Supporting Information

Formal total synthesis of (±)-7-deoxycylindrospermopsin and its 8-epi isomer

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1. General Information.

All reactions were carried out under nitrogen atmosphere in anhydrous conditions, unless otherwise noted. Dry solvents tetrahydrofuran (THF) were obtained by sodium and freshly distilled, dry methylene chloride (CH₂Cl₂) were obtained by calcium hydride and freshly distilled. Anhydrous methanol (MeOH), triethylamine (Et₃N), acetic acid (CH₃COOH) and N, N-Dimethylformamide (DMF) were purchased from Adamas-beta or other commercial suppliers and used without further purification. HPLC water, methanol and trifluoroacetic acid (TFA) were purchased from sigma-aldrich. Other reagents were purchased commercially and used without further purification. NMR spectra were recorded on a Bruker AV-400 instrument, operating for ¹H NMR at 400 MHz, ¹³C NMR at 100 MHz, chemical shifts were given relative to CDCl₃ (7.26 ppm for ¹H NMR, 77.16 ppm for ¹³C NMR) The following abbreviations (or combinations thereof) were used to explain multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad. Mass spectroscopy data of the products were collected on an HRMS-TOF instrument using EI ionization or ESI ionization in several cases. IR spectra were recorded on a Perkin-Elmer Spectrum One FTIR spectrometer.
To a solution of 4-methoxy-pyridine (7.64 g, 70 mmol) in 500 mL THF at -30 °C was added TrocCl (10.6 mL, 77 mmol) dropwise, the reaction was stirred for 1 hour at -30 °C before 1.0 M vinyl Grignard (90 mL) was transferred. The reaction was stirred for 3 hours at -30 °C and 1.0 M Hydrochloric acid (100 mL) was added, the mixture was stirred at room temperature for 1 hour and then diluted with water (100 mL). The organic layers was concentrated in vacuo, then the water layer was extracted with EtOAc (3×100 mL), the organic layers was washed with brine (100 mL), dried with Na₂SO₄ and concentrated. Flash column chromatography (silica gel, hexane: EtOAc = 4:1) afforded 8 (18.87 g, 90%) as a colorless oil. Rₐ = 0.50 (hexane:EtOAc = 4:1).

**¹H NMR** (400 MHz, CDCl₃) δ 7.76 (d, J = 8.3 Hz, 1H), 5.90 – 5.71 (ddd, J = 5.2, 10.4, 17.2, 1H), 5.37 (d, J = 8.0 Hz, 1H), 5.21 (d, J = 10.5 Hz, 1H), 5.17 (m, 2H), 4.83 (s, 2H), 2.91 (dd, J = 16.6, 6.9 Hz, 1H), 2.55 (d, J = 16.5 Hz, 1H).

**¹³C NMR** (100 MHz, CDCl₃) δ 191.8, 151.0, 140.5, 132.3, 118.0, 108.9, 94.4, 75.9, 55.2, 39.9.

**HRMS (TOF, EI)** calced for C₁₀H₁₀Cl₃NO₃ 296.9726, found 296.9726.

**IR** (film) ν<sub>max</sub> 3090, 2960, 1736, 1672, 1607, 1420, 1380, 1328, 1300, 1260, 1221, 1188, 1127, 1059, 995, 933, 825, 787, 756, 717, 679 cm⁻¹.

To a solution of 8 (9.00 g, 30.1 mmol) in 150 mL THF at -78 °C was added 2.0 M sodium bis(trimethylsilyl)amide (16.6 mL, 33.2 mmol) dropwise, the reaction was stirred for 1 hour at -78 °C before methyl iodide (5.6 mL, 90.3 mmol) was added dropwise. The reaction was stirred for 12 hour at -78 °C, the reaction mixture was allowed to warm to room temperature and then diluted with water (100 mL).
The organic layer was concentrated \textit{in vacuo}, then the water layer was extracted with \( \text{EtOAc} \) (3×80 mL), the organic layers was washed with brine (80 mL), dried with \( \text{Na}_2\text{SO}_4 \) and concentrated. Flash column chromatography (silica gel, hexane: EtOAc = 5:1) afforded \( 9 \) (5.27 g, 56%, dr > 20:1) as a colorless oil.

\( R_f = 0.45 \) (hexane:EtOAc = 5:1).

\(^1\text{H NMR}\) (400 MHz, CDCl\(_3\)) \( \delta \) 7.73 (d, \( J = 8.3 \) Hz, 1H), 5.85 – 5.68 (ddd, \( J = 5.6,10.8,16.2 \)Hz,1H), 5.28 (d, \( J = 8.1 \) Hz, 1H), 5.18(d, \( J = 11.2 \) Hz,1H), 5.15(d, \( J = 16.2 \) Hz,1H), 4.97 – 4.75 (m, 3H), 2.51 (dd, \( J = 14.2, \) 7.0 Hz, 1H), 1.22 (d, \( J = 7.3 \) Hz, 3H).

\(^{13}\text{C NMR}\) (100 MHz, CDCl\(_3\)) \( \delta \) 196.3, 151.7, 139.6, 132.3, 117.8, 107.0, 94.5, 75.8, 61.5, 44.1, 16.9.

HRMS (TOF, EI) calcd for C\(_{11}\)H\(_{12}\)Cl\(_3\)O\(_3\) 310.9883, found 310.9879.

\( \text{IR} \) (film) \( \nu_{\text{max}} \) 3089, 2969, 1736, 1672, 1605, 1419, 1378, 1322, 1264, 1206, 1125, 1091, 1057, 996, 894, 814, 792, 757, 715, 647 cm\(^{-1}\).

To a solution of indium (7.00 g, 61 mmol) in 60 mL THF was added (3-bromoprop-1-yn-1-yl) triisopropylsilane \( 10 \) (25.22 g, 91.6 mmol) at room temperature. After stirred for 30 min, the reaction was removed to water bath at room temperature, then chlorotrimethylsilane (19.3 mL, 152.5 mmol) was added. After stirred for 1 hour, then \( 9 \) (9.53 g, 30.5 mmol) was added to reaction mixture. After 12 hours, the reaction mixture was poured into pH 7.0 buffer solution (100mL, K\(_2\)HPO\(_4\)/KH\(_2\)PO\(_4\)) which was pre-cooled. The organic layer was concentrated \textit{in vacuo}, then the water layer was extracted with \( \text{EtOAc} \) (3×80 mL), the organic layers was washed with brine (80 mL), dried with \( \text{Na}_2\text{SO}_4 \) and concentrated. Flash column chromatography (silica gel, hexane: EtOAc = 10:1) afforded \( 11 \) (11.52 g, 74%) as a colorless oil.

\( R_f = 0.35 \) (hexane:EtOAc = 10:1).
H NMR (400 MHz, CDCl₃) δ 5.97 (ddd, J = 5.2, 10.4, 17.2 Hz, 1H), 5.25 (dd, J = 11.6, 1.6 Hz, 1H), 5.22 (dd, J = 4.8, 1.6 Hz, 1H), 4.83 (s, 2H), 4.74 (s, 1H), 4.68 – 4.56 (m, 1H), 2.88 – 2.58 (m, 5H), 1.21 (d, J = 7.2 Hz, 3H), 1.02 (s, 2H).

C NMR (100 MHz, CDCl₃) δ 208.8, 154.2, 137.9, 117.6, 103.5, 95.3, 84.1, 75.3, 60.1, 52.0, 45.6, 40.7, 27.7, 18.6, 15.3, 11.2.

HRMS (ESI) m/z: [M+H]+ Calcd for C₂₃H₃₇ClNO₃Si 508.1603; Found 508.1618.

IR (film) νmax 2943, 2865, 1714, 1461, 1402, 1378, 1325, 1274, 1122, 1062, 995, 929, 883, 823, 762, 717, 677 cm⁻¹.

To a solution of 11 (13.6 g, 26.7 mmol) in 150 mL THF at -78 °C was added 1.0 M L-selectride (107 mL, 107 mmol) dropwise, the reaction was stirred for 24 hours at -78 °C and 2.0M aqueous NaOH (55 mL, 110 mmol) and 30% aqueous H₂O₂ (36.4 mL, 321 mmol) were added slowly. The reaction mixture was allowed to warm to room temperature and then diluted with water (60 mL). The organic layers was concentrated in vacuo, then the water layer was extracted with EtOAc (3×100 mL), the organic layers was washed with brine (100 mL), dried with Na₂SO₄ and concentrated. Flash column chromatography (silica gel, hexane:EtOAc = 10:1 to 5:1) afforded 12 (6.65 g, 49%) and C12 diasteomer 12' (4.86 g, 36%) as a colorless oil.

12: Rf = 0.45 (hexane:EtOAc = 5:1)

12: H NMR (400 MHz, CDCl₃) δ 5.95 – 5.80 (m, 1H), 5.21 (dd, J = 36.8, 14.1 Hz, 2H), 4.86 (d, J = 11.9 Hz, 1H), 4.65 (ddd, J = 22.8, 14.7, 4.4 Hz, 3H), 4.22 (d, J = 10.4 Hz, 1H), 2.56 (d, J = 7.7 Hz, 2H), 2.28 (s, 1H), 2.05 (dd, J = 13.2, 3.6 Hz, 1H), 1.94 – 1.83 (m, 1H), 1.63 (s, 1H), 1.01 (dd, J = 18.3, 6.2 Hz, 2H).

C NMR (100 MHz, CDCl₃) δ 154.5, 138.2, 116.5, 105.0, 95.6, 83.0, 75.2, 63.1, 59.3, 51.8, 36.2, 29.0, 26.6, 18.6, 11.2, 11.2.
HRMS (ESI) m/z: [M+H]+ Calcd for C_{23}H_{39}ClNO_3Si 510.1759; Found 510.1762.

IR (film) ν_{max} 3478, 2943, 2865, 2174, 1714, 1461, 1410, 1381, 1324, 1267, 1121, 1064, 996, 920, 883, 819, 765, 716, 678 cm\(^{-1}\).

C12 diasteomer 12\(^*\): R\(_f\) = 0.50 (hexane:EtOAc = 5:1).

\(^1\)H NMR (400 MHz, CDCl\(_3\)) δ 6.08 (ddd, \(J = 17.2, 10.3, 7.1\) Hz, 1H), 5.22 (d, \(J = 17.1\) Hz, 1H), 5.11 (d, \(J = 10.3\) Hz, 1H), 4.84 (d, \(J = 11.9\) Hz, 1H), 4.69 (d, \(J = 11.9\) Hz, 1H), 4.51 – 4.34 (m, 2H), 3.69 (s, 1H), 2.86 – 2.67 (m, 2H), 2.34 – 2.19 (m, 1H), 1.95 (ddd, \(J = 14.3, 10.4, 4.3\) Hz, 2H), 1.65 (d, \(J = 3.1\) Hz, 1H), 1.10 (d, \(J = 6.9\) Hz, 3H), 1.05 (d, \(J = 4.0\) Hz, 2H).

\(^{13}\)C NMR (100 MHz, CDCl\(_3\)) δ 154.3, 139.4, 116.5, 105.3, 95.6, 82.8, 75.2, 70.6, 59.7, 50.6, 39.9, 31.7, 28.2, 18.6, 17.9, 11.3.

HRMS (ESI) m/z: [M+H]+ Calcd for C_{23}H_{39}ClNO_3Si 510.1759; Found 510.1763.

IR (film) ν_{max} 3487, 2942, 2865, 2174, 1713, 1461, 1410, 1382, 1317, 1277, 1122, 1062, 995, 925, 883, 823, 764, 716, 678 cm\(^{-1}\).

To a solution of 12 (1.76 g, 3.44 mmol) in 20 mL CH\(_2\)Cl\(_2\) was added imidazole (1.43 g, 21 mmol), t-butyldimethylchlorosilane (1.05g, 7.0 mmol) and DMAP (130 mg, 1.05 mmol). The mixture was stirred at room temperature for 24 hours and was added 20 mL saturated NH\(_4\)Cl solution. The water layer was extracted with CH\(_2\)Cl\(_2\) (3×20 mL), the organic layers was washed with brine (20 mL), dried with Na\(_2\)SO\(_4\) and concentrated. Flash column chromatography (silica gel, hexane: EtOAc = 20:1) afforded 13 (1.90 g, 88%) as a colorless oil.

R\(_f\) = 0.7 (hexane:EtOAc = 10:1).
\( ^1H \text{NMR} \) (400 MHz, CDCl\(_3\)) \( \delta \) 5.86 (ddd, \( J = 16.0, 10.7, 4.9 \) Hz, 1H), 5.30 – 5.08 (m, 2H), 4.83 (d, \( J = 11.9 \) Hz, 1H), 4.74 – 4.62 (m, 2H), 4.56 (dd, \( J = 13.5, 6.6 \) Hz, 1H), 4.20 – 4.07 (m, 1H), 2.63 – 2.49 (m, 2H), 2.13 (s, 1H), 2.03 – 1.93 (m, 1H), 1.93 – 1.80 (m, 1H), 1.01 (m, 24H), 0.87 (s, 9H), 0.06 (s, 6H).

\( ^{13}C \text{NMR} \) (100 MHz, CDCl\(_3\)) \( \delta \) 154.4, 138.7, 115.9, 105.1, 95.7, 82.6, 75.1, 63.5, 59.3, 51.9, 36.9, 29.4, 26.5, 25.8, 18.6, 18.0, 11.6, 11.2, -4.7, -4.8.

HRMS (ESI) m/z: [M+H]\(^+\) Calcd for C\(_{29}\)H\(_{53}\)Cl\(_3\)NO\(_3\)Si\(_2\) 624.2624; Found 624.2629.

IR (film) \( \nu_{\text{max}} \) 2953, 2864, 2174, 1715, 1462, 1408, 1323, 1260, 1115, 1091, 996, 920, 883, 853, 836, 775, 742, 713, 674 cm\(^{-1}\).

The ozone was dried by calcium chloride before it was introduced into a solution of 13 (0.85 g, 1.37 mmol) in 20 mL CH\(_2\)Cl\(_2\) at -78 °C until the material completely disappeared. Nitrogen was bubbled through the solution for 5 min to purge the excess ozone before 1.0 mL Me\(_2\)S was added, and the mixture was then slowly warmed to room temperature. The solution was concentrated, flash column chromatography (silica gel, hexane: EtOAc = 10:1) afforded 14 (0.62 g, 71%) as a colorless oil. 

\( R_f = 0.5 \) (hexane:EtOAc = 10:1).

\( ^1H \text{NMR} \) (400 MHz, CDCl\(_3\)) \( \delta \) 9.63 (s, 1H), 4.85 (d, \( J = 11.9 \) Hz, 1H), 4.72 (d, \( J = 9.7 \) Hz, 1H), 4.58 (m, 2H), 3.86 – 3.74 (m, 1H), 2.58 (m, 2H), 2.35 (dd, \( J = 16.6, 10.3 \) Hz, 1H), 1.96 – 1.81 (m, 2H), 1.07 (d, \( J = 7.0 \) Hz, 3H), 1.04 (m, 21H), 0.87 (s, 9H), 0.06 (d, \( J = 5.3 \) Hz, 6H).

\( ^{13}C \text{NMR} \) (100 MHz, CDCl\(_3\)) \( \delta \) 200.0, 154.6, 104.1, 95.3, 83.3, 75.4, 66.9, 64.0, 51.7, 32.6, 29.6, 25.7, 18.6, 18.0, 11.4, 11.2, -4.8, -4.9.

HRMS (ESI) m/z: [M+H]\(^+\) Calcd for C\(_{28}\)H\(_{51}\)Cl\(_3\)NO\(_4\)Si\(_2\) 626.2417; Found 626.2410.

IR (film) \( \nu_{\text{max}} \) 2954, 2864, 2174, 1719, 1462, 1410, 1331, 1254, 1115, 1092, 922, 883, 856, 837, 776, 741, 715, 676, 614 cm\(^{-1}\).
To a solution of 14 (7.10 g, 11.32 mmol) in 30 mL dichloroethane at -78 °C was added CH$_3$COOH (323uL, 5.66 mmol), 4-methoxybenzylamine (1.8 mL, 13.6 mmol) and sodium triacetoxyborohydride (3.6 g, 17 mmol). The mixture was then slowly warmed to room temperature and stirred for 12 hours at room temperature before neutralized with saturated aqueous Na$_2$CO$_3$ and extracted with CH$_2$Cl$_2$ (3×30 mL). The organic layers were washed with brine (30 mL), dried with Na$_2$SO$_4$ and concentrated. Flash column chromatography (silica gel, hexane: EtOAc = 4:1) afforded the crude product as a colorless oil. To a solution of the crude product in 7 mL CH$_2$Cl$_2$ and 21 mL CH$_3$COOH was added zinc dust (3.10 g, 47.15 mmol) and stirred vigorously at room temperature for 6 h. The mixture was filtered and the filtrate was neutralized with saturated Na$_2$CO$_3$ solution and extracted with CH$_2$Cl$_2$ (3×40 mL), the organic layers were washed with brine (40 mL), dried with Na$_2$SO$_4$ and concentrated. Flash column chromatography (silica gel, hexane: EtOAc = 1:1) afforded 16 (2.79 g, 43%, 2 steps) as a colorless oil. R$_f$ = 0.4 (hexane:EtOAc = 1:1).

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.22 (d, $J$ = 8.4 Hz, 2H), 6.84 (d, $J$ = 8.4 Hz, 2H), 3.84 (s, 1H), 3.79 (s, 3H), 3.70 (q, $J$ = 13.1 Hz, 2H), 3.18 – 3.05 (m, 1H), 2.79 (m, 2H), 2.40 (dd, $J$ = 11.6, 9.2 Hz, 1H), 2.31 (d, $J$ = 6.0 Hz, 2H), 1.97 (s, 2H), 1.80 (d, $J$ = 13.2 Hz, 1H), 1.34 (m, 2H), 1.04 (m, 21H), 0.89 (s, 9H), 0.82 (d, $J$ = 6.7 Hz, 3H), 0.03 (d, $J$ = 5.2 Hz, 6H).

$^{13}$C NMR (100 MHz, CDCl$_3$) δ 158.5, 132.8, 129.3, 113.7, 105.9, 82.2, 55.2, 55.1, 71.2, 53.7, 52.1, 49.2, 40.5, 39.7, 27.9, 25.9, 18.7, 18.1, 15.0, 11.3, -4.3, -4.9.

HRMS (ESI) m/z: [M+H]$^+$ Calcd for C$_{33}$H$_{61}$N$_2$O$_2$Si$_2$ 573.4266; Found 573.4256.

IR (film) $\nu_{\text{max}}$ 2939, 2863, 2349, 2171, 1716, 1613, 1586, 1512, 1462, 1350, 1249, 1174, 1110, 1037, 940, 883, 837, 775, 743, 677, 636 cm$^{-1}$.
To a solution of 16 (1.28 g, 2.24 mmol) in 20 mL CH₂Cl₂ was added 17 (1.39 g, 4.48 mmol) and triethylamine (0.78 mL, 5.6 mmol). The mixture was stirred at room temperature for 12 hours. The solution was concentrated, flash column chromatography (silica gel, hexane: EtOAc = 10:1) afforded 18 (1.38 g, 88%) as a flocculent solid.

Rf = 0.5 (hexane: EtOAc = 4:1).

^1H NMR (400 MHz, CDCl₃) δ 7.22 (d, J = 8.4 Hz, 2H), 6.83 (d, J = 8.4 Hz, 2H), 4.80 (d, J = 14.9 Hz, 1H), 4.69 – 4.58 (m, 2H), 4.55 (d, J = 14.9 Hz, 1H), 3.86 (s, 1H), 3.84 – 3.68 (m, 4H), 3.57 (dd, J = 19.5, 9.8 Hz, 1H), 3.41 – 3.20 (m, 3H), 2.86 (t, J = 9.9 Hz, 1H), 2.13 – 2.01 (m, 1H), 1.80 (d, J = 12.0 Hz, 1H), 1.60 – 1.49 (m, 1H), 0.99 (dd, J = 18.9, 5.8 Hz, 21H), 0.84 (s, 9H), 0.75 (d, J = 6.6 Hz, 3H), 0.02 (d, J = 12.5 Hz, 6H).

^13C NMR (100 MHz, CDCl₃) δ 159.5, 157.4, 130.1, 126.8, 114.2, 104.9, 94.5, 83.0, 78.0, 68.6, 57.5, 55.3, 50.7, 50.6, 49.4, 39.9, 39.3, 25.9, 24.4, 18.7, 18.0, 13.6, 11.3, -4.3, -4.9.

HRMS (ESI) m/z: [M+H]^+ Caled for C₃₆H₆₁Cl₃N₃O₅SSi₂ 808.2931; Found 808.2906.

IR (film) νmax 2942, 2864, 2173, 1572, 1462, 1345, 1249, 1179, 1141, 1092, 1034, 938, 883, 838, 775, 728, 678, 616 cm⁻¹.

To a stirred solution of 18 (144 mg, 0.18 mmol) in 10 mL CH₃OH was added AgF (45.2 mg, 0.36 mmol) in the dark. The reaction mixture was stirred at room temperature for 24 hours in dark and then 1 M HCl (5.0 mL) was added. The mixture was stirred for 15 min, diluted with water (5 mL) then was concentrated in vacuo, then the water layer was extracted with CH₂Cl₂ (3×10 mL), the organic layers was washed with
brine (10 mL), dried with Na$_2$SO$_4$ and concentrated. Flash column chromatography (silica gel, hexane: EtOAc = 2:1) afforded 19 (101 mg, 87%) as a colorless oil. 

$R_f = 0.4$ (hexane: EtOAc = 2:1).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.21 (d, $J = 8.4$ Hz, 2H), 6.83 (d, $J = 8.4$ Hz, 2H), 4.75 (d, $J = 14.9$ Hz, 1H), 4.62 (m, 3H), 3.87 (s, 1H), 3.75 (s, 4H), 3.57 (dd, $J = 19.0$, 8.8 Hz, 1H), 3.30 (t, $J = 9.4$ Hz, 1H), 3.20 (t, $J = 6.6$ Hz, 2H), 2.92 (t, $J = 9.1$ Hz, 1H), 2.03 (t, $J = 14.9$ Hz, 1H), 1.96 (s, 1H), 1.74 (t, $J = 12.6$ Hz, 1H), 1.62 – 1.48 (m, 1H), 0.85 (s, 9H), 0.74 (d, $J = 6.6$ Hz, 3H), 0.02 (d, $J = 13.4$ Hz, 6H).

$^1$C NMR (100 MHz, CDCl$_3$) $\delta$ 159.5, 157.1, 130.0, 126.8, 114.2, 94.6, 81.2, 77.9, 70.7, 68.8, 57.8, 55.3, 51.0, 50.5, 49.0, 39.8, 39.0, 25.9, 22.6, 18.1, 13.5, -4.4, -5.0.

HRMS (ESI) m/z: [M+H]$^+$ Calcd for C$_{27}$H$_{41}$Cl$_3$N$_3$O$_5$SSi 652.1596; Found 652.1579.

IR (film) $\nu_{\text{max}}$ 3309, 2930, 1562, 1513, 1462, 1348, 1306, 1247, 1178, 1139, 1111, 1090, 1030, 938, 836, 774, 726, 616 cm$^{-1}$.

To a solution of 6-bromo-2,4-dimethoxypyrimidine 20 (0.38 g, 1.72 mmol) and 19 (0.75 g, 1.15 mmol) in 10 mL of triethylamine was added a mixture of bis(triphenylphosphine)palladium(II) chloride (16.1 mg, 0.023 mmol) and copper(I) iodide (9 mg, 0.046 mmol). The resulting mixture was stirred vigorously at room temperature for 24 hours. The reaction mixture filtered through a plug of Celite and the filtrate was concentrated. Flash column chromatography (silica gel, hexane: EtOAc = 2:1) afforded 21 (101 mg, 87%) as a flocculent solid.

$R_f = 0.35$ (hexane: EtOAc = 2:1).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.20 (d, $J = 8.5$ Hz, 2H), 6.80 (d, $J = 8.5$ Hz, 2H), 6.40 (s, 1H), 4.79 – 4.62 (m, 4H), 3.93 (s, 1H), 3.91 (s, 1H), 3.87 (m, 2H), 3.74 (s, 3H), 3.60 (d, $J = 19.3$, 8.8 Hz, 1H), 3.49 – 3.25 (m, 1H), 2.90 (t, $J = 8.5$ Hz, 2H), 2.03 (t, $J = 14.9$ Hz, 1H), 1.96 (s, 1H), 1.74 (t, $J = 12.6$ Hz, 1H), 1.62 – 1.48 (m, 1H), 0.85 (s, 9H), 0.74 (d, $J = 6.6$ Hz, 3H), 0.02 (d, $J = 13.4$ Hz, 6H).
(d, \( J = 6.0 \) Hz, 2H), 3.32 (t, \( J = 9.4 \) Hz, 1H), 2.94 (t, \( J = 9.3 \) Hz, 1H), 2.07 (d, \( J = 13.9 \) Hz, 1H), 1.82 (t, \( J = 12.2 \) Hz, 1H), 1.58 (dd, \( J = 8.5, 7.0 \) Hz, 1H), 0.84 (s, 9H), 0.76 (d, \( J = 6.7 \) Hz, 3H), 0.02 (d, \( J = 13.5 \) Hz, 6H).

\(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \) 171.7, 165.3, 159.5, 157.1, 151.6, 129.9, 126.7, 114.2, 104.7, 94.5, 90.7, 81.0, 77.9, 68.7, 57.8, 55.2, 54.9, 53.9, 50.7, 50.4, 49.0, 39.7, 39.4, 25.8, 23.7, 18.0, 13.5, -4.3, -5.0.

HRMS (ESI) m/z: [M+H]^+ Calcd for C\(_{33}\)H\(_{47}\)Cl\(_3\)N\(_5\)O\(_7\)SSi 790.2026; Found 790.1997.

IR (film) \( \nu_{\text{max}} \) 2953, 2236, 1576, 1556, 1513, 1480, 1459, 1389, 1347, 1248, 1202, 1139, 1104, 1029, 965, 939, 835, 775, 730, 615 cm\(^{-1}\).

To a solution of 21 (638 mg, 0.807 mmol) in 10 mL CH\(_3\)OH and 10 mL CH\(_3\)COOH was added zinc dust (264 mg, 4.04 mmol) and stirred vigorously at room temperature for 1 h. The mixture was filtered and the filtrate was neutralized with saturated Na\(_2\)CO\(_3\) solution and concentrated in vacuo then extracted with CH\(_2\)Cl\(_2\) (3×20 mL), the organic layers was washed with brine (20 mL), dried with Na\(_2\)SO\(_4\) and concentrated. Flash column chromatography (CH\(_2\)Cl\(_2\)/CH\(_3\)OH = 10/1) afforded 22 (223 mg, 36%) as a colorless oil. 

\( R_f = 0.4 \) (CH\(_2\)Cl\(_2\)/CH\(_3\)OH = 10/1).

\(^1\)H NMR (400 MHz, CDCl\(_3\)) \( \delta \) 7.18 (d, \( J = 8.3 \) Hz, 2H), 6.88 (d, \( J = 8.4 \) Hz, 2H), 6.43 (s, 1H), 5.26 (d, \( J = 15.1 \) Hz, 1H), 4.99 (s, 1H), 4.39 (d, \( J = 15.1 \) Hz, 1H), 3.95 (m, 7H), 3.81 (s, 4H), 3.68 (dd, \( J = 20.6 \) 10.3 Hz, 1H), 3.54 (t, \( J = 10.2 \) Hz, 1H), 3.20 (t, \( J = 10.4 \) Hz, 1H), 3.02 (dd, \( J = 13.8, 7.5 \) Hz, 1H), 2.67 (dd, \( J = 13.9, 8.8 \) Hz, 1H), 2.17 – 2.07 (m, 1H), 1.96 (dd, \( J = 18.7, 9.8 \) Hz, 2H), 1.65 – 1.55 (m, 1H), 1.54 – 1.45 (m, 1H), 0.94 – 0.82 (m, 12H), 0.06 (d, \( J = 1.8 \) Hz, 6H).

\(^{13}\)C NMR (100 MHz, CDCl\(_3\)) \( \delta \) 171.3, 166.4, 164.4, 158.7, 152.8, 129.2, 125.8, 113.4, 99.6, 67.3, 54.3, 54.1, 53.7, 52.9, 52.4, 50.6, 49.0, 42.5, 41.3, 39.2, 38.4, 28.0, 24.8, 17.1, 12.8, -5.5, -5.9.

S11
HRMS (ESI) m/z: [M+H]\(^+\) Calcd for C\(_{31}\)H\(_{48}\)N\(_5\)O\(_4\)Si 582.3470; Found 582.3460.

IR (film) \(\nu_{\text{max}}\): 2929, 2348, 1712, 1570, 1514, 1461, 1357, 1251, 1206, 1177, 1112, 1050, 938, 839, 776, 683, 614 cm\(^{-1}\).

A solution of 22 (49.3 mg, 0.085 mmol) in 10 mL concentrated HCl was heated at 95 °C for 18 hours. The mixture was evaporated under reduced pressure to give 23 without further purification.

\(^1\)H NMR (400 MHz, D\(_2\)O) \(\delta\): 5.67 (s, 1H), 4.02 (s, 1H), 3.93 (m, 1H), 3.88 – 3.77 (m, 2H), 3.72 (dddd, \(J = 11, 11, 3.6, 3.6\) Hz, 1H), 3.30 – 3.18 (m, 1H), 2.75 – 2.63 (m, 2H), 2.16 (dt, \(J = 13.6, 3.4\) Hz, 1H), 2.06 (\(J = 13.6, 3.4\) Hz, 1H), 1.82 (ddd, \(J = 14.8, 10.4, 4.8\) Hz, 1H), 1.77 – 1.65 (m, 1H), 1.54 (t, \(J = 12.0\) Hz, 1H), 0.95 (d, \(J = 6.8\) Hz, 3H).

\(^{13}\)C NMR (100 MHz, D\(_2\)O) \(\delta\): 166.9, 154.3, 153.7, 152.9, 100.8, 67.9, 56.8, 46.7, 40.9, 39.2, 37.8, 37.3, 30.6, 12.9.

To a solution of 23 in dry DMF was added SO\(_3\)•pyr (160 mg, 1.07 mmol), the resulting mixture was stirred vigorously at room temperature for 12 hours. The filtrate was concentrated and the residue was purified by HPLC as same as Williams, using the Waters Symmetry C-18 column (4.6×250 mm) eluting with 8% MeOH/H\(_2\)O with 1% TFA at 1.0 mL/min, monitoring at 263 nm to give 8-epi-7-deoxycylindrospermopsin 24 (26.2 mg, 80% for 2 steps, \(t_R = 10.2\) min).

(±)-8-epi-7-deoxycylindrospermopsin 24: \(^1\)H NMR (400 MHz, D\(_2\)O) \(\delta\): 5.71 (s, 1H), 4.67 (s, 1H), 4.00-3.93 (m, 1H), 3.93–3.79 (m, 3H), 3.35 -3.25 (m, 1H), 2.78-2.67 (m, 2H), 2.48 (dt, \(J = 14.1, 3.5\) Hz, 1H), 2.26-2.17 (dt, \(J = 14.0, 3.6\) Hz, 1H), 1.89 (m, 2H), 1.60 (t, \(J = 12.8\) Hz, 1H), 1.03 (d, \(J = 6.7\) Hz, 3H).

\(^{13}\)C NMR (100 MHz, D\(_2\)O) \(\delta\): 166.9, 154.3, 153.7, 153.0, 100.8, 77.1, 56.9, 46.8, 46.6, 41.2, 38.6, 37.8, 34.9, 30.4, 12.7.

HRMS (ESI) m/z: [M+H]\(^+\) Calcd for C\(_{15}\)H\(_{22}\)N\(_5\)O\(_6\)S 400.1291; Found 400.1301.
IR (film) $\nu_{\text{max}}$ 3208, 2366, 1628, 4136, 1203, 1141, 839, 801, 723 cm$^{-1}$.

A solution of 21 (42 mg, 0.053 mmol) in 10 mL concentrated HCl was heated at 95 $^\circ$C for 12 hours. The mixture was evaporated under reduced pressure to give the crude product which was used for hydrogenation step without any purification. To a solution of crude product in 1 mL methanol and 1 mL trifluoroacetic acid was added 100 mg 5% Pd/C, under a hydrogen atmosphere for 24 h, and then filtered through Celite, the filtrate was concentrated. The residue was purified by HPLC, using the Waters Symmetry C-18 column (4.6×250 mm) eluting with 8% MeOH/H$_2$O with 1% TFA at 1.0 mL/min, monitoring at 263 nm to give 25 (1.6 mg, 7%, $t_R$ = 26.1 min) and 26 (7.0 mg, 30%, $t_R$ = 50.2 min).

**25**: $^1$H NMR (400 MHz, D$_2$O) $\delta$ 5.71 (s, 1H), 4.06 (s, 1H), 4.02 – 3.94 (m, 1H), 3.94 – 3.82 (m, 2H), 3.75 (dddd, $J$ = 11, 11, 3.6, 3.6 Hz, 1H), 3.28 (m, 1H), 2.79 – 2.69 (m, 2H), 2.20 (dt, $J$ = 13.6, 3.4 Hz, 1H), 2.10 (dt, $J$ = 13.9, 3.4 Hz, 1H), 1.86 (ddd, $J$ = 14.8, 10.4, 4.8 Hz, 1H), 1.81 – 1.69 (m, 1H), 1.58 (t, $J$ = 12.0 Hz, 1H), 0.99 (d, $J$ = 6.9 Hz, 3H).

$^{13}$C NMR (100 MHz, D$_2$O) $\delta$ 166.9, 163.0 (q, $J$ = 35.3 Hz), 154.3, 153.7, 153.0, 116.3 (q, $J$ = 289.8 Hz), 100.8, 67.9, 56.7, 46.7, 46.7, 40.9, 39.2, 37.8, 37.3, 30.7, 12.8.

HRMS (ESI) m/z: [M+H]$^+$ Calcd for C$_{15}$H$_{22}$N$_5$O$_3$ 320.1717; Found 320.1712.

IR (film) $\nu_{\text{max}}$ 3329, 3194, 1663, 1429, 1345, 1201, 1136, 837, 801, 721 cm$^{-1}$.
26: $^1$H NMR (400 MHz, D$_2$O) $\delta$ 5.75 (s, 1H), 4.03 (s, 1H), 3.85 (m, 2H), 3.76 (ddd, $J = 10.8, 10.8, 8.8$ Hz, 1H), 3.64 (ddt, $J = 10.8, 10.8, 3.6$ Hz, 1H), 3.26 (dd, $J = 10.6, 9.0$ Hz, 1H), 2.76 (d, $J = 6.8$ Hz, 2H), 2.29 (dt, $J = 13.2, 3.5$ Hz, 1H), 2.10 (dt, $J = 14.0, 3.5$ Hz, 1H), 1.71 (m, 1H), 1.52 (dd, $J = 24.2, 11.5$ Hz, 2H), 0.97 (d, $J = 6.9$ Hz, 3H).

$^{13}$C NMR (100 MHz, D$_2$O) $\delta$ 166.8, 162.9 (q, $J = 35.5$ Hz), 154.9, 153.3, 152.9, 116.3 (q, $J = 289.8$ Hz), 100.9, 67.9, 56.4, 47.6, 47.3, 44.0, 39.4, 37.3, 36.9, 33.1, 12.7.

HRMS (ESI) m/z: [M+H]$^+$ Calcd for C$_{15}$H$_{22}$N$_5$O$_3$ 320.1717; Found 320.1713.

IR (film) $\nu_{\text{max}}$ 3188, 2921, 1662, 1425, 1344, 1200, 1134, 836, 802 cm$^{-1}$. 
3. $^1$H NMR Signal Assignment of Compound 22

Figure S1 $^1$H NMR signal assignment of compound 22
4. NOESY of Compound 22

Figure S2  NOESY spectral contour plot of 22
5. Comparison of $^1$H NMR Spectra of Reported and Synthetic 8-epi-7-deoxycylindrospermopsin

**Figure S3** $^1$H NMR spectrum of Reported 8-epi-7-Deoxycylindrospermopsin (17) by Williams (Copyright: Williams et al. Angew. Chem., Int. Ed., 2005, 44, 3879).

**Figure S4** $^1$H NMR spectrum of Synthetic 8-epi-7-deoxycylindrospermopsin (24)
6. Comparison of NMR Data of Reported and Synthetic 25

![Chemical Structure of 25](image)

**Table S1** Comparison of $^1$H NMR Data of 25

<table>
<thead>
<tr>
<th></th>
<th>Reported Data by Williams (500 MHz, D$_2$O)$^a$</th>
<th>Synthetic Data (400 MHz, D$_2$O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.68 (s, 1H)</td>
<td>5.71 (s, 1H)</td>
<td></td>
</tr>
<tr>
<td>4.03 (br s, 1H)</td>
<td>4.06 (s, 1H)</td>
<td></td>
</tr>
<tr>
<td>3.92 (m, 1H)</td>
<td>4.02 – 3.94 (m, 1H)</td>
<td></td>
</tr>
<tr>
<td>3.82 (dd, $J = 9, 9$ Hz, 1H)</td>
<td>3.94 – 3.82 (m, 2H)</td>
<td></td>
</tr>
<tr>
<td>3.78 (dd, $J = 9,9$ Hz, 1H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.72 (dddd, $J = 11, 11, 4, 4$ Hz, 1H)</td>
<td>3.75 (dddd, $J = 11, 11, 3.6, 3.6$ Hz, 1H)</td>
<td></td>
</tr>
<tr>
<td>3.25 (m, 1H)</td>
<td>3.28 (m, 1H)</td>
<td></td>
</tr>
<tr>
<td>2.71 (dd, $J = 14, 5.5$ Hz, 1H)</td>
<td>2.79 – 2.69 (m, 2H)</td>
<td></td>
</tr>
<tr>
<td>2.67 (dd, $J = 14, 9$ Hz, 1H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.16 (dt, $J = 14, 4, 4$ Hz, 1H)</td>
<td>2.20 (dt, $J = 13.6, 3.4$ Hz, 1H)</td>
<td></td>
</tr>
<tr>
<td>2.06 (dt, $J = 15, 3$ Hz, 1H)</td>
<td>2.10 (dt, $J = 13.9, 3.4$ Hz, 1H)</td>
<td></td>
</tr>
<tr>
<td>1.83(ddd, $J = 15, 11, 5$ Hz, 1H)</td>
<td>1.86 (ddd, $J = 14.8, 10.4, 4.8$ Hz, 1H)</td>
<td></td>
</tr>
<tr>
<td>1.72 (ddq, $J = 14, 7, 3$ Hz, 1H)</td>
<td>1.81 – 1.69 (m, 1H)</td>
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</tr>
<tr>
<td>1.55 (ddd, $J = 14, 14, 1.5$ Hz, 1H)</td>
<td>1.58 (t, $J = 12.0$ Hz, 1H)</td>
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</tr>
<tr>
<td>0.95 (d, $J = 7$ Hz, 3H)</td>
<td>0.99 (d, $J = 6.9$ Hz, 3H)</td>
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</tr>
</tbody>
</table>

7. Comparison of NMR Data of Reported and Synthetic 26

![Structural diagram of compound 26](image)

**Table S2** Comparison of $^1$H NMR Data of 26

<table>
<thead>
<tr>
<th></th>
<th>Reported Data by Williams (500 MHz, D$_2$O)$^a$</th>
<th>Reported Data by Zakarian (600 MHz, D$_2$O)$^b$</th>
<th>Synthetic Data (400 MHz, D$_2$O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.72 (s, 1H)</td>
<td>5.72 (s, 1H)</td>
<td>5.75 (s, 1H)</td>
<td></td>
</tr>
<tr>
<td>4.00 (br s, 1H)</td>
<td>4.00 (s, 1H)</td>
<td>4.03 (s, 1H)</td>
<td></td>
</tr>
<tr>
<td>3.86 (buried m, 1H)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.82 (dd, $J$ = 9.0, 9.0 Hz, 1H)</td>
<td>3.91 – 3.80 (m, 2H)</td>
<td>3.85 (m, 2H)</td>
<td></td>
</tr>
<tr>
<td>3.74 (dd, $J$ = 10,10 Hz, 1H)</td>
<td>3.78 – 3.68 (m, 1H)</td>
<td>3.76 (ddd, $J$ = 10.8, 10.8, 8.8 Hz, 1H)</td>
<td></td>
</tr>
<tr>
<td>3.61 (ddt, $J$ = 11, 11, 3.5 Hz, 1H)</td>
<td>3.66 – 3.55 (m, 1H)</td>
<td>3.64 (ddt, $J$ = 10.8, 10.8, 3.6 Hz, 1H)</td>
<td></td>
</tr>
<tr>
<td>3.23 (dd, $J$ = 10, 10 Hz, 1H)</td>
<td>3.23 (dd, $J$ = 10.8, 9.4 Hz, 1H)</td>
<td>3.26 (dd, $J$ = 10.6, 9.0 Hz, 1H)</td>
<td></td>
</tr>
<tr>
<td>2.73 (app d, $J$ = 5 Hz, 1H)</td>
<td>2.74 (d, $J$ = 6.9 Hz, 2H)</td>
<td>2.76 (d, $J$ = 6.8 Hz, 2H)</td>
<td></td>
</tr>
<tr>
<td>2.26 (dt, $J$ = 15, 5, 5 Hz, 1H)</td>
<td>2.31 – 2.23 (m, 1H)</td>
<td>2.29 (dt, $J$ = 13.2, 3.5 Hz, 1H)</td>
<td></td>
</tr>
<tr>
<td>2.07 (dt, $J$ = 15, 3, 3, Hz, 1H)</td>
<td>2.16 – 2.03 (m, 1H)</td>
<td>2.10 (dt, $J$ = 14.0, 3.5 Hz, 1H)</td>
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</tr>
<tr>
<td>1.70 (ddq, $J$ = 9, 6.5, 2.5, 1H)</td>
<td>1.75 – 1.65 (m, 1H)</td>
<td>1.71 (m, 1H)</td>
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</tr>
<tr>
<td>1.50 (app q, $J$ = 11 Hz, 2H)</td>
<td>1.56 – 1.43 (m, 2H)</td>
<td>1.52 (dd, $J$ = 24.2, 11.5 Hz, 2H)</td>
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</tr>
<tr>
<td>0.95 (d, $J$ = 6.5 Hz, 3H)</td>
<td>0.95 (d, $J$ = 6.9 Hz, 3H)</td>
<td>0.97 (d, $J$ = 6.9 Hz, 3H).</td>
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Table S3  Comparison of $^{13}$C NMR Data of 26

<table>
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<tr>
<th></th>
<th>Reported Data by Zakarian (150 MHz, D$_2$O)$^a$</th>
<th>Synthetic Data (100 MHz, D$_2$O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>166.6</td>
<td>166.8</td>
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</tr>
<tr>
<td>162.6 (q, $J = 35.6$ Hz)</td>
<td>162.9 (q, $J = 35.5$ Hz)</td>
<td></td>
</tr>
<tr>
<td>154.7</td>
<td>154.9</td>
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</tr>
<tr>
<td>153.1</td>
<td>153.3</td>
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</tr>
<tr>
<td>152.7</td>
<td>152.9</td>
<td></td>
</tr>
<tr>
<td>116.1 (q, $J = 291.4$ Hz)</td>
<td>116.3 (q, $J = 289.8$ Hz)</td>
<td></td>
</tr>
<tr>
<td>100.7</td>
<td>100.9</td>
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</tr>
<tr>
<td>67.7</td>
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</tr>
<tr>
<td>56.2</td>
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<td>47.4</td>
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<td>47.1</td>
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<td>39.2</td>
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</tr>
<tr>
<td>37.1</td>
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<td>36.7</td>
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</tr>
<tr>
<td>32.9</td>
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<tr>
<td>12.6</td>
<td>12.7</td>
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</tbody>
</table>

8. NMR Spectra

Compound 8
Compound 11
Compound 12
Compound 13
Compound 14
Compound 18
Compound 19
Compound 21
Compound 22
NOESY
Compound 23
(±)-8-epi-7-deoxycylindrospermopsin 24
Compound 25
Compound 26