Supporting Information

Regiocontrolled First Synthesis of Procyanidin B₆, Catechin Dimer with Rare Connectivity:
Halo-capping Strategy for Formation of 4,6-Interflavan Bond

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General Experimental Procedures

All reactions utilizing air- and moisture-sensitive reagents were performed in dried glassware under an atmosphere of dry argon or nitrogen. Ethereal solvents (anhydrous; Kanto Chemical Co., Inc.) were used as received. N,N-Dimethylformamide (DMF) was distilled from CaH₂ under reduced pressure and stored over molecular sieves 4A.

For thin-layer chromatography (TLC) analysis, Merck pre-coated plates (silica gel 60 F254, Art 5715, 0.25 mm). Preparative silica gel TLC (PTLC) was performed on Merck Silica gel 60 PF254 (Art 7747). For flash column chromatography, silica gel 60N (Spherical, neutral, 63–210 μm) from Kanto Chemical was used.

Melting point (mp) determinations were performed by using a Yanako MP-S3 or MP-500 instrument and are uncorrected. ¹H NMR and ¹³C NMR were measured on a JEOL ECX-500 (500 MHz) spectrometer. Chemical shifts are expressed in parts per million (ppm) downfield from internal standard (tetramethylsilane, 0.00 ppm), and coupling constants are reported as hertz (Hz). Splitting patterns are indicated as follows: br, broad; s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet. Infrared (IR) spectra were recorded on a Perkin Elmer Spectrum 100 spectrometer. Elemental analyses were recorded on an Elementar vario MICRO cube analyzer. Optical rotations ([α]D) were measured on a JASCO P-2300 polarimeter. Low-resolution mass spectra (LRMS) were obtained on a Shimadzu MALDI–TOF Mass AXIMA® Confidence. High-resolution mass spectra (HRMS) were obtained with micrOTOF-Q II (Bruker Daltonics).
**Synthesis of 3a and 3b**

To a suspension of NaH (63%, dispersion in mineral oil, washed with hexane, 8.4 g, 0.22 mol) in DMF (70 mL), was added (+)-catechin pentaacetate (10 g, 20 mmol), d$_7$-benzyl chloride [1] (10 mL, 90 mmol), and $n$-Bu$_4$NI (1.5 g, 4.0 mmol). A solution of H$_2$O (1.4 mL, 80 mmol) in DMF (13 mL) was added dropwise over 25 min at 0 $^\circ$C. The reaction mixture was stirred for 16 h at room temperature. The reaction was quenched by adding Et$_2$NH (4.2 mL, 40 mmol) at 0 $^\circ$C. The reaction mixture was stirred for 2 h at room temperature. The mixture was poured into 6 M HCl solution and the products were extracted with EtOAc ($\times$3). The combined organic extracts were washed with brine, dried (Na$_2$SO$_4$), and concentrated in vacuo. The residue was dissolved in the mixed solvent of EtOH (40 mL) and 1,4-Dioxane (40 mL), and was added 9 M KOH solution (20 mL) at 0 $^\circ$C. The reaction mixture was stirred for 4 h at room temperature. The reaction was quenched by adding 6 M HCl solution at 0 $^\circ$C. The products were extracted with EtOAc ($\times$3). The combined organic extracts were washed with brine, dried (Na$_2$SO$_4$), and concentrated in vacuo. The residue was purified by flash column chromatography (hexane/EtOAc/CHCl$_3$ = 8/1/1) to afford S1 (7.5 g, 55%) as a white solid and S2 (4.7 g, 31%) as a white solid.
**S1:** Rf 0.80 (hexane/EtOAc/CHCl₃ = 4/1/1); mp 128–130 °C; [α]D²⁰ = −1.0 ° (c 1.0, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 1.71 (brs, 1H, OH), 2.68 (dd, 1H, J = 16.6, 8.6 Hz), 3.13 (dd, 1H, J = 16.6, 5.7 Hz), 4.01 (ddd, 1H, J = 8.6, 8.1, 5.7 Hz), 4.65 (d, 1H, J = 8.1 Hz), 6.25 (d, 1H, J = 2.3 Hz), 6.31 (d, 1H, J = 2.3 Hz), 6.97 (d, 2H, J = 1.2 Hz), 7.06 (s, 1H); ¹³C NMR (125 MHz, CDCl₃) δ 27.8, 68.3, 68.9–71.2 (m), 81.7, 94.0, 94.5, 102.4, 114.1, 115.2, 120.7, 126.5–128.4 (m), 131.1, 136.7, 136.9, 137.0, 155.4, 157.9, 159.0; IR (neat) 3012, 2905, 2277, 2191, 2119, 1616, 1616, 1592, 1511, 11493, 1442, 1428, 1380, 1328, 1272, 1233, 1203, 1184, 1155, 1122, 1087, 1054, 1033, 1000, 978, 839, 819, 755. 543 cm⁻¹; Anal. calcd for C₄₃H₁₀D₂₈O₆: C 76.07, H(D) 5.64. Found: C 75.97, H(D) 5.85.

**S2:** 0.42 (hexane/EtOAc/CHCl₃ = 4/1/1); [α]D²⁰ = +34.0 ° (c 1.32, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 2.79 (dd, 1H, J = 16.6, 8.6 Hz), 3.14 (dd, 1H, J = 16.6, 5.6 Hz), 3.80 (ddd, 1H, J =8.6, 8.0, 5.6 Hz), 4.86 (d, 1H, J = 8.0 Hz), 6.31 (d, 1H, J = 2.3 Hz), 6.34 (d, 1H, J = 2.3 Hz), 7.02 (s, 2H), 7.10 (s, 1H); ¹³C NMR (125 MHz, CDCl₃) δ 26.3, 68.9–71.3 (m), 74.7, 80.3, 93.9, 94.6, 102.5, 114.1, 115.2, 120.7, 126.7–128.5 (m), 132.6, 136.8, 136.9, 137.1, 137.2, 137.9, 149.0, 149.1, 155.6, 157.9, 159.0; IR (neat) 3452 (br), 3011, 2906 2277, 2203, 2120, 1617, 1592, 1509, 1493, 1428, 1327, 1271, 1204, 1185, 1154, 1116, 1086, 1053, 1000, 839, 819, 754, 545 cm⁻¹; Anal. calcd for C₅₀H₃₅D₃₅O₆: C 77.38, H(D) 5.71. Found: C 77.63, H(D) 5.99.

**Preparation of S4a**

To a solution of alcohol S1 (0.40 g, 0.59 mmol) and 2-ethoxyethanol (0.80 mL) in CH₂Cl₂ (8.0 mL) was added portion wise DDQ (0.20 g, 0.88 mmol) at 0 °C. The reaction mixture was stirred for 2 h at room temperature. The reaction was quenched by adding DMAP (0.16 g, 1.3 mmol). The reaction mixture was stirred for 1 h. The mixture was filtered through CeliteⓇ pad and washed with CH₂Cl₂. The filtrate was washed successively with water and brine, dried (Na₂SO₄), and concentrated in vacuo. The residue was passed through a short column (hexane/EtOAc = 2/1) to afford crude material of S3, which was dissolved in CH₂Cl₂ (4.0 mL), and was added pyridine (0.11 mL, 1.3 mmol), Ac₂O (67 μL, 0.71 mmol) and DMAP (3.6 mg, 0.030 mmol). The reaction mixture was stirred for 11 h at room temperature. The reaction was quenched by adding 1 M HCl solution. The
mixture was extracted with EtOAc (×3) and the combined organic extracts were washed with brine, dried (Na₂SO₄), and concentrated in vacuo. The residue was purified by flash column chromatography (hexane/EtOAc = 4/1) to afford S₄a (0.45 g, 93% 2 steps) as a colorless amorphous foam.

**S₄a:** Rf 0.33 (hexane/EtOAc = 3/1); [α]D²₀ = +65 (c 0.86, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ: 1.17 (t, 3H, J = 6.9 Hz), 1.82 (s, 3H), 3.39–3.48 (m, 2H), 3.50 (t, 2H, J = 5.7 Hz), 3.74–3.86 (m, 2H), 4.90 (d, 1H, J = 2.9 Hz), 5.24 (dd, 1H, J = 10.9, 2.9 Hz), 5.30 (d, 1H, J = 10.9 Hz), 6.17 (d, 1H, J = 2.3 Hz), 6.27 (d, 1H, J = 2.3 Hz), 6.95 (d, 1H, J = 8.3 Hz), 7.00 (dd, 1H, J = 8.3, 1.8 Hz), 7.09 (d, 1H, J = 1.8 Hz); ¹³C NMR (125 MHz, CDCl₃) δ 15.4, 20.8, 66.5, 68.4, 68.8–71.0 (m), 69.9, 70.9, 72.8, 74.4, 93.8, 94.4, 103.7, 114.6, 114.9, 121.4, 126.8–128.4 (m), 130.7, 136.3, 136.4, 137.0, 149.0, 149.3, 155.9, 158.6, 161.0, 169.8; IR (neat) 2973, 2928, 2869, 1741, 1614, 1592, 1512, 1489, 1432, 1372, 1328, 1272, 1232, 1204, 1160, 1109, 1085, 1053, 999, 961, 916, 839, 819, 755, 601, 546 cm⁻¹; Anal. calcd for C₄₉H₂₀D₂₈O₉: C 72.74, H(D) 5.98. Found: C 72.70, H(D) 5.85.

**Preparation of S₄b**

To a solution of crude S₃ (1.5 g, ca. 2.0 mmol) and Et₃N (0.54 mL, 4.0 mmol) in CH₂Cl₂ (20 mL) was added benzoyl chloride (0.34 mL, 2.9 mmol) and DMAP (24 mg, 0.20 mmol). The reaction mixture was stirred for 14 h at room temperature. The reaction was quenched by adding successively N,N-dimethyl-1,3-propanediamine (0.30 mL) and 1 M HCl solution. The mixture was extracted with EtOAc (×3) and the combined organic extracts were washed with water and brine, dried (Na₂SO₄), and concentrated in vacuo. The residue was purified by flash column chromatography (hexane/EtOAc/CHCl₃ = 3/1) to afford S₄b (1.4 g, ca 82%) as a colorless amorphous foam.

**S₄b:** Rf 0.60 (hexane/EtOAc = 3/1); [α]D²₀ = +93 (c 0.82, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ: 1.11 (t, 3H, J = 6.9 Hz), 3.32–3.43 (m, 2H), 3.44–3.52 (m, 2H), 3.75–3.81 (m, 2H), 3.87–3.88 (m, 2H), 5.04 (d, 1H, J = 1.8 Hz), 5.49 (brs, 2H), 6.22 (d, 1H, J = 2.3 Hz), 6.30 (d, 1H, J = 2.3 Hz), 6.90 (d, 1H, J = 8.6 Hz), 6.92 (dd, 1H, J = 8.6, 2.3 Hz), 7.15 (d, 1H, J = 2.3 Hz), 7.38 (t, 2H, J = 8.1 Hz), 7.53 (t, 1H, J = 7.5 Hz), 7.94 (d, 2H, J = 8.6 Hz); ¹³C NMR (125 MHz, CDCl₃) δ 15.3, 66.4, 68.7, 68.8–72.0 (m), 70.0, 71.3, 73.5, 74.5, 93.9, 94.4, 103.9, 114.7, 115.1, 121.4, 126.8–128.4 (m), 128.4,
Preparation of 3a
To a solution of S4a (0.32 g, 0.40 mmol) in CH₂Cl₂ (4.0 mL) was added N-bromosuccinimide (74 mg, 0.42 mmol) at 0 °C. The reaction mixture was stirred for 2 h at same temperature. The reaction was quenched by adding Et₃N and 10% aqueous Na₂S₂O₃. The mixture was extracted with EtOAc (×3) and the combined organic extracts were washed with brine, dried (Na₂SO₄), and concentrated in vacuo. The residue was purified by flash column chromatography (hexane/EtOAc = 4/1) to afford 3a (0.32 g, 89%) as a colorless amorphous foam.

3a: Rf 0.27 (hexane/EtOAc = 3/1); [α]D²⁰ = +22.7 (c 1.08, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 1.19 (t, 3H, J = 6.9 Hz), 1.87 (s, 3H), 3.42–3.51 (m 2H), 3.53 (t, 2H, J = 5.2 Hz), 3.75–3.81 (m, 1H), 3.81–3.87 (m, 1H), 4.94 (d, 1H, J = 3.4 Hz), 5.12 (dd, 1H, J = 10.3, 3.4 Hz), 5.43 (d, 1H, J = 10.3 Hz), 6.27 (s, 1H), 6.96 (d, 1H, J = 8.0 Hz), 7.04 (dd, 1H, J = 8.0, 1.7 Hz), 7.17 (d, 1H, J = 1.7 Hz); ¹³C NMR (125 MHz, CDCl₃) δ 15.4, 20.9, 66.6, 68.2, 69.8–71.2 (m), 69.9, 70.8, 73.0, 74.6, 92.4, 92.7, 105.1, 114.3, 114.8, 121.1, 126.4–128.6 (m), 130.6, 136.0, 136.3, 137.06, 137.11, 148.9, 149.3, 152.4, 157.0, 157.2, 169.7; IR (neat) 2973, 2928, 2869, 2278, 2206, 2120, 1742, 1602, 1577, 1512, 1484, 1418, 1370, 1328, 1272, 1231, 1202, 1188, 1115, 1087, 1052, 1032, 1000, 840, 820, 754, 544 cm⁻¹; Anal. calcd for C₅₄H₂₂D₂₈O₉: C 74.45, H(D) 5.79. Found: C 74.53, H(D) 6.06.

Preparation of 3b
To a solution of S4b (1.0 g, 1.1 mmol) in CH₂Cl₂ (25 mL) was added N-bromosuccinimide (0.21 g, 1.2 mmol) at 0 °C. The reaction mixture was stirred for 3 h at same temperature. The reaction was quenched by adding Et₃N and 10% aqueous Na₂S₂O₃. The mixture was extracted with EtOAc (×3) and the combined organic extracts were washed with brine, dried (Na₂SO₄), and concentrated in vacuo. The residue was purified by flash column chromatography (hexane/EtOAc = 4/1) to afford 3b (1.1 g, 99%) as a colorless amorphous foam.
3b: Rf 0.55 (hexane/EtOAc = 3/1); $[\alpha]_D^{20} = +73$ (c 0.99, CHCl$_3$); $^1$H NMR (500 MHz, CDCl$_3$) δ 1.14 (t, 3H, $J = 6.9$ Hz), 3.36–3.48 (m, 2H), 3.52 (t, 2H, $J = 5.2$ Hz), 3.77–3.82 (m, 2H), 3.85–3.91 (m, 2H), 5.08 (d, 1H, $J = 3.5$ Hz), 5.38 (dd, 1H, $J = 10.9, 3.5$ Hz), 5.62 (d, 1H, $J = 10.9$ Hz), 6.31 (s, 1H), 6.92 (d, 1H, $J = 8.6$ Hz), 7.15 (dd, 1H, $J = 8.6, 1.7$ Hz), 7.22 (d, 1H, $J = 1.7$ Hz), 7.42 (t, 2H, $J = 8.0$ Hz), 7.56 (t, 2H, $J = 8.0$ Hz), 8.00 (t, 2H, $J = 8.1$ Hz); $^{13}$C NMR (125 MHz, CDCl$_3$) δ; 15.4, 66.6, 68.4, 68.8–71.2 (m), 70.0, 71.3, 73.7, 74.7, 92.5, 92.8, 105.3, 114.4, 115.1, 121.0, 126.4–128.3 (m), 128.5, 129.7, 129.8, 130.6, 133.3, 136.0, 136.3, 137.0, 137.1, 149.0, 149.3, 152.4, 157.1, 157.3, 165.2; IR (neat) 3064, 2973, 2927, 2869, 2278, 2205, 2119, 1723, 1603, 1578, 1512, 1485, 1451, 1418, 1365, 1328, 1315, 1272, 1201, 1189, 1121, 1106, 1053, 1029, 1000, 840, 820, 755, 713, 544 cm$^{-1}$; Anal. calcd for C$_{54}$H$_{21}$D$_{28}$Br$_7$O$_9$: C 68.27, H(D) 5.20. Found: C 68.42, H(D) 5.30.
Synthesis of 4a, 4b and 4c

Preparation of 4a
To a solution of S2 (0.10 g, 0.13 mmol) in CH₂Cl₂ (2.0 mL) was added N-bromosuccinimide (24 mg, 0.14 mmol) at 0 °C. The reaction mixture was stirred for 2 h at same temperature. The reaction was quenched by adding Et₃N and 10% aqueous Na₂S₂O₃. The mixture was extracted with EtOAc (×3) and the combined organic extracts were washed with brine, dried (Na₂SO₄), and concentrated in vacuo. The residue was purified by PTLC (hexane/EtOAc = 3/1) to afford 4a (0.11 g, 99%) as a colorless amorphous foam.

4a: Rf 0.38 (hexane/EtOAc = 3/1); [α]D₂⁰ = −5.6 (c 0.81, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 2.79 (dd, 1H, J = 16.6, 7.5 Hz), 2.94 (dd, 1H, J = 16.6, 5.2 Hz), 3.76 (ddd, 1H, J = 7.5, 6.9, 5.2 Hz), 5.04 (d, 1H, J = 7.5 Hz), 6.27 (s, 1H), 6.96 (brs, 2H), 7.06 (s, 1H); ¹³C NMR (125 MHz, CDCl₃) δ 25.5, 69.2–71.4 (m), 74.2, 79.9, 92.9, 104.2, 113.7, 115.1, 120.0, 126.5–128.5 (m), 132.1, 136.55, 136.61, 137.0, 137.2, 137.8, 148.8, 148.9, 151.2, 154.9, 156.3; IR (neat) 3011, 2908, 2277, 2191, 2119, 1604, 1579, 1511, 1486, 1413, 1361, 1327, 1271, 1202, 1187, 1126, 1095, 1051, 1030, 1000, 839, 820, 756, 542 cm⁻¹; Anal. calcd for C₅₀H₈₃D₃₅Br₁O₆: C 70.24, H(D) 5.07. Found: C 70.07, H(D) 5.36.

Preparation of 4b
To a solution of S2 (0.10 g, 0.13 mmol) in CH₂Cl₂ (2.0 mL) was added N-iodosuccinimide (58 mg, 0.26 mmol) at −78 °C. The reaction mixture was stirred for 2 h at 0 °C. The reaction was quenched by adding Et₃N and 10% aqueous Na₂S₂O₃. The mixture was extracted with EtOAc (×3) and the combined organic extracts were washed with brine, dried (Na₂SO₄), and concentrated in vacuo. The
residue was purified by PTLC (hexane/EtOAc = 3/1) to afford 4b (0.11 mg, 98%) as a colorless amorphous foam.

4b: Rf 0.38 (hexane/EtOAc = 3/1); [α]D20 = −27 (c 0.76, CHCl3); 1H NMR (500 MHz, CDCl3) δ 2.72 (dd, 1H, J = 16.6, 7.5 Hz), 2.87 (dd, 1H, J = 16.6, 5.2 Hz), 3.68 (ddd, 1H, J = 7.5, 6.9, 5.2 Hz), 4.98 (d, 1H, J = 6.9 Hz), 6.17 (s, 1H), 6.91 (brs, 2H), 7.03 (s, 1H); 13C NMR (125 MHz, CDCl3) δ 25.6, 69.1–71.4 (m), 67.6, 74.4, 80.1, 92.2, 103.7, 113.6, 114.9, 120.0, 126.5–128.5 (m), 132.1, 136.6, 137.0, 137.2, 148.7, 148.9, 154.1, 157.3, 158.0; IR (neat) 3226, 3010, 2906, 2277, 2190, 2119, 1600, 1575, 1511, 1481, 1428, 1408, 1356, 1327, 1271, 1202, 1186, 1171, 1126, 1094, 1052, 1030, 1000, 960, 839, 820, 786, 756, 667, 543 cm−1; Anal. calcd for C50H8D35I1O6: C 66.58, H 4.81. Found: C 66.60, H 5.11.

Preparation of 4c
To a solution of S2 (0.10 g, 0.13 mmol) in CH2Cl2 (1.0 mL) was added N-chlorosuccinimide (36 mg, 0.27 mmol) at 0 °C. The reaction mixture was stirred for 24 h at room temperature. The reaction was quenched by adding Et3N and 10% aqueous Na2S2O3. The mixture was extracted with EtOAc (∼3) and the combined organic extracts were washed with brine, dried (Na2SO4), and concentrated in vacuo. The residue was purified by PTLC (hexane/EtOAc = 3/1) to afford C8-chlorinated 4c (68 mg, 65%) as a light yellow amorphous foam and C6-chlorinated 4c' (32 mg, 31%) as a light yellow amorphous foam.

4c: Rf 0.40 (hexane/EtOAc = 3/1); [α]D20 = +7.2 (c 1.0, CHCl3); 1H NMR (500 MHz, CDCl3) δ 2.75 (dd, 1H, J = 16.6, 7.5 Hz), 2.92 (dd, 1H, J = 16.6, 5.2 Hz), 3.75 (ddd, 1H, J = 7.5, 7.5, 5.2 Hz), 5.00 (d, 1H, J = 7.5 Hz), 6.28 (s, 1H), 6.93 (brs, 2H), 7.02 (d, 1H, J = 1.7 Hz); 13C NMR (125 MHz, CDCl3) δ 25.5, 68.4–71.4 (m), 74.0, 79.9, 93.0, 103.5, 104.1, 113.6, 115.0, 120.0, 126.7–128.4 (m), 132.0, 136.5, 136.6, 137.0, 137.1, 137.7, 148.9, 151.0, 153.9, 155.3; IR (neat) 3012, 2908, 2277, 2202, 2119, 1606, 1586, 1511, 1489, 1418, 1364, 1328, 1271, 1202, 1127, 1107, 1052, 1030, 839, 820, 755, 542 cm−1; Anal. calcd for C50H8D35Cl1O6: C 74.09, H(D) 5.35. Found: C 74.03, H(D) 5.55.

4c': Rf 0.43 (hexane/EtOAc = 3/1); 1H NMR (500 MHz, CDCl3) δ 2.62 (dd, 1H, J = 16.3, 8.0 Hz), 2.85 (dd, 1H, J = 16.3, 5.2 Hz), 3.61 (ddd, 1H, J = 8.0, 7.5, 5.2 Hz), 4.76 (d, 1H, J = 7.5 Hz), 6.40 (s,
1H), 6.84 (dd, 1H, J = 8.3, 2.0 Hz), 6.89–6.93 (m, 2H); $^{13}$C NMR (125 MHz, CDCl$_3$) δ 26.2, 69.8–71.3 (m), 74.0, 80.2, 98.6, 108.5, 109.6, 113.8, 115.1, 120.4, 126.4–128.4 (m), 132.0, 136.3, 136.8, 137.0, 137.1, 149.0, 153.5, 154.2, 154.2; IR (neat) 3012, 2908, 2277, 2205, 2118, 1605, 1579, 1510, 1464, 1423, 1380, 1328, 1270, 1234, 1203, 1183, 1173, 1100, 1052, 1029, 1000, 840, 820, 755, 542 cm$^{-1}$;
General experimental procedure for the coupling reaction of 3 and 4.

(the formation of C4, 6-inter-flavan linkage)

To a solution of bromo-capped benzoate 3b (1.1 g, 1.2 mmol) and chloro-capped unit 4c (1.5 g, 1.8 mmol) in CH2Cl2 (60 mL) was added a solution of BF3·OEt2 (0.26 g, 1.8 mmol) in CH2Cl2 (6.0 mL) at –78 ºC. The reaction gradually warmed to 5 ºC during 2 h. The reaction was quenched by adding Et3N and saturated aqueous NaHCO3. The mixture was extracted with EtOAc (×3). The combined organic extracts were washed with brine, dried (Na2SO4), and concentrated in vacuo. The residue was purified by flash column chromatography (silica gel, toluene/EtOAc = 30/1) to afford the C4,6-dimer 5c (1.9 g, 93%, as a colorless amorphous foam, α-

5c: Rf 0.53 (toluene/EtOAc = 10/1); [α]D20 = –93.4 (c 1.17, CHCl3); 1H NMR (500 MHz, CDCl3) the rotamer ratio = 65:35, δ 2.39 (dd, 0.35H, J = 16.4, 8.6 Hz), 2.50 (dd, 0.35H, J = 16.4, 5.2 Hz), 2.80 (dd, 0.65H, J = 15.5, 8.6 Hz), 3.11 (dd, 0.65H, J = 15.5, 5.2 Hz), 3.48 (ddd, 0.35H, J = 8.6, 8.0, 5.2 Hz), 3.63 (ddd, 0.65H, J = 8.6, 8.0, 5.2 Hz), 4.75 (d, 0.35H, J = 8.0 Hz), 4.84 4.93 (br, 1H), 4.95 (d, 0.65H, J = 8.0 Hz), 4.99 (d, 0.35H, J = 9.2 Hz), 5.03 (d, 0.65H, J = 8.6 Hz), 5.84–5.96 (m, 1H), 6.23 (s, 0.35H), 6.27 (s, 0.65H), 6.73 (d, 0.35H, J = 8.6 Hz), 6.79 (d, 0.65H, J = 8.1 Hz), 6.84–7.05 (m, 5H), 7.23–7.26 (m, 2H), 7.42–7.46 (m, 1H), 7.71 (t, 2H, J = 7.5 Hz); 13C NMR (125 MHz, CDCl3, the signals of minor rotamer’s are marked with an asterisk) δ 26.7*, 28.0, 37.5, 37.6*, 69.2–73.0 (m), 73.9*, 74.7, 75.0*, 80.2*, 80.4, 80.7, 93.9, 94.0*, 94.5, 109.5*, 109.7, 111.1*, 111.7, 111.8, 112.2*, 113.6, 113.8, 114.2*, 115.0, 115.1, 120.3*, 120.4, 120.5, 120.7*, 122.9*, 123.3, 126.6–128.4 (m), 128.3, 129.2*, 129.7, 130.0*, 130.2, 130.4, 131.9, 132.0*, 132.8, 132.9*, 135.3,
135.9*, 136.40, 136.44, 136.8, 136.9, 136.97, 137.01, 137.1, 137.2, 137.5, 137.6, 137.7, 137.9, 148.9, 149.00, 149.01, 149.06, 149.13, 150.1, 152.9*, 153.5, 153.6, 154.3, 154.8, 154.9*, 156.3, 156.4*, 164.4*, 164.8; IR (neat) 3010, 2912, 2277, 2205, 2120, 1727, 1560, 1571, 1511, 1483, 1428, 1359, 1328, 1315, 1269, 1235, 1201, 1182, 1112, 1051, 1028, 998, 960, 839, 820, 754, 711, 542 cm⁻¹; MS (MALDI–TOF, DHBA matrix) m/z 1690.6 ([M+Na]⁺ calcd for C₁₀₀H₁₉D₆₃Br₁Cl₁O₁₃Na₁ : 1690.9); HRMS (ESI) m/z 1690.8479 ([M+Na]⁺ calcd for C₉₃H₁₆D₆₃Cl₁O₁₂Na₁: 1690.8630); Anal. Calcd for C₁₀₀H₁₉D₆₃Br₁Cl₁O₁₃: C, 71.90; H(D), 4.95. Found: C, 71.92; H(D), 5.13.
Hydrogenolysis of Benzoyl group

To a solution of C4,6-dimer 5c (0.32 g, 0.19 mmol) in 1,4-Dioxane (4.0 mL) and EtOH (4.0 mL) was added a solution of 9 M KOH (2.0 mL, 18 mmol) at 0 ºC. The reaction mixture was refluxed for 21 h. After cooling to room temperature, pH value of the mixture was adjusted to ca. 5 by addition of 6 M HCl solution. The mixture was extracted with EtOAc (×3). The combined organic extracts were successively washed with water and brine, dried (Na2SO4), and concentrated in vacuo. The residue was purified by flash column chromatography (silica gel, toluene/EtOAc = 30/1) to afford dimer 8 (0.30 mg, 99%, as a colorless amorphous foam).

8: Rf 0.49 (toluene/EtOAc = 10/1); [α]D20 = −87.6 (c 1.14, CHCl3); 1H NMR (500 MHz, CDCl3) the rotamer ratio = 50:50, δ 1.63 (brs, 0.5H, OH), 1.68 (brs, 0.5H, OH), 2.67 (dd, 0.5H, J = 16.1, 9.2 Hz), 2.75–2.83 (m, 1H), 3.02 (dd, 0.5H, J = 16.1, 5.2 Hz), 3.45–3.57 (m, 1H), 4.26–4.41 (m, 1H), 4.56 (d, 0.5H, J = 10.9 Hz), 4.58 (d, 0.5H, J = 9.8 Hz), 4.68 (d, 0.5H, J = 8.6 Hz), 4.69 (d, 0.5H, J = 8.6 Hz), 4.81 (d, 0.5H, J = 8.1 Hz), 4.95 (d, 0.5H, J = 8.1 Hz), 6.15 (s, 0.5H), 6.19 (s, 0.5H), 6.80–7.23 (m, 6H); 13C NMR (125 MHz, CDCl3) δ 72.9, 73.5, 74.7, 74.8, 80.4, 80.7, 82.4, 82.6, 93.9, 94.3, 94.4, 94.6, 110.1, 111.4, 111.6, 111.9, 112.0, 112.2, 113.7, 113.9, 114.1, 114.2, 114.8, 115.0, 115.1, 120.51, 120.54, 120.9, 121.0, 124.7, 124.8, 126.2–128.8 (m), 131.0, 131.1, 131.8, 132.0, 135.6, 136.1, 136.4, 136.7, 136.76, 136.82, 136.95, 137.00, 137.1, 137.2, 137.4, 137.7, 137.8, 149.0, 149.2, 149.3, 149.86, 149.89, 152.3, 153.6, 154.0, 154.6, 154.7, 155.6, 156.2, 156.5; IR (neat) 3573, 3430, 3011, 2913, 2277, 2206, 2120, 1596, 1570, 1510, 1481, 1427,
1359, 1328, 1272, 1230, 1200, 1184, 1119, 1100, 1051, 1030, 959, 942, 840, 820, 753, 541 cm$^{-1}$; HRMS (ESI) $m/z$ 1586.8217 ([M+Na]$^+$ calcd for C$_{93}$H$_{167}$D$_{63}$Cl$_1$O$_{12}$Na$_1$: 1586.8214); Anal. Calcd for C$_{93}$H$_{15}$D$_{63}$Br$_1$Cl$_1$O$_{12}$: C, 71.30; H(D), 5.02. Found: C, 71.12; H(D), 4.78.
**Sequential one-pot hydrogenolysis and Actylation**

A mixture of 9 (50 mg, 0.037 mmol) and 5 % Pd(OH)$_2$/C (0.27 g) in MeOH (1.0 mL), THF (1.0 mL), and H$_2$O (0.5 mL) was hydrogenated under H$_2$ atmosphere at room temperature for 2.5 h. Then Et$_3$N (23 µL, 0.17 mmol) was added to the reaction mixture and was hydrogenated under H$_2$ atmosphere again for 30 min. The mixture was filtrated through a glass fiber filter under Ar atmosphere. The filtrate was added H$_2$O and evaporated only partially so as to remove most of the organic solvents. The solution was lyophilized to afford procyanidin B$_6$ (2) (26 mg, quant.) as an off-white powder.

**procyanidin B$_6$ (2):** MS (MALDI–TOF, DHBA matrix) $m/z$ 578.9 ([M]$^-$; calcd for C$_{30}$H$_{26}$O$_{12}$Na: 578.1); HRMS (ESI) $m/z$ 579.1496 ([M+H]$^+$ calcd for C$_{30}$H$_{27}$O$_{12}$: 579.1497).

2 (21 mg) was dissolved in pyridine/acetic anhydride (3.0 mL, 1:1 v/v) at 0 °C. The reaction mixture was stirred for 24 h at 0 °C. The reaction mixture was diluted CH$_2$Cl$_2$, and quenched by adding saturated CuSO$_4$ solution at 0 °C. The products were extracted with CH$_2$Cl$_2$ (x3). The combined organic extracts were washed successively with 10% aqueous CuSO$_4$ solution, water and brine, dried (MgSO$_4$), and concentrated in vacuo. The residue was purified by flash column chromatography (toluene/acetone = 8/1) to afford acetate 11 (24 mg, 2 steps 88%) as a white solid.

**11:** Rf 0.50 (benzene/acetone = 4/1); $[\alpha]_D^{20} = -70$ (c 0.53, CHCl$_3$); {lit.$^2$} $[\alpha]_D^{20} = -20$ (c 0.70, CHCl$_3$); $^1$H NMR (500 MHz, CDCl$_3$) the rotamer ratio = 50:50, δ 1.68–2.35 (m, 30H), 2.48 (dd,
0.5H, J = 16.1, 9.8 Hz), 2.60 (dd, 0.5H, J = 16.7, 8.6 Hz), 2.90 (dd, 0.5H, J = 16.7, 5.2 Hz), 2.93–3.01 (m, 0.5H), 4.39 (d, 0.5H, J = 9.2 Hz), 4.48 (d, 0.5H, J = 9.2 Hz), 4.83 (d, 0.5H, J = 9.8 Hz), 4.85 (d, 0.5H, J = 9.7 Hz), 4.91 (d, 0.5H, J = 8.6 Hz), 5.03 (d, 0.5H, J = 8.0 Hz), 5.05–5.10 (m, 0.5H), 5.10–5.17 (m, 0.5H), 5.67–5.74 (m, 0.5H), 5.74–5.81 (m, 0.5H), 6.46 (d, 0.5H, J = 1.7 Hz), 6.50 (d, 0.5H, J = 2.3 Hz), 6.60 (s, 0.5H), 6.68 (brs, 1.5H), 7.12–7.40 (m, 6H); 13C NMR (125 MHz, CDCl3) δ 20.0–21.1 (m), 29.4, 29.8, 36.7, 37.2, 68.6, 68.7, 71.7, 71.9, 77.8, 78.5, 79.8, 108.6, 109.7, 108.9, 110.4, 110.7, 110.9, 113.3, 113.4, 115.6, 115.8, 118.0, 118.1, 122.4, 122.8, 123.1, 123.5, 123.6, 125.0, 125.3, 125.5, 125.6, 134.7, 134.8, 135.7, 135.8, 141.9, 142.1, 142.3, 142.4, 142.6, 148.0, 148.1, 148.2, 148.3, 149.7, 150.0, 150.1, 150.2, 153.1, 153.4, 155.9, 166.6–170.0 (m); IR (neat) 3026 (br), 3025, 2937, 1722, 1629, 1592, 1507, 1481, 1430, 1371, 1260, 1207, 1186, 1125, 1111, 1050, 1014, 900, 840, 755 cm⁻¹; MS (MALDI–TOF, DHBA matrix) m/z 1020.85 ([M+Na]⁺ calcd for C50H46O13Na1 : 1021.24); HRMS (ESI) m/z 1021.2385 ([M+Na]⁺ calcd for C50H46O13Na1 : 1021.2373).
