A Formal *anti*-Markovnikov Hydroamination of Allylic Alcohols via Tandem Oxidation/1,4-Conjugate Addition/1,2-Reduction with Ru Catalyst

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1. General information

NMR spectra were recorded with Varian Mercury Plus 300-4N spectrometers by using TMS ($\delta = 0$ ppm) as an internal standard for $^1$H NMR and CDCl$_3$ ($\delta = 77$ ppm) for $^{13}$C NMR spectroscopy. Mass spectra (GC-MS) were recorded with a Shimazu QP5000 instrument. High-resolution mass spectra (FAB) were recorded by using a JEOL JMS-700 instrument with meta-nitrobenzyl alcohol as the matrix and PEG-200 as the calibration standard. Elemental analysis was depended on A Rabbit Science. All catalytic reactions were carried out under argon in sealed tube. Unless noted otherwise, all reagents and solvents were purchased from commercial suppliers. Reagents obtained from commercial sources were used without purification. Ru complexes ([RuCl$_2$(p-cymene)]$_2$, $^1$RuCl$_2$(DMSO)$_4$, $^1$RuCl$_2$(PPh$_3$)$_3$, $^1$RuClH(CO)(PPh$_3$)$_3$, $^1$RuCl$_2$(PPh$_3$)$_2$(en), $^2$RuCl$_2$(dppe)(en), $^3$RuCl$_2$(dppf)(en), $^3$RuCl$_2$(dp benzene)(en)$_2$) and a part of Ligands ($^1$L$_1$-$^1$L$_6$) were synthesized according to literature protocols. A part of allylic alcohols ($^1$L$_7$-$^1$L$_{10}$) were also synthesized according to literature protocols. 2,6-Bis(n-butyliminomethyl)pyridine ($^1$L$_4$) was synthesized by reference to literature protocol. 

2. Screening of Ru catalysts for hydroamination

2.1. Screening of Ru Precursors or Solvents for Hydroamination

To an argon-purged reaction tube equipped with J-Young stop valve was added Ru pre. (2 mol% Ru), Dppe (0.044 mmol), and anhydrous CH$_2$Cl$_2$ (1 mL). The mixture was degassed by using freeze-pump-thaw cycles (FPT cycles) and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then the solvent was removed under reduced pressure. To the residue was added 3-buten-2-ol (1a) (6 mmol), morpholine (2a) (2 mmol), and anhydrous solvent (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 95°C for 5 h, then to the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by $^1$H NMR.

Table S1. Screening of Ru Precursors or Solvents for Hydroamination

<table>
<thead>
<tr>
<th>Entry</th>
<th>Ru pre.</th>
<th>Solvent (mL)</th>
<th>NMR Yield (3aa/4aa) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>[RuCl$_2$(p-cymene)]$_2$</td>
<td>Toluene/H$_2$O (0.4/0.1)</td>
<td>0/60</td>
</tr>
<tr>
<td>2</td>
<td>[RuCl$_2$(p-cymene)]$_2$</td>
<td>1,4-Dioxane (0.5)</td>
<td>0/32</td>
</tr>
<tr>
<td>3</td>
<td>[RuCl$_2$(p-cymene)]$_2$</td>
<td>IPA (0.5)</td>
<td>0/62</td>
</tr>
<tr>
<td>4</td>
<td>RuCl$_2$(DMSO)$_4$</td>
<td>IPA (0.5)</td>
<td>0/13</td>
</tr>
<tr>
<td>5</td>
<td>RuCl$_2$(PPh$_3$)$_3$</td>
<td>IPA (0.5)</td>
<td>0/18</td>
</tr>
<tr>
<td>6</td>
<td>RuClH(CO)(PPh$_3$)$_3$</td>
<td>IPA (0.5)</td>
<td>0/trace</td>
</tr>
</tbody>
</table>
2.2. Screening of Ligands for Hydroamination

**Method A:** To an argon-purged reaction tube equipped with J-Young stop valve was added $[\text{RuCl}_2(p\text{-cymene})]_2$ (0.02 mmol), Ligand (0.044 mmol), and anhydrous CH$_2$Cl$_2$ (1 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then the solvent was removed under reduced pressure. To the residue was added 3-buten-2-ol (1a) (6 mmol), morpholine (2a) (2 mmol), and anhydrous IPA (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 95°C for 5 h, then to the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by $^1$H NMR.

**Method B:** To an argon-purged reaction tube equipped with J-Young stop valve was added $[\text{RuCl}_2(p\text{-cymene})]_2$ (0.02 mmol), Ligand (0.044 mmol), and anhydrous CH$_2$Cl$_2$ (1 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then the solvent was removed under reduced pressure. To the residue was added 3-buten-2-ol (1a) (2.2 mmol), morpholine (2a) (2 mmol), and anhydrous IPA (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 95°C for 22 h, then to the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by $^1$H NMR.

**Fig. S1** Structure of Screening Ligands
Table S2. Screening of Ligands for Hydroamination

\[
\begin{align*}
\text{OH} & \quad + \quad \text{HN} \quad \text{O} \\
\begin{array}{c}
1a \\
2a
\end{array} & \quad \rightarrow \\
\text{Method A or B} & \quad \rightarrow \\
\begin{array}{c}
3aa \\
4aa
\end{array}
\end{align*}
\]

<table>
<thead>
<tr>
<th>Entry</th>
<th>Ligand</th>
<th>Method</th>
<th>NMR Yield (3aa/4aa) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dppe</td>
<td>Method A</td>
<td>0/63</td>
</tr>
<tr>
<td>2</td>
<td>PPh₃</td>
<td>Method A</td>
<td>0/trace</td>
</tr>
<tr>
<td>3</td>
<td>(R)-BINAP</td>
<td>Method A</td>
<td>0/13</td>
</tr>
<tr>
<td>4</td>
<td>(S)-SEGPHOS</td>
<td>Method A</td>
<td>0/7</td>
</tr>
<tr>
<td>5</td>
<td>S-Phos</td>
<td>Method A</td>
<td>0/4</td>
</tr>
<tr>
<td>6</td>
<td>Xantphos</td>
<td>Method A</td>
<td>0/22</td>
</tr>
<tr>
<td>7</td>
<td>Dppf</td>
<td>Method A</td>
<td>0/trace</td>
</tr>
<tr>
<td>8</td>
<td>Dppbenzene</td>
<td>Method A</td>
<td>0/65</td>
</tr>
<tr>
<td>9</td>
<td>Ethylenediamine</td>
<td>Method A</td>
<td>0/0</td>
</tr>
<tr>
<td>10</td>
<td>1,10-Phenanthroline</td>
<td>Method A</td>
<td>0/trace</td>
</tr>
<tr>
<td>11</td>
<td>2,2'-Bis(2-oxazoline)</td>
<td>Method A</td>
<td>0/5</td>
</tr>
<tr>
<td>12</td>
<td>L7</td>
<td>Method A</td>
<td>0/0</td>
</tr>
<tr>
<td>13</td>
<td>L8</td>
<td>Method A</td>
<td>0/5</td>
</tr>
<tr>
<td>14</td>
<td>L1</td>
<td>Method A</td>
<td>0/15</td>
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<tr>
<td>15a</td>
<td>L1</td>
<td>Method A</td>
<td>0/20</td>
</tr>
<tr>
<td></td>
<td>L1</td>
<td>Method A</td>
<td>0/20</td>
</tr>
<tr>
<td>16c</td>
<td>RuCl₂(PPh₃)₂(en)</td>
<td>Method B</td>
<td>0/6</td>
</tr>
<tr>
<td>17c</td>
<td>RuCl₂(dppe)(en)</td>
<td>Method B</td>
<td>0/0</td>
</tr>
<tr>
<td>18c</td>
<td>RuCl₂(dppe)(en)</td>
<td>Method B</td>
<td>0/7</td>
</tr>
<tr>
<td>19c</td>
<td>RuCl₂(dppf)(en)</td>
<td>Method B</td>
<td>0/3</td>
</tr>
<tr>
<td>20c</td>
<td>RuCl₂(dpbenzene)(en)</td>
<td>Method B</td>
<td>0/4</td>
</tr>
<tr>
<td>21</td>
<td>L2</td>
<td>Method B</td>
<td>0/4</td>
</tr>
<tr>
<td>22</td>
<td>L3</td>
<td>Method B</td>
<td>0/5</td>
</tr>
<tr>
<td>23</td>
<td>L4</td>
<td>Method B</td>
<td>0/5</td>
</tr>
<tr>
<td>24d</td>
<td>L4</td>
<td>Method B</td>
<td>trace/7</td>
</tr>
<tr>
<td>25d,e</td>
<td>L4</td>
<td>Method B</td>
<td>26/0</td>
</tr>
<tr>
<td>26d,e</td>
<td>L5</td>
<td>Method B</td>
<td>0/12</td>
</tr>
<tr>
<td>27d,e</td>
<td>L6</td>
<td>Method B</td>
<td>trace/0</td>
</tr>
</tbody>
</table>

aKOH (5 mol%) was added. b-en = ethylenediamine. cPrepared Ru complex (2 mol% Ru) was used. dRuClH(CO)(PPh₃)₃ (2 mol% Ru) was used as a catalyst precursor. eKOBU (5 mol%) was added.
3. Optimization of reaction conditions

3.1. Optimization of Reaction Conditions for Hydroamination with 3-Buten-2-ol (1a) and Morpholine (2a)

To an argon-purged reaction tube equipped with J-Young stop valve was added RuClH(CO)(PPh$_3$)$_3$ (0.04 mmol), 2,6-bis($n$-butyliminomethyl)pyridine (L4) (0.044 mmol) prepared from pyridine-2,6-carbaldehyde and $n$-butylamine, and anhydrous CH$_2$Cl$_2$ (1 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then the solvent was removed under reduced pressure. To the residue was added KOBu', 3-buten-2-ol (1a), morpholine (2a) (2 mmol), and anhydrous IPA (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at the respective temperature for 22 h, then the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by $^1$H NMR.

Table S3. Optimization of Reaction Conditions for Hydroamination with 3-Buten-2-ol (1a) and Morpholine (2a)

<table>
<thead>
<tr>
<th>Entry</th>
<th>1a (mmol)</th>
<th>KOBu' (mol%)</th>
<th>Temp. (°C)</th>
<th>NMR Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.2</td>
<td>5</td>
<td>95</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>2.2</td>
<td>5</td>
<td>70</td>
<td>56</td>
</tr>
<tr>
<td>3</td>
<td>2.2</td>
<td>7.5</td>
<td>70</td>
<td>38</td>
</tr>
<tr>
<td>4</td>
<td>2.2</td>
<td>3</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>2.6</td>
<td>3</td>
<td>70</td>
<td>&gt;99</td>
</tr>
<tr>
<td>6</td>
<td>2.6</td>
<td>3</td>
<td>70</td>
<td>72</td>
</tr>
<tr>
<td>7</td>
<td>2.6</td>
<td>3</td>
<td>70</td>
<td>0</td>
</tr>
</tbody>
</table>

$^a$RuCl$_2$(PPh$_3$)$_3$ was used. $^b$[Ru(CO)$_3$Cl$_2$]$_2$ was used.

3.2. Optimization of Reaction Conditions for Hydroamination with Allyl Alcohol (1h) and Morpholine (2a)

To an argon-purged reaction tube equipped with J-Young stop valve was added RuClH(CO)(PPh$_3$)$_3$ (0.04 mmol), 2,6-bis($n$-butyliminomethyl)pyridine (L4) prepared from pyridine-2,6-carbaldehyde and $n$-butylamine (0.044 mmol), and anhydrous CH$_2$Cl$_2$ (1 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then the solvent was removed under reduced pressure. To the residue was added KOBu' (0.06 mmol), allyl alcohol (1a) (2.6 mmol), morpholine (2a) (2 mmol), and anhydrous solvent (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at the respective temperature for 22 h, then to the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by $^1$H NMR.
Table S4. Optimization of Reaction Conditions for Hydroamination with Allyl Alcohol (1h) and Morpholine (2a)

\[
\text{RuCl}(\text{CO})(\text{PPh}_3)_3 \ (2 \text{ mol}\% \text{ Ru}) \\
\text{L4} \ (2.2 \text{ mol}\%) \\
\text{KOBu}^+ \ (3 \text{ mol}\%)
\]

Solvent, Temp., 22 h

<table>
<thead>
<tr>
<th>Entry</th>
<th>Solvent (mL)</th>
<th>Temp.</th>
<th>NMR Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IPA (0.5)</td>
<td>70</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>IPA (0.5)</td>
<td>80</td>
<td>82</td>
</tr>
<tr>
<td>3</td>
<td>IPA (0.5)</td>
<td>85</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>IPA (0.5)</td>
<td>90</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>IPA/Toluene (0.5/0.5)</td>
<td>85</td>
<td>99</td>
</tr>
</tbody>
</table>
4. Synthesis of materials
Synthesis of 2,6-bis(n-butyliminomethyl)pyridine (L4)

Scheme S1. Synthesis of 2,6-bis(n-butyliminomethyl)pyridine (L4)

Under argon atmosphere, to a 80 mL Schlenk flask was added MgSO₄ (0.6 g), pyridine-2,6-carbaldehyde (0.1 mmol), n-butylamine (0.05 mL), and CHCl₃ (1.6 mL). The reaction mixture was stirred at r.t. for 4 h, then filtrated, and the filtrate was concentrated. The residue was dried under reduced pressure to give the product as a colorless oil quantitatively. The 0.05M solution of L4 in CH₂Cl₂ was prepared by adding CH₂Cl₂ (2 mL) to the residue, and used for catalytic reactions.

¹H NMR: δ = 0.95 (t, J = 7.2 Hz, 6H, -CH₃), 1.41 (sex, J = 7.5 Hz, 4H, -C₂H₅), 1.72 (quin, J = 7.2 Hz, 4H, -CH₂CH₃), 3.69 (t, J = 7.2 Hz, 4H, -CH₂N-), 7.80 (t, J = 7.8 Hz, 1H, Ar-H), 8.00 (d, J = 7.8 Hz, 2H, Ar-H), 8.41 (s, 2H, -NC₃H₃) ppm. ¹³C NMR: δ = 13.8, 20.4, 32.7, 61.3, 122.1, 137.0, 154.4, 161.4 ppm. GC-MS: m/z = 245. HRMS (FAB, m-NBA): Calcd. for C₁₅H₂₄N₃ ([M+H]+) 246.1970; found 246.1964. CAS Registry Number: 1469980-53-7.

Synthesis of (3-methoxy-4-penten-1-yl)benzene (1c’)

Scheme S2. Synthesis of (3-methoxy-4-penten-1-yl)benzene (1c’)

Under argon, to a 200 mL reaction container was added 1c (11.7 mmol), and THF (20 mL). To the mixture was slowly added NaH, in oil (14 mmol) at 0°C, and the mixture was stirred at r.t. for 1 h. Then, methyl iodide (17.6 mmol) was added at 0°C, and the reaction mixture was stirred at r.t. for 17 h. After the reaction was quenched with the distilled water and sat. NH₄Cl aq., the solution extracted with Et₂O from the resulting mixture was washed with Brine, dehydrated with Na₂SO₄, and then filtrated. The filtrate was concentrated, and the residue was dried under reduced pressure. The residue was purified by vacuum distillation to give the product as a colorless oil (82 % yield).

¹H NMR: δ = 1.71-1.98 (m, 2H, -CH₂Ar), 2.60-2.80 (m, 2H, -CH₂CH₃), 3.27 (s, 3H, -OCH₃), 3.50 (quart, J = 7.2 Hz, 1H, -CHOCH₃), 5.16-5.24 (m, 2H, -CH=CH₂), 5.62-5.74 (m, 1H, -CH=CH₂), 7.15-7.30 (m, 5H, Ar-H) ppm. ¹³C NMR: δ = 31.5, 37.0, 56.2, 82.0, 117.3, 125.8, 128.3, 128.5, 138.6, 142.1 ppm. GC-MS: m/z = 176. HRMS (FAB, m-NBA): Calcd. for C₁₂H₁₆O (M⁺) 176.1201; found 176.1201. CAS Registry Number: 37904-38-4.
5. Hydroamination methods

Method A: Hydroamination of 3-buten-2-ol (1a)

To an argon-purged reaction tube equipped with J-Young stop valve was added RuClH(CO)(PPh_{3})_{3} (0.04 mmol), 2,6-bis(n-butyliminomethyl)pyridine (L4) (0.044 mmol) prepared from pyridine-2,6-carbaldehyde and n-butylamine, and anhydrous CH_{2}Cl_{2} (1 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then the solvent was removed under reduced pressure. To the residue was added KOBu' (0.06 mmol), 3-buten-2-ol (1a) (2.6 mmol), amine (2 mmol), and anhydrous IPA (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred for at 70°C 22 h, then to the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by \textsuperscript{1}H NMR.

Method B: Hydroamination of allylic alcohols

To an argon-purged reaction tube equipped with J-Young stop valve was added RuClH(CO)(PPh_{3})_{3} (0.04 mmol), 2,6-bis(n-butyliminomethyl)pyridine (L4) (0.044 mmol) prepared from pyridine-2,6-carbaldehyde and n-butylamine, and anhydrous CH_{2}Cl_{2} (1 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then vacuum distilled. To the residue was added KOBu' (0.06 mmol), allylic alcohols (2.6 mmol), morphoíne (2a) (2 mmol), and corresponding anhydrous solvent (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at the corresponding temperature for 22 h, then to the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by \textsuperscript{1}H NMR.

Method C: Hydroamination of allyl alcohol (1h)

To an argon-purged reaction tube equipped with J-Young stop valve was added RuClH(CO)(PPh_{3})_{3} (0.04 mmol), 2,6-bis(n-butyliminomethyl)pyridine (L4) (0.044 mmol) prepared from pyridine-2,6-carbaldehyde and n-butylamine, and anhydrous CH_{2}Cl_{2} (1 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then vacuum distilled. To the residue was added KOBu' (0.06 mmol), allyl alcohol (1h) (2.6 mmol), amine (2 mmol), anhydrous IPA (0.5 mL), and Toluene (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 85°C for 22 h, then to the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by \textsuperscript{1}H NMR.

Method D: Hydroamination of (3-methoxy-4-penten-1-yl)benzene (1c’)

To an argon-purged reaction tube equipped with J-Young stop valve was added RuClH(CO)(PPh_{3})_{3} (0.04 mmol), 2,6-bis(n-butyliminomethyl)pyridine (L4) (0.044 mmol) prepared from pyridine-2,6-carbaldehyde and n-butylamine, and anhydrous CH_{2}Cl_{2} (1 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 40°C for 1 h, then vacuum distilled. To the residue was added KOBu' (0.06 mmol), (3-methoxy-4-penten-1-yl)benzene (1c’) (2.6 mmol), morphoíne (2a) (2 mmol), and IPA (0.5 mL). The mixture was degassed by using FPT cycles and then purged with argon again. The reaction mixture was stirred at 70°C for 22 h, then to the mixture was added triphenylmethane (0.2 mmol) as an internal standard for NMR yield. A part of the solution was picked up and evaporated, and then the yield was measured by \textsuperscript{1}H NMR.
6. Characterization of products

4-(Morpholin-1-yl)butan-2-ol (3aa)

The reaction was conducted according to Method A with amine 2a (>99% yield). The product was purified by column chromatography (EtOAc:MeOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.18$ (d, $J = 6.0$ Hz, 3H, -C\(\text{H}_3\)), 1.45-1.53 (m, 1H, -CHCH\(\text{H}\)), 1.58-1.72 (m, 1H, -CHCH\(\text{H}\)), 2.40 (br-s, 2H, -CH\(\text{CH}2\CH2\)), 2.53-2.70 (m, 4H, -NCH\(\text{H}2\CH2O\)), 3.71 (br-s, 4H, -NCH\(\text{H}2\CH2O\)), 3.91-4.01 (m, 1H, -CH\(\text{H}OH\)) ppm.

$^{13}$C NMR: $\delta = 23.2, 32.8, 53.5, 58.1, 66.8, 69.6$ ppm. GC-MS: $m/z = 159$. HRMS (FAB, m-NBA): Calcd. for C\(\text{H}8\)H\(\text{N}2\O  ([M+H]+) 160.1338; found 160.1342. CAS Registry Number: 858440-45-6.

4-(Piperizin-1-yl)butan-2-ol (3ab)

The reaction was conducted according to Method A with amine 2b (86% yield). The product was purified by column chromatography (EtOAc:MeOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR (CDCl\(\text{3}\)): $\delta = 1.16$ (d, $J = 6.0$ Hz, 3H, -C\(\text{H}_3\)), 1.31-1.70 (m, 8H, -CH\(\text{CH}2\)), 2.30 (br-s, 2H, -CH\(\text{CH}2\CH2\)), 2.44-2.63 (m, 4H, -NCH\(\text{H}2\CH2\)), 3.89-4.00 (m, 1H, -CH\(\text{H}OH\)) ppm.

$^{13}$C NMR: $\delta = 23.4, 24.1, 25.9, 33.2, 54.5, 58.4, 69.8$ ppm. GC-MS: $m/z = 157$. HRMS (FAB, m-NBA): Calcd. for C\(\text{H}9\)\(\text{N}2\O  ([M+H]+) 158.1545; found 158.1546. CAS Registry Number: 71648-40-3.

4-(4-Phenylpiperazin-1-yl)butan-2-ol (3ac)

The reaction was conducted according to Method A with amine 2c (>99% yield). The product was purified by column chromatography (CHCl\(\text{3}\):Hexane = 1:1). The product was obtained as a white solid.

$^1$H NMR: $\delta = 1.19$ (d, $J = 6.0$ Hz, 3H, -C\(\text{H}_3\)), 1.48-1.57 (m, 1H, -CHCH\(\text{H}\)), 1.62-1.75 (m, 1H, -CHCH\(\text{H}\)), 2.51-2.86 (m, 6H, -CH\(\text{CH}2\CH2\), -CH\(\text{H}2\\CH2\CH2\)), 3.15-3.25 (m, 4H, -CH\(\text{H}2\\CH2\CH2\)), 3.94-4.02 (m, 1H, -CH\(\text{H}OH\)), 5.91 (br-s, 1H, -OH), 6.84-6.93 (m, 3H, Ar-\(\text{H}\)), 7.24-7.29 (m, 2H, Ar-\(\text{H}\)) ppm.

$^{13}$C NMR: $\delta = 23.3, 33.2, 49.1, 53.2, 57.7, 69.7, 116.1, 119.8, 129.0, 151.0$ ppm. GC-MS: $m/z = 234$. HRMS (FAB, m-NBA): Calcd. for C\(\text{H}14\)\(\text{N}2\)\(\text{O}2\) ([M+H]+) 235.1810; found 235.1812. CAS Registry Number: 1034267-00-9.
4-(1,2,3,4-Tetrahydroisoquinolin-2-yl)butan-2-ol (3ad)

![Chemical Structure of 3ad](image)

Fig S5. Chemical Structure of 3ad

The reaction was conducted according to Method A with amine 2d (90% yield). The product was purified by column chromatography (EtOAc:MeOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.18$ (d, $J = 6.3$ Hz, 3H, -CH$_3$), 1.54-1.61 (m, 1H, -CHCHH-), 1.68-1.81 (m, 1H, -NCHHAr), 2.58-3.01 (m, 6H, -CHCH$_2$CH$_2$-, -N(CH$_2$)$_2$Ar), 3.61-3.66 (d, $J = 14.7$ Hz, 1H, -NCCHHAr), 3.73-3.78 (d, $J = 14.7$ Hz, 1H, -NCHHAr), 3.96-4.03 (m, 1H, -CH$_2$OH), 7.01-7.15 (m, 4H, Ar-) ppm.

$^{13}$C NMR: $\delta = 23.4$, 28.8, 33.6, 50.5, 56.3, 57.5, 69.7, 125.7, 126.2, 126.5, 128.5, 133.9, 134.0 ppm. GC-MS: $m/z = 205$. HRMS (FAB, m-NBA): Calcd. for C$_{13}$H$_{20}$NO ([M+H]$^+$) 206.1545; found 206.1548. CAS Registry Number: 1247753-69-0.

4-(1,4-Dioxa-8-azaspiro[4.5]decan-8-yl)butan-2-ol (3ae)

![Chemical Structure of 3ae](image)

Fig S6. Chemical Structure of 3ae

The reaction was conducted according to Method A with amine 2e (75% yield). The product was purified by column chromatography (EtOAc:MeOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.17$ (d, $J = 6.3$ Hz, 3H, -CH$_3$), 1.43-1.52 (m, 1H, -CHCHH-), 1.58-1.73 (m, 1H, -CCCH$_2$-), 2.46 (br-s, 2H, -CHCH$_2$C-), 2.54-2.80 (m, 4H, -NCCH$_2$CH$_2$C-), 3.90-4.00 (m, 5H, -CH$_2$OH, -CH$_2$O-), 6.23 (br-s, 1H, -OAr) ppm. $^{13}$C NMR: $\delta = 23.3$, 33.6, 34.7, 51.4, 57.4, 64.2, 69.7, 106.8 ppm. GC-MS: $m/z = 215$. Anal. Calcd. for C$_{11}$H$_{21}$NO$_3$: C, 61.37; H, 9.83; N, 6.51. Found: C, 61.43; H, 9.76; N, 6.55.

4-(Indolin-1-yl)butan-2-ol (3af)

![Chemical Structure of 3af](image)

Fig S7. Chemical Structure of 3af

The reaction was conducted according to Method A with amine 2f (86% yield). The product was purified by column chromatography (EtOAc:Hexane = 1:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.24$ (d, $J = 6.0$ Hz, 3H, -CH$_3$), 1.70-1.83 (m, 2H, -CHCH$_2$-), 2.95 (t, $J = 8.1$ Hz, 2H, -NCH$_2$CH$_2$Ar), 3.10-3.51 (m, 5H, -CHCH$_2$CH$_2$-, -NCH$_2$CH$_2$Ar, -OAr), 3.96-4.07 (m, 1H, -CHOH), 6.61 (d, $J = 7.8$ Hz, 1H, Ar-H), 6.72 (t, $J = 7.2$ Hz, 1H, Ar-H), 7.09 (t, $J = 7.2$ Hz, 2H, Ar-H) ppm. $^{13}$C NMR: $\delta = 23.6$, 28.5, 35.7, 48.5, 53.9, 67.9, 108.0, 118.6, 124.4, 127.2, 130.4, 152.4 ppm. GC-MS: $m/z = 191$. HRMS (FAB, m-NBA): Calcd. for C$_{12}$H$_{17}$NO (M$^+$) 191.1310; found 191.1309. CAS Registry Number: 56771-63-2.
4-(N,N-dibenzylamino)butan-2-ol (3ag)

Fig S8. Chemical Structure of 3ag

The reaction was conducted according to Method A with amine 2g (74% yield). The product was purified by column chromatography (EtOAc:Hexane = 1:5) and vacuum distillation. The product was obtained as a colorless oil.

1H NMR: δ = 1.08 (d, J = 6.3 Hz, 3H, -CH3), 1.45-1.54 (m, 1H, -CHCCH3), 2.71-2.81 (m, 1H, -CHCH2), 3.24 (d, J = 13.2 Hz, 2H, -CH2Ar), 3.68-3.78 (m, 1H, -CHOH), 3.89 (d, J = 13.2 Hz, 2H, -CH2Ar), 7.23-7.36 (m, 10H, Ar-H) ppm.

13C NMR: δ = 23.1, 34.0, 52.6, 58.5, 69.2, 127.3, 128.4, 129.2, 138.0 ppm. GC-MS: m/z = 269. HRMS (FAB, m-NBA): Calcd. for C18H24NO ([M+H]+) 270.1858; found 270.1857. CAS Registry Number: 177550-45-7.

4-(benzylamino)butan-2-ol (3ah)

Fig S9. Chemical Structure of 3ah

The reaction was conducted according to Method A with amine 2h (44% yield). The product was purified by column chromatography (EtOAc:Hexane = 6:5, + Et3N (7%)) and vacuum distillation. The product was obtained as a colorless oil.

1H NMR: δ = 1.17 (d, J = 6.0 Hz, 3H, -CH3), 1.42-1.65 (m, 2H, -CH2), 2.74-2.83 (m, 1H, -CH2CH2H), 2.98-3.05 (m, 1H, -CHCH2H), 3.73 (d, J = 12.9 Hz, 1H, -CH2Ar), 3.82 (d, J = 13.2Hz, 2H, -CH2Ar), 3.94-4.02 (m, 1H, -CHOH), 7.22-7.35 (m, 5H, Ar-H) ppm. 13C NMR: δ = 23.1, 34.0, 52.6, 58.5, 69.2, 127.3, 128.4, 139.3 ppm. GC-MS: m/z = 179. HRMS (FAB, m-NBA): Calcd. for C11H18NO ([M+H]+) 180.1388; found 180.1391. CAS Registry Number: 93293-37-9.

1-(Morpholin-1-yl)heptan-3-ol (3ba)

Fig S10. Chemical Structure of 3ba

The reaction was conducted according to Method B with allylic alcohols 1b at 70°C in IPA (0.5 mL) (>99% yield). The product was purified by column chromatography (EtOAc only) and vacuum distillation. The product was obtained as a colorless oil.

1H NMR: δ = 0.91 (t, J = 7.2 Hz, 3H, -CH3), 1.21-1.70 (m, 8H, -(CH2)3CH3, -CHCH2CH2N-), 2.43 (br-s, 2H, -CH2CH2H2N-), 2.51-2.69 (m, 4H, -NCH2CH2O-), 3.56-3.81 (m, 5H, -NCH2CH2O-,-CHOH) ppm. 13C NMR: δ = 14.0, 22.7, 27.7, 31.2, 37.4, 53.6, 58.3, 66.9, 73.7 ppm. GC-MS: m/z = 201. HRMS (FAB, m-NBA): Calcd. for C11H24NO2 ([M+H]+) 202.1802; found 202.1801.
5-Phenyl-1-(morpholin-1-yl)pentan-3-ol (3ca)

![Chemical Structure of 3ca](image)

The reaction was conducted according to Method B with allylic alcohols 1c at 70°C in IPA (0.5 mL) (90% yield). The product was purified by column chromatography (EtOAc:Hexane = 1:1) and vacuum distillation. The product was obtained as a colorless oil.

\(^1H\) NMR: \(\delta = 1.41-1.54\) (m, 1H, -CHC\(\text{H}_2\)N-), 1.60-1.87 (m, 3H, -CHCH\(\text{H}CH_2\)N-), 2.41 (br-s, 2H, -CHCH\(\text{H}_2\)N-), 2.55-2.87 (m, 6H, -CH\(\text{H}_2\)Ar, -NCH\(\text{H}_2\)CH\(\text{H}_2\)O-), 3.62-3.85 (m, 5H, -NCH\(\text{H}_2\)C\(\text{H}_2\)O-, -CHOH), 6.09 (br-s, 1H, -CHOH), 7.15-7.31 (m, 5H, Ar-H) ppm.

\(^{13}\)C NMR: \(\delta = 31.2, 31.9, 39.4, 53.6, 58.3, 66.9, 73.0, 125.6, 128.3, 128.4, 142.4\) ppm. GC-MS: \(m/z = 249\). HRMS (FAB, \(m\)-NBA): Calcd. for C\(_{15}\)H\(_{24}\)NO\(_2\) ([M+H])\(^{+}\) 250.1807; found 250.1803.

4-(Morpholin-1-yl)-1-phenylbutan-2-ol (3da)

![Chemical Structure of 3da](image)

The reaction was conducted according to Method B with allylic alcohols 1d at 100°C in IPA (0.5 mL) and Toluene (0.5 mL) (91% yield). The product was purified by column chromatography (EtOAc:Hexane = 1:1) and vacuum distillation. The product was obtained as a colorless oil.

\(^1H\) NMR: \(\delta = 1.46-1.55\) (m, 1H, -CHC\(\text{H}_2\)HCH\(\text{H}_2\)N-), 1.61-1.74 (m, 1H, -CHCH\(\text{H}CH_2\)N-), 2.39 (br-s, 2H, -CHCH\(\text{H}_2\)C\(\text{H}_2\)N-), 2.54-2.70 (m, 5H, -CH\(\text{H}_2\)Ar, -NCH\(\text{H}_2\)CH\(\text{H}_2\)O-), 2.85 (dd, \(J = 13.5\) Hz, \(J = 6.9\) Hz, 1H, -CH\(\text{H}_2\)Ar), 3.61-3.78 (m, 4H, -NCH\(\text{H}_2\)C\(\text{H}_2\)O-), 3.99-4.07 (m, 1H, -C\(\text{H}_2\)OH), 7.17-7.32 (m, 5H, Ar-H) ppm. \(^{13}\)C NMR: \(\delta = 30.4, 44.1, 53.6, 58.2, 66.8, 74.8, 126.1, 128.2, 129.2, 138.8\) ppm. GC-MS: \(m/z = 235\). HRMS (FAB, \(m\)-NBA): Calcd. for C\(_{14}\)H\(_{22}\)NO\(_2\) ([M+H])\(^{+}\) 236.1651; found 236.1651.

3-(Morpholin-1-yl)-1-phenylpropan-1-ol (3ea)

![Chemical Structure of 3ea](image)

The reaction was conducted according to Method B with allylic alcohols 1e at 80°C in IPA (0.5 mL) and Toluene (0.5 mL) (>99% yield). The product was purified by column chromatography (EtOAc only) and vacuum distillation. The product was obtained as a colorless oil.

\(^1H\) NMR (CDCl\(_3\)): \(\delta = 1.84-1.91\) (m, 2H, -CHCH\(\text{H}_2\)z), 2.40-2.74 (m, 6H, -CHCH\(\text{H}_2\)CH\(\text{H}_2\)O-), 3.76 (t, \(J = 4.8\) Hz, 4H, -NCH\(\text{H}_2\)CH\(\text{H}_2\)O-), 4.95 (t, \(J = 5.4\) Hz, 1H, -CHOH), 6.47 (br-s, 1H, -OH), 7.20-7.39 (m, 5H, Ar-H) ppm. \(^{13}\)C NMR: \(\delta = 33.4, 53.7, 57.6, 66.9, 75.5, 125.5, 127.0, 128.3, 144.7\) ppm. GC-MS: \(m/z = 221\). CAS Registry Number: 4441-34-3.
3-(Morpholin-1-yl)-1-(4-methoxyphenyl)propan-1-ol (3fa)

The reaction was conducted according to Method B with allylic alcohols 1f at 65°C in IPA (0.5 mL) and Toluene (0.5 mL) (70% yield). The product was purified by column chromatography (EtOAc only) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.76-1.93$ (m, 2H, -CH$_2$CH$_2$-), 2.49 (br-s, 2H, -CHCH$_2$C$_6$H$_5$-), 2.54-2.73 (m, 4H, -NCH$_2$CH$_2$O-), 3.75 (t, $J = 4.5$ Hz, 4H, -NCH$_2$C$_6$H$_5$O-), 3.80 (s, 3H, Ar-OC$_6$H$_3$), 4.89 (dd, $J = 7.8$ Hz, $J = 3.6$ Hz, 1H, -COH), 6.86-6.89 (m, 2H, Ar-H), 7.26-7.30 (m, 2H, Ar-H) ppm. $^{13}$C NMR: $\delta = 33.5, 53.7, 55.3, 57.6, 66.9, 75.2, 113.6, 126.6, 136.9, 158.6$ ppm. GC-MS: $m/z = 251$. CAS Registry Number: 109562-49-4.

4-(Morpholin-1-yl)-1-phenoxybutan-2-ol (3ga)

The reaction was conducted according to Method B with allylic alcohols 1g at 90°C in IPA (0.5 mL) and Toluene (0.5 mL) (92% yield). The product was purified by column chromatography (EtOAc only) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.68-1.89$ (m, 2H, -CH$_2$CH$_2$-), 2.47 (br-s, 2H, -CHCH$_2$C$_6$H$_5$-), 2.57-2.77 (m, 4H, -NCH$_2$CH$_2$O-), 3.80 (dd, $J = 9.3$ Hz, $J = 5.7$ Hz, 1H, -OCHCH-), 3.97 (dd, $J = 9.3$ Hz, $J = 5.7$ Hz, 1H, -OCHHCH-), 4.15-4.23 (m, 1H, -OH), 4.15-4.23 (m, 1H, -OCH), 6.89-6.97 (m, 3H, Ar-H), 7.24-7.31 (m, 2H, Ar-H) ppm. $^{13}$C NMR: $\delta = 28.0, 53.7, 57.6, 66.9, 71.4, 71.7, 114.5, 120.8, 129.4, 158.8$ ppm. FAB-MS: $m/z = 252$ ([M + H]$^+$). HRMS (FAB, m-NBA): Calcd. for C$_{14}$H$_{22}$NO$_3$ ([M+H]$^+$) 252.1600; found 252.1595. CAS Registry Number: 873390-19-3.

3-(Morpholin-1-yl)propan-1-ol (3ha)

The reaction was conducted according to Method C with amine 2a (99% yield). The product was purified by column chromatography (EtOAc:MeOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.73$ (quin, $J = 5.4$ Hz, 2H, -CH$_2$CH$_2$OH), 2.53 (br-s, 2H, -CH$_2$CH$_2$CH$_2$OH), 2.59 (t, $J = 5.7$ Hz, 4H, -NCH$_2$CH$_2$O-), 3.71 (t, $J = 4.5$ Hz, 4H, -NCH$_2$CH$_2$O-), 3.81 (t, $J = 5.4$ Hz, 2H, -CH$_2$OH), 4.44 (br-s, 1H, -OH) ppm. $^{13}$C NMR: $\delta = 26.8, 53.7, 59.0, 64.3, 66.8$ ppm. GC-MS: $m/z = 145$. CAS Registry Number: 4441-30-9.
3-(Piperizin-1-yl)propan-1-ol (3hb)

![Chemical Structure of 3hb]

The reaction was conducted according to Method C with amine 2b (94% yield). The product was purified by column chromatography (EtOAc:MrOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.37-1.49$ (m, 2H, -CH$_2$CH$_2$CH$_2$N-), 1.57 (quin, $J = 5.4$ Hz, 4H, -CH$_2$CH$_2$CH$_2$N-), 1.68 (quin, $J = 5.4$ Hz, 2H, -CH$_2$CH$_2$OH), 2.45 (br-s, 2H, -CH$_2$CH$_2$CH$_2$OH), 2.56 (t, $J = 5.7$ Hz, 4H, -CH$_2$CH$_2$CH$_2$CH$_2$N-), 3.80 (t, $J = 5.4$ Hz, 2H, -CH$_2$OH) ppm. $^{13}$C NMR: $\delta = 24.2, 26.0, 27.0, 54.7, 59.7, 64.8$ ppm. GC-MS: $m/z = 143$. CAS Registry Number: 104-58-5.

3-(4-Phenylpiperazin-1-yl)propan-1-ol (3hc)

![Chemical Structure of 3hc]

The reaction was conducted according to Method C with amine 2c at 90°C (98% yield). The product was purified by column chromatography (EtOAc:MrOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.76$ (quart, $J = 5.4$ Hz, 2H, -CH$_2$CH$_2$O), 2.65-2.71 (m, 6H, -CH$_2$CH$_2$CH$_2$OH, -CH$_2$CH$_2$NAr), 3.20 (t, $J = 5.1$ Hz, 4H, -CH$_2$NAr), 3.82 (t, $J = 5.1$ Hz, 2H, -CH$_2$O), 5.13 (br-s, 1H, -OH), 6.84-6.94 (m, 3H, Ar-H), 7.23-7.29 (m, 2H, Ar-H) ppm. $^{13}$C NMR: $\delta = 27.1, 49.2, 53.3, 58.7, 64.5, 116.1, 119.9, 129.1, 151.1$ ppm. GC-MS: $m/z = 220$. HRMS (FAB, m-NBA): Calcd. for C$_{13}$H$_{21}$N$_2$O ([M+H]$^+$) 221.1654; found 221.1652. CAS Registry Number: 67514-07-2.

3-(1,2,3,4-Tetrahydroisoquinolin-2-yl)propan-1-ol (3hd)

![Chemical Structure of 3hd]

The reaction was conducted according to Method C with amine 2d (95% yield). The product was purified by column chromatography (EtOAc:MrOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta = 1.82$ (quin, 2H, $J = 5.7$ Hz, -CH$_2$CH$_2$OH), 2.76-2.81 (m, 4H, -CH$_2$CH$_2$CH$_2$OH, -CH$_2$CH$_2$Ar), 2.91 (t, $J = 5.7$ Hz, 2H, -CH$_2$CH$_2$Ar), 3.70 (s, 2H, -NCH$_2$Ar), 3.84 (t, 2H, $J = 5.4$ Hz, -CH$_2$OH) ppm. $^{13}$C NMR: $\delta = 27.5, 29.0, 50.8, 56.5, 58.7, 64.6, 125.7, 126.3, 126.5, 128.6, 134.1, 134.2$ ppm. GC-MS: $m/z = 191$. CAS Registry Number: 86368-07-2.
3-(1,4-Dioxa-8-azaspiro[4.5]decan-8-yl)propan-1-ol (3he)

![Chemical Structure of 3he](image)

The reaction was conducted according to Method C with amine 2e (80% yield). The product was purified by column chromatography (EtOAc:MeOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta$ = 1.68-1.76 (m, 6H, -C$_2$H$_5$CH$_2$OH, -C$_2$H$_5$C-), 2.51-2.65 (m, 6H, -C$_2$H$_5$CH$_2$CH$_2$OH, -NC$_2$H$_5$CH$_2$C-), 3.81 (t, $J$ = 5.1 Hz, 2H, -C$_2$H$_5$OH), 3.95 (s, 4H, -C$_2$H$_5$O-), 5.44 (br-s, 1H, -OH) ppm.

$^{13}$C NMR: $\delta$ = 27.4, 34.8, 51.6, 58.6, 64.2, 64.7, 106.9 ppm. GC-MS: $m/z$ = 201. HRMS (FAB, m-NBA): Calcd. for C$_{10}$H$_{20}$NO$_3$ ([M+H]$^+$) 202.1443; found 202.1446. CAS Registry Number: 91017-21-9.

3-(Indolin-1-yl)propan-1-ol (3hf)

![Chemical Structure of 3hf](image)

The reaction was conducted according to Method C with amine 2f (92% yield). The product was purified by column chromatography (EtOAc:Hexane = 1:2) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta$ = 1.89 (quin, $J$ = 6.6 Hz, 2H, -CH$_2$CH$_2$OH), 2.40 (br-s, 1H, -OH), 2.96 (t, $J$ = 8.1 Hz, 2H, -CH$_2$CH$_2$CH$_2$OH), 3.22 (t, $J$ = 6.3 Hz, 2H, -CH$_2$Ar), 3.36 (t, $J$ = 8.1 Hz, 2H, -NCH$_2$CH$_2$Ar), 3.79-3.84 (m, 2H, -C$_2$H$_5$OH), 6.59 (d, $J$ = 7.8 Hz, 1H, Ar-$H$), 6.70 (t, $J$ = 7.5 Hz, 1H, Ar-$H$), 7.10-7.12 (m, 2H, Ar-$H$) ppm. $^{13}$C NMR: $\delta$ = 28.6, 29.9, 48.1, 53.8, 62.1, 107.7, 118.3, 124.5, 127.3, 130.2, 152.5 ppm. GC-MS: $m/z$ = 177. HRMS (FAB, m-NBA): Calcd. for C$_{11}$H$_{15}$NO (M$^+$) 177.1154; found 177.1158. CAS Registry Number: 105150-22-9.

3-(N,N-dipropylamino)propan-1-ol (3hi)

![Chemical Structure of 3hi](image)

The reaction was conducted according to Method C with amine 2i (87% yield). The product was purified by column chromatography (EtOAc:MeOH = 20:3) and vacuum distillation. The product was obtained as a colorless oil.

$^1$H NMR: $\delta$ = 0.89 (t, $J$ = 7.5, 6H, -CH$_3$), 1.44-1.57 (m, 4H, -CH$_2$CH$_3$), 1.68 (quin, $J$ = 5.4 Hz, 2H, -CH$_2$CH$_2$OH), 2.34-2.41 (m, 4H, -NCH$_2$CH$_2$CH$_2$), 2.65 (t, $J$ = 5.4 Hz, 2H, -CH$_2$CH$_2$CH$_2$OH), 3.81 (t, $J$ = 5.1 Hz, 2H, -CH$_2$OH) ppm. $^{13}$C NMR: $\delta$ = 11.8, 20.0, 27.8, 55.4, 56.1, 64.8 ppm. GC-MS: $m/z$ = 159. HRMS (FAB, m-NBA): Calcd. for C$_9$H$_{22}$NO ([M+H]$^+$) 160.1701; found 160.1705. CAS Registry Number: 34003-67-3.
7. Analysis Charts

Fig S23. $^1$H NMR spectrum of L4
Fig S24. $^{13}$C NMR spectrum of L4
Fig S25. $^1$H NMR spectrum of 1c’
Fig S26. $^{13}$C NMR spectrum of 1c'
Fig S27. $^1$H NMR spectrum of 3aa
Fig S28. $^{13}$C NMR spectrum of 3aa
Fig S29. $^1$H NMR spectrum of 3ab
**Fig S30.** $^{13}$C NMR spectrum of 3ab
Fig S31. $^1$H NMR spectrum of 3ac
Fig S32. $^{13}$C NMR spectrum of 3ac
Fig S33. $^1$H NMR spectrum of 3ad
Fig S34. $^1$C NMR spectrum of 3ad
Fig S35. $^1$H NMR spectrum of 3ae
Fig S36. $^{13}$C NMR spectrum of 3ae
Fig S37. $^1$H NMR spectrum of 3af
Fig S38. $^{13}$C NMR spectrum of 3af
Fig S39. $^1$H NMR spectrum of 3ag
Fig S40. $^{13}$C NMR spectrum of 3ag
Fig S41. $^1$H NMR spectrum of 3ah
Fig S42. $^{13}$C NMR spectrum of 3ah
Fig S43. $^1$H NMR spectrum of 3ba
Fig S44. $^{13}$C NMR spectrum of 3ba
Fig S45. $^1$H NMR spectrum of 3ca
Fig S46. $^{13}$C NMR spectrum of 3ca
Fig S47. $^1$H NMR spectrum of 3da
Fig S48. $^{13}$C NMR spectrum of 3da
Fig S49. $^1$H NMR spectrum of 3ea
Fig S50. $^{13}$C NMR spectrum of 3ea
Fig S51. $^1\text{H}$ NMR spectrum of 3fa
Fig S52. $^{13}$C NMR spectrum of 3fa
Fig S53. $^1$H NMR spectrum of 3ga
Fig S54. $^{13}$C NMR spectrum of 3ga
Fig S55. $^1$H NMR spectrum of 3ha
Fig S56. $^{13}$C NMR spectrum of 3ha
Fig S57. \(^1\)H NMR spectrum of 3hb
Fig S58. $^{13}$C NMR spectrum of 3hb
Fig S59. $^1$H NMR spectrum of 3hc
Fig S60. $^{13}$C NMR spectrum of 3hc
Fig S61. $^1$H NMR spectrum of 3hd
Fig S62. $^{13}$C NMR spectrum of 3hd
Fig S63. $^1$H NMR spectrum of 3he
Fig S64. $^{13}$C NMR spectrum of 3he
Fig S65. $^1$H NMR spectrum of 3hf
Fig S66. $^{13}$C NMR spectrum of 3hf
Fig S67. $^1$H NMR spectrum of 3hi
Fig S68. $^{13}$C NMR spectrum of 3hi
8. References