# Electronic Supplementary Information (ESI)

# "Two Stereocentered HKR of *anti-β,β'*-diphenylpropanoxirane and *anti*-3-phenylethyloxiranes Catalysed by Co(III)(salen)-OAc Complex : An Enantioselective Synthesis of (+)-Sertraline and (+)-Naproxen"

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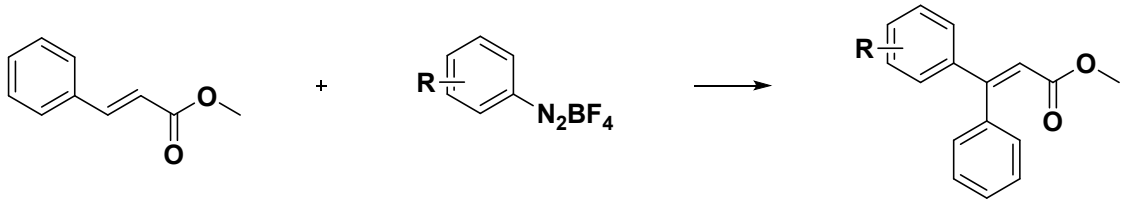
**1. General information:**

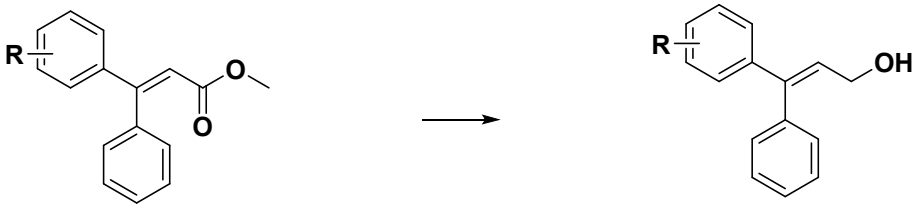
Solvents were purified and dried by standard procedures before use. Optical rotations were measured using sodium D line on a JASCO-181 digital polarimeter. IR spectra were recorded on a Perkin-Elmer model 683 B and absorption is expressed in $cm^{-1}$. $^{1}H$ NMR and $^{13}C$ NMR spectra were recorded on Brucker AC-200 spectrometer unless mentioned otherwise. The peak at δ 96.16 corresponds to the Carbon Tetrachloride in Chloroform-D. Elemental analysis was carried out on a Carlo Erba CHNS-O analyzer. Purification was done using column chromatography (60-120 mesh). Enantiomeric excesses were determined on Agilent HPLC instrument equipped with a chiral column. HRMS data were recorded on a Thermo Scientific Q-Exactive, Accela 1250 pump. Diphenyl cinnamates (10a-e) [1] and allylic alcohols (11a-e) [2] were prepared from known methods.

**2. Synthesis of substituted methyl-3,3'-diphenylacrylate[1]:**




To a solution of methyl cinnamate (10 mmol) in methanol (60 mL), $Pd(OAc)_2$ (10 mol%) and substitutedbenzenediazonium tetrafluoroborate (12 mmol) was added. The reaction mixture was stirred to reflux for 4 h. After completion of reaction (monitored by TLC), it was filtered through a pad of Celite and washed with methanol (3 x 15 mL). The combined filtrates were concentrated to give crude product, which upon column chromatographic purification with flash silica gel using petroleum ether: ethyl acetate (3:7) as eluent gave pure substituted methyl-3,3'-diphenylacrylate.

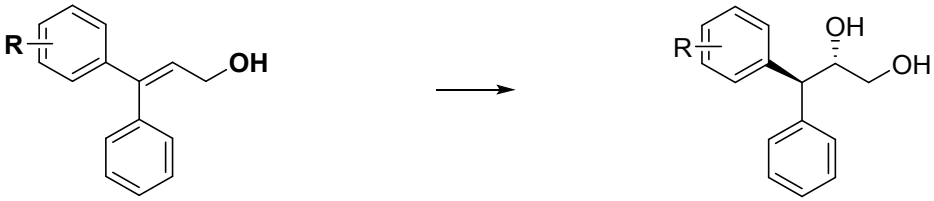
**3. Synthesis of substituted 3,3'-diphenylprop-2-en-1-ol[2] ;**




To a stirred solution of the ester (3.26 mmol), in dry $CH_2Cl_2$ (25 mL), a solution of diisobutylaluminium hydride (1 M solution in toluene, 7.18 mmol)) was added dropwise at 0 °C and the reaction mixture was stirred at this

temperature for 2 h. After completion of reaction (monitored by TLC), it was diluted with a saturated solution of Rochelle salt and stirred for further 3 h. The organic phase was separated and the aqueous phase extracted twice with $CH_2Cl_2$. The combined organic layers were washed with brine, dried over anhyd. $Na_2SO_4$ and concentrated under reduced pressure to give crude product, which upon column chromatographic purification with silica gel using petroleum ether: ethyl acetate (8:2) as eluent gave pure as colorless oil.

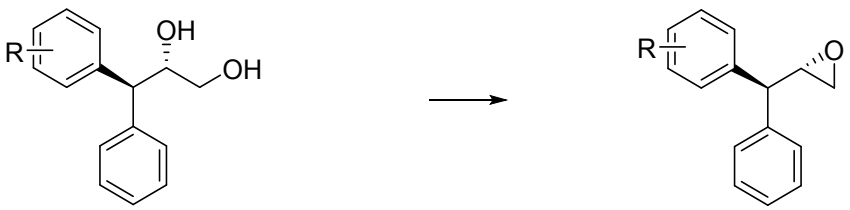
**4. General Procedure for hydroboration of allylic alcohol ;**




**(±)**

To a stirred solution of homoallyl alcohol (9.4 mmol) in THF (5 mL) at 0 °C, $BH_3.SMe_2$ (4.5 mmol) was added and the reaction mixture was stirred at 25 °C for 4 h. After dilution with THF/MeOH (1:1) followed by the addition of 3 M solution of NaOH (4 mL) and an aq. solution 30% $H_2O_2$ (4 mL), the reaction was stirred for 4 h and quenched with a saturated solution of $Na_2SO_3$ (20 mL). The reaction mixture was then cooled to 0 °C, diluted with sat. $NaHCO_3$ (35 mL) and $Et_2O$ (35 mL). The organic layer was separated and the aqueous layer extracted with $Et_2O$ (2 x 30 mL). The combined organic extracts were washed with brine and dried over anhyd. $Na_2SO_4$ and concentrated under reduced pressure to give the crude product, which upon column chromatographic purification with silica gel using petroleum ether: ethyl acetate (5:5) as eluent gave pure diol.

**4. General procedure for Synthesis of Racemic oxiranes ;**




**(±)** **(±)**

A solution of corresponding diol (1.18 mmol) in $CH_2Cl_2$ (10 mL) was treated with TsCl (1.18 mmol), $Bu_2SnO$ (30 mol%), $Et_3N$ (30 mmol) and DMAP (cat.) at 0 °C. After being stirred for 1 h, the mixture was extracted with $CH_2Cl_2$ (3 × 20 mL), washed with water and the combined organic phases were dried over anhydrous $Na_2SO_4$

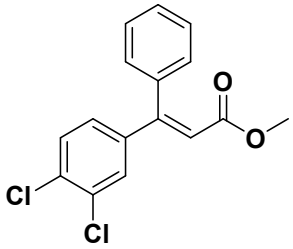
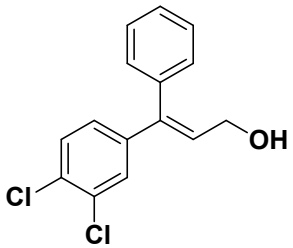
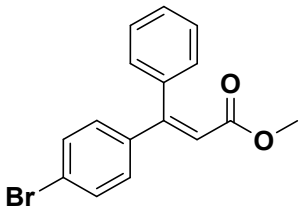
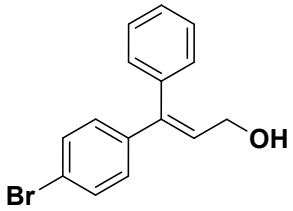
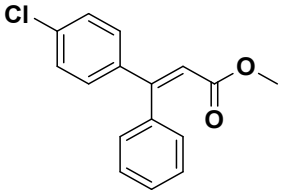
and concentrated to give the crude tosylate. To a solution of crude tosylate in MeOH (20 mL) was added $K_2CO_3$ (13 mmol) and the mixture was stirred at 0 °C for 30 min. After the reaction was complete (monitored by TLC), solvent was evaporated and the residue was extracted with diethyl ether (3 × 20 mL). The combined organic phases were dried over anhydrous $Na_2SO_4$ and concentrated to give the crude product which was then purified by column chromatography using petroleum ether/EtOAc (8:2 v/v) to give epoxide as a colorless oil.

## References relevant to supporting information:


**1.** Pastre, Cezar J., Correia, Duarte C.R.; *Advanced Synthesis and Catalysis*, **2009**, *351* (9), 1217

**2.** Ebner C., Pfaltz A.; *Tetra*. **2011**, *67*, 10287-10290

# Spectral Data

| **Methyl (*E*)-3-(3,4-dichlorophenyl)-3-phenylacrylate (10a)** | |
|---|---|
|  | **Yield:** 82%, colorless oil; **IR ($CHCl_3$, $cm^{-1}$):** $\upsilon_{max}$ 699, 823, 874, 1190, 1275, 1549, 1620, 1727, 2948; **$^1$H NMR (200 MHz, $CDCl_3$): δ** 3.61 (s, 3H), 6.32 (s, 1H), 7.07-7.19 (m, 3H), 7.37-7.41 (5H); **$^{13}$C NMR** (50 MHz, $CDCl_3$): δ 51.3, 118.1, 127.4, 128.1, 128.7, 129.0, 130.0, 130.3, 132.9, 133.7, 137.7, 140.9, 154.3, 165.7; **Anal. Calcd** for $C_{16}H_{12}O_2Cl_2$ requires C, 62.56; H, 3.94; found C, 62.50; H, 3.95%. |
| **(*E*)-3-(3,4-Dichlorophenyl)-3-phenylprop-2-en-1-ol (11a)** | |
|  | **Yield:** 95%, colorless oil; **IR ($CHCl_3$, $cm^{-1}$):** $\upsilon_{max}$ 1055, 1130, 1430, 1520, 2847, 2956, 3430; **$^1$H NMR (200 MHz, $CDCl_3$): δ** 4.22 (d, *J* = 6.8 Hz, 2H), 6.22 (t, *J* = 6.6 Hz, 1H), 7.04 (m, 3H), 7.32-73.39 (m, 5H); **$^{13}$C NMR (50 MHz, $CDCl_3$): δ** 60.4, 126.8, 128.0, 128.5, 129.0, 129.4, 129.6, 130.1, 132.5, 137.9, 141.8, 141.9; **Anal. Calcd** for $C_{15}H_{12}OCl_2$ requires C, 64.54; H, 4.33; found C, 64.66; H, 4.38%. |
| **Methyl-(E)-3-(4-bromophenyl)-3-phenylacrylate (10b):** | |
|  | **Yield**: 84% (710 mg) , Colorless thick liquid**; IR: (CHCl3, $cm^{-1}$)** – 1738; **$^1$H NMR: (200 MHz, CDCl3) δ** 3.60 (d, s, 1H), 6.32 (s, 1H), 7.15 (m, 5H), 7.46 (m, 4H); **$^{13}$C NMR (50 MHz, CDCl3): δ** 51.2, 117.1, 124.0, 128.0, 128.4, 129.8, 131.6, 138.2, 139.7, 155.7, and 165.9. |
| **(E)-3-(4-bromophenyl)-3-phenylprop-2-en-1-ol (11b):** | |
|  | **Yield:** 96% (621mg), White solid, **IR: (CHCl3, $cm^{-1}$)-** 3340; **$^1$H NMR: (200 MHz, $CDCl_3$) δ** 1.55 (bs, 1H), 4.18-4.21 (d, 2H, J= 6Hz), 6.18-6.25 (t, 1H, J=6Hz), 7.08 (m, 4H), 7.34-7.42 (m, 5H); **$^{13}$C NMR (50 MHz, $CDCl_3$) δ** 60.6, 12.8, 127.8, 128.0, 128.4, 129.2, 129.7, 131.3, 140.8 and 147.2; |
| **Methyl-(E)-3-(4-chlorophenyl)-3-phenylacrylate (10c)** | |
|  | **Yield:** 88% (652 mg), greenish gummy; **$^1$H NMR: (200 MHz, $CDCl_3$) δ** 3.60 (s, 3H), 6.32 (s, 1H), 7.15-7.25 (m, 6H), 7.37-7.40 (t, 3H, J=4Hz); **$^{13}$C NMR (50 MHz, $CDCl_3$) δ** 51.2, 117.2, 128.0, 128.4, 128.6, 129.1, 129.6, 135.7, 138.3, 139.3, 155.6, 166; |
| **(E)-3-(4-chlorophenyl)-3-phenylprop-2-en-1-ol (11c)** | |
| | **Yield**: 89% (520 mg) ; Gummy; **$^1$H NMR: (200 MHz,** |

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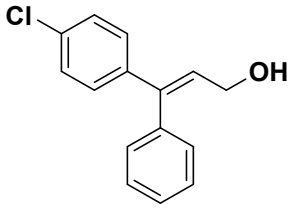
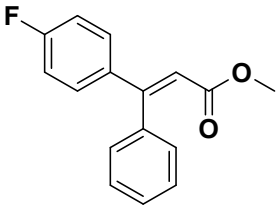
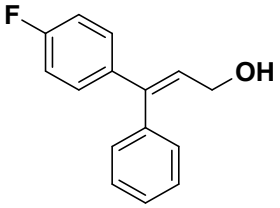
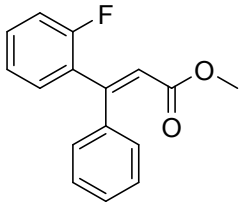
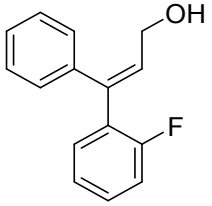
|  | **$CDCl_3$) δ** 1.69 (bs, 1H), 4.22-4.23 (d, 2H, J=4Hz), 6.22-6.25 (t, 1H, J=8Hz), 7.15-7.21 (m, 4H), 7.28-7.25 (m, 2H), 7.35-7.41 (m, 3H); **$^{13}$C NMR (50 MHz, $CDCl_3$) δ** 60.6, 127.8, 127.9, 128.4, 128.9, 129.7, 133.6, 140.2, 143.1; |
| **Methyl-(E)-3-(4-fluorophenyl)-3-phenylacrylate (10d);** | |
|  | **Yield:** 82% (521 mg); Gummy; **$^1$H NMR: (200 MHz, $CDCl_3$) δ** 3.69 (s, 3H), 4.34 (s, 1H), 7.02-7.20 (m, 3H), 7.27-7.35 (m, 5H); **$^{13}$C NMR (50 MHz, $CDCl_3$) δ** 51.6, 115.3 (d, J= 21.2 Hz, CH), 116.4 (d,*J*= 1.6 Hz), 128.1, 128.3, 129.2, 130.5 (d, *J*= 8.3 Hz), 136.8 (d, J= 3.1 Hz), 138.9, 155.9, 163.3(d, *J*= 250.3 Hz), 166.3 |
| **(E)-3-(4-fluorophenyl)-3-phenylprop-2-en-1-ol (11d):** | |
|  | **Yield:** 92% (426 mg) , Colorless gummy; **$^1$H NMR: (200 MHz, $CDCl_3$) δ** 1.77 (bs, 1H), 4.16-4.19 (d, 2H, J=6Hz), 6.15 (t, 1H, J=8Hz), 6.90-6.99 (t, 2H, J=8Hz), 7.10-7.25 (m,4H), 7.30-7.39 (m, 3H); **$^{13}$C NMR (50 MHz, $CDCl_3$) δ** 60.6, 115.0-115.5 (d, J=21 Hz), 127.6-127.8 (d, J=7Hz), 128.3, 131.4-131.5 (d, J=8Hz), 141.7, 143.4; |
| **Methyl (*E*)-3-(2-fluorophenyl)-3-phenylacrylate (10e)** | |
|  | **Yield:** 91% (622mg) ; Gummy; **$^1$H NMR: (200 MHz, $CDCl_3$) δ** 3.6 (s, 3H), 6.32 (s, 1H), 7.05-7.11 (m, 3H), 7.19-7.24 (m, 1H), 7.30 (m, 5H); **$^{13}$C NMR (50 MHz, $CDCl_3$) δ** 51.2, 116.1-116.3 (d, J= 23Hz), 120.8 (d, *J* = 5.76 Hz), 124.0 (d, *J* = 4 Hz), 127.8, 128.3, 128.5, 128.7, 130.4 (d, *J* = 8.62 Hz), 131.4, 138.6, 150.8, 158.9, 161.4, 166.0; |
| **(*E*)-3-(2-fluorophenyl)-3-phenylprop-2-en-1-ol (11e)** | |
|  | **Yield:** 91% (503 mg) ; White Solid; **$^1$H NMR(200MHz, $CDCl_3$) δ** 1.53 (bs, 1H), 4.31-4.35 (m, 2H), 6.17(t, J=7Hz, 1H), 7.03 (ddd, J=10.8, 8.4, 1.2Hz, 1H), 7.09 (td, J=7.8 Hz, 1H), 7.16-7.21 (m,3H), 7.23-7.27 (m, 1H), 7.30-7.36 (m, 3H); **$^{13}$C NMR (50 MHz, $CDCl_3$) δ** 600.4, 115.9-116.1 (d, J=23 Hz), 123.9 (d, J=2.88), 127.7, 128.2, 129.2, 131.3-131.4 (d, J=3.84), 131.7-131.8 (d, J=3.84), 138.7, 159.0, 161.5; |
| **Ethyl-(E)-3-phenylbut-2-enoate (10f)** | |
| | **Yield:** 91% (503 mg) ; colorless oil; **$^1$H** |

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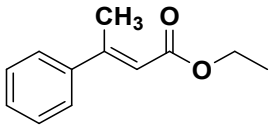
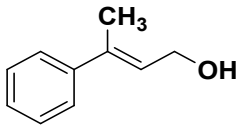
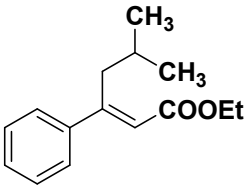
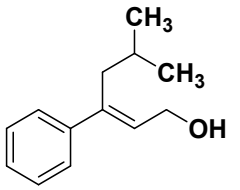
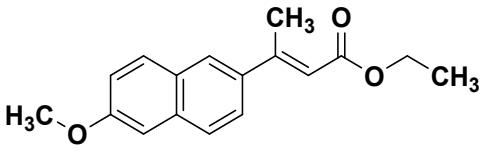
|  | **NMR(200MHz, $CDCl_3$) δ** 1.33 (t, 3H), 2.59 (S, 3H), 4.20-4.25 (q, 2H), 6.13-6.14 (d, 1H), 7.27-7.38 (m, 3H), 7.47-7.49 ( dd , 2H); $^{13}$C NMR (50 MHz, CDCl3) δ 14.4, 17.9, 59.7, 117.2, 126.3, 128.4, 128.9, 142.3, 156.4, 166.6 |
| **(E)-3-phenylbut-2-en-1-ol (11f)** | |
|  | Yield: 96% (376 mg); $^1$H NMR (200 MHz, CDCl3) δ 2.02 (bs, 1H), 2.05 (s, 3H), 4.29-433 (dd, 2H, J=6Hz), 5.89-5.98 (qt, 1H, J= 6Hz), 7.21-7.39 (m, 5H); $^{13}$C NMR (50 MHz, CDCl3) δ 16.0, 59.7, 125.7, 126.5, 127.2, 128.2, 137.6, 142.8; |
| **Ethyl (E)-5-methyl-3-phenylhex-2-enoate (10g)** | |
|  | **Yield**: 90% (526 mg); Colorless Oil $^1$H NMR (400 MHz, $CDCl_3$) δ 0.88-0.90 (d, 6H, J= 6.87 Hz), 1.07 (t, 3H, J= 6.87 Hz), 1.52-1.62 (m, 1H), 2.31-2.33 (d, 2H, J= 7.31 Hz), 3.95-4.00 (q, 2H, J= 6.87, 7.31 Hz), 5.84 (s,1H),7.13-7.16 (m,2H), 7.28-7.34 (m, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) 14.0, 22.3, 25.8, 50.0, 59.7, 118.4, 127.2, 127.6, 127.8, 140.0, 158.6, 165.9 |
| **(E)-5-methyl-3-phenylhex-2-en-1-ol (11g)** | |
|  | **Yield**: 94% (404 mg); gummy; $^1$H NMR (200 MHz, $CDCl_3$) δ 0.83-0.86 (d, 6H, J=6.8 Hz),1.25-1.55 (m,3H), 2.24-2.27 (d, 2H, J=7.20 Hz),4.01-4.04 (d, 2H, J= 7 Hz),5.64 (t, 1H, J= 7 Hz), 7.08-7.13 (m,2H), 7.23-7.35 (m, 3H); $^{13}$C NMR (100 MHz, $CDCl_3$) 22.3, 26.0, 48.6,60.1, 27.0, 128.0 ,128.14, 139.9, 143.5 |
| **Ethyl-(E)-3-(6-methoxynaphthalen-2-yl)but-2-enoate (10h)** | |
|  | **Yield**: 91% (421 mg); Colorless Oil; $^1$H NMR: (200 MHz, CDCl3) δ 1.30-1.37 (t, 3H, J=8Hz), 2.67-2.68 (d, 3H), 3.91 (s, 3H), 4.17-4.28 (q, 2H, J=8Hz), 6.26 (s, 1H), 7.09-7.17 (m, 2H), 7.54-7.59 (dd, 1H, J=8Hz), 7.67-7.76 (t, 2H, J=8Hz), 7.86 (s, 1H); $^{13}$C NMR (50 MHz, CDCl3) δ 14.4, 17.4, 55.2, 59.7, 105.5, 116.7, 119.3,124.4, 125.8, 126.9, 128.6, 130.0, 134.8, 137.0, 155.2, 158.4, 166.9; |
| **(E)-3-(6-methoxynaphthalen-2-yl) but-2-en-1-ol (11h)** | |
| | **Yield**: 95% (337 mg); Colorless Oil; $^1$H NMR: (200 MHz, CDCl3) δ 1.43 (bs, 1H), 2.17 (s, 3H), 3.91(s, 3H), 4.38-4.42 (d, 2H, J=6Hz), 6.06-6.13 (dt, 1H, J=6Hz), 7.09-7.14 ( m, 2H), 7.51-7.56 (dd,1H,J=8Hz), |

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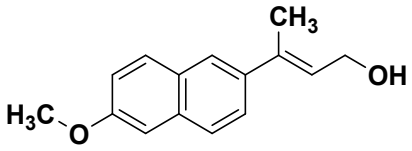
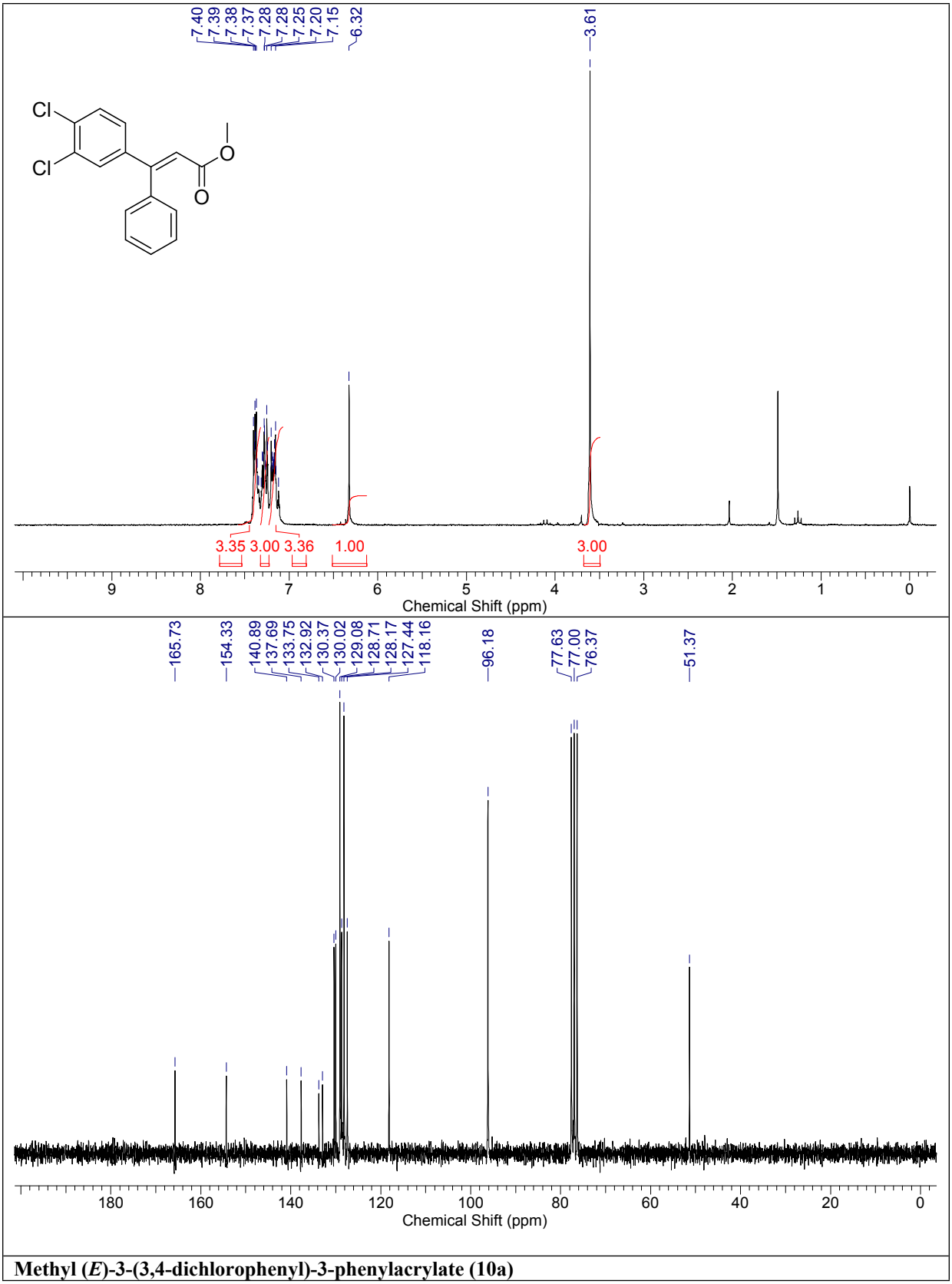
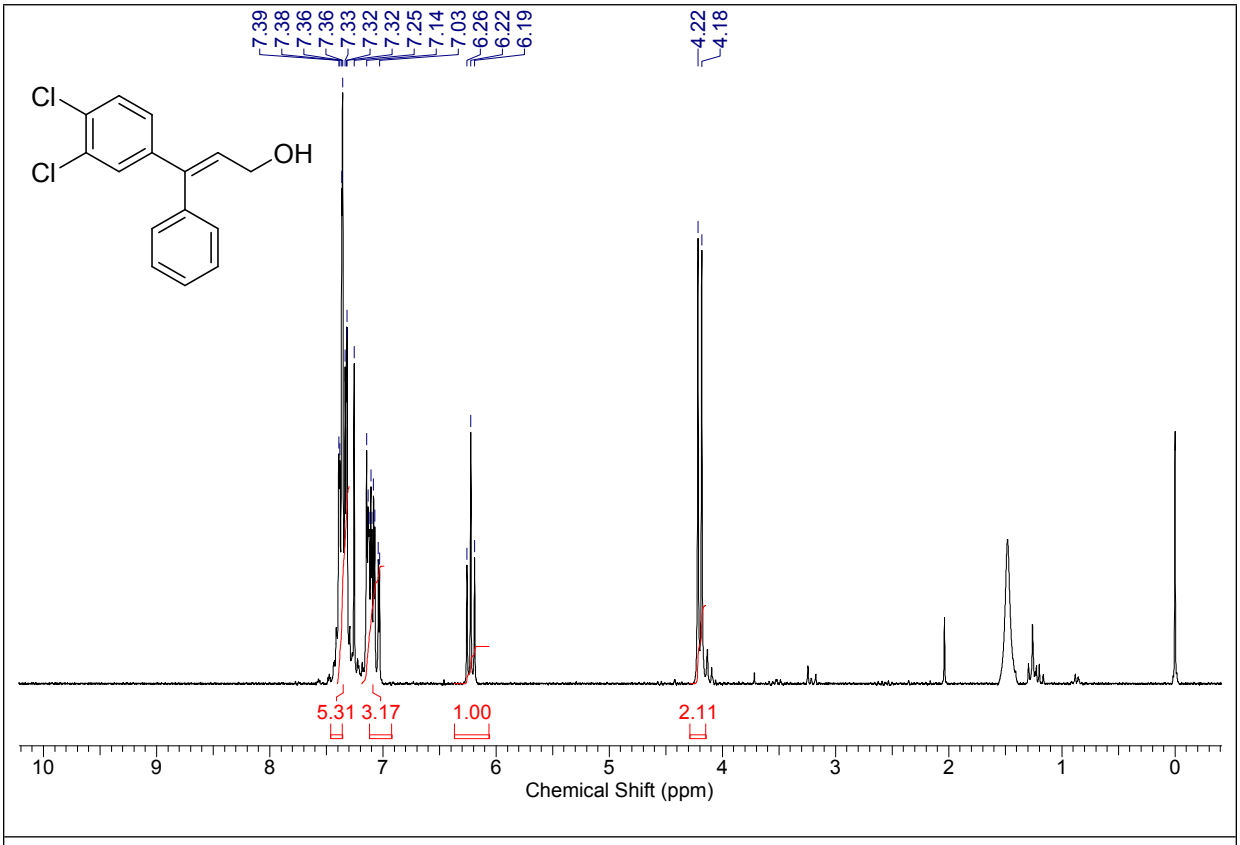
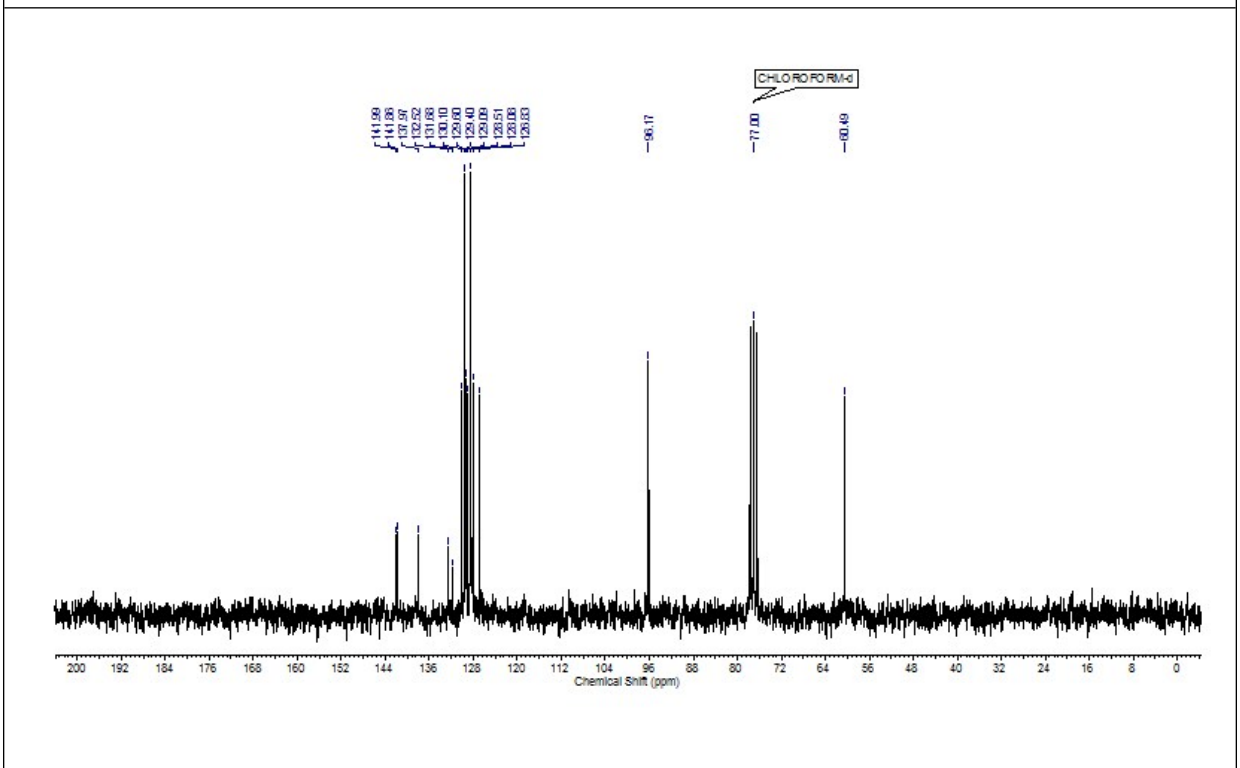
|---|---|
|  | 7.64-7.73 (m, 3H); $^{13}$C NMR (50 MHz, CDCl3) δ 16.0, 55.2, 60.0, 105.5, 119.0, 12.4, 124.6, 126.3, 126.7, 128.8, 129.7, 133.9, 137.7, 137.8, 157.7; |

# 4. Spectra

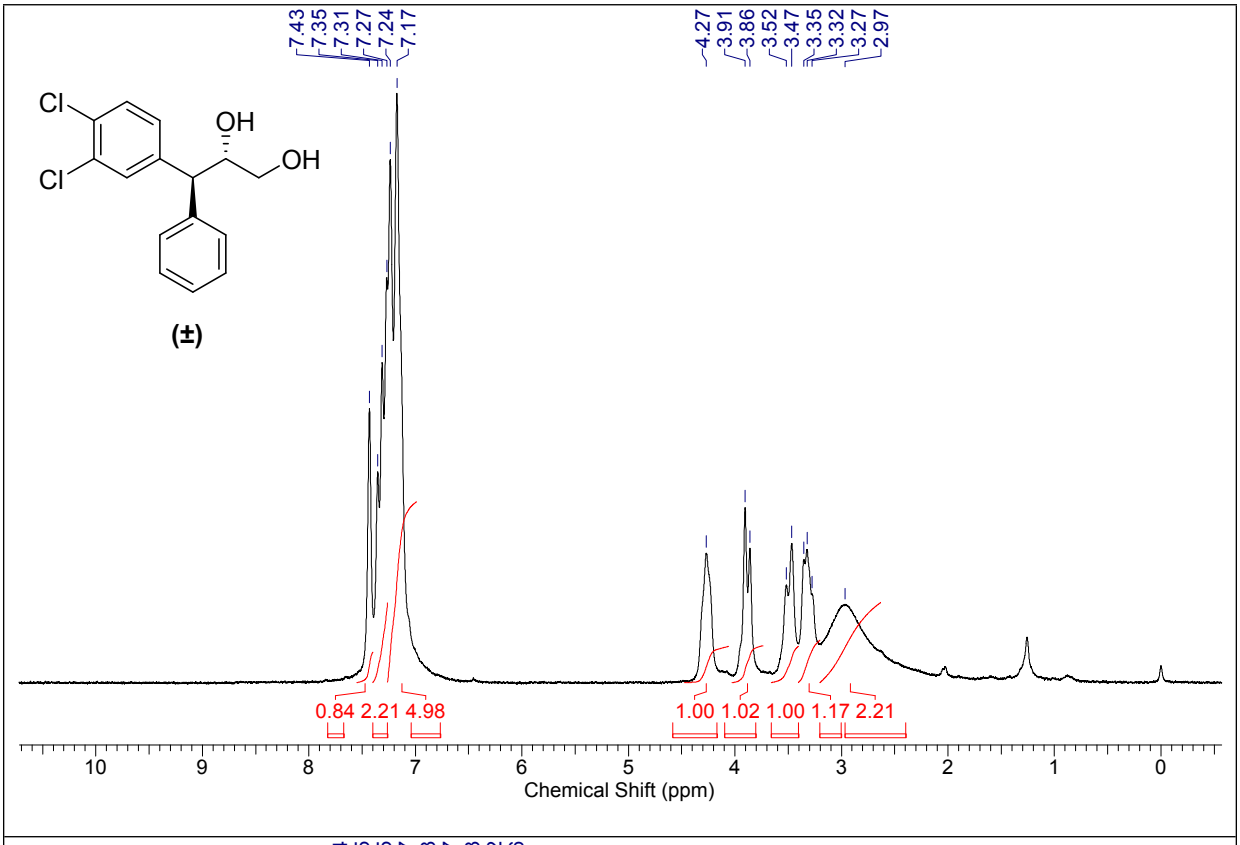


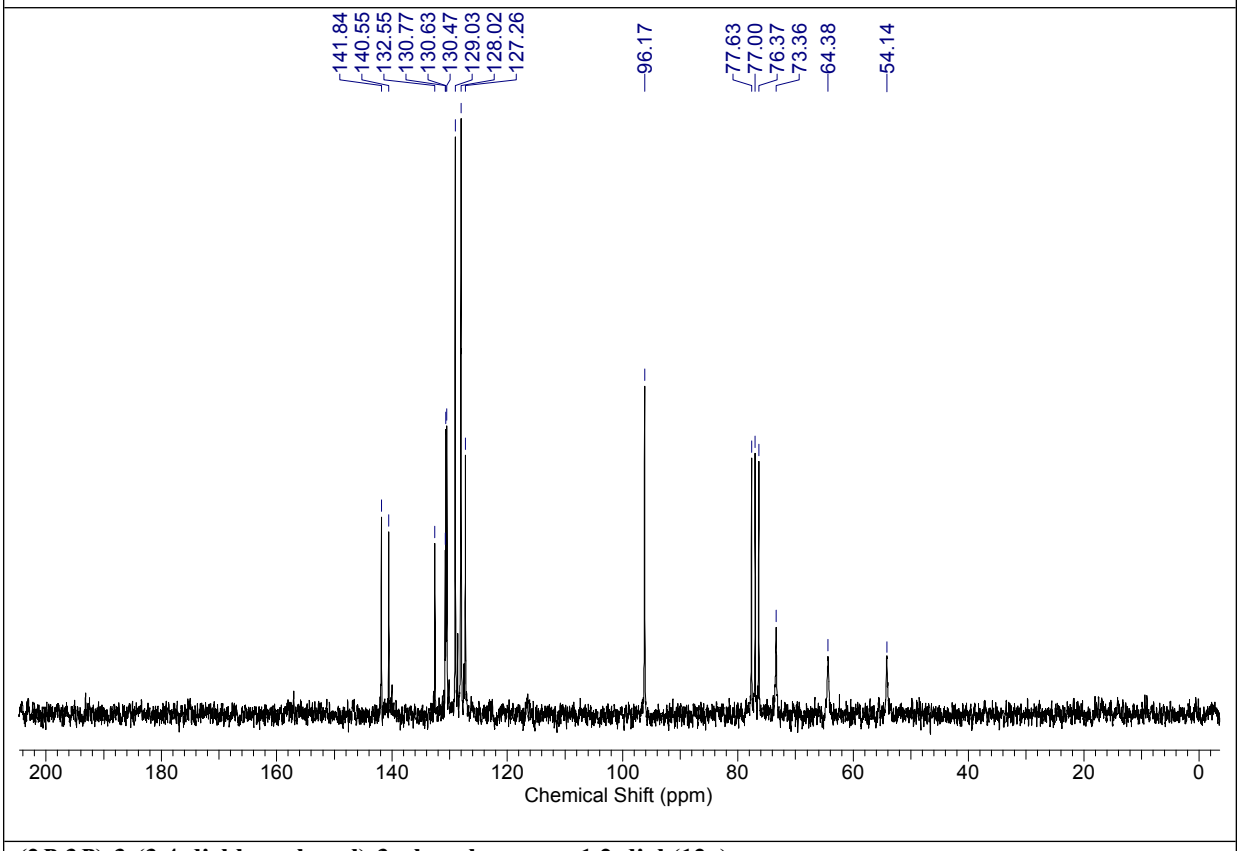

**Methyl (*E*)-3-(3,4-dichlorophenyl)-3-phenylacrylate (10a)**



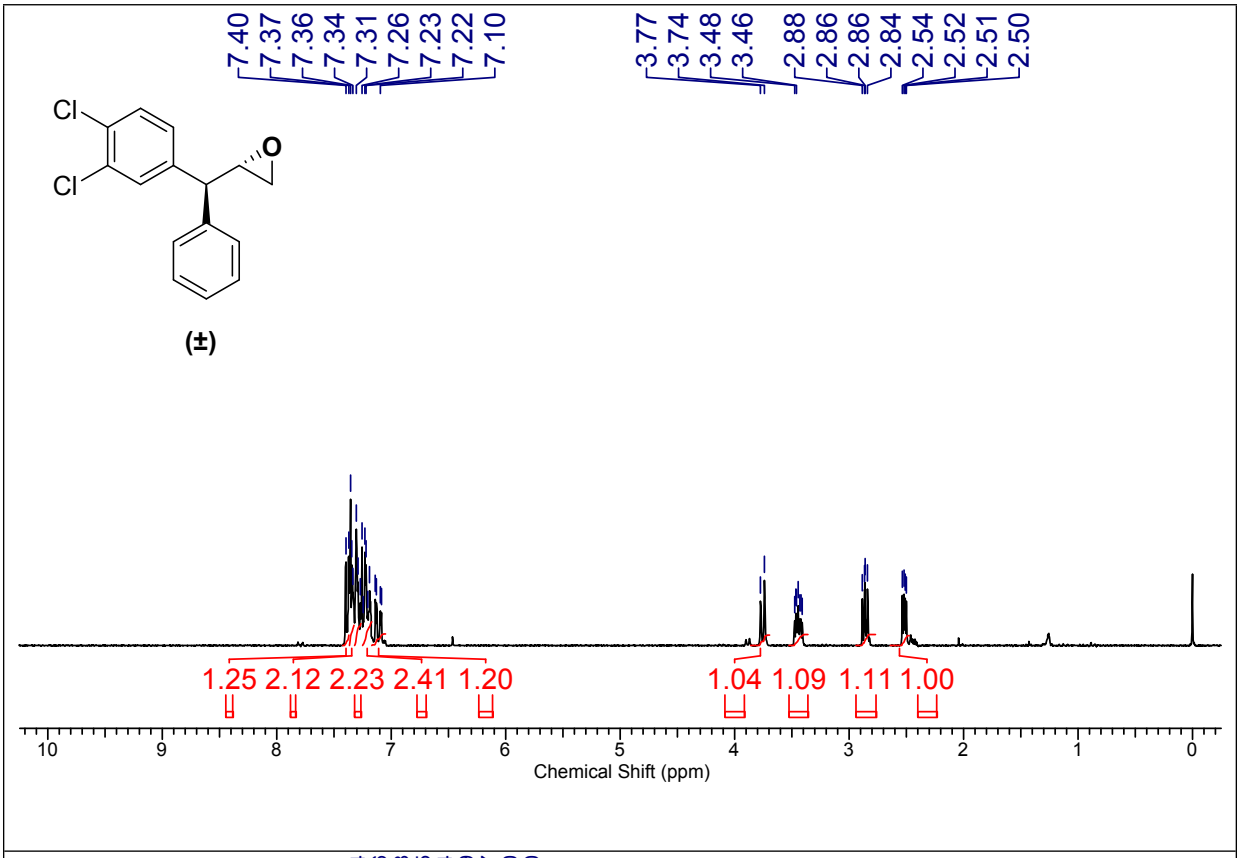



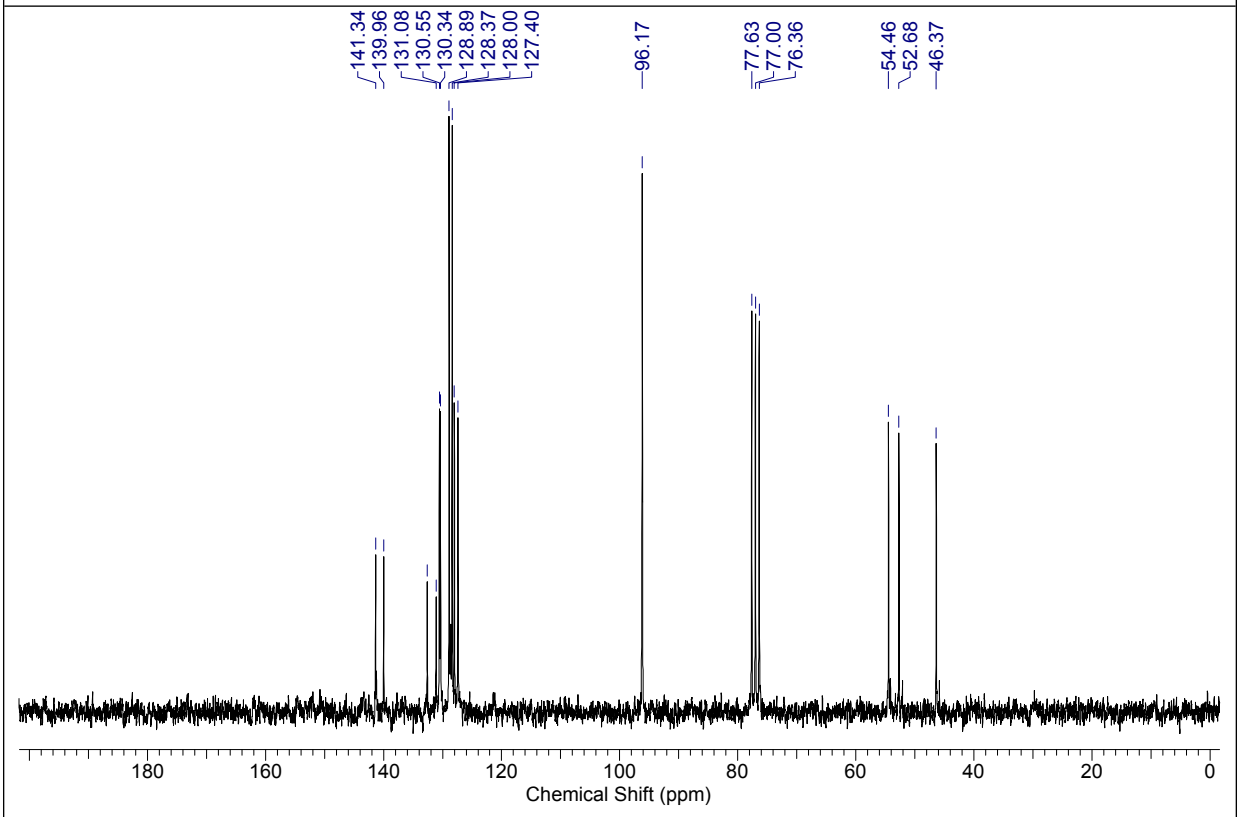

**(*E*)-3-(3,4-Dichlorophenyl)-3-phenylprop-2-en-1-ol (11a)**



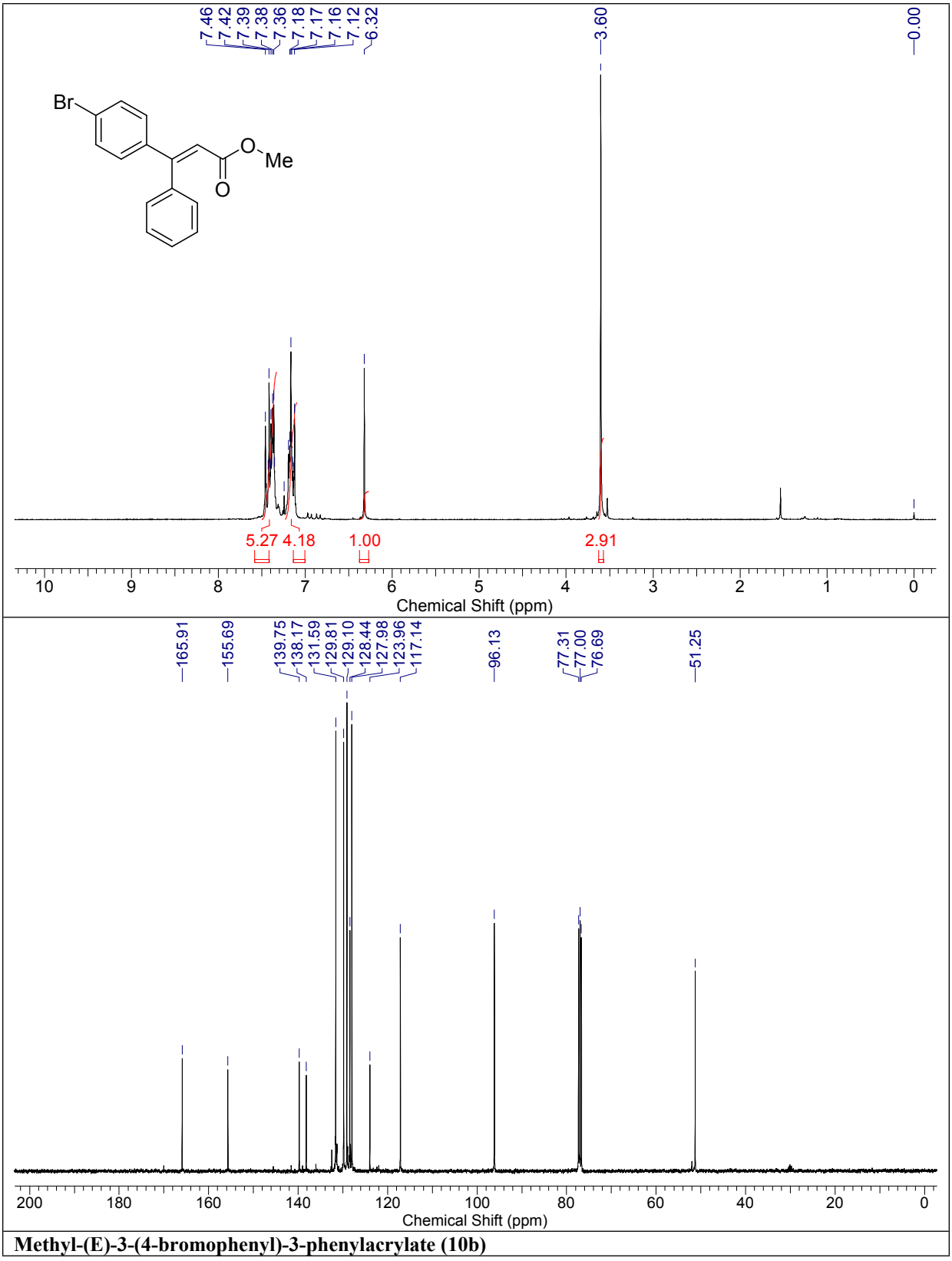




**(2*R*,3*R*)-3-(3,4-dichlorophenyl)-3-phenylpropane-1,2-diol (12a)**

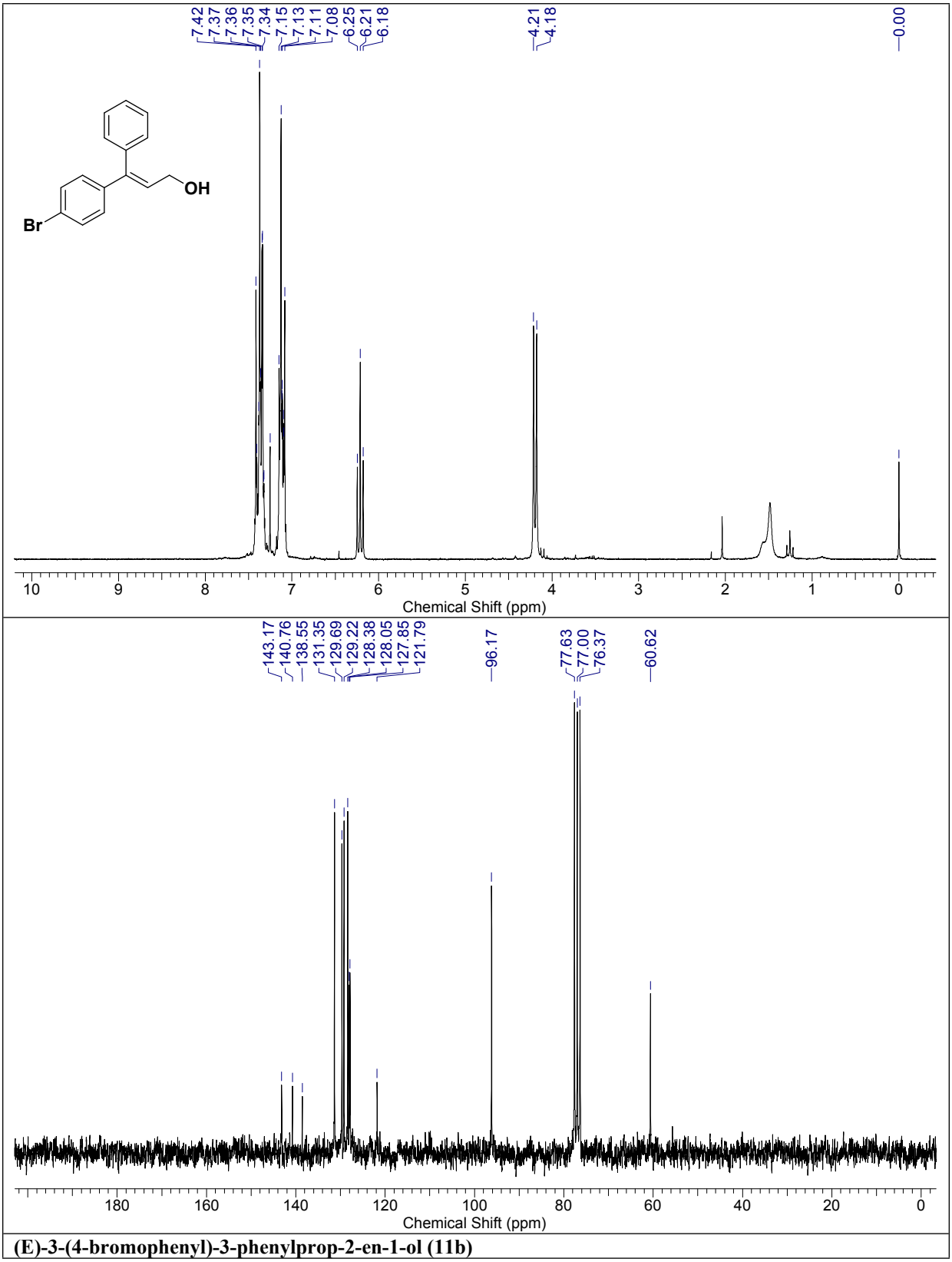


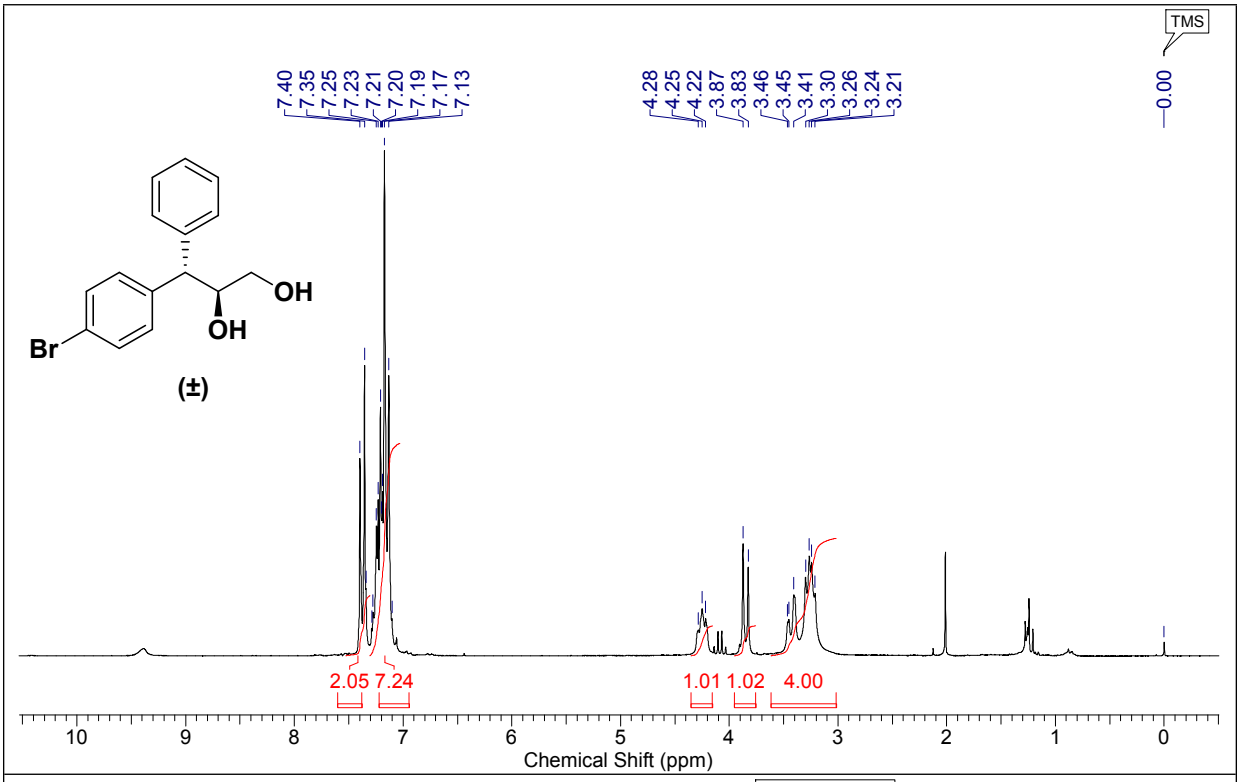

**(2*S*,3*S*)-3-[(3,4-Dichlorophenyl)(phenyl)]methyl)oxirane (13a)**

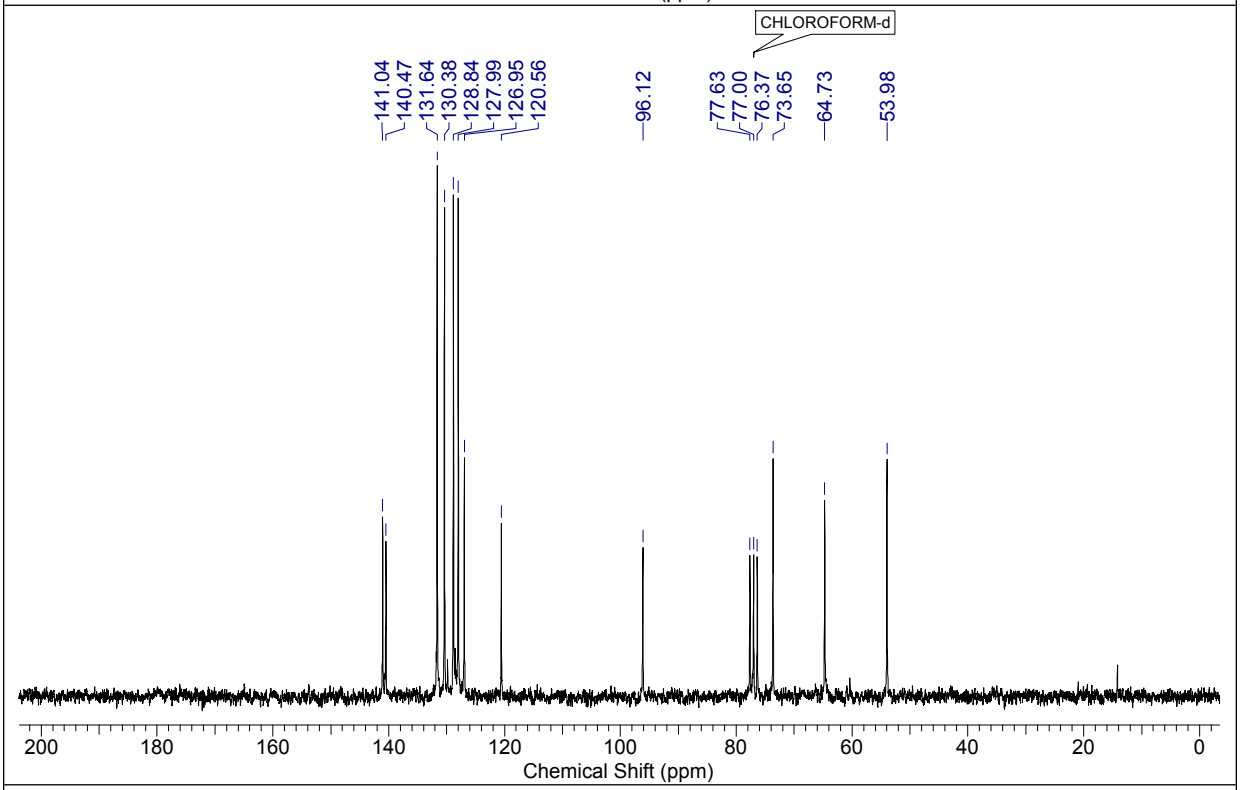



**Methyl-(E)-3-(4-bromophenyl)-3-phenylacrylate (10b)**

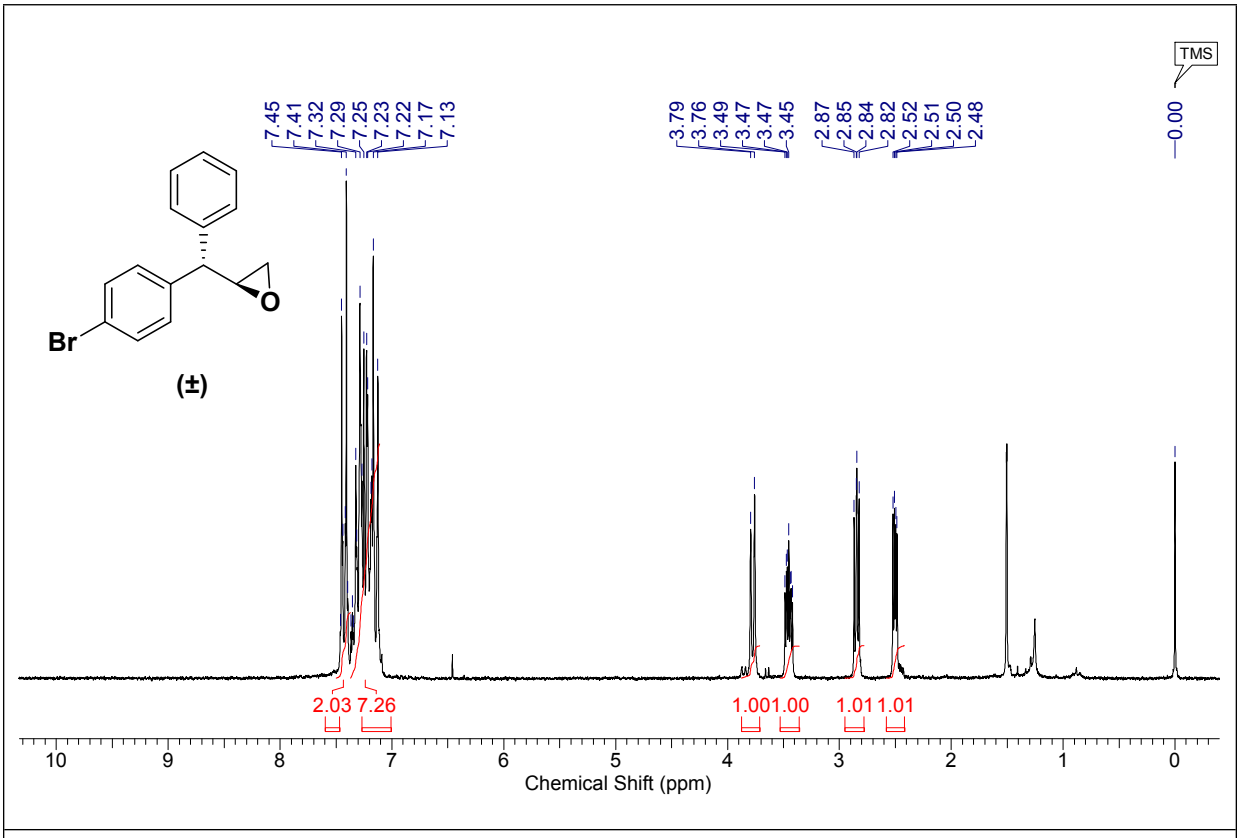


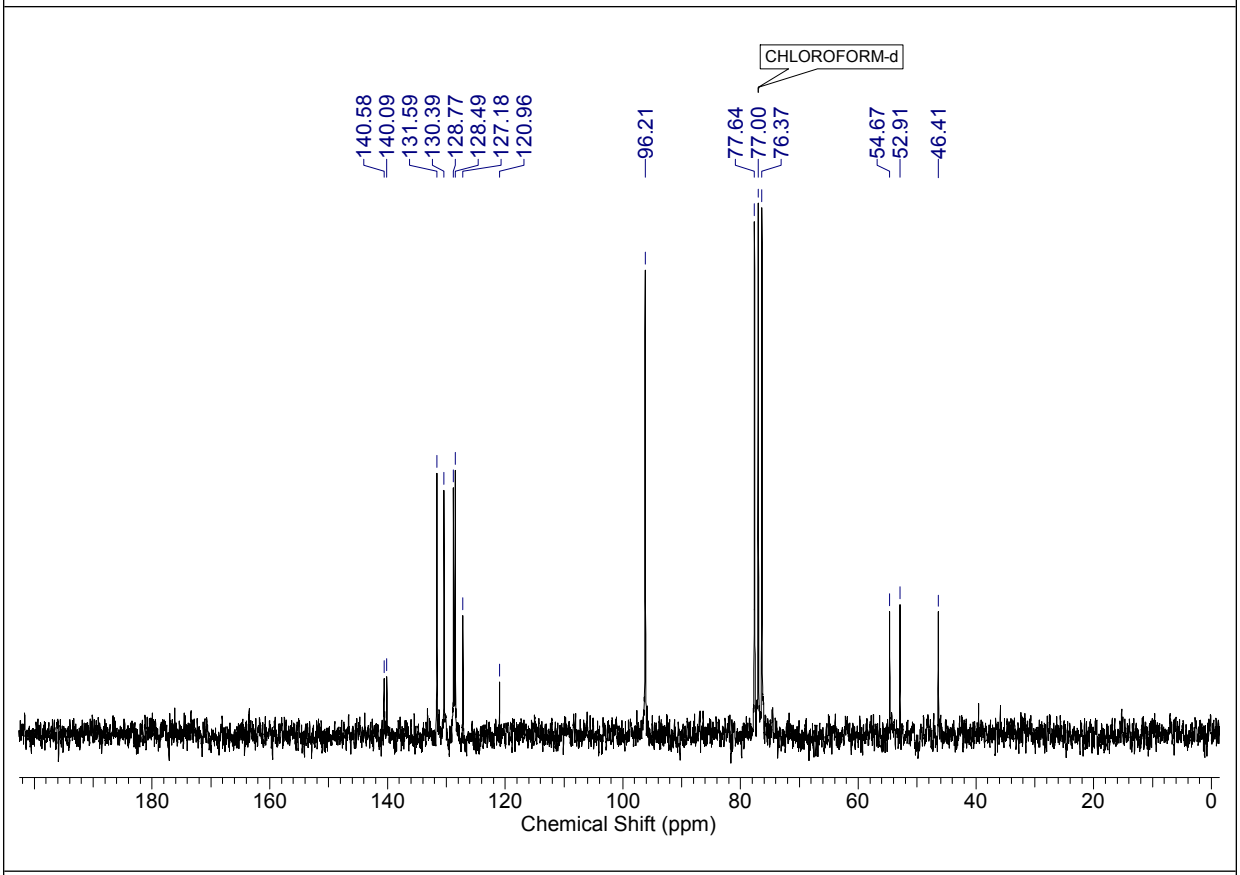

**(E)-3-(4-bromophenyl)-3-phenylprop-2-en-1-ol (11b)**



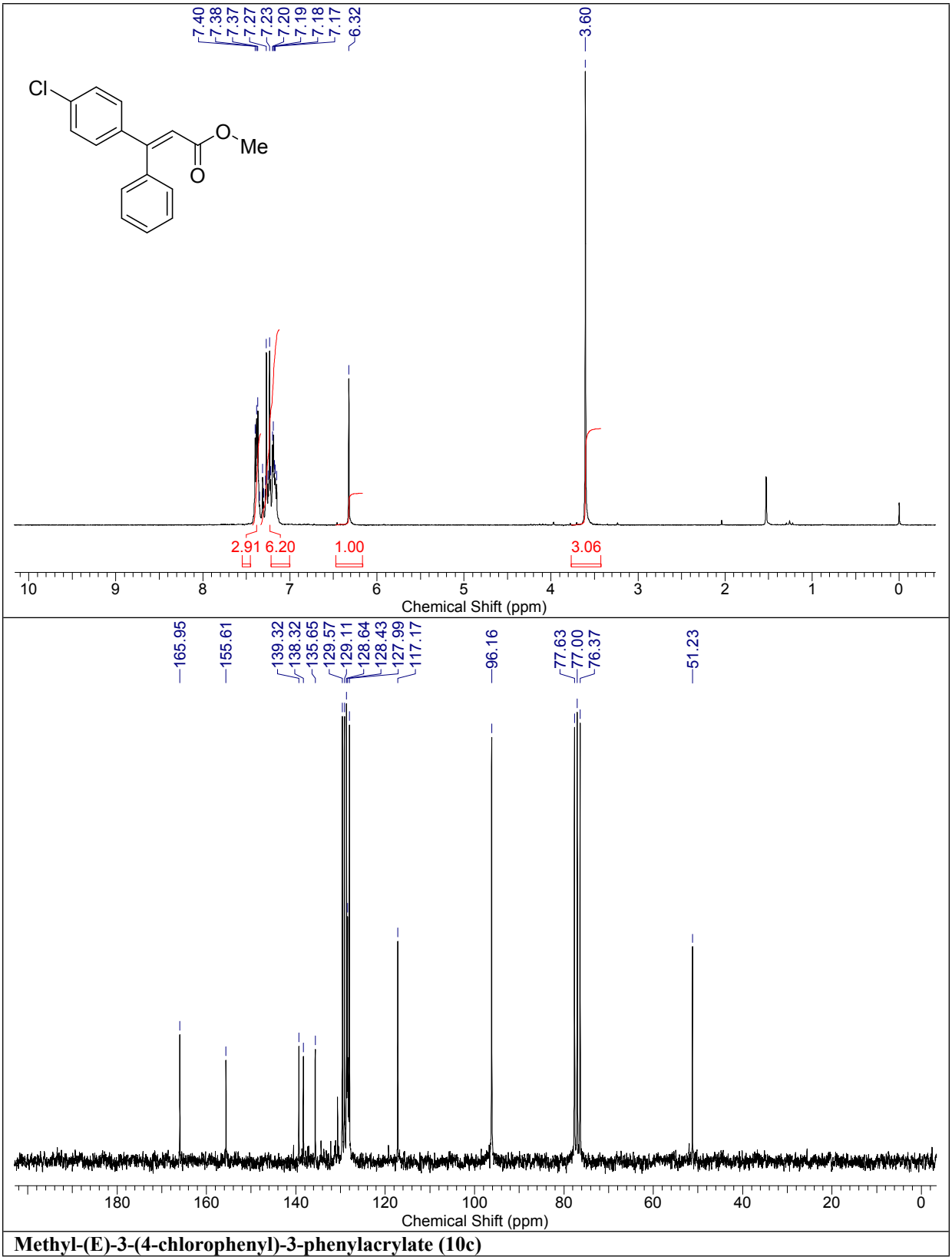




**(2*R*,3*R*)-3-(4-bromophenyl)-3-phenylpropane-1,2-diol (12b)**

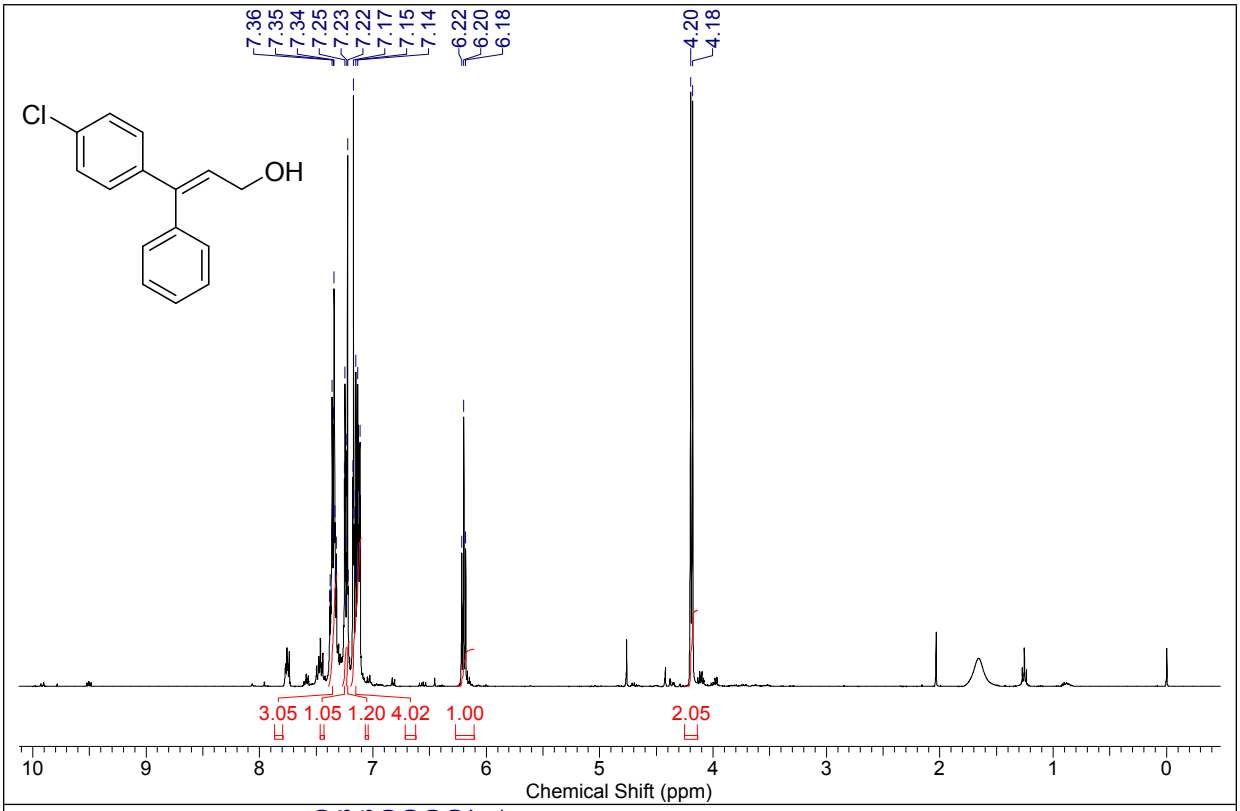


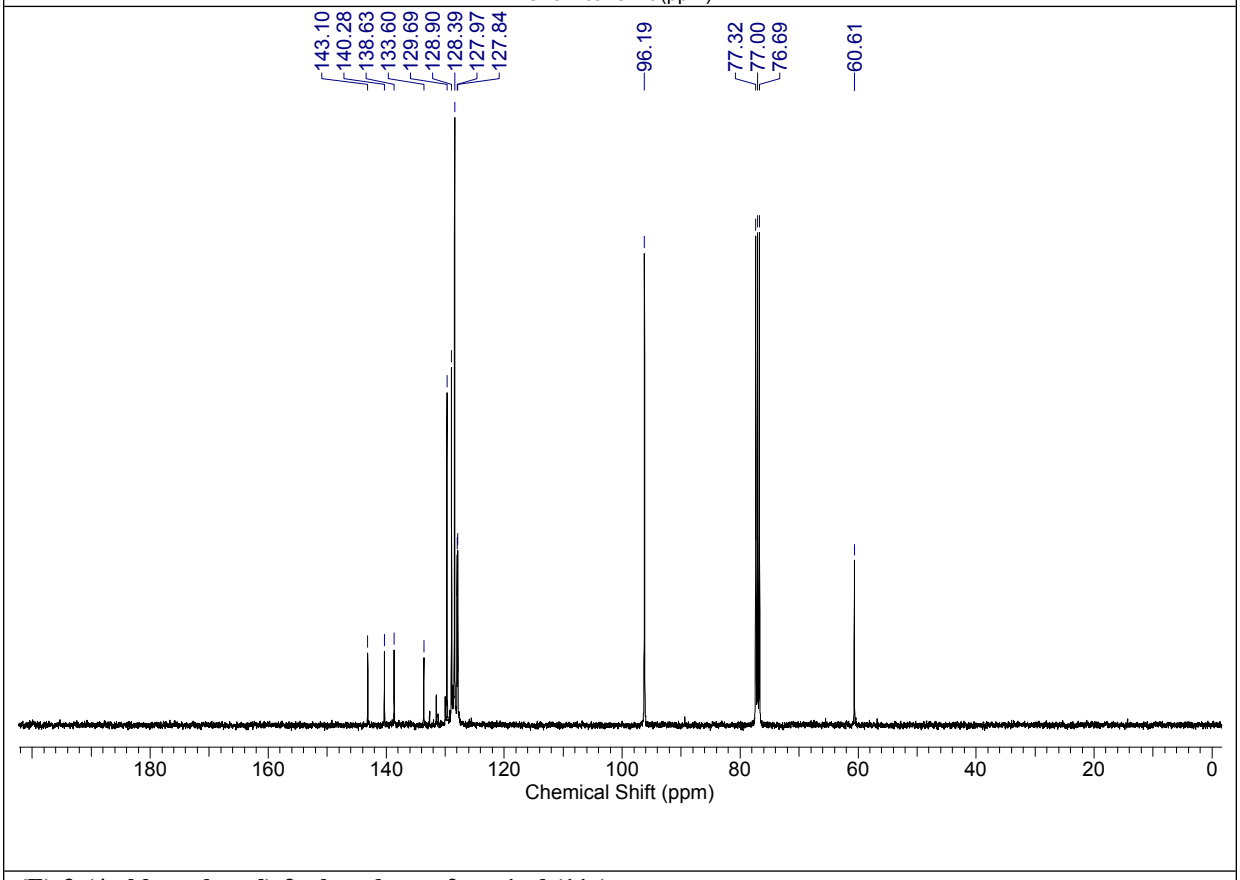




**(2*S*,3*S*)-2-[(4-bromophenyl)(phenyl)]methyloxirane (13b)**

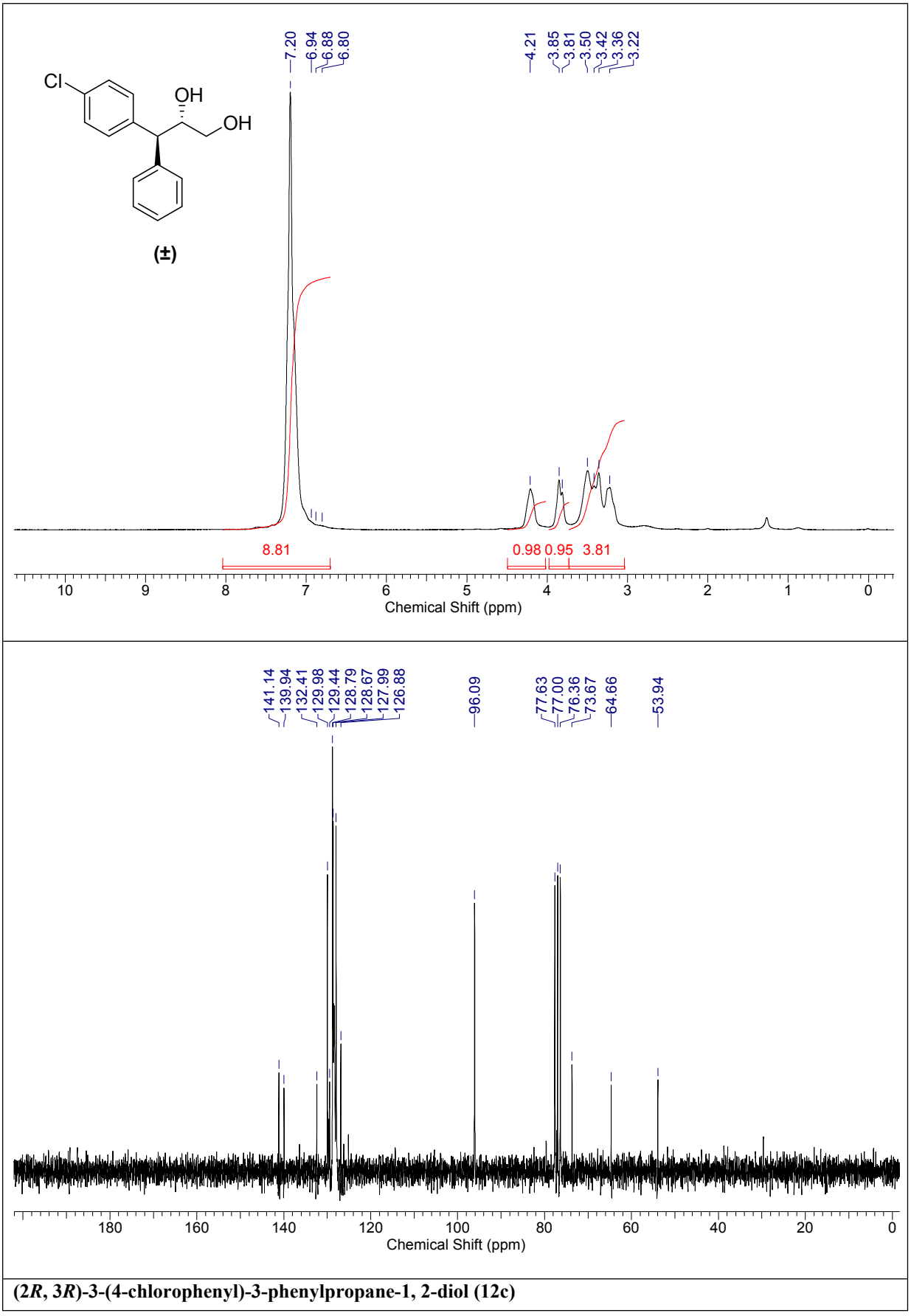



**Methyl-(E)-3-(4-chlorophenyl)-3-phenylacrylate (10c)**

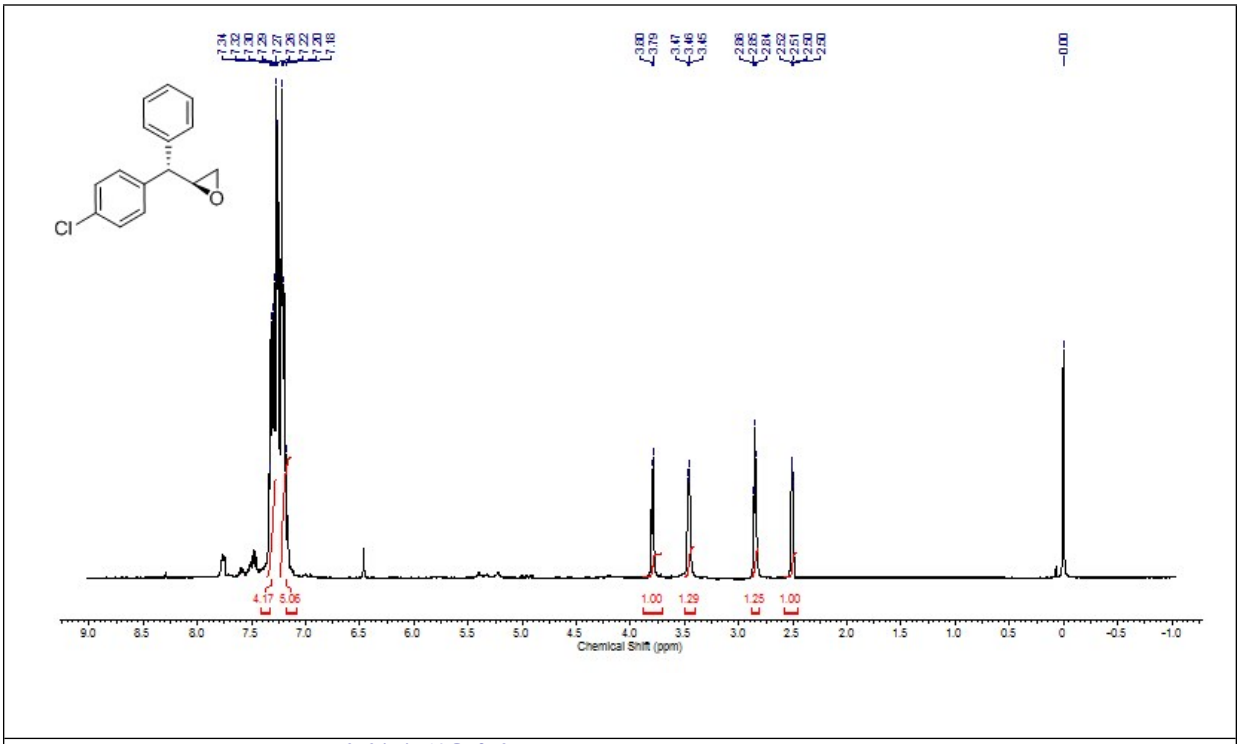


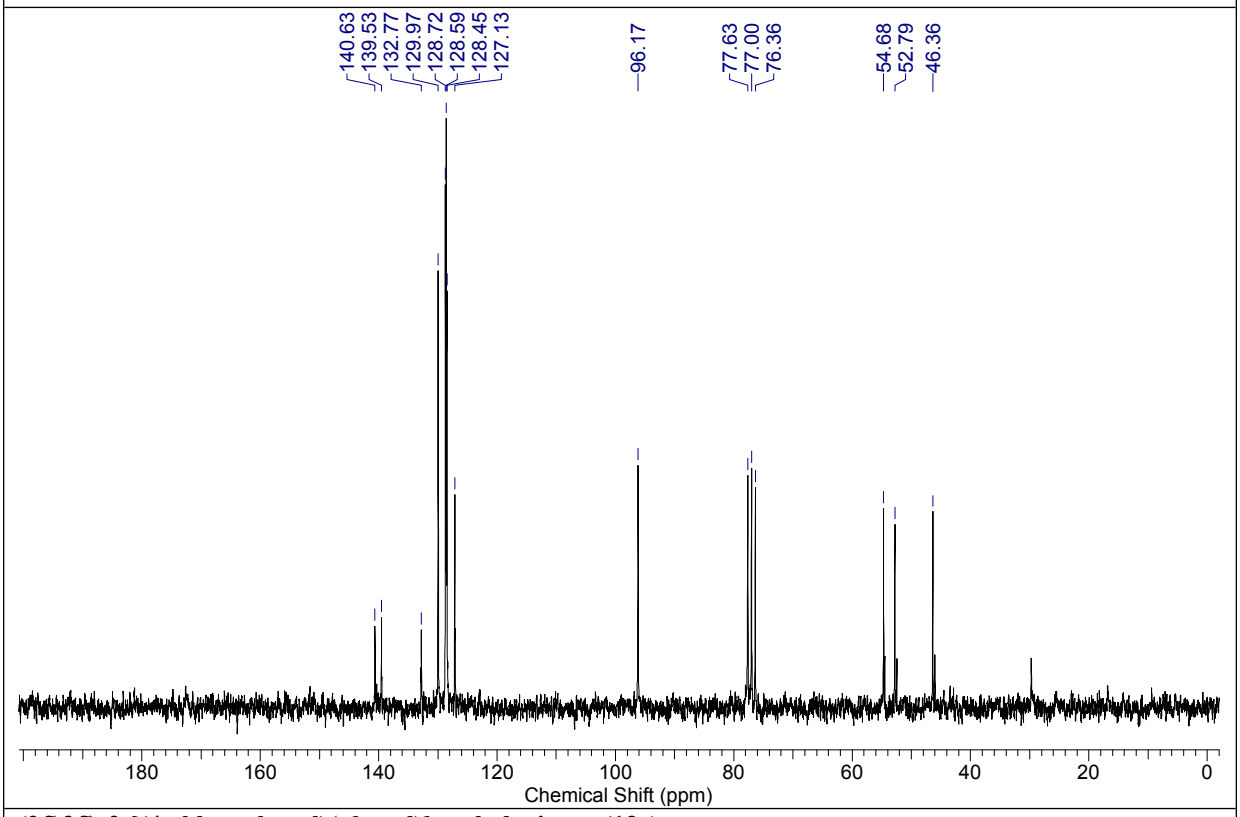




**(E)-3-(4-chlorophenyl)-3-phenylprop-2-en-1-ol (11c)**

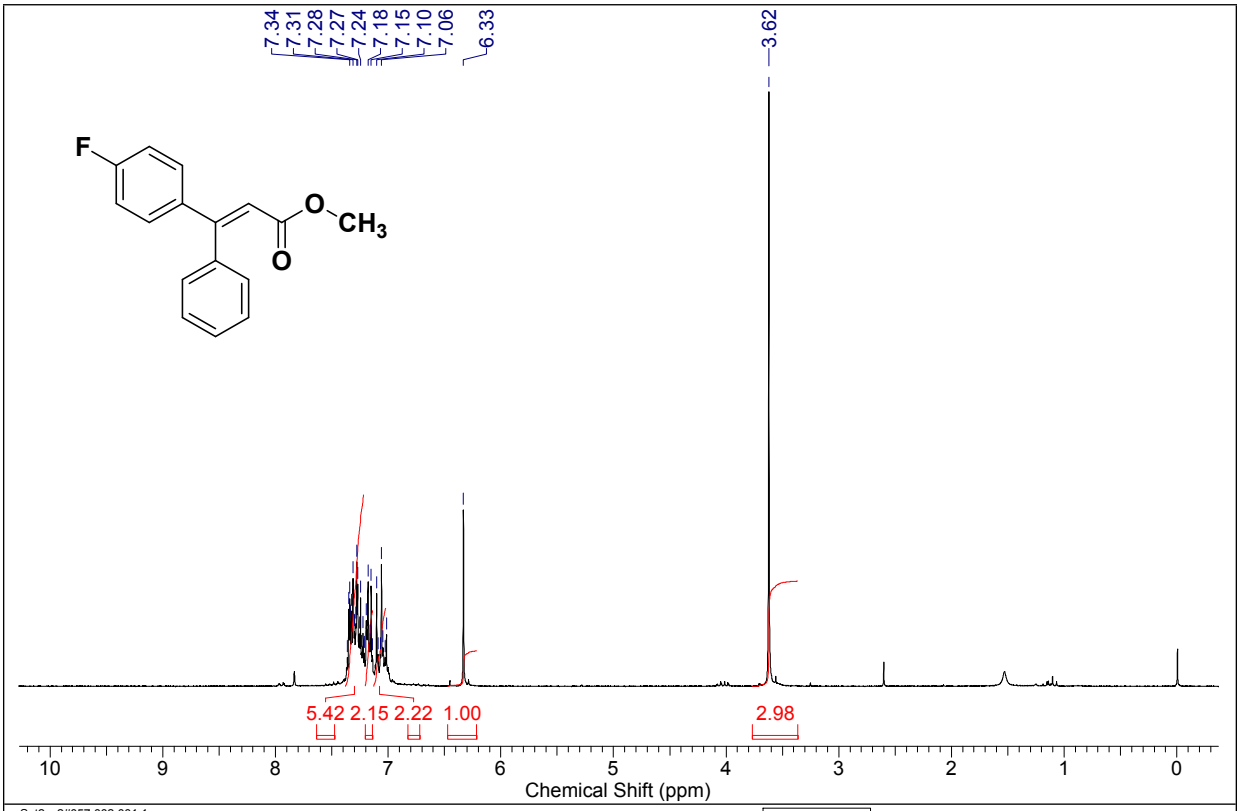


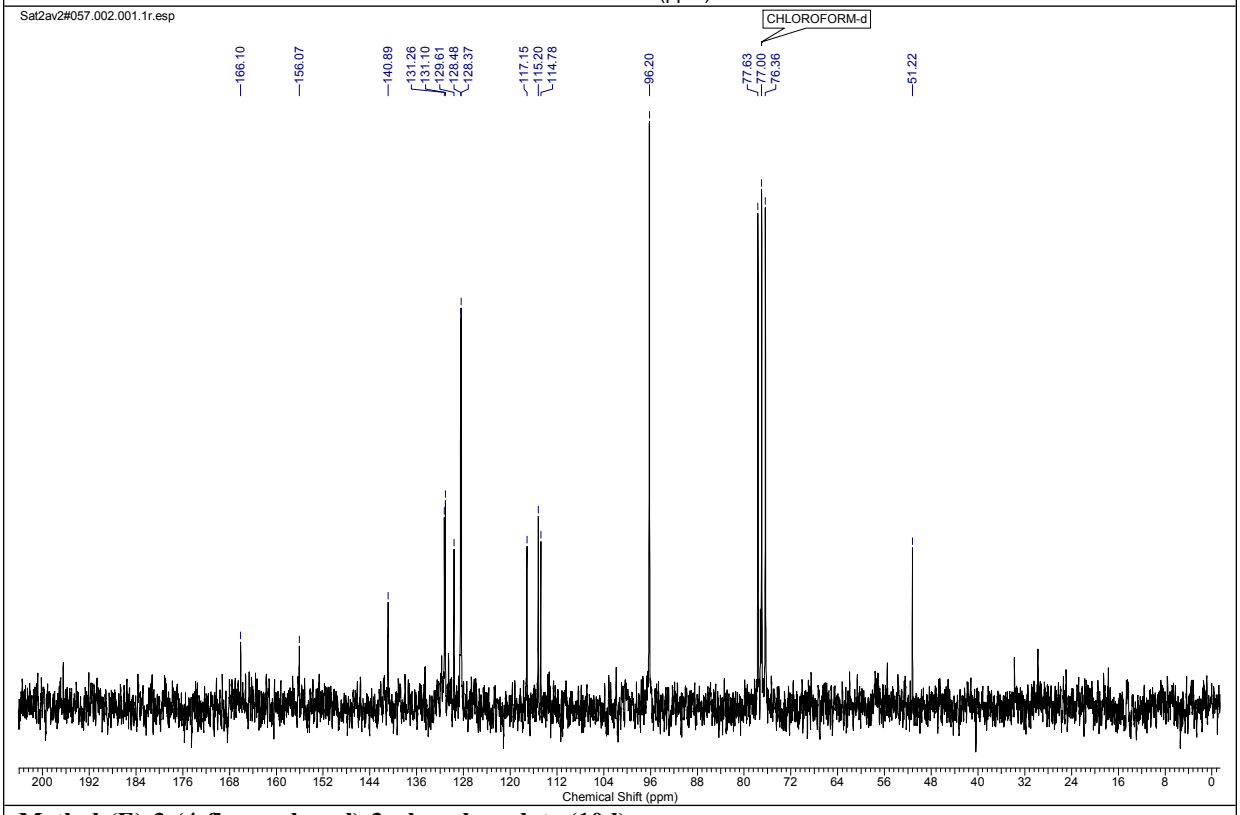

**(2*R*, 3*R*)-3-(4-chlorophenyl)-3-phenylpropane-1, 2-diol (12c)**



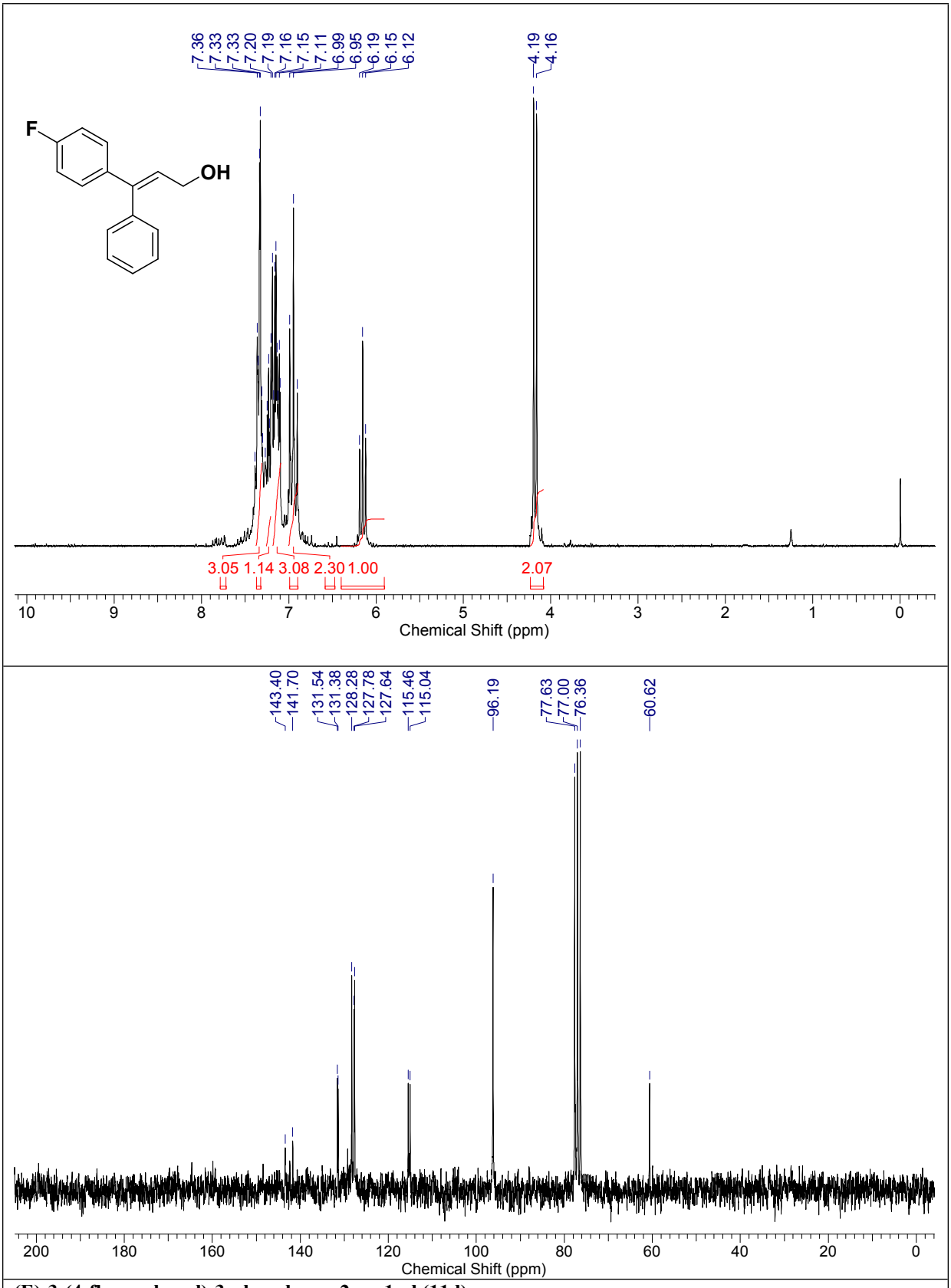




**(2*S*,3*S*)-2-[(4-chlorophenyl)(phenyl)]methyloxirane (13c)**

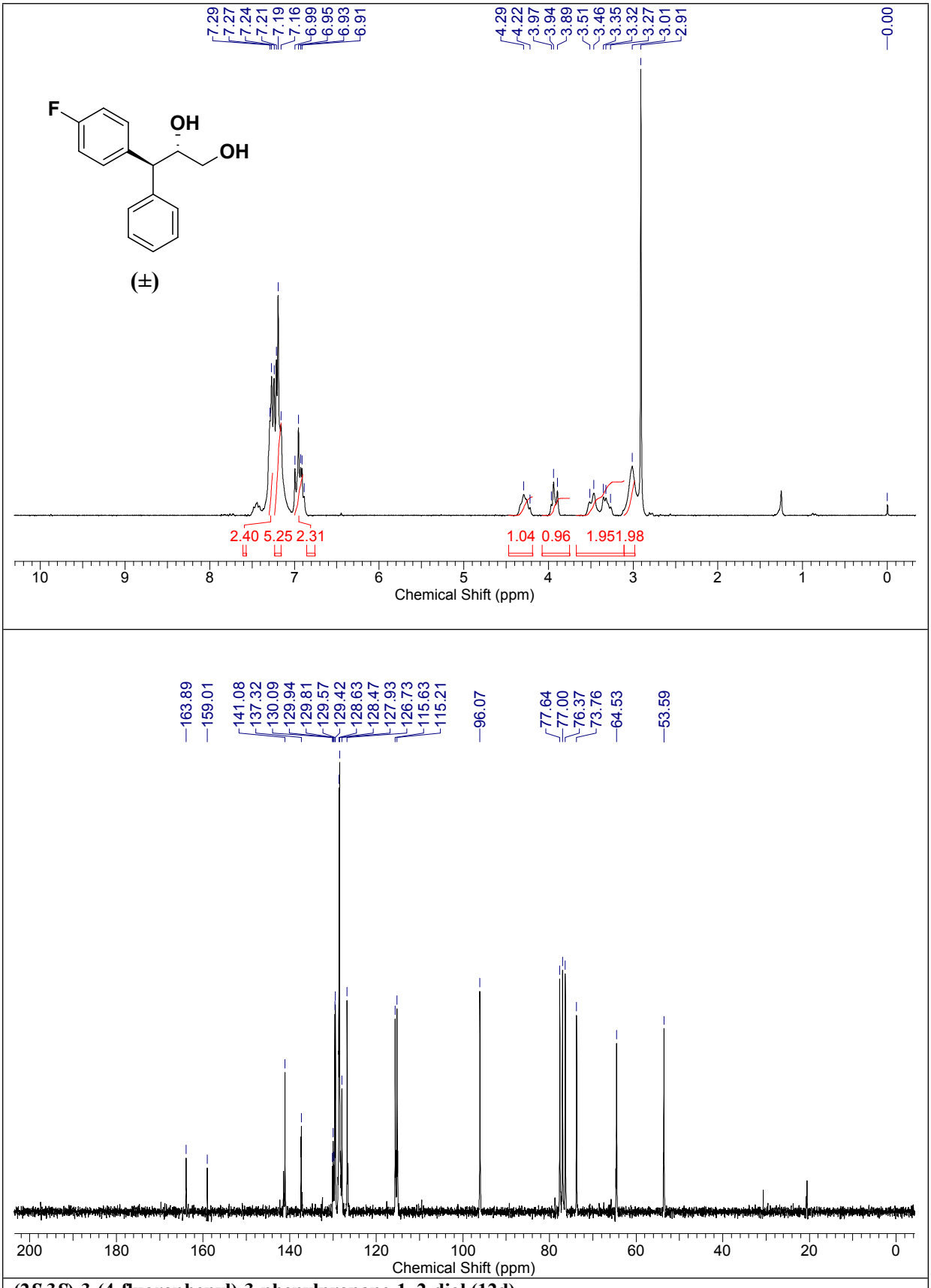


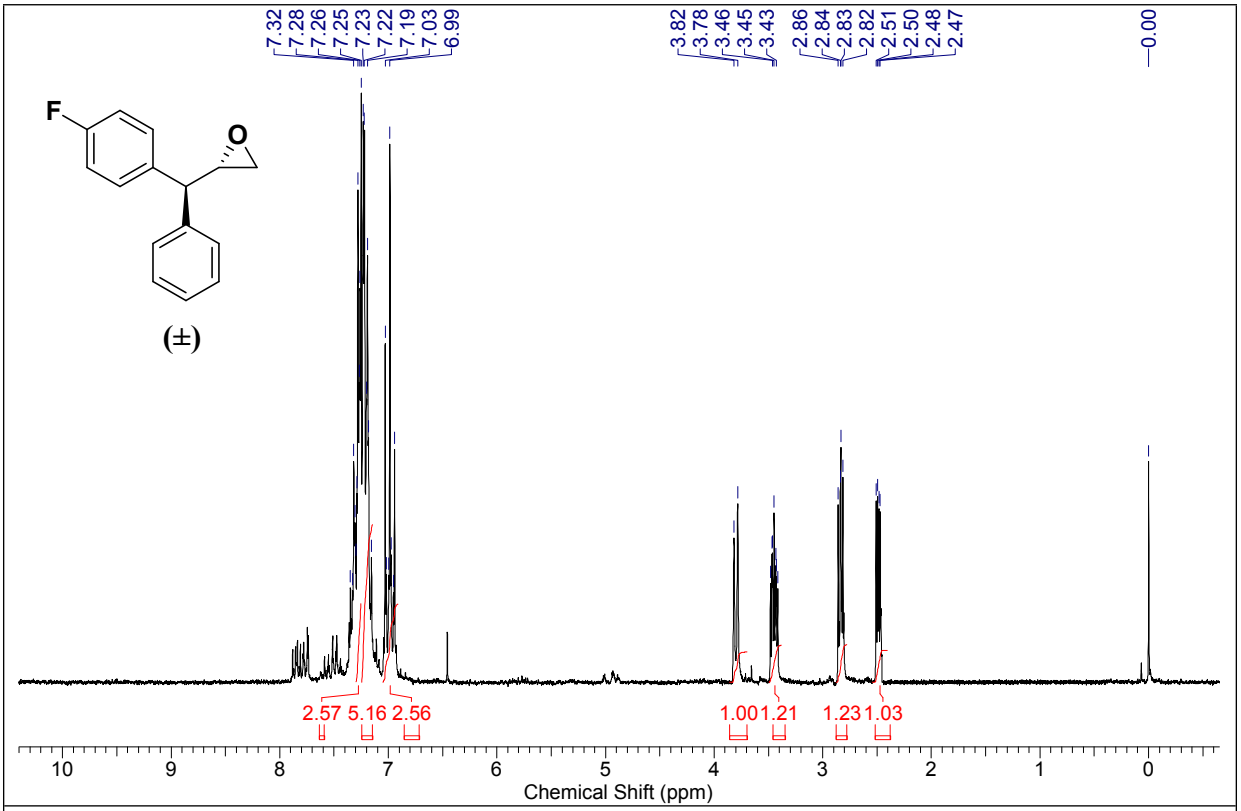

**Methyl-(E)-3-(4-fluorophenyl)-3-phenylacrylate (10d)**

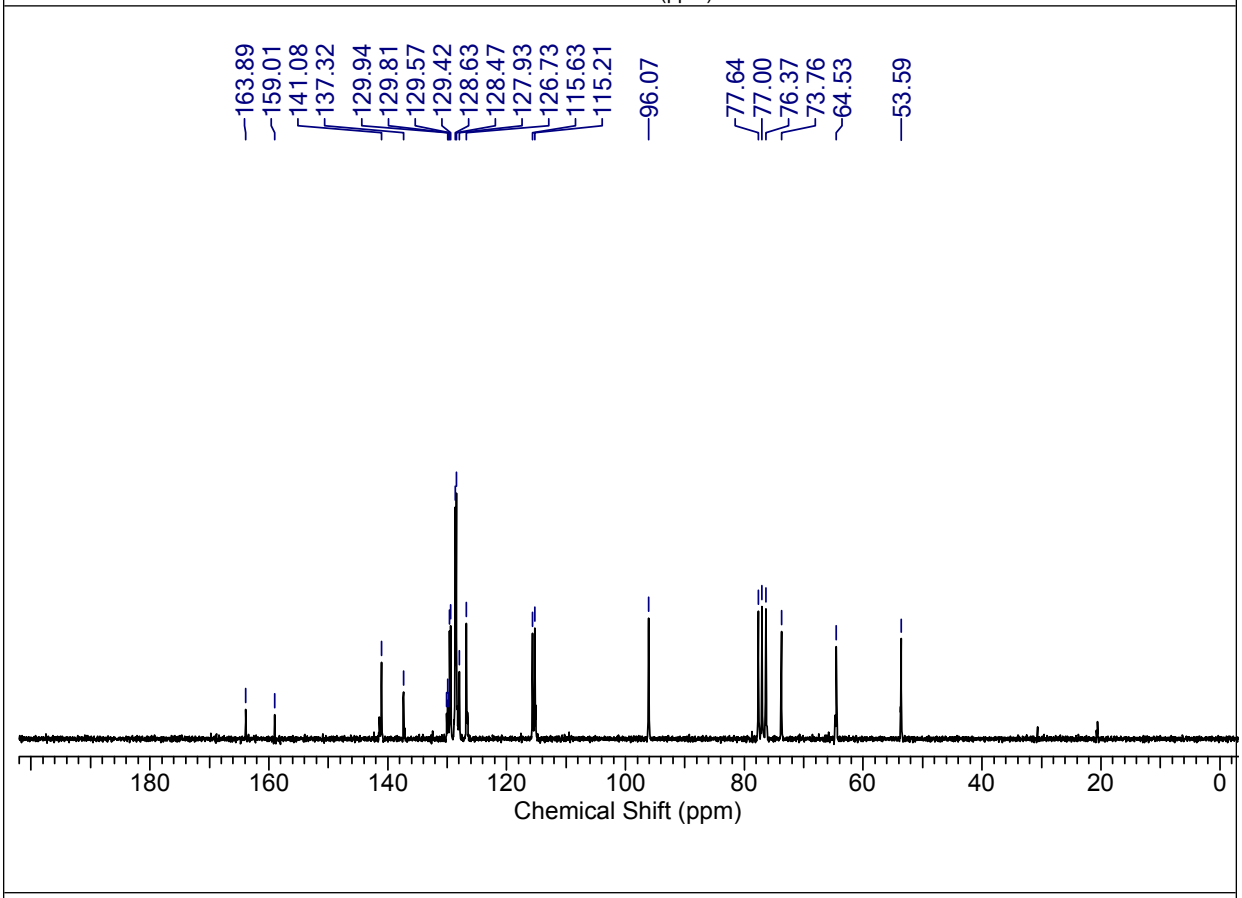



**(E)-3-(4-fluorophenyl)-3-phenylprop-2-en-1-ol (11d)**

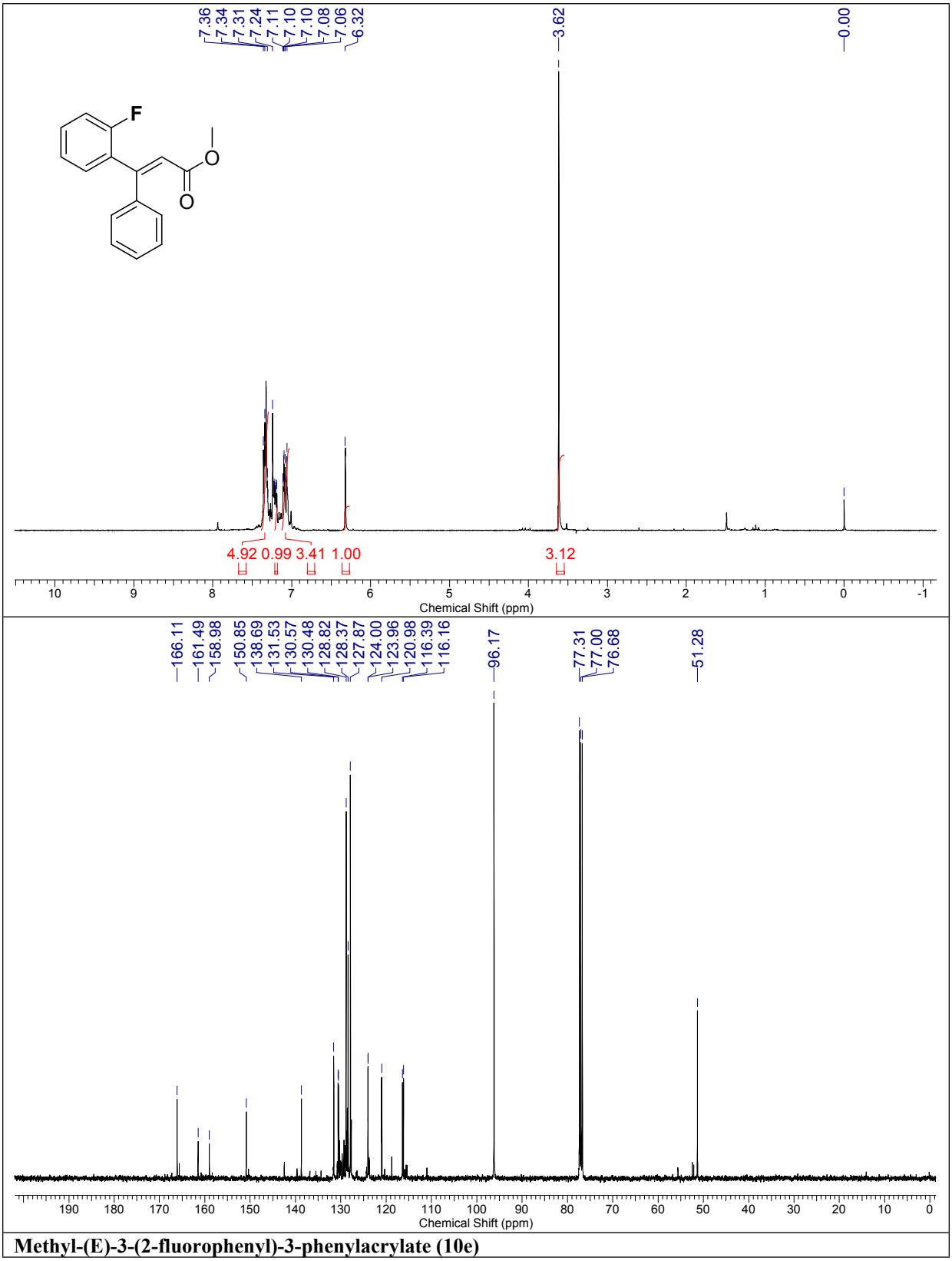



**(2*S*,3*S*)-3-(4-fluorophenyl)-3-phenylpropane-1, 2-diol (12d)**

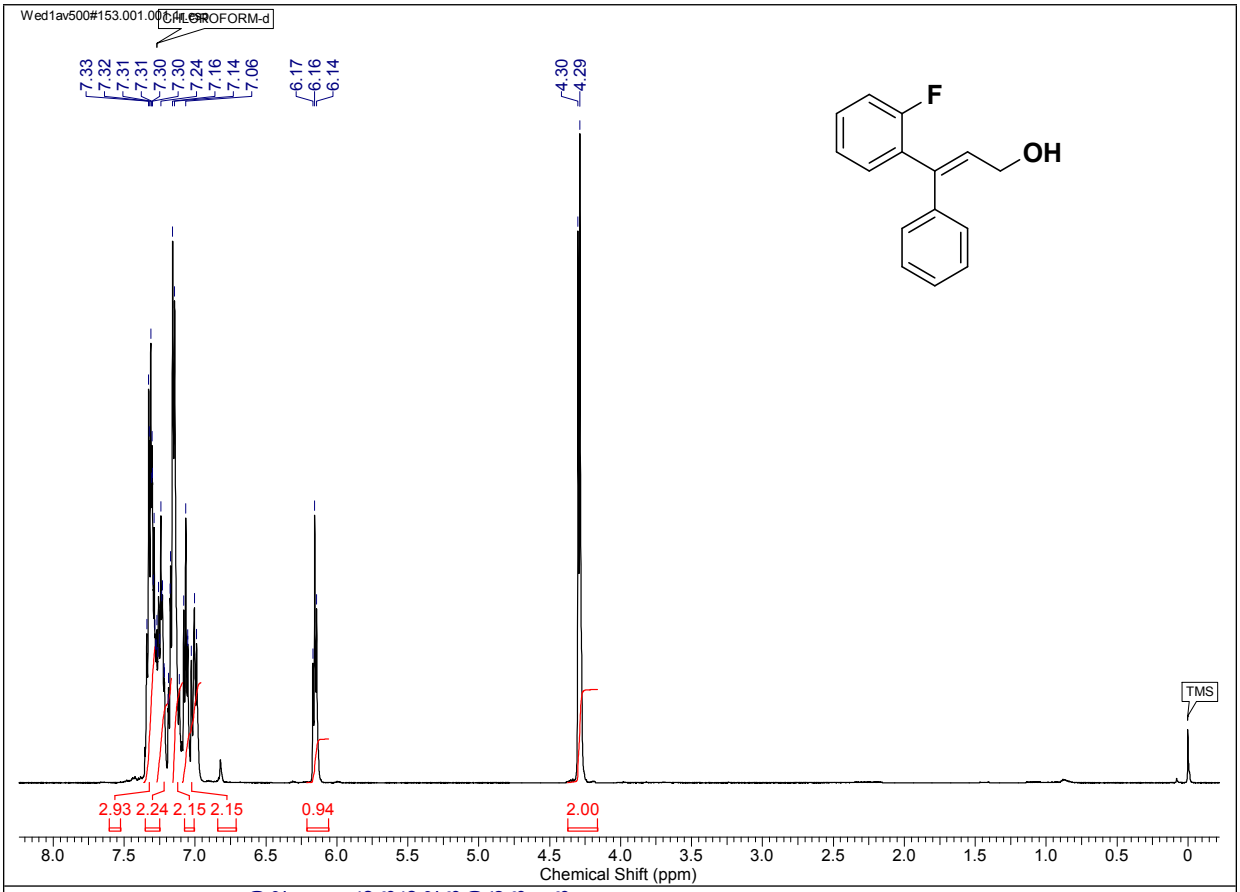


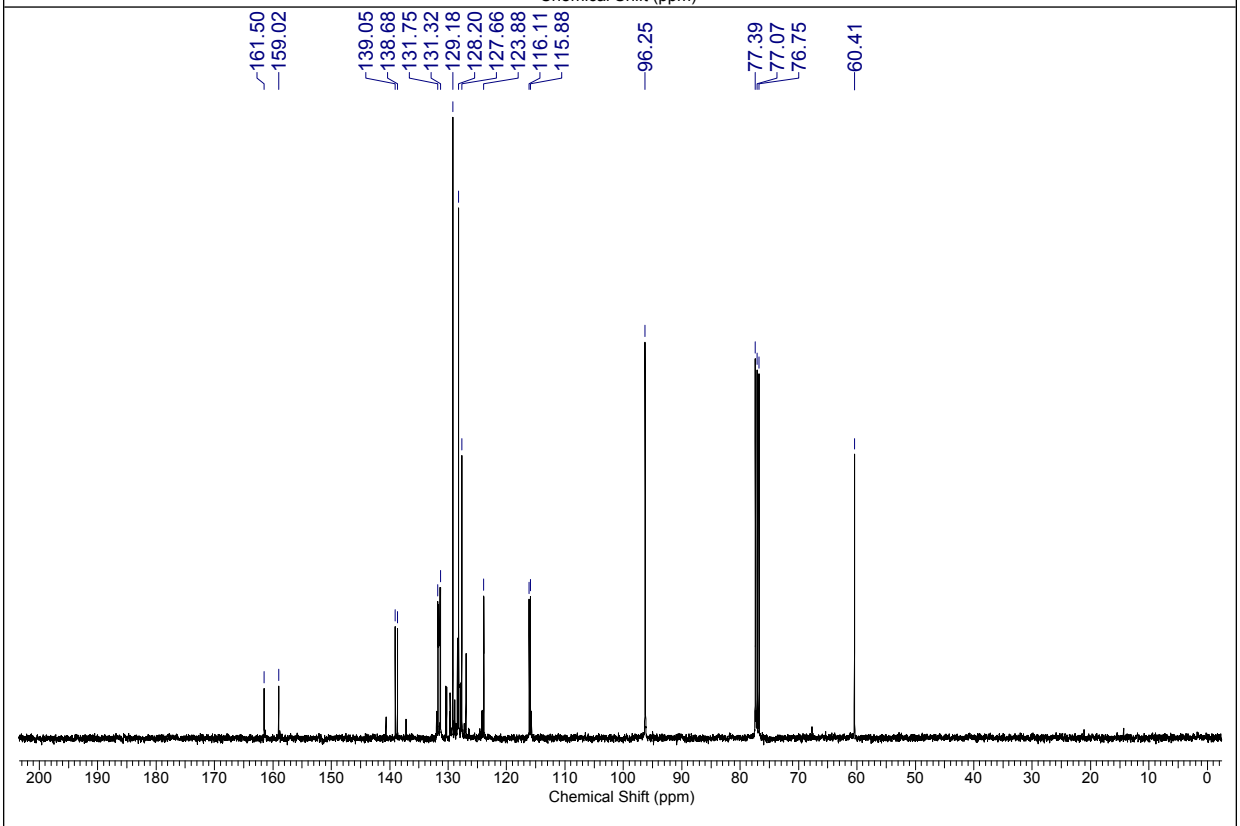




**(2*R*,3*R*)-3-(4-fluorophenyl)(phenyl)methyl)oxirane (13d)**

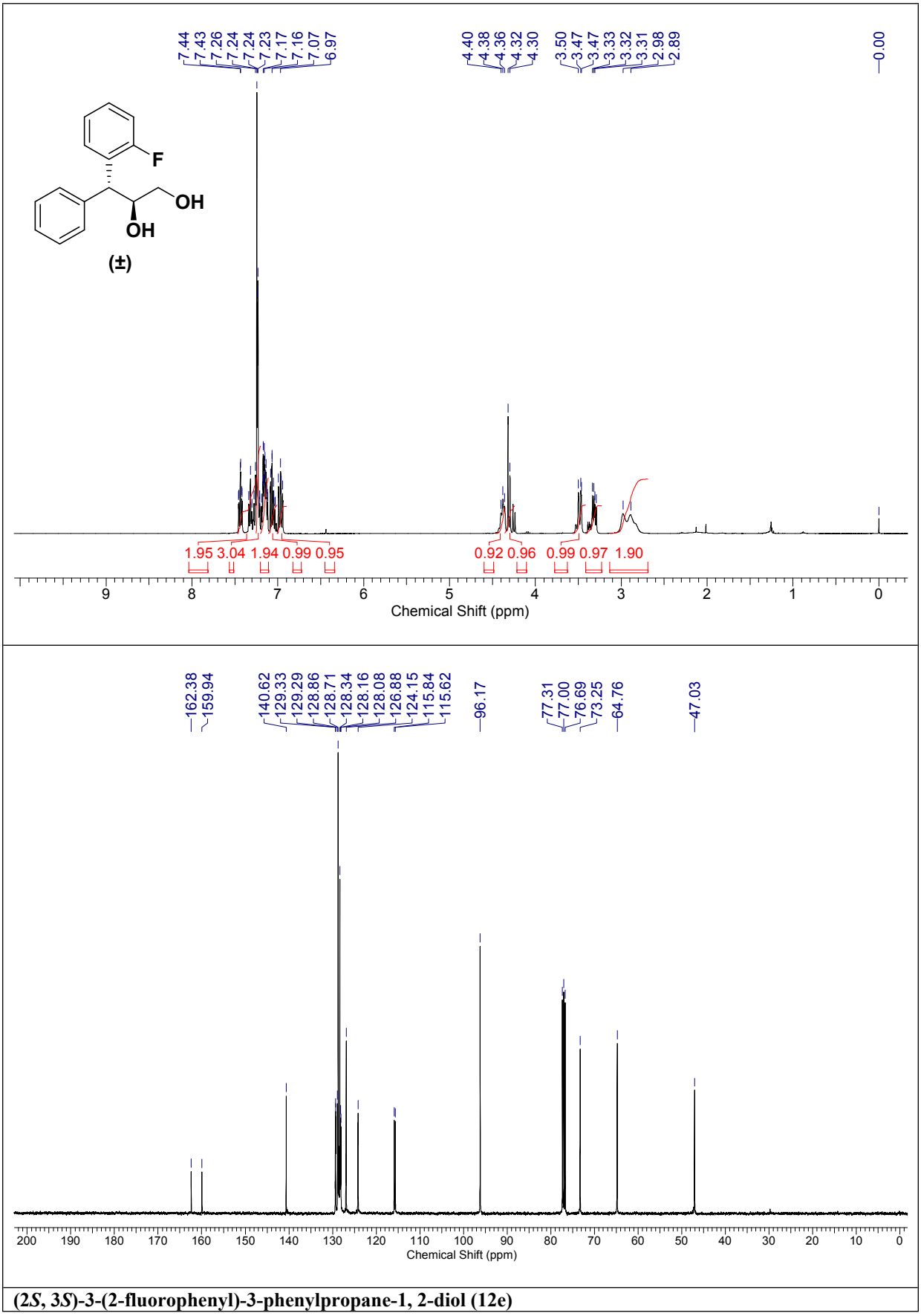



**Methyl-(E)-3-(2-fluorophenyl)-3-phenylacrylate (10e)**

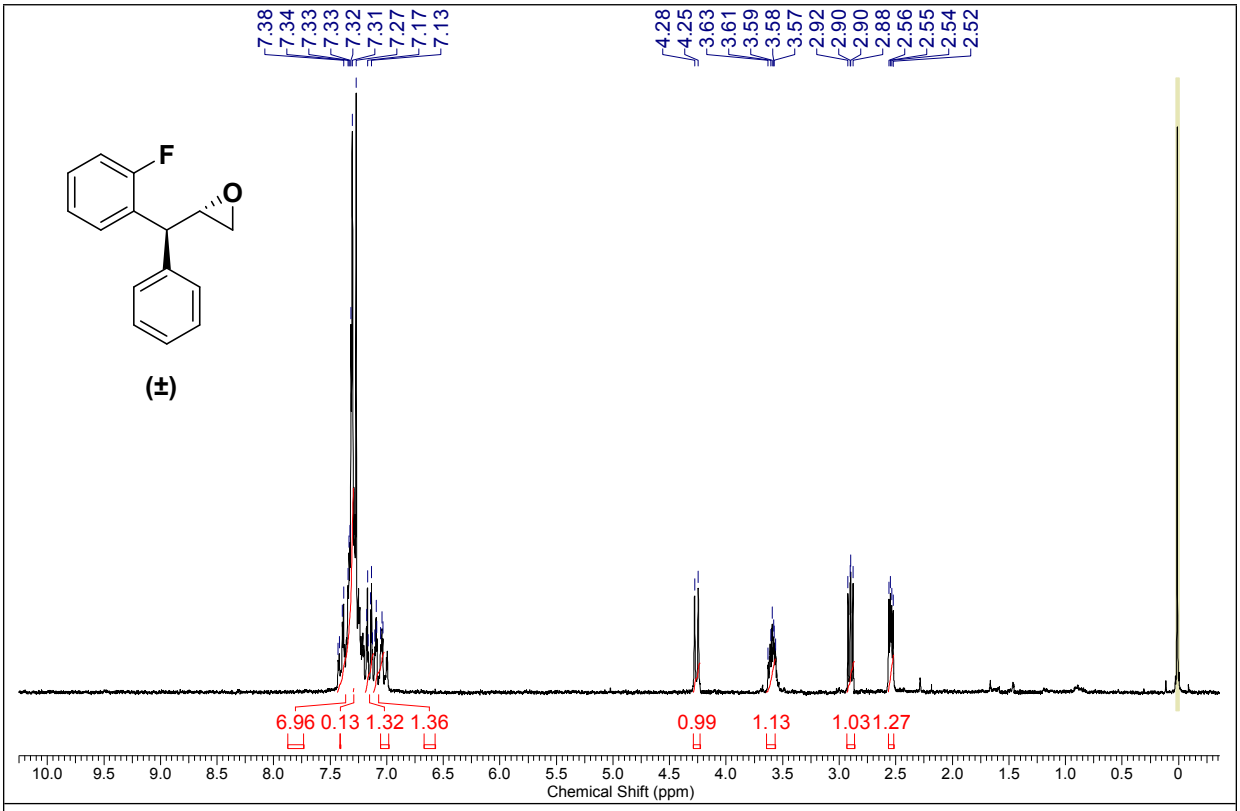


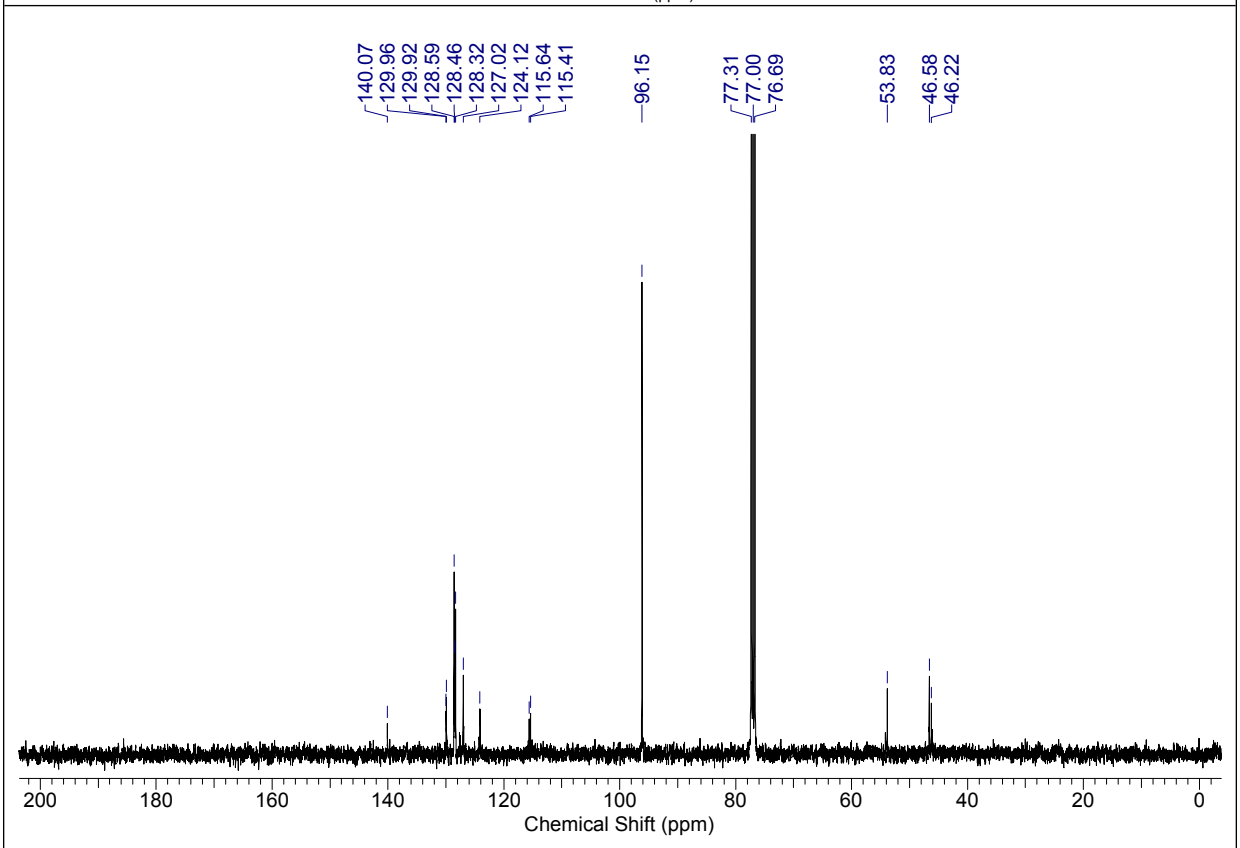




**3-(2-fluorophenyl)-3-phenylprop-2-en-1-ol (11e)**

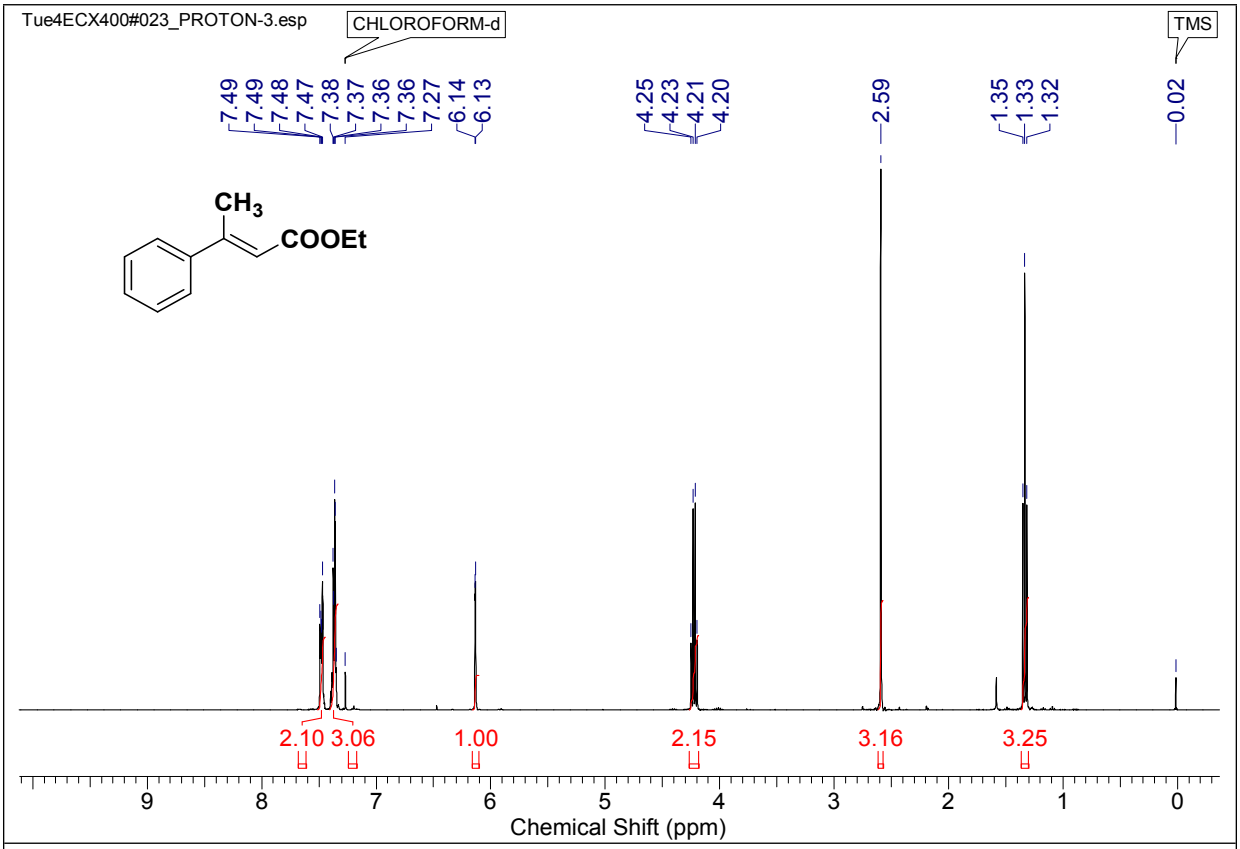


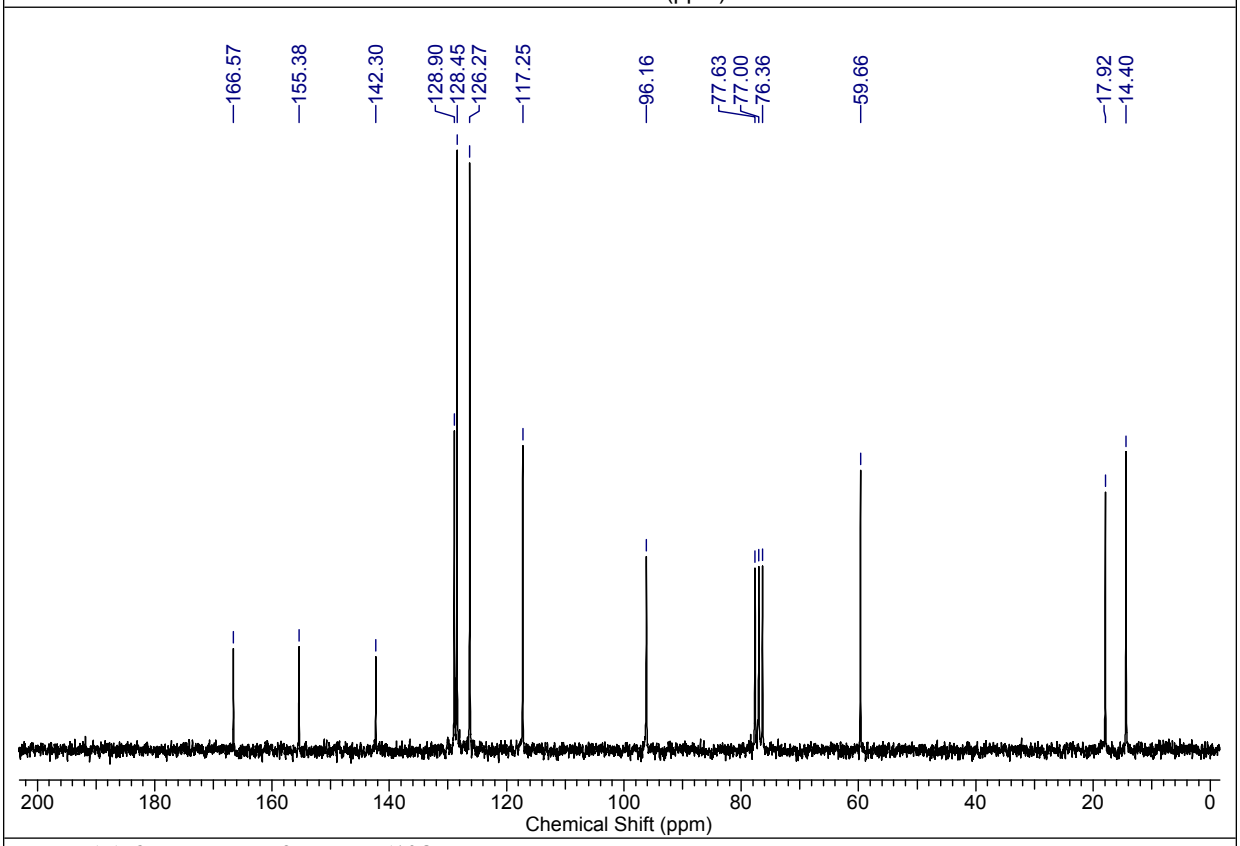

**(2*S*, 3*S*)-3-(2-fluorophenyl)-3-phenylpropane-1, 2-diol (12e)**



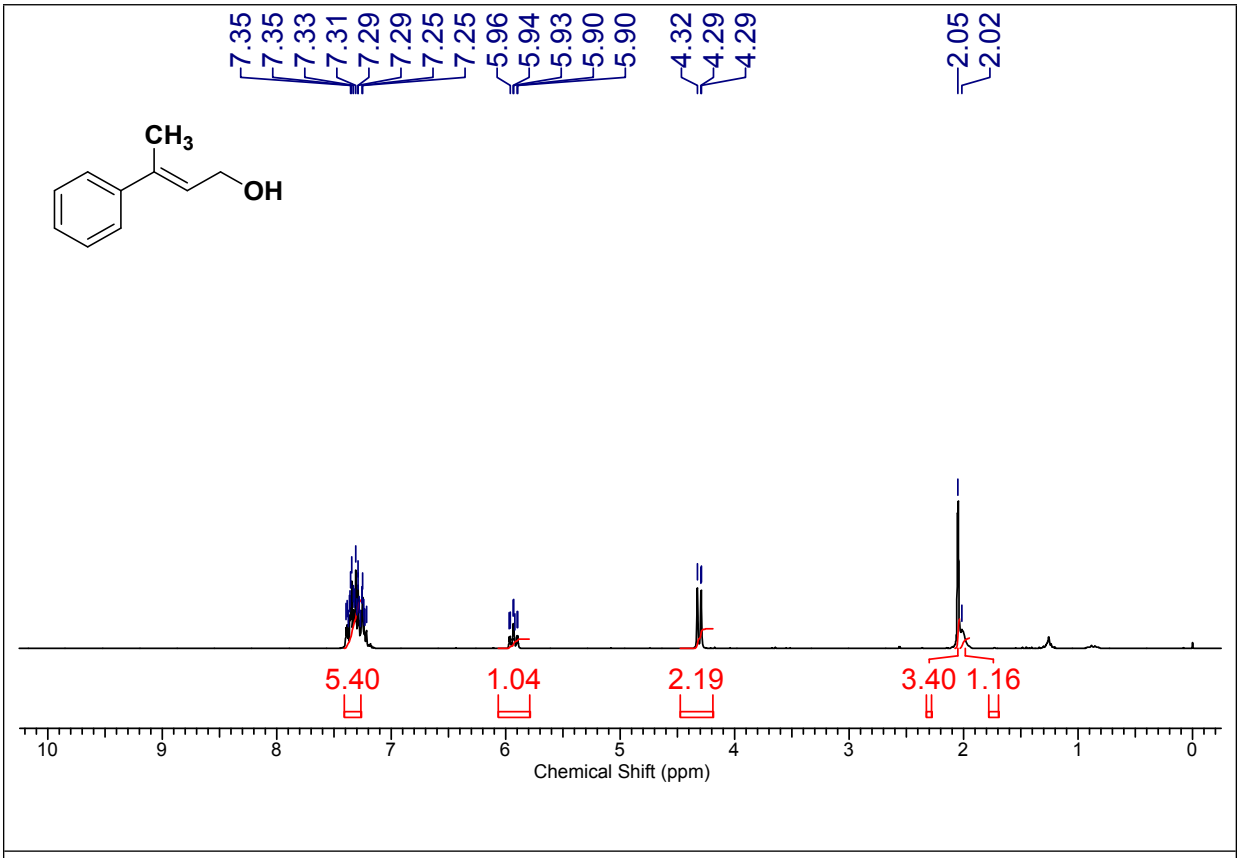



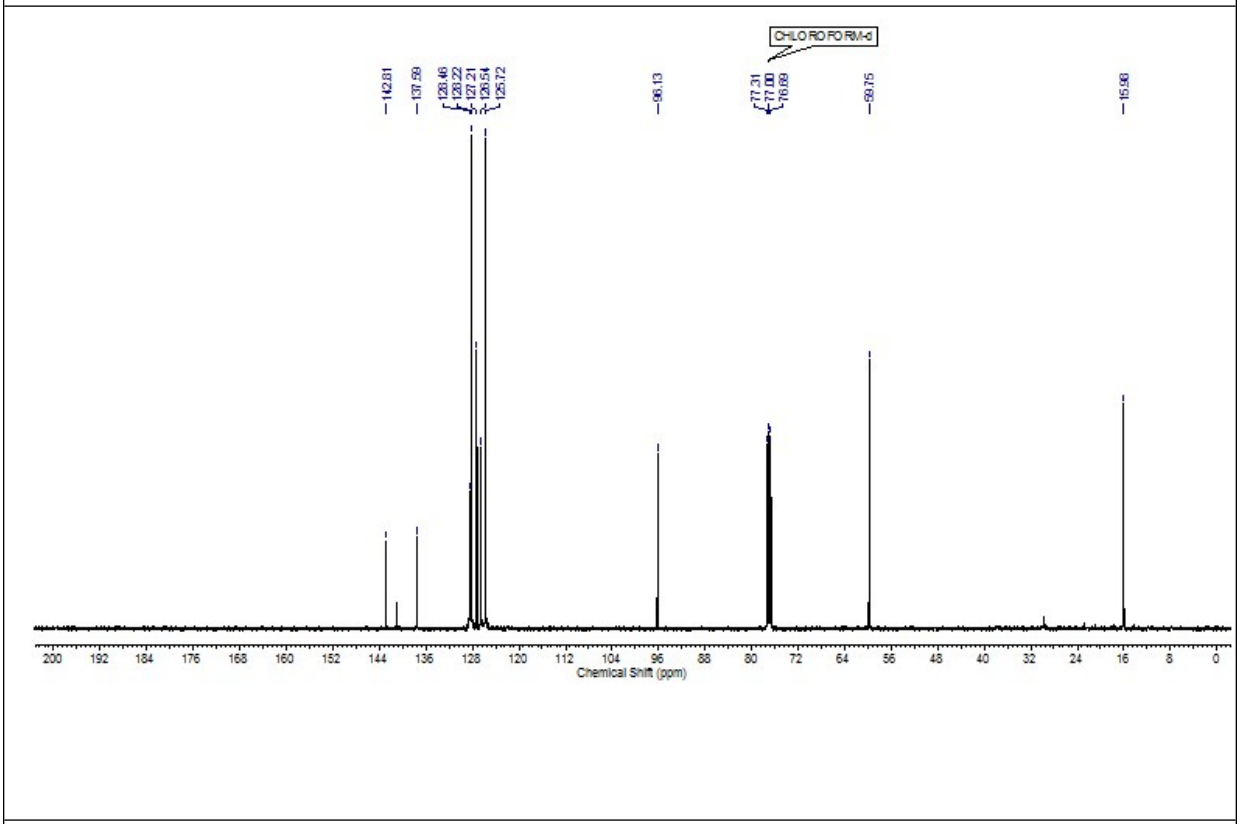

**(2*R*,3 *R*)-2-[(2-fluorophenyl)(phenyl)]methyloxirane (13e)**



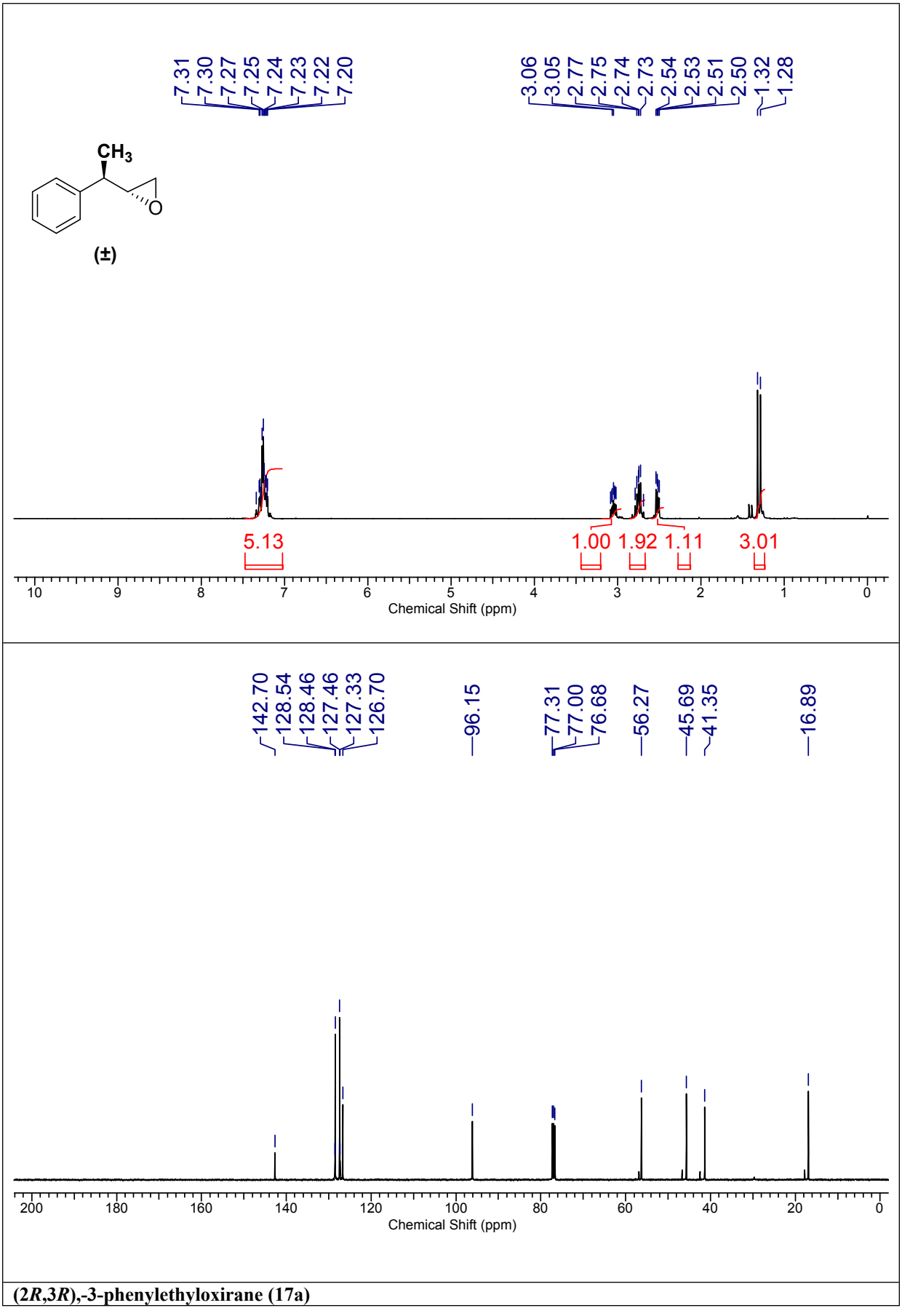




**Ethyl-(E)-3-phenylbut-2-enoate (10f)**

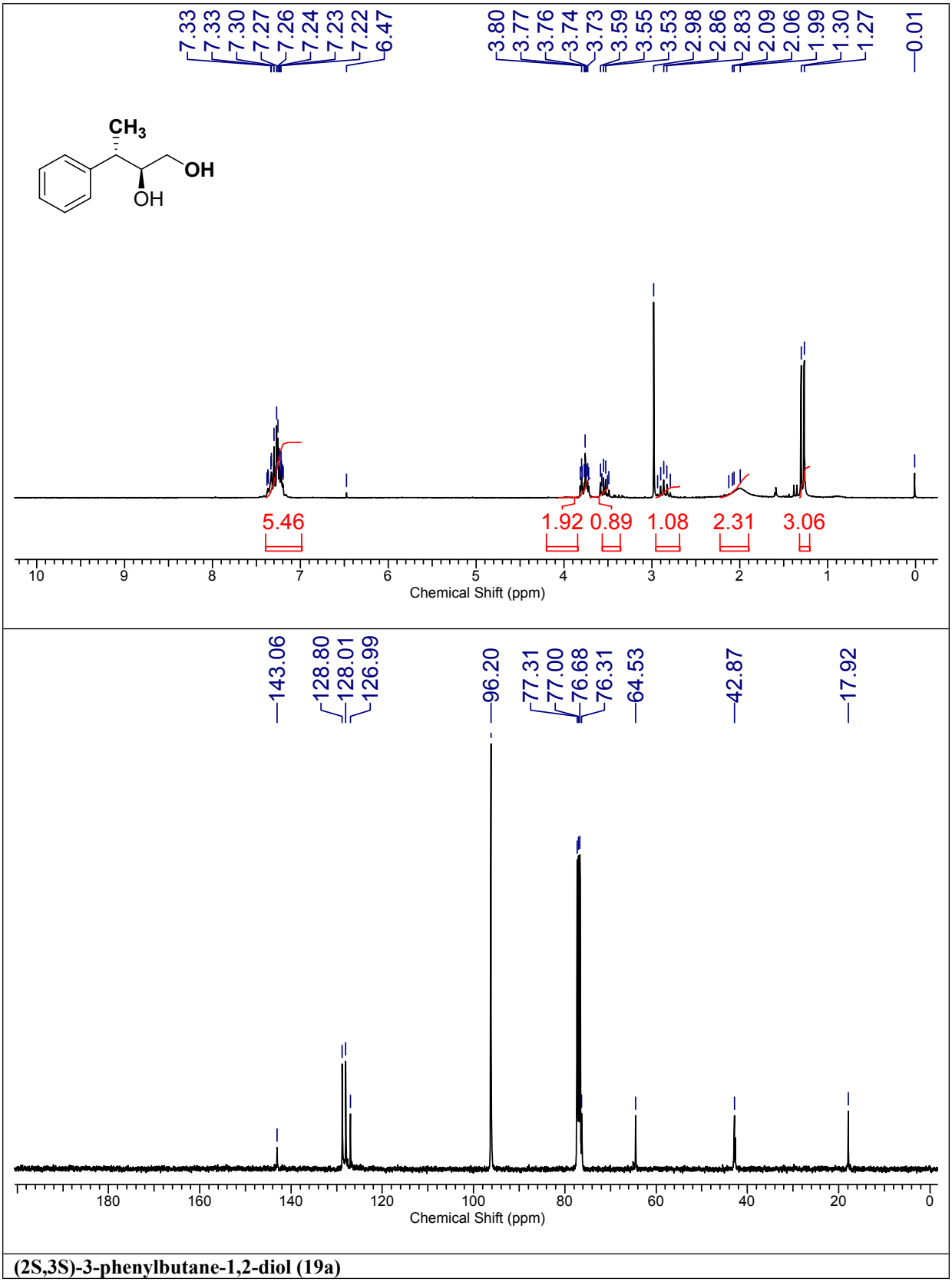


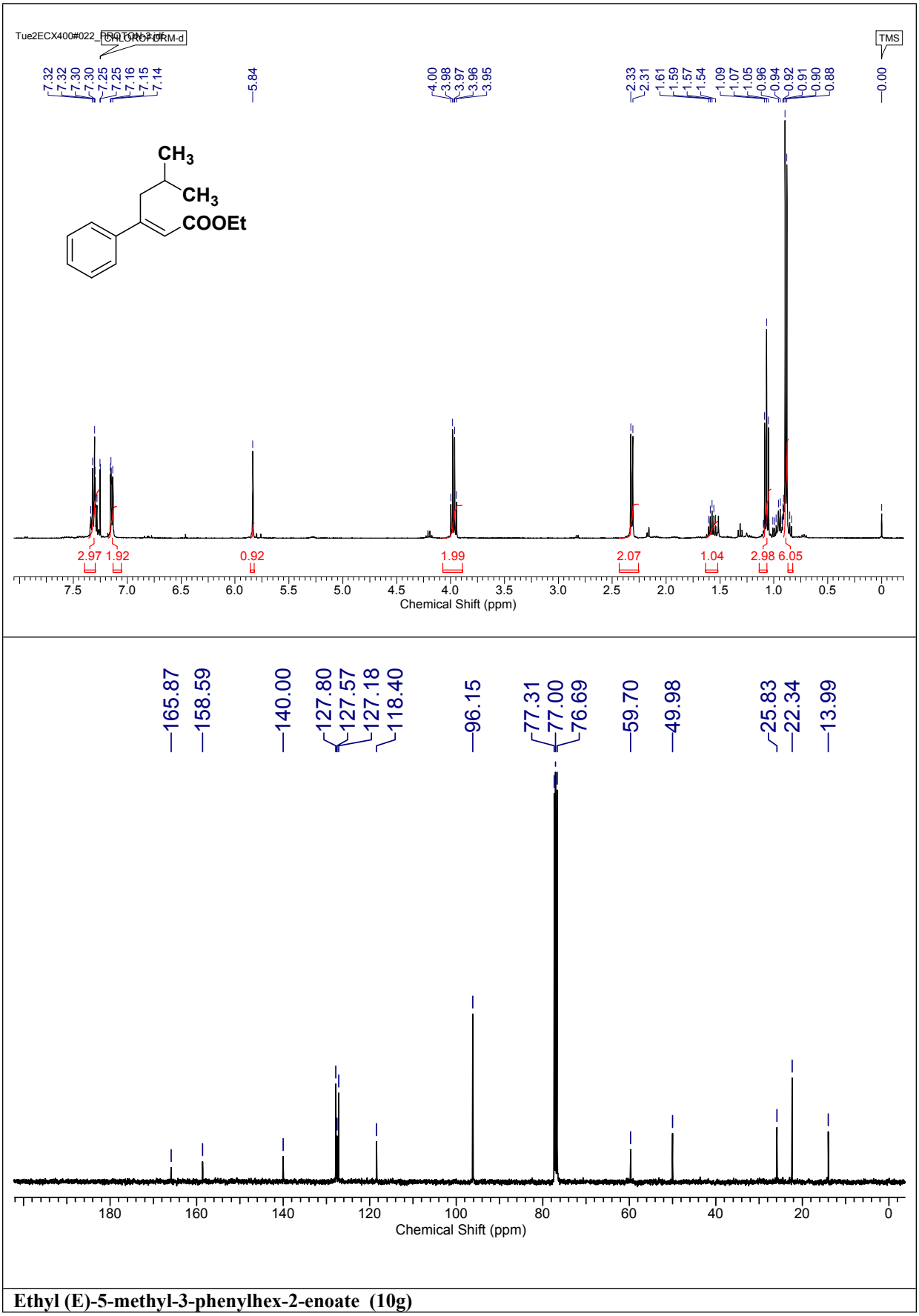

**(E)-3-phenylbut-2-en-1-ol (11f)**



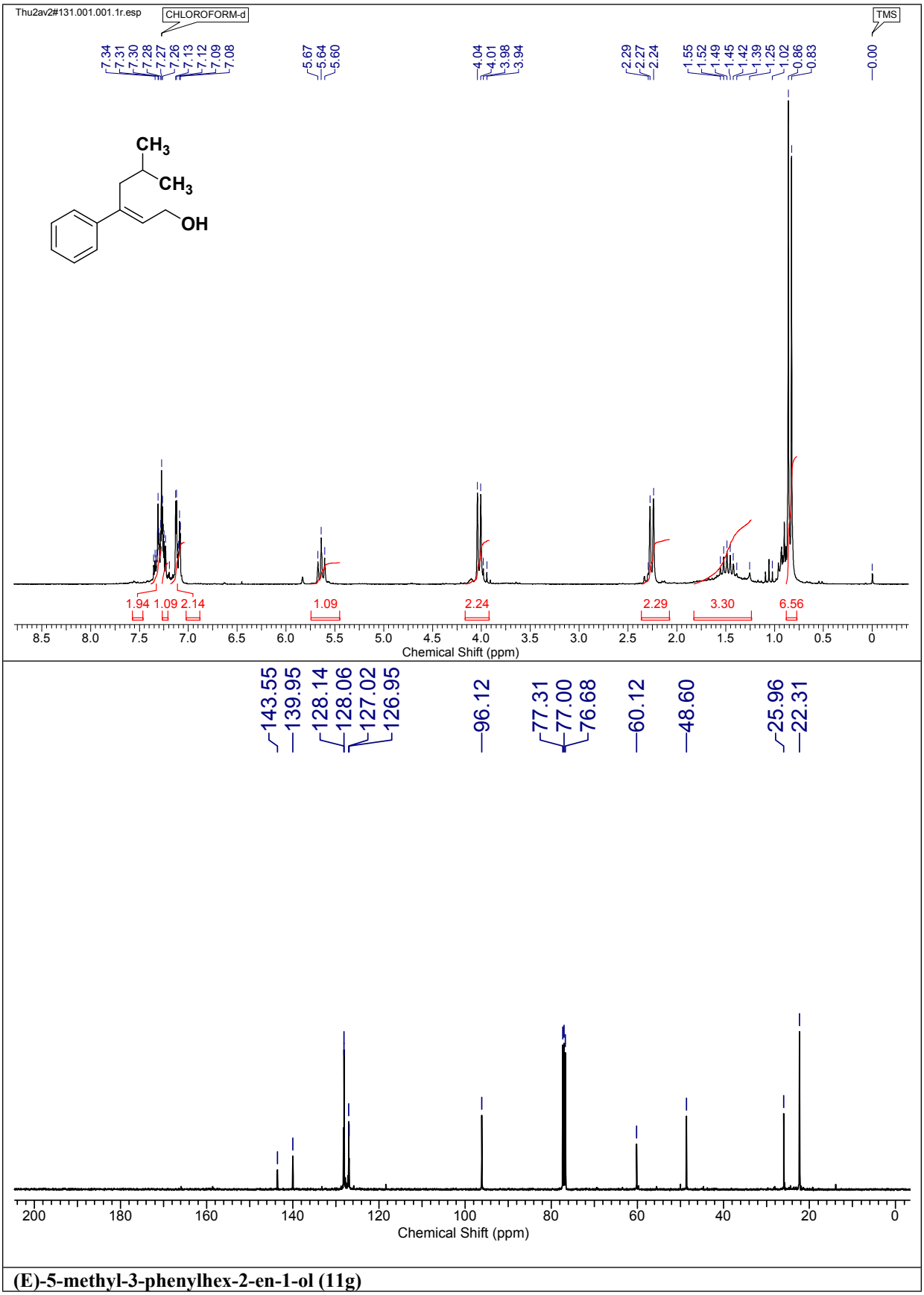

**(2*R*,3*R*),-3-phenylethyloxirane (17a)**



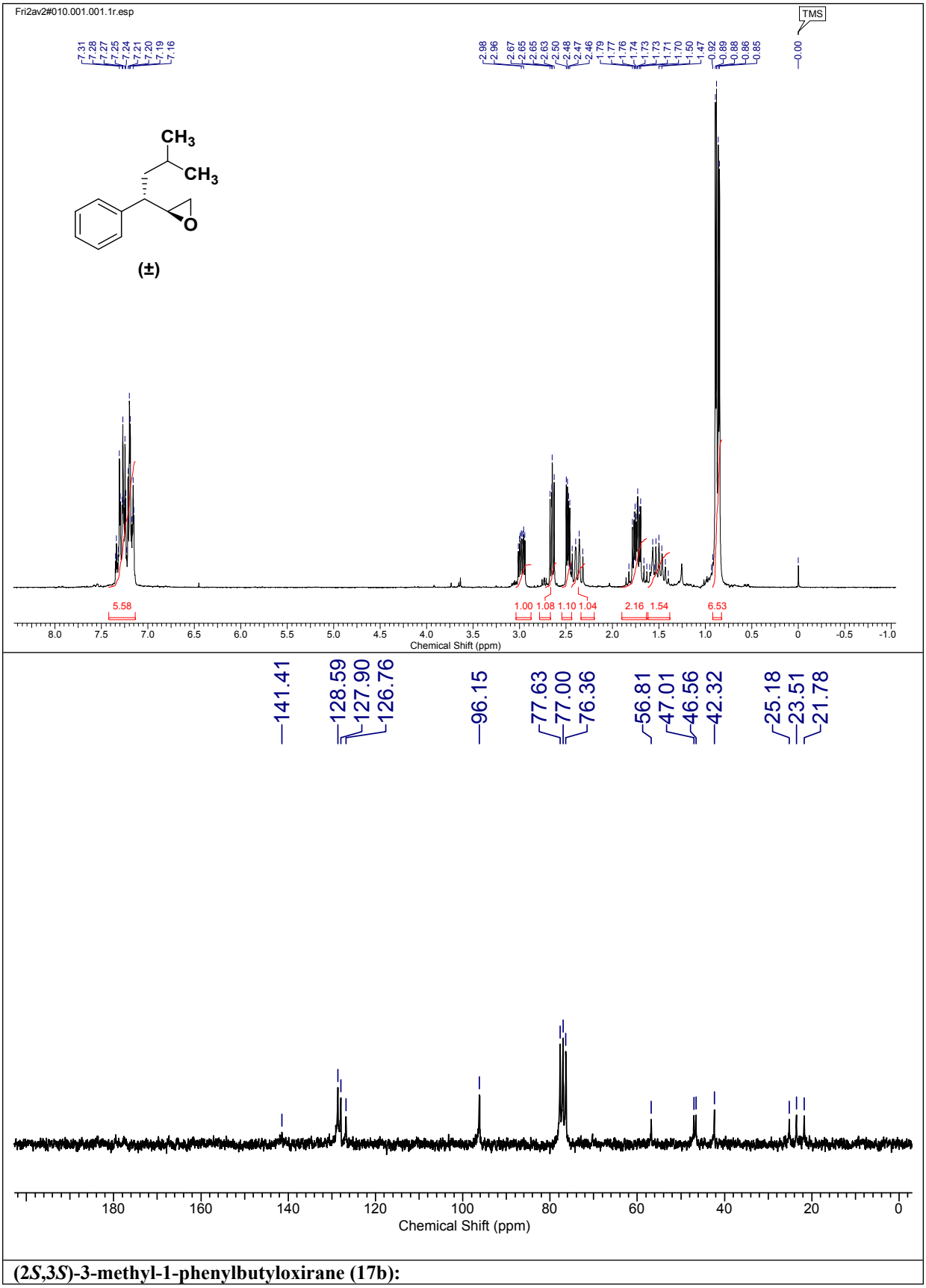

**(2S,3S)-3-phenylbutane-1,2-diol (19a)**



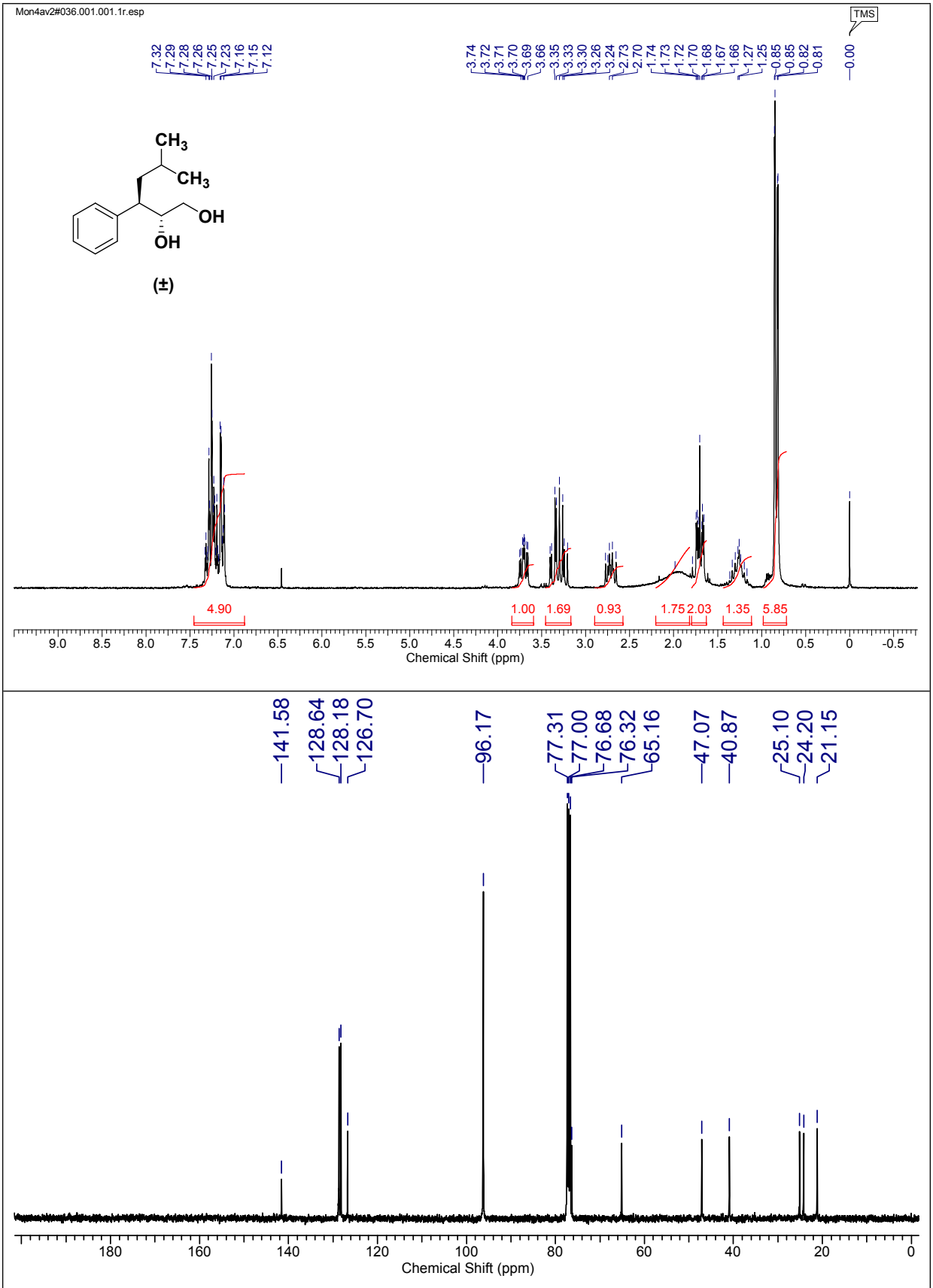

**Ethyl (E)-5-methyl-3-phenylhex-2-enoate (10g)**



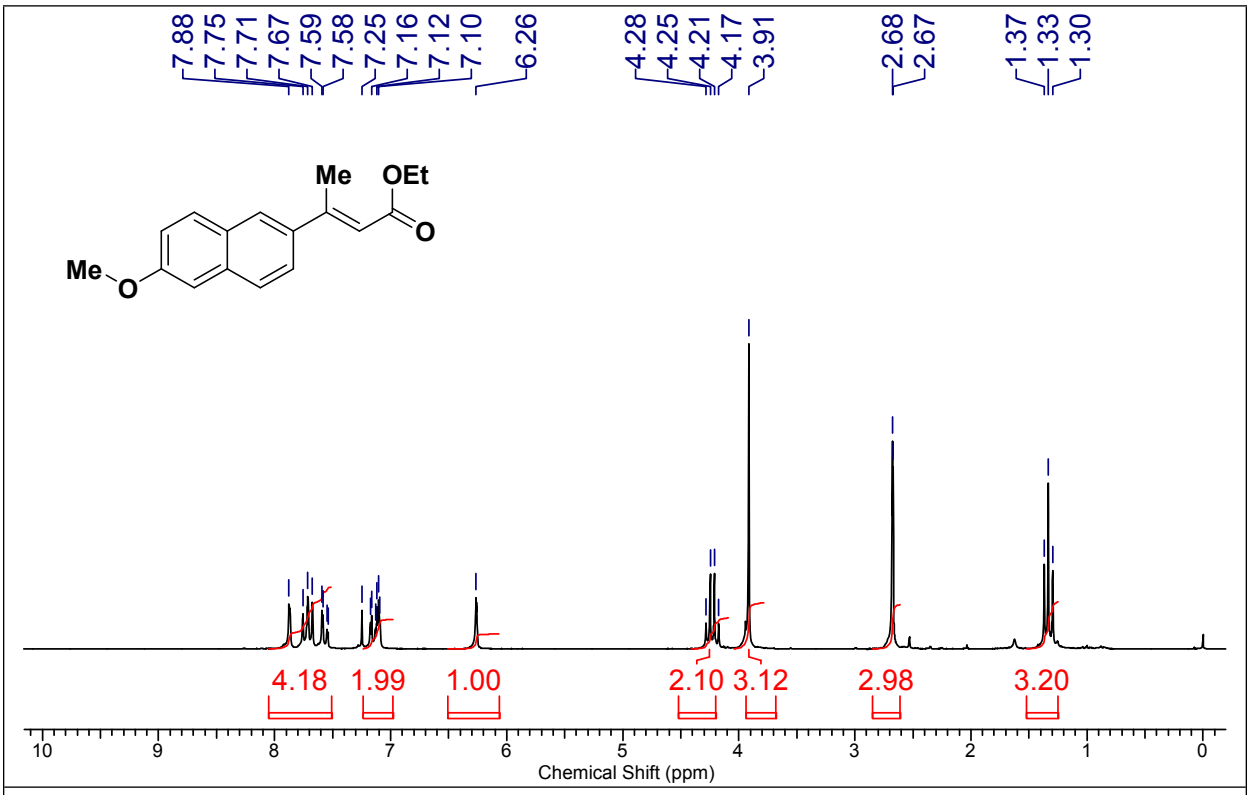

**(E)-5-methyl-3-phenylhex-2-en-1-ol (11g)**

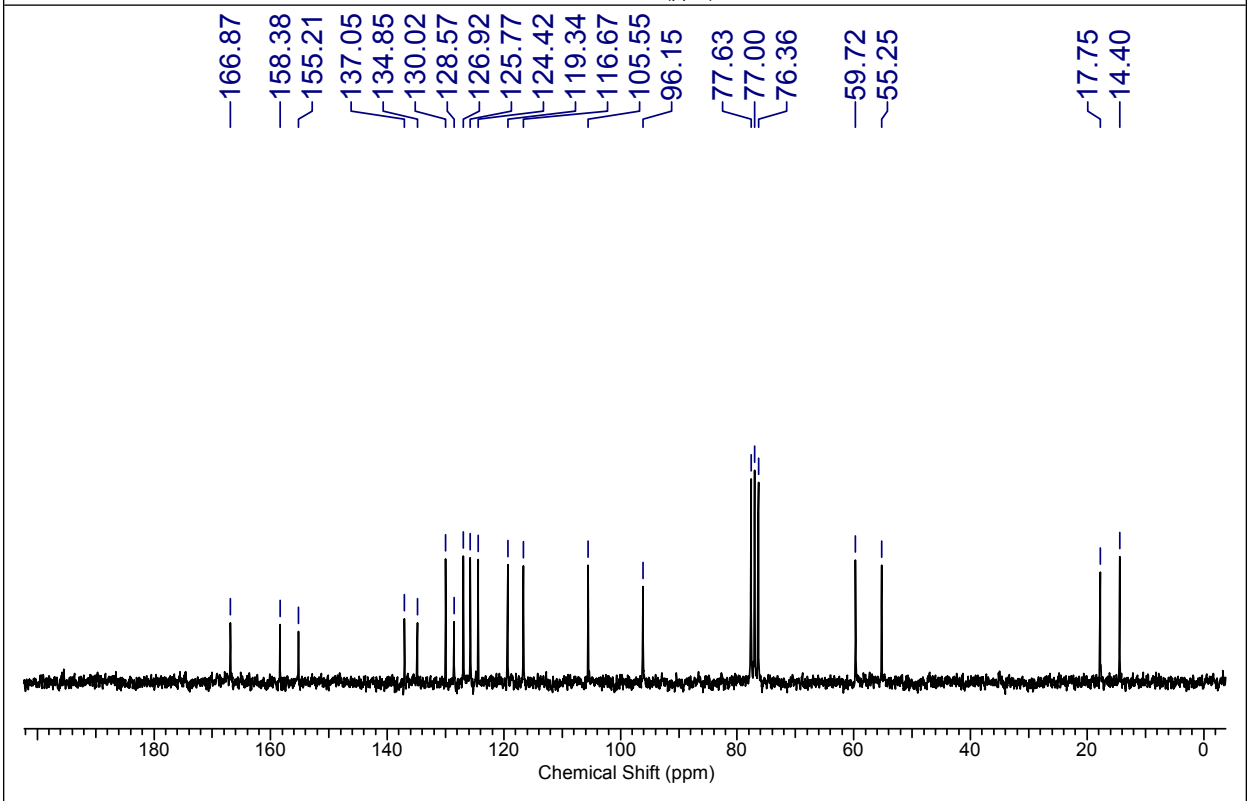



**(2*S*,3*S*)-3-methyl-1-phenylbutyloxirane (17b):**

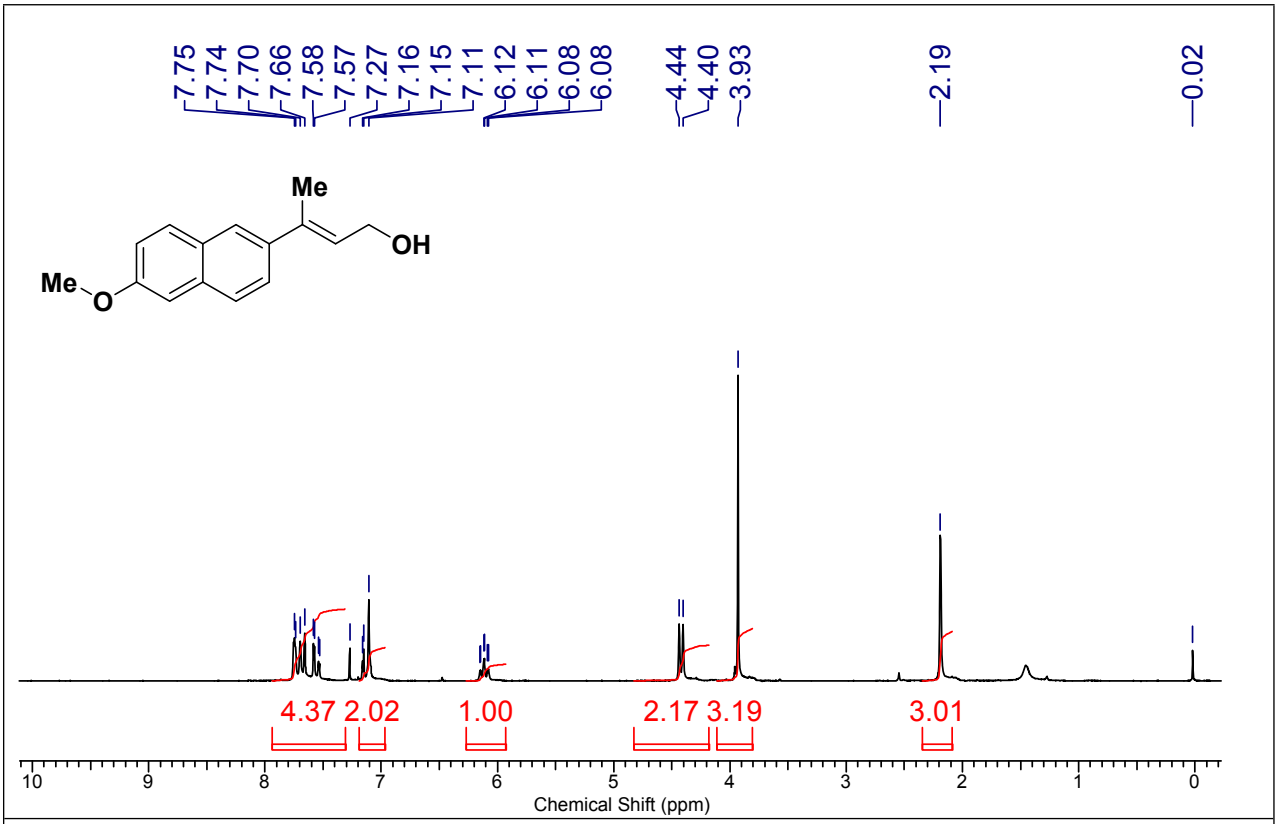


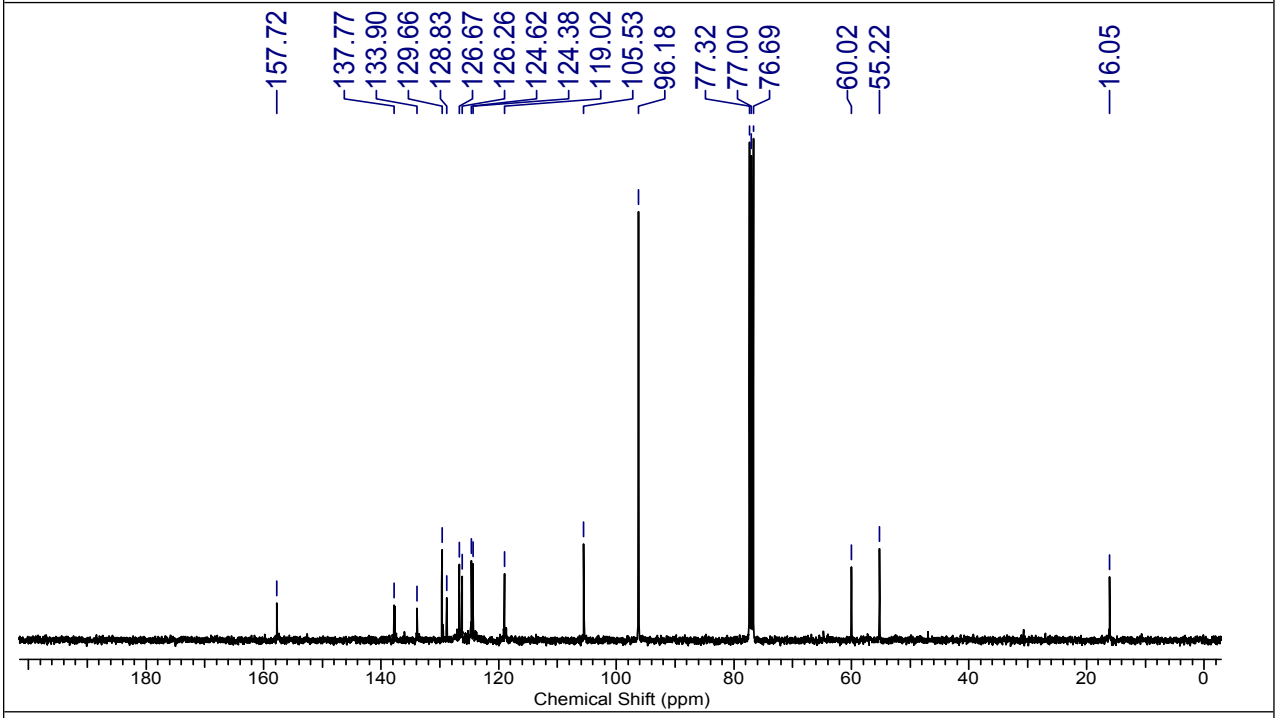

**(2*R*,3*R*)-5-methyl-3-phenylhexane-1,2-diol (19b):**



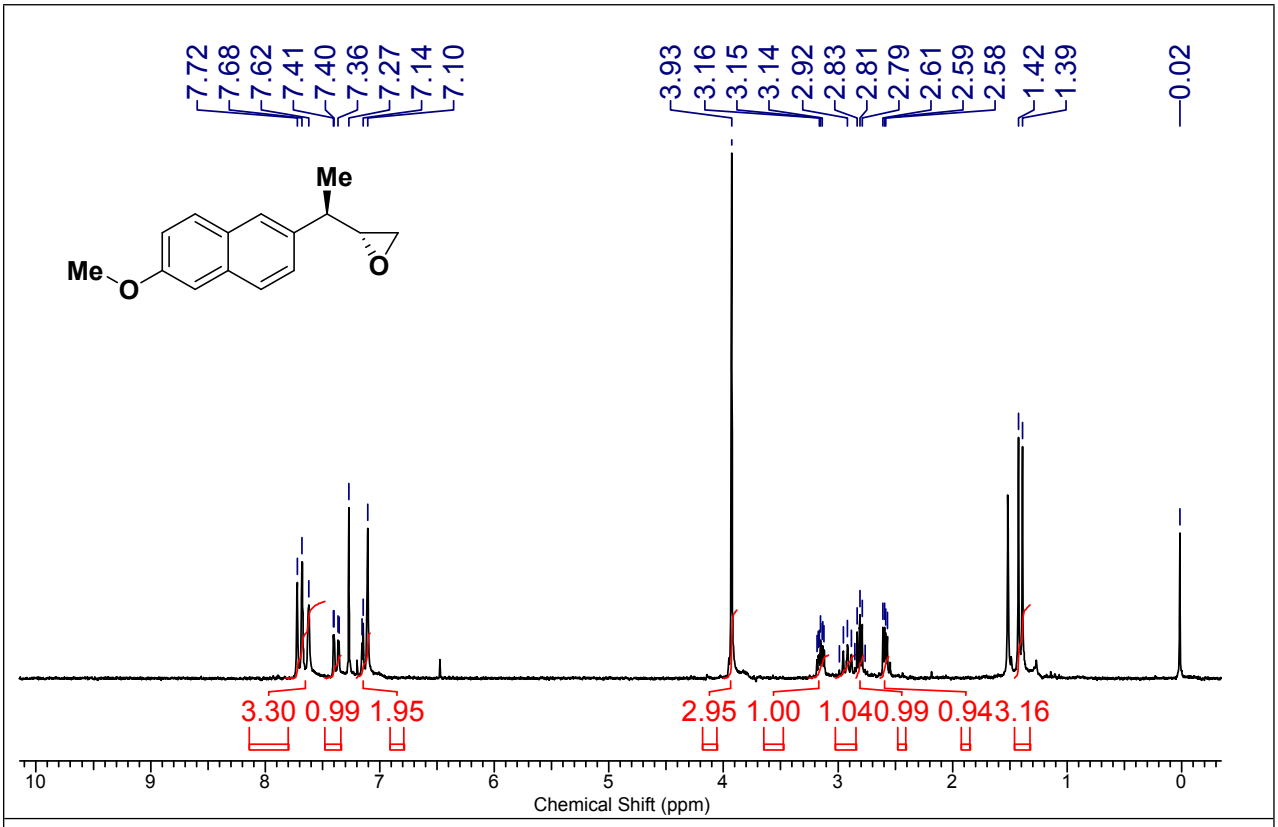



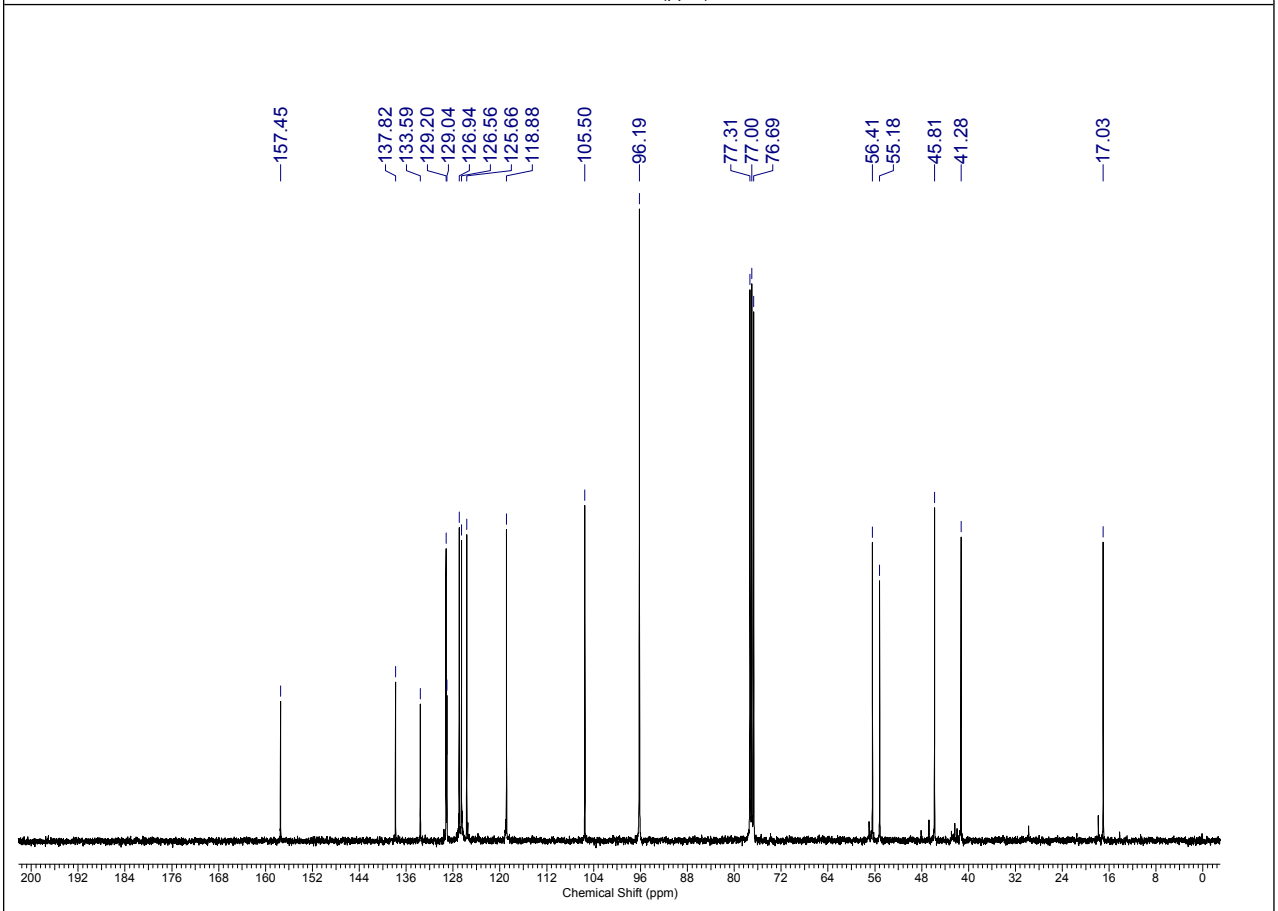

**Ethyl-(E)-3-(6-methoxynaphthalen-2-yl)but-2-enoate (10h)**



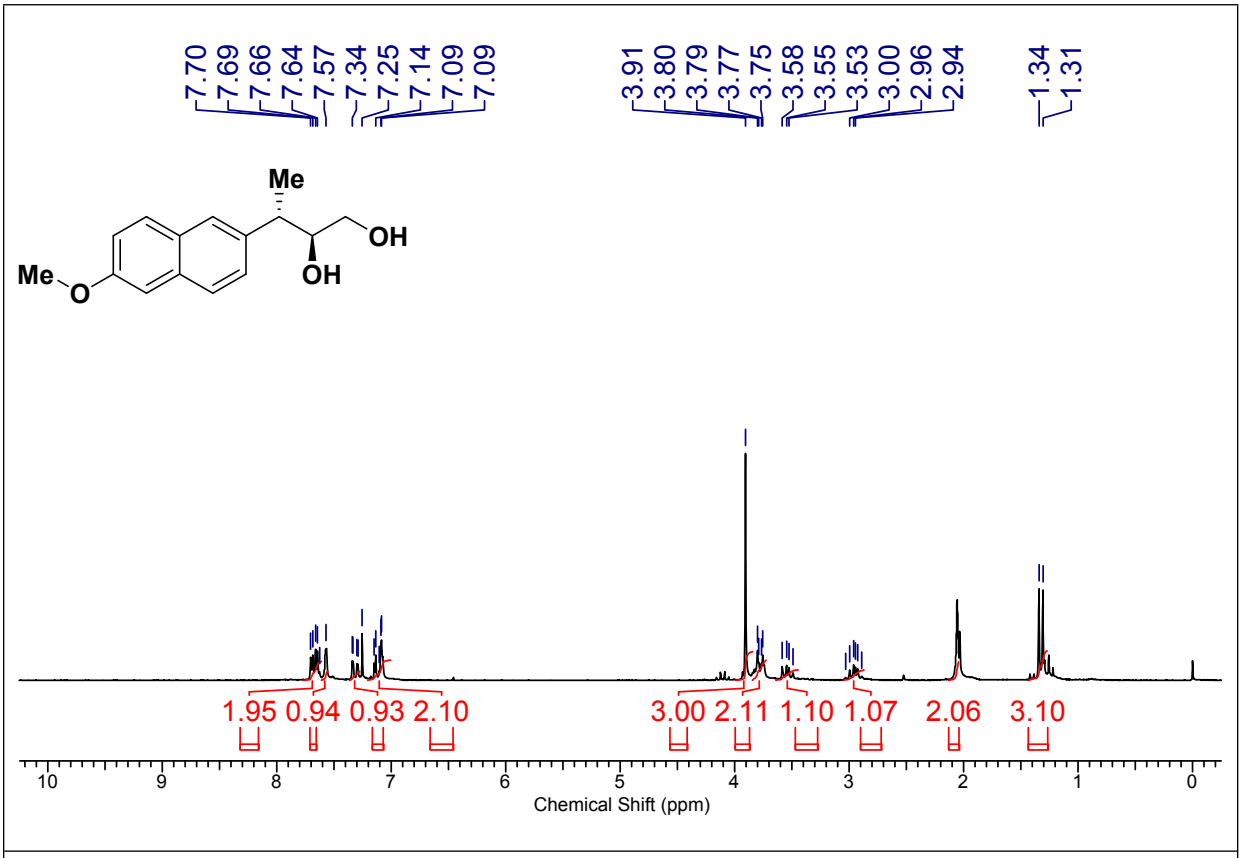



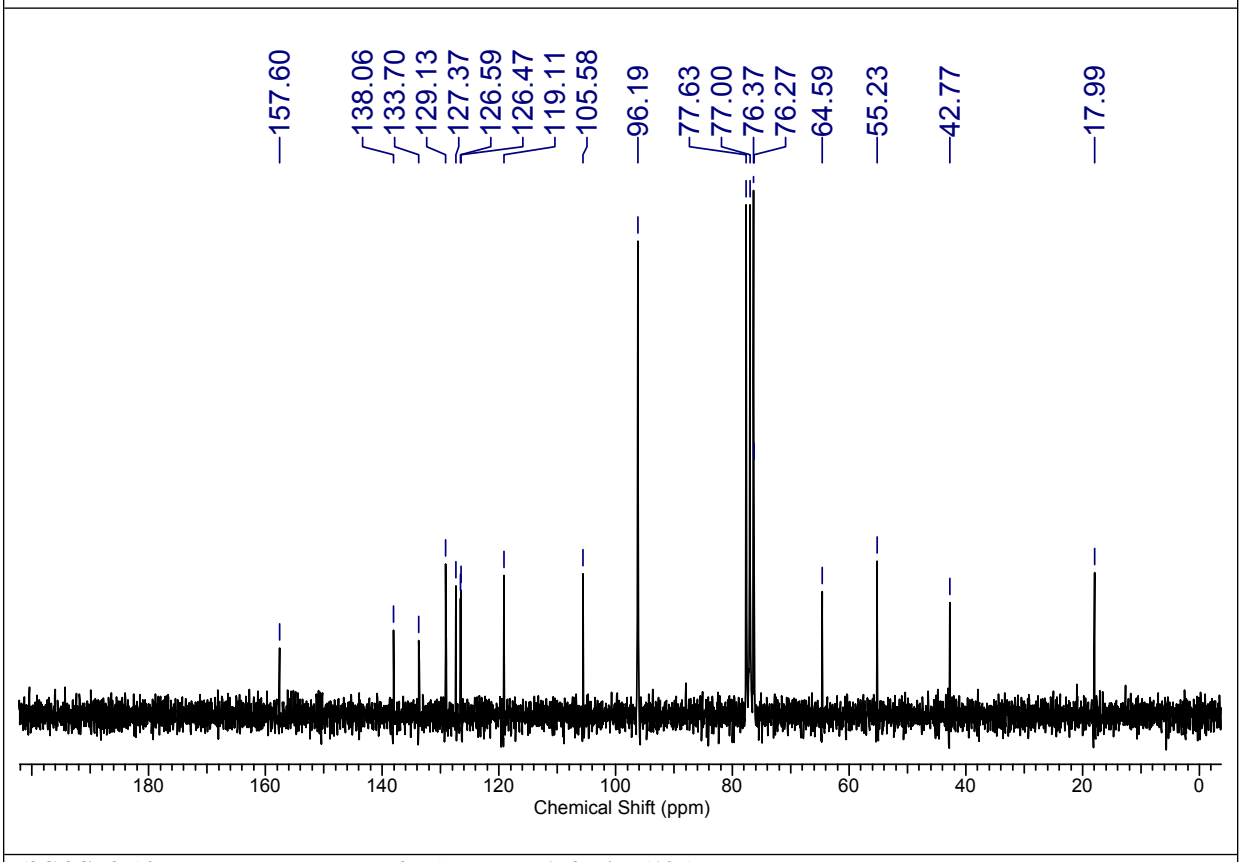

**(E)-3-(6-methoxynaphthalen-2-yl) but-2-en-1-ol (11h)**



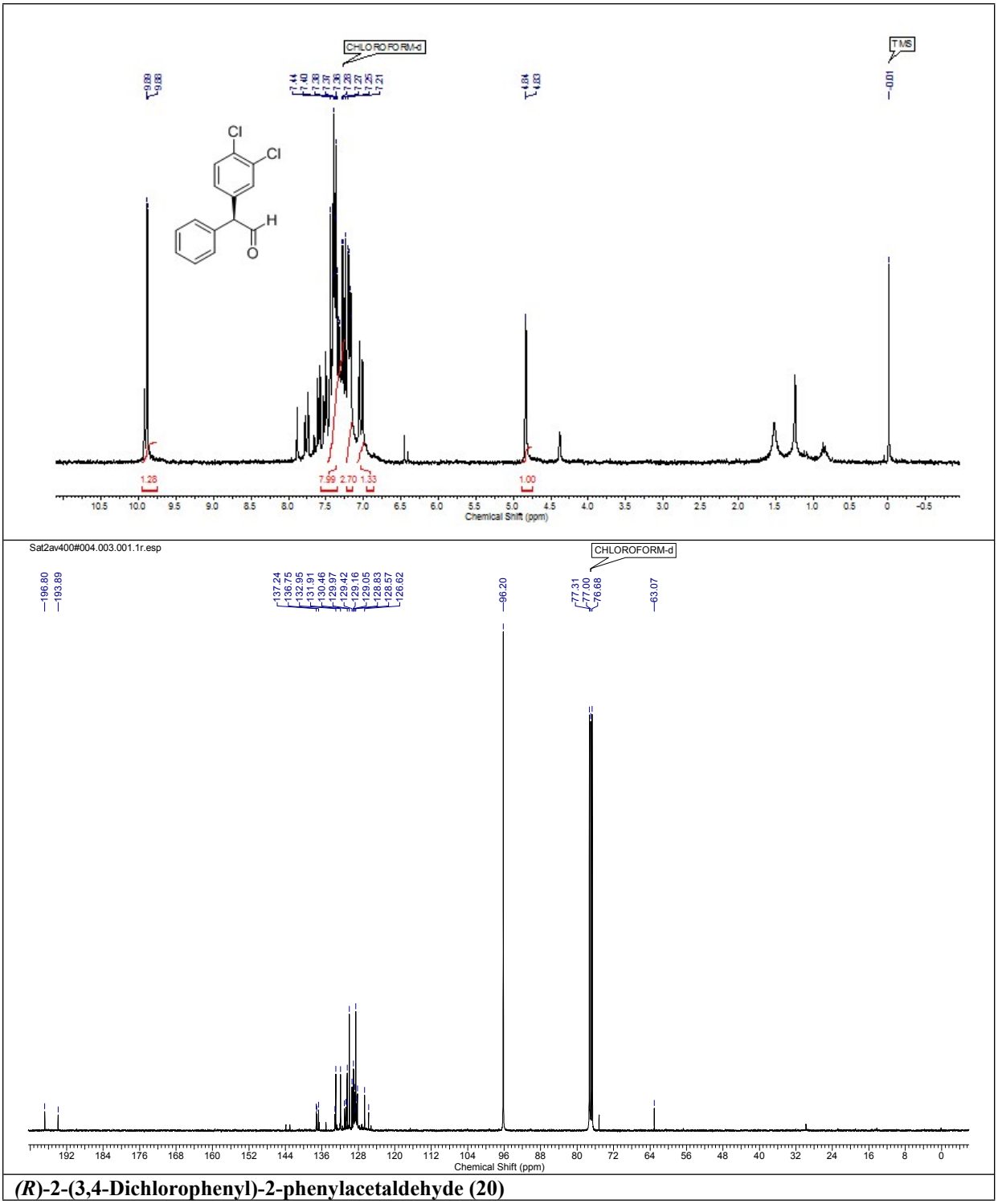




**(2R,3*R*)-2-((R)-1-(6-methoxynaphthalen-2-yl) ethyl)oxirane (17c)**

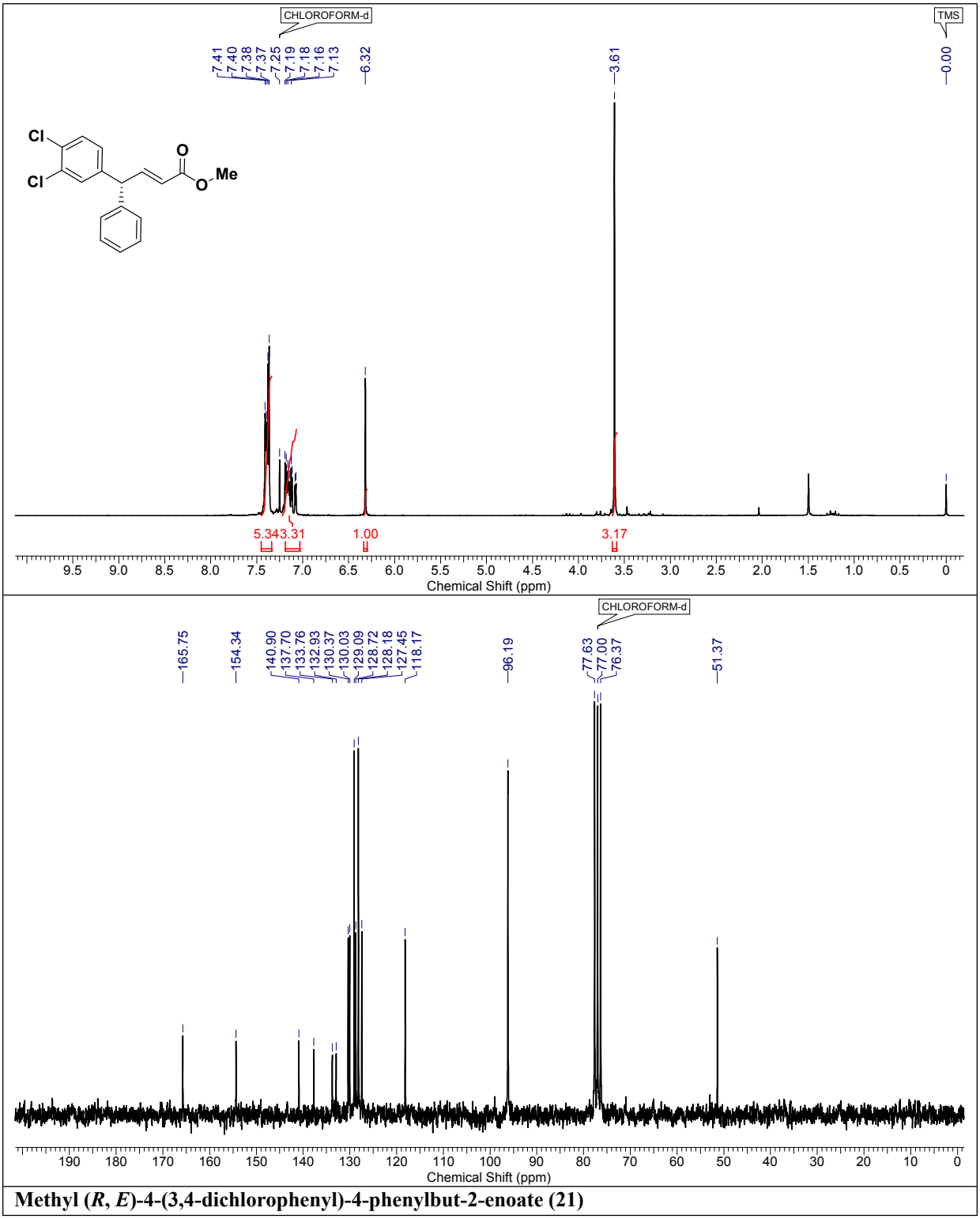


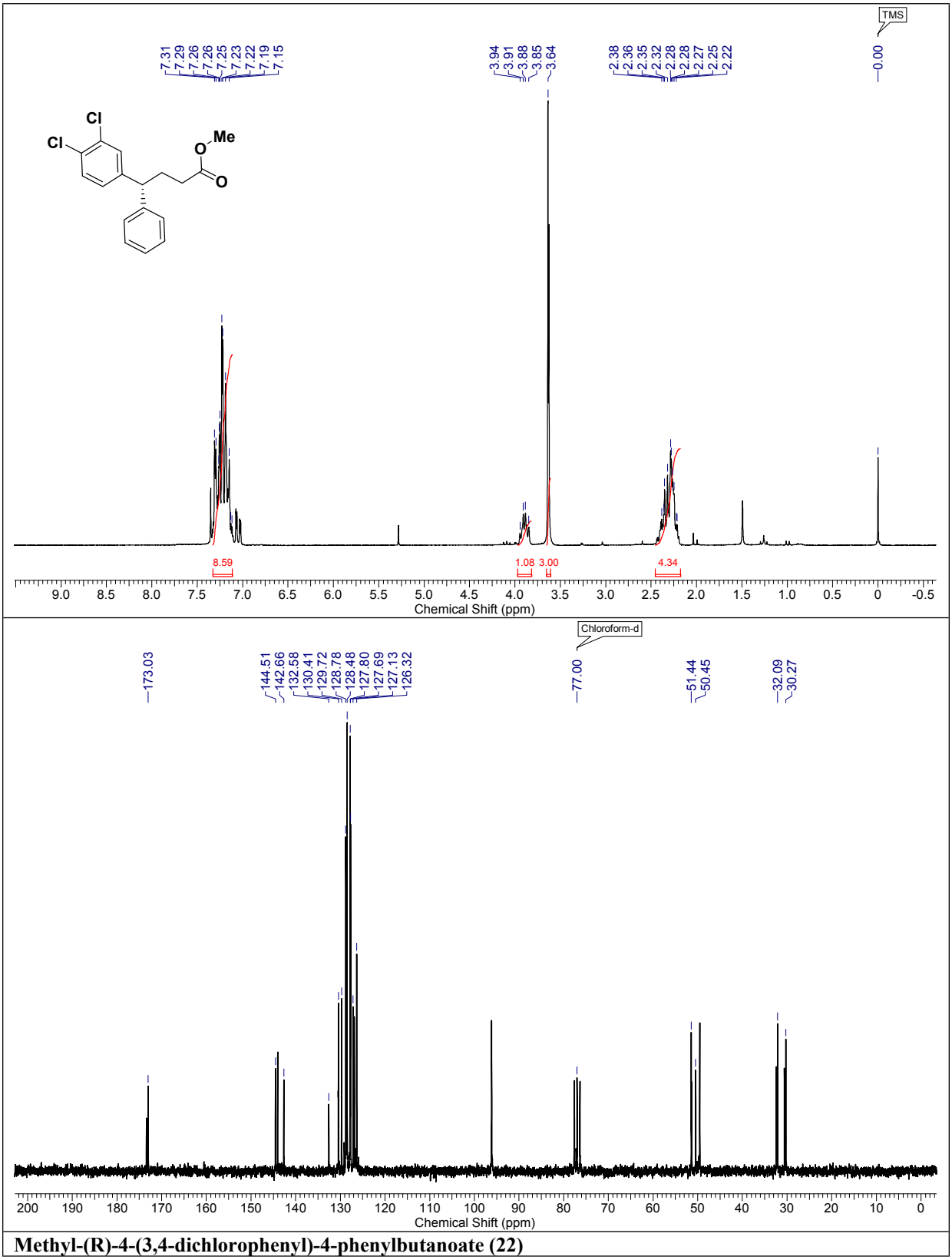

**(2*S*,3*S*)-3-(6-methoxynaphthalen-2-yl) butane-1, 2-diol (19c)**



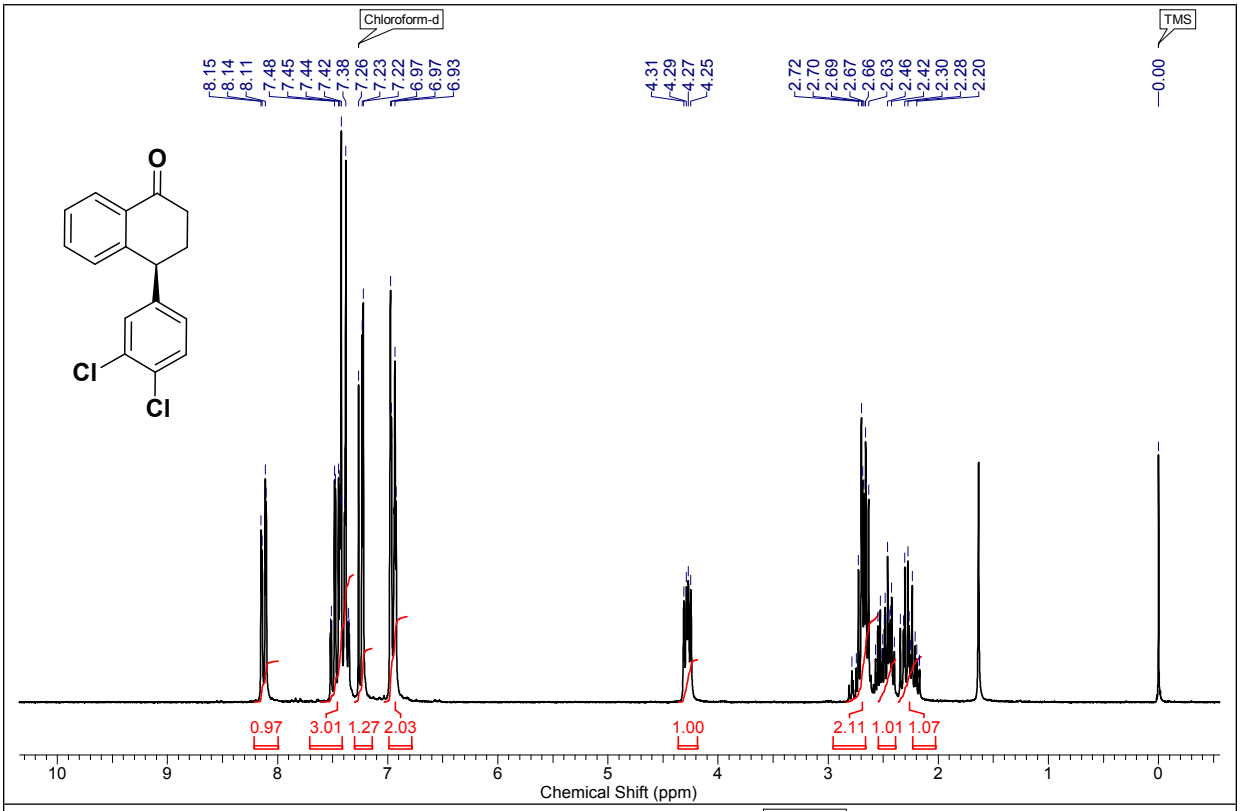

***(R)*-2-(3,4-Dichlorophenyl)-2-phenylacetaldehyde (20)**

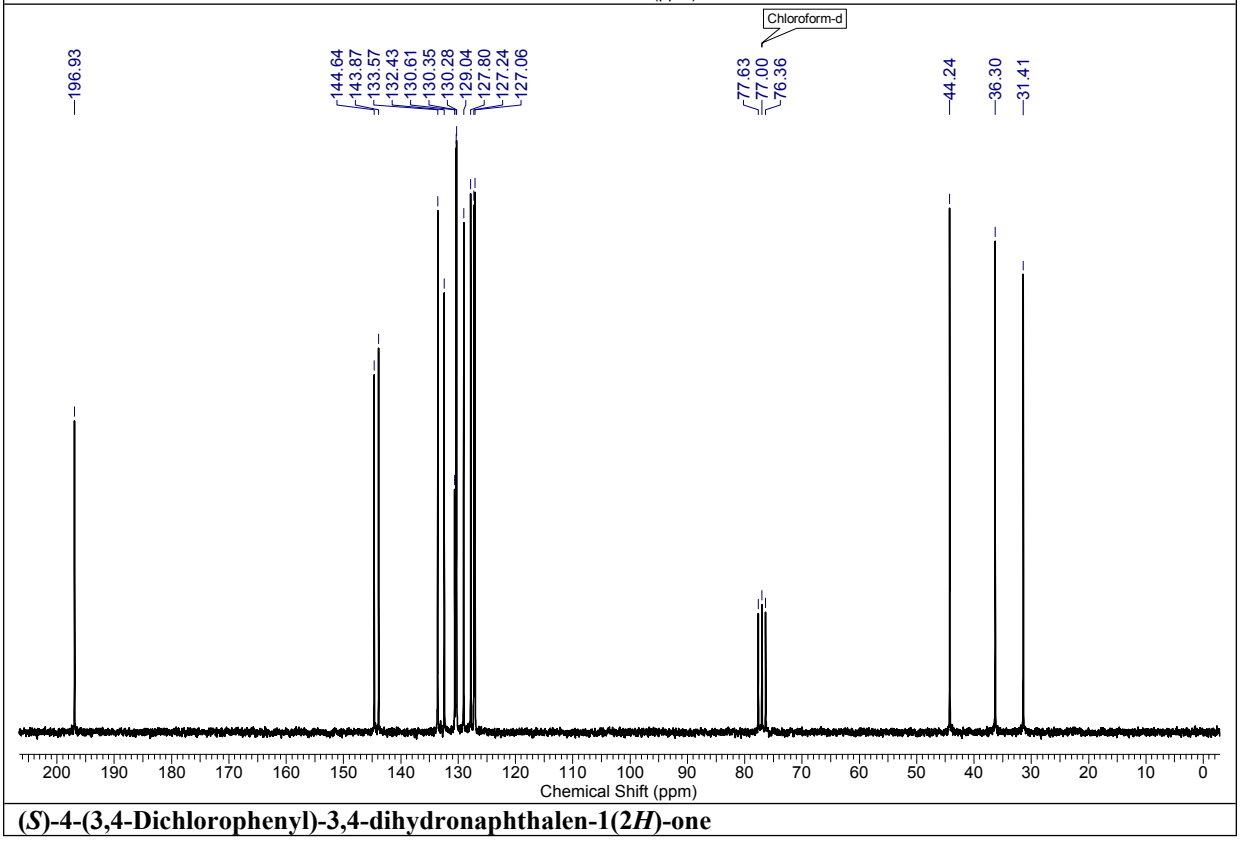



**Methyl (*R*, *E*)-4-(3,4-dichlorophenyl)-4-phenylbut-2-enoate (21)**

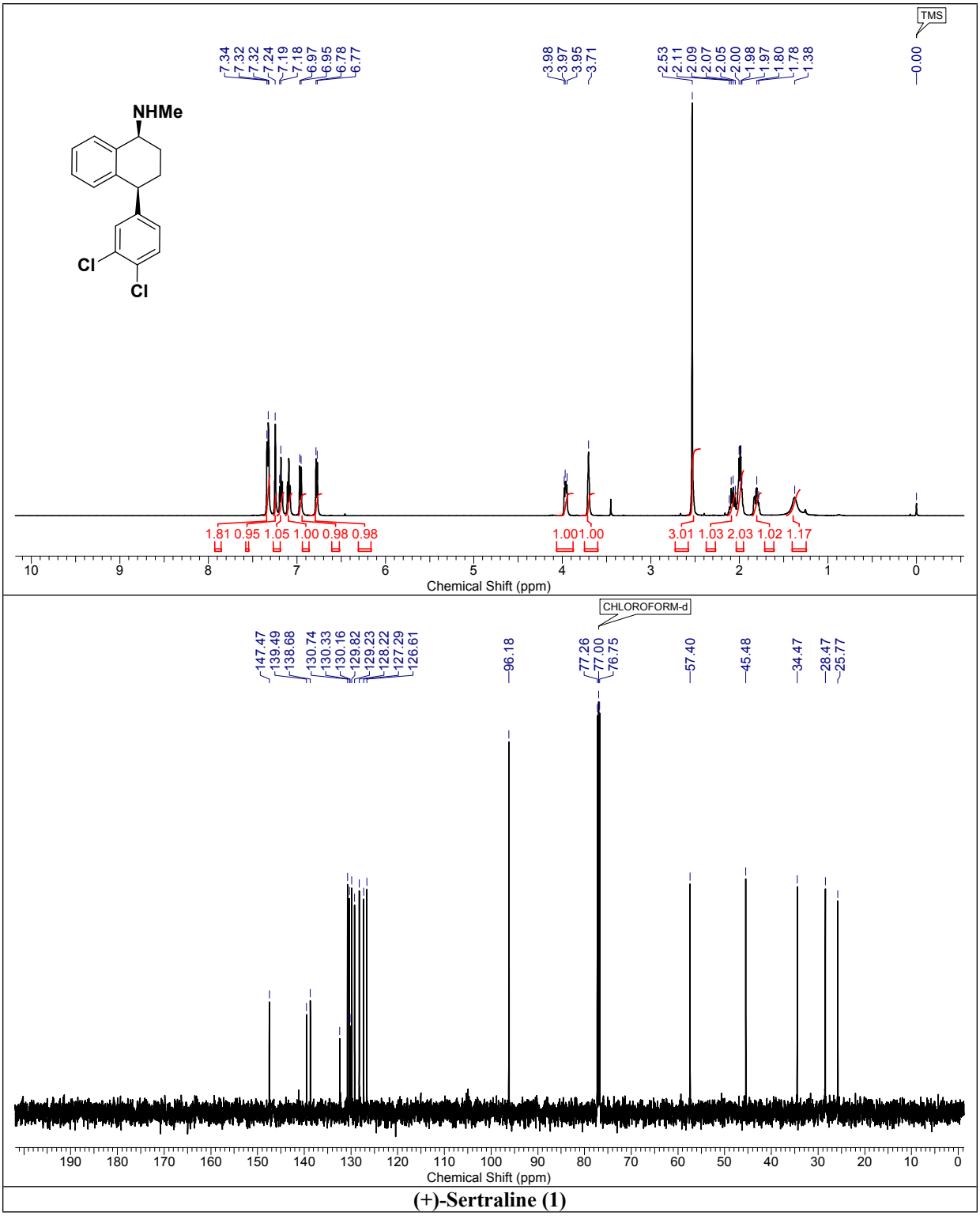



**Methyl-(R)-4-(3,4-dichlorophenyl)-4-phenylbutanoate (22)**

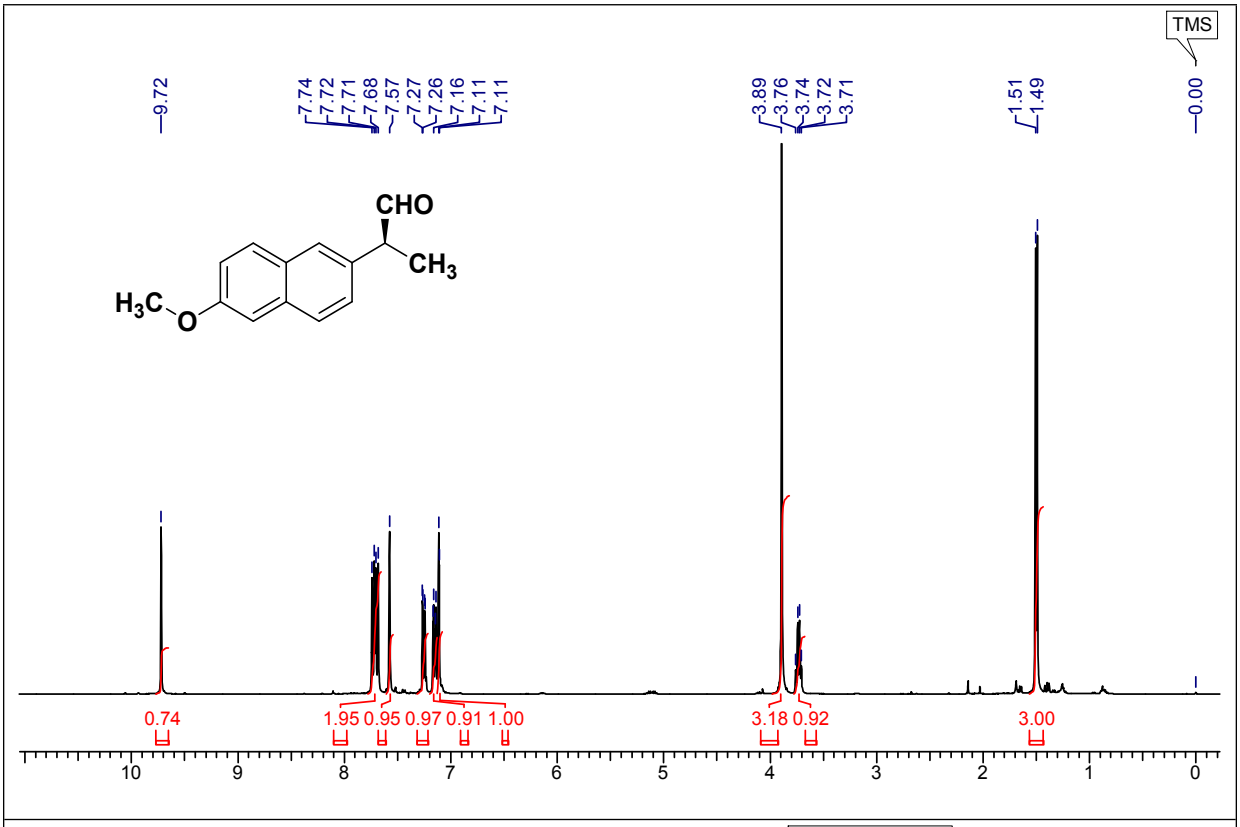


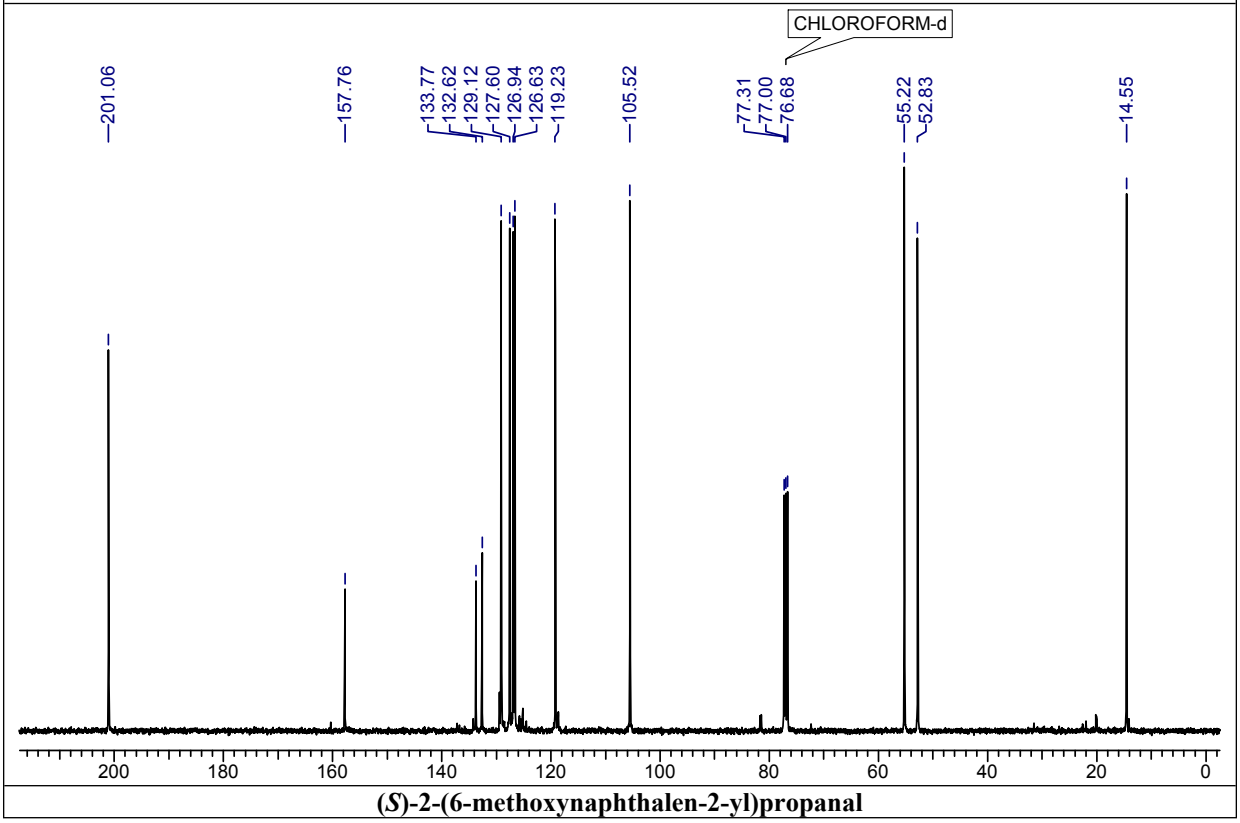




**(*S*)-4-(3,4-Dichlorophenyl)-3,4-dihydronaphthalen-1(2*H*)-one**

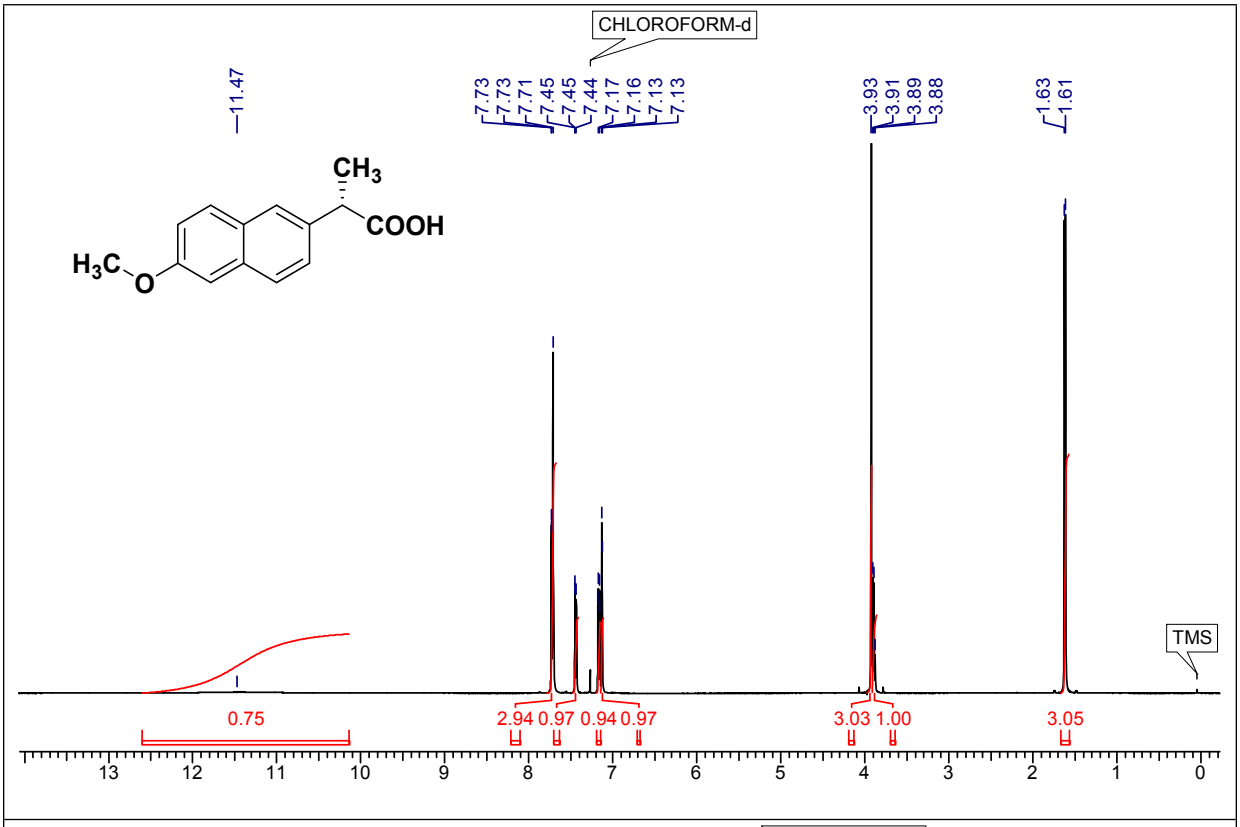


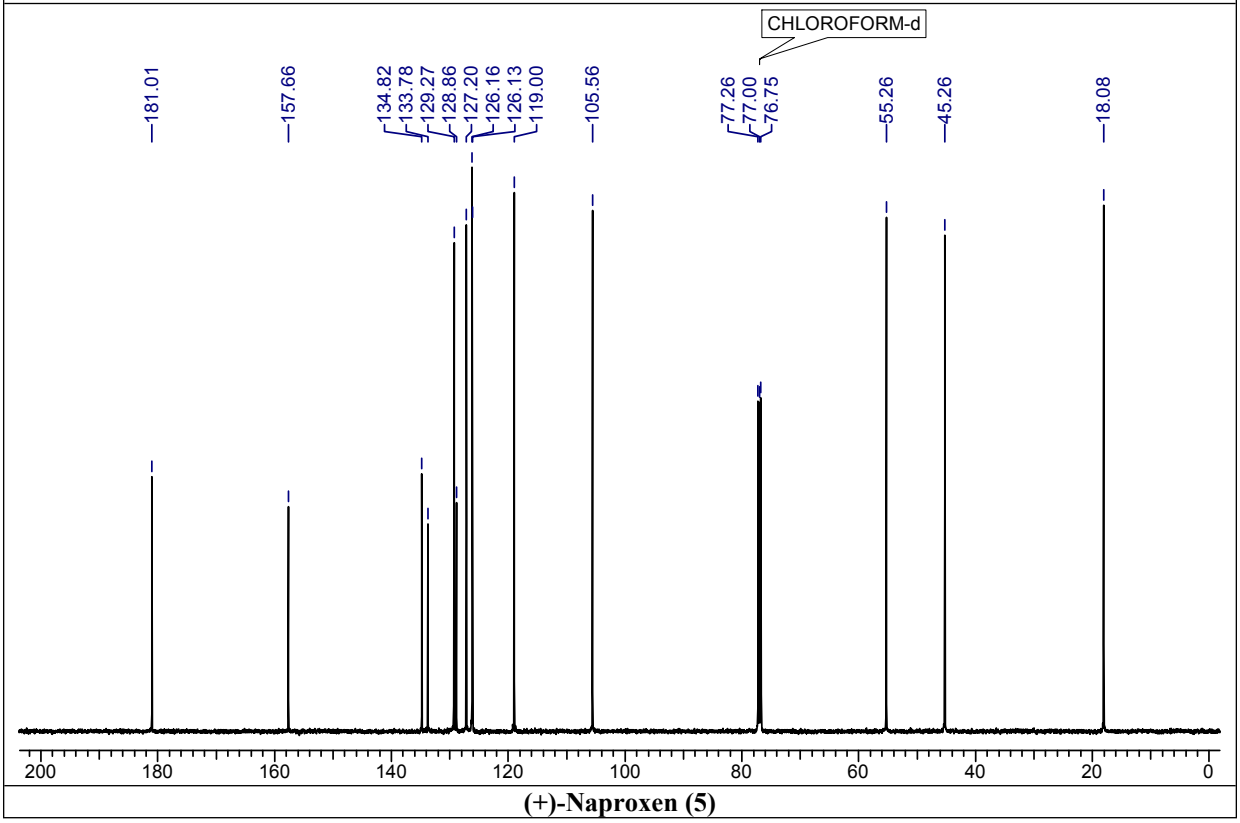

**(+)-Sertraline (1)**



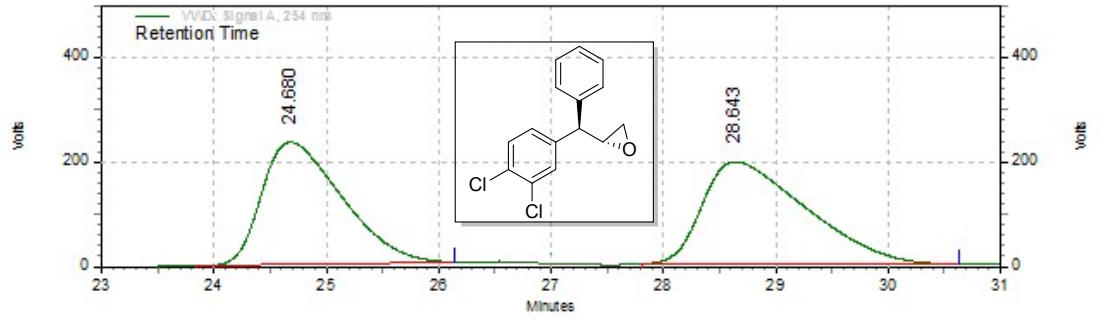



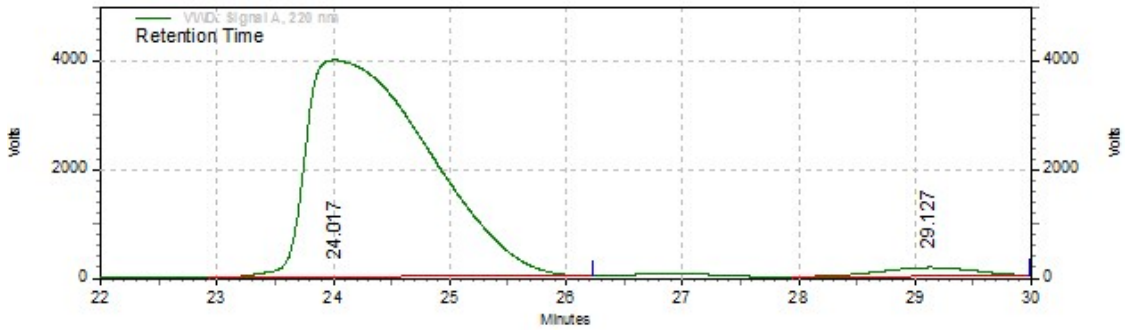

**(*S*)-2-(6-methoxynaphthalen-2-yl)propanal**


CHLOROFORM-d
11.47
7.73
7.73
7.71
7.45
7.45
7.44
7.17
7.16
7.13
7.13
3.93
3.91
3.89
3.88
1.63
1.61
CH3
COOH
H3C
O
TMS
0.75
2.94
0.97
0.94
0.97
3.03
1.00
3.05
13
12
11
10
9
8
7
6
5
4
3
2
1
0


CHLOROFORM-d
181.01
157.66
134.82
133.78
129.27
128.86
127.20
126.16
126.13
119.00
105.56
77.26
77.00
76.75
55.26
45.26
18.08
200
180
160
140
120
100
80
60
40
20
0

**(+)-Naproxen (5)**




**VWD: Signal,**
**A, 254nm, Results**

| Retention Time | Area | Conc. | Height |
|---|---|---|---|
| 24.017 | 4883290118 | 97.22 | 67088890 |
| 29.127 | 139847311 | 2.78 | 2575790 |
| Total | 5023137429 | 100 | 69664680 |

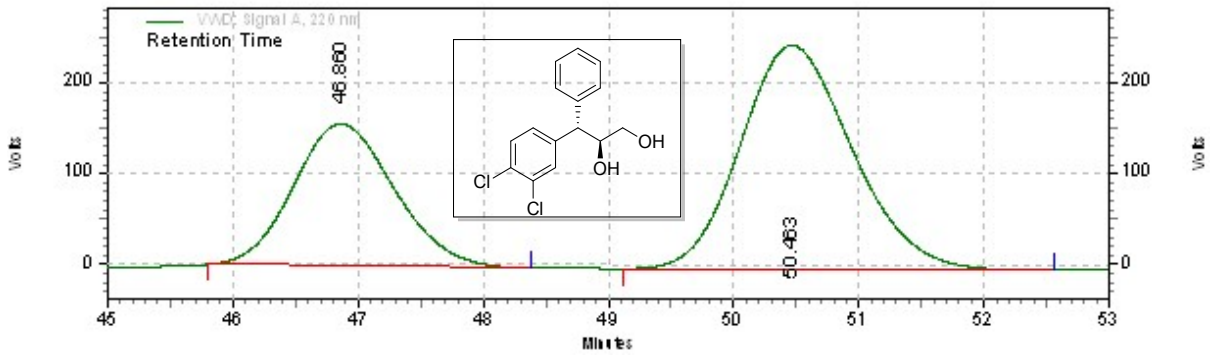
Column : Chiracel OD-H (4.6X250 nm)

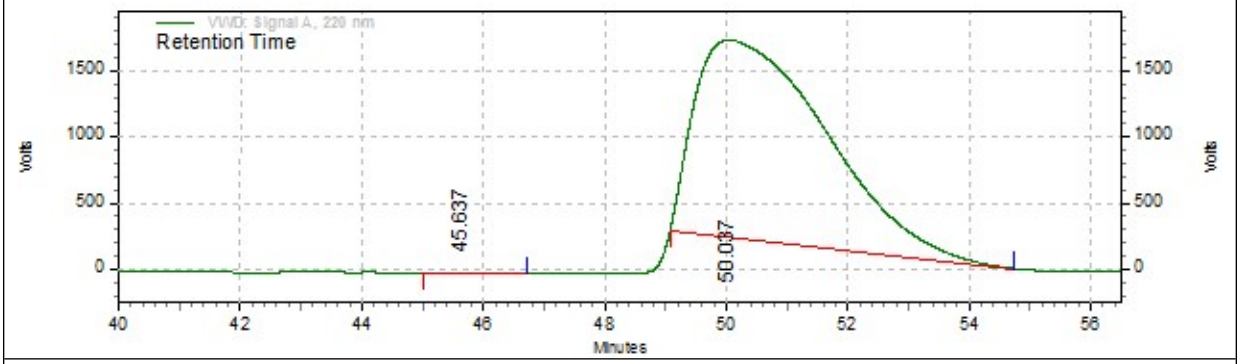
Mobile Phase : IPA:n-Hexane(2.5:97.5)

Wavelength : 254nm

Flow rate : 0.5ml/min

**(2*S*, *3S*)-3-(3,4-Dichlorophenyl)-3-(phenyl)methyl)oxirane (15a)**




**VWD: Signal A, 254nm Results**

| Retention Time | Area | Area % |
|---|---|---|
| 45.637 | 1488287 | 0.88 |
| 50.037 | 4831367878 | 99.12 |
| Totals | 8233289958 | 100.00 |

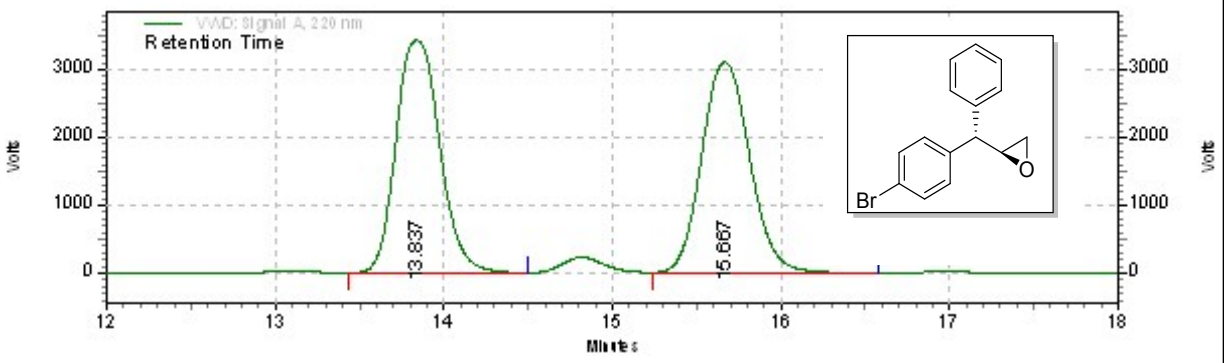
Column : Chiracel AD-H (4.6X250 nm)

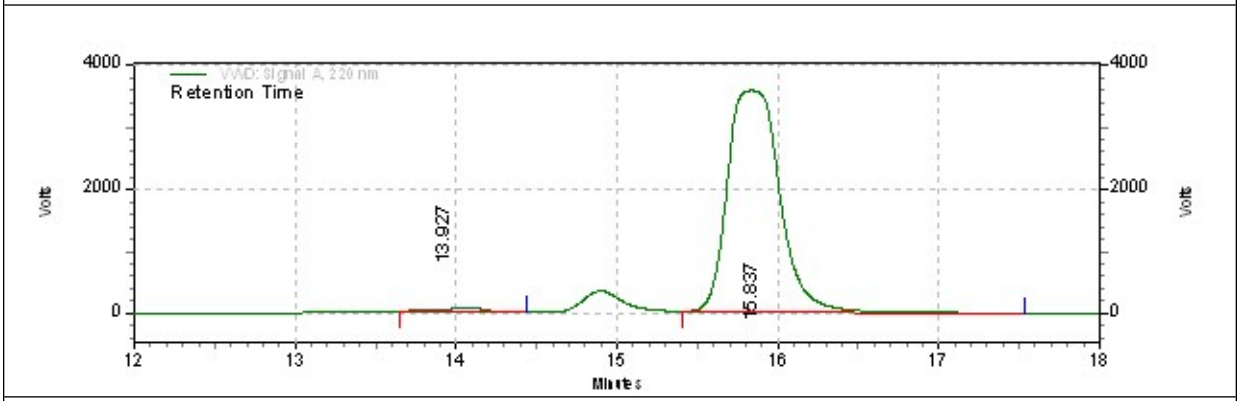
Mobile Phase : IPA:n-Hexane(5:95)

Wavelength : 254nm

Flow rate : 0.5ml/min

**(2*R*,3*R*)-3-(3,4-dichlorophenyl)-3-phenylpropane-1,2-diol (16a)**



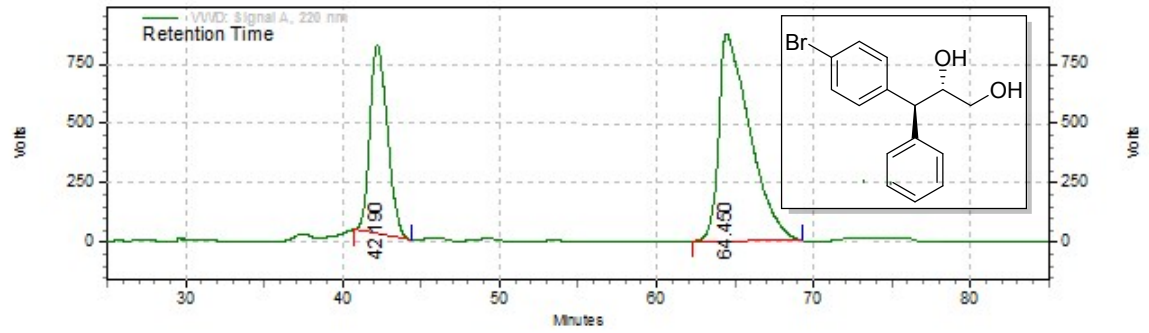



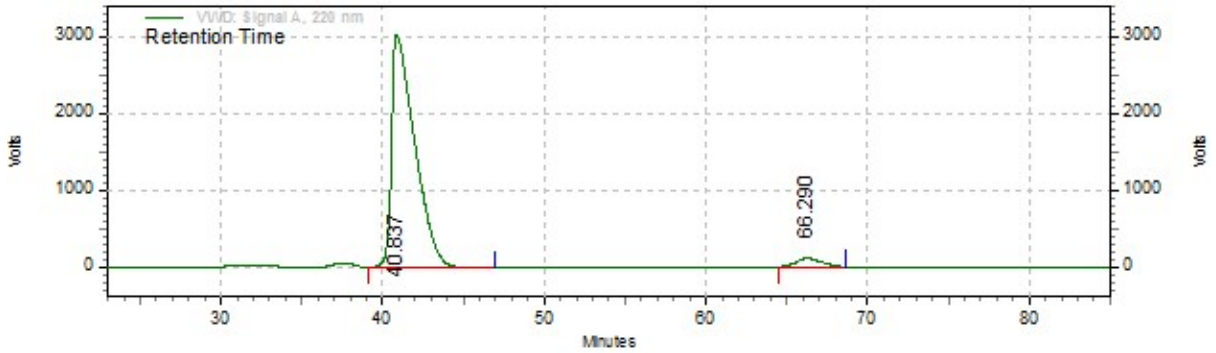

**VWD: Signal, A, 254 nm**
**Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 13.927 | 28419306 | 1.95 | 908590 |
| 15.837 | 1428980963 | 98.05 | 66394326 |
| Totals | 1457400269 | 100.00 | 67302916 |

Column : Chiracel OD-H (4.6X250 nm)
Mobile Phase : IPA:n-Hexane(2.5:97.5)
Wavelength : 254nm
Flow rate : 0.5ml/min

**(2*S*, *3S*)-3-[(4-bromophenyl)-3-(phenyl)]methyloxirane: (15b)**




**VWD: Signal, A, 254nm, Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 40.837 | 5055800703 | 97.17 | 50698385 |
| 66.290 | 211276274 | 2.83 | 1857010 |
| Total | 5267076977 | 100 | 52555395 |

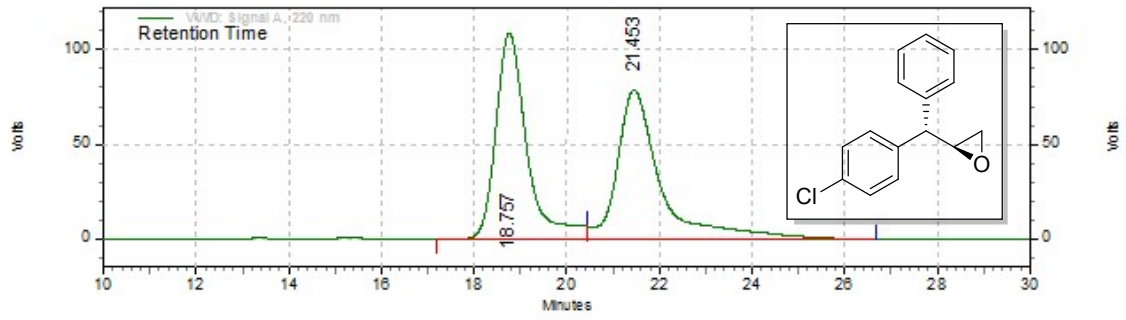
Column : Chiracel AD-H (4.6X250 nm)

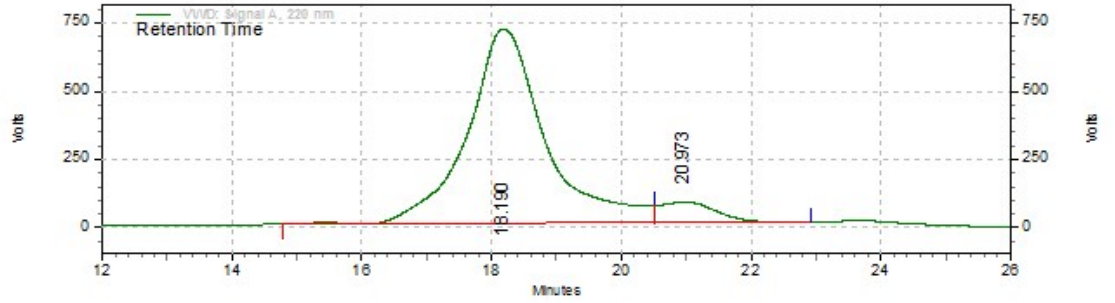
Mobile Phase : IPA:n-Hexane(5:95)

Wavelength : 254nm

Flow rate : 0.5ml/min

**(2R,3R)-3-(4-bromophenyl)-3-phenylpropane-1,2-diol (16b)**




**VWD: Signal, A, 254 nm, Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 18.190 | 1034826679 | 95.76 | 11991940 |
| 20.973 | 45819393 | 4.24 | 1297069 |
| Total | 1080646072 | 100 | 13289009 |

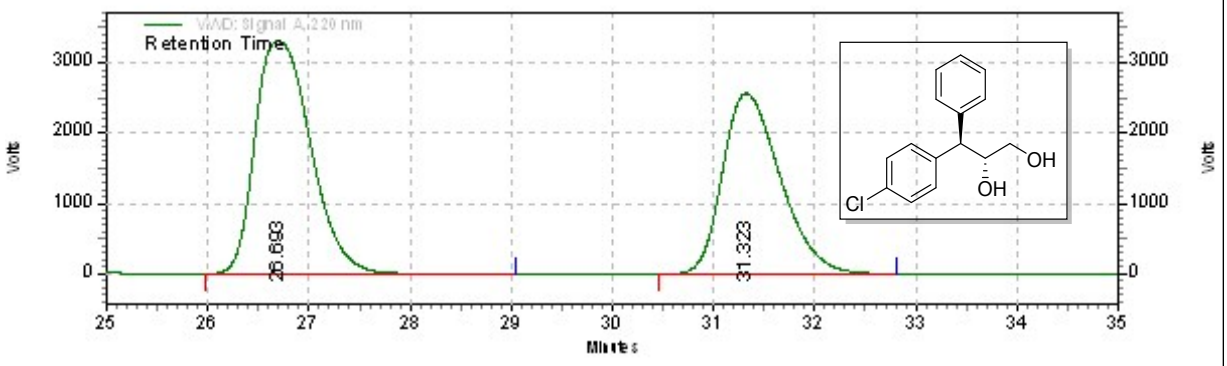
Column : Chiracel OD-H (4.6X250 nm)

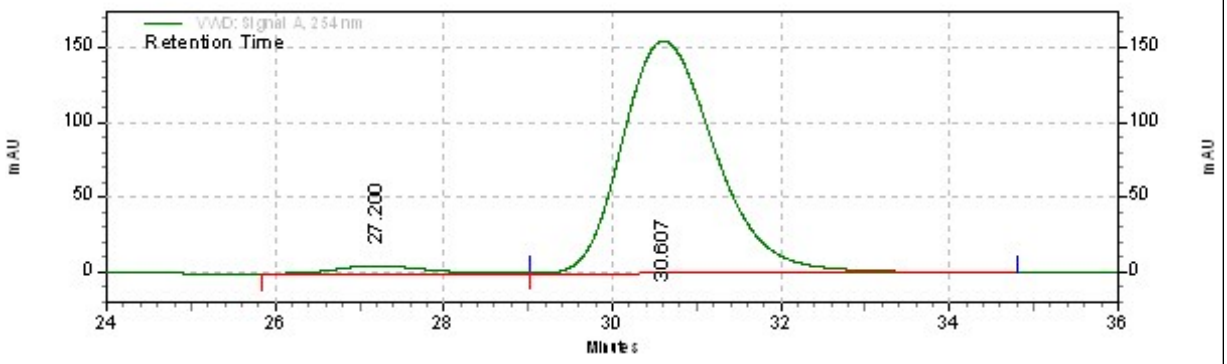
Mobile Phase : IPA:n-Hexane(2.5:97.5)

Wavelength : 254nm

Flow rate : 0.5ml/min

**(2*S, 3S*)-3-[(4-chlorophenyl)-3-(phenyl)]methyloxirane (15c)**




**VWD: Signal, A, 254 nm, Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 27.200 | 6026001 | 2.94 | 85701 |
| 30.607 | 198857225 | 97.06 | 2598245 |
| Totals | 204883226 | 100.00 | 2683946 |

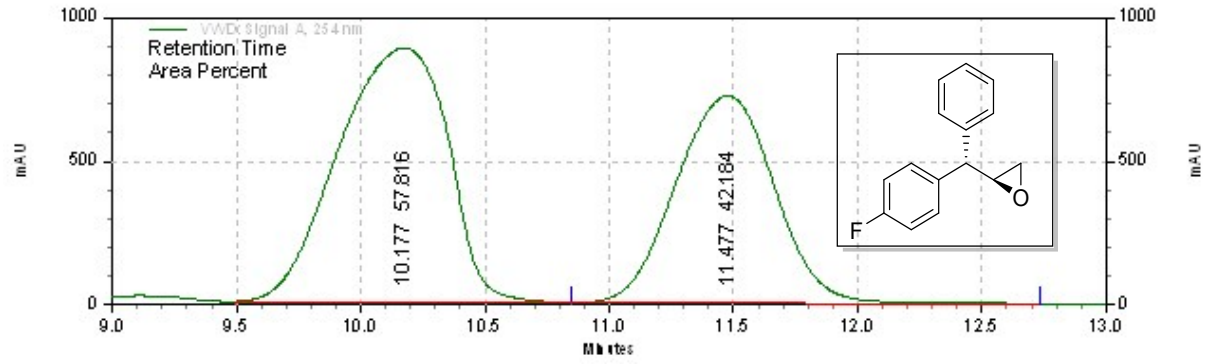
Column : Chiracel AD-H (4.6X250 nm)

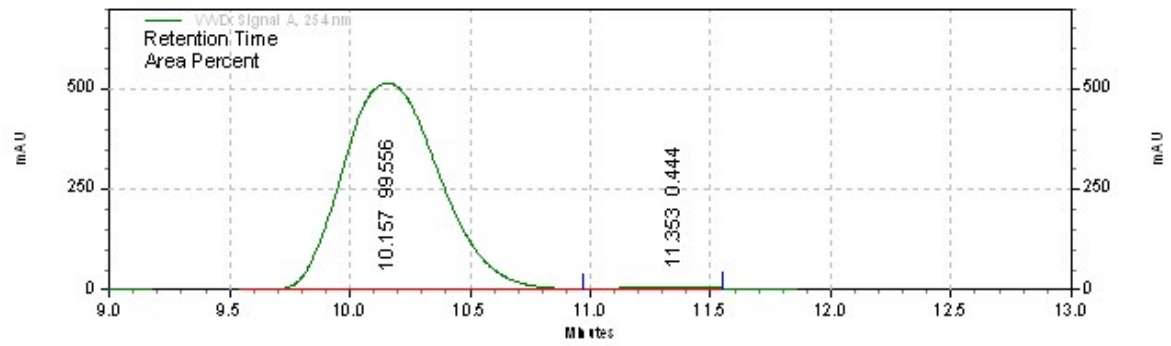
Mobile Phase : IPA:n-Hexane(5:95)

Wavelength : 254nm

Flow rate : 0.5ml/min

**(2*R, 3R*)-3-(4-chlorophenyl)-3-phenylpropane-1, 2-diol (16c)**




**VWD: Signal A,**
**254 nm**
**Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 10.157 | 239861276 | 99.56 | 8617320 |
| 11.353 | 1070458 | 0.44 | 52774 |
| Totals | 240931734 | 100.00 | 8670094 |

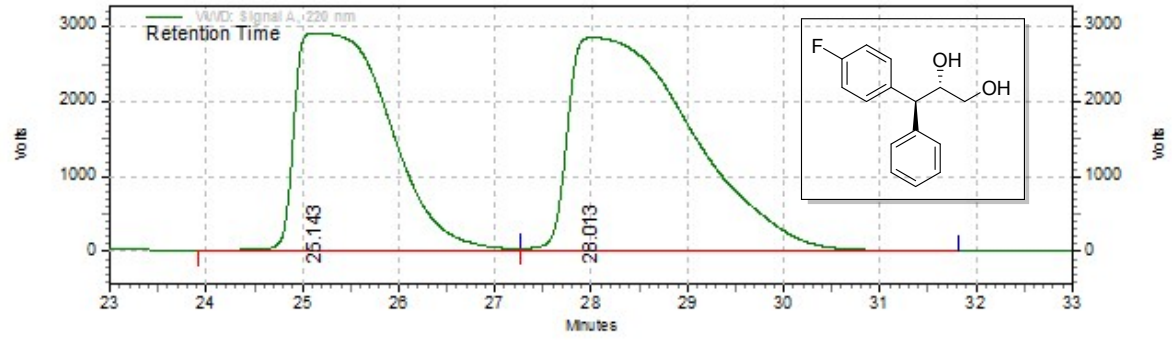
Column : Chiracel OD-H (4.6X250 nm)

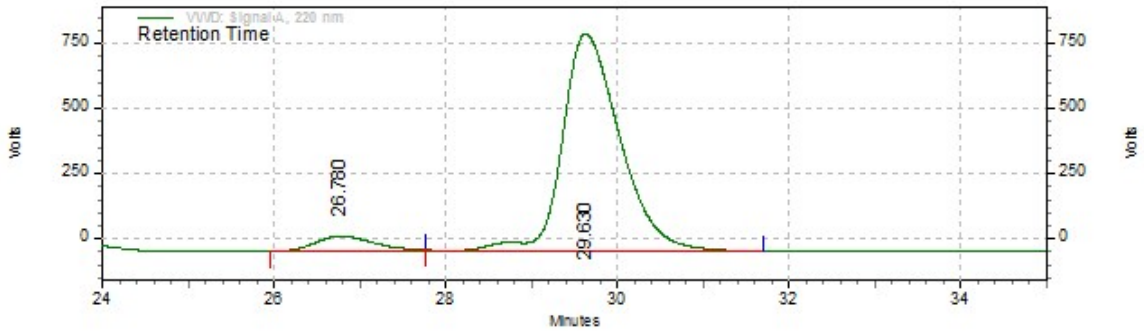
Mobile Phase : IPA:n-Hexane(2.5:97.5)

Wavelength : 254 nm

Flow rate : 0.5ml/min

**2-(2*S*,3*S*)-(4-fluorophenyl)(phenyl)methyl)oxirane (15d)**




**VWD: Signal A,**
**254 nm**
**Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 26.780 | 48849942 | 4.52 | 993265 |
| 29.630 | 660992825 | 95.48 | 14060767 |
| Totals | 709842767 | 100.00 | 15054032 |

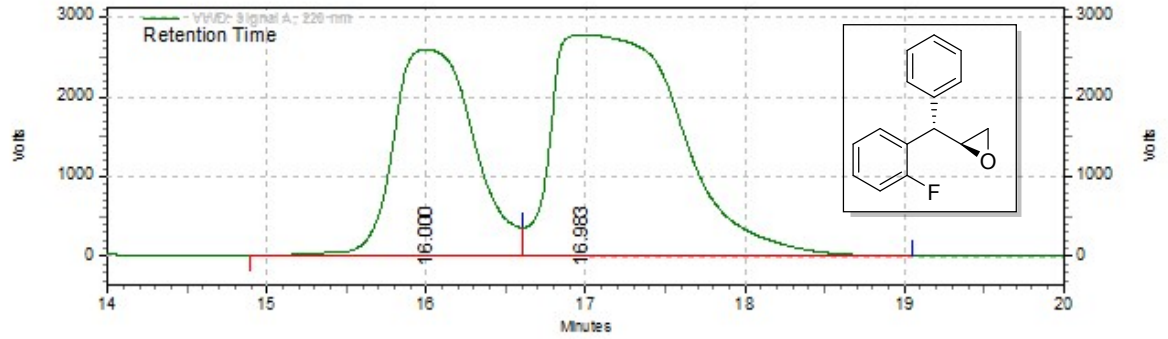
Column : Chiracel AD-H (4.6X250 nm)

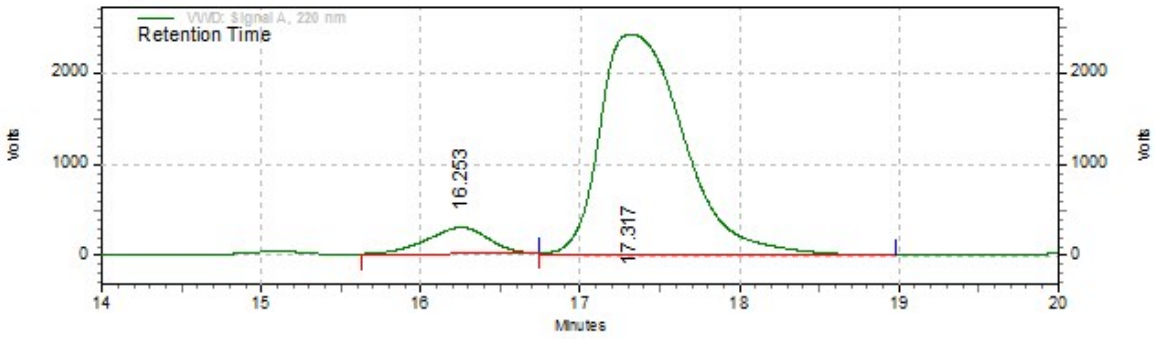
Mobile Phase : IPA:n-Hexane(5:95)

Wavelength : 254 nm

Flow rate : 0.5ml/min

**(*2R,3R*)-3-(4-fluorophenyl)-3-phenylpropane-1, 2-diol (16d)**




**VWD: Signal A,**
**254 nm**
**Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 16.253 | 127949994 | 4.96 | 4800475 |
| 17.317 | 1479570056 | 95.04 | 40616457 |
| Total | 1607520050 | 100 | 45446932 |

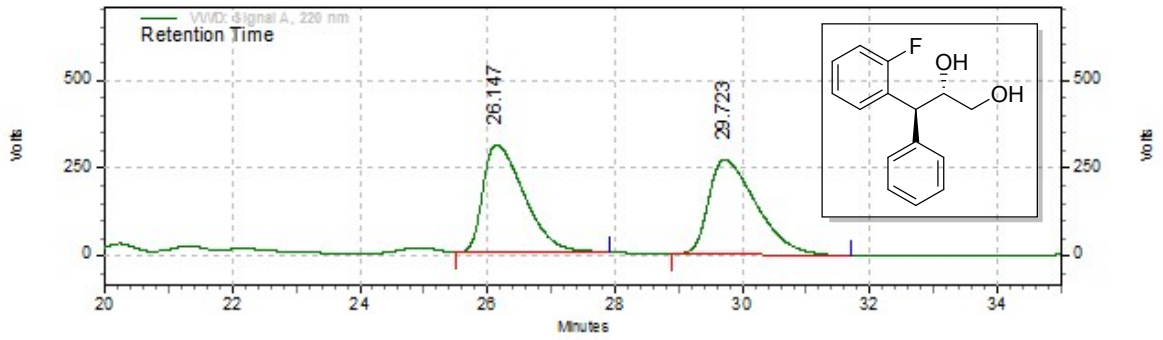
Column : Chiracel OD-H (4.6X250 nm)

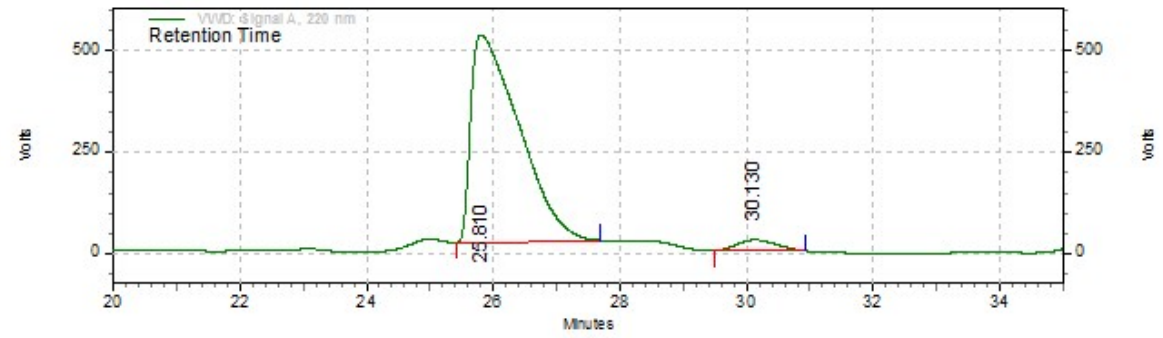
Mobile Phase : IPA:n-Hexane(2.5:97.5)

Wavelength : 254nm

Flow rate : 0.5ml/min

**(2*S*,3*S*)-3-(2-fluorophenyl)(phenyl)methyl)oxirane (15e)**




**VWD: Signal A,**
**254 nm**
**Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 25.810 | 452815957 | 95.95 | 8587946 |
| 30.130 | 19116198 | 4.05 | 449632 |
| Total | 471932155 | 100 | 9037578 |

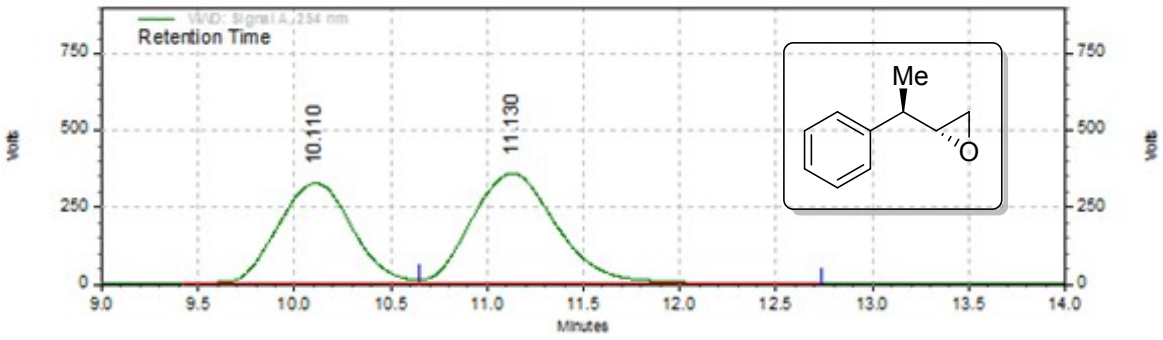
Column : Chiracel AD-H (4.6X250 nm)

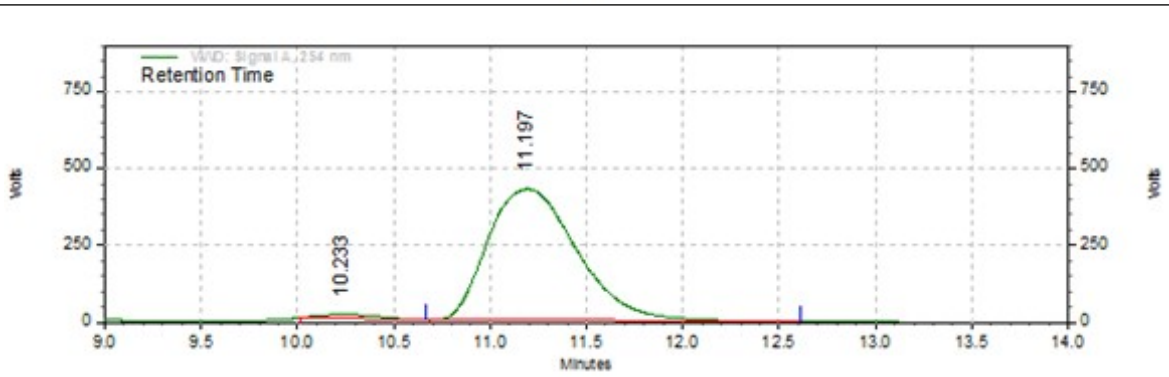
Mobile Phase : IPA:n-Hexane(5:95)

Wavelength : 210nm

Flow rate : 0.5ml/min

**(2*R*, 3*R*)-3-(2-fluorophenyl)-3-phenylpropane-1, 2-diol (16e);**




**VWD: Signal A, 220 nm Result**

| | Retention Time | Area | Conc. | Height |
|---|---|---|---|---|
| | 10.233 | 4980694 | 2.10 | 229461 |
| | 11.197 | 231657212 | 97.90 | 7181886 |
| | Total | 236637906 | 100 | 4204832 |

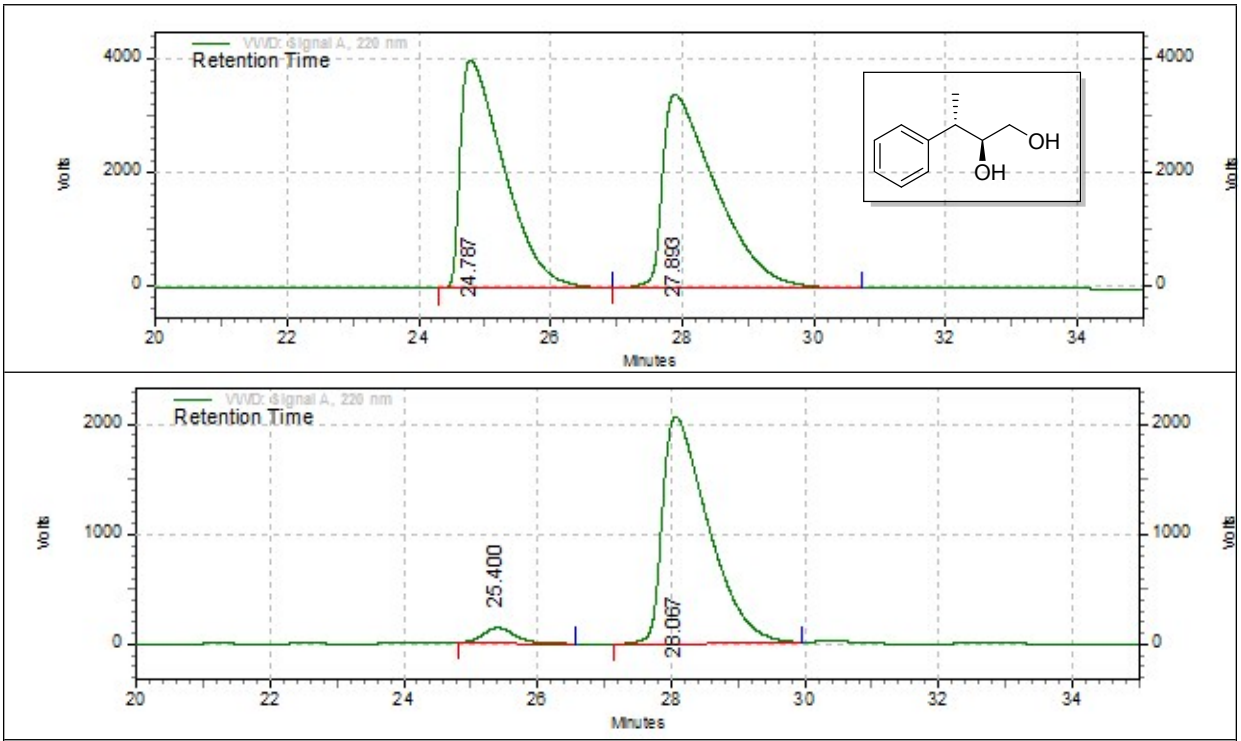
Column : Chiracel AD-H (4.6X250 nm)

Mobile Phase : IPA:n-Hexane(2.5:97.5)

Wavelength : 220nm

Flow rate : 0.5ml/min

**(2*R*, 3*R*)-3-methyl-1-phenylbutyloxirane (18a)**




**VWD: Signal A,**
**220 nm Result**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 25.400 | 71363378 | 4.17 | 2237840 |
| 28.067 | 1640468138 | 95.83 | 34610990 |
| Total | 1711831516 | 100 | 36848830 |

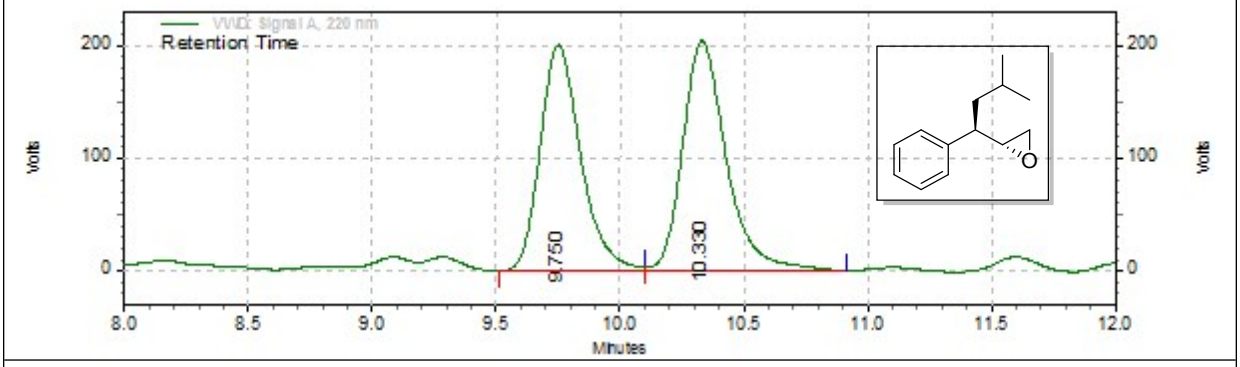
Column : Chiracel AD-H (4.6X250 nm)

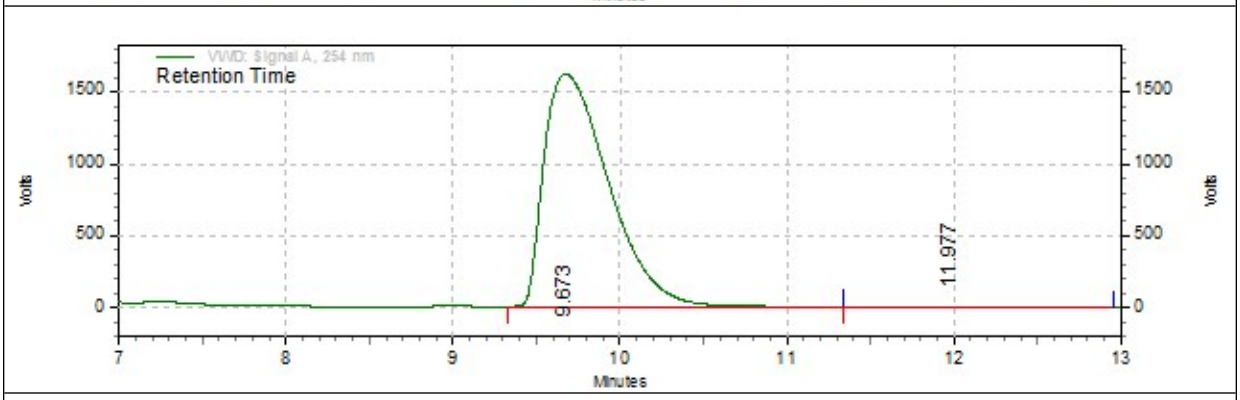
Mobile Phase : IPA:n-Hexane(5:95)

Wavelength : 220nm

Flow rate : 0.5ml/min

**(2*S*, 3*S*)-5-methyl-3-phenylhexane-1,2-diol (19a)**




**VWD: Signal A,**
**220nm Results**

| Retention Time | Area | Area % | Height | Height % |
|---|---|---|---|---|
| 9.673 | 727322027 | 99.59 | 27122776 | 99.70 |
| 11.977 | 2964458 | 0.41 | 82537 | 0.30 |
| | 730286485 | 100.00 | 27205313 | 100.00 |

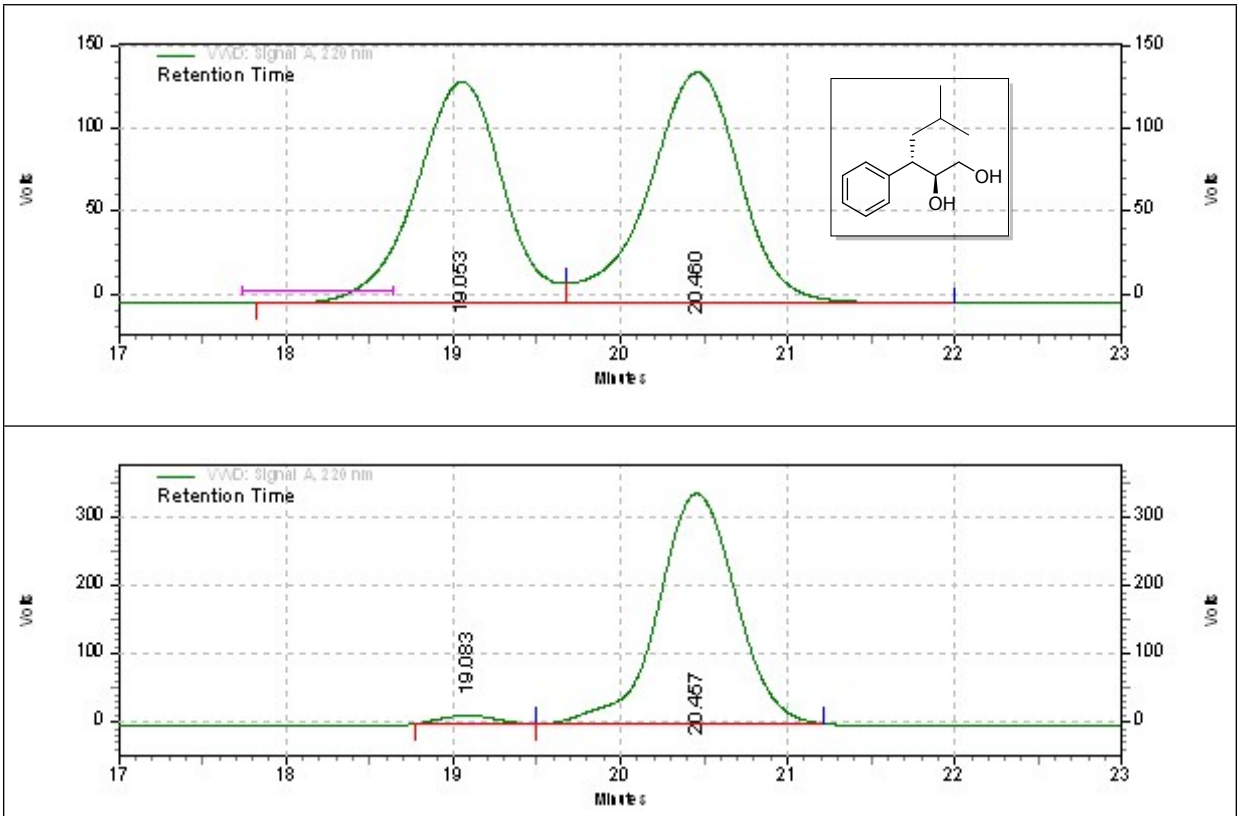
Column :Chiracel AD-H (4.6X250 nm)

Mobile Phase :IPA:n-Hexane(2.5:97.5)

Wavelength :220 nm

Flow rate :0.5ml/min

**(*R*)-2-((*R*)-3-methyl-1-phenylbutyl)oxirane (18b)**




**VWD: Signal A, 220 nm Results**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 19.083 | 4787370 | 2.55 | 209553 |
| 20.457 | 182995857 | 97.45 | 5675614 |
| Totals | 187783227 | 100.00 | 5885167 |

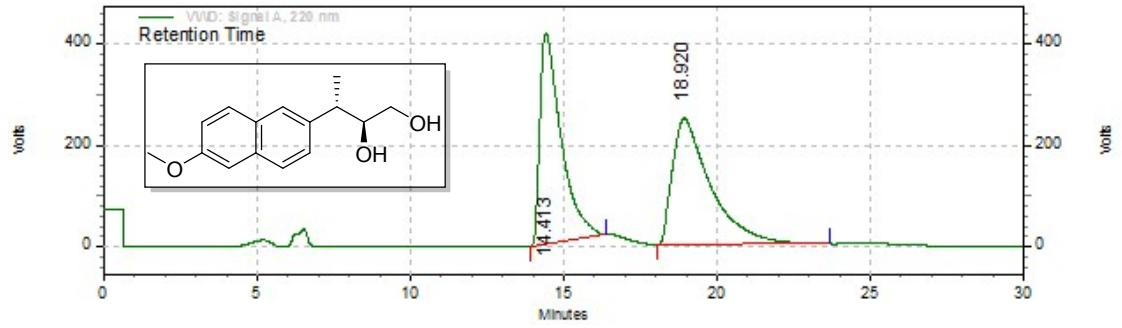
Column : Chracel AD-H (4.6X250 nm)

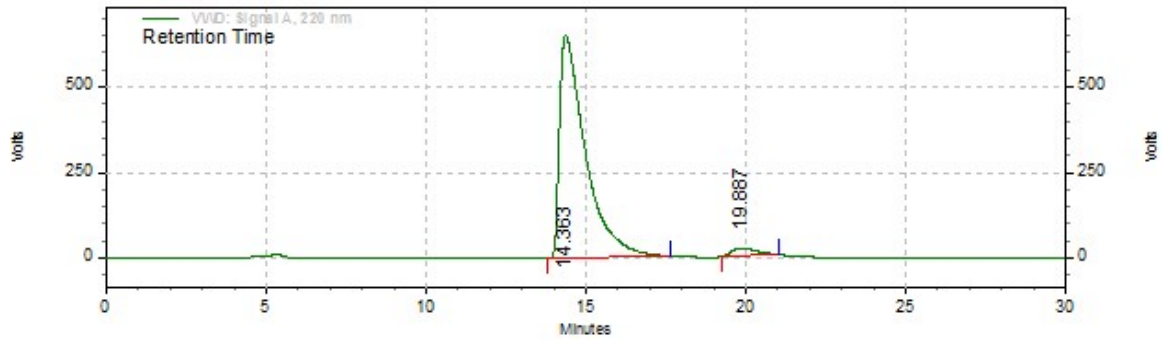
Mobile Phase : IPA:n-Hexane(20:80)

Wavelength : 220nm

Flow rate : 0.5ml/min

**(2*S*,3*S*)-5-methyl-3-phenylhexane-1,2-diol (19b)**




**VWD: Signal A, 220 nm Results**

| Retention Time | Area | Conc. | Height |
|---|---|---|---|
| 14.363 | 612546105 | 96.72 | 10911976 |
| 19.887 | 20741660 | 3.28 | 374813 |
| Total | 63287765 | 100 | 11286789 |

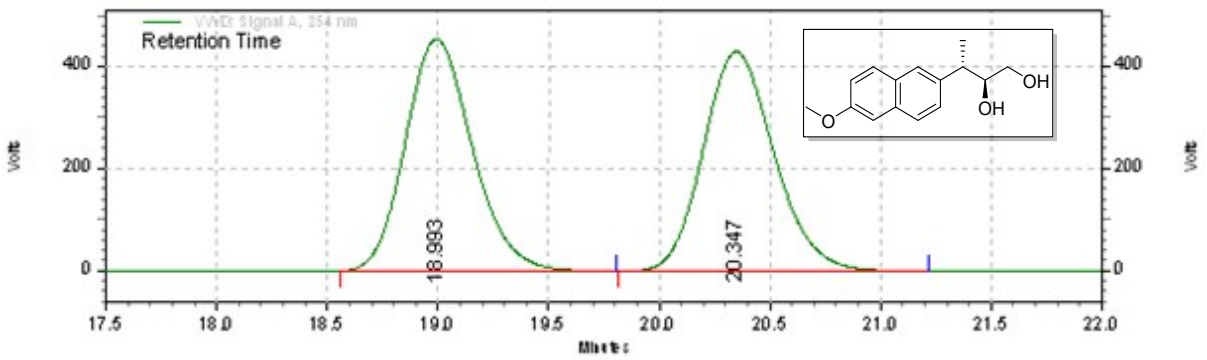
Column : Chiracel AD-H (4.6X250 nm)

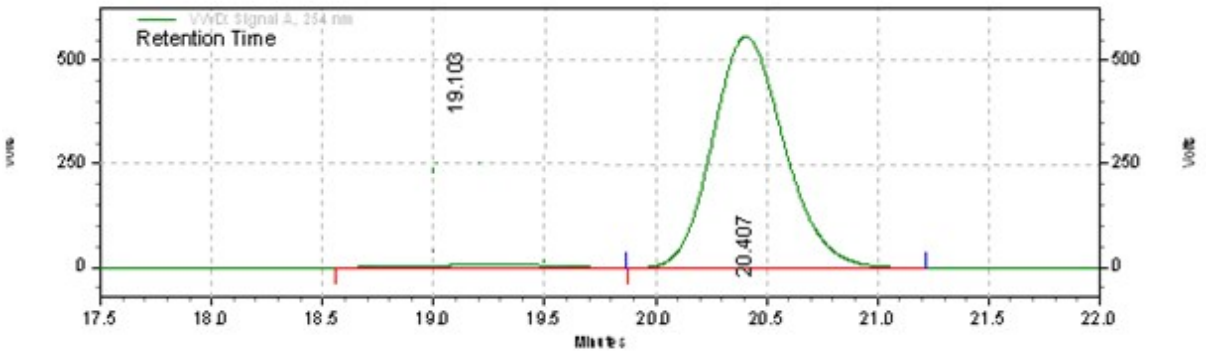
Mobile Phase : IPA:n-Hexane(2.5 :97.5 )

Wavelength : 220nm

Flow rate : 0.5ml/min

**(2*R*,3*R*)-3-(6-methoxynaphthalen-2-yl) ethyl) oxirane (18c)**




**VWD: Signal A,**
**220 nm Result**

| Retention Time | Area | Area % | Height |
|---|---|---|---|
| 19.103 | 5033084 | 1.54 | 5427878 |
| 20.407 | 321790489 | 98.46 | 9393121 |
| Totals | 326823573 | 100.00 | 14822660 |

Column : Chracel AD-H (4.6X250 nm)

Mobile Phase : IPA:n-Hexane(20:80)

Wavelength : 220nm

Flow rate : 0.5ml/min

**(2*S*,3*S*)-3-(6-methoxynaphthalen-2-yl)butane-1,2-diol (19c)**