Supporting Information

Formal Total Synthesis of Macarpine via a Au(I)-Catalyzed 6-endo-dig Cycloisomerization Strategy

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1. General Information

Unless otherwise stated, the reagents were commercially available and can be used without further purification. THF and Et₂O were distilled from sodium under a nitrogen atmosphere. DCM was distilled from calcium hydride (CaH) under a nitrogen atmosphere. TLC analysis of the reaction mixture was performed on Dynamicadsorbents silica F-254 TLC plates. Flash column chromatography was performed on Zeoprep 60 (200-300 mesh) silica gel. ¹H and ¹³C NMR spectra were recorded on a Bruker Avance-III 600 spectrometer with reference to CDCl₃ and DMSO-d₆. HR-ESI-MS were recorded on Bruker micro-TOFQ-Q instrument. IR spectra were recorded on Bruker IFS 55 spectrometer. Melting points were tested on Thomas Hoover capillary melting point apparatus.

2. General Procedures for the Preparation of 3-5, 8-12 and Characterization Data

In a manner analogous to literature[¹¹-¹⁹] to afford the product 3 (14.40 g, 58.55 mmol, 89%) and data are in agreement with those reported in literature.[²¹-²⁸]

6-((Trimethylsilyl)ethynyl)benzo[d][1,3]dioxole-5-carbaldehyde (3)

1-(6-((Trimethylsilyl)ethynyl)benzo[d][1,3]dioxol-5-yl)ethan-1-ol (4)
In a manner analogous to literature\[^{[s20]}\] to afford the product 4 (2.02 g, 7.70 mmol, 99%) as a yellow oily liquid (EtOAc/petroleum ether = 1:10); \(^1\)H NMR (600 MHz, DMSO-\(d_6\)) \(\delta\) 7.04 (s, 1H), 6.88 (s, 1H), 6.07 – 5.99 (m, 2H), 5.23 (d, \(J = 4.2\) Hz, 1H), 5.03 (dd, \(J = 6.3, 4.3\) Hz, 1H), 1.26 (d, \(J = 6.4\) Hz, 3H), 0.26 – 0.17 (m, 9H); \(^1^3\)C NMR (150 MHz, DMSO-\(d_6\)) \(\delta\) 147.95, 145.62, 145.11, 110.99, 110.07, 104.89, 102.87, 101.00, 96.79, 65.61, 39.58, 39.45, 39.24, 39.10, 38.89, 38.68, 24.43, -0.46; IR (thin film, cm\(^{-1}\)): 2944, 2832, 1663, 1483, 1449, 1371, 1252, 1114, 1020, 857, 846; HRMS (ESI): \(m/z\) Calcd. for \(C_{14}H_{19}O_3Si\) \([M+H]^+\) 263.1098, Found 263.1090.

1-(6-Ethynylbenzo[d][1,3]dioxol-5-yl)ethan-1-one (5)

In a manner analogous to literature\[^{[s21]}\] to afford the product 5 (487 mg, 2.60 mmol, 96% for 2 steps) as a yellow oily liquid (EtOAc/petroleum ether = 1:15); \(^1\)H NMR (600 MHz, DMSO-\(d_6\)) \(\delta\) 7.32 (s, 1H), 7.10 (s, 1H), 6.15 (s, 2H), 4.34 (s, 1H), 2.58 (s, 3H); \(^1^3\)C NMR (150 MHz, DMSO-\(d_6\)) \(\delta\) 197.99, 150.21, 148.48, 136.65, 115.31, 113.71, 109.01, 103.06, 85.09, 82.94, 30.09; IR (thin film, cm\(^{-1}\)): 2937, 2852, 1674, 1582, 1457, 1121, 912, 891, 727; HRMS (ESI): \(m/z\) Calcd. for \(C_{11}H_{9}O_3\) \([M+H]^+\) 189.0546, Found 189.0540.

5-Iodo-6-methoxybenzo[d][1,3]dioxole (8)

In a manner analogous to literature to afford the product 8 (3.71 g, 13.40 mmol, 67% for 2 steps) and data are in agreement with those reported in literature.\[^{[s22,s23]}\]
1-(6-((6-Methoxybenzo[d][1,3]dioxol-5-yl)ethynyl)benzo[d][1,3]dioxol-5-yl)ethan-1-one (9)

In a manner analogous to literature\[^{21}\] to afford the product 9 (3.50 g, 10.50 mmol, 95%) as a black solid (EtOAc/petroleum ether = 1:20); Mp 80.0 – 80.9 °C; \(^1\)H NMR (600 MHz, DMSO-\(d_6\)) \(\delta\) 7.28 (s, 1H), 7.10 (s, 1H), 7.01 (s, 1H), 6.88 (s, 1H), 6.16 (s, 2H), 6.04 (s, 2H), 3.79 (s, 3H), 2.71 (s, 3H); \(^{13}\)C NMR (150 MHz, DMSO-\(d_6\)) \(\delta\) 198.33, 157.32, 150.48, 149.74, 148.16, 141.08, 135.41, 117.28, 112.61, 111.50, 108.73, 103.01, 102.25, 95.76, 91.87, 91.61, 57.00, 30.47; IR (thin film, \(\text{cm}^{-1}\)): 2944, 2833, 1472, 1418, 1448, 1268, 1195, 1113, 1020; HRMS (ESI): \(m/z\) Calcd. for \(C_{19}H_{15}O_6\) [M+H]\(^{+}\) 339.0863, Found 339.0859.

\textit{tert-Butyl}((1-(6-((6-methoxybenzo[d][1,3]dioxol-5-yl)ethynyl)benzo[d][1,3]dioxol-5-yl)vinyl)oxy)dimethylsilane (10)
In a manner analogous to literature\textsuperscript{[s21]} to afford the product \textbf{10} (1.10 g, 2.50 mmol, 87\%) as a yellow solid (EtOAc/petroleum ether = 1:50); Mp 90.1 – 91.5 °C; \textsuperscript{1}H NMR (600 MHz, DMSO-\textit{d}_6) \delta 7.00 (s, 1H), 6.98 (s, 1H), 6.89 (s, 1H), 6.85 (s, 1H), 6.09 (s, 2H), 6.03 (s, 2H), 5.19 (d, \textit{J} = 1.5 Hz, 1H), 4.69 (d, \textit{J} = 1.5 Hz, 1H), 3.78 (s, 3H), 0.90 (s, 9H), 0.13 (s, 6H); \textsuperscript{13}C NMR (150 MHz, DMSO-\textit{d}_6) \delta 159.23, 155.75, 151.52, 150.08, 149.50, 143.21, 137.10, 116.45, 114.48, 113.56, 109.81, 105.89, 104.56, 104.38, 99.16, 98.04, 94.18, 91.97, 59.21, 28.30, 20.61, 2.07; IR (thin film, cm\textsuperscript{-1}): 2954, 2927, 2897, 2856, 2201, 1592, 1557, 1515, 1501, 1459, 1417, 1378, 1256, 1214, 1192, 1175, 1168, 1074, 1038, 937, 860, 831, 781, 760, 686; HRMS (ESI): \textit{m/z} Calcd. for C\textsubscript{25}H\textsubscript{29}O\textsubscript{6}Si [M+H]\textsuperscript{+} 453.1728, Found 453.1718.

\textit{tert}-Butyl((7-(6-methoxybenzo[\textit{d}][1,3]dioxol-5-yl)naphtho[2,3-\textit{d}][1,3]dioxol-5-yl)oxy)dimethylsilane (\textbf{11})

In a manner analogous to literature\textsuperscript{[s21]} to afford the product \textbf{11} (371 mg, 0.82 mmol, 82\%) as a yellow oily liquid (EtOAc/petroleum ether = 1:10); \textsuperscript{1}H NMR (600 MHz, DMSO-\textit{d}_6) \delta 7.37 (d, \textit{J} = 1.2 Hz, 1H), 7.28 (s, 2H), 6.96 – 6.93 (m, 2H), 6.90 (s, 1H), 6.12 (s, 2H), 6.02 (s, 2H), 3.71 (s, 3H), 1.04 (s, 9H), 0.27 (s, 6H); \textsuperscript{13}C NMR (150 MHz, DMSO-\textit{d}_6) \delta 151.99, 149.83, 148.11, 147.78, 147.51, 141.59, 135.07, 132.01, 122.66, 122.36, 120.71, 114.47, 110.11, 104.43, 101.67, 98.27, 96.39, 57.01, 26.20, 18.59, 3.92; IR (thin film, cm\textsuperscript{-1}): 3032, 2990, 2877, 2865, 1460, 1431, 1352, 940, 757; HRMS (ESI): \textit{m/z} Calcd. for C\textsubscript{25}H\textsubscript{29}O\textsubscript{6}Si [M+H]\textsuperscript{+} 453.1728, Found 453.1725.
7-(6-Methoxybenzo[d][1,3]dioxol-5-yl)naphtho[2,3-d][1,3]dioxol-5-ol (12)

In a manner analogous to literature\textsuperscript{[24]} to afford the product 12 (200 mg, 0.59 mmol, 74\%) and data are in agreement with those reported in literature.\textsuperscript{[23,25]}

3. References

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4. NMR Spectra
Parameter | Value
--- | ---
1. Origin | Bruker BioSpin GmbH
2. Owner | nmrsu
3. Spectrometer | spect
4. Solvent | DMSO
5. Temperature | 299.9
6. Number of Scans | 63
7. Spectrometer Frequency | 150.90
8. Nuclei

Chemical Structure:
Parameter | Value
---|---
1 Origin | Bruker BioSpin GmbH
2 Owner | nmrsu
3 Spectrometer | spect
4 Solvent | DMSO
5 Temperature | 300.0
6 Number of Scans | 8
7 Spectrometer Frequency | 600.13
8 Nucleus | 1H
9 Spectrum | Bruker Biospin GmbH
10 Parameters

Chemical Structure:

```
\begin{align*}
\text{O} & \quad \text{O} \\
\text{Me} & \quad \text{Me}
\end{align*}
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\begin{align*}
\text{O} & \quad \text{O} \\
\text{Me} & \quad \text{Me}
\end{align*}
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Parameter Value

1 Origin Bruker BioSpin GmbH
2 Owner nmrsu
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6 Number of Scans 16
7 Spectrometer Frequency 600.13
8 Nucleus 1H
9 Spectrometer Frequency 600.13

H1 Spectrometer Frequency 600.13
6 Number of Scans 16
5 Temperature 300.0
4 Solvent DMSO
3 Spectrometer spect
2 Owner nmrsu
1 Origin Bruker BioSpin GmbH
Parameter Value
1 Origin Bruker BioSpin GmbH
2 Owner nmrsu
3 Spectrometer spect
4 Solvent DMSO
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6 Number of Scans 8
7 Spectrometer Frequency 600.13
8 Nucleus1H S19
Parameter | Value
---|---
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1 Spectrometer Frequency | 150.90
2 Number of Scans | 124
3 Temperature | 300.0
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5 Spectrometer | spect
6 Owner | nmrsu
7 Origin | Bruker BioSpin GmbH
