Electronic Supplementary Material (ESI) for Chemical Communications

Nucleophilic fluorination of β-ketoester derivatives with tetrafluoroboric acid

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SUPPLEMENTARY INFORMATION

General Experimental Details

Commercially available reagents were used throughout without purification unless otherwise stated. All anhydrous solvents were purchased from Sigma Aldrich or Acros, except dichloromethane which was freshly distilled according to standard procedures. Reactions were routinely carried out under an argon atmosphere and all glassware was flame-dried before use. Light petroleum refers to the fraction with bp 40-60 ºC. Ether refers to diethyl ether.

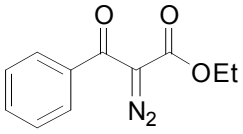
Analytical thin layer chromatography was carried out on aluminium backed plates coated with Merck Kieselgel 60 GF_{254} and visualized under UV light at 254 and/or 360 nm and/or by chemical staining. Flash chromatography was carried out using Davisil silica 60A, with the eluent specified.

All fully characterized compounds were chromatographically homogeneous. Infrared spectra were recorded using a Perkin Elmer 1600 series FT-IR spectrometer or an Avatar 320 FTIR with ATR accessory as a solid over the range 4000-600 cm^{-1}. NMR spectra were recorded using a Bruker AV400, DPX400 (400 MHz ^{1}H frequency, 100 MHz ^{13}C frequency) or Bruker AV500 (500 MHz ^{1}H frequency, 126 MHz ^{13}C frequency). Chemical shifts are quoted in parts per million (ppm), and are referenced to residual H in the deuterated solvent as the internal standard. Coupling constants, *J*, are quoted in Hz. Mass spectra were recorded on a Bruker MicroTOF 61 time-of-flight mass spectrometer using electrospray ionization (ESI), or an EI magnetic sector instrument. Melting points were measured on a Riechert-Kofler hot stage apparatus and are uncorrected.

General method A: Diazo transfer

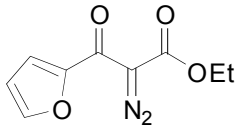
To a solution of ethyl acetoacetate (2.60 mmol) and 4-acetamidobenzenesulfonyl azide (686 mg, 2.86 mmol) in acetonitrile (18 mL) at 0°C, triethylamine (1.80 mL, 7.80 mmol) was added dropwise. After stirring at room temperature for 16 h the reaction mixture was concentrated in *vacuo* and the resulting solid was triturated with light petroleum. The filtrate was concentrated *in vacuo* and the residue was purified over silica gel using a solvent system of 20% ethyl acetate in light petroleum to yield the α-diazo-β-ketoester **1**.

Ethyl 2-diazo-3-oxo-3-phenylpropanoate, 1a



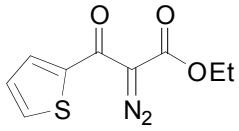
According to general method A, ethyl benzoylacetate (450 μL, 2.60 mmol) and 4-acetamidobenzenesulfonyl azide (686 mg, 2.86 mmol) and triethylamine (1.80 mL, 7.80 mmol) in acetonitrile (18 mL) gave the *title compound* as yellow oil (464 mg, 82%); (Found: $M+H^+$, 219.0769. $C_{11}H_{10}N_2O_3+H^+$ requires 219.0764); ν_{max} ($CHCl_3$)/cm^{-1} 2986, 2147, 1721, 1627, 1447, 1393, 1322, 1308, 1119; δ_H (400 MHz; $CDCl_3$) 7.65 (2 H, dd, *J* 8.0 Hz, *J* 1.6 Hz), 7.55 (1 H, tt, *J* 8.0 Hz, *J* 1.6 Hz), 7.45 (2 H, tt, *J* 8.0 Hz, *J* 1.6 Hz), 4.27 (2 H, q, *J* 7.2 Hz), 1.28 (3 H, t, *J* 7.2 Hz); δ_C (100 MHz; $CDCl_3$) 186.9 (C), 161.0 (C), 137.1 (C), 132.2 (CH), 128.3 (CH), 127.8 (CH), 61.6 (CH_2), 14.2 (Me); diazo C not observed. Spectroscopic data consistent with those previously reported.[1]

Ethyl 2-diazo-3-(2-furyl)-3-oxopropanoate, 1b



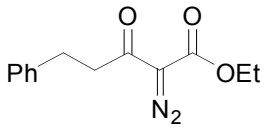
According to general method A, ethyl 3-(2-furyl)-3-oxopropanoate (474 mg, 2.60 mmol) and 4-acetamidobenzenesulfonyl azide (686 mg, 2.86 mmol) and triethylamine (1.80 mL, 7.80 mmol) in acetonitrile (18 mL) gave the *title compound* as yellow solid (405 mg, 75%); mp 36-39 °C (Found: M+Na^+, 231.0359. $C_9H_8N_2O_4$+Na^+ requires 231.0382); ν_{max} ($CHCl_3$)/cm^{-1} 3010, 2156, 1726, 1625, 1467, 1392, 1328, 1274, 1088; δ_H (400 MHz; $CDCl_3$) 7.62 (1 H, d, *J* 1.0 Hz), 7.54 (1 H, d, *J* 4.0 Hz), 6.59 (1 H, dd, *J* 4.0 Hz, *J* 1.0 Hz), 4.27 (2 H, q, *J* 7.2 Hz), 1.28 (3 H, t, *J* 7.2 Hz); δ_C (100 MHz; $CDCl_3$) 171.0 (C), 161.0 (C), 150.5 (C), 146.0 (CH), 119.4 (CH), 112.3 (CH), 61.7 (CH_2), 14.3 (Me); diazo C not observed.

Ethyl 2-diazo-3-oxo-3-(2-thienyl)propanoate, 1c



According to general method A**,** ethyl 3-oxo-3-(2-thienyl)propanoate (514 mg, 2.60 mmol) and 4-acetamidobenzenesulfonyl azide (686 mg, 2.86 mmol) and triethylamine (1.80 mL, 7.80 mmol) in acetonitrile (18 mL) gave the *title compound* as yellow oil (454 mg, 78%); (Found: M+Na^+, 247.0160. $C_9H_8N_2O_3S$+Na^+ requires 247.0148); ν_{max} ($CHCl_3$)/cm^{-1} 3011, 2145, 1718, 1587, 1465, 1393, 1371, 1320, 1262, 1079; δ_H (400 MHz; $CDCl_3$) 8.10 (1 H, dd, *J* 4.0 Hz, *J* 1.2 Hz), 7.69 (1 H, dd, *J* 5.2 Hz, *J* 1.2 Hz), 7.15 (1 H, dd, *J* 5.2 Hz, *J* 4.0 Hz), 4.27 (2 H, q, *J* 7.2 Hz), 1.28 (3 H, t, *J* 7.2 Hz); δ_C (100 MHz; $CDCl_3$) 176.7 (C), 160.9 (C), 141.4 (C), 133.9 (CH), 119.4 (CH), 112.3 (CH), 61.7 (CH_2), 14.3 (Me); diazo C not observed.

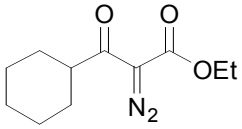
Ethyl 2-diazo-3-oxo-5-phenylpentanoate, 1d



To a stirring solution of hydrocinnamaldehyde (1.58 mL, 12.0 mmol) and $BF_3.OEt_2$ (15 μL, 0.12 mmol) in dichloromethane (12 mL), a solution of ethyl diazoacetate (1.56 mL, 12.6 mmol) in dichloromethane (12 mL) was added dropwise over 30 min. The reaction was stirred at room temperature for 1 h before the addition of brine (30 mL). The organic layer was separated and the aqueous layer extracted with dichloromethane (3 x 20 mL). The combined organic extracts were dried ($MgSO_4$) and concentrated to give the crude β-ketoester (2.64 g).

According to general method A, the crude β-ketoester (2.64 g, 12.0 mmol) and 4-acetamidobenzenesulfonyl azide (3.17 g, 13.2 mmol) and triethylamine (5.02 mL, 36.0 mmol) in acetonitrile (84 mL) gave the *title compound* as a pale yellow oil (1.85 g, 63%); (Found: $M+H^+$, 247.1068. $C_{13}H_{14}N_2O_3+H^+$ requires 247.1077); ν_{max} ($CHCl_3$)/cm^{-1} 2983, 2938, 2140, 1714, 1651, 1454, 1374, 1313, 1128, 1052, 986; δ_H (400 MHz; $CDCl_3$) 7.34-7.20 (5 H, m), 4.32 (2 H, q, *J* 7.1 Hz), 3.24-3.19 (2 H, m), 2.99 (2 H, t, *J* 8.0 Hz), 1.35 (3 H, t, *J* 7.1 Hz); δ_C (100 MHz; $CDCl_3$) 192.0 (C), 161.3 (C), 140.9 (C), 128.5 (CH), 128.4 (CH), 126.1 (CH), 61.4 (CH_2), 41.8 (CH_2), 30.2 (CH_2), 14.4 (Me); diazo C not observed. Spectroscopic data consistent with those previously reported.[2]

Ethyl 3-cyclohexyl-2-diazo-3-oxopropanoate, 1e



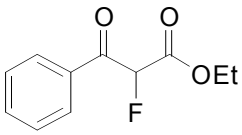
To a stirring solution of cyclohexanecarboxaldehyde (1.33 mL, 11.0 mmol) and $BF_3.OEt_2$ (14 μL, 0.11 mmol) in dichloromethane (12 mL), a solution of ethyl diazoacetate (1.42 mL, 11.6 mmol) in dichloromethane (12 mL) was added dropwise over 30 min. The reaction was stirred at room temperature for 1 h before the addition of brine (30 mL). The organic layer was separated and the aqueous layer extracted with dichloromethane (3 x 20 mL). The combined organic extracts were dried ($MgSO_4$) and concentrated to give the crude β-ketoester (2.18 g).

According to general method A, the crude β-ketoester (2.18 g, 11.0 mmol) and 4-acetamidobenzenesulfonyl azide (2.90 g, 12.1 mmol) and triethylamine (4.60 mL, 33.0 mmol) in acetonitrile (77 mL) gave the *title compound* as a pale yellow oil (1.90 g, 77%); (Found: $M+H^+$, 225.1234. $C_{11}H_{16}N_2O_3+H^+$ requires 225.1234); ν_{max} ($CHCl_3$)/cm^{-1} 2929, 2856, 2138, 1715, 1651, 1451, 1371, 1318, 1146, 1118, 1093, 1077, 1057, 1044, 1007, 978; δ_H (400 MHz; $CDCl_3$) 4.30 (2 H, q, *J* 7.2 Hz), 3.36-3.27 (1 H, m), 1.85-1.78 (4 H, m), 1.74-1.66 (1 H, m), 1.46-1.39 (2 H, m), 1.37-1.29 (5 H, m), 1.28-1.19 (1 H, m); δ_C (100 MHz; $CDCl_3$) 196.0 (C), 161.3 (C), 61.3 (CH_2), 46.8 (CH), 28.7 (CH_2), 25.8 (CH_2), 25.7 (CH_2), 14.3 (Me); diazo C not observed.

General method B: Fluorination

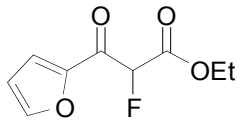
To a solution of the α-diazo-β-ketoester **1** (0.32 mmol) in dichloromethane (3.2 mL) at 0 °C, tetrafluoroboronic acid etherate (25 μL, 0.35 mmol) was added dropwise. The resulting solution was stirred at room temperature for 5 h. The reaction was quenched with ice-water (2 mL), and extracted with dichloromethane (3 x 3 mL). The organic layers were dried over $MgSO_4$ and concentrated under reduced pressure. The residue was purified over silica using 10% ethyl acetate in light petroleum to give α-fluoro-β-ketoester **2**.

Ethyl 2-fluoro-3-oxo-3-phenylpropanoate, 2a



According to general method B, ethyl 2-diazo-3-oxo-3-phenylpropanoate **1a** (70 mg, 0.32 mmol) and tetrafluoroboronic acid etherate (25 μL, 0.35 mmol) in dichloromethane (3.2 mL) gave the *title compound* as yellow oil (52 mg, 82%); (Found: M+Na$^+$, 233.0587. $C_{11}H_{12}FO_3$+Na$^+$ requires 233.0584); ν_{max} ($CHCl_3$)/cm^{-1} 2986, 2360, 1760, 1694, 1581, 1449, 1285, 1241; δ_H (400 MHz; $CDCl_3$) 8.07 (2 H, dt, *J* 8.0 Hz, *J* 1.6 Hz), 7.66 (1 H, tt, *J* 8.0 Hz, *J* 1.6 Hz), 7.52 (2 H, tt, *J* 8.0 Hz, *J* 1.6 Hz), 5.90 (1 H, d, *J* 48.0 Hz), 4.31 (2 H, qd, *J* 8.0 Hz, *J* 1.6 Hz), 1.28 (3 H, t, *J* 8.0 Hz); δ_C (100 MHz; $CDCl_3$) 189.6 (d, *J* 21 Hz, C), 165.0 (d, *J* 24 Hz, C), 134.5 (CH), 133.3 (d, *J* 2 Hz, C), 129.5 (d, *J* 4 Hz, CH), 128.8 (CH), 90.0 (d, *J* 197 Hz, CH), 62.7 (CH_2), 13.9 (Me); δ_F (377 MHz; $CDCl_3$) -190.5 (s, CF). Spectroscopic data consistent with those previously reported.[3]

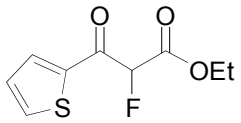
Ethyl 2-fluoro-3-(2-furyl)-3-oxopropanoate, 2b



According to general method B, ethyl 2-diazo-3-(2-furyl)-3-oxopropanoate **1b** (66 mg, 0.32 mmol) and tetrafluoroboronic acid etherate (25 μL, 0.35 mmol) in dichloromethane (3.2 mL) gave the *title compound* as yellow oil (39 mg, 61%); (Found: M+Na$^+$, 223.0380. $C_9H_{10}FO_4$+Na$^+$ requires 223.0377); ν_{max} ($CHCl_3$)/cm^{-1} 2986, 2133, 1760, 1683, 1569, 1464, 1395, 1260, 1113, 1023; δ_H (400 MHz; $CDCl_3$) 7.75 (1 H, d, *J* 0.8 Hz), 7.53 (1 H, d, *J* 4.0 Hz), 6.65 (1 H, dd, *J* 4.0 Hz, *J* 1.2 Hz), 5.73 (1 H, d, *J* 48 Hz), 4.33 (2 H, q, *J* 7.2 Hz), 1.31 (3 H, t, *J* 7.2 Hz); δ_C (100

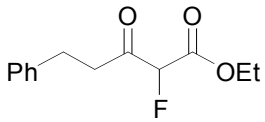
MHz; $CDCl_3$), 177.5 (d, *J* 21 Hz, C), 164.4 (d, *J* 25 Hz, C), 149.2 (C), 148.4 (CH), 121.9 (d, *J* 6 Hz, CH), 112.9 (CH), 89.3 (d, *J* 197 Hz, CH), 62.7 (CH_2), 13.9 (Me); δ_F (377 MHz; $CDCl_3$) -189.0 (s, CF).

Ethyl 2-fluoro-3-oxo-3-(2-thienyl)propanoate, 2c



According to general method B, ethyl 2-diazo-3-oxo-3-(2-thienyl)propanoate **1c** (72 mg, 0.32 mmol) and tetrafluoroboronic acid etherate (25 μL, 0.35 mmol) in dichloromethane (3.2 mL) gave the *title compound* as yellow oil (53 mg, 76%); (Found: $M+Na^+$, 239.0143. $C_9H_9FO_3S+Na^+$ requires 239.0149); ν_{max} ($CHCl_3$)/cm^{-1} 2986, 2133, 1760, 1683, 1569, 1464, 1395, 1260, 1113, 1023; δ_H (400 MHz; $CDCl_3$) 8.5 (1 H, ddd, *J* 3.9 Hz, *J* 1.9 Hz, *J* 1.1 Hz), 7.82 (1 H, dd, *J* 4.0 Hz, *J* 1.0 Hz), 7.22 (1 H, dd, *J* 5.0 Hz, *J* 3.9 Hz), 5.71 (1 H, d, *J* 48 Hz), 4.33 (2 H, m), 1.31 (3 H, t, *J* 8.0 Hz); δ_C (100 MHz; $CDCl_3$) 182.3 (d, *J* 21 Hz, C), 164.6 (d, *J* 23 Hz, C), 139.2 (d, *J* 1.5 Hz, C), 136.2 (d, *J* 1.5 Hz, CH), 135.4 (d, *J* 7 Hz, CH), 128.7 (CH), 90.5 (d, *J* 197 Hz, CH), 62.8 (CH_2), 13.9 (Me); δ_F (377 MHz; $CDCl_3$) -189.0 (s, CF).

Ethyl 2-fluoro-3-oxo-5-phenylpentanoate, 2d

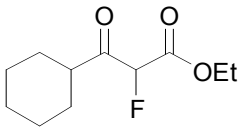


According to general method B, ethyl 2-diazo-3-oxo-5-phenylpentanoate, **1d** (800 mg, 3.25 mmol and tetrafluoroboronic acid (0.49 mL, 3.58 mmol) in dichloromethane (16 mL) gave the *title compound* as a colourless oil (395 mg, 51%); (Found: $M+Na^+$, 261.0889. $C_{13}H_{15}FO_3+Na^+$

requires 261.0897); ν_{max} ($CHCl_3$)/cm^{-1}; 2984, 2940, 1757, 1733, 1604, 1496, 1454, 1397, 1371, 1327, 1300, 1129, 1101; δ_H (400 MHz; $CDCl_3$) 7.32-7.27 (2 H, m), 7.23-7.18 (3 H, m), 5.20 (1 H, d, *J* 48.0 Hz), 4.27 (2 H, qd, *J* 7.2 Hz, *J* 3.1 Hz), 3.10-2.99 (2 H, m), 2.98-2.93 (2 H, m), 1.29 (3 H, d, *J* 7.2 Hz); δ_C (100 MHz; $CDCl_3$) 200.3 (d, *J* 23 Hz, C), 164.0 (d, *J* 24 Hz, C), 140.1 (C), 128.5 (CH), 128.3 (CH), 128.4 (CH), 91.4 (d, *J* 197 Hz, CH), 62.7 (CH_2), 40.0 (CH_2), 28.7 (CH_2), 13.9 (Me); δ_F (377 MHz; d_6-DMSO) -140.0 (s, CF). Spectroscopic data consistent with those previously reported.[4]

In addition **Ethyl 3,3-difluoro-2-hydroxy-5-phenylpentanoate** was isolated as a colourless oil (192 mg, 21%); (Found: M+Na^+, 281.0955. $C_{13}H_{16}F_2O_3$+Na^+ requires 281.0960); ν_{max} ($CHCl_3$)/cm^{-1} 3520, 2983, 2941, 2873, 1732, 1604, 1497, 1455, 1369, 1306, 1131, 1103, 1055, 1015; δ_H (400 MHz; $CDCl_3$) 7.38-7.32 (2 H, m), 7.29-7.23 (3 H, m), 4.47-4.30 (3 H, m), 3.32 (1 H, br s), 2.91 (2 H, t, *J* 8.0 Hz), 2.45-2.26 (2 H, m), 1.39 (3 H, t, *J* 7.2 Hz); δ_C (126 MHz; $CDCl_3$) 169.8 (t, *J* 1 Hz, C), 140.2 (C), 128.6 (CH), 128.3 (CH), 126.3 (CH), 121.6 (t, *J* 249 Hz, C), 71.9 (dd, *J* 32 Hz, *J* 29 Hz, CH), 62.9 (CH_2), 35.2 (t, *J* 24 Hz, CH_2), 27.7 (dd, *J* 5 Hz, *J* 4 Hz, CH_2), 14.0 (Me); δ_F (377 MHz; $CDCl_3$) -108.0 (d, *J* 251, CF_2), -110.4 (d, *J* 251, CF_2).

Ethyl 3-cyclohexyl-2-fluoro-3-oxopropanoate, 2e



According to general method B, ethyl 3-cyclohexyl-2-diazo-3-oxopropanoate, **1e** (688 mg, 3.10 mmol and tetrafluoroboronic acid (0.46 mL, 3.37 mmol) in dichloromethane (15 mL) gave the *title compound* as a colourless oil (410 mg, 61%); (Found: M+Na^+, 229.1045. $C_{11}H_{17}FO_3$+Na^+ requires 239.1054); ν_{max} ($CHCl_3$)/cm^{-1} 2935, 2858, 1756, 1725, 1451, 1371, 1326, 1299, 1147,

1099, 1024, 992; δ_H (400 MHz; $CDCl_3$) 5.27 (1 H, d, *J* 49.3 Hz), 4.31 (2 H, q, *J* 7.2 Hz), 2.92-2.83 (1 H, m), 1.92-1.77 (4 H, m), 1.72-1.66 (1 H, m), 1.46-1.38 (1 H, m), 1.37-1.29 (6 H, m), 1.28-1.20 (1 H, m); δ_C (100 MHz; $CDCl_3$) 203.9 (d, *J* 21 Hz, C), 164.4 (d, *J* 25 Hz, C), 90.7 (d, *J* 198 Hz, CH), 62.5 (CH_2), 46.5 (CH), 28.1 (CH_2), 27.6 (CH_2), 25.6 (CH_2), 25.5 (CH_2), 25.2 (CH_2), 14.0 (Me). Spectroscopic data consistent with those previously reported.[5]

In addition **Ethyl 3-cyclohexyl-3,3-difluoro-2-hydroxypropanoate** was isolated as a colourless solid (117 mg, 16%); mp 51-52 °C; (Found: M+Na^+, 259.1117. $C_{11}H_{18}F_2O_3$+Na^+ requires 259.1116); ν_{max} ($CHCl_3$)/cm^{-1} 3523, 2937, 2858, 1733, 1453, 1369, 1304, 1156, 1142, 1105, 1050, 1028, 995; δ_H (400 MHz; $CDCl_3$) 5.27 (1 H, d, *J* 49.2 Hz), 4.31 (2 H, q, *J* 7.2 Hz), 2.92-2.84 (1 H, m), 1.92-1.87 (1 H, m), 1.86-1.77 (3 H, m), 1.72-1.65 (1 H, m), 1.45-1.37 (1 H, m), 1.36-1.22 (7 H, m); δ_C (100 MHz; $CDCl_3$) 170.4 (C), 122.8 (t, *J* 250 Hz, C), 70.3 (t, *J* 32 Hz, CH), 62.7 (CH_2), 40.8 (t, *J* 22 Hz, CH), 25.9 (CH_2), 25.8 (t, *J* 14 Hz, CH_2), 25.6 (CH_2), 25.5 (CH_2), 24.1 (t, *J* 4 Hz, CH_2), 14.0 (Me); δ_F (377 MHz; d_6-DMSO) -117.0 (s, CF_2).

Procedure for Fluorination in Flow

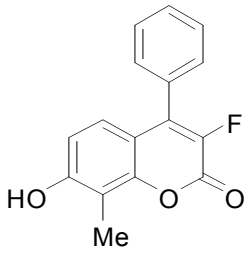
The flow reaction was controlled using Vapourtec Flowcommander software. A solution of the diazo compound **1** (0.40 mmol) in dichloromethane (2 mL) was injected into one of the 2 mL sample loops of the R2+ unit. The other 2 mL sample loop was loaded with a solution of tetrafluoroboronic acid (0.44 mmol) in dichloromethane (2 mL). The valves of the loop were set to load and the reagents pumped through the system using dichloromethane as a system solvent at a flow rate of 0.200 mL/min (0.100 mL/min per pump). The reagents mixed in a T-piece before entering a 2 mL coil reactor (PFA), maintained at 70 °C (R4 unit). A back pressure regulator (250 psi) was added in line after the reactor and the output (6.0 mL total volume) was

quenched into a vial containing water (5 mL). The organic layer was separated and the aqueous layer extracted with dichloromethane (3 x 10 mL). The combined organic extracts were dried ($MgSO_4$) and concentrated and the residue purified over silica using a solvent system of 10% ethyl acetate in light petroleum to give the fluorinated β-ketoester **2**.

General method C: Coumarin synthesis

A solution of α-fluoro-β-ketoester **2** (0.50 mmol) and 2-methylresorcinol (68 mg, 0.55 mmol), in trifluoroacetic acid (0.5 mL) was heated at reflux for 10 h. The mixture was quenched with water (0.5 mL) and filtered. The residue was recrystallized from ethanol to yield the 3-fluoro-7-hydroxy-coumarin **3**.

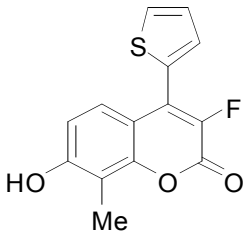
3-Fluoro-7-hydroxy-8-methyl-4-phenyl-2*H*-chromen-2-one, 3a



According to general method C, ethyl 2-fluoro-3-oxo-3-phenylpropanoate **2a** (105 mg, 0.50 mmol) and 2-methylresorcinol (68 mg, 0.55 mmol) in trifluoroacetic acid (0.5 mL) gave the *title compound* as a colourless solid (121 mg, 92%); mp 279-283 °C (lit.,[6] mp 223-224 °C); (Found: $M+Na^+$, 293.0577. $C_{16}H_{11}FO_3+Na^+$ requires 293.0584); ν_{max} ($CHCl_3$)/cm^{-1} 3370, 1698, 1624, 1602, 1572, 1508, 1444, 1353, 1306, 1265, 1123, 1079; δ_H (400 MHz; d_6-DMSO) 10.48 (1 H, s), 7.54-7.66 (3 H, m), 7.48 (2 H, dd, *J* 8.0 Hz, *J* 1.8), 6.89 (2 H, d, *J* 1.0 Hz), 2.23 (3 H, s); δ_C (100 MHz; d_6-DMSO) 158.7 (d, *J* 2 Hz, C), 155.8 (d, *J* 29 Hz, C), 150.4 (C), 140.5 (d, *J* 240 Hz, C), 135.3 (d, *J* 12 Hz, C), 130.0 (C), 129.5 (CH), 129.4 (CH), 129.3 (CH), 125.1 (d, *J* 6 Hz, CH),

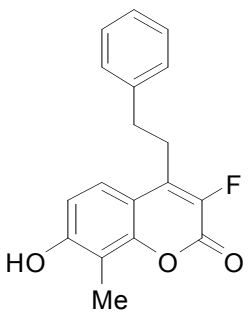
113.2 (CH), 111.8 (C), 111.0 (C), 8.6 (Me); δ_F (377 MHz; $CDCl_3$) -142.0 (s, CF). Spectroscopic data consistent with those previously reported.[6]

3-Fluoro-7-hydroxy-8-methyl-4-(2-thienyl)-2*H*-chromen-2-one, 3b



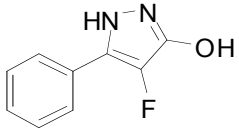
According to general method C, ethyl 2-fluoro-3-oxo-3-(2-thienyl)propanoate **2c** (108 mg, 0.50 mmol) and 2-methylresorcinol (68 mg, 0.55 mmol) in trifluoroacetic acid (0.5 mL) gave the *title compound* as a colourless solid (114 mg, 83%); mp 263-267 °C; (Found: M+Na^+, 299.0148. $C_{14}H_9FO_3S$+Na^+ requires 299.0149); ν_{max} ($CHCl_3$)/cm^{-1} 3256, 1681, 1623, 1601, 1573, 1504, 1423, 1358, 1265, 1127; δ_H (400 MHz; $CDCl_3$) 10.53 (1 H, s), 7.98 (1 H, dd, *J* 5.1 Hz, *J* 1.1 Hz), 7.46 (1 H, dd, *J* 3.6 Hz, *J* 0.5 Hz), 7.32-7.35 (2 H, m), 6.92 (1 H, d, *J* 8.0 Hz) 2.20 (3 H, s); δ_C (100 MHz; $CDCl_3$) 158.5 (d, *J* 2 Hz, C), 155.4 (d, *J* 29 Hz, C), 150.2 (d, *J* 2 Hz, C), 140.4 (d, *J* 240 Hz, C), 131.8 (CH), 130.5 (CH), 128.6 (d, *J* 6 Hz, C), 128.3 (CH), 128.8 (C), 124.9 (d, *J* 6 Hz, CH), 113.2 (CH), 111.9 (C), 110.3 (C), 8.6 (Me); δ_F (377 MHz; $CDCl_3$) -138.5 (s, CF).

3-Fluoro-7-hydroxy-8-methyl-4-phenethyl-2*H*-chromen-2-one, 3c



According to general method C, ethyl 2-fluoro-3-oxo-5-phenylpentanoate **2c** (50 mg, 0.21 mmol) and 2-methylresorcinol (26 mg, 0.22 mmol) in trifluoroacetic acid (0.2 mL) gave the *title compound* as a colourless solid (32 mg, 51%); mp 202-204 °C; (Found: M+Na^+, 321.0869. $C_{18}H_{15}FO_3$+Na^+ requires 321.0903); ν_{max} ($CHCl_3$)/cm^{-1} 3247, 1698, 1640, 1581, 1526, 1508, 1454, 1367, 1333, 1266, 1148, 1085; δ_H (400 MHz; d_6-DMSO) 10.43 (1 H, s), 7.57 (1 H, d, *J* 8.8 Hz), 7.20-7.31 (5 H, m), 6.95 (1 H, d, *J* 8.8 Hz), 3.08 (2 H, t, *J* 7.8 Hz), 2.88 (2 H, t, *J* 7.8 Hz), 2.18 (3 H, s); δ_C (100 MHz; d_6-DMSO) 158.5 (d, *J* 2 Hz, C), 155.4 (d, *J* 29 Hz, C), 150.3 (C), 141.3 (d, *J* 240 Hz, C), 135.5 (d, *J* 12 Hz, C), 128.9 (CH), 128.8 (CH), 126.8 (CH), 123.6 (d, *J* 6 Hz, CH), 113.1 (CH), 110.6 (C), 110.3 (C), 111.0 (C), 34.5 (CH_2), 26.3 (CH_2), 8.6 (Me); δ_F (377 MHz; $CDCl_3$) -143.2 (s, CF).

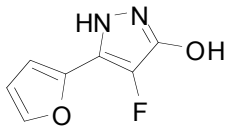
4-Fluoro-5-phenyl-1*H*-pyrazol-3-ol, 4a



To a solution of ethyl 2-fluoro-3-oxo-3-phenylpropanoate **2a** (90 mg, 0.42 mmol) in 2-propanol (4 mL), hydrazine monohydrate (24 μL, 0.50 mmol) was added. The resulting mixture was heated at reflux for 5 h. The solvent was evaporated in *vacuo* and the residue was purified over silica gel using 20% ethyl acetate in dichloromethane to give the *title compound* as a colourless solid (46 mg, 62%); mp 181-184 °C (lit.,[7] mp 184-186 °C); (Found: M+Na^+, 221.0246. $C_9H_{10}O_3S$+Na^+ requires 221.0243); ν_{max} ($CHCl_3$)/cm^{-1} 2654, 1604, 1552, 1482, 1250, 1129, 1072, 1020; δ_H (400 MHz; $CDCl_3$) 12.0 (1 H, s), 10.1 (1 H, s), 7.66 (2 H, d, *J* 7.6 Hz), 7.49 (2 H, t, *J* 7.6 Hz), 7.37 (1 H, t, *J* 7.6 Hz); δ_C (125 MHz; $CDCl_3$) 148.8 (C), 132.7 (d, *J* 240 Hz, C),

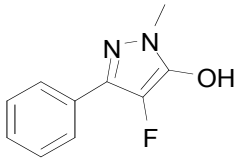
129.5 (CH), 129.3 (C), 128.5 (CH), 126.7 (d, *J* 21 Hz, C), 125.1 (d, *J* 32 Hz, CH); δ_F (377 MHz; $CDCl_3$) -186.1 (s, CF). Spectroscopic data consistent with those previously reported.[7]

4-Fluoro-5-(2-furyl)-1*H*-pyrazol-3-ol, 4b



To a solution of ethyl 2-fluoro-3-(2-furyl)-3-oxopropanoate **2b** (84 mg, 0.42 mmol) in 2-propanol (4 mL), hydrazine monohydrate (24 μL, 0.50 mmol) was added. The resultant mixture was heated at reflux for 5 h. The solvent was evaporated in *vacuo* and the residue was purified over silica using 20% ethyl acetate in dichloromethane to give the *title compound* as a colourless solid (41 mg, 58%); mp 166-169 °C; (Found: M+Na^+, 191.0234. $C_7H_5FN_2O_2$+Na^+ requires 191.0227); ν_{max} ($CHCl_3$)/cm^{-1} 2665, 1602, 1552, 1489, 1371, 1250, 1176, 1137; δ_H (400 MHz; $CDCl_3$) 12.15 (1 H, s), 10.23 (1 H, s), 7.81 (1 H, s), 6.69 (1 H, s), 6.64 (1 H, s); δ_C (125 MHz; $CDCl_3$) 148,5 (C), 143.4 (CH), 142.7 (C), 131.2 (d, *J* 240 Hz, C), 120.4 (C), 112.1 (CH), 107.5 (CH); δ_F (377 MHz; $CDCl_3$) -184.3 (s, CF).

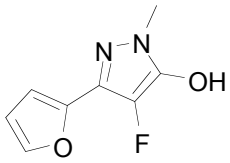
4-Fluoro-1-methyl-3-phenyl-1*H*-pyrazol-5-ol, 4c



To a solution of ethyl 2-fluoro-3-oxo-3-phenylpropanoate **2a** (116 mg, 0.54 mmol) in 2-propanol (5 mL), methylhydrazine (57 μL, 1.08 mmol) was added. The resultant mixture was heated at reflux for 12 h. The solvent was evaporated in *vacuo* and the residue was purified over silica

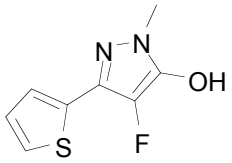
using 30% ethyl acetate in light petroleum to give the *title compound* as a colourless solid (43 mg, 41%); mp 135-138 °C (lit.,[7] mp 130-132 °C); (Found: M+Na$^+$, 215.0601. $C_{10}H_9FN_2O$+Na$^+$ requires 215.0591); ν_{max} ($CHCl_3$)/cm^{-1} 3007, 2631, 1729, 1604, 1582, 1524, 1351, 1294, 1249, 1181, 1009; δ_H (400 MHz; $CDCl_3$) 7.45-7.57 (5 H, m), 3.70 (3 H, s); δ_C (100 MHz; $CDCl_3$) 148.3 (d, *J* 4 Hz, C), 131.6 (d, *J* 240 Hz, C), 131.2 (C), 131.0 (C), 129.2 (CH), 128.9 (CH), 126.9 (CH), 36.8 (Me); δ_F (377 MHz; $CDCl_3$) -188.1 (s, CF). Spectroscopic data consistent with those previously reported.[7]

4-Fluoro-3-(2-furyl)-1-methyl-1*H*-pyrazol-5-ol, 4d



To a solution of ethyl 2-fluoro-3-(2-furyl)-3-oxopropanoate **2b** (108 mg, 0.54 mmol) in 2-propanol (5 mL), methylhydrazine (57 μL, 1.08 mmol) was added. The resultant mixture was heated at reflux for 12 h. The solvent was evaporated in *vacuo* and the residue was purified over silica using 30% ethyl acetate in light petroleum to give the *title compound* as a colourless solid (35 mg, 36%); mp 145-147 °C; (Found: M+Na$^+$, 205.0395. $C_8H_7FN_2O_2$+Na$^+$ requires 205.0384); ν_{max} ($CHCl_3$)/cm^{-1} 3011, 2632, 1732, 1608, 1566, 1519, 1444, 1381, 1296, 1254, 1192, 1024; δ_H (400 MHz; $CDCl_3$) 7.58 (1 H, dd, *J* 2.1 Hz, *J* 0.7 Hz), 6.76 (1 H, dt, *J* 3.2 Hz, *J* 1.0 Hz), 6.58 (1 H, dd, *J* 3.4 Hz, *J* 1.7 Hz), 3.90 (3 H, s); δ_C (100 MHz; $CDCl_3$) 147.7 (d, *J* 9.1 Hz, C), 142.9 (CH), 141.4 (d, *J* 5.0 Hz, C), 130.9 (d, *J* 245.0 Hz, C), 122.1 (d, *J* 18.0 Hz, C), 111.6 (CH), 110.6 (d, *J* 6.0 Hz, CH), 38.4 (Me); δ_F (377 MHz; $CDCl_3$) -183.6 (s, CF).

4-Fluoro-1-methyl-3-(2-thienyl)-1*H*-pyrazol-5-ol, 4e

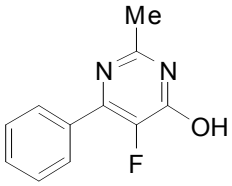


To a solution of ethyl 2-fluoro-3-oxo-3-(2-thienyl)propanoate **2c** (117 mg, 0.54 mmol) in 2-propanol (5 mL), methylhydrazine (57 μL, 1.08 mmol) was added. The resultant mixture was heated at reflux for 12 h. The solvent was evaporated in *vacuo* and the residue was purified over silica using 30% ethyl acetate in light petroleum to give the *title compound* as a colourless solid (44 mg, 41%); mp 139-141 °C; (Found: M+Na$^+$, 199.0339. $C_8H_8FN_2OS+H^+$ requires 199.0336); ν_{max} ($CHCl_3$)/cm^{-1} 2647, 1618, 1583, 1534, 1448, 1419, 1358, 1331, 1224, 1068; δ_H (400 MHz; $CDCl_3$) 7.53 (1 H, dd, *J* 5.0 Hz, *J* 1.2 Hz), 7.33 (1 H, dd, *J* 3.6 Hz, *J* 1.0 Hz), 7.20 (1 H, dd, *J* 5.1 Hz, *J* 3.6 Hz), 3.80 (3 H, s); δ_C (100 MHz; $CDCl_3$) 147.9 (d, *J* 9 Hz, C), 131.8 (d, *J* 244 Hz, C), 128.4 (d, *J* 3 Hz, CH), 127.7 (CH), 127.6 (d, *J* 1 Hz, CH), 126.7 (d, *J* 5 Hz, C), 125.0 (d, *J* 20 Hz, C), 37.3 (Me); δ_F (377 MHz; $CDCl_3$) -184.3 (s, CF).

General Method D: pyrimidinol synthesis

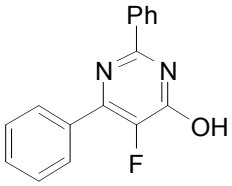
To a stirring solution of the fluorinated β-ketoester **2** (1.00 eq.) in ethanol (1 mL), amidine hydrochloride (1.05 eq.) and 1,8-diazabicycloundec-7-ene (2.00 eq.) were added sequentially. The resulting solution was stirred at room temperature for 18 h before being concentrated under reduced pressure. The residue was purified over silica using a solvent system of 3% methanol in dichloromethane and the resultant solid recrystallized from ethyl acetate to give the pyrimidin-4-ol **5**.

5-Fluoro-2-methyl-6-phenylpyrimidin-4-ol, 5a



According to general method D, ethyl 2-fluoro-3-oxo-3-phenylpropanoate **2a** (46 mg, 0.22 mmol), acetamidine hydrochloride (22 mg, 0.23 mmol) and 1,8-diazabicycloundec-7-ene (66 μL, 0.44 mmol) in ethanol (1 mL) gave the *title compound* as a colourless solid (42 mg, 94%); mp 255-257 °C; (Found: $M+H^+$, 205.0776. $C_{11}H_9FN_2O+H^+$ requires 205.0772); ν_{max} (solid)/cm^{-1} 2769, 1669, 1615, 1310, 1204, 1189, 1041, 1029, 933; δ_H (400 MHz; d_6-DMSO) 7.92-7.88 (2 H, m), 7.54-7.49 (3 H, m), 2.34 (3 H, s); δ_C (100 MHz; d_6-DMSO) 156.8 (d, *J* 26 Hz, C), 154.2 (d, *J* 6 Hz, C), 146.1 (d, *J* 252 Hz, C), 143.6 (d, *J* 6 Hz, C), 133.4 (d, *J* 5 Hz, C), 130.7 (CH), 129.1 (d, *J* 7 Hz, CH), 129.0 (CH), 21.5 (Me); δ_F (377 MHz; d_6-DMSO) -155.6 (s, CF).

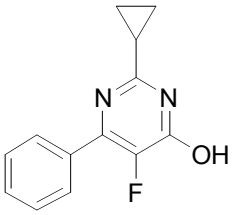
5-Fluoro-2,6-diphenylpyrimidin-4-ol, 5b



According to general method D, ethyl 2-fluoro-3-oxo-3-phenylpropanoate **2a** (50 mg, 0.24 mmol), benzamidine hydrochloride (39 mg, 0.25 mmol) and 1,8-diazabicycloundec-7-ene (71 μL, 0.48 mmol) in ethanol (1 mL) gave the *title compound* as a colourless solid (59 mg, 93%); mp 273-275 °C (decomp.); (Found: $M+H^+$, 267.0935. $C_{16}H_{11}FN_2O+H^+$ requires 267.0928); ν_{max} (solid)/cm^{-1} 1660, 1603, 1571, 1552, 1308, 1222; δ_H (400 MHz; d_6-DMSO) 13.35 (1 H, br s), 8.17 (2 H, d, *J* 8.0 Hz), 8.06 (2 H, dd, *J* 8.0 Hz, *J* 2.0 Hz), 7.62-7.55 (6 H, m); δ_C (100 MHz; d_6-DMSO) 157.4 (d, *J* 26 Hz, C), 152.1 (C), 146.5 (d, *J* 256 Hz, C), 143.6 (C), 133.5 (d, *J* 6 Hz, C),

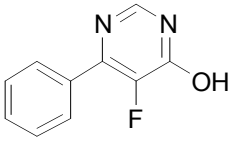
132.5 (C), 132.0 (CH), 130.9 (CH), 129.2 (CH), 129.1 (CH), 129.0 (CH), 128.3 (CH); δ_F (377 MHz; d_6-DMSO) -152.4 (s, CF).

2-Cyclopropyl-5-fluoro-6-phenylpyrimidin-4-ol, 5c



According to general method D, ethyl 2-fluoro-3-oxo-3-phenylpropanoate **2a** (52 mg, 0.25 mmol), cyclopropylcarbamidine hydrochloride (31 mg, 0.26 mmol) and 1,8-diazabicycloundec-7-ene (74 μL, 0.50 mmol) in ethanol (1 mL) gave the *title compound* as a colourless solid (54 mg, 95%); mp 266-267 °C; (Found: $M+H^+$, 231.0939. $C_{13}H_{11}FN_2O+H^+$ requires 231.0928); ν_{max} (solid)/cm^{-1} 2744, 1667, 1606, 1278, 1028, 1017, 935; δ_H (400 MHz; d_6-DMSO) 7.89-7.84 (2 H, m), 7.52-7.48 (3 H, m), 1.98-1.92 (1 H, m), 1.11-1.02 (4 H, m); δ_C (100 MHz; d_6-DMSO) 158.6 (d, *J* 6 Hz, C), 156.7 (d, *J* 25 Hz, C), 145.6 (d, *J* 252 Hz, C), 143.8 (C), 133.7 (C), 130.6 (CH), 129.0 (d, *J* 7 Hz, CH), 128.9 (CH), 13.7 (CH), 10.3 (CH_2); δ_F (377 MHz; d_6-DMSO) -154.9 (s, CF).

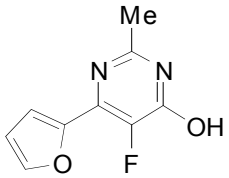
5-Fluoro-6-phenylpyrimidin-4-ol, 5d



According to general method D, ethyl 2-fluoro-3-oxo-3-phenylpropanoate **2a** (40 mg, 0.19 mmol), formamidine hydrochloride (16 mg, 0.20 mmol) and 1,8-diazabicycloundec-7-ene (57

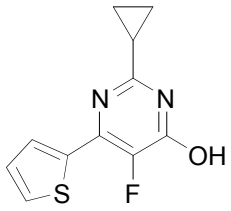
μL, 0.38 mmol) in ethanol (1 mL) gave the *title compound* as a colourless solid (30 mg, 72%); mp 240-241 °C; (Found: M+H$^+$, 191.0620. $C_{10}H_7FN_2O$+H$^+$ requires 191.0615); ν_{max} (solid)/cm^{-1} 2976, 2873, 1666, 1612, 1444, 1412, 1242, 944, 919; δ_H (400 MHz; d$_6$-DMSO) 13.13 (1 H, br s), 8.17 (1 H, s), 7.95-7.91 (2 H, m), 7.57-7.51 (3 H, m); δ_C (100 MHz; d$_6$-DMSO) 156.1 (d, *J* 25 Hz, C), 147.6 (d, *J* 255 Hz, C), 145.2 (d, *J* 7 Hz, CH), 143.9 (d, *J* 7 Hz, C), 133.2 (d, *J* 6 Hz, C), 130.8 (CH), 129.1 (d, *J* 7 Hz, CH), 129.0 (CH); δ_F (377 MHz; d$_6$-DMSO) -149.5 (s, CF).

5-Fluoro-6-(2-furyl)-2-methylpyrimidin-4-ol, 5e



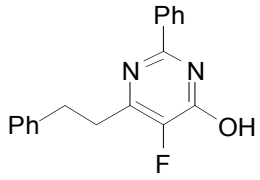
According to general method D, ethyl 2-fluoro-3-(2-furyl)-3-oxopropanoate **2b** (61 mg, 0.31 mmol), acetamidine hydrochloride (30 mg, 0.32 mmol) and 1,8-diazabicycloundec-7-ene (91 μL, 0.61 mmol) in ethanol (1 mL) gave the *title compound* as a colourless solid (43 mg, 71%); mp 265-266 °C (decomp.); (Found: M+H$^+$, 195.0562. $C_9H_7FN_2O_2$+H$^+$ requires 195.0564); ν_{max} (solid)/cm^{-1} 2839, 1666, 1632, 1591, 1478, 1320, 1205, 1044, 1015; δ_H (400 MHz; d$_6$-DMSO) 7.98 (1 H, d, *J* 1.4 Hz), 7.14 (1 H, d, *J* 3.2 Hz), 6.73 (1 H, dd, *J* 3.2 Hz, *J* 1.4 Hz), 2.31 (3 H, s); δ_C (100 MHz; d$_6$-DMSO) 156.4 (d, *J* 24 Hz, C), 154.9 (d, *J* 7 Hz, C), 147.5 (d, *J* 7 Hz, C), 146.4 (d, *J* 4 Hz, CH), 143.2 (d, *J* 256 Hz, C), 135.7 (d, *J* 8 Hz, C), 115.5 (d, *J* 8 Hz, CH), 112.9 (CH), 21.4 (Me); δ_F (377 MHz; d$_6$-DMSO) -154.2 (s, CF).

2-Cyclopropyl-5-fluoro-6-(2-thienyl)pyrimidin-4-ol, 5f



According to general method D, ethyl 2-fluoro-3-oxo-3-(2-thienyl)propanoate **2c** (47 mg, 0.22 mmol), cyclopropylcarbamidine hydrochloride (28 mg, 0.23 mmol) and 1,8-diazabicycloundec-7-ene (66 μL, 0.44 mmol) in ethanol (1 mL) gave the *title compound* as a colourless solid (40 mg, 77%); mp 295-297 °C (decomp.); (Found: $M+H^+$, 237.0496. $C_{11}H_9FN_2OS+H^+$ requires 237.0492); ν_{max} (solid)/cm^{-1} 2751, 1667, 1602, 1578, 1427, 1281, 1005, 767; δ_H (400 MHz; d_6-DMSO) 13.09 (1 H, br s), 7.85 (1 H, dd, *J* 4.8 Hz, *J* 0.6 Hz), 7.74 (1 H, d, *J* 3.9 Hz), 7.24 (1 H, dd, *J* 4.8 Hz, *J* 3.9 Hz), 1.93 (1 H, quin., *J* 6.3 Hz), 1.08-1.04 (4 H, m); δ_C (100 MHz; d_6-DMSO) 159.0 (d, *J* 5 Hz, C), 156.2 (d, *J* 24 Hz, C), 143.1 (d, *J* 252 Hz, C), 139.3 (d, *J* 9 Hz, C), 137.3 (d, *J* 8 Hz, C), 131.5 (d, *J* 5 Hz, CH), 130.2 (d, *J* 12 Hz, CH), 129.3 (CH), 13.5 (CH), 10.3 (CH_2); δ_F (377 MHz; d_6-DMSO) -152.6 (s, CF).

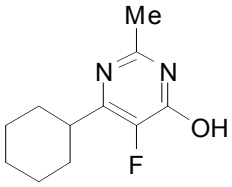
5-Fluoro-6-phenylethyl-2-phenylpyrimidin-4-ol, 5g



According to general method D, ethyl 2-fluoro-3-oxo-5-phenylpentanoate **2d** (76 mg, 0.32 mmol), benzamidine hydrochloride (53 mg, 0.34 mmol) and 1,8-diazabicycloundec-7-ene (96 μL, 0.64 mmol) in ethanol (1 mL) gave the *title compound* as a colourless solid (80 mg, 85%); mp 203-204 °C; (Found: $M+H^+$, 295.1240. $C_{18}H_{15}FN_2O+H^+$ requires 295.1241); ν_{max} ($CHCl_3$)/cm^{-1} 2929, 2863, 1668, 1610, 1556, 1455, 1315, 1097, 1036; δ_H (400 MHz; $CDCl_3$)

13.26 (1 H, br s), 8.26-8.22 (2 H, m), 7.62-7.58 (3 H, m), 7.37-7.23 (5 H, m), 3.19-3.08 (4 H, m); δ_C (100 MHz; $CDCl_3$) 157.8 (d, *J* 24 Hz, C), 151.4 (d, *J* 7 Hz, C), 151.3 (d, *J* 14 Hz, C), 146.2 (d, *J* 250 Hz, C), 140.7 (C), 131.8 (CH), 131.4 (C), 129.0 (CH), 128.5 (CH), 128.4 (CH), 127.5 (CH), 126.2 (CH), 33.2 (CH_2), 32.1 (CH_2); δ_F (377 MHz; d_6-DMSO) -154.1 (s, CF).

6-Cyclohexyl-5-fluoro-2-methylpyrimidin-4-ol, 5h



According to general method D, ethyl 3-cyclohexyl-2-fluoro-3-oxopropanoate **2e** (65 mg, 0.30 mmol), acetamidine hydrochloride (30 mg, 0.32 mmol) and 1,8-diazabicycloundec-7-ene (89 μL, 0.60 mmol) in ethanol (1 mL) gave the *title compound* as a colourless solid (40 mg, 63%); mp 198-199 °C; (Found: $M+H^+$, 211.1245. $C_{11}H_{15}FN_2O+H^+$ requires 211.1241); ν_{max} ($CHCl_3$)/cm^{-1} 2932, 2856, 1668, 1614, 1461, 1318, 1039; δ_H (400 MHz; $CDCl_3$) 13.24 (1 H, br s), 2.95-2.85 (1 H, m), 2.47 (3 H, s), 1.88-1.82 (2 H, m), 1.77-1.58 (5 H, m), 1.44-1.25 (3 H, m); δ_C (100 MHz; $CDCl_3$) 158.4 (d, *J* 25 Hz, C), 156.4 (d, *J* 12 Hz, C), 153.1 (d, *J* 7 Hz, C), 144.7 (d, *J* 246 Hz, C), 38.6 (CH), 30.0 (CH_2), 26.0 (CH_2), 25.6 (CH_2), 21.4 (Me); δ_F (377 MHz; $CDCl_3$) -158.1 (s, CF).

Procedure for one-pot heterocycle formation

To a stirring solution of ethyl 2-diazo-3-oxo-3-phenylpropanoate **1a** (60 mg, 0.28 mmol) in dichloromethane (1.4 mL) at 0 °C, tetrafluoroboronic acid (41 μL, 0.30 mmol) was added dropwise. The resulting solution was stirred at room temperature for 5 h before ethanol (1.4 mL), acetamidine hydrochloride (55 mg, 0.58 mmol) and 1,8-diazabicycloundec-7-ene (0.16 mL, 1.1

mmol) were added sequentially. The resulting solution was stirred at room temperature for 18 h before being concentrated under reduced pressure. The residue was purified over silica using a solvent system of 3% methanol in dichloromethane to give 5-fluoro-2-methyl-6-phenylpyrimidin-4-ol, **5a** as a colourless solid (39 mg, 66%). Spectroscopic data consistent with those previously reported herein.

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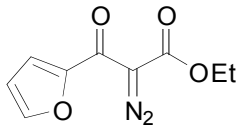
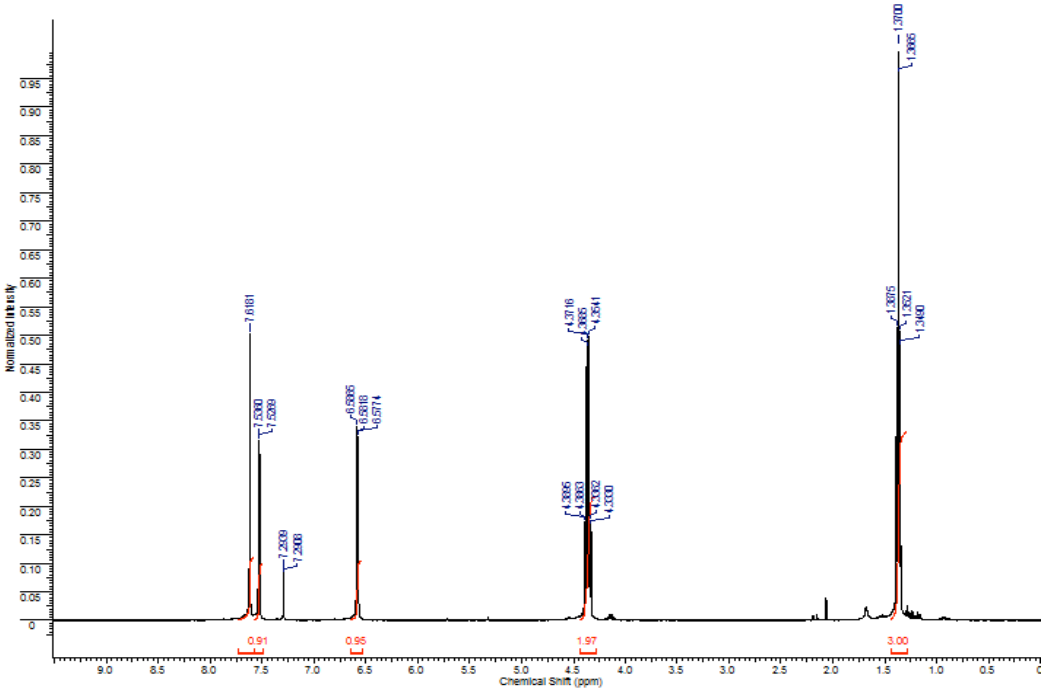
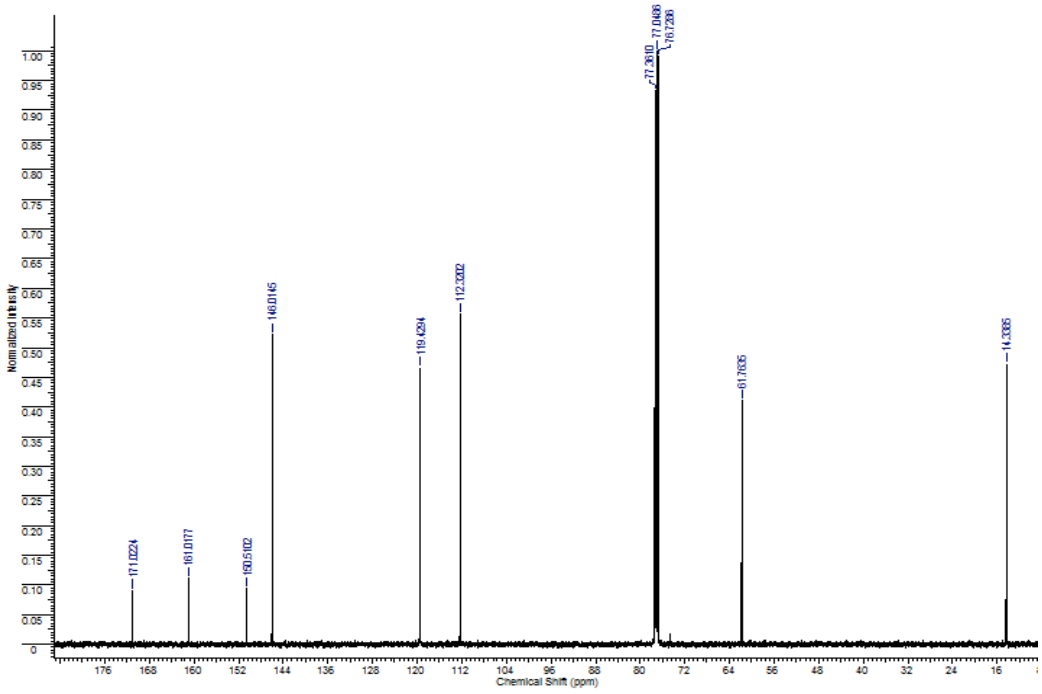
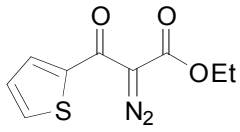
Ethyl 2-diazo-3-(2-furyl)-3-oxopropanoate, 1b

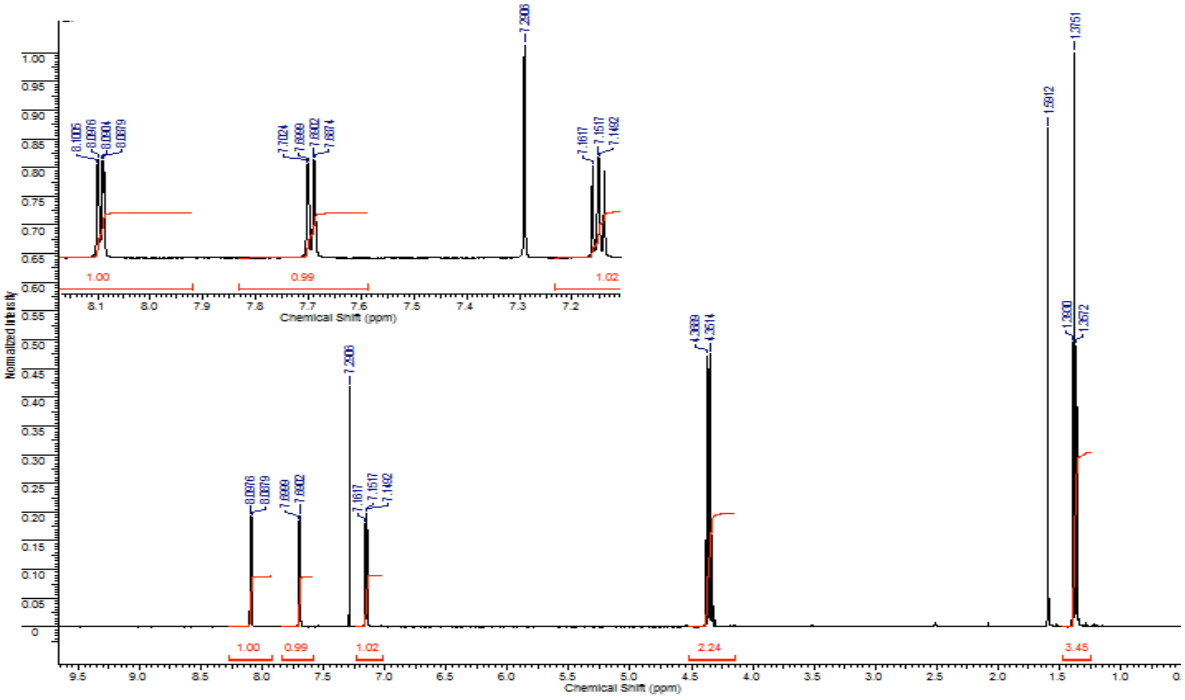


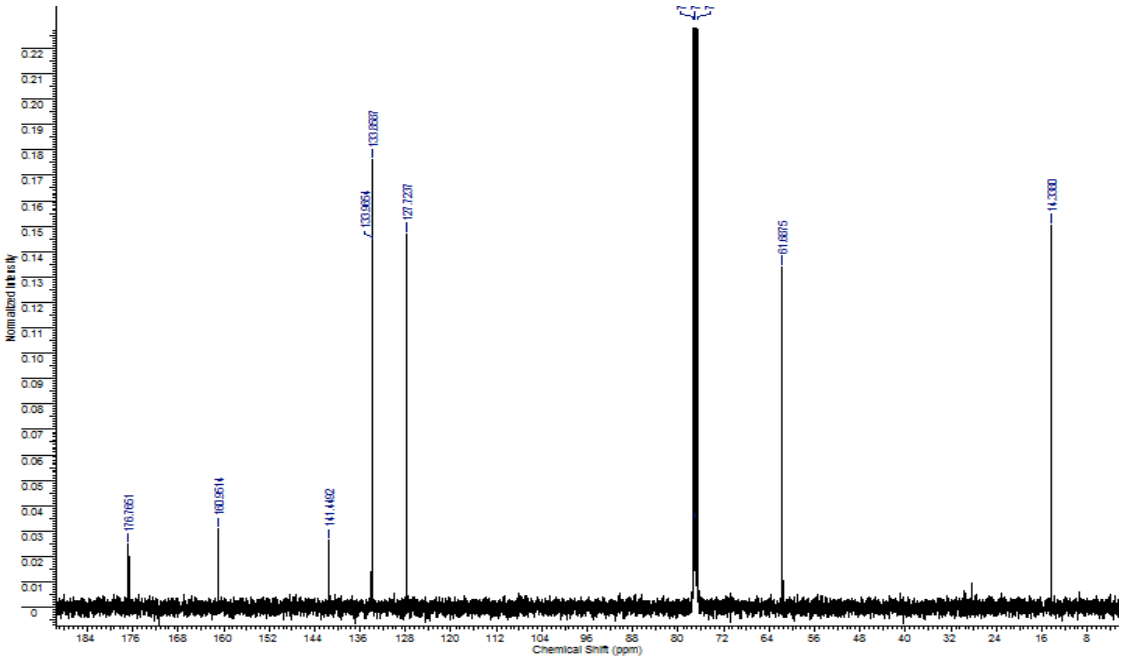




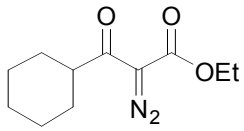
Ethyl 2-diazo-3-oxo-3-(2-thienyl)propanoate, 1c

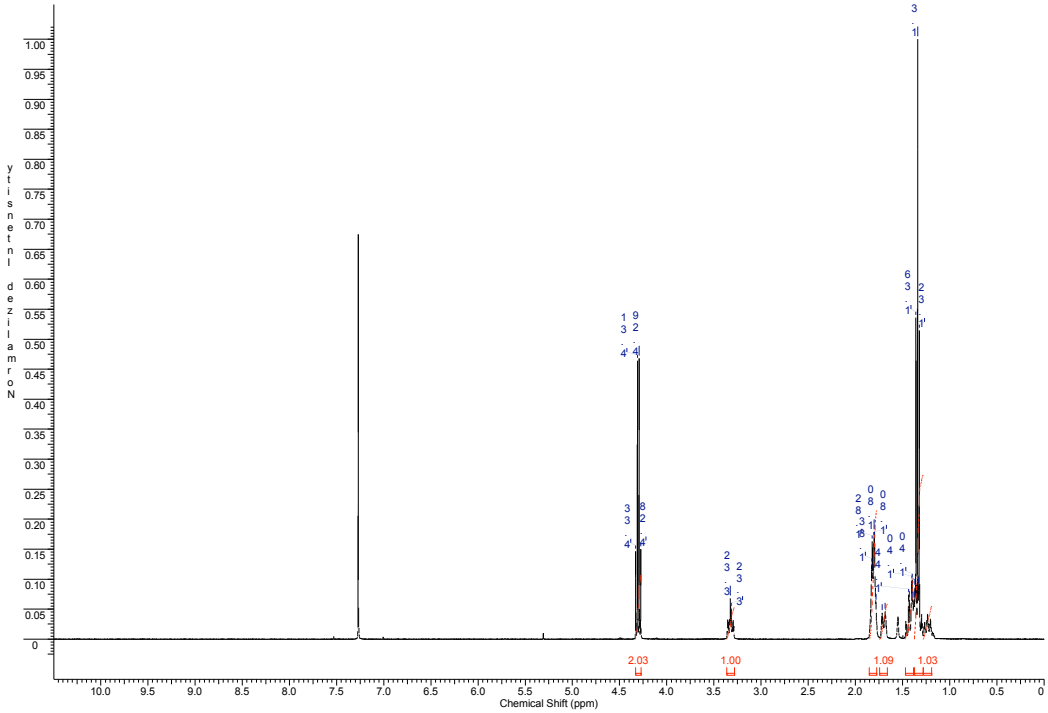


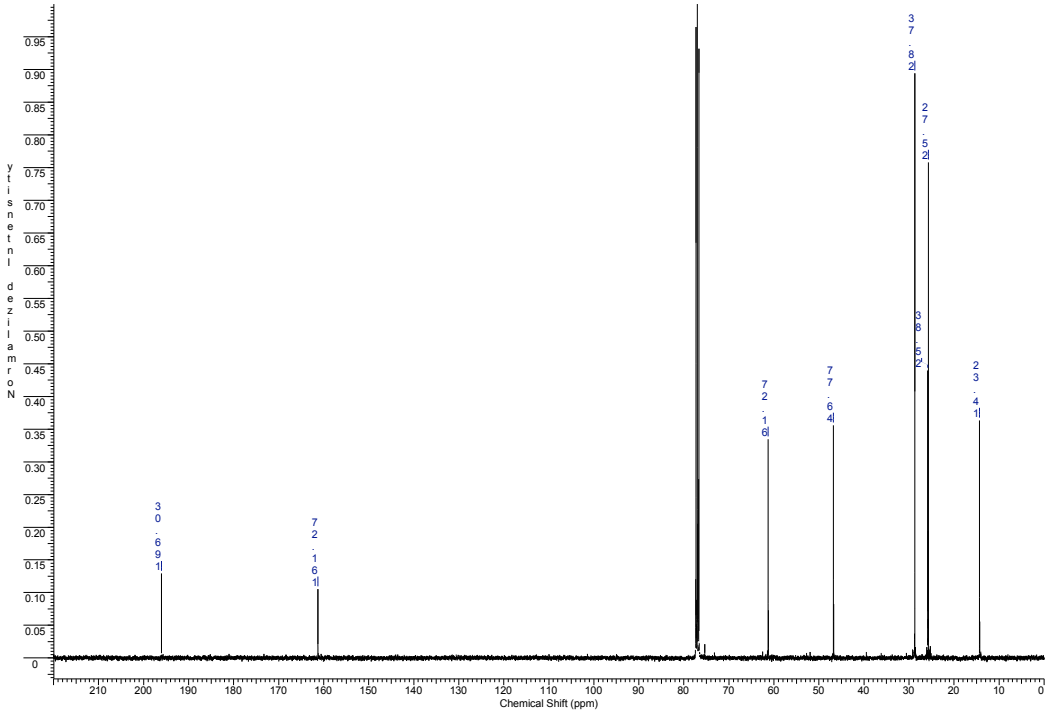




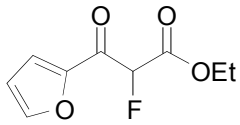
Ethyl 3-cyclohexyl-2-diazo-3-oxopropanoate, 1e

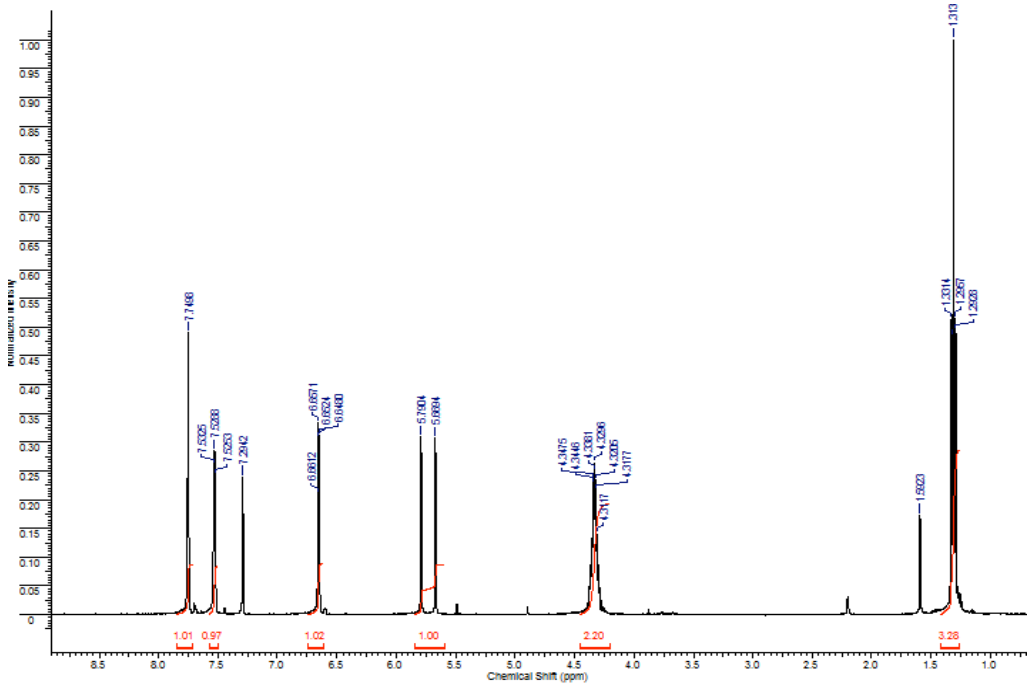


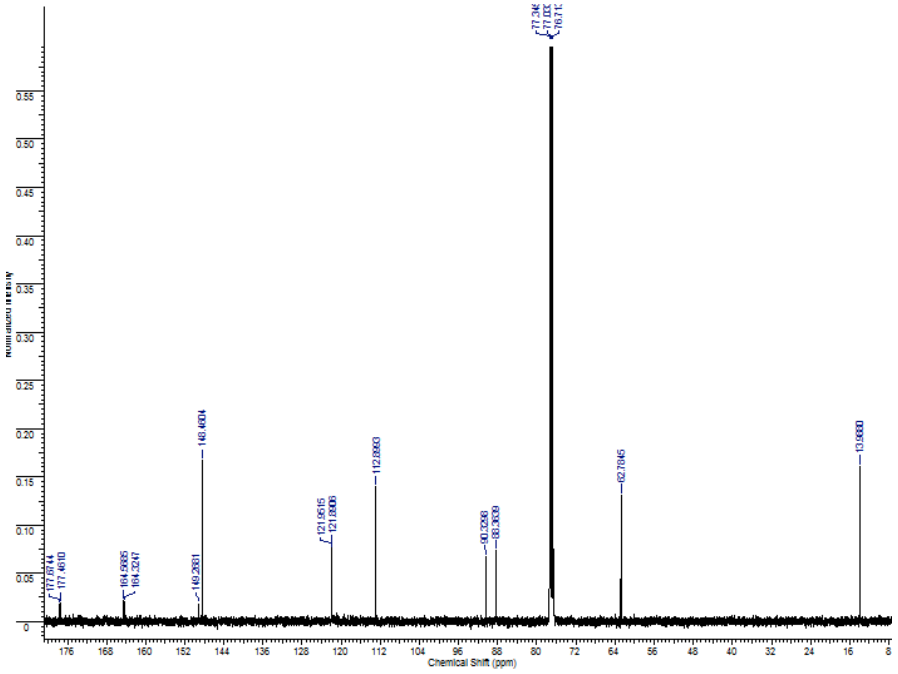




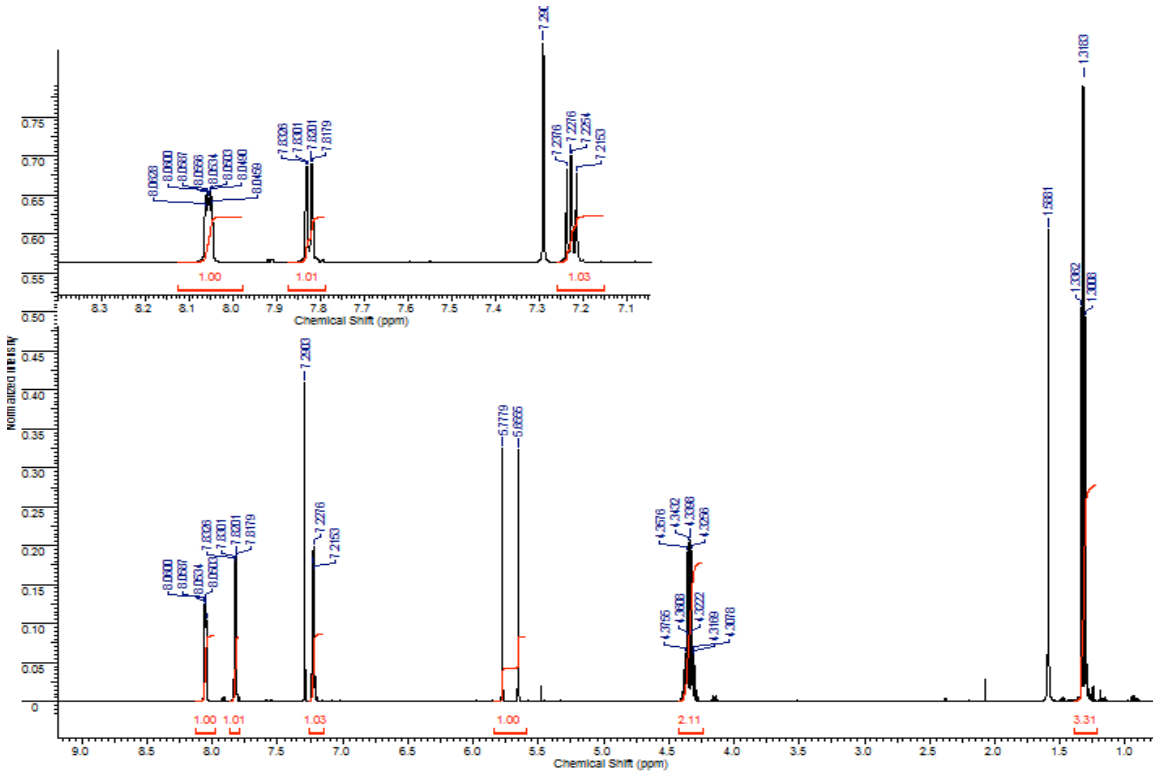
Ethyl 2-fluoro-3-(2-furyl)-3-oxopropanoate, 2b

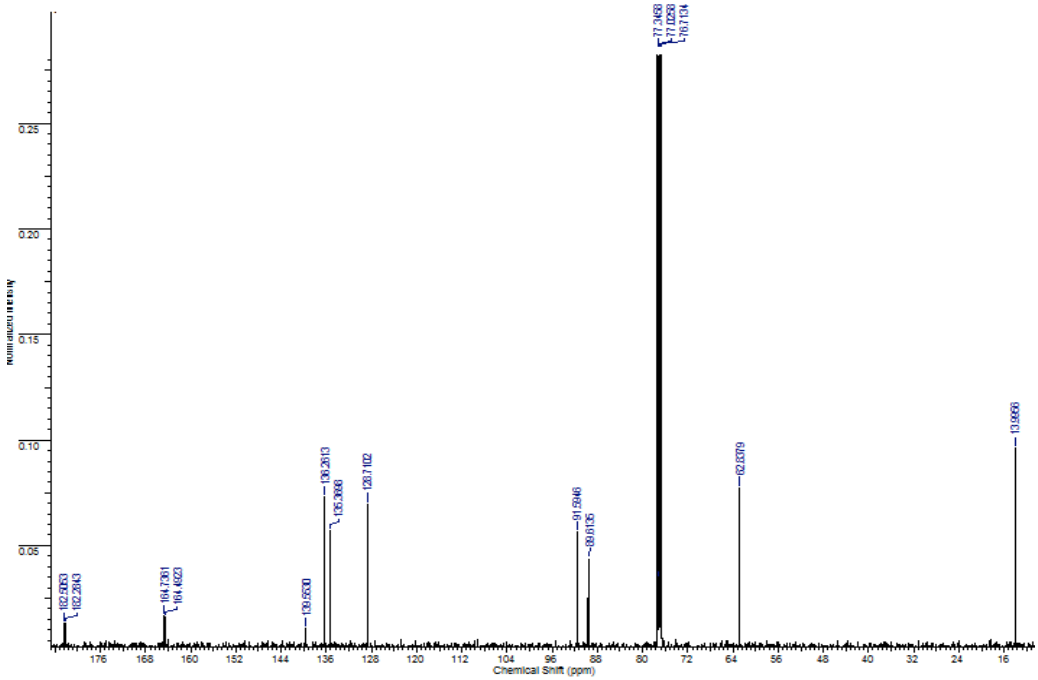




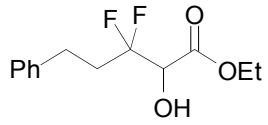


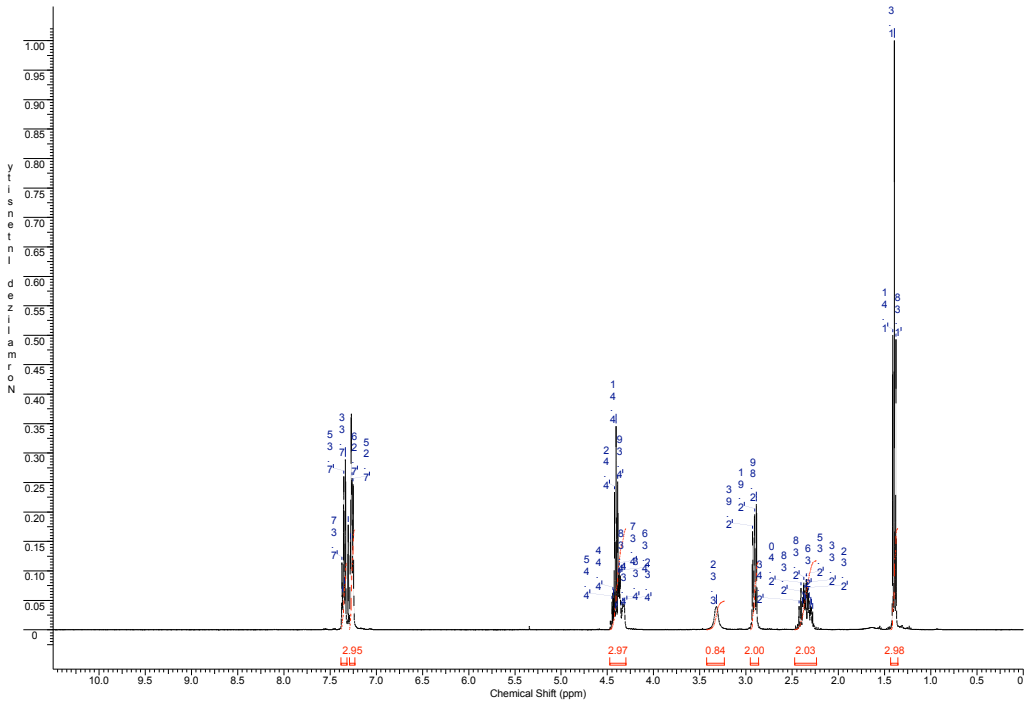
Ethyl 2-fluoro-3-oxo-3-(2-thienyl)propanoate, 2c

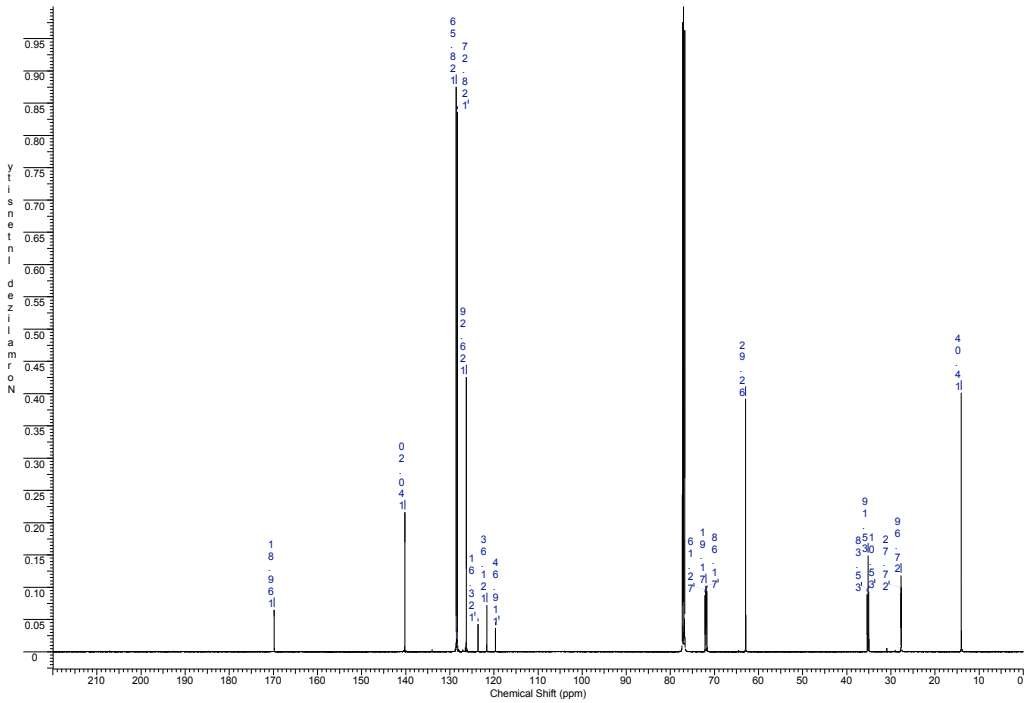




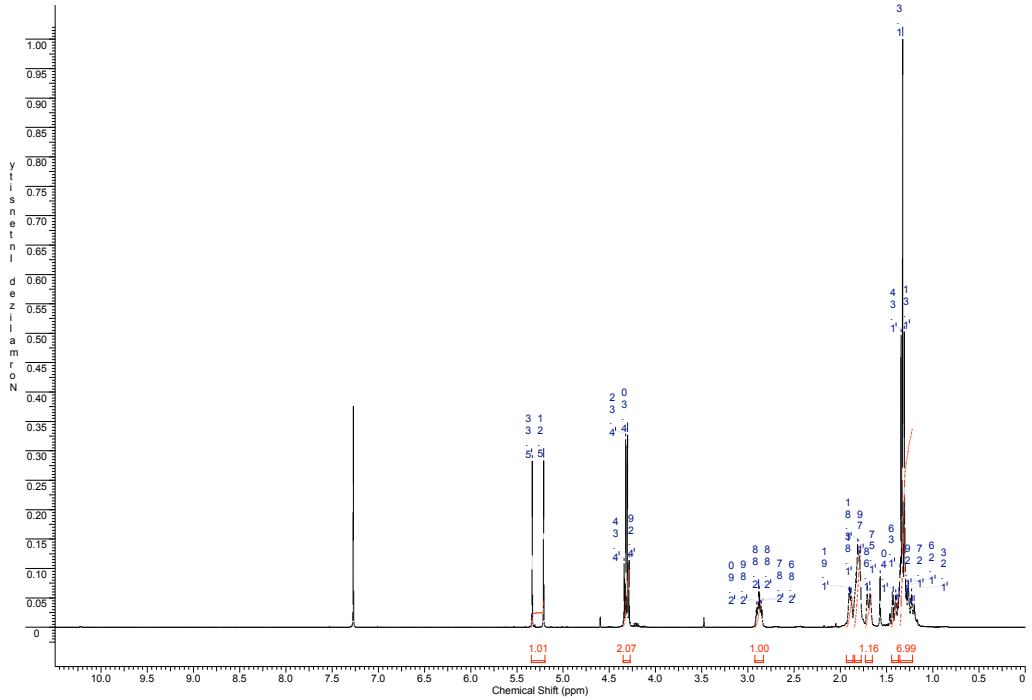
Ethyl 3,3-difluoro-2-hydroxy-5-phenylpentanoate

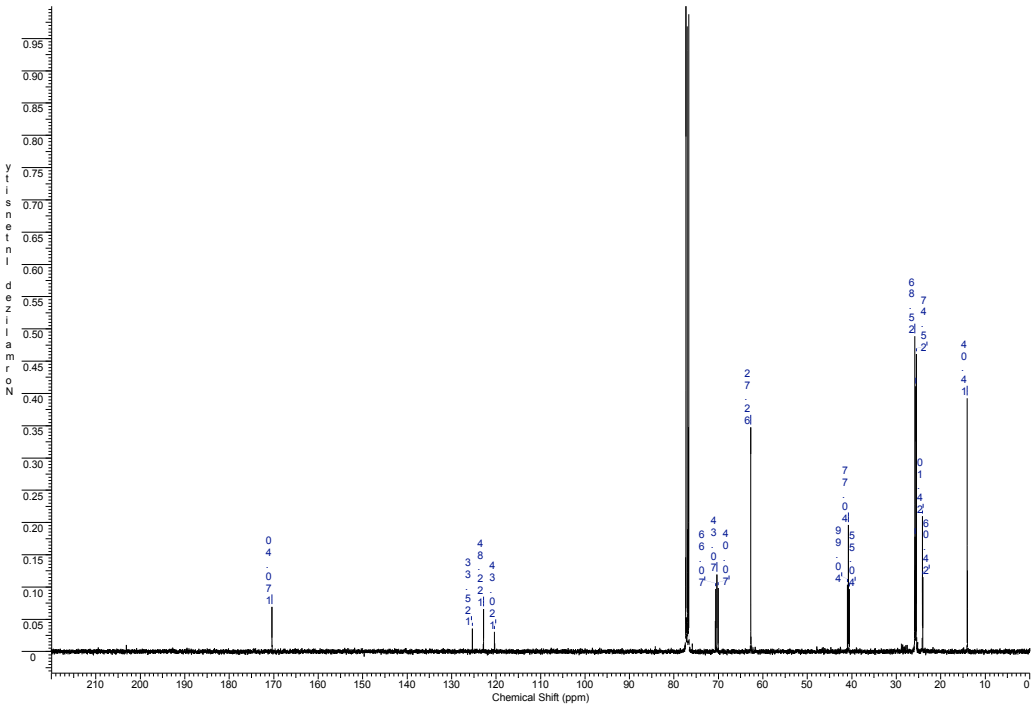




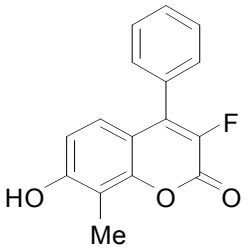


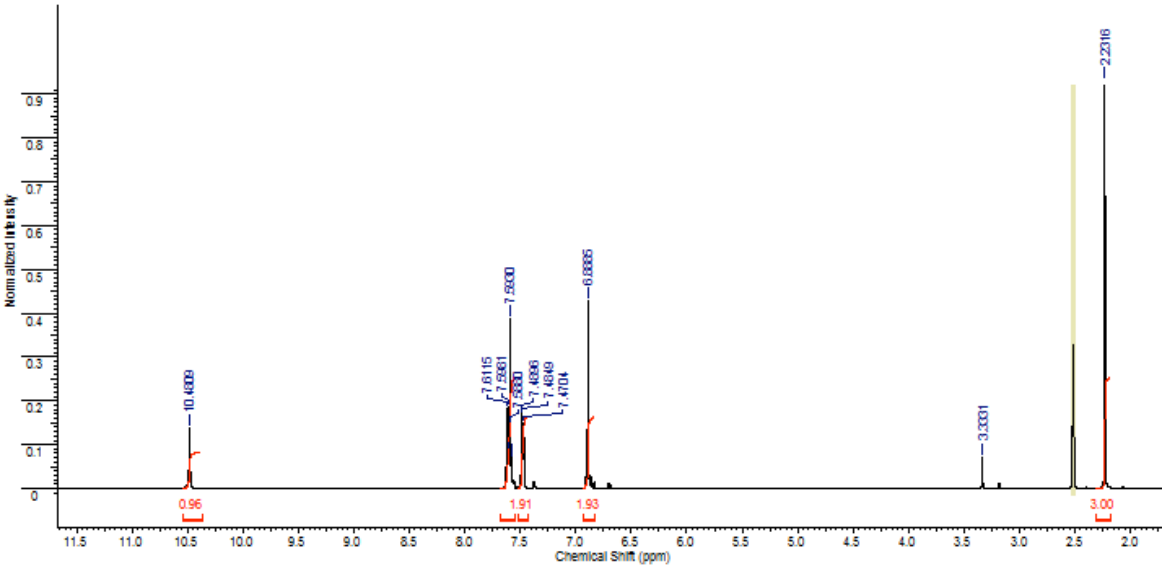
Ethyl 3-cyclohexyl-3,3-difluoro-2-hydroxypropanoate

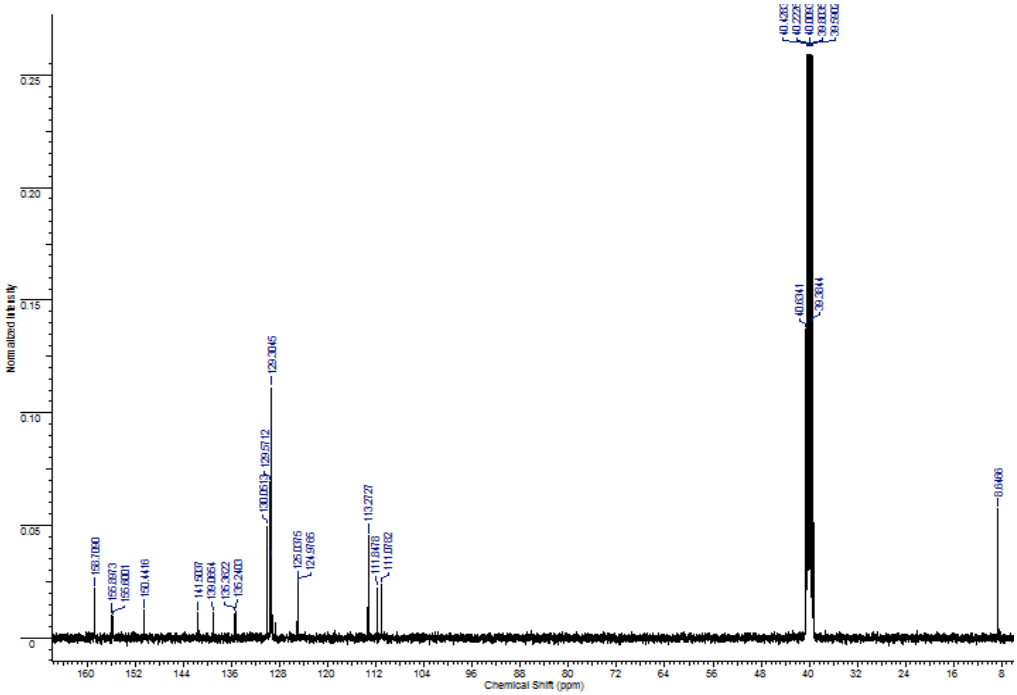




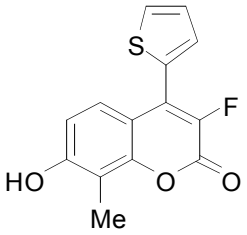
3-Fluoro-7-hydroxy-8-methyl-4-phenyl-2*H*-chromen-2-one, 3a

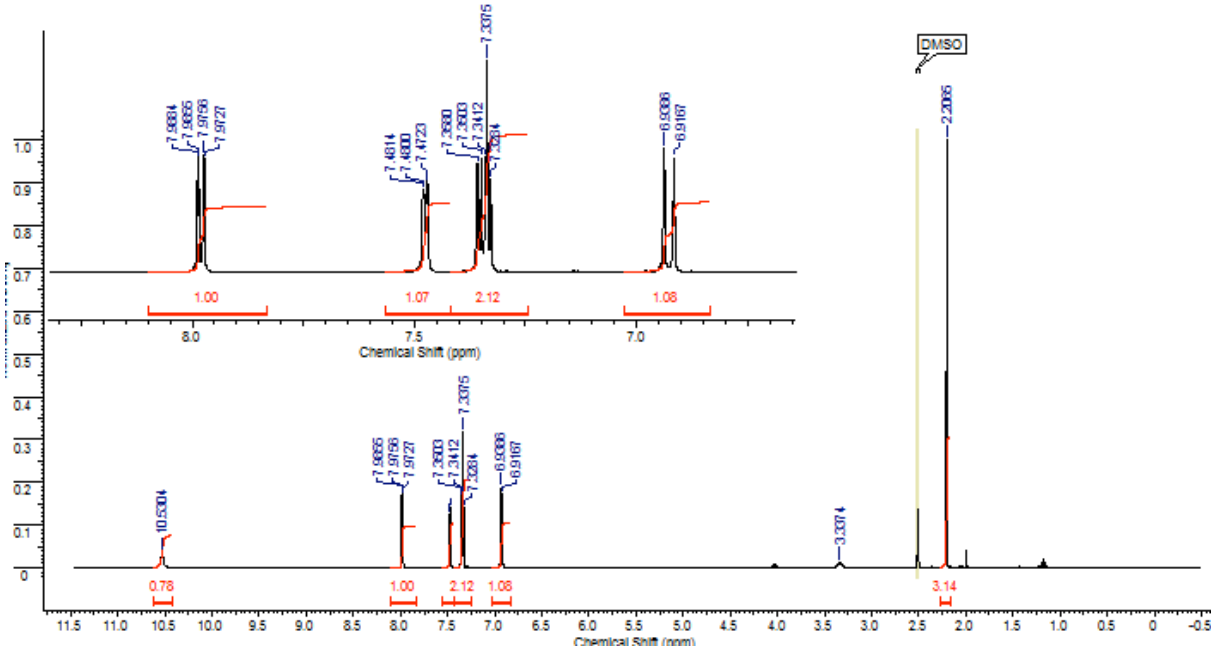


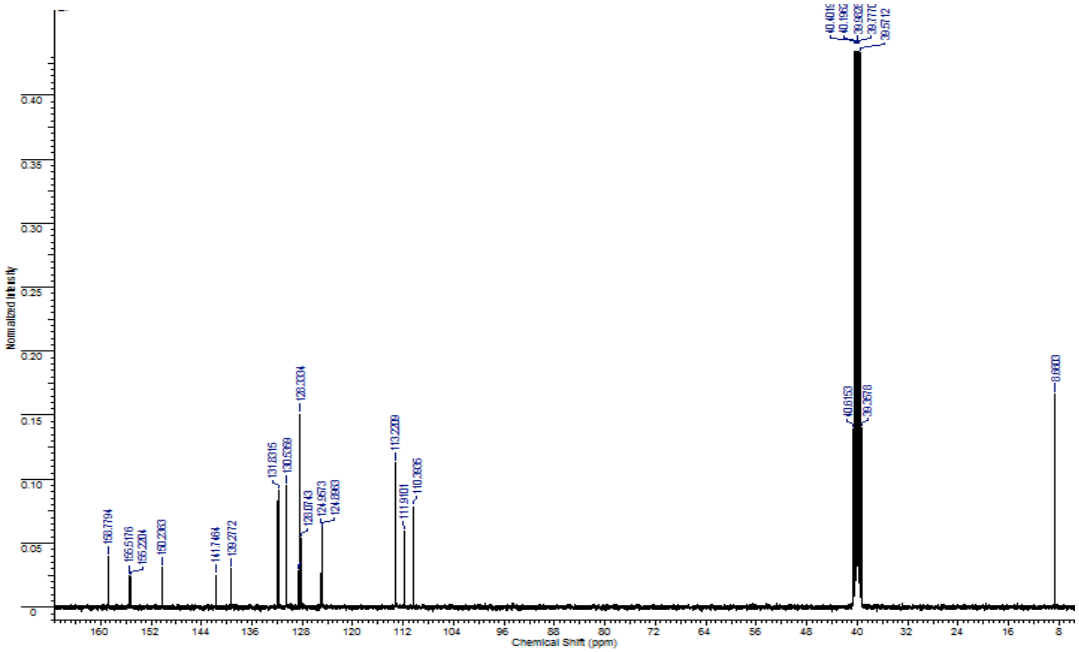




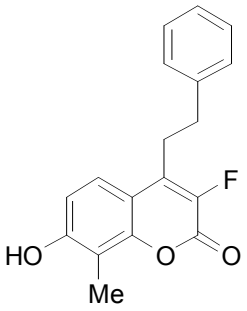
3-Fluoro-7-hydroxy-8-methyl-4-(2-thienyl)-2*H*-chromen-2-one, 3b

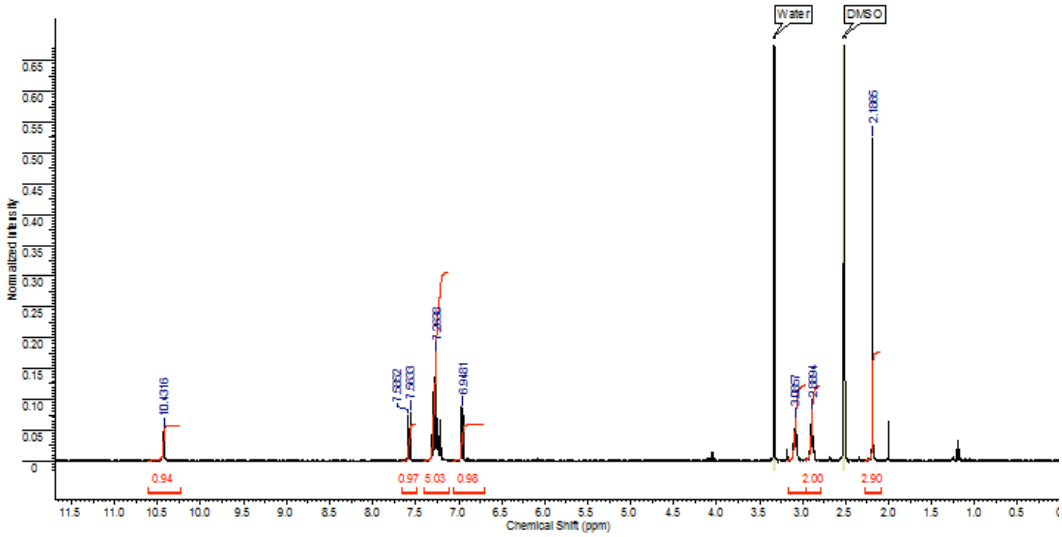


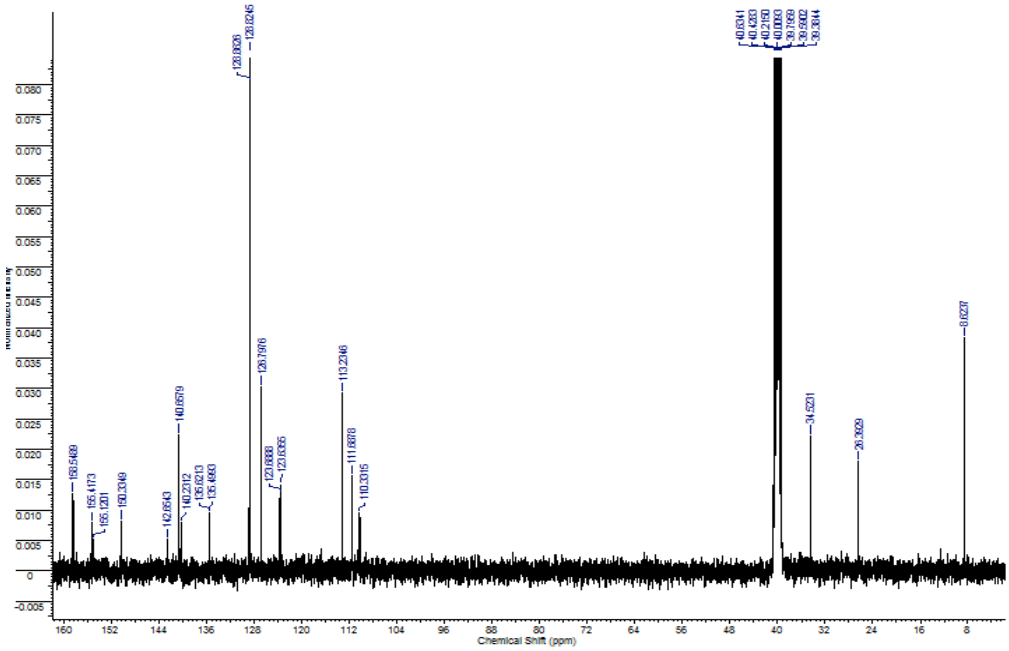




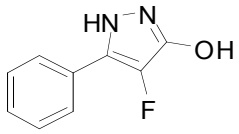
3-Fluoro-7-hydroxy-8-methyl-4-phenethyl-2*H*-chromen-2-one, 3c

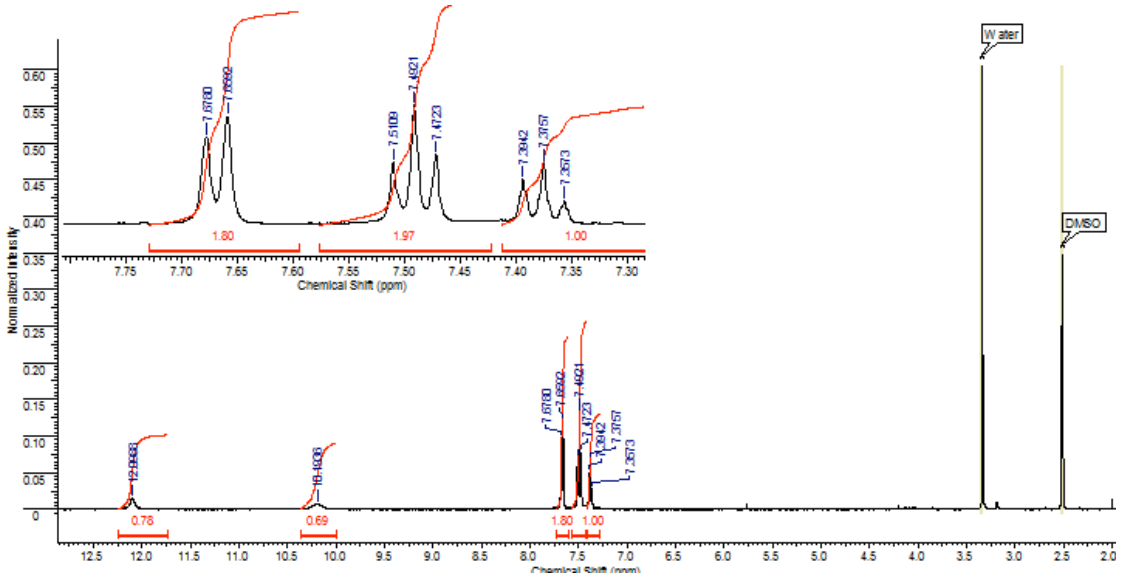


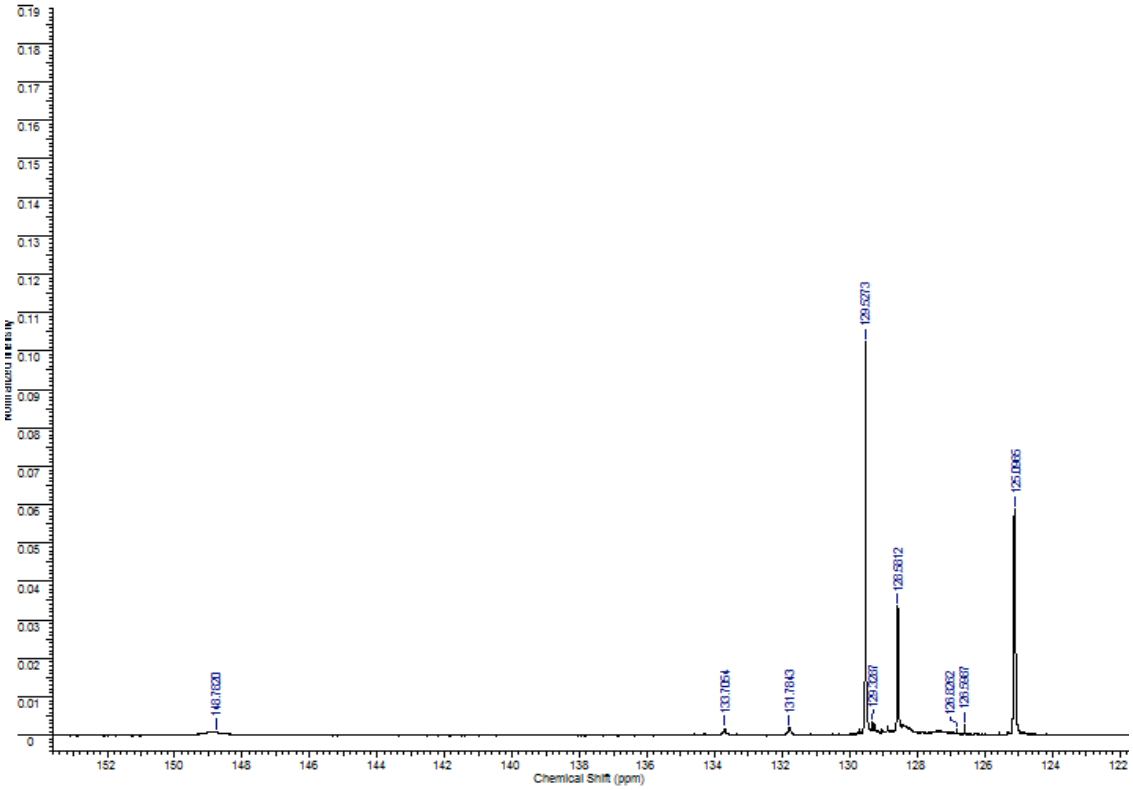




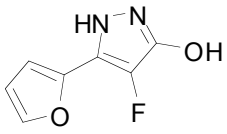
4-Fluoro-5-phenyl-1*H*-pyrazol-3-ol, 4a

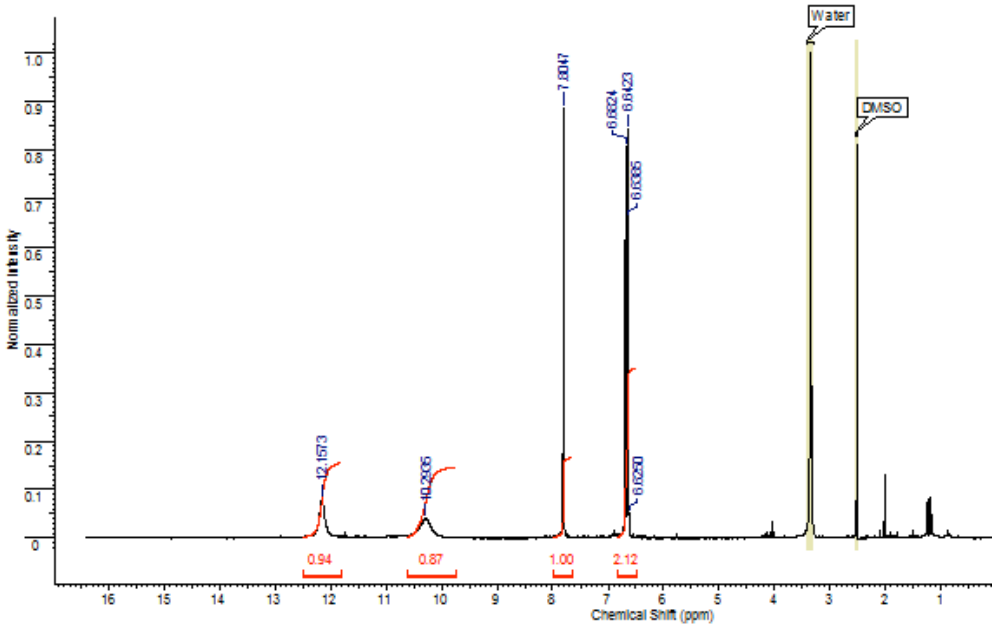


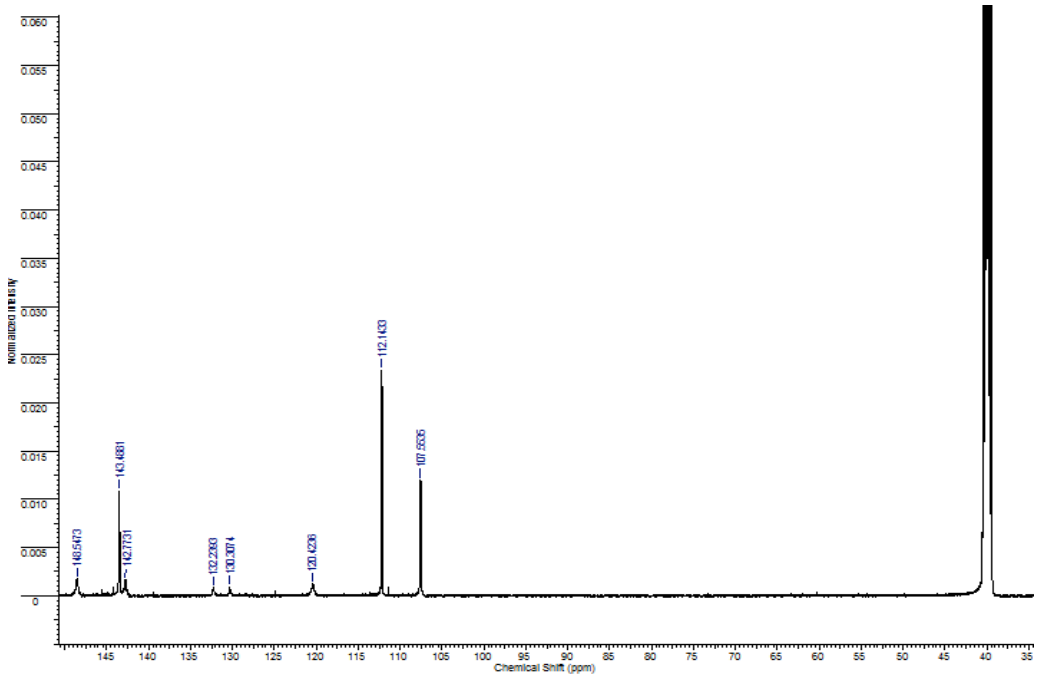




4-Fluoro-5-(furan-2-yl)-1*H*-pyrazol-3-ol, 4b







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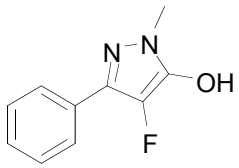

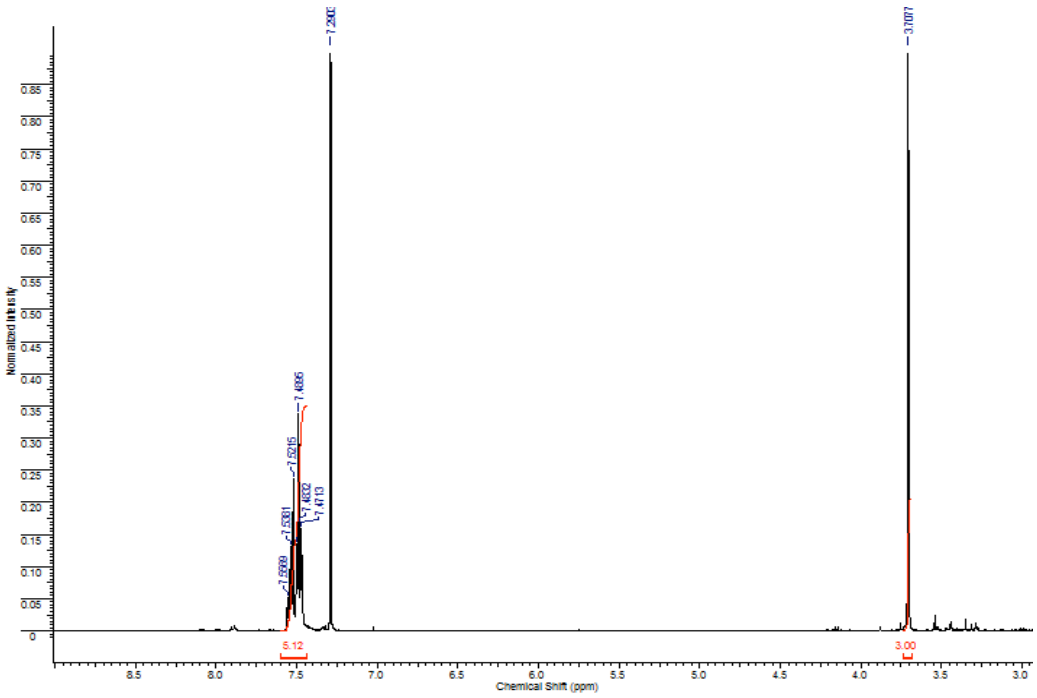

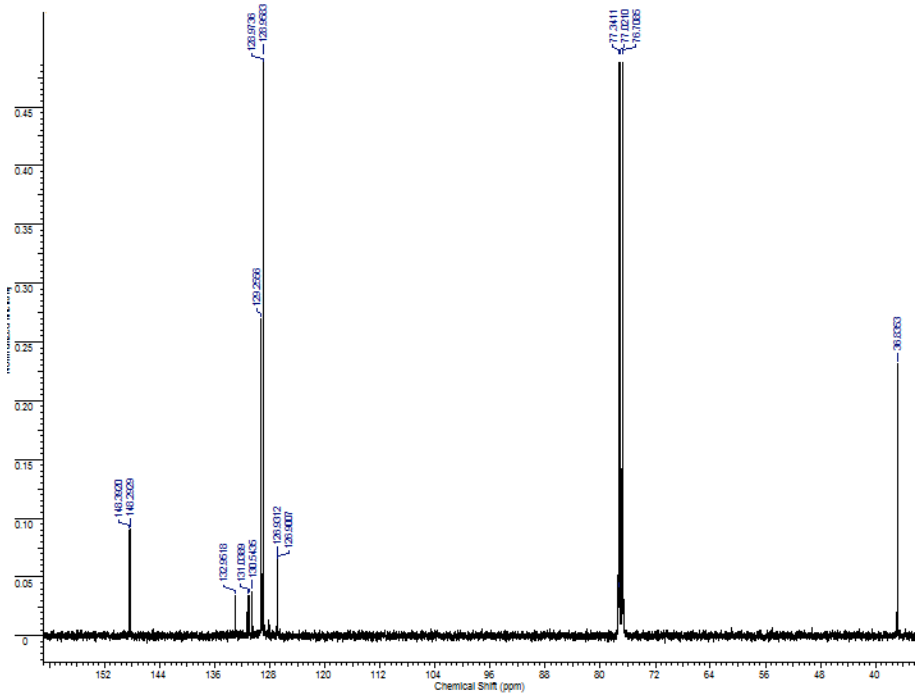

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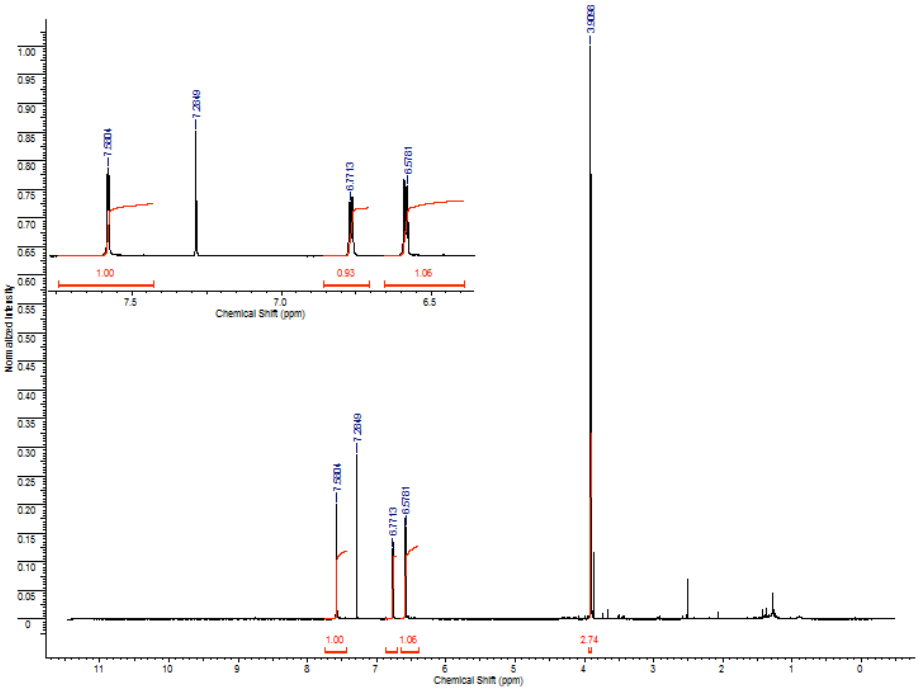

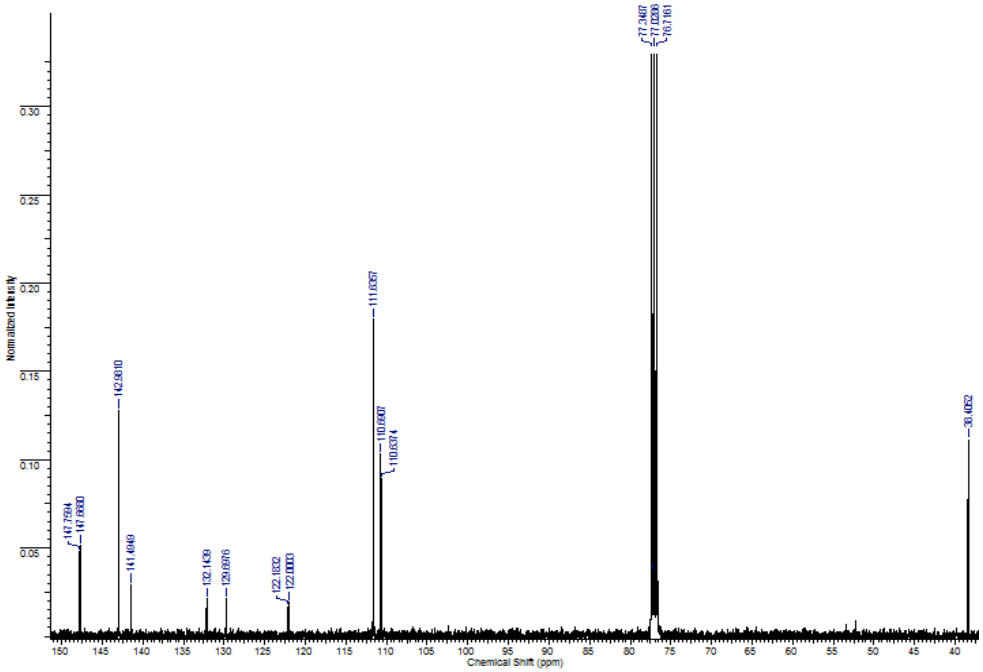

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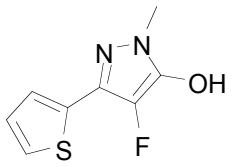
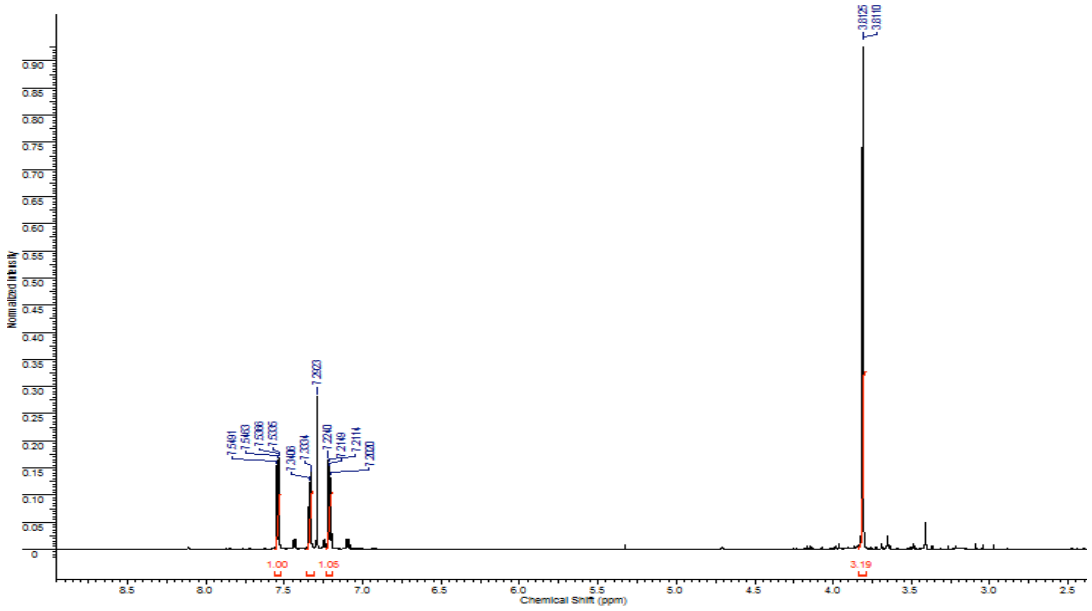
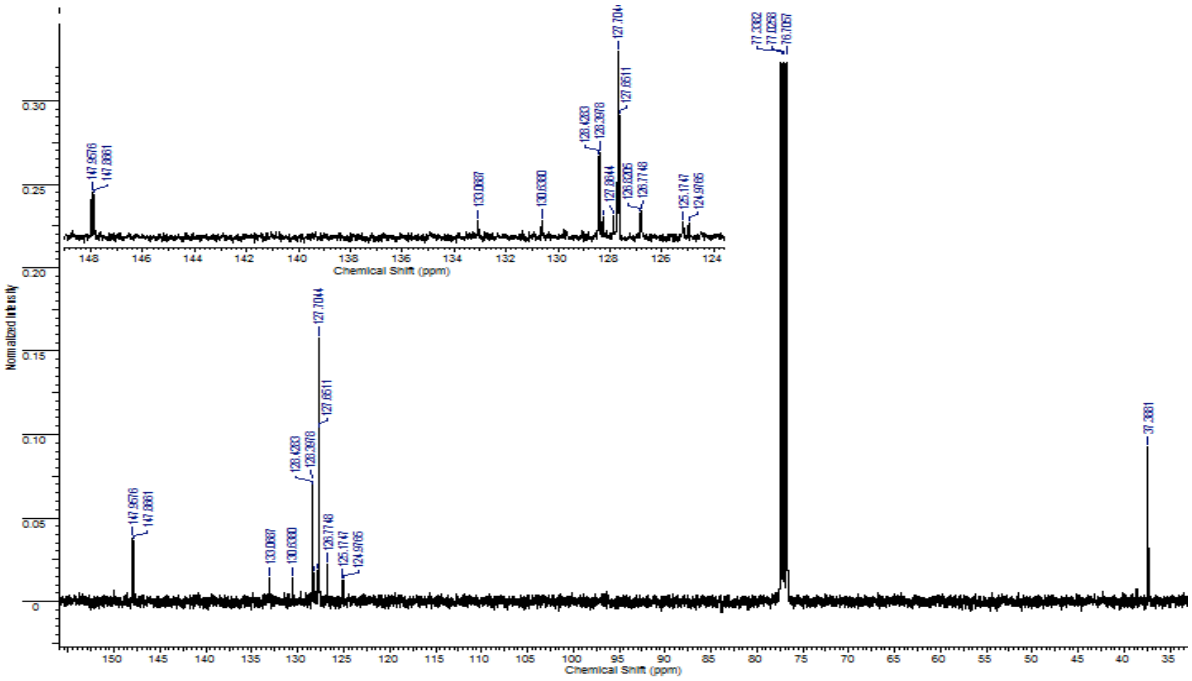
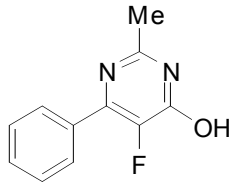
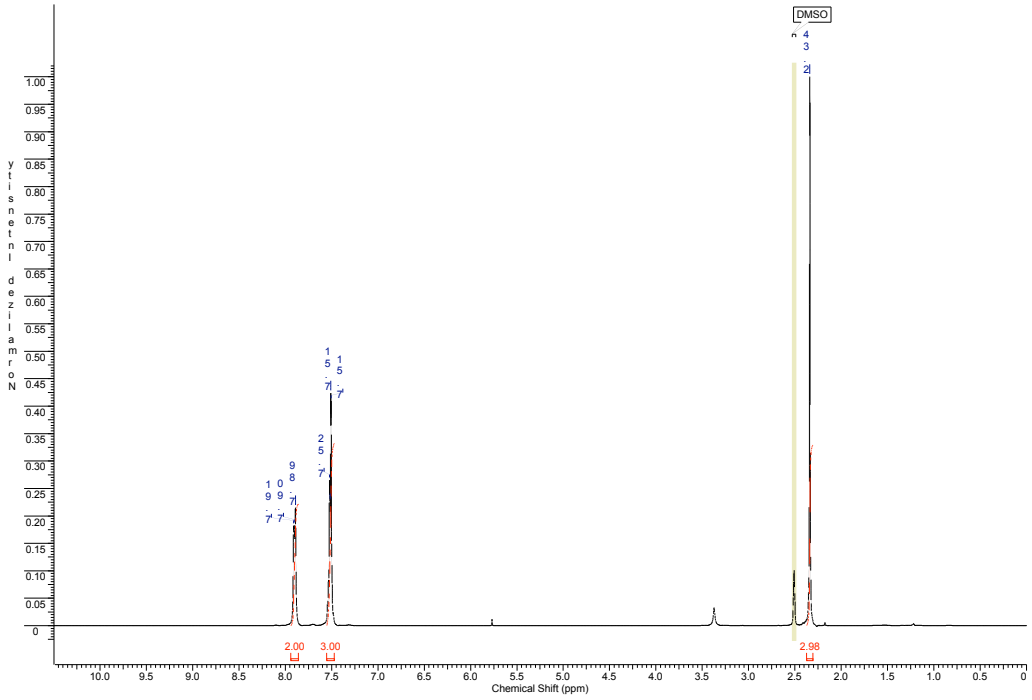


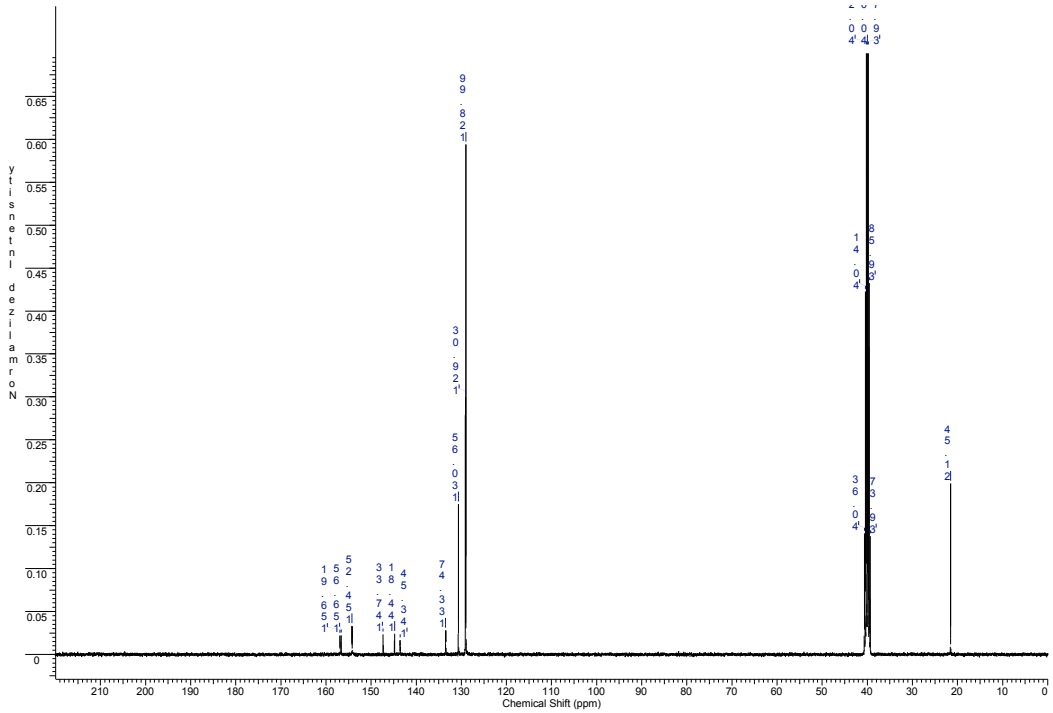




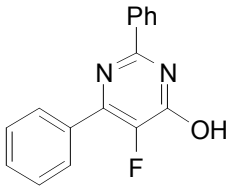
5-Fluoro-2-methyl-6-phenylpyrimidin-4-ol, 5a

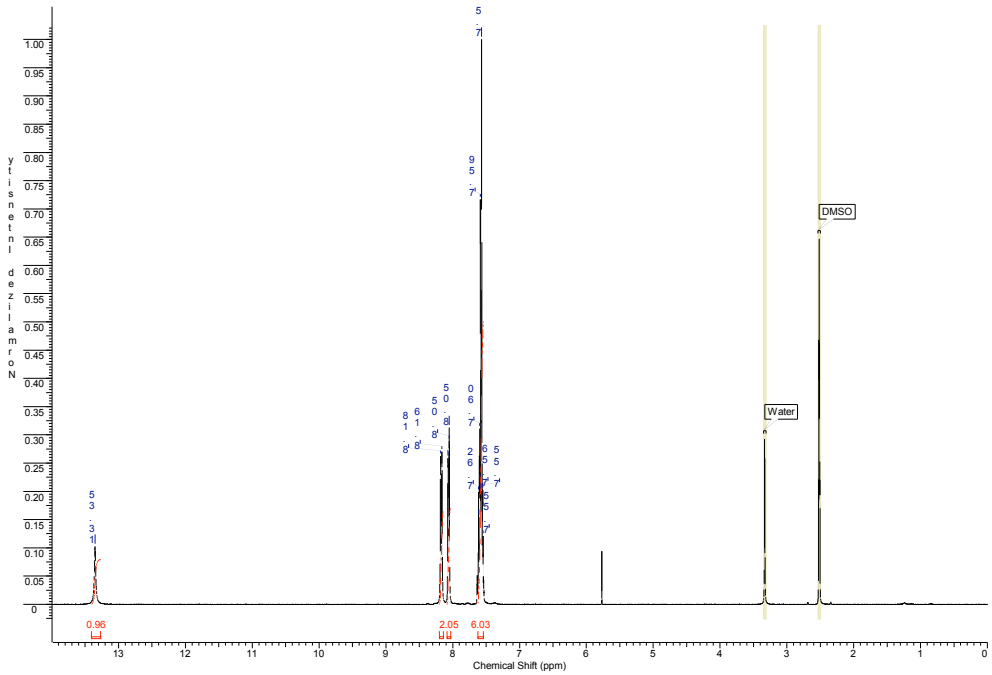


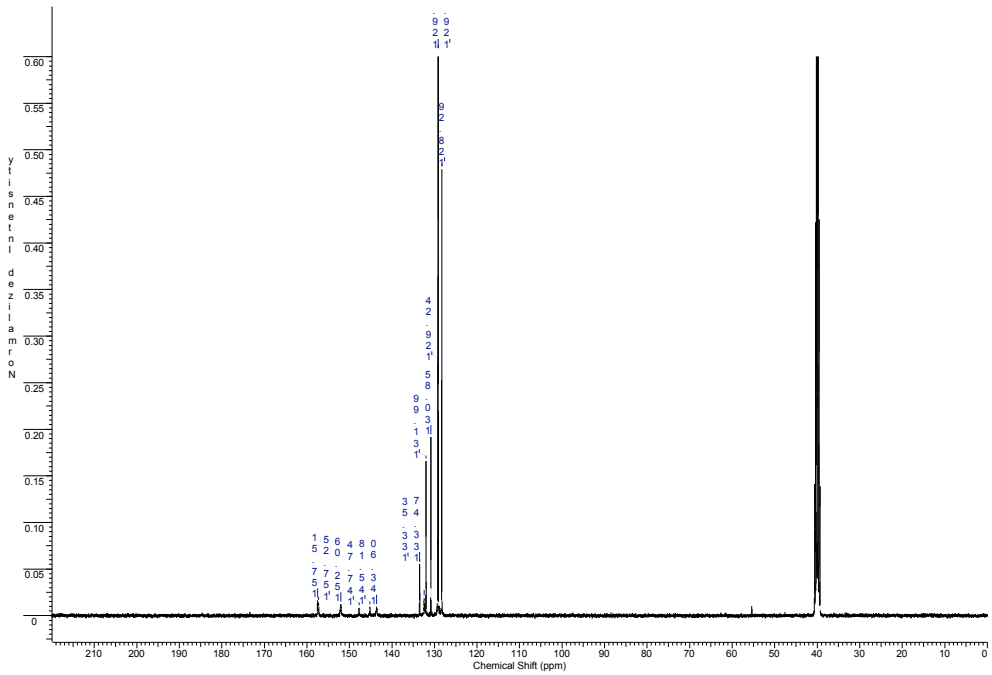




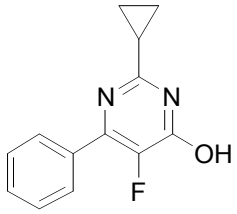
5-Fluoro-2,6-diphenylpyrimidin-4-ol, 5b

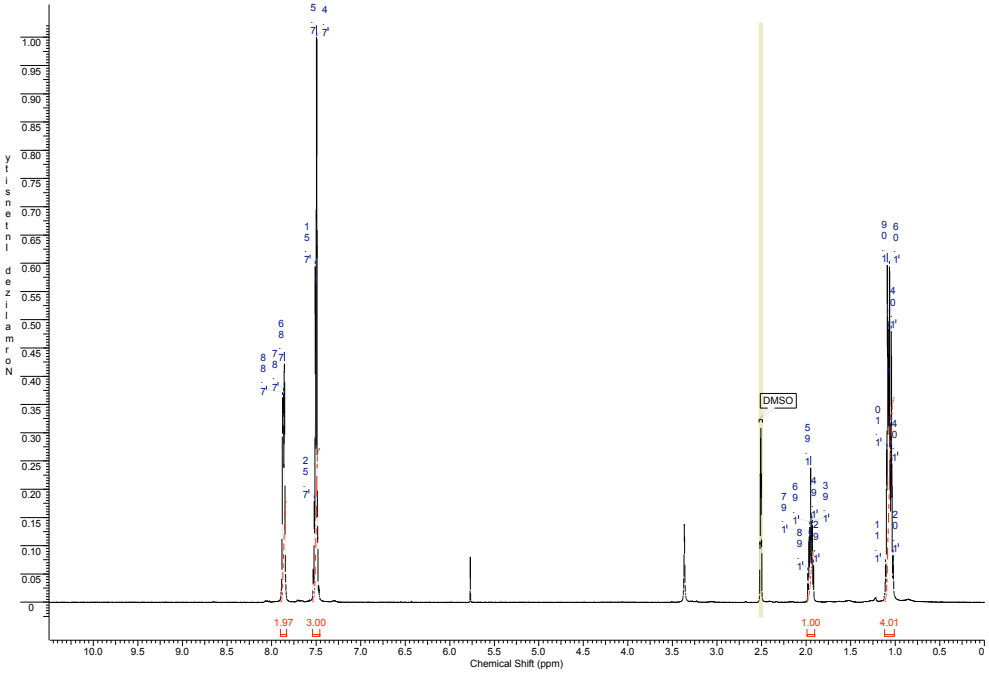


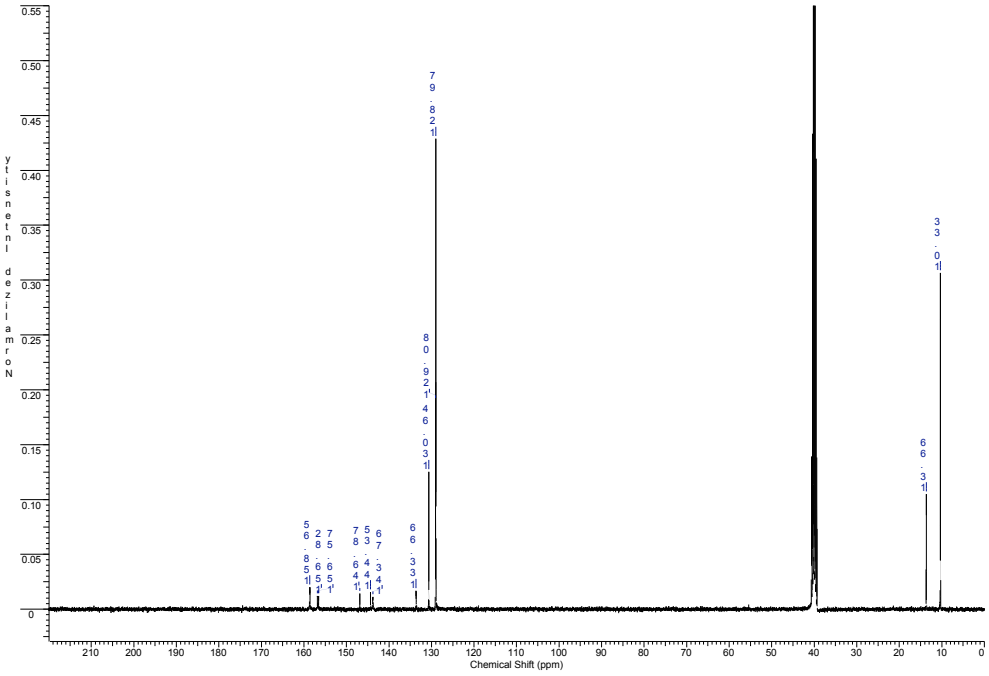




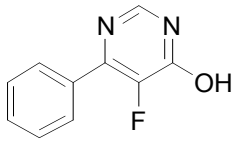
2-Cyclopropyl-5-fluoro-6-phenylpyrimidin-4-ol, 5c

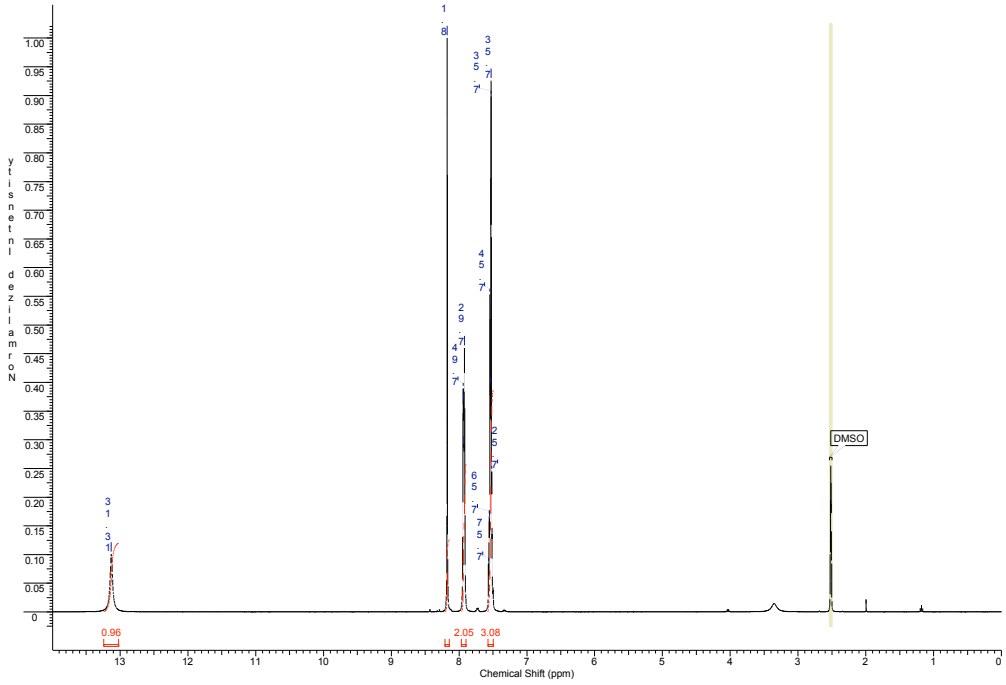


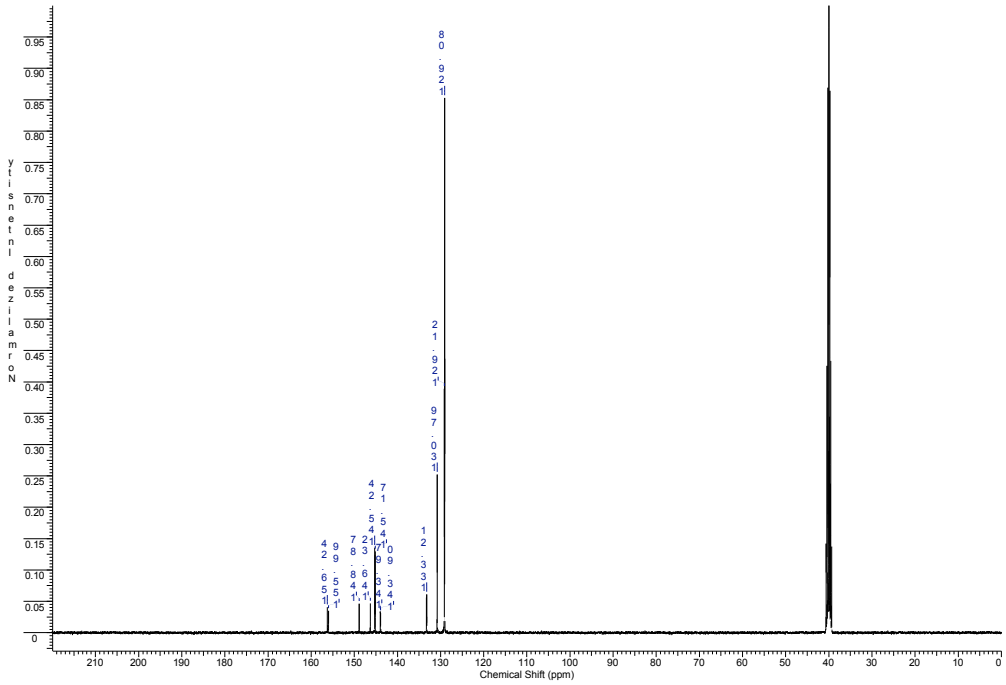




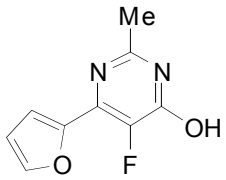
5-Fluoro-6-phenylpyrimidin-4-ol, 5d

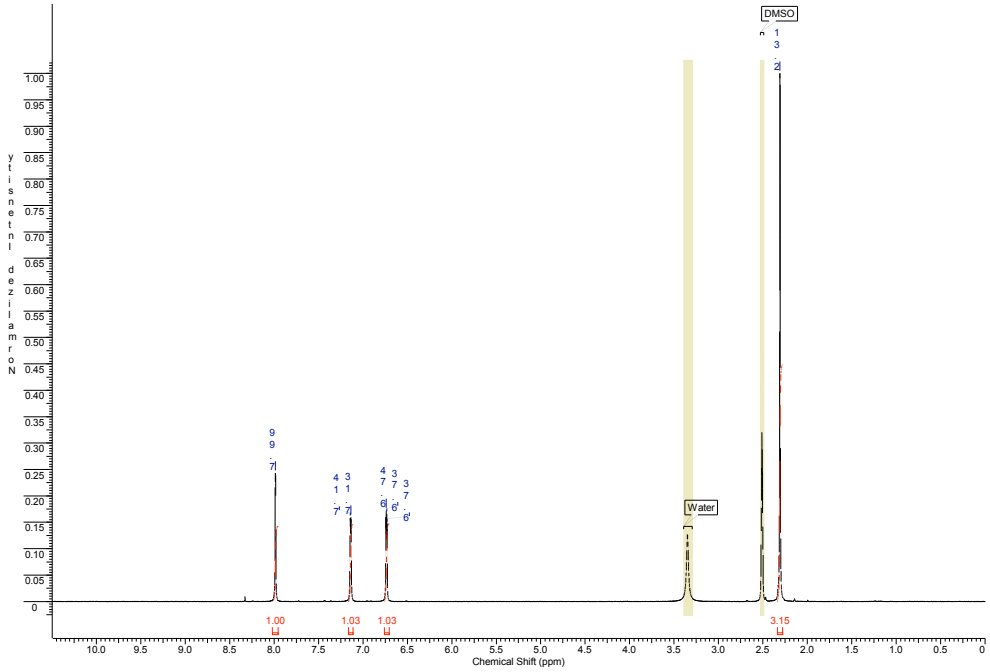


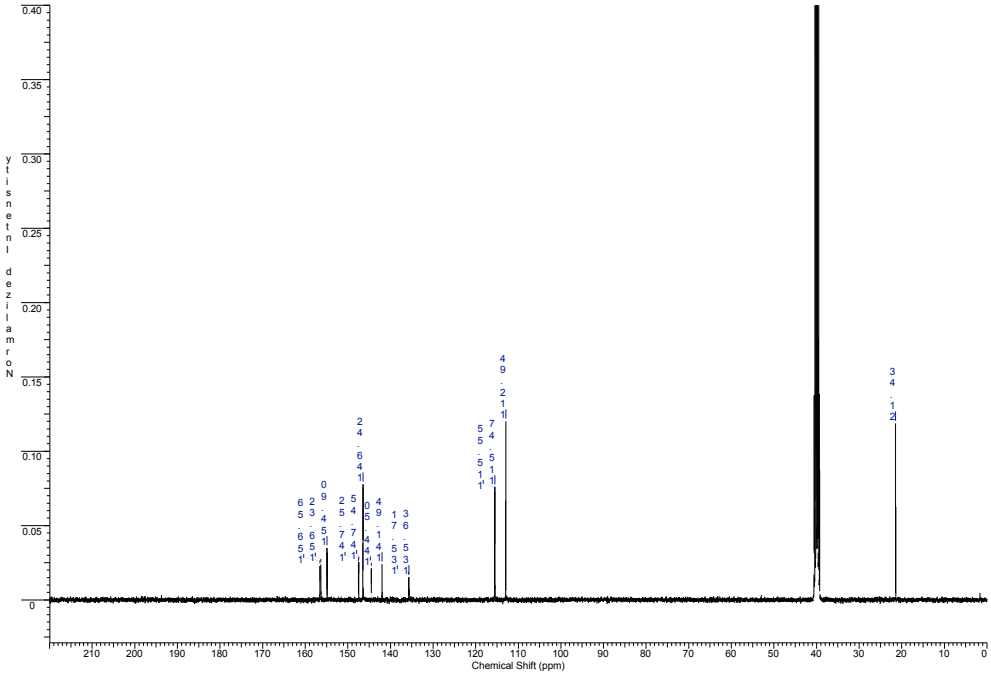




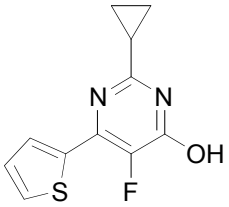
5-Fluoro-6-(furan-2-yl)-2-methylpyrimidin-4-ol, 5e

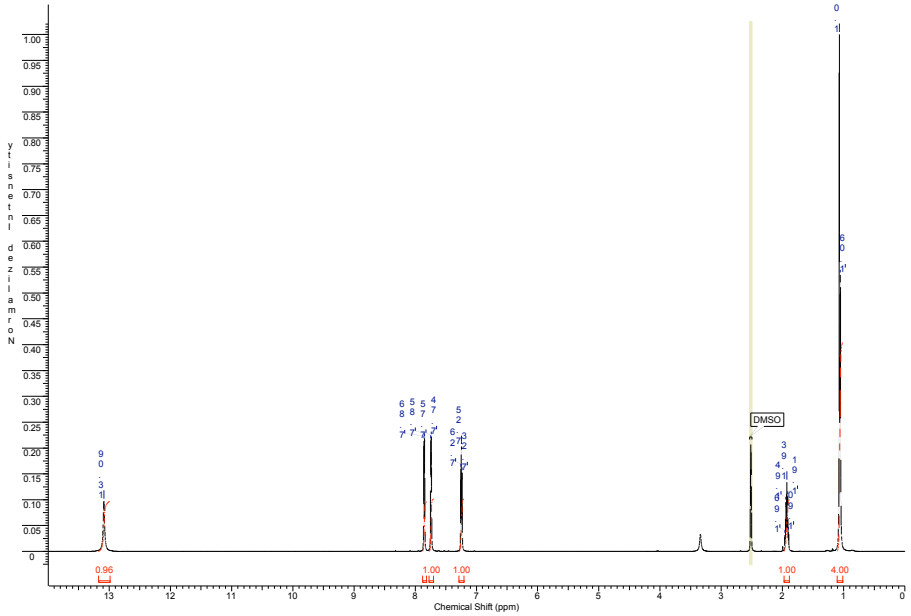


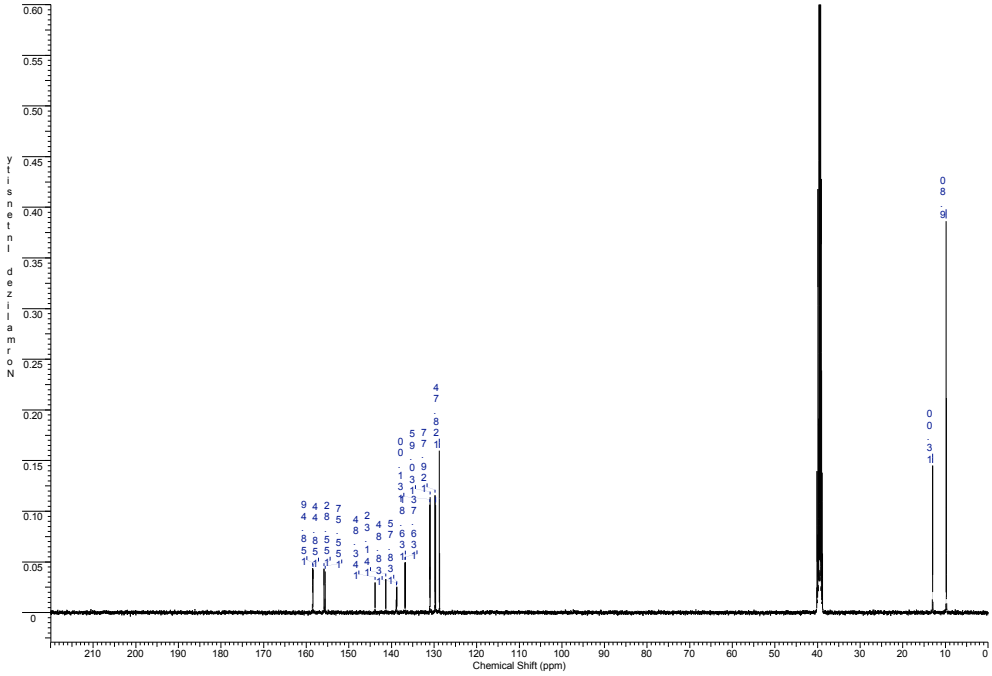




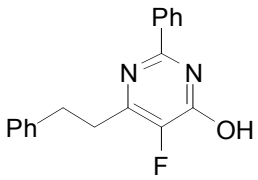
2-Cyclopropyl-5-fluoro-2-6-(thiophen-2-yl)pyrimidin-4-ol, 5f

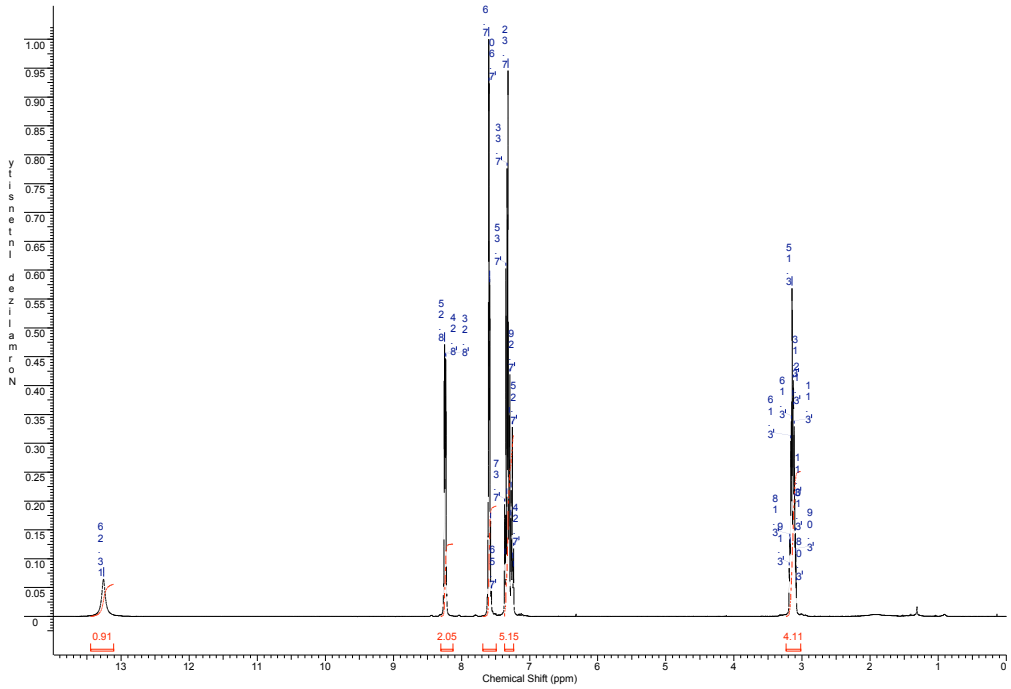


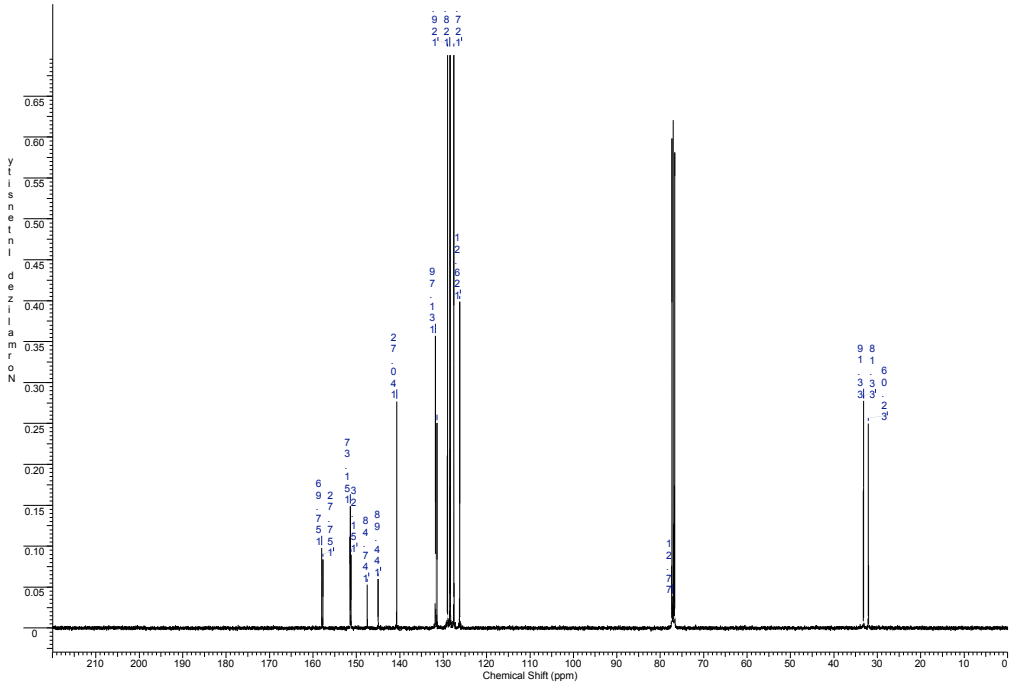




5-Fluoro-6-phenylethyl-2-phenylpyrimidin-4-ol, 5g







6-Cyclohexyl-5-fluoro-2-methylpyrimidin-4-ol, 5h