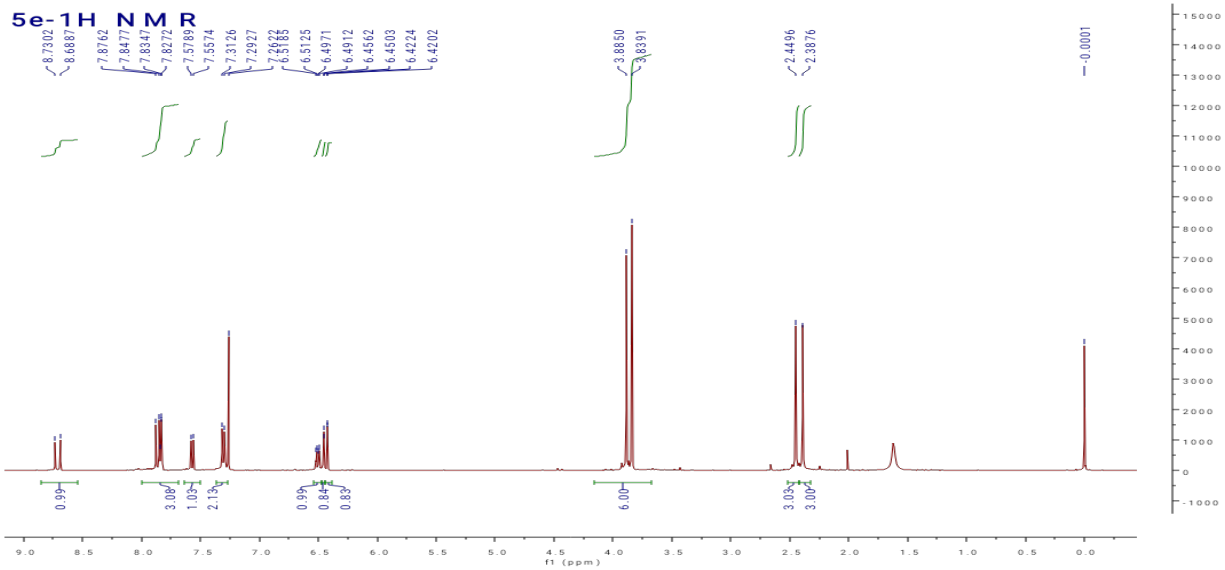

Figure S8. ^{1}H NMR of compound 5e

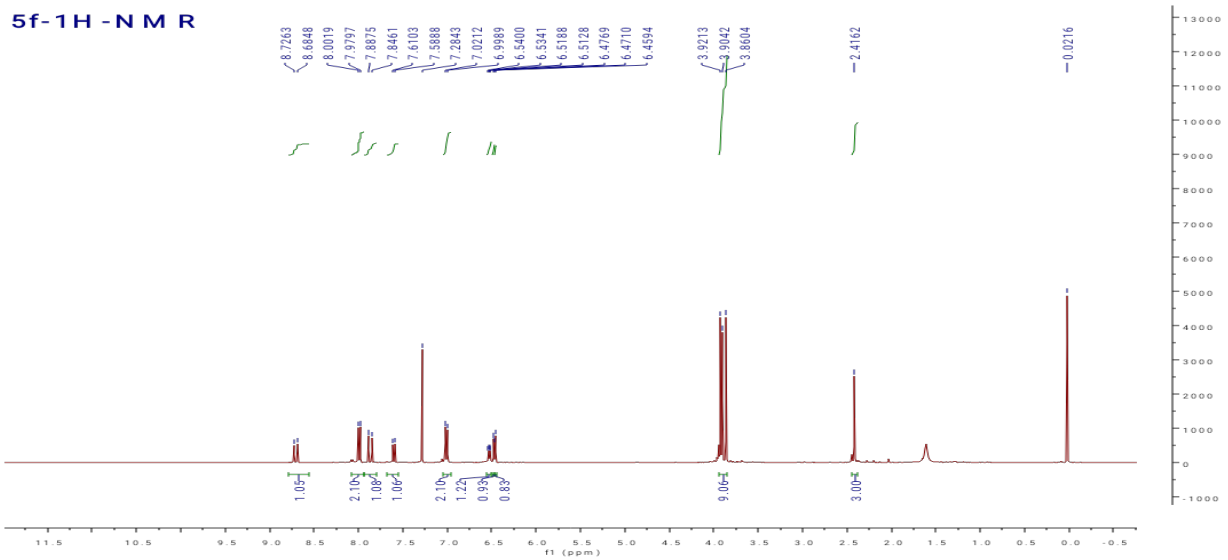

Figure S9. ^{1}H NMR of compound 5f

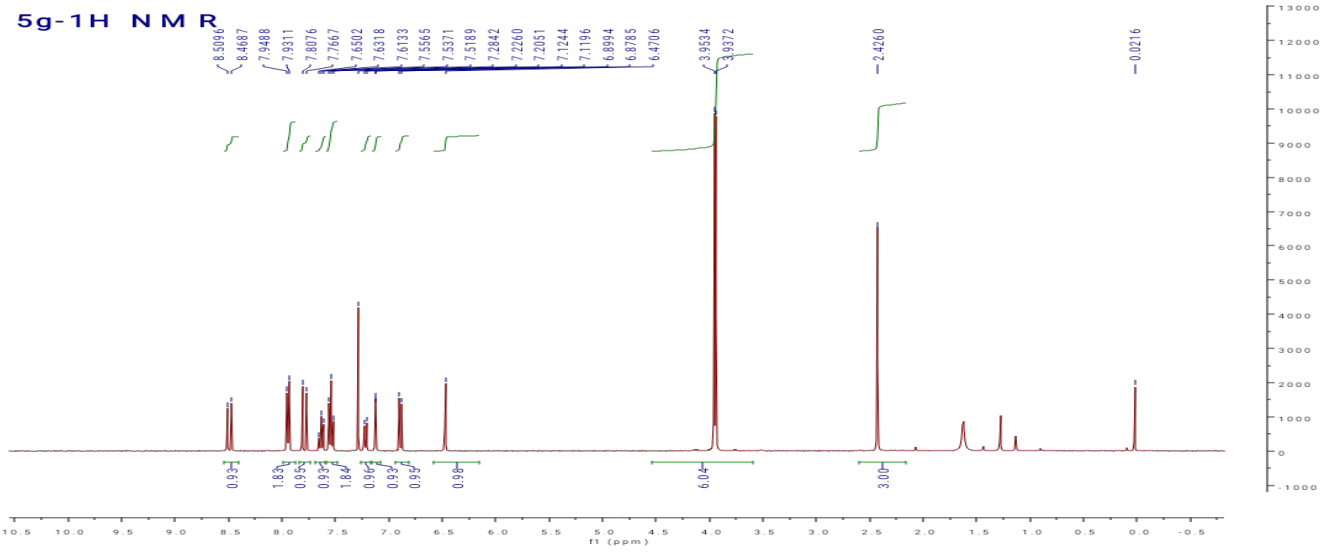

Figure S10. ^{1}H NMR of compound 5g

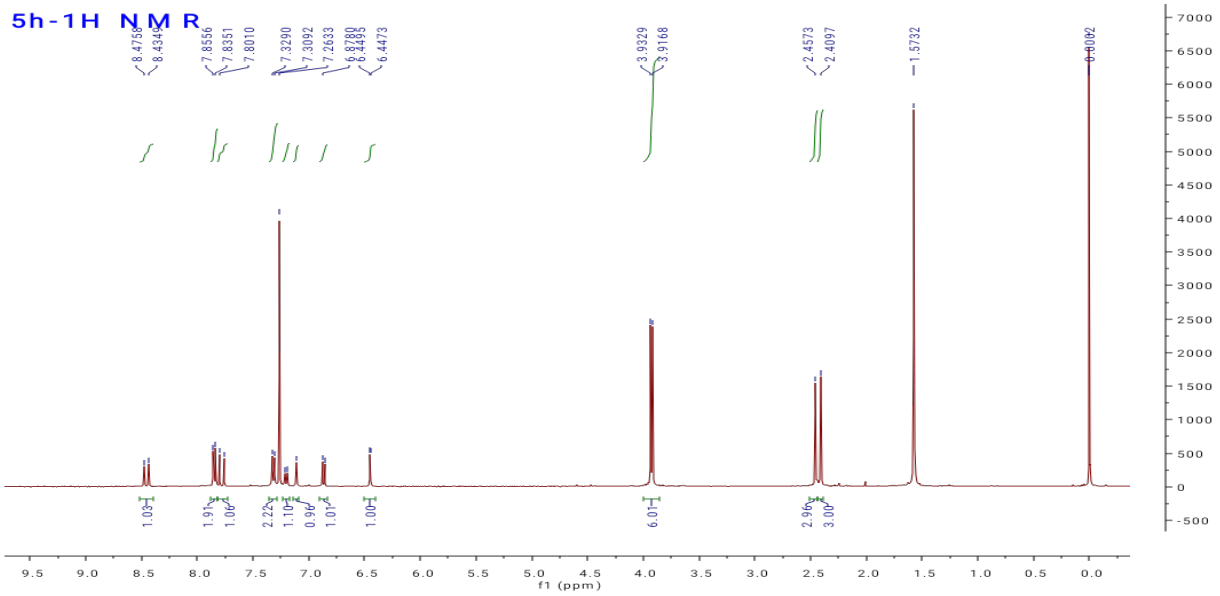

Figure S11. ^{1}H NMR of compound 5h

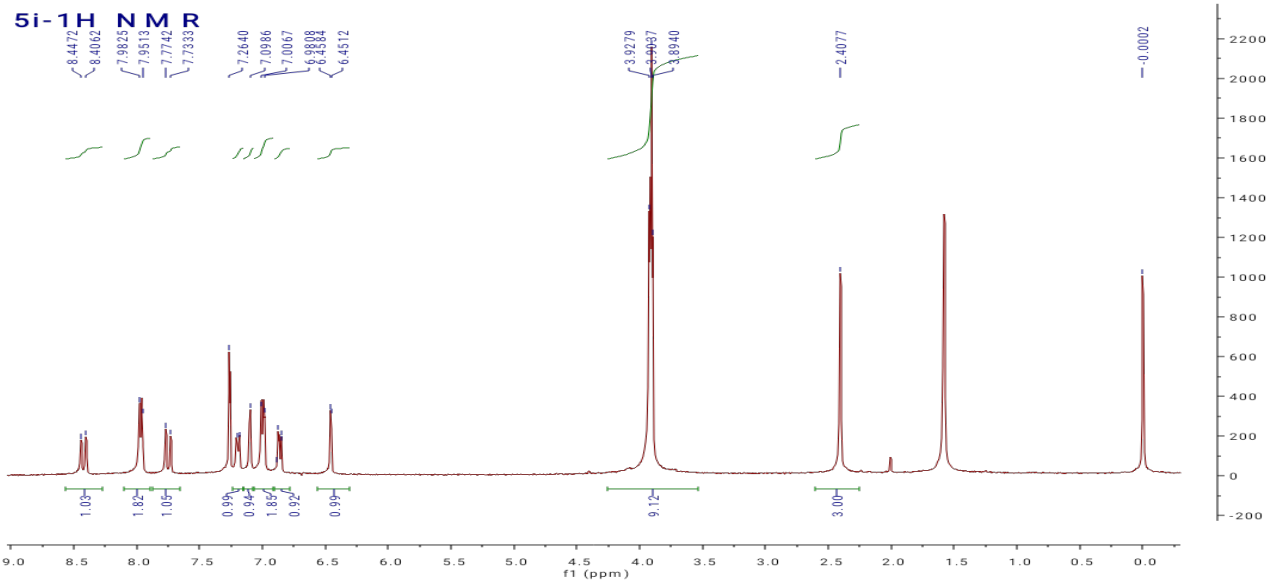

Figure S12. ^{1}H NMR of compound 5i

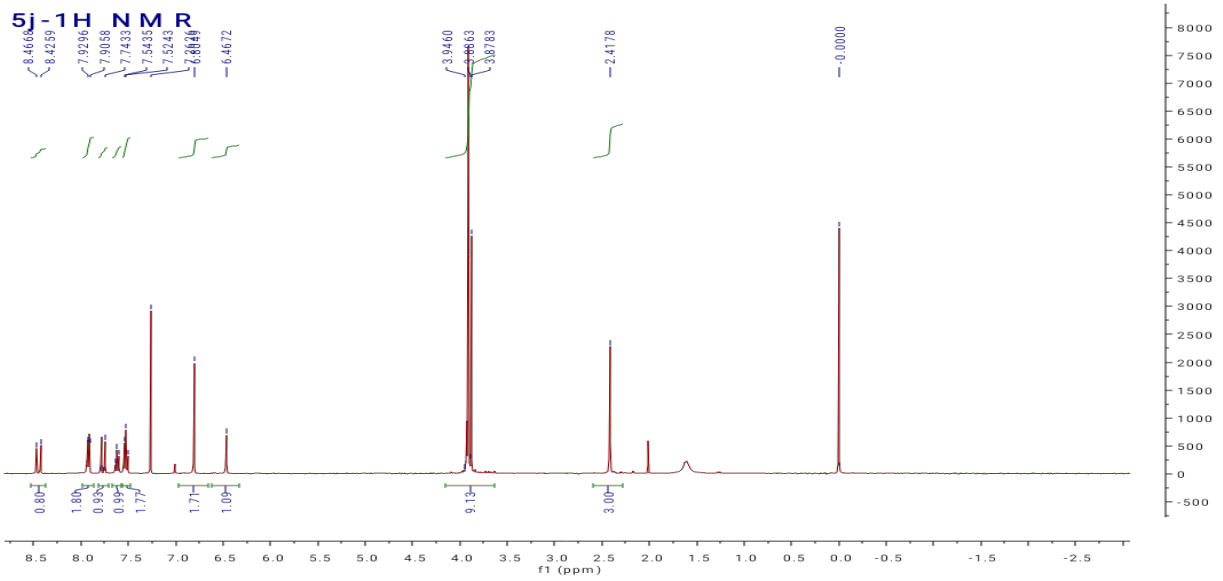

Figure S13. ^{1}H NMR of compound 5j

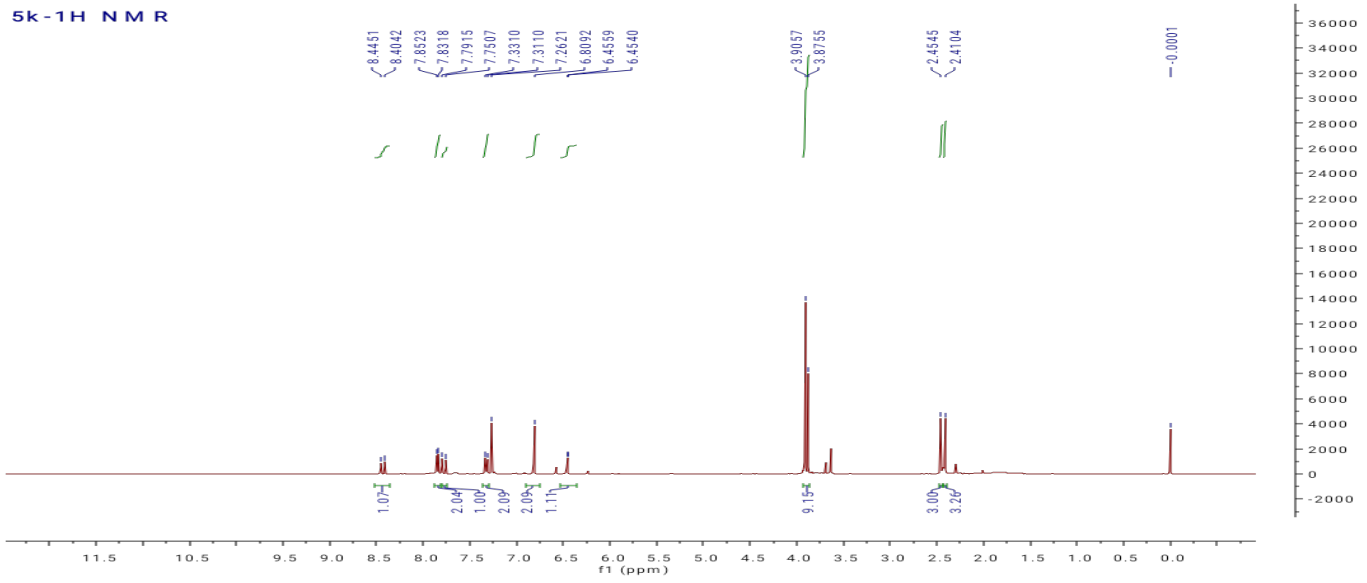

Figure S14. ^{1}H NMR of compound 5k

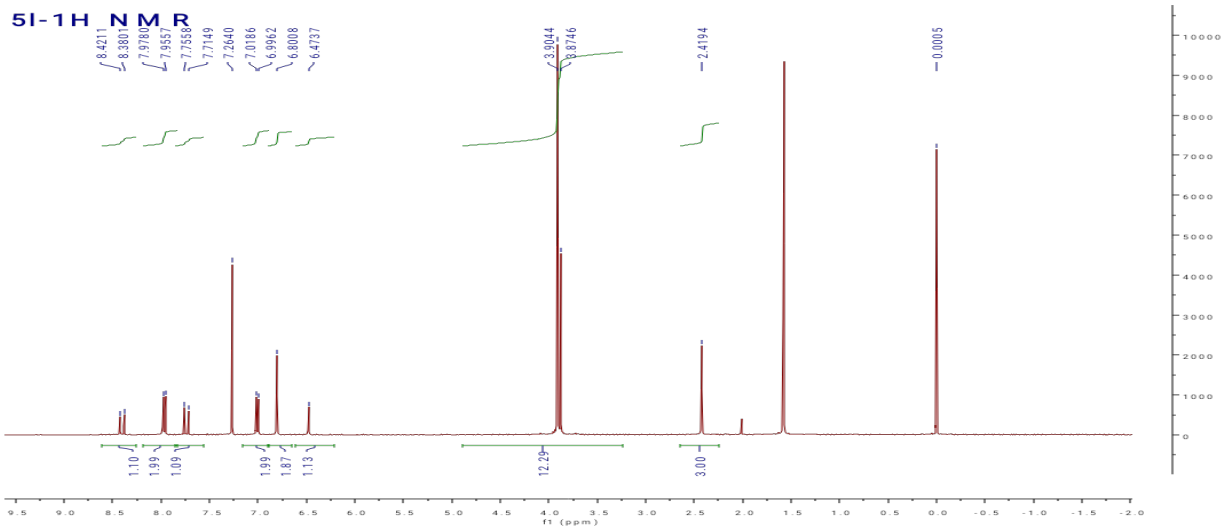

Figure S15. ^{1}H NMR of compound 5l

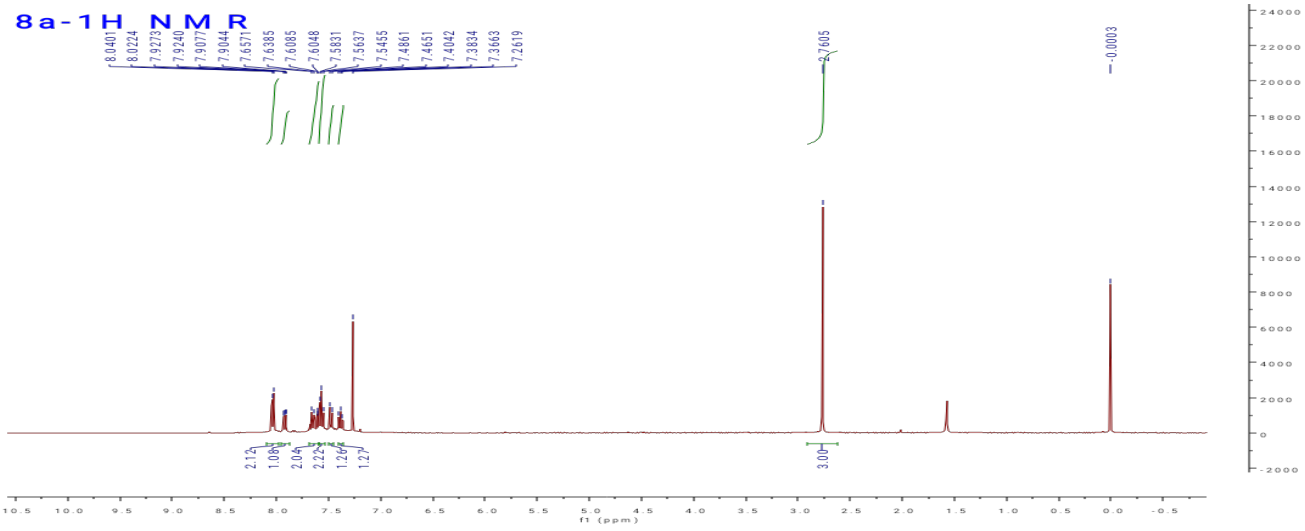

Figure S16. ^{1}H NMR of compound 8a

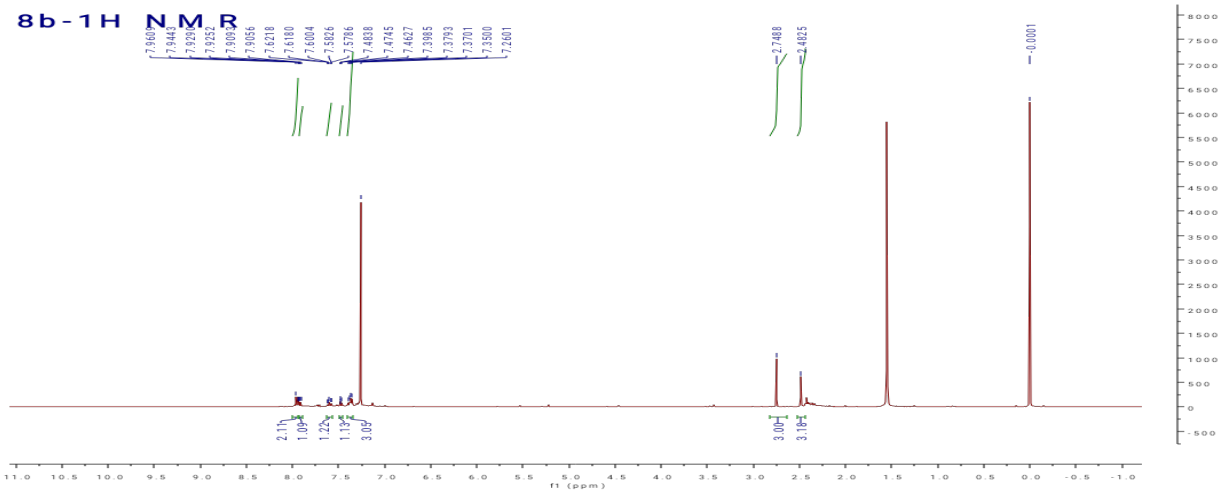

Figure S17. ^{1}H NMR of compound 8b

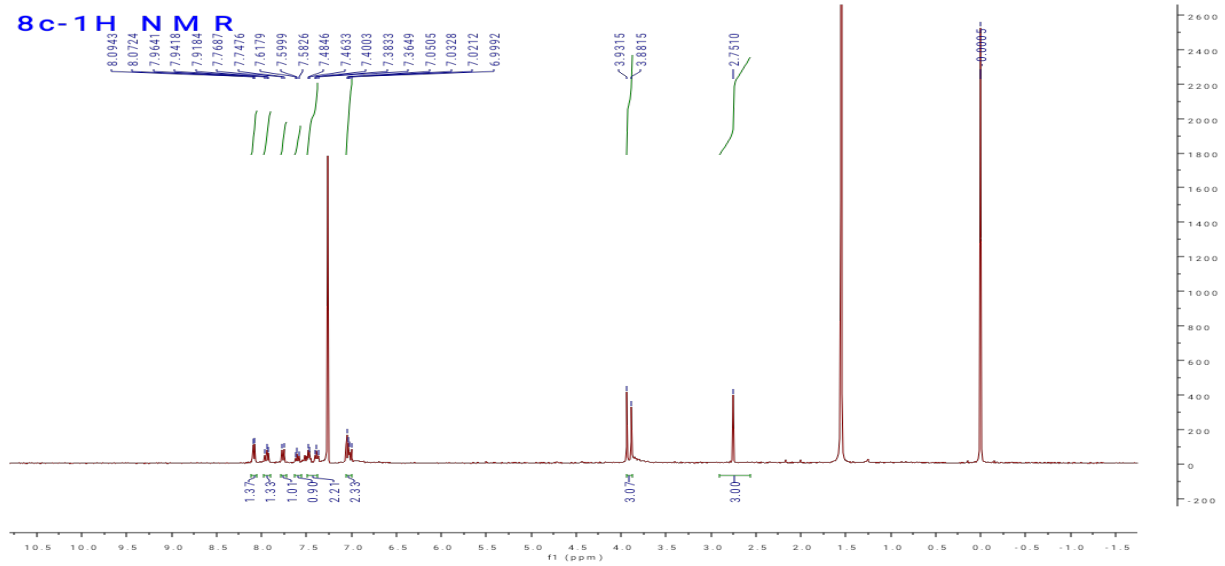

Figure S18. ^{1}H NMR of compound 8c

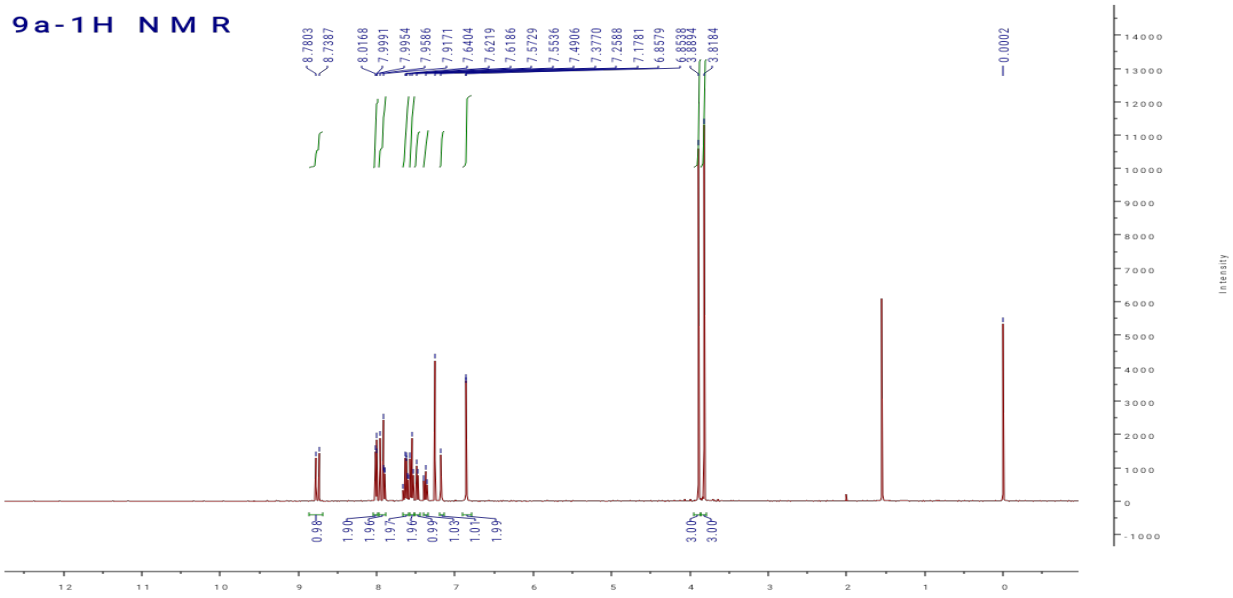

Figure S19. ^{1}H NMR of compound 9a

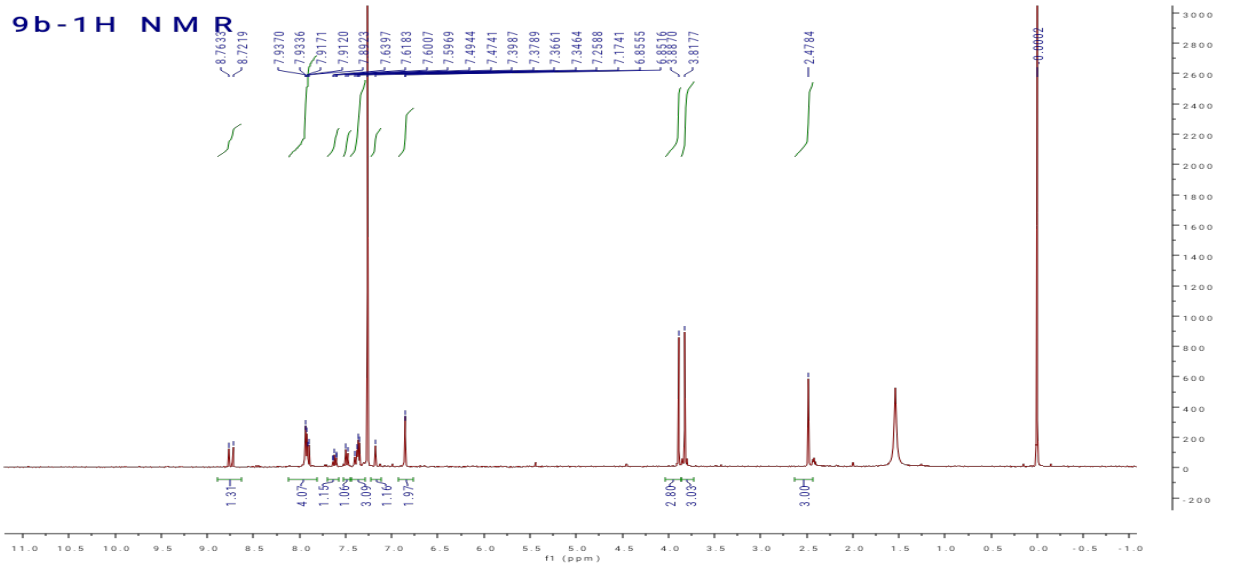

Figure S20. ^{1}H NMR of compound 9b

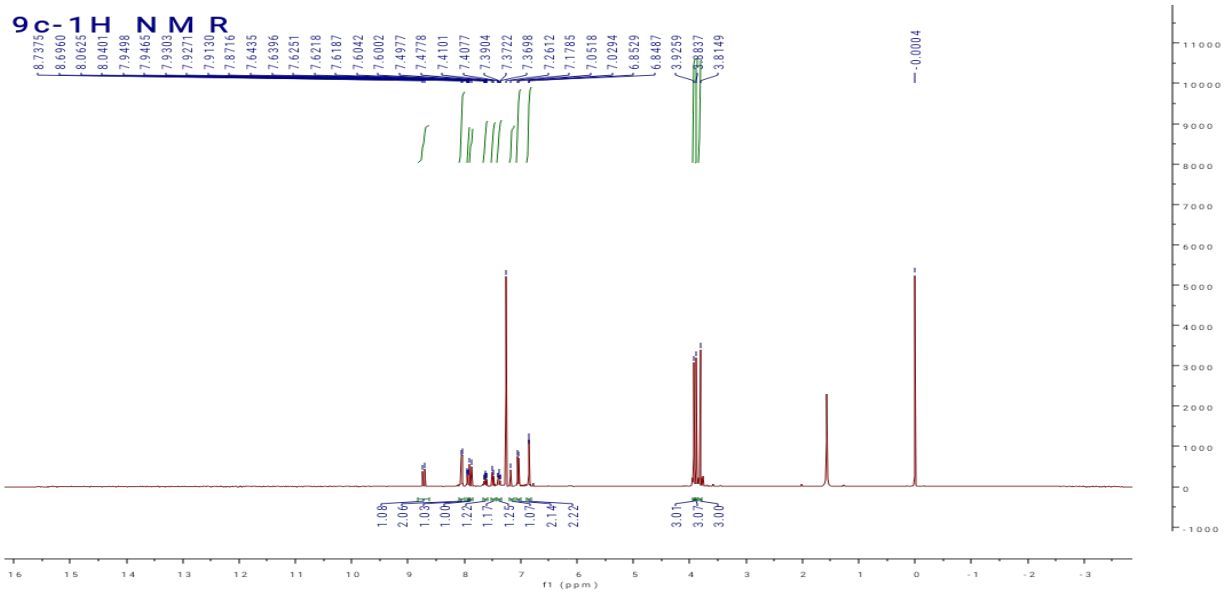

Figure S21. ^{1}H NMR of compound 9c

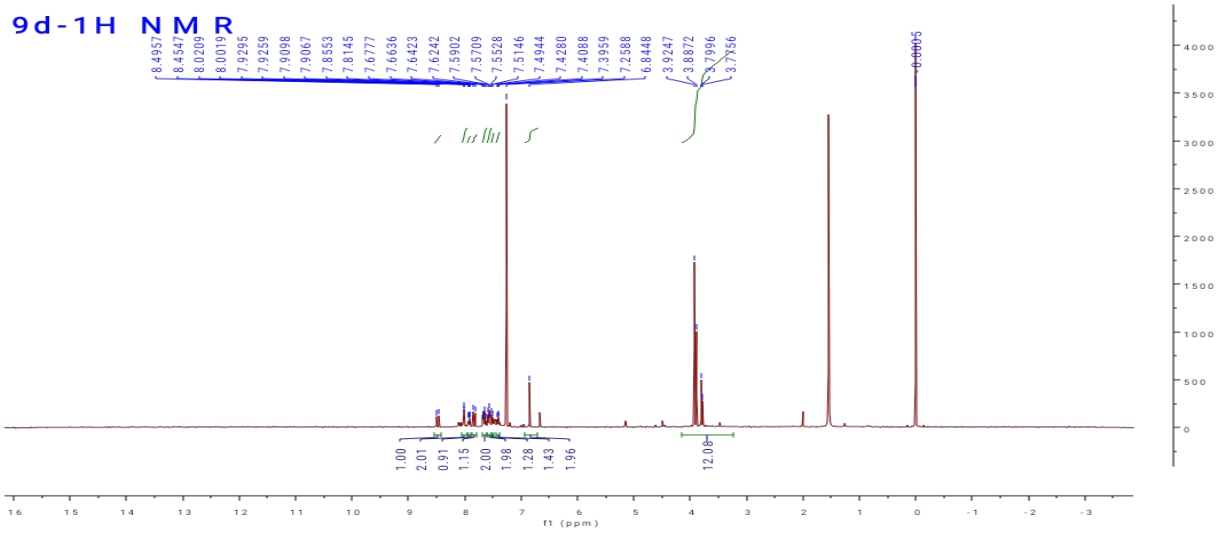

Figure S22. ^{1}H NMR of compound 9d

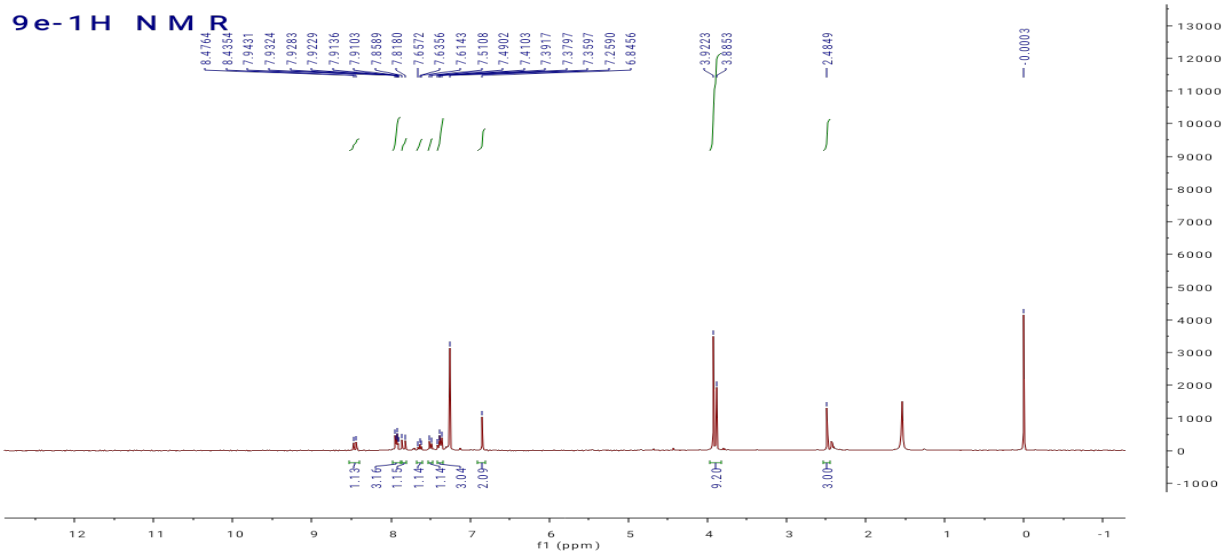

Figure S23. ^{1}H NMR of compound 9e

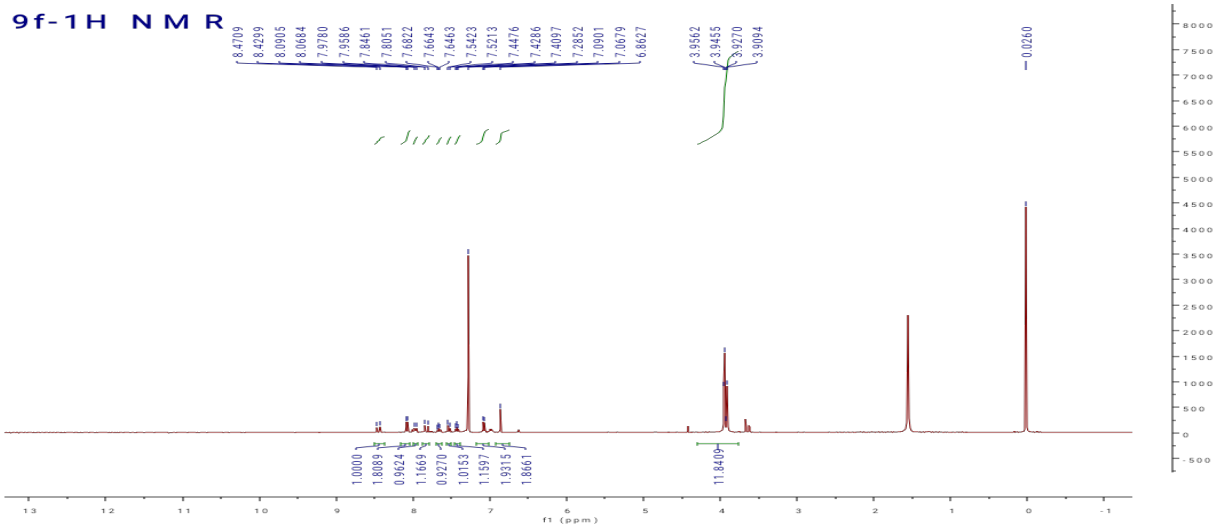

Figure S24. ^{1}H NMR of compound 9f

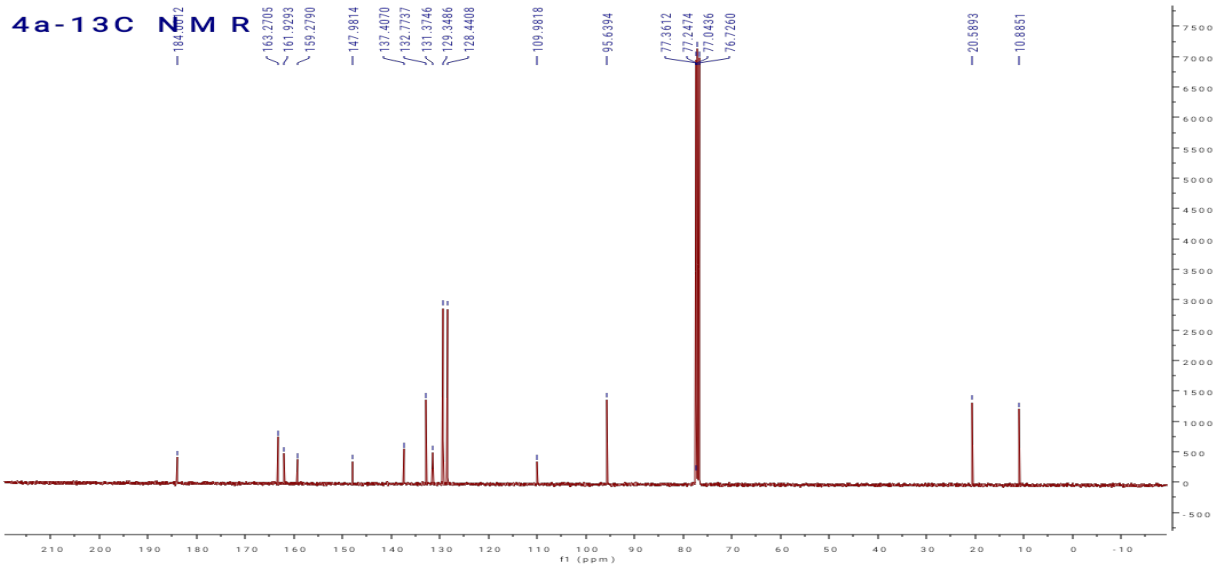

Figure S 25. ^{13}C NMR of compound 4a

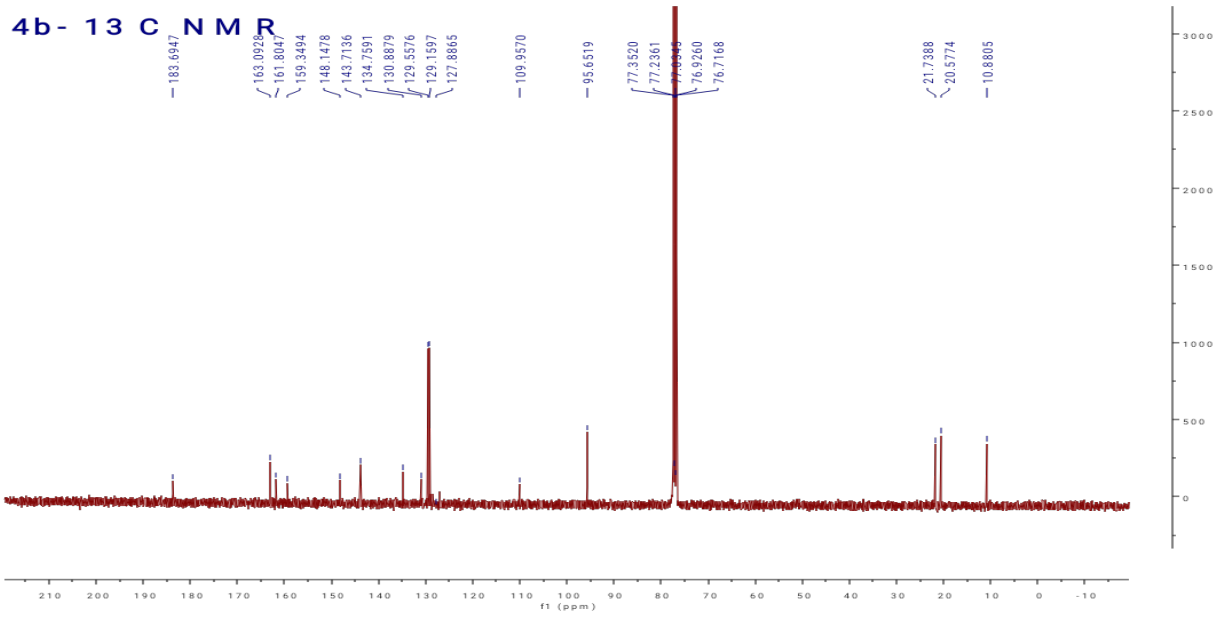

Figure S 26. ^{13}C NMR of compound 4b

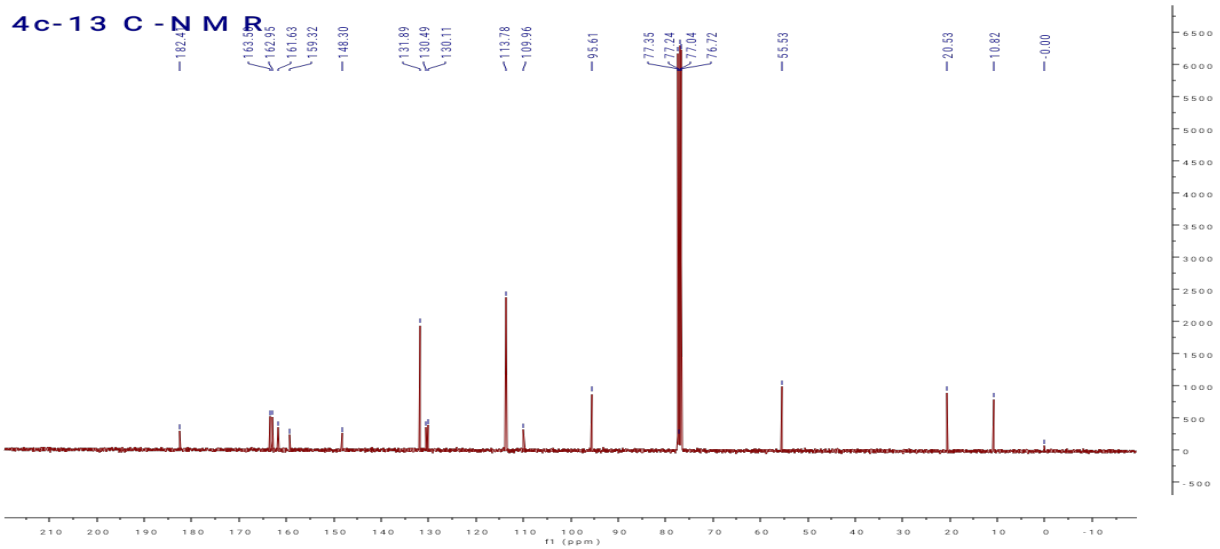

Figure S 27. ^{13}C NMR of compound 4c

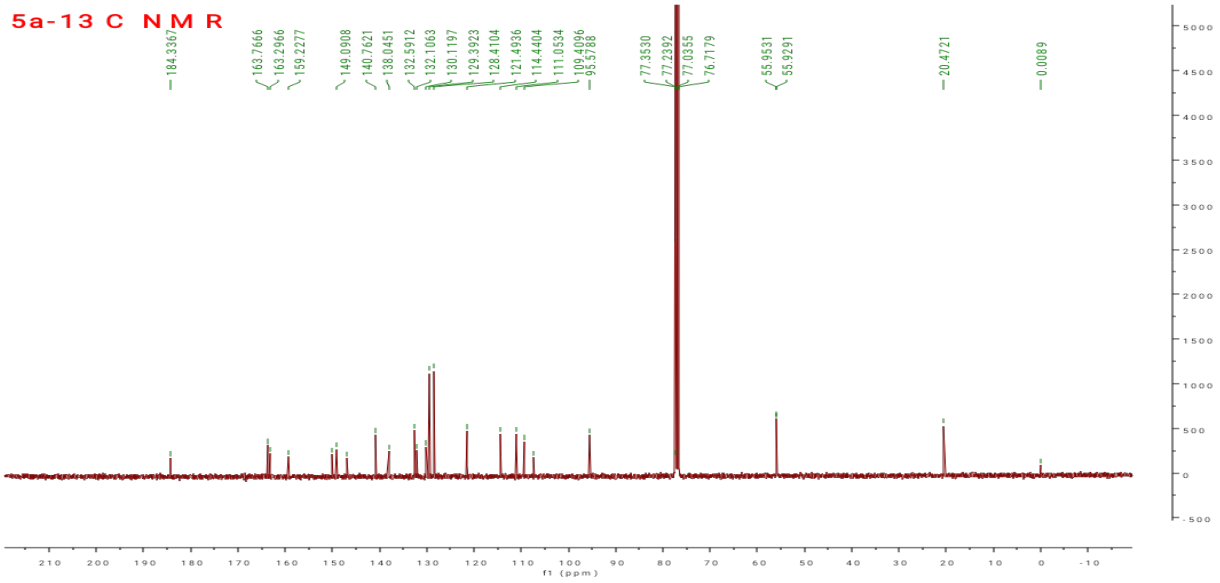

Figure S 28. ^{13}C NMR of compound 5a

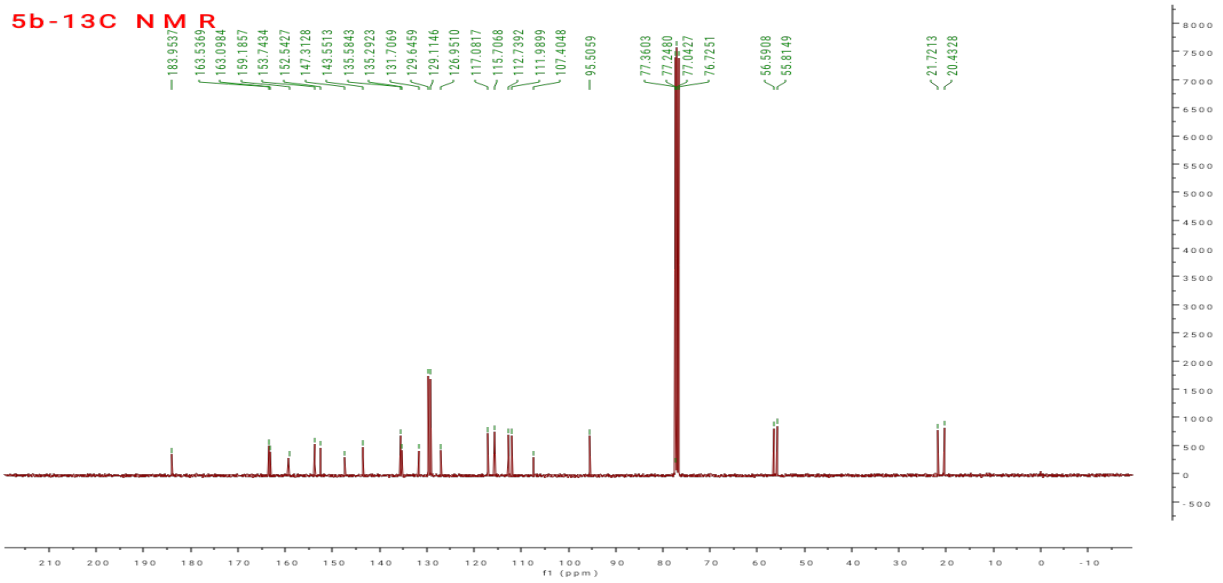

Figure S 29. ^{13}C NMR of compound 5b

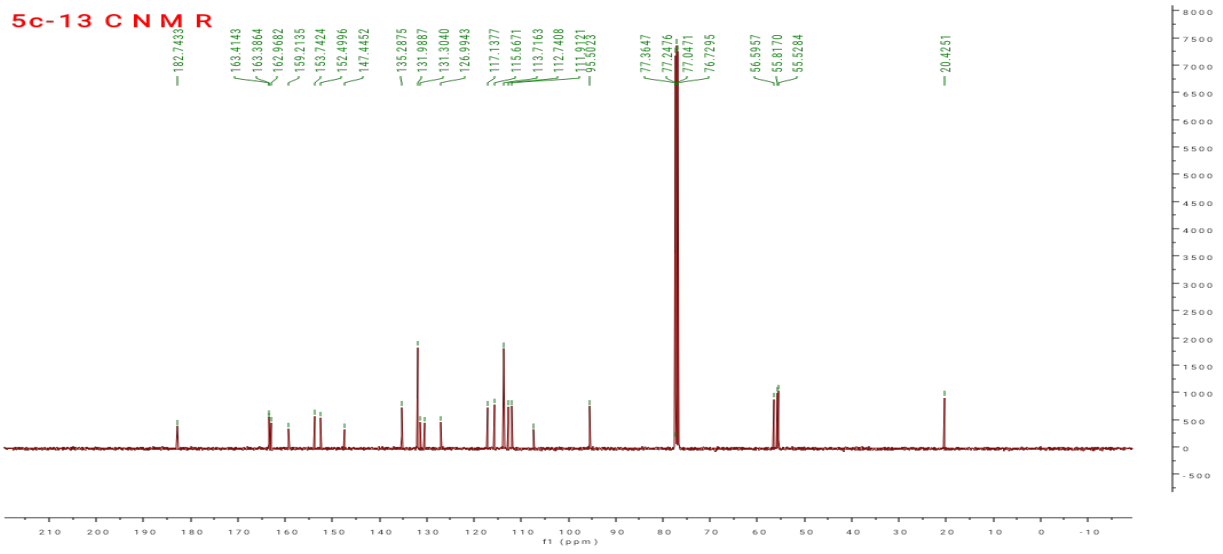

Figure S 30. ^{13}C NMR of compound 5c

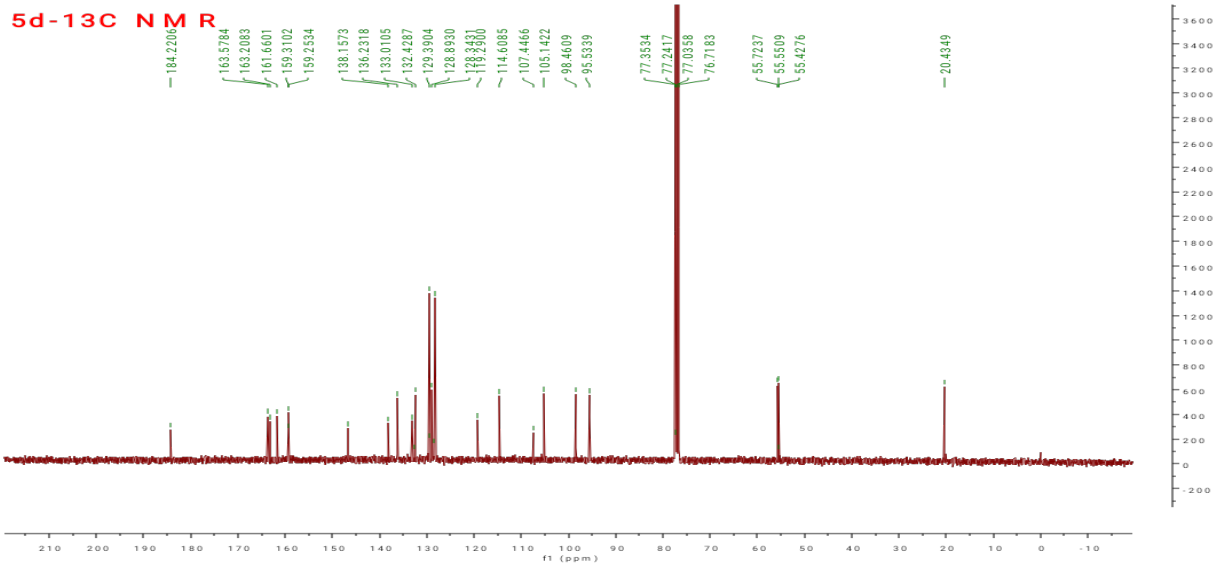

Figure S 31. ^{13}C NMR of compound 5d

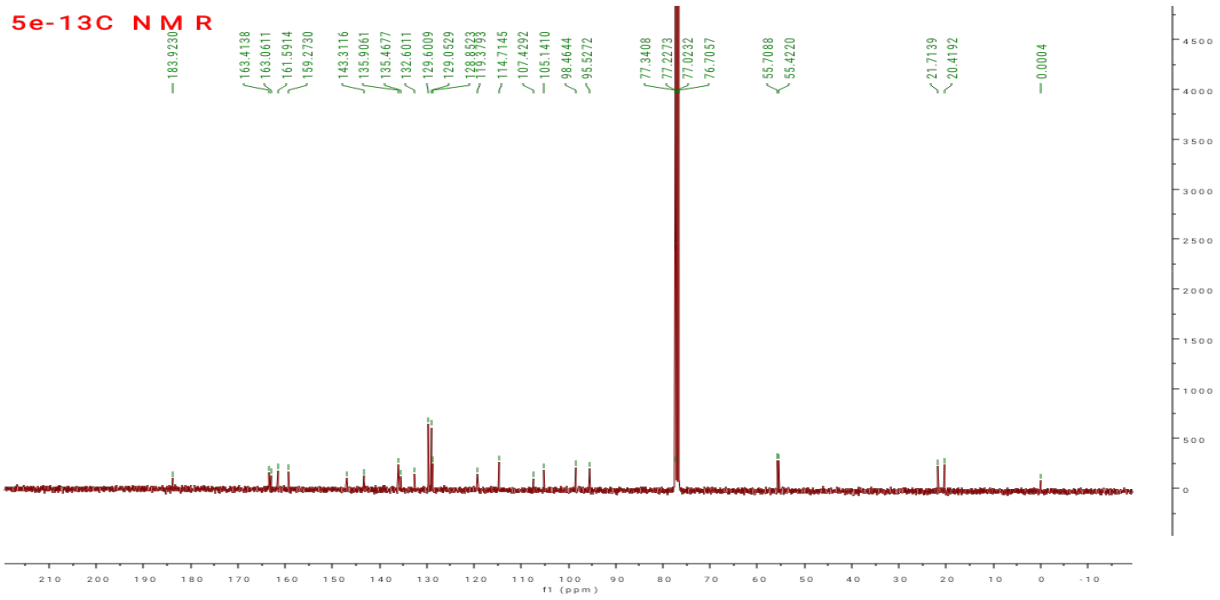

Figure S 32. ^{13}C NMR of compound 5e

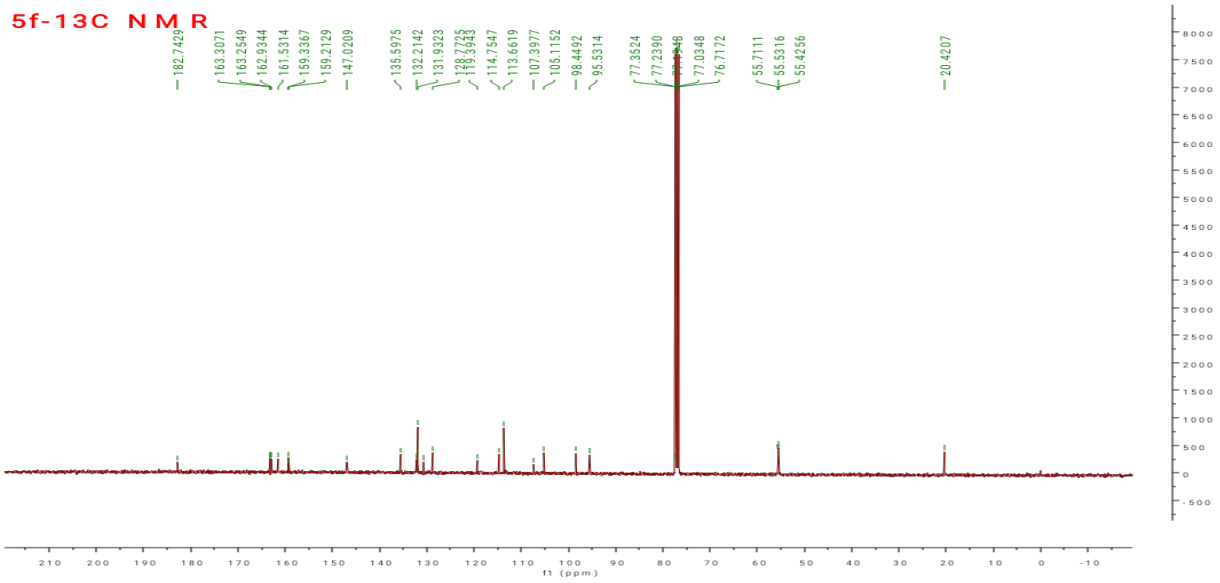

Figure S 33. ^{13}C NMR of compound 5f

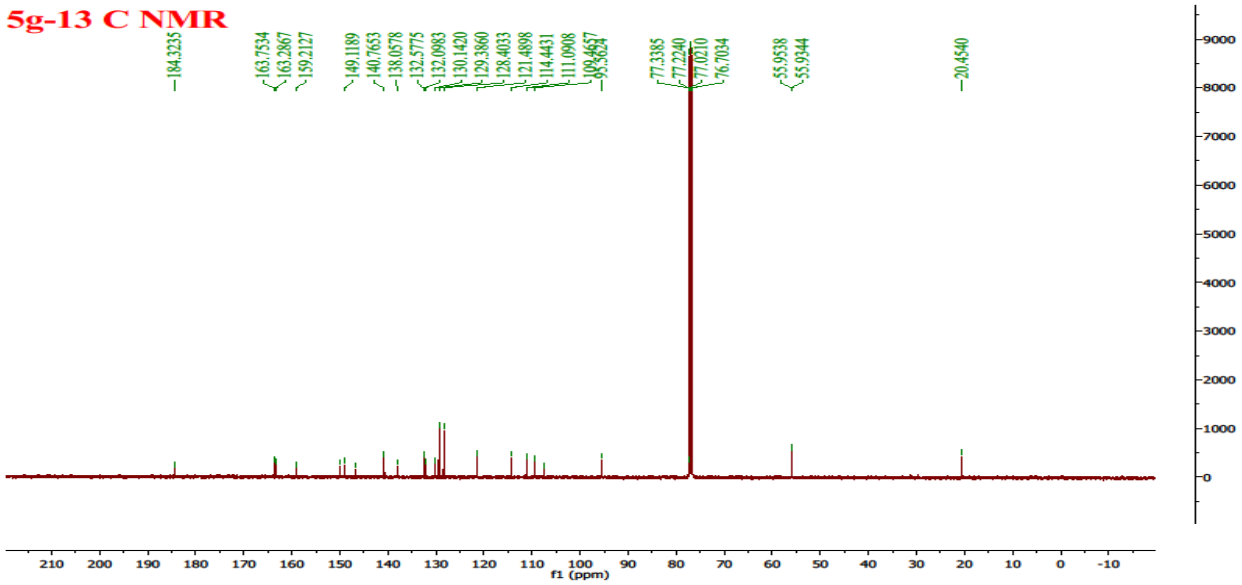

Figure S 34. ^{13}C NMR of compound 5g

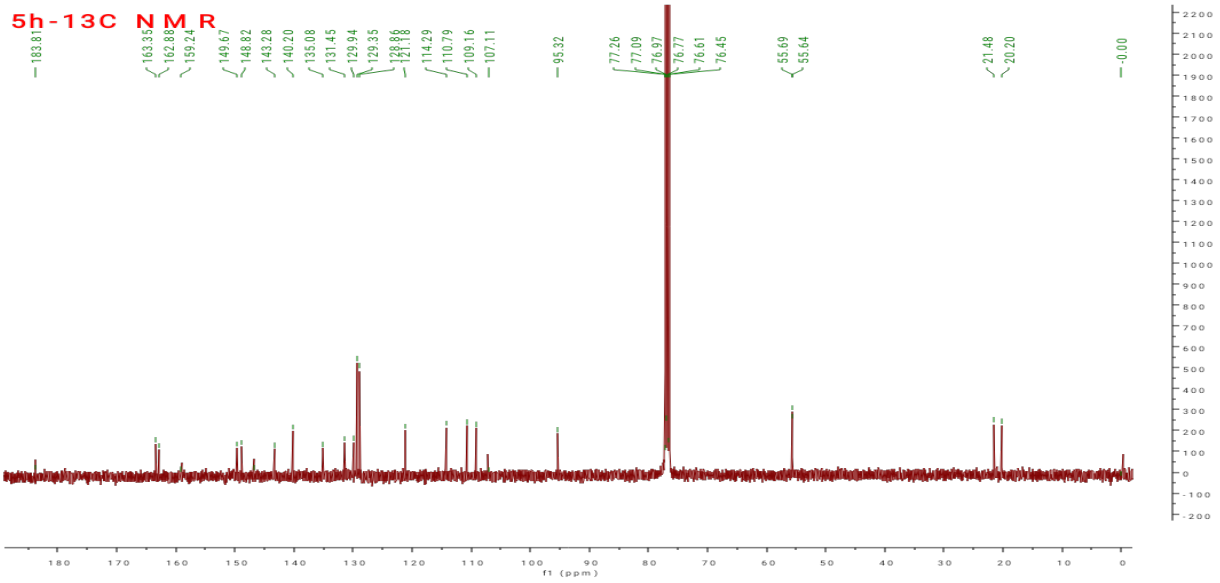

Figure S 35. ^{13}C NMR of compound 5h

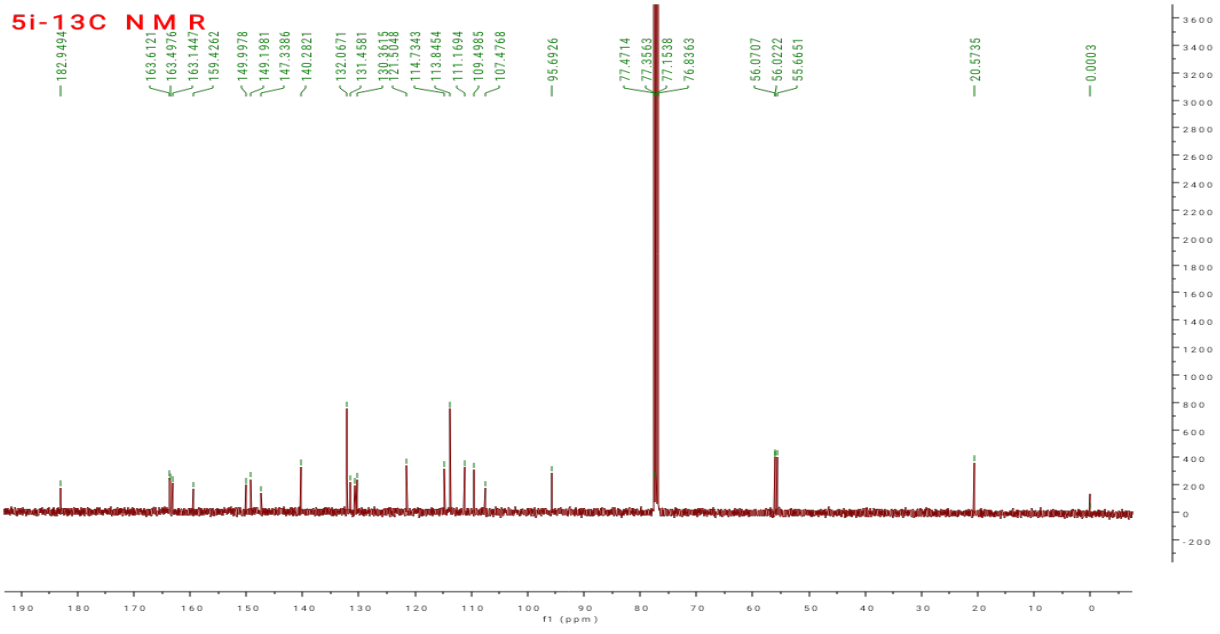

Figure S 36. ^{13}C NMR of compound 5i

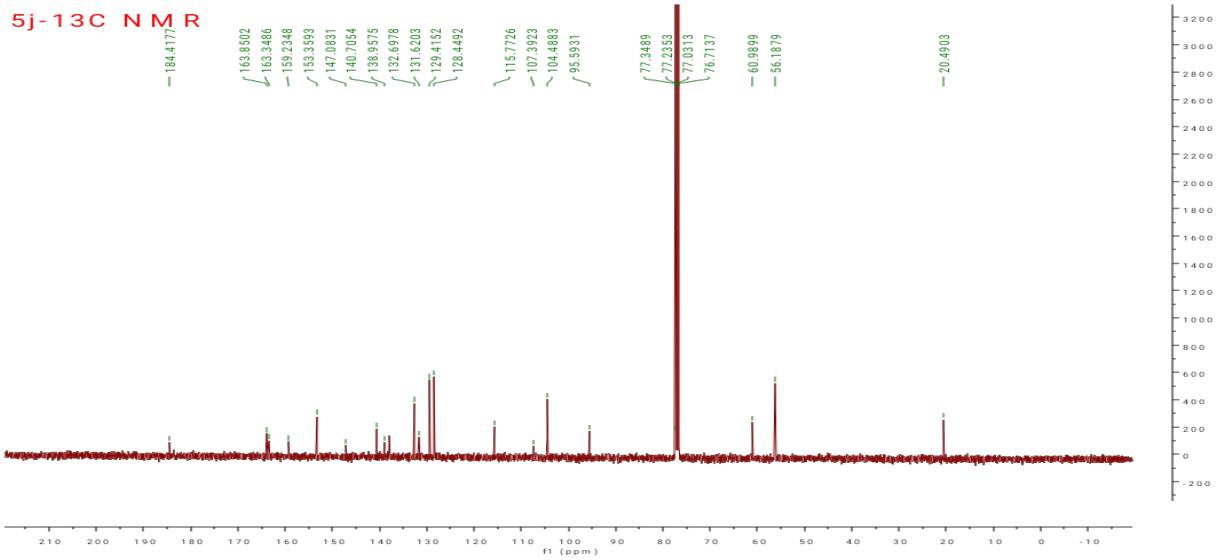

Figure S 37. ^{13}C NMR of compound 5j

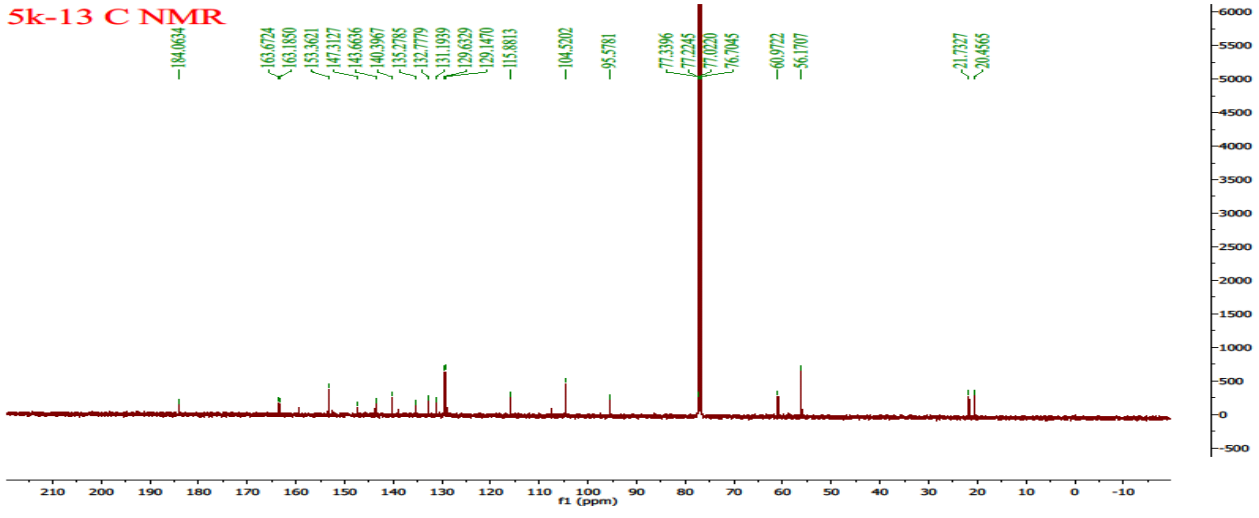

Figure S 38. ^{13}C NMR of compound 5k

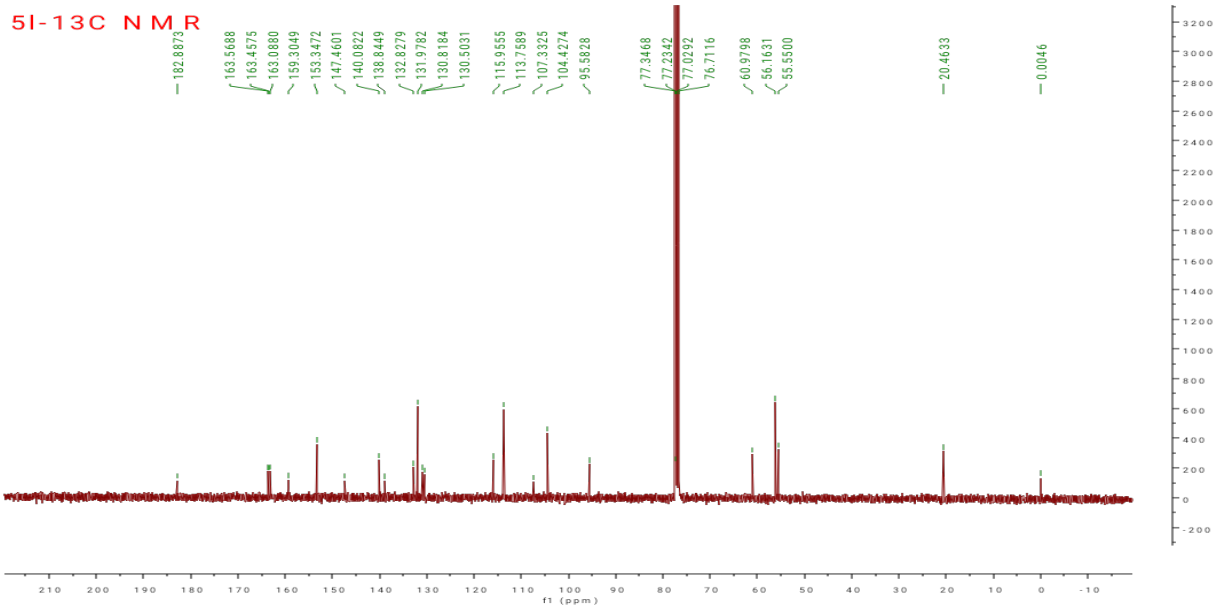

Figure S 39. ^{13}C NMR of compound 5l

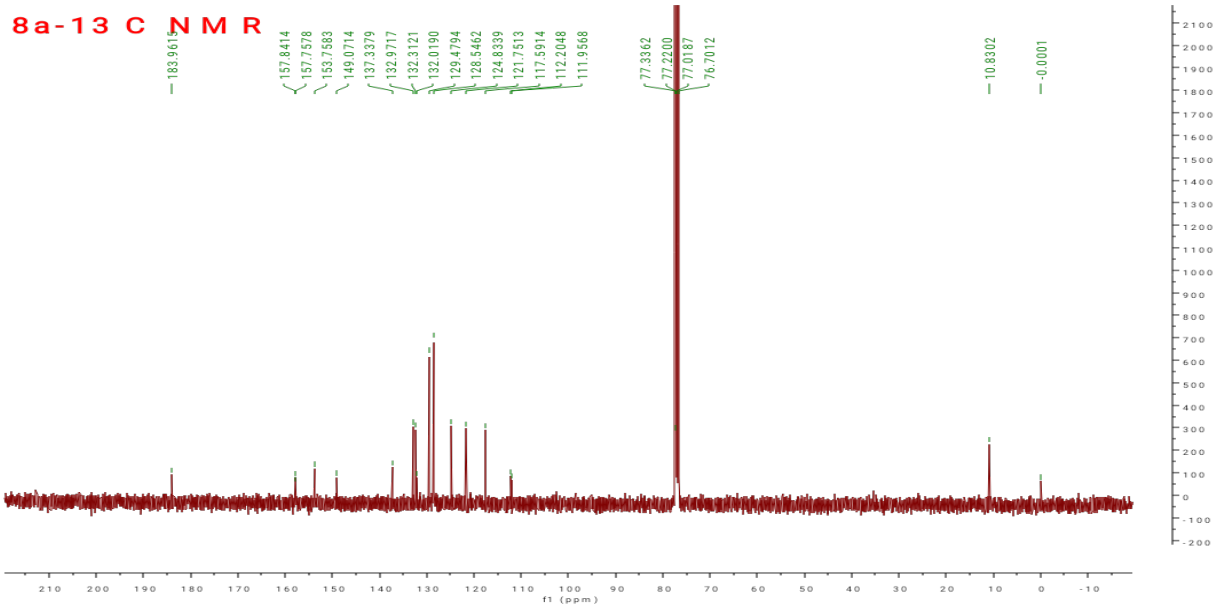

Figure S 40. ^{13}C NMR of compound 8a

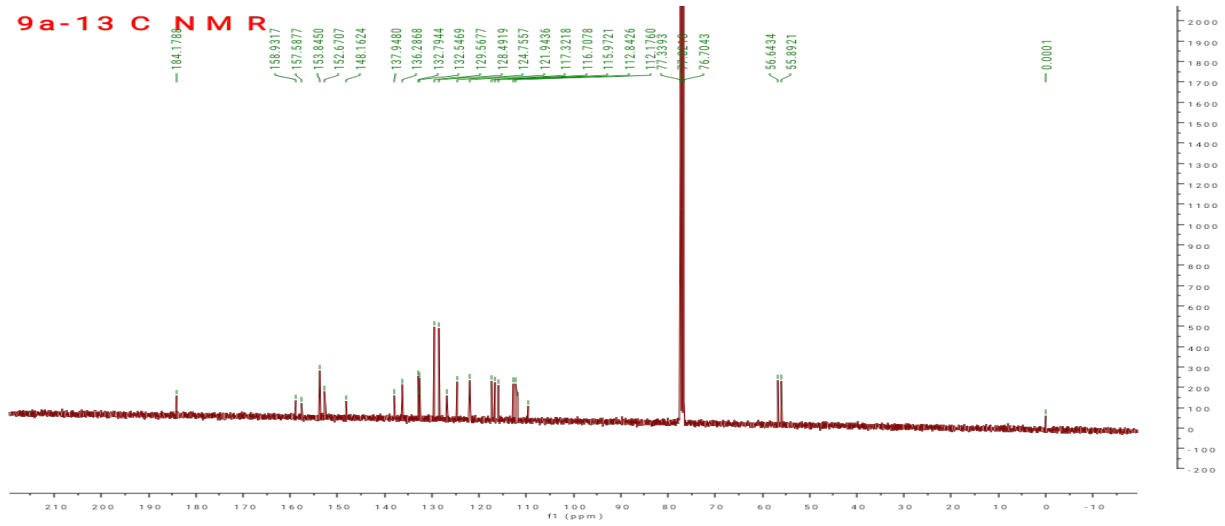

Figure S 41. ^{13}C NMR of compound 9a

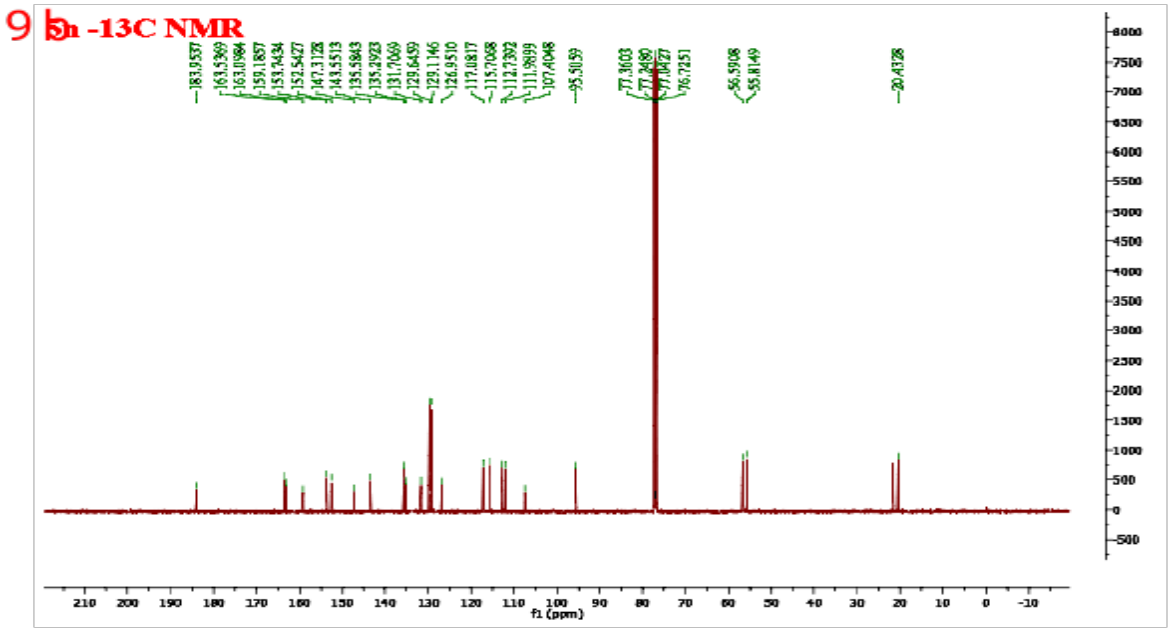

Figure S 42. ^{13}C NMR of compound 9b

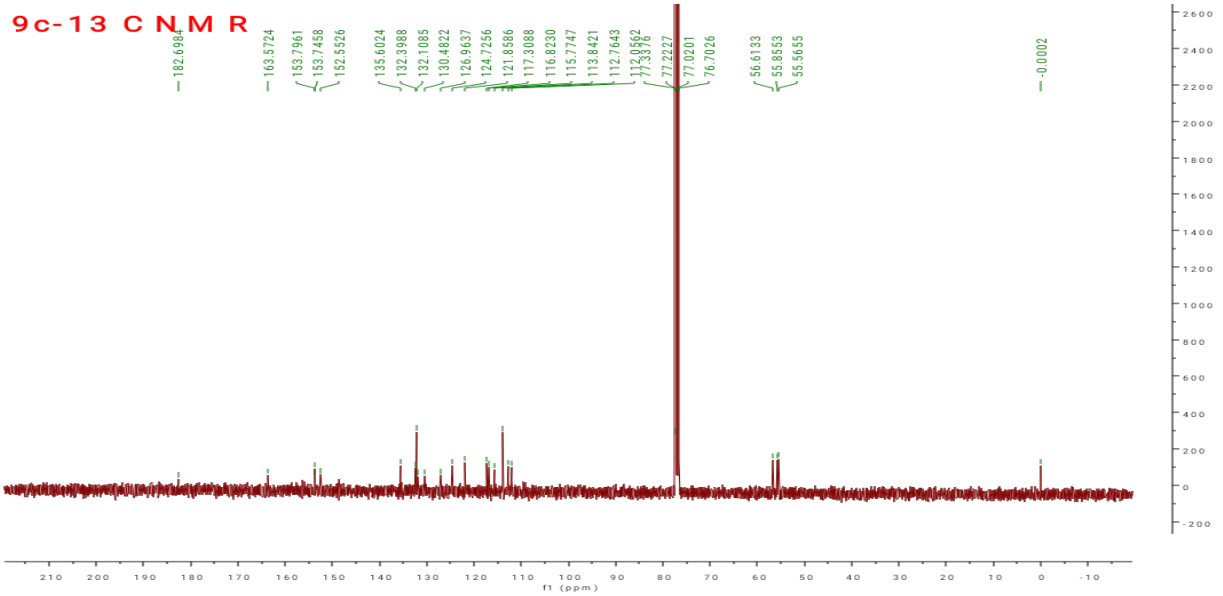

Figure S 43. ^{13}C NMR of compound 9c

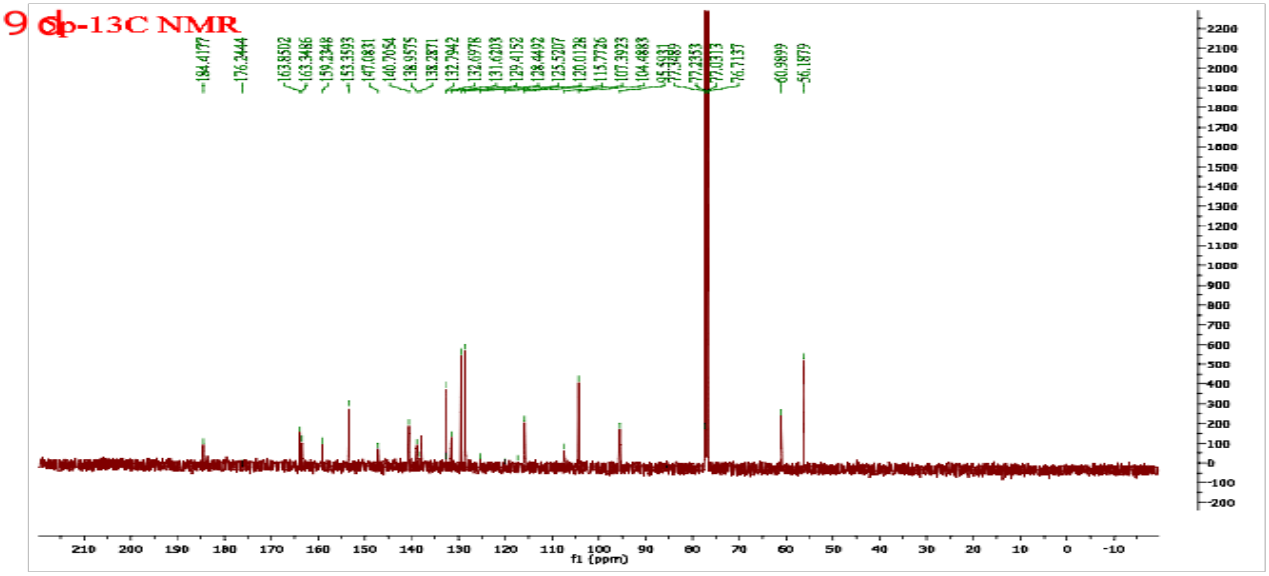

Figure S 44. ^{13}C NMR of compound 9d

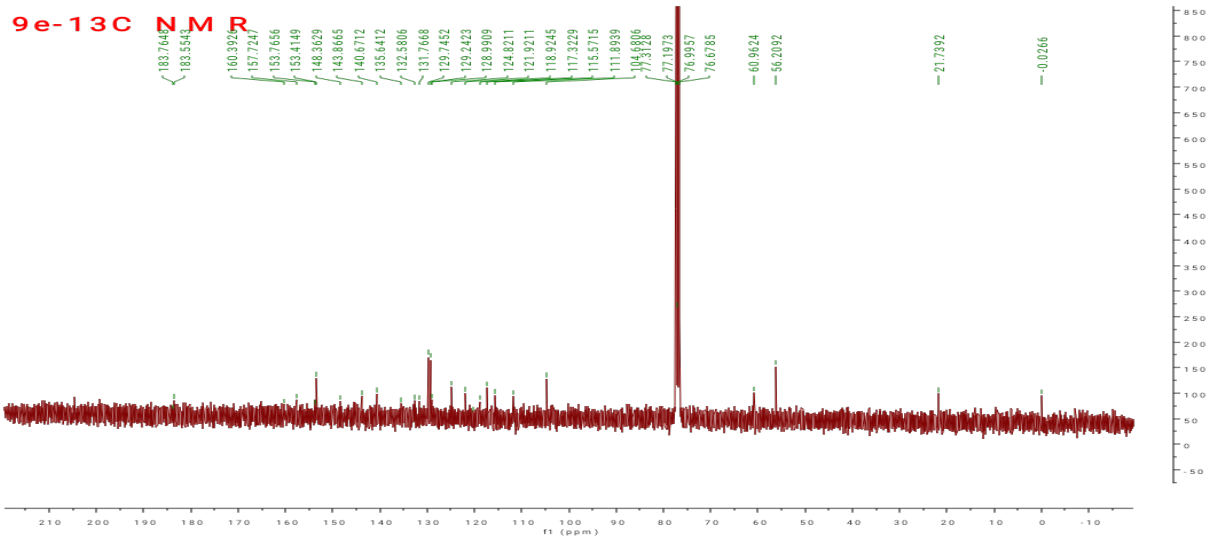

Figure S 45. ^{13}C NMR of compound 9c

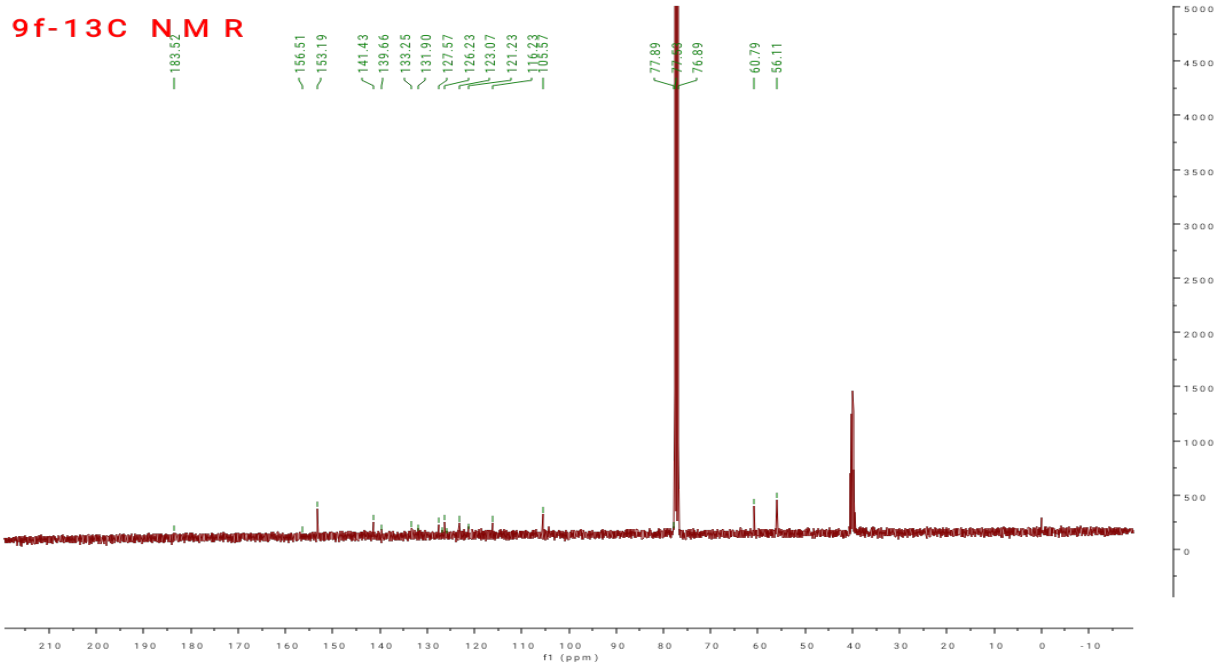

Figure S 46. ^{13}C NMR of compound 9f

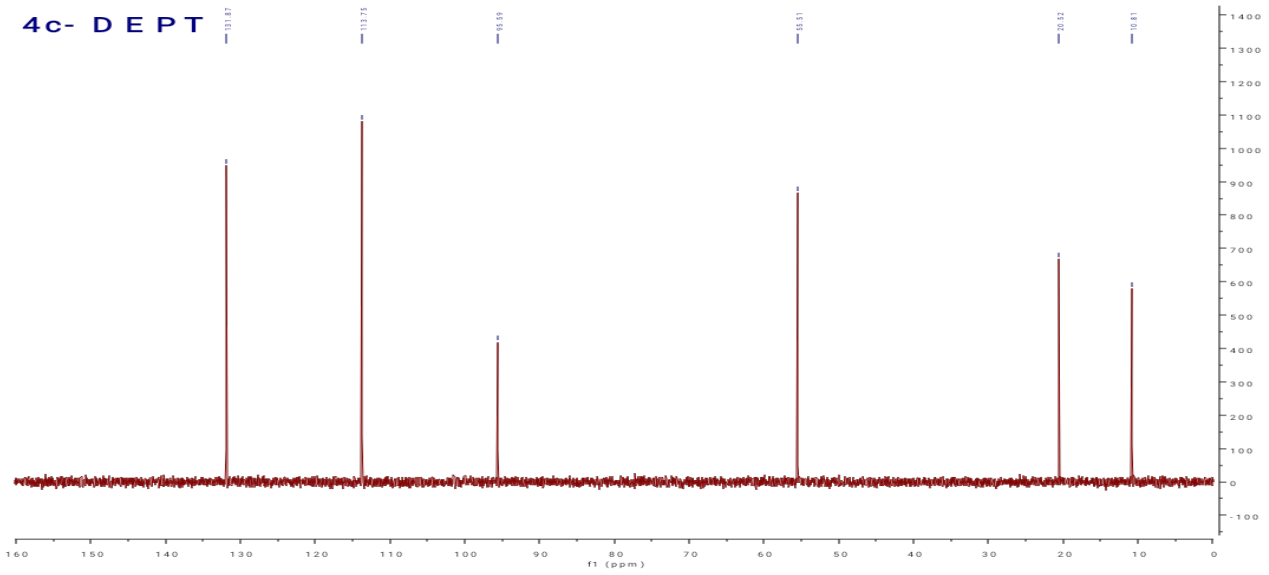

Figure S 47.DEPT of compound 4c

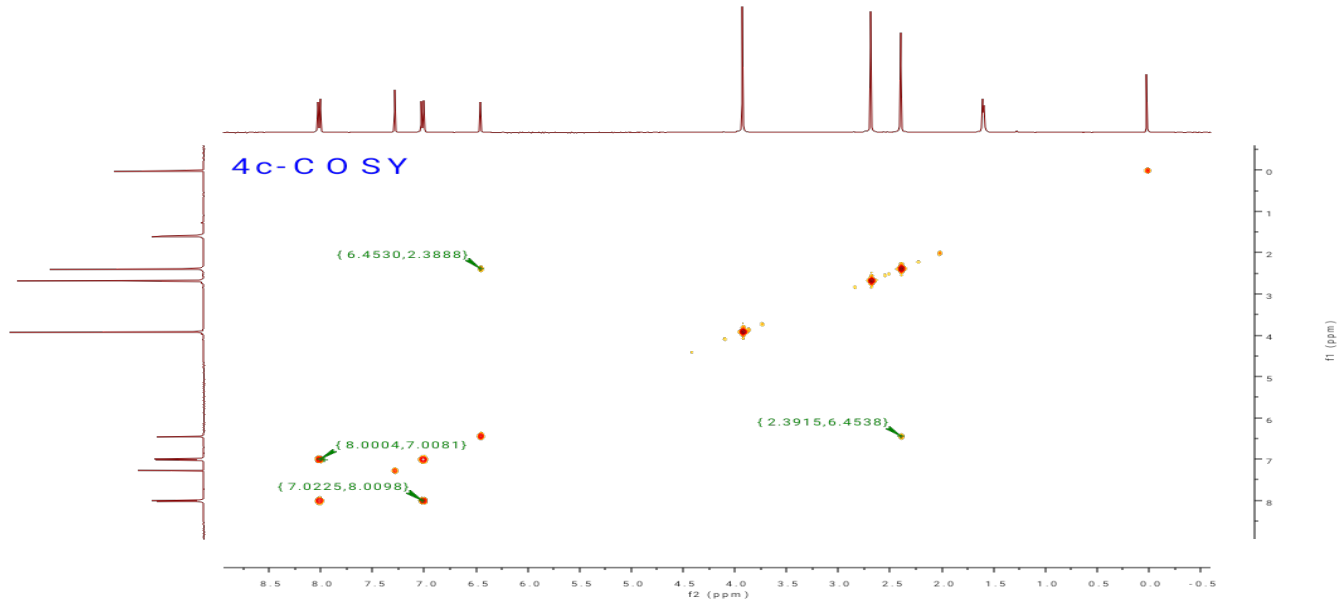

Figure S 48.2D NMR (COSY) of compound 4c

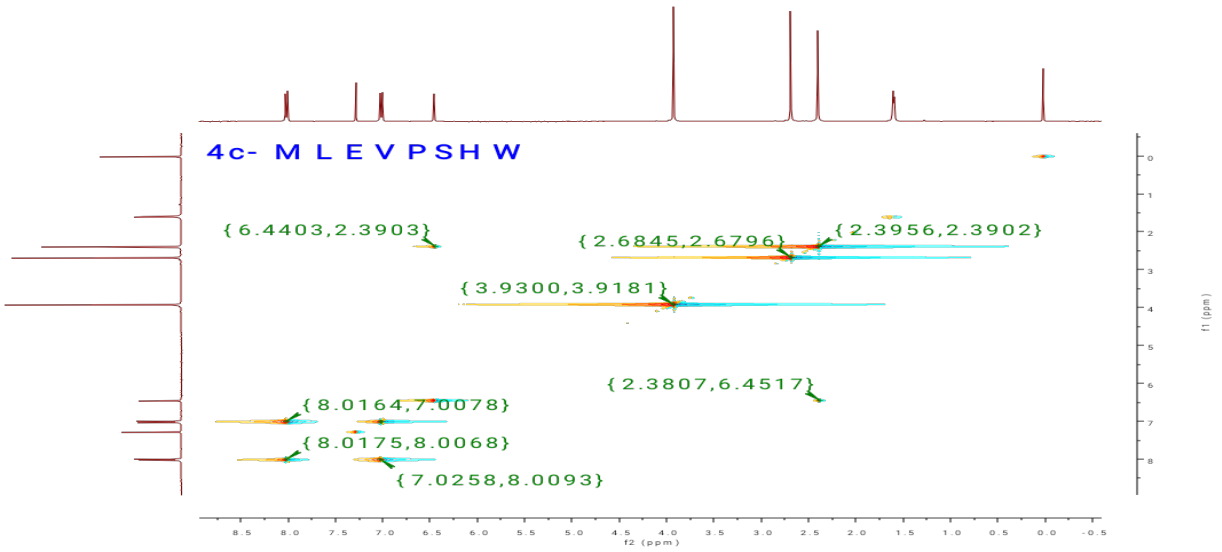

Figure S 49.2D NMR (MLEPSHW) of compound 4c

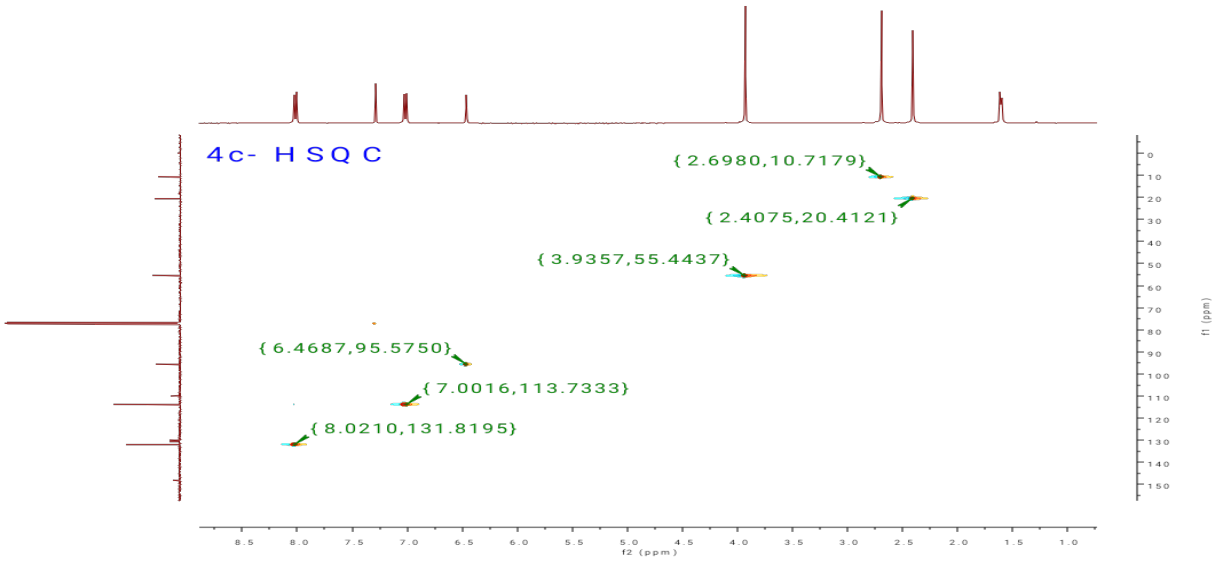

Figure S 50.2D NMR (HSQC) of compound 4c

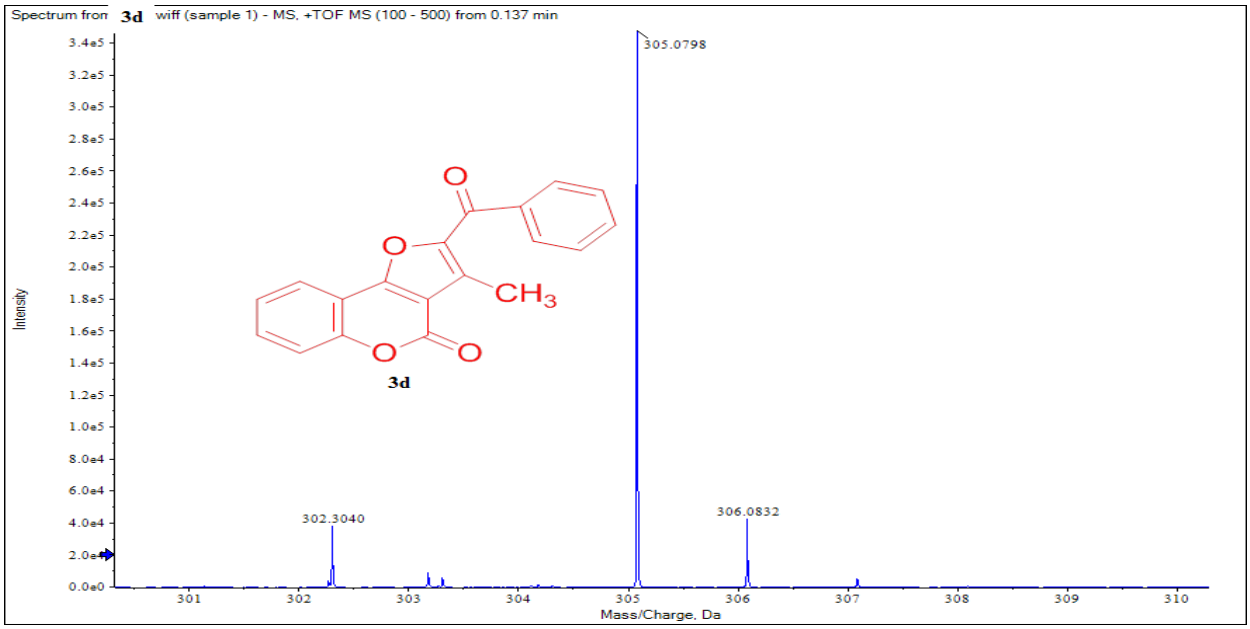

Figure S 51.HRMS of compound 8a

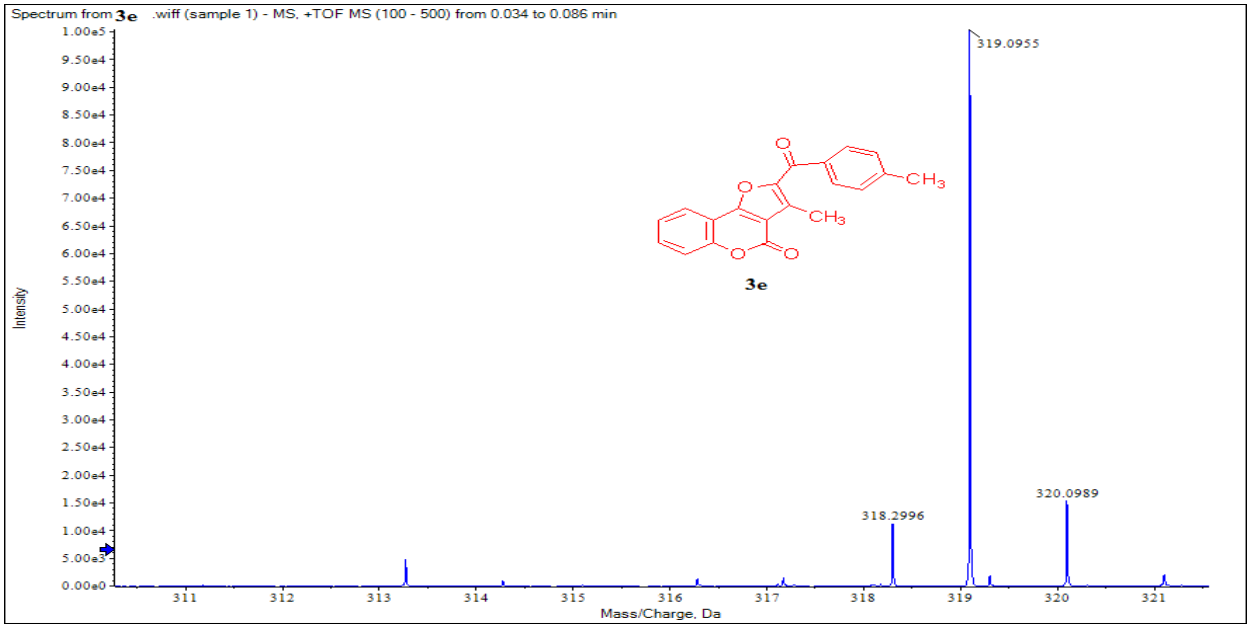

Figure S 52.HRMS of compound 8b

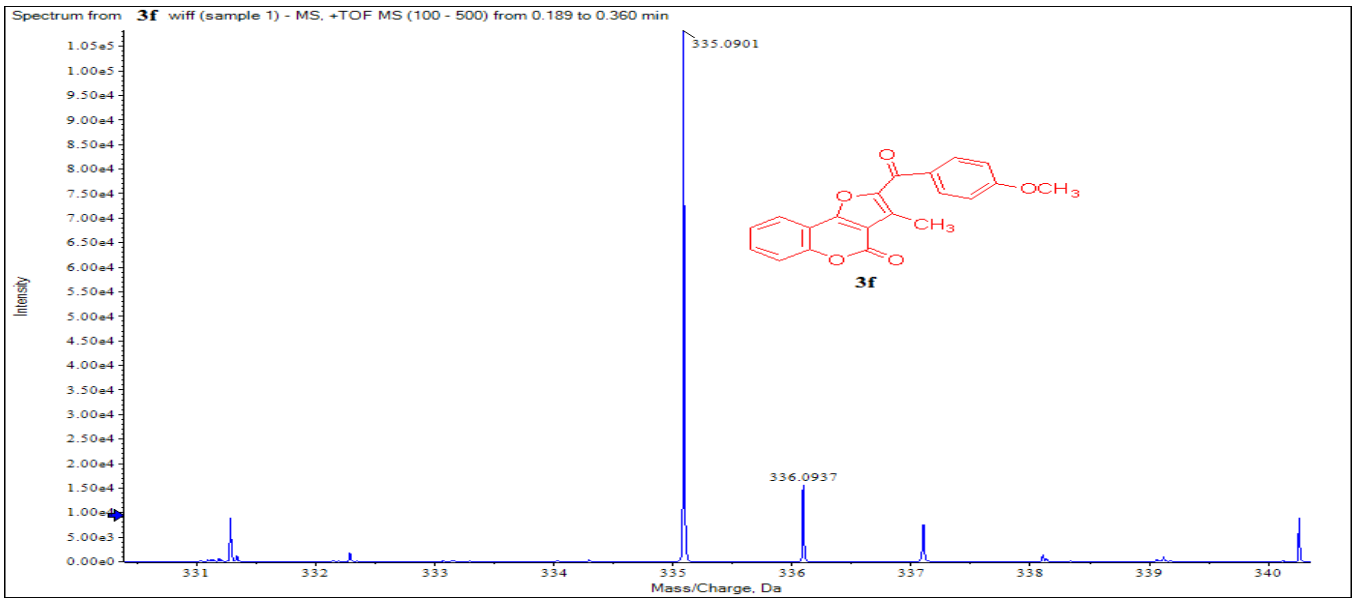

Figure S 53.HRMS of compound 8c

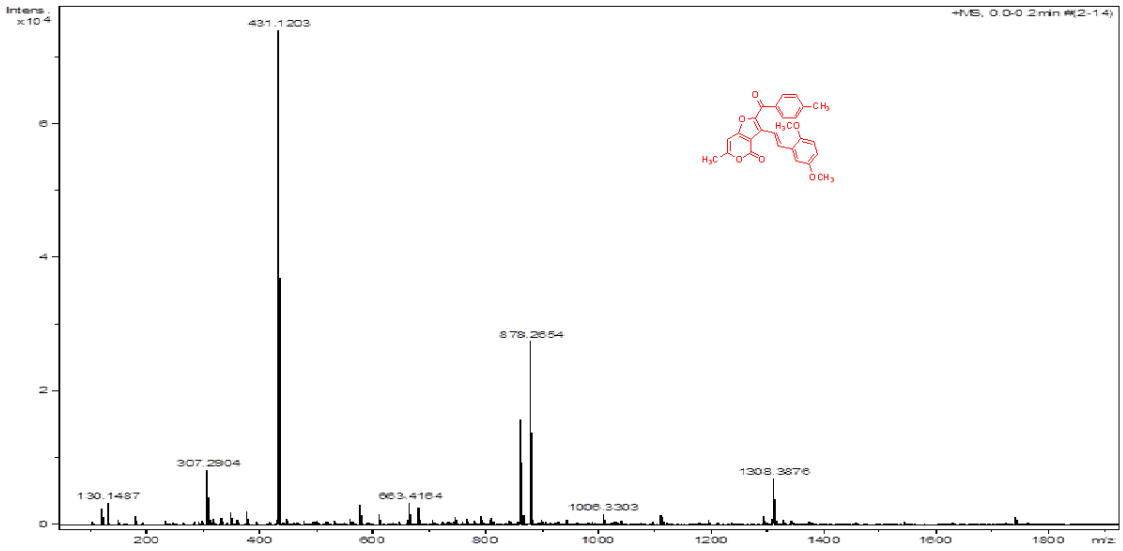

Figure S 54.HRMS of compound 5a

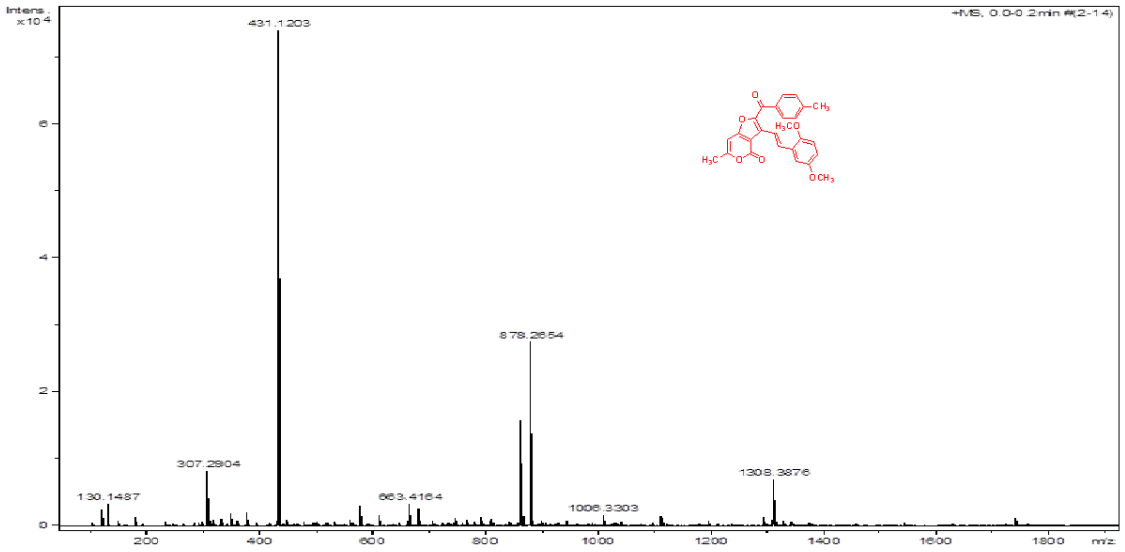

Figure S 55.HRMS of compound 5b

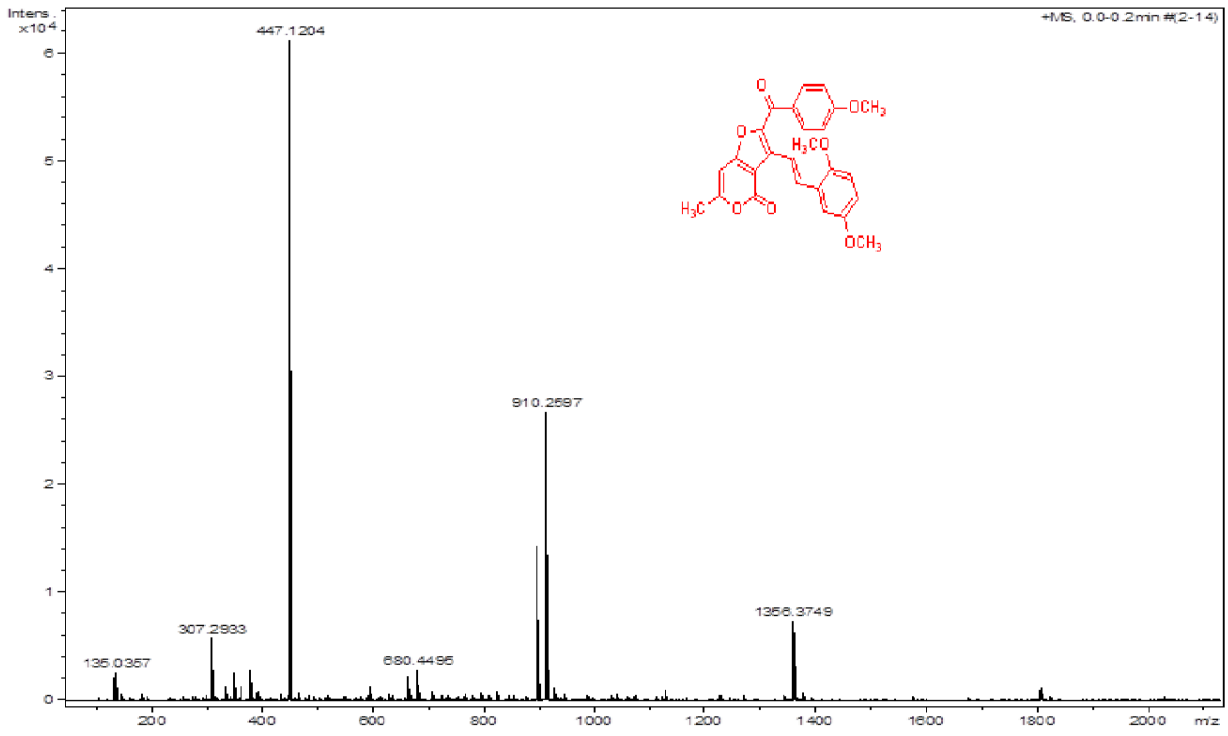

Figure S 56.HRMS of compound 5c

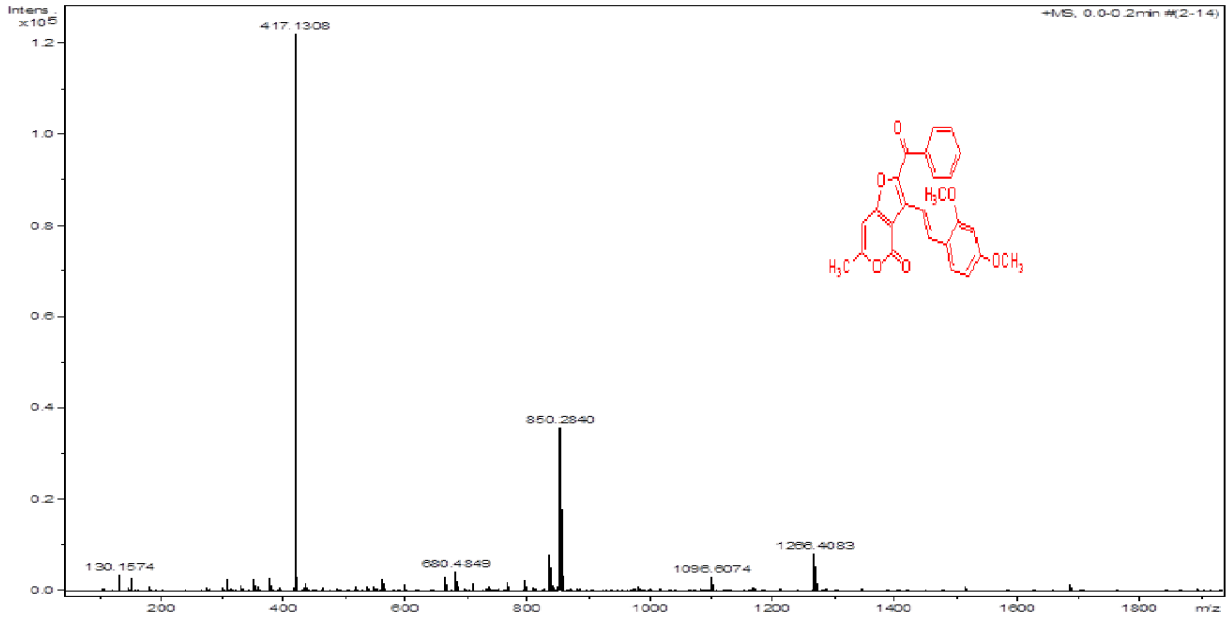

Figure S 57.HRMS of compound 5d

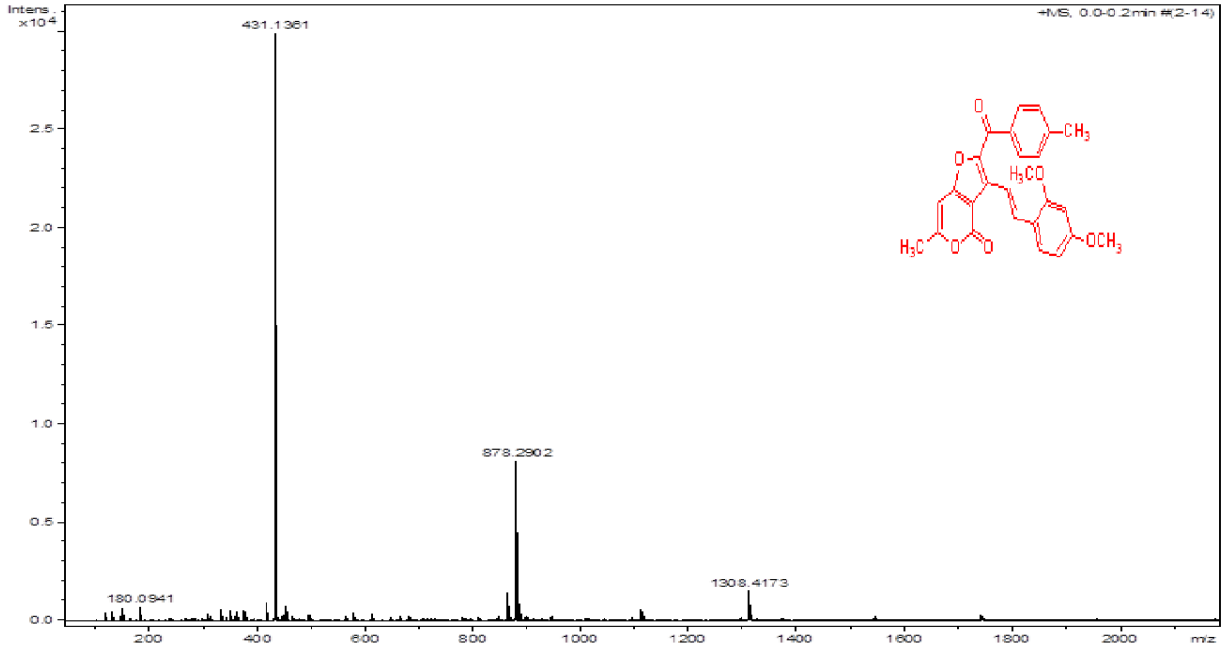

Figure S 58.HRMS of compound 5e

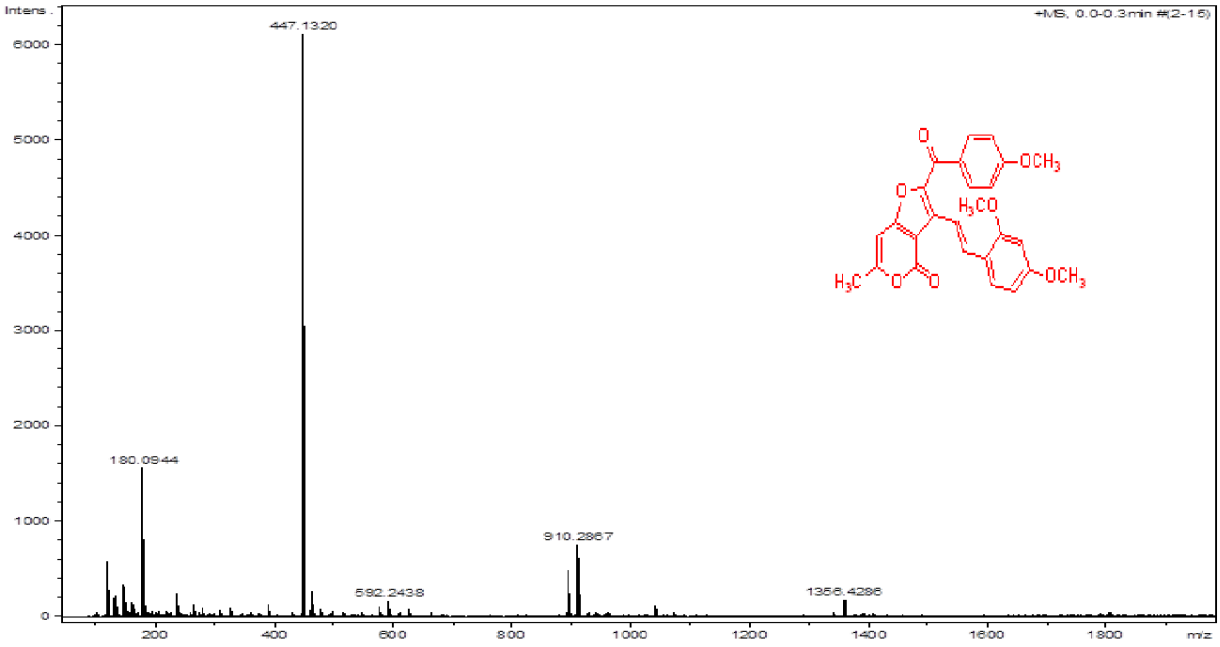

Figure S 59.HRMS of compound 5f

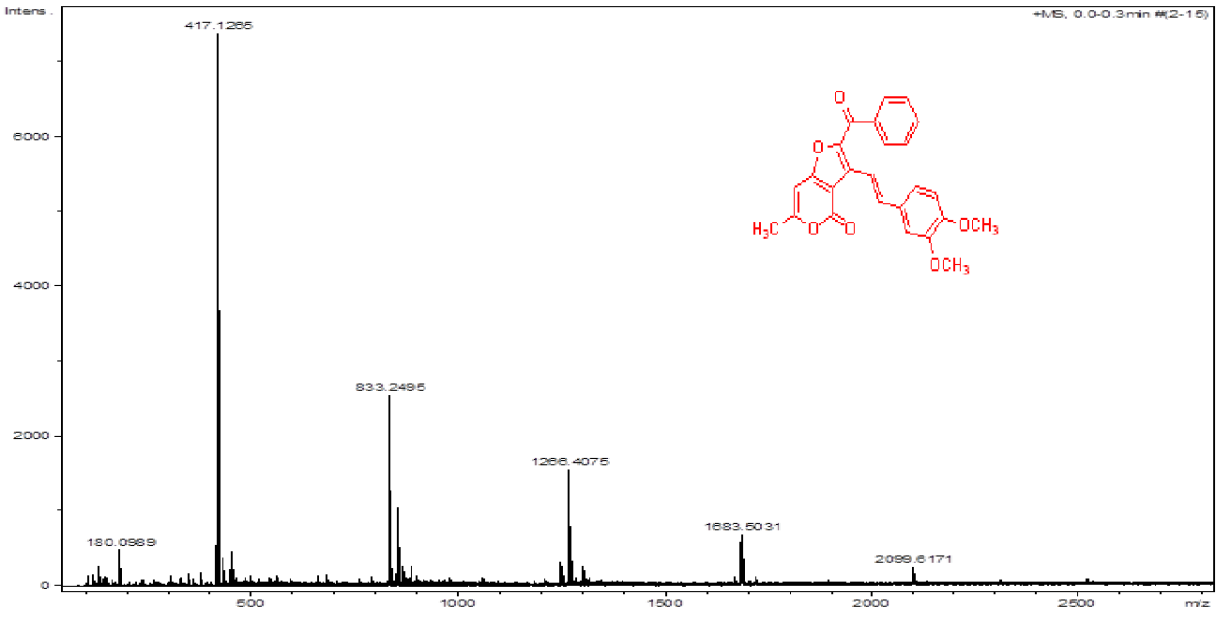

Figure S 60.HRMS of compound 5g

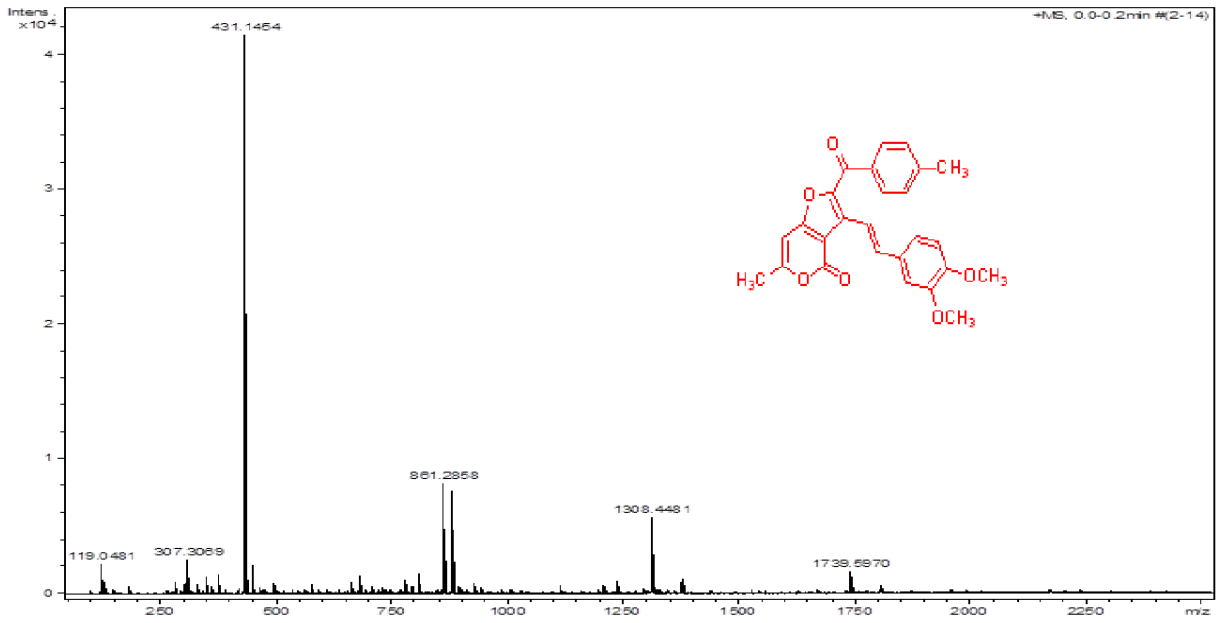

Figure S 61.HRMS of compound 5h

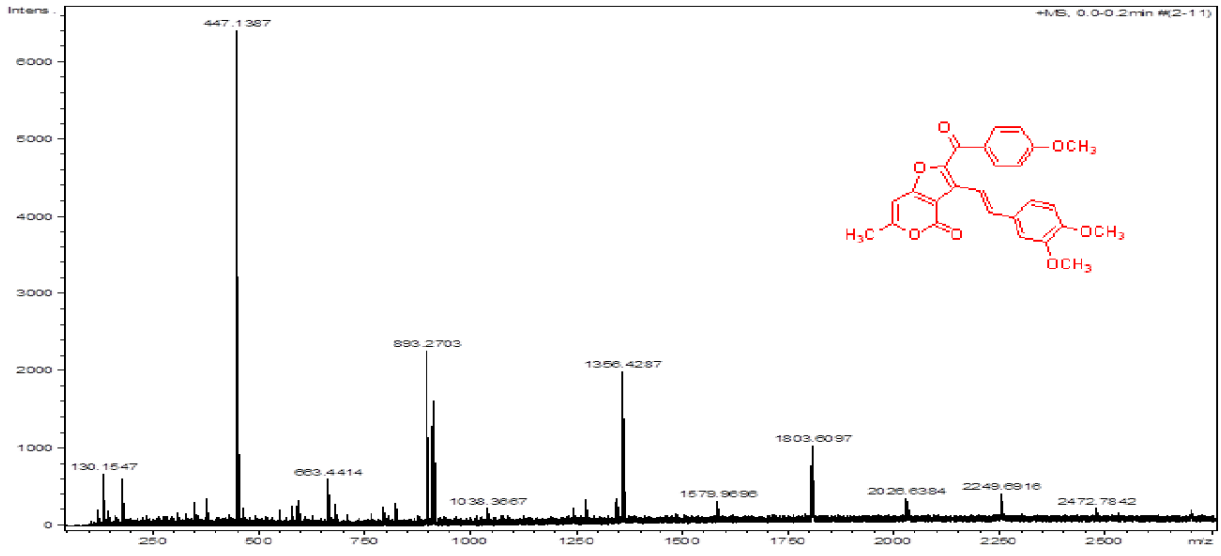

Figure S 62.HRMS of compound 5i

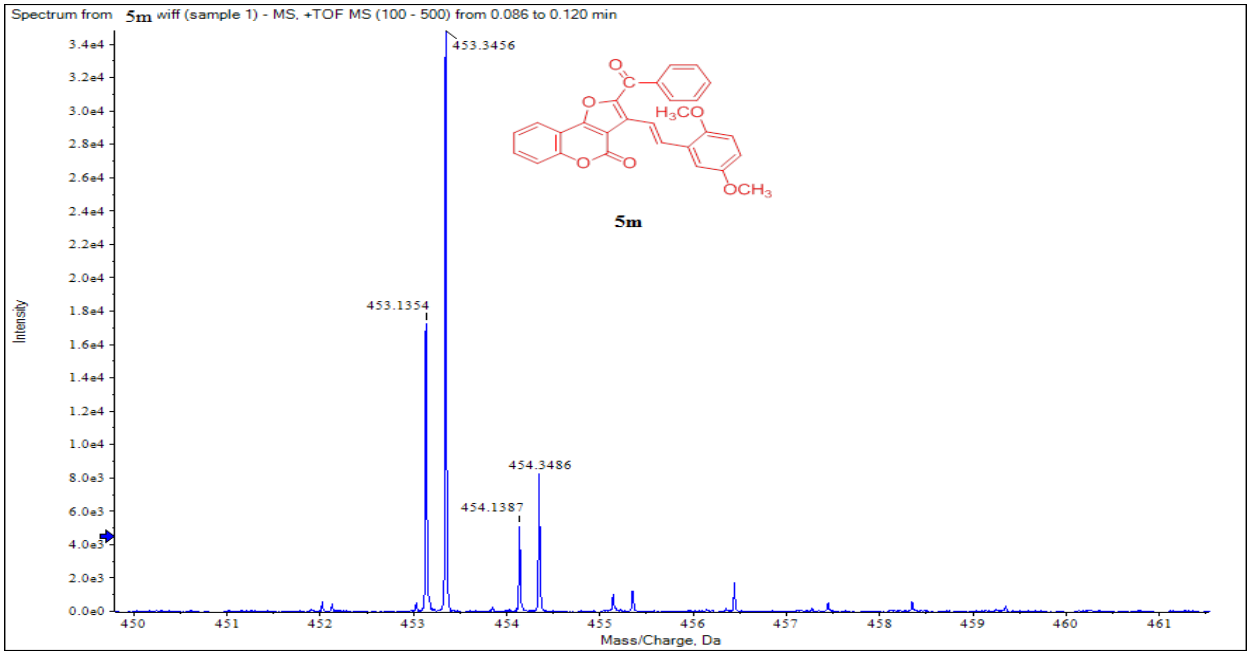

Figure S 63.HRMS of compound 9a

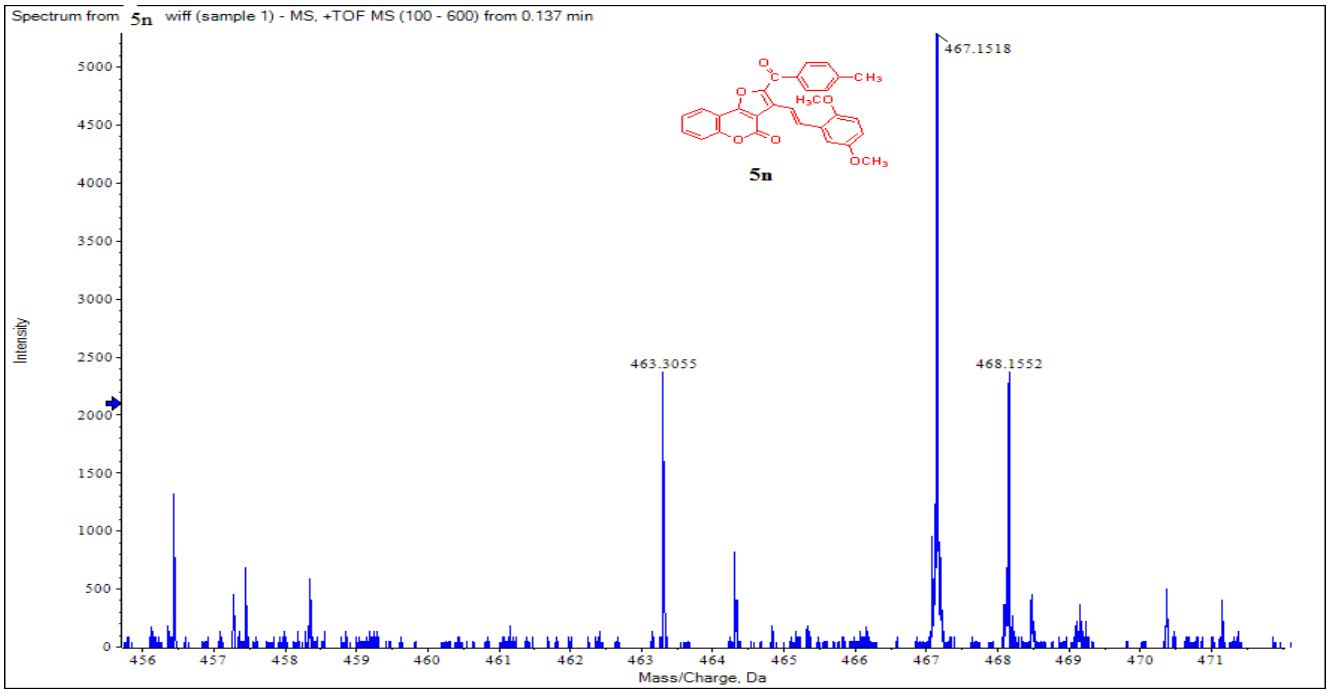

Figure S 64.HRMS of compound 9b

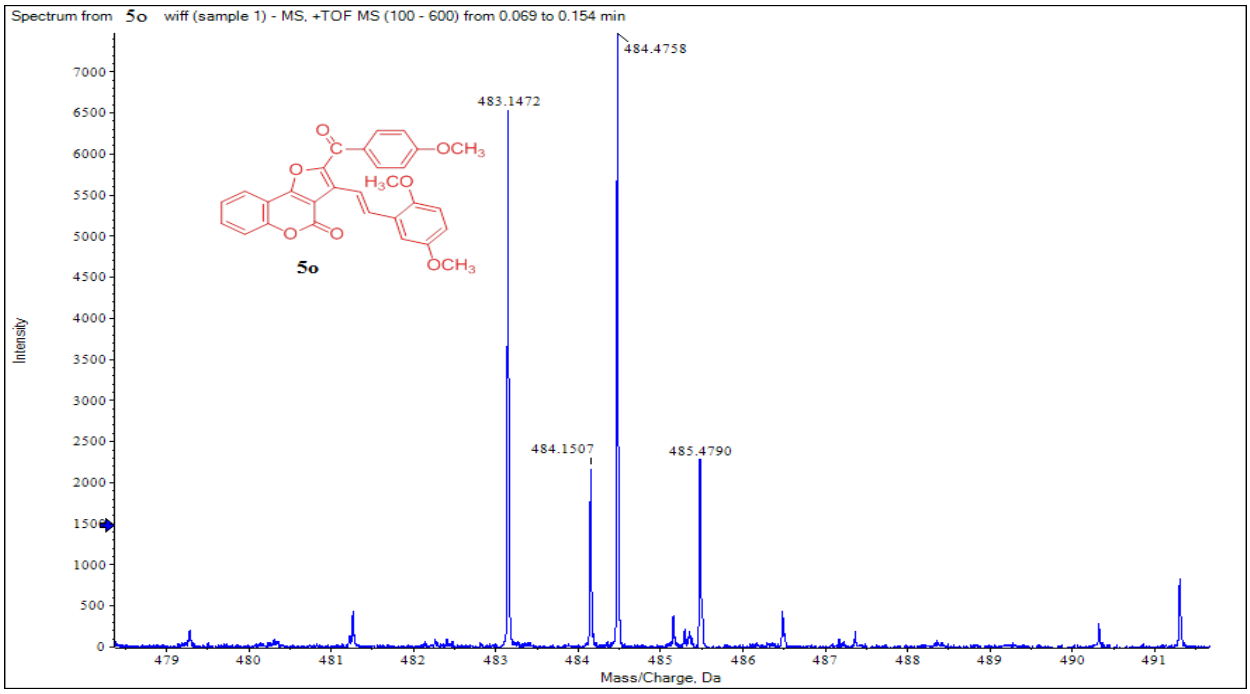

Figure S 65.HRMS of compound 9c

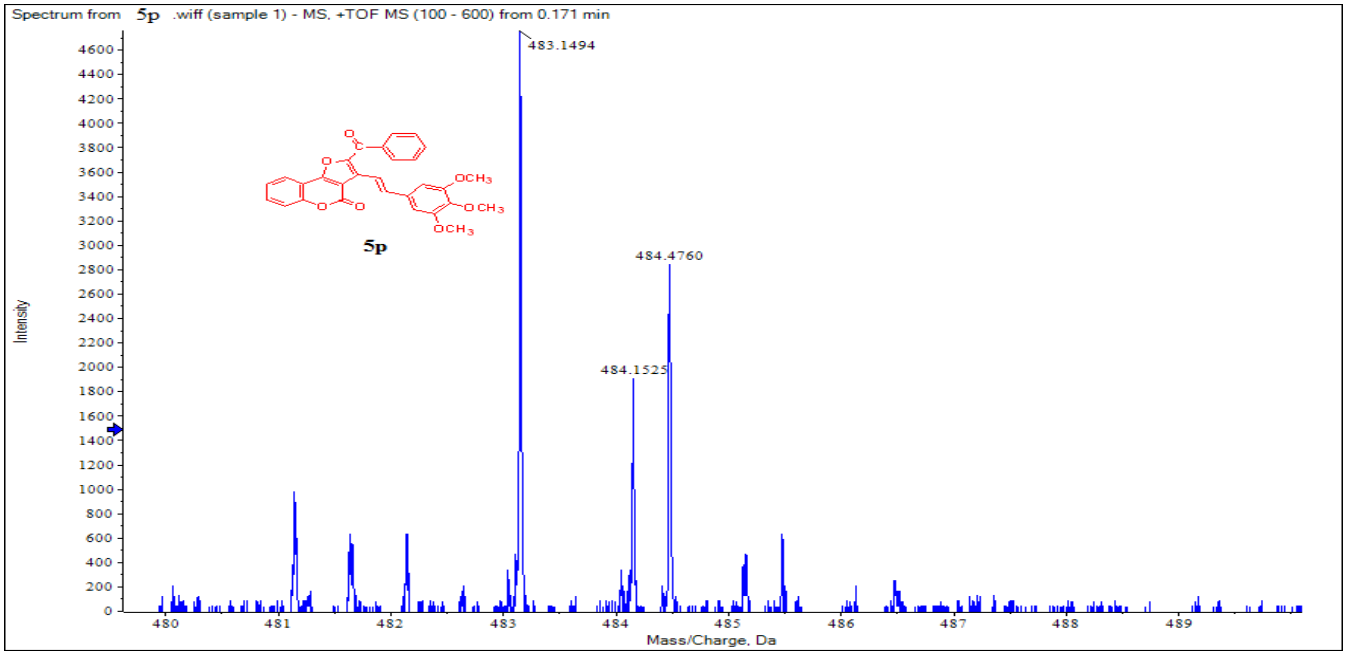

Figure S 66.HRMS of compound 9d

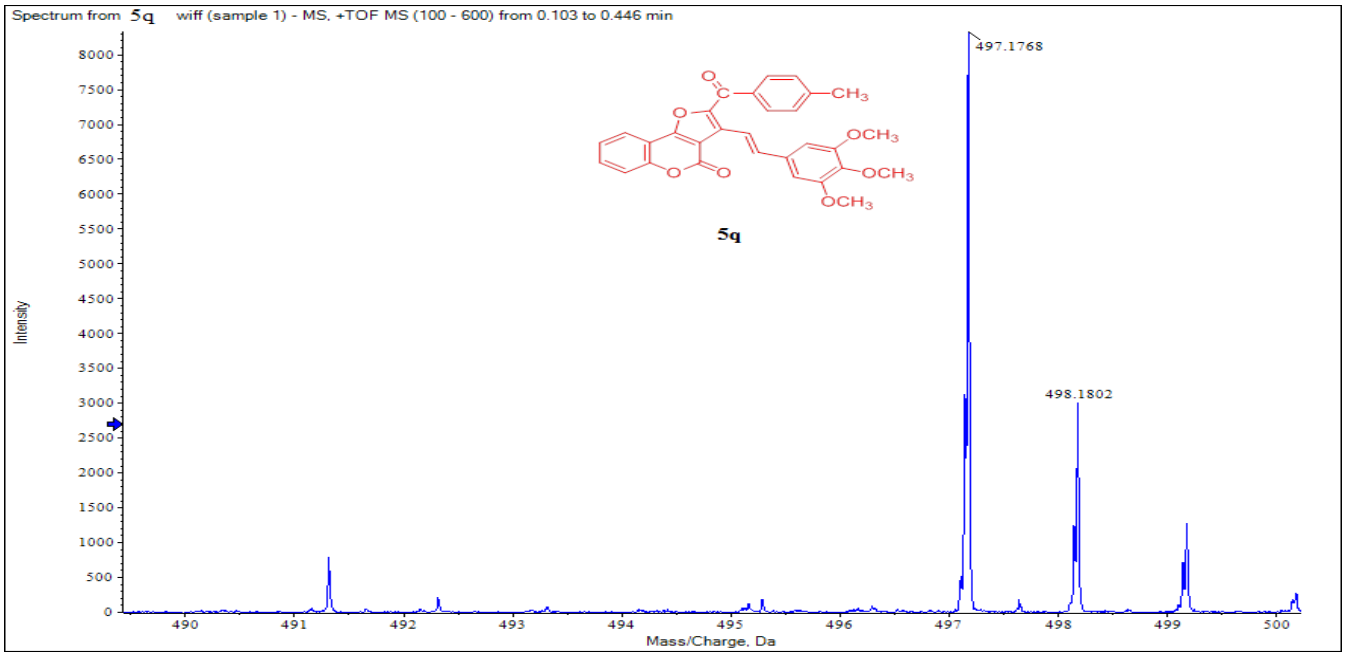

Figure S 67.HRMS of compound 9e

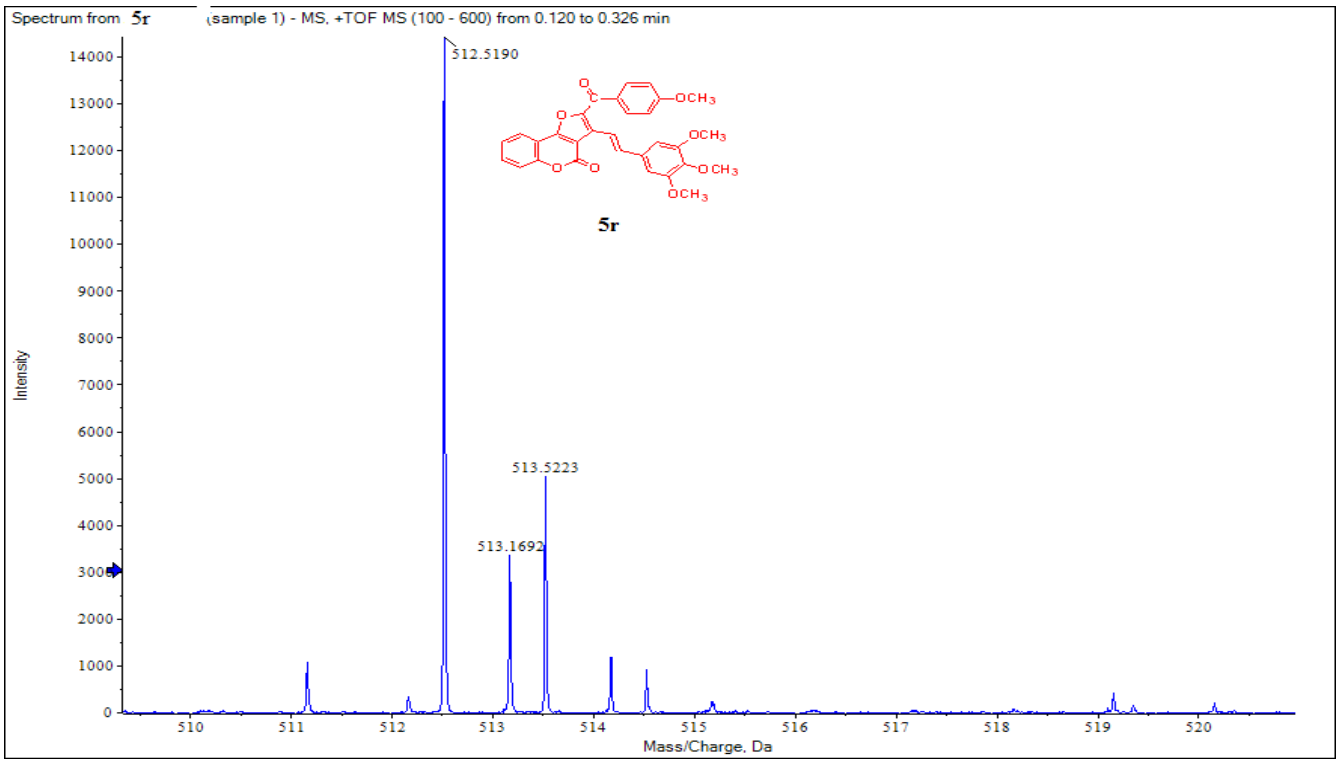

Figure S 68.HRMS of compound 9f

References

1. Houghton, P.; Fang, R.; Techatanawat, I.; Steventon, G.; Hylands, P. J.; Lee, C. C.. *Methods.* **2007**, 42, 377-387. doi: 10.1016/j.ymeth.2007.01.003.
2. Cappuccino, C. J.; Sherman, N. Microbiology- a laboratory manual. Addison Wesley, Californiaa, **1999**, 263.