Supporting information for

Tandem Allylic Alcohol Isomerization/Oxo-Michael Addition Reaction Promoted by Re_2O_7

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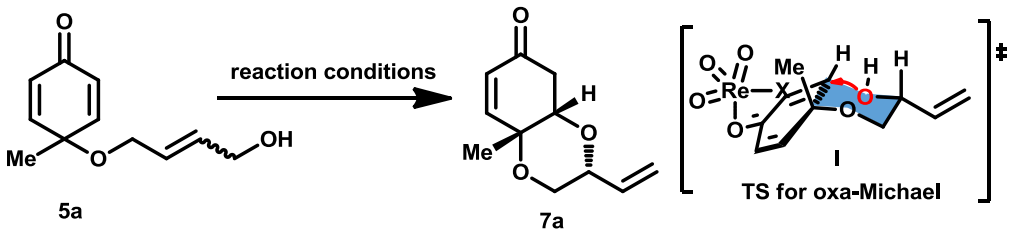
Table of Contents

1. General information

Unless otherwise noted, reagents were obtained from commercial sources and used without further purification.Non-aqueous reaction were conducted under an inert atmosphere of argon in flame-dried glassware. Anhydrous solvent were treated as follow: tetrahydrofuran and diethyl ether were distilled from sodium under argon atmosphere, dichcloromethane and toluene was distilled distilled from calcium hydride under argon atmosphere. Anhydrous chloroform, acetonitrile and ethyl acetate were commercial available. Thin layer chromatography was conducted on Merck 60 F254 pre-coated silica gel plates. Column chromatography was carried out by normal silica gel (40-60 μm, 200-400 mesh, Silicycle P60). NMR data including ^{1}H NMR or ^{13}C NMR spectra were recorded on Agilent 500 and Agilent 400. ^{1}H NMR Chemical shifts were reported in ppm from the solvent resonanceas the internal standard ($CDCl_3$: 7.26 ppm). ^{13}C NMR chemical shifts were reported in ppm relative to the solvent ($CDCl_3$:77.16 ppm). Infrared spectra were performed on a Nicolet 380FT-IR and are reported in terms of frequency of absorption (cm^{-1}). Low mass spectra were measured on a Shimadzu LCMS-2010EV mass spectrometer (ESI). High resolution mass spectra were obtained from IonSpec 4.7 Tesla FTMS mass spectrometer (MALDI), Bruker APEXIII 7.0 TESLA FTMS (ESI).

2. Optimization of the reaction conditions

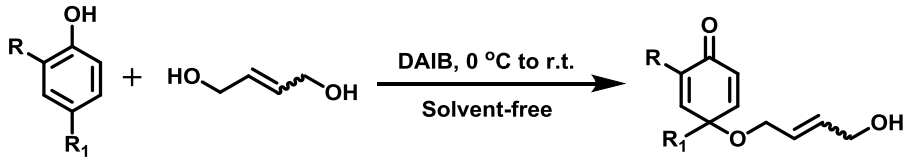
Table 1. Optimization of reaction conditions [a]



Entry	Catalyst (equiv)	Solvent	*t* (h)	**5a** (%)[b]	**yield** (%)[b]
1	--	CH_2Cl_2	15	100	0
2	$O=VSO_4$	CH_2Cl_2	15	100	0
3	POVO	CH_2Cl_2	15	100	0
4	MTO	CH_2Cl_2	15	100	0
5	Ph_3SiO-ReO_3	CH_2Cl_2	1	0	82[g]
6	Re_2O_7	CH_2Cl_2	1	0	83
7	Re_2O_7	$CHCl_3$	1	0	67
8	Re_2O_7	Toluene	15	21	52[c]
9	Re_2O_7	CH_3CN	15	43	35[c]
10	Re_2O_7	EtOAc	15	53	28[c]
11	Re_2O_7	THF	15	58	19[c]
12[e]	Re_2O_7	CH_2Cl_2	1	0	82
13[f]	Re_2O_7	CH_2Cl_2	1	0	83[g]

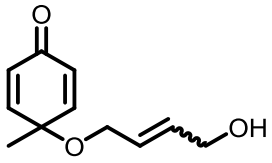
[a] **5a** (0.1 mmol) in 0.5 mL solvent was added to a solution of catalyst (10 mol%) in 0.5 mL solvent at rt. [b] Isolated yields. [c] Determined by ^{1}H-NMR using 1,4-dimethoxybenzene as inner standard. [d] 10 mol% catalyst loading. [e] 5 mol% catalyst loading. [f] 2.5 mol% catalyst loading. [g] dr 40:1 determined by ^{1}H NMR.

3. General procedure for the preparation of substrates



5a-5g

General procedure A[1]: To a stirred suspension of *phenols* (10 mmol, 1.0 equiv) in *but-2-ene-1,4-diol* (10 mL) was added *iodobenzene diacetate* (DAIB, 12 mmol, 1.2 equiv) in small portions within 1h at 0℃ and the reaction mixture was warmed to room temperature successively until all *phenols* was consumed as judged by TLC. The reaction mixture was diluted with ethyl acetate and quenched with saturated $NaHCO_3$ (10mL) and extracted with ethyl acetate (50mL×3). Combined extracts were washed with brine, dried over Na_2SO_4, and solvent was removed under vacuum. The residue was purified by flash column chromatography (ethyl acetate/petroleum ether = 1/5, v/v) to afford the product.



5a

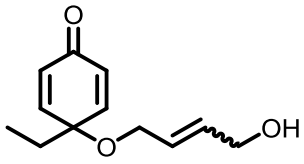
This compound was prepared according to the general procedure A as a pale brown oil (7.37g, 38% yield in 100 mmol scale) to serve as the initial substrate and was isolated as a mixture of alkene geometrical isomers (E:Z; 5:1). Spectral data for the major isomer is reported.

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.80-6.76 (m, 2H), 6.29-6.24 (m, 2H), 5.86-5.69 (m, 2H), 4.12-4.09 (m, 2H), 3.83-3.80 (m, 2H), 2.09 (brs, 1H), 1.42 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 185.31, 151.97, 132.47, 130.16, 127.53, 72.64, 65.81, 62.77, 26.40.

IR (neat) 3442, 2944, 2859, 1685, 1646, 1077cm^{-1}.

HRMS (EI) exact mass calcd for $C_{11}H_{14}O_3$: m/z 194.0943 $[M]^+$, found: m/z 194.0942.



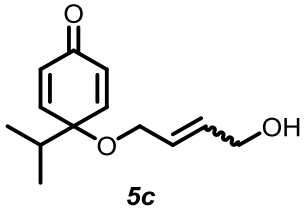
5b

This compound was prepared according to the general procedure A as a pale brown oil (581mg, 28% yield in 10 mmol scale) and was isolated as a mixture of alkene geometrical isomers (E:Z; 5:1). Spectral data for the major isomer is reported.

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.76-6.72 (m, 2H), 6.37-6.32 (m, 2H), 5.88-5.72 (m, 2H), 4.13 (dd, *J* = 5.2, 1.3 Hz, 2H), 3.86 (dd, *J* = 5.5, 1.3 Hz, 2H), 1.81-1.76 (m, 3H), 0.83 (t, *J* = 7.6 Hz, 3H).

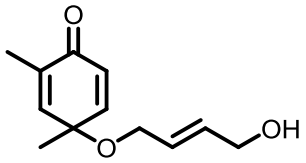
[1] Liu, Q.; Rovis, T., Asymmetric Synthesis of Hydrobenzofuranones via Desymmetrization of Cyclohexadienones Using the Intramolecular Stetter Reaction. Journal of the American Chemical Society 2006, 128, (8), 2552-2553.

^{13}C NMR (126 MHz, $CDCl_3$) δ 185.66, 151.15, 132.15, 131.47, 127.88, 76.40, 65.63, 62.96, 32.42, 7.95.
IR (neat) 3439, 2934, 2857, 1667, 1644, 1075cm^{-1}.
HRMS (EI) exact mass calcd for $C_{12}H_{16}O_3$: m/z 208.1099 $[M]^+$, found: m/z 208.1103.



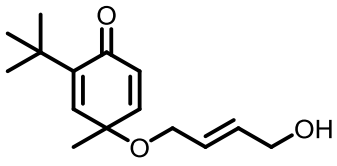
5c

This compound was prepared according to the general procedure A as a pale brown oil (700mg, 32% yield in 10 mmol scale) and was isolated as a mixture of alkene geometrical isomers (E:Z; 5:1). Spectral data for the major isomer is reported.
^{1}H NMR (500 MHz, $CDCl_3$) δ 6.77-6.72 (m, 2H), 6.40-6.36 (m, 2H), 5.90-5.72 (m, 2H), 4.15 (dd, *J* = 5.3, 1.4 Hz, 2H), 3.85 (dd, *J* = 5.4, 1.4 Hz, 2H), 2.07-1.98 (m, 1H), 1.67 (brs, 1H), 0.94 (d, *J* = 6.9 Hz, 6H)
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.79, 150.31, 132.10, 131.51, 128.24, 78.37, 65.40, 63.10, 36.78, 17.22.
IR (neat) 3441, 2938, 2860, 1671, 1649, 1065cm^{-1}.
HRMS (EI) exact mass calcd for $C_{13}H_{18}O_3$: m/z 222.1256 $[M]^+$, found: m/z 222.1261.



5d

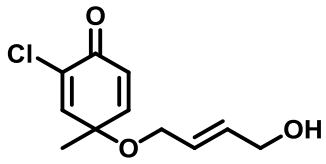
This compound was prepared according to the general procedure A as a pale yellow oil (1.41g, 68% yield in 10 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 6.78-6.73 (m, 1H), 6.56-6.53 (m, 1H), 6.27 (dd, *J* = 10.0, 2.0 Hz, 1H), 5.78-5.71 (m, 1H), 5.65-5.58 (m, 1H), 4.12 (dd, *J* = 6.4, 1.7 Hz, 2H), 3.88 (dd, *J* = 6.4, 1.7 Hz, 2H), 2.00 (brs, 1H), 1.89 (s, 3H), 1.41 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.99, 151.47, 146.92, 136.97, 132.14, 130.15, 128.63, 73.12, 61.30, 58.74, 26.64, 15.83.
IR (neat) 3442, 2939, 2862, 1668, 1663, 1069cm^{-1}.
HRMS (EI) exact mass calcd for $C_{12}H_{16}O_3$: m/z 208.1099 $[M]^+$, found: m/z 208.1097.



5e

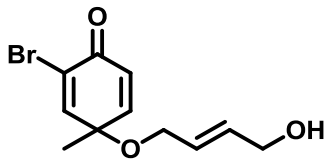
This compound was prepared according to the general procedure A as a pale yellow oil (1.83g, 73% yield in 10 mmol scale).

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.67 (dd, *J* = 9.9, 3.0 Hz, 1H), 6.52 (d, *J* = 3.1 Hz, 1H), 6.18 (d, *J* = 9.9 Hz, 1H), 5.78-5.72 (m, 1H), 5.66-5.59 (m, 1H), 4.16-4.09 (m, 2H), 3.91-3.80 (m, 2H), 1.99 (brs, 1H), 1.40 (s, 3H), 1.22 (s, 9H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.48, 149.03, 147.75, 144.85, 132.26, 132.01, 128.72, 73.18, 61.06, 58.75, 34.77, 29.32, 26.96.
IR (neat) 3440, 2959, 2868, 1667, 1633, 1079cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{15}H_{23}O_3$: m/z 251.1647 $[M+H]^+$, found: m/z 251.1641.



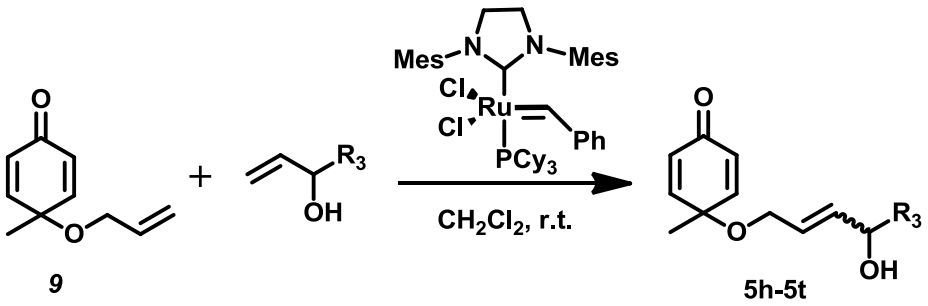
5f

This compound was prepared according to the general procedure A as a pale yellow oil (985mg, 43% yield in 10 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 6.97 (d, *J* = 2.9 Hz, 1H), 6.83 (dd, *J* = 10.1, 2.9 Hz, 1H), 6.39 (d, *J* = 10.1 Hz, 1H), 5.80-5.74 (m, 1H), 5.65-5.59 (m, 1H), 4.16-4.12 (m, 2H), 3.96-3.93 (m, 2H), 1.74 (brs, 1H), 1.49 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 178.24, 151.93, 147.64, 133.57, 132.42, 129.18, 128.19, 74.82, 61.93, 58.84, 26.52.
IR (neat) 3442, 2961, 2865, 1669, 1645, 1068cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{11}H_{14}ClO_3$: m/z 229.0631 $[M+H]^+$, found: m/z 229.0626.



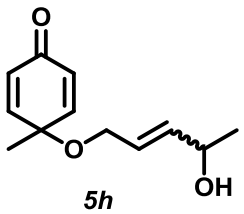
5g

This compound was prepared according to the general procedure A as a pale yellow oil (1.12g, 41% yield in 10 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.25 (d, *J* = 2.8 Hz, 1H), 6.84 (dd, *J* = 10.0, 2.9 Hz, 1H), 6.41 (d, *J* = 10.0 Hz, 1H), 5.81-5.73 (m, 1H), 5.66-5.59 (m, 1H), 4.17-4.12 (m, 2H), 3.97-3.94 (m, 2H), 1.70 (brs, 1H), 1.48 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 178.04, 152.26, 151.82, 132.44, 128.70, 128.20, 125.31, 75.47, 62.00, 58.87, 26.32.
IR (neat) 3440, 2959, 2865, 1667, 1646, 1068cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{11}H_{14}BrO_3$: m/z 273.0126 $[M+H]^+$, found: m/z 273.0121.



9 was prepared with *p-Cresol* and *Allyl alcohol* according to the general procedure A.

General procedure B: To a mixture of the *4-(allyloxy)-4-methylcyclohexa-2,5-dien-1-one(**9**)* (5.5 mmol, 1.1 equiv) and *secondary alcohol* (5.0 mmol, 1.0 equiv) in CH_2Cl_2 (20 mL, 0.25M) was added Grubbs' 2nd (0.05 mmol, 1 mol%). The reaction mixture was stirred at room temperature under argon atomsphere until all *secondary alcohols* was consumed as judged by TLC. The solvent was removed under vacuum. The residue was purified by flash column chromatography (ethyl acetate/petroleum ether = 1/2, v/v) to afford the product.



5h

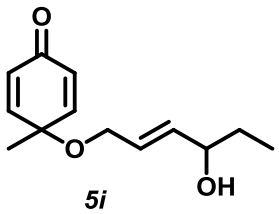
This compound was prepared according to the general procedure B as a dark grey oil (332mg, 32% yield in 5 mmol scale) and was isolated as a mixture of alkene geometrical isomers (E:Z; 10:1). Spectral data for the major isomer is reported.

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.82-6.77 (m, 2H), 6.32-6.26 (m, 2H), 5.79-5.67 (m, 2H), 4.35-4.28 (m, 1H), 3.85-3.81 (m, 2H), 1.58 (brs, 1H), 1.46 (s, 3H), 1.27 (d, *J* = 6.4 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 185.28, 151.91, 137.25, 130.29, 126.28, 72.72, 68.24, 65.90, 26.52, 23.27.

IR (neat) 3446, 2970, 1738, 1671, 1082cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{12}H_{17}O_3$: m/z 209.1178 $[M+H]^+$, found: m/z 209.1173.



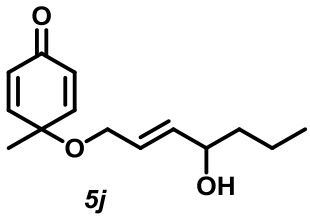
5i

This compound was prepared according to the general procedure B as a dark grey oil (388mg, 35% yield in 5 mmol scale).

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.82-6.76 (m, 2H), 6.28 (d, *J* = 9.8 Hz, 2H), 5.72-5.67 (m, 2H), 4.05-4.00 (m, 1H), 3.83 (d, *J* = 3.5 Hz, 2H), 1.74 (brs, 1H), 1.57-1.50 (m, 2H), 1.44 (s, 3H), 0.90 (t, *J* = 7.4 Hz, 3H).

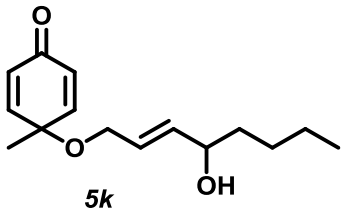
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.28, 151.96, 135.92, 130.23, 127.24, 73.58, 72.70, 65.95, 30.06, 26.48, 9.80.

IR (neat) 3448, 2980, 1733, 1671, 1078cm^{-1}.
HRMS (EI) exact mass calcd for $C_{13}H_{18}O_3$: m/z 222.1256 $[M]^+$, found: m/z 222.1260.



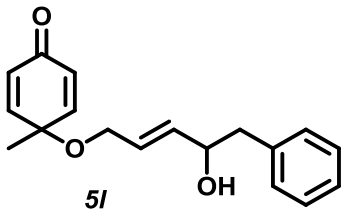
5j

This compound was prepared according to the general procedure B as a dark grey oil (340mg, 33% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 6.82-6.77 (m, 2H), 6.31-6.26 (m, 2H), 5.72-5.69 (m, 2H), 4.14-4.09 (m, 1H), 3.84-3.82 (m, 2H), 1.67 (brs, 1H), 1.55-1.47 (m, 2H), 1.45 (s, 3H), 1.42-1.27 (m, 2H), 0.91 (t, *J* = 7.3 Hz, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.30, 151.97, 136.27, 130.25, 127.01, 72.72, 72.07, 65.96, 39.35, 26.50, 18.73, 14.09.
IR (neat) 3453, 2958, 2931, 1737, 1673, 1083cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{14}H_{21}O_3$: m/z 237.1491 $[M+H]^+$, found: m/z 237.1486.



5k

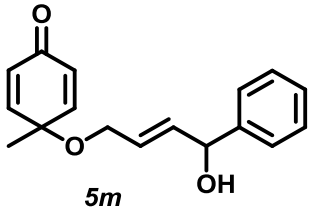
This compound was prepared according to the general procedure B as a dark grey oil (373mg, 30% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 6.79 (d, *J* = 9.8 Hz, 2H), 6.28 (d, *J* = 9.8 Hz, 2H), 5.73-5.68 (m, 2H), 4.12-4.06 (m, 1H), 3.83 (d, *J* = 3.5 Hz, 2H), 1.68 (brs, 1H), 1.54-1.47 (m, 2H), 1.44 (s, 3H), 1.39-1.24 (m, 4H), 0.88 (t, *J* = 6.8 Hz, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.28, 151.96, 136.30, 130.24, 127.00, 72.71, 72.30, 65.96, 36.92, 27.66, 26.49, 22.71, 14.14.
IR (neat) 3458, 2962, 2931, 1726, 1653, 1081cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{15}H_{23}O_3$: m/z 251.1647 $[M+H]^+$, found: m/z 251.1641.



5l

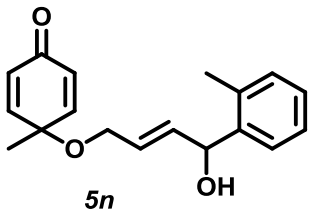
This compound was prepared according to the general procedure B as a dark grey oil (526mg, 37% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.34-7.28 (m, 2H), 7.26-7.23 (m, 1H), 7.23-7.19 (m, 2H), 6.81-6.75 (m, 2H), 6.31-6.25 (m, 2H), 5.82-5.71 (m, 2H), 4.39-4.33 (m, 1H), 3.84 (dd, *J* = 4.9, 1.1 Hz, 2H), 2.87 (dd, *J* = 13.6, 4.9 Hz, 1H), 2.77 (dd, *J* = 13.7, 8.3 Hz, 1H), 1.69 (brs, 1H), 1.45 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 185.27, 151.90, 137.78, 134.96, 130.27, 129.62, 128.67, 127.48, 126.77, 72.81, 72.73, 65.85, 43.98, 26.50.
IR (neat) 3446, 3027, 2928, 1738, 1671, 1083cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{18}H_{21}O_3$: m/z 285.1491 $[M+H]^+$, found: m/z 285.1486.



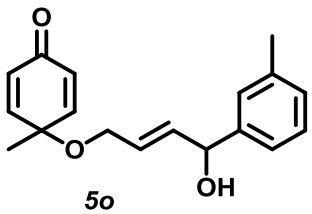
5m

This compound was prepared according to the general procedure B as a dark grey oil (432mg, 32% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36-7.33 (m, 4H), 7.30-7.27 (m, 1H), 6.80-6.75 (m, 2H), 6.28-6.23 (m, 2H), 5.93-5.87 (m, 1H), 5.84-5.78 (m, 1H), 5.21 (d, *J* = 5.9 Hz, 1H), 3.89-3.83 (m, 2H), 2.12 (brs, 1H), 1.44 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.27, 151.92, 142.67, 134.96, 130.22, 128.70, 127.92, 127.64, 126.39, 74.52, 72.73, 65.74, 26.47.
IR (neat) 3435, 3028, 2929, 1738, 1668, 1082cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{17}H_{19}O_3$: m/z 271.1334 $[M+H]^+$, found: m/z 271.1328.



5n

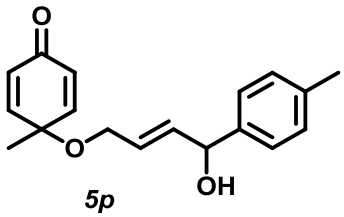
This compound was prepared according to the general procedure B as a dark grey oil (495mg, 35% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.45-7.41 (m, 1H), 7.24-7.13 (m, 3H), 6.79-6.75 (m, 2H), 6.29-6.23 (m, 2H), 5.92-5.85 (m, 1H), 5.81-5.74 (m, 1H), 5.42 (d, *J* = 5.7 Hz, 1H), 3.89-3.83 (m, 2H), 2.34 (s, 3H), 1.92 (brs, 1H), 1.44 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.27, 151.93, 140.58, 135.29, 134.08, 130.67, 130.25, 127.79, 127.70, 126.48, 125.97, 72.73, 71.23, 65.77, 26.50, 19.29.
IR (neat) 3435, 3029, 2932, 1736, 1667, 1084cm^{-1}.
HRMS (EI) exact mass calcd for $C_{18}H_{20}O_3$: m/z 284.1412 $[M]^+$, found: m/z 284.1415.



5o

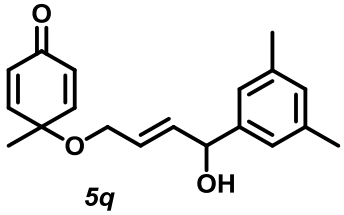
This compound was prepared according to the general procedure B as a dark grey oil (466mg, 33% yield in 5 mmol scale).

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.24 (t, *J* = 7.6 Hz, 1H), 7.18-7.13 (m, 2H), 7.09 (d, *J* = 7.5 Hz, 1H), 6.80-6.75 (m, 2H), 6.29-6.23 (m, 2H), 5.93-5.86 (m, 1H), 5.85-5.77 (m, 1H), 5.17 (d, *J* = 5.9 Hz, 1H), 3.88-3.83 (m, 2H), 2.35 (s, 3H), 2.14 (brs, 1H), 1.44 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.30, 151.96, 142.64, 138.40, 135.09, 130.20, 128.67, 128.61, 127.47, 127.05, 123.45, 74.55, 72.74, 65.79, 26.47, 21.56.
IR (neat) 3447, 3018, 2928, 1738, 1671, 1082cm^{-1}.
HRMS (EI) exact mass calcd for $C_{18}H_{20}O_3$: m/z 284.1412 $[M]^+$, found: m/z 284.1411.



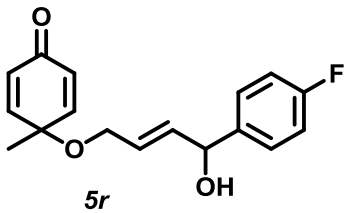
5p

This compound was prepared according to the general procedure B as a dark grey oil (523mg, 37% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.23 (d, *J* = 8.1 Hz, 2H), 7.16 (d, *J* = 7.8 Hz, 2H), 6.78 (dd, *J* = 10.0, 1.2 Hz, 2H), 6.29-6.24 (m, 2H), 5.94-5.86 (m, 1H), 5.83-5.76 (m, 1H), 5.18 (d, *J* = 6.0 Hz, 1H), 3.88-3.83 (m, 2H), 2.34 (s, 3H), 2.00 (brs, 1H), 1.44 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.29, 151.96, 139.77, 137.69, 135.11, 130.23, 129.39, 127.42, 126.37, 74.38, 72.73, 65.79, 26.49, 21.26.
IR (neat) 3446, 3016, 2928, 1738, 1671, 1082cm^{-1}.
HRMS (EI) exact mass calcd for $C_{18}H_{20}O_3$: m/z 284.1412 $[M]^+$, found: m/z 284.1413.



5q

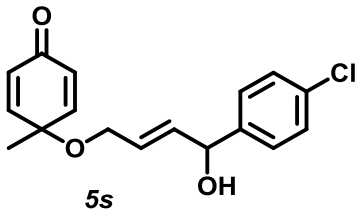
This compound was prepared according to the general procedure B as a dark grey oil (508mg, 34% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 6.99-6.90 (m, 3H), 6.82-6.76 (m, 2H), 6.30-6.24 (m, 2H), 5.92-5.77 (m, 2H), 5.14 (d, *J* = 5.8 Hz, 1H), 3.91-3.83 (m, 2H), 2.31 (s, 6H), 2.15 (brs, 1H), 1.45 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.28, 151.97, 138.34, 135.14, 130.24, 130.22, 129.58, 127.34, 124.14, 74.61, 72.73, 65.83, 26.49, 21.44.
IR (neat) 3447, 3019, 2929, 1737, 1671, 1083cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{19}H_{23}O_3$: m/z 299.1647 $[M+H]^+$, found: m/z 299.1642.



5r

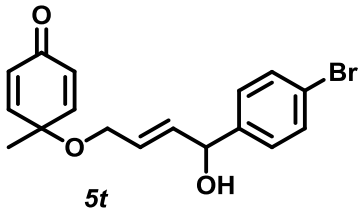
This compound was prepared according to the general procedure B as a dark grey oil (374mg, 26% yield in 5 mmol scale).

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.32 (dd, *J* = 8.5, 5.5 Hz, 2H), 7.03 (t, *J* = 8.7 Hz, 2H), 6.77 (d, *J* = 9.8 Hz, 2H), 6.30-6.24 (m, 2H), 5.91-5.76 (m, 2H), 5.20 (d, *J* = 5.8 Hz, 1H), 3.86 (d, *J* = 5.2 Hz, 2H), 2.05 (brs, 1H), 1.44 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.24 , 162.44 (d, *J* = 245.8 Hz), 151.81 , 138.41 (d, *J* = 3.1 Hz), 134.75 , 130.30 , 128.12 (d, *J* = 8.2 Hz), 127.92 , 115.52 (d, *J* = 21.4 Hz), 73.89 , 72.75 , 65.65 , 26.47 .
IR (neat) 3444, 2929, 1736, 1667, 1083cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{17}H_{18}FO_3$: m/z 289.1240 $[M+H]^+$, found: m/z 289.1164.



5s

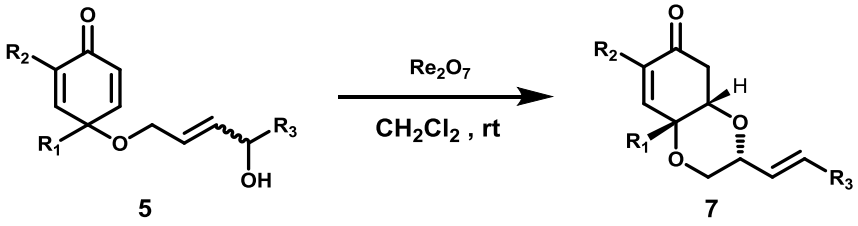
This compound was prepared according to the general procedure B as a dark grey oil (474mg, 31% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.33-7.27 (m, 4H), 6.81-6.74 (m, 2H), 6.31-6.23 (m, 2H), 5.89-5.77 (m, 2H), 5.20 (d, *J* = 5.8 Hz, 1H), 3.88-3.84 (m, 2H), 2.03 (brs, 1H), 1.45 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.24, 151.79, 141.07, 134.47, 133.64, 130.34, 128.83, 128.19, 127.78, 73.90, 72.76, 65.59, 26.47.
IR (neat) 3442, 2929, 1738, 1667, 1081cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{17}H_{18}ClO_3$: m/z 305.0944 $[M+H]^+$, found: m/z 305.0940.



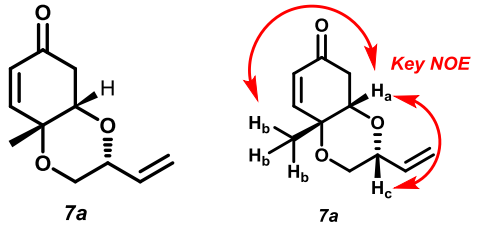
5t

This compound was prepared according to the general procedure B as a dark grey oil (627mg, 36% yield in 5 mmol scale).
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.46 (d, *J* = 8.4 Hz, 2H), 7.22 (d, *J* = 8.4 Hz, 2H), 6.81-6.71 (m, 2H), 6.31-6.20 (m, 2H), 5.90-5.72 (m, 2H), 5.17 (d, *J* = 5.9 Hz, 1H), 3.88-3.80 (m, 2H), 2.20 (brs, 1H), 1.44 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 185.25, 151.81, 141.63, 134.41, 131.75, 130.29, 128.18, 128.12, 121.72, 73.89, 72.75, 65.57, 26.44.
IR (neat) 3440, 2929, 1737, 1668, 1082cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{17}H_{18}BrO_3$: m/z 349.0439 $[M+H]^+$, found: m/z 349.0436.

4. General procedure for the Tandem Reaction



General procedure C: The *dienone* (0.1 mmol, 1.0 equiv) in 0.5 mL CH_2Cl_2 was added to a solution of Re_2O_7 (2.5 mol%) in 0.5 mL CH_2Cl_2. The reaction mixture was stirred at room temperature under argon atmosphere until all starting material was consumed as judged by TLC. The solvent was removed under vacuum. The residue was purified by flash column chromatography (ethyl acetate/petroleum ether = 1/15, v/v) to afford the product.



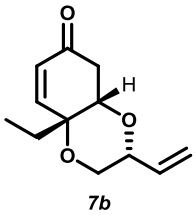
This compound was prepared according to the general procedure C as a pale-yellow solid (17mg, 88% yield in 0.1 mmol scale; 955mg, 82% yield in 6 mmol scale). d.r. = 40:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.64 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.09 (d, *J* = 10.3 Hz, 1H), 5.70-5.62 (m, 1H), 5.32-5.28 (m, 1H), 5.20-5.16 (m, 1H), 4.14-4.09 (m, 1H), 3.99-3.98 (m, 1H), 3.65 (dd, *J* = 11.7, 2.7 Hz, 1H), 3.45 (dd, *J* = 11.8, 10.4 Hz, 1H), 2.67 (d, *J* = 3.1 Hz, 2H), 1.39 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.82, 152.22, 133.45, 130.88, 118.01, 78.09, 76.02, 71.49, 66.99, 42.14, 24.53.

IR (neat) 2972, 1735, 1688, 1363, 1123cm^{-1}.

HRMS (EI) exact mass calcd for $C_{11}H_{14}O_3$: m/z 194.0943 [M]$^+$, found: m/z 194.0941.



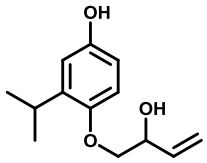
This compound was prepared according to the general procedure C as a pale-yellow solid (16mg, 75% yield in 0.1 mmol scale). d.r. = 40:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.69 (dd, *J* = 10.5, 2.7 Hz, 1H), 6.12 (dd, *J* = 10.5, 1.0 Hz, 1H), 5.70-5.62 (m, 1H), 5.33-5.27 (m, 1H), 5.20-5.16 (m, 1H), 4.11-4.06 (m, 1H), 4.04-4.02 (m, 1H), 3.67 (dd, *J* = 11.7, 2.7 Hz, 1H), 3.44 (dd, *J* = 11.7, 10.4 Hz, 1H), 2.69-2.65 (m, 2H), 1.81-1.66 (m, 2H), 1.04 (t, *J* = 7.5 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.99, 152.17, 133.56, 131.24, 117.96, 76.76, 75.98, 73.31, 66.82, 41.94, 31.50, 7.46.

IR (neat) 2970, 1738, 1686, 1365, 1124cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{12}H_{17}O_3$: m/z 209.1178 [M+H]$^+$, found: m/z 209.1172.



8a

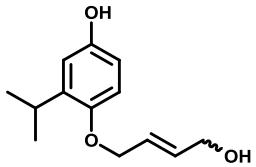
This compound was prepared according to the general procedure C as a white solid (85mg, 38% yield in 1 mmol scale).

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.75-6.71 (m, 2H), 6.60 (dd, *J* = 8.7, 3.1 Hz, 1H), 6.01-5.92 (m, 1H), 5.49-5.43 (m, 1H), 5.31-5.27 (m, 1H), 4.59-4.52 (m, 2H), 3.98 (dd, *J* = 9.3, 3.6 Hz, 1H), 3.86 (dd, *J* = 9.3, 7.3 Hz, 1H), 3.33-3.24 (m, 1H), 2.38 (d, *J* = 4.1 Hz, 1H), 1.21 (d, *J* = 7.0 Hz, 3H), 1.20 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 150.32, 149.65, 139.08, 136.35, 117.24, 113.77, 113.62, 112.65, 73.00, 71.74, 26.95, 22.88, 22.86.

IR (neat) 3408, 3317, 2973, 2928, 1508, 1472, 917 cm^{-1}.

HRMS (EI) exact mass calcd for $C_{13}H_{18}O_3$: m/z 222.1256 [M]$^+$, found: m/z 222.1261.



8b

This compound was prepared according to the general procedure C as a white solid (80mg, 36% yield in 1 mmol scale) and was isolated as a mixture of alkene geometrical isomers (E:Z; 1.3:1). Spectral data for the two isomers are reported respectively.

E isomer

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.73-6.71 (m, 2H), 6.60-6.58 (m, 1H), 6.05-5.98 (m, 1H), 5.86-5.84 (m, 1H), 4.50-4.45 (m, 2H), 4.24-4.19 (m, 2H), 3.35-3.29 (m, 1H), 1.17 (d, *J* = 5.4 Hz, 6H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 150.11, 149.91, 139.28, 131.64, 127.33, 113.78, 113.72, 112.48, 69.06, 63.19, 26.93, 22.87.

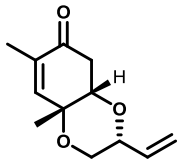
Z isomer

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.71-6.68 (m, 2H), 6.58-6.55 (m, 1H), 6.00-5.92 (m, 1H), 5.86-5.83 (m, 1H), 4.59-4.52 (m, 2H), 4.31-4.25 (m, 2H), 3.32-3.23 (m, 1H), 1.19 (d, *J* = 5.7 Hz, 6H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 149.98, 149.81, 139.45, 131.89, 128.14, 113.80, 113.54, 112.53, 65.36, 59.05, 26.89, 22.92.

IR (neat) 3404, 3328, 2973, 2928, 1506, 1472, 919 cm^{-1}.

HRMS (EI) exact mass calcd for $C_{13}H_{18}O_3$: m/z 222.1256 [M]$^+$, found: m/z 222.1254.



7d

This compound was prepared according to the general procedure C as a pale-yellow solid (12mg, 58% yield in 0.1 mmol scale) and was isolated as a mixture of diastereoisomers (d.r. = 2:1). Spectral data for the two isomers are reported respectively.

Major isomer

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.38-6.37 (m, 1H), 5.70-5.62 (m, 1H), 5.33-5.15 (m, 2H), 4.12-4.07 (m, 1H), 3.97-3.95 (m, 1H), 3.62 (dd, *J* = 11.7, 2.8 Hz, 1H), 3.47 (dd, *J* = 11.7, 10.4 Hz, 1H), 2.67 (dd, *J* = 3.8, 3.1 Hz, 2H), 1.83 (d, *J* = 1.4 Hz, 3H), 1.36 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 196.11, 147.04, 137.18, 133.66, 117.95, 78.38, 76.06, 66.74, 64.15, 42.18, 24.79, 15.95.

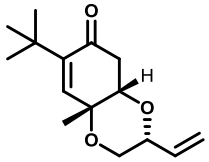
Minor isomer

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.41-6.39 (m, 1H), 6.14-6.05 (m, 1H), 5.43-5.34 (m, 2H), 4.17-4.15 (m, 1H), 4.00-3.97 (m, 1H), 3.99-3.97 (m, 1H), 3.72 (dd, *J* = 12.0, 1.9 Hz, 1H), 2.64-2.61 (m, 2H), 1.84 (d, *J* = 1.5 Hz, 3H), 1.36 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 196.46 , 146.65 , 137.42 , 134.55 , 119.24 , 72.18 , 72.03 , 71.72 , 71.61 , 41.66 , 24.41 , 15.95 .

IR (neat) 2962, 1737, 1688, 1365, 1124cm^{-1}.

HRMS (EI) exact mass calcd for $C_{12}H_{16}O_3$: m/z 208.1099 [M]$^+$, found: m/z 208.1096.



7e

This compound was prepared according to the general procedure C as a pale-yellow solid (21mg, 82% yield in 0.1 mmol scale; major isomer 181mg, minor isomer 22mg, 81% yield in total in 1 mmol scale) and was isolated as single diastereoisomer by PTLC (d.r. = 8:1) . Spectral data for the two isomers are reported respectively.

Major isomer

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.33 (d, *J* = 2.8 Hz, 1H), 5.68-5.60 (m, 1H), 5.30-5.25 (m, 1H), 5.18-5.13 (m, 1H), 4.11-4.04 (m, 1H), 3.91-3.89 (m, 1H), 3.61 (dd, *J* = 11.7, 2.7 Hz, 1H), 3.40 (dd, *J* = 11.7, 10.4 Hz, 1H), 2.62 (d, *J* = 3.0 Hz, 2H), 1.35 (s, 3H), 1.18 (s, 9H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.20, 148.18, 144.25, 133.54, 117.57, 77.48, 75.35, 71.52, 66.60, 43.80, 34.59, 29.23, 24.60.

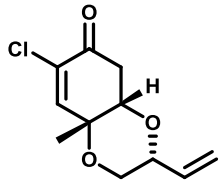
Minor isomer

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.35 (d, *J* = 2.3 Hz, 1H), 6.14-6.05 (m, 1H), 5.43-5.34 (m, 2H), 4.15-4.09 (m, 2H), 3.92 (dd, *J* = 12.0, 3.5 Hz, 1H), 3.74-3.68 (m, 1H), 2.62-2.58 (m, 2H), 1.36 (s, 3H), 1.21 (s, 9H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.97, 148.52, 144.00, 134.57, 119.21, 72.04, 71.73, 71.59, 64.16, 43.61, 34.76, 29.45, 24.56.

IR (neat) 2959, 1738, 1683, 1365, 1128cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{15}H_{23}O_3$: m/z 251.1647 [M+H]$^+$, found: m/z 251.1642.



7f

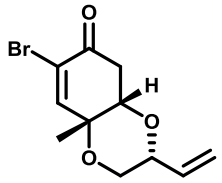
This compound was prepared according to the general procedure C as a pale-yellow solid (16mg, 68% yield in 0.1 mmol scale). d.r. = 15:1. Spectral data for the major isomer is reported.

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.82 (d, *J* = 2.6 Hz, 1H), 5.70-5.61 (m, 1H), 5.34-5.16 (m, 2H), 4.15-4.08 (m, 1H), 4.01-3.96 (m, 1H), 3.67 (dd, *J* = 11.9, 2.8 Hz, 1H), 3.48 (dd, *J* = 11.9, 10.4 Hz, 1H), 2.87 (dd, *J* = 17.2, 3.1 Hz, 1H), 2.75 (dd, *J* = 17.2, 3.0 Hz, 1H), 1.43 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 187.97, 147.98, 133.10, 132.81, 118.32, 77.83, 76.11, 72.92, 67.02, 42.03, 24.43.

IR (neat) 2962, 1737, 1685, 1365, 1126cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{11}H_{14}ClO_3$: m/z 229.0631 $[M+H]^+$, found: m/z 229.0625.



7g

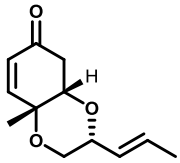
This compound was prepared according to the general procedure C as a pale-yellow solid (18mg, 66% yield in 0.1 mmol scale). d.r. = 15:1. Spectral data for the major isomer is reported.

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.10 (d, *J* = 2.6 Hz, 1H), 5.70-5.62 (m, 1H), 5.33-5.19 (m, 2H), 4.14-4.10 (m, 1H), 4.01-3.99 (m, 1H), 3.68 (dd, *J* = 11.9, 2.7 Hz, 1H), 3.49 (dd, *J* = 11.9, 10.4 Hz, 1H), 2.92 (dd, *J* = 17.2, 3.1 Hz, 1H), 2.77 (dd, *J* = 17.2, 3.0 Hz, 1H), 1.42 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 187.84, 152.57, 133.08, 124.40, 118.39, 77.83, 76.12, 73.69, 67.09, 41.68, 24.21.

IR (neat) 2958, 1738, 1684, 1365, 1127cm^{-1}.

HRMS (EI) exact mass calcd for $C_{11}H_{13}BrO_3$: m/z 272.0048 $[M]^+$, found: m/z 272.0051.



7h

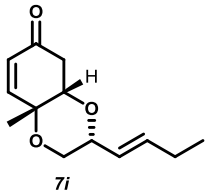
This compound was prepared according to the general procedure C as a pale-yellow solid (19mg, 93% yield in 0.1 mmol scale). d.r. = 10:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.64 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.08 (d, *J* = 10.5 Hz, 1H), 5.80-5.72 (m, 1H), 5.33-5.26 (m, 1H), 4.07-4.02 (m, 1H), 3.97-3.95 (m, 1H), 3.60 (dd, *J* = 11.8, 2.7 Hz, 1H), 3.45 (dd, *J* = 11.8, 10.4 Hz, 1H), 2.66 (d, *J* = 3.1 Hz, 2H), 1.69-1.64 (m, 3H), 1.38 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.81, 152.35, 130.82, 130.51, 126.49, 78.07, 76.08, 71.36, 67.22, 42.17, 24.55, 18.05.

IR (neat) 2970, 1684, 1372, 1121cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{12}H_{17}O_3$: m/z 209.1178 $[M+H]^+$, found: m/z 209.1170.



7i

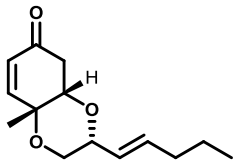
This compound was prepared according to the general procedure C as a pale-yellow solid (20mg, 91% yield in 0.1 mmol scale). d.r. = 20:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.64 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.08 (d, *J* = 10.3 Hz, 1H), 5.83-5.75 (m, 1H), 5.29-5.23 (m, 1H), 4.08-4.03 (m, 1H), 3.97-3.95 (m, 1H), 3.60 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.45 (dd, *J* = 11.8, 10.4 Hz, 1H), 2.66 (d, *J* = 3.2 Hz, 2H), 2.07-1.97 (m, 2H), 1.38 (s, 3H), 0.96 (t, *J* = 7.5 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.85, 152.39, 137.05, 130.83, 124.21, 78.11, 76.15, 71.36, 67.33, 42.18, 25.48, 24.56, 13.15.

IR (neat) 2965, 1684, 1372, 1119cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{13}H_{19}O_3$: m/z 223.1334 $[M+H]^+$, found: m/z 223.1328.



7j

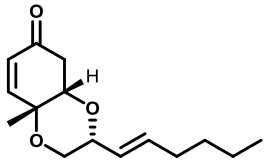
This compound was prepared according to the general procedure C as a pale-yellow solid (21mg, 89% yield in 0.1 mmol scale). d.r. = 20:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.64 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.08 (d, *J* = 10.3 Hz, 1H), 5.77-5.69 (m, 1H), 5.29-5.24 (m, 1H), 4.07-4.02 (m, 1H), 3.97-3.95 (m, 1H), 3.59 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.48-3.42 (m, 1H), 2.66 (d, *J* = 2.9 Hz, 2H), 2.00-1.94 (m, 2H), 1.38 (s, 3H), 1.39-1.33 (m, 2H), 0.86 (t, *J* = 7.3 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.88, 152.41, 135.38, 130.82, 125.30, 78.07, 76.15, 71.36, 67.34, 42.17, 34.58, 24.57, 22.11, 13.78.

IR (neat) 2960, 1684, 1372, 1120cm^{-1}.

HRMS (EI) exact mass calcd for $C_{14}H_{20}O_3$: m/z 236.1412 $[M]^+$, found: m/z 236.1415.



7k

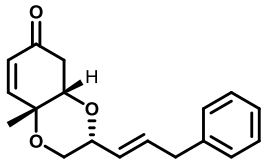
This compound was prepared according to the general procedure C as a pale-yellow solid (23mg, 92% yield in 0.1 mmol scale). d.r. = 20:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.64 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.08 (d, *J* = 10.4 Hz, 1H), 5.77-5.69 (m, 1H), 5.29-5.23 (m, 1H), 4.07-4.02 (m, 1H), 3.97-3.94 (m, 1H), 3.59 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.44 (dd, *J* = 11.8, 10.4 Hz, 1H), 2.66 (d, *J* = 3.0 Hz, 2H), 2.02-1.96 (m, 2H), 1.38 (s, 3H), 1.34-1.22 (m, 4H), 0.86 (t, *J* = 7.1 Hz, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.86, 152.40, 135.58, 130.82, 125.12, 78.08, 76.15, 71.35, 67.34, 42.17, 32.18, 31.11, 24.56, 22.32, 14.00.

IR (neat) 2959, 1683, 1372, 1122cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{15}H_{23}O_3$: m/z 251.1647 $[M+H]^+$, found: m/z 251.1642.



7l

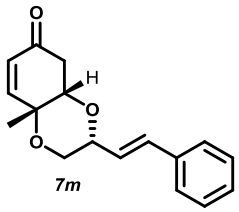
This compound was prepared according to the general procedure C as a colorless oil (24mg, 87% yield in 0.1 mmol scale). d.r. = 40:1

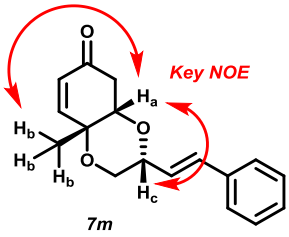
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.31-7.27 (m, 2H), 7.22-7.18 (m, 1H), 7.15-7.12 (m, 2H), 6.64 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.09 (d, *J* = 10.3 Hz, 1H), 5.94-5.87 (m, 1H), 5.37-5.31 (m, 1H), 4.13-4.07 (m, 1H), 3.98-3.95 (m, 1H), 3.62 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.47 (dd, *J* = 11.8, 10.4 Hz, 1H), 3.36-3.33 (m, 2H), 2.67 (d, *J* = 3.1 Hz, 2H), 1.39 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.84, 152.34, 139.58, 133.74, 130.86, 128.75, 128.61, 126.58, 126.34, 78.12, 75.84, 71.40, 67.22, 42.15, 38.90, 24.55.

IR (neat) 2968, 1678, 1372, 1121cm^{-1}.

HRMS (EI) exact mass calcd for $C_{18}H_{20}O_3$: m/z 284.1412 $[M]^+$, found: m/z 284.1406.





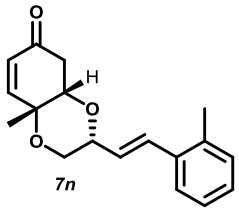
This compound was prepared according to the general procedure C as a pale-yellow solid (25mg, 92% yield in 0.1 mmol scale). d.r. = 20:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.36-7.33 (m, 2H), 7.31-7.27 (m, 2H), 7.25-7.21 (m, 1H), 6.70-6.60 (m, 2H), 6.13 (d, *J* = 10.3 Hz, 1H), 6.01 (dd, *J* = 16.1, 6.1 Hz, 1H), 4.32-4.26 (m, 1H), 4.05-4.03 (m, 1H), 3.72 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.55 (dd, *J* = 11.8, 10.4 Hz, 1H), 2.71 (d, *J* = 3.0 Hz, 2H), 1.42 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.83, 152.26, 136.32, 132.98, 130.93, 128.68, 128.13, 126.66, 124.36, 78.20, 76.00, 71.51, 67.18, 42.18, 24.56.

IR (neat) 2970, 2862, 1738, 1684, 1372, 1118cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{17}H_{19}O_3$: m/z 271.1334 $[M+H]^+$, found: m/z 271.1329.



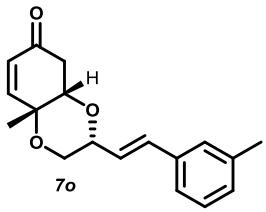
This compound was prepared according to the general procedure C as a pale-yellow solid (20mg, 72% yield in 0.1 mmol scale). d.r. = 20:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.40-7.36 (m, 1H), 7.16-7.10 (m, 3H), 6.85 (dd, *J* = 16.0, 1.2 Hz, 1H), 6.68 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.13 (d, *J* = 10.3 Hz, 1H), 5.89 (dd, *J* = 16.0, 6.4 Hz, 1H), 4.34-4.27 (m, 1H), 4.07-4.02 (m, 1H), 3.74-3.68 (m, 1H), 3.57 (dd, *J* = 11.8, 10.3 Hz, 1H), 2.71 (d, *J* = 3.1 Hz, 2H), 2.31 (s, 3H), 1.43 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.82, 152.26, 135.74, 135.39, 130.97, 130.91, 130.43, 128.01, 126.19, 125.78, 125.71, 78.16, 76.28, 71.49, 67.27, 42.18, 24.56, 19.84.

IR (neat) 2968, 2863, 1741, 1683, 1372, 1120cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{18}H_{21}O_3$: m/z 285.1491 $[M+H]^+$, found: m/z 285.1485.



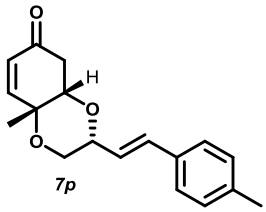
This compound was prepared according to the general procedure C as a pale-yellow solid (24mg, 83% yield in 0.1 mmol scale). d.r. = 20:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.21-7.12 (m, 3H), 7.07-7.03 (m, 1H), 6.70-6.57 (m, 2H), 6.13 (d, *J* = 10.4 Hz, 1H), 5.99 (dd, *J* = 16.1, 6.2 Hz, 1H), 4.31-4.25 (m, 1H), 4.06-4.02 (m, 1H), 3.71 (dd, *J* = 11.8, 2.7 Hz, 1H), 3.55 (dd, *J* = 11.8, 10.3 Hz, 1H), 2.71 (d, *J* = 3.1 Hz, 2H), 2.32 (s, 3H), 1.42 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.84, 152.27, 138.24, 136.26, 133.08, 130.93, 128.92, 128.58, 127.37, 124.17, 123.84, 78.19, 76.04, 71.50, 67.21, 42.19, 24.56, 21.47.

IR (neat) 2970, 2861, 1737, 1684, 1372, 1121cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{18}H_{21}O_3$: m/z 285.1491 $[M+H]^+$, found: m/z 285.1488.



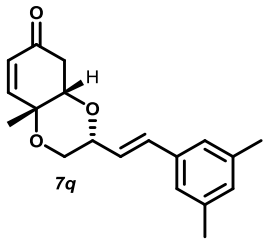
This compound was prepared according to the general procedure C as a pale-yellow solid (23mg, 82% yield in 0.1 mmol scale). d.r. = 40:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.24 (d, *J* = 8.1 Hz, 2H), 7.10 (d, *J* = 7.8 Hz, 2H), 6.68 (dd, *J* = 10.3, 2.8 Hz, 1H), 6.59 (dd, *J* = 16.1, 1.1 Hz, 1H), 6.13 (d, *J* = 10.3 Hz, 1H), 5.95 (dd, *J* = 16.1, 6.3 Hz, 1H), 4.30-4.24 (m, 1H), 4.05-4.03 (m, 1H), 3.71 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.55 (dd, *J* = 11.8, 10.3 Hz, 1H), 2.71 (d, *J* = 3.1 Hz, 2H), 2.32 (s, 3H), 1.42 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.87, 152.33, 138.04, 133.54, 133.01, 130.93, 129.40, 126.59, 123.29, 78.20, 76.16, 71.49, 67.25, 42.20, 24.58, 21.35.

IR (neat) 2970, 2860, 1738, 1682, 1366, 1118cm^{-1}.

HRMS (ESI) exact mass calcd for $C_{18}H_{21}O_3$: m/z 285.1491 $[M+H]^+$, found: m/z 285.1492.



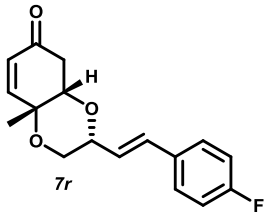
This compound was prepared according to the general procedure C as a pale-yellow solid (24mg, 81% yield in 0.1 mmol scale). d.r. = 15:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 6.97 (s, 2H), 6.88 (s, 1H), 6.68 (dd, *J* = 10.4, 2.7 Hz, 1H), 6.56 (dd, *J* = 16.1, 1.2 Hz, 1H), 6.13 (d, *J* = 10.4 Hz, 1H), 5.98 (dd, *J* = 16.1, 6.3 Hz, 1H), 4.31-4.24 (m, 1H), 4.06-4.02 (m, 1H), 3.71 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.54 (dd, *J* = 11.8, 10.3 Hz, 1H), 2.71 (d, *J* = 3.1 Hz, 2H), 2.28 (s, 3H), 1.42 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.91, 152.31, 138.14, 136.19, 133.17, 130.92, 129.86, 124.57, 123.95, 78.14, 76.08, 71.49, 67.23, 42.19, 24.55, 21.35.

IR (neat) 2968, 2862, 1738, 1683, 1372, 1119cm^{-1}.

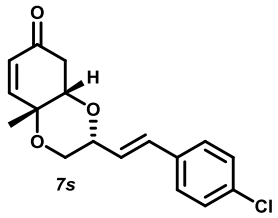
HRMS (ESI) exact mass calcd for $C_{19}H_{23}O_3$: m/z 299.1647 $[M+H]^+$, found: m/z 299.1642.



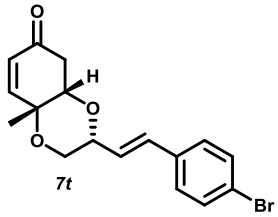
This compound was prepared according to the general procedure C as a pale-yellow solid (20mg, 69% yield in 0.1 mmol scale). d.r. = 40:1

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.34-7.28 (m, 2H), 7.01-6.95 (m, 2H), 6.67 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.62-6.56 (m, 1H), 6.13 (d, *J* = 10.3 Hz, 1H), 5.92 (dd, *J* = 16.1, 6.1 Hz, 1H), 4.30-4.24 (m, 1H), 4.06-4.02 (m, 1H), 3.72 (dd, *J* = 11.8, 2.7 Hz, 1H), 3.54 (dd, *J* = 11.8, 10.4 Hz, 1H), 2.71 (d, *J* = 3.1 Hz, 2H), 1.42 (s, 3H).

^{13}C NMR (126 MHz, $CDCl_3$) δ 195.82 , 162.66 (d, *J* = 247.3 Hz), 152.22 , 132.51 (d, *J* = 3.3 Hz), 131.81 , 130.95 , 128.23 (d, *J* = 8.1 Hz), 124.11 (d, *J* = 2.2 Hz), 115.64 (d, *J* = 21.7 Hz), 78.24 , 75.88 , 71.53 , 67.16 , 42.19 , 24.55 .
IR (neat) 2970, 1738, 1683, 1372, 1121cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{17}H_{18}FO_3$: m/z 289.1240 $[M+H]^+$, found: m/z 289.1235.

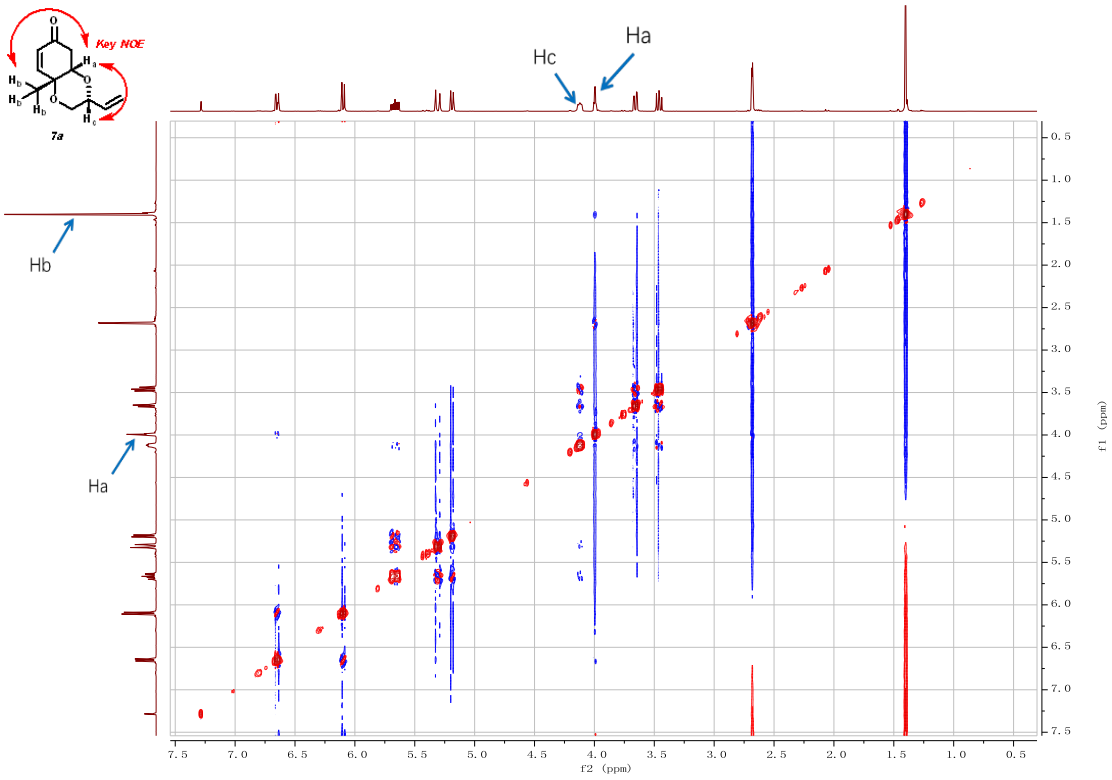


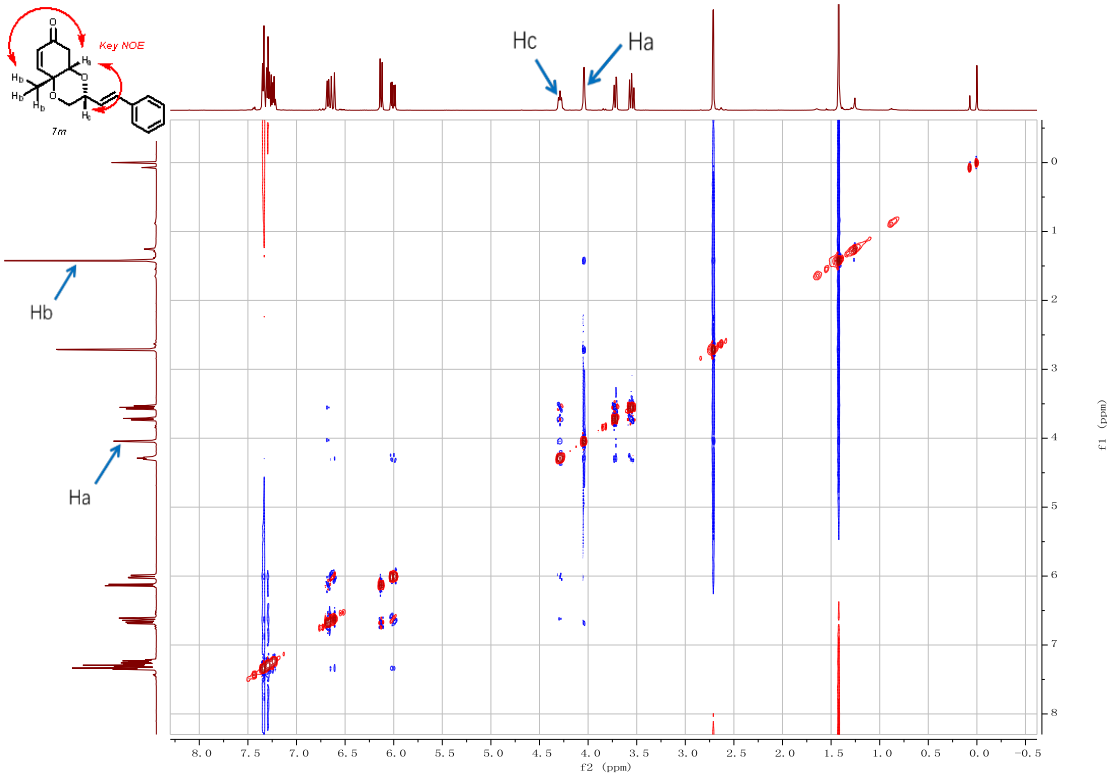
This compound was prepared according to the general procedure C as a pale-yellow solid (22mg, 73% yield in 0.1 mmol scale). d.r. = 40:1
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.26 (s, 4H), 6.67 (dd, *J* = 10.3, 2.8 Hz, 1H), 6.58 (dd, *J* = 16.1, 1.4 Hz, 1H), 6.12 (d, *J* = 10.4 Hz, 1H), 5.98 (dd, *J* = 16.1, 6.0 Hz, 1H), 4.31-4.25 (m, 1H), 4.07-4.01 (m, 1H), 3.72 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.53 (dd, *J* = 11.8, 10.4 Hz, 1H), 2.71 (d, *J* = 3.1 Hz, 2H), 1.42 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 195.77, 152.16, 134.86, 133.78, 131.62, 130.94, 128.86, 127.86, 125.04, 78.24, 75.77, 71.53, 67.07, 42.17, 24.52.
IR (neat) 2970, 1736, 1683, 1372, 1118cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{17}H_{18}ClO_3$: m/z 305.0944 $[M+H]^+$, found: m/z 305.0937.

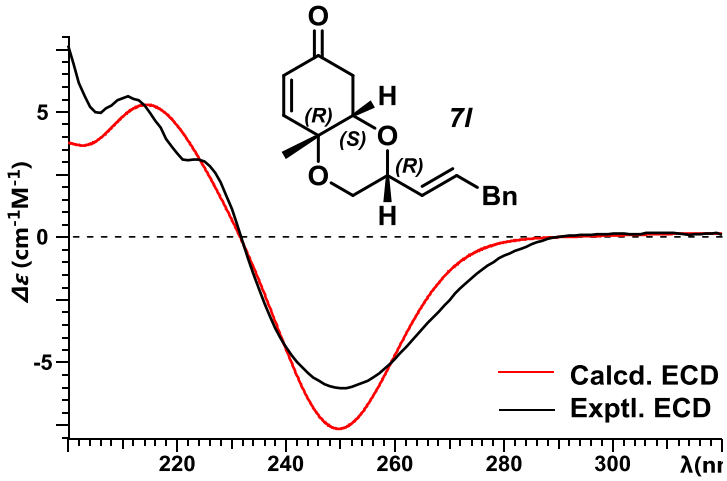


This compound was prepared according to the general procedure C as a pale-yellow solid (26mg, 74% yield in 0.1 mmol scale). d.r. = 40:1
^{1}H NMR (500 MHz, $CDCl_3$) δ 7.41 (d, *J* = 8.5 Hz, 2H), 7.20 (d, *J* = 8.5 Hz, 2H), 6.67 (dd, *J* = 10.4, 2.8 Hz, 1H), 6.56 (dd, *J* = 16.1, 1.4 Hz, 1H), 6.12 (d, *J* = 10.4 Hz, 1H), 6.00 (dd, *J* = 16.1, 6.0 Hz, 1H), 4.30-4.25 (m, 1H), 4.05-4.01 (m, 1H), 3.74-3.68 (m, 1H), 3.53 (dd, *J* = 11.8, 10.3 Hz, 1H), 2.71 (d, *J* = 3.0 Hz, 2H), 1.42 (s, 3H).
^{13}C NMR (126 MHz, $CDCl_3$) δ 195.76, 152.15, 135.30, 131.82, 131.65, 130.95, 128.17, 125.17, 121.95, 78.24, 75.76, 71.54, 67.04, 42.17, 24.53.
IR (neat) 2970, 1738, 1684, 1372, 1119cm^{-1}.
HRMS (ESI) exact mass calcd for $C_{17}H_{18}BrO_3$: m/z 349.0439 $[M+H]^+$, found: m/z 349.0432.

5. Relative configuration of 7a, 7l, 7m







Calculation method[2,3,4]:

A preliminary conformational search was performed in Conflex6.7[1] using MMFF94s forcefield. Conformers were saved and further optimized using B3LYP/6-311++G(d,p) level with CPCM solvent model in Gaussian 09 software package.[2] Frequency was calculated at the same level to check optimized results. The stable conformers with populations greater than 1% and without imaginary frequencies were submitted to ECD calculation by the TDDFT (cam-B3LYP/TZVP) method associated with CPCM solvent model in MeCN. The excitation energies (E), oscillator strength (f), rotatory strength in velocity form (Rvel), and rotatory strength in length form (Rlen) of the lowest 32 excited states were calculated. ECD spectra of different conformers were summated in SpecDis[3] according to their Boltzmann-calculated distributions.

---------- Table of Energy analysis----------

conformer	E(a.u.)	ΔE(kcal/mol)	Boltz Distribution(%)
1a-1CD	-923.4353037	0.0464357	24.17
1a-2CD	-923.4353777	0.0000000	26.15
1a-3CD	-923.4347545	0.3910642	13.50
1a-6CD	-923.4347781	0.3762550	13.85
1a-7CD	-923.4342613	0.7005522	8.01
1a-8CD	-923.4348101	0.3561747	14.32

==========

Comparison of CD Curve：

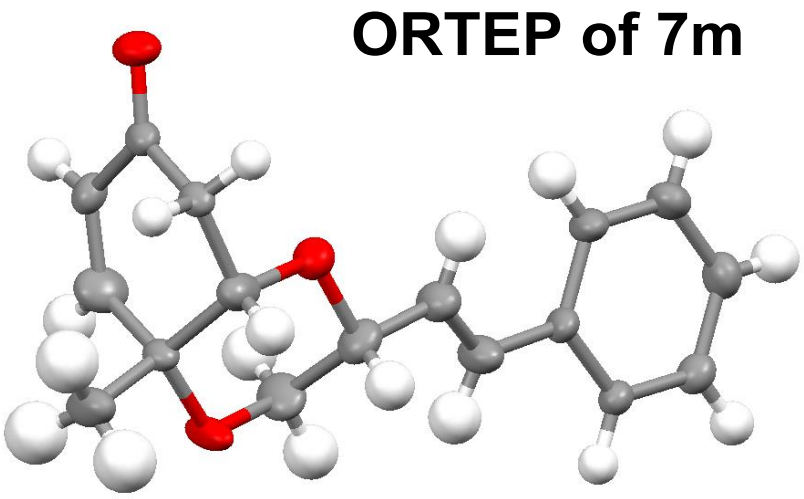
Best Similarity factor (S = 0.9744) was found for sigma =0.3 eV at 7 nm shift

[2] Conflex 6.7, Conflex Corp.: Tokyo Yokohama, Japan, 2010; Conflex Corp.: Tokyo Yokohama, Japan

[3] Frisch, M. J.; Trucks, G. W.; Schlegel, H. B.; Scuseria, G. E.; Robb, M. A.; Cheeseman, J. R.; Scalmani, G.; Barone, V.; Mennucci, B.; Petersson, G. A.; et al. Gaussian 09 revision D.01; Gaussian Inc.: Wallingford CT, 2013.

[4] Bruhn, T.; Schaumloeffel, A.; Hemberger, Y.; Bringmann, G. Chirality **2013**, 25, 243–249.

6. X-ray data of 7m

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 'H'   'H'    0.0000    0.0000
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 'O'   'O'    0.0106    0.0060
 'International Tables Vol C Tables 4.2.6.8 and 6.1.1.4'

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  'x, -y-1/2, z-1/2'

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_cell_length_c                      12.604(2)
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_cell_formula_units_Z               4
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 F^2^ > 2sigma(F^2^) is used only for calculating R-factors(gt) etc. and is
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_refine_ls_weighting_details
 'calc w=1/[\s^2^(Fo^2^)+(0.2000P)^2^+0.0000P] where P=(Fo^2^+2Fc^2^)/3'
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H14 H 0.0898 1.1168 0.1557 0.037 Uiso 1 1 calc R . .
C15 C 0.1955(5) 1.0227(6) 0.0665(5) 0.0456(13) Uani 1 1 d . . .
H15 H 0.2223 1.1100 0.0421 0.055 Uiso 1 1 calc R . .
C16 C 0.2450(3) 0.8867(5) 0.0231(3) 0.0261(9) Uani 1 1 d . . .
O3 O 0.3610(3) 0.9024(5) 0.0058(3) 0.0475(11) Uani 1 1 d . . .
C10 C 0.4276(4) 0.9290(7) 0.1035(5) 0.0492(14) Uani 1 1 d . . .
H10A H 0.4012 1.0151 0.1378 0.059 Uiso 1 1 calc R . .
H10B H 0.5055 0.9435 0.0884 0.059 Uiso 1 1 calc R . .
C9 C 0.4176(4) 0.8022(6) 0.1749(4) 0.0397(12) Uani 1 1 d . . .
H9 H 0.4415 0.7152 0.1384 0.048 Uiso 1 1 calc R . .
C8 C 0.4839(4) 0.8173(6) 0.2776(4) 0.0416(12) Uani 1 1 d . . .
H8 H 0.4506 0.7916 0.3397 0.050 Uiso 1 1 calc R . .
C7 C 0.5905(4) 0.8666(7) 0.2854(4) 0.0456(14) Uani 1 1 d . . .
H7 H 0.6197 0.8966 0.2223 0.055 Uiso 1 1 calc R . .
C4 C 0.6658(3) 0.8786(5) 0.3811(4) 0.0308(10) Uani 1 1 d . . .
C5 C 0.7811(3) 0.8883(4) 0.3705(4) 0.0269(9) Uani 1 1 d . . .
H5 H 0.8084 0.8901 0.3030 0.032 Uiso 1 1 calc R . .
C6 C 0.8560(4) 0.8953(5) 0.4593(4) 0.0316(10) Uani 1 1 d . . .
```

H6 H 0.9326 0.8994 0.4508 0.038 Uiso 1 1 calc R . .
C1 C 0.8165(4) 0.8960(5) 0.5598(4) 0.0386(11) Uani 1 1 d . . .
H1 H 0.8665 0.9020 0.6191 0.046 Uiso 1 1 calc R . .
C13 C 0.0749(3) 0.8913(5) 0.1823(4) 0.0293(9) Uani 1 1 d . . .
C12 C 0.1143(3) 0.7531(5) 0.1372(3) 0.0258(9) Uani 1 1 d . . .
H12A H 0.1119 0.6781 0.1906 0.031 Uiso 1 1 calc R . .
H12B H 0.0641 0.7255 0.0773 0.031 Uiso 1 1 calc R . .
C11 C 0.2305(4) 0.7646(5) 0.1015(4) 0.0389(12) Uani 1 1 d . . .
H11 H 0.2513 0.6733 0.0689 0.047 Uiso 1 1 calc R . .
O2 O 0.3013(3) 0.7879(4) 0.1982(3) 0.0367(9) Uani 1 1 d . . .
C17 C 0.1918(4) 0.8601(8) -0.0853(4) 0.0517(15) Uani 1 1 d . . .
H17A H 0.1893 0.9485 -0.1250 0.078 Uiso 1 1 calc R . .
H17B H 0.1170 0.8246 -0.0794 0.078 Uiso 1 1 calc R . .
H17C H 0.2348 0.7900 -0.1214 0.078 Uiso 1 1 calc R . .
C2 C 0.7015(4) 0.8879(6) 0.5725(4) 0.0393(12) Uani 1 1 d . . .
H2 H 0.6748 0.8865 0.6403 0.047 Uiso 1 1 calc R . .
C3 C 0.6270(4) 0.8817(6) 0.4837(4) 0.0378(12) Uani 1 1 d . . .
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C15 0.049(3) 0.037(3) 0.052(3) 0.004(2) 0.012(2) -0.014(2)
C16 0.0186(17) 0.036(2) 0.024(2) 0.0036(17) 0.0030(15) -0.0044(16)
O3 0.0197(15) 0.100(3) 0.0223(17) 0.0109(17) 0.0002(12) -0.0101(16)
C10 0.024(2) 0.070(4) 0.053(4) 0.011(3) 0.000(2) -0.013(2)
C9 0.022(2) 0.047(3) 0.050(3) -0.001(2) 0.0011(19) -0.0027(19)
C8 0.027(2) 0.060(3) 0.038(3) 0.005(2) 0.0032(19) -0.002(2)
C7 0.027(2) 0.077(4) 0.033(3) 0.007(2) 0.004(2) -0.001(2)
C4 0.0184(18) 0.045(3) 0.029(2) 0.0059(19) 0.0008(16) 0.0046(17)
C5 0.0205(18) 0.031(2) 0.029(2) 0.0020(17) 0.0022(15) 0.0019(15)
C6 0.0232(19) 0.035(2) 0.037(3) -0.0014(19) -0.0002(17) -0.0014(17)
C1 0.034(2) 0.047(3) 0.034(3) 0.001(2) -0.0070(19) 0.002(2)
C13 0.0190(17) 0.040(2) 0.028(2) 0.0057(18) 0.0014(15) 0.0008(17)
C12 0.0193(17) 0.033(2) 0.025(2) 0.0029(16) -0.0001(15) -0.0059(15)
C11 0.040(3) 0.034(2) 0.044(3) 0.009(2) 0.016(2) 0.006(2)
O2 0.0262(15) 0.044(2) 0.039(2) 0.0032(15) 0.0006(13) -0.0032(13)
C17 0.030(2) 0.096(5) 0.029(3) 0.000(3) 0.000(2) 0.003(3)
C2 0.037(3) 0.054(3) 0.027(2) 0.001(2) 0.0050(19) 0.003(2)
C3 0.024(2) 0.059(3) 0.031(3) 0.007(2) 0.0072(18) 0.007(2)

```
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  and torsion angles; correlations between esds in cell parameters are only
  used when they are defined by crystal symmetry.  An approximate (isotropic)
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C14 H14 0.9300 . ?
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C15 H15 0.9300 . ?
C16 O3 1.424(5) . ?
C16 C17 1.493(7) . ?
C16 C11 1.520(6) . ?
O3 C10 1.448(6) . ?
C10 C9 1.490(8) . ?
C10 H10A 0.9700 . ?
C10 H10B 0.9700 . ?
C9 O2 1.444(5) . ?
C9 C8 1.484(7) . ?
C9 H9 0.9800 . ?
C8 C7 1.352(7) . ?
C8 H8 0.9300 . ?
C7 C4 1.465(7) . ?
C7 H7 0.9300 . ?
C4 C5 1.395(6) . ?
C4 C3 1.400(7) . ?
C5 C6 1.392(6) . ?
C5 H5 0.9300 . ?
C6 C1 1.378(7) . ?
C6 H6 0.9300 . ?
C1 C2 1.395(7) . ?
C1 H1 0.9300 . ?
C13 C12 1.490(6) . ?
C12 C11 1.488(6) . ?
C12 H12A 0.9700 . ?
C12 H12B 0.9700 . ?
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C11 O2 1.459(6) . ?
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C3 H3 0.9300 . ?

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O3 C16 C17 104.0(4) . . ?
O3 C16 C15 112.1(4) . . ?
C17 C16 C15 108.4(4) . . ?
O3 C16 C11 109.0(3) . . ?
C17 C16 C11 114.4(4) . . ?
C15 C16 C11 108.9(4) . . ?
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O3 C10 C9 108.6(4) . . ?
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C9 C10 H10B 110.0 . . ?
H10A C10 H10B 108.3 . . ?
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O1 C13 C14 120.1(4) . . ?
C12 C13 C14 117.0(4) . . ?
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C11 C12 H12B 109.2 . . ?
C13 C12 H12B 109.2 . . ?
H12A C12 H12B 107.9 . . ?
O2 C11 C12 105.3(4) . . ?
O2 C11 C16 110.5(4) . . ?
C12 C11 C16 113.3(4) . . ?
O2 C11 H11 109.2 . . ?
C12 C11 H11 109.2 . . ?
C16 C11 H11 109.2 . . ?
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C16 C17 H17B 109.5 . . ?
H17A C17 H17B 109.5 . . ?
C16 C17 H17C 109.5 . . ?
H17A C17 H17C 109.5 . . ?
H17B C17 H17C 109.5 . . ?
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C17 C16 O3 C10 -179.8(4) . . . . ?
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C11 C16 O3 C10 -57.4(5) . . . . ?
C16 O3 C10 C9 62.3(5) . . . . ?
O3 C10 C9 O2 -61.6(5) . . . . ?
O3 C10 C9 C8 179.4(4) . . . . ?
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C9 C8 C7 C4 -176.4(5) . . . . ?
C8 C7 C4 C5 160.0(6) . . . . ?
C8 C7 C4 C3 -20.4(9) . . . . ?
C3 C4 C5 C6 2.4(7) . . . . ?
C7 C4 C5 C6 -177.9(4) . . . . ?
C4 C5 C6 C1 -1.5(7) . . . . ?
C5 C6 C1 C2 0.8(7) . . . . ?
C15 C14 C13 O1 175.7(5) . . . . ?
C15 C14 C13 C12 -6.8(7) . . . . ?
O1 C13 C12 C11 -150.2(4) . . . . ?
C14 C13 C12 C11 32.4(5) . . . . ?
C13 C12 C11 O2 66.0(4) . . . . ?
C13 C12 C11 C16 -54.8(5) . . . . ?
O3 C16 C11 O2 53.8(5) . . . . ?
C17 C16 C11 O2 169.8(4) . . . . ?
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O3 C16 C11 C12 171.6(4) . . . . ?
C17 C16 C11 C12 -72.4(5) . . . . ?
C15 C16 C11 C12 49.0(5) . . . . ?
C8 C9 O2 C11 -176.9(4) . . . . ?
C10 C9 O2 C11 60.6(5) . . . . ?
C12 C11 O2 C9 -179.6(4) . . . . ?
C16 C11 O2 C9 -57.0(5) . . . . ?
C6 C1 C2 C3 -1.2(8) . . . . ?
C1 C2 C3 C4 2.2(8) . . . . ?
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C7 C4 C3 C2 177.6(5) . . . . ?

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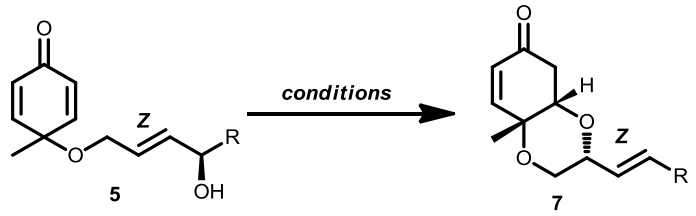
7. Chirality transfer studies

Table 3. Chirality transfer studies using enantiopure allylic alcohols.



R = Bn, 5l, 96% ee	Re_2O_7, CH_2Cl_2 , 0 °C	73%, d.r. 25:1 85% ee
	Ph_3SiO-ReO_3, Et_2O , -78 °C	54%, d.r. 26:1 92% ee
R = Ph, 5m, 99% ee	Re_2O_7,CH_2Cl_2 , 0 °C	84%, d.r. 32:1 0% ee
	Ph_3SiO-ReO_3, Et_2O , -78 °C	53%, d.r. 34:1 81% ee

The enantiomeric excess of **5l** was found to be 96% by chiral HPLC (ChiralPak PA-2 column, hexane/*i*-PrOH 80:20 0.7 mL/min, t_{major} = 20.00 min, t_{minor} = 22.07 min).

Condition A : Re_2O_7, CH_2Cl_2, 0℃

The enantiomeric excess of **7l** was found to be 85% by chiral HPLC (ChiralPak IC column, hexane/*i*-PrOH 90:10 0.7 mL/min, t_{major} = 22.04 min, t_{minor} = 25.81 min).

Condition B : Ph_3SiO-ReO_3, Et_2O, -78℃

The enantiomeric excess of **7l** was found to be 92% by chiral HPLC (ChiralPak IC column, hexane/*i*-PrOH 90:10 0.7 mL/min, t_{major} = 22.33 min, t_{minor} = 26.10 min).

The enantiomeric excess of **5m** was found to be 99% by chiral HPLC (ChiralPak AD-H column, hexane/*i*-PrOH 80:20 0.7 mL/min, t_{major} = 12.08 min, t_{minor} = 12.87 min).

Condition A : Re_2O_7, CH_2Cl_2, 0℃

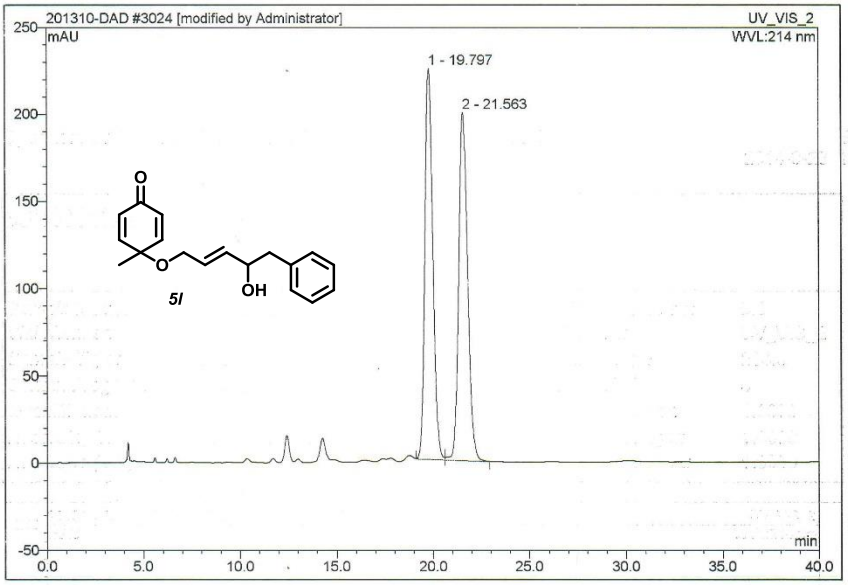
The enantiomeric excess of **7m** was found to be 0% by chiral HPLC (ChiralPak IC column, hexane/*i*-PrOH 90:10 0.7 mL/min, t_{major} = 24.95 min, t_{minor} = 28.11 min).

Condition B : Ph_3SiO-ReO_3, Et_2O, -78℃

The enantiomeric excess of **7m** was found to be 81% by chiral HPLC (ChiralPak IC column, hexane/*i*-PrOH 90:10 0.7 mL/min, t_{major} = 25.67 min, t_{minor} = 29.35 min).

3024 XZL-2043-1+- PA-2 82 214 0.7

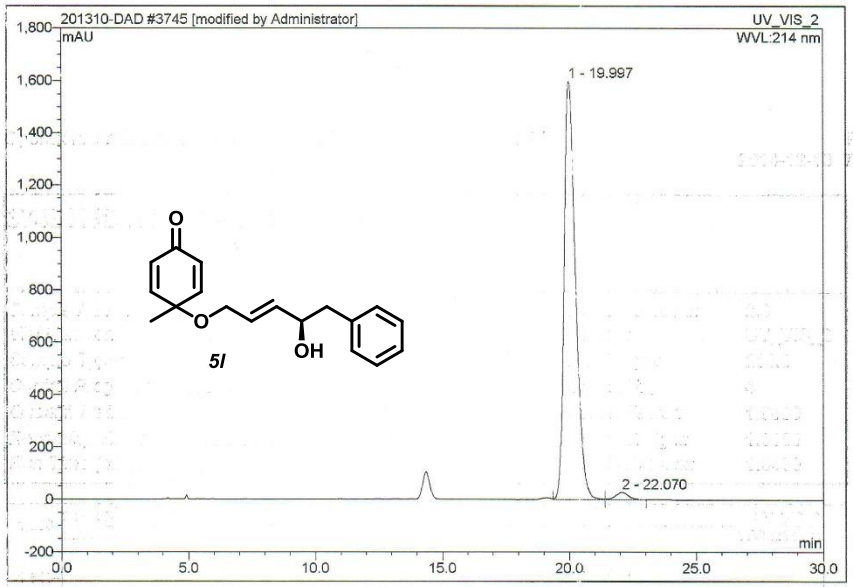
Sample Name:	**XZL-2043-1+- PA-2 82 214 0.7**	*Injection Volume:*	**5.0**
Vial Number:	**BA5**	*Channel:*	**UV_VIS_2**
Sample Type:	**unknown**	*Wavelength:*	**214.0**
Control Program:	**test-dad2**	*Bandwidth:*	**4**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014-9-26 10:52**	*Sample Weight:*	**1.0000**
Run Time (min):	**39.97**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	19.80	n.a.	224.552	106.502	49.83	n.a.	BM *
2	21.56	n.a.	199.883	107.239	50.17	n.a.	MB*
Total:			424.435	213.741	100.00	0.000	

3745 HJD-2-23 PA-2 82 214 0.7

Sample Name:	**HJD-2-23 PA-2 82 214 0.7**	*Injection Volume:*	**2.0**
Vial Number:	**BC1**	*Channel:*	**UV_VIS_2**
Sample Type:	**unknown**	*Wavelength:*	**214.0**
Control Program:	**test-dad2**	*Bandwidth:*	**4**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014-12-16 17:23**	*Sample Weight:*	**1.0000**
Run Time (min):	**30.00**	*Sample Amount:*	**1.0000**



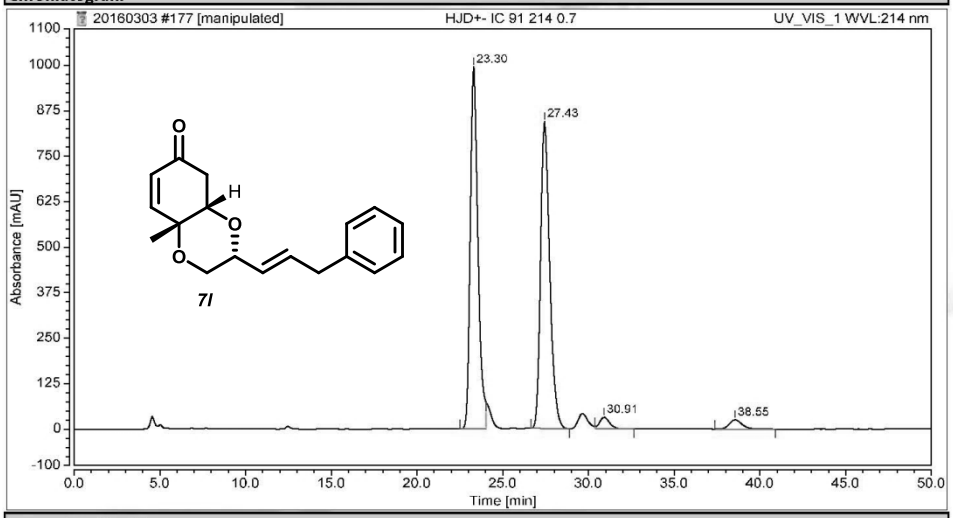
No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	20.00	n.a.	1599.679	831.120	98.08	n.a.	M *
2	22.07	n.a.	27.780	16.286	1.92	n.a.	MB*
Total:			1627.459	847.406	100.00	0.000	

Chromatogram and Results

Injection Details

Injection Name:	**HJD+- IC 91 214 0.7**	*Run Time (min):*	**50.00**
Vial Number:	**RC2**	*Injection Volume:*	**5.00**
Injection Type:	**Unknown**	*Channel:*	**UV_VIS_1**
Calibration Level:		*Wavelength:*	**214.0**
Instrument Method:	**20160223-DAD2**	*Bandwidth:*	**4**
Processing Method:	**20160223**	*Dilution Factor:*	**1.0000**
Injection Date/Time:	**28/三月/16 18:04**	*Sample Weight:*	**1.0000**

Chromatogram

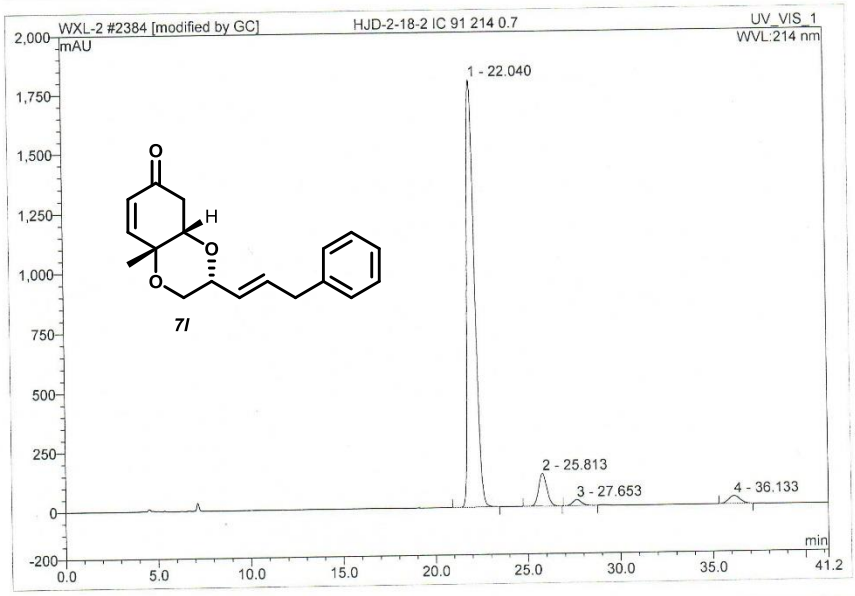


Integration Results

No.	Retention Time min	Area mAU*min	Height mAU	Relative Area %
1	23.300	515.630	994.673	47.70
2	27.433	521.758	844.099	48.27
3	30.913	21.943	32.082	2.03
4	38.547	21.671	25.321	2.00
Total:		**1081.002**	**1896.174**	**100.00**

2384 HJD-2-18-2 IC 91 214 0.7

Sample Name:	**HJD-2-18-2 IC 91 214 0.7**	*Injection Volume:*	**5.0**
Vial Number:	**BA2**	*Channel:*	**UV_VIS_1**
Sample Type:	**unknown**	*Wavelength:*	**214**
Control Program:	**WXL-2014-2**	*Bandwidth:*	**n.a.**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014/12/10 16:45**	*Sample Weight:*	**1.0000**
Run Time (min):	**41.24**	*Sample Amount:*	**1.0000**



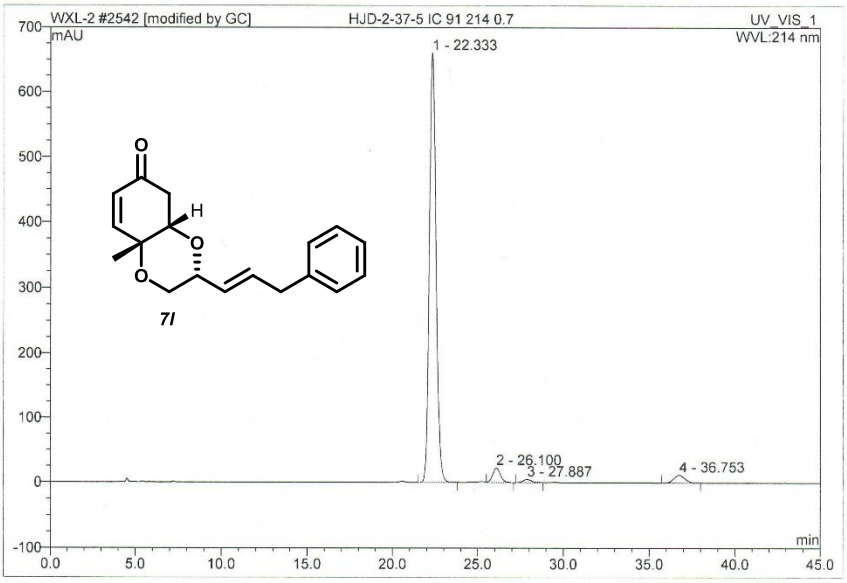
No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	22.04	n.a.	1797.691	872.109	88.86	n.a.	BMB*
2	25.81	n.a.	138.793	71.501	7.29	n.a.	BMB*
3	27.65	n.a.	25.475	13.746	1.40	n.a.	BMB*
4	36.13	n.a.	33.939	24.113	2.46	n.a.	BMB*
Total:			1995.898	981.468	100.00	0.000	

R = Bn, Re_2O_7, CH_2Cl_2, 0°C

yield = 73%, 85% e.e.

2542 HJD-2-37-5 IC 91 214 0.7

Sample Name:	**HJD-2-37-5 IC 91 214 0.7**	*Injection Volume:*	**3.0**
Vial Number:	**RE5 ;'**	*Channel:*	**UV_VIS_1**
Sample Type:	**unknown**	*Wavelength:*	**214**
Control Program:	**WXL-2014-1**	*Bandwidth:*	**n.a.**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014/12/26 21:10**	*Sample Weight:*	**1.0000**
Run Time (min):	**45.00**	*Sample Amount:*	**1.0000**



7l

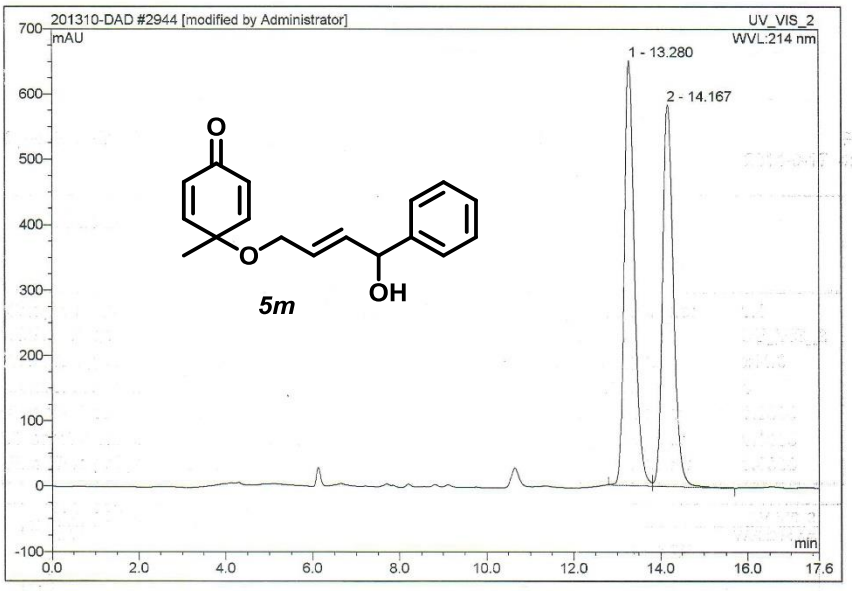
No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	22.33	n.a.	660.986	299.670	92.68	n.a.	BM *
2	26.10	n.a.	22.249	11.812	3.65	n.a.	MB*
3	27.89	n.a.	4.918	2.934	0.91	n.a.	BM *
4	36.75	n.a.	12.048	8.918	2.76	n.a.	BM *
Total:			700.201	323.334	100.00	0.000	

R = Bn, Ph_3SiO-ReO_3, Et_2O, -78°C

Yield = 54%, 92% e.e.

2944 XZL-2041-1+- AD-H 82 214 0.7

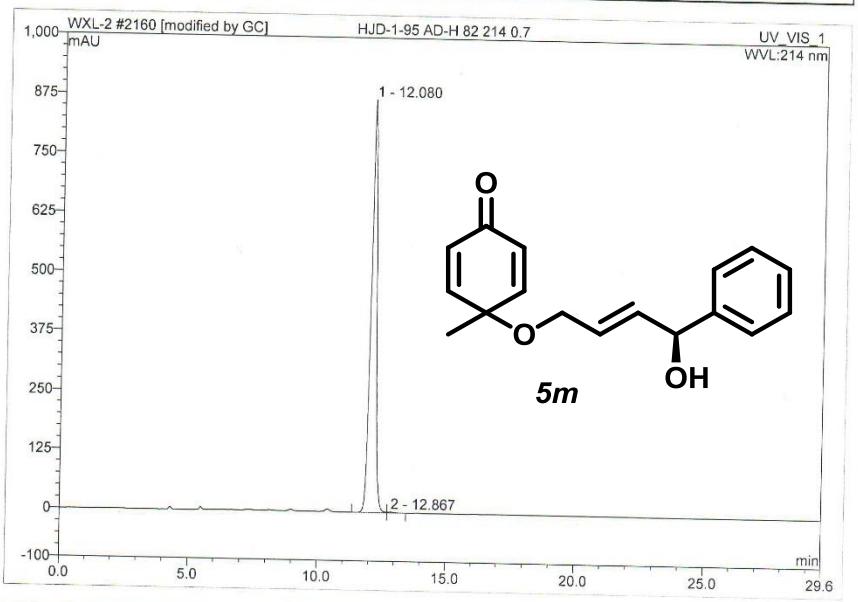
Sample Name:	**XZL-2041-1+- AD-H 82 214 0.7**	*Injection Volume:*	**1.0**
Vial Number:	**BD3**	*Channel:*	**UV_VIS_2**
Sample Type:	**unknown**	*Wavelength:*	**214.0**
Control Program:	**test-dad**	*Bandwidth:*	**4**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014-9-17 14:48**	*Sample Weight:*	**1.0000**
Run Time (min):	**17.64**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	13.28	n.a.	650.070	176.544	50.99	n.a.	BM *
2	14.17	n.a.	583.902	169.693	49.01	n.a.	MB*
Total:			1233.973	346.237	100.00	0.000	

2160 HJD-1-95 AD-H 82 214 0.7

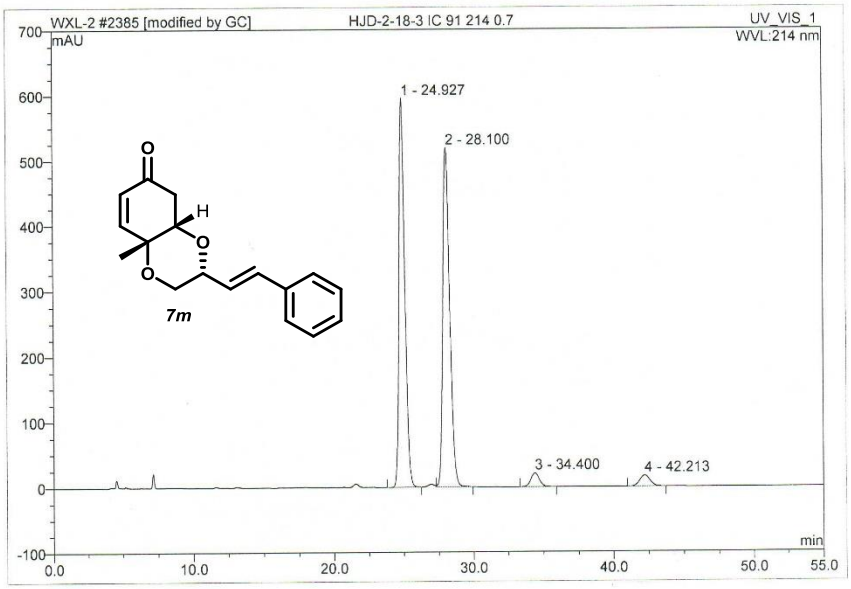
Sample Name:	**HJD-1-95 AD-H 82 214 0.7**	*Injection Volume:*	**3.0**
Vial Number:	**RC5 1'**	*Channel:*	**UV_VIS_1**
Sample Type:	**unknown**	*Wavelength:*	**214**
Control Program:	**WXL-2014-1**	*Bandwidth:*	**n.a.**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014/11/17 16:32**	*Sample Weight:*	**1.0000**
Run Time (min):	**29.58**	*Sample Amount:*	**1.0000**



No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	12.08	n.a.	868.954	221.893	99.80	n.a.	BM *
2	12.87	n.a.	1.563	0.441	0.20	n.a.	MB*
Total:			870.516	222.334	100.00	0.000	

2385 HJD-2-18-3 IC 91 214 0.7

Sample Name:	**HJD-2-18-3 IC 91 214 0.7**	*Injection Volume:*	**5.0**
Vial Number:	**BA3**	*Channel:*	**UV_VIS_1**
Sample Type:	**unknown**	*Wavelength:*	**214**
Control Program:	**WXL-2014-2**	*Bandwidth:*	**n.a.**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014/12/10 17:30**	*Sample Weight:*	**1.0000**
Run Time (min):	**55.00**	*Sample Amount:*	**1.0000**

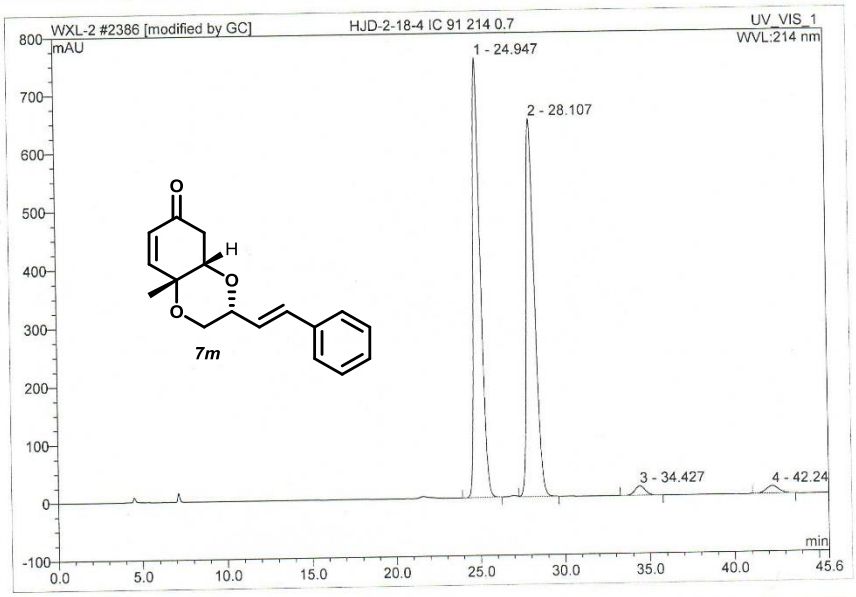


No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	24.93	n.a.	595.372	294.843	47.57	n.a.	BMB*
2	28.10	n.a.	518.952	295.726	47.72	n.a.	MB*
3	34.40	n.a.	21.235	14.662	2.37	n.a.	BMB*
4	42.21	n.a.	17.004	14.533	2.34	n.a.	BMB*
Total:			1152.563	619.764	100.00	0.000	

R=Ph, +/-

2386 HJD-2-18-4 IC 91 214 0.7

Sample Name:	**HJD-2-18-4 IC 91 214 0.7**	*Injection Volume:*	**5.0**
Vial Number:	**BA4**	*Channel:*	**UV_VIS_1**
Sample Type:	**unknown**	*Wavelength:*	**214**
Control Program:	**WXL-2014-2**	*Bandwidth:*	**n.a.**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014/12/10 18:27**	*Sample Weight:*	**1.0000**
Run Time (min):	**45.59**	*Sample Amount:*	**1.0000**



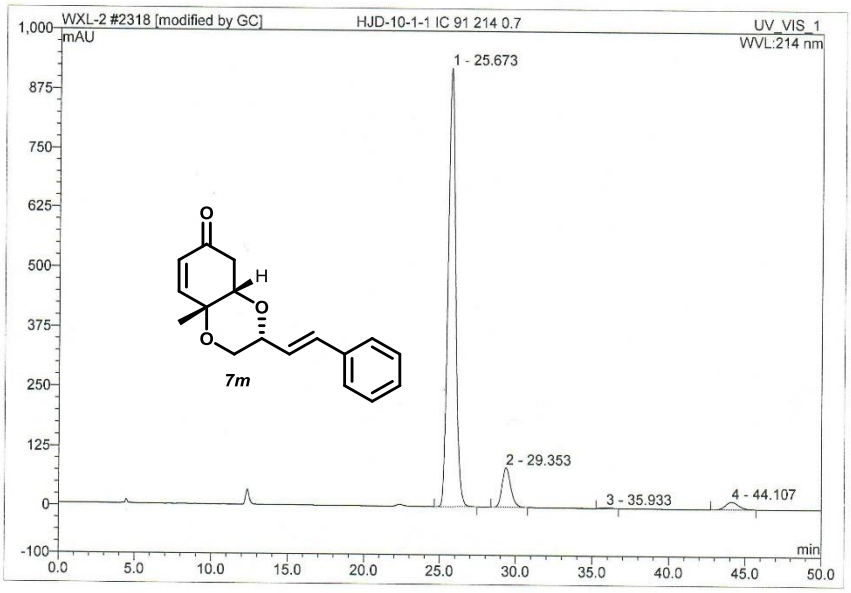
No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	24.95	n.a.	757.057	375.974	48.86	n.a.	BMB*
2	28.11	n.a.	649.689	370.434	48.14	n.a.	MB*
3	34.43	n.a.	16.716	11.517	1.50	n.a.	BMB*
4	42.24	n.a.	13.499	11.506	1.50	n.a.	BMB*
Total:			1436.961	769.432	100.00	0.000	

R = Ph, Re_2O_7, CH_2Cl_2, 0°C

Yield = 84%, 0% e.e.

2318 HJD-10-1-1 IC 91 214 0.7

Sample Name:	**HJD-10-1-1 IC 91 214 0.7**	*Injection Volume:*	**5.0**
Vial Number:	**BA3**	*Channel:*	**UV_VIS_1**
Sample Type:	**unknown**	*Wavelength:*	**214**
Control Program:	**WXL-2014-2**	*Bandwidth:*	**n.a.**
Quantif. Method:	**WXL**	*Dilution Factor:*	**1.0000**
Recording Time:	**2014/12/4 15:58**	*Sample Weight:*	**1.0000**
Run Time (min):	**50.01**	*Sample Amount:*	**1.0000**

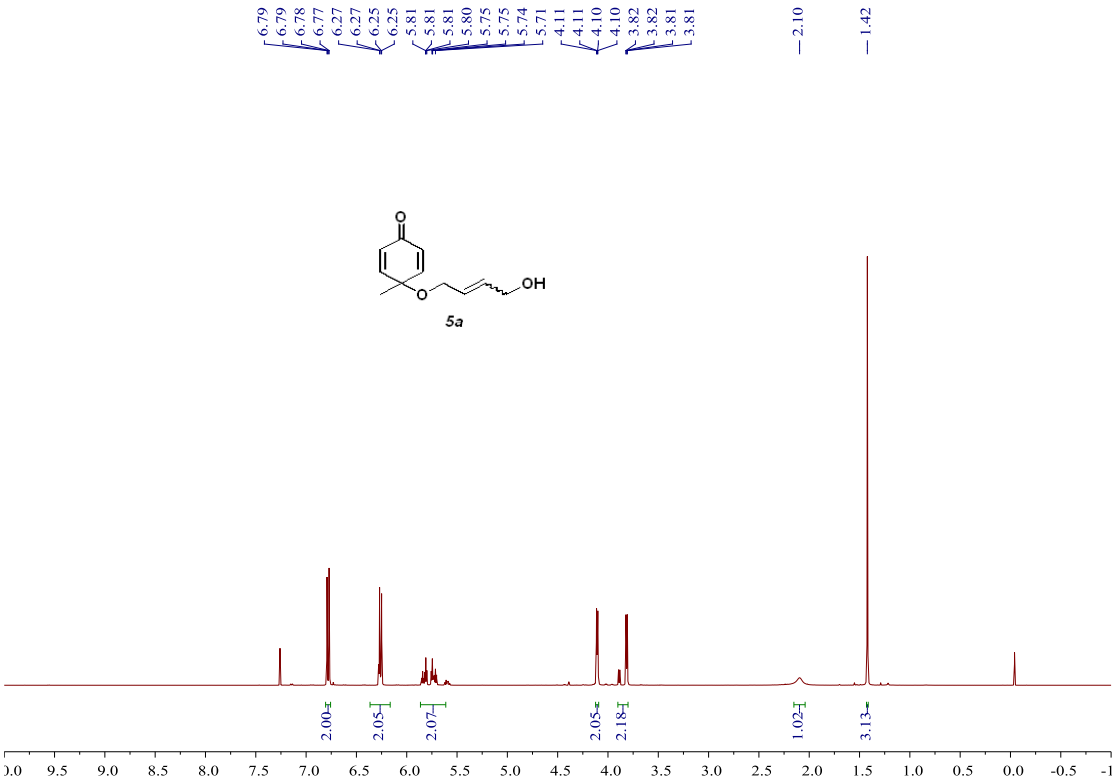


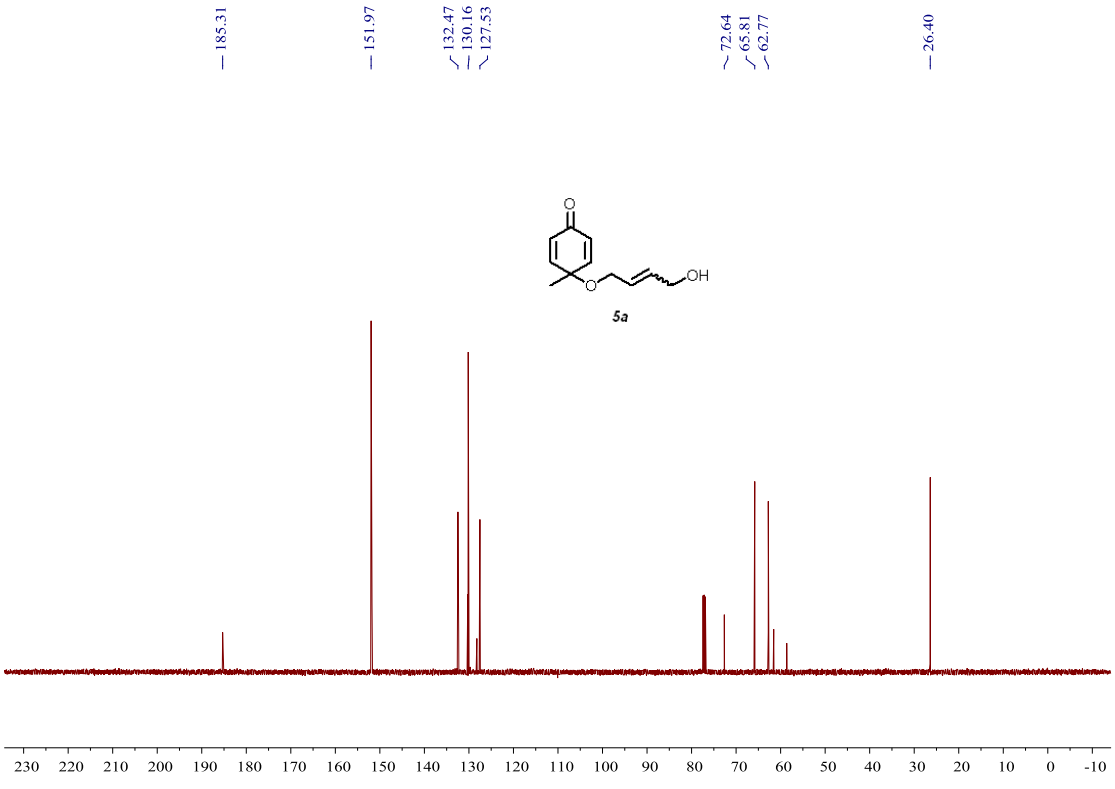
No.	Ret.Time min	Peak Name	Height mAU	Area mAU*min	Rel.Area %	Amount	Type
1	25.67	n.a.	921.507	528.676	88.10	n.a.	BMB*
2	29.35	n.a.	82.953	54.254	9.04	n.a.	BMB*
3	35.93	n.a.	1.898	1.357	0.23	n.a.	BMB*
4	44.11	n.a.	15.976	15.770	2.63	n.a.	BMB*
Total:			1022.335	600.058	100.00	0.000	

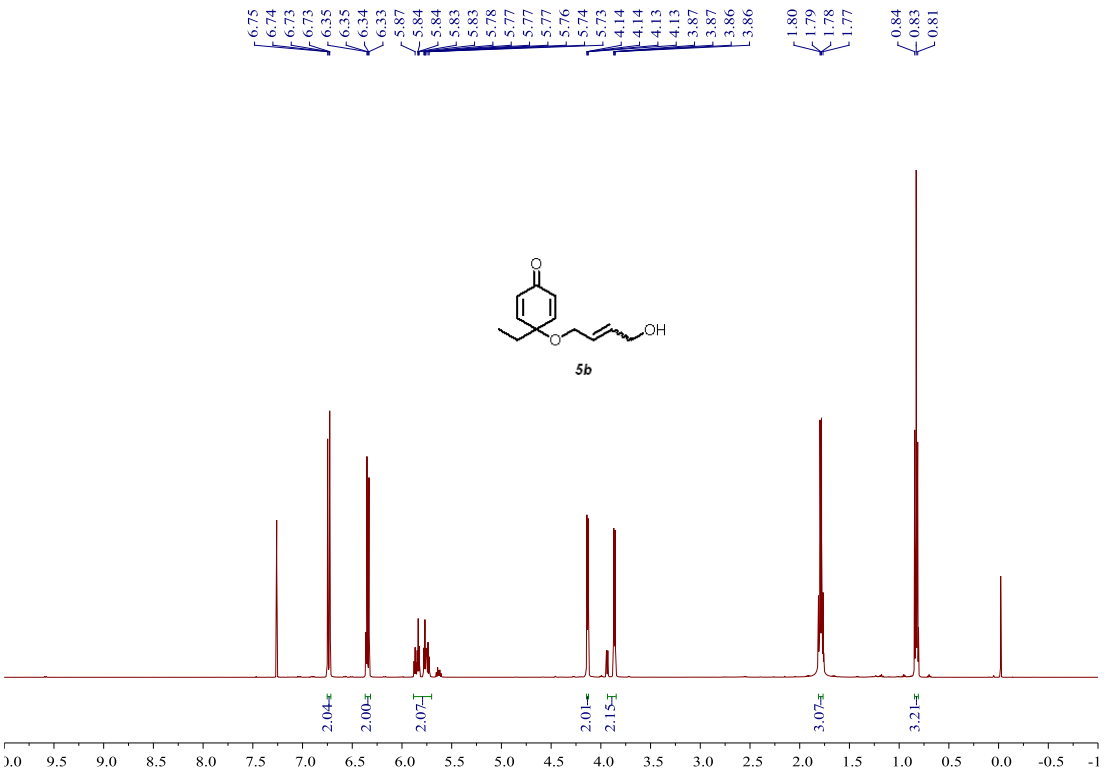
R=Ph, Rh_2Si_2O-ReO_3, Et_2O, -78°C.

yield = 53%, 81% e.e.

8. Copies of spectrums



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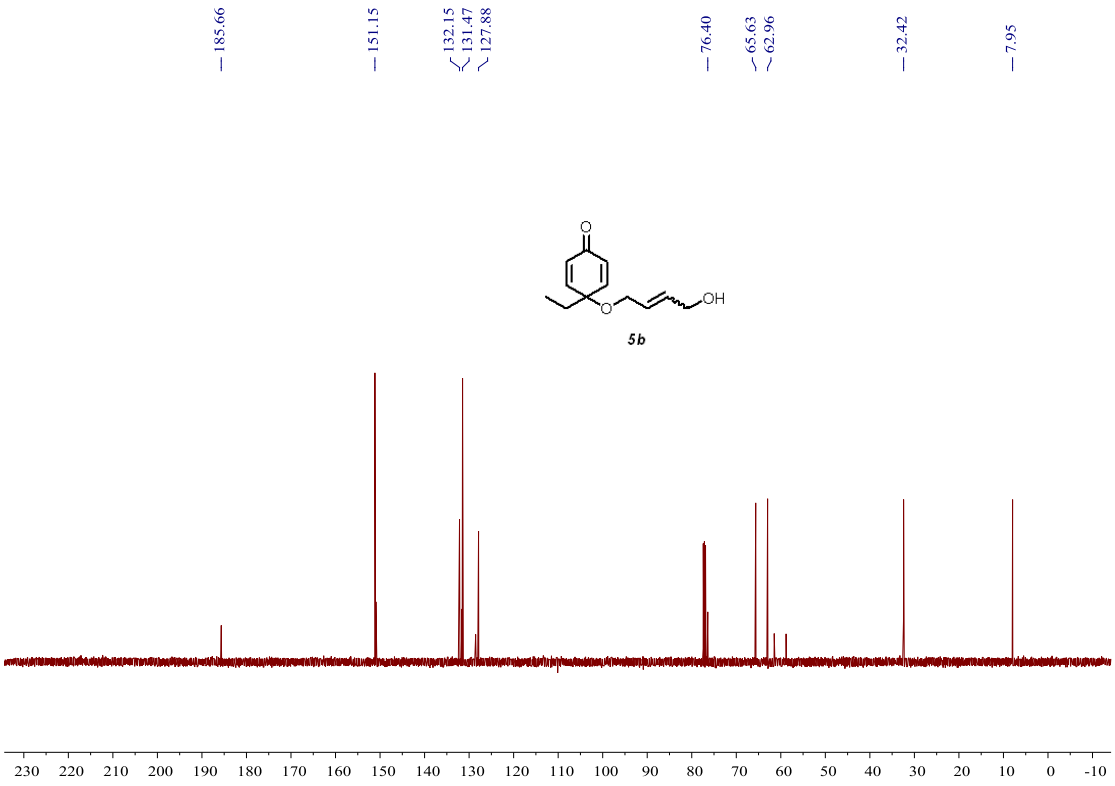
3.21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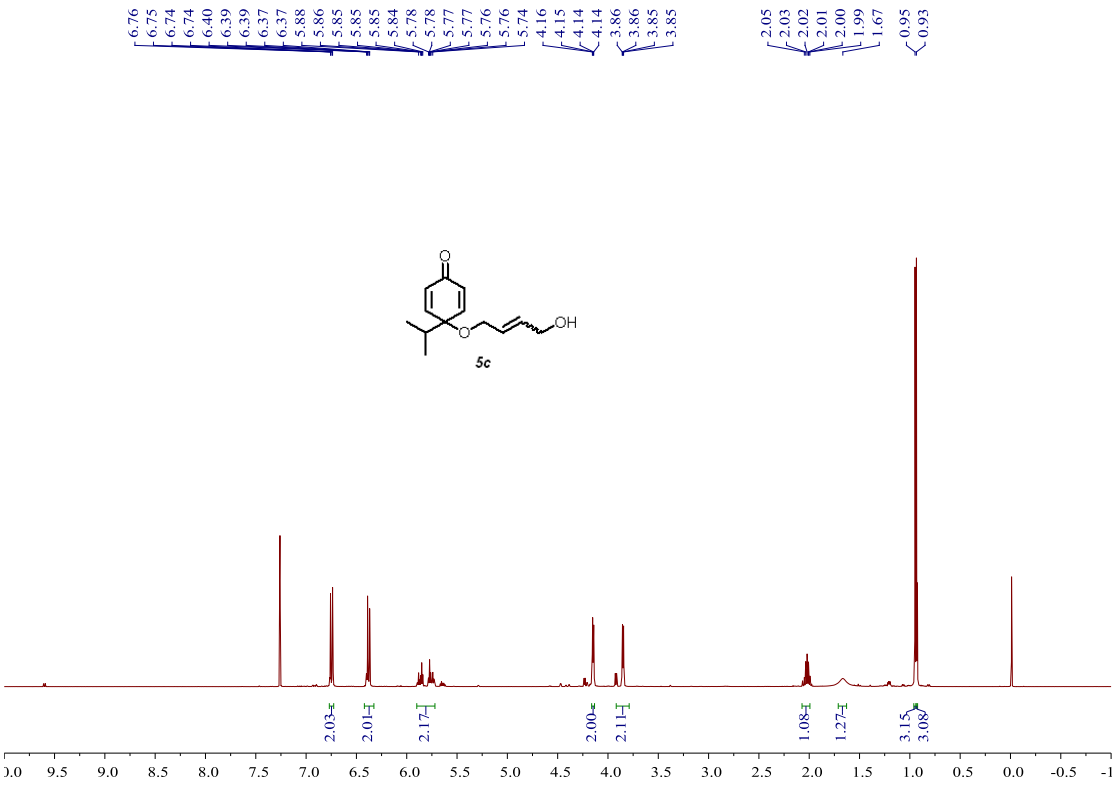
5b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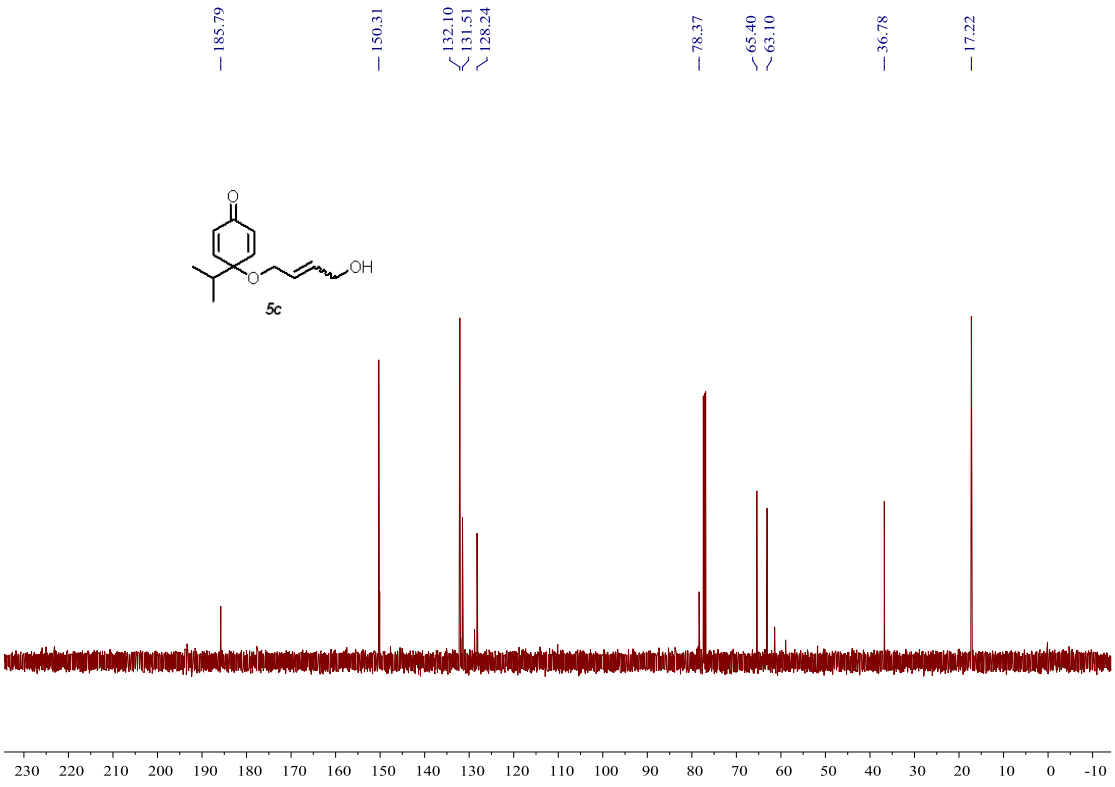
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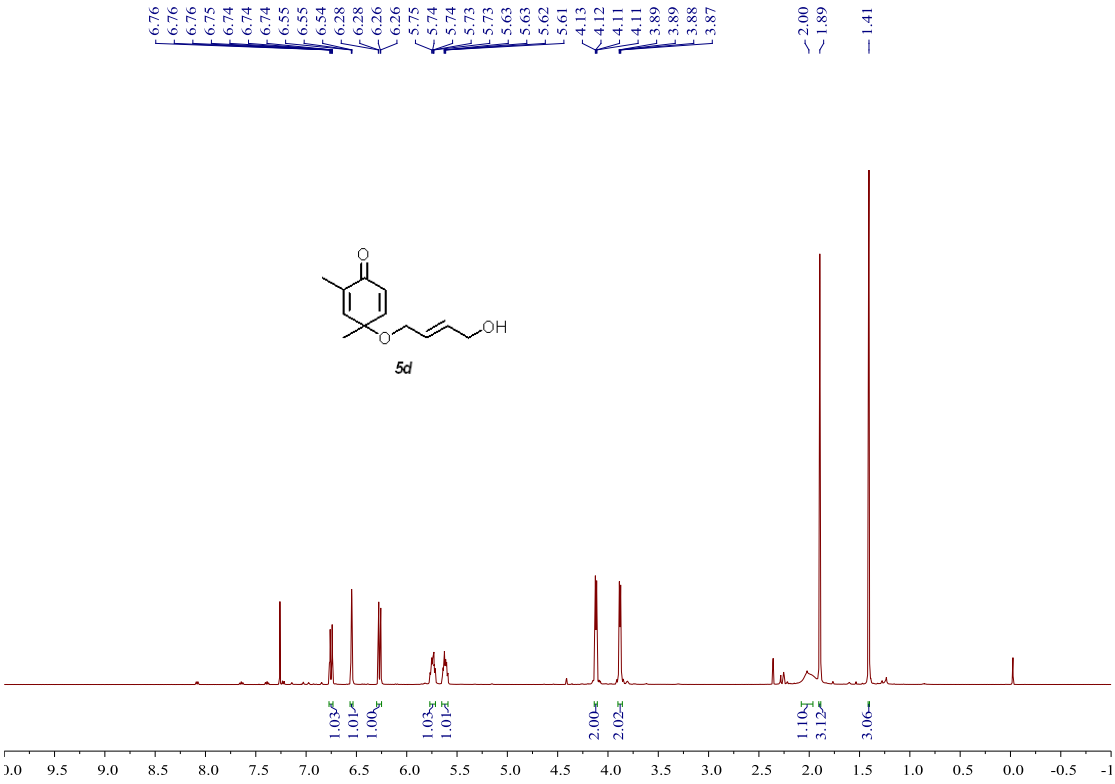
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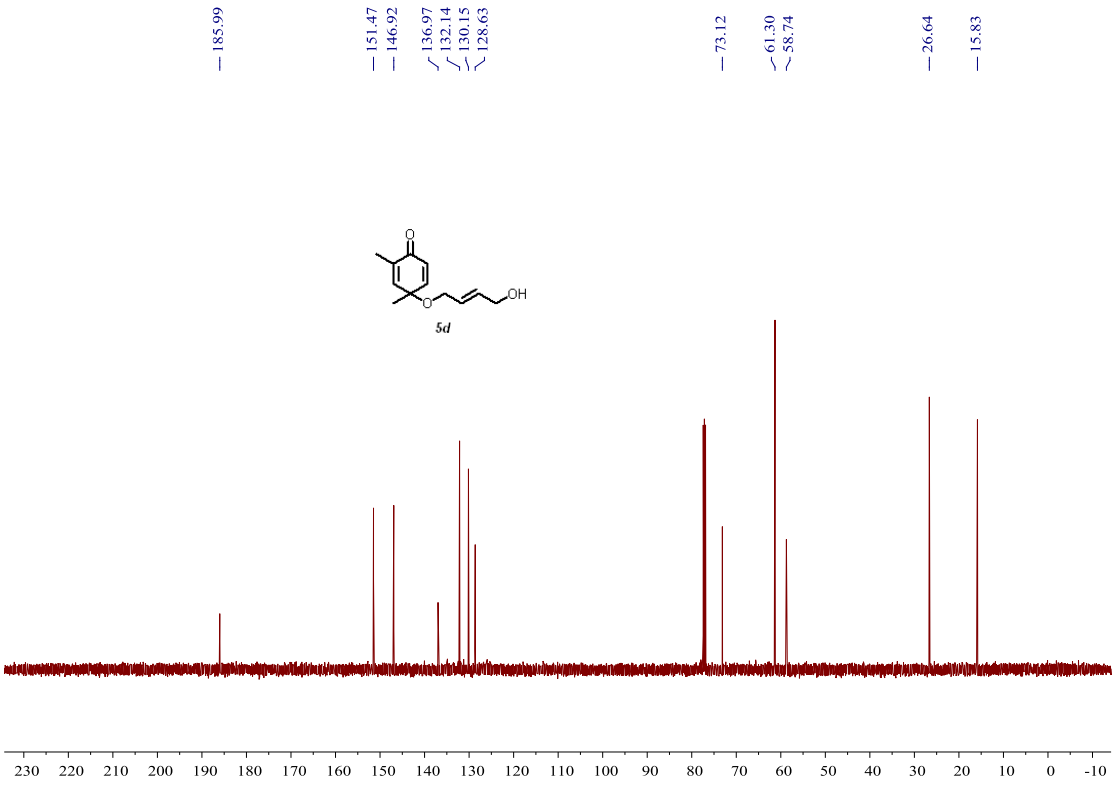
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5d
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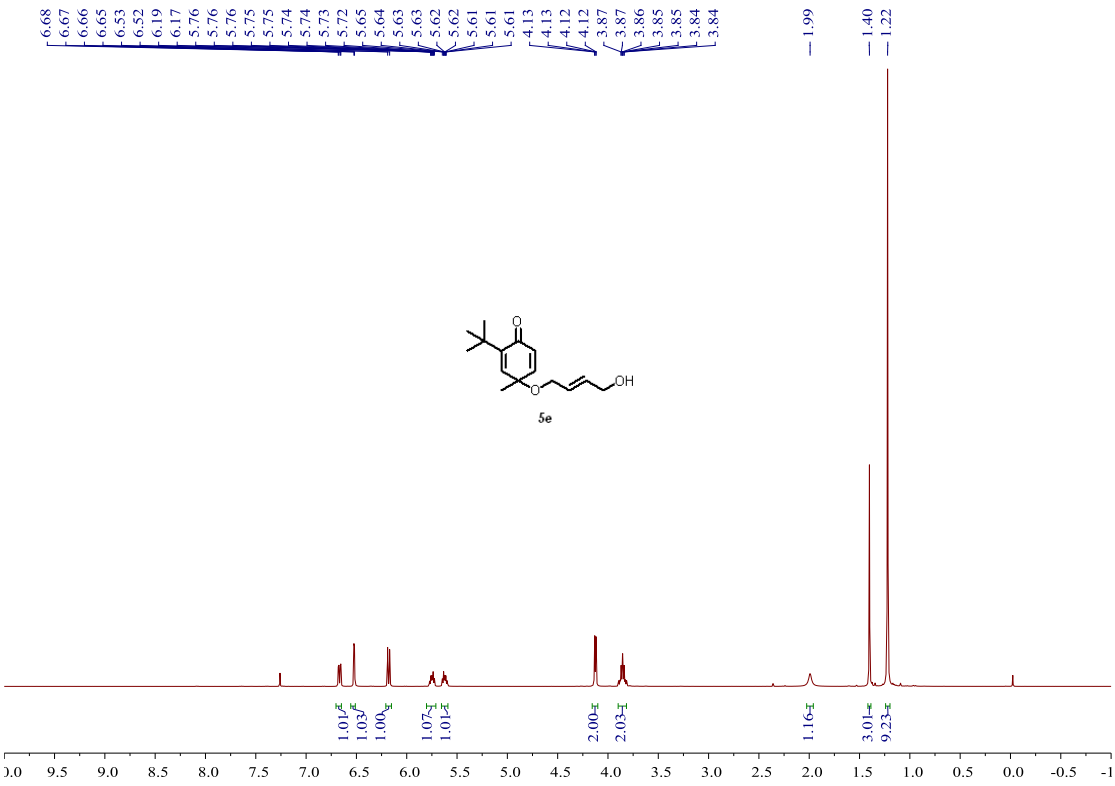
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O
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1.03
1.00
1.07
1.01
2.00
2.03
1.16
3.01
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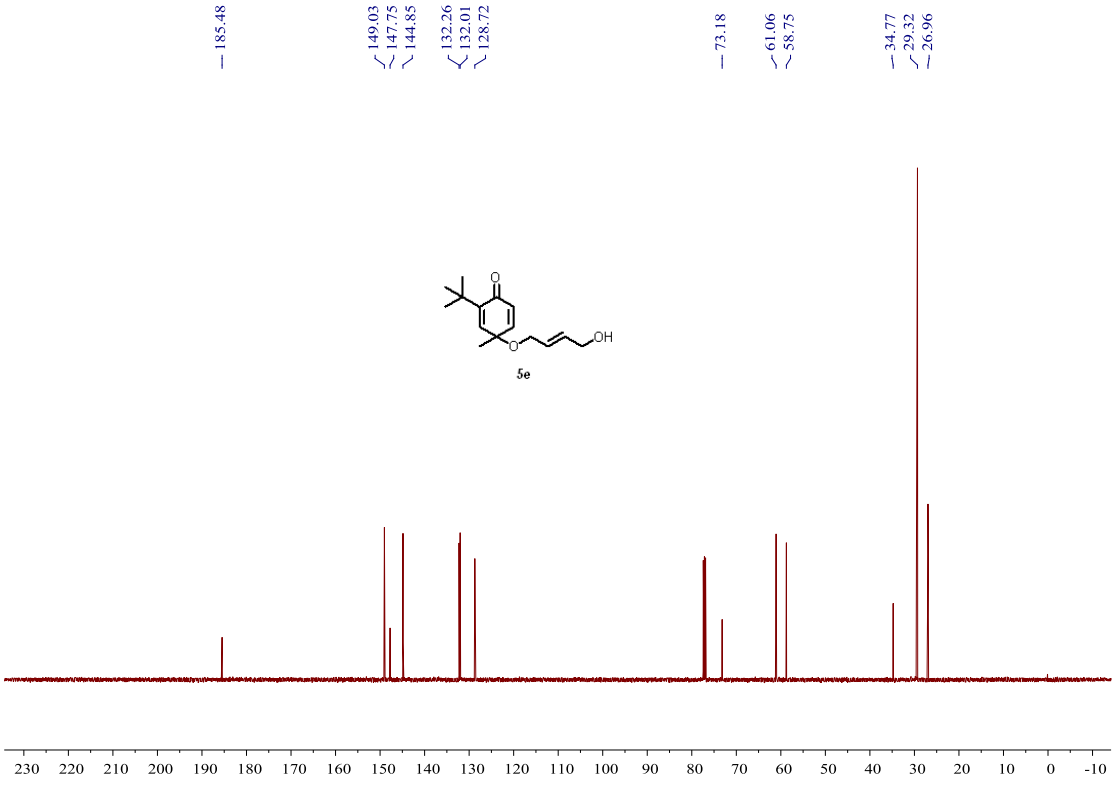
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O
OH
5e
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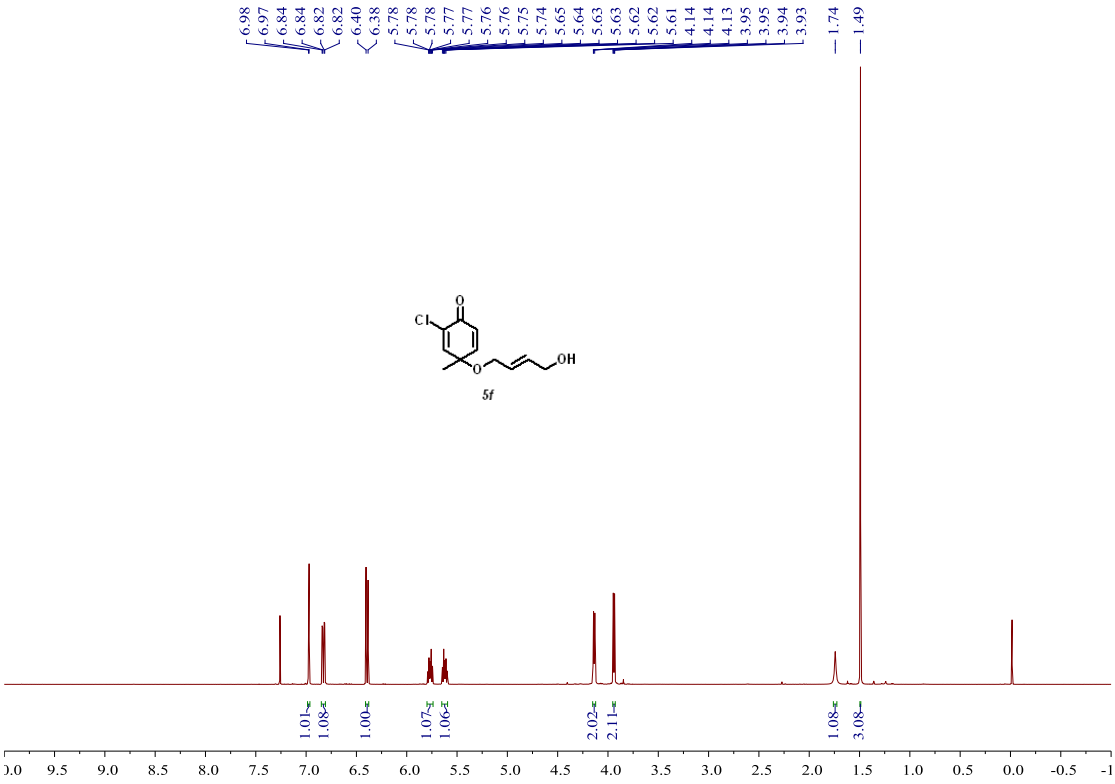
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5.62
5.62
5.61
4.14
4.14
4.13
3.95
3.95
3.94
3.93
1.74
1.49
Cl
O
O
OH
5f
1.01
1.08
1.00
1.07
1.06
2.02
2.11
1.08
3.08
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9.0
8.5
8.0
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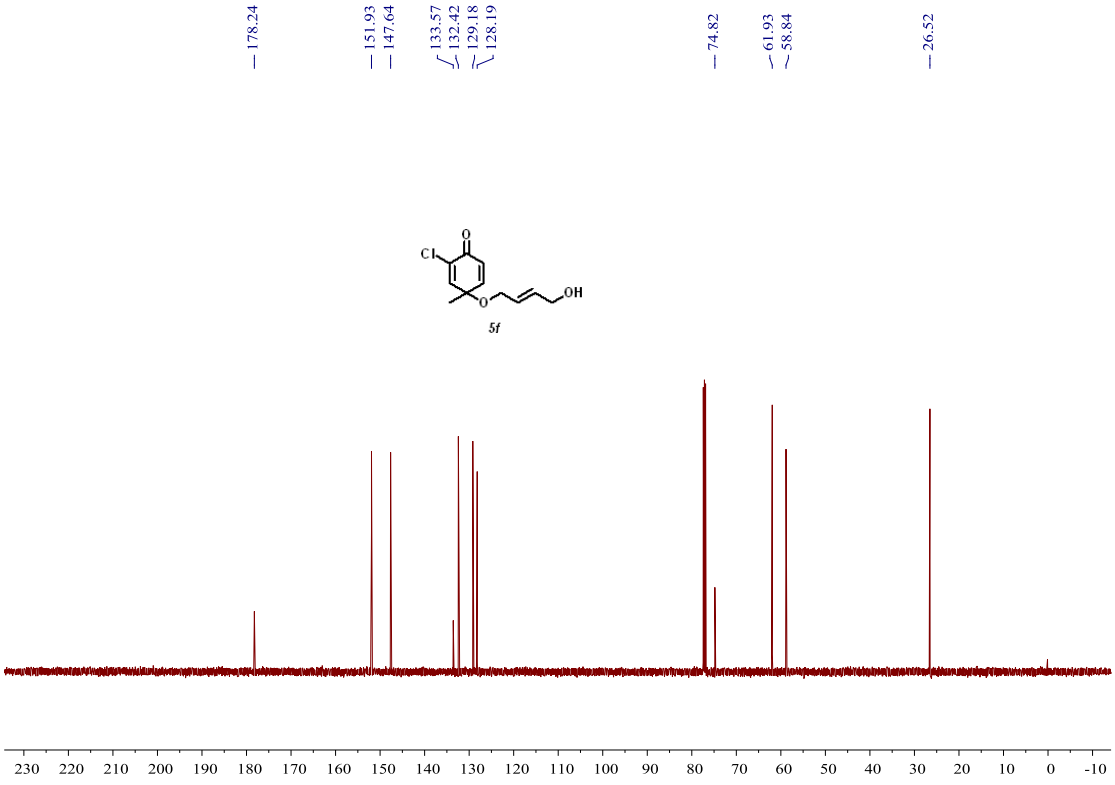
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58.84
26.52
Cl
O
O
OH
5f
230
220
210
200
190
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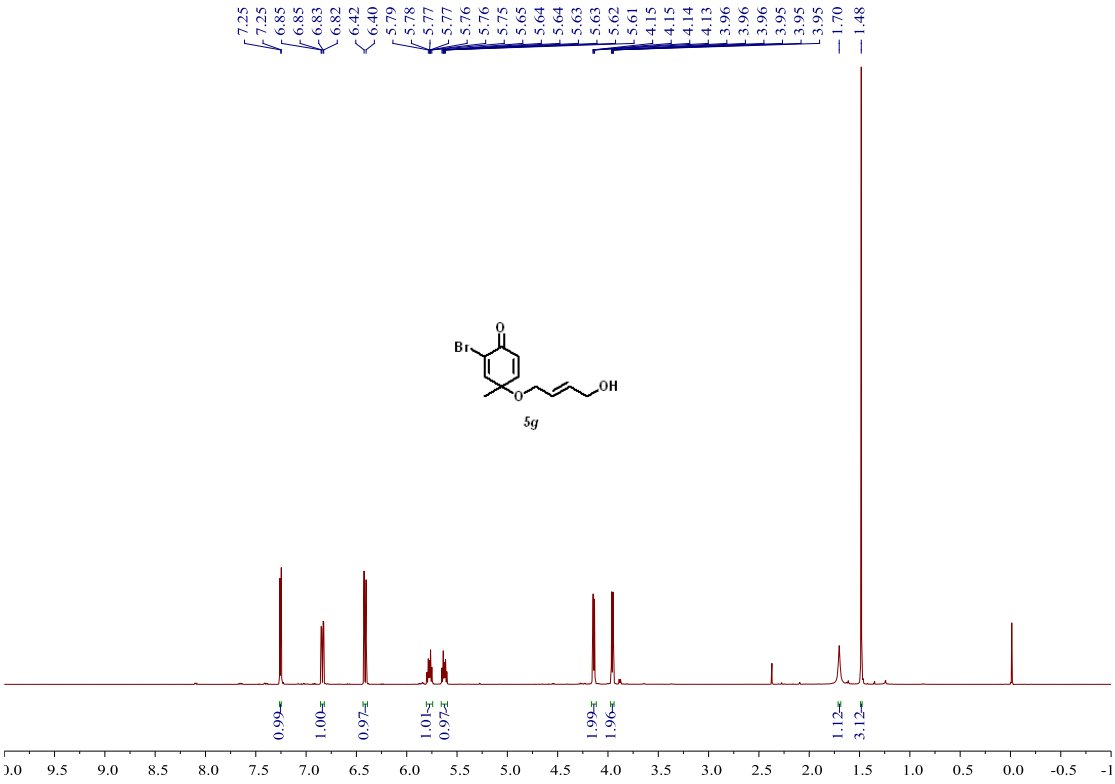
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5.61
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4.15
4.14
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3.95
3.95
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O
Br
O
OH
5g
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0.97
1.01
0.97
1.99
1.96
1.12
3.12
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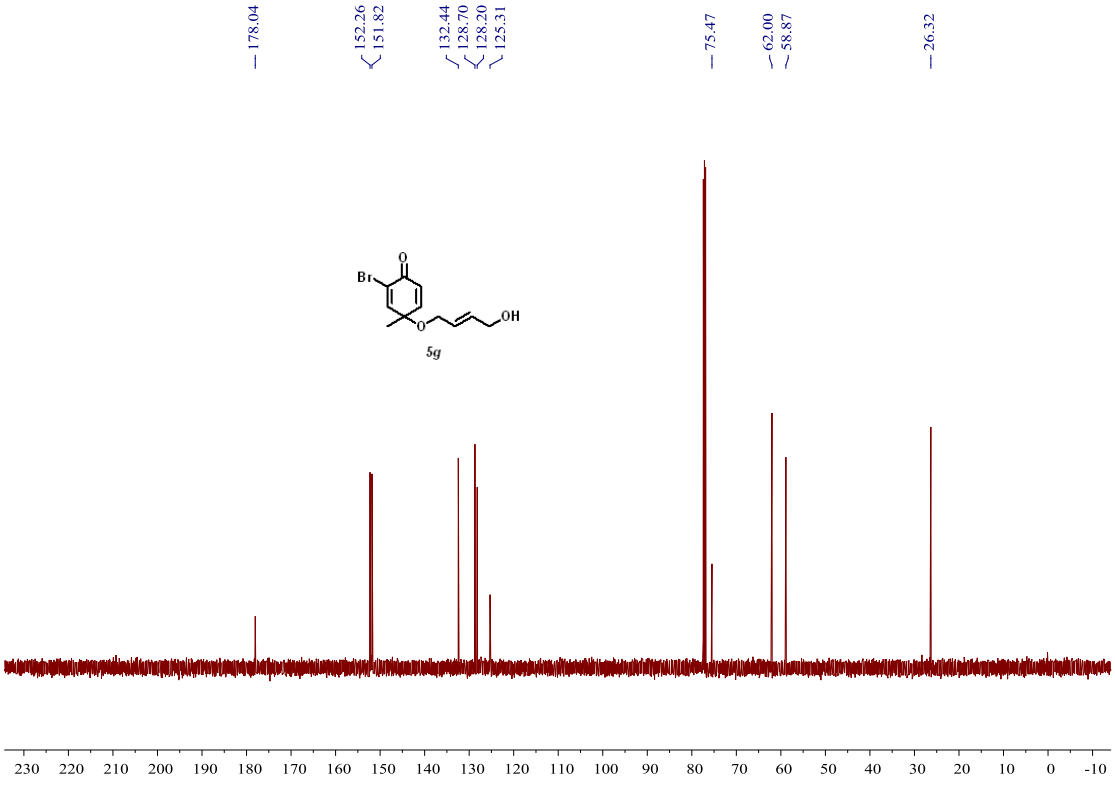
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Br
O
OH
5g
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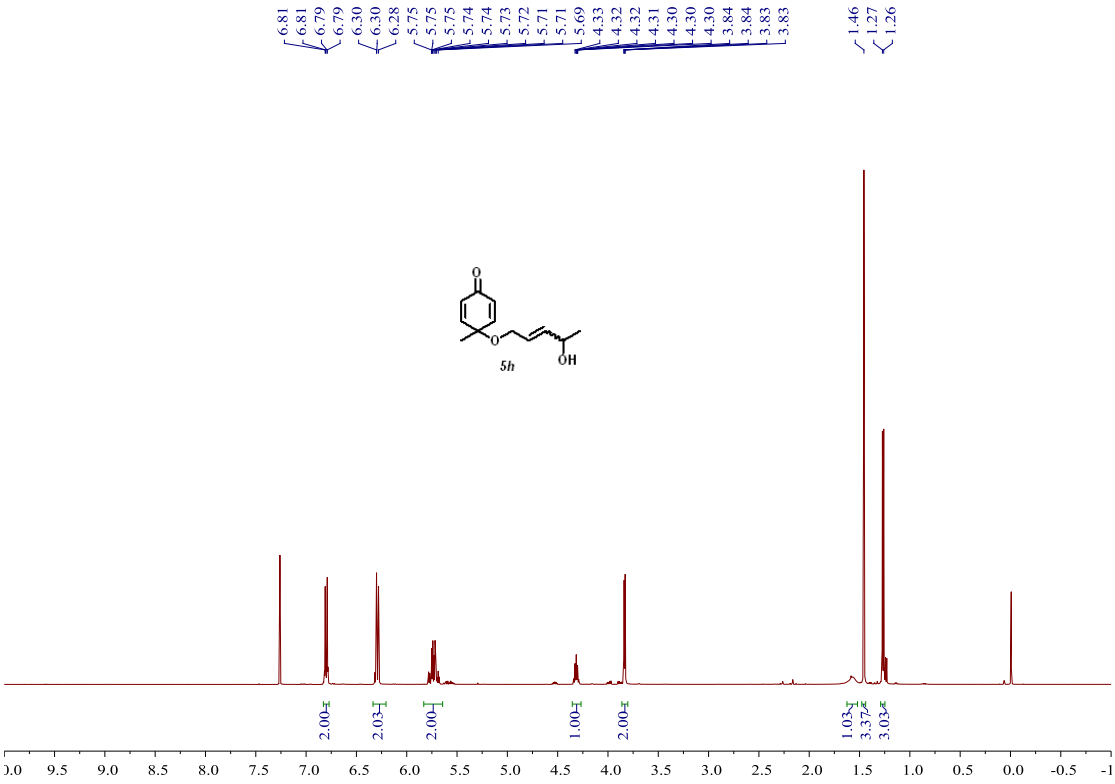
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5.71
5.69
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4.31
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4.30
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1.26
O
O
OH
5h
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2.03
2.00
1.00
2.00
1.03
3.37
3.03
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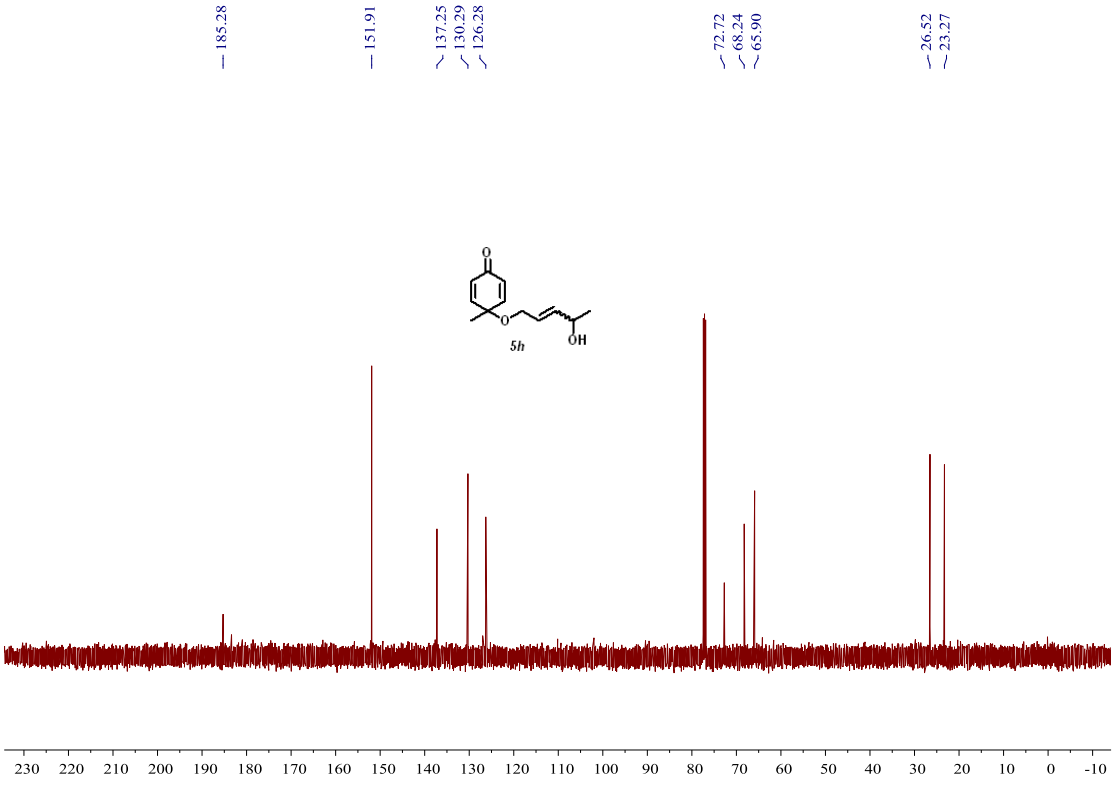
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OH
5h
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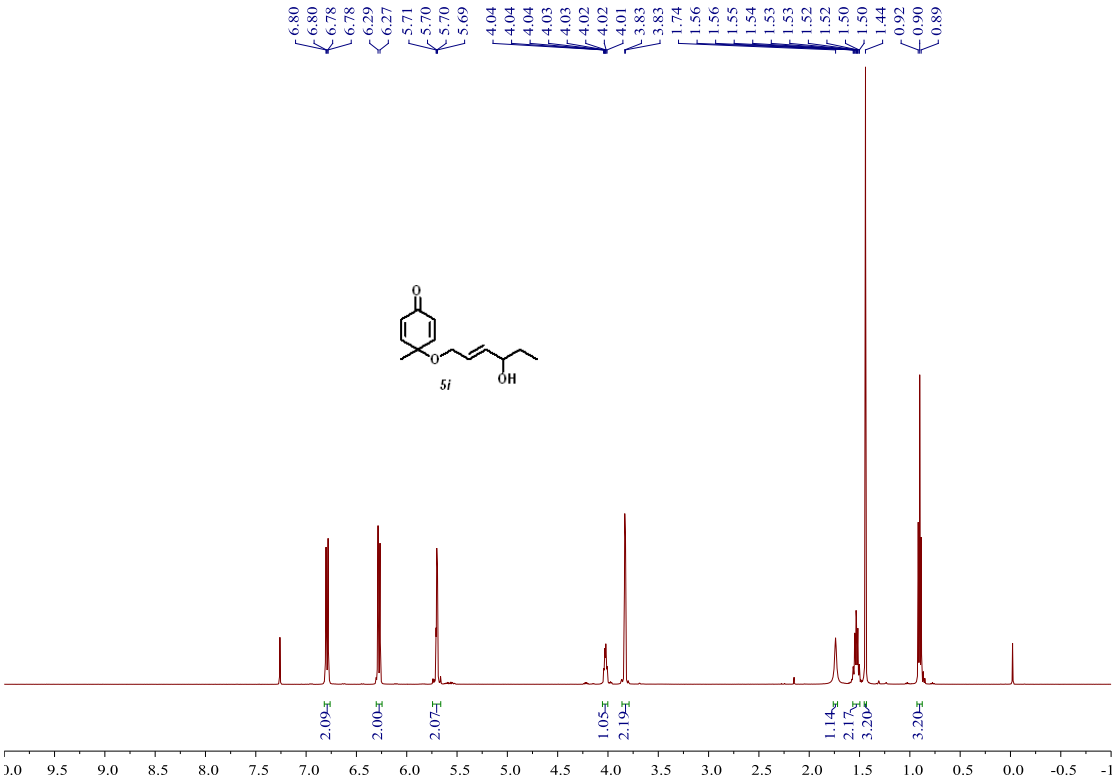
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4.03
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4.02
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1.56
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1.53
1.52
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1.50
1.50
1.44
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0.90
0.89
O
O
OH
5i
2.09
2.00
2.07
1.05
2.19
1.14
2.17
3.20
3.20
9.5
9.0
8.5
8.0
7.5
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6.0
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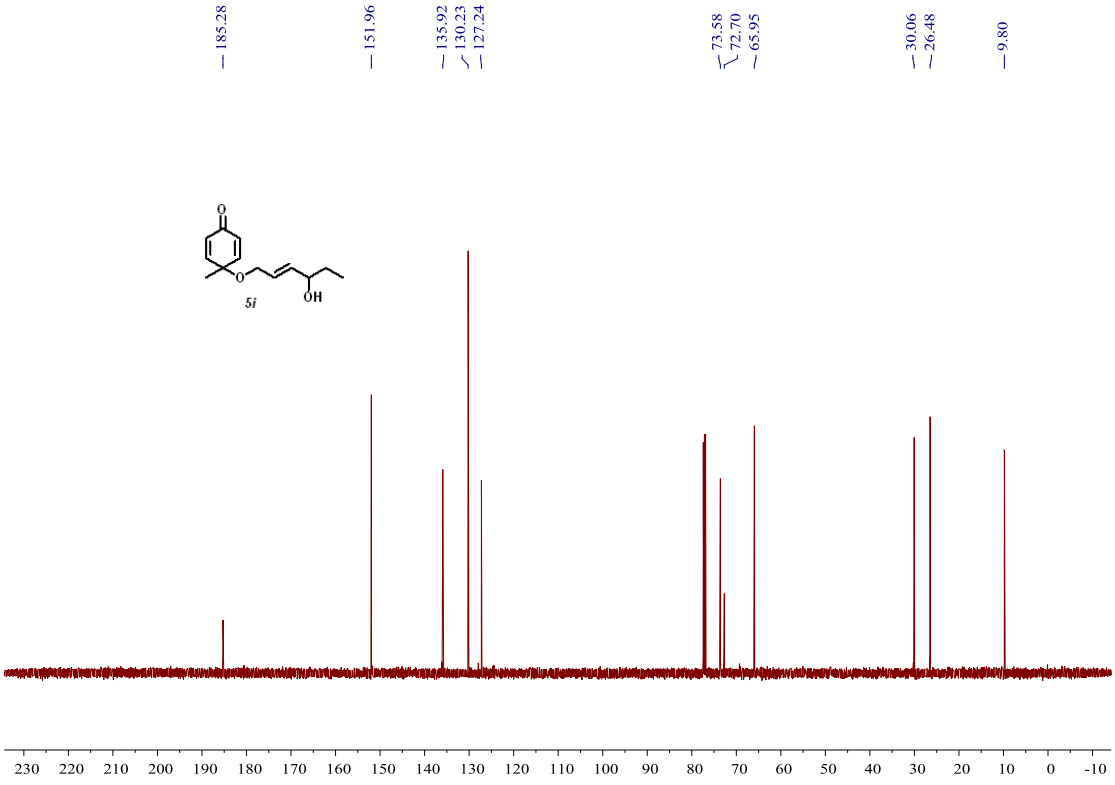
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9.80
O
O
OH
5i
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220
210
200
190
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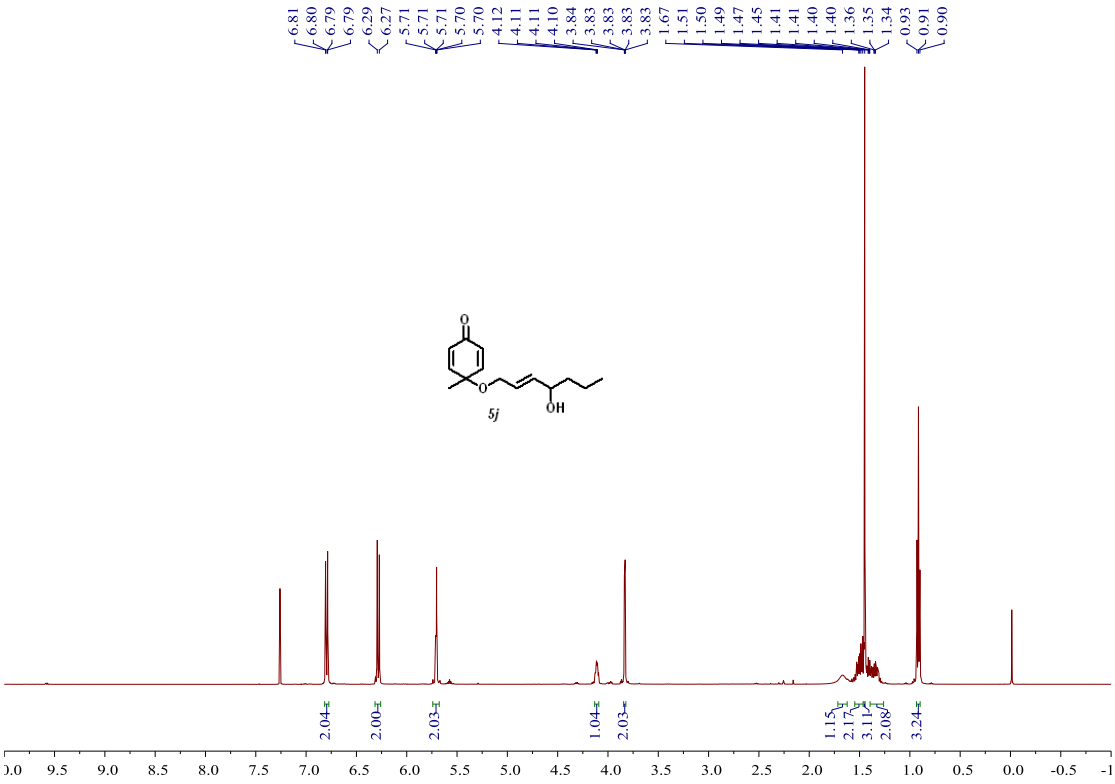
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1.34
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0.91
0.90
O
O
OH
5j
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2.00
2.03
1.04
2.03
1.15
2.17
3.11
2.08
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9.5
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5.5
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0.0
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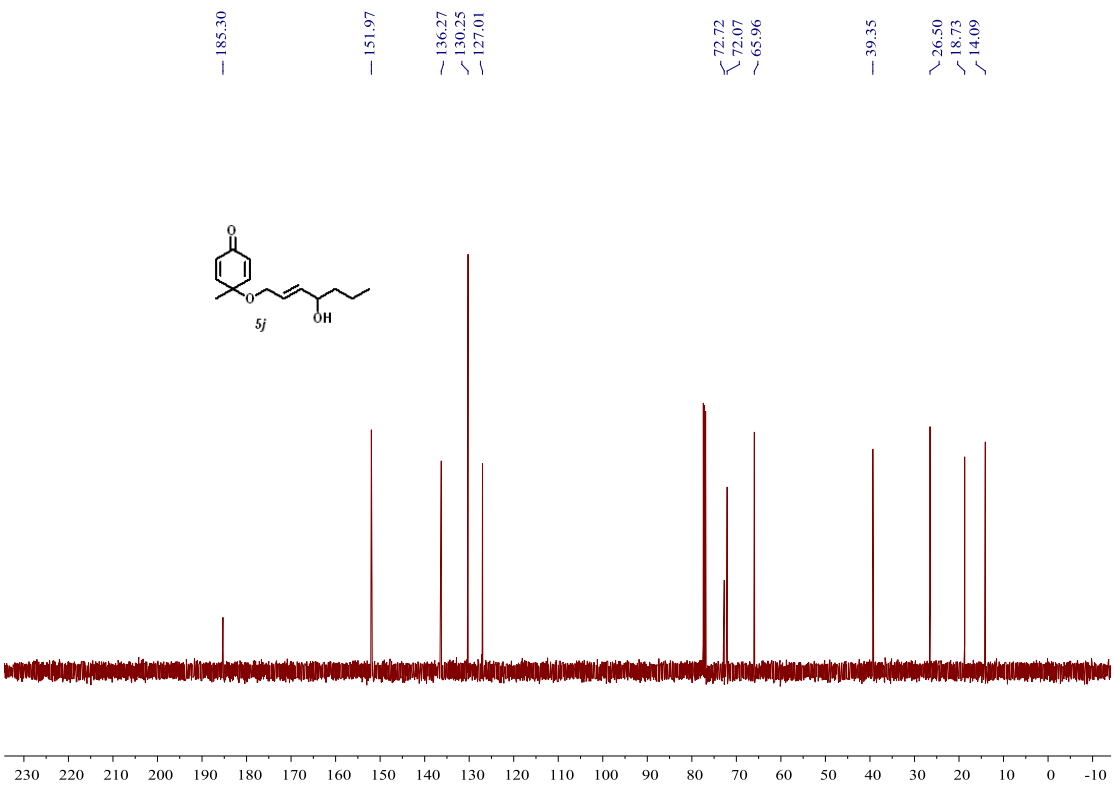
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OH
5j
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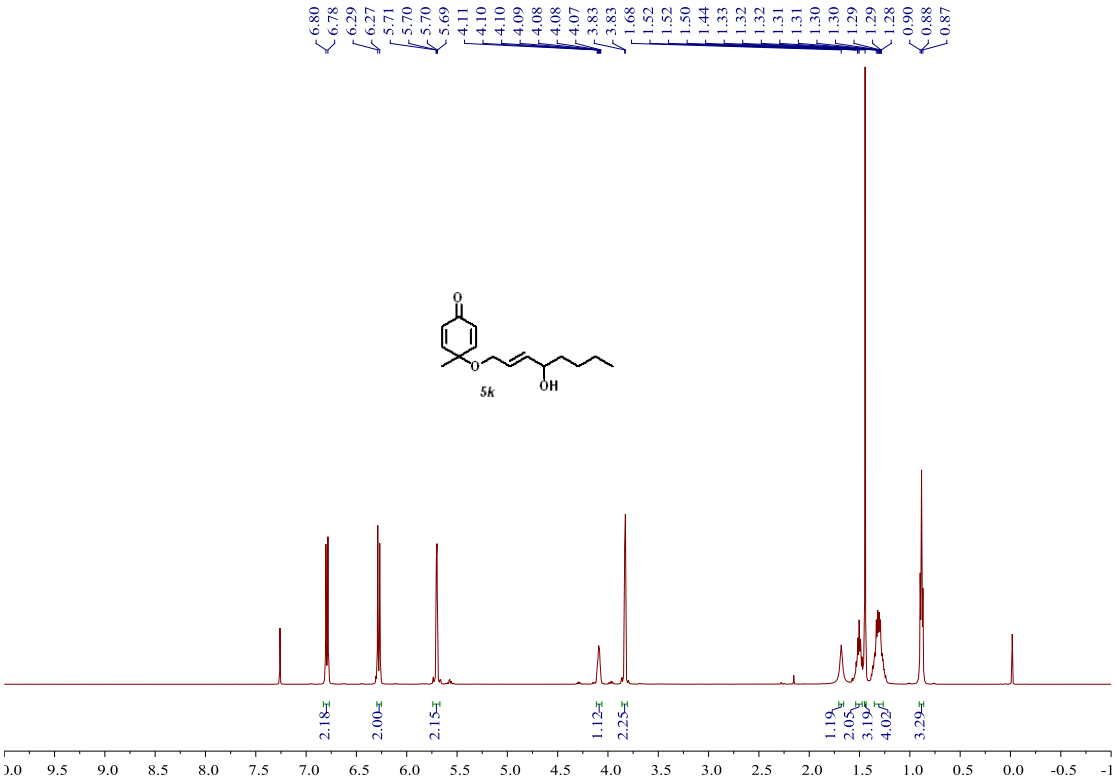
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4.02
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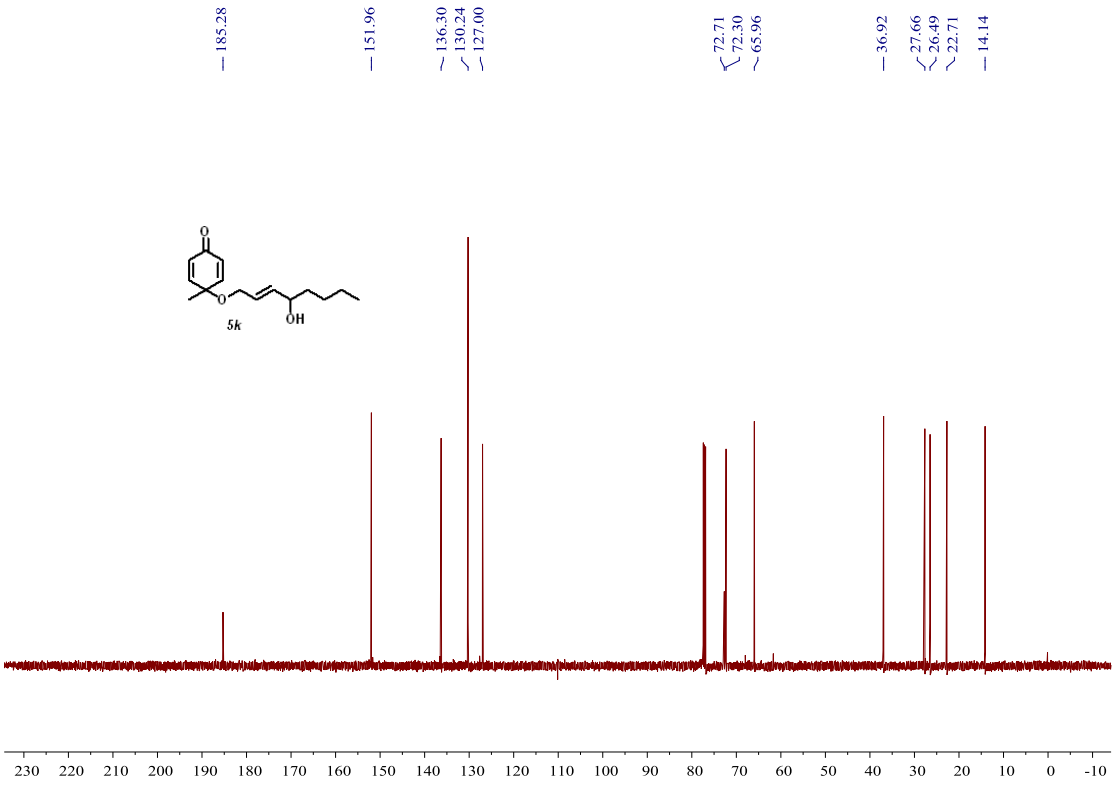
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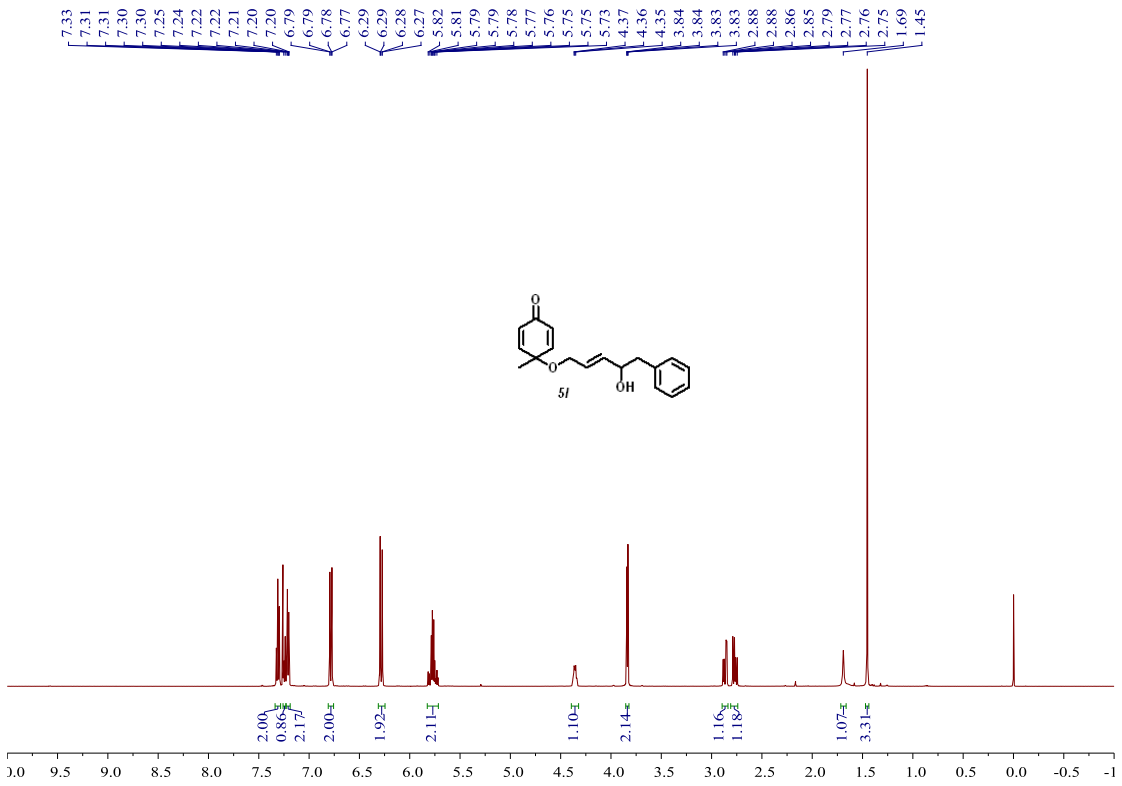
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O
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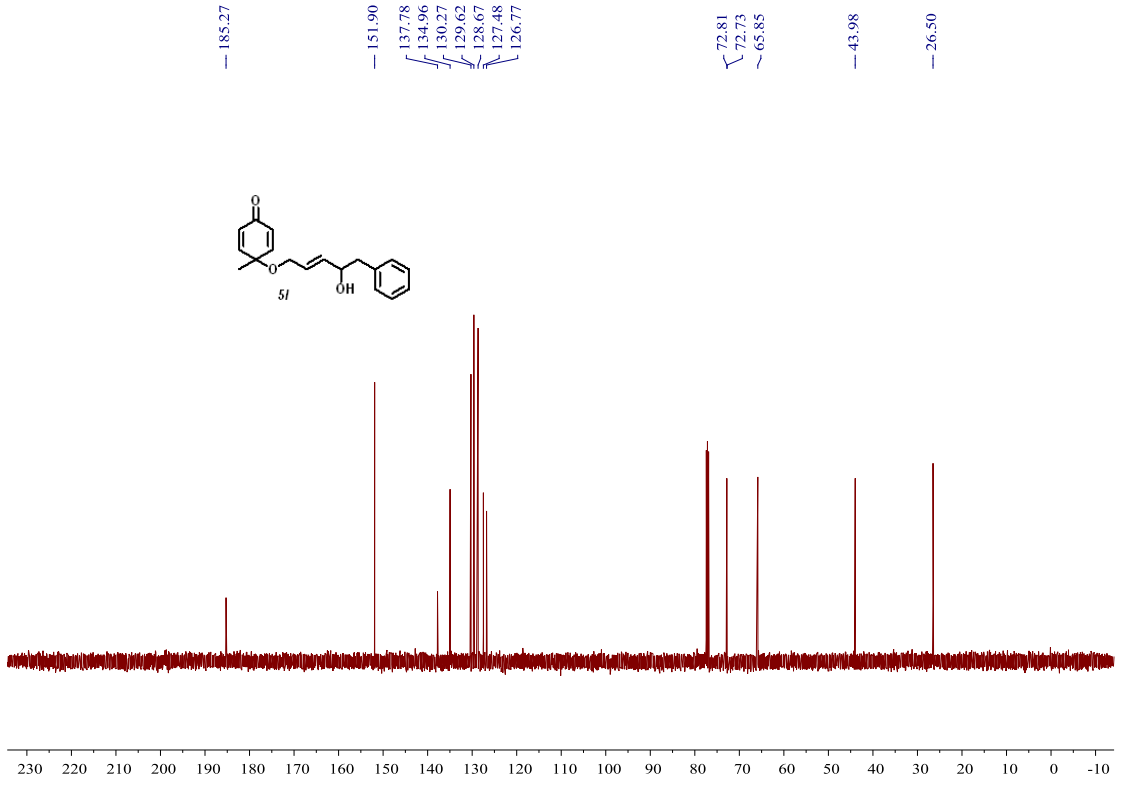
2.14
1.16
1.18
1.07
3.31
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1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O
OH
5l
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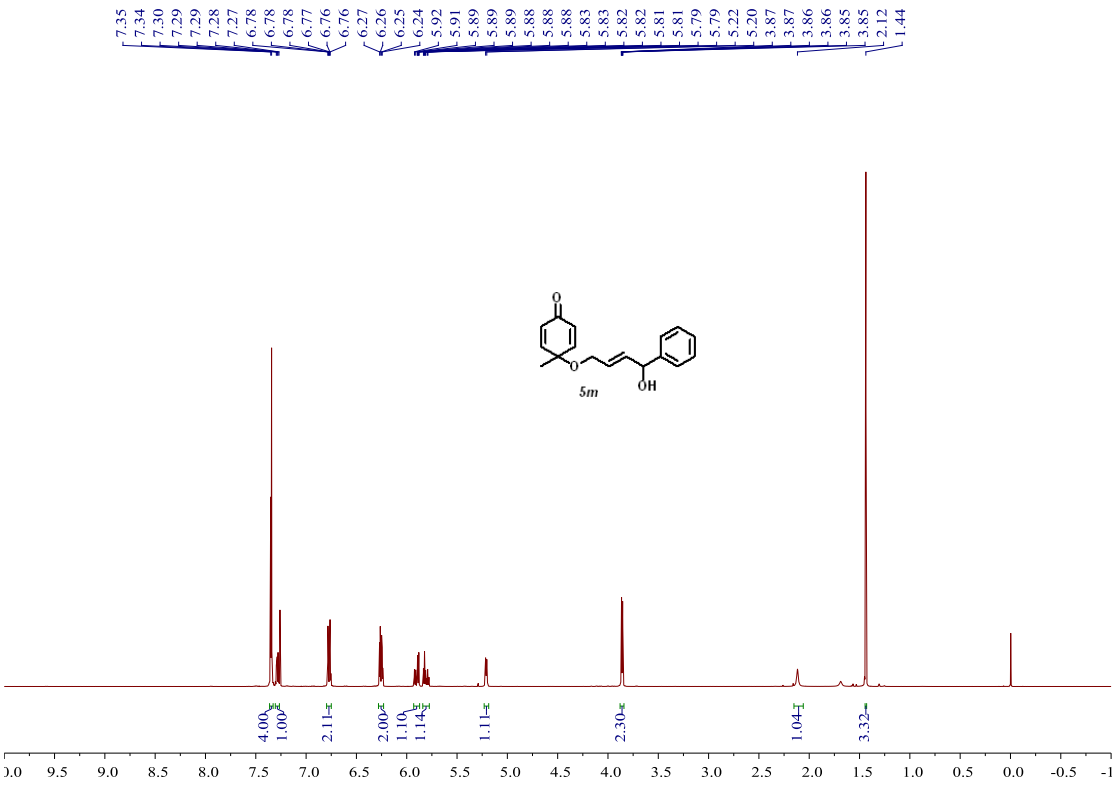
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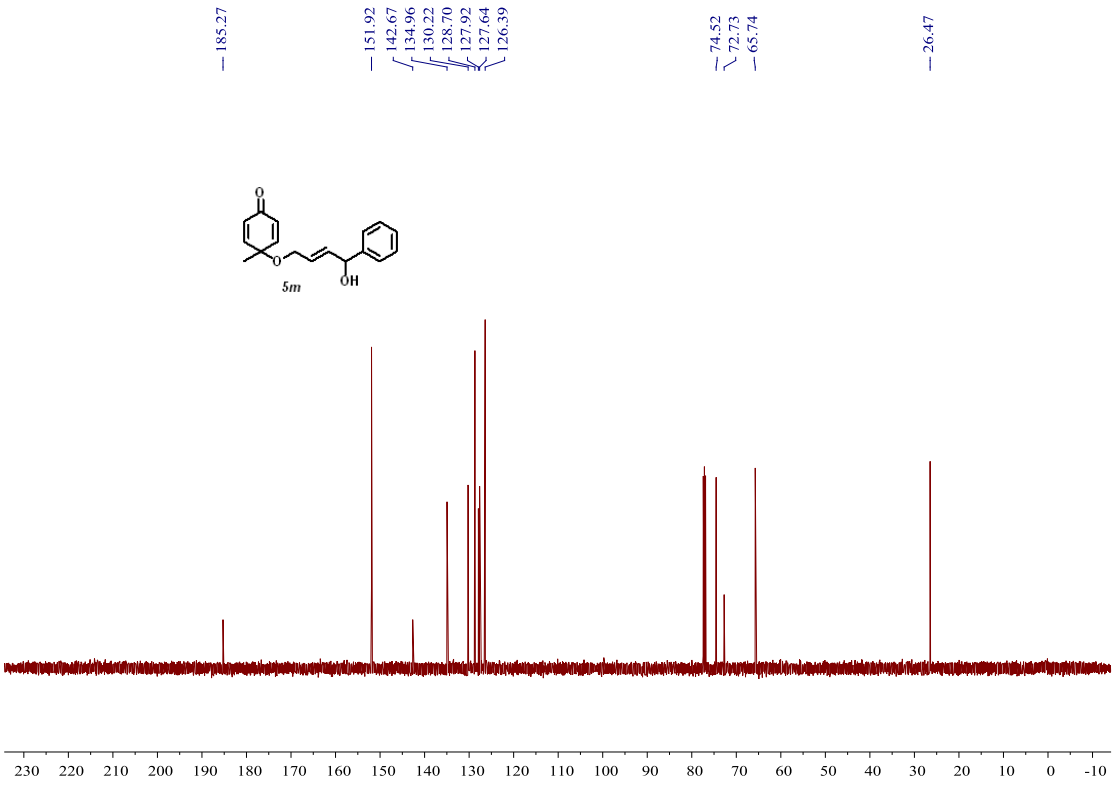
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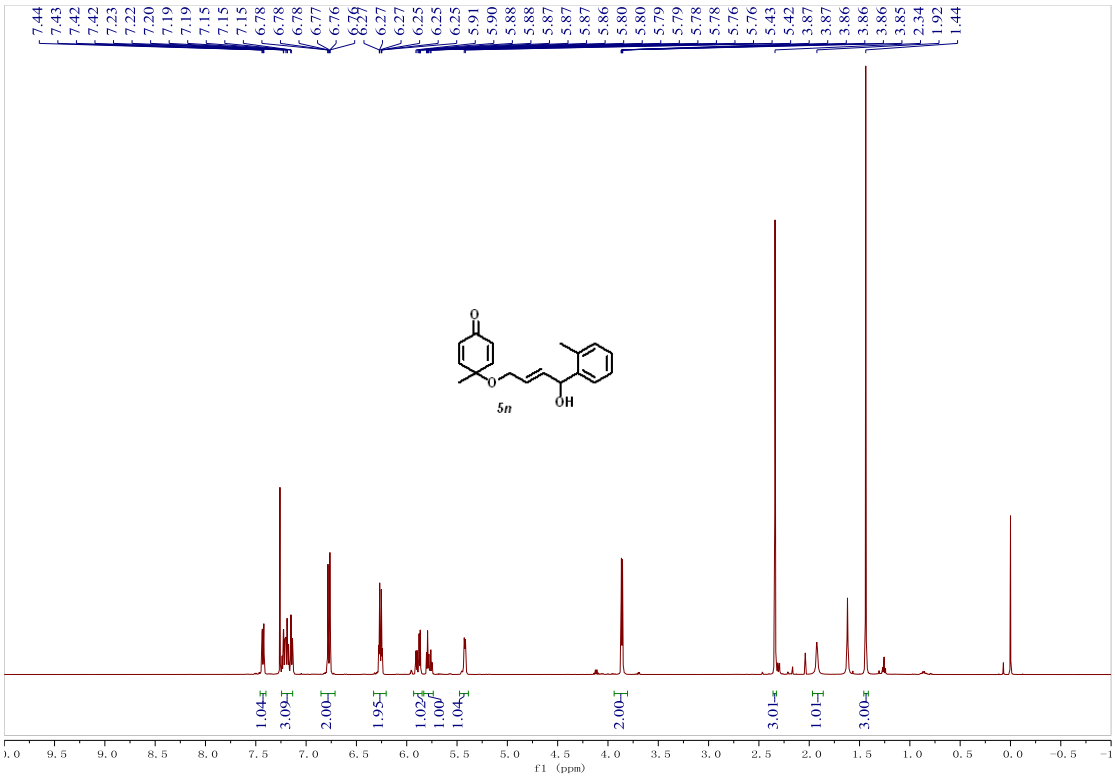
5m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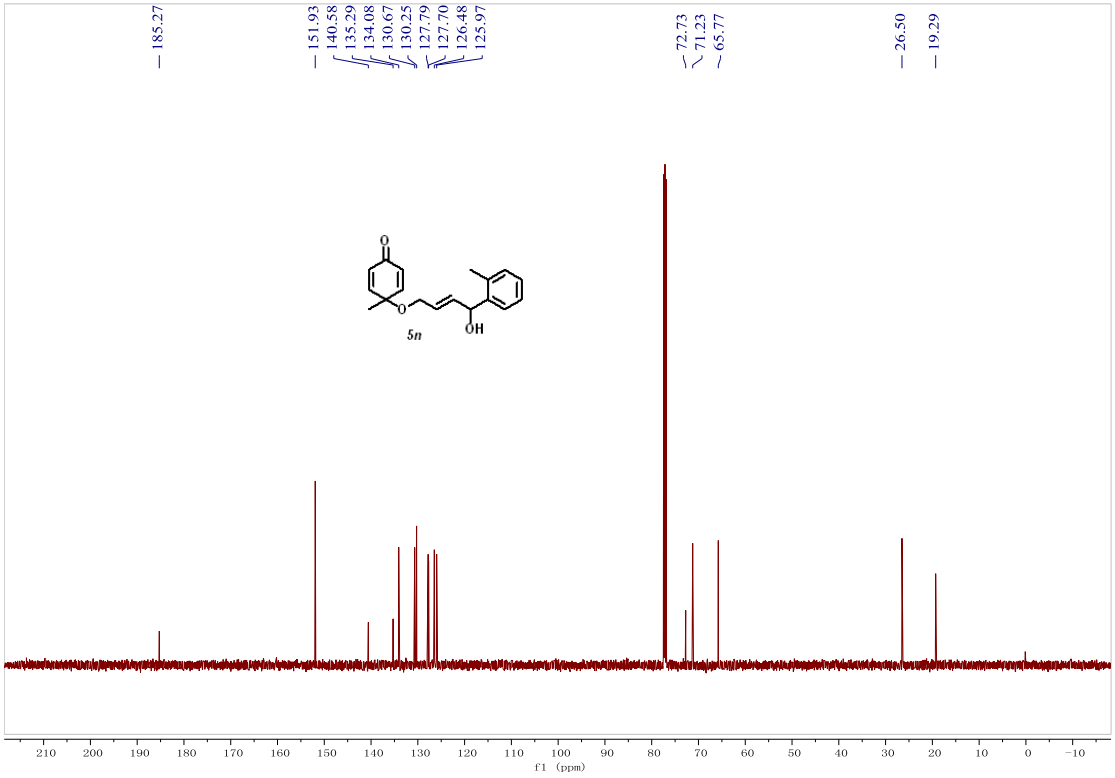
1.01
3.00
5n
f1 (ppm)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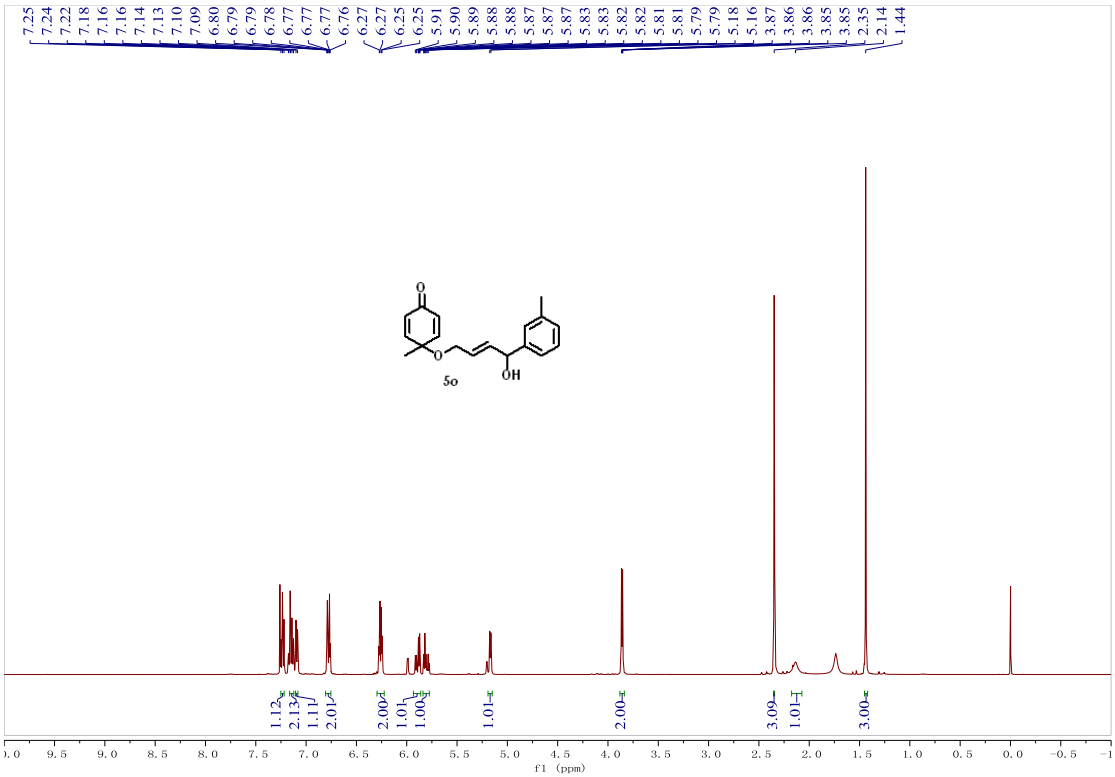
5n
f1 (ppm)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O
OH
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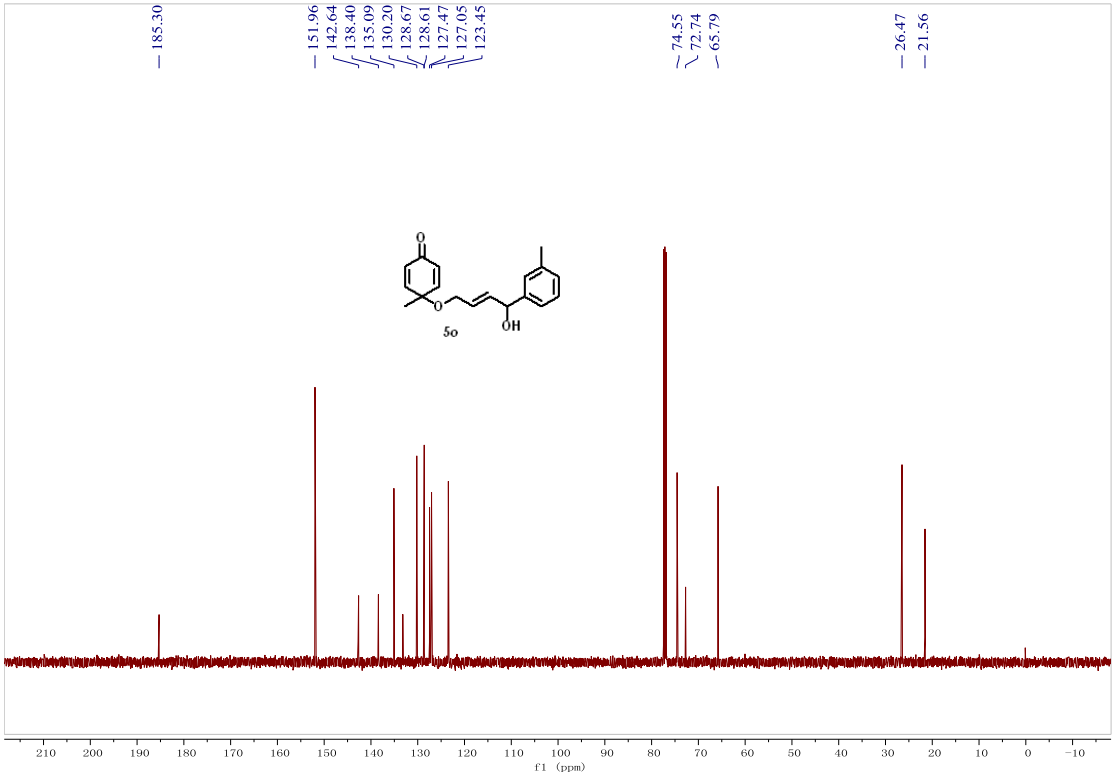
1.00
1.01
2.00
3.09
1.01
3.00
f1 (ppm)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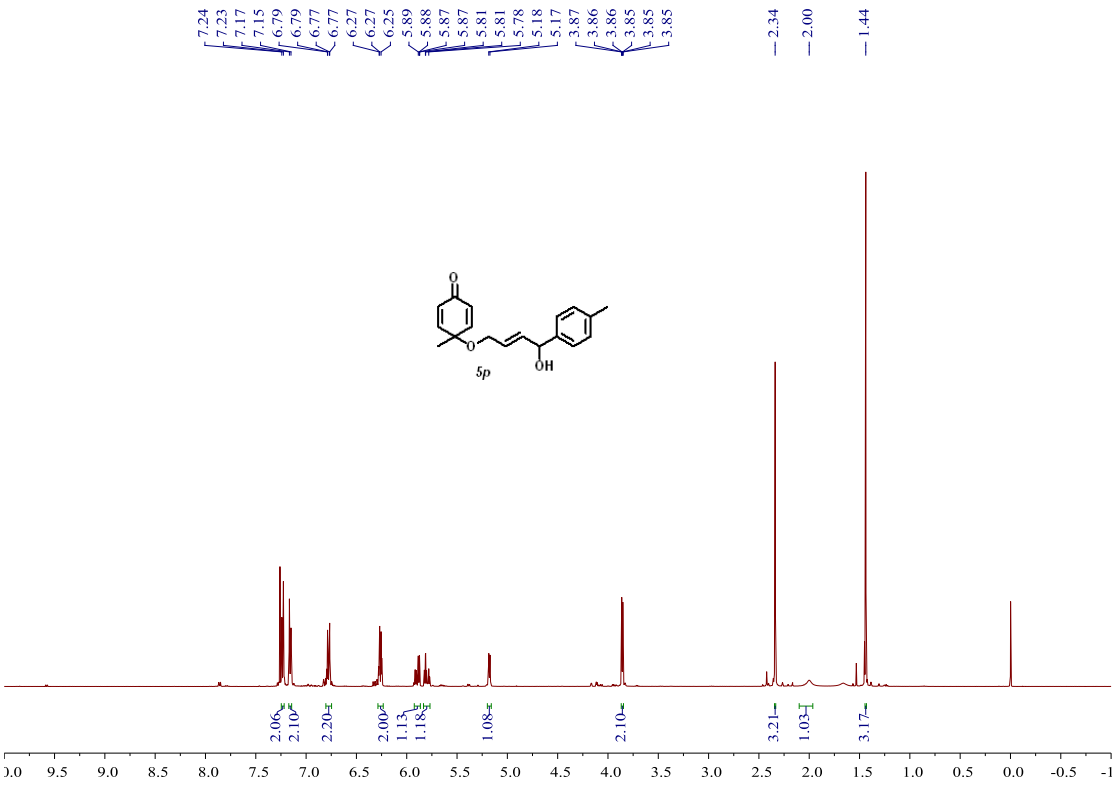
OH
5o
f1 (ppm)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1.08
2.10
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3.17
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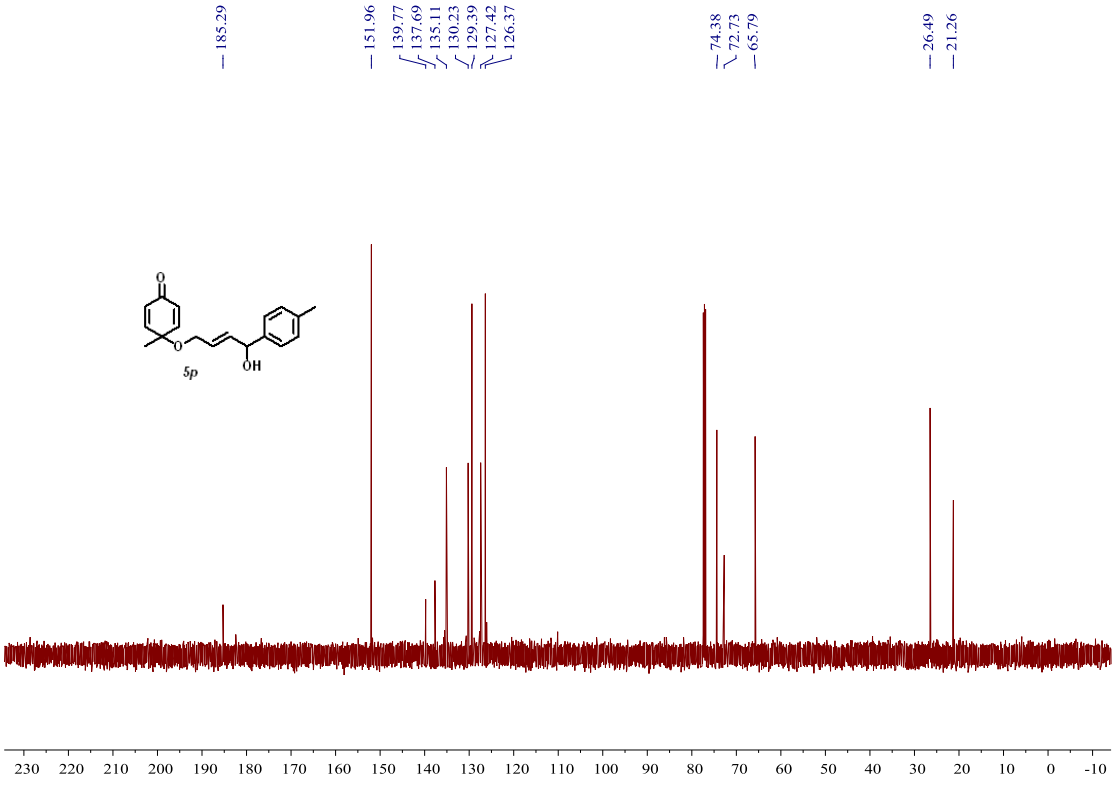
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21.26
5p
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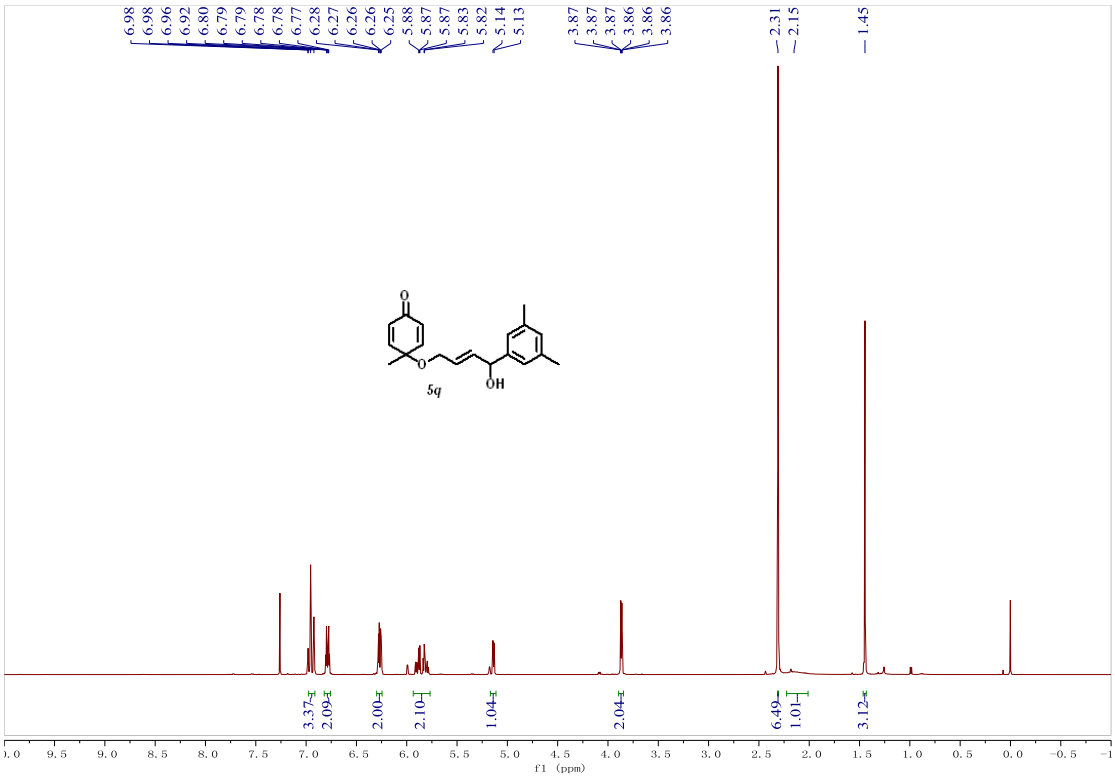
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O
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5q
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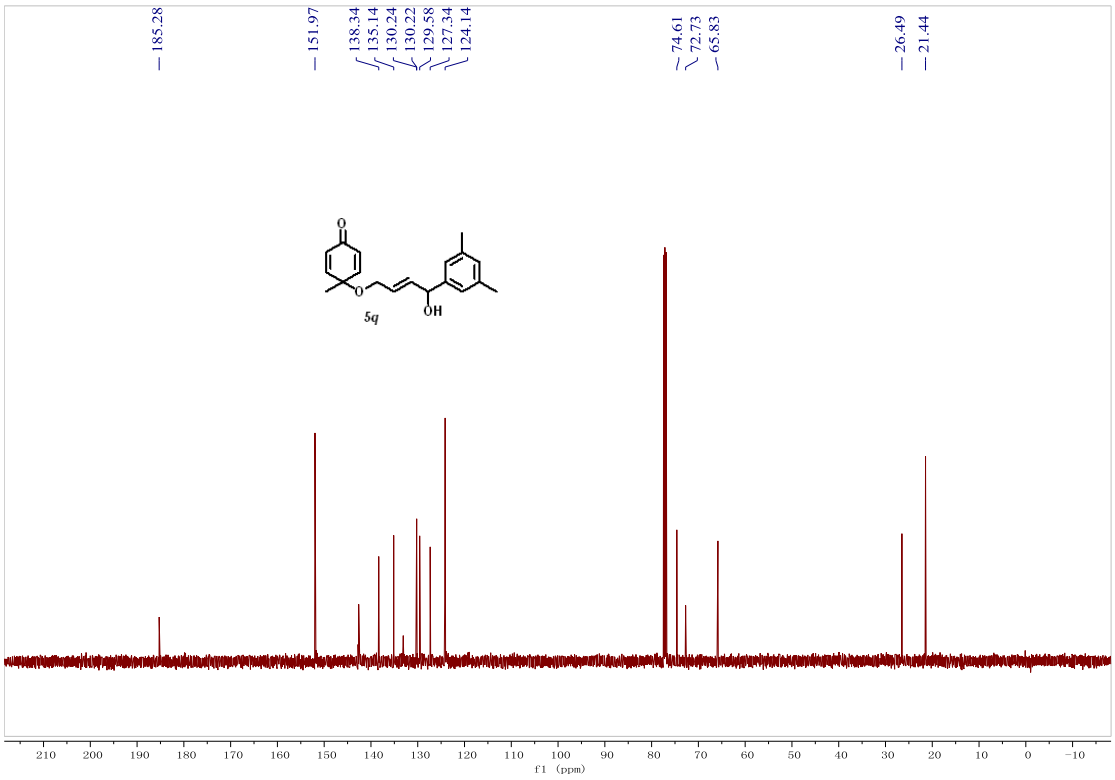
2.00
2.10
1.04
2.04
6.49
1.01
3.12
f1 (ppm)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130.22
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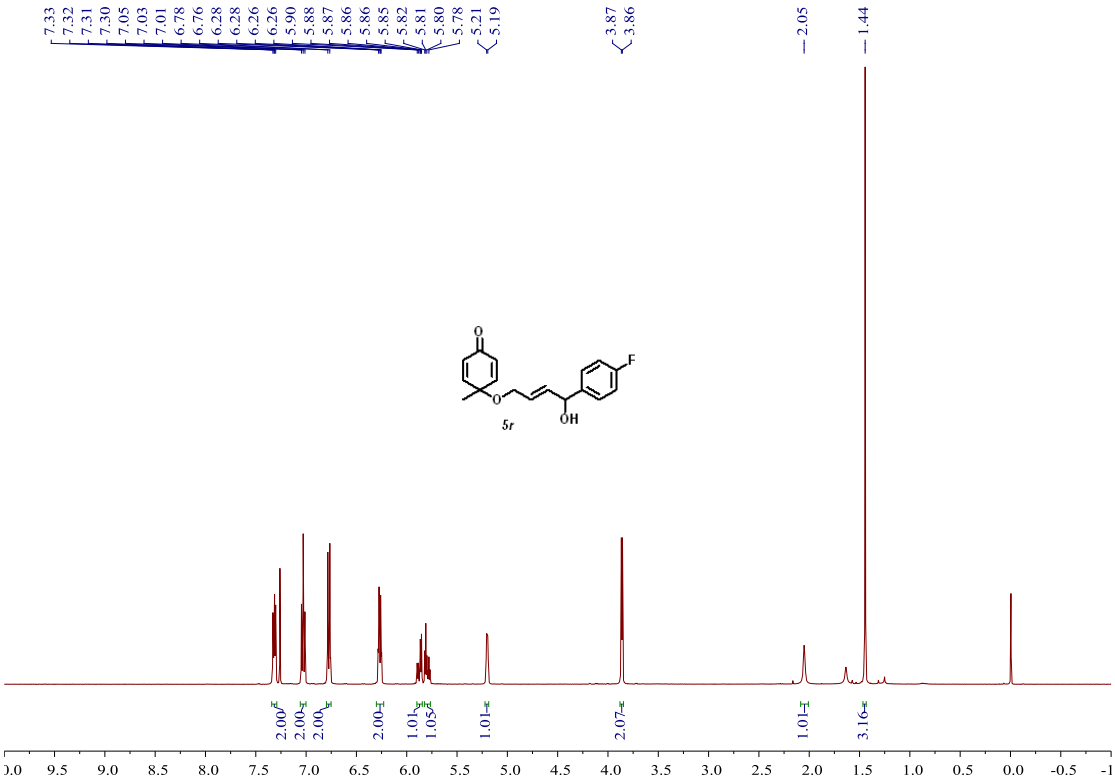
65.83
26.49
21.44
O
O
OH
5q
f1 (ppm)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7.01
6.78
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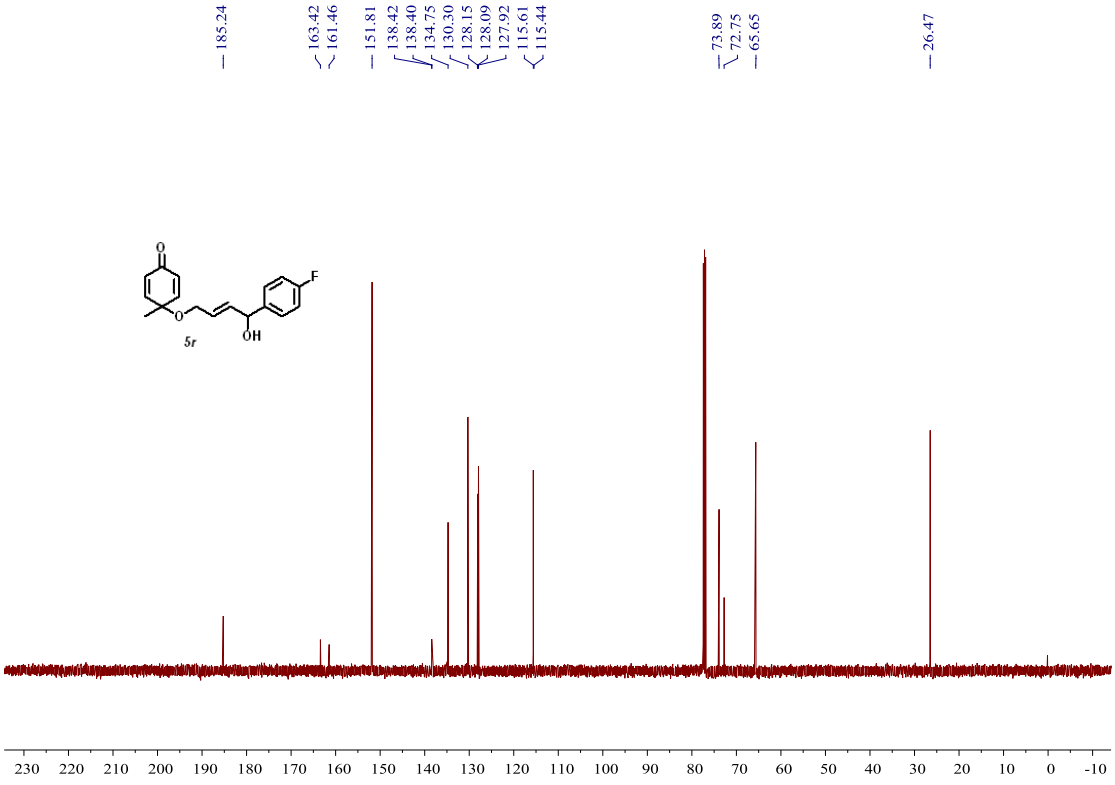
6.26
6.26
5.90
5.88
5.87
5.86
5.86
5.85
5.82
5.81
5.80
5.78
5.21
5.19
3.87
3.86
2.05
1.44
O
O
OH
F
5r
2.00
2.00
2.00
2.00
1.01
1.05
1.01
2.07
1.01
3.16
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1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130.30
128.15
128.09
127.92
115.61
115.44
73.89
72.75
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26.47
O
O
OH
F
5r
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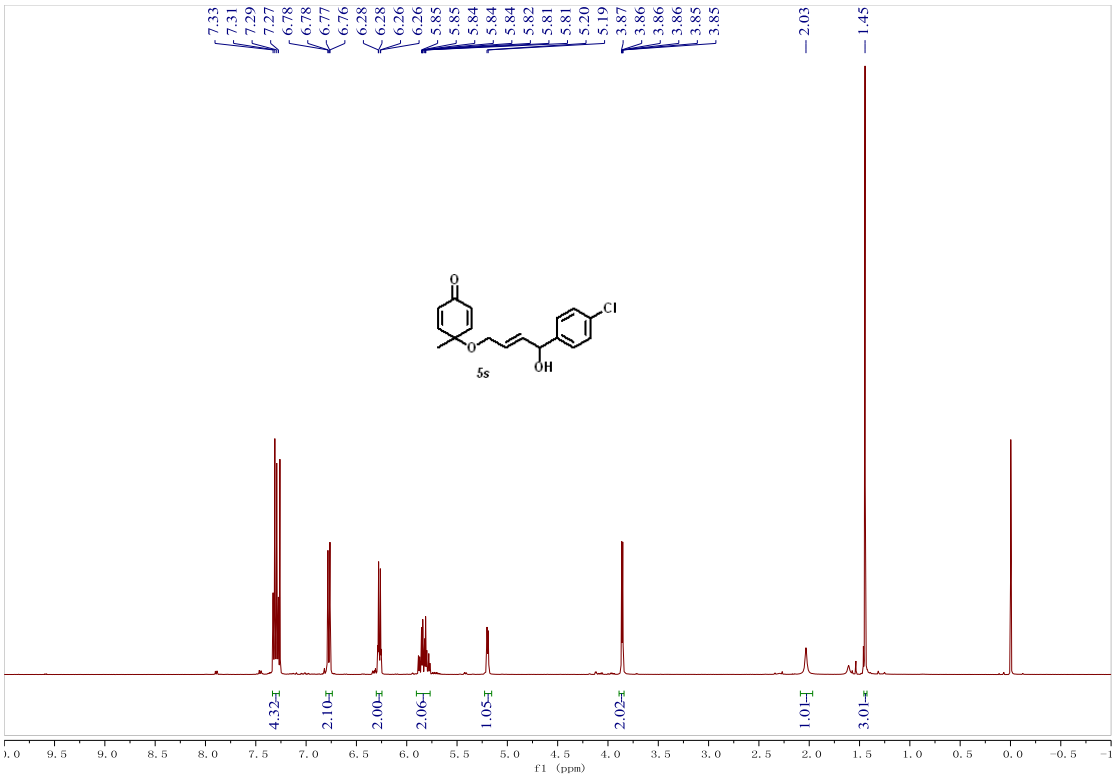
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6.26
5.85
5.85
5.84
5.84
5.84
5.82
5.81
5.81
5.20
5.19
3.87
3.86
3.86
3.86
3.85
3.85
2.03
1.45
O
O
OH
Cl
5s
4.32
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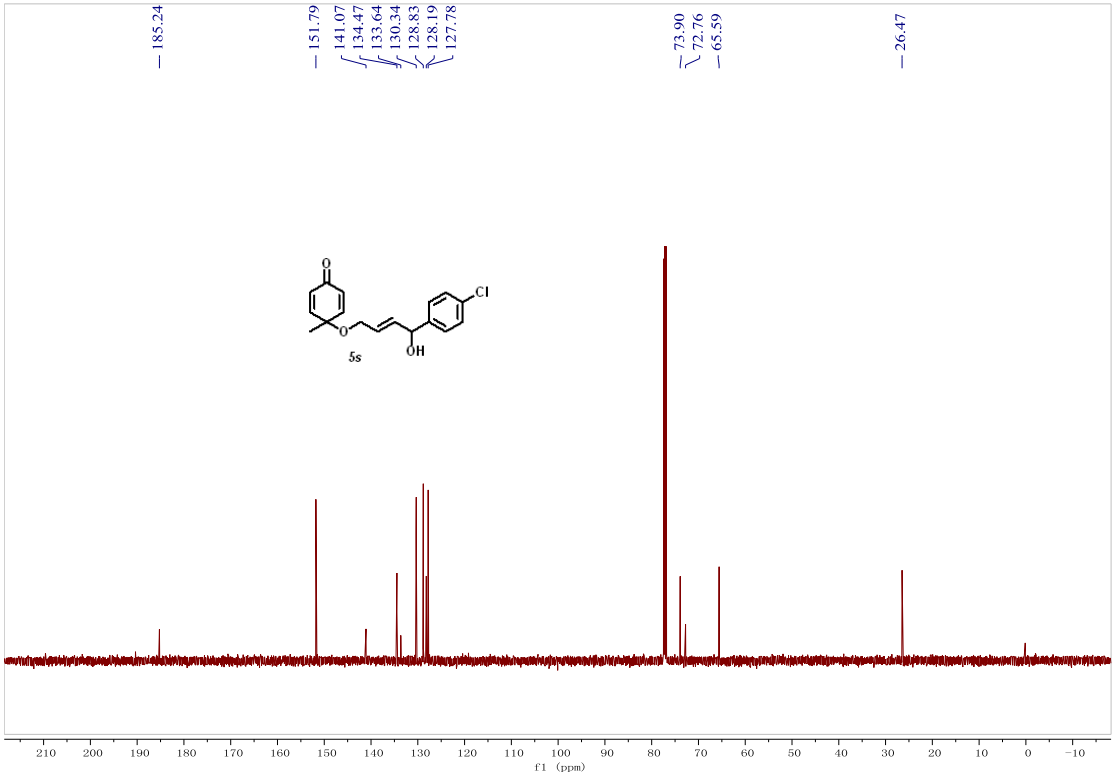
1.05
2.02
1.01
3.01
f1 (ppm)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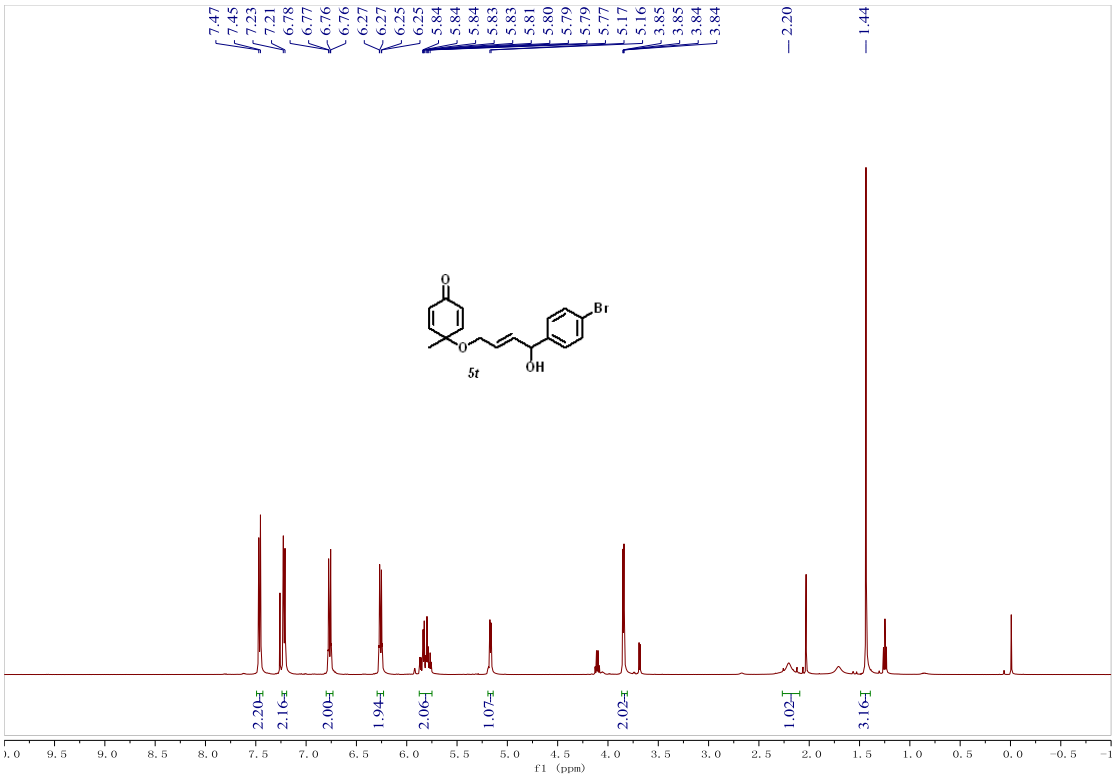
72.76
65.59
26.47
O
O
OH
Cl
5s
f1 (ppm)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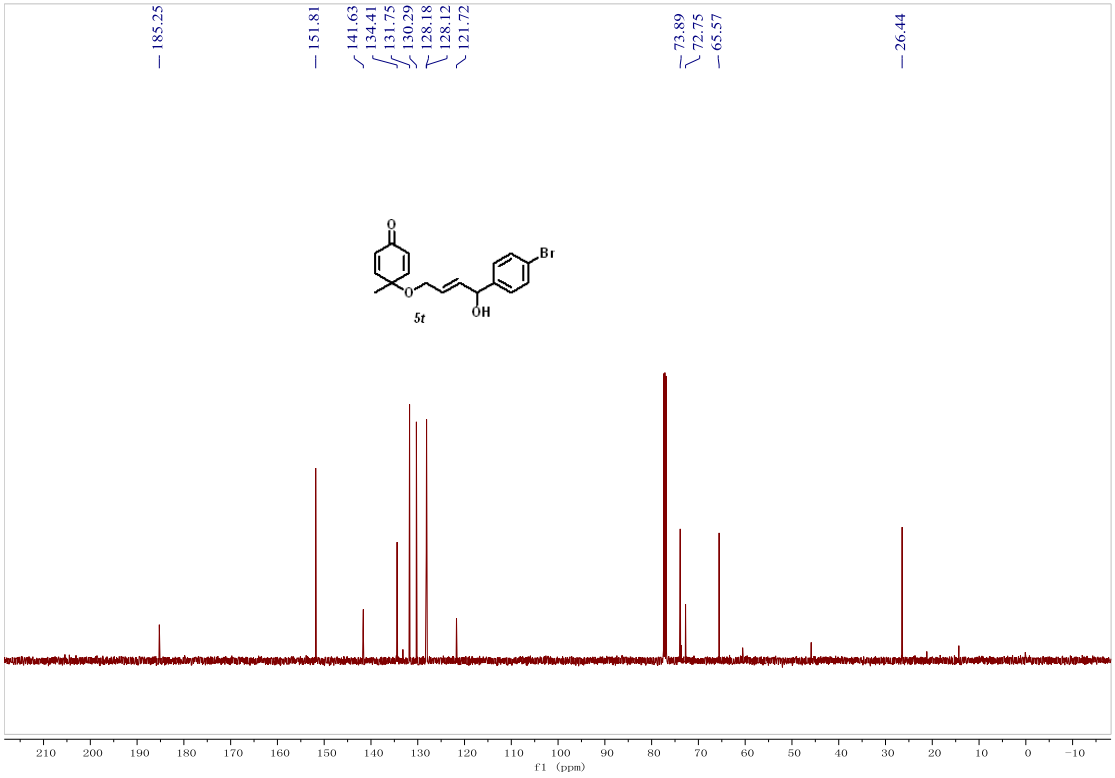
5.84
5.84
5.83
5.83
5.81
5.80
5.79
5.79
5.77
5.17
5.16
3.85
3.85
3.84
3.84
2.20
1.44
O
Br
O
OH
5t
2.20
2.16
2.00
1.94
2.06
1.07
2.02
1.02
3.16
f1 (ppm)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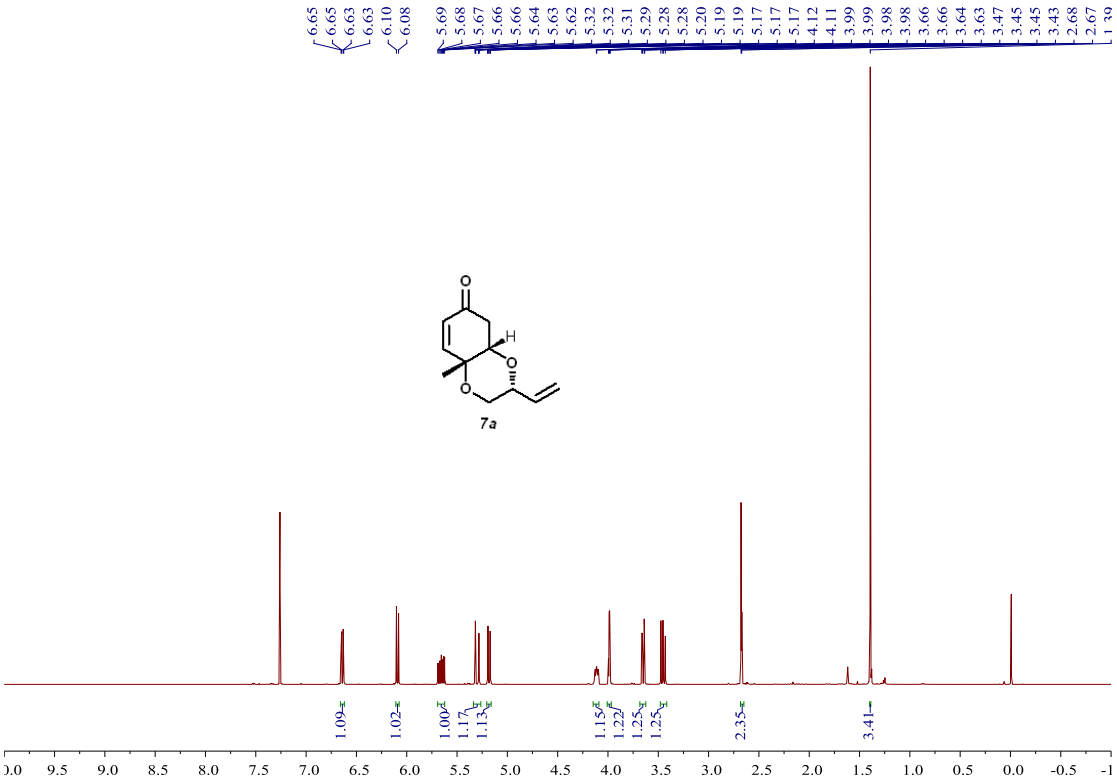
72.75
65.57
26.44
O
Br
O
OH
5t
f1 (ppm)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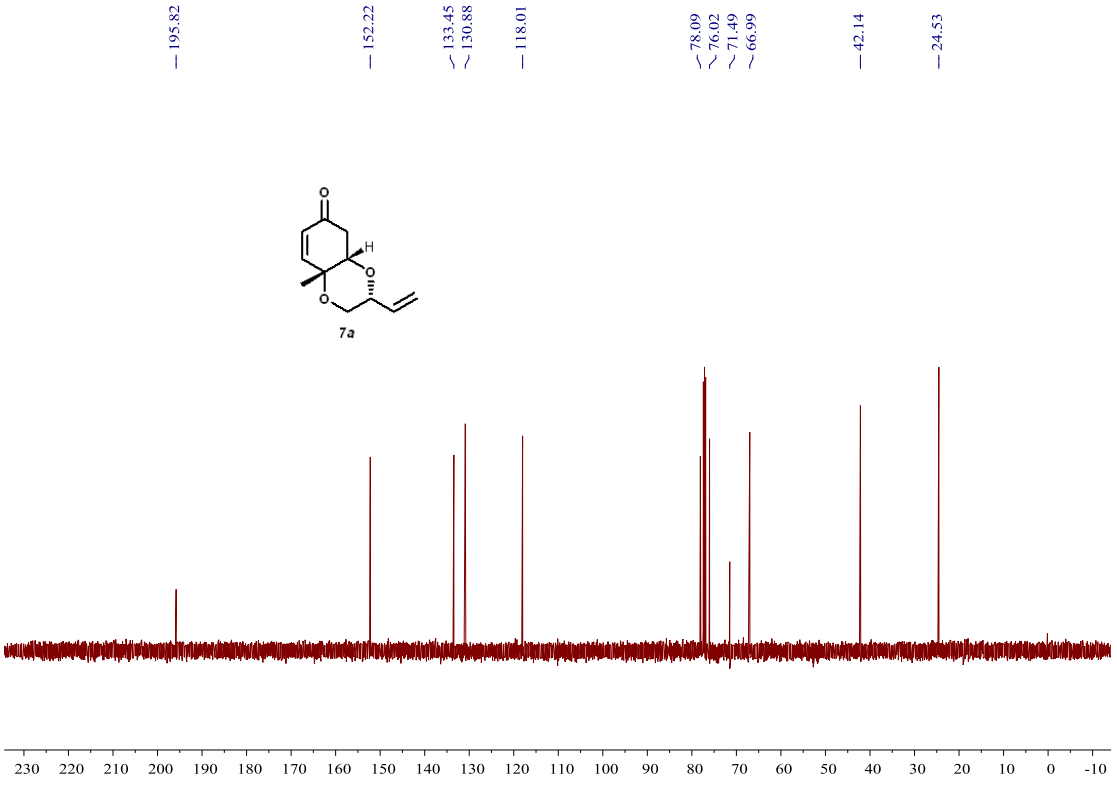
5.63
5.62
5.32
5.32
5.31
5.29
5.28
5.28
5.20
5.19
5.19
5.17
5.17
5.17
4.12
4.11
3.99
3.99
3.98
3.98
3.66
3.64
3.63
3.47
3.45
3.45
3.43
2.68
2.67
1.09
1.02
1.00
1.17
1.13
1.15
1.22
1.25
1.25
2.35
3.41
7a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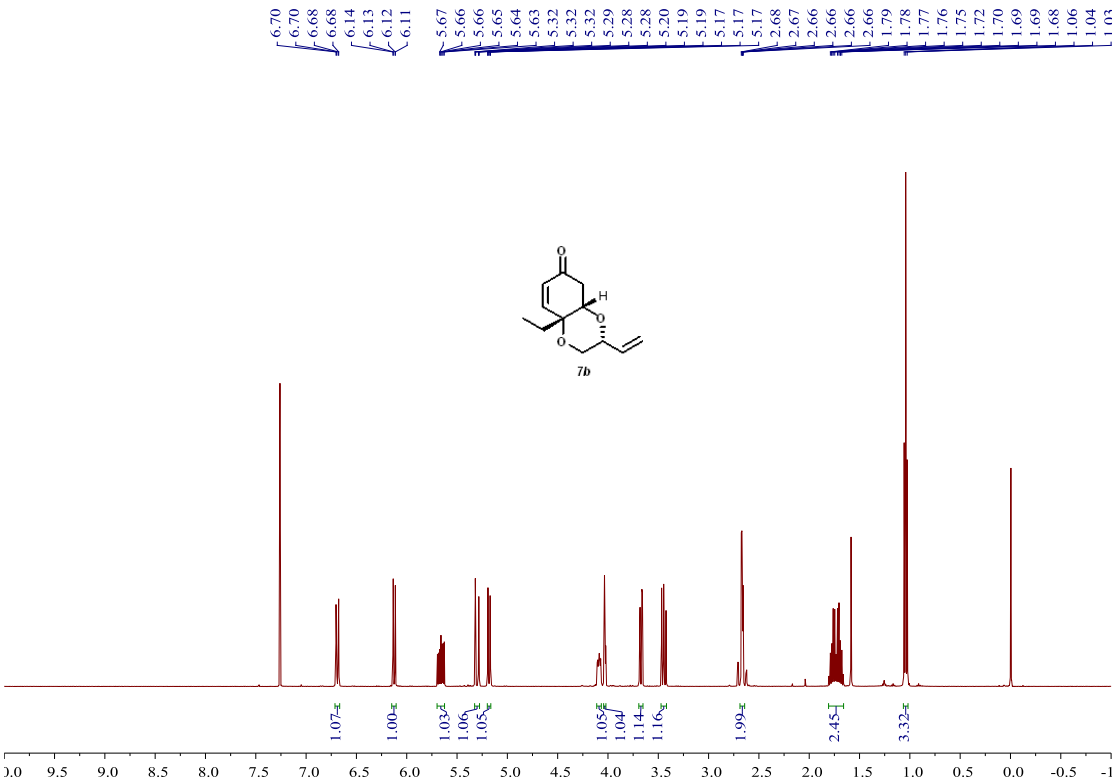
78.09
76.02
71.49
66.99
42.14
24.53
7a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6.70
6.68
6.68
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6.13
6.12
6.11
5.67
5.66
5.66
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5.64
5.63
5.32
5.32
5.29
5.28
5.28
5.20
5.19
5.19
5.17
5.17
2.68
2.67
2.66
2.66
2.66
1.79
1.78
1.77
1.76
1.75
1.72
1.70
1.69
1.69
1.68
1.06
1.04
7b
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1.06
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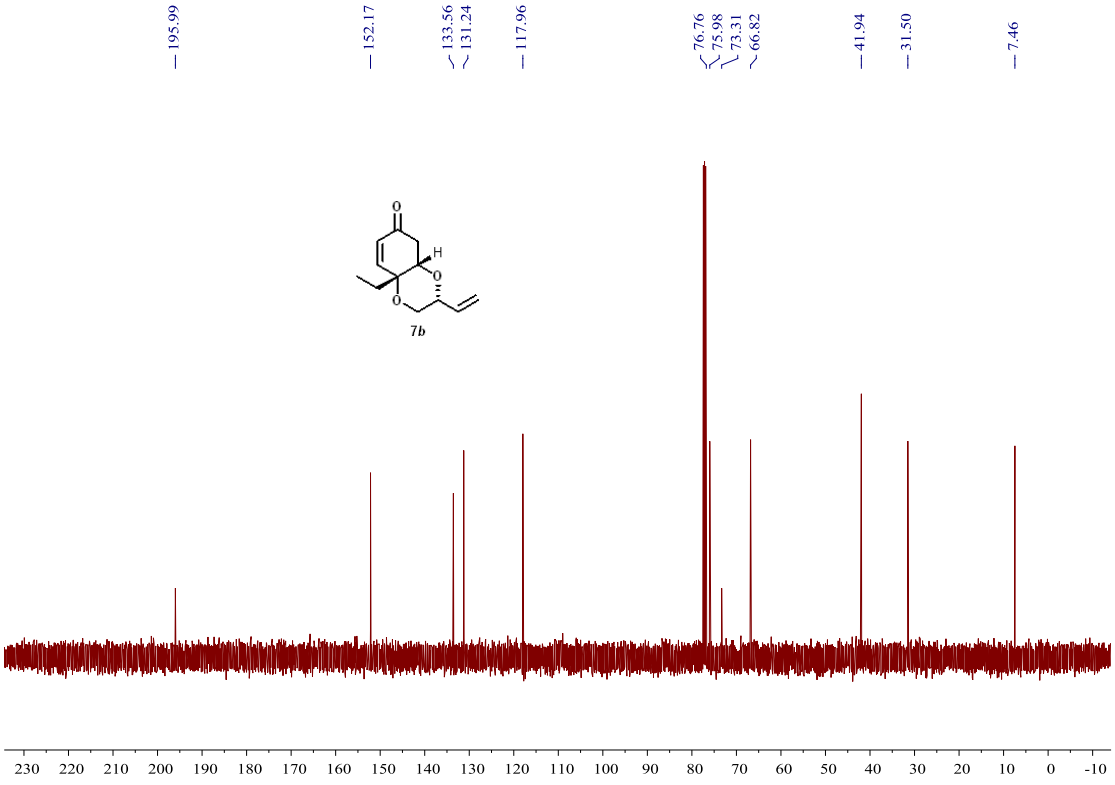
1.05
1.04
1.14
1.16
1.99
2.45
3.32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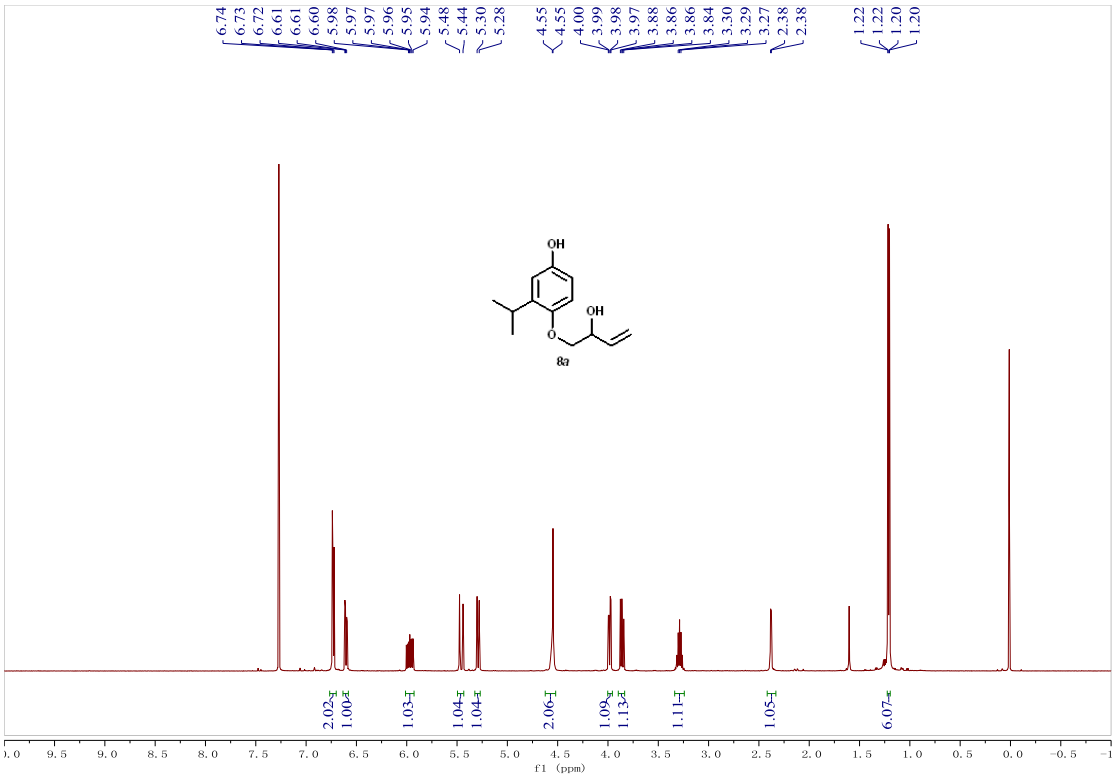
75.98
73.31
66.82
41.94
31.50
7.46
7b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6.73
6.72
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5.97
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5.96
5.95
5.94
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5.44
5.30
5.28
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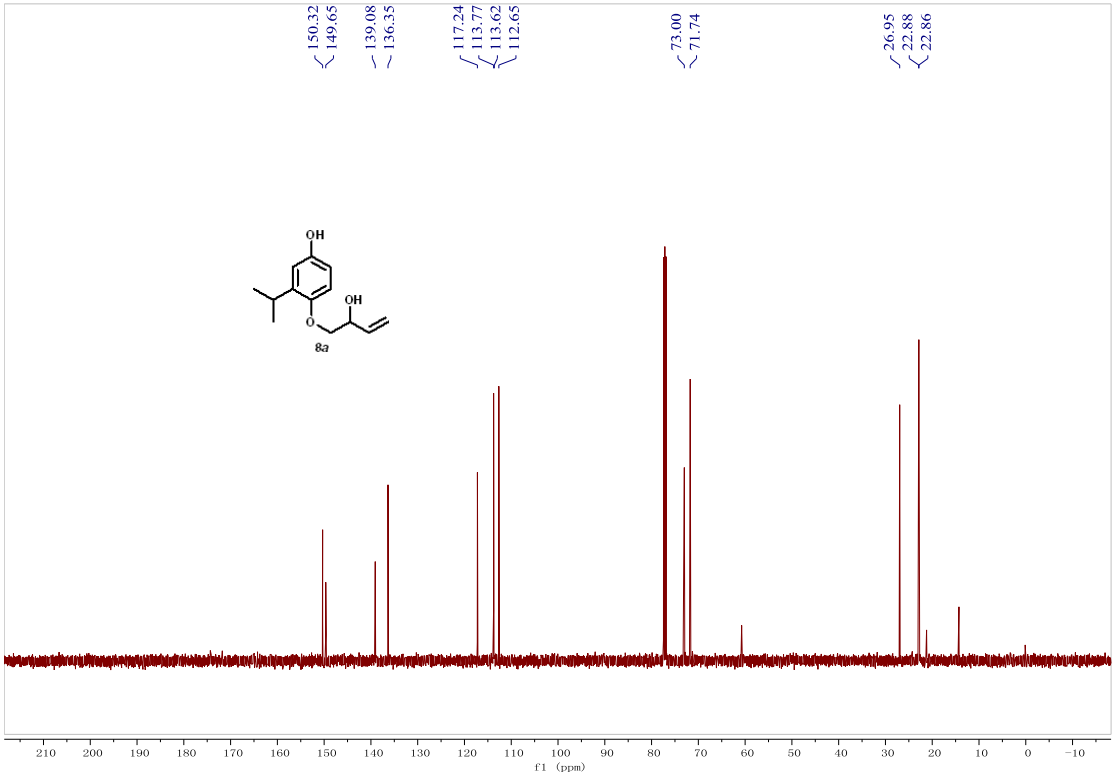
3.99
3.98
3.97
3.88
3.86
3.86
3.84
3.30
3.29
3.27
2.38
2.38
1.22
1.22
1.20
1.20
OH
OH
O
8a
2.02
1.00
1.03
1.04
1.04
2.06
1.09
1.13
1.11
1.05
6.07
f1 (ppm)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117.24
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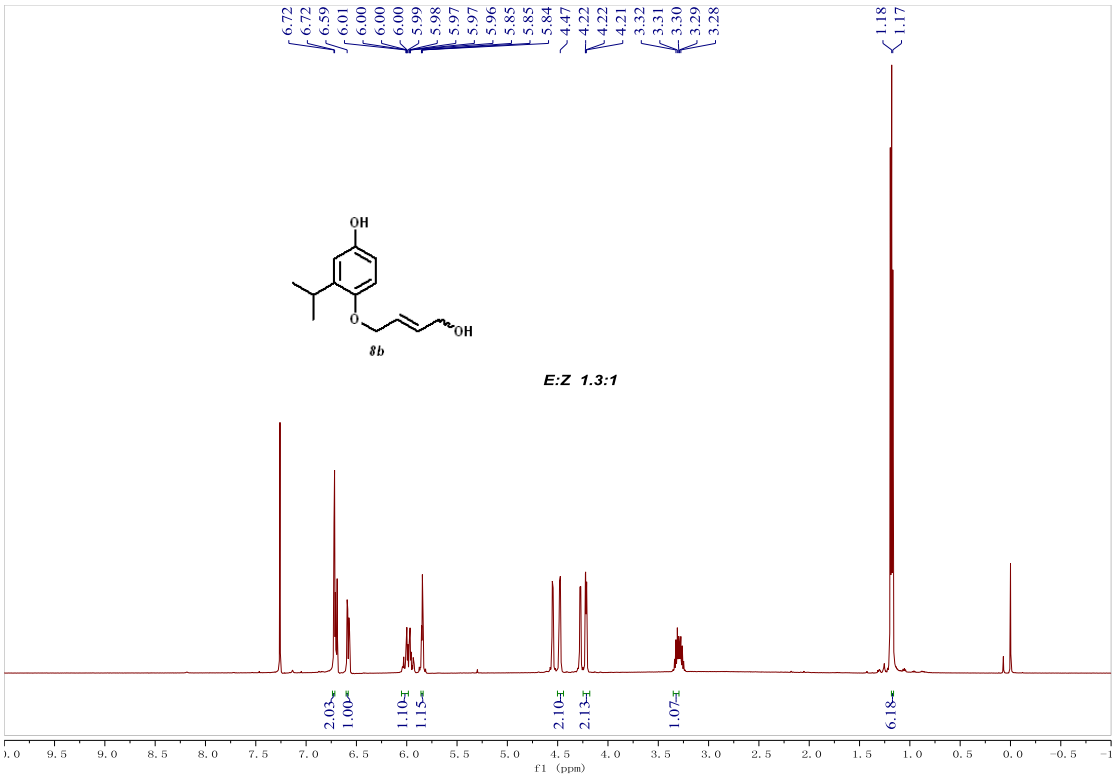
112.65
73.00
71.74
26.95
22.88
22.86
OH
OH
O
8a
f1 (ppm)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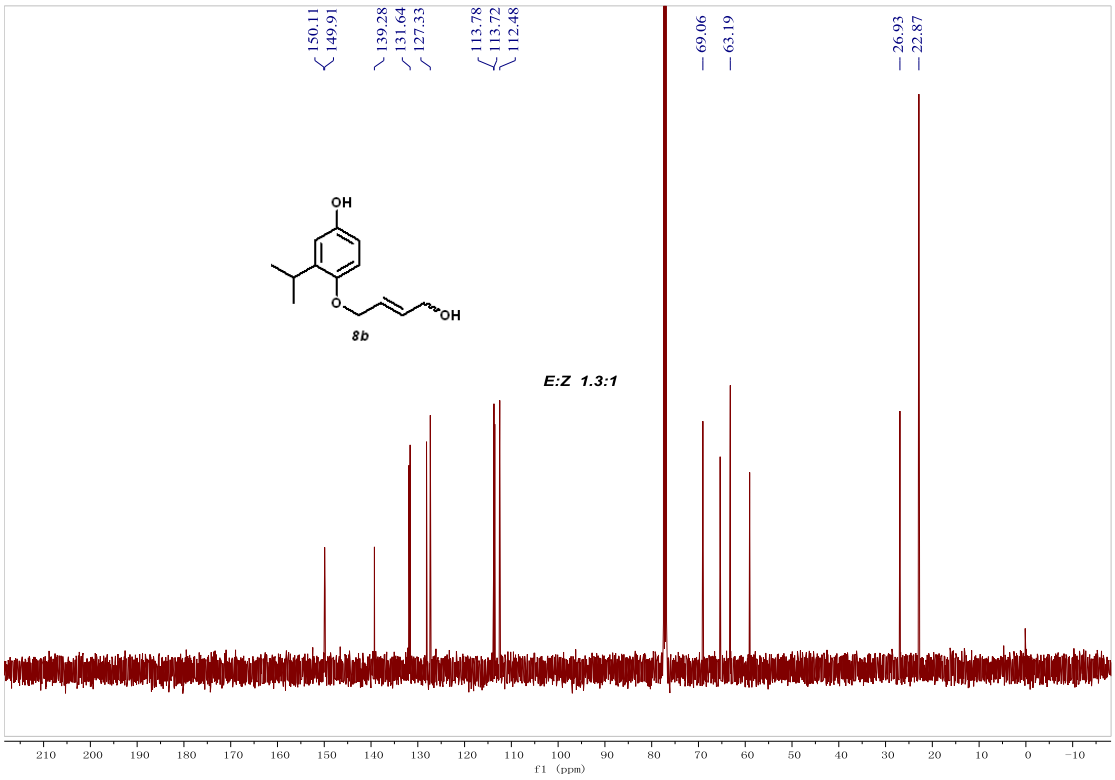
5.85
5.84
4.47
4.22
4.22
4.21
3.32
3.31
3.30
3.29
3.28
1.18
1.17
OH
O
OH
8b
E:Z 1.3:1
2.03
1.00
1.10
1.15
2.10
2.13
1.07
6.18
f1 (ppm)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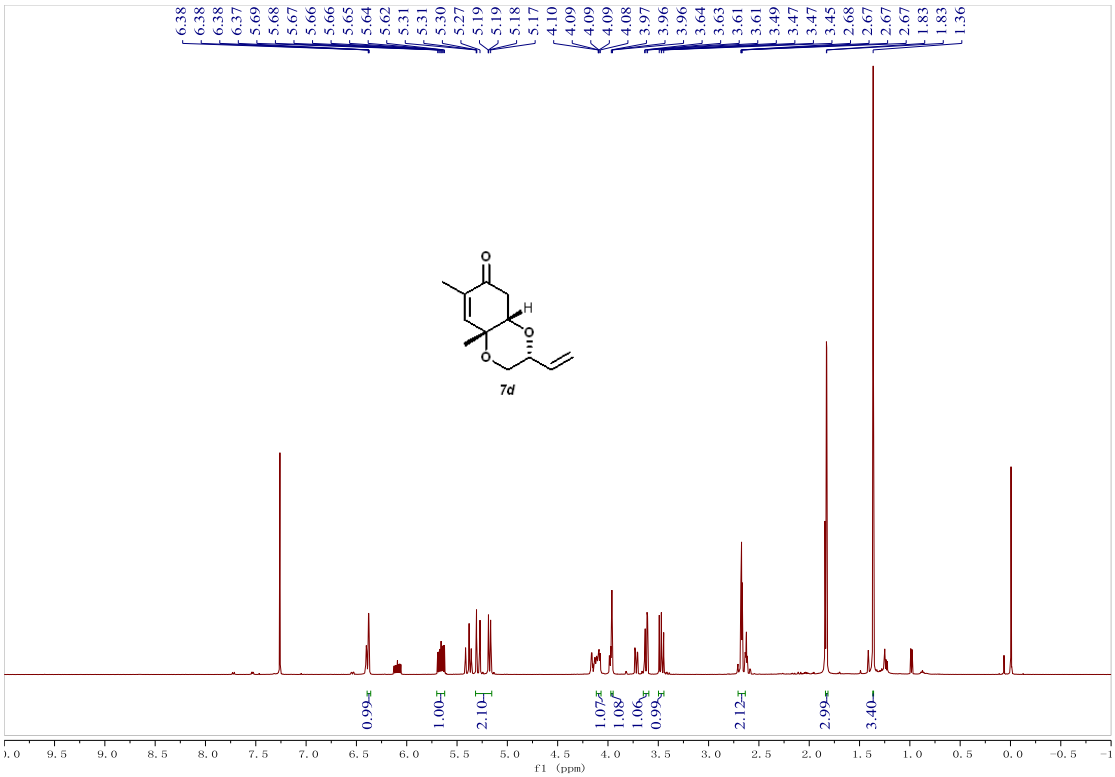
26.93
22.87
OH
O
OH
8b
E:Z 1.3:1
f1 (ppm)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5.31
5.30
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5.19
5.19
5.18
5.17
4.10
4.09
4.09
4.09
4.08
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3.96
3.96
3.64
3.63
3.61
3.61
3.49
3.47
3.47
3.45
2.68
2.67
2.67
2.67
1.83
1.83
1.36
7d
0.99
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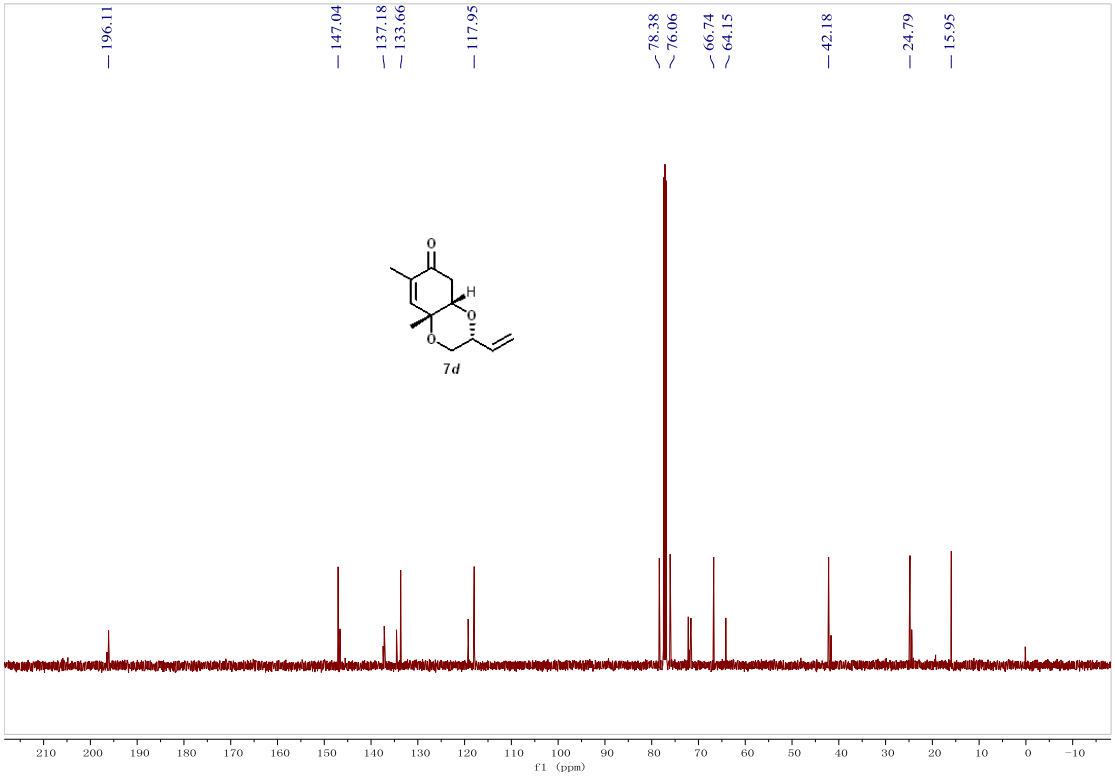
1.07
1.08
1.06
0.99
2.12
2.99
3.40
f1 (ppm)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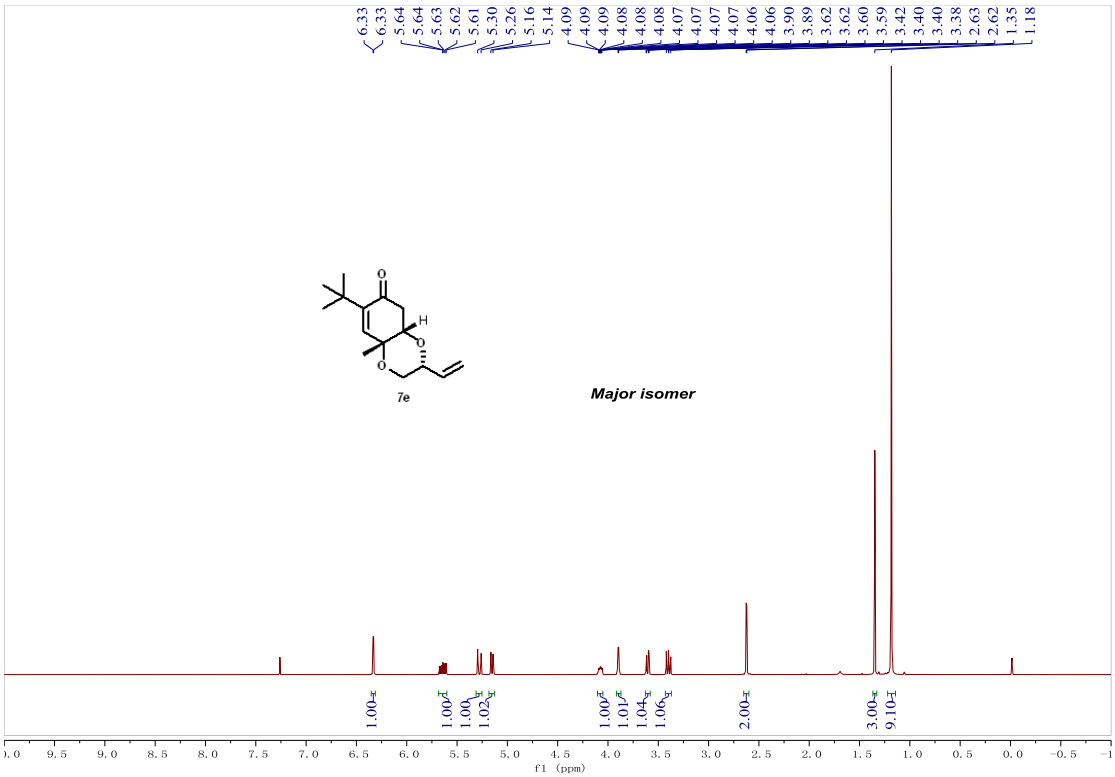
66.74
64.15
42.18
24.79
15.95
7d
f1 (ppm)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4.06
4.06
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3.89
3.62
3.62
3.60
3.59
3.42
3.40
3.40
3.38
2.63
2.62
1.35
1.18
7e
Major isomer
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1.00
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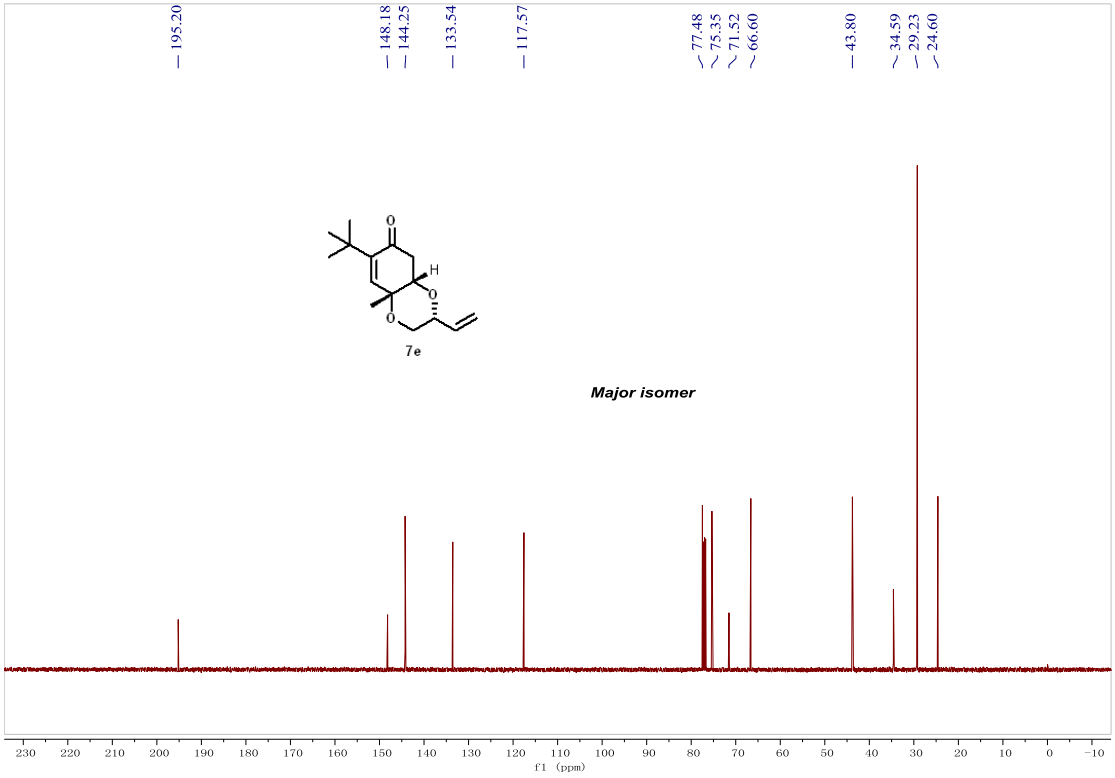
1.01
1.04
1.06
2.00
3.00
9.10
f1 (ppm)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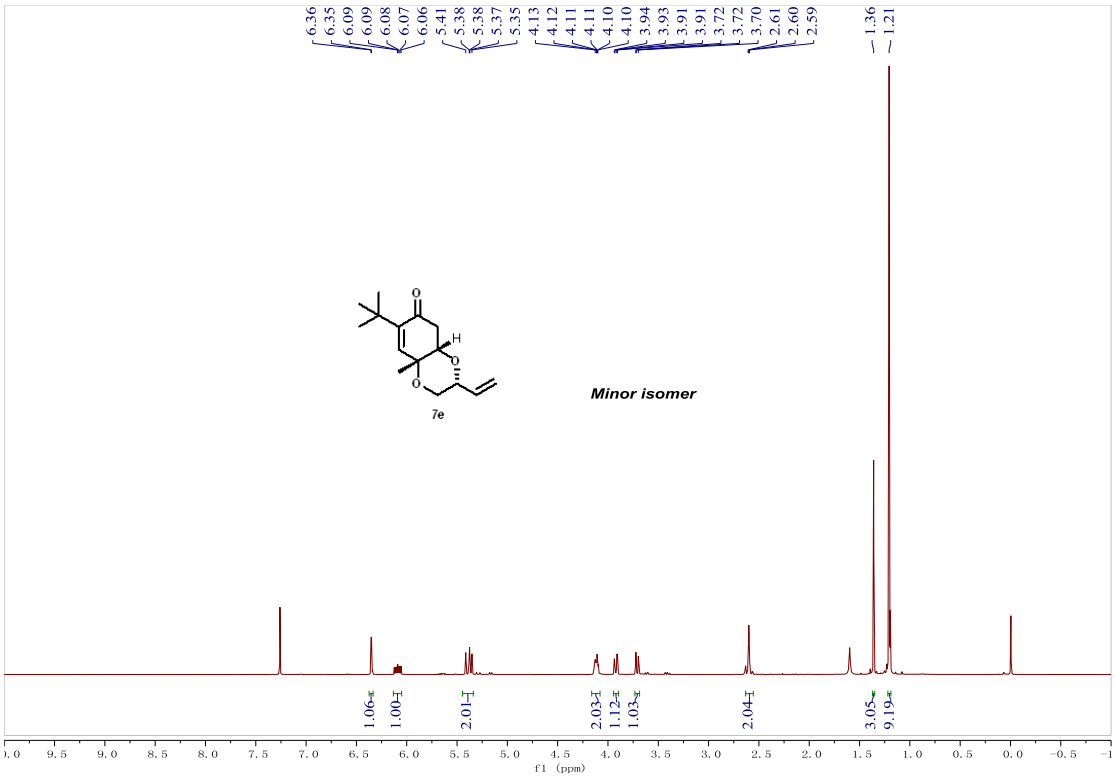
43.80
34.59
29.23
24.60
7e
Major isomer
f1 (ppm)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6.08
6.07
6.06
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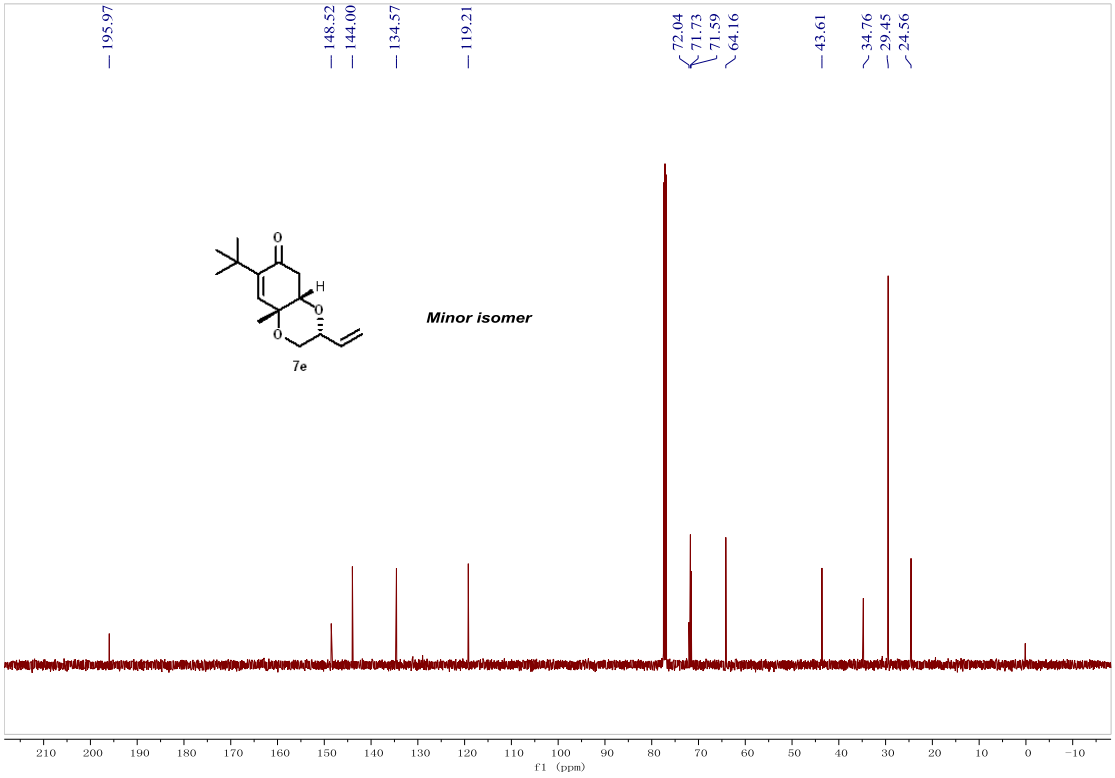
5.38
5.37
5.35
4.13
4.12
4.11
4.11
4.10
4.10
3.94
3.93
3.91
3.91
3.72
3.72
3.70
2.61
2.60
2.59
1.36
1.21
Minor isomer
7e
1.06
1.00
2.01
2.03
1.12
1.03
2.04
3.05
9.19
f1 (ppm)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134.57
119.21
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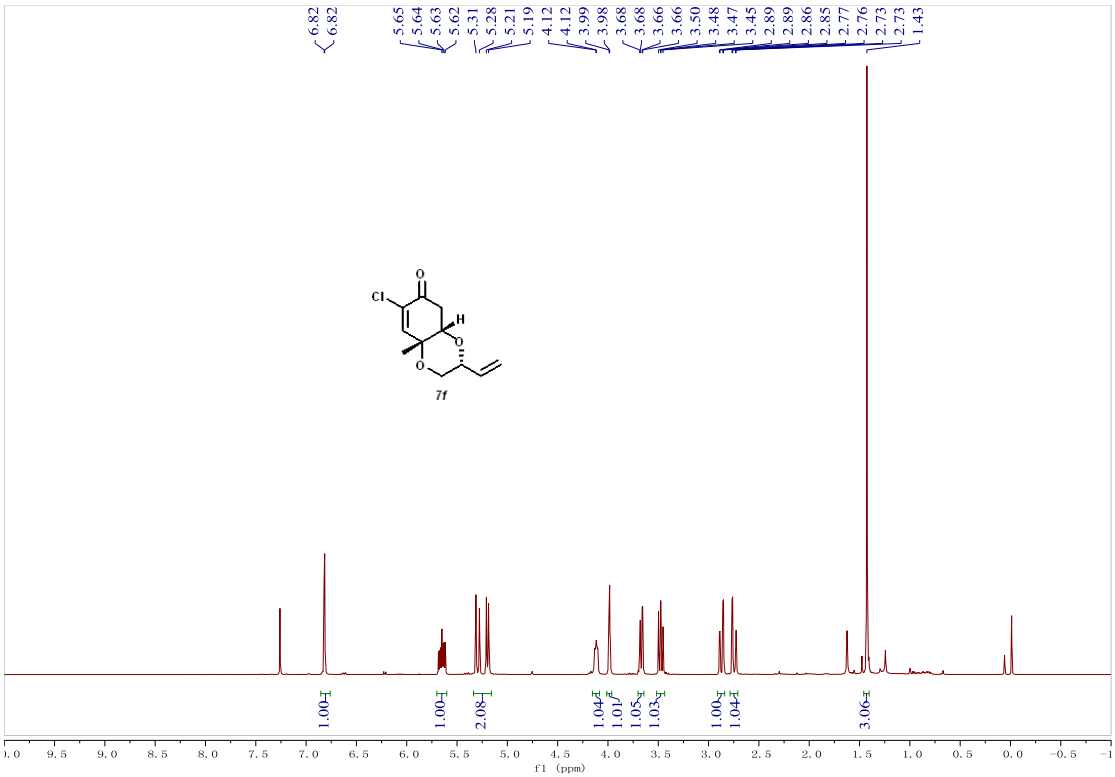
71.59
64.16
43.61
34.76
29.45
24.56
Minor isomer
7e
f1 (ppm)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5.62
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5.28
5.21
5.19
4.12
4.12
3.99
3.98
3.68
3.68
3.66
3.66
3.50
3.48
3.47
3.45
2.89
2.89
2.86
2.85
2.77
2.76
2.73
2.73
1.43
1.00
1.00
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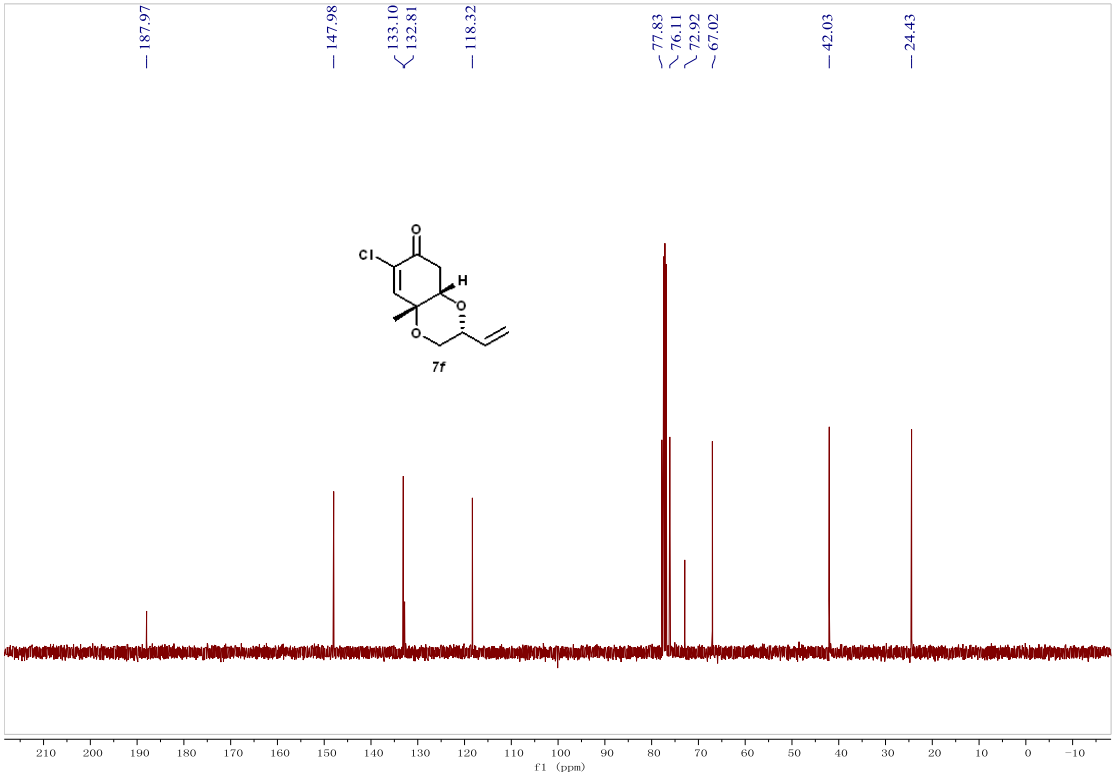
1.04
1.01
1.05
1.03
1.00
1.04
3.06
f1 (ppm)
7f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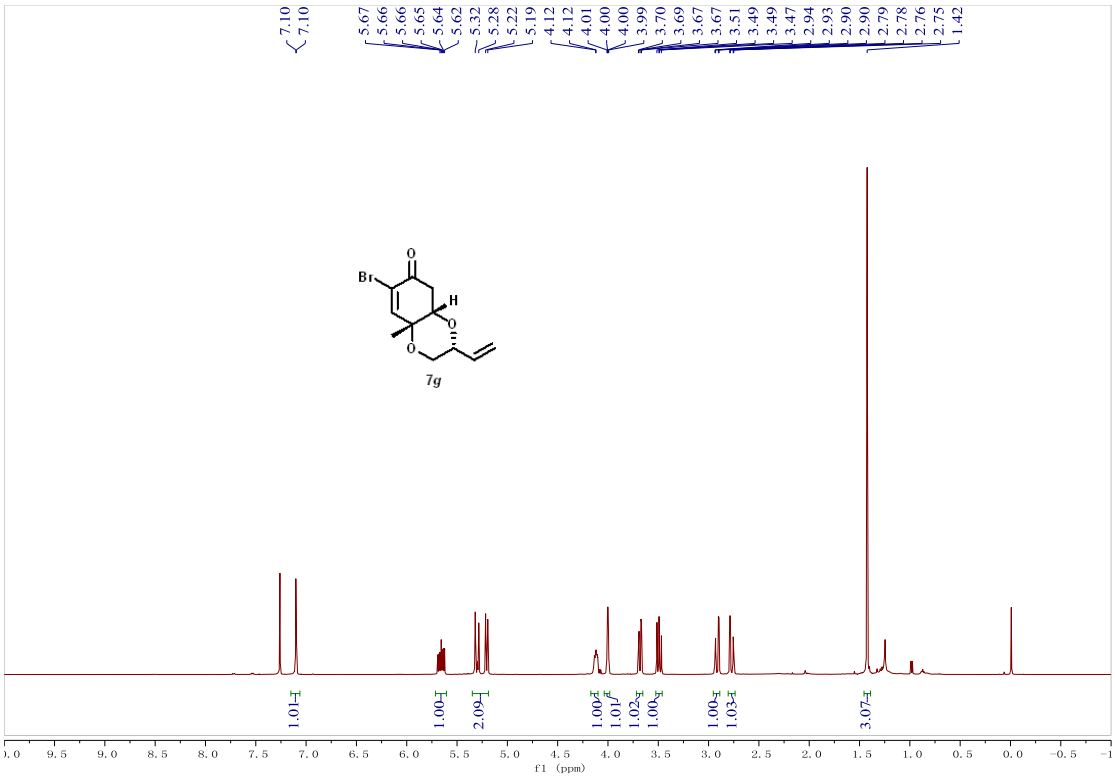
77.83
76.11
72.92
67.02
42.03
24.43
f1 (ppm)
7f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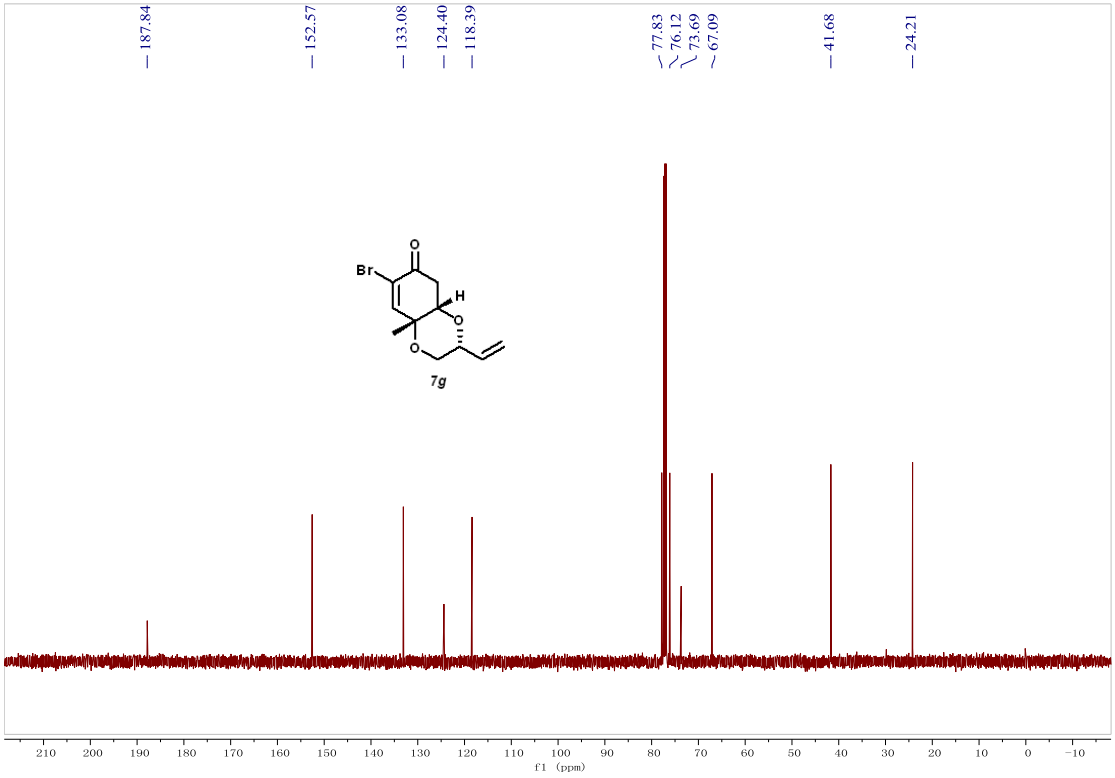
5.28
5.22
5.19
4.12
4.12
4.01
4.00
4.00
3.99
3.70
3.69
3.67
3.67
3.51
3.49
3.49
3.47
2.94
2.93
2.90
2.90
2.79
2.78
2.76
2.75
1.42
Br
O
H
O
O
7g
1.01
1.00
2.09
1.00
1.01
1.02
1.00
1.00
1.03
3.07
f1 (ppm)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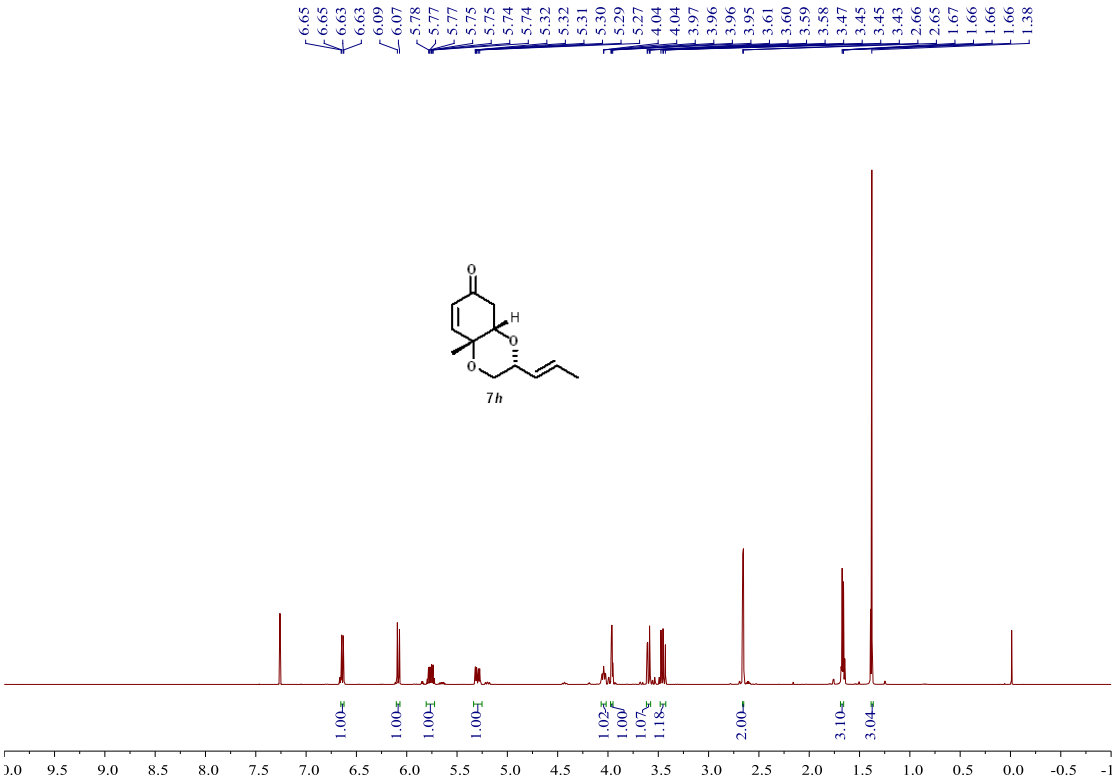
73.69
67.09
41.68
24.21
Br
O
H
O
O
7g
f1 (ppm)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6.63
6.63
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5.75
5.74
5.74
5.32
5.32
5.31
5.30
5.29
5.27
4.04
4.04
3.97
3.96
3.96
3.95
3.61
3.60
3.59
3.58
3.47
3.45
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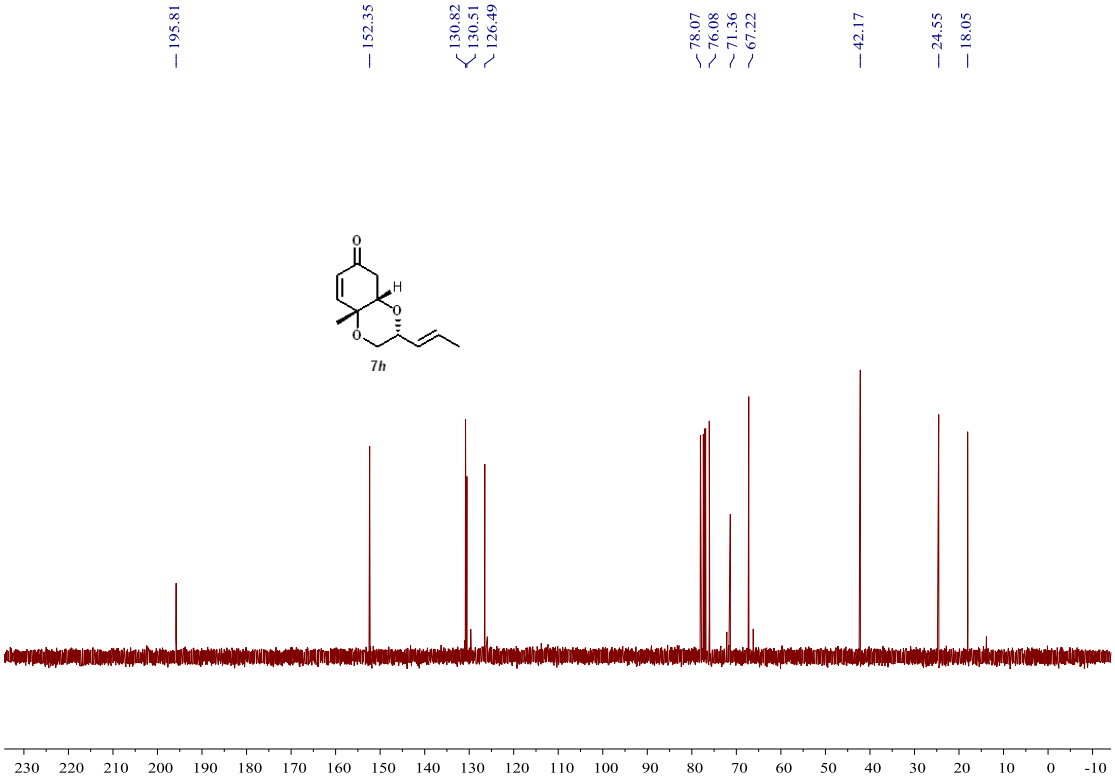
3.43
2.66
2.65
1.67
1.66
1.66
1.66
1.38
7h
1.00
1.00
1.00
1.00
1.02
1.00
1.07
1.18
2.00
3.10
3.04
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1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152.35
130.82
130.51
126.49
78.07
76.08
71.36
67.22
42.17
24.55
18.05
7h
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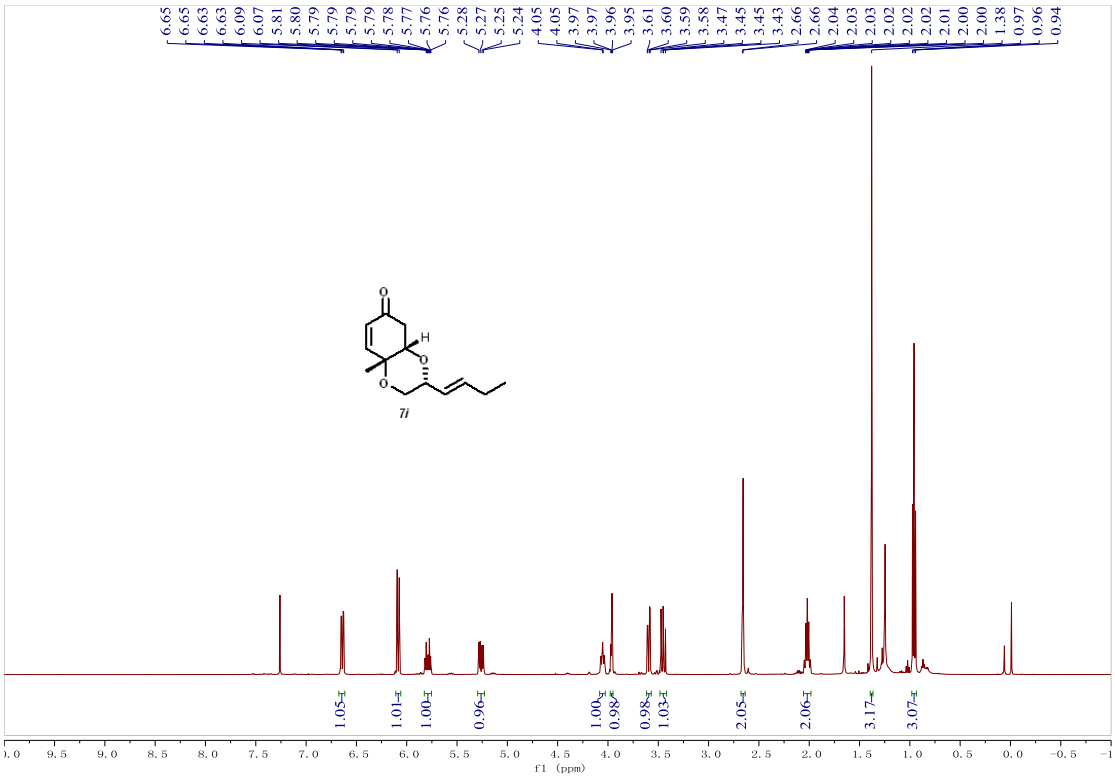
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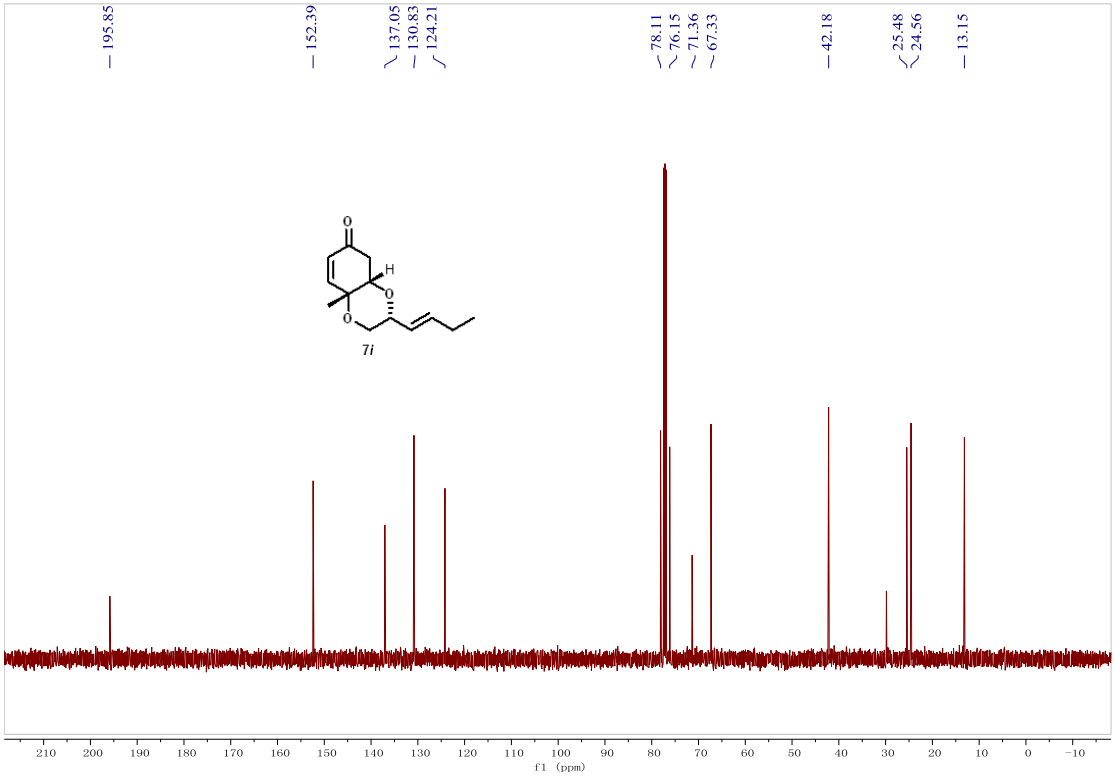
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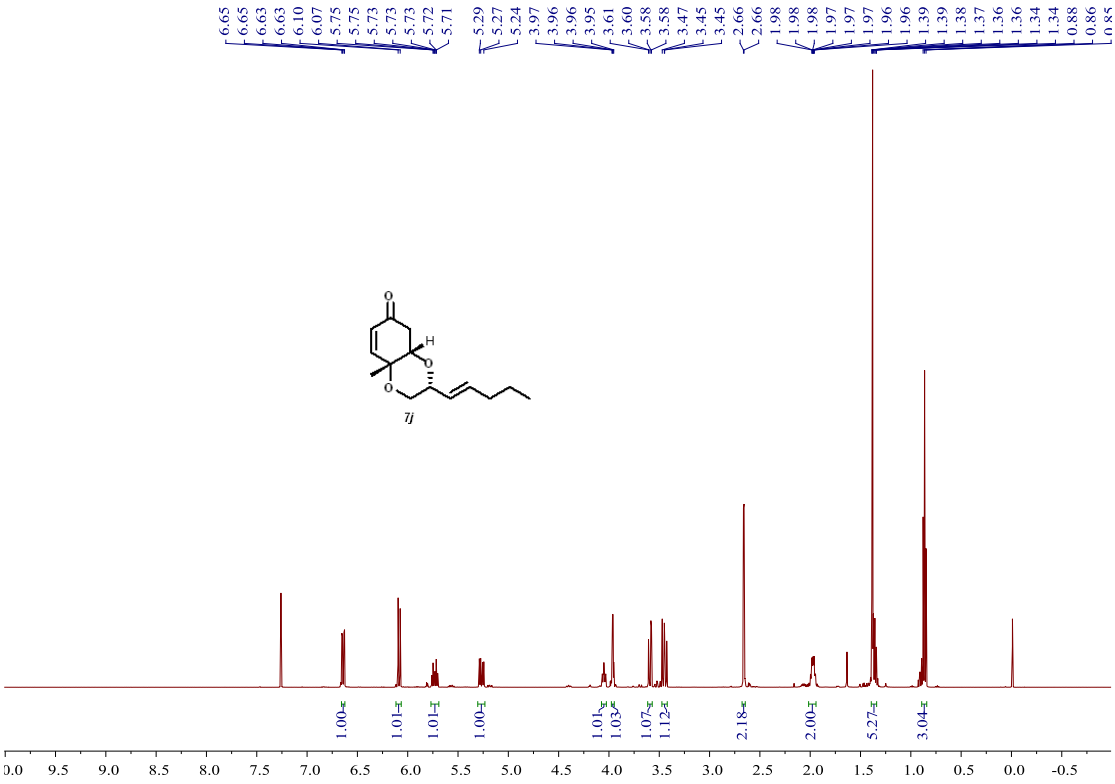
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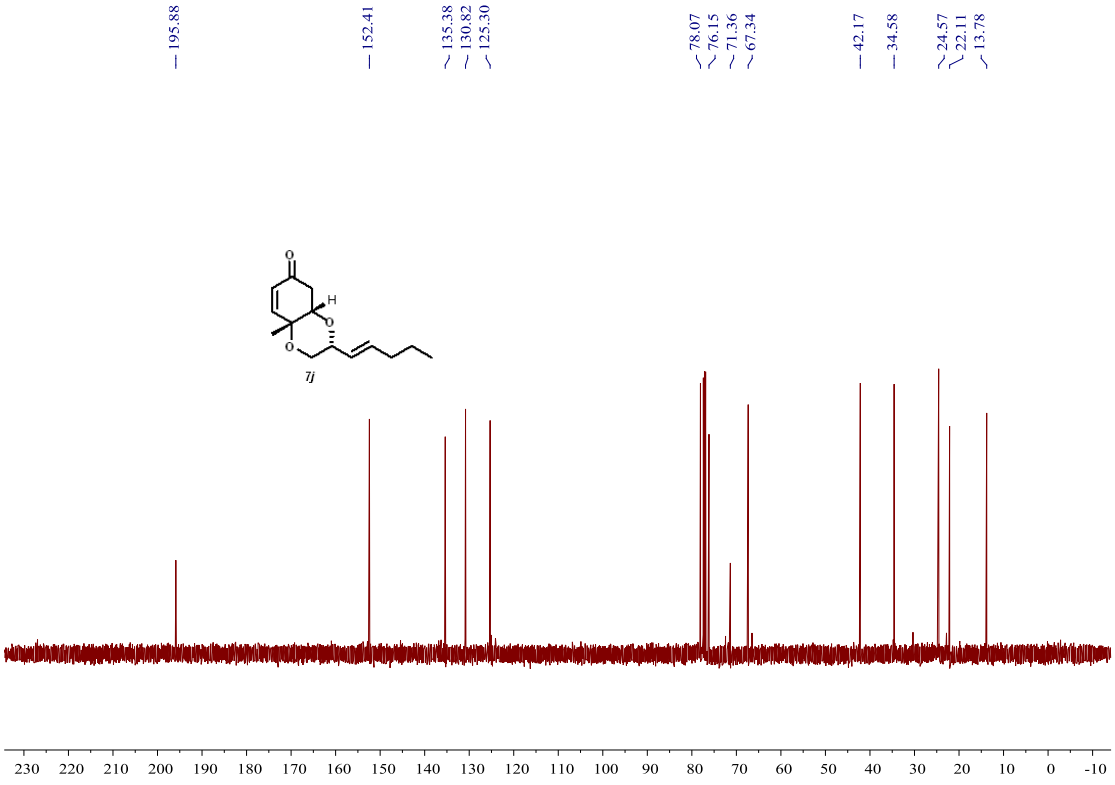
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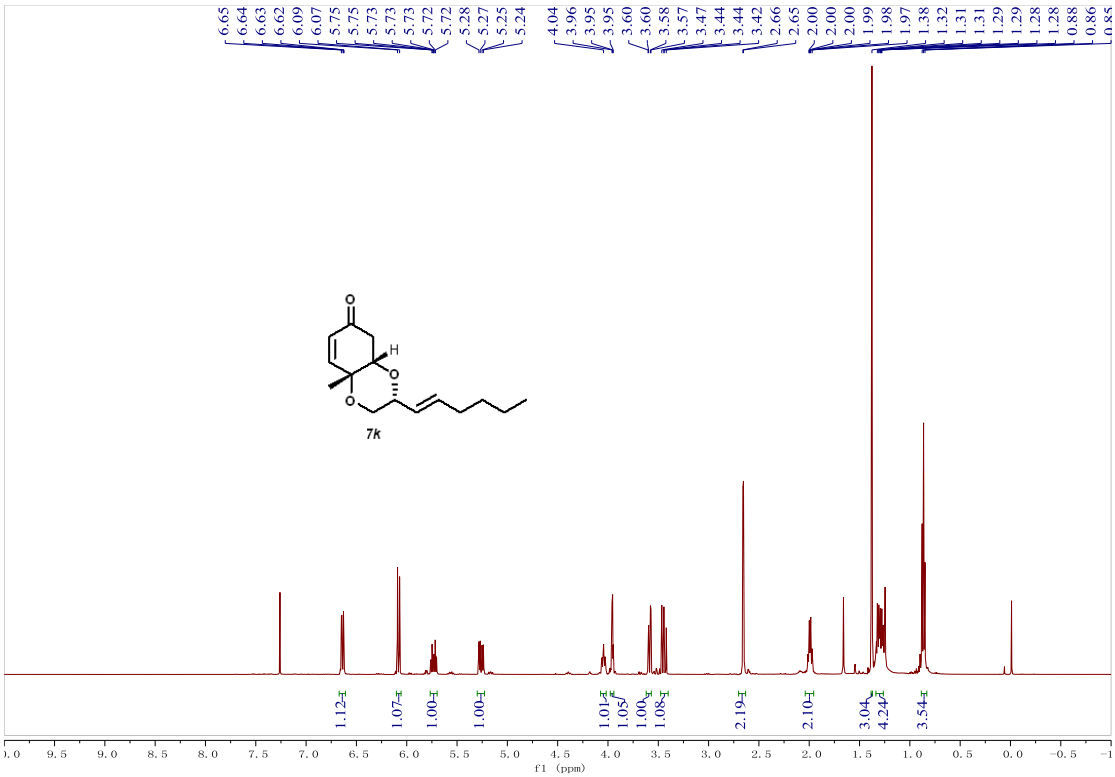
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1.12
1.07
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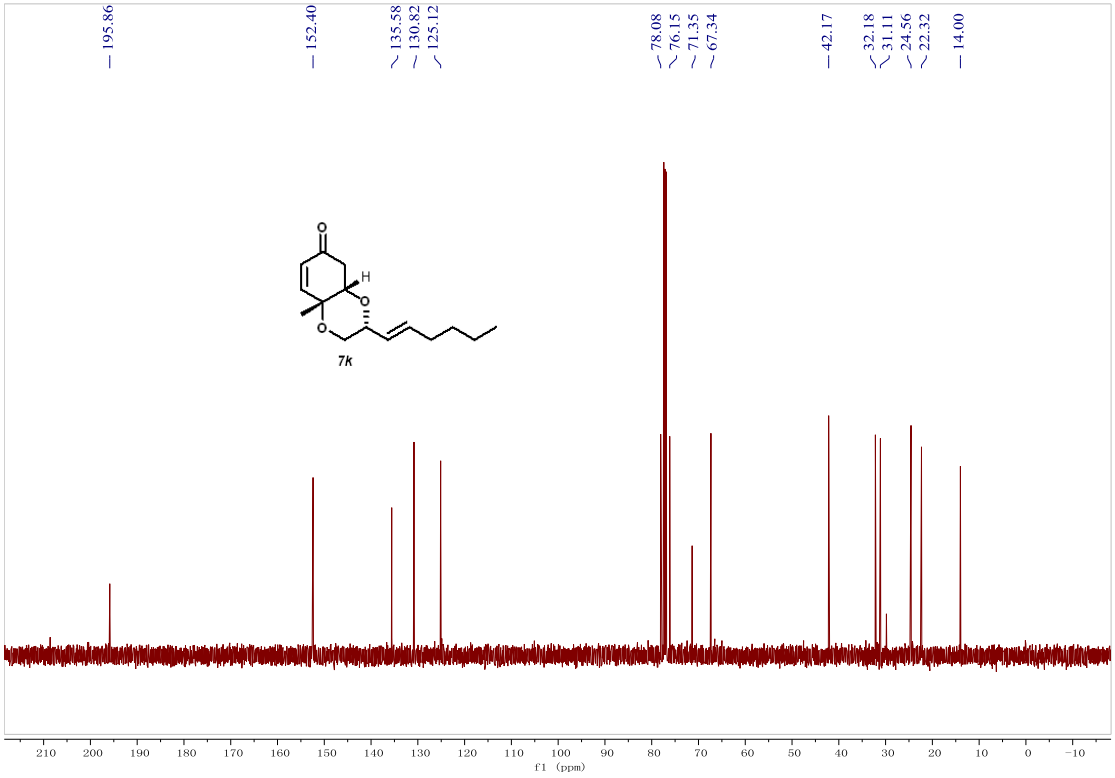
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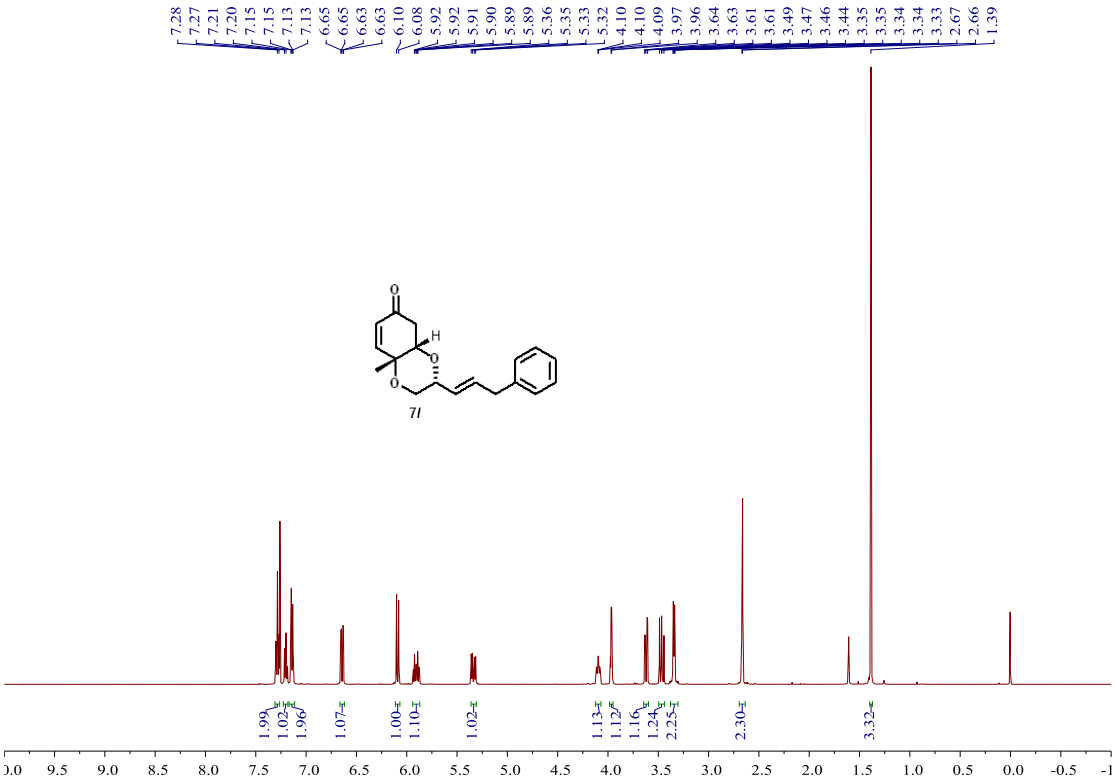
f1 (ppm)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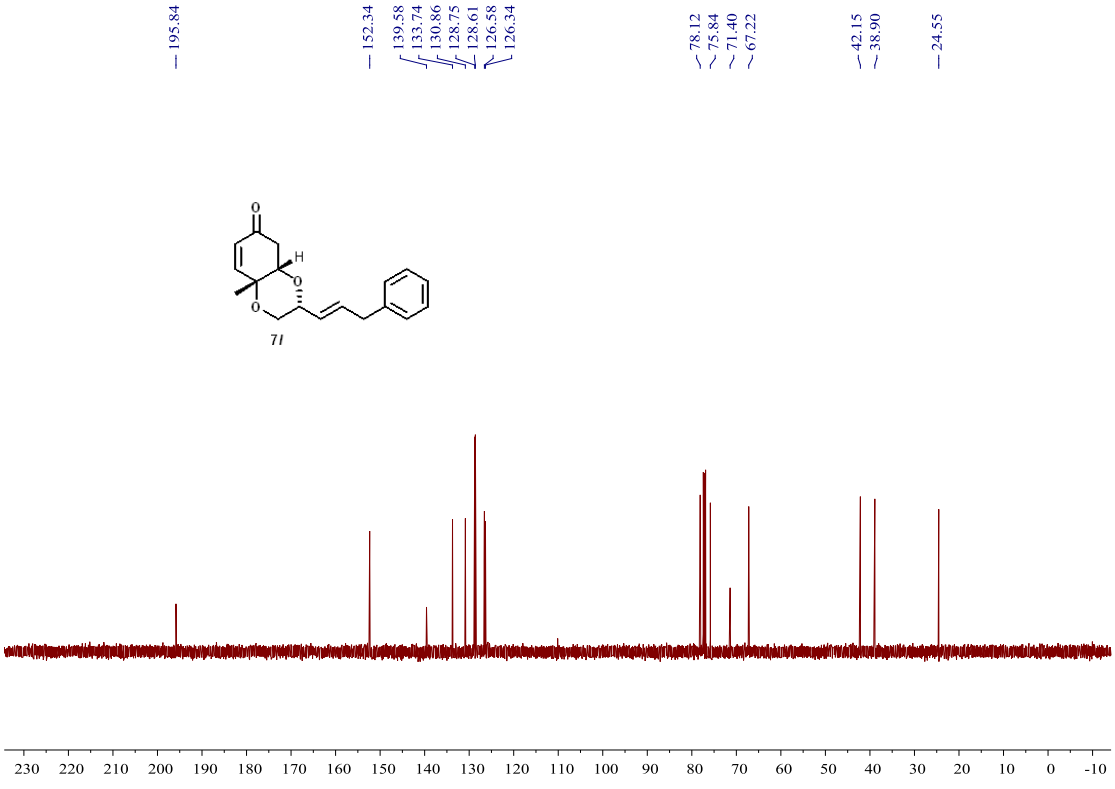
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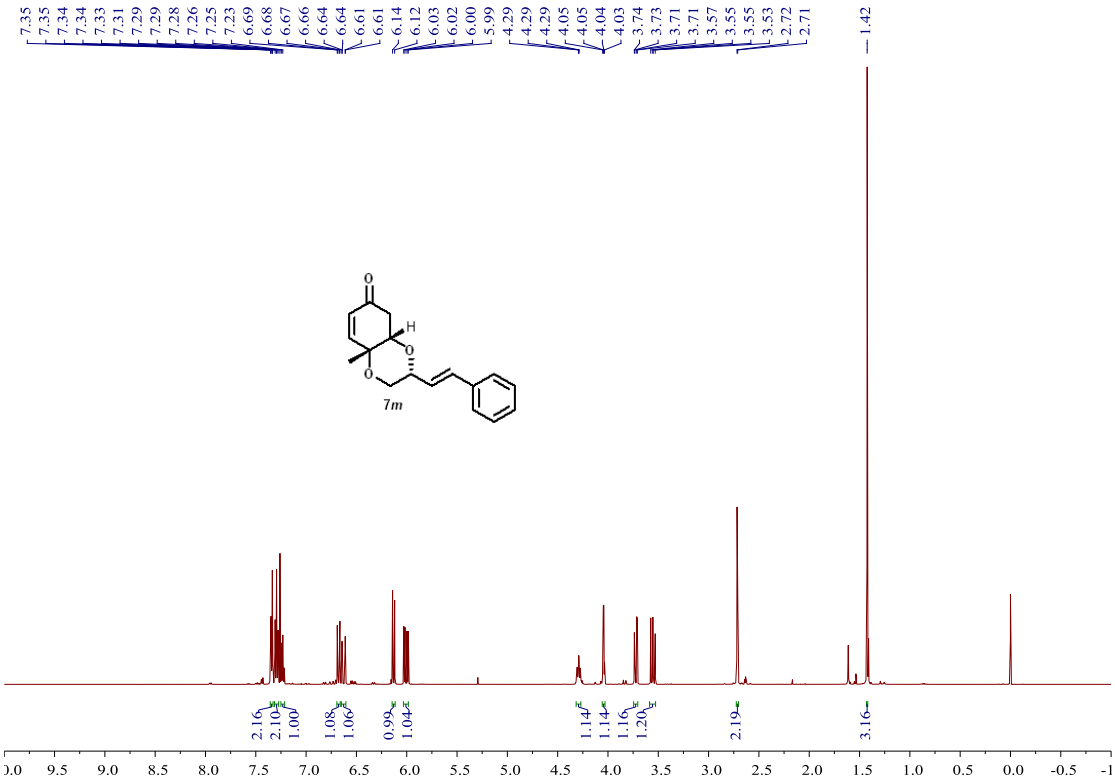
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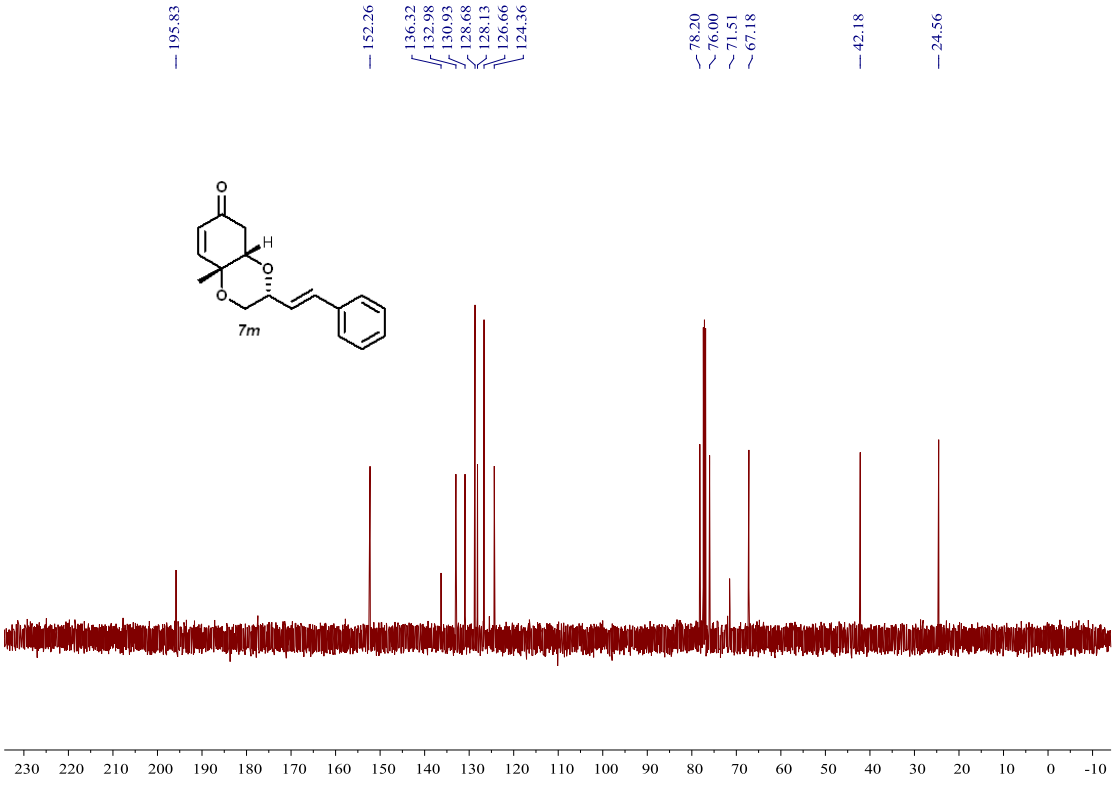
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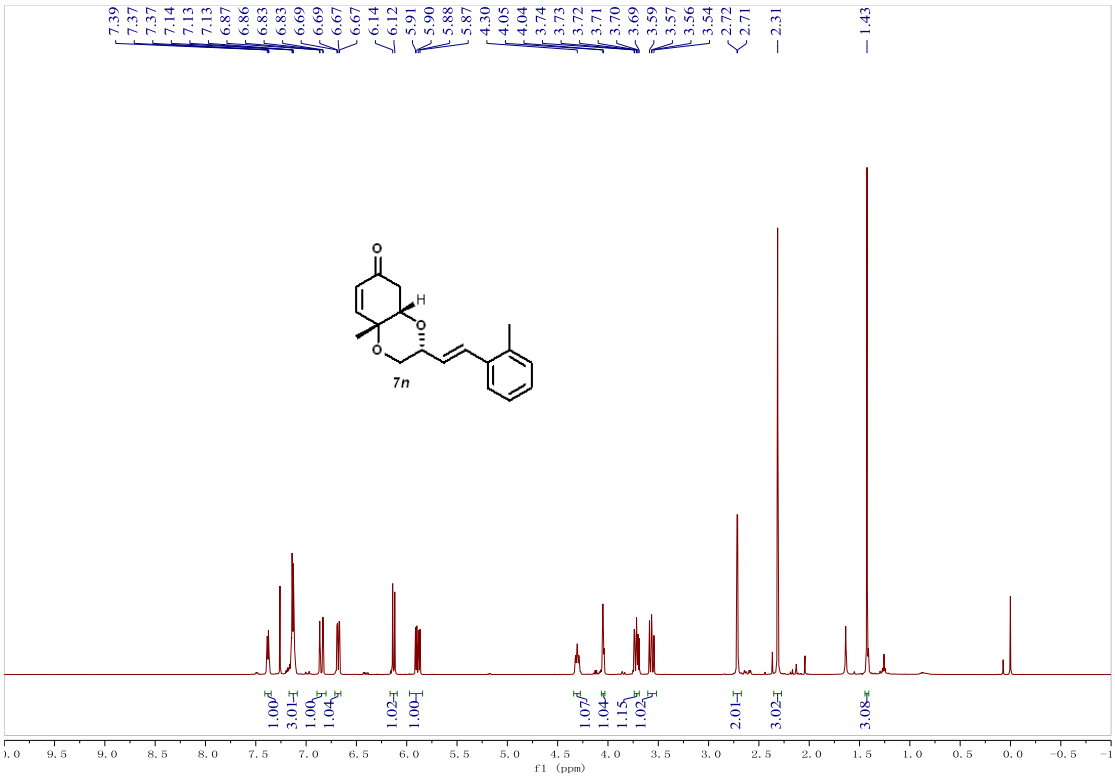
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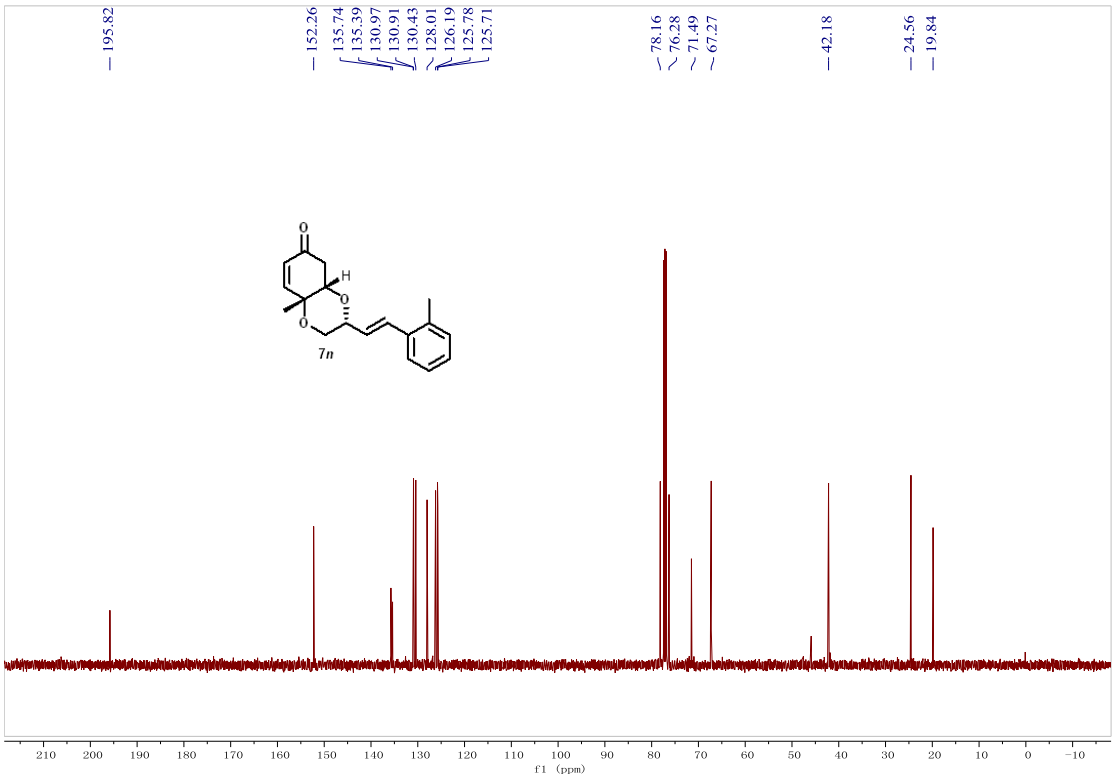
f1 (ppm)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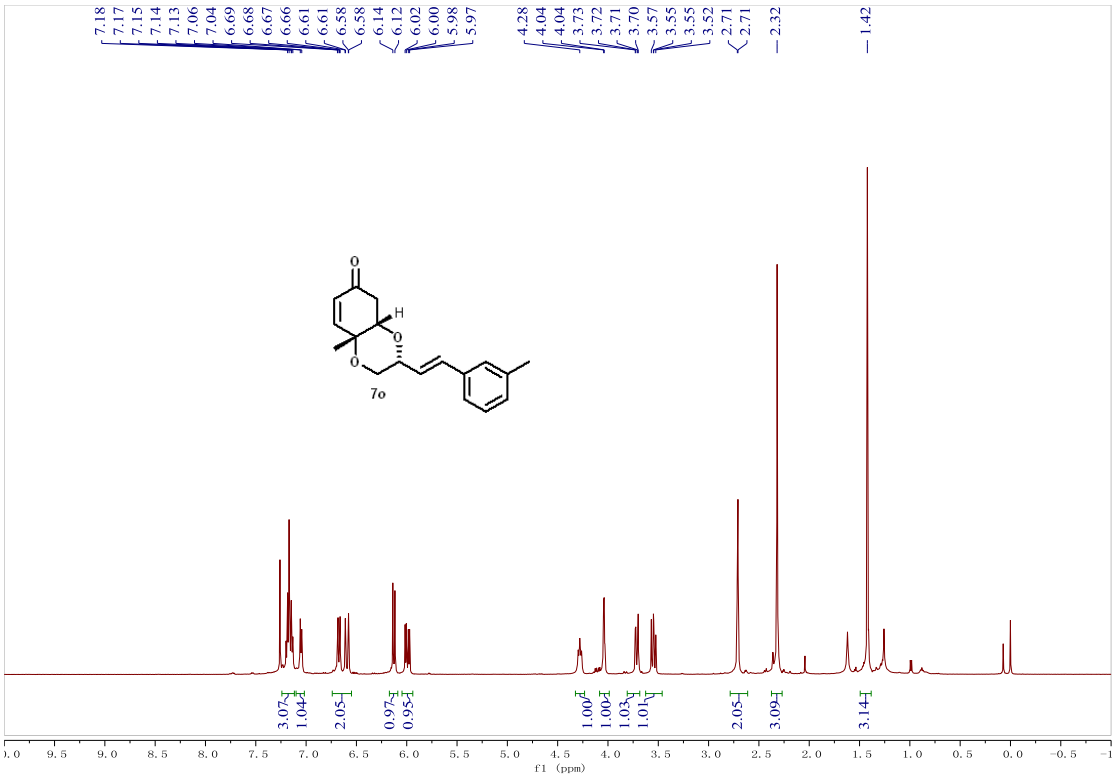
f1 (ppm)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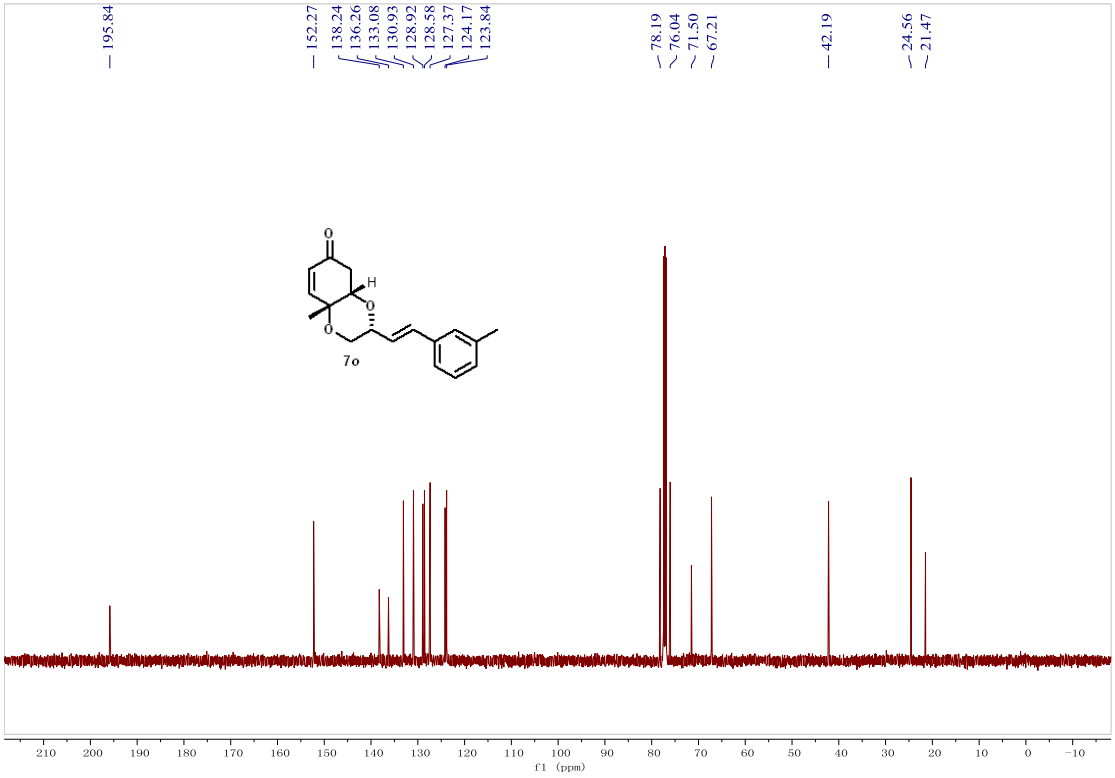
3.14
f1 (ppm)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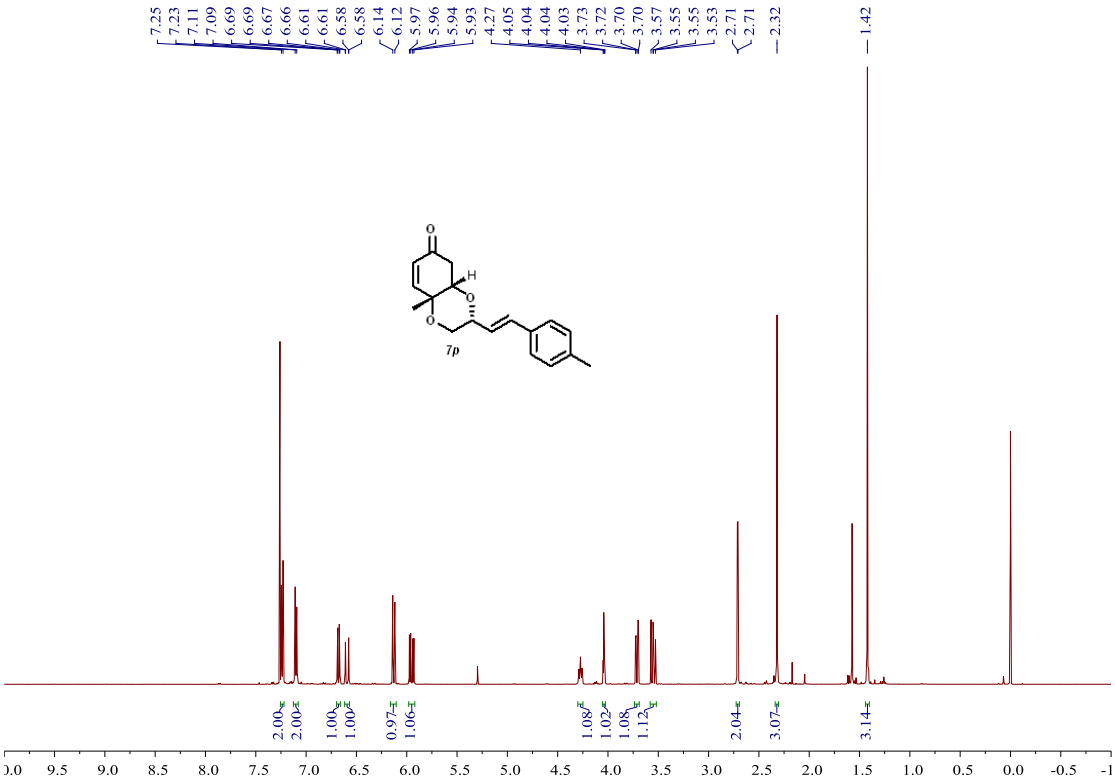
f1 (ppm)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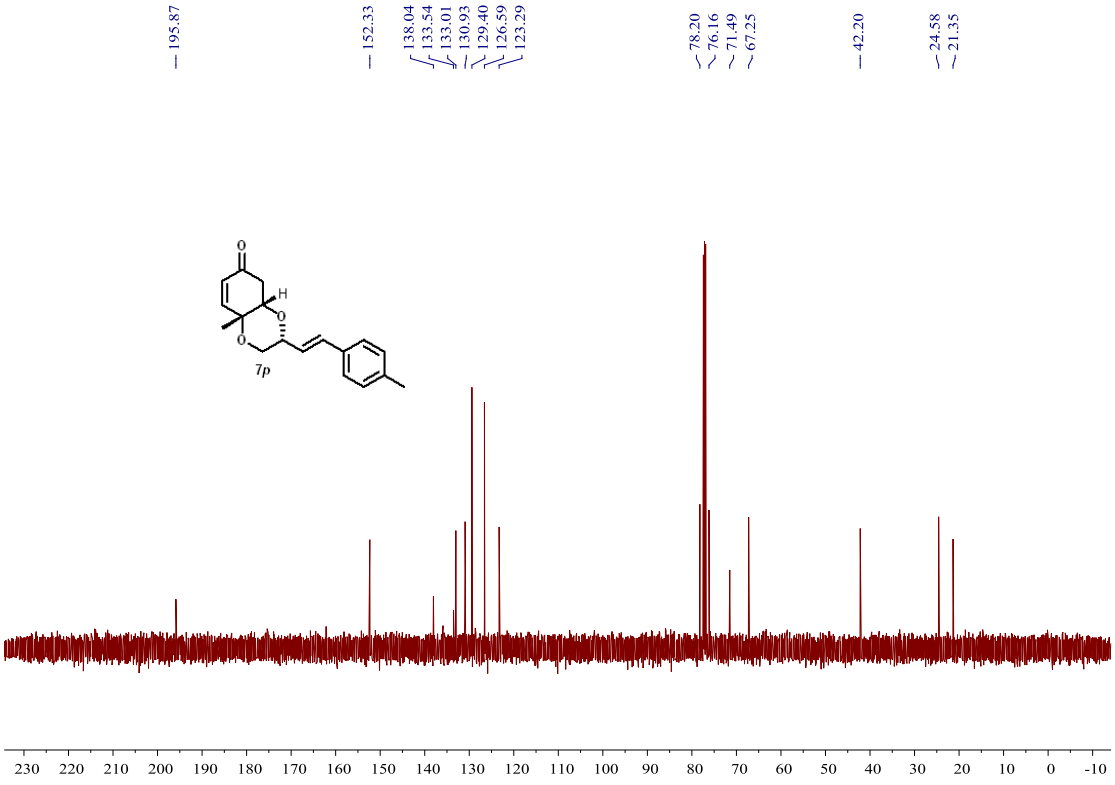
3.14
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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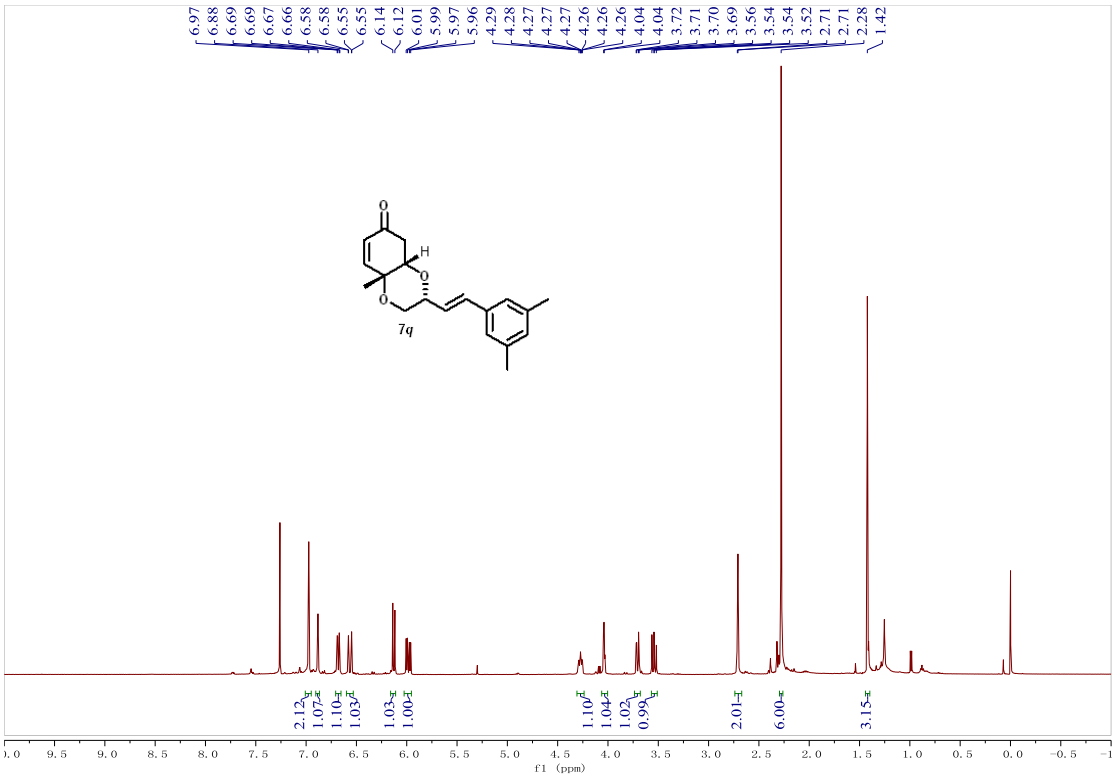
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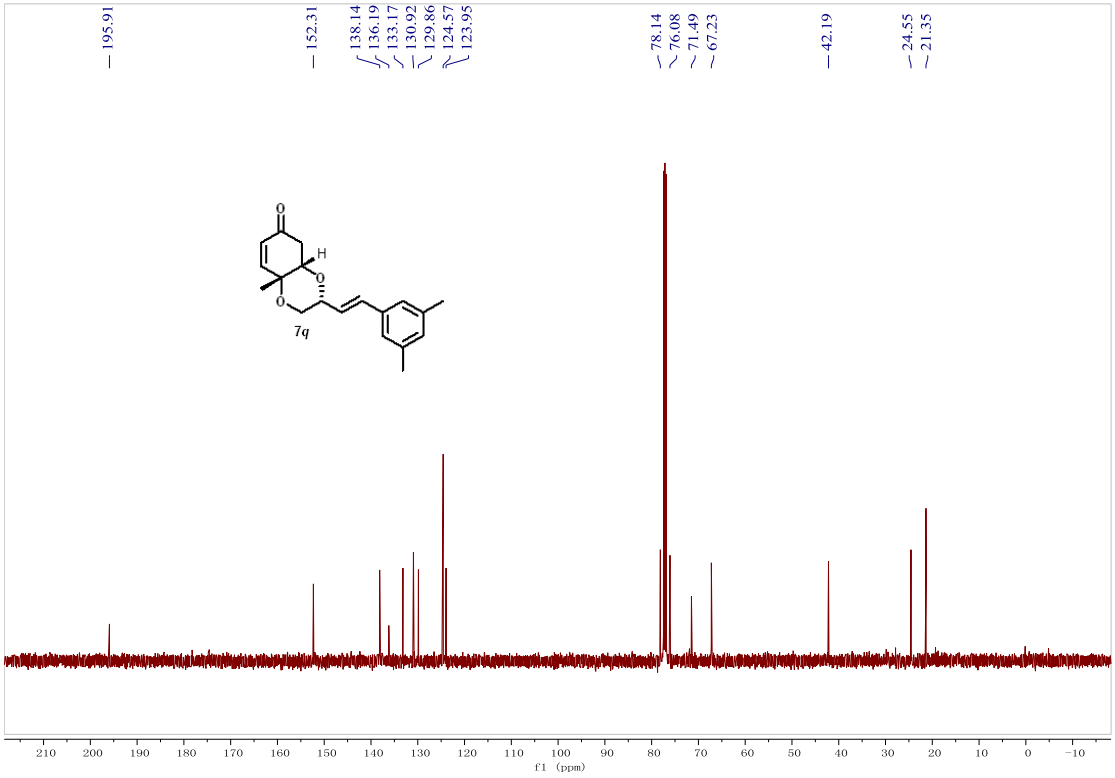
f1 (ppm)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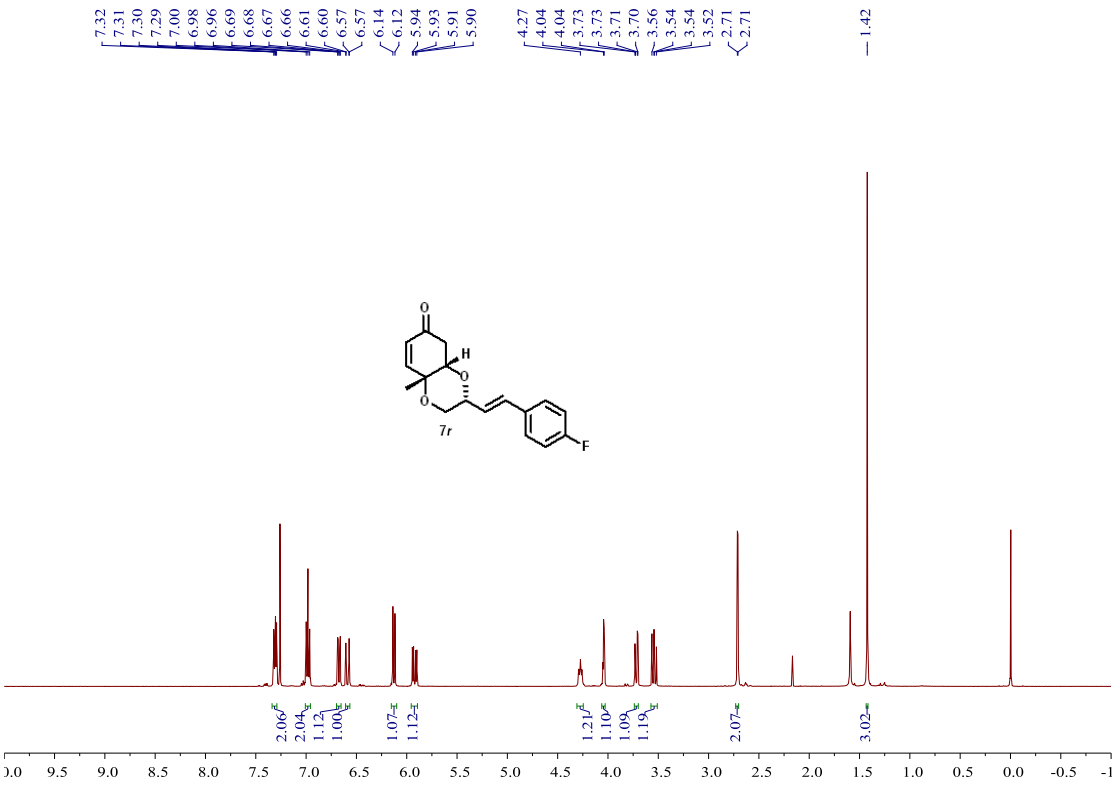
7q
f1 (ppm)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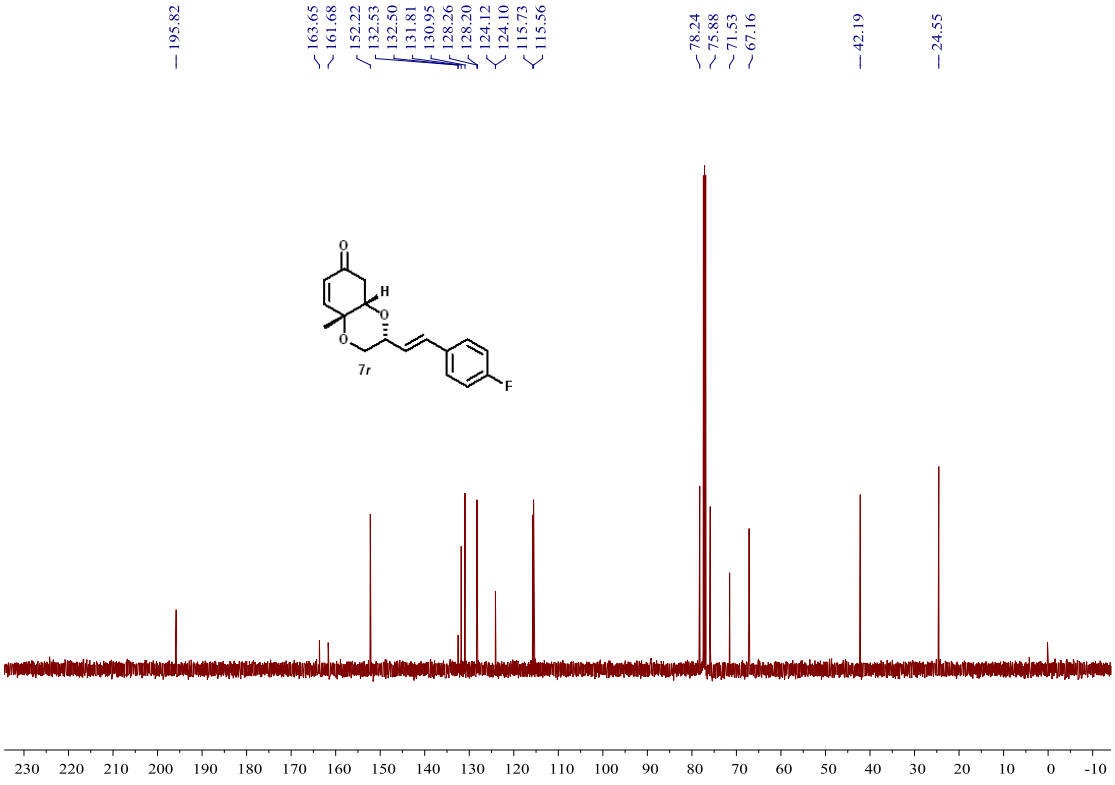
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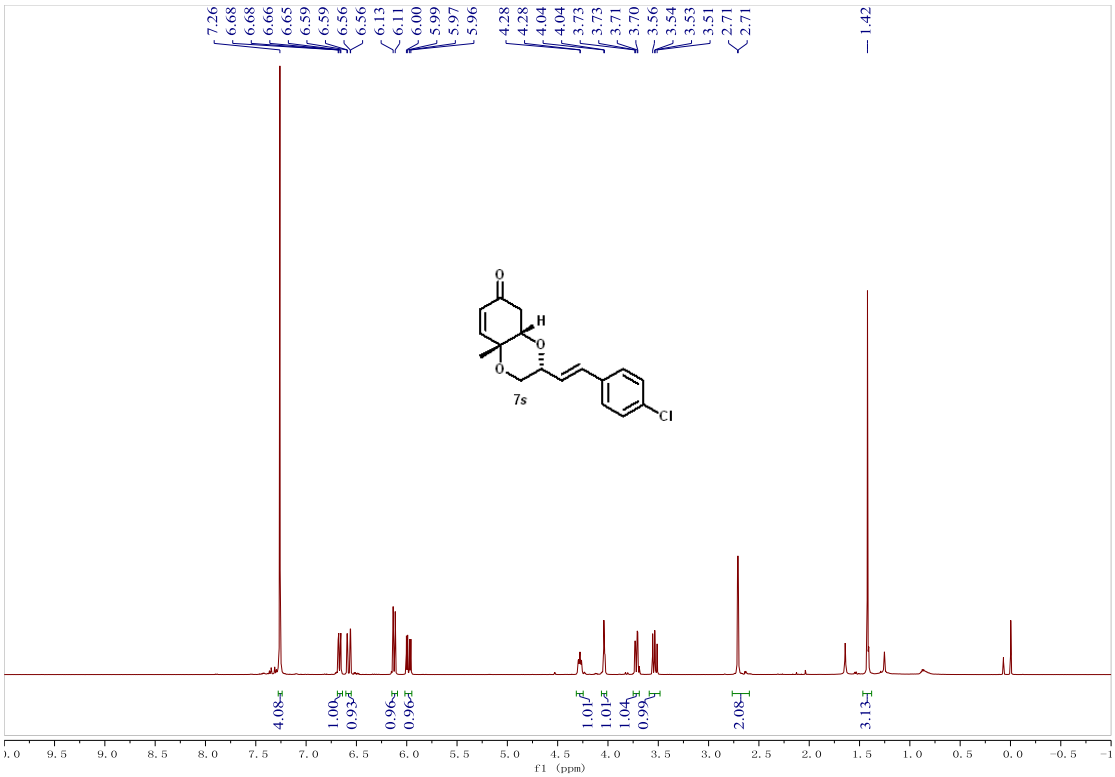
F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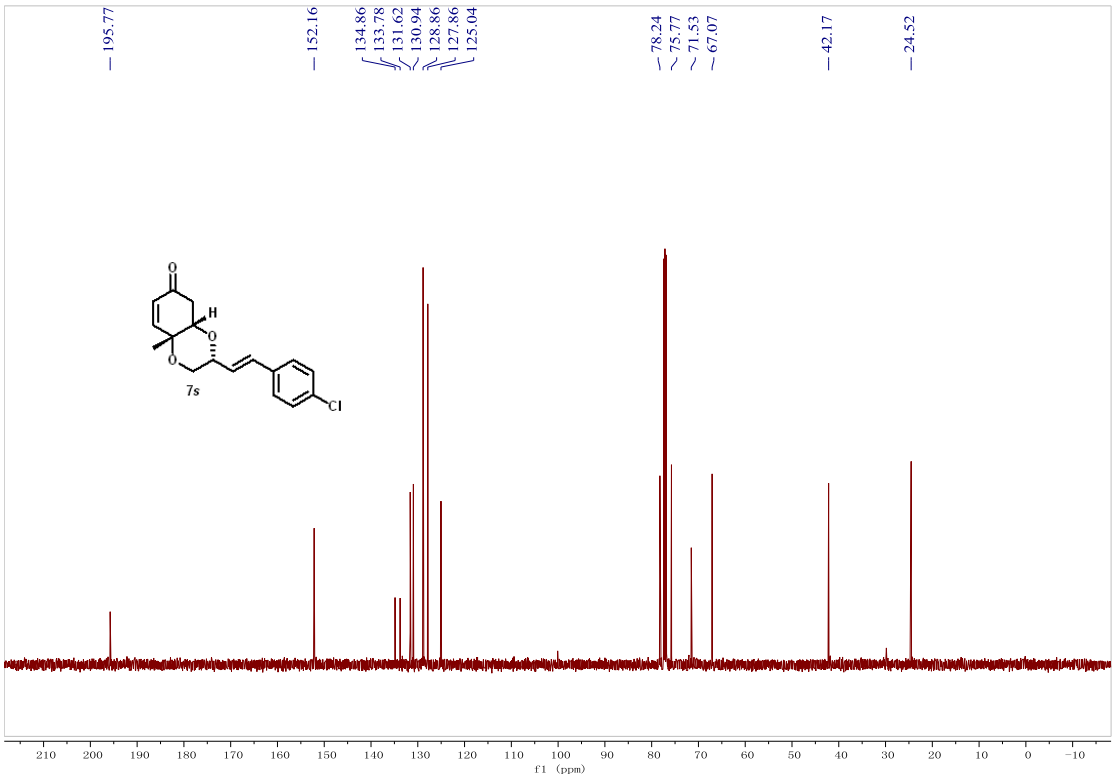
Cl
f1 (ppm)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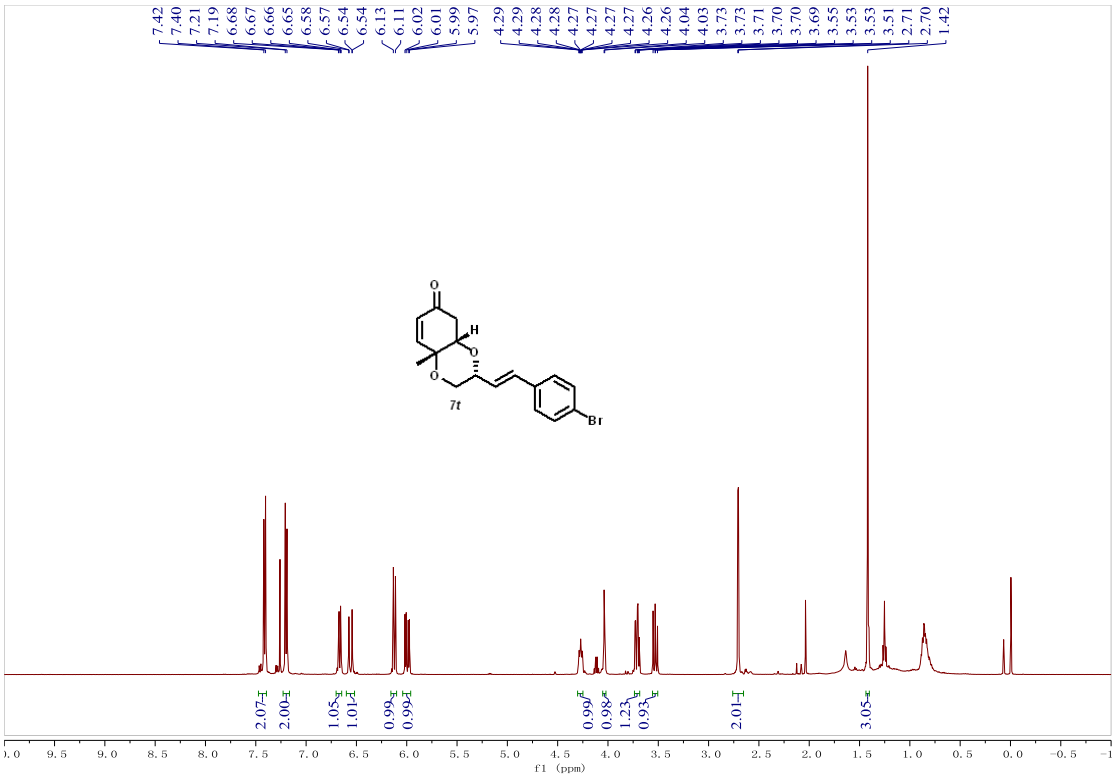
Cl
f1 (ppm)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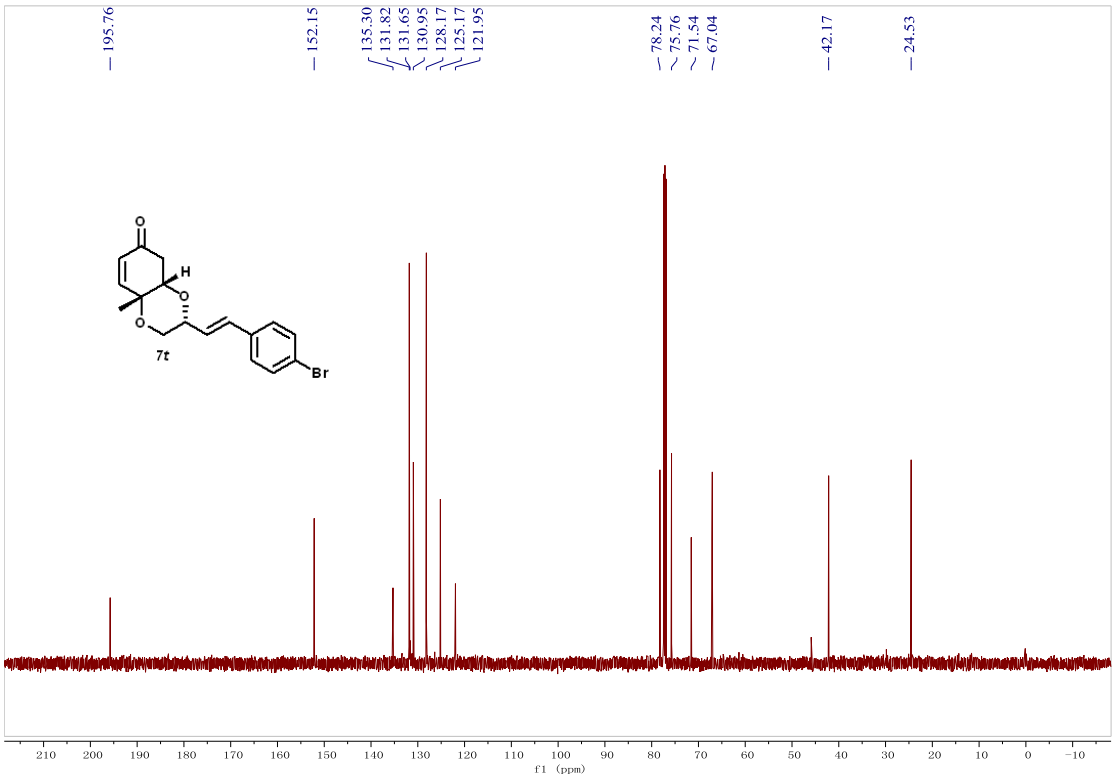
3.05
f1 (ppm)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24.53
7t
Br
f1 (ppm)