Supporting Information for

A Synthetic Strategy toward Eight-Membered Cyclic Amines by Cycloetherification and Claisen Rearrangement

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Materials and Methods

Unless otherwise stated, reactions were performed in flame-dried glassware under an argon or nitrogen atmosphere using dry, deoxygenated solvents. Reaction progress was monitored by thin-layer chromatography (TLC). THF, Et₂O, CH₂Cl₂, toluene, benzene, CH₃CN, and dioxane were dried by passage through an activated alumina column under argon. Purified water was obtained using a Barnstead NANOpure Infinity UV/UF system. Brine solutions are saturated aqueous solutions of sodium chloride. Commercially available reagents were purchased from Sigma-Aldrich, Acros Organics, Strem, or Alfa Aesar and used as received unless otherwise stated. Reaction temperatures were controlled by an IKAmag temperature modulator unless otherwise indicated. Glove box manipulations were performed under a N₂ atmosphere. TLC was performed using E. Merck silica gel 60 F254 precoated glass plates (0.25 mm) and visualized by UV fluorescence quenching, p-anisaldehyde, KMnO₄ or PMA (phosphomolybdic acid) staining. Silicycle SiliaFlash P60 Academic Silica gel (particle size 0.040-0.064 mm) was used for flash column chromatography. ¹H NMR spectra were recorded on a Varian Inova 300 MHz, 500 MHz and 600 MHz and Bruker 400 MHz spectrometers. The ¹H NMR spectra are reported relative to residual CHCl₃ (δ 7.26 ppm), C₆D₆ (δ 7.16 ppm) or CD₃OD (δ 3.31 ppm). ¹³C NMR spectra are recorded on a Varian Inova 300 MHz (75 MHz) and 500 MHz spectrometer (125 MHz) and Bruker 400 MHz spectrometers (100 MHz). The ¹³C NMR spectra are reported relative to CHCl₃ (δ 77.16 ppm), C₆D₆ (δ 128.06 ppm), or CD₃OD (δ 49.01 ppm). Data for ¹H NMR are reported as follows: chemical shift (δ ppm) (multiplicity, coupling constant (Hz), integration). Multiplicities are reported as follows: s = singlet, d = doublet, t = triplet, q = quartet, p = pentet, sept = septuplet, m = multiplet, br s = broad singlet, br d = broad doublet, app = apparent. Data for ¹³C NMR are reported
in terms of chemical shifts (δ ppm). IR spectra were obtained using a Perkin Elmer Paragon 1000 spectrometer using thin films deposited on NaCl plates and reported in frequency of absorption (cm⁻¹). High resolution mass spectra (HRMS) were obtained from the Caltech Mass Spectral Facility using JEOL JMS-600H High Resolution Mass Spectrometer in fast atom bombardment (FAB+) or electron ionization (EI+) mode, or using an Agilent 6200 Series TOF with an Agilent G1978A Multimode source in electrospray ionization (ESI+), atmospheric pressure chemical ionization (APCI+), or mixed ionization mode (MM: ESI-APCI+).
Representative procedure for aminoalcohols 1

To a solution of ester SI-1 (3.58 mmol, 1.00 equiv) in THF (18.0 mL) was added vinylmagnesium bromide (1 M in THF) (17.9 mmol, 5.00 equiv) dropwise at −78 °C. The solution was stirred for 12 h at 23 °C. The solution was quenched with sat. NH₄Cl at 0 °C. The aqueous phase was washed with Et₂O (3 x 20.0 mL). The combined organic phase was washed with brine, dried over anhydrous MgSO₄, and concentrated in vacuo. The residue was purified by flash column chromatography on silica gel to give tertiary alcohols.

To a solution of tertiary alcohol (1.38 mmol, 1.00 equiv) in MeCN (6.90 mL) were added K₂CO₃ (6.90 mmol, 5.00 equiv) and allyl bromide SI-2 (1.45 mmol, 1.05 equiv). The solution was stirred for 12 h at 23 °C. After the reaction was completed, water was added. The aqueous phase was washed with EtOAc (3 x 6.00 mL). The combined organic phases were washed with brine, dried over anhydrous MgSO₄, and concentrated in vacuo. The residue was purified by flash column chromatography on silica gel to give aminoalcohols 1.

\[
\text{SI-1} \quad \xrightarrow{1. \text{THF, } -78 \rightarrow 23 ^\circ C} \quad \text{SI-2} \quad \xrightarrow{2. K_2CO_3, MeCN, 23 ^\circ C} \quad 1
\]

**Formula:**

\[
\text{MeO} \quad \text{HCl} \quad \xrightarrow{\text{SI-1}} \quad \text{R}^1 \quad \text{OH} \quad \xrightarrow{\text{R}^2 \text{MgBr (1M in THF)}} \quad \text{THF, } -78 \rightarrow 23 ^\circ C \quad (64-86\% \text{ yield}) \quad \xrightarrow{\text{K}_2\text{CO}_3, \text{MeCN, } 23 \ ^\circ C} \quad (32-57\% \text{ yield}) \quad \text{SI-2} \quad \xrightarrow{\text{X = Br, I}} \quad \text{1}
\]

**Formula:**

\[
\text{R}^1 \quad \text{R}^2 \quad \text{R}^3 \quad \text{R}^4 \quad \text{R}^5
\]

**Notes:**

1. X = Br, I
2. \(1b\)
**1b** (178 mg, 0.482 mmol) was synthesized from sarconic methyl ester hydrochloride (193 mg, 1.38 mmol); 35% yield (2 steps); \( R_f = 0.25 \) (1:8 EtOAc:hexanes); \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.65 – 7.48 (m, 2H), 7.41 – 7.31 (m, 3H), 6.96 (s, 1H), 5.93 (dd, \( J = 17.3, 10.6 \) Hz, 2H), 5.41 (d, \( J = 17.3 \) Hz, 2H), 5.16 (d, \( J = 10.7 \) Hz, 2H), 4.14 (s, br, 1H), 3.45 (s, 2H), 2.69 (s, 2H), 2.32 (s, 3H); \(^1^3\)C NMR (101 MHz, CDCl\(_3\)) \( \delta \) 142.0, 137.4, 136.2, 128.8, 128.8, 128.3, 114.0, 107.4, 74.5, 71.8, 66.0, 43.1; IR (Neat Film NaCl) 2846, 2792, 2361, 2343, 1447, 999, 921, 750, 695 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{16}\)H\(_{21}\)OIN [M+H]\(^+\): 370.0662; found: 370.0688.

![1c](image)

**1c** (117 mg, 0.367 mmol) was synthesized from proline methyl ester hydrochloride (145 mg, 0.875 mmol); 42% yield (2 steps); \( R_f = 0.55 \) (1:8 EtOAc:hexanes); \(^1\)H NMR (500 MHz, CDCl\(_3\)) \( \delta \) 6.28 (dt, \( J = 2.1, 1.1 \) Hz, 1H), 5.93 (dd, \( J = 17.2, 10.6 \) Hz, 1H), 5.86 (dd, \( J = 17.3, 10.8 \) Hz, 1H), 5.80 (t, \( J = 1.5 \) Hz, 1H), 5.45 (dd, \( J = 17.2, 1.5 \) Hz, 1H), 5.32 (dd, \( J = 17.3, 1.6 \) Hz, 1H), 5.12 (dd, \( J = 11.5, 10.7, 1.6 \) Hz, 2H), 3.75 (dt, \( J = 14.2, 1.8 \) Hz, 1H), 3.60 (s, 1H), 3.08 – 3.00 (m, 1H), 2.95 – 2.85 (m, 2H), 2.33 – 2.22 (m, 1H), 1.92 – 1.81 (m, 1H), 1.83 – 1.53 (m, 4H); \(^1^3\)C NMR (126 MHz, CDCl\(_3\)) \( \delta \) 142.6, 140.1, 125.7, 113.7, 113.2, 112.4, 69.6, 67.8, 54.6, 27.9, 24.5; IR (Neat Film NaCl) 2964, 2871, 2799, 1617, 1409, 1355, 1114, 998, 920 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{12}\)H\(_{19}\)ONI [M+H]\(^+\): 320.0506; found: 320.0512.

![1d](image)
**1d** (88.8 mg, 0.289 mmol) was synthesized from sarconic methyl ester hydrochloride (115 mg, 0.826 mmol); 35% yield (2 steps); R_f = 0.35 (1:8 EtOAc:hexanes); ¹H NMR (400 MHz, CDCl₃) δ 6.42 (qt, J = 7.2, 1.2 Hz, 1H), 5.92 (d, J = 10.7 Hz, 1H), 5.87 (d, J = 10.7 Hz, 2H), 5.39 (dd, J = 17.2, 1.5 Hz, 2H), 5.13 (dd, J = 10.6, 1.5 Hz, 2H), 4.17 (s, 1H), 3.16 (s, 2H), 2.62 (s, 2H), 2.24 (s, 3H), 1.71 (dt, J = 7.0, 0.8 Hz, 3H); ¹³C NMR (101 MHz, CDCl₃) δ 142.1, 138.7, 113.9, 102.8, 74.4, 66.0, 62.3, 43.0, 17.1; IR (Neat Film NaCl) 2948, 2846, 1452, 1303, 1112, 1039, 996, 922 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C₁₁H₁₉ONI [M+H]⁺: 308.0506; found: 308.0517.

![1e](image)

**1e** (158 mg, 0.408 mmol) was synthesized from sarconic methyl ester hydrochloride (130 mg, 0.928 mmol); 44% yield (2 steps); R_f = 0.35 (1:8 EtOAc:hexanes); ¹H NMR (400 MHz, CDCl₃) δ 7.55 – 7.44 (m, 2H), 7.10 – 6.99 (m, 2H), 6.91 (s, 1H), 5.92 (dd, J = 17.3, 10.7 Hz, 2H), 5.40 (dd, J = 17.3, 1.5 Hz, 2H), 5.15 (dd, J = 10.7, 1.5 Hz, 2H), 4.09 (s, 1H), 3.42 (s, 2H), 2.69 (s, 2H), 2.31 (s, 3H); ¹³C NMR (101 MHz, CDCl₃) δ 162.5 (d, J = 248.2 Hz), 142.0, 135.0, 133.4 (d, J = 3.4 Hz), 130.7 (d, J = 8.1 Hz), 115.3 (d, J = 21.6 Hz), 114.0, 107.7, 74.6, 71.8, 66.0, 43.2; ¹⁹F NMR (282 MHz, CDCl₃) δ -112.9; IR (Neat Film NaCl) 2848, 2360, 2342, 1601, 1506, 1227, 1158, 997, 923 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C₁₆H₂₀ONIF [M+H]⁺: 388.0568; found: 388.0578.

![1f](image)
1f (61.3 mg, 0.209 mmol) was synthesized from sarconic methyl ester hydrochloride (122 mg, 0.873 mmol); 24% yield (2 steps); R_f = 0.35 (1:8 EtOAc:hexanes); ^1H NMR (400 MHz, CDCl_3) δ 6.27 (q, J = 1.4 Hz, 1H), 5.92 (d, J = 10.6 Hz, 2H), 5.92 – 5.83 (m, 3H), 5.39 (dd, J = 17.3, 1.5 Hz, 2H), 5.14 (dd, J = 10.7, 1.5 Hz, 2H), 4.03 (s, 1H), 3.14 (s, 2H), 2.63 (s, 2H), 2.26 (s, 3H); ^13C NMR (101 MHz, CDCl_3) δ 141.9, 127.3, 114.0, 111.9, 74.4, 70.0, 66.0, 43.2; IR (Neat Film NaCl) 2917, 2848, 2791, 1617, 1451, 1406, 1304, 1154, 1117, 1038, 996, 992 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C_{10}H_{17}ONI [M+H]^+: 294.0349; found: 294.0364.

1g (106 mg, 0.385 mmol) was synthesized from sarconic methyl ester hydrochloride (110 mg, 0.786 mmol); 49% yield (2 steps); R_f = 0.35 (1:8 EtOAc:hexanes); ^1H NMR (500 MHz, CDCl_3) δ 5.89 (dd, J = 17.3, 10.7 Hz, 2H), 5.37 (dd, J = 17.3, 1.6 Hz, 2H), 5.12 (dd, J = 10.6, 1.5 Hz, 2H), 3.40 (s, 2H), 2.60 (s, 2H), 2.27 (s, 3H), 1.91 (s, 3H), 1.83 (s, 3H); ^13C NMR (126 MHz, CDCl_3) δ 142.3, 134.9, 119.8, 113.7, 74.1, 65.9, 62.9, 43.0, 25.8, 21.2; IR (Neat Film NaCl) 2918, 2846, 1458, 1410, 1364, 1305, 1040, 998, 922 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C_{12}H_{21}ONBr [M+H]^+: 274.0801; found: 274.0826.

A 500 mL flame-dried round bottom flask, equipped with a stir bar, was placed under an argon atmosphere. Vinyl magnesium bromide (1 M in THF, 26.0 mL, 26.0 mmol)
was charged to the reaction vessel. After cooling the solution for 10 min at 4 °C, 2-
bromo-1-phenylethanone (3.50 g, 17.2 mmol) in THF (88.0 mL) was added slowly. Then, aq. NaOH (1 M, 80.0 mL, 80.0 mmol) was poured into the reaction pot at 4 °C. The reaction mixture was allowed to warm to 23 °C and stirred for 2 h. Water (50.0 mL) and EtOAc (40.0 mL) were added. Additional extract was obtained using EtOAc (2 x 50 mL). The combined organic layers were washed with brine (250 mL), dried over anhydrous sodium sulfate, filtered, and concentrated for purification. The residue was purified using basic alumina with EtOAc/Petroleum ether (1:50) to obtain 2-phenyl-2-vinlyoxirane (1.68 g, 67% yield).

2-Phenyl-2-vinlyoxirane (800 mg, 5.47 mmol), methyl amine (2 M in THF, 3.60 mL, 7.20 mmol), and MeOH (3.20 mL) were combined in 20 mL vial with a stir bar. The vial was heated at 80 °C via heating block for 12 h. The vial was allowed to cool to 23 °C. Solvent was removed under reduced pressure and placed on high vacuum for 10 min to afford an aminoalcohol.

To the residue were added MeCN (8.00 mL), Et3N (2.00 mL, 14.0 mmol), and (Z)-(3-
bromo-2-iodoprop-1-en-1-yl)benzene (1.58 g, 4.89 mmol). After 11.5 h, solvent was removed under reduced pressure and purified by silica gel chromatography to give (Z)-1-((2-iodo-3-phenylallyl)(methyl)amino)-2-phenylbut-3-en-2-ol (1.07 g, 47% 2-step yield) as an orange oil.\(^1\)

\( R_f = 0.59 \) (1:4 EtOAc:hexanes); \(^1\)H NMR (500 MHz, CDCl₃) \( \delta 7.56 - 7.47 \) (m, 4H), 7.40 – 7.31 (m, 5H), 7.27 – 7.22 (m, 1H), 6.93 (s, 1H), 6.21 (dd, \( J = 17.1, 10.6 \) Hz, 1H), 5.46 (dd, \( J = 17.0, 1.5 \) Hz, 1H), 5.16 (dd, \( J = 10.6, 1.5 \) Hz, 1H), 4.74 (s, 1H), 3.43 (dd, \( J = 13.4, 1.2 \) Hz, 1H), 3.29 (dd, \( J = 13.4, 1.2 \) Hz, 1H), 3.04 – 2.96 (m, 2H), 2.19 (s,

$^{13}$C NMR (126 MHz, CDCl$_3$) δ 145.5, 143.7, 137.4, 136.3, 128.8, 128.4, 128.3, 128.2, 126.8, 125.3, 113.6, 107.2, 74.9, 71.7, 67.5, 42.8; IR (Neat Film NaCl) 3468, 2953, 2928, 2857, 1617, 1465, 1378, 1255, 1154, 1086, 991, 921, 903 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{20}$H$_{23}$INO [M+H]$^+$: 420.0830; found: 420.0844.

Ii (214 mg, 0.502 mmol) was synthesized from sarconic methyl ester hydrochloride (350 mg, 2.51 mmol); 20% yield (2 steps); $R_f$ = 0.38 (1:8 EtOAc:hexanes); $^1$H NMR (400 MHz, CDCl$_3$) δ 7.55 – 7.50 (m, 2H), 7.35 (tdd, $J$ = 8.7, 7.4, 3.7 Hz, 3H), 6.96 (s, 1H), 5.40 (dt, $J$ = 2.7, 1.3 Hz, 2H), 3.47 (s, 2H), 2.71 (s, 2H), 2.35 (s, 3H), 1.76 (d, $J$ = 1.3 Hz, 6H), 1.71 (d, $J$ = 1.4 Hz, 6H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 137.5, 135.9, 133.7, 131.8, 131.1, 128.9, 128.2, 107.7, 73.5, 72.4, 68.0, 43.1, 26.8, 19.8; IR (Neat Film NaCl) 2913, 2790, 1446, 1374, 1083, 1030, 750, 695 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{20}$H$_{29}$ONI [M+H]$^+$: 426.1288; found: 426.1290.

Ij (67.7 mg, 0.152 mmol) was synthesized from methyl 2-(benzylamino)acetate (75.8 mg, 0.423 mmol); 36% yield (2 steps); $R_f$ = 0.38 (1:8 EtOAc:hexanes); $^1$H NMR (400 MHz, CDCl$_3$) δ 7.53 – 7.44 (m, 2H), 7.39 – 7.29 (m, 8H), 6.95 (s, 1H), 5.90 (dd, $J$ = 17.2, 10.6 Hz, 2H), 5.40 (dd, $J$ = 17.2, 1.5 Hz, 2H), 5.13 (dd, $J$ = 10.6, 1.5 Hz, 2H),
3.82 (s, 1H), 3.78 (s, 2H), 3.56 (s, 2H), 2.80 (s, 2H); \textsuperscript{13}C NMR (101 MHz, CDCl\textsubscript{3}) \(\delta\) 142.1, 137.9, 137.6, 137.1, 129.7, 128.8, 128.5, 128.3, 127.6, 114.1, 106.8, 74.4, 67.4, 62.0, 58.8, 29.9; IR (Neat Film NaCl) 2916, 2849, 1250, 869, 696 cm\textsuperscript{-1}; HRMS (MM: ESI-APCI+) m/z calc’d for C\textsubscript{22}H\textsubscript{25}ONI [M+H]\textsuperscript{+}: 446.0975; found: 446.0984.

\textbf{1k} (200 mg, 0.504 mmol) was synthesized from sarconic methyl ester hydrochloride (306 mg, 2.19 mmol); 23% yield (2 steps); \(R_f = 0.34\) (1:8 EtOAc:hexanes); \textsuperscript{1}H NMR (400 MHz, CDCl\textsubscript{3}) \(\delta\) 7.55 – 7.48 (m, 2H), 7.41 – 7.27 (m, 3H), 6.96 (s, 1H), 5.12 (s, 2H), 4.97 (s, 2H), 4.63 (s, 1H), 3.42 (s, 2H), 2.96 (s, 2H), 2.28 (s, 3H), 1.71 (s, 6H); \textsuperscript{13}C NMR (101 MHz, CDCl\textsubscript{3}) \(\delta\) 147.3, 137.4, 136.2, 128.8, 128.3, 111.8, 107.5, 71.8, 61.8, 42.5, 18.9; IR (Neat Film NaCl) 2953, 2849, 2792, 1640, 1446, 1369, 1309, 1067, 1017, 898, 750, 695 cm\textsuperscript{-1}; HRMS (MM: ESI-APCI+) m/z calc’d for C\textsubscript{18}H\textsubscript{25}ONI [M+H]\textsuperscript{+}: 398.0975; found: 398.0981.

Ni-catalyzed C–O bond formation experiments were performed in a nitrogen-filled glove box. To a solution of aminoalcohol \textbf{1b} (46.3 mg, 0.125 mmol, 1.00 equiv) in MeCN (0.830 mL) in a scintillation vial were added Et\textsubscript{3}N (19 \(\mu\)L, 0.138 mmol, 1.10 equiv), Zn powder (16.3 mg, 0.250 mmol, 2.00 equiv), and Ni(COD)\textsubscript{2} (1.70 mg, 0.00627 mmol, 0.05 equiv). The reaction mixture was stirred at 23 °C for 24 h. After
the reaction was completed, the vial was removed from the glove box and uncapped. Solids were removed via filtration through a celite plug, and the resulting solution was concentrated under reduced pressure. The residue was purified by flash column chromatography (1:4 EtOAc:hexanes) to give morpholine 2b (22.3 mg, 74% yield).

Rf = 0.35 (1:4 EtOAc:hexanes); 1H NMR (400 MHz, CD2Cl2) δ 7.68 – 7.61 (m, 2H), 7.28 (dd, J = 8.4, 7.1 Hz, 2H), 7.16 – 7.11 (m, 1H), 5.93 (dd, J = 17.4, 10.9 Hz, 2H), 5.47 (s, 1H), 5.31 (dd, J = 17.4, 1.2 Hz, 2H), 5.17 (dd, J = 10.9, 1.2 Hz, 2H), 3.05 – 2.98 (s, 2H), 2.58 (s, 2H), 2.26 (s, 3H); 13C NMR (101 MHz, CD2Cl2) δ 149.4, 139.8, 136.5, 128.9, 128.7, 126.3, 115.4, 108.0, 81.5, 62.8, 58.4, 46.3; IR (Neat Film NaCl) 2941, 2782, 1663, 1449, 1360, 1345, 1178, 1142, 983, 925, 754, 695 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C16H20ON [M+H]⁺: 242.1539; found: 242.1564.

Representative procedure for the one-pot cycloetherification and Claisen rearrangement of tertiary alcohols

Experiments were performed in a nitrogen-filled glove box. To a solution of aminoalcohol 1 (0.0934 mmol, 1.00 equiv) in MeCN (1.90 mL) in a scintillation vial were added Et3N (14.3 µL, 0.103 mmol, 1.10 equiv), Zn powder (12.2 mg, 0.187 mmol, 2.00 equiv), and Ni(COD)2 (0.00467 mmol, 0.05 equiv). The reaction mixture was stirred at 80 °C for 24 h. After the reaction was completed, the vial was removed from the glove box and uncapped. Solids were removed via filtration through a celite plug,
and the resulting solution was concentrated under reduced pressure. The residue was purified by flash column chromatography to give hexahydroazocine 3.

**Note:** Due to the COVID-19 pandemic, we are unable to conduct this experiment on a 1 mmol scale due to limitations in our experimental lab in terms of capacity and personnel.

3b (11.0 mg, 0.0454 mmol) was synthesized from 1b (20.0 mg, 0.0541 mmol); 84% yield; Rf = 0.55 (1:2 EtOAc:hexanes); 1H NMR (400 MHz, CDCl3) δ 7.46 – 7.39 (m, 2H), 7.38 – 7.32 (m, 2H), 7.31 – 7.26 (m, 1H), 6.30 (ddd, J = 17.7, 11.0, 0.8 Hz, 1H), 6.00 – 5.89 (m, 1H), 5.16 (d, J = 17.7 Hz, 1H), 5.01 (dt, J = 11.0, 0.7 Hz, 1H), 3.97 – 3.82 (m, 2H), 3.63 – 3.52 (m, 1H), 3.44 – 3.29 (m, 2H), 2.93 – 2.81 (m, 1H), 2.54 (ddd, J = 9.9, 7.9, 4.3 Hz, 1H), 2.44 (s, 3H); 13C NMR (101 MHz, CDCl3) δ 210.0, 139.6, 138.1, 136.8, 131.8, 128.9, 128.0, 127.6, 112.3, 65.4, 60.8, 56.2, 46.0, 29.2; IR (Neat Film NaCl) 2939, 1702, 1452, 902, 765, 701 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C16H20ON [M+H]^+: 242.1539; found: 242.1548.

3c (4.20 mg, 0.0219 mmol) was synthesized from 1c (10.6 mg, 0.0332 mmol); 66% yield; Rf = 0.35 (1:8 EtOAc:hexanes); 1H NMR (400 MHz, CD2Cl2) δ 6.19 (dd, J = 17.7, 11.1 Hz, 1H), 5.74 (t, J = 8.9 Hz, 1H), 5.07 (d, J = 17.7 Hz, 1H), 4.93 (d, J = 11.2 Hz, 1H), 4.15 – 4.01 (m, 1H), 3.59 (d, J = 16.1 Hz, 1H), 3.19 (td, J = 8.4, 2.0 Hz, 1H), 3.05 (dd, J = 9.7, 7.6 Hz, 1H), 2.89 (ddd, J = 14.0, 7.7, 1.7 Hz, 1H), 2.82 (dd, J = 16.1,
1.9 Hz, 1H), 2.39 (dddd, J = 13.9, 11.8, 7.6, 2.0 Hz, 1H), 2.30 – 2.19 (m, 2H), 1.99 (dddd, J = 12.2, 8.8, 7.6, 1.6 Hz, 1H), 1.87 (m, J = 12.8, 11.2, 9.5, 8.0, 5.0 Hz, 1H), 1.81 – 1.70 (m, 1H), 1.64 (dddd, J = 12.5, 11.2, 9.7, 5.7 Hz, 1H); \(^{13}\)C NMR (101 MHz, CD\(_2\)Cl\(_2\)) \(\delta\) 212.5, 140.6, 139.8, 131.7, 111.9, 67.4, 67.4, 56.1, 53.5, 43.4, 33.4, 23.2, 22.7; IR (Neat Film NaCl) 2945, 2798, 1706, 1222, 895 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{12}\)H\(_{18}\)ON [M+H]\(^+\): 192.1383; found: 192.1383.

![3d](image)

3d (7.30 mg, 0.0410 mmol) was synthesized from 1d (20.0 mg, 0.0651 mmol); 63% yield; \(R_f = 0.25\) (1:4 EtOAc:hexanes); \(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 6.27 (ddd, J = 17.5, 10.9, 0.8 Hz, 1H), 5.91 (t, J = 8.5 Hz, 1H), 5.18 (dt, J = 17.6, 0.7 Hz, 1H), 4.99 (dt, J = 10.8, 0.8 Hz, 1H), 3.42 – 3.26 (m, 2H), 3.17 (d, J = 2.1 Hz, 2H), 2.78 – 2.67 (m, 1H), 2.67 – 2.53 (m, 2H), 2.46 (s, 3H), 1.14 (d, J = 6.7 Hz, 3H); \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 213.7, 139.5, 137.2, 132.2, 112.4, 64.0, 54.0, 48.8, 45.4, 31.1, 16.4; IR (Neat Film NaCl) 2969, 2931, 1702, 1451, 898 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{11}\)H\(_{18}\)ON [M+H]\(^+\): 180.1383; found: 180.1386.

![3e](image)

3e (9.50 mg, 0.0368 mmol) was synthesized from 1d (25.0 mg, 0.0646 mmol); 57% yield; \(R_f = 0.27\) (1:4 EtOAc:hexanes); \(^1\)H NMR (500 MHz, CDCl\(_3\)) \(\delta\) 7.41 – 7.35 (m, 2H), 7.07 – 7.01 (m, 2H), 6.28 (ddd, J = 17.7, 11.0, 0.8 Hz, 1H), 5.99 – 5.88 (m, 1H),
5.16 (d, J = 17.6 Hz, 1H), 5.01 (dt, J = 11.0, 0.7 Hz, 1H), 3.91 – 3.79 (m, 2H), 3.54 (dt, J = 15.1, 1.2 Hz, 1H), 3.35 – 3.27 (m, 2H), 2.89 (dt, J = 15.6, 0.7 Hz, 1H), 2.59 – 2.49 (m, 1H), 2.43 (s, 3H); ^{13}C NMR (126 MHz, CDCl₃) δ 210.1, 162.2 (d, J = 246.2 Hz), 139.5, 136.9, 134.0 (d, J = 3.3 Hz), 131.4, 129.7 (d, J = 8.2 Hz), 115.7 (d, J = 21.1 Hz), 112.4, 65.6, 59.9, 56.5, 46.2, 29.5; ^{19}F NMR (282 MHz, CDCl₃) δ -115.2; IR (Neat Film NaCl) 2929, 1702, 1508, 1224, 1160, 832 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C₁₆H₁₉ONF [M+H]^+: 260.1445; found: 260.1449.

3f (5.30 mg, 0.0321 mmol) was synthesized from 1f (20.0 mg, 0.0682 mmol); 47% yield; R_f = 0.30 (1:2 EtOAc:hexanes); ^{1}H NMR (500 MHz, CDCl₃) δ 6.28 (ddd, J = 17.6, 11.0, 0.8 Hz, 1H), 5.92 (tq, J = 8.5, 0.8 Hz, 1H), 5.18 (dt, J = 17.5, 0.7 Hz, 1H), 5.02 – 4.97 (m, 1H), 3.36 (s, 2H), 3.16 (s, 2H), 2.72 (dt, J = 8.6, 6.9 Hz, 2H), 2.58 (dd, J = 7.8, 5.8 Hz, 2H), 2.46 (s, 3H); ^{13}C NMR (126 MHz, CDCl₃) δ 211.9, 139.4, 137.0, 133.0, 112.4, 65.3, 54.2, 45.3, 44.5, 22.8; IR (Neat Film NaCl) 2924, 2851, 1703, 1560, 1450, 1042, 902 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C₁₀H₁₆ON [M+H]^+: 166.1226; found: 166.1228.
**3g** (13.5 mg, 0.0700 mmol) was synthesized from **1g** (30.0 mg, 0.109 mmol); 64% yield; \( R_f = 0.35 \) (1:4 EtOAc:hexanes); \(^1^H\) NMR (400 MHz, CDCl\(_3\)) \( \delta \) 6.23 (ddd, \( J = 17.6, 11.0, 0.8 \) Hz, 1H), 5.85 (tq, \( J = 8.8, 0.8 \) Hz, 1H), 5.13 (d, \( J = 17.6 \) Hz, 1H), 4.95 (dd, \( J = 11.0, 0.8 \) Hz, 1H), 3.38 (s, 2H), 3.23 (s, 2H), 2.78 – 2.64 (m, 2H), 2.42 (s, 3H), 1.17 (s, 6H); \(^1^C\) NMR (101 MHz, CDCl\(_3\)) \( \delta \) 214.2, 139.8, 137.4, 131.9, 112.0, 64.3, 55.4, 50.7, 45.4, 37.5, 24.9; IR (Neat Film NaCl) 2970, 2930, 1702, 1452, 1126, 891 cm\(^{-1}\); HRMS (MM: ESI-APCI\(^+\)) m/z calc’d for C\(_{12}\)H\(_{20}\)ON [M+H]\(^+\): 194.1539; found: 194.1547.

![3g](image)

**3h** (49.1 mg, 0.169 mmol) was synthesized from **1h** (102 mg, 0.242 mmol); 70% yield; \( R_f = 0.53 \) (1:4 EtOAc:hexanes); \(^1^H\) NMR (400 MHz, CDCl\(_3\)) \( \delta \) \(^1^H\) NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.42 – 7.14 (m, 10H), 6.12 – 6.03 (m, 1H), 3.94 – 3.78 (m, 3H), 3.34 (dd, \( J = 15.2, 1.3 \) Hz, 2H), 2.93 (d, \( J = 15.2 \) Hz, 1H), 2.63 – 2.51 (m, 1H), 2.37 (s, 3H); \(^1^C\) NMR (101 MHz, CDCl\(_3\)) \( \delta \) 210.1, 142.9, 139.3, 138.0, 128.7, 128.5, 128.2, 127.9, 127.3, 127.1, 126.2, 65.0, 60.8, 60.7, 45.9, 29.0; IR (Neat Film NaCl) 3058, 3029, 2900, 2928, 2825, 2801, 1956, 1882, 1806, 1698, 1597, 1490, 1442, 1276, 1260, 1124, 876, 761, 702 cm\(^{-1}\); HRMS (MM: ESI-APCI\(^+\)) m/z calc’d for C\(_{20}\)H\(_{22}\)NO [M+H]\(^+\): 292.1623; found: 292.2742.

![3h](image)

**3i** (10.1 mg, 0.042 mmol) was synthesized from **1i** (20.1 mg, 0.085 mmol); 92% yield; \( R_f = 0.26 \) (1:4 EtOAc:hexanes); \(^1^H\) NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.42 – 7.14 (m, 10H), 3.94 – 3.78 (m, 3H), 3.23 (s, 2H), 2.87 – 2.55 (m, 2H), 2.37 (s, 3H); \(^1^C\) NMR (101 MHz, CDCl\(_3\)) \( \delta \) 142.9, 139.3, 138.0, 128.7, 128.5, 128.2, 127.9, 127.3, 127.1, 126.2, 65.0, 60.8, 60.7, 45.9, 29.0; IR (Neat Film NaCl) 3058, 3029, 2900, 2928, 2825, 2801, 1956, 1882, 1806, 1698, 1597, 1490, 1442, 1276, 1260, 1124, 876, 761, 702 cm\(^{-1}\); HRMS (MM: ESI-APCI\(^+\)) m/z calc’d for C\(_{16}\)H\(_{18}\)NO [M+H]\(^+\): 256.1244; found: 256.1253.
**3i** (5.00 mg, 0.0169 mmol) was synthesized from **1i** (30.0 mg, 0.0705 mmol); 24% yield; \( R_f = 0.45 \) (1:8 EtOAc:hexanes); \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta 7.55 - 7.47 \) (m, 2H), 7.23 (dd, \( J = 8.6, 7.0 \) Hz, 3H), 5.89 (s, 1H), 4.91 (d, \( J = 5.2 \) Hz, 2H), 4.65 (s, 1H), 3.44 (d, \( J = 12.7 \) Hz, 1H), 3.10 (dd, \( J = 15.4, 1.9 \) Hz, 1H), 3.02 (d, \( J = 13.1 \) Hz, 1H), 2.72 (d, \( J = 3.8 \) Hz, 1H), 2.68 (d, \( J = 6.5 \) Hz, 1H), 2.45 (s, 3H), 2.10 (d, \( J = 13.2 \) Hz, 1H), 1.81 (s, 3H), 1.04 (s, 3H), 0.74 (s, 3H); \(^13\)C NMR (101 MHz, CDCl\(_3\)) \( \delta 212.3, 143.0, 138.1, 134.8, 134.5, 131.0, 127.6, 126.7, 114.6, 71.6, 70.7, 59.2, 46.5, 42.7, 41.3, 31.5, 23.1, 21.8; IR (Neat Film NaCl) 2943, 2796, 1709, 1450, 1357, 1127, 704 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{20}\)H\(_{28}\)ON [M+H]\(^+\): 298.2165; found: 298.2168.

![Image](image.png)

**3j** (22.0 mg, 0.0691 mmol) was synthesized from **1j** (41.6 mg, 0.0934 mmol); 74% yield; \( R_f = 0.35 \) (1:8 EtOAc:hexanes); \(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta 7.43 - 7.31 \) (m, 4H), 7.33 – 7.20 (m, 6H), 6.27 (dd, \( J = 17.6, 11.0 \) Hz, 1H), 5.97 (t, \( J = 8.4 \) Hz, 1H), 5.05 (d, \( J = 17.6 \) Hz, 1H), 4.96 (d, \( J = 11.0 \) Hz, 1H), 3.96 (td, \( J = 11.5, 8.8 \) Hz, 1H), 3.90 – 3.83 (m, 1H), 3.69 (d, \( J = 1.7 \) Hz, 2H), 3.59 (d, \( J = 15.2 \) Hz, 1H), 3.53 – 3.43 (m, 1H), 3.34 (d, \( J = 15.2 \) Hz, 1H), 2.97 (d, \( J = 15.2 \) Hz, 1H), 2.66 (ddd, \( J = 11.7, 8.2, 5.2 \) Hz, 1H); \(^13\)C NMR (101 MHz, CDCl\(_3\)) \( \delta 210.6, 139.5, 138.4, 138.3, 136.8, 131.4, 129.5, 128.8, 128.6, 127.9, 127.6, 127.4, 112.4, 63.9, 62.6, 60.1, 54.8, 29.3; IR (Neat Film NaCl) 2923, 1703, 1494, 1453, 901, 699 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{22}\)H\(_{24}\)ON [M+H]\(^+\): 318.1852; found: 318.1858.
Experiments were performed in a nitrogen-filled glove box. To a solution of aminoalcohol 1k (50.0 mg, 0.126 mmol, 1.00 equiv) in MeCN (2.52 mL) in a scintillation vial were added Et$_3$N (19.3 µL, 0.139 mmol, 1.10 equiv), Zn powder (16.5 mg, 0.252 mmol, 2.00 equiv), and Ni(COD)$_2$ (0.00629 mmol, 0.05 equiv). The reaction mixture was stirred at 80 °C for 24 h. After the reaction was completed, the vial was removed from the glove box and uncapped. Solids were removed via filtration through a celite plug, and the resulting solution was concentrated under reduced pressure. The residue was purified by flash column chromatography to give morpholine 2k (34.0 mg, 99% yield).

R$_f$ = 0.25 (1:8 EtOAc:hexanes); $^1$H NMR (400 MHz, CDCl$_3$) δ 7.67 – 7.58 (m, 2H), 7.28 (dd, $J$ = 8.5, 7.1 Hz, 3H), 7.20 – 7.09 (m, 1H), 5.47 (s, 1H), 5.04 (s, 2H), 5.01 (p, $J$ = 1.4 Hz, 3H), 3.09 (s, 2H), 2.79 (s, 2H), 2.31 (s, 3H), 1.73 (dd, $J$ = 1.5, 0.8 Hz, 6H);

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 148.4, 144.1, 135.9, 128.7, 128.2, 125.8, 113.2, 107.5, 85.4, 59.5, 58.4, 46.5, 19.2; IR (Neat Film NaCl) 2971, 2767, 1663, 1645, 1448, 1361, 1345, 1249, 1179, 1141, 1078, 1060, 984, 903, 695 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{18}$H$_{24}$ON [M+H]$^+$: 270.1852; found: 270.1862.
Experiments were performed in a nitrogen-filled glove box. To a solution of aminoalcohol 1k (20.0 mg, 0.0503 mmol, 1.00 equiv) in MeCN (1.00 mL) in a scintillation vial were added Et$_3$N (7.70 µL, 0.0553 mmol, 1.10 equiv), Zn powder (6.60 mg, 0.101 mmol, 2.00 equiv), and Ni(COD)$_2$ (0.70 mg, 0.00252 mmol, 0.05 equiv). The reaction mixture was stirred at 80 °C for 24 h. After the reaction was completed, the vial was removed from the glove box and uncapped. Solids were removed via filtration through a celite plug, and the resulting solution was concentrated under reduced pressure. The residue was purified by flash column chromatography to give hexahydropyrazocine 3k (6.60 mg, 49% yield).

R$_f$ = 0.27 (1:8 EtOAc:hexanes); $^1$H NMR (500 MHz, CDCl$_3$) δ 7.53 – 7.46 (m, 2H), 7.39 – 7.31 (m, 2H), 7.33 – 7.25 (m, 1H), 4.91 (dq, $J$ = 3.0, 1.6 Hz, 1H), 4.59 (dq, $J$ = 1.9, 0.9 Hz, 1H), 4.22 (t, $J$ = 12.2 Hz, 1H), 3.91 (dd, $J$ = 12.4, 6.3 Hz, 1H), 3.68 – 3.59 (m, 1H), 3.26 (dd, $J$ = 16.0, 0.9 Hz, 1H), 2.82 (dt, $J$ = 16.0, 1.0 Hz, 1H), 2.75 (d, $J$ = 14.8 Hz, 1H), 2.33 (s, 3H), 2.12 (dd, $J$ = 12.0, 6.3 Hz, 1H), 1.76 (m, 6H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 210.0, 146.6, 138.2, 134.8, 132.1, 128.9, 128.2, 127.5, 113.3, 65.8, 61.7, 60.3, 46.1, 34.8, 22.0, 21.0; IR (Neat Film NaCl) 2913, 2794, 1701, 1450, 903, 768, 699 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{18}$H$_{24}$ON [M+H]$^+$: 270.1852; found: 270.1871.

*Representative procedure for secondary aminoalcohols*

![Representative procedure for secondary aminoalcohols](image-url)
To epoxide SI-3 (4.28 mmol, 1.00 equiv) was added RNH$_2$ (42.8 mmol, 10.0 equiv). The solution was stirred for 12 h at 23 °C. Volatiles were evaporated, and the residue was used without further purification.

To a solution of the amine (4.28 mmol, 1.00 equiv) in MeCN (11.0 mL) were added K$_2$CO$_3$ (21.4 mmol, 5.00 equiv) and allyl bromide SI-4 (2.14 mmol, 0.50 equiv). The solution was stirred for 12 h at 23 °C. After the reaction was completed, water was added. The aqueous phase was extracted with EtOAc (3 x 7.00 mL). The combined organic phases were washed with brine, dried over anhydrous MgSO$_4$ and concentrated in vacuo. The residue was purified by flash column chromatography (1:4 EtOAc:hexanes) on silica gel to give secondary alcohols 1 in 14-36% 2-step yield based on equivalent of allyl bromide SI-4.

\[
\begin{align*}
&\text{Me} \\
&\text{Ph} \\
\text{OH} \\
\end{align*}
\]

1 (515 mg, 1.50 mmol) was synthesized from 3,4-epoxy-1-butene (300 mg, 4.28 mmol); 35% yield (2 steps); R$_f$ = 0.65 (1:2 EtOAc:hexanes); $^1$H NMR (400 MHz, CDCl$_3$) δ 7.60 – 7.55 (m, 2H), 7.43 – 7.34 (m, 3H), 7.10 – 6.98 (s, br, 1H), 5.84 (ddd, J = 17.2, 10.5, 5.8 Hz, 1H), 5.45 – 5.37 (m, 1H), 5.21 (dt, J = 10.5, 1.5 Hz, 1H), 4.29 (s, br, 1H), 3.54 (s, br, 1H), 3.41 (s, br, 1H), 2.58 (s, br, 2H), 2.40 (s, 3H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 138.0, 137.2, 136.9, 128.8, 128.4, 128.3, 116.3, 70.7, 68.7, 62.8, 61.1, 41.2; IR (Neat Film NaCl) 3435, 2795, 1491, 1446, 1083, 1029, 921, 750, 695 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{14}$H$_{19}$NOI [M+H]$^+$: 344.0506; found: 344.0523.
\( \text{1n} \) (731 mg, 1.77 mmol) was synthesized from 3,4-epoxy-1-butene (452 mg, 6.45 mmol); 27% yield (2 steps); \( R_f = 0.69 \) (1:4 EtOAc:hexanes); \(^1\text{H NMR} \) (500 MHz, CDCl\(_3\)) \( \delta \) 7.57 – 7.49 (m, 2H), 7.41 – 7.29 (m, 3H), 6.97 (s, 1H), 5.81 (ddd, \( J = 17.3, 10.5, 5.7 \) Hz, 1H), 5.36 (dt, \( J = 17.2, 1.6 \) Hz, 1H), 5.17 (dt, \( J = 10.5, 1.5 \) Hz, 1H), 4.27 – 4.13 (m, 1H), 3.72 (s, 1H), 3.59 (d, \( J = 13.9 \) Hz, 1H), 3.33 (d, \( J = 13.8 \) Hz, 1H), 2.64 (dt, \( J = 13.1, 7.9 \) Hz, 1H), 2.60 – 2.41 (m, 3H), 1.61 – 1.44 (m, 2H), 1.41 – 1.21 (m, 6H), 0.96 – 0.83 (m, 3H); \(^{13}\text{C NMR} \) (126 MHz, CDCl\(_3\)) \( \delta \) 138.2, 137.5, 136.3, 128.8, 128.28, 128.25, 116.1, 107.6, 68.8, 67.6, 59.7, 53.4, 31.8, 27.3, 26.6, 22.8, 14.2; IR (Neat Film NaCl) 3460, 2953, 2928, 2856, 1491, 1445, 1362, 1286, 1150, 1080, 992, 921, 860, 749, 695 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for \( \text{C}_{19}\text{H}_{29}\text{INO} [\text{M+H}]^+ \): 414.1288; found: 414.1296.

\( \text{1o} \) (552 mg, 1.49 mmol) was synthesized from 3,4-epoxy-1-butene (452 mg, 6.45 mmol); 23% yield (2 steps); \( R_f = 0.61 \) (1:4 EtOAc:hexanes); \(^1\text{H NMR} \) (300 MHz, CDCl\(_3\)) \(^1\text{H NMR} \) (300 MHz, CDCl\(_3\)) \( \delta \) 7.58 – 7.49 (m, 2H), 7.42 – 7.28 (m, 3H), 6.98 (s, 1H), 5.99 – 5.85 (m, 1H), 5.86 – 5.70 (m, 1H), 5.42 – 5.09 (m, 4H), 4.33 – 4.16 (m, 1H), 3.76 – 3.55 (m, 2H), 3.35 (dd, \( J = 14.2, 4.7 \) Hz, 2H), 3.15 (dd, \( J = 14.3, 7.7 \) Hz, 1H), 2.57 (qd, \( J = 12.8, 6.8 \) Hz, 2H); \(^{13}\text{C NMR} \) (126 MHz, CDCl\(_3\)) 138.0, 137.2, 136.5,
134.0, 128.7, 128.2, 128.1, 118.8, 116.0, 107.0, 68.6, 66.6, 58.9, 55.8; IR (Neat Film NaCl): 3450, 3078, 2978, 2929, 2820, 1949, 1851, 1688, 1491, 1446, 1362, 1251, 1081, 993, 923, 751, 696 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for \(C_{16}H_{21}INO\) [M+H]\(^+\): 370.0662; found: 370.0664.

\begin{center}
\includegraphics[width=0.5\textwidth]{1p.png}
\end{center}

**1p** (283 mg, 0.635 mmol) was synthesized from 3,4-epoxy-1-butene (409 mg, 5.84 mmol); 11% yield (2 steps); R\(_f\) = 0.38 (1:4 EtOAc:hexanes); \(^1\)H NMR (500 MHz, CDCl\(_3\)) \(\delta\) 7.54 – 7.47 (m, 2H), 7.39 – 7.28 (m, 3H), 6.99 (s, 1H), 5.80 (ddd, \(J = 17.2, 10.5, 5.8\) Hz, 1H), 5.34 (dt, \(J = 17.2, 1.6\) Hz, 1H), 5.15 (dt, \(J = 10.5, 1.5\) Hz, 1H), 4.65 (t, \(J = 5.4\) Hz, 1H), 4.28 – 4.19 (m, 1H), 3.95 (s, 1H), 3.77 – 3.65 (m, 3H), 3.58 (dpd, \(J = 9.2, 7.0, 2.9\) Hz, 3H), 2.90 – 2.70 (m, 3H), 2.59 (dd, \(J = 13.1, 10.2\) Hz, 1H), 1.24 (td, \(J = 7.0, 1.0\) Hz, 6H); \(^{13}\)C NMR (126 MHz, CDCl\(_3\)) \(\delta\) 138.0, 137.3, 136.2, 128.7, 128.2, 128.1, 115.9, 107.0, 101.8, 69.7, 69.3, 62.9, 62.3, 61.2, 56.5, 15.5, 15.4; IR(Neat Film NaCl) 3457, 2975, 2879, 1686, 1646, 1491, 1445, 1374, 1255, 1122, 1063, 921, 859, 750, 696 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for \(C_{19}H_{29}INO_3\) [M+H]\(^+\): 446.1187; found: 446.1185.

\begin{center}
\includegraphics[width=0.5\textwidth]{1q.png}
\end{center}
**1q** (306 mg, 0.748 mmol) was synthesized from 3,4-epoxy-1-butene (452 mg, 6.45 mmol); 12% (2 steps); \( R_f = 0.59 \) (1:4 EtOAc:hexanes) ; \(^1\)H NMR (500 MHz, CDCl\(_3\)) \( \delta \) 7.59 – 7.52 (m, 2H), 7.44 – 7.29 (m, 4H), 7.04 (s, 1H), 6.35 (dd, \( J = 3.2, 1.9 \) Hz, 1H), 6.23 (dd, \( J = 3.2, 0.8 \) Hz, 1H), 5.81 (ddd, \( J = 17.2, 10.5, 5.7 \) Hz, 1H), 5.36 (dt, \( J = 17.2, 1.6 \) Hz, 1H), 5.17 (dt, \( J = 10.5, 1.5 \) Hz, 1H), 4.24 (ddddd, \( J = 10.3, 5.7, 3.1, 1.5 \) Hz, 1H), 3.86 – 3.76 (m, 2H), 3.70 (s, 1H), 3.60 (dd, \( J = 13.9, 1.4 \) Hz, 1H), 3.42 (dd, \( J = 13.8, 1.1 \) Hz, 1H), 2.72 (dd, \( J = 13.0, 3.2 \) Hz, 1H), 2.55 (dd, \( J = 13.0, 10.3 \) Hz, 1H); \(^{13}\)C NMR (126 MHz, CDCl\(_3\)) \( \delta \) 151.5, 142.5, 138.1, 137.3, 137.0, 128.8, 128.4, 128.3, 116.2, 110.3, 109.4, 106.9, 68.9, 66.5, 59.3, 48.4; IR (Neat Film NaCl) 3458, 3080, 2932, 2831, 1951, 1754, 1645, 1598, 1501, 1445, 1364, 1318, 1285, 1250, 1148, 1074, 1012, 921, 750, 696 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{18}\)H\(_{21}\)INO\(_2\) [M+H]\(^+\): 410.0611; found: 410.0615.

\[
\text{OH} \quad \text{N} \quad \text{Ph} \\
\text{1q}
\]

**1r** (334 mg, 0.797 mmol) was synthesized from 3,4-epoxy-1-butene (452 mg, 6.45 mmol); 12% yield (2 steps); \( R_f = 0.43 \) (1:4 EtOAc:hexanes); \(^1\)H NMR (500 MHz, CDCl\(_3\)) \( \delta \) 7.56 – 7.50 (m, 2H), 7.41 – 7.27 (m, 8H), 7.01 (s, 1H), 5.76 (ddd, \( J = 17.2, 10.5, 5.8 \) Hz, 1H), 5.32 (dt, \( J = 17.2, 1.5 \) Hz, 1H), 5.14 (dt, \( J = 10.5, 1.4 \) Hz, 1H), 4.22 (tdd, \( J = 7.3, 5.4, 1.4 \) Hz, 1H), 3.93 (d, \( J = 13.5 \) Hz, 1H), 3.66 (dd, \( J = 13.8, 1.4 \) Hz, 1H), 3.55 (d, \( J = 13.6 \) Hz, 2H), 3.36 (dd, \( J = 13.7, 0.9 \) Hz, 1H), 2.62 – 2.54 (m, 2H); \(^{13}\)C NMR (126 MHz, CDCl\(_3\)) \( \delta \) 138.1, 137.7, 137.4, 137.1, 129.6, 128.8, 128.6, 128.34, 128.25, 127.6, 116.2, 107.0, 68.9, 67.1, 59.3, 57.9; IR (Neat Film NaCl) 3460, 3082, 3060, 3025, 2935, 2813, 1950, 1880, 1808, 1710, 1645, 1600, 1493, 1446, 1364, 1245,
1125, 1076, 991, 921, 744, 697 cm⁻¹; HRMS (MM: ESI-APCI⁺) m/z calc’d for C_{20}H_{23}INO [M+H]^+: 420.0819; found: 420.0836.

1s (158 mg, 0.351 mmol) was synthesized from 3,4-epoxy-1-butene (452 mg, 6.45 mmol); 5% (2 steps); R_f = 0.45 (1:4 EtOAc:hexanes); ¹H NMR (500 MHz, CDCl_3) δ 7.56 – 7.47 (m, 2H), 7.39 – 7.27 (m, 5H), 7.00 (s, 1H), 6.91 – 6.85 (m, 2H), 5.75 (ddd, J = 17.3, 10.5, 5.8 Hz, 1H), 5.31 (dt, J = 17.2, 1.5 Hz, 1H), 5.13 (dt, J = 10.5, 1.4 Hz, 1H), 4.24 – 4.15 (m, 1H), 3.86 (d, J = 13.4 Hz, 1H), 3.81 (s, 3H), 3.63 (d, J = 13.7 Hz, 1H), 3.55 (s, 1H), 3.49 (d, J = 13.4 Hz, 1H), 3.32 (d, J = 13.8 Hz, 1H), 2.63 – 2.50 (m, 2H); ¹³C NMR (126 MHz, CDCl_3) δ 158.9, 138.0, 137.2, 136.8, 130.6, 129.5, 128.7, 128.2, 128.1, 116.0, 113.8, 107.0, 68.7, 66.8, 59.0, 57.1, 55.2; IR (Neat Film NaCl) 3448, 2933, 2833, 1611, 1511, 1444, 1302, 1249, 1174, 1081, 1034, 922, 845, 750, 696 cm⁻¹; HRMS (MM: ESI-APCI⁺) m/z calc’d for C_{21}H_{25}INO_2 [M+H]^+: 450.0924; found: 450.0914.

Representative procedure for morpholines

Ni-Catalyzed C–O bond formation experiments were performed in a nitrogen-filled glove box. To a solution of aminoalcohol 1 (0.291 mmol, 1.00 equiv) in MeCN (1.94
mL) in a scintillation vial were added Et₃N (0.320 mmol, 1.10 equiv), Zn powder (0.582 mmol, 2.00 equiv), and Ni(COD)₂ (0.0146 mmol, 0.05 equiv). The mixture was stirred at 23 °C for 24 h. After the reaction was completed, the vial was removed from the glovebox and uncapped. Solids were removed via filtration through a celite plug, and the resulting solution was concentrated under reduced pressure. The residue was purified by flash column chromatography using a mixture of hexanes and ethyl acetate as eluent to furnish morpholine 2.

\[ \text{2l} (149 \text{ mg, } 0.692 \text{ mmol}) \text{ was synthesized from } \text{1l} (379 \text{ mg, } 1.10 \text{ mmol}); 63\% \text{ yield; } \text{R}_f = 0.23 (1:2 \text{ EtOAc:hexanes); } ^1\text{H NMR (400 MHz, CD}_2\text{Cl}_2) \delta 7.51 (\text{dd, } J = 8.3, 1.4 \text{ Hz, 2H}), 7.18 (\text{dd, } J = 8.4, 7.0 \text{ Hz, 2H}), 7.08 - 7.01 (\text{m, 1H}), 5.89 (\text{ddd, } J = 17.3, 10.7, 5.6 \text{ Hz, 1H}), 5.40 - 5.32 (\text{m, 2H}), 5.19 - 5.16 (\text{m, 1H}), 4.35 (\text{dddt, } J = 9.8, 5.7, 2.9, 1.5 \text{ Hz, 1H}), 3.09 (\text{dd, } J = 12.6, 1.6 \text{ Hz, 1H}), 2.78 - 2.69 (\text{m, 2H}), 2.21 (\text{s, 3H}), 2.08 (\text{dd, } J = 11.7, 9.5 \text{ Hz, 1H}); ^13\text{C NMR (101 MHz, CD}_2\text{Cl}_2) \delta 150.5, 136.4, 136.2, 128.9, 128.6, 126.4, 117.1, 107.9, 78.0, 59.5, 58.3, 46.2; \text{IR (Neat Film NaCl) 2939, 2784, 2360, 1666, 1448, 1328, 1176, 1133, 1047, 985, 937, 755, 694 cm}^{-1}; \text{HRMS (MM: ESI-APCI+) m/z calc’d for C}_{14}\text{H}_{18}\text{NO }[\text{M+H}]^+: 216.1383; \text{found: 216.1399.} \]
2n (262 mg, 0.918 mmol) was synthesized from 1n (436 mg, 1.05 mmol); 87% yield; 
R_f = 0.32 (1:4 EtOAc:hexanes); \(^1\)H NMR (300 MHz, CDCl\(_3\)) \(\delta\) 7.63 – 7.57 (m, 2H),
7.27 (dd, \(J = 8.4, 7.1\) Hz, 2H), 7.17 – 7.10 (m, 1H), 5.95 (ddd, \(J = 17.3, 10.7, 5.5\) Hz, 1H), 5.50 (d, \(J = 1.3\) Hz, 1H), 5.46 (dt, \(J = 17.3, 1.5\) Hz, 1H), 5.27 (dt, \(J = 10.7, 1.4\) Hz, 1H), 4.46 (dddt, \(J = 9.8, 5.6, 2.9, 1.5\) Hz, 1H), 3.30 (dd, \(J = 12.6, 1.6\) Hz, 1H), 2.95 – 2.83 (m, 2H), 2.42 – 2.33 (m, 2H), 2.20 (dd, \(J = 11.8, 9.8\) Hz, 1H), 1.58 – 1.46 (m, 2H),
1.38 – 1.23 (m, 6H), 0.94 – 0.85 (m, 3H); \(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 149.5, 135.7,
135.5, 128.4, 128.1, 125.9, 116.9, 108.2, 77.1, 58.5, 57.2, 56.2, 31.7, 27.1, 26.5, 22.6,
14.0; IR (Neat Film NaCl): 3087, 3022, 2930, 2858, 2806, 1945, 1875, 1741, 1667,
1598, 1449, 1373, 1326, 1178, 1116, 987, 939, 826, 754, 694 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{19}\)H\(_{28}\)NO [M+H]\(^+\): 286.2165; found: 286.2165.

![Structure](image)

2o (161 mg, 0.667 mmol) was synthesized from 1o (289 mg, 0.783 mmol); 85% yield;
R_f = 0.31 (1:4 EtOAc:hexanes); \(^1\)H NMR (300 MHz, CDCl\(_3\)) \(\delta\) 7.65 – 7.57 (m, 2H),
7.33 – 7.24 (m, 2H), 7.19 – 7.11 (m, 1H), 6.03 – 5.80 (m, 2H), 5.53 – 5.41 (m, 2H),
5.31 – 5.18 (m, 3H), 4.51 – 4.41 (m, 1H), 3.29 (dd, \(J = 12.6, 1.7\) Hz, 1H), 3.05 (dt, \(J =
6.5, 1.3\) Hz, 2H), 2.97 – 2.84 (m, 2H), 2.21 (dd, \(J = 11.8, 9.7\) Hz, 1H); \(^{13}\)C NMR (75 MHz, CDCl\(_3\)) \(\delta\) 149.3, 135.6, 135.4, 134.1, 128.4, 128.1, 125.9, 118.8, 116.9, 108.3,
77.2, 61.4, 56.9, 56.0; IR (Neat Film NaCl): 3083, 3022, 2905, 2794, 1947, 1874, 1742,
1668, 1598, 1494, 1325, 1178, 1047, 994, 928, 827, 756, 695 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{16}\)H\(_{20}\)NO [M+H]\(^+\): 242.1539; found: 242.1543.
**2p** (128 mg, 0.403 mmol) was synthesized from **1p** (307 mg, 0.689 mmol); 58% yield; 
R$_f$ = 0.61 (1:4 EtOAc:hexanes); 
$^1$H NMR (300 MHz, CDCl$_3$) δ 7.65 – 7.55 (m, 2H), 7.34 – 7.21 (m, 2H), 7.19 – 7.07 (m, 1H), 5.94 (ddd, $J$ = 17.3, 10.7, 5.5 Hz, 1H), 5.52 – 5.38 (m, 2H), 5.26 (dt, $J$ = 10.7, 1.4 Hz, 1H), 4.68 (t, $J$ = 5.3 Hz, 1H), 4.46 (dddt, $J$ = 9.8, 5.7, 2.9, 1.4 Hz, 1H), 3.76 – 3.51 (m, 4H), 3.37 (dd, $J$ = 12.7, 1.6 Hz, 1H), 3.08 – 2.94 (m, 2H), 2.68 – 2.50 (m, 2H), 2.38 (dd, $J$ = 11.9, 9.7 Hz, 1H), 1.23 (td, $J$ = 7.1, 3.6 Hz, 6H); 
$^{13}$C NMR (75 MHz, CDCl$_3$) δ (ppm) 149.5, 135.6, 135.4, 128.4, 128.0, 125.8, 116.8, 107.9, 101.4, 77.0, 62.0, 61.9, 60.3, 57.8, 56.6, 15.3; IR (Neat Film NaCl) 2975, 2928, 1741, 1667, 1598, 1494, 1449, 1374, 1322, 1121, 1063, 943, 847, 756, 695 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{19}$H$_{28}$NO$_3$ [M+H]$^+$: 318.2064; found: 318.2066.

**2q** (187 mg, 0.665 mmol) was synthesized from **1q** (298 mg, 0.728 mmol); 91% yield (2 steps); 
R$_f$ = 0.52 (1:4 EtOAc:hexanes); 
$^1$H NMR (500 MHz, CDCl$_3$) δ 7.61 – 7.57 (m, 2H), 7.42 (dd, $J$ = 1.9, 0.8 Hz, 1H), 7.30 – 7.25 (m, 2H), 7.17 – 7.12 (m, 1H), 6.36 (dd, $J$ = 3.2, 1.8 Hz, 1H), 6.27 (dd, $J$ = 3.2, 0.8 Hz, 1H), 5.93 (ddd, $J$ = 17.3, 10.7, 5.5 Hz, 1H), 5.49 – 5.43 (m, 2H), 5.27 (dt, $J$ = 10.7, 1.4 Hz, 1H), 4.50 – 4.45 (m, 1H), 3.62 (s, 2H), 3.30 (dd, $J$ = 12.6, 1.7 Hz, 1H), 3.00 – 2.89 (m, 2H), 2.28 (dd, $J$ = 11.7, 9.9 Hz,
$^1$H NMR (126 MHz, CDCl$_3$) δ 150.5, 149.1, 142.5, 135.6, 135.2, 128.4, 128.1, 125.9, 117.0, 110.2, 109.3, 108.5, 77.0, 56.6, 55.5, 54.4; IR (Neat Film NaCl) 3086, 2935, 2809, 1950, 1880, 1737, 1666, 1598, 1494, 1450, 1326, 1178, 1148, 1040, 1013, 991, 934, 820, 756, 738, 695 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{18}$H$_{20}$NO$_2$: 282.1488; found: 282.1494.

![Structure 2r](image)

2r (136 mg, 0.467 mmol) was synthesized from 1r (247 mg, 0.589 mmol); 79% yield; R$_f$ = 0.50 (1:4 EtOAc:hexanes); $^1$H NMR (300 MHz, CDCl$_3$) δ 7.64 – 7.54 (m, 2H), 7.40 – 7.20 (m, 7H), 7.18 – 7.07 (m, 1H), 5.93 (ddd, $J$ = 17.1, 10.6, 5.5 Hz, 1H), 5.49 – 5.37 (m, 2H), 5.24 (dt, $J$ = 10.7, 1.4 Hz, 1H), 4.46 (dddt, $J$ = 9.7, 5.6, 2.9, 1.4 Hz, 1H), 3.55 (s, 2H), 3.25 (dd, $J$ = 12.6, 1.6 Hz, 1H), 2.98 – 2.81 (m, 2H), 2.23 (dd, $J$ = 11.7, 9.6 Hz, 1H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ (ppm) 149.5, 137.2, 135.7, 135.4, 129.1, 128.4, 128.1, 127.4, 125.9, 116.9, 108.0, 77.1, 62.7, 56.9, 56.1; IR (Neat Film NaCl) 3085, 3024, 2943, 2875, 2805, 2757, 1954, 1881, 1812, 1744, 1666, 1598, 1493, 1451, 1322, 1239, 1177, 1111, 1043, 826, 991, 933, 755, 696 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{20}$H$_{22}$NO [M+H]$^+$: 292.1696; found: 292.1703.

![Structure 2s](image)
2s (128 mg, 0.398 mmol) was synthesized from 1s (236 mg, 0.525 mmol); 76% yield; 
Rf = 0.52 (1:4 EtOAc:hexanes) = 0.52; \(^1\)H NMR (500 MHz, CDCl\(_3\)) \(\delta\) 7.69 – 7.63 (m, 2H), 7.33 (ddd, \(J = 9.5, 4.4, 2.0\) Hz, 4H), 7.20 (td, \(J = 7.3, 1.3\) Hz, 1H), 6.98 – 6.92 (m, 2H), 6.04 – 5.94 (m, 1H), 5.54 – 5.46 (m, 2H), 5.31 (dt, \(J = 10.7, 1.4\) Hz, 1H), 4.52 (dddt, \(J = 9.7, 5.7, 2.9, 1.4\) Hz, 1H), 3.88 (d, \(J = 1.2\) Hz, 3H), 3.56 (d, \(J = 1.6\) Hz, 2H), 3.32 (dd, \(J = 12.7, 1.6\) Hz, 1H), 2.98 (dd, \(J = 12.6, 1.4\) Hz, 1H), 2.93 (ddd, \(J = 11.7, 2.9, 1.6\) Hz, 1H), 2.32 – 2.22 (m, 1H); \(^{13}\)C NMR (126 MHz, CDCl\(_3\)) \(\delta\) 158.9, 149.5, 135.7, 135.4, 130.3, 129.1, 128.4, 128.1, 125.8, 116.8, 113.7, 108.0, 77.1, 62.1, 56.8, 56.0, 55.2; IR (Neat Film NaCl) 3056, 3020, 2933, 2834, 2801, 1738, 1666, 1612, 1454, 1324, 1289, 1249, 1177, 1106, 1036, 992, 938, 830, 756, 696 cm\(^{-1}\); HRMS (MM: ESI-APCI+) m/z calc’d for C\(_{21}\)H\(_{24}\)NO\(_2\) [M+H]: 322.1802, Found: 322.1797.

**Representative procedure for Claisen rearrangement**

![Claisen rearrangement reaction](image)

A half dram vial, equipped with a stir bar, was charged with morpholine 2 (0.0929 mmol) and m-xylene (860 \(\mu\)L) in a nitrogen-filled glove box. The vial was heated at 130 °C using a heating block for 12 h. After cooling to 23 °C, the mixture was purified using silica gel chromatography with a mixture of hexanes and ethyl acetate as eluent to afford Claisen rearrangement product 3.

**Note:** Due to the COVID-19 pandemic, we are unable to conduct this experiment on a 1 mmol scale due to limitations in our experimental lab in terms of capacity and personnel.
3l (15.3 mg, 0.0711 mmol) was synthesized from 2l (20.0 mg, 0.0929 mmol); Note: the reaction was setup at 135 °C for 12 h; 77% yield; R_f = 0.39 (1:2 EtOAc:hexanes); ^1H NMR (500 MHz, CDCl_3) δ 7.46 – 7.41 (m, 2H), 7.35 (ddd, J = 7.7, 6.8, 1.2 Hz, 2H), 7.31 – 7.26 (m, 1H), 5.94 (m, 1H), 5.61 (dt, J = 10.8, 5.1 Hz, 1H), 3.87 (d, J = 13.8 Hz, 2H), 3.55 (d, J = 15.8 Hz, 1H), 3.42 (d, J = 15.3 Hz, 1H), 3.02 (t, J = 15.3 Hz, 1H), 2.84 (d, J = 15.4 Hz, 1H), 2.48 – 2.43 (m, 1H), 2.40 (s, 3H); ^13C NMR (101 MHz, CDCl_3) δ 210.7, 138.3, 130.9, 129.0, 128.7, 128.1, 127.6, 66.1, 61.3, 58.1, 45.9, 29.1; IR (Neat Film NaCl) 2928, 2791, 1696, 1493, 1451, 1268, 1126, 699 cm^{-1}; HRMS (MM: ESI-APCI+) m/z calc’d for C_{14}H_{18}NO [M+H]^+: 216.1383; found: 216.1398.

3n (18.2 mg, 0.0638 mmol) was synthesized from 2n (23.8 mg, 0.0834 mmol); 76% yield; R_f = 0.43 (1:4 EtOAc:hexanes); ^1H NMR (400 MHz, CDCl_3) δ 7.36 – 7.14 (m, 5H), 5.83 (dtd, J = 11.0, 8.5, 8.0, 2.0 Hz, 1H), 5.56 – 5.46 (m, 1H), 3.93 – 3.76 (m, 2H), 3.49 (dt, J = 16.2, 3.0 Hz, 1H), 3.37 (d, J = 15.3 Hz, 1H), 2.95 (dd, J = 16.0, 5.4 Hz, 1H), 2.80 (d, J = 15.3 Hz, 1H), 2.38 (td, J = 7.7, 6.9, 5.3 Hz, 3H), 1.48 – 1.32 (m, 2H), 1.32 – 1.15 (m, 6H), 0.82 (t, J = 6.8 Hz, 3H); ^13C NMR (101 MHz, CDCl_3) δ 211.1, 138.1, 130.2, 128.6, 128.1, 127.8, 127.3, 64.4, 60.5, 57.4, 55.6, 31.7, 28.6, 27.1, 27.0,
22.6, 14.0; IR (Neat Film NaCl): 3023, 1703, 1494, 1454, 1376, 1262, 1163, 1031, 768, 723, 700 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C₁₉H₂₈NO [M+H]^+: 286.2165; found: 286.2191.

3o (15.2 mg, 0.0630 mmol) was synthesized from 2o (26.7 mg, 0.111 mmol); 57% yield; Rf = 0.38 (1:4 EtOAc:hexanes); ¹H NMR (500 MHz, CDCl₃) δ 7.43 – 7.38 (m, 2H), 7.34 (dd, J = 8.4, 6.8 Hz, 2H), 7.31 – 7.25 (m, 1H), 5.96 – 5.80 (m, 2H), 5.58 (dt, J = 10.4, 4.9 Hz, 1H), 5.23 – 5.12 (m, 2H), 4.00 – 3.91 (m, 1H), 3.91 – 3.85 (m, 1H), 3.57 (dt, J = 16.0, 3.3 Hz, 1H), 3.46 (d, J = 15.5 Hz, 1H), 3.10 (t, J = 5.0 Hz, 2H), 3.02 (dd, J = 16.0, 5.4 Hz, 1H), 2.86 (d, J = 15.4 Hz, 1H), 2.47 (ddd, J = 11.4, 7.8, 5.4 Hz, 1H); ¹³C NMR (101 MHz, CDCl₃) δ 211.1, 138.1, 134.8, 130.2, 128.7, 128.5, 128.1, 127.8, 127.3, 118.6, 63.9, 60.5, 55.6, 28.7; IR (Neat Film NaCl) 3023, 2919, 2804, 1701, 1493, 1450, 1327, 1265, 1164, 993, 769, 700 cm⁻¹; HRMS (MM: ESI-APCI+) m/z calc’d for C₁₆H₂₀NO [M+H]^+: 242.1539; found: 242.1537.

3p (8.80 mg, 0.0280 mmol) was synthesized from 2p (24.8 mg, 0.0781 mmol); 35% yield; Rf = 0.50 (1:4 EtOAc:hexanes); ¹H NMR (500 MHz, CDCl₃) δ 7.44 (dd, J = 7.5, 1.6 Hz, 2H), 7.34 (dd, J = 8.4, 6.8 Hz, 2H), 7.30 – 7.23 (m, 1H), 5.94 – 5.85 (m, 1H), 5.56 (m, 1H), 4.62 (t, J = 5.2 Hz, 1H), 3.98 (td, J = 11.7, 9.0 Hz, 1H), 3.90 (dd, J = 11.6, 5.8 Hz, 1H), 3.73 – 3.42 (m, 6H), 3.20 (dd, J = 16.2, 5.2 Hz, 1H), 3.03 (d, J = 15.6 Hz, 1H), 2.75 – 2.63 (m, 2H), 2.49 (ddd, J = 11.8, 7.7, 5.9 Hz, 1H), 1.22 (dt, J = 15.3, 7.1
Hz, 6H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 211.5, 138.3, 130.1, 128.7, 128.2, 127.9, 127.3, 101.2, 65.2, 62.2, 61.8, 60.4, 59.7, 56.5, 28.7, 15.4, 15.4; IR (Neat Film NaCl) 3023, 2974, 2927, 1702, 1599, 1452, 1374, 1269, 1124, 1064, 769, 700 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{19}$H$_{28}$NO$_3$ [M+H]$^+$: 318.2064; found: 318.2093.

![3q](image)

3q (12.2 mg, 0.0434 mmol) was synthesized from 2q (23.5 mg, 0.0835 mmol); 52% yield; R$_f$ = 0.45 (1:4 EtOAc:hexanes); $^1$H NMR (400 MHz, CDCl$_3$) δ 7.37 – 7.28 (m, 3H), 7.26 – 7.21 (m, 2H), 7.20 – 7.14 (m, 1H), 6.25 (dd, $J$ = 3.2, 1.9 Hz, 1H), 6.18 – 6.12 (m, 1H), 5.89 – 5.77 (m, 1H), 5.50 (m, 1H), 4.00 – 3.87 (m, 1H), 3.79 (dd, $J$ = 12.0, 5.9 Hz, 1H), 3.62 – 3.44 (m, 4H), 3.00 (dd, $J$ = 16.0, 5.4 Hz, 1H), 2.82 (d, $J$ = 15.6 Hz, 1H), 2.35 (ddd, $J$ = 12.0, 7.7, 5.9 Hz, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 210.9, 151.5, 142.4, 138.1, 130.4, 128.7, 127.9, 127.8, 127.3, 110.1, 109.3, 63.6, 60.9, 55.6, 53.7, 28.9; IR (Neat Film NaCl) 3024, 2924, 2809, 1698, 1494, 1450, 1336, 1241, 1147, 1012, 947, 916, 737, 700 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{18}$H$_{20}$NO$_2$ [M+H]$^+$: 282.1489; found: 282.1496.

![3r](image)

3r (15.2 mg, 0.0522 mmol) was synthesized from 2r (24.9 mg, 0.0854 mmol); 61% yield; R$_f$ = 0.34 (1:4 EtOAc:hexanes); $^1$H NMR (500 MHz, CDCl$_3$) δ 7.40 – 7.20 (m, 10H), 5.90 (m, 1H), 5.56 (m, 1H), 4.08 – 3.97 (m, 1H), 3.89 (dd, $J$ = 11.7, 6.0 Hz, 1H), 3.66 – 3.50 (m, 4H), 3.04 (dd, $J$ = 16.0, 5.4 Hz, 1H), 2.89 (d, $J$ = 14.9 Hz, 1H), 2.53
(ddd, J = 12.2, 7.7, 6.0 Hz, 1H); $^{13}$C NMR (101 MHz, CDCl$_3$) δ 210.9, 138.3, 137.9, 129.8, 129.3, 128.7, 128.4, 128.2, 127.7, 127.4, 127.2, 64.5, 62.1, 60.5, 56.2, 28.9; IR (Neat Film NaCl) 3060, 3026, 2922, 2806, 1699, 1953, 1880, 1494, 1453, 1310, 1161, 1109, 949, 733, 699 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{20}$H$_{22}$NO [M+H]$^+$: 292.1696; found: 292.1721.

3s (20.0 mg, 0.0622 mmol) was synthesized from 2s (25.1 mg, 0.0781 mmol); 80% yield; R$_f$ = 0.32 (1:4 EtOAc:hexanes); $^1$H NMR (500 MHz, CDCl$_3$) δ 7.37 – 7.23 (m, 7H), 6.93 – 6.87 (m, 2H), 5.92 (m, 1H), 5.59 (m, 1H), 4.04 (td, J = 12.0, 8.9 Hz, 1H), 3.93 – 3.88 (m, 1H), 3.85 (s, 3H), 3.64 – 3.51 (m, 4H), 3.05 (dd, J = 16.3, 5.3 Hz, 1H), 2.59 – 2.50 (m, 1H), 2.58 – 2.52 (m, 1H); $^{13}$C NMR (126 MHz, CDCl$_3$) δ 211.1, 158.9, 138.3, 130.5, 130.0, 129.6, 128.6, 128.3, 127.7, 127.2, 113.7, 64.4, 61.5, 60.5, 56.2, 55.3, 28.9; IR (Neat Film NaCl) 3023, 2931, 2835, 2807, 1699, 1611, 1512, 1453, 1302, 1247, 1174, 1104, 1034, 832, 760, 700 cm$^{-1}$; HRMS (MM: ESI-APCI+) m/z calc’d for C$_{21}$H$_{24}$NO$_2$ [M+H]$^+$: 322.1802; found: 322.1828.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 1b.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 1b.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 1c.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 1c.

- 27.9 ppm
- 49.6 ppm
- 77.2 ppm
- 54.6 ppm
- 67.8 ppm
- 72.9 ppm
- 112.4 ppm
- 113.2 ppm
- 113.7 ppm
- 125.2 ppm
- 134.1 ppm
$^1$H NMR (400 MHz, CDCl$_3$) of compound 1d.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 1d.
\[ ^1\text{H} \text{NMR (400 MHz, CDCl}_3 \text{) of compound 1e.} \]
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 1e.
$^{1}$H NMR (400 MHz, CDCl$_3$) of compound 1f.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 1f.
$\text{H NMR (500 MHz, CDCl}_3\text{) of compound 1g.}$
\(^{13}\)C NMR (126 MHz, CDCl\(_3\)) of compound \(1g\).
$^1$H NMR (500 MHz, CDCl$_3$) of compound 1h.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 1h.
$^1$H NMR (400 MHz, CDCl$_3$) of compound li.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 1i.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 1j.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 1j.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 1k.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 1k.
$^1$H NMR (400 MHz, CD$_2$Cl$_2$) of compound 2b.
$^{13}$C NMR (101 MHz, CD$_2$Cl$_2$) of compound 2b.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 3b.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 3b.
$^1$H NMR (400 MHz, CD$_2$Cl$_2$) of compound 3c.
$^{13}$C NMR (101 MHz, CD$_2$Cl$_2$) of compound 3c.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 3d.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 3d.
\(^{1}\text{H NMR (500 MHz, CDCl}\text{)}_3\) of compound 3e.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 3e.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 3f.
\[ ^{13}C \text{NMR (126 MHz, CDCl}_3 \text{) of compound 3f.} \]
\[^1\text{H} \text{NMR (400 MHz, CDCl}_3\text{)}\] of compound 3g.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 3g.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 3h.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 3h.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 3i.
$\text{C NMR (101 MHz, CDCl}_3\text{) of compound 3i.}$

![NMR spectrum of compound 3i](image)
$^1$H NMR (400 MHz, CDCl$_3$) of compound 3j.
$^1^3$C NMR (101 MHz, CDCl$_3$) of compound 3j.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 2k.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 2k.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 3k.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 3k.
$^1$H NMR (400 MHz, CDCl$_3$) of compound II.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound II.

SI-78
$^1$H NMR (500 MHz, CDCl$_3$) of compound In.

$R =$ o-phenyl

SI-79
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 1n.
\( ^1H \) NMR (300 MHz, CDCl\(_3\)) of compound 10.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 1o.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 1p.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 1p.
$^{1}$H NMR (500 MHz, CDCl$_3$) of compound 1q.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 1q.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 1r.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 1r.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 1s.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 1s.
$^1$H NMR (400 MHz, CD$_2$Cl$_2$) of compound 21.
$^{13}$C NMR (101 MHz, CD$_2$Cl$_2$) of compound 2l.
$^1$H NMR (300 MHz, CDCl$_3$) of compound 2n.

$R = n$-hexyl
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound $2n$. 

$\text{R} = n$-hexyl
$^1$H NMR (300 MHz, CDCl$_3$) of compound 2o.
$^{13}$C NMR (75 MHz, CDCl$_3$) of compound 2o.
$^1$H NMR (300 MHz, CDCl$_3$) of compound 2p.
$^{13}$C NMR (75 MHz, CDCl$_3$) of compound 2p.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 2q.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 2q.
$^1$H NMR (300 MHz, CDCl$_3$) of compound 2r.
$^{13}\text{C NMR (126 MHz, CDCl}_3\text{)}$ of compound 2r.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 2s.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 2s.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 3I.
\[^{13}\text{C} \text{NMR (101 MHz, CDCl}_3\text{)}\] of compound 3l.
$^1$H NMR (400 MHz, CDCl$_3$) of compound 3n.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 3n.

R = n-hexyl

$\text{CDCl}_3$
$^1$H NMR (500 MHz, CDCl$_3$) of compound 30.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 3o.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 3p.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 3p.

- 15.4 ppm
- 28.7 ppm
- 35.8 ppm
- 53.6 ppm
- 69.6 ppm
- 75.0 ppm
- 101.2 ppm
- 127.3 ppm
- 127.9 ppm
- 128.2 ppm
- 128.7 ppm
- 130.1 ppm
- 130.4 ppm
- 131.3 ppm
- 211.5 ppm
$^1$H NMR (400 MHz, CDCl$_3$) of compound 3q.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 3q.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 3r.
$^{13}$C NMR (101 MHz, CDCl$_3$) of compound 3r.
$^1$H NMR (500 MHz, CDCl$_3$) of compound 3s.
$^{13}$C NMR (126 MHz, CDCl$_3$) of compound 3s.