Supporting information

Ethyl 3-Bromopropanoate Mediated Tandem Knoevenagel–Aldol Annulation: A new strategy for the synthesis of Indolizines

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General Information

All reagents and chemicals were purchased from commercial suppliers (Merck, Sigma-Aldrich, TCI, Aginitio, and Thermofisher). Thin-layer chromatography (TLC) was conducted on silica gel pre-coated aluminum plates and visualized under a UV lamp (λ=254 nm). Column chromatography was performed using a normal-phase 60-120 mesh silica gel. ^{1}H NMR and ^{13}C NMR spectra were recorded using *JEOL* Nuclear Magnetic Resonance-ECZR series spectrometers, operating at 500 MHz and 125 MHz, respectively. Range of final compound **(5a-x)** ^{1}H-NMR δ (ppm) Aromatic proton resonated at 6.75-9.72 ppm. The aliphatic methyl protons CH_3 appeared in the range of 1.29-1.3 ppm as a triplet, and the methylene protons of ester CH_2 of the final compounds appeared in the range of 4.00-4-45 ppm. ^{13}C NMR δ (ppm): ketone resonates around at C=O 192.92-191.61 ppm, ester carbonyl carbon around 162-165 ppm, aliphatic CH_2 appears at 62.99-62.68. Coupling constants (*J*) are reported in Hertz (Hz). Multiplicities in ^{1}H NMR spectra are indicated as singlet (s), doublet (d), triplet (t), quartet (q), multiplet (m), and broad (br). High-resolution mass spectra (HRMS) were obtained using a Waters LCT Premier XE mass spectrometer with electrospray ionization time-of-flight (ESI-TOF)..

General method for the Synthesis of 2-(2-substituted-1*H*-pyrrol-1-yl)-1-phenylethan-1-one (3a-w)

To the stirred solution of pyrrolo-2-carboxaldehyde **(1a)**, (0.5 g, 5.2mmol) and potassium carbonate, (1.09 g, 7.8mmol) in acetonitrile (15 mL), phenacyl bromide (**2a**), (1.04 g, 5.2mmol) was added and stirred at room temperature for 24 h. The reaction completion was monitored by TLC. After completion of the reaction, the organic solvent was evaporated under reduced pressure and diluted with ethyl acetate (50 mL), wash the organic layer with water (25 mL × 2), and brine solution (25 mL × 1) and dried the organic layer over anhydrous sodium sulfate. The organic layer was concentrated under reduced pressure to get crude 1-(2-oxo-2-phenylethyl)-1*H*-pyrrole-2-carbaldehyde **3a.** The crude residue was purified via column chromatography using 100-200 mesh silica gel by using an ethyl acetate/hexane mixture as the eluent, yielding 1.2 g (92%) of pure **3a** 1-(2-oxo-2-phenylethyl)-1*H*-pyrrole-2-carbaldehyde. The remaining compounds **(3b-w)** were synthesized using the same protocol[1].

General method for the Synthesis of 8-substituted Ethyl 5-benzoylindolizine-7-carboxylate derivatives (5a-x)

To a stirred solution of 1-(2-oxo-2-phenylethyl)-1*H*-pyrrole-2-carbaldehyde (0.3 g, 1.4 mmol) and ethyl 3-bromopropanoate (160 µL, 0.2547 g, 1.4 mmol) in N, N-dimethylformamide (5 mL), added cesium carbonate (1.14g, 3.5 mmol), The resulting mixture was allowed to heat at 120 °C for 6 h, and the reaction's progress was monitored via thin-layer chromatography (TLC). Upon completion of the reaction, the crude reaction mixture was quenched with ice, and then the reaction mixture was diluted with ethyl acetate (50 mL) and washed with water (5 × 25 mL) and brine solution (1 × 25 mL), dried with anhydrous sodium sulfate. The crude residue was purified via column chromatography using 100-200 mesh silica gel and an ethyl

acetate/hexane mixture as the eluent, yielding 0.2 g (86%) of pure **5a** ethyl 5-benzoylindolizine-7-carboxylate. The remaining compounds (**5b-x**) were synthesised using the same protocol.

Characterization details

1-(2-Oxo-2-phenylethyl)-1*H*-pyrrole-2-carbaldehyde (3a): White solid, (1.02 g, 91%), ^{1}H NMR (500 MHz, DMSO-d_6): δ 9.41 (s, 1H), 8.00 (d, *J* =7.3 Hz, 2H), 7.68 (t, *J* =7.4 Hz,1H), 7.56 (t, *J*= 7.7 Hz, 2H), 7.24 (s1H), 7.07 (dd, *J* = 4.0,1.6 Hz,1H), 6.28 (dd, *J* =3.9, 2.5 Hz,1H), 5.88 (s, 2H); ^{13}C NMR (125 MHz, DMSO-d_6): δ 194.0, 180.1, 135.1, 134.3, 133.7, 131.9, 129.4, 128.4, 124.7, 110.1, 55.6; HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{13}H_{11}NO_2$, 214.0860; found: 214.0867 [1]

1-(2-(4-Methoxyphenyl)-2-oxoethyl)-1*H*-pyrrole-2-carbaldehyde(3b): White solid; (1.11 g, 87%); ^{1}H NMR (500 MHz, DMSO-d_6): δ 9.39 (s,1H), 7.97 (d, *J*= 8.9 Hz,2H), 7.22 (s,1H), 7.08 (s, 1H), 7.06 (dd, *J*= 4.0,1.6 Hz, 2H), 6.26 (dd, *J* = 4.0, 2.5 Hz,1H), 5.82 (s, 2H), 3.83 (s, 3H); ^{13}C NMR (125 MHz, DMSO-d_6): δ 192.2,180.0, 164.0, 133.7, 132.0, 130.7,128.0,124.6,114.6,110.0, 56.1, 55.2; HRMS (ESI-TOF) m/z:$[M+H]^+$ calculated for $C_{14}H_{13}NO_3$, 244.0965; found: 244.0984. [1]

1-(2-(4-Fluorophenyl)-2-oxoethyl)-1H-pyrrole-2-carbaldehyde (3c): White solid, (1.08 g, 89%), ^{1}H NMR (500 MHz, DMSO-d_6): δ 9.40 (s, 1H), 8.09 (dd, *J* =8.9, 5.5 Hz, 2H), 7.39 (t, *J* = 8.9 Hz,2H), 7.23 (s,1H), 7.07 (dd, *J* = 4.5, 2.2 Hz, 1H), 6.28 (m, 1H), 5.86 (s, 2H); ^{13}C NMR (125 MHz, DMSO-d_6): δ 192.7, 180.1, 165.8 (d, $^{1}J_{C\text{-}F}$ =251.2 Hz), 133.6, 131.7 (d,$^{3}J_{C\text{-}F}$ = 9.52 Hz), 131.5, 131.4, 124.7, 116.6 (d, $^{2}J_{C\text{-}F}$= 21.9 Hz), 116.4, 110.0, 55.5; HRMS (ESI-TOF) m/z:$[M+H]^+$ calculated for $C_{13}H_{10}FNO_2$, 232.0766, 232.0773; found: 232.0776. [1]

1-(2-(4-Chlorophenyl)-2-oxoethyl)-1*H*-pyrrole-2-carbaldehyde (3d): ^{1}H NMR (500 MHz, DMSO-d_6): δ 9.38 (s, 1H), 8.01 (d, *J* = 8.8 Hz, 2H), 7.64 (d, *J*= 9.6 Hz, 2H), 7.22 (s,1H), 7.08 (dd, *J* = 4.0,1.4 Hz,1H), 6.28 (t, J =2.8 Hz,1H), 5.85 (s, 2H); ^{13}C NMR (125 MHz, DMSO-d_6): δ 193.2,180.1,139.2,133.8,133.7,131.8,130.3, 129.6, 124.8, 110.1, 55.5; HRMS (ESI-TOF) m/z:$[M+H]^+$ calculated for $C_{13}H_{10}ClNO_2$, 248.6850; found: 248.6858. [1]

1-(2-(4-Bromophenyl)-2-oxoethyl)-1*H*-pyrrole-2-carbaldehyde (3e): White solid, (1.26 g, 84%), ^{1}H NMR (500 MHz, DMSO- d_6): δ 9.38 (s, 1H), 7.93 (d, *J* = 8.6 Hz, 2H), 7.78 (d, *J*= 8.6 Hz, 2H), 7.23 (s,1H), 7.07 (dd, *J*= 4.1,1.8 Hz,1H), 6.27 (dd, *J* =4.1, 2.4 Hz,1H), 5.84 (s, 2H); ^{13}C NMR(125 MHz, DMSO-d_6): δ 193.4,180.1,134.1,133.6,132.5,131.8, 130.4, 128.4, 110.1, 55.5; HRMS (ESI-TOF) m/z:$[M+H]^+$ calculated for $C_{13}H_{10}BrNO_2$, 293.1390; found: 293.1382.[1]

1-(2-Oxo-2-(*p*-tolyl)ethyl)-1*H*-pyrrole-2-carbaldehyde (3f): White solid, (1.06 g, 89%), ^{1}H NMR (500 MHz, DMSO-d_6): δ 9.41 (s,1H), 7.91 (d, *J* =7.8 Hz,2H), 7.35 (d, *J* = 7.6 Hz, 2H), 7.24 (s,1H), 7.07 (s,1H), 6.28 (s, 1H), 5.86 (s, 2H), 2.37 (s, 3H); ^{13}C NMR (125 MHz, DMSO- d_6): δ 193.4, 180.0, 144.8, 133.7, 132.6,

131.9, 129.9, 128.5, 124.7, 110.0, 55.4, 21.7; HRMS (ESI-TOF) m/z:$[M+H]^+$ calculated for $C_{14}H_{13}NO_3$, 228.1016; found: 228.0978.[1]

1-(2-(3-Methoxyphenyl)-2-oxoethyl)-1*H*-pyrrole-2-carbaldehyde (3g): White solid, (1.16 g, 91%), ^{1}H NMR (500 MHz, DMSO-d_6): δ 9.40 (s, 1H), 7.61 (s, 1H), 7.50-7.46 (m, 2H), 7.25 (dd, *J* =10.2, 4.2 Hz, 2H), 7.07 (d, *J* =3.8 Hz,1H), 6.30e6.26 (m,1H), 5.86 (s, 2H), 3.80 (s, 3H); ^{13}CNMR(125MHz,DMSO-d_6):δ193.8,180.0, 160.0,136.5,133.6,131.9,130.6,
124.7,120.8,120.2,112.9,110.0, 55.9, 55.7; HRMS (ESI-TOF) m/z:$[M+H]^+$ calculated for $C_{14}H_{13}NO_3$, 244.0965; found: 244.0986.[1]

1-(2-([1,1'-Biphenyl]-4-yl)-2-oxoethyl)-1*H*-pyrrole-2-carbaldehyde (3h): White solid, (1.39 g, 91%), ^{1}H NMR (500 MHz, DMSO- d_6): δ 9.42(s), 8.08 (d, *J* =8.3 Hz), 7.86 (d, *J* =8.3 Hz), 7.75 (d, *J* =7.5 Hz), 7.49 (t, *J* =7.5 Hz), 7.41 (d, *J* =7.3 Hz), 7.26 (s), 7.09 (dd, *J* =3.9,1.3 Hz), 6.29(dd, *J* =3.8, 2.5 Hz),5.91 (s);^{13}C NMR(125MHz, DMSO -d_6): δ 193.5, 180.1, 145.6, 139.3, 133.9, 133.8 (d, J ¼ 29.3 Hz), 131.9,129.6,129.1 (d, J ¼ 10.4 Hz),127.6 (d, J ¼ 2.3,124.7,110.0, 55.6; HRMS (ESI-TOF) m/z:$[M+H]^+$ calculated for $C_{19}H_{15}NO_2$, 290.1173; found: 290.1186.[1]

1-(2-(Naphthalen-1-yl)-2-oxoethyl)-1*H*-pyrrole-2-carbaldehyde (3i): White solid,(1.16g, 89%),^{1}HNMR(500MHz, DMSO d_6): δ 9.42 (s,1H), 8.77 (s,1H), 8.13 (d, *J* =7.9 Hz,1H), 8.05 (d, *J* =8.8 Hz, 1H), 7.99 (dd, *J* =16.4, 7.6 Hz, 2H), 7.69 e 7.61 (m, 2H), 7.29 (s, 1H), 7.09 (dd, J ¼ 3.9,1.9 Hz, 1H), 6.34 e 6.27 (m,1H), 6.02 (s, 2H); ^{13}C NMR (125 MHz, DMSO- d_6) :δ 193.92,180.15,179.69,135.84,133.80,132.70,132.45,132.00,130.42,130.14,129.49,129.12,128.35, 127.73, 124.81, 123.85, 110.13, 55.68, 40.52. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_9H_{11}NO_3$, 264.1024; found: 264.1049. [1]

2-(2-Acetyl-1*H*-pyrrol-1-yl)-1-phenylethan-1-one (3j): Yellow solid, (0.246 g, 60%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.01 (d, *J* = 8.2 Hz, 2H), 7.60 (d, *J* = 8.4 Hz, 1H), 7.52-7.46 (m, 2H), 7.06 (d, *J* = 4.1 Hz, 1H), 6.86 (d, *J* = 1.9 Hz, 1H), 6.30-6.22 (m, 1H), 5.75 (s, 2H), 2.42 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.57, 188.90, 135.25, 133.73, 131.52, 130.48, 128.93, 128.13, 120.44, 108.92, 55.69, 26.89; HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{14}H_{14}NO_6$, 228.1024; found, 228.1026.

2-(2-Acetyl-1*H*-pyrrol-1-yl)-1-(4-methoxyphenyl)ethan-1-one (3k): Yellow solid, (0.312 g, 65%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.9 Hz, 2H), 7.04 (d, *J* = 4.0 Hz, 1H), 6.95 (d, *J* = 8.8 Hz, 2H), 6.84 (d, *J* = 2.1 Hz, 1H), 6.25 (d, *J* = 3.8 Hz, 1H), 5.70 (s, 2H), 3.86 (s, 3H), 2.38 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.60, 188.92, 131.62, 130.44, 128.95, 128.14, 120.47, 114.12, 108.83, 55.71, 55.29, 26.92. HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{15}H_{16}NO_3$, 258.113; found, 258.1136.

2-(2-Acetyl-1*H*-pyrrol-1-yl)-1-(p-tolyl)ethan-1-one (3l): Yellow solid, (0.215 g, 56%); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.89 (d, *J* = 8.2 Hz, 2H), 7.28 (d, *J* = 8.0 Hz, 2H), 7.04 (d, *J* = 3.9 Hz, 1H), 6.84 (d, *J* = 1.9 Hz, 1H), 6.27-6.22 (m, 1H), 5.72 (s, 2H), 2.42 (s, 3H), 2.38 (s, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.20, 188.90,

144.68, 132.67, 131.57, 130.47, 129.61, 128.24, 120.43, 108.87, 55.57, 26.95, 21.87; HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{15}H_{16}NO_2$, 242.1181; found, 242.1180.

2-(2-Acetyl-1*H*-pyrrol-1-yl)-1-(4-bromophenyl)ethan-1-one (3m): Yellow solid, (0.300 g, 62%); ^{1}H NMR (500 MHz, DMSO-d_6) δ 7.98 (d, J = 8.6 Hz, 2H), 7.61 (d, J = 8.7 Hz, 2H), 7.09 (dd, J = 5.4, 1.5 Hz, 2H), 6.18 – 6.16 (m, 1H), 5.77 (s, 2H), 2.27 (s, 3H);^{13}C NMR (125 MHz, DMSO-d_6) δ 193.40, 188.16, 138.99, 134.37, 132.57, 130.52, 130.25, 129.51, 120.56, 108.63, 56.07, 27.06; HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{14}H_{13}BrNO_2$, 307.1029; found, 308.0109.

2-(2-Acetyl-1*H*-pyrrol-1-yl)-1-(4-fluorophenyl)ethan-1-one (3n): Yellow solid, (0.230 g, 50%); ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.13 – 8.08 (m, 2H), 7.41 (t, J = 8.7 Hz, 2H), 7.14 (d, J = 3.1 Hz, 2H), 7.01 (d, J = 49.8 Hz, 1H), 6.19 (dd, J = 14.9, 2.0 Hz, 1H), 5.82 (s, 2H), 2.30 (s, 3H); ^{13}C NMR (125 MHz, DMSO-d_6) δ 192.97, 188.17, 187.43, 166.77, 164.77, 132.53, 132.25, 131.45, 131.37, 130.45, 125.80, 120.71, 117.39, 116.55, 116.38, 110.21, 108.62, 56.09, 27.10, 26.10; HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{14}H_{13}FNO_2$, 246.0930; found, 246.0929.

2-(2-Acetyl-1*H*-pyrrol-1-yl)-1-(4-chlorophenyl)ethan-1-one (3o): Yellow solid, (0.260 g, 55%); ^{1}H NMR (500 MHz, DMSO-d_6) δ 7.90 (d, J = 8.4 Hz, 2H), 7.75 (d, J = 8.6 Hz, 2H), 7.10 (d, J = 2.0 Hz, 1H), 7.09 (d, J = 4.2 Hz, 1H), 6.19 – 6.15 (m, 1H), 5.76 (s, 2H), 2.27 (s, 3H); ^{13}C NMR (125 MHz, DMSO-d_6) δ 193.61, 188.16, 134.71, 132.51, 132.47, 130.52, 130.34, 128.09, 120.63, 108.63, 56.04, 27.05; HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{14}H_{13}BrNO_2$, 307.1029; found, 262.0636.

1-([1,1'-Biphenyl]-4-yl)-2-(2-acetyl-1*H*-pyrrol-1-yl)ethan-1-one (3p): Yellow solid, (0.290 g, 65%); ^{1}H NMR (500 MHz, DMSO-*d*6) δ 8.10 (d, J = 8.5 Hz, 2H), 7.89 (d, J = 8.5 Hz, 2H), 7.78 (d, J = 7.1 Hz, 2H), 7.53 (d, J = 7.5 Hz, 3H), 7.45 (d, J = 2.4 Hz, 1H), 7.17 (d, J = 2.6 Hz, 1H), 6.24 – 6.19 (m, 1H), 5.87 (s, 2H), 2.32 (s, 3H); ^{13}C NMR (125 MHz, DMSO-d_6) δ 193.85, 188.16, 145.48, 139.42, 134.31, 132.57, 130.48, 129.67, 129.12, 129.02, 127.58, 120.71, 108.61, 56.17, 27.14; HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{20}H_{18}NO_2$, 326.1156; found, 326.1171.

2-(2-Acetyl-1*H*-pyrrol-1-yl)-1-(naphthalen-1-yl)ethan-1-one (3q): Yellow solid, (0.312 g, 65%); ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.78 (s, 1H), 8.16 (d, J = 8.0 Hz, 1H), 8.07 (d, J = 8.7 Hz, 1H), 8.03 (d, J = 8.2 Hz, 1H), 8.00 (dd, J = 8.6, 1.8 Hz, 1H), 7.73 – 7.63 (m, 2H), 7.22 – 7.19 (m, 1H), 7.17 (d, J = 4.1 Hz, 1H), 6.24 – 6.21 (m, 1H), 5.99 (s, 2H), 2.32 (s, 3H);^{13}C NMR (125 MHz, DMSO-d_6) δ 194.19, 188.21, 135.77, 132.76, 132.73, 132.62, 130.54, 130.24, 130.11, 129.35, 129.03, 128.32, 127.65, 123.94, 120.75, 108.65, 56.25, 27.15; HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{18}H_{16}NO_2$, 278.1181; found, 278.1170.

2-(2-Benzoyl-1*H*-pyrrol-1-yl)-1-phenylethan-1-one (3r): Creamy white solid, (1.23 g, 83%), ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.04 (d, J = 8.5 Hz, 2H), 7.79 (d, J = 6.2 Hz, 2H), 7.64 – 7.58 (m, 1H), 7.54 – 7.47 (m, 3H), 7.45 – 7.40 (m, 2H), 7.00 – 6.96 (m, 1H), 6.87 (s, 1H), 6.32 (d, J = 4.1, 2.6 Hz, 1H), 5.87 (s, 2H). ^{13}C NMR

(125 MHz, $CDCl_3$) δ 193.11, 186.10, 139.20, 134.73, 133.36, 131.87, 131.53, 131.15, 129.79, 128.88, 128.53, 127.73, 123.16, 122.94, 108.76, 55.09. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{19}H_{15}NO_2$, 290.1181; found: 290.1198

2-(2-Benzoyl-1*H*-pyrrol-1-yl)-1-(p-tolyl)ethan-1-one (3s): Creamy white solid, (1.3 g, 82%) ^1H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, *J* = 6.3 Hz, 2H), 7.78 (d, *J* = 8.4 Hz, 2H), 7.51 (t, *J* = 7.4 Hz, 1H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.30 (d, *J* = 7.9 Hz, 2H), 7.00 – 6.97 (m, 1H), 6.86 (d, *J* = 4.1 Hz, 1H), 6.31 (d, *J* = 4.1 Hz, 1H), 5.85 (s, 2H), 2.43 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.12, 186.53, 144.70, 139.69, 132.66, 132.09, 131.55, 129.63, 129.34, 128.32, 128.11, 123.43, 109.07, 77.41, 76.91, 55.36, 21.85. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{20}H_{17}NO_2$, 304.1337; found: 304.1136.

2-(2-Benzoyl-1*H*-pyrrol-1-yl)-1-(4-flourophenyl)ethan-1-one (3t): Creamy white solid, (1.1 g, 84%) ^1H NMR (500 MHz, $CDCl_3$) δ 8.07 (d, *J* = 3.6 Hz, 2H), 7.77 (d, *J* = 7.0 Hz, 2H), 7.51 (t, *J* = 7.4 Hz, 1H), 7.42 (t, *J* = 8.1 Hz, 2H), 7.18 (t, *J* = 8.6 Hz, 2H), 7.01 – 6.96 (m, 1H), 6.87 (d, *J* = 4.1 Hz, 1H), 6.31 (d, *J* = 6.7 Hz, 1H), 5.81 (s, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 192.06, 186.60, 167.24, 165.21, 139.58, 132.11, 131.66, 130.98, 130.91, 130.17, 129.31, 128.18, 123.57, 116.31, 109.24, 77.42, 76.91, 55.38. $C_{19}H_{14}FNO_2$, 368.0286; found: 368.0290.

2-(2-Benzoyl-1*H*-pyrrol-1-yl)-1-(4-bromophenyl)ethan-1-one (3u): Creamy white solid, (1.5 g, 90%) ^1H NMR (500 MHz, DMSO-d_6) δ 8.00 (d, *J* = 11.1 Hz, 2H), 7.82 (d, *J* = 8.7 Hz, 2H), 7.68 (d, *J* = 10.7 Hz, 2H), 7.58 (d, *J* = 7.3 Hz, 1H), 7.49 (t, *J* = 6.6 Hz, 2H), 7.33 – 7.30 (m, 1H), 6.78 (d, *J* = 5.2 Hz, 1H), 6.29 (d, *J* = 5.3 Hz, 1H), 5.93 (s, 2H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 193.65, 185.36, 139.64, 134.44, 133.41, 132.55, 132.14, 130.49, 129.78, 129.25, 128.80, 128.33, 122.96, 109.13, 56.06. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{19}H_{14}BrNO_2$, 368.0286; found: 368.0290.

1-([1,1'-Biphenyl]-4-yl)-2-(2-benzoyl-1*H*-pyrrol-1-yl)ethan-1-one (3v): Creamy white solid, (0.9 g, 85%) ^1H NMR (500 MHz, $CDCl_3$) δ 8.12 (d, *J* = 10.5 Hz, 2H), 7.79 (s, 2H), 7.73 (d, *J* = 8.6 Hz, 2H), 7.64 (d, *J* = 8.5 Hz, 2H), 7.51 – 7.46 (m, 3H), 7.43 (t, *J* = 6.7 Hz, 3H), 7.02 (d, *J* = 4.2 Hz, 1H), 6.91 – 6.86 (m, 1H), 6.32 (d, *J* = 4.1 Hz, 1H), 5.89 (s, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.16, 186.57, 146.52, 139.95, 139.66, 133.88, 132.15, 131.60, 130.24, 129.35, 129.11, 128.83, 128.45, 128.15, 127.63, 127.43, 123.52, 109.17, 77.41, 76.91, 55.52. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{25}H_{19}NO_2$, 366.1494; found: 366.1491.

2-(2-Benzoyl-1*H*-pyrrol-1-yl)-1-(4-chlorophenyl)ethan-1-one (3w) : Creamy white solid, (1.5 g, 88%) ^1H NMR (500 MHz, DMSO-d_6) δ 8.04 (d, *J* = 8.6 Hz, 2H), 7.64 (d, *J* = 6.8 Hz, 4H), 7.54 (d, *J* = 5.8 Hz, 1H), 7.45 (t, *J* = 7.6 Hz, 2H), 7.28 (t, *J* = 2.1 Hz, 1H), 6.74 (d, *J* = 5.7 Hz, 1H), 6.25 (dd, *J* = 4.1, 2.5 Hz, 1H), 5.90 (s, 2H). . ^{13}C NMR (125 MHz, DMSO-d_6) δ 193.44, 185.36, 139.64, 139.14, 134.12, 133.41, 132.14, 130.41, 129.78, 129.60, 129.25, 129.07, 128.95, 128.80, 122.95, 109.13, 56.09. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{19}H_{14}ClNO_2$, 324.7838; found: 324.7833.

Ethyl 5-Benzoylindolizine-7-carboxylate (5a): Orange solid, (0.23 g, 88%), ^{1}H NMR (500 MHz, DMSO-*d6*): δ 8.81 (s, 1H), 8.53 (s, 1H), 7.81 (d, J = 7.1 Hz, 2H), 7.71 (t, J = 7.4 Hz, 1H), 7.59 (t, J = 7.7 Hz, 2H), 7.52 (d, J = 1.6 Hz, 1H), 7.18-7.16 (m, 1H), 7.14 (dd, J = 4.0, 2.8 Hz,1H), 4.26 (q, J = 7.1 Hz, 2H), 1.27 (t, J = 7.1 Hz, 3H);^{13}C NMR(125 MHz, DMSO-d_6) δ 190.31,164.5,137.2,133.7,132.1, 129.0, 129.6, 128.1, 126.5, 121.9, 119.9, 117.8, 115.2, 108.1, 60.4, 14.13; HRMS (ESI-TOF) m/z:[M+H]$^+$ calculated for $C_{18}H_{15}NO_3$, 294.1122; found: 294.1156.

Ethyl 5-(4-methoxybenzoyl) indolizine-7-carboxylate (5b): Orange solid, (0.23 g, 88%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.57 (s, 1H), 8.50 (s, 1H), 7.85 (d, J = 8.0 Hz, 2H), 7.46 (d, J = 3.4 Hz, 1H), 7.15 (d, J = 3.5 Hz, 1H), 7.13 (d, J = 2.5 Hz, 2H), 7.10 (d, J = 2.6 Hz, 1H), 4.29 (q, J = 7.1, 5.3 Hz, 2H), 3.89 (s, 3H), 1.34 – 1.26 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 188.86, 164.67, 163.26, 132.94, 132.12, 129.68, 129.57, 126.36, 119.14, 118.77, 116.93, 115.88, 114.07, 107.98, 60.84, 55.66, 14.20. HRMS (ESI-TOF) m/z: [M+H]$^+$ calculated for $C_{19}H_{17}NO_4$, 324.1228; found: 324.1248.

Ethyl 5-(4-fluoro benzoyl) indolizine-7-carboxylate (5c): Orange solid, (0.22 g, 82%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.76 (s, 1H), 8.53 (s, 1H), 7.92 (d, J = 10.2 Hz, 2H), 7.50 (d, J = 2.3 Hz, 1H), 7.45 (d, J = 6.7 Hz, 2H), 7.17 (s, 1H), 7.15 (d, J = 1.4 Hz, 1H), 4.33 – 4.25 (m, 2H), 1.32 – 1.26 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.5,165.1 (d, $J_{C\text{-}F}$ =249.8 Hz),165.0, 134.6, 133.6, 132.9 (d, J ¼ 9.1 Hz), 129.5, 127.5, 121.5, 119.9, 117.8, 116.5e116.0, 109.0, 61.4, 14.6; HRMS (ESI-TOF) m/z: [M+H]$^+$ calculated for $C_{18}H_{14}FNO_3$, 312.1028; found: 312.1058.

Ethyl 5-(4-chlorobenzoyl) indolizine-7-carboxylate (5d): Orange semi-solid, (0.29 g, 84%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.81 (s, 1H), 8.55 (s, 1H), 7.84 (d, J = 8.6 Hz, 2H), 7.68 (d, J = 8.5 Hz, 2H), 7.51 (d, J = 1.8 Hz, 1H), 7.19 (d, J = 5.6 Hz, 1H), 7.17 – 7.14 (m, 1H), 4.29 (q, J = 7.2 Hz, 2H), 1.29 (t, J = 7.1 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.14, 164.51, 137.50, 136.40, 133.22, 131.40, 128.91, 128.70, 127.11, 121.37, 119.51, 117.36, 115.70, 108.66, 60.87, 14.17. HRMS (ESI-TOF) m/z: [M+H]$^+$ calculated for $C_{21}H_{19}NO_5$, 328.0740; found, 328.0749.

Ethyl 5-(4-bromobenzoyl) indolizine-7-carboxylate (5e): Orange solid, (0.24 g, 78%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.81 (s, 1H), 8.56 (s, 1H), 7.82 (d, J = 13.5 Hz, 2H), 7.77 (d, J = 7.2 Hz, 2H), 7.50 (d, J = 3.2 Hz, 1H), 7.18 (d, J = 4.9 Hz, 1H), 7.17 – 7.13 (m, 1H), 4.33 – 4.25 (q, 2H), 1.33 – 1.26 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.34, 164.56, 136.79, 133.26, 131.68, 131.57, 128.91, 127.19, 126.59, 121.48, 119.58, 117.43, 115.71, 108.74, 60.94, 14.23. HRMS (ESI-TOF) m/z: [M+H]$^+$ calculated for $C_{18}H_{14}BrNO_3$, 372.0227; found: 372.0237.

Ethyl 5-(4-methylbenzoyl) indolizine-7-carboxylate (5f): Orange solid, (0.23 g, 86%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.72 (s, 1H), 8.53 (s, 1H), 7.73 (d, J = 8.0 Hz, 2H), 7.51 (d, 1H), 7.41 (d, J = 8.0 Hz, 2H), 7.16

(d, J = 2.9 Hz, 1H), 7.14 (m, J = 4.2 Hz, 1H), 4.32 – 4.25 (q, 2H), 2.44 (s, 3H), 1.31 – 1.27 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 190.01, 164.66, 143.35, 134.83, 133.15, 129.80, 129.34, 126.84, 120.70, 119.22, 117.68, 115.78, 108.84, 107.94, 60.90, 21.24, 14.24. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{19}H_{17}NO_3$, 308.1278; found: 308.1289.

Ethyl 5-(3-methoxybenzoyl) indolizine-7-carboxylate (5g): Orange solid, (0.22 g, 84%),^{1}H NMR (500 MHz, DMSO-d_6) δ 8.77 (s, 1H), 8.50 (s, 1H), 7.61 (s, 1H), 7.53 – 7.48 (m, 1H), 7.36 (d, J = 7.1 Hz, 2H), 7.28 (d, J = 8.0 Hz, 1H), 7.16 – 7.11 (m, 2H), 4.32 (q, J = 6.4 Hz, 2H), 3.86 (s, 3H), 1.35 – 1.27 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.45, 164.07, 158.98, 138.67, 132.87, 129.17, 128.87, 126.35, 120.53, 118.85, 118.10, 116.47, 115.69, 114.02, 107.84, 60.22, 55.09, 13.57. HRMS (ESI-TOF) m/z: $[M+H]^+$calculated for $C_{19}H_{17}NO_4$, 324.1228; found: 324.1264.

Ethyl 5-(2-methoxybenzoyl) indolizine-7-carboxylate (5h): Yellow solid, (0.150 g, 70%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 9.13 (s, 1H), 8.56 (s, 1H), 7.60 (dd, J = 8.4, 7.4, 1.8 Hz, 1H), 7.51 (d, J = 1.7 Hz, 1H), 7.46 (dd, J = 7.4, 1.7 Hz, 1H), 7.25 (d, J = 8.6 Hz, 1H), 7.23 – 7.19 (m, 2H), 7.13 (t, J = 7.9 Hz, 1H), 4.25 (q, J = 7.2 Hz, 2H), 3.71 (s, 3H), 1.26 (t, J = 7.1 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 190.27, 164.44, 156.61, 133.59, 132.26, 129.44, 129.05, 127.78, 127.43, 122.51, 120.58, 119.72, 117.88, 115.73, 112.13, 108.94, 60.87, 55.72, 14.09. HRMS (ESI-TOF) m/z: $[M+H]^+$calculated for $C_{19}H_{17}NO_4$, 324.1228; found: 324.1264

Ethyl 5-([1,10-biphenyl]-4-carbonyl) indolizine-7-carboxylate (5i): Orange solid, (0.21 g, 83%),^{1}H NMR (500 MHz, DMSO-d_6) δ 8.80 (s, 1H), 8.56 (s, 1H), 7.91 (d, J = 7.3 Hz, 4H), 7.83 – 7.78 (m, 2H), 7.59 (d, J = 7.2 Hz, 1H), 7.57 – 7.51 (m, 2H), 7.46 (t, J = 7.4 Hz, 1H), 7.17 (dd, J = 14.3, 7.0, 4.2, 1.9 Hz, 2H), 4.28 (t, J = 7.2 Hz, 2H), 1.28 (d, J = 7.2 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.82, 164.62, 144.21, 138.82, 136.41, 133.21, 130.37, 129.17, 128.49, 127.07, 126.79, 120.92, 119.35, 117.30, 115.79, 108.53, 60.90, 40.02, 14.20. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{24}H_{19}NO_3$, 370.1435; found: 370.1428.

Ethyl 5-(1-naphthoyl)indolizine-7-carboxylate (5j): Yellow colour Solid; Yield: 75%, (0.250 g); ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.77 (s, 1H), 8.52 (s, 1H), 8.42 (s, 1H), 8.10 (t, J = 7.8 Hz, 2H), 8.05 (d, J = 7.9 Hz, 1H), 7.90 (d, J = 8.4 Hz, 1H), 7.70 (t, J = 7.5 Hz, 1H), 7.63 (d, J = 10.6 Hz, 2H), 7.20 – 7.11 (m, 2H), 4.29 (q, J = 7.0 Hz, 2H), 1.27 (t, J = 6.0 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 190.72, 165.11, 135.42, 135.25, 133.74, 132.39, 131.43, 129.91, 129.18, 128.90, 128.33, 127.74, 127.40, 125.90, 121.64, 119.85, 117.78, 116.43, 108.99, 61.34, 14.67. HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{22}H_{17}NO_3$, 344.1286; found, 344.1286.

Ethyl 5-benzoyl-8-methylindolizine-7-carboxylate (5k): Yellow solid, (0.1 g, 70%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.81 (s, 1H), 7.79 (d, J = 7.6 Hz, 2H), 7.70 (t, J = 7.4 Hz, 1H), 7.60 (d, J = 8.4 Hz, 3H), 7.23 (d, J = 4.4 Hz, 1H), 7.11 – 7.08 (m, 1H), 4.22 (q, J = 7.1 Hz, 2H), 2.83 (s, 3H), 1.22 (t, J = 7.2 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 190.10, 165.36, 139.32, 137.89, 134.44, 132.48, 129.46, 128.52, 127.18, 123.78,

119.30, 116.43, 114.28, 107.19, 60.65, 16.60, 14.07. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated for $C_{19}H_{17}NO_3$, 308.1286; found: 308.1288

Ethyl 5-(4-methoxybenzoyl)-8-methylindolizine-7-carboxylate (5l): Yellow solid, (0.15 g, 71%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.52 (s, 1H), 7.82 (d, J = 10.8 Hz, 2H), 7.53 (s, 1H), 7.13 (d, J = 6.9 Hz, 2H), 7.11 (d, J = 4.9 Hz, 1H), 7.04 – 7.01 (m, 1H), 4.32 – 4.26 (m, 2H), 3.90 (s, 3H), 2.83 (s, 3H), 1.32 – 1.25 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 188.24, 165.15, 162.84, 137.47, 133.90, 131.36, 129.57, 127.63, 120.58, 118.06, 115.41, 114.45, 113.65, 105.76, 60.07, 55.23, 15.71, 13.59. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated calculated for $C_{20}H_{19}NO_4$, 338.1392; found: 338.1397

Ethyl 8-methyl-5-(4-methylbenzoyl)indolizine-7-carboxylate (5m): Yellow solid, (0.12 g, 69%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.67 (s, 1H), 7.70 (d, J = 8.4 Hz, 2H), 7.59 (d, J = 9.1 Hz, 1H), 7.39 (d, J = 8.2 Hz, 2H), 7.15 (d, J = 4.4 Hz, 1H), 7.05 (d, J = 3.1 Hz, 1H), 4.28 (q, J = 6.9 Hz, 2H), 2.84 (s, 3H), 2.44 (s, 3H), 1.27 (t, J = 6.9 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.23, 165.05, 142.48, 137.86, 134.68, 133.98, 128.98, 128.59, 127.33, 121.71, 118.38, 115.63, 114.43, 106.11, 60.01, 20.49, 15.57, 13.48. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated $C_{20}H_{19}NO_3$, 322.1443; found: 338.1446

Ethyl 5-(4-bromobenzoyl)-8-methylindolizine-7-carboxylate (5n): Yellow solid, (0.1g, 67%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.75 (s, 1H), 7.78 (d, J = 8.9 Hz, 2H), 7.74 (d, J = 8.7 Hz, 2H), 7.59 (d, J = 4.8 Hz, 1H), 7.19 (d, J = 1.4 Hz, 1H), 7.11 – 7.05 (m, 1H), 4.29 (dd, J = 7.1, 4.7 Hz, 2H), 2.85 (s, 3H), 1.30 – 1.24 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 188.45, 164.90, 138.45, 136.59, 134.04, 131.02, 130.64, 126.79, 125.69, 122.82, 118.70, 115.75, 114.41, 106.27, 60.04, 15.71, 13.46. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated $C_{19}H_{16}BrNO_3$, 386.0392; found: 386.0394

Ethyl 5-(4-fluorobenzoyl)-8-methylindolizine-7-carboxylate (5o): Yellow solid, (0.13 g, 64%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.76 (s, 1H), 7.89 (d, J = 10.9 Hz, 2H), 7.58 (d, J = 2.3 Hz, 1H), 7.42 (d, J = 17.7 Hz, 2H), 7.24 – 7.21 (m, 1H), 7.09 (d, J = 8.7 Hz, 1H), 4.25 (q, J = 7.1 Hz, 2H), 2.85 (s, 3H), 1.25 (t, J = 7.1 Hz, 3H). ^{13}C NMR (126 MHz, DMSO-D_6) δ 188.75, 165.38, 163.57, 139.26, 134.40, 132.43, 132.36, 127.20, 123.40, 119.26, 116.41, 115.73, 115.56, 114.35, 107.15, 60.69, 39.02, 16.57, 14.09. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated $C_{19}H_{16}FNO_3$, 326.1192; found: 326.1181.

Ethyl 5-(4-cholrobenzoyl)-8-methylindolizine-7-carboxylate (5p): Yellow solid, (0.15 g, 70%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.76 (s, 1H), 7.81 (d, J = 8.4 Hz, 2H), 7.64 (d, J = 8.5 Hz, 2H), 7.60 (d, J = 5.9 Hz, 1H), 7.19 (d, J = 4.1 Hz, 1H), 7.08 (t, J = 5.2 Hz, 1H), 4.32 – 4.25 (m, 2H), 2.86 (s, 3H), 1.29 (d, J = 5.8 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-D_6) δ 188.43, 165.00, 138.61, 136.98, 136.29, 134.11, 130.67, 128.16, 126.87, 122.99, 118.80, 115.87, 114.41, 106.47, 60.16, 15.85, 13.58. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated $C_{19}H_{16}ClNO_3$, 342.0897; found: 342.0917

Ethyl 5-([1,1'-biphenyl]-4-carbonyl)-8-methylindolizine-7-carboxylate (5q): Orange solid, (0.1g, 67%), ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.57, 165.46, 144.04, 139.20, 138.84, 136.62, 134.44, 130.33, 129.18, 128.93, 128.47, 127.33, 127.06, 126.90, 126.71, 123.34, 119.25, 116.42, 114.40, 107.16, 60.71, 16.62, 14.11. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated $C_{25}H_{21}NO_3$, 384.1599; found: 384.1592.

Ethyl 5-(1-naphthoyl)-8-methylindolizine-7-carboxylate (5r): Yellow colour Solid; Yield: 60%, (0.100 g); ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.81 (s, 1H), 8.43 (d, J = 1.9 Hz, 1H), 8.13 – 8.09 (m, 2H), 8.06 (d, J = 8.0 Hz, 1H), 7.89 (d, J = 6.7 Hz, 1H), 7.73 – 7.67 (m, 2H), 7.67 – 7.62 (m, 1H), 7.25 (d, J = 4.3 Hz, 1H), 7.13 – 7.09 (m, 1H), 4.19 (q, J = 7.1 Hz, 2H), 2.85 (s, 3H), 1.16 (t, J = 7.1 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.98, 165.45, 139.22, 135.07, 134.68, 134.47, 131.88, 130.94, 129.34, 128.65, 128.36, 127.84, 127.46, 127.23, 125.50, 123.63, 119.26, 116.45, 114.49, 60.64, 16.62, 14.07. HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{23}H_{19}NO_3$, 358.1443; found, 358.1405.

Ethyl 5-benzoyl-8-phenylindolizine-7-carboxylate (5s): Orange liquid, (0.2g, 80%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.85 (s, 1H), 7.86 (d, J = 9.7 Hz, 2H), 7.75 – 7.70 (m, 1H), 7.64 – 7.60 (m, 3H), 7.52 – 7.48 (m, 3H), 7.39 – 7.36 (m, 2H), 7.08 – 7.05 (m, 1H), 6.43 (d, J = 4.2 Hz, 1H), 3.90 (q, J = 7.1 Hz, 2H), 0.78 (t, J = 7.1 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 190.11, 165.37, 140.29, 137.71, 136.74, 134.14, 132.62, 129.50, 128.58, 128.39, 128.32, 128.16, 127.95, 123.25, 119.18, 117.04, 115.15, 108.10, 60.34, 13.27. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated $C_{24}H_{19}NO_4$, 370.1443; found: 338.1446

Ethyl 5-(4-methylbenzoyl)-8-phenylindolizine-7-carboxylate (5t): Orange liquid, (0.2g, 80%), ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.75 (s, 1H), 7.78 (d, J = 8.2 Hz, 2H), 7.59 (s, 1H), 7.51 – 7.49 (m, 3H), 7.43 (d, J = 8.3 Hz, 2H), 7.39 – 7.36 (m, 2H), 7.05 (dd, J = 4.3, 2.7 Hz, 1H), 6.41 (dd, J = 4.3, 1.3 Hz, 1H), 3.90 (q, J = 7.1 Hz, 2H), 2.45 (s, 3H) 0.78 (t, J = 7.1 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.82, 165.53, 143.37, 140.08, 136.84, 134.87, 134.10, 129.80, 129.26, 128.67, 128.36, 128.21, 128.03, 122.47, 118.93, 117.20, 116.76, 115.24, 107.90, 60.42, 21.23, 13.35. HRMS (ESI-TOF) m/z: $[M+H]^+$ calculated $C_{25}H_{21}NO_4$, 384.1599; found: 384.1622.

Ethyl 5-(4-chlorobenzoyl)-8-phenylindolizine-7-carboxylate (5u): Yellow colour liquid; Yield: 81%, (0.278g); ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.81 (s, 1H), 7.86 (d, J = 4.6 Hz, 2H), 7.67 (s, 2H), 7.58 (s, 1H), 7.50 – 7.45 (m, 3H), 7.38 – 7.31 (m, 2H), 7.07 – 7.01 (m, 1H), 6.42 (d, J = 4.2 Hz, 1H), 3.88 (q, J = 7.2 Hz, 2H), 0.77 (t, J = 7.1 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-*d6*) δ 188.90, 165.37, 140.39, 137.52, 136.69, 136.42, 134.11, 131.40, 128.70, 128.30, 128.19, 127.96, 123.31, 119.28, 117.09, 115.20, 108.19, 60.38, 40.02, 13.28. HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{24}H_{18}ClNO_3$, 404.0078; found, 404.0079.

Ethyl 5-(4-bromombenzoyl)-8-phenylindolizine-7-carboxylate (5v): Yellow colour liquid; Yield: 85%, (0.160 g); ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.84 (s, 1H), 7.83 (d, J = 8.3 Hz, 2H), 7.80 (d, J = 8.6 Hz, 2H), 7.59 (d, J = 5.0 Hz, 1H), 7.52 – 7.48 (m, 3H), 7.39 – 7.35 (m, 2H), 7.10 – 7.04 (m, 1H), 6.44 (d, J = 4.3 Hz, 1H), 3.91 (q, J = 7.0 Hz, 2H), 0.79 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 189.09, 165.39, 140.41, 136.79,

136.69, 134.12, 131.65, 131.52, 128.31, 128.21, 127.98, 126.54, 123.35, 119.31, 117.13, 115.23, 108.22, 60.40, 39.02, 13.30. HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{24}H_{18}BrNO_3$, 449.3238; found, 450.0561

Ethyl 5-(4-flourobenzoyl)-8-phenylindolizine-7-carboxylate (5w): Yellow colour liquid; Yield: 68.29%, (0.203g); ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.77 (s, 1H), 7.94 (d, J = 14.2 Hz, 2H), 7.61 – 7.54 (m, 1H), 7.49 – 7.45 (m, 3H), 7.42 (d, J = 9.1 Hz, 2H), 7.35 (d, J = 6.0 Hz, 2H), 7.06 – 6.99 (m, 1H), 6.41 (d, J = 9.6 Hz, 1H), 3.88 (q, J = 7.0 Hz, 2H), 0.81 – 0.72 (m, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 188.71, 165.67, 165.38, 163.67, 140.24, 136.73, 134.16, 134.08, 132.49, 132.42, 128.30, 128.15, 127.94, 122.92, 119.14, 116.97, 115.78, 115.60, 115.18, 108.05, 60.36, 40.02, 13.27. HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{24}H_{18}NO_3$, 388.1349; found, 410.1160.

Ethyl 5-([1,1'-biphenyl]-4-carbonyl)-8-phenylindolizine-7-carboxylate (5x): Yellow colour liquid; Yield: 70%, (0.200 g); ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.80 (s, 1H), 7.95 (d, J = 8.3 Hz, 2H), 7.90 (d, J = 6.6 Hz, 2H), 7.79 (d, J = 7.2 Hz, 2H), 7.66 (s, 1H), 7.54 – 7.51 (m, 2H), 7.51 – 7.47 (m, 4H), 7.39 – 7.35 (m, 2H), 7.05 (dd, J = 4.3, 2.7 Hz, 1H), 6.42 (dd, J = 4.2, 1.3 Hz, 1H), 3.89 (q, J = 7.2 Hz, 2H), 0.77 (t, J = 7.1 Hz, 3H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 190.12, 166.01, 144.74, 140.75, 139.37, 137.33, 136.97, 134.66, 130.92, 129.69, 129.07, 129.00, 128.88, 128.71, 128.52, 127.60, 127.32, 123.37, 119.67, 117.56, 115.78, 108.60, 60.92, 39.57, 13.84. HRMS (ESI-TOF) (m/z): $[M+H]^+$ calculated for $C_{30}H_{23}NO_3$, 450.1757; found, 450.1757.

References:

1. K. Lakshmikanth, S. M. Saini, S. T. Dorai and S. Chandrashekharappa, *Tetrahedron*, 2023, **142**, 133516.

Spectral details

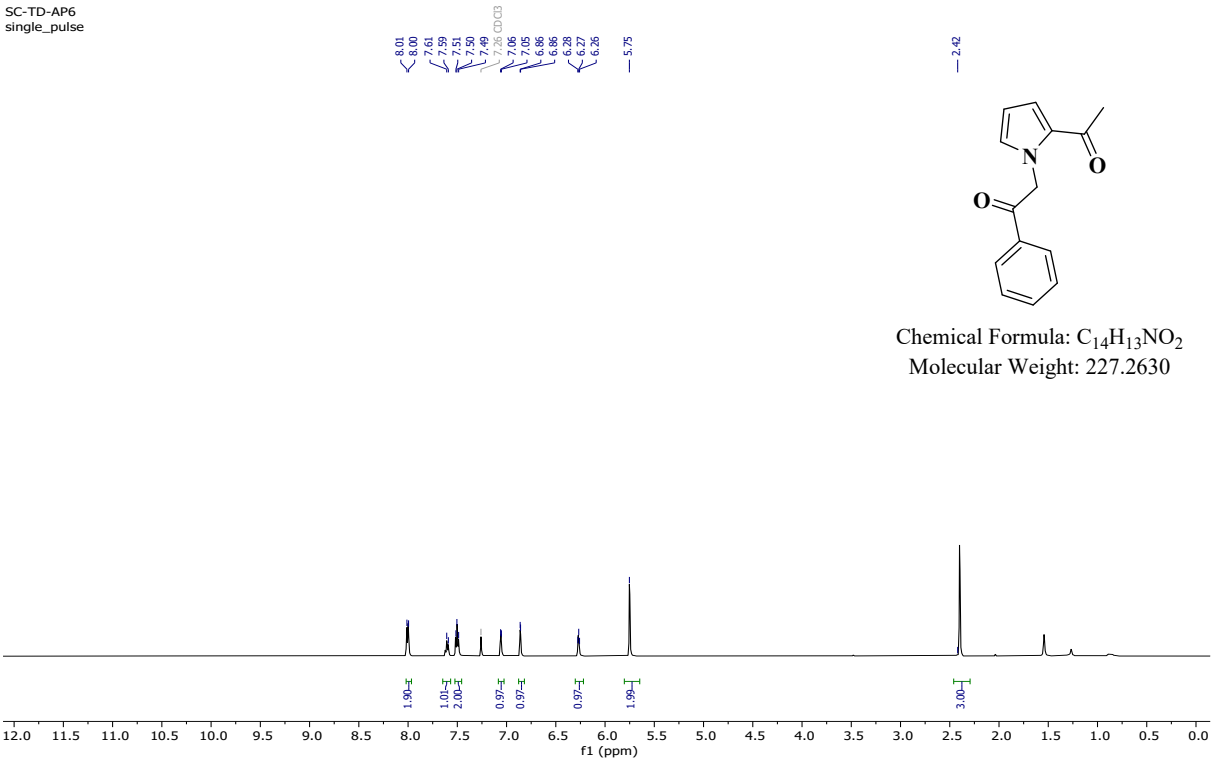


Fig 1. ^{1}H NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-phenylethan-1-one (3j)

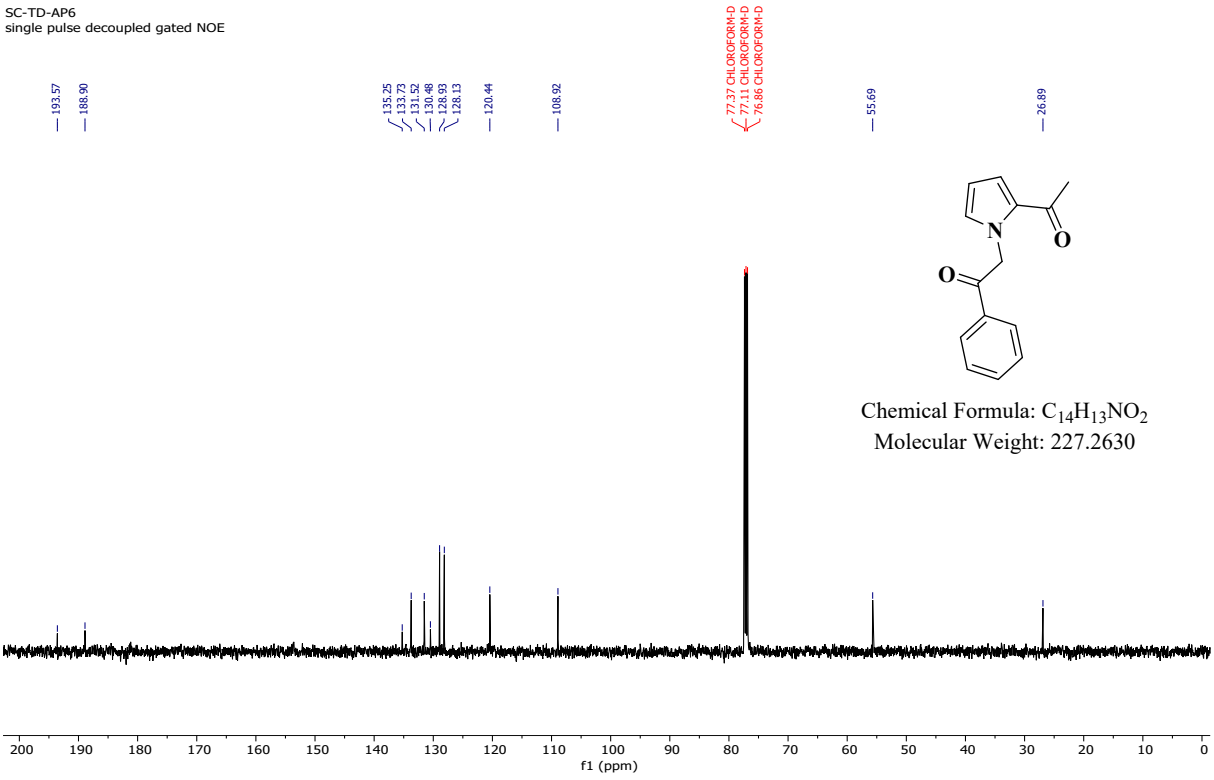


Fig 2. ^{13}C NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-phenylethan-1-one (3j)

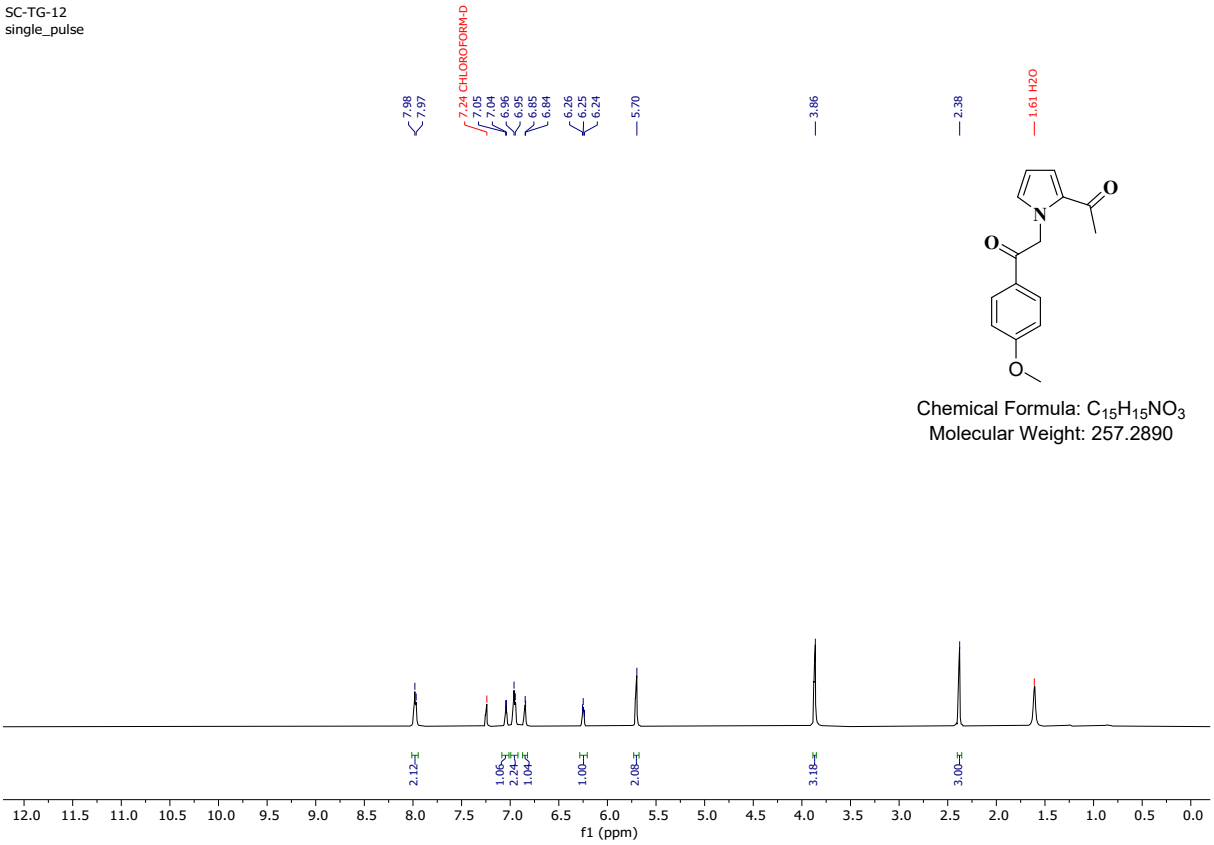


Fig 2. ^{1}H NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(4-methoxyphenyl)ethan-1-one (3k)

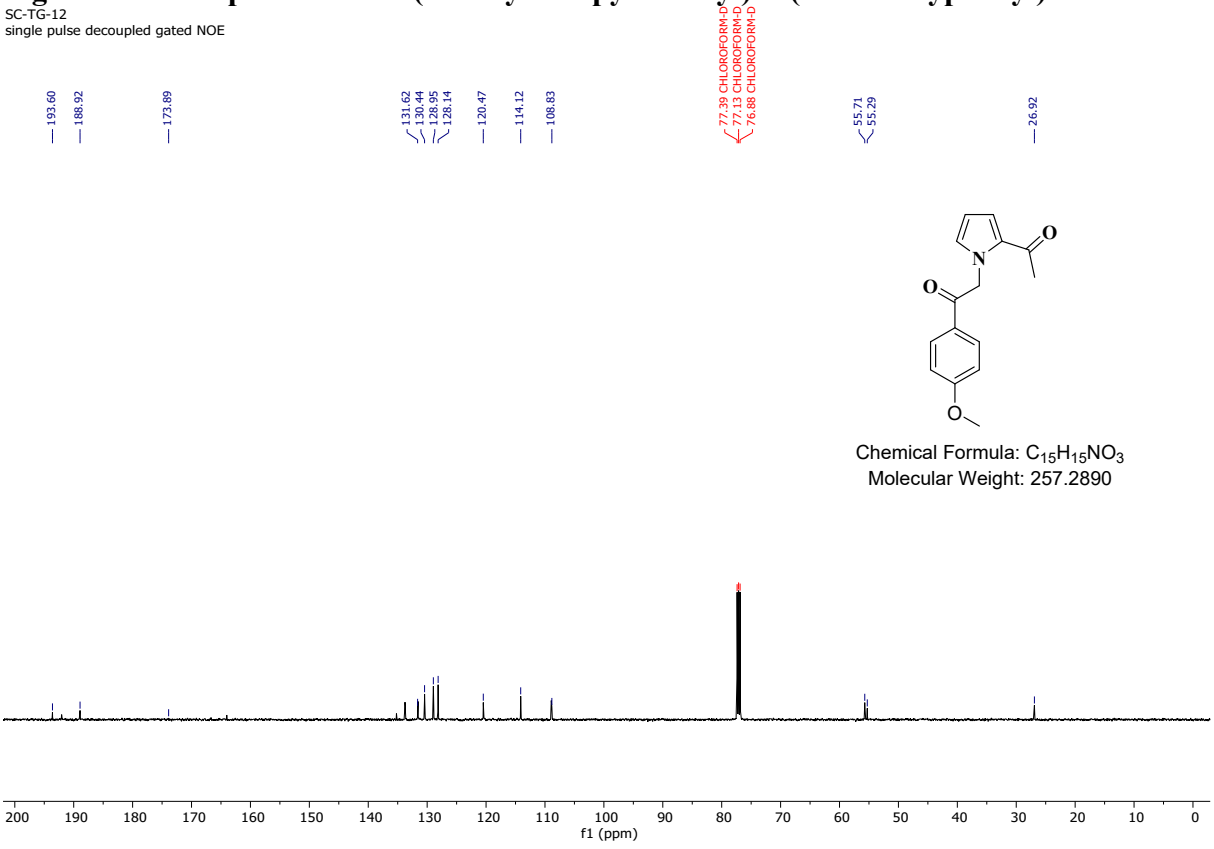


Fig 3. ^{13}C NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(4-methoxyphenyl)ethan-1-one (3k)

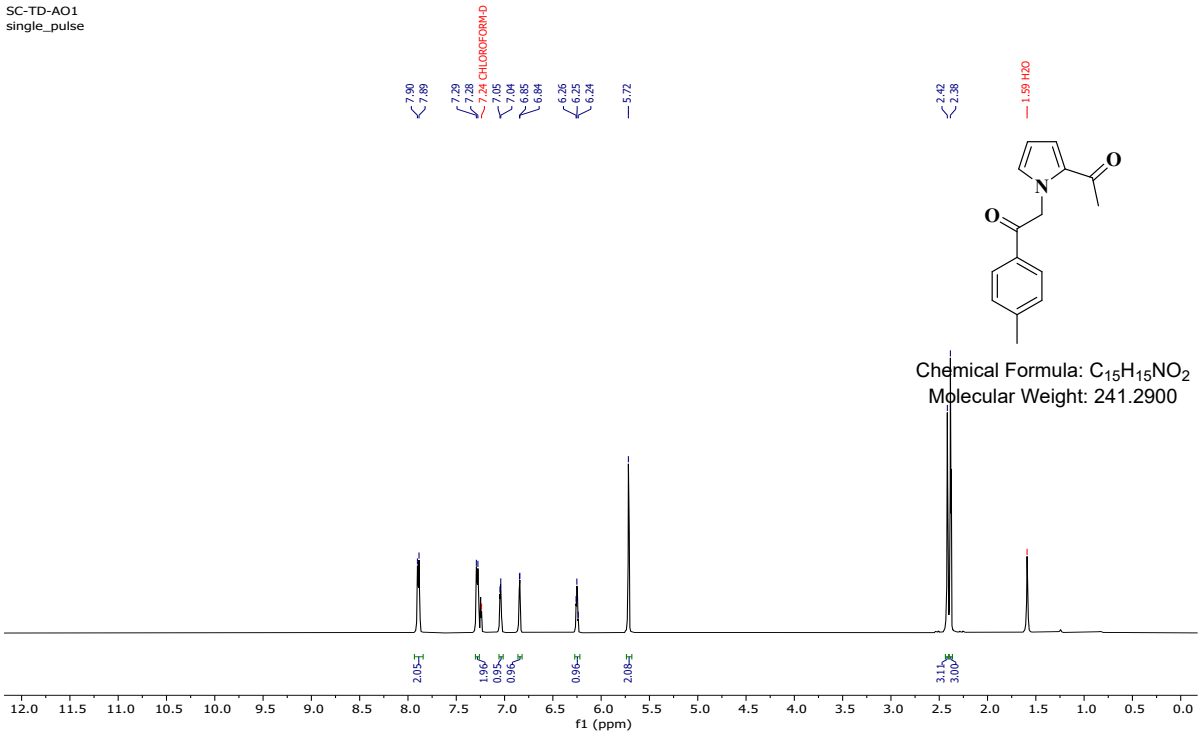


Fig 4. ^{1}H NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(p-tolyl)ethan-1-one (3l)

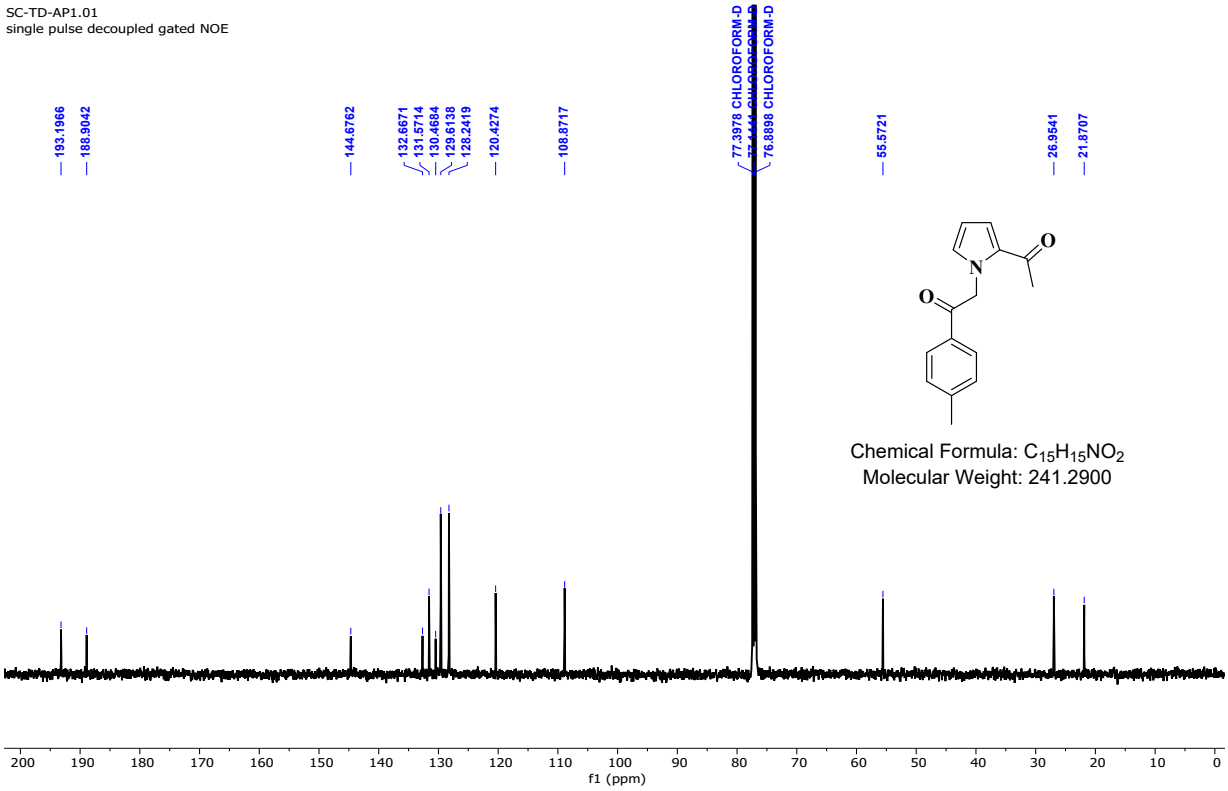


Fig 5. ^{13}C NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(p-tolyl)ethan-1-one (3l)

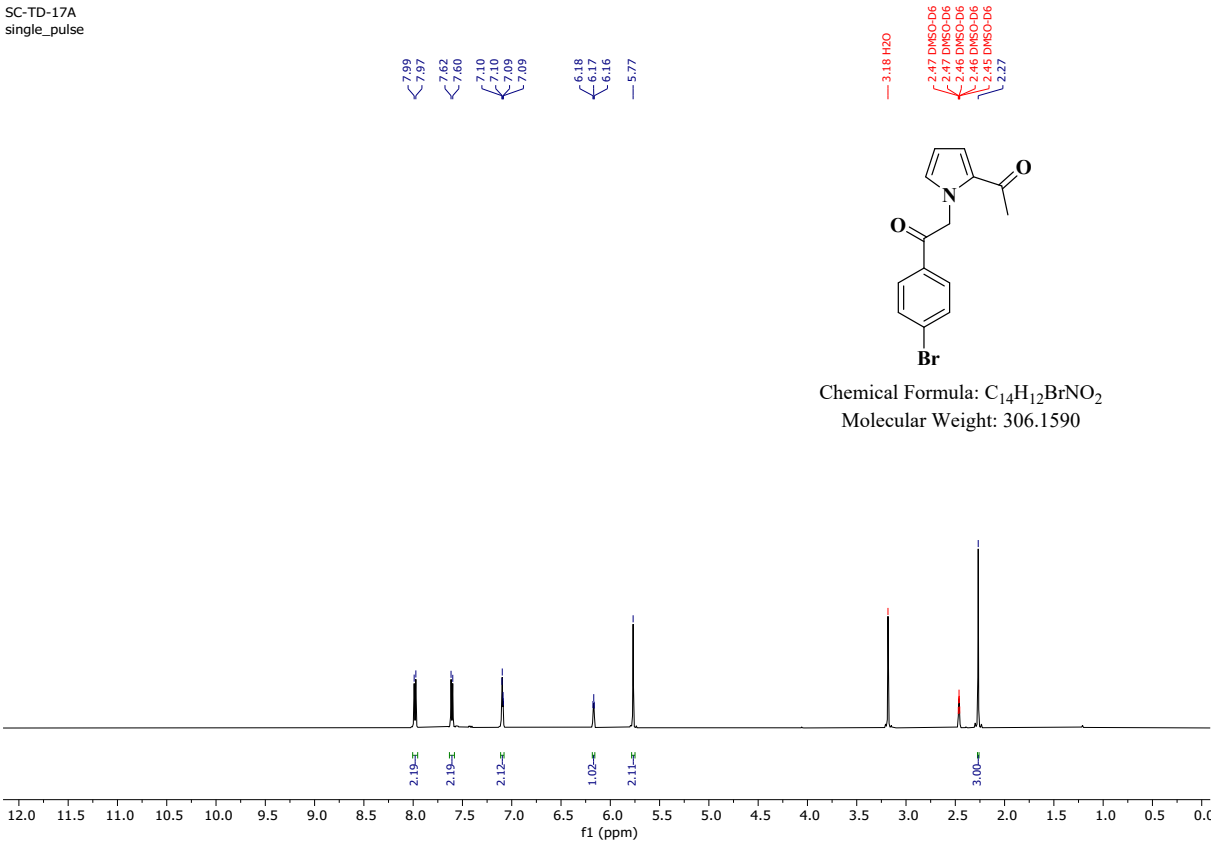


Fig 6. ^{1}H NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(4-bromophenyl)ethan-1-one (3m)

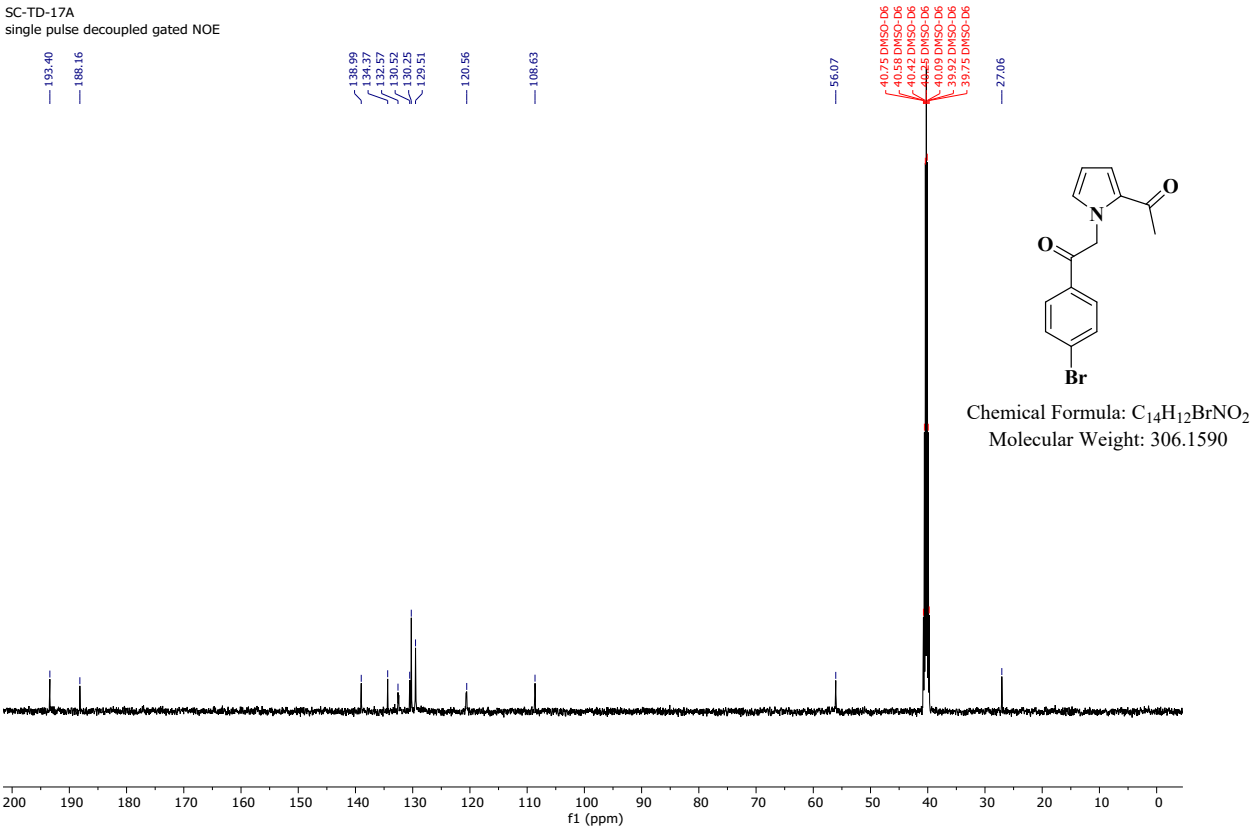


Fig 7. ^{13}C NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(4-bromophenyl)ethan-1-one (3m)

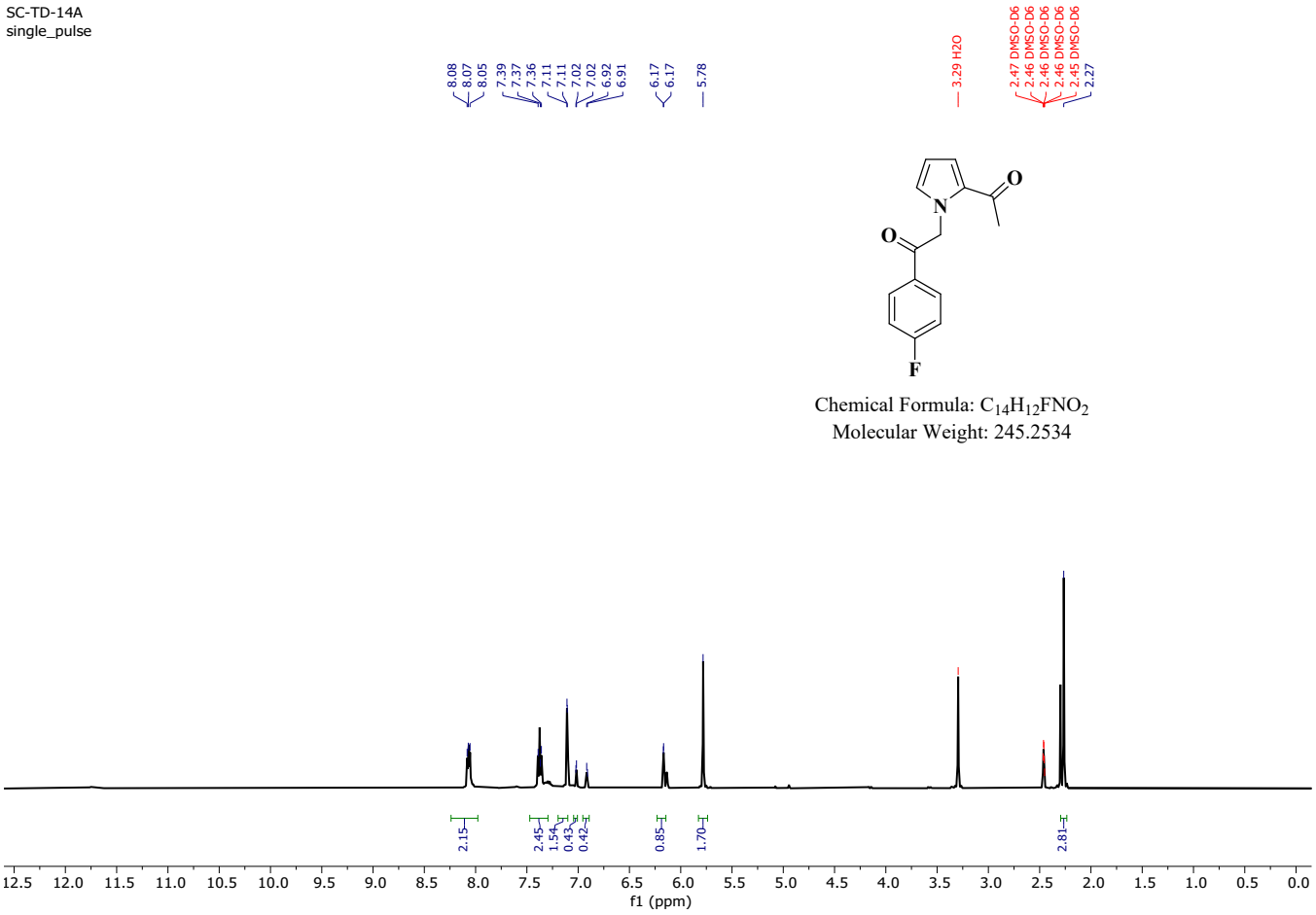


Fig 8. ^{1}H NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(4-fluorophenyl)ethan-1-one (3n)

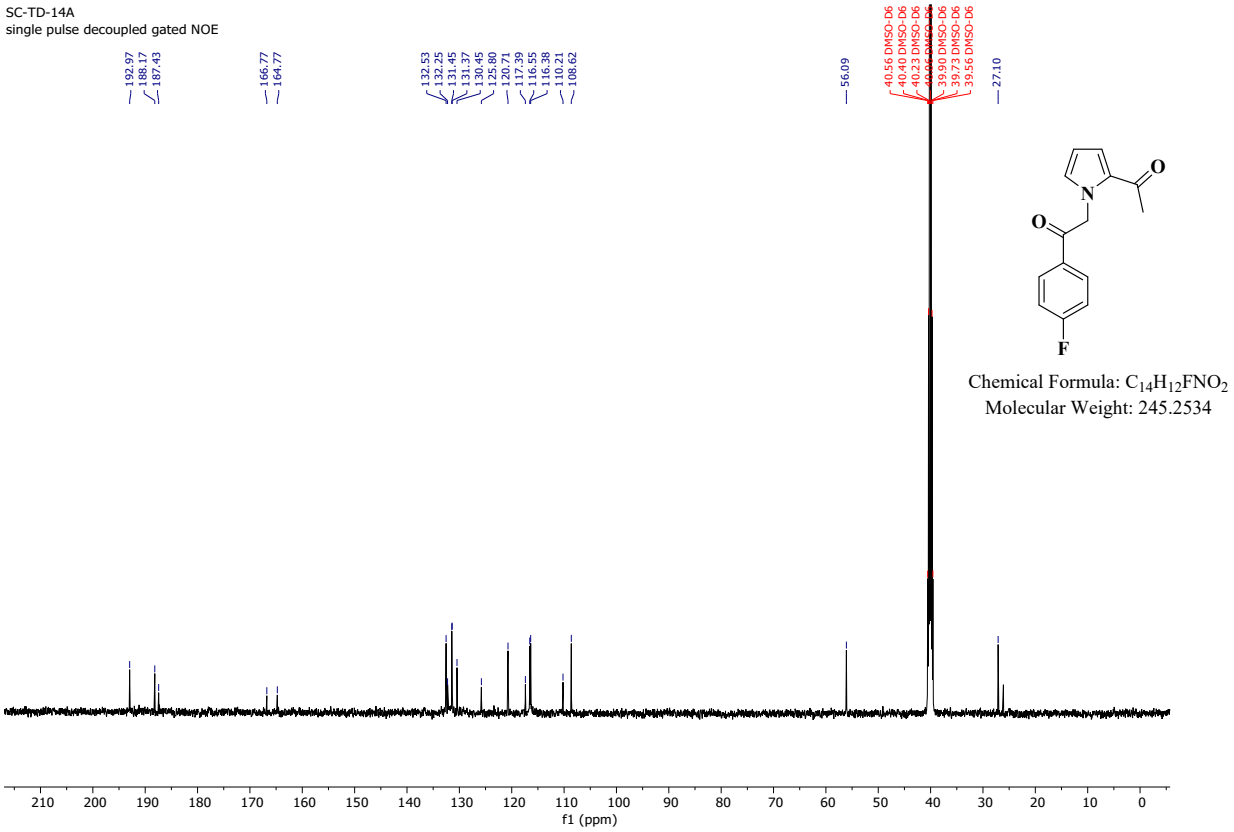


Fig 9. ^{13}C NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(4-fluorophenyl)ethan-1-one (3n)

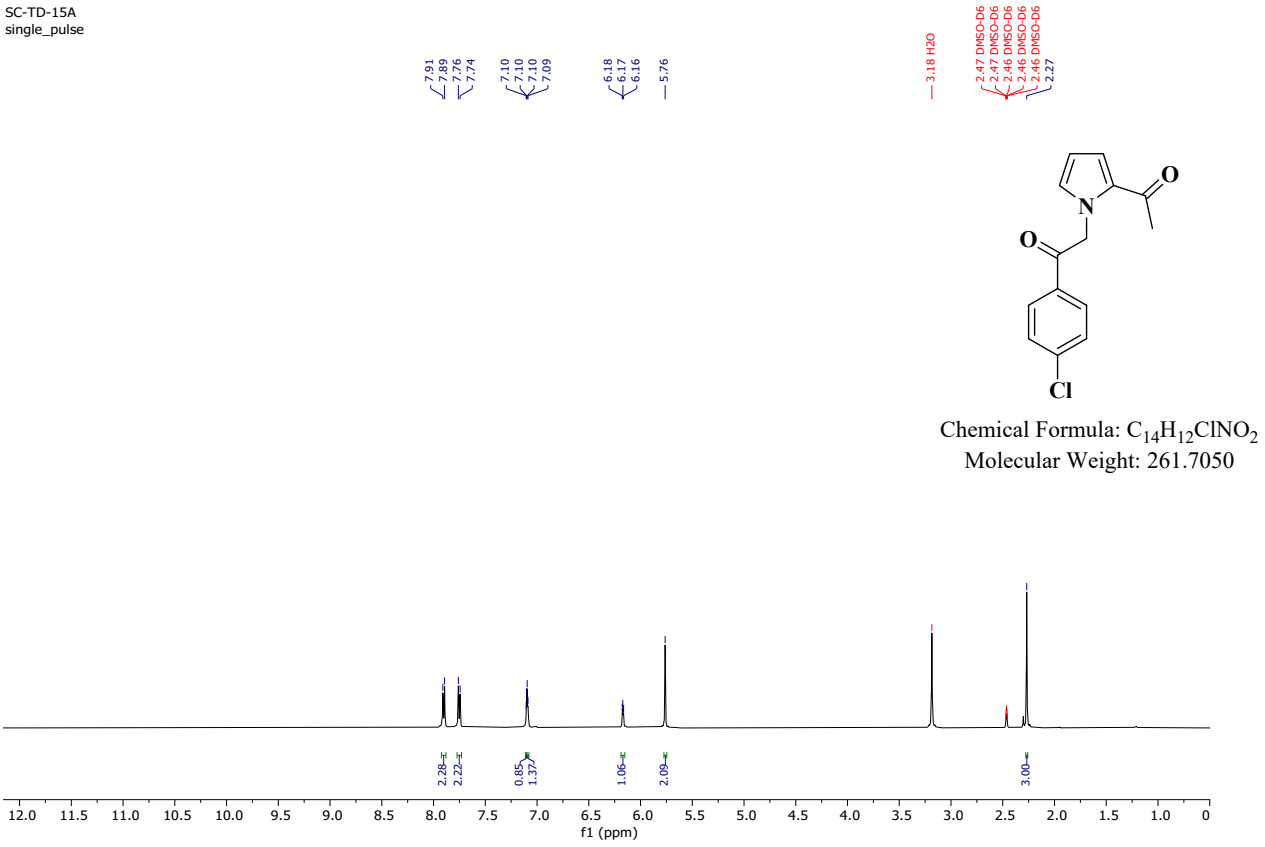


Fig 10. ^{1}H NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(4-chlorophenyl)ethan-1-one (3o)

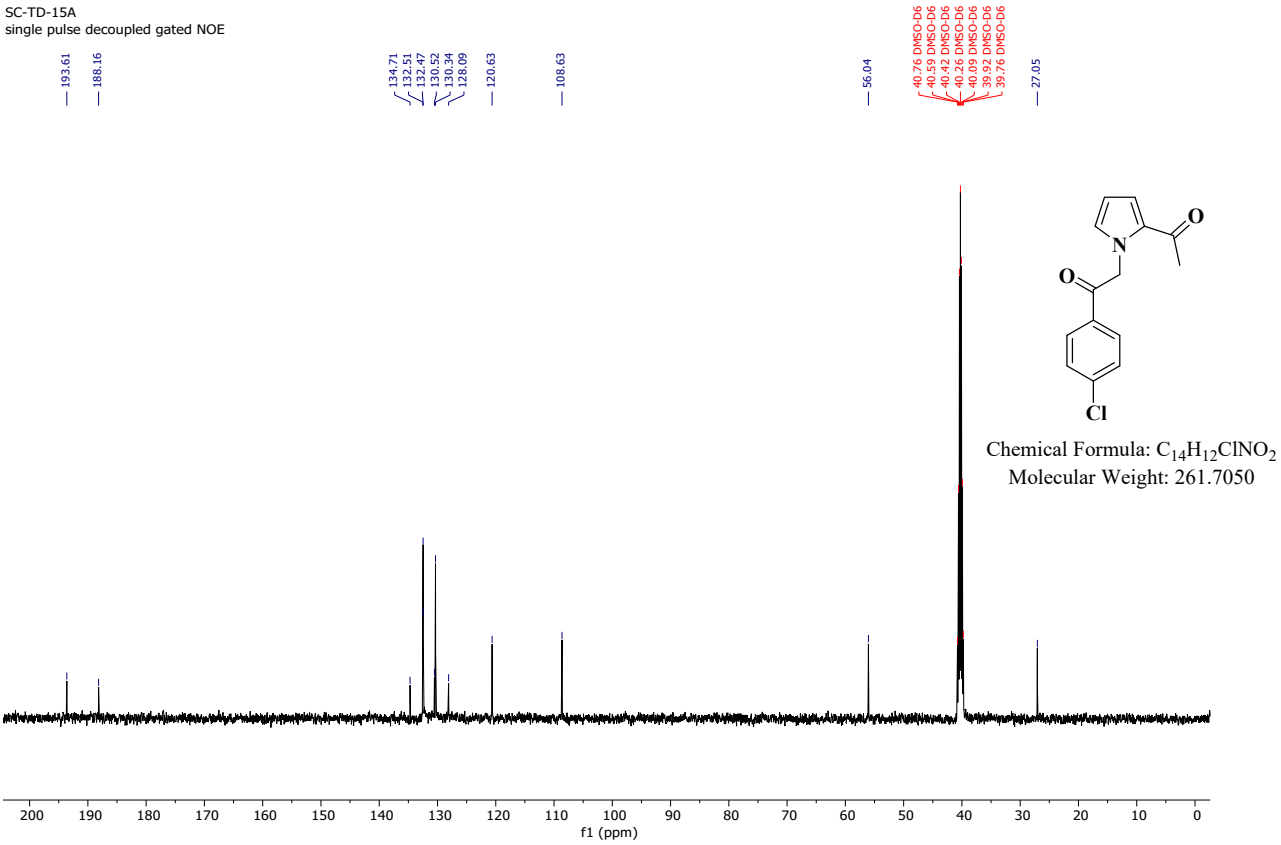


Fig 11. ^{13}C NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(4-chlorophenyl)ethan-1-one (3o)

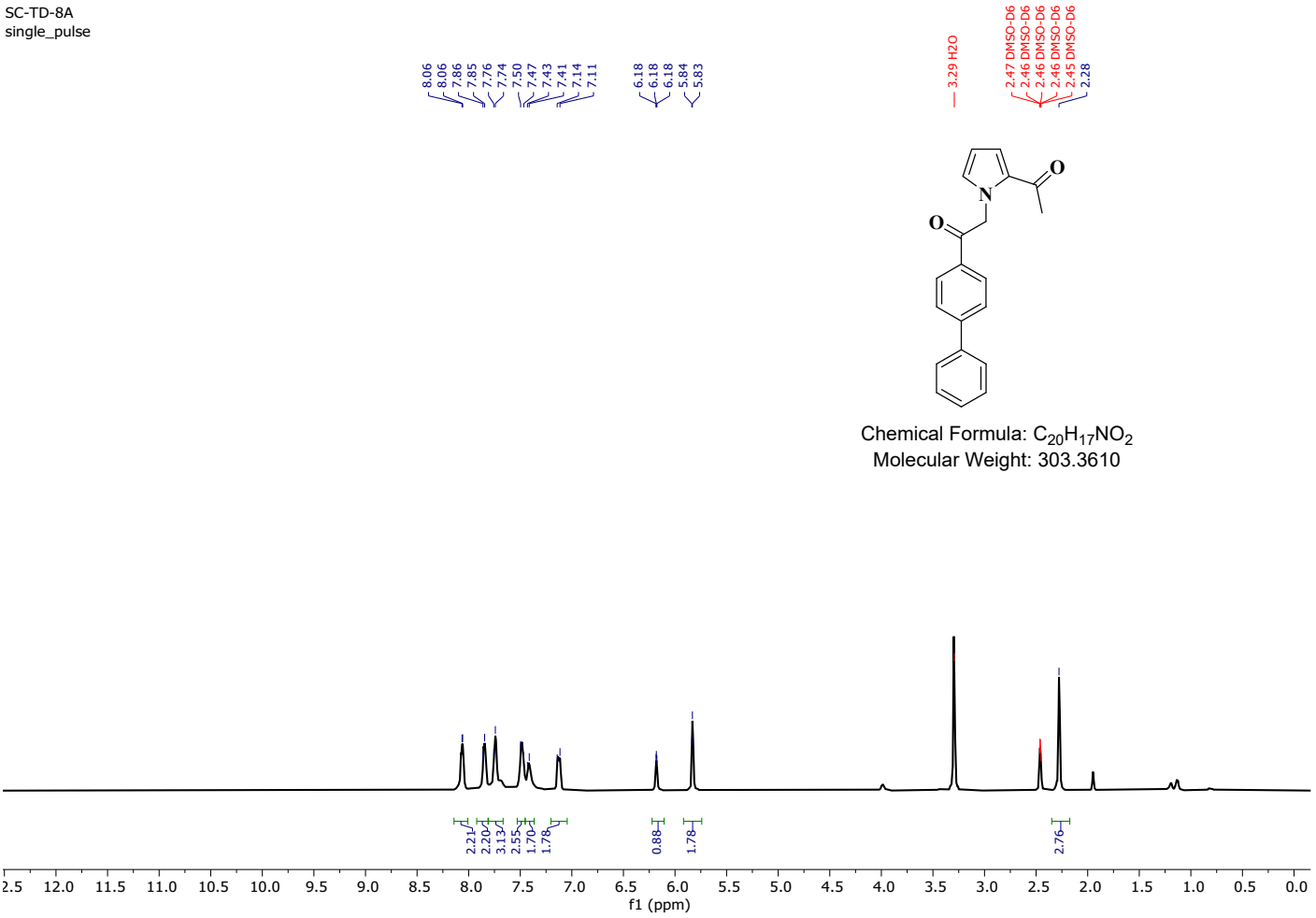


Fig 12. ^{1}H NMR spectrum of 1-([1,1'-biphenyl]-4-yl)-2-(2-acetyl-1*H*-pyrrol-1-yl)ethan-1-one (3p)

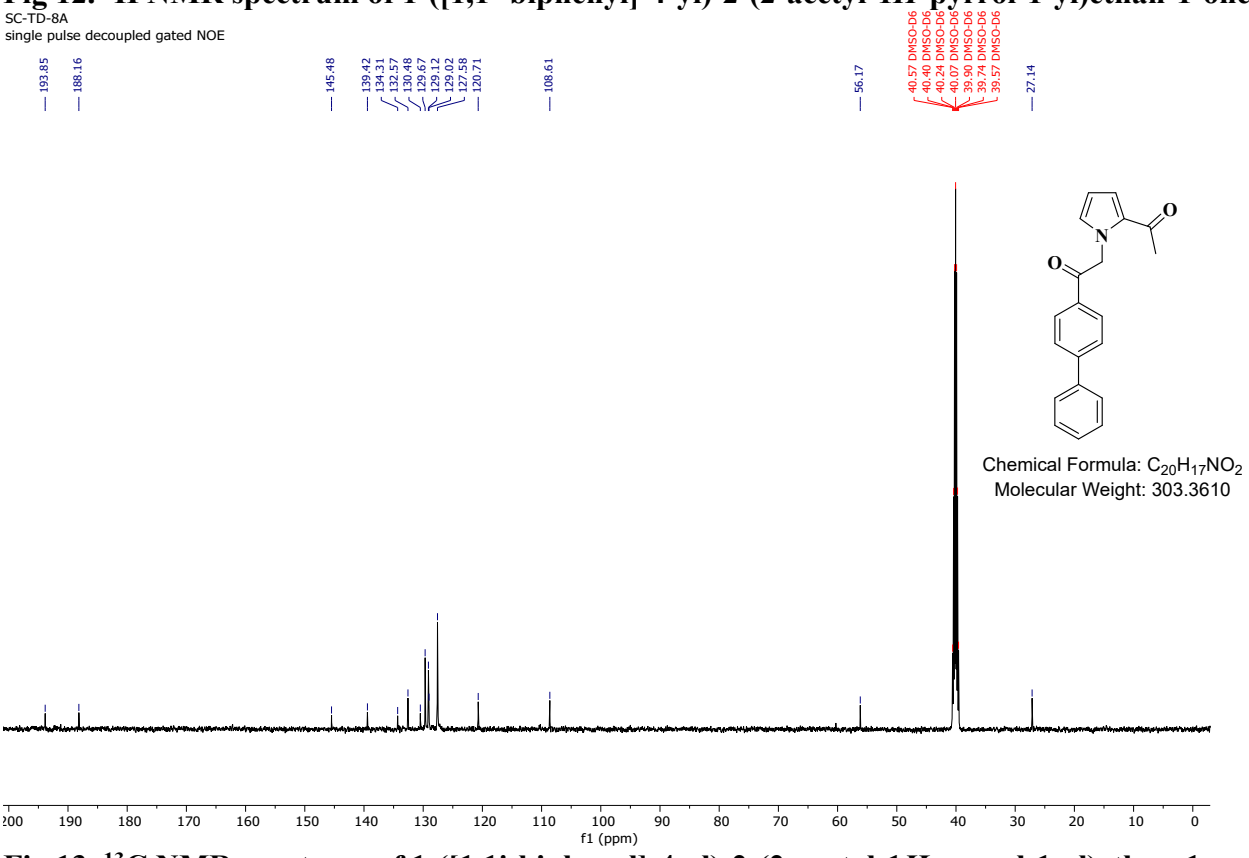


Fig 13. ^{13}C NMR spectrum of 1-([1,1'-biphenyl]-4-yl)-2-(2-acetyl-1*H*-pyrrol-1-yl)ethan-1-one (3p)

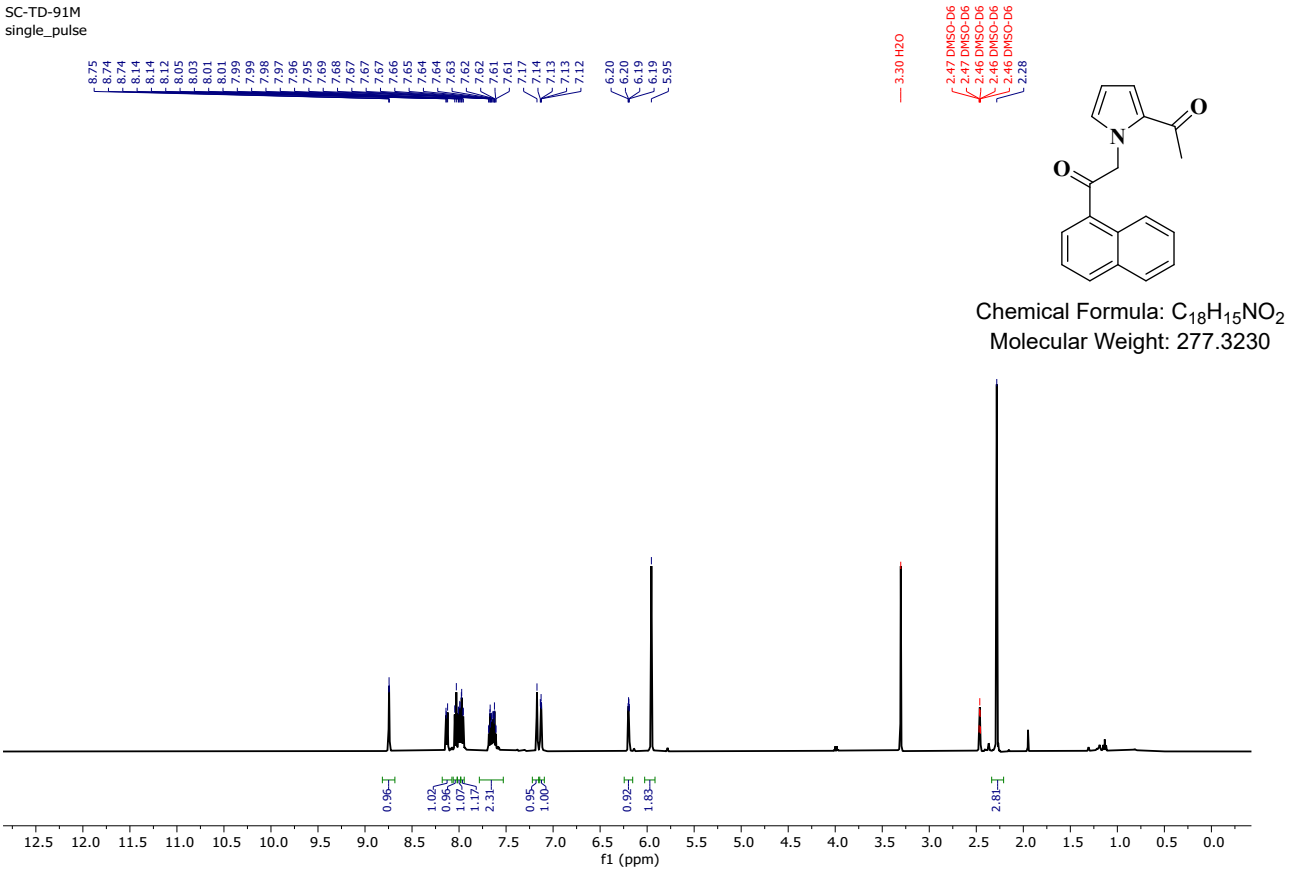


Fig 14. ^{1}H NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(naphthalen-1-yl)ethan-1-one (3q)

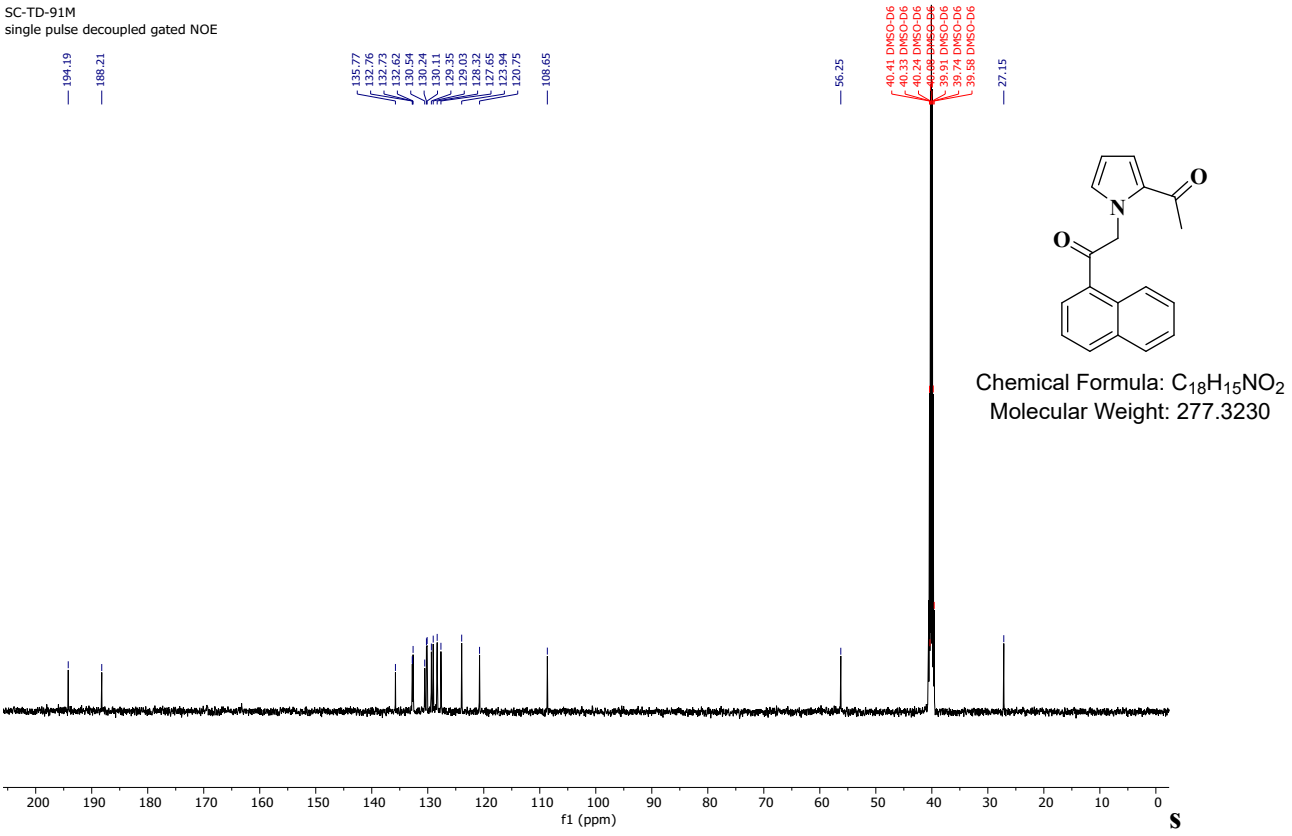


Fig 15.^{13}C NMR spectrum of 2-(2-acetyl-1*H*-pyrrol-1-yl)-1-(naphthalen-1-yl)ethan-1-one (3q)

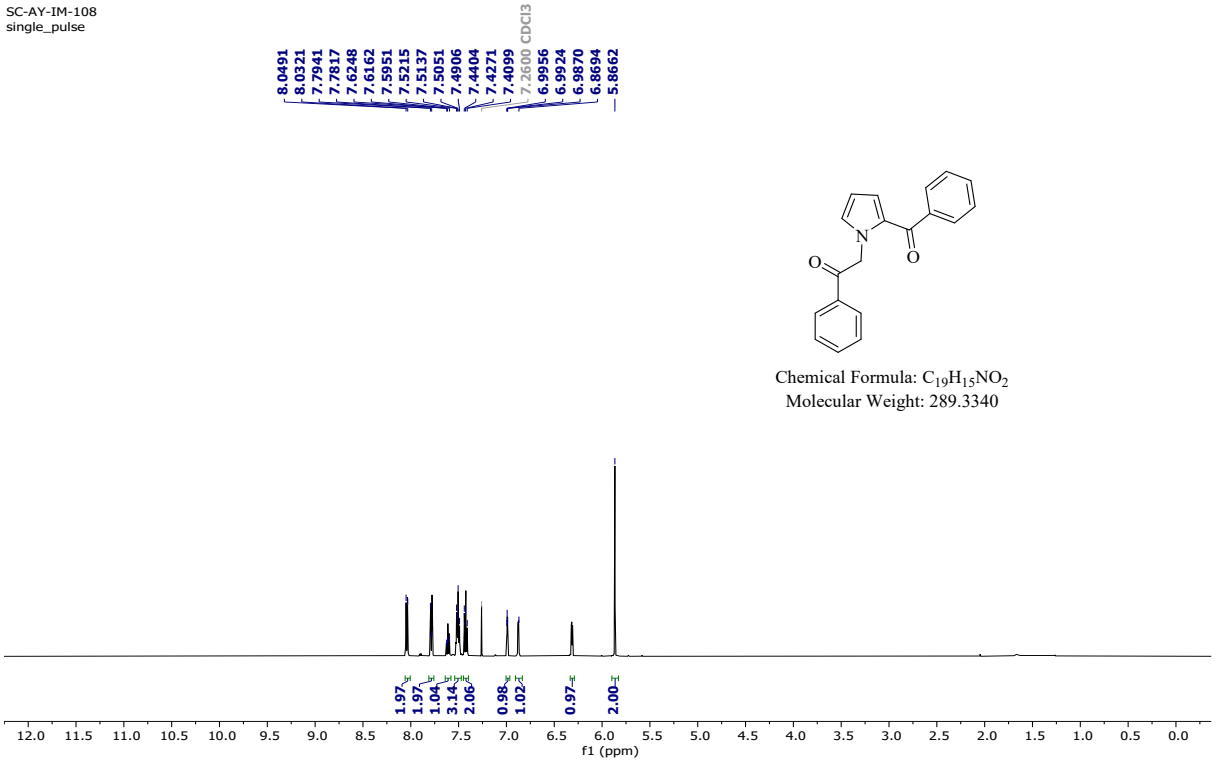


Fig 16 ^{1}H NMR spectra of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-phenylethan-1-one (3r)

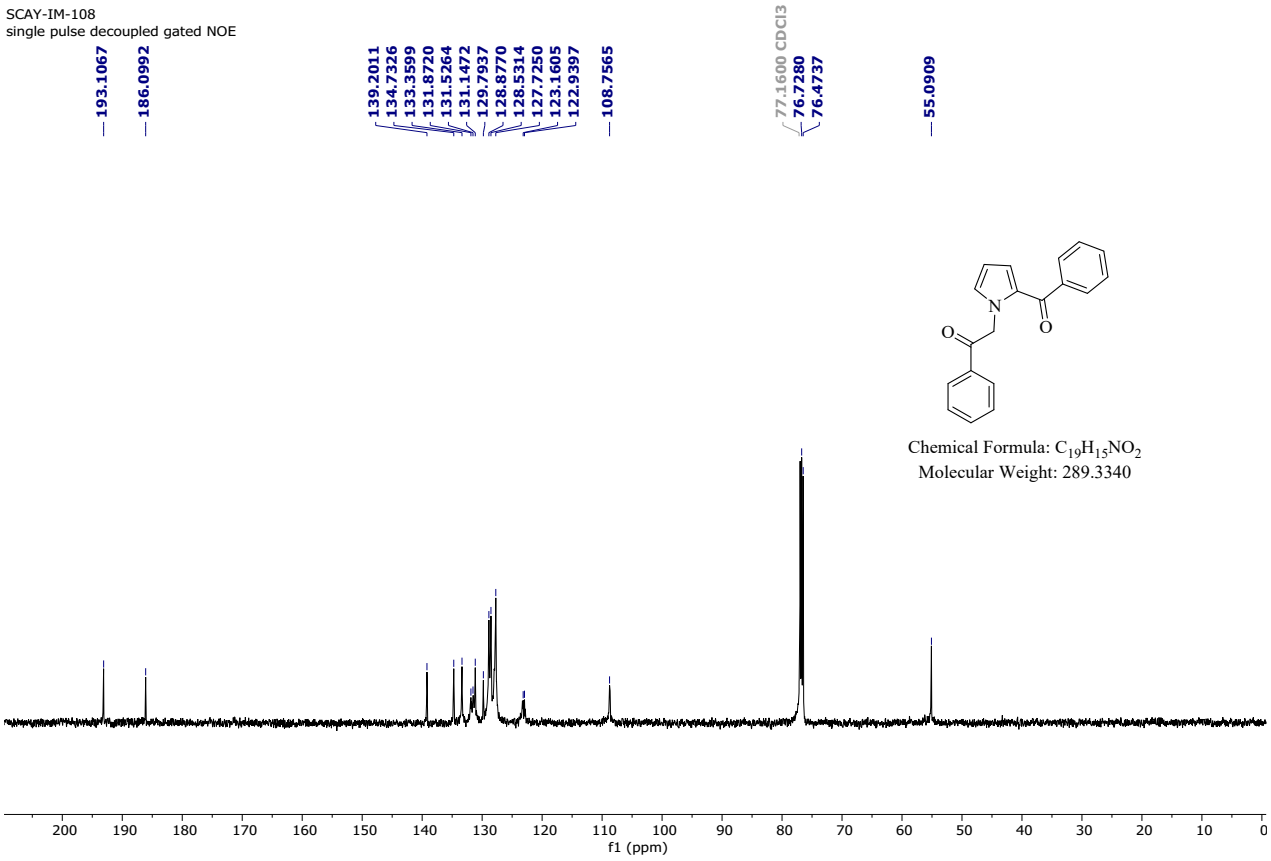


Fig 17. ^{13}C NMR spectra of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-phenylethan-1-one (3r)

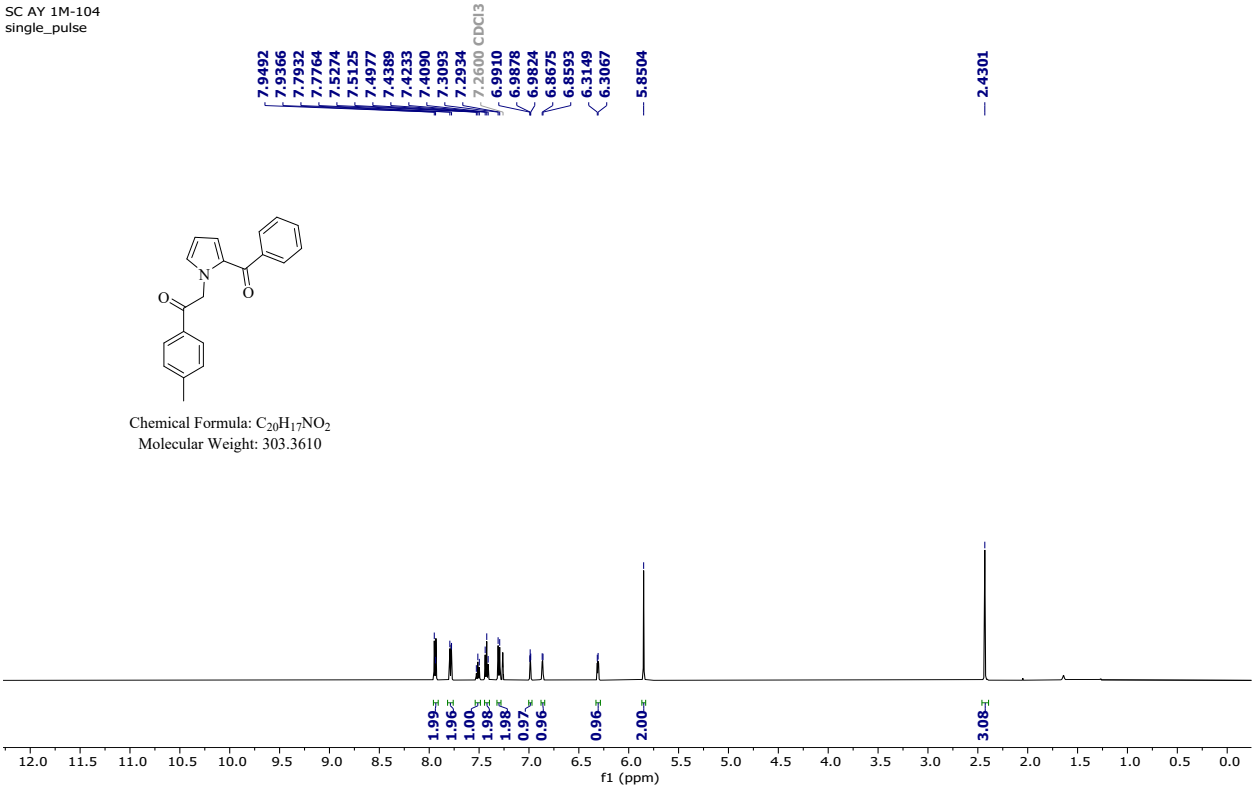


Fig 18. ^{1}H NMR spectra of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-(p-tolyl)ethan-1-one (3s)

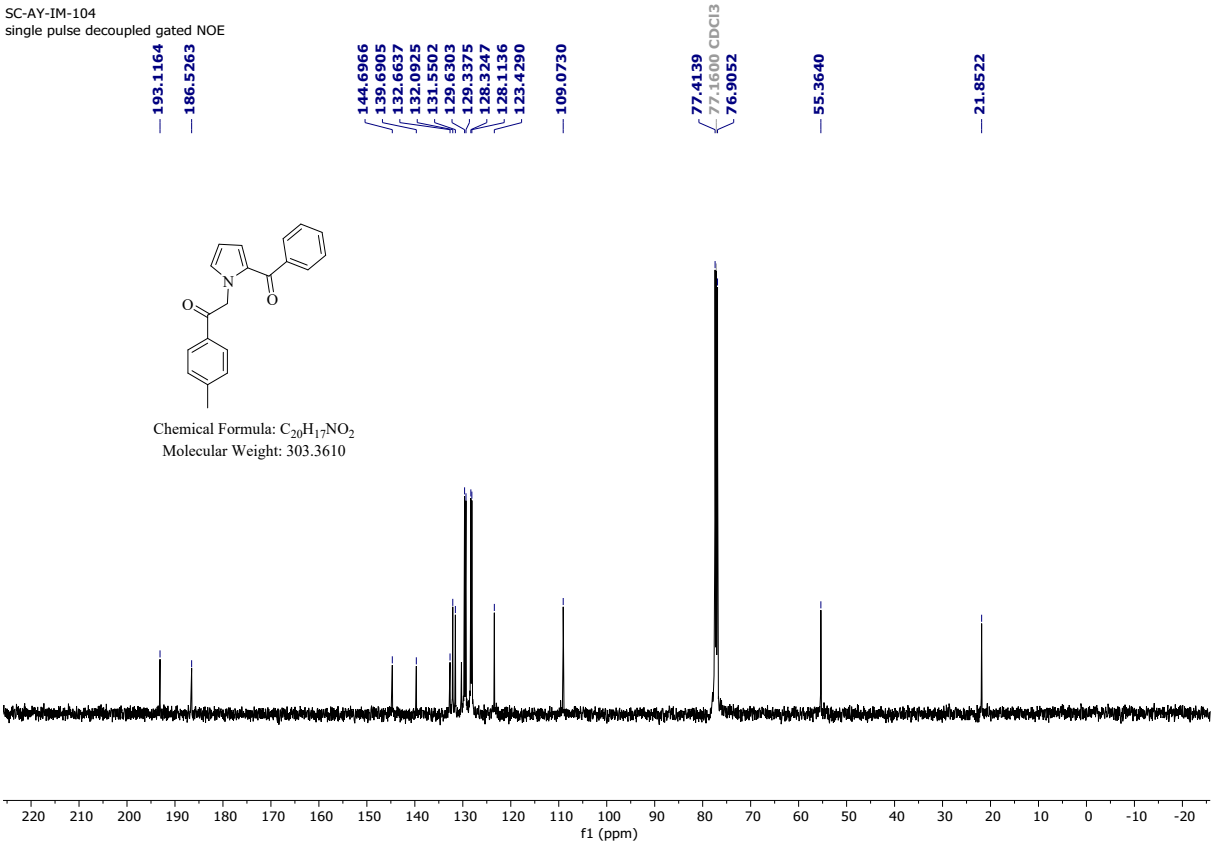


Fig 19. ^{13}C NMR spectra of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-(p-tolyl)ethan-1-one (3s)

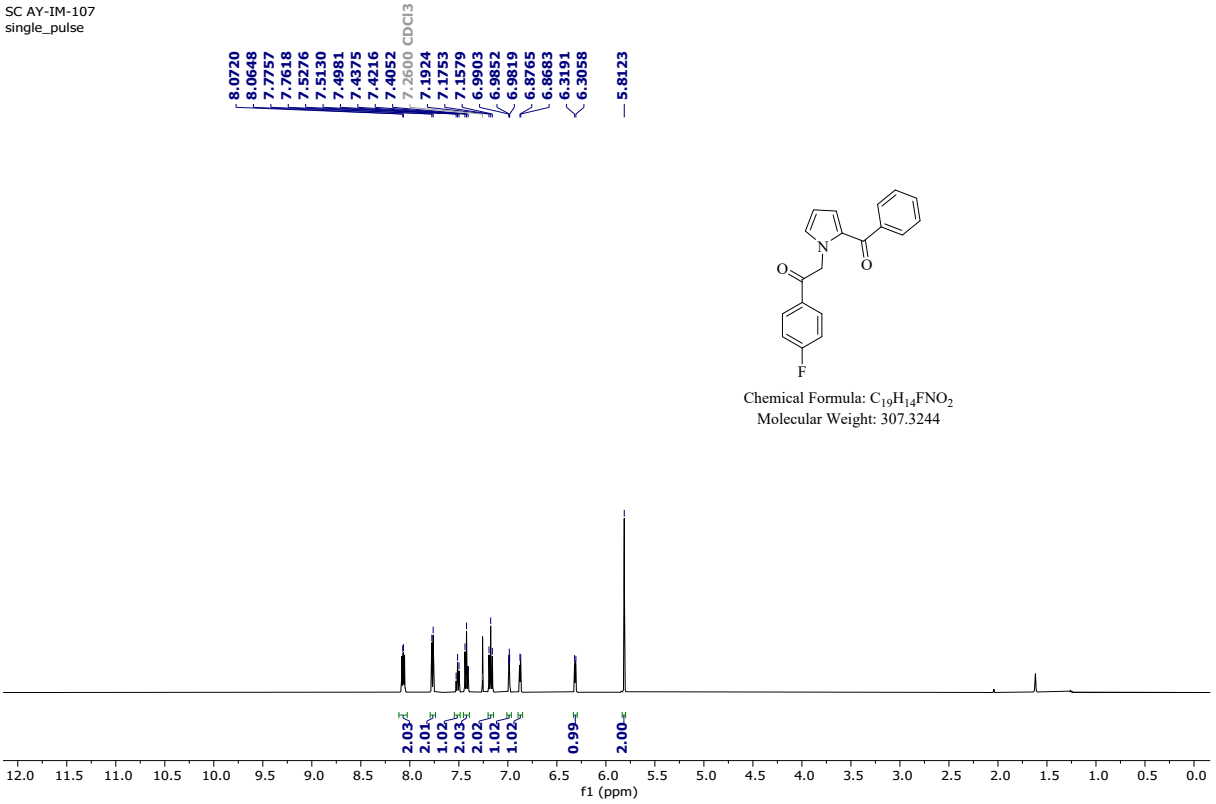


Fig 20. ^{1}H NMR spectra of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-(4-flourophenyl)ethan-1-one (3\t)

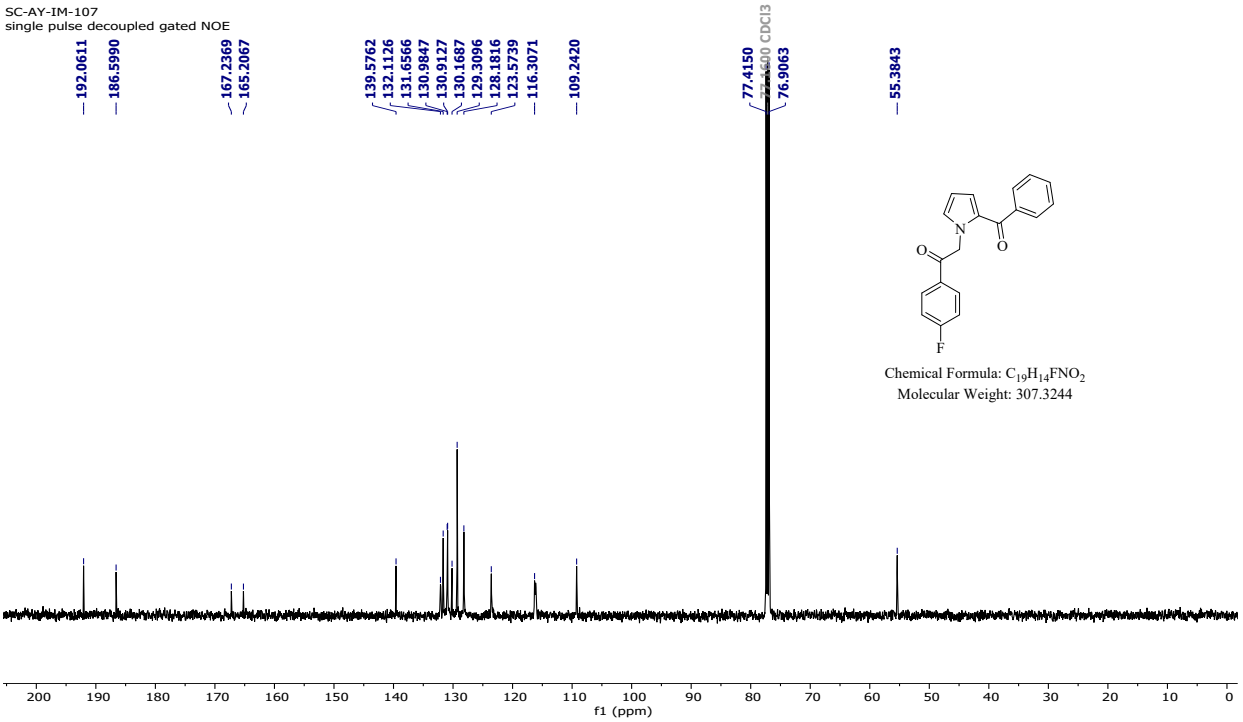


Fig 21. ^{13}C NMR spectra of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-(4-flourophenyl)ethan-1-one (3t

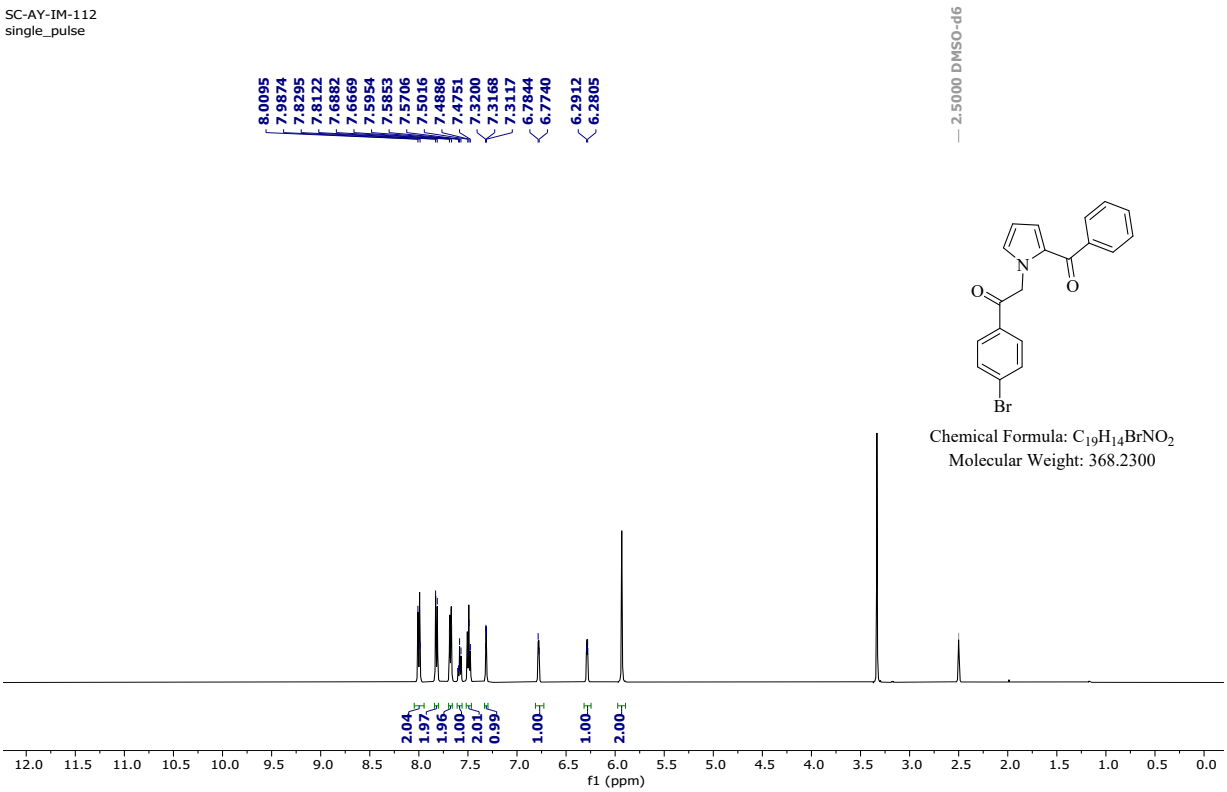


Fig 22. ^{1}H NMR spectra of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-(4-bromophenyl)ethan-1-one (3u)

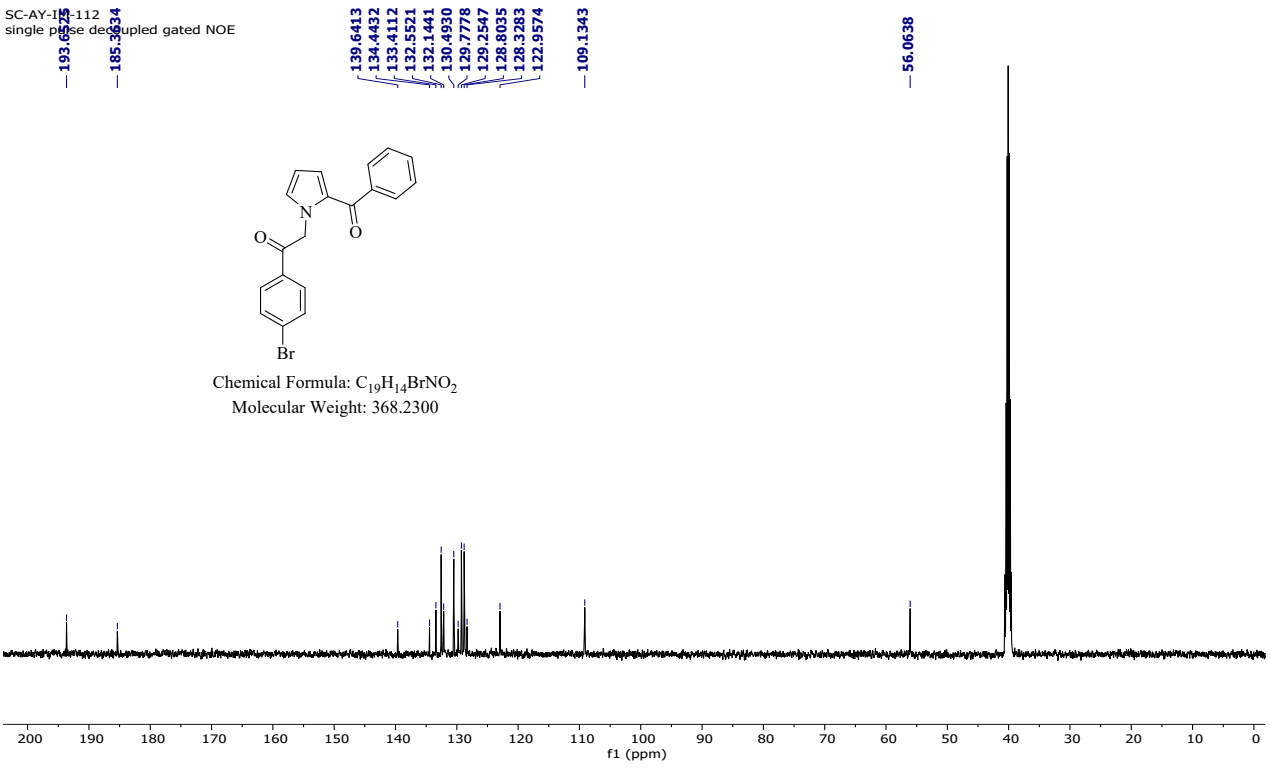


Fig 23. ^{13}C NMR spectra of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-(4-bromophenyl)ethan-1-one (3u)

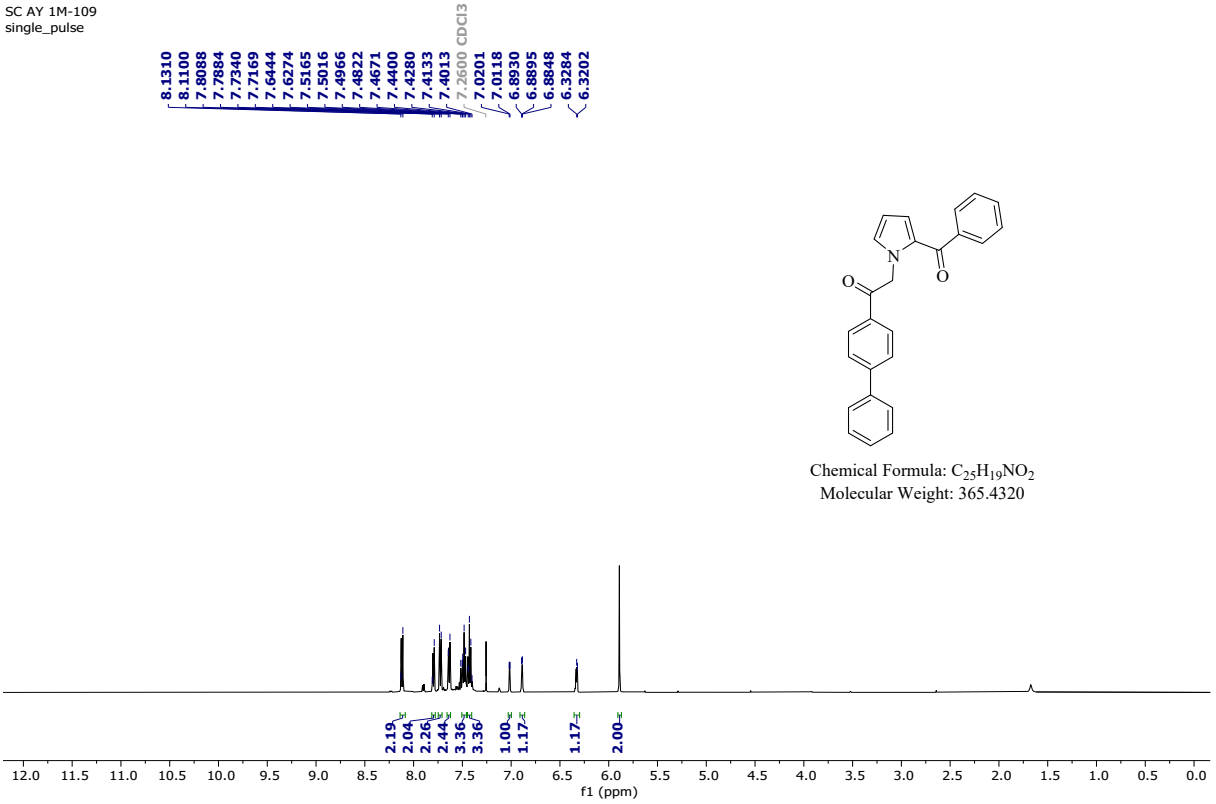


Fig 24. ^{1}H NMR spectra of 1-([1,1'-biphenyl]-4-yl)-2-(2-benzoyl-1*H*-pyrrol-1-yl)ethan-1-one (3v)

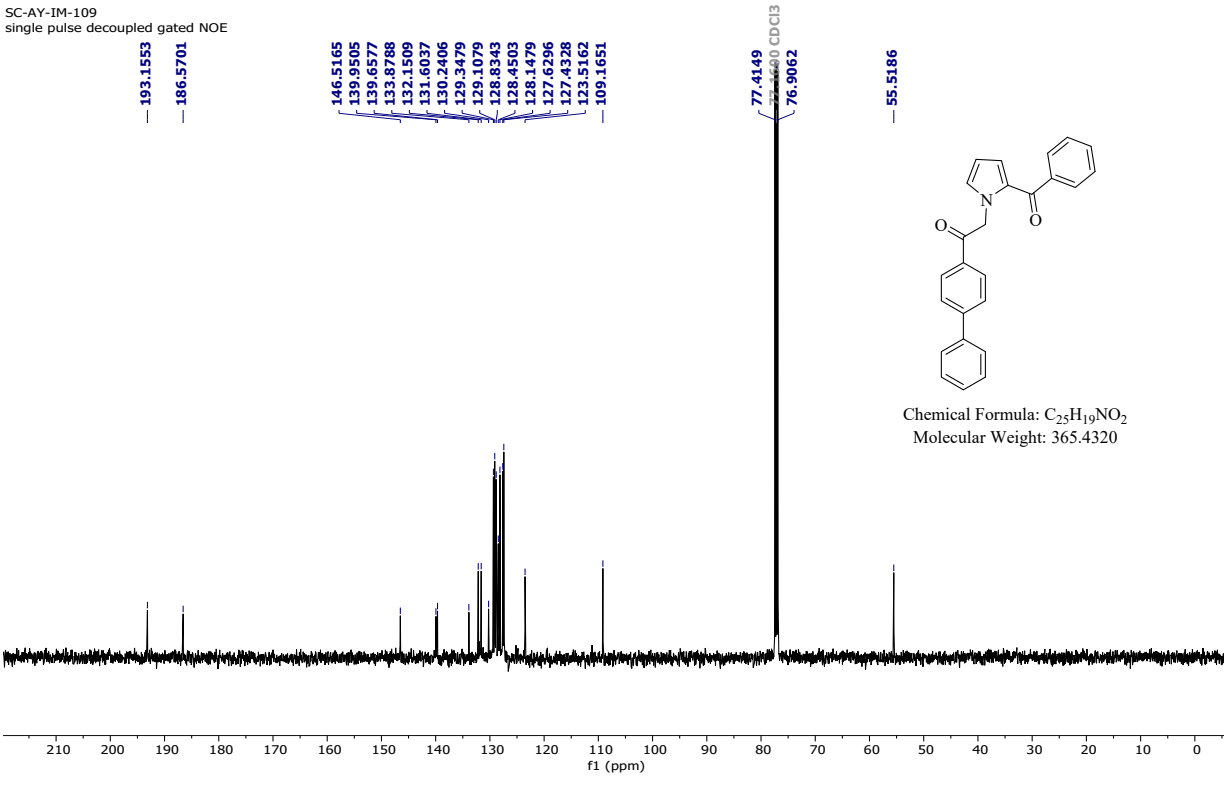


Fig 25. ^{13}C NMR spectra of 1-([1,1'-biphenyl]-4-yl)-2-(2-benzoyl-1*H*-pyrrol-1-yl)ethan-1-one (3v)

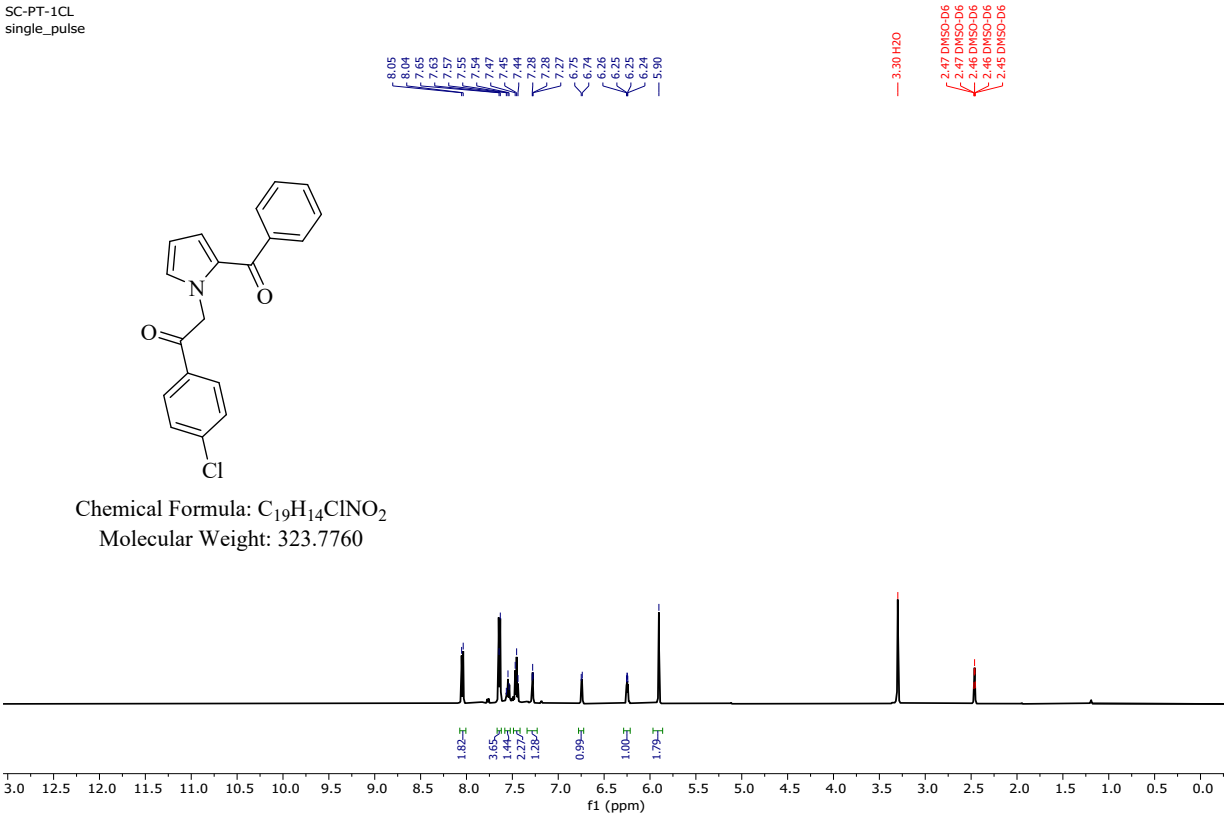


Fig 26. ^{1}H-NMR of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-(4-chlorophenyl)ethan-1-one (3w)

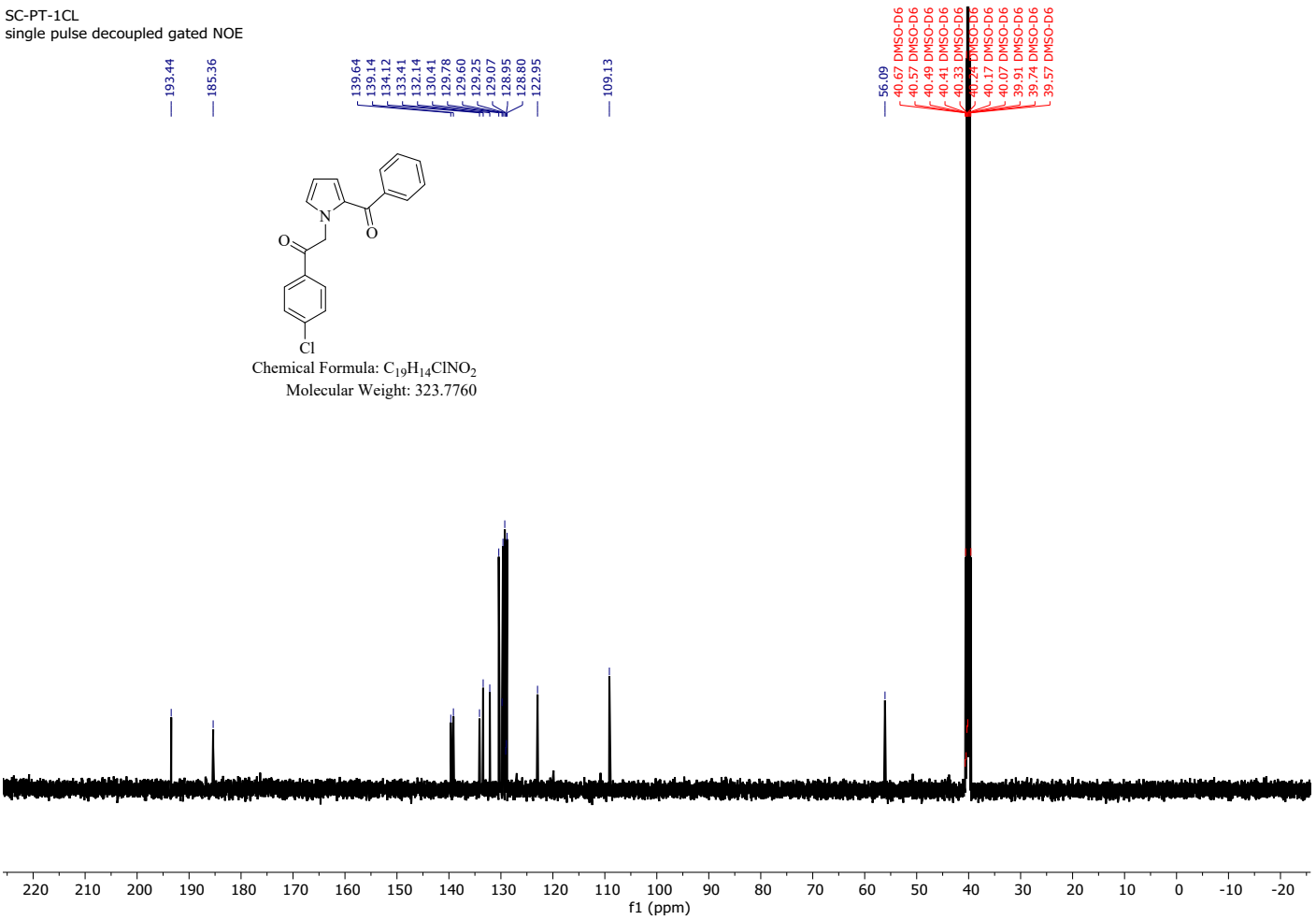


Fig 27. ^{13}C-NMR of 2-(2-benzoyl-1*H*-pyrrol-1-yl)-1-(4-chlorophenyl)ethan-1-one (3w)

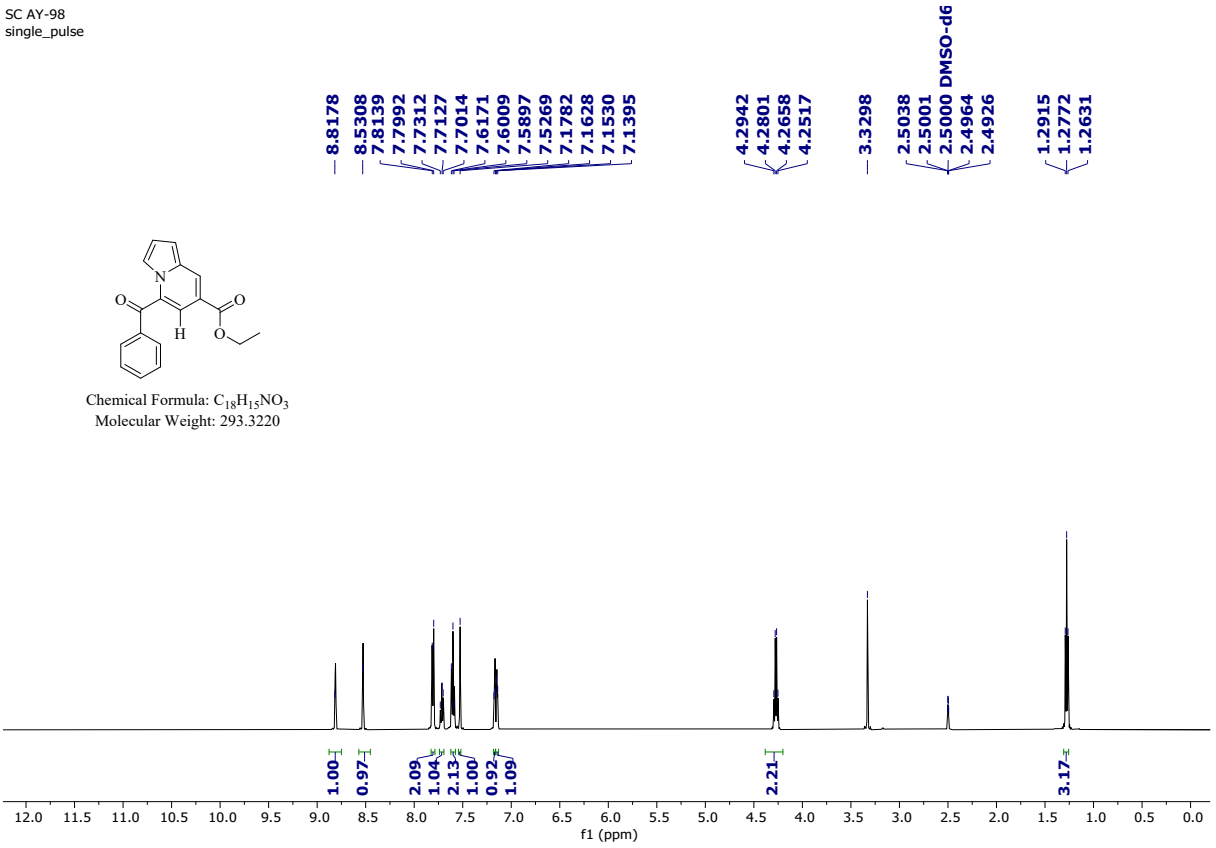


Fig 28. ^{1}H-NMR of Ethyl 5-benzoylindolizine-7-carboxylate (5a)

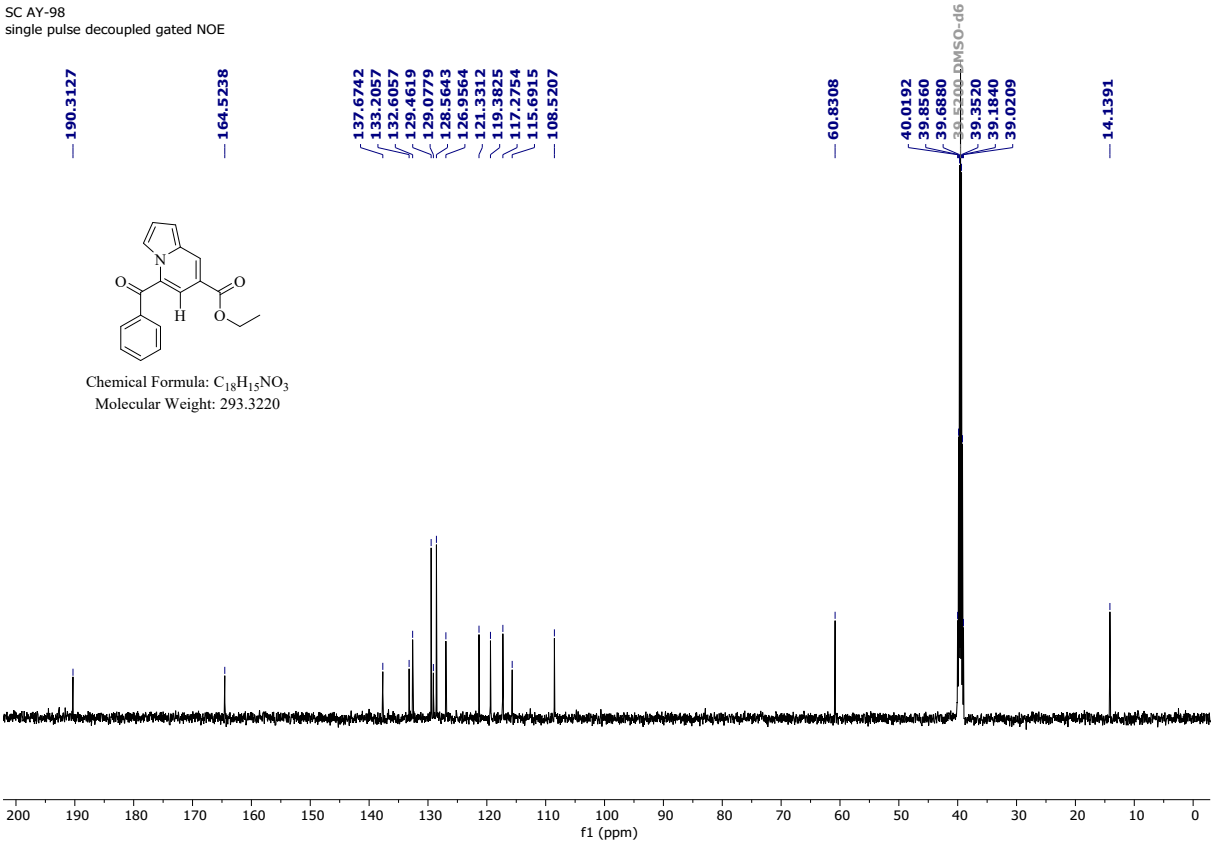


Fig 29. ^{13}C-NMR of Ethyl 5-benzoylindolizine-7-carboxylate (5a)

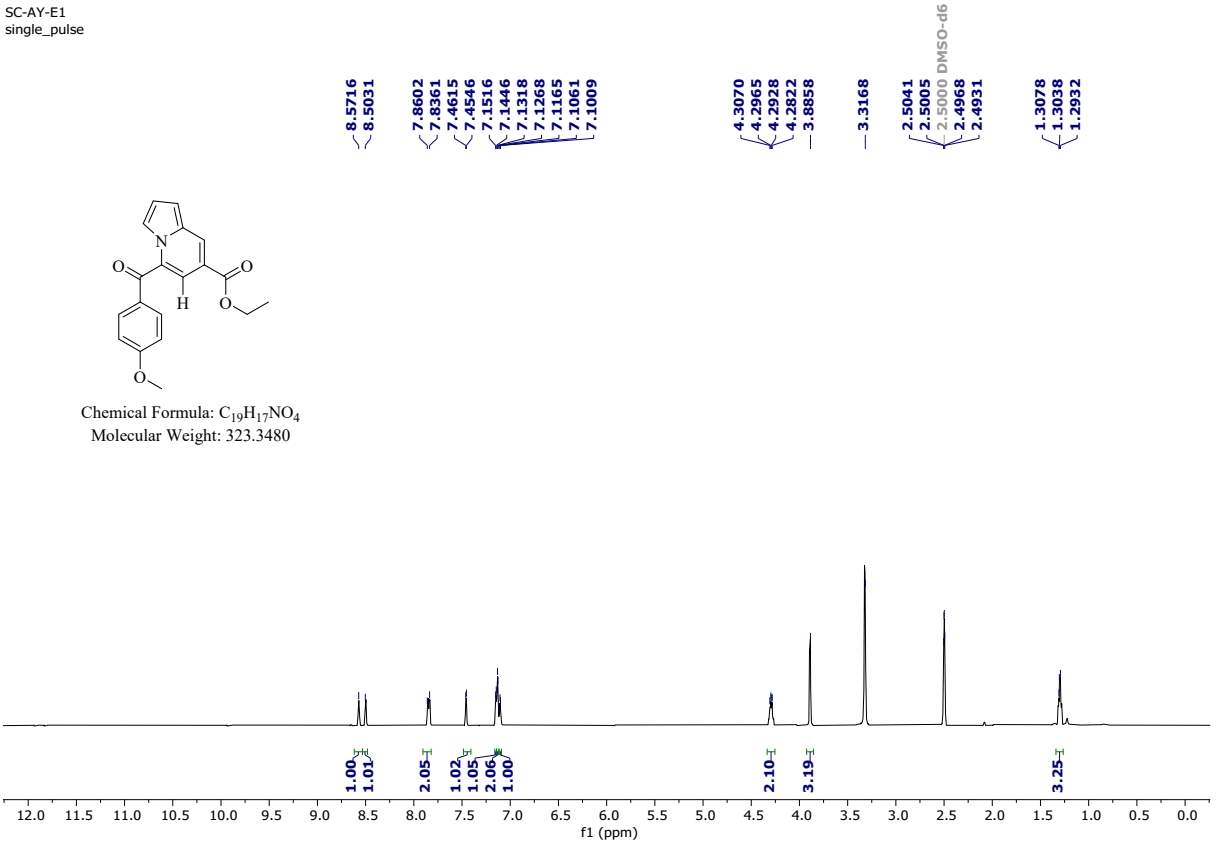


Fig 30. ^{1}H-NMR of Ethyl 5-(4-methoxybenzoyl) indolizine-7-carboxylate (5b)

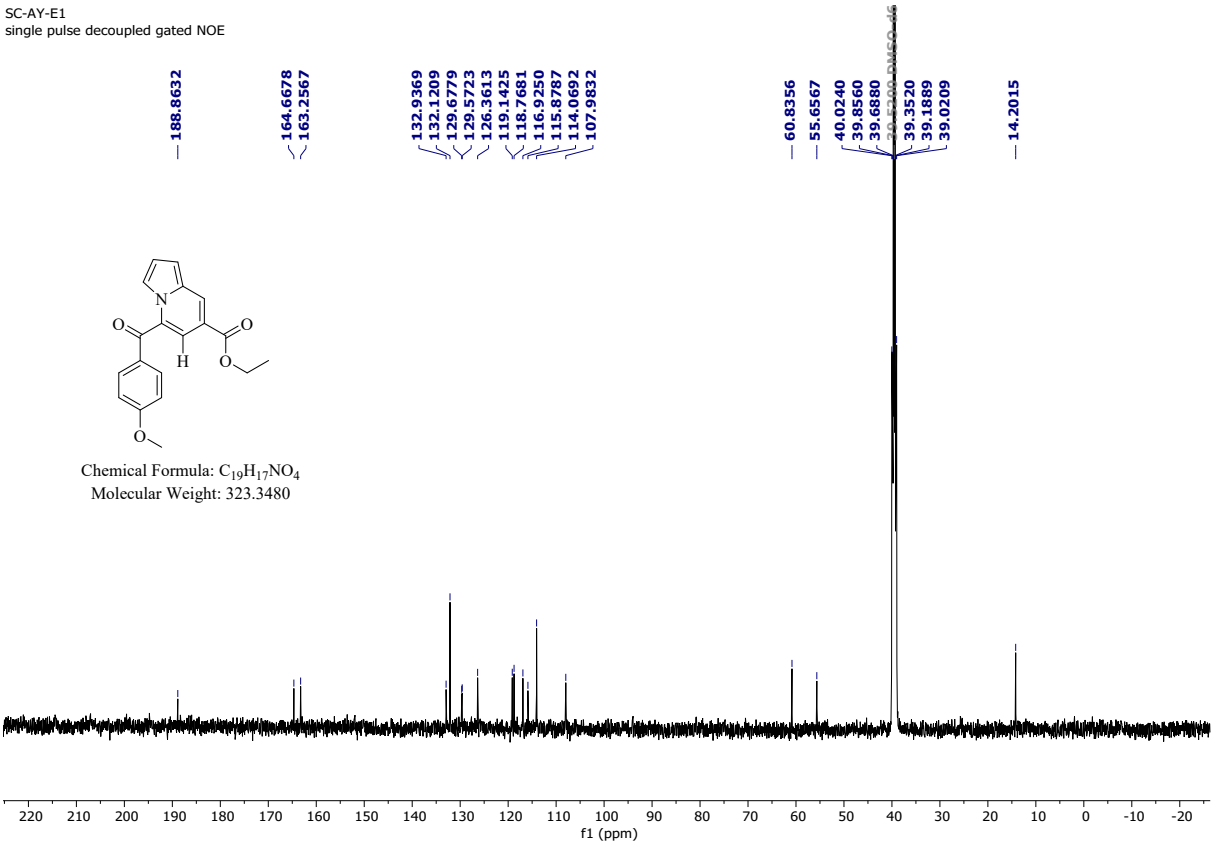


Fig 31. ^{13}C-NMR of Ethyl 5-(4-methoxybenzoyl) indolizine-7-carboxylate (5b)

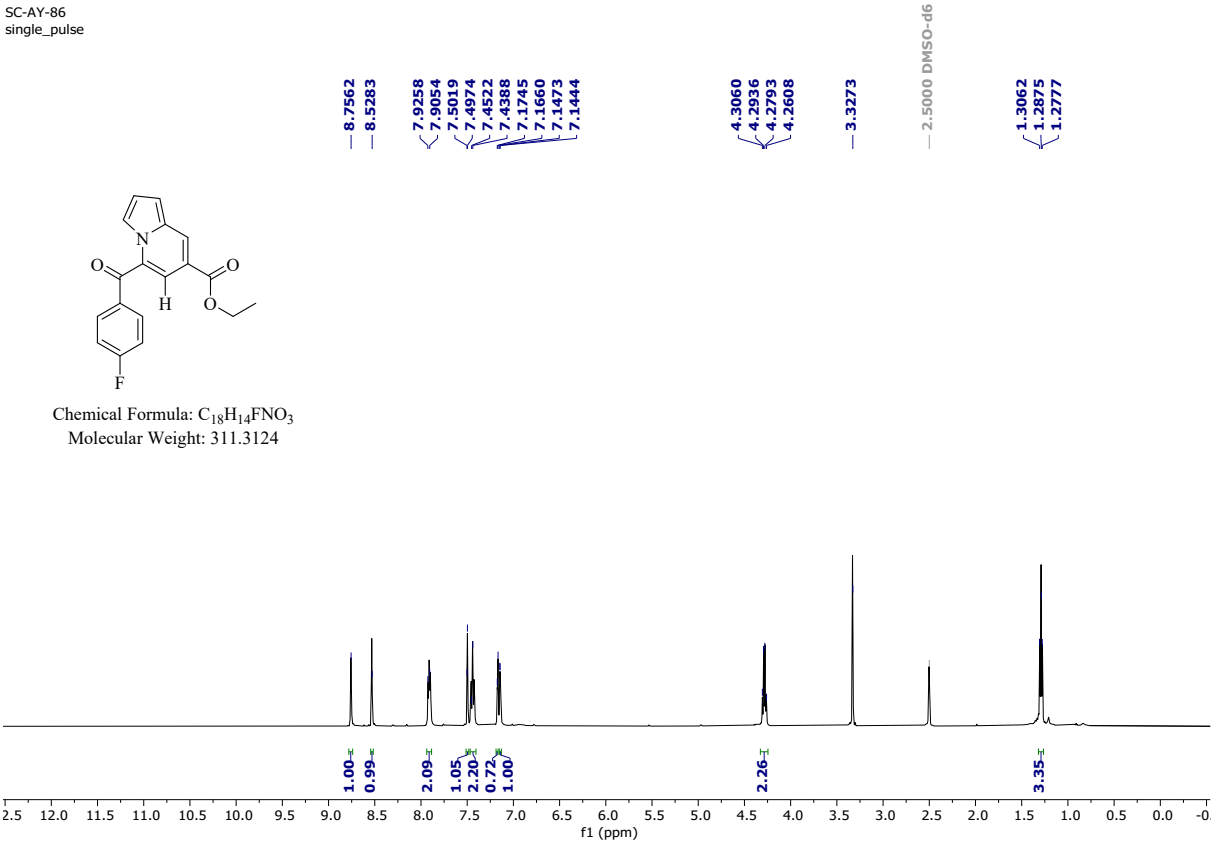


Fig 32. ^{1}H-NMR of Ethyl 5-(4-fluorobenzoyl) indolizine-7-carboxylate (5c)

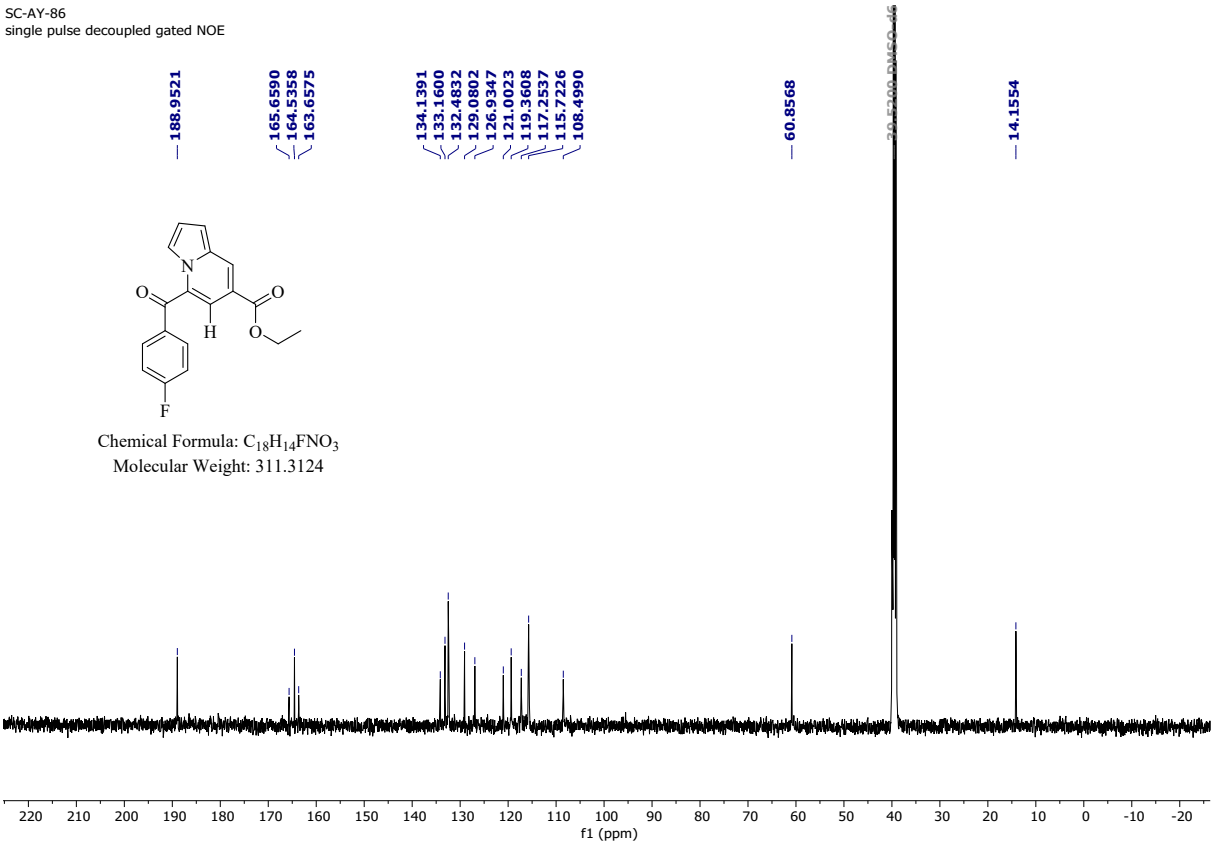


Fig 33. ^{13}C-NMR of Ethyl 5-(4-fluorobenzoyl) indolizine-7-carboxylate (5c)

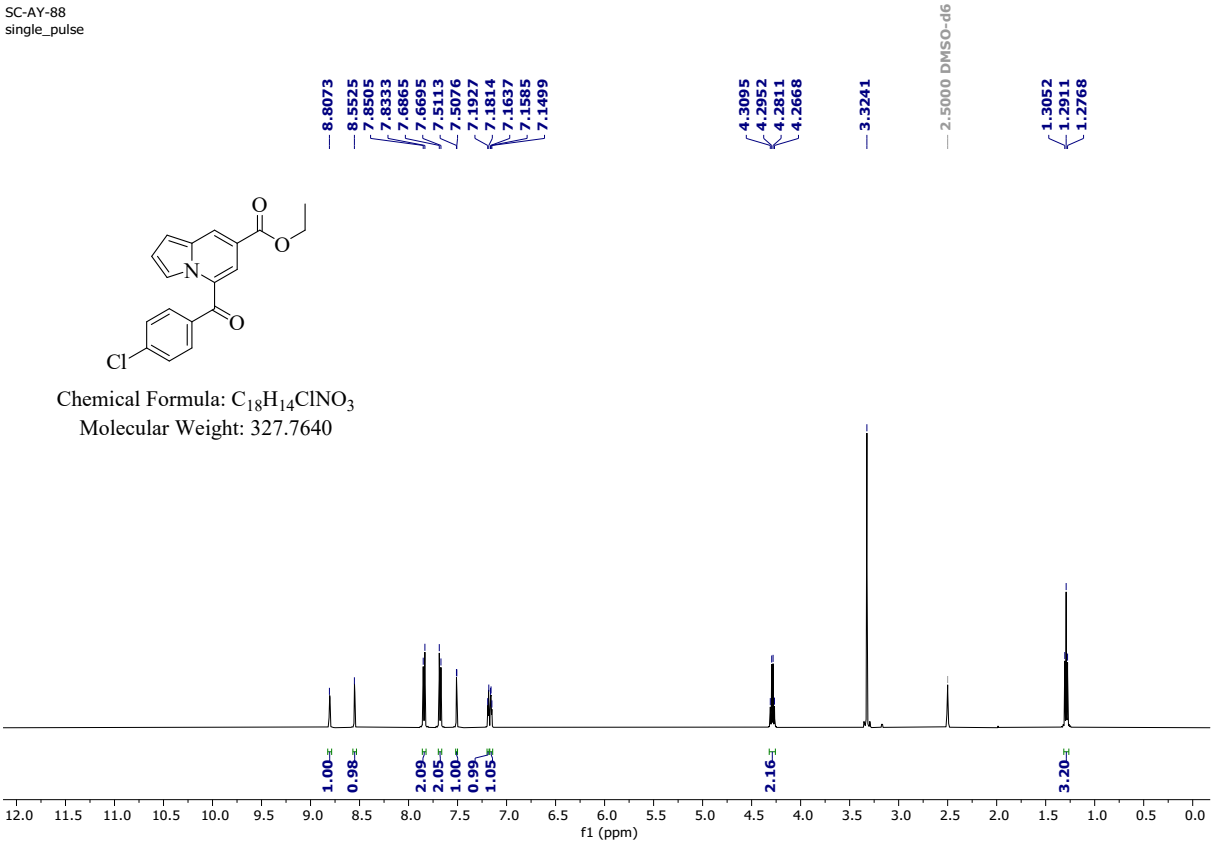


Fig 34. ^{1}H-NMR of Ethyl 5-(4-chlorobenzoyl)indolizine-7-carboxylate (5d)

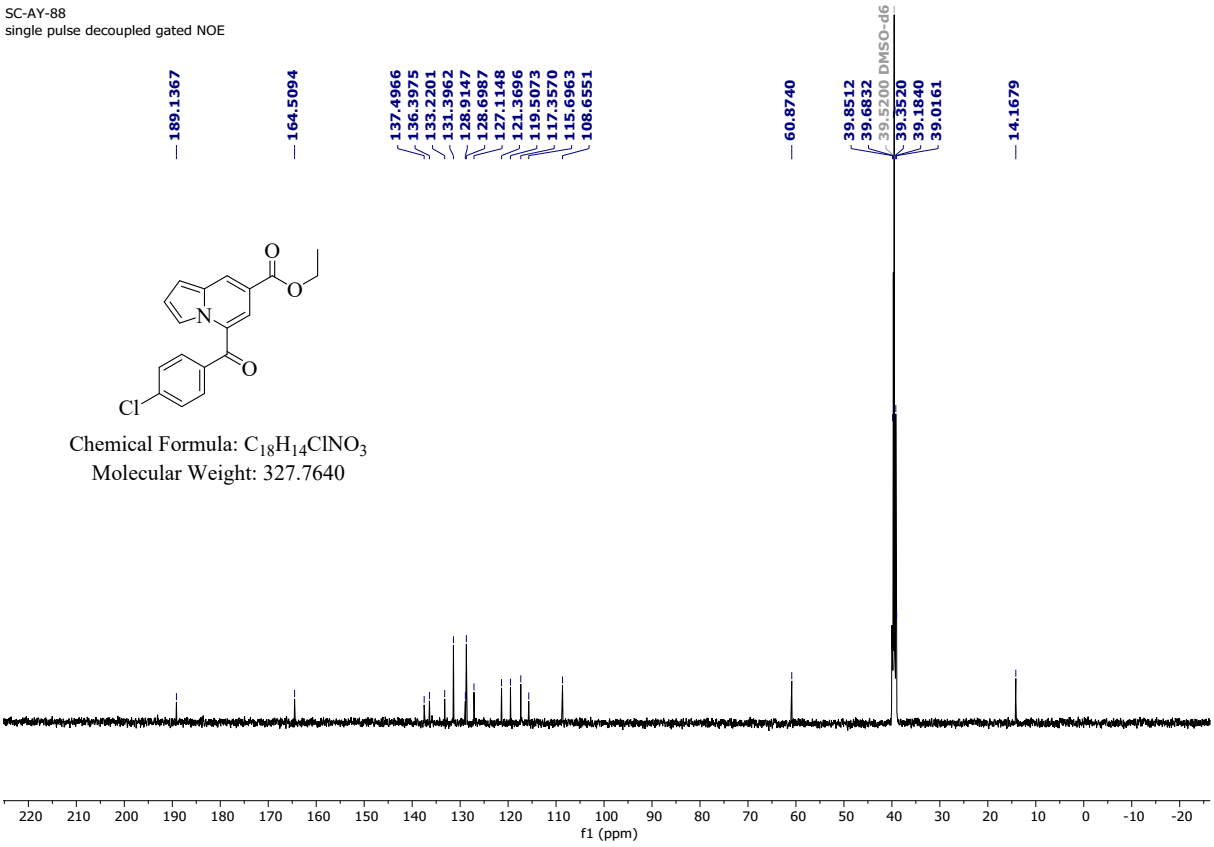


Fig 35. ^{13}C-NMR of Ethyl 5-(4-chlorobenzoyl)indolizine-7-carboxylate (5d),

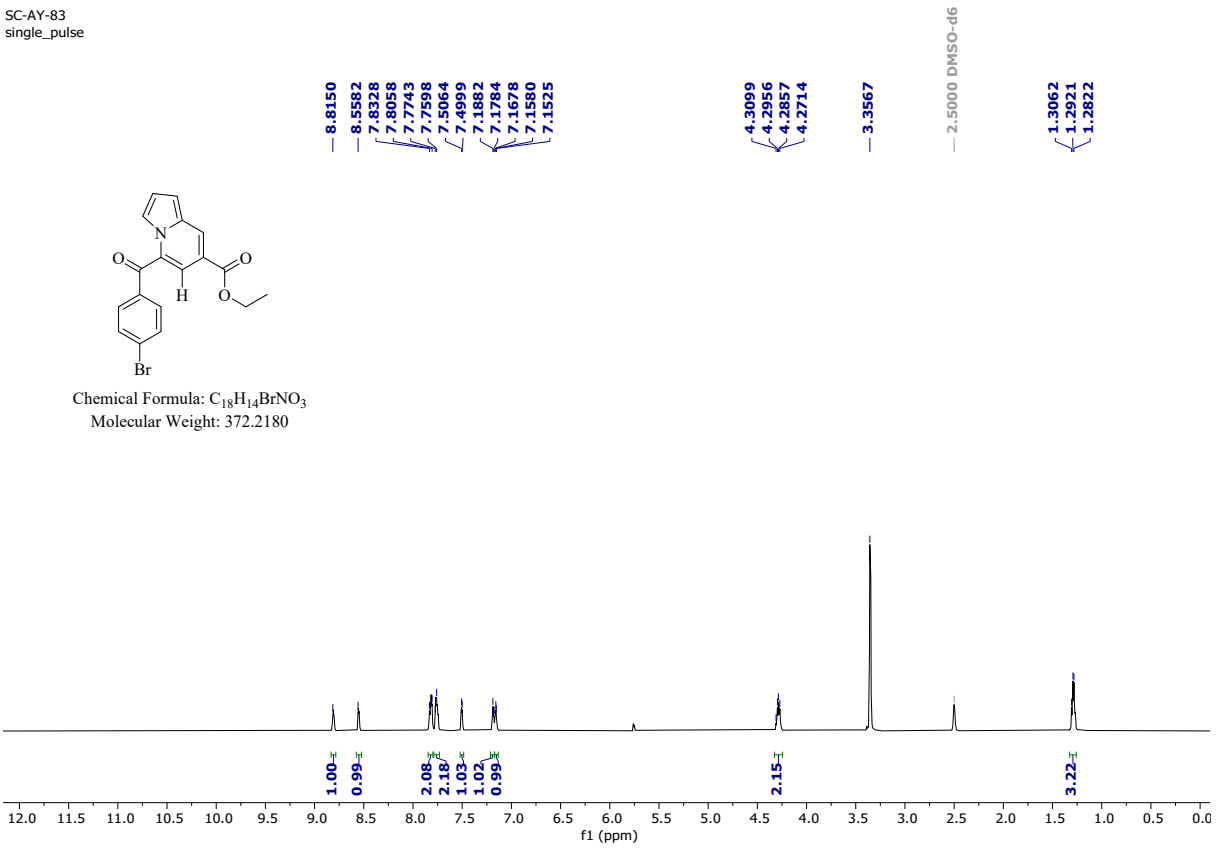


Fig 36. ^{1}H-NMR of Ethyl 5-(4-bromobenzoyl) indolizine-7-carboxylate (5e)

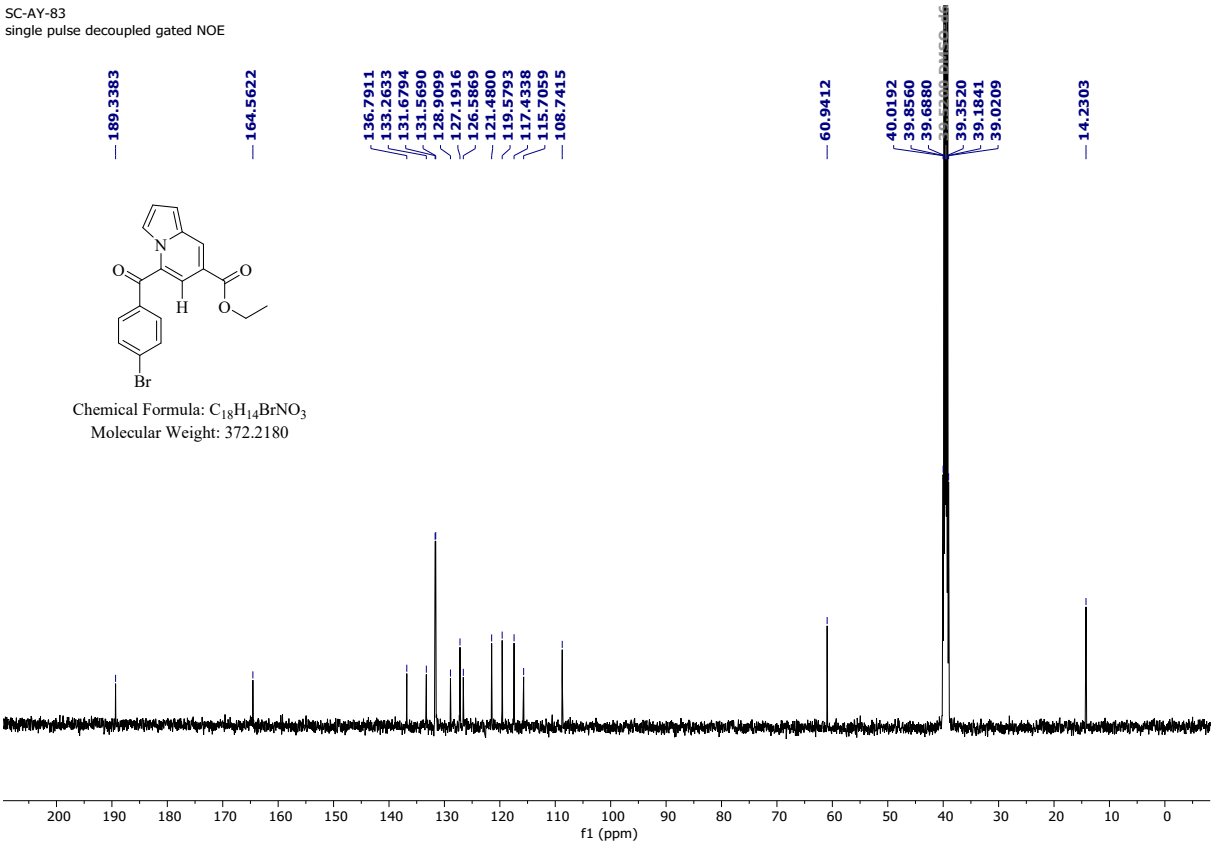


Fig 37. ^{13}C-NMR of Ethyl 5-(4-bromobenzoyl) indolizine-7-carboxylate (5e)

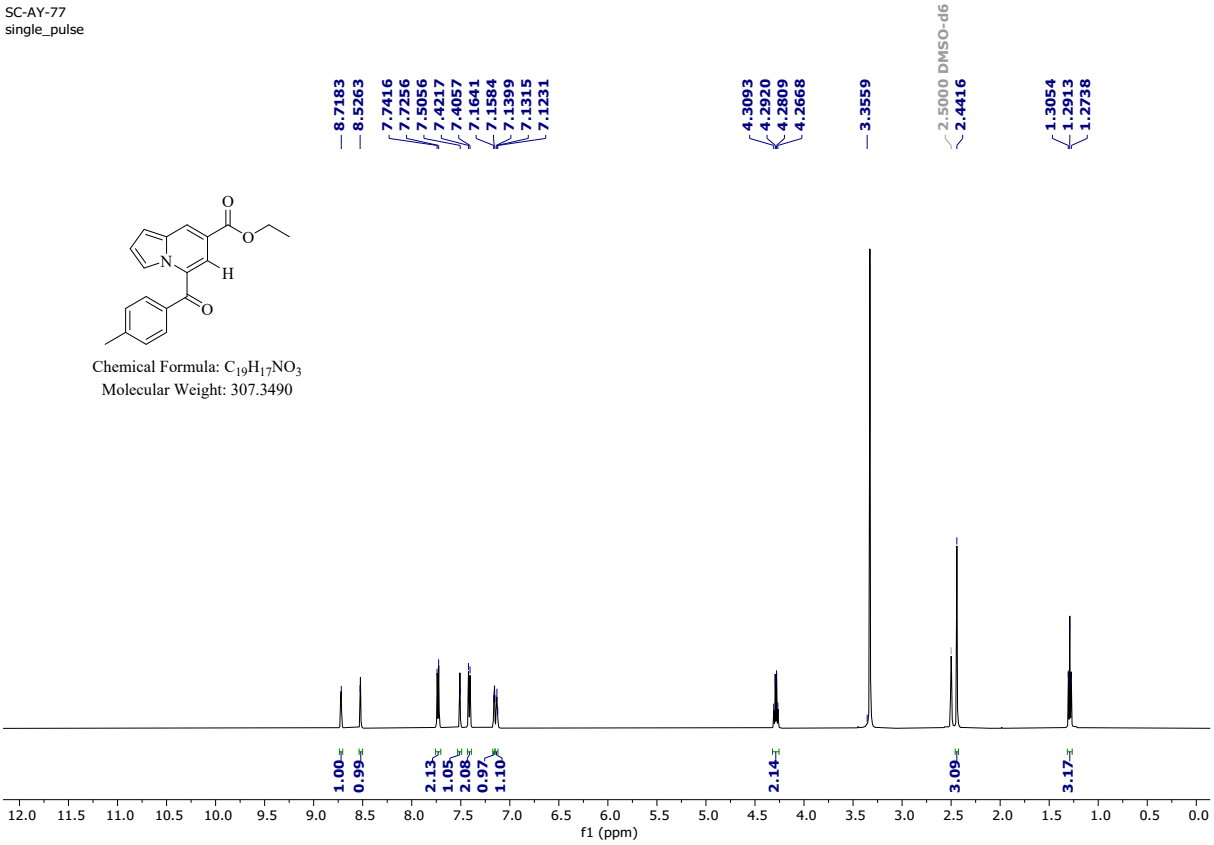


Fig 38. ^{1}H-NMR of Ethyl 5-(4-methylbenzoyl) indolizine-7-carboxylate (5f)

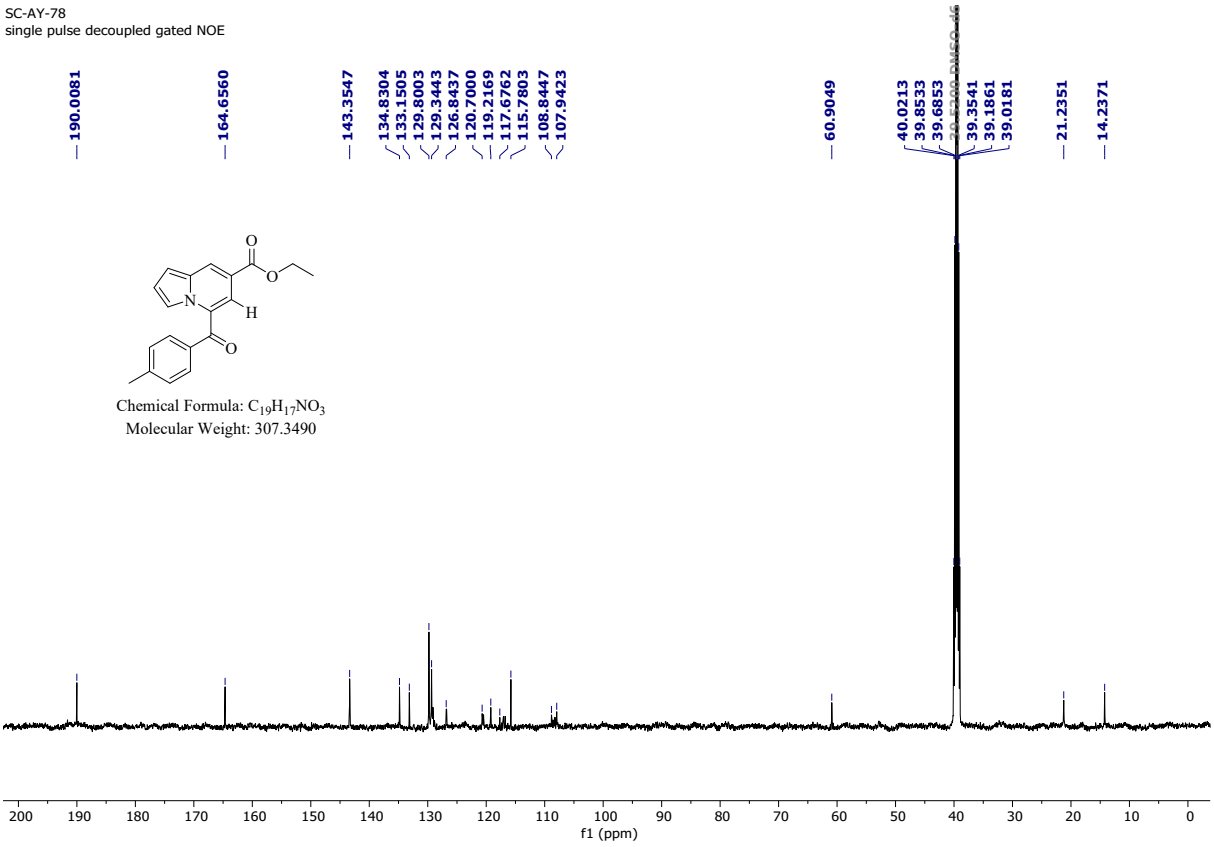


Fig 39. ^{13}C-NMR of Ethyl 5-(4-methylbenzoyl) indolizine-7-carboxylate (5f)

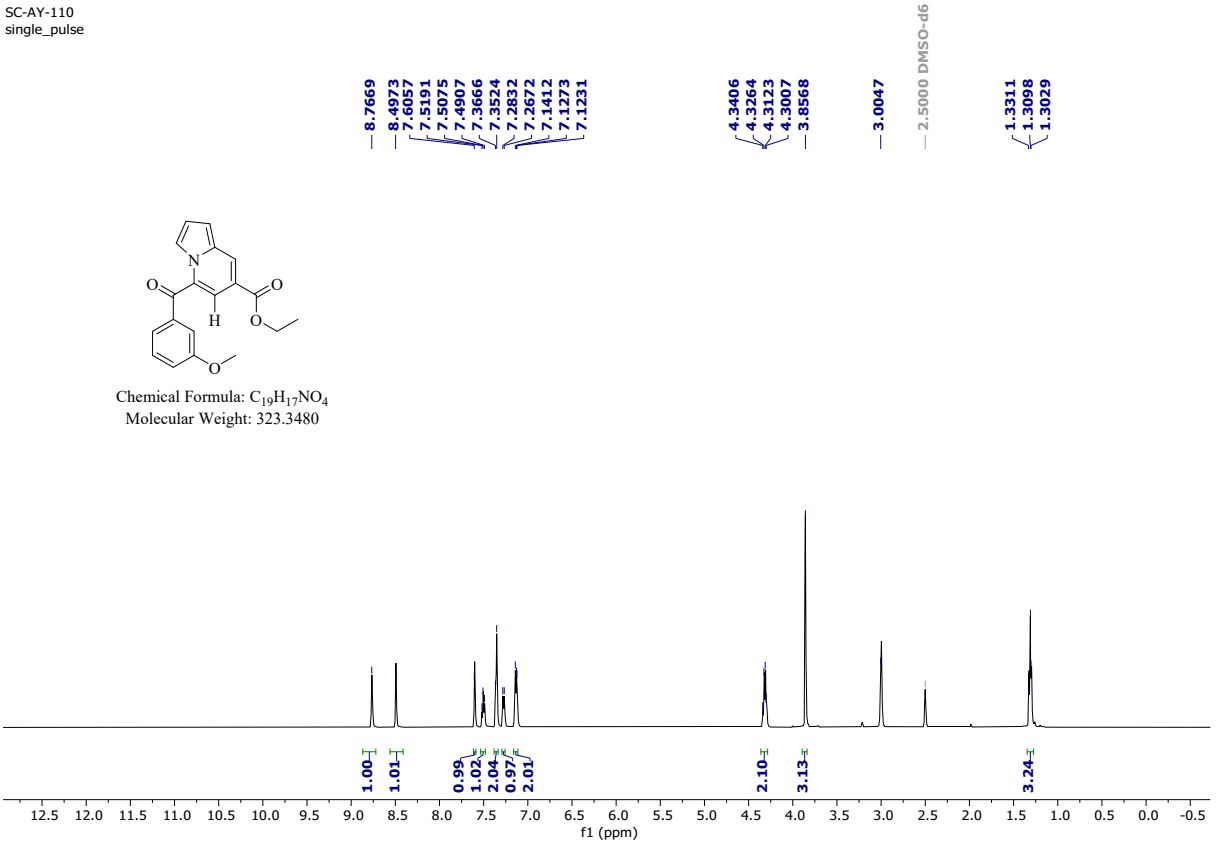


Fig 40. ^{1}H-NMR of Ethyl 5-(3-methoxybenzoyl) indolizine-7-carboxylate (5g)

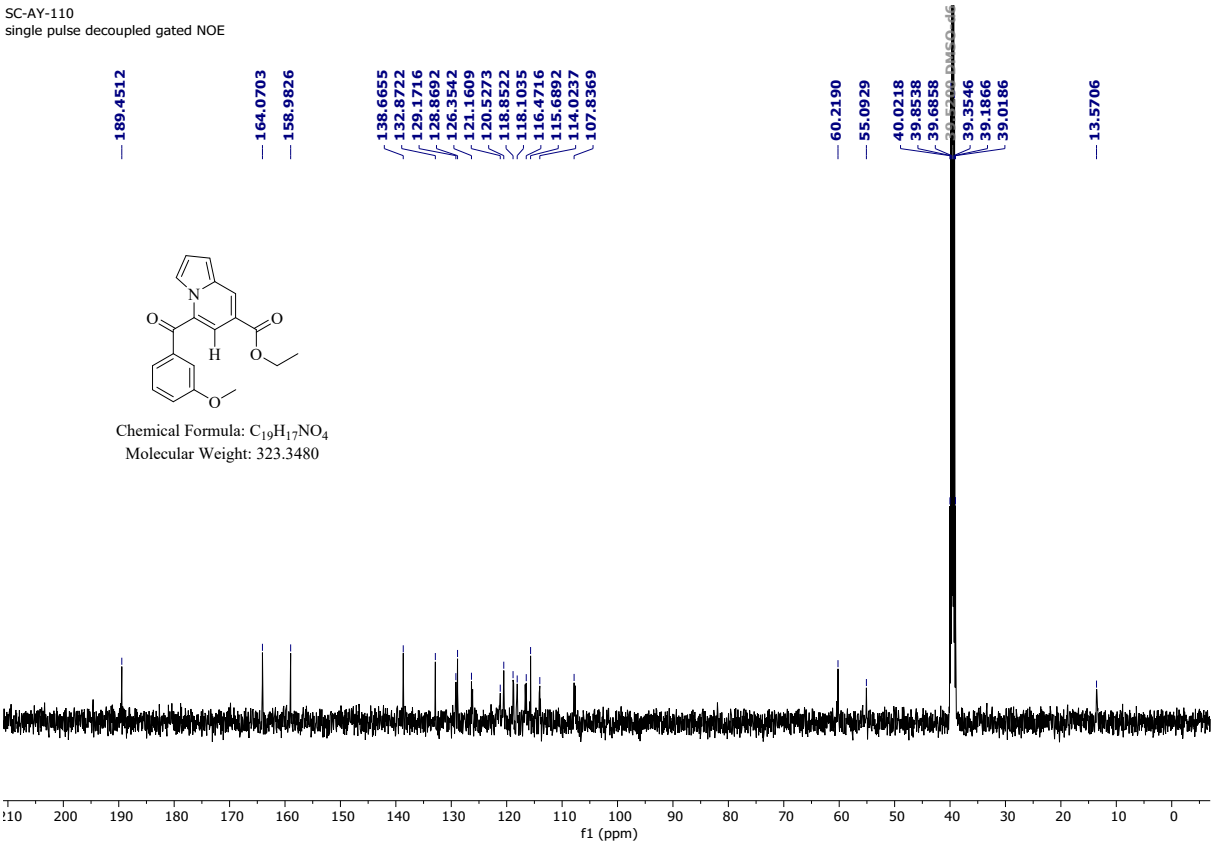


Fig 41. ^{13}C-NMR of Ethyl 5-(3-methoxybenzoyl) indolizine-7-carboxylate (5g)

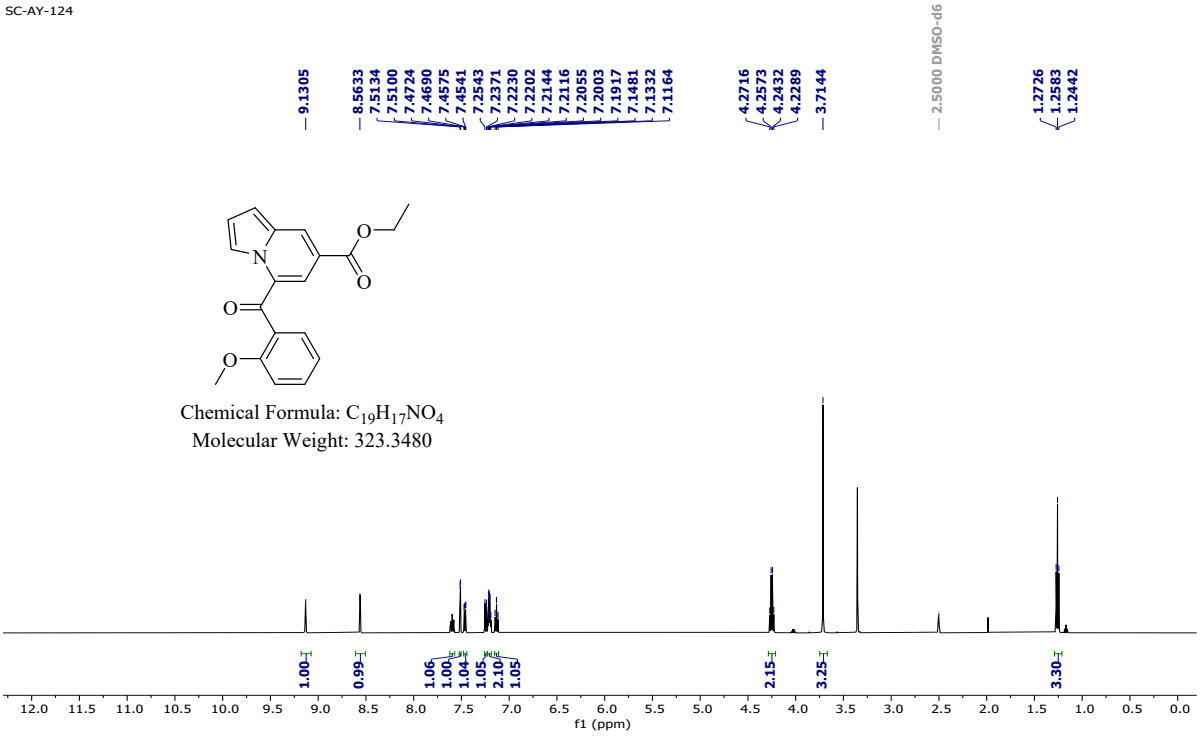


Fig 42. ^{1}H NMR spectra of Ethyl 5-(2-methoxybenzoyl) indolizine-7-carboxylate (5h)

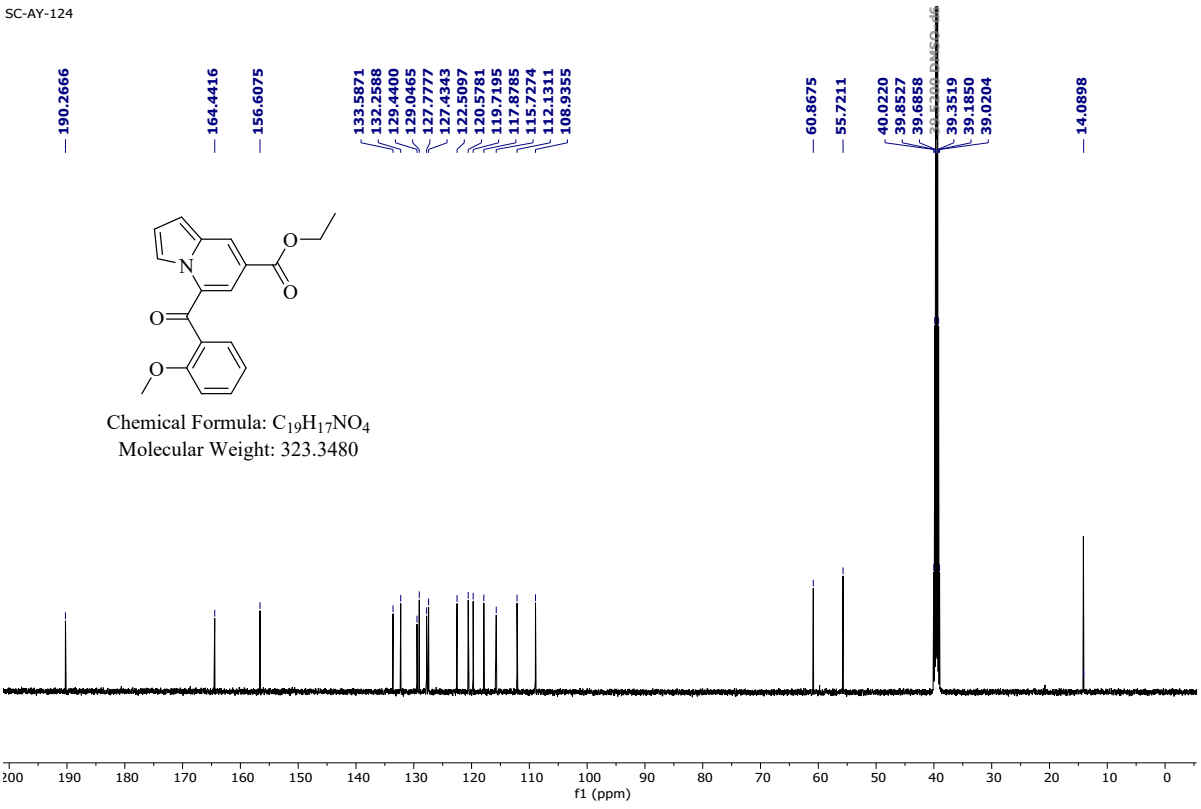


Fig 43. ^{13}C NMR spectra of Ethyl 5-(2-methoxybenzoyl) indolizine-7-carboxylate (5h)

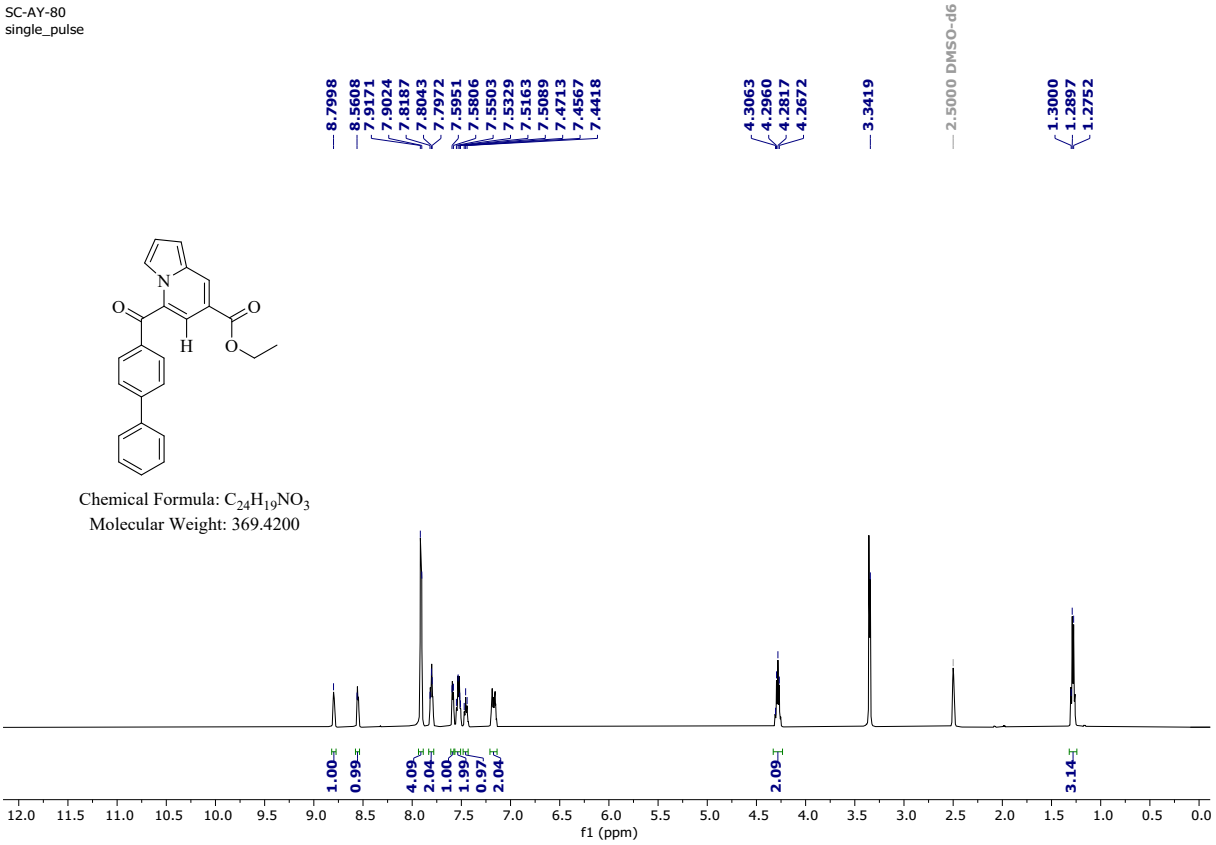


Fig 44. ^{1}H-NMR of Ethyl 5-([1,1'-biphenyl]-4-carbonyl) indolizine-7-carboxylate (5i)

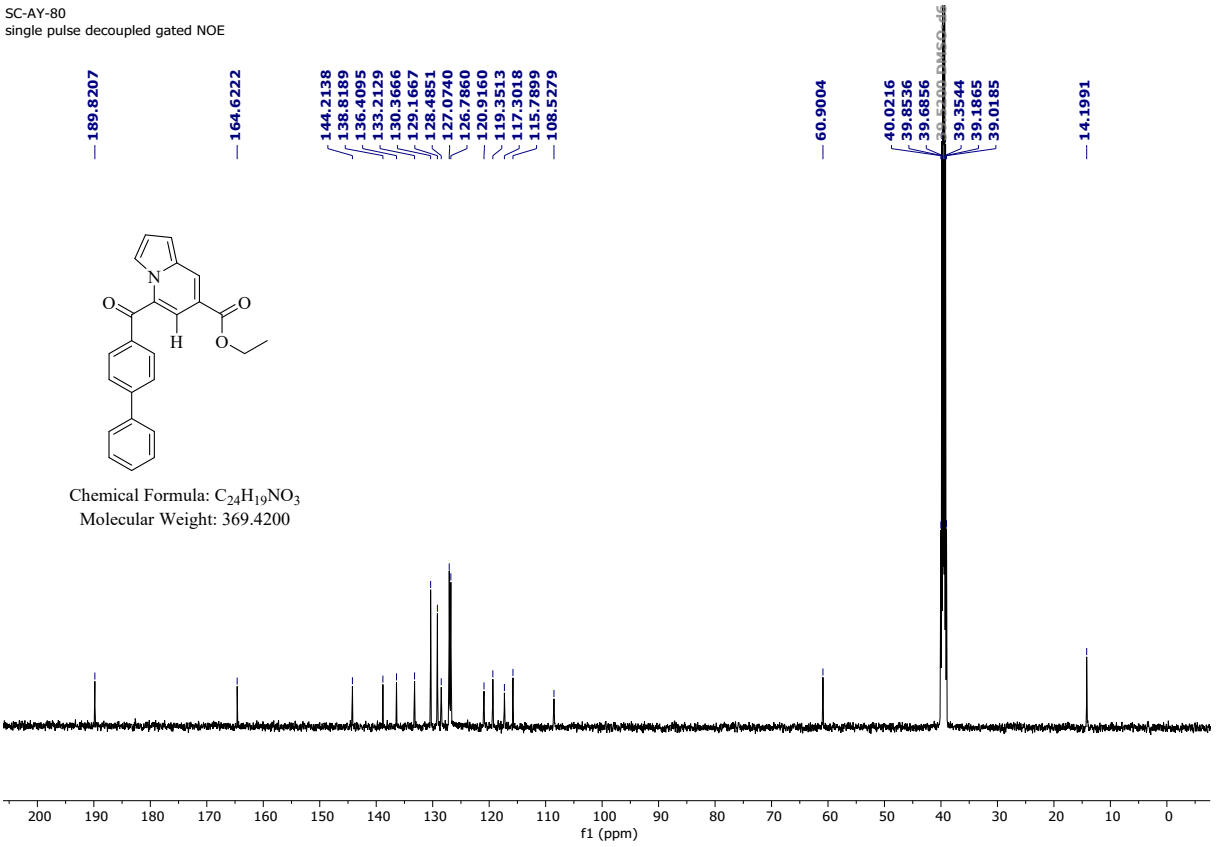


Fig 45. ^{13}C-NMR of Ethyl 5-([1,1'-biphenyl]-4-carbonyl) indolizine-7-carboxylate (5i)

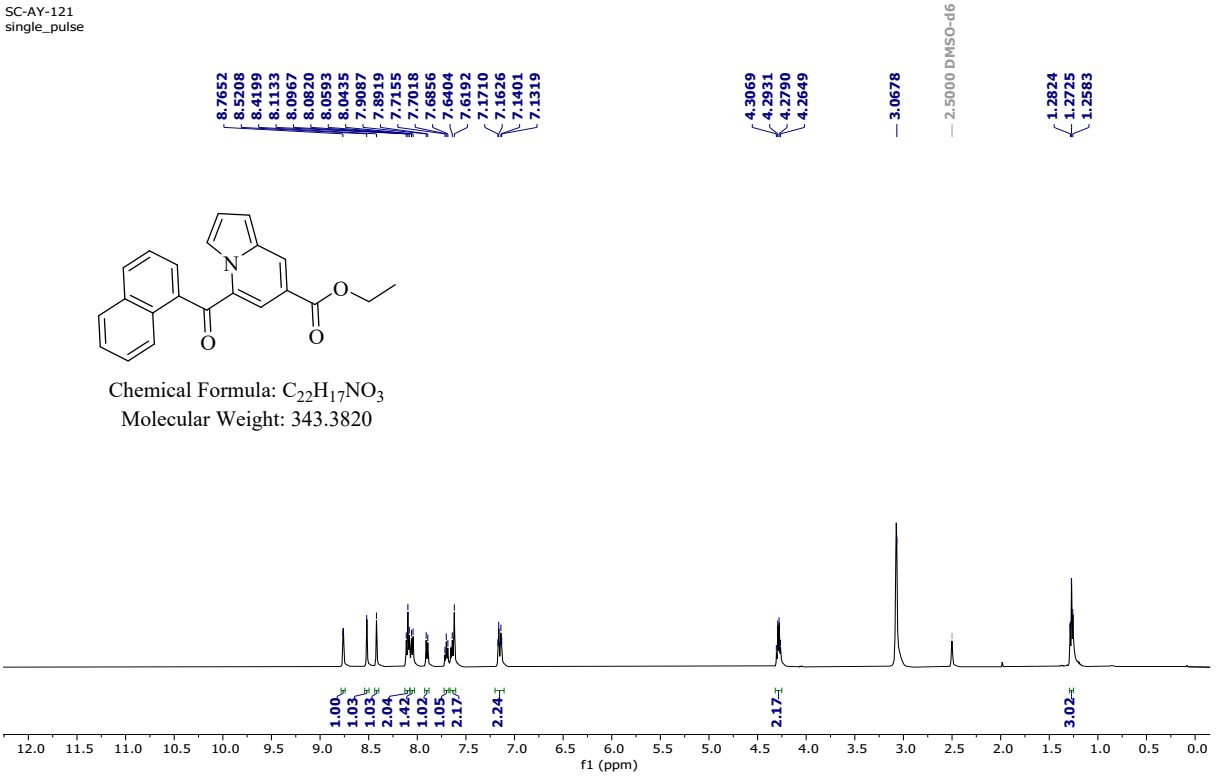


Fig 46. ^{1}H NMR spectra of Ethyl 5-(1-naphthoyl)indolizine-7-carboxylate (5j)

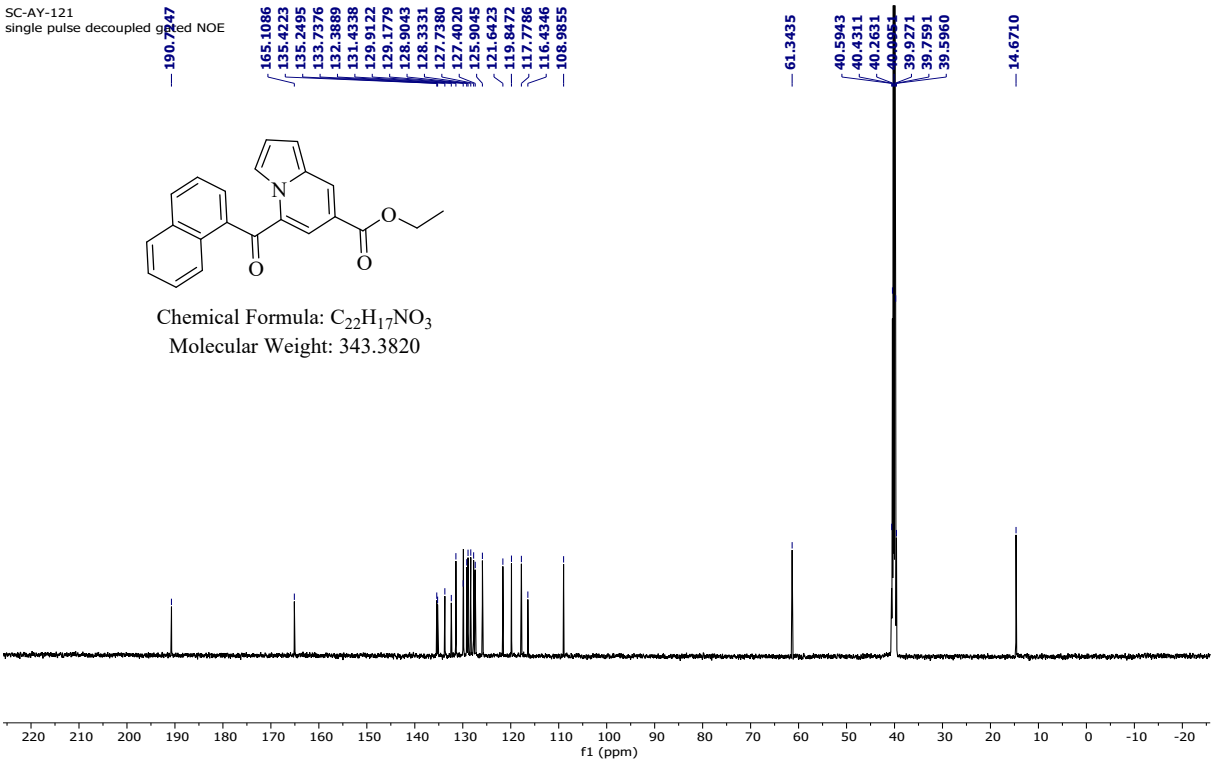


Fig 47. ^{13}C NMR spectra of Ethyl 5-(1-naphthoyl)indolizine-7-carboxylate (5j)

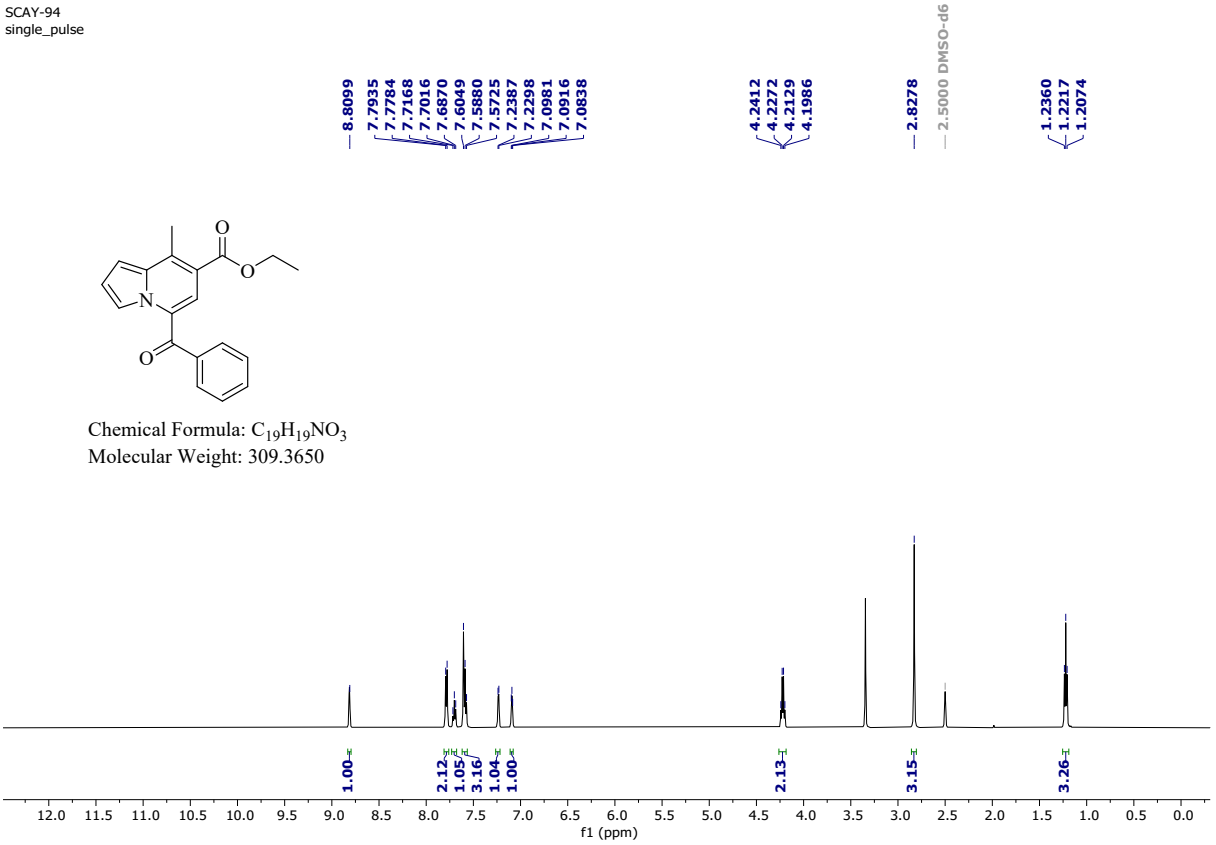


Fig 48. ^{1}H-NMR of Ethyl 5-benzoyl-8-methylindolizine-7-carboxylate (5k)

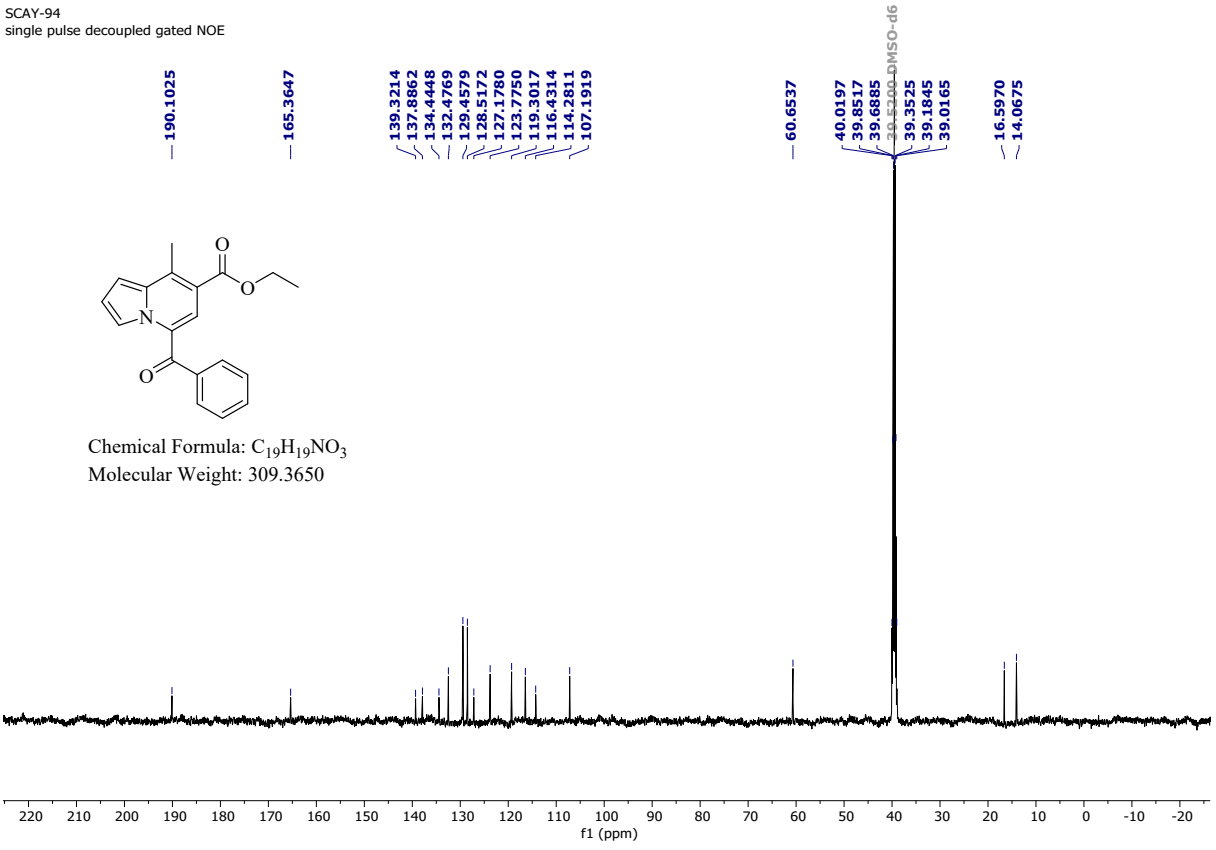


Fig 49. ^{13}C-NMR of Ethyl 5-benzoyl-8-methylindolizine-7-carboxylate (5k)

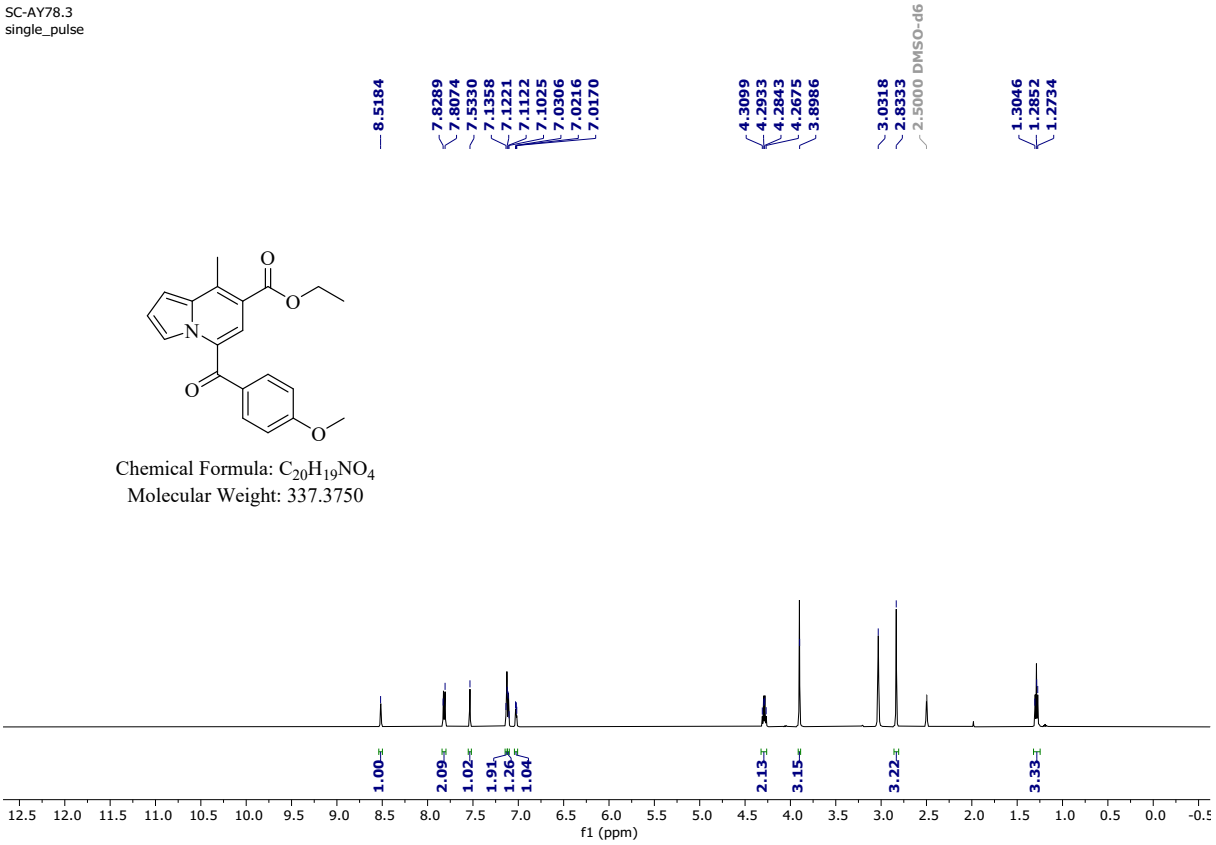


Fig 50. ^{1}H-NMR of Ethyl 5-(4-methoxybenzoyl)-8-methylindolizine-7-carboxylate (5l)

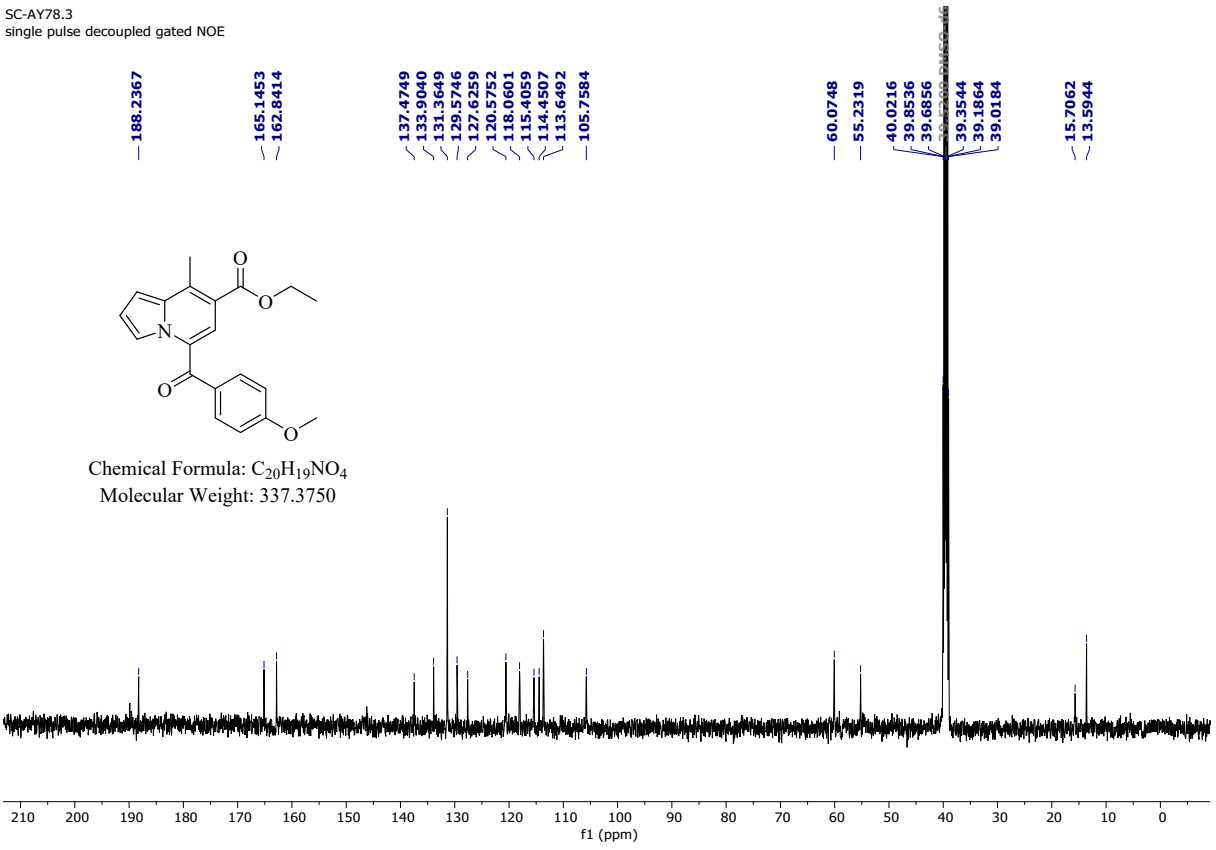


Fig 51. ^{13}C-NMR of Ethyl 5-(4-methoxybenzoyl)-8-methylindolizine-7-carboxylate (5l)

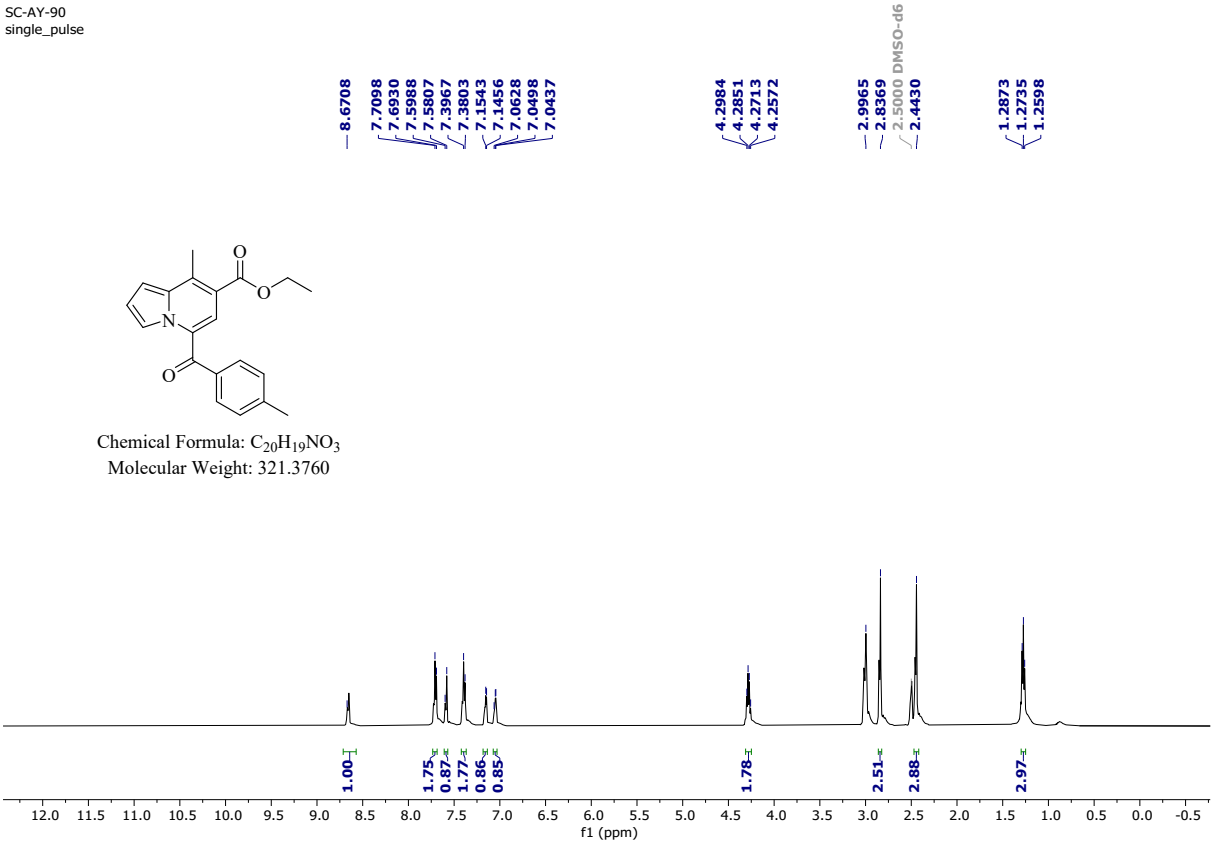


Fig 52. ^{1}H-NMR of Ethyl 8-methyl-5-(4-methylbenzoyl)indolizine-7-carboxylate (5m)

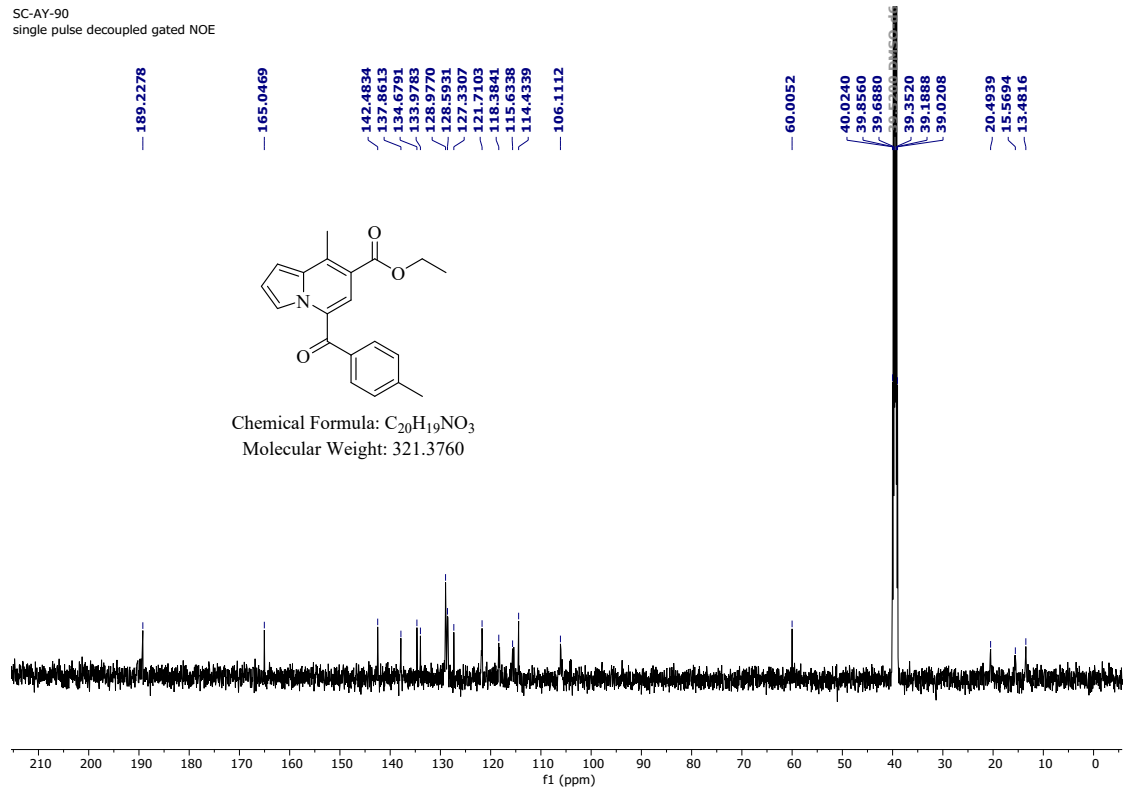


Fig 53. ^{13}C-NMR of Ethyl 8-methyl-5-(4-methylbenzoyl)indolizine-7-carboxylate (5m)

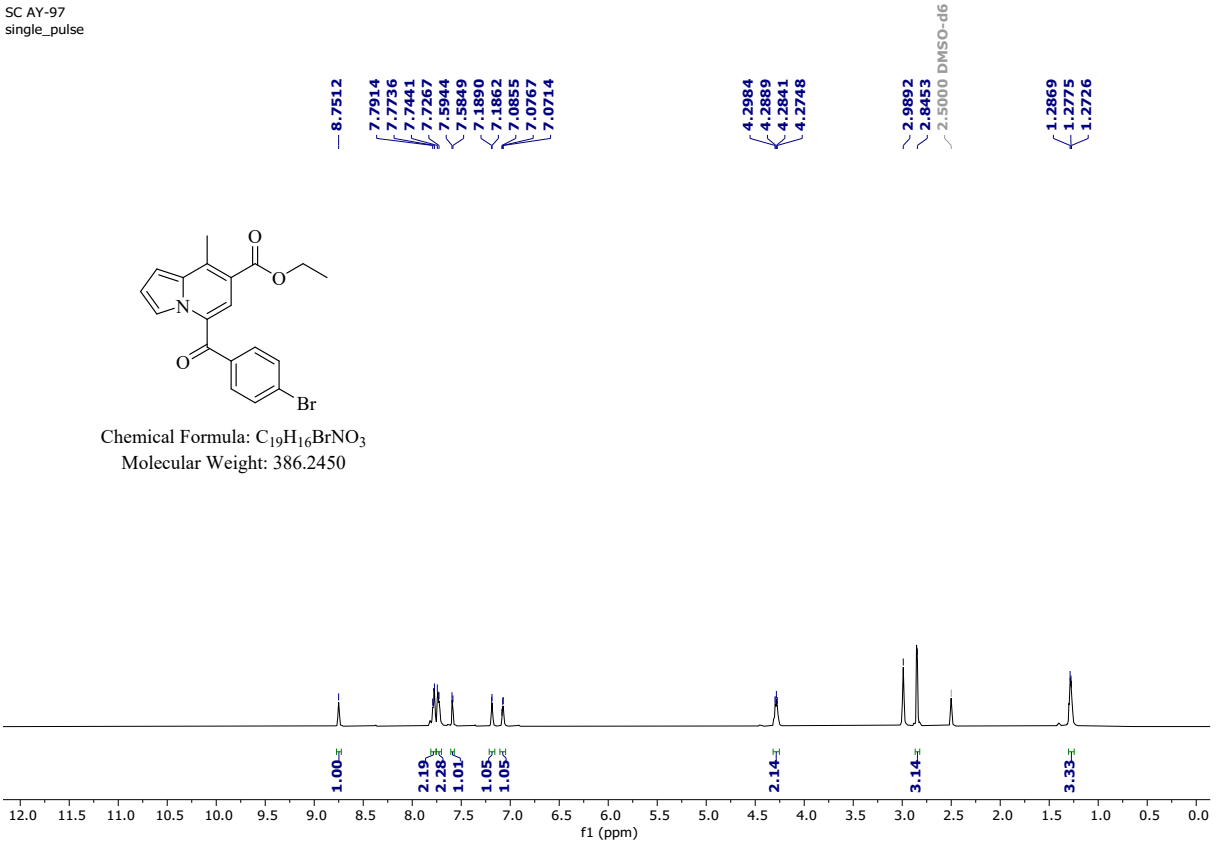


Fig 54.[1]H-NMR of Ethyl 5-(4-bromobenzoyl)-8-methylindolizine-7-carboxylate (5n)

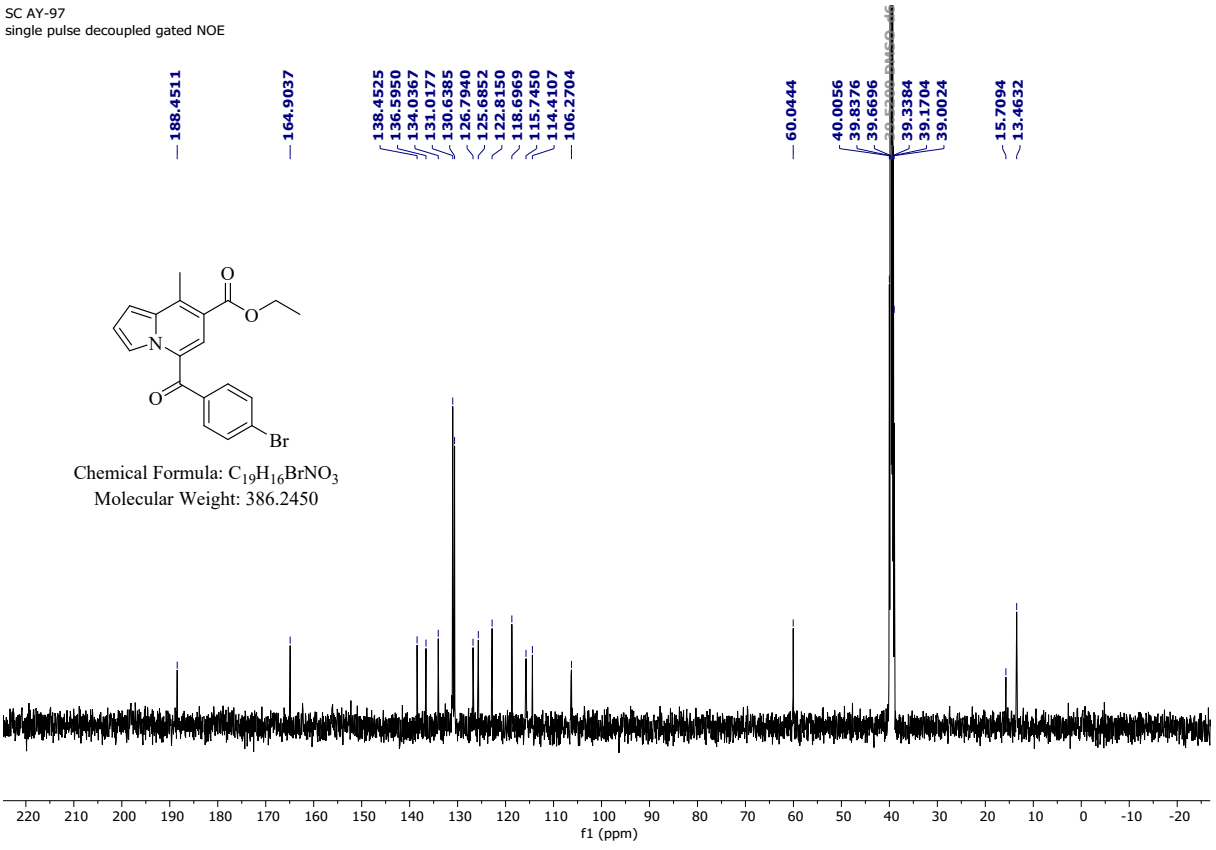


Fig 55.[13]C-NMR of Ethyl 5-(4-bromobenzoyl)-8-methylindolizine-7-carboxylate (5n)

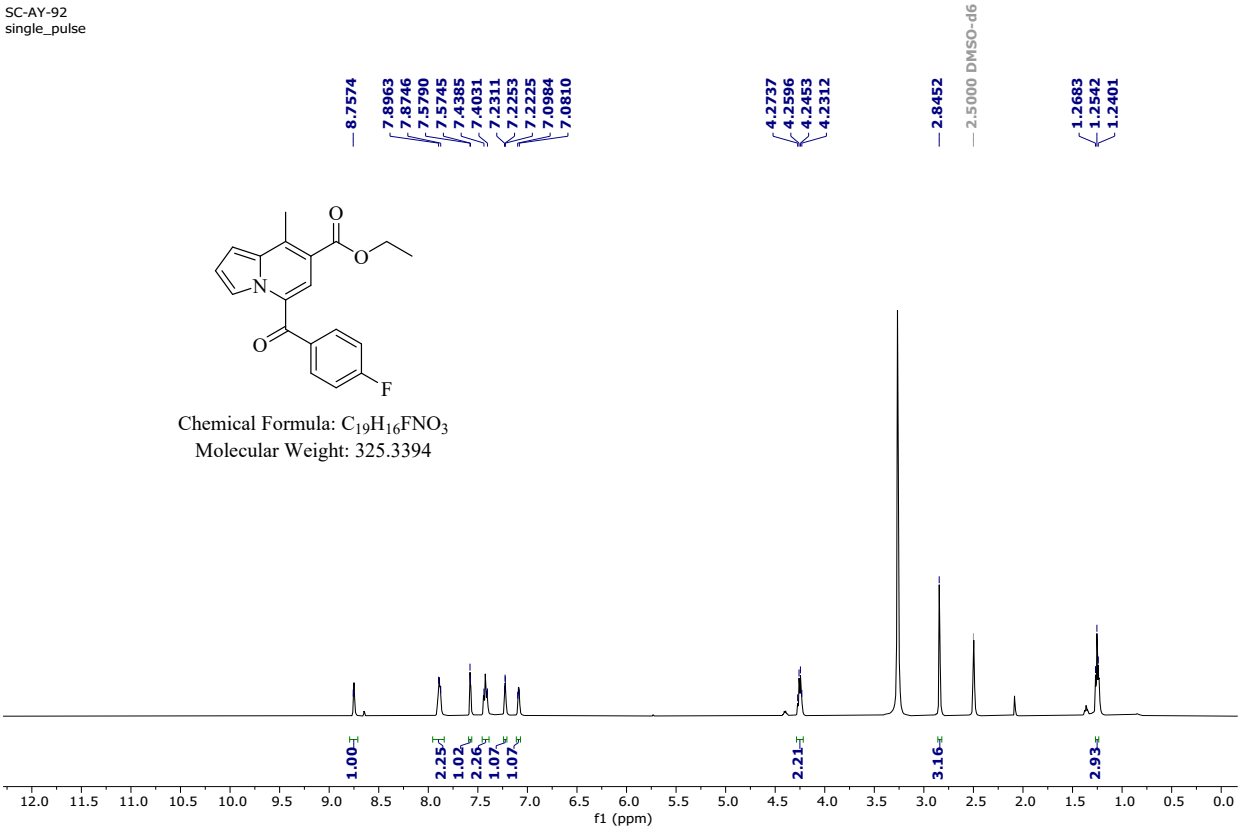


**Fig 56.[1]H NMR spectra of Ethyl 5-(4-fluorobenzoyl)-8-methylindolizine-7-carboxylate (5o), **

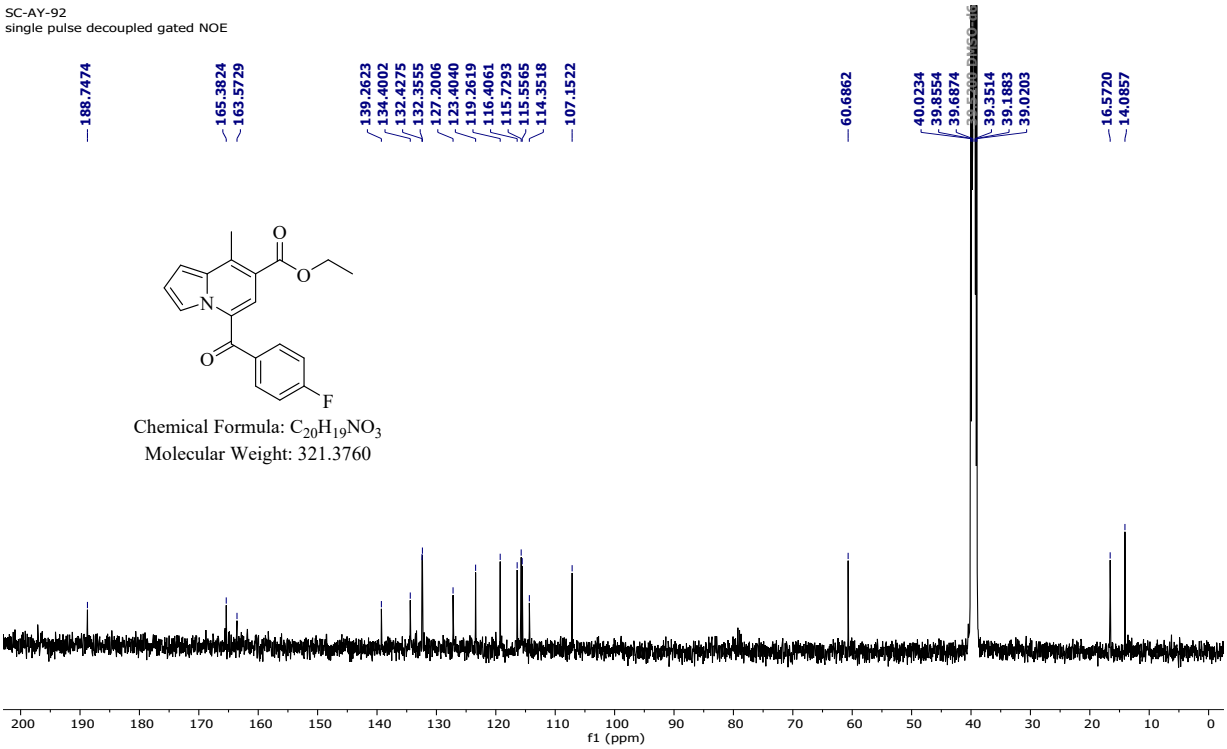


Fig 57.[13]C NMR spectra of Ethyl 8-methyl-5-(4-flourobenzoyl)indolizine-7-carboxylate (5o)

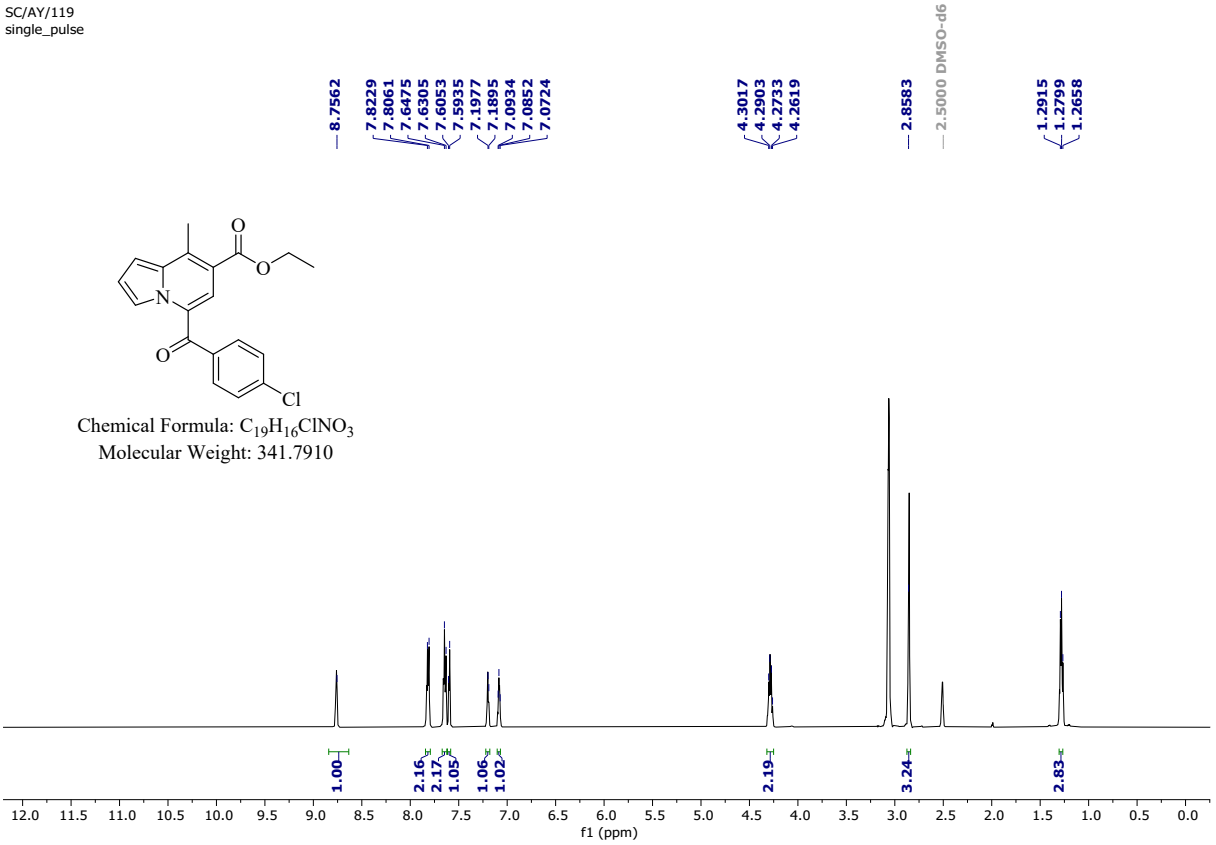


Fig 58.[1]H NMR spectra of Ethyl 5-(4-chlorobenzoyl)-8-methylindolizine-7- carboxylate (5p)

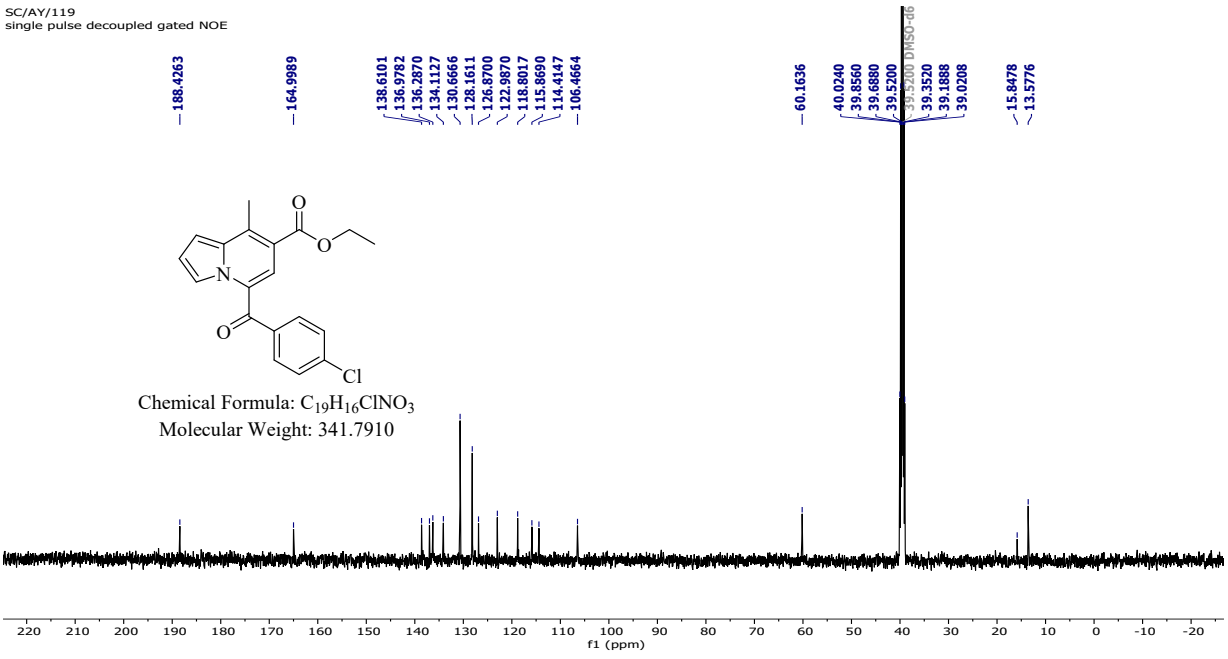


Fig 59.[13]C NMR spectra of Ethyl 5-(4-chlorobenzoyl)-8-methylindolizine-7-carboxylate (5k)

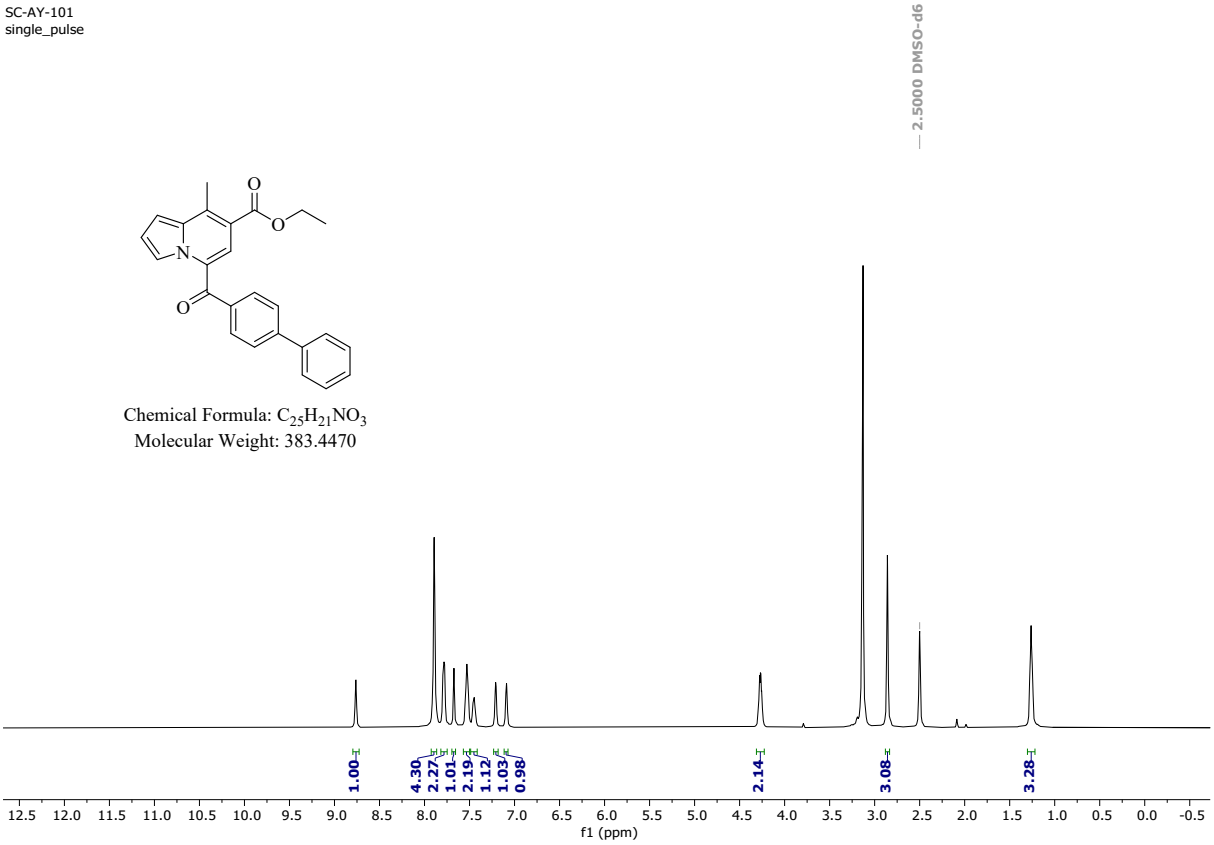


Fig 60.[1]H-NMR of Ethyl 5-([1,1'-biphenyl]-4-carbonyl)-8-methylindolizine-7-carboxylate (5q)

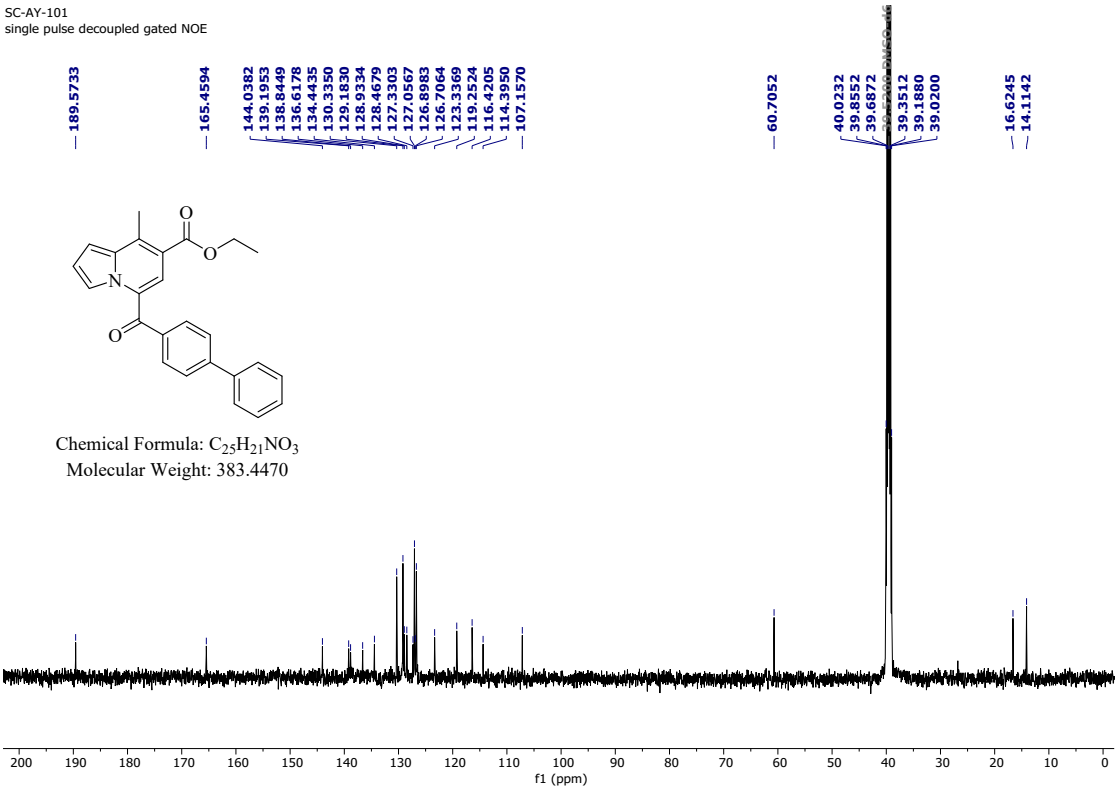
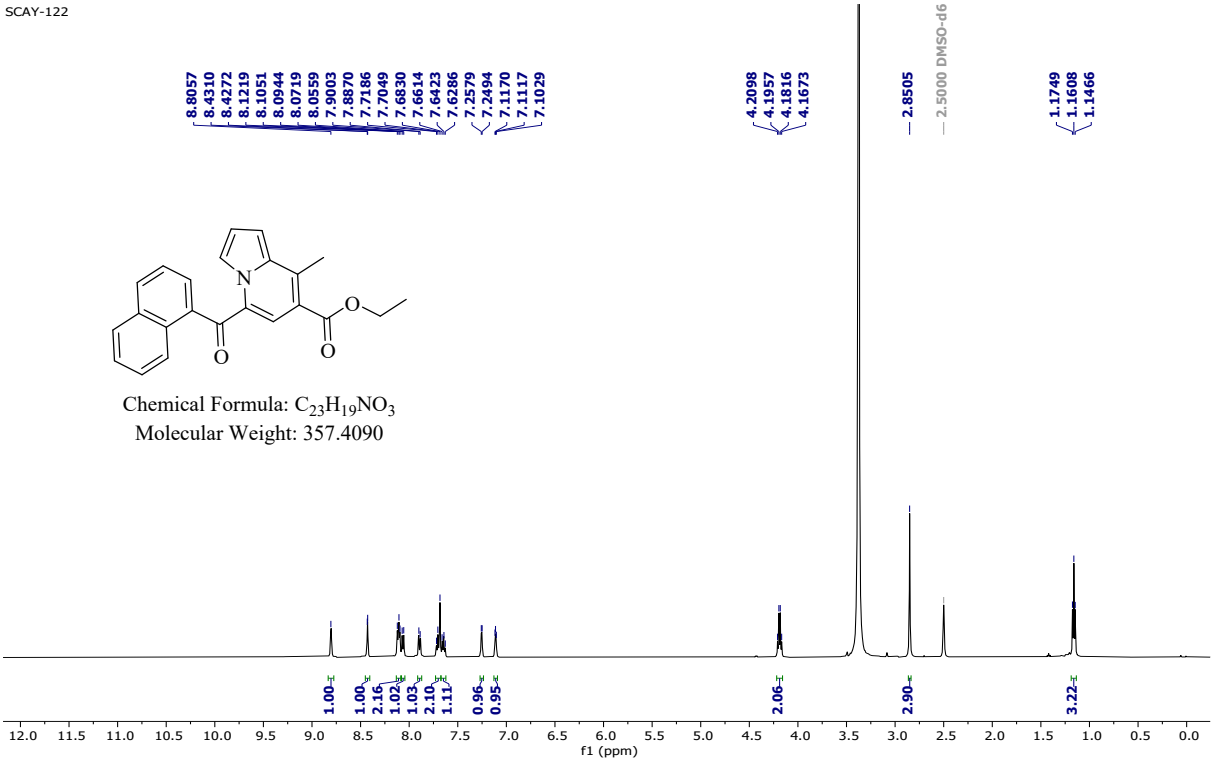
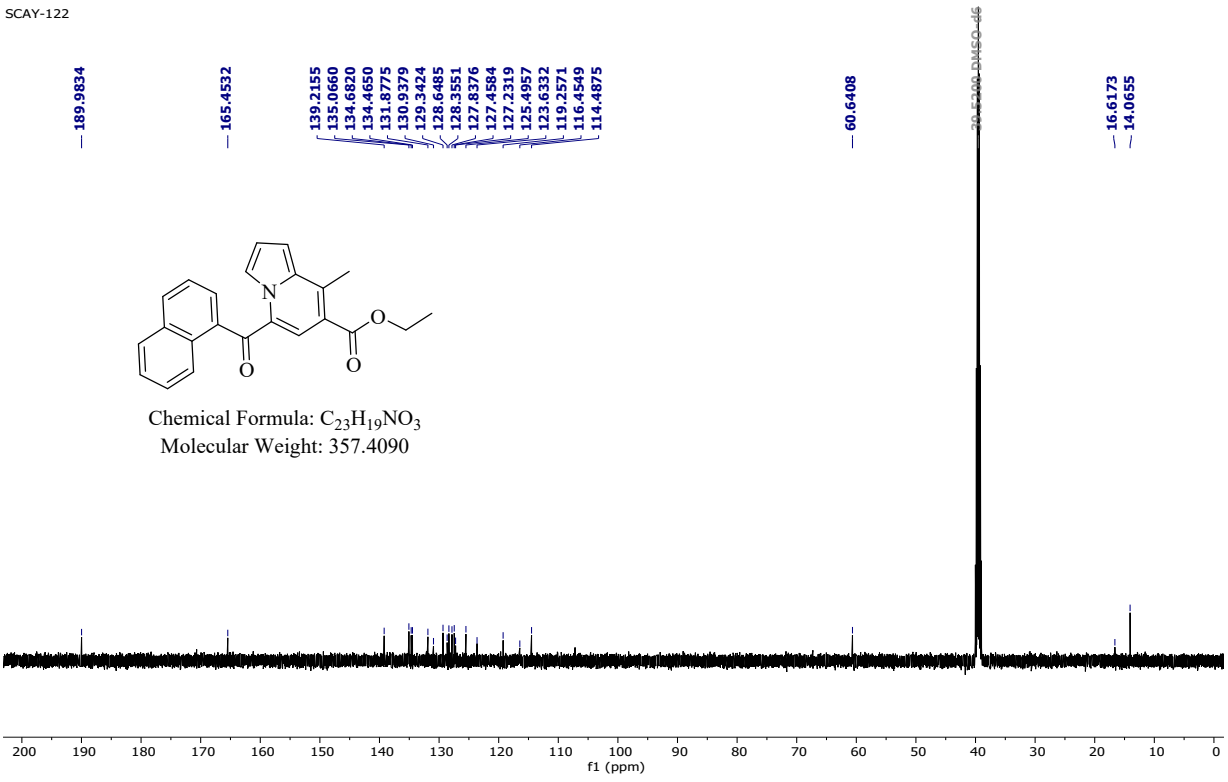


Fig 61.[13]C-NMR of Ethyl 5-([1,1'-biphenyl]-4-carbonyl)-8-methylindolizine-7-carboxylate (5q)



Chemical Formula: $C_{23}H_{19}NO_3$
Molecular Weight: 357.4090

Fig 62.^{1}H NMR spectra of Ethyl 5-(1-naphthoyl)-8-methylindolizine-7-carboxylate (5r)



Chemical Formula: $C_{23}H_{19}NO_3$
Molecular Weight: 357.4090

Fig 63.^{13}C NMR spectra of Ethyl 5-(1-naphthoyl)-8-methylindolizine-7-carboxylate (5r)

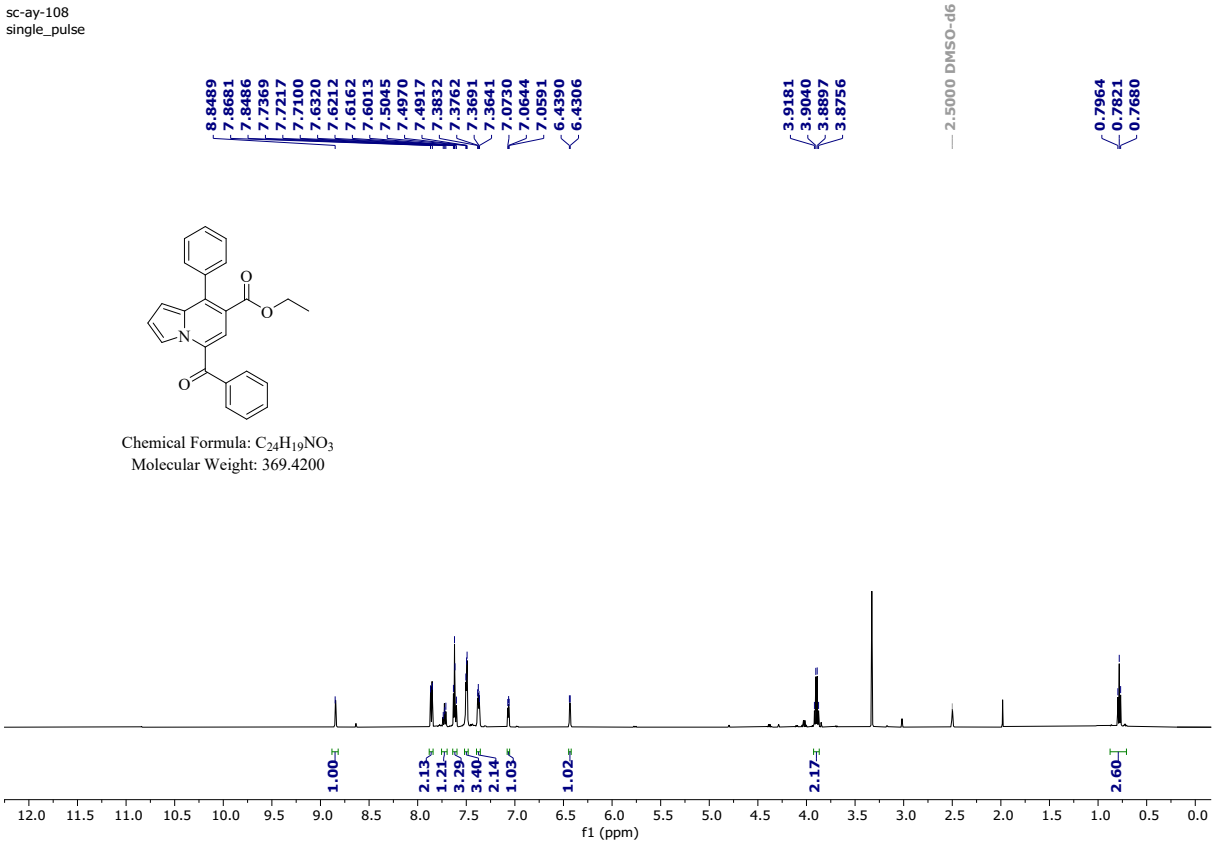


Fig 64.[1]H-NMR of Ethyl 5-benzoyl-8-phenylindolizine-7-carboxylate (5s)

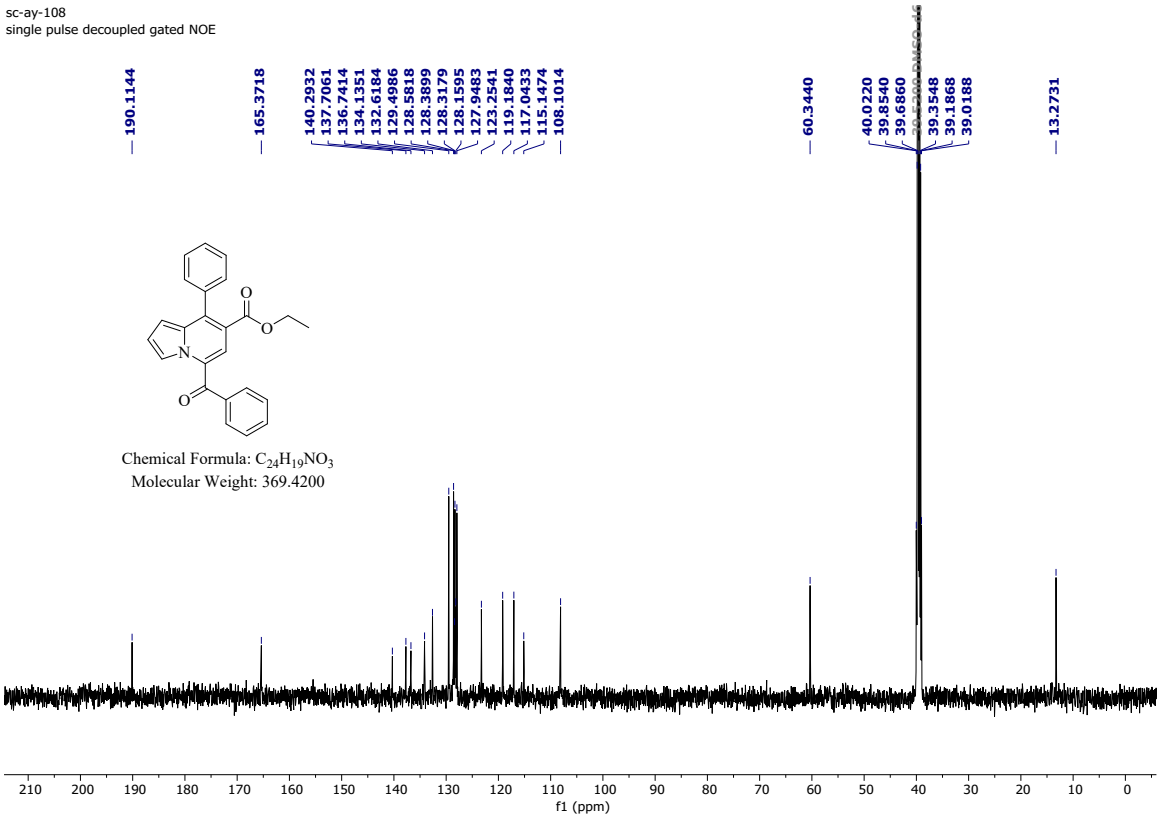


Fig 65.[13]C-NMR of Ethyl 5-benzoyl-8-phenylindolizine-7-carboxylate (5s)

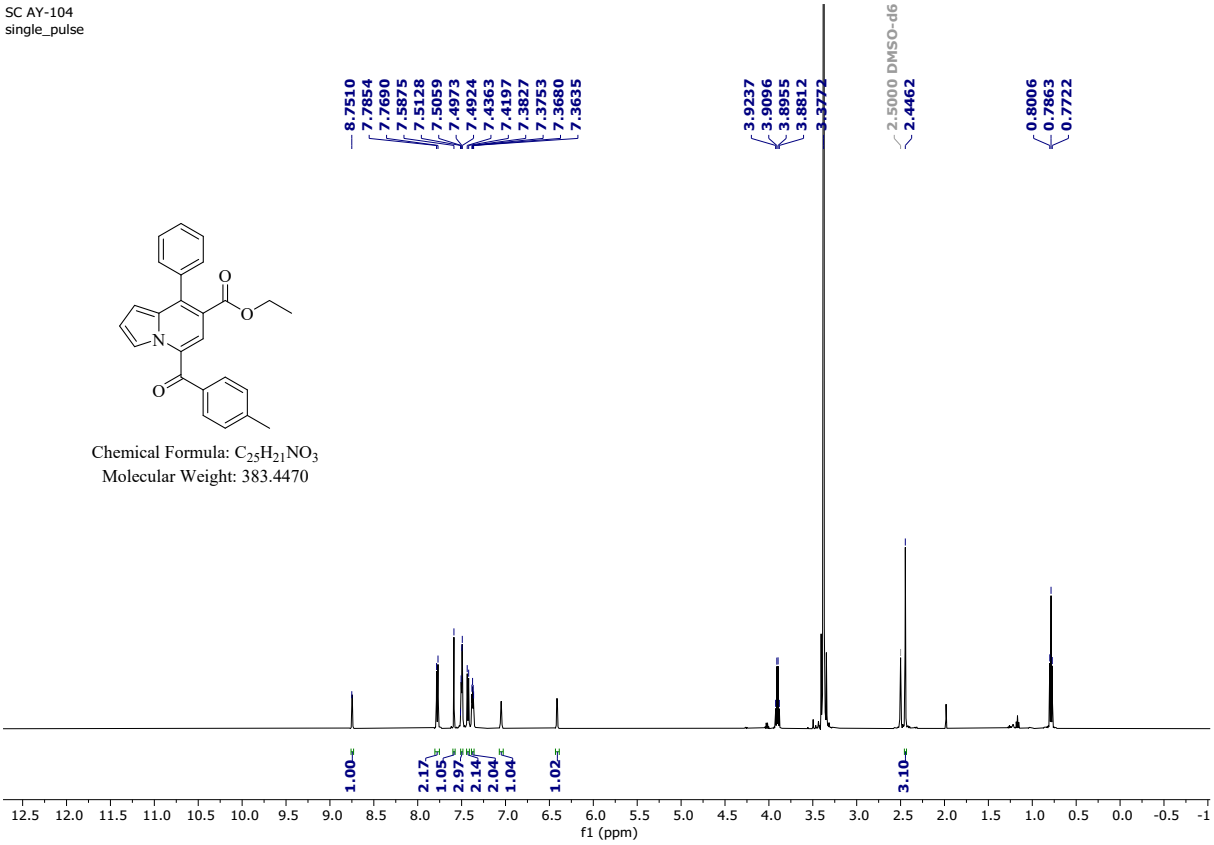


Fig 66.^{1}H-NMR of Ethyl 5-(4-methylbenzoyl)-8-phenylindolizine-7-carboxylate (5t)

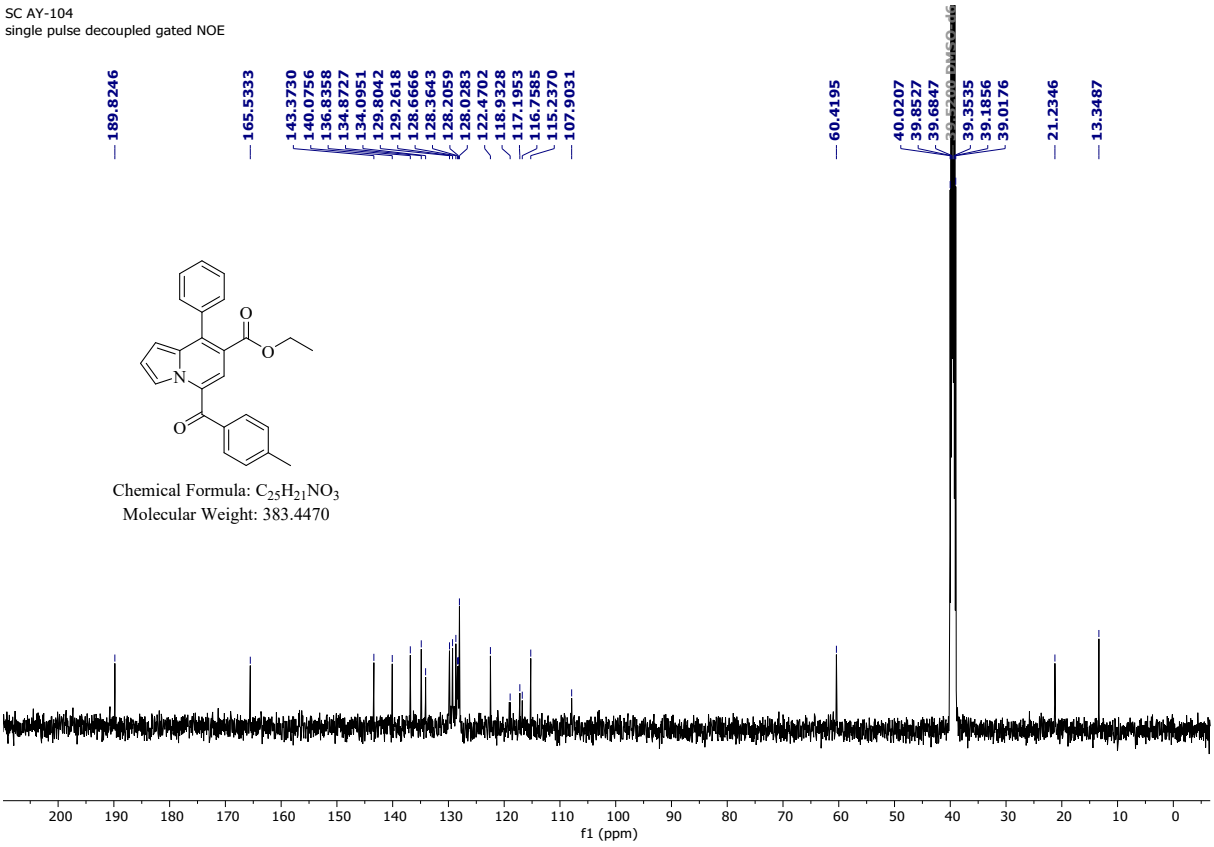


Fig 67.^{13}C-NMR of Ethyl 5-(4-methylbenzoyl)-8-phenylindolizine-7-carboxylate (5t)

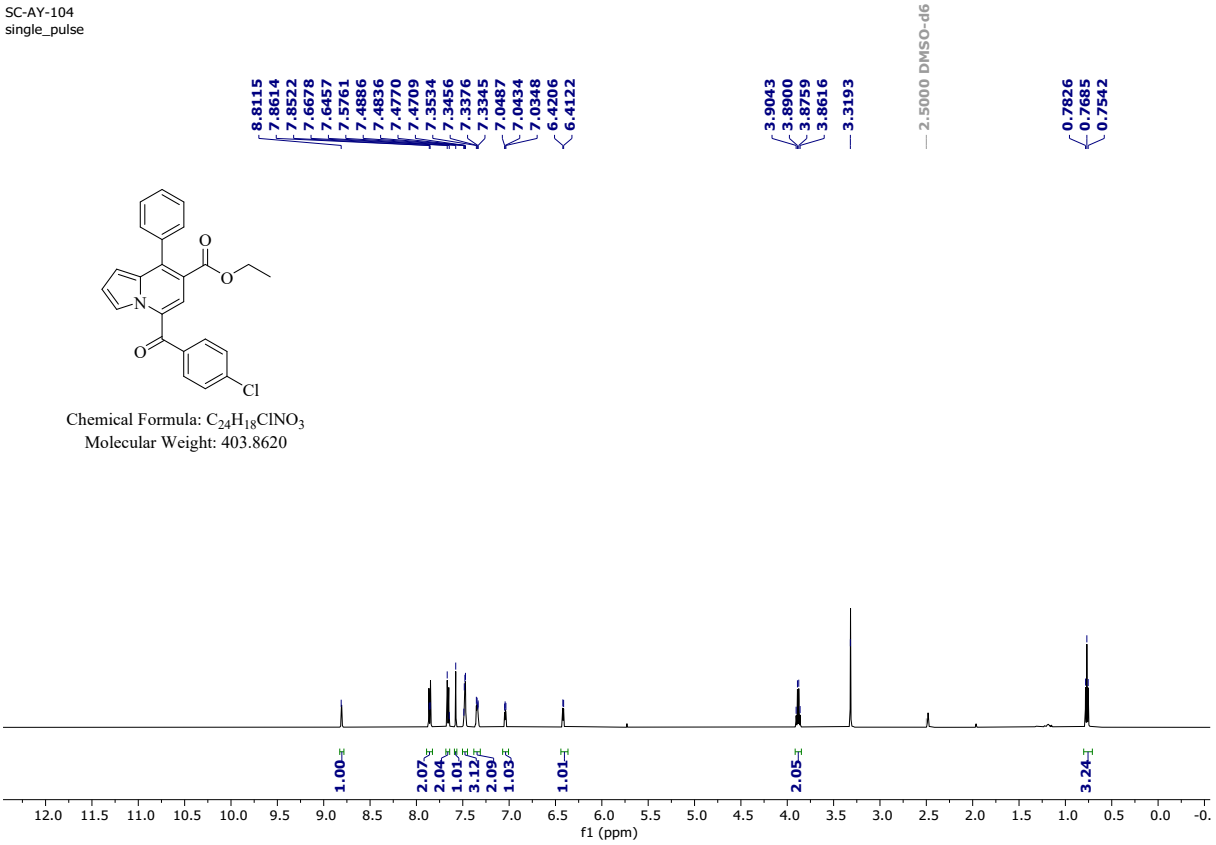


Fig 68.^{1}H-NMR of Ethyl 5-(4-chlorobenzoyl)-8-phenylindolizine-7-carboxylate (5u)

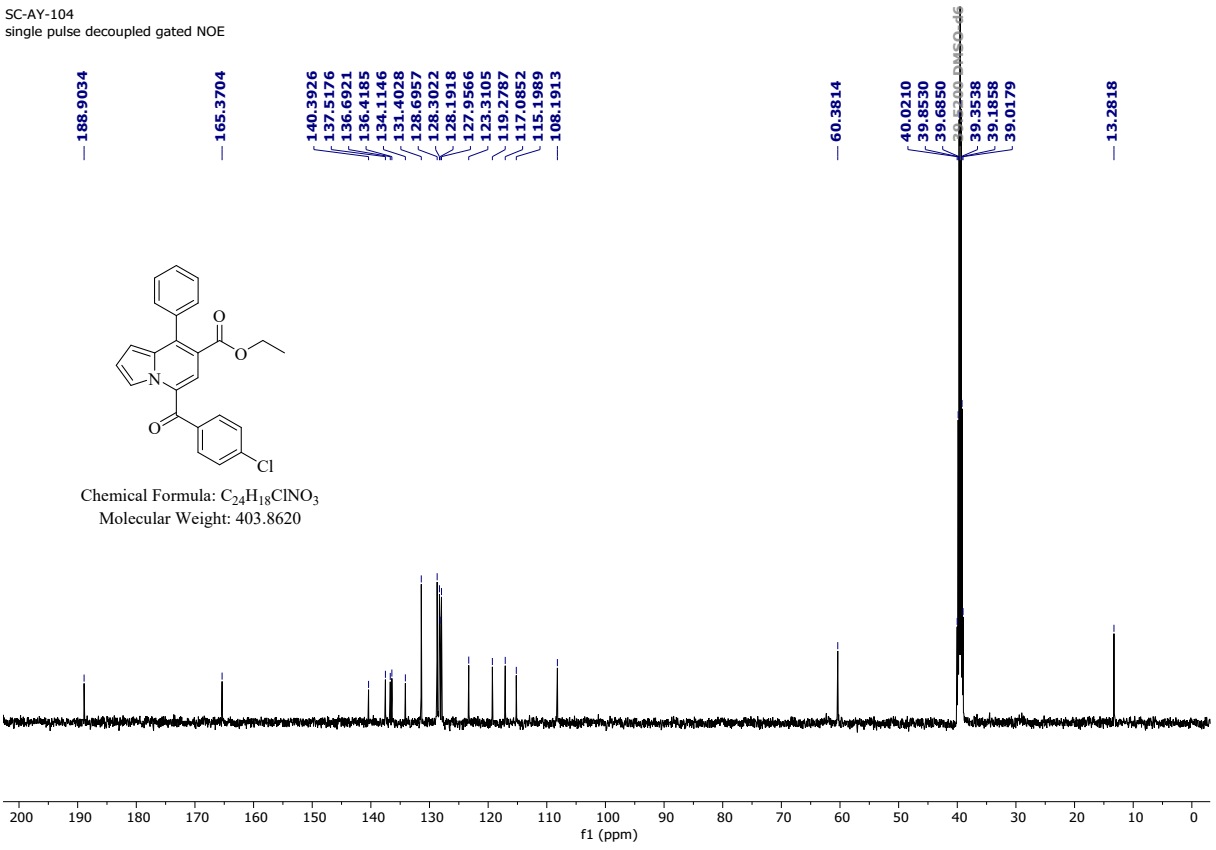


Fig 69.^{13}C-NMR of Ethyl 5-(4-chlorobenzoyl)-8-phenylindolizine-7-carboxylate (5u)

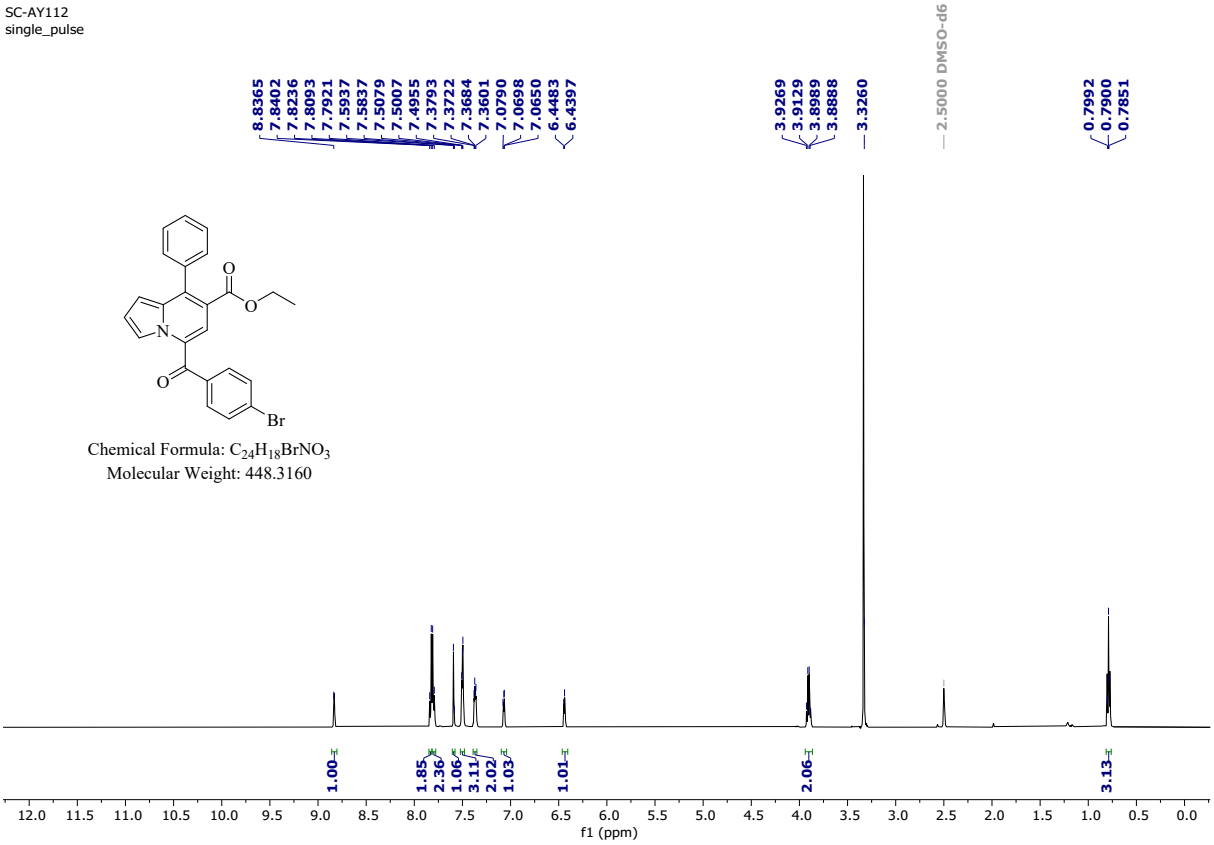


Fig 70.^{1}H-NMR of Ethyl 5-(4-bromobenzoyl)-8-phenylindolizine-7-carboxylate (5v)

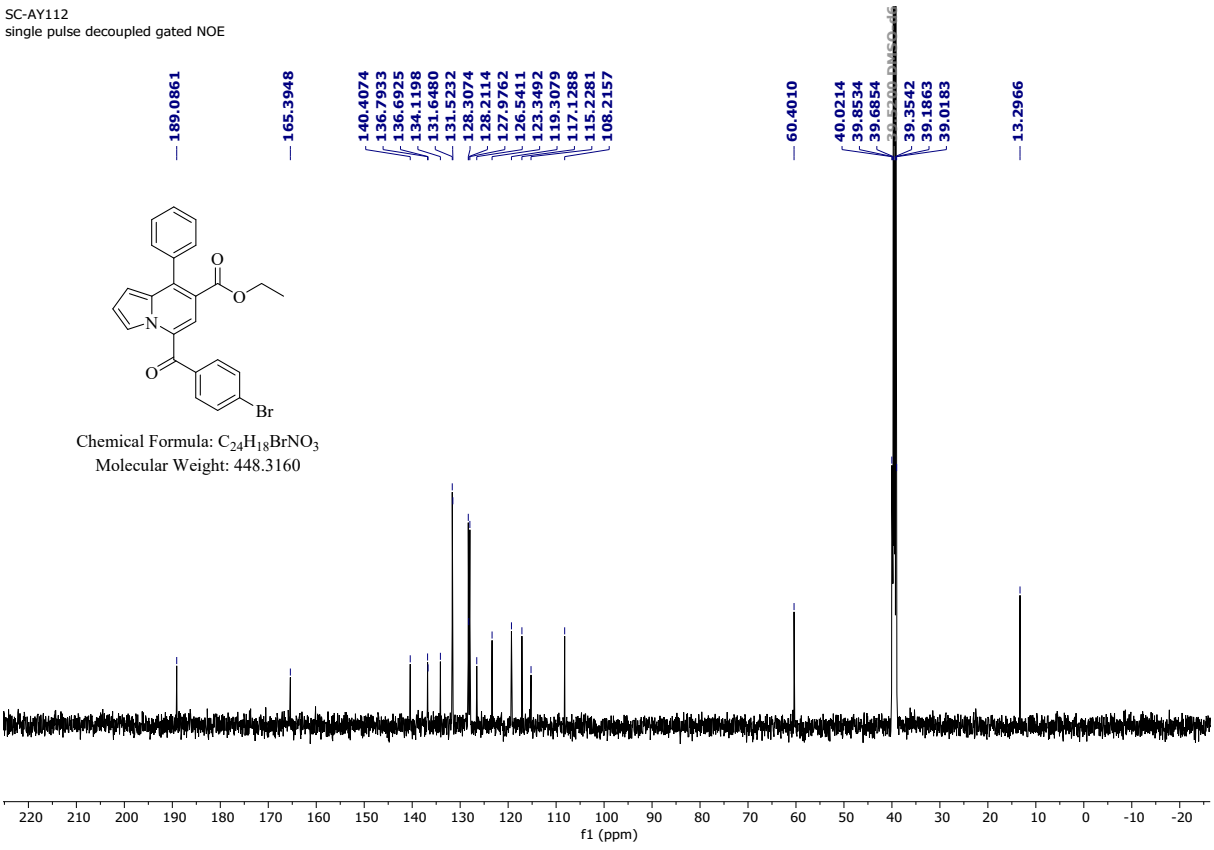


Fig 71.^{13}C-NMR of Ethyl 5-(4-bromobenzoyl)-8-phenylindolizine-7-carboxylate (5v)

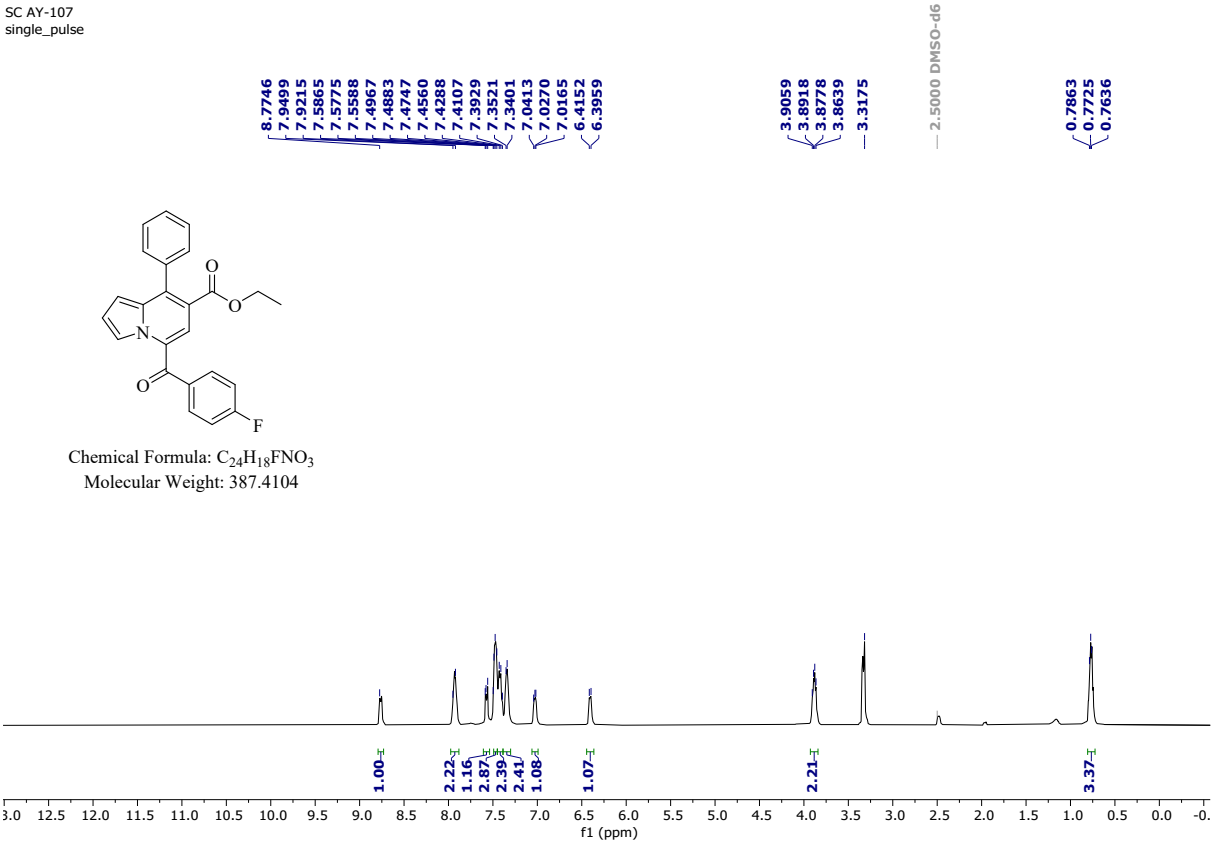


Fig 72[1]H-NMR of Ethyl 5-(4-flourobenzoyl)-8-phenylindolizine-7-carboxylate (5w)

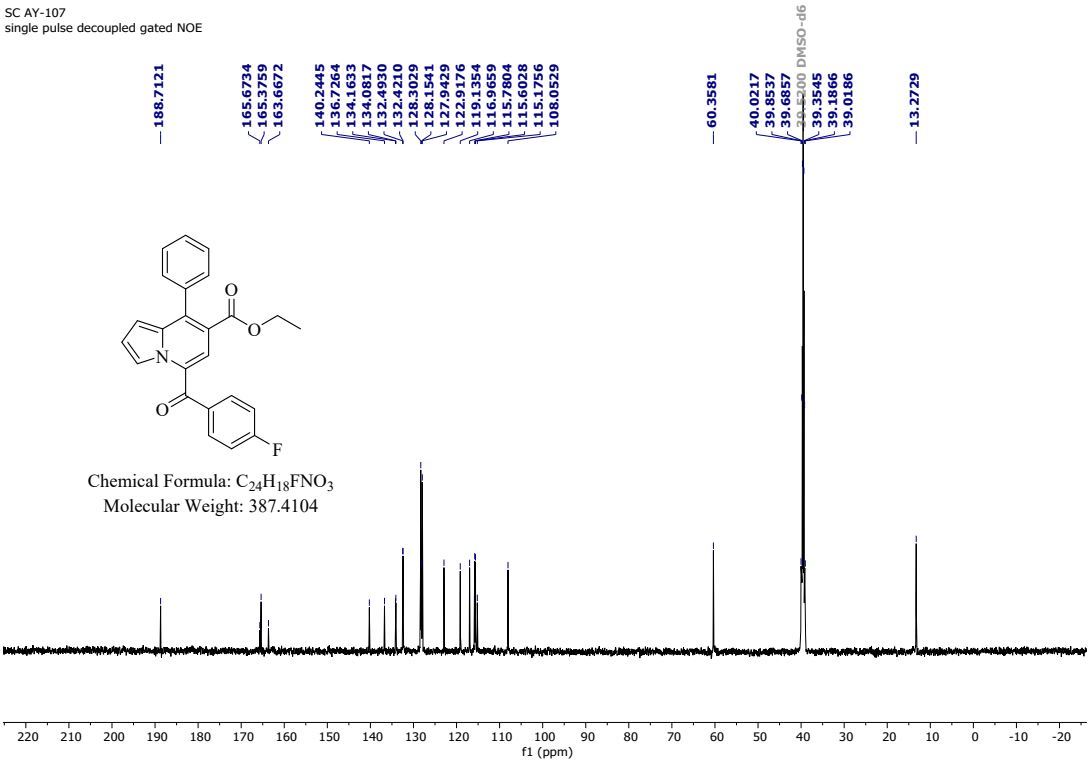


Fig 73.[13]C-NMR of Ethyl 5-(4-flourobenzoyl)-8-phenylindolizine-7-carboxylate (5w)

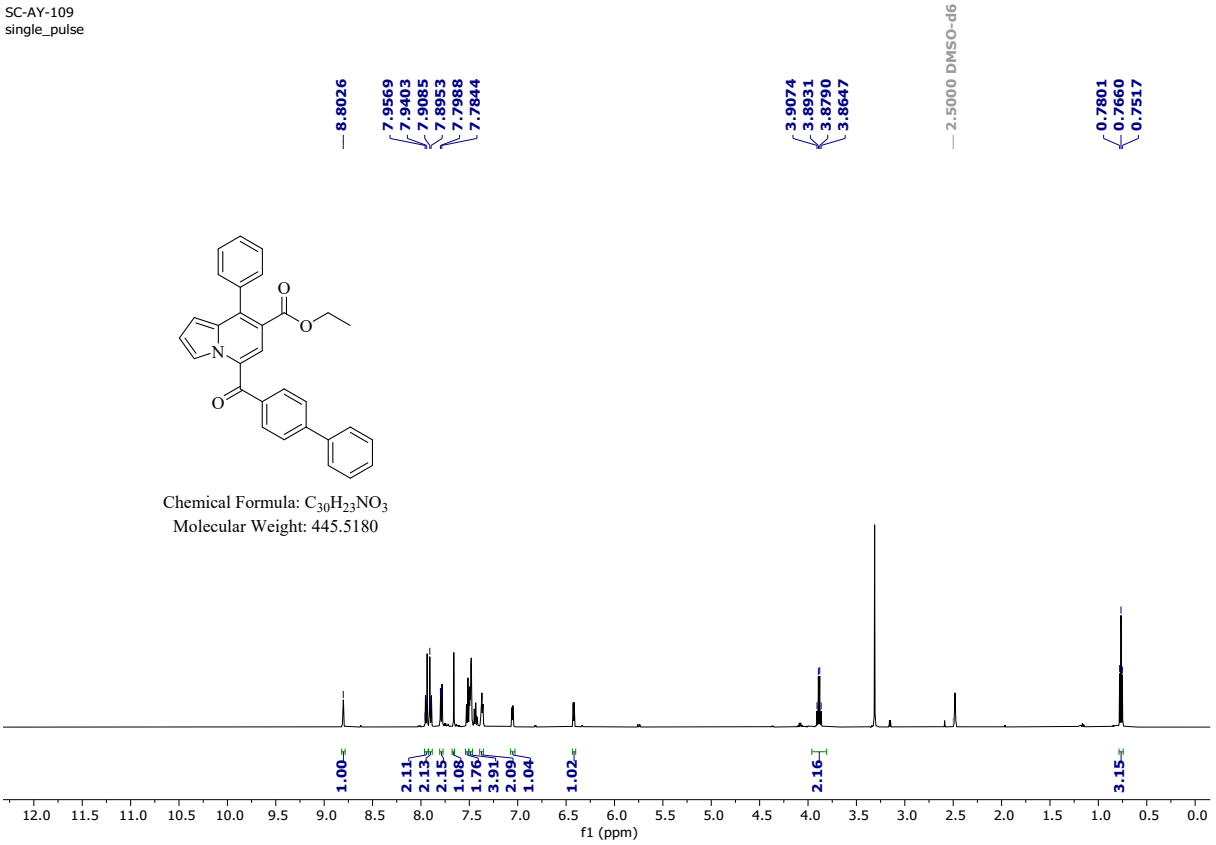


Fig 74.[1]H NMR spectra of Ethyl 5-([1,1'-biphenyl]-4-carbonyl)-8-phenylindolizine-7-carboxylate (5x)

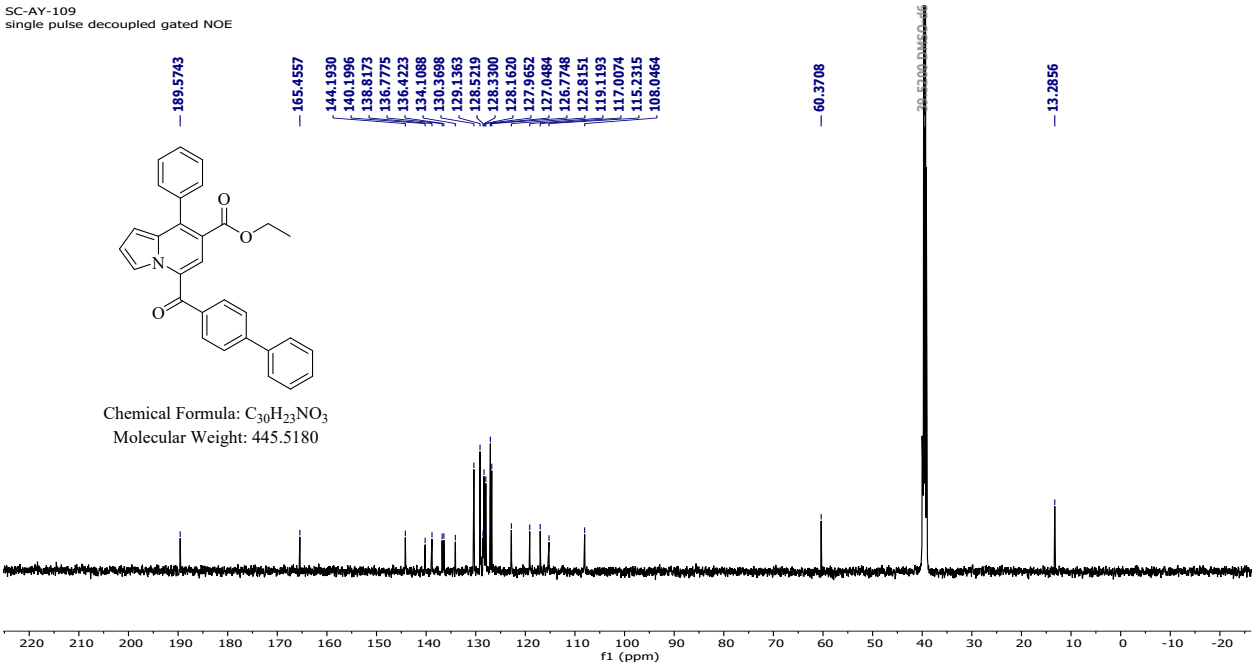


Fig 75.[13]C NMR spectra of Ethyl 5-([1,1'-biphenyl]-4-carbonyl)-8-phenylindolizine-7-carboxylate (5x)