

***Supporting Information***

**Synthesis of the C45-C53 tetrahydropyran domain of Norhalichondrins and C14-C22 tetrahydrofuran domain of Halichondrin Family**

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## 1. General information

Unless otherwise mentioned, all reactions were carried out using standard syringe, septa and cannula techniques. All glassware was flame/oven-dried and cooled under an inert atmosphere of nitrogen unless otherwise stated. Column chromatography was performed using silica gel (60–120 mesh) and the column was usually eluted with ethyl acetate-Hexanes. The diastereomeric excess of the products were measured by chiral-phase HPLC using Chiraldak AS column. Analytical thin layer chromatography (TLC) was performed on precoated silica gel-60 F254 (0.5 mm) glass plates. Visualization of the spots on TLC plates was achieved either by exposure to iodine vapor or UV light or by dipping the plates to sulphuric acid- $\beta$ -naphthol or to ethanolic anisaldehyde-sulphuric acid-acetic acid and heating the plates at 120 °C.  $^1\text{H}$  NMR spectra were recorded at 300, 500, 600 MHz &  $^{13}\text{C}$  NMR spectra were recorded at 75, 125 MHz in  $\text{CDCl}_3$  using Tetramethylsilane as the reference standard. s, brs, d, dd, ddd, dt, t, q, qt, and m refer to singlet, broad singlet, doublet, doublet of doublet, doublet of doublet of doublet, doublet of triplet, triplet, quartet, quintet and multiplet respectively unless otherwise mentioned. Infrared spectra were recorded on Perkin-Elmer Infrared-683 spectrophotometer with NaCl optics. Spectra were calibrated against the polystyrene absorption at 1610  $\text{cm}^{-1}$ . Samples were scanned neat. The optical rotations were measured on JASCO DIP-360 Digital Polarimeter. Mass spectra were recorded on Micro Mass VG-7070H mass spectrometer for ESI and EI are given in mass units ( $m/z$ ). High-resolution mass spectra (HRMS) [ESI+] were obtained using either a TOF or a double focusing spectrometer.

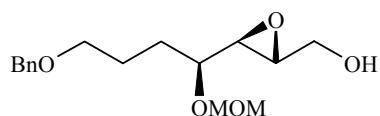
## 2. Physical and spectroscopic data of the products

### (S,E)-ethyl 7-(benzyloxy)-4-(methoxymethoxy)hept-2-enoate (7):



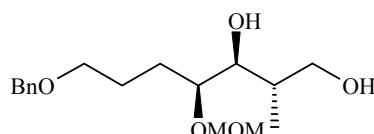
$[\alpha]_D^{25} = -40.4$  ( $c = 1.0, \text{CHCl}_3$ ); IR (Neat): 2943, 1720, 1656, 1270, 1099, 1034  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 500 MHz):  $\delta$  7.32-7.22 (m, 5H), 6.76 (dd,  $J = 5.9, 15.8$  Hz, 1H), 5.93 (d,  $J = 15.8$  Hz, 1H), 4.59 (d,  $J = 6.9$  Hz, 1H), 4.53 (d,  $J = 6.9$  Hz, 1H), 4.46 (s, 2H), 4.21-4.19 (m, 1H), 4.18 (q,  $J = 6.9, 2$  H), 3.48-3.43 (m, 2H), 3.33 (s, 3H), 1.75-1.63 (m, 4H), 1.30 (t,  $J = 6.9$  Hz, 3H);  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75 MHz):  $\delta$  166.1, 147.5, 138.3, 128.2, 127.5, 127.4, 121.9, 94.5, 74.8, 72.8, 69.8, 60.3, 55.5, 31.4, 25.3, 14.1; ESI-MS:  $m/z = 345$  [ $\text{M}+\text{Na}$ ] $^+$ ; HRMS calcd for  $\text{C}_{18}\text{H}_{26}\text{O}_5\text{Na}$ : 345.16725; found: 345.16693.

### ((2*R*,3*R*)-3-((*S*)-4-(benzyloxy)-1-(methoxymethoxy)butyl)oxiran-2-yl)methanol (4):



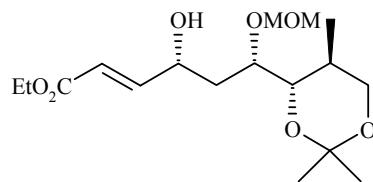
$[\alpha]_D^{25} = -15.6$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ); IR (Neat): 3446, 2933, 1637, 1098, 1033  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz):  $\delta$  7.34-7.22 (m, 5H), 4.81 (d,  $J = 6.7$  Hz, 1H), 4.59 (d,  $J = 6.7$  Hz, 1H), 4.47 (s, 2H), 3.88-3.81 (m, 1H), 3.65-3.56 (m, 1H), 3.49-3.42 (m, 2H), 3.37-3.30 (m, 1H), 3.35 (s, 3H), 2.98 (dd,  $J = 2.2, 7.5$  Hz, 1H), 2.91 (q,  $J = 2.2$ , 1H), 1.77-1.57 (m, 4H);  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75 MHz):  $\delta$  138.1, 128.3, 127.6, 127.5, 95.3, 76.8, 72.8, 69.8, 61.1, 57.9, 55.5, 55.4, 28.9, 25.5; ESI-MS:  $m/z = 319$   $[\text{M}+\text{Na}]^+$ ; HRMS calcd for  $\text{C}_{16}\text{H}_{24}\text{O}_5\text{Na}$ : 319.15160; found: 319.15126.

**(2*S*,3*S*,4*S*)-7-(benzyloxy)-4-(methoxymethoxy)-2-methylheptane-1,3-diol (9):**



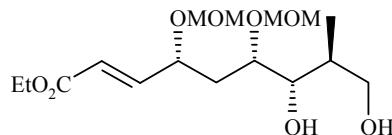
$[\alpha]_D^{25} = +31.6$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ); IR (Neat): 3422, 2934, 2879, 1453, 1096, 1033  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 500 MHz):  $\delta$  7.32-7.22 (m, 5H), 4.66 (q,  $J = 6.9$ , 2H), 4.46 (s, 2H), 3.69 (dd,  $J = 2.9, 10.8$  Hz, 1H), 3.64 (q,  $J = 5.9$ , 1H), 3.58 (dd,  $J = 5.9, 10.8$  Hz, 1H), 3.45 (t,  $J = 5.9$  Hz, 2H), 3.39 (s, 3H), 3.41-3.35 (m, 1H), 1.88-1.80 (m, 1H), 1.74-1.56 (m, 4H), 0.95 (d,  $J = 6.9$  Hz, 3H);  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75 MHz):  $\delta$  138.2, 128.3, 127.6, 127.5, 96.3, 79.4, 77.8, 72.9, 70.0, 66.8, 55.9, 36.4, 27.5, 25.4, 14.1; ESI-MS:  $m/z = 335$   $[\text{M}+\text{Na}]^+$ ; HRMS calcd for  $\text{C}_{17}\text{H}_{28}\text{O}_5\text{Na}$ : 335.18290; found: 335.18201.

**(4*R*,6*S*,*E*)-ethyl 4-hydroxy-6-(methoxymethoxy)-6-((4*S*,5*S*)-2,2,5-trimethyl-1,3-dioxan-4-yl)hex-2-enoate (12):**



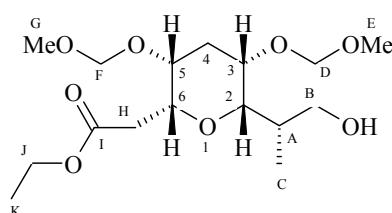
$[\alpha]_D^{25} = +21.3$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ); IR (Neat): 3441, 2934, 1718, 1374, 1269, 1036  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz):  $\delta$  6.95 (dd,  $J = 3.7, 15.1$  Hz, 1H), 6.10 (dd,  $J = 2.2, 15.8$  Hz, 1H), 4.71 (q,  $J = 6.7$ , 2H), 4.56-4.46 (m, 1H), 4.21 (q,  $J = 7.5$  Hz, 2H), 3.99-3.92 (m, 1H), 3.74 (dd,  $J = 5.2, 11.3$  Hz, 1H), 3.62 (dd,  $J = 2.2, 10.5$  Hz, 1H), 3.57-3.51 (m, 1H), 3.42 (s, 3H), 2.19-2.02 (m, 2H), 1.81-1.69 (m, 1H), 1.45 (s, 3H), 1.43 (s, 3H); 1.29 (t,  $J = 7.5$  Hz, 3H), 0.84 (d,  $J = 6.0$  Hz, 3H);  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75 MHz):  $\delta$  166.6, 149.8, 120.0, 98.6, 96.1, 76.0, 74.6, 67.7, 65.8, 60.3, 56.0, 37.2, 29.5, 29.3, 18.8, 14.1, 12.3; ESI-MS:  $m/z = 369$   $[\text{M}+\text{Na}]^+$ ; HRMS calcd for  $\text{C}_{17}\text{H}_{30}\text{O}_7\text{Na}$ : 369.18837; found: 369.18838.

**(4*R*,6*S*,7*S*,8*S*,*E*)-ethyl 7,9-dihydroxy-4,6-bis(methoxymethoxy)-8-methylnon-2-enoate (13):**



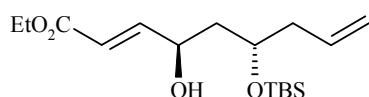
$[\alpha]_D^{25} = +87.3$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ); IR (Neat): 3430, 2932, 1718, 1153, 1029  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz):  $\delta$  6.83 (dd,  $J = 6.7, 15.8$  Hz, 1H), 6.01 (d,  $J = 15.8$  Hz, 1H), 4.75-4.56 (m, 4H), 4.41-4.30 (m, 1H), 4.21 (q,  $J = 6.7$  Hz, 2H), 3.88-3.80 (m, 1H), 3.79-3.62 (m, 2H), 3.56-3.49 (m, 1H), 3.42 (s, 3H), 3.38 (s, 3H), 2.08-1.84 (m, 3H), 1.30 (t,  $J = 7.5$  Hz, 3H), 0.95 (d,  $J = 7.5$  Hz, 3H),  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75 MHz):  $\delta$  166.0, 147.0, 122.2, 96.2, 94.7, 77.5, 75.8, 72.6, 67.0, 60.5, 56.0, 55.9, 36.6, 36.0, 14.1, 13.8; ESI-MS:  $m/z = 373$  [ $\text{M}+\text{Na}]^+$ ; HRMS calcd for  $\text{C}_{16}\text{H}_{30}\text{O}_8\text{Na}$ : 373.18329; found: 369.18333.

**Ethyl 2-((2*R*,3*R*,5*S*,6*S*)-6-((*S*)-1-hydroxypropan-2-yl)-3,5-bis(methoxymethoxy)-tetrahydro-2*H*-pyran-2-yl)acetate (1):**



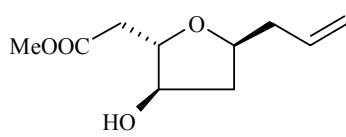
$[\alpha]_D^{25} = +8.0$  ( $c = 0.4$ ,  $\text{CHCl}_3$ ); IR (Neat): 3444, 2925, 2932, 1714, 1456, 1151, 1042  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 600 MHz):  $\delta$  4.81 (d,  $J = 7.1$  Hz,  $\text{H}_{\text{D}\alpha}$ ), 4.70 (d,  $J = 6.9$  Hz,  $\text{H}_{\text{F}\alpha}$ ), 4.66 (d,  $J = 6.9$  Hz,  $\text{H}_{\text{F}\beta}$ ), 4.63 (d,  $J = 7.1$  Hz,  $\text{H}_{\text{D}\beta}$ ), 4.40 (td,  $J = 4.0, 10.1$  Hz,  $\text{H}_6$ ), 4.22 (m,  $\text{H}_{\text{J}\alpha}$ ), 4.18 (m,  $\text{H}_{\text{J}\beta}$ ), 3.82 (td,  $J = 4.0, 1.9$  Hz,  $\text{H}_3$ ), 3.75 (dd,  $J = 2.8, 11.3$  Hz,  $\text{H}_{\text{B}\alpha}$ ), 3.58 (q,  $J = 4.1$  Hz,  $\text{H}_5$ ), 3.53 (dd,  $J = 1.9, 10.1$  Hz,  $\text{H}_2$ ), 3.49 (dd,  $J = 5.2, 11.2$  Hz,  $\text{H}_{\text{B}\beta}$ ), 3.42 (s,  $\text{H}_{\text{E}}$ ), 3.38 (s,  $\text{H}_{\text{G}}$ ), 2.73 (dd,  $J = 10.1, 14.3$  Hz,  $\text{H}_{\text{H}\alpha}$ ), 2.54 (dd,  $J = 4.0, 14.3$  Hz,  $\text{H}_{\text{H}\beta}$ ), 2.24 (m,  $\text{H}_{\text{A}}$ ), 2.22 (m,  $\text{H}_{\text{4}\alpha}$ ), 1.86 (td,  $J = 4.0, 15.2$  Hz,  $\text{H}_{\text{4}\beta}$ ), 1.28 (t,  $J = 7.0$  Hz,  $\text{H}_{\text{K}}$ ), 0.93 (d,  $J = 7.0$  Hz,  $\text{H}_{\text{C}}$ );  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 125 MHz):  $\delta$  171.2, 94.6, 94.4, 75.0, 73.2, 70.2, 68.3, 65.8, 61.1, 55.9, 55.5, 36.2, 34.8, 27.9, 14.0, 12.9; ESI-MS:  $m/z = 351$  [ $\text{M}+\text{H}]^+$ ; HRMS calcd for  $\text{C}_{16}\text{H}_{30}\text{O}_8\text{Na}$ : 373.18329; found: 373.18286

**(4*R*,6*S*,*E*)-ethyl 6-(tert-butyldimethylsilyloxy)-4-hydroxynona-2,8-dienoate (20):**



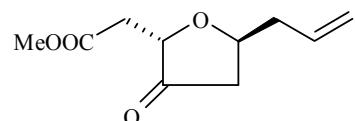
$[\alpha]_D^{25} = +12.1$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ); IR (Neat): 3476, 3076, 2933, 2858, 1716, 1259, 1081  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz):  $\delta$  6.90 (dd,  $J = 3.9, 15.0$  Hz, 1H), 6.09 (dd,  $J = 2.0, 15.9$  Hz, 1H), 5.82-5.71 (m, 1H), 5.12-5.03 (m, 2H), 4.49-4.43 (m, 1H), 4.19 (q,  $J = 7.9, 2$  H), 4.06-4.00 (m, 1H), 3.38 (brs, OH), 2.34-2.28 (m, 2H), 1.78 (dt,  $J = 13.9, 2.9$  Hz, 1H), 1.67-1.60 (m, 1H), 1.28 (t,  $J = 6.9$  Hz, 3H), 0.92 (s, 9H), 0.14 (s, 3H), 0.13 (s, 3H);  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75 MHz):  $\delta$  166.6, 150.3, 134.0, 119.8, 117.8, 70.4, 67.8, 60.3, 41.0, 40.6, 25.7, 17.9, 14.2, -4.4, -4.8; ESI-MS:  $m/z = 351$  [ $\text{M}+\text{Na}]^+$ .

**methyl 2-((2*S*,3*R*,5*S*)-5-allyl-3-hydroxytetrahydrofuran-2-yl)acetate (21):**

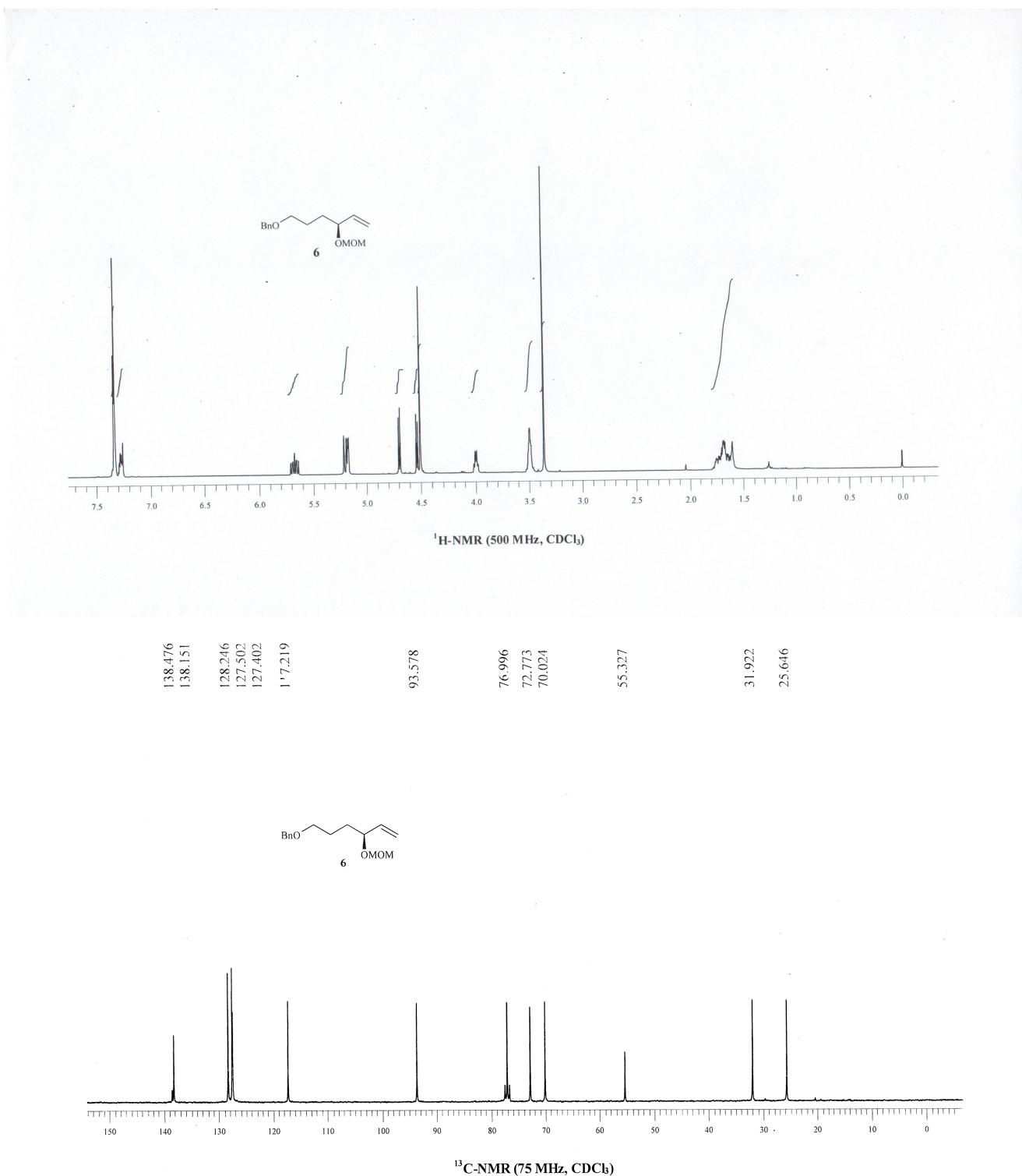


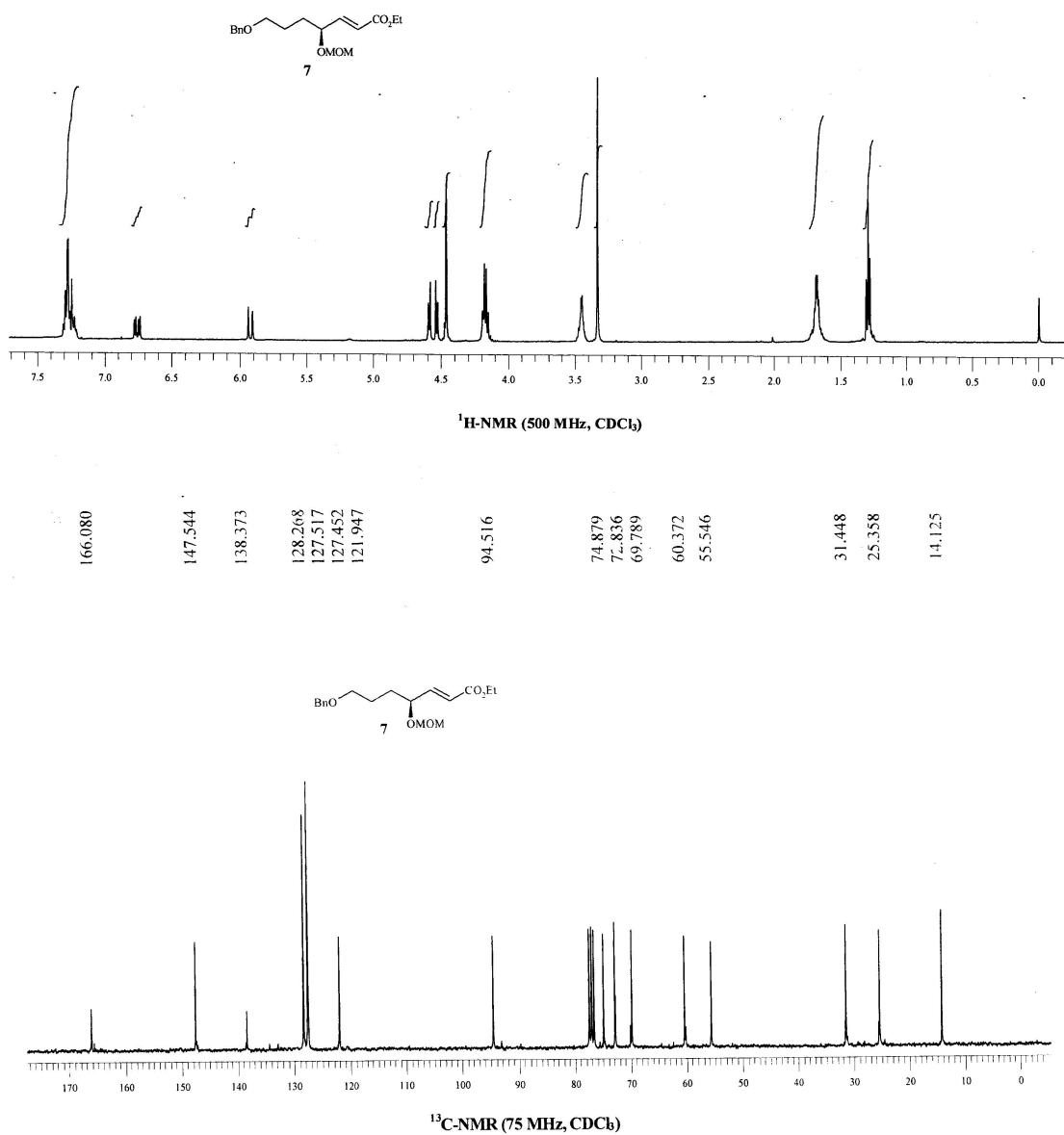
$[\alpha]_D^{25} = +11.0$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ); IR (Neat): 3442, 3076, 2926, 1734, 1438, 1270, 1080  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 500 MHz):  $\delta$  5.86-5.75 (m, 1H), 5.15-5.06 (m, 2H), 4.19-4.06 (m, 3H), 3.71 (s, 3H), 2.75 (dd,  $J = 6.0, 16.8\text{Hz}$ , 1H), 2.52 (dd,  $J = 7.9, 15.8\text{Hz}$ , 1H), 2.46-2.29 (m, 3H), 1.77-1.70 (m, 1H);  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75 MHz):  $\delta$  172.5, 134.2, 117.4, 80.3, 76.9, 76.5, 51.9, 40.2, 39.3, 38.2; ESI-MS:  $m/z = 223$   $[\text{M}+\text{Na}]^+$ . HRMS calcd for  $\text{C}_{10}\text{H}_{16}\text{O}_4\text{Na}$ : 223.09408; found: 223.09404.

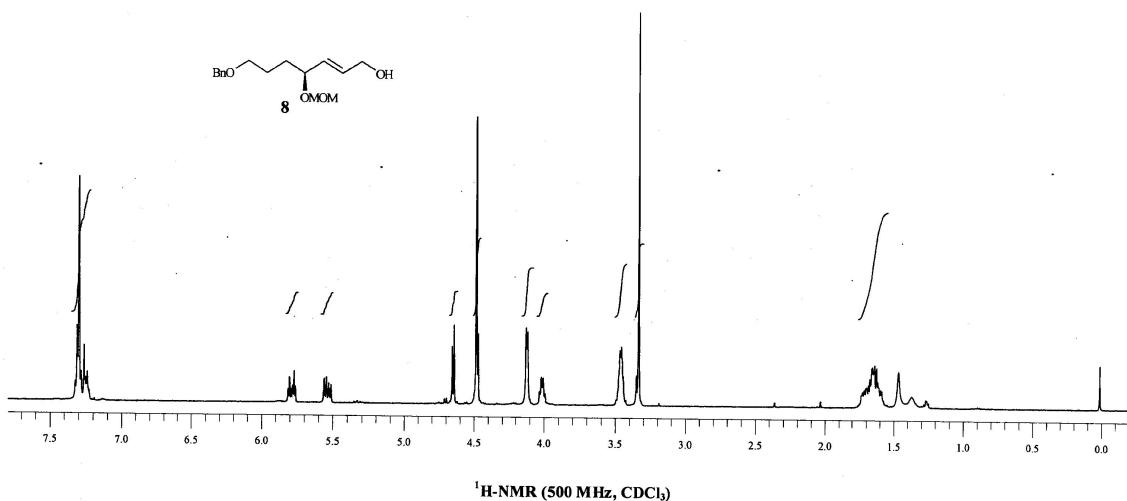
**methyl 2-((2*S*,5*S*)-5-allyl-3-oxotetrahydrofuran-2-yl)acetate (14):**



$[\alpha]_D^{25} = -17.5$  ( $c = 1.0$ ,  $\text{CHCl}_3$ ); IR (Neat): 2954, 1738, 1439, 1173, 1017  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR ( $\text{CDCl}_3$ , 300 MHz):  $\delta$  5.89-5.73 (m, 1H), 5.19-5.11 (m, 2H), 4.56 (qt,  $J = 6.0, 12.8\text{ Hz}$ , 1H), 4.23 (t,  $J = 4.5\text{ Hz}$ , 1H), 3.69 (s, 3H), 2.79 (d,  $J = 4.5\text{ Hz}$ , 2H), 2.74 (d,  $J = 7.5\text{ Hz}$ , 1H), 2.53-2.29 (m, 3H);  $^{13}\text{C}$  NMR ( $\text{CDCl}_3$ , 75 MHz):  $\delta$  215.0, 170.7, 133.0, 118.4, 75.7, 75.5, 52.0, 41.1, 40.1, 36.5; ESI-MS:  $m/z = 221$   $[\text{M}+\text{Na}]^+$ .

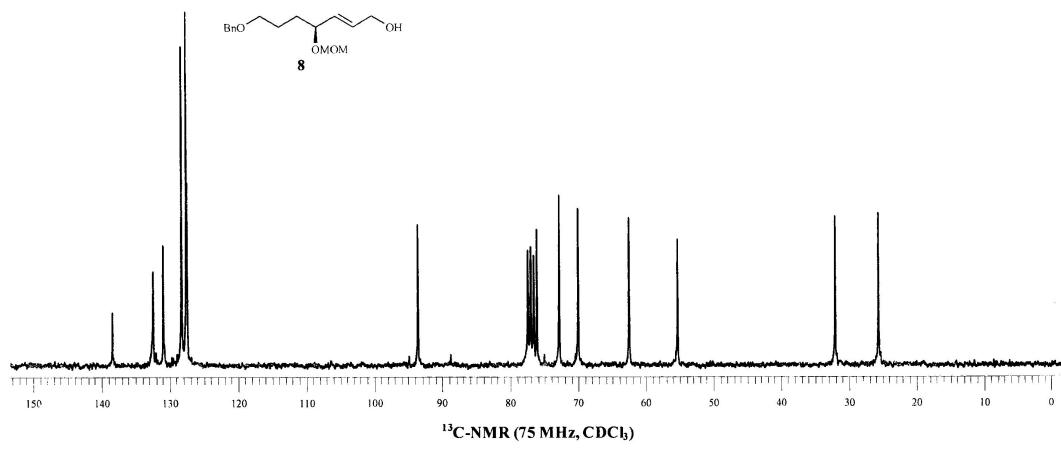


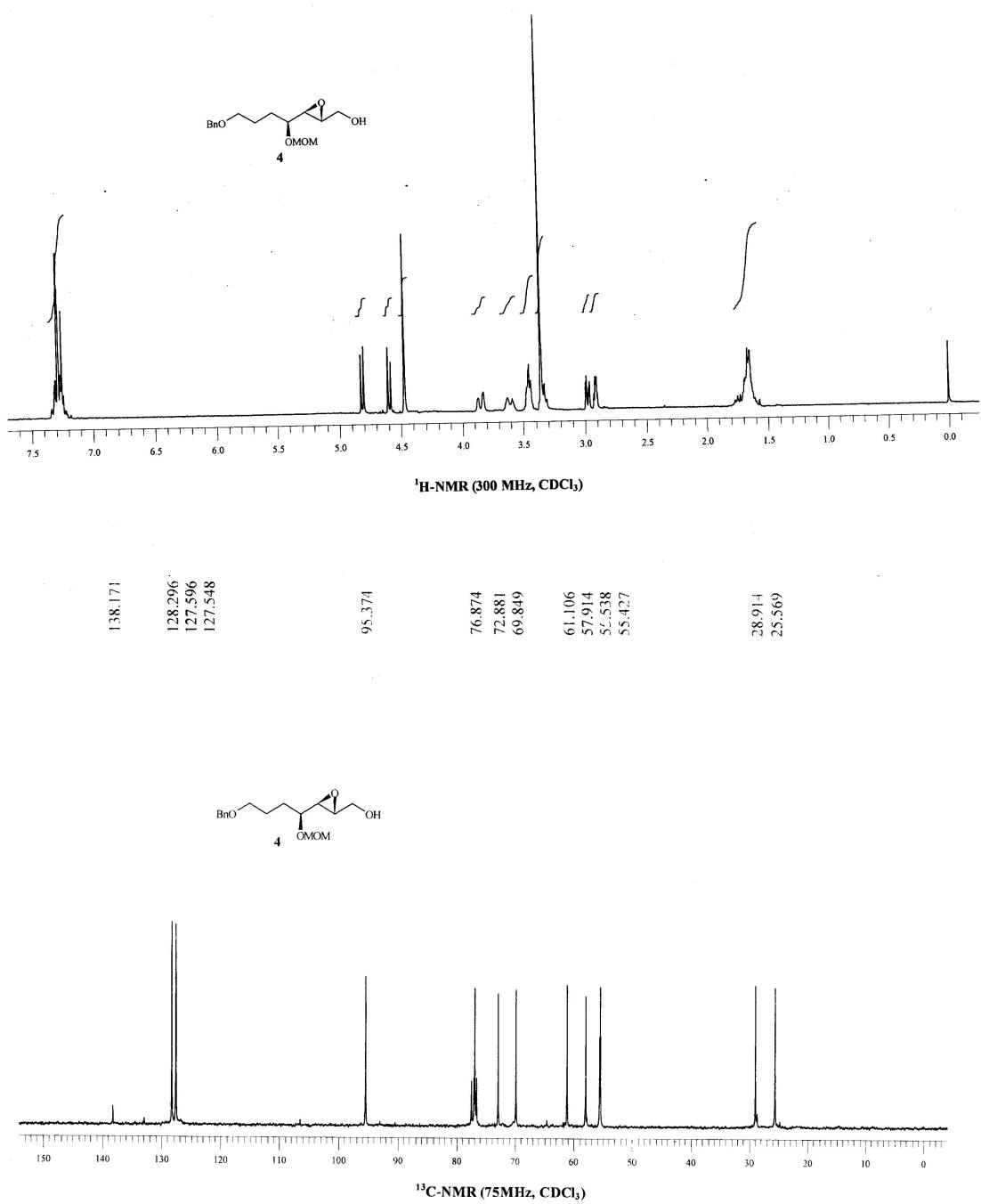


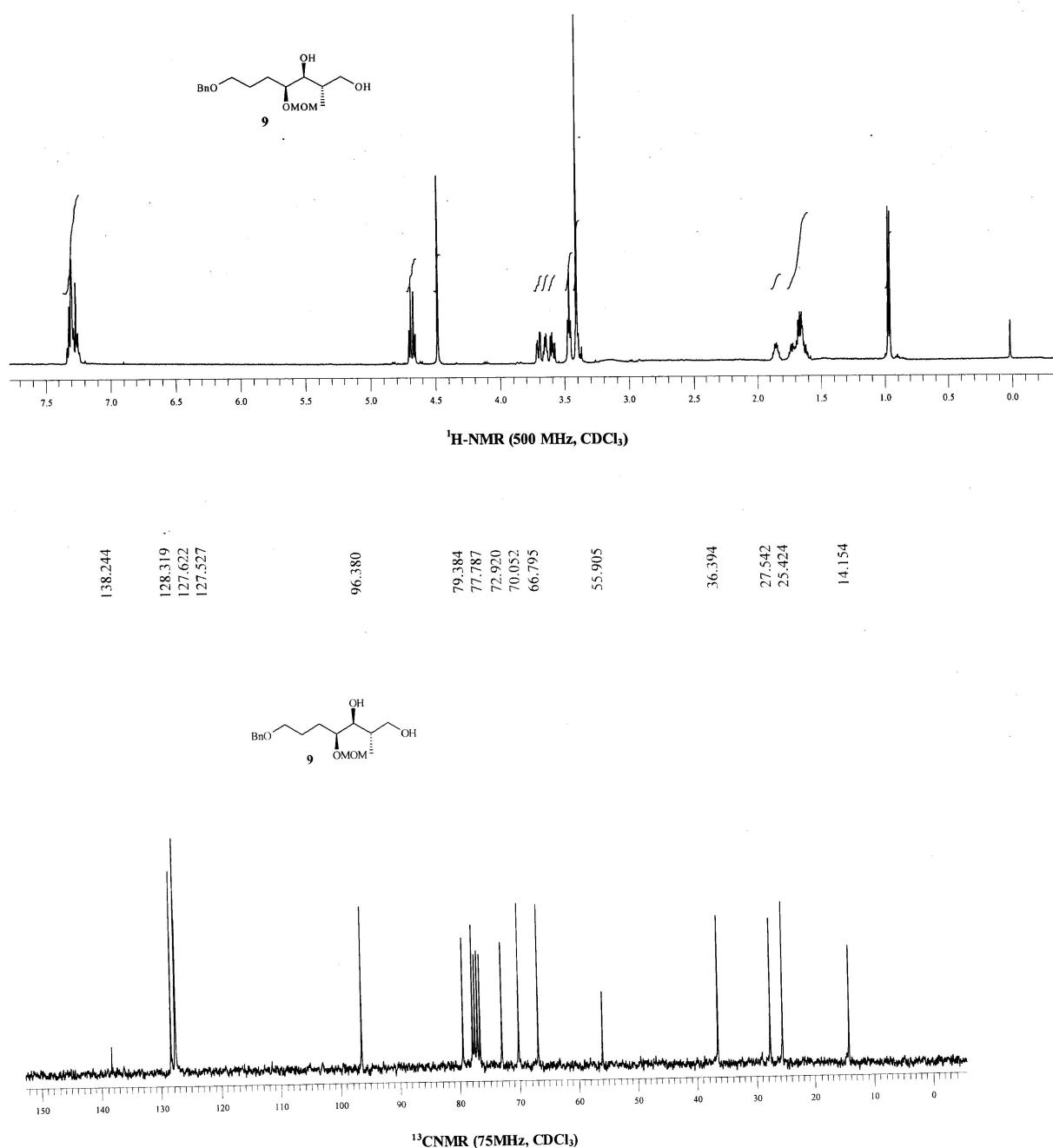


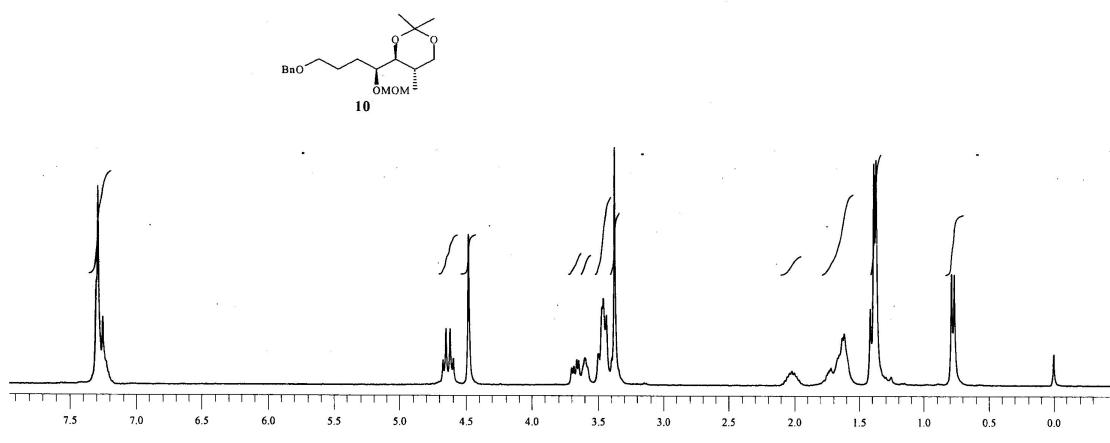
138.351  
132.351  
130.884  
128.246  
127.534  
127.438

93.553  
76.097  
72.787  
70.001  
62.502  
55.299  
32.038  
25.607



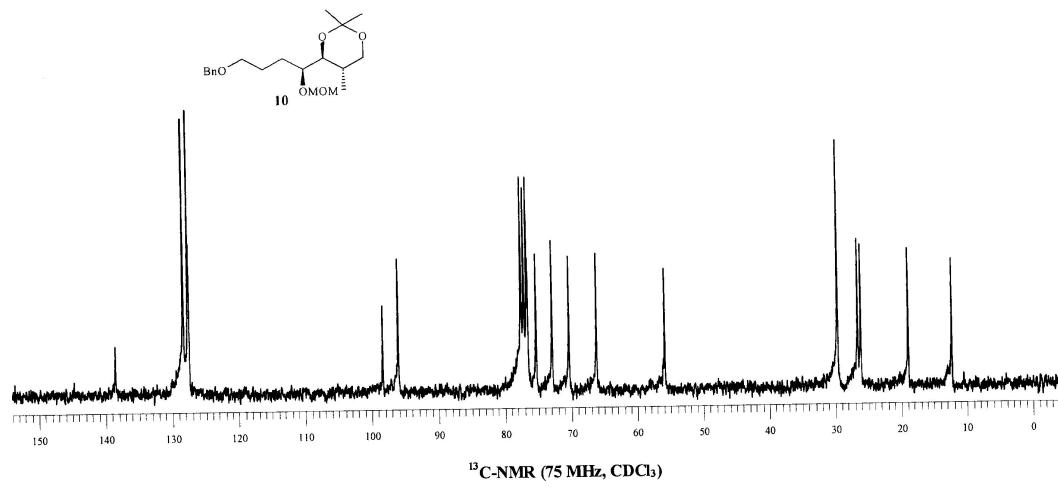




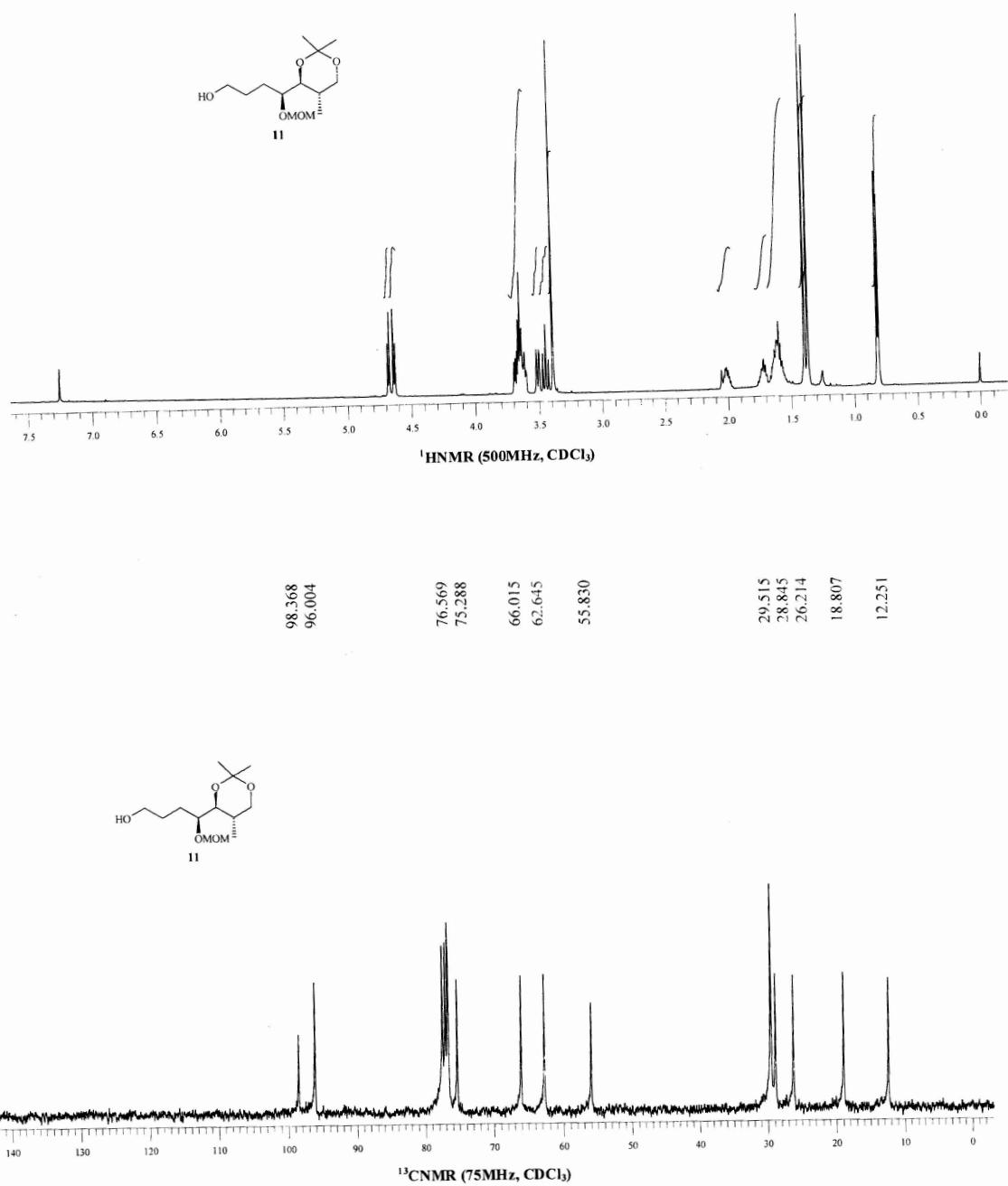


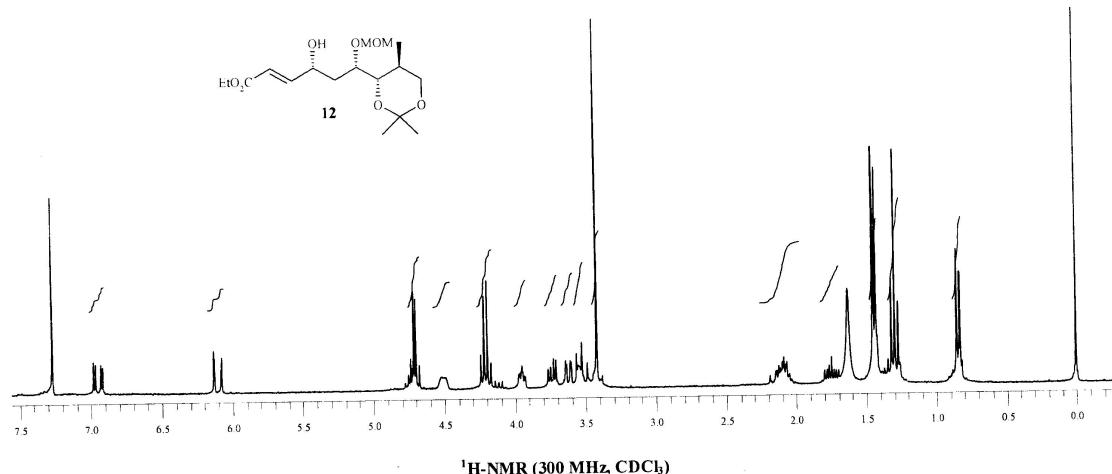
<sup>1</sup>H-NMR (300 MHz, CDCl<sub>3</sub>)

138.482  
128.268  
127.547  
127.445  
98.330  
95.999  
76.433  
75.208  
72.795  
70.258  
66.011  
55.816  
29.559  
26.527  
26.052  
18.841  
12.215

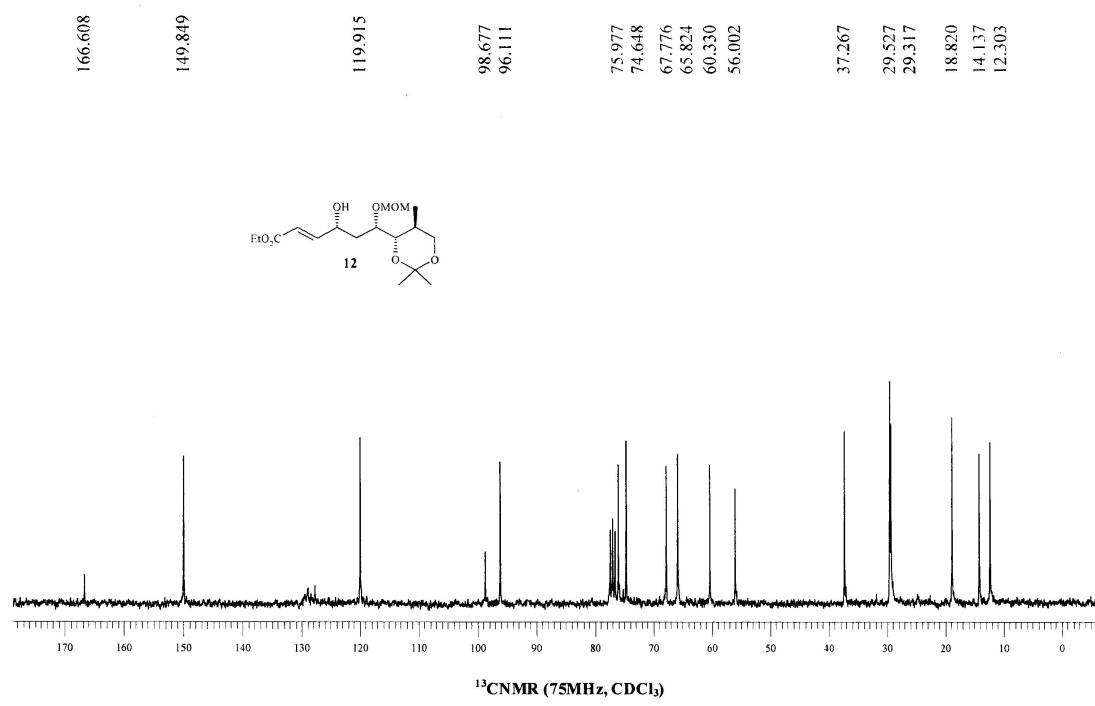


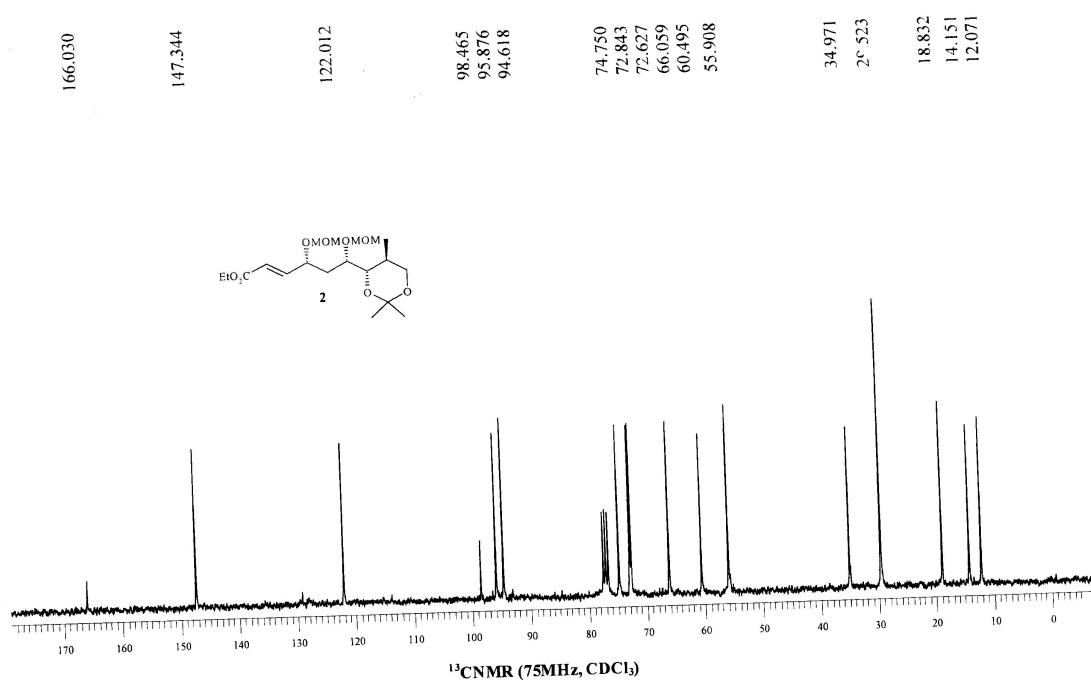
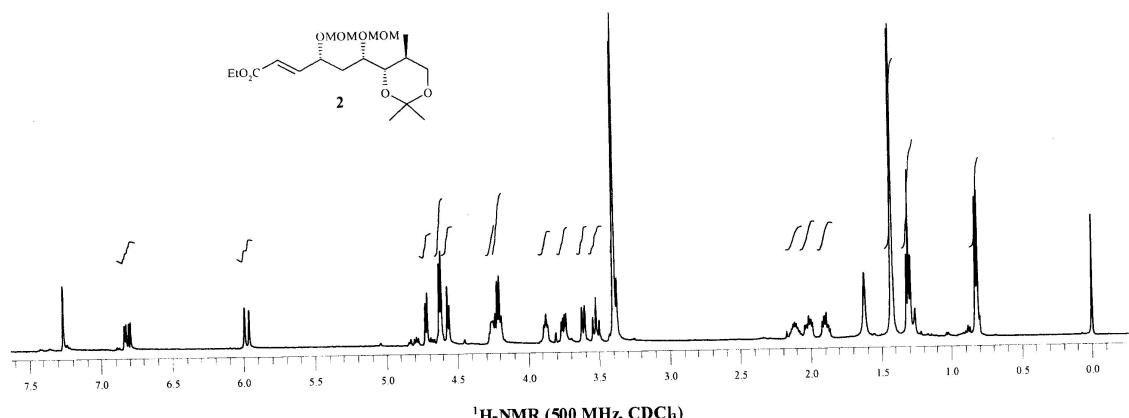
<sup>13</sup>C-NMR (75 MHz, CDCl<sub>3</sub>)

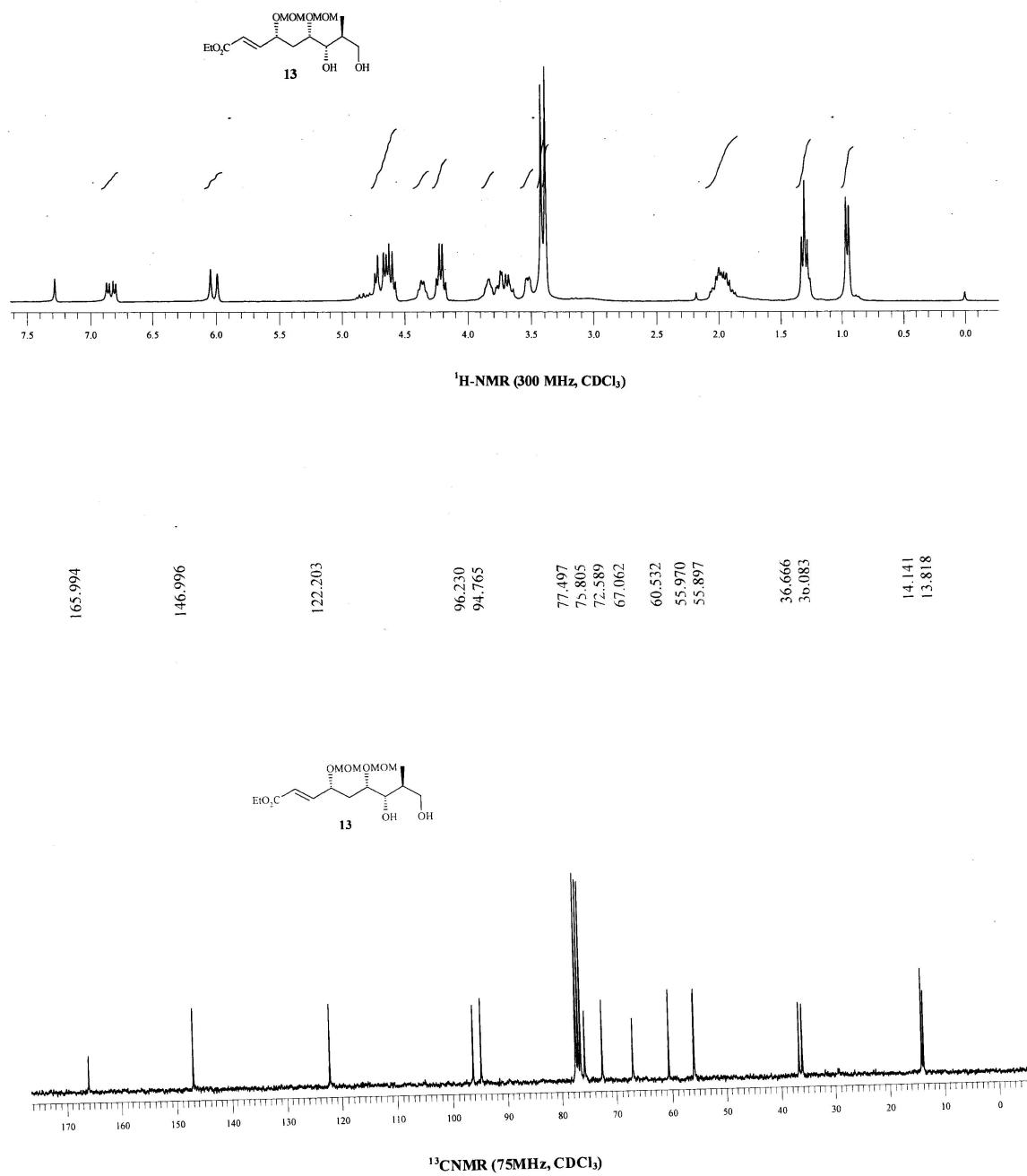


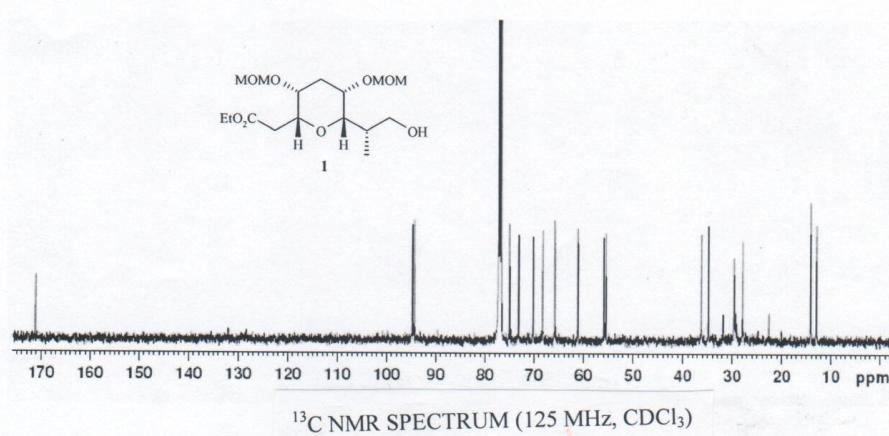
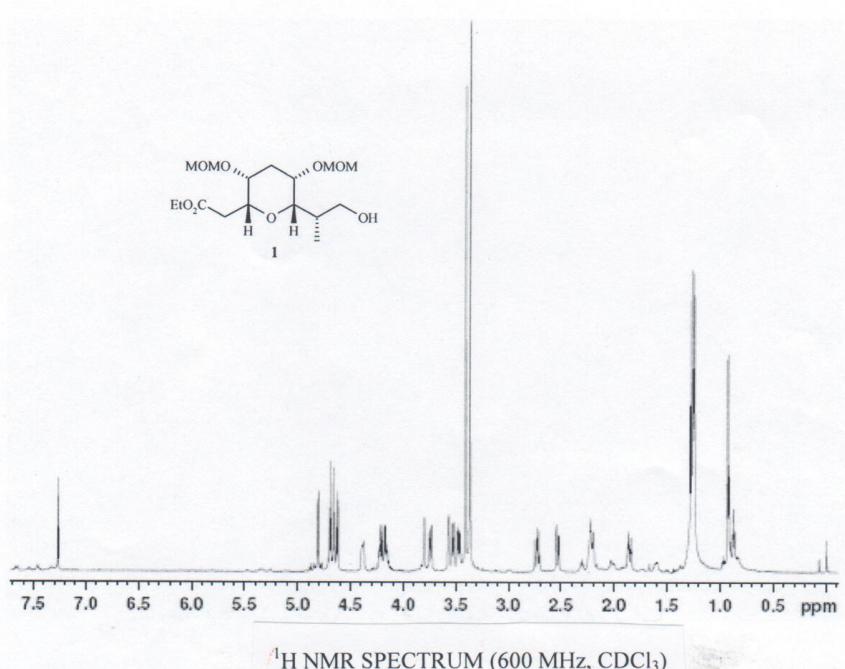


<sup>1</sup>H-NMR (300 MHz, CDCl<sub>3</sub>)

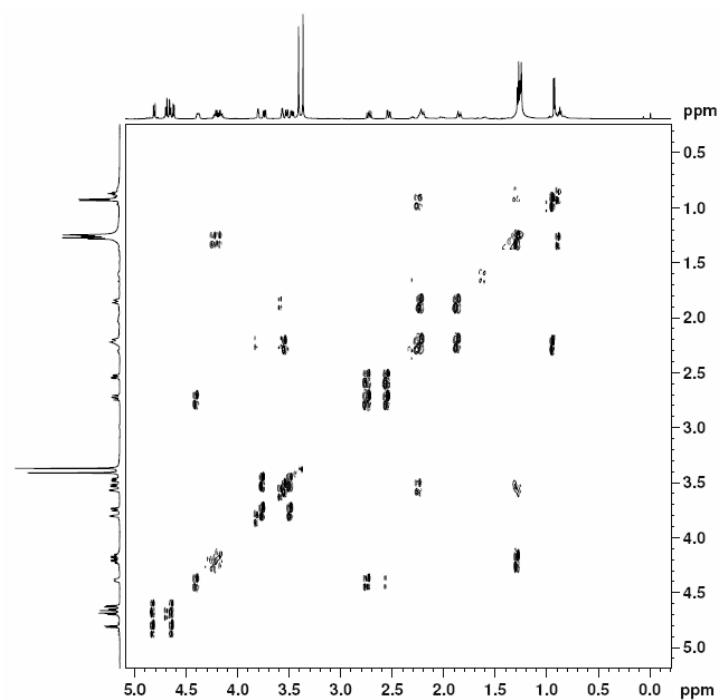




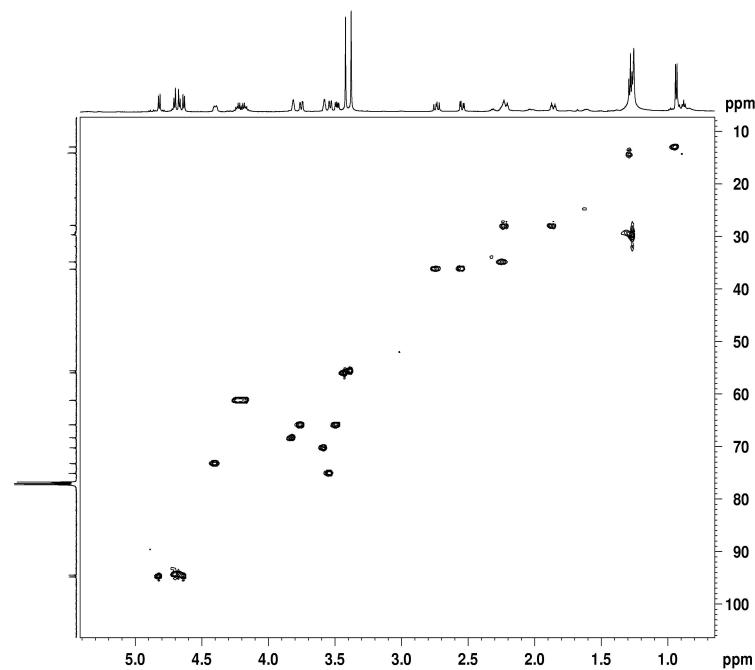




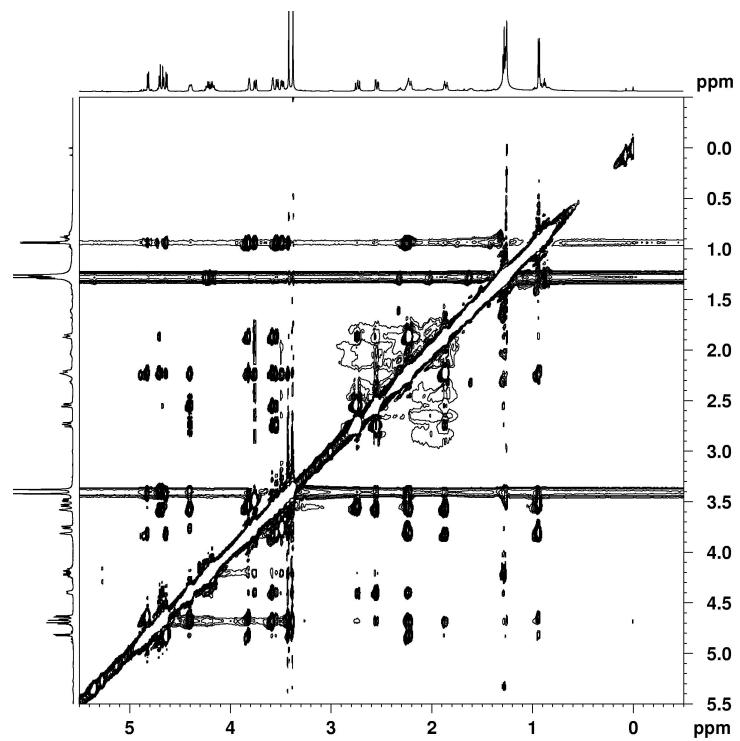
**COSY NMR Spectrum of compound 1 in  $\text{CDCl}_3$  solution at 600 MHz**

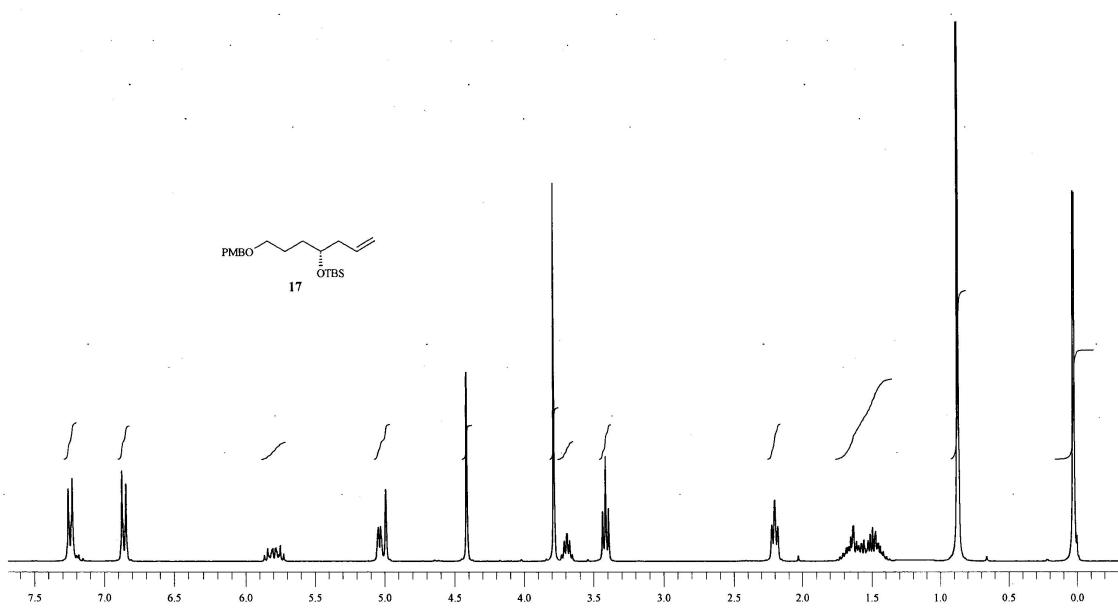


**HSQC NMR Spectrum of compound 1 in  $\text{CDCl}_3$  solution at 600 MHz**

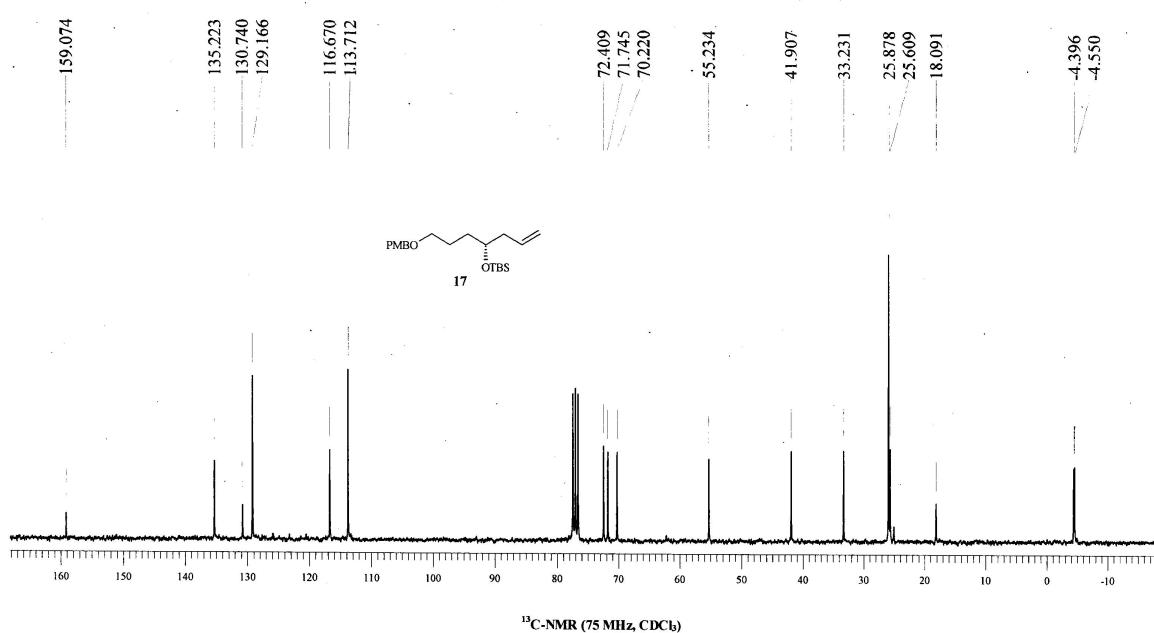


**Expanded NOESY NMR Spectrum of compound 1 in CDCl<sub>3</sub> solution at 600 MHz**

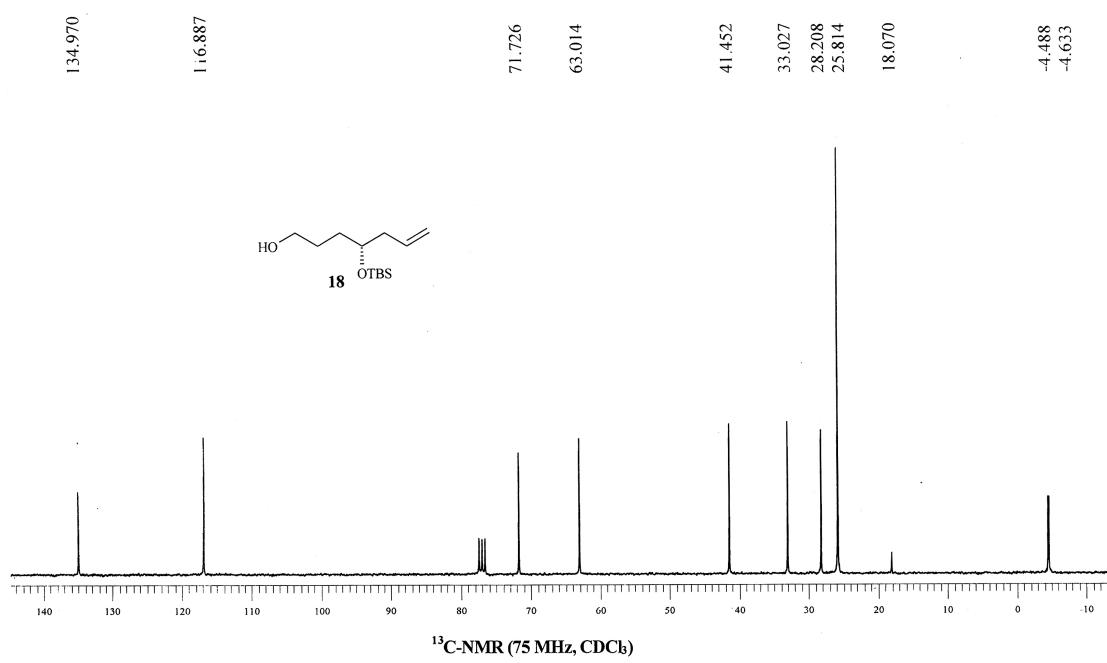
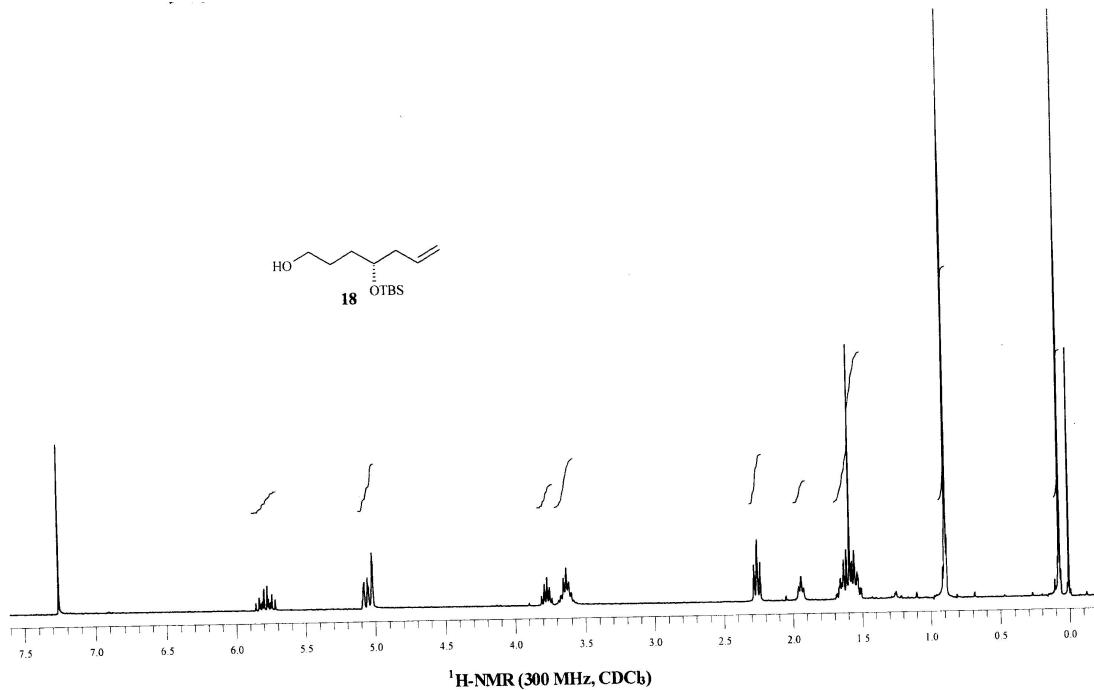


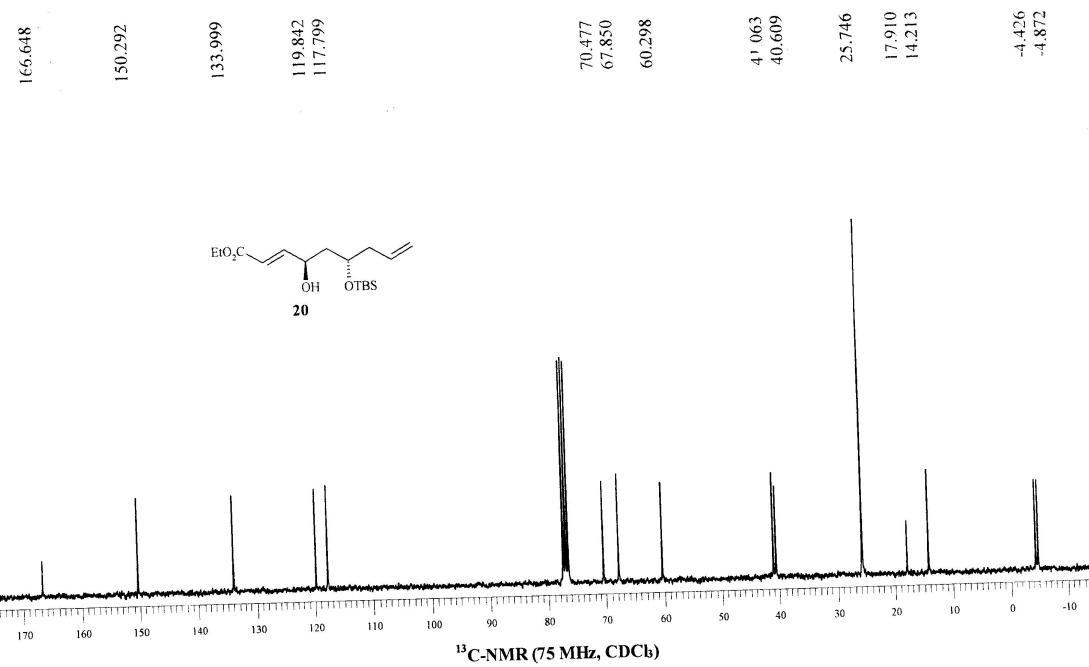
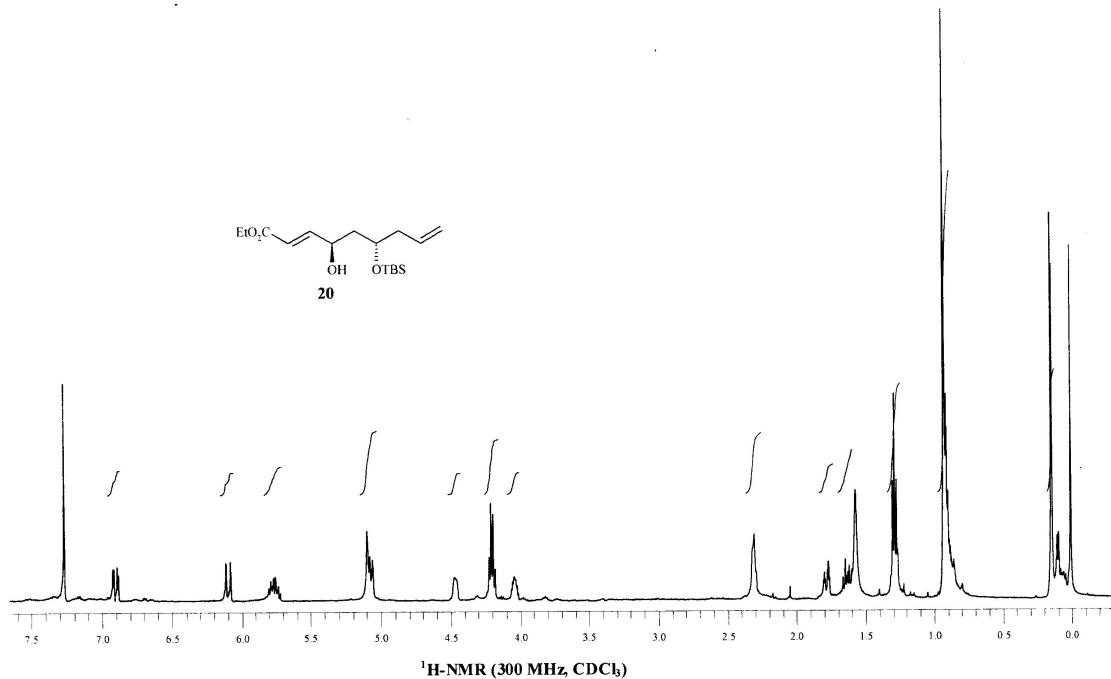


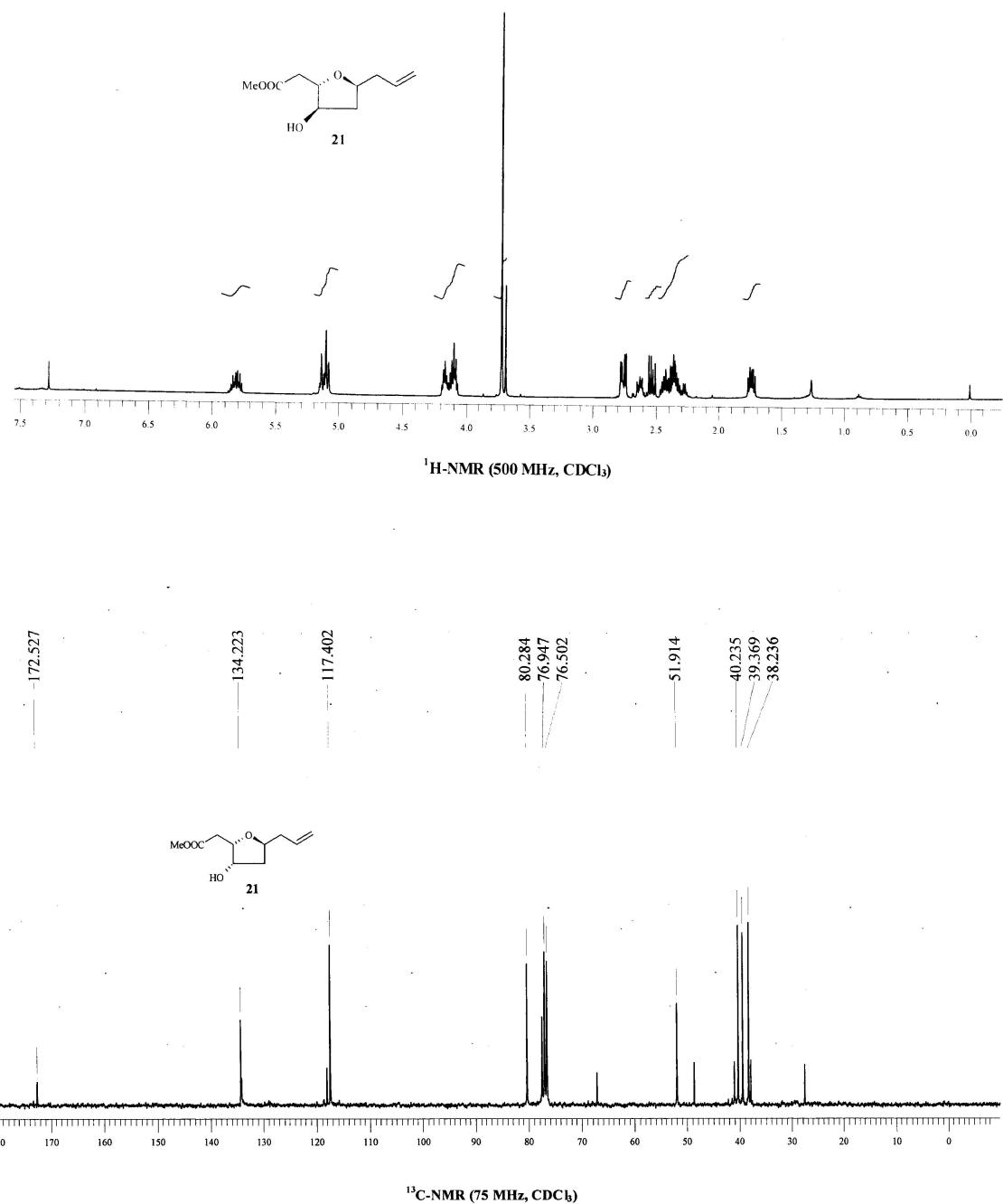
<sup>1</sup>H-NMR (300 MHz, CDCl<sub>3</sub>)



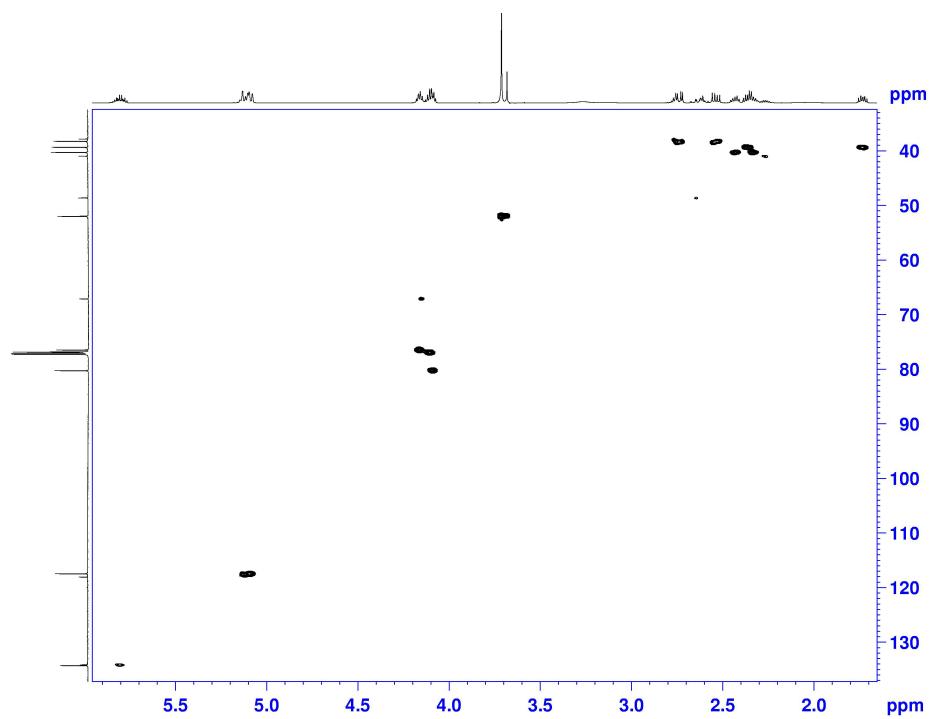
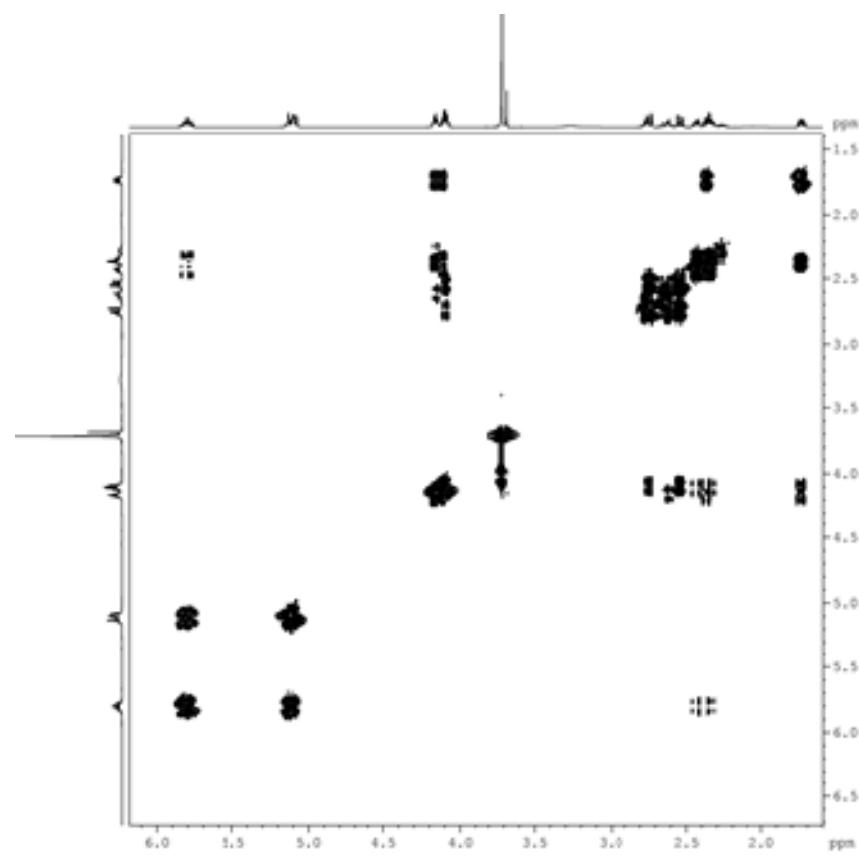
<sup>13</sup>C-NMR (75 MHz, CDCl<sub>3</sub>)



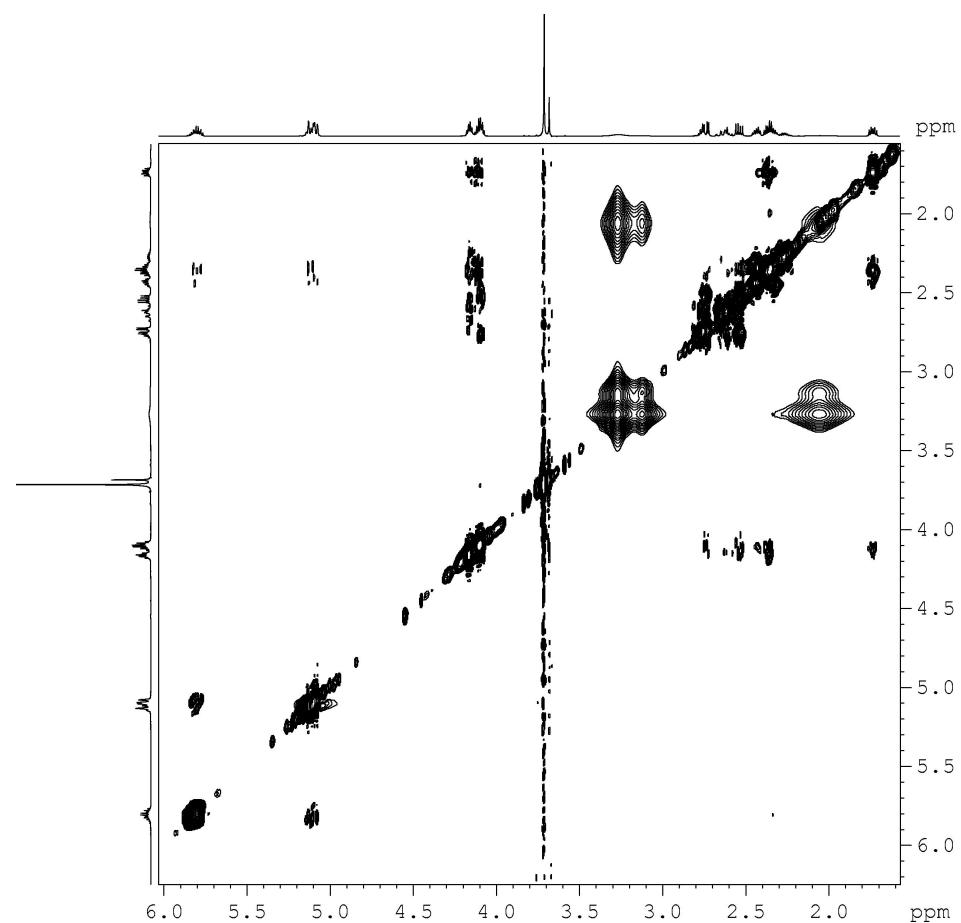


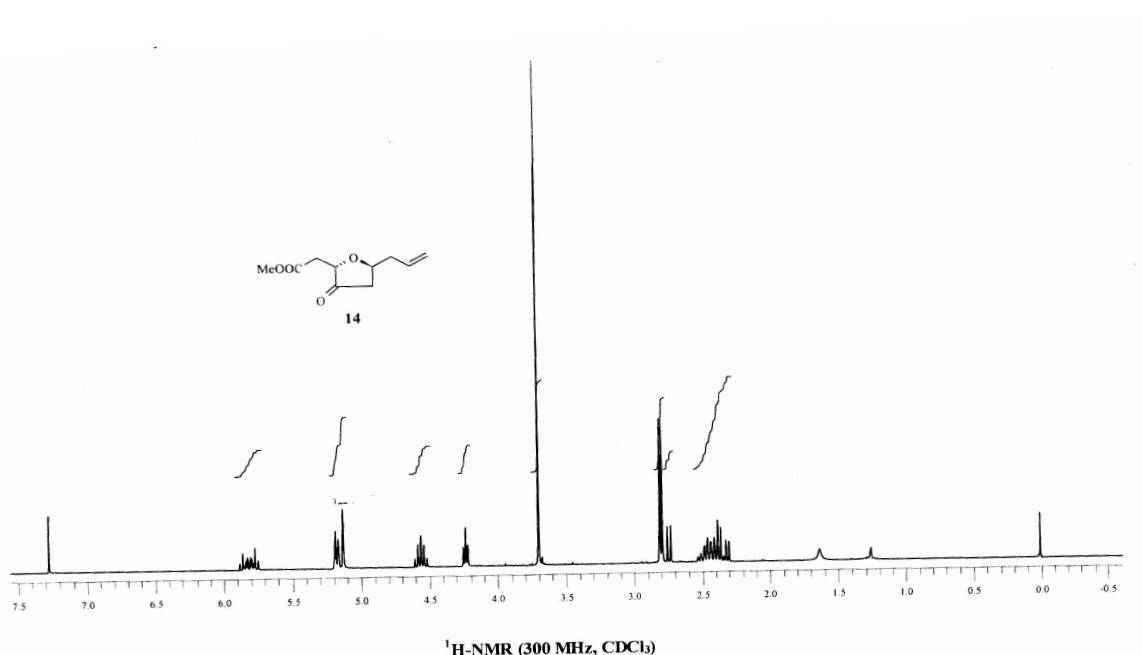


**COSY NMR Spectrum of compound 21 in CDCl<sub>3</sub> solution at 600MHz**



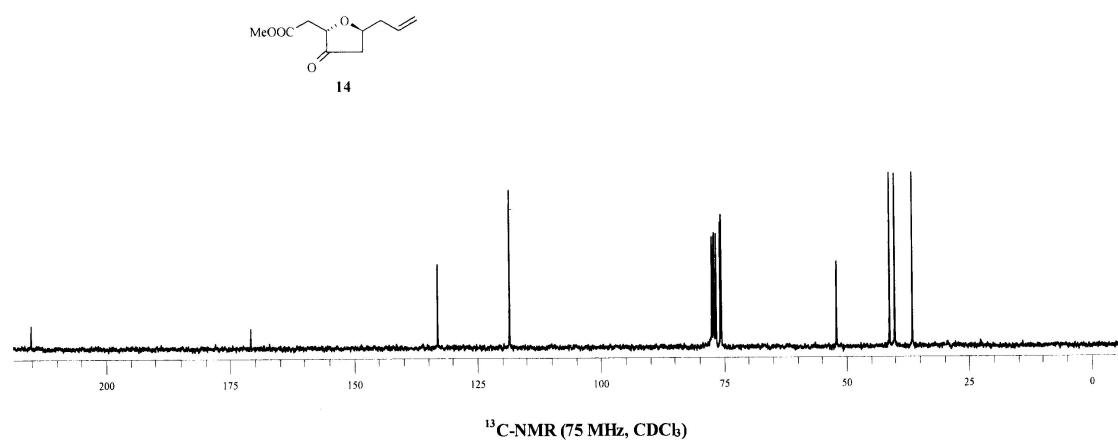
**NOESY NMR Spectrum of compound 21 in CDCl<sub>3</sub> solution at 600MHz**





<sup>1</sup>H-NMR (300 MHz, CDCl<sub>3</sub>)

215.047  
170.750  
133.030  
118.443  
52.018  
75.687  
75.529  
41.151  
40.091  
36.514<sup>+</sup>



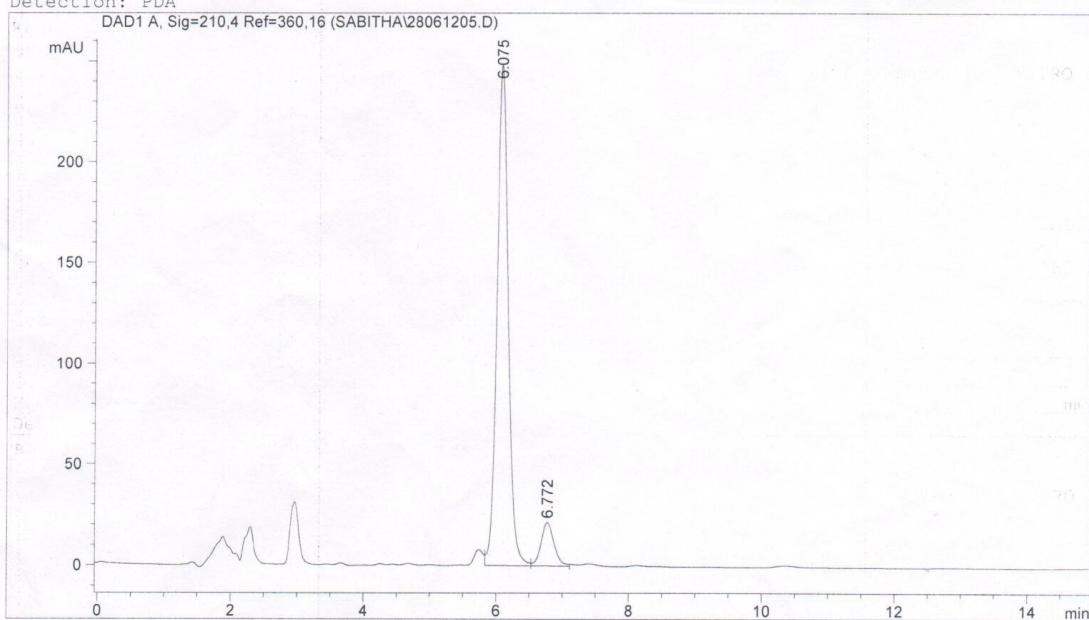
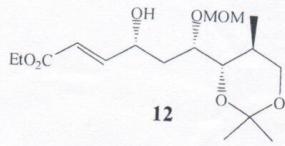
<sup>13</sup>C-NMR (75 MHz, CDCl<sub>3</sub>)

Data File D:\DATA\SABITHA\28061205.D

Sample Name: GSR-NITRO 1

HR C18: 40% ACN IN WATER

=====  
Injection Date : 6/28/2012 10:19:29 PM  
Sample Name : GSR-NITRO 1  
Acq. Operator : B.RAMESH  
Acq. Method : D:\METHODS\GEN.M  
Last changed : 6/28/2012 10:34:55 PM by B.RAMESH  
Analysis Method : D:\METHODS\GEN.M  
Last changed : 6/28/2012 10:32:57 PM by RAJU  
(modified after loading)  
Mobile phase: 40% Acetonitrile + 60% Water  
Column: WATERS HR C18 300 x 3.9mm 6, micron  
Flow rate: 1.0mL/min  
Detector: PDA  
=====



## Area Percent Report

Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=210,4 Ref=360,16

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	6.075	VV	0.1799	2941.80176	248.82742	90.9674
2	6.772	VB	0.2066	292.10458	21.48468	9.0326

Totals : 3233.90634 270.31211

Results obtained with enhanced integrator!

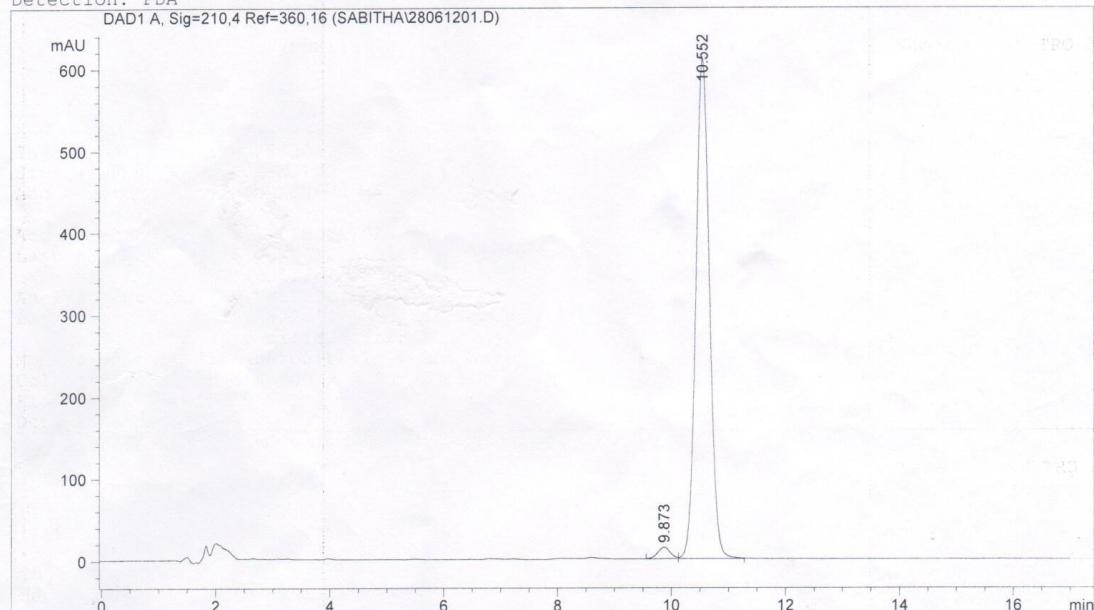
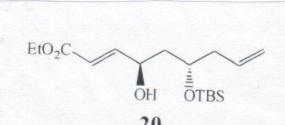
\*\*\* End of Report \*\*\*

Data File D:\DATA\SABITHA\28061201.D Sample Name: GSR-NITRO 2

HR C18: 75% ACN IN WATER

Sample Name: GSR-NITRO 2

=====  
Injection Date : 6/28/2012 8:54:06 PM  
Sample Name : GSR-NITRO 2 I  
Acq. Operator : B.RAMESH In  
Acq. Method : D:\METHODS\GEN.M  
Last changed : 6/28/2012 8:52:23 PM by B.RAMESH  
(modified after loading)  
Analysis Method : D:\METHODS\GEN.M  
Last changed : 6/28/2012 10:14:44 PM by RAJU  
(modified after loading)  
Mobile phase: 75% Acetonitrile + 25% Water  
Column: WATERS HR C18 300 x 3.9mm 6 micron  
Flow rate: 1.0mL/min  
Detection: PDA



## ===== Area Percent Report

Sorted By : Signal  
Multiplier : 1.0000  
Dilution : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=210, 4 Ref=360, 16

Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	9.873	BV	0.2422	215.65994	13.96120	2.0954
2	10.552	VB	0.2568	1.00762e4	609.80548	97.9046

Totals : 1.02919e4 623.76668

Results obtained with enhanced integrator!

=====  
\*\*\* End of Report \*\*\*