Gold(I) Operational in Synergistic Catalysis for the Intermolecular α-Addition Reaction of Aldehydes across Allenamides

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**General Considerations:**

All reactions were carried out using oven dried glassware under an atmosphere of nitrogen (99.99 %) or argon (99.999 %). The solvents used in column chromatography: hexane, ethyl acetate and dichloromethane were obtained from commercial suppliers and used without further distillation.

Acetonitrile and toluene used in the addition reactions were purified through a Innovative Technology System, provided with two one metre length columns, filled with activated alumina. Addition reactions were performed in a RR9803012 place Carousel Reaction StationTM from Radleys Discovery Technologies, equipped with gastight threaded caps with a valve, cooling reflux head system, and digital temperature controller.

TLC was performed on aluminium-backed plates coated with silica gel 60 with F254 indicator (Merck), using UV light as a visualizing agent and phosphomolybdic acid in ethanol, and heat as developing agent. Flash chromatography was performed on silica gel 60 (230-400 mesh).

$^1$H NMR (300, 400, 600 MHz) and $^{13}$C NMR (75.5, 100 MHz) spectra were measured in CDCl$_3$ at room temperature on a Bruker DPX-300, Bruker AV-300 MHz, Bruker AV-400 and Bruker AV-600 instruments, with CDCl$_3$ (δ = 7.26, $^1$H NMR; δ = 77.16, $^{13}$C NMR) as internal standard. Data are reported as follows: chemical shift, multiplicity (s: singlet, d: doublet, t: triplet, q: quartet, hex: hexet; br: broad, m: multiplet), coupling constants (J in Hz) and integration. Carbon multiplicities were assigned by DEPT techniques. 2D NMR experiments were recorded on a Bruker AV-400 MHz. Enantiomer ratios were determined by chiral HPLC analyses with a Vis-UV photodiode Array 2996 or 996 as detector, and compared with the authentic racemic products.

All common reagents and solvents were obtained from commercial suppliers and used without any further purification unless otherwise noted. The different aldehydes used were purchased from available commercial sources and were distilled under argon atmosphere before used. High-resolution mass spectra (HRMS) were determined by Universidad de Burgos and Universidad de Vigo (CACTI) with a VG AutoSpec M Mass Spectrometers and a microTOF focus (Bruker Daltonics, Bremen Germany) respectively.
N-tosylallenamides (1a-1g) were prepared through base promoted isomerization reaction of N-tosyl propargylamines according to previously reported procedures.2

To a solution of N-tosyl propargylamine (5.0 mmol) in 15 ml of anhydrous THF under N₂ atmosphere at 0°C was added in portions 169 mg of KOᵗBu (1.5 mmol). The reaction was allowed to stir at room temperature. After 12 h the mixture was diluted with 10 ml of Et₂O, and then filtrated over celite. The residue was washed with diethyl ether. The collected filtrate was concentrated in vacuo and the residue purified by flash column chromatography on silica gel (Hexane: Et₂O = 5:1), affording the N-tosylallenamides as white solids.

N,4-dimethyl-N-(propa-1,2-dien-1-yl)benzenesulfonamid (1a). White solid (88%). 1H-NMR (400MHz, CDCl₃): δ (ppm) = 7.68 (d, J = 8.3 Hz, 2H), 7.33 (d, J = 8.1 Hz, 2H), 6.90 (t, J = 6.2 Hz, 1H), 5.30 (d, J = 6.2 Hz, 2H), 2.72 (s, 3H), 2.44 (s, 3H). 13C-NMR (75 MHz, CDCl₃): δ (ppm) = 201.5 (C), 143.8 (C), 133.4 (C), 129.7 (2 CH), 129.6 (2 CH), 101.7 (CH), 87.7 (CH₂), 33.2 (CH₃), 21.6 (CH₃). HRMS (El): calcd for C₁₁H₁₃NO₂S: 223.0667. Found: 223.0650.


4-methyl-N-phenyl-N-(propa-1,2-dien-1-yl)benzenesulfonamide (1b). White solid, (94%). $^1$H-NMR (400MHz, CDCl$_3$): $\delta$ (ppm) = 7.56 (d, $J = 8.1$ Hz, 2H), 7.55 - 7.27 (m, 5H), 7.12 (t, $J = 6.2$ Hz, 1H), 7.01 (m, 2H), 5.03 (d, $J = 6.2$ Hz, 2H), 2.45 (s, 3H). $^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 201.1 (C), 143.9 (C), 137.2 (C), 135.3 (C), 129.6 (2 CH), 129.5 (2 CH), 128.7 (2 CH), 128.6 (2 CH), 127.7 (CH), 102.4 (CH), 87.5 (CH$_2$), 21.6 (CH$_3$). HRMS (El): calcd for C$_{16}$H$_{15}$NO$_2$S: 285.0824. Found: 285.0819.

N-(cyclohexylmethyl)-4-methyl-N-(propa-1,2-dien-1-yl)benzenesulfonamide (1c). White solid (59%). $^1$H-NMR (300MHz, CDCl$_3$): $\delta$ (ppm) = 7.67 (d, $J = 8.3$ Hz, 2H), 7.30 (d, $J = 8.1$ Hz, 2H), 6.82 (t, $J = 6.2$ Hz, 1H), 5.26 (d, $J = 6.2$ Hz, 2H), 2.87 (d, $J = 7.1$ Hz, 2H), 2.43 (s, 3H), 1.81 - 1.55 (m, 6H), 1.31 - 1.09 (m, 3H), 0.98 - 0.81 (m, 2H). $^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 202.0 (C), 143.6 (C), 135.4 (C), 129.8 (2 CH), 127.3 (2 CH), 100.9 (CH), 87.6 (CH$_2$), 52.7 (CH$_2$), 36.2 (CH), 30.7 (2 CH$_3$), 26.6 (CH$_3$), 26.0 (2 CH$_3$), 21.7 (CH$_3$). HRMS (El): calcd for C$_{17}$H$_{23}$NO$_2$S: 305.1450. Found: 305.1453.

N-benzyl-4-methyl-N-(propa-1,2-dien-1-yl)benzenesulfonamide (1d). White solid (88%). $^1$H-NMR (300MHz, CDCl$_3$): $\delta$ (ppm) = 7.75 (d, $J = 8.3$ Hz, 2H), 7.40 - 7.22 (m, 7H), 6.86 (t, $J = 6.2$ Hz, 1H), 5.17 (d, $J = 6.2$ Hz, 2H), 4.33 (s, 2H), 4.33 (s, 2H). $^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 202.2 (C), 143.8 (C), 136.2 (C), 135.3 (C), 129.8 (2 CH), 128.3 (2 CH), 127.9 (2 CH), 127.4 (CH), 127.2 (2 CH), 100.1 (CH), 88.1 (CH$_2$), 50.0 (CH$_2$), 21.6 (CH$_3$). HRMS (El): calcd for C$_{17}$H$_{19}$NO$_2$S: 299.0980. Found: 299.0980.
\[ \text{N-(4-bromophenyl)-4-methyl-N-(propa-1,2-dien-1-yl)benzenesulfonamide (1e).} \]
Light yellow solid (91%). \[^1\text{H-NMR}\ (400\text{MHz},\ \text{CDCl}_3): \delta \ (\text{ppm}) = 7.56 (d, J = 8.3 \text{ Hz}, 2\text{H}), \ 7.43 (d, J = 8.7 \text{ Hz}, 2\text{H}), \ 7.31 (d, J = 8.1 \text{ Hz}, 2\text{H}), \ 7.10 (t, J = 6.3 \text{ Hz}, 1\text{H}), \ 6.89 (d, J = 8.7 \text{ Hz}, 2\text{H}), \ 5.07 (d, J = 6.3 \text{ Hz}, 2\text{H}), \ 2.47 (s, 3\text{H}). \]
\[^{13}\text{C-NMR}\ (100\text{ MHz},\ \text{CDCl}_3): \delta \ (\text{ppm}) = 202.3 (\text{C}), \ 143.8 (\text{C}), \ 137.9 (\text{C}), \ 135.1 (\text{C}), \ 132.6 (\text{C}), \ 129.5 (2\text{ CH}), \ 129.2 (2\text{ CH}), \ 124.6 (2\text{ CH}), \ 120.1 (2\text{ CH}), \ 102.4 (\text{CH}), \ 87.3 (\text{CH}_2), \ 21.3 (\text{CH}_3). \]
\[^{\text{HRMS}}\ (\text{EI}): \text{calcd for C}_{16}\text{H}_{14}\text{BrNO}_2\text{S}: 362.9929. \text{Found: 362.9931.} \]

\[ \text{4-methyl-N-(propa-1,2-dien-1-yl)-N-(p-tolyl)benzenesulfonamide (1f).} \]
White solid (92%). \[^1\text{H-NMR}\ (400\text{MHz},\ \text{CDCl}_3): \delta \ (\text{ppm}) = 7.57 (d, J = 8.4 \text{ Hz}, 2\text{H}), \ 7.34 (d, J = 8.2 \text{ Hz}, 2\text{H}), \ 7.23 (d, J = 8.3 \text{ Hz}, 2\text{H}), \ 7.13 (t, J = 6.2 \text{ Hz}, 1\text{H}), \ 6.88 (d, J = 8.3 \text{ Hz}, 2\text{H}), \ 5.06 (d, J = 6.2 \text{ Hz}, 2\text{H}), \ 2.47 (s, 3\text{H}). \]
\[^{13}\text{C-NMR}\ (100\text{ MHz},\ \text{CDCl}_3): \delta \ (\text{ppm}) = 201.1 (\text{C}), \ 144.2 (\text{C}), \ 138.9 (\text{C}), \ 135.3 (\text{C}), \ 134.6 (\text{C}), \ 129.6 (2\text{ CH}), \ 129.4 (2\text{ CH}), \ 129.2 (2\text{ CH}), \ 127.6 (2\text{ CH}), \ 102.4 (\text{CH}), \ 87.1 (\text{CH}_2), \ 21.3 (\text{CH}_3), \ 20.9 (\text{CH}_3). \]
\[^{\text{HRMS}}\ (\text{EI}): \text{Calcd for C}_{17}\text{H}_{17}\text{NO}_2\text{S}: 299.0980. \text{Found: 299.0969.} \]

\[ \text{N-(4-methoxyphenyl)-4-methyl-N-(propa-1,2-dien-1-yl)benzenesulfonamide (1g).} \]
Yellow solid (74%). \[^1\text{H-NMR}\ (300\text{MHz},\ \text{CDCl}_3): \delta \ (\text{ppm}) = 7.56 (d, J = 6.6 \text{ Hz}, 2\text{H}), \ 7.28 (d, J = 7.7 \text{ Hz}, 2\text{H}), \ 7.13 (t, J = 6.0 \text{ Hz}, 1\text{H}), \ 6.88 – 66.93 (m, 2\text{H}), \ 6.76 – 6.81 (m, 2\text{H}), \ 5.04 (d, J = 6.0 \text{ Hz}, 2\text{H}), \ 3.80 (s, 3\text{H}), \ 2.45 (s, 3\text{H}). \]
\[^{13}\text{C-NMR}\ (75\text{ MHz},\ \text{CDCl}_3): \delta \ (\text{ppm}) = 200.9 (\text{C}), \ 159.5 (\text{C}), \ 143.8 (\text{C}), \ 135.1 (\text{C}), \ 130.7 (\text{C}), \ 129.5 (2\text{ CH}), \ 129.5 (2\text{ CH}), \ 127.7 (2\text{ CH}), \ 113.8 (2\text{ CH}), \ 102.7 (\text{CH}), \ 87.5 (\text{CH}_2), \ 55.3 (\text{CH}_3), \ 21.6 (\text{CH}_3). \]
\[^{\text{HRMS}}\ (\text{EI}): \text{Calcd for C}_{17}\text{H}_{17}\text{NO}_3\text{S: 315.0929. Found: 315.0927.} \]
Control experiments with HNTf₂

The following control experiments with HNTf₂ were performed:

1) \[
\text{Ts-NMe-} + \text{PhCO} \xrightleftharpoons{\text{DL-Pro (20 mol%) \ HNTf₂ (5 mol%) \ CH₃CN (0.2 M) \ RT}} \text{NMe-} \text{Ph\textsuperscript{+}} \text{CH}_3\text{CN} \text{NMe-} \text{Ph\textsuperscript{+}}
\]

2) \[
\text{Ts-NMe-} + \text{PhCO} \xrightleftharpoons{\text{DL-Pro (20 mol%) \ HNTf₂ (5 mol%) \ CH₃CN (0.2 M) \ RT}} \text{NMe-} \text{Ph\textsuperscript{+}} \text{CH}_3\text{CN} \text{NMe-} \text{Ph\textsuperscript{+}}
\]

3) \[
\text{Ts-NMe-} + \text{PhCO} + \text{FPhCOOH} \xrightleftharpoons{\text{OTBS \ (20 mol%) \ HNTf₂ (5 mol%) \ CH₃CN (0.2 M) \ RT}} \text{NMe-} \text{Ph\textsuperscript{+}} \text{CH}_3\text{CN} \text{NMe-} \text{Ph\textsuperscript{+}}
\]

Experiment 1 yielded 11% of the reaction product. Only 60% of conversion was achieved, determined by internal standard.

Experiment 2 yielded 51% of the isolated product.

Experiment 3 yielded 18% of the reaction product, determined by internal standard.
General Procedure for the addition reaction

- **Method A:**

\[
\begin{align*}
\text{R}_1\text{N} & \text{Ts}^- + \text{R}_2\text{R}_3\text{O}^- \\
\text{IPrAuNTf}_2 & \text{L-Pro} \\
\text{CH}_3\text{CN}, \text{RT} & \\
\text{NaBH}_4 & \text{CH}_3\text{OH} \\
\end{align*}
\]

First, L-Pro (4.6 mg, 0.04 mmol) was suspended in 1 mL of acetonitrile. Then aldehyde 2 was added (0.4 mmol, unless otherwise noted). The mixture was stirred for 10 minutes. After that, IPrAuNTf₂ (8.7 mg, 0.01 mmol) and allenamide 1 (0.2 mmol) were added. The reaction was monitored until all the allenamide is consumed (TLC or GCMS). The reaction is stopped by the addition of PPh₃ (5.2 mg, 0.02 mmol). Then 0.5 mL of MeOH and NaBH₄ (15.2 mg, 0.4 mmol) were added and the reaction was stirred for 20 minutes. The mixture was concentrated in vacuo and purified by flash chromatography on silica gel (4 Hex: 2 DCM: 1 AcOEt). All the reported yields are isolated yields.

- **Method B**

\[
\begin{align*}
\text{R}_1\text{N} & \text{Ts}^- + \text{R}_2\text{R}_3\text{O}^- \\
\text{IPrAuNTf}_2 & \text{Organocatalyst} \\
\text{CH}_3\text{CN}, \text{RT} & \\
\text{NaBH}_4 & \text{CH}_3\text{OH} \\
\end{align*}
\]

First, the organocatalyst (0.04 mmol) was dissolved in 1 mL of acetonitrile. Then 2-fluorobenzoic acid (28 mg, 0.2 mmol), IPrAuNTf₂ (8.7 mg, 0.01 mmol), allenamide 1 (0.2 mmol) and aldehyde 2 (0.4 mmol) were added. The reaction was monitored until all the allenamide is consumed (TLC or GCMS). The reaction is stopped by the addition of PPh₃ (5.2 mg, 0.02 mmol). Then 0.5 mL of MeOH and NaBH₄ (15.2 mg, 0.4 mmol) were added and the reaction was stirred...
for 20 minutes. The mixture was concentrated in vacuo and purified by flash chromatography on silica gel (4 Hex: 2 DCM: 1 AcOEt). All the reported yields are isolated yields.

Characterization data:

\[
\text{(E)-N-(4-(hydroxymethyl)hex-1-en-1-yl)-N,4-dimethylbenzenesulfonamide (3a) was prepared following method A; but 1 mmol (5 eq) of aldehyde was used. The reaction was stirred for 2h 45 min. Colorless oil (63 %).}
\]

\[\text{\textsuperscript{1}H-NMR (400 MHz, CDCl}_3\text{): } \delta \text{ (ppm) = 7.63 (d, } J = 8.2 \text{ Hz, 2H), 7.29 (d, } J = 8.0 \text{ Hz, 2H), 6.73 (d, } J = 14.0 \text{ Hz, 1H), 4.68 (dt, } J = 14.4, 7.5 \text{ Hz, 1H), 3.50 (s, 2H), 2.82 (s, 3H), 2.42 (s, 3H), 2.08 (ddd, } J = 7.3, 5.4, 2.2 \text{ Hz, 2H), 1.47 – 1.38 (m, 1H), 1.36 – 1.13 (m, 3H), 0.89 (t, } J = 7.4 \text{ Hz, 3H).}
\]

\[\text{\textsuperscript{13}C-NMR (75 MHz, CDCl}_3\text{): } \delta \text{ (ppm) = 143.7 (C), 134.4 (C), 129.7 (2 CH), 128.8 (CH), 127.1 (2 CH), 109.4 (CH), 64.8 (CH)_2, 42.6 (CH), 32.3 (CH)_3, 31.2 (CH)_2, 22.9 (CH)_3, 21.5 (CH), 11.2 (CH)_3.}
\]

HRMS (ESI): calcd for C\textsubscript{15}H\textsubscript{24}NO\textsubscript{3}S: 298.1471. Found: 298.1474

\[
\text{(E)-N-(4-(hydroxymethyl)hex-1-en-1-yl)-4-methyl-N-phenylbenzenesulfonamide (3b) was prepared following method A. The reaction was stirred for 2h 45 min. Colorless oil (32 %).}
\]

\[\text{\textsuperscript{1}H-NMR (300 MHz, CDCl}_3\text{): } \delta \text{ (ppm) = 7.58 (d, } J = 8.2 \text{ Hz, 2H), 7.43 – 7.24 (m, 5H), 7.04 – 6.93 (m, 3H), 4.40 (dt, } J = 14.5, 7.6 \text{ Hz, 1H), 3.46 (d, } J = 4.9 \text{ Hz, 2H), 2.46 (s, 3H), 2.04 (t, } J = 6.9 \text{ Hz, 2H), 1.63 (bs, 1H), 1.47 – 1.14 (m, 3H), 0.87 (t, } J = 7.2 \text{ Hz, 3H).}
\]

\[\text{\textsuperscript{13}C-NMR (75 MHz, CDCl}_3\text{): } \delta \text{ (ppm) = 143.8 (C), 137.0 (C), 135.9 (C), 130.0 (2 CH), 129.8 (CH), 129.5 (2 CH), 129.4 (2 CH), 128.8 (CH), 127.5 (2 CH), 110.8 (CH), 64.9 (CH)_2, 42.5 (CH), 31.0 (CH)_2, 23.1 (CH)_2, 21.6 (CH), 11.2 (CH)_3.}
\]

HRMS (ESI): Calcd for C\textsubscript{20}H\textsubscript{26}NO\textsubscript{3}S: 360.1628. Found: 360.1634.
(E)-N-(4-(hydroxymethyl)oct-1-en-1-yl)-N,4-dimethylbenzenesulfonamide (3c) was prepared following method A; but 1 mmol (5 eq) of aldehyde was used. The reaction was stirred for 4h 35 min. Colorless oil (70%).

$^1$H-NMR (300 MHz, CDCl$_3$): $\delta$ (ppm) = 7.64 (d, $J = 8.2$ Hz, 2H), 7.31 (d, $J = 8.1$ Hz, 2H), 6.75 (dd, $J = 14.1$, 1.3 Hz, 1H), 4.70 (dt, $J = 14.1$, 7.5 Hz, 1H), 3.51 (t, $J = 5.7$ Hz, 2H), 2.85 (s, 3H), 2.43 (s, 3H), 2.12 – 2.10 (m, 2H), 1.60 – 1.42 (m, 1H), 1.55 – 1.04 (m, 7H), 1.00 – 0.79 (m, 3H).

$^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.7 (C), 134.4 (C), 129.7 (2 CH), 128.8 (CH), 127.0 (2 CH), 109.5 (CH), 65.2 (CH$_2$), 41.0 (CH), 32.3 (CH$_3$), 31.6 (CH$_3$), 30.1 (CH$_2$), 29.1 (CH$_2$), 23.0 (CH$_2$), 21.5 (CH$_3$), 14.1 (CH$_3$). HRMS (ESI): calcd for C$_{17}$H$_{28}$NO$_3$S: 326.1784. Found: 326.1780

(E)-N-(5-hydroxy-4-methylpent-1-en-1-yl)-N,4-dimethylbenzenesulfonamide (3d) was prepared following method A. The reaction was stirred for 4h. Colorless oil (52%).

$^1$H-NMR (400 MHz, CDCl$_3$): $\delta$ (ppm) = 7.62 (d, $J = 8.2$ Hz, 2H), 7.29 (d, $J = 7.9$ Hz, 2H), 6.72 (d, $J = 14.0$ Hz, 1H), 4.67 (dt, $J = 14.5$, 7.5 Hz, 1H), 3.49 – 3.38 (m, 2H), 2.82 (s, 3H), 2.41 (s, 3H), 2.15 (dt, $J = 14.1$, 6.8 Hz, 1H), 1.90 (dt, $J = 14.4$, 7.6 Hz, 1H), 1.70 – 1.57 (m, 2H), 0.86 (d, $J = 6.8$ Hz, 3H). $^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.8 (C), 134.6 (C), 129.8 (2 CH), 129.0 (CH), 127.2 (2 CH), 109.5 (CH), 67.7 (CH$_2$), 36.5 (CH), 33.9 (CH$_2$), 32.5 (CH$_3$), 21.7 (CH$_3$), 16.3 (CH$_3$). HRMS (ESI): calcd for C$_{14}$H$_{22}$NO$_3$S: 284.1315. Found: 284.1320.

(E)-N-(4-(hydroxymethyl)-5-methylhex-1-en-1-yl)-N,4-dimethylbenzenesulfonamide (3e) was prepared following method A; but 1 mmol (5 eq) of aldehyde was used. The reaction was stirred for 4h 5 min. Colorless oil (59%).
\( ^1H \text{-NMR} \) (300 MHz, CDCl\(_3\)): \( \delta \) (ppm) = 7.62 (dt, \( J = 8.3, 1.8 \) Hz, 2H), 7.29 (d, \( J = 8.0 \) Hz, 2H), 6.73 (dt, \( J = 14.0, 1.2 \) Hz, 1H), 4.70 (dt, \( J = 14.3, 7.5 \) Hz, 1H), 3.55 (qd, \( J = 10.6, 5.8 \) Hz, 2H), 2.82 (s, 3H), 2.42 (s, 3H), 2.20 – 1.97 (m, 2H), 1.80 – 1.67 (m, 1H), 1.39 – 1.24 (m, 1H), 1.04 (bs, 1H), 0.89 (d, \( J = 6.9 \) Hz, 6H). \( ^{13}C \text{-NMR} \) (75 MHz, CDCl\(_3\)): \( \delta \) (ppm) = 143.7 (C), 134.3 (C), 129.7 (2 CH), 128.6 (CH), 127.0 (2 CH), 110.5 (CH), 63.3 (CH\(_2\)), 47.2 (CH), 32.3 (CH\(_3\)), 28.9 (CH\(_2\)), 27.7 (CH), 21.6 (CH\(_3\)), 19.7 (CH\(_3\)), 19.6 (CH\(_3\)). \( \text{HRMS} \) (ESI): calcd for C\(_{16}\)H\(_{26}\)NO\(_3\)S: 312.1628. Found: 312.1619

\[(E)-N-(4-benzyl-5-hydroxypent-1-en-1-yl)-N,4-dimethylbenzenesulfonamide \ (3f)\] was prepared following method A. The reaction was stirred for 1h 10 min. Colorless oil (74 %).

\( ^1H \text{-NMR} \) (400 MHz, CDCl\(_3\)): \( \delta \) (ppm) = 7.63 (d, \( J = 8.3 \) Hz, 2H), 7.27 (t, \( J = 7.7 \) Hz, 4H), 7.23 – 7.17 (m, 1H), 7.16 – 7.10 (m, 2H), 6.74 (d, \( J = 14.1 \) Hz, 1H), 4.67 (dt, \( J = 14.4, 7.5 \) Hz, 1H), 3.49 (t, \( J = 5.0 \) Hz, 2H), 2.81 (s, 3H), 2.67 – 2.47 (m, 2H), 2.39 (s, 3H), 2.20 – 2.00 (m, 2H), 1.90 – 1.76 (m, 1H). \( ^{13}C \text{-NMR} \) (75 MHz, CDCl\(_3\)): \( \delta \) (ppm) = 143.8 (C), 140.4 (C), 134.4 (C), 129.7 (2 CH), 129.1 (CH), 129.1 (2 CH), 128.4 (2 CH), 127.0 (2 CH), 126.0 (CH), 109.3 (CH), 64.5 (CH\(_2\)), 43.2 (CH), 37.2 (CH\(_3\)), 32.3 (CH\(_3\)), 31.5 (CH\(_3\)), 21.5 (CH\(_3\)). \( \text{HRMS} \) (ESI): calcd for C\(_{20}\)H\(_{26}\)NO\(_3\)S: 360.1628. Found: 360.1628

\[(E)-N-(5-hydroxy-4-phenylpent-1-en-1-yl)-N,4-dimethylbenzenesulfonamide \ (3g)\] was prepared following method A, but in this case the organocatalyst and the aldehyde were not stirred for 10 minutes before the other components were added. The reaction was stirred for 3h. Colorless oil (78 %).

\( ^1H \text{-NMR} \) (300 MHz, CDCl\(_3\)): \( \delta \) (ppm) = 7.49 (d, \( J = 8.3 \) Hz, 2H), 7.38 – 7.20 (m, 5H), 7.20 – 7.12 (m, 2H), 6.72 (dt, \( J = 14.1, 1.2 \) Hz, 1H), 4.57 (dt, \( J = 14.3, 7.3 \) Hz, 1H), 3.74 (d, \( J = 6.7 \) Hz, 2H), 2.86 – 2.75 (m, 1H), 2.72 (s, 3H), 2.54 – 2.43 (m, 1H), 2.41 (s, 3H), 2.39 – 2.29 (m, 1H), 1.30 (bs, 1H). \( ^{13}C \text{-NMR} \) (75 MHz, CDCl\(_3\)): \( \delta \) (ppm) = 143.6 (C), 141.5 (C), 134.4 (C), 129.7 (2 CH), 129.1
(CH), 128.7 (2 CH), 128.0 (2 CH), 126.9 (2 CH), 126.8 (CH), 108.6 (CH), 66.8 (CH$_2$), 49.1 (CH), 32.7 (CH$_2$), 32.2 (CH$_3$), 21.5 (CH$_3$). **HRMS (ESI):** calcd for C$_{19}$H$_{24}$NO$_3$S: 346.1471. Found: 346.1474

![Chemical Structure](image)

*(E)-N-((4-benzyl-5-hydroxypent-1-en-1-yl)-N-(cyclohexylmethyl)-4-methylbenzenesulfonamide (3h)* was prepared following *method A*. The reaction was stirred for 5h 20min. Colorless oil (55%).

**$^1$H-NMR** (300 MHz, CDCl$_3$): $\delta$ (ppm) = 7.62 (d, $J = 8.3$ Hz, 2H), 7.34 – 7.16 (m, 5H), 7.16 – 7.09 (m, 2H), 6.48 (d, $J = 14.1$ Hz, 1H), 4.81 (dt, $J = 14.5$, 7.5 Hz, 1H), 3.48 (t, $J = 4.7$ Hz, 2H), 3.03 (d, $J = 7.0$ Hz, 2H), 2.57 (h, $J = 7.2$ Hz, 2H), 2.38 (s, 3H), 2.20 – 2.01 (m, 2H), 1.89 – 1.78 (m 1H), 1.78 – 1.62 (m, 6H), 1.29 – 1.10 (m, 4H), 1.01 – 0.84 (m, 2H). **$^{13}$C-NMR** (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.4 (C), 140.4 (C), 135.9 (C), 129.6 (2 CH), 129.1 (2 CH), 128.4 (2 CH), 127.9 (CH), 126.9 (2 CH), 126.0 (CH), 111.7 (CH), 64.5 (CH$_2$), 51.9 (CH$_2$), 43.2 (CH), 37.2 (CH$_2$), 35.1 (CH), 31.8 (CH$_2$), 30.8 (2 CH$_2$), 26.4 (CH$_2$), 25.9 (2 CH$_3$), 21.5 (CH$_3$). **HRMS (ESI):** calcd for C$_{26}$H$_{36}$NO$_3$S: 442.2410. Found: 442.2413.

![Chemical Structure](image)

*(E)-N-benzyl-N-((4-benzyl-5-hydroxypent-1-en-1-yl)-4-methylbenzenesulfonamide (3i)* was prepared following *method A*. The reaction was stirred for 5h 20 min. Colorless oil (71%).

**$^1$H-NMR** (300 MHz, CDCl$_3$): $\delta$ (ppm) = 7.71 (d, $J = 8.3$ Hz, 2H), 7.41 – 7.14 (m, 10H), 7.05 – 6.96 (m, 2H), 6.63 (d, $J = 14.1$ Hz, 1H), 4.66 (dt, $J = 14.4$, 7.5 Hz, 1H), 4.50 (s, 2H), 3.26 (p, $J = 5.3$ Hz, 2H), 2.44 (s, 3H), 2.36 (ddd, $J = 13.6$, 6.8, 6.3 Hz, 2H), 1.99 (t, $J = 7.0$ Hz, 2H), 1.75 – 1.53 (m, 2H), 1.08 (bs, 1H). **$^{13}$C-NMR** (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.8 (C), 140.3 (C), 135.9 (C), 135.6 (C), 129.8 (2 CH), 129.0 (2 CH), 128.6 (2 CH), 128.3 (2 CH), 127.5 (CH), 127.0 (2 CH), 127.0 (2 CH), 126.8 (CH), 125.9 (CH), 111.8 (CH), 64.3 (CH$_2$), 49.5 (CH$_2$), 43.0 (CH), 36.7 (CH$_3$), 31.6 (CH$_2$), 21.6 (CH$_3$). **HRMS (ESI):** calcd for C$_{26}$H$_{30}$NO$_3$S: 436.1941. Found: 436.1944.
(E)-N-(5-hydroxy-4-phenylpent-1-en-1-yl)-4-methyl-N-phenylbenzenesulfonamide (3j) was prepared following method A, but in this case the organocatalyst and the aldehyde were not stirred for 10 minutes before the other components were added. The reaction was stirred for 6h. Colorless oil (61%).

$^1$H-NMR (300 MHz, CDCl$_3$): $\delta$ (ppm) = 7.45 – 7.37 (m, 2H), 7.35 – 7.18 (m, 8H), 7.15 – 7.05 (m, 2H), 6.92 – 6.78 (m, 3H), 4.27 (dt, $J = 13.9$, 7.5 Hz, 1H), 3.69 (m, 2H), 2.71 (p, $J = 6.9$ Hz, 1H), 2.44 (s, 3H), 2.41 – 2.33 (m, 1H), 2.31 – 2.20 (m, 1H), 1.27 (bs, 1H).

$^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.8 (C), 141.8 (C), 136.9 (C), 136.0 (C), 130.4 (CH), 130.2 (2 CH), 129.7 (2 CH), 129.4 (2 CH), 128.9 (CH), 128.2 (2 CH), 128.1 (2 CH), 127.5 (2 CH), 126.9 (CH), 110.1 (CH), 66.7 (CH$_2$), 49.0 (CH), 32.9 (CH$_2$), 21.7 (CH$_3$). HRMS (ESI): calcd for C$_{24}$H$_{26}$NO$_3$S: 408.1628. Found: 436.1636.

(E)-N-benzyl-N-(5-hydroxy-4-phenylpent-1-en-1-yl)-4-methylbenzenesulfonamide (3k) was prepared following method A, but in this case the organocatalyst and the aldehyde were not stirred for 10 minutes before the other components were added. The reaction was stirred for 4h. Colorless oil (94%).

$^1$H-NMR (300 MHz, CDCl$_3$): $\delta$ (ppm) = 7.58 (d, $J = 8.3$ Hz, 2H), 7.36 – 7.15 (m, 10H), 7.03 – 6.96 (m, 2H), 6.62 (d, $J = 14.1$ Hz, 1H), 4.58 (dt, $J = 14.6$, 7.4 Hz, 1H), 4.40 (d, $J = 3.0$ Hz, 2H), 3.62 (t, $J = 5.7$ Hz, 2H), 2.73 – 2.60 (m, 1H), 2.46 (s, 3H), 2.42 – 2.20 (m, 2H), 1.19 (bs, 1H). $^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.6 (C), 141.3 (C), 135.9 (C), 135.5 (C), 129.8 (2 CH), 128.6 (2 CH), 128.5 (2 CH), 127.9 (2 CH), 127.3 (CH), 127.0 (CH), 126.9 (2 CH), 126.9 (2 CH), 126.7 (CH), 110.5 (CH), 66.4 (CH$_2$), 49.3 (CH$_2$), 48.8 (CH), 33.2 (CH$_2$), 21.6 (CH$_3$). HRMS (ESI): calcd for C$_{25}$H$_{28}$NO$_3$S: 422.1784. Found: 422.1787.
(E)-N-(cyclohexylmethyl)-N-(5-hydroxy-4-phenylpent-1-en-1-yl)-4-methylbenzenesulfonamide (3l) was prepared following method A, but in this case the organocatalyst and the aldehyde were not stirred for 10 minutes before the other components were added. In this case 1 mmol (5 eq) of aldehyde was used. The reaction was stirred for 8h. Colorless oil (88%).

$^1$H-NMR (300 MHz, CDCl$_3$): $\delta$ (ppm) = 7.48 (d, $J$ = 8.3 Hz, 2H), 7.37 – 7.13 (m, 7H), 6.46 (d, $J$ = 14.2 Hz, 1H), 6.46 (dt, $J$ = 14.4, 7.3 Hz, 1H), 3.74 (d, $J$ = 5.0 Hz, 2H), 2.97 – 2.76 (m, 3H), 2.48 (dt, $J$ = 13.2, 6.7 Hz, 1H), 2.40 (s, 3H), 2.33 (dt, $J$ = 14.3, 7.7 Hz, 1H), 1.80 – 1.57 (m, 5H), 1.24 (m, 2H), 1.22 – 1.04 (m, 3H), 0.94 – 0.74 (m, 2H). $^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.2 (C), 141.4 (C), 135.9 (C), 129.6 (2 CH), 128.7 (2 CH), 128.1 (2 CH), 127.7 (CH), 126.9 (CH), 126.8 (2 CH), 111.0 (CH), 66.9 (CH$_2$), 51.7 (CH$_2$), 49.2 (CH), 34.8 (CH), 33.0 (CH$_3$), 30.8 (2 CH$_2$), 26.4 (CH$_3$), 25.8 (2 CH$_2$), 21.5 (CH$_3$). HRMS (ESI): calcd for C$_{25}$H$_{34}$NO$_3$S: 428.2254. Found: 428.2255.

(F)-N-(4-bromophenyl)-N-(5-hydroxy-4-phenylpent-1-en-1-yl)-4-methylbenzenesulfonamide (3m) was prepared following method A, but in this case the organocatalyst and the aldehyde were not stirred for 10 minutes before the other components were added. The reaction was stirred for 6h. Colorless oil (27%).

$^1$H-NMR (300 MHz, CDCl$_3$): $\delta$ (ppm) = 7.42 (dd, $J$ = 8.4, 6.3 Hz, 4H), 7.36 – 7.21 (m, 5H), 7.15 – 7.08 (m, 2H), 6.84 (d, $J$ = 14.0 Hz, 1H), 6.69 (d, $J$ = 8.7 Hz, 2H), 4.30 (dt, $J$ = 14.3, 7.4 Hz, 1H), 3.72 (d, $J$ = 6.4 Hz, 2H), 2.74 (dt, $J$ = 13.3, 6.6 Hz, 1H), 2.46 (s, 3H), 2.46 – 2.34 (m, 1H), 2.26 (dt, $J$ = 15.4, 8.0 Hz, 1H), 1.27 (bs, 1H). $^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.9 (C), 141.5 (C), 135.9 (C), 135.4 (C), 132.6 (2 CH), 131.6 (2 CH), 130.0 (CH), 129.6 (2 CH), 128.6 (2 CH), 128.0 (2 CH), 127.3 (2 CH), 126.8 (CH), 122.9 (C), 110.5 (CH), 66.6 (CH$_2$), 48.8 (CH), 32.6 (CH$_2$), 21.6 (CH$_3$). HRMS (ESI): calcd for C$_{25}$H$_{25}$BrNO$_3$S: 486.0733. Found: 486.0732.
(E)-N-(5-hydroxy-4-phenylpent-1-en-1-yl)-4-methyl-N-(p-tolyl)benzenesulfonamide (3n) was prepared following method A, but in this case the organocatalyst and the aldehyde were not stirred for 10 minutes before the other components were added. The reaction was stirred for 7h 30m. Colorless oil (42 %).

^1H-NMR (300 MHz, CDCl3): δ (ppm) = 7.41 (d, J = 8.3 Hz, 2H), 7.34 – 7.18 (m, 5H), 7.15 – 7.04 (m, 4H), 6.86 (d, J = 13.9 Hz, 1H), 6.70 (d, J = 8.2 Hz, 2H), 4.27 (dt, J = 14.2, 7.5 Hz, 1H), 3.70 (d, J = 7.2 Hz, 2H), 2.71 (p, J = 7.1 Hz, 1H), 2.43 (s, 3H), 2.41 – 2.34 (m, 1H), 2.33 (s, 3H), 2.31 – 2.18 (m, 1H), 1.26 (bs, 1H). 13C-NMR (75 MHz, CDCl3): δ (ppm) = 143.7 (C), 141.9 (C), 139.0 (C), 136.1 (C), 134.1 (C), 130.5 (CH), 130.1 (2 CH), 129.9 (2 CH), 129.6 (2 CH), 128.8 (2 CH), 128.1 (2 CH), 127.5 (2 CH), 126.9 (CH), 109.7 (CH), 66.7 (CH2), 49.0 (CH), 33.0 (CH2), 21.7 (CH3), 21.3 (CH3). HRMS (ESI): calcd for C25H28NO3S: 422.1784. Found: 422.1786.

(E)-N-(5-hydroxy-4-phenylpent-1-en-1-yl)-N-(4-methoxyphenyl)-4-methylbenzenesulfonamide (3o) was prepared following method A, but in this case the organocatalyst and the aldehyde were not stirred for 10 minutes before the other components were added. The reaction was stirred for 7h 30m. Colorless oil (47 %).

^1H-NMR (300 MHz, CDCl3): δ (ppm) = 7.40 (d, J = 8.3 Hz, 2H), 7.33 – 7.16 (m, 5H), 7.10 (d, J = 6.8 Hz, 2H), 6.87 (d, J = 14.0 Hz, 1H), 6.82 – 6.66 (m, 4H), 4.26 (dt, J = 14.2, 7.5 Hz, 1H), 3.79 (s, 3H), 3.75 – 3.65 (m, 2H), 2.71 (p, J = 7.1 Hz, 1H), 2.43 (s, 3H), 2.41 – 2.32 (m, 1H), 2.31 – 2.18 (m, 1H), 1.24 (bs, 1H). 13C-NMR (75 MHz, CDCl3): δ (ppm) = 159.7 (C), 143.7 (C), 141.8 (C), 136.0 (C), 131.3 (2 CH), 130.6 (CH), 129.6 (2 CH), 129.1 (C), 128.8 (2 CH), 128.1 (2 CH), 127.5 (2 CH), 126.9 (CH), 114.7 (2 CH), 109.4 (CH), 66.7 (CH2), 55.6 (CH3), 49.1 (CH), 32.9 (CH2), 21.8 (CH3). HRMS (ESI): calcd for C25H28NO4S: 438.1734. Found: 438.1735.
(E)-N-(5-hydroxy-4-methyl-4-phenylpent-1-en-1-yl)-N,4-dimethylbenzenesulfonamide (3p) was prepared following:

- **Method A.** The reaction was stirred for 23h. Colorless oil (47%).
- **Method B, Rᵣ = TBS.** The reaction was stirred for 4h. Colorless oil (72 %, 76 %ee)
- **Method B, Rᵣ = TIPS.** The reaction was stirred for 3h. Colorless oil (25 %, 86 %ee)

\[ ^1H-\text{NMR} \ (300 \text{ MHz, } \text{CDCl}_3): \delta \text{ (ppm) } = 7.45 \ (d, J = 8.3 \text{ Hz, } 2\text{H}), 7.31 - 7.11 \ (m, 7\text{H}), 6.64 \ (d, J = 14.0 \text{ Hz, } 1\text{H}), 4.36 \ (dt, J = 14.3, 7.6 \text{ Hz, } 1\text{H}), 3.63 \ (d, J = 10.9 \text{ Hz, } 1\text{H}), 3.49 \ (d, J = 10.9 \text{ Hz, } 1\text{H}), 2.62 \ (s, 3\text{H}), 2.45 \ (dd, J = 13.9, 6.8 \text{ Hz, } 1\text{H}), 2.34 \ (s, 3\text{H}), 2.24 \ (dd, J = 14.3, 7.8 \text{ Hz, } 1\text{H}), 1.53 \ (bs, 1\text{H}), 1.20 \ (s, 3\text{H}). \]

\[ ^{13}C-\text{NMR} \ (75 \text{ MHz, } \text{CDCl}_3): \delta \text{ (ppm) } = 144.3 \ (C), 143.6 \ (C), 134.4 \ (C), 129.8 \ (C), 129.7 \ (2 \text{ CH}), 128.5 \ (2 \text{ CH}), 127.0 \ (2 \text{ CH}), 126.6 \ (2 \text{ CH}), 126.3 \ (CH), 106.6 \ (CH), 71.6 \ (CH_2), 43.6 \ (C), 39.1 \ (CH_3), 32.2 \ (CH_3), 21.7 \ (CH_3), 21.5 \ (CH_3). \] \( \text{HRMS} \ (\text{ESI}): \text{ calcd for } C_{20}H_{26}NO_3S: 360.1628. \text{ Found: 360.1635.} \)

(E)-N-(4-(4-chlorophenyl)-5-hydroxy-4-methylpent-1-en-1-yl)-N,4-dimethylbenzenesulfonamide (3q) was prepared following:

- **Method A.** The reaction was stirred for 8h. Colorless oil (28 %).
- **Method B, Rᵣ = TBS.** The reaction was stirred for 3h. Colorless oil (27 %, 24 %ee)
- **Method B, Rᵣ = TIPS.** The reaction was stirred for 8h. Colorless oil (23 %, 60 %ee)

\[ ^1H-\text{NMR} \ (300 \text{ MHz, } \text{CDCl}_3): \delta \text{ (ppm) } = 7.52 \ (d, J = 8.3 \text{ Hz, } 2\text{H}), 7.34 - 7.18 \ (m, 6\text{H}), 6.71 \ (dt, J = 14.0, 0.9 \text{ Hz, } 1\text{H}), 4.40 \ (dt, J = 14.1, 7.6 \text{ Hz, } 1\text{H}), 3.68 \ (dd, J = 10.7, 4.9 \text{ Hz, } 1\text{H}), 3.55 \ (dd, J = 10.8, 6.4 \text{ Hz, } 1\text{H}), 2.70 \ (s, 3\text{H}), 2.49 \ (ddd, J = 13.9, 7.3, 1.0 \text{ Hz, } 1\text{H}), 2.42 \ (s, 3\text{H}), 2.30 \ (ddd, J = 14.0, 7.9, 1.0 \text{ Hz, } 1\text{H}), 1.26 \ (s, 3\text{H}). \]

\[ ^{13}C-\text{NMR} \ (75 \text{ MHz, } \text{CDCl}_3): \delta \text{ (ppm) } = 143.9 \ (C), 143.1 \ (C), 134.6 \ (C), 132.3 \ (C), 130.2 \ (CH), 129.8 \ (2 \text{ CH}), 128.7 \ (2 \text{ CH}), 128.3 \ (2 \text{ CH}), 127.1 \ (2 \text{ CH}), 106.1 \ (CH), 71.6 \ (CH_2), 43.6 \ (C), 39.2 \ (CH_3), 32.3 \ (CH_3), 21.8 \ (CH_3), 21.7 \ (CH_3). \] \( \text{HRMS} \ (\text{ESI}): \text{ calcd for } C_{20}H_{25}ClNO_3S: 394.1238. \text{ Found: 394.1240.} \)
(E)-N-(5-hydroxy-4-methyl-4-(p-tolyl)pent-1-en-1-yl)-N,4-dimethylbenzenesulfonamide (3r) was prepared following:

- **Method A.** The reaction was stirred for 23h. Colorless oil (46%).
- **Method B, R4 = TBS.** The reaction was stirred for 2h 15m. Colorless oil (80%, 60 %ee)
- **Method B, R4 = TIPS.** The reaction was stirred for 7h. Colorless oil (35 %, 82 %ee)

$^1$H-NMR (400 MHz, CDCl$_3$): $\delta$ (ppm) = 7.54 (d, $J = 8.0$ Hz, 2H), 7.29 – 7.24 (m, 2H), 7.19 (d, $J = 8.0$ Hz, 2H), 7.14 (d, $J = 14.1$ Hz, 1H), 4.45 (dt, $J = 14.5$, 7.5 Hz, 1H), 3.68 (d, $J = 10.7$ Hz, 1H), 3.54 (d, $J = 10.7$ Hz, 1H), 2.70 (s, 3H), 2.50 (dd, $J = 13.9$, 6.9 Hz, 1H), 2.42 (s, 3H), 2.33 (s, 3H), 2.32 – 2.26 (m, 1H), 1.25 (s, 3H), 1.21 (bs, 1H).

$^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 143.6 (C), 141.2 (C), 135.8 (C), 134.4 (C), 129.8 (CH), 129.6 (2 CH), 129.2 (2 CH), 127.0 (2 CH), 126.5 (2 CH), 106.8 (CH), 71.7 (CH$_2$), 43.3 (C), 39.1 (CH$_2$), 32.2 (CH$_3$), 21.7 (CH$_3$), 21.6 (CH$_3$), 20.9 (CH$_3$).

HRMS (ESI): Calcd for C$_{23}$H$_{28}$NO$_3$S: 374.1784. Found: 374.1791.

(E)-N-(5-hydroxy-4-(4-methoxyphenyl)-4-methylpent-1-en-1-yl)-N,4-dimethylbenzenesulfonamide (3s) was prepared following:

- **Method A.** The reaction was stirred for 30h. Colorless oil (25%).
- **Method B, R4 = TBS.** The reaction was stirred for 4h. Colorless oil (73 %, 68 %ee)
- **Method B, R4 = TIPS.** The reaction was stirred for 7h. Colorless oil (32 %, 80 %ee)

$^1$H-NMR (300 MHz, CDCl$_3$): $\delta$ (ppm) = 7.53 (d, $J = 7.8$ Hz, 2H), 7.34 – 7.13 (m, 4H), 6.86 (d, $J = 8.4$ Hz, 2H), 6.71 (d, $J = 14.0$ Hz, 1H), 4.43 (dt, $J = 14.3$, 7.4 Hz, 1H), 3.80 (s, 3H), 3.66 (d, $J = 10.3$ Hz, 1H), 3.54 (d, $J = 9.6$, 1H), 2.69 (s, 3H), 2.48 (dd, $J = 14.1$, 7.2 Hz, 1H), 2.41 (s, 3H), 2.28 (dd, $J = 13.7$, 8.1 Hz, 1H), 1.24 (s, 3H).

$^{13}$C-NMR (75 MHz, CDCl$_3$): $\delta$ (ppm) = 157.9 (C), 143.6 (C),
136.1 (C), 134.4 (C), 129.8 (CH), 129.6 (2 CH), 127.7 (2 CH), 127.0 (2 CH), 113.8 (2 CH), 106.7 (CH), 71.8 (CH$_3$), 55.2 (CH$_2$), 43.0 (C), 39.2 (CH$_2$), 32.2 (CH$_3$), 21.8 (CH$_3$), 21.5 (CH$_3$). **HRMS (ESI):** calcd for C$_{21}$H$_{28}$NO$_4$S: 390.1734. Found: 390.1735.
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**Diagram:***

- **OH**
- **Ph**
- **N**
- **Ts**
- **Br**
- **3m**
HPLC-Chromatogram

(E)-N-(5-hydroxy-4-methyl-4-phenylpent-1-en-1-yl)-N,4-
dimethylbenzenesulfonamide (3p)

CHIRALPAK ADH n-Hexane : IPrOH 80:20, flow 0.6 ml/min (λ 250.8 nm)

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(E)-N-(4-(4-chlorophenyl)-5-hydroxy-1-penten-1-yl)-N,4-
dimethylbenzenesulfonamide (3q)

CHIRALPAK ADH n-Hexane : iPrOH 80:20, flow 0.6 ml/min (λ252.0 nm)
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(E)-N-(5-hydroxy-4-methyl-4-(p-tolyl)pent-1-en-1-yl)-N,4-
dimethylbenzenesulfonamide (3r)

**CHIRALPAK ADH n-Hexane : iPrOH 80:20, flow 0.6 ml/min (λ252.0 nm)**

**Peak Results**

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**Peak Results**

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<th>Height</th>
<th>% Area</th>
</tr>
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<tbody>
<tr>
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<td>2</td>
<td>28.225</td>
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</table>
(E)-N-(5-hydroxy-4-(4-methoxyphenyl)-4-methylpent-1-en-1-yl)-N,N-dimethylbenzenesulfonamide (3s)

CHIRALPAK ADH n-Hexane : iPrOH 80:20, flow 0.6 ml/min (λ254.4 nm)
R\textsuperscript{4} = TBS

### Peak Results

<table>
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<td>2</td>
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</table>

R\textsuperscript{4} = TIPS

### Peak Results

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<td>2</td>
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