

Synthetic studies towards naturally occurring γ -(*Z*)/(*E*)-alkylidenebutenolides through bimetallic cascade cyclization and an adventitious photoisomerization method

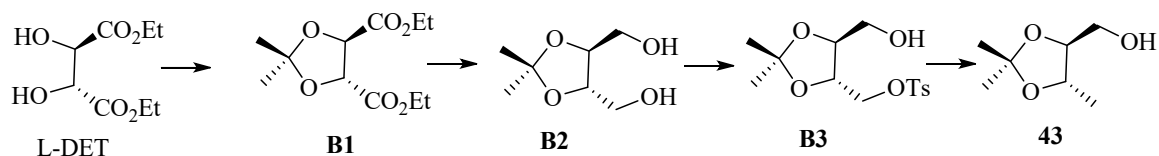
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India

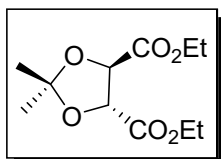
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Experimental procedures for few known compounds	2-4
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(d, $J = 4.7$ Hz, 5H), 7.32 – 7.25 (m, 3H), 5.0 (d, 1.9 Hz, 1H) 1.13 (s, 9H). HRMS (ESI) m/z : for $C_{24}H_{26}O_2SiNa[M + Na]^+$, calculated: 397.1600; found: 397.1609.

Synthesis of compound 43: Compound **43** was synthesized according to known procedure starting from C_2 -symmetric L-DET.²

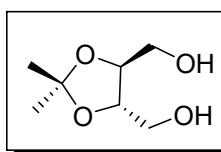


((4*R*,5*R*)-diethyl 2,2-dimethyl-1,3-dioxolane-4,5-dicarboxylate (B1): To a stirred solution



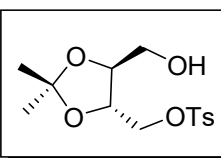
of diethyl *L*-tartrate in dry toluene, fitted with Dean-Stark apparatus, 2,2-DMP and PTSA were added. The reaction was then heated to reflux for 12 h. After completion of the reaction, it was quenched with a saturated solution of $NaHCO_3$. The mixture was then extracted with ethyl acetate (30 mL \times 2). The combined organic layer was washed with brine, dried over anhydrous Na_2SO_4 , and evaporated under reduced pressure. The crude product was then purified with flash column chromatography to afford compound **B1** as a colorless liquid in a 95% yield. The spectral data of **B1** matches well with the previous literature report.² $[\alpha]_D^{25} = -41.4$ (c 1.0, $CHCl_3$).

((4*S*,5*S*)-2,2-dimethyl-1,3-dioxolane-4,5-diyl)dimethanol (B2): To a stirred suspension of



lithium aluminum hydride (LAH) in dry THF, a solution of compound **B1** in dry THF was added drop-wise at 0 °C. The reaction was warmed at room temperature and stirred for 2 h at the same temperature. After completion of the reaction, it was cooled to 0 °C and a saturated solution of Na_2SO_4 was added to the reaction mixture drop-wise till a white precipitate appears. The precipitate was then filtered through a celite bed and washes with ethyl acetate. The combined filtrate was dried over anhydrous Na_2SO_4 and evaporated under reduced pressure. The crude product was purified by flash column chromatography to afford the compound **B2** as a colorless liquid in 90% yield. The spectral data of **B2** matches well with the previous literature report.² $[\alpha]_D^{25} = -24.2$ (c 1.0, MeOH).

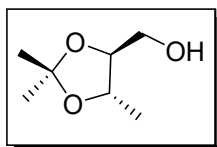
((4*S*,5*S*)-5-(hydroxymethyl)-2,2-dimethyl-1,3-dioxolan-4-yl)methyl-4-



methylbenzenesulfonate (B3): To a stirred solution of compound **B2**, in dry DCM, Et_3N was added at 0 °C and stirred for 5 min. Freshly recrystallized tosyl chloride and DMAP were added to the reaction mixture at 0 °C and stirred for 6 h. After the complete disappearance of the starting material, the reaction was quenched with water and extracted with DCM. The organic layer was washed with brine, dried over anhydrous Na_2SO_4 , and evaporated under reduced pressure. The crude reaction mixture was then purified with flash column chromatography to afford compound **B3** as a colorless liquid in 85% yield. $[\alpha]_D^{25} = -15.2$ (c 1.0, $CHCl_3$). ¹H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.75 (m, 2H), 7.33 (d, $J = 8.1$ Hz, 2H), 4.12 (t, $J = 4.5$ Hz, 2H), 4.10 – 4.04 (m, 1H), 3.94 (dt, $J = 7.8, 4.0$ Hz, 1H), 3.79 – 3.70 (m, 1H), 3.61 (dd, $J = 12.0, 4.2$ Hz, 1H), 2.43 (s, 3H), 1.36 (s, 3H), 1.32 (s, 3H). ¹³C NMR (101

MHz, CDCl₃) δ 145.1, 132.5, 129.9, 128.0, 110.0, 78.0, 74.5, 68.9, 61.7, 27.0, 26.7, 21.6. HRMS (ESI) m/z : for C₁₄H₂₀O₆SNa[M + Na]⁺, calculated: 339.0878; found: 339.0885.

((4*S*,5*S*)-2,2,5-trimethyl-1,3-dioxolan-4-yl)methanol (43): To a suspension of LAH in dry



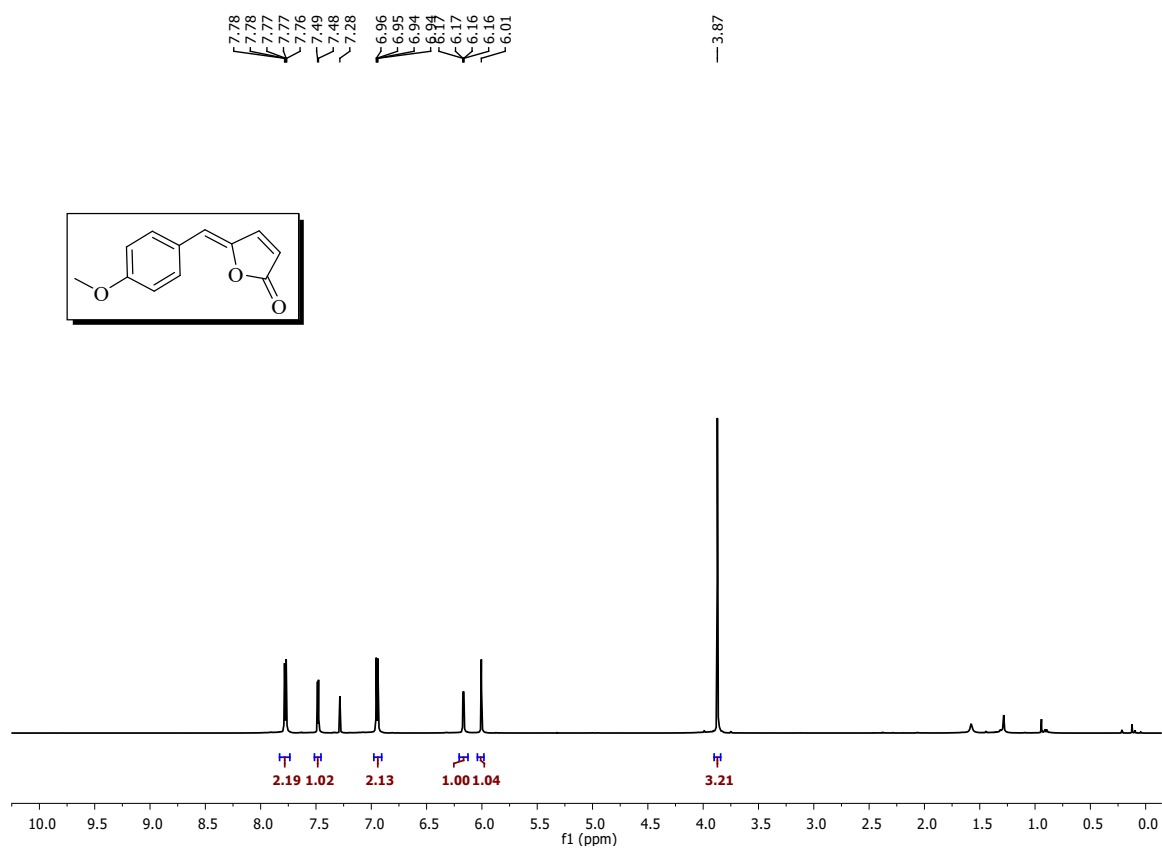
THF, a solution of compound **B3** in dry THF was added drop-wise at 0 °C. The reaction was then warmed at room temperature and stirred for 12 h. After complete consumption of the starting material, the reaction

solution was cooled to 0 °C and a saturated solution of Na₂SO₄ was added to it drop-wise till a white precipitate appears. The precipitate was then filtered through a celite bed and washed with ethyl acetate. The combined filtrate was dried over anhydrous Na₂SO₄ and evaporated under reduced pressure. The crude product was then purified by flash column chromatography to furnish compound **43** as a colorless liquid in 80% yield. $[\alpha]_D^{25} = +2.3$ (c 1.0, CHCl₃). ¹H NMR (400 MHz, CDCl₃) δ 4.02 (dq, $J = 8.3, 6.0$ Hz, 1H), 3.85 – 3.78 (m, 1H), 3.70 – 3.56 (m, 2H), 1.42 (d, $J = 10.0$ Hz, 6H), 1.30 (d, $J = 6.0$ Hz, 3H). ¹³C NMR (100 MHz, CDCl₃) δ 108.4, 82.7, 72.7, 61.3, 27.3, 26.9, 17.6. HRMS (ESI) m/z : for C₇H₁₄O₃Na[M + Na]⁺, calculated: 169.0841; found: 169.0847.

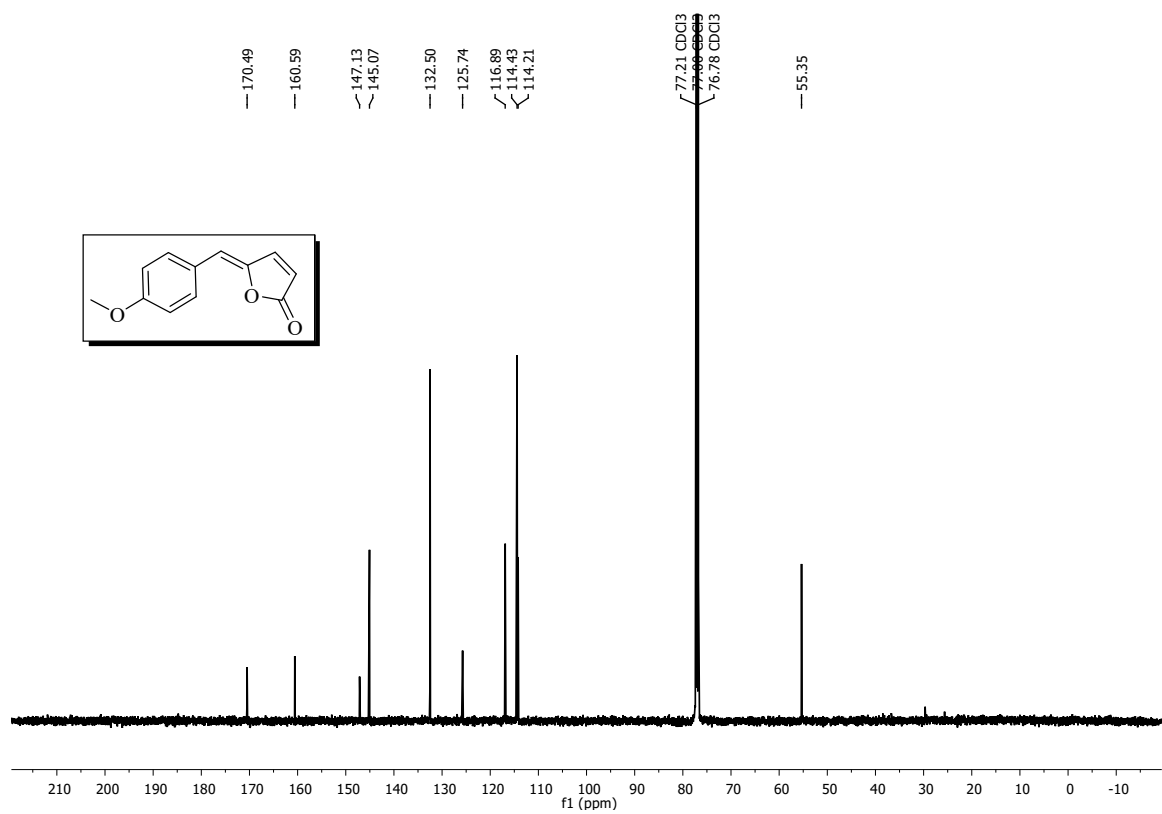
References:

1. (a) Y. Sun, X. Wan, J. Wang, Q. Meng, H. Zhang, L. Jiang, and Z. Zhang, *Org. Lett.* **2005**, *7*, 5425-5427. (b) T. Peňaška, P. Koukal, and M. Katora, *Eur. J. Org. Chem.* **2018**, 147–149.
2. (a) S. Vrbkova, M. Dracinsky, and A. Holy. *Tetrahedron: Asymmetry.* **2007**, *18*, 2233-2247. (b) L. Wang, and W. Zhu, *Tetrahedron Lett.* **2013**, *54*, 6729–6731.

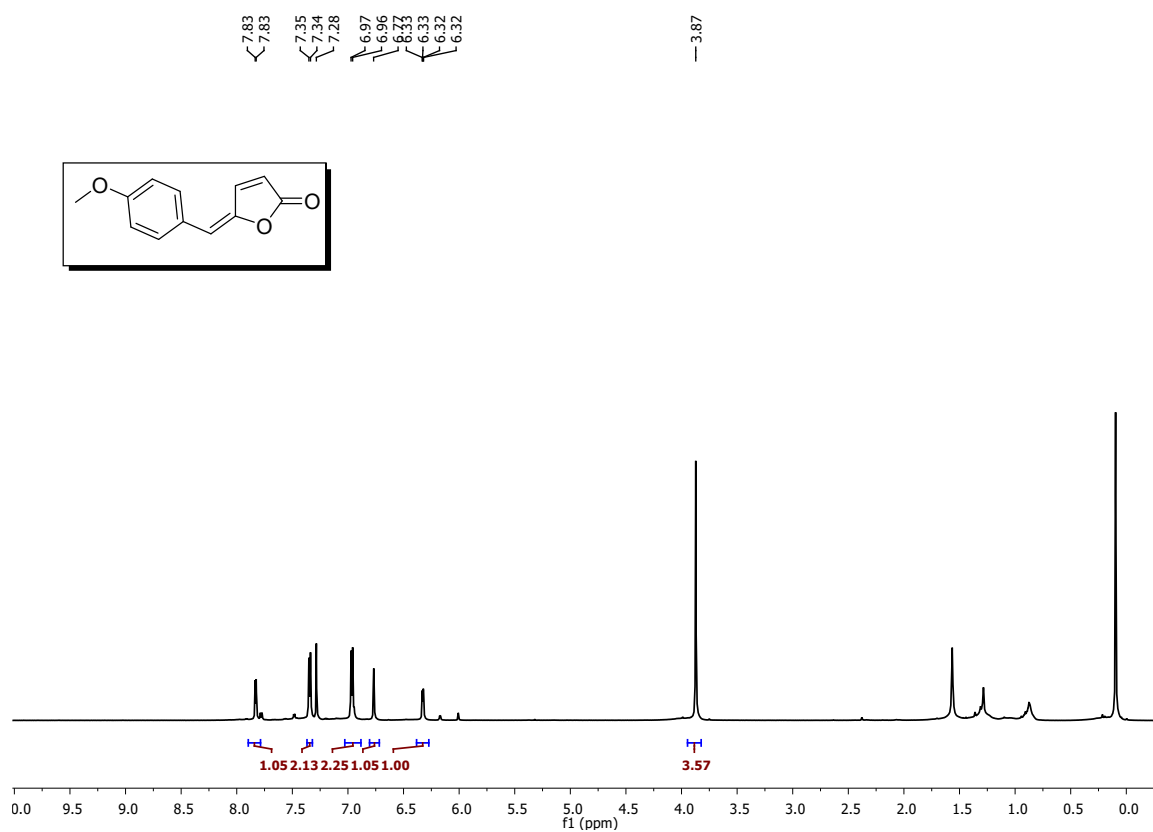
¹H NMR of compound 3a (600 MHz, CDCl₃)



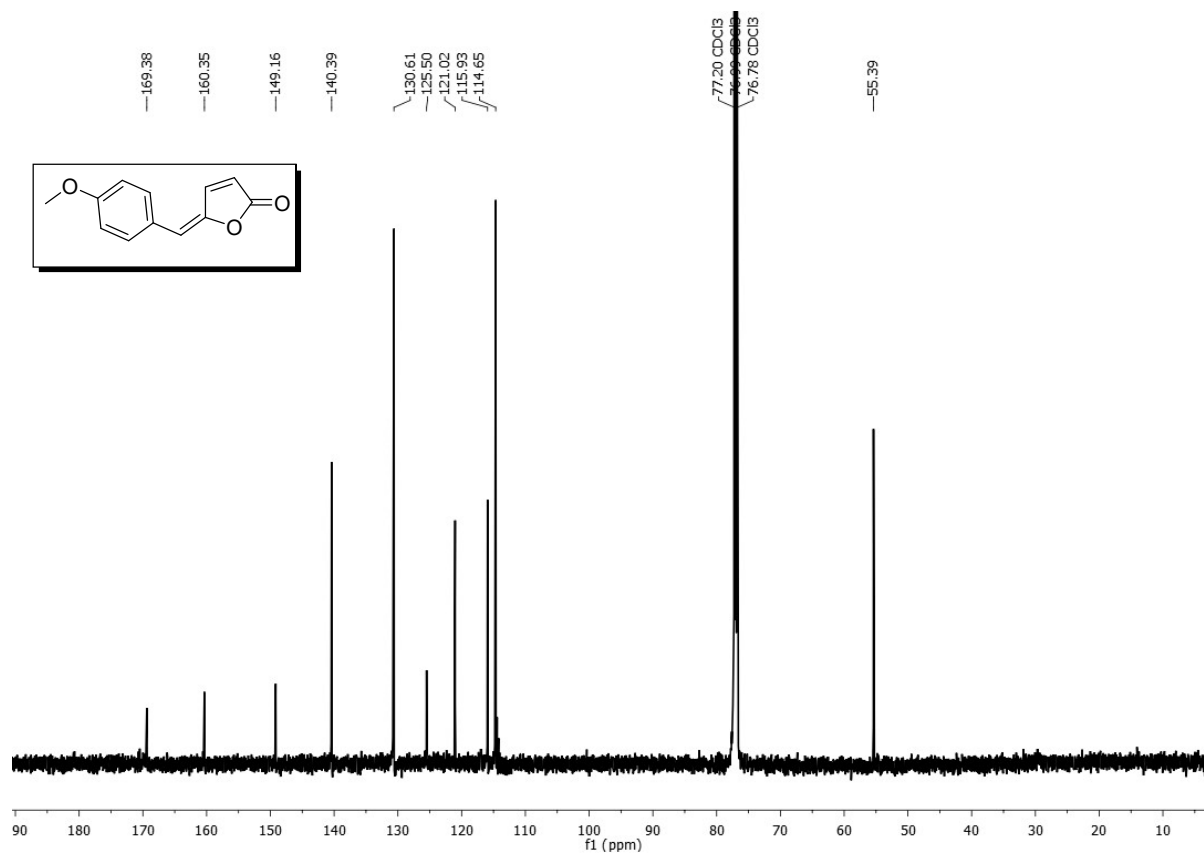
¹³C NMR of compound 3a (150 MHz, CDCl₃)



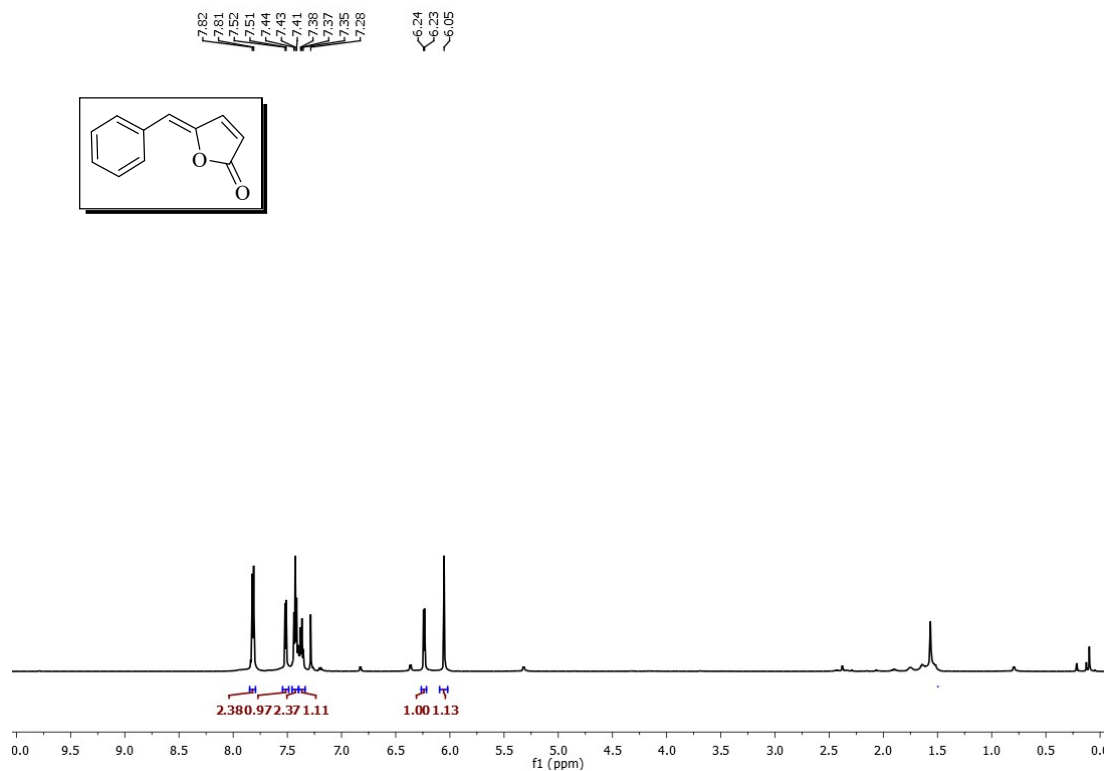
¹H NMR of compound 4a (600 MHz, CDCl₃)



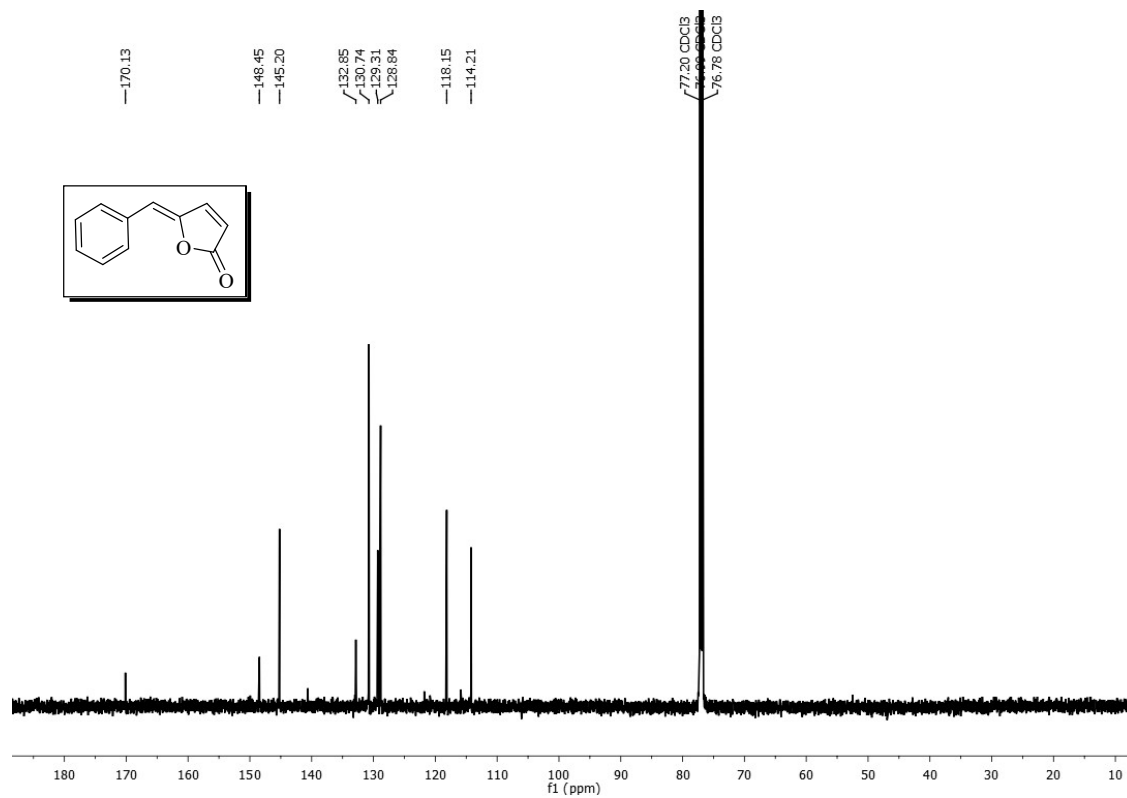
¹³C NMR of compound 4a (150 MHz, CDCl₃)



^1H NMR of compound 3b (600 MHz, CDCl_3)

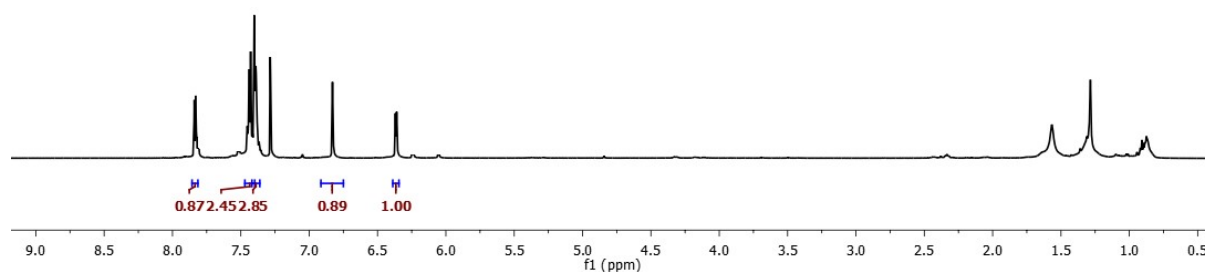
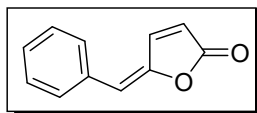


^{13}C NMR of compound 3b (150 MHz, CDCl_3)



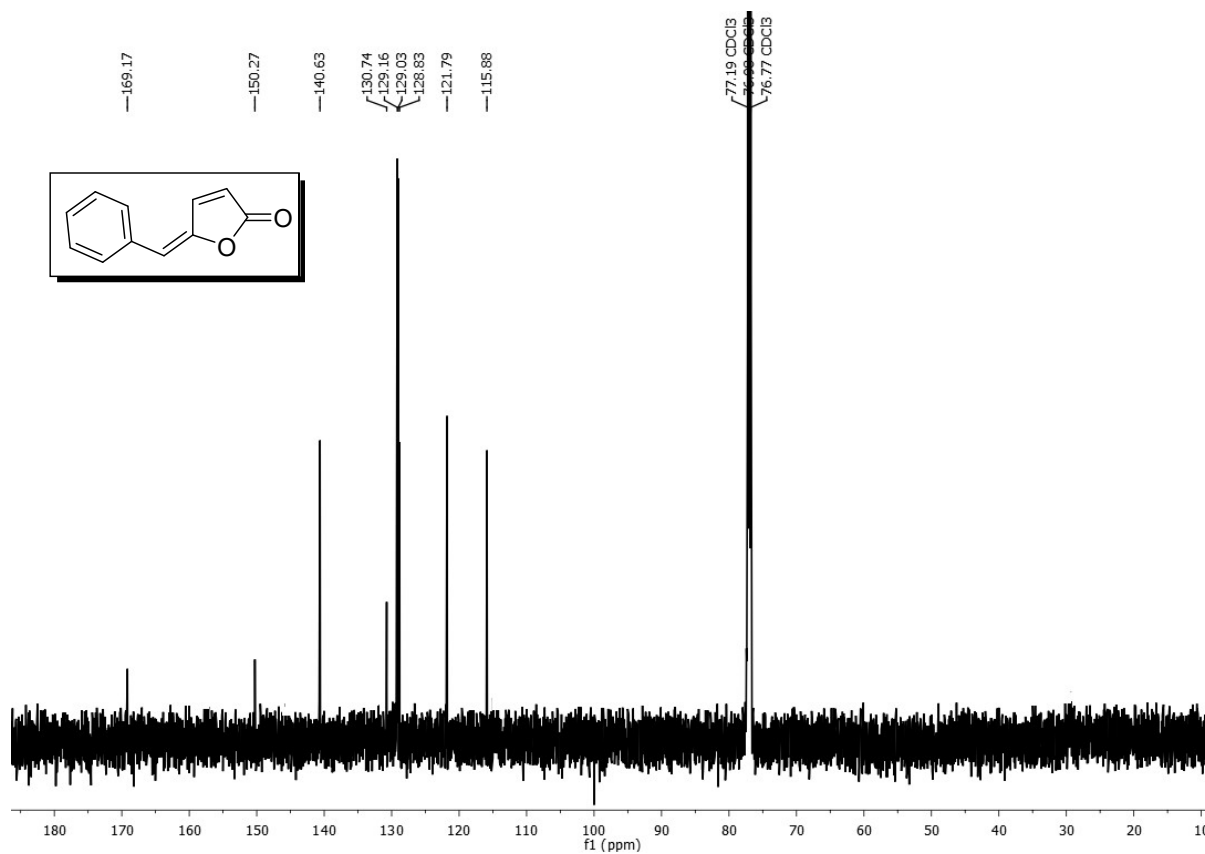
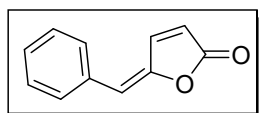
^1H NMR of compound 4b (600 MHz, CDCl_3)

7.84
7.83
7.44
7.43
7.40
7.39
7.39
7.38
6.37
6.37
6.36
6.36



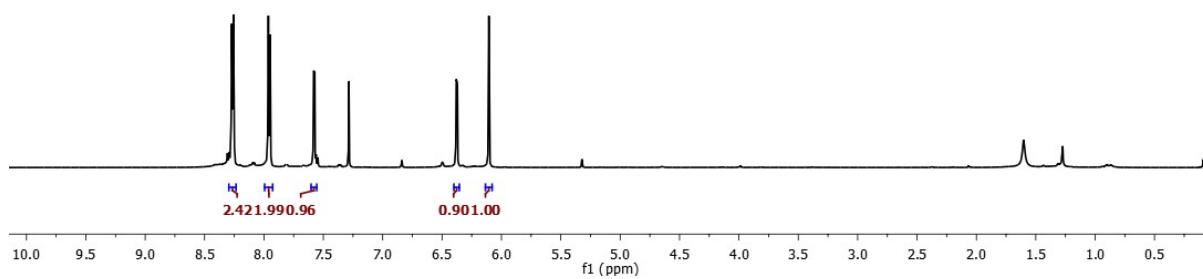
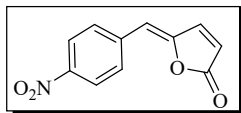
^{13}C NMR of compound 4b (150 MHz, CDCl_3)

169.17
150.27
140.63
130.74
129.16
129.03
128.83
121.79
115.88
77.19 CDCl_3
76.77 CDCl_3



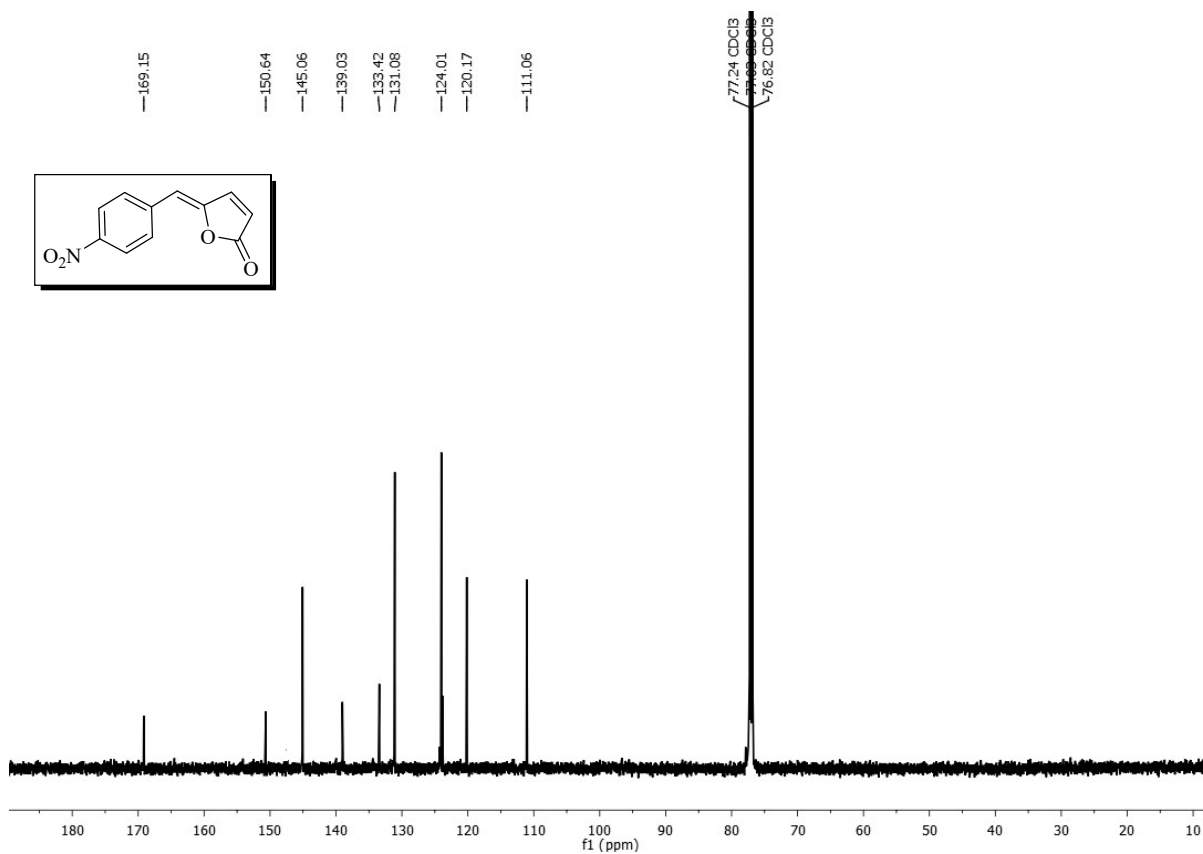
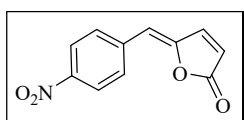
^1H NMR of compound 3c (600 MHz, CDCl_3)

8.28
8.27
8.26
8.25
7.97
7.96
7.95
7.94
7.58
7.57
7.28
6.38
6.37
6.11



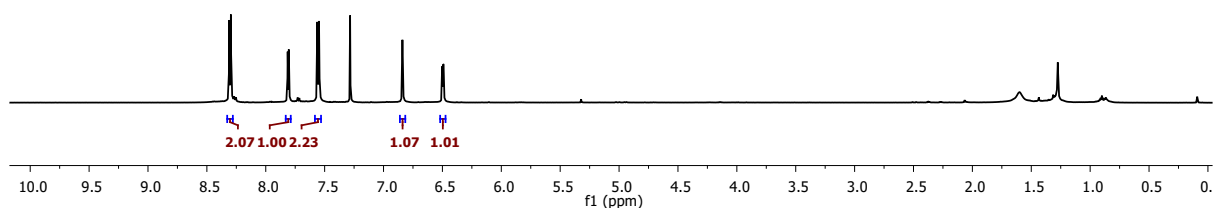
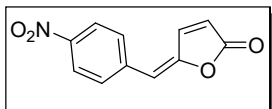
^{13}C NMR of compound 3c (150 MHz, CDCl_3)

169.15
150.64
145.06
139.03
133.42
131.08
124.01
120.17
111.06



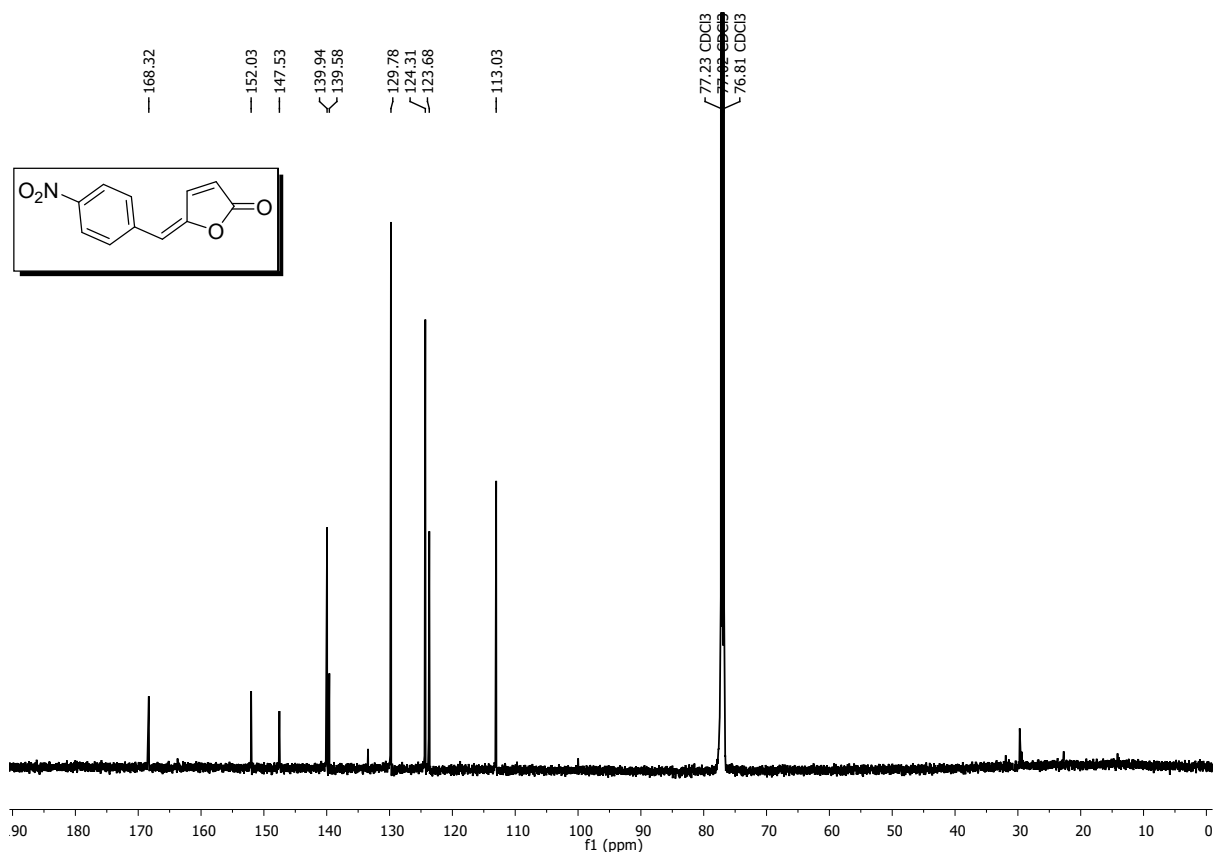
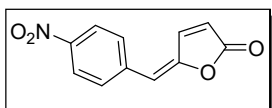
¹H NMR of compound 4c (600 MHz, CDCl₃)

8.31
8.30
8.30
7.81
7.80
7.56
7.55
7.28
6.84
6.84
6.50
6.49
6.49

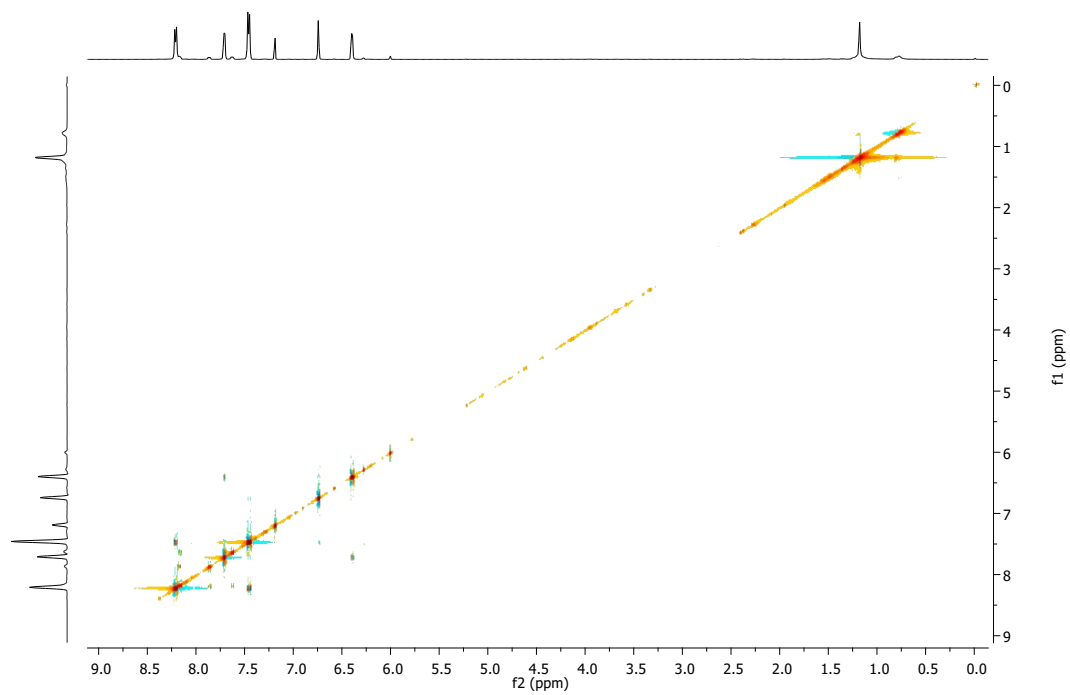


¹³C NMR of compound 4c (150 MHz, CDCl₃)

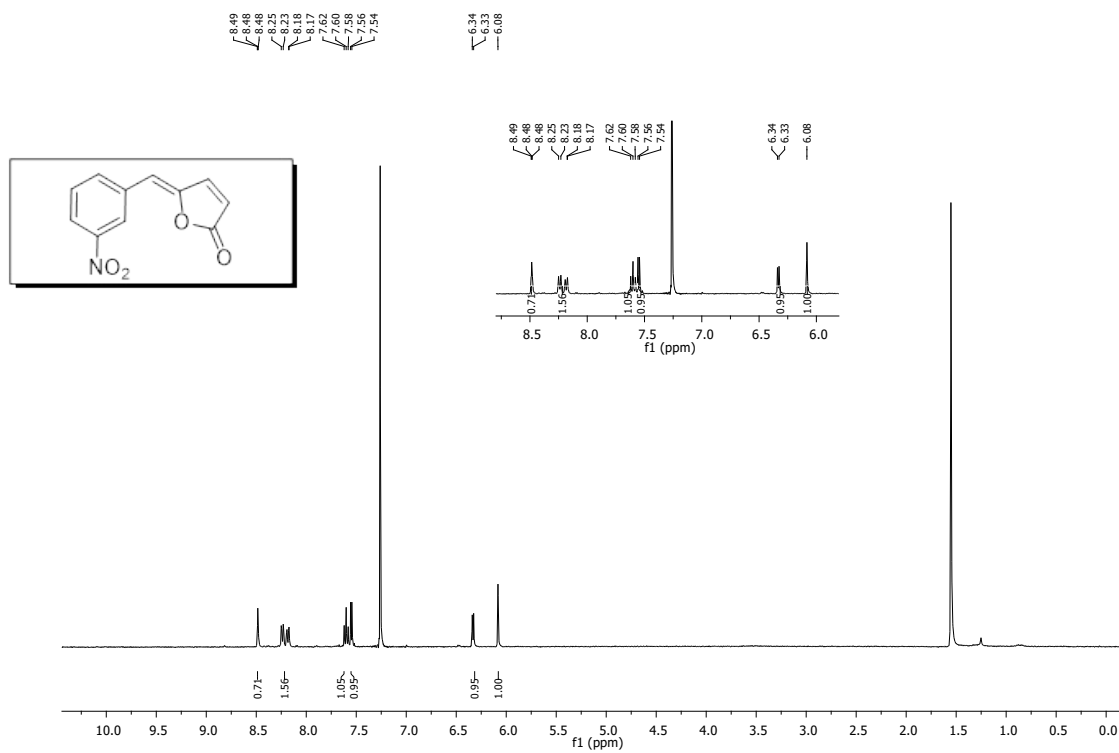
168.32
152.03
147.53
139.94
139.58
129.78
124.31
123.68
113.03



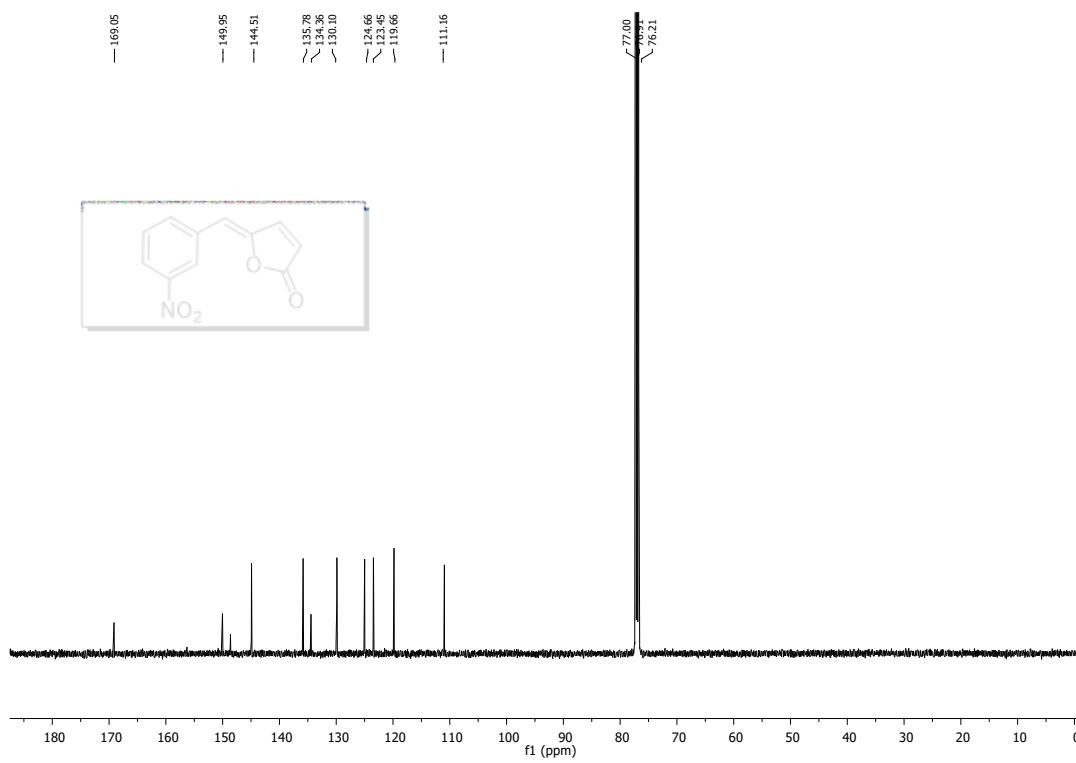
2D NOESY OF COMPOUND 3C:



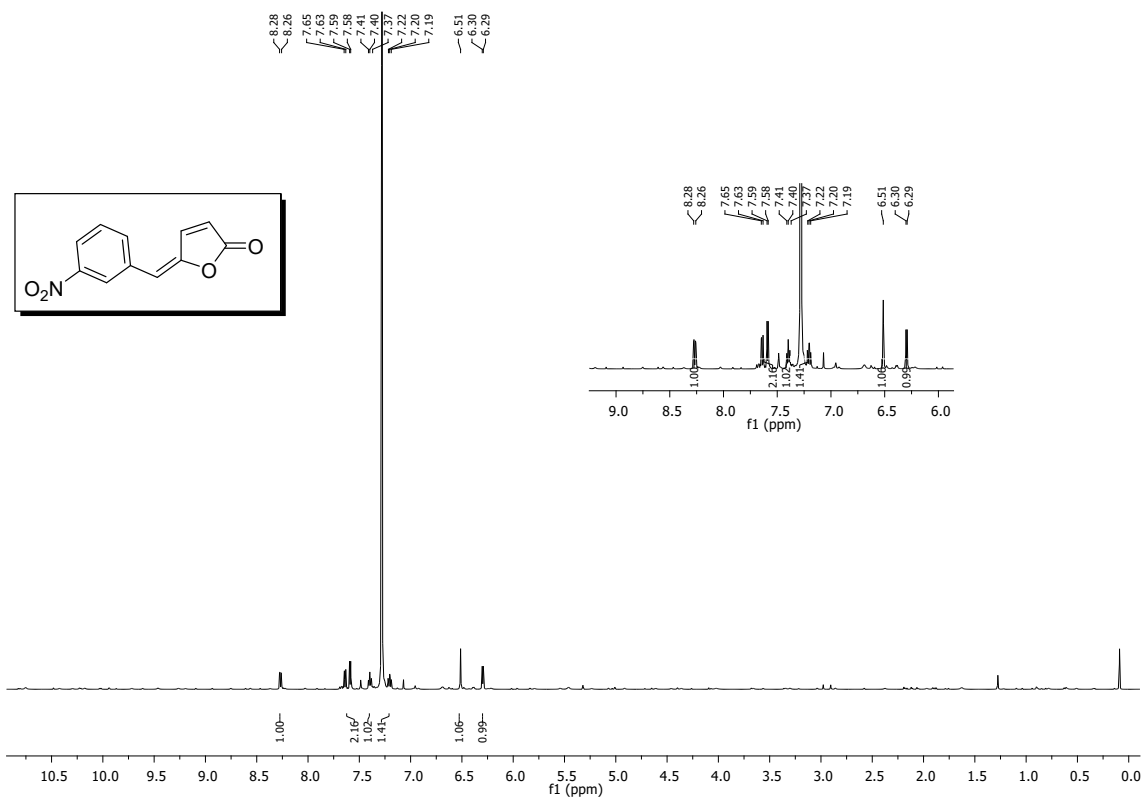
¹H NMR (400 MHz, CDCl₃) of compound 3d



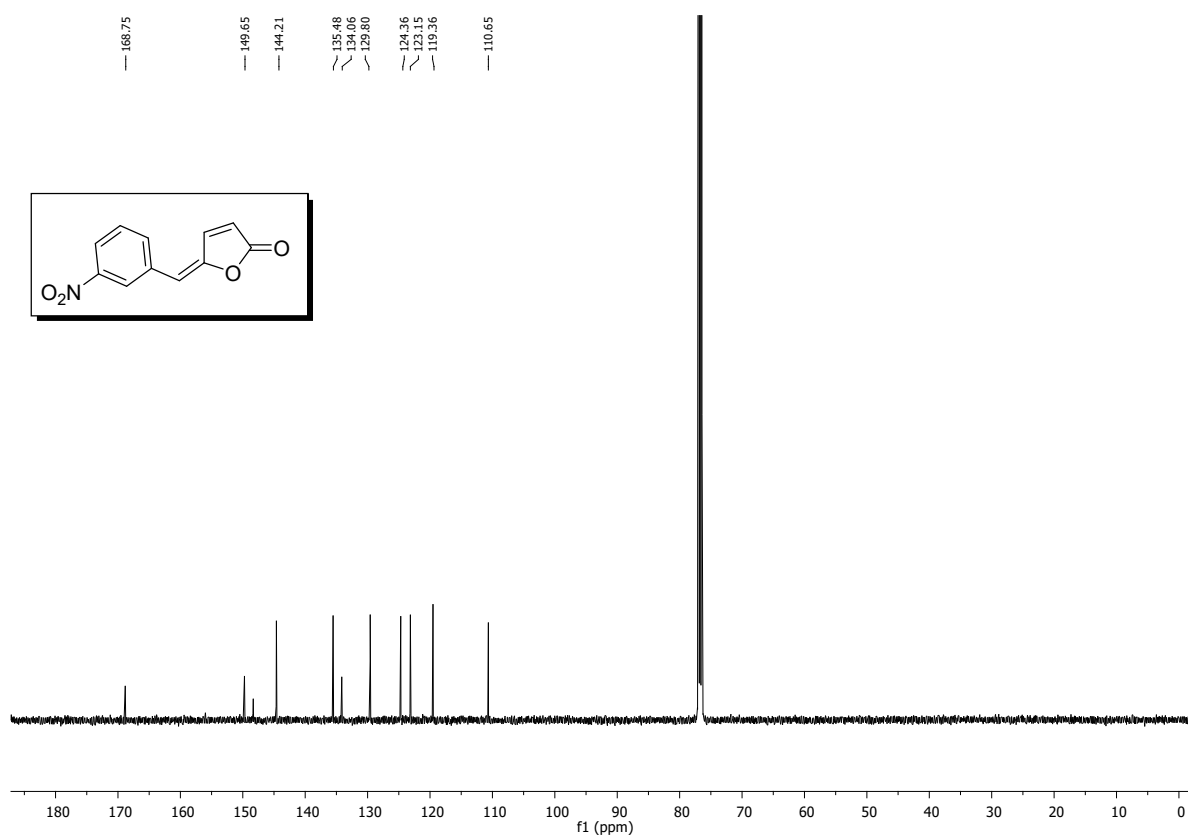
¹³C NMR of compound 3d (125 MHz, CDCl₃)



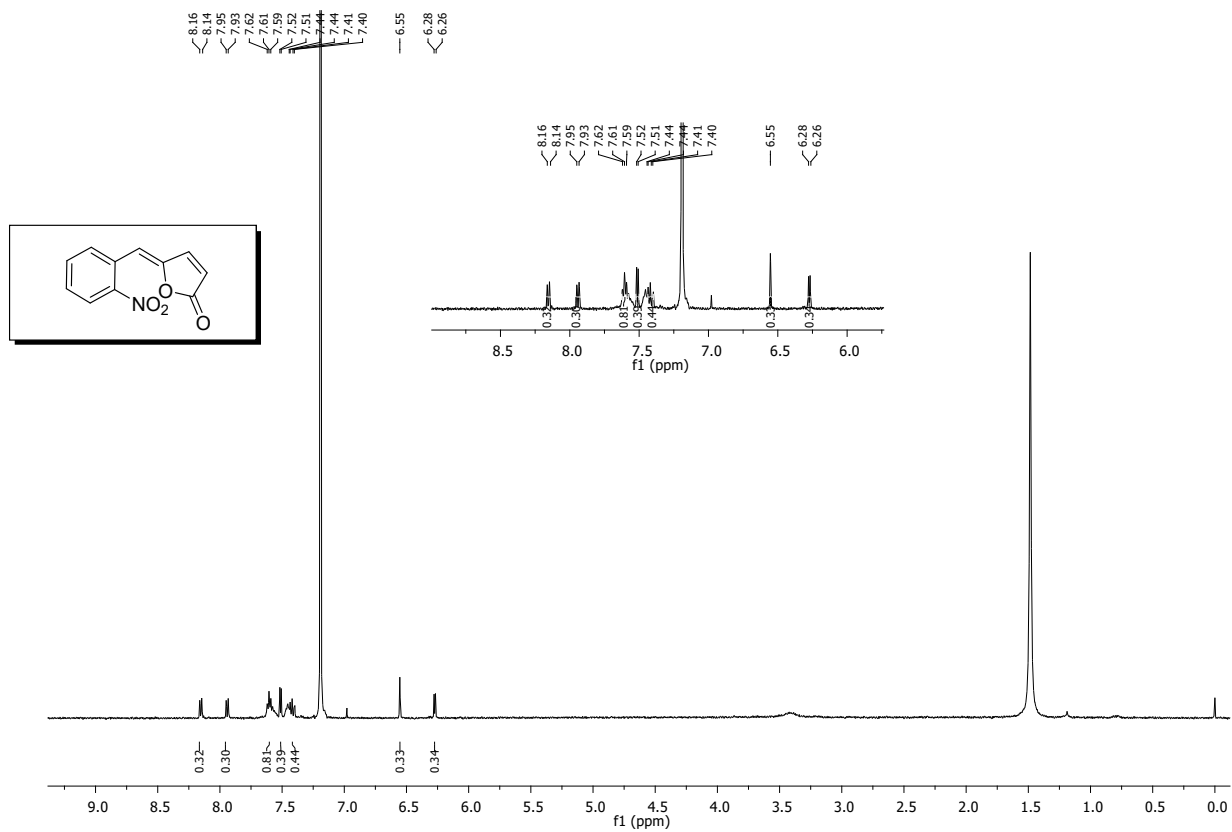
¹H NMR (500 MHz, CDCl₃) of compound 4d



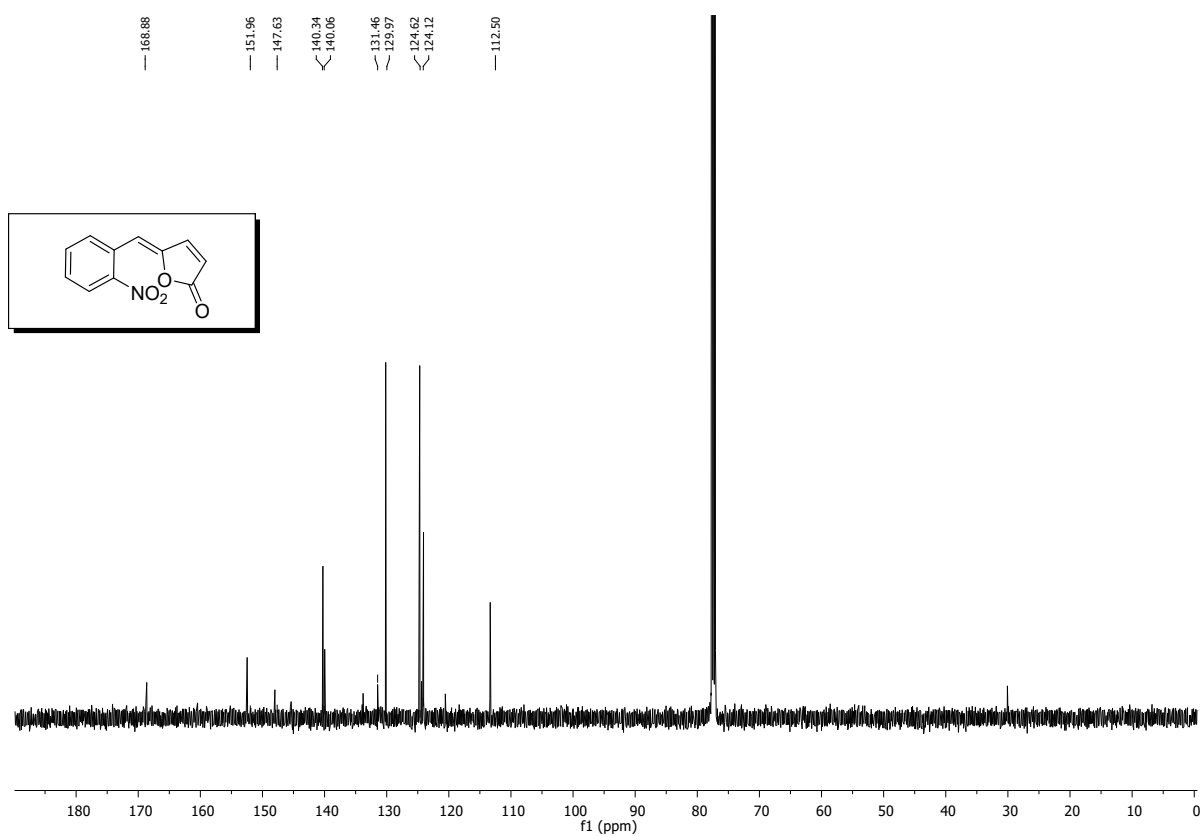
¹³C NMR of compound 4d (125 MHz, CDCl₃)



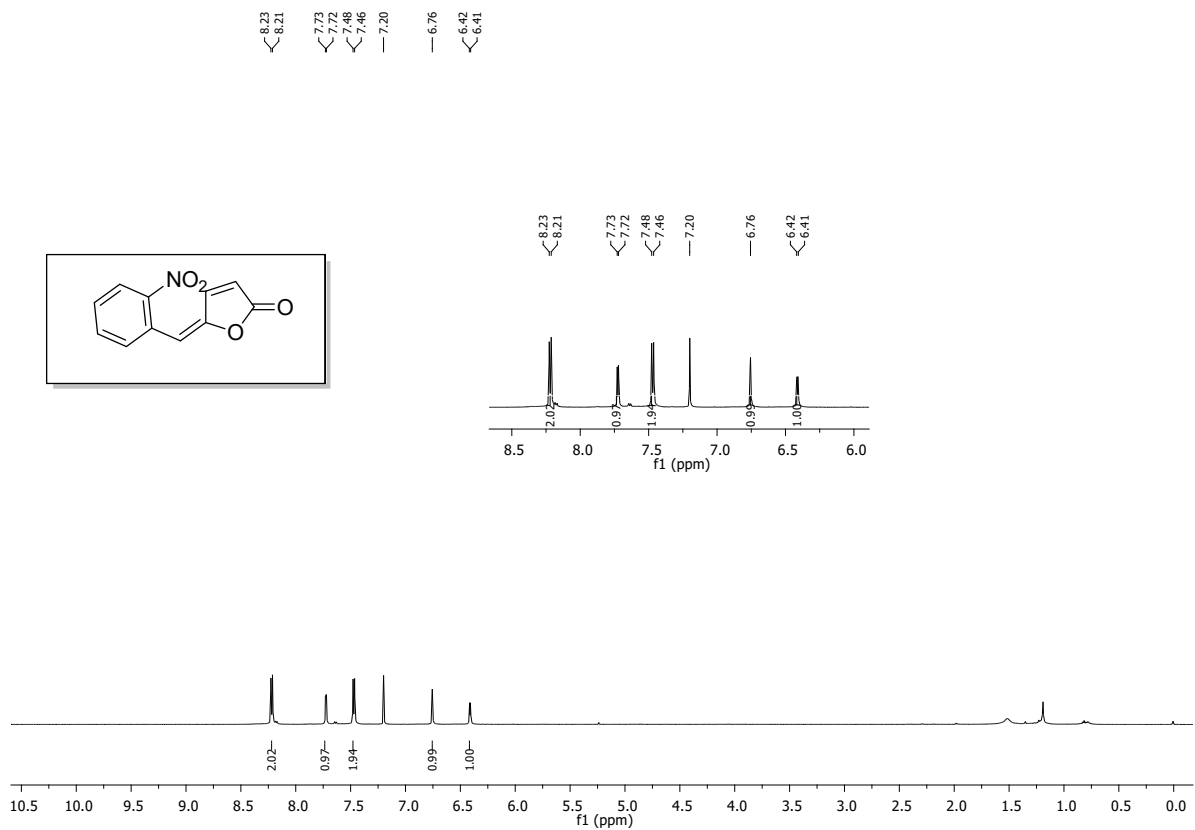
¹H NMR (500 MHz, CDCl₃) of compound 3e



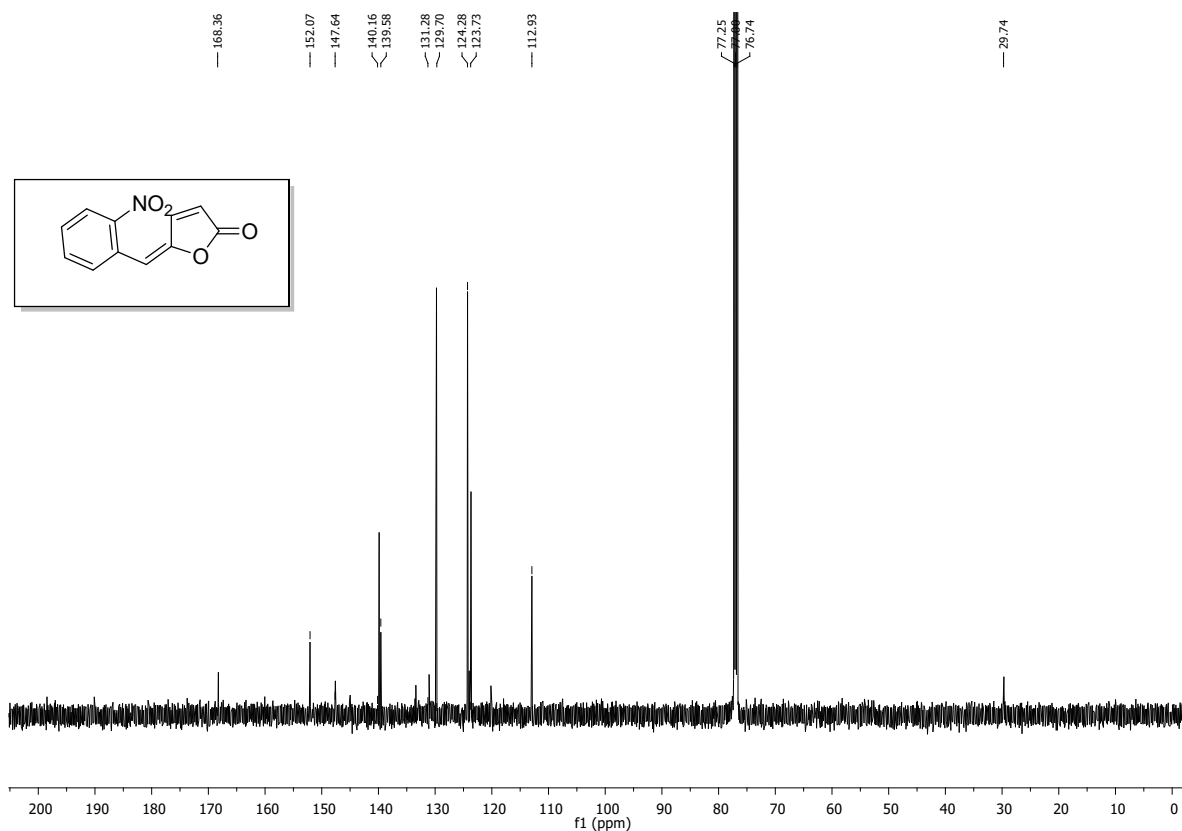
¹³C NMR of compound 3e (125 MHz, CDCl₃)



¹H NMR (500 MHz, CDCl₃) of compound 4e



¹³C NMR of compound 4e (100 MHz, CDCl₃)

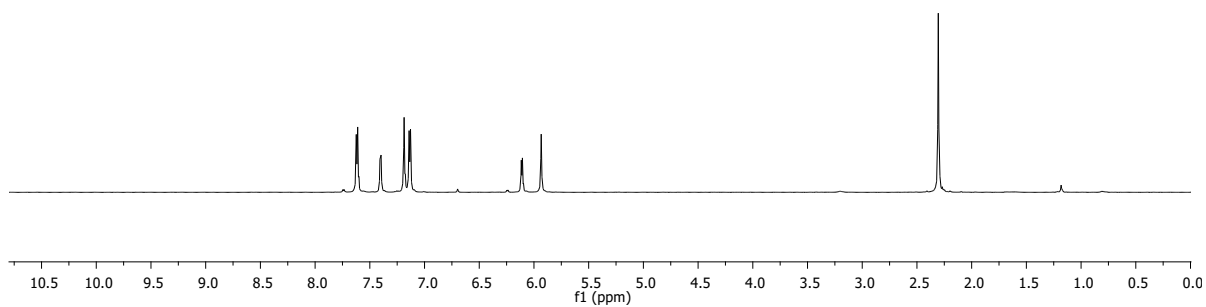
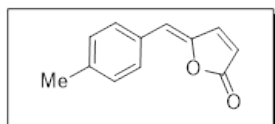


^1H NMR (600 MHz, CDCl_3) of compound 3f

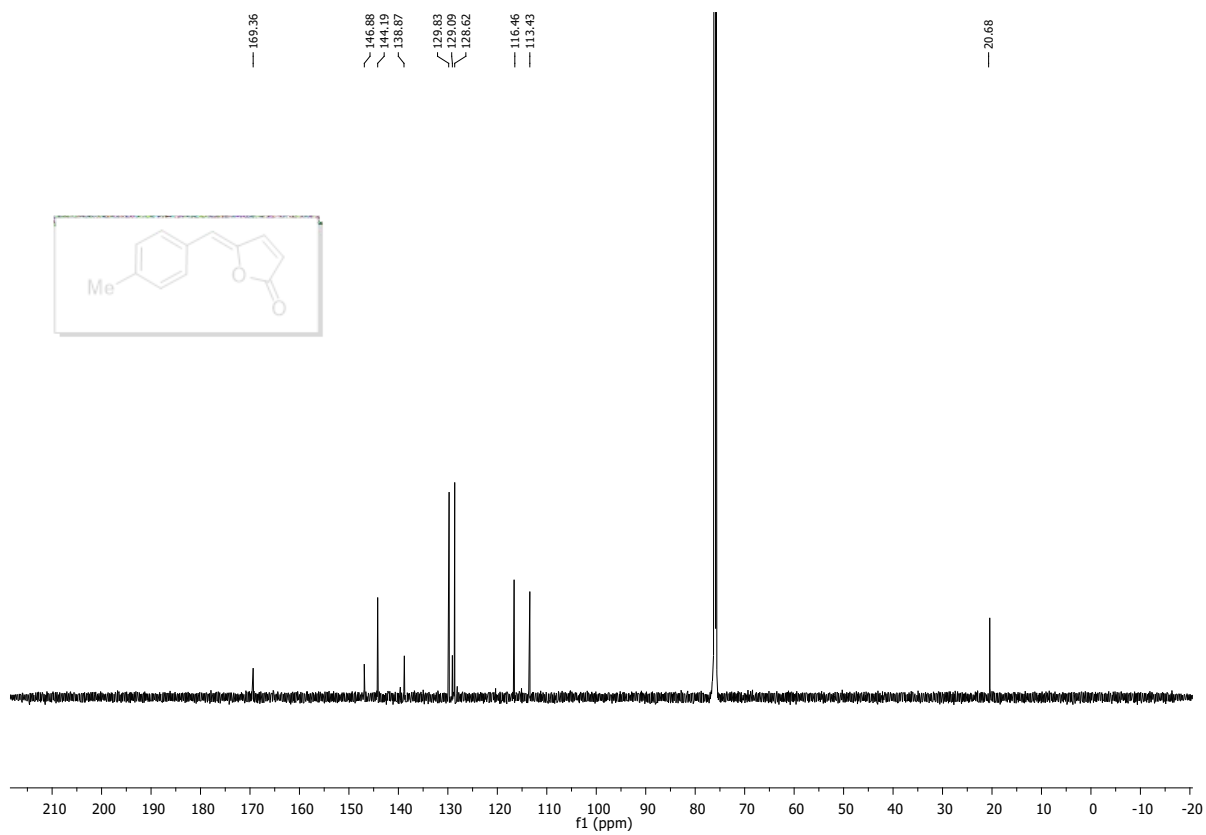
7.62
7.61
7.41
7.40
7.14
7.13

6.12
6.11
5.93

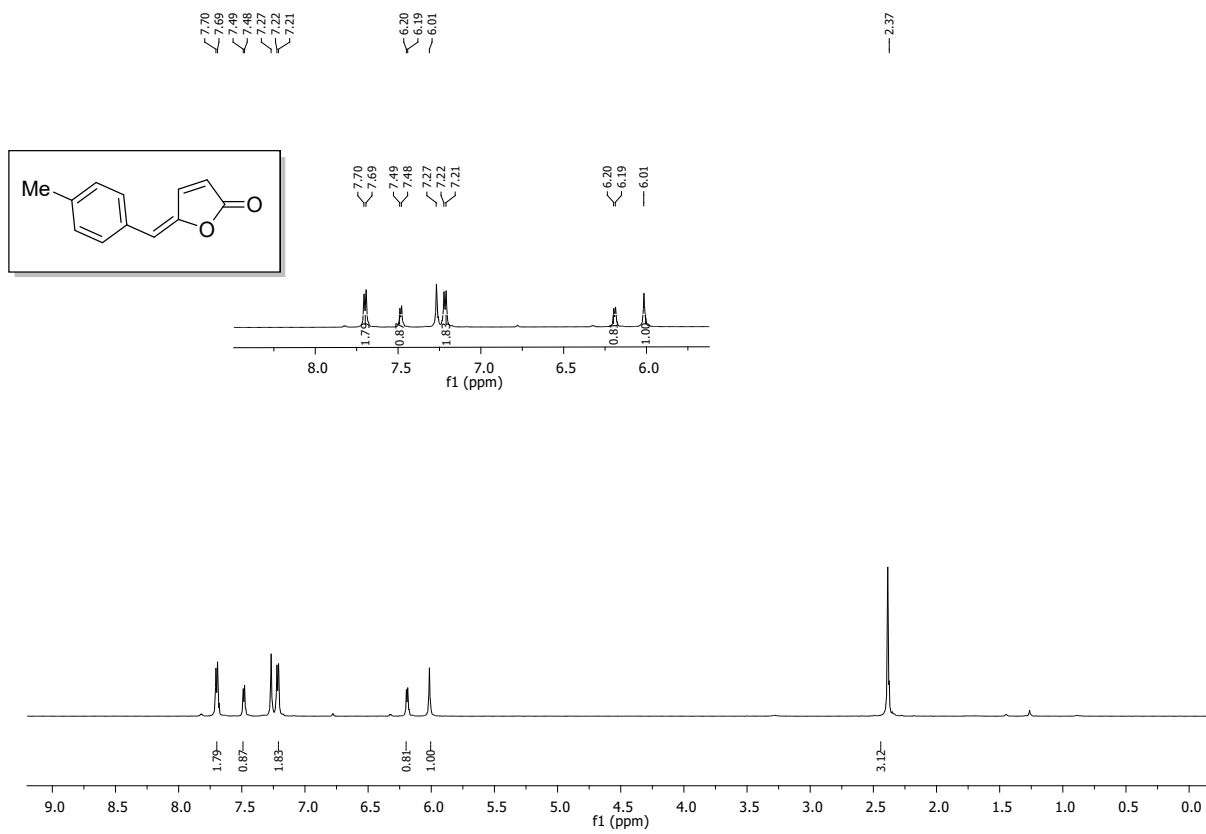
2.30



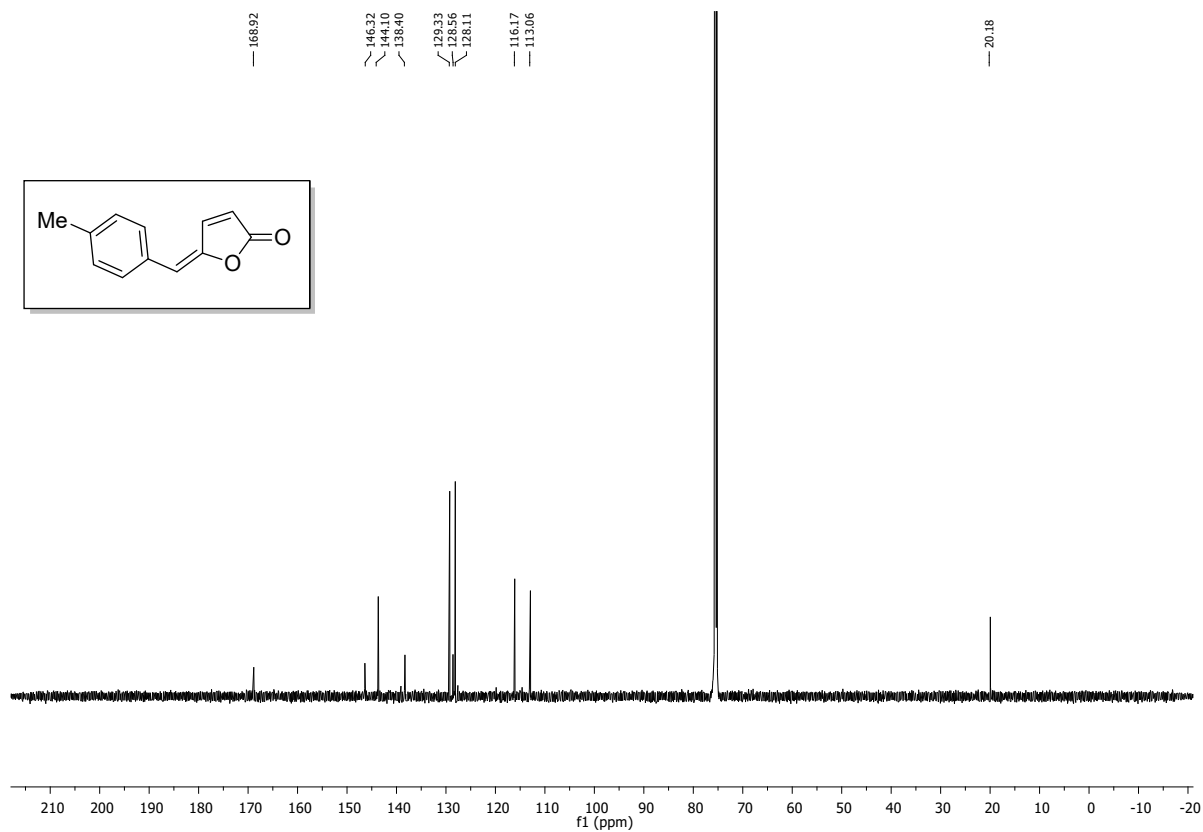
¹³C NMR of compound 3f (150 MHz, CDCl₃)



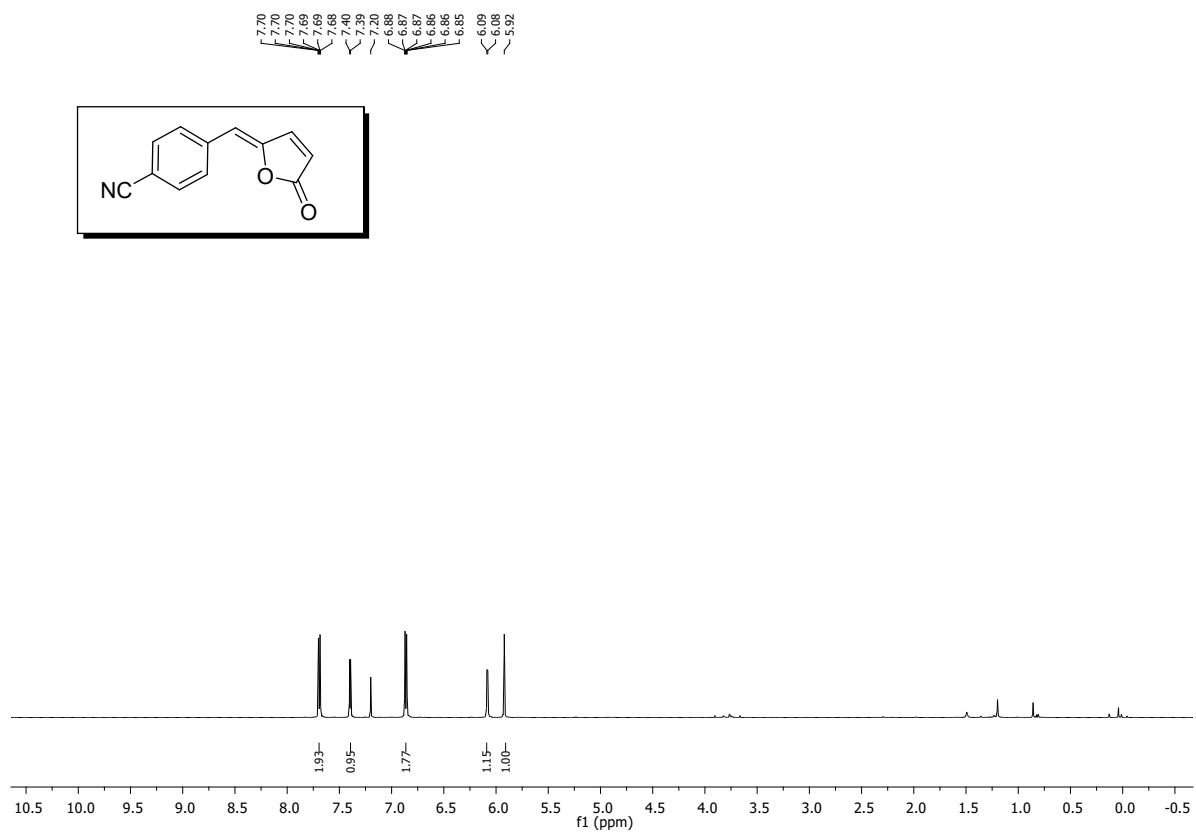
^1H NMR (400 MHz, CDCl_3) of compound 4f



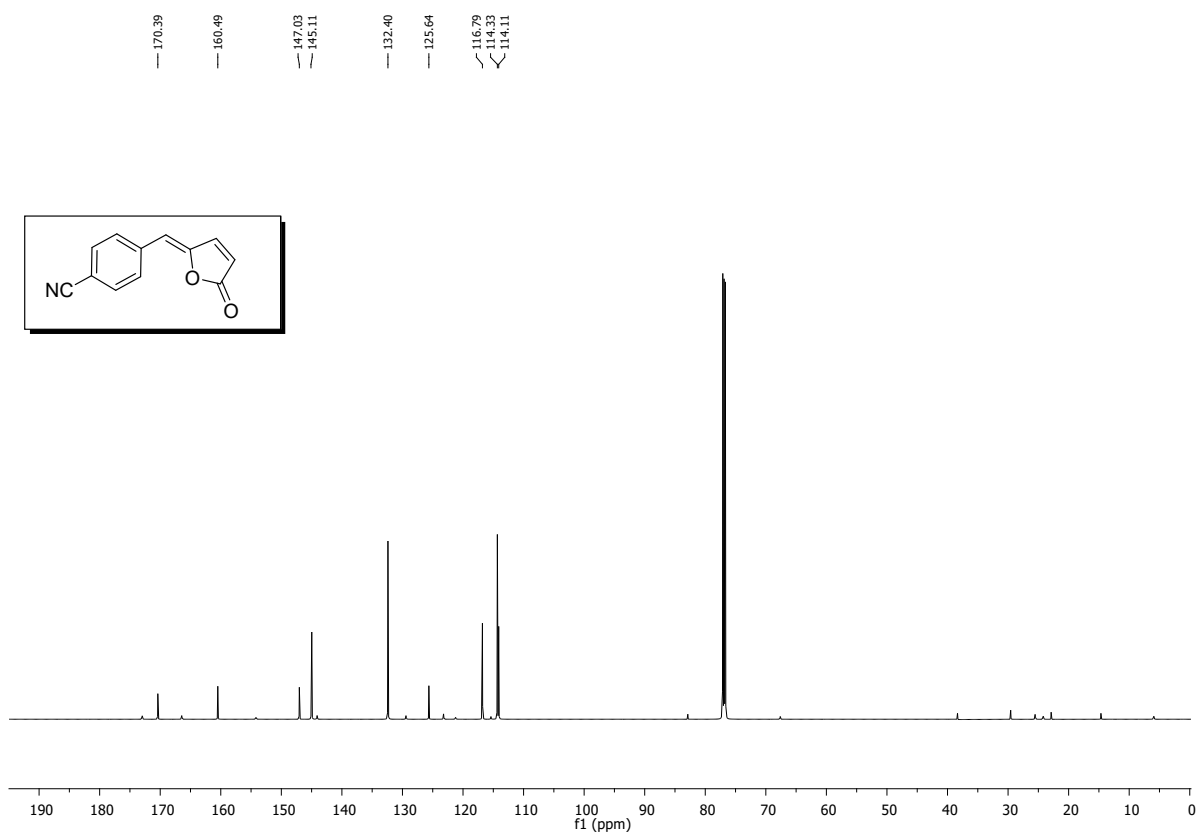
^{13}C NMR of compound 4f (100 MHz, CDCl_3)



^1H NMR (600 MHz, CDCl_3) of compound 3g

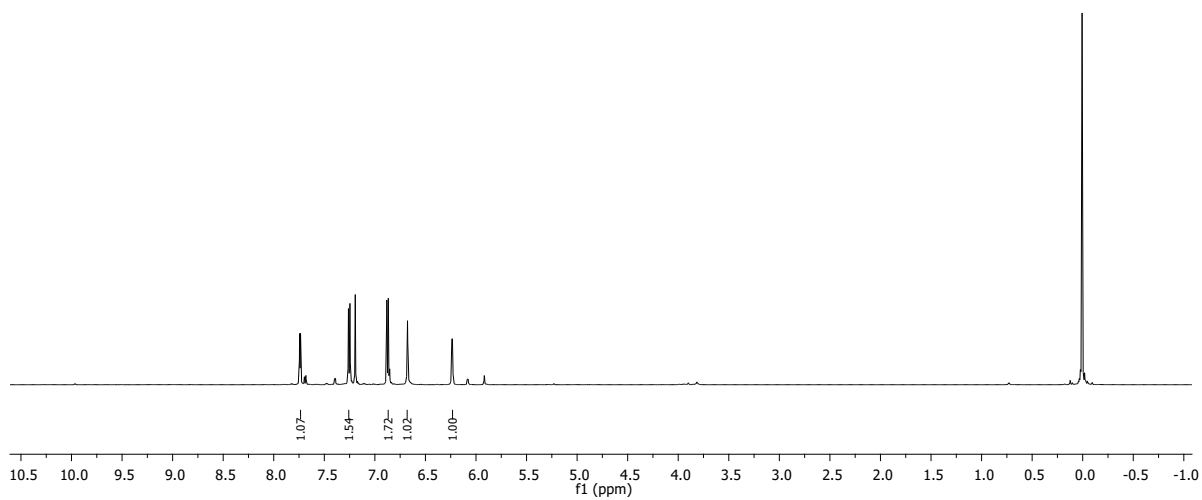
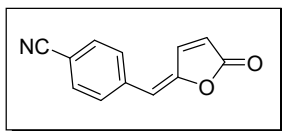


¹³C NMR of compound 3g (125 MHz, CDCl₃)



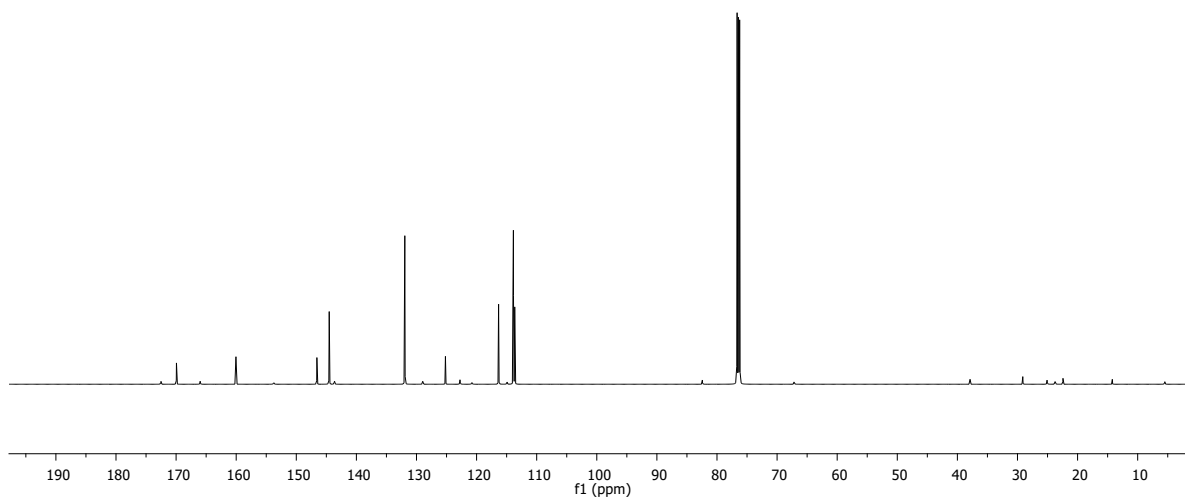
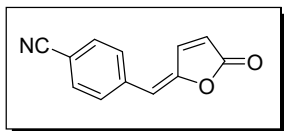
^1H NMR (600 MHz, CDCl_3) of compound 4g

7.74
7.74
7.26
7.25
6.88
6.87
6.68
6.24
6.23

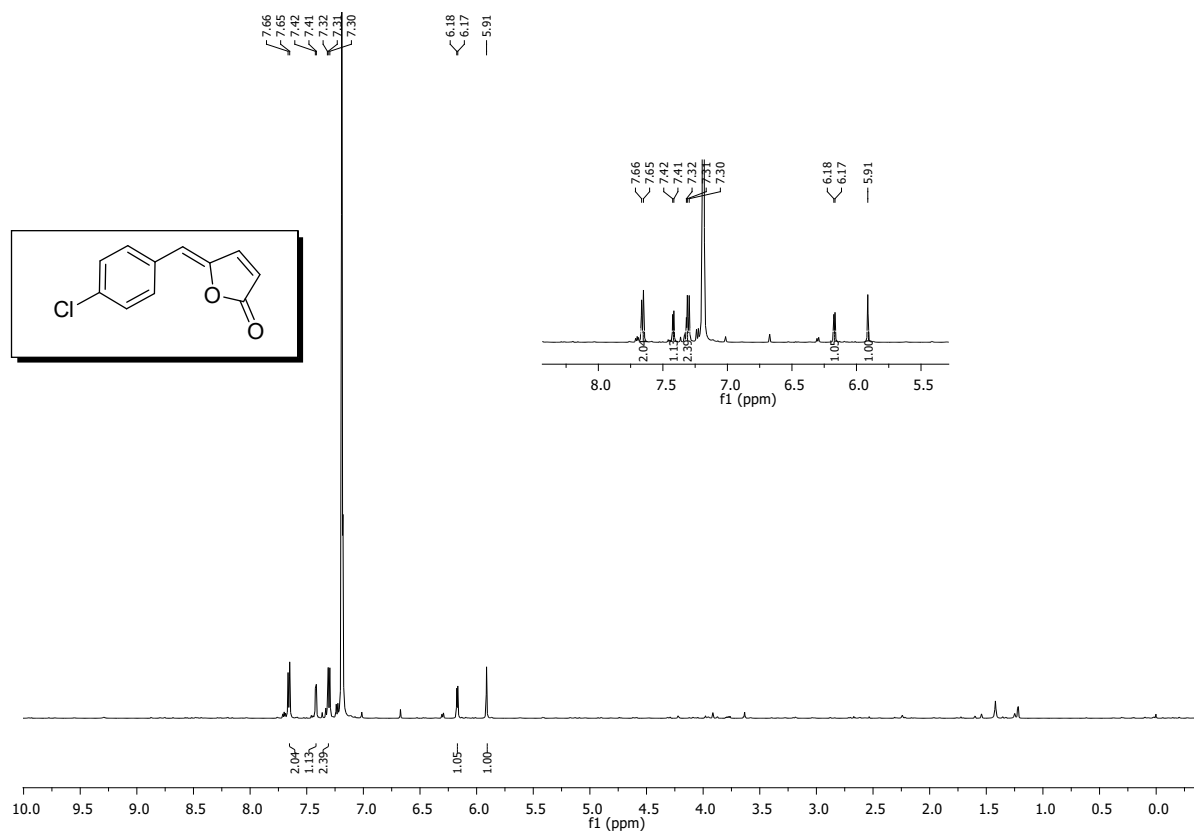


¹³C NMR of compound 4g (125 MHz, CDCl₃)

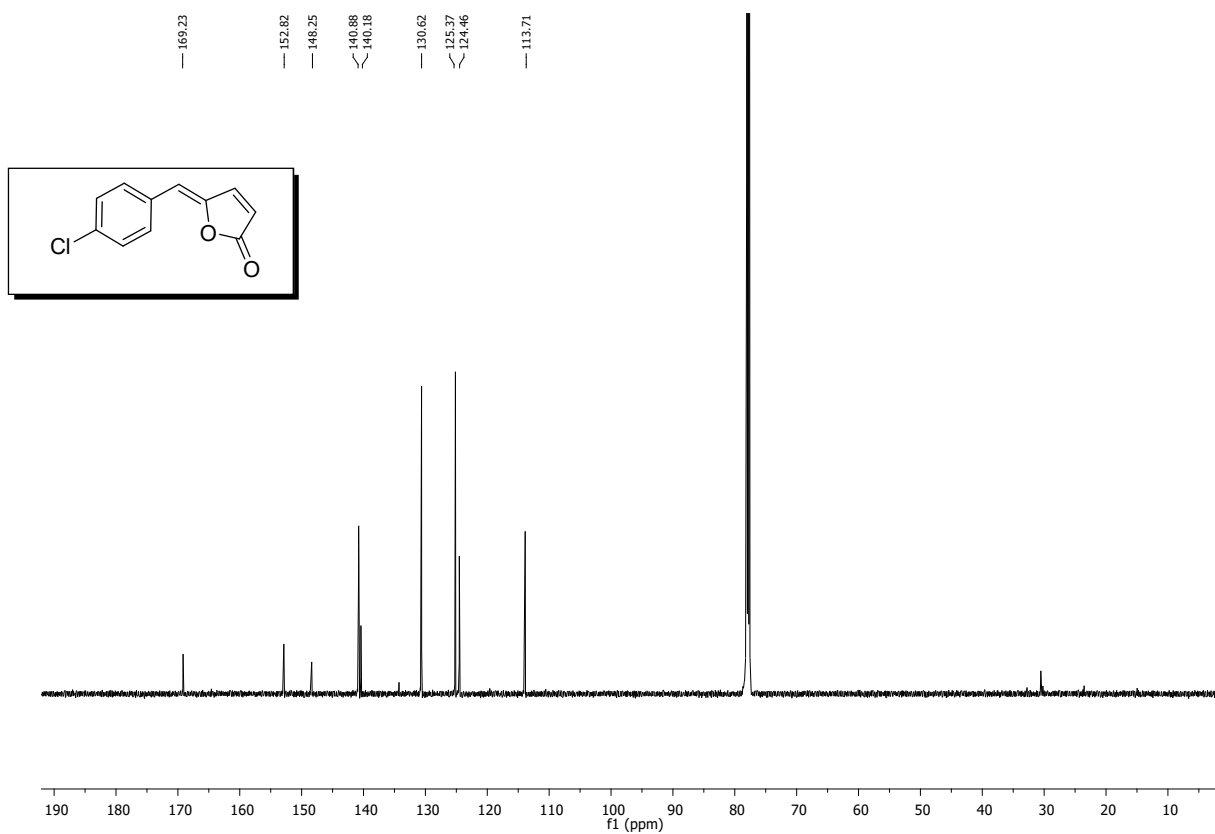
— 169.94
— 160.04
— 146.57
— 144.65
— 131.94
— 125.18
— 116.34
— 113.87
— 113.65



¹H NMR (600 MHz, CDCl₃) of compound 3h

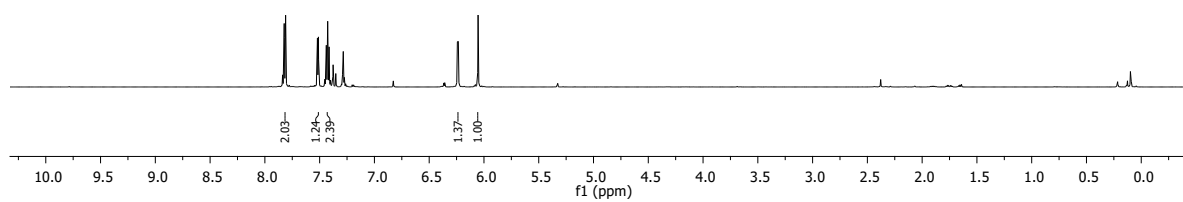
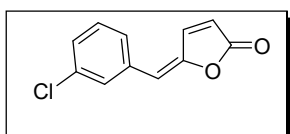


¹³C NMR of compound 3h (150 MHz, CDCl₃)

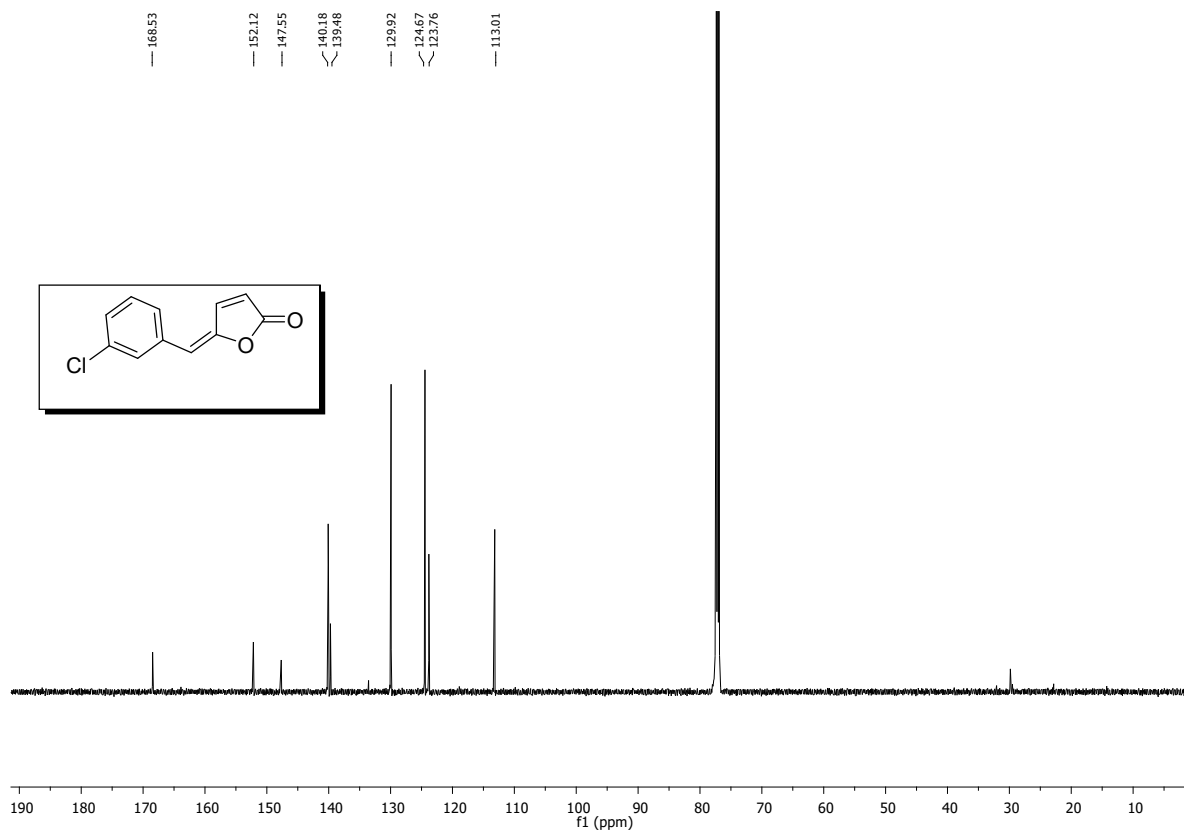


¹H NMR (500 MHz, CDCl₃) of compound 4h

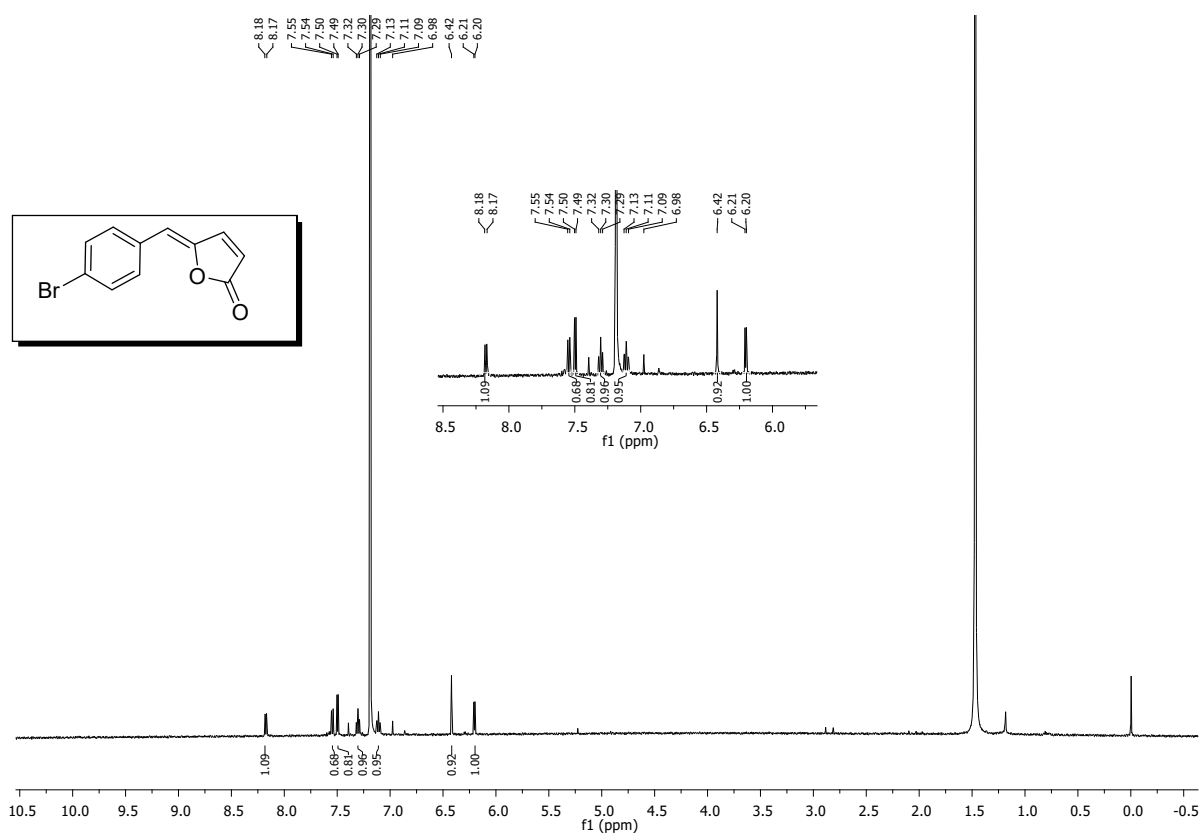
7.82
7.81
7.52
7.51
7.44
7.43
7.41
6.24
6.23
6.05



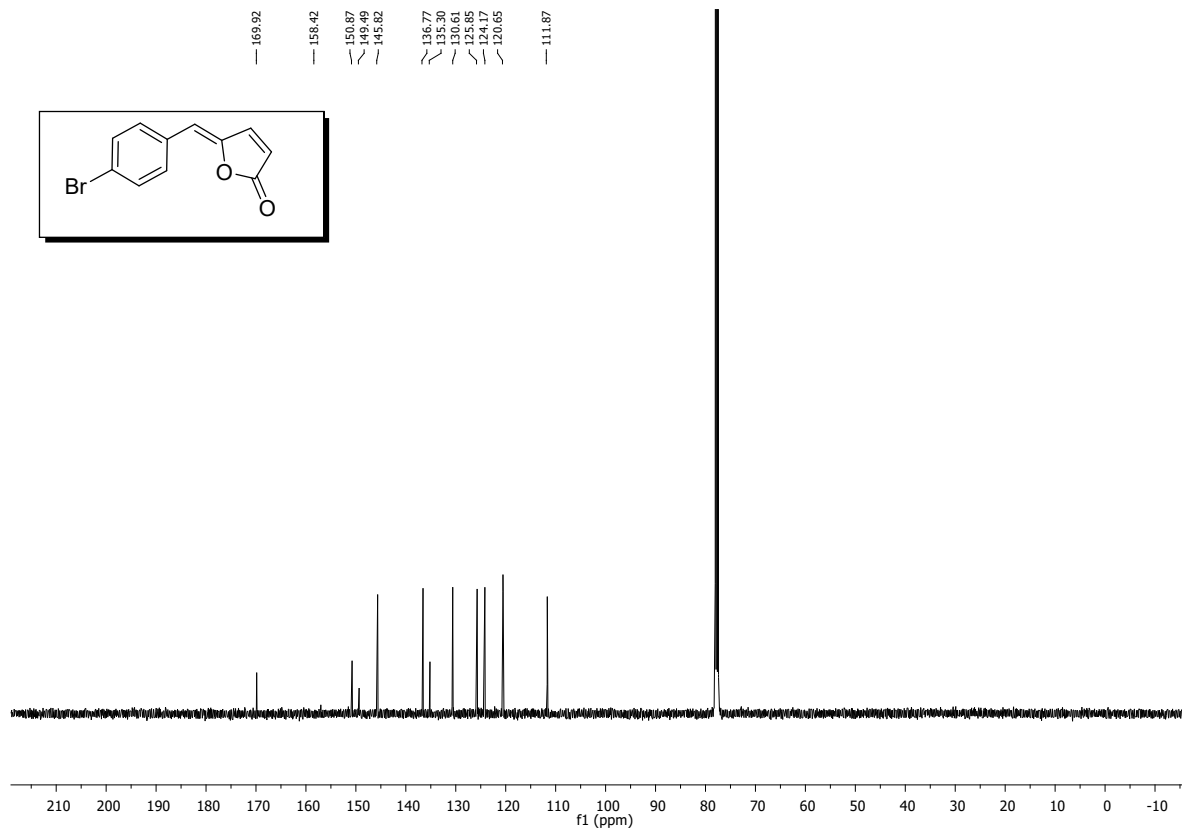
^{13}C NMR of compound 4h (125 MHz, CDCl_3)



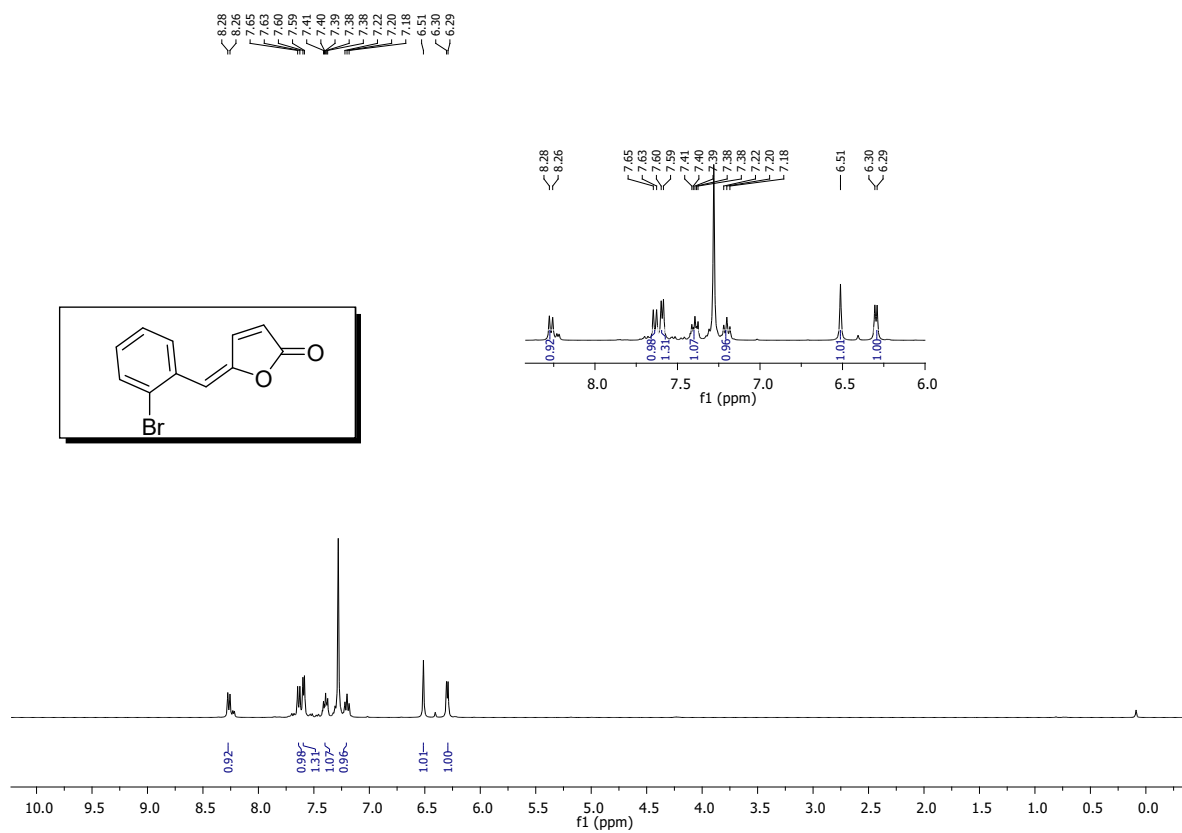
¹H NMR (500 MHz, CDCl₃) of compound 3i



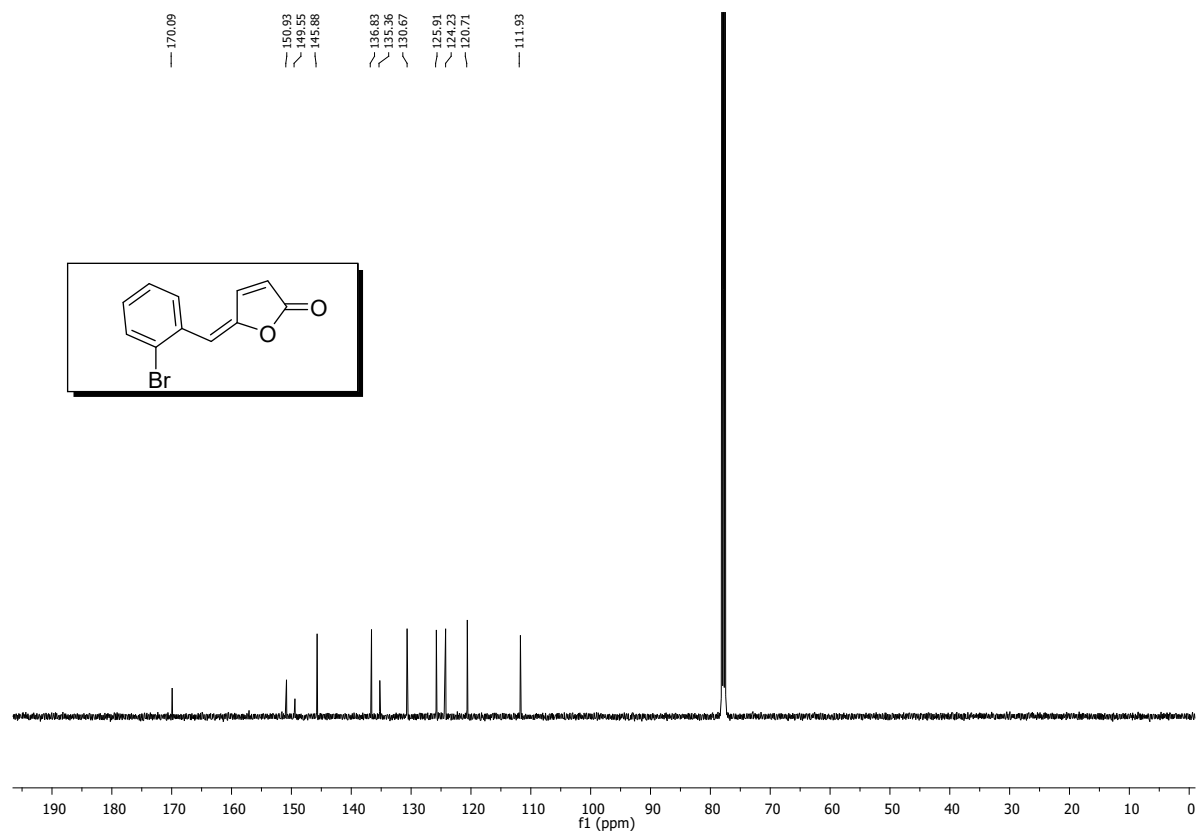
^{13}C NMR of compound 3i (125 MHz, CDCl_3)



¹H NMR (400 MHz, CDCl₃) of compound 4i

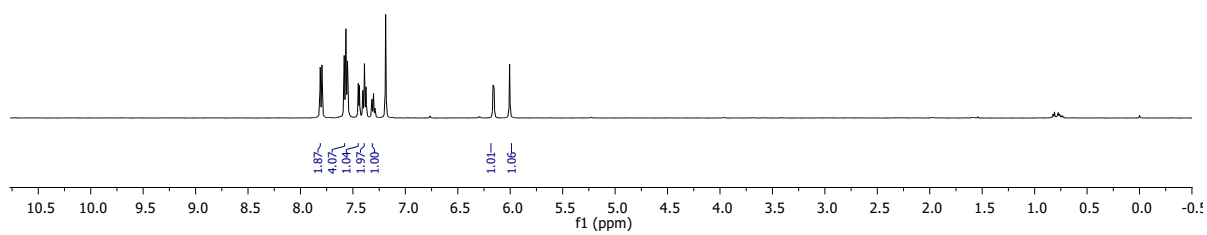
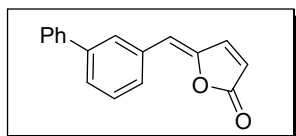


¹³C NMR of compound 4i (125 MHz, CDCl₃)

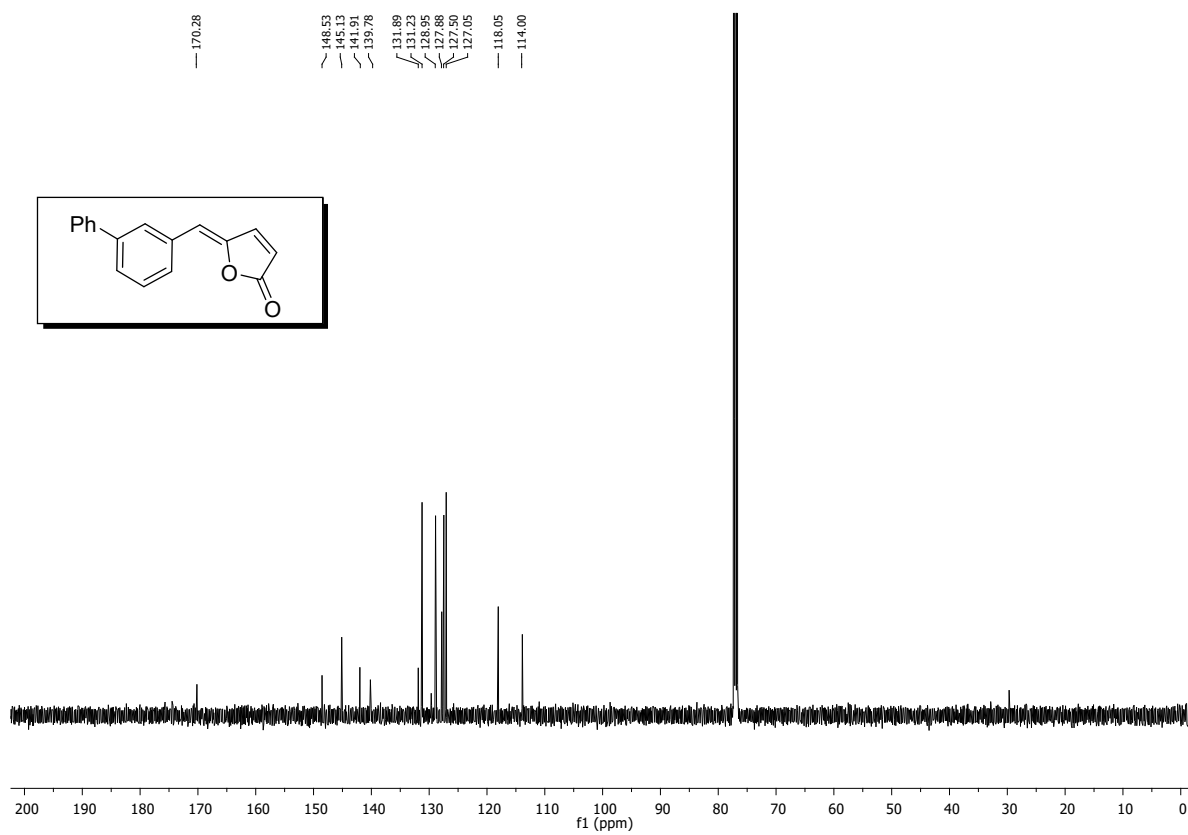


¹H NMR (500 MHz, CDCl₃) of compound 3j

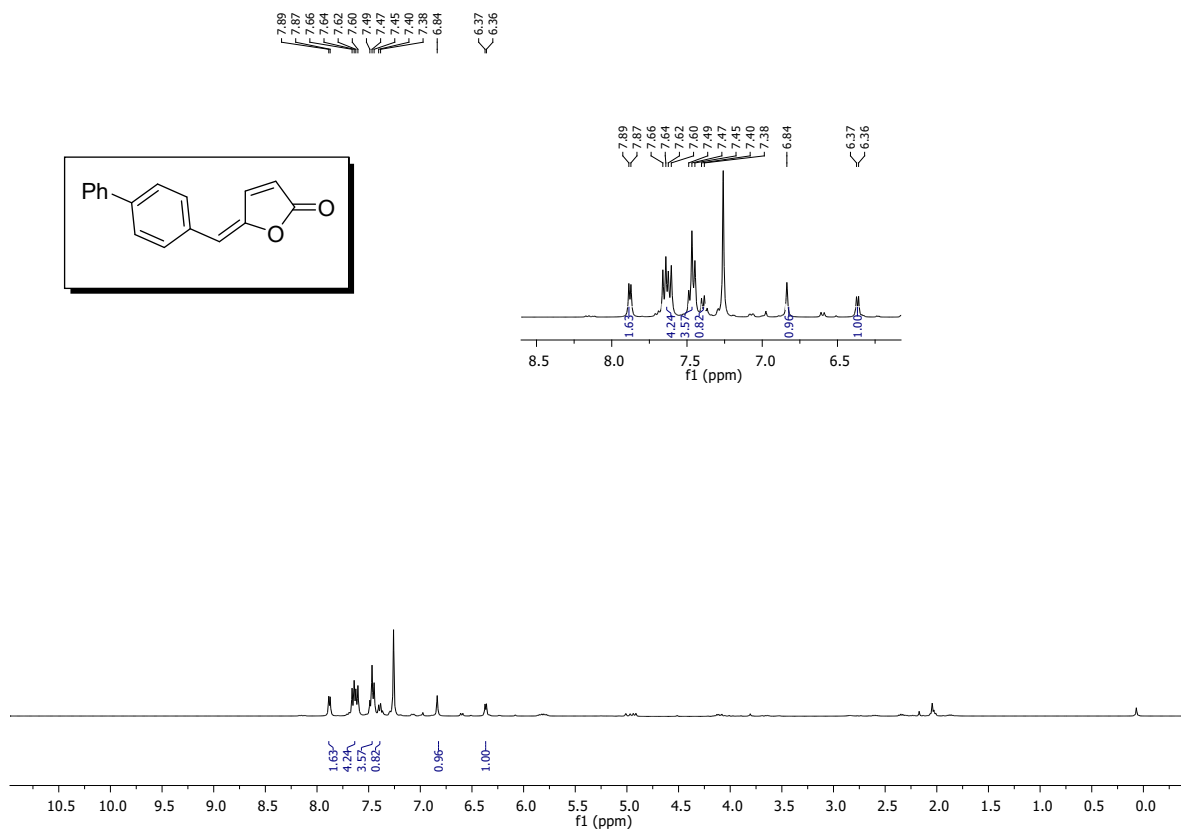
7.81
7.79
7.58
7.57
7.55
7.45
7.44
7.41
7.39
7.37
7.32
7.30
7.29
6.16
6.15
6.01



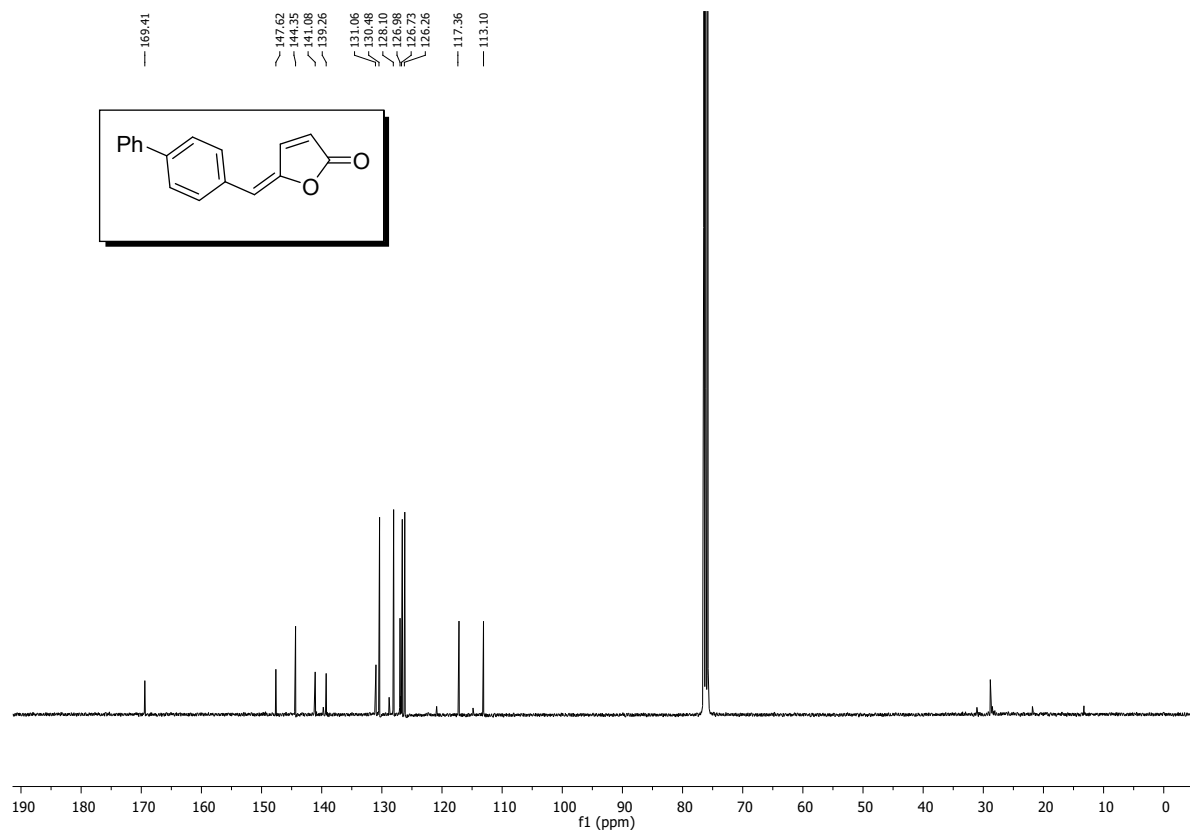
^{13}C NMR of compound 3j (125 MHz, CDCl_3)



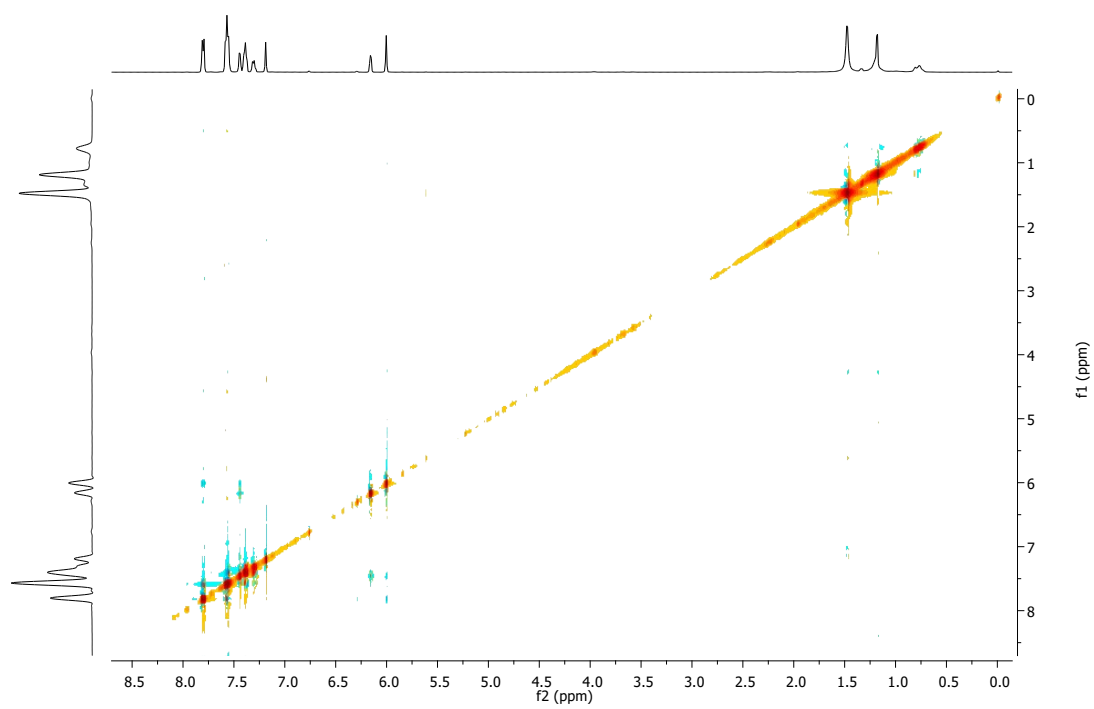
¹H NMR (400 MHz, CDCl₃) of compound 4j



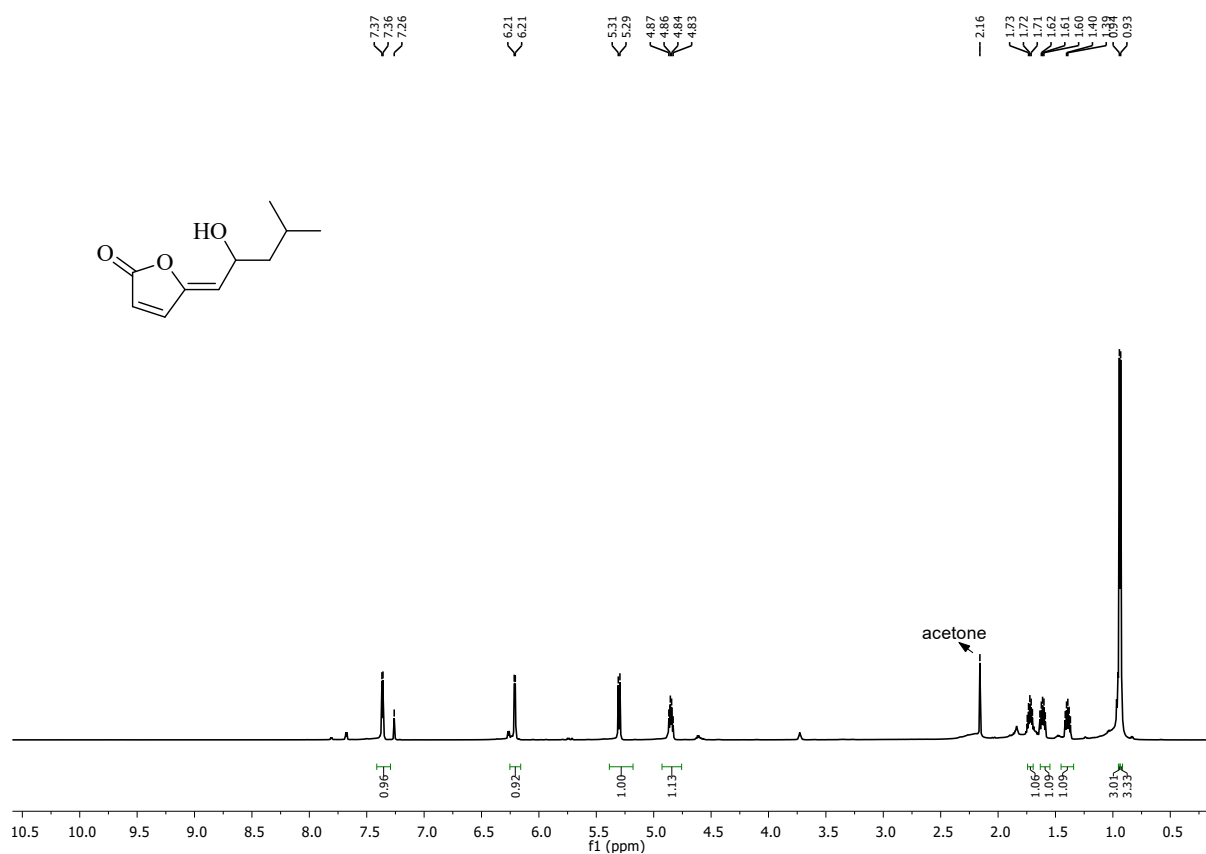
¹³C NMR of compound 4j (100 MHz, CDCl₃)



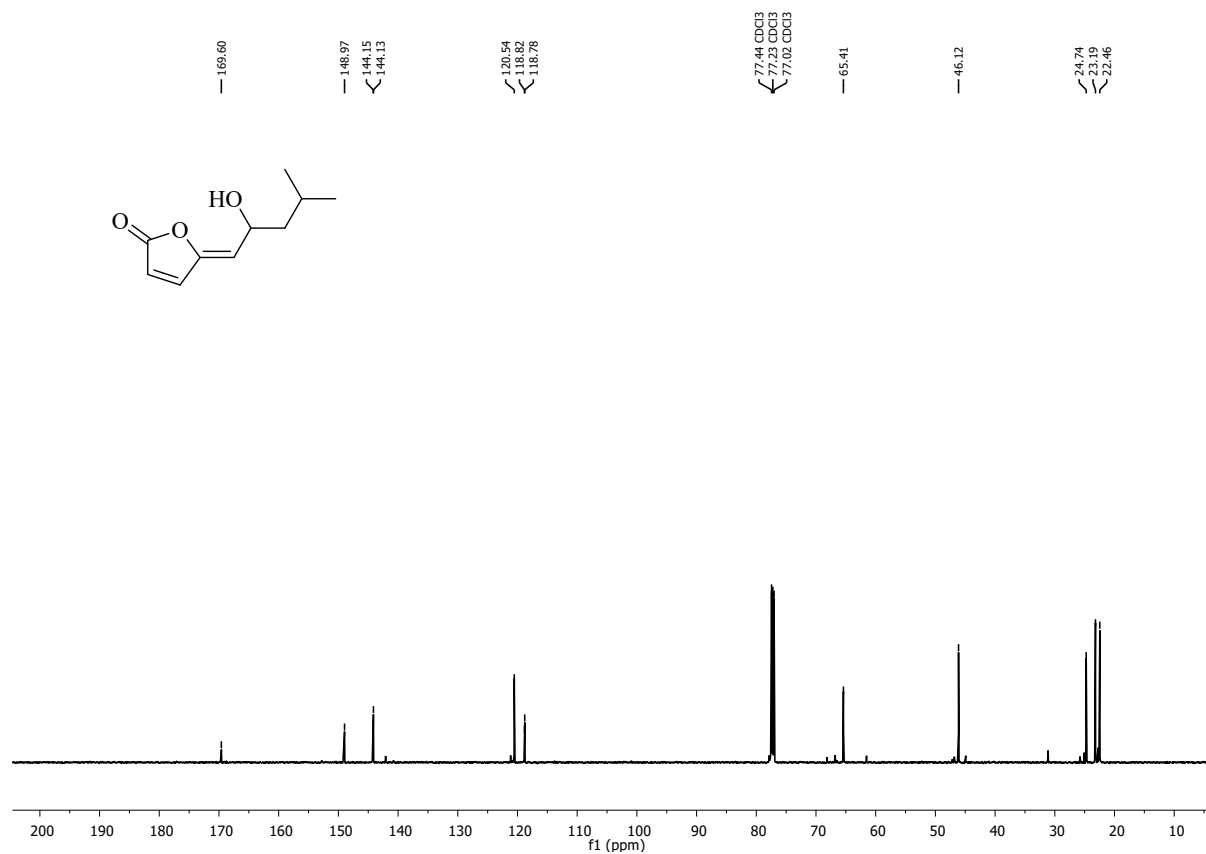
2D NOESY OF COMPOUND 3j:



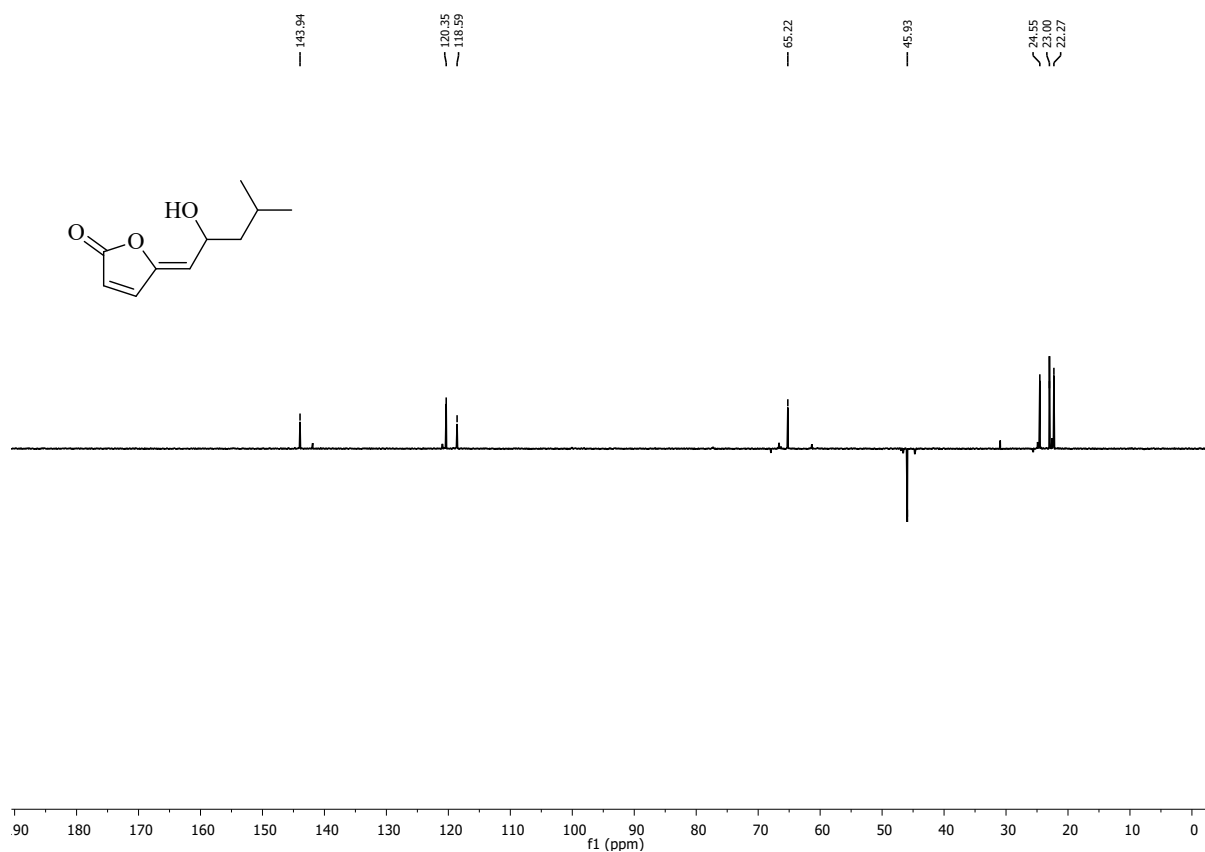
^1H NMR of compound 3k (400 MHz, CDCl_3)



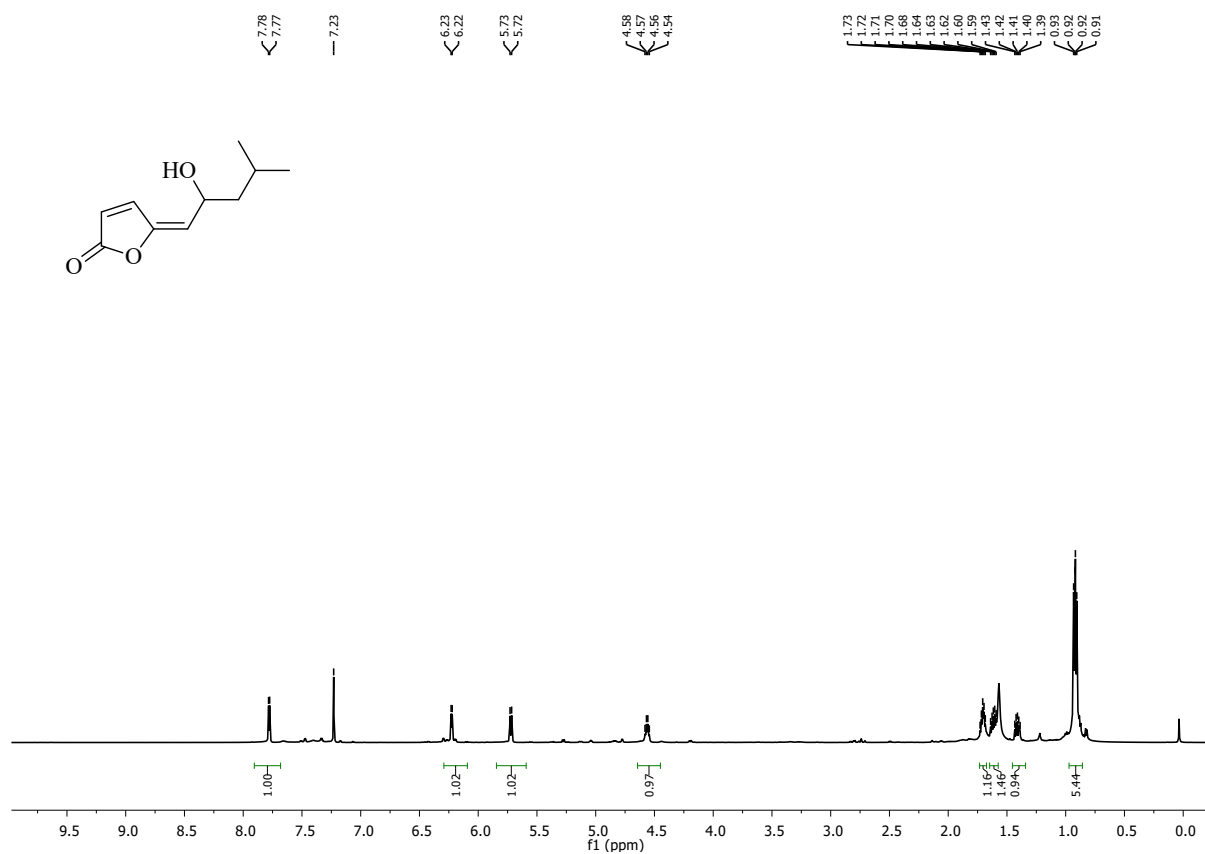
^{13}C NMR of compound 3k (100 MHz, CDCl_3)



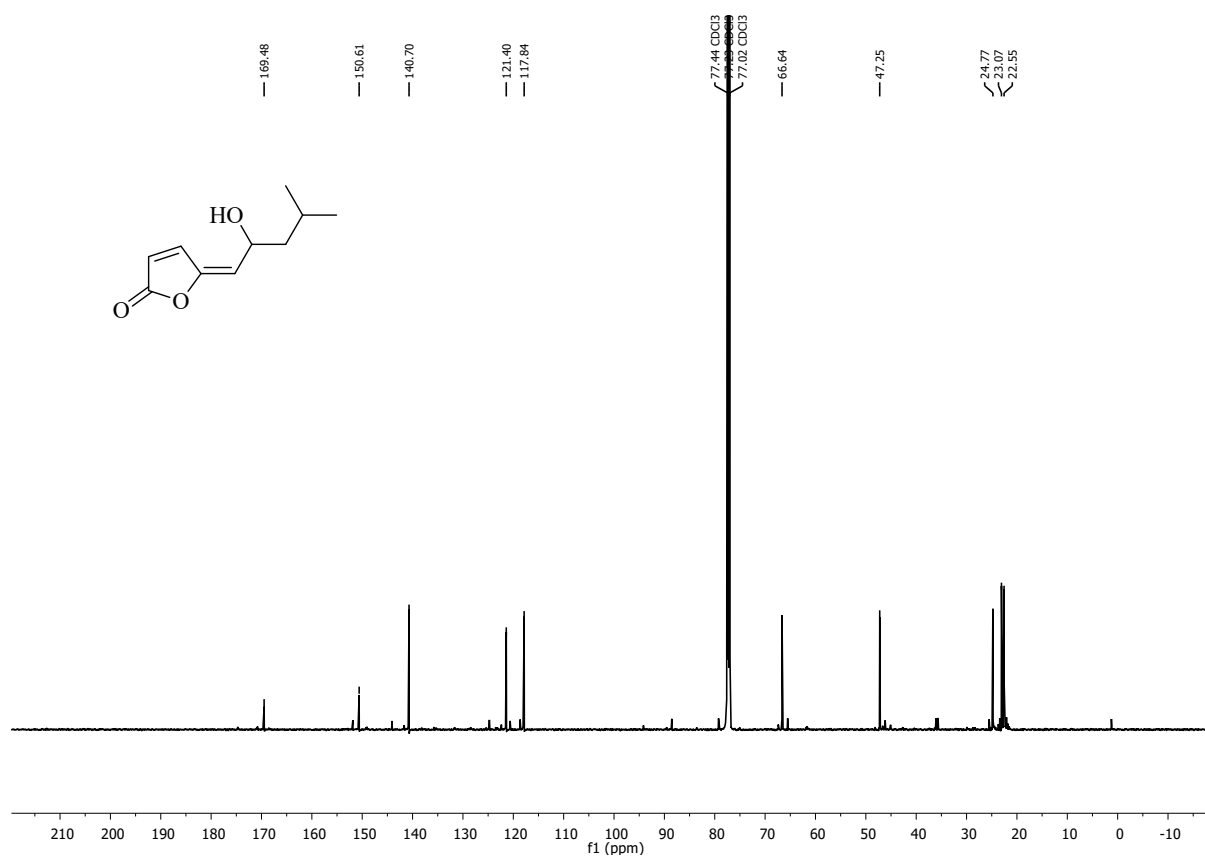
DEPT NMR of compound 3k (100 MHz, CDCl₃)



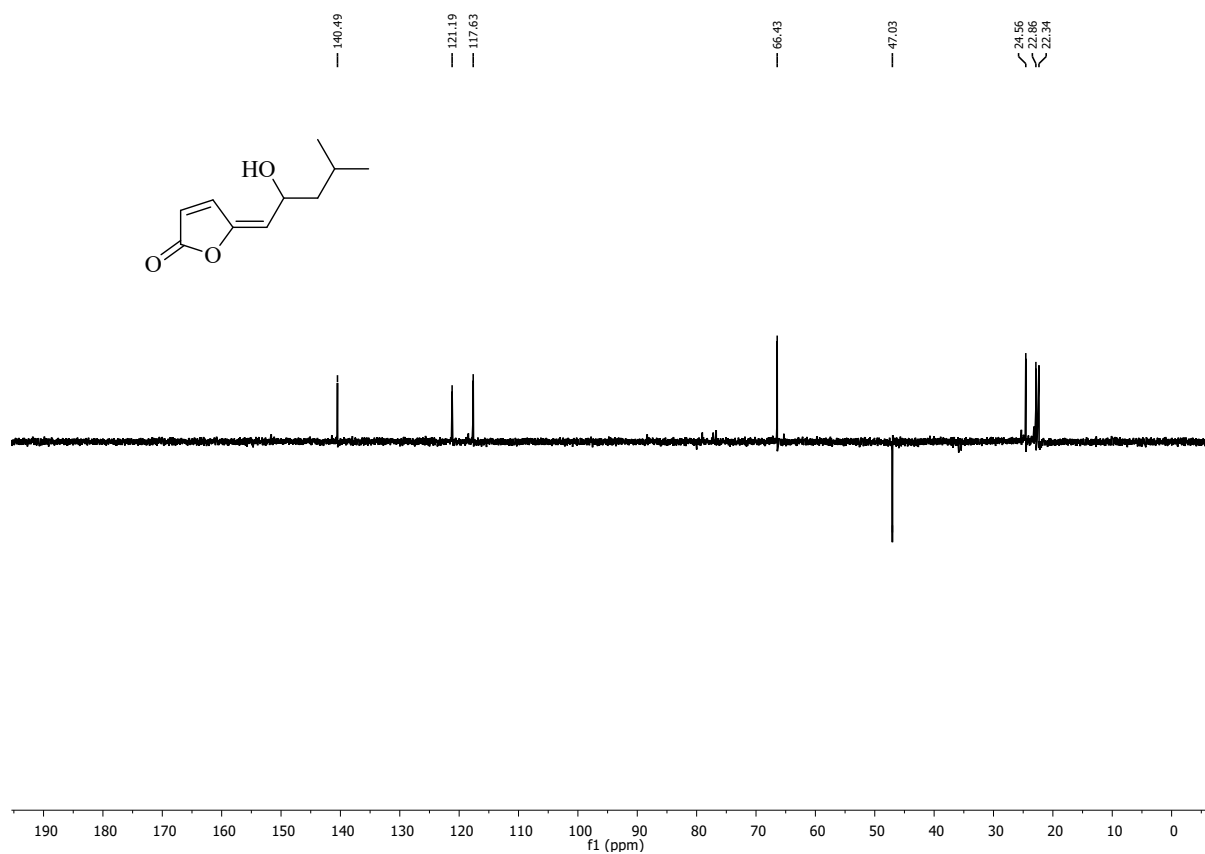
¹H NMR of compound 4k (400 MHz, CDCl₃)



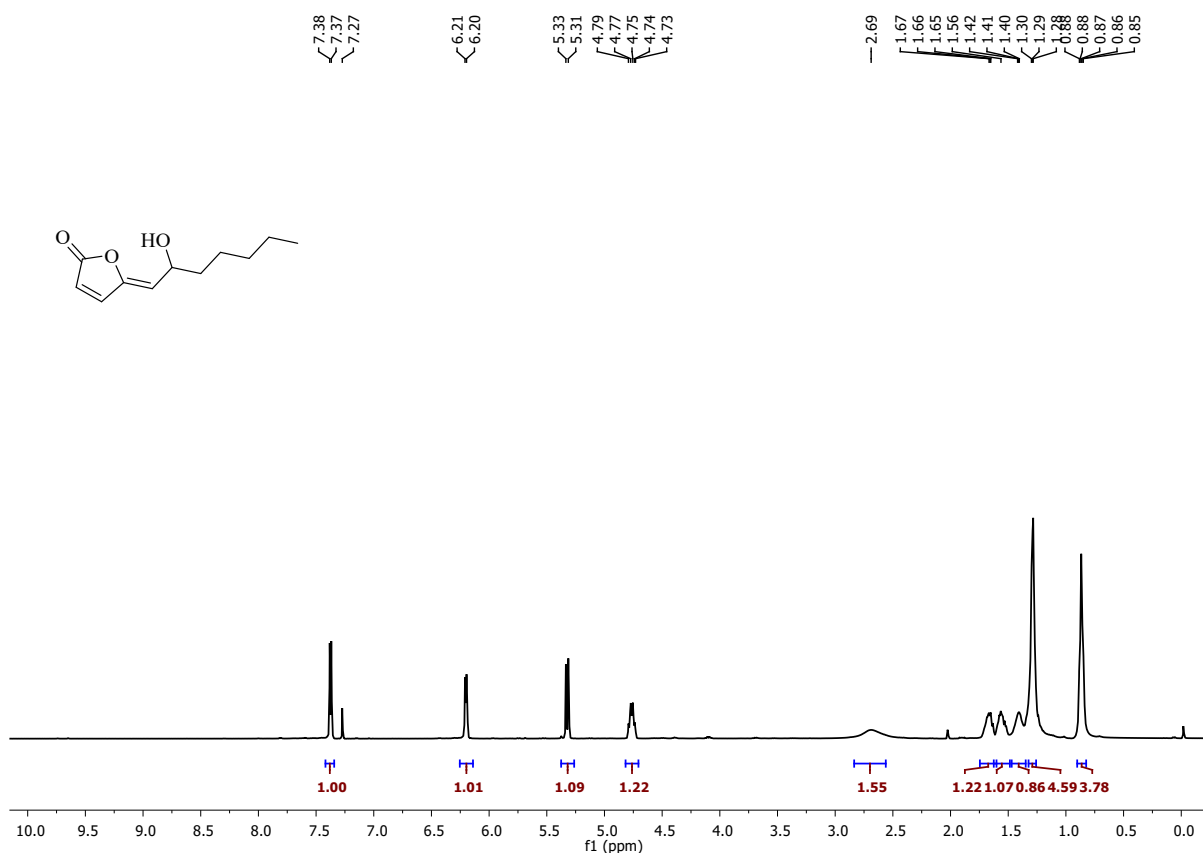
¹³C NMR of compound 4k (100 MHz, CDCl₃)



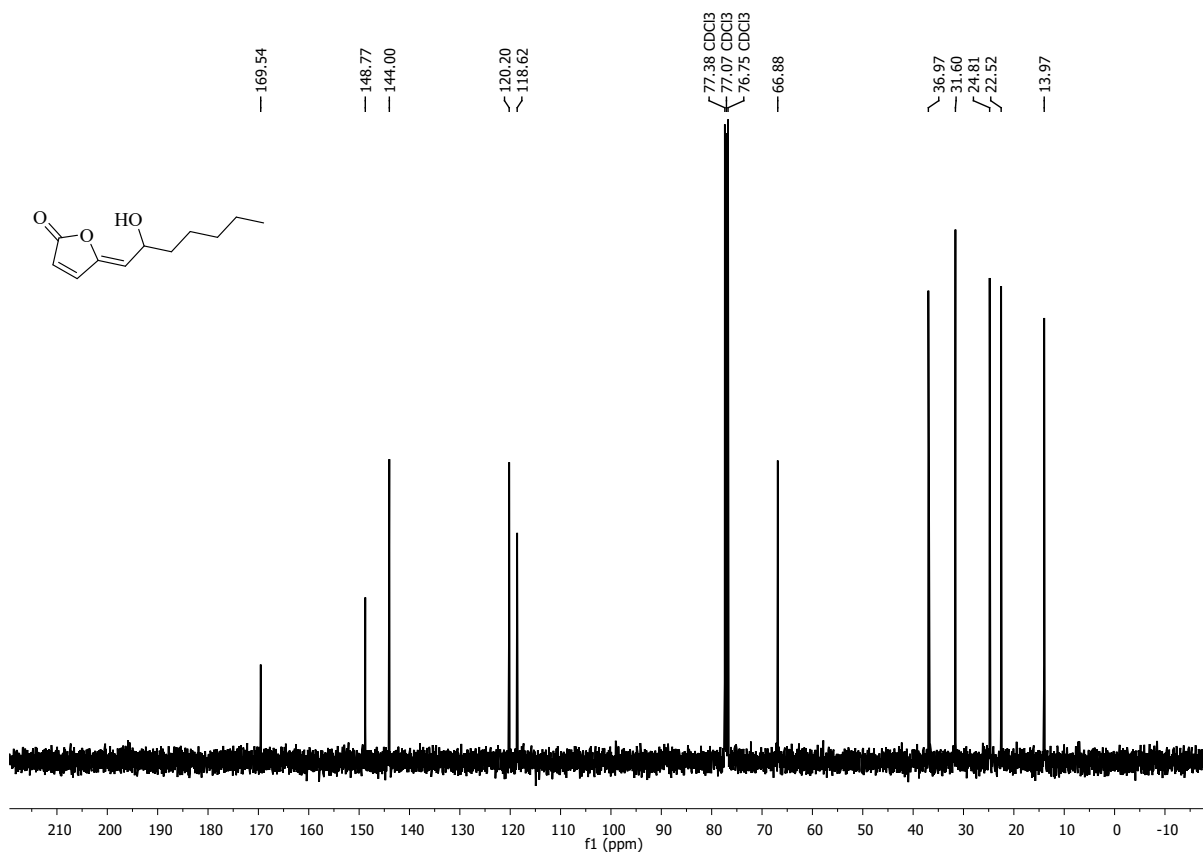
DEPT NMR of compound 4k (100 MHz, CDCl₃)



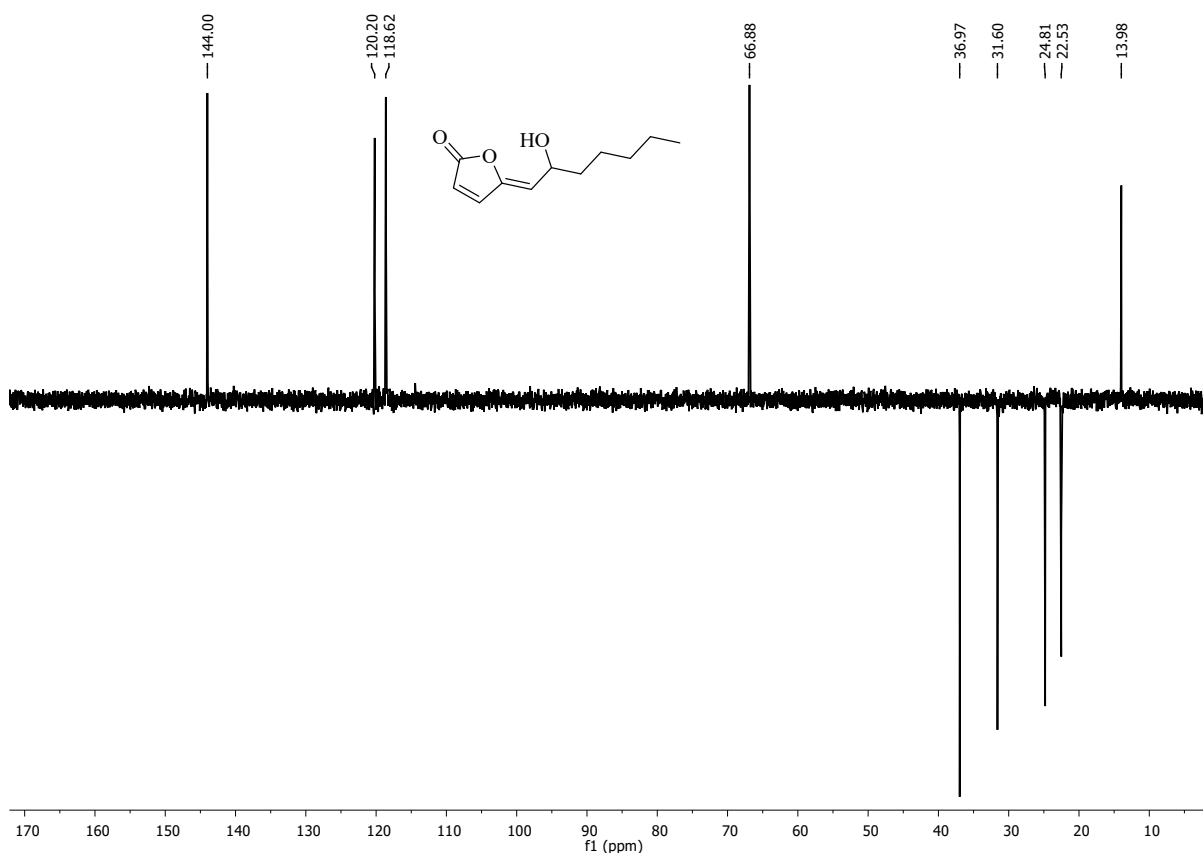
^1H NMR of compound 31 (400 MHz; CDCl_3)



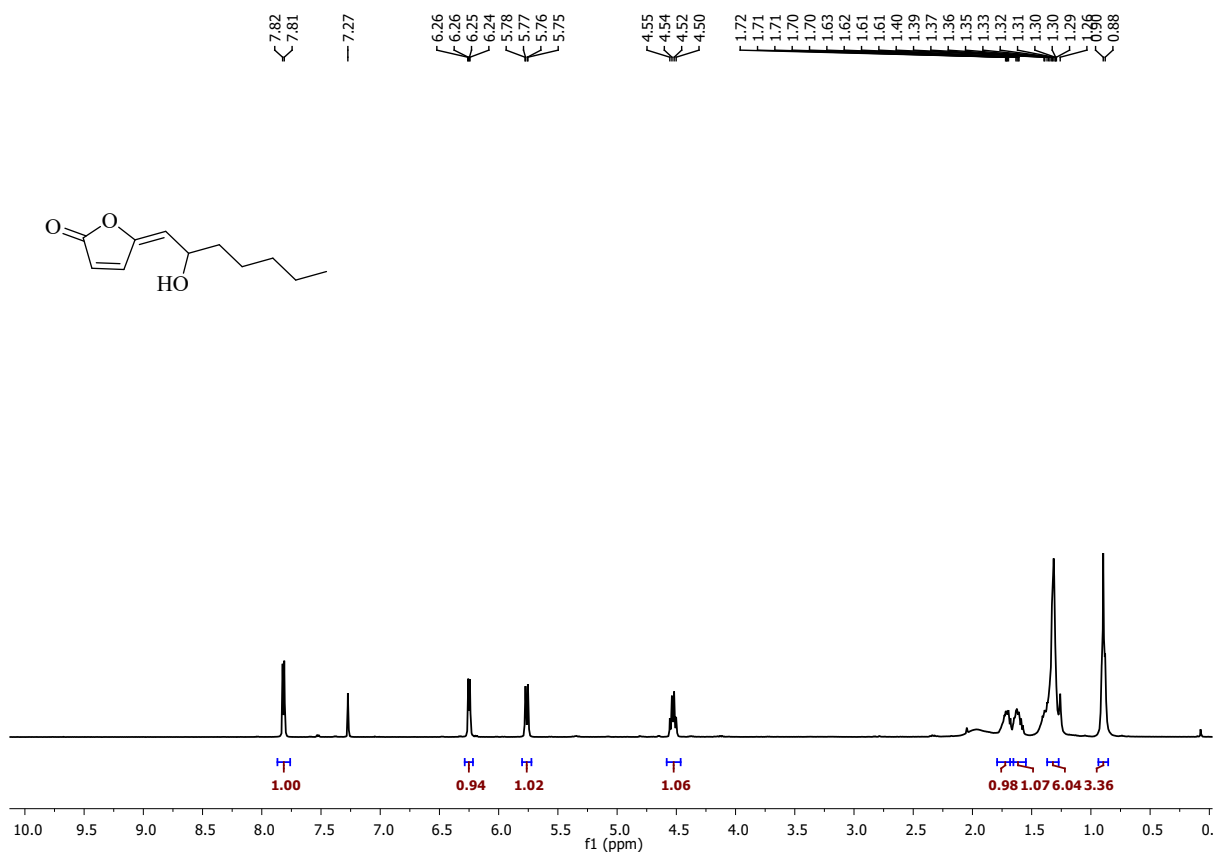
^{13}C NMR of compound 31 (100 MHz, CDCl_3)



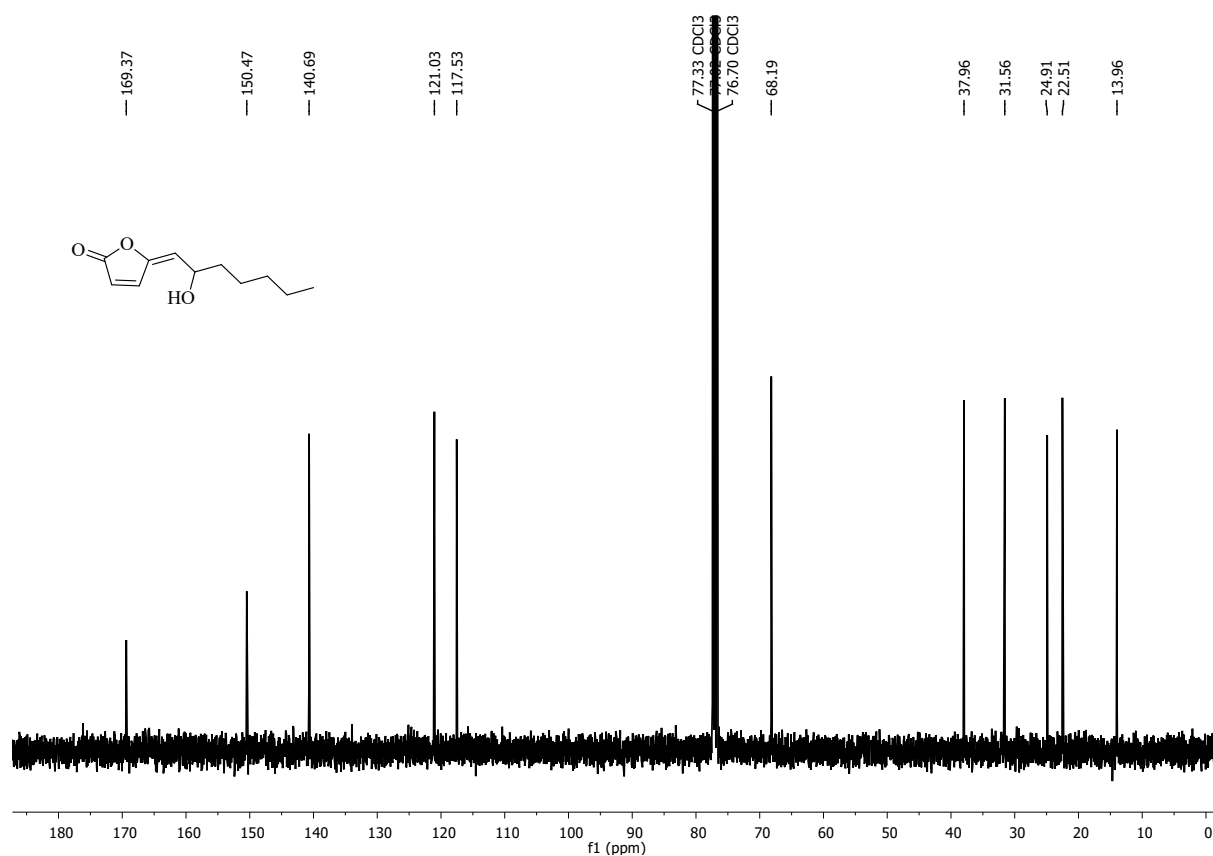
DEPT NMR of compound 3l (100 MHz, CDCl₃)



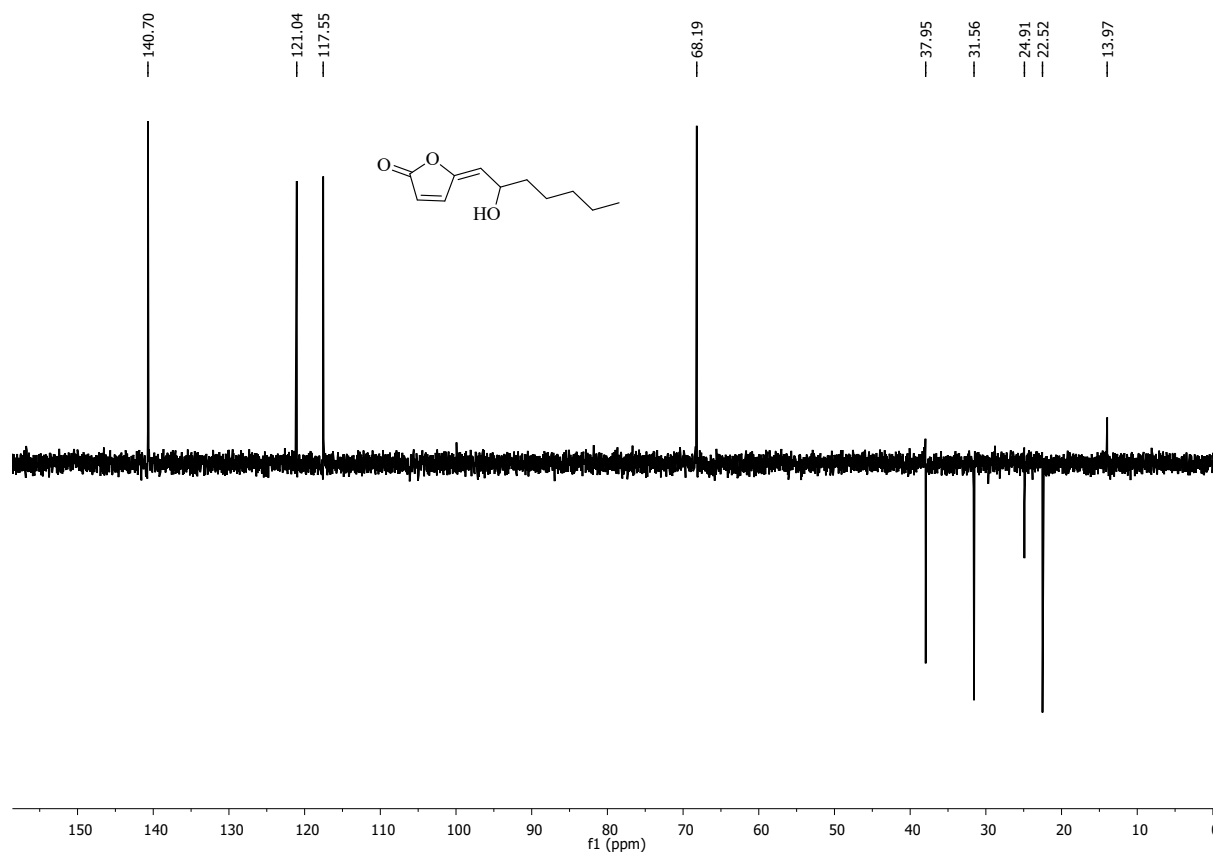
¹H NMR of compound 4l (400 MHz, CDCl₃)



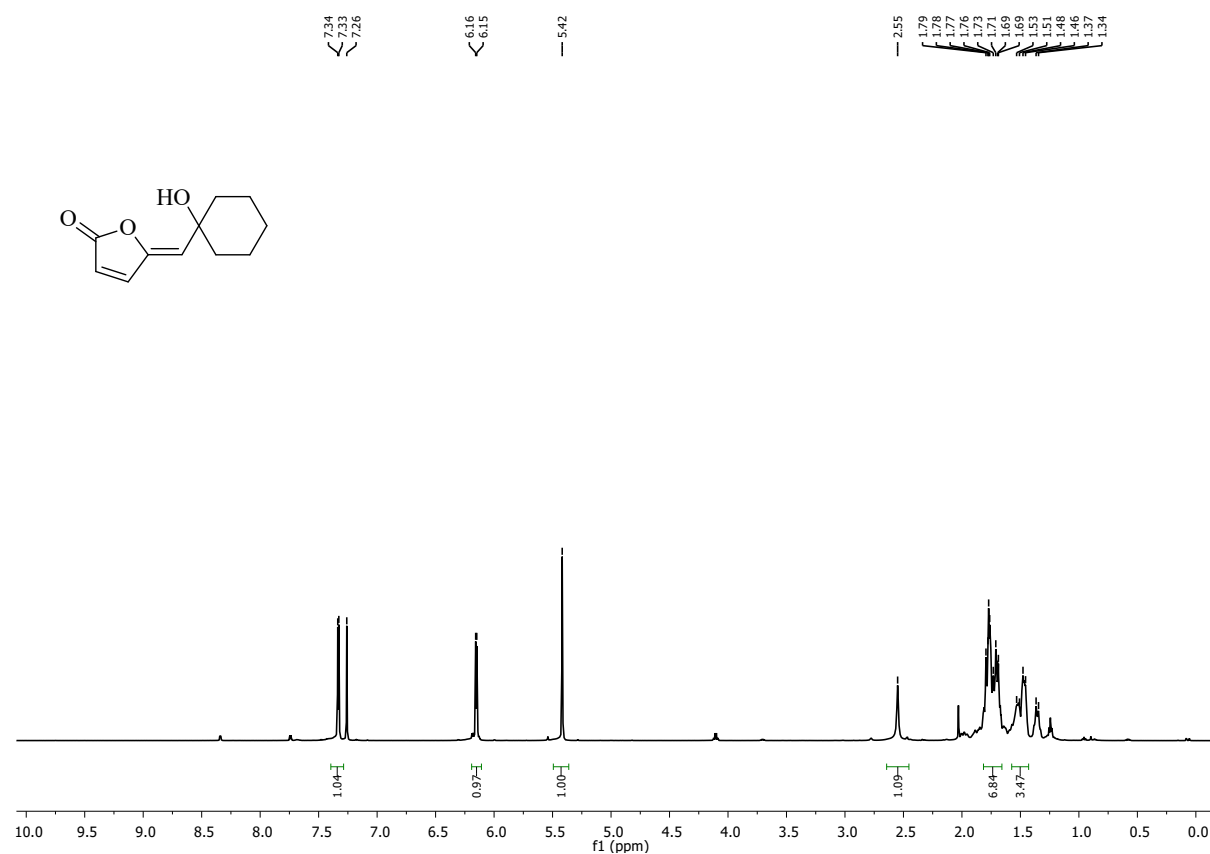
¹³C NMR of compound 4l (100 MHz, CDCl₃)



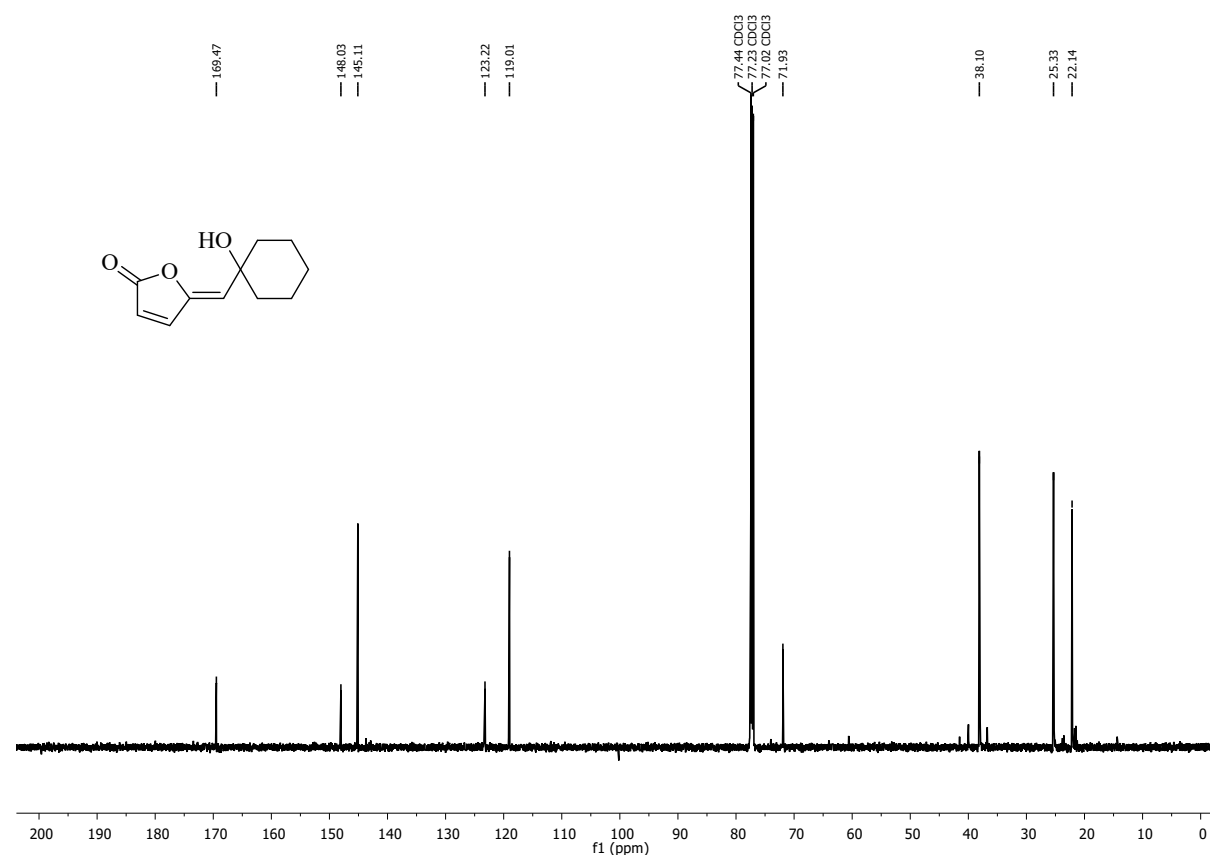
DEPT NMR of compound 4l (100 MHz, CDCl₃)



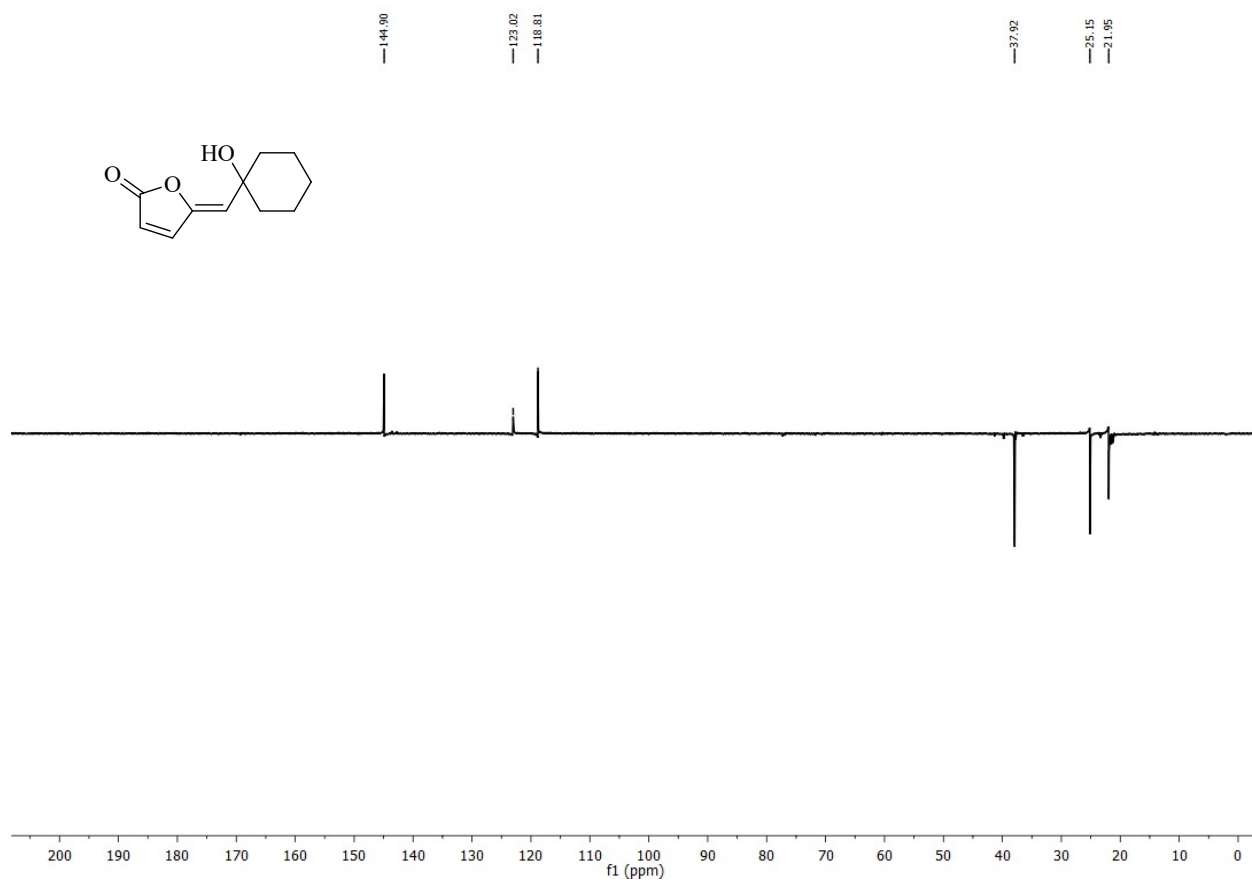
¹H NMR of compound 3m (400 MHz, CDCl₃)



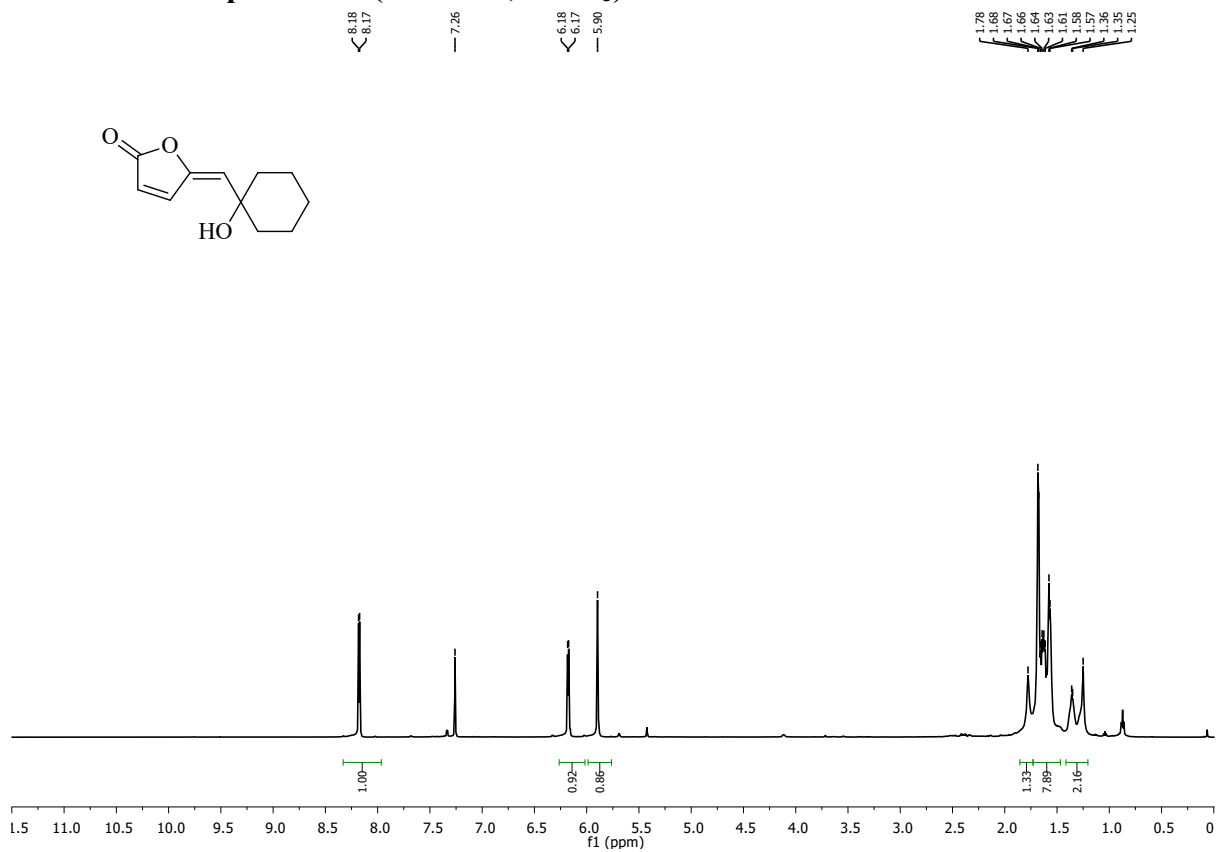
¹³C NMR of compound 3m (100 MHz, CDCl₃)



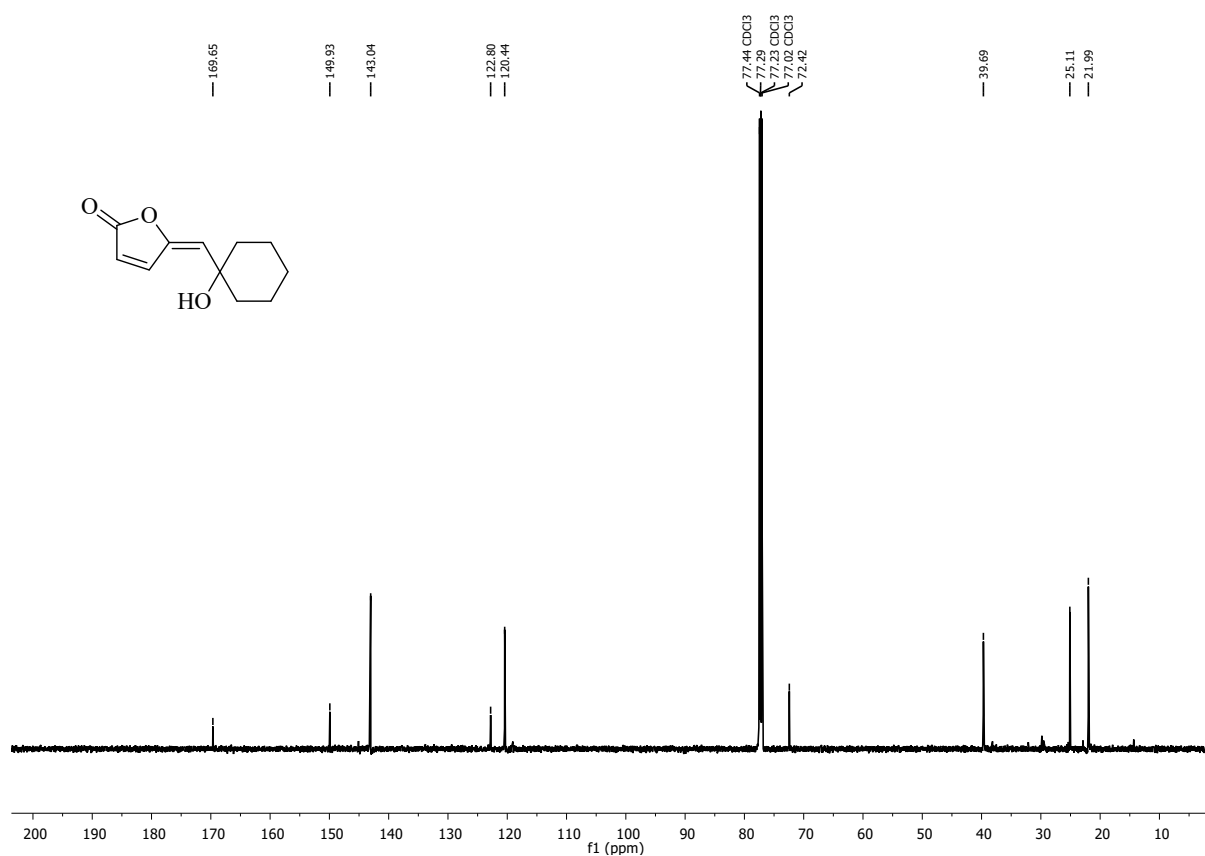
DEPT NMR of compound 3m (100 MHz, CDCl₃)



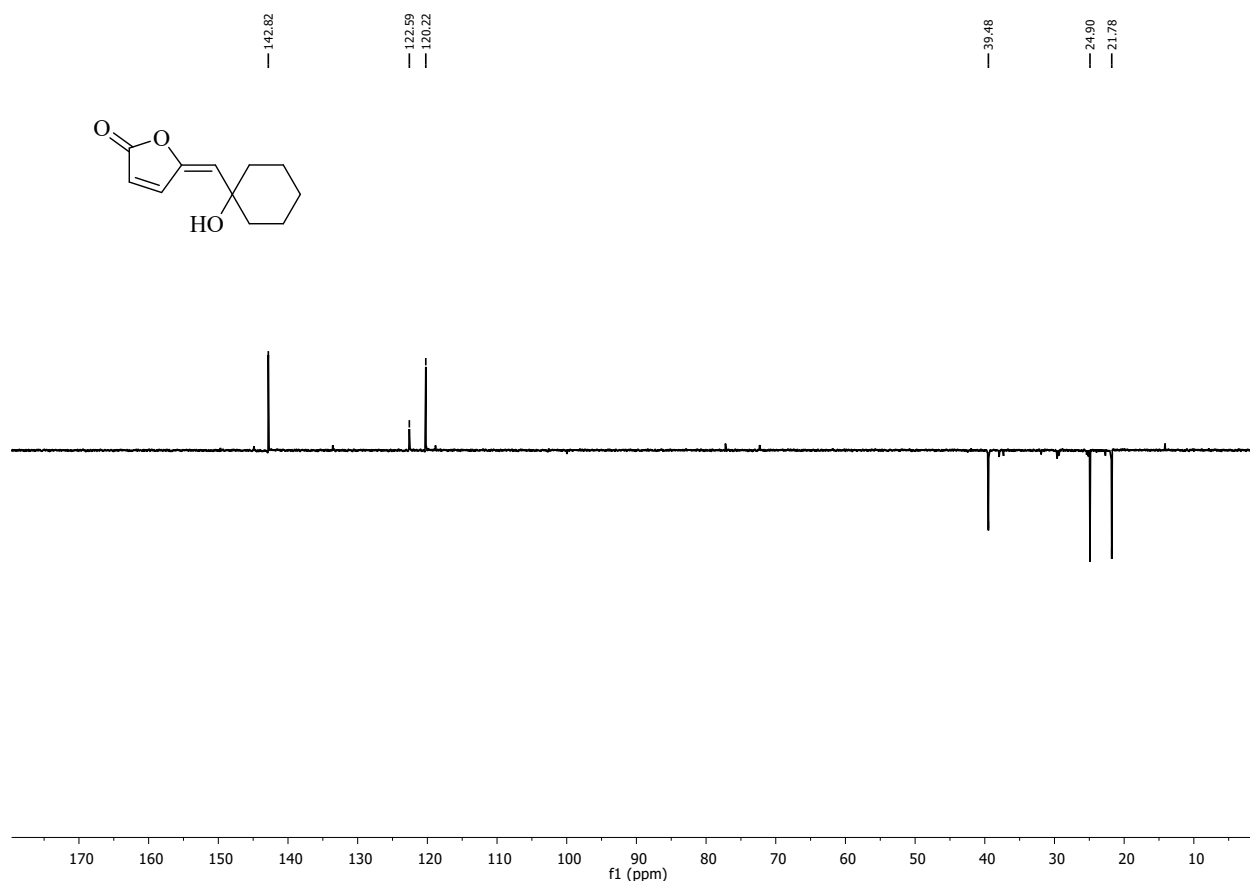
¹H NMR of compound 4m (400 MHz, CDCl₃)



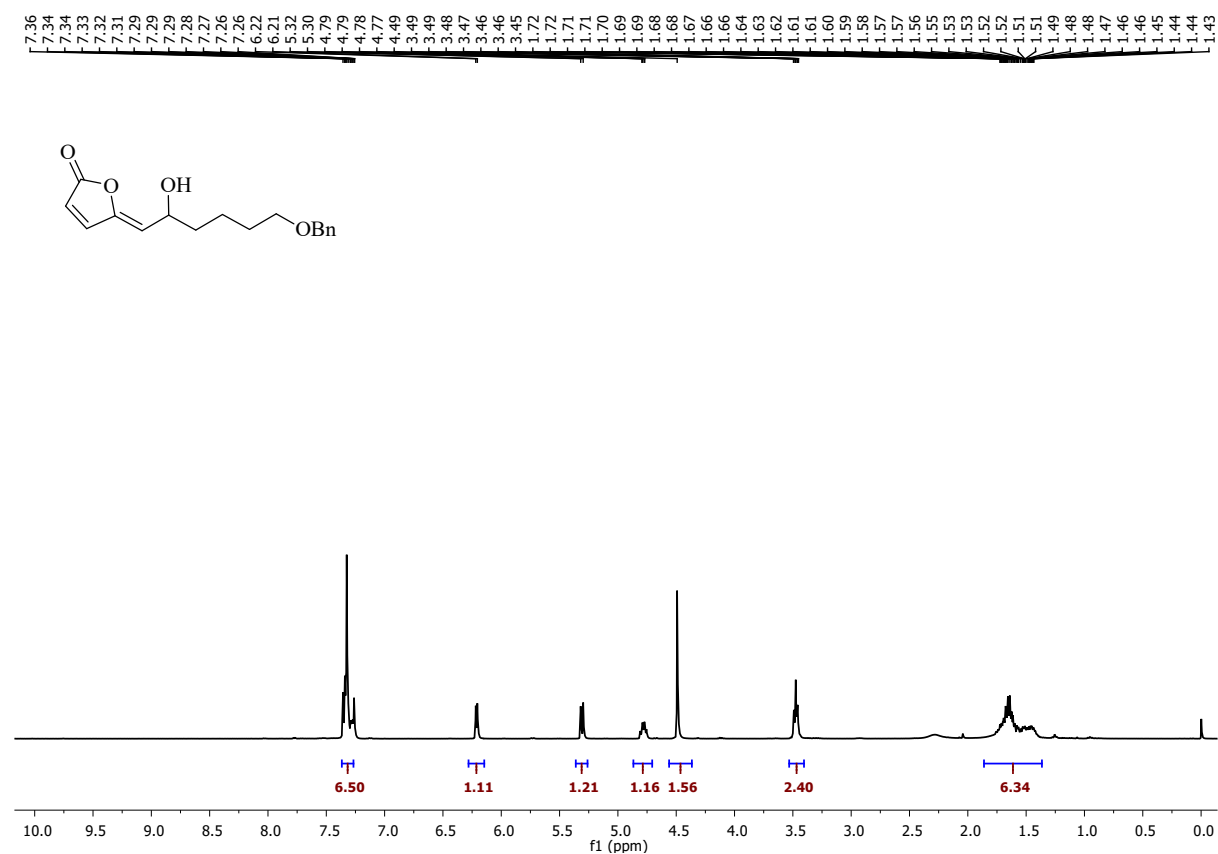
^{13}C NMR of compound 4m (100 MHz, CDCl_3)



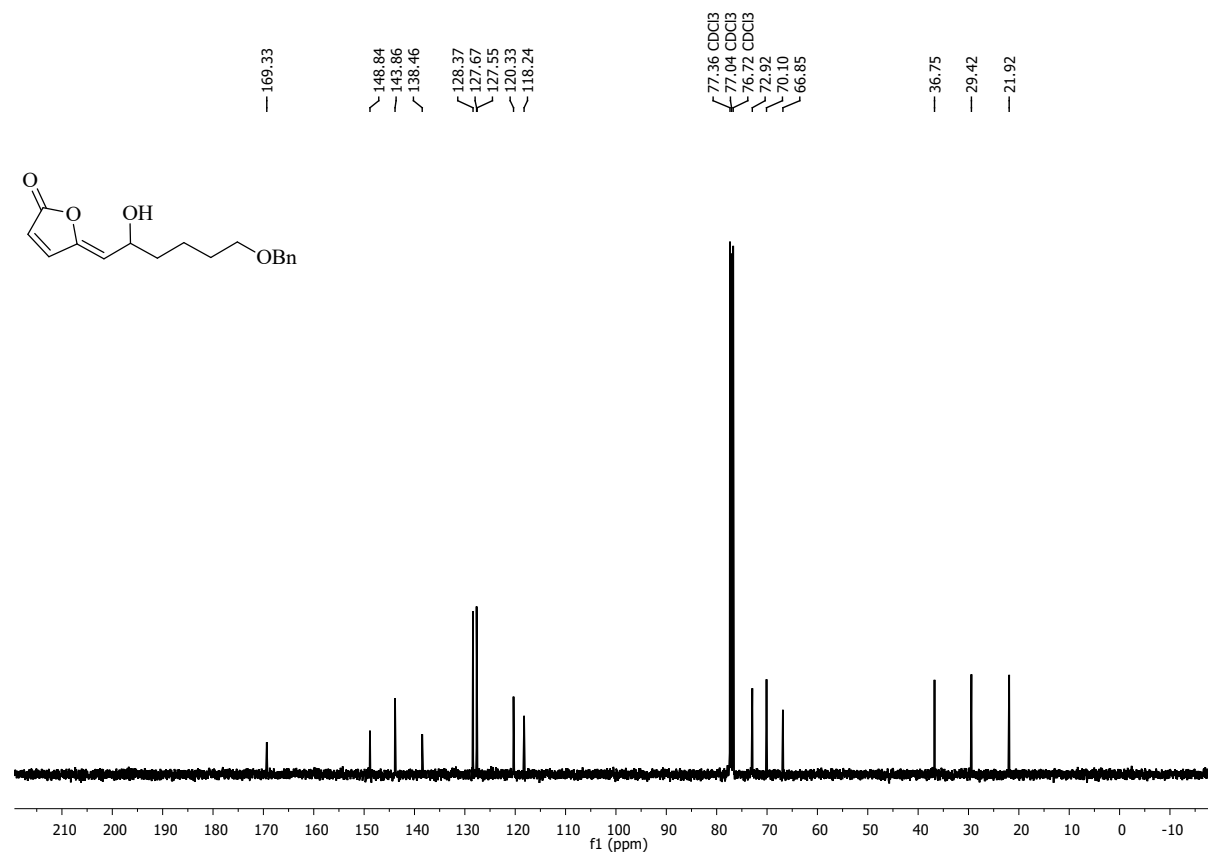
DEPT NMR of compound 4m (100 MHz, CDCl_3)



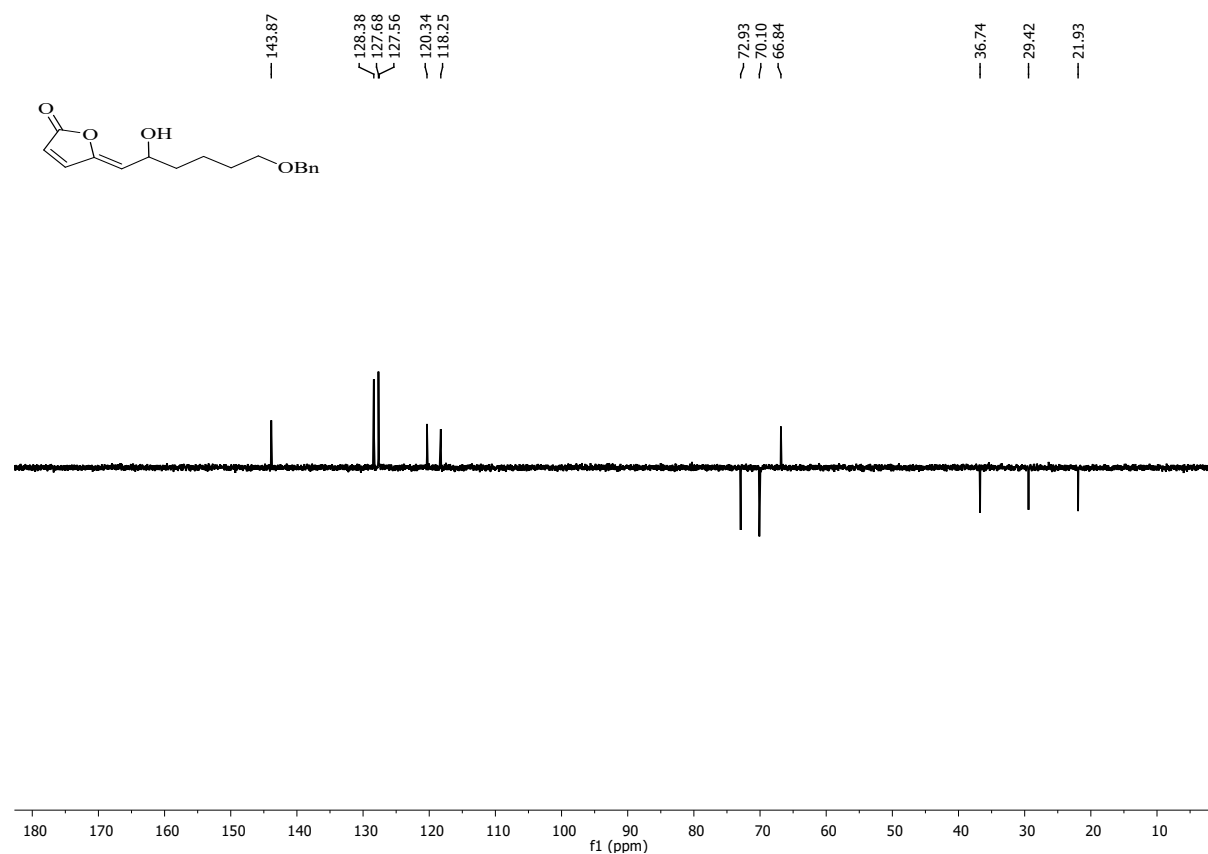
^1H NMR of compound 3n (400 MHz, CDCl_3)



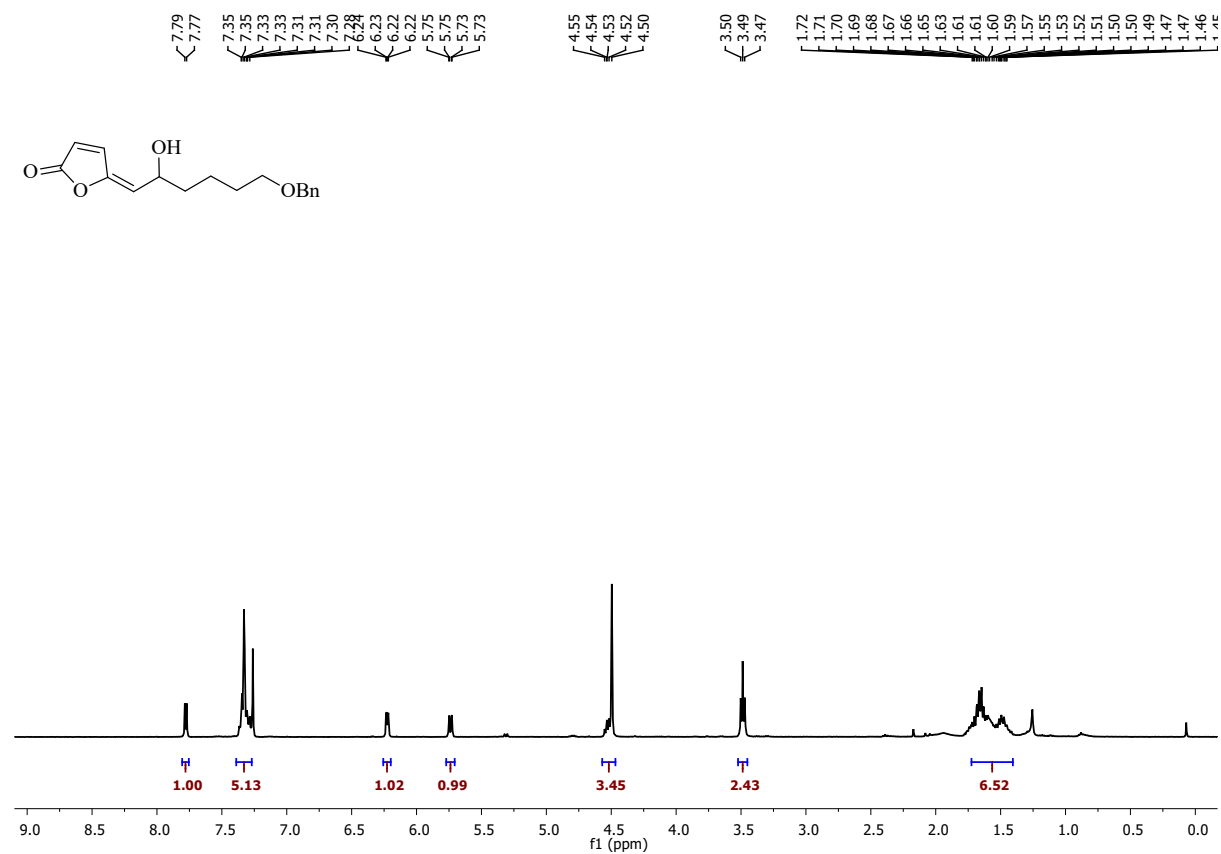
^{13}C NMR of compound 3n (100 MHz, CDCl_3)



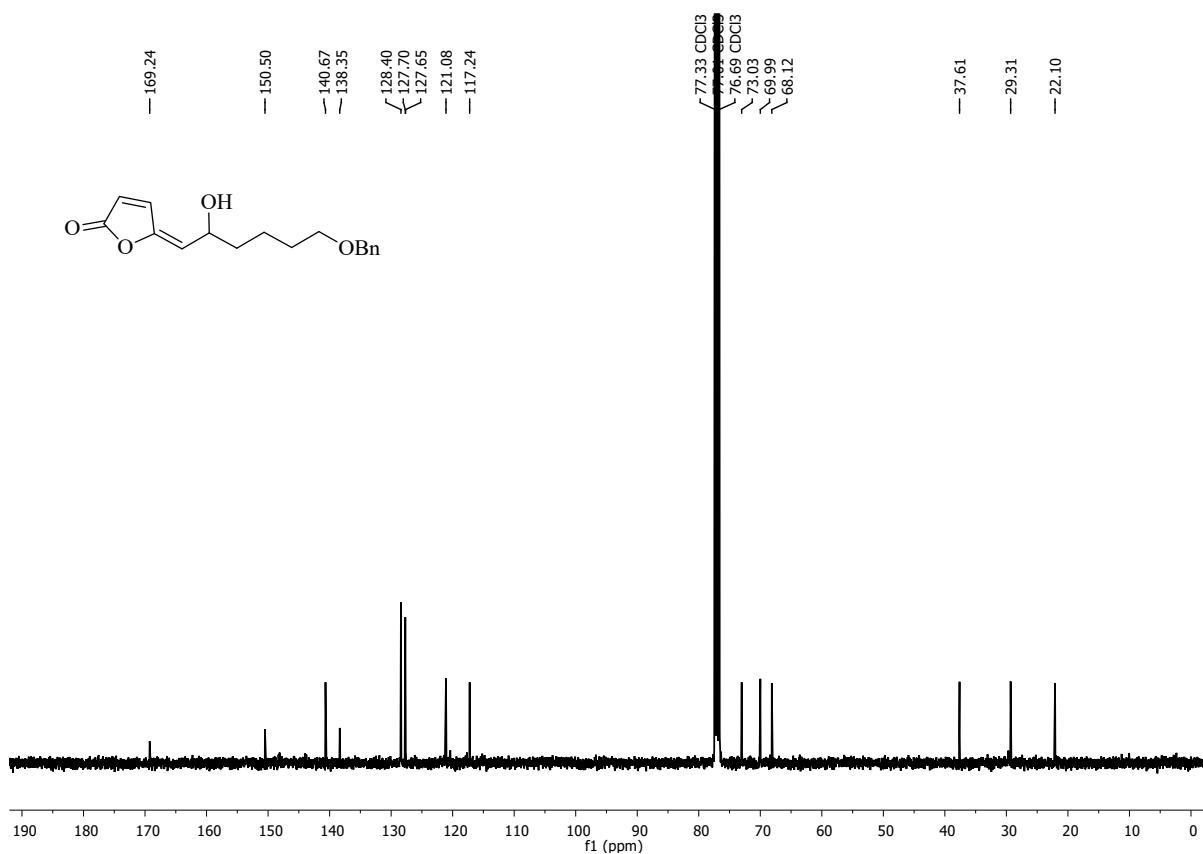
DEPT NMR of compound 3n (100 MHz, CDCl₃)



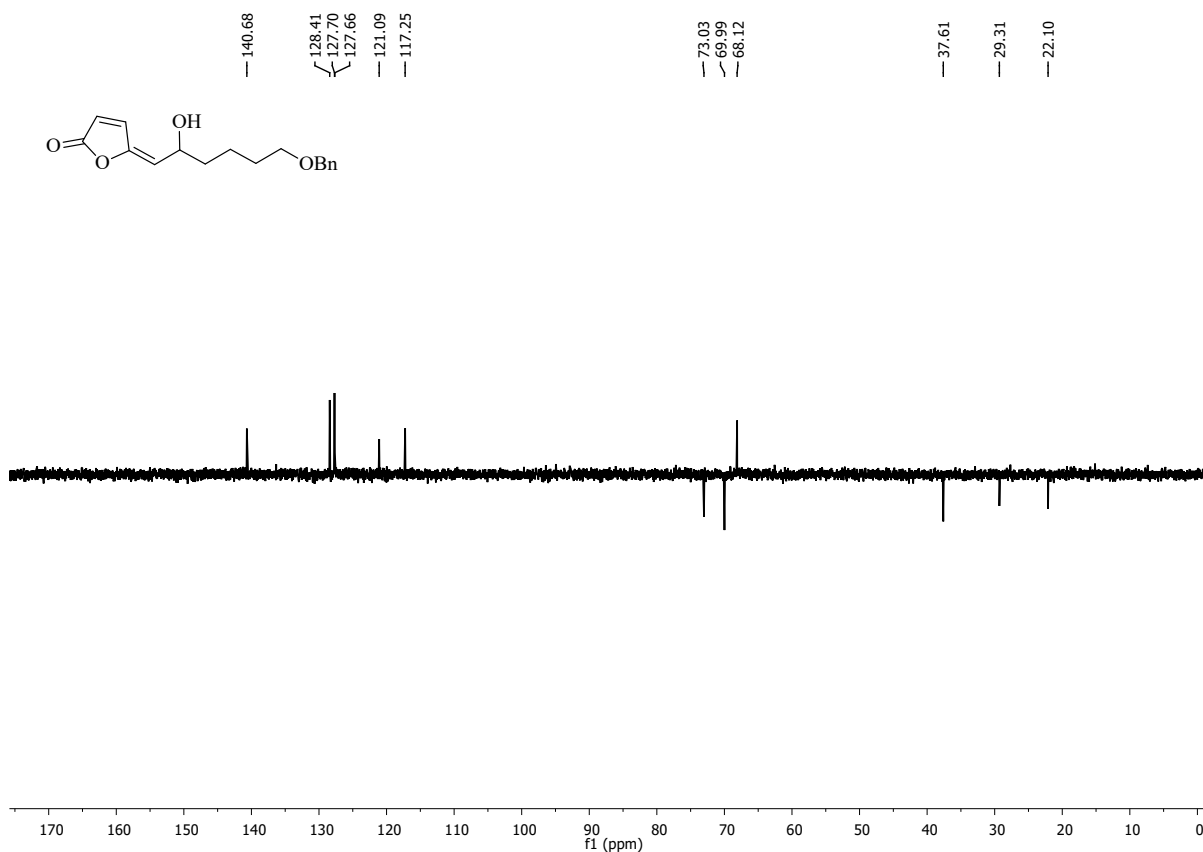
¹H NMR of compound 4n (400 MHz, CDCl₃)



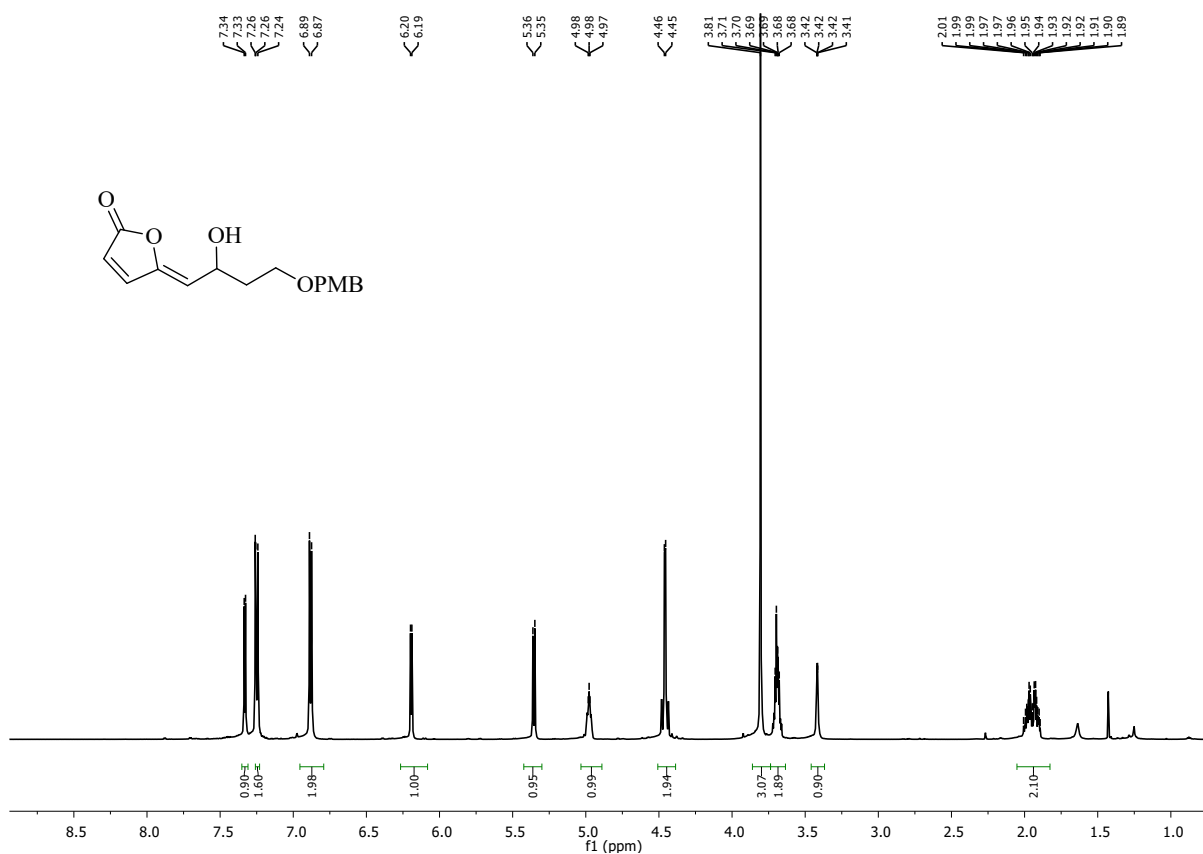
^{13}C NMR of compound 4n (100 MHz, CDCl_3)



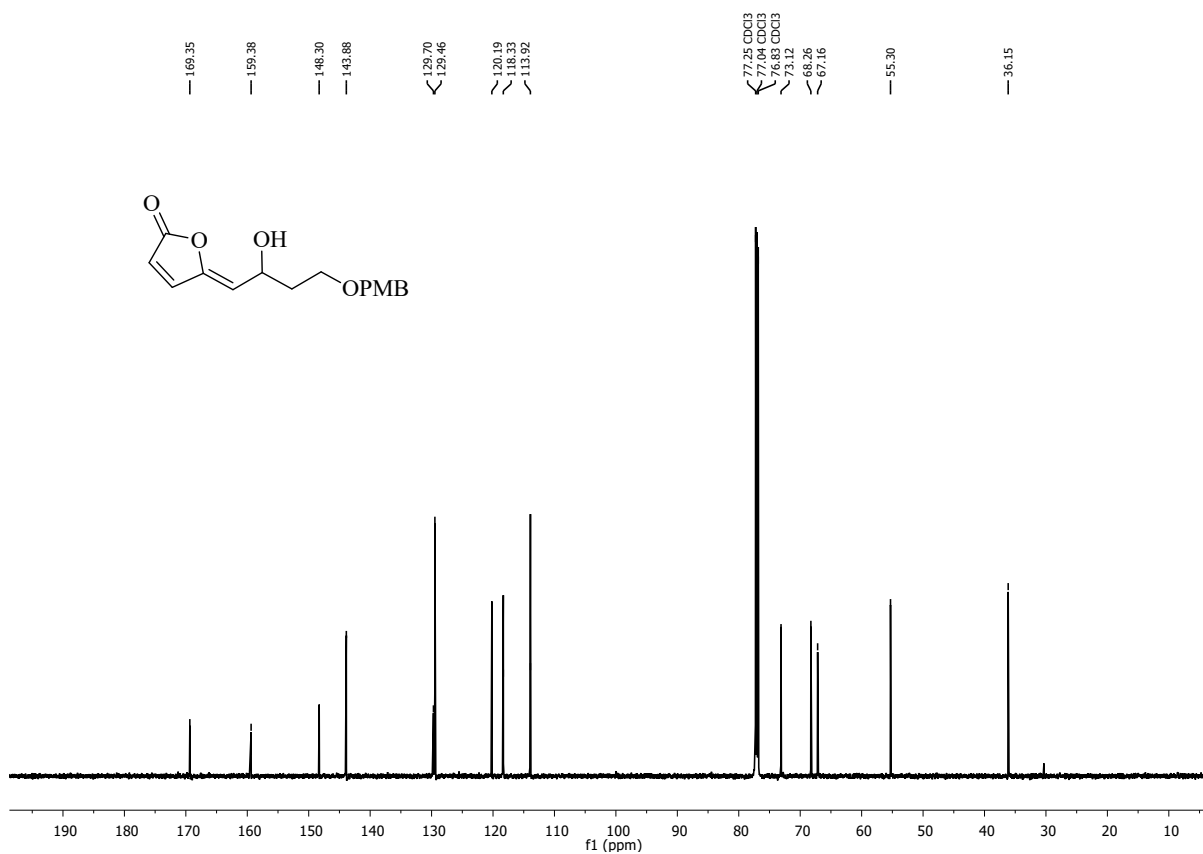
DEPT NMR of compound 4n (100 MHz, CDCl_3)



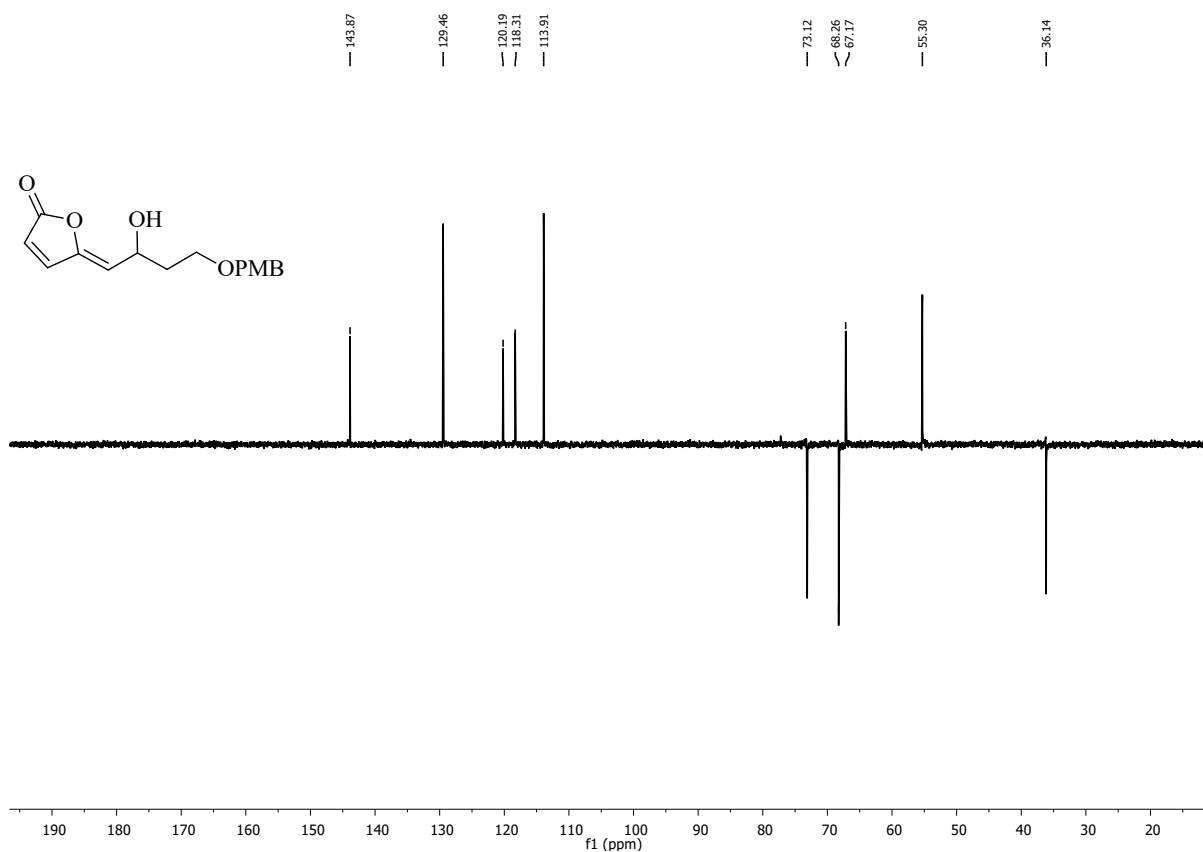
^1H NMR of compound 3o (600 MHz, CDCl_3)



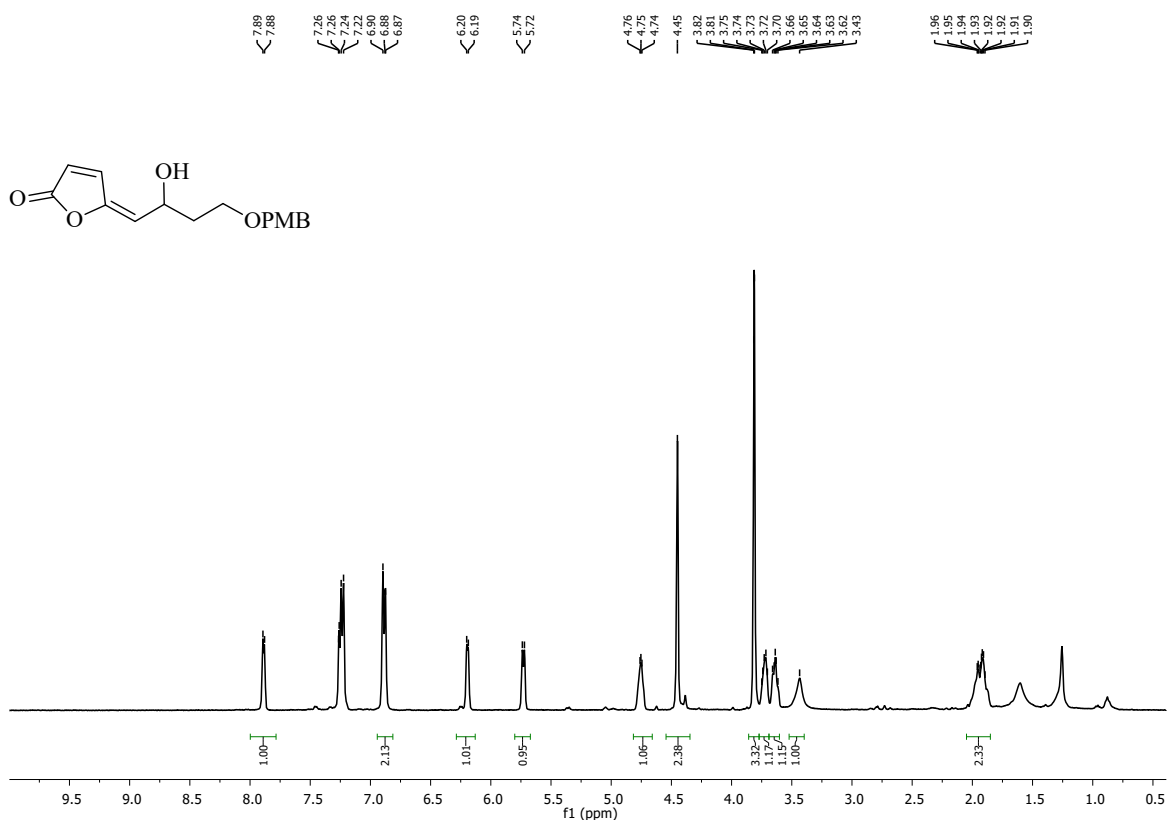
^{13}C NMR of compound 3o (150 MHz, CDCl_3)



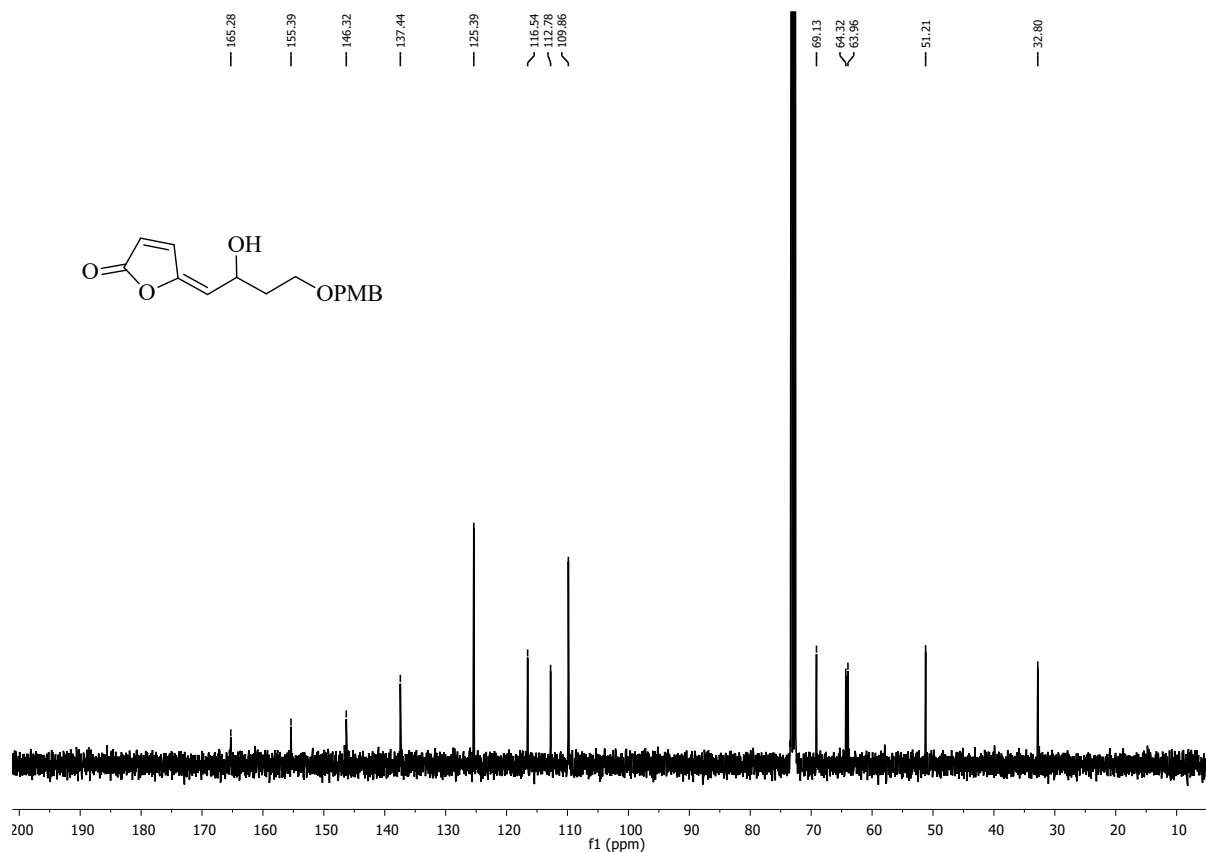
DEPT-135 NMR of compound 3o (150 MHz, CDCl₃)



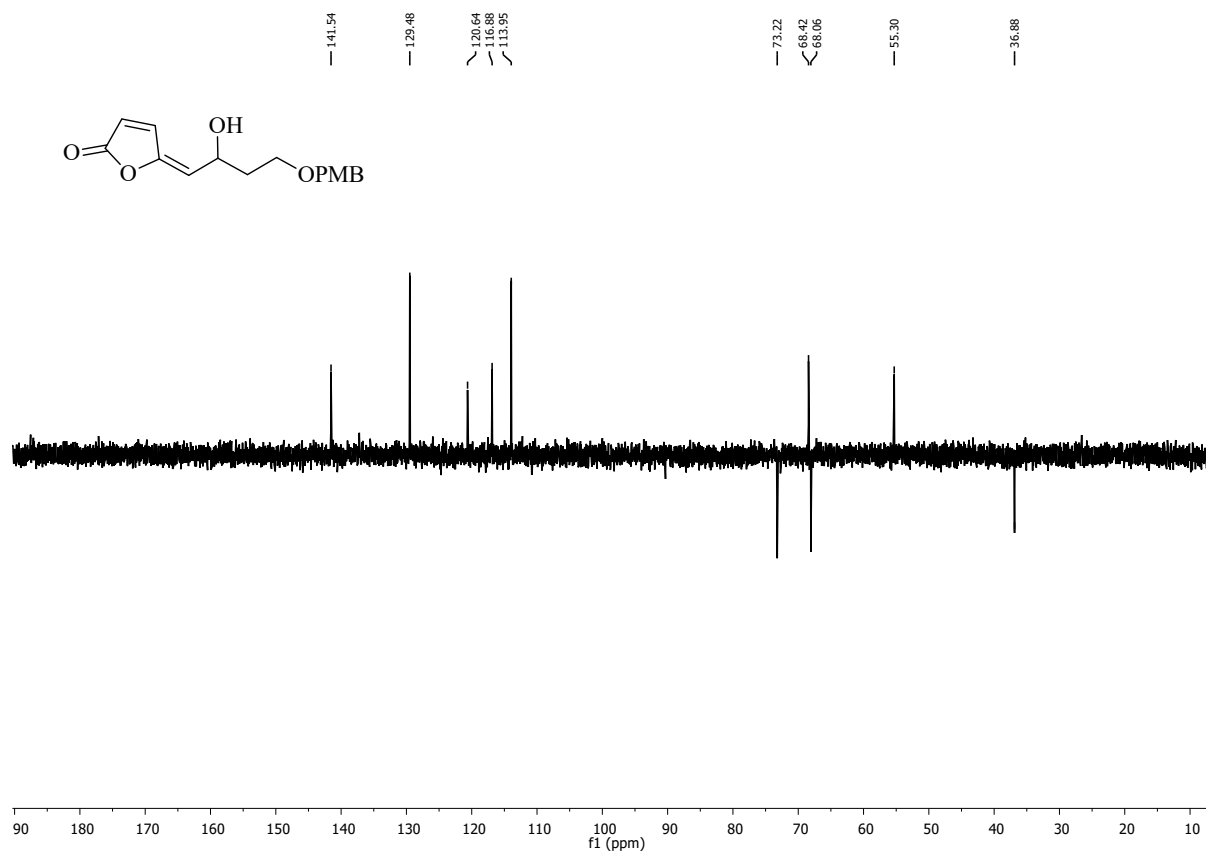
¹H NMR of compound 4o (600 MHz, CDCl₃)



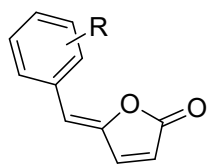
^{13}C NMR of compound 4o (150 MHz, CDCl_3)



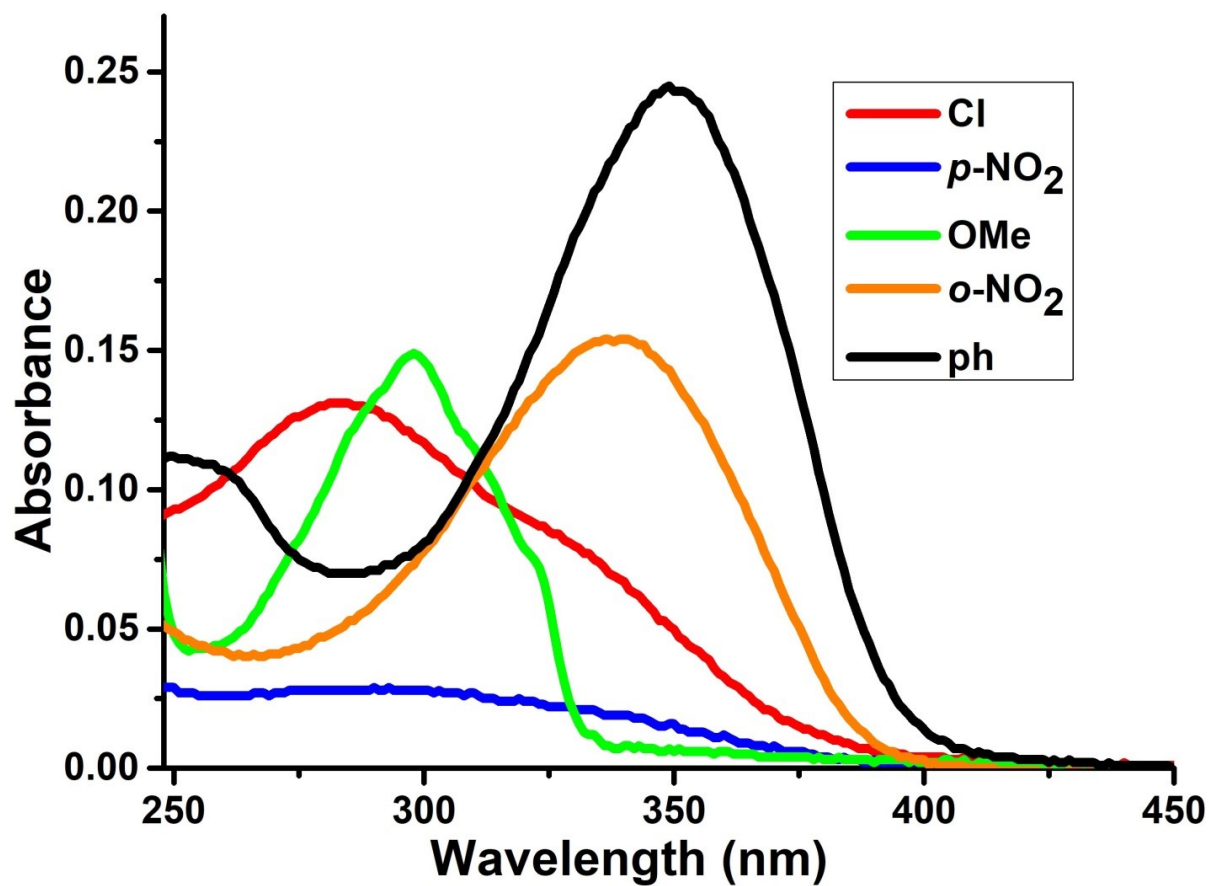
DEPT-135 NMR of compound 4o (150 MHz, CDCl_3)



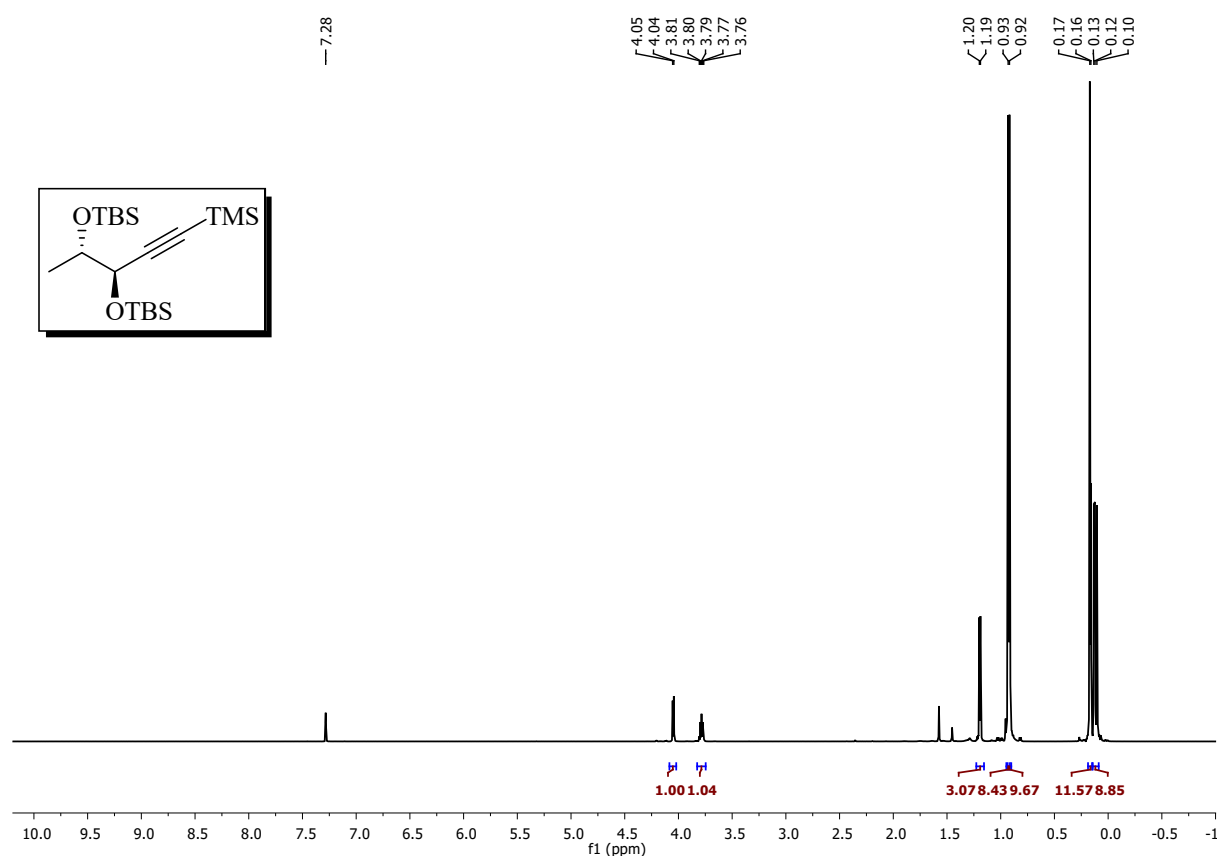
UV-Vis spectrum of few γ -Z-alkylidenebutenolides



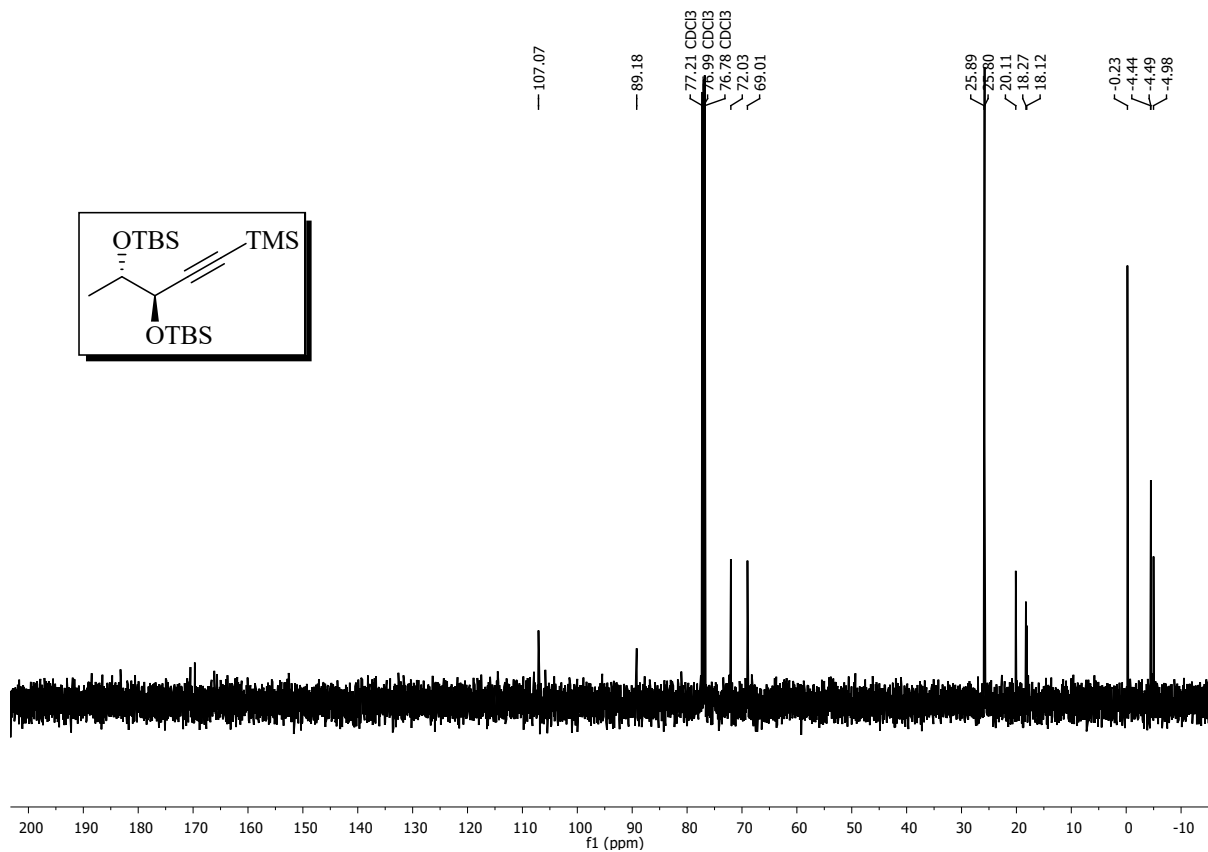
R = *p*-Cl, *p*-NO₂, *p*-OMe, *o*-NO₂ and *p*-Ph



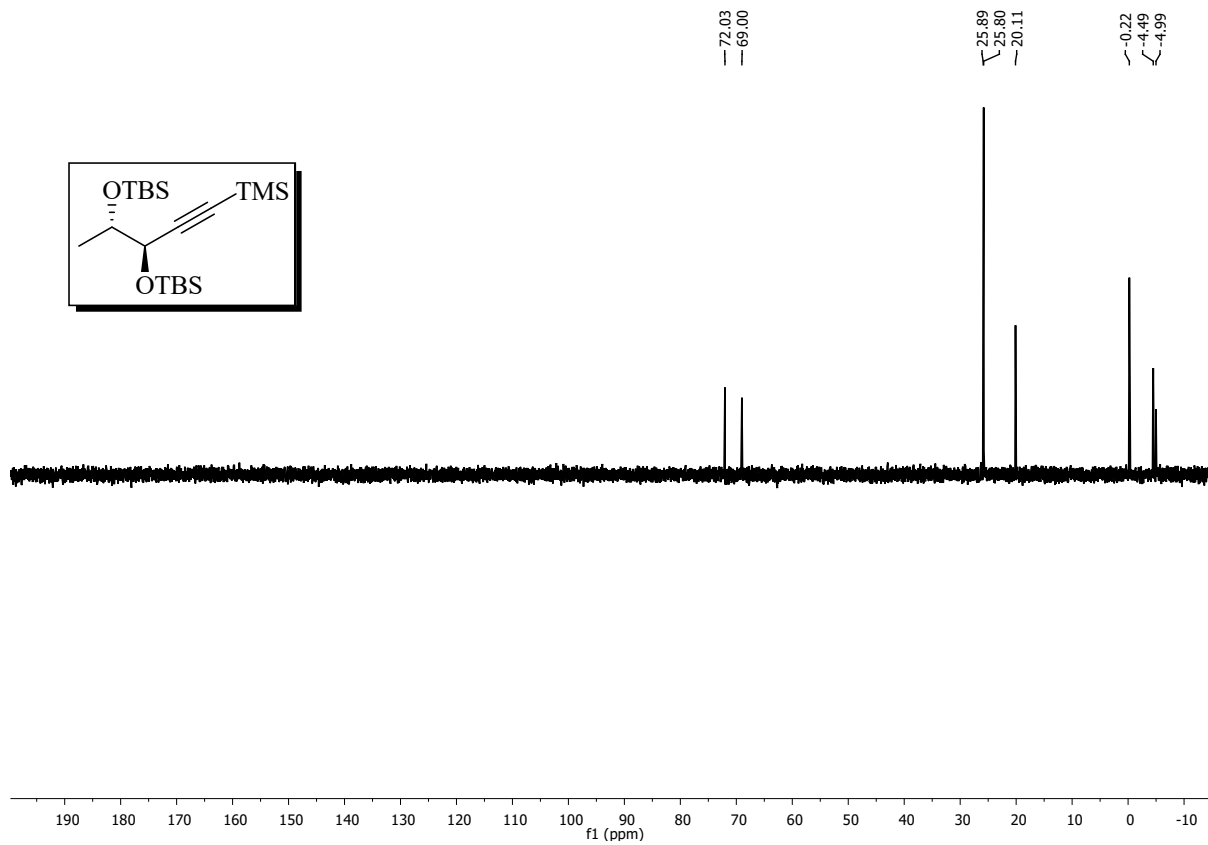
^1H (600 MHz) NMR of compound 12 in CDCl_3



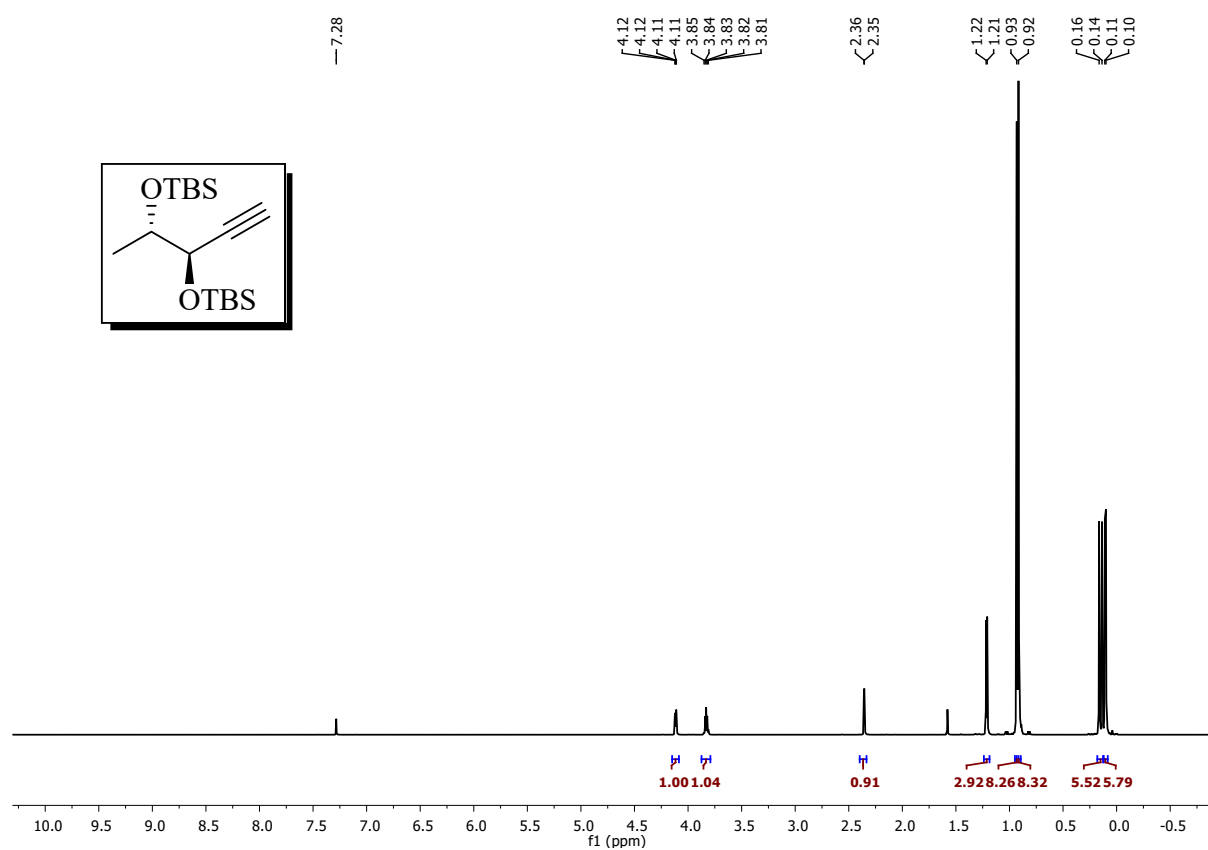
^{13}C (150 MHz) NMR of compound 12 in CDCl_3



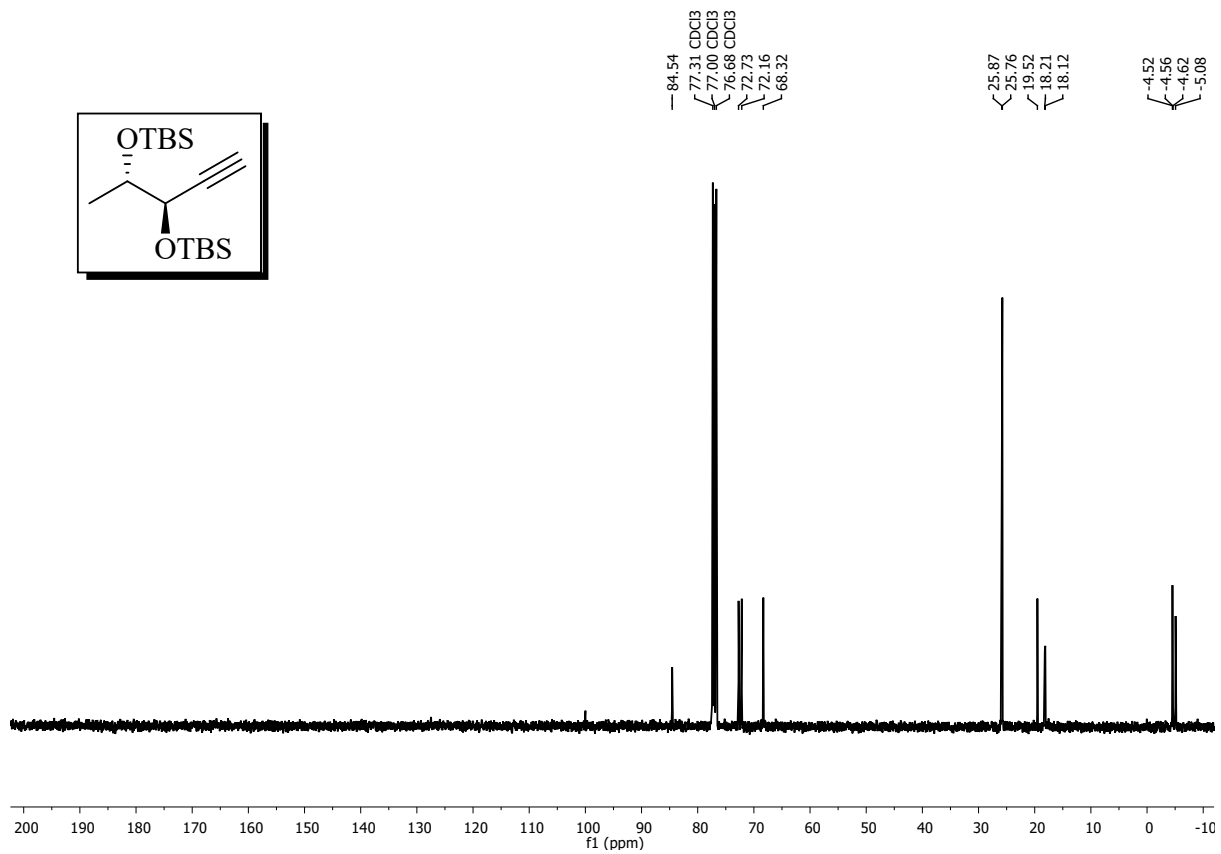
DEPT (150 MHz) NMR of compound 12 in CDCl₃



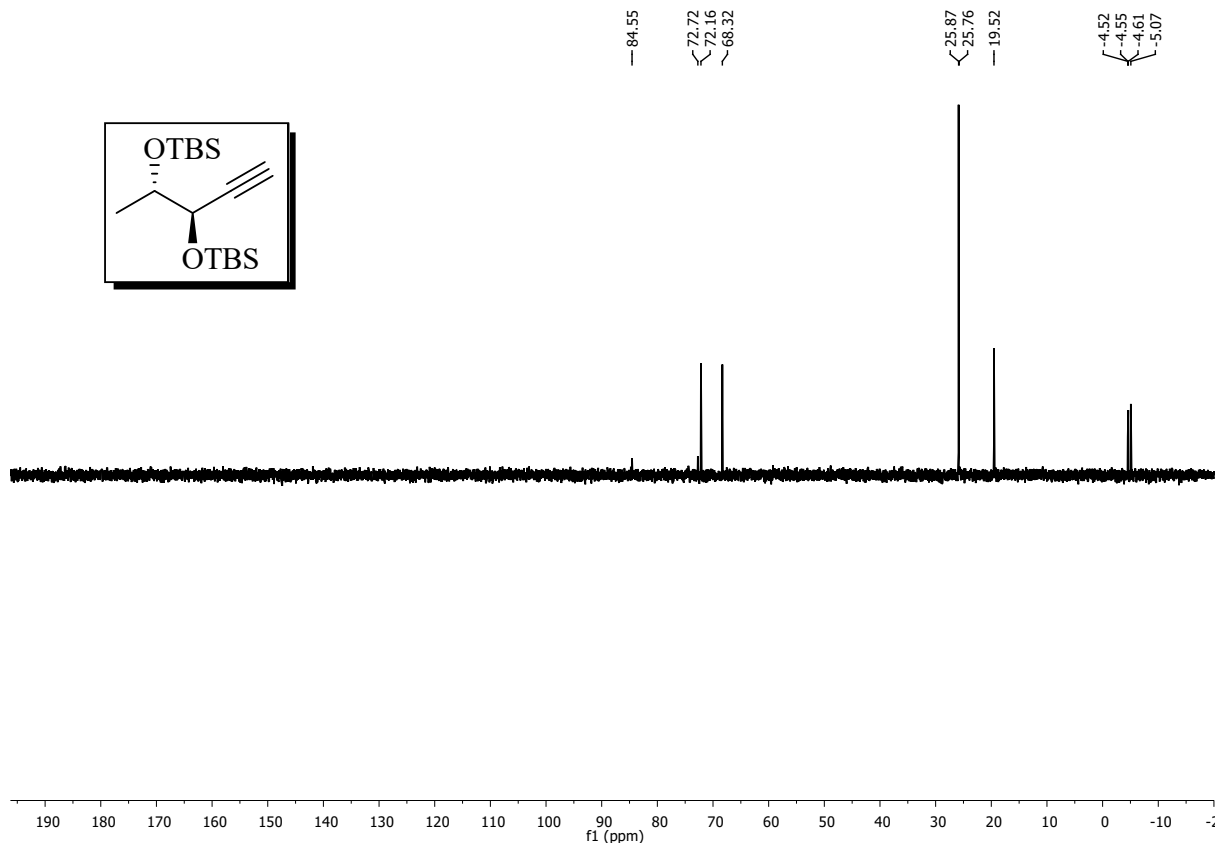
¹H (600 MHz) NMR of compound 7 in CDCl₃



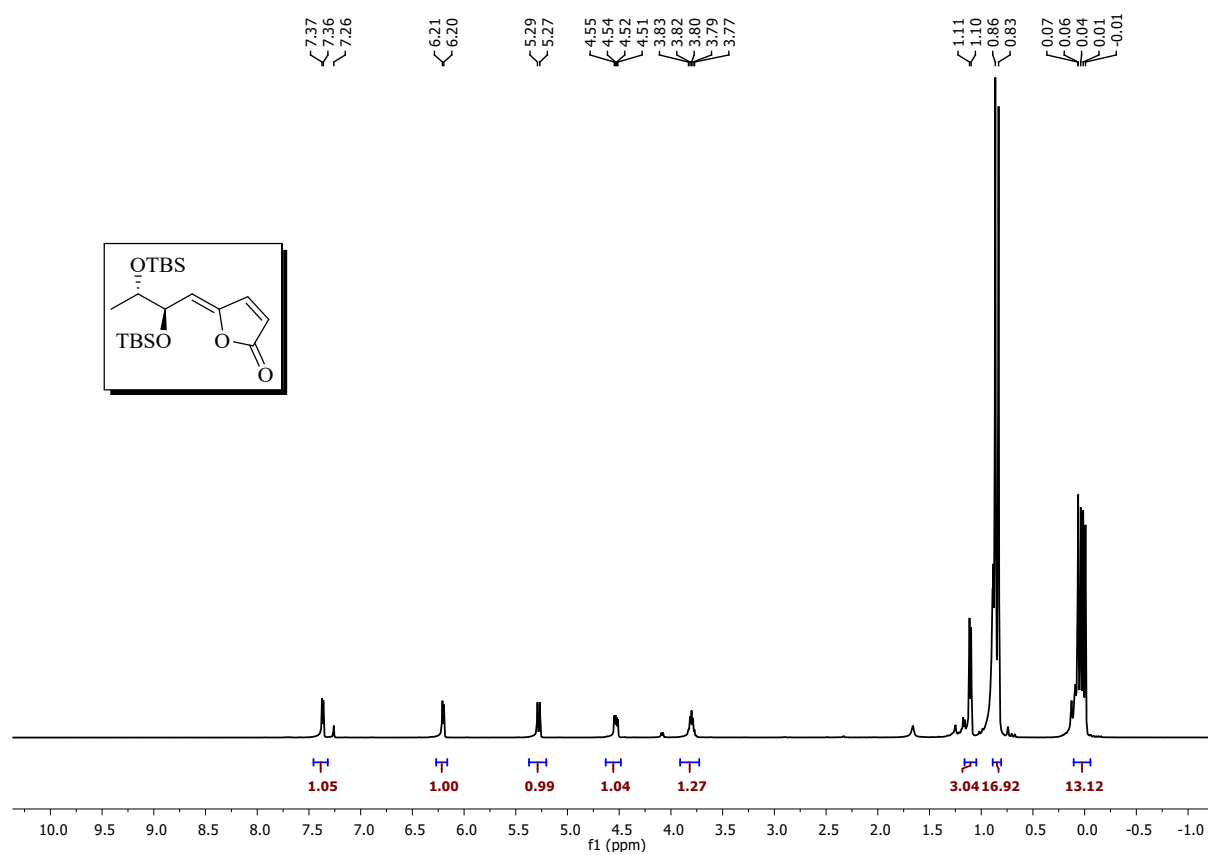
¹³C (150 MHz) NMR of compound 7 in CDCl₃



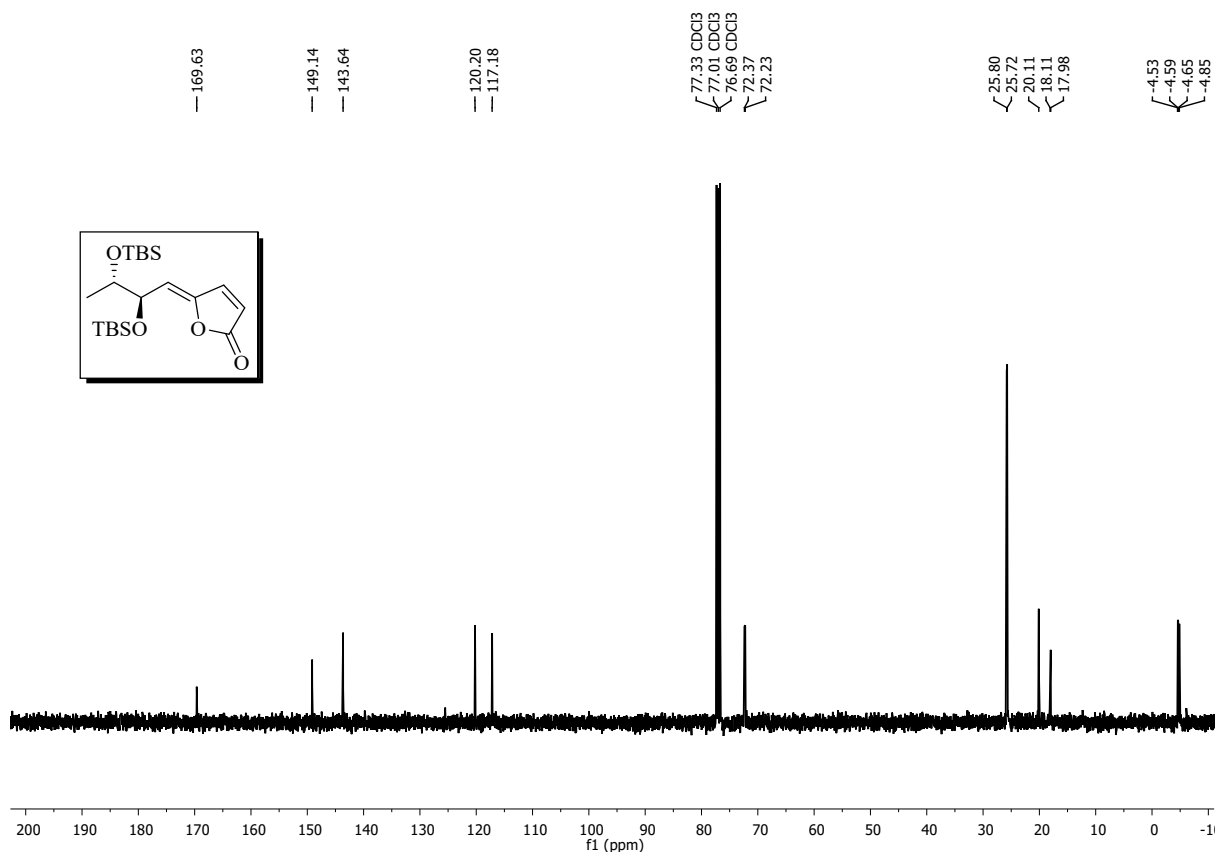
DEPT (150 MHz) NMR of compound 7 in CDCl₃



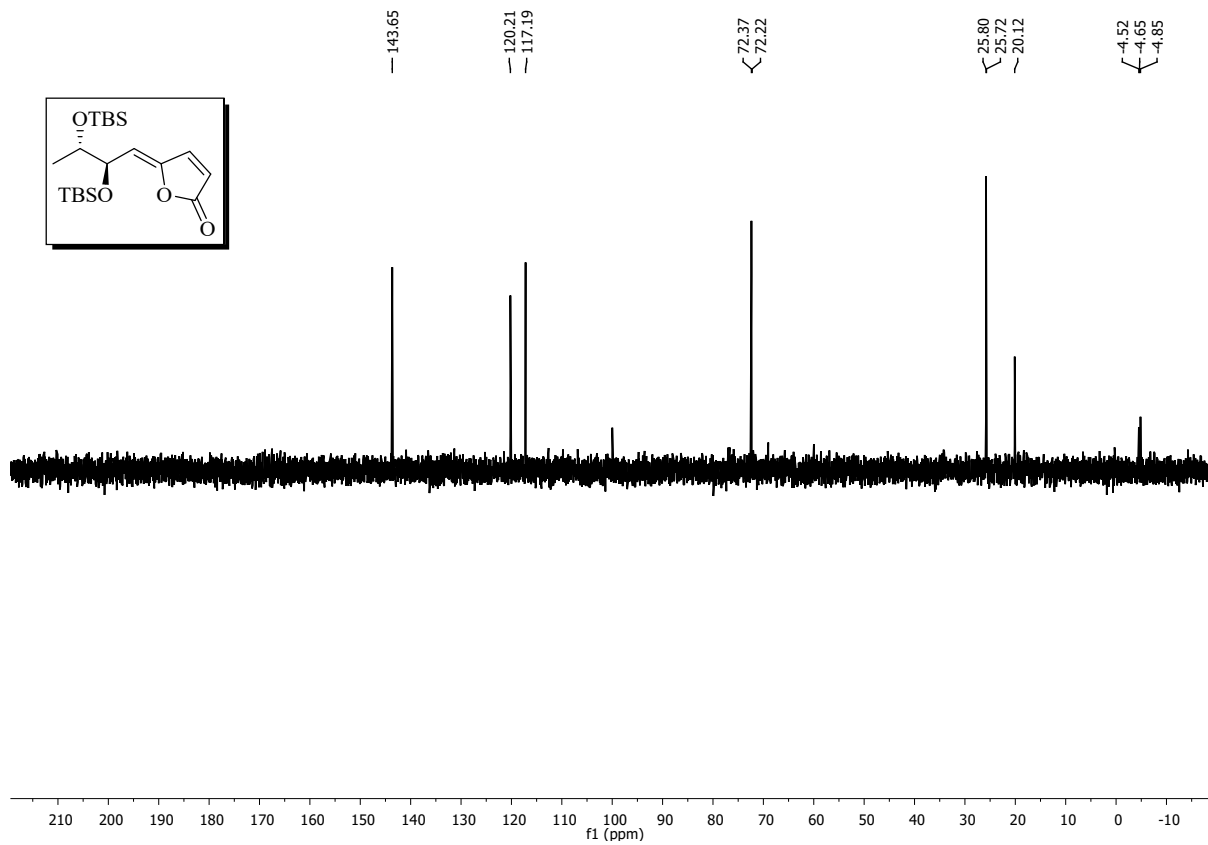
^1H (400 MHz) NMR of compound 13 in CDCl_3



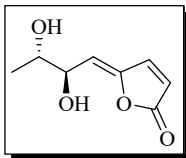
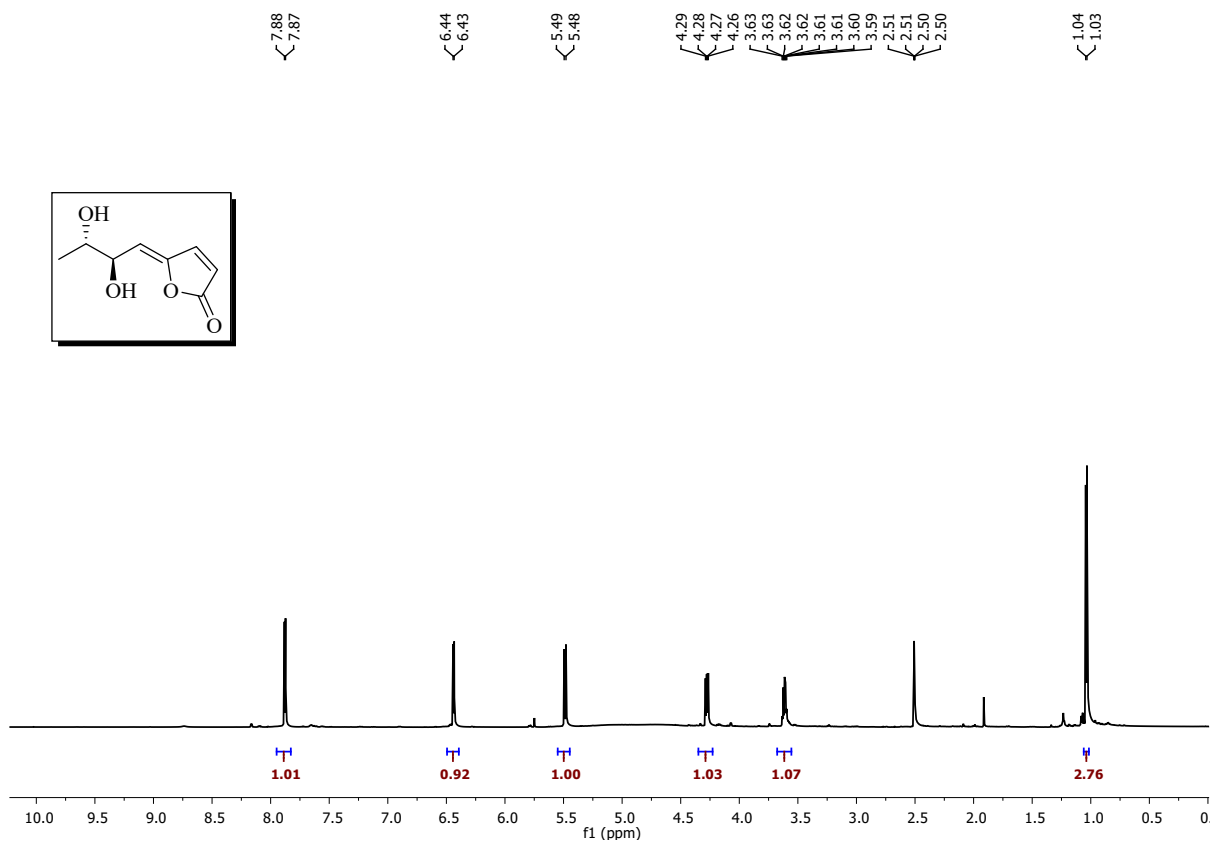
^{13}C (100 MHz) NMR of compound 13 in CDCl_3



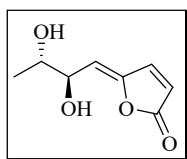
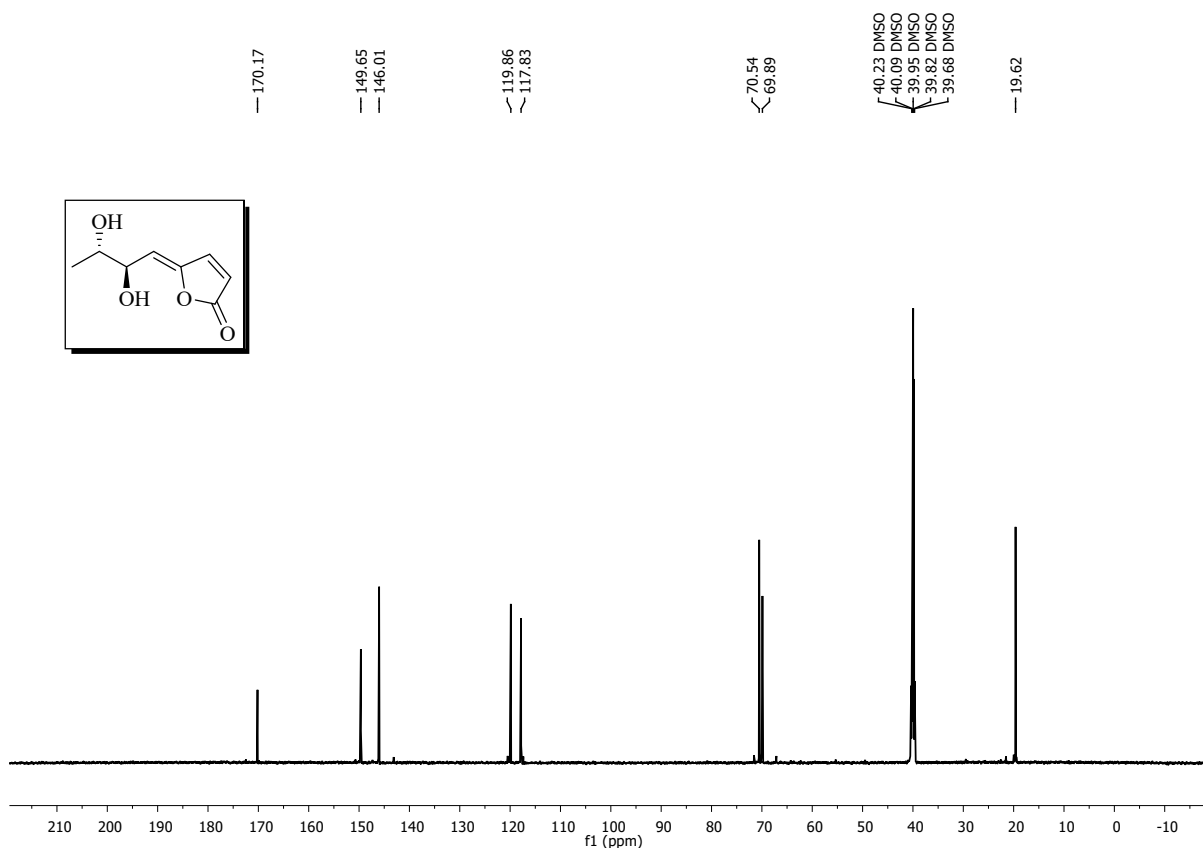
DEPT (100 MHz) NMR of compound 13 in CDCl₃



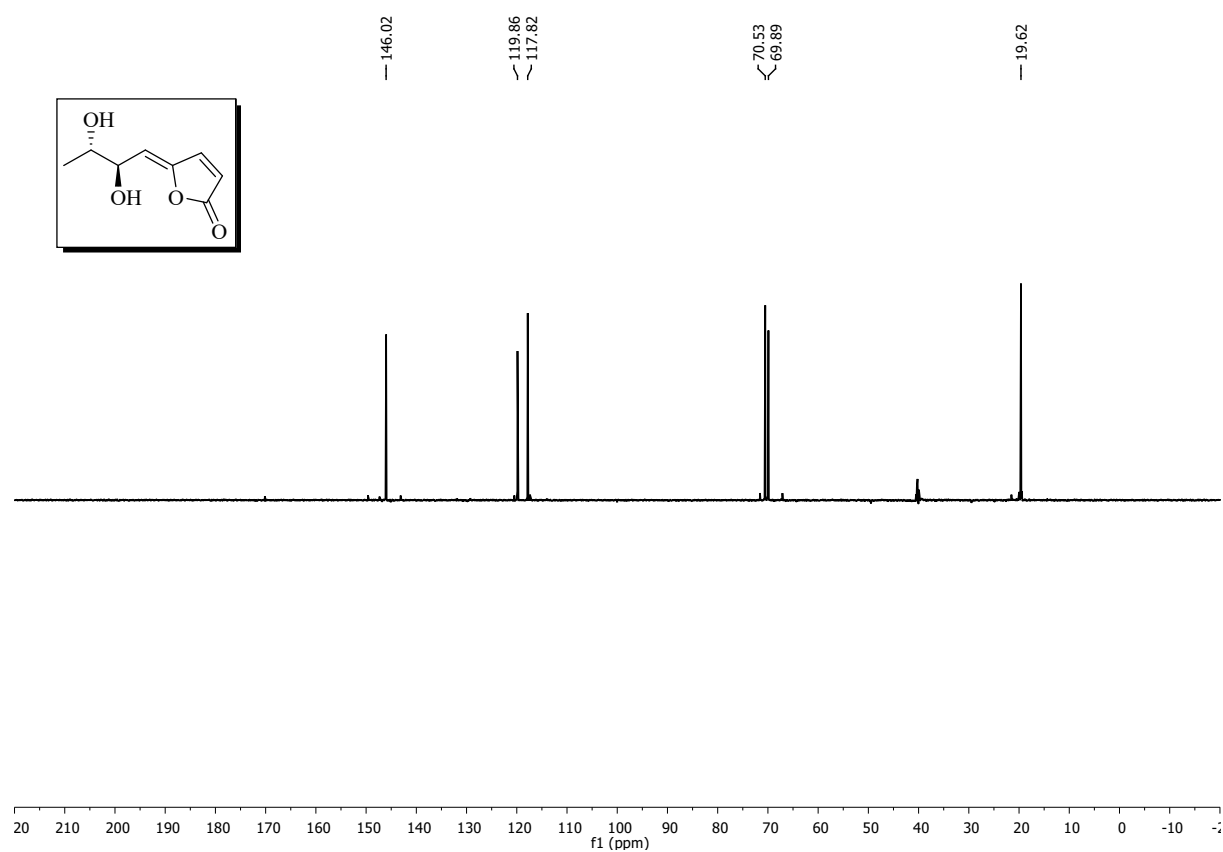
^1H NMR of versicolactone A (6) (600 MHz, DMSO-D_6)



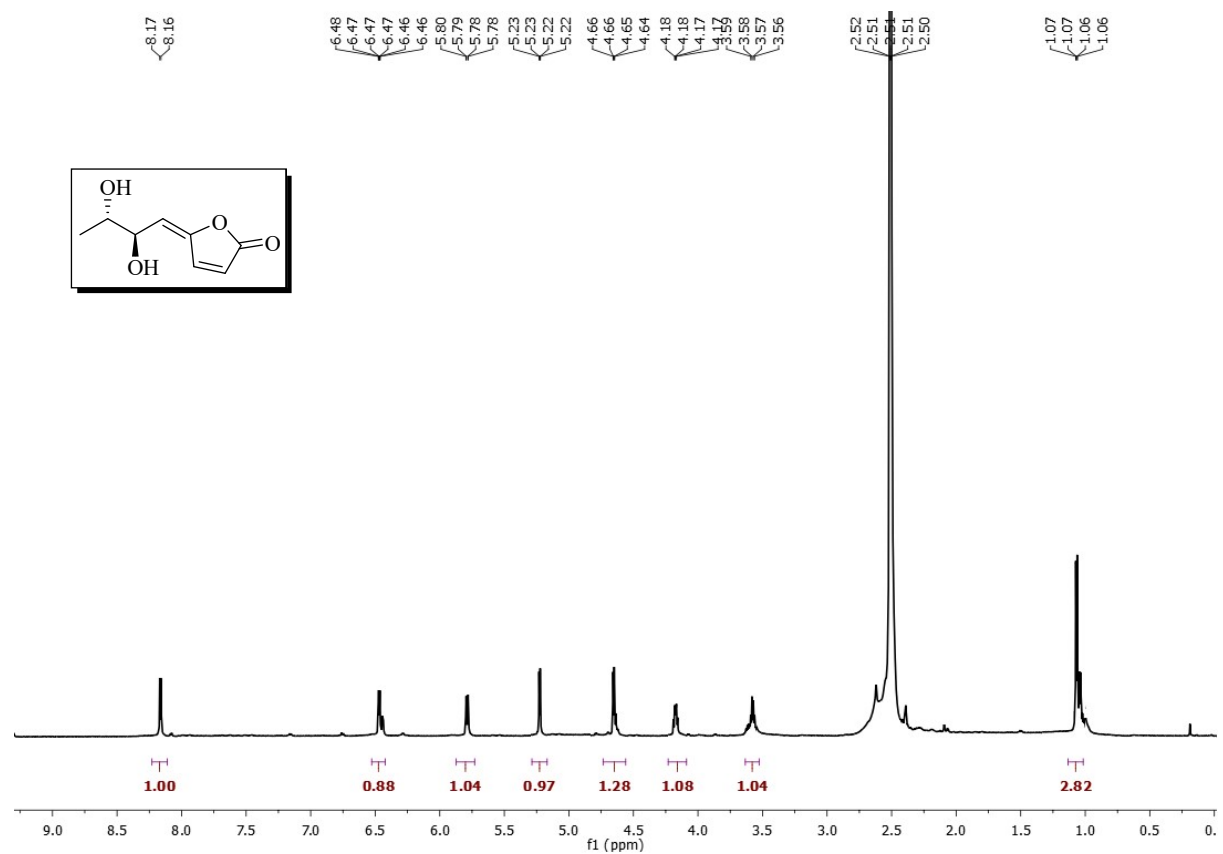
^{13}C NMR of versicolactone A (6) (150 MHz, DMSO-D_6)



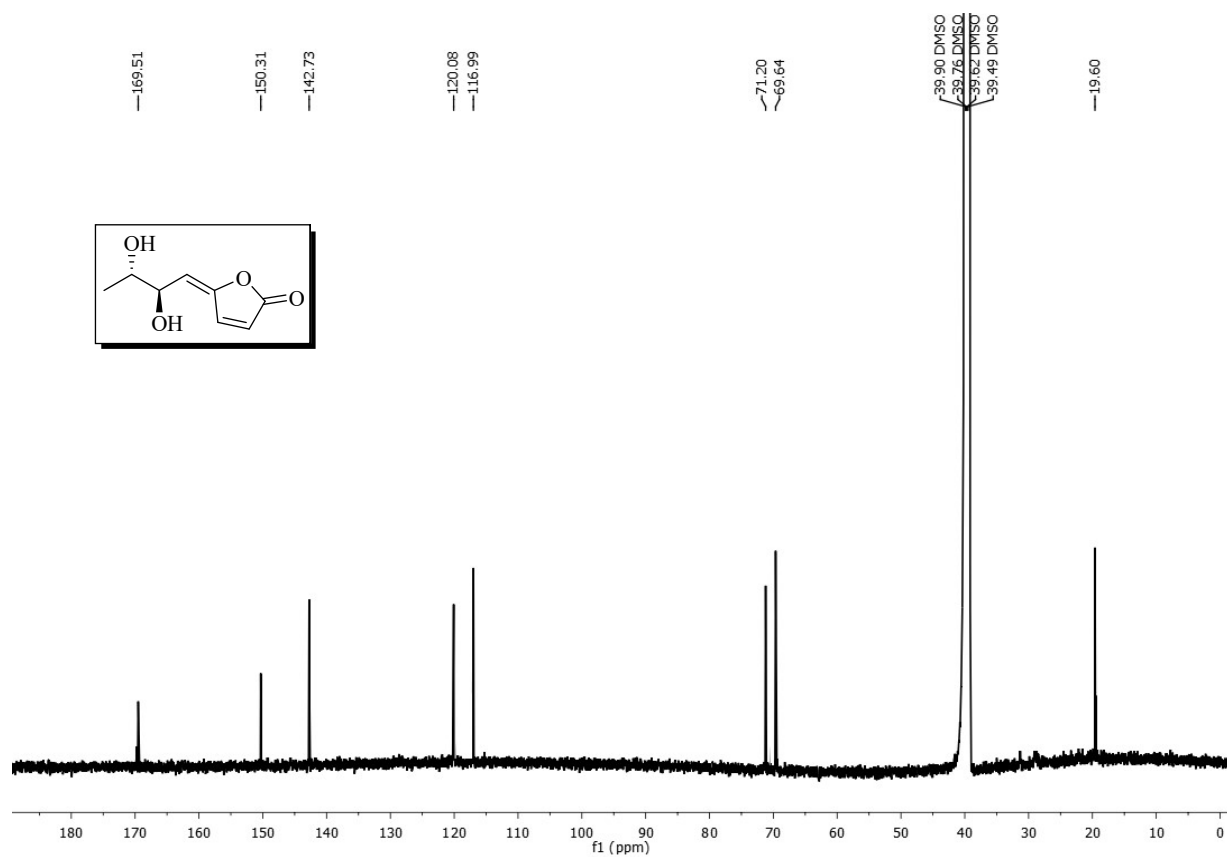
DEPT-135- NMR of versicolactone A (6) (150 MHz, DMSO-D₆)



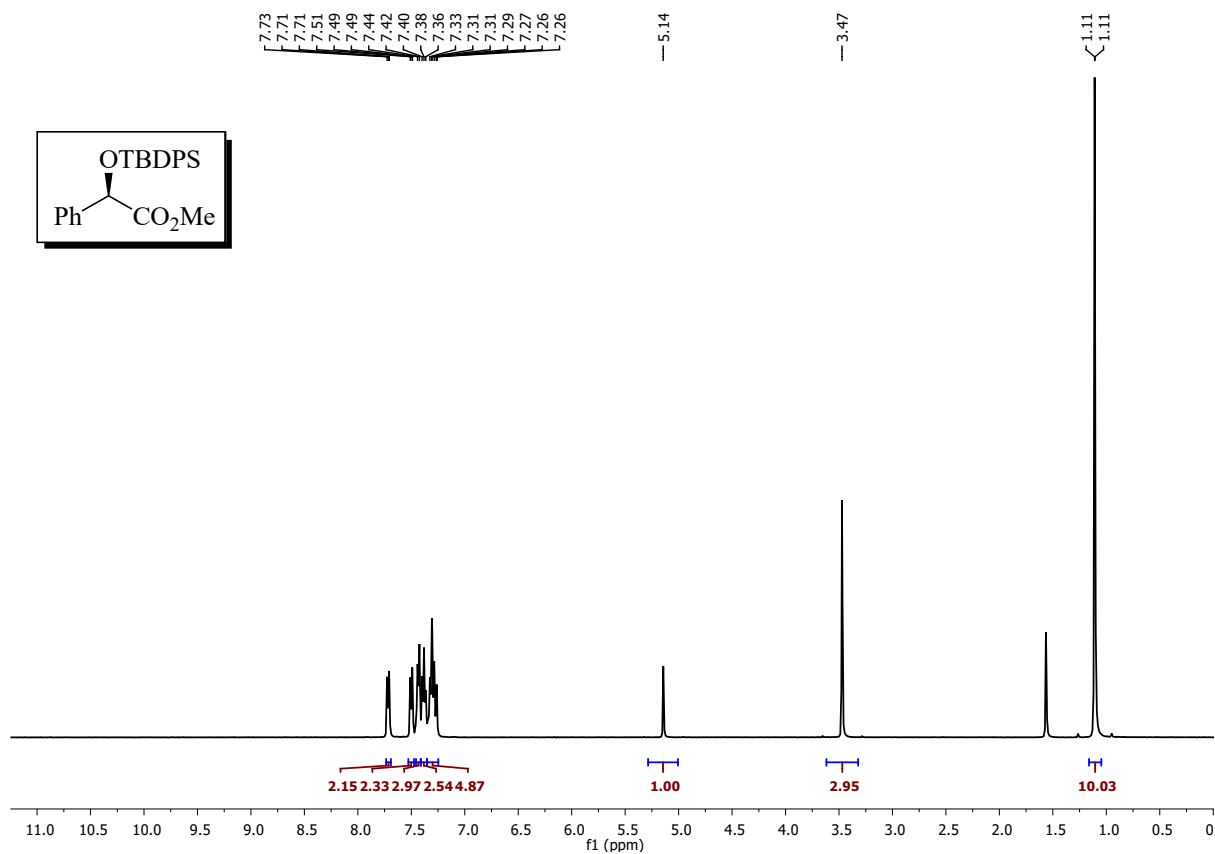
¹H NMR of versicolactone B (5) (600 MHz, DMSO-D₆)



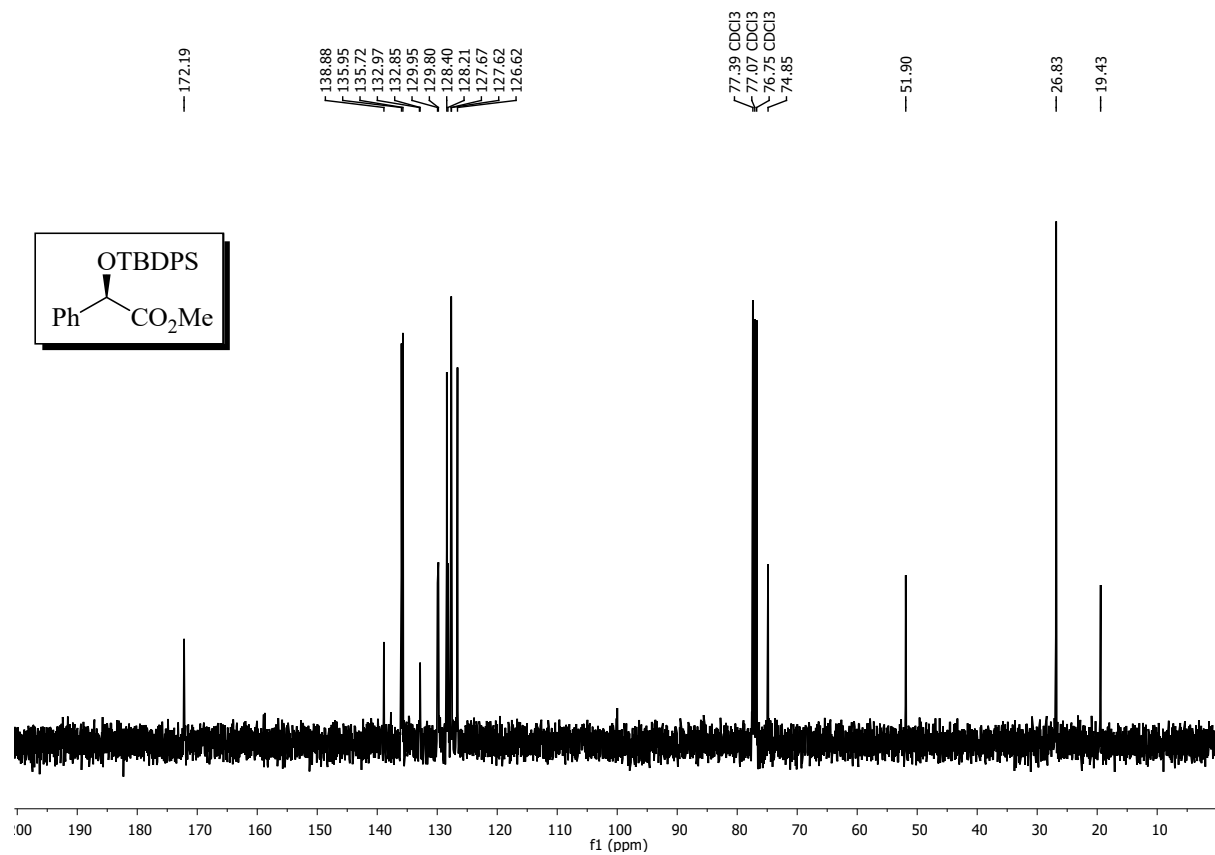
^{13}C NMR of versicolactone B (5) (150 MHz, $\text{DMSO-}D_6$)



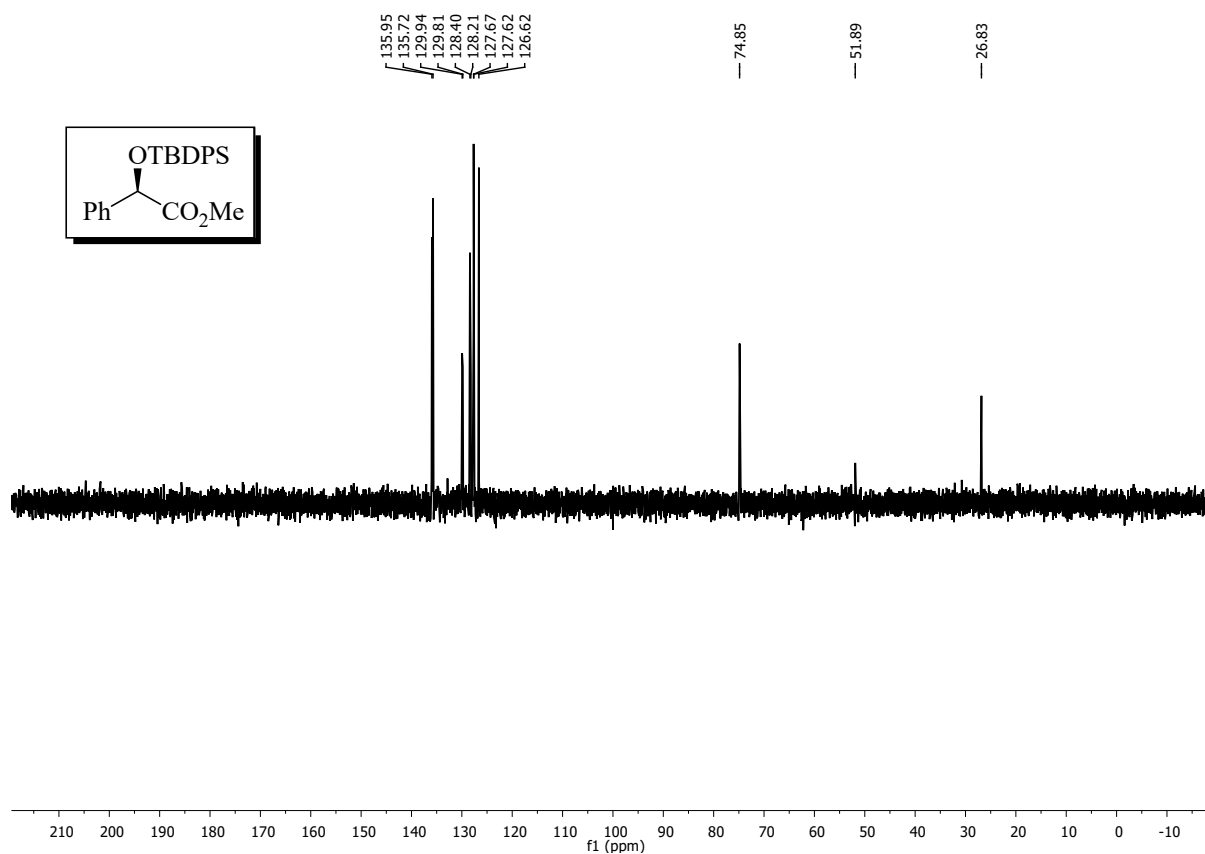
^1H (400 MHz) NMR of compound 18 in CDCl_3



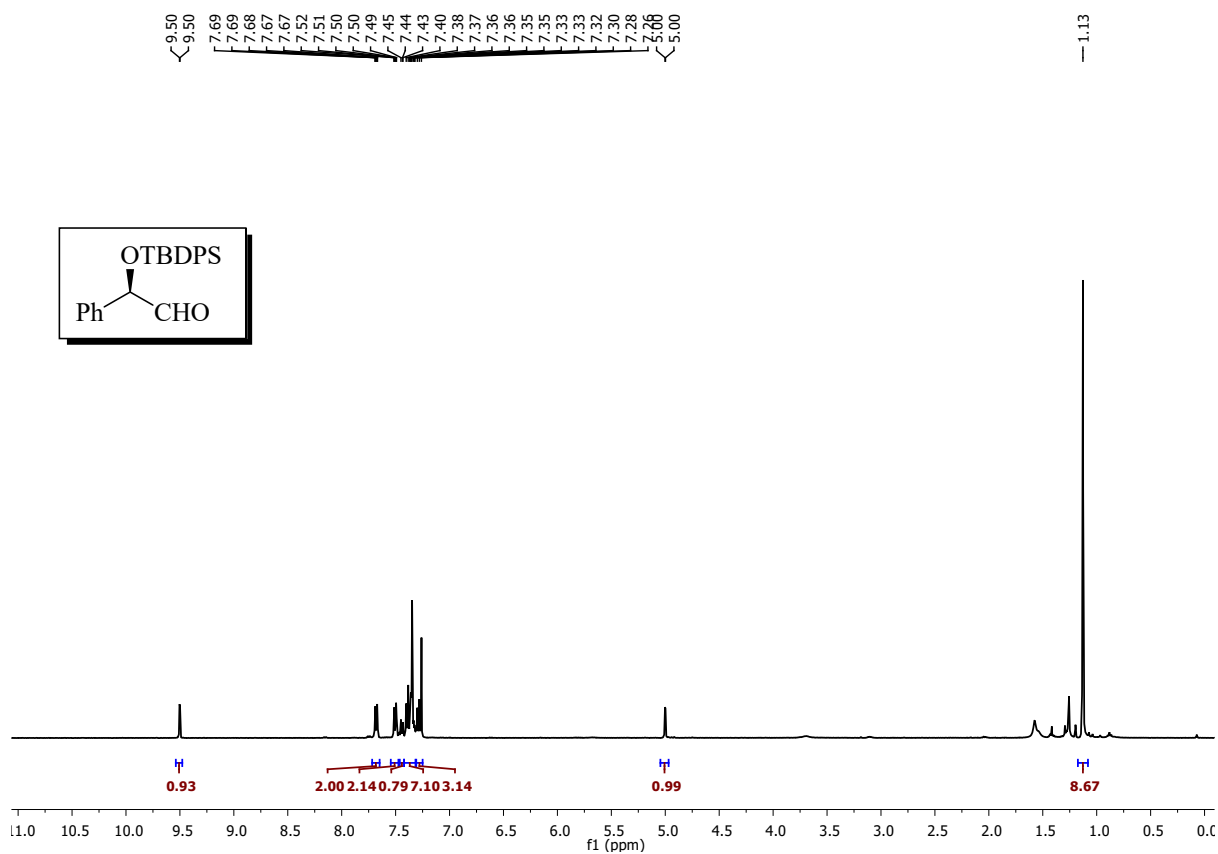
¹³C (100 MHz) NMR of compound 18 in CDCl₃



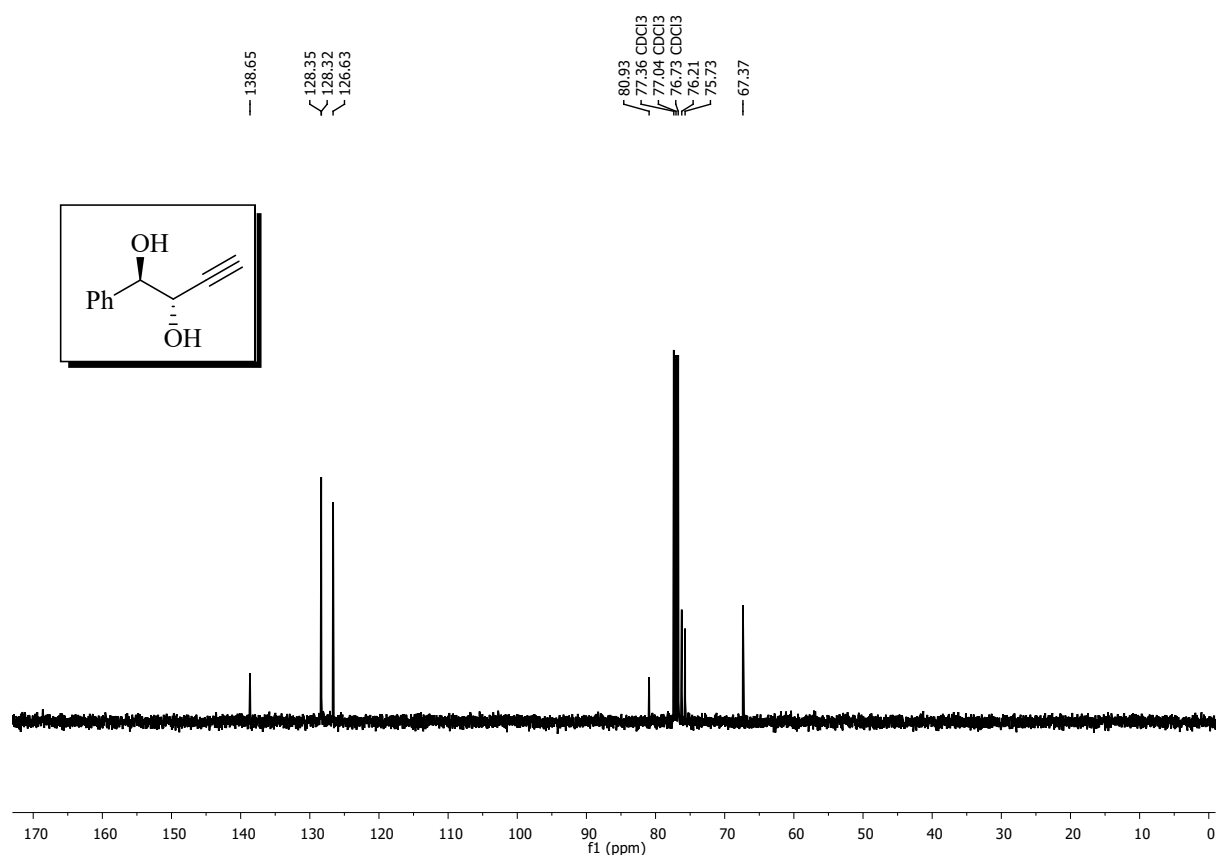
DEPT (100 MHz) NMR of compound 18 in CDCl₃



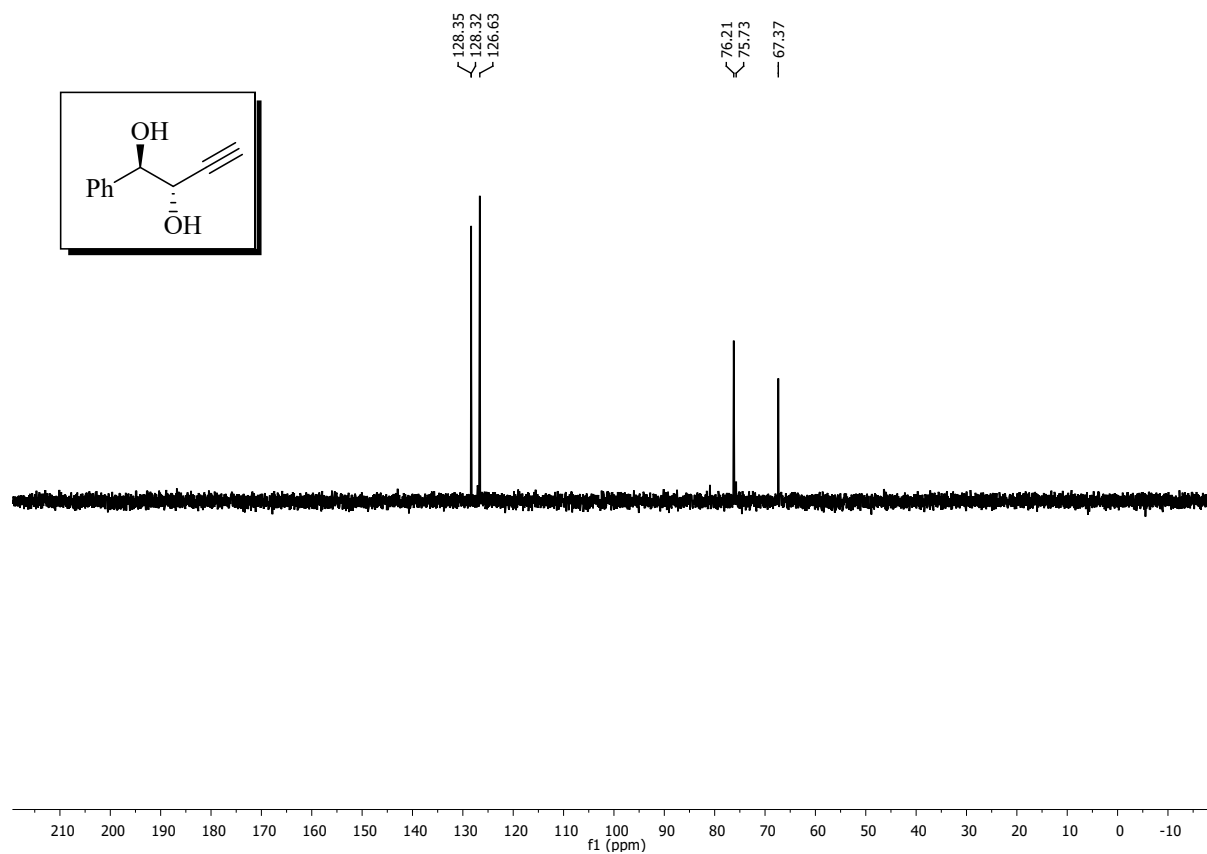
¹H (400 MHz) NMR of compound 17 in CDCl₃



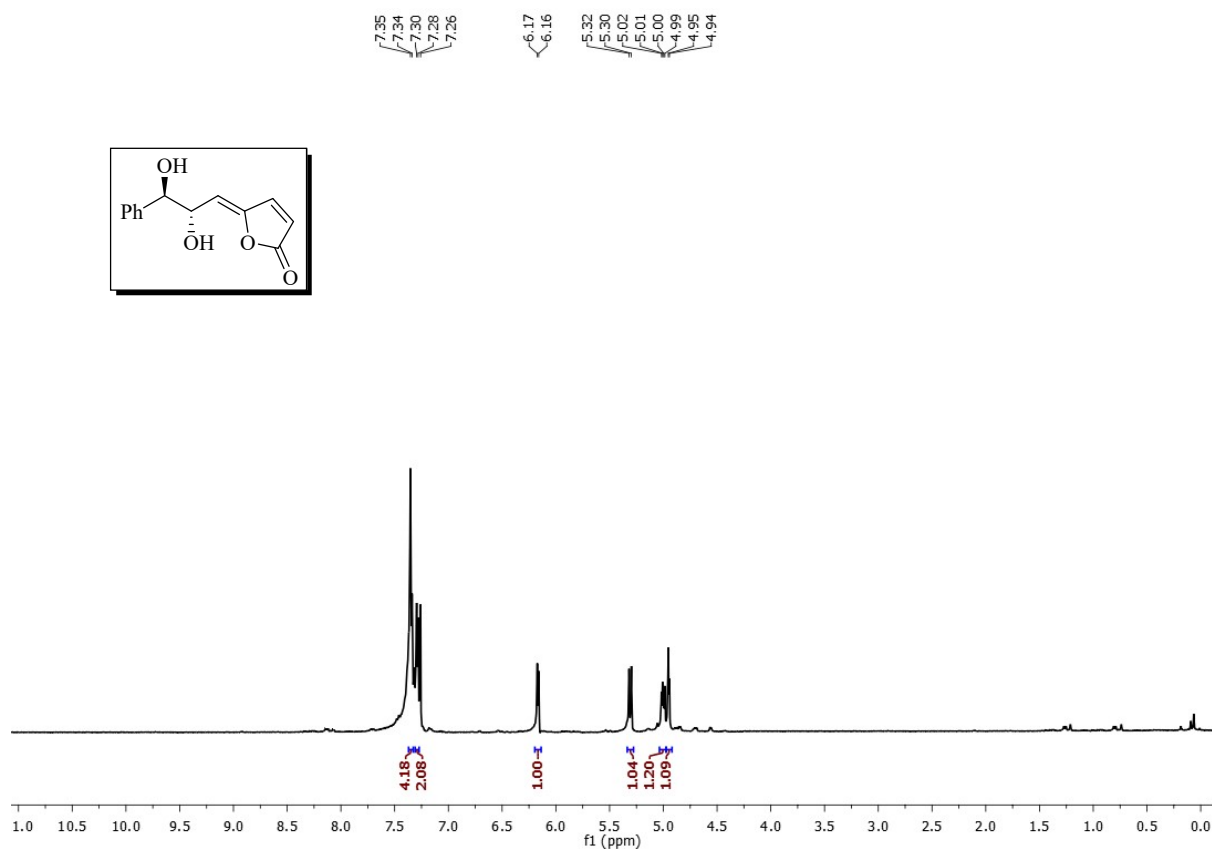
^{13}C (100 MHz) NMR of compound 16 in CDCl_3



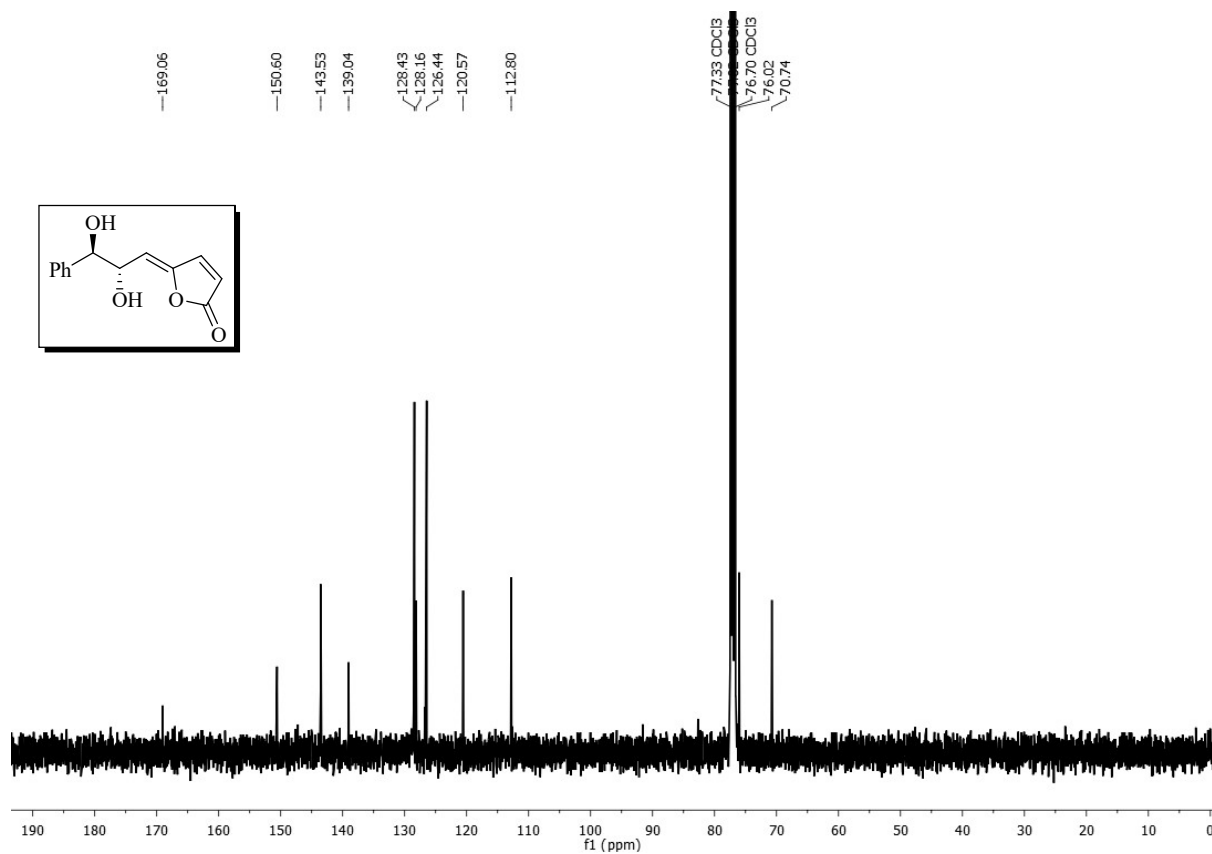
DEPT (100 MHz) NMR of compound 16 in CDCl_3



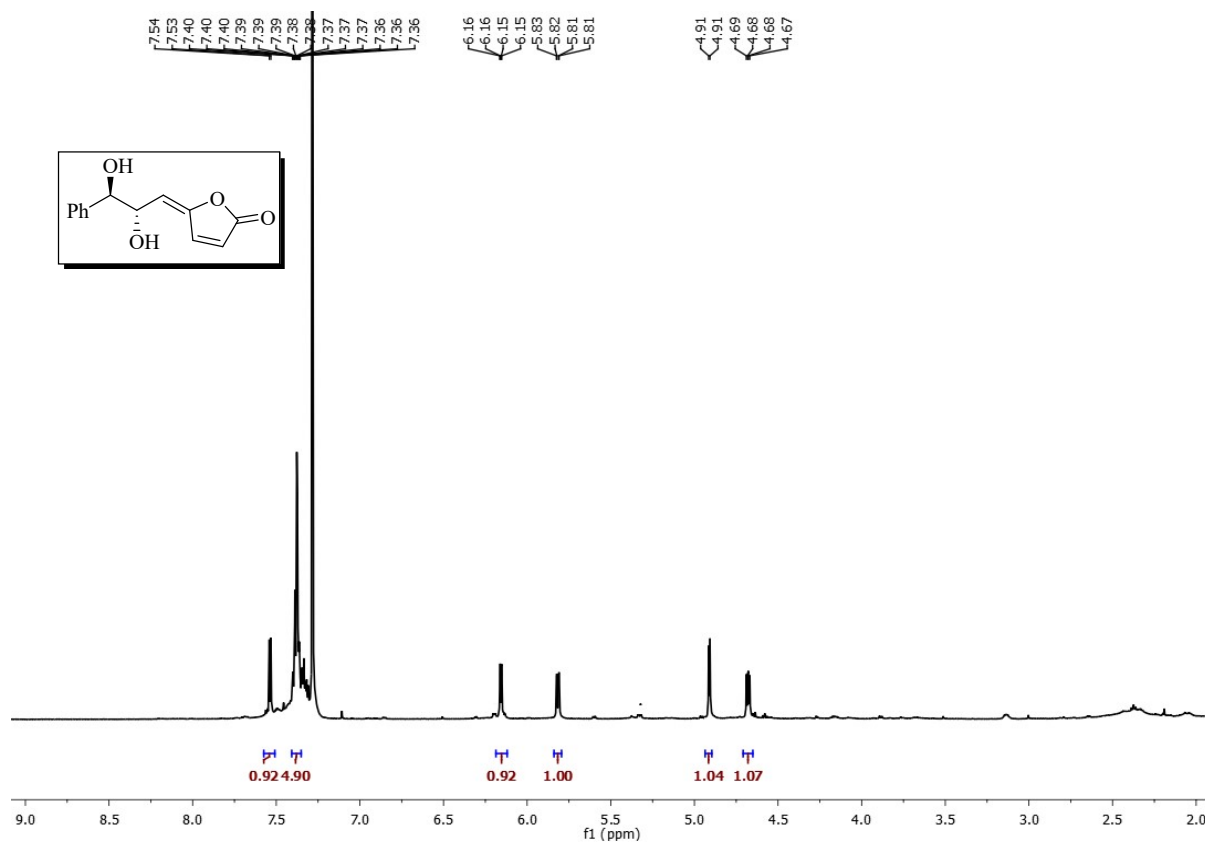
^1H NMR of goniobutenolide A (15) (400 MHz, CDCl_3)



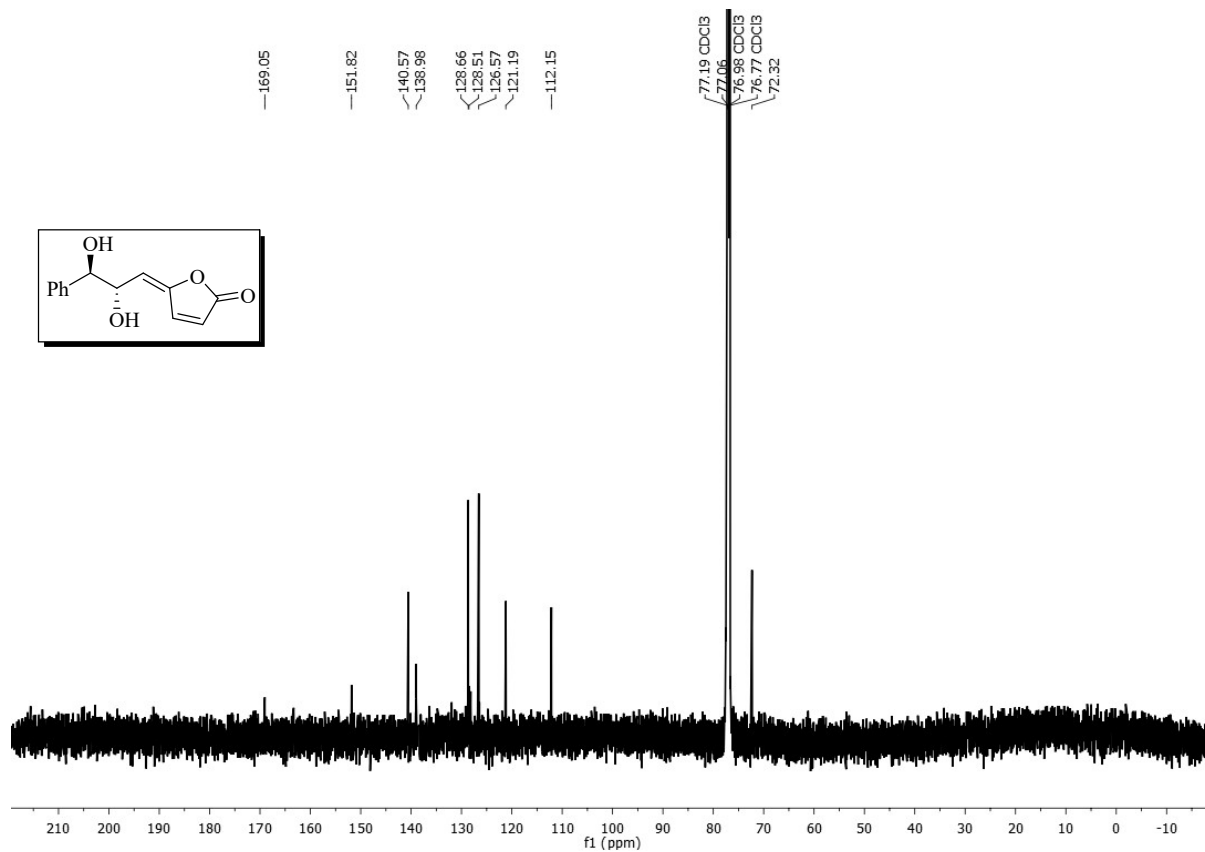
^{13}C NMR of goniobutenolide A(15) (100 MHz, CDCl_3)



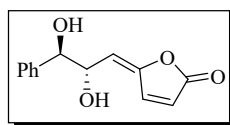
^1H NMR of goniobutenolide B (14) (400 MHz, CDCl_3)



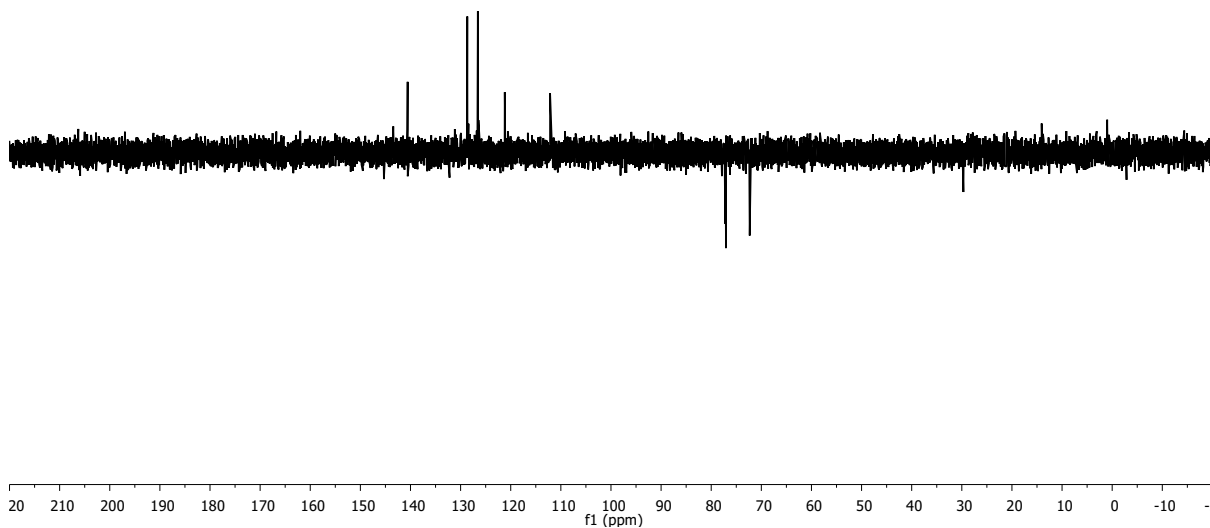
^{13}C NMR of goniobutenolide B (14) (150 MHz, CDCl_3)



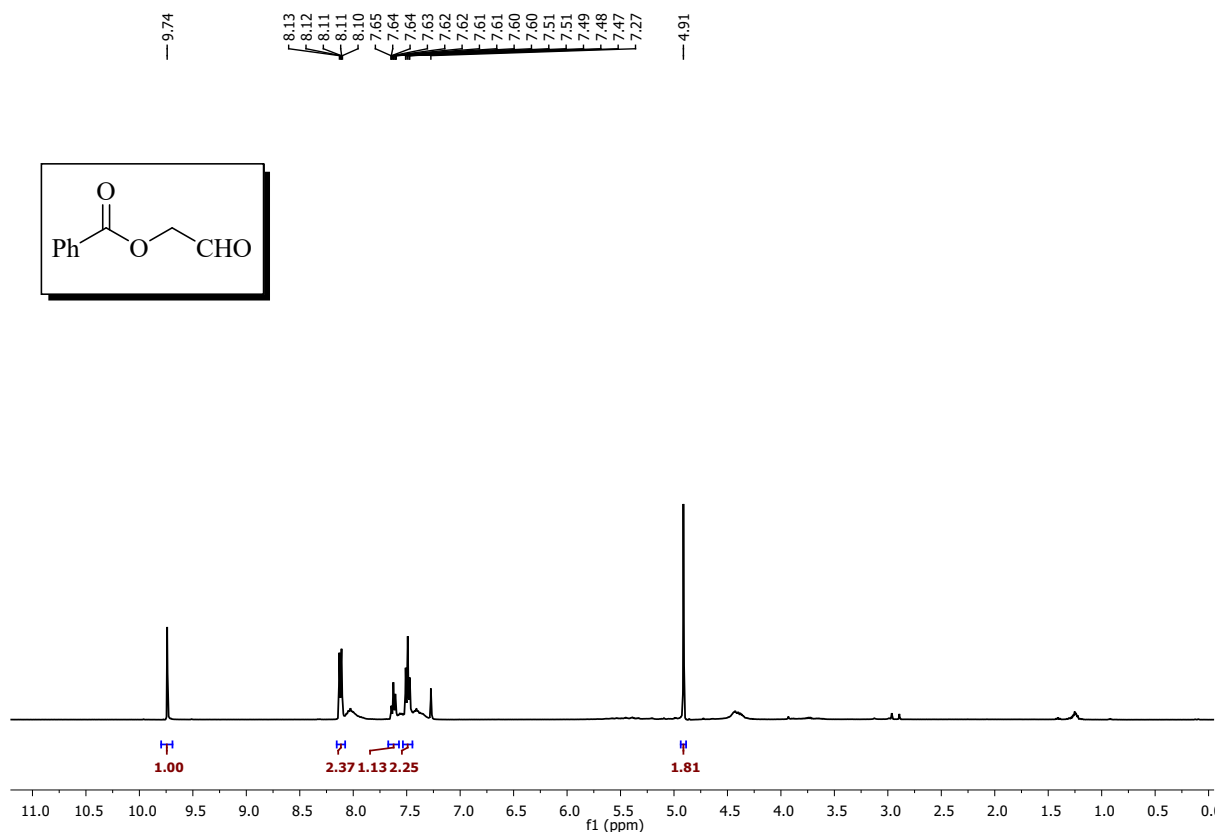
DEPT (150 MHz) NMR of goniobutenolide B (14) in CDCl₃



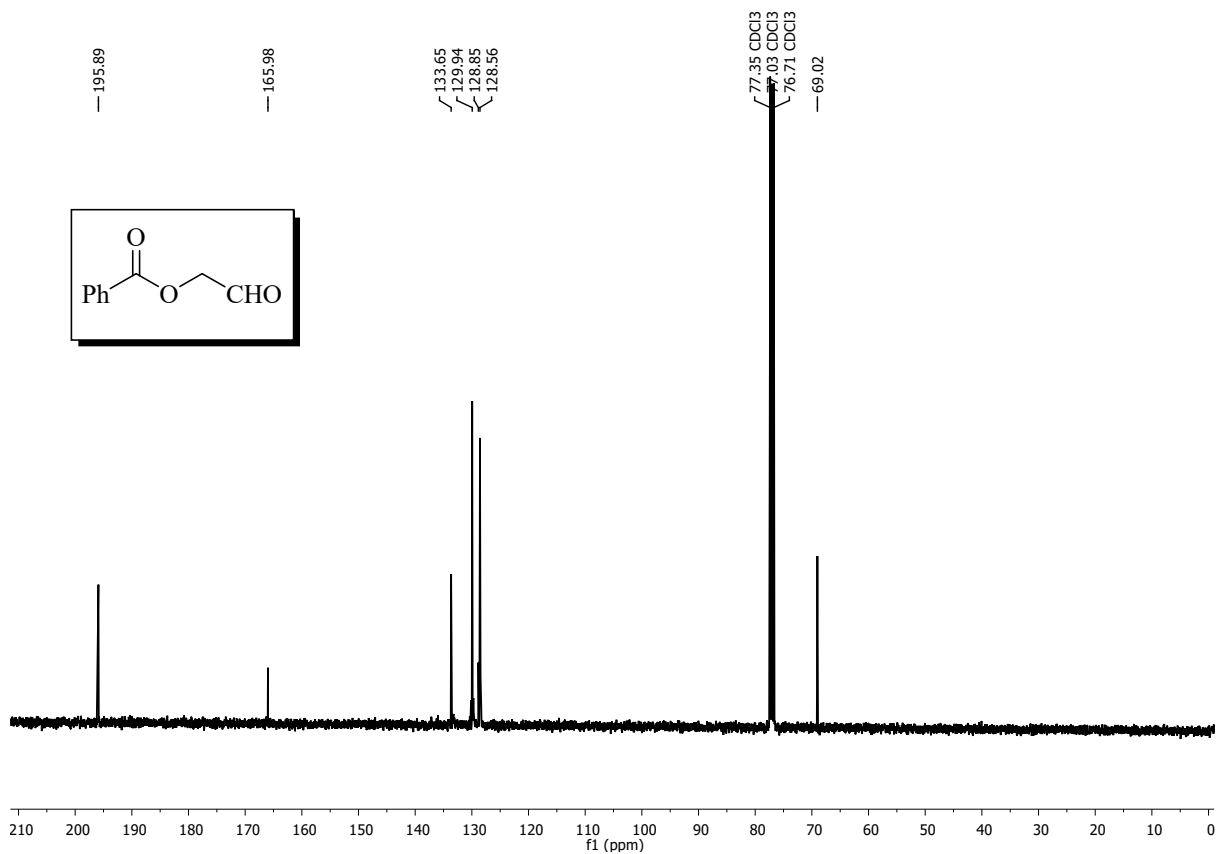
— 140.57
— 128.66
— 128.51
— 128.56
— 121.19
— 112.14
— 77.06
— 72.32



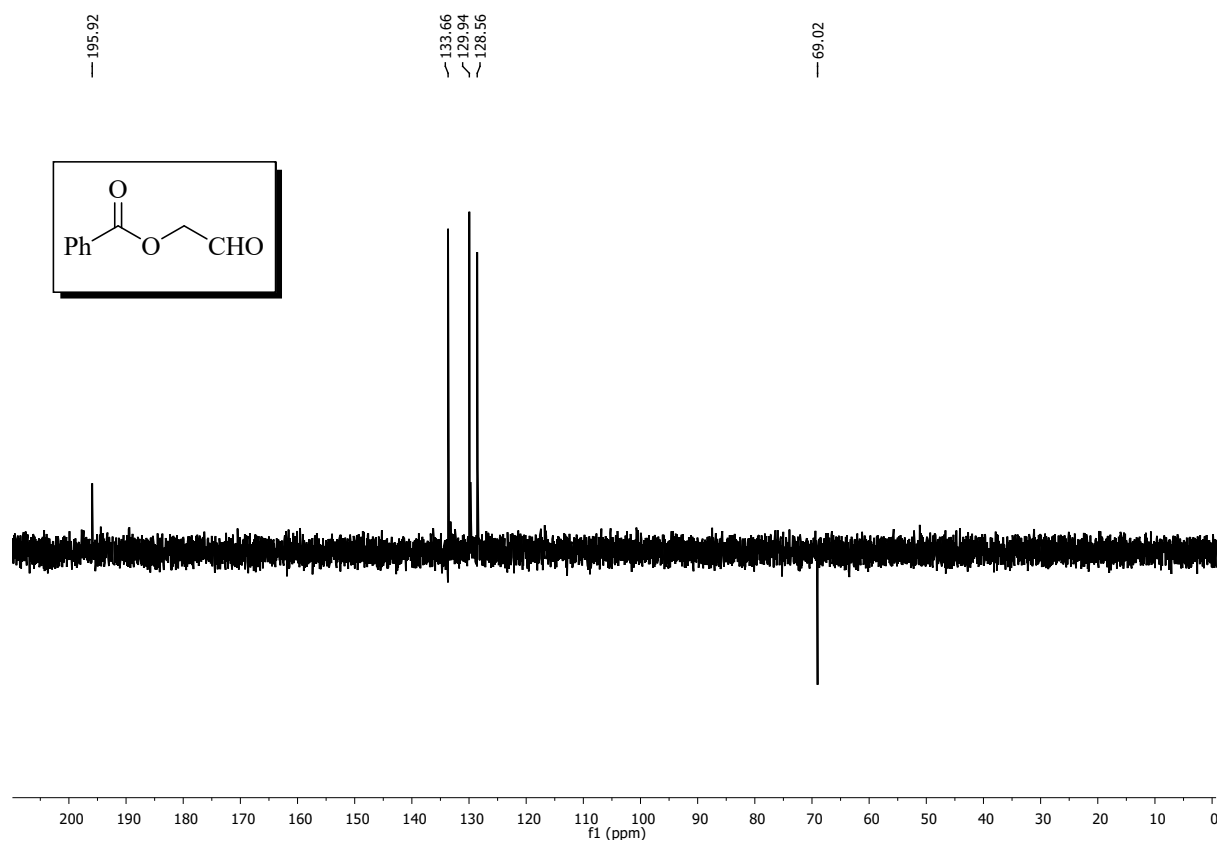
¹H (400 MHz) NMR of compound 26 in CDCl₃



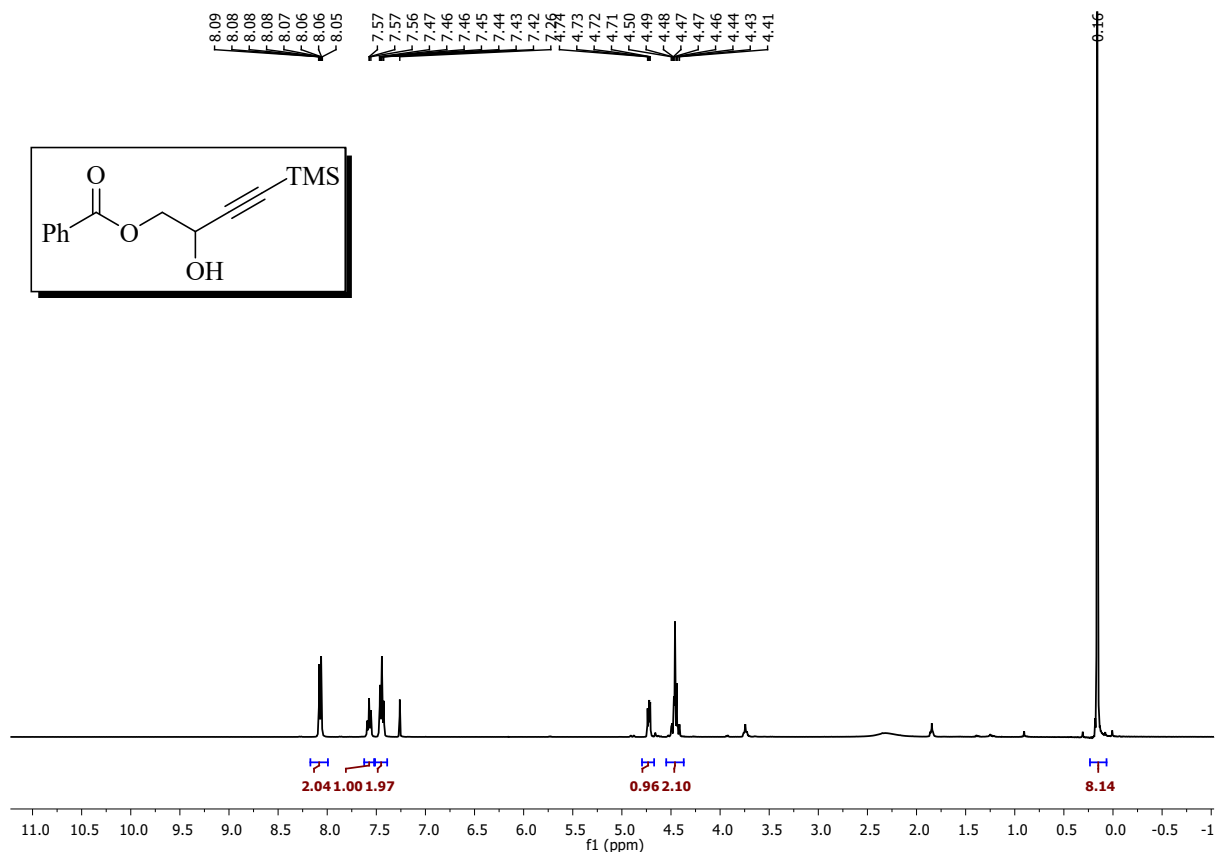
¹³C (100 MHz) NMR of compound 26 in CDCl₃



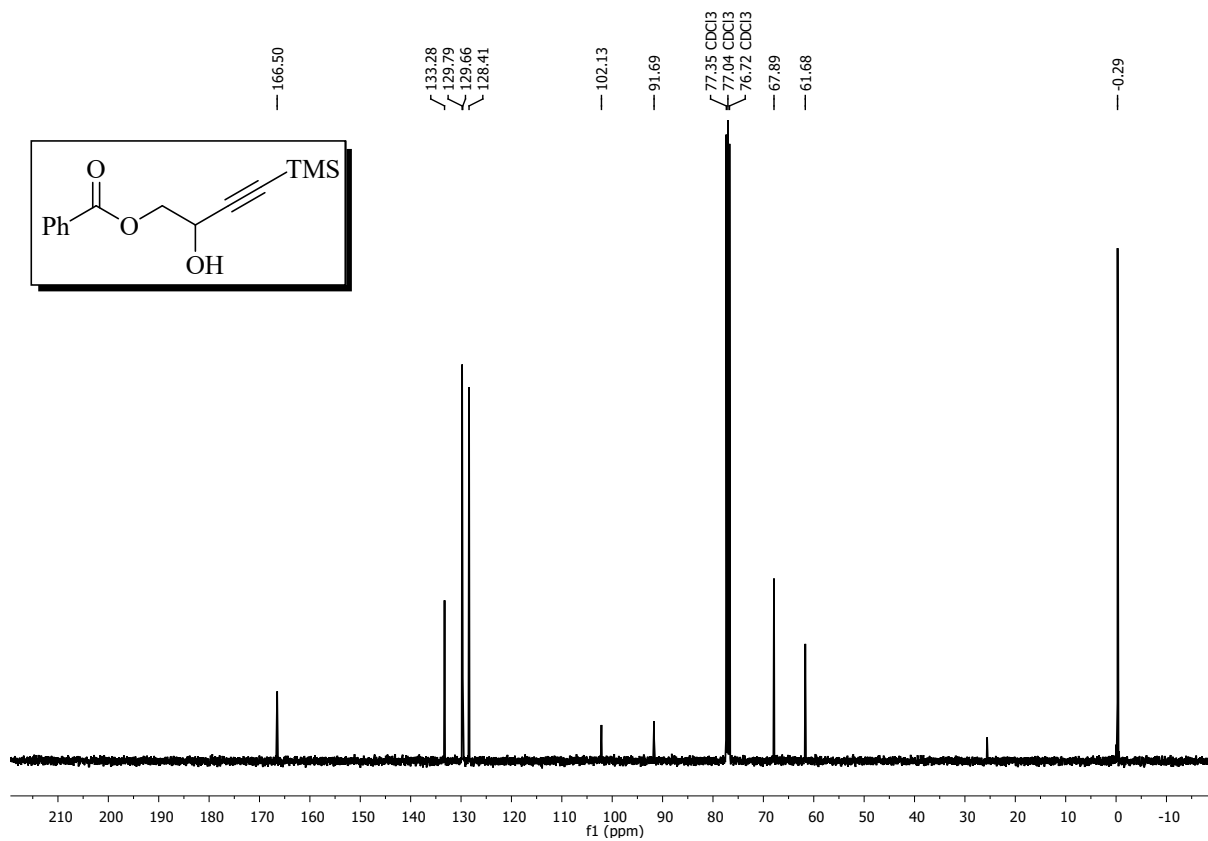
DEPT (100 MHz) NMR of compound 26 in CDCl₃



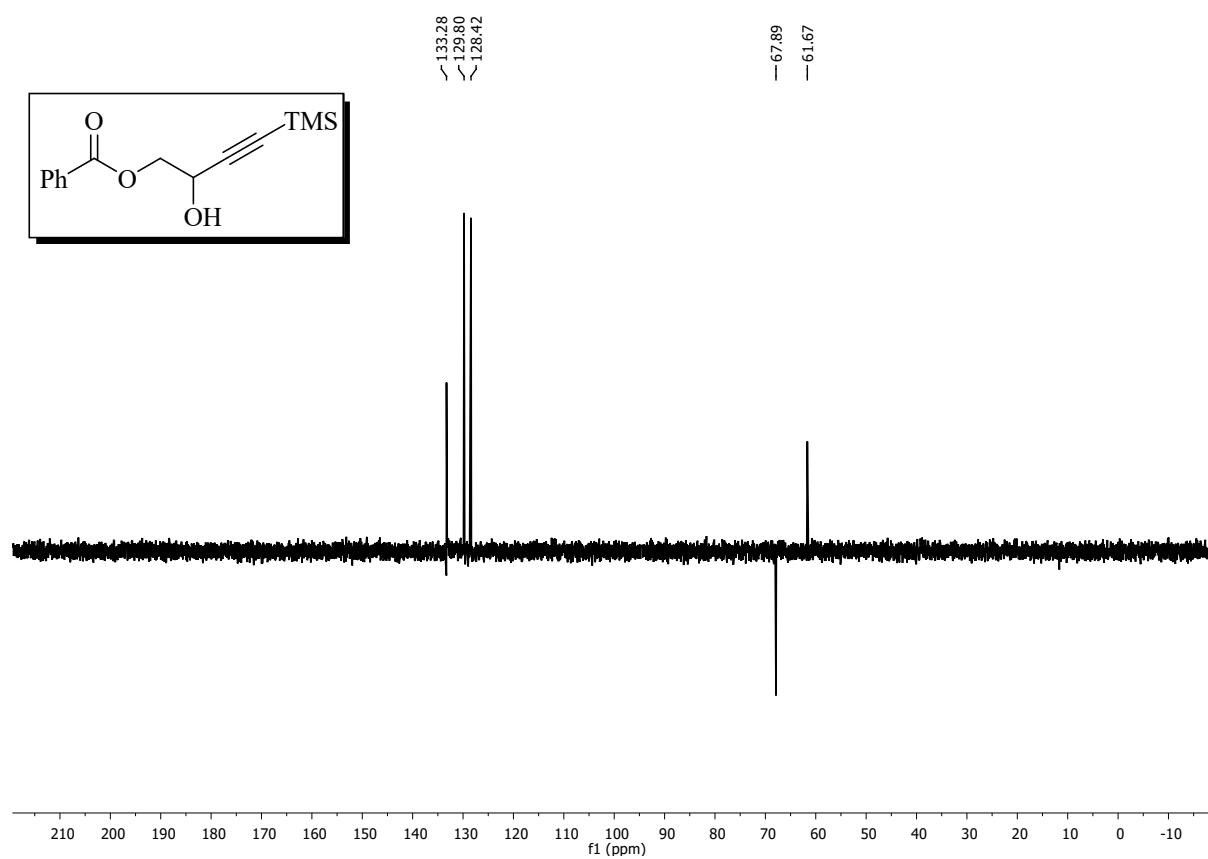
¹H (400 MHz) NMR of compound 27 in CDCl₃



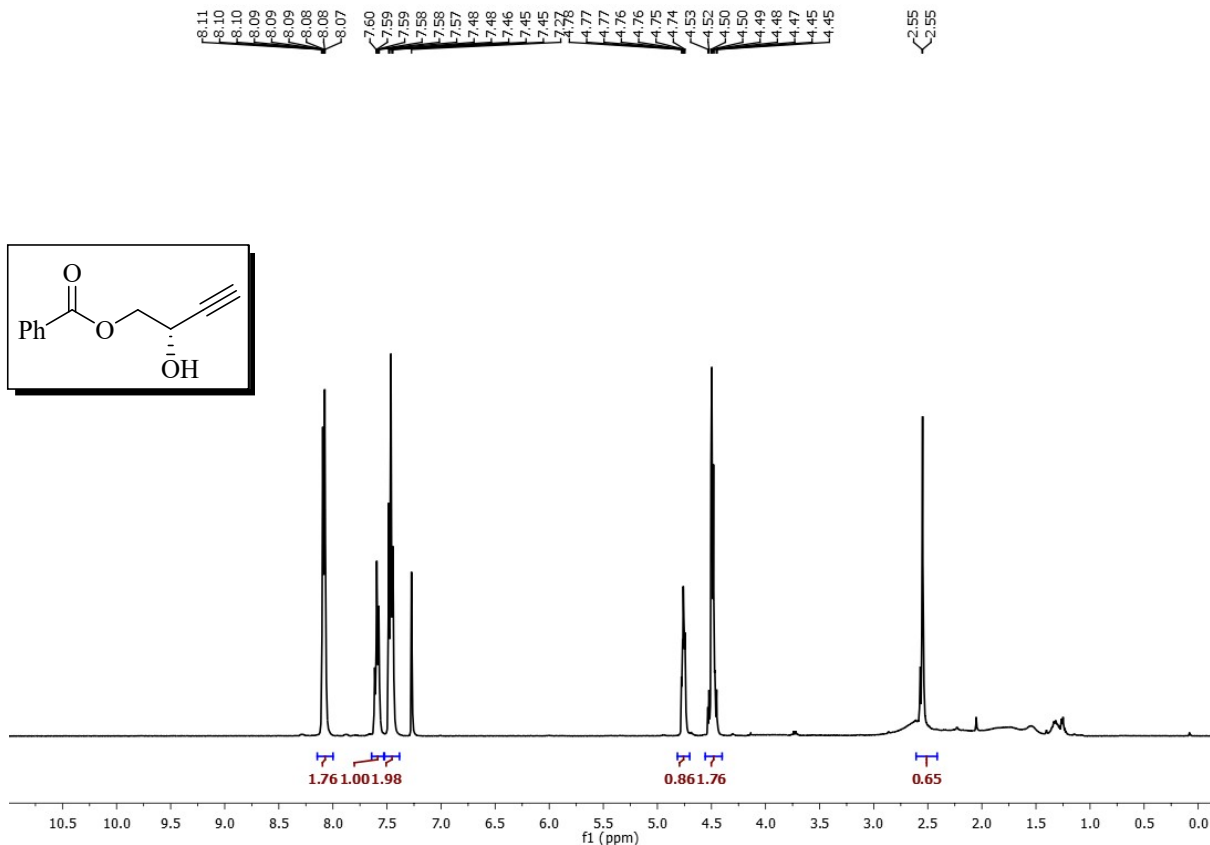
¹³C (100 MHz) NMR of compound 27 in CDCl₃



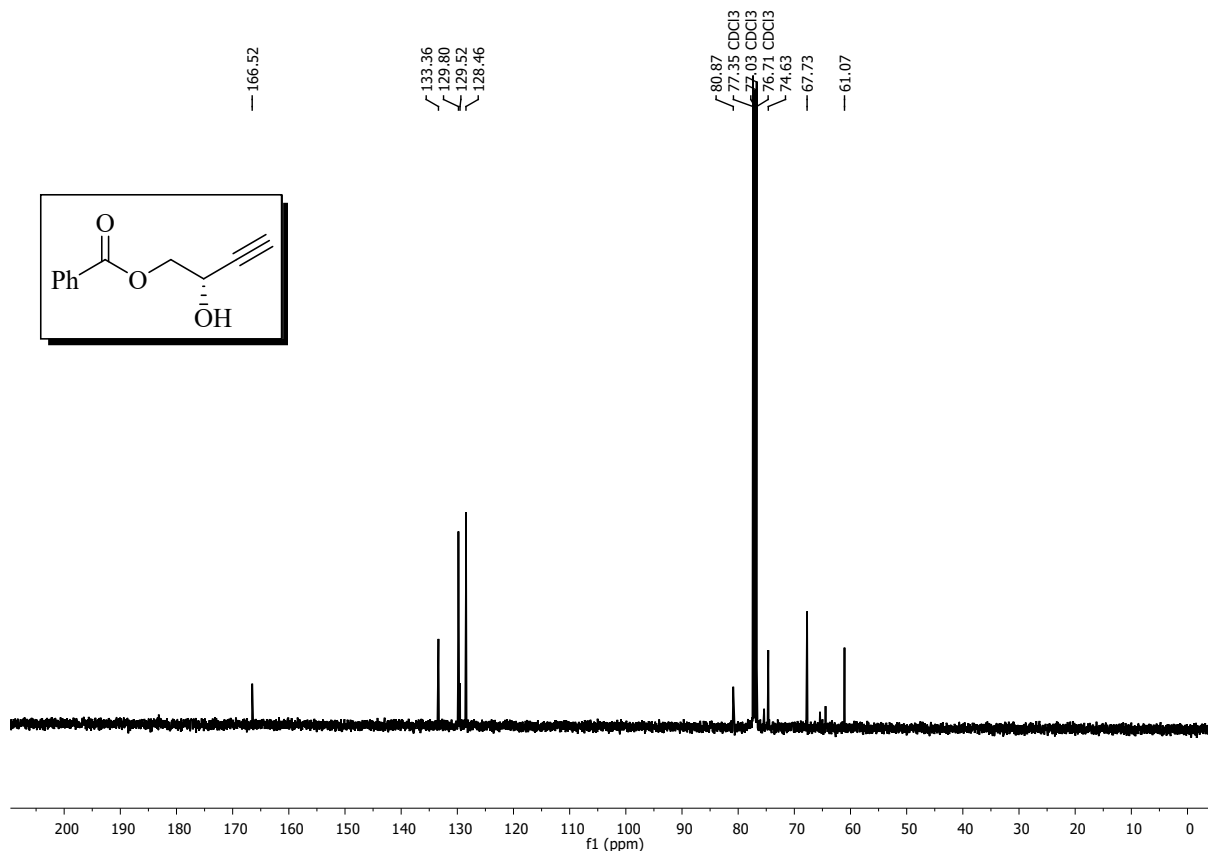
DEPT (100 MHz) NMR of compound 27 in CDCl₃



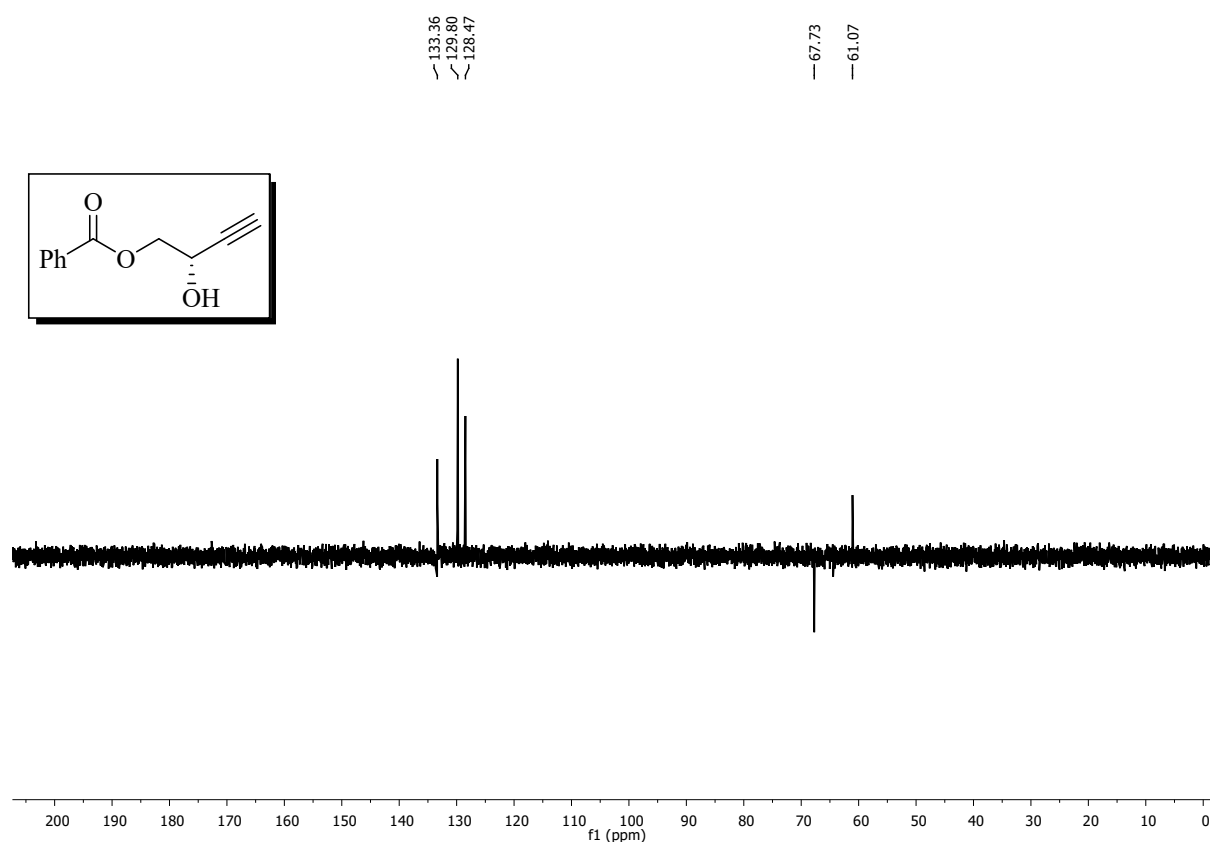
¹H (400 MHz) NMR of compound (S)-25 in CDCl₃



¹³C (100 MHz) NMR of compound (S)-25 in CDCl₃

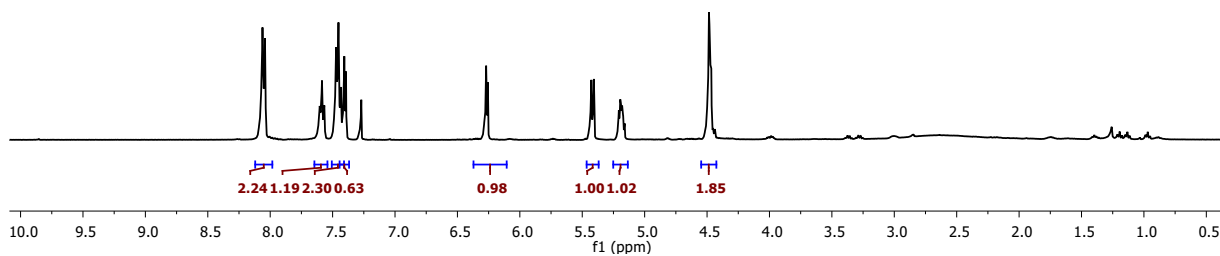
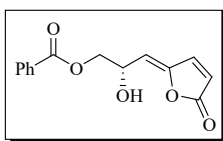


DEPT (100 MHz) NMR of compound (S)-25 in CDCl₃



¹H NMR of Z-melodorinol (24) (400 MHz, CDCl₃)

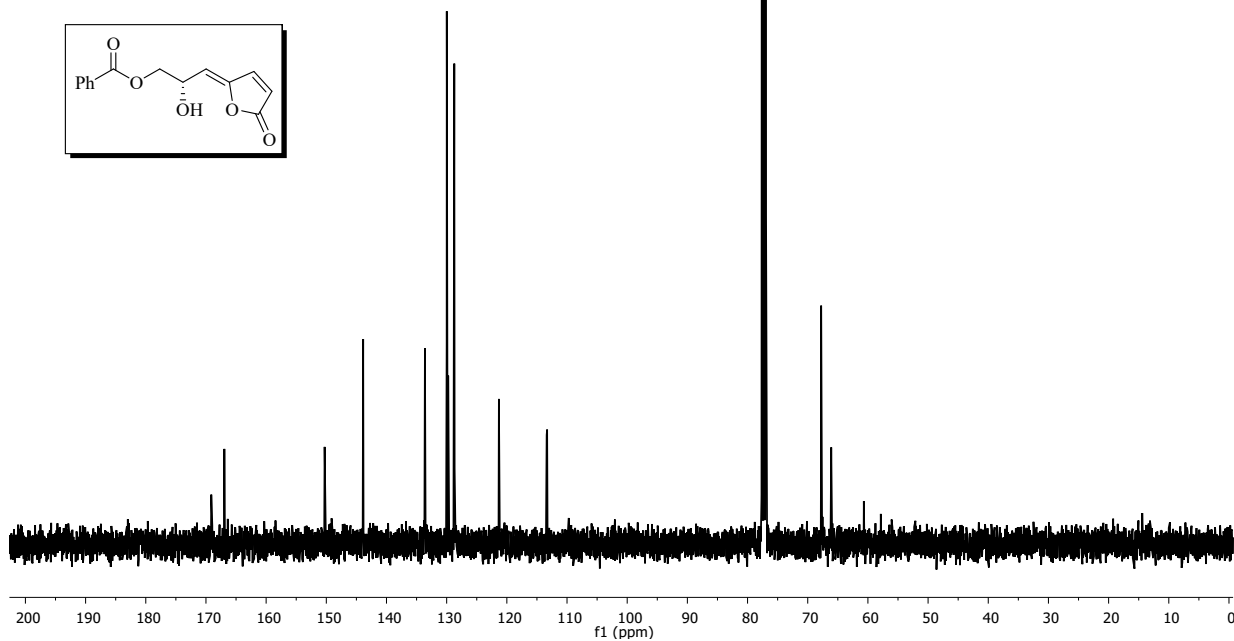
8.09
8.07
8.06
8.04
8.04
7.58
7.48
7.47
7.45
7.44
7.43
7.41
7.39
7.28
6.27
6.26
5.43
5.41
5.21
5.20
5.19
5.18
5.18
4.50
4.49
4.48
4.47
4.47



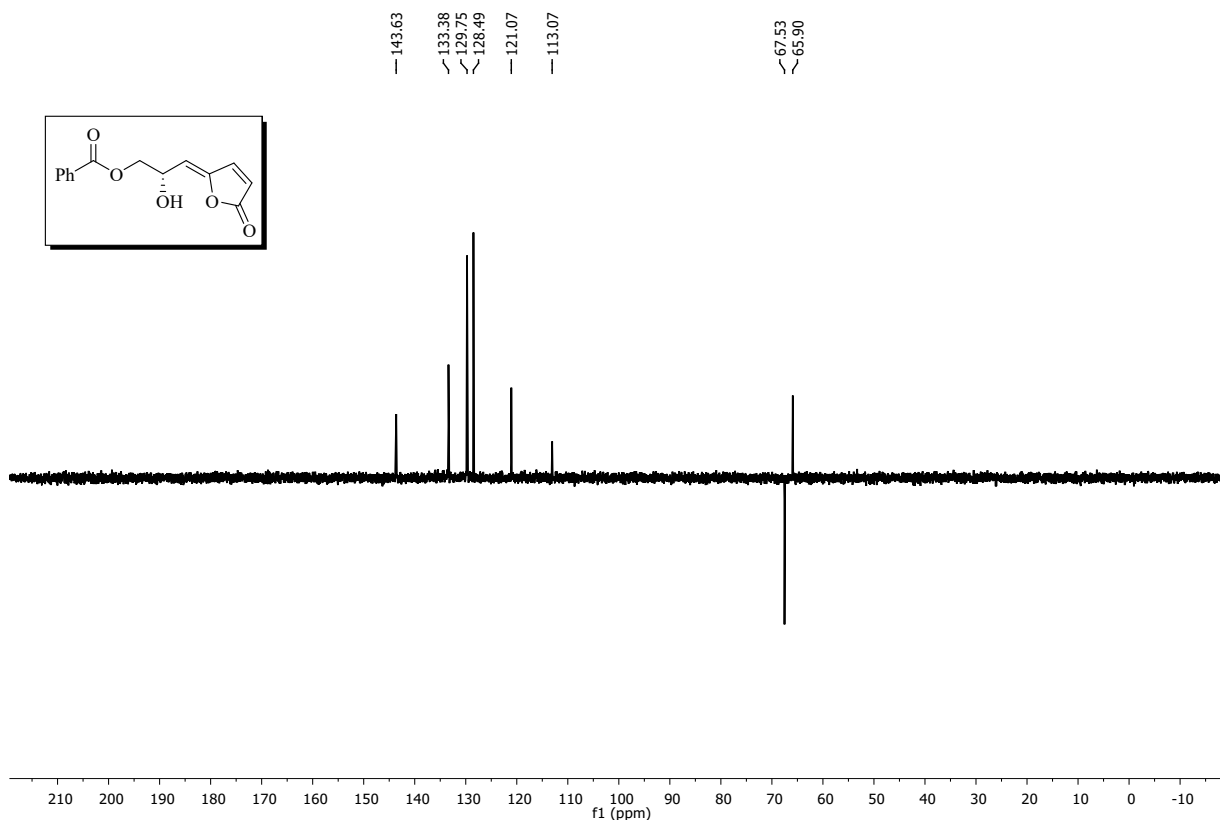
¹³C NMR of Z-melodorinol (24) (100 MHz, CDCl₃)

169.12
166.94
150.28
143.87
133.61
129.98
129.75
128.72
121.32
113.38

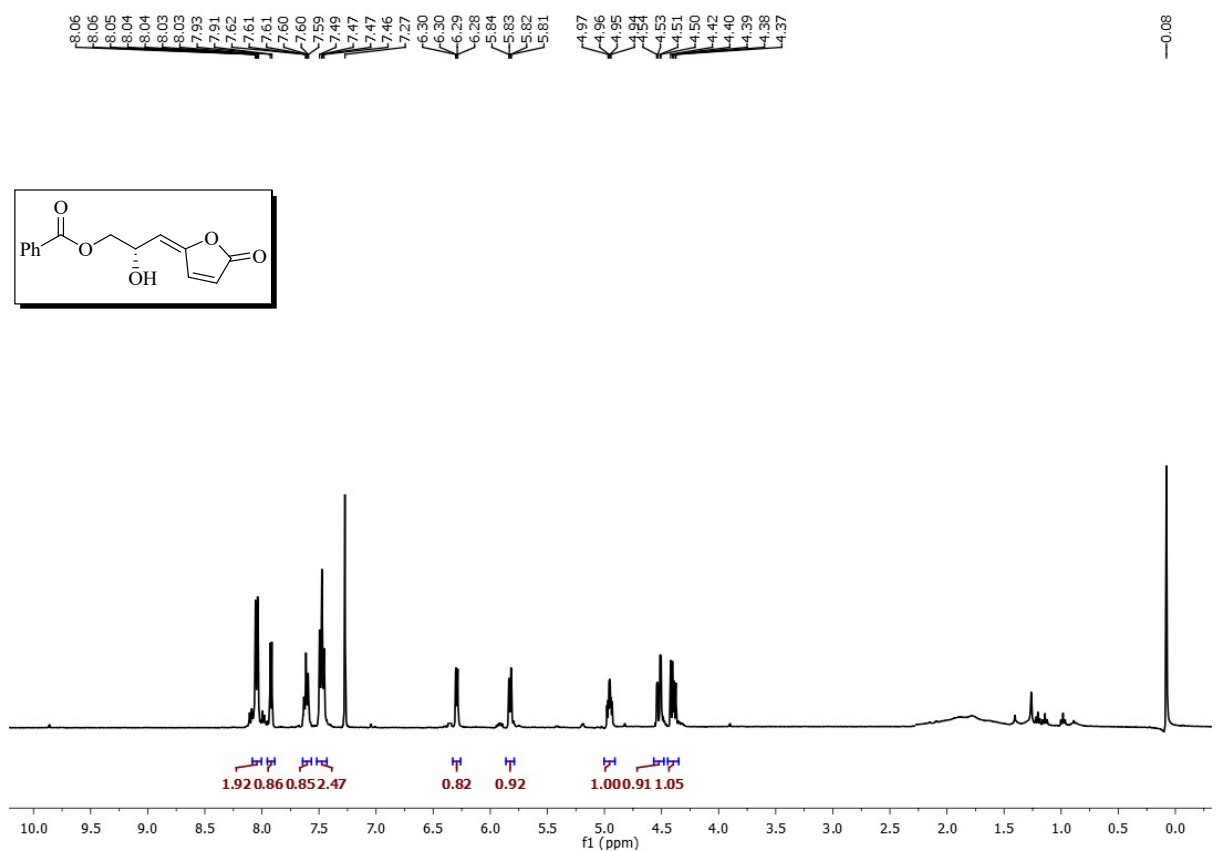
77.59 CDCl₃
77.56 CDCl₃
76.96 CDCl₃
67.76
66.10



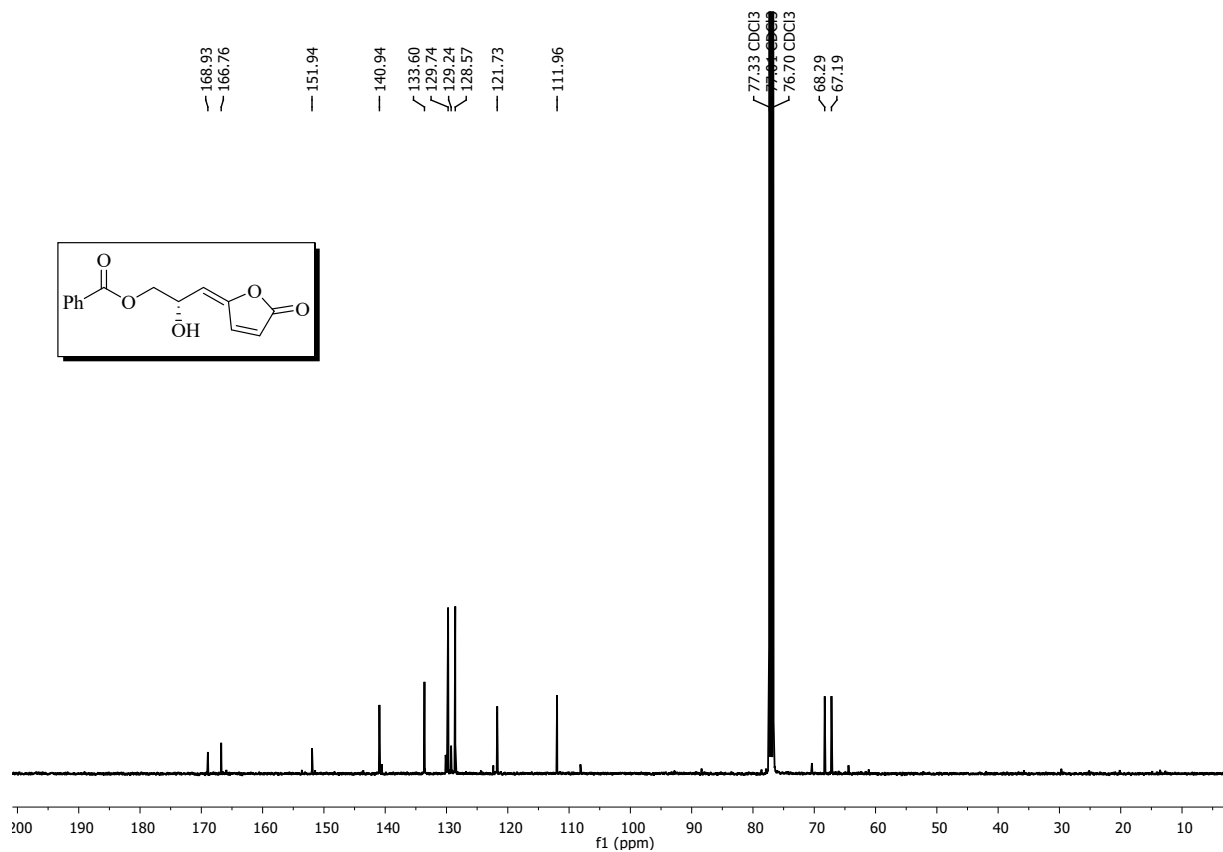
DEPT-135- NMR of Z-melodorinol (24) (100 MHz, CDCl₃)



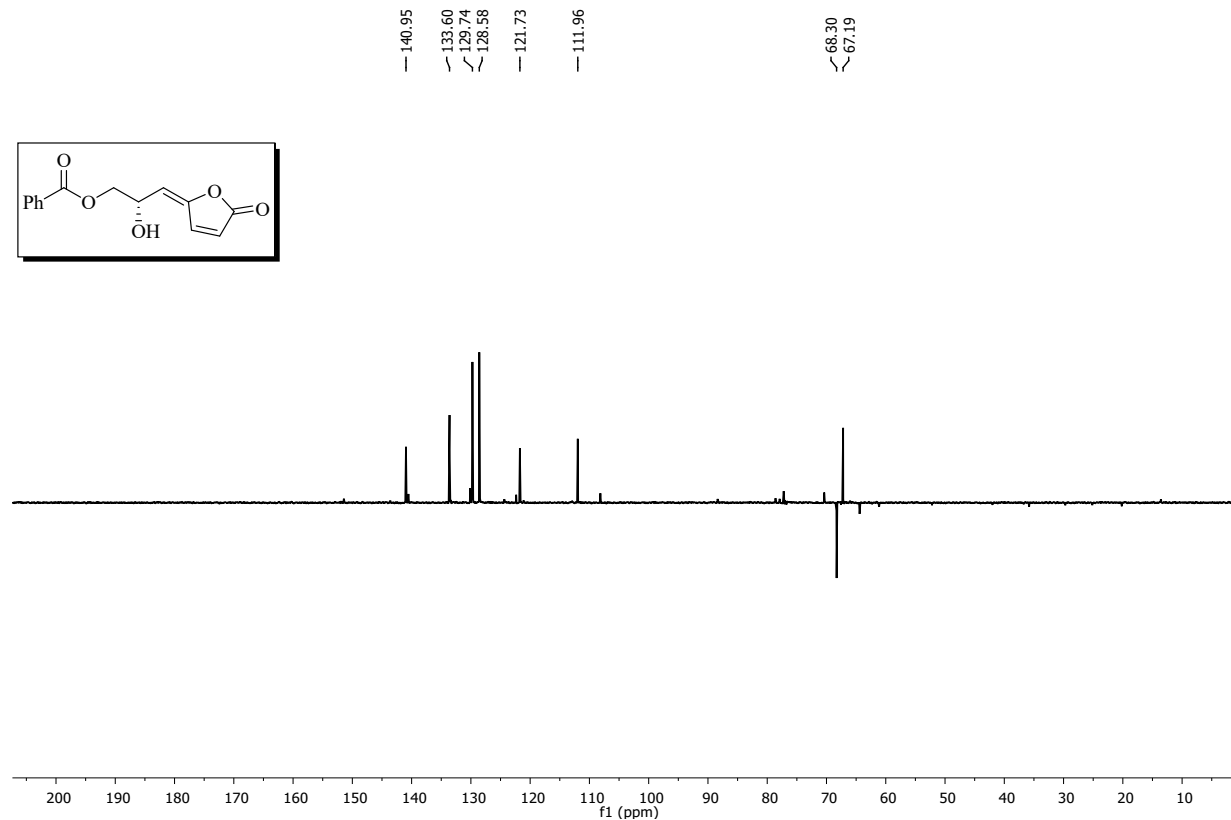
¹H NMR of *E*-melodorinol (23) (400 MHz, CDCl₃)



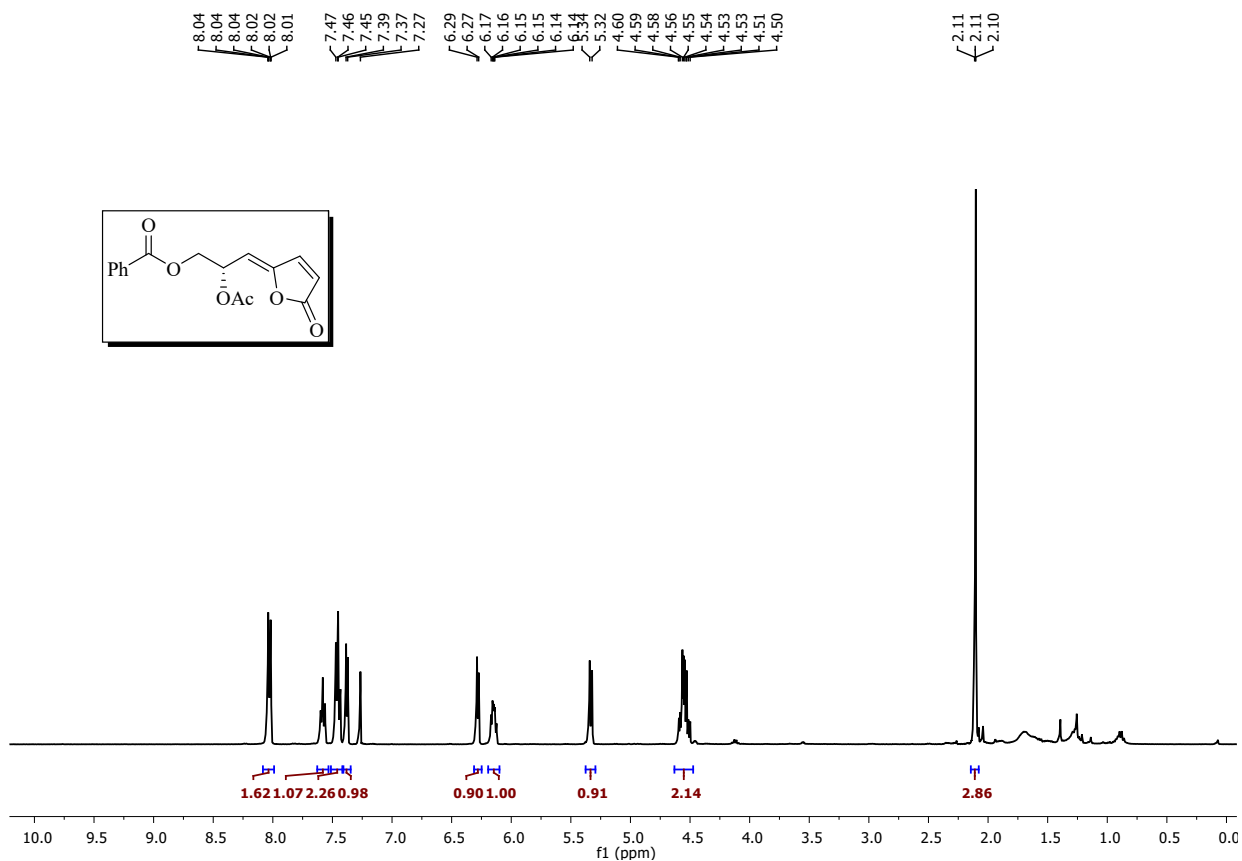
¹³C NMR of *E*-melodorinol (23) (100 MHz, CDCl₃)



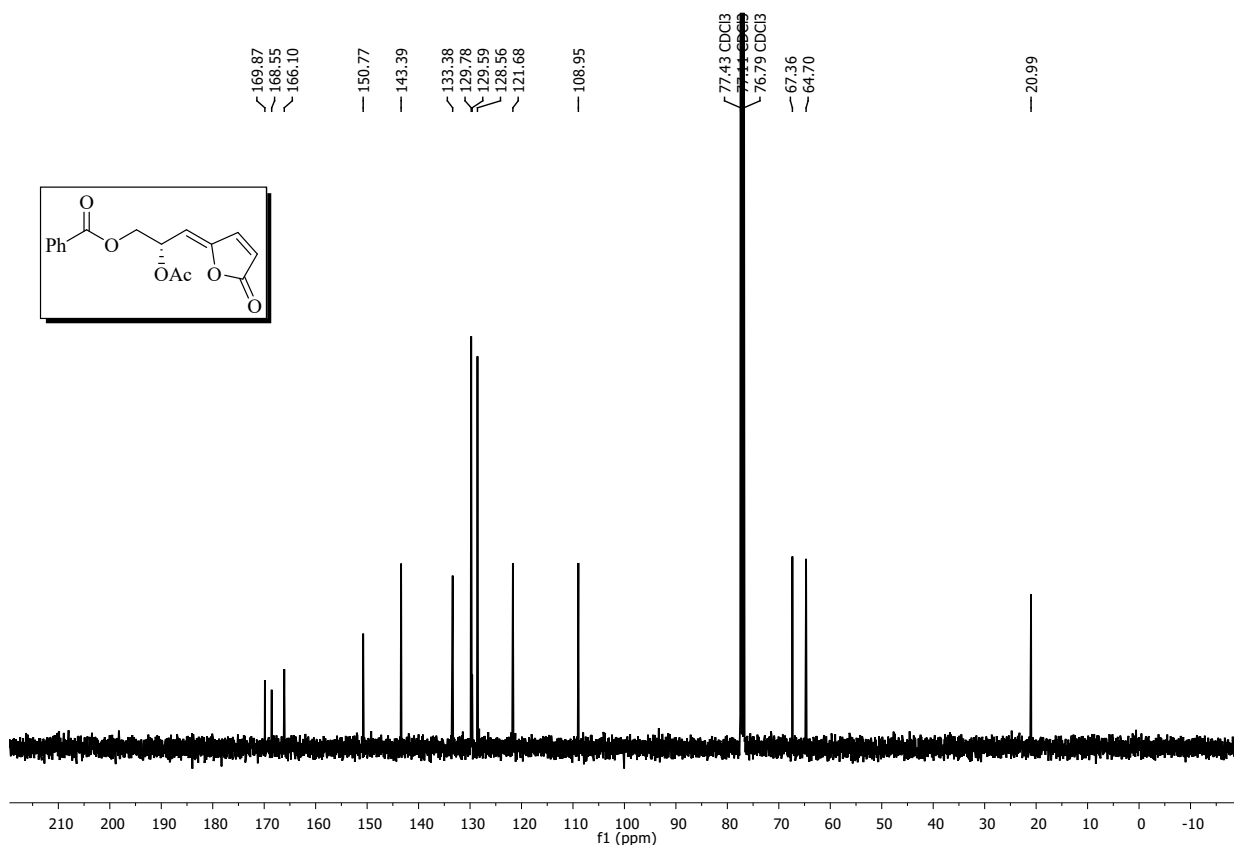
DEPT-135- NMR of *E*-melodorinol (23) (100 MHz, CDCl₃)



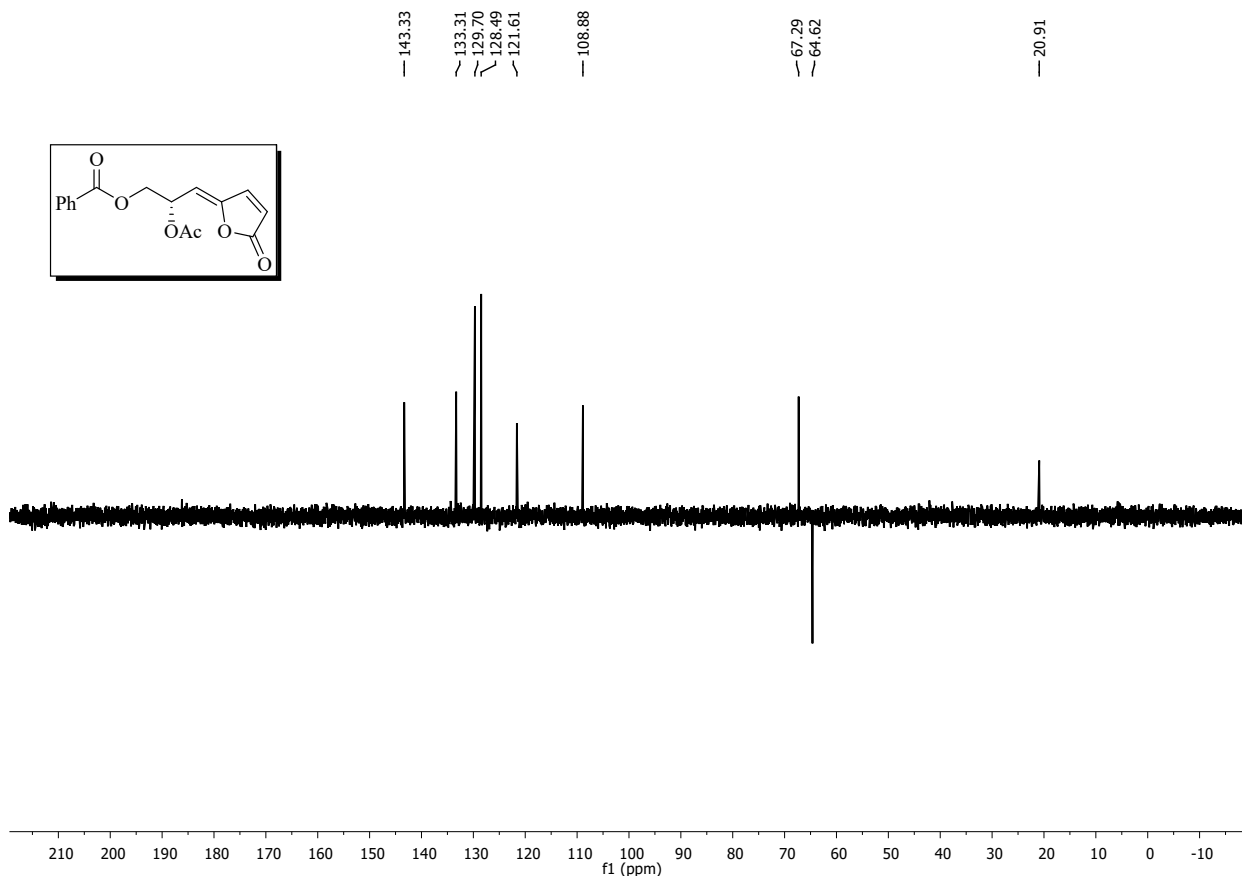
¹H NMR of *Z*-acetylmelodorinol (28) (400 MHz, CDCl₃)



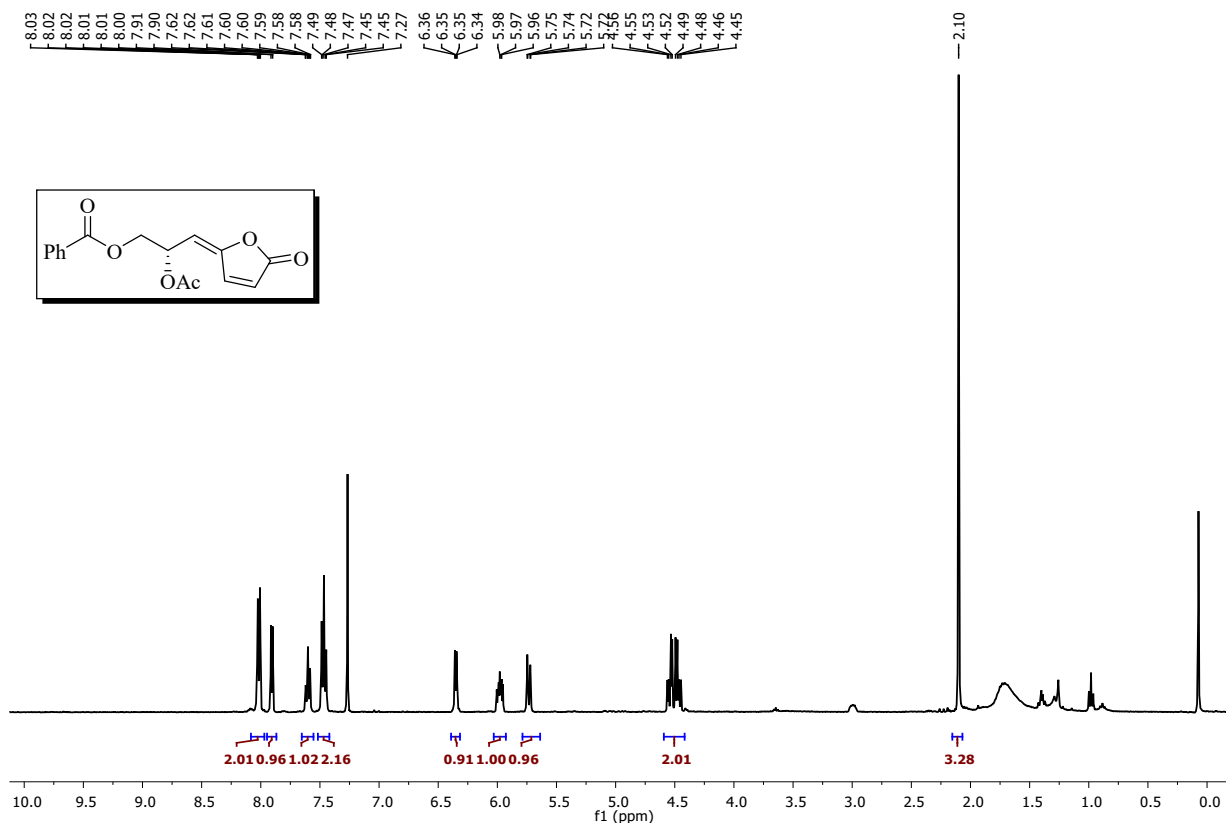
¹³C NMR of Z-acetylmelodorinol (28) (100 MHz, CDCl₃)



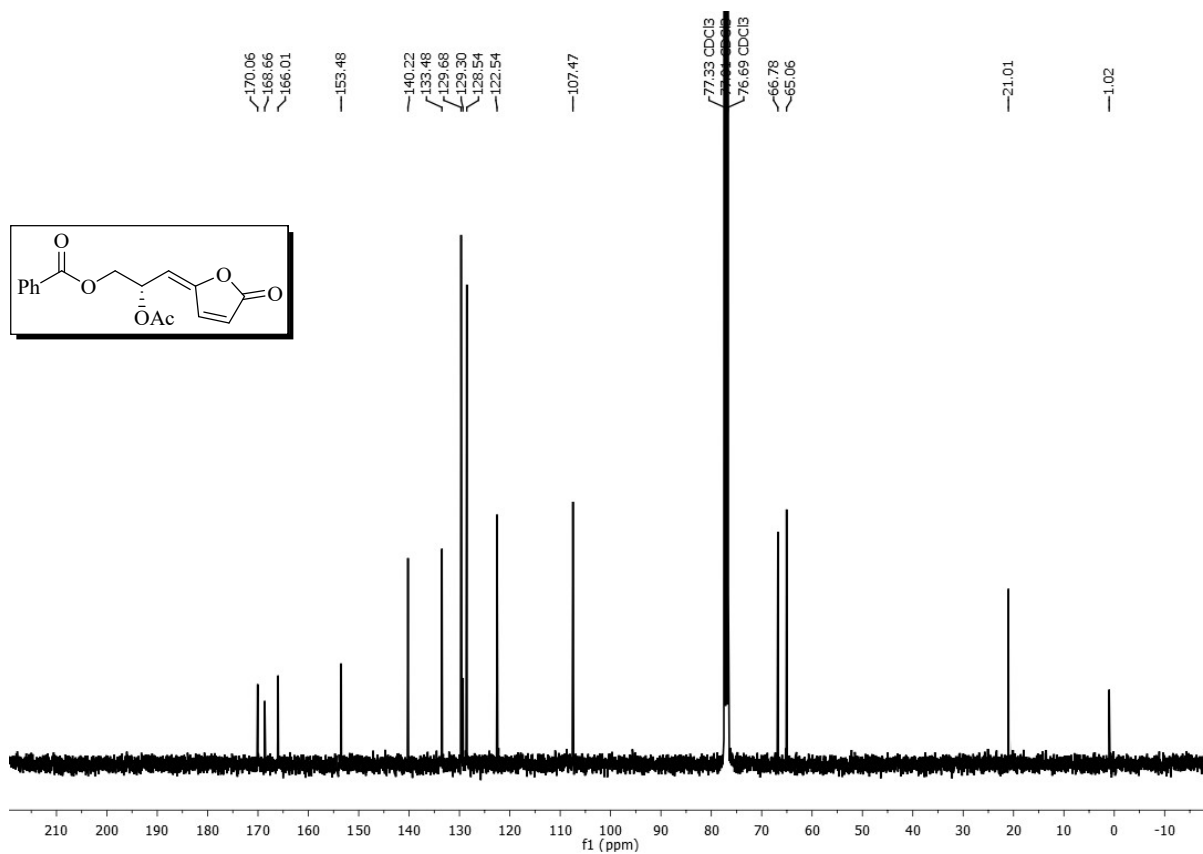
DEPT-135- NMR of Z-acetylmelodorinol (28) (100 MHz, CDCl₃)



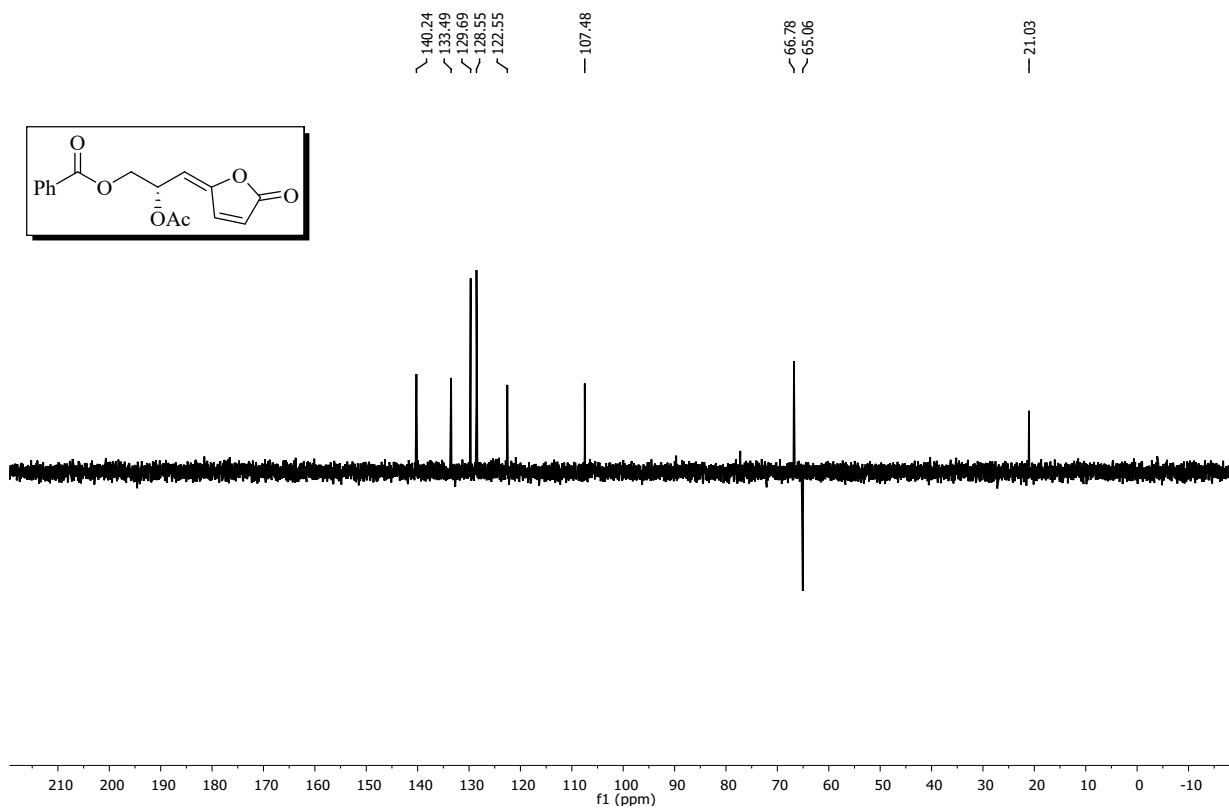
¹H NMR of *E*-acetylmelodorinol (22) (400 MHz, CDCl₃)



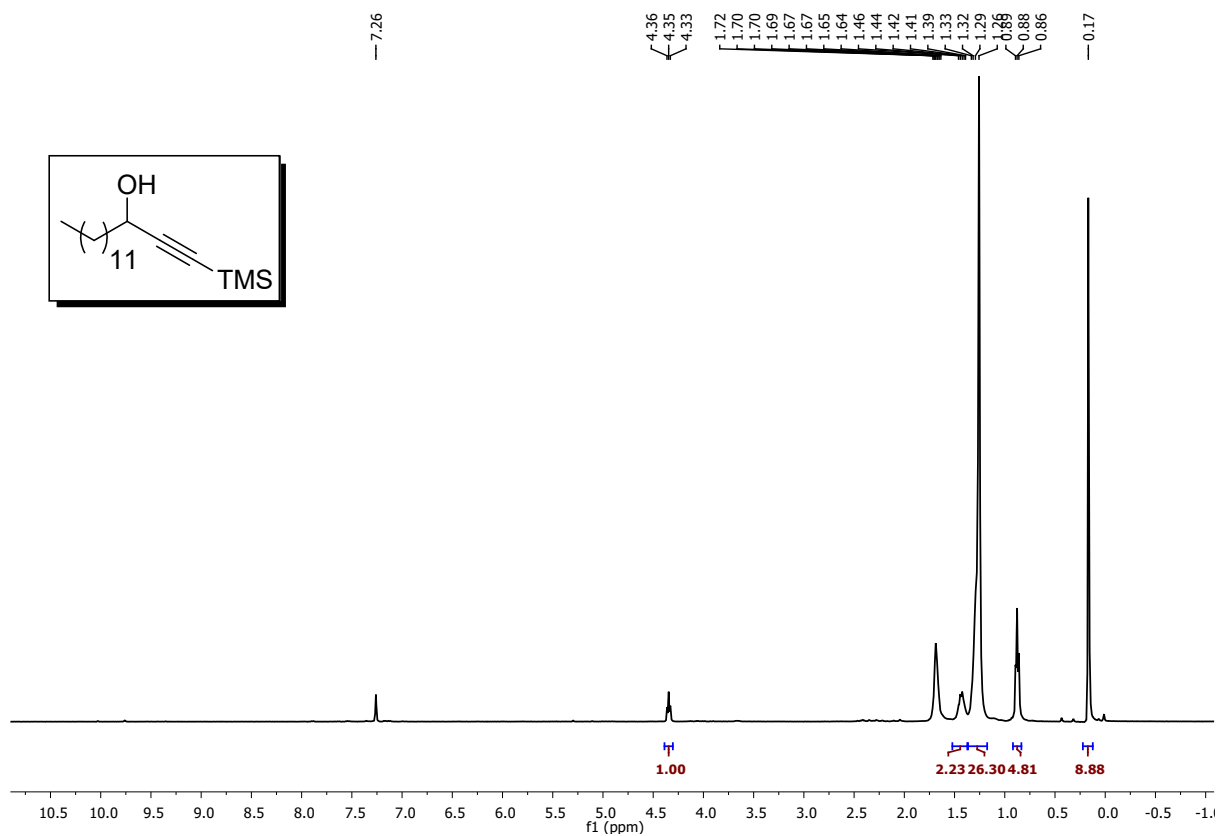
¹³C NMR of *E*-acetylmelodorinol (22) (100 MHz, CDCl₃)



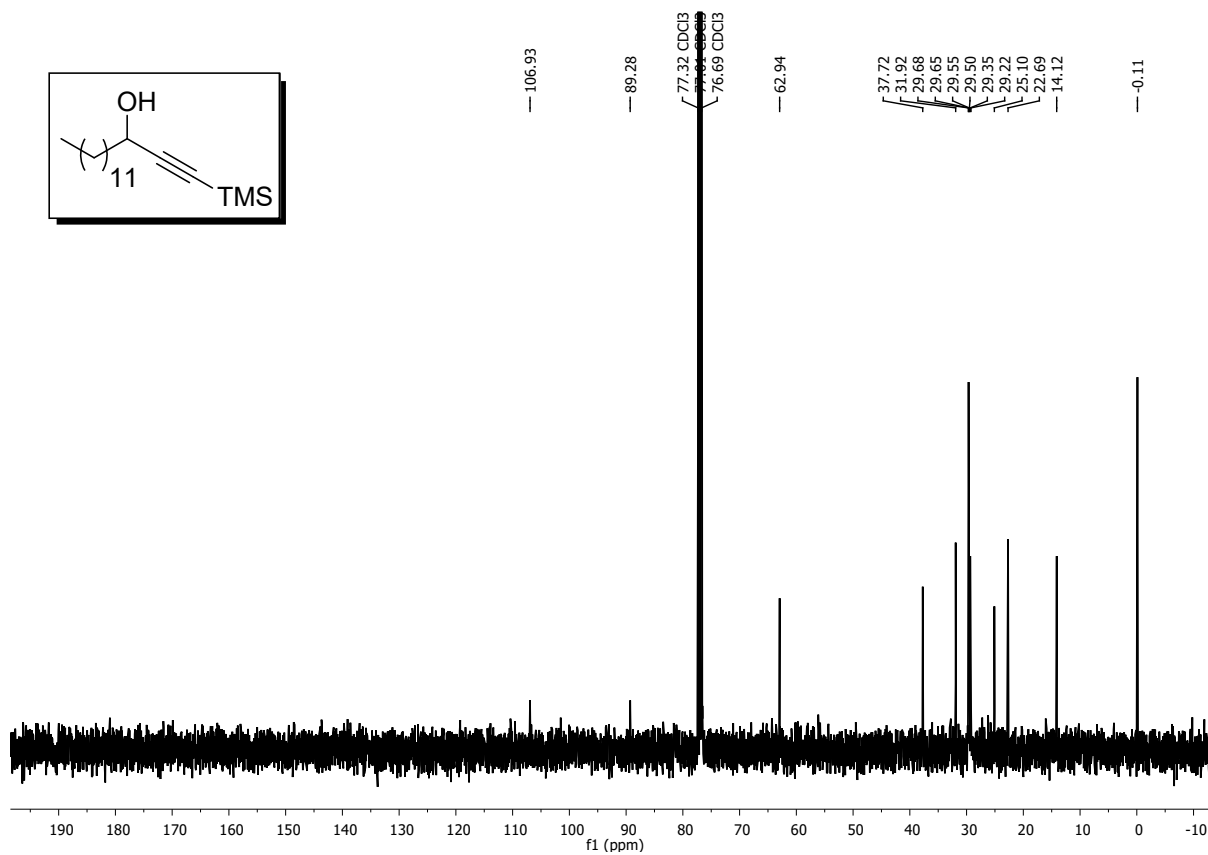
DEPT-135- NMR of *E*-acetylmelodorinol (22) (100 MHz, CDCl₃)



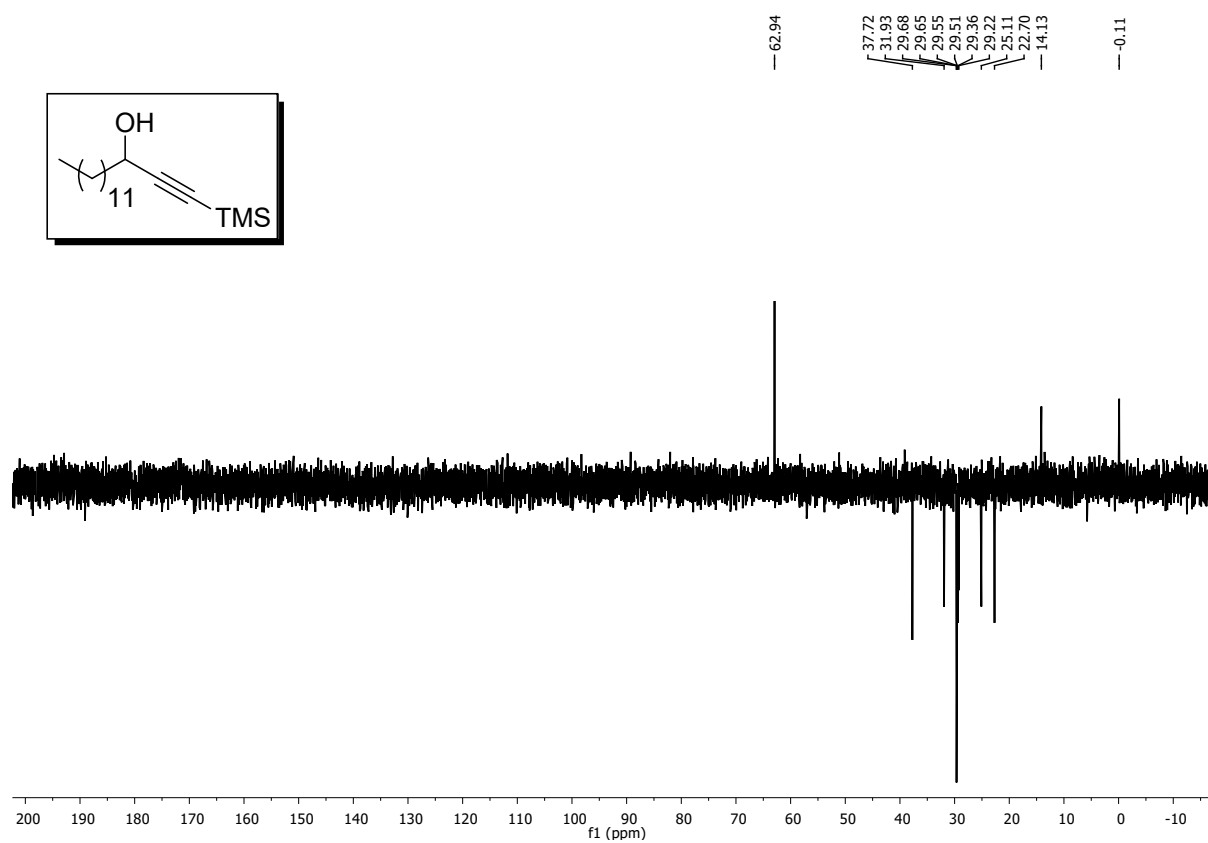
¹H (400 MHz) NMR of compound 32 in CDCl₃



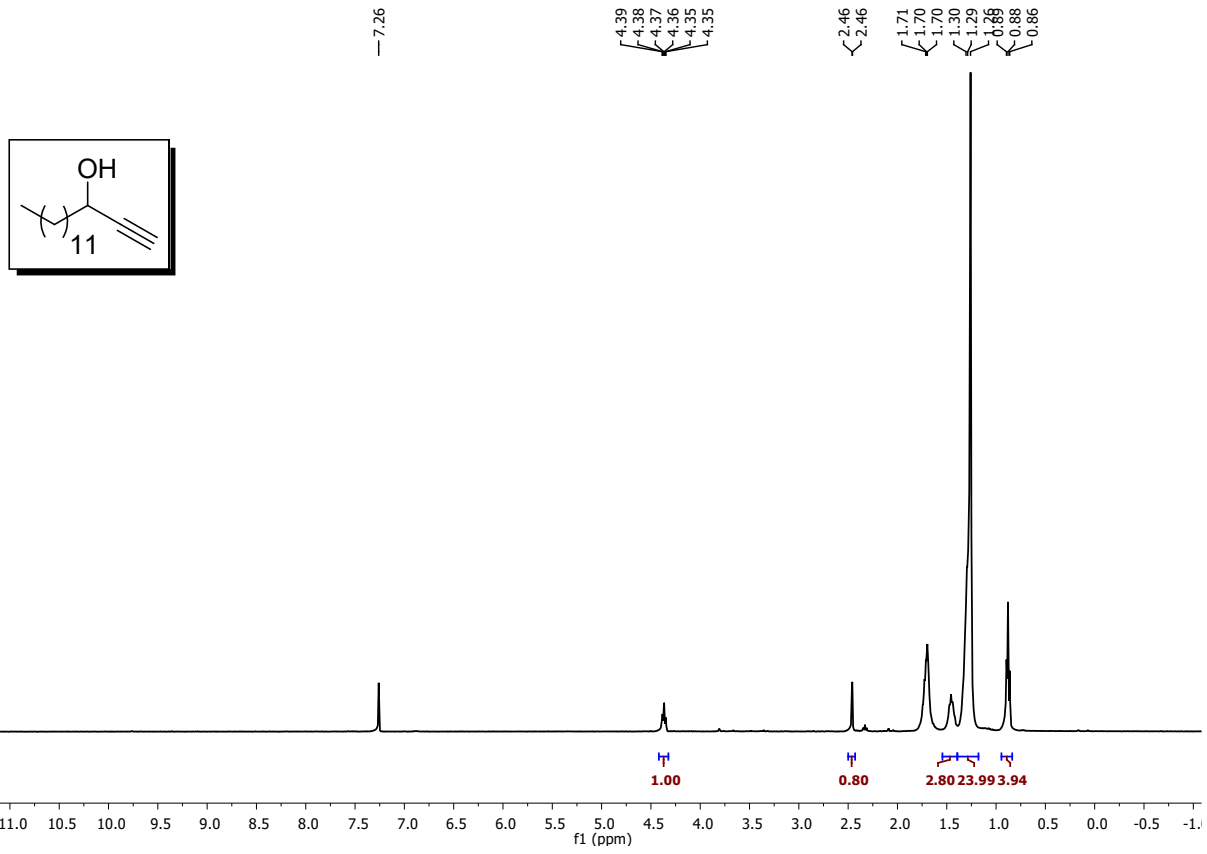
¹³C (100 MHz) NMR of compound 32 in CDCl₃



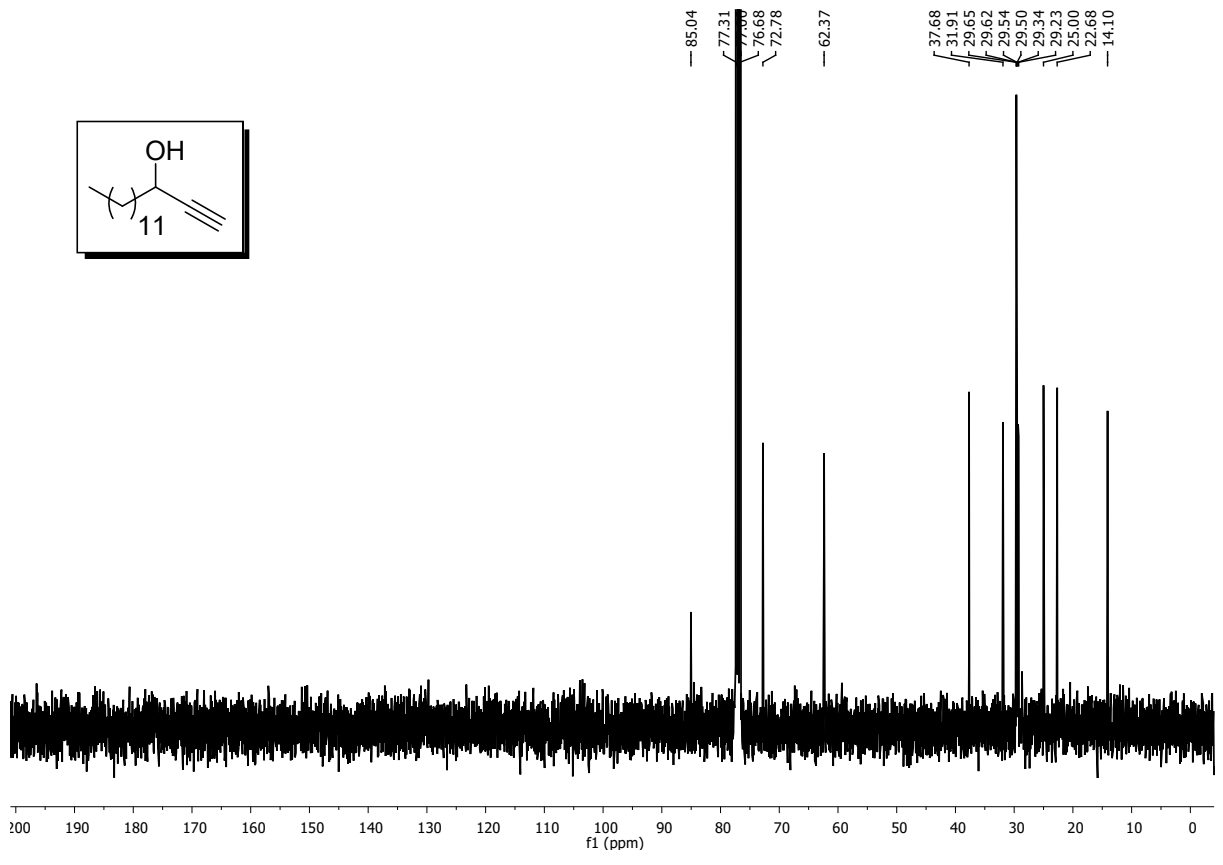
DEPT (100 MHz) NMR of compound 32 in CDCl₃



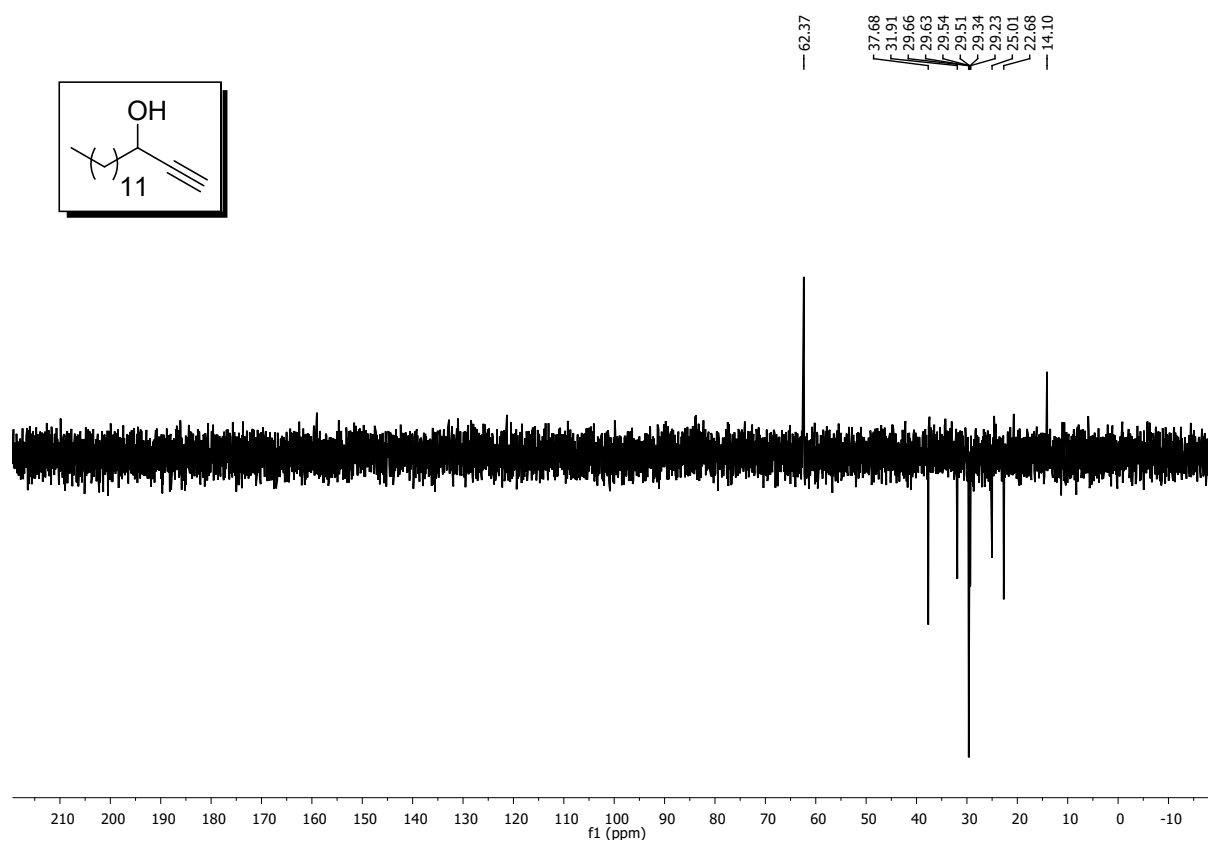
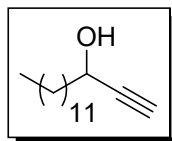
¹H (400 MHz) NMR of compound 31 in CDCl₃



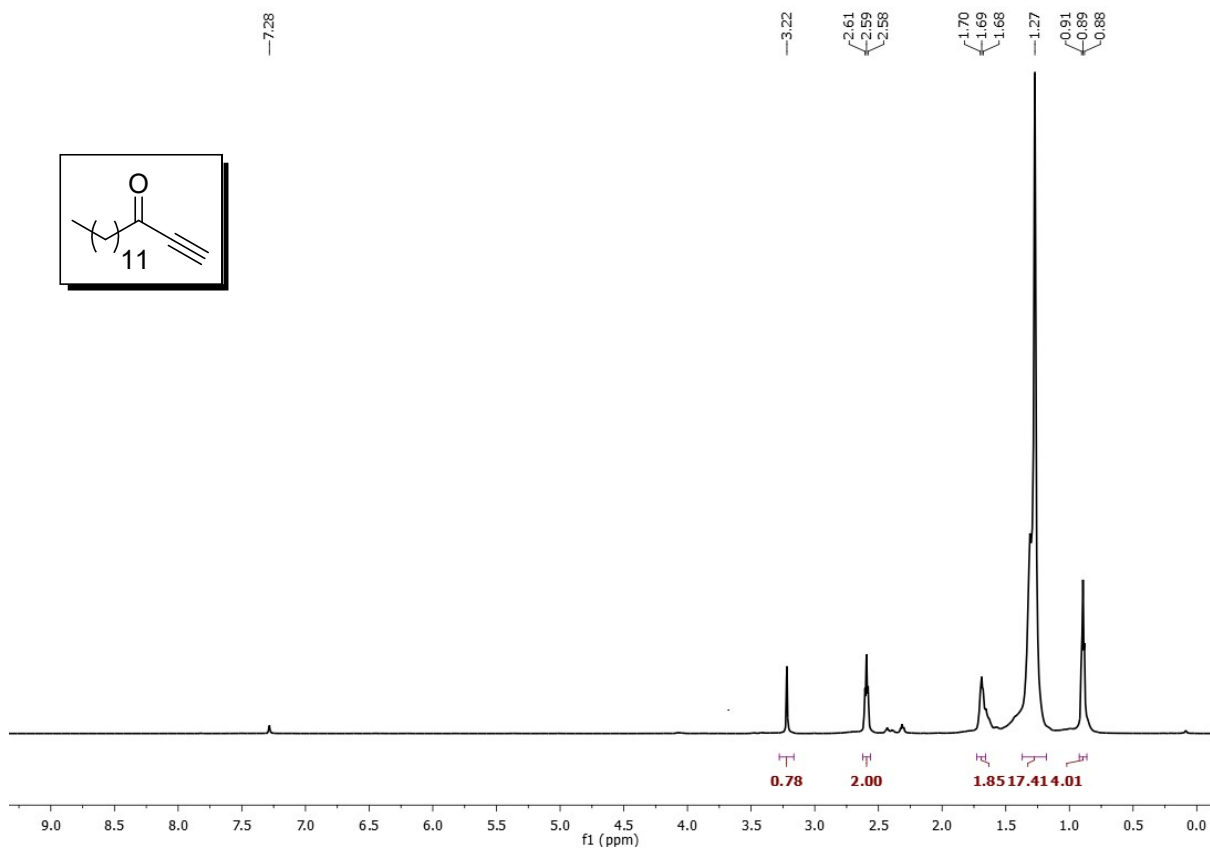
^{13}C (100 MHz) NMR of compound 31 in CDCl_3



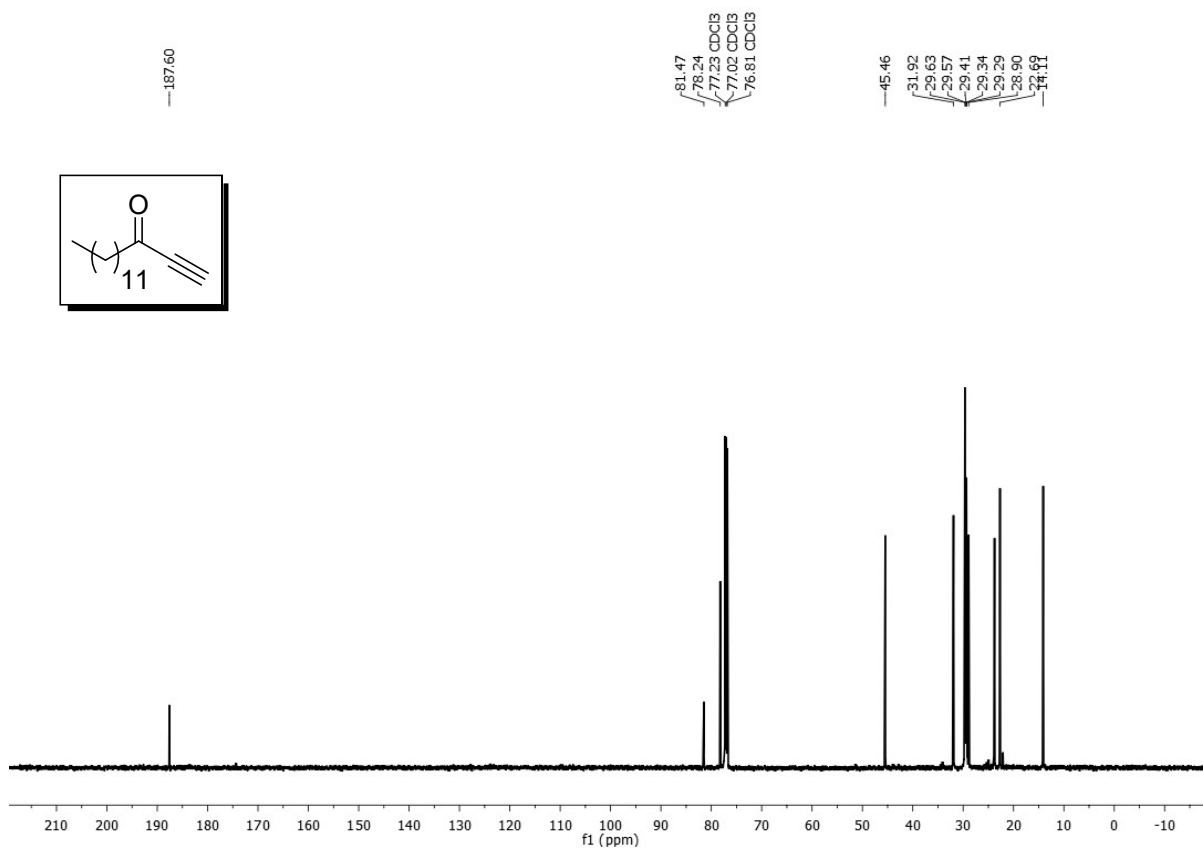
DEPT (100 MHz) NMR of compound 31 in CDCl₃



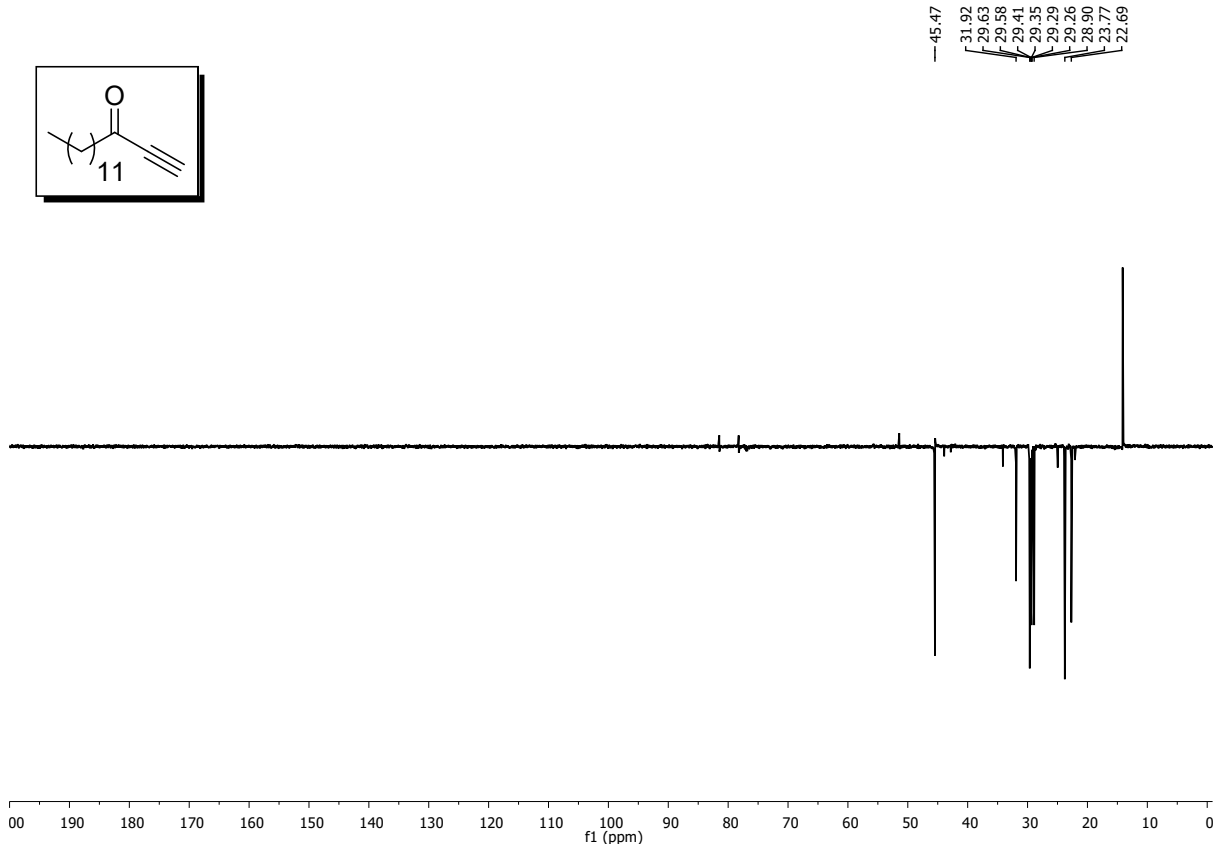
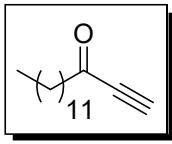
¹H (600 MHz) NMR of compound 34 in CDCl₃



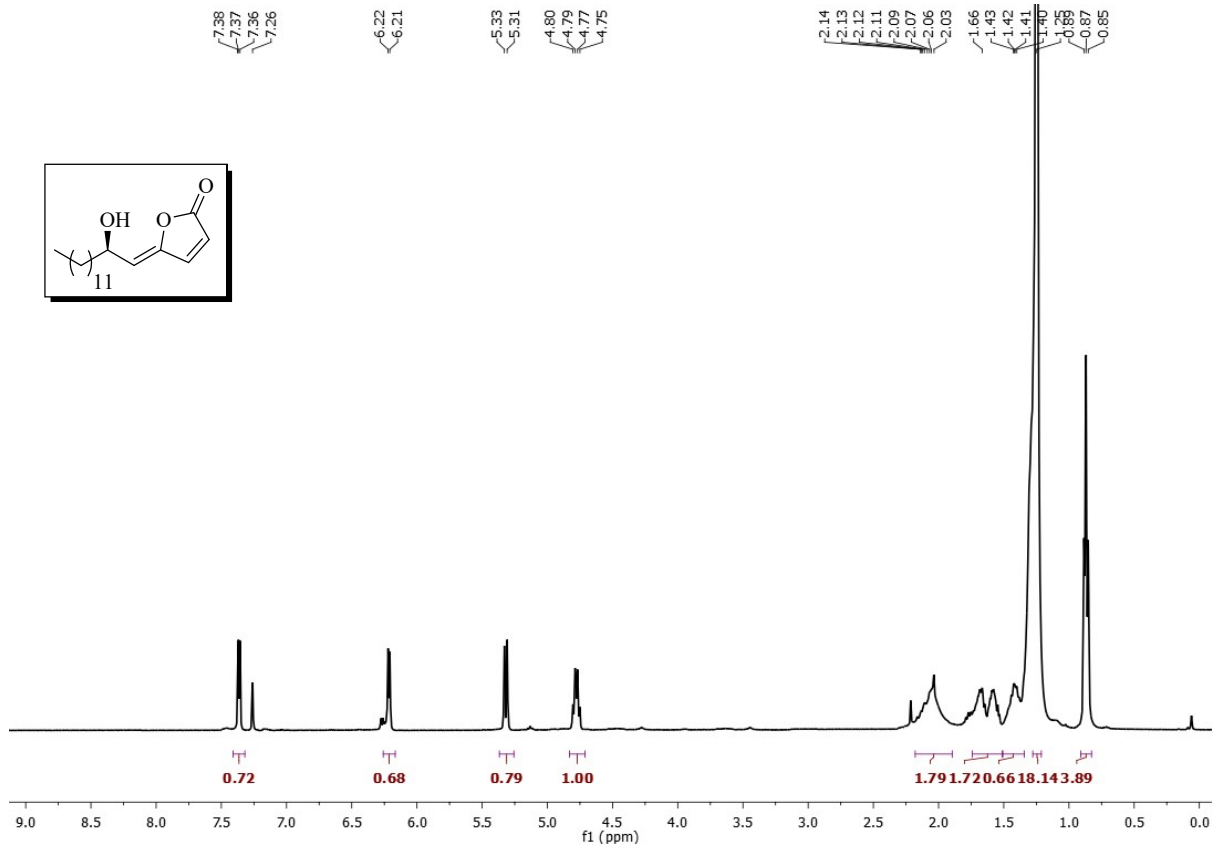
^{13}C (150 MHz) NMR of compound 34 in CDCl_3



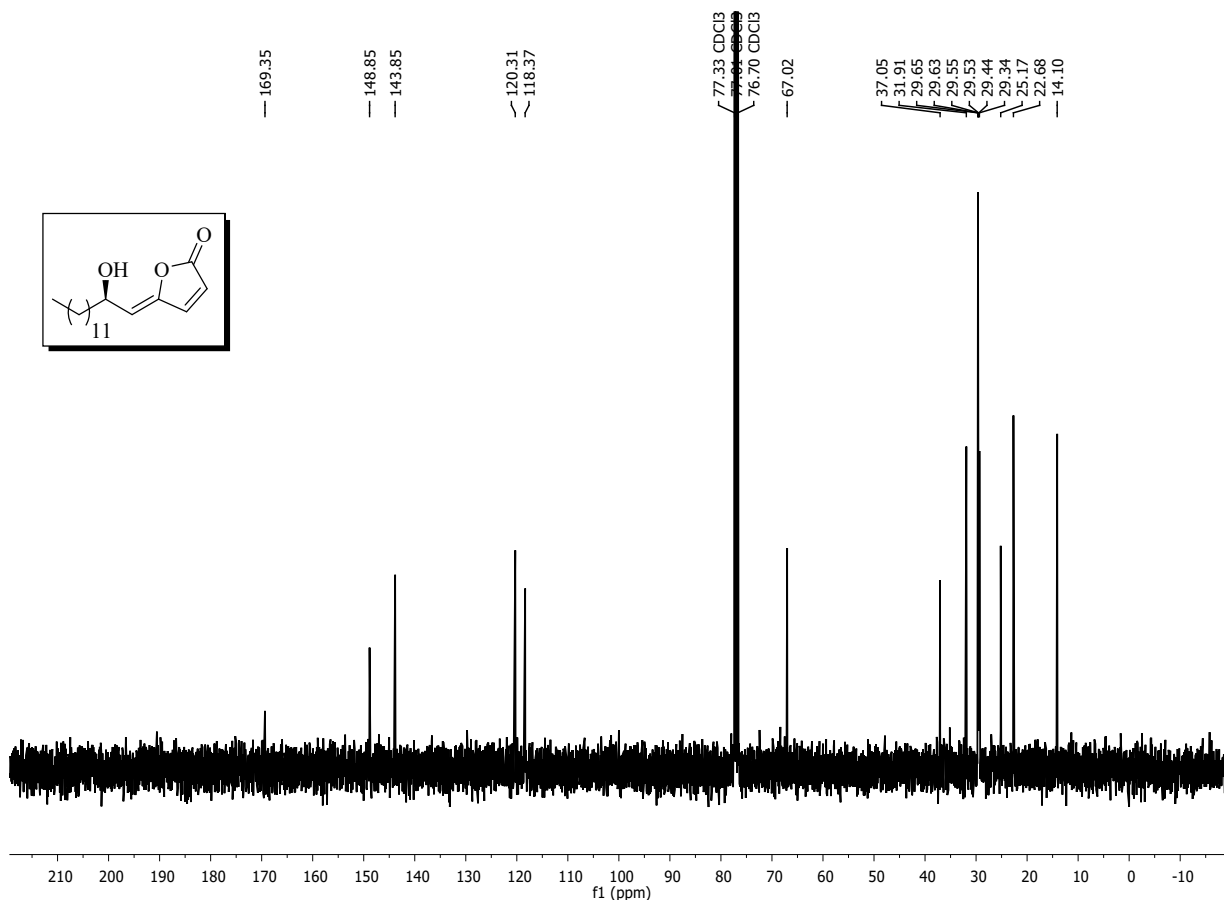
DEPT (100 MHz) NMR of compound 34 in CDCl_3



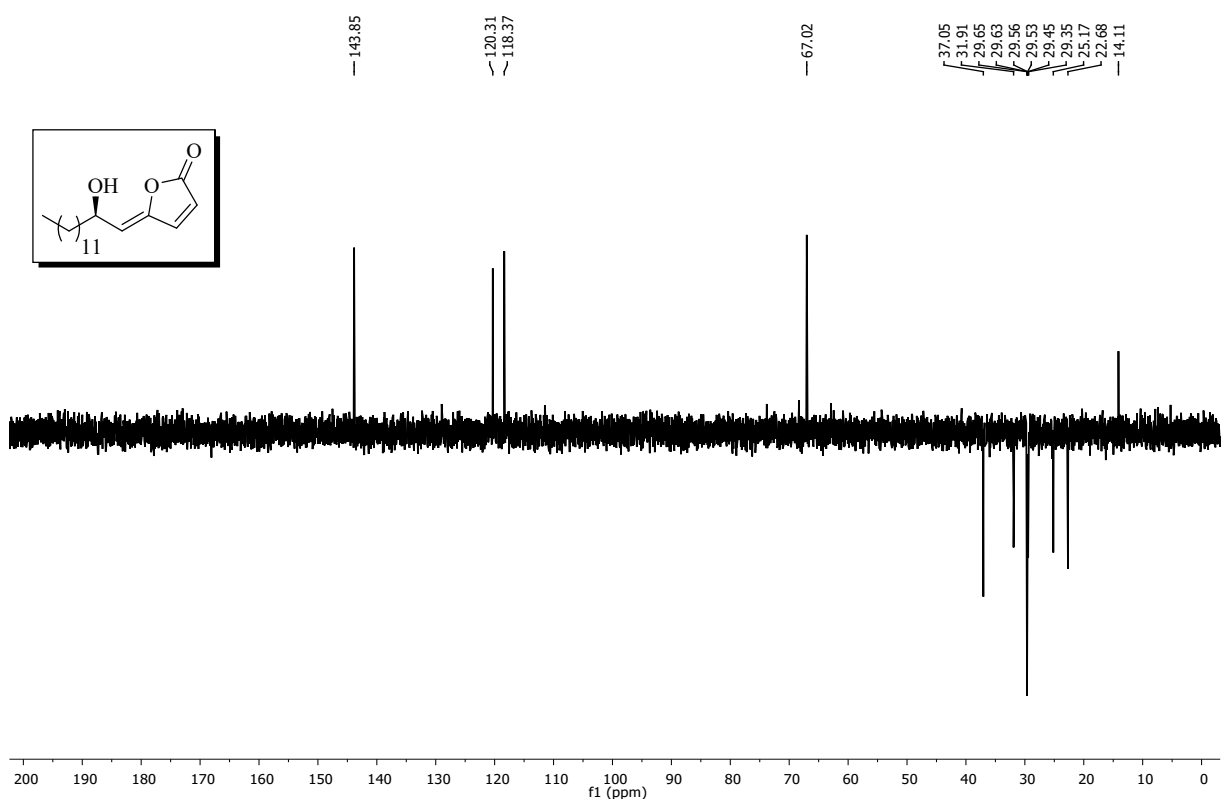
^1H NMR of hygrophorone G (30) (400 MHz, CDCl_3)



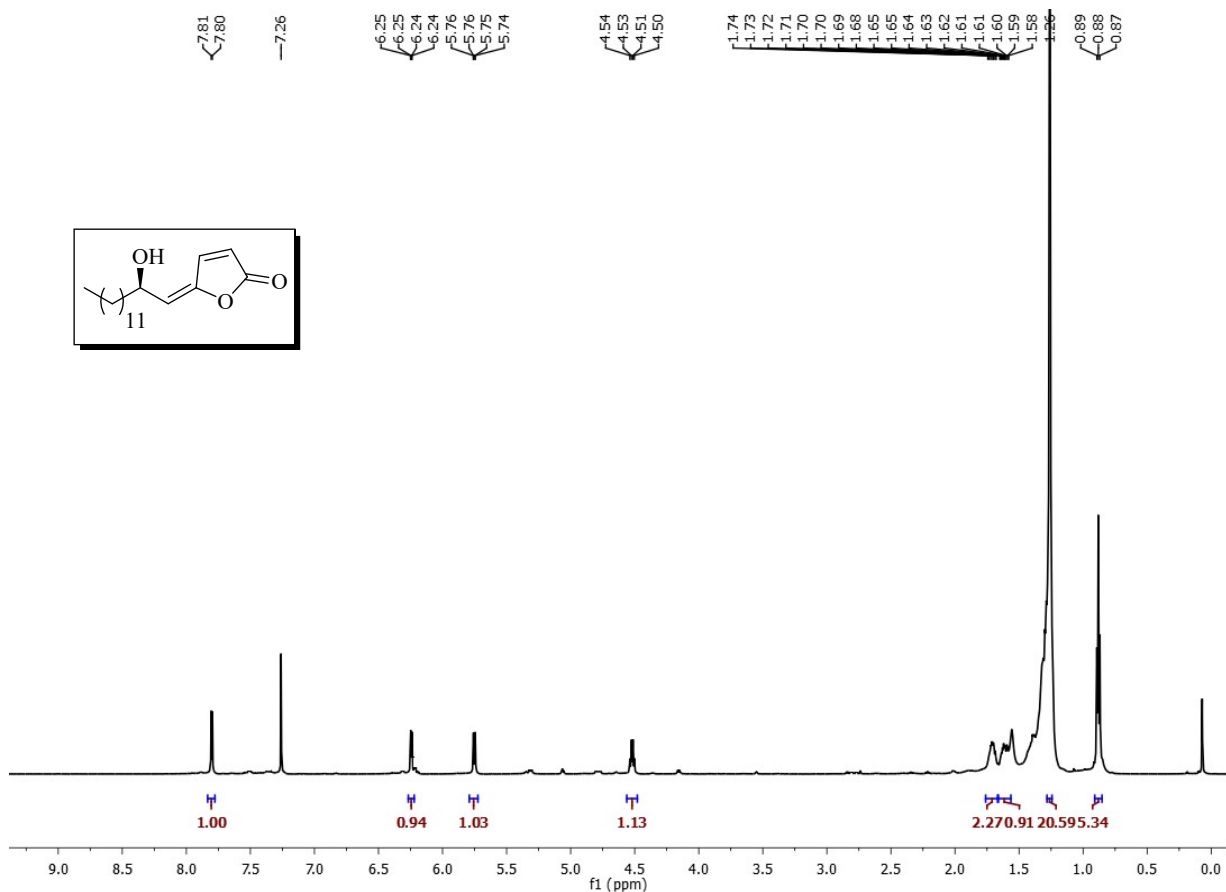
^{13}C NMR of hygrophorone G (30) (100 MHz, CDCl_3)



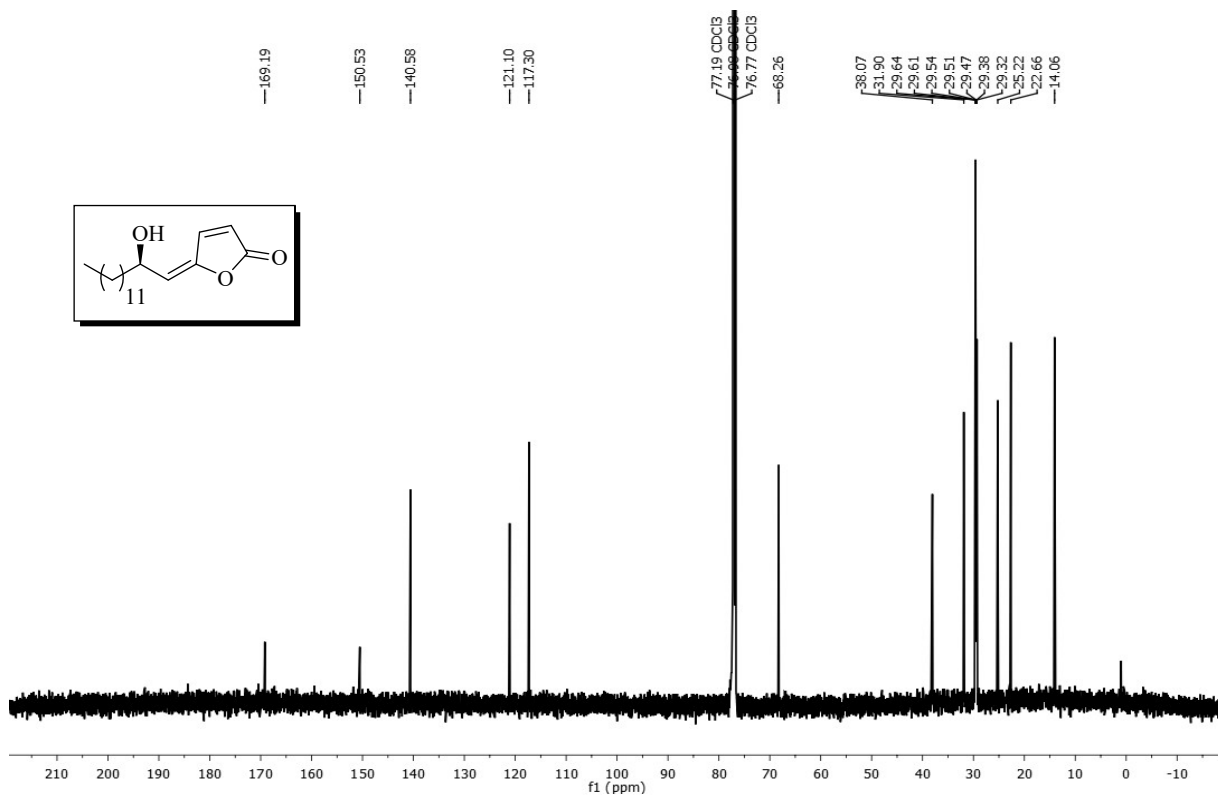
DEPT-135- NMR of hygrophorone G (30) (100 MHz, CDCl₃)



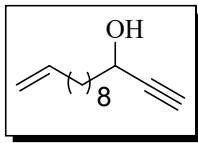
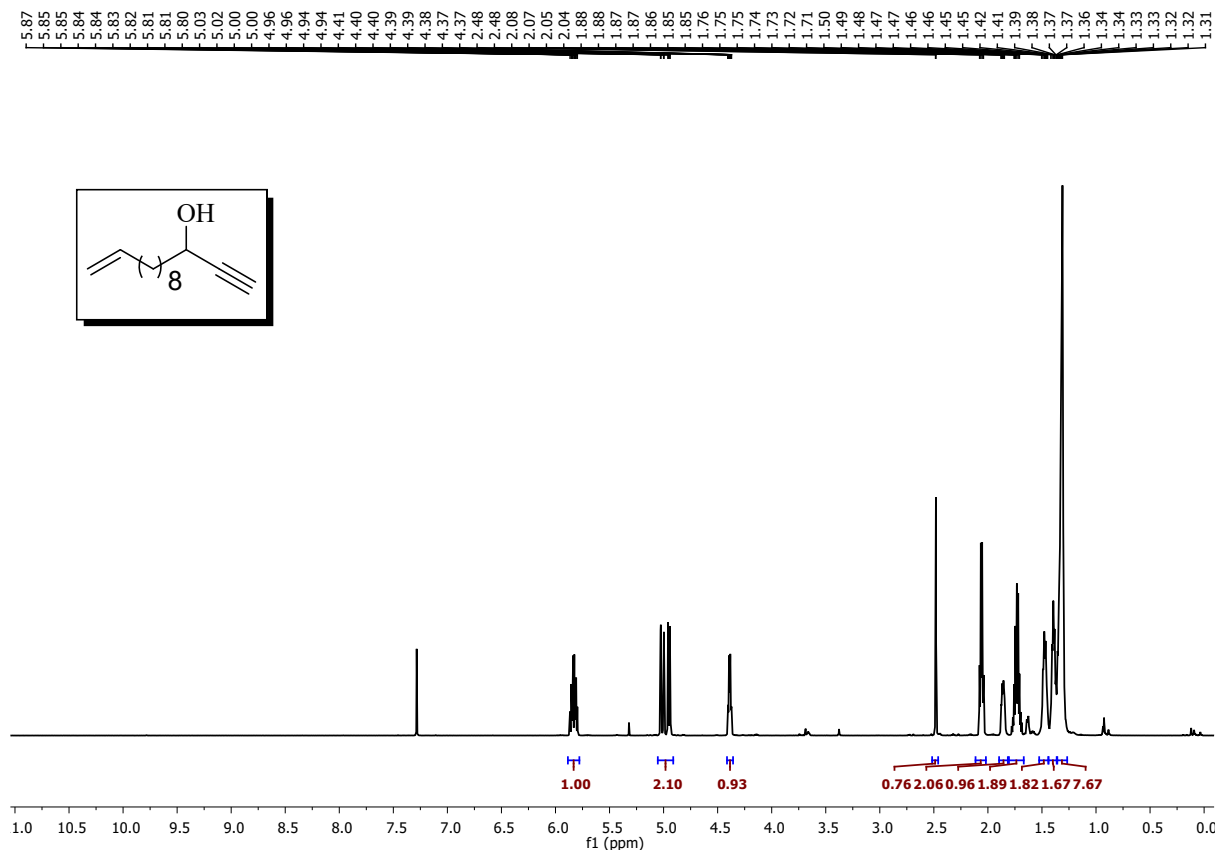
¹H NMR of hygrophorone F (29) (600 MHz, CDCl₃)



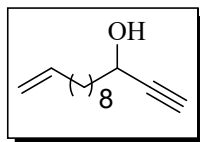
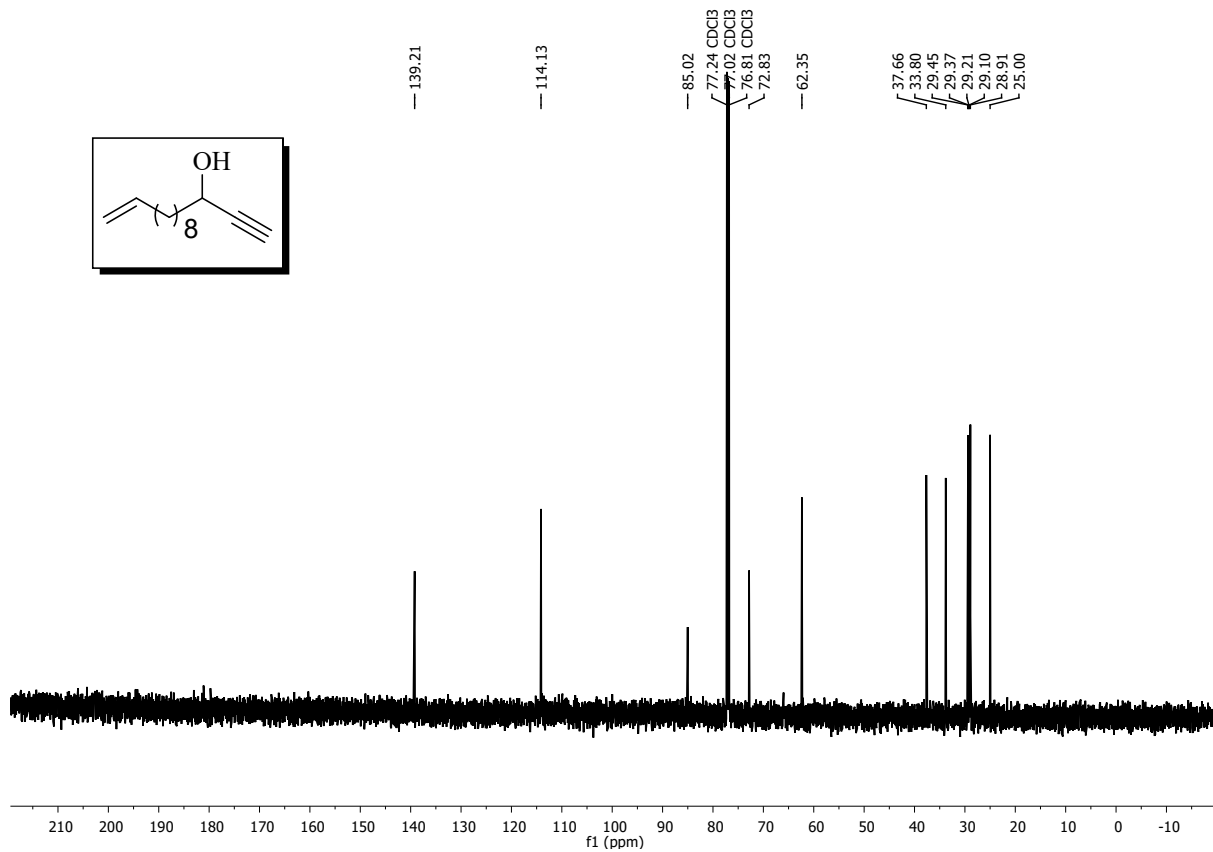
¹³C NMR of hygrophorone F (29) (150 MHz, CDCl₃)



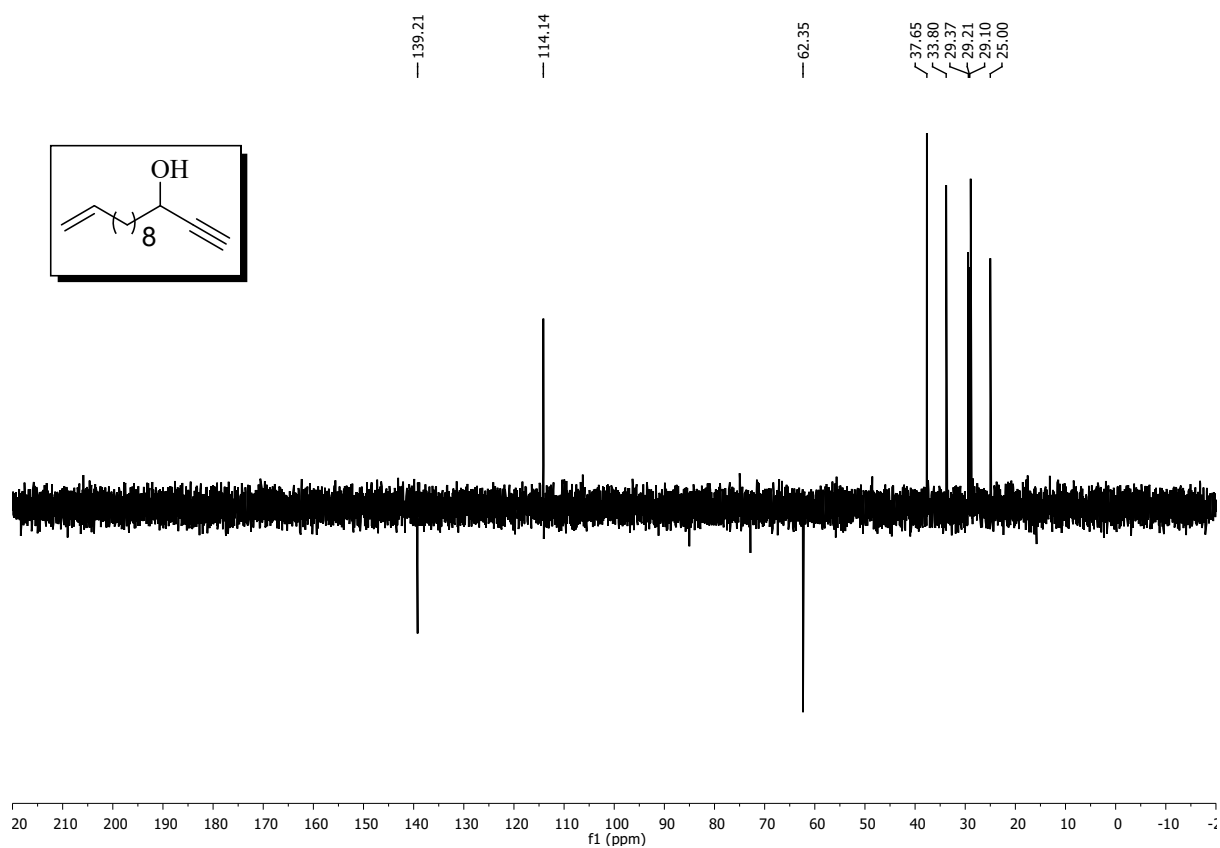
¹H (600 MHz) NMR of compound 37 in CDCl₃



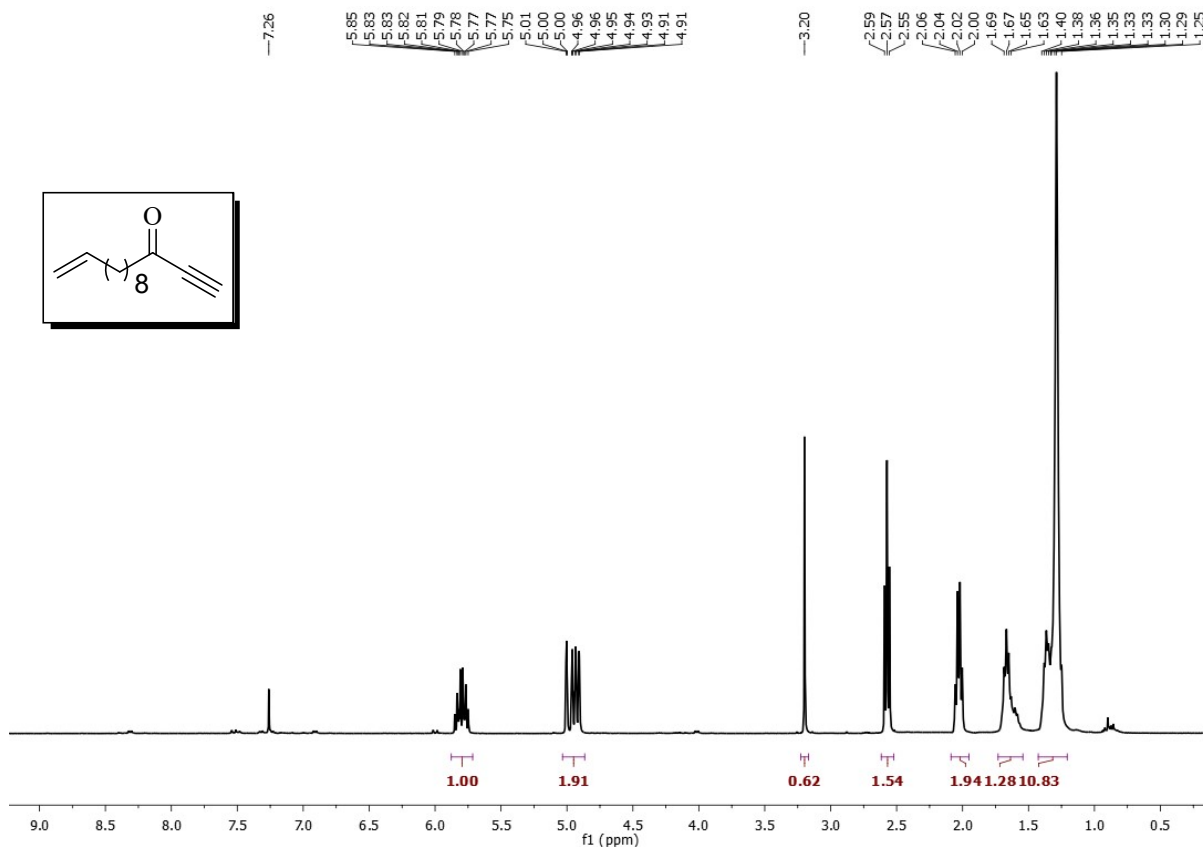
¹³C (150 MHz) NMR of compound 37 in CDCl₃



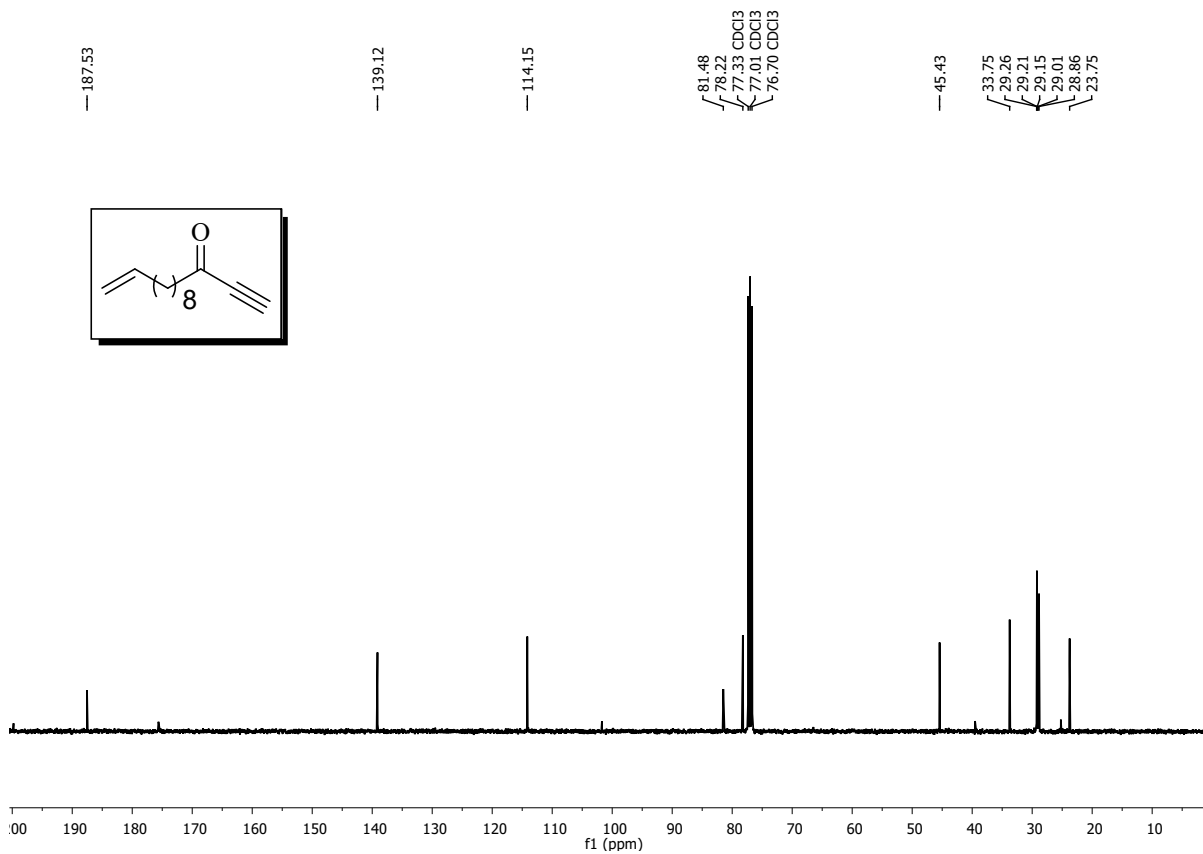
DEPT (100 MHz) NMR of compound 37 in CDCl₃



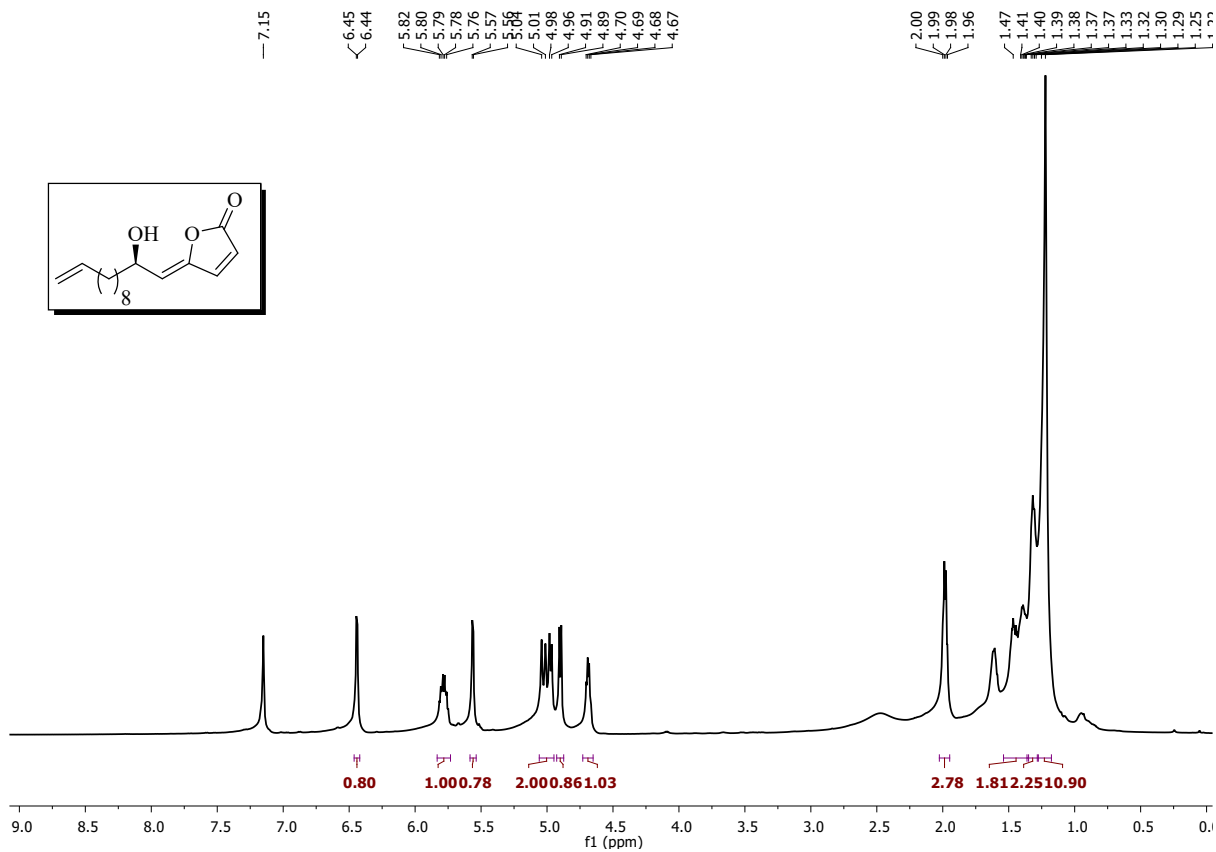
¹H (600 MHz) NMR of compound 38 in CDCl₃



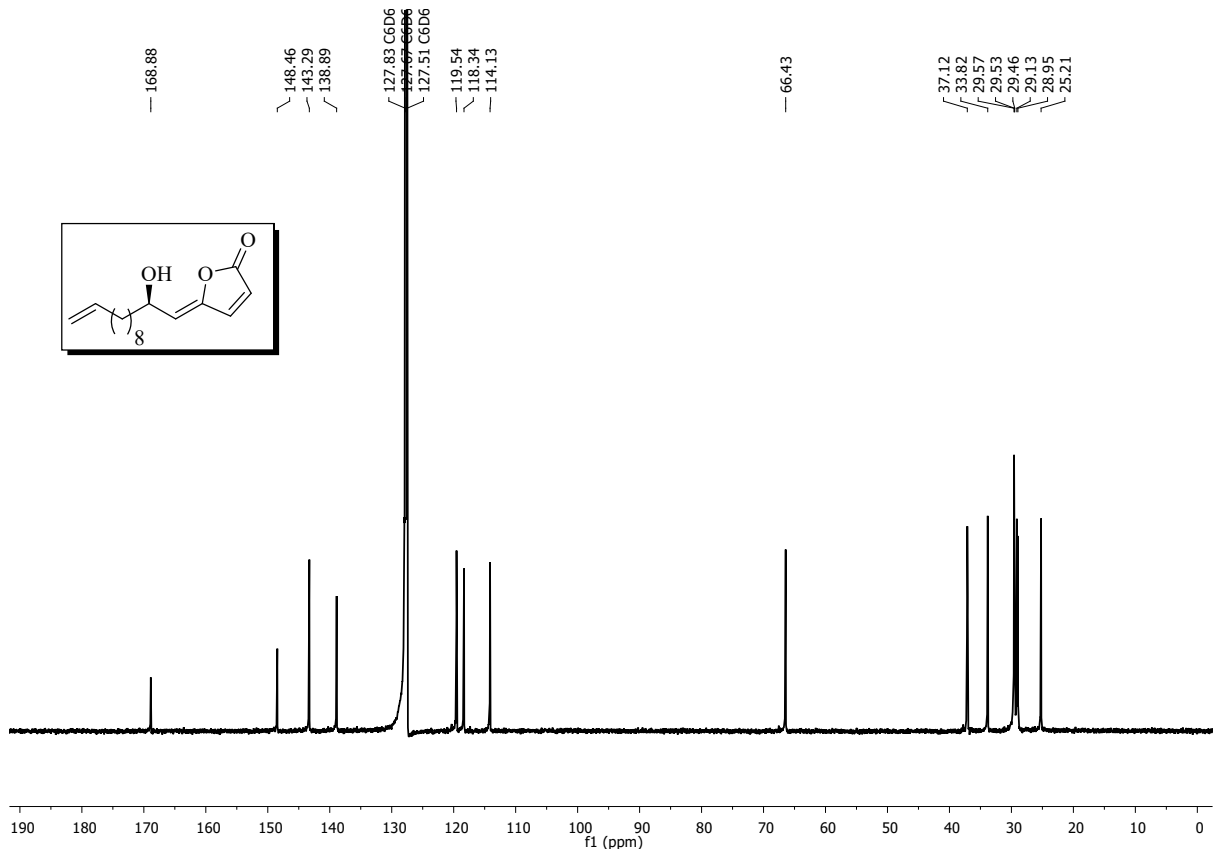
^{13}C (150 MHz) NMR of compound 38 in CDCl_3



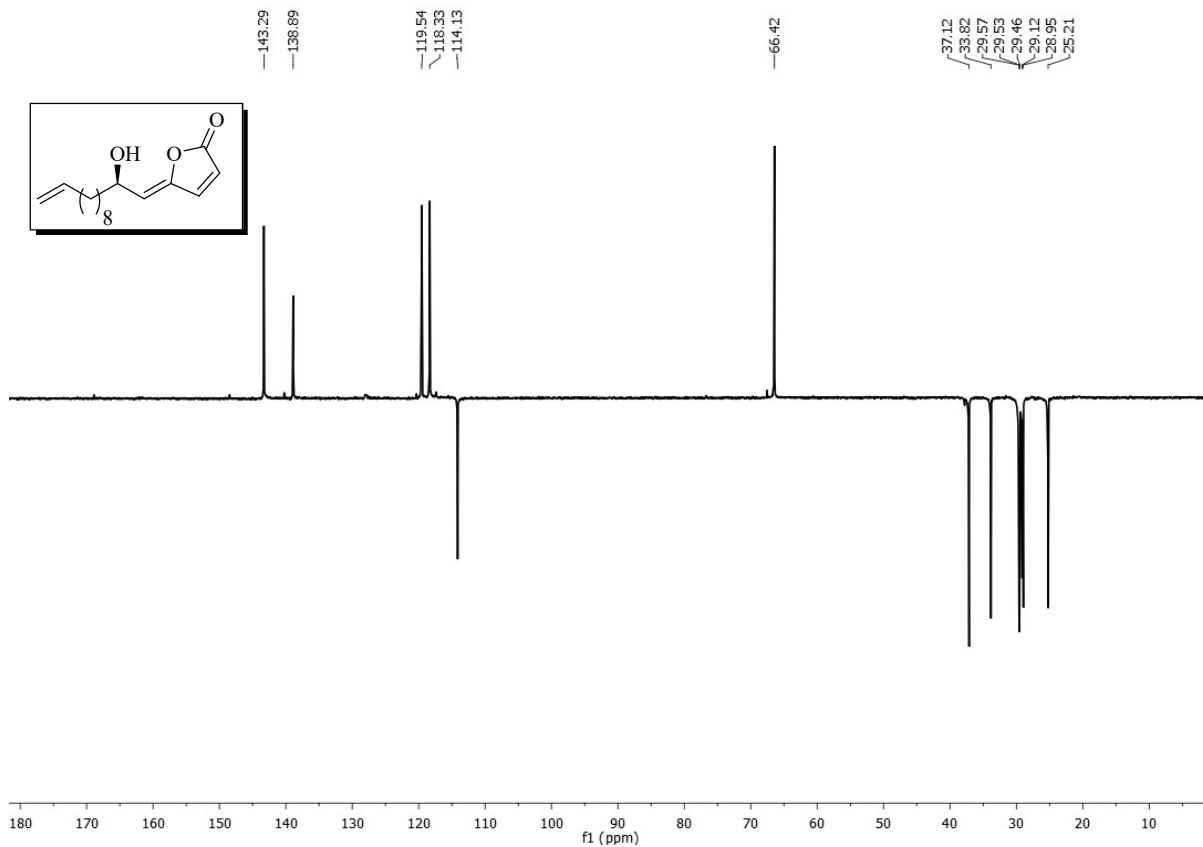
^1H NMR of compound 36 (600 MHz, C_6D_6)



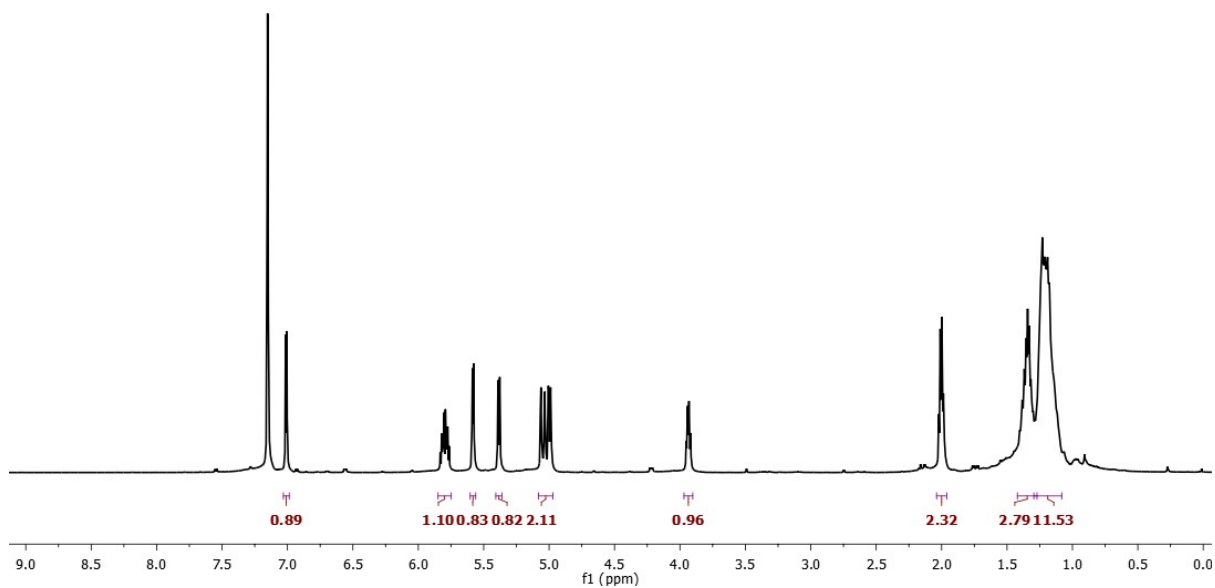
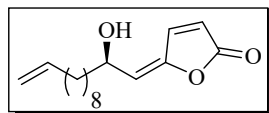
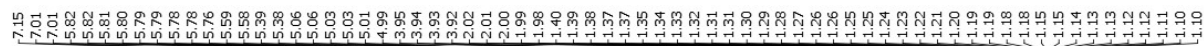
¹³C NMR of compound 36 (100 MHz, C₆D₆)



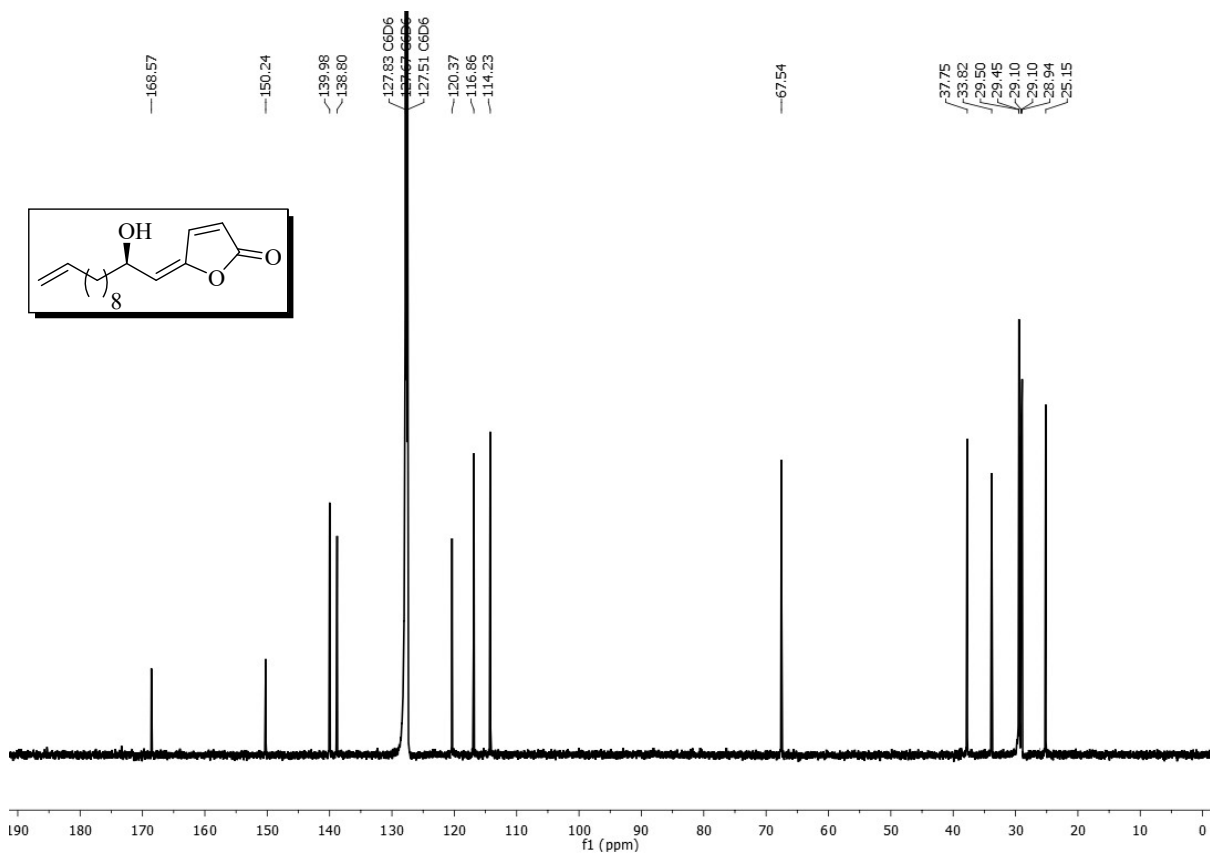
DEPT-135- NMR of compound 36 (100 MHz, C₆D₆)



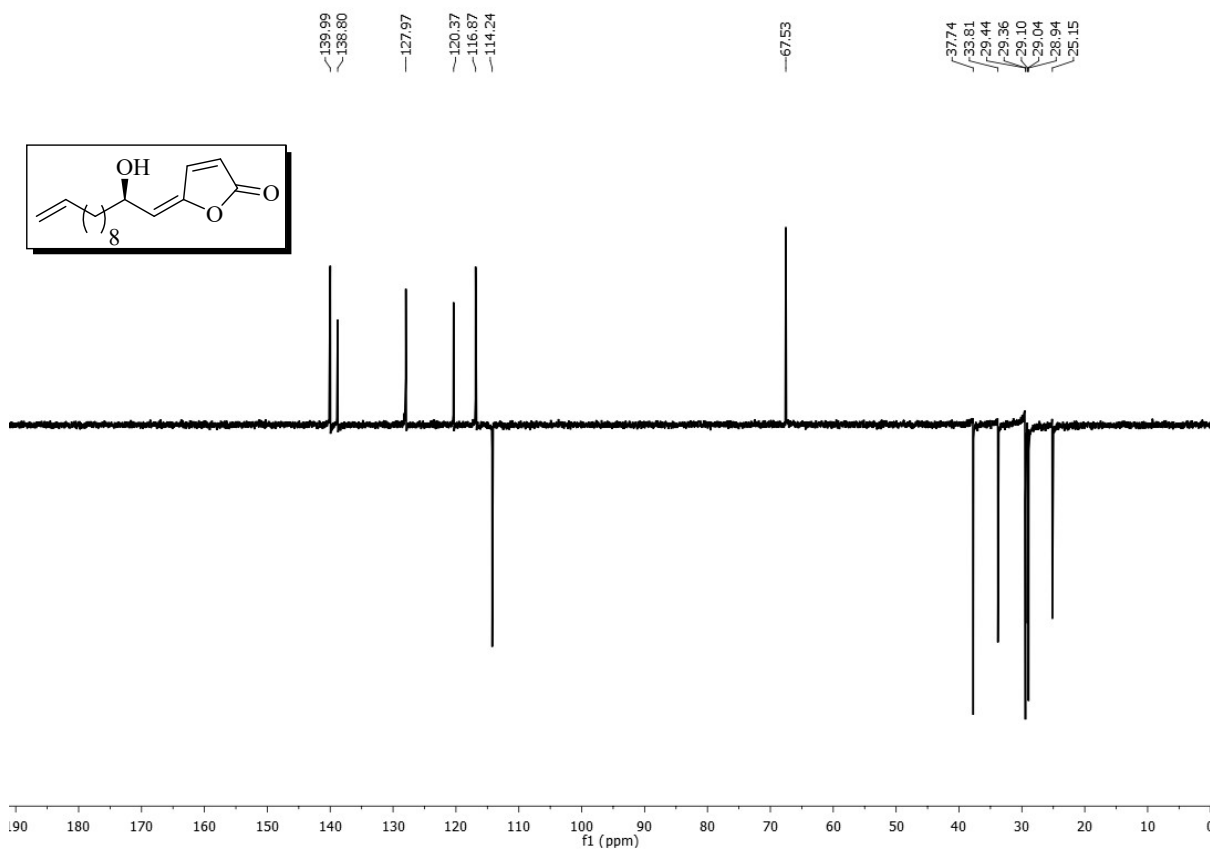
¹H NMR of ramariolide D (35) (600 MHz, C₆D₆)



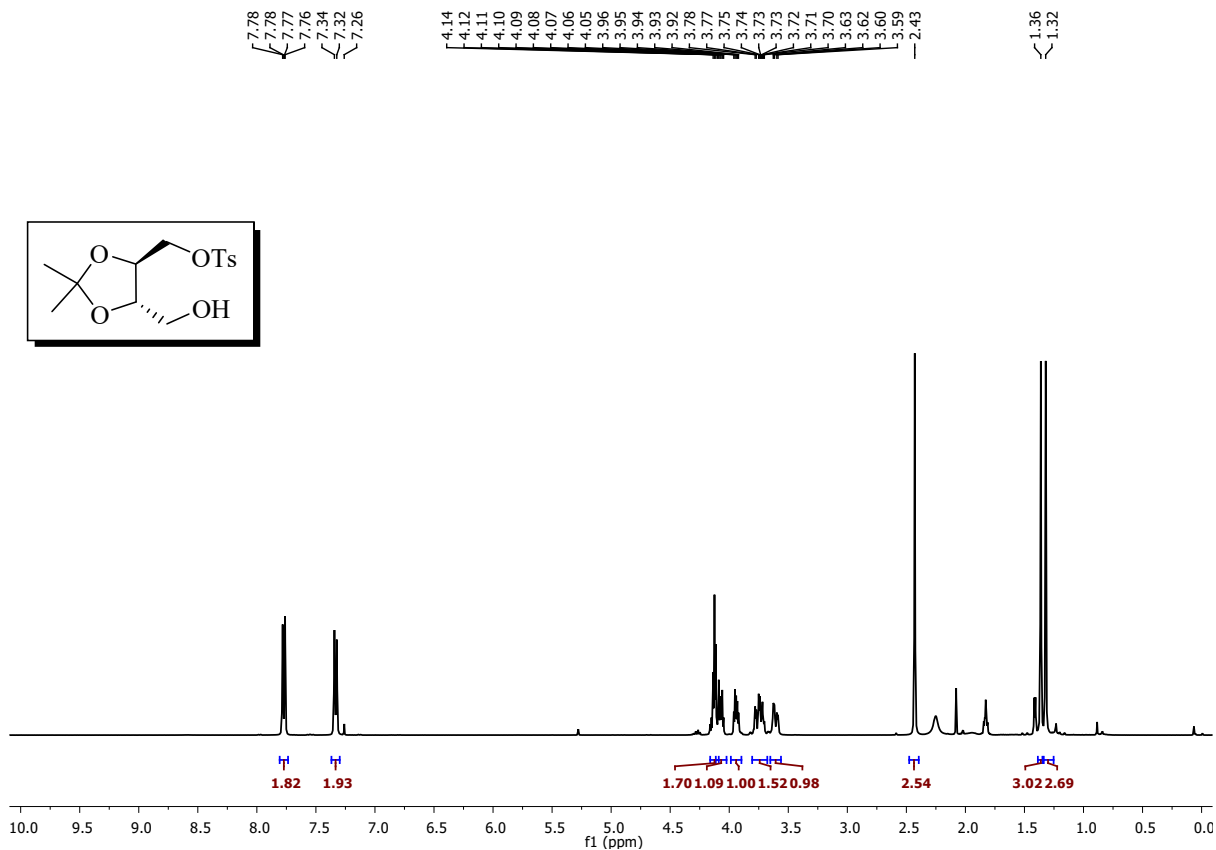
¹³C NMR of ramariolide D (35) (150 MHz, C₆D₆)



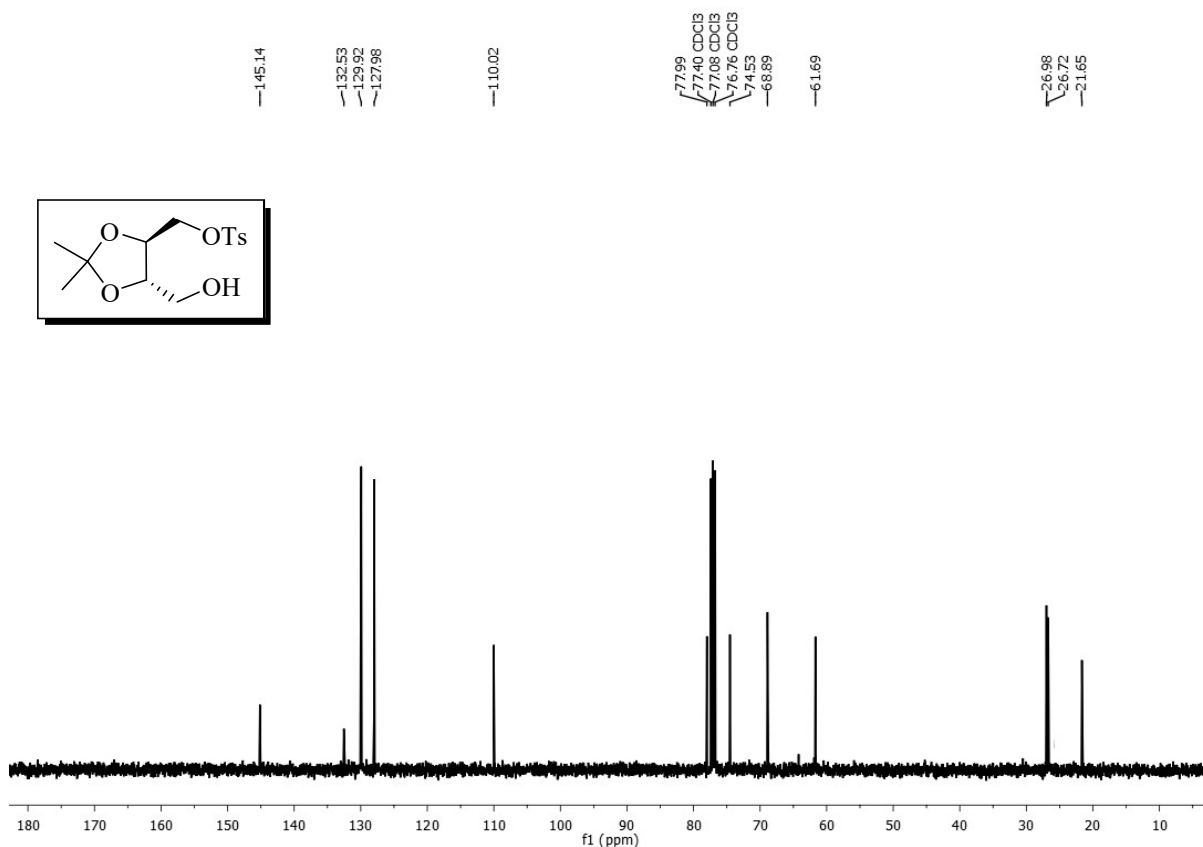
DEPT-135- NMR of ramariolide D (35) (150 MHz, C₆D₆)



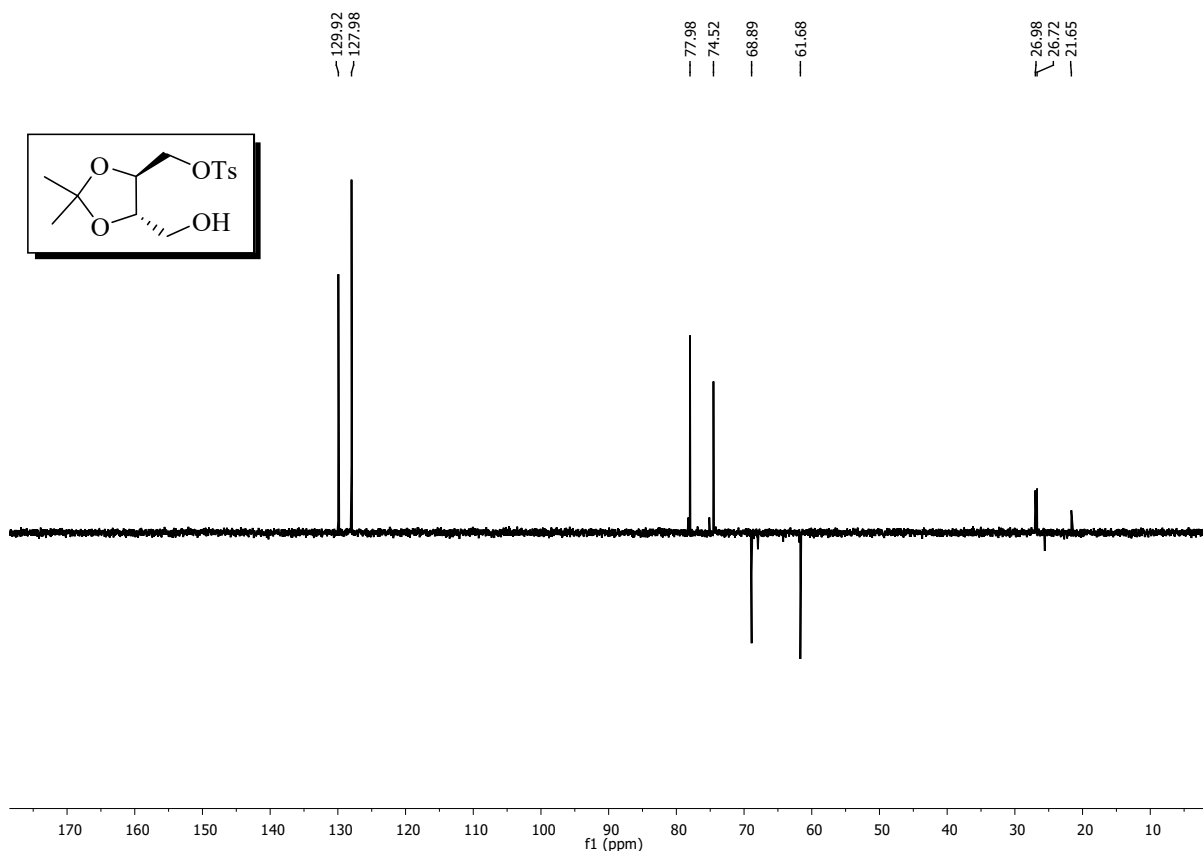
¹H (400 MHz) NMR of compound B3 in CDCl₃



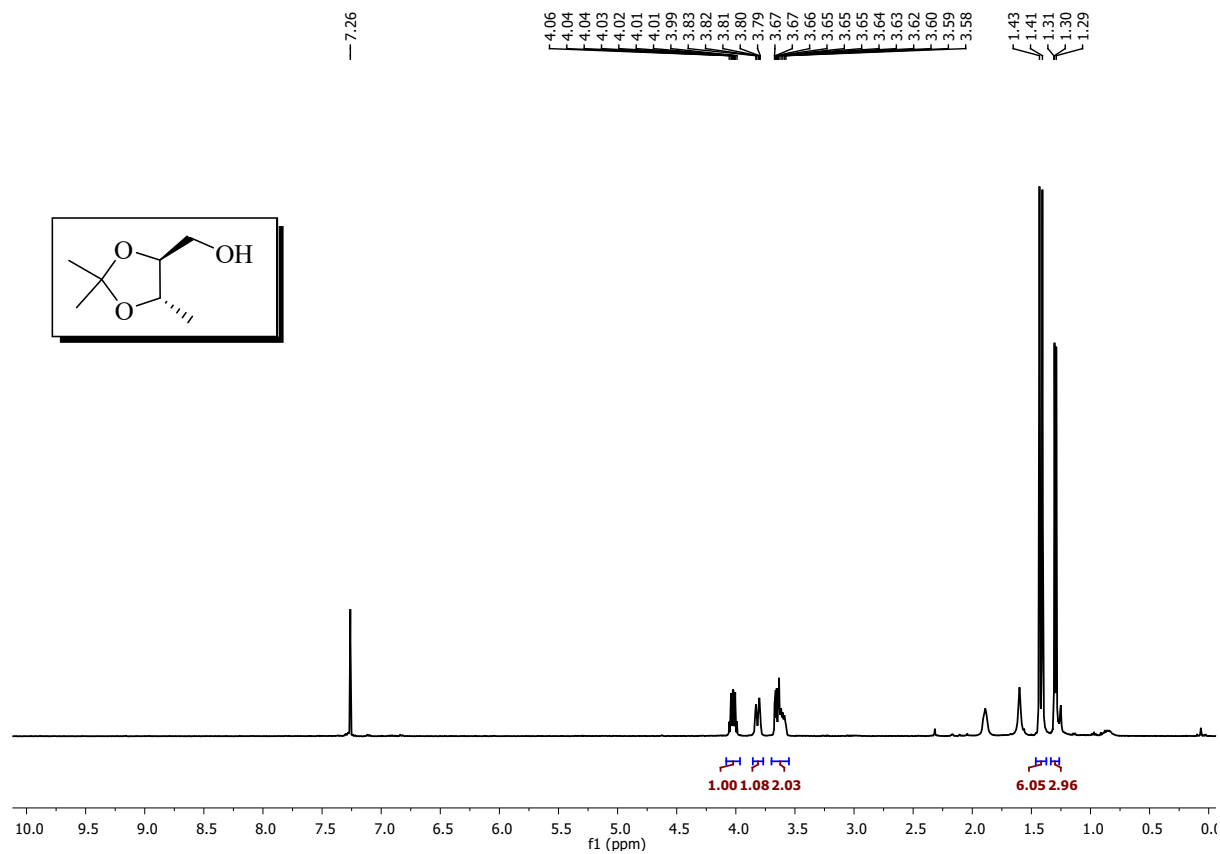
¹³C (100 MHz) NMR of compound B3 in CDCl₃



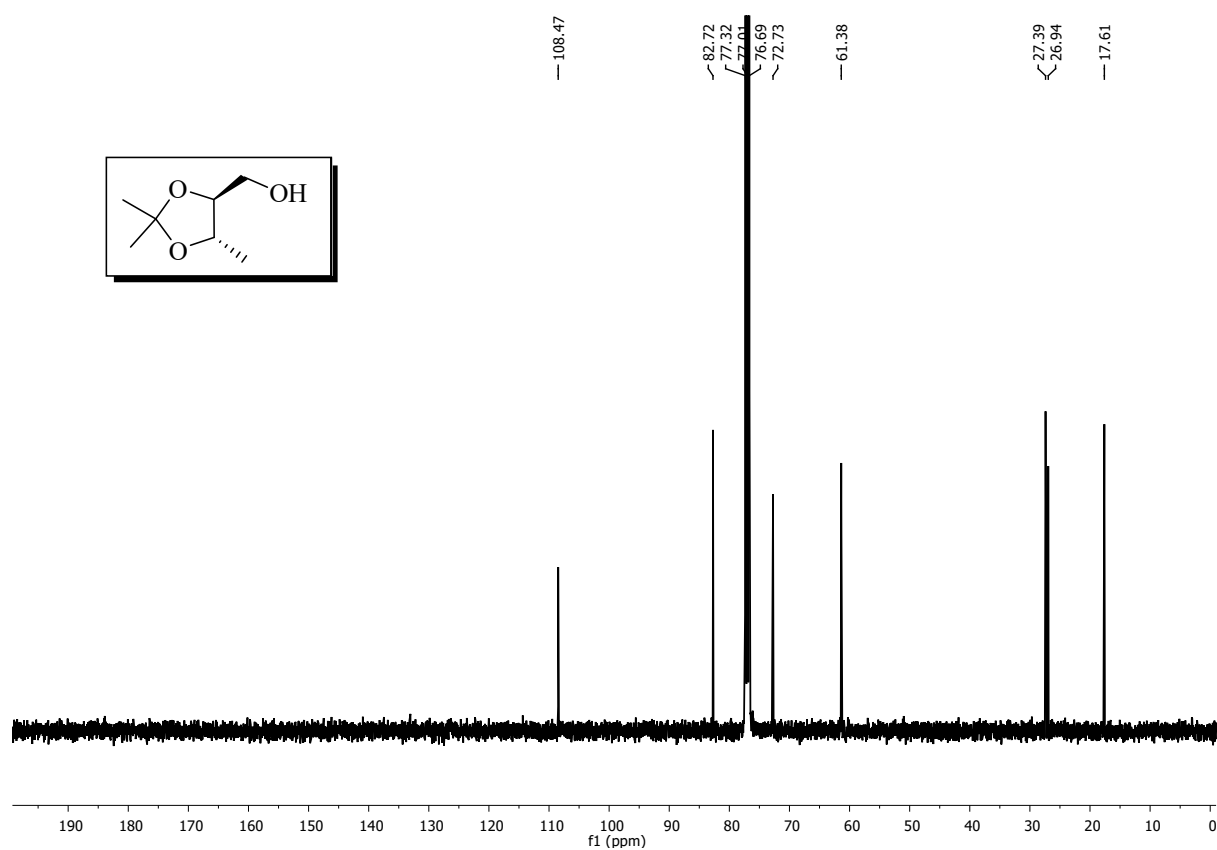
DEPT (100 MHz) NMR of compound B3 in CDCl₃



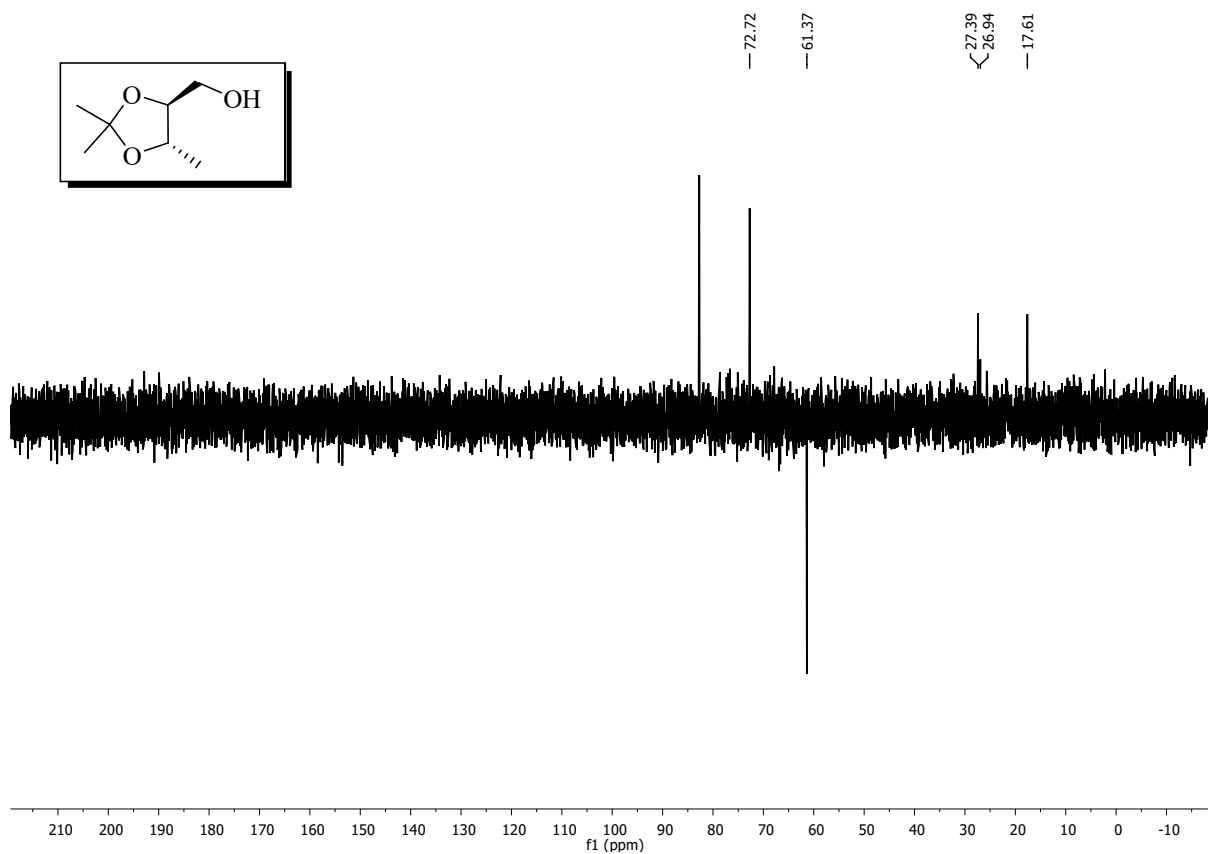
^1H (400 MHz) NMR of compound 43 in CDCl_3



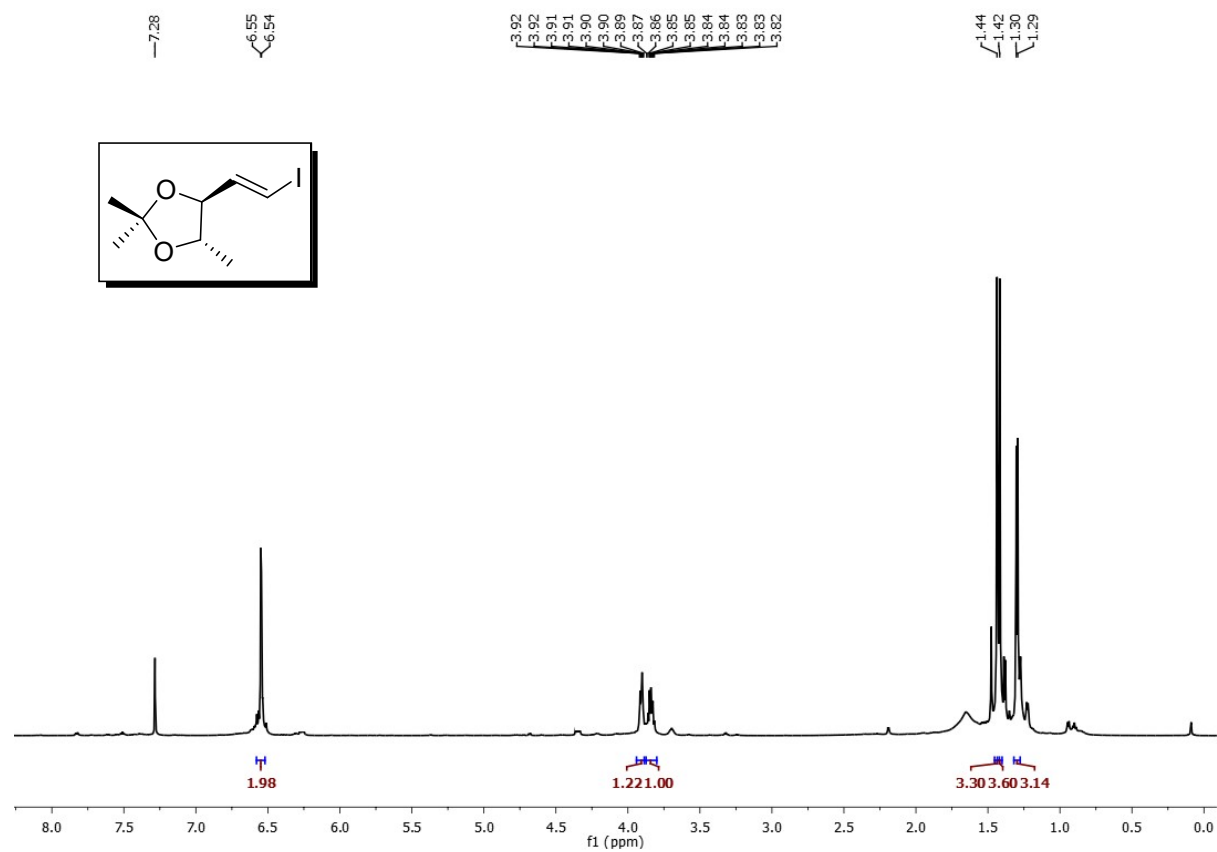
^{13}C (100 MHz) NMR of compound 43 in CDCl_3



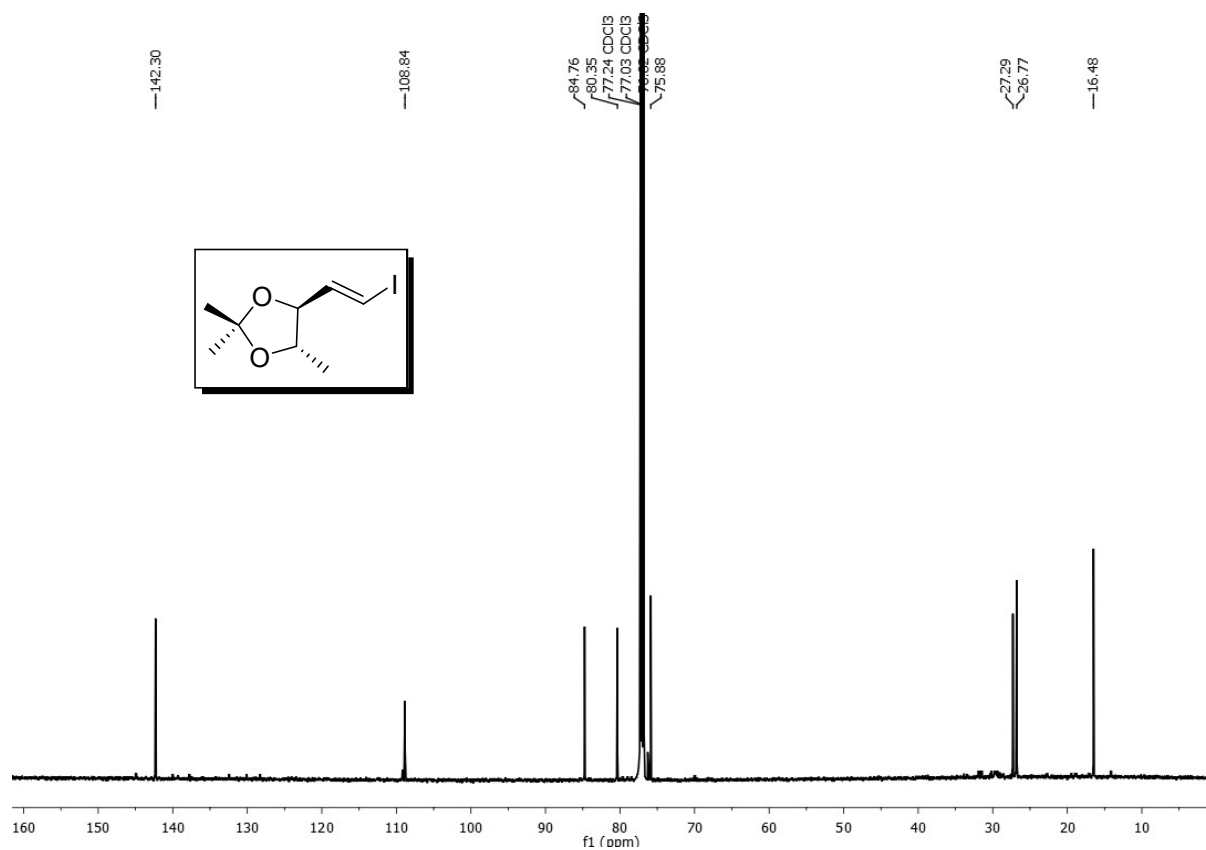
DEPT (100 MHz) NMR of compound 43 in CDCl_3



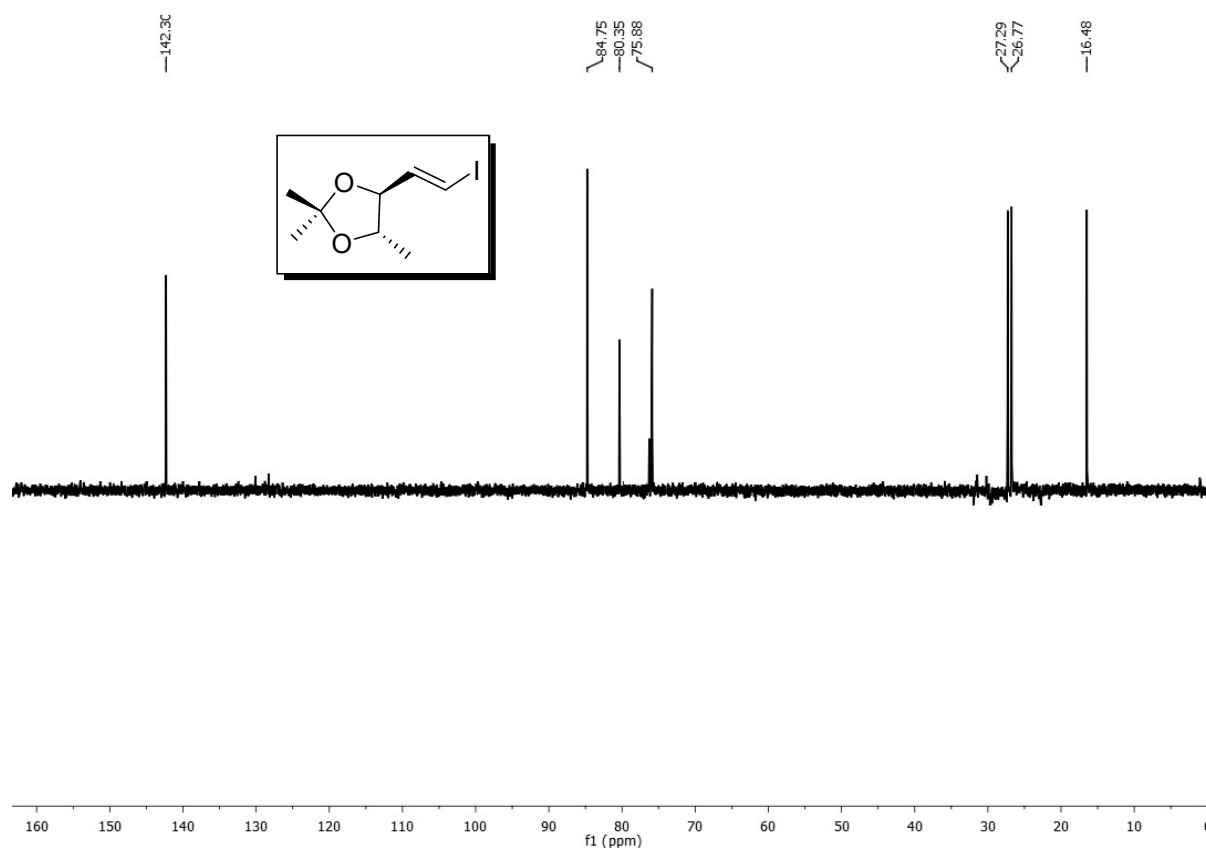
^1H (400 MHz) NMR of compound 42 in CDCl_3



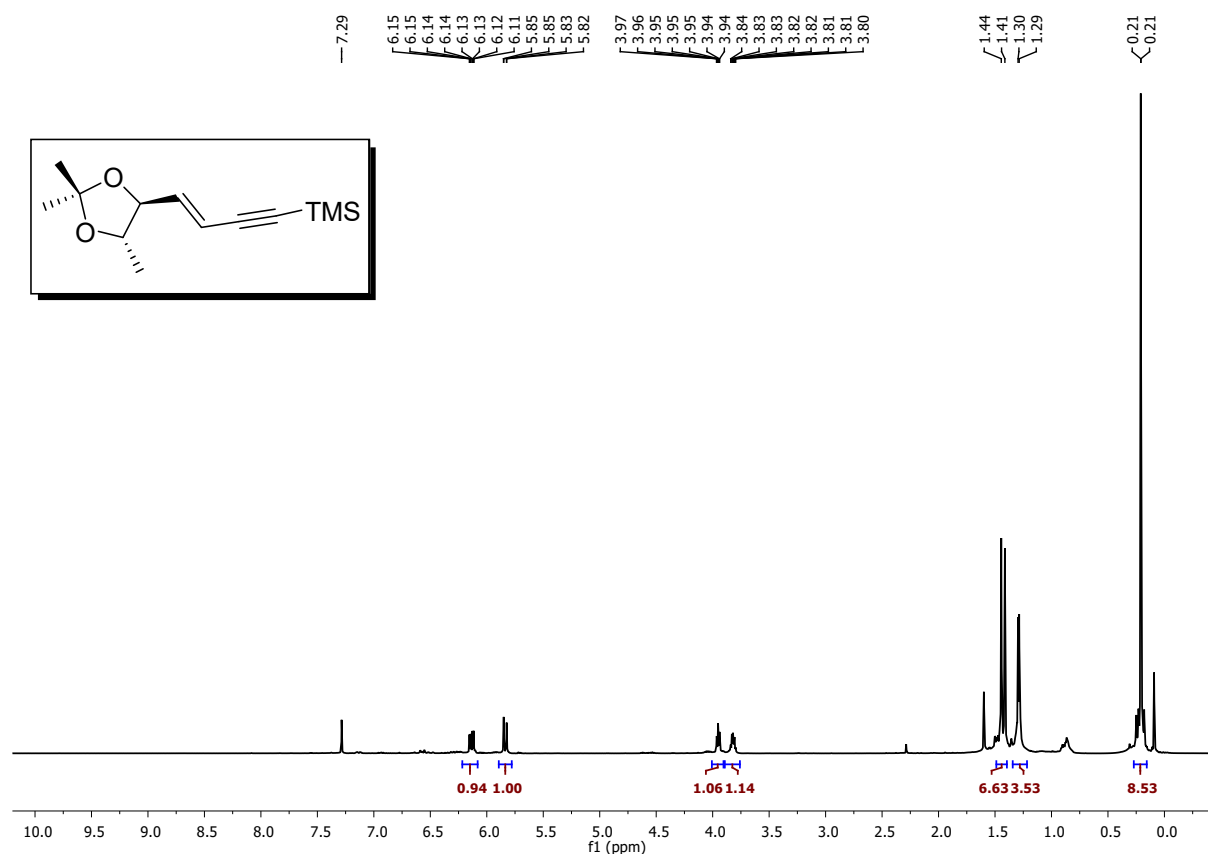
^{13}C (100 MHz) NMR of compound 42 in CDCl_3



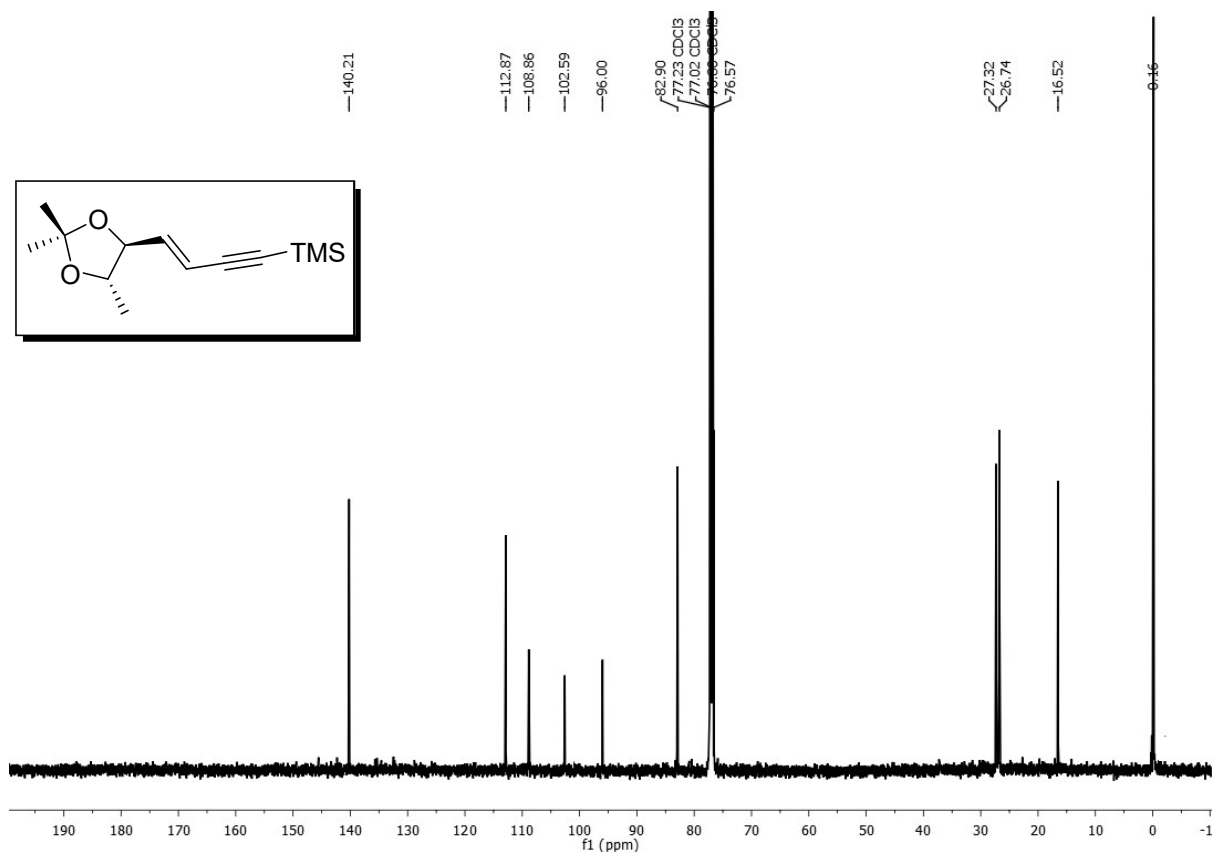
DEPT (100 MHz) NMR of compound 42 in CDCl_3



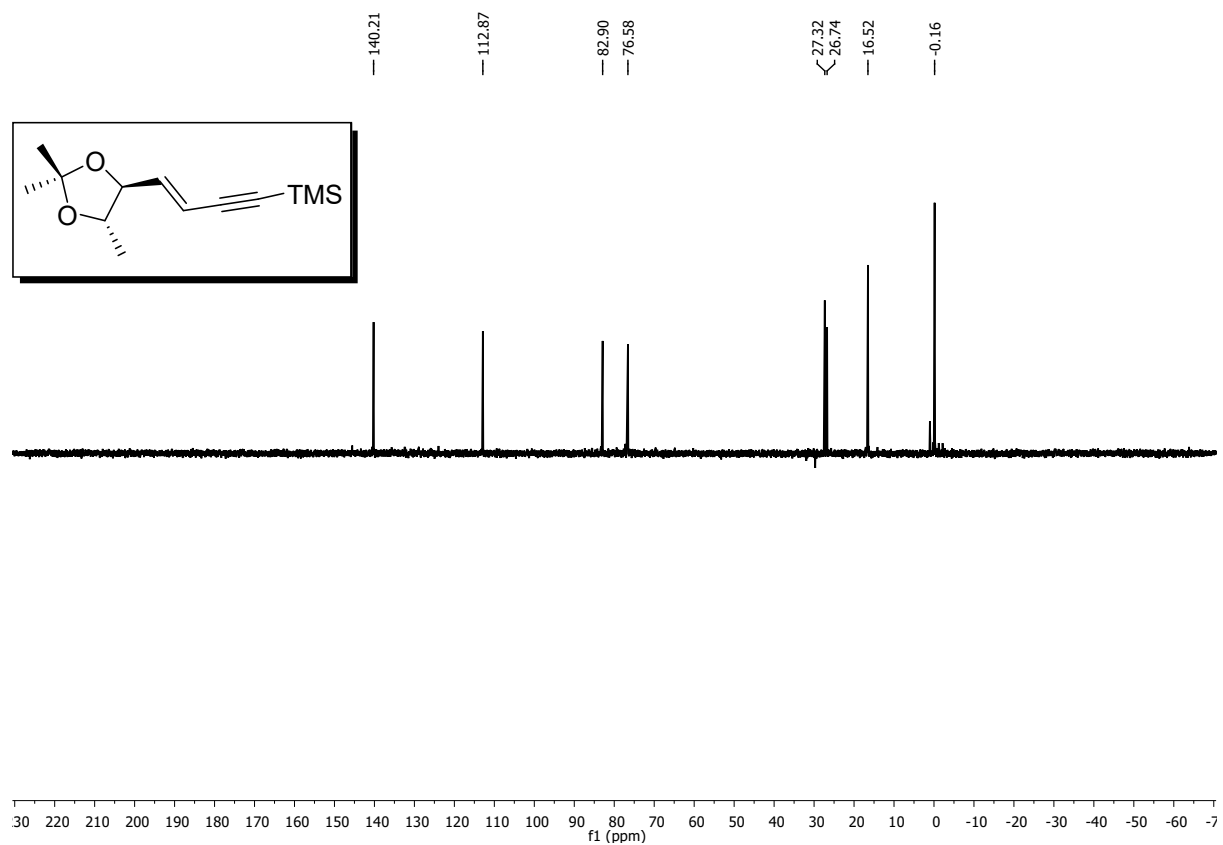
^1H (400 MHz) NMR of compound 45 in CDCl_3



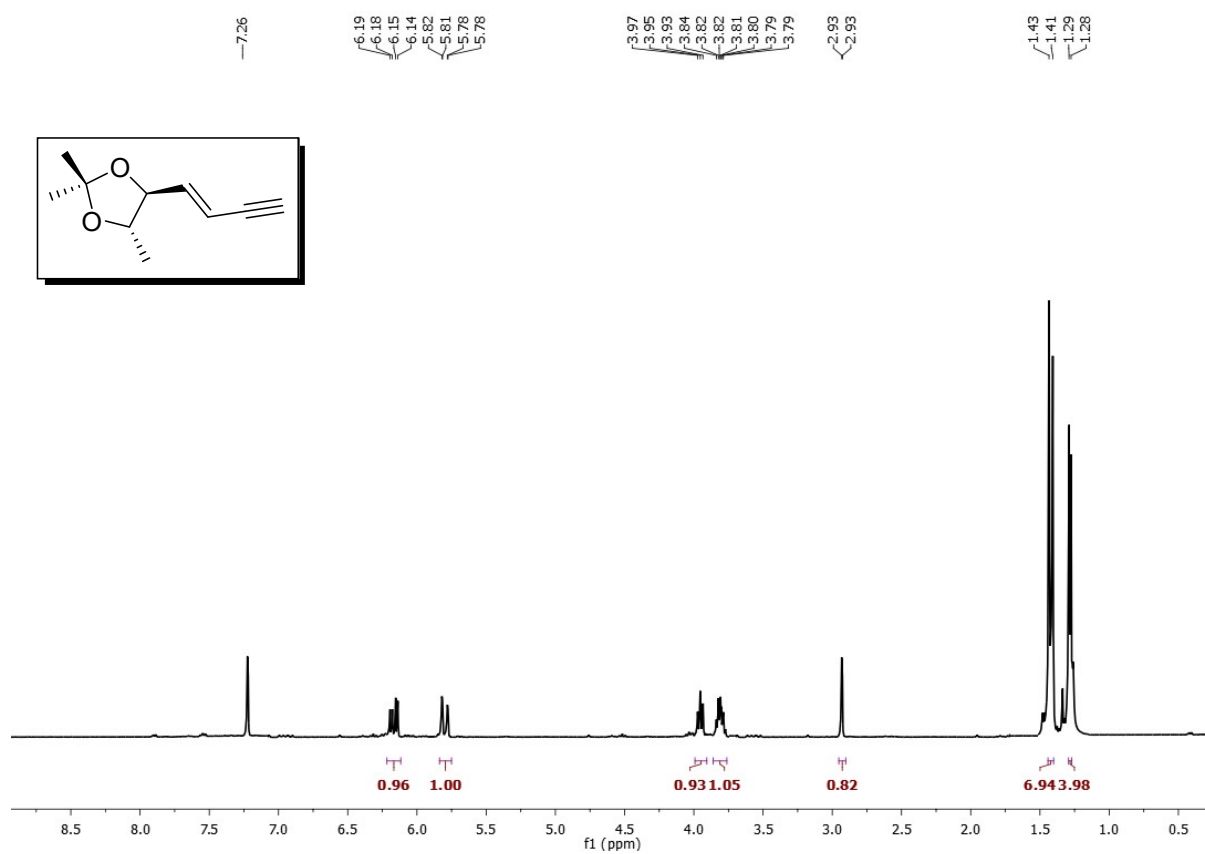
^{13}C (100 MHz) NMR of compound 45 in CDCl_3



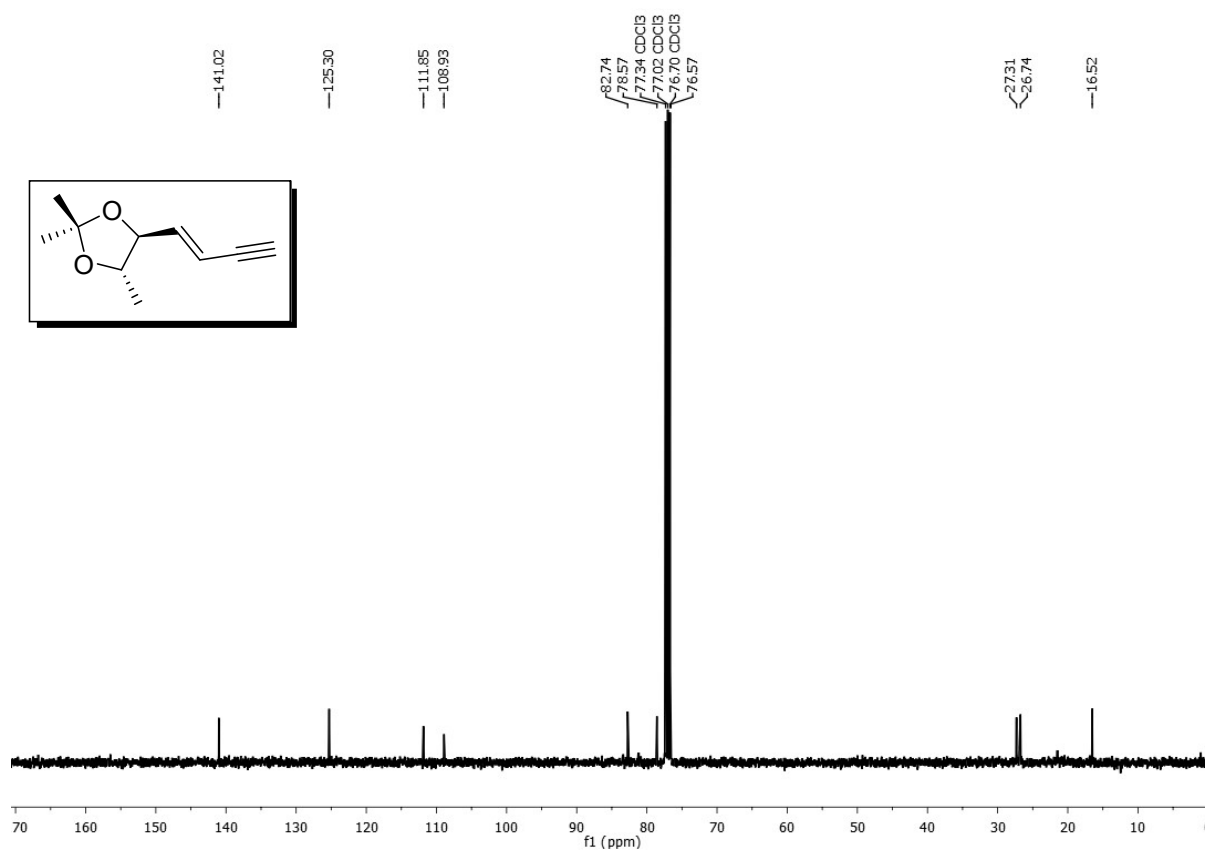
DEPT (100 MHz) NMR of compound 45 in CDCl₃



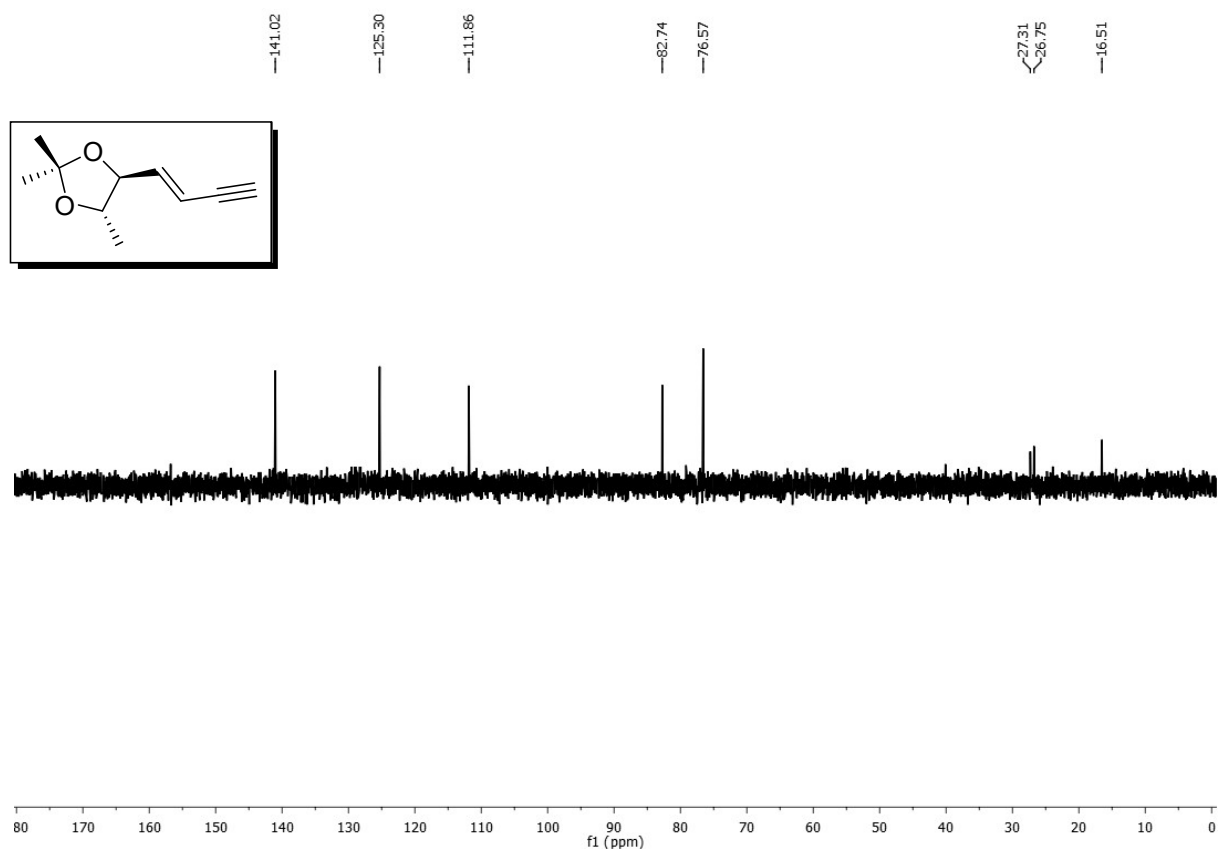
^1H (400 MHz) NMR of compound 41 in CDCl_3



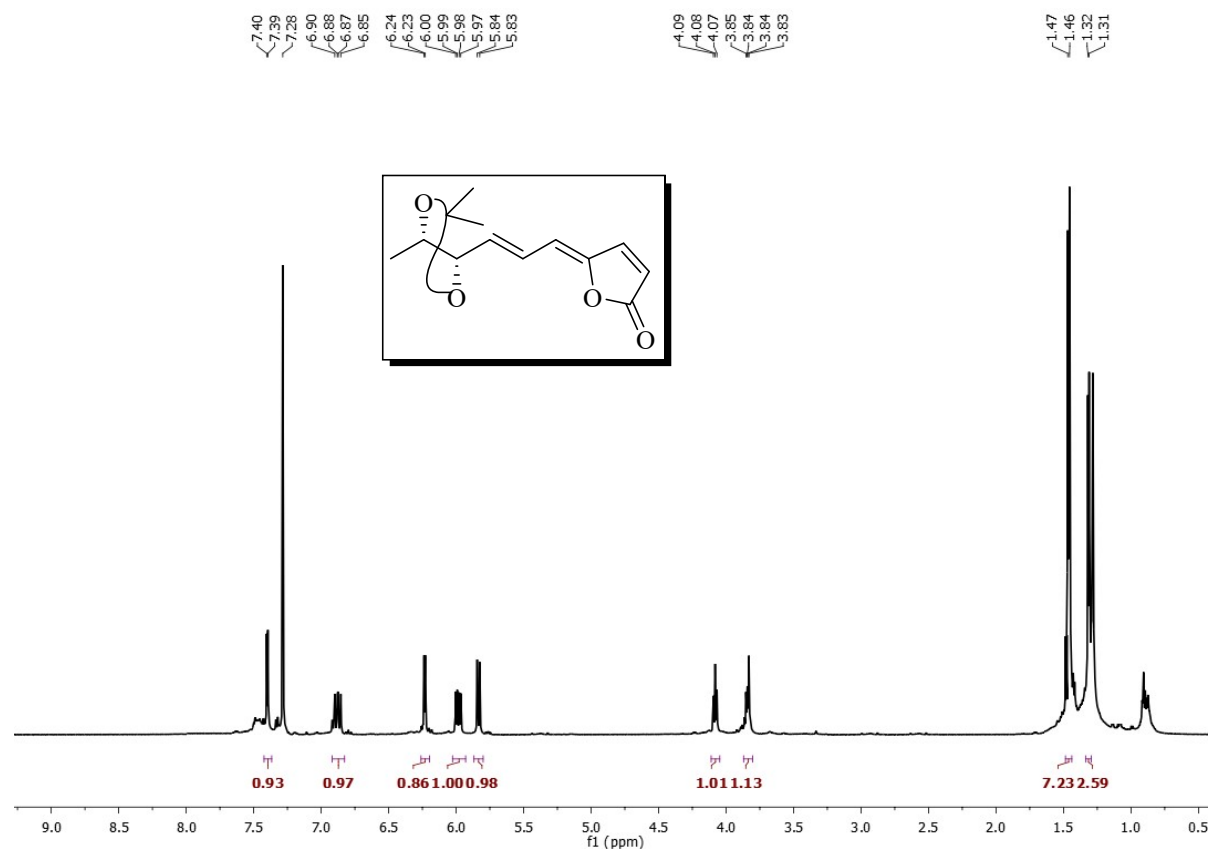
^{13}C (100 MHz) NMR of compound 41 in CDCl_3



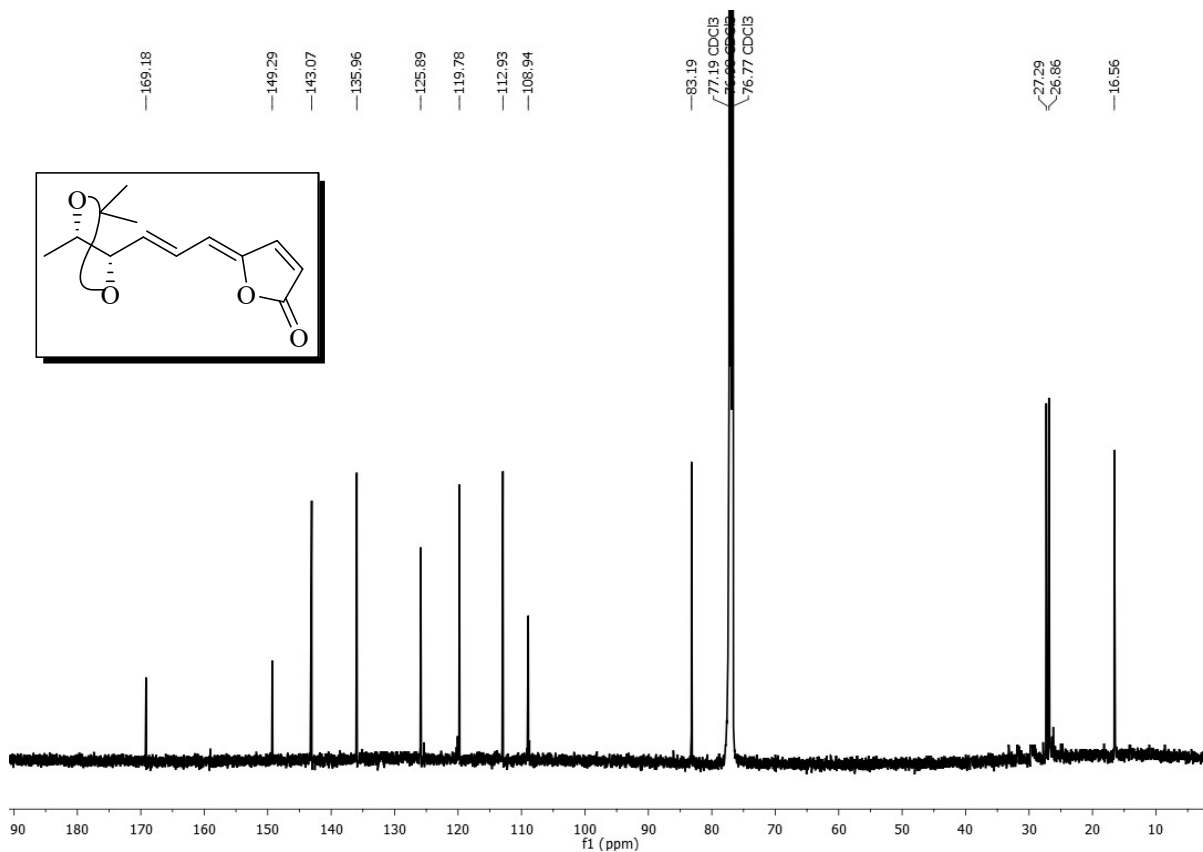
DEPT (100 MHz) NMR of compound 41 in CDCl₃



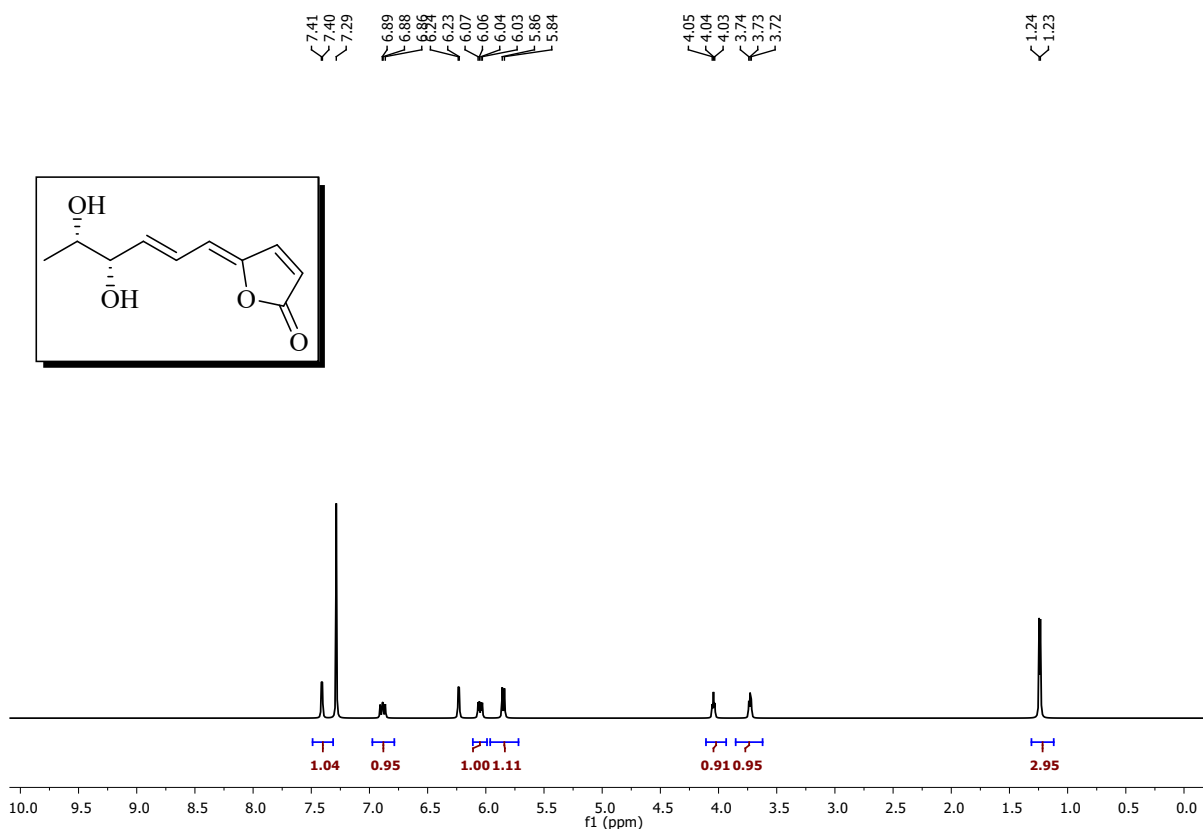
¹H (600 MHz) NMR of compound 46 in CDCl₃



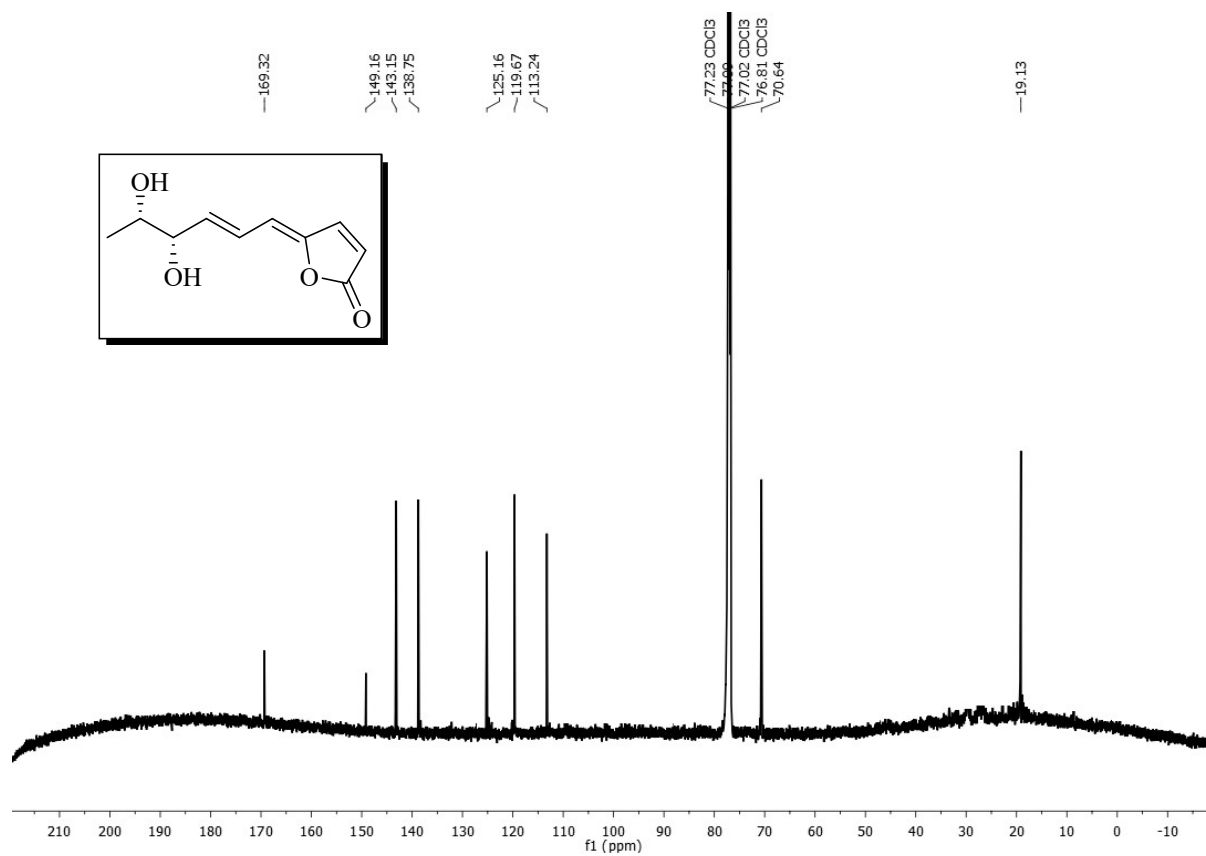
^{13}C (150 MHz) NMR of compound 46 in CDCl_3



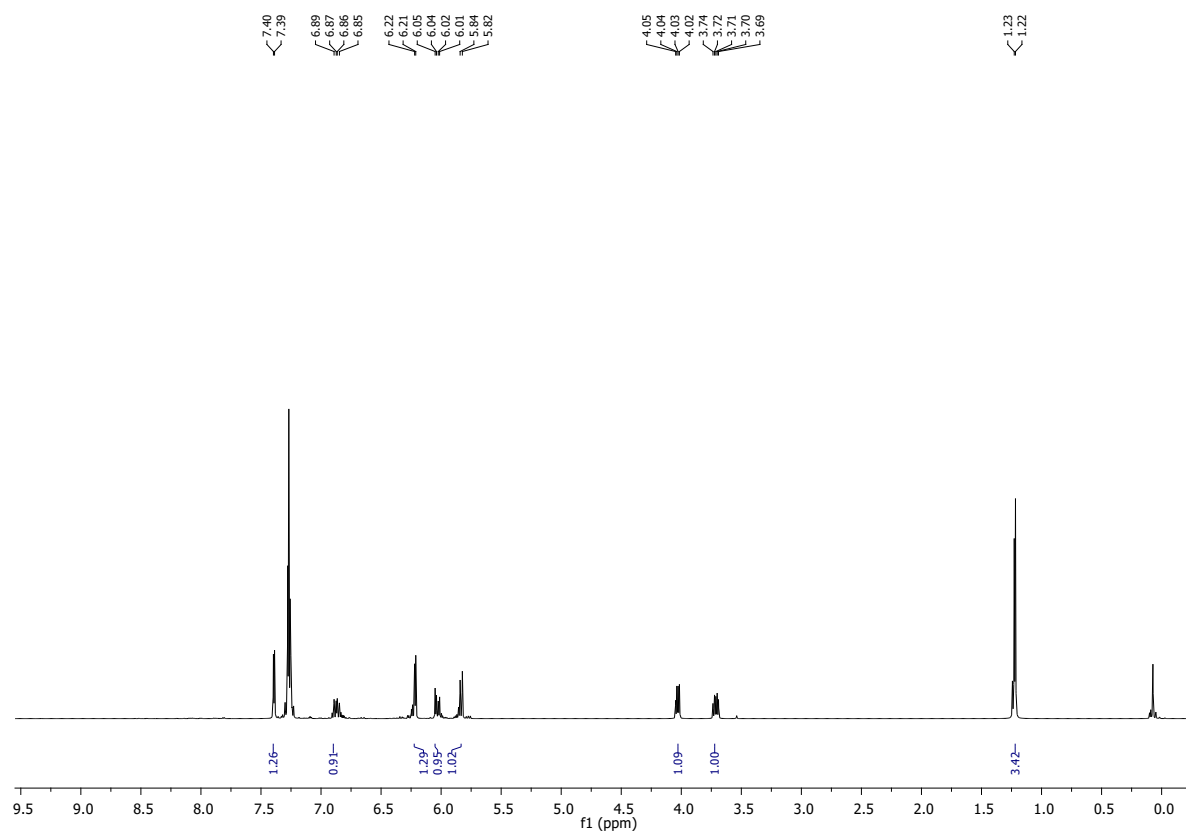
^1H (400 MHz) NMR of phomopsolidone C (40) in CDCl_3



^{13}C (150 MHz) NMR of compound phomopsolidone C (40) in CDCl_3



^1H (500 MHz) NMR of phomopsolidone D (39) in CDCl_3



¹³C (125 MHz) NMR of phomopsolidone D (39) in CDCl₃

