Supporting Information

New and Facile Synthesis of Aminobicyclo[2.2.1]heptane-2-carboxylic Acids

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General Procedure.

The solvents used for chemical synthesis were dried prior to use. All reactions were carried out under nitrogen atmosphere with dry solvents. The reactions were monitored by TLC analysis using Merck silica gel 60 F-254 thin layer plates. Flash column chromatography was carried on Merck silica gel 60 (230-400 mesh). NMR spectra were recorded on Bruker-Ascend™ 600 (1H-NMR and 13C-NMR were recorded at 600 MHz and 150 MHz, respectively).

Representative procedure for the preparation of a,b-(±)-BCH.

(Endo,Exo)- Methyl bicyclo[2.2.1]hept-5-ene-2-carboxylate (1a)

To a solution of 5-norbornene-2-carboxylic acid (50.67 mmol, 7.00 g; predominantly endo mixture) in anhydrous DCM (150 ml), oxalyl chloride (5.2 mL, 60.80 mmol) and DMF (390 µL, 5.07 mmol) were added at 0 °C under inert condition. The reaction slowly warm up to room temperature and stirred for 12 hours at ambient temperature. The resulting solution was maintained at 0 °C and then anhydrous MeOH (4.10 mL, 101.33 mmol) and triethylamine (10.6 mL, 76.00 mmol) were added at 0 °C. The reaction mixture was allowed to ambient temperature and stirred for 6 hours. After completion of reaction, the reaction mixture was diluted with DCM (1000 mL), washed with water (700 mL), dried over MgSO₄, filtered and the solvent was concentrated in vacuo. The residue was purified by flash column chromatography (Hexanes : EtOAc = 20 : 1) to give ester compound (5.92 g, 77%) as a colorless oil.

Endo(major) : 1H NMR (600 MHz, CDCl₃) δ 6.20–6.19 (dd, J = 3.6, 6.0 Hz, 1H), 5.94–5.92 (dd, J = 6.0, 3.0 Hz, 1H), 3.63 (s, 3H), 3.20–3.20 (d, J = 0.6 Hz, 1H), 2.97–2.94 (td, J = 3.6, 9.6 Hz, 1H), 2.91 (s, 1H), 1.94–1.89 (m, 1H), 1.44–1.41 (m, 2H), 1.28–1.27 (d, J = 8.4 Hz, 1H) ppm; 13C-NMR (150 MHz, CDCl₃) δ 175.28, 137.75, 132.37, 51.48, 49.61, 45.66, 43.17, 42.51, 29.25 ppm.

Exo(minor) : 1H NMR (600 MHz, CDCl₃) δ 6.15–6.13 (dd, J = 5.4, 5.4 Hz, 1H), 6.11–6.10 (dd, J = 5.4, 5.4 Hz, 1H), 3.69 (s, 3H), 3.04–3.04 (d, J = 0.6 Hz, 1H), 2.92 (s, 1H), 2.24–2.22, (dd, J = 4.8, 10.8 Hz, 1H), 1.94–1.91 (m, 1H), 1.54–1.52 (d, J = 9 Hz, 1H), 1.39–1.35 (m, 2H) ppm; 13C-NMR (150 MHz, CDCl₃) δ 176.76, 138.05, 135.73, 51.71, 46.57, 46.36, 42.98, 41.62, 29.25 ppm.
2-Benzyl 2-methyl bicyclo[2.2.1]hept-5-ene-2,2-dicarboxylate (2a)

![Chemical Structure of 2a]

To a solution of (Endo,Exo-) methyl bicyclo[2.2.1]hept-5-ene-2-carboxylate 1a (8.39 g, 55.13 mmol) in anhydrous THF (150 mL), LDA (2.0 M solution in THF, 28.9 mL, 57.88 mmol) and benzyl chloroformate (8.26 mL, 57.88 mmol) was slowly added at -78 °C and then stirred for 72 hours. The reaction mixture was quenched with sat.NH₄Cl and slowly warm up to room temperature. The solvent was removed in vacuo and the residue was diluted with EtOAc (1000 mL), washed with water (700 mL), dried over MgSO₄ and filtered. The residue was purified by flash column chromatography (Hexanes : EtOAc = 100 : 1) to give diester compound (14.02 g, 89%) as a colorless oil.

¹H NMR (600 MHz, CDCl₃) δ 7.38–7.30 (m, 5H), 6.27–6.26 (dd, J = 3.0, 5.4 Hz, 1H), 5.99–5.98 (dd, J = 3.0, 5.4 Hz, 1H), 5.23–5.21 (d, J = 12.6 Hz, 1H), 5.16–5.14 (d, J = 12.6 Hz, 1H), 3.60 (s, 3H), 3.42–3.42 (d, J = 0.6 Hz, 1H), 2.92 (s, 1H) 2.14–2.12 (dd, J = 3.6, 12.6 Hz, 1H), 2.03–2.00 (dd, J = 3.0, 12.6 Hz, 1H), 1.65–1.64 (d, J = 9.0 Hz, 1H), 1.52–1.51 (dd, J = 1.2, 9.0 Hz, 1H) ppm; ¹³C-NMR (150 MHz, CDCl₃) δ 172.29, 171.31, 139.82, 135.71, 133.45, 128.51, 128.21, 127.84, 66.96, 60.30, 52.28, 49.80, 48.80, 48.77, 42.03, 35.86 ppm.

2-(Methoxycarbonyl)bicyclo[2.2.1]heptane-2-carboxylic acid (5a).

![Chemical Structure of 5a]

To a solution of diester compound 2a (300 mg, 1.05 mmol) in EtOAc (5 mL), palladium on activated carbon 10% (30 mg, 10 wt.%) was added under inert atmosphere and the mixture was hydrogenated at 1 atm for 3 hours. After completion of the reaction, the catalyst was removed by filtration through Celite pad. The filtrate was concentrated under reduced pressure. The residue was purified by flash column chromatography (Hexanes : EtOAc = 20 : 1 to 1:1) to give desired compound 5a (205 mg, 99%) as a white solid.

¹H NMR (600 MHz, CDCl₃) δ 3.75 (s, 3H), 2.86–2.84 (d, J = 3.6 Hz, 1H), 2.31–2.29 (dd, J = 3.0, 13.2 Hz, 2H), 1.93–1.90 (m, 1H), 1.66–1.65 (m, 1H), 1.56–1.46 (m, 2H), 1.41–1.38 (m, 1H), 1.31–1.27 (m, 1H), 1.15–1.11 (m, 1H); ¹³C-NMR (150 MHz, CDCl₃) δ 176.81, 171.50, 61.17, 52.68, 43.94, 39.40, 38.55, 36.35, 27.61, 25.23 ppm.
Methyl 2-(azidocarbonyl)bicyclo[2.2.1]heptane-2-carboxylate (6a).

![Chemical structure](image)

To a solution of acid compound 5a (205mg, 1.03 mmol) in DCM (5 mL), diphenylphosphoryl azide (268 µL, 1.24 mmol) and triethylamine (173 µL, 1.24 mmol) were added at ambient temperature and stirred for 12 hours. After completion of the reaction, the reaction mixture was diluted with DCM (120 mL), washed with water (80 mL), dried over MgSO₄, filtered, and concentrated in vacuo. The residue was purified by flash column chromatography (Hexanes : EtOAc = 50 : 1) to give the desired acyl azide 6a (216 g, 94%) as a colorless oil.

^1^H NMR (600 MHz, CDCl₃) δ 3.75 (s, 3H), 2.89–2.89 (d, J = 3.0 Hz, 1H), 2.32–2.31 (t, J = 3.9 Hz, 1H), 2.26–2.23 (dd, J = 3.0, 13.2 Hz, 1H), 1.83–1.80 (m, 1H), 1.56–1.46 (m, 3H), 1.41–1.38 (m, 1H) 1.30–1.26 (m, 1H), 1.13–1.09 (m, 1H) ppm; ^13^C-NMR (150 MHz, CDCl₃) δ 178.98, 170.74, 63.29, 52.77, 43.46, 39.49, 38.76, 36.55, 27.61, 25.09 ppm.

Methyl 2-[(tert-butoxycarbonyl)amino]bicyclo[2.2.1]heptane-2-carboxylate (7a).

![Chemical structure](image)

The acyl azide compound 6a (202 mg, 1.02 mmol) was diluted with anhydrous toluene (4 mL) and refluxed for 1 hour. After completion of the reaction, solvent was removed under reduced pressure. The isocyanate intermediate was used in the next step without further purification. To a solution of isocyanate compound in ^1^BuOH (4 mL), NaO^1^Bu (147 mg, 1.53 mmol) was added and stirred for 30 min at ambient temperature. After completion of the reaction, the reaction mixture was quenched with sat. NH₄Cl solution, concentrated in vacuo. The reaction mixture was diluted with EtOAc (100 mL), washed with brine (70 mL), dried over MgSO₄, filtered, and the solvent was concentrated in vacuo. The residue was purified by flash column chromatography (Hexanes : EtOAc = 10 : 1) to give the desired N-Boc amino ester compound 7a (198 mg, 2 steps 72%) as a white solid.

^1^H NMR (600 MHz, CDCl₃) δ 4.96 (s, 1H), 3.71 (s, 3H), 2.45–2.42 (d, J = 12.6 Hz, 1H), 2.34 (s, 1H), 2.15–2.15 (d, J = 3.0 Hz, 1H), 1.81–1.79 (m, 1H), 1.69–1.67 (d, J = 14.4 Hz, 1H), 1.53–1.47 (m, 1H), 1.43–1.37 (m, 1H), 1.40 (s, 9H), 1.35–1.30 (m, 2H), 1.21–1.18 (m, 1H) ppm; ^13^C-NMR (150 MHz,
CDCl₃) δ 173.86, 154.87, 79.91, 66.50, 52.07, 47.14, 42.82, 38.28, 37.21, 28.24, 27.23, 24.23 ppm.

(±)-2-Aminobicyclo[2.2.1]heptane-2-carboxylic acid (a-(±)-BCH).

To a solution of amino ester compound 8 in water (5 mL), solid KOH (79 mg, 1.41) was added at ambient temperature and then heated to reflux for 12 hours. After cooling the reaction mixture to ambient temperature, the reaction mixture was concentrated in vacuo, treated with 4N-HCl in 1,4-dioxane (5 mL), stirred at ambient temperature for 12 hours. After completion of the reaction, the reaction mixture was concentrated in vacuo, purified by DOWEX®-50WX8 ion-exchange resin column chromatography to give the desired amino acid compound a-BCH (90 mg, 81% for 2 steps) as an ivory solid.

¹H NMR (600 MHz, D₂O) δ 2.32 (s, 2H), 2.06–2.04 (dd, J = 1.2, 13.2 Hz, 1H), 1.59–1.57 (d, J = 10.8 Hz, 1H), 1.48–1.35 (m, 4H), 1.29–1.25 (m, 1H), 1.19–1.15 (m, 1H) ppm; ¹³C-NMR (150 MHz, CDCl₃) δ 175.87, 68.10, 45.55, 38.77, 37.04, 37.02, 26.15, 23.88 ppm.

■ General procedure for the identification of stereochemistry

Benzyl 6-bromo-2-oxohexahydro-2H-3,5-methanocyclopentafuran-3-carboxylate (3).

To a solution of diester compound 2a (46 mg, 0.16 mmol) in DCM (2 mL), Br₂ (21 µL, 0.40 mmol) was added at 0 °C and stirred for 30 min. The reaction mixture quenched with sat. Na₂S₂O₃ solution, diluted DCM (50 mL), washed with water (30 mL), dried over MgSO₄, filtered and the solvent was concentrated in vacuo. The filtrate was concentrated and the residue was purified by flash column chromatography (Hexanes : EtOAc = 30 : 1) to give the desired product 3 (39 mg, 70%) as a colorless oil.

¹H NMR (600 MHz, CDCl₃) δ 7.39–7.33 (m, 5H), 5.26–5.21 (dd, J = 12.6, 16.8 Hz, 2H), 4.98–4.97 (dd, J = 1.2, 5.4 Hz, 1H), 3.87–3.87 (d, J = 1.8 Hz, 1H), 3.57–3.55 (m, 1H), 2.76–2.75 (m, 1H),
2.68–2.65 (dd, $J = 4.2, 14.4$ Hz, 1H), 2.35–2.32 (m, 1H), 1.99–1.97 (dd, $J = 1.8, 13.8$ Hz, 1H), 1.79–1.76 (m, 1H); $^{13}$C-NMR (150 MHz, CDCl$_3$) δ 174.54, 168.45, 135.02, 128.66, 128.52, 128.06, 86.27, 67.97, 53.03, 52.53, 51.19, 45.73, 73.36, 35.02 ppm.

**Methyl 6-bromo-2-oxohexahydro-2H-3,5-methanocyclopentafuran-3-carboxylate (4).**

![4](image)

$^1$H NMR (600 MHz, CDCl$_3$) δ 4.99–4.98 (dd, $J = 1.2, 5.4$ Hz, 1H), 3.87–3.86 (dd, $J = 2.4$ Hz, 1H), 3.81 (s, 1H), 3.57–3.56 (m, 1H), 2.76–2.75 (d, $J = 3.0$ Hz, 1H), 2.66–2.63 (dd, $J = 4.2, 14.4$ Hz, 1H), 2.36–2.33 (m, 1H), 1.98–1.95 (dd, $J = 2.4, 13.8$ Hz, 1H), 1.80–1.78 (m, 1H); $^{13}$C-NMR (150 MHz, CDCl$_3$) δ 174.65, 169.05, 86.26, 53.35, 52.94, 52.55, 51.13, 45.72, 37.42, 35.04 ppm.

**Characterization of stereoselective synthesis of a- and b-(±)-BCH compounds.**

**Benzyl bicyclo[2.2.1]hept-5-ene-2-carboxylate (1b).**

![1b](image)

**Endo(major)**: $^1$H NMR (600 MHz, CDCl$_3$) δ 7.41–7.31 (m, 5H), 6.20–6.19 (dd, $J = 3.0, 6.0$ Hz, 1H), 5.89–5.87 (dd, $J = 6.0, 3.0$ Hz, 1H), 5.11–5.05 (dd, $J = 12.0, 25.2$ Hz, 2H), 3.24 (s, 1H), 3.03–3.00 (td, $J = 4.2, 9.0$ Hz, 1H), 2.91 (s, 1H), 1.94–1.90 (m, 1H), 1.48–1.45 (m, 1H), 1.45–1.42 (m, 1H), 1.29–1.27 (d, $J = 7.8$ Hz, 1H) ppm; $^{13}$C-NMR (150 MHz, CDCl$_3$) δ 174.61, 137.81, 135.73, 132.29, 128.49, 128.06, 128.05, 66.01, 49.63, 45.80, 43.37, 42.57, 29.24 ppm.

**Exo(minor)**: $^1$H NMR (600 MHz, CDCl$_3$) δ 7.41–7.31 (m, 5H), 6.15–6.14 (dd, $J = 2.4, 5.4$ Hz, 1H), 6.11–6.10 (dd, $J = 5.4, 3.0$ Hz, 1H), 5.16–5.12 (dd, $J = 12.6, 13.8$ Hz, 2H), 3.08–3.07 (m, 1H), 2.93 (s, 1H), 2.03–2.28 (m, 1H), 1.97–1.94 (m, 1H), 1.57–1.54 (m, 1H), 1.41–1.37 (m, 2H) ppm; $^{13}$C-NMR (150 MHz, CDCl$_3$) δ 176.10, 138.10, 136.34, 133.26, 128.56, 128.13, 128.08, 66.26, 54.88, 46.64, 46.37, 43.18, 41.65, 30.38 ppm.
**tert-Butyl bicyclo[2.2.1]hept-5-ene-2-carboxylate (1c).**

![Diagram of 1c]

**Endo (major):** $^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 6.20–6.18 (dd, $J = 3.0$, 5.4 Hz, 1H), 5.94–5.93 (dd, $J = 5.4$, 2.4 Hz, 1H), 3.17–3.16 (d, $J = 1.2$ Hz, 1H), 2.89–2.86 (m, 2H), 1.85–1.81 (m, 1H), 1.42 (s, 9H), 1.40–1.39 (m, 1H) 1.36–1.31 (m, 1H), 1.26–1.24 (d, $J = 8.4$ Hz, 1H) ppm; $^{13}$C-NMR (150 MHz, CDCl$_3$) $\delta$ 175.61, 174.07, 137.95, 135.89, 49.64, 44.25, 44.16, 42.63, 41.59, 30.25, 28.12 ppm.

**Exo (minor):** $^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 6.13–6.10 (ddd, $J = 3.0$, 6.0, 6.6 Hz, 2H), 3.0 (s, 1H), 2.87–2.86 (m, 1H), 2.14–2.11 (m, 1H), 1.88–1.84 (m, 1H), 1.59–1.57 (m, 1H), 1.52–1.51 (d, $J = 8.4$ Hz, 1H), 1.45 (s, 9H), 1.38–1.37 (t, $J = 3.6$ Hz, 1H) ppm; $^{13}$C-NMR (150 MHz, CDCl$_3$) $\delta$ 173.94, 172.97, 137.61, 132.89, 79.71, 46.58, 45.93, 44.23, 42.63, 28.95, 28.06 ppm.

2-Benzyl 2-methyl bicyclo[2.2.1]hept-5-ene-2,2-dicarboxylate (2b).

![Diagram of 2b]

$^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 7.37–7.31 (m, 5H), 6.25–6.24 (dd, $J = 3.0$, 5.4 Hz, 1H), 5.90–5.89 (dd, $J = 3.0$, 5.4 Hz, 1H), 5.14–5.09 (dd, $J = 12.6$, 3.6 Hz, 2H), 3.65 (s, 3H), 3.42–3.41 (m, 1H), 2.92 s, 1H), 2.12–2.09 (dd, $J = 3.6$, 12.6 Hz, 1H), 2.05–2.03 (dd, dd, $J = 12.6$, 3.6 Hz, 2H), 1.68–1.66 (d, $J = 9.0$ Hz, 1H), 1.52–1.50 (m, 1H); $^{13}$C-NMR (150 MHz, CDCl$_3$) $\delta$ 172.94, 170.71, 139.77, 135.75, 133.49, 128.46, 128.22, 128.19, 66.82, 60.28, 52.56, 49.80, 48.75, 42.02, 35.91, 29.70 ppm.

2-**tert-**Butyl 2-methyl bicyclo[2.2.1]hept-5-ene-2,2-dicarboxylate (2c).

![Diagram of 2c]
\[ ^1H \text{NMR (600 MHz, CDCl}_3) \delta 6.27-6.26 (dd, } J = 3.0, 5.4 \text{ Hz, 1H}, 6.01-5.99 (dd, } J = 3.0, 5.4 \text{ Hz, 1H), 3.73 (s, 3H), 3.36-3.35 (m, } 1H), 2.89-2.89 (t, } J = 0.6 \text{ Hz, 1H}, 1.99-1.99 (d, } J = 1.8 \text{ Hz, 2H), 1.66-1.64 (d, } J = 9.0 \text{ Hz, 1H), 1.51-1.50 (m, 1H), 1.41 (s, 9H) ppm; } ^13\text{C-NMR (150 MHz, CDCl}_3) \delta 173.59, 169.79, 139.60, 133.27, 81.14, 60.76, 52.39, 49.69, 48.95, 42.04, 35.57, 27.84 \text{ ppm.} \]

2-Benzyl 2-tert-Butyl bicyclo[2.2.1]hept-5-ene-2,2-Dicarboxylate (2d).

\[ \text{CO}_2\text{Bn} \]
\[ \text{CO}_2\text{t-Bu} \]

\[ ^1H \text{NMR (600 MHz, CDCl}_3) \delta 7.38-7.29 (m, 5H), 6.28-6.26 (dd, } J = 3.0, 6.0 \text{ Hz, 1H}, 6.00-5.98 (dd, } J = 3.0, 6.0 \text{ Hz, 1H), 5.28-5.26 (d, } J = 12.6 \text{ Hz, 1H), 5.10-5.08 (d, } J = 12.6 \text{ Hz, 1H), 3.38-3.37 (m, 1H), 2.89-2.89 (d, } J = 1.2 \text{ Hz, 1H), 2.03-1.98 (m, 1H), 1.66-1.64 (d, } J = 9.0 \text{ Hz, 1H), 1.51-1.50 (m, 1H), 1.29 (s, 9H) ppm; } ^13\text{C-NMR (150 MHz, CDCl}_3) \delta 172.86, 169.56, 139.67, 135.77, 133.17, 128.49, 128.39, 128.25, 81.15, 66.83, 60.78, 49.82, 49.72, 42.09, 27.70 \text{ ppm.} \]

2-(Methoxycarbonyl)bicyclo[2.2.1]heptane-2-carboxylic acid (5b).

\[ \text{CO}_2\text{Me} \]
\[ \text{CO}_2\text{H} \]

\[ ^1H \text{NMR (600 MHz, CDCl}_3) \delta 3.72 (s, 3H), 2.92-2.91 (d, } J = 1.2 \text{ Hz, 1H), 2.29 (s, 1H), 2.21 (dd, } J = 2.4, 13.2 \text{ Hz, 1H), 1.83-1.80 (ddd, } J = 2.4, 4.2, 13.2 \text{ Hz, 1H), 1.63-1.61 (m, 1H), 1.58-1.48 (m, 2H), 1.42-1.39 (m, 1H), 1.32-1.25 (m, 2H) ppm; } ^13\text{C-NMR (150 MHz, CDCl}_3) \delta 176.73, 172.42, 61.34, 52.65, 43.98, 39.55, 38.34, 36.36, 27.70, 25.07 \text{ ppm.} \]

Methyl 2-(azidocarbonyl)bicyclo[2.2.1]heptane-2-carboxylate (6b).

\[ \text{CO}_2\text{Me} \]
\[ \text{CON}_3 \]

\[ ^1H \text{NMR (600 MHz, CDCl}_3) \delta 6.68 (s, 1H), 3.56 (s, 3H), 2.76-2.69 (d, } J = 2.0 \text{ Hz, 1H), 2.29 (s, 1H), 2.21 (dd, } J = 2.4, 13.2 \text{ Hz, 1H), 1.63-1.60 (m, 1H), 1.58-1.48 (m, 2H), 1.42-1.35 (m, 1H), 1.31-1.25 (m, 2H) ppm; } ^13\text{C-NMR (150 MHz, CDCl}_3) \delta 156.22, 143.20, 52.65, 43.98, 39.55, 38.34, 36.36, 27.70, 25.07 \text{ ppm.} \]
$^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 3.71 (s, 3H), 2.83 (s, 1H), 2.28 (s, 1H), 2.27–2.24 (dd, $J = 3.0, 13.2$ Hz, 1H), 1.78–1.74 (ddd, $J = 2.4, 4.2, 13.2$ Hz, 1H), 1.64–1.62 (m, 1H), 1.56–1.47 (m, 2H), 1.42–1.39 (m, 1H), 1.28–1.21 (m, 2H) ppm; 178.11, 171.81, 6325, 52.70, 43.90, 39.57, 37.96, 36.45, 27.67, 24.85 ppm.

Methyl 2-[(tert-butoxycarbonyl)amino]bicyclo[2.2.1]heptane-2-carboxylate (7b).

![Image](https://example.com/image)

$^1$H NMR (600 MHz, CDCl$_3$) $\delta$ 5.04 (s, 1H), 3.70 (s, 3H), 2.66 (s, 1H), 2.42 (d, $J = 12.6$ Hz, 1H), 2.27 (s, 1H), 1.79–1.78 (d, $J = 3.6$ Hz, 1H), 1.67 (s, 1H), 1.61–1.55 (m, 1H), 1.46–1.42 (m, 1H), 1.42 (s, 9H), 1.33–1.31 (m, 1H), 1.26–1.21 (m, 1H), 1.81–1.16 (d, $J = 12.6$ Hz, 1H); $^{13}$C-NMR (150 MHz, CDCl$_3$) $\delta$ 175.13, 155.73, 79.79, 64.52, 52.26, 44.78, 43.12, 37.79, 36.18, 28.28, 28.24, 23.29 ppm.

($\pm$)-2-aminobicyclo[2.2.1]heptane-2-carboxylic acid (b-(±)-BCH).

![Image](https://example.com/image)

$^1$H NMR (600 MHz, D$_2$O) $\delta$ 2.36 (s, 1H), 2.22 (s, 1H), 2.16–2.13 (td, $J = 3.6, 13.2$ Hz, 1H), 1.82–1.80 (d, $J = 10.2$ Hz, 1H), 1.58–1.52 (m, 1H), 1.50–1.42 (m, 2H), 1.29–1.28 (dd, $J = 1.2, 9.0$ Hz, 1H), 1.20–1.16 (m, 1H), 1.14–1.12 (dd, $J = 3.0, 13.2$ Hz, 1H) ppm $^{13}$C-NMR (150 MHz, D$_2$O) $\delta$ 179.50, 65.41, 44.82, 40.55, 38.30, 36.10, 27.18, 22.60 ppm.
\[ \text{a-(-)-BCH} \]

\[ \text{a-(+)-BCH} \]