

**Supporting Information**

Poly(4-vinylimidazolium)s: A Highly Recyclable Organocatalyst Precursor for  
Benzoin Condensation Reaction

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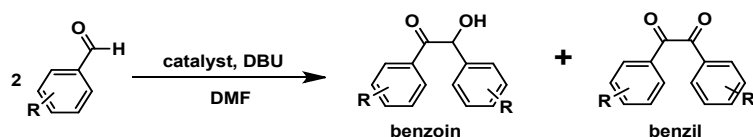
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## I. General Information

All solvents were obtained by passing through activated alumina columns of solvent purification systems from Glass Contour. *n*-Hexanes and ethyl acetate were used without further purification. Reagents were purchased from Sigma-Aldrich, Alfa Aesar, Acros, TCI and were used as received. Reactions were carried out in a flame-dried glassware equipped with a stirring bar and capped with a rubber septum under N<sub>2</sub>, unless otherwise indicated. Elevated temperatures were maintained in thermostat-controlled oil baths. The TLC plate was carried out on 0.25 mm E. Merck silica gel plates (60F-254) visualized by UV-light (254 nm) and treatment with acidic *p*-anisaldehyde and KMnO<sub>4</sub> stain followed by gentle heating. Workup procedures were done in air. Flash chromatography was carried out on Merck 60 silica gel (230 – 400 mesh). IR spectra were measured on a Thermo Scientific Nicolet 6700 spectrometer. <sup>1</sup>H and <sup>13</sup>C NMR spectra were recorded with Bruker (300 MHz) and Varian spectrometer (400 MHz) spectrometer. <sup>1</sup>H NMR spectra were referenced to residual TMS (0 ppm) except D<sub>2</sub>O (solvent reference, 4.79 ppm) and reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, ddd = doublet of doublet of doublets, ddt = doublet of doublet of triplets, dt = doublets of triplets, br s = broad singlet, m = multiplet). Chemical shifts of the <sup>13</sup>C NMR spectra were measured relative to CDCl<sub>3</sub> (77.16 ppm). Mass spectral data were obtained from the Korea Basic Science Institute (Daegu) on a Jeol JMS 700 high resolution mass spectrometer. Static light scattering (SLS) measurements were measured by Dynamic Light Scattering Spectrophotometer (DLS-7000) at National Instrumentation Center for Environmental Management (NICEM), College of Agriculture and Life Sciences, Seoul National University, Korea.

## II. General Procedure

### A. Procedure for the Synthesis of Benzoin and Benzils from Benzaldehydes

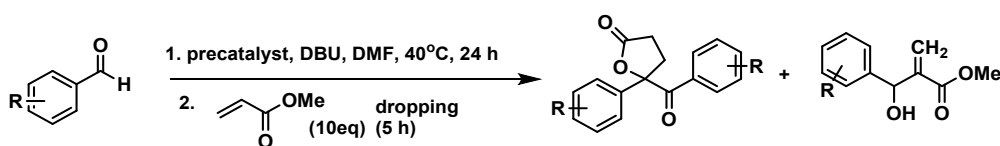


Reactions were performed in a schlenk tube equipped with a stirring bar and a rubber septum and the followings were placed in the tube in order: 7 mol% of catalyst (31 mg, 0.13 mmol), 1.8 mmol of benzaldehyde, 0.3 eq of DBU (81  $\mu$ L, 0.54 mmol) and 1 mL of DMF. After the mixture was stirred at 40  $^{\circ}$ C for 24 h, 0.45 mL of 4 M HCl in dioxane solution was added to the reaction mixture. The resulting solution was stirred for an additional 1 h. Addition of excess acetone to the reaction mixture led to precipitate poly(NHC)s. After filtration, the filtrate was concentrated under reduced pressure. Purification by a flash chromatography on silica gel column eluting with *n*-hexane and ethyl acetate affords benzoin and benzil as products. In a case of pyridine-3-carboxaldehyde, purification was done by using an alumina column eluting with dichloromethane and methanol.

\*Base screening

Entry	Base	Isolated yield (%)		
		Benzoin	Benzil	Total
1	t-BuOK	11	9	20
2	TEA	0	0	0
3	K <sub>2</sub> CO <sub>3</sub>	82	4	86
4	DBU	82	15	97

C. Procedure for the Synthesis of  $\gamma$ -Butyrolactones from Benzaldehyde and Methyl Acrylate.



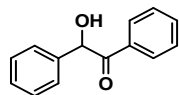
Reactions were performed in a flame-dried 8 mL Schlenk tube equipped with a stirring bar and a rubber septum. The flask was charged with 7 mol% of catalyst (31 mg, 0.13 mmol), 1.8 mmol of benzaldehyde, 30 mol% of DBU (81  $\mu$ L, 0.54 mmol) and 1 mL of DMF. The mixture was stirred at 40 °C for 24 h. Then, methyl acrylate (1.63 ml, 18 mmol) was added, and the reaction mixture was stirred for an additional 5 h. Water was added to the reaction mixture and products were extracted with ethyl acetate 5 times. The organic layer was dried over anhydrous MgSO<sub>4</sub> and concentrated under reduced pressure. Purification by flash chromatography on a silica gel column eluting with *n*-hexane and ethyl acetate afforded  $\gamma$ -butyrolactones and allylic alcohols, respectively.

### III. Recycling Experiment

A Schlenk tube was charged with 7 mol% of catalyst **2** (31 mg, 0.126 mmol), 0.3 equiv of DBU (81  $\mu$ L, 0.54 mmol), benzaldehyde (0.191 g, 1.8 mmol), and 1 mL of DMF. After the mixture was stirred for 24 h at 40 °C, poly(4-vinylNHC)s were successfully recovered by precipitation from the reaction mixture by addition of acetone. The filtrate was immediately introduced to the acid solution to avoid formation of benzil. 4 M HCl in dioxane solution was used for the acid solution. The solvent was evaporated from the filtrate, and the residue was purified by a flash column chromatography. The recovered poly(4-vinylNHC)s were reused for the next run of benzoin condensation reaction. The catalytic performance of poly(4-vinylNHC)s were well maintained during the seven times of the catalyst reuse, leading to benzoin and benzil products in a range of 97-100% isolated yields.

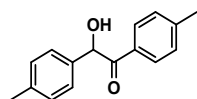
<sup>1</sup>H NMR, <sup>13</sup>C NMR, HRMS and Melting Point data of Products are Provided:

[benzoins]



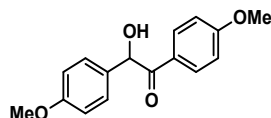
Benzoin

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.95 – 7.88 (m, 2 H), 7.51 (t, *J* = 7.4 Hz, 1 H), 7.39 (t, *J* = 7.7 Hz, 2 H), 7.34 – 7.23 (m, 5 H), 5.95 (d, *J* = 6.1 Hz, 1 H), 4.55 (d, *J* = 6.1 Hz, 1 H) ppm. <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 199.0, 139.1, 134.0, 133.6, 129.2(2), 128.7, 128.6, 127.8, 76.3 ppm. HRMS (EI) calc. for [C<sub>14</sub>H<sub>12</sub>O<sub>2</sub>]: 212.0837, found: 212.0835. **m.p.**: 131 °C, white solid.



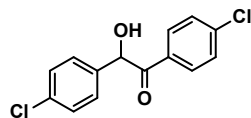
p-Methyl benzoin

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.72 (d, *J* = 8.2 Hz, 2 H), 7.12 (d, *J* = 8.0 Hz, 2 H), 7.06 (d, *J* = 8.1 Hz, 2 H), 7.00 (d, *J* = 7.9 Hz, 2 H), 5.80 (d, *J* = 5.5 Hz, 1 H), 4.50 (d, *J* = 5.9 Hz, 1 H), 2.22 (s, 3 H), 2.16 (s, 3 H) ppm. <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 198.5, 144.9, 138.3, 136.4, 130.9, 129.8, 129.3(2), 127.6, 75.8, 21.7, 21.1 ppm. HRMS (EI) calc. for [C<sub>16</sub>H<sub>16</sub>O<sub>2</sub>]: 240.1150, found: 240.1151. **m.p.**: 86 °C, white solid.



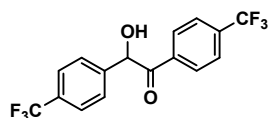
p-Methoxy benzoin

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 7.89 (d, *J* = 8.9 Hz, 2 H), 7.24 (d, *J* = 8.7 Hz, 2 H), 6.83 (dd, *J* = 8.8, 2.9 Hz, 4 H), 5.85 (d, *J* = 5.4 Hz, 1 H), 4.61 (d, *J* = 5.7 Hz, 1 H), 3.78 (s, 3 H), 3.72 (s, 3 H) ppm. <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 197.4, 164.1, 159.7, 131.9, 131.6, 129.1, 126.4, 114.6, 114.0, 75.3, 55.6, 55.3 ppm. HRMS (EI) calc. for [C<sub>16</sub>H<sub>16</sub>O<sub>4</sub>]: 272.1049, found: 272.1049. **m.p.**: 108 °C, white solid.



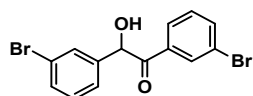
p-Chloro benzoin

<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>) δ 7.82 (d, *J* = 8.4 Hz, 2 H), 7.37 (d, *J* = 8.4 Hz, 2 H), 7.27 (q, *J* = 8.5 Hz, 4 H), 5.88 (s, 1 H), 4.53 (bs, 1 H) ppm. <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 197.4, 140.6, 137.2, 134.7, 131.5, 130.4, 129.4, 129.2, 129.1, 75.5 ppm. HRMS (EI) calc. for [C<sub>14</sub>H<sub>10</sub>Cl<sub>2</sub>O<sub>2</sub>]: 280.0058, found: 280.0057. **m.p.**: 87 °C, white solid.



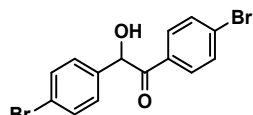
p-Trifluoromethyl benzoin

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 8.00 (d, *J* = 8.2 Hz, 2 H), 7.69 (d, *J* = 8.3 Hz, 2 H), 7.60 (d, *J* = 8.1 Hz, 2 H), 7.45 (d, *J* = 8.1 Hz, 2 H), 6.02 (d, *J* = 5.9 Hz, 1 H), 4.51 (d, *J* = 5.9 Hz, 1 H) ppm. **<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 197.8, 142.6, 136.0, 135.7, 135.3, 131.4, 131.0, 129.5, 128.2, 126.4(q, *J* = 3.8 Hz), 126.1(q, *J* = 3.6 Hz), 76.1 ppm. **HRMS (EI)** calc. for [C<sub>16</sub>H<sub>10</sub>F<sub>6</sub>O<sub>2</sub>]: 348.0585, found: 348.0583. **m.p.:** 93 °C, white solid.



m-Bromo benzoin

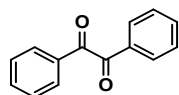
**<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 8.06 (s, 1 H), 7.77 (d, *J* = 7.4 Hz, 1 H), 7.65 (d, *J* = 7.5 Hz, 1 H), 7.53 – 7.37 (m, 2 H), 7.33 – 7.17 (m, 3 H), 5.86 (s, 1 H), 4.45 (bs, 1 H) ppm. **<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)** δ 197.2, 140.4, 136.9, 134.9, 131.9(2), 130.7, 130.6, 130.3, 127.5, 126.3, 123.2, 123.1, 75.5 ppm. **HRMS (EI)** calc. for [C<sub>14</sub>H<sub>10</sub>Br<sub>2</sub>O<sub>2</sub>]: 367.9048, found: 367.9044. **m.p.:** 57 °C, yellow solid.



p-Bromo benzoin

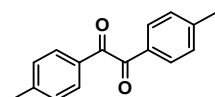
**<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 7.74 (d, *J* = 8.4 Hz, 2 H), 7.56 (d, *J* = 8.6 Hz, 2 H), 7.46 (d, *J* = 8.8 Hz, 2 H), 7.18 (d, *J* = 8.1 Hz, 2 H), 5.86 (d, *J* = 6.0 Hz, 1 H), 4.46 (d, *J* = 6.3 Hz, 1 H) ppm. **<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 197.7, 137.7, 132.5, 132.3, 132.0, 130.6, 129.6, 129.4, 123.1, 75.6 ppm. **HRMS (EI)** calc. for [C<sub>14</sub>H<sub>8</sub>Br<sub>2</sub>O<sub>2</sub>]: 367.9048, found: 367.9049. **m.p.:** 92 °C, white solid.

### [benzils]



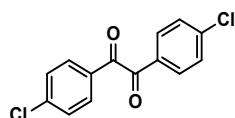
Benzil

**<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 7.98 (d, *J* = 7.6 Hz, 4 H), 7.67 (t, *J* = 7.4 Hz, 2H), 7.52 (t, *J* = 7.7 Hz, 4 H) ppm. **<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 194.7, 135.0, 133.1, 130.0, 129.1 ppm. **HRMS (EI)** calc. for [C<sub>14</sub>H<sub>10</sub>O<sub>2</sub>]: 210.0681, found: 210.0684. **m.p.:** 92 °C, yellow solid.



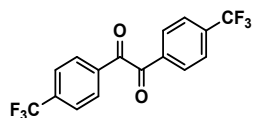
p-methyl benzil

**<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 7.86 (d, *J* = 8.2 Hz, 4 H), 7.30 (d, *J* = 8.0 Hz, 4 H), 2.43 (s, 6H) ppm. **<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)** δ 194.6, 146.2, 130.8, 130.1, 129.8, 22.0 ppm. **HRMS (EI)** calc. for [C<sub>16</sub>H<sub>14</sub>O<sub>2</sub>]: 238.0994, found: 238.0996. **m.p.:** 94 °C, yellow solid.



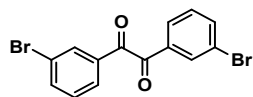
p-Chloro benzil

$^1\text{H NMR}$  (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.92 (d,  $J = 8.6$  Hz, 4 H), 7.50 (d,  $J = 8.6$  Hz, 4 H) ppm.  $^{13}\text{C NMR}$  (100 MHz,  $\text{CDCl}_3$ )  $\delta$  192.5, 141.9, 131.4, 131.2, 129.6 ppm. **HRMS (EI)** calc. for  $[\text{C}_{14}\text{H}_8\text{Cl}_2\text{O}_2]$ : 277.9901, found: 277.9901. **m.p.**: 195 °C, yellow solid.



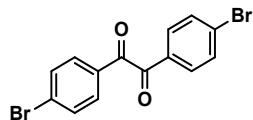
p-Trifluoromethyl benzil

$^1\text{H NMR}$  (300 MHz,  $\text{CDCl}_3$ )  $\delta$  8.12 (d,  $J = 8.1$  Hz, 4 H), 7.81 (d,  $J = 8.3$  Hz, 4 H) ppm.  $^{13}\text{C NMR}$  (75 MHz,  $\text{CDCl}_3$ )  $\delta$  192.0, 136.6, 136.1, 135.3, 130.5, 126.3(q,  $J = 3.7$  Hz) ppm. **HRMS (EI)** calc. for  $[\text{C}_{16}\text{H}_8\text{F}_6\text{O}_2]$ : 346.0428, found: 346.0431. **m.p.**: 132 °C, white solid.



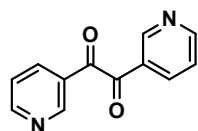
m-Bromo benzil

$^1\text{H NMR}$  (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.13 (t,  $J = 1.8$  Hz, 2 H), 7.89 (ddd,  $J = 7.8, 1.6, 1.1$  Hz, 2 H), 7.81 (ddd,  $J = 8.0, 2.0, 1.1$  Hz, 2 H), 7.42 (dd,  $J = 11.7, 4.1$  Hz, 2 H) ppm.  $^{13}\text{C NMR}$  (100 MHz,  $\text{CDCl}_3$ )  $\delta$  192.0, 138.1, 134.4, 132.7, 130.7, 128.7, 123.5 ppm. **HRMS (EI)**  $[\text{C}_{14}\text{H}_8\text{Br}_2\text{O}_2]$ : 365.8891, found: 365.8894. **m.p.**: 122 °C, yellow solid.



p-Bromo benzil

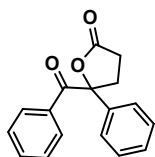
$^1\text{H NMR}$  (300 MHz,  $\text{CDCl}_3$ )  $\delta$  7.84 (d,  $J = 8.5$  Hz, 4 H), 7.67 (d,  $J = 8.5$  Hz, 4 H) ppm.  $^{13}\text{C NMR}$  (75 MHz,  $\text{CDCl}_3$ )  $\delta$  192.6, 132.6, 131.6, 131.4, 130.9 ppm. **HRMS (EI)**  $[\text{C}_{14}\text{H}_8\text{Br}_2\text{O}_2]$ : 365.8891, found: 365.8889. **m.p.**: 220 °C, yellow solid.



1,2-Di(pyridin-3-yl)ethane-1,2-dione

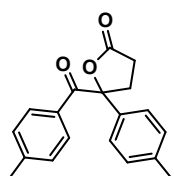
$^1\text{H NMR}$  (400 MHz,  $\text{CDCl}_3$ )  $\delta$  9.20 – 9.15 (m, 2 H), 8.87 (dd,  $J = 4.8, 1.7$  Hz, 2 H), 8.32 (dt,  $J = 8.0, 2.0$  Hz, 2 H), 7.49 (dd,  $J = 8.0, 4.9$  Hz, 2 H) ppm.  $^{13}\text{C NMR}$  (100 MHz,  $\text{CDCl}_3$ )  $\delta$  191.0, 155.2, 151.5, 137.1, 128.3, 124.0 ppm. **HRMS (EI)**  $[\text{C}_{12}\text{H}_8\text{N}_2\text{O}_2]$ : 212.0586, found: 212.0587.

[lactones]



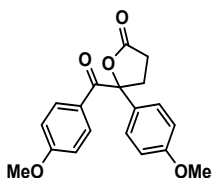
5-Benzoyl-5-phenyltetrahydro-2(3H)-furanone

$^1\text{H NMR}$  (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.98 – 7.92 (m, 2 H), 7.47 (m, 3 H), 7.42 – 7.36 (m, 2 H), 7.33 (ddd,  $J = 7.5, 4.3, 1.9$  Hz, 3 H), 3.42 (ddd,  $J = 13.0, 8.2, 7.1$  Hz, 1 H), 2.63 – 2.52 (m, 2 H), 2.33 (dt,  $J = 13.0, 8.4$  Hz, 1 H) ppm.  $^{13}\text{C NMR}$  (75 MHz,  $\text{CDCl}_3$ )  $\delta$  195.3, 175.5, 139.4, 133.6, 133.5, 130.8, 129.3, 128.6, 128.3, 123.8, 92.1, 34.4, 29.0 ppm. HRMS (EI) calc. for  $[\text{C}_{17}\text{H}_{14}\text{O}_3]$ : 266.0943, found: 266.0940, colorless oil.



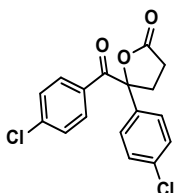
5-(4-Methylbenzoyl)-5-(4-methylphenyl)-tetrahydro-2(3H)-furanone

$^1\text{H NMR}$  (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.89 – 7.84 (m, 2 H), 7.37 – 7.32 (m, 2 H), 7.18 (d,  $J = 7.9$  Hz, 2 H), 7.14 – 7.10 (m, 2 H), 3.39 (m, 1 H), 2.59 – 2.51 (m, 2 H), 2.34 – 2.25 (m, 7 H) ppm.  $^{13}\text{C NMR}$  (75 MHz,  $\text{CDCl}_3$ )  $\delta$  194.9, 175.8, 144.4, 138.4, 136.7, 131.0, 131.0, 129.9, 129.0, 123.7, 92.3, 34.4, 28.1, 21.7, 21.1 ppm. HRMS (EI) calc. for  $[\text{C}_{19}\text{H}_{18}\text{O}_5]$ : 294.1256, found: 294.1256, colorless oil.



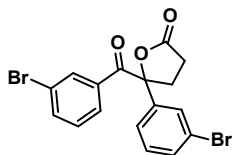
5-(4-Methoxybenzoyl)-5-(4-methoxyphenyl)-tetrahydro-2(3H)-furanone

$^1\text{H NMR}$  (400 MHz,  $\text{CDCl}_3$ )  $\delta$  8.00 – 7.94 (m, 2 H), 7.40 – 7.34 (m, 2 H), 6.92 – 6.87 (m, 2 H), 6.83 – 6.78 (m, 2 H), 3.79 (s, 3 H), 3.77 (s, 3 H), 3.38 (m, 1 H), 2.58 – 2.51 (m, 2 H), 2.29 (dt,  $J = 13.0, 8.3$  Hz, 1 H) ppm.  $^{13}\text{C NMR}$  (75 MHz,  $\text{CDCl}_3$ )  $\delta$  193.7, 175.8, 163.6, 159.6, 133.2, 131.6, 126.3, 125.1, 114.5, 113.5, 92.0, 55.4, 55.2, 34.3, 28.0 ppm. HRMS (EI) calc. for  $[\text{C}_{19}\text{H}_{18}\text{O}_5]$ : 326.1154, found: 326.1154, pale-yellow oil.



5-(4-Chlorobenzoyl)-5-(4-chlorophenyl)-tetrahydro-2(3H)-furanone

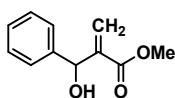
$^1\text{H NMR}$  (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.91 – 7.86 (m, 2 H), 7.38 (s, 4 H), 7.34 – 7.30 (m, 2 H), 3.42 (ddd,  $J = 13.2, 8.3, 6.8$  Hz, 1 H), 2.62 – 2.54 (m, 2 H), 2.28 (dd,  $J = 8.6, 4.5$  Hz, 1 H) ppm.  $^{13}\text{C NMR}$  (75 MHz,  $\text{CDCl}_3$ )  $\delta$  193.7, 175.0, 140.3, 137.7, 134.9, 132.1, 131.6, 129.6, 128.8, 125.2, 91.5, 34.2, 27.9 ppm. HRMS (FAB, [M+H]) calc. for  $[\text{C}_{17}\text{H}_{13}\text{Cl}_2\text{O}_3]$ : 335.0242, found: 335.0243, colorless oil.



5-(3-Bromobenzoyl)-5-(3-bromophenyl)-tetrahydro-2(3H)-furanone

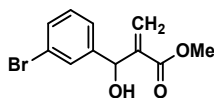
**<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>)** δ 8.08 (t, *J* = 1.8 Hz, 1 H), 7.85 (m, 1 H), 7.62 (m, 2 H), 7.48 (m, 1 H), 7.38 (m, 1 H), 7.31 – 7.19 (m, 2 H), 3.46 – 3.38 (m, 1 H), 2.61 – 2.55 (m, 2 H), 2.33 – 2.27 (m, 1 H) ppm. **<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 193.6, 174.9, 141.3, 136.7, 135.0, 133.4, 132.1, 131.1, 130.0, 129.5, 126.9, 123.8, 122.8, 122.4, 91.2, 34.3, 27.9 ppm. **HRMS (EI)** calc. for [C<sub>17</sub>H<sub>12</sub>Br<sub>2</sub>O<sub>3</sub>]: 421.9153, found: 421.9156, colorless oil.

### [allylic alcohols]



Methyl 2-(hydroxy(phenyl)methyl)acrylate

**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.31 – 7.11 (m, 5 H), 6.25 (s, 1 H), 5.76 (s, 1 H), 5.47 (s, 1 H), 3.62 (s, 3 H), 3.08 (s, 1 H) ppm. **<sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>)** 166.8, 142.0, 141.3, 128.5, 127.9, 126.6, 126.1, 73.2, 52.0 ppm. **HRMS (EI)** calc. for [C<sub>11</sub>H<sub>12</sub>O<sub>3</sub>]: 192.0786, found: 192.0783. colorless oil.

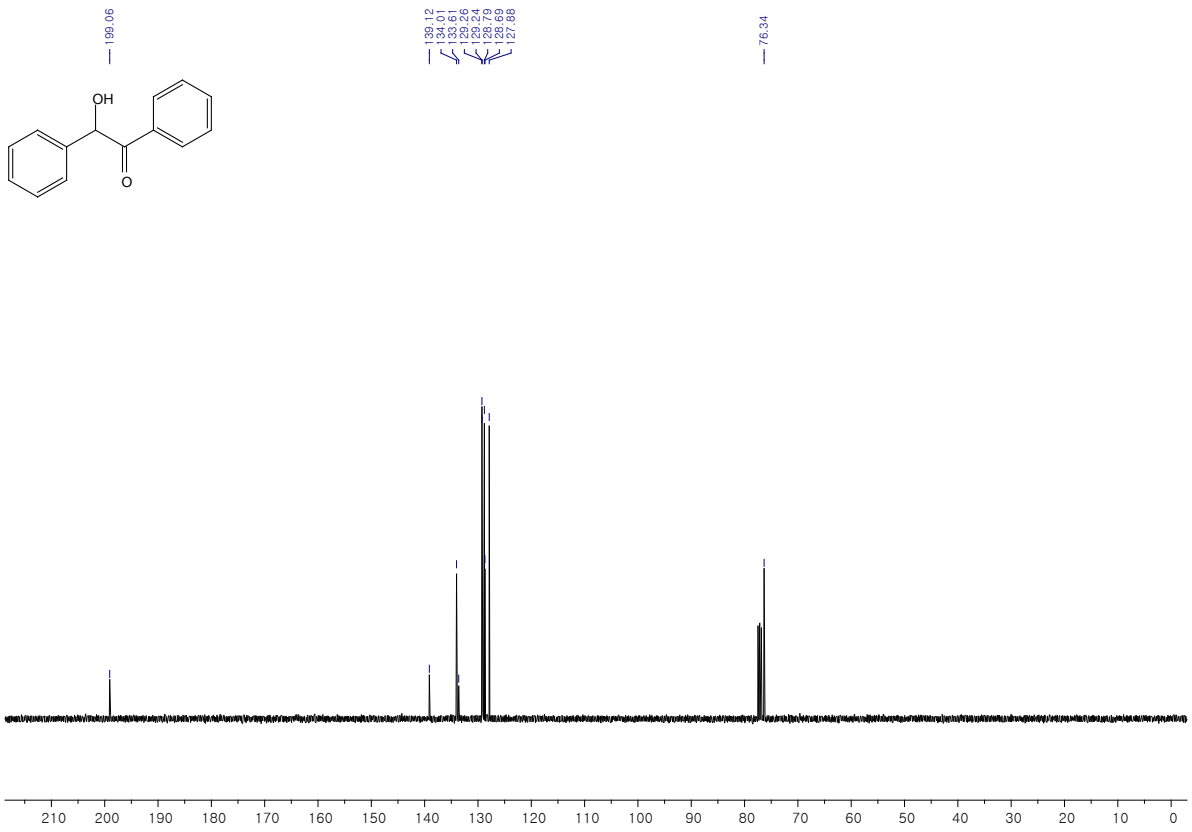
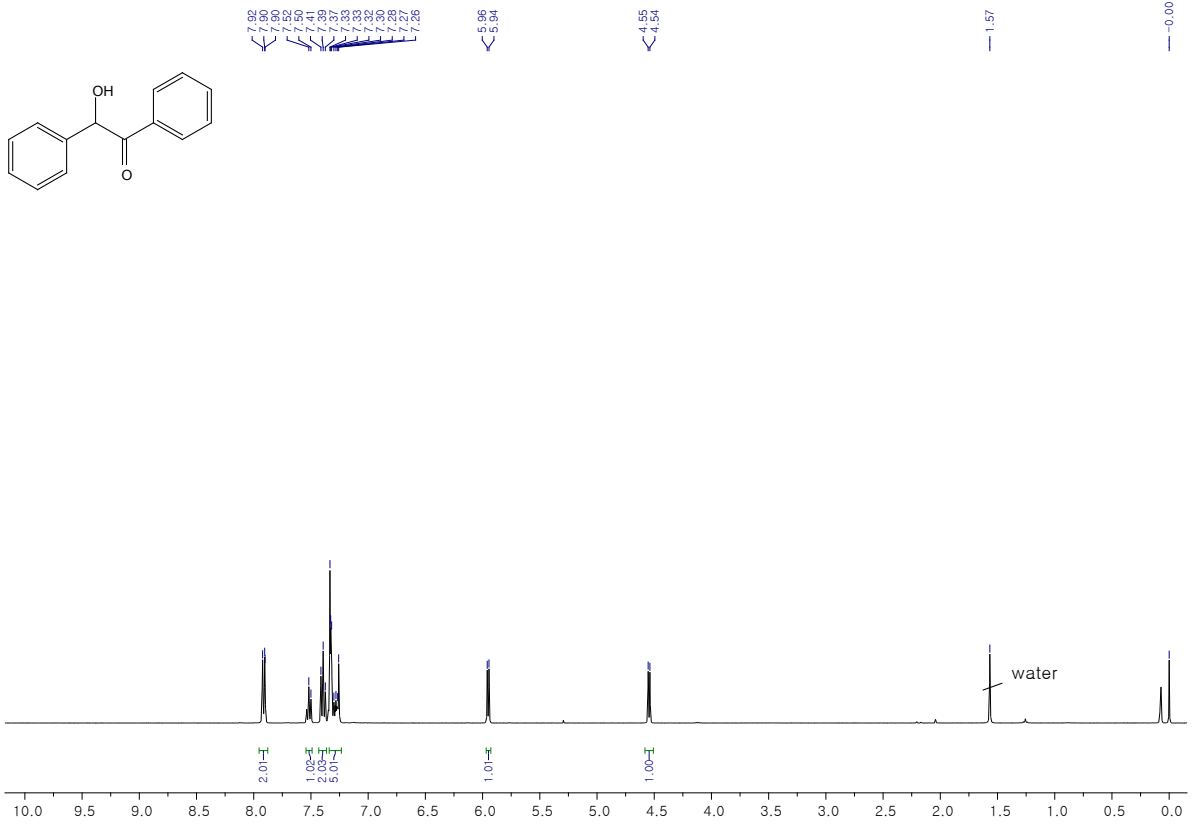


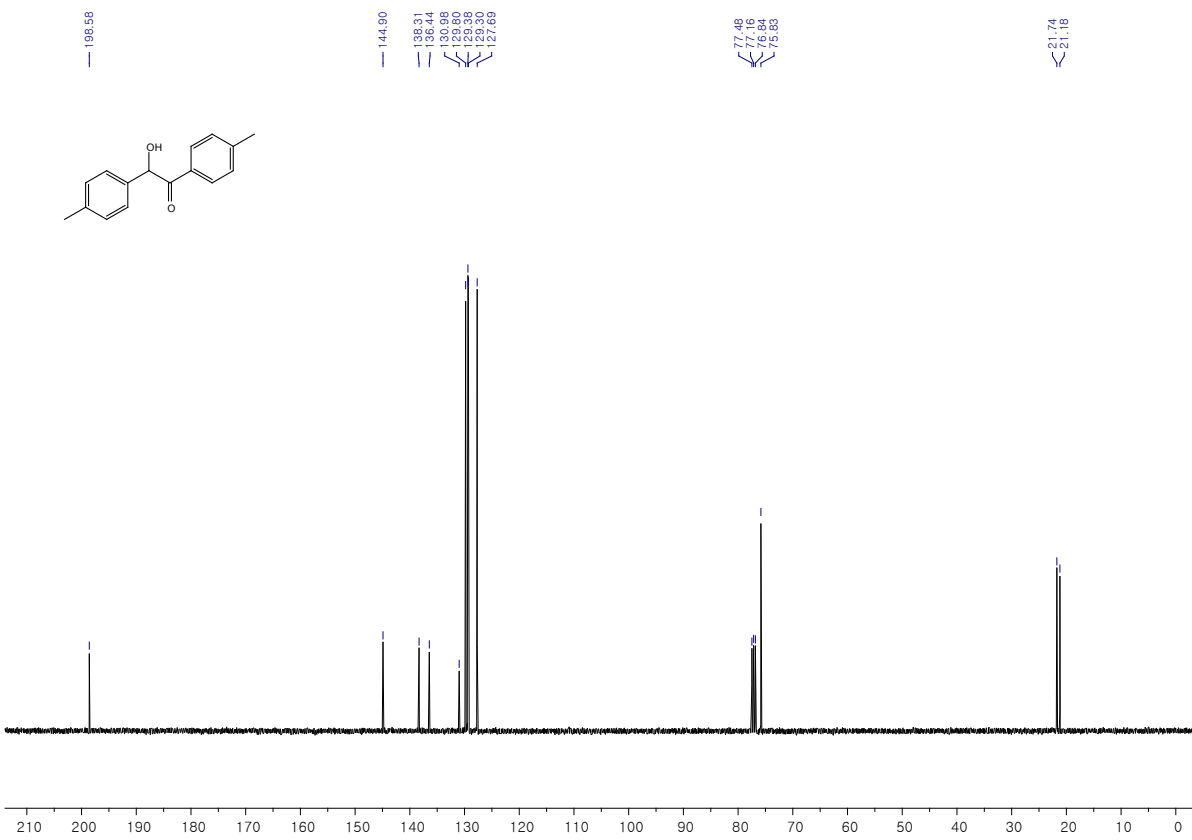
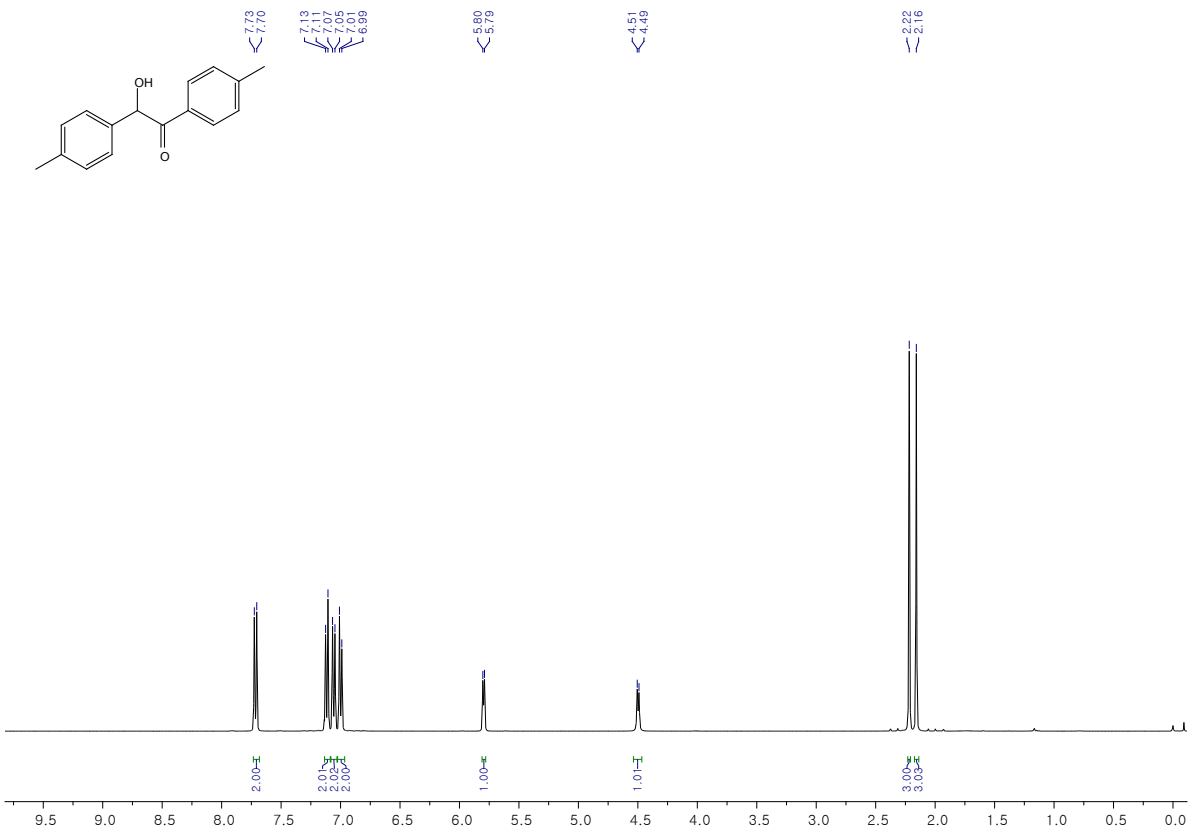
Methyl 2-((3-bromophenyl)(hydroxy)methyl)acrylate

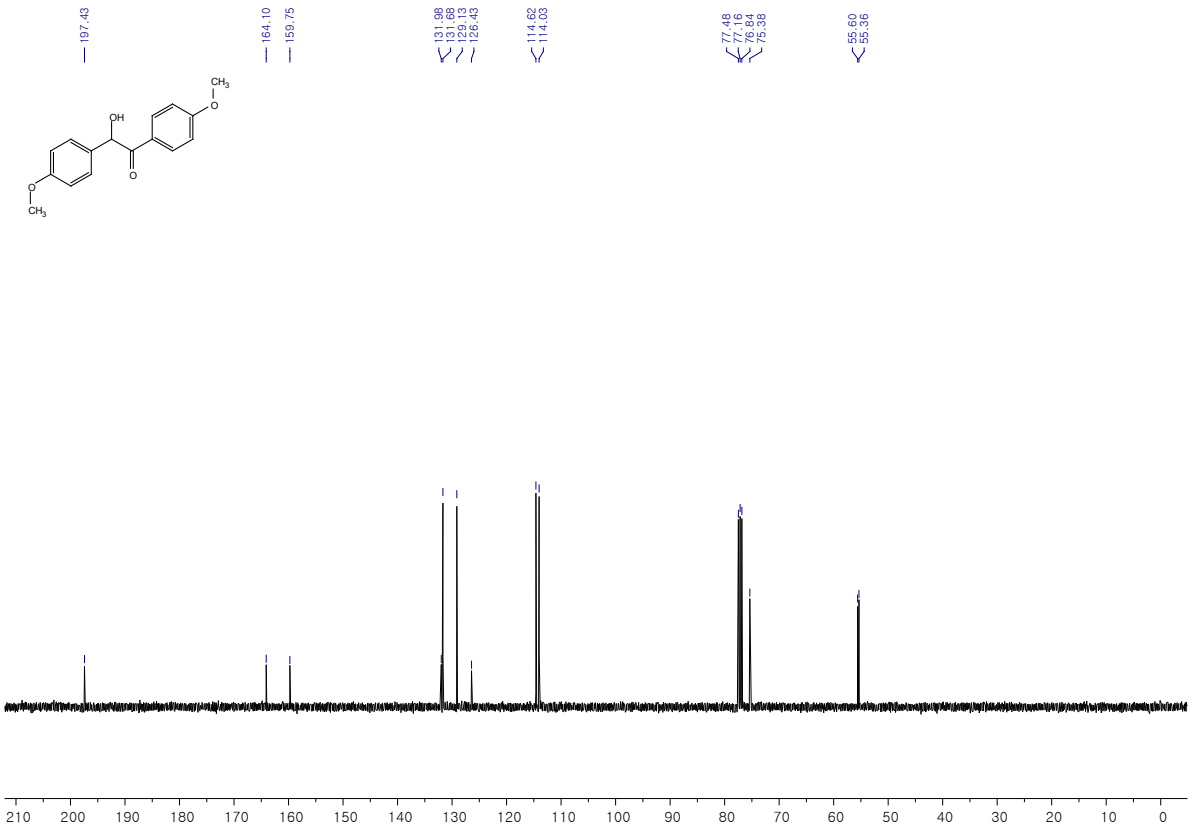
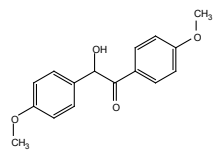
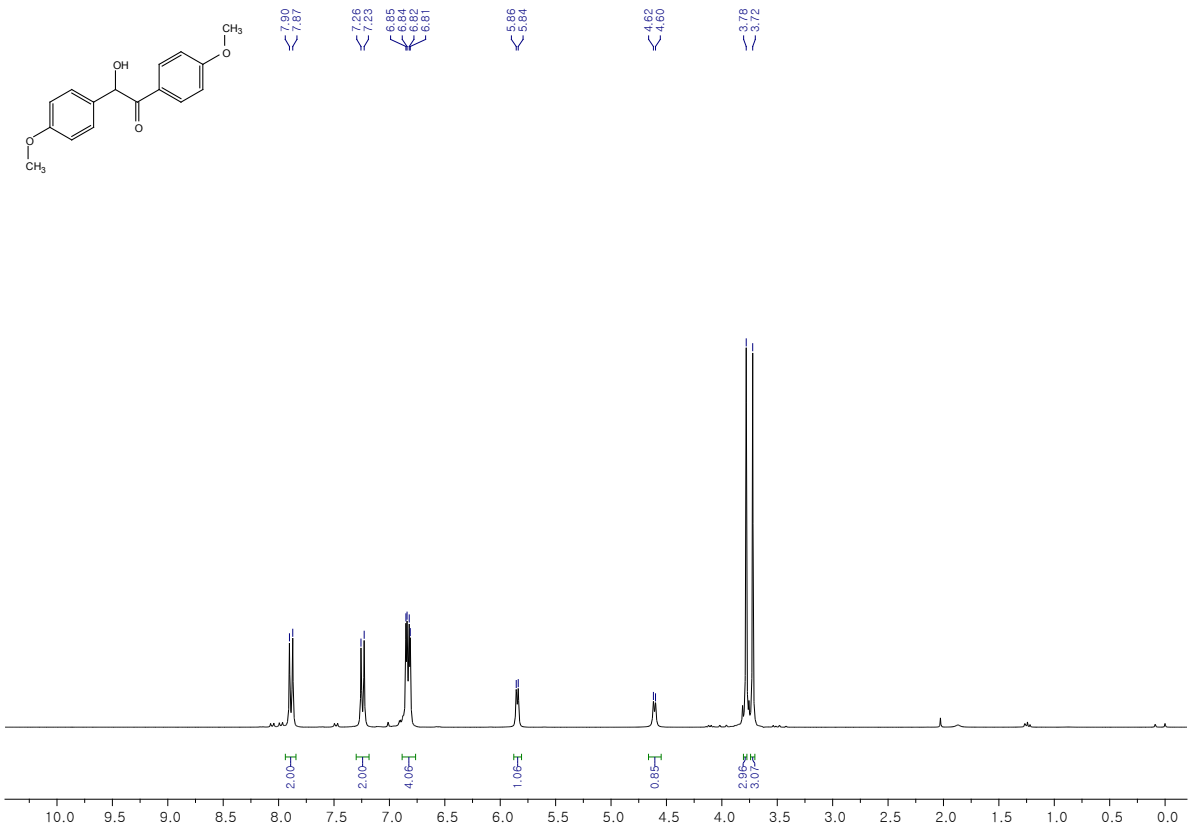
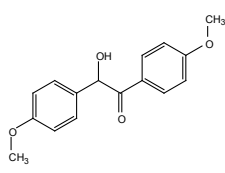
**<sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>)** δ 7.46 (s, 1 H), 7.34 (d, *J* = 7.8 Hz, 1 H), 7.23 (d, *J* = 7.7 Hz, 1 H), 7.19 – 7.11 (m, 1 H), 6.29 (s, 1 H), 5.77 (s, 1 H), 5.44 (d, *J* = 5.5 Hz, 1 H), 3.66 (s, 3 H), 3.09 (d, *J* = 5.8 Hz, 1 H) ppm. **<sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>)** δ 166.7, 143.7, 141.4, 131.1, 130.0, 129.7, 126.9, 125.3, 122.7, 72.9, 52.2 ppm. **HRMS (EI)** calc. for [C<sub>11</sub>H<sub>11</sub>BrO<sub>3</sub>]: 269.9892, found: 269.9893. colorless oil

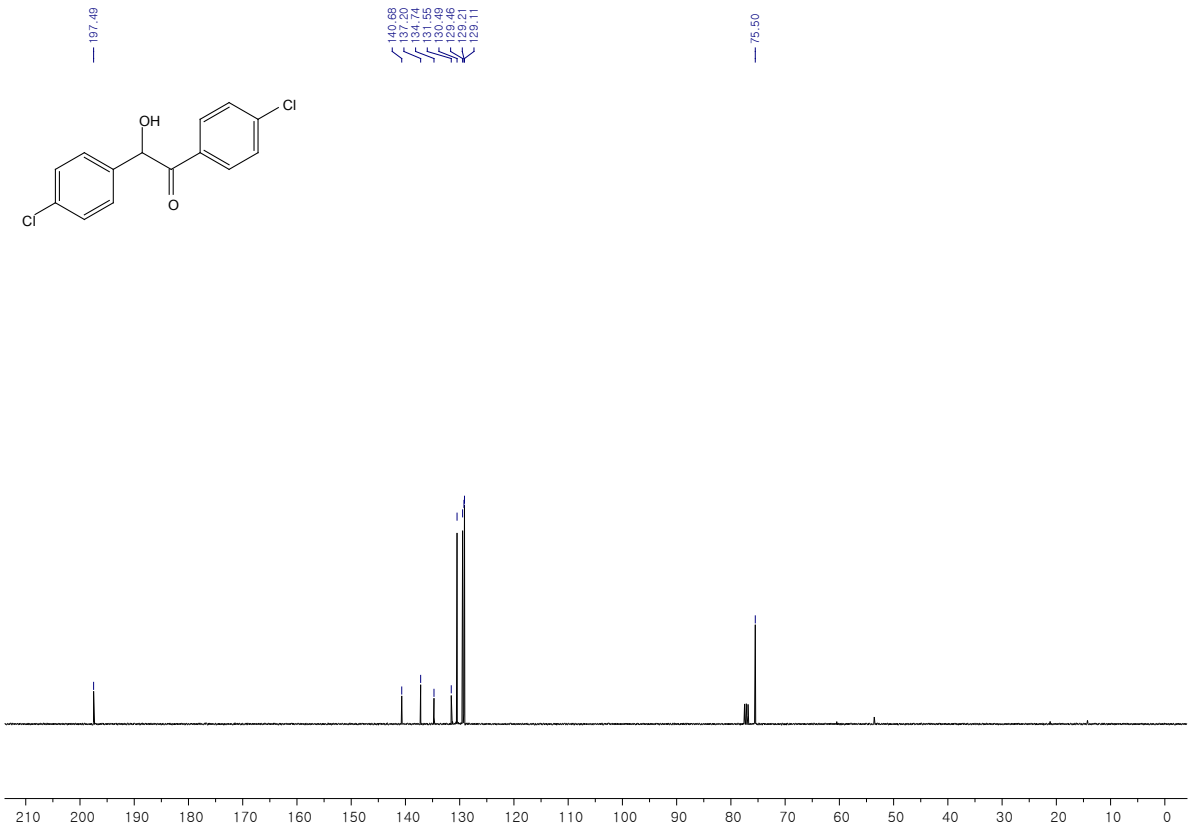
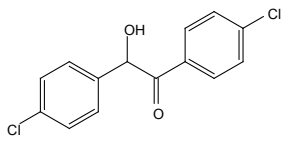
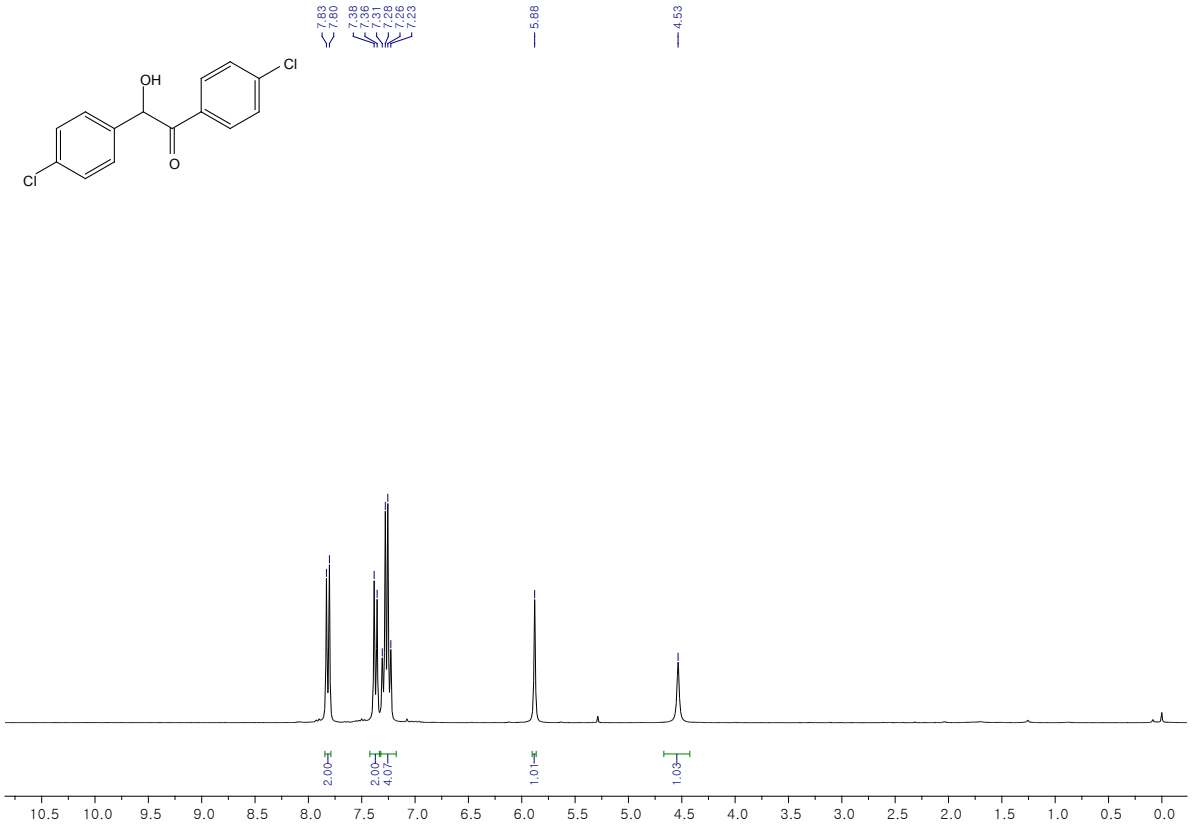
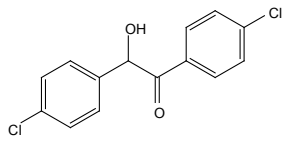


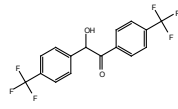
# IV. NMR spectra







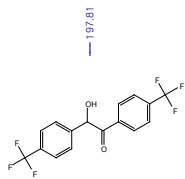
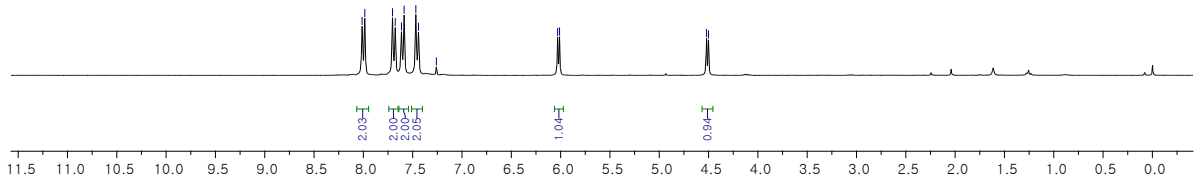




8.01  
7.99  
7.68  
7.61  
7.59  
7.44  
7.26

6.03  
6.01

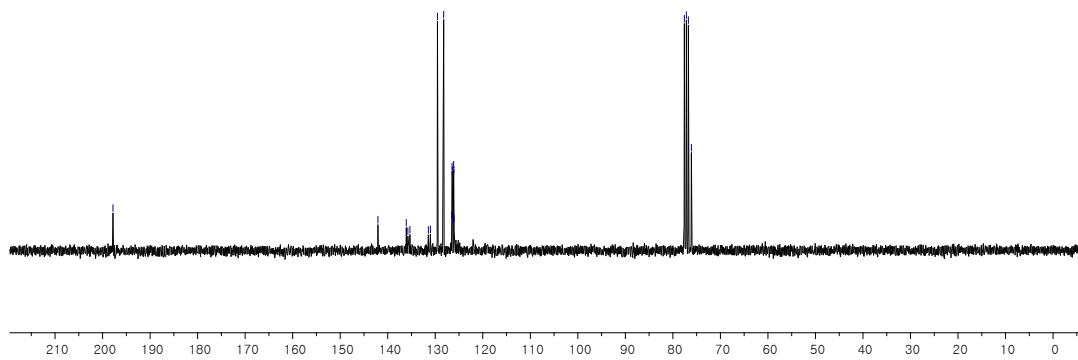
4.52  
4.30

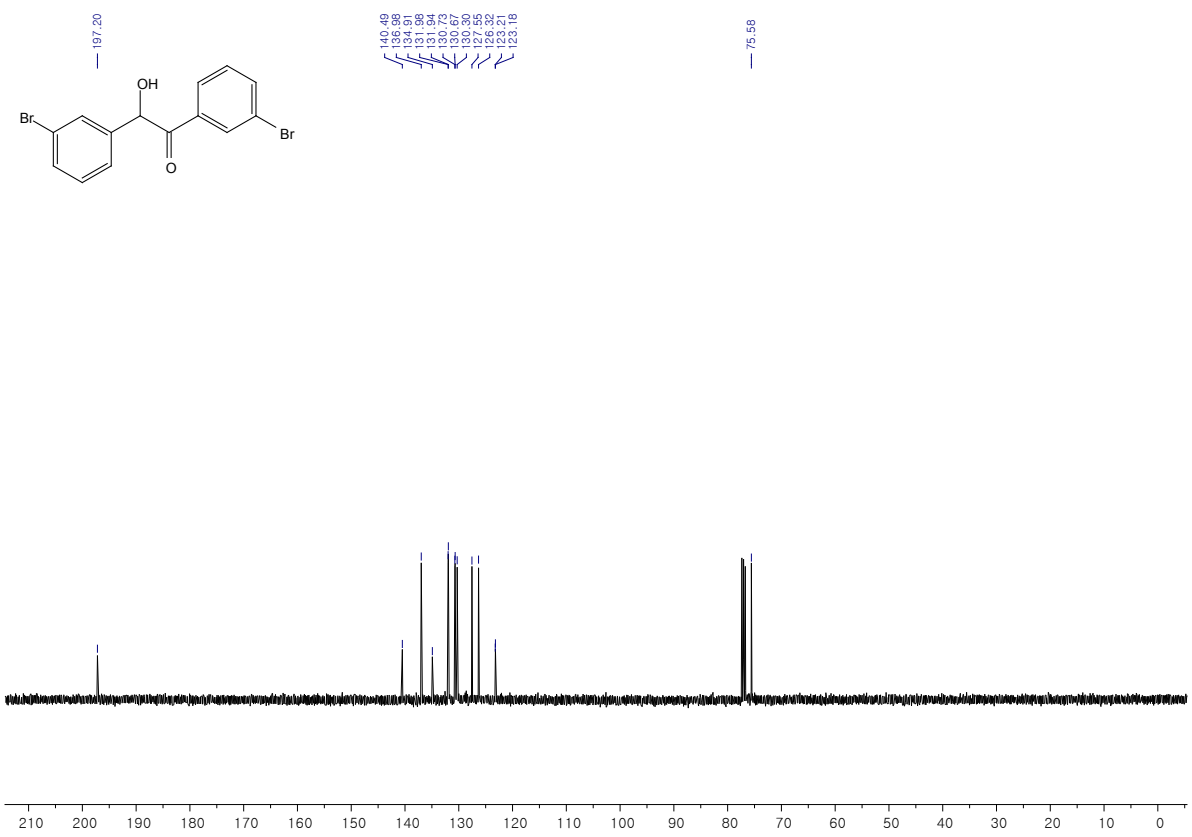
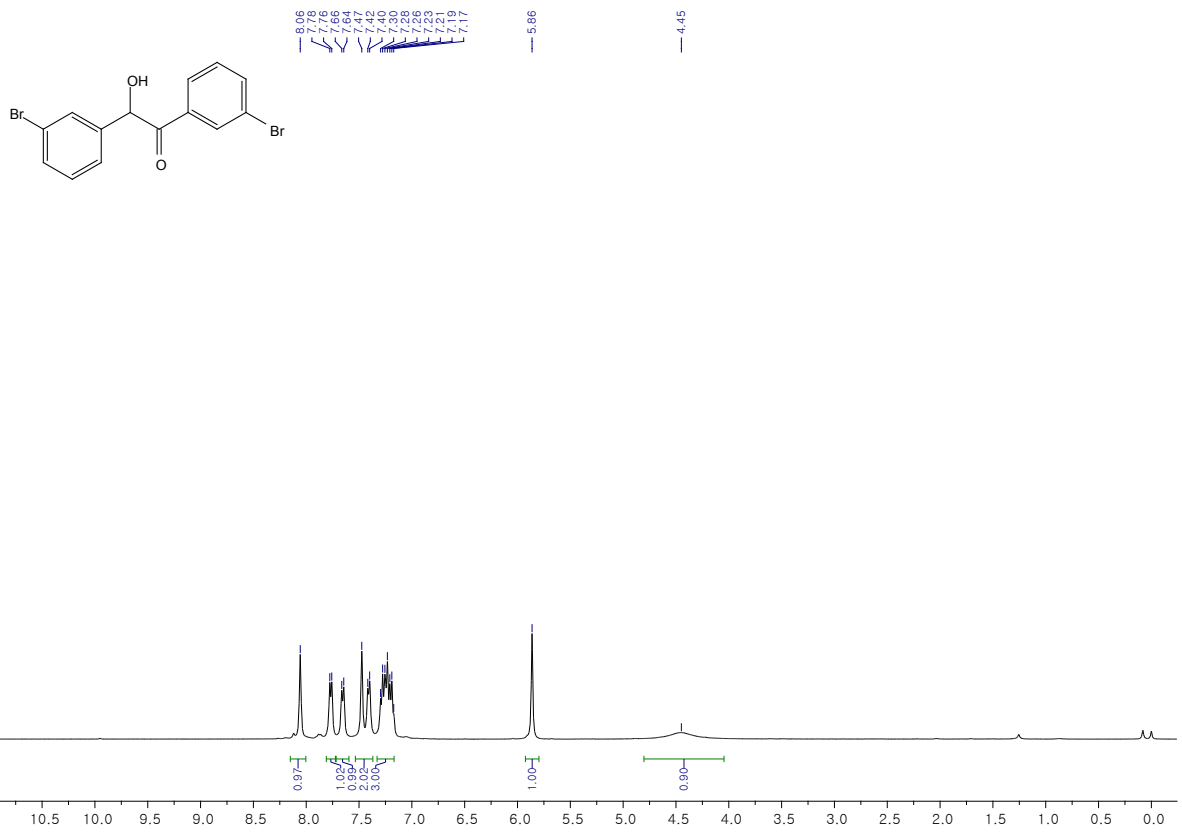


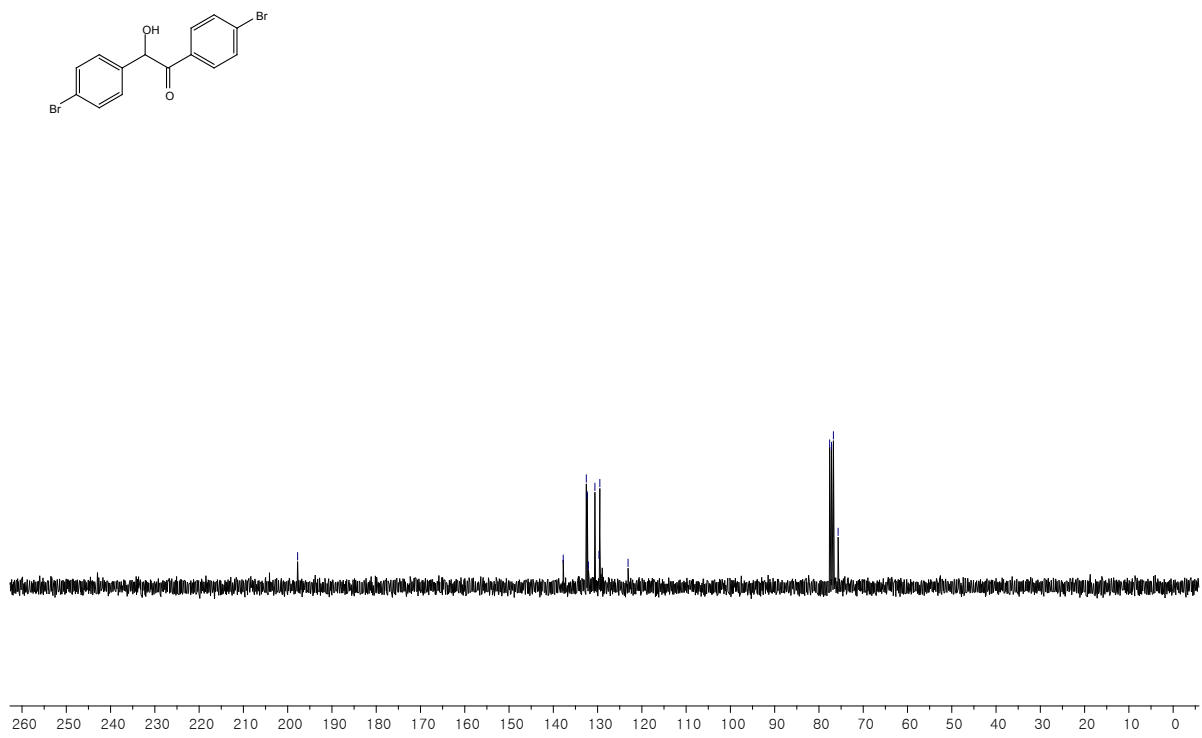
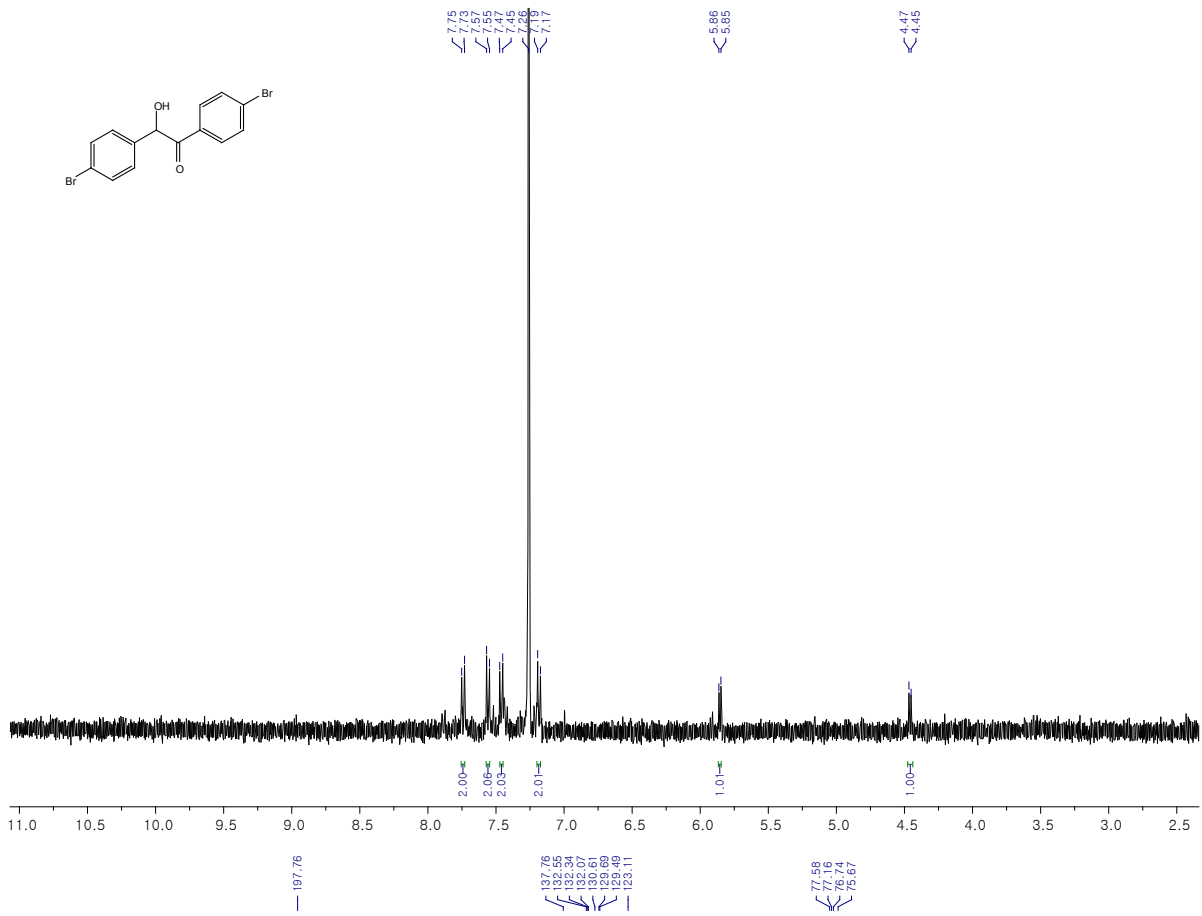
137.81

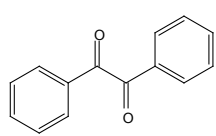
142.06  
136.09  
135.33  
131.45  
129.54  
128.56  
128.41  
126.98  
126.13  
126.03

77.58  
76.74  
76.11

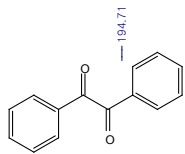
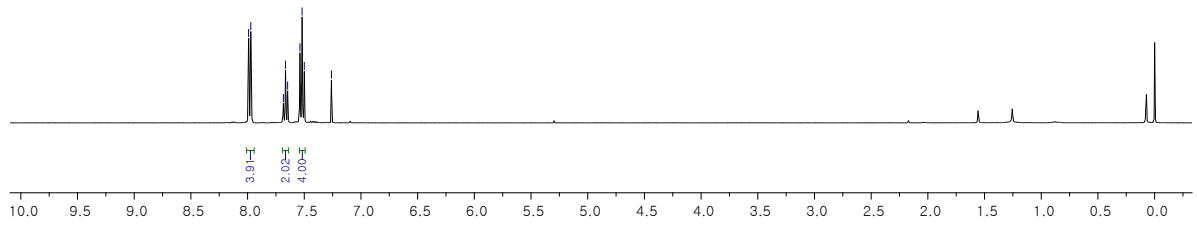








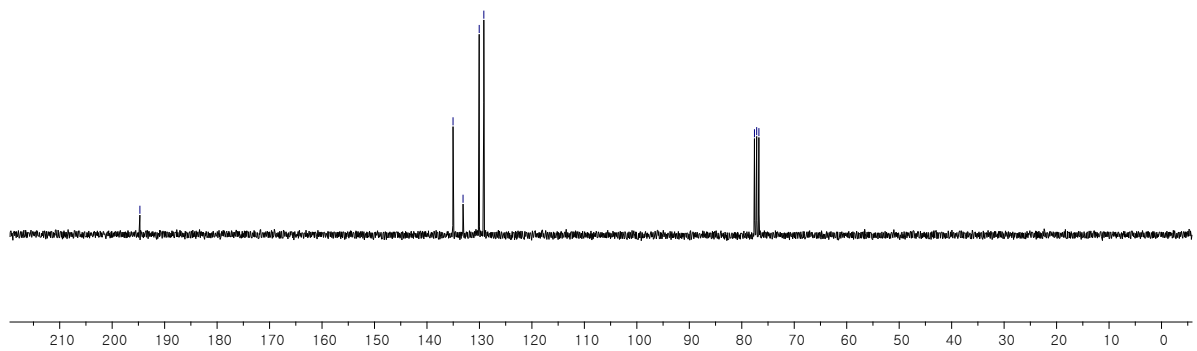
7.99  
7.97  
7.67  
7.65  
7.59  
7.58



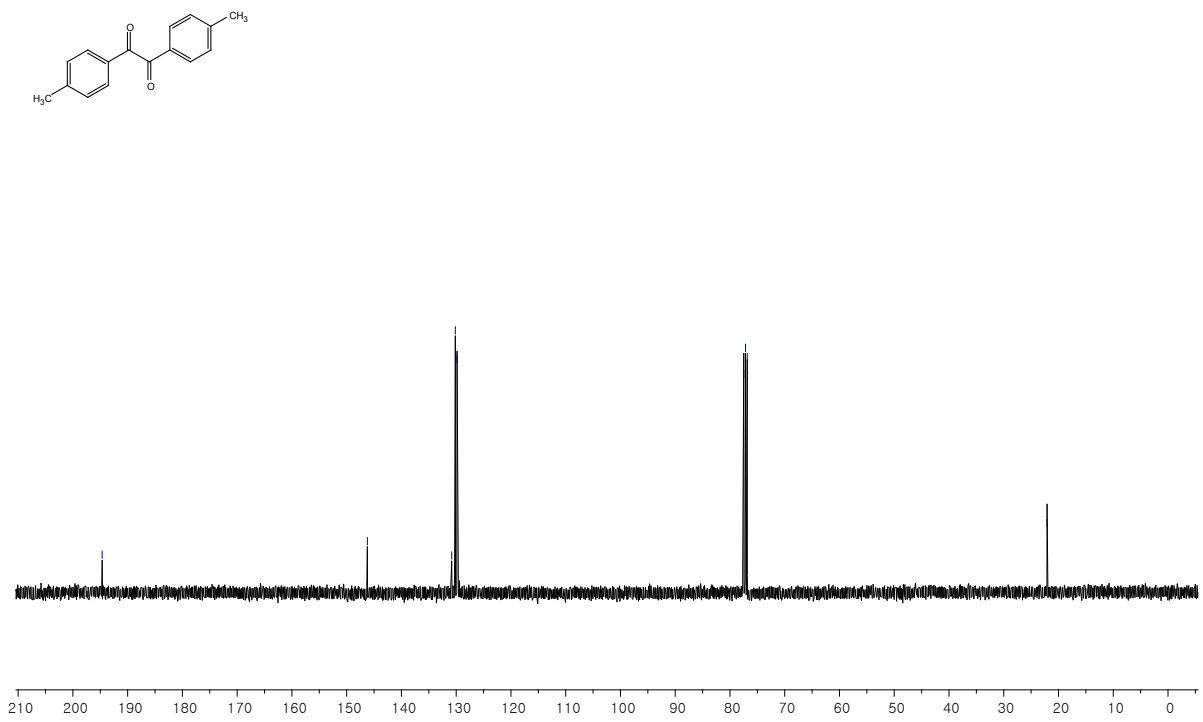
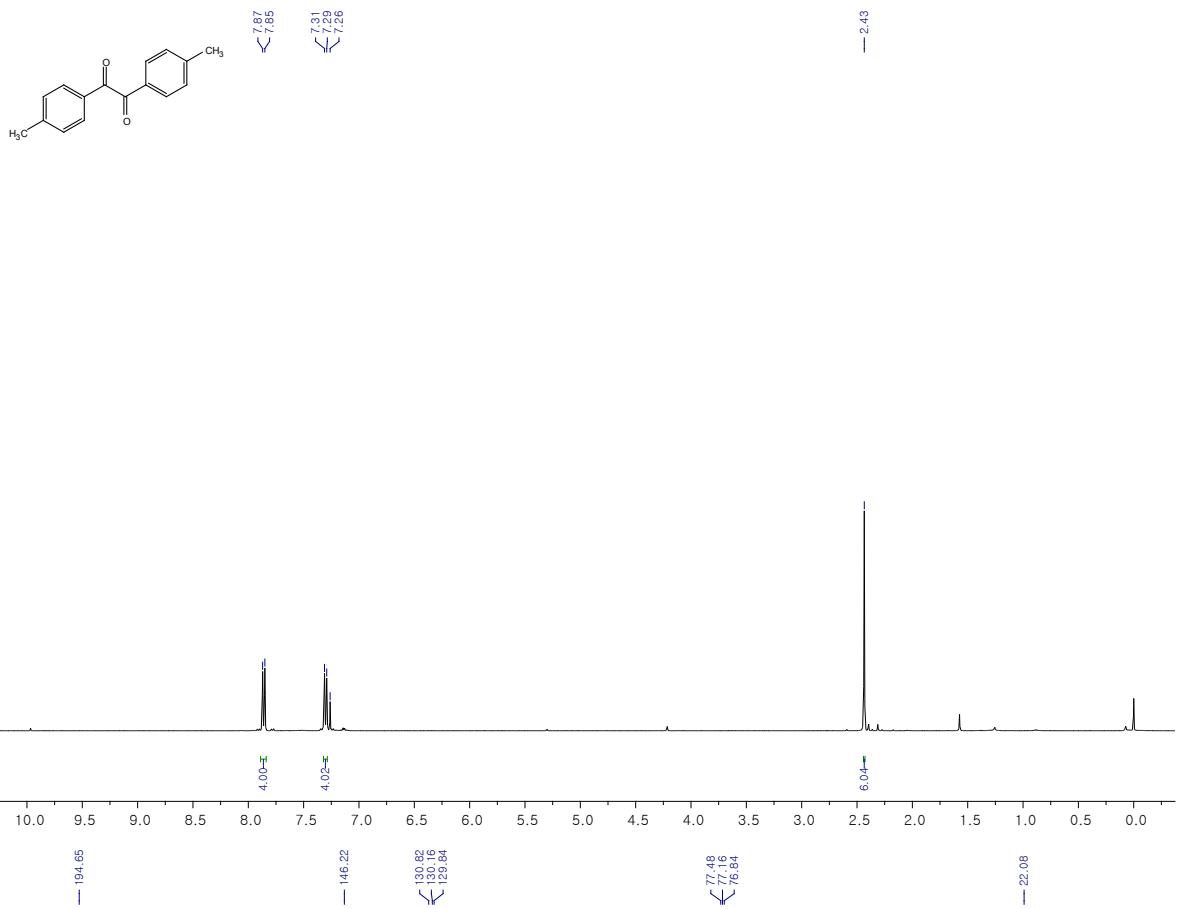
194.71

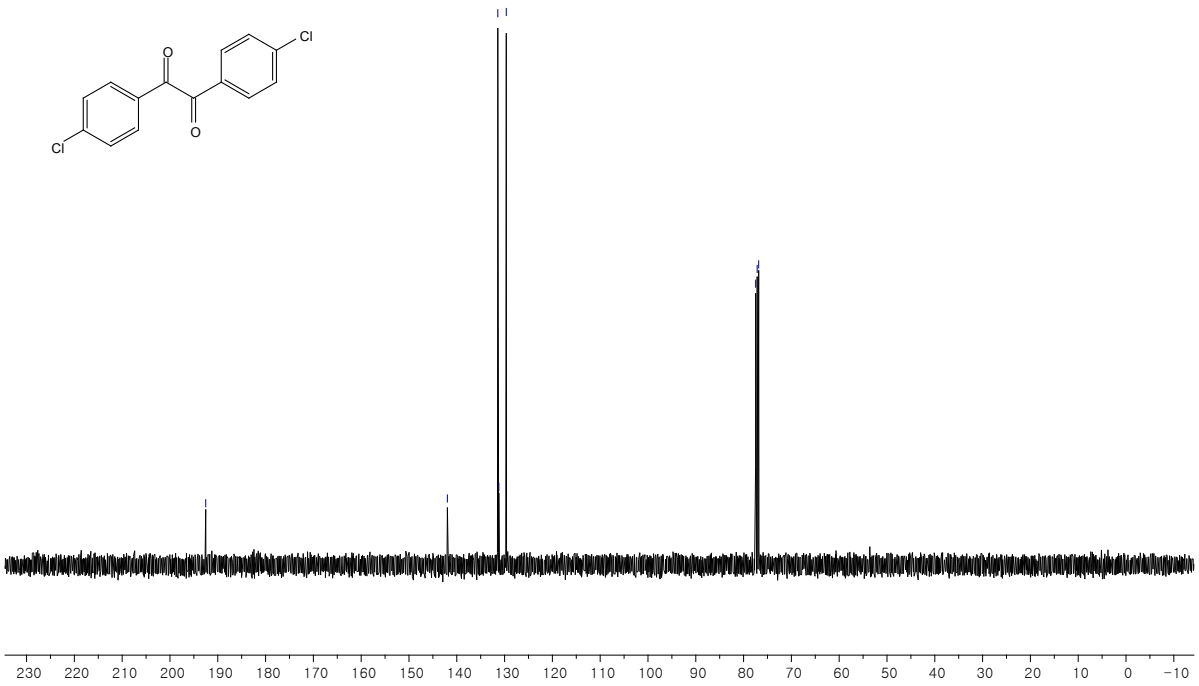
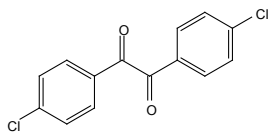
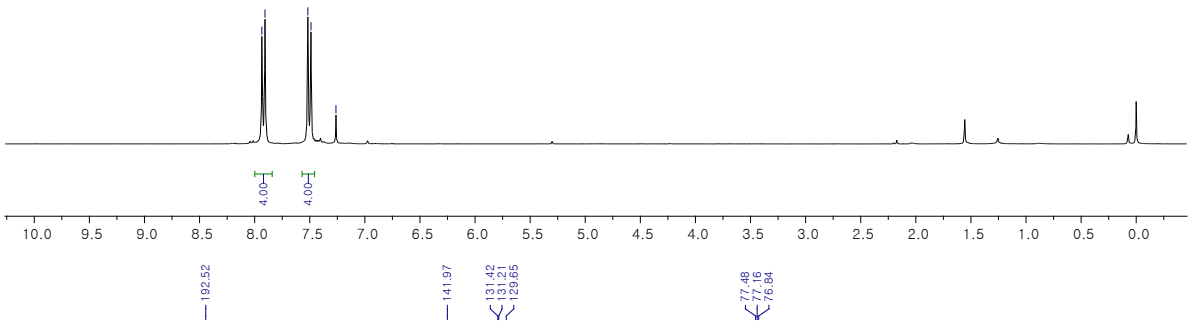
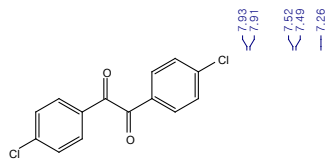
135.03  
133.03  
129.16

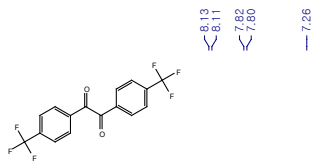
77.58  
77.16  
76.74



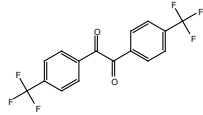
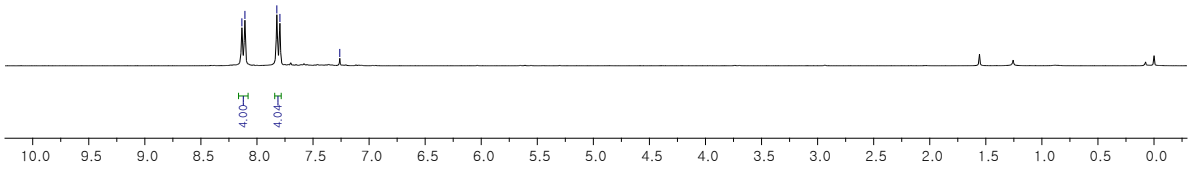




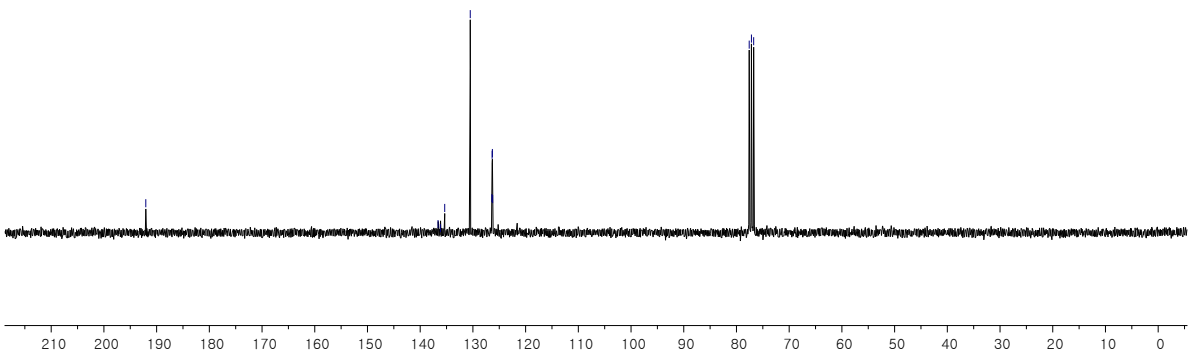


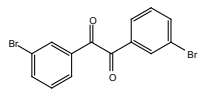


8.13  
8.11  
7.82  
7.80  
7.26

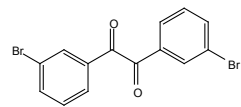
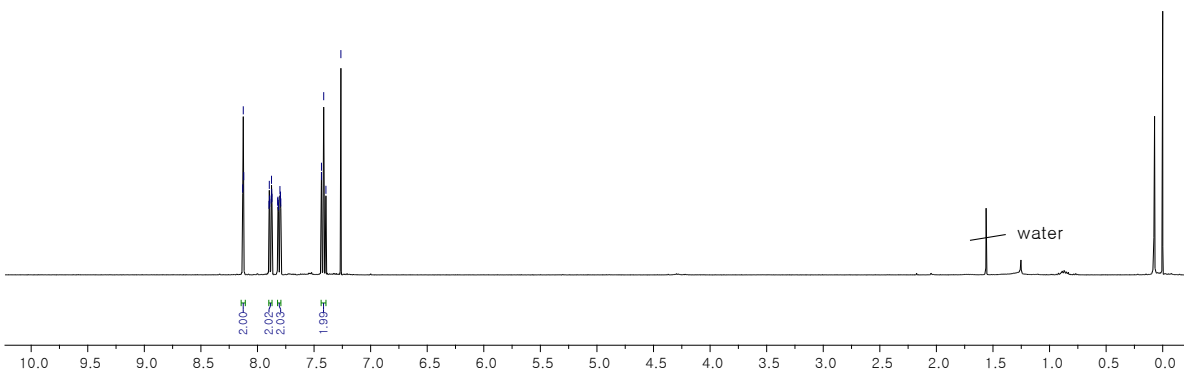


192.05  
136.61  
135.76  
135.16  
130.50  
126.40  
126.30  
126.25  
77.58  
77.16  
76.74





8.13  
8.12  
7.90  
7.89  
7.43  
7.41  
7.29

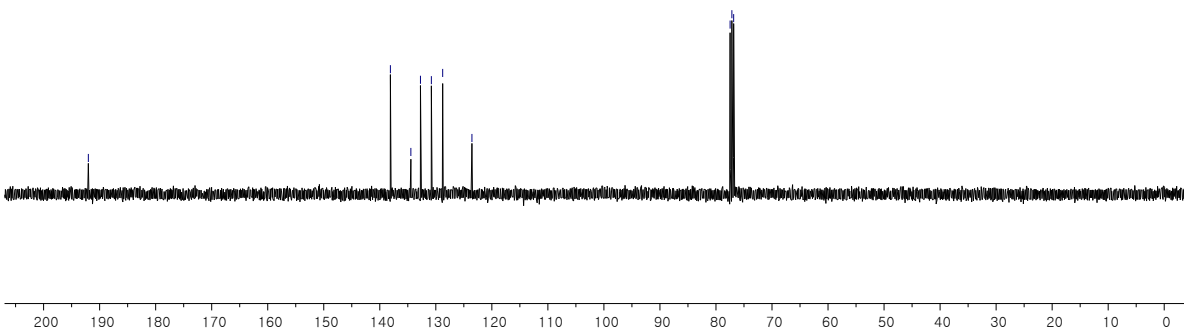


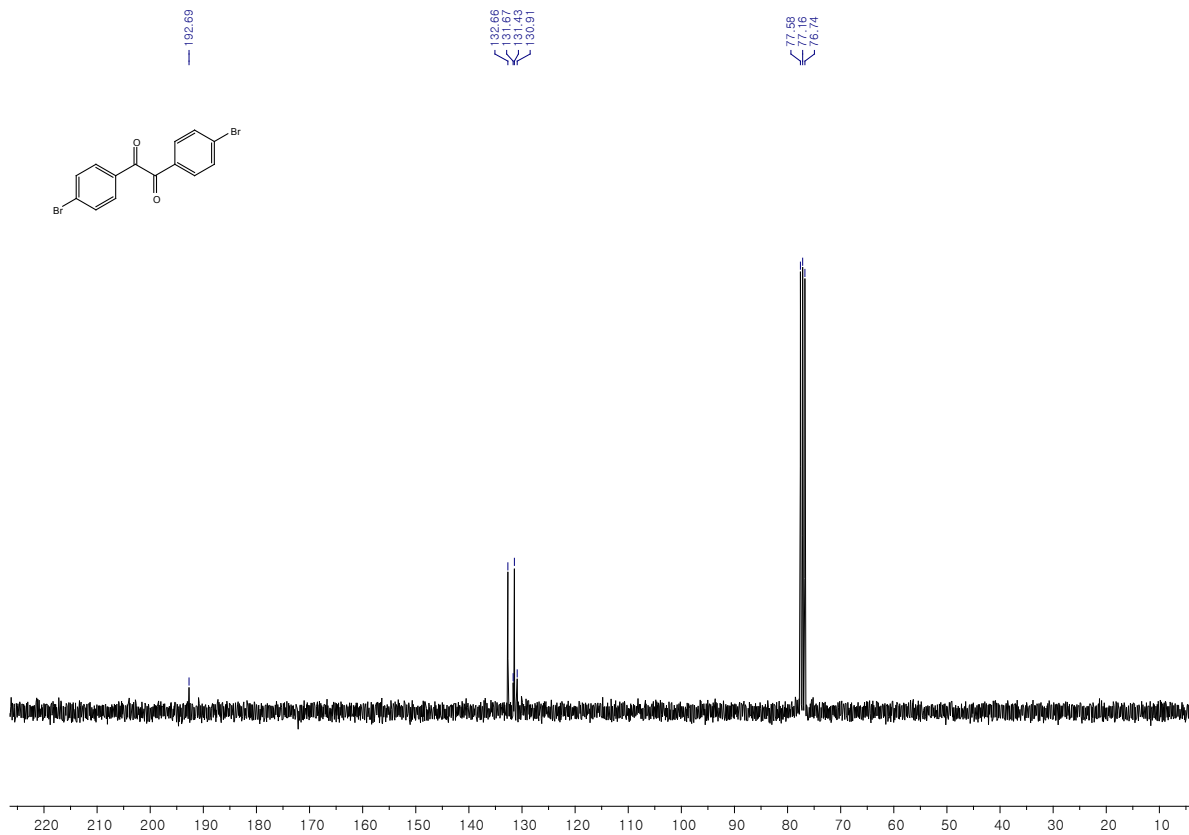
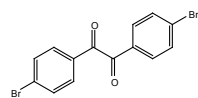
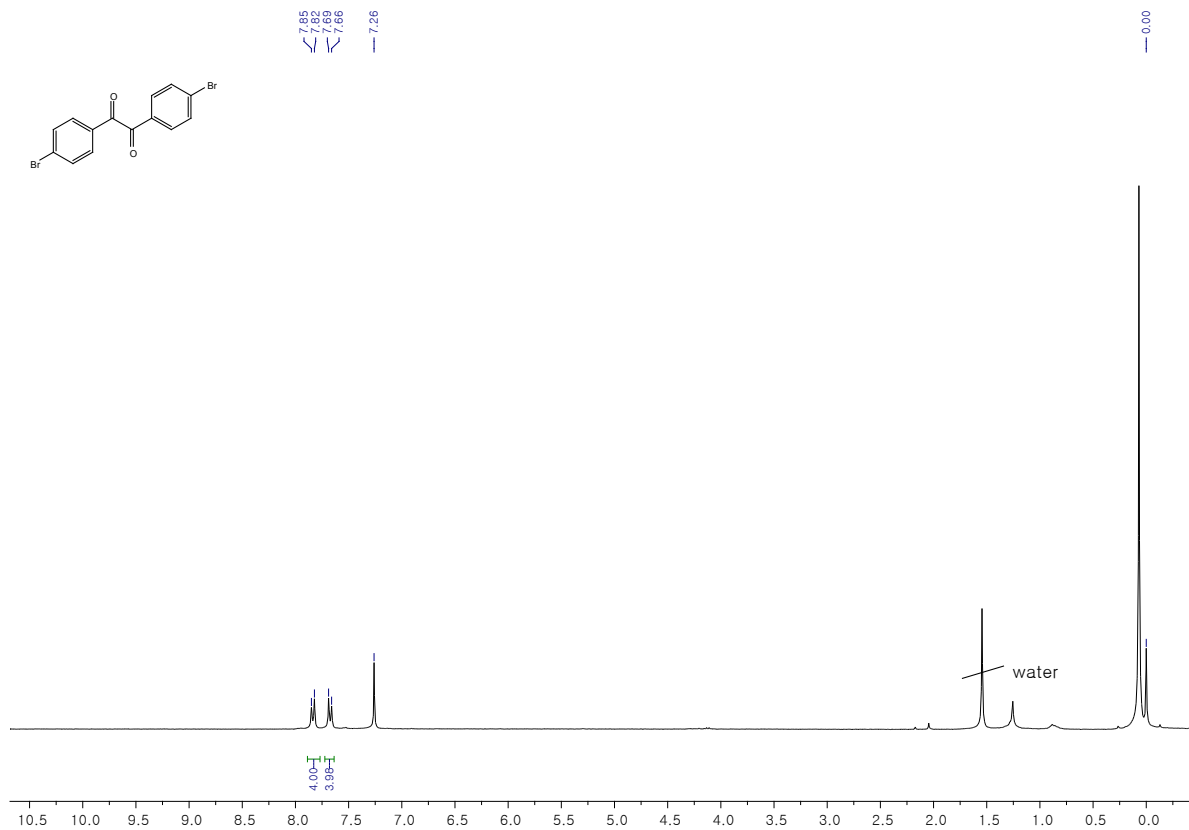
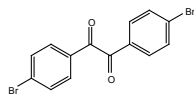
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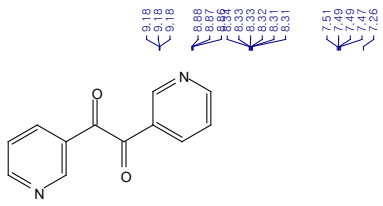
138.11  
132.74  
130.79  
128.77

123.55

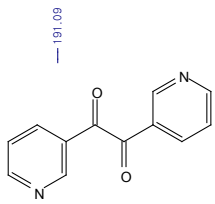
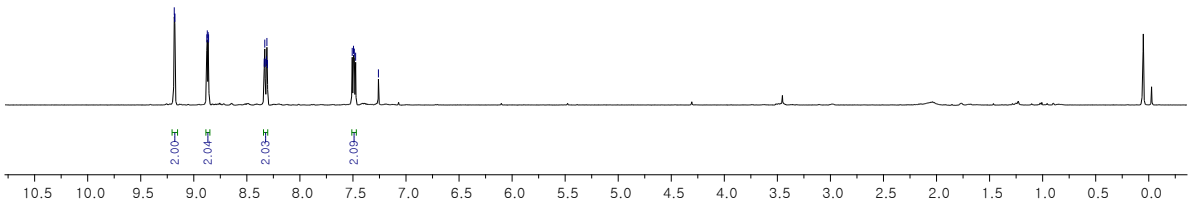
77.48  
77.16  
76.84







9.18  
9.18  
8.88  
8.87  
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8.33  
8.31  
8.31  
7.51  
7.49  
7.47



191.09  
155.22  
151.59  
137.18  
128.39  
124.06

