**Synthesis and Biological Evaluation of Novel Fused Indolo [3, 2-c] [1, 8] Naphthyridine Derivatives as Potential Antibacterial Agents**

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**Supporting Information**

**Characterization data of compound 4a-i listed in Scheme 1:**

1-methyl-6-phenyl-6, 7-dihydro-5H-indolo [3, 2-c] [1, 8] naphthyridine (**4a)**



Yield 88%, reddish brown solid, mp 184 - 186 0C. IR (KBr): ѵ 3390-3271 (N-H), 2854 (CH), 1675-1618 (N-H & C=C), 1479 (C-N) and 744 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): δ 10.80 (s, N-H) , 7.37-7.39 (3H, d, *J* = 8.1 Hz, H-5, H-8 & H-15), 7.32 (2H, d, *J* = 8.1 Hz, H-2’& H-6’), 7.24 -7.29 (2H, t, *J* = 7.4 Hz, H-3’ & H-5’), 7.17 (1H, t, *J* = 8.2 Hz, H-4’), 7.07 (1H, t, *J* = 8.0 Hz, H-7), 6.89 (1H, t, *J* = 7.8 Hz, H-6), 6.85 (1H, d, *J* = 7.2 Hz, H-14), 5.87 (s, H-2), 2.0 (s, CH3). 13C NMR (400 MHz, DMSO-d6): δ 20.7, 39.7, 111.1, 111.4, 118.0, 118.2, 119.1, 120.9, 123.5, 125.8, 127.9, 128.2, 128.4, 131.0, 136.6, 138.4, 144.9 ppm. TOF-MS *m*/*z*: 311.2 [M+]. Anal. calcd for C21H17N3: C, 80.00; H, 5.50; N, 13.49; found: C, 80.06; H, 5.48; N, 13.46.

1-methyl-6-(p-tolyl)-6, 7-dihydro-5H-indolo [3, 2-c] [1, 8] naphthyridine (**4b)**



Yield 83%, reddish brown solid, mp 188 - 190 0C. IR (KBr): ѵ 3419-3277 (N-H), 1618 (N-H & C=C), 1454 (C-N) and 744 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): δ 10.8 (s, N-H) , 7.40 (3H, d, *J* = 7.3 Hz, H-5, H-8 & H-15), 7.33 (2H, d, *J* = 7.3 Hz, H-2’& H-6’),7.27 (2H, d, *J* = 8.0 Hz, H-3’ & H-5’), 7.08 (1H, t, J = 7.3 Hz, H-7), 6.9 (1H, t, *J* = 7.3 Hz, H-6), 6.85 (1H, d, *J* = 7.2 Hz, H-14), 5.83 (s, H-2), 2.26 (s, CH3) ppm.13C NMR (400 MHz, DMSO-d6): δ 20.6, 39.5, 111.1, 118.2, 118.3, 119.1, 120.9, 123.5, 126.7, 128.5, 134.5, 136.6, 141.9 ppm. TOF-MS *m*/*z*: 325.2 [M+]. Anal. calcd for C22H19N3: C, 81.20; H, 5.89; N, 12.91; found: C, 81.08; H, 5.82; N, 12.87.

6-(4-chlorophenyl)-1-methyl-6, 7-dihydro-5H-indolo [3, 2-c] [1, 8] naphthyridine (**4c)**



Yield 88%, reddish brown solid, mp 194-196 0C. IR (KBr): ѵ 3401-3262 (N-H), 1618 (N-H & C=C), 1465 (C-N) and 744 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): δ 10.89 (s, N-H) , 7.40-7.39 (3H, d, *J* = 8.8 Hz, H-5, H-8 & H-15), 7.33 (2H, d, *J* = 8.5 Hz, H-2’ & H-6’), 7.32 (2H, d, *J* = 8.4 Hz, H-3’& H-5’), 7.08 (1H, t, *J* = 7.2 Hz, H-7), 6.92 (1H, d, *J* = 7.3 Hz, H-6), 6.88 (1H, d, *J* = 7.6 Hz, H-14), 5.90 (s, H-2), 2.0 (s, CH3) ppm. 13C NMR (400 MHz, DMSO-d6): δ 20.7, 39.8, 111.5, 117.6, 118.3, 119.0, 120.9, 123.6, 127.9, 130.1, 130.3, 136.6, 143.9 ppm. TOF-MS *m*/*z*: 347.1 [M+]. Anal. calcd for C21H16ClN3: C, 72.93; H, 4.66; N, 12.15; found: C, 72.51; H, 5.20; N, 12.08.

6-(4-fluorophenyl)-1-methyl-6, 7-dihydro-5H-indolo [3, 2-c] [1, 8] naphthyridine (**4d)**



Yield 79%, reddish brown solid, mp 189-191 0C. IR (KBr): ѵ 3408 (N-H), 1519 (N-H), 1454 (C-N), 1005 (C-F) and 742 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): δ 10.85 (s, N-H), 7.38 (3H, d, *J* = 8.6 Hz, H-5, H-8 & H-15), 7.30 (2H, d, *J* = 8.9 Hz, H-2’& H-6’), 7.08 (1H, t, *J* = 6.5 Hz, H-7), 7.03 (2H, d, *J* = 8.2 Hz, H-3’ & H-5’), 6.89 (1H, d, *J* = 7.3 Hz, H-6), 6.83 (1H, d, *J* = 7.6 Hz, H-14), 5.87 (s, H-2), 1.99 (s, CH3) ppm. 19F NMR (400 MHz, DMSO-d6): δ -117.6 ppm (Ar-F). 13C NMR (400 MHz, DMSO-d6): δ 20.9, 38.7, 111.5, 114.5, 117.9, 118.2, 119.0, 120.9, 123.5, 125.6, 126.5, 129.9, 136.6, 141.1, 159.3, 161.7 ppm. TOF-MS *m*/*z*: 340.1 [M++1]. Anal. calcd for C21H16FN3: C, 76.58; H, 4.90; N, 12.76; found: C, 76.56; H, 4.95; N, 12.68.

1-methyl-6-(4-(trifluoromethyl) phenyl)-6, 7-dihydro-5H-indolo [3, 2-c] [1, 8] naphthyridine (**4e)**



Yield 86%, pink solid, mp 184-186 0C. IR (KBr): ѵ 3244 (N-H), 1615 (N-H & C=C), 1438 (C-N), 1339 (C-F) and 745 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): δ 10.89 (s, N-H), 7.64 (1H, d, *J* = 8.3 Hz, H-15), 7.58 (3H, d, *J* = 8.2 Hz, H-5, H-3’& H-5’), 7.37 (2H, d, *J* = 8.1 Hz, H-2’& H-6’), 7.30 (1H, d, *J* = 8.0 Hz, H-8), 7.07 (1H, t, *J* = 7.0 Hz, H-7), 6.90 (1H, d, *J* = 8.1 Hz, H-6), 6.86 (1H, d, *J* = 7.6 Hz, H-14), 5.97 (s, H-2), 1.98 (s, CH3) ppm. 19F NMR (400 MHz, DMSO-d6): δ -60.6 ppm (Ar-CF3). 13C NMR (400 MHz, DMSO-d6): δ 20.7, 39.7, 111.5, 117.1, 118.3, 118.9, 120.9, 123.7, 124.9, 126.4, 128.9, 136.6, 149.8 ppm. TOF-MS *m*/*z*: 380.1 [M++1]. Anal. calcd for C22H16F3N3: C, 69.65; H, 4.25; N, 11.08; found: C, 69.62; H, 4.28; N, 11.11.

1-methyl-6-(4-nitrophenyl)-6, 6a, 7, 11b-tetrahydro-5H-indolo [3, 2-c] [1, 8] naphthyridine (**4f**)



Yield 84%, yellow solid, mp 238-240 0C. IR (KBr): ѵ 3386-3455 (N-H), 1594 (N-H & C=C), (C-N), 1340 (N-O) and 745 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): δ 10.93 (s, N-H), 8.15 (2H, d, *J* = 8.8 Hz, H-3’ & H-5’), 7.61 (2H, d, *J* = 8.7 Hz, H-15 & H-5), 7.37 (2H, d, *J* = 8.1 Hz, H-2’& H-6’), 7.30 (1H, d, *J* = 7.9 Hz, H-8), 7.07 (1H, t, *J* = 7.1 Hz, H-7), 6.90 (1H, t, *J* = 7.0 Hz, H-6), 6.87 (1H, d, *J* = 7.9 Hz, H-14), 6.03 (s, H-2), 2.00 (s, CH3) ppm. 13C NMR (400 MHz, DMSO-d6): δ 20.7, 39.6, 111.6, 116.6, 118.4, 118.9, 121.1, 123.3, 123.8, 126.3, 129.4, 136.6, 145.7, 151.3 ppm. TOF-MS *m*/*z*: 357.1 [M++1]. Anal. calcd for C21H16N4O2: C, 70.77; H, 4.53; N, 15.72; found: C, 70.81; H, 5.76; N, 15.76.

6-(4-methoxyphenyl)-1-methyl-6, 6a, 7, 11b-tetrahydro-5H-indolo [3, 2-c] [1, 8]naphthyridine (**4g)**



Yield 70%, orange solid, mp 181-183 0C. IR (KBr): ѵ 3396 (N-H), 1610 (N-H & C=C), 1509 (C-N), 1093 (C-O-C) and 724 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): ): δ 10.79 (s, N-H) , 7.35 (2H, d, *J* = 8.1 Hz, H-15 & H-5), 7.29 (1H, d, *J* = 8.0 Hz, H-8), 7.26 (2H, d, *J* = 8.4 Hz, H-2’ & H-6’), 7.04 (1H, t, *J* = 7.2 Hz, H-7), 6.88 (1H, t, *J* = 7.2 Hz, H-6), 6.83 (2H, d, *J* = 8.7 Hz, H-3’ & 5’), 6.81 (1H, d, *J* = 7.6 Hz, H-14), 5.78 (s, H-2), 3.69 (s, OCH3), 2.00 (s, CH3) ppm. 13C NMR (400 MHz, DMSO-d6): δ 20.7, 39.7, 54.9, 111.1, 113.3, 118.0, 118.4, 119.1, 120.8, 123.4, 126.6, 129.2, 136.6, 136.9, 157.2 ppm. TOF-MS *m*/*z*: 342.1 [M++1]. Anal. calcd for C22H19N3O: C, 77.40; H, 5.61; N, 12.31; found: C, 77.37; H, 5.58; N, 12.29.

2-methoxy-4-(1-methyl-6, 6a, 7, 11b-tetrahydro-5H-indolo [3, 2-c] [1, 8] naphthyridin-6-yl) phenol (**4h)**



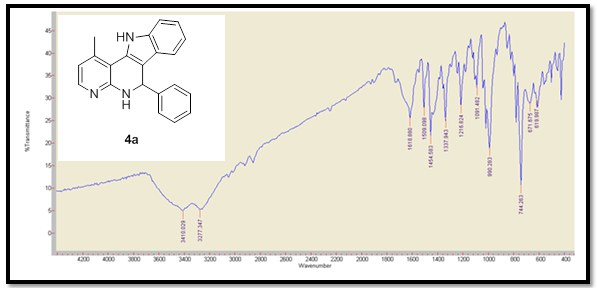
Yield 73%, reddish brown solid, mp 195-197 0C. IR (KBr): ѵ 3485 (N-H), 3412 (OH), 1591 (N-H & C=C), 1454 (C-N), 1028 (C-O-C) and 745 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): δ 10.77 (s, N-H), 8.71 (s, OH), 7.36 (2H, d, *J* = 8.1 Hz, H-15 & H-5), 7.31 (1H, d, *J* = 7.9 Hz, H-8), 7.05 (1H, t, *J* = 7.1 Hz, H-7), 6.98 (1H, d, *J* = 7.6 Hz, H-5’), 6.87 (1H, t, *J* = 7.1 Hz, H-6), 6.83 (1H, d, *J* = 8.5 Hz, H-2’), 6.73 (1H, d, *J* = 7.6 Hz, H-14), 6.69 (1H, d, *J* = 7.6 Hz, H-6’), 5.75 (s, H-2), 3.67 (s, OCH3), 2.21 (s, CH3) ppm. 13C NMR (400 MHz, DMSO-d6): δ 20.9, 39.7, 55.6, 111.4, 112.8, 115.0, 118.0, 118.6, 119.1, 120.5, 120.8, 123.4, 126.7, 135.9, 136.6, 144.5, 147.2 ppm. TOF-MS *m*/*z*: 358.1 [M++1]. Anal. calcd for C22H19N3O2: C, 73.93; H, 5.36; N, 11.76; found: C, 73.89; H, 5.42; N, 11.78.

2-bromo-6-methoxy-4-(1-methyl-6, 7-dihydro-5H-indolo [2, 3-c] [1, 8] naphthyridin-6-yl) phenol (**4i)**

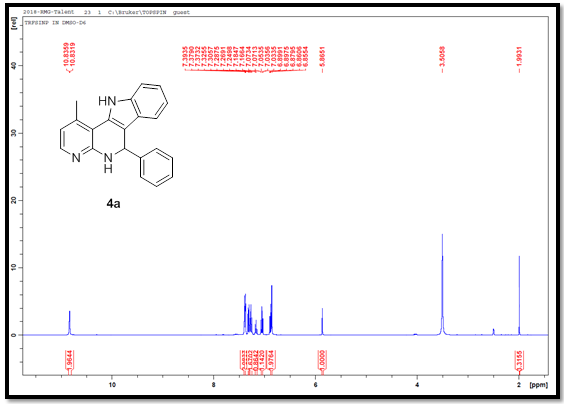


Yield 81%, reddish brown solid, mp 205-207 0C. IR (KBr): ѵ 3283 (OH), 1603 (N-H & C=C), 1494 (C-N), 1038 (C-O-C) and 741 (N-H) cm -1. 1H NMR (400 MHz, DMSO-d6): δ 10.81 (s, N-H), 9.19 (s. OH), 7.38 (2H, d, *J* = 8.2 Hz, H-15 & H-5), 7.33 (1H, d, *J* = 7.9 Hz, H-8), 7.08 (1H, t, *J* = 8.0 Hz, H-7), 7.04 (1H, d, *J* = 7.6 Hz, H-2’), 6.99 (1H, d, *J* = 7.6 Hz, H-6’), 6.91 (1H, t, *J* = 7.1 Hz, H-6), 6.87 (1H, d, *J* = 7.2 Hz, H-14), 5.79 (s, H-2), 3.74 (s, OCH3), 2.0 (s, CH3) ppm. 13C NMR (400 MHz, DMSO-d6): δ 20.7, 39.7, 56.1, 108.9, 111.5, 111.8, 117.9, 118.2, 119.0, 120.9, 123.5, 126.6, 136.6, 137.1, 141.8, 148.2 ppm. TOF-MS *m*/*z*: 435.1 [M+]. Anal. calcd for C22H18BrN3O2: C, 60.56; H, 4.16; N, 9.63; found: C, 60.59; H, 4.18; N, 9.59.

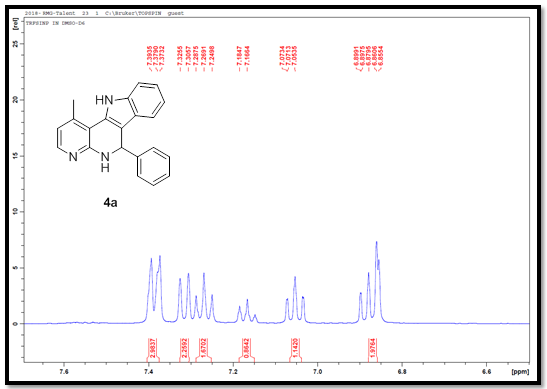
Appendix 1: FT-IR spectra for compound **4a**

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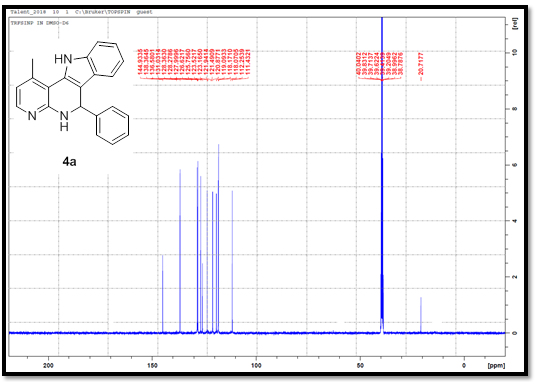
Appendix 2: 1H NMR spectra for compound **4a**



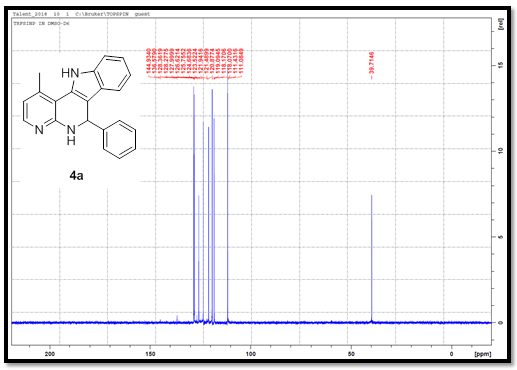
Appendix 3: Expanded 1H NMR spectra for compound **4a**



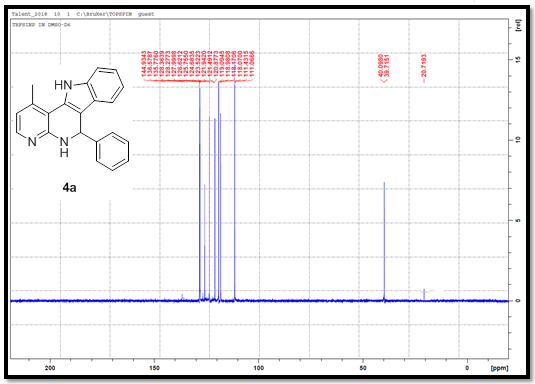
Appendix 4: 13C NMR spectra for compound **4a**



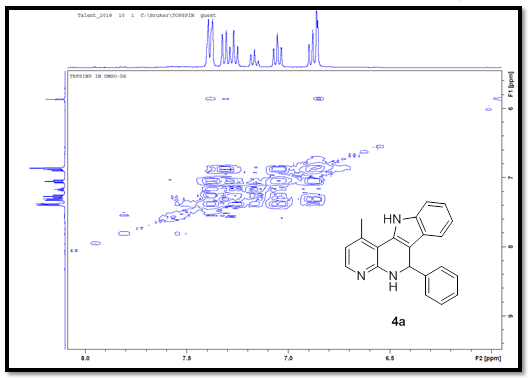
Appendix 5: 900 DEPT NMR spectra for compound **4a**



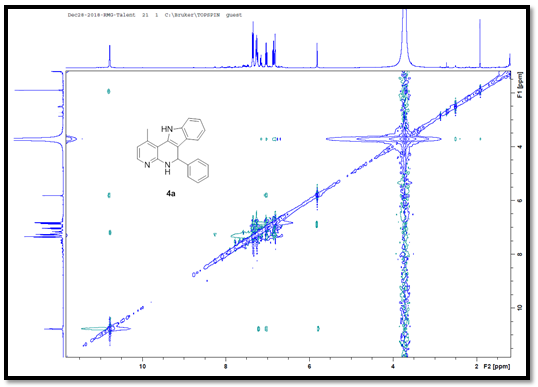
Appendix 6: 1350 DEPT NMR spectra for compound **4a**



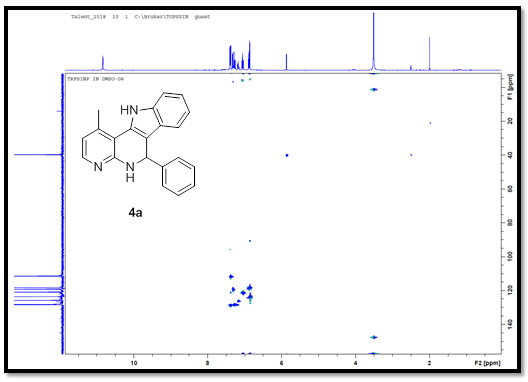
Appendix 7: 1H COSY NMR spectra for compound **4a**



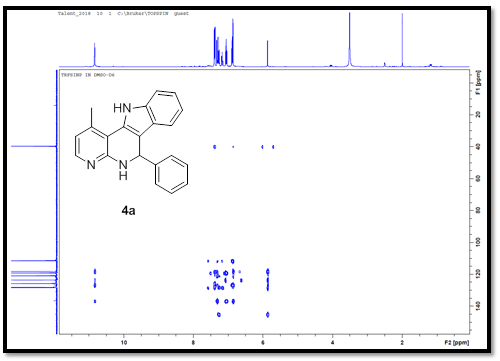
Appendix 8: NOESY NMR spectra for compound **4a**



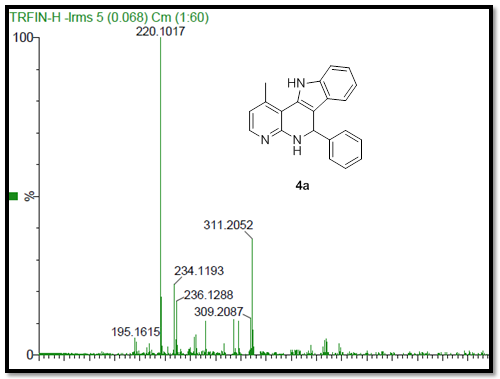
Appendix 9: HSQC NMR spectra for compound **4a**



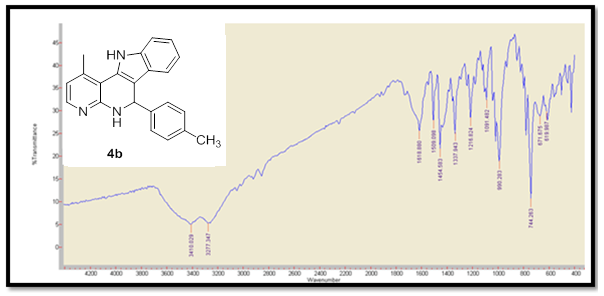
Appendix 10: HMBC NMR spectra for compound **4a**



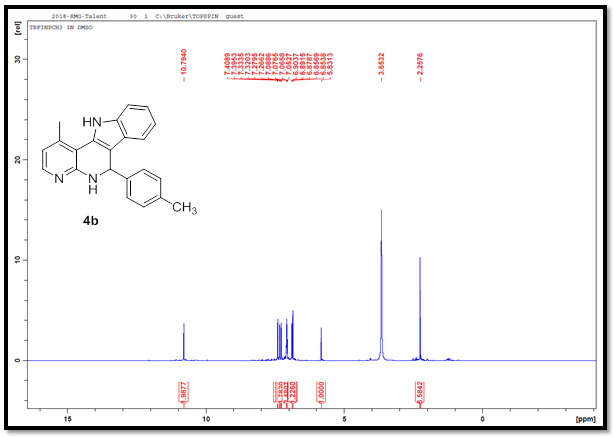
Appendix 11: TOF-MS spectra for compound **4a**



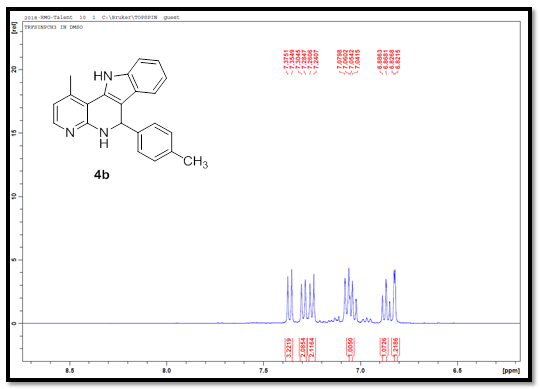
Appendix 12: FT-IR spectra for compound **4b**



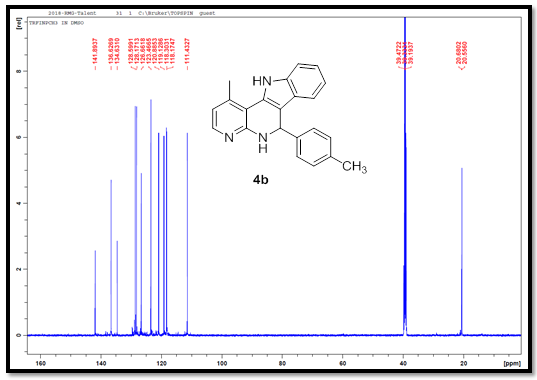
Appendix 13: 1H NMR spectra for compound **4b**



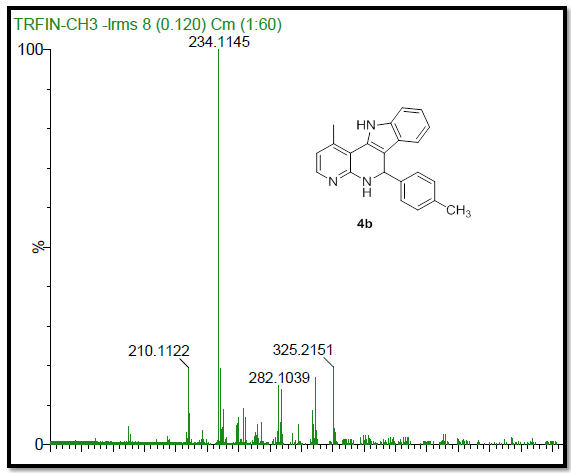
Appendix 14: 1H NMR expanded spectra for compound **4b**



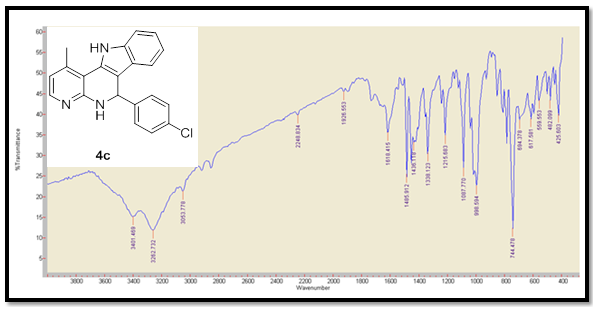
Appendix 15: 13C NMR spectra for compound **4b**



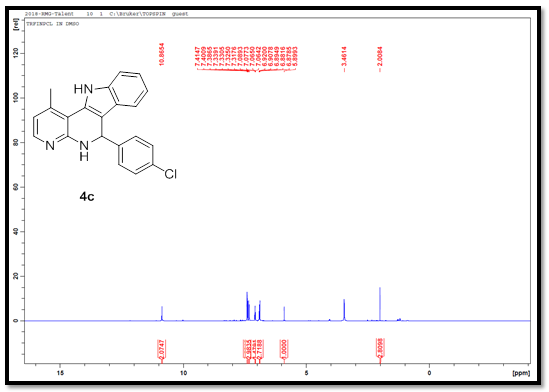
Appendix 16: TOF-MS spectra for compound **4b**



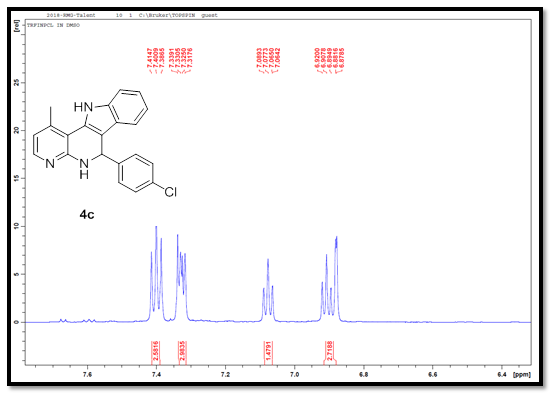
Appendix 17: FT-IR spectra for compound **4c**



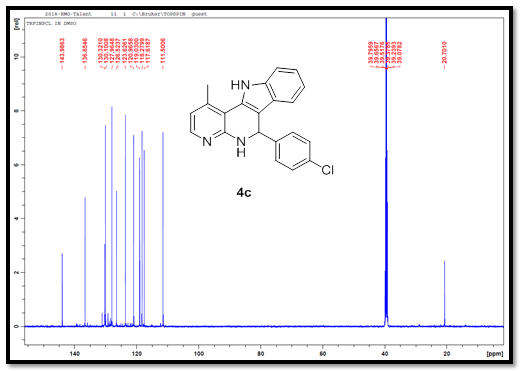
Appendix 18: 1H NMR spectra for compound **4c**



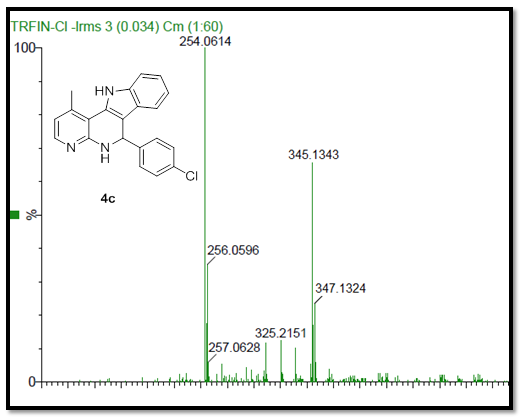
Appendix 19: 1H NMR expanded spectra for compound **4c**



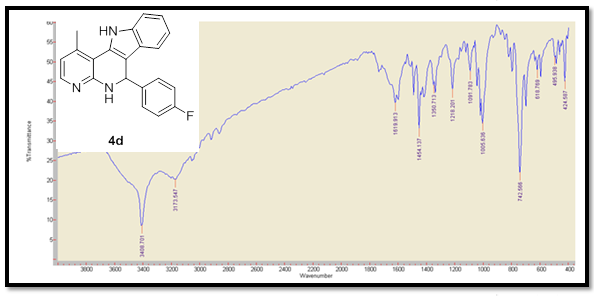
Appendix 20: 13C NMR spectra for compound **4c**



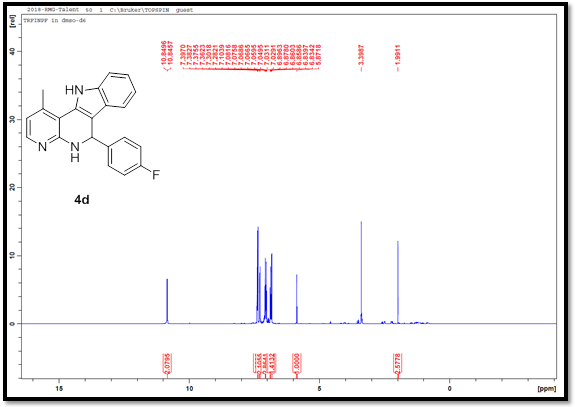
Appendix 21: TOF-MS spectra for compound **4c**



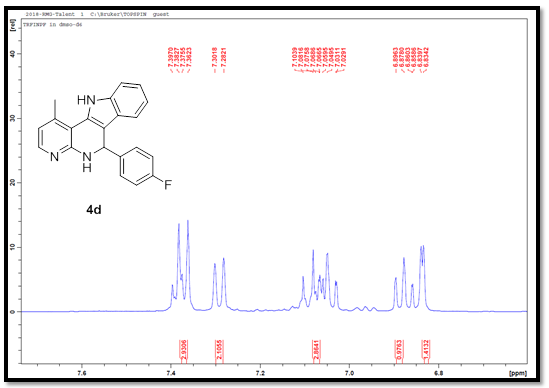
Appendix 22: FT-IR spectra for compound **4d**



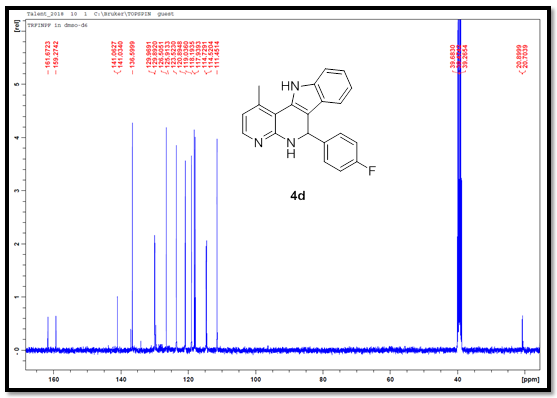
Appendix 23: 1H NMR spectra for compound **4d**



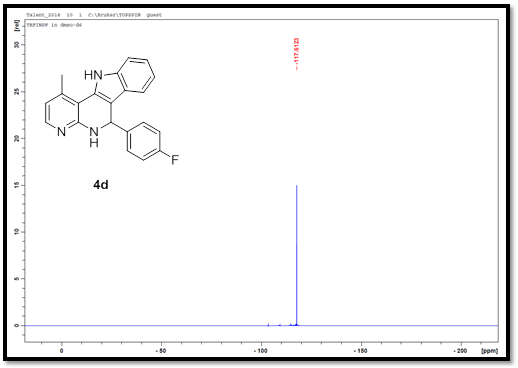
Appendix 24: 1H NMR expanded spectra for compound **4d**



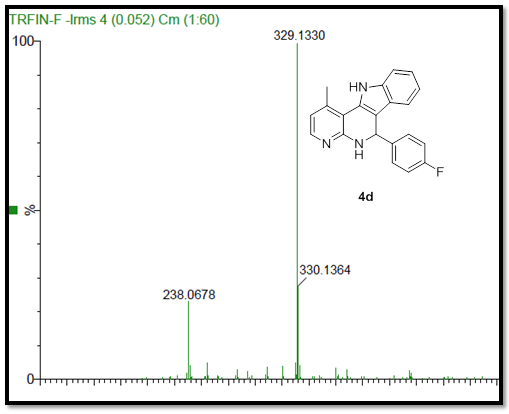
Appendix 25: 13C NMR spectra for compound **4d**



Appendix 26: 19F NMR spectra for compound **4d**



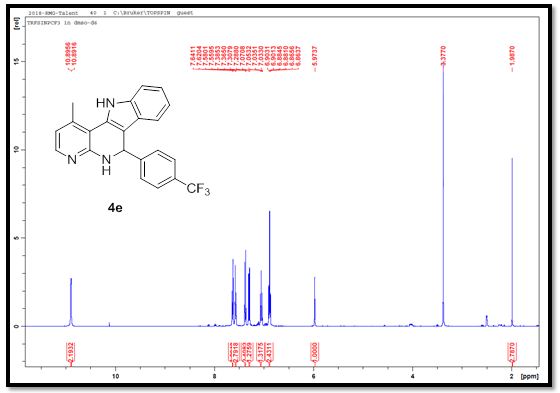
Appendix 27: TOF-MS spectra for compound **4d**



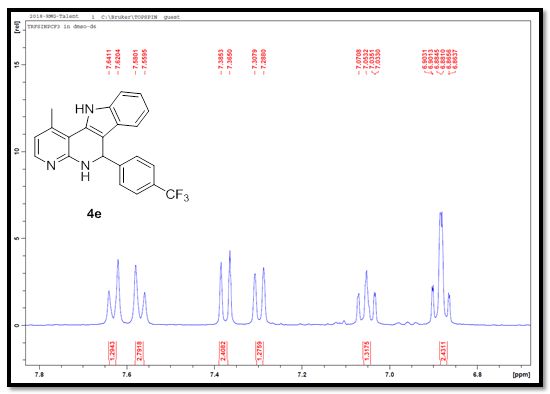
Appendix 28: FT-IR spectra for compound **4e**



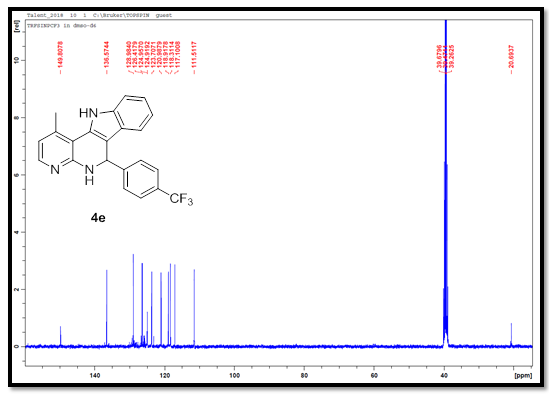
Appendix 29: 1H NMR spectra for compound **4e**



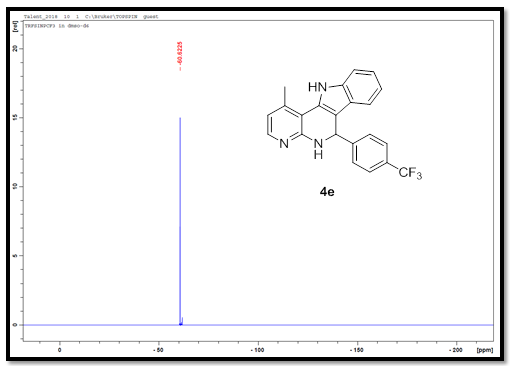
Appendix 30: 1H NMR expanded spectra for compound **4e**



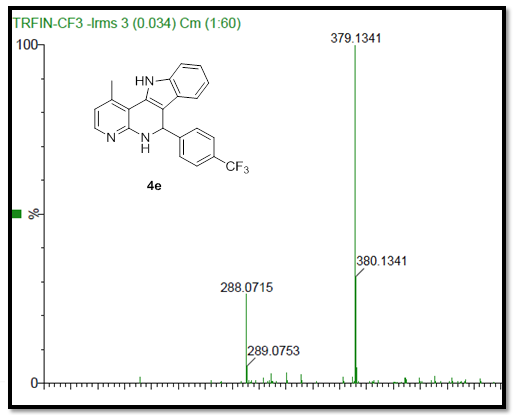
Appendix 31: 13C NMR spectra for compound **4e**



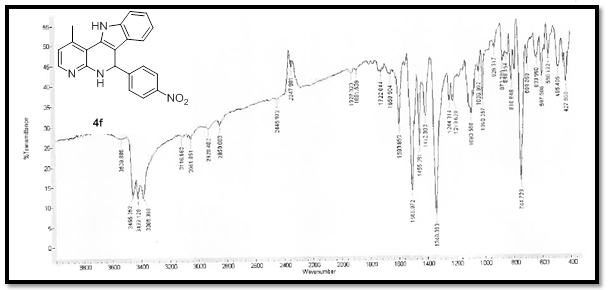
Appendix 32: 19F NMR spectra for compound **4e**



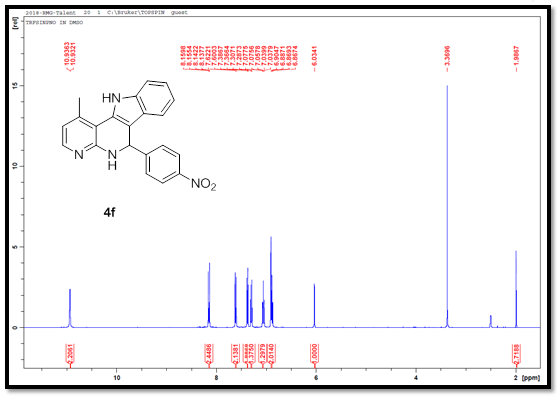
Appendix 33: TOF-MS spectra for compound **4e**



Appendix 34: FT-IR spectra for compound **4f**



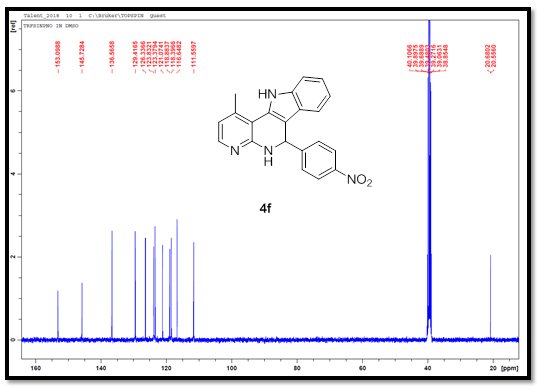
Appendix 35: 1H NMR spectra for compound **4f**



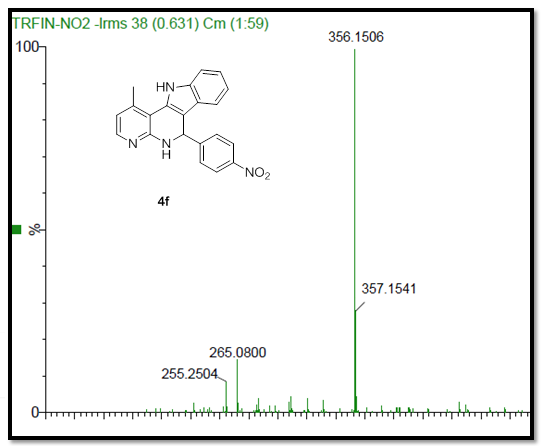
Appendix 36: 1H NMR expanded spectra for compound **4f**



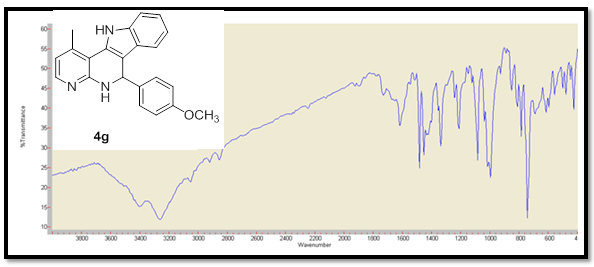
Appendix 37: 13C NMR spectra for compound **4f**



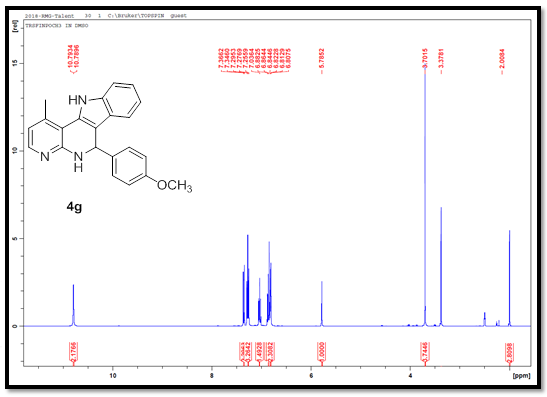
Appendix 38: TOF-MS spectra for compound **4f**



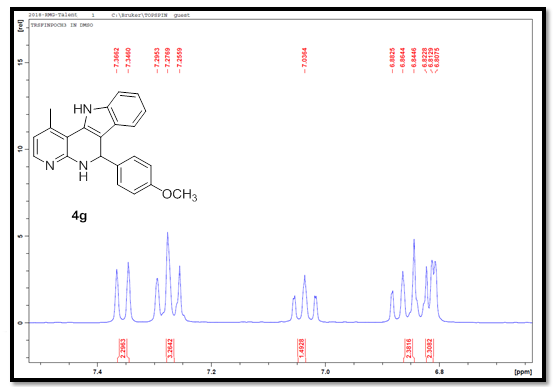
Appendix 39: FT-IR spectra for compound **4g**



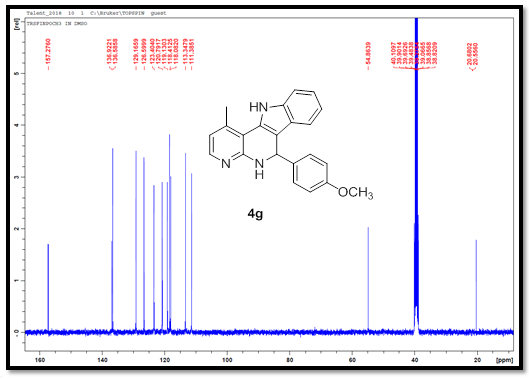
Appendix 40: 1H NMR spectra for compound **4g**



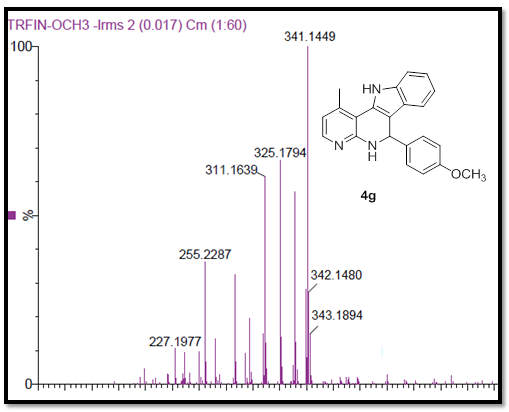
Appendix 41: 1H NMR expanded spectra for compound **4g**



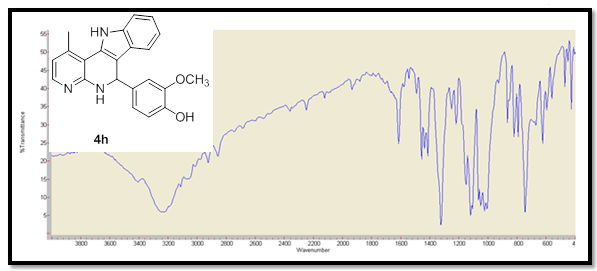
Appendix 42: 13C NMR spectra for compound **4g**



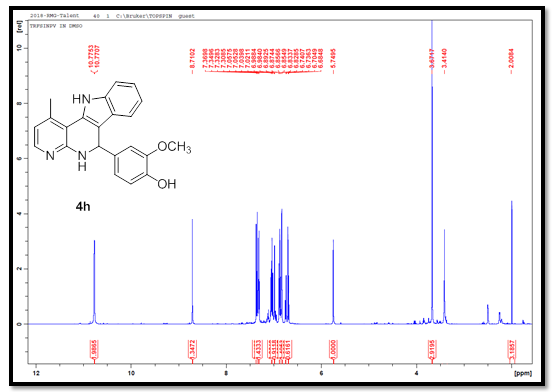
Appendix 43: TOF-MS spectra for compound **4g**



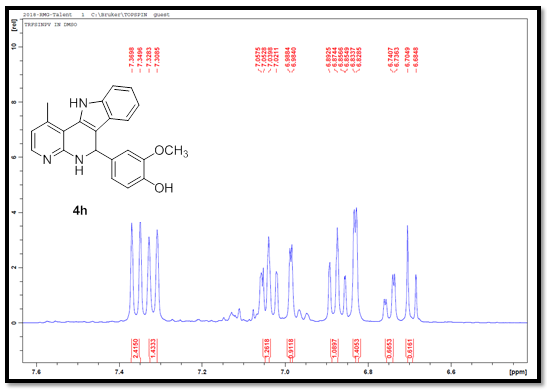
Appendix 44: FT-IR spectra for compound **4h**



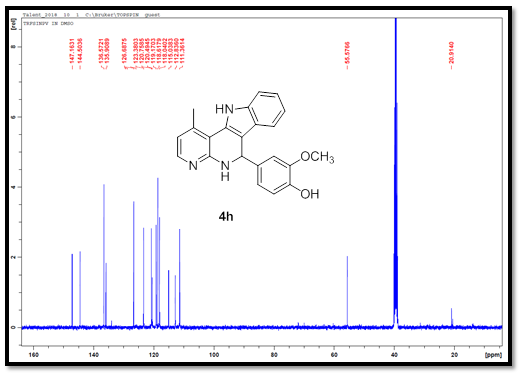
Appendix 45: 1H NMR spectra for compound **4h**



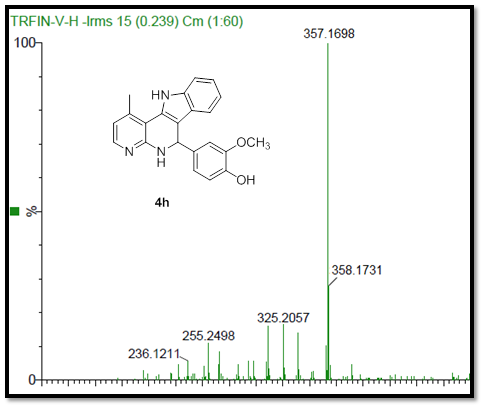
Appendix 46: 1H NMR expanded spectra for compound **4h**



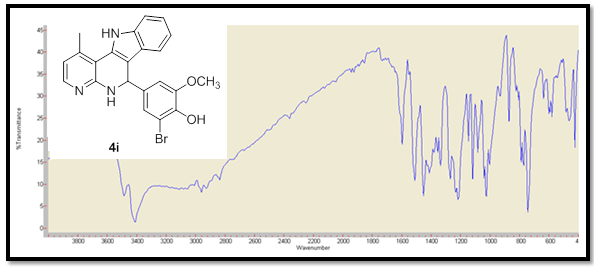
Appendix 47: 13C NMR spectra for compound **4h**



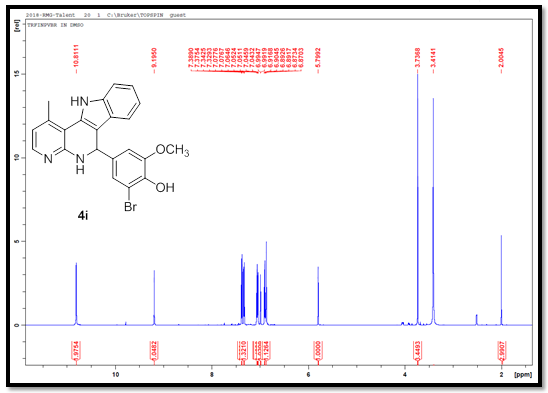
Appendix 48: TOF-MS spectra for compound **4h**



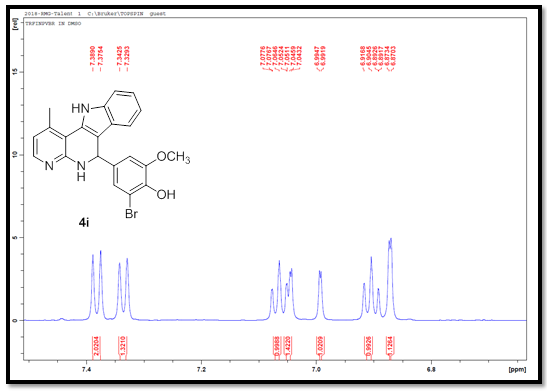
Appendix 49: FT-IR spectra for compound **4i**



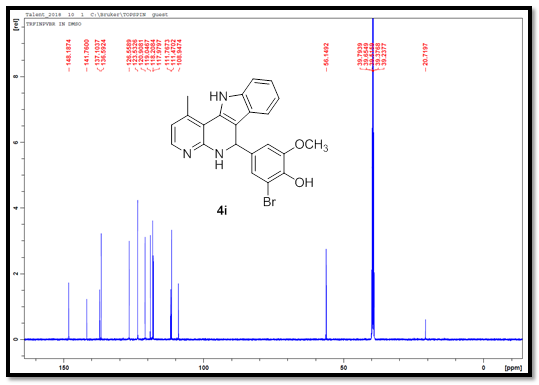
Appendix 50: 1H NMR spectra for compound **4i**



Appendix 51: 1H NMR expanded spectra for compound **4i**



Appendix 52: 13C NMR spectra for compound **4i**



Appendix 53: TOF-MS spectra for compound **4i**

