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An unorthodox metal free synthesis of dihydro-6*H*-quinoline-5-ones in ethanol/water using a non-nucleophilic base and their cytotoxic studies on human cancer cell line

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Supplementary Information

➢ Experimental

General methods

Open capillary tubes on Kofler block apparatus was used for determining melting points of the compounds and are uncorrected. Perkin Elmer RXI FTIR spectrophotometer for recording IR spectra using KBr discs in cm^{-1}. Bruker AV-300 Supercon NMR spectrometer was used for recording NMR spectra (^{1}H, ^{13}C) in $CDCl_3$ or DMSO-D_6 solution in 5 mm BBO probe fitted with a pulse field gradient and working with Topsin 1.3 programme (chemical shifts in δ ppm and J in Hz). Bruker Smart Apex 2 diffractometer equipped with a CCD area detector with graphite monochromatized Mo K_α radiation was used for collecting X-ray crystallographic data. Further information on the crystal structure investigations may be obtained from Cambridge Crystallographic Data Center CCDC, 12 Union Road, Cambridge CB2 1EZ, UK, fax (+44-(0)1223-336033 or email: (deposit@ccdc.cam.ac.uk) on quoting the depository numbers.

➢ General Procedure for the study of in Vitro Evaluation of Anticancer Activity.

Chemicals and reagents

3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) (Sigma) and Dimethyl sulfoxide (DMSO) (Merck) were used in cell viability assays. Sodium bicarbonate ($NaHCO_3$) (Himedia) were used in cell culture. Ethylenediaminetetraacetic acid (EDTA), Tris(hydroxymethyl)-aminomethane (Tris), Acetic acid (Merck), Agarose, Ethidium bromide (EtBr) (Sigma) were used for Agarose gel (1.5%) electrophoresis and Acridine Orange (Sigma) was used for fluorescence microscopic study.

Cell line

To determine cytotoxic potential and IC_{50} doses, HeLa cell line was used. HeLa cells are Human Papilloma virus (HPV) 18 positive cervical carcinoma cell line, showing high risk of E6 and E7 oncoproteins [45] and low level of p53. Immortal HeLa cell line can be grown indefinitely in culture. The original cell was isolated from malignant tumor from the body of a 31-year-old African American woman, named Henrietta Lacks. The cells were collected by Dr. George Gey, in 1951.

Cancer cell maintenance

HeLa cell line, used in this study, was collected from NCCS, Pune, India. It was maintained in Dalbacco's Minimal Essential Medium or DMEM (high glucose content) (HiMedia) containing glutamine, sodium pyruvate and non- essential amino acids supplemented with 10% FBS (Gibco) and 1x Antibiotic-antimycotic solution (HIMEDIA, containing Penicillin, Streptomycin, Amphotericin B). Cell line was maintained in a humidified incubator at 37^0 C (Thermo Scientific) and 5% CO_2 with standard ATCC protocol.

➢ Characterization of the products

7,7-dimethyl-2-phenyl-7,8-dihydroquinolin-5(6*H*)-one (3a)

Yield: 92% (0.231 g), MP: `64 °C, White crystalline solid; IR υ_{max} (KBr): 2952, 2866, 1679, 1582, 1444, 1304, 1121, 837, 752; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.05 (6H, s), 2.48 (2H, s), 3.03 (2H, s), 7.37-7.44 (3H, m), 7.62 (1H, d, *J* = 8.1 Hz), 7.96-7.99 (2H, m), 8.23 (1H, d, *J* = 8.1 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 28.3, 32.9, 46.6, 52.0, 118.7, 125.5, 127.4, 128.8, 129.9, 135.3, 138.3, 160.9, 162.3, 197.7; Analysis Calculated for $C_{17}H_{17}NO$ C: 81.24; H: 6.82; N: 5.57; O: 6.37% found C: 82.20; H: 6.80; N: 5.80; O: 5.37%

2-(4-bromophenyl)-7,7-dimethyl-7,8-dihydroquinolin-5(6*H*)-one (3b)

Yield: 95%, (0.314 g), MP: 120 °C , Red crystalline solid, IR υ_{max} (KBr): 2950, 2869, 2342, 1679, 1576, 1413, 1302, 1074, 1009, 824; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.14 (6H, s), 2.57 (2H, s), 3.12 (2H, s), 7.60-7.69 (3H, m), 7.94 (2H, d, *J* = 8.7 Hz), 8.32 (1H, d, *J* = 8.1 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 28.3, 32.9, 46.3, 52.1, 118.9, 124.9, 125.9, 129.1, 132.1, 135.9, 136.7, 159.7, 162.3, 197.4; Analysis Calculated for $C_{17}H_{16}BrNO$ C: 61.83; H: 4.88; Br: 24.20; N: 4.24; O: 4.85 % found C: 62.08; H: 4.57; Br: 25.16; N: 4.37; O: 6.12 %

2-(4-chlorophenyl)-7,7-dimethyl-7,8-dihydroquinolin-5(6*H*)-one (3c)

Yield: 96%, (0.274 g), MP: 98 °C , White crystalline solid; IR υ_{max} (KBr): 2951, 2365, 1684, 1577, 1443, 1416, 1382, 1305, 1280, 1090, 809; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.14 (6H, s), 2.57 (2H, s), 3.11 (2H, s), 7.46 (2H, d, *J* = 8.4 Hz), 7.68 (1H, d, *J* = 8.1 Hz), 8.01 (2H, d, *J* = 8.4 Hz), 8.32 (1H, d, *J* = 8.1 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 28.3, 32.9, 46.5, 52.0, 118.7, 125.8, 128.8, 129.1, 135.7, 136.4, 136.5, 159.6, 162.3, 197.5; Analysis Calculated for $C_{17}H_{16}ClNO$ C: 71.45; H: 5.64; Cl: 12.41; N: 4.90; O: 5.60 % found C: 70.68; H: 4. 42; Cl: 13.73; N: 5.08; O: 4.98 %

7,7-dimethyl-2-(3-nitrophenyl)-7,8-dihydroquinolin-5(6*H*)-one (3d)

Yield: 97%, (0.287 g), MP: 122 °C , Yellow crystalline solid; IR υ_{max} (KBr): 3442, 3092, 2933, 2869, 1688, 1581, 1526, 1442, 1350, 1301, 1195, 836; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.03 (6H, s), 2.47 (2H, s), 3.04 (2H, s), 7.56 (1H, t, *J* = 7.8, 8.1 Hz), 7.68 (1H, d, *J* = 8.1 Hz), 8.17-8.19 (1H, m), 8.26-8.31 (2H, m), 8.82 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 28.2, 30.8, 32.9, 46.5, 52.0, 118.9, 122.4, 124.4, 126.5, 129.8, 133.1, 135.9, 139.9, 148.8, 158.1, 162.6, 197.4;

Analysis Calculated for $C_{17}H_{16}N_2O_3$ C: 68.91; H: 5.44; N: 9.45; O: 16.20 % found C: 69.03; H: 4.94; N: 10.05; O: 17.97 %

7,7-dimethyl-2-(4-nitrophenyl)-7,8-dihydroquinolin-5(6*H*)-one (3e)

Yield: 93%, (0.276 g), MP: 126 °C, Yellow crystalline solid; IR υ_{max} (KBr): 2930, 2375, 2346, 1685, 1580, 1513, 1420, 1379, 1342, 1305, 836, 850; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.13 (6H, s), 2.58-2.66 (2H, m), 3.11 (2H, s), 7.77 (1H, s), 8.21-8.24 (2H, m), 8.31-8.37 (3H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 28.1, 32.8, 46.5, 51.9, 119.3, 123.9, 124.5, 125.1, 127.3, 128.1, 128.7, 135.6, 137.1, 138.9, 139.3, 161.3, 162.2, 197.6; Analysis Calculated for $C_{17}H_{16}N_2O_3$ C: 68.91; H: 5.44; N: 9.45; O: 16.20 % found C: 68.37; H: 4.98; N: 10.10; O: 16.03

2-(4-methoxyphenyl)-7,7-dimethyl-7,8-dihydroquinolin-5(6*H*)-one (3f)

Yield: 96%, (0.270 g), MP: 114 °C, White crystalline solid, IR υ_{max} (KBr): 2961, 2346, 1676, 1579, 1510, 1451, 1421, 1330, 1310, 1108, 1026, 815; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.13 (6H, s), 2.55 (2H, s), 3.08 (2H, s), 3.87 (3H, s), 6.99 (2H, d, J = 8.7 Hz), 7.64 (1H, d, J = 8.4 Hz), 8.04 (2H, d, J = 8.7 Hz), 8.26 (1H, d, J = 8.1 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 28.3, 30.8, 32.9, 46.5, 52.0, 55.4, 114.3, 118.0, 125.0, 128.9, 130.7, 135.4, 160.6, 161.4, 162.2, 197.7 Analysis Calculated for $C_{18}H_{19}NO_2$ C: 76.84; H: 6.81; N: 4.98; O: 11.37 % found C: 76.41; H: 7.07; N: 5.13; O: 12.06 %

7,7-dimethyl-2-(p-tolyl)-7,8-dihydroquinolin-5(6*H*)-one (3g)

Yield: 94%, (0.249 g), MP: 118 °C, White crystalline solid, IR υ_{max} (KBr): 2952, 2874, 2341, 1676, 1582, 1450, 1304, 1183, 805, 755; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.13 (6H, s), 2.41 (3H, s), 2.55 (2H, s), 3.09 (2H, s), 7.26-7.30 (2H, m), 7.67 (1H, d, J = 8.1), 7.96 (2H, d, J = 8.1 Hz), 8.28 (1H, d, J = 8.1 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.3, 28.2, 32.9, 46.7, 52.1, 118.4, 125.3, 127.2, 127.3, 127.4, 129.4, 129.5, 129.6, 135.2, 135.6, 140.2, 161.0, 162.2, 197.7;

Analysis Calculated for $C_{18}H_{19}NO$ C: 81.47; H: 7.22; N: 5.28; O: 6.03 % found C: 81.08; H: 6.98; N: 5.62; O: 5.91 %

3,7,7-trimethyl-2-phenyl-7,8-dihydroquinolin-5(6*H*)-one (3h)

Yield: 96%, (0.255 g), MP: 78 °C, White crystalline solid, IR υ_{max} (KBr): 2951, 2869, 2368, 1680, 1591, 1550, 1448, 1420, 1330, 1312, 1232, 1199, 1006, 977, 921, 746, 703; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.07 (6H, s), 2.32 (3H, s), 2.50 (2H, s), 3.00 (2H, s), 7.35-7.43 (3H, m), 7.48-7.51 (2H, m), 8.09 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 19.6, 28.2, 28.3, 32.9, 46.1, 52.1, 125.5, 128.1, 128.2, 128.3, 128.5, 128.6, 128.7, 128.8, 129.4, 136.5, 139.8, 159.3, 162.9, 198.2; Analysis Calculated for $C_{18}H_{19}NO$ C: 81.47; H: 7.22; N: 5.28; O: 6.03 % found C: 80.93; H: 6.87; N: 5.19; O: 5.96 %

2-phenyl-7,8-dihydroquinolin-5(6*H*)-one (4a)

Yield: 91%, (0.203 g), MP: 76 °C, White crystalline solid, IR υ_{max} (KBr): 3456, 2949, 1683, 1579, 1489, 1451, 1417, 1385, 1333, 1280, 1187, 1130, 1009, 820, 863; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.18-2.26 (2H, m), 2.71 (2H, t, *J* = 6.9, 6.0 Hz), 3.25 (2H, t, *J* = 6.0, 6.3 Hz), 7.44-7.52 (3H, m), 7.70 (1H, d, *J* = 8.1 Hz), 8.04-8.07 (2H, m), 8.34 (1H, d, *J* = 8.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.9, 32.6, 38.6, 119.2, 126.7, 127.5, 127.6, 127.7, 128.8, 128.9, 130.2, 136.2, 138.0, 160.6, 163.7, 197.6; Analysis Calculated for $C_{15}H_{13}NO$ C: 80.69; H: 5.87; N: 6.27; O: 7.17 % found C: 81.03; H: 6.01; N: 5.89; O: 7.21 %

2-(4-bromophenyl)-7,8-dihydroquinolin-5(6*H*)-one (4b)

Yield: 97%, (0.293 g), MP: 110°C, Red crystalline solid; IR υ_{max} (KBr): 2925, 1680, 1577, 1451, 1415, 1383, 1343, 1184, 1129, 1022, 1004, 818, 771; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.09-2.19 (2H, m), 2.63 (2H, t, *J* = 6.9, 6.3 Hz), 3.17 (2H, t, *J* = 6.3, 6.0 Hz), 7.53 (2H, d, *J* =

8.4 Hz), 7.60 (1H, d, *J* = 8.4 Hz), 7.84-7.87 (2H, m), 8.27 (1H, d, *J* = 8.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.7, 32.3, 38.4, 118.9, 124.9, 126.8, 128.9, 129.0, 129.1, 131.9, 132.0, 136.4, 159.1, 163.5, 197.2; Analysis Calculated for $C_{15}H_{12}BrNO$ C: 59.62; H: 4.00; Br: 26.44; N: 4.64; O: 5.29 % found C: 60.04; H: 3.97; Br: 26.19; N: 5.13; O: 4.99 %

2-(4-chlorophenyl)-7,8-dihydroquinolin-5(6*H*)-one (4c)

Yield: 96%, (0.247 g), MP: 94°C, White crystalline solid, IR υ_{max} (KBr): 2921, 1683, 1498, 1463, 1419, 1371, 1339, 1176, 1124, 1103, 1067, 1005, 884, 819, 763; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.08-2.19 (2H, m), 2.65 (2H, t, *J* = 6.9, 6.3 Hz), 3.22 (2H, t, *J* = 6.0, 6.3 Hz), 7.33-7.40 (2H, m), 7.62 (1H, d, *J* = 8.4 Hz), 7.89-7.96 (2H, m), 8.30 (1H, d, *J* = 8.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.7, 31.9, 38.4, 119.6, 127.1, 129.1, 129.2, 129.3, 135.1, 137.1, 137.2, 158.8, 163.3, 196.8; Analysis Calculated for $C_{15}H_{12}ClNO$ C: 69.91; H: 4.69; Cl: 13.76; N: 5.43; O: 6.21 % found C: 70.07; H: 4.61; Cl: 13.99; N: 4.98; O: 5.98 %

2-(3-nitrophenyl)-7,8-dihydroquinolin-5(6*H*)-one (4d)

Yield: 94%, (0.252 g), MP: 155 °C, Yellow crystalline solid; IR υ_{max} (KBr): 3448, 3075, 2954, 1679, 1580, 1521, 1484, 1443, 1399, 1349, 1272, 1180, 1133, 1023; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.09-2.20 (2H, m), 2.61-2.69 (2H, m), 3.17-3.21 (2H, m), 7.58-7.63 (1H, m), 7.71-7.73 (1H, m), 8.22-8.25 (1H, m), 8.32-8.35 (2H, m), 8.86 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.7, 32.2, 38.5, 119.6, 122.6, 124.8, 127.7, 129.9, 133.4, 137.1, 139.1, 148.8, 157.4, 163.8, 196.9; Analysis Calculated for $C_{15}H_{12}N_2O_3$ C: 67.16; H: 4.51; N: 10.44; O: 17.89 % found C: 66.98; H: 4.59; N: 9.99; O: 18.01 %

2-(4-nitrophenyl)-7,8-dihydroquinolin-5(6*H*)-one (4e)

Yield: 96%, (0.258 g), MP: 162 °C, Yellow crystalline solid; IR υ_{max} (KBr): 2949, 1688, 1578, 1513, 1418, 1387, 1331, 1275, 1242, 1110, 835, 746; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.14-2.21 (2H, m), 2.63-2.68 (2H, m), 3.16-3.19 (2H, m), 7.68-7.72 (1H, m), 8.14-8.17 (2H, m), 8.22- 8.26 (2H, m), 8.29-8.33 (1H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.7, 32.6, 38.5, 119.7, 123.9, 127.5, 128.4, 136.5, 143.8, 148.7, 157.7, 163.9, 197.3; Analysis Calculated for $C_{15}H_{12}N_2O_3$ C: 67.16; H: 4.51; N: 10.44; O: 17.89 % found C: 67.29; H: 5.01; N: 10.21; O: 18.07 %

2-(4-methoxyphenyl)-7,8-dihydroquinolin-5(6*H*)-one (4f)

Yield: 95%, (0.241 g), MP: 132 °C, White crystalline solid; IR υ_{max} (KBr): 2969, 2351, 1672, 1589, 1497, 1449, 1417, 1327, 1307, 1113, 1032, 817; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.18-2.22 (2H, m), 2.68 (2H, t, J = 6.9, 6.3 Hz), 3.20 (2H, t, J = 6.3, 6.0 Hz), 3.85 (3H, s), 6.97-7.00 (2H, m), 7.63 (1H, d, J = 8.4 Hz), 8.01-8.04 (2H, m), 8.27 (1H, d, J = 8.4 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 21.8, 32.6, 38.4, 55.3, 114.1, 114.2, 114.3, 118.1, 125.9, 128.9, 129.0, 130.4, 135.8, 160.3, 161.4, 163.5, 197.5; Analysis Calculated for $C_{16}H_{15}NO_2$ C: 75.87; H: 5.97; N: 5.53; O: 12.63 % found C: 76.08; H: 6.07; N: 5.37; O: 11.99 %

3-methyl-2-phenyl-7,8-dihydroquinolin-5(6*H*)-one (4g)

Yield: 95%, (0.225 g), MP: 70 °C, White crystalline solid, IR υ_{max} (KBr): 2940, 1681, 1590, 1574, 1548, 1459, 1447, 1353, 1333, 1290, 1258, 1218, 1161, 1123, 1073, 1041, 1011, 926, 909, 763, 707; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.03-2.26 (2H, m), 2.38 (3H, s), 2.71 (2H, t, J = 6.9, 6.3 Hz), 3.24 (2H, t, J = 6, 6.3 Hz), 7.43-7.50 (3H, m), 7.51- 7.55 (2H, m), 8.22 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 19.7, 21.9, 31.6, 38.5, 126.8, 128.3, 128.4, 128.6, 128.7, 128.8,

128.9, 130.0, 130.2, 133.7, 137.9, 138.6, 160.4, 162.0, 197.8; Analysis Calculated for $C_{16}H_{15}NO$ C: 80.98; H: 6.37; N: 5.90; O: 6.74 % found C: 80.89; H: 6.70; N: 5.88; O: 6.83 %

10,10-dimethyl-5,6,10,11-tetrahydrobenzo[c]acridin-8(9*H*)-one (6a)

Yield: 95%, (0.263 g), MP: 116 °C, White crystalline solid; IR υ_{max} (KBr): 2950, 2869, 1676, 1589, 1426, 1324, 1309, 1271, 1237, 1195, 928, 744; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.11 (6H, s), 2.51 (2H, s), 2.92 (4H, s), 3.04 (2H, s), 7.19-7.23 (1H, m), 7.32-7.35 (2H, m), 8.03 (1H, s), 8.33-8.36 (1H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 27.6, 27.9, 28.3, 33.1, 45.9, 52.1, 125.8, 126.5, 127.4, 128.0, 130.6, 134.2, 139.3, 156.1, 160.3, 197.7; Analysis Calculated for $C_{19}H_{19}NO$ C: 82.28; H: 6.90; N: 5.05; O: 5.77 % found C: 81.99; H: 7.01; N: 4.97; O: 5.62 %

3-methoxy-10,10-dimethyl-5,6,10,11-tetrahydrobenzo[c]acridin-8(9*H*)-one (6b)

Yield: 92%, (0.283 g), MP: 134 °C , White crystalline solid; IR υ_{max} (KBr): 2931, 2866, 1671, 1587, 1498, 1441, 1416, 1333, 1314, 1188, 1114, 1037, 977, 862, 829; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 0.98 (6H, s), 2.37 (2H, s), 2.77 (4H, s), 2.89 (2H, s), 3.71 (3H, s), 6.61 (1H, s), 6.74 (1H, d, J = 8.7 Hz), 7.86 (1H, s), 8.16 (1H, d, J = 8.7 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 27.6, 28.3, 33.0, 46.1, 52.1, 55.4, 112.9, 113.2, 125.0, 128.2, 129.5, 133.7, 141.3, 156.3, 160.4, 161.7, 197.8; Analysis Calculated for $C_{20}H_{21}NO_2$ C: 78.15; H: 6.89; N: 4.56; O: 10.41 % found C: 77.92; H: 7.01; N: 4.58; O: 10.70 %

2,3-dimethoxy-10,10-dimethyl-5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (6c)

Yield: 97%, (0.327 g), MP: 178 °C, White crystalline solid, IR υ_{max} (KBr): 2953, 2932, 2341, 1671, 1584, 1509, 1450, 1339, 1302, 1265, 1191, 1010, 886; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.13 (6H, s), 2.53 (2H, s), 2.88-2.90 (2H, m), 2.93-2.95 (2H, m), 3.11 (2H, s), 3.94 (3H, s), 4.03 (3H, s), 6.74 (1H, s), 7.98 (1H, s), 8.04 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 27.5, 27.7, 28.3,

32.9, 46.3, 52.0, 55.9, 56.0, 108.7, 110.6, 124.9, 126.3, 129.2, 132.8, 133.2, 148.3, 150.9, 156.2, 160.5, 197.9; Analysis Calculated for $C_{21}H_{23}NO_3$ C: 74.75; H: 6.87; N: 4.15; O: 14.23 % found C: 75.03; H: 7.10; N: 4.12; O: 14.05 %

7,7-dimethyl-7,8-dihydro-6*H*-indeno[1,2-*b*]quinolin-9(11*H*)-one (6d)

Yield: 90%, (0.237 g), MP: 76 °C, White crystalline solid, IR υ_{max} (KBr): 3456, 2949, 1683, 1579, 1489, 1451, 1417, 1385, 1333, 1280, 1187, 1089, 1009, 820; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 1.09 (6H, s), 2.52 (2H, s), 3.14 (2H, s), 3.87 (2H, s), 7.19 (1H, s), 7.42-7.46 (1H, m), 7.53-7.56 (1H, m), 8.21 (1H, brs), 8.35 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 19.8, 28.3, 29.1, 29.7, 33.1, 34.4, 46.2, 52.2, 58.4, 97.5, 122.6, 123.6, 125.2, 125.5, 127.7, 130.4, 130.9, 135.5, 139.2, 145.6, 161.5, 197.8; Analysis Calculated for $C_{18}H_{17}NO$ C: 82.10; H: 6.51; N: 5.32; O: 6.08 % found C: 81.99; H: 6.76; N: 5.23; O: 6.09 %

5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (7a)

Yield: 95%, (0.237 g), MP: 134 °C, White crystalline solid; IR υ_{max} (KBr): 2940, 1674, 1588, 1553, 1460, 1418, 1353, 1335, 1295, 1262, 1229, 1183, 1162, 1132, 1102, 1032, 929, 907, 882; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.07-2.15 (2H, m), 2.59 (2H, t, J = 6.9, 6.3 Hz), 2.86 (4H, s), 3.11 (2H, t, J = 6.0, 6.0 Hz), 7.14-7.18 (2H, m), 7.25-7.29 (1H, m), 7.99 (1H, s), 8.29-8.32 (1H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 22.0, 27.5, 27.9, 32.3, 38.6, 126.2, 126.3, 126.7, 127.3, 127.9, 128.0, 130.4, 130.5, 130.6, 133.4, 134.3, 139.3, 155.8, 161.8, 197.9; Analysis Calculated for $C_{17}H_{15}NO$ C: 81.90; H: 6.06; N: 5.62; O: 6.42 % found C: 82.06; H: 5.97; N: 5.43; O: 6.87 %

3-methoxy-5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (7b)

Yield: 90%, (0.251 g), MP: 138 °C, White crystalline solid; IR υ_{max} (KBr): 2940, 1682, 1589, 1415, 1350, 1332, 1266, 1227, 1178, 1147, 1077, 1045, 1028, 925, 904, 815; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.09 (2H, t, *J* = 6.3, 6.3 Hz), 2.58 (2H, t, *J* = 6.6, 6.3 Hz), 2.83 (4H, s), 3.07 (2H, t, *J* = 6.0, 6.0 Hz), 3.77 (3H, s), 6.67 (1H, s), 6.71-6.83 (1H, m), 7.94 (1H, s), 8.23 (1H, d, *J* = 8.7 Hz); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 22.1, 27.6, 28.3, 32.5, 38.6, 55.4, 112.9, 113.2, 125.9, 126.6, 128.0, 129.5, 133.9, 141.3, 156.0, 161.5, 162.0, 198.0; Analysis Calculated for $C_{18}H_{17}NO_2$ C: 77.40; H: 6.13; N: 5.01; O: 11.46 % found C: 77.56; H: 5.97; N: 4.99; O: 11.52 %

2,3-dimethoxy-5,6,10,11-tetrahydrobenzo[c]acridin-8(9*H*)-one (7c)

Yield: 96%, (0.297 g), MP: 204 °C, Dark green crystalline solid, IR υ_{max} (KBr): 2936, 1669, 1578, 1551, 1511, 1431, 1346, 1334, 1297, 1221, 1140, 1130, 1072, 1039, 1005, 961, 901, 844; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 2.09-2.15 (2H, m), 2.59 (2H, t, *J* = 6.9, 6.0 Hz), 2.79-2.86 (4H, m), 3.11-3.15 (2H, m), 3.86 (3H, s), 3.95 (3H, s), 6.65 (1H, s), 7.89 (1H, s), 7.97 (1H, s); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 22.0, 27.5, 27.7, 32.2, 38.5, 55.9, 56.1, 56.2, 108.8, 110.6, 125.9, 129.6, 133.1, 133.9, 148.3, 151.1, 155.7, 161.8, 197.8; Analysis Calculated for $C_{19}H_{19}NO_3$ C: 73.77; H: 6.19; N: 4.53; O: 15.52 % found C: 73.98; H: 5.99; N: 4.37; O: 15.67 %

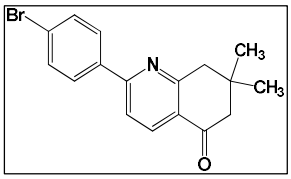
3,3,6,6-tetramethyl-9-(2-oxo-2-phenylethyl)-3,4,5,6,7,9-hexahydro-1*H*-xanthene-1,8(2*H*)-dione (8)

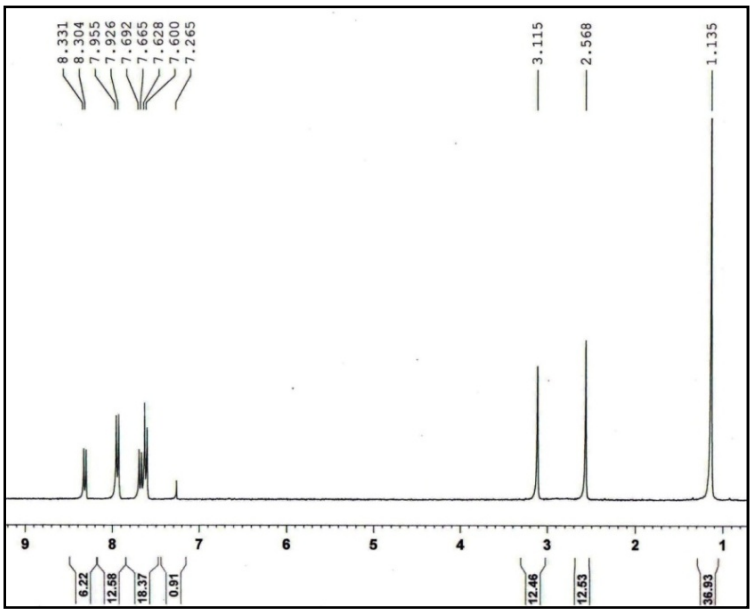
Yield: 98%, (0.384 g), MP: 202 °C, White solid; IR υ_{max} (KBr): 2941, 2936, 1693, 1669, 1578, 1547, 1507, 1452, 1362, 1334, 1228, 1141, 1123, 1039, 967; ^{1}H NMR (300 MHz, $CDCl_3$) δ_H: 0.99-1.26 (12H, m), 2.13-2.53 (8H, m), 4.02 (1H, s), 4.79-4.96 (2H, br m), 7.27- 7.46 (5H, m); ^{13}C NMR (75 MHz, $CDCl_3$) δ_C: 17.3, 26.9, 29.3, 29.6, 30.8, 32.1, 41.3, 43.5, 49.9, 51.2, 110.4,

110.5, 115.4, 128.0, 128.3, 128.9, 134.1, 144.8, 169.4, 196.8, 200.9; Analysis Calculated for $C_{25}H_{28}O_4$ C: 76.50; H: 7.19; O: 16.31% found C: 76.32; H: 7.36; O: 16.21%

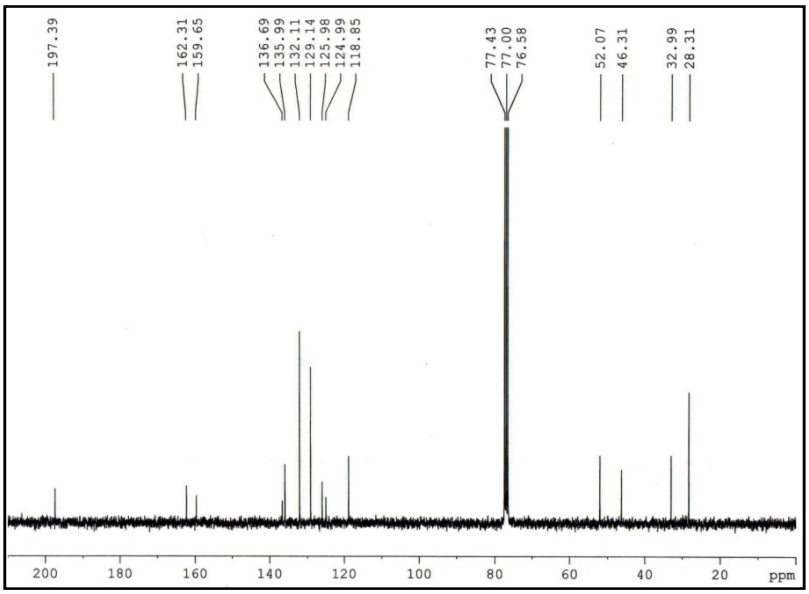
➢ Spectra of some representative compounds

2-(4-bromophenyl)-7,7-dimethyl-7,8-dihydroquinolin-5(6*H*)-one (3b)



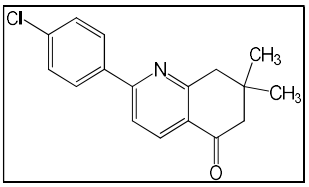


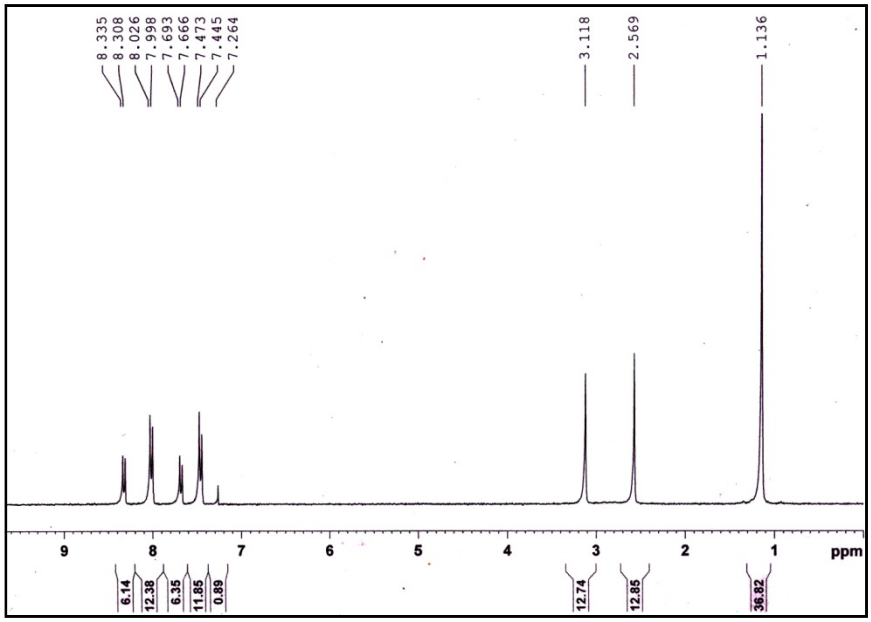
^{1}H- NMR, 300 MHz, $CDCl_3$



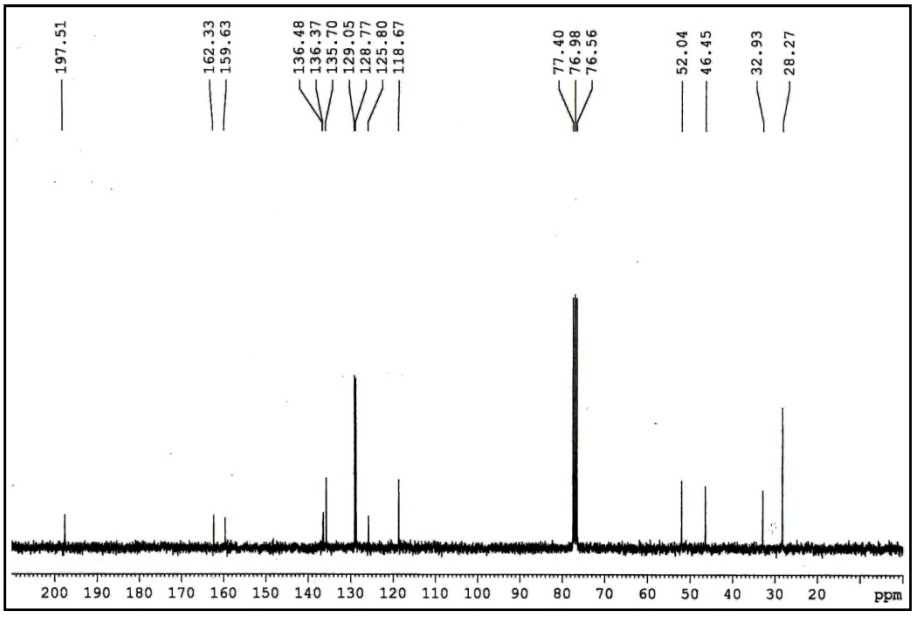
^{13}C- NMR, 75 MHz, $CDCl_3$

2-(4-chlorophenyl)-7,7-dimethyl-7,8-dihydroquinolin-5(6*H*)-one (3c)



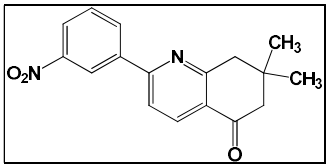


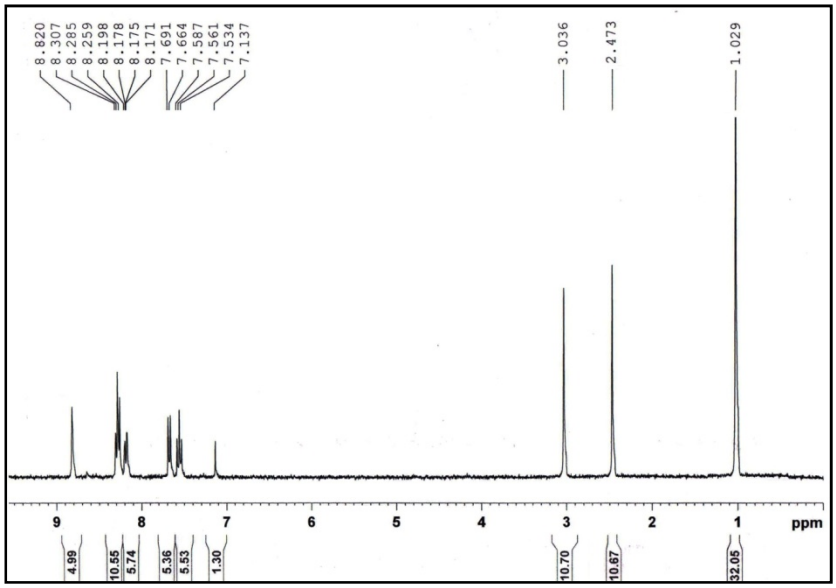
^{1}H- NMR, 300 MHz, $CDCl_3$



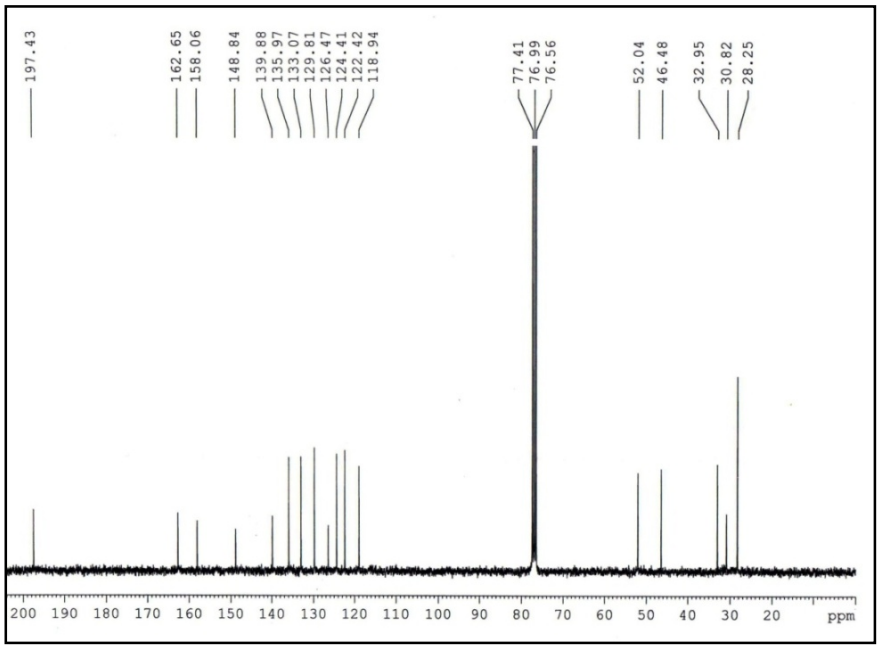
^{13}C- NMR, 75 MHz, $CDCl_3$

7,7-dimethyl-2-(3-nitrophenyl)-7,8-dihydroquinolin-5(6*H*)-one (3d)



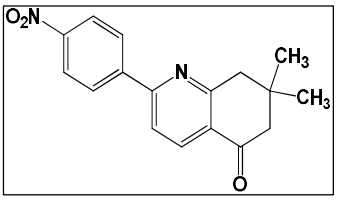


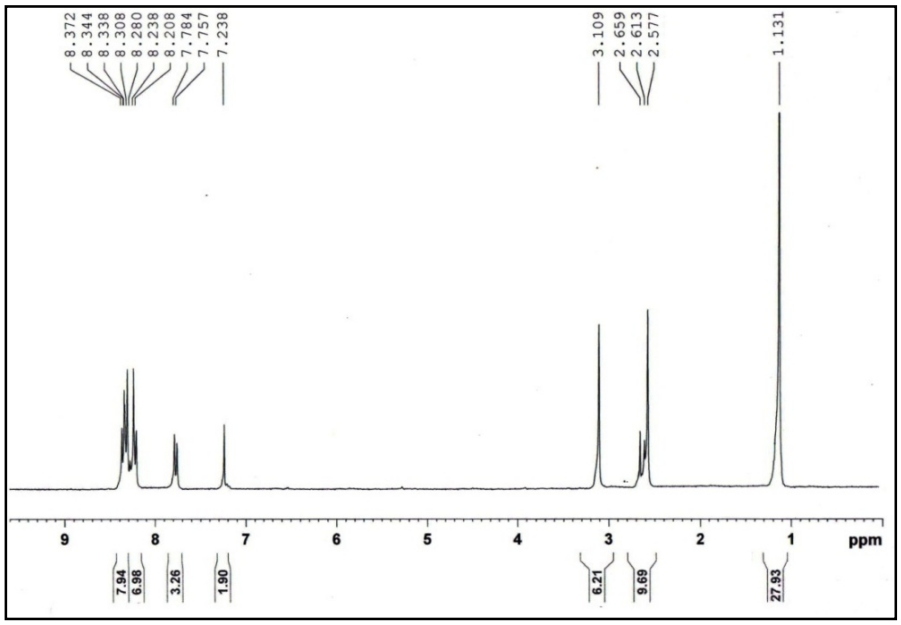
^{1}H- NMR, 300 MHz, $CDCl_3$



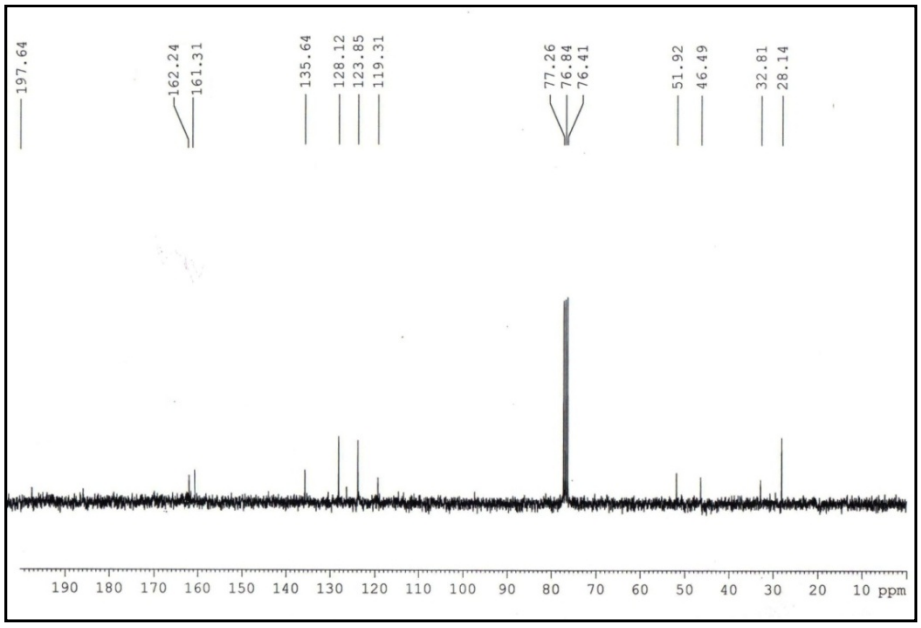
^{13}C- NMR, 75 MHz, $CDCl_3$

7,7-dimethyl-2-(4-nitrophenyl)-7,8-dihydroquinolin-5(6*H*)-one (3e)



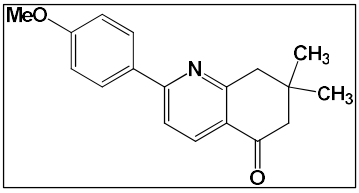


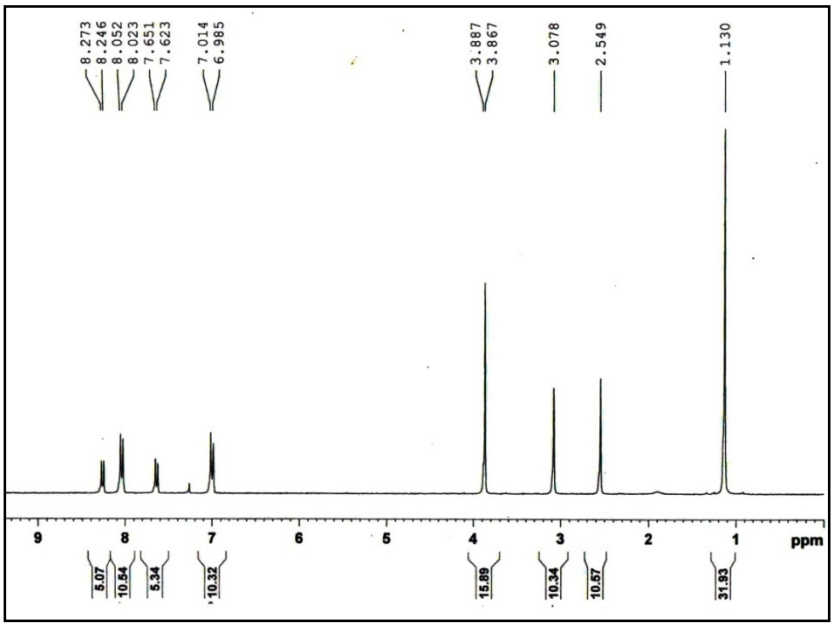
^{1}H- NMR, 300 MHz, $CDCl_3$



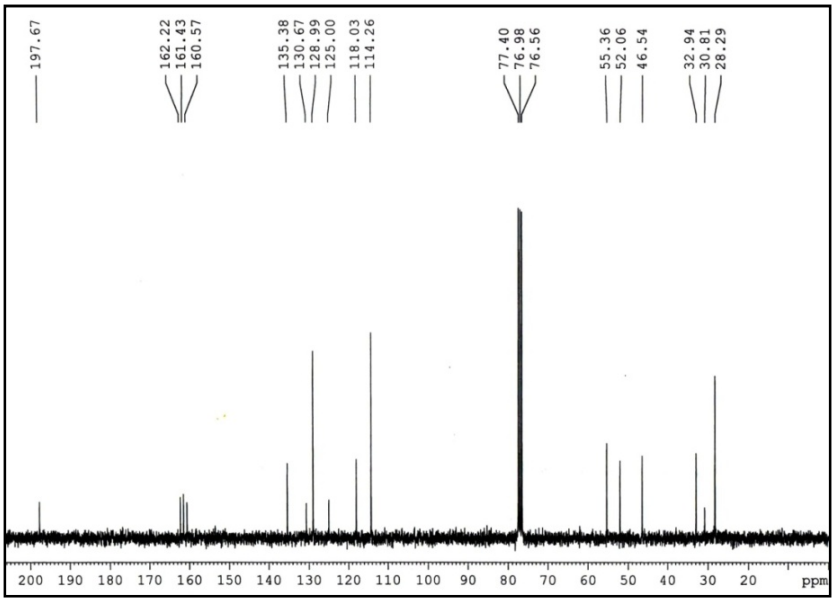
^{13}C- NMR, 75 MHz, $CDCl_3$

2-(4-methoxyphenyl)-7,7-dimethyl-7,8-dihydroquinolin-5(6*H*)-one (3f)



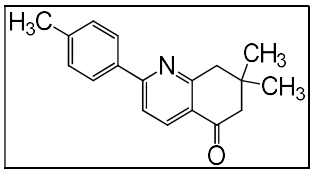


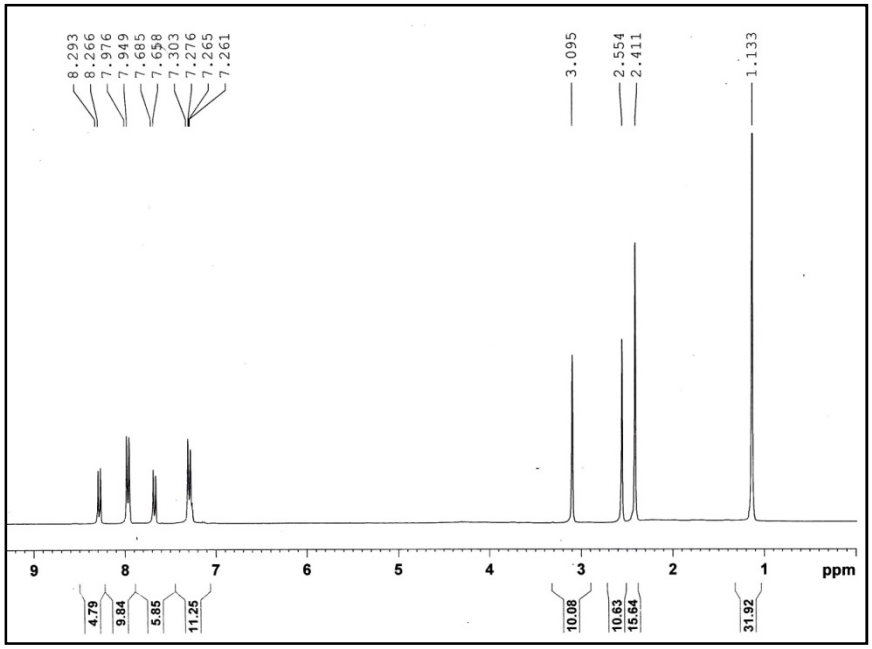
^{1}H- NMR, 300 MHz, $CDCl_3$



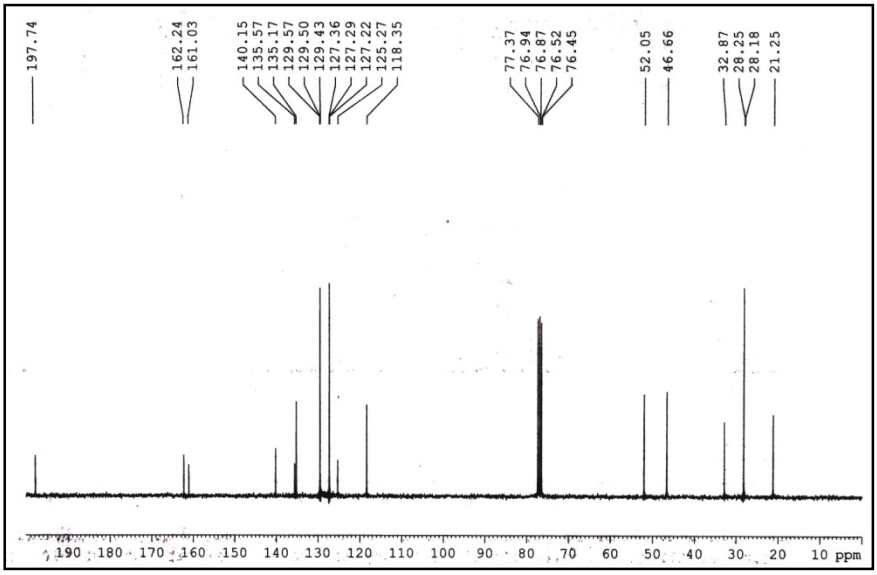
^{13}C- NMR, 75 MHz, $CDCl_3$

7,7-dimethyl-2-(p-tolyl)-7,8-dihydroquinolin-5(6*H*)-one (3g)



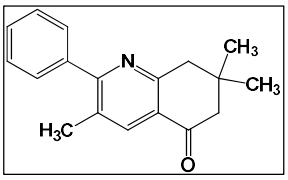


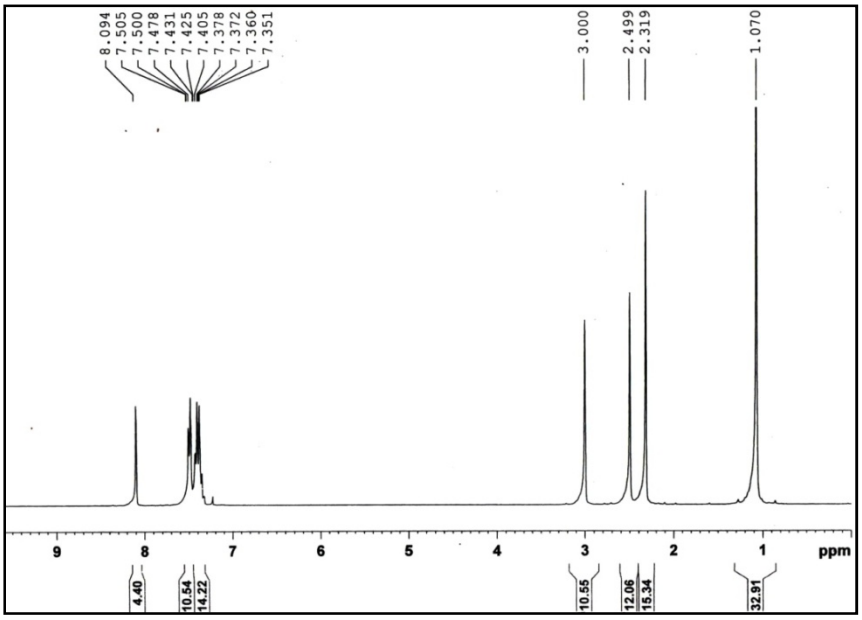
^{1}H- NMR, 300 MHz, $CDCl_3$



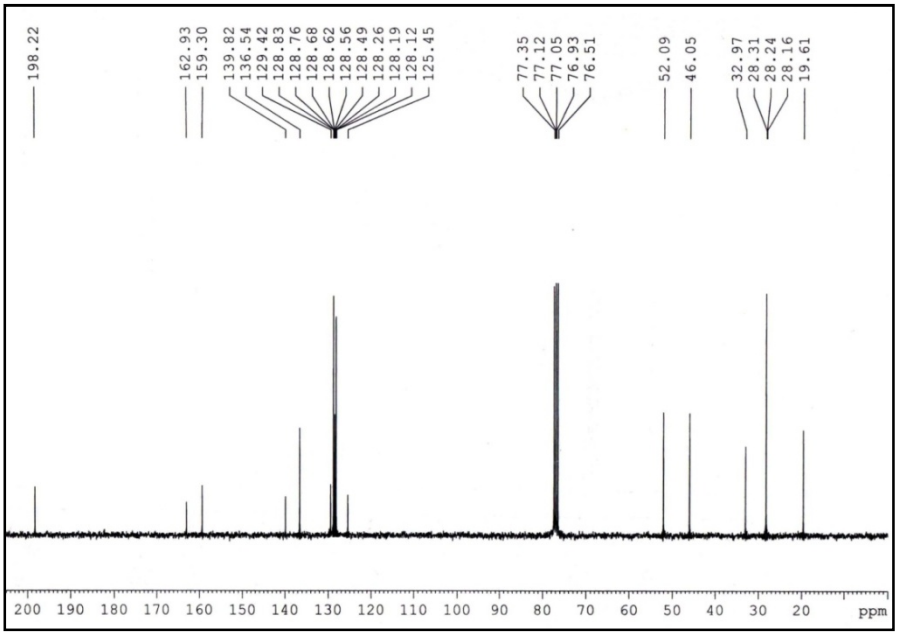
^{13}C- NMR, 75 MHz, $CDCl_3$

3,7,7-trimethyl-2-phenyl-7,8-dihydroquinolin-5(6*H*)-one (3h)



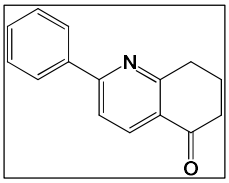


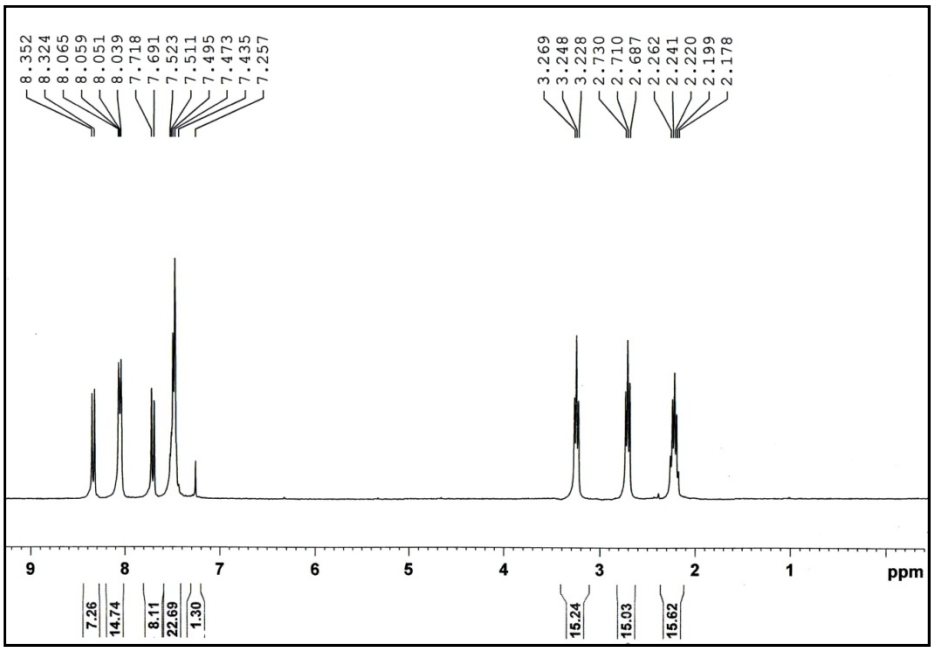
^{1}H- NMR, 300 MHz, $CDCl_3$



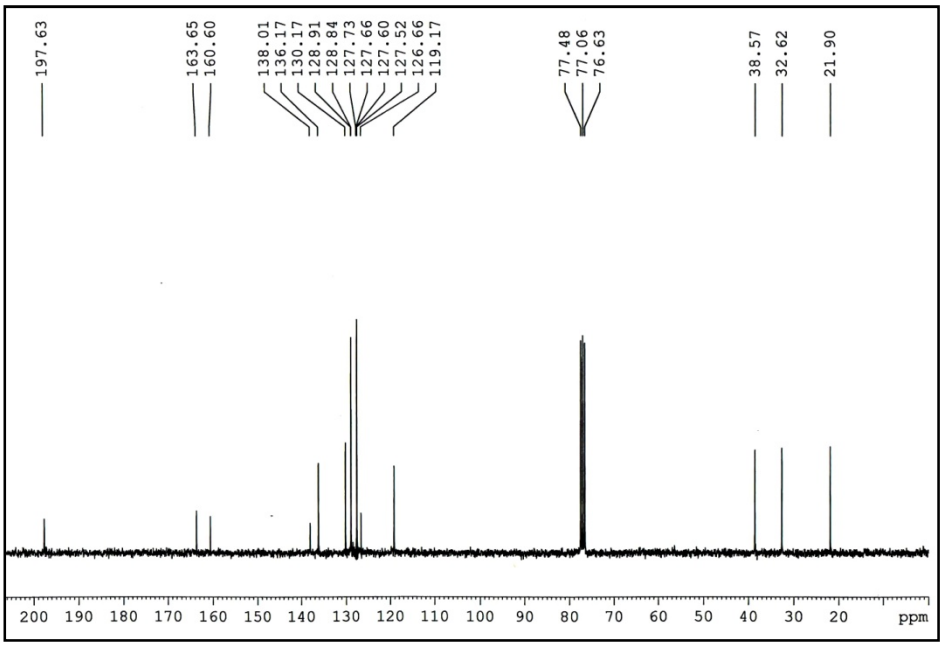
^{13}C- NMR, 75 MHz, $CDCl_3$

2-phenyl-7,8-dihydroquinolin-5(6*H*)-one (4a)



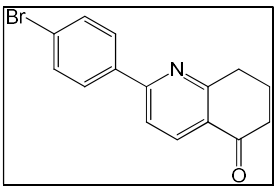


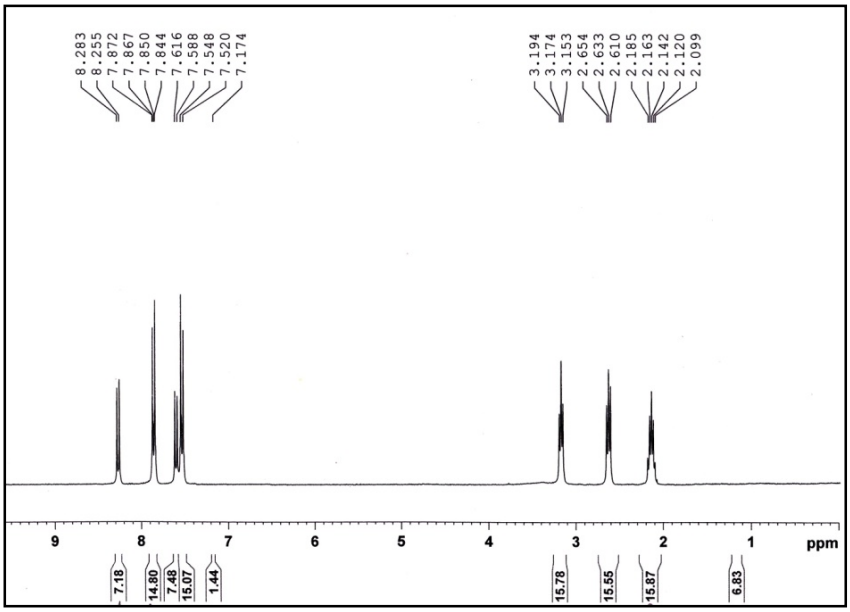
^{1}H- NMR, 300 MHz, $CDCl_3$



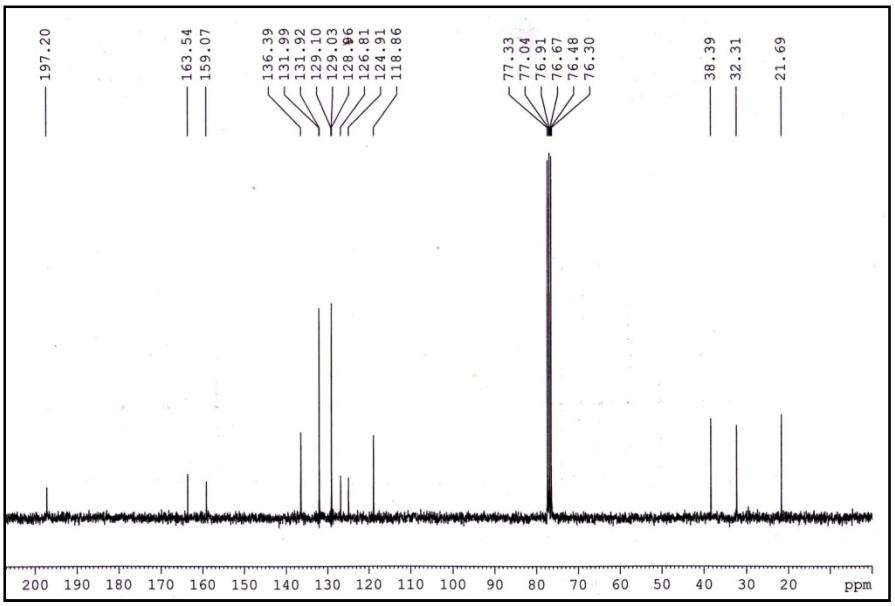
^{13}C- NMR, 75 MHz, $CDCl_3$

2-(4-bromophenyl)-7,8-dihydroquinolin-5(6*H*)-one (4b)



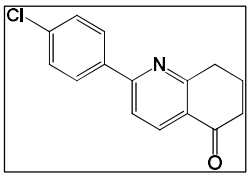


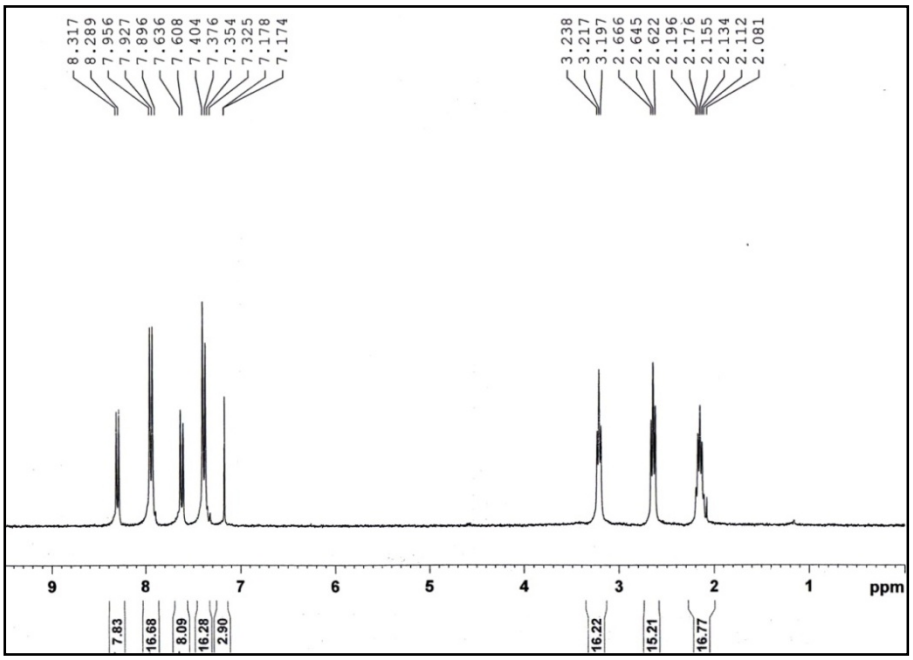
^{1}H- NMR, 300 MHz, $CDCl_3$



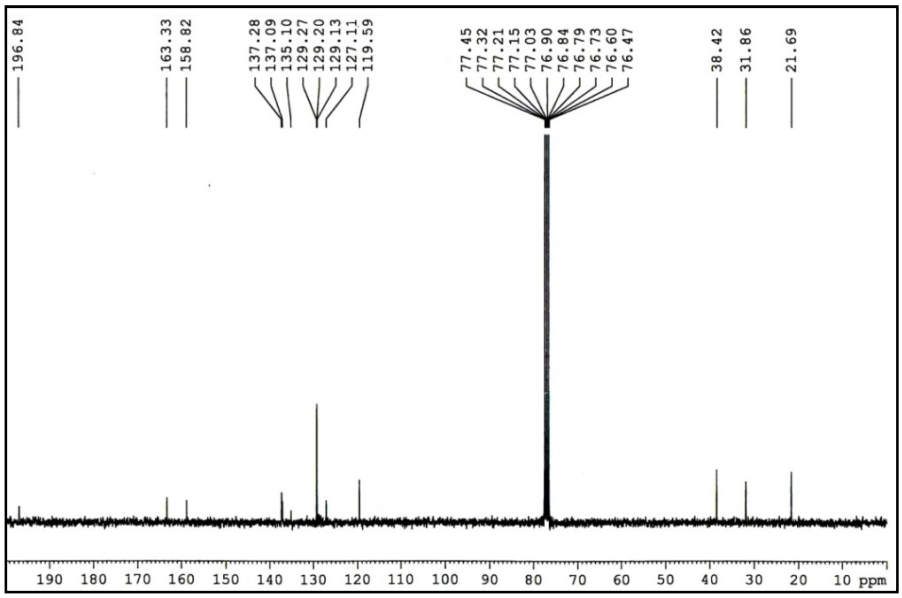
^{13}C- NMR, 75 MHz, $CDCl_3$

2-(4-chlorophenyl)-7,8-dihydroquinolin-5(6*H*)-one (4c)



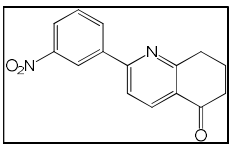


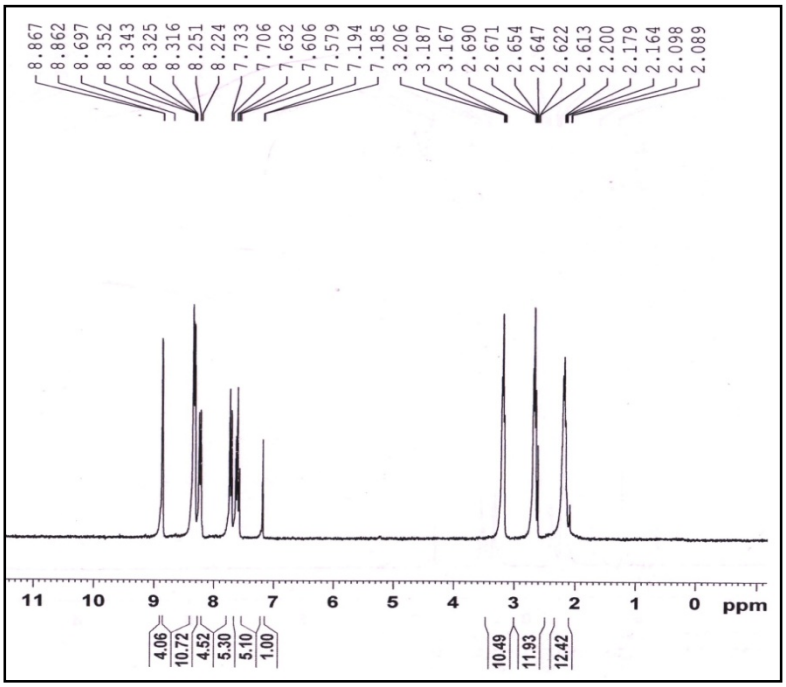
^{1}H- NMR, 300 MHz, $CDCl_3$



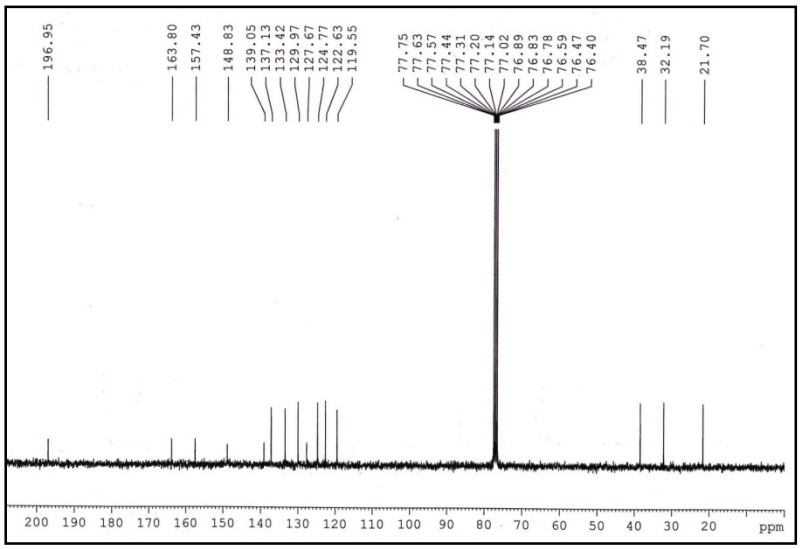
^{13}C- NMR, 75 MHz, $CDCl_3$

2-(3-nitrophenyl)-7,8-dihydroquinolin-5(6*H*)-one (4d)



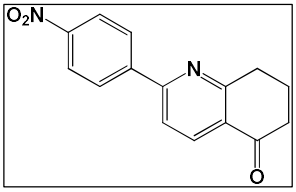


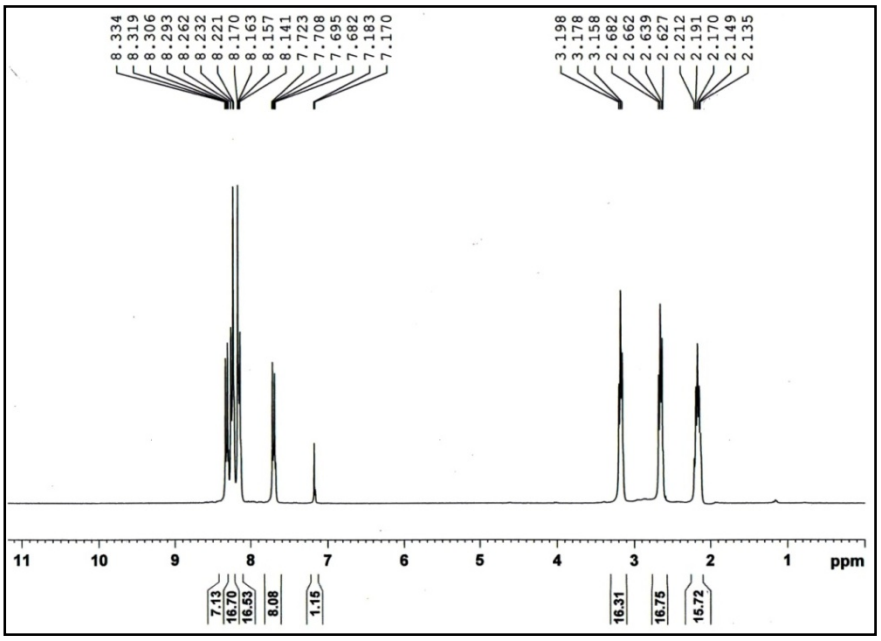
^{1}H- NMR, 300 MHz, $CDCl_3$



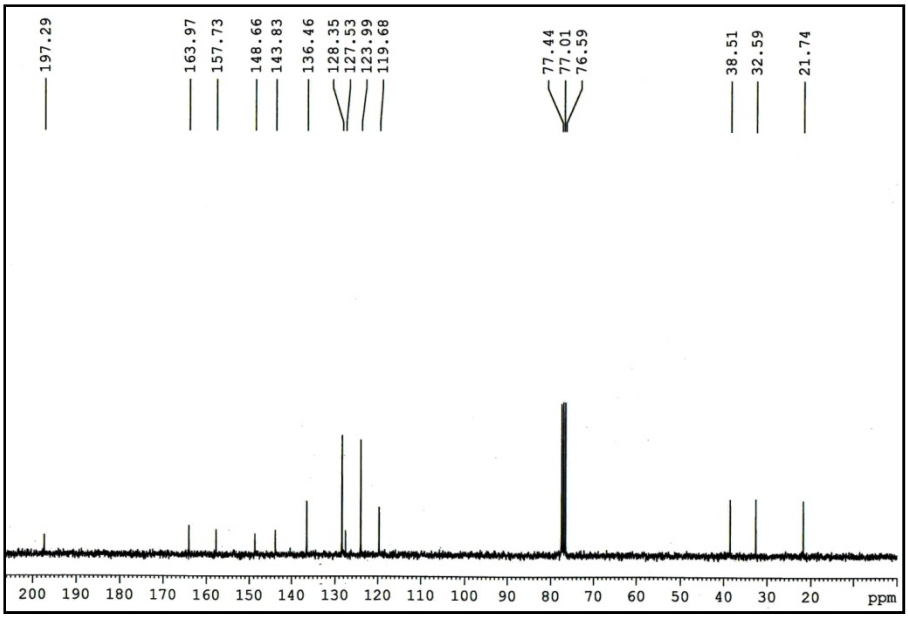
^{13}C- NMR, 75 MHz, $CDCl_3$

2-(4-nitrophenyl)-7,8-dihydroquinolin-5(6*H*)-one (4e)



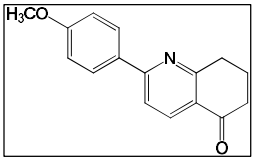


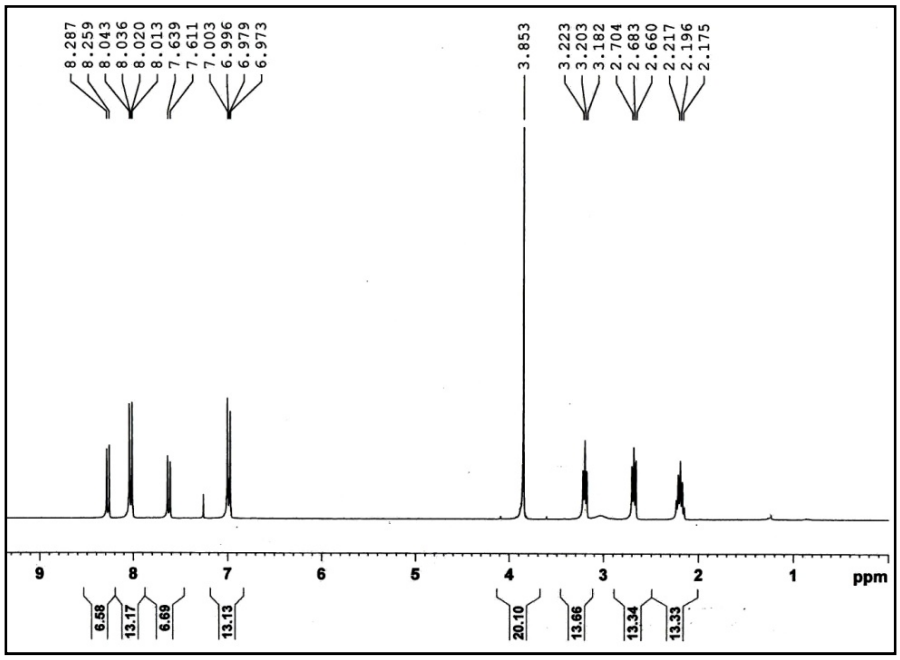
^{1}H- NMR, 300 MHz, $CDCl_3$



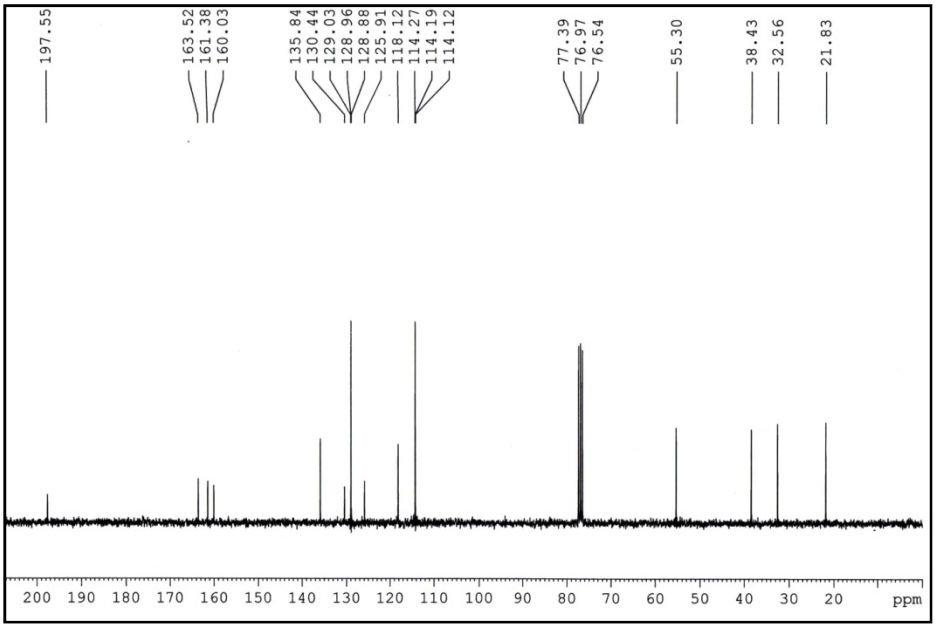
^{13}C- NMR, 75 MHz, $CDCl_3$

2-(4-methoxyphenyl)-7,8-dihydroquinolin-5(6*H*)-one (4f)



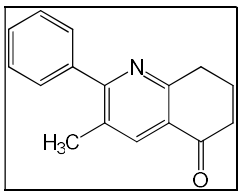


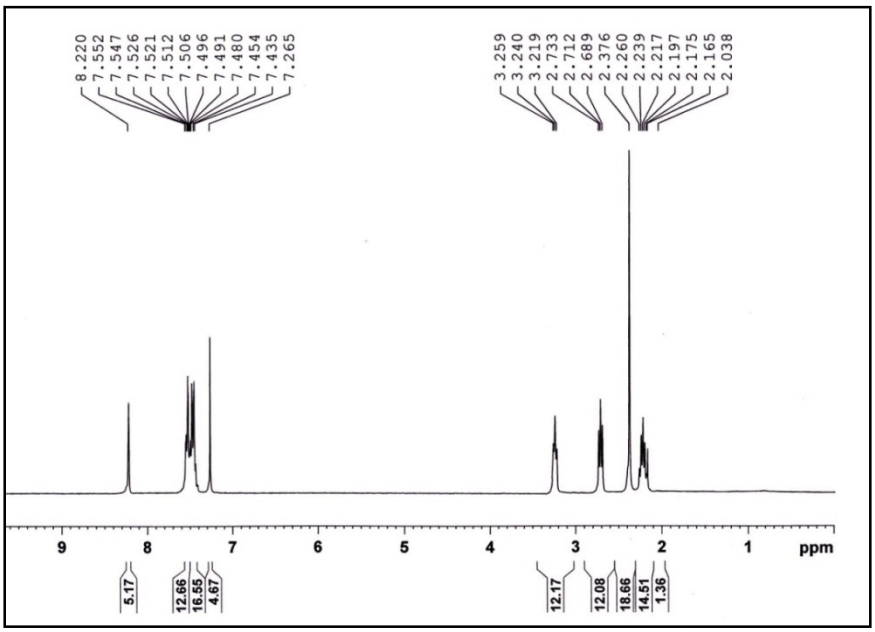
^{1}H- NMR, 300 MHz, $CDCl_3$



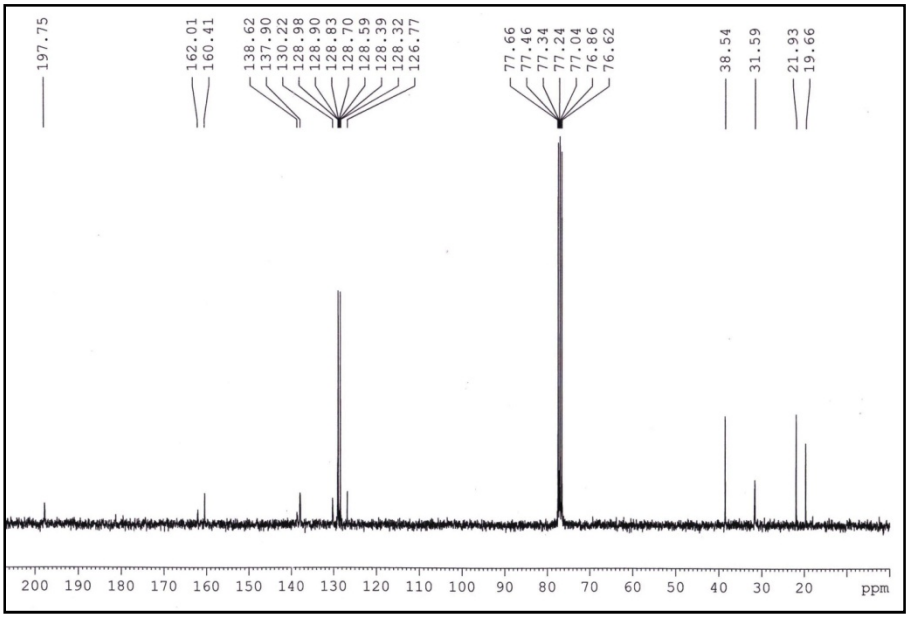
^{13}C- NMR, 75 MHz, $CDCl_3$

3-methyl-2-phenyl-7,8-dihydroquinolin-5(6*H*)-one (4g)



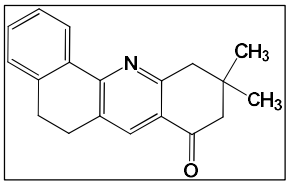


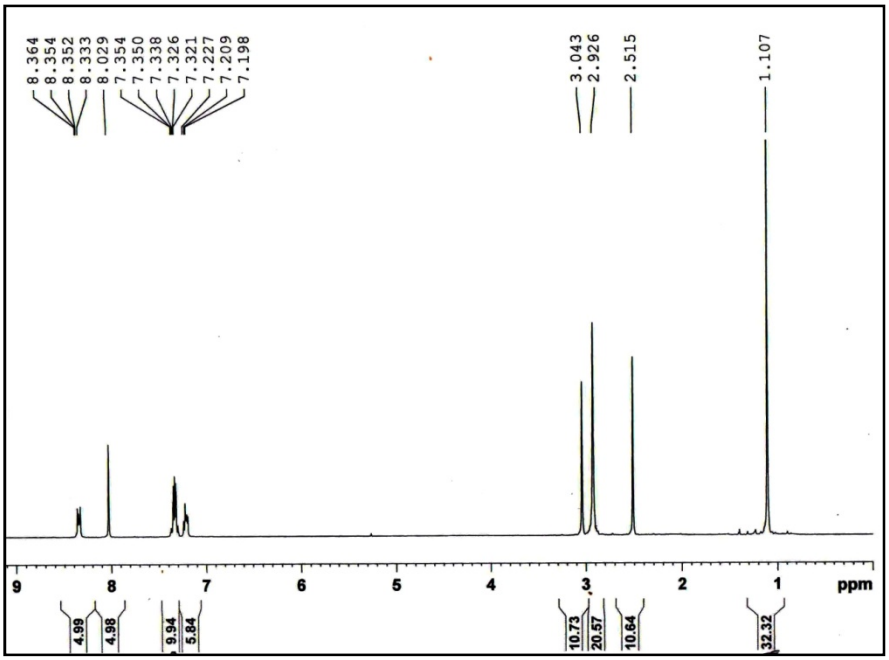
^{1}H- NMR, 300 MHz, $CDCl_3$



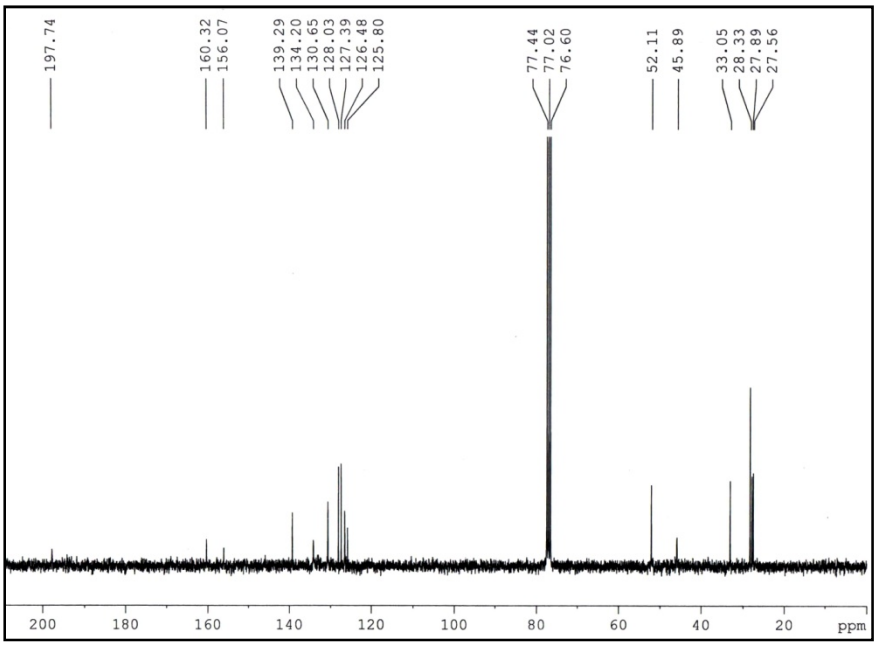
^{13}C- NMR, 75 MHz, $CDCl_3$

10,10-dimethyl-5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (6a)



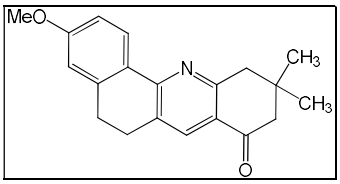


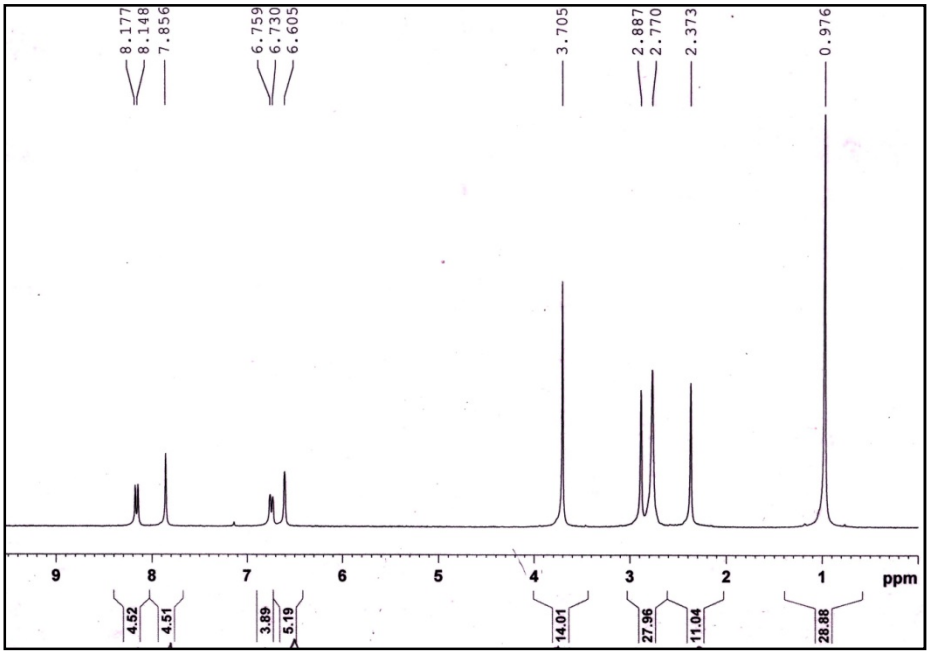
^{1}H- NMR, 300 MHz, $CDCl_3$



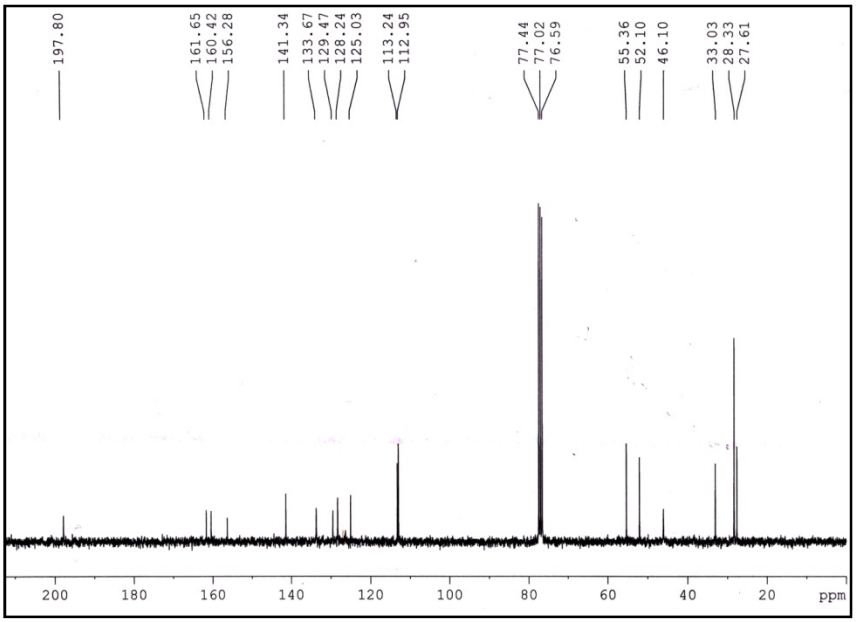
^{13}C- NMR, 75 MHz, $CDCl_3$

3-methoxy-10,10-dimethyl-5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (6b)



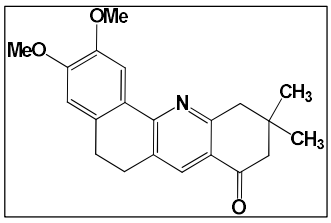


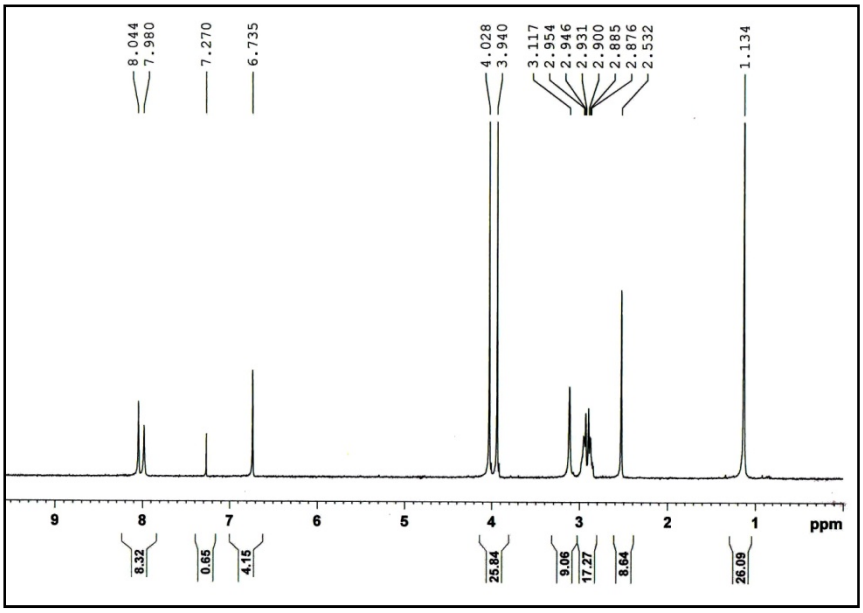
^{1}H- NMR, 300 MHz, $CDCl_3$



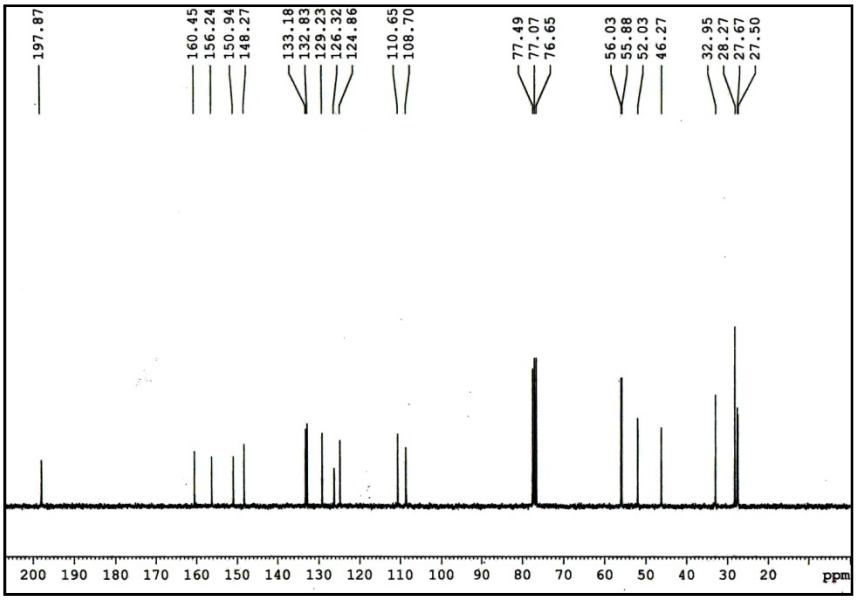
^{13}C- NMR, 75 MHz, $CDCl_3$

2,3-dimethoxy-10,10-dimethyl-5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (6c)



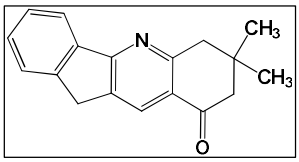


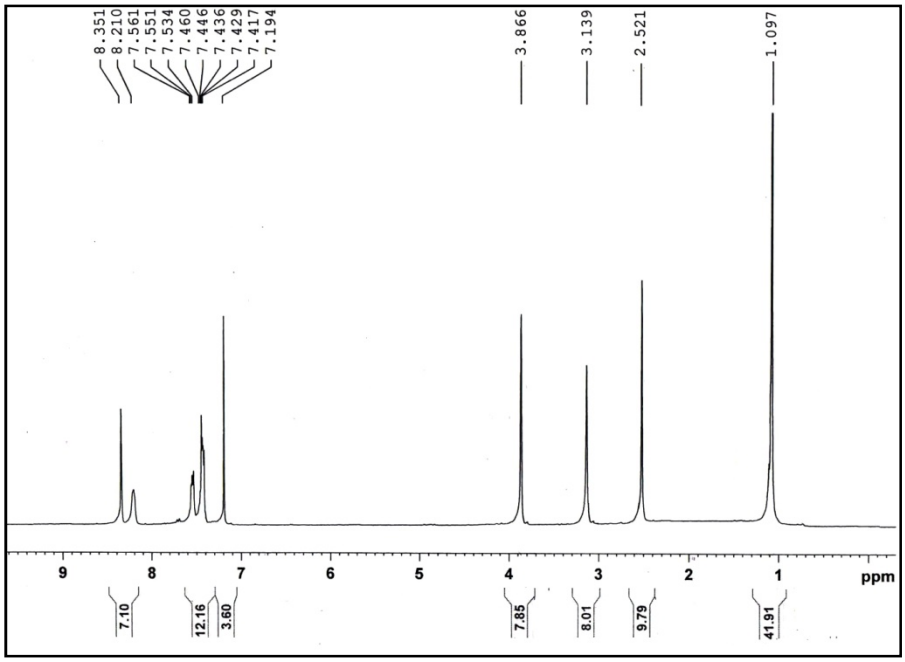
^{1}H- NMR, 300 MHz, $CDCl_3$



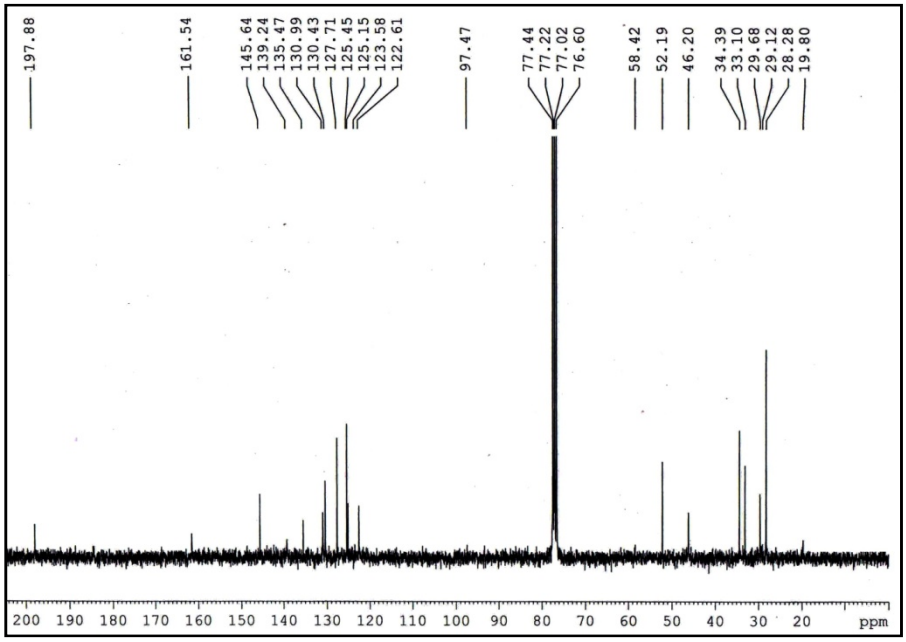
^{13}C- NMR, 75 MHz, $CDCl_3$

7,7-dimethyl-7,8-dihydro-6H-indeno[1,2-b]quinolin-9(11*H*)-one (6d)



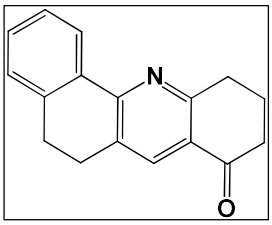


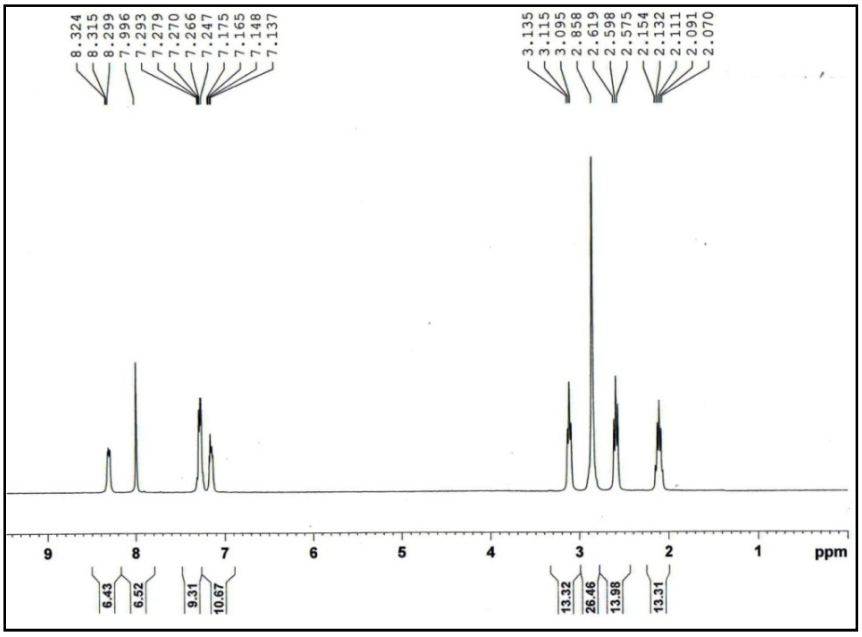
^{1}H- NMR, 300 MHz, $CDCl_3$



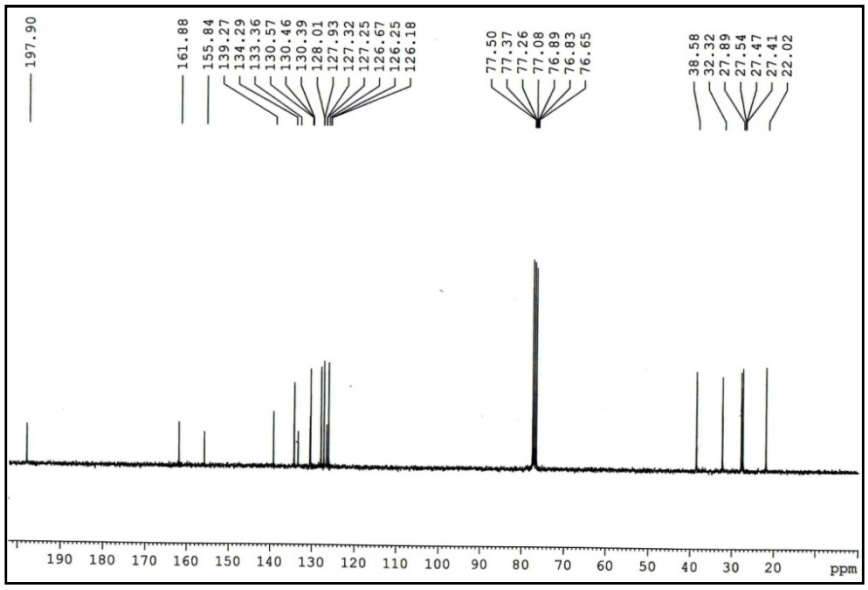
^{13}C- NMR, 75 MHz, $CDCl_3$

5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (7a)



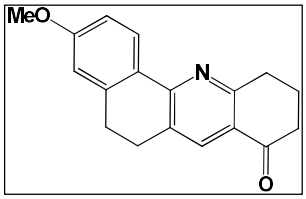


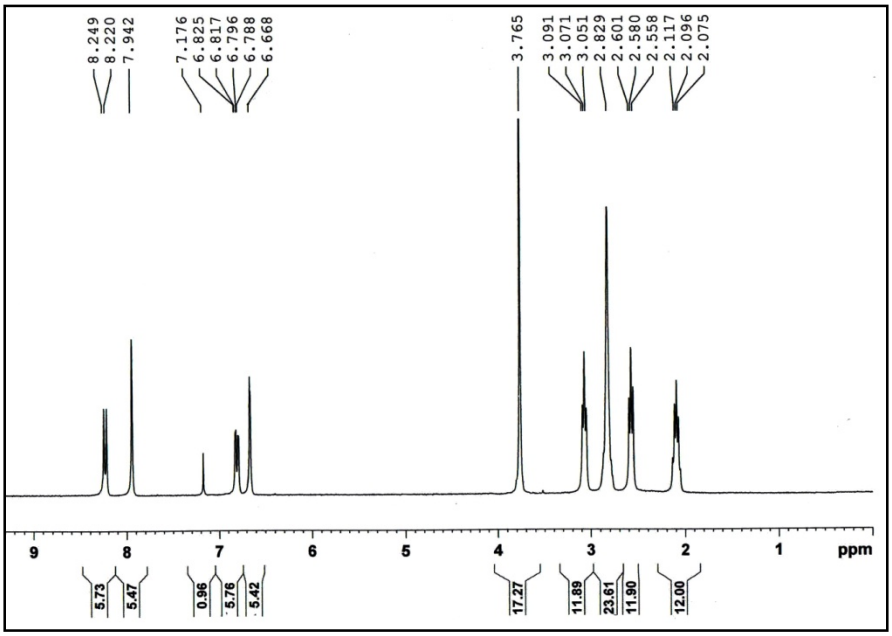
^{1}H- NMR, 300 MHz, $CDCl_3$



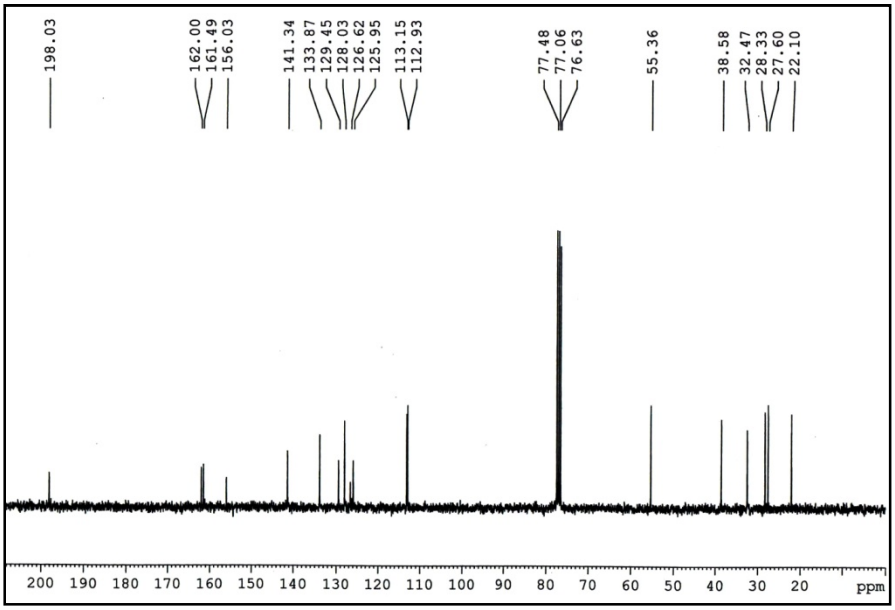
^{13}C- NMR, 75 MHz, $CDCl_3$

3-methoxy-5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (7b)



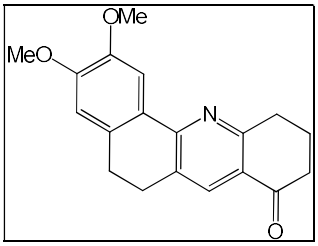


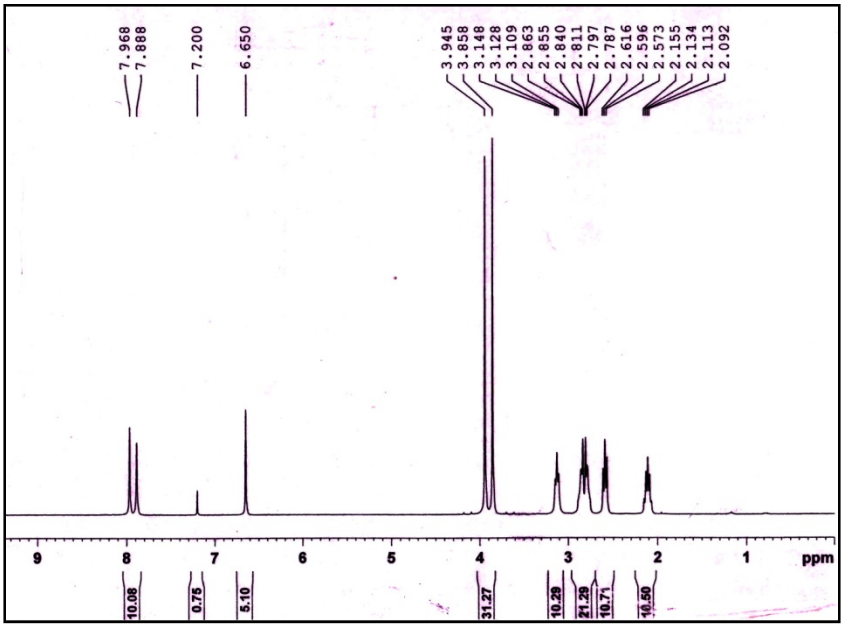
^{1}H- NMR, 300 MHz, $CDCl_3$



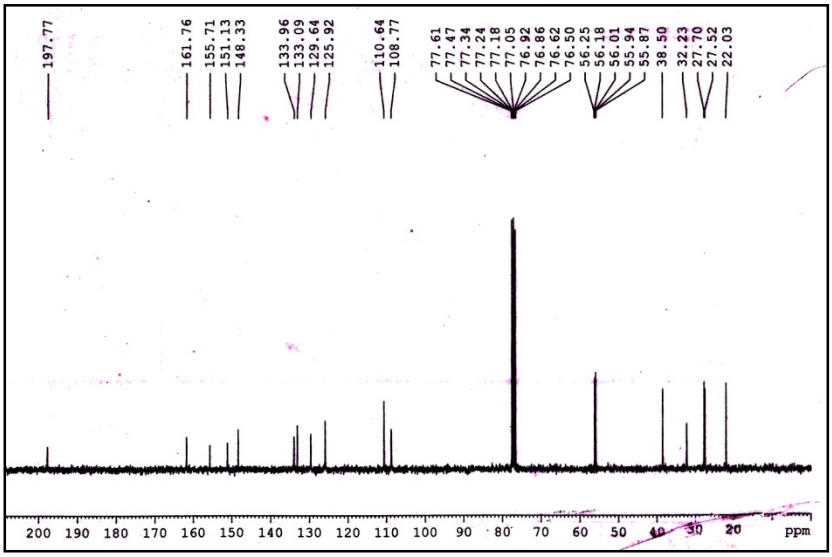
^{13}C- NMR, 75 MHz, $CDCl_3$

2,3-dimethoxy-5,6,10,11-tetrahydrobenzo[*c*]acridin-8(9*H*)-one (7c)



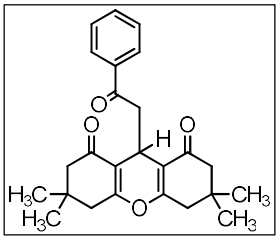


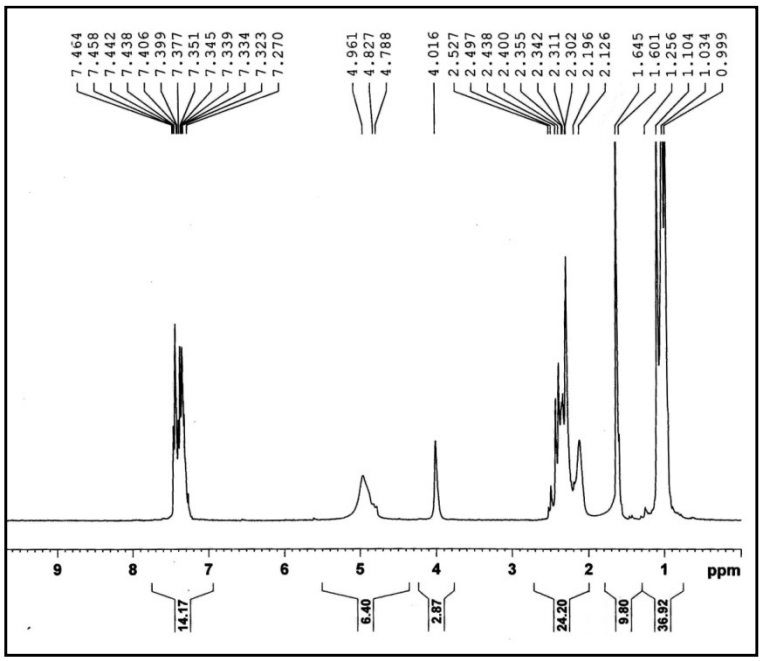
^{1}H- NMR, 300 MHz, $CDCl_3$



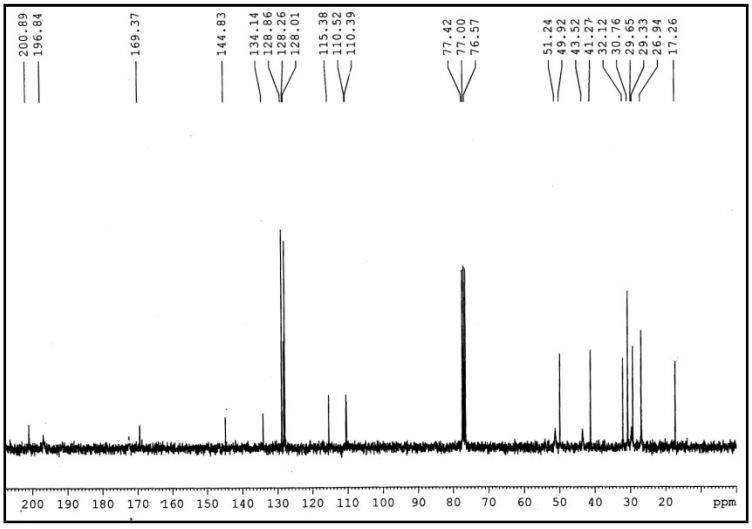
^{13}C- NMR, 75 MHz, $CDCl_3$

3,3,6,6-tetramethyl-9-(2-oxo-2-phenylethyl)-3,4,5,6,7,9-hexahydro-1*H*-xanthene-1,8(2*H*)-dione (8)





^{1}H- NMR, 300 MHz, $CDCl_3$



^{13}C- NMR, 75 MHz, $CDCl_3$