Supplementary Material

A novel synthesis of acridones via iron(II)-catalyzed intramolecular acylation of *N*-phenylanthranilic acids

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1. Experimental Section

General: Reagents were obtained commercially and used without further purification. Solvents were technical grade and distilled prior to use. Catalysts were purchased as analytical reagent grade. Reactions were monitored by thin-layer chromatography on silica gel plates (60F-254) visualized under UV light and/or using 5% phosphomolybdic acid in ethanol. All ^{1}H and ^{13}C NMR spectra were recorded at room temperature in $CDCl_3$, or DMSO-d_6 on a Bruker Advance ARX-300 spectrophotometer. Chemical shifts (δ) are reported in parts per million (ppm) from tetramethylsilane (TMS) using the residual solvent resonance. Multiplicities are abbreviated as follows: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, brs = broad signal. IR spectra were recorded on a Nicolet Nexus 470/670/870 FT-IR spectrometer at room temperature. Melting points were determined using a Büchi 510 apparatus and are not corrected. Mass spectra (EI) were obtained at 70 eV on a Hewlett Packard HP-5890 GC-MS instrument equipped with a HP-5972 selective mass detector. The purity of volatile compounds and the chromatographic analyses (GC) were determined with a GC Shimadzu (GC-14B) with a flame ionization detector equipped with a HP-5MS column (30 m × 0.25 mm × 0.25 µm) using nitrogen as carrier gas. High resolution mass spectra were recorded on Thermo Fisher LTQ Orbitrap XL, (for EI). Flash column chromatography was performed using Macherey Nagel MN silica 60M (0.040-0.063 mm / 230-240 mesh ASTM). Substrates **1a-1f**, **1i**-**1j** and **1l** were obtained from commercially available sources.

General procedure for the synthesis of substituted *N*-phenylanthranilic acids

A mixture of substituted 2-halobenzoic acid (0.04 mol) and substituted aniline (0.08 mol) was refluxed in *N,N*-dimethylformamide (DMF) in the presence of anhydrous sodium carbonate (1 mol%) and copper powder (3 mol%) for 4 hours. The progress of the reaction was monitored by thin-layer chromatography (TLC). Upon completion, the reaction mixture was cooled to room temperature and then slowly poured, with stirring, into a 1:1 (v/v) mixture of hydrochloric acid and water (100 mL). The resulting mixture was allowed to stand overnight. The precipitated solid was collected by filtration, washed thoroughly with boiling water, and recrystallized from an ethanol–water (1:1) mixture to afford the desired substituted *N*-phenylanthranilic acid.

2-((3,5-Dimethylphenyl)amino)benzoic acid (**1g**)

Prepared from 2-chlorobenzoic acid and 3,5-dimethylaniline; yellow solid (217 mg, 90 %); 189-191 °C. IR (solid, KBr, νmax, cm^{-1}): 3338, 3072, 1668, 1591, 1460, 1282, 790. ^{1}H NMR (300 MHz, DMSO-d_6): δ_H 2.29 (3H, s, CH_3), 2.33 (3H, s, CH_3), 6.72 (1H, s), 6.85 (1H, d, *J*= 8.2 Hz), 7.12 (1H, dd, *J* 7.2 Hz and 7.4 Hz), 7.20-7.34 (4H, m), 8.05 (1H, d, *J* 7.2 Hz), 9.18 (1H, s). ^{13}C NMR (75 MHz, DMSO-d_6): δ_C 17.0, 18.0, 113.4,122.6, 124.0, 126.6, 130.9, 131.3, 131.3, 134.7, 138.7, 138.8, 148.6, 170.1. HRMS (EI): m/z $[M]^+$ calcd for $C_{15}H_{15}NO_2$: 241.1103; found: 241.1106.

2-((3,5-Dihydroxyphenyl)amino)benzoic acid (**1h**)

Prepared from 2-chlorobenzoic acid and 3,5-dihydroxyaniline; yellow solid (191 mg, 76 %); 293-294 °C. IR (solid, KBr, νmax, cm^{-1}): 3440, 3169, 3076, 1629, 1450, 1174, 790. ^{1}H

NMR (300 MHz, DMSO-*d*$_6$): δ_H 6.72 (1H, s), 6.25 (2H, s), 7.32 (1H, d, *J* 7.2 Hz), 7.75 (1H, d, *J* 7.2 Hz), 8.05 (1H, d, *J* 7.2 Hz), 8.4 (1H, d, *J* 7.2 Hz), 9.18 (1H, s). ^{13}C NMR (75 MHz, DMSO-*d*$_6$): δ_C 93.1, 97.8, 97.9, 111.9, 113.4,118.0, 131.3, 134.7, 141.3, 148.6, 160.5, 160.7, 170.1. HRMS (EI): m/z $[M]^+$ calcd for $C_{13}H_{11}NO_4$: 245.0688; found: 245.0685.

5-Chloro-2-(phenylamino)benzoic acid (**1j´**)

Prepared from 2-iodo-5-cholorobenzoic acid and aniline; yellow solid (173 mg, 70 %); 175-178 °C. IR (solid, KBr, νmax, cm^{-1}): 3330, 3165, 3070, 1635, 1448, 1174, 792. ^{1}H NMR (300 MHz, DMSO-*d*$_6$): δ_H 6.75-6.82 (1H, d, *J* 7.7 Hz), 7.28-7.33 (3H, m), 7.34-7.40 (3H, m), 8.02-8.08 (1H, m), 9.32 (1H, s). ^{13}C NMR (75 MHz, DMSO-*d*$_6$): δ_C 114.0, 119.7, 120.3, 121.6, 123.3, 129.1, 135.4, 142.5, 146.7, 173.61. HRMS (EI): m/z $[M]^+$ calcd for $C_{13}H_{10}ClNO_2$: 247.0400; found: 247.0404.

2-((4-Cyanophenyl)amino)benzoic acid (**1k**)

Prepared from 2-cholorobenzoic acid and 4-aminobenzonitrile; yellow solid (121 mg, 51 %); 200-201 °C. IR (solid, KBr, νmax, cm^{-1}): 3345, 3057, 2252, 1668, 1464, 1262, 796, 740. ^{1}H NMR (300 MHz, DMSO-*d*$_6$): 7.13 (1H, dd, *J* 7.1 Hz and 2.0 Hz), 7.47 (2H, d, *J* 8.8 Hz), 7.61-7.68 (2H, m), 7.78 (2H, d, *J* 8.8 Hz), 8.22 (1H, d, *J* 7.3 Hz), 9.30 (1H, s). ^{13}C NMR (75 MHz, DMSO-*d*$_6$): δ_C 104.4, 116.9, 118.7, 119.3, 120.4, 131.7, 132.8, 143.1, 145.9, 170.6. HRMS (EI): m/z $[M]^+$ calcd for $C_{14}H_{10}N_2O_2$: 238.0742; found: 238.0745.

5-Bromo-2-(*p*-tolylamino)benzoic acid (**1m**)

Prepared from 2-iodo-5-bromobenzoic acid and 4-methylaniline; yellow solid (199 mg, 65 %); 215-217 °C. IR (solid, KBr, nmax, cm^{-1}): 3341, 3063, 1683, 1591, 1464, 1262, 800, 590. ^{1}H NMR (300 MHz, DMSO-*d*$_6$): 2.32 (3H, s, CH_3), 7.29-7.33 (2H, m), 7.38-7.42 (2H, m), 7.48-7.60 (2H, m), 7.90 (1H, d, *J* 2.4 Hz), 9.30 (1H, s). ^{13}C NMR (75 MHz, DMSO-*d*$_6$): δ_C 21.3, 115.3, 116.7, 117.4, 121.2, 124.4, 129.4, 129.5,130.2, 134.3, 137.2, 140.7, 147.0, 169.4. HRMS (EI): m/z $[M]^+$ calcd for $C_{14}H_{12}BrNO_2$: 305.0051; found: 305.0048.

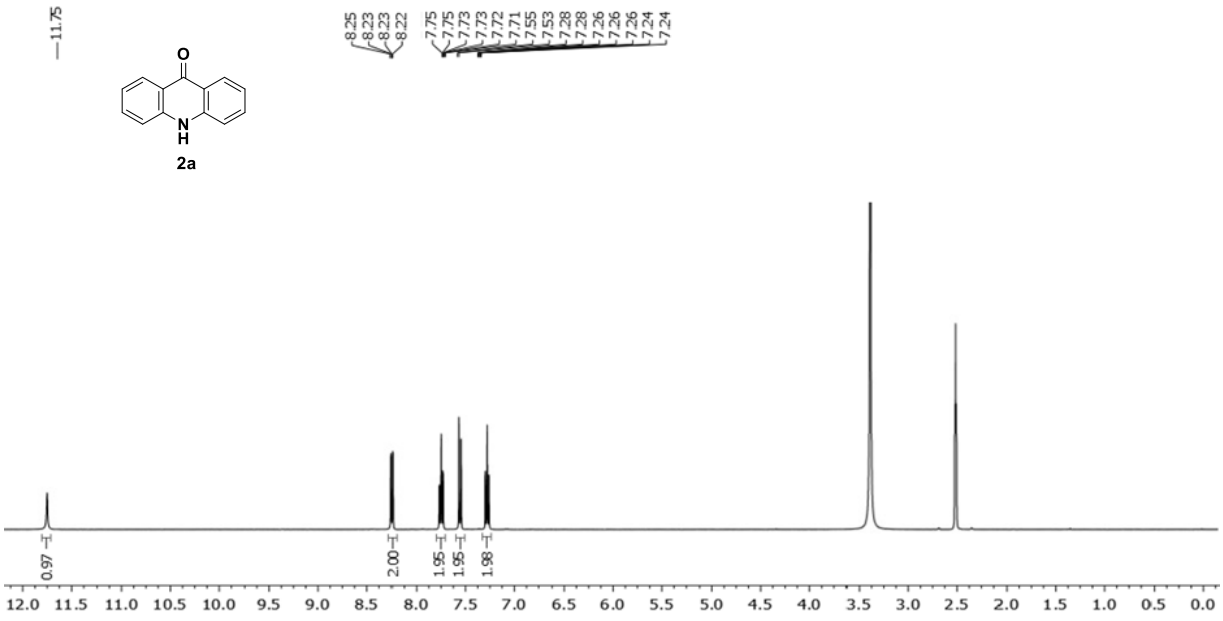
5-Bromo-2-((4-chlorophenyl)amino)benzoic acid (**1n**)

Prepared from 2-iodo-5-bromobenzoic acid and 4-cholorolaniline; yellow solid (253 mg, 78 %); 233-234 °C. IR (solid, KBr, νmax, cm^{-1}): 3345, 3170, 1670, 1591, 1433, 1270, 790, 500. ^{1}H NMR (300 MHz, DMSO-*d*$_6$): 7.29-7.33 (2H, m), 7.38-7.42 (2H, m), 7.48-7.60 (2H, m), 8.00 (1H, d, *J* 2.4 Hz), 9.32 (1H, s). ^{13}C NMR (75 MHz, DMSO-*d*$_6$): δ_C 112.3, 115.5, 121.4, 124.2, 124.4, 127.4, 129.5, 130.2, 134.3, 137.2, 140.7, 147.0, 169.4. HRMS (EI): m/z $[M]^+$ calcd for $C_{13}H_9BrClNO_2$: 324.9505; found: 324.9508.

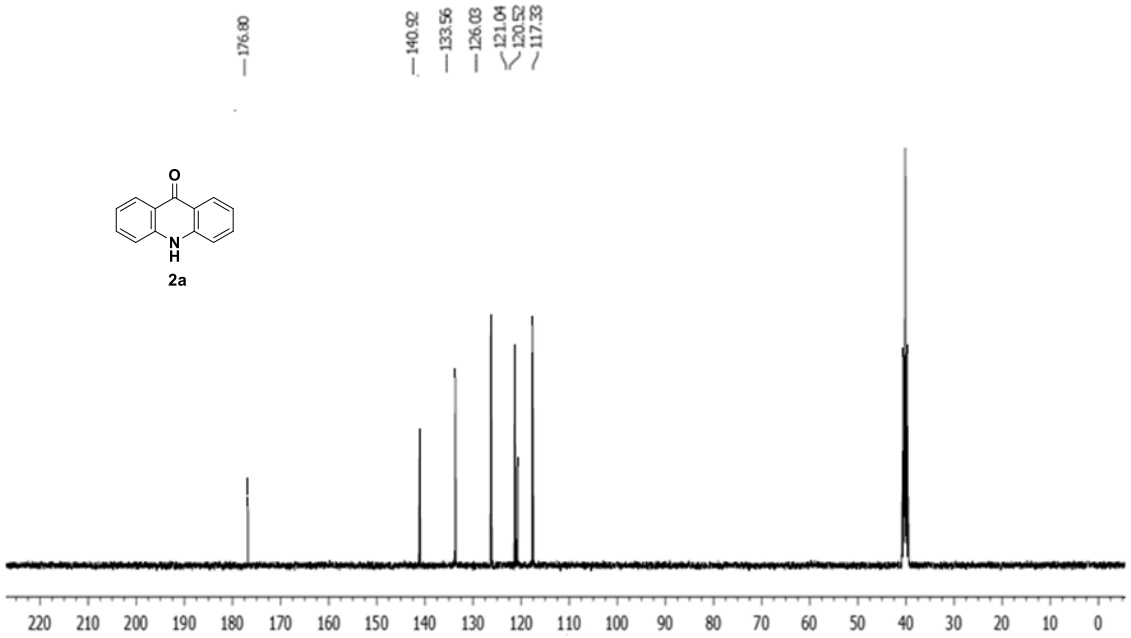
5-Chloro-2-((3,5-dihydroxyphenyl)amino)benzoic acid (**1o**)

Prepared from 2-bromo-5-cholorobenzoic acid and 3,5-dihydroxyaniline; yellow solid (184 mg, 66 %); 288 °C. IR (solid, KBr, νmax, cm^{-1}): 3442, 3163, 3076, 1635, 1450, 1174, 790. ^{1}H NMR (300 MHz, DMSO-*d*$_6$): 6.02 (1H, s), 6.23 (2H, s), 7.29-7.33 (1H, m), 7.48-7.60 (1H, m), 7.81 (1H, d, *J* 2.4 Hz), 9.30 (1H, s). ^{13}C NMR (75 MHz, DMSO-*d*$_6$): δ_C 93.3, 97.8, 114.3, 120.4, 123.9, 131.2, 134.9, 141.7, 146.2, 160.8, 169.3. HRMS (EI): m/z $[M]^+$ calcd for $C_{13}H_{10}ClNO_4$: 279.0298; found: 279.0295.

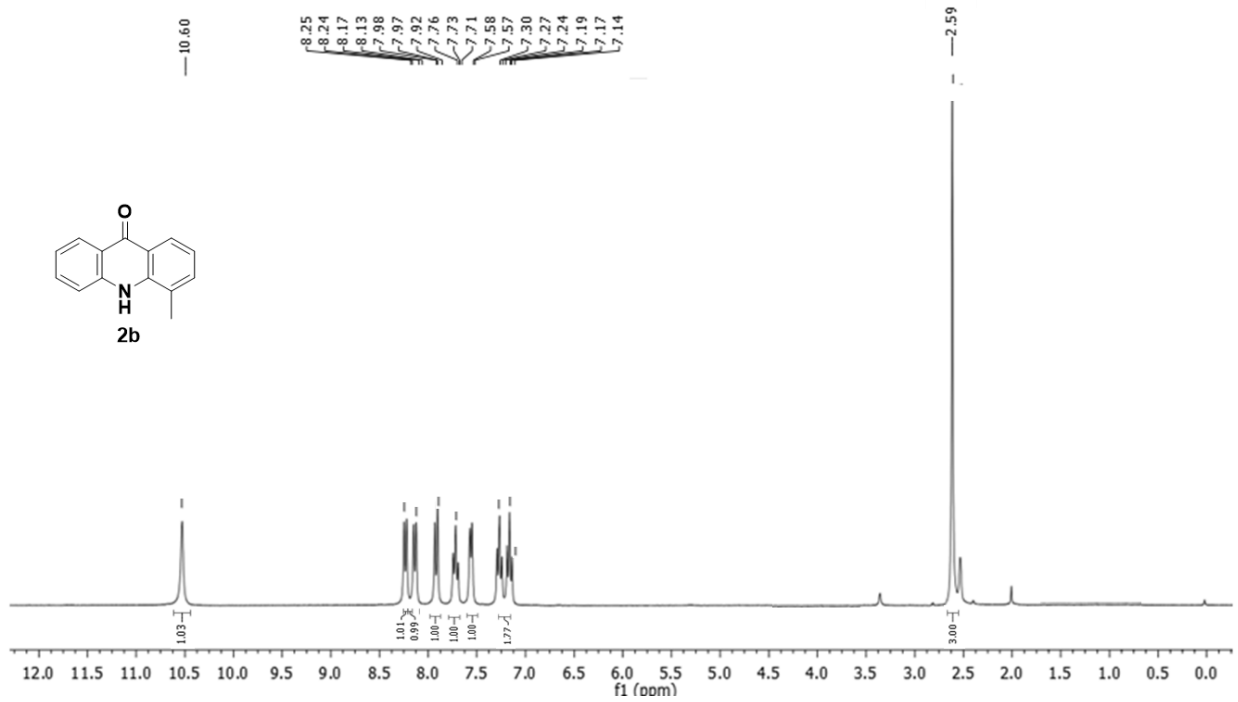
2. Copies of ^{1}H NMR and ^{13}C NMR Spectra



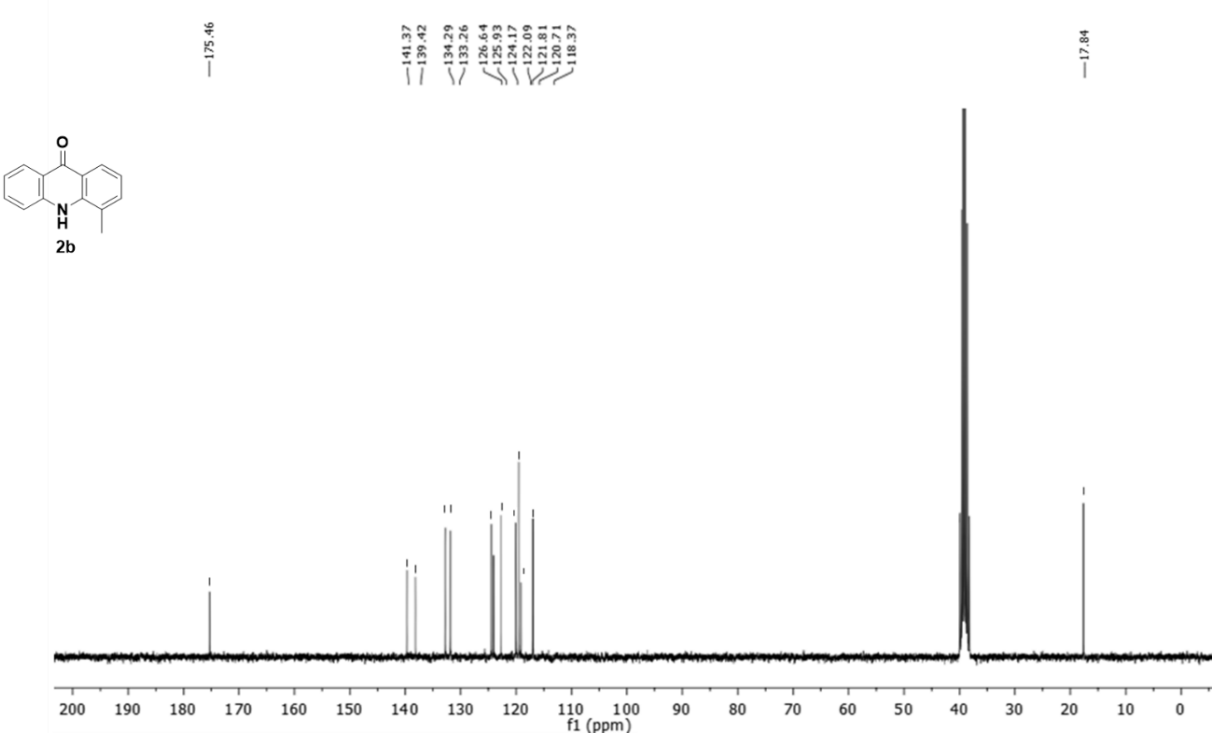
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of Acridin-9(10*H*)-one (**2a**).



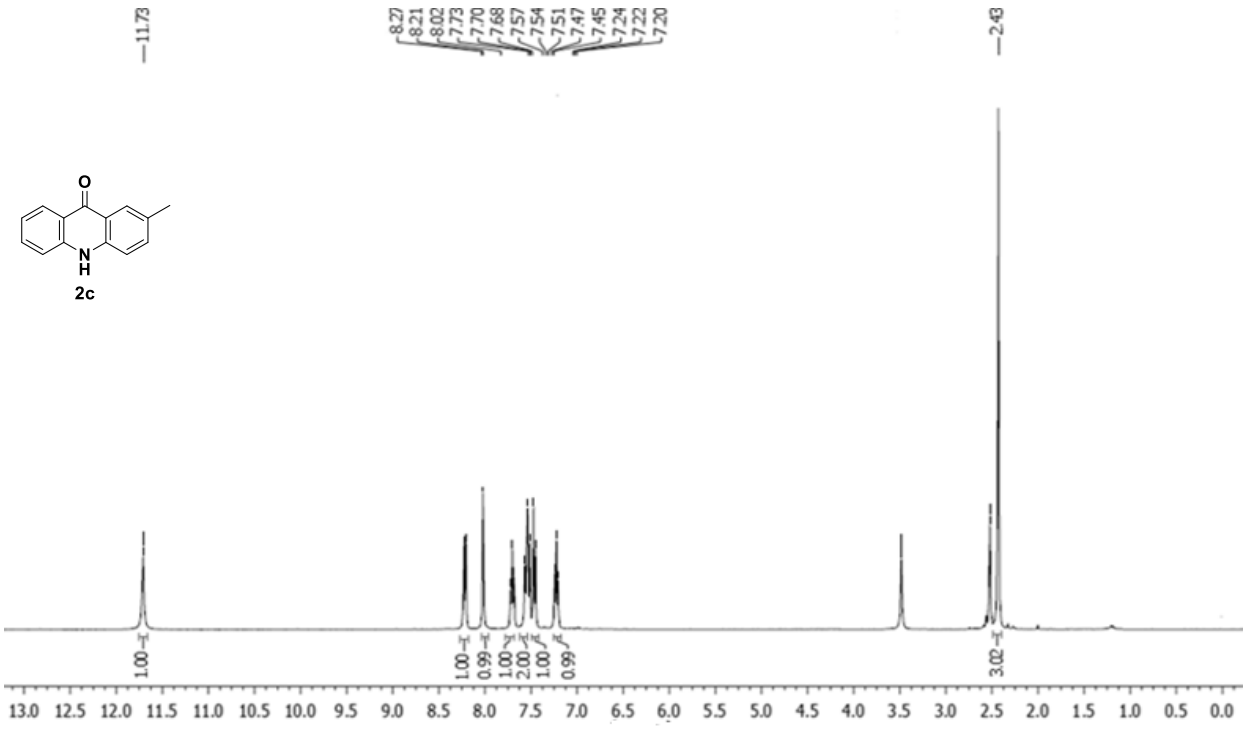
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of Acridin-9(10*H*)-one (**2a**).



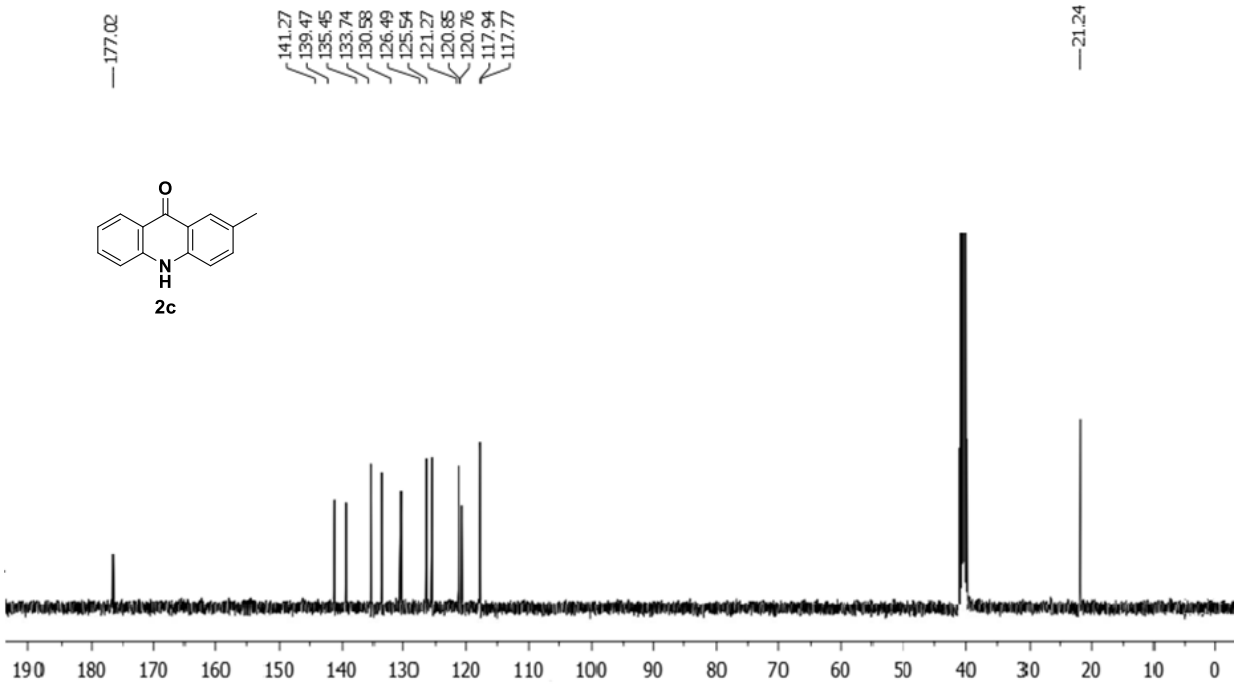
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 4-Methylacridin-9(10*H*)-one (**2b**).



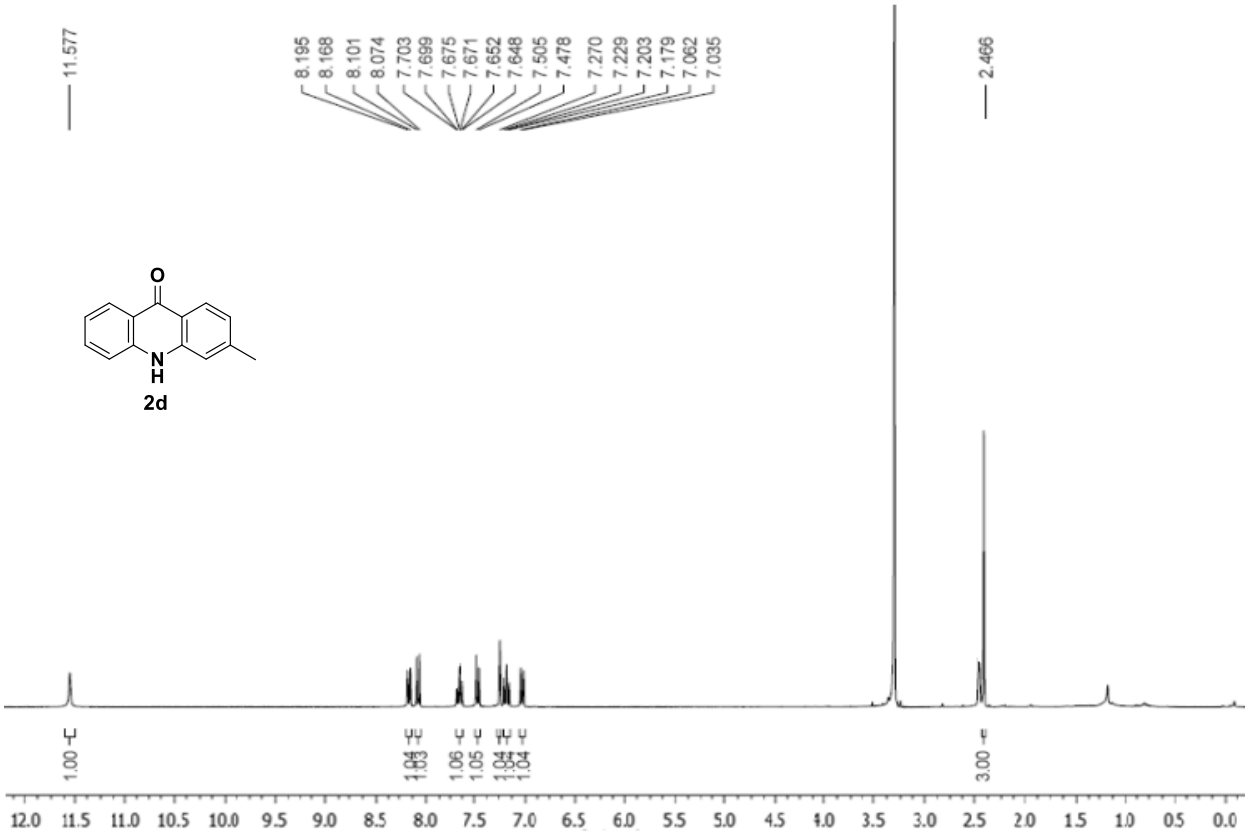
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 4-Methylacridin-9(10*H*)-one (**2b**).



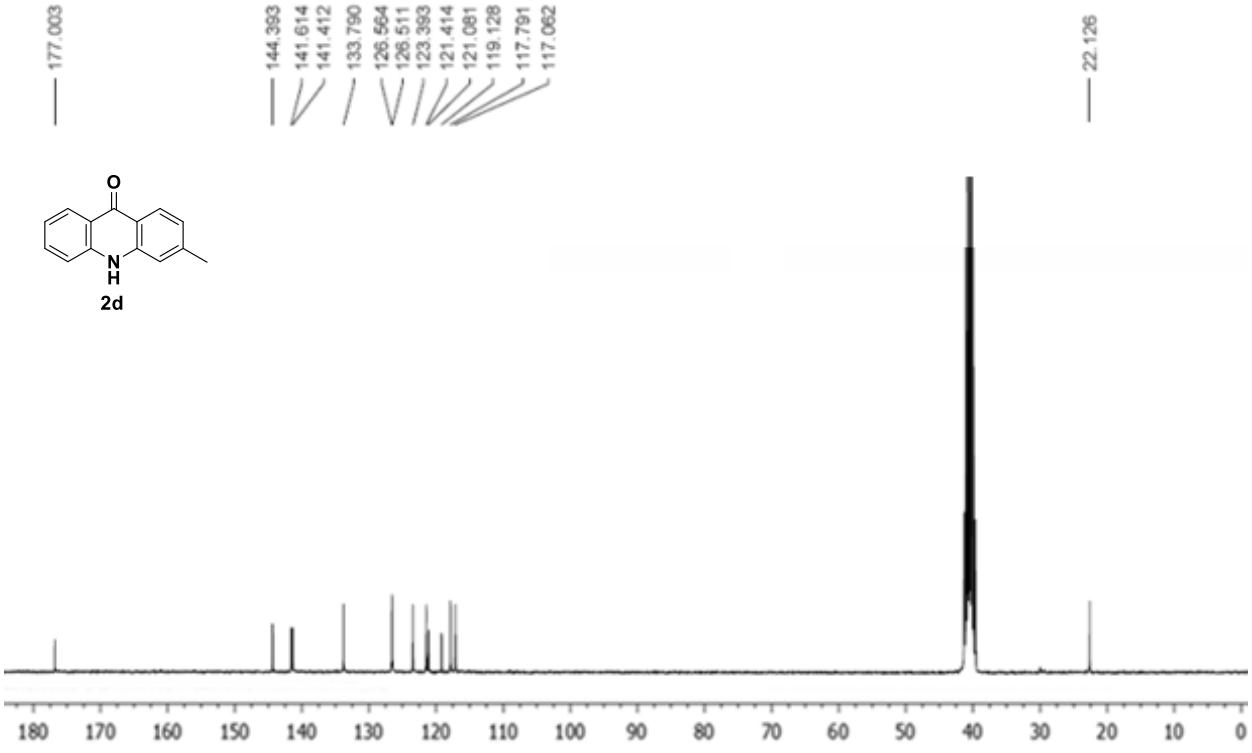
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 2-Methylacridin-9(10*H*)-one (**2c**).



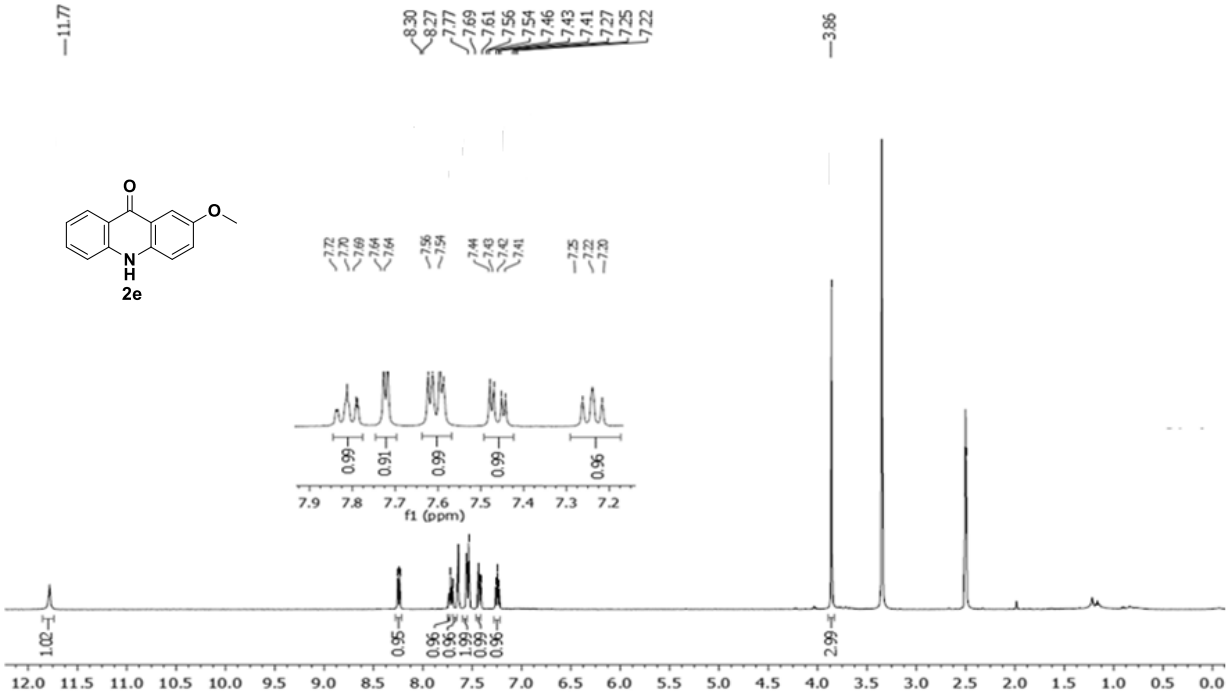
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 2-Methylacridin-9(10*H*)-one (**2c**).



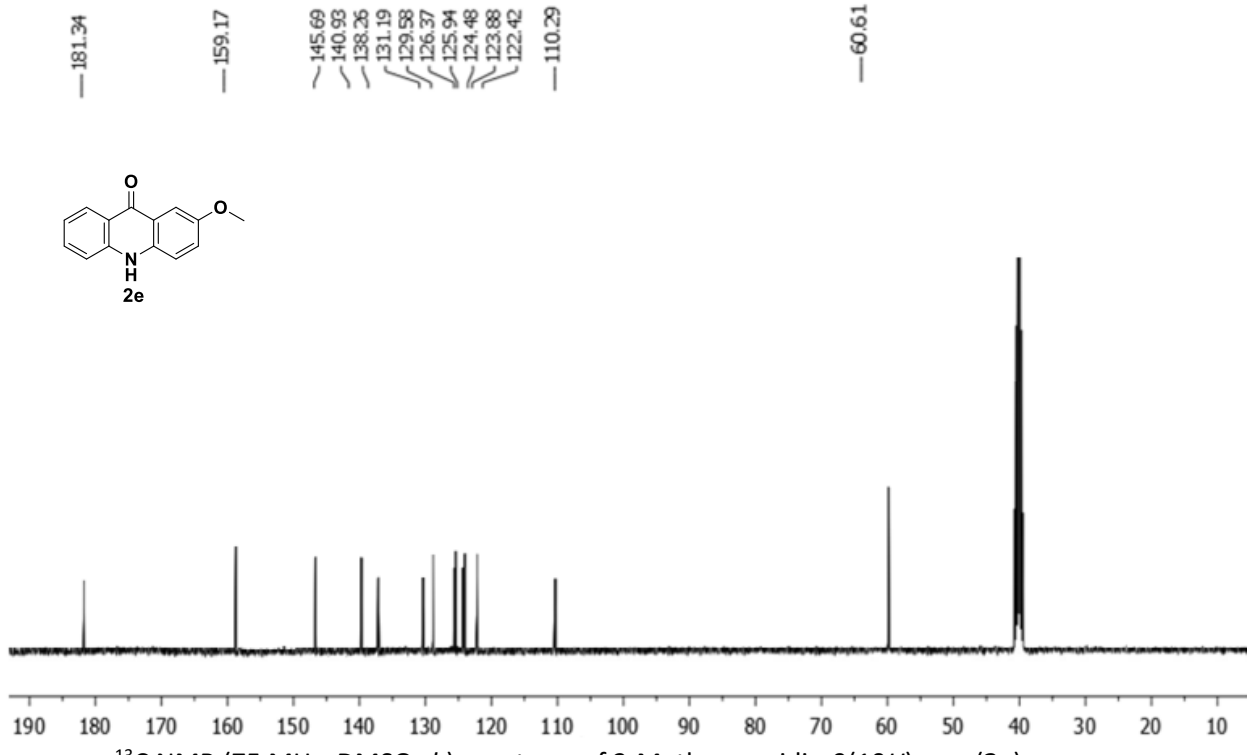
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 3-Methylacridin-9(10*H*)-one (**2d**).



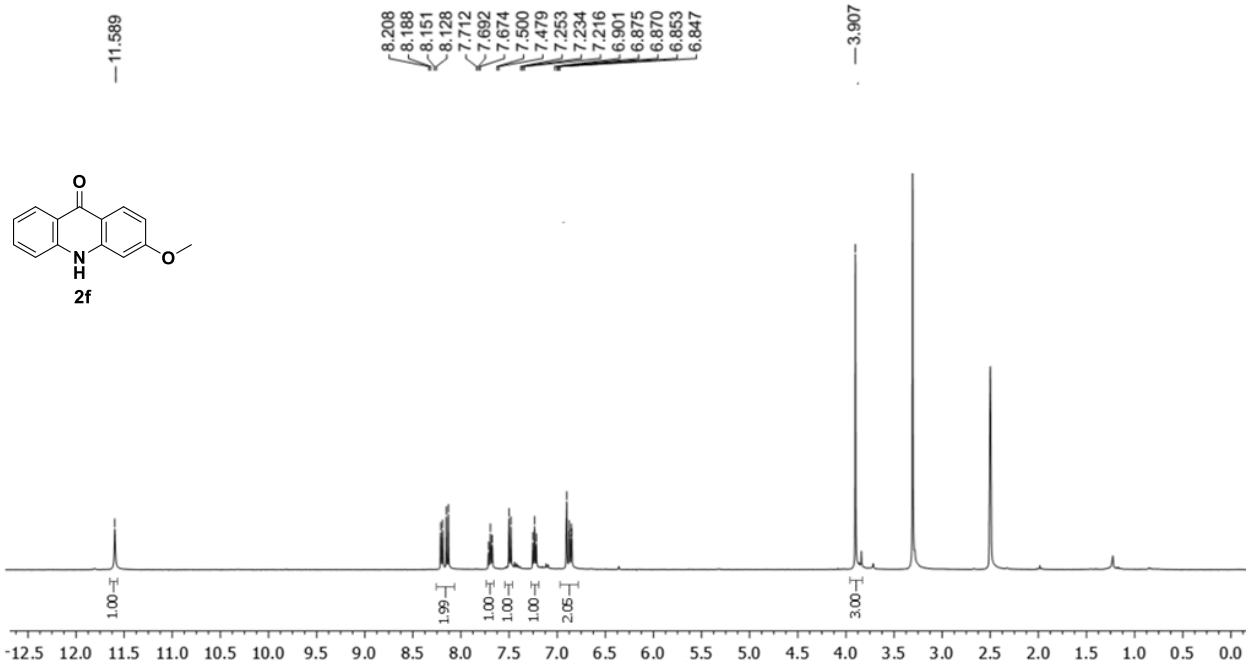
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 3-Methylacridin-9(10*H*)-one (**2d**).



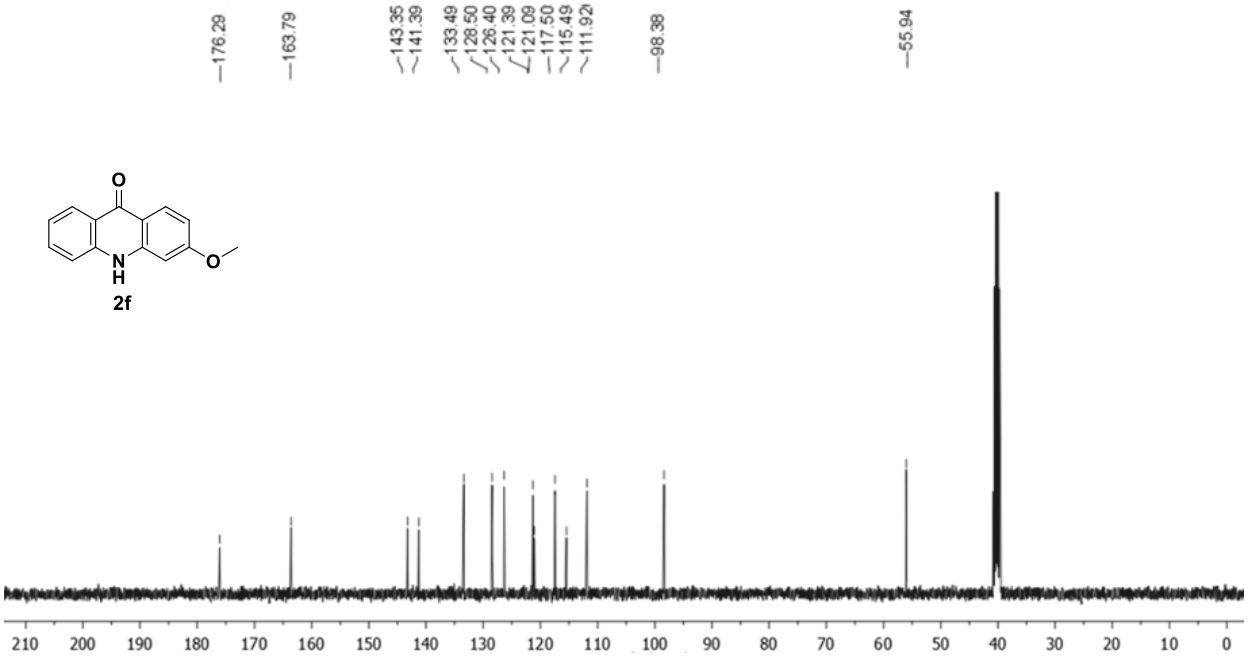
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 2-Methoxyacridin-9(10*H*)-one (**2e**).



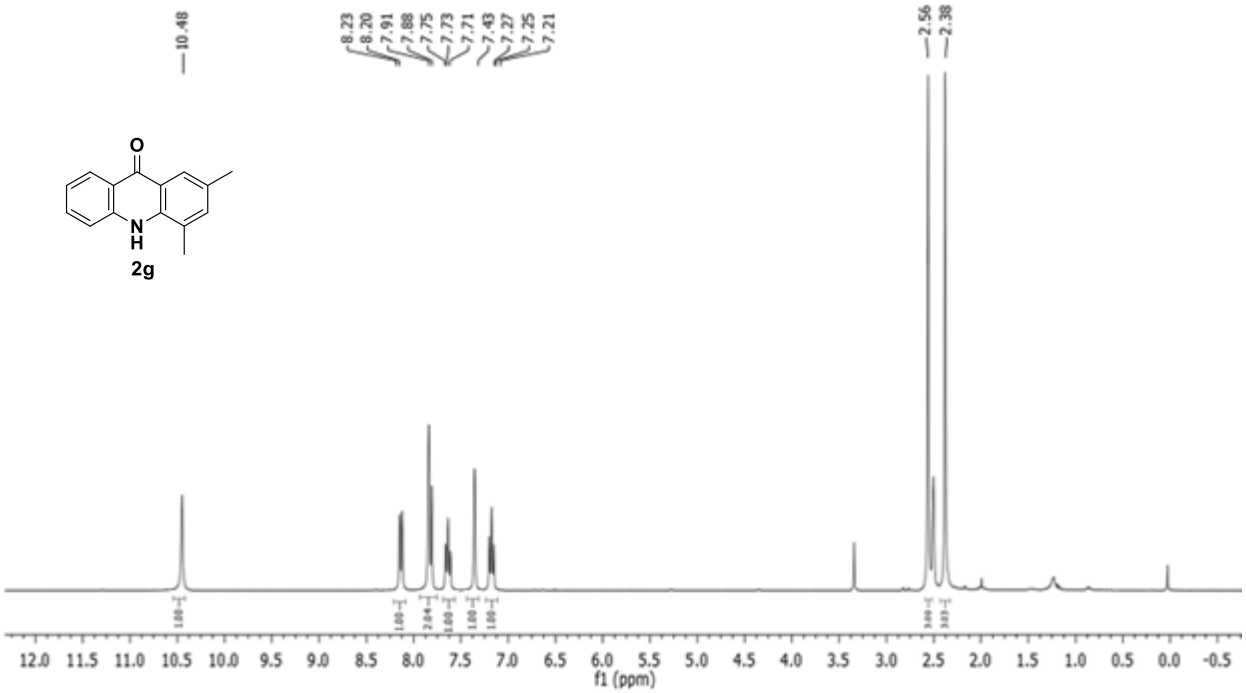
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 2-Methoxyacridin-9(10*H*)-one (**2e**).



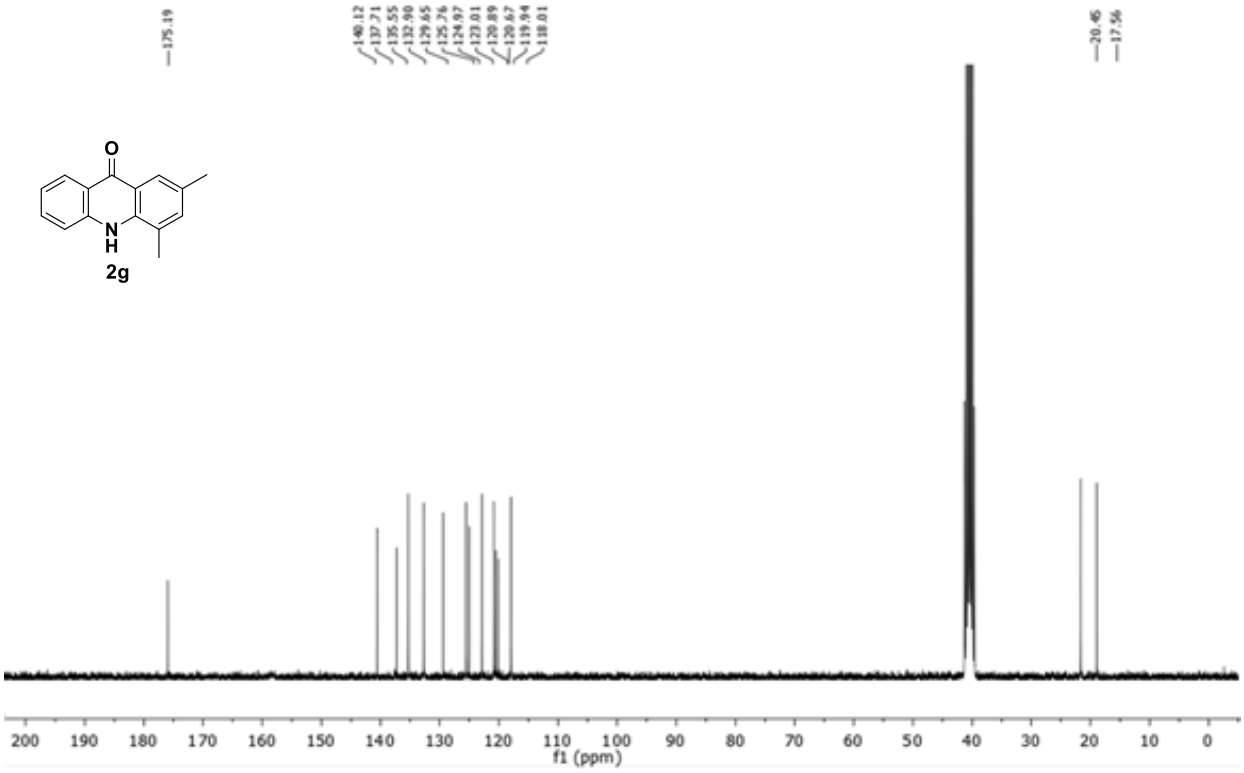
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 3-Methoxyacridin-9(10*H*)-one (**2f**).



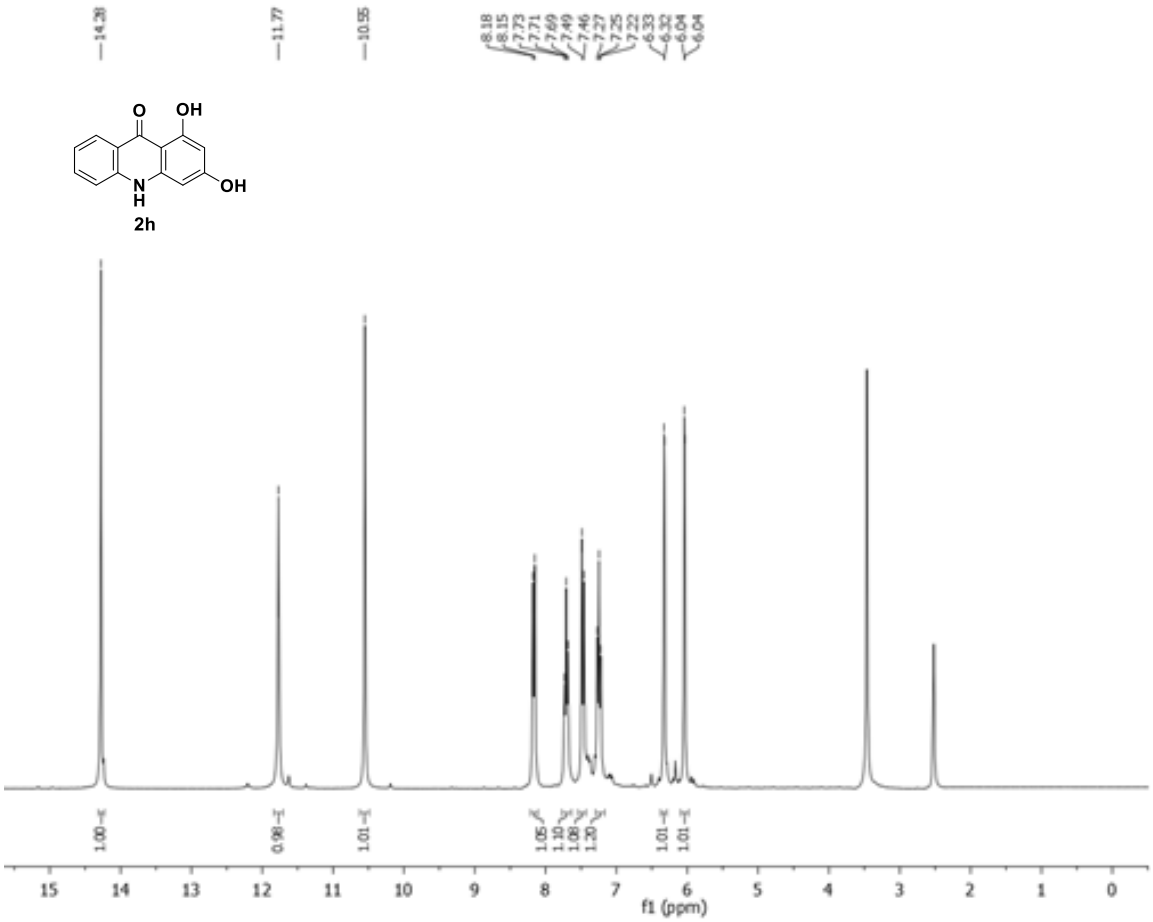
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 3-Methoxyacridin-9(10*H*)-one (**2f**).



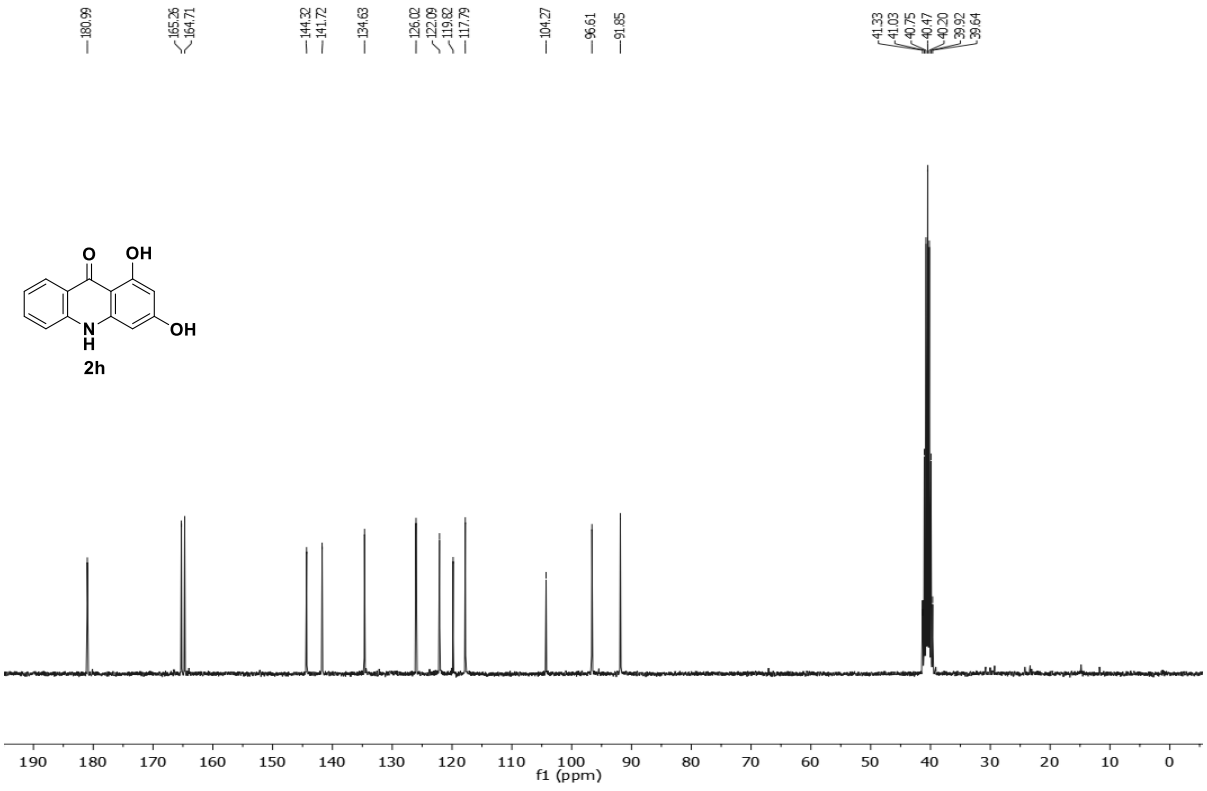
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 1,3-Dimethylacridin-9(10*H*)-one (**2g**).



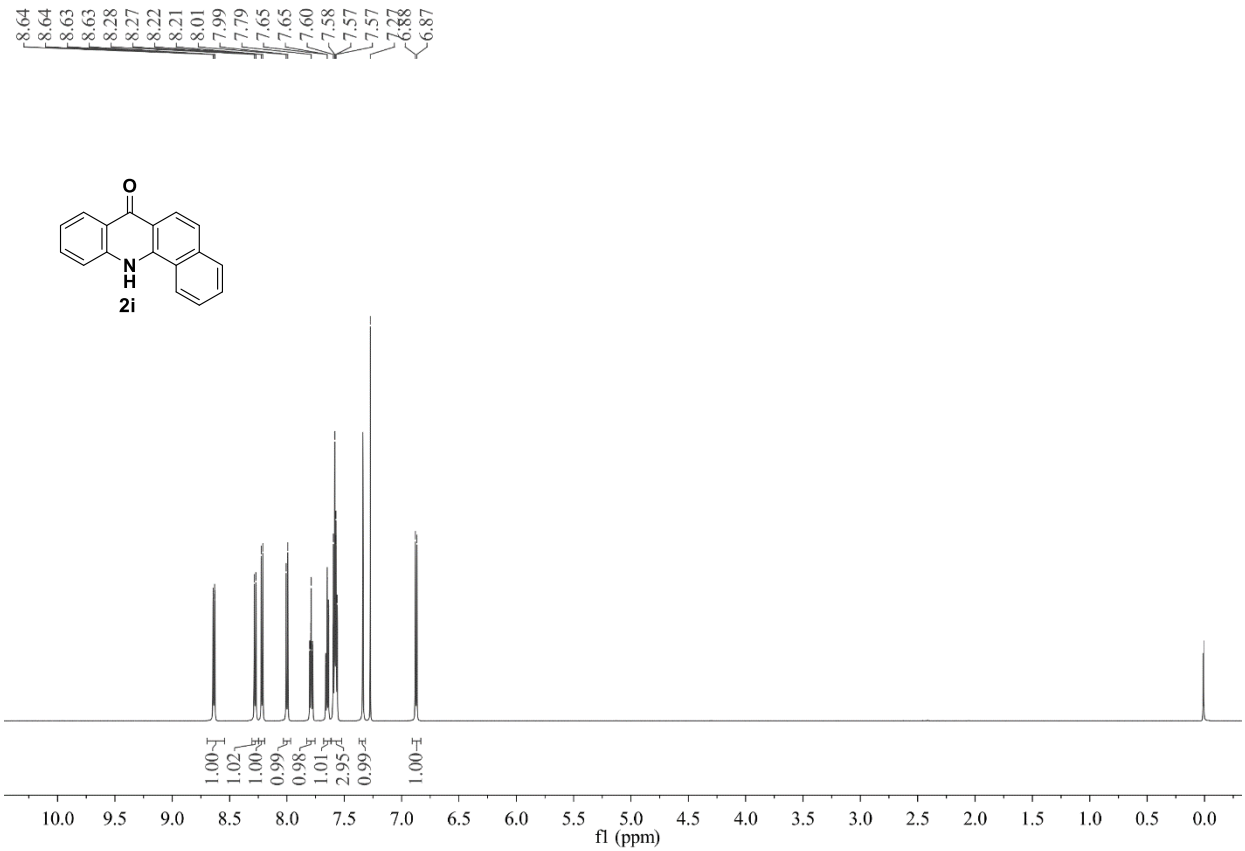
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 1,3-Dimethylacridin-9(10*H*)-one (**2g**).



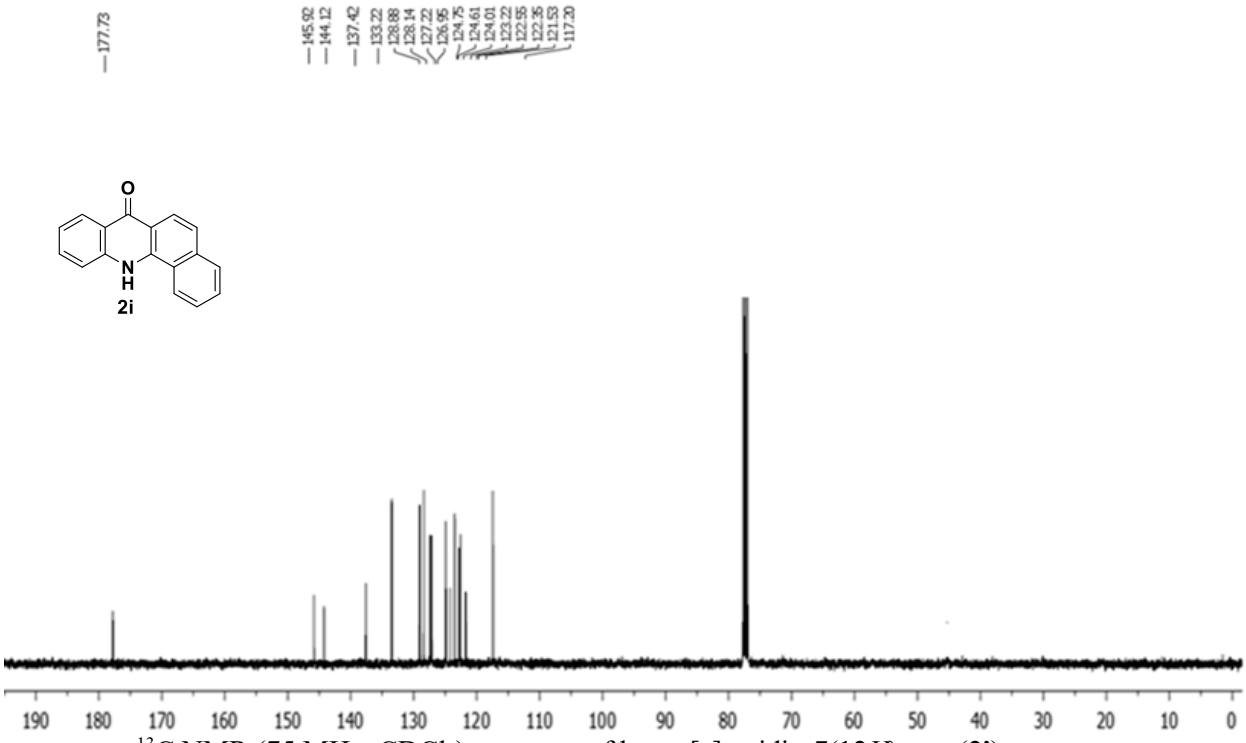
NMR (300 MHz, DMSO-d_6) spectrum of 1,3-Dihydroxyacridin-9(10*H*)-one (**2h**).



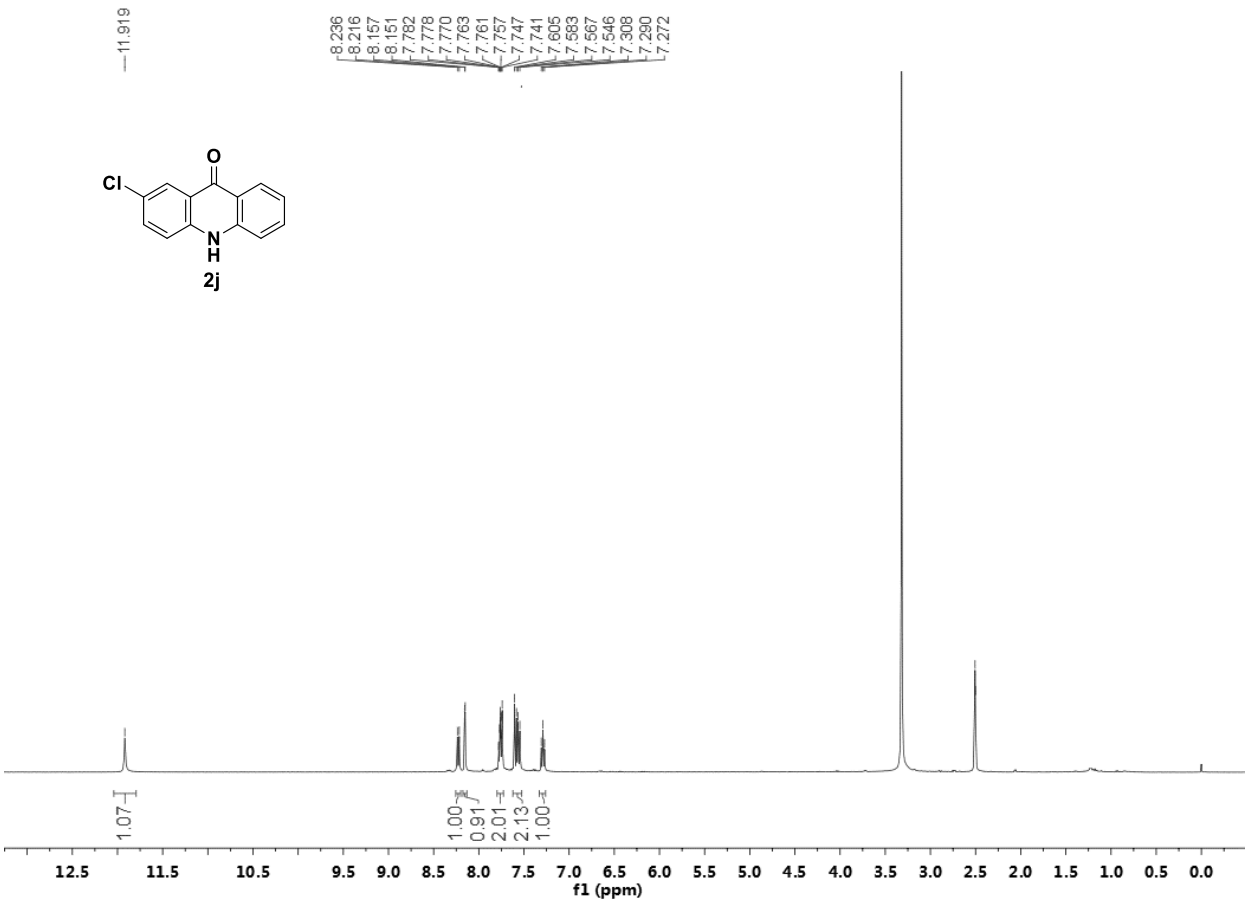
NMR (75 MHz, DMSO-d_6) spectrum of 1,3-Dihydroxyacridin-9(10*H*)-one (**2h**).



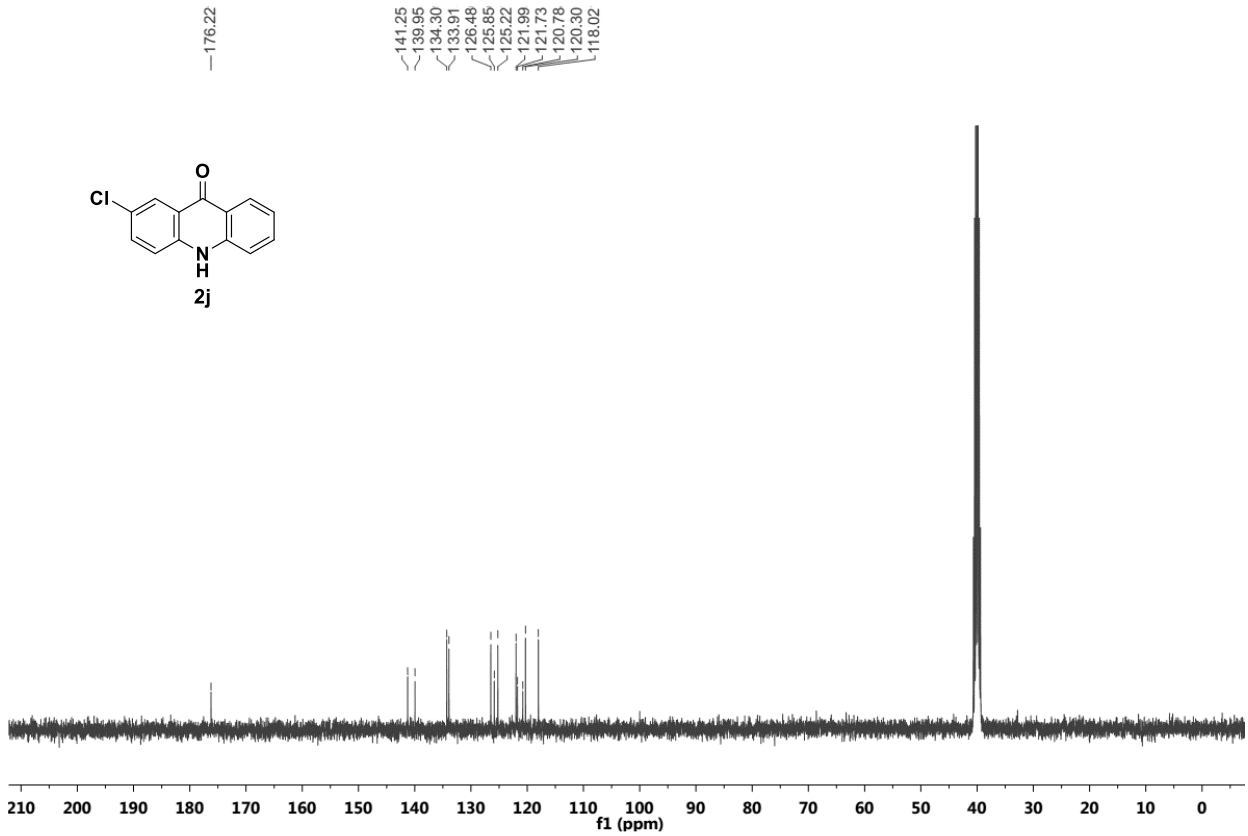
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of Benzo[c]acridin-7(12*H*)-one (**2i**).



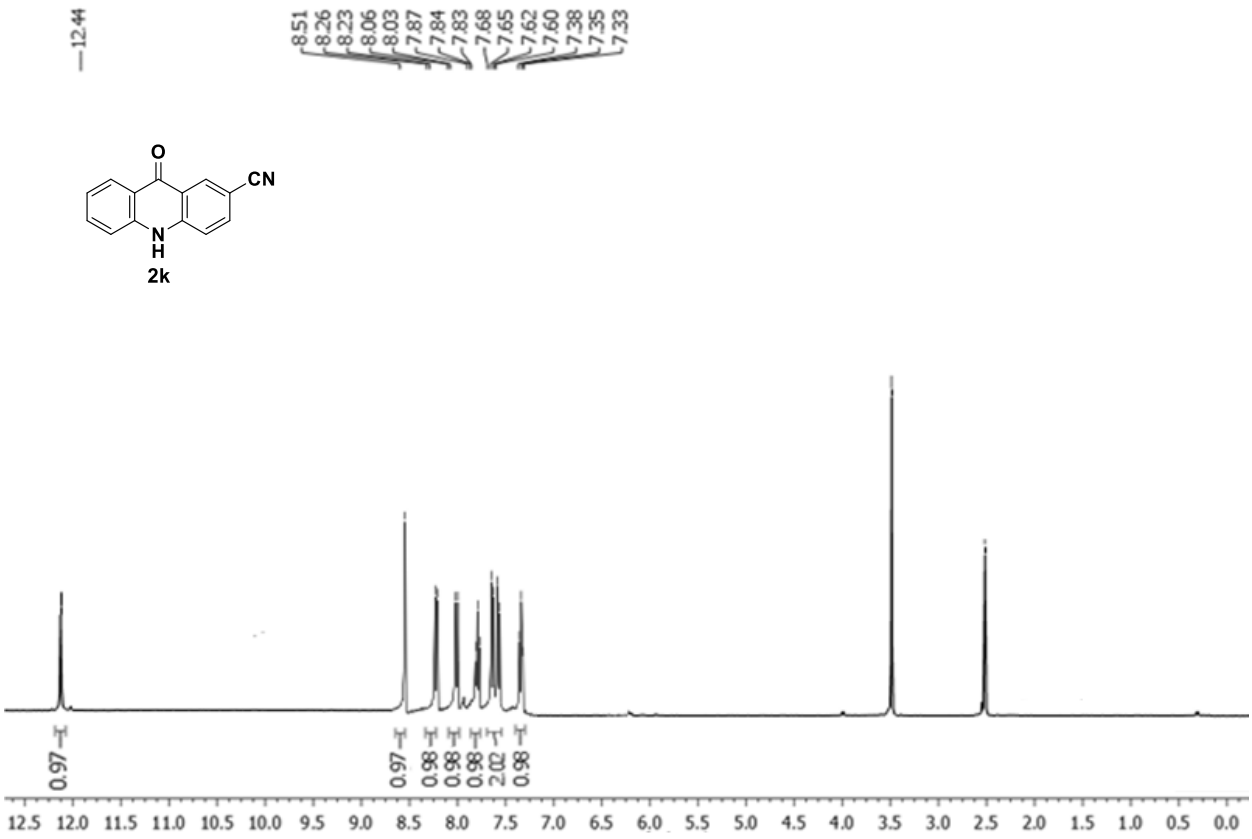
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of benzo[c]acridin-7(12*H*)-one (**2i**).



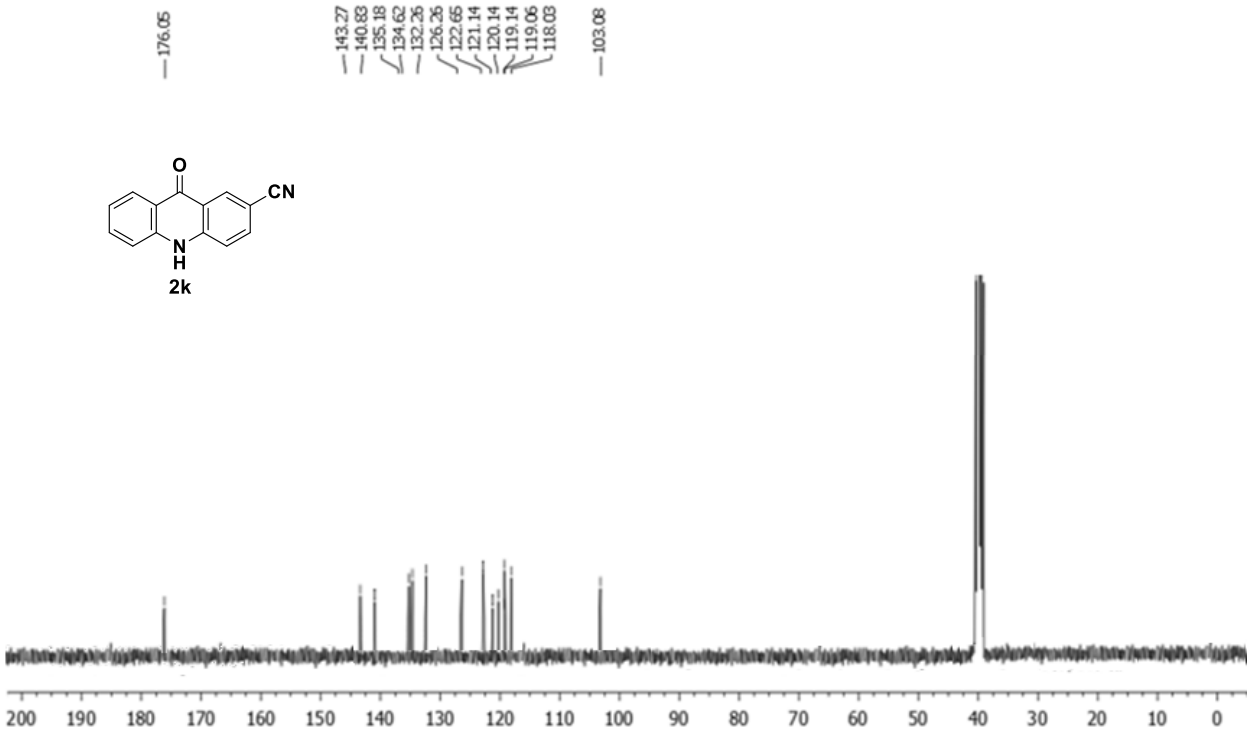
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 2-Chloroacridin-9(10*H*)-one (**2j**).



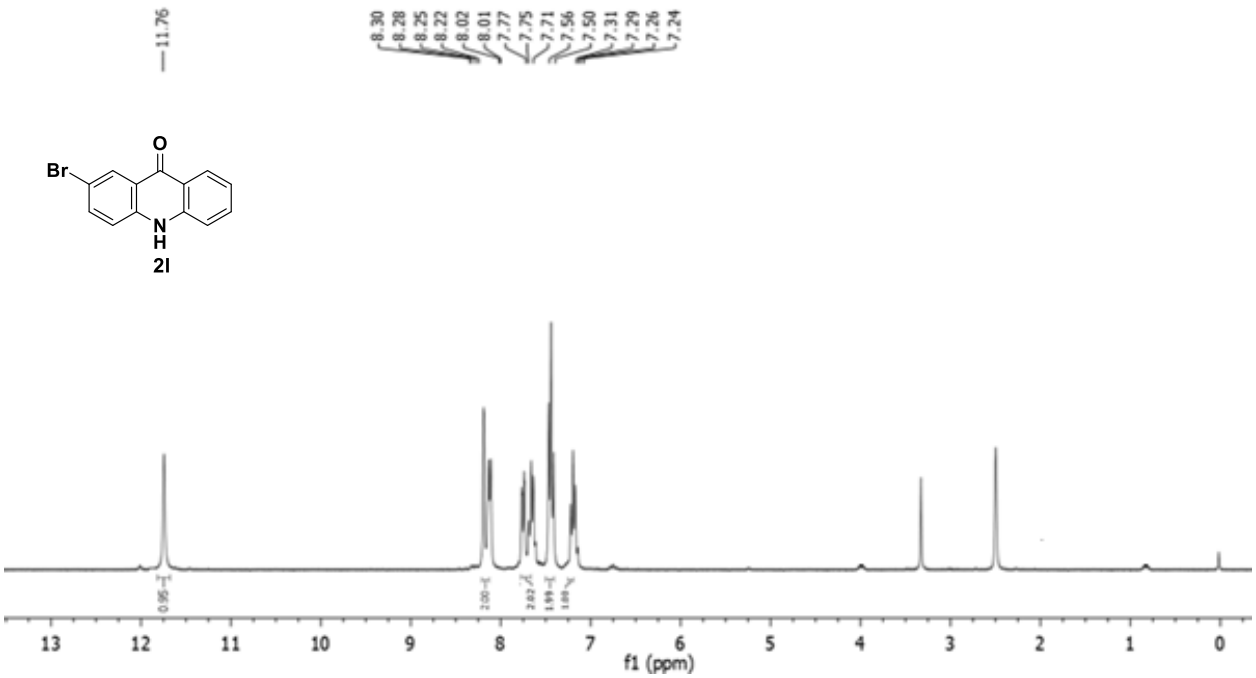
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 2-Chloroacridin-9(10*H*)-one (**2j**).



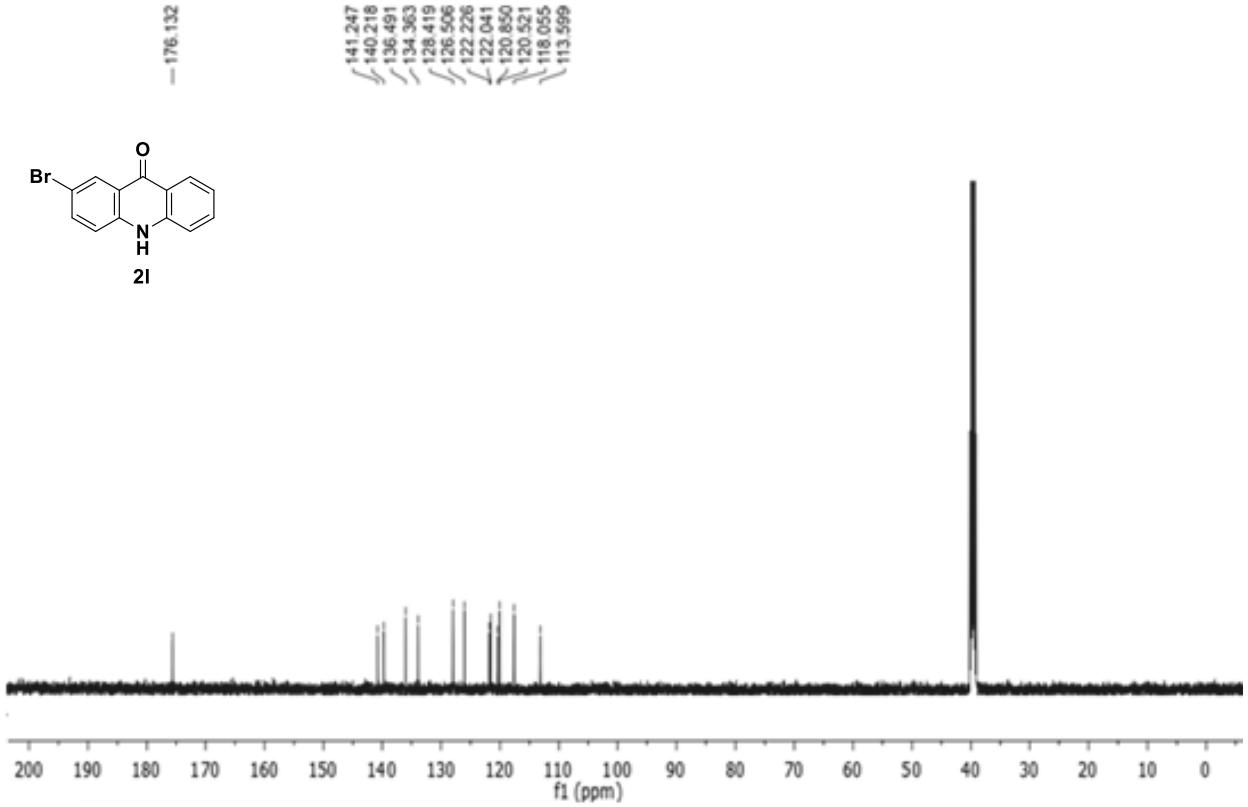
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 9-Oxo-9,10-dihydroacridine-2-carbonitrile (**2k**).



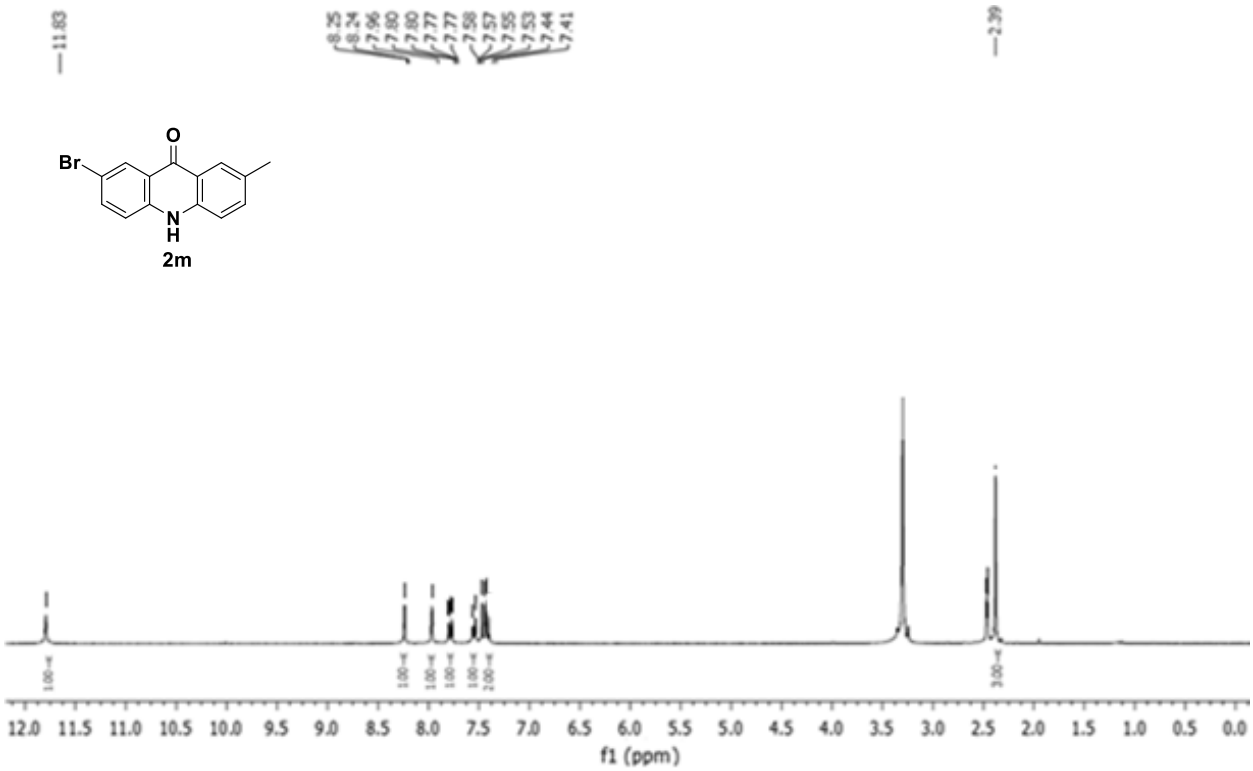
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 9-Oxo-9,10-dihydroacridine-2-carbonitrile (**2k**).



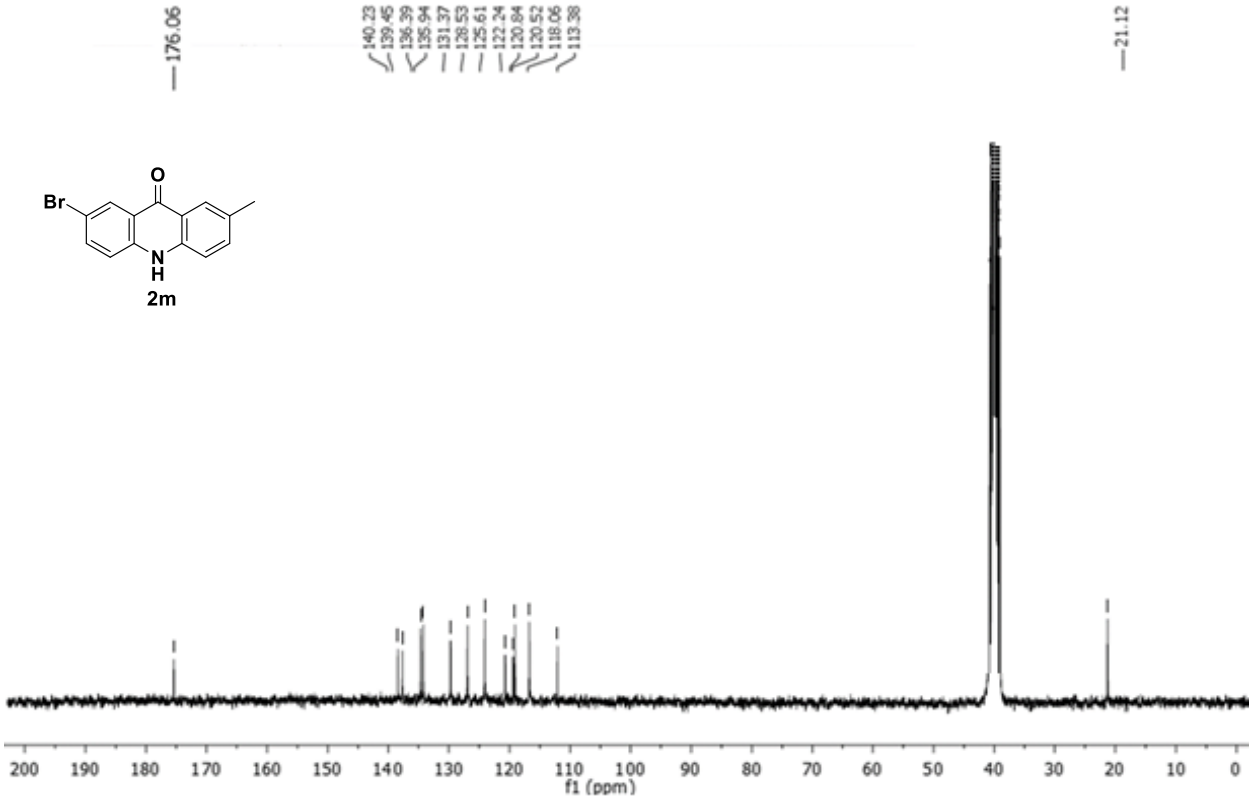
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 2-Bromoacridin-9(10*H*)-one (**2l**).



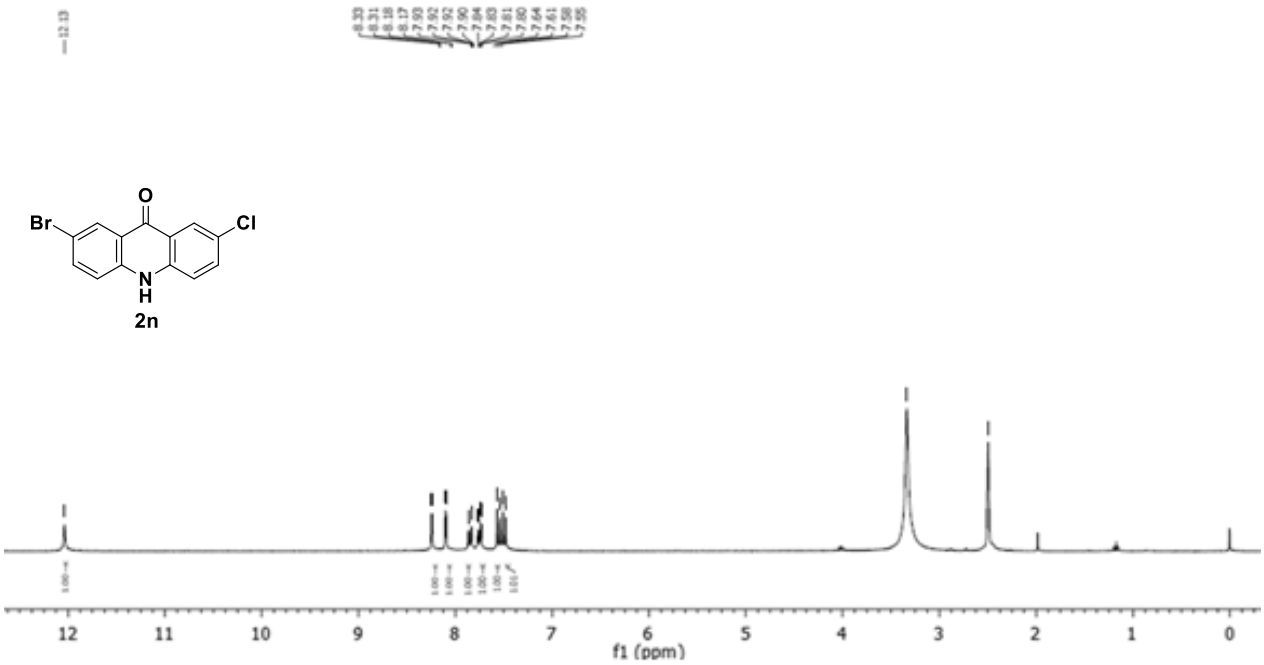
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 2-Bromoacridin-9(10*H*)-one (**2l**).



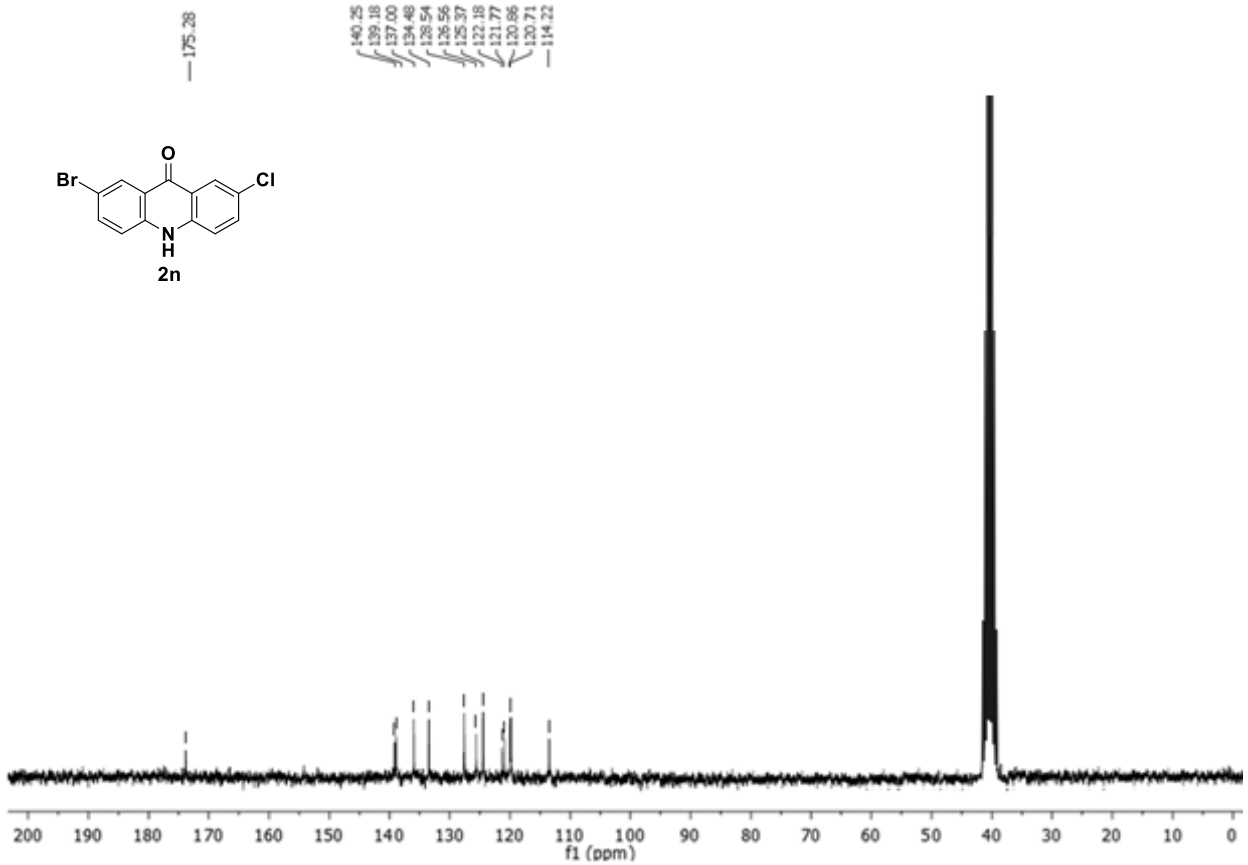
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 2-Bromo-7-methylacridin-9(10*H*)-one (**2m**).



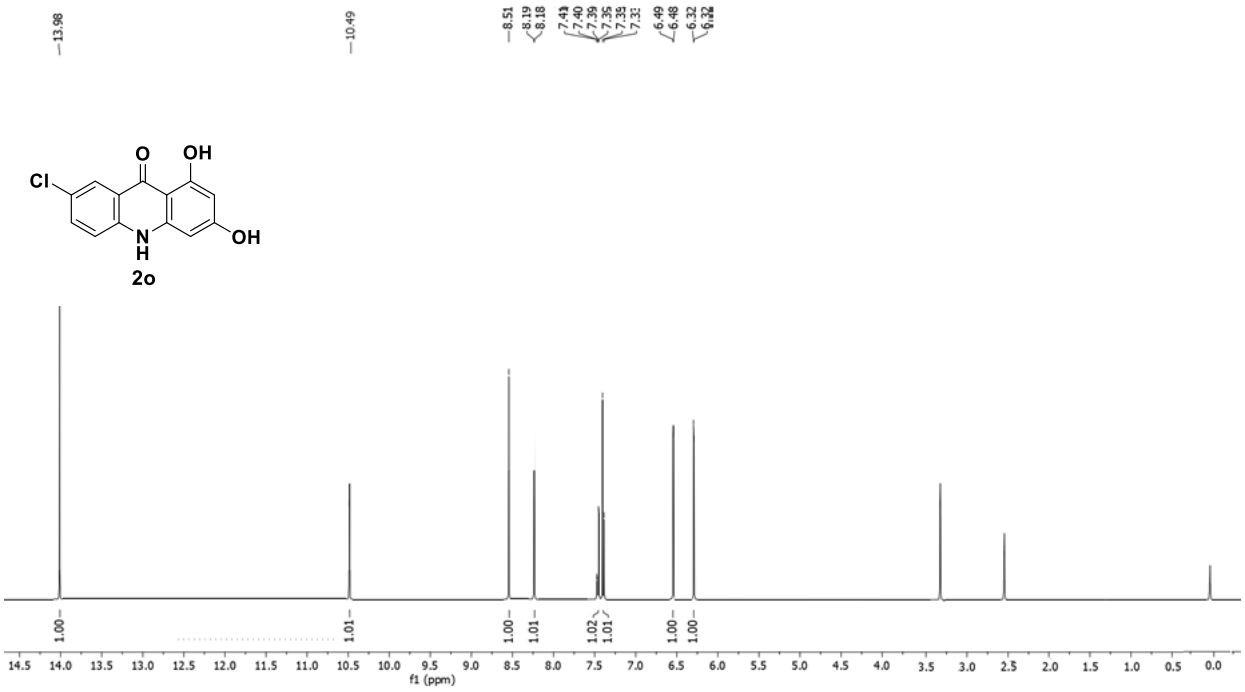
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 2-Bromo-7-methylacridin-9(10*H*)-one (**2m**).



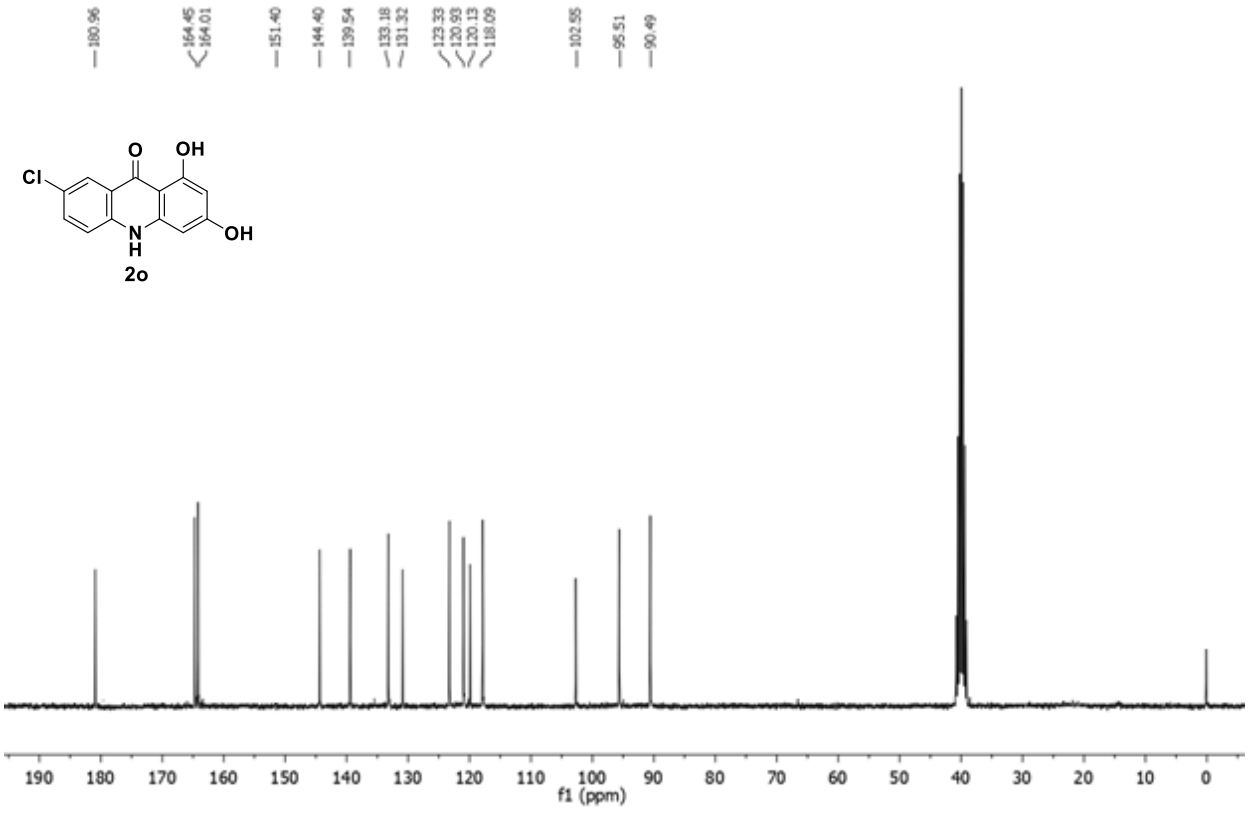
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 2-Bromo-7-chloroacridin-9(10*H*)-one (**2n**).



^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 2-Bromo-7-chloroacridin-9(10*H*)-one (**2n**).



^{1}H NMR (300 MHz, DMSO-d_6) spectrum of 7-Chloro-1,3-dihydroxyacridin-9(10*H*)-one (**2o**).



^{13}C NMR (75 MHz, DMSO-d_6) spectrum of 7-Chloro-1,3-dihydroxyacridin-9(10*H*)-one (**2o**).