Electronic Supplementary Material (ESI) for RSC Advances.

Vinyl esters as effective acetaldehyde surrogates in [4+1] cycloaddition based multicomponent cascade

Manoj Kumar, Sourav Bagchi and **Anuj Sharma***

Department of Chemistry, Indian Institute of Technology Roorkee, Roorkee-247667, India
(Phone: +91-1332-284751; e-mail: anujsharma.mcl@gmail.com, anujsfcy@iitr.ac.in)

General Experimental Detail.

NMR spectra were recorded on a Jeol Resonance ECX-400II. Chemical shifts are reported in parts per million and are referenced to TMS. Spectra were processed using MestReNova[6] software. Mass spectrometry (HRMS) was performed using a Bruker daltronics microTOF-QII® spectrometer using ESI ionization, with less than 5 ppm error for all HRMS analyses. Analytical Thin layer chromatography (TLC) was performed on a silica gel plate (Merck® $60F_{254}$). IR spectra were done on Perkin Elmer FT-IR spectrometer (Spectrun Two). Melting points were performed with Ambassador® and Digital Melting point apparatus (Nutronics), Popular India. All chemicals were purchased from sigma-Aldrich® and used without further purification.

Microwave Irradiation Experiment.

All microwave experiments were carried out in a dedicated Anton Paar Monowave 300 reactor®, operating at a frequency of 2.455 GHz with continuous irradiation power of 0 to 300 W. The reactions were performed in a G10 Borosilicate glass vial sealed with Teflon septum and placed in a microwave cavity. Initially, microwave of required power was used and temperature was being ramped from room temperature to a desired temperature. Once this temperature was attained, the process vial was held at this temperature for required time. The reactions were continuously stirred. Temperature was measured by an IR sensor. After the experiments a cooling jet cooled the reaction vessel to ambient temperature.

General procedure for the microwave-assisted three component reaction.

4-hydroxycoumarins 1a (1.0 mmol), vinyl acetate 2a (1.5 mmol), isonitrile 3a (1.0 mmol) DABCO (30 mol %) in isopropanol was taken in G10 process vial capped with Teflon septum. After a pre-stirring of 1 or 2 minutes, the vial was subjected to microwave irradiation with the initial ramp time of 1 minute at 70 °C. The temperature was then raised to 120 °C with the holding time of 10 minutes. The reaction mixture was cooled down to 0-5 °C by a cooling air jet. The product got crystallized in the reaction vial, which was then filtered off, in most of the cases, was pure enough for spectral elucidation by ^{1}H NMR, ^{13}C NMR and HRMS.

2-(tert-Butylamino)-3-methyl-4H- furo[3,2-c]chromen-4-one **(4a).** Yield: 77% (using vinyl acetate), 75% (using vinyl pivalate); crystalline yellow solid; mp: 143-145 °C; IR (KBr) ν: 3311, 2975, 1716, 1641, 1412, 1223, 980, 763 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.22 (s, 9H), 2.12 (s, 3H), 5.23 (s, 1H), 7.32-7.37 (m, 1H), 7.39-7.45 (m, 1H), 7.45-7.52 (m, 1H), 7.65-7.80 (m, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 8.3, 29.9, 53.3, 102.5, 110.8, 112.4, 116.6, 119.8, 124.4, 129.3, 150.4, 151.2, 154.8, 157.7. HRMS (ESI) m/z calcd. for $C_{16}H_{17}NO_3$ $[M+Na]^+$: 294.1106, found: 294.1102.

3-methyl-2-(2,4,4-trimethylpentan-2-ylamino)-4H-furo[3,2-c]chromen-4-one **(4b)**. Yield: 70% (using vinyl acetate); crystalline yellow solid; mp: 178-180 °C; IR (KBr) ν: 3332, 2925, 1721, 1640, 1422, 1235, 992, 784 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.08 (s, 9H), 1.26 (s, 2H), 1.42 (s, 6H), 2.02 (s, 3H), 5.23 (s, 1H), 7.19-7.27 (m, 2H), 7.31 (td, 1H, J = 6.0 & 1.1 Hz), 7.60 (dd, 1H, J = 5.9 & 1.3 Hz). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 10.6, 28.8, 31.6, 31.9, 54.0, 57.1, 85.5, 113.2, 114.8, 117.1, 124.4, 125.0, 132.8, 146.3, 152.6, 156.0, 161.8. HRMS (ESI) m/z calcd. for $C_{20}H_{25}NO_3$ $[M+Na]^+$: 350.1732, found: 350.1724.

2-(cyclohexylamino)-3-methyl-4H-furo[3,2-c]chromen-4-one (**4c**). Yield: 67% (using vinyl acetate); crystalline yellow solid; mp: 145-147 °C; IR (KBr) ν: 3320, 2928, 2853, 1725, 1613, 1413, 1193, 1013, 801, 751 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.08-1.19 (m, 1H), 1.21-1.35 (m, 4H), 1.52-1.63 (m, 1H), 1.69-1.77 (m, 2H), 1.85-1.95 (m, 2H), 2.10 (s, 3H), 3.29-3.33 (m, 1H), 5.89 (d, 1H, J = 8.0 Hz), 7.30-7.35 (m, 1H), 7.36-7.46 (m, 2H), 7.69 (d, 1H, J = 7.8 Hz). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 7.3, 24.6, 25.3, 33.4, 53.5, 91.9, 112.1, 112.4, 116.4, 119.1, 124.5, 128.3, 148.0, 150.4, 155.5, 157.8. HRMS (ESI) m/z calcd. for $C_{18}H_{19}NO_3$ $[M+Na]^+$: 320.1263, found: 320.1255.

2-(2,6-dimethylphenylamino)-3-methyl-4H- furo[3,2-c]chromen-4-one (**4d**). Yield: 62% (using vinyl acetate), 73% (using vinyl benzoate); crystalline yellow solid; mp: 195-196 °C; IR (KBr) ν: 3443, 2999, 1704, 1653, 1563, 1412, 1249, 1206, 807, 755 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.76 (s, 3H), 2.05 (s, 6H), 5.34 (s, 1H), 6.61 (t, 1H, *J* = 5.9 Hz), 6.76 (d, 2H, *J* = 5.9 Hz), 6.96-7.04 (m, 2H), 7.19 (td, 1H, *J* = 6.0 & 1.2 Hz), 7.41 (dd, 1H, *J* = 6.0 & 1.2 Hz). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 10.6, 18.2, 95.0, 113.2, 114.8, 117.1, 124.4, 125.0, 126.6, 128.9, 132.8, 133.6, 140.9, 146.3, 152.6, 156.0, 157.4. HRMS (ESI) m/z calcd. for $C_{20}H_{17}NO_3$ $[M+Na]^+$: 342.1106, found: 342.1101.

2-(tert-Butylamino)-3-(4'-methyl)-4H-benzo[f]furo[3,2-c]chromen-4-one (**4e**). Yield: 69% (using vinyl acetate), 67% (using vinyl pivalate); crystalline yellow solid; mp: 208-210 °C; IR (KBr) ν: 3443, 2963, 1716, 1563, 1413, 1222, 1018, 817 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.31 (s, 9H), 2.20 (s, 3H), 5.40 (s, 1H), 7.58-7.66 (m, 2H), 7.77 (t, 1H, *J* = 7.1 Hz), 8.06 (dd, 2H, *J* = 8.5 & 3.6 Hz), 8.92 (d, 1H, *J* = 8.2 Hz). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 8.2, 29.9, 53.7, 102.2, 106.6, 111.5, 117.2, 124.3, 126.0, 126.1, 128.3, 128.9, 130.0, 130.2, 150.7, 151.8, 154.9, 157.7. HRMS (ESI) m/z calcd. for $C_{20}H_{19}NO_3$ $[M+Na]^+$: 344.1263, found: 344.1259.

3-(4'-Methyl)-2-((2'',4'',4''-trimethylpentan-2-yl)amino)-4H-benzo[f]furo[3,2-c]chromen-4-one (**4f**). Yield: 67% (using vinyl acetate), 66% (using vinyl pivalate); crystalline yellow solid; mp: 128-130 °C; IR (KBr) ν: 3445, 2954, 1715, 1639, 1561, 1413, 1220, 1009, 811 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.06 (s, 9H), 1.33 (s, 6H), 1.74 (s, 2H), 2.18 (s, 3H), 5.34 (s, 1H), 7.53-7.63 (m, 2H), 7.69 (t, 1H, *J* = 8.4 Hz), 8.00 (d, 1H, *J* = 9.0 Hz), 8.03 (d, 1H, *J* = 7.9 Hz), 8.90 (d, 1H, *J* = 8.4 Hz). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 8.2, 29.8, 31.4, 31.5,

54.0, 56.9, 100.1, 106.6, 111.7, 117.1, 124.3, 125.9, 126.0, 127.9, 128.8, 129.8, 130.0, 150.4, 151.0, 154.9, 157.7. HRMS (ESI) m/z calcd. for $C_{24}H_{27}NO_3$ $[M+Na]^+$: 400.1889, found: 400.1881.

2-(Cyclohexylamino)-3-(4'-methyl)-4H-benzo[f]furo[3,2-c]chromen-4-one (**4g**). Yield: 69% (using vinyl acetate); crystalline yellow solid; mp: 166-168 °C; IR (KBr) ν: 3442, 2930, 1708, 1637, 1558, 1413, 1232, 1018, 804 cm^{-1}. ^1H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.37-1.45 (m, 5H), 1.68-1.75 (m, 3H), 2.03 (s, 3H), 2.10-2.15 (m, 2H), 3.57 (quint, 1H, *J* = 5.9 Hz), 5.4 (s, 1H), 7.38-7.43 (m, 2H), 7.65-7.72 (m, 2H), 7.78-7.83 (m, 1H), 7.95-7.99 (m, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 10.6, 24.7, 25.9, 33.5, 51.3, 90.8, 105.6, 108.0, 117.3, 123.7, 126.3, 126.7, 126.8, 130.4, 130.8, 131.3, 154.3, 154.6, 156.0, 156.4. HRMS (ESI) m/z calcd. for $C_{22}H_{21}NO_3$ $[M+Na]^+$: 370.1419, found: 370.1411.

2-(tert-butylamino)-3-methylnaptho[2,3-b]furan-4,9-dione (**4h**). Yield: 72% (using vinyl acetate), 85% (using vinyl chloroacetate); crystalline purple solid; mp: 164-166 °C; IR (KBr) ν: 3433, 2972, 1671, 1641, 1563, 1413, 1268, 1207, 1017, 818, 720 cm^{-1}. ^1H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.46 (s, 9H), 2.15 (s, 3H), 4.21 (s, 1H), 7.58 (td, 1H, *J* = 7.5 & 1.4 Hz), 7.66 (td, 1H, *J* = 7.5 & 1.4 Hz), 8.04 (dd, 1H, *J* = 7.5 & 1.3 Hz), 8.13 (dd, 1H, *J* = 7.8 & 1.4 Hz). ^{13}C NMR: (100 MHz, $CDCl_3$): δ (ppm) 7.9, 30.2, 54.1, 126.2, 132.1, 132.2, 133.1, 133.8, 133.9, 159.8, 168.8, 183.3. HRMS (ESI) m/z calcd. for $C_{17}H_{17}NO_3$ $[M+Na]^+$: 306.1106, found: 306.1101.

3-methyl-2-(2,4,4-trimethylpentan-2-ylamino)naphtho[2,3-b]furan-4,9-dione (**4i**). Yield: 69% (using vinyl acetate), 68% (using vinyl pivalate); crystalline purple solid; mp: 176-177 °C; IR (KBr) ν: 3439, 2969, 1674, 1641, 1563, 1413, 1211, 1018, 781 cm^{-1}. ^1H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.01 (s, 9H), 1.52 (s, 6H), 1.78 (s, 2H), 2.14 (s, 3H), 4.32 (s, 1H), 7.57 (td, 1H, *J* = 7.5 & 1.4 Hz), 7.66 (td, 1H, *J* = 7.5 & 1.4 Hz),

8.03 (dd, 1H, *J* = 7.6 & 1.3 Hz), 8.13 (dd, 1H, *J* = 7.5 & 1.3 Hz). ^{13}C NMR: (100 MHz, $CDCl_3$): δ (ppm) 7.7, 30.5, 31.6, 31.9, 53.5, 57.7, 126.1, 131.9, 132.2, 133.0, 133.8, 134.0, 159.8, 168.4, 183.5. HRMS (ESI) m/z calcd. for $C_{21}H_{25}NO_3$ $[M+Na]^+$: 362.1732, found: 362.1726.

Ethyl 2-(3-methyl-4,9-dioxo-4,9-dihydronaptho [2,3-b]furan-2-ylamino)acetate (**4j**). Yield: 77% (using vinyl acetate); crystalline purple solid; mp: 193-194 °C; IR (KBr) ν: 3311, 2978, 1719, 1648, 1558, 1412, 1223, 1031, 894, 763 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.39 (t, 3H, *J* = 4.7 Hz), 2.09 (s, 3H), 4.24 (q, 2H, *J* = 4.7 Hz), 4.32 (s, 1H), 4.75 (s, 1H), 7.73 (td, 1H, *J* = 6.0 & 1.3 Hz), 7.77 (td, 1H, *J* = 5.9 & 1.4 Hz), 8.22 (dd, 1H, *J* = 5.8 & 1.4 Hz), 8.25 (dd, 1H, *J* = 5.8 & 1.4 Hz), 9.51 (s, 1H). ^{13}C NMR: (100 MHz, $CDCl_3$): δ (ppm) 5.2, 14.7, 46.1, 61.2, 86.3, 126.6, 132.2, 133.7, 136.0, 143.2, 159.3, 170.5, 174.9, 178.5. HRMS (ESI) m/z calcd. for $C_{17}H_{15}NO_5$ $[M+Na]^+$: 336.0848, found: 336.0842.

2-(tert-butylamino)-3-methyl-4H-furo[3,2-c]pyran-4-one (**4k**). Yield: 75% (using vinyl acetate), 72% (using vinyl benzoate), 83% (using vinyl chloroacetate); crystalline yellow solid; mp: 146-148 °C; IR (KBr) ν: 3310, 2976, 1712, 1642, 1553, 1412, 1223, 979, 763 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.33 (s, 9H), 1.97 (s, 3H), 2.18 (s, 3H), 4.33 (s, 1H), 5.98 (s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 8.23, 16.7, 27.3, 51.2, 76.9, 89.8, 104.9, 153.9, 154.0, 158.2, 158.3. HRMS (ESI) m/z calcd. for $C_{12}H_{15}NO_3$ $[M+Na]^+$: 244.0950, found: 244.0941.

3,6-dimethyl-2-(2,4,4-trimethylpentan-2-ylamino)-4H-furo[3,2-c]pyran-4-one (**4l**). Yield: 69% (using vinyl acetate); crystalline yellow solid; mp: 178-180 °C; IR (KBr) ν: 3428, 2949, 1639, 1555, 1414, 1221, 1014, 925, 757 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.09 (s, 9H), 1.28 (s, 2H), 1.41 (s, 6H), 2.01 (s, 3H), 2.22 (s, 3H), 5.40 (s, 1H), 6.04 (s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 11.3, 19.8, 29.6, 32.4, 32.7, 54.8, 57.8, 82.3, 92.9, 108.0, 157.0, 157.1, 161.3, 161.5. HRMS (ESI) m/z calcd. for $C_{17}H_{25}NO_3$ $[M+Na]^+$: 314.1732, found: 314.1728.

2,6-bis(tert-butylamino)-benzofuro[5,6-b]furan-4-8-diones (**4m**). Yield: 72% (using vinyl acetate), 74% (using vinyl pivalate); black solid; mp: >300 °C; IR (KBr) ν: 3438, 2969, 1698, 1639, 1567, 1412, 1207, 1020, 795 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.43 (s, 18H), 2.24 (s, 6H), 5.40 (s, 2H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 4.5, 29.0, 52.9, 94.3, 119.2, 151.1, 153.1, 166.5. HRMS (ESI) m/z calcd. for $C_{20}H_{26}N_2O_4$ $[M+Na]^+$: 381.1791, found: 381.1785.

2-(tert-butylamino)-3-methylfuro[3,2-c]quinolin-4-(5H)-one (**4n**). Yield: 65% (using vinyl acetate); yellow solid; mp: 145-147 °C; IR (KBr) ν: 3437, 3311, 2975, 1715, 1641, 1412, 1223, 979, 763 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.22 (s, 9H), 1.90 (s, 3H), 5.72 (s, 1H), 7.17 (td, 1H, *J* = 6.0 & 1.3 Hz), 7.25 (td, 1H, *J* = 5.9 & 1.1 Hz), 7.31 (dd, 1H, *J* = 6.0 & 1.1 Hz), 7.58 (dd, 1H, *J* = 5.8 & 1.1 Hz), 9.25 (s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 10.6, 29.7, 53.6, 100.3, 110.7, 118.1, 119.1, 123.0, 123.7, 131.8, 137.1, 156.7, 157.0, 169.2. HRMS (ESI) m/z calcd. for $C_{16}H_{18}N_2O_2$ $[M+Na]^+$: 293.1266, found: 293.1260.

2-(cyclohexylamino)-3-methylfuro[3,2-c]quinolin-4-(5H)-one (**4o**). Yield: 69% (using vinyl acetate); yellow solid; mp: 147-149 °C; IR (KBr) ν: 3320, 2929, 2852, 1725, 1638, 1412, 1192, 1016, 751 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.30-1.42 (m, 5H), 1.66-1.74 (m, 3H), 1.89-1.99 (m, 2H), 2.13 (s, 3H), 3.43 (quint, 1H, *J* = 5.8 Hz), 5.87 (s, 1H), 7.30 (td, 1H, *J* = 6.0 & 1.3 Hz), 7.38 (td, 1H, *J* = 5.9 & 1.1 Hz), 7.45 (dd, 1H, *J* = 6.0 & 1.1 Hz), 7.73 (dd, 1H, *J* = 5.9 & 1.1 Hz), 9.22 (s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 10.6, 24.7, 25.9, 33.5, 51.3, 102.2, 110.7, 118.1, 119.1, 123.0, 123.7, 131.8, 137.1, 156.7, 161.4. HRMS (ESI) m/z calcd. for $C_{18}H_{20}N_2O_2$ $[M+Na]^+$: 319.1423, found: 319.1418.

2-(benzylamino)-3-methylfuro[3,2-c]quinolin-4-(5H)-one (**4p**). Yield: 65% (using vinyl acetate); yellow solid; mp: 173-175 °C; IR (KBr) ν: 3442, 3305, 2928, 2853, 1707, 1413, 1207, 1018, 840 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.17 (s, 3H), 3.70 (d, 2H, *J* = 10.4 Hz), 4.86 (s, 1H), 6.15-6.20 (m, 1H), 6.21- 6.26 (m, 4H), 6.28 (td, 1H, *J* = 5.9 & 1.3 Hz), 6.36 (td, 1H, *J* = 5.9 & 1.3 Hz), 6.43 (dd, 1H, *J* = 6.0 & 1.3 Hz), 6.70 (dd, 1H, *J* = 6.0 & 1.1 Hz), 8.65 (s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 10.6, 46.9, 97.3, 110.7, 118.1, 119.1, 123.0, 123.7, 126.9, 128.4, 131.8, 137.1, 139.8, 156.7, 157.0, 157.9. HRMS (ESI) m/z calcd. for $C_{19}H_{16}N_2O_2$ $[M+Na]^+$: 327.1110, found: 327.1107.

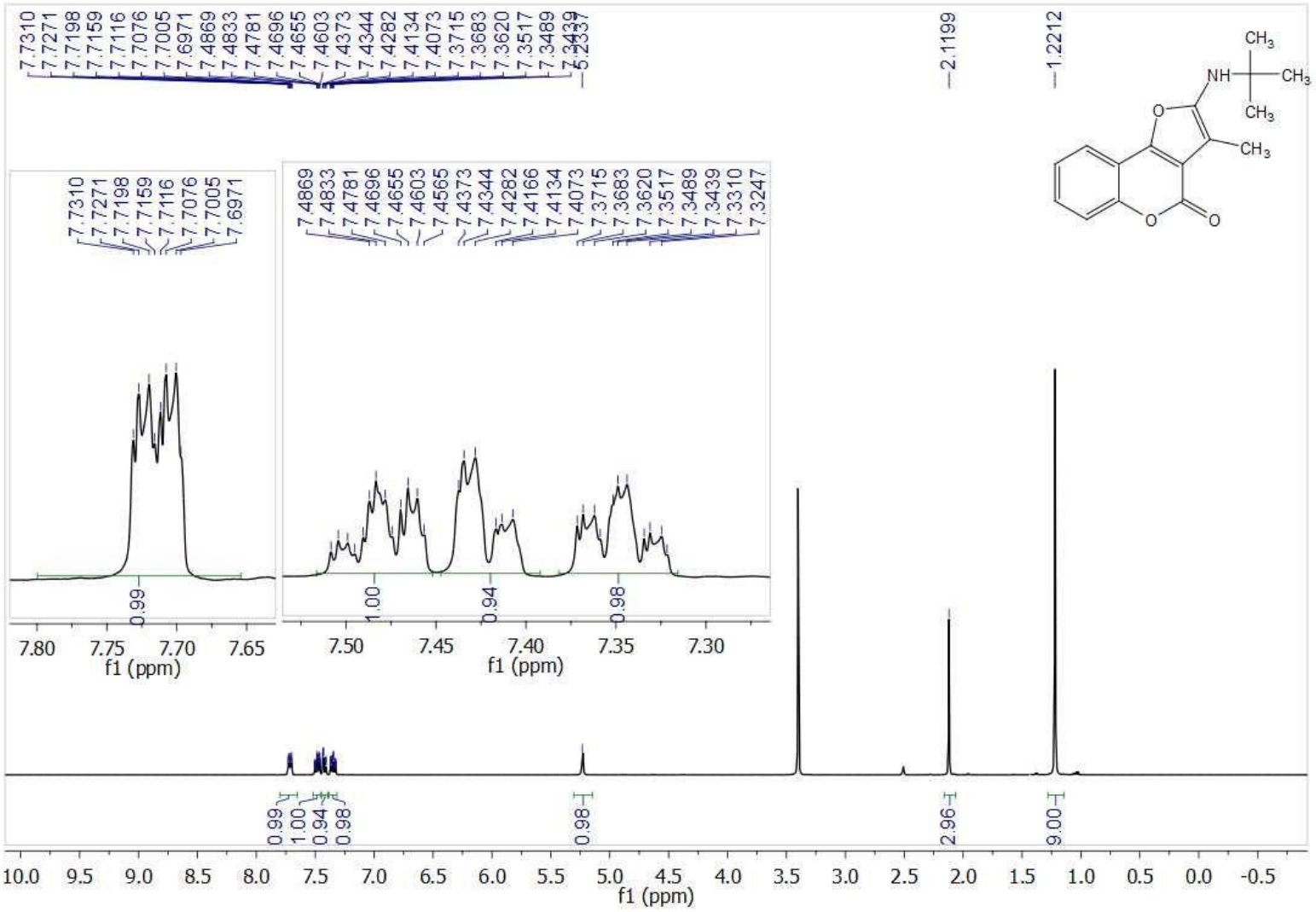
3-((tert-Butylamino)methylene)-3H-chromene-2,4-dione (**5a**). Yield: 25%; Yellow orange solid; mp: 182-184°C; IR (KBr) ν: 3449, 3240, 2977, 1696, 1635, 1619, 1568 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.33 (s, 9H), 7.21 (td, 1H, *J* = 6.0 & 1.3 Hz), 7.25 (dd, 1H, *J* = 6.0 & 1.1 Hz), 7.48 (td, 1H, *J* = 6.0 & 1.1 Hz), 7.89 (dd, 1H, *J* = 6.0 & 1.1 Hz), 8.99 (s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 28.8, 53.2, 101.5, 119.1, 123.8, 127.6, 136.2, 156.9, 161.6, 167.3, 176.2. HRMS (ESI) m/z calcd. for $C_{14}H_{15}NO_3$ $[M+Na]^+$: 268.0950, found: 268.0942.

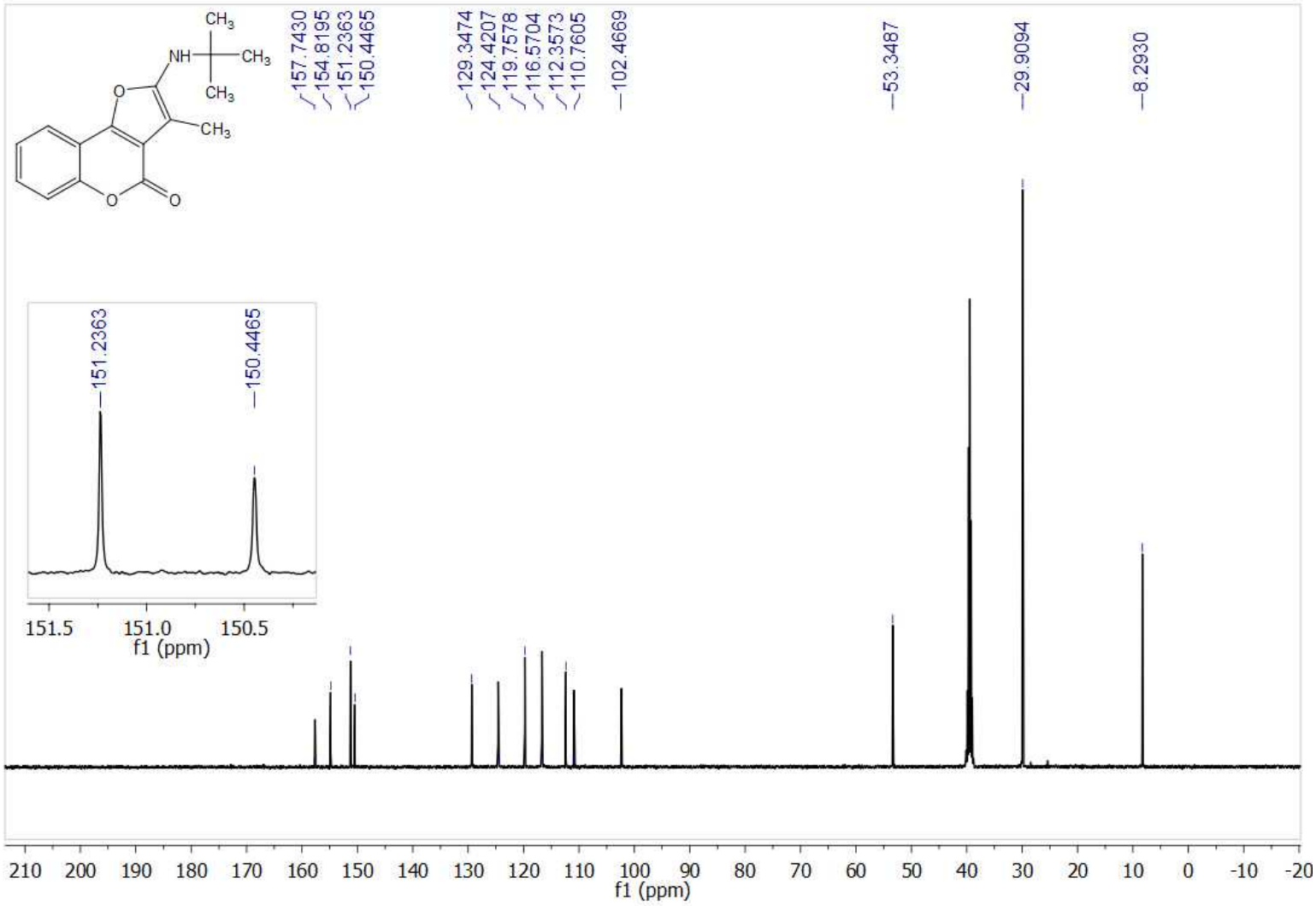
3,3,6,6,9-pentamethyl-3,4,6,7,9,10-hexahydroacridine-1,8-(2H,5H)-dione (***6a***). Yield: 81% (using vinyl acetate); greenish yellow solid; mp: 269-271 °C; IR (KBr) ν: 3443, 3272, 2956, 2869, 1641, 1412, 1727, 1144, 1020, 802 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 0.79 (d, 3H, J = 6.4 Hz), 0.98 (dd, 12H, J = 10.1 & 4.6 Hz), 2.05 (dd, 2H, J = 15.9 & 3.5 Hz), 2.18 (td, 4H, J = 16.7 & 4.4 Hz), 2.33 (dd, 2H, J = 17.0 & 4.2 Hz), 3.68 (q, 1H, J = 6.4 Hz), 9.05 (s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 22.0, 22.3, 26.9, 29.6, 32.6, 50.6, 112.5, 150.3, 195.0. HRMS (ESI) m/z calcd. for $C_{18}H_{25}NO_2$ $[M+Na]^+$: 310.1783, found: 310.1779.

9-methyl-3,4,6,7,9,10-hexahydroacridine-1,8-(2H,5H)-dione ***(6b)***. Yield: 87% (using vinyl acetate), 81% (using vinyl benzoate); yellow solid; mp: 298-299 °C; IR (KBr) ν: 3442, 3276, 2953, 1632, 1413, 1242, 1138, 1020, 801 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 0.76 (d, 3H, J = 6.5 Hz), 1.75-1.94 (m, 4H), 2.12-2.28 (m, 4H), 2.34-2.45 (m, 4H), 3.71 (q, 1H, J = 6.5 Hz), 9.17 (s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 21.5, 22.3, 22.8, 26.7, 37.3, 114.1, 151.8, 195.5. HRMS (ESI) m/z calcd. for $C_{14}H_{17}NO_2$ $[M+Na]^+$: 254.1157, found: 254.1149.

2,2'-(ethane-1,1-diyl)bis(3-hydroxy-5,5-dimethylcyclohex-2-enone) ***(7a)***. Yield: 79% (using vinyl acetate), 75% (using vinyl benzoate); yellow solid; mp: 127-129 °C; IR (KBr) ν: 3441, 3272, 2961, 1642, 1572, 1411, 1021, 804 cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6): δ (ppm) 1.01 (s, 12H), 1.40 (d, 3H, J = 5.1 Hz), 2.11 (s, 4H), 2.65 (s, 4H), 3.1 (q, 1H, J = 5.1 Hz), 13.12 (br s, 1H), 13.95 (br s, 1H). ^{13}C NMR: (100 MHz, DMSO-d_6): δ (ppm) 24.7, 28.8, 33.2, 33.5, 45.0, 51.5, 116.9, 185.2, 192.7. HRMS (ESI) m/z calcd. for $C_{18}H_{26}O_4$ $[M+Na]^+$: 329.1729, found: 329.1723.

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

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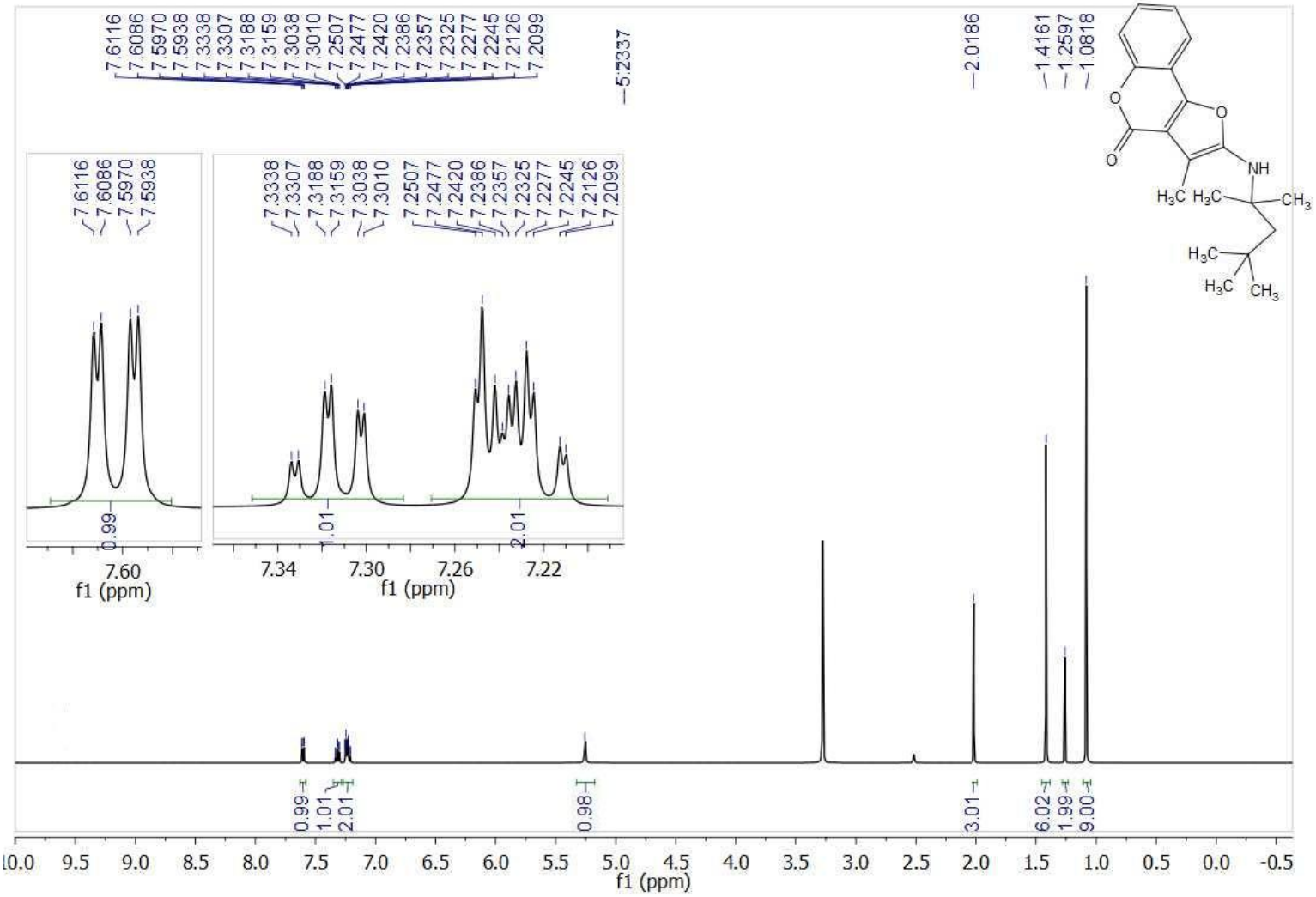
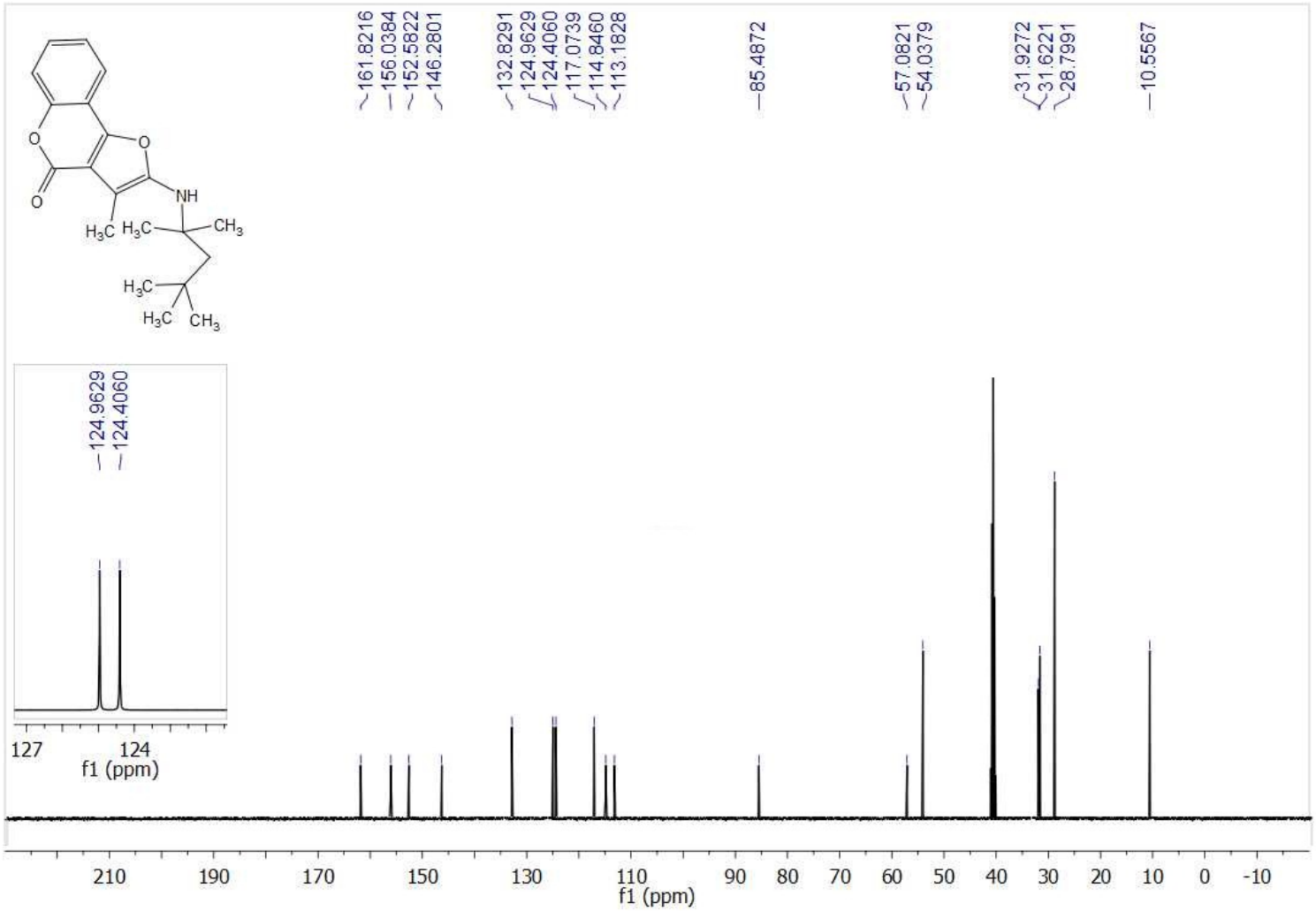
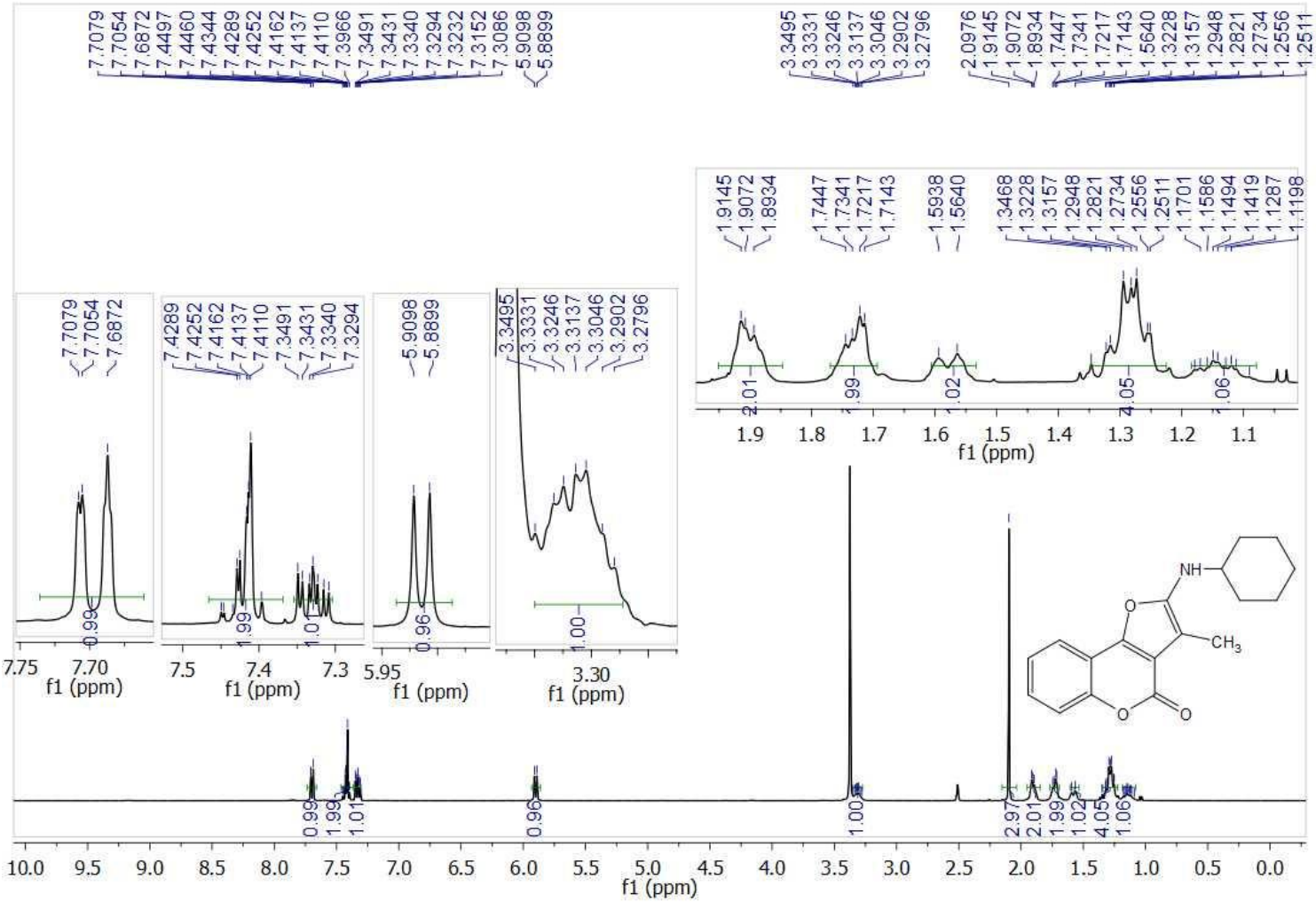
150.5
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20
f1 (ppm)

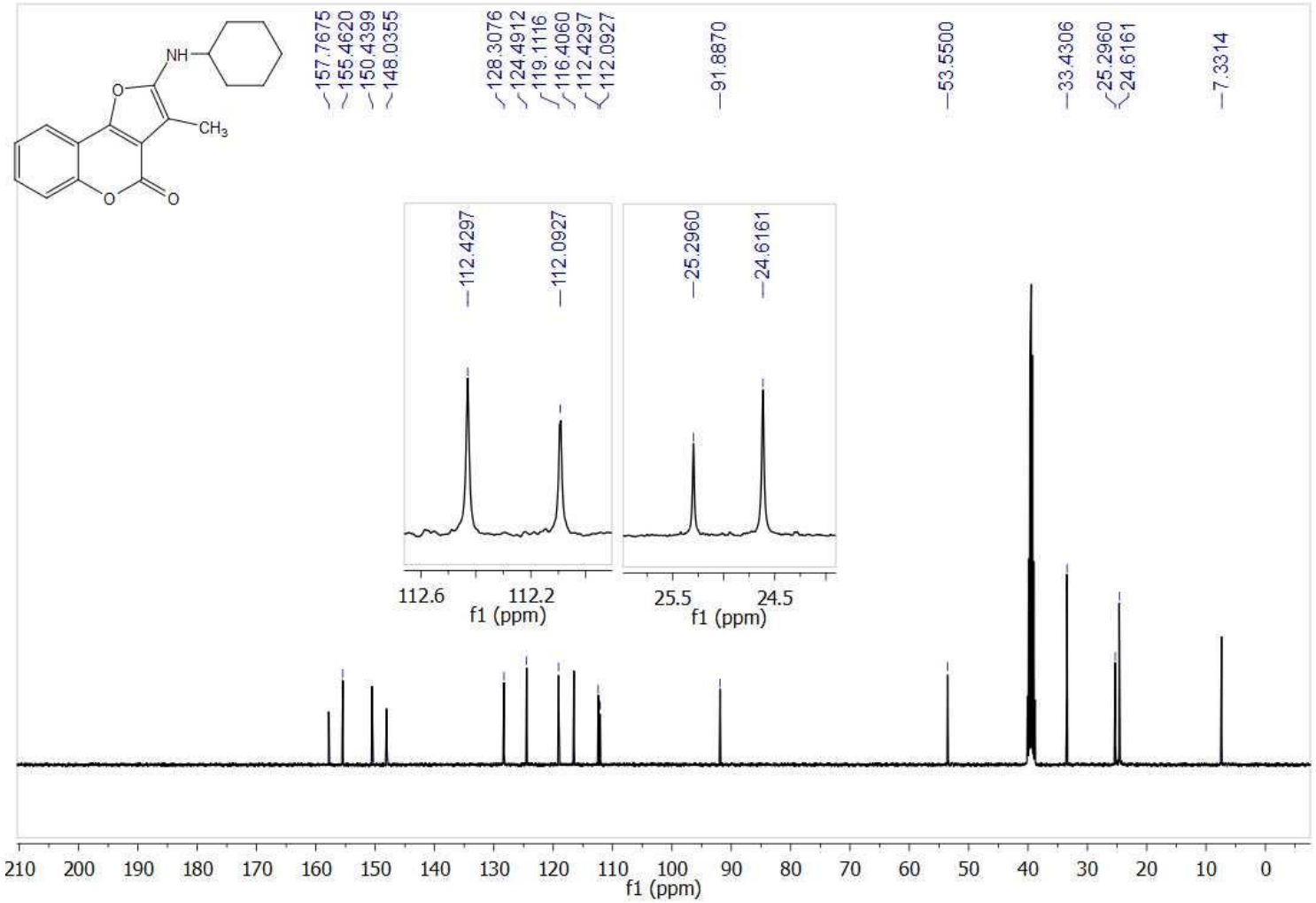
3-methyl-2-(2,4,4-trimethylpentan-2-ylamino)-4H-furo[3,2-c]chromen-4-one **(4b)**



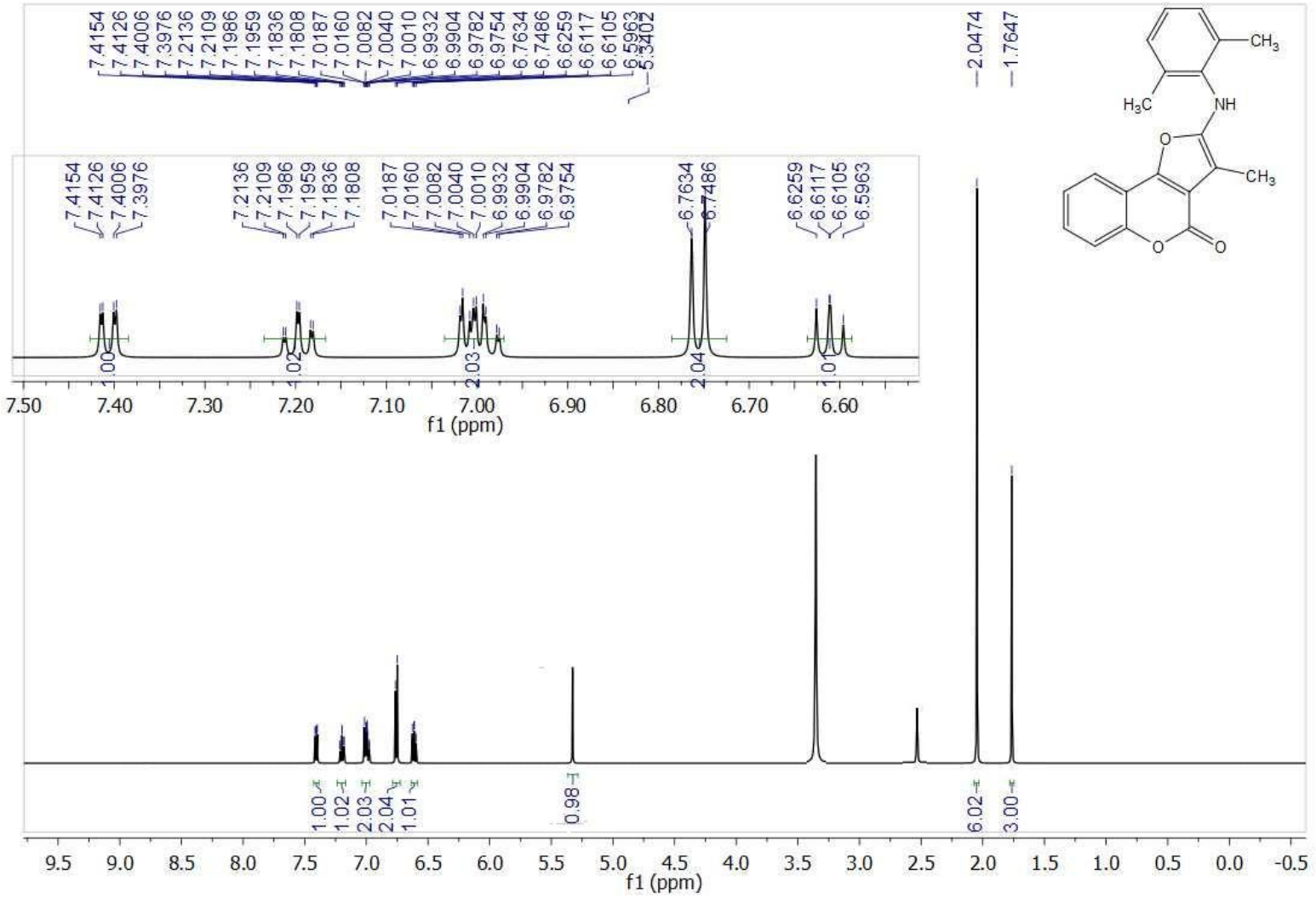

161.8216
156.0384
152.5822
146.2801
132.8291
124.9629
124.4060
117.0739
114.8460
113.1828
85.4872
57.0821
54.0379
31.9272
31.6221
28.7991
10.5567
O
O
O
NH
H3C H3C
CH3
H3C
H3C CH3
124.9629
124.4060
127
124
f1 (ppm)
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

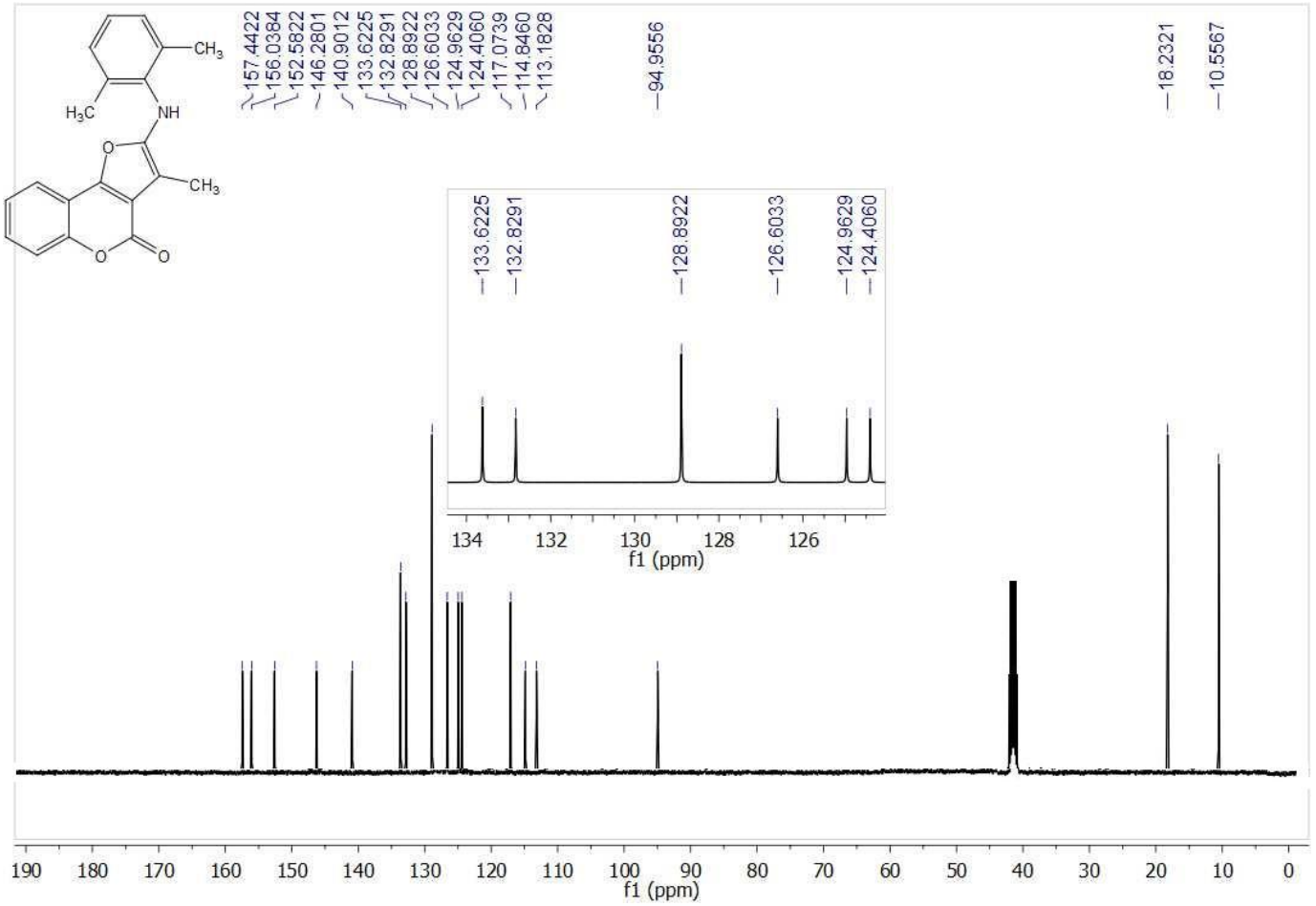
2-(cyclohexylamino)-3-methyl-4H-furo[3,2-c]chromen-4-one (**4c**)



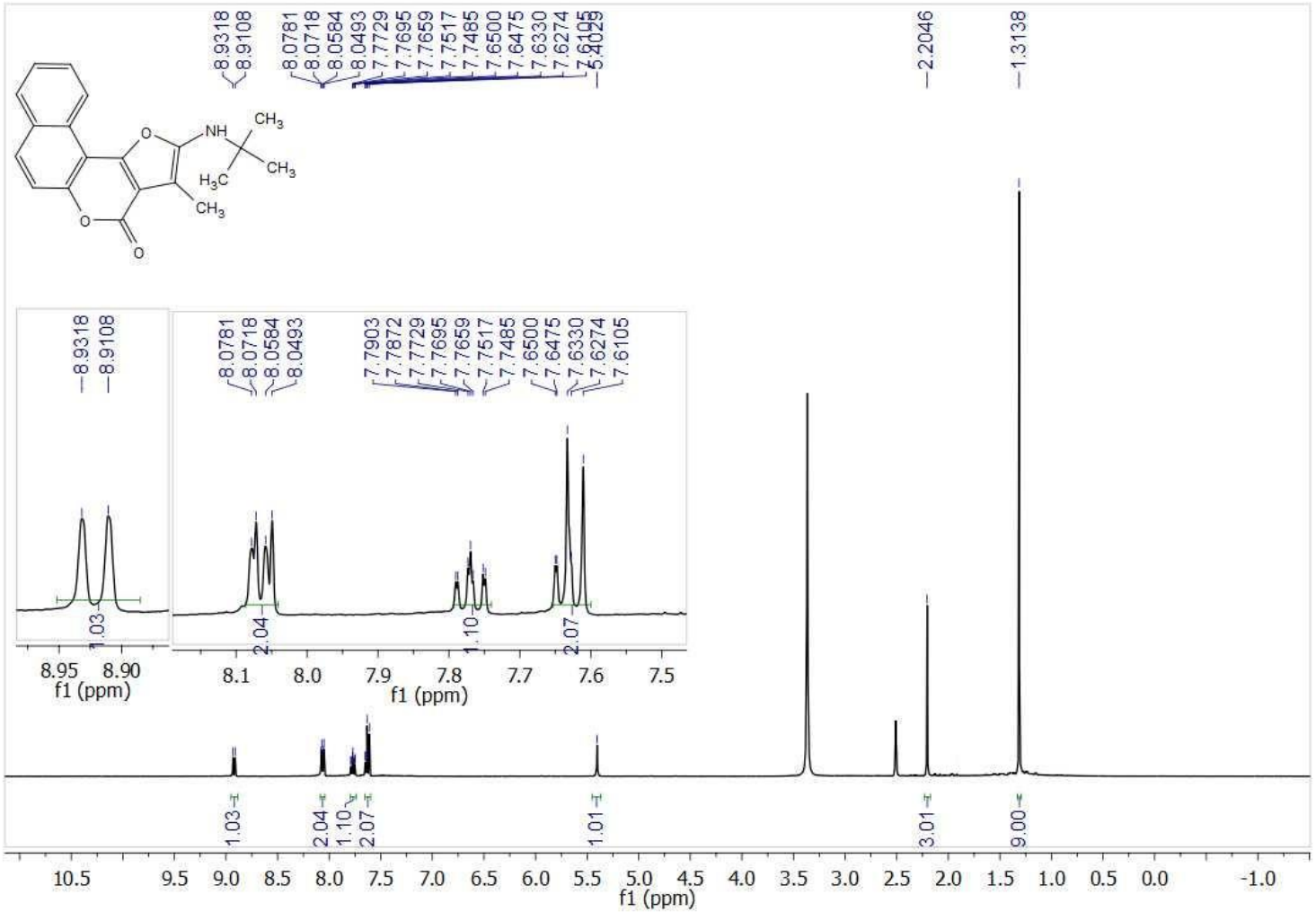

NH
O
CH3
O
O
157.7675
155.4620
150.4399
148.0355
128.3076
124.4912
119.1116
116.4060
112.4297
112.0927
91.8870
53.5500
33.4306
25.2960
24.6161
7.3314
112.4297
112.0927
25.2960
24.6161
112.6
112.2
f1 (ppm)
25.5
24.5
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

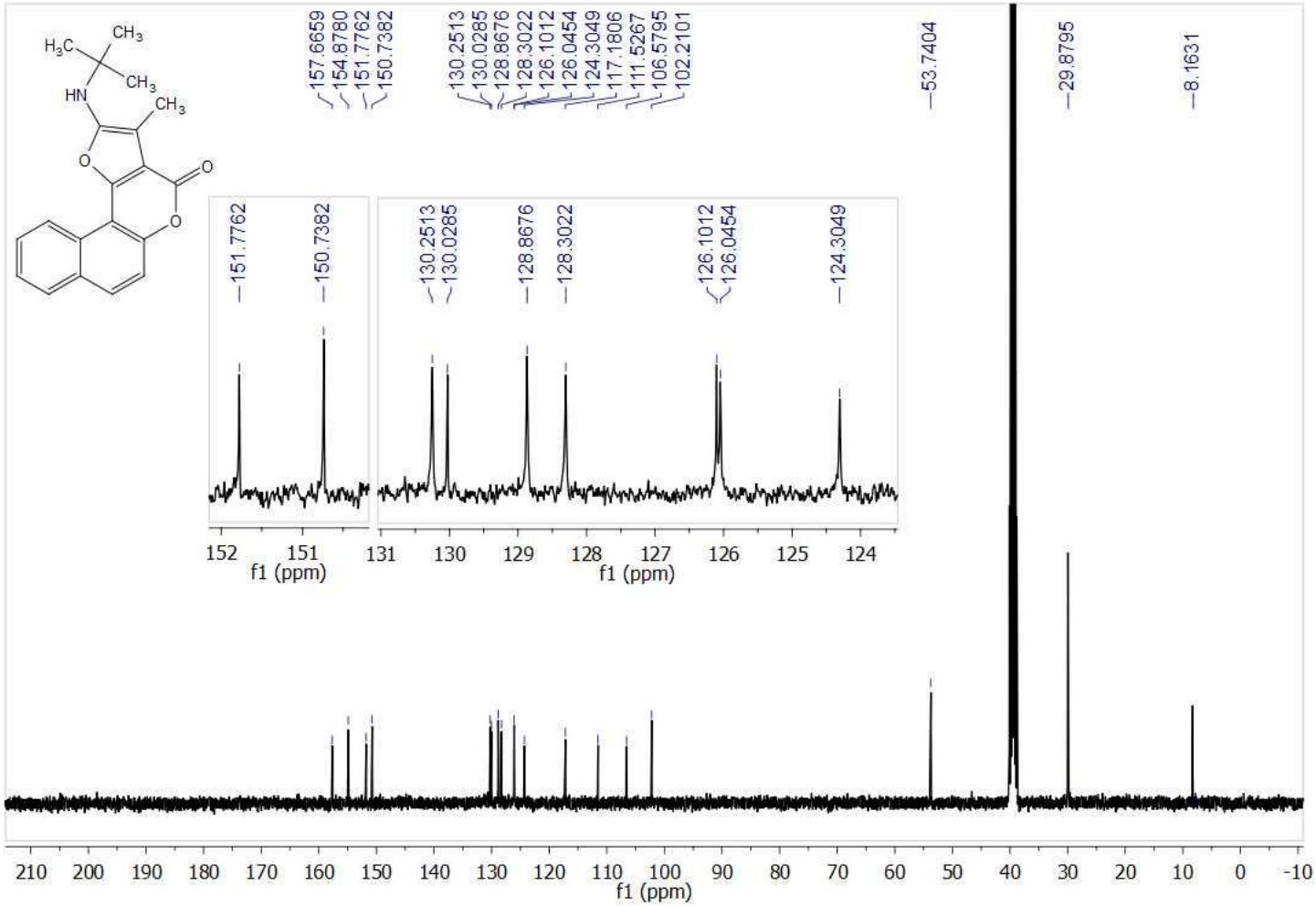
2-(2,6-dimethylphenylamino)-3-methyl-4H- furo[3,2-c]chromen-4-one (**4d**)



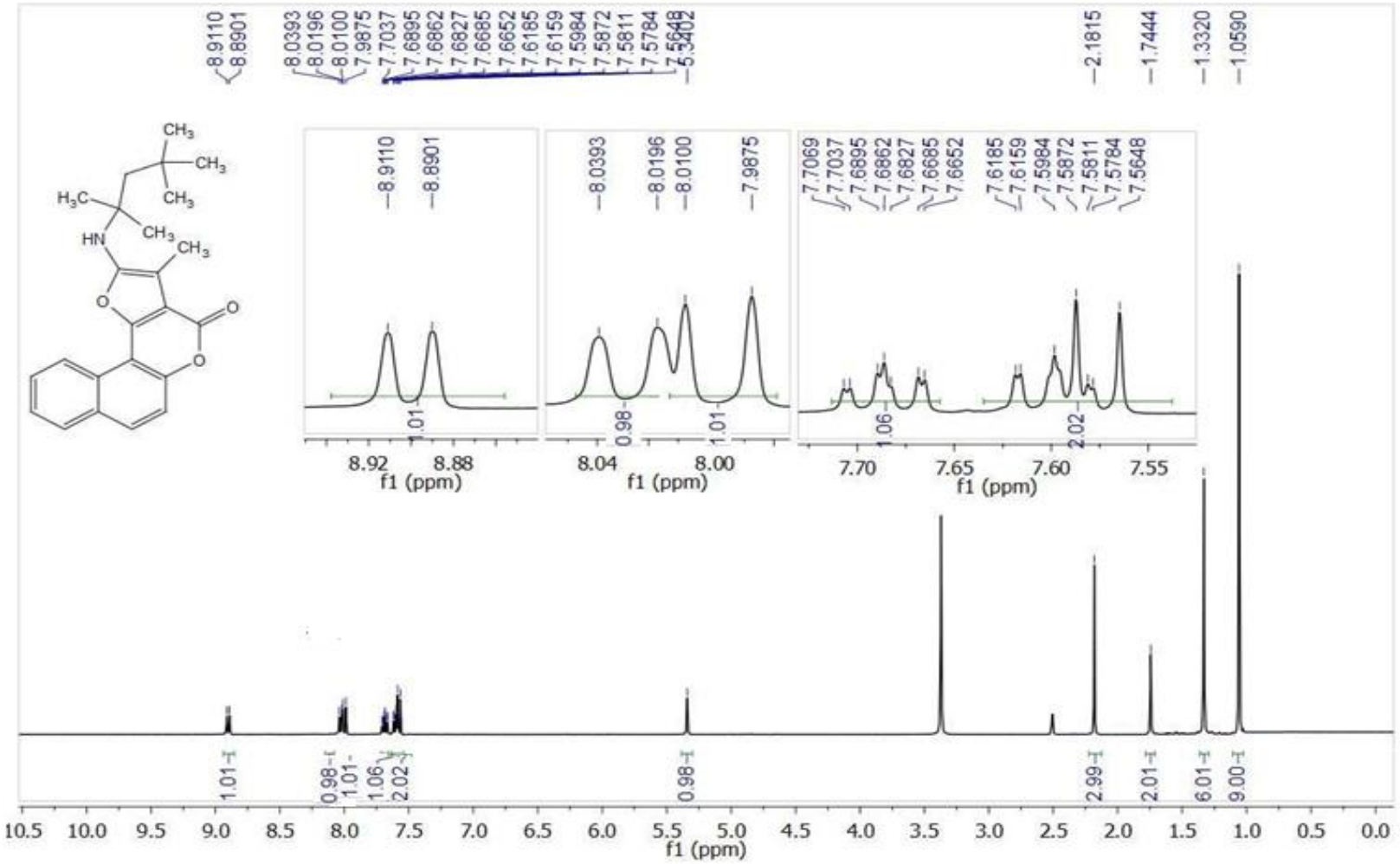

157.4422
156.0384
152.5822
146.2801
140.9012
133.6225
132.8291
128.8922
126.6033
124.9629
124.4060
117.0739
114.8460
113.1828
94.9556
18.2321
10.5567
CH3
H3C
NH
O
CH3
O
O
133.6225
132.8291
128.8922
126.6033
124.9629
124.4060
134
132
130
128
126
f1 (ppm)
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

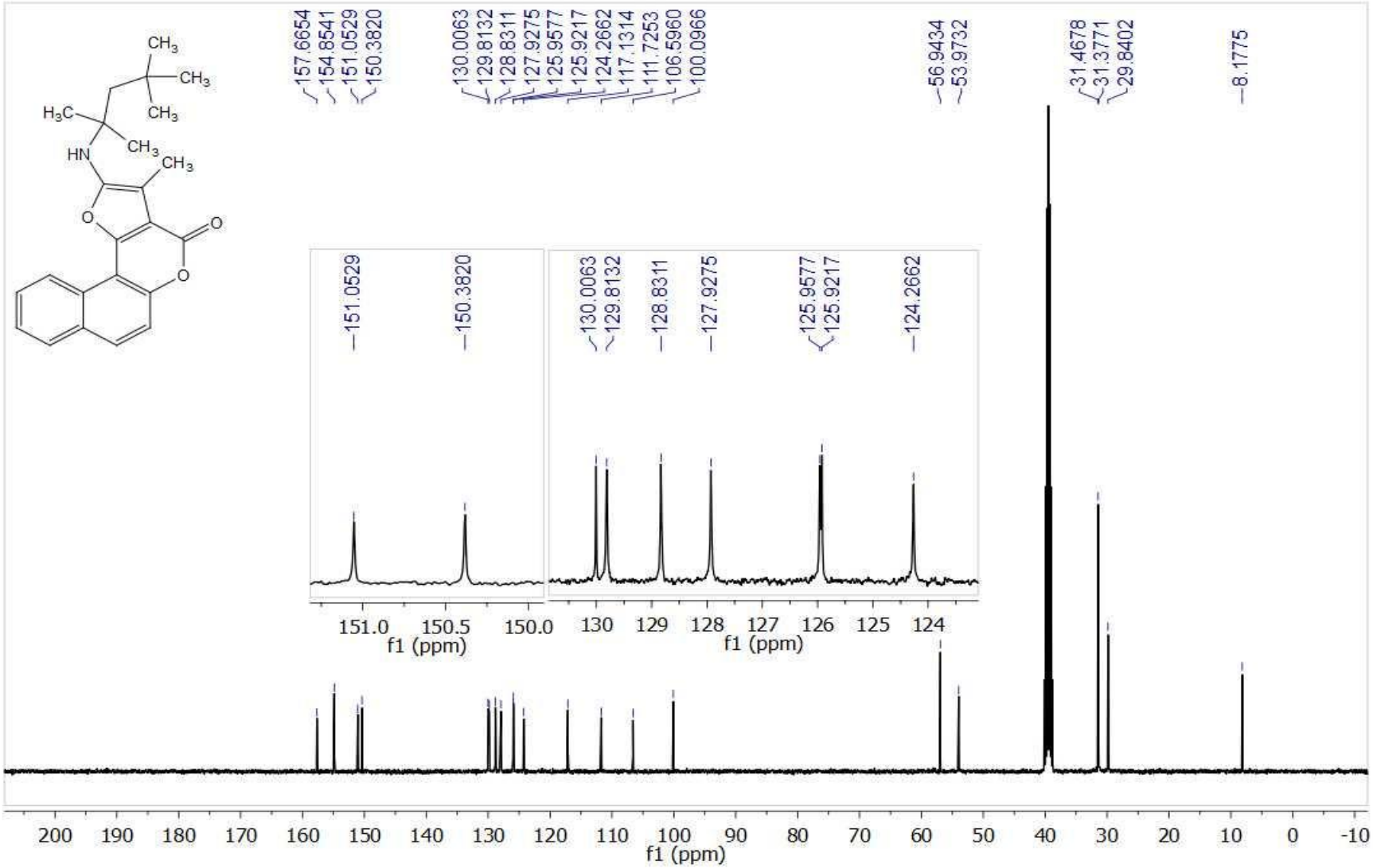
2-(tert-Butylamino)-3-(4'-methyl)-4H-benzo[f]furo[3,2-c]chromen-4-one (**4e**)



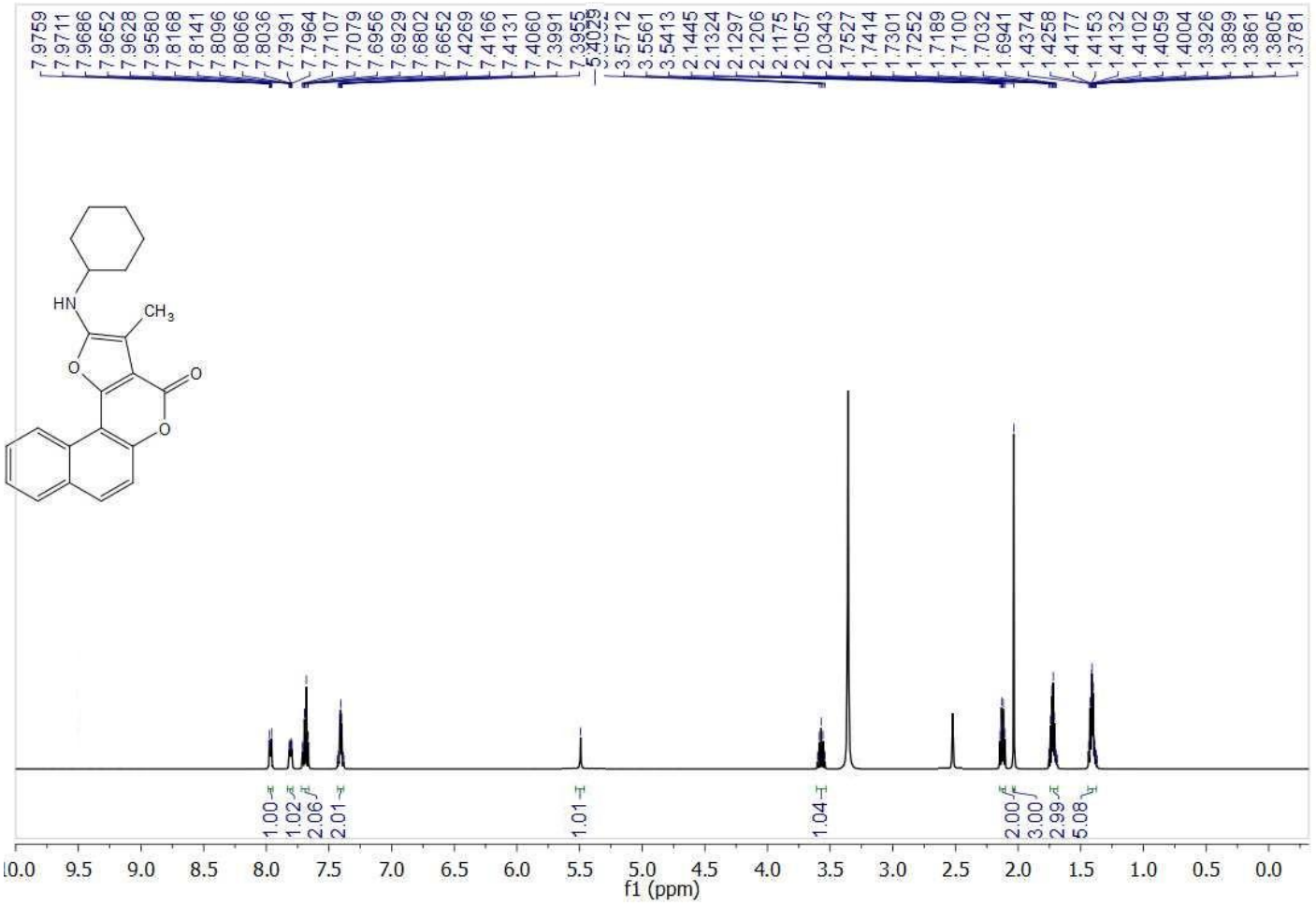

157.6659
154.8780
151.7762
150.7382
130.2513
130.0285
128.8676
128.3022
126.1012
126.0454
124.3049
117.1806
111.5267
106.5795
102.2101
53.7404
29.8795
8.1631
151.7762
150.7382
130.2513
130.0285
128.8676
128.3022
126.1012
126.0454
124.3049
f1 (ppm)
f1 (ppm)
f1 (ppm)

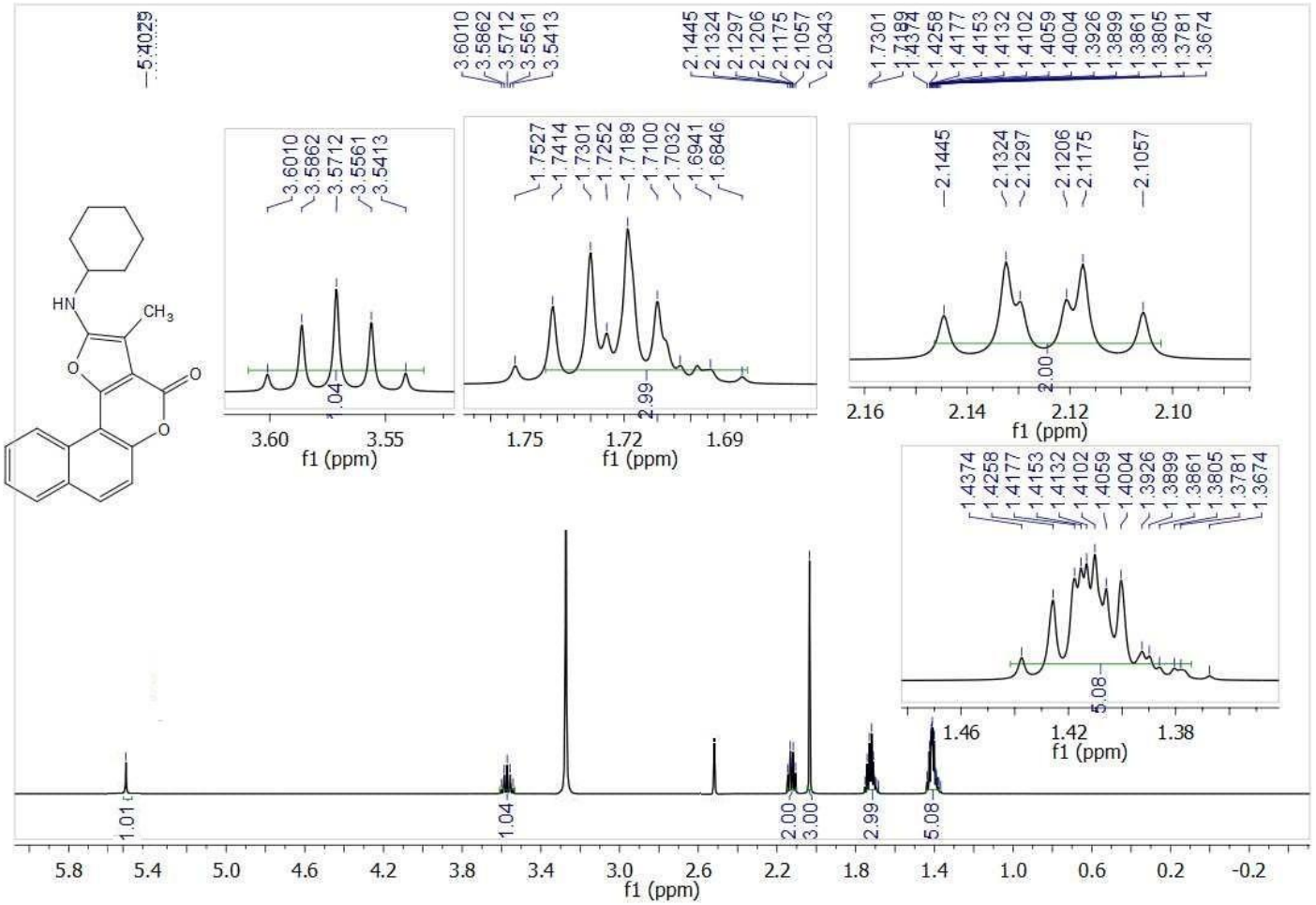
3-(4'-Methyl)-2-((2'',4'',4''-trimethylpentan-2-yl)amino)-4H-benzo[f]furo[3,2-c]chromen-4-one (**4f**)

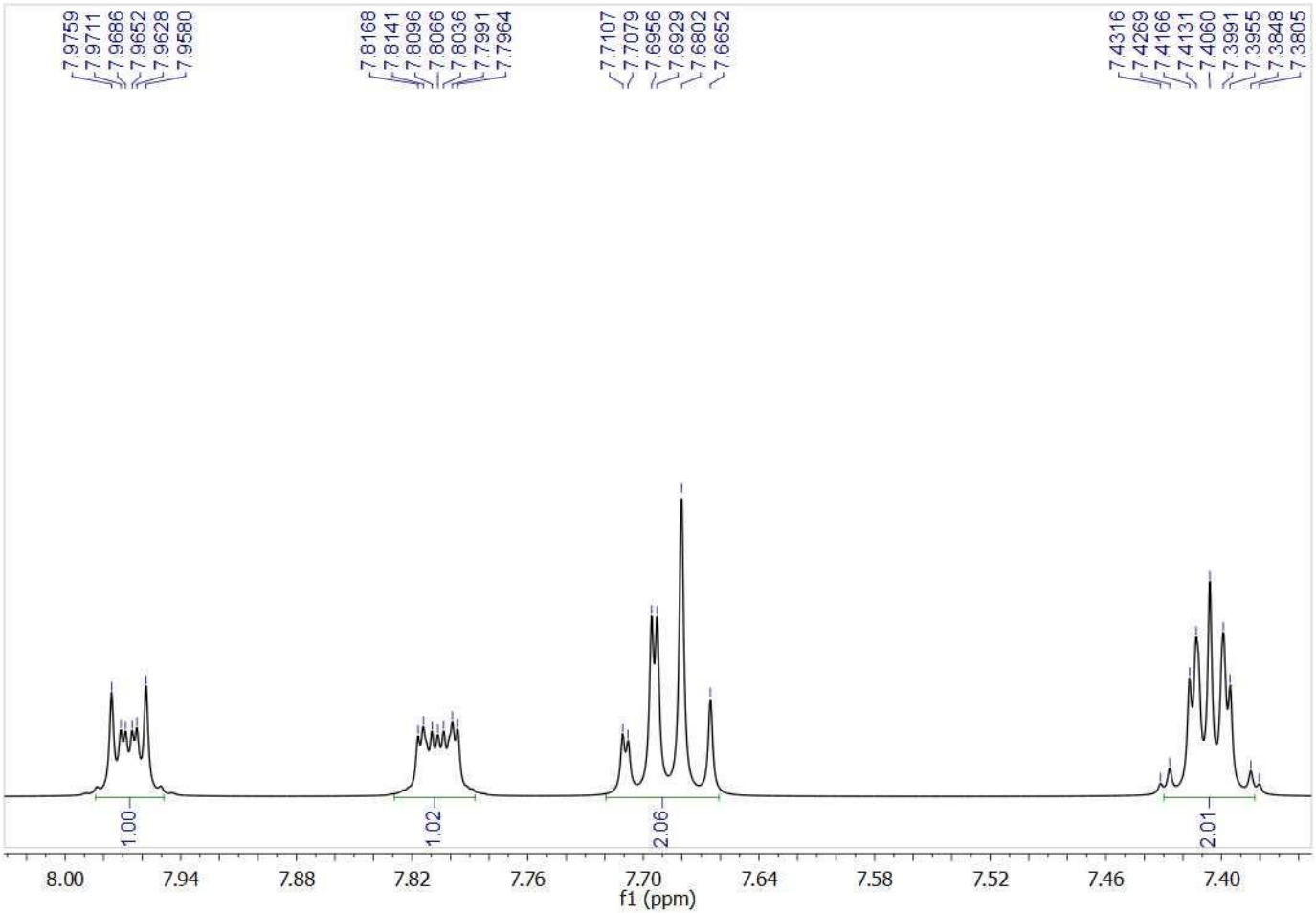


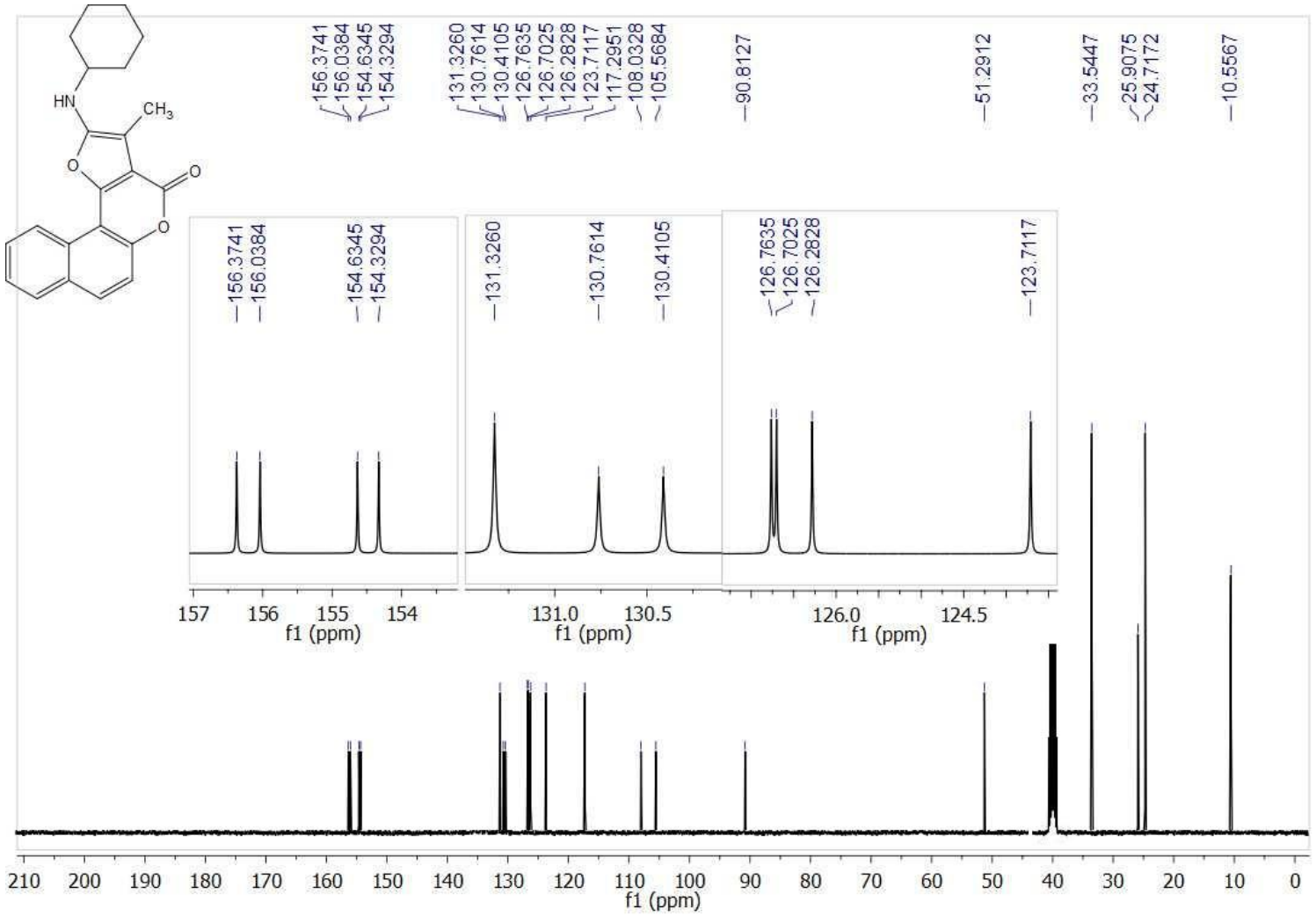

157.6654
154.8541
151.0529
150.3820
130.0063
129.8132
128.8311
127.9275
125.9577
125.9217
124.2662
117.1314
111.7253
106.5960
100.0966
56.9434
53.9732
31.4678
31.3771
29.8402
8.1775
CH3
CH3
H3C
CH3
HN
CH3
CH3
O
O
O
151.0529
150.3820
130.0063
129.8132
128.8311
127.9275
125.9577
125.9217
124.2662
151.0 150.5 150.0
f1 (ppm)
130 129 128 127 126 125 124
f1 (ppm)
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

2-(Cyclohexylamino)-3-(4'-methyl)-4H-benzo[f]furo[3,2-c]chromen-4-one (**4g**)

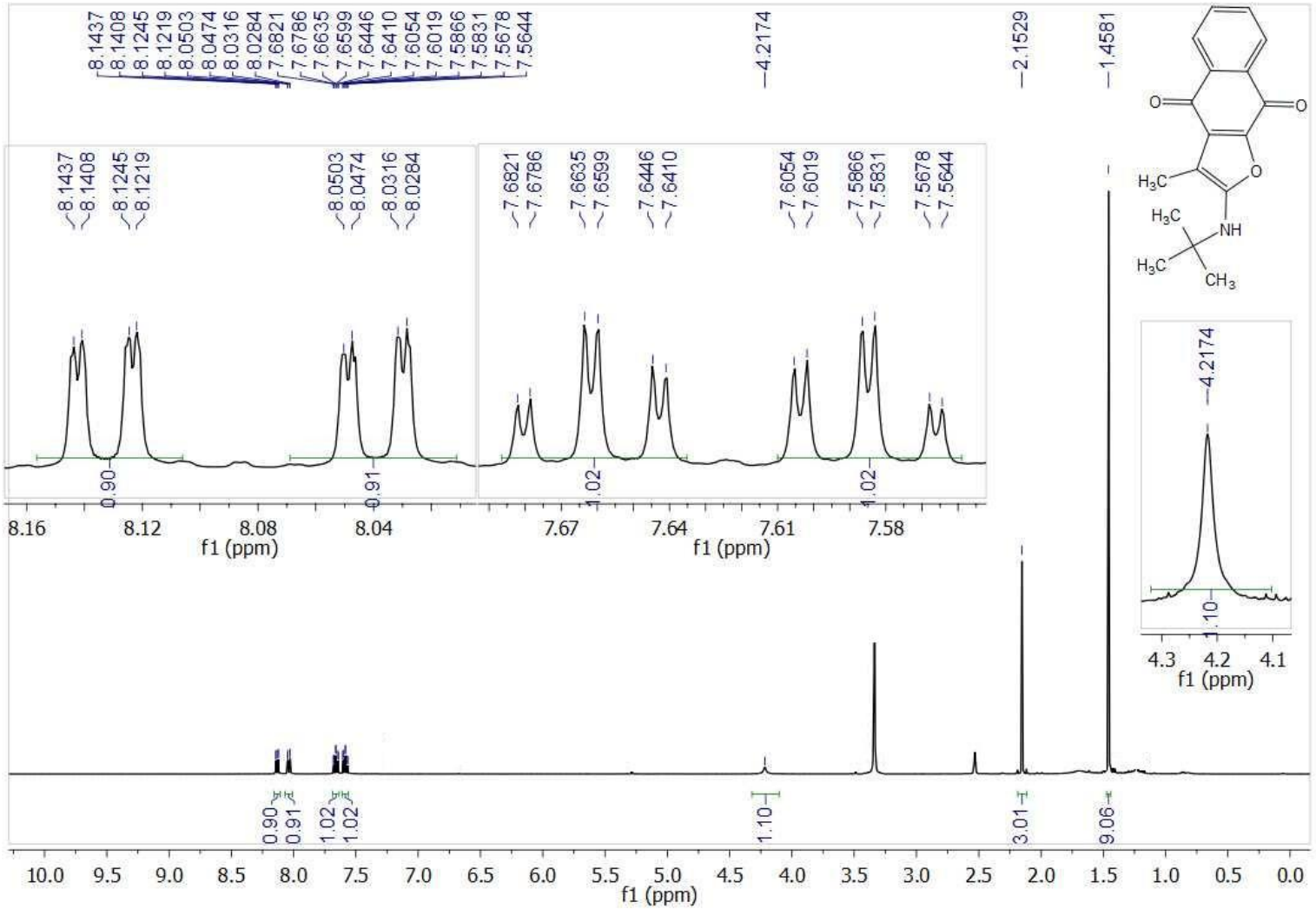


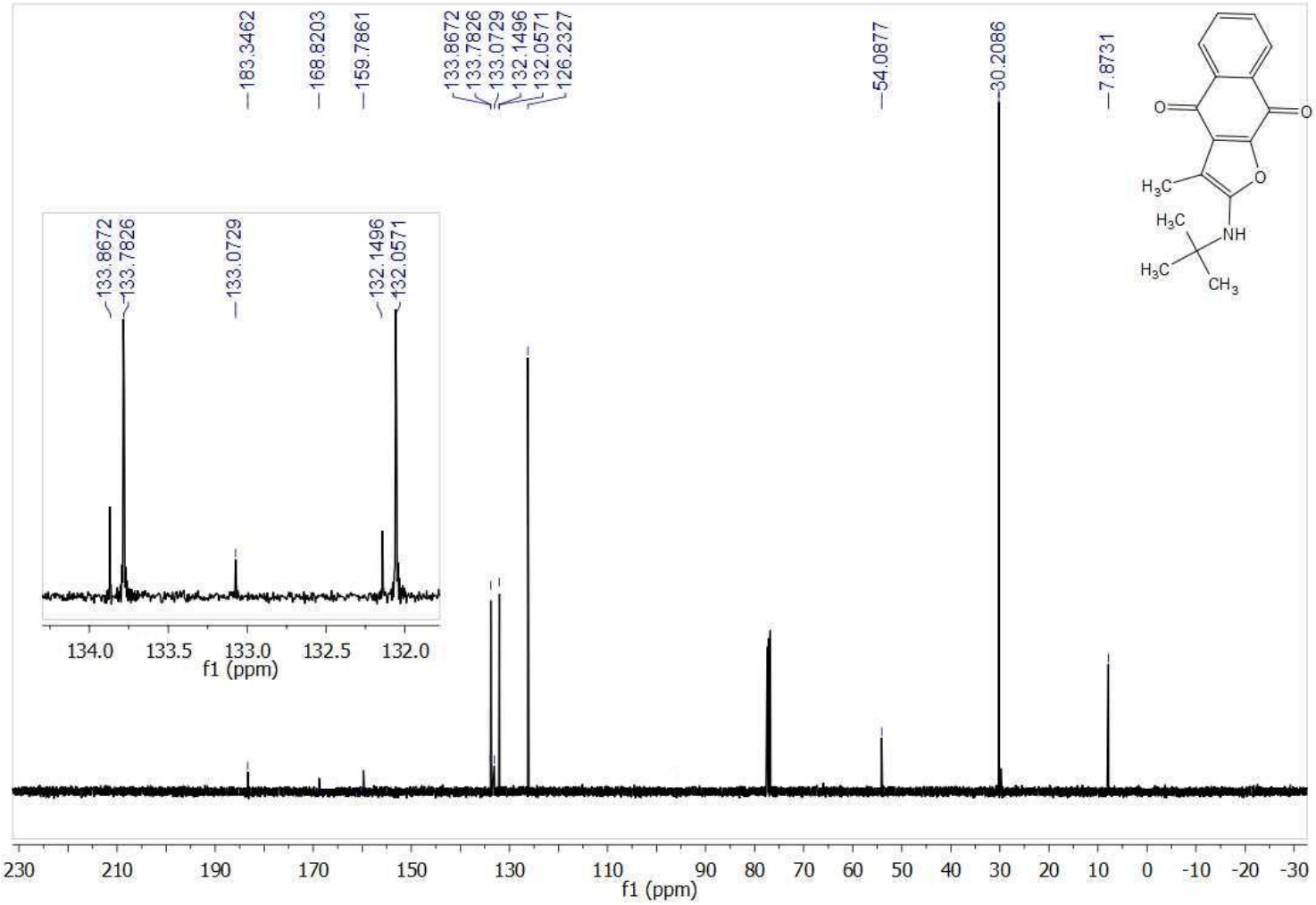

HN
CH3
O
O
O
3.6010
3.5862
3.5712
3.5561
3.5413
1.04
3.60
3.55
f1 (ppm)
1.7527
1.7414
1.7301
1.7252
1.7189
1.7100
1.7032
1.6941
1.6846
2.99
1.75
1.72
1.69
f1 (ppm)
2.1445
2.1324
2.1297
2.1206
2.1175
2.1057
2.00
2.16
2.14
2.12
2.10
f1 (ppm)
1.4374
1.4258
1.4177
1.4153
1.4132
1.4102
1.4059
1.4004
1.3926
1.3899
1.3861
1.3805
1.3781
1.3674
5.08
1.46
1.42
1.38
f1 (ppm)
1.01
1.04
2.00
3.00
2.99
5.08
5.8
5.4
5.0
4.6
4.2
3.8
3.4
3.0
2.6
2.2
1.8
1.4
1.0
0.6
0.2
-0.2
f1 (ppm)


7.9759
7.9711
7.9686
7.9652
7.9628
7.9580
7.8168
7.8141
7.8096
7.8066
7.8036
7.7991
7.7964
7.7107
7.7079
7.6956
7.6929
7.6802
7.6652
7.4316
7.4269
7.4166
7.4131
7.4060
7.3991
7.3955
7.3848
7.3805
1.00
1.02
2.06
2.01
8.00
7.94
7.88
7.82
7.76
7.70
7.64
7.58
7.52
7.46
7.40
f1 (ppm)

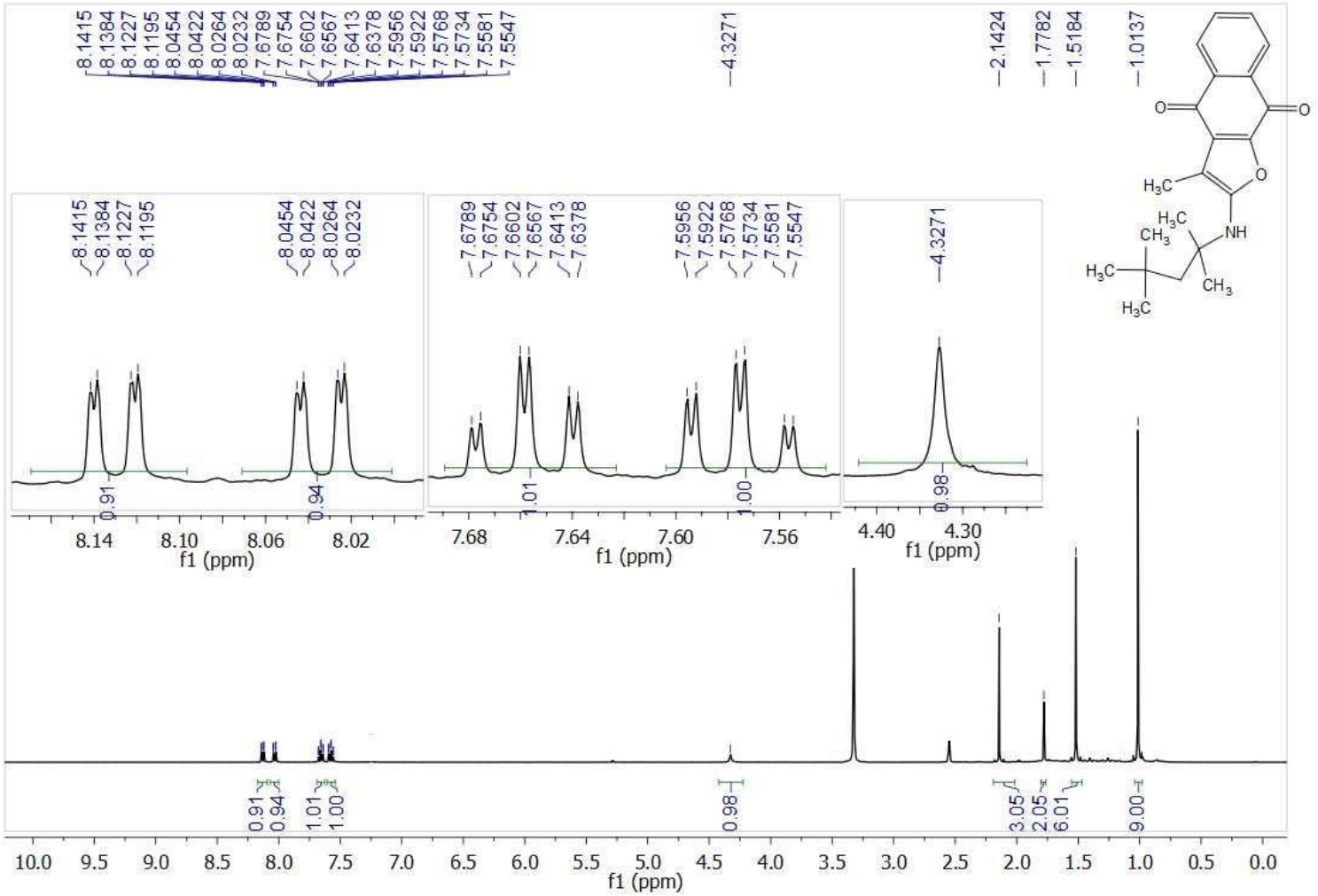

HN
CH3
O
O
O
156.3741
156.0384
154.6345
154.3294
131.3260
130.7614
130.4105
126.7635
126.7025
126.2828
123.7117
117.2951
108.0328
105.5684
90.8127
51.2912
33.5447
25.9075
24.7172
10.5567
157
156
155
154
f1 (ppm)
131.0
130.5
f1 (ppm)
126.0
124.5
f1 (ppm)
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

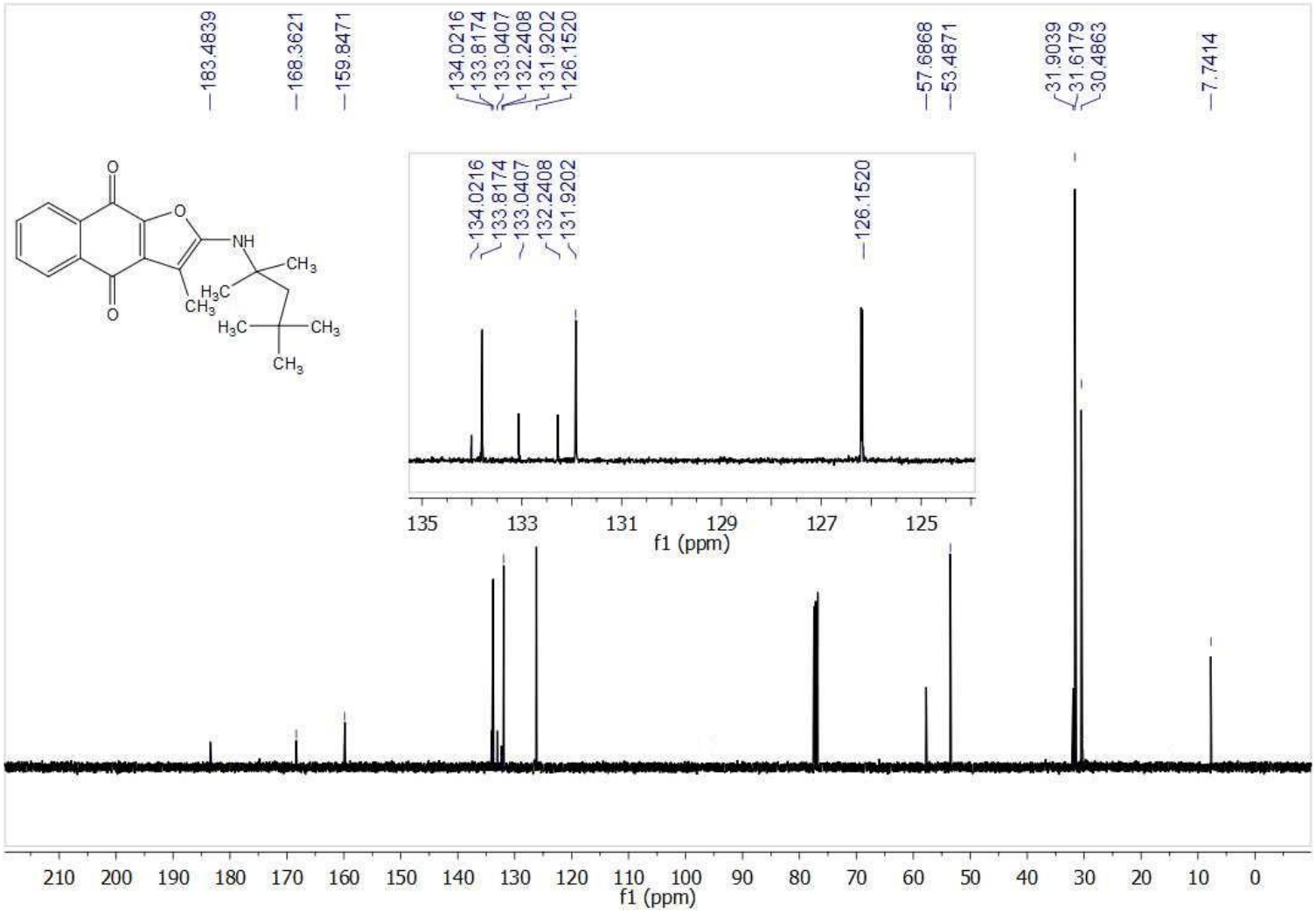
2-(tert-butylamino)-3-methylnaptho[2,3-b]furan-4,9-dione (**4h**)



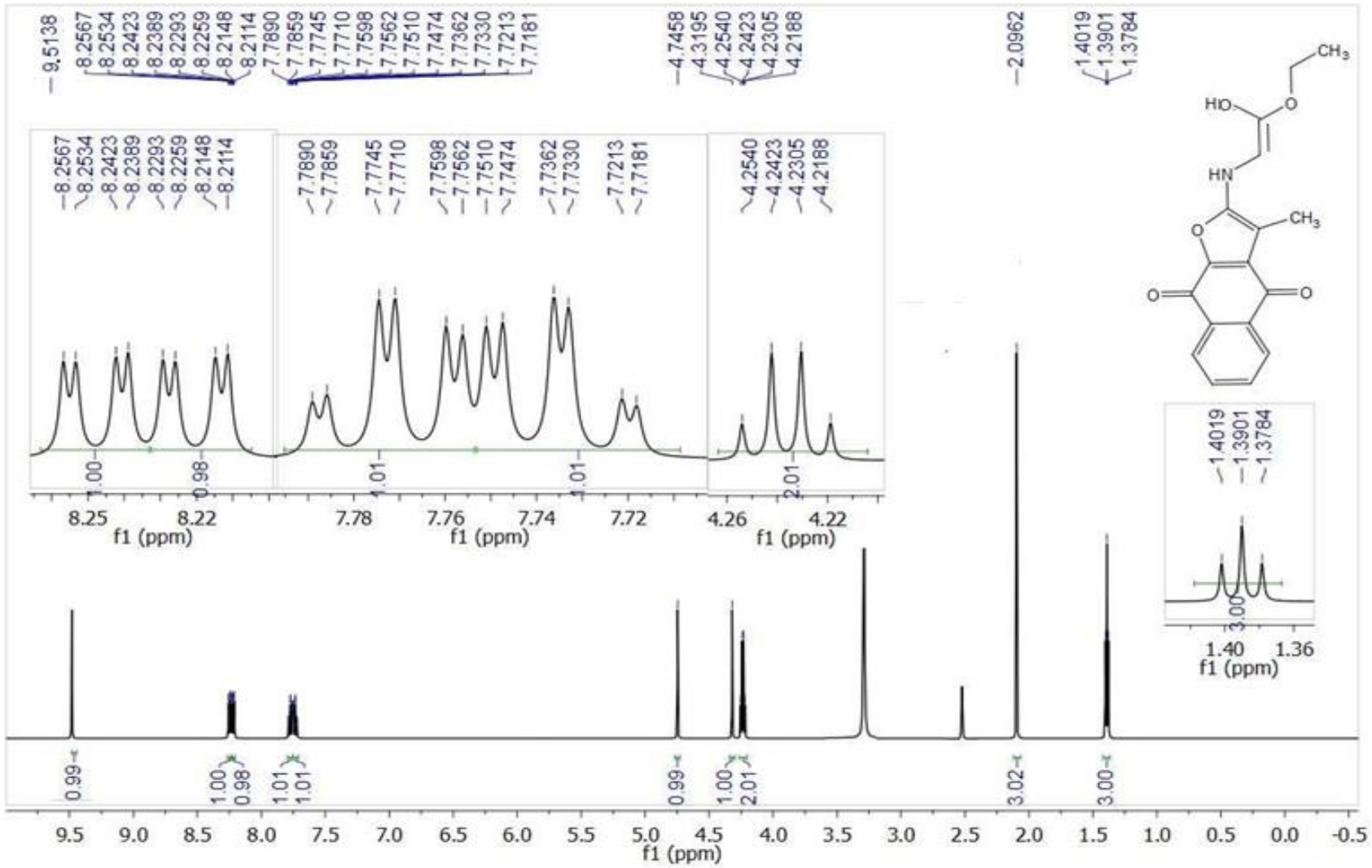

183.3462
168.8203
159.7861
133.8672
133.7826
133.0729
132.1496
132.0571
126.2327
54.0877
30.2086
7.8731
O
O
O
H3C
H3C
NH
H3C
CH3
133.8672
133.7826
133.0729
132.1496
132.0571
134.0
133.5
133.0
132.5
132.0
f1 (ppm)
230
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
f1 (ppm)

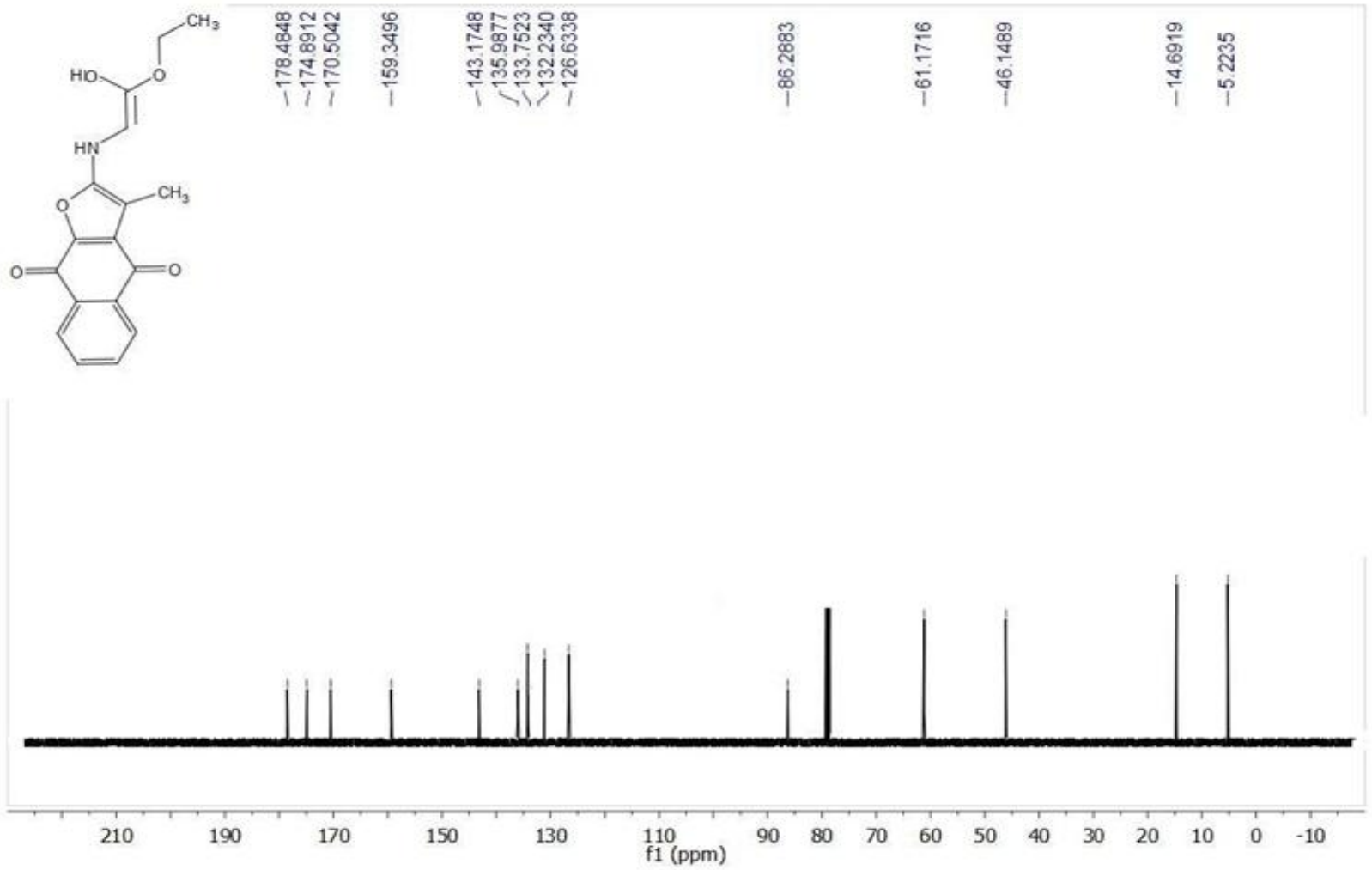
3-methyl-2-(2,4,4-trimethylpentan-2-ylamino)naphtho[2,3-b]furan-4,9-dione (**4i**)



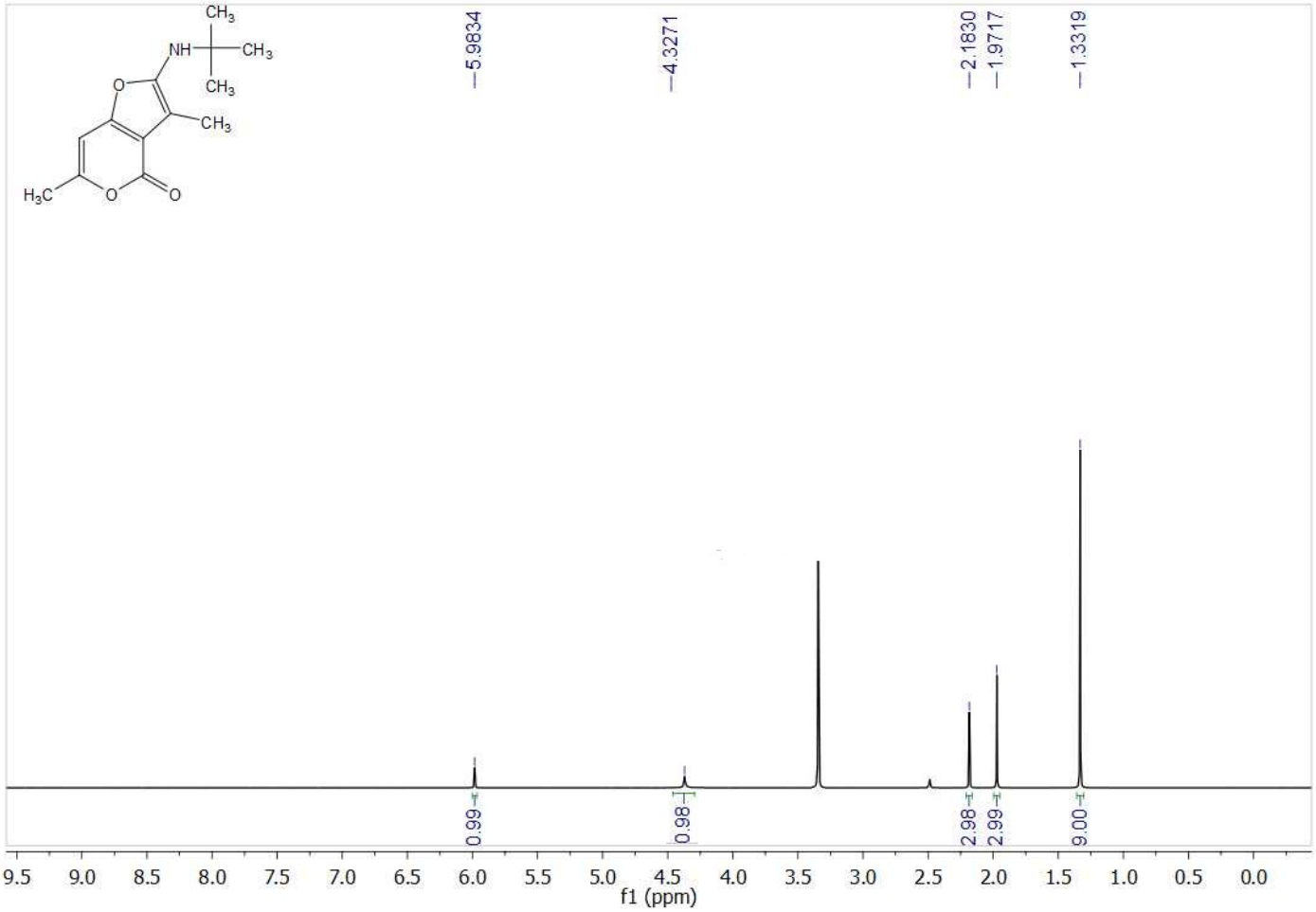

183.4839
168.3621
159.8471
134.0216
133.8174
133.0407
132.2408
131.9202
126.1520
57.6868
53.4871
31.9039
31.6179
30.4863
7.7414
O
O
O
NH
CH3
H3C
CH3
H3C
CH3
CH3
f1 (ppm)
f1 (ppm)

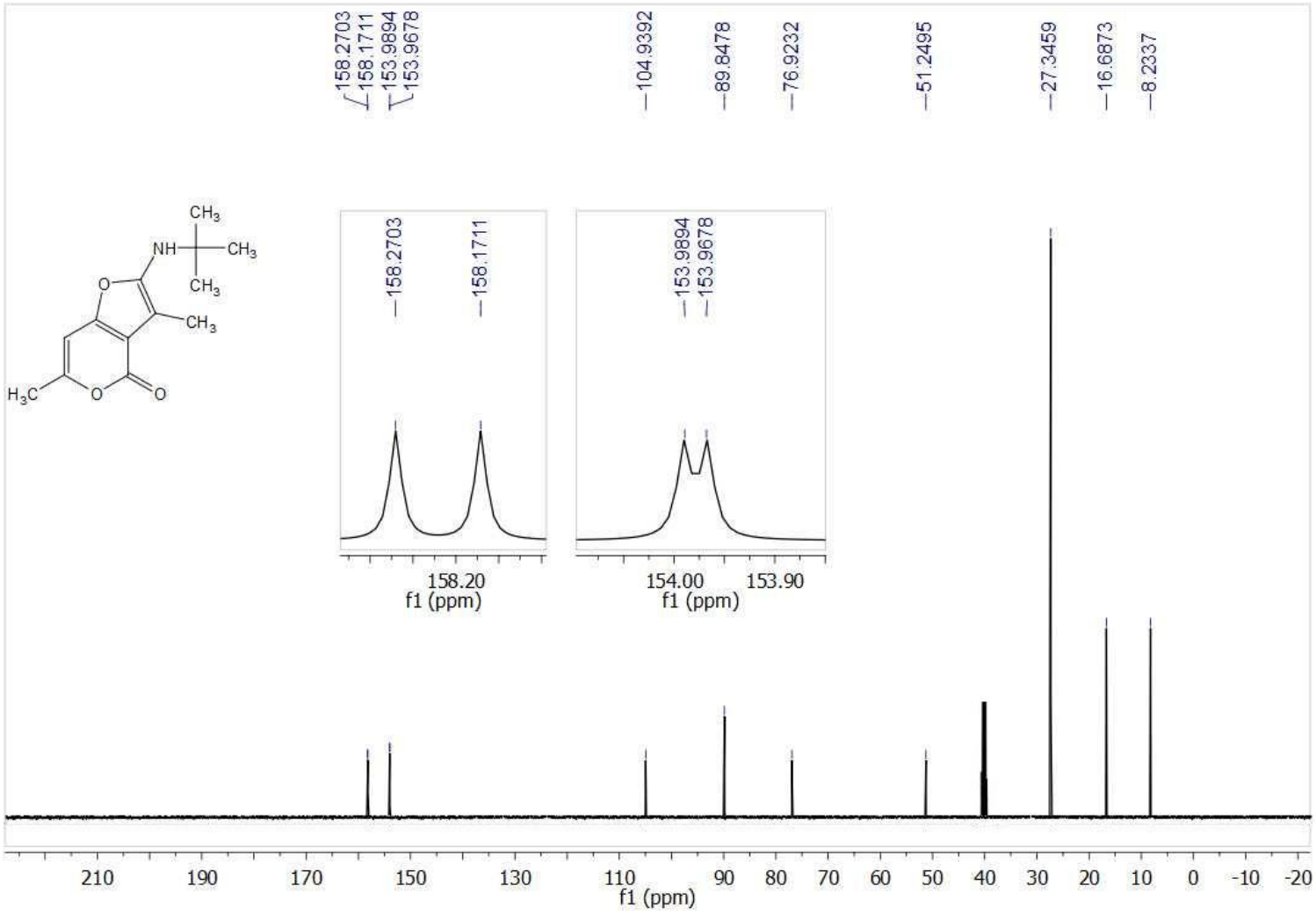
Ethyl 2-(3-methyl-4,9-dioxo-4,9-dihydronaptho[2,3-b]furan-2-ylamino)acetate (**4j**)



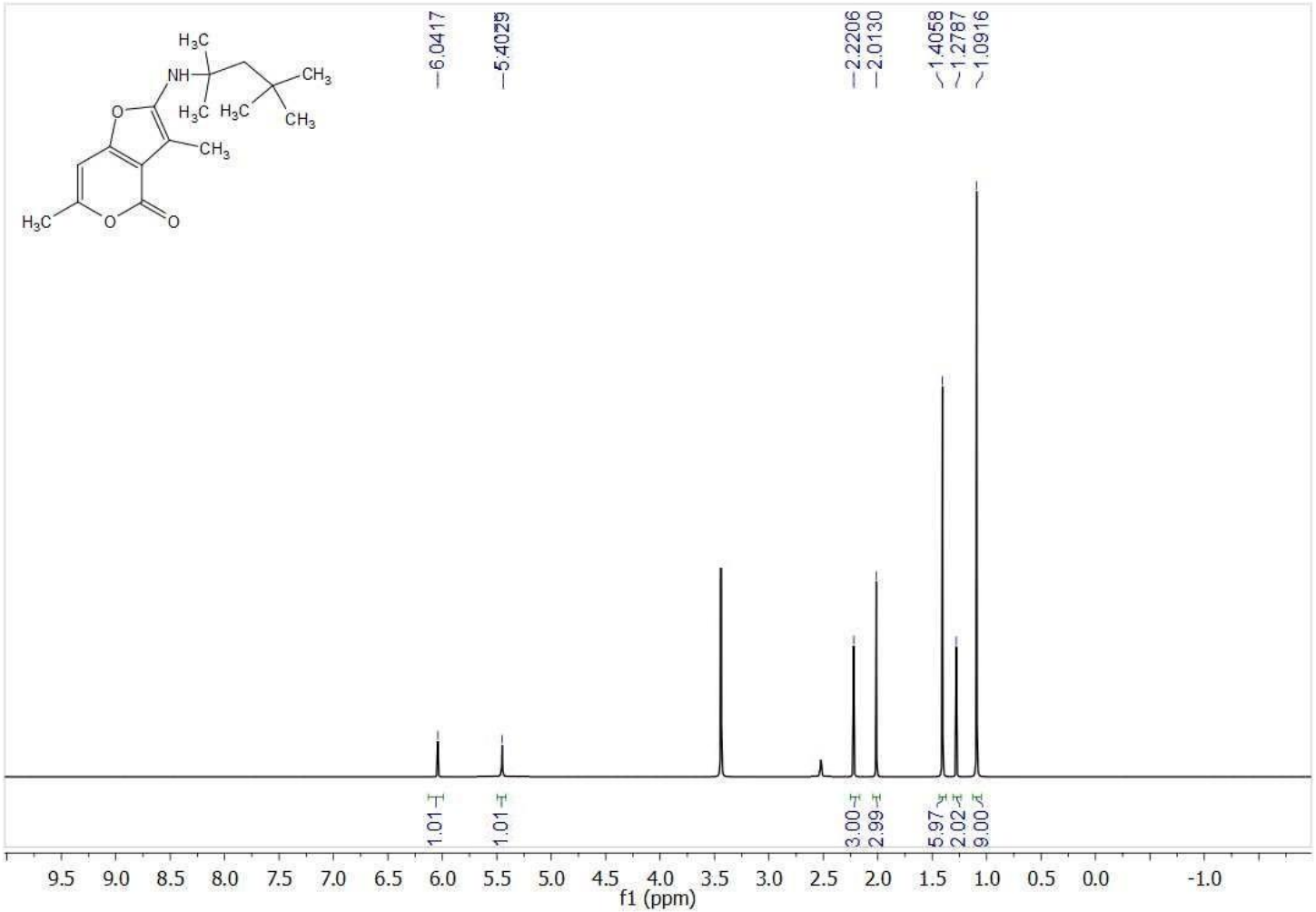

HO
O
CH3
HN
O
CH3
O
O
178.4848
174.8912
170.5042
159.3496
143.1748
135.9877
133.7523
132.2340
126.6338
86.2883
61.1716
46.1489
14.6919
5.2235
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

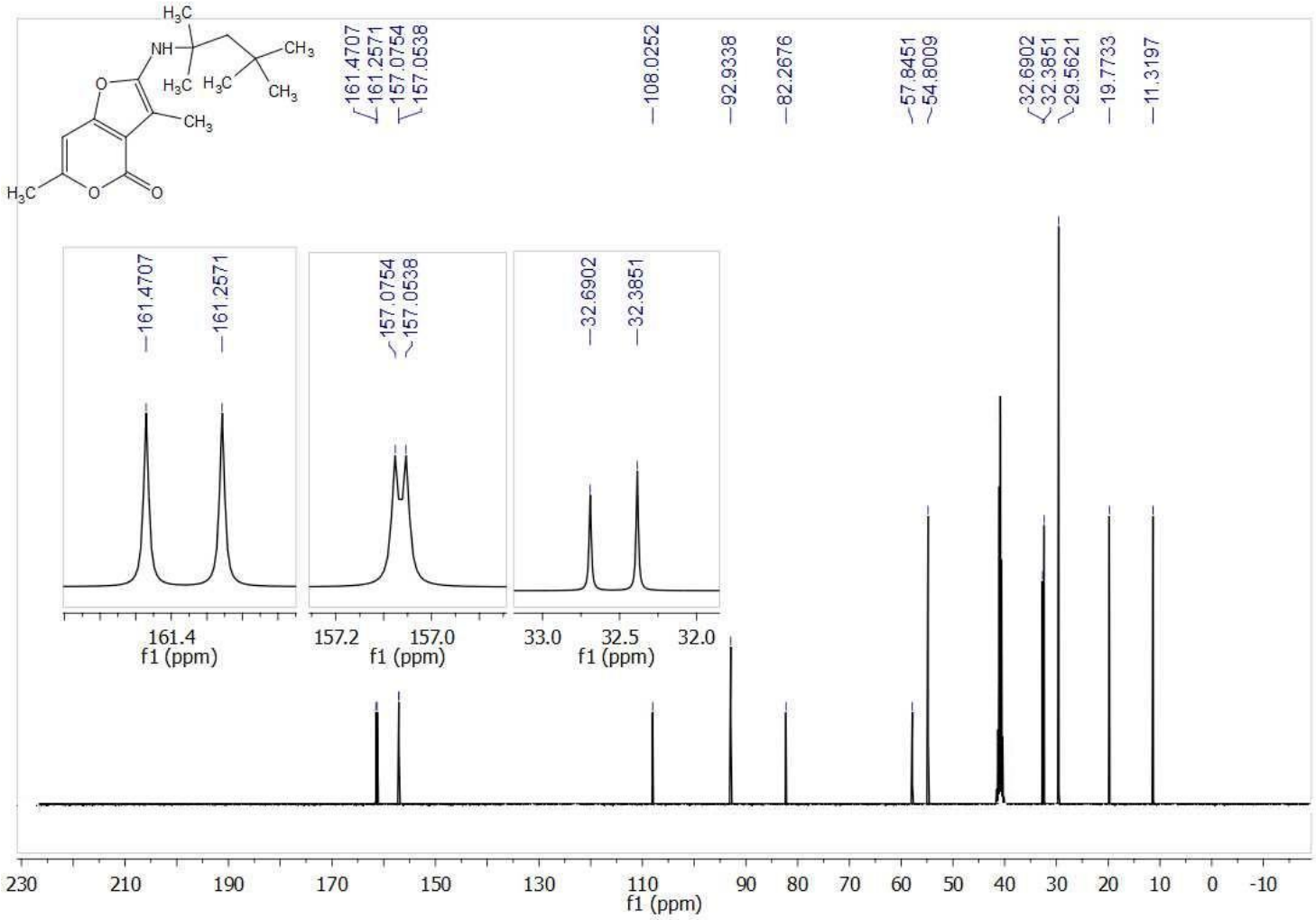
2-(tert-butylamino)-3-methyl-4H-furo[3,2-c]pyran-4-one (**4k**)



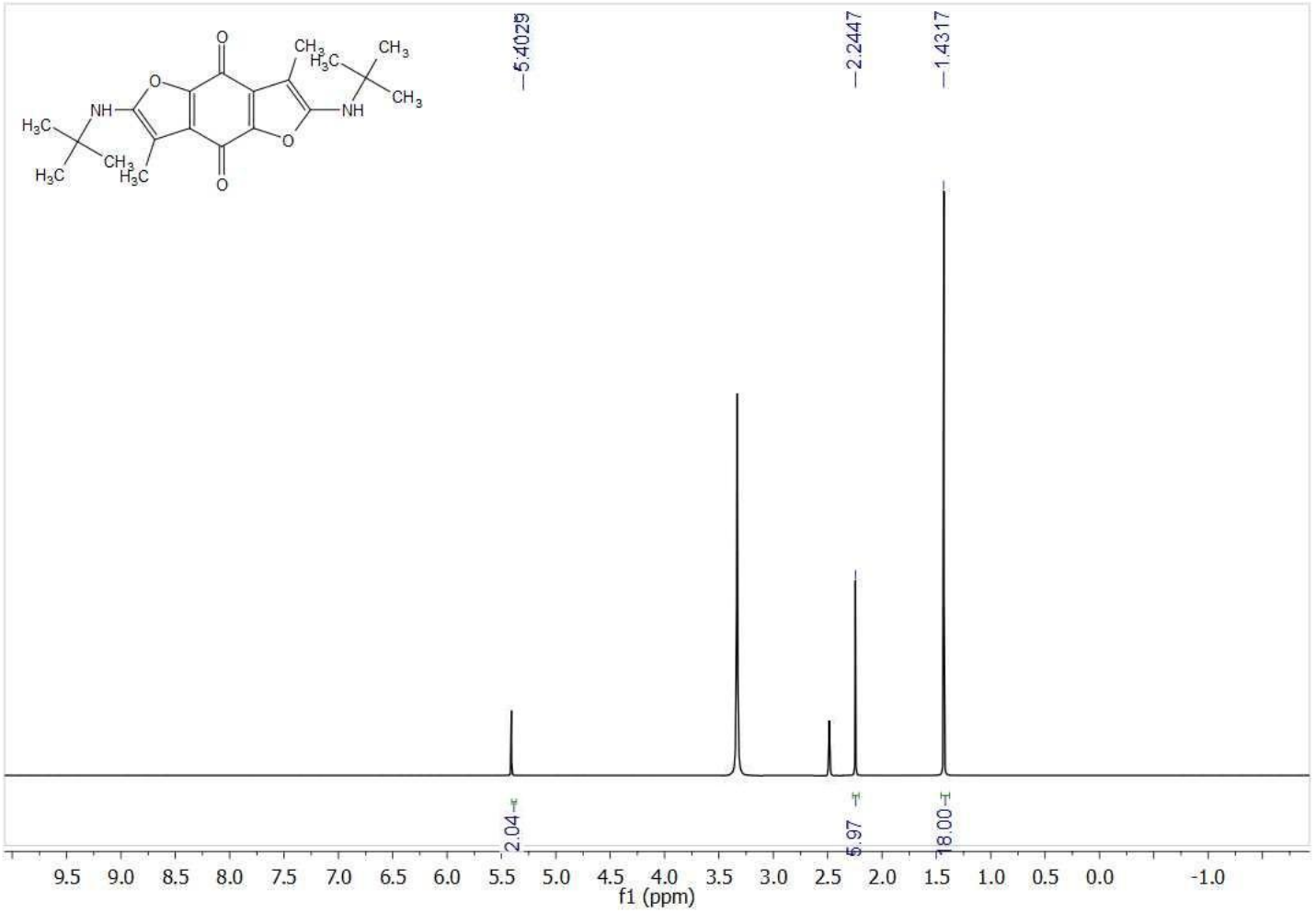

158.2703
158.1711
153.9894
153.9678
104.9392
89.8478
76.9232
51.2495
27.3459
16.6873
8.2337
NH
CH3
CH3
CH3
CH3
O
O
O
H3C
158.20
f1 (ppm)
154.00
153.90
f1 (ppm)
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
-20
f1 (ppm)

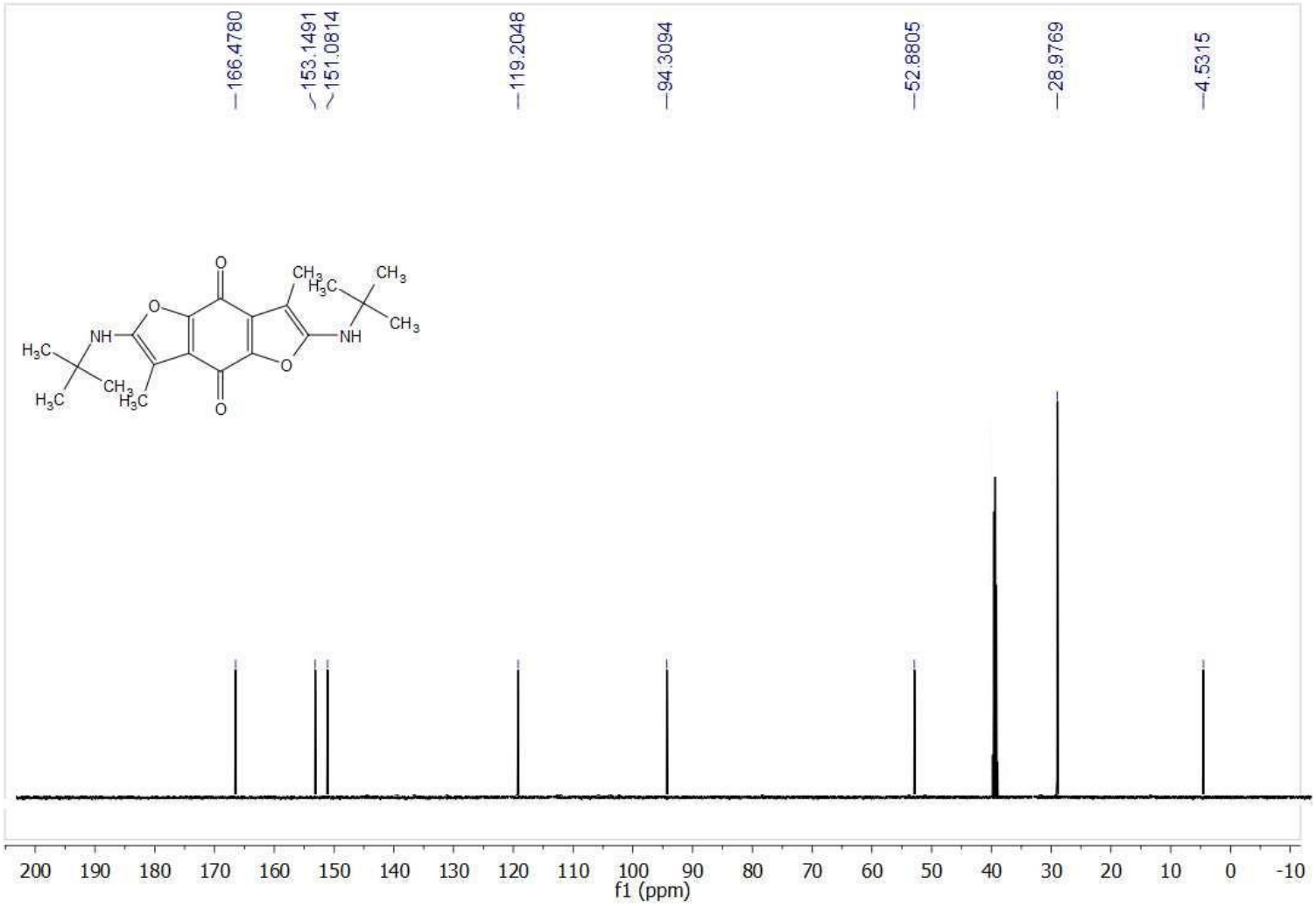
3,6-dimethyl-2-(2,4,4-trimethylpentan-2-ylamino)-4H-furo[3,2-c]pyran-4-one (**4l**)



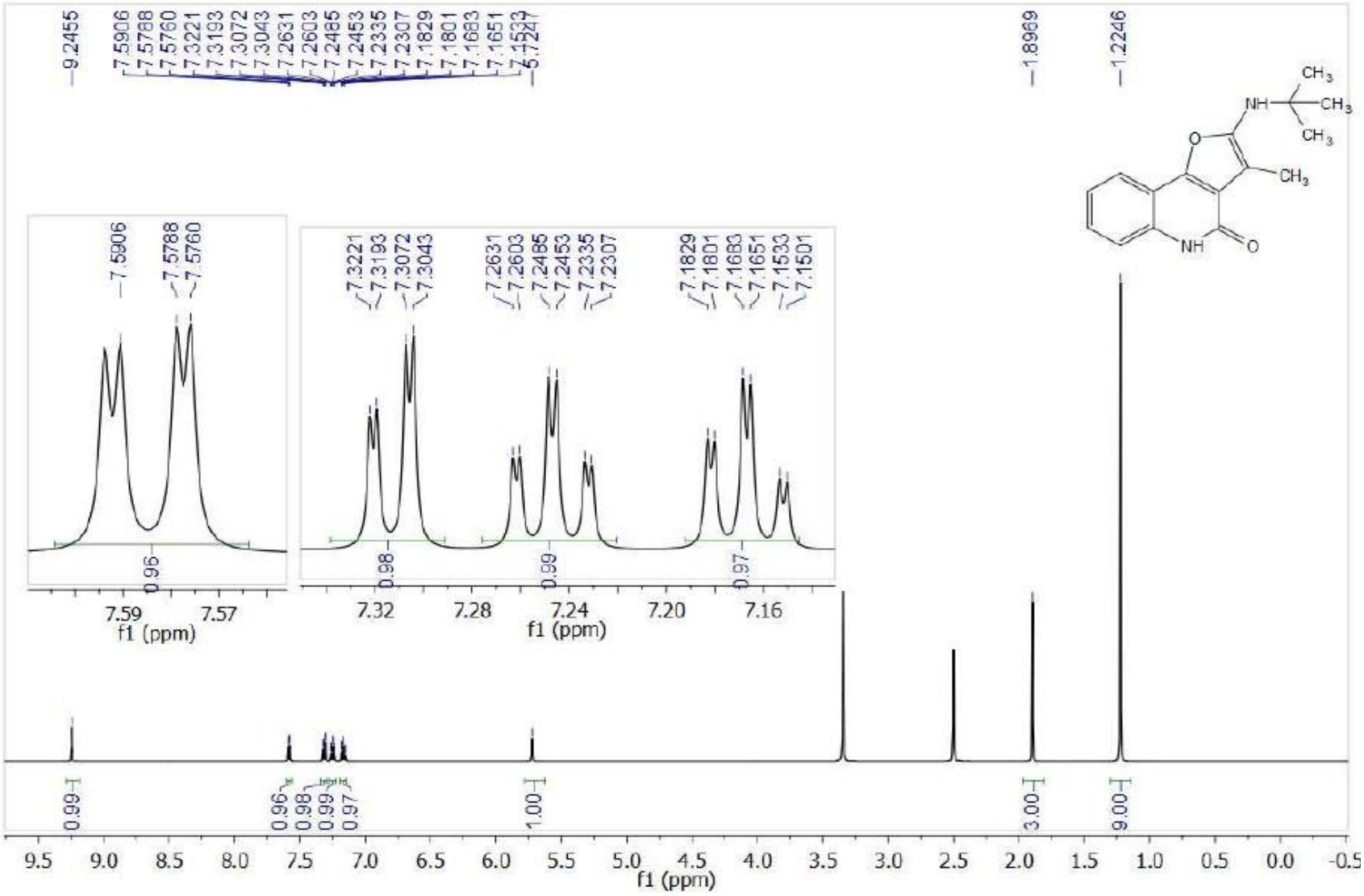

161.4707
161.2571
157.0754
157.0538
108.0252
92.9338
82.2676
57.8451
54.8009
32.6902
32.3851
29.5621
19.7733
11.3197
161.4
f1 (ppm)
157.2
157.0
f1 (ppm)
33.0
32.5
32.0
f1 (ppm)
230
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

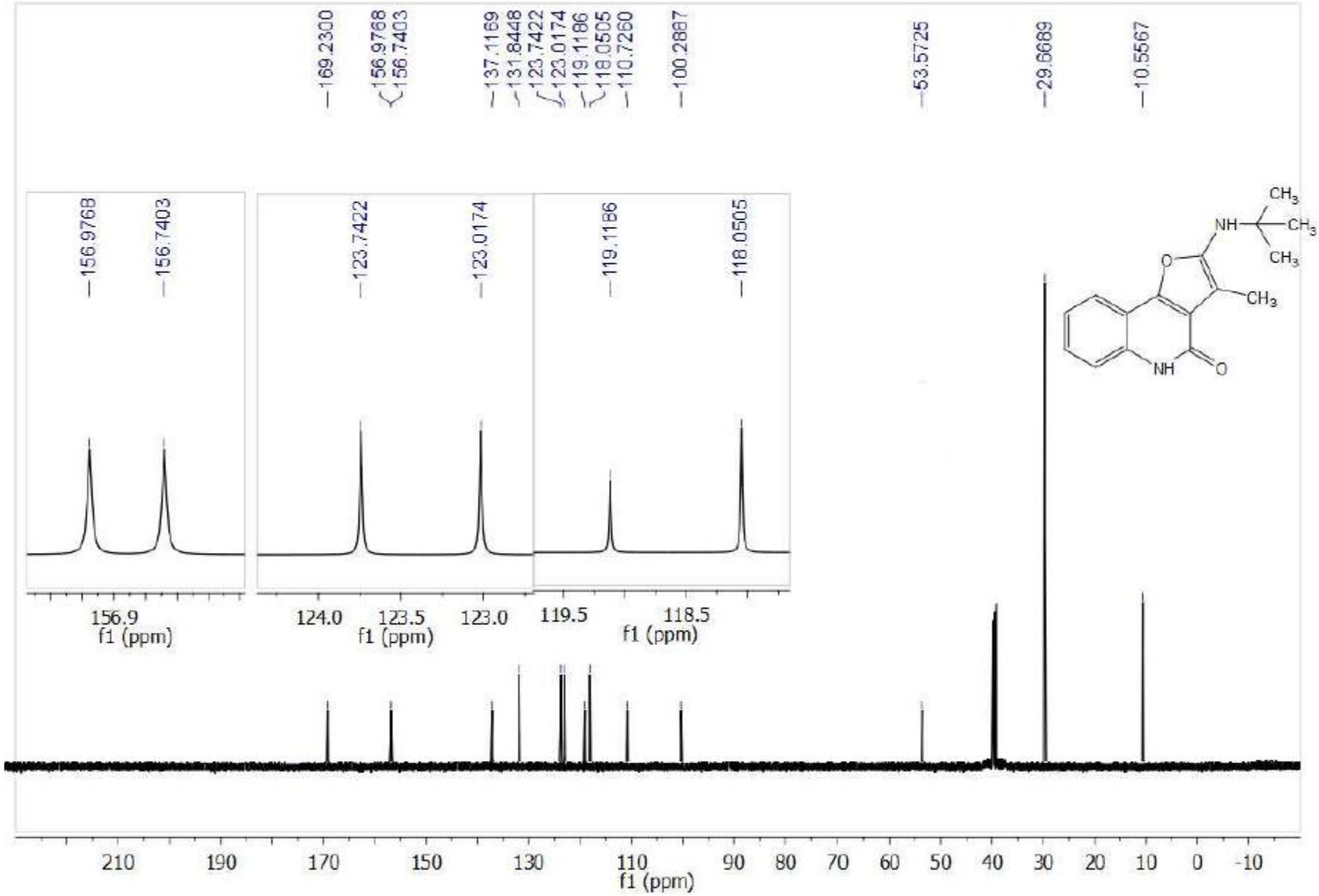
2,6-bis(tert-butylamino)-benzofuro[5,6-b]furan-4-8-diones (**4m**)




166.4780
153.1491
151.0814
119.2048
94.3094
52.8805
28.9769
4.5315
O
CH3
H3C
CH3
NH
CH3
H3C
NH
O
H3C
CH3
H3C
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

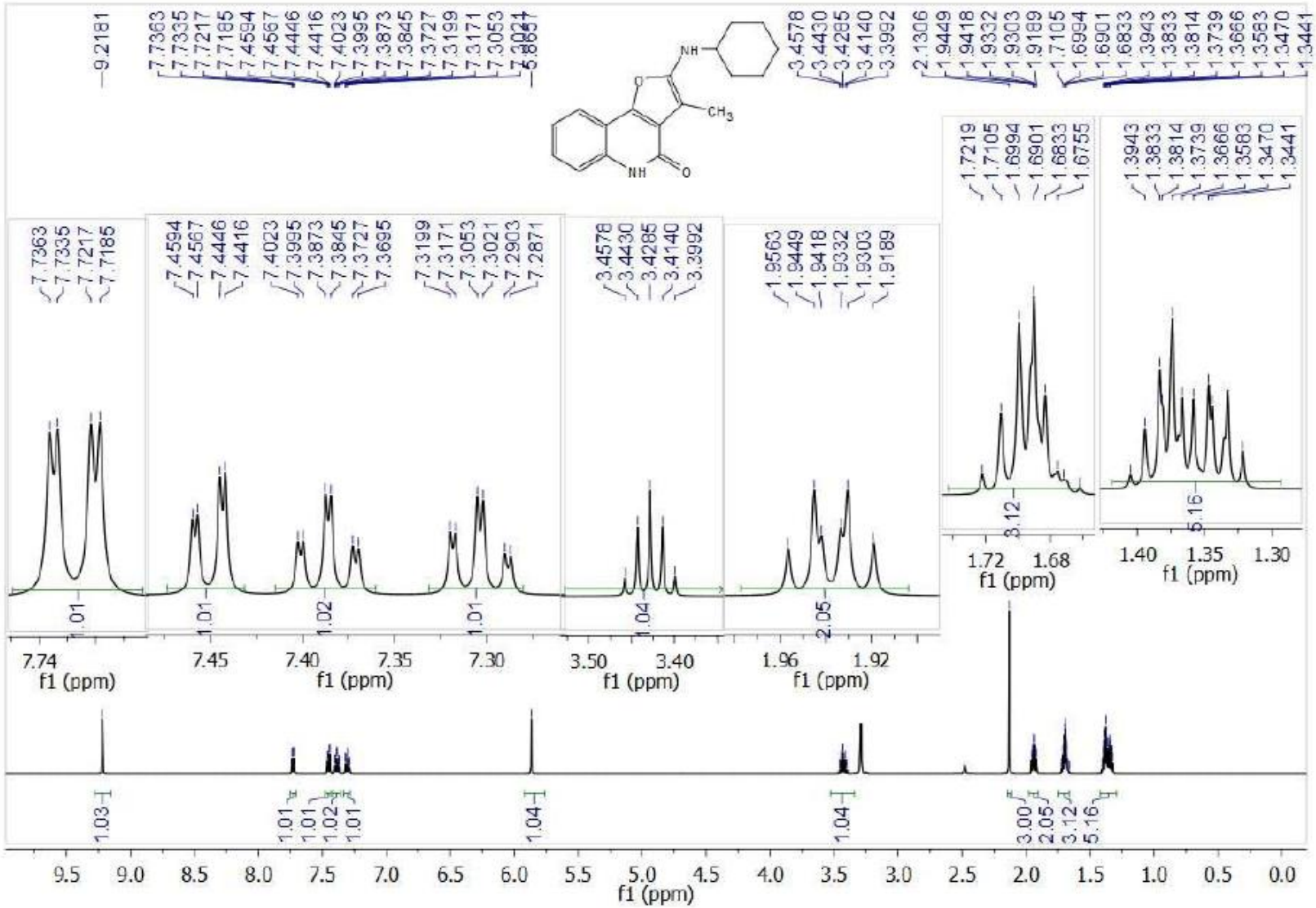
2-(tert-butylamino)-3-methylfuro[3,2-c]quinolin-4-(5H)-one (**4n**)

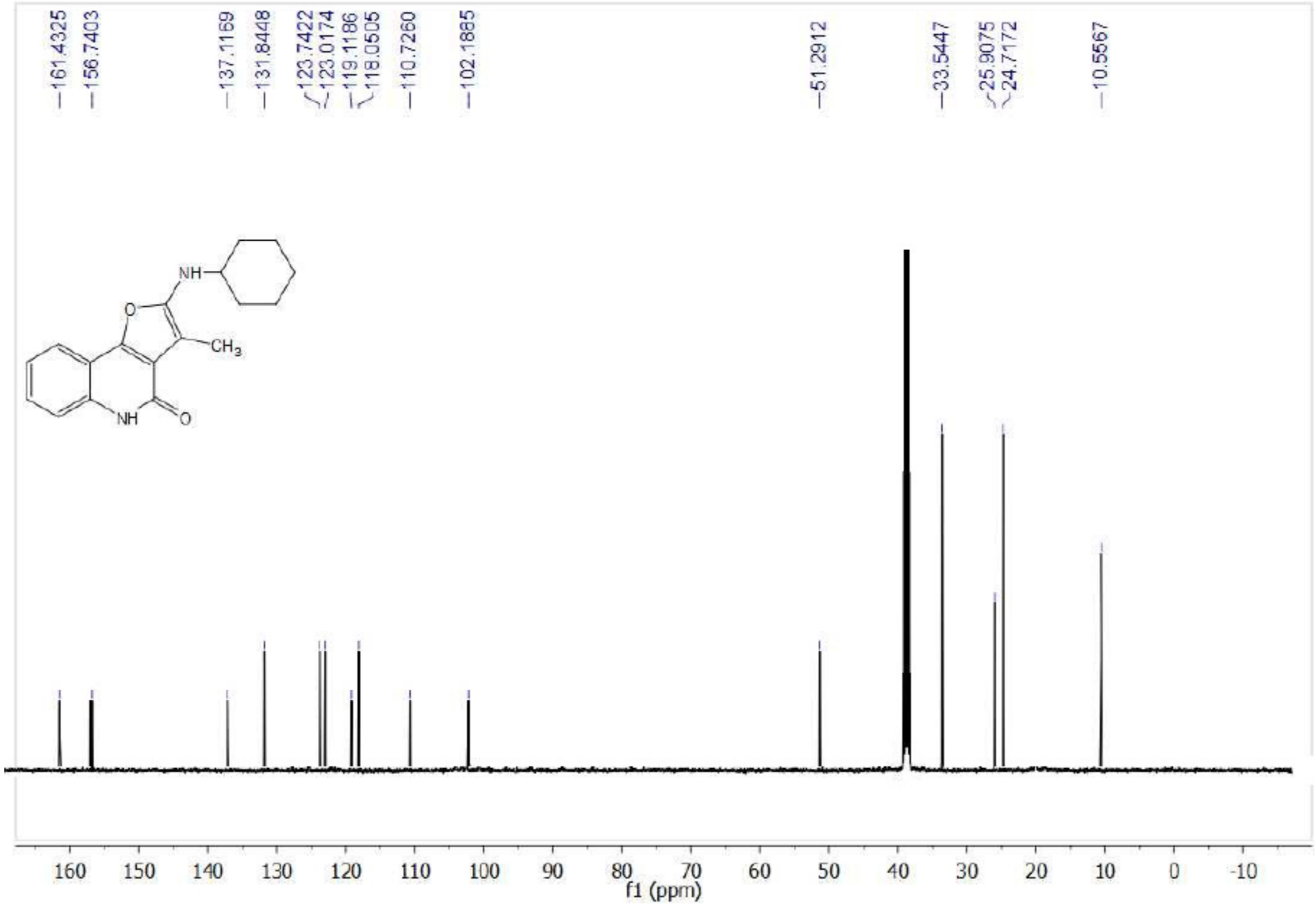



169.2300
156.9768
156.7403
137.1169
131.8448
123.7422
123.0174
119.1186
118.0505
110.7260
100.2887
53.5725
29.6689
10.5567
156.9768
156.7403
123.7422
123.0174
119.1186
118.0505
156.9
f1 (ppm)
124.0
123.5
123.0
119.5
118.5
f1 (ppm)
CH3
NH
CH3
CH3
O
CH3
NH
O
210
190
170
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

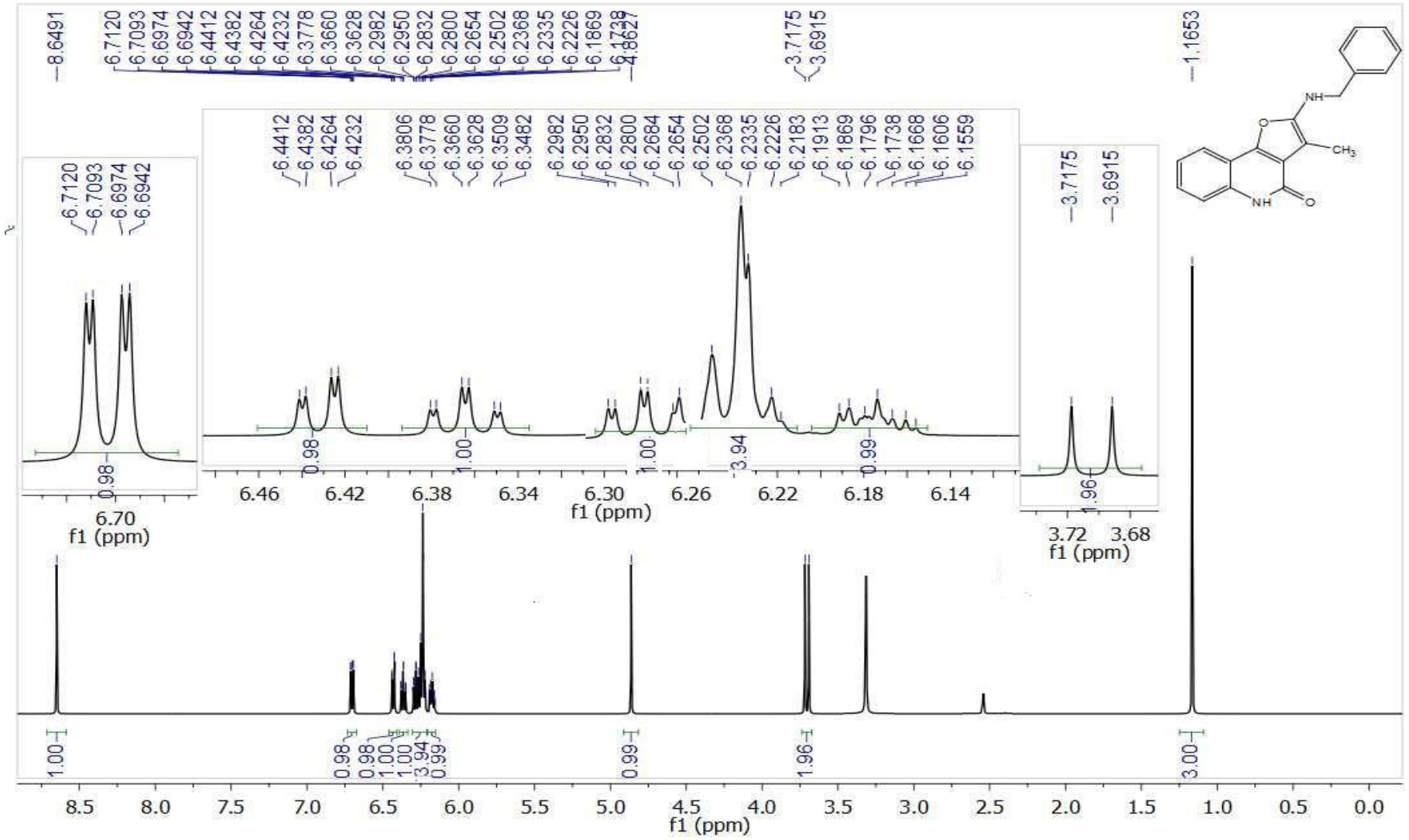
0

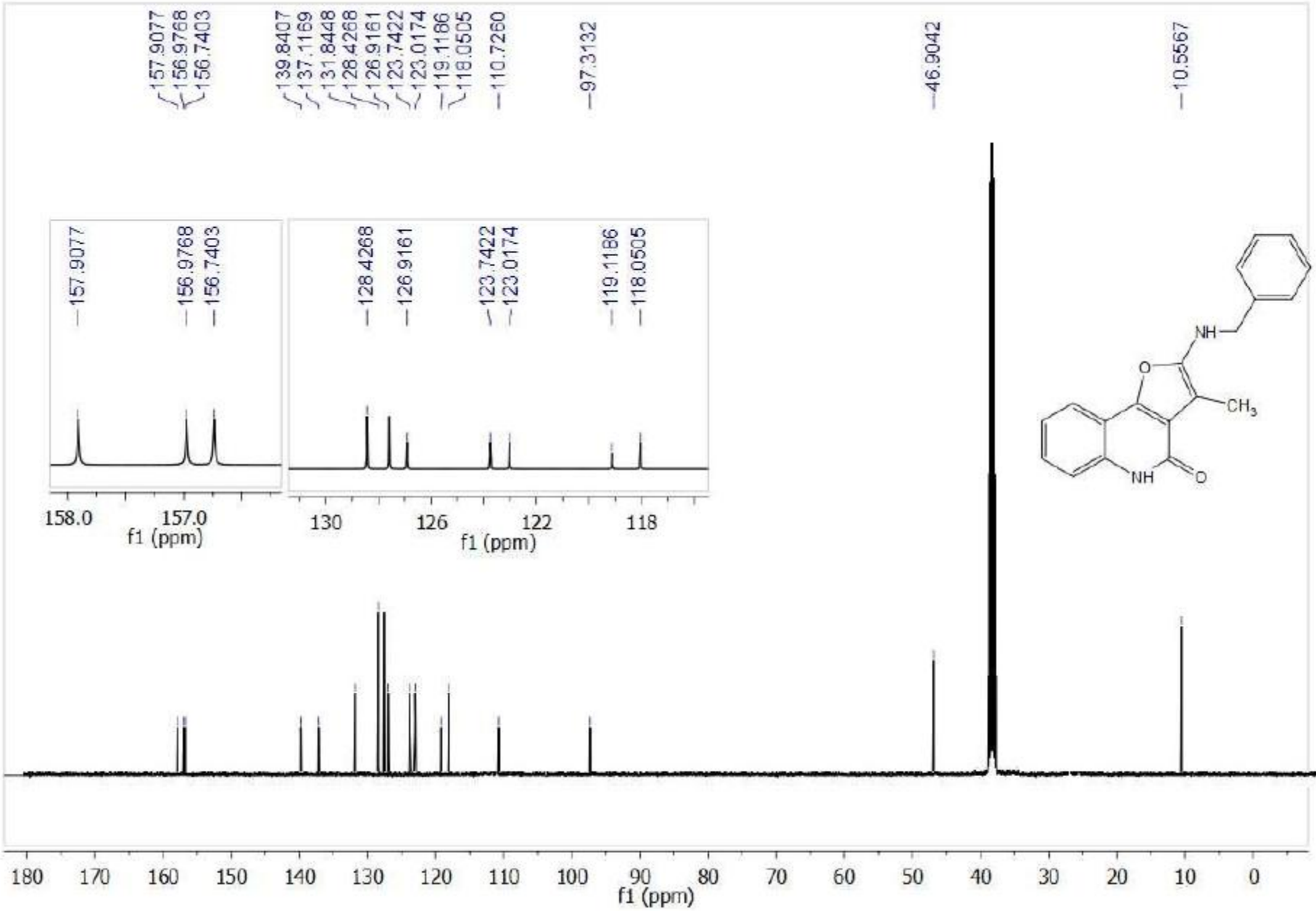
2-(cyclohexylamino)-3-methylfuro[3,2-c]quinolin-4-(5H)-one (**4o**)



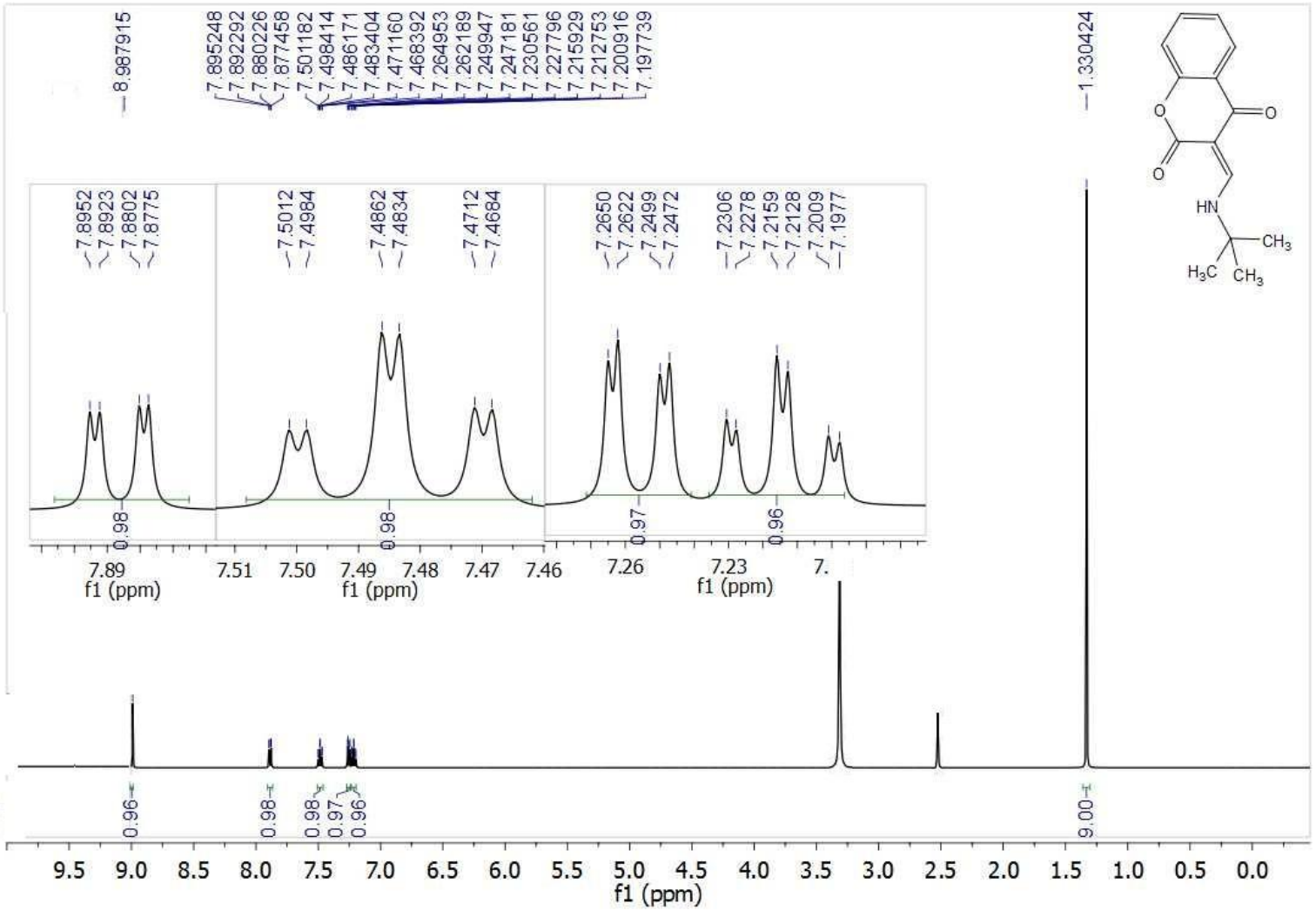

161.4325
156.7403
137.1169
131.8448
123.7422
123.0174
119.1186
118.0505
110.7260
102.1885
51.2912
33.5447
25.9075
24.7172
10.5567
NH
O
CH3
NH
O
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

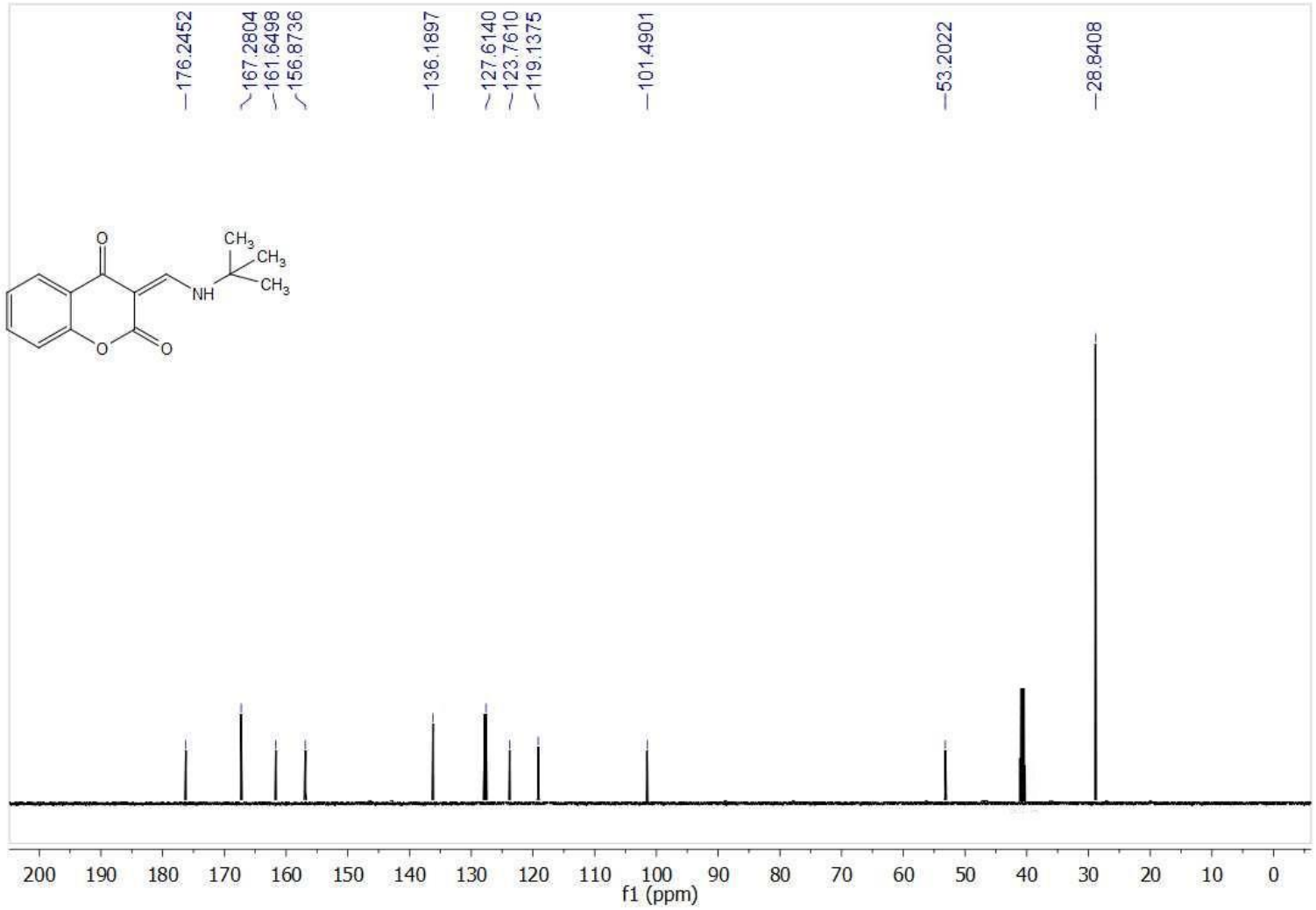
2-(benzylamino)-3-methylfuro[3,2-c]quinolin-4-(5H)-one (**4p**)



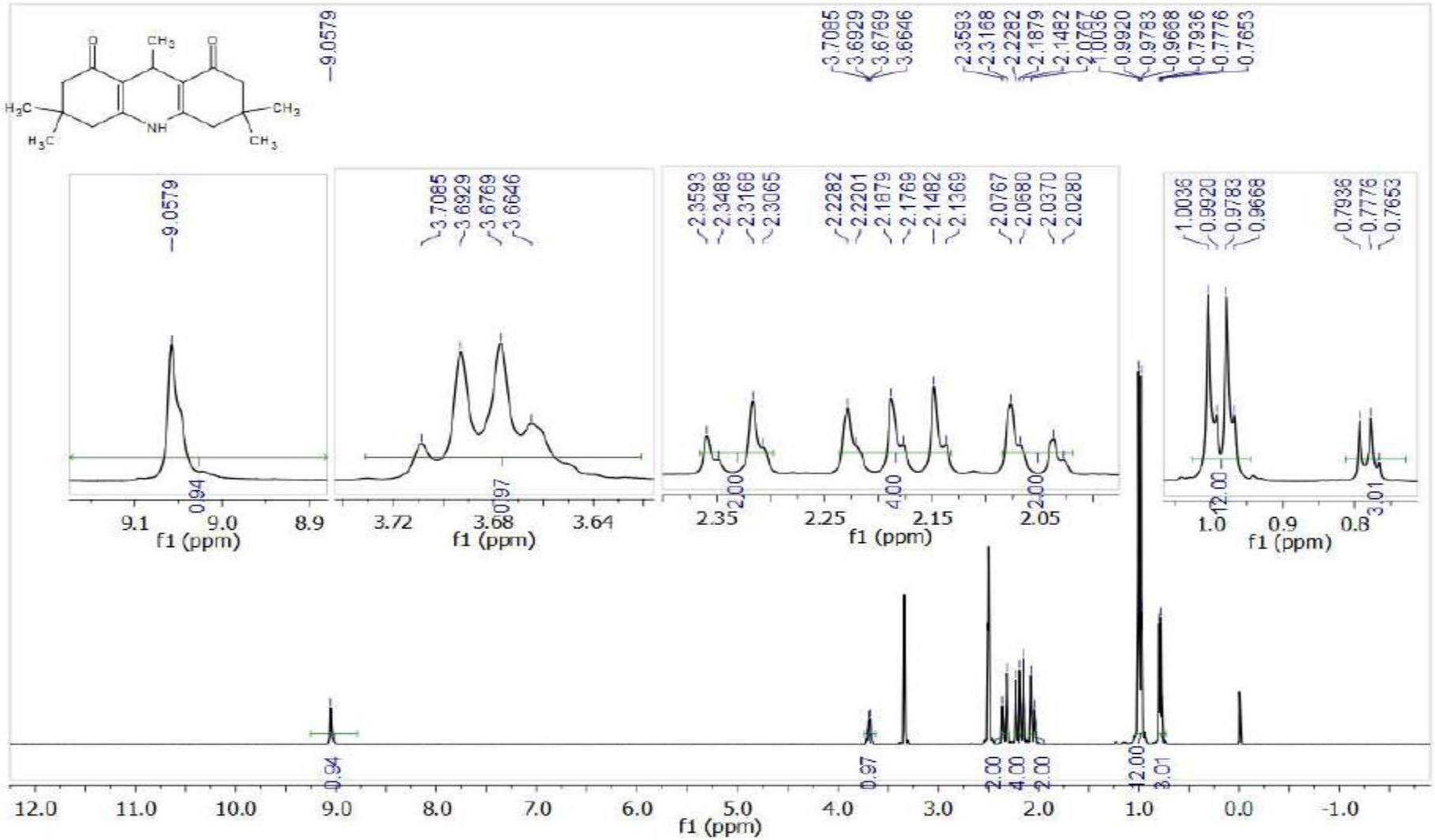

157.9077
156.9768
156.7403
139.8407
137.1169
131.8448
128.4268
126.9161
123.7422
123.0174
119.1186
118.0505
110.7260
97.3132
46.9042
10.5567
NH
O
CH3
NH
O
f1 (ppm)

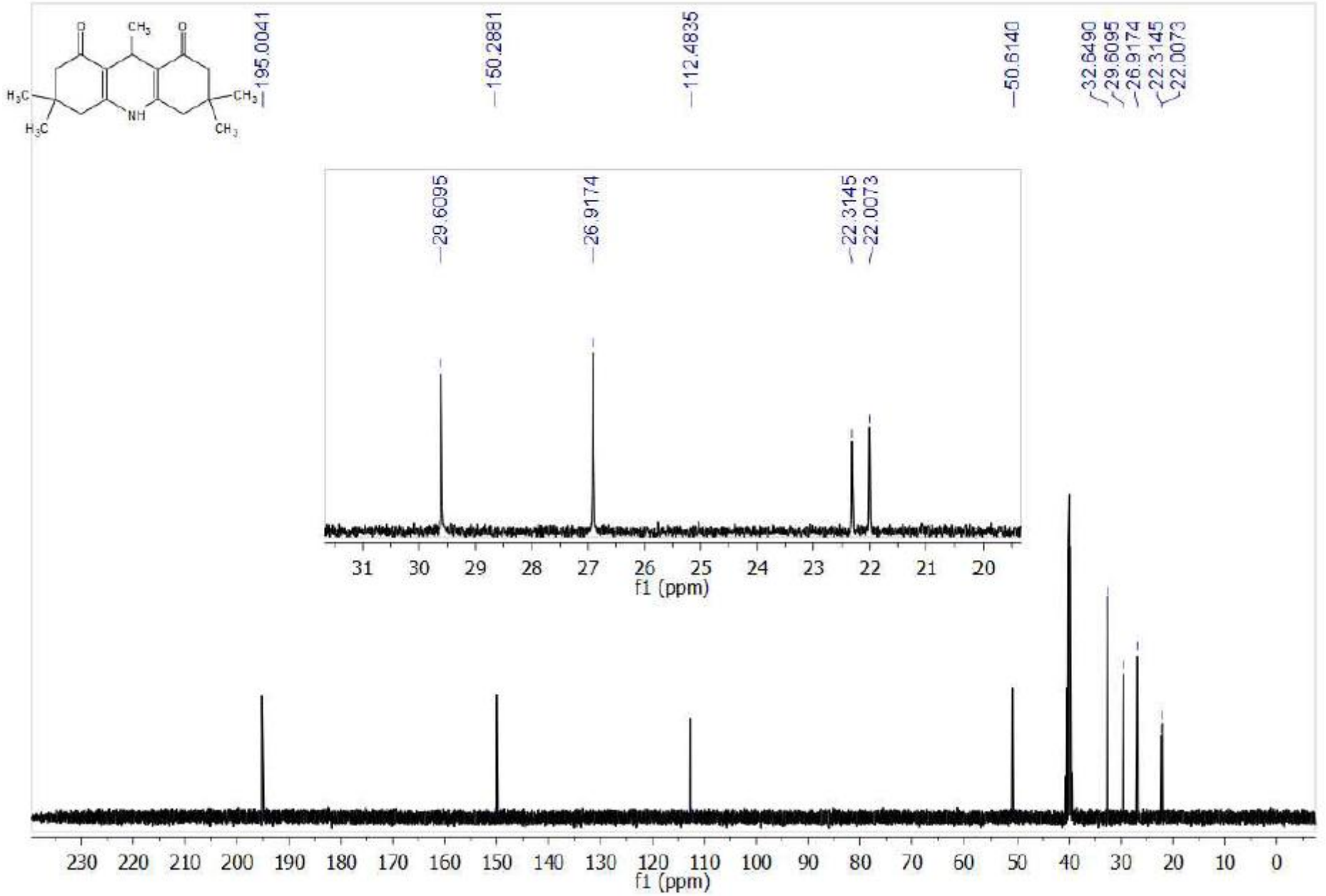
3-((tert-Butylamino)methylene)-3H-chromene-2,4-dione (**5a**)



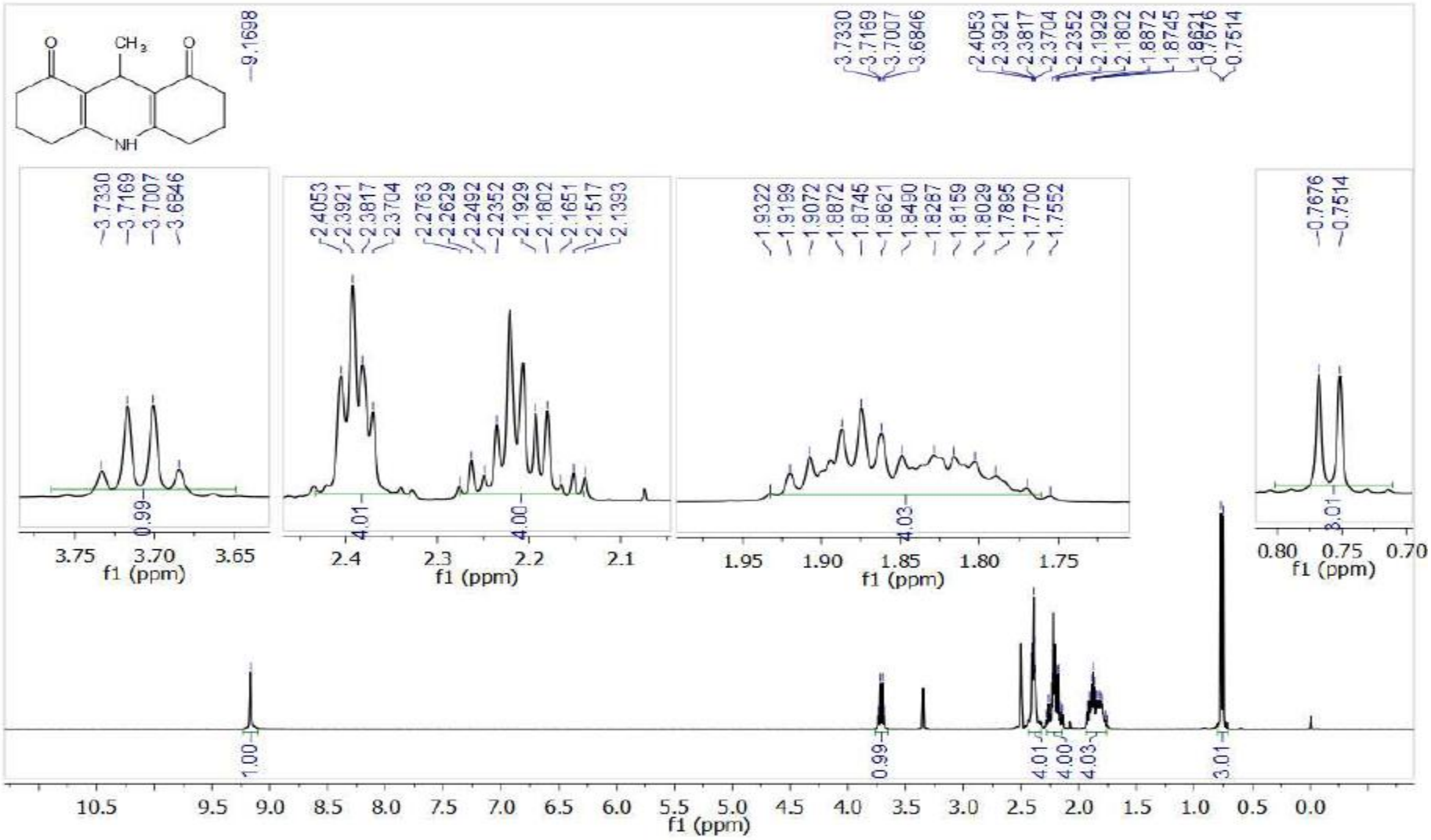

176.2452
167.2804
161.6498
156.8736
136.1897
127.6140
123.7610
119.1375
101.4901
53.2022
28.8408
O
CH3
CH3
CH3
NH
O
O
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

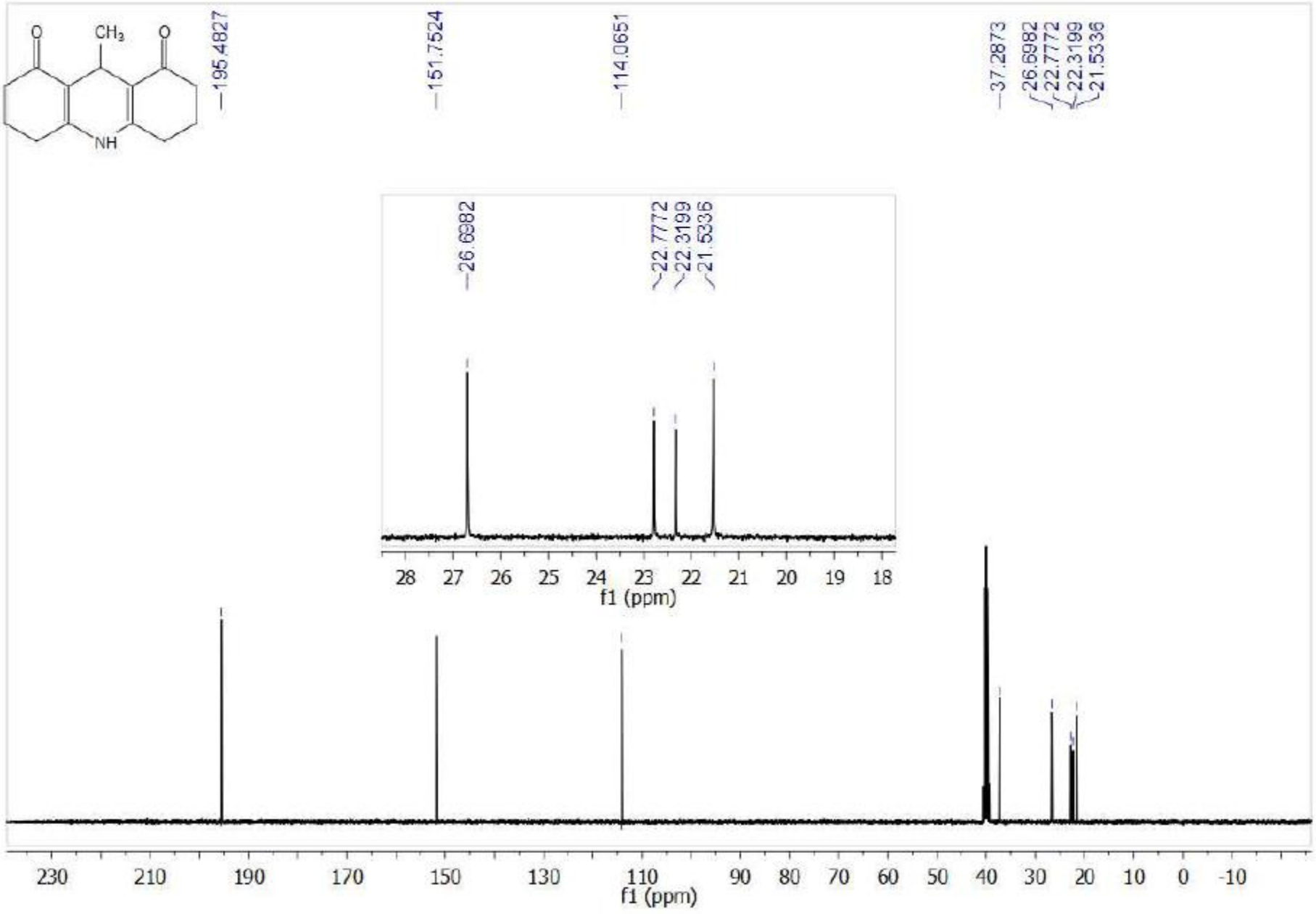
3,3,6,6,9-pentamethyl-3,4,6,7,9,10-hexahydroacridine-1,8-(2H,5H)-dione ***(6a)***



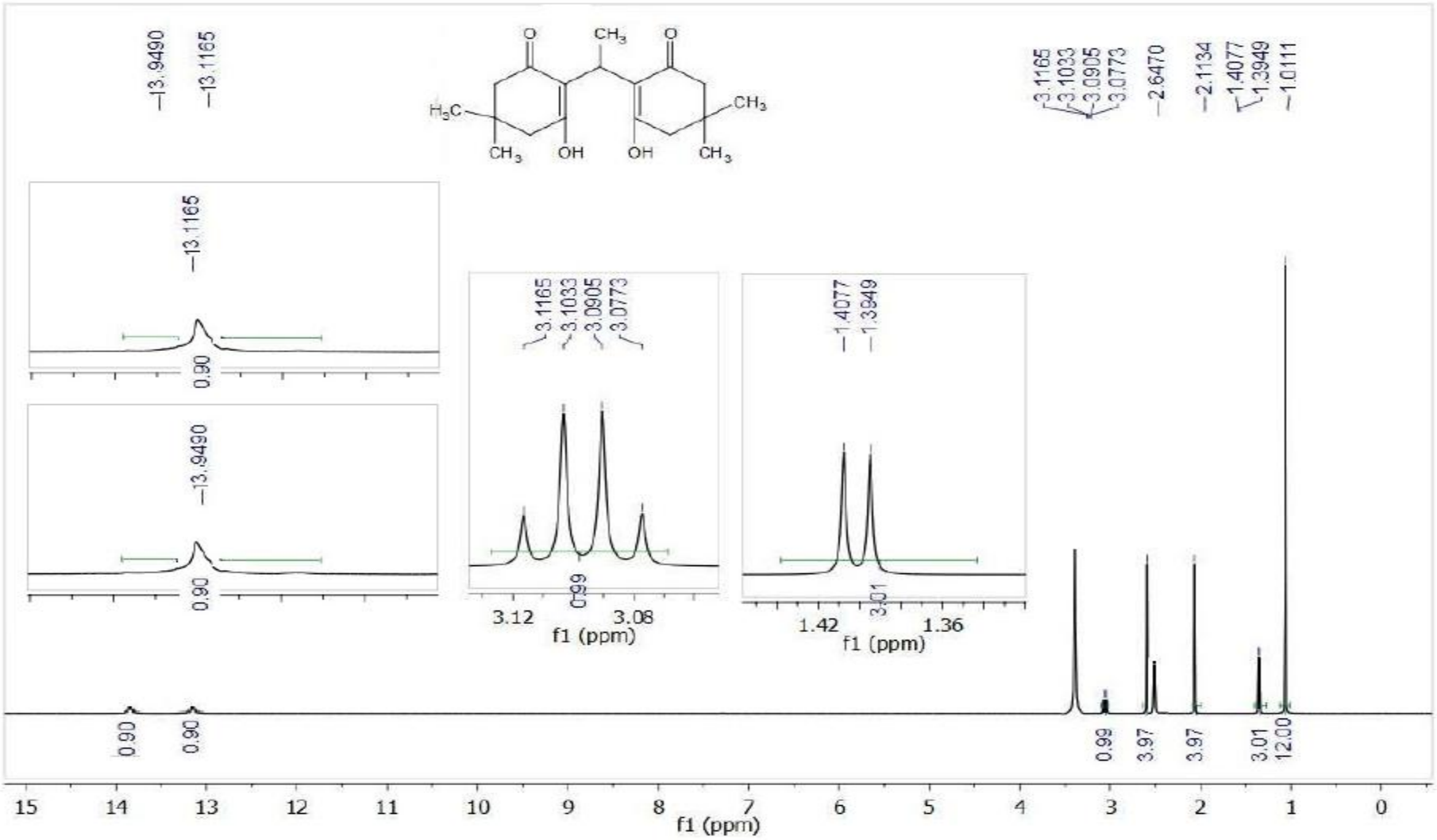

195.0041
150.2881
112.4835
50.6140
32.6490
29.6095
26.9174
22.3145
22.0073
f1 (ppm)
f1 (ppm)

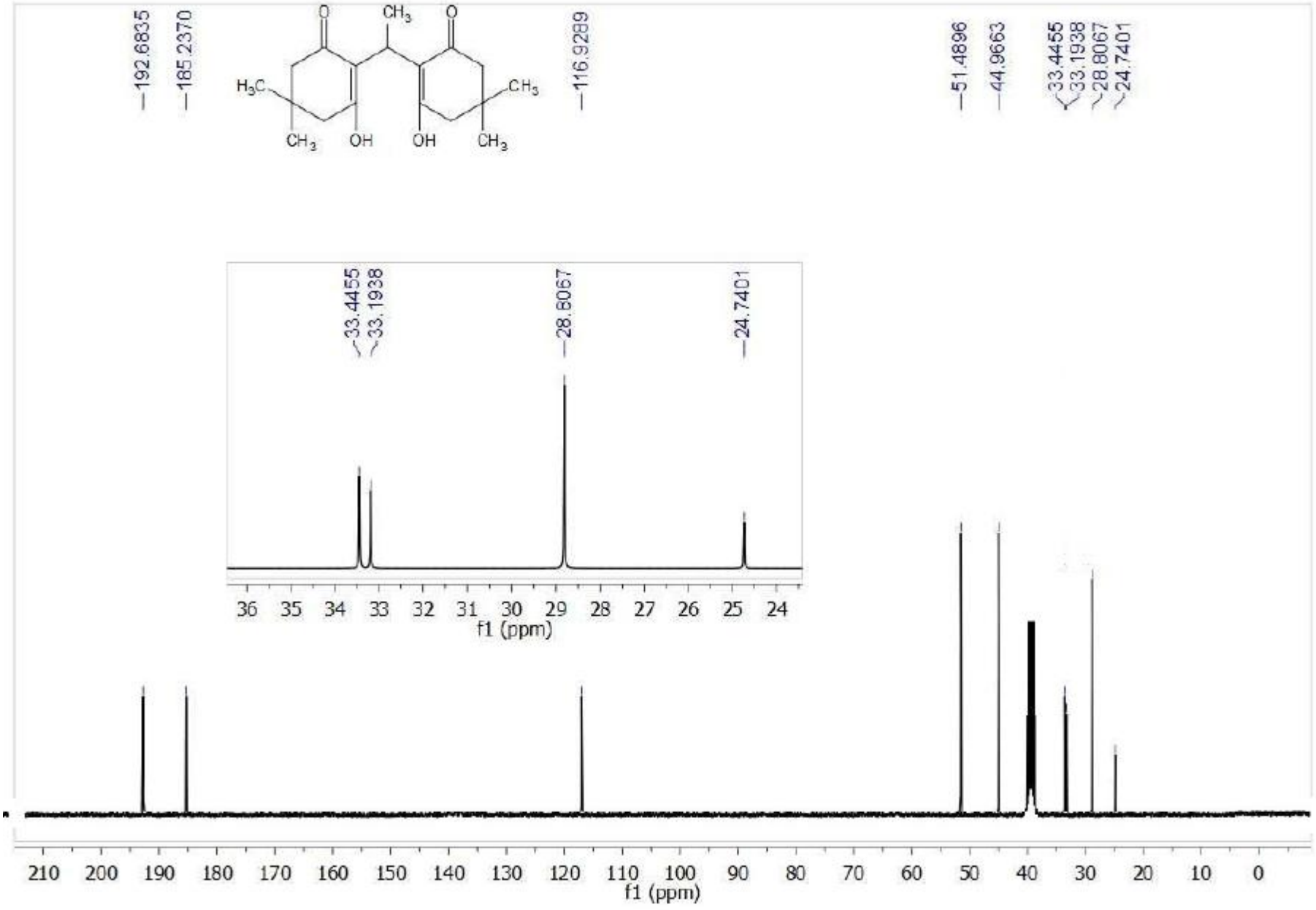
9-methyl-3,4,6,7,9,10-hexahydroacridine-1,8-(2H,5H)-dione ***(6b)***




O
CH3
O
NH
195.4827
151.7524
114.0651
37.2873
26.6982
22.7772
22.3199
21.5336
f1 (ppm)
f1 (ppm)

2,2'-(ethane-1,1-diyl)bis(3-hydroxy-5,5-dimethylcyclohex-2-enone) ***(7a)***




192.6835
185.2370
116.9289
51.4896
44.9663
33.4455
33.1938
28.8067
24.7401
CH3
O
O
H3C
CH3
CH3
OH
OH
CH3
f1 (ppm)
f1 (ppm)