Combining electronic and steric effects to generate hindered propargylic alcohols in high enantiomeric excess
Vijyesh K. Vyas,†,‡ Richard C. Knighton,† Bhalchandra M. Bhanage,*,† Martin Wills*,†
† Department of Chemistry, University of Warwick, Coventry, CV4 7AL, United Kingdom.
‡ Institute of Chemical Technology, N. Parekh Marg, Matunga, Mumbai-400019, India.

Contents.

General procedures. S2

ATH of o-OMe ketone to give alcohol 16 using other catalysts and conditions not listed in main paper. S4

Data for alcohols and ketones. S5

Data for synthesis of intermediate to allocolchicine S47

1H and 13C NMR spectra S50

Synthesis and X-ray crystallographic data of 26 S157

Synthesis and X-ray crystallographic data for 1-(2,6-Difluorophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-one 37. S163

Summary of literature survey on aryl/propargylic ketone reduction products S172
All reagents and solvents were used as purchased and without further purification. All reactions were carried out under a nitrogen atmosphere unless otherwise specified. Reactions at elevated temperature were maintained by thermostatically controlled aluminium heating blocks or in oil baths. A temperature of 0 °C refers to an ice slush bath. NMR spectra were recorded on a Bruker AV (250 MHz), Bruker DPX (300 or 400MHz) or Bruker DRX (500 MHz) instrument. All chemical shifts are reported in ppm and are referenced to the solvent chemical shift, and coupling constants are given in Hz. Mass spectra were recorded on an Esquire 2000 and high resolution mass spectra were recorded on a Bruker Micro ToF or MaXis. IR spectra were recorded on a PerkinElmer spectrum100. Optical rotations were measured on an Optical Activity Ltd. AA-1000. The chiral GC measurements were carried out on a PerkinElmer 8500 or Hewlett-Packard 1050 instrument linked to PC running DataApex Clarity software. HPLC was carried out on a Hewlett-Packard 1050 HPLC system. Melting points were determined on a Stuart scientific melting point apparatus and are uncorrected. Flash column chromatography was performed using silica gel of mesh size 230-400, Thin layer chromatography was carried out on aluminium backed silica gel 60 (F254) plates, visualized using 254nm UV light or iodine stains as appropriate.

General procedures for the syntheses.

Procedure A: Synthesis of Racemic Alcohols.

\[
\begin{align*}
  &\begin{array}{c}
  \text{CHO} \\
  \text{R}_1 \\
  \text{R}_2 \\
  \text{R}_3 \\
  \end{array}
  \quad + \quad
  \begin{array}{c}
  \text{R} \\
  \text{R}_1 \\
  \text{R}_2 \\
  \text{R}_3 \\
  \end{array}
  \quad \text{nBuLi, dry THF, -78 °C to rt}
  \quad \rightarrow
  \begin{array}{c}
  \text{OH} \\
  \text{R}_1 \\
  \text{R}_2 \\
  \text{R}_3 \\
  \end{array}
\end{align*}
\]

To a solution of acetylene (6.0 mmol, 1.2 equiv) in dry THF (25 mL) was added nBuLi (2.5 M in n-hexane, 2.0 mL, 5.0 mmol, 1.0 equiv) dropwise at −78 °C under nitrogen atmosphere. After the reaction mixture had been stirred at −78 °C for 1 h, aldehyde (5.0 mmol, 1.0 equiv) was added dropwise at 78 °C. Upon stirring at same temperature for 1 h, the reaction mixture was stirred at ambient temperature for 1 h. It was then concentrated under reduced pressure, extracted with ethyl acetate (3 x 50 mL), washed with brine (50 mL), dried over Na$_2$SO$_4$, filtered, concentrated, and purified by column chromatography on silica gel to yield the alcohol product.
Procedure B: Oxidation of alcohols to ketones.

To a stirred solution of alkynol (4 mmol) in DCM (15 mL) was added activated manganese dioxide (2.40 g, 28 mmol, 7.0 equiv) at rt under nitrogen atmosphere. After 24 h, the reaction mixture was filtered through a Celite pad with CH$_2$Cl$_2$. The filtrate was concentrated and purified by column chromatography on silica gel to yield the ketone.

Procedure C: Asymmetric Transfer Hydrogenation (ATH) of ketones.

The ketone (0.2 mmol), catalyst (2.0 x 10$^{-3}$ mmol), DCM (2 mL) and FA/TEA (0.2 mL) azeotrope was added sequentially to the reaction tube and stirred at rt. The reaction was monitored by TLC. After the completion of reaction, it was quenched by water (10 mL) and extracted with ethyl acetate (2 x 10 mL). The organic layer was dried with Na$_2$SO$_4$ and concentrated to obtain a residue. The residue was purified with a silica gel column eluted with petroleum ether and ethyl acetate to obtain the pure desired product. Reaction time at rt is ca 40h.
ATH of o-OMe ketone to give alcohol 16 using other catalysts and conditions not listed in main paper.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Catalyst</th>
<th>Conv./%</th>
<th>Ee/%</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RR-DENEB 4</td>
<td>70</td>
<td>53 (S)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RR 3C Ms Teth A</td>
<td>100</td>
<td>20 (S)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>RR C4 tris teth B</td>
<td>100</td>
<td>20 (S)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RR 3C teth 2</td>
<td>100</td>
<td>60 (S)</td>
<td>40 °C</td>
</tr>
<tr>
<td>5</td>
<td>RR 3C teth 2</td>
<td>100</td>
<td>64 (S)</td>
<td>40 °C, no DCM</td>
</tr>
<tr>
<td>6</td>
<td>RR 3C teth 2</td>
<td>100</td>
<td>60 (S)</td>
<td>60 °C</td>
</tr>
<tr>
<td>7</td>
<td>RR-DENEB 4</td>
<td>93</td>
<td>35 (S)</td>
<td>40 °C</td>
</tr>
</tbody>
</table>

Conditions; 1 mol% catalyst, rt, DCM, 24h.

![Catalyst A](image1.png) ![Catalyst B](image2.png)
**Data for alcohols and ketones.**

**Racemic and (S)-1,3-diphenylprop-2-yn-1-ol (7).**

This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), benzaldehyde (0.51 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1,3-Diphenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (408 mg, 2.0 mmol, 39.6%).

This compound was prepared in enantiomerically-enriched form following procedure C, using 1,3-diphenylprop-2-yn-1-one (50 mg, 0.24 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpenRuCl] (1.5 mg, 2.4 x 10⁻³ mmol, 1 mol%) and DCM (2 mL). (S)-1,3-Diphenylprop-2-yn-1-ol was formed in 17 % conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

\(^1\)H NMR (400 MHz, CDCl₃) δ 7.61 (2H, dd, \(J = 7.2, 1.8 \text{ Hz, ArH}\)), 7.47 – 7.43 (2H, m, ArH), 7.41 – 7.28 (6H, m, ArH), 5.67 (1H, d, \(J = 5.9 \text{ Hz, CH}\)), 2.52 (1H, d, \(J = 6.1 \text{ Hz, OH}\));

\(^13\)C NMR (101 MHz, CDCl₃) δ 140.6, 131.7, 128.7, 128.6, 128.4, 128.3, 128.2, 126.7, 122.4, 88.8, 86.6, 65.1;

m/z (ESI) 230.0 ([M+Na]⁺, 100%)

Enantiomeric excess determined by HPLC analysis (CHIRALPAK IB column, hexane 90:10 iPrOH, 0.7 mL/min, \(T = 30^\circ\text{C}\), \(\lambda = 250\text{ nm}\), Ketone 7.5 min, \(R\) enantiomer 12.1 min, \(S\)-enantiomer 17.7 min). 35.4% ee (S).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 8% and the ee was 29%.

Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under conditions in the paper cited above, and which are substantiated by reports in other papers. See Table at end of SI.
1,3-Diphenylprop-2-yn-1-one.

This compound has been reported and fully characterised.
This compound was prepared following procedure B using 1,3-diphenylprop-2-yn-1-ol (350 mg, 1.68 mmol, 1.0 equiv), MnO₂ (910 mg, 10.6 mmol, 7.0 equiv) and DCM (15 mL). 1,3-Diphenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow solid (297 mg, 1.45 mmol, 86.3%)

\[ 1^1H \text{ NMR (400 MHz, CDCl}_3) \delta 8.26 - 8.18 (2H, m, ArH), 7.73 - 7.58 (3H, m, ArH), 7.55 - 7.38 (5H, m, ArH). \]

\[ 13C \text{ NMR (101 MHz, CDCl}_3) \delta 178.0, 136.9, 134.1, 133.0, 130.8, 129.5, 128.7, 128.6, 120.1, 93.1, 86.9. \]

\[ m/z (ESI) 228.0 ([M+Na]^+, 100\%). \]

Racemic and (S)-1-(4-fluorophenyl)-3-phenylprop-2-yn-1-ol (8).

This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), p-fluoro benzaldehyde (0.53 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(4-Fluorophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (250 mg, 1.1 mmol, 22.1%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(4-fluorophenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.18 mmol, 1.0 equiv), FA/TEA (0.2 mL),
[(R,R)Teth-TsDpen RuCl] (1.1 mg, 1.8 x 10^{-3} mmol, 1 mol%) and DCM (2 mL). (S)-1-(4-Fluorophenyl)-3-phenylprop-2-yn-1-ol was formed in 15 % conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

1H NMR (400 MHz, CDCl₃) δ 7.59 (2H, dd, J = 8.5, 5.4 Hz, ArH), 7.49 – 7.43 (2H, m, ArH), 7.39 – 7.26 (3H, m, ArH), 7.08 (2H, t, J = 8.7 Hz, ArH), 5.67 (1H, s, CH) 2.18 (1H, s, OH).

13C NMR (101 MHz, CDCl₃) δ 162.7 (d, J = 247.0 Hz), 136.5, 131.7, 128.7, 128.6, 128.5, 128.3, 115.5 (d, J = 21.6 Hz), 88.4, 86.9, 64.4.

m/z (ESI) 248.0 ([M+Na]^+, 100%).

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 80:20 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm, Ketone 5.1 min, R enantiomer 6.1 min, S-enantiomer 13.5 min). 14.0% ee (S).

Not screened with OMe catalyst. Major product configuration was established by comparison of elution of HPLC peaks - order matched that under reported conditions in the paper cited above, and which are substantiated by reports in other papers. See Table at end of SI.

1-(4-Fluorophenyl)-3-phenylprop-2-yn-1-one.

This compound has been reported and fully characterised.


This compound was prepared following procedure B using 1-(4-fluorophenyl)-3-phenylprop-2-yn-1-ol (200 mg, 0.889 mmol, 1.0 equiv), MnO₂ (550 mg, 6.4 mmol, 7.0 equiv), DCM (10 mL). 1-(4-Fluorophenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a white solid (151 mg, 0.67 mmol, 76.1%)

mp: 65-67 °C

1H NMR (400 MHz, CDCl₃) δ 8.25 (2H, dd, J = 8.5, 5.5 Hz, ArH), 7.73 – 7.65 (2H, m, ArH), 7.53 – 7.39 (3H, m, ArH), 7.19 (2H, t, J = 8.5 Hz, ArH).

13C NMR (101 MHz, CDCl₃) δ 176.3, 166.4 (d, J = 256.5 Hz), 133.4, 133.0, 132.2, 130.9, 128.7, 119.9, 115.8 (d, J = 22.2 Hz), 93.3, 86.6.

m/z (ESI) 246.0 ([M+Na]^+, 100%).
Racemic and (S)-1-(4-Bromophenyl)-3-phenylprop-2-yn-1-ol (9).

This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), p-bromo benzaldehyde (0.50 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(4-Bromophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/EtOAc: 80:20) as a yellow oil (442 mg, 1.5 mmol, 31.0%).

This compound was prepared in enantiomerically-enriched form following procedure C, using 1-(4-bromophenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.14 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (0.9 mg, 1.4 x 10^{-3} mmol, 1 mol%) and DCM (2 mL). (S)-1-(4-Bromophenyl)-3-phenylprop-2-yn-1-ol was formed in 48% conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

1H NMR (400 MHz, CDCl3) δ 7.54 – 7.45 (6H, m, ArH), 7.37 – 7.27 (3H, m, ArH), 5.65 (1H, s, CH), 2.28 (1H, s, OH).

13C NMR (101 MHz, CDCl3) δ 139.6, 131.7, 131.4, 128.8, 128.4, 128.3, 122.4, 122.1, 88.1, 87.0, 64.4.

m/z (ESI) 308.7 ([M + Na]+, 68 %), 310.7 ([M + 2+ Na]+, 70 %)

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 80:20 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm, Ketone 5.7 min, R enantiomer 6.6 min, S-enantiomer 15.7 min). 8.4% ee (S).

Not screened with OMe catalyst. Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under conditions in the paper cited above, and which are substantiated by reports in other papers. See Table at end of SI.

1-(4-Bromophenyl)-3-phenylprop-2-yn-1-one.
This compound has been reported and fully characterised.
This compound was prepared following procedure B using 1-(4-bromophenyl)-3-phenylprop-2-yn-1-ol (400 mg, 1.4 mmol, 1.0 equiv), MnO$_2$ (850 mg, 9.9 mmol, 7.0 equiv) and DCM (10 mL)
1-(4-Bromophenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a white solid (231 mg, 0.82 mmol, 58.2%).
mp: 112-114 °C.
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.08 (2H, d, $J = 8.3$ Hz, ArH), 7.68 (4H, t, $J = 7.7$ Hz, ArH), 7.54 – 7.38 (3H, m, ArH).
$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 176.8, 135.7, 133.1, 132.0, 131.0, 130.9, 129.5, 128.7, 119.8, 93.7, 86.5.
m/z (ESI) 306.7 ([M + Na]+, 100 %), 308.7 ([M + 2+ Na]$,^+$, 98 %).

**Racemic and (S)-1-(4-methoxyphenyl)-3-phenylprop-2-yn-1-ol (10).**

This compound is known and has been fully characterized:
This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), p-methoxy benzaldehyde (0.61 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(4-Methoxyphenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a white solid (978 mg, 4.1 mmol, 83.0%).
This compound was prepared in enantiomerically-enriched form following procedure C, 1-(4-methoxyphenyl)-3-phenylprop-2-yn-1-one (42 mg, 0.18 mmol, 1.0 equiv), FA/TEA (0.2 mL),
[(R,R)Teth-TsDpenRuCl] (1.1 mg, 1.8 x 10^{-3} mmol, 1 mol%) and DCM (2 mL). (S)- 1-(4-Methoxyphenyl)-3-phenylprop-2-yn-1-ol was formed in 24% conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

mp 94-96 °C

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.57 – 7.51 (2H, m, ArH), 7.50 – 7.42 (2H, m, ArH), 7.36 – 7.26 (2H, m, ArH), 6.96 – 6.89 (2H, m, ArH), 5.64 (1H, d, J = 5.9 Hz, CH), 3.81 (3H, s, OCH$_3$), 2.31 (1H, d, J = 6.0 Hz, OH).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 159.7, 133.0, 131.7, 128.5, 128.3, 128.1, 122.5, 114.0, 88.9, 86.5, 64.7, 55.3.

m/z (ESI) 260.8 ([M + Na$^+$], 100 %).

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 90:10 iPrOH, 1.0 mL/min, $T$ = 30 °C, $\lambda$ = 250 nm, Ketone 12.1 min, $R$ enantiomer 15.3 min, $S$-enantiomer 32.3 min). 39.0% ee ($S$).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 6% and the ee was 37%.

Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under conditions in the paper cited above, and which are substantiated by reports in other papers. See Table at end of SI.

1-(4-Methoxyphenyl)-3-phenylprop-2-yn-1-one.

This compound has been reported and fully characterised.


This compound was prepared following procedure B using 1-(4-methoxyphenyl)-3-phenylprop-2-yn-1-ol (950 mg, 4.0 mmol, 1.0 equiv), MnO$_2$ (2.40 g, 28.0 mmol, 7.0 equiv) and DCM (15 mL).

1-(4-Methoxyphenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow solid (597 2.54 mmol, 63.0%)

mp: 90-92 °C.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.24 – 8.16 (2H, m, ArH), 7.70 – 7.62 (2H, m, ArH), 7.52 – 7.36 (3H, m, ArH), 7.03 – 6.94 (2H, m, ArH), 3.90 (3H, s, OCH$_3$).
S11

13C NMR (101 MHz, CDCl3) δ 176.68, 164.49, 132.96, 131.99, 130.59, 130.34, 128.66, 120.38, 113.90, 92.31, 86.94, 55.62.
m/z (ESI) 260.8 ([M + Na]+, 100 %).

**Racemic and (S)-3-phenyl-1-(o-tolyl)prop-2-yn-1-ol (11).**

\[
\text{OH} \quad \text{OH}
\]

This compound is known and has been fully characterized: Zheng, B.; Li, Z.; Liu, F.; Wu, Y.; Shen, J.; Bian, Q.; Hou, S.; Wang, M. *Molecules*, 2013, 18, 15422-15433.

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), o-tolualdehyde (0.6 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 3-Phenyl-1-(o-tolyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (1050 mg, 4.70 mmol, 95.5%).

This compound was prepared in enantiomerically-enriched form following procedure C, 3-phenyl-1-(o-tolyl)prop-2-yn-1-one (42 mg, 0.19 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (1.2 mg, 1.9 x 10^-3 mmol, 1 mol%) and DCM (2 mL). (S)- 3-Phenyl-1-(o-tolyl)prop-2-yn-1-ol was formed in 27% conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

1H NMR (400 MHz, CDCl3) δ 7.75 – 7.66 (1H, m, ArH), 7.48 – 7.40 (2H, m, ArH), 7.32 – 7.14 (6H, m, ArH), 5.79 (1H, s, CH), 2.46 (3H, s, CH3), 2.45 (1H, s, OH).

13C NMR (101 MHz, CDCl3) δ 138.4, 136.0, 131.7, 130.8, 128.5, 128.5, 128.3, 126.6, 126.2, 122.5, 88.6, 86.5, 62.9, 19.0.
m/z (ESI) 244.8 ([M + Na]+, 100 %).

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 80:20 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm, Ketone 4.7 min, R enantiomer 6.4 min, S-enantiomer 11.1 min). 14.4% ee (S).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 17% and the ee was 35%.
Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under reported conditions in the paper cited above, and which are substantiated by reports in other papers. See Table at end of SI.

3-Phenyl-1-(o-tolyl)prop-2-yn-1-one.

![Chemical structure of 3-Phenyl-1-(o-tolyl)prop-2-yn-1-one]

This compound has been reported and fully characterised.


This compound was prepared following procedure B using 3-phenyl-1-(o-tolyl)prop-2-yn-1-ol (1.00 g, 4.5 mmol, 1.0 equiv), MnO₂ (2.70 g, 31.0 mmol, 7.0 equiv) and DCM (15 mL). 3-Phenyl-1-(o-tolyl)prop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a colourless oil (768 mg, 3.5 mmol, 70.0%)

1H NMR (400 MHz, CDCl₃) δ 8.30 (1H, dd, J = 7.7, 1.4 Hz, ArH), 7.67 – 7.61 (2H, m, ArH), 7.49 – 7.33 (5H, m, ArH), 7.30 – 7.24 (1H, m, ArH), 2.68 (3H, s, CH₃).

13C NMR (101 MHz, CDCl₃) δ 179.77, 140.49, 135.75, 133.18, 132.93, 132.91, 132.19, 130.60, 128.65, 125.90, 120.37, 91.82, 88.41, 21.96.

m/z (ESI) 242.8 ([M + Na]+, 100 %).

Racemic and (R)-1-(2-fluorophenyl)-3-phenylprop-2-yn-1-ol (12).

![Chemical structures of racemic and (R)-1-(2-fluorophenyl)-3-phenylprop-2-yn-1-ol]

This compound is known and has been fully characterized:


This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), o-fluoro benzaldehyde (0.53 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-Fluorophenyl)-3-
phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (1060 mg, 4.7 mmol, 93.8%).

This compound was prepared in enantiomerically-enriched form following procedure C, 31-(2-fluorophenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.18 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (1.1 mg, 1.8 x 10^{-3} mmol, 1 mol%) and DCM (2 mL). (R)-1-(2-Fluorophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (38 mg, 0.17 mmol, 94%).

\[ \alpha_D^{25} -28.3^o \text{ (c 0.21 in CHCl}_3 \text{) 62.6 \% ee (R) (lit} \alpha_D^{19} +6.5^o \text{ (c 0.71 in CHCl}_3, 94\% ee (S) \]

\[ ^1H \text{ NMR (400 MHz, CDCl}_3 \delta 7.77 – 7.68 (1H, m, ArH), 7.50 – 7.43 (2H, m, ArH), 7.38 – 7.26 (4H, m, ArH), 7.23 – 7.14 (1H, m, ArH), 7.14 – 7.04 (1H, m, ArH), 5.96 (1H, s, CH), 2.50 (1H, s, OH). \]

\[ ^13C \text{ NMR (101 MHz, CDCl}_3 \delta 160.27 (d, J = 248.3 Hz), 131.80, 130.32, 128.71, 128.46, 128.32, 124.44, 122.26, 115.79, 115.58, 87.09 (d, J = 96.5 Hz), 59.57. \]

\[ m/z \text{ (ESI) 248.8 ([M + Na]+, 100 \%).} \]

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 80:20 iPrOH, 1.0 mL/min, T = 30°C, \lambda = 250 nm, Ketone 5.2 min, R enantiomer 6.0 min, S-enantiomer 7.4 min). 62.6% ee (R).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 100%, yield 95% and the ee was 59%.

Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under reported conditions in the paper cited above, linking configuration to HPLC. This was also supported by a comparison of the reported optical rotation. See Table at end of SI.

1-(2-Fluorophenyl)-3-phenylprop-2-yn-1-one.

This compound has been reported and fully characterised.

This compound was prepared following procedure B using 1-(2-fluorophenyl)-3-phenylprop-2-
y-1-ol (1.00 g, 4.4 mmol, 1.0 equiv), MnO$_2$ (2.70 g, 31.0 mmol, 7.0 equiv) and DCM (15 mL) 1-
(2-Fluorophenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ 
EtOAc: 90:10) as a yellow viscous oil (636 mg, 2.8 mmol, 63.0%).

$\nu_{\text{max}}$: 3063, 2195, 1627, 1605, 1482, 1306, 1203, 1010, 747, 685 cm$^{-1}$.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.16 – 8.06 (1H, m, ArH), 7.71 – 7.55 (3H, m, ArH), 7.51 – 7.38 
(3H, m, ArH), 7.32 – 7.24 (1H, m, ArH), 7.23 – 7.13 (1H, m, ArH).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 174.22, 162.15 (d, $J$ = 261.7 Hz), 135.63, 133.23, 131.84, 130.94, 
128.68, 124.24, 120.11, 117.13 (d, $J$ = 21.9 Hz), 93.05, 88.52.

m/z (ESI) 246.8 ([M + Na]$^+$, 100 %).

**Racemic and (R)-1-(2-Chlorophenyl)-3-phenylprop-2-yn-1-ol (13).**

This compound is known and has been fully characterized:


This compound was prepared in racemic form following procedure A using: phenyl acetylene 
(0.65 mL, 6.0 mmol, 1.2 equiv), o-chloro benzaldehyde (750 mg, 5.0 mmol, 1.0 equiv), nBuLi, 
2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-chlorophenyl)-3-
phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a 
colourless oil (1069 mg, 4.40 mmol, 89.1%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-
chlorophenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.16 mmol, 1.0 equiv), FA/TEA (0.2 mL), 
[(R,R)Teth-TsDpen RuCl] (1.0 mg, 1.6 x 10$^{-3}$ mmol, 1 mol%), DCM (2 mL). (R)-1-(2-
chlorophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 
80:20) as a colourless oil (39 mg, 0.16 mmol, 97%).

[$\alpha$]$_D^{25}$ -26.8$^o$ (c 0.14 in CHCl$_3$) 62.2 % ee (R) (lit [$\alpha$]$^D$ -49.7$^o$ (c 0.5 in CHCl$_3$, 91% ee, (R).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.80 (1H, dd, $J$ = 7.5, 1.9 Hz, ArH), 7.49 – 7.40 (2H, m, ArH), 
7.35 – 7.17 (6H, m, ArH), 6.01 (1H, s, CH), 2.98 (1H, s, OH).
13C NMR (101 MHz, CDCl₃) δ 138.0, 132.8, 131.8, 129.8, 129.7, 128.7, 128.5, 128.3, 127.3, 122.4, 87.8, 86.6, 62.4.
m/z (ESI) 264.7 ([M + Na]+, 100%), 266.7 ([M + 2+ Na]+, 35%).

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 97:3 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm, Ketone 10.7 min, R enantiomer 34.5 min, S-enantiomer 53.7 min). 62.2% ee.

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 100%, yield 94% and the ee was 68.4% (R).

Major product configuration was established by comparison of elution of HPLC peaks - order matched that under reported conditions in the paper cited above, and which are substantiated by reports in other papers. This was also supported by a comparison of the reported optical rotation. See Table at end of SI.

1-(2-Chlorophenyl)-3-phenylprop-2-yn-1-one.

This compound has been reported and fully characterised.

This compound was prepared following procedure B using 1-(2-chlorophenyl)-3-phenylprop-2-yn-1-ol (1.04 mg, 4.3 mmol, 1.0 equiv), MnO₂ (2.70 mg, 31.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-chlorophenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/EtOAc: 90:10) as a yellow oil (731 mg, 3.04 mmol, 70.7%)

1H NMR (400 MHz, CDCl₃) δ 8.12 – 8.04 (1H, m, ArH), 7.69 – 7.61 (2H, m, ArH), 7.52 – 7.38 (6H, m, ArH).

13C NMR (101 MHz, CDCl₃) δ 176.80, 135.89, 133.56, 133.38, 133.12, 132.53, 131.54, 130.96, 128.69, 126.81, 120.05, 93.96, 88.33.
m/z (ESI) 262.7 ([M + Na]+, 100%), 264.7 ([M + 2+ Na]+, 35%)

Racemic and (R)-1-(2-Bromophenyl)-3-phenylprop-2-yn-1-ol (14).
This compound is known and has been fully characterized:


This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.33 mL, 3 mmol, 1.2 equiv), o-bromo benzaldehyde (0.3 mL, 2.5 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (1.0 mL, 2.5 mmol, 1.0 equiv) and dry THF (16 mL). 1-(2-bromophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (631 mg, 2.2 mmol, 88.5%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-bromophenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.14 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (0.9 mg, 1.4 x 10⁻³ mmol, 1 mol%), DCM (2 mL). (R)-1-(2-bromophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (40 mg, 0.14 mmol, 99%).

[α]D²⁵ -22.6° (c 0.23 in CHCl₃) 52.8 % ee (R) (lit [α]D₂²¹ -53.9° (c 0.5 in CHCl₃, 88% ee (R))

¹H NMR (400 MHz, CDCl₃) δ 7.77 (1H, dd, J = 7.7, 1.7 Hz, ArH), 7.51 (1H, dd, J = 8.0, 1.3 Hz, ArH), 7.43 – 7.36 (2H, m, ArH), 7.33 – 7.11 (5H, m, ArH), 5.94 (1H, d, J = 4.9 Hz, CH), 2.52 (1H, d, J = 5.3 Hz, OH).

¹³C NMR (101 MHz, CDCl₃) δ 139.5, 133.1, 131.8, 130.0, 128.7, 128.4, 128.3, 127.9, 122.8, 122.3, 87.6, 86.8, 64.7.

m/z (ESI) 308.7 ([M + Na]⁺, 100%), 310.7 ([M + 2+ Na]⁺, 85%).

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 97:3 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm, Ketone 16.0 min, R enantiomer 34.6 min, S-enantiomer 44.9 min). 52.8% ee (R).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 100%, yield 99% and the ee was 68.4%.

Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under conditions in the paper cited above. This was also supported by a comparison of the reported optical rotation. See Table at end of SI.
1-(2-Bromophenyl)-3-phenylprop-2-yn-1-one.

This compound has been reported and fully characterised.
This compound was prepared following procedure B using 1-(2-bromophenyl)-3-phenylprop-2-
yn-1-ol (600 mg, 1.7 mmol, 1.0 equiv), MnO$_2$ (1.00 g, 12.0 mmol, 7.0 equiv) and DCM (10 mL)
1-(2-bromophenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ 
EtOAc: 90:10) as a colorless oil (340 mg, 1.20 mmol, 57.1%)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.00 (1H, dd, $J$ = 7.7, 1.8 Hz, ArH), 7.67 – 7.55 (3H, m, ArH), 
7.46 – 7.28 (5H, m, ArH).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 174.7, 137.6, 134.9, 133.3, 133.1, 132.7, 131.0, 128.7, 127.4, 
121.2, 119.6, 94.2, 87.9.

m/z (ESI) 306.7 ([M + Na$^{+}$], 100%), 308.7 ([M + 2+ Na$^{+}$], 85%).

Racemic and (R)-1-(2-Iodophenyl)-3-phenylprop-2-yn-1-ol (15).

This compound has been reported but not fully characterized:
This compound was prepared in racemic form following procedure A using: phenyl acetylene 
(0.65 mL, 6.0 mmol, 1.2 equiv), o-iodo benzaldehyde (1000 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 
M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-iodophenyl)-3-phenylprop-
2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (1129 
mg, 3.4 mmol, 78.9%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-
iodophenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.12 mmol, 1.0 equiv), FA/TEA (0.2 mL), 
[(R,R)Teth-TsDpen RuCl] (0.7 mg, 1.2 x 10$^{-3}$ mmol, 1 mol%), DCM (2 mL). (R)-1-(2-iodophenyl)-
3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (16 mg, 0.048 mmol, 42%).

$[\alpha]_{D}^{25} -30.5^\circ$ (c 0.1 in CHCl$_3$) 40.0 % ee ($R$).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.89 – 7.77 (2H, m, ArH), 7.49 – 7.38 (3H, m, ArH), 7.31 (3H, d, $J = 4.5$ Hz, ArH), 7.08 – 6.99 (1H, m, ArH), 5.88 (1H, s, CH), 2.59 (1H, s, OH).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 142.5, 139.8, 131.8, 130.2, 128.8, 128.7, 128.3, 128.2, 122.3, 98.1, 87.9, 87.0, 69.0.

m/z (ESI) 356.7 ([M + Na]+, 100 %).

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 97:3 iPrOH, 1.0 mL/min, $T = 30^\circ$C, $\lambda = 250$ nm, Ketone 11.2 min, $R$ enantiomer 44.6 min, $S$-enantiomer 58.9 min). 40.0% ee ($R$).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 47% and the ee was 69%. There is no report of an assigned configuration for this compound therefore HPLC and optical rotations could not be compared. The configuration was assigned by analogy with closely-related substrates.

**1-(2-Iodophenyl)-3-phenylprop-2-yn-1-one.**

This compound has been reported and fully characterised.


This compound was prepared following procedure B using 1-(2-iodophenyl)-3-phenylprop-2-yn-1-ol (1.05 mg, 3.2 mmol, 1.0 equiv), MnO$_2$ (1.90 mg, 22.0 mmol, 7.0 equiv) and DCM (15 mL)

1-(2-iodophenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a colorless oil (853 mg, 2.53 mmol 81.2%)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.13 (1H, dd, $J = 7.8$, 1.6 Hz, ArH), 8.06 (1H, dd, $J = 7.9$, 1.1 Hz, ArH), 7.69 – 7.62 (2H, m, ArH), 7.54 – 7.37 (4H, m, ArH), 7.24 – 7.18 (1H, m, ArH).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 178.1, 142.1, 139.4, 133.4, 133.1, 133.0, 131.0, 128.7, 128.1, 119.9, 94.4, 92.8, 87.2.

m/z (ESI) 354.7 ([M + Na]+, 100 %).
Racemic and \((R)\)-1-(2-Methoxyphenyl)-3-phenylprop-2-yn-1-ol (16).

This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), o-methoxy benzaldehyde (0.61 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-methoxyphenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 70:30) as a colourless oil (1117 mg, 4.7 mmol, 94.7%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-methoxyphenyl)-3-phenylprop-2-yn-1-one (50 mg, 0.21 mmol, 1.0 equiv), FA/TEA (0.2 mL), \([(R,R)\text{Teth-TsDpen RuCl}] (1.3 mg, 2.1 x 10^{-3} \text{ mmol, 1 mol%)}, \text{DCM (2 mL)}). (R)-1-(2-methoxyphenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (47 mg, 0.20 mmol, 95%).

\([\alpha]_{D}^{25} -7.6^\circ \) (c 0.15 in CHCl\(_3\)) 79.2 % ee \((R)\) (lit \([\alpha]_{D}^{20} -10.5^\circ \) (c 1.2 in CHCl\(_3\), 92% ee \((R)\))

\(^1\text{H NMR}\) (400 MHz, CDCl\(_3\)) \(\delta\) 7.64 (1H, dd, \(J = 7.5, 1.7 \text{ Hz, ArH}\)), 7.47 (2H, dd, \(J = 6.6, 3.1 \text{ Hz, ArH}\)), 7.33 – 7.26 (4H, m, ArH), 7.03 – 6.94 (1H, m, ArH), 6.93 – 6.88 (1H, m, ArH), 5.93 (1H, d, \(J = 6.1 \text{ Hz, CH}\)), 3.88 (3H, s, OCH\(_3\)), 3.15 (1H, d, \(J = 6.2 \text{ Hz, OH}\)).

\(^{13}\text{C NMR}\) (101 MHz, CDCl\(_3\)) \(\delta\) 156.9, 131.8, 129.7, 128.8, 128.4, 128.3, 128.1, 122.8, 120.9, 110.9, 88.5, 86.1, 61.6, 55.6.

m/z (ESI) 260.8 ([M + Na]+, 100 %).

Enantiomeric excess determined by HPLC analysis (CHIRALPAK IB column, hexane 90:10 iPrOH, 0.7 mL/min, \(T = 30^\circ \text{C}, \lambda = 250 \text{ nm, Ketone 11.2 min, R enantiomer 14.2 min, S-enantiomer 16.3 min}\)). 79.2% ee \((R)\).

Using \([(\text{MeO})(R,R)\text{Teth-TsDpenRuCl}]\) as catalyst, the conversion was 97.2%, yield 91.2% and the ee was 59.3%.
Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under conditions in the papers cited above and in other papers. This was also supported by a comparison of the reported optical rotation. See Table at end of SI.

1-(2-Methoxyphenyl)-3-phenylprop-2-yn-1-one.

This compound has been reported and fully characterised.

This compound was prepared following procedure B using 1-(2-methoxyphenyl)-3-phenylprop-2-yn-1-ol (1.05 mg, 4.4 mmol, 1.0 equiv), MnO$_2$ (2.70 g, 31.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-methoxyphenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/EtOAc: 90:10) as a colourless oil (702 mg, 2.97 mmol, 66.7%).

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.08 (1H, dd, $J =$ 7.8, 1.8 Hz, ArH), 7.67 – 7.59 (2H, m, ArH), 7.57 – 7.50 (1H, m, ArH), 7.47 – 7.36 (3H, m, ArH), 7.08 – 7.00 (2H, m, ArH), 3.96 (s, OCH$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 176.7, 159.8, 135.0, 132.9, 132.6, 130.5, 128.6, 126.8, 120.7, 120.3, 112.2, 91.6, 89.2, 55.9.

m/z (ESI) 260.8 ([M + Na]$^+$, 100 %).

Racemic and (R)-1-(2-Ethoxyphenyl)-3-phenylprop-2-yn-1-ol (17).

This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), o-ethoxy benzaldehyde (0.7 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-ethoxyphenyl)-3-
phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (863 mg, 3.4 mmol, 66.9%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.16 mmol, 1.0 equiv), FA/TEA (0.2 mL), [OMe (R,R)Teth-TsDpen RuCl] (1.0 mg, 1.5 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (R)-1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (38 mg, 0.15 mmol, 94%).

[α]D 25 -3.6° (c 0.34 in CHCl₃) 58.4 % ee (R). Lit. [α]D 24 +2.92 (c 1.38, CHCl₃).

1H NMR (400 MHz, CDCl₃) δ 7.61 (1H, dd, J = 7.6, 1.6 Hz, ArH), 7.47 (2H, dd, J = 6.6, 2.9 Hz, ArH), 7.33 – 7.26 (4H, m, ArH), 7.01 – 6.89 (2H, m, ArH), 5.90 (1H, d, J = 6.1 Hz, CH), 4.15 (CH₂, qd, J = 7.0, 2.9 Hz, ArH), 7.33 – 7.26 (4H, m, ArH), 7.01 – 6.89 (2H, m, ArH), 5.90 (1H, d, J = 6.1 Hz, CH), 4.15 (CH₂, qd, J = 7.0, 2.9 Hz, ArH), 3.24 (1H, d, J = 6.4 Hz, OH), 1.47 (3H, t, J = 7.0 Hz, CH₃).

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 90:10 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm, Ketone 7.5 min, R enantiomer 10.6 min, S-enantiomer 16.3 min). 58.4% ee (R).

m/z (ESI) 274.8 ([M + Na]+, 100 %).

Using [(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 69%, yield 52.5% and the ee was 58.4%.

Major product configuration was assigned by analogy with the o-OMe product.

1-(2-Ethoxyphenyl)-3-phenylprop-2-yn-1-one.

This compound has been reported and fully characterised.


This compound was prepared following procedure B using 1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-ol (815 mg, 3.3 mmol, 1.0 equiv), MnO₂ (1.80 mg, 21.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a colourless oil (579 mg, 2.30 mmol, 70.8%).
$^1$H NMR (400 MHz, CDCl$_3$) δ 8.00 (1H, dd, $J = 7.8$, 1.8 Hz, ArH), 7.66 – 7.37 (6H, m, ArH), 7.06 – 6.93 (2H, m, ArH), 4.17 (2H, q, $J = 7.0$ Hz, CH$_2$), 1.46 (3H, t, $J = 7.0$ Hz, CH$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 176.9, 159.2, 134.8, 132.7, 131.9, 130.3, 128.6, 127.1, 120.8, 120.2, 113.1, 91.5, 89.6, 64.5, 14.8.

m/z (ESI) 272.8 ([M + Na]$^+$, 100 %).

Racemic and (R)-1-(2-isopropoxyphenyl)-3-phenylprop-2-yn-1-ol (18).

This compound is novel.

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), o-isopropoxy benzaldehyde (0.80 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-isopropoxyphenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/EtOAc: 80:20) as a colourless oil (718 mg, 2.7 mmol, 54.4%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-isopropoxyphenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.15 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (0.94 mg, 1.5 x 10$^{-3}$ mmol, 1 mol%), DCM (2 mL). (R)-1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-ol was formed in 37% conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

(found (ESI) [M+Na]$^+$, 289.1201. C$_{18}$H$_{18}$NaO$_2$ requires 289.1199).

$\nu_{\text{max}}$: 3404 (broad), 2976, 1598, 1486, 1235, 1115, 1014, 949, 749, 690 cm$^{-1}$.

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.58 (1H, dd, $J = 7.5$, 1.7 Hz, ArH), 7.49 – 7.43 (2H, m, ArH), 7.32 – 7.25 (4H, m, ArH), 6.98 – 6.91 (2H, m, ArH), 5.85 (1H, d, $J = 6.5$ Hz, CH), 4.68 (1H, hept, $J = 5.8$ Hz, CH), 3.36 (1H, d, $J = 6.6$ Hz, OH), 1.40 (6H, dd, $J = 6.0$, 4.9 Hz, 2CH$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 155.2, 131.7, 129.7, 129.5, 128.8, 128.3, 128.2, 122.9, 120.7, 113.9, 74.8, 70.6, 62.8, 22.2.

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 90:10 iPrOH, 1.0 mL/min, $T = 30^\circ$C, $\lambda = 250$ nm, Ketone 5.8 min, R enantiomer 7.4 min, S-enantiomer 17.8 min). 40.4% ee (R).
m/z (ESI) 288.8 ([M + Na]+, 100 %).

Using [(R,R)Teth-TsDpenRuCl] as catalyst, no reduction was observed. Major product configuration was assigned by analogy with o-OMe and other ortho-substituted products. There are no reports of chiral HPLC or optical rotation data for this compound.

1-(2-Isopropoxyphenyl)-3-phenylprop-2-yn-1-one.

\[
\begin{align*}
\text{O} & \text{Pr} \text{ O} \\
\text{phenyl} & \text{phenyl} 
\end{align*}
\]

This compound is novel.

This compound was prepared following procedure B using 1-(2-isopropoxyphenyl)-3-phenylprop-2-yn-1-ol (670 mg, 2.5 mmol, 1.0 equiv), MnO\textsubscript{2} (1.55 mg, 18.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-isopropoxyphenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow solid (491 mg, 1.86 mmol, 73.8%).

\[(\text{found (ESI) [M+Na]+, 287.1038, C}_{18}\text{H}_{16}\text{NaO}_{2} \text{requires 287.1099})
\]

\[\nu_{\text{max}}: 2978, 2198, 1587, 1306, 1244, 1099, 944, 753, 690 \text{ cm}^{-1} .\]

\[\text{mp: 44–46 °C}\]

\[\text{H NMR (400 MHz, CDCl}_{3}\text{) } \delta 7.94 (1H, dd, } J = 7.9, 1.8 \text{ Hz, ArH}), 7.64 – 7.58 (2H, m, ArH), 7.52 – 7.36 (4H, m, ArH), 7.03 – 6.96 (2H, m, ArH), 4.69 (1H, hept, } J = 5.9 \text{ Hz, CH}), 1.40 (6H, d, } J = 6.1 \text{ Hz, 2CH}_{3}\text{).}\]

\[\text{C NMR (101 MHz, CDCl}_{3}\text{) } \delta 177.2, 158.2, 134.6, 132.7, 131.8, 130.2, 128.6, 128.2, 120.9, 120.2, 114.6, 91.5, 89.9, 71.3, 22.0.\]

m/z (ESI) 286.8 ([M + Na]+, 100 %).

Racemic and (R)-1-(2-benzyloxyphenyl)-3-phenylprop-2-yn-1-ol (19).

\[
\begin{align*}
\text{O} & \text{Bn OH} \\
\text{phenyl} & \text{phenyl} 
\end{align*}
\]

This compound is known and has been fully characterized:
This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), o-benzyloxy benzaldehyde (1060 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2- benzyloxy phenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (1231 mg, 3.7 mmol, 82.2%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-benzyloxyphenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.12 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (0.8 mg, 1.3 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (R)-1-(2- benzyloxy phenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (40 mg, 0.13 mmol, 99%).

[α]_{D}^{25} -6.7° (c 0.5 in CHCl₃) 79.4 % ee (R).

$^{13}$C NMR (101 MHz, CDCl₃) δ 156.0, 136.6, 131.7, 129.7, 129.3, 128.7, 128.4, 128.3, 128.2, 128.1, 127.3, 122.8, 121.2, 112.3, 88.7, 85.9, 70.3, 62.1.

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 80:20 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm, Ketone 5.8 min, R enantiomer 11.1 min, S-enantiomer 19.4 min). 79.4% ee (R).

m/z (ESI) 336.9 ([M + Na]+, 100 %).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 100%, yield 93% and the ee was 51.4%.

Major product configuration was assigned by analogy with o-OMe and other ortho-substituted products. There are no reports of chiral HPLC or optical rotation data for this compound.

1-(2-(Benzyloxyphenyl)-3-phenylprop-2-yn-1-one.

This compound has been reported and fully characterised.

This compound was prepared following procedure B using 1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-ol (1.13 mg, 3.5 mmol, 1.0 equiv), MnO$_2$ (2.06 mg, 24.0 mmol, 7.0 equiv), DCM (15 mL) 1-(2-benzyloxyphenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/EtOAc: 90:10) as a colourless oil (952 mg, 3.04 mmol, 84.0%).

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.04 (1H, dd, $J$ = 7.9, 1.8 Hz, ArH), 7.53 – 7.47 (3H, m, ArH), 7.42 – 7.37 (3H, m, ArH), 7.32 – 7.23 (5H, m, ArH), 7.10 – 7.01 (2H, m, ArH), 5.23 (2H, s, CH$_2$).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 176.8, 158.8, 136.3, 134.8, 132.9, 132.2, 130.3, 128.6, 128.4, 127.9, 127.4, 127.2, 120.7, 120.6, 113.5, 91.9, 89.6, 70.7.

m/z (ESI) 334.9 ([M + Na]$^+$, 100 %).

1-[(1,1'-biphenyl)-2-yl]-3-phenylprop-2-yn-1-ol (20).

This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), o-phenyl benzaldehyde (940 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-[(1,1'-biphenyl)-2-yl]-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/EtOAc: 80:20) as a yellow oil (1268 mg, 4.5 mmol, 90.0%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-[(1,1'-biphenyl)-2-yl]-3-phenylprop-2-yn-1-one (40 mg, 0.14 mmol, 1.0 equiv), FA/TEA (0.2 mL), [$(R,R)$Teth-TsDpen RuCl] (0.9 mg, 1.4 x 10$^{-3}$ mmol, 1 mol%), DCM (2 mL). 1-[(1,1'-biphenyl)-2-yl]-3-phenylprop-2-yn-1-one was not converted into corresponding product and remained unreacted and data was obtained using racemic compound.

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.94 (1H, dd, $J$ = 7.7, 1.4 Hz, ArH), 7.49 – 7.37 (10H, m, ArH), 7.30 – 7.28 (3H, m, ArH), 5.68 (1H, s, CH), 2.03 (1H, s, OH).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 141.0, 140.2, 138.4, 131.7, 130.3, 129.5, 128.5, 128.4, 128.3, 128.1, 128.0, 127.6, 127.5, 122.6, 89.6, 86.4, 62.3.

m/z (ESI) 306.8 ([M + Na]$^+$, 100 %).
No asymmetric product was formed from this substrate.

1-([1,1'-Biphenyl]-2-yl)-3-phenylprop-2-yn-1-one.

![Chemical structure of 1-([1,1'-Biphenyl]-2-yl)-3-phenylprop-2-yn-1-one]

This compound has been reported and fully characterised.

This compound was prepared following procedure B using 1-([1,1'-biphenyl]-2-yl)-3-phenylprop-2-yn-1-ol (1.20 mg, 4.2 mmol, 1.0 equiv), MnO$_2$ (2.60 mg, 30.0 mmol, 7.0 equiv), DCM (15 mL)
1-([1,1'-biphenyl]-2-yl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (989 mg, 3.49 mmol, 83.1%).

$^1$H NMR (400 MHz, CDCl$_3$) δ 7.96 (1H, dd, $J = 7.7, 1.3$ Hz, ArH), 7.63 – 7.54 (1H, m, ArH), 7.49 – 7.24 (12H, m, ArH).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 180.6, 142.7, 140.4, 138.0, 132.9, 132.1, 131.0, 130.4, 130.0, 129.5, 128.4, 128.3, 127.8, 127.4, 120.1, 93.8, 88.8.

m/z (ESI) 304.8 ([M + Na]$^+$, 100 %).

**Racemic and (R)-1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-ol (21).**

![Chemical structures of racemic and (R)-1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-ol]

This compound is known but not fully characterized:

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), 2,6-difluoro benzaldehyde (0.54 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2,6-difluorophenyl)-3-
phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/EtOAc: 80:20) as a white solid (960 mg, 3.9 mmol, 78.7%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-one (41 mg, 0.17 mmol, 1.0 equiv), FA/TEA (0.2 mL), 

\([(R,R)_\text{Teth-TsDpen RuCl}] (1.1 mg, 1.8 \times 10^{-3} \text{ mmol}, 1 \text{ mol%), DCM (2 mL). (R)-1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/EtOAc: 80:20) as a white solid (40 mg, 0.16 mmol, 94.0%).

\[ [\alpha]_D^{25} -21.9^\circ \text{ (c 0.26 in CHCl}_3 \text{) 94.0 \% ee (R).} \]

mp: 51-53 \^\circ \text{C.}

\[^1\text{H NMR (400 MHz, CDCl}_3 \text{) \delta 7.44 (2H, dd, } J = 7.4, 2.2 \text{ Hz, ArH), 7.33 – 7.26 (4H, m, ArH), 6.93 (2H, t, } J = 8.2 \text{ Hz, ArH), 5.98 (1H, d, } J = 8.6 \text{ Hz, CH), 2.79 (1H, d, } J = 8.9 \text{ Hz, OH).} \]

\[^{13}\text{C NMR (101 MHz, CDCl}_3 \text{) \delta 160.6 (d, } J = 257.8 \text{ Hz), 130.1 (t, } J = 10.6 \text{ Hz), 129.9, 128.7, 128.2, 122.2, 117.6, 111.9 (d, } J = 25.3 \text{ Hz), 87.1, 85.5, 55.6 (t, } J = 5.4 \text{ Hz).} \]

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 90:10 iPrOH, 1.0 mL/min, T = 30^\circ \text{C, } \lambda = 250 \text{ nm, Ketone 5.9 min, } R \text{ enantiomer 7.2 min, } S \text{-enantiomer 10.6 min). 94.0\% ee (R).}

\[ \text{m/z (ESI) 266.7 ([M + Na]+, 100 \%).} \]

Using \([(\text{MeO})(R,R)_\text{Teth-TsDpenRuCl}] \text{ as catalyst, the conversion was 100\%, yield 94\% and the ee was 93.8\%.} \]

Major product configuration was established by X-ray crystallographic analysis of a diastereoisomeric derivative, described herein. There are no reports of chiral HPLC or optical rotation data for this compound.

\textbf{1-(2,6-Difluorophenyl)-3-phenylprop-2-yn-1-one.}

\[
\begin{array}{c}
\text{F} \\
\text{O} \\
\text{F} \\
\end{array}
\]

This compound is known and has been fully characterized:

This compound was prepared following procedure B using 1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-ol (893 mg, 3.6 mmol, 1.0 equiv), MnO\textsubscript{2} (2.25 mg, 26.0 mmol, 7.0 equiv) and DCM (15
mL) 11-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a brown solid (989 mg, 2.93 mmol, 80.3%).

mp: 45-47 °C

$\nu_{\text{max}}$: 3084, 2194, 1636, 1489, 1023, 976, 753, 681 cm$^{-1}$.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.66 – 7.59 (2H, m, ArH), 7.51 – 7.36 (4H, m, ArH), 7.00 (2H, t, $J = 8.4$ Hz, ArH).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 171.4, 160.9 (d, $J = 264.2$ Hz), 133.7 (t, $J = 10.8$ Hz), 133.3, 131.1, 128.7, 119.8, 117.6, 112.3 (d, $J = 25.6$ Hz), 93.4, 89.2.

m/z (ESI) 264.7 ([M + Na]$^+$, 100 %).

**Racemic and (R)-1-(2,6-dichlorophenyl)-3-phenylprop-2-yn-1-ol (22).**

This compound is known and has been fully characterized:


This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), 2,6-dichloro benzaldehyde (875 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2,6-dichlorophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (1310 mg, 4.7 mmol, 94.2%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2,6-dichlorophenyl)-3-phenylprop-2-yn-1-one (32 mg, 0.116 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (0.7 mg, 1.2 x 10$^{-3}$ mmol, 1 mol%), DCM (1 mL). (R)- 1-(2,6-dichlorophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (3.3 mg, 0.012 mmol, 10%). The major product was 1-(2,6-dichlorophenyl)-3-phenylpropanone (28 mg, 0.101 mmol, 87%).

$[\alpha]_D^{25}$ -16.8$^o$ (c 0.3 in CHCl$_3$) 96.0 % ee (R) (lit $[\alpha]_D^{24}$ 3.67$^o$ (c 1.26 in CHCl$_3$, 87% ee (S))

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.48 – 7.40 (2H, m, ArH), 7.37 – 7.23 (5H, m, ArH), 7.19 (1H, dd, $J = 8.6$, 7.5 Hz, ArH), 6.40 (1H, s, CH), 3.34 (1H, s, OH).
$^{13}$C NMR (101 MHz, CDCl$_3$) δ 135.5, 134.5, 131.8, 129.7, 129.3, 128.7, 128.3, 122.4, 86.7, 86.2, 61.5.

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 90:10 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm. Ketone 5.9 min, R enantiomer 7.4 min, S-enantiomer 10.3 min). 96.0% ee (R).

m/z (ESI) 298.7 ([M + Na]+, 100%), 300.7 ([M + 2+ Na]+, 70%).

Using [(OMe)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 8% (NMR) and the ee was 96% (R), and the major product was 1-(2,6-dichlorophenyl)-3-phenylpropanone (92% conversion by NMR).

Configuration assigned in analogy with 1,6-difluoro reduction product, for which configuration was confirmed by X-ray crystallography.

1-(2,6-Dichlorophenyl)-3-phenylpropanone.

(found (ESI) [M+Na]+, 301.0155, C$_{15}$H$_8^{35}$Cl$_2$ONa requires 301.0157; 303.0126, C$_{15}$H$_8^{35}$Cl$_{35}$Cl ONa requires 303.0128; 305.0097, C$_{15}$H$_8^{37}$Cl$_2$ONa requires 305.0098)

$^1$H NMR (300 MHz, CDCl$_3$) δ 7.40-7.20 (6H, nm, ArH), 3.15-3.05 (4H, m, CH$_2$CH$_2$) ppm.

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 201.4, 140.5 (C), 139.7 (C), 130.5, 129.7 (C), 129.3, 128.7, 128.5, 126.2, 45.27, 29.1 ppm.

υ$_{max}$: 1715, 1560, 1496, 1102, 777, 696 cm$^{-1}$.

m/z (ESI); 301 (M+Na, 2 x $^{35}$Cl), 303 (M+Na, $^{35}$Cl, $^{37}$Cl), 305 (M+Na, 2 x $^{37}$Cl).

HPLC analysis (CHIRALCEL OD-H column, hexane 90:10 iPrOH, 1.0 mL/min, T = 30°C, λ = 250 nm. Ketone 6.56 min.

1-(2,6-Dichlorophenyl)-3-phenylprop-2-yn-1-one.

This compound is novel.

This compound was prepared following procedure B using 1-(2,6-dichlorophenyl)-3-phenylprop-2-yn-1-ol (1.25 mg, 4.5 mmol, 1.0 equiv), MnO$_2$ (2.70 mg, 31.0 mmol, 7.0 equiv), DCM (15 mL)
11-(2,6-dichlorophenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a white solid (1.14 mg, 4.16 mmol, 91.8%).

(found (ESI) [M+Na]+, 296.9843. C_{15}H_{3}Cl_{2}NaO requires 296.9844).

mp: 72-74 °C.

ν_{max}: 3059, 2185, 1653, 1430, 1283, 1100, 756, 683 cm^{-1}.

^{1}H NMR (400 MHz, CDCl_{3}) δ 7.65 – 7.57 (2H, m, ArH), 7.51 – 7.45 (1H, m, ArH), 7.42 – 7.29 (5H, m, ArH).

^{13}C NMR (101 MHz, CDCl_{3}) δ 138.15, 133.43, 131.64, 131.30, 131.06, 128.67, 128.43, 119.58, 95.27, 88.15.

m/z (ESI) 296.7 ([M + Na]+, 100%), 298.7 ([M + 2+ Na]+, 70%).

Racemic and (R)-1-(2,6-dimethoxyphenyl)-3-phenylprop-2-yn-1-ol (23).

This compound is known and has been fully characterized:


This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), 2,6-dimethoxy benzaldehyde (830 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2,6-dimethoxyphenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 70:30) as a white solid (1130 mg, 4.2 mmol, 84.3%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2,6-dimethoxyphenyl)-3-phenylprop-2-yn-1-one (40 mg, 0.15 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (0.9 mg, 1.5 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (R)- 1-(2,6-dimethoxyphenyl)-3-phenylprop-2-yn-1-ol was formed in 8% conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

^{1}H NMR (400 MHz, CDCl_{3}) δ 7.43 – 7.37 (2H, m, ArH), 7.29 – 7.21 (4H, m, ArH), 6.60 (2H, d, J = 8.3 Hz, ArH), 6.12 (1H, d, J = 11.5 Hz, CH), 4.09 (1H, d, J = 11.5 Hz, OH), 3.89 (6H, s, 2OCH_{3}).
\( ^{13} \text{C NMR (101 MHz, CDCl}_3 \) \( \delta 157.6, 131.7, 129.4, 128.1, 128.0, 123.3, 117.7, 104.7, 90.2, 83.0, 56.9, 56.1. \)
m/z (ESI) 290.8 ([M + Na]+, 100 %).

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 80:20 iPrOH, 1.0 mL/min, \( T = 30^\circ \text{C}, \lambda = 250 \text{ nm} \), Ketone 14.8 min, \( R \) enantiomer 20.6 min, \( S \)-enantiomer 26.3 min). 20.4% ee (\( R \)).

Using \([(\text{MeO})(\text{R},\text{R})\text{Teth-TsDpenRuCl]}\) as catalyst, the conversion was 0%.

Major product configuration was tentatively assigned by comparison of order of HPLC elution times by HPLC with those reported for this compound. However very low conversion coupled to overlaps in the HPLC of our product make the unambiguous assignment of the configuration of this product uncertain. See Table at end of SI.

1-(2,6-Dimethoxyphenyl)-3-phenylprop-2-yn-1-one.

This compound is known and has been fully characterized:

This compound was prepared following procedure B using 1-(2,6-dimethoxyphenyl)-3-phenylprop-2-yn-1-ol (1.09 g, 4.06 mmol, 1.0 equiv), MnO\(_2\) (2.70 g, 31.0 mmol, 7.0 equiv), DCM (15 mL) 1-(2,6-methoxyphenyl)-3-phenylprop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (0.84 g, 3.16 mmol, 77.8%).

\( ^1 \text{H NMR (400 MHz, CDCl}_3 \) \( \delta 7.59 – 7.52 (2\text{H, m, ArH}), 7.44 – 7.30 (4\text{H, m, ArH}), 6.60 (2\text{H, d,} \)
\( J = 8.4 \text{ Hz, ArH}), 3.85 (6\text{H, s, 2OCH}_3). \)

\( ^{13} \text{C NMR (101 MHz, CDCl}_3 \) \( \delta 178.4, 158.2, 133.0, 132.0, 130.4, 128.5, 120.7, 119.1, 104.3, 90.5, 90.0, 56.1. \)
m/z (ESI) 288.8 ([M + Na]+, 100 %).

\textbf{Racemic and (S)-3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-ol (24).}
This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), 2,4,6-trimethoxy benzaldehyde (980 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 70:30) as a white solid (1070 mg, 3.6 mmol, 72.3%).

This compound was prepared in enantiomerically-enriched form following procedure C, 3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-one (42 mg, 0.14 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (0.9 mg, 1.4 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (S)-3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-ol was formed in 20% conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

\[ \text{m/z (ESI) 320.8 ([M + Na]^+), 100 %}. \]

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 19.1% and the ee was 74.4%.

This product has not been reported in asymmetric form, therefore the configuration was tentatively assigned by analogy with the 2,6-disubstituted products. However very low conversion coupled to overlaps in the HPLC of our product make the unambiguous assignment of the configuration of this product uncertain.
3-Phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-one.

This compound is known but not fully characterized:
This compound was prepared following procedure B using 3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-ol (950 mg, 3.2 mmol, 1.0 equiv), MnO₂ (1.90 mg, 22.0 mmol, 7.0 equiv) and DCM (15 mL) 3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 70:30) as a yellow oil (720 mg, 2.45 mmol, 76.3%).

^1^H NMR (400 MHz, CDCl₃) δ 7.57 – 7.53 (2H, m, ArH), 7.43 – 7.32 (3H, m, ArH), 6.13 (2H, s, ArH), 3.86 (9H, s, 3OCH₃).

^1^C NMR (101 MHz, CDCl₃) δ 176.6, 163.7, 160.3, 132.8, 130.0, 128.4, 121.0, 115.5, 90.8, 89.1, 56.0, 55.4.

m/z (ESI) 318.8 ([M + Na]+, 100 %).

1-Mesityl-3-phenylprop-2-yn-1-ol (25).

This compound is novel.
This compound was prepared in racemic form following procedure A using: phenyl acetylene (0.65 mL, 6.0 mmol, 1.2 equiv), mesitaldehyde (740 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-mesityl-3-phenylprop-2-yn-1-ol-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a yellow oil (1125 mg, 4.5 mmol, 90.7%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-mesityl-3-phenylprop-2-yn-1-one (40 mg, 0.16 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (1.0 mg, 1.6 x 10⁻³ mmol, 1 mol%), DCM (2 mL). (S)-1-mesityl-3-phenylprop-2-
yn-1-ol was not converted into the corresponding product and remained unreacted and data was obtained using racemic compound.

(found (ESI) [M+Na]+, 273.1254. C_{18}H_{18}NaO requires 273.1250)

\(\nu_{\text{max}}\): 3419 (broad), 3060, 2194, 1487, 1201, 1008, 754, 729, 687 cm\(^{-1}\).

\(^1^H\) NMR (400 MHz, CDCl\(_3\)) \(\delta 7.45 - 7.39\) (2H, m, ArH), 7.28 (3H, dd, \(J = 5.3, 2.4\) Hz, ArH), 6.88 - 6.84 (2H, m, ArH), 6.10 (1H, d, \(J = 9.8\) Hz, CH), 2.44 (6H, s, 2CH\(_3\)), 2.26 (3H, s, CH\(_3\)) 1.62 (1H, s, OH).

\(^1^3^C\) NMR (101 MHz, CDCl\(_3\)) \(\delta 137.7, 131.7, 131.7, 130.0, 129.7, 128.2, 128.2, 123.0, 87.6, 86.3, 64.3, 20.9, 20.3.

m/z (ESI) 272.8 ([M + Na]+, 100 %).

Using [((MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 0%

This product has not been reported, and no reduction product was formed in the ATH reaction.

1-Mesityl-3-phenylprop-2-yn-1-one.

This compound is known and has been fully characterized:

This compound was prepared following procedure B using 1-mesityl-3-phenylprop-2-yn-1-ol (1.07 mg, 4.3 mmol, 1.0 equiv), MnO\(_2\) (2.60 mg, 30.0 mmol, 7.0 equiv) and DCM (15 mL) 1-mesityl-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (809 mg, 3.26 mmol, 75.6%)

\(^1^H\) NMR (400 MHz, CDCl\(_3\)) \(\delta 7.60 - 7.54\) (2H, m, ArH), 7.47 - 7.42 (1H, m, ArH), 7.37 (2H, dd, \(J = 8.2, 6.7\) Hz, ArH), 6.89 (2H, s, ArH), 2.41 (6H, s, CH\(_3\)), 2.31 (3H, s, CH\(_3\)).

\(^1^3^C\) NMR (101 MHz, CDCl\(_3\)) \(\delta 184.2, 139.8, 137.4, 135.1, 133.1, 130.8, 129.0, 128.6, 120.1, 93.2, 89.6, 21.2, 19.8.

m/z (ESI) 270.8 ([M + Na]+, 100 %).

Racemic and (R)-1-(2-methoxyphenyl)hept-2-yn-1-ol (27).
This compound is known and has been fully characterized: Scheidt, K. A.; Lettan, R. B. *Org. Lett.* **2005**, *7*, 3227-3230.

This compound was prepared in racemic form following procedure A using: 1-hexyne (0.4 mL, 6.0 mmol, 1.2 equiv), o-methoxy benzaldehyde (0.61 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-methoxyphenyl)hept-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 85:15) as a colourless oil (781 mg, 3.6 mmol, 71.6%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-methoxyphenyl)hept-2-yn-1-one (40 mg, 0.18 mmol, 1.0 equiv), FA/TEA (0.2 mL), [OMe(R,R)Teth-TsDpen RuCl] (1.2 mg, 1.8 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (R)-1-(2-methoxyphenyl)hept-2-yn-1-ol was formed in 15% conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

\[^1\text{H} \text{NMR (400 MHz, CDCl}_3\] \(\delta\) 7.59 (1H, dd, \(J = 7.5, 1.7 \text{ Hz, ArH}\)), 7.32 – 7.24 (1H, m, ArH), 7.02 – 6.93 (1H, m, ArH), 6.89 (1H, dd, \(J = 8.3, 1.0 \text{ Hz, ArH}\)), 5.71 (1H, d, \(J = 2.4 \text{ Hz, CH}\)), 3.88 (3H, s, OCH\(_3\)), 2.92 (1H, d, \(J = 4.2 \text{ Hz, OH}\)), 2.28 (2H, td, \(J = 7.1, 2.0 \text{ Hz, CH}_2\)), 1.58 – 1.37 (4H, m, 2CH\(_2\)), 0.91 (3H, t, \(J = 7.2 \text{ Hz, CH}_3\)).

\[^{13}\text{C} \text{NMR (101 MHz, CDCl}_3\] \(\delta\) 156.7, 129.4, 129.3, 127.9, 120.7, 110.7, 87.2, 79.1, 61.2, 55.5, 30.7, 21.9, 18.5, 13.6.

Enantiomeric excess determined by HPLC analysis (CHIRALPAK AD-H column, hexane 90:10 iPrOH, 1.0 mL/min, \(T = 30^\circ \text{C, } \lambda = 250 \text{ nm}\), Ketone 7.7 min, \(S\) enantiomer 10.2 min, \(R\)-enantiomer 14.4 min). 86% ee (\(R\)).

m/z (ESI) 240.8 ([M + Na]+, 100 %).

Using [(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 33.7% and the ee was 59.4%.

Major product configuration was assigned by analogy with related products in this study. There are no reports of the asymmetric synthesis of this product.

**1-(2-Methoxyphenyl)hept-2-yn-1-one.**
This compound is shown and has been fully characterized:

This compound was prepared following procedure B using 1-(2-methoxyphenyl)hept-2-yn-1-ol (731 mg, 3.3 mmol, 1.0 equiv), MnO$_2$ (2.00 mg, 23.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-methoxyphenyl)hept-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (625 mg, 2.92 mmol, 87.2%).

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.01 (1H, dd, J = 7.8, 1.8 Hz, ArH), 7.54 – 7.46 (1H, m, ArH), 7.07 – 6.92 (2H, m, ArH), 3.91 (3H, s, OCH$_3$), 2.46 (2H, t, J = 7.1 Hz, CH$_2$), 1.67 – 1.57 (2H, m, CH$_2$), 1.54 – 1.43 (2H, m, CH$_2$), 0.95 (3H, t, J = 7.3 Hz, CH$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) δ 177.1, 159.6, 134.6, 132.9, 126.8, 120.1, 112.1, 95.3, 81.7, 55.8, 29.8, 22.0, 18.9, 13.5.

m/z (ESI) 238.8 ([M + Na]+, 100 %).

**Racemic and (R)-1-(2-methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (28).**

This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: trimethylsilylacetylene (0.8 mL, 6.0 mmol, 1.2 equiv), o-methoxy benzaldehyde (0.61 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (767 mg, 3.3 mmol, 65.5%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-one (40 mg, 0.17 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (1.1 mg, 1.8 x 10$^{-3}$ mmol, 1 mol%), DCM (2 mL). (R)- 1-(2-
methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (39 mg, 0.16 mmol, 94%).

$[\alpha]_D^{25} \, 17.8^o \, (c \, 0.21 \, in \, CHCl_3) \, 96.0 \, \% \, ee \, (R) \, (lit \, [\alpha]_D^{20} \, -15.4^o \, (c \, 1.1 \, in \, CHCl_3, \, 94\% \, ee \, (S))$

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.38 (1H, dd, $J = 7.6, 1.6$ Hz, ArH), 7.15 – 7.06 (1H, m, ArH), 6.83 – 6.74 (1H, m, ArH), 6.70 (1H, dd, $J = 8.2, 1.0$ Hz, ArH), 5.51 (1H, s, CH), 3.68 (3H, s, OCH$_3$), 2.73 (1H, s, OH), 0.00 (9H, s, Si(CH$_3$)$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 157.0, 129.8, 128.6, 128.1, 120.9, 110.9, 104.5, 91.0, 61.5, 55.6, 0.0.

Enantiomeric excess determined by HPLC analysis (CHIRALPAK AD-H column, hexane 90:10 iPrOH, 1.0 mL/min, $T = 30^\circ C$, $\lambda = 220$ nm, Ketone 7.2 min, $S$ enantiomer 15.3 min, $R$-enantiomer 16.9 min). 96% ee ($R$).

m/z (ESI) 256.8 ([M + Na]$^+$, 100 %).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 82.4% and the ee was 96%.

Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under conditions in the paper cited above. The configuration was also confirmed through comparison of the optical rotation with that quoted. The configuration was also assigned by analogy with the o-Br alcohol used in the formal synthesis in the paper. See Table at end of SI.

**1-(2-Methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-one.**

This compound is known and has been fully characterized:

This compound was prepared following procedure B using 1-(2-methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (720 mg, 3.1 mmol, 1.0 equiv), MnO$_2$ (1.90 mg, 22.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (546 mg, 2.37 mmol, 77.2%).
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 8.01 (1H, dd, $J = 7.7, 1.8$ Hz, ArH), 7.57 – 7.48 (1H, m, ArH), 7.05 – 6.95 (2H, m, ArH), 3.92 (3H, s, OCH$_3$), 0.27 (9H, s, Si(CH$_3$)$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 177.0, 160.5, 135.7, 133.4, 126.9, 120.8, 112.8, 103.5, 99.1, 56.3, 0.0.

m/z (ESI) 254.8 ([M + Na]$^+$, 100 %).

**Racemic and (R)-1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (29).**

![Structure of 1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol](structure.png)

This compound is known and has been fully characterized:

This compound was prepared in racemic form following procedure A using: trimethylsilylacetylene (0.8 mL, 6.0 mmol, 1.2 equiv), o-fluoro benzaldehyde (0.6 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/EtOAc: 80:20) as a colourless oil (570 mg, 3.3 mmol, 51.3%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one (44 mg, 0.20 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (1.2 mg, 1.9 x 10$^{-3}$ mmol, 1 mol%), DCM (2 mL). (R)-1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/EtOAc: 80:20) as a colourless oil (43 mg, 0.19 mmol, 95%).

[α]$^D_{25}$ +14.8° (c 0.21 in CHCl$_3$) 94.8 % ee (R) (lit [α]$^D_{20}$ -12.8° (c 1.17 in CHCl$_3$, 94% ee (S)

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.51 – 7.40 (1H, m, ArH), 7.16 – 7.08 (1H, m, ArH), 7.02 – 6.93 (1H, m, ArH), 6.91 – 6.81 (1H, m, ArH), 5.53 (1H, d, $J = 5.5$ Hz, CH), 2.18 (1H, d, $J = 5.8$ Hz, OH), 0.00 (9H, s, Si(CH$_3$)$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 160.5 (d, $J = 248.5$ Hz), 130.4 (d, $J = 8.2$ Hz), 128.6 (d, $J = 3.3$ Hz), 127.7 (d, $J = 13.3$ Hz), 124.5 (d, $J = 3.6$ Hz), 115.8 (d, $J = 21.3$ Hz), 103.8, 91.9, 59.6 (d, $J = 4.9$ Hz).
Enantiomeric excess determined by GC analysis (CROMPAC CYCLODEXTRIN- β-236M-19, 50m × 0.25mm × 0.25µm, gas: hydrogen, T=125°C, P = 18 psi, FID = 250 °C, inj = 220 °C), ketone 66.3 min, S isomer 96.2 min, R isomer 98.6 min. 94.8% ee (R).

m/z (ESI) 244.6 ([M + Na]+, 100 %).

Using [(MeO)(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 100%, yield 96% and the ee was 95%.

The configuration was also confirmed through comparison of the optical rotation with that quoted. The configuration was also assigned by analogy with the o-Br alcohol used in the formal synthesis. See Table at end of SI.

1-(2-Fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one.

\[
\begin{align*}
\text{F} & \quad \text{O} \\
& \quad \text{SiMe}_3
\end{align*}
\]

This compound is known but not fully characterized:

This compound was prepared following procedure B using 1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (516 mg, 2.3 mmol, 1.0 equiv), MnO₂ (1.40 mg, 16.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (389 mg, 1.77 mmol, 75.6%).

\(^1\)H NMR (400 MHz, CDCl₃) δ 7.95 – 7.84 (1H, m, ArH), 7.48 – 7.37 (1H, m, ArH), 7.15 – 7.06 (1H, m, ArH), 7.05 – 6.95 (m, ArH), 0.00 (9H, s, Si(CH₃)₃).
\n\n\(^13\)C NMR (101 MHz, CDCl₃) δ 174.8, 162.89 (d, J = 262.7 Hz), 136.42 (d, J = 9.2 Hz), 132.9, 126.07 (d, J = 7.6 Hz), 124.93 (d, J = 4.0 Hz), 117.88 (d, J = 21.7 Hz) 102.7, 101.3, 0.0.

m/z (ESI) 242.6 ([M + Na]+, 100 %).

Racemic and 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (30).

\[
\begin{align*}
\text{Cl} & \quad \text{OH} \\
& \quad \text{SiMe}_3
\end{align*}
\]

This compound is known but not in enantiomerically-pure form:
This compound was prepared in racemic form following procedure A using: trimethylsilylacetylene (0.8 mL, 6.0 mmol, 1.2 equiv), o-chloro benzaldehyde (0.8 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (1.05 g, 4.4 mmol, 88.9%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one (40 mg, 0.17 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (1.1 mg, 1.8 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (R)-1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (40 mg, 0.17 mmol, 99%).

This compound was also prepared in enantiomerically-enriched form on a scale of > 1 mmol following procedure C, 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one (355 mg, 1.5 mmol, 1.0 equiv), FA/TEA (1.5 mL), [(R,R)Teth-TsDpen RuCl] (9.3 mg, 0.015 mmol, 1 mol%), DCM (1.5 mL). (R)-1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (237 mg, 1.0 mmol, 67%).

[α]D^25 2.7o (c 0.2 in CHCl_3) 93.8 % ee (R).

1H NMR (500 MHz, CDCl_3) δ 7.56 (1H, dd, J = 7.5, 1.8 Hz, ArH), 7.21 – 7.02 (3H, m, ArH), 5.62 (1H, d, J = 5.6 Hz, CH), 2.30 (1H, brs., OH), 0.00 (9H, s, Si(CH_3)_3).

13C NMR (126 MHz, CDCl_3) δ 137.7, 133.1, 129.9, 129.9 (overlapped), 128.6, 127.4, 103.8, 92.1, 62.5, 0.0.

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 97:03 iPrOH, 1.0 mL/min, T = 30°C, λ = 220 nm, Ketone 4.4 min, S enantiomer 8.2 min, R-enantiomer 10.0 min). 93.8% ee (R).

Enantiomeric excess for >1 mmol scale reaction determined by HPLC analysis (CHIRALCEL OD-H column, hexane 97:03 iPrOH, 0.5 mL/min, T = 30°C, λ = 220 nm, Ketone 8.4 min, S enantiomer 16.6 min, R-enantiomer 19.2 min). 94.2% ee. The lower flow rate gave improved separation, although the peak shape was unchanged.

m/z (ESI) 260.6 ([M + Na]^+), 262.6 ([M + 2+ Na]^+, 40%).

Using [(MeO)(R,R)Teth-TsDpen RuCl] as catalyst, the conversion was 100% and the ee was 90.6% but the alcohol was not isolated.
Major product configuration was assigned by analogy to related compounds as no asymmetric preparations of this compound have been reported. The configuration was also assigned by analogy with the o-Br alcohol used in the formal synthesis.

1-(2-Chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one.

This compound is novel.

This compound was prepared following procedure B using 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (456 mg, 1.9 mmol, 1.0 equiv), MnO₂ (1.10 mg, 13.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (223 mg, 0.93 mmol, 48.2%).

(Found (ESI) [M+Na]+, 259.0312. C₁₂H₁₃ClNaOSi requires 259.0316).

$\nu_{\text{max}}$: 2961, 2095, 1651, 1434, 1225, 1011, 841, 739, 624 cm⁻¹.

$^1$H NMR (400 MHz, CDCl₃) δ 8.06 – 8.02 (1H, m, ArH), 7.48 – 7.44 (2H, m, ArH), 7.41 – 7.36 (1H, m, ArH), 0.29 (9H, s, Si(CH₃)₃).

$^{13}$C NMR (101 MHz, CDCl₃) δ 177.1, 136.0, 134.4, 134.2, 133.7, 132.3, 127.5, 102.6, 102.2, 0.0.

m/z (ESI) 258.6 ([M + Na]+, 100%), 260.5 ([M + 2+ Na]+, 40%).

Racemic and 1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (31).

This compound is known and has been fully characterized:
This compound was prepared in racemic form following procedure A using: trimethylsilylacetylene (0.8 mL, 6.0 mmol, 1.2 equiv), o-bromo benzaldehyde (0.6 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (1076 mg, 3.8 mmol, 76.3%).
This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-one (45 mg, 0.16 mmol, 1.0 equiv), FA/TEA (0.2 mL), [OMe(R,R)Teth-TsDpen RuCl] (1 mg, 1.5 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (R)-1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (43 mg, 0.15 mmol, 94%).

\[
\begin{align*}
\alpha D_{25} & = 11.7^\circ (c 0.4 \text{ in CHCl}_3) 96.2 \% \text{ ee (R)} \\
1^1H \text{ NMR (400 MHz, CDCl}_3) & \delta 7.57 (1H, dd, J = 7.8, 1.7 Hz, ArH), 7.36 (1H, dd, J = 8.0, 1.1 Hz, ArH), 7.20 – 7.12 (1H, m, ArH), 7.04 – 6.95 (1H, m, ArH), 5.58 (1H, d, J = 5.5 Hz, CH), 2.32 (1H, d, J = 5.5 Hz, OH), 0.0 (9H, s, Si(CH}_3)_3).
\end{align*}
\]

\[
13C \text{ NMR (101 MHz, CDCl}_3) \delta 139.4, 133.2, 130.1, 128.9, 128.0, 123.2, 103.8, 92.2, 64.7, 0.0.
\]

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 97:03 iPrOH, 1.0 mL/min, T = 30°C, λ = 220 nm, Ketone 4.6 min, S enantiomer 8.5 min, R-enantiomer 10.9 min). 96.2% ee (R).

m/z (ESI) 304.6 ([M + Na]+, 100%), 306.5 ([M + 2+ Na]+, 98%).

Using [(R,R)Teth-TsDpenRuCl] as catalyst, the conversion was 100%, yield 98% and the ee was 91.8%.

Major product configuration was assigned by result obtained from the subsequent formal synthesis as no asymmetric preparations of this compound have been reported.

\[
\begin{align*}
1-(2-\text{Bromophenyl})-3-(\text{trimethylsilyl})\text{prop-2-yn-1-one.}
\end{align*}
\]

This compound is known and has been fully characterized:

This compound was prepared following procedure B using 1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (1.01 mg, 3.6 mmol, 1.0 equiv), MnO₂ (2.10 mg, 24.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (818 mg, 2.93 mmol, 81.8%).

\[
1^1H \text{ NMR (400 MHz, CDCl}_3) \delta 8.04 (1H, dd, J = 7.7, 1.8 Hz, ArH), 7.68 (1H, dd, J = 7.8, 1.1 Hz, ArH), 7.47 – 7.33 (2H, m, ArH), 0.29 (9H, s, Si(CH}_3)_3).
\]
\(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 177.7, 137.6, 135.8, 134.2, 134.0, 128.0, 122.0, 102.4, 102.2, 0.0.
m/z (ESI) 302.6 ([M + Na]+, 98%), 304.6 ([M + 2+ Na]+, 100%).

**Racemic and (R)-1-(o-tolyl)-3-(trimethylsilyl)prop-2-yn-1-ol (32).**

![Chemical structure of racemic and (R)-1-(o-tolyl)-3-(trimethylsilyl)prop-2-yn-1-ol (32).](image)

This compound is known and has been fully characterized:


This compound was prepared in racemic form following procedure A using: trimethylsilylacetylene (0.8 mL, 6.0 mmol, 1.2 equiv), o-tolualdehyde (0.6 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(o-tolyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (813 mg, 3.7 mmol, 74.6%).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(o-tolyl)-3-(trimethylsilyl)prop-2-yn-1-one (42 mg, 0.19 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(\text{R,R})Teth-TsDpen RuCl] (1.2 mg, 1.9 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (R)- 1-(o-tolyl)-3-(trimethylsilyl)prop-2-yn-1-ol was formed in 36% conversion (HPLC data) and was not isolated. The data was obtained using the mixture.

\(^{1}\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.49 – 7.41 (1H, m, ArH), 7.07 – 6.95 (3H, m, ArH), 5.39 (1H, d, \(J = 5.6\) Hz, CH), 2.24 (3H, s, CH\(_3\)), 1.97 (1H, d, \(J = 5.7\) Hz, OH), 0.00 (9H, s, Si(CH\(_3\))\(_3\)).

\(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 138.2, 136.2, 130.9, 128.5, 126.7, 126.3, 104.9, 91.6, 63.0, 19.1, 0.0.

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 97:03 iPrOH, 1.0 mL/min, \(T = 30\)°C, \(\lambda = 220\) nm, Ketone 3.8 min, S enantiomer 9.0 min, R-enantiomer 10.8 min). 58.8% ee (R).
m/z (ESI) 240.6 ([M + Na]+, 100 %).

Using [(MeO)(\text{R,R})Teth-TsDpenRuCl] as catalyst, the conversion was 21% and the ee was 43%.

Major product configuration was established by comparison of elution of HPLC peaks - order matched that reported under reported conditions in the paper cited above. The configuration was
also assigned by analogy with the o-Br alcohol used in the formal synthesis. See Table at end of SI.

1-(o-Tolyl)-3-(trimethylsilyl)prop-2-yn-1-one.

\[
\text{\textbf{Racemic and (R)-1-(2-benzyloxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (33).}}
\]

This compound is novel:

This compound was prepared in racemic form following procedure A using: trimethylsilylacetylene (0.8 mL, 6.0 mmol, 1.2 equiv), o-benzyloxy benzaldehyde (1060 mg, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL).

1-(2-benzylphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (1289 mg, 4.1 mmol, 83.2).

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-benzylphenyl)-3-(trimethylsilyl)prop-2-yn-1-one (44 mg, 0.14 mmol, 1.0 equiv), FA/TEA (0.2 mL), [(R,R)Teth-TsDpen RuCl] (0.9 mg, 1.4 x 10^{-3} mmol, 1 mol%), DCM (2 mL). (R)- 1-(2-
benzylphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/ EtOAc: 80:20) as a colourless oil (44 mg, 0.14 mmol, 99%).

(found (ESI) [M+Na]+, 333.1283. C_{19}H_{22}NaO_{2}Si requires 333.1281).

$[\alpha]_D^{25}$ 5.1$^o$ (c 0.3 in CHCl$_3$) 93.4 % ee ($R$).

$\nu_{\text{max}}$: 3453 (broad), 2959, 2170, 1597, 1247, 1026, 839, 750, 695 cm$^{-1}$.

$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.37 (1H, dd, $J = 7.5, 1.6$ Hz, ArH), 7.27 (2H, d, $J = 7.2$ Hz, ArH), 7.22 – 7.04 (4Hm, ArH), 6.83 – 6.74 (2H, m, ArH), 5.53 (1H, d, $J = 6.5$ Hz, CH), 4.96 (2H, d, $J = 3.6$ Hz, CH$_2$), 2.83 (1H, d, $J = 6.6$ Hz, OH), 0.00 (9H, s, Si(CH$_3$)$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 156.0, 136.6, 129.7, 129.1, 128.7, 128.2, 128.1, 127.3, 121.2, 112.3, 104.8, 90.8, 70.3, 62.0, 0.0.

Enantiomeric excess determined by HPLC analysis (CHIRALCEL OD-H column, hexane 97:03 iPrOH, 1.0 mL/min, T = 30°C, $\lambda$ = 220 nm, Ketone 9.3 min, $S$ enantiomer 19.6 min, $R$-enantiomer 24.2 min). 93.4% ee ($R$).

m/z (ESI) 332.7 ([M + Na]+, 100 %).

Using [(MeO)$^{(R,R)}$Teth-TsDpenRuCl] as catalyst, the conversion was 100% and the ee was 88.0% but the alcohol was not isolated.

Major product configuration was assigned by analogy to related compounds as no asymmetric preparations of this compound have been reported. The configuration was also assigned by analogy with the o-Br alcohol used in the formal synthesis.

1-(2-Benzylphenyl)-3-(trimethylsilyl)prop-2-yn-1-one

This compound is novel:

This compound was prepared following procedure B using 1-(2-benzylphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (1.21 mg, 3.9 mmol, 1.0 equiv), MnO$_2$ (2.30 mg, 27.0 mmol, 7.0 equiv) and DCM (15 mL) 1-(2-benzylphenyl)-3-(trimethylsilyl)prop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (941 mg, 3.05 mmol, 78.2%).

(found (ESI) [M+Na]+, 331.1126. C$_{19}$H$_{20}$NaO$_2$Si requires 331.1125).

$\nu_{\text{max}}$: 2960, 2151, 1644, 1594, 1221, 1004, 840, 753, 693 cm$^{-1}$.
\(^1\)H NMR (400 MHz, CDCl\(_3\)) \(\delta\) 7.77 (1H, dd, \(J = 7.8, 1.8\) Hz, ArH), 7.33 – 7.06 (6H, m, ArH), 6.85 – 6.75 (2H, m, ArH), 5.01 (2H, s, CH\(_2\)), 0.00 (9H, s, Si(CH\(_3\))\(_3\)).

\(^{13}\)C NMR (101 MHz, CDCl\(_3\)) \(\delta\) 177.4, 159.4, 137.1, 135.5, 133.4, 129.2, 128.5, 127.8, 127.5, 121.3, 114.3, 103.7, 99.4, 71.0, 0.0.

m/z (ESI) 330.7 ([M + Na]+, 100 %).
Catalytic Synthesis of the key intermediate in the synthesis of Allocolchicine.

\begin{align*}
\text{(R)-1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol 31.} \\
\end{align*}

This compound was prepared in enantiomerically-enriched form following procedure C, 1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-one (200 mg, 0.71 mmol, 1.0 equiv), FA/TEA (0.5 mL), [OMe(R,R)Teth-TsDpen RuCl] (4.6 mg, 7.1 x 10^{-3} mmol, 1 mol%), DCM (5 mL). (R)-1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol was isolated by flash chromatography (pet ether/EtOAc: 80:20) as a colourless oil (191 mg, 0.68 mmol, 96%). 96% ee.

\begin{align*}
\text{(R)-1-Bromo-2-(1-(methoxymethoxy)prop-2-yn-1-yl)benzene 34.} \\
\end{align*}

This compound is novel:

To a solution of (R)-1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol 31 (180 mg, 0.63 mmol) in 28 mL of dry THF was added sodium hydride 60% in mineral oil (60 mg, 1.5 mmol) at 0°C. The resulting mixture was stirred at rt for 1h. Bromo(methoxy)methane (90 mg, 0.06 mL, 0.72
mmol) was added and the resulting mixture was stirred at 0 °C for 15 min before letting the solution warm to rt and stir overnight. Water was added slowly and THF was removed under rotary evaporator. The resulting thick oil was extracted twice with ether. The organic layer was dried over NaSO₄, filtered and concentrated. The colourless oil was purified by column chromatography on silica gel using 30% EtOAc/hexane to give (S)-1-bromo-2-(1-(methoxymethoxy)prop-2-yn-1-yl)benzene as a colourless oil (80 mg, 0.31 mmol, 48%).

(found (ESI) [M+Na]+, 276.9829, C₁₁H₁₁BrNaO₂ requires 276.9835).

νmax: 2938, 1575, 1502, 1463, 1409, 1234, 1123, 1004, 831, 754, 630 cm⁻¹.

¹H NMR (400 MHz, CDCl₃) δ 7.58 (1H, dd, J = 7.9, 1.6 Hz, ArH), 7.42 – 7.34 (1H, m, ArH), 7.23 – 7.14 (1H, m, ArH), 7.06 – 6.95 (1H, m, ArH), 5.60 (1H, d, J = 2.1 Hz, CH), 4.88 – 4.73 (1H, m, CH₂), 4.68 – 4.49 (1H, m, CH₂), 3.26 (3H, s, CH₃), 2.44 – 2.40 (1H, m, CH).

¹³C NMR (101 MHz, CDCl₃) δ 137.5, 132.9, 130.1, 129.4, 127.9, 123.0, 94.3, 89.1, 75.4, 66.6, 56.2.

m/z (ESI) 292.5 ([M+K]+, 98%), 294.5 ([M+ K]+, 100%).

(R)-5-(3-(2-Bromophenyl)-3-(methoxymethoxy)prop-1-yn-1-yl)-1,2,3-trimethoxybenzene 35.

This compound is known and has been fully characterized:

A mixture of (R)-1-bromo-2-(1-(methoxymethoxy)prop-2-yn-1-yl)benzene 34 (80 mg, 0.31 mmol, 1.0 equiv), Pd(PPh₃)₂Cl₂ (11 mg, 0.016 mmol, 5 mol%), CuI (5 mg, 0.026 mmol, 8 mol%) and 5-Bromo-1,2,3-trimethoxybenzene (80 mg, 0.32 mmol, 1.0 equiv) was dissolved in pyridine (2 mL) and Et₃N (5 mL) under nitrogen atmosphere. The reaction was heated at 90 °C for 18 hours. The reaction was allowed to cool to ambient temperature, filtered through celite and washed with EtOAc. The reaction mixture was acidified to pH 7 with 10% HCl(aq), extracted with EtOAc, dried over Na₂SO₄, and solvent removed in vacuo. The residue was purified by column chromatography (pet ether/ EtOAc: 90:10) as a yellow oil (92 mg, 0.22 mmol, 73%).

[α]D²⁵ 19.0° (c 0.1 in CH₂Cl₂) 95.0% ee (R); lit: [α]D²² -22.5 (c 1, CH₂Cl₂) 95.4% ee (S)
$^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 7.83 (1H, dd, $J$ = 7.8, 1.7 Hz, ArH), 7.59 (1H, dd, $J$ = 8.0, 1.2 Hz, ArH), 7.44 – 7.35 (1H, m, ArH), 7.26 – 7.17 (1H, m, ArH), 6.70 (2H, s, ArH), 6.00 (1H, s, CH), 5.12 (1H, d, $J$ = 6.8 Hz, CH$_2$), 4.75 (1H, d, $J$ = 6.8 Hz, CH$_2$), 3.84 (9H, s, 3OCH$_3$), 3.48 (3H, s, CH$_3$).

$^{13}$C NMR (101 MHz, CDCl$_3$) $\delta$ 153.0, 138.0, 132.9, 130.0, 129.5, 127.9, 123.1, 117.3, 109.0, 94.3, 87.2, 85.1, 67.3, 60.9, 56.2.

m/z (ESI) 442.8 ([M + Na]$^+$, 100%), 444.8 ([M + 2+ Na]$^+$, 100%).

Enantiomeric excess determined by HPLC analysis (CHIRALPAK AD-H column, hexane 90:10 iPrOH, 1.0 mL/min, $T$ = 30°C, $\lambda$ = 250 nm, Ketone 4.6 min, $R$ enantiomer 10.6 min, $S$-enantiomer 11.8 min). 95.0% ee ($R$). This matches the reported data on the same column and conditions by LeBlanc and Fagnou.
1,3-Diphenylprop-2-yn-1-ol (7).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1,3-diphenylprop-2-yn-1-ol (7).

HPLC after ATH 1,3-diphenylprop-2-yn-1-ol (7) (17% conversion, 35.4% ee).
1,3-Diphenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1,3-diphenylprop-2-yn-1-one.
1-(4-Fluorophenyl)-3-phenylprop-2-yn-1-ol (8).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(4-fluorophenyl)-3-phenylprop-2-yn-1-ol (8).

HPLC after ATH of 1-(4-fluorophenyl)-3-phenylprop-2-yn-1-ol (8) (15% conversion, 14% ee).
1-(4-Fluorophenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(4-fluorophenyl)-3-phenylprop-2-yn-1-one.
1-(4-Bromophenyl)-3-phenylprop-2-yn-1-ol (9).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(4-bromophenyl)-3-phenylprop-2-yn-1-ol (9).

HPLC after ATH of 1-(4-bromophenyl)-3-phenylprop-2-yn-1-ol (9) (48% conversion, 8.4% ee).
1-(4-Bromophenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(4-bromophenyl)-3-phenylprop-2-yn-1-one.
1-(4-Methoxyphenyl)-3-phenylprop-2-yn-1-ol (10).

\(^1\)H NMR (400 MHz, CDCl\(_3\))

\(^{13}\)C NMR (101 MHz, CDCl\(_3\))
Racemic HPLC of 1-(4-methoxyphenyl)-3-phenylprop-2-yn-1-ol (10).

HPLC after ATH of 1-(4-methoxyphenyl)-3-phenylprop-2-yn-1-ol (10) (24% conversion, 39% ee).
1-(4-Methoxyphenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(4-methoxyphenyl)-3-phenylprop-2-yn-1-one.
3-Phenyl-1-(o-tolyl)prop-2-yn-1-ol (11).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 3-phenyl-1-(o-tolyl)prop-2-yn-1-ol (11).

HPLC after ATH of 3-phenyl-1-(o-tolyl)prop-2-yn-1-ol (11) (27% conversion, 14.4% ee).
3-Phenyl-1-(o-tolyl)prop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 3-phenyl-1-(o-tolyl)prop-2-yn-1-one.

![Chromatogram](image)

### Result Table

<table>
<thead>
<tr>
<th>Reten. Time [min]</th>
<th>Area [mV.s]</th>
<th>Height [mV]</th>
<th>Area [%]</th>
<th>Height [%]</th>
<th>WOB [min]</th>
<th>Compound Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28888.930</td>
<td>1107.995</td>
<td>100.0</td>
<td>100.0</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>28888.930</td>
<td>1107.995</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1-(2-Fluorophenyl)-3-phenylprop-2-yn-1-ol (12).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-fluorophenyl)-3-phenylprop-2-yn-1-ol (12).

HPLC after ATH of 1-(2-fluorophenyl)-3-phenylprop-2-yn-1-ol (12) (100% conversion, 62.6% ee).
1-(2-Fluorophenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-fluorophenyl)-3-phenylprop-2-yn-1-one.
1-(2-Chlorophenyl)-3-phenylprop-2-yn-1-ol (13).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-chlorophenyl)-3-phenylprop-2-yn-1-ol (13).

HPLC after ATH of 1-(2-chlorophenyl)-3-phenylprop-2-yn-1-ol (13) (100% conversion, 62.2% ee).
1-(2-Chlorophenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-chlorophenyl)-3-phenylprop-2-yn-1-one.

---

**Chromatogram C:\CLARITY\WORK2\DATA\V\VYAS\SUBSTRATE METHOD\NEW ADH\V29 KETONE\U-PAD2 - 1**

**Result Table (Uncal - C:\CLARITY\WORK2\DATA\V\VYAS\SUBSTRATE METHOD\NEW ADH\V29 KETONE\U-PAD2 - 1)**

<table>
<thead>
<tr>
<th>Reten. Time (min)</th>
<th>Area (mV-s)</th>
<th>Height (mV)</th>
<th>Area (%)</th>
<th>Height (%)</th>
<th>WBB (min)</th>
<th>Compound Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10477.930</td>
<td>143.377</td>
<td>100.0</td>
<td>100.0</td>
<td>1.18</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10477.930</td>
<td>143.377</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1-(2-Bromophenyl)-3-phenylprop-2-yn-1-ol (14).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-bromophenyl)-3-phenylprop-2-yn-1-ol (\(14\)).

HPLC after ATH of 1-(2-Bromophenyl)-3-phenylprop-2-yn-1-ol (\(14\)) (100% conversion, 52.8% ee).
1-(2-Bromophenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-bromophenyl)-3-phenylprop-2-yn-1-one.
1-(2-Iodophenyl)-3-phenylprop-2-yn-1-ol (15).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-iodophenyl)-3-phenylprop-2-yn-1-ol (15).

HPLC after ATH of 1-(2-Iodorophenyl)-3-phenylprop-2-yn-1-ol (15) (56% conversion, 40.0% ee).
1-(2-Iodophenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-iodophenyl)-3-phenylprop-2-yn-1-one.
1-(2-Methoxyphenyl)-3-phenylprop-2-yn-1-ol (16).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-methoxyphenyl)-3-phenylprop-2-yn-1-ol (16).

HPLC after ATH of 1-(2-methoxyphenyl)-3-phenylprop-2-yn-1-ol (16) (100% conversion, 79.2% ee).
1-(2-Methoxyphenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-methoxyphenyl)-3-phenylprop-2-yn-1-one.
1-(2-Ethoxyphenyl)-3-phenylprop-2-yn-1-ol (17).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-ol (17).

HPLC after ATH of 1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-ol (17) (100% conversion, 58.4% ee).
1-(2-Ethoxyphenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-ethoxyphenyl)-3-phenylprop-2-yn-1-one.
1-(2-Isoproxyphenyl)-3-phenylprop-2-yn-1-ol (18).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-isoproxyphenyl)-3-phenylprop-2-yn-1-ol (18).

HPLC after ATH of 1-(2-isoproxyphenyl)-3-phenylprop-2-yn-1-ol (18) (37% conversion, 40.4% ee).
1-(2-Isopropoxyphenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-isopropoxyphenyl)-3-phenylprop-2-yn-1-one.
1-(2- Benzyloxyphenyl)-3-phenylprop-2-yn-1-ol (19).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic alcohol 1-(2-benzyloxyphenyl)-3-phenylprop-2-yn-1-ol (19).

HPLC after ATH of 1-(2-benzyloxyphenyl)-3-phenylprop-2-yn-1-ol (19) (100% conversion, 79.4% ee).
1-(2- Benzyloxyphenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-benzyloxyphenyl)-3-phenylprop-2-yn-1-one.
1-[[1,1'-Biphenyl]-2-yl]-3-phenylprop-2-yn-1-ol (20).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
1-([1,1'-Biphenyl]-2-yl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
1-(2,6-Difluorophenyl)-3-phenylprop-2-yn-1-ol (21).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2,6-Difluorophenyl)-3-phenylprop-2-yn-1-ol (21).

HPLC after ATH of 1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-ol (21) (100% conversion, 94.0% ee).
1-(2,6-Difluorophenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-one.
1-(2,6-Dichlorophenyl)-3-phenylprop-2-yn-1-ol (22).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2,6-Dichlorophenyl)-3-phenylprop-2-yn-1-ol (22).

HPLC after ATH of 1-(2,6-Dichlorophenyl)-3-phenylprop-2-yn-1-ol (22) (96.0% ee).
1-(2,6-Dichlorophenyl)-3-phenylprop-2-yne-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2,6-dichlorophenyl)-3-phenylprop-2-yn-1-one.
1-(2,6-Dichlorophenyl)-3-phenylpropanone.

$^1$H NMR (300 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
HPLC of 1-(2,6-dichlorophenyl)-3-phenylpropanone.
1-(2,6-Dimethoxyphenyl)-3-phenylprop-2-yn-1-ol (23).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2,6-dimethoxyphenyl)-3-phenylprop-2-yn-1-ol (23).

HPLC after ATH of 1-(2,6-Dimethoxyphenyl)-3-phenylprop-2-yn-1-ol (23) (8% conversion, 20.4% ee).
1-(2,6-Dimethoxyphenyl)-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2,6-dimethoxyphenyl)-3-phenylprop-2-yn-1-one.
3-Phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-ol (24).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-ol (24).

HPLC after ATH of 3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-ol (24) (20% conversion, 20% ee).
3-Phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 3-phenyl-1-(2,4,6-trimethoxyphenyl)prop-2-yn-1-one.

![Chromatography SW Graph](image)

### Result Table

<table>
<thead>
<tr>
<th></th>
<th>Retention Time [min]</th>
<th>Area [mIU]</th>
<th>Height [%]</th>
<th>Area [%]</th>
<th>Height [%]</th>
<th>W/5 [min]</th>
<th>Compound Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8.888</td>
<td>15307.919</td>
<td>821.568</td>
<td>100.0</td>
<td>100.0</td>
<td>3.28</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>15307.919</td>
<td>821.568</td>
<td>100.0</td>
<td>100.0</td>
<td>3.28</td>
<td></td>
</tr>
</tbody>
</table>
1-Mesityl-3-phenylprop-2-yn-1-ol (25).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
1-Mesityl-3-phenylprop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
1-(2-methoxyphenyl)hept-2-yn-1-ol (27).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-methoxyphenyl)hept-2-yn-1-ol (27).

HPLC after ATH of 1-(2-methoxyphenyl)hept-2-yn-1-ol (27) (15% conversion, 86% ee).
1-(2-Methoxyphenyl)hept-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-Methoxyphenyl)hept-2-yn-1-one.
1-(2-Methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (28).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (28).

HPLC after ATH of 1-(2-methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (28) (100% conversion, 96% ee).
1-(2-Methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-one.

$^{1}H$ NMR (400 MHz, CDCl$_3$)

$^{13}C$ NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-methoxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-one.
1-(2-Fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (29).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic GC of 1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (29).

GC after ATH of 1-(2-Fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (29) (100% conversion, 94.8% ee).
1-(2-Fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone GC of 1-(2-fluorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one.
1-(2-Chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (30).

$^1$H NMR (500 MHz, CDCl$_3$)

$^{13}$C NMR (126 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (30).

HPLC after ATH of 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (30) (100% conversion, 93.8% ee).
Racemic HPLC of 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (30) from larger scale reaction under different HPLC conditions:

HPLC after ATH of 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (30) from larger scale reaction under different HPLC conditions (100% conversion, 94.2% ee).
1-(2-Chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-chlorophenyl)-3-(trimethylsilyl)prop-2-yn-1-one.
1-(2-Bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (31).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (31).

HPLC after ATH of 1-(2-bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (31) (100% conversion, 96.2% ee).
1-(2-Bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-Bromophenyl)-3-(trimethylsilyl)prop-2-yn-1-one.
1-(o-Tolyl)-3-(trimethylsilyl)prop-2-yn-1-ol (32).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(o-tolyl)-3-(trimethylsilyl)prop-2-yn-1-ol (32).

HPLC after ATH of 1-(o-tolyl)-3-(trimethylsilyl)prop-2-yn-1-ol (32) (36% conversion, 58.8% ee).
1-(o-Tolyl)-3-(trimethylsilyl)prop-2-yn-1-one.

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(o-tolyl)-3-(trimethylsilyl)prop-2-yn-1-one.
1-(2-Benzyl oxy phenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (33).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 1-(2-benzyloxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (33).

HPLC after ATH of 1-(2-benzyloxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-ol (33) (100% conversion, 93.4% ee).
1-(2-Benzyloxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-one.

$^{1}$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Ketone HPLC of 1-(2-benzyloxyphenyl)-3-(trimethylsilyl)prop-2-yn-1-one.

<table>
<thead>
<tr>
<th>Reten. Time [min]</th>
<th>Area [mV.s]</th>
<th>Height [mV]</th>
<th>Area [%]</th>
<th>Height [%]</th>
<th>W05 [min]</th>
<th>Compound Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.352</td>
<td>9428.496</td>
<td>355.730</td>
<td>100.0</td>
<td>100.0</td>
<td>0.36</td>
<td></td>
</tr>
</tbody>
</table>
1-Bromo-2-(1-(methoxymethoxy)prop-2-yn-1-yl)benzene (34).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
5-(3-(2-Bromophenyl)-3-(methoxymethoxy)prop-1-yn-1-yl)-1,2,3-trimethoxybenzene (35).

$^{1}H$ NMR (400 MHz, CDCl$_3$)

$^{13}C$ NMR (101 MHz, CDCl$_3$)
Racemic HPLC of 5-(3-(2-bromophenyl)-3-(methoxymethoxy)prop-1-yn-1-yl)-1,2,3-trimethoxybenzene (35).

HPLC of 5-(3-(2-bromophenyl)-3-(methoxymethoxy)prop-1-yn-1-yl)-1,2,3-trimethoxybenzene (35) after catalytic synthesis (95.0% ee).
Determination of absolute configuration of 26 (CCDC 1574558).

(R)-1-(2,6-Difluorophenyl)-3-phenylprop-2-yn-1-ol 21 (93 mg, 0.38 mmol, 1 equiv) was dissolved in DCM (2 mL) at rt in a dry schlenk tube under a nitrogen atmosphere. DMAP (a few crystals) and (R)-(+)-α-Methylbenzyl isocyanate (60 µL, 0.38 mmol, 1 equiv) were added. The reaction mixture was stirred overnight. At the end of this time the isocyanate adduct was purified by column chromatography on silica gel (n-hexane:EtOAc 85/15) as a white solid (75 mg, 0.19 mmol, 50%).


(R)-1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-y1 ((R)-1-phenylethyl)carbamate (36).

This compound is novel.

(found (ESI) [M+Na]+, 414.1282. C_{24}H_{19}F_{2}NNaO_{2} requires 414.1276).

υ max: 3387 (sharp), 1689, 1514, 1472, 1236, 1050, 1010, 789, 703, 548 cm⁻¹.

mp: 139-141 °C

{H NMR (400 MHz, CDCl₃) δ 7.50 (2H, d, J = 7.3 Hz, ArH), 7.38 – 7.27 (9H, m, ArH), 7.01 (1H, s, CH), 6.95 (2H, t, J = 8.2 Hz, ArH), 5.17 (1H, d, J = 7.7 Hz, NH), 4.89 (1H, p, J = 7.2 Hz, CH), 1.54 (3H, d, J = 6.9 Hz, CH₃).

{C NMR (101 MHz, CDCl₃) δ 160.91 (d, J = 260.3 Hz), 153.95, 132.05, 130.75 (t, J = 10.5 Hz), 128.80, 128.66, 128.22, 127.43, 126.00, 122.09, 114.46 (t, J = 16.4 Hz), 111.85 (d, J = 25.3 Hz), 85.94, 84.39, 56.92, 51.03, 22.47.

m/z (ESI) 413.9 ([M + Na]+, 100 %).
(R)-1-(2,6-difluorophenyl)-3-phenylprop-2-yn-1-yl ((R)-1-phenylethyl)carbamate (26).

$^1$H NMR (400 MHz, CDCl$_3$)

$^{13}$C NMR (101 MHz, CDCl$_3$)
Compound 26; CCDC 1574558

Single crystal x-ray structure of 26 (ellipsoids are plotted at the 50% probability level)

Single crystal x-ray structure of 26 (ellipsoids are plotted at the 50% probability level, non-chiral H-atoms omitted for clarity)
One-dimensional solid-state packing of 26 (ellipsoids are plotted at the 50% probability level)

X-ray crystallographic structure of 26 with atom labelling (CCDC 1574558). See the .cif file for full crystallographic details.
Single crystals of 26 were grown from vapour diffusion of $n$-hexane into a chloroform solution of the compound over several days. A suitable crystal was mounted on a Mitegen head with Fomblin oil and collected on an Xcalibur Gemini diffractometer with a Ruby CCD area detector at 150(2) K. The structure was solved using Olex2 and the ShelXT structure solution program using Direct Methods and refined with the ShelXL refinement package using Least Squares refinement.

The asymmetric unit contains the diastereomerically pure carbamate. There are two molecules within the unit cell. The molecule adopts a layered structure in the solid state with offset aromatic donor-acceptor (π-π) interactions of the difluorophenyl moieties.

The molecule displayed an absolute configuration of R,R which was deduced through the use of an enantiopure chiral axillary which allowed assignment of the remaining chiral centre. Additionally Flack and Hooft parameters were obtained and found to be 0.15(14) and 0.07(7) respectively.

<table>
<thead>
<tr>
<th>Compound Reference</th>
<th>Compound 26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Formula</td>
<td>C$<em>{24}$H$</em>{19}$F$<em>{2}$NO$</em>{2}$</td>
</tr>
<tr>
<td>Formula Mass</td>
<td>391.40</td>
</tr>
<tr>
<td>Crystal system</td>
<td>Monoclinic</td>
</tr>
<tr>
<td>$a$/ Å</td>
<td>5.3070(1)</td>
</tr>
<tr>
<td>$b$/ Å</td>
<td>11.1814(1)</td>
</tr>
<tr>
<td>$c$/ Å</td>
<td>16.4228(2)</td>
</tr>
<tr>
<td>$\alpha$/ °</td>
<td>90</td>
</tr>
<tr>
<td>$\beta$/ °</td>
<td>96.202(1)</td>
</tr>
<tr>
<td>$\gamma$/ °</td>
<td>90</td>
</tr>
<tr>
<td>Unit cell volume/ Å</td>
<td>968.82(2)</td>
</tr>
<tr>
<td>Temperature/ K</td>
<td>150(2)</td>
</tr>
</tbody>
</table>
Space group: $P \overline{2}yb$

Crystal size/ mm: $0.2 \times 0.12 \times 0.05$

Radiation: CuKα (λ = 1.54178)

Goodness-of-fit on $F^2$: 0.9683

No. of formula units per unit cell, $Z$: 2

No. of reflections measured: 20164

No. of independent reflections: 9300

Final $R_1$ values ($I > 2\sigma(I)$): 0.0375

Final $wR(F^2)$ values ($I > 2\sigma(I)$): 0.1092

Final $R_1$ values (all data): 0.0427

Final $wR(F^2)$ (all data): 0.1231


Synthesis and X-ray crystallographic data for 1-(2,6-Difluorophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-one 37.

1-(2,6-Difluorophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-ol.

This compound was prepared in racemic form following procedure A using: 4-methoxyphenyl acetylene (0.80 mL, 6.0 mmol, 1.2 equiv), 2,6-difluoro benzaldehyde (0.53 mL, 5.0 mmol, 1.0 equiv), nBuLi, 2.5 M in hexane (2.0 mL, 5.0 mmol, 1.0 equiv) and dry THF (25 mL). 1-(2,6-difluorophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-ol was isolated by flash chromatography (hexane/ EtOAc: 80:20) as a colourless oil (710 mg, 2.58 mmol, 51.8%).

\[ ^1H \text{ NMR} (500 \text{ MHz, CDCl}_3) \delta 7.41 – 7.34 (2H, m, ArH), 7.33 – 7.23 (1H, m, ArH), 6.93 (2H, t, J = 8.2 Hz, ArH), 6.86 – 6.79 (2H, m, ArH), 5.97 (1H, dt, J = 9.0, 1.4 Hz, HCO), 3.80 (1H, s, OCH\textsubscript{3}), 2.74 (1H, dt, J = 8.9, 1.7 Hz, OH). \]

\[ ^13C \text{ NMR} (126 \text{ MHz, CDCl}_3) \delta 161.8 (d, J = 7.9 Hz), 160.0, 159.8 (d, J = 7.9 Hz), 133.5, 130.1 (t, J = 10.6 Hz), 114.4, 114.0, 112.2 – 119.9, 86.0, 85.7, 55.8 (t, J = 5.4 Hz), 55.4. \]

\[ \text{HRMS (found (ESI) [M+Na]+, 297.0698. C}_{16}H_{12}F_{2}NaO}_{2} \text{ requires 297.0698) \]

\[ \text{max}: 3392, 1625, 1603, 1508, 1466, 1286, 1232, 1175, 1026, 992, 827, 787, 736, 556, 533 \text{ cm}^{-1}. \]

\[ \text{mp: 72-75 °C.} \]

1-(2,6-Difluorophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-one 37.

This compound was prepared following procedure B using 1-(2,6-difluorophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-ol (127 mg, 0.463 mmol, 1.0 equiv), MnO\textsubscript{2} (402 mg, 4.6 mmol, 10.0
equiv), DCM (10 mL). 1-(4-Fluorophenyl)-3-phenylprop-2-yn-1-one was isolated by flash chromatography (pet ether/ EtOAc: 90:10) as a white solid (126 mg, 0.46 mmol, 85.7%)
mp: 72-75 °C
$^1$H NMR (500 MHz, CDCl$_3$) $\delta$ 7.61 – 7.55 (2H, m, ArH), 7.49 – 7.42 (m, 1H, ArH), 6.99 (2H, t, $J = 8.4$ Hz, ArH), 6.94 - 6.88 (2H, m, ArH), 3.85 (s, 3H, OCH$_3$).
$^{13}$C NMR (126 MHz, CDCl$_3$) $\delta$ 171.4, 162.2, 161.0 (d, $J = 5.8$ Hz), 159.9 (d, $J = 5.5$ Hz), 135.6, 133.6 (t, $J = 10.8$ Hz), 114.6, 112.6 – 112.3 (m), 111.7, 95.1 (d, $J = 1.9$ Hz), 89.6, 55.6.
HRMS (found (ESI) [M+Na]$^+$, 295.0543. C$_{16}$H$_{10}$F$_2$NaO$_2$ requires 295.0541)
$\nu$ max: 2185, 1621,1597, 1507, 1461, 1319, 1237, 1171, 1068, 1031, 995, 827, 789, 749, 685, 624, 589, 562, 540 cm$^{-1}$.
mp: 78-81 °C
1-(2,6-Difluorophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-ol.

$^1$H NMR (500 MHz, CDCl$_3$)
$^{13}$C NMR (126 MHz, CDCl$_3$)
1-(2,6-Difluorophenyl)-3-(4-methoxyphenyl)prop-2-yn-1-one 37.

$^1$H NMR (500 MHz, CDCl$_3$)
$^{13}$C NMR (126 MHz, CDCl$_3$).
Compound 37. CCDC 1582072

Single crystal x-ray structure of 37 (ellipsoids are plotted at the 50% probability level)

Single crystal X-ray structure of 37 (ellipsoids are plotted at the 50% probability level).

X-ray crystallographic structure of 37 with atom labelling (CCDC 1582072). See the .cif file for full crystallographic details
CCDC 1582072 contains the supplementary crystallographic data for this compound. These can be obtained free of charge from the Cambridge Crystallographic Data Centre via

www.ccdc.cam.ac.uk/data_request/cif.

Single crystals of 37 were grown from slow evaporation of a n-hexane/EtOAc (1:1) solution of the compound over several days. A suitable crystal was mounted on a glass fibre with Fomblin oil and collected on a Rigaku Oxford Diffraction SuperNova diffractometer with a duel source (Cu at zero) equipped with an AtlasS2 CCD area detector at 150(2) K. The structure was solved using Olex2 and the ShelXT structure solution program using Direct Methods and refined with the ShelXL refinement package using Least Squares refinement.

The asymmetric unit contains two distinct molecules. The crystal exhibits a layered structure with significant donor-acceptor (π-π) interactions of the difluorophenyl moieties. The molecules display significant non-planarity arising from the steric requirements of the 2,6-difluoro functionalised phenyl ring and the adjacent carbonyl moiety. The dihedral angles between the difluorobenzene and ketone are 41.9° and -37.8° for the two independent molecules.
<table>
<thead>
<tr>
<th><strong>Compound Reference</strong></th>
<th><strong>Compound 37</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Formula</td>
<td>C_{20}H_{16}F_{2}O_{2}</td>
</tr>
<tr>
<td>Formula Mass</td>
<td>272.24</td>
</tr>
<tr>
<td>Crystal system</td>
<td>triclinic</td>
</tr>
<tr>
<td>(a/) Å</td>
<td>3.83441(11)</td>
</tr>
<tr>
<td>(b/) Å</td>
<td>15.5277(4)</td>
</tr>
<tr>
<td>(c/) Å</td>
<td>22.1954(5)</td>
</tr>
<tr>
<td>(\alpha/) °</td>
<td>108.682(2)</td>
</tr>
<tr>
<td>(\beta/) °</td>
<td>91.293(2)</td>
</tr>
<tr>
<td>(\gamma/) °</td>
<td>96.764(2)</td>
</tr>
<tr>
<td>Unit cell volume/ Å</td>
<td>1240.60(6)</td>
</tr>
<tr>
<td>Temperature/ K</td>
<td>150(2)</td>
</tr>
<tr>
<td>Space group</td>
<td>P-1</td>
</tr>
<tr>
<td>Crystal size/ mm</td>
<td>0.3 \times 0.08 \times 0.02</td>
</tr>
<tr>
<td>Radiation</td>
<td>CuKα ((\lambda = 1.54178))</td>
</tr>
<tr>
<td>Goodness-of-fit on (F^2)</td>
<td>1.029</td>
</tr>
<tr>
<td>No. of formula units per unit cell, (Z)</td>
<td>4</td>
</tr>
<tr>
<td>No. of reflections measured</td>
<td>4965</td>
</tr>
<tr>
<td>No. of independent reflections</td>
<td>4179</td>
</tr>
<tr>
<td>Final (R_1) values ((I &gt; 2\sigma(I)))</td>
<td>0.0373</td>
</tr>
<tr>
<td>Final (wR(F^2)) values ((I &gt; 2\sigma(I)))</td>
<td>0.0908</td>
</tr>
<tr>
<td>Final (R_1) values (all data)</td>
<td>0.0468</td>
</tr>
<tr>
<td>Final (wR(F^2)) (all data)</td>
<td>0.0971</td>
</tr>
</tbody>
</table>

Summary of literature survey on aryl/propargylic ketone reduction products.

In this report we follow the convention in the literature for assignment of R/S used throughout the preceding literature, i.e.

Irrespective of substituents on the aromatic ring:

![Chemical structure](image)

The product configurations were confirmed as follows:

i) The p-substituted/Ph product configurations were confirmed by literature comparisons where possible, and others were then related to them.

ii) The o-substituted/Ph product configurations were confirmed by literature comparisons where possible and others were then related to them.

iii) The 2,6-disubstituted/Ph were confirmed by the X-ray analysis of the difluoro derivative, and others were related to that compound.

iv) The o-substituted/TMS product configurations were confirmed by comparison of the rotation and HPLC data for the reported derivative of the o-Br alcohol used in the formal synthesis.

The Table below summarises literature comparisons that we have made between configuration, sign of optical rotation and HPLC data where available. The list is not fully comprehensive and for reasons of space not all reports for commonly-prepared compounds are included.

Tables of literature precedent for each reduction product which were used to aid our assignments of configurations; The result in our study is given in first row of each Table. Literature references are given at the end of the Tables.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Major enantiomer illustrated</th>
<th>HPLC conditions</th>
<th>Retention times.</th>
</tr>
</thead>
<tbody>
<tr>
<td>This work.</td>
<td><img src="image" alt="Chemical structure" /></td>
<td>OD-H Hex:IPA 90:10 0.7 mpm.</td>
<td>12.1 (minor) R 17.7 (major) S</td>
</tr>
<tr>
<td></td>
<td>17% conv. Not isolated.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference</th>
<th>Major enantiomer illustrated</th>
<th>HPLC conditions</th>
<th>Retention times.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image" alt="Chemical structure" /></td>
<td>OD-H Hex:IPA 90:10 0.7 mpm.</td>
<td>12.1 (minor) R 17.7 (major) S</td>
</tr>
<tr>
<td></td>
<td>17% conv. Not isolated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>Configuration</td>
<td>Column 1</td>
</tr>
<tr>
<td>---</td>
<td>---------------</td>
<td>---------------</td>
<td>----------</td>
</tr>
<tr>
<td>19.</td>
<td>Ramos Tombo 1990</td>
<td>S</td>
<td>correlation with reduction product</td>
</tr>
<tr>
<td>22.</td>
<td>Soai 1990</td>
<td>R-(+)</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Corey 1994</td>
<td>R-(+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 90:10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 10:1</td>
</tr>
<tr>
<td>15.</td>
<td>Pu 2004.</td>
<td></td>
<td>OD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 90:10 1 mpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 9:1 1 mpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 90:10 1 mpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 90:10 1 mpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 90:10 1 mpm</td>
</tr>
<tr>
<td>1.</td>
<td>Zhang 2008</td>
<td></td>
<td>ODH</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 80:20</td>
</tr>
<tr>
<td>9.</td>
<td>Wang 2009.</td>
<td></td>
<td>OD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 80:20</td>
</tr>
<tr>
<td>5.</td>
<td>Nishiyama 2010.</td>
<td></td>
<td>OD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hex/IPA 80:20 1 mpm</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>HPLC conditions</td>
<td>Retention times</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>This work</td>
<td>Not isolated in our work.</td>
<td>OD-H Hex/IPA 80:20 1 mpm</td>
<td>6.6 (minor) R 15.7 (major) S</td>
</tr>
<tr>
<td>15. Pu 2004</td>
<td></td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>12.2 (major) R 40.7 (minor) S</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>HPLC conditions</td>
<td>Retention times</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>This work</td>
<td>Not isolated, 15% Conv.</td>
<td>OD-H Hex/IPA 80:20 1 mpm</td>
<td>6.1 (minor) R. 13.5 (major) S.</td>
</tr>
<tr>
<td>9. Wang 2009.</td>
<td><img src="image" alt="chemical structure" /></td>
<td>OD Hex/IPA 80:20 1 mpm</td>
<td>5.77 (minor) R 11.09 (major) S</td>
</tr>
<tr>
<td>3. Chen. 2012.</td>
<td><img src="image" alt="chemical structure" /></td>
<td>OD-H Hex/IPA 90:10 1 mpm</td>
<td>8.92 (major) R 24.97 (minor) S</td>
</tr>
<tr>
<td>8. Bian/Hou 2013.</td>
<td><img src="image" alt="chemical structure" /></td>
<td>OD-H Hex/IPA 80:20 1 mpm</td>
<td>6.45 (minor) R 12.47 (major) S</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>HPLC conditions</td>
<td>Retention times</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------------</td>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>This work.</td>
<td>Low conv, not isolated. S.</td>
<td>OD-H Hex/IPA 90:10 1 mpm</td>
<td>15.3 (minor) R 32.3 (major) S</td>
</tr>
<tr>
<td>15. Pu 2004</td>
<td></td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>16.7 (major) R 37.9 (minor) S</td>
</tr>
<tr>
<td>16. Xu 2005</td>
<td></td>
<td>OD Hex:IPA 90:10 1 mpm</td>
<td>15.17 (minor) R 33.24 (major) S</td>
</tr>
<tr>
<td>5. Nishiyama 2010.</td>
<td></td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>14.8 (major) R 36.3 (minor) S</td>
</tr>
<tr>
<td>3. Chen. 2012.</td>
<td></td>
<td>OD-H Hex/IPA 90:10 1 mpm</td>
<td>13.56 (major) R 30.01 (minor) S</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>HPLC conditions</td>
<td>Retention times.</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------</td>
<td>-----------------</td>
<td>------------------</td>
</tr>
<tr>
<td>8. Bian/Hou 2013.</td>
<td><img src="image1.png" alt="Structure" /></td>
<td>OD-H Hex:IPA 80:20 1 mpm</td>
<td>10.05 (minor) R 14.41 (major) S</td>
</tr>
<tr>
<td>7. Xu 2014.</td>
<td><img src="image2.png" alt="Structure" /></td>
<td>OD-H Hex:IPA 80:20 1 mpm</td>
<td>8.7 (minor) R 14.4 (major) S</td>
</tr>
<tr>
<td>12. Pu 2015</td>
<td><img src="image3.png" alt="Structure" /></td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>15.5 (major) R 30.0 (minor) S</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>HPLC conditions</td>
<td>Retention times.</td>
</tr>
<tr>
<td>This work.</td>
<td><img src="image5.png" alt="Structure" /></td>
<td>OD-H Hex/IPA 80:20 1 mpm</td>
<td>6.4 (minor) R 11.1 (major) S</td>
</tr>
<tr>
<td>15. Pu 2004</td>
<td><img src="image6.png" alt="Structure" /></td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>12.0 (major) R 27.1 (minor) S</td>
</tr>
<tr>
<td>16. Xu 2005</td>
<td><img src="image7.png" alt="Structure" /></td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>11.45 (minor) R 23.98 (major) S</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>Configuration assigned by rotn.</td>
<td>HPLC conditions</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------</td>
<td>---------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>3. Chen 2012.</td>
<td><img src="image1.png" alt="Structure" /></td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>9.58 (major) R 20.52 (minor) S</td>
</tr>
<tr>
<td>7. Xu 2014.</td>
<td><img src="image3.png" alt="Structure" /></td>
<td>OD-H Hex:IPA 80:20 1 mpm</td>
<td>6.0 (minor) R 11.1 (major) S</td>
</tr>
<tr>
<td>12. Pu 2015</td>
<td><img src="image4.png" alt="Structure" /></td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>10.6 (major) R 22.5 (minor) S</td>
</tr>
</tbody>
</table>

**Reference Major enantiomer illustrated**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Major enantiomer illustrated</th>
<th>HPLC conditions</th>
<th>Retention times</th>
</tr>
</thead>
<tbody>
<tr>
<td>This work.</td>
<td>Isolated, 94% R [α]_D^{25} -28.3° (c 0.21 in CHCl₃)</td>
<td>OD-Hex/IPA 80:20 1 mpm</td>
<td>6.0 (major) R 7.4 (minor) S</td>
</tr>
<tr>
<td>16. Xu 2005</td>
<td>S [α]_D^{20} = +5.68 (C=0.6, CHCl₃).</td>
<td>OD Hex/IPA 90:10 1 mpm</td>
<td>10.22 (minor) R 14.76 (major) S</td>
</tr>
<tr>
<td>9. Wang 2009.</td>
<td>S [α]_D^{25} = +6.5 (c=0.71, CHCl₃)</td>
<td>OD Hex:IPA 80:20 1 mpm</td>
<td>5.74 (minor) R 7.08 (major) S</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>Configuration assigned by rotH</td>
<td>HPLC conditions</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------------</td>
<td>--------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>This work.</td>
<td>Isolated, 99%.</td>
<td>$R \ \left[ \alpha \right]_{D}^{25} = -26.8^\circ$ (c 0.14 in CHCl$_3$)</td>
<td>OD-H Hex/IPA 97:3 1 mpm</td>
</tr>
<tr>
<td>8. Bian/Hou 2013.</td>
<td></td>
<td>$\text{OD-D hex:IPA 97:3}$</td>
<td>29.93 (minor) R 34.49 (major) S</td>
</tr>
<tr>
<td>14. Wang 2017.</td>
<td></td>
<td>$\text{OD-D hex:IPA 90:10}$</td>
<td>10.46 (R) 11.56 (S)</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>Configuration assigned by rotn</td>
<td>HPLC conditions</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------</td>
<td>--------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>5. Nishiyama 2010.</td>
<td>![Chemical structure]</td>
<td>R ([\alpha]_{D}^{23} = -55.7\ (c\ 1.47, \ CHCl_3))</td>
<td>OD hex:IPA 98:2 1 mpm</td>
</tr>
<tr>
<td>3. Chen 2012.</td>
<td>![Chemical structure]</td>
<td>R ([\alpha]_{D}^{22} = -53.9\ (c\ 1.05, \ CHCl_3))</td>
<td>OD-H hex:IPA 90:10 0.25 mpm</td>
</tr>
<tr>
<td>8. Bian/Hou 2013.</td>
<td>![Chemical structure]</td>
<td>S ([\alpha]_{D}^{20} = +71.9\ (c=1.01, \ CHCl_3))</td>
<td>OD-H Hex/IPA 80:20 1 mpm</td>
</tr>
<tr>
<td><strong>Reference Major enantiomer illustrated</strong></td>
<td><strong>Configuration assigned by rotn</strong></td>
<td><strong>HPLC conditions</strong></td>
<td><strong>Retention times</strong></td>
</tr>
<tr>
<td>This work.</td>
<td>![Chemical structure] 95% isolated</td>
<td>R ([\alpha]_{D}^{25} = 7.6^\circ\ (c\ 0.15\ in \ CHCl_3))</td>
<td>OD-H Hex:IPA 90:10 1 mpm</td>
</tr>
<tr>
<td>4. Wang 2004.</td>
<td>![Chemical structure]</td>
<td>R ([\alpha]_{D}^{18} = -8\ (c\ 1.20, \ CHCl_3))</td>
<td>OD Hex:IPA 10:1</td>
</tr>
<tr>
<td>16. Xu 2005.</td>
<td>![Chemical structure]</td>
<td>S ([\alpha]_{D}^{20} = +9.83\ (c=0.6, \ CHCl_3))</td>
<td>OD Hex/IPA 90:10 1 mpm</td>
</tr>
<tr>
<td>9. Wang, 2009.</td>
<td>![Chemical structure]</td>
<td>S ([\alpha]_{D}^{25} = +9.36\ (c=0.53, \ CHCl_3))</td>
<td>OD hex/IPA 80:20 1 mpm</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>Configuration assigned by rotn.</td>
<td>HPLC conditions</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------------------</td>
<td>---------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>This work</td>
<td>Low conv Not isolated. R in analogy with difluoro n/a Not isolated.</td>
<td>OD-H Hex:IPA 80:20 1 mpm</td>
<td>20.6 (major) R 26.3 (minor) S</td>
</tr>
<tr>
<td>14. Wang 2017.</td>
<td></td>
<td>[α]D = -15.0 (c=0.24, CHCl₃)</td>
<td>OD Hex:IPA 90:10 1 mpm</td>
</tr>
<tr>
<td>17. Trost 2005</td>
<td></td>
<td>[α]D = -13.5 (c=0.5, DCM)</td>
<td>OD Hept/IPA 90:10</td>
</tr>
<tr>
<td>Reference</td>
<td>Major enantiomer illustrated</td>
<td>Configuration assigned by rotn</td>
<td>HPLC conditions</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------</td>
<td>--------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>This work.</td>
<td></td>
<td>R [α]D^25 = +17.8° (c 0.21 in CHCl_3)</td>
<td>OD Hex:IPA 90:10 1 mpm</td>
</tr>
</tbody>
</table>

**Reference** Major enantiomer illustrated Configuration assigned by rotn HPLC conditions Retention times

<table>
<thead>
<tr>
<th>Reference</th>
<th>Major enantiomer illustrated</th>
<th>Configuration assigned by rotn</th>
<th>HPLC conditions</th>
<th>Retention times</th>
</tr>
</thead>
<tbody>
<tr>
<td>This work.</td>
<td></td>
<td>R [α]D^25 = 14.8° (c 0.21 in CHCl_3)</td>
<td>GC used</td>
<td>96.2 (Minor) S 98.6 (Major) R</td>
</tr>
</tbody>
</table>

**Reference** Major enantiomer illustrated Configuration assigned by rotn HPLC conditions Retention times

<table>
<thead>
<tr>
<th>Reference</th>
<th>Major enantiomer illustrated</th>
<th>Configuration assigned by rotn</th>
<th>HPLC conditions</th>
<th>Retention times</th>
</tr>
</thead>
<tbody>
<tr>
<td>This work.</td>
<td></td>
<td>Rotation not taken R by analogy.</td>
<td>OD-H, hexane/IPA 97:3 1.0 mpm</td>
<td>9.0 (minor) S 10.8 (major) R</td>
</tr>
</tbody>
</table>
(c=1.65, CHCl₃)

References to Tables above:

In addition, this paper was used to establish the absolute configuration of the S-MOM.tri(methoxy)aryl ortho-Br derivative 35 and hence reduction product 31: Leblanc, M.; Fagnou, K. *Org. Lett.* **2005**, 7, 2849-2852 (pinene and 9-BBN combination gives reduction of a derivative in 97% ee). Data for the S-derivative; HPLC was on AD-H column, 0.9 mpm, 90:10 hex:IPA 10.23 (minor), 11.03 (major), $[\alpha]_D^{22} = -22.5$ (c=1, DCM). Our product had a (+) rotation which supports $R$, as predicted. We used an AD-H column as well 90:10, 1 mpm gives $R$ at 10.6 (major) and $S$ at 11.8 min (minor), so confirms the major configuration.