*Supporting Information*

# Total synthesis and Stereochemical Assignment of Cubensic Acid

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# 1. General Information

All reactions were conducted in flame-dried or oven-dried glassware under an atmosphere of dry nitrogen or argon. Oxygen and/or moisture-sensitive solids and liquids were transferred appropriately. The concentration of solutions in vacuo was accomplished using a rotary evaporator fitted with a water aspirator. Residual solvents were removed under a high vacuum (0.1-0.2 mm Hg). All reaction solvents were purified before use: tetrahydrofuran was distilled from Na/benzophenone. Toluene was distilled over molten sodium metal. Dichloromethane, acetonitrile, triethylamine, and diisopropylethylamine were distilled from $CaH_2$. Methanol was distilled from $Mg/I_2$. Reagents were purchased at the highest commercial quality and used without further purification unless otherwise stated. Flash chromatography was performed using the indicated solvents on E. Qingdao silica gel 60 (230 – 400 mesh ASTM). Thin-layer chromatography (TLC) was carried out using pre-coated sheets (Qingdao silica gel 60-F250, 0.2 mm). Compounds were visualized with UV light, iodine, p-anisaldehyde stain, or phosphomolybdic acid in EtOH. Nuclear magnetic resonance (NMR) spectra were recorded on a Bruker Avance 400 MHz, a Quantum-I Plus 400 MHz, and a Bruker Avance 500 MHz spectrometer. The following abbreviations are used to describe spin multiplicity: s = singlet, d = doublet, t = triplet, q = quartet, qn = quintet, m = multiplet, br = broad, dd = doublet of doublets, dt = doublet of triplets, dq = doublet of quartets, ddd = doublet of doublet of doublets; other combinations are derived from those listed above. Coupling constants are reported in Hertz (Hz) for corresponding solutions. Residual $CHCl_3$ served as internal standard (δH = 7.26 ppm, δC = 77.16 ppm) for $^1H$ NMR and $^{13}C$ NMR. Residual $(CH_3)_2SO$ served as internal standard (δH = 2.50 ppm, δC = 39.52 ppm) for $^1H$ NMR and $^{13}C$ NMR. High-resolution mass spectra (HRMS) were measured on the ABI Q-star Elite. Optical rotations were recorded on a Rudolph AutoPol-I polarimeter at 589 nm, 100 mm cell. Data were reported as follows: optical rotation (*c* (g/100 mL), solvent).

## 2. Proposed biosynthetic pathway of cubensic acid (1) based on Biochemistry-based Rule

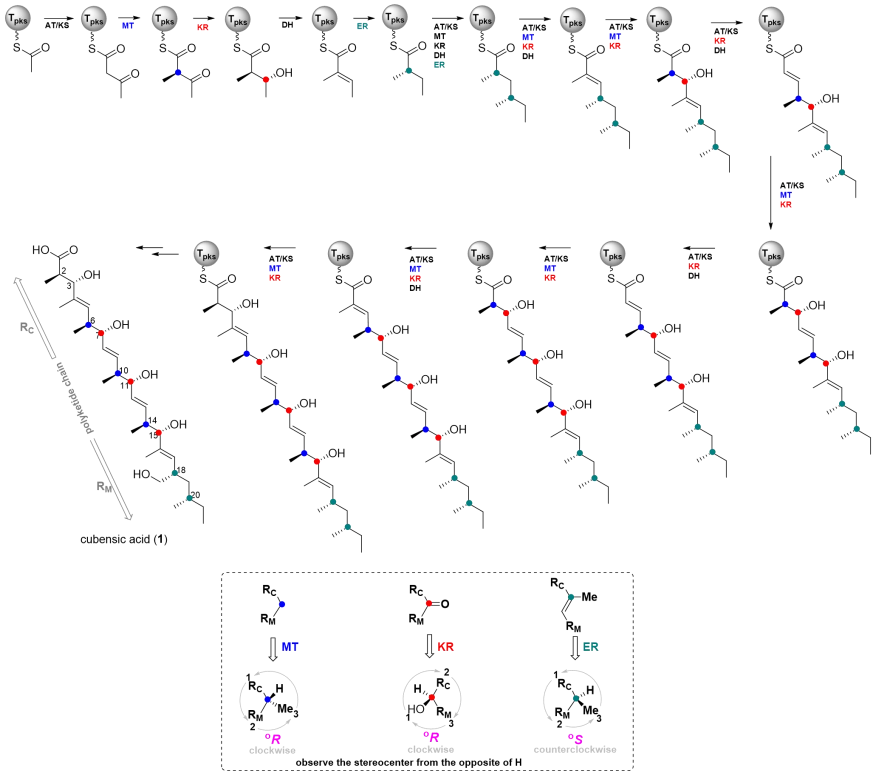
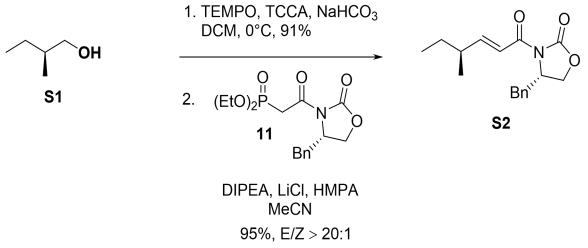



Figure S1. Proposed biosynthetic pathway of cubensic acid (**1**).

# 3. Experimental details and characterization data

## Preparation of Compound S2




To a solution of compound **S1** (5.00 g, 56.70 mmol, 1.00 eq.) in anhydrous DCM (200.00 mL) at 0 °C were added sequentially TCCA (14.50 g, 62.40 mmol, 1.10 eq.), $NaHCO_3$ (9.53 g, 113.40 mmol, 2.00 eq.) and TEMPO (442.00 mg, 2.84 mmol, 0.05 eq.). The mixture was stirred at 0 °C for 10 minutes before it was filtered through a pad of celite with the aid of DCM (100.0 mL). The filtrate was quenched by the simultaneous addition of saturated aqueous $Na_2S_2O_3$ (50.0 mL) and saturated aqueous $NaHCO_3$ (50.0 mL). The mixture was extracted with DCM (3 × 100.0 mL) and the combined organic layers were washed with brine (100.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (*n*-Pentane : $Et_2O$ = 10 : 1) gave aldehyde **7** (4.44g, 91%) as a colorless oil.

To a solution of compound **11**[1] (6.49 g, 46.4 mmol, 2.0 eq.) and LiCl (1.59 g, 92.8 mmol, 4.0 eq.) in anhydrous $CH_3CN$ (50.0 mL) at 0 °C were added sequentially DIPEA (4.95 mL, 28.0 mmol, 3.0 eq.) and HMPA (0.96 mL, 5.5 mmol, 4.0 eq.). The resulting yellow solution was stirred at room temperature for 30 minutes, and then a solution of above aldehyde **7** (2.00 g, 23.2 mmol, 1.00 eq.) in anhydrous $CH_3CN$ (30.0 mL) was added and stirred at room temperature for 24 hours. The reaction mixture was filtered through a short pad of celite with the aid of EtOAc (200.0 mL). The filtrate was concentrated and purified by flash chromatography on silica gel (PE : EtOAc = 50 : 1), giving compound **S2** (6.32 g, 95%, E/Z > 20:1) as a light yellow oil.

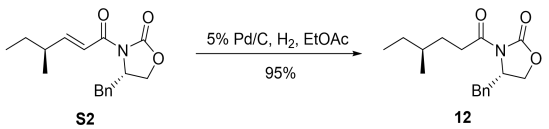
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 63.20 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 7.42 – 7.34 (m, 2H), 7.35 – 7.25 (m, 4H), 7.15 (dd, *J* = 15.4, 7.9 Hz, 1H), 4.82 – 4.67 (m, 1H), 4.28 – 4.18 (m, 2H), 3.39 (dd, *J* = 13.4, 3.3 Hz, 1H), 2.83 (dd, *J* = 13.4, 9.6 Hz, 1H), 2.46 – 2.28 (m, 1H), 1.58 – 1.45 (m, 2H), 1.14 (d, *J* = 6.7 Hz, 3H), 0.95 (t, *J* = 7.5 Hz, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 165.42, 157.02, 153.55, 135.61, 129.57, 129.06, 127.41, 119.04, 66.23, 55.50, 38.69, 38.08, 28.98, 19.09, 11.74.

**HRMS (ESI) m/z:** $C_{17}H_{21}NNaO_3^+$ $[M+Na]^+$: calcd: 310.1414; found: 310.1414..

## Preparation of Compound 12




S2 12

To a solution of compound **S2** (8.00 g, 27.84 mmol, 1.00 eq.) in EtOAc (120.00 mL) at room temperature was added Pd/C (1.50 g, 5% Pd on charcoal). The reaction vessel was evacuated, purged with $H_2$ three times, and stirred at room temperature under a hydrogen atmosphere for 24 hours. The reaction flask was then evacuated and purged with nitrogen three times. The catalyst was removed by filtration through a pad of celite and rinsed thoroughly with EtOAc (150.00 mL). The filtrate was concentrated and purified by flash chromatography on silica gel (PE : EtOAc = 30 : 1), giving compound **12** (7.64 g, 95%) as a light yellow oil

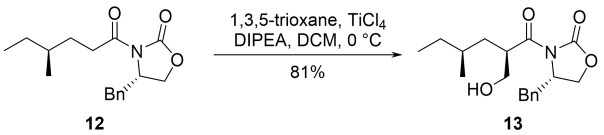
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 31.20 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 7.41 – 7.28 (m, 3H), 7.28 – 7.23 (m, 2H), 4.76 – 4.66 (m, 1H), 4.27 – 4.15 (m, 2H), 3.34 (dd, *J* = 13.4, 3.3 Hz, 1H), 3.10 – 2.99 (m, 1H), 2.99 – 2.89 (m, 1H), 2.81 (dd, *J* = 13.4, 9.6 Hz, 1H), 1.78 – 1.65 (m, 1H), 1.62 – 1.51 (m, 1H), 1.51 – 1.39 (m, 2H), 1.29 – 1.19 (m, 1H), 0.99 – 0.91 (m, 6H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 173.88, 153.58, 135.49, 129.55, 129.08, 127.46, 66.27, 55.31, 38.08, 34.16, 33.53, 31.03, 29.36, 19.07, 11.42.

**HRMS (ESI) m/z:** $C_{17}H_{23}NNaO_3^+$ $[M+Na]^+$: calcd: 312.1571; found: 312.1570.

## Preparation of Compound 13




12 13

To a solution of compound **12** (2.00 g, 6.90 mmol, 1.00 eq.) in anhydrous DCM (48.0 mL) at 0 °C was added $TiCl_4$ (1 M in DCM, 6.90 mL, 6.90 mmol, 1.00 eq.). The reaction mixture was stirred at 0 °C for 15 minutes, followed by the addition of DIPEA (1.20 mL, 7.60 mmol, 1.10 eq.). The reaction mixture was stirred at 0 ° C for 1 hour, followed by the addition of a solution of 1,3,5-trioxane (0.60 g, 6.62 mmol, 0.96 eq.) in anhydrous DCM (20.0 mL). The reaction mixture was stirred at 0 °C for 15 minutes, followed by the second addition of $TiCl_4$ (1 M in DCM, 6.90 mL, 6.90 mmol, 1.00 eq.). The reaction mixture was stirred at 0 °C for 7 hours before it was quenched with aqueous saturated $NH_4Cl$ (50.0 mL). The reaction mixture was extracted with DCM (3 × 50.0 mL) and the combined organic extracts were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, and evaporated under reduced pressure. Purification of the crude product by flash chromatography on silica gel (PE : EtOAc = 8 : 1) gave compound **13** (1.79 g, 81 %, dr > 20:1) as a white foamy solid.

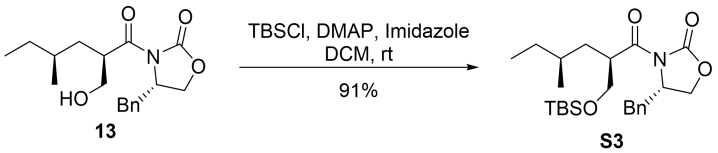
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 47.98 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 7.37 – 7.30 (m, 2H), 7.30 – 7.21 (m, 3H), 4.74 – 4.66 (m, 1H), 4.26 – 4.13 (m, 3H), 3.87 (dd, *J* = 10.9, 4.6 Hz, 1H), 3.78 (dd, *J* = 10.9, 7.8 Hz, 1H), 3.31 (dd, *J* = 13.5, 3.4 Hz, 1H), 2.81 (dd, *J* = 13.5, 9.4 Hz, 1H), 2.30 (s, 1H), 1.82 (ddd, *J* = 13.5, 8.8, 5.1 Hz, 1H), 1.44 – 1.30 (m, 2H), 1.31 – 1.21 (m, 1H), 1.20 – 1.09 (m, 1H), 0.90 – 0.85 (m, 6H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 176.08, 153.85, 135.39, 129.61, 129.05, 127.45, 66.27, 65.11, 55.78, 43.57, 37.95, 35.60, 32.46, 29.58, 19.41, 11.32.

**HRMS (ESI) m/z:** $C_{18}H_{25}NNaO_4^+$ $[M+Na]^+$: calcd: 342.1676; found:342.1675.

## Preparation of Compound S3




13 S3

To a solution of compound **13** (1.58 g, 4.95 mmol, 1.00 eq.) in anhydrous DCM (50.0 mL) at 0 °C was added sequentially imidazole (674 mg, 9.90 mmol, 2.00 eq.), DMAP (60 mg, 0.495 mmol, 0.10 eq.) and a solution of TBSCl (61.12 g, 7.43 mmol, 1.50 eq.) in anhydrous DCM (10.0 mL). The reaction mixture was stirred at room temperature for 7 hours before it was quenched with aqueous saturated $NH_4Cl$ (50.0 mL). The reaction mixture was extracted with DCM (3 × 100 mL) and the combined organic extracts were washed with brine (100.0 mL), dried over anhydrous $Na_2SO_4$, and evaporated under reduced pressure. Purification of the crude product by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave compound **S3** (1.95 g, 91 %) as a white foamy solid.

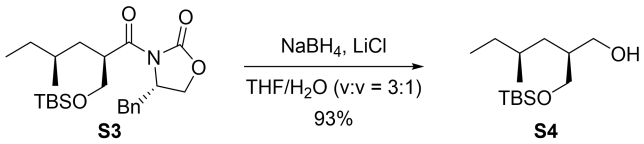
$[\alpha]_D^{25}$ = + 12.60 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 7.36 – 7.30 (m, 2H), 7.29 – 7.20 (m, 3H), 4.75 – 4.67 (m, 1H), 4.31 – 4.19 (m, 1H), 4.19 – 4.11 (m, 2H), 3.85 (dd, *J* = 9.6, 7.6 Hz, 1H), 3.79 (dd, *J* = 9.5, 5.2 Hz, 1H), 3.34 (dd, *J* = 13.4, 3.3 Hz, 1H), 2.67 (dd, *J* = 13.4, 9.9 Hz, 1H), 1.81 (ddd, *J* = 13.7, 9.1, 4.9 Hz, 1H), 1.42 – 1.34 (m, 1H), 1.34 – 1.26 (m, 1H), 1.26 – 1.16 (m, 1H), 1.17 – 1.10 (m, 1H), 0.89 – 0.85 (m, 15H), 0.06 (s, 3H), 0.06 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 175.69, 153.25, 135.80, 129.54, 129.05, 127.38, 65.95, 65.62, 55.62, 43.63, 38.23, 35.84, 32.57, 29.92, 26.00, 19.46, 18.41, 11.36, -5.32, -5.41.

**HRMS (ESI) m/z:** $C_{24}H_{39}NNaO_4Si^+$ $[M+Na]^+$: calcd: 456.2541; found: 456.2542.

## Preparation of Compound S4




To a solution of compound **S3** (8.87 g, 20.45 mmol, 1.00 eq.) in THF/ $H_2O$ (150.0 mL/ 50.0 mL) at 0 °C were added $NaBH_4$ (7.74 g, 204.5 mmol, 10.0 eq.) and LiCl (0.87 g, 20.45 mmol, 1.00 eq.). The reaction mixture was stirred at room temperature for 24 hours before it was quenched with saturated aqueous $NH_4Cl$ (100.0 mL). The reaction mixture was stirred at room temperature for an additional one hour, and then extracted with EtOAc (3 × 200.0 mL). The combined organic layers were washed with brine (100.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave compound **S4** (4.95 g, 93%) as a colorless oil.

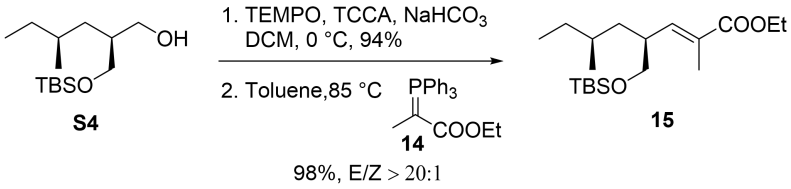
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 0.50 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 3.82 – 3.75 (m, 1H), 3.71 (dd, *J* = 10.8, 3.2 Hz, 1H), 3.63 – 3.52 (m, 2H), 3.01 (s, 1H), 1.89 – 1.78 (m, 1H), 1.42 – 1.28 (m, 2H), 1.26 – 1.09 (m, 2H), 0.91 – 0.84 (m, 16H), 0.07 (s, 6H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 68.44, 67.01, 39.57, 34.76, 31.96, 29.93, 25.99, 19.47, 18.30, 11.38, -5.41, -5.49.

**HRMS (ESI) m/z:** $C_{14}H_{32}NaO_2Si^+$ $[M+Na]^+$: calcd: 283.2064; found: 283.2065.

## Preparation of Compound 15




To a solution of compound **S4** (4.96 g, 19.04 mmol, 1.00 eq.) in anhydrous DCM (190.0 mL) at 0 °C were added sequentially TCCA (4.87 g, 5.46 mmol, 1.10 eq.), $NaHCO_3$ (3.20 g, 38.08 mmol, 2.0 eq.) and TEMPO (297 mg, 1.90 mmol, 0.10 eq.). The mixture was stirred at 0 °C for 10 minutes before it was filtered through a pad of celite and silica gel and rinsed with DCM (200.0 mL). The filtrate was quenched by the simultaneous addition of saturated aqueous $Na_2S_2O_3$ (100.0 mL) and saturated aqueous $NaHCO_3$ (100.0 mL)). The mixture was extracted with DCM (3 × 200.0 mL) and the combined organic layers were washed with brine (100.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 20 : 1) gave the aldehyde **S5** (4.62 g, 94%) as a colorless oil.

To a solution of the above aldehyde **S5** (2.00 g, 7.74 mmol, 1.0 eq.) in anhydrous toluene (30.0 mL) at 0 °C was added (carbethoxyethylidene)triphenylphosphorane **14** (5.61 g, 15.48 mmol, 2.0 eq.). The reaction mixture was stirred at 85 °C for 24 hours before it was quenched with brine (50.0 mL). The mixture was extracted with EtOAc (3 × 100.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound **15** (2.60 g, 98%, E/Z > 20 : 1) as a colorless oil.

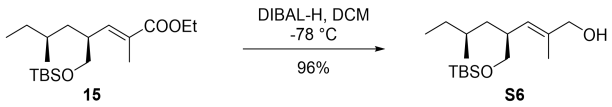
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 13.40 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 6.49 (dd, *J* = 10.4, 1.5 Hz, 1H), 4.25 – 4.13 (m, 2H), 3.53 (dd, *J* = 9.8, 5.9 Hz, 1H), 3.48 (dd, *J* = 9.8, 6.6 Hz, 1H), 2.77 – 2.61 (m, 1H), 1.87 (d, *J* = 1.4 Hz, 3H), 1.33 – 1.22 (m, 7H), 1.21 – 1.12 (m, 1H), 0.89 – 0.81 (m, 15H), 0.02 (s, 3H), 0.01 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 168.39, 144.60, 128.85, 66.61, 60.51, 39.93, 38.42, 32.23, 30.55, 26.03, 19.08, 18.44, 14.43, 13.06, 11.39, -5.20, -5.27.

**HRMS (ESI) m/z:** $C_{19}H_{38}NaO_3Si^+$ $[M+Na]^+$: calcd: 365.2483; found: 365.2483.

## Preparation of Compound S6




To a solution of compound **15** (4.74 g, 13.84 mmol, 1.00 eq.) in anhydrous DCM (140.0 mL) was added dropwise DIBAL-H (1.5 M in Toluene, 28.7 mL, 41.52 mmol, 3.00 eq.) at -78 °C. The mixture was stirred at -78 °C for 5 hours before it was quenched with saturated aqueous $NH_4Cl$ (50.0 mL) and Rochelle's salt (100.0 mL) at 0 °C. The biphasic mixture was vigorously stirred at room temperature for 2 hours. The mixture was extracted with DCM (3 × 100.0 mL) and the combined organic layers were washed with brine (100.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 10 : 1) gave the **S6** (4.00 g, 96%) as a colorless oil.

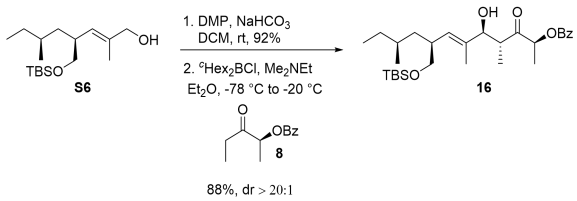
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 19.60 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 5.09 (dq, *J* = 9.9, 1.4 Hz, 1H), 4.00 (d, *J* = 1.2 Hz, 2H), 3.42 (d, *J* = 6.5 Hz, 2H), 2.62 – 2.50 (m, 1H), 1.70 (d, *J* = 1.4 Hz, 3H), 1.33 – 1.22 (m, 3H), 1.20 – 1.11 (m, 2H), 0.88 (s, 9H), 0.84 (t, *J* = 7.2 Hz, 3H), 0.81 (d, *J* = 5.7 Hz, 3H), 0.02 (s, 3H), 0.02 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 136.15, 128.60, 69.17, 67.37, 38.92, 38.56, 31.99, 30.71, 26.06, 19.05, 18.47, 14.36, 11.50, -5.14, -5.17.

**HRMS (ESI) m/z:** $C_{17}H_{36}NaO_2Si^+$ $[M+Na]^+$: calcd: 323.2377; found: 323.2380.

## Preparation of Compound 16




To a solution of compound **S6** (2.00 g, 6.65 mmol, 1.00 eq.) in anhydrous DCM (20.0 mL) at 0 °C, Dess-Martin periodinane (7.05 g, 16.63 mmol, 2.50 eq.) and $NaHCO_3$ (1.40 g, 16.63 mmol, 2.50 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 2 hours before it was quenched with saturated aqueous $Na_2S_2O_3$ (100.0 mL) and saturated aqueous $NaHCO_3$ (100.0 mL). The reaction mixture was stirred at room temperature for an additional one hour before it was extracted with DCM (3 × 50.0 mL). The combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound aldehyde **S7** (1.83 g, 92%) as a color less oil.

To a cooled (-78 °C) solution of *c*-$Hex_2BCl$ (1.0 M in hexanes, 9.18 mL, 9.18 mmol, 1.50 eq.) in anhydrous $Et_2O$ (15.0 mL) was added $Me_2NEt$ (1.19 mL, 11.02 mmol, 1.80 eq.), followed by compound **8**[2] (1.39 g, 6.73 mmol, 1.10 eq.) in anhydrous $Et_2O$ (10.0 mL). The reaction mixture was allowed to warm to 0 °C and stirred for 2 hours before recooling to -78 °C. The above aldehyde **S7** (1.83 g, 6.12 mmol, 1.0 eq.) was added and the stirring continued for a further 1 hour at -78 °C and then at -20 °C for 14 hours. The reaction mixture was quenched at 0 °C with the addition of MeOH (3.0 mL), pH = 7 buffer solution (30.0 mL), 30% aqueous $H_2O_2$ (3.0 mL), and stirring maintained for one hour at room temperature. The mixture was extracted with EtOAc (3 × 100.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 10 : 1) gave compound **16** (2.72 g, 88%, dr > 20 : 1) as a colorless oil.

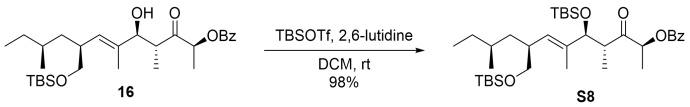
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 12.30 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR (400 MHz, CDCl$_3$)** δ 8.14 – 8.05 (m, 2H), 7.63 – 7.56 (m, 1H), 7.48 – 7.44 (m, 2H), 5.46 (q, *J* = 7.0 Hz, 1H), 5.13 (dd, *J* = 9.9, 1.6 Hz, 1H), 4.22 (d, *J* = 9.6 Hz, 1H), 3.44 (d, *J* = 6.4 Hz, 2H), 3.05 (dq, *J* = 9.6, 7.1 Hz, 1H), 2.64 – 2.49 (m, 1H), 1.65 (d, *J* = 1.3 Hz, 3H), 1.58 (d, *J* = 7.0 Hz, 3H), 1.28 – 1.14 (m, 5H), 1.02 (d, *J* = 7.1 Hz, 3H), 0.87 (s, 9H), 0.86 – 0.79 (m, 6H), 0.02 (s, 3H), 0.02 (s, 3H).

**$^{13}$C NMR: (101 MHz, CDCl$_3$)** δ 211.05, 166.06, 135.69, 133.38, 133.01, 129.96, 129.87, 128.57, 80.83, 75.37, 67.22, 45.59, 38.75, 38.67, 32.33, 30.75, 26.07, 19.08, 18.47, 15.70, 14.54, 11.58, 11.01, -5.14, -5.15.

**HRMS (ESI) m/z:** $C_{29}H_{48}NaO_5Si^+$ $[M+Na]^+$: calcd: 527.3164; found: 527.3167.

## Preparation of Compound S8




To a solution of compound **16** (2.67 g, 5.29 mmol, 1.00 eq.) in anhydrous DCM (50.0 mL) at 0 °C, 2,6-lutidine (1.23 mL, 10.58 mmol, 2.0 eq.) and TBSOTf (1.82 mL, 7.94 mmol, 1.5 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 2 hours before it was quenched with saturated aqueous $H_2O$ (50.0 mL) at 0 °C. The mixture was extracted with DCM (3 × 100.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound **S8** (3.21 g, 98%) as a colorless oil.

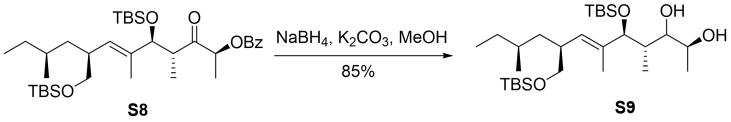
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 14.30 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, CDCl$_3$)** δ 8.11 – 8.05 (m, 2H), 7.62 – 7.52 (m, 1H), 7.50 – 7.40 (m, 2H), 5.44 (q, *J* = 7.0 Hz, 1H), 5.12 (dd, *J* = 9.8, 1.6 Hz, 1H), 4.24 (d, *J* = 9.6 Hz, 1H), 3.53 (dd, *J* = 9.7, 4.6 Hz, 1H), 3.37 (dd, *J* = 9.7, 7.3 Hz, 1H), 3.02 (dq, *J* = 9.7, 7.1 Hz, 1H), 2.57 – 2.46 (m, 1H), 1.60 (d, *J* = 1.3 Hz, 3H), 1.54 (d, *J* = 6.9 Hz, 3H), 1.35 – 1.28 (m, 1H), 1.27 – 1.13 (m, 4H), 0.94 (d, *J* = 7.1 Hz, 3H), 0.89 (s, 9H), 0.84 – 0.79 (m, 15H), 0.04 (s, 3H), 0.03 (s, 3H), -0.03 (s, 3H), -0.03 (s, 3H).

**$^{13}$C NMR: (126 MHz, CDCl$_3$)** δ 209.52, 165.88, 135.62, 133.29, 132.13, 129.98, 128.54, 81.75, 75.49, 66.76, 46.33, 39.03, 38.67, 32.34, 30.81, 26.13, 26.00, 19.10, 18.54, 18.20, 15.38, 14.64, 11.58, 10.92, -4.42, -4.93, -5.20.

**HRMS (ESI) m/z:** $C_{35}H_{62}NaO_5Si_2^+$ $[M+Na]^+$: calcd:641.4028; found: 641.4030.

## Preparation of Compound S9




To a solution of compound **S8** (1.00 g, 1.62 mmol, 1.00 eq.) in anhydrous MeOH (16.0 mL) at 0 °C was added $NaBH_4$ (896 mg, 6.48 mmol, 2.00 eq.). The reaction mixture was stirred at 0 °C until the starting material was consumed as judged by TLC analysis. After being stirred at 0 °C for one hour, $K_2CO_3$ (2.83 g, 20.50 mmol, 4.0 eq.) was added. The reaction mixture was stirred at room temperature for 10 hours before it was quenched with brine (50.0 mL). The mixture was extracted with EtOAc (3 × 100.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 5 : 1) gave compound **S9** (712 mg, 85%) as a colorless oil.

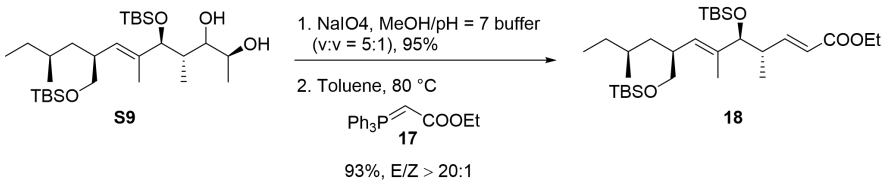
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 8.30 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR (500 MHz, CDCl$_3$)** δ 5.11 (dd, *J* = 9.7, 1.6 Hz, 1H), 4.33 (s, 1H), 3.90 (d, *J* = 8.6 Hz, 1H), 3.82 – 3.74 (m, 1H), 3.67 (dd, *J* = 8.4, 3.3 Hz, 1H), 3.53 (dd, *J* = 9.8, 5.0 Hz, 1H), 3.42 (dd, *J* = 9.7, 6.7 Hz, 1H), 2.57 – 2.46 (m, 1H), 1.70 – 1.65 (m, 1H), 1.62 (d, *J* = 1.4 Hz, 3H), 1.33 – 1.19 (m, 5H), 1.16 (d, *J* = 6.3 Hz, 3H), 0.91 (s, 9H), 0.89 (s, 9H), 0.85 – 0.80 (m, 6H), 0.67 (d, *J* = 6.9 Hz, 3H), 0.11 (s, 3H), 0.04 (s, 3H), 0.04 (s, 3H), 0.03 (s, 3H).

**$^{13}$C NMR (126 MHz, CDCl$_3$)** δ 136.40, 131.85, 86.45, 77.94, 68.79, 66.81, 39.15, 38.82, 38.63, 32.30, 30.73, 26.15, 26.05, 19.15, 18.57, 18.25, 16.33, 13.22, 11.85, 11.55, -3.83, -4.93, -5.17, -5.21.

**HRMS (ESI) m/z:** $C_{28}H_{60}NaO_4Si_2^+$ $[M+Na]^+$: calcd:539.3923; found: 539.3925.

## Preparation of Compound 18




To a solution of the compound **S9** (1.00 g, 1.93 mmol, 1.00 eq.) in MeOH/pH = 7 phosphate buffer (50.0 mL /10.0 mL) at 0 °C was added sodium periodate (1.45 g, 6.76 mmol, 3.5 eq.). The reaction mixture was stirred at room temperature for 12 hours before it was quenched with brine (50.0 mL). The mixture was extracted with EtOAc (3 × 150.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave aldehyde **S10** (0.86 g, 95%) as a colorless oil.

To a solution of the above aldehyde **S10** (0.86 g, 1.83 mmol, 1.00 eq.) in anhydrous toluene (18.0 mL) at 0 °C was added (carbethoxymethylene)triphenylphosphorane **17** (3.19 g, 9.15 mmol, 5.0 eq.). The reaction mixture was stirred at 80 °C for 24 hours before it was quenched with brine (50.0 mL). The mixture was extracted with EtOAc (3 × 50.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound **18** (920 mg, 93%, E/Z > 20 : 1) as a colorless oil.

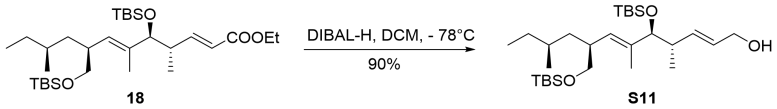
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 11.40 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, CDCl$_3$)** δ 6.99 (dd, *J* = 15.8, 7.8 Hz, 1H), 5.78 (dd, *J* = 15.8, 1.2 Hz, 1H), 5.03 (dd, *J* = 9.8, 1.6 Hz, 1H), 4.18 (q, *J* = 7.2 Hz, 2H), 3.68 (d, *J* = 8.4 Hz, 1H), 3.50 (dd, *J* = 9.8, 4.8 Hz, 1H), 3.35 (dd, *J* = 9.8, 7.4 Hz, 1H), 2.59 – 2.47 (m, 1H), 2.44 (q, *J* = 7.1 Hz, 1H), 1.60 (d, *J* = 1.3 Hz, 3H), 1.32 – 1.15 (m, 8H), 0.90 – 0.87 (m, 12H), 0.86 – 0.84 (m, 12H), 0.81 (d, *J* = 6.0 Hz, 3H), 0.04 (s, 3H), 0.03 (s, 3H), -0.00 (s, 3H), -0.05 (s, 3H).

**$^{13}$C NMR: (126 MHz, CDCl$_3$)** δ 166.83, 152.86, 136.85, 130.73, 121.08, 83.24, 66.93, 60.12, 41.22, 39.14, 38.67, 32.33, 30.84, 26.14, 25.97, 19.08, 18.54, 18.31, 15.88, 14.45, 11.57, -4.32, -4.93, -5.19.

**HRMS (ESI) m/z:** $C_{30}H_{60}NaO_4Si_2^+$ $[M+Na]^+$: calcd:563.3923; found: 563.3925.

## Preparation of Compound S11




To a solution of compound **18** (7.49 g, 13.84 mmol, 1.00 eq.) in anhydrous DCM (140.0 mL) was added dropwise DIBAL-H (1.5 M in Toluene, 28.7 mL, 41.52 mmol, 3.00 eq.) at -78 °C. The mixture was stirred at -78 °C for 5 hours before it was quenched with saturated aqueous $NH_4Cl$ (50.0 mL) and Rochelle's salt (100.0 mL) at 0 °C. The biphasic mixture was vigorously stirred at room temperature for 2 hours. The mixture was extracted with DCM (3 × 100.0 mL) and the combined organic layers were washed with brine (100.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 10 : 1) gave the compound **S11** (6.21 g, 90%) as a colorless oil.

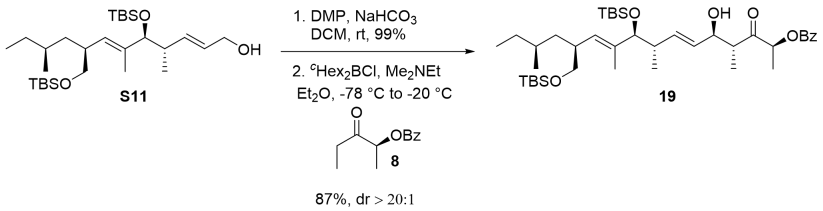
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 11.20 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 5.67 (d, *J* = 7.5 Hz, 1H), 5.63 (d, *J* = 5.7 Hz, 1H), 4.99 (dd, *J* = 9.8, 1.7 Hz, 1H), 4.15 – 4.04 (m, 2H), 3.62 (d, *J* = 8.0 Hz, 1H), 3.50 (dd, *J* = 9.8, 4.8 Hz, 1H), 3.34 (dd, *J* = 9.8, 7.4 Hz, 1H), 2.57 – 2.47 (m, 1H), 2.32 – 2.25 (m, 1H), 1.59 (d, *J* = 1.3 Hz, 3H), 1.36 – 1.29 (m, 1H), 1.28 – 1.21 (m, 3H), 1.20 – 1.15 (m, 1H), 0.89 (s, 9H), 0.87 – 0.80 (m, 18H), 0.04 (s, 3H), 0.03 (s, 3H), -0.01 (s, 3H), -0.05 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 137.41, 137.01, 129.85, 128.57, 83.54, 67.05, 64.25, 40.90, 39.18, 38.57, 32.25, 30.88, 26.15, 26.01, 19.06, 18.54, 18.37, 16.89, 11.84, 11.59, -4.27, -4.79, -5.17.

**HRMS (ESI) m/z:** $C_{28}H_{58}NaO_3Si_2^+$ $[M+Na]^+$: calcd: 521.3817; found: 521.3821.

## Preparation of Compound 19




To a solution of compound **S11** (221 mg, 0.44 mmol, 1.00 eq.) in anhydrous DCM (5.0 mL) at 0 °C, Dess-Martin periodinane (933 mg, 2.20 mmol, 5.00 eq.) and $NaHCO_3$ (370 mg, 4.40 mmol, 10.00 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 2 hours before it was quenched with saturated aqueous $Na_2S_2O_3$ (20.0 mL) and saturated aqueous $NaHCO_3$ (20.0 mL). The reaction mixture was stirred at room temperature for an additional one hour before it was extracted with DCM (3 × 30.0 mL). The combined organic layers were washed with brine (20.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound aldehyde **S12** (216 mg, 99%) as a colorless oil.

To a cooled (-78 °C) solution of *c*-$Hex_2BCl$ (1.0 M in hexanes, 0.65 mL, 0.65 mmol, 1.50 eq.) in anhydrous $Et_2O$ (2.0 mL) was added $Me_2NEt$ (95 μL, 0.88 mmol, 2.00 eq.), followed by compound **8** (100 mg, 0.48 mmol, 1.10 eq.) in anhydrous $Et_2O$ (3.0 mL). The reaction mixture was allowed to warm to 0 °C and stirred for 2 hours before recooling to -78 °C. The above aldehyde **S12** (216 mg, 0.44 mmol, 1.0 eq.) in anhydrous $Et_2O$ (3.0 mL) was added dropwise and the stirring continued for a further 1 hours at -78 °C and then at -20 °C for 12 hours. The reaction mixture was quenched at 0 °C with the addition of MeOH (1.0 mL), pH = 7 buffer solution (10.0 mL), 30% aqueous $H_2O_2$ (1.0 mL), and stirring maintained for one hour at room temperature. The mixture was extracted with EtOAc (3 × 30 mL) and the combined organic layers were washed with brine (30.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 20 : 1) gave compound **19** (269 mg, 87%, dr > 20 : 1)) as a colorless oil.

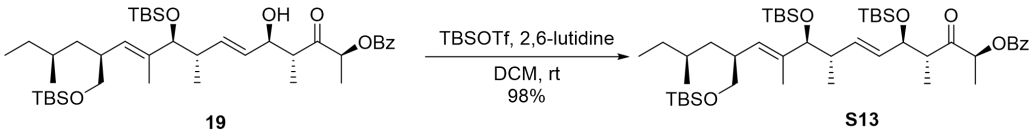
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 13.70 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 8.12 – 8.03 (m, 2H), 7.63 – 7.55 (m, 1H), 7.47 – 7.43 (m, 2H), 5.78 (ddd, *J* = 15.5, 7.2, 0.8 Hz, 1H), 5.44 (q, *J* = 7.1 Hz, 1H), 5.37 (ddd, *J* = 15.4, 8.1, 1.2 Hz, 1H), 5.00 (dd, *J* = 9.8, 1.6 Hz, 1H), 4.22 (t, *J* = 8.3 Hz, 1H), 3.63 (d, *J* = 7.7 Hz, 1H), 3.49 (dd, *J* = 9.8, 4.9 Hz, 1H), 3.36 (dd, *J* = 9.8, 7.2 Hz, 1H), 2.89 (dq, *J* = 8.8, 7.1 Hz, 1H), 2.57 – 2.43 (m, 1H), 2.36 – 2.23 (m, 1H), 2.07 (s, 1H), 1.58 (d, *J* = 1.3 Hz, 3H), 1.57 (d, *J* = 7.0 Hz, 3H), 1.33 – 1.16 (m, 5H), 1.14 (d, *J* = 7.1 Hz, 3H), 0.89 (s, 9H), 0.85 (s, 9H), 0.85 – 0.79 (m, 9H), 0.04 (s, 3H), 0.03 (s, 3H), -0.01 (s, 3H), -0.05 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 211.03, 166.01, 138.39, 137.31, 133.38, 129.98, 129.93, 129.90, 129.55, 128.58, 83.43, 75.79, 75.28, 67.08, 48.46, 40.82, 39.23, 38.60, 32.25, 30.85, 26.15, 26.04, 19.05, 18.54, 18.36, 16.97, 15.71, 14.68, 12.01, 11.58, -4.25, -4.79, -5.14, -5.16.

**HRMS (ESI) m/z:** $C_{40}H_{70}NaO_6Si_2^+$ $[M+Na]^+$: calcd: 725.4604; found: 725.4606.

## Preparation of Compound S13




To a solution of compound **19** (200 mg, 0.28 mmol, 1.00 eq.) in anhydrous DCM (10.0 mL) at 0 °C, 2,6-lutidine (98 μL, 0.84 mmol, 3.0 eq.) and TBSOTf (96 μL, 0.42 mmol, 1.5 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 2 hours before it was quenched with saturated aqueous $H_2O$ (10.0 mL) at 0 °C. The mixture was extracted with DCM (3 × 20.0 mL) and the combined organic layers were washed with brine (20.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave compound **S13** (224 mg, 98%) as a colorless oil.

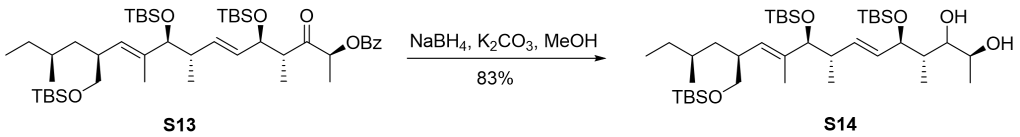
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 2.00 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 8.12 – 8.05 (m, 2H), 7.63 – 7.53 (m, 1H), 7.45 (t, *J* = 7.7 Hz, 2H), 5.88 (dd, *J* = 15.9, 5.5 Hz, 1H), 5.43 (q, *J* = 6.9 Hz, 1H), 5.31 – 5.26 (m, 1H), 5.00 (d, *J* = 9.9 Hz, 1H), 4.25 (t, *J* = 8.7 Hz, 1H), 3.62 (d, *J* = 7.6 Hz, 1H), 3.50 (dd, *J* = 9.8, 4.8 Hz, 1H), 3.35 (dd, *J* = 9.8, 7.5 Hz, 1H), 2.88 (dq, *J* = 9.5, 7.1 Hz, 1H), 2.56 – 2.47 (m, 1H), 2.38 – 2.27 (m, 1H), 1.61 – 1.59 (m, 3H), 1.53 (d, *J* = 7.0 Hz, 3H), 1.38 – 1.29 (m, 1H), 1.29 – 1.21 (m, 2H), 1.23 – 1.14 (m, 2H), 1.04 (d, *J* = 7.1 Hz, 3H), 0.89 (s, 9H), 0.87 – 0.80 (m, 27H), 0.04 (s, 3H), 0.03 (s, 3H), -0.02 (d, *J* = 1.9 Hz, 9H), -0.05 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 209.41, 165.89, 137.50, 136.68, 133.28, 130.10, 130.01, 129.89, 128.55, 83.63, 75.59, 66.99, 49.29, 40.04, 39.27, 38.63, 32.28, 30.88, 26.15, 26.09, 26.07, 19.06, 18.54, 18.35, 18.19, 16.17, 15.33, 14.72, 12.09, 11.59, -3.87, -4.22, -4.62, -4.84, -5.16, -5.17.

**HRMS (ESI) m/z:** $C_{46}H_{84}NaO_6Si_3^+$ $[M+Na]^+$: calcd: 839.5468; found: 839.5470.

## Preparation of Compound S14




**S13** **S14**

To a solution of compound **S13** (200 mg, 0.25 mmol, 1.00 eq.) in anhydrous MeOH (5.0 mL) at 0 °C was added $NaBH_4$ (19 mg, 0.50 mmol, 2.00 eq.). The reaction mixture was stirred at 0 °C until the starting material was consumed as judged by TLC analysis. After being stirred at 0 °C for one hour, $K_2CO_3$ (276 mg, 2.00 mmol, 8.00 eq.) was added. The reaction mixture was stirred at room temperature for 12 hours before it was quenched with brine (10.0 mL). The mixture was extracted with EtOAc (3 × 20.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 20 : 1) gave compound **S14** (148 mg, 85%, dr = 5:1) as a colorless oil.

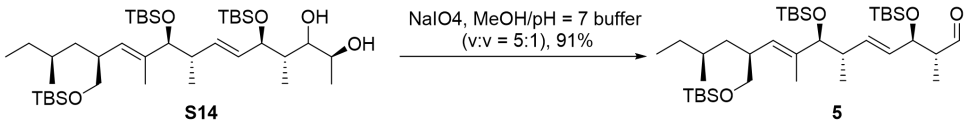
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 16.00 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 5.85 (dd, *J* = 15.9, 5.2 Hz, 1H), 5.61 – 5.31 (m, 1H), 5.02 (d, *J* = 9.7 Hz, 1H), 4.22 – 3.28 (m, 8H), 2.53 (d, *J* = 9.5 Hz, 1H), 2.33 (q, *J* = 6.1 Hz, 1H), 1.62 – 1.56 (m, 4H), 1.37 – 1.20 (m, 5H), 1.16 (d, *J* = 6.3 Hz, 3H), 0.90 (s, 9H), 0.89 (s, 9H), 0.87 (d, *J* = 1.8 Hz, 9H), 0.86 – 0.79 (m, 9H), 0.76 (d, *J* = 6.9 Hz, 3H), 0.09 (s, 3H), 0.05 (s, 3H), 0.04 (s, 3H), 0.03 (s, 3H), -0.00 (s, 3H), -0.04 (s, 3H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 137.38, 136.17, 130.42, 129.81, 83.46, 77.37, 68.50, 67.00, 42.05, 39.54, 39.21, 38.57, 32.22, 30.89, 26.14, 26.07, 26.05, 26.00, 19.02, 18.55, 18.38, 18.20, 16.29, 15.98, 12.76, 12.15, 11.64, -3.32, -4.20, -4.56, -4.86, -5.15.

**HRMS (ESI) m/z:**$C_{39}H_{82}NaO_5Si_3^+$ $[M+Na]^+$: calcd: 737.5362; found: 737.5366.

## Preparation of Compound 5




To a solution of the compound **S14** (150 mg, 0.21 mmol, 1.00 eq.) in MeOH/ pH = 7 phosphate buffer (5.0 mL /1.0 mL) at 0 °C was added sodium periodate (158 mg, 0.74 mmol, 3.5 eq.). The reaction mixture was stirred at room temperature for 12 hours before it was quenched with brine (10.0 mL). The mixture was extracted with EtOAc (3 × 15.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound **5** (128 mg, 91%) as a colorless oil.

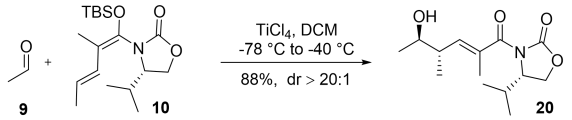
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = – 7.10 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 9.75 (d, *J* = 2.6 Hz, 1H), 5.87 (dd, *J* = 15.8, 6.0 Hz, 1H), 5.39 (dd, *J* = 15.7, 7.4 Hz, 1H), 5.02 (d, *J* = 9.8 Hz, 1H), 4.23 (t, *J* = 7.2 Hz, 1H), 3.65 (d, *J* = 7.5 Hz, 1H), 3.50 (dd, *J* = 9.8, 4.8 Hz, 1H), 3.35 (t, *J* = 8.5 Hz, 1H), 2.53 – 2.49 (m, 1H), 2.46 – 2.43 (m, 1H), 2.35 – 2.31 (m, 1H), 1.60 (s, 3H), 1.35 – 1.17 (m, 5H), 0.99 (d, *J* = 7.0 Hz, 3H), 0.89 (s, 9H), 0.88 (s, 9H), 0.86 – 0.81 (m, 18H), 0.04 (s, 9H), 0.01 (s, 3H), -0.00 (s, 3H), -0.04 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 204.85, 137.46, 136.41, 129.90, 129.79, 83.56, 75.98, 67.00, 53.13, 40.23, 39.27, 38.63, 32.28, 30.87, 26.15, 26.09, 25.96, 19.07, 18.55, 18.39, 18.23, 16.56, 12.14, 11.59, 11.03, 1.16, -3.59, -4.20, -4.78, -4.82, -5.16.

**HRMS (ESI) m/z:** $C_{37}H_{76}NaO_4Si_3^+$ $[M+Na]^+$: calcd: 691.4944; found: 691.4945.

## Preparation of Compound 20




To a solution of aldehyde **9** (3.30 mL, 58.90 mmol, 5.00 eq.) in anhydrous DCM (59.0 mL) at –78 °C, $TiCl_4$ (1.0 M in DCM, 11.80 mL, 11.80 mmol, 1.0 eq.) was added dropwise. The reaction mixture was stirred at -78 °C for 10 minutes before a solution of compound **10** [3] (4.0 g, 11.80 mmol, 1.00 eq.) in anhydrous DCM (20.0 mL) was added dropwise at -78 °C. The reaction mixture was stirred at -40 °C for 24 hours before it was quenched with saturated aqueous $NaHCO_3$ (100.0 mL) and Rochelle's salt (100.0 mL). The biphasic mixture was vigorously stirred at room temperature for 2 hours. The mixture was extracted with DCM (3 × 150.0 mL) and the combined organic layers were washed with brine (100.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 1 : 1) gave compound **20** (2.80 g, 88%, dr > 20:1) as a slightly yellow oil. Spectroscopic data were in accord with those reported previously.[3]

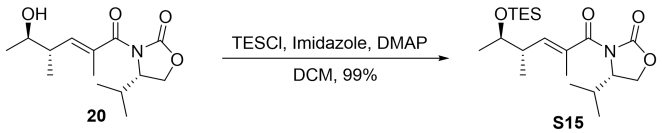
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = +42.10 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 5.79 (dd, *J* = 10.4, 3.0 Hz, 1H), 4.58 (dt, *J* = 9.7, 5.1 Hz, 1H), 4.34 (t, *J* = 9.0 Hz, 1H), 4.18 (dd, *J* = 9.0, 5.7 Hz, 1H), 3.56 – 3.45 (m, 1H), 3.24 (s, 1H), 2.55 – 2.41 (m, 1H), 2.41 – 2.27 (m, 1H), 1.94 (d, *J* = 1.5 Hz, 3H), 1.24 (d, *J* = 6.0 Hz, 3H), 0.97 (d, *J* = 6.7 Hz, 3H), 0.92 (d, *J* = 7.3 Hz, 3H), 0.91 (d, *J* = 6.7 Hz, 3H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 171.69, 154.67, 142.27, 131.40, 71.78, 63.59, 58.21, 42.09, 28.54, 20.20, 17.98, 16.35, 15.33, 14.09.

**HRMS (ESI) m/z:** $C_{14}H_{23}NNaO_4^+$ $[M+Na]^+$: calcd: 292.1520; found: 292.1529.

## Preparation of Compound S15




To a solution of compound **20** (1.90 g, 7.05 mmol, 1.00 eq.) in anhydrous DCM (35.0 mL) at 0 °C, imidazole (0.72 g, 10.57mmol, 1.5 eq.) and DMAP (87 mg, 0.71 mmol, 0.10 eq.) were added sequentially. The reaction mixture was stirred at 0 °C for 5 minutes before a solution of TESCl (1.90 g, 7.05 mmol, 1.30 eq.) in anhydrous DCM (10.0 mL) was added dropwise. The reaction mixture was stirred at room temperature for 10 hours before it was quenched with saturated aqueous $NH_4Cl$ (30.0 mL) at 0 °C. The mixture was extracted with DCM (3 × 50.0 mL) and the combined organic layers were washed with brine (20.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 10 : 1) gave compound **S15** (2.68 g, 99%) as a colorless oil.

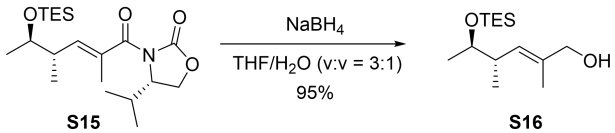
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 16.00 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 6.01 (dd, *J* = 9.8, 1.5 Hz, 1H), 4.53 – 4.45 (m, 1H), 4.29 (t, *J* = 8.8 Hz, 1H), 4.16 (dd, *J* = 9.0, 5.3 Hz, 1H), 3.82 (qd, *J* = 6.3, 3.8 Hz, 1H), 2.59 – 2.48 (m, 1H), 2.44 – 2.31 (m, 1H), 1.90 (d, *J* = 1.5 Hz, 3H), 1.11 (d, *J* = 6.3 Hz, 3H), 1.00 (d, *J* = 6.9 Hz, 3H), 0.95 (t, *J* = 7.9 Hz, 9H), 0.91 (d, *J* = 7.1 Hz, 3H), 0.90 (d, *J* = 6.9 Hz, 3H), 0.61 – 0.55 (m, 6H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 172.20, 153.66, 141.20, 130.90, 71.15, 63.50, 58.45, 40.45, 28.47, 21.19, 17.97, 15.50, 15.09, 13.85, 7.01, 5.19.

**HRMS (ESI) m/z:** $C_{20}H_{37}NNaO_4Si^+$ $[M+Na]^+$: calcd: 406.2383; found: 406.2386.

## Preparation of Compound S16




S15 S16

To a solution of **S15** (2.00 g, 5.21 mmol, 1.00 eq.) in THF/ $H_2O$ (51.0 mL/ 17.0 mL) was added $NaBH_4$ (1.97 g, 52.10 mmol, 10.0 eq.) at 0 °C. The reaction mixture was stirred at room temperature for 24 hours before it was quenched with saturated aqueous $NH_4Cl$ (100.0 mL). The reaction mixture was stirred at room temperature for an additional 1 hour, and then extracted with EtOAc (3 × 100.0 mL). The combined organic layers were washed with brine (100.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 9 : 1) gave compound **S16** (1.28 g, 95%) as a colorless oil.

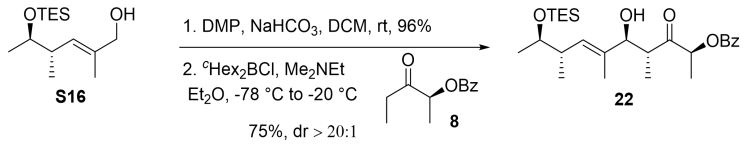
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = – 1.80 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 5.34 – 5.27 (m, 1H), 4.01 (d, *J* = 1.2 Hz, 2H), 3.77 – 3.64 (m, 1H), 2.48 – 2.37 (m, 1H), 1.68 (d, *J* = 1.4 Hz, 3H), 1.06 (d, *J* = 6.2 Hz, 3H), 0.98 – 0.93 (m, 12H), 0.63 – 0.54 (m, 6H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 134.76, 129.25, 71.78, 69.33, 39.72, 20.83, 16.30, 14.06, 7.03, 5.22.

**HRMS (ESI) m/z:** $C_{14}H_{30}NaO_2Si^+$ $[M+Na]^+$: calcd: 281.1908; found: 281.1908.

## Preparation of Compound 22




To a solution of compound **S16** (569 mg, 2.20 mmol, 1.00 eq.) in anhydrous DCM (22.0 mL) at 0 °C, Dess-Martin periodinane (1.87 g, 4.40 mmol, 2.00 eq.) and $NaHCO_3$ (740 mg, 8.80 mmol, 4.00 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 2 hours before it was quenched with saturated aqueous $Na_2S_2O_3$ (20.0 mL) and saturated aqueous $NaHCO_3$ (20.0 mL). The reaction mixture was stirred at room temperature for an additional one hour before it was extracted with DCM (3 × 30.0 mL). The combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound aldehyde **S17** (563 mg, 99%) as a colorless oil.

To a cooled (-78 °C) solution of *c*-$Hex_2BCl$ (1.0 M in hexanes, 3.30 mL, 3.30 mmol, 1.50 eq.) in anhydrous $Et_2O$ (5.0 mL) was added $Me_2NEt$ (0.48 mL, 0.88 mmol, 2.00 eq.), followed by compound **8** (498 mg, 2.42 mmol, 1.10 eq.) dissolved in anhydrous $Et_2O$ (10.0 mL). The reaction mixture was allowed to warm to 0 °C and stirred for 2 hours before recooling to -78 °C. The above aldehyde **S17** (563 mg, 2.20 mmol, 1.0 eq.) dissolved in anhydrous $Et_2O$ (10.0 mL) was added dropwise and the stirring continued for a further 1 hours at -78 °C and then at -20 °C for 12 hours. The reaction mixture was quenched at 0 °C with the addition of MeOH (5.0 mL), pH = 7 buffer solution (30.0 mL), 30% aqueous $H_2O_2$ (5.0 mL), and stirring maintained for 1 hour at room temperature. The mixture was extracted with EtOAc (3 × 50 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 10 : 1) gave compound **22** (763 mg, 75%, dr > 20 : 1) as a colorless oil.

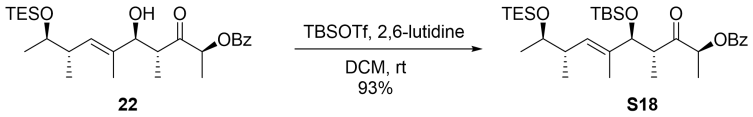
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 8.50 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 8.14 – 8.03 (m, 2H), 7.62 – 7.56 (m, 1H), 7.46 (dd, *J* = 8.4, 7.1 Hz, 2H), 5.46 (q, *J* = 7.0 Hz, 1H), 5.35 (dd, *J* = 9.6, 1.6 Hz, 1H), 4.21 (d, *J* = 9.5 Hz, 1H), 3.71 (qd, *J* = 6.2, 4.4 Hz, 1H), 3.04 (dq, *J* = 9.5, 7.1 Hz, 1H), 2.48 – 2.35 (m, 1H), 1.61 (d, *J* = 1.3 Hz, 3H), 1.58 (d, *J* = 7.0 Hz, 3H), 1.07 (d, *J* = 6.2 Hz, 3H), 1.02 (d, *J* = 7.1 Hz, 3H), 0.97 – 0.91 (m, 12H), 0.58 (q, *J* = 8.2 Hz, 6H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 211.21, 166.04, 134.01, 133.39, 133.04, 129.93, 129.75, 128.56, 80.53, 75.32, 71.57, 45.69, 39.74, 21.03, 16.49, 15.72, 14.63, 10.84, 7.07, 5.15.

**HRMS (ESI) m/z:** $C_{26}H_{42}NaO_5Si^+$ $[M+Na]^+$: calcd: 485.2694; found: 485.2696.

## Preparation of Compound S18




22 S18

To a solution of compound **22** (1.20 g, 2.60 mmol, 1.00 eq.) in anhydrous DCM (26.0 mL) at 0 °C, 2,6-lutidine (0.60 mL, 5.20 mmol, 2.0 eq.) and TBSOTf (0.90 mL, 3.90 mmol, 1.5 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 2 hours before it was quenched with $H_2O$ (20.0 mL) at 0 °C. The mixture was extracted with DCM (3 × 50.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound **S18** (1.40 g, 93%) as a colorless oil.

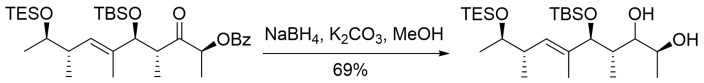
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 1.50 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 8.15 – 8.05 (m, 2H), 7.62 – 7.54 (m, 1H), 7.49 – 7.39 (m, 2H), 5.44 (q, *J* = 7.0 Hz, 1H), 5.33 (dd, *J* = 9.5, 1.6 Hz, 1H), 4.23 (d, *J* = 9.7 Hz, 1H), 3.82 – 3.72 (m, 1H), 2.99 (dq, *J* = 9.8, 7.1 Hz, 1H), 2.50 – 2.37 (m, 1H), 1.57 (d, *J* = 1.3 Hz, 3H), 1.54 (d, *J* = 7.0 Hz, 3H), 1.05 (d, *J* = 6.3 Hz, 3H), 0.98 – 0.91 (m, 15H), 0.82 (s, 9H), 0.58 (q, *J* = 7.7 Hz, 6H), -0.02 (s, 6H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 209.66, 165.88, 134.37, 133.32, 131.91, 129.95, 129.91, 128.53, 81.47, 75.49, 71.06, 46.47, 39.40, 25.94, 20.52, 18.21, 15.89, 15.36, 14.74, 10.75, 7.06, 5.15, -4.62, -4.95.

**HRMS (ESI) m/z:** $C_{32}H_{56}NaO_5Si_2^+$ $[M+Na]^+$: calcd: 599.3559; found: 599.3561.

## Preparation of Compound S19




**S18** **S19**

To a solution of compound **S18** (783 mg, 1.36 mmol, 1.00 eq.) in anhydrous MeOH (13.0 mL) at 0 °C was added $NaBH_4$ (103 mg, 2.71 mmol, 2.00 eq.). The reaction mixture was stirred at 0 °C until the starting material was consumed as judged by TLC analysis. After being stirred at 0 °C for 1 hour, $K_2CO_3$ (2.83 g, 10.88 mmol, 8.0 eq.) was added. The reaction mixture was stirred at room temperature for 10 hours before it was quenched with brine (20.0 mL). The mixture was extracted with EtOAc (3 × 50.0 mL) and the combined organic layers were washed with brine (20.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 5 : 1) gave compound **S19** (445 mg, 69%, dr = 20:1) as a colorless oil.

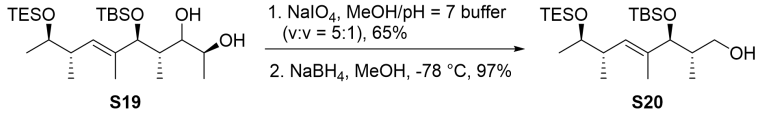
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = – 6.10 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 5.31 (dd, *J* = 9.4, 2.1 Hz, 1H), 4.35 (s, 1H), 3.90 (d, *J* = 8.7 Hz, 1H), 3.82 – 3.73 (m, 2H), 3.67 (dd, *J* = 8.4, 3.3 Hz, 1H), 2.50 – 2.37 (m, 1H), 1.70 – 1.61 (m, 1H), 1.59 (d, *J* = 1.4 Hz, 3H), 1.16 (d, *J* = 6.3 Hz, 3H), 1.06 (d, *J* = 6.2 Hz, 3H), 0.99 – 0.89 (m, 21H), 0.65 (d, *J* = 6.9 Hz, 3H), 0.59 (q, *J* = 8.1 Hz, 6H), 0.13 (s, 3H), 0.04 (s, 3H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 135.13, 131.64, 86.50, 77.95, 71.05, 68.70, 39.47, 38.91, 25.98, 20.74, 18.22, 16.22, 15.90, 13.12, 11.53, 7.06, 5.15, -4.00, -5.08.

**HRMS (ESI) m/z:** $C_{25}H_{54}NaO_4Si_2^+$ $[M+Na]^+$: calcd: 497.3453; found: 497.3455.

## Preparation of Compound S20




**S19** **S20**

To a solution of the compound **S19** (133 mg, 0.28 mmol, 1.00 eq.) in MeOH/pH = 7 phosphate buffer (5.0 mL /1.0 mL) at 0 °C was added sodium periodate (209 mg, 0.98 mmol, 3.5 eq.). The reaction mixture was stirred at room temperature for 12 hours before it was quenched with brine (10.0 mL). The mixture was extracted with EtOAc (3 × 50.0 mL) and the combined organic layers were washed with brine (20.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave aldehyde **23** (78 mg, 65%) as a colorless oil.

To a solution of the above aldehyde **23** (78 mg, 0.18 mmol, 1.00 eq.) in anhydrous MeOH (10.0 mL) at -78 °C was added $NaBH_4$ (34 mg, 0.90 mmol, 5.0 eq.). The reaction mixture was stirred at -78 °C for 4 hours before it was quenched with saturated aqueous $NH_4Cl$ (10.0 mL). The mixture was extracted with EtOAc (3 × 50.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound **S20** (75 mg, 97%) as a colorless oil.

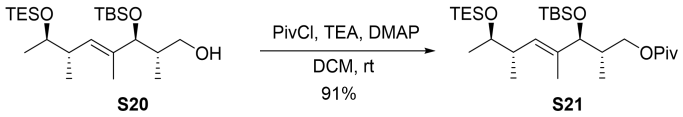
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = – 5.70 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 5.31 (dd, *J* = 9.6, 2.4 Hz, 1H), 3.84 (d, *J* = 7.1 Hz, 1H), 3.83 – 3.73 (m, 1H), 3.61 (d, *J* = 5.2 Hz, 2H), 2.88 (s, 1H), 2.50 – 2.38 (m, 1H), 1.88 – 1.78 (m, 1H), 1.58 (d, *J* = 1.4 Hz, 3H), 1.06 (d, *J* = 6.3 Hz, 3H), 1.01 – 0.92 (m, 12H), 0.90 (s, 9H), 0.78 (d, *J* = 7.0 Hz, 3H), 0.59 (q, *J* = 8.1 Hz, 6H), 0.09 (s, 3H), 0.02 (s, 3H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 135.61, 130.08, 84.92, 71.22, 67.10, 39.43, 38.54, 26.01, 20.64, 18.24, 15.91, 14.57, 11.92, 7.06, 5.20, -4.19, -5.05.

**HRMS (ESI) m/z:** $C_{23}H_{50}NaO_3Si_2^+$ $[M+Na]^+$: calcd: 453.3191; found: 453.3193.

## Preparation of Compound S21




To a solution of compound **S20** (93 mg, 0.22 mmol, 1.00 eq.) in anhydrous DCM (5.0 mL) at 0 °C were added sequentially TEA (0.31 mL, 2.20 mmol, 10.00 eq.), DMAP (5 mg, 0.044 mmol, 0.20 eq.) and PivCl (0.14 mL, 1.10 mmol, 5.00 eq.). The reaction mixture was allowed to warm to 40 °C and stirred for 24 hours before it was quenched with saturated aqueous $NH_4Cl$ (20.0 mL). The mixture was extracted with EtOAc (3 × 50.0 mL) and the combined organic layers were washed with brine (20.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound **S21** (104 mg, 91%) as a colorless oil.

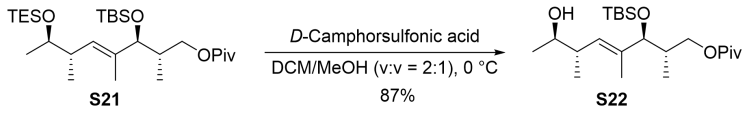
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = – 3.70 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 5.24 (dd, *J* = 9.6, 2.2 Hz, 1H), 4.24 (dd, *J* = 10.6, 3.5 Hz, 1H), 4.00 (dd, *J* = 10.6, 6.0 Hz, 1H), 3.83 – 3.75 (m, 2H), 2.51 – 2.38 (m, 1H), 1.96 – 1.84 (m, 1H), 1.56 (d, *J* = 1.4 Hz, 3H), 1.21 (s, 9H), 1.06 (d, *J* = 6.3 Hz, 3H), 0.98 – 0.92 (m, 12H), 0.87 (s, 9H), 0.75 (d, *J* = 6.9 Hz, 3H), 0.59 (q, *J* = 8.1 Hz, 6H), 0.02 (s, 3H), -0.02 (s, 3H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 178.69, 135.53, 130.40, 80.54, 71.19, 66.43, 39.34, 39.08, 37.20, 27.45, 25.97, 20.48, 18.30, 15.78, 13.94, 11.16, 7.04, 5.19, -4.37, -5.11.

**HRMS (ESI) m/z:** $C_{28}H_{58}NaO_4Si_2^+$ $[M+Na]^+$: calcd: 537.3766; found: 537.3770.

## Preparation of Compound S22




To a solution of compound **S21** (132 mg, 0.26 mmol, 1.0 eq.) in anhydrous DCM/MeOH (10.0 mL/ 5.0 mL) at 0 °C was added *D*-Camphorsulfonic acid (18 mg, 0.078 mmol, 0.3 eq.). The reaction mixture was stirred at 0 °C for 1 hour before it was quenched with saturated aqueous $NaHCO_3$ (10.0 mL). The mixture was extracted with DCM (3 × 30.0 mL) and the combined organic layers were washed with brine (20.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 20 : 1) gave compound **S22** (91 mg, 87%) as a colorless oil.

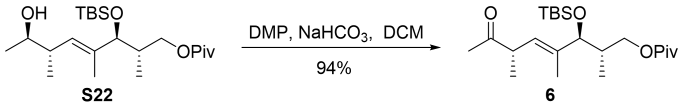
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = – 17.20 (*c* = 0.1, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 5.21 (d, *J* = 9.8 Hz, 1H), 4.26 (dd, *J* = 10.7, 3.5 Hz, 1H), 3.97 (dd, *J* = 10.7, 6.0 Hz, 1H), 3.83 (d, *J* = 8.4 Hz, 1H), 3.60 (p, *J* = 6.2 Hz, 1H), 2.47 – 2.36 (m, 1H), 1.96 – 1.86 (m, 1H), 1.62 (d, *J* = 1.2 Hz, 3H), 1.21 (s, 9H), 1.19 (d, *J* = 6.2 Hz, 3H), 0.94 (d, *J* = 6.8 Hz, 3H), 0.88 (s, 9H), 0.79 (d, *J* = 6.9 Hz, 3H), 0.03 (s, 3H), -0.01 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 178.64, 138.24, 129.88, 80.32, 71.91, 66.28, 40.27, 39.11, 37.40, 27.48, 25.96, 20.43, 18.31, 16.81, 14.15, 11.72, -4.27, -4.98.

**HRMS (ESI) m/z:** $C_{22}H_{44}NaO_4Si^+$ $[M+Na]^+$: calcd: 423.2902; found: 423.2903.

## Preparation of Compound 6



**S22** **6**

To a solution of compound **S22** (647 mg, 1.61 mmol, 1.0 eq.) in anhydrous DCM (20.0 mL) at 0 °C were sequentially added Dess-Martin periodinane (1.37 g, 3.22 mmol, 2.0 eq.) and $NaHCO_3$ (0.54 g, 6.44 mmol, 4.0 eq.). The reaction mixture was stirred at room temperature for 2 hours before it was quenched with saturated aqueous $Na_2S_2O_3$ (20.0 mL) and saturated aqueous $NaHCO_3$ (20.0 mL). The mixture was extracted with DCM (3 × 50.0 mL) and the combined organic layers were washed with brine (50.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave compound **6** (602 mg, 94%) as a colorless oil.

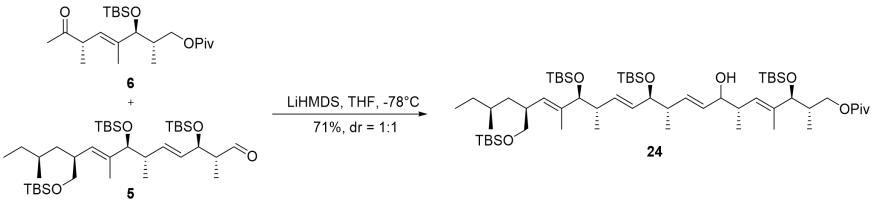
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 43.50 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 5.26 – 5.20 (m, 1H), 4.23 (dd, *J* = 10.7, 3.5 Hz, 1H), 3.99 (dd, *J* = 10.7, 5.9 Hz, 1H), 3.83 (d, *J* = 8.7 Hz, 1H), 3.42 (dd, *J* = 9.6, 6.8 Hz, 1H), 2.13 (s, 3H), 1.92 (dddd, *J* = 8.6, 7.1, 5.9, 3.5 Hz, 1H), 1.66 (d, *J* = 1.4 Hz, 3H), 1.21 (s, 9H), 1.12 (d, *J* = 6.8 Hz, 3H), 0.87 (s, 9H), 0.77 (d, *J* = 6.9 Hz, 3H), 0.02 (s, 3H), -0.05 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 209.36, 178.58, 139.05, 126.84, 79.97, 66.06, 46.79, 39.11, 37.39, 28.40, 27.47, 25.95, 18.29, 16.44, 13.97, 11.63, -4.35, -5.06.

**HRMS (ESI) m/z:** $C_{22}H_{42}NaO_4Si^+$ $[M+Na]^+$: calcd: 421.2745; found: 421.2745.

## Preparation of Compound 24



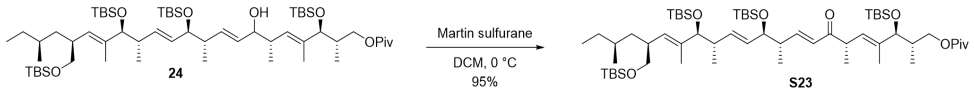

To a solution of compound **6** (128 mg, 0.32 mmol, 3.00 eq.) in anhydrous THF (2.0 mL) at -78 °C was added LiHMDS (1.0 M in THF, 0.32 mL, 0.32 mmol, 3.00 eq.). The reaction mixture was stirred at -78 °C for 1 hour before a solution of compound **5** (74 mg, 0.11 mmol, 1.0 eq.) in anhydrous THF (2.0 mL) was added dropwise at -78 °C. The reaction mixture was stirred at -78 °C for 6 hours before it was quenched with saturated aqueous $NH_4Cl$ (5.0 mL). The mixture was extracted with EtOAc (3 × 10.0 mL) and the combined organic layers was washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 33 : 1) gave a pair of inseparable isomers **24** (82 mg, 71%, dr = 1:1) as a colorless oil.

**$^1$H NMR: (400 MHz, $CDCl_3$)** δ 5.92 – 4.96 (m, 4H), 4.59 – 3.61 (m, 6H), 3.52 – 3.32 (m, 3H), 2.81 – 2.18 (m, 4H), 1.97 – 1.86 (m, 1H), 1.75 – 1.59 (m, 7H), 1.37 – 1.23 (m, 4H), 1.19 – 1.22 (m, 10H), 1.13 – 1.09 (m, 3H), 0.93 – 0.89 (m, 11H), 0.88 – 0.85 (m, 29H), 0.85 – 0.74 (m, 11H), 0.08 – 0.00 (m, 16H), -0.01 – -0.08 (m, 8H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 212.65, 211.35, 178.63, 178.61, 139.00, 137.53, 135.82, 135.76, 130.83, 130.02, 129.88, 129.68, 126.90, 126.86, 83.91, 83.61, 79.93, 79.88, 79.13, 69.77, 67.38, 66.97, 66.05, 46.86, 46.69, 46.31, 45.49, 44.82, 43.70, 40.11, 39.89, 39.18, 39.10, 38.55, 37.31, 32.22, 30.90, 27.46, 26.14, 26.09, 26.07, 26.05, 25.94, 19.02, 18.53, 18.36, 18.26, 18.24, 18.20, 16.48, 16.33, 16.22, 16.07, 13.93, 13.91, 12.06, 11.90, 11.82, 11.64, 11.48, 11.40, 11.02, -3.53, -3.64, -4.16, -4.21, -4.24, -4.64, -4.82, -4.85, -5.10, -5.16.

**HRMS (ESI) m/z:** $C_{59}H_{118}NaO_8Si_4^+$ $[M+Na]^+$: calcd: 1073.7847; found: 1073.7821.

## Preparation of Compound S23




To a solution of compound **24** (181 mg, 0.17 mmol, 1.0 eq.) in anhydrous DCM (5.0 mL) at 0 °C was added Martin sulfurane (229 mg, 0.34 mmol, 2.0 eq.). The reaction mixture was stirred at 0 °C for 2 hours before it was quenched with saturated aqueous $NaHCO_3$ (10.0 mL). The mixture was extracted with DCM (3 × 10.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 200 : 1) gave compound **S23** (169 mg, 95%) as a colorless oil.

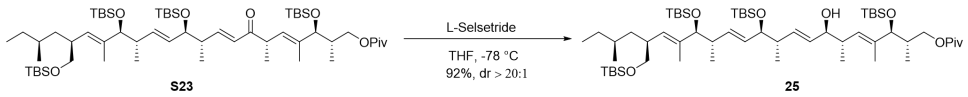
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 12.90 (*c* = 1.0, $CHCl_3$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 6.91 (dd, *J* = 15.8, 8.0 Hz, 1H), 6.12 (d, *J* = 15.8 Hz, 1H), 5.79 (dd, *J* = 15.8, 6.1 Hz, 1H), 5.35 – 5.27 (m, 2H), 5.00 (d, *J* = 9.8 Hz, 1H), 4.22 (dd, *J* = 10.6, 3.4 Hz, 1H), 4.01 (dd, *J* = 10.7, 5.6 Hz, 1H), 3.91 (t, *J* = 6.8 Hz, 1H), 3.81 (d, *J* = 9.0 Hz, 1H), 3.66 – 3.57 (m, 2H), 3.50 (dd, *J* = 9.7, 4.8 Hz, 1H), 3.34 (dd, *J* = 9.7, 7.4 Hz, 1H), 2.57 – 2.46 (m, 1H), 2.41 – 2.31 (m, 1H), 2.34 – 2.25 (m, 1H), 1.96 – 1.86 (m, 1H), 1.64 (d, *J* = 1.6 Hz, 3H), 1.59 (d, *J* = 1.3 Hz, 3H), 1.35 – 1.19 (m, 5H), 1.20 (s, 9H), 1.14 (d, *J* = 6.8 Hz, 3H), 0.98 (d, *J* = 6.7 Hz, 3H), 0.89 (s, 9H), 0.87 (s, 9H), 0.86 (s, 9H), 0.86 – 0.79 (m, 18H), 0.75 (d, *J* = 7.0 Hz, 3H), 0.03 (s, 3H), 0.03 (s, 3H), 0.01 (s, 3H), -0.01 (s, 6H), -0.02 (s, 3H), -0.04 (s, 3H), -0.08 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 200.54, 178.57, 150.34, 138.32, 137.58, 135.95, 130.22, 129.82, 128.39, 127.45, 83.71, 80.03, 77.81, 67.00, 66.13, 44.47, 43.79, 40.38, 39.25, 39.10, 38.60, 37.42, 32.26, 30.87, 27.48, 26.15, 26.10, 26.04, 25.97, 19.06, 18.53, 18.38, 18.30, 18.26, 16.98, 16.68, 15.94, 13.86, 12.08, 11.59, 11.35, -3.75, -4.15, -4.23, -4.66, -4.79, -5.14, -5.17.

**HRMS (ESI) m/z:** $C_{59}H_{116}NaO_7Si_4^+$ $[M+Na]^+$: calcd: 1071.7691; found: 1071.7695.

## Preparation of Compound 25




To a solution of compound **S23** (62 mg, 0.059 mmol, 1.0 eq.) in anhydrous THF (6.0 mL) at -78 °C was added L-Selsetride (1.0 M in THF, 0.59 mL, 0.59 mmol, 10.0 eq.) dropwise. The reaction mixture was stirred at -78 °C for 1 hour before it was quenched with saturated aqueous $NaHCO_3$ (5.0 mL). The mixture was extracted with EtOAc (3 × 10.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave compound **25** (57 mg, 92%, dr > 20 : 1) as a colorless oil.

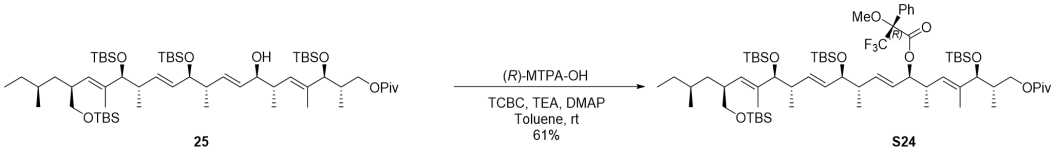
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 3.86 (c = 0.78, $(CH_3)_2CO$).

**$^1$H NMR: (500 MHz, $CDCl_3$)** δ 5.76 (ddd, *J* = 15.7, 6.2, 1.0 Hz, 1H), 5.73 – 5.68 (m, 1H), 5.44 (ddd, *J* = 15.5, 7.7, 1.1 Hz, 1H), 5.35 (ddd, *J* = 15.8, 7.1, 1.4 Hz, 1H), 5.24 – 5.19 (m, 1H), 5.02 – 4.96 (m, 1H), 4.26 (dd, *J* = 10.7, 3.4 Hz, 1H), 3.99 (dd, *J* = 10.7, 5.9 Hz, 1H), 3.93 – 3.86 (m, 1H), 3.85 – 3.80 (m, 2H), 3.65 (d, *J* = 7.4 Hz, 1H), 3.50 (dd, *J* = 9.7, 4.8 Hz, 1H), 3.34 (dd, *J* = 9.7, 7.6 Hz, 1H), 2.56 – 2.46 (m, 2H), 2.33 – 2.20 (m, 2H), 1.95 – 1.85 (m, 1H), 1.61 (d, *J* = 1.4 Hz, 3H), 1.59 (d, *J* = 1.4 Hz, 3H), 1.37 – 1.31 (m, 1H), 1.29 – 1.24 (m, 2H), 1.21 (s, 9H), 1.20 – 1.15 (m, 2H), 0.95 (d, *J* = 6.7 Hz, 3H), 0.91 (d, *J* = 6.8 Hz, 3H), 0.90 – 0.87 (m, 36H), 0.85 – 0.80 (m, 9H), 0.77 (d, *J* = 6.9 Hz, 3H), 0.04 (s, 3H), 0.03 (s, 6H), 0.02 (s, 3H), 0.01 (s, 3H), -0.00 (s, 3H), -0.01 (s, 3H), -0.04 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 178.61, 137.79, 137.74, 136.45, 135.04, 130.59, 130.54, 130.16, 129.64, 83.74, 80.37, 78.06, 77.59, 67.02, 66.33, 43.88, 40.49, 39.28, 39.10, 39.05, 38.61, 37.41, 32.26, 30.89, 27.48, 26.16, 26.12, 25.99, 19.07, 18.54, 18.39, 18.31, 16.91, 16.81, 16.19, 14.08, 12.15, 11.59, -3.77, -4.19, -4.23, -4.61, -4.73, -5.01, -5.15, -5.17.

**HRMS (ESI) m/z:** $C_{59}H_{118}NaO_7Si_4^+$ $[M+Na]^+$: calcd: 1073.7847; found: 1073.7833.

## Preparation of Compound S24




To a solution of compound **25** (8 mg, 7.60 μmol, 1.0 eq.) and (*R*)-MTPA-OH (18 mg, 76.00 μmol, 10.0 eq.) in anhydrous toluene (1.50 mL) at 0 °C, TCBC (35 μL, 228 μmol, 30.0 eq.) and TEA (60 μL, 456 μmol, 60.0 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 1 hour and cooled to 0 °C, then a solution of DMAP (46 mg, 380 μmol, 50.0 eq.) in anhydrous toluene (1.5 mL) was added. The resulting slurry was slowly warmed to room temperature and stirred for 1 hours before it was quenched with saturated aqueous $NH_4Cl$ (5.0 mL). The mixture was extracted with EtOAc (3 × 10.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 20 : 1) gave compound **S24** (6 mg, 61%) as a colorless oil.

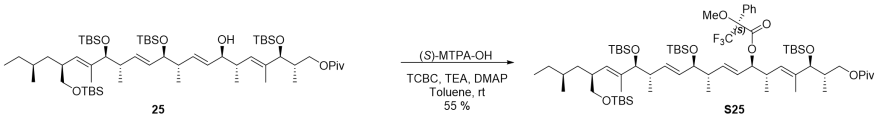
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 24.00 (*c* = 0.1, $CHCl_3$).

**$^1$H NMR: (400MHz, $CDCl_3$)** δ 7.55 – 7.49 (m, 2H), 7.41 – 7.35 (m, 3H), 5.86 (dd, *J* = 14.9, 7.6 Hz, 1H), 5.76 (dd, *J* = 15.7, 6.2 Hz, 1H), 5.42 – 5.29 (m, 3H), 5.17 (d, *J* = 9.5 Hz, 1H), 4.98 (d, *J* = 9.7 Hz, 1H), 4.21 (dd, *J* = 10.7, 3.5 Hz, 1H), 3.99 (dd, *J* = 10.7, 5.8 Hz, 1H), 3.88 (t, *J* = 6.1 Hz, 1H), 3.76 (d, *J* = 8.8 Hz, 1H), 3.61 (d, *J* = 7.8 Hz, 1H), 3.52 (s, 3H), 3.52 – 3.49 (m, 1H), 3.33 (dd, *J* = 9.8, 7.6 Hz, 1H), 2.81 – 2.72 (m, 1H), 2.55 – 2.47 (m, 1H), 2.31 – 2.23 (m, 1H), 2.24 – 2.19 (m, 1H), 1.92 – 1.85 (m, 1H), 1.59 (d, *J* = 1.3 Hz, 6H), 1.36 – 1.32 (m, 1H), 1.28 – 1.24 (m, 3H), 1.21 (s, 9H), 1.18 – 1.15 (m, 1H), 0.98 (d, *J* = 6.9 Hz, 3H), 0.91 (d, *J* = 6.9 Hz, 3H), 0.89 (s, 9H), 0.88 – 0.85 (m, 27H), 0.84 – 0.77 (m, 9H), 0.72 (d, *J* = 6.9 Hz, 3H), 0.03 (s, 3H), 0.03 (s, 3H), 0.00 (s, 3H), -0.00 (s, 6H), -0.02 (s, 3H), -0.04 (s, 3H), -0.05 (s, 3H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 178.61, 165.86, 139.44, 137.76, 137.70, 135.36, 132.49, 130.13, 129.59, 128.43, 127.74, 124.74, 83.95, 81.38, 80.07, 77.90, 66.94, 66.20, 55.45, 43.97, 40.09, 39.12, 39.06, 38.48, 37.35, 36.71, 32.16, 30.90, 29.85, 27.43, 26.12, 26.06, 25.94, 18.98, 18.53, 18.36, 18.33, 18.24, 16.88, 16.67, 16.10, 13.90, 11.84, 11.62, 11.35, 1.93, 1.18, -3.85, -4.12, -4.25, -4.71, -4.76, -5.14, -5.17.

**HRMS (ESI) m/z:** $C_{69}H_{125}F_3NaO_9Si_4^+$ $[M+Na]^+$: calcd:1289.8245; found:1289.8252.

## Preparation of Compound S25




To a solution of compound **25** (10 mg, 9.50 μmol, 1.0 eq.) and (*S*)-MTPA-OH (22 mg, 95.0 μmol, 10.0 eq.) in anhydrous toluene (1.50 mL) at 0 °C, TCBC (44 μL, 285 μmol, 30.0 eq.) and TEA (79 μL, 570 μmol, 60.0 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 1 hour and cooled to 0 °C, then a solution of DMAP (58 mg, 475 μmol, 50.0 eq.) in anhydrous toluene (1.5 mL) was added. The resulting slurry was slowly warmed to room temperature and stirred for 1 hours before it was quenched with saturated aqueous $NH_4Cl$ (5.0 mL). The mixture was extracted with EtOAc (3 × 10.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 20 : 1) gave compound **S25** (7 mg, 55%) as a colorless oil.

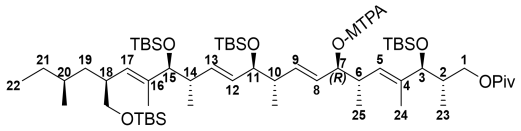
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 27.99 (*c* = 0.1, $CHCl_3$).

**$^1$H NMR: (400MHz, $CDCl_3$)** δ 7.56 – 7.49 (m, 2H), 7.40 – 7.34 (m, 3H), 5.92 (dd, *J* = 13.9, 7.4 Hz, 1H), 5.75 (dd, *J* = 15.7, 6.1 Hz, 1H), 5.50 – 5.41 (m, 2H), 5.35 – 5.27 (m, 1H), 5.13 (d, *J* = 9.5 Hz, 1H), 5.00 – 4.92 (m, 1H), 4.21 (dd, *J* = 10.7, 3.5 Hz, 1H), 3.98 (dd, *J* = 10.6, 5.8 Hz, 1H), 3.92 – 3.86 (m, 1H), 3.75 (d, *J* = 8.8 Hz, 1H), 3.59 (d, *J* = 7.8 Hz, 1H), 3.54 (s, 3H), 3.50 (dd, *J* = 9.7, 4.7 Hz, 1H), 3.33 (dd, *J* = 9.7, 7.6 Hz, 1H), 2.77 – 2.70 (m, 1H), 2.55 – 2.47 (m, 1H), 2.31 – 2.20 (m, 2H), 1.91 – 1.83 (m, 1H), 1.59 – 1.57 (m, 6H), 1.37 – 1.29 (m, 2H), 1.28 – 1.22 (m, 2H), 1.20 (s, 9H), 1.18 – 1.13 (m, 1H), 0.94 (d, *J* = 6.8 Hz, 3H), 0.91 – 0.88 (m, 12H), 0.87 – 0.85 (m, 27H), 0.85 – 0.74 (m, 9H), 0.70 (d, *J* = 6.8 Hz, 3H), 0.03 (s, 3H), 0.03 (s, 3H), 0.01 (s, 3H), 0.00 (s, 3H), -0.01 – -0.02 (m, 6H), -0.04 (s, 3H), -0.05 (s, 3H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 178.61, 165.85, 139.77, 137.67, 135.43, 130.07, 129.61, 128.42, 127.69, 127.57, 124.84, 83.91, 81.25, 80.12, 77.91, 66.94, 66.18, 55.47, 43.94, 40.08, 39.13, 38.47, 37.29, 36.71, 32.17, 30.89, 29.85, 27.42, 26.13, 26.06, 25.94, 18.97, 18.53, 18.35, 18.24, 16.64, 16.58, 16.12, 13.90, 11.84, 11.63, 11.33, -3.83, -4.07, -4.25, -4.70, -4.77, -5.12, -5.17.

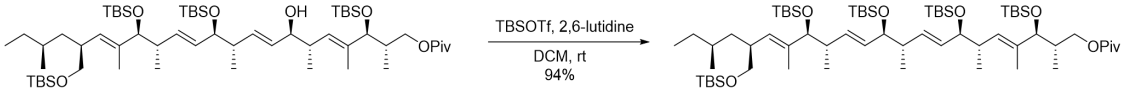
**HRMS (ESI) m/z:** $C_{69}H_{125}F_3NaO_9Si_4^+$ $[M+Na]^+$: calcd:1289.8245; found:1289.8245.

**Table 1. Δδ ( = δ*S* - δ*R* ) data for the *S*- and *R*-MTPA- Mosher esters S25 and S24.**




| Hydrogen | $\delta_S$ (*S*-MTPA ester **S25**) ppm | $\delta_R$ (*R*-MTPA ester **S24**) ppm | $\Delta\delta$ ($\delta_S$ - $\delta_R$ ) ppm |
|---|---|---|---|
| 12 | 5.31 | 5.31 | 0 |
| 11 | 3.89 | 3.88 | + 0.01 |
| 10 | 2.27 | 2.22 | + 0.05 |
| 9 | 5.92 | 5.86 | + 0.06 |
| 8 | 5.45 | 5.37 | +0.08 |
| 7 | 5.44 | 5.37 | / |
| 6 | 2.73 | 2.76 | - 0.03 |
| 5 | 5.13 | 5.17 | - 0.04 |
| 25 | 0.89 | 0.91 | - 0.02 |
| 3 | 3.75 | 3.76 | - 0.01 |
| 24 | 1.58 | 1.59 | - 0.01 |

## Preparation of Compound S26




**25** **S26**

To a solution of compound **25** (13 mg, 12 μmol, 1.00 eq.) in anhydrous DCM (2.0 mL) at 0 °C, 2,6-lutidine (42 μL, 360 μmol, 30.0 eq.) and TBSOTf (41 μL, 180 μmol, 15.0 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 2 hours before it was quenched with $H_2O$ (5.0 mL) at 0 °C. The mixture was extracted with DCM (3 × 10.0 mL) and the combined organic layers were washed with brine (5.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave compound **S26** (13 mg, 94%) as a colorless oil.

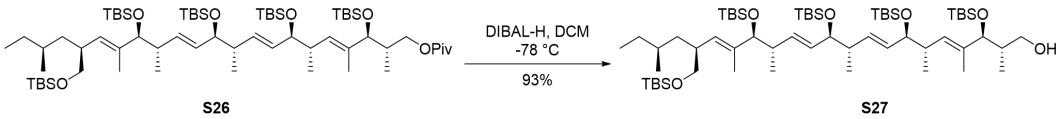
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 6.00 (c = 0.1, $CHCl_3$).

**$^1$H NMR: (500MHz, $CDCl_3$)** δ 5.76 (ddd, *J* = 15.8, 6.2, 0.9 Hz, 1H), 5.58 (ddd, *J* = 15.6, 7.9, 0.9 Hz, 1H), 5.46 – 5.34 (m, 2H), 5.29 – 5.23 (m, 1H), 4.98 (dd, *J* = 9.7, 1.7 Hz, 1H), 4.24 (dd, *J* = 10.6, 3.5 Hz, 1H), 4.05 – 3.97 (m, 2H), 3.94 (ddd, *J* = 7.5, 4.0, 1.0 Hz, 1H), 3.79 (d, *J* = 9.0 Hz, 1H), 3.63 (d, *J* = 7.7 Hz, 1H), 3.51 (dd, *J* = 9.7, 4.7 Hz, 1H), 3.34 (dd, *J* = 9.8, 7.6 Hz, 1H), 2.56 – 2.45 (m, 2H), 2.34 – 2.23 (m, 1H), 2.25 – 2.15 (m, 1H), 1.95 – 1.84 (m, 1H), 1.59 (d, *J* = 1.3 Hz, 3H), 1.54 (d, *J* = 1.4 Hz, 3H), 1.36 – 1.30 (m, 1H), 1.29 – 1.25 (m, 2H), 1.21 (s, 9H), 1.20 – 1.14 (m, 2H), 0.95 (d, *J* = 6.9 Hz, 3H), 0.93 (d, *J* = 6.8 Hz, 3H), 0.90 (s, 9H), 0.89 (s, 9H), 0.88 (s, 9H), 0.88 (s, 9H), 0.88 (s, 9H), 0.85 – 0.80 (m, 9H), 0.73 (d, *J* = 6.9 Hz, 3H), 0.07 (s, 3H), 0.05 (s, 3H), 0.04 (s, 3H), 0.03 (s, 6H), 0.03 (s, 3H), 0.02 (s, 3H), 0.00 (s, 3H), -0.00 (s, 3H), -0.01 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 178.59, 137.81, 135.21, 134.94, 133.52, 131.75, 130.80, 130.51, 129.69, 84.11, 80.66, 78.22, 77.48, 67.01, 66.50, 44.27, 40.47, 39.73, 39.28, 39.10, 38.60, 37.48, 32.28, 30.91, 27.48, 26.16, 26.13, 26.09, 26.04, 19.06, 18.54, 18.40, 18.38, 18.33, 16.79, 16.50, 13.91, 11.98, 11.63, 11.24, 1.17, -3.74, -3.79, -4.10, -4.22, -4.63, -4.65, -4.70, -5.02, -5.16.

**HRMS (ESI) m/z:** $C_{65}H_{132}NaO_7Si_5^+$ $[M+Na]^+$: calcd: 1187.8712; found: 1187.8696.

## Preparation of Compound S27




S26 S27

To a solution of compound **S26** (14 mg, 12 μmol, 1.00 eq.) in anhydrous DCM (2.0 mL) was added dropwise DIBAL-H (1.5 M in Toluene, 40 μL, 60 μmol, 5.00 eq.) at -78 °C. The mixture was stirred at -78 °C for 2 hours before it was quenched with saturated aqueous $NH_4Cl$ (2.0 mL) and Rochelle's salt (2.0 mL) at 0 °C. The biphasic mixture was vigorously stirred at room temperature for 2 hours. The mixture was extracted with DCM (3 × 10.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 50 : 1) gave the compound **S27** (12 mg, 91%) as a colorless oil.

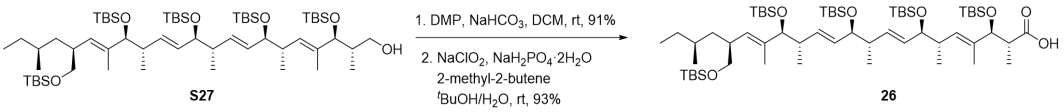
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 4.00 (c = 0.1, $CHCl_3$).

**$^1$H NMR: (500MHz, $CDCl_3$)** δ 5.75 (ddd, *J* = 15.8, 6.3, 0.9 Hz, 1H), 5.59 (ddd, *J* = 15.7, 7.9, 0.9 Hz, 1H), 5.42 – 5.35 (m, 2H), 5.33 – 5.28 (m, 1H), 4.98 (dd, *J* = 9.7, 1.6 Hz, 1H), 4.00 (dd, *J* = 7.6, 3.0 Hz, 1H), 3.94 (dd, *J* = 7.2, 3.6 Hz, 1H), 3.82 (d, *J* = 8.0 Hz, 1H), 3.62 (dd, *J* = 8.7, 6.4 Hz, 3H), 3.51 (dd, *J* = 9.8, 4.7 Hz, 1H), 3.34 (dd, *J* = 9.8, 7.6 Hz, 1H), 2.87 (s, 1H), 2.57 – 2.44 (m, 2H), 2.33 – 2.25 (m, 1H), 2.27 – 2.15 (m, 1H), 1.87 – 1.77 (m, 1H), 1.59 (d, *J* = 1.3 Hz, 3H), 1.57 (d, *J* = 1.3 Hz, 3H), 1.38 – 1.30 (m, 1H), 1.30 – 1.23 (m, 2H), 1.22 – 1.14 (m, 2H), 0.94 (t, *J* = 7.2 Hz, 6H), 0.90 (s, 9H), 0.90 (s, 9H), 0.89 (s, 9H), 0.88 (s, 9H), 0.87 (s, 9H), 0.85 – 0.80 (m, 9H), 0.75 (d, *J* = 7.1 Hz, 3H), 0.10 (s, 3H), 0.05 (s, 3H), 0.04 (s, 3H), 0.03 (s, 6H), 0.03 (s, 3H), 0.02 (s, 3H), 0.00 (s, 3H), -0.01 (s, 3H), -0.04 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 137.80, 135.36, 134.95, 133.50, 131.75, 130.77, 130.23, 129.69, 85.04, 84.10, 78.19, 77.45, 67.18, 67.01, 44.20, 40.47, 39.83, 39.28, 38.83, 38.59, 32.28, 30.91, 26.16, 26.12, 26.11, 26.06, 19.06, 18.54, 18.40, 18.38, 18.26, 16.81, 16.71, 16.56, 14.49, 11.98, 11.89, 11.63, 1.17, -3.75, -3.80, -3.94, -4.23, -4.62, -4.66, -4.70, -4.97, -5.16.

**HRMS (ESI) m/z:** $C_{60}H_{124}NaO_6Si_5^+$ $[M+Na]^+$: calcd: 1103.8137; found: 1103.8140.

## Preparation of Compound 26




To a solution of compound **S27** ( 10 mg, 9 μmol, 1.00 eq.) in anhydrous DCM (1.0 mL) at 0 °C, Dess-Martin periodinane (38 mg, 90 μmol, 10.00 eq.) and $NaHCO_3$ (15 mg, 4.40 mmol, 20.00 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 2 hours before it was quenched with saturated aqueous $Na_2S_2O_3$ (2.0 mL) and saturated aqueous $NaHCO_3$ (2.0 mL). The reaction mixture was stirred at room temperature for additional 1 hour before it was extracted with DCM (3 × 10.0 mL). The combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 100 : 1) gave compound aldehyde **S28** (9 mg,94%) as a colorless oil.

To a solution of the above aldehyde **S28** (9 mg, 8 μmol, 1.00 eq.) in $^t$BuOH/$H_2O$ (1.0 mL/1.0 mL) at 0 °C, 2-methyl-2-butene (50 μL, 480 μmol, 60.00 eq.), $NaH_2PO_4{\cdot}2H_2O$ (25 mg, 160 μmol, 20.00 eq.) and $NaClO_2$ (14 mg, 160 μmol, 20.00 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 1 hour before it was quenched with brine (5.0 mL). The reaction mixture was extracted with EtOAc (3 × 10.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 20 : 1) gave compound **26** (8 mg,93%) as a colorless oil.

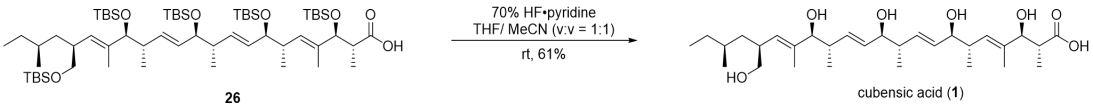
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 8.00 (c = 0.1, $CHCl_3$).

**$^1$H NMR: (500MHz, $CDCl_3$)** δ 5.75 (ddd, *J* = 15.9, 6.2, 1.0 Hz, 1H), 5.59 (dd, *J* = 15.6, 7.9 Hz, 1H), 5.42 – 5.35 (m, 3H), 4.98 (dd, *J* = 9.6, 1.7 Hz, 1H), 4.09 (d, *J* = 9.0 Hz, 1H), 3.99 (dd, *J* = 7.5, 3.1 Hz, 1H), 3.97 – 3.91 (m, 1H), 3.63 (d, *J* = 7.7 Hz, 1H), 3.51 (dd, *J* = 9.8, 4.7 Hz, 1H), 3.34 (dd, *J* = 9.8, 7.6 Hz, 1H), 2.64 – 2.56 (m, 1H), 2.56 – 2.44 (m, 2H), 2.33 – 2.23 (m, 1H), 2.24 – 2.15 (m, 1H), 1.59 (d, *J* = 1.4 Hz, 3H), 1.55 (d, *J* = 1.3 Hz, 3H), 1.36 – 1.31 (m, 1H), 1.28 – 1.25 (m, 2H), 1.21 – 1.16 (m, 2H), 0.98 (d, *J* = 7.0 Hz, 3H), 0.95 (t, *J* = 6.5 Hz, 6H), 0.90 (s, 9H), 0.89 (s, 9H), 0.88 (s, 9H), 0.88 (s, 9H), 0.86 (s, 9H), 0.85 – 0.79 (m, 9H), 0.05 (d, *J* = 1.0 Hz, 6H), 0.04 (s, 3H), 0.03 (s, 3H), 0.03 (s, 3H), 0.02 (s, 3H), 0.02 (s, 3H), 0.00 (s, 3H), -0.01 (s, 3H), -0.04 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 179.42, 137.81, 134.96, 133.84, 133.63, 132.06, 131.71, 130.78, 129.68, 84.09, 81.69, 78.20, 67.01, 44.83, 44.21, 40.49, 39.88, 39.28, 38.59, 32.28, 30.90, 26.16, 26.12, 26.10, 25.89, 19.06, 18.54, 18.39, 18.37, 18.20, 16.81, 16.77, 16.66, 14.50, 11.99, 11.62, 10.96, -3.74, -3.81, -4.17, -4.23, -4.63, -4.66, -4.70, -5.16, -5.17, -5.27.

**HRMS (ESI) m/z:** $C_{60}H_{122}NaO_7Si_5^+$ $[M+Na]^+$: calcd: 1117.7930; found: 1117.7936.

## Preparation of cubensic acid (1)




To a solution of compound **26** (21 mg, 19 μmol, 1.0 eq.) in anhydrous MeCN/THF (0.5 mL/ 0.5 mL) at 0 °C was added 70% HF·pyridine (0.2 mL). The reaction mixture was stirred at room temperature for 36 hours before it was quenched with saturated aqueous $NaHCO_3$ (10.0 mL). The mixture was acidified to pH 4 with 1 N HCl at 0 °C, extracted with $CHCl_3$ (5 × 20.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (DCM: MeOH: HCOOH = 1000 : 50: 1) gave cubensic acid (**1**) (6 mg, 61 %) as a white powdery solid.

$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{23}}$ = + 51.22 (c = 1.0, $CHCl_3$).

Natural cubensic acid (**1**): $[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{23}}$ = + 62.5 (c = 1.0, $CHCl_3$).[4]

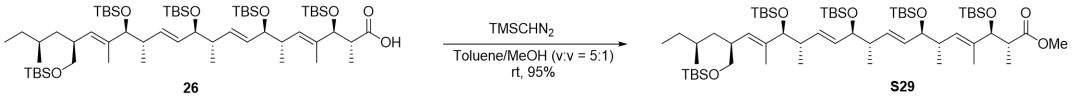
**$^1$H NMR: (400MHz, $(CD_3)_2SO$)** δ 5.65 – 5.49 (m, 2H), 5.35 (dd, *J* = 15.6, 6.8 Hz, 2H), 5.17 (d, *J* = 9.4 Hz, 1H), 4.92 (d, *J* = 9.7 Hz, 1H), 3.84 (d, *J* = 9.5 Hz, 1H), 3.78 – 3.72 (m, 2H), 3.48 (d, *J* = 8.3 Hz, 1H), 3.25 (dd, *J* = 10.4, 5.9 Hz, 1H), 3.18 (dd, *J* = 10.4, 6.8 Hz, 1H), 2.48 – 2.34 (m, 2H), 2.34 – 2.26 (m, 1H), 2.22 – 2.11 (m, 2H), 1.54 (s, 3H), 1.49 (s, 3H), 1.26 – 1.17 (m, 3H), 1.17 – 1.08 (m, 2H), 0.88 (d, *J* = 6.8 Hz, 3H), 0.85 – 0.72 (m, 15H).

**$^{13}$C NMR: (101 MHz, $(CD_3)_2SO$)** δ 177.18, 137.46, 134.82, 134.27, 133.40, 131.32, 130.86, 130.82, 129.08, 81.33, 79.32, 75.12, 65.38, 54.95, 43.55, 42.37, 39.21 (hidden by the solvent, deduced from HSQC), 38.54, 38.26, 38.20, 31.62, 30.27, 18.78, 16.93, 16.42, 15.70, 14.35, 11.40, 11.38, 10.83.

**HRMS (ESI) m/z:** $C_{30}H_{51}O_7^-$ [M-H]$^-$: calcd: 523.3640; found: 523.3638.

**HRMS (ESI) m/z:** $C_{30}H_{52}NaO_7^+$ [M+Na]$^+$: calcd: 547.3606; found: 547.3611.

## Preparation of Compound S29




To a solution of compound **26** (20 mg, 18.5 μmol, 1.00 eq.) in anhydrous toluene/MeOH (2.0 mL/ 0.4 mL) at 0 °C was added $TMSCHN_2$ (2.0 M in Hexane, 185 μL, 185 μmol, 10.00 eq. ). The reaction mixture was stirred at room temperature for 2 hours before it was quenched with saturated aqueous $NH_4Cl$ (2.0 mL). The reaction mixture was extracted with MTBE (3 × 10.0 mL). The combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (PE : EtOAc = 200 : 1) gave compound **S29** (19 mg,95%) as a colorless oil.

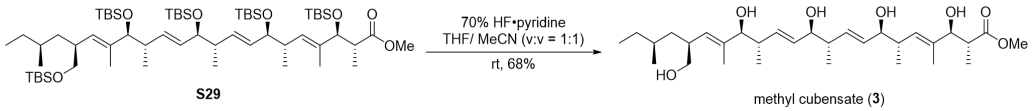
$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{25}}$ = + 39.99 (c = 0.1, $CHCl_3$).

**$^1$H NMR: (500MHz, $CDCl_3$)** δ 5.76 (ddd, *J* = 15.8, 6.2, 1.0 Hz, 1H), 5.59 (dd, *J* = 15.6, 8.0 Hz, 1H), 5.43 – 5.31 (m, 3H), 4.98 (dd, *J* = 9.7, 1.7 Hz, 1H), 4.08 (d, *J* = 9.7 Hz, 1H), 3.99 (dd, *J* = 7.5, 3.1 Hz, 1H), 3.94 (dd, *J* = 7.3, 3.9 Hz, 1H), 3.67 (s, 3H), 3.63 (d, *J* = 7.7 Hz, 1H), 3.51 (dd, *J* = 9.7, 4.6 Hz, 1H), 3.34 (dd, *J* = 9.8, 7.7 Hz, 1H), 2.63 – 2.56 (m, 1H), 2.56 – 2.43 (m, 2H), 2.33 – 2.24 (m, 1H), 2.23 – 2.15 (m, 1H), 1.59 (d, *J* = 1.4 Hz, 3H), 1.53 (d, *J* = 1.3 Hz, 3H), 1.38 – 1.31 (m, 1H), 1.29 – 1.23 (m, 2H), 1.19 – 1.15 (m, 2H), 0.95 (d, *J* = 6.9 Hz, 3H), 0.93 (d, *J* = 6.8 Hz, 3H), 0.90 (s, 9H), 0.89 (s, 9H), 0.88 (s, 9H), 0.87 (s, 9H), 0.86 – 0.79 (m, 21H), 0.07 (s, 6H), 0.05 (s, 3H), 0.04 (s, 3H), 0.03 (s, 3H), 0.02 (s, 3H), 0.02 (s, 3H), 0.01 (s, 3H), 0.00 (s, 3H), -0.04 (s, 3H).

**$^{13}$C NMR: (126 MHz, $CDCl_3$)** δ 176.41, 137.81, 134.94, 134.11, 133.55, 131.86, 131.71, 130.79, 129.68, 84.11, 81.90, 78.21, 67.01, 51.52, 45.19, 44.24, 40.46, 39.83, 39.28, 38.60, 32.28, 30.91, 26.16, 26.12, 26.10, 25.84, 19.05, 18.54, 18.39, 18.38, 18.13, 16.79, 16.66, 14.36, 11.97, 11.62, 10.76, 1.17, -3.75, -3.80, -4.22, -4.64, -4.66, -4.70, -5.16, -5.17, -5.27.

**HRMS (ESI) m/z:** $C_{61}H_{124}NaO_7Si_5^+$ $[M+Na]^+$: calcd: 1131.8086; found: 1131.8081.

## Preparation of methyl cubensate (3)




To a solution of compound **S27** (20 mg, 18 μmol, 1.0 eq.) in anhydrous MeCN/THF (0.5 mL/ 0.5 mL) at 0 °C was added 70% HF·pyridine (0.2 mL). The reaction mixture was stirred at room temperature for 24 hours before it was quenched with saturated aqueous $NaHCO_3$ (10.0 mL). The mixture was extracted with EtOAc (5 × 20.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (EA: MeOH = 10 : 1) gave methyl cubensate (**3**) (7 mg, 68 %) as a white foamy solid.

$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{22}}$ = + 79.90 (c = 0.1, $CHCl_3$).

Naturally-derived methyl cubensate (**3**): $[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\mathbf{22}}$ = + 75.3 (c = 1.0, $CHCl_3$).[4]

**$^1$H NMR: (400MHz, $C_5D_5N$)** δ 6.12 – 5.97 (m, 2H), 5.90 – 5.77 (m, 3H), 5.70 (d, *J* = 9.5 Hz, 1H), 5.37 (d, *J* = 9.8 Hz, 1H), 4.60 (d, *J* = 9.8 Hz, 1H), 4.20 (q, *J* = 7.5 Hz, 2H), 4.05 (d, *J* = 8.4 Hz, 1H), 3.79 (dd, *J* = 10.2, 6.0 Hz, 1H), 3.74 (s, 3H), 3.70 (dd, *J* = 10.1, 7.0 Hz, 1H), 2.96 – 3.03 (m, 1H), 2.92 – 2.85 (m, 1H), 2.85 – 2.71 (m, 1H), 2.57 – 2.64 (m, 1H), 2.56 – 2.48 (m, 1H), 1.91 (d, *J* = 1.2 Hz, 2H), 1.85 (d, *J* = 1.3 Hz, 3H), 1.47 – 1.36 (m, 3H), 1.32 – 1.25 (m, 2H), 1.17 (d, *J* = 6.8 Hz, 3H), 1.12 (dd, *J* = 7.0, 1.5 Hz, 6H), 1.05 (d, *J* = 6.8 Hz, 3H), 0.89 (d, *J* = 6.0 Hz, 3H), 0.85 (t, *J* = 7.4 Hz, 3H).

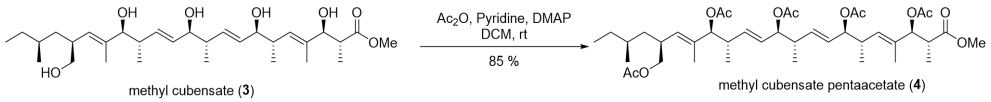
**$^{13}$C NMR: (101 MHz, $C_5D_5N$)** δ 176.89, 138.56, 136.20, 135.57 (deduced from HSQC), 135.34 (deduced from HSQC), 133.23, 133.05, 132.88, 130.75, 82.75, 80.89, 77.23, 77.14, 66.83, 51.46, 44.44, 43.74, 40.71, 39.25, 39.16, 39.03, 32.40, 30.98, 19.09, 18.04, 17.44, 17.35, 14.85, 11.97, 11.72, 11.02.

**$^1$H NMR: (400MHz, $CD_3OD$)** δ 5.63 (dd, *J* = 15.4, 7.9 Hz, 2H), 5.54 – 5.45 (m, 2H), 5.32 (dd, *J* = 9.6, 1.7 Hz, 1H), 5.07 (dd, *J* = 9.8, 1.5 Hz, 1H), 4.04 (d, *J* = 9.9 Hz, 1H), 3.88 – 3.79 (m, 2H), 3.69 (s, 3H), 3.66 (d, *J* = 9.1 Hz, 1H), 3.44 (dd, *J* = 10.7, 6.0 Hz, 1H), 3.39 – 3.34 (m, 1H), 2.69 – 2.56 (m, 2H), 2.57 – 2.47 (m, 1H), 2.39 – 2.29 (m, 1H), 2.30 – 2.18 (m, 1H), 1.66 (d, *J* = 1.3 Hz, 3H), 1.61 (d, *J* = 1.3 Hz, 3H), 1.34 – 1.30 (m, 2H), 1.24 – 1.17 (m, 3H), 0.98 (d, *J* = 6.8 Hz, 3H), 0.94 (d, *J* = 7.1 Hz, 3H), 0.91 (d, *J* = 6.9 Hz, 3H), 0.89 – 0.84 (m, 9H).

**$^{13}$C NMR: (101 MHz, $CD_3OD$)** δ 178.03, 138.83, 137.51, 136.59, 136.06, 133.84, 132.78, 132.64, 132.35, 84.08, 81.73, 78.25, 78.06, 67.49, 52.17, 44.79, 44.02, 41.12, 39.74, 39.69, 39.56, 33.42, 31.79, 19.29, 17.86, 17.16, 16.89, 14.79, 11.87, 11.44, 10.86.

**HRMS (ESI) m/z:** $C_{31}H_{54}NaO_7^+$ $[M+Na]^+$: calcd:561.3762; found:561.3761.

## Preparation of methyl cubensate pentaacetate (4)




To a solution of methyl cubensate (**3**) (10 mg, 19 μmol, 1.00 eq.) in anhydrous DCM (1.5 mL) at 0 °C, pyridine (92 μL, 1.14 mmol, 60.00 eq.), DMAP (2 mg, 19 μmol, 1.00 eq.) and $Ac_2O$ (54 μL, 570 μmol, 30.00 eq.) were added sequentially. The reaction mixture was stirred at room temperature for 12 hours before it was quenched with saturated aqueous $NH_4Cl$ (10.0 mL). The mixture was extracted with EtOAc (3 × 20.0 mL) and the combined organic layers were washed with brine (10.0 mL), dried over anhydrous $Na_2SO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (EA: MeOH = 10 : 1) gave cubensate pentaacetate (**4**) (12 mg, 85 %) as a white solid.

$[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\boldsymbol{24}}$ = – 17.58 (c = 0.1, $CHCl_3$);

Naturally-derived cubensate pentaacetate (**4**): $[\boldsymbol{\alpha}]_{\boldsymbol{D}}^{\boldsymbol{24}}$ = – 16.6 (c = 1.0, $CHCl_3$).[4]

**$^1$H NMR: (400MHz, $C_5D_5N$)** δ 5.92 (dd, *J* = 15.5, 7.6 Hz, 1H), 5.88 (dd, *J* = 15.4, 8.0 Hz, 1H), 5.72 – 5.64 (m, 1H), 5.68 – 5.62 (m, 1H), 5.61 (d, *J* = 10.2 Hz, 1H), 5.60 (d, *J* = 10.2 Hz, 1H) ,5.41 (t, *J* = 7.3 Hz, 1H), 5.39 (t, *J* = 7.4 Hz, 1H), 5.31 (d, *J* = 9.8, 1H), 5.24 (d, *J* = 8.7 Hz, 1H), 4.10 (dd, *J* = 10.6, 7.3 Hz, 1H), 4.04 (dd, *J* = 10.7, 6.5 Hz, 1H), 3.71 (s, 3H), 3.03 (dq, *J* = 10.3, 7.1 Hz, 1H), 2.94 – 2.86 (m, 1H), 2.87 – 2.79 (m, 1H), 2.68 – 2.53 (m, 2H), 2.12 (s, 3H), 2.10 (s, 3H), 2.10 (s, 3H), 2.05 (s, 3H), 2.01 (s, 3H), 1.78 (d, *J* = 1.3 Hz, 3H), 1.72 (d, *J* = 1.3 Hz, 3H), 1.30 – 1.11 (m, 5H), 1.09 (d, *J* = 7.1 Hz, 3H), 1.09 (d, *J* = 6.9 Hz, 3H), 1.00 (d, *J* = 6.8 Hz, 3H), 0.98 (d, *J* = 6.8 Hz, 3H), 0.86 (t, *J* = 7.3 Hz, 3H), 0.83 (d, *J* = 6.2 Hz, 1H).

**$^{13}$C NMR: (101 MHz, $C_5D_5N$)** δ 174.66, 170.66, 169.89, 169.84, 169.68, 169.33, 137.24, 136.66, 134.80, 134.19, 131.85, 131.36, 128.29, 128.02, 82.25, 81.22, 77.89, 77.70, 67.73, 51.74, 42.21, 41.12, 39.18, 38.68, 36.89, 35.41, 32.26, 30.64, 21.07, 21.04, 20.99, 20.81, 20.75, 18.93, 16.88, 16.41, 16.16, 14.07, 12.63, 11.62, 11.58.

**$^1$H NMR: (400MHz, $CDCl_3$)** δ 5.66 – 5.53 (m, 2H), 5.43 – 5.32 (m, 3H), 5.22 (d, *J* = 10.2 Hz, 1H), 5.17 – 5.11 (m, 1H), 5.06 (t, *J* = 7.0 Hz, 1H), 5.04 (t, *J* = 7.1 Hz, 1H), 4.91 (d, *J* = 8.9 Hz, 1H), 3.95 – 3.82 (m, 2H), 3.68 (s, 3H), 2.83 – 2.69 (m, 2H), 2.69 – 2.59 (m, 1H), 2.50 – 2.41 (m, 1H), 2.40 – 2.33 (m, 1H), 2.01 (s, 3H), 2.01 (s, 3H), 2.00 (s, 3H), 1.98 (s, 3H), 1.98 (s, 3H), 1.63 (d, *J* = 1.3 Hz, 3H), 1.60 – 1.60 (m, 3H), 1.24 – 1.14 (m, 5H), 1.02 (d, *J* = 7.1 Hz, 3H), 0.94 (d, *J* = 6.8 Hz, 3H), 0.90 (d, *J* = 6.8 Hz, 3H), 0.88 (d, *J* = 6.9 Hz, 3H), 0.83 (t, *J* = 6.9 Hz, 3H), 0.80 (d, *J* = 5.1 Hz, 3H).

**$^{13}$C NMR: (101 MHz, $CDCl_3$)** δ 174.44, 170.97, 169.96, 169.86, 169.69, 169.11, 136.66, 136.01, 134.19, 133.52, 131.25, 131.07, 127.42, 127.22, 82.03, 80.57, 77.37, 77.15, 67.59, 51.78, 42.04, 40.67, 38.75, 38.46, 36.45, 34.94, 31.97, 30.33, 21.06, 20.98, 20.88, 20.82, 18.80, 16.60, 16.10, 15.87, 13.81, 12.38, 11.55, 11.39.

**HRMS (ESI) m/z:** $C_{41}H_{64}NaO_{12}^+$ $[M+Na]^+$: calcd:771.4290; found:771.4291.

## 4. Comparison of $^{1}$H NMR of methyl cubensate (3) derived from natural cubensic acid (1) and synthetic methyl cubensate (3), measured at different concentrations

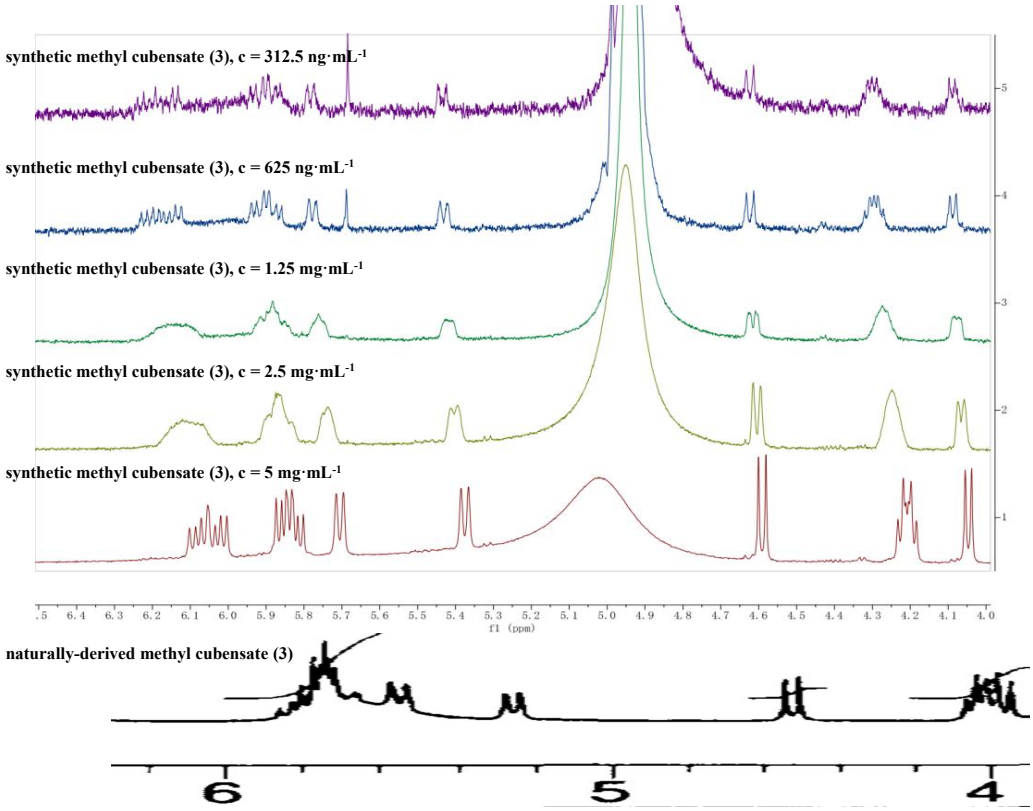



Figure S2. Comparison of $^{1}$H NMR for naturally-derived methyl cubensate (**3**)[4] (270 MHz, $C_5D_5N$) and synthetic methyl cubensate (**3**) (400 MHz, $C_5D_5N$), 6.50 – 4.00 ppm.

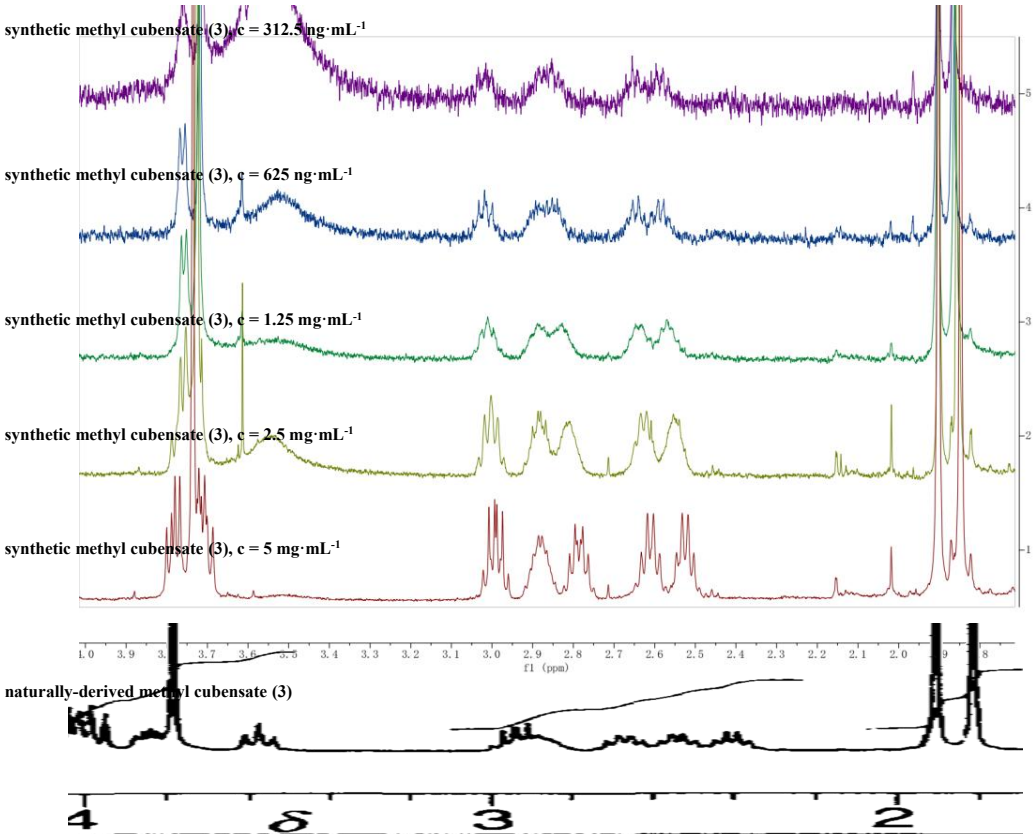



Figure S3. Comparison of $^{1}$H NMR for naturally-derived methyl cubensate (**3**)[4] (270 MHz, $C_5D_5N$) and synthetic methyl cubensate (**3**) (400 MHz, $C_5D_5N$), 4.00 – 1.75 ppm.

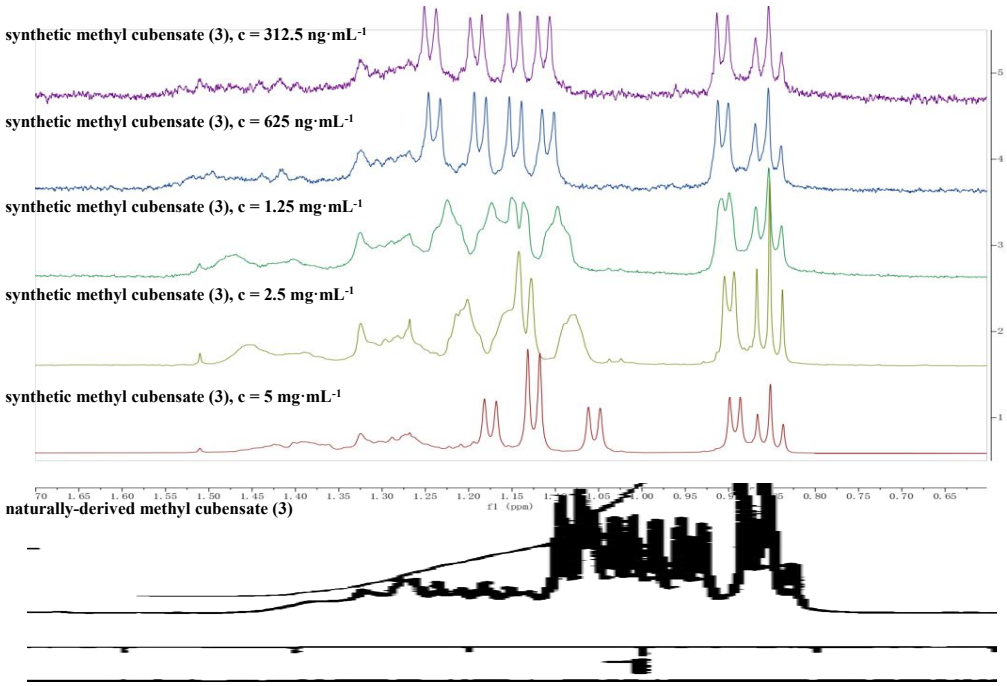



Figure S4. Comparison of $^{1}$H NMR for naturally-derived methyl cubensate (**3**)[4] (270 MHz, $C_5D_5N$) and synthetic methyl cubensate (**3**) (400 MHz, $C_5D_5N$), 1.70 – 0.75 ppm.

# 5. Comparison of $^{13}C$ NMR of synthetic methyl cubensate (3), measured at different concentrations.

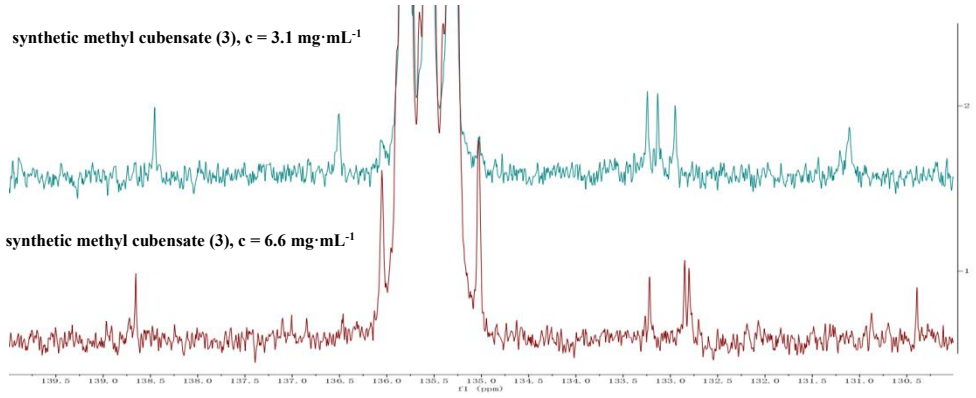



Figure S5. Comparison of $^{13}C$ NMR for synthetic methyl cubensate (**3**)[4] measured at different concentrations (101 MHz, $C_5D_5N$), 140 – 130 ppm.

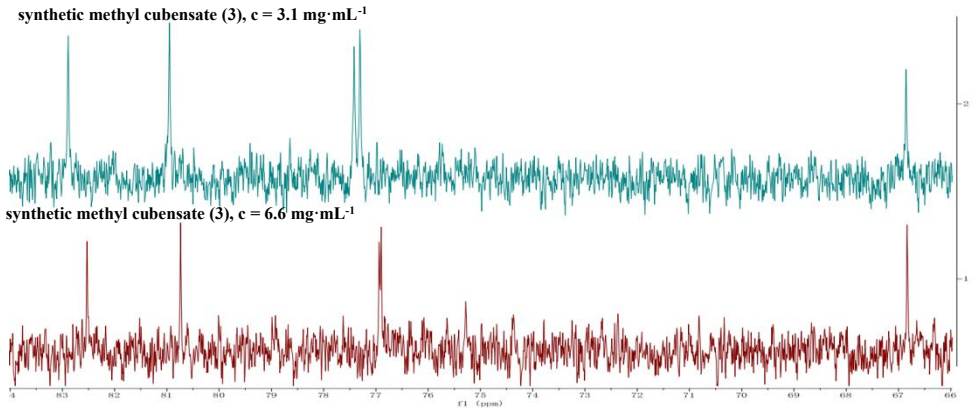



Figure S6. Comparison of $^{13}C$ NMR for synthetic methyl cubensate (**3**)[4] measured at different concentrations (101 MHz, $C_5D_5N$), 84 – 66 ppm.

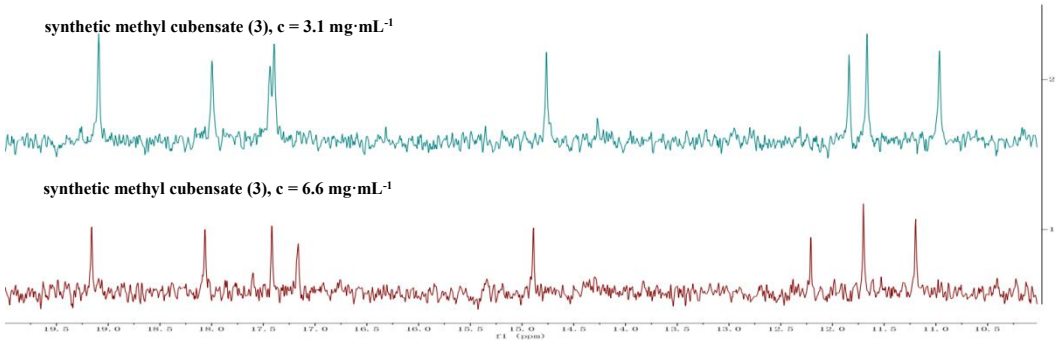



Figure S7. Comparison of $^{13}C$ NMR for synthetic methyl cubensate (**3**)[4] measured at different concentrations (101 MHz, $C_5D_5N$), 20 – 10 ppm.

## 6. Comparison of $^{1}$H NMR of natural cubensic acid (1) and synthetic cubensic acid (1), measured at different concentrations.

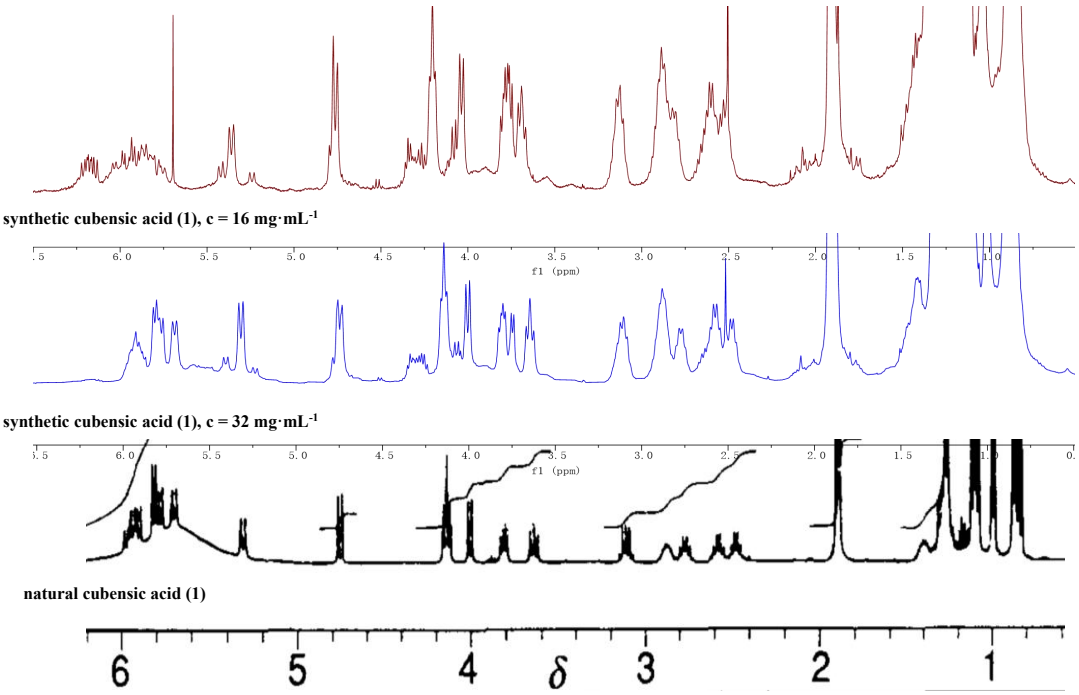
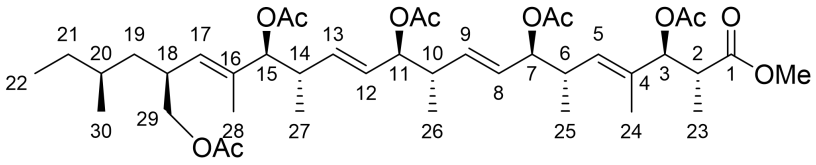



Figure S8. Comparison of $^{1}$H NMR for natural cubensic acid (**1**)[4] (270 MHz, $C_5D_5N$) and synthetic cubensic acid (**1**) (400 MHz, $C_5D_5N$), 0.6 – 6.5 ppm.

# 7. Comparison of NMR data of naturally-derived and synthetic methyl cubensate pentaacetate (4)

Table S1. $^{1}$H NMR comparison of naturally-derived and synthetic methyl cubensate pentaacetate (**4**) in $C_5D_5N$.




methyl cubensate pentaacetate (**4**)

| Carbon No. | Naturally-derived methyl cubensate pentaacetate (**4**)/ $\delta_{Nat}$ (ppm, mult., *J*)/270 MHz | Synthetic methyl cubensate pentaacetate (**4**)/ $\delta_{Syn}$ (ppm, mult., *J*) /400 MHz | $\Delta\delta = \delta_{Syn} - \delta_{Nat}$/ppm |
|---|---|---|---|
| C1 | / | / | / |
| C2 | 3.03 (dq, *J* = 10.3, 7.1 Hz, 1H) | 3.03 (dq, *J* = 10.3, 7.1 Hz, 1H) | 0.00 |
| C3 | 5.60 (d, J =10.1 Hz, 1H) | 5.60 (d, *J* = 10.2 Hz, 1H) | 0.00 |
| C4 | / | / | / |
| C5 | 5.61 (d, *J* = 10.1 Hz, 1H) | 5.61 (d, *J* = 10.2 Hz, 1H) | 0.00 |
| C6 | 2.83 (m, 1H) | 2.83 (m, 1H) | 0.00 |
| C7 | 5.39 (t, *J* = 7.3 Hz, 1H) | 5.39 (t, *J* = 7.4 Hz, 1H) | 0.00 |
| C8 | 5.68 (dd, *J* = 15.4, 7.6 Hz, 1H) | 5.68 (m, 1H) | 0.00 |
| C9 | 5.92 (dd, *J* = 15.4, 7.5 Hz, 1H) | 5.92 (dd, *J* = 15.5, 7.6 Hz, 1H) | 0.00 |
| C10 | 2.58 (ps, 1H) | 2.58 (m, 1H) | 0.00 |
| C11 | 5.41 (t, *J* = 7.3 Hz, 1H) | 5.41 (t, *J* = 7.3 Hz, 1H) | 0.00 |
| C12 | 5.65 (dd, *J* = 15.5, 8.0 Hz, 1H) | 5.65 (m, 1H) | 0.00 |
| C13 | 5.88 (dd, *J* = 15.5, 7.6 Hz, 1H) | 5.88 (dd, *J* = 15.4, 8.0 Hz, 1H) | 0.00 |
| C14 | 2.62 (ps, 1H) | 2.62 (m, 1H) | 0.00 |
| C15 | 5.23 (d, *J* = 8.8 Hz, 1H) | 5.24 (d, *J* = 8.7 Hz, 1H) | 0.01 |
| C16 | / | / | / |
| C17 | 5.30 (d, *J* = 10.0 Hz, 1H) | 5.31 (d, *J* = 9.8) | 0.01 |
| C18 | 2.90 (br m, 1H) | 2.90 (m, 1H) | 0.00 |
| C19 | 1.20-1.30 (m, 2H) | 1.20-1.30 (m, 2H) | 0.00 |
| C20 | 1.20-1.34 (m, 1H) | 1.20-1.34 (m, 1H) | 0.00 |
| C21 | 1.11-1.24 (m, 2H) | 1.11-1.24 (m, 2H) | 0.00 |
| C22 | 0.85 (t, *J* = 7.3 Hz, 3H) | 0.86 (t, *J* = 7.3 Hz, 3H) | 0.01 |
| C23 | 1.08 (d, *J* = 7.1 Hz, 3H) | 1.09 (d, *J* = 7.1 Hz, 3H) | 0.01 |
| C24 | 1.71 (d, *J* = 1.2 Hz, 3H) | 1.72 (d, *J* = 1.3 Hz, 3H) | 0.00 |

Table S1. (continued) $^{1}$H NMR comparison of naturally-derived and synthetic methyl cubensate pentaacetate (**4**) in $C_5D_5N$.

| Carbon No. | Naturally-derived methyl cubensate pentaacetate (**4**)/ $\delta_{Nat}$ (ppm, mult., J)/270 MHz | Synthetic methyl cubensate pentaacetate (**4**)/ $\delta_{Syn}$ (ppm, mult., J)/400 MHz | $\Delta\delta = \delta_{Syn} - \delta_{Nat}$/ppm |
|---|---|---|---|
| C25 | 1.00 (d, *J* = 6.8 Hz, 3H) | 1.00 (d, *J* = 6.8 Hz, 3H) | 0.00 |
| C26 | 1.09 (d, *J* = 6.8 Hz, 3H) | 1.09 (d, *J* = 6.9 Hz, 3H) | 0.00 |
| C27 | 0.97 (d, *J* = 6.8 Hz, 3H) | 0.98 (d, *J* = 6.8 Hz, 3H) | 0.01 |
| C28 | 1.78 (d, *J* = 1.2 Hz, 3H) | 1.78 (d, *J* = 1.3 Hz, 3H) | 0.00 |
| C29 | 4.10 (dd, *J* = 10.7, 7.3 Hz, 1H)<br>4.04 (dd, *J* = 10.7, 6.6 Hz, 1H) | 4.10 (dd, *J* = 10.6, 7.3 Hz, 1H)<br>4.04 (dd, *J* = 10.7, 6.5 Hz, 1H) | 0.00<br>0.00 |
| C30 | 0.82 (d, *J* = 6.6 Hz, 3H) | 0.83 (d, *J* = 6.2 Hz, 3H) | 0.01 |
| MeO | 3.71 (s, 3H) | 3.71 (s, 3H) | 0.00 |
| MeCO2 | 2.01-2.13 (5s,15H) | 2.01-2.12 (5s,15H) | / |

Table S2. $^{13}C$ NMR comparison of naturally-derived and synthetic methyl cubensate pentaacetate (**4**) in $C_5D_5N$.

| Carbon No. | Naturally-derived methyl cubensate pentaacetate (**4**)/ $\delta_{Nat}$ (ppm)/67.8 MHz | Synthetic methyl cubensate pentaacetate (**4**)/ $\delta_{Syn}$ (ppm) /101MHz | $\Delta\delta = \delta_{Syn} - \delta_{Nat}$/ppm |
|---|---|---|---|
| C1 | 174.71 | 174.66 | -0.05 |
| C2 | 42.17 | 42.21 | 0.04 |
| C3 | 81.24 | 81.22 | -0.02 |
| C4 | 131.81 | 131.85 | 0.04 |
| C5 | 134.23 | 134.19 | -0.04 |
| C6 | 36.87 | 36.89 | 0.02 |
| C7 | 77.90 | 77.89 | -0.01 |
| C8 | 128.28 | 128.29 | 0.01 |
| C9 | 136.68 | 136.66 | -0.02 |
| C10 | 41.13 | 41.12 | -0.01 |
| C11 | 77.70 | 77.70 | 0.00 |
| C12 | 128.03 | 128.02 | -0.01 |
| C13 | 137.27 | 137.24 | -0.03 |
| C14 | 39.17 | 39.18 | 0.01 |
| C15 | 82.25 | 82.25 | 0.00 |
| C16 | 134.80 | 134.80 | 0.00 |
| C17 | 131.37 | 131.36 | -0.01 |
| C18 | 35.38 | 35.41 | 0.03 |
| C19 | 38.63 | 38.68 | 0.05 |
| C20 | 32.25 | 32.26 | 0.01 |
| C21 | 30.66 | 30.64 | -0.02 |
| C22 | 11.66 | 11.62 | -0.04 |
| C23 | 14.09 | 14.07 | -0.02 |
| C24 | 11.55 | 11.58 | 0.03 |
| C25 | 16.43 | 16.41 | -0.02 |
| C26 | 16.17 | 16.16 | -0.01 |
| C27 | 16.88 | 16.88 | 0.00 |
| C28 | 12.59 | 12.63 | 0.04 |

Table S2. (continued) $^{13}C$ NMR comparison of naturally-derived and synthetic methyl cubensate pentaacetate (**4**) in $C_5D_5N$.

| Carbon No. | Naturally-derived methyl cubensate pentaacetate (**4**)/ $\delta_{Nat}$ (ppm)/67.8 MHz | Synthetic methyl cubensate pentaacetate (**4**)/ $\delta_{Syn}$ (ppm) /101MHz | $\Delta\delta = \delta_{Syn} - \delta_{Nat}$/ppm |
|---|---|---|---|
| C29 | 67.73 | 67.73 | 0.00 |
| C30 | 18.92 | 18.93 | 0.01 |
| MeO | 51.77 | 51.74 | -0.03 |
| MeCO2- | 20.77-21.05 | 20.75-21.07 | / |
| MeCO2- | 169.36-170.71 | 169.33-170.66 | / |

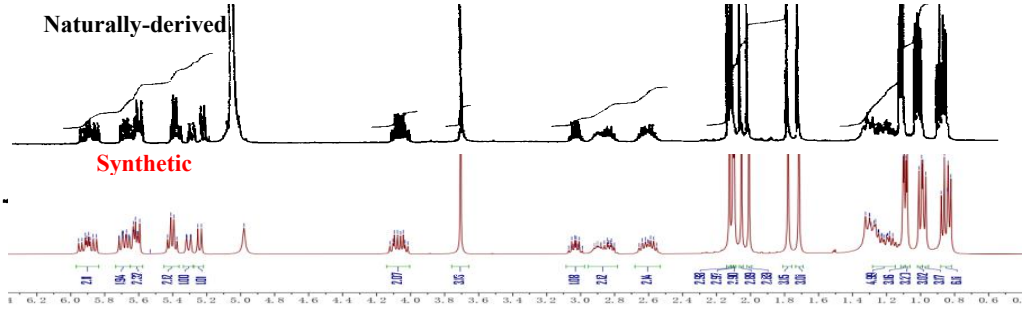
Table S3. $^{13}C$ NMR comparison of naturally-derived and synthetic methyl cubensate pentaacetate (**4**) in $CDCl_3$.

| Carbon No. | Naturally-derived methyl cubensate pentaacetate (**4**)/ $\delta_{Nat}$ (ppm)/67.8 MHz | Synthetic methyl cubensate pentaacetate (**4**) /$\delta_{Syn}$ (ppm) /101MHz | $\Delta\delta = \delta_{Syn} - \delta_{Nat}$/ppm |
|---|---|---|---|
| C1 | 174.34 | 174.44 | 0.10 |
| C2 | 41.91 | 42.04 | 0.13 |
| C3 | 80.65 | 80.57 | -0.08 |
| C4 | 131.25 | 131.25 | 0.00 |
| C5 | 133.63 | 133.52 | -0.11 |
| C6 | 36.47 | 36.45 | -0.02 |
| C7 | 77.40 | 77.37 | -0.03 |
| C8 | 127.51 | 127.42 | -0.09 |
| C9 | 136.03 | 136.01 | -0.02 |
| C10 | 40.71 | 40.67 | -0.04 |
| C11 | 77.27 | 77.15 | -0.12 |
| C12 | 127.32 | 127.22 | -0.10 |
| C13 | 136.61 | 136.66 | 0.05 |
| C14 | 38.74 | 38.75 | 0.01 |
| C15 | 81.94 | 82.03 | 0.09 |
| C16 | 134.29 | 134.19 | -0.10 |
| C17 | 130.93 | 131.07 | 0.14 |
| C18 | 35.00 | 34.94 | -0.06 |
| C19 | 38.45 | 38.46 | 0.01 |
| C20 | 32.01 | 31.97 | -0.04 |
| C21 | 30.40 | 30.33 | -0.07 |
| C22 | 11.50 | 11.55 | 0.05 |
| C23 | 16.67 | 16.60 | -0.07 |
| C24 | 11.47 | 11.39 | -0.08 |
| C25 | 16.14 | 16.10 | -0.04 |
| C26 | 15.88 | 15.87 | -0.01 |
| C27 | 13.86 | 13.81 | -0.05 |
| C28 | 12.48 | 12.38 | -0.10 |

TableS4. (continued) $^{13}C$ NMR comparison of naturally-derived and synthetic methyl cubensate pentaacetate (**4**) in $CDCl_3$.

| Carbon No. | Naturally-derived methyl cubensate pentaacetate (**4**)/ $\delta_{Nat}$ (ppm)/67.8 MHz | Synthetic methyl cubensate pentaacetate (**4**) /$\delta_{Syn}$ (ppm)/101MHz | $\Delta\delta = \delta_{Syn} - \delta_{Nat}$/ppm |
|---|---|---|---|
| C29 | 67.52 | 67.59 | 0.07 |
| C30 | 18.87 | 18.80 | -0.07 |
| MeO | 51.77 | 51.78 | 0.01 |
| MeCO2 | 20.78-21.04 | 20.82-21.06 | / |
| MeCO2 | 168.98-170.72 | 169.11-170.97 | / |

**$^{1}$H NMR (400 MHz, $C_5D_5N$)**




**$^{13}$C NMR (101 MHz, $CDCl_3$)**

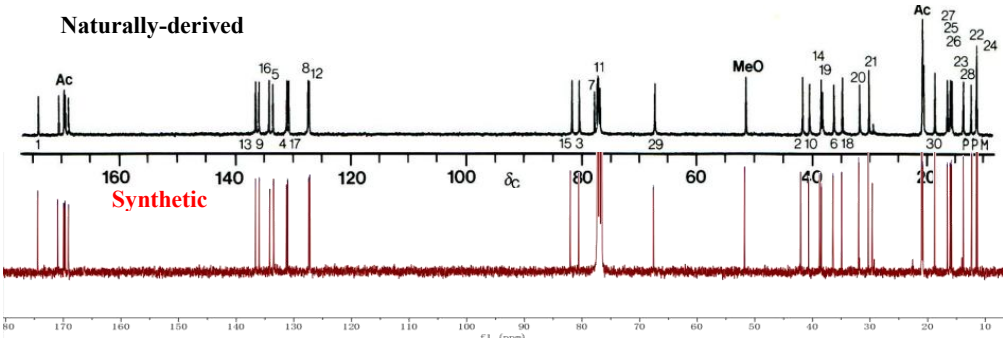



Figure S9. NMR spectra comparison of naturally-derived (black) methyl cubensate pentaacetate (**4**)[4] and synthetic (red) methyl cubensate pentaacetate (**4**).

# 8. References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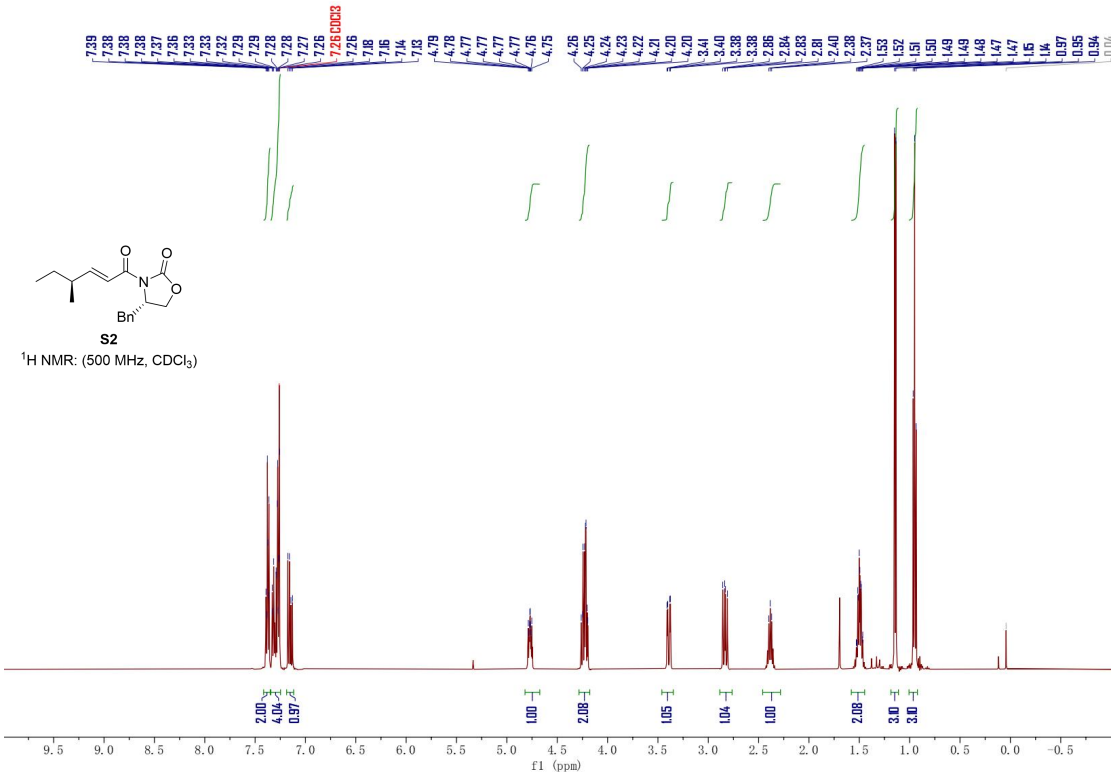
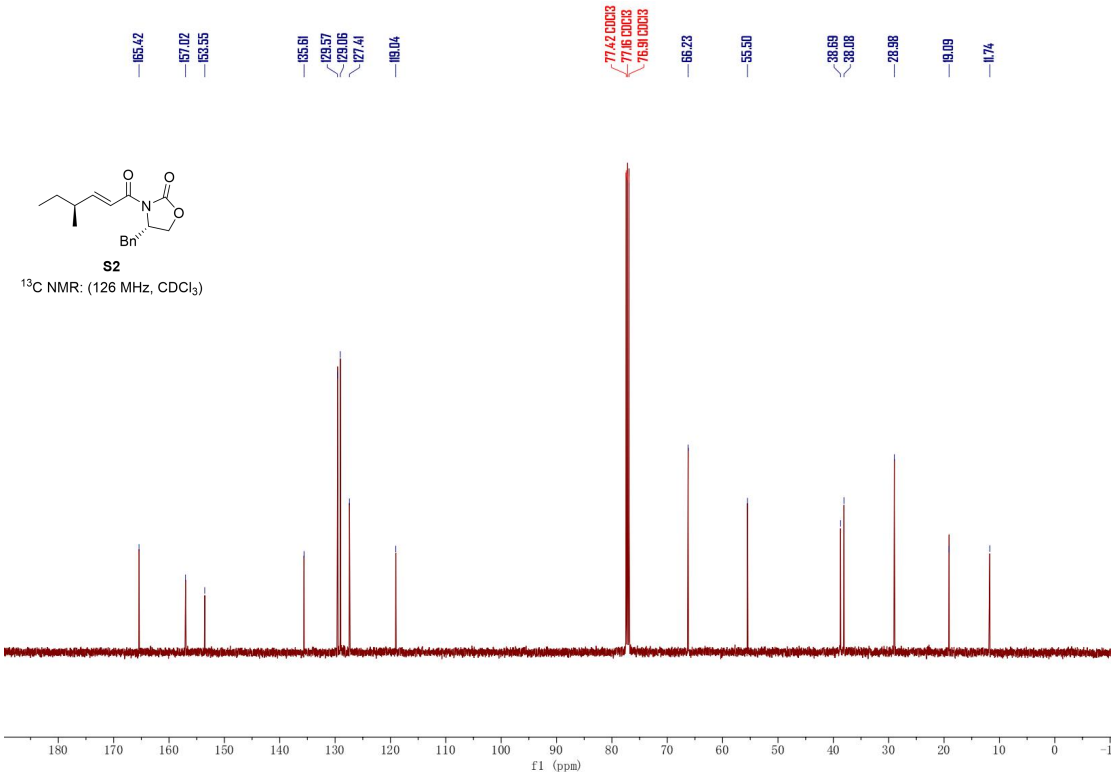
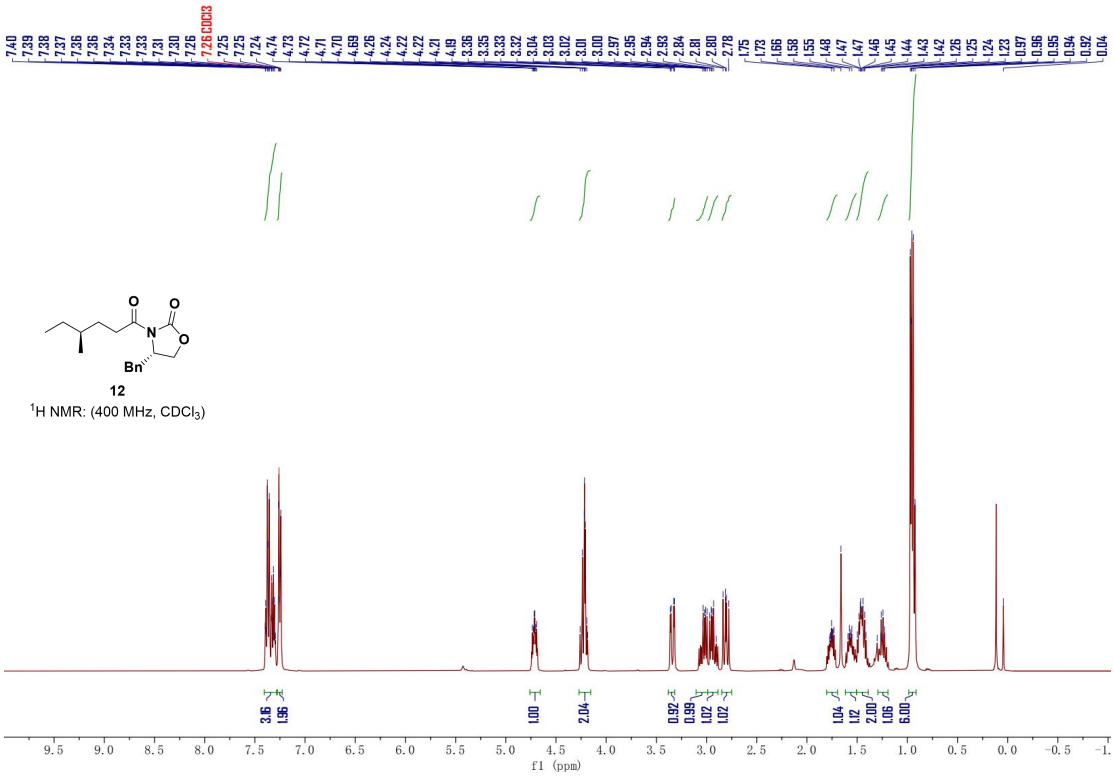
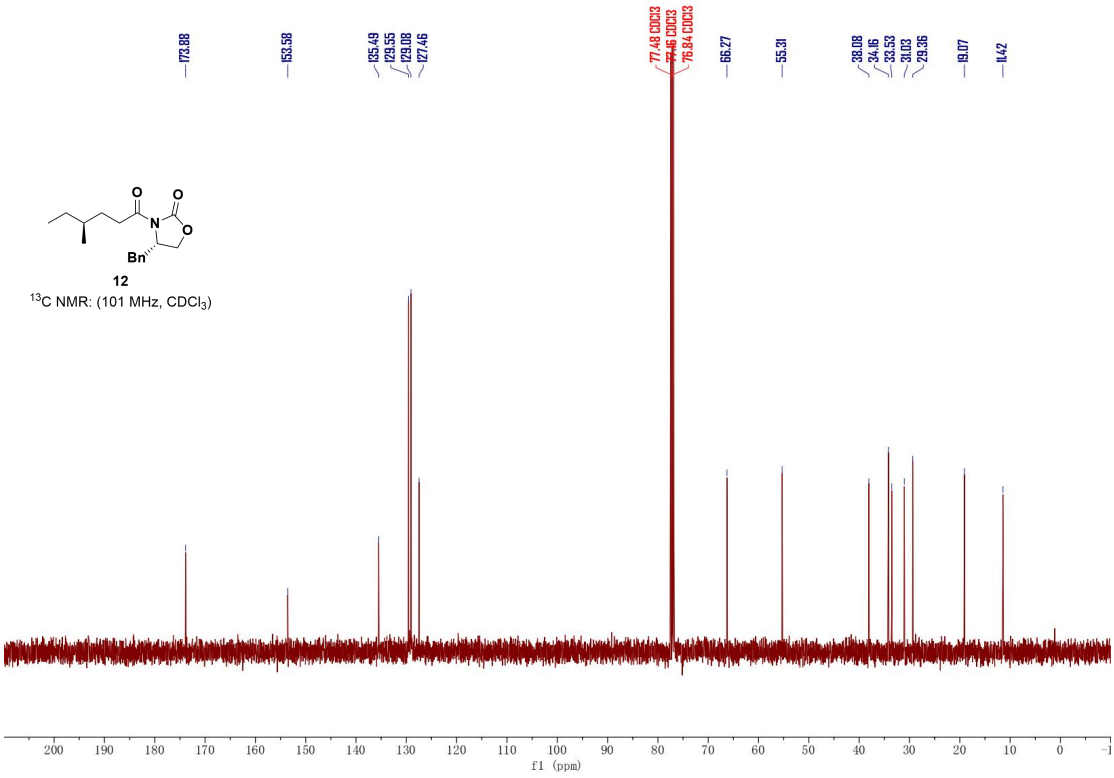
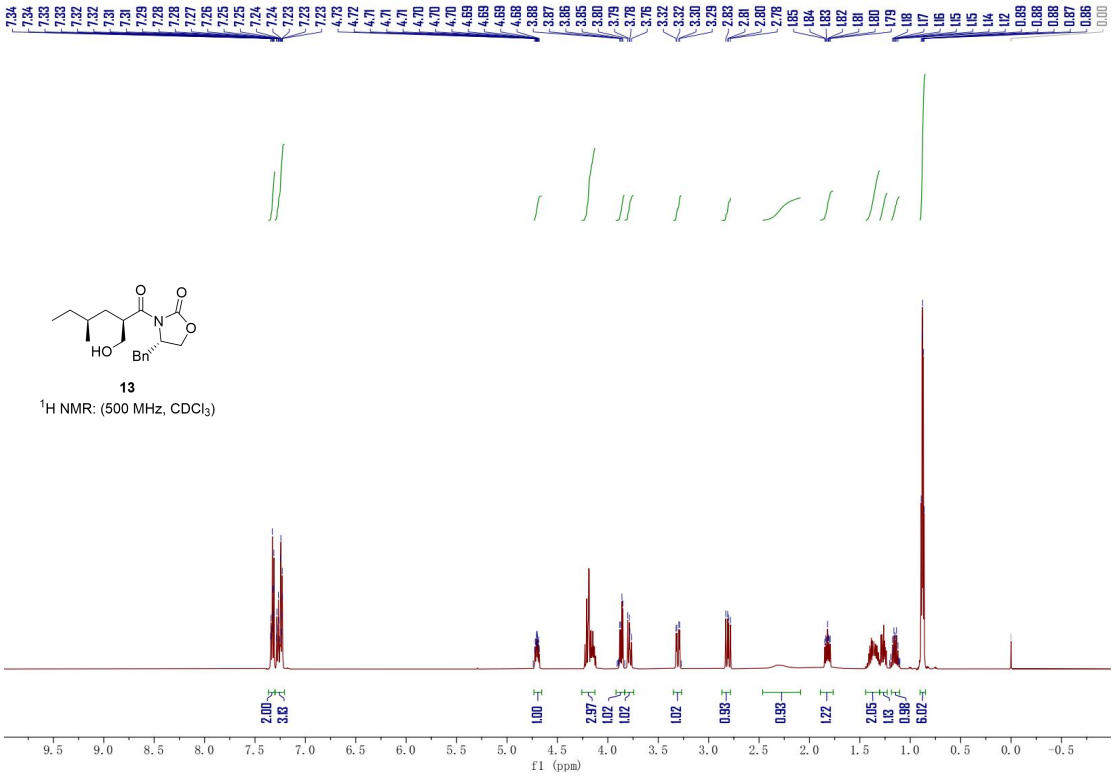
# 9. NMR Spectra



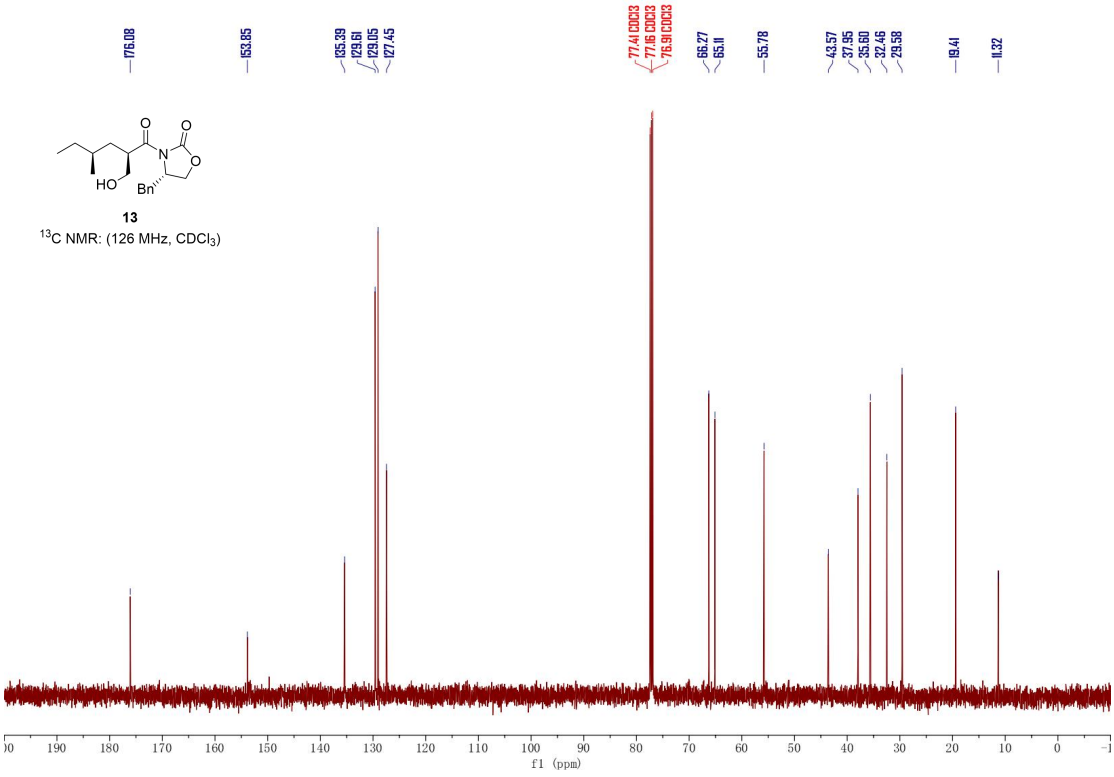



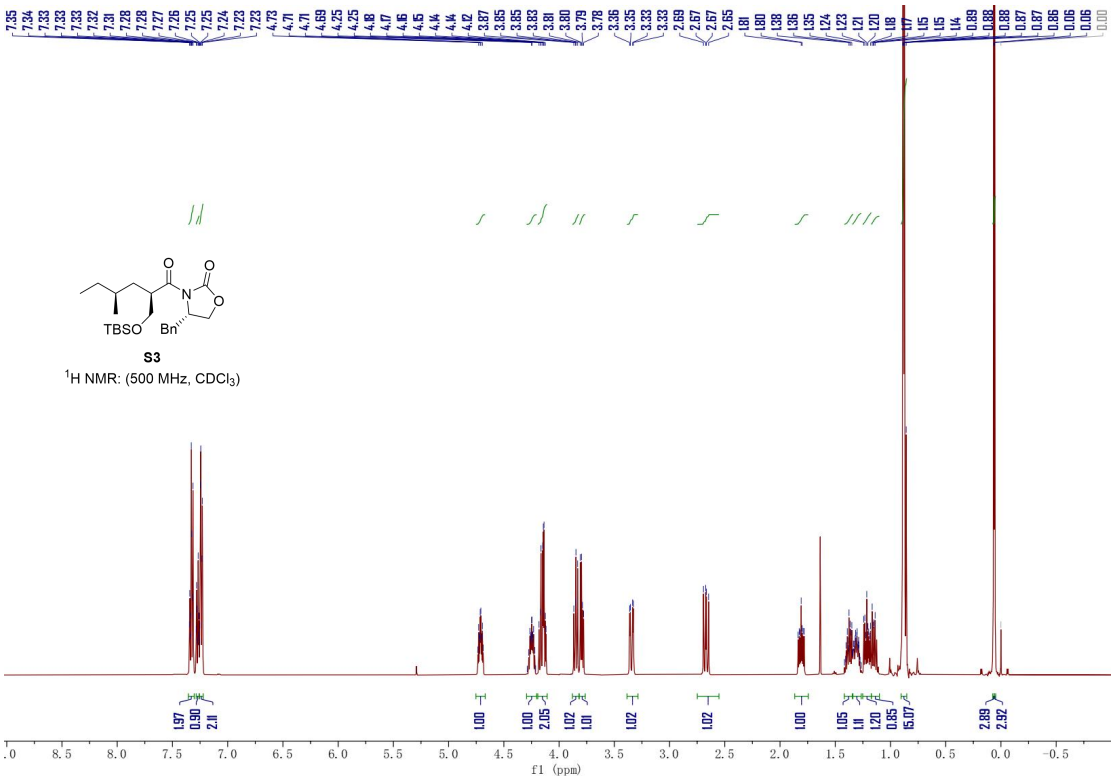

12
1H NMR: (400 MHz, CDCl3)
f1 (ppm)

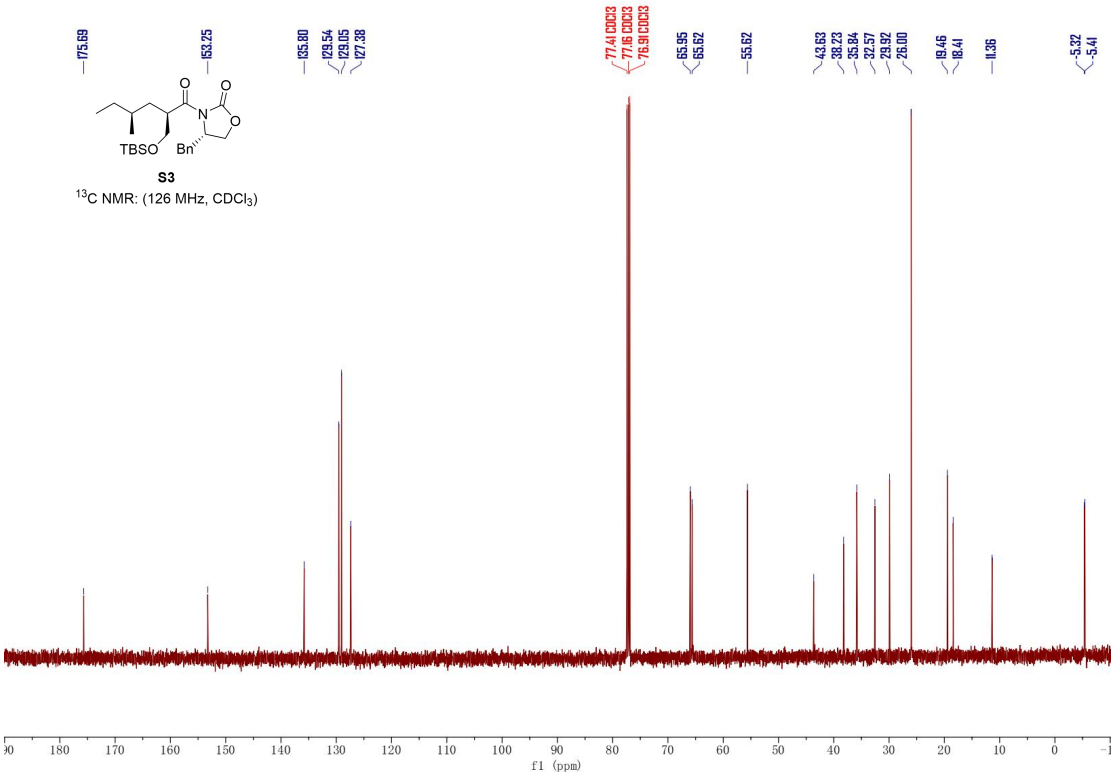

12
13C NMR: (101 MHz, CDCl3)
f1 (ppm)

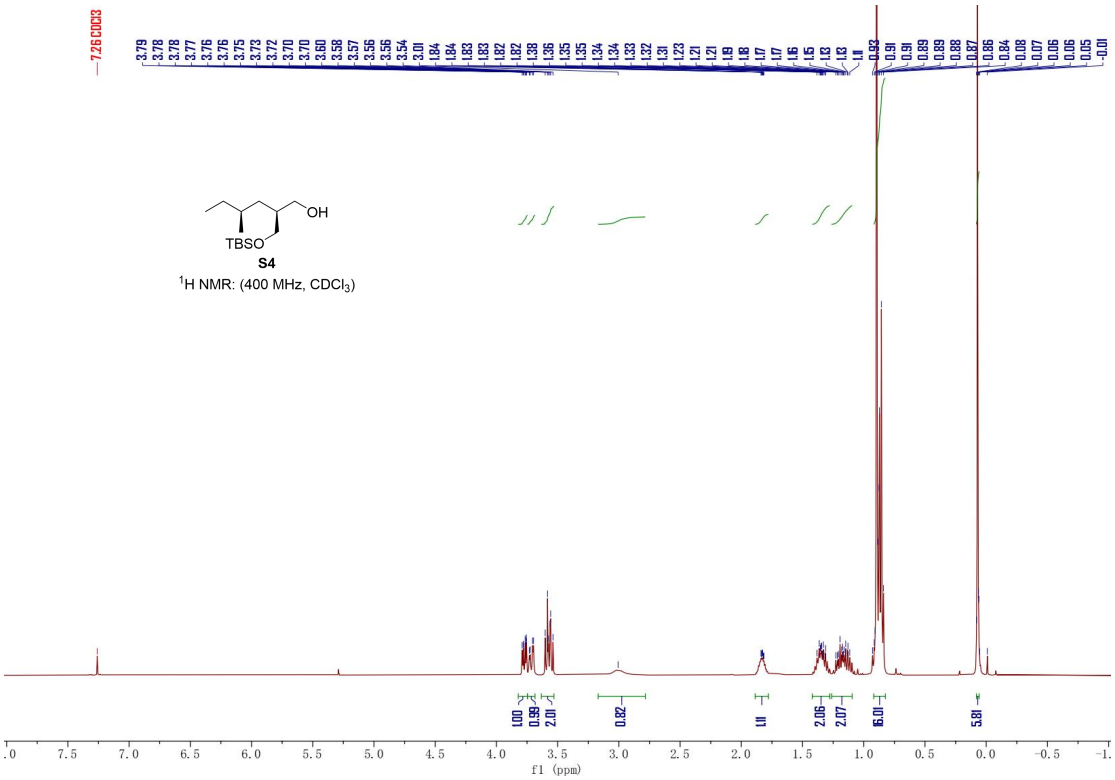



Z



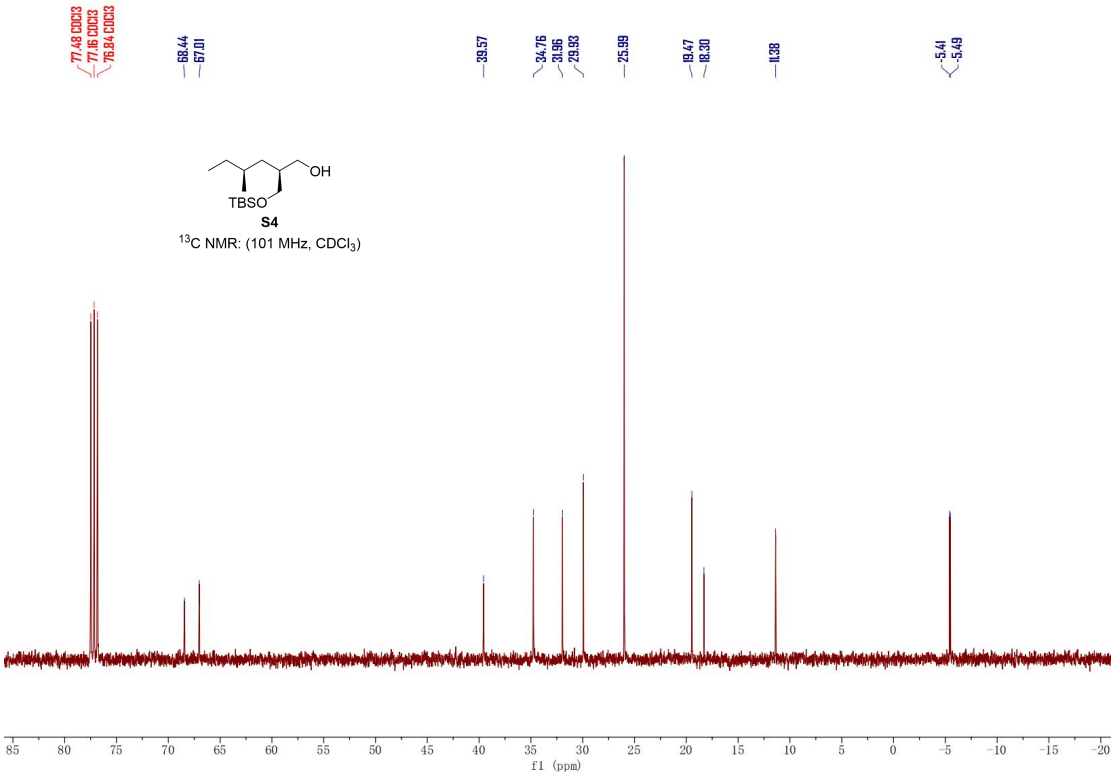

TBSO
Bn
S3
1H NMR: (500 MHz, CDCl3)
f1 (ppm)


TBSO
Bn
S3
13C NMR: (126 MHz, CDCl3)
f1 (ppm)



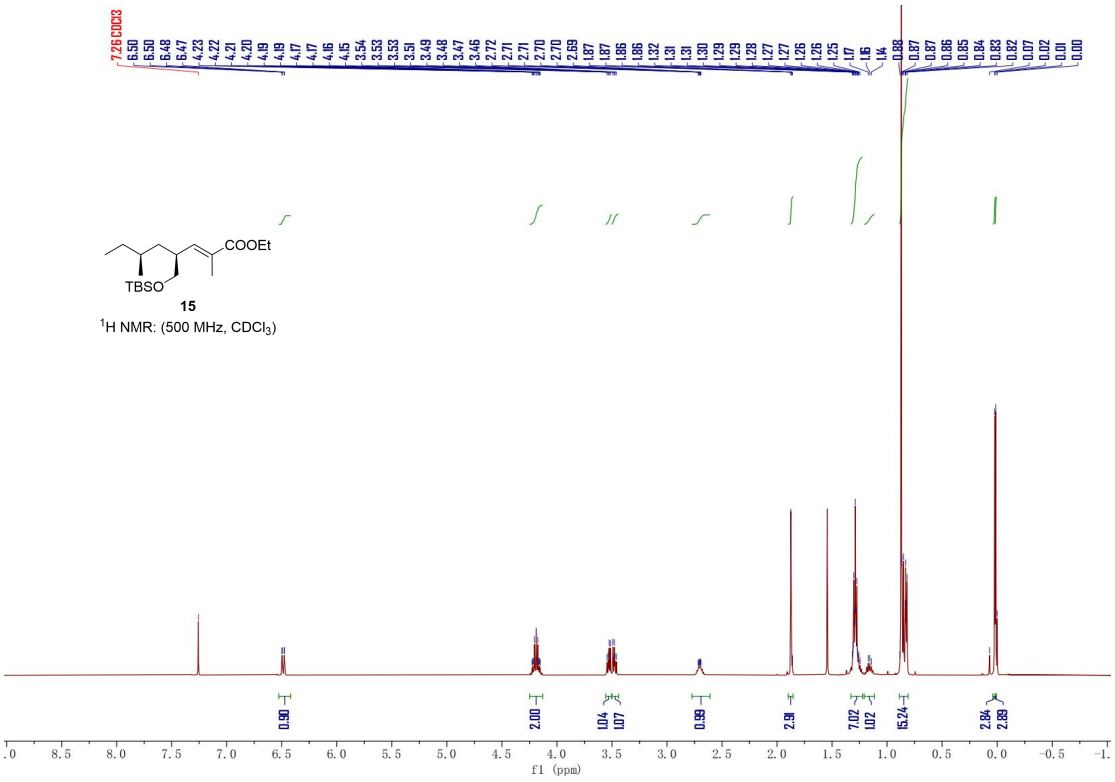

**S4**

$^{1}$H NMR: (400 MHz, $CDCl_3$)



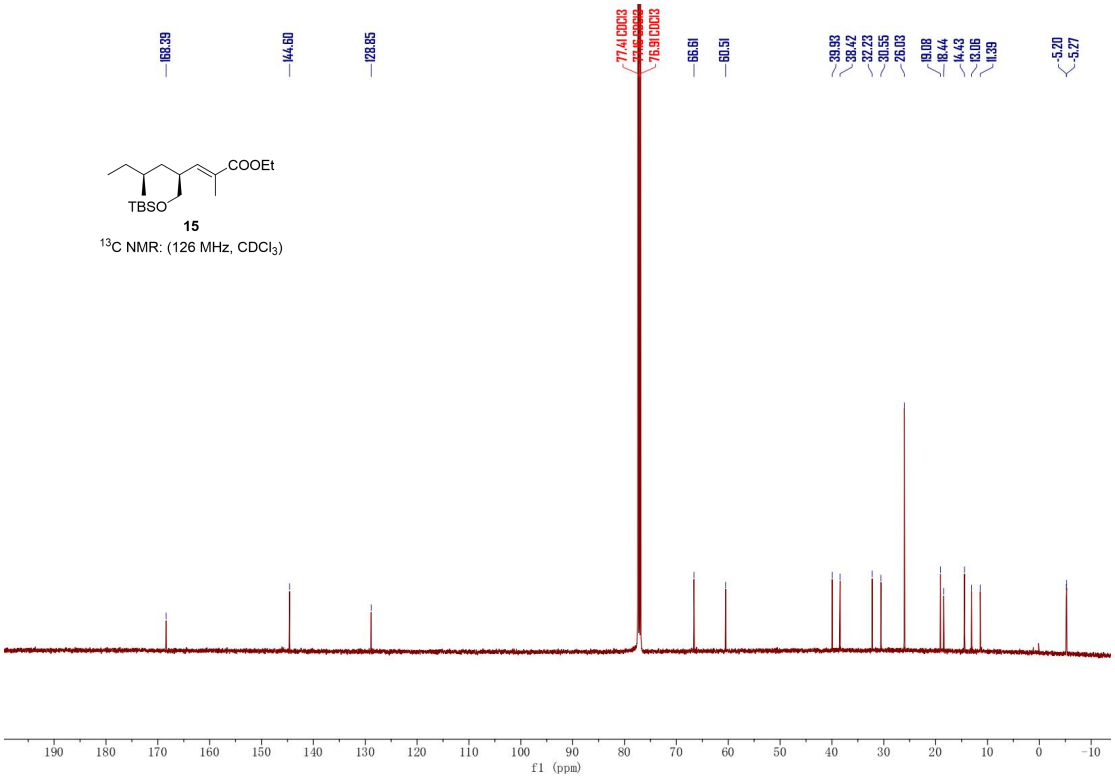

**S4**

$^{13}$C NMR: (101 MHz, $CDCl_3$)



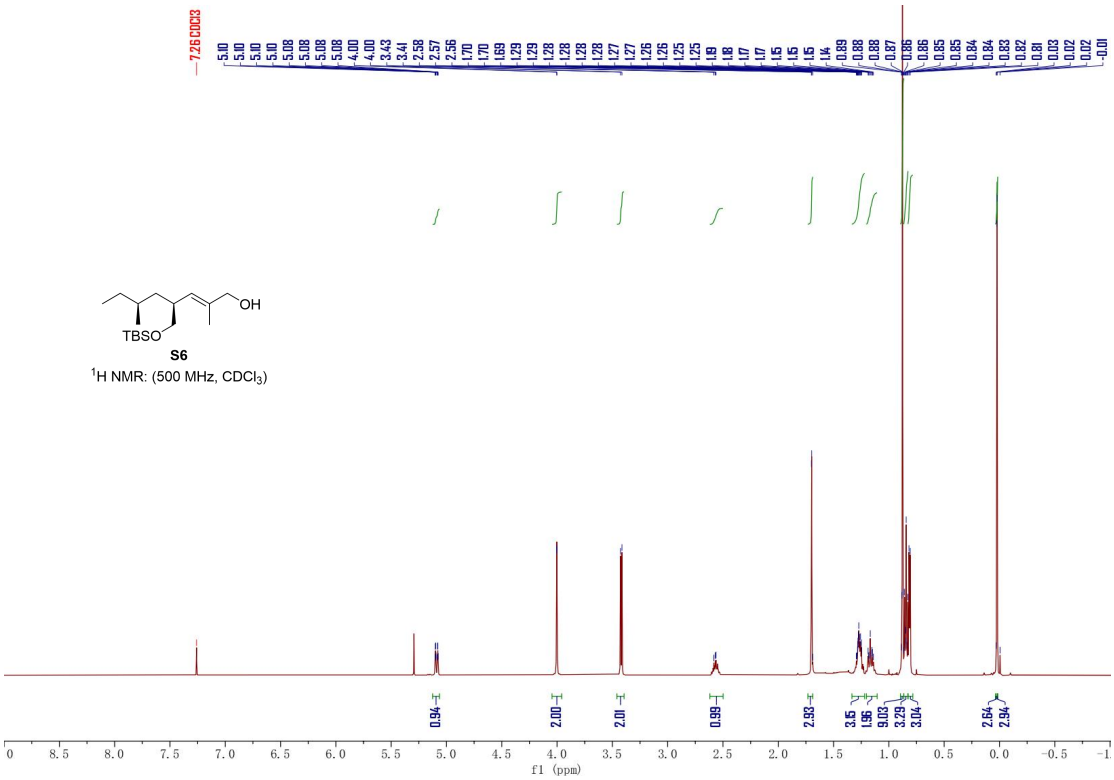

**15**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



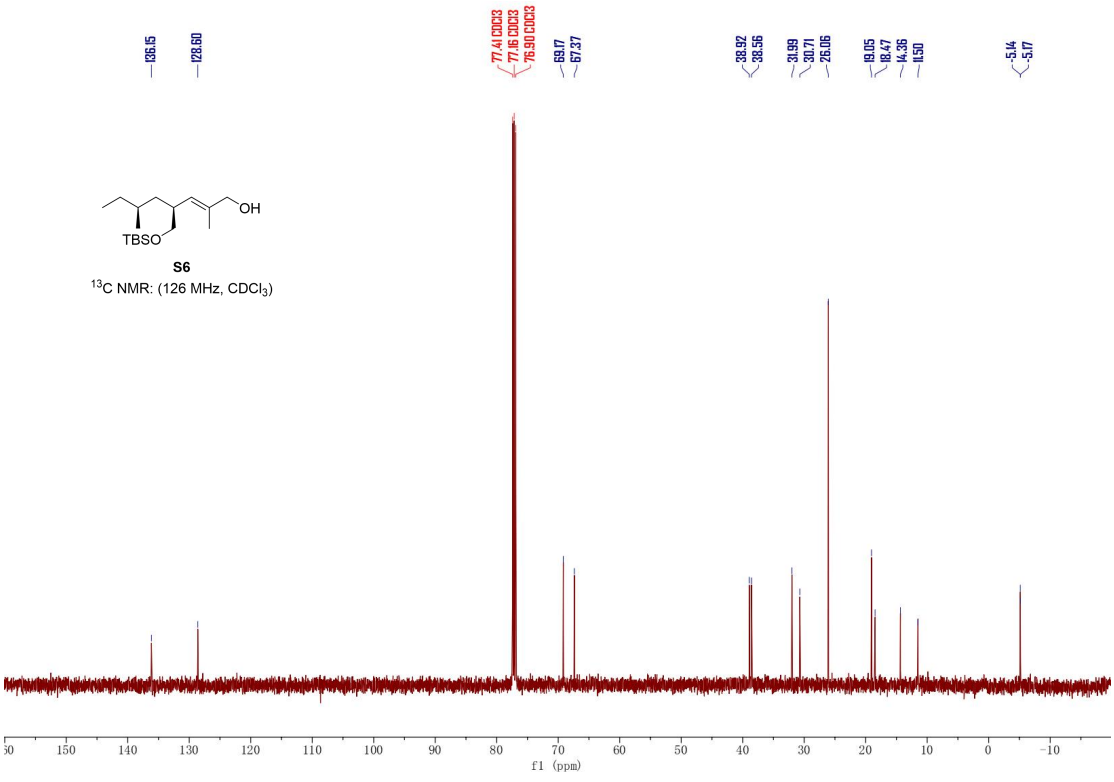

**15**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



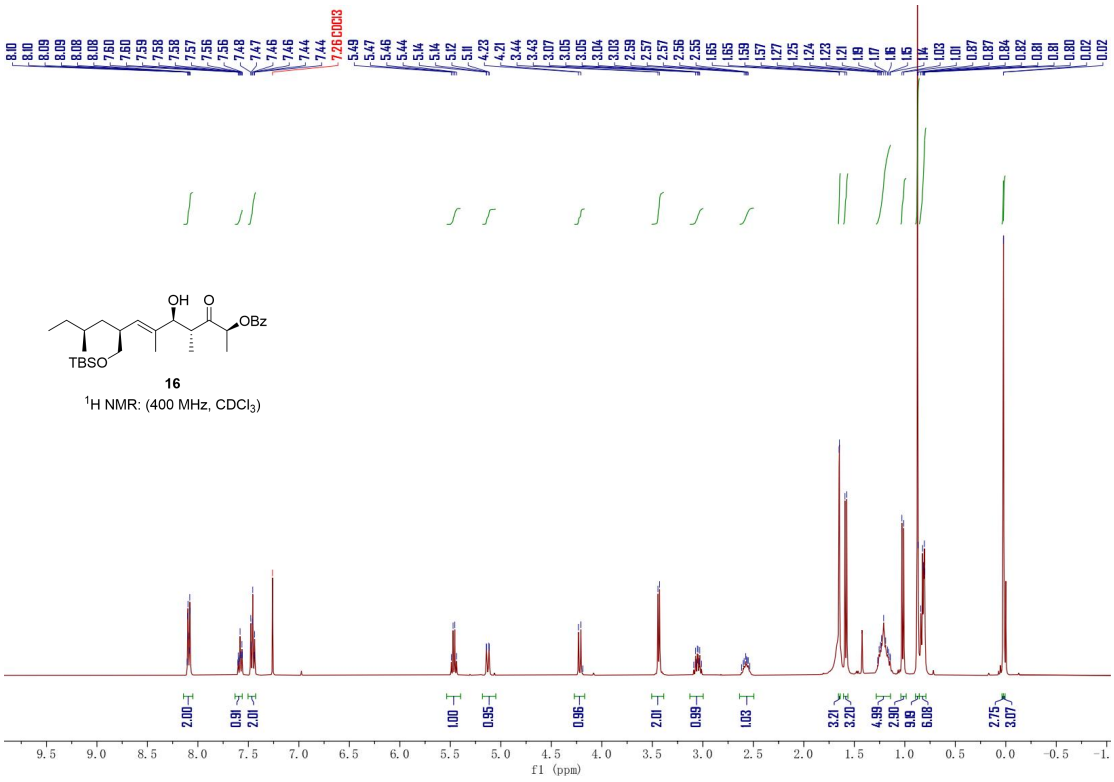

**S6**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



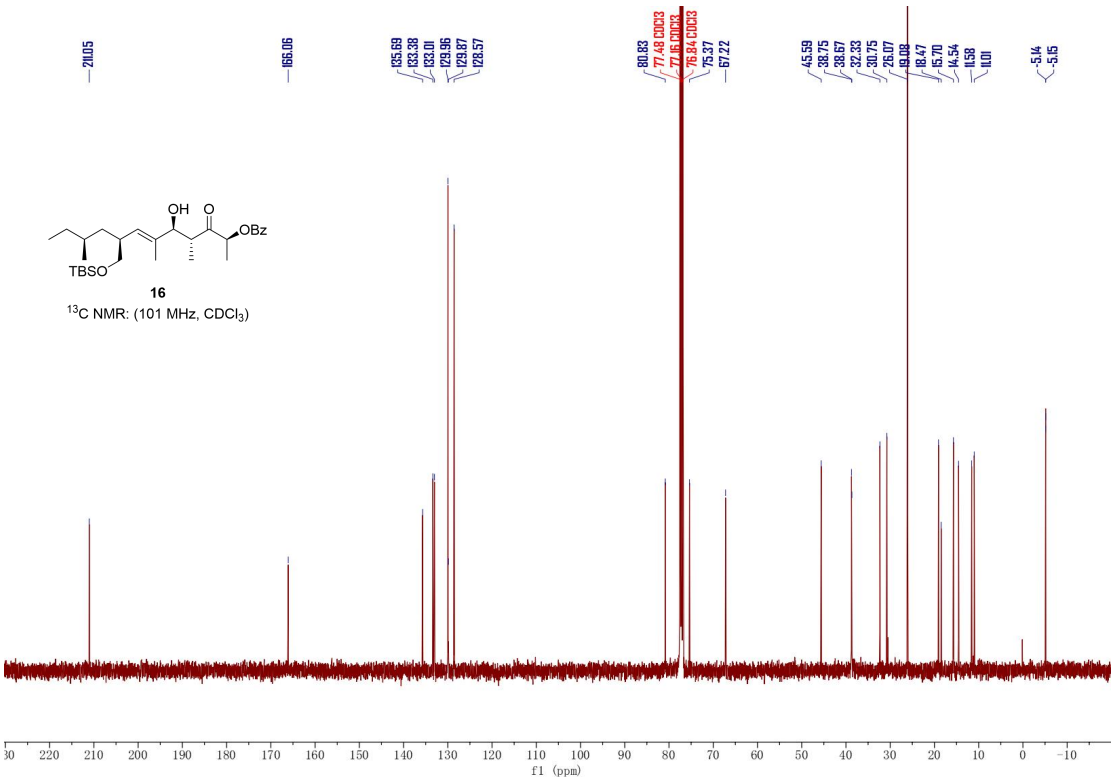

**S6**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



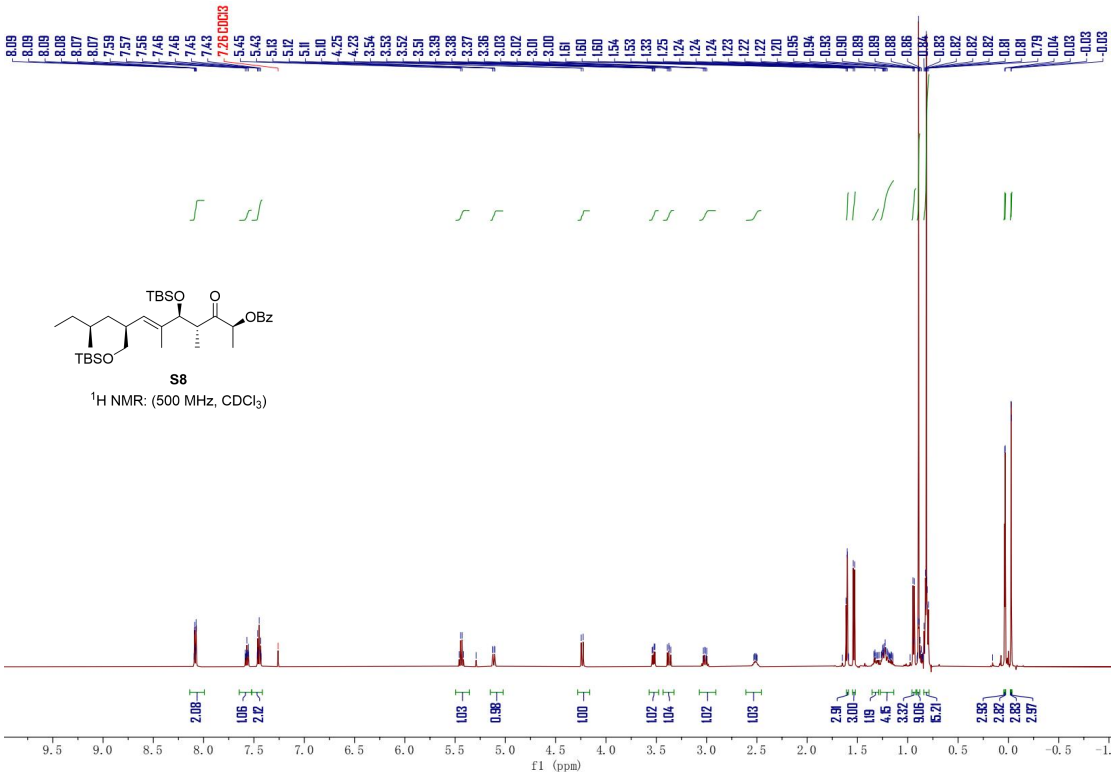

**16**

$^{1}$H NMR: (400 MHz, $CDCl_3$)



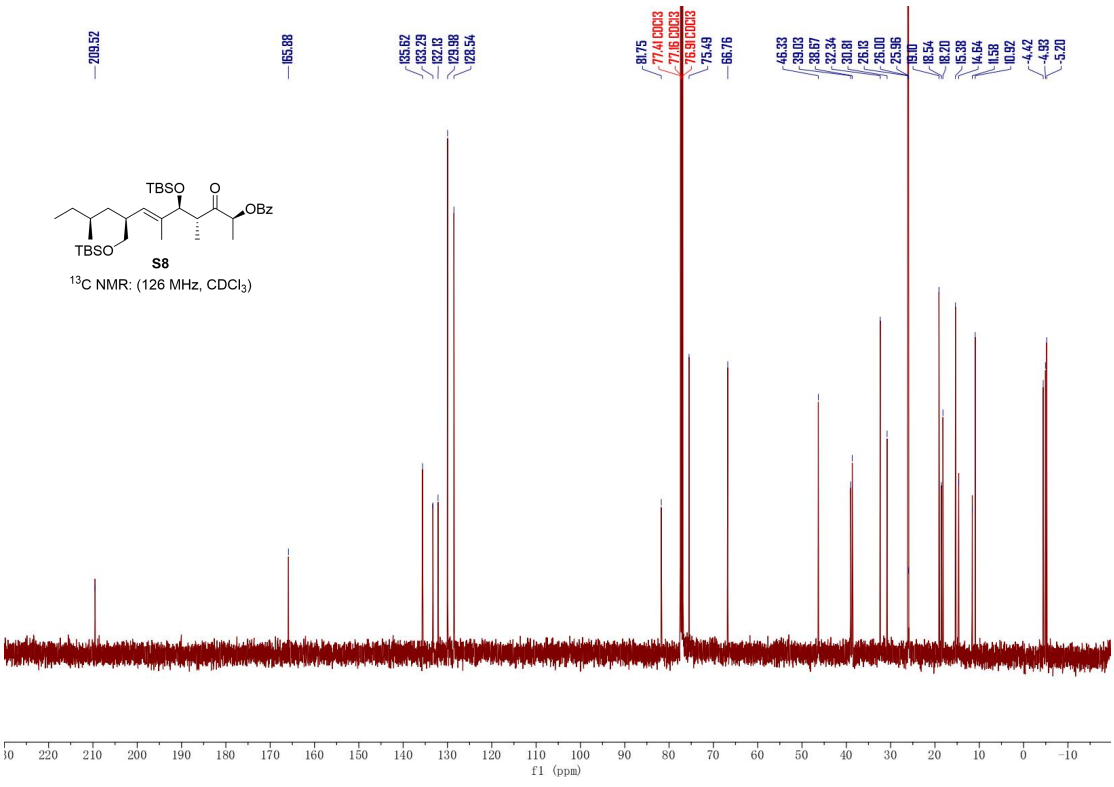

**16**

$^{13}$C NMR: (101 MHz, $CDCl_3$)



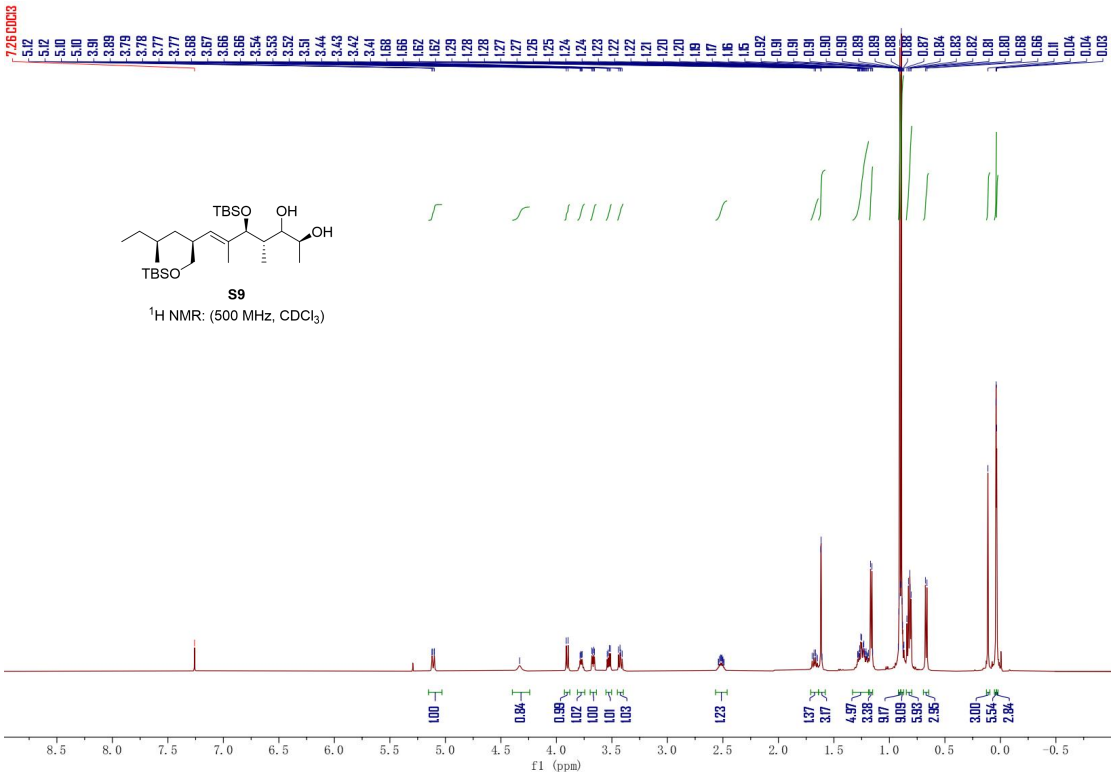

**S8**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



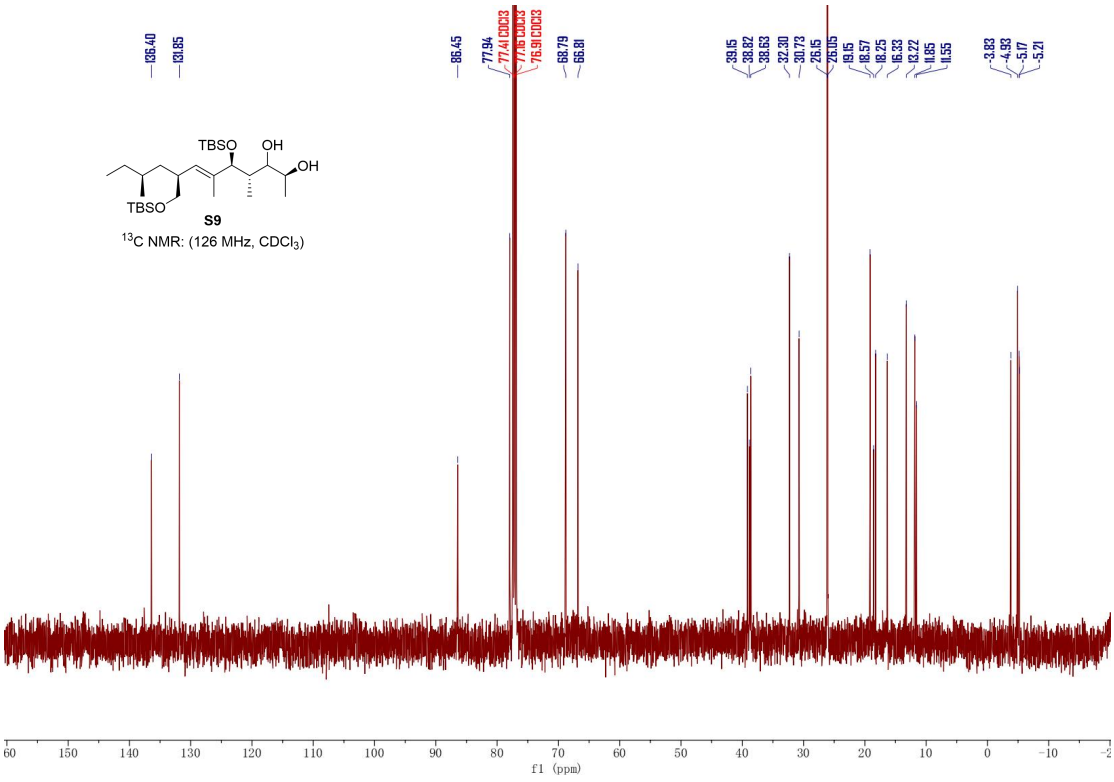

**S8**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



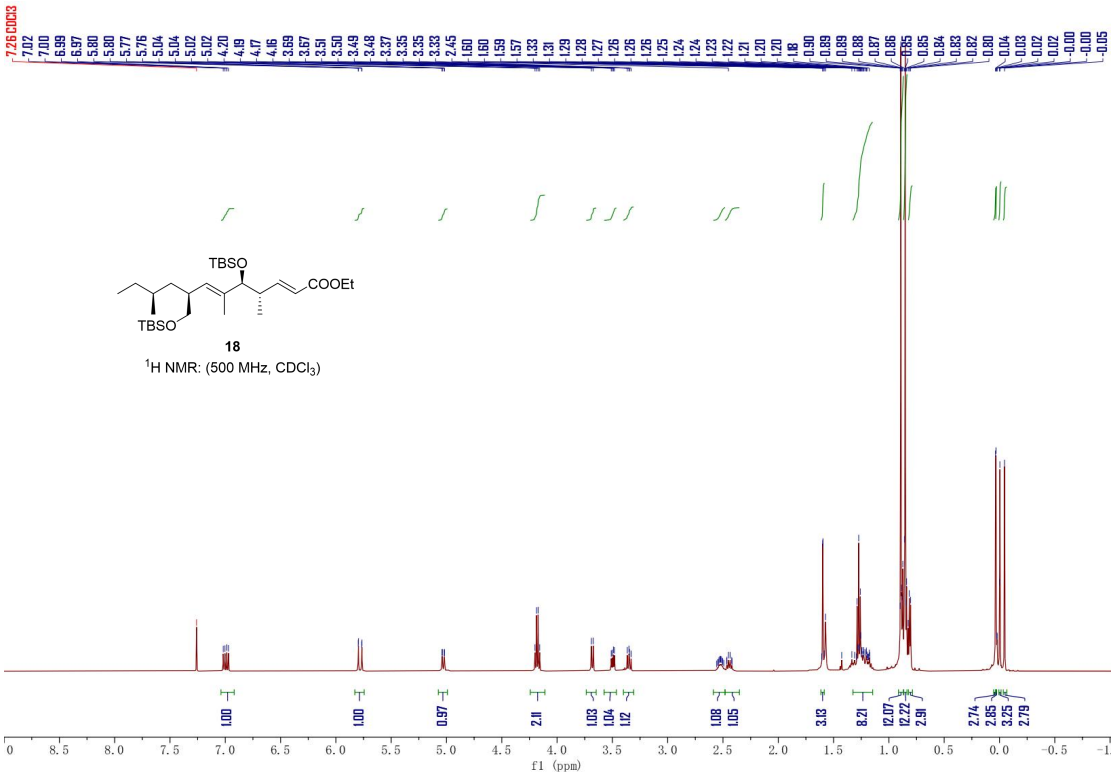

**S9**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



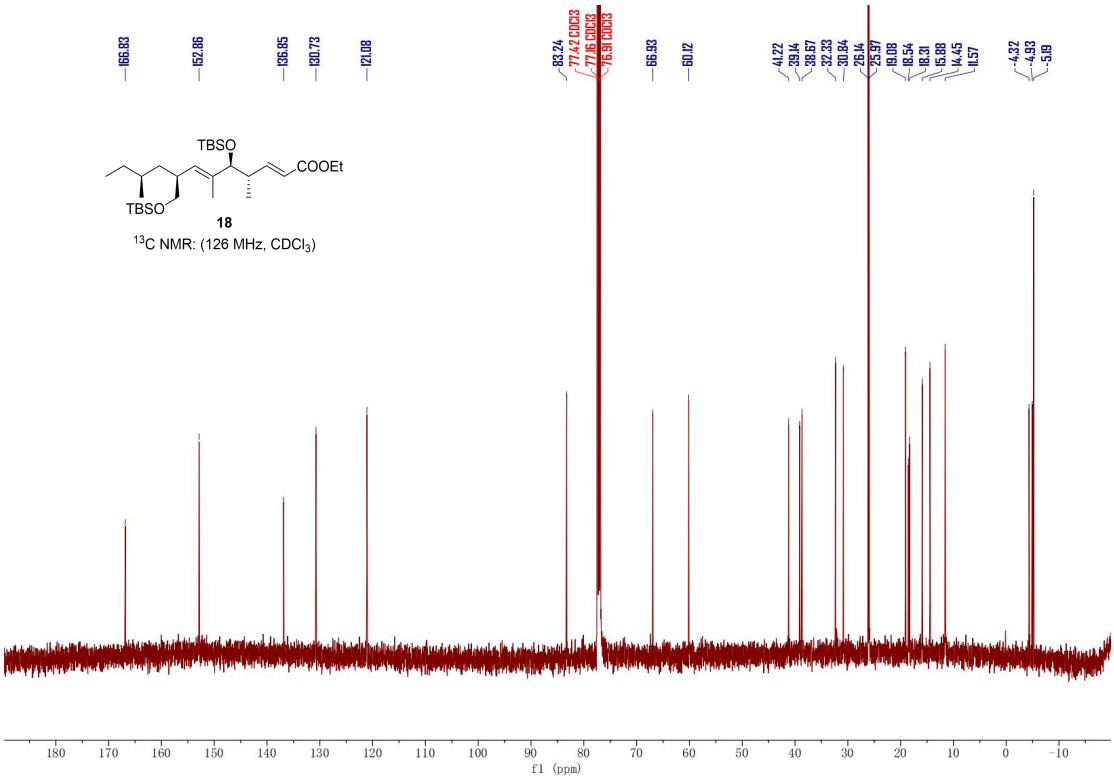

**S9**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



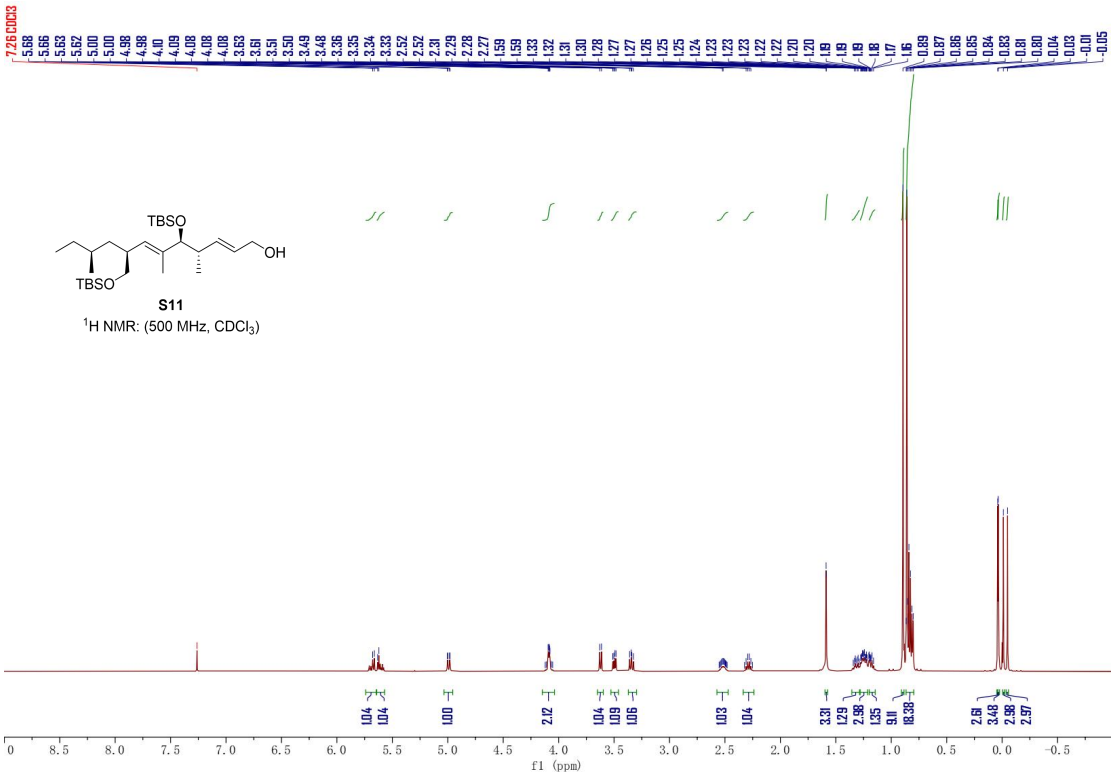

**18**

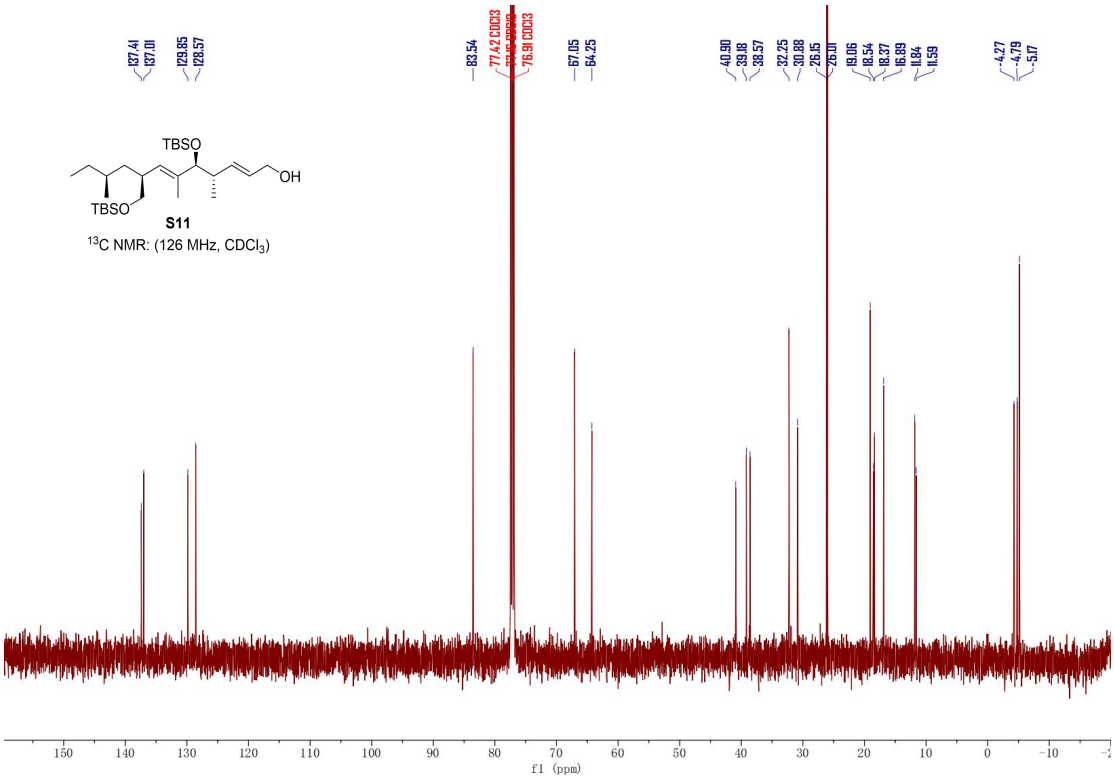
$^{1}$H NMR: (500 MHz, $CDCl_3$)

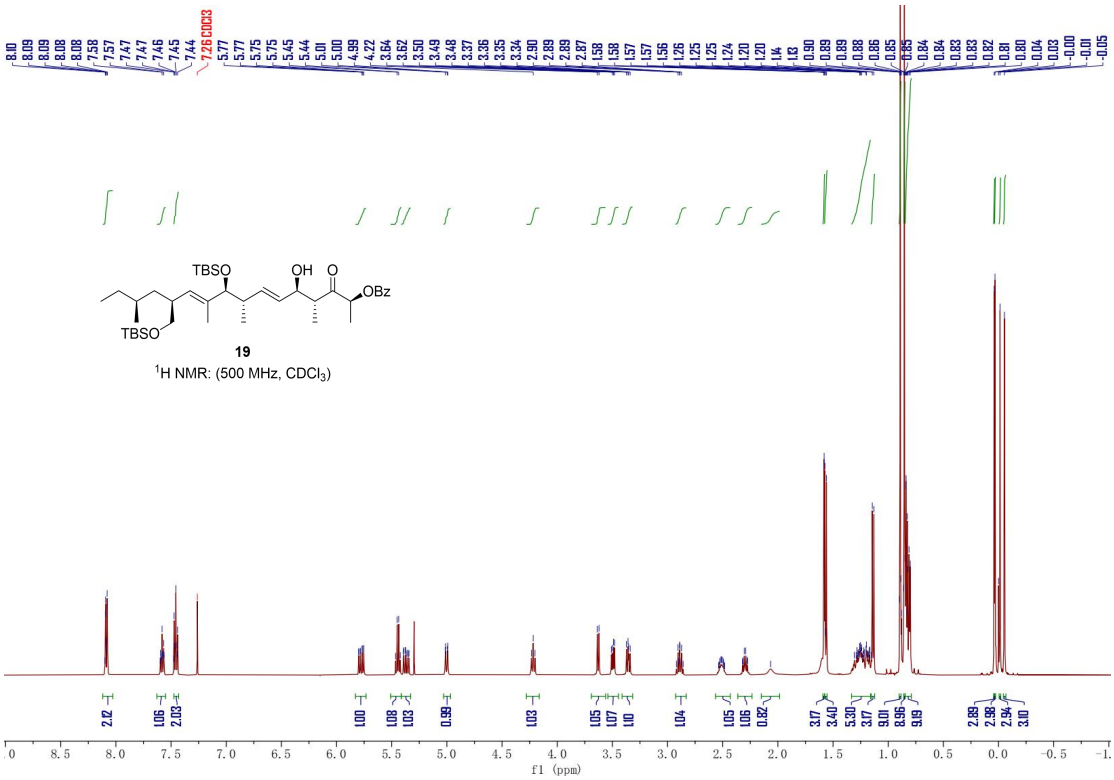


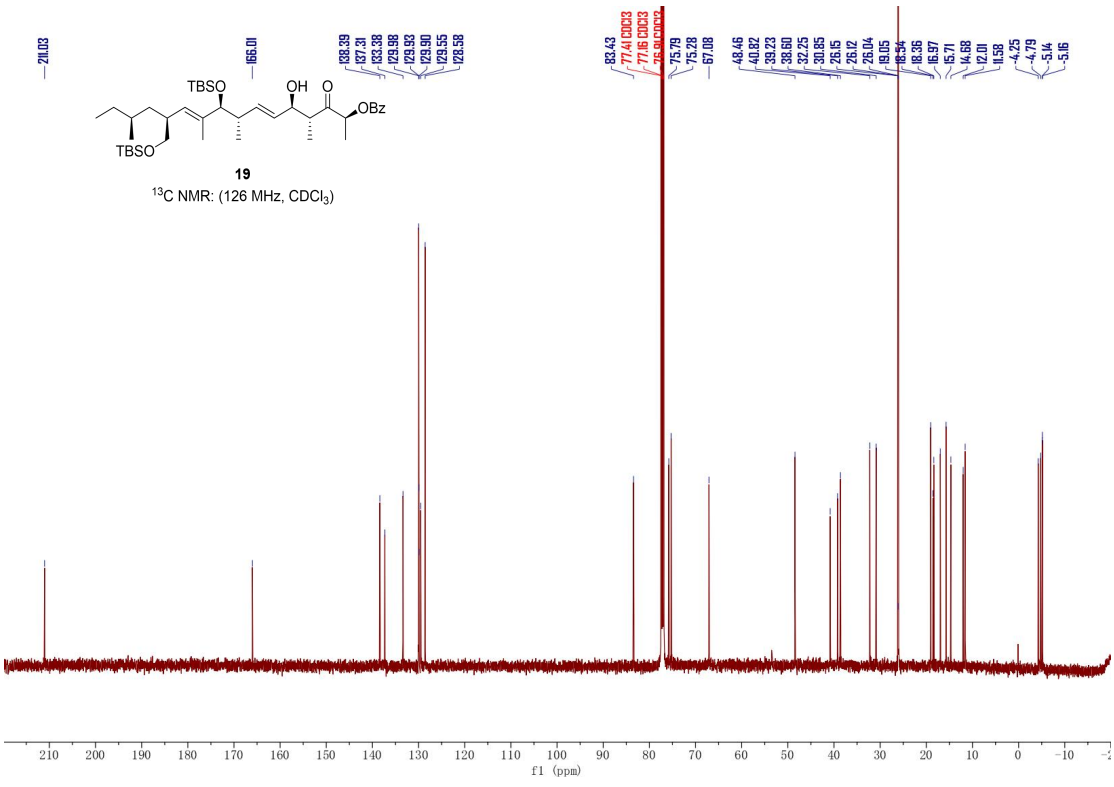

**18**

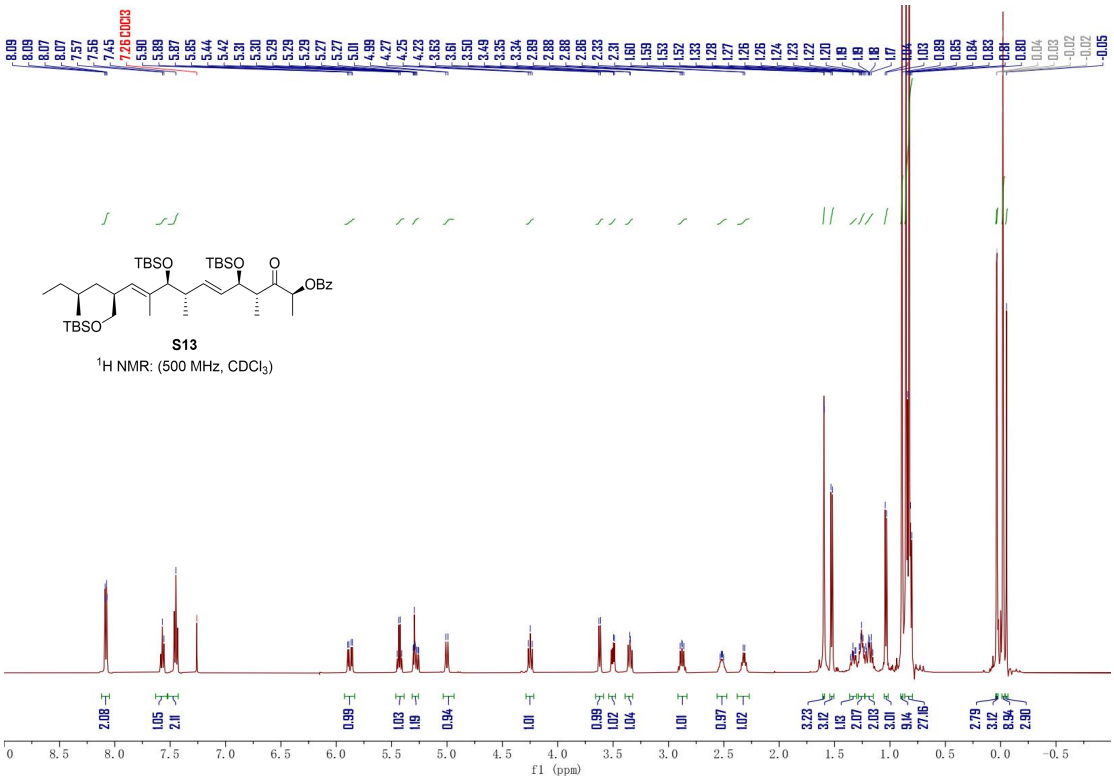
$^{13}$C NMR: (126 MHz, $CDCl_3$)


TBSO
OH
TBSO
S11
1H NMR: (500 MHz, CDCl3)
f1 (ppm)


TBSO
OH
TBSO
S11
13C NMR: (126 MHz, CDCl3)
f1 (ppm)

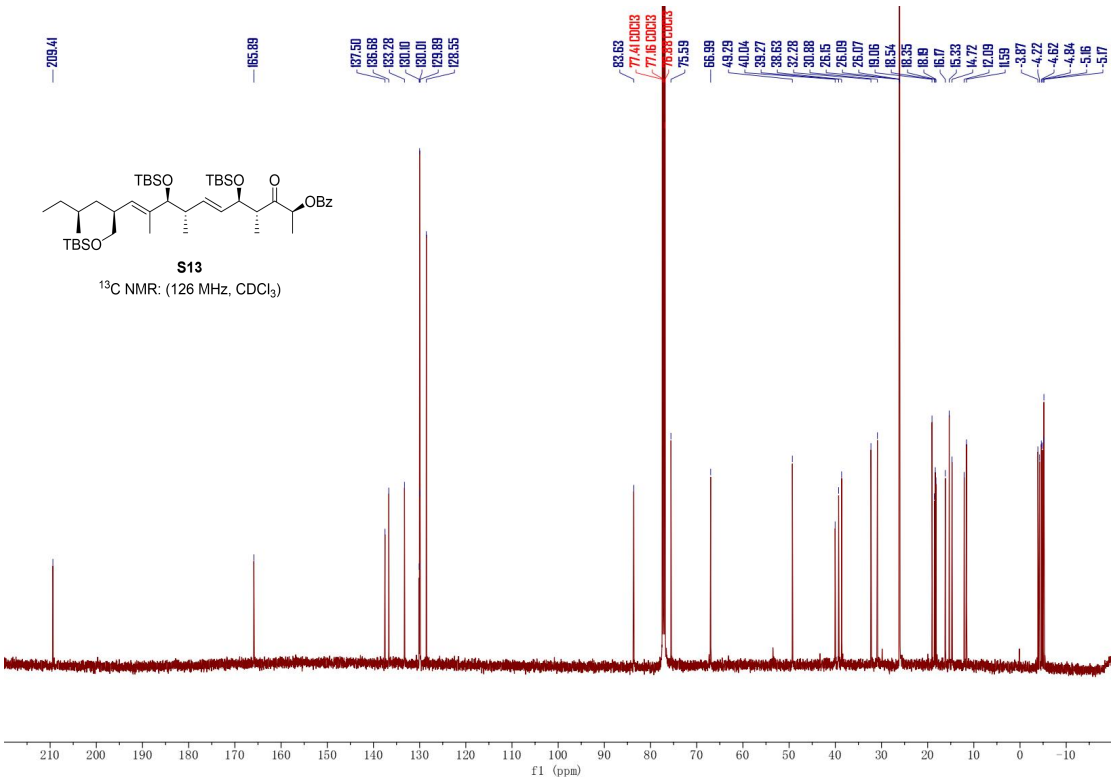

TBSO
OH
O
OBz
TBSO
19
1H NMR: (500 MHz, CDCl3)
f1 (ppm)


TBSO
OH
O
OBz
TBSO
19
13C NMR: (126 MHz, CDCl3)
f1 (ppm)



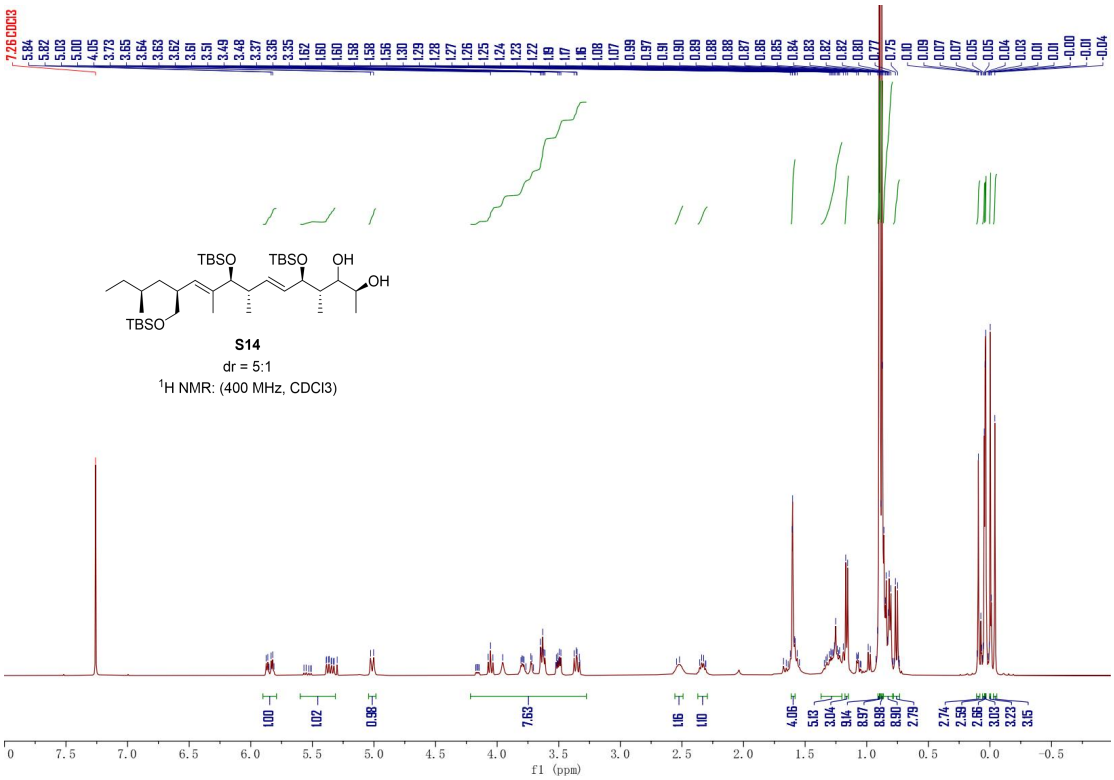

**S13**

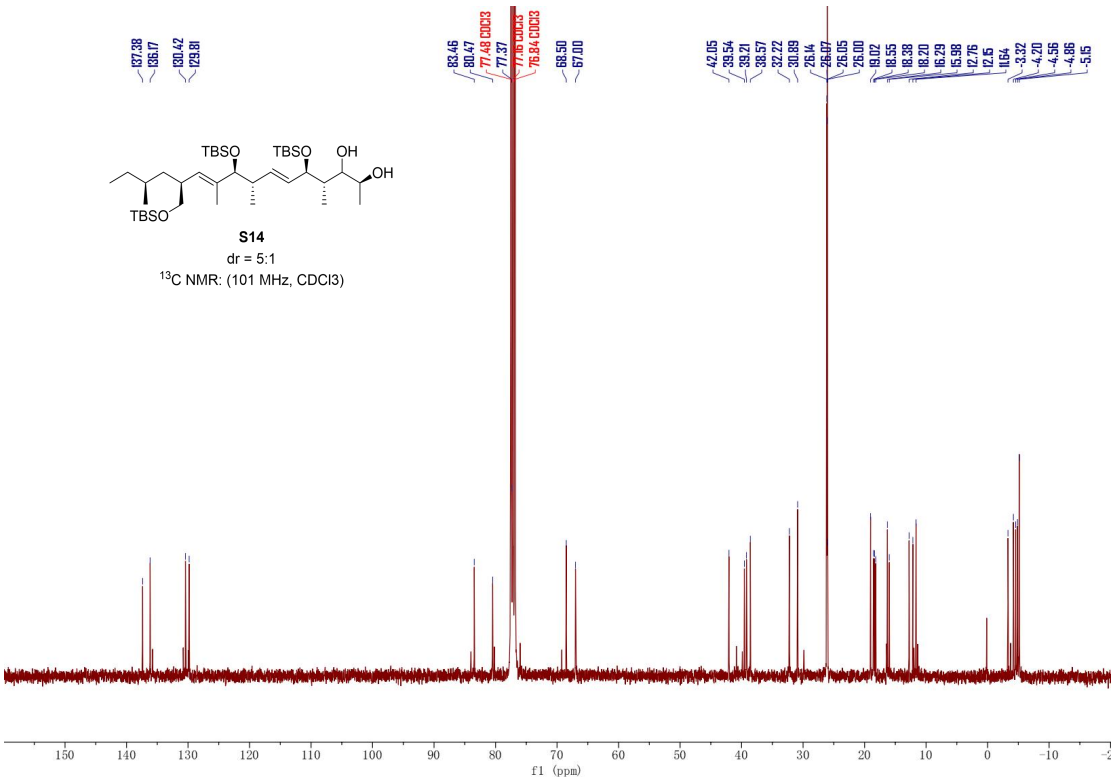
$^{1}$H NMR: (500 MHz, $CDCl_3$)

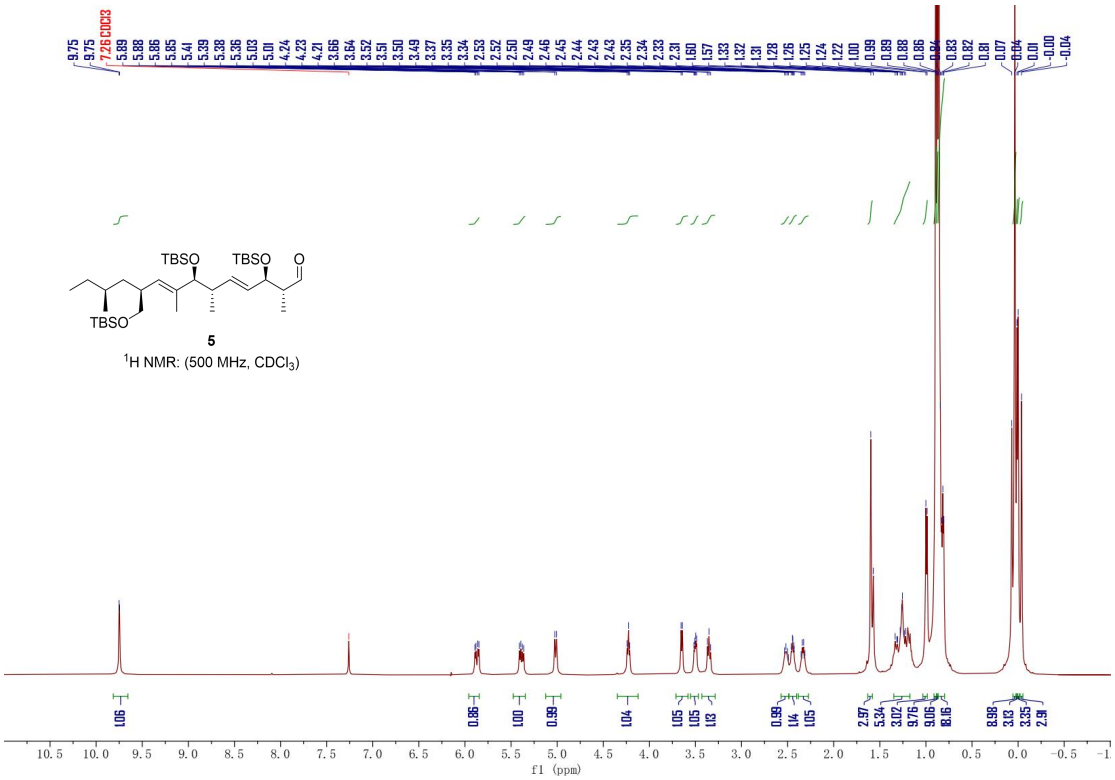



**S13**

$^{13}$C NMR: (126 MHz, $CDCl_3$)

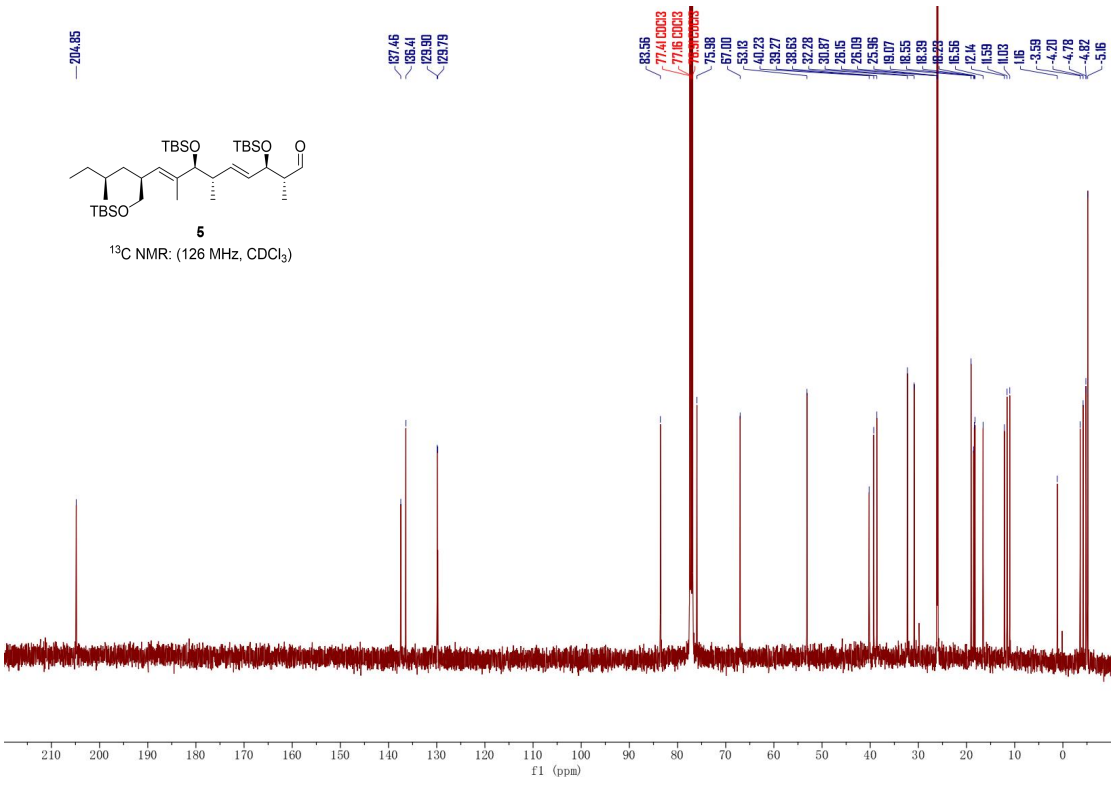

TBSO
TBSO
OH
OH
TBSO
S14
dr = 5:1
1H NMR: (400 MHz, CDCl3)
f1 (ppm)


TBSO
TBSO
OH
OH
TBSO
S14
dr = 5:1
13C NMR: (101 MHz, CDCl3)
f1 (ppm)



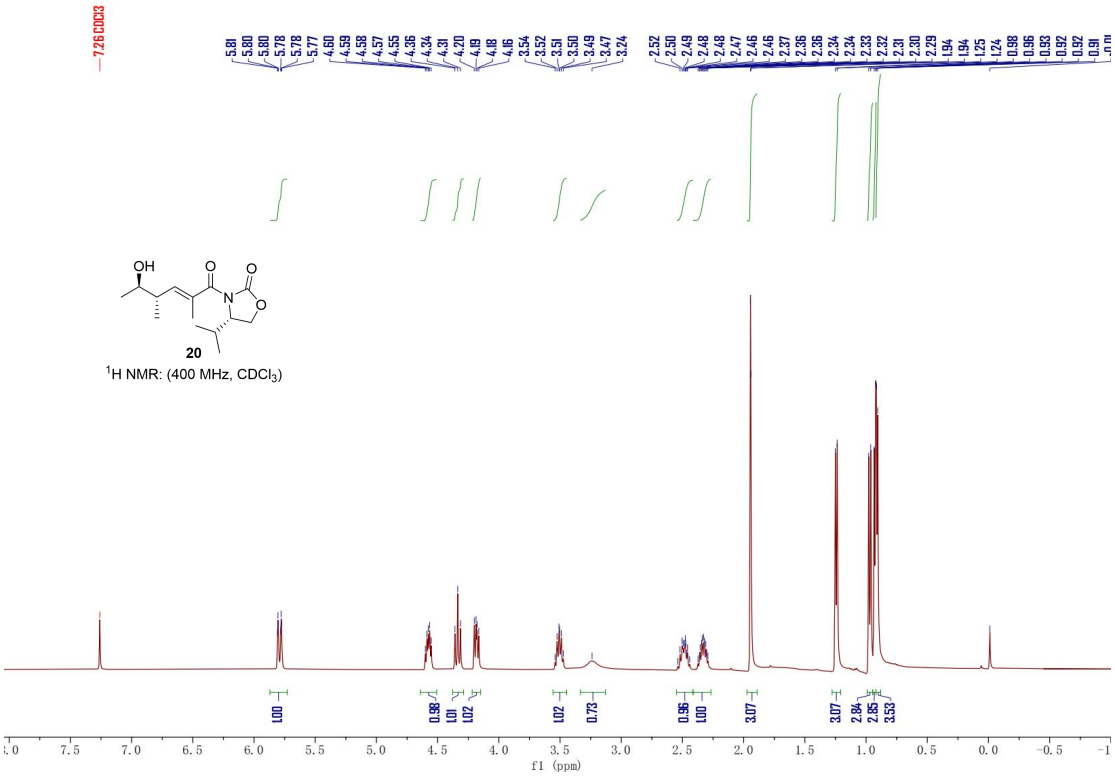

**5**

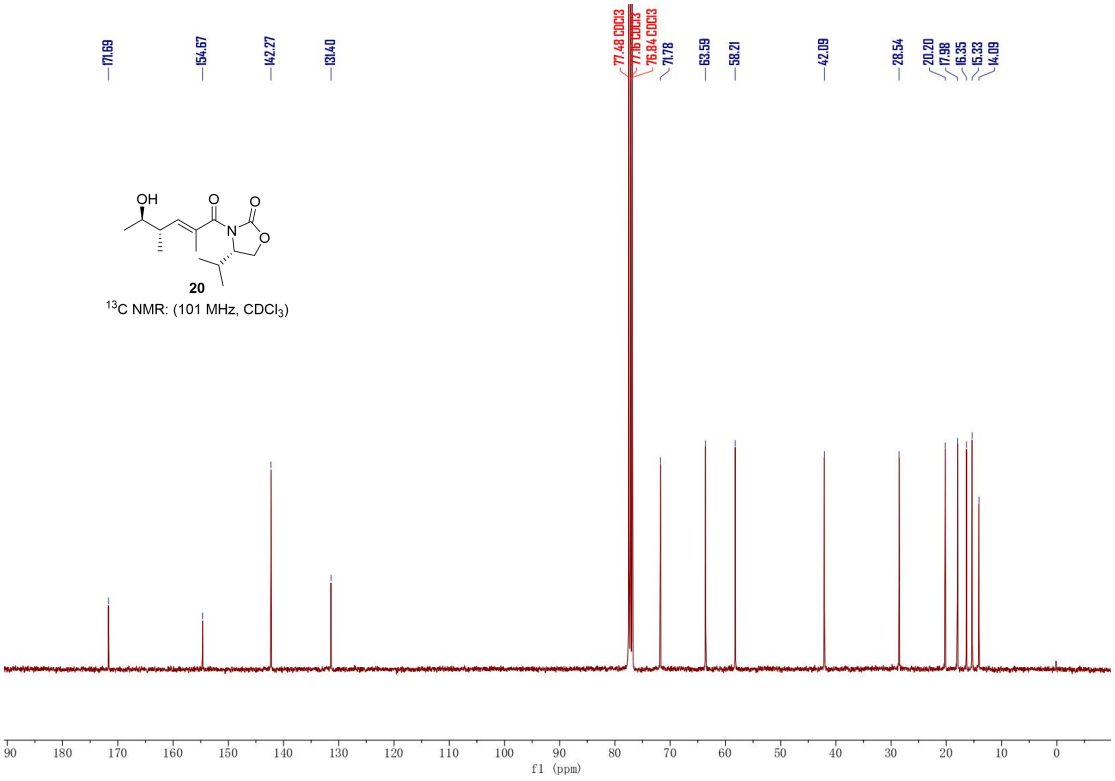
$^{1}$H NMR: (500 MHz, $CDCl_3$)

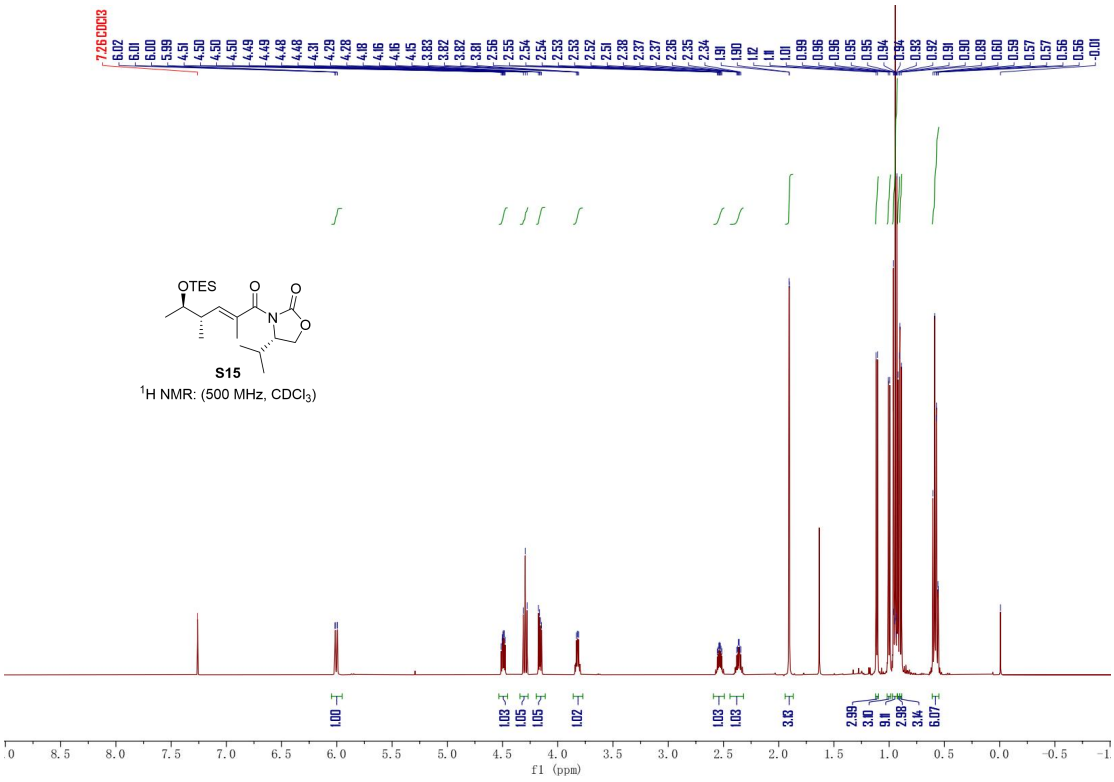


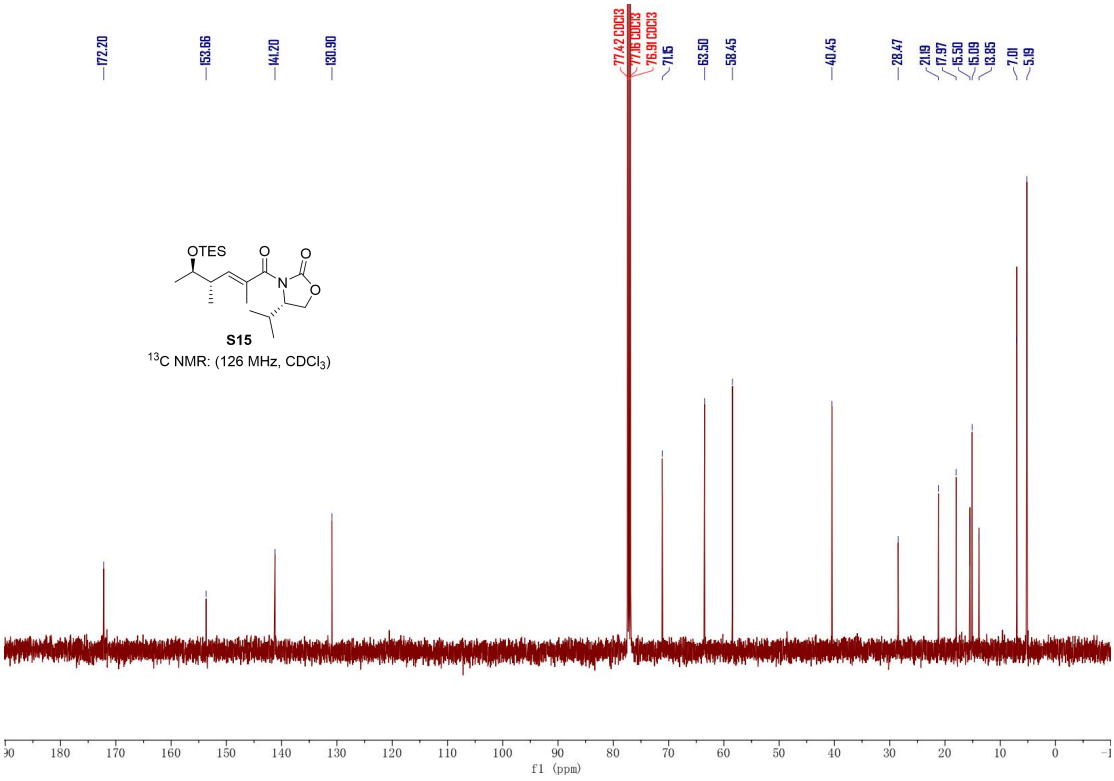

**5**

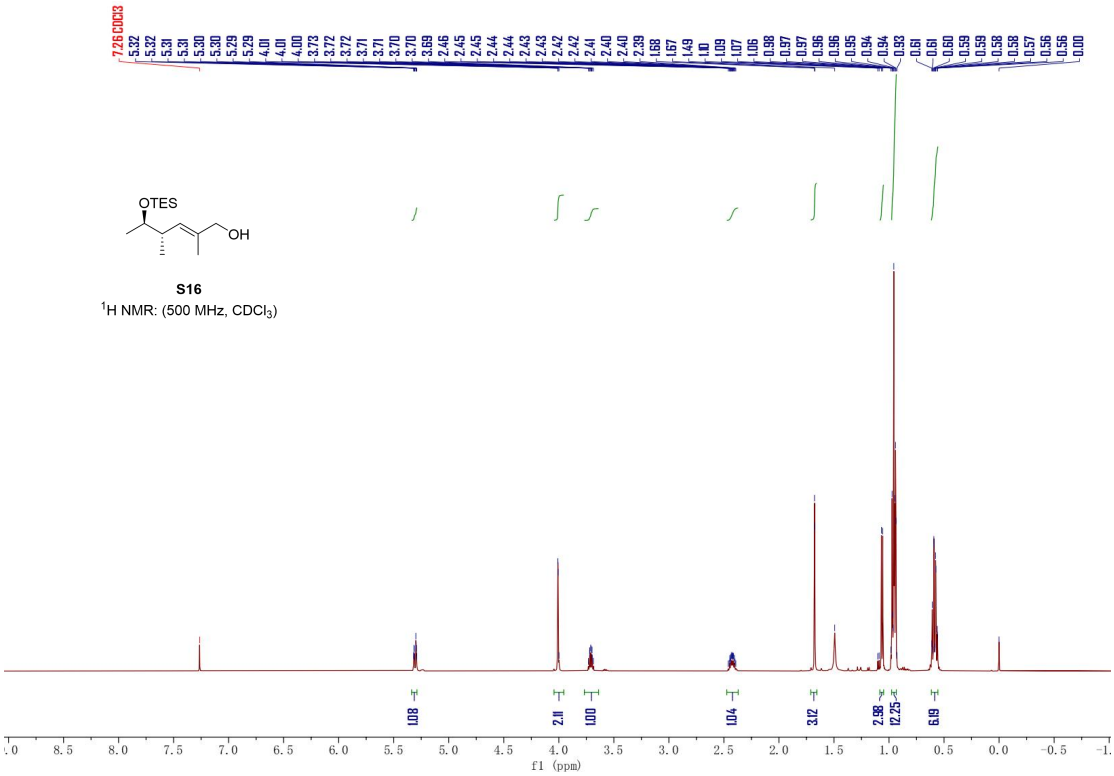
$^{13}$C NMR: (126 MHz, $CDCl_3$)


7.26 CDCl3
5.81
5.80
5.80
5.78
5.78
5.77
4.60
4.59
4.58
4.57
4.55
4.36
4.34
4.31
4.20
4.19
4.18
4.16
3.54
3.52
3.51
3.50
3.49
3.47
3.24
2.52
2.50
2.49
2.48
2.48
2.47
2.46
2.46
2.37
2.36
2.36
2.34
2.34
2.33
2.32
2.31
2.30
2.29
1.94
1.94
1.25
1.24
0.98
0.96
0.93
0.92
0.92
0.91
OH
O
O
N
O
20
1H NMR: (400 MHz, CDCl3)
1.00
0.98
1.01
1.02
1.02
0.73
0.96
1.00
3.07
3.07
2.84
2.85
3.53
f1 (ppm)


171.69
154.67
142.27
131.40
77.48 CDCl3
77.16 CDCl3
76.84 CDCl3
71.78
63.59
58.21
42.09
28.54
20.20
17.98
16.35
15.33
14.09
OH
O
O
N
O
20
13C NMR: (101 MHz, CDCl3)
f1 (ppm)

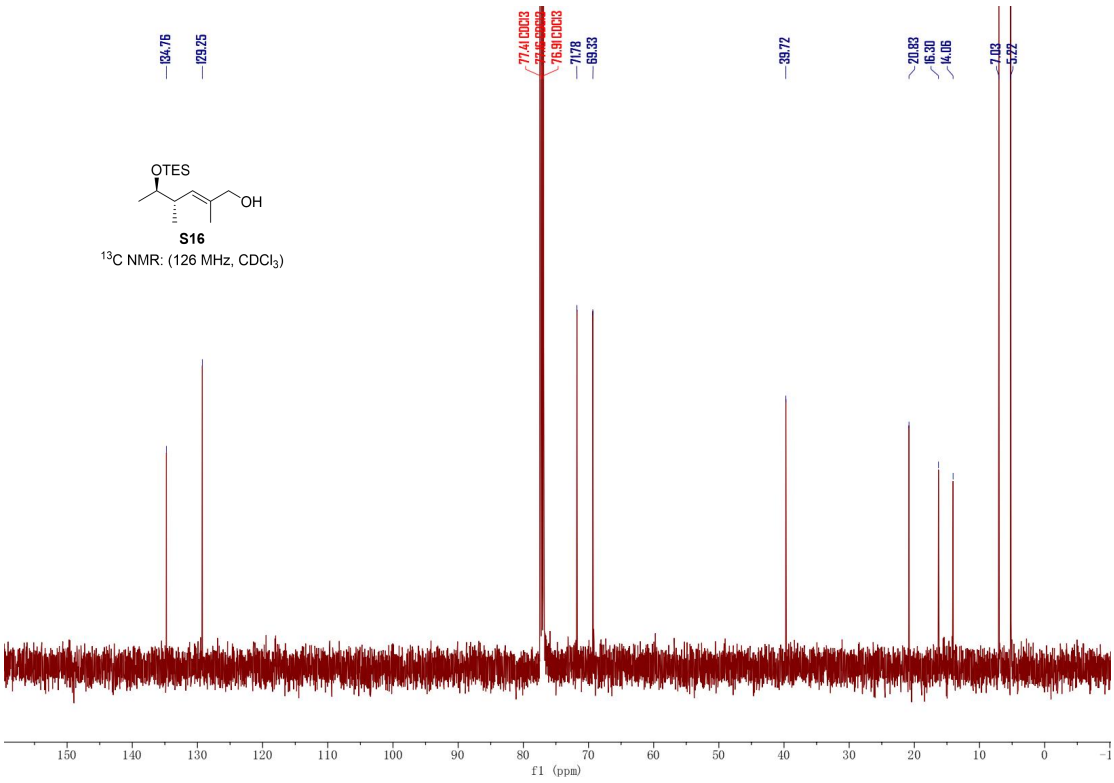

OTES
O
O
N
O
S15
$^1$H NMR: (500 MHz, $CDCl_3$)
f1 (ppm)


OTES
O
O
N
O
S15
$^{13}$C NMR: (126 MHz, $CDCl_3$)
f1 (ppm)



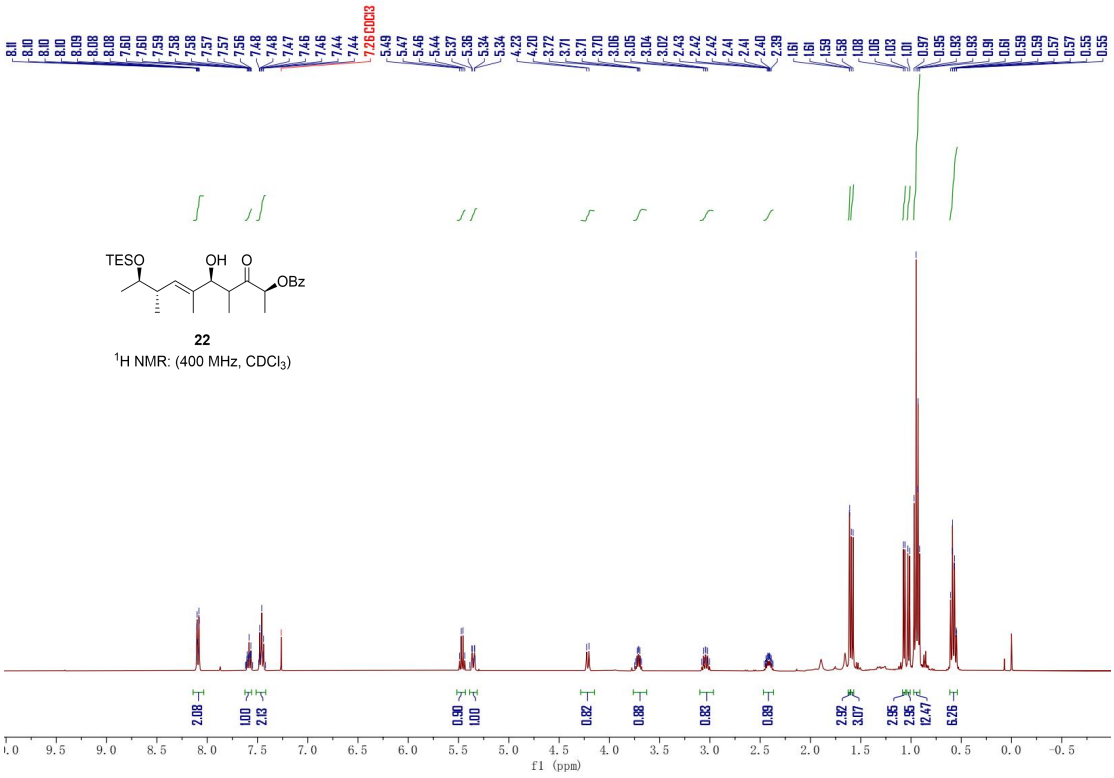

**S16**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



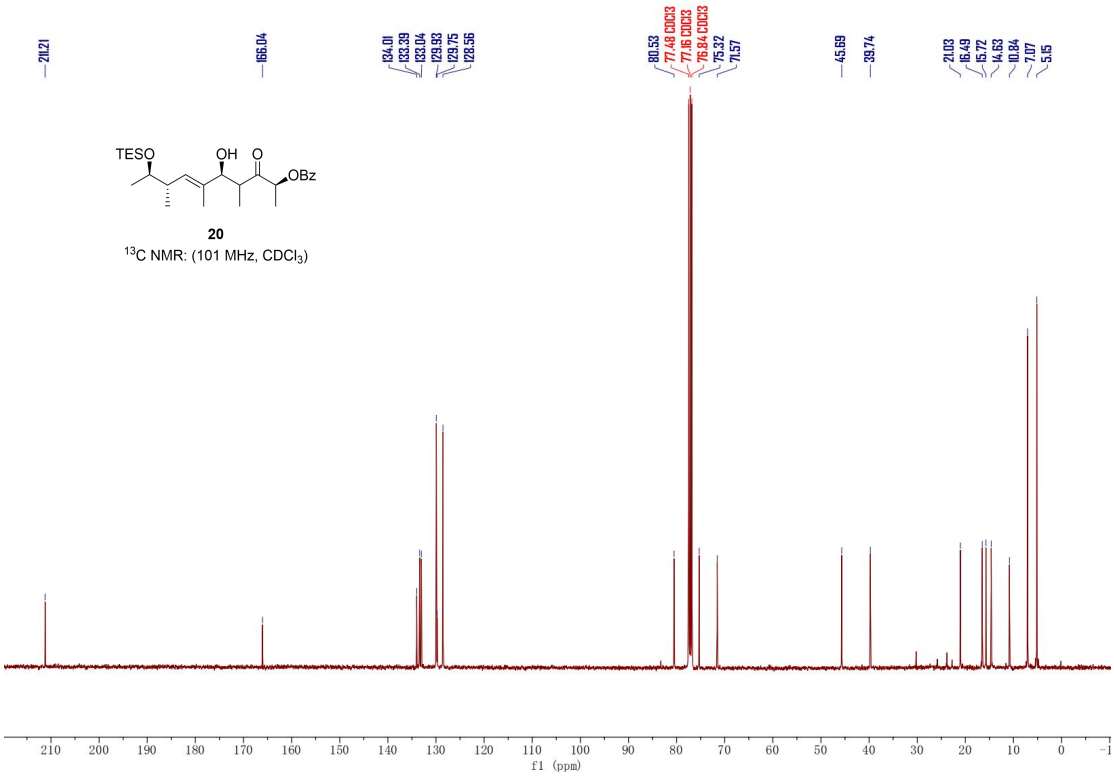

**S16**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



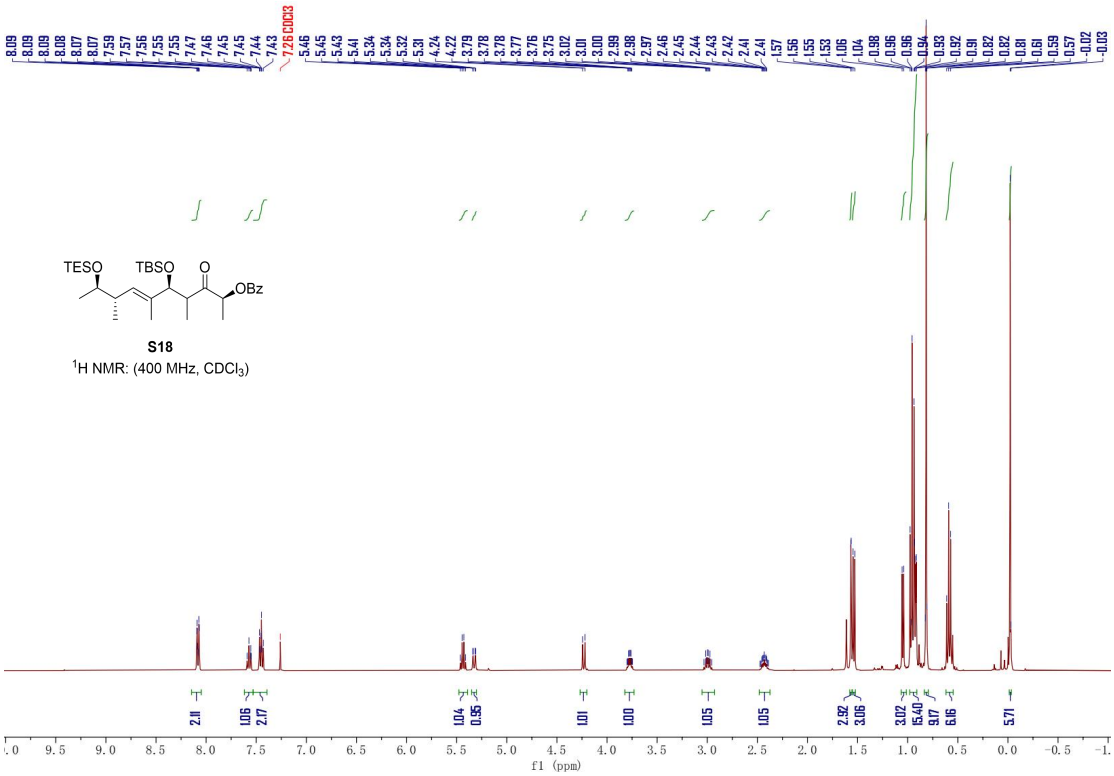

**22**

$^{1}$H NMR: (400 MHz, $CDCl_3$)



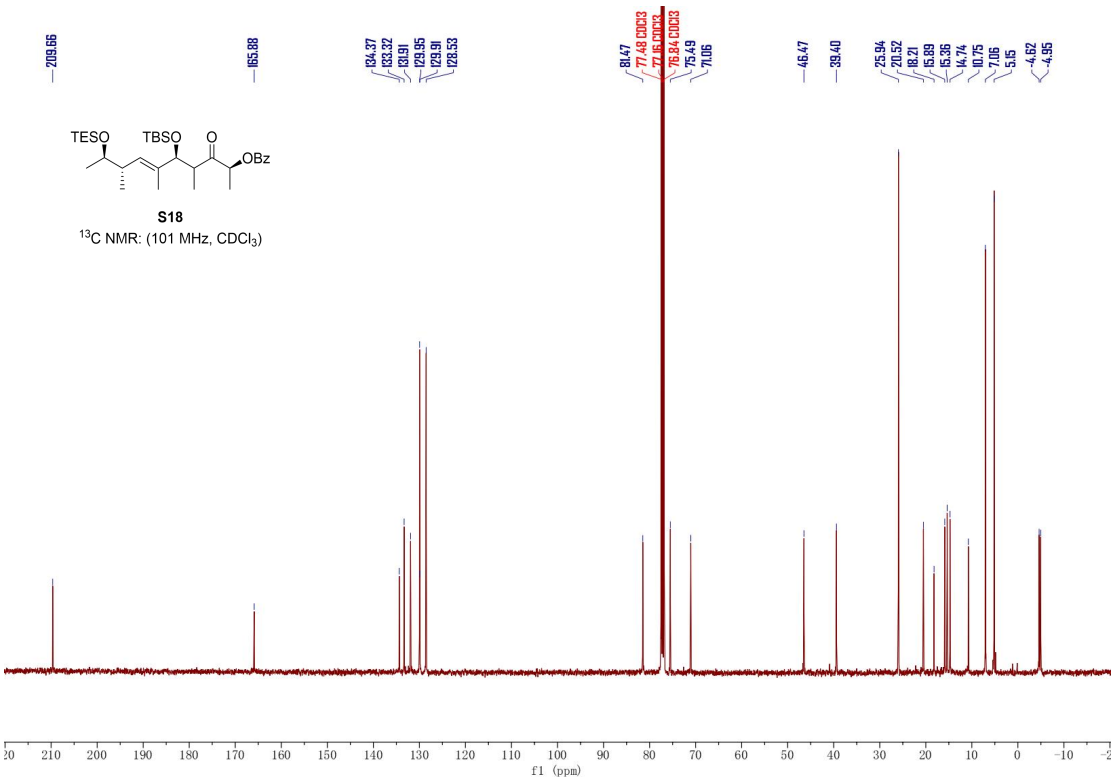

**20**

$^{13}$C NMR: (101 MHz, $CDCl_3$)



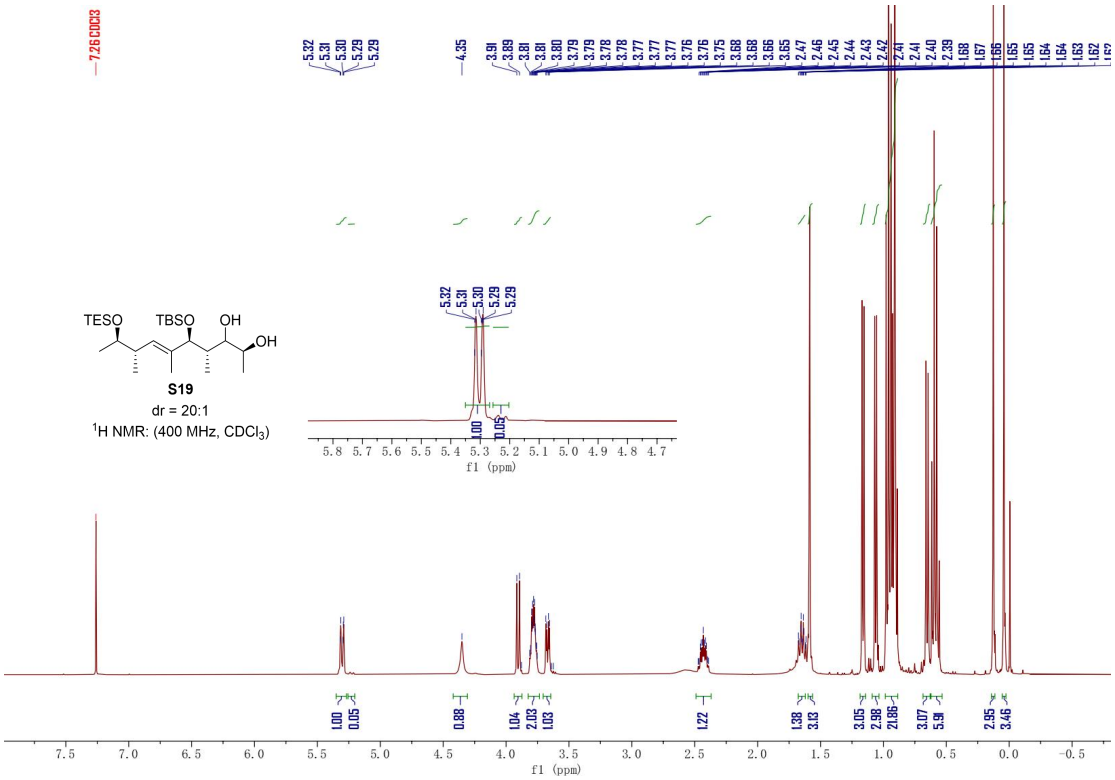

**S18**

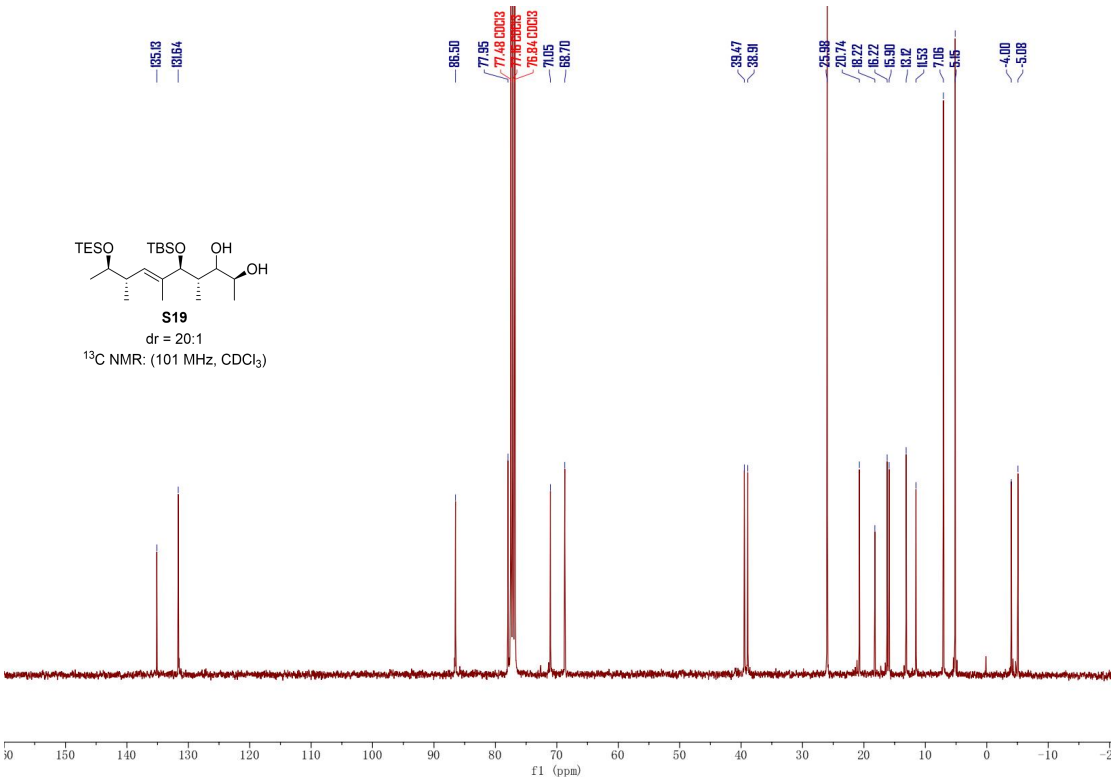
$^{1}$H NMR: (400 MHz, $CDCl_3$)

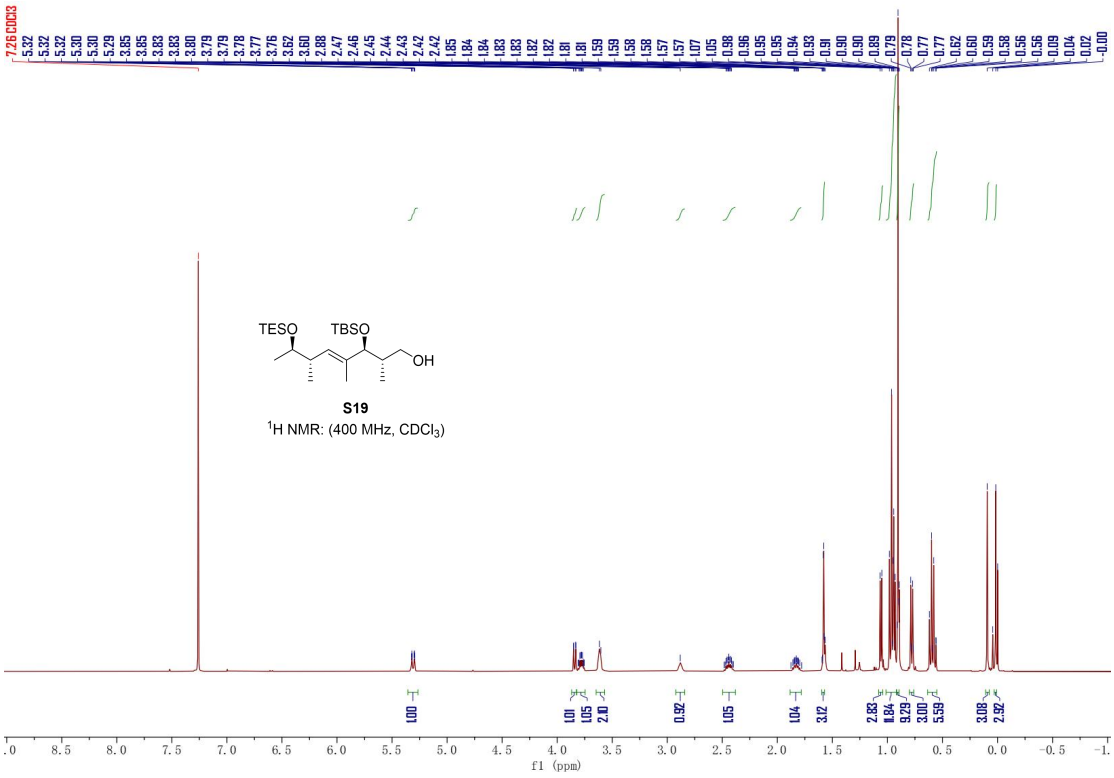



**S18**

$^{13}$C NMR: (101 MHz, $CDCl_3$)

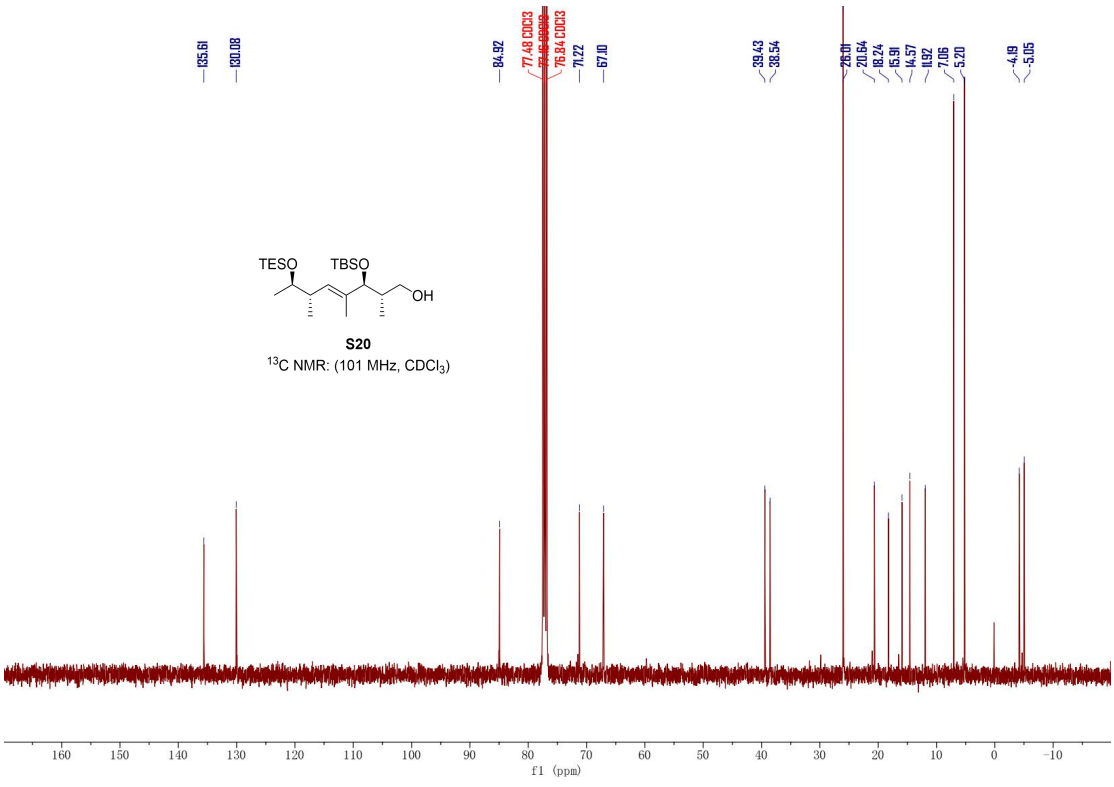

TESO
TBSO
OH
OH
S19
dr = 20:1
1H NMR: (400 MHz, CDCl3)
f1 (ppm)


TESO
TBSO
OH
OH
S19
dr = 20:1
13C NMR: (101 MHz, CDCl3)
f1 (ppm)



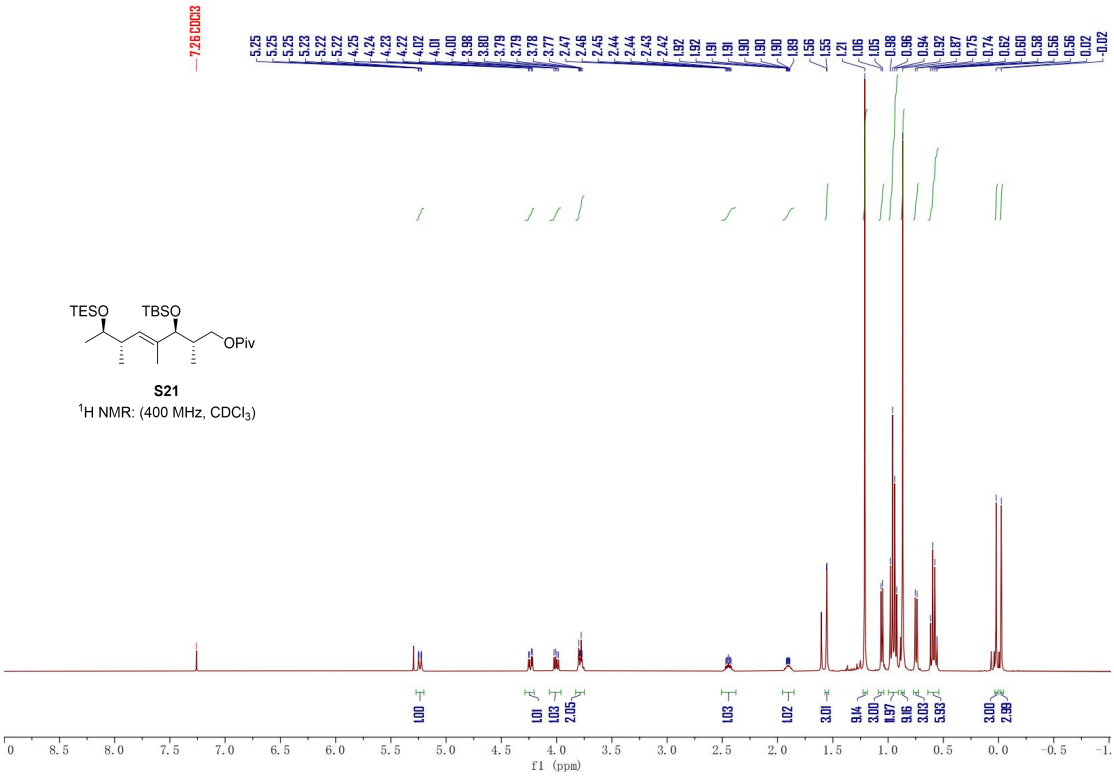

**S19**

$^{1}$H NMR: (400 MHz, $CDCl_3$)



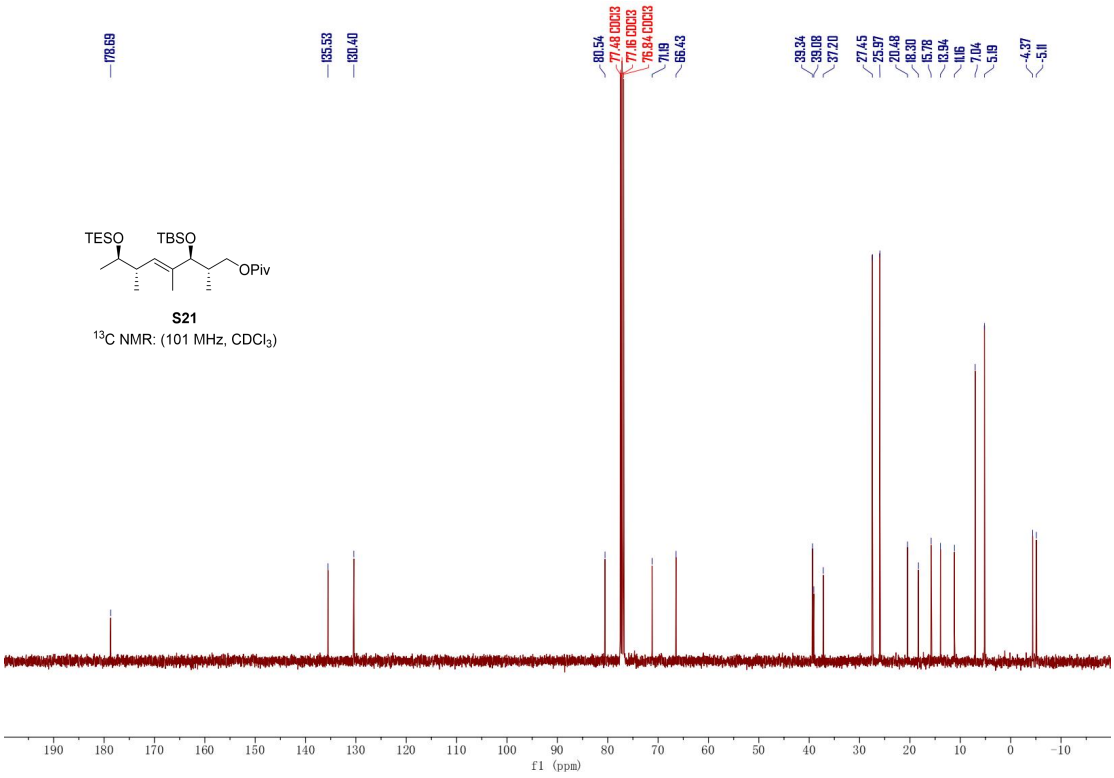

**S20**

$^{13}$C NMR: (101 MHz, $CDCl_3$)



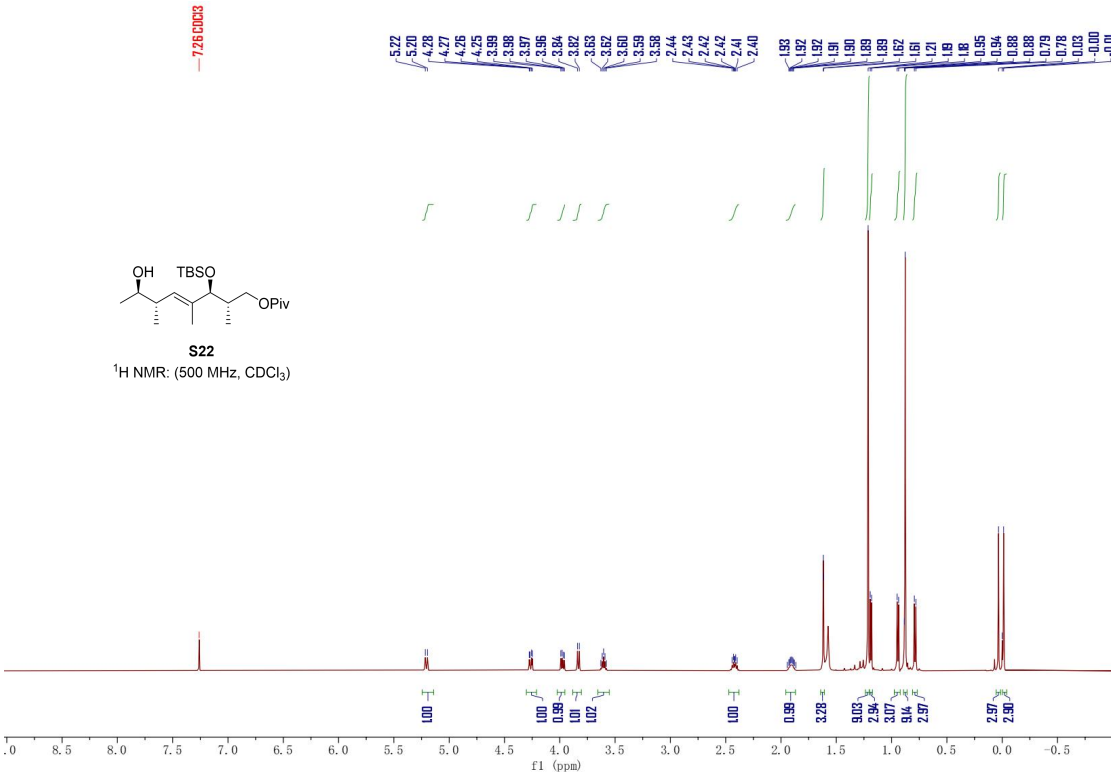

**S21**

$^{1}$H NMR: (400 MHz, $CDCl_3$)



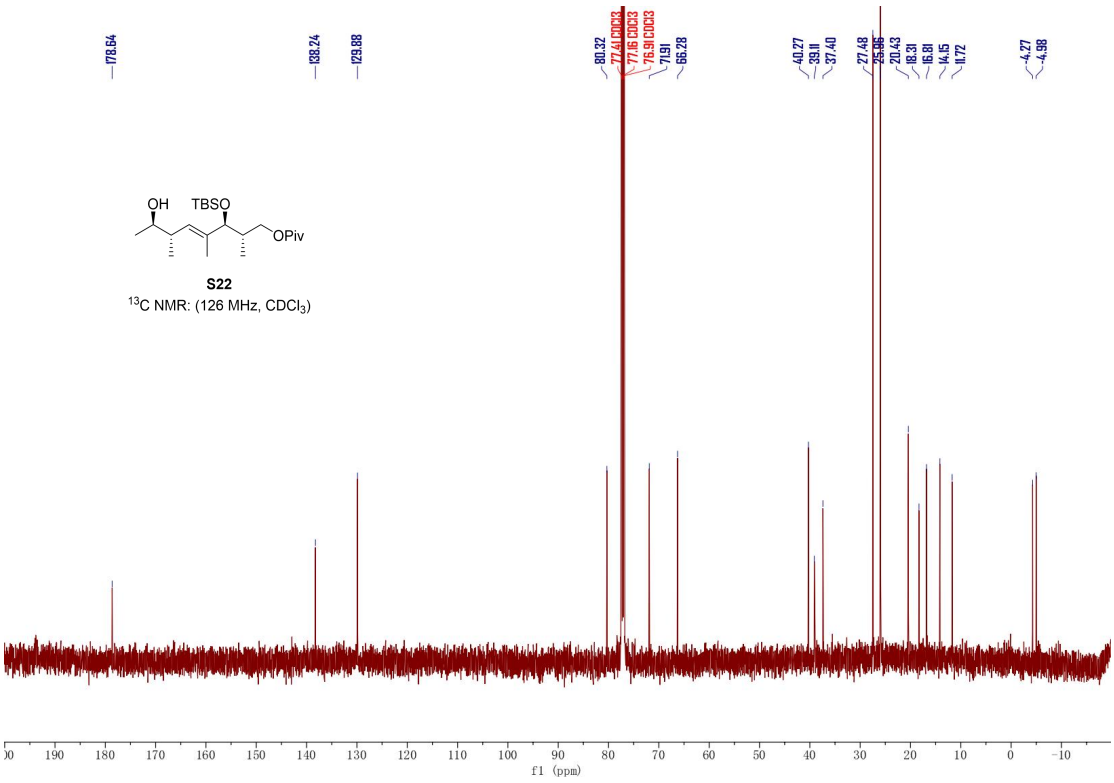

**S21**

$^{13}$C NMR: (101 MHz, $CDCl_3$)



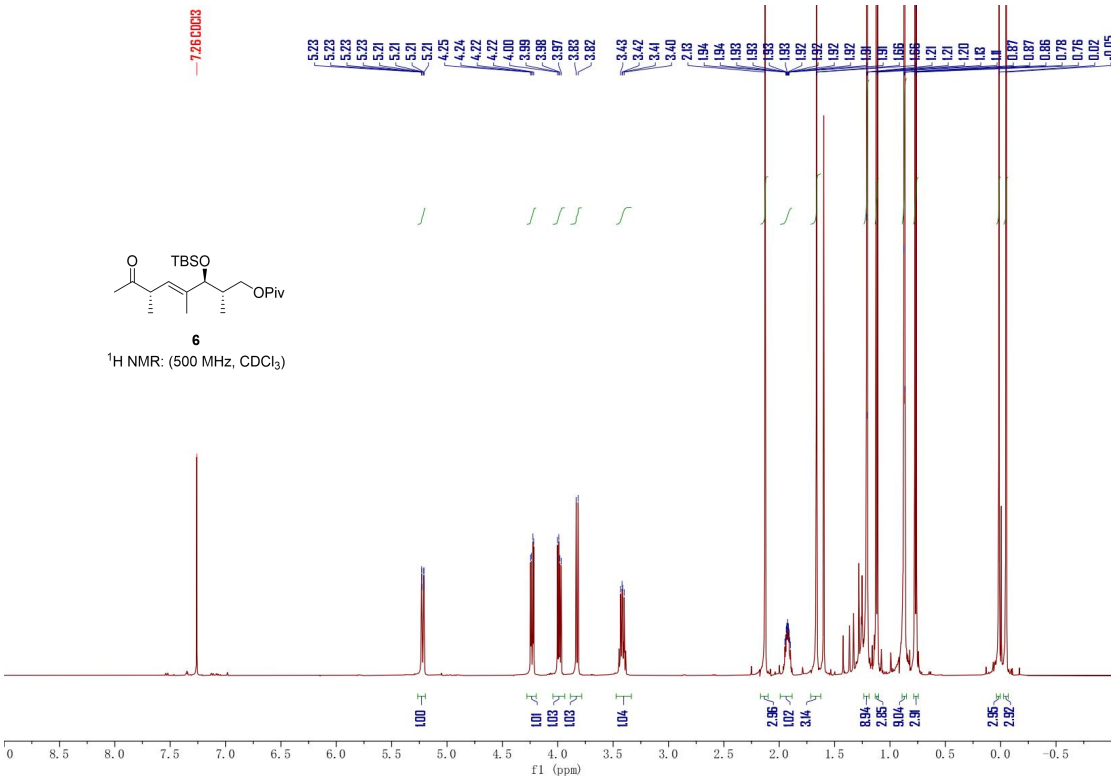

**S22**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



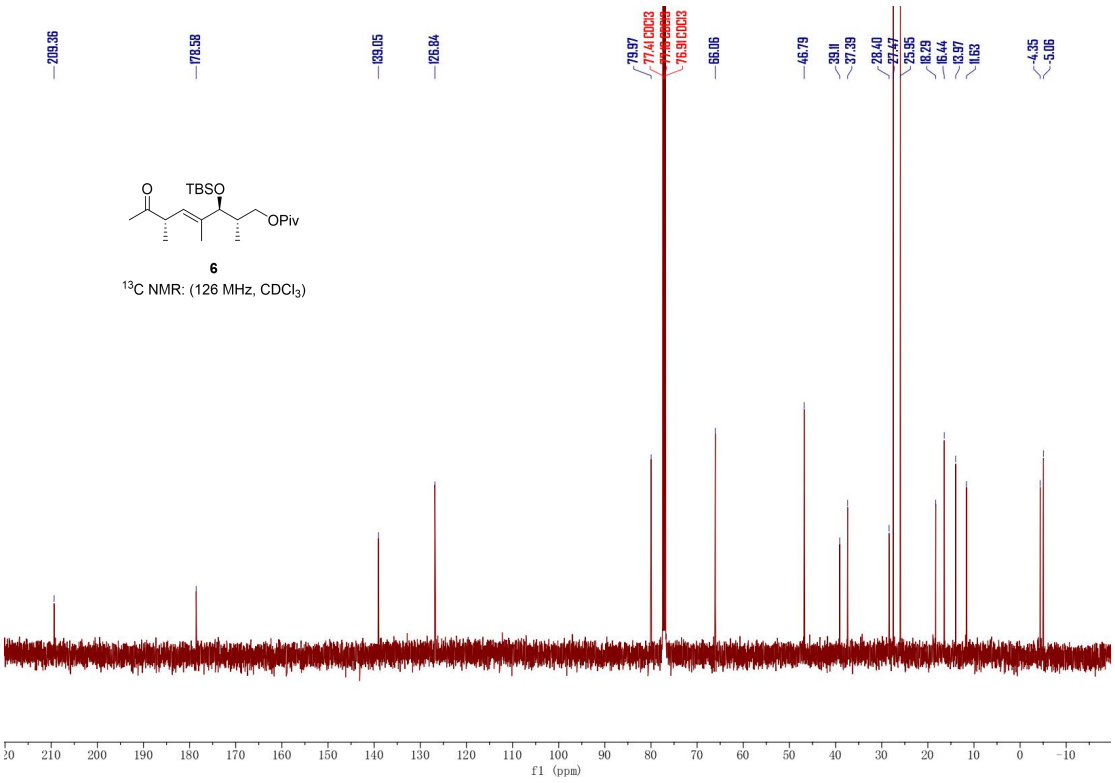

**S22**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



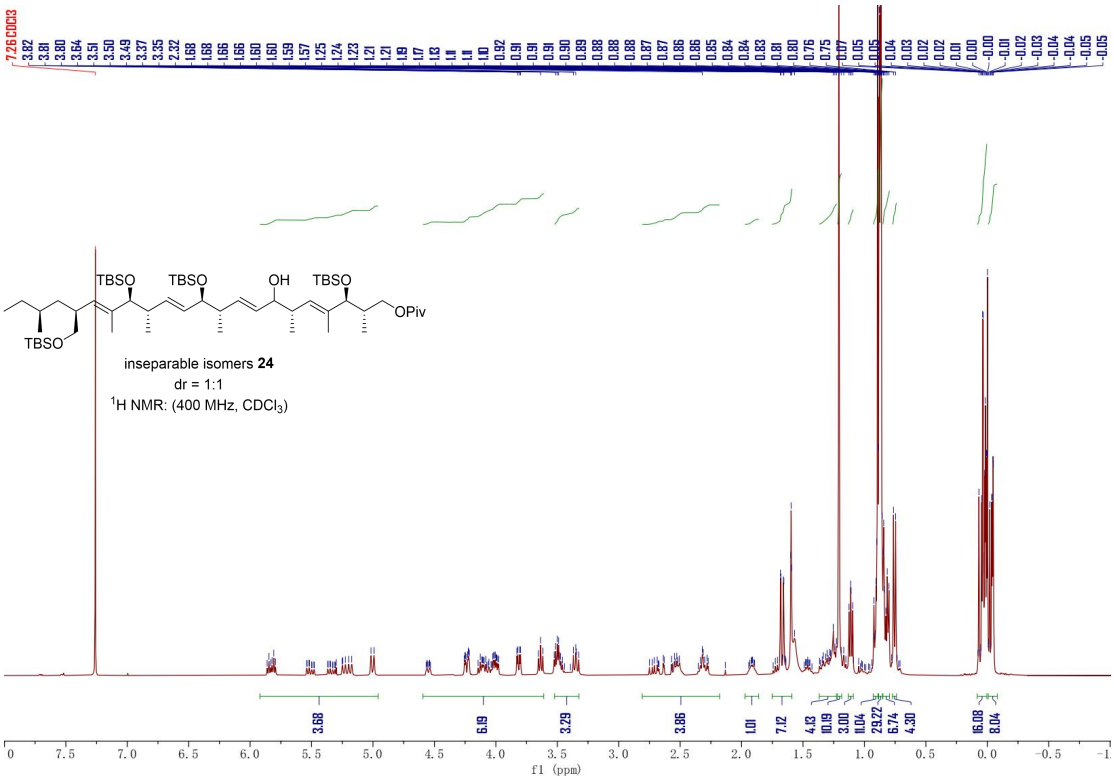

**6**

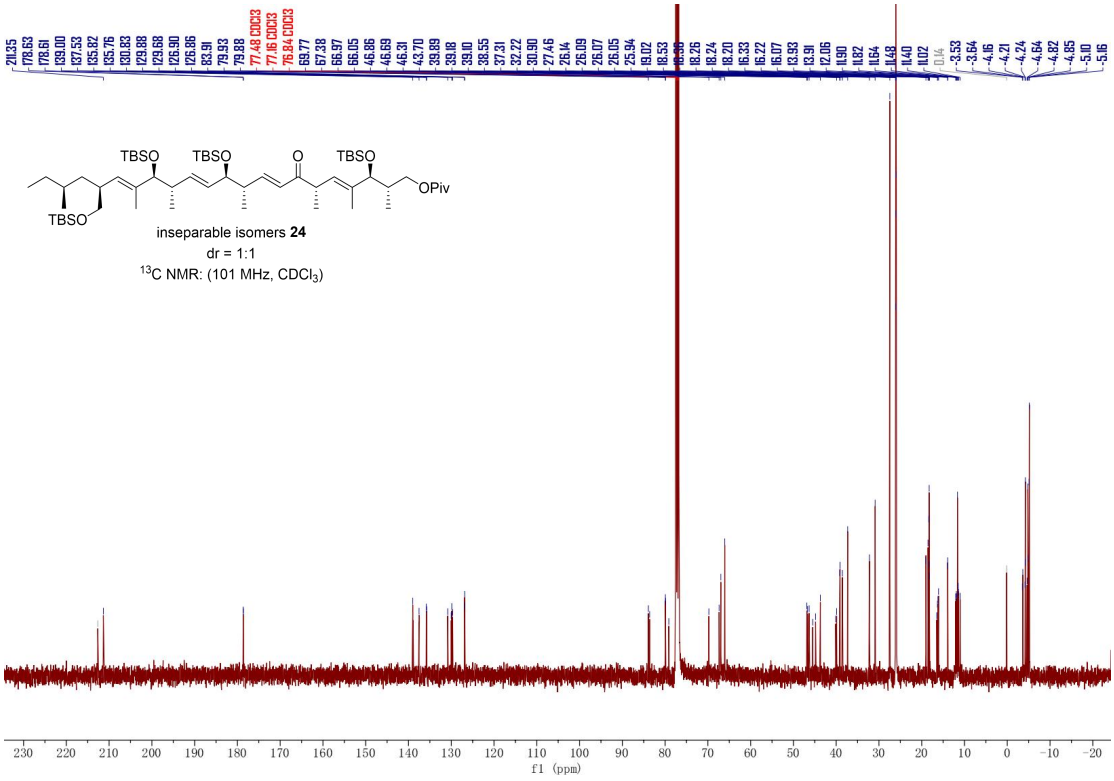
$^{1}$H NMR: (500 MHz, $CDCl_3$)

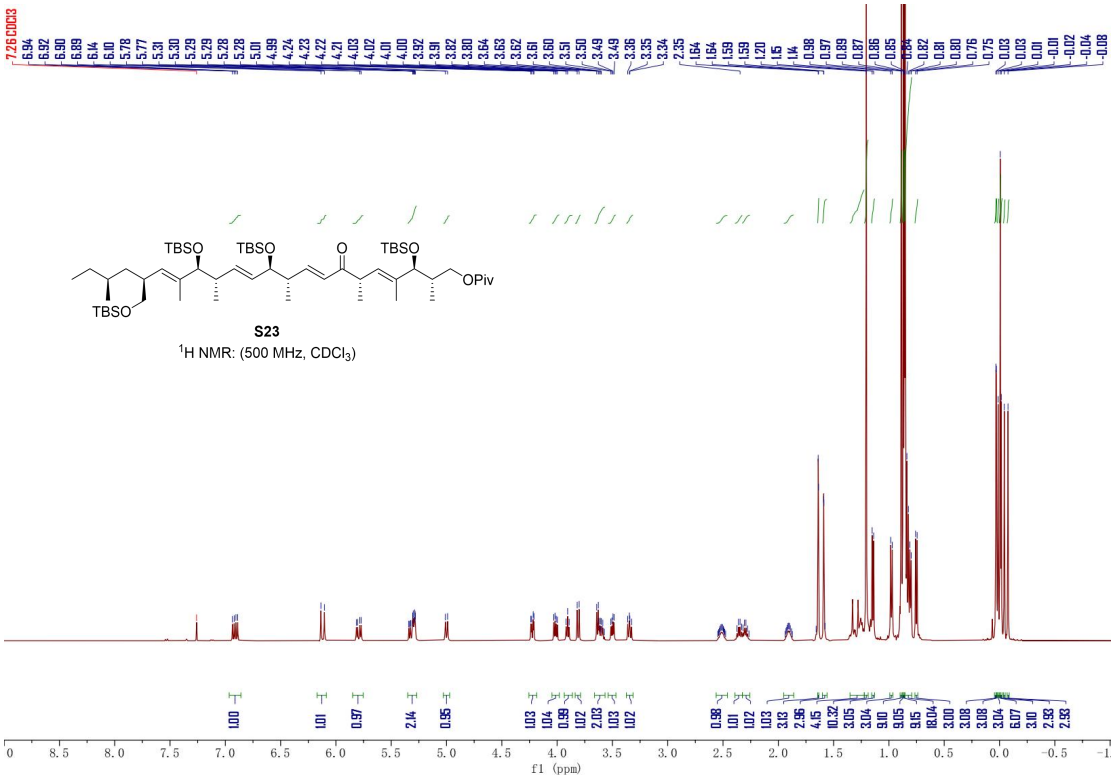



**6**

$^{13}$C NMR: (126 MHz, $CDCl_3$)

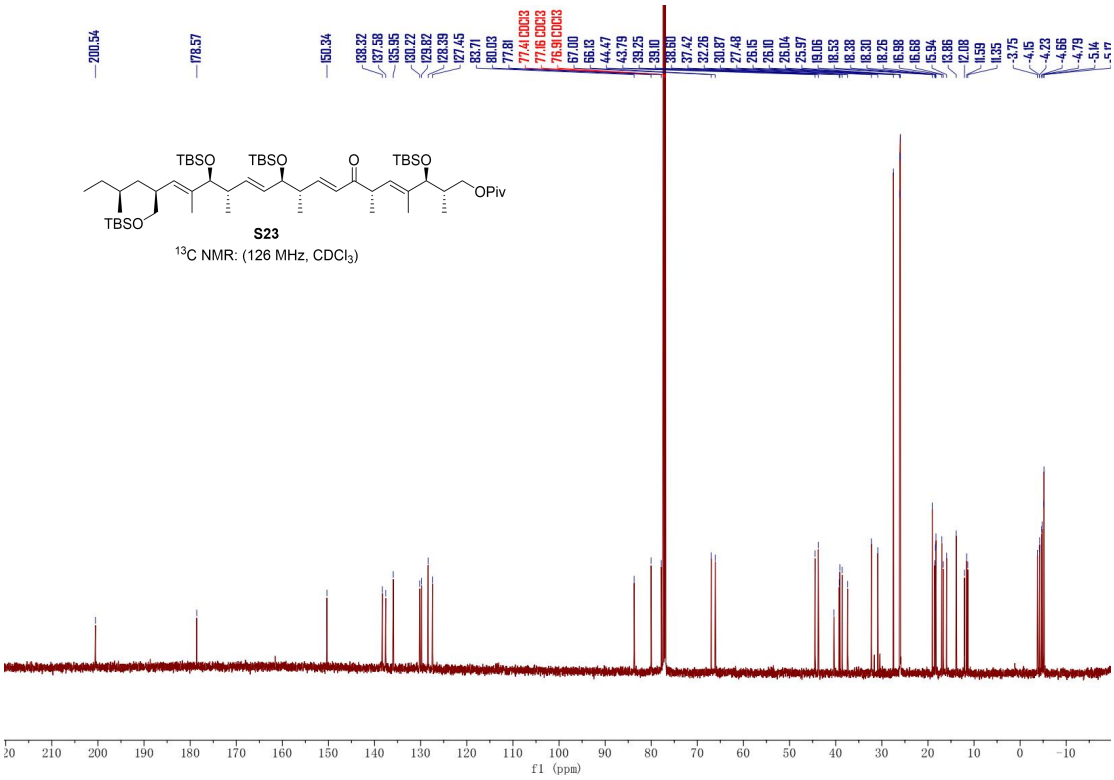

TBSO
TBSO
OH
TBSO
OPiv
TBSO
inseparable isomers 24
dr = 1:1
1H NMR: (400 MHz, CDCl3)
f1 (ppm)


TBSO
TBSO
O
TBSO
OPiv
TBSO
inseparable isomers 24
dr = 1:1
13C NMR: (101 MHz, CDCl3)
f1 (ppm)



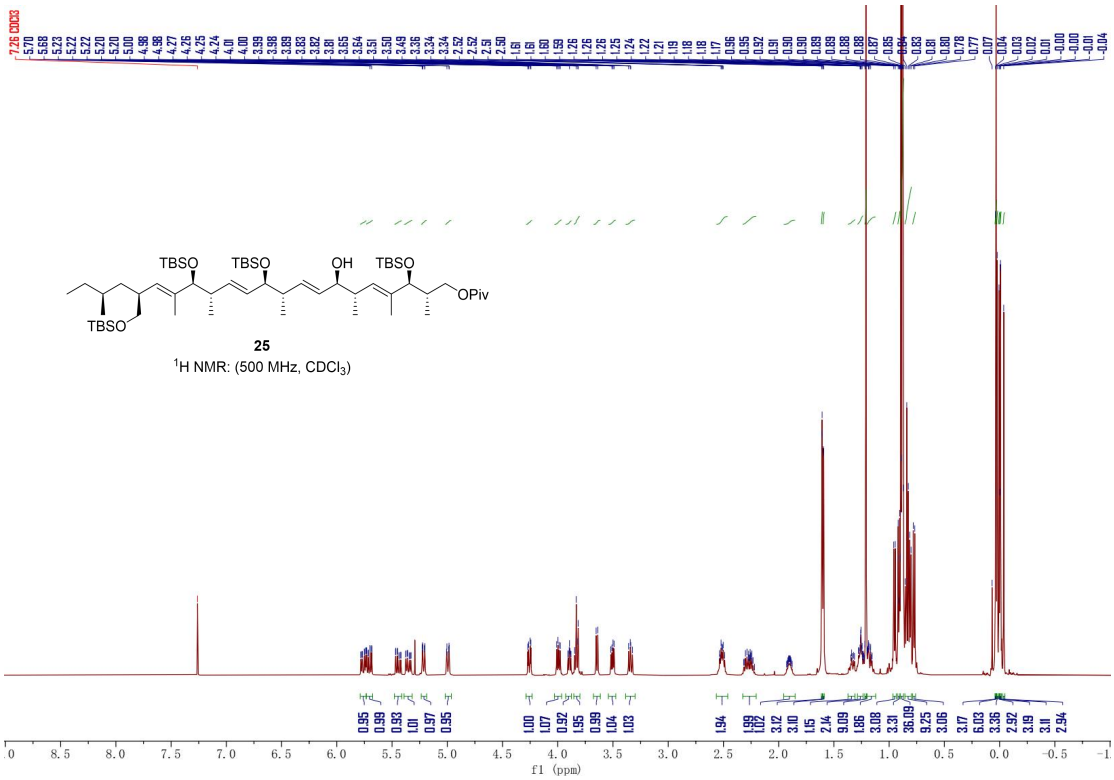

**S23**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



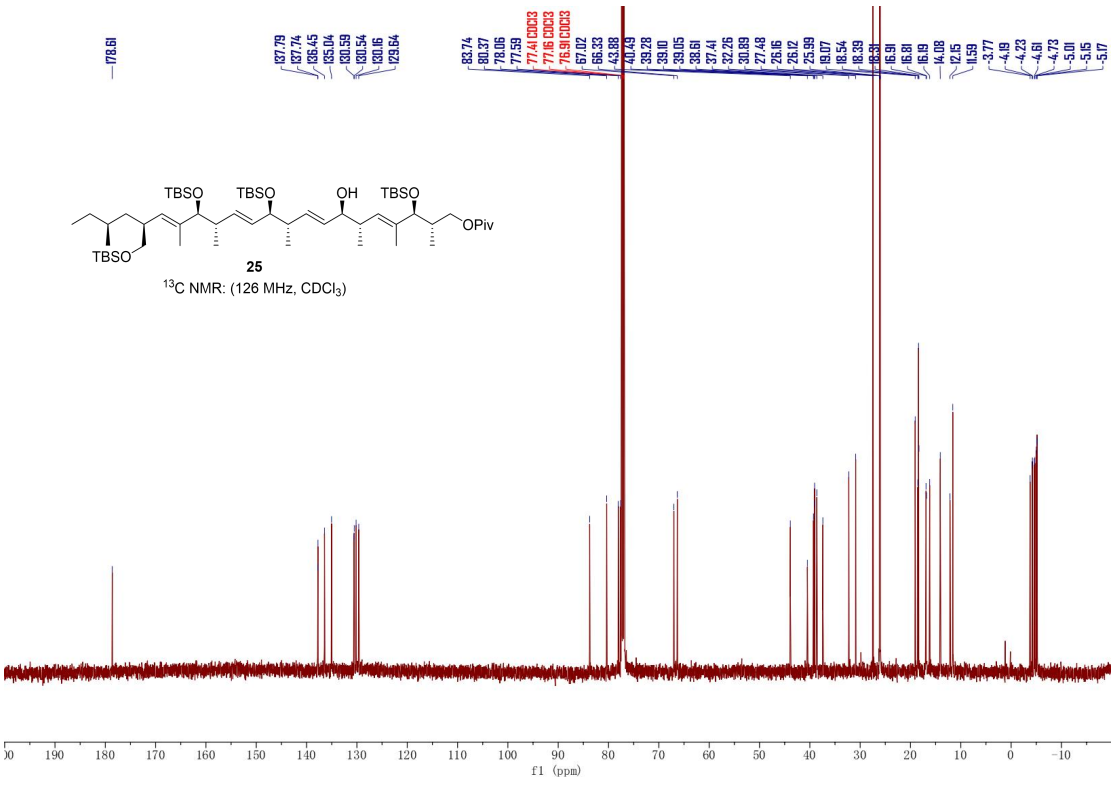

**S23**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



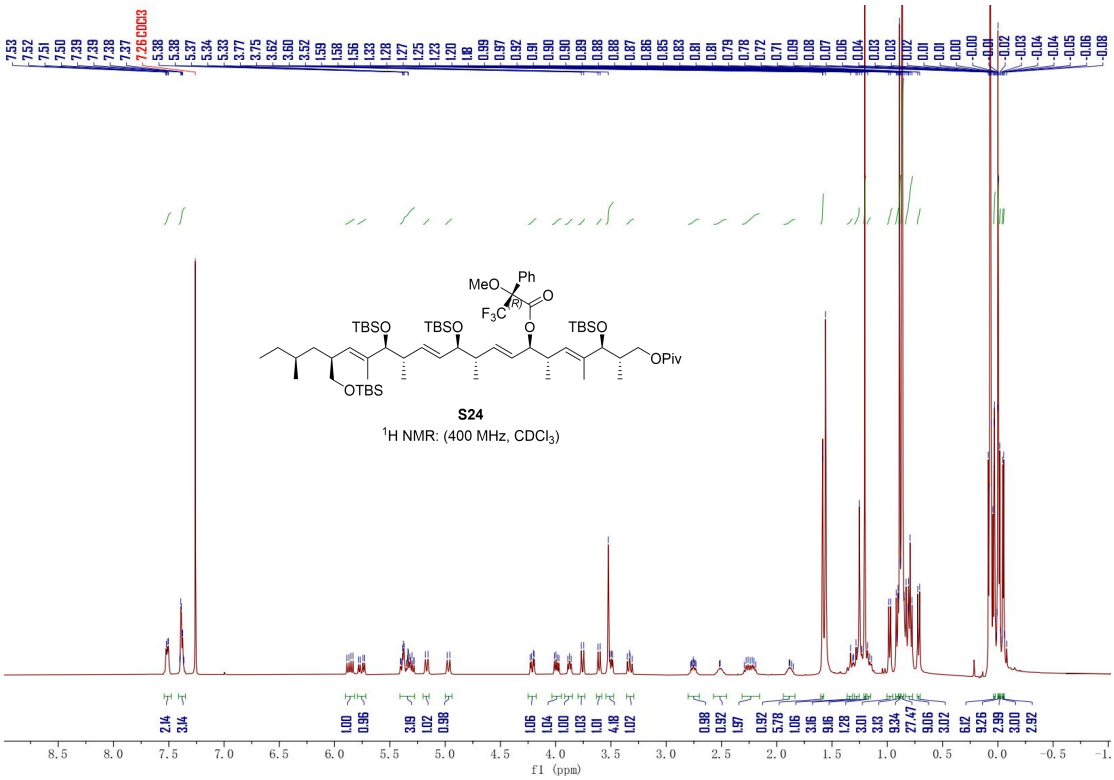

**25**

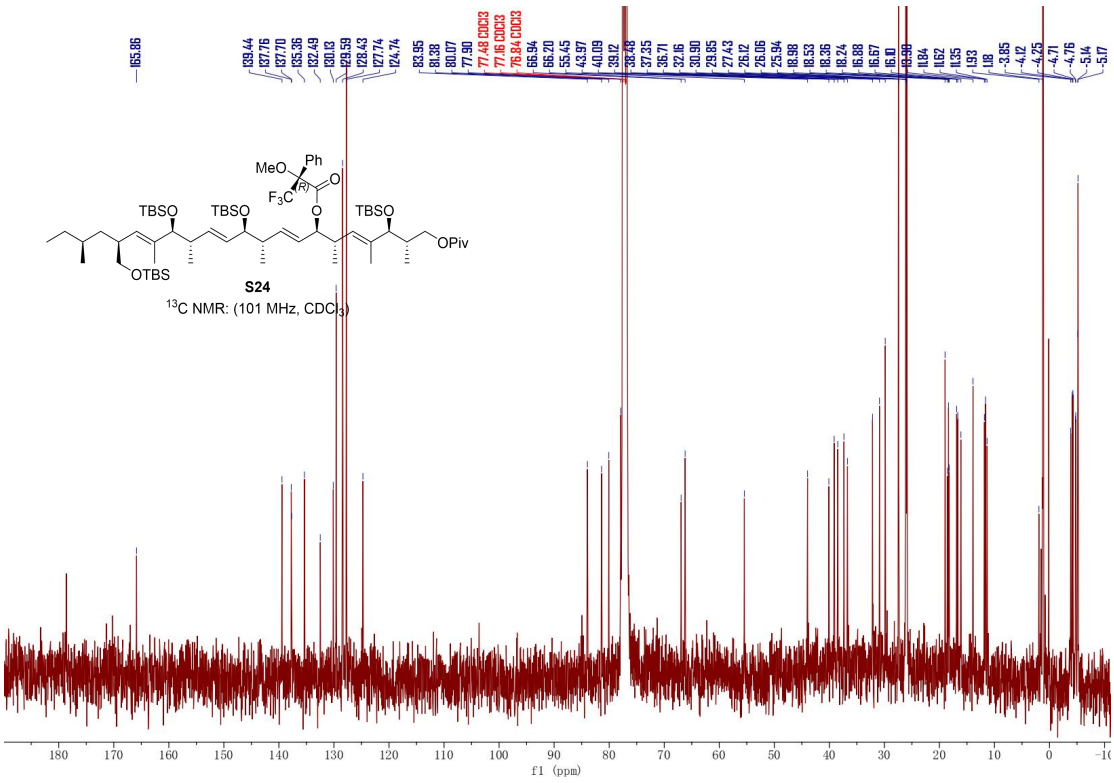
$^{1}$H NMR: (500 MHz, $CDCl_3$)

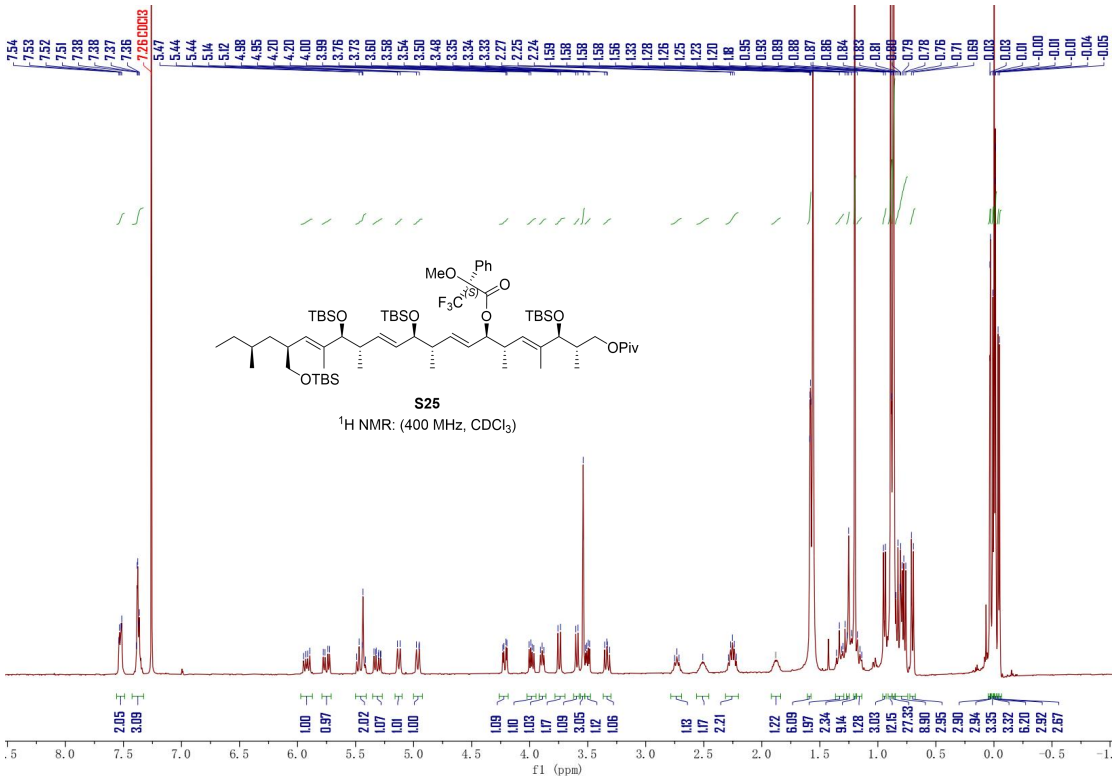



**25**

$^{13}$C NMR: (126 MHz, $CDCl_3$)

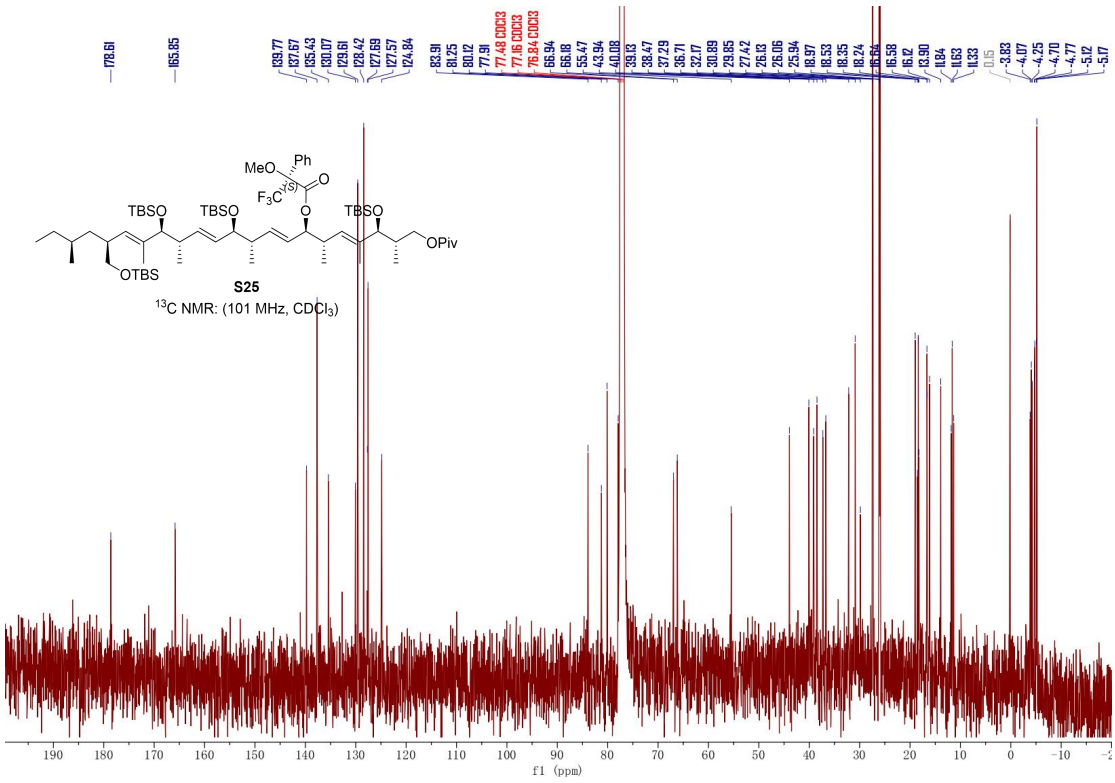

MeO
Ph
F3C
O
TBSO
TBSO
O
TBSO
OPiv
OTBS
S24
1H NMR: (400 MHz, CDCl3)
f1 (ppm)


MeO
Ph
F3C
O
TBSO
TBSO
O
TBSO
OPiv
OTBS
S24
13C NMR: (101 MHz, CDCl3)
f1 (ppm)



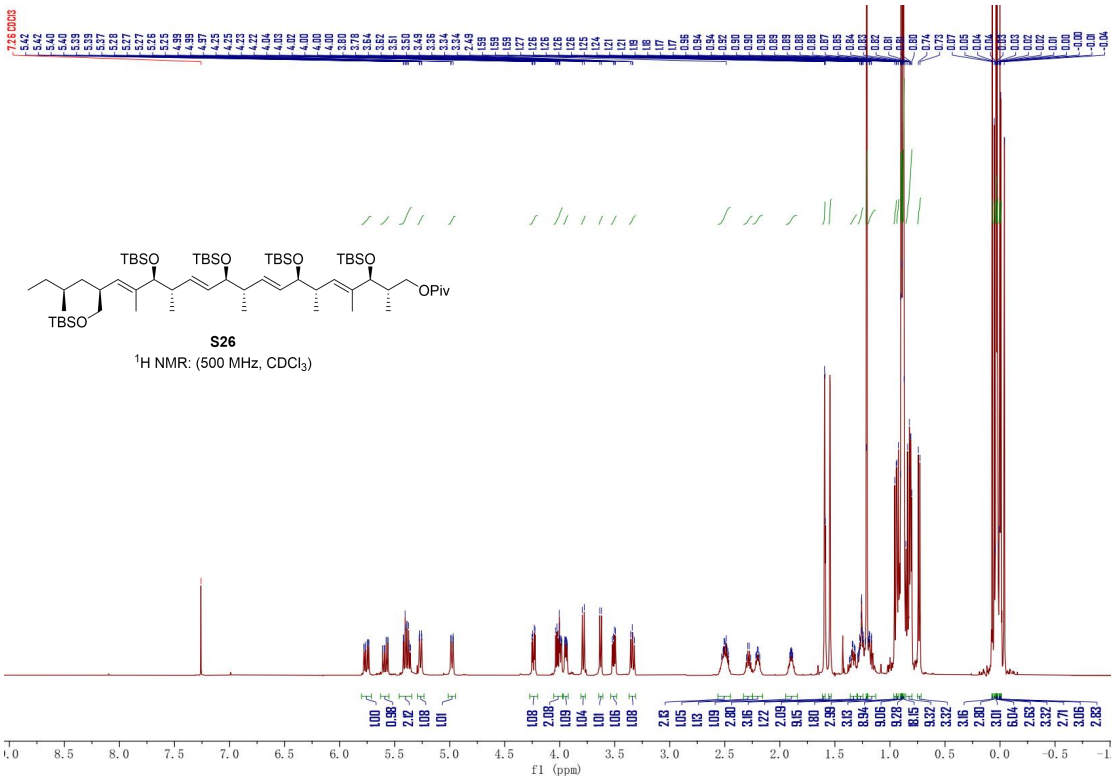

**S25**

$^{1}$H NMR: (400 MHz, $CDCl_3$)



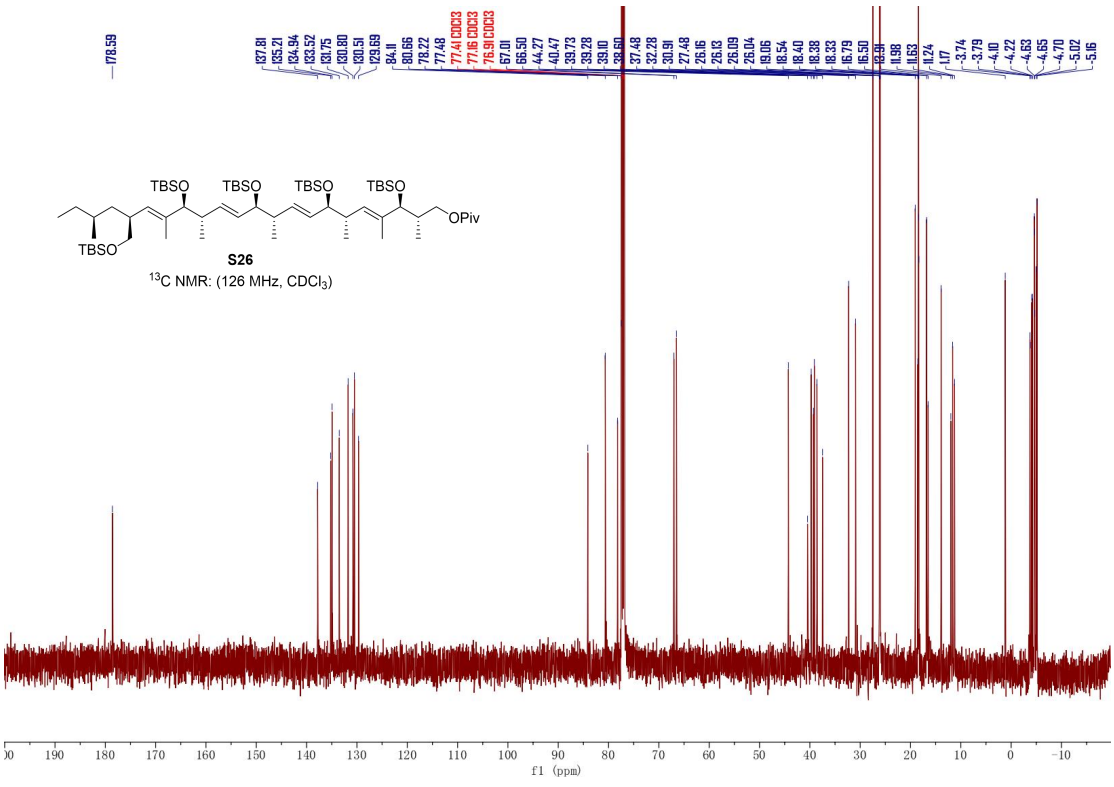

**S25**

$^{13}$C NMR: (101 MHz, $CDCl_3$)



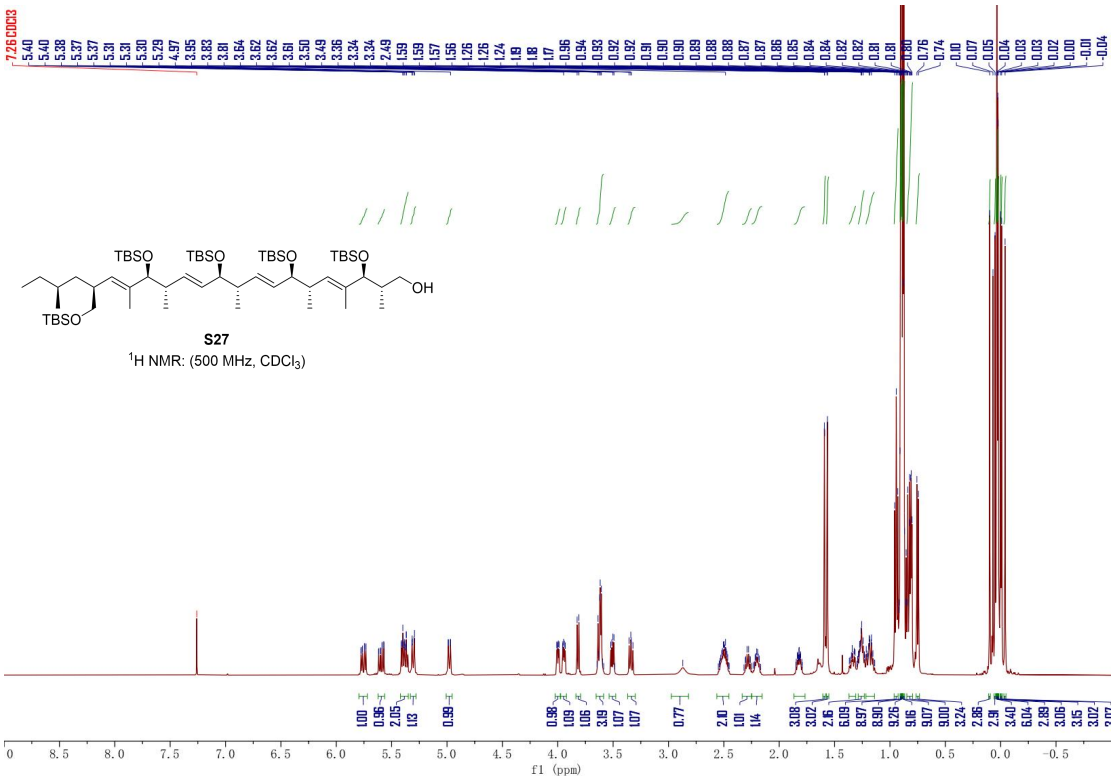

**S26**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



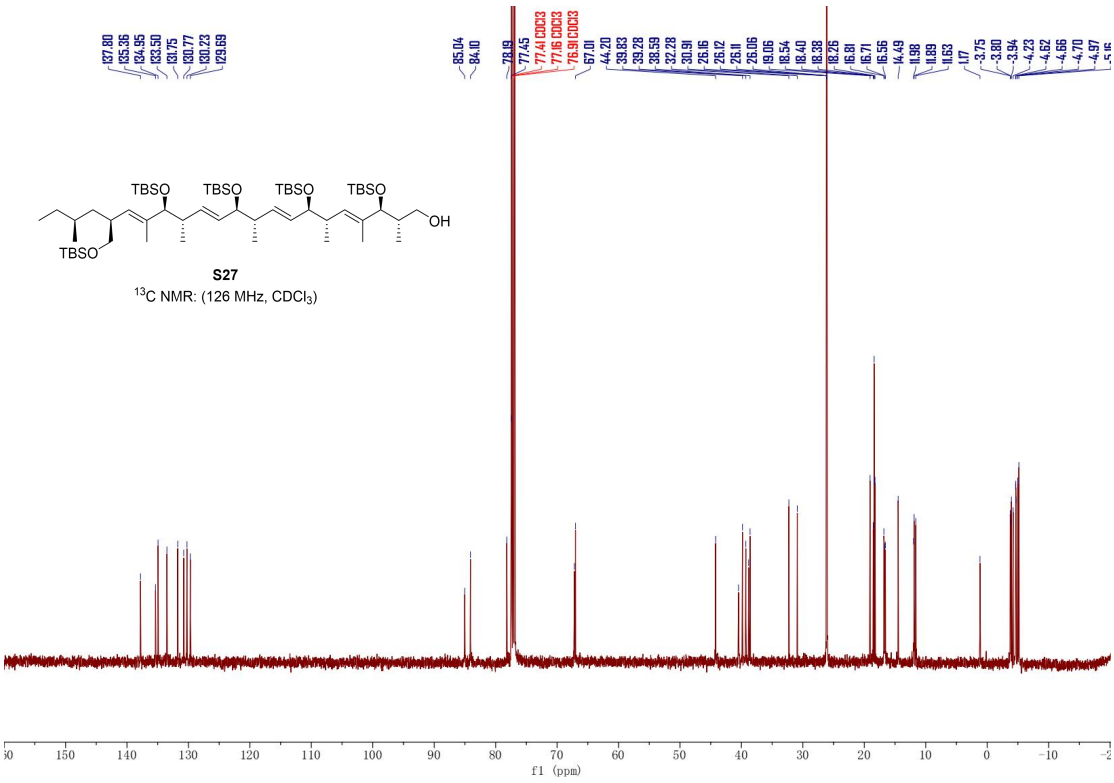

**S26**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



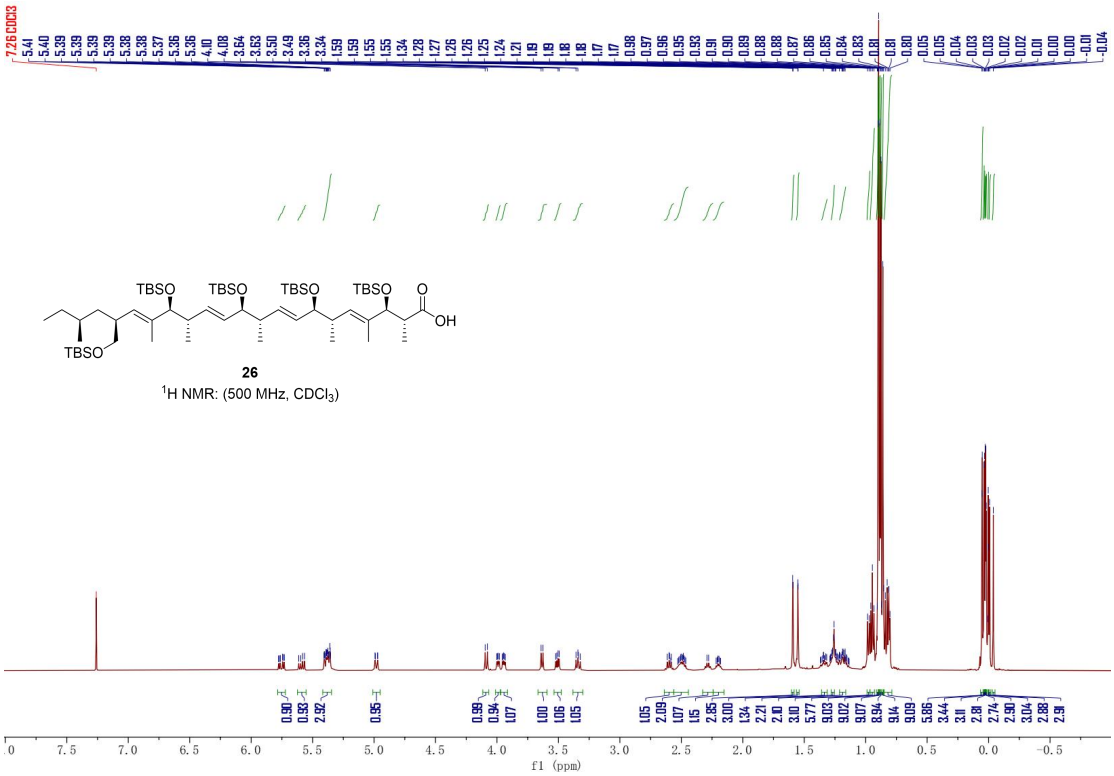

**S27**

$^{1}$H NMR: (500 MHz, $CDCl_3$)



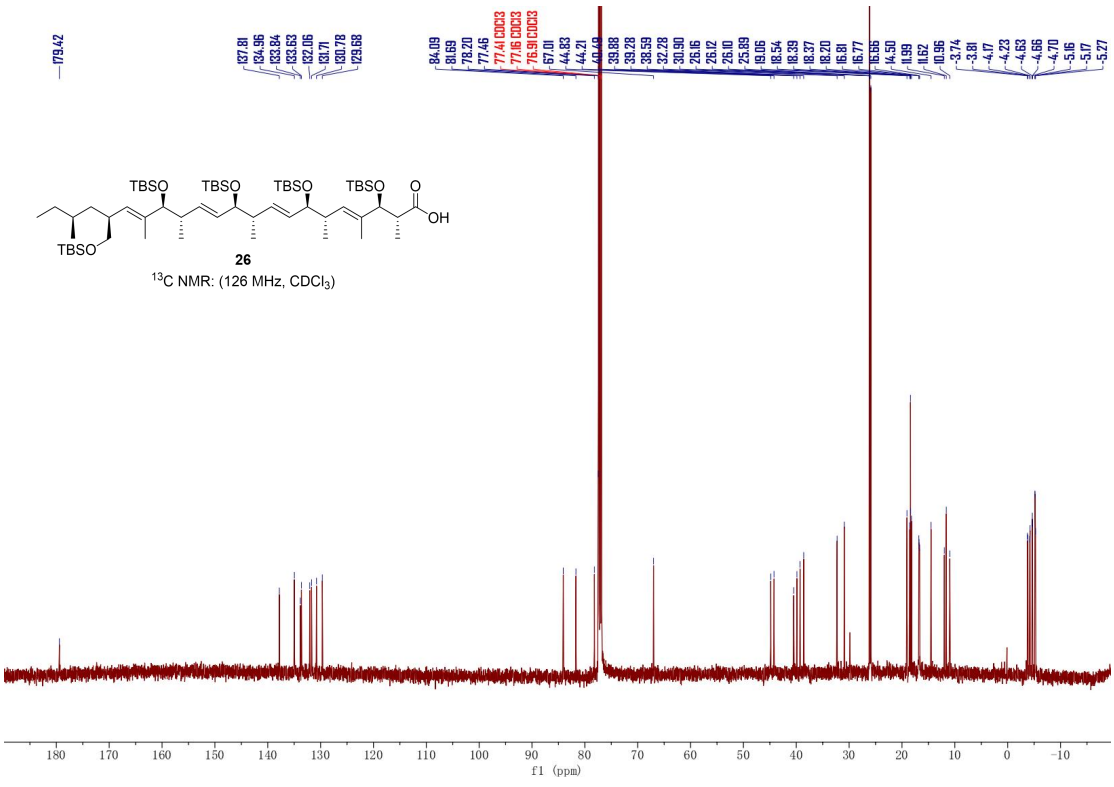

**S27**

$^{13}$C NMR: (126 MHz, $CDCl_3$)



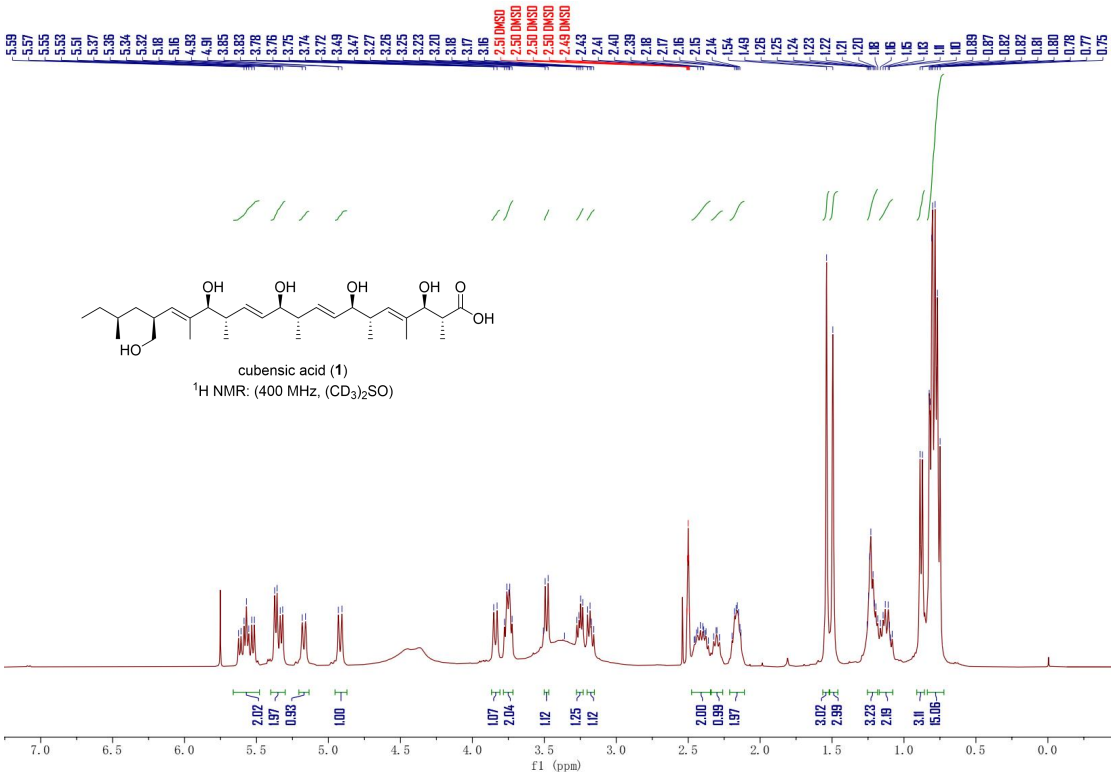

**26**

$^{1}$H NMR: (500 MHz, $CDCl_3$)

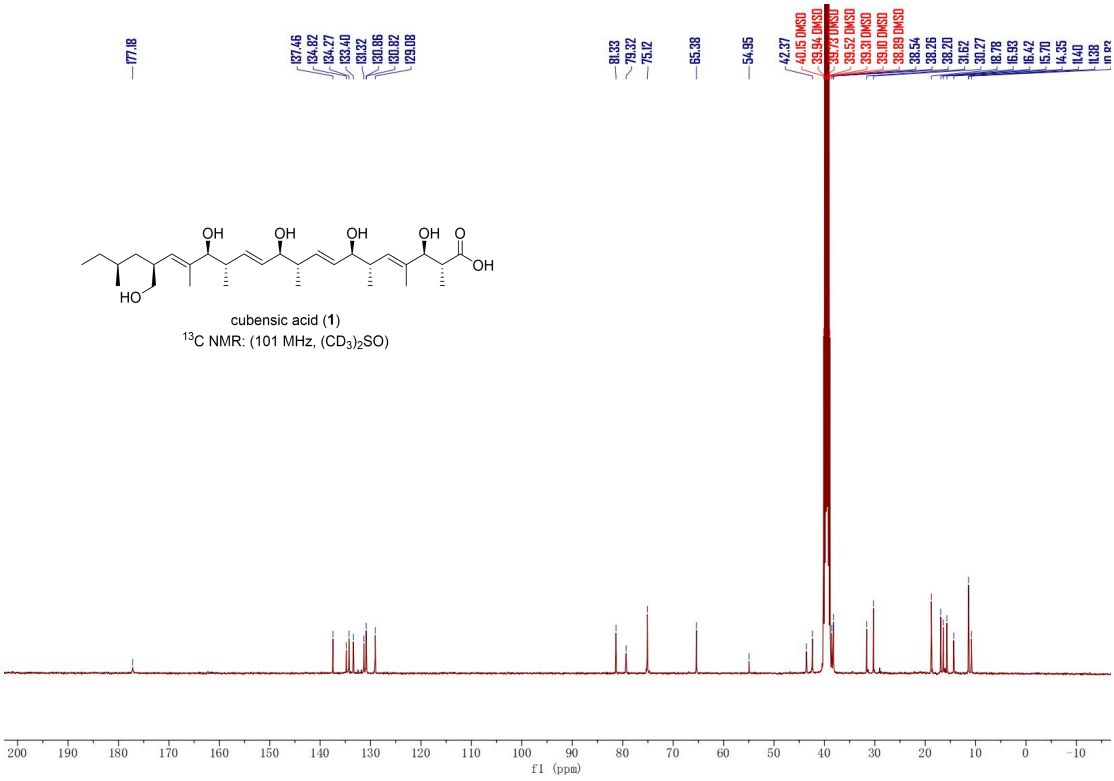



**26**

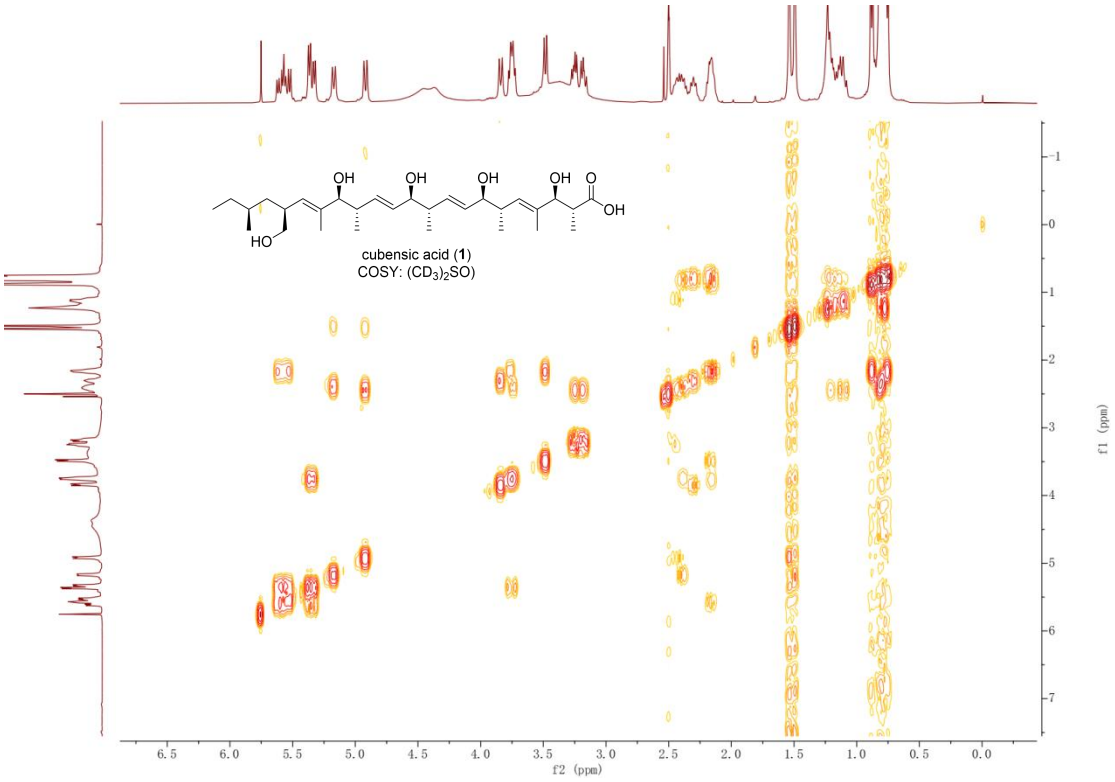
$^{13}$C NMR: (126 MHz, $CDCl_3$)

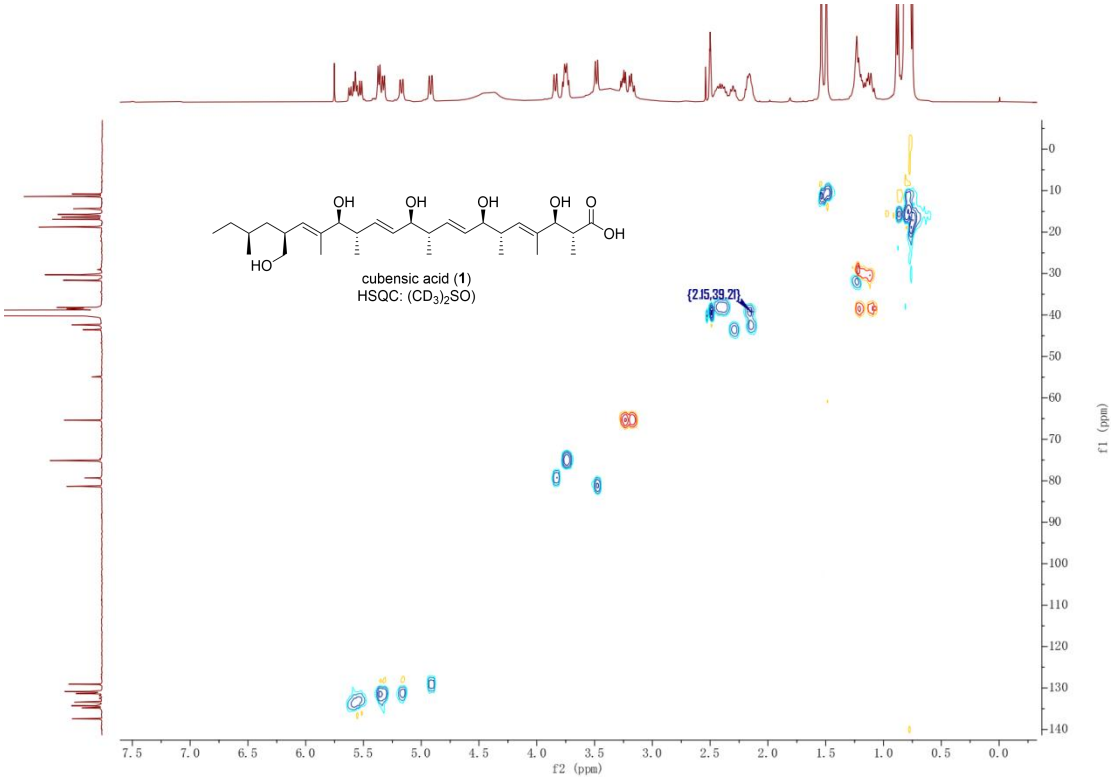


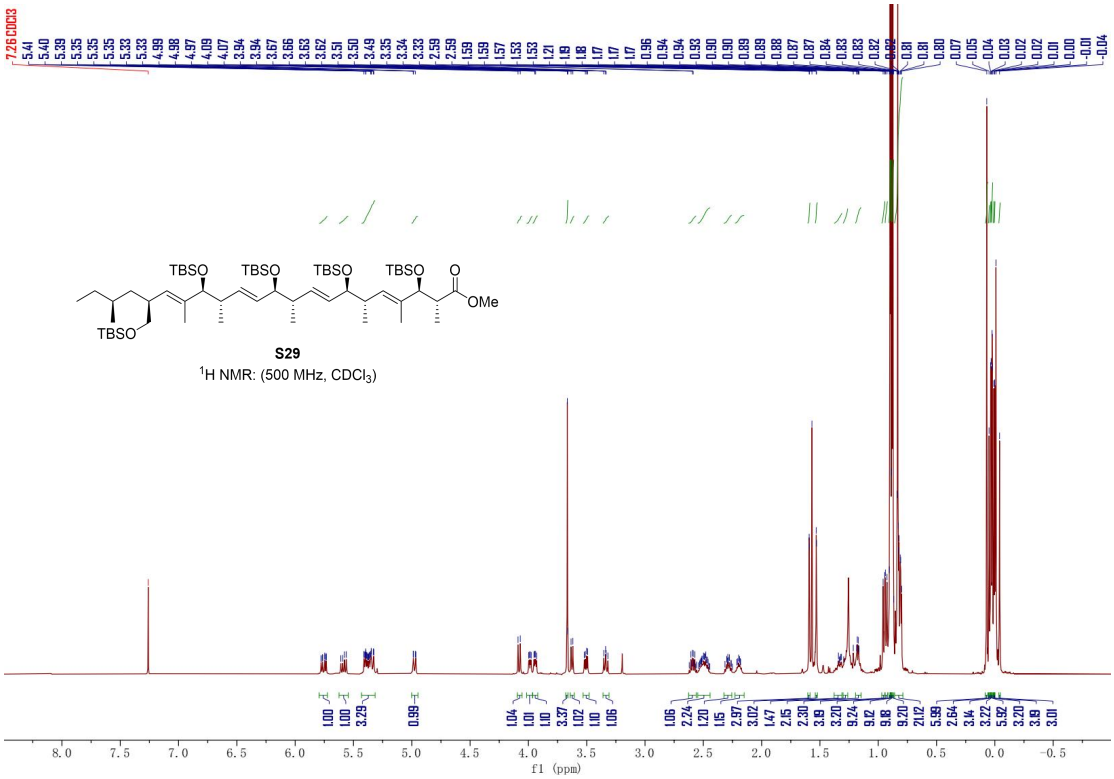

cubensic acid (**1**)
$^{1}$H NMR: (400 MHz, $(CD_3)_2SO$)




cubensic acid (**1**)
$^{13}$C NMR: (101 MHz, $(CD_3)_2SO$)

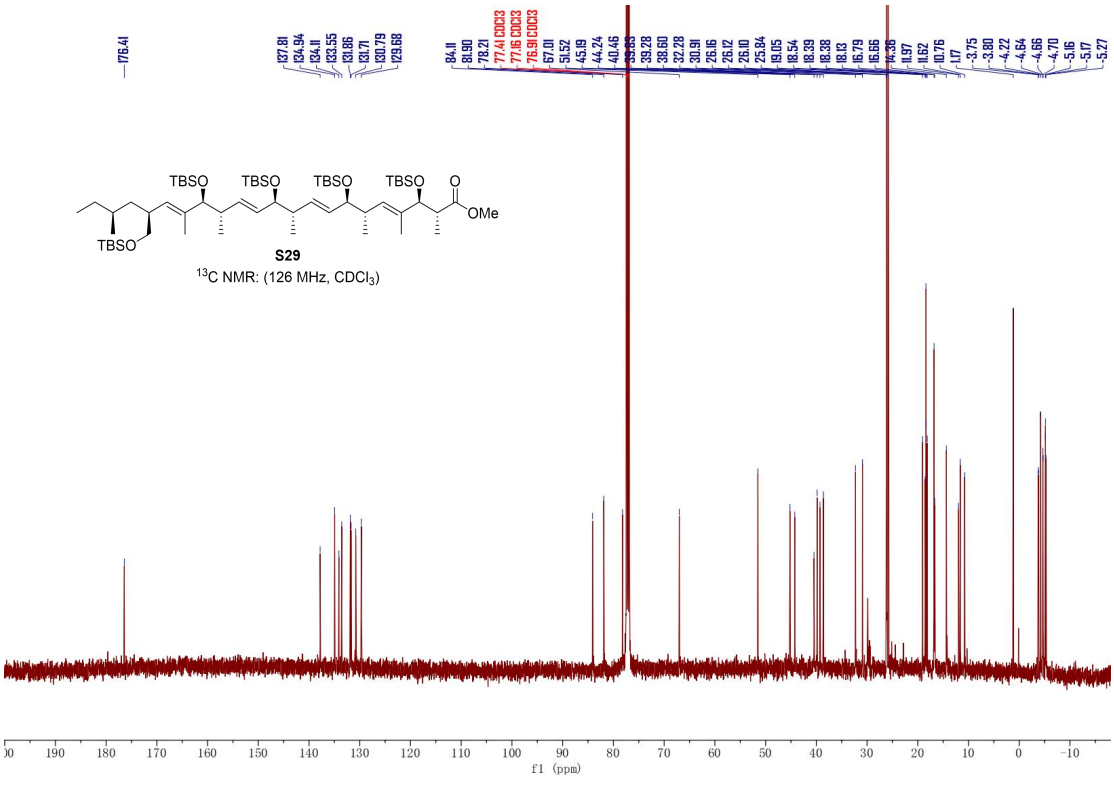

OH
OH
OH
OH
O
OH
HO
cubensic acid (1)
COSY: (CD3)2SO
f2 (ppm)
f1 (ppm)


OH
OH
OH
OH
O
OH
HO
cubensic acid (1)
HSQC: (CD3)2SO
(2.15,39.21)
f2 (ppm)
f1 (ppm)



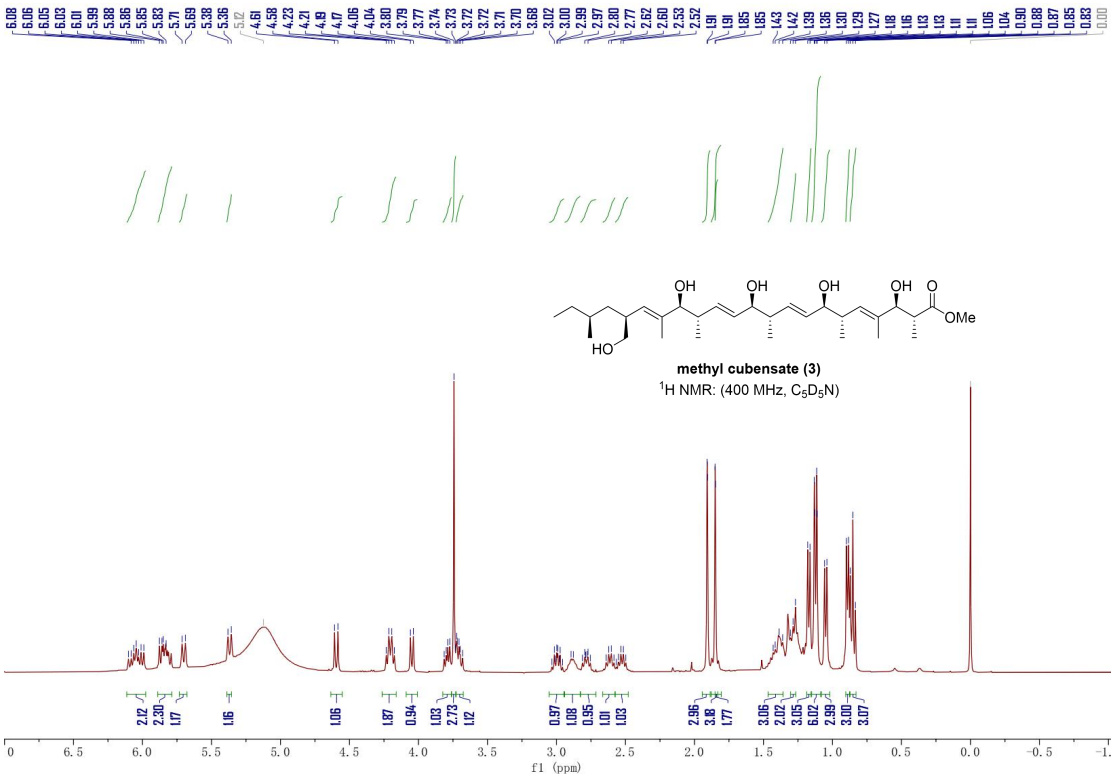

**S29**

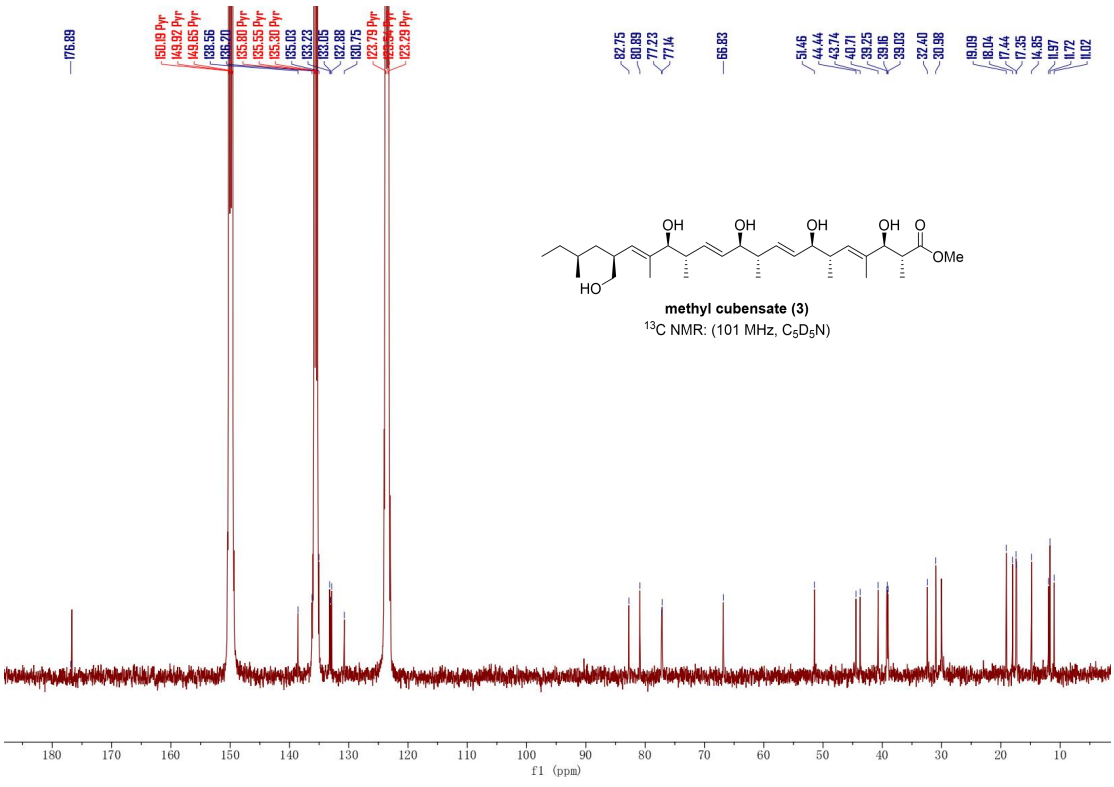
$^{1}$H NMR: (500 MHz, $CDCl_3$)

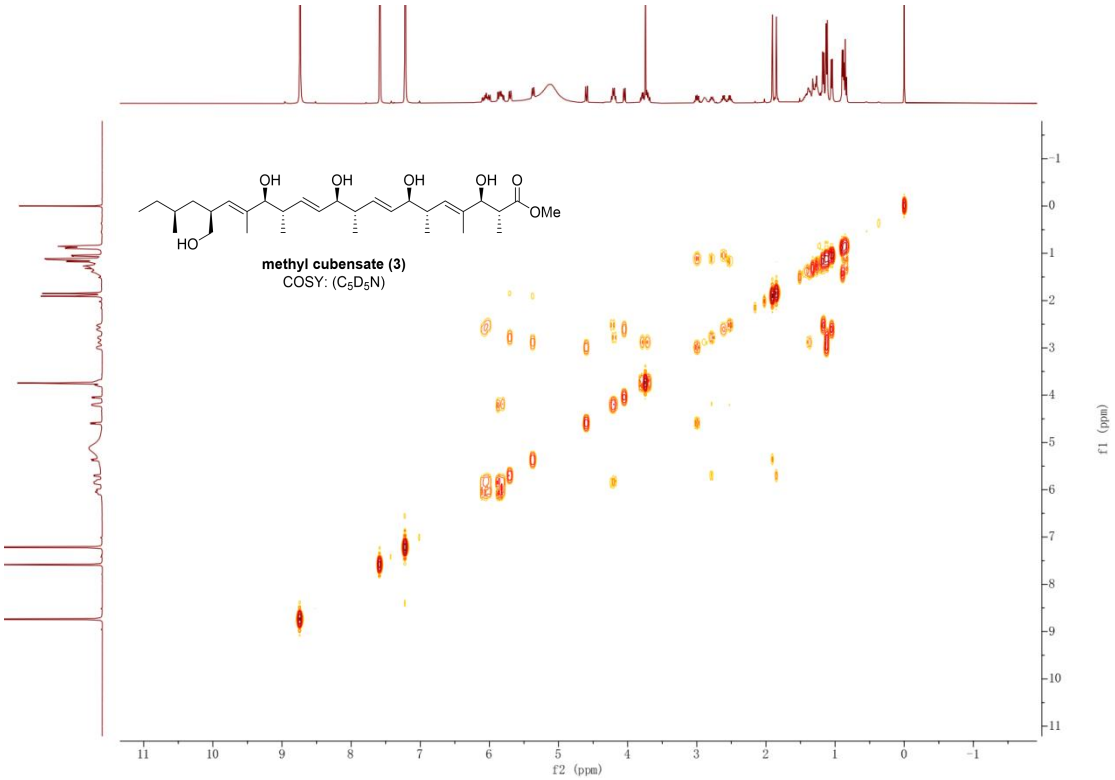


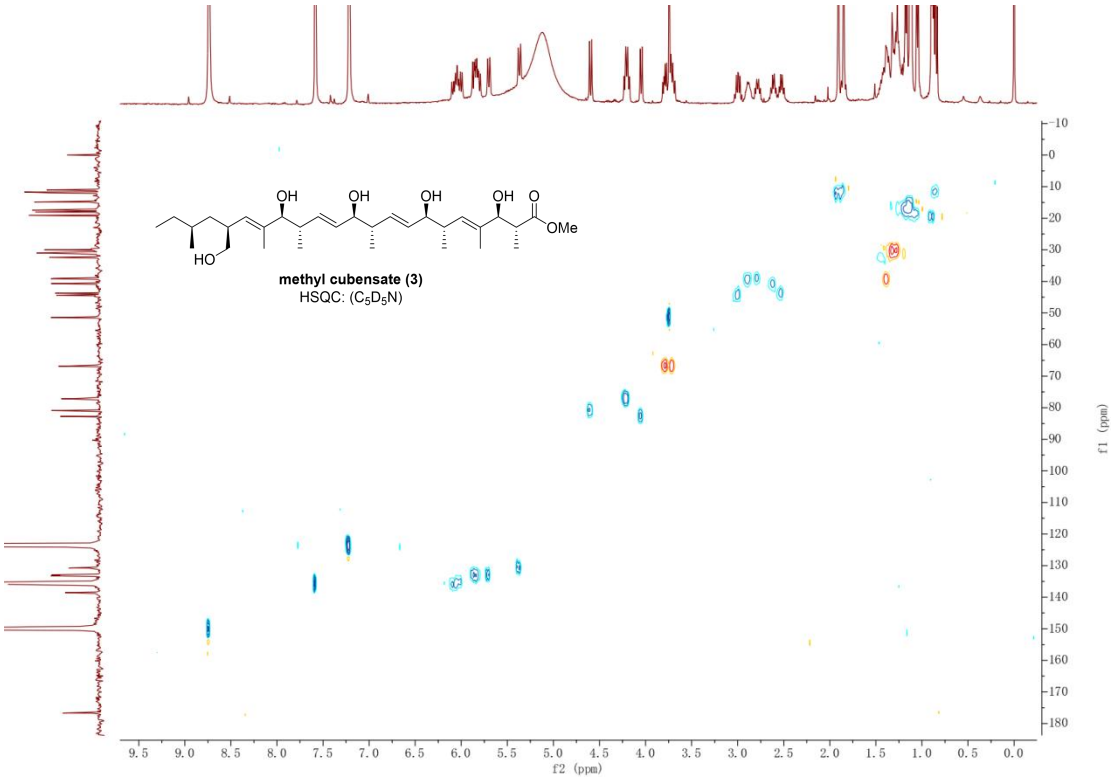

**S29**

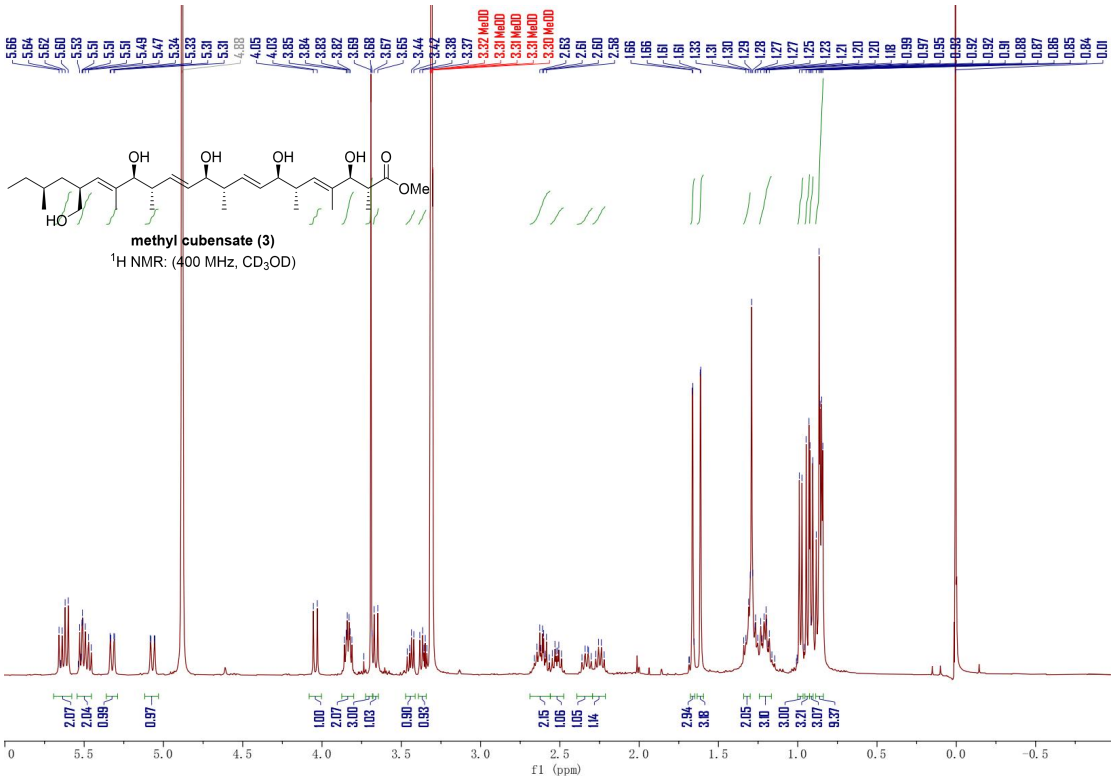
$^{13}$C NMR: (126 MHz, $CDCl_3$)

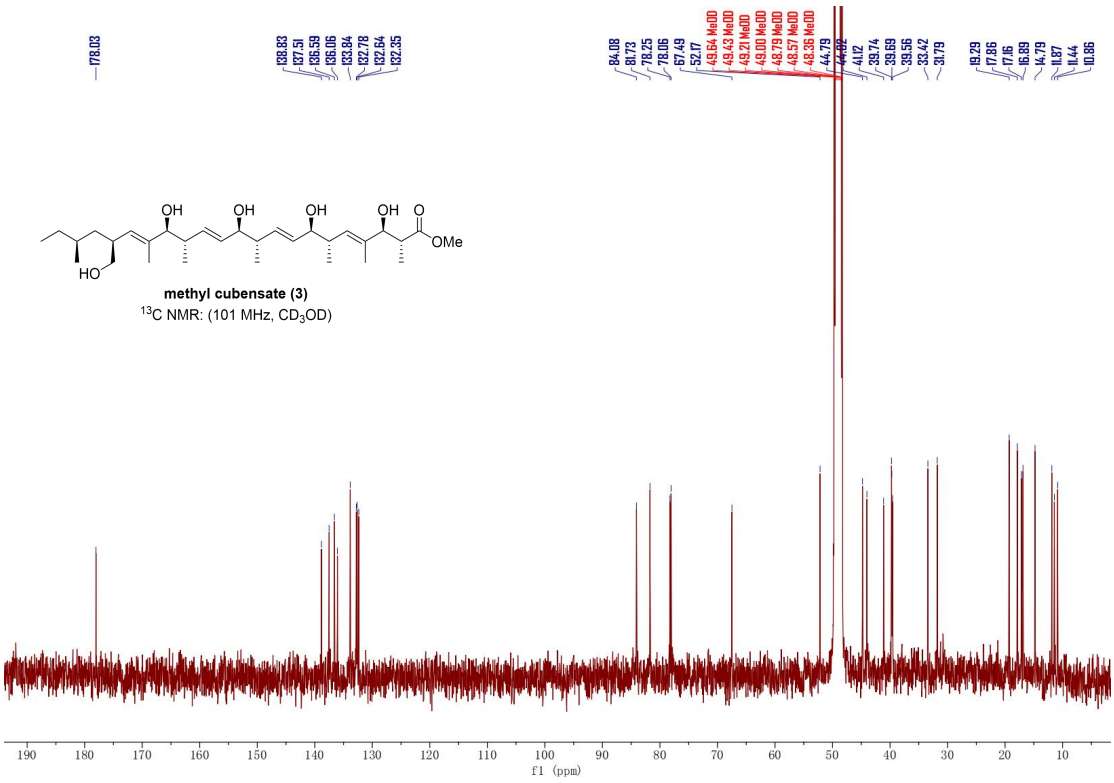

OH
OH
OH
OH
O
OMe
HO
methyl cubensate (3)
$^{1}$H NMR: (400 MHz, $C_5D_5N$)
f1 (ppm)

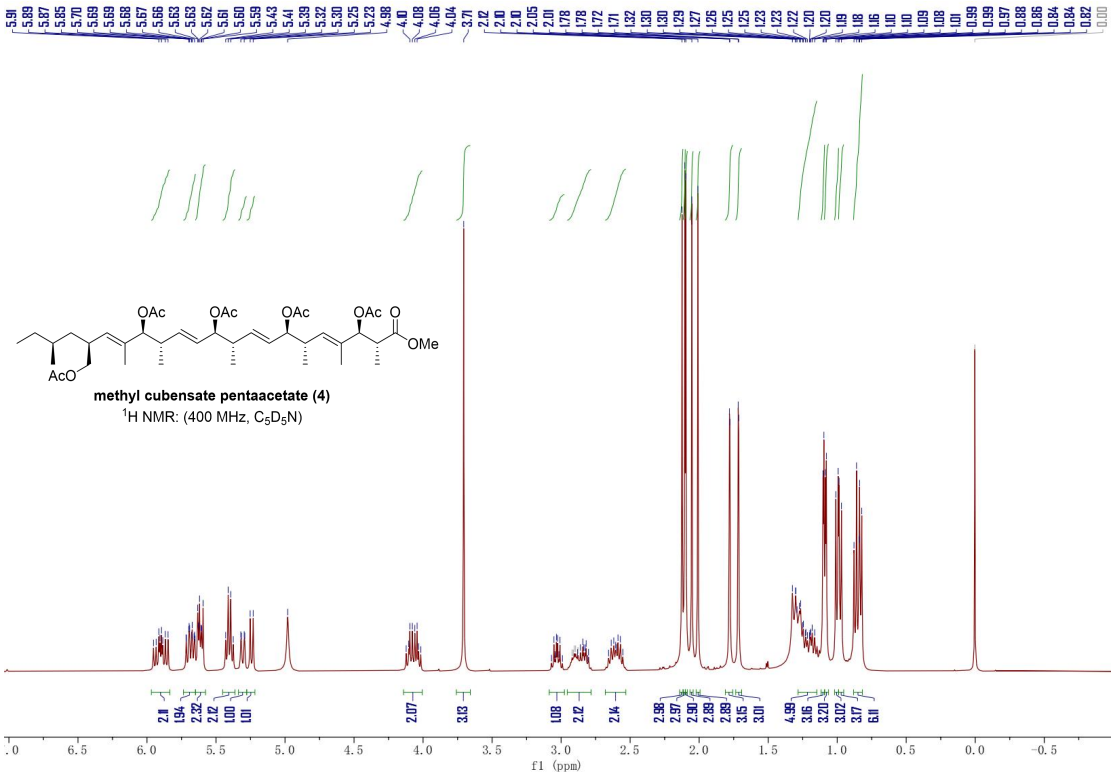

OH
OH
OH
OH
O
OMe
HO
methyl cubensate (3)
$^{13}$C NMR: (101 MHz, $C_5D_5N$)
f1 (ppm)


OH
OH
OH
OH
O
OMe
HO
methyl cubensate (3)
COSY: (C5D5N)
f2 (ppm)
f1 (ppm)


OH
OH
OH
OH
O
OMe
HO
methyl cubensate (3)
HSQC: (C5D5N)
f2 (ppm)
f1 (ppm)

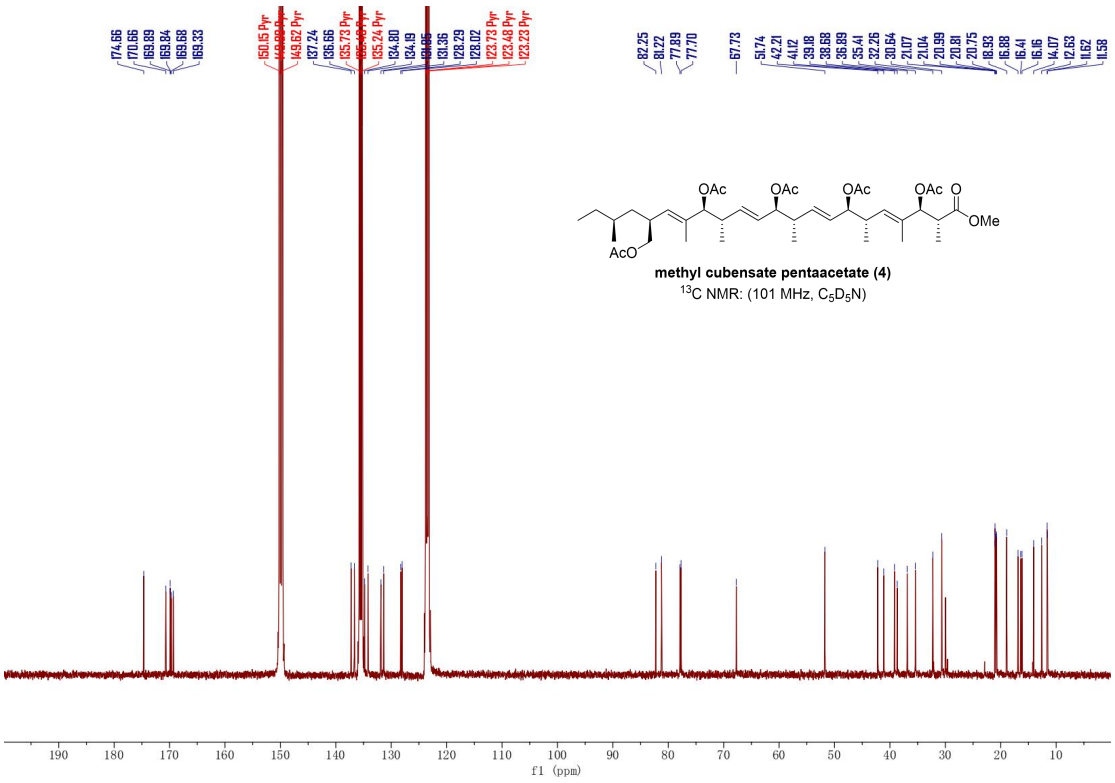

OH
OH
OH
OH
O
OMe
HO
methyl cubensate (3)
1H NMR: (400 MHz, CD3OD)
f1 (ppm)


OH
OH
OH
OH
O
OMe
HO
methyl cubensate (3)
13C NMR: (101 MHz, CD3OD)
f1 (ppm)



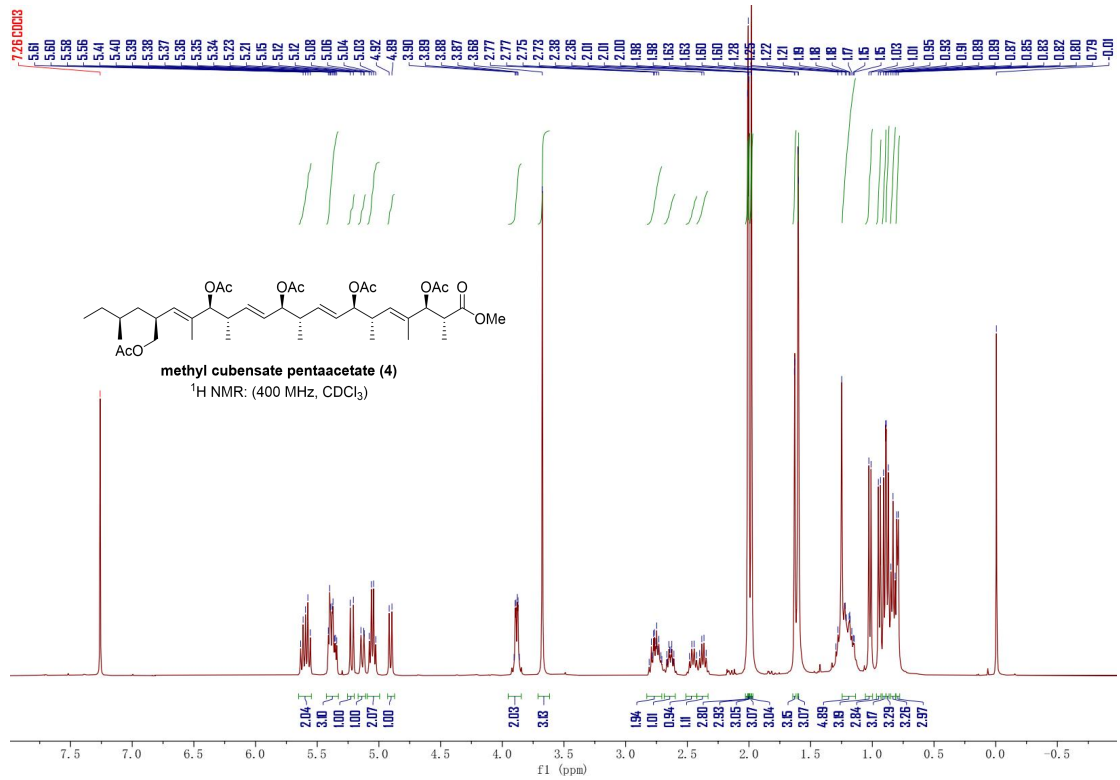

**methyl cubensate pentaacetate (4)**

$^{1}$H NMR: (400 MHz, $C_5D_5N$)



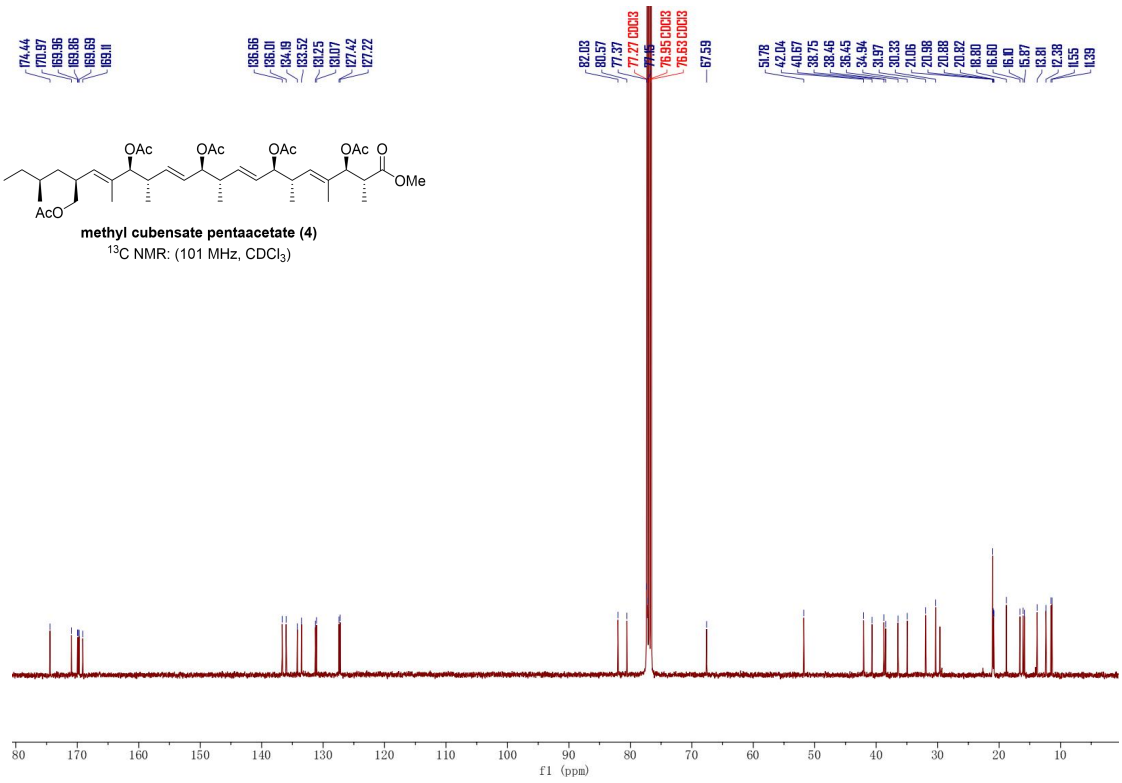

**methyl cubensate pentaacetate (4)**

$^{13}$C NMR: (101 MHz, $C_5D_5N$)




**methyl cubensate pentaacetate (4)**

$^{1}$H NMR: (400 MHz, $CDCl_3$)




**methyl cubensate pentaacetate (4)**

$^{13}$C NMR: (101 MHz, $CDCl_3$)