

## Electronic Supporting Information

### Rhodium-catalysed hydroformylation of *N*-(2-propenyl)- $\beta$ -lactams as a key step in the synthesis of functionalised *N*-[4-(2-oxoazetidin-1-yl)-but-1-enyl]acetamides

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#### ***cis*-3-Methoxy-1-(4-oxobutyl)-4-phenylazetidin-2-one 4b.**

Light-yellow oil.  $R_f = 0.15$  (hexane/EtOAc 1/1). Yield 78%.  $^1\text{H NMR}$  (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  1.73-1.88 (2H, m); 2.38 (2H, t,  $J = 7.2$  Hz); 3.00 (1H, d x d x d,  $J = 14.3, 6.5, 6.5$  Hz); 3.11 (3H, s); 3.48 (1H, d x d x d,  $J = 14.3, 7.3, 7.3$  Hz); 4.69 (1H, d,  $J = 4.4$  Hz); 4.76 (1H, d,  $J = 4.4$  Hz); 7.32-7.40 (5H, m); 9.74 (1H, s).  $^{13}\text{C NMR}$  (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  22.8; 31.4; 39.7; 58.2; 62.2; 85.5; 128.5; 128.6; 128.9; 133.6; 167.7; 201.6. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1736$ ;  $\nu_{\text{max}} = 2931, 1357, 1210, 701$ . MS (70eV):  $m/z$  (%) 248 ( $M^+ + 1$ , 100). Anal. Calcd. for  $\text{C}_{14}\text{H}_{17}\text{NO}_3$ : C 68.00, H 6.93, N 5.66. Found C 67.79, H 7.10, N 5.33.

#### ***cis*-3-Benzoyloxy-1-(4-oxobutyl)-4-phenylazetidin-2-one 4c.**

Light-yellow oil.  $R_f = 0.19$  (hexane/EtOAc 1/1). Yield 80%.  $^1\text{H NMR}$  (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  1.61-1.82 (2H, m); 2.42 (2H, t x d,  $J = 6.9, 2.2$  Hz); 2.91 (1H, d x d x d,  $J = 14.3, 6.5, 6.5$  Hz); 3.37 (1H, d x d x d,  $J = 14.3, 7.3, 7.3$  Hz); 4.08 and 4.21 (2 x 1H, 2 x d,  $J = 11.3$  Hz); 4.68 (1H, d,  $J = 4.4$  Hz); 4.79 (1H, d,  $J = 4.4$  Hz); 6.83-6.87, 7.06-7.21 and 7.27-7.34 (10H, 3 x m); 9.66 (1H, s).  $^{13}\text{C NMR}$  (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  20.0; 39.9; 41.4; 62.3; 72.4; 83.6; 128.0; 128.26, 128.33; 128.6; 128.7; 128.9; 133.8; 136.4; 167.6; 201.2. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{NC=O}} = 1741$ ;  $\nu_{\text{HC=O}} = 1722$ ;  $\nu_{\text{max}} = 2915, 1408, 1069, 750, 697$ . MS (70eV):  $m/z$  (%) 324 ( $M^+ + 1$ , 100). Anal. Calcd. for  $\text{C}_{20}\text{H}_{21}\text{NO}_3$ : C 74.28, H 6.55, N 4.33. Found C 74.58, H 6.82, N 4.12.

#### ***cis*-4-(4-Chlorophenyl)-1-(4-oxobutyl)-3-phenoxyazetidin-2-one 4d.**

Light-brown crystals. Mp 106.3 °C.  $R_f = 0.23$  (hexane/EtOAc 1/1). Yield 86%.  $^1\text{H NMR}$  (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  1.71-1.94 (2H, m); 2.54 (2H, t x d,  $J = 7.0, 4.4$  Hz); 2.99 (1H, d x d x d,  $J = 14.2, 7.0, 5.9$  Hz); 3.48 (1H, d x d x d,  $J = 14.2, 7.3, 7.3$  Hz); 4.93 (1H, d,  $J = 4.4$  Hz); 5.39 (1H, d,  $J = 4.4$  Hz); 6.69-6.73, 6.86-6.91, 7.10-7.16 and 7.22-7.30 (9H, 4 x m); 9.76 (1H, s).

$^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  19.9; 40.1; 41.4; 61.6; 81.8; 115.5; 122.3; 128.7; 129.4; 130.0; 131.7; 134.8; 156.7; 166.1; 201.0. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{NC=O}}$  = 1750;  $\nu_{\text{HC=O}}$  = 1716;  $\nu_{\text{max}}$  = 1492, 1240, 1089, 750, 688. MS (70eV):  $m/z$  (%) 344/6 ( $\text{M}^+$ +1, 100). Anal. Calcd. for  $\text{C}_{19}\text{H}_{18}\text{ClNO}_3$ : C 66.38, H 5.28, N 4.07. Found C 66.51, H 5.37, N 3.98.

***cis*-3-Benzoyloxy-4-(2-bromophenyl)-1-(4-oxobutyl)azetid-2-one 4e.**

Light-yellow oil.  $R_f$  = 0.30 (hexane/EtOAc 1/1). Yield 67%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  1.80-1.91 (2H, m); 2.40 (2H, t,  $J$  = 7.4 Hz); 2.94-3.06 and 3.50-3.63 (2 x 1H, 2 x m); 4.28 and 4.35 (2 x 1H, 2 x d,  $J$  = 11.6 Hz); 4.93 (1H, d,  $J$  = 4.4 Hz); 5.27 (1H, d x d,  $J$  = 4.4, 1.1 Hz); 6.93-6.97, 7.19-7.22, 7.36-7.38 and 7.60-7.62 (9H, 4 x m); 9.75 (1H, s).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  22.8; 31.2; 40.1; 61.7; 72.7; 83.5; 124.0; 127.7; 128.1; 128.4; 129.4; 130.0; 133.2; 133.4; 136.4; 167.6; 201.3. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}}$  = 1746;  $\nu_{\text{max}}$  = 2933, 1402, 1342, 1169, 1025, 752, 736, 698. MS (70eV):  $m/z$  (%) 402/4 ( $\text{M}^+$ +1, 100). Anal. Calcd. for  $\text{C}_{20}\text{H}_{20}\text{BrNO}_3$ : C 59.71, H 5.01, N 3.48. Found C 59.58, H 5.37, N 3.32.

***cis*-1-(2-Methyl-4-oxobutyl)-3-phenoxy-4-phenylazetid-2-one 4f.**

Light-brown crystals. Mp 89 °C.  $R_f$  = 0.43 (hexane/EtOAc 1/1). Yield 82%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.95 and 1.00 (2 x 3H, 2 x d,  $J$  = 6.6 Hz); 2.28-2.52 and 2.58-2.68 (5H and 1H, 2 x m); 2.80 (1H, d x d,  $J$  = 14.3, 5.0 Hz); 2.86 (1H, d x d,  $J$  = 13.8, 5.5 Hz); 3.36-3.47 (2H, m); 4.92 and 4.98 (2 x 1H, 2 x d,  $J$  = 4.4 Hz); 5.40 and 5.47 (2 x 1H, 2 x d,  $J$  = 4.4 Hz); 6.70-6.74, 6.84-6.89, 7.09-7.14 and 7.26-7.32 (20H, 4 x m); 9.68 and 9.78 (2 x 1H, 2 x s).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  18.3; 18.5; 26.8; 27.3; 46.3; 48.6; 49.2; 62.8; 63.3; 81.9; 115.6; 122.07; 122.11; 128.4; 128.6; 128.8; 128.9; 129.0; 129.3; 132.77; 132.82; 156.9; 166.6; 166.8; 201.1; 201.5. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{NC=O}}$  = 1745;  $\nu_{\text{HC=O}}$  = 1719;  $\nu_{\text{max}}$  = 1410, 1229, 862, 753, 694. MS (70eV):  $m/z$  (%) 324 ( $\text{M}^+$ +1, 100). Anal. Calcd. for  $\text{C}_{20}\text{H}_{21}\text{NO}_3$ : C 74.28, H 6.55, N 4.33. Found C 74.53, H 6.92, N 4.07.

***cis*-3-Methoxy-1-(2-methyl-4-oxobutyl)-4-phenylazetid-2-one 4g.**

Light-yellow oil.  $R_f$  = 0.28 (hexane/EtOAc 1/1). Yield 95%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.92 and 0.96 (2 x 3H, 2 x d,  $J$  = 6.6 Hz); 2.10-2.87 (8H, m); 3.09 and 3.11 (2 x 3H, 2 x s); 3.25-3.49 (2H, m); 4.66, 4.73, 4.74 and 4.79 (4 x 1H, 4 x d,  $J$  = 4.6 Hz); 7.33-7.44 (10H, m); 9.66 and 9.75 (2 x 1H, 2 x s).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  18.2; 18.4; 26.8; 27.2; 45.7; 46.1; 48.6; 49.1; 58.2; 62.4; 62.9; 85.5; 85.6; 128.6; 128.88; 128.93; 133.4; 167.9; 168.1; 201.2; 201.6. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}}$  = 1746;  $\nu_{\text{max}}$  = 2931, 1456, 1405, 1359, 1210, 1072, 701.

MS (70eV):  $m/z$  (%) 262 ( $M^+ + 1$ , 100). Anal. Calcd. for  $C_{15}H_{19}NO_3$ : C 68.94, H 7.33, N 5.36. Found C 69.13, H 7.57, N 5.21.

***cis*-3-Benzoyloxy-1-(2-methyl-4-oxobutyl)-4-phenylazetididin-2-one 4h.**

Light-brown crystals. Mp 76.4 °C.  $R_f$  = 0.37 (hexane/EtOAc 1/1). Yield 92%.  $^1H$  NMR (300 MHz,  $CDCl_3$ ):  $\delta$  0.91 and 0.95 (2 x 3H, 2 x d,  $J$  = 6.1 Hz); 2.23-2.49 and 2.53-2.62 (5H and 1H, 2 x m); 2.74 (1H, d x d,  $J$  = 14.2, 5.2 Hz); 2.80 (1H, d x d,  $J$  = 14.0, 5.5 Hz); 3.34 (1H, d x d,  $J$  = 14.2, 7.2 Hz); 3.36 (1H, d x d,  $J$  = 14.0, 8.8 Hz); 4.14 and 4.16 (2 x 1H, 2 x d,  $J$  = 11.0 Hz); 4.27 and 4.29 (2 x 1H, 2 x d,  $J$  = 11.0 Hz); 4.73 and 4.78 (2 x 1H, 2 x d,  $J$  = 4.4 Hz); 4.85 and 4.91 (2 x 1H, 2 x d,  $J$  = 4.4 Hz); 6.89-6.94 and 7.16-7.70 (20H, 2 x m); 9.65 and 9.74 (2 x 1H, 2 x s).  $^{13}C$  NMR (75 MHz, ref =  $CDCl_3$ ):  $\delta$  18.2; 18.4; 26.8; 27.3; 45.8; 46.1; 48.6; 49.1; 62.7; 63.2; 72.4; 83.5; 83.6; 128.0; 128.25; 128.33; 128.7; 128.9; 133.6; 136.4; 167.8; 201.1; 201.5. IR (ATR,  $cm^{-1}$ ):  $\nu_{NC=O}$  = 1731;  $\nu_{HC=O}$  = 1703;  $\nu_{max}$  = 2919, 1157, 1079, 1009, 759, 698. MS (70eV):  $m/z$  (%) 338 ( $M^+ + 1$ , 100). Anal. Calcd. for  $C_{21}H_{23}NO_3$ : C 74.75, H 6.87, N 4.15. Found C 74.93, H 7.04, N 4.02.

***cis*-4-(4-Chlorophenyl)-1-(2-methyl-4-oxobutyl)-3-phenoxyazetididin-2-one 4i.**

Light-brown crystals. Mp 98.3 °C.  $R_f$  = 0.40 (hexane/EtOAc 1/1). Yield 89%.  $^1H$  NMR (300 MHz,  $CDCl_3$ ):  $\delta$  0.95 and 1.01 (2 x 3H, 2 x d,  $J$  = 6.6 Hz); 2.29-2.52 and 2.59-2.69 (5H and 1H, 2 x m); 2.76 (1H, d x d,  $J$  = 13.9, 4.7 Hz); 2.82 (1H, d x d,  $J$  = 14.0, 5.2 Hz); 3.39 (1H, d x d,  $J$  = 13.9, 7.2 Hz); 3.41 (1H, d x d,  $J$  = 14.0, 8.5 Hz); 4.91 and 4.96 (2 x 1H, 2 x d,  $J$  = 4.4 Hz); 5.38 and 5.46 (2 x 1H, 2 x d,  $J$  = 4.4 Hz); 6.71-6.75, 6.87-6.92, 7.11-7.17 and 7.24-7.31 (18H, 4 x m); 9.70 and 9.79 (2 x 1H, 2 x s).  $^{13}C$  NMR (75 MHz, ref =  $CDCl_3$ ):  $\delta$  18.3; 18.5; 26.7; 27.2; 46.3; 46.4; 48.6; 49.2; 62.1; 62.6; 81.9; 115.5; 122.26; 122.32; 128.7; 129.4; 129.6; 130.1; 131.5; 134.85; 134.93; 156.7; 166.4; 166.6; 200.9; 201.4. IR (ATR,  $cm^{-1}$ ):  $\nu_{NC=O}$  = 1743;  $\nu_{HC=O}$  = 1717;  $\nu_{max}$  = 1492, 1233, 1089, 825, 751, 689. MS (70eV):  $m/z$  (%) 358/60 ( $M^+ + 1$ , 100). Anal. Calcd. for  $C_{20}H_{20}ClNO_3$ : C 67.13, H 5.63, N 3.91. Found C 67.37, H 5.91, N 3.73.

***cis*-3-Benzoyloxy-4-(2-bromophenyl)-1-(2-methyl-4-oxobutyl)azetididin-2-one 4j.**

Yellow oil.  $R_f$  = 0.23 (hexane/EtOAc 1/1). Yield 77%.  $^1H$  NMR (300 MHz,  $CDCl_3$ ):  $\delta$  0.98 and 1.01 (2 x 3H, 2 x d,  $J$  = 6.6 Hz); 2.18-2.45 (6H, m); 2.79 (1H, d x d,  $J$  = 13.9, 5.2 Hz); 2.89 (1H, d x d,  $J$  = 14.3, 5.0 Hz); 3.47 (1H, d x d,  $J$  = 13.9, 7.2 Hz); 3.52 (1H, d x d,  $J$  = 14.3, 8.0 Hz); 4.28 and 4.29 (2 x 1H, 2 x d,  $J$  = 11.6 Hz); 4.35 and 4.36 (2 x 1H, 2 x d,  $J$  = 11.6 Hz); 4.97

and 5.00 (2 x 1H, 2 x d,  $J= 4.4$  Hz); 5.30 and 5.33 (2 x 1H, 2 x d,  $J= 4.4$  Hz); 6.94-6.98, 7.16-7.40 and 7.61-7.63 (18H, 3 x m); 9.70 and 9.75 (2 x 1H, 2 x s).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  18.0; 18.3; 29.3; 39.0; 39.2; 46.1; 46.2; 62.2; 62.3; 72.7; 83.5; 124.1; 124.2; 127.7; 128.1; 128.4; 129.2; 129.4; 130.0; 133.2; 136.4; 167.9; 201.1; 201.4. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1748$ ;  $\nu_{\text{max}} = 2962, 1402, 1341, 1019, 909, 728, 697$ . MS (70eV):  $m/z$  (%) 416/8 ( $\text{M}^+ + 1, 100$ ). Anal. Calcd. for  $\text{C}_{21}\text{H}_{22}\text{BrNO}_3$ : C 60.59, H 5.33, N 3.36. Found C 60.83, H 5.57, N 3.20.

***cis*-3-Benzoyloxy-1-(4-isopropyliminobutyl)-4-phenylazetid-2-one 6b.**

Yellow oil. Yield 92%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  1.02 and 1.03 (2 x 3H, 2 x d,  $J= 6.6$  Hz); 1.57-1.78 (2H, m); 2.11 (2H, t x d,  $J= 7.7, 4.9$  Hz); 2.86 (1H, d x d x d,  $J= 14.2, 8.0, 6.1$  Hz); 3.16 (1H, sept,  $J= 6.6$  Hz); 3.43 (1H, d x d x d,  $J= 14.2, 7.3, 7.3$  Hz); 4.09 and 4.21 (2 x 1H, 2 x d,  $J= 11.0$  Hz); 4.69 (1H, d,  $J= 4.4$  Hz); 4.80 (1H, d,  $J= 4.4$  Hz); 6.83-6.87, 7.12-7.15 and 7.26-7.36 (10H, 3 x m); 7.53 (1H, t,  $J= 4.9$  Hz).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  23.9; 24.0; 24.1; 33.1; 39.8; 61.3; 62.2; 72.3; 83.6; 127.9; 128.3; 128.5; 128.6; 134.0; 136.5; 160.4; 167.1. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1752$ ;  $\nu_{\text{C=N}} = 1665$ ;  $\nu_{\text{max}} = 2964, 1402, 1156, 734, 698$ . MS (70eV):  $m/z$  (%) 365 ( $\text{M}^+ + 1, 47$ ).

***cis*-4-(4-Chlorophenyl)-3-phenoxy-1-(4-propyliminobutyl)azetid-2-one 6c.**

Yellow oil. Yield 95%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.86 (3H, t,  $J= 7.4$  Hz); 1.47-1.65 and 1.68-1.89 (2 x 2H, 2 x m); 2.25 (2H, t x d,  $J= 7.4, 4.4$  Hz); 2.98 (1H, d x d x d,  $J= 14.1, 7.8, 6.2$  Hz); 3.30 (2H, t,  $J= 6.9$  Hz); 3.54 (1H, d x d x d,  $J= 14.1, 7.2, 7.2$  Hz); 4.93 (1H, d,  $J= 4.4$  Hz); 5.41 (1H, d,  $J= 4.4$  Hz); 6.71-6.75, 6.87-6.92 and 7.11-7.28 (9H, 3 x m); 7.62 (1H, t,  $J= 4.4$  Hz).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  11.8; 23.8; 23.9; 33.0; 40.2; 61.6; 63.1; 81.8; 115.5; 122.1; 128.5; 129.4; 130.0; 131.9; 134.6; 156.8; 162.7; 165.8. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1742$ ;  $\nu_{\text{C=N}} = 1667$ ;  $\nu_{\text{max}} = 2928, 1492, 1234, 750, 689$ . MS (70eV):  $m/z$  (%) 385/7 ( $\text{M}^+ + 1, 100$ ).

***cis*-3-Benzoyloxy-1-(4-cyclohexylimino-2-methylbutyl)-4-phenylazetid-2-one 6d.**

Yellow oil. Yield 96%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.92 and 0.94 (2 x 3H, 2 x d,  $J= 6.1$  Hz); 1.01-1.84 (20H, m); 2.01-2.08 and 2.14-2.26 (4H and 2H, 2 x m); 2.73 (1H, d x d,  $J= 13.9, 5.5$  Hz); 2.78 (1H, d x d,  $J= 13.9, 5.3$  Hz); 2.83-2.95 (2H, m); 3.35 (1H, d x d,  $J= 13.9, 7.4$  Hz); 3.42 (1H, d x d,  $J= 13.9, 6.6$  Hz); 4.16 (2H, d,  $J= 11.3$  Hz); 4.28 (2H, d,  $J= 11.3$  Hz); 4.76 and 4.77 (2 x 1H, 2 x d,  $J= 4.4$  Hz); 4.90 (2H, d,  $J= 4.4$  Hz); 6.81-6.93 and 7.20-7.40 (20H, 2 x m); 7.56 and 7.61 (2 x 1H, 2 x t,  $J= 5.0$  Hz).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$

17.9; 18.0; 24.9; 25.2; 25.6; 25.7; 30.1; 30.4; 34.4; 34.5; 40.4; 40.6; 45.8; 46.2; 62.7; 63.3; 69.75; 69.83; 72.3; 83.6; 128.0; 128.28; 128.32; 128.6; 128.8; 132.1; 132.2; 133.8; 133.9; 160.2; 160.4; 167.6. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1746$ ;  $\nu_{\text{C=N}} = 1666$ ;  $\nu_{\text{max}} = 2925, 1413, 1078, 1008, 757, 699$ . MS (70eV):  $m/z$  (%) 419 ( $\text{M}^+ + 1, 100$ ).

***cis*-1-(4-Benzylimino-2-methylbutyl)-3-methoxy-4-phenylazetid-2-one 6e.**

Yellow oil. Yield 93%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.95 and 0.96 (2 x 3H, 2 x d,  $J = 6.1$  Hz); 2.12-2.19 and 2.28-2.36 (5H and 1H, 2 x m); 2.74 (1H, d x d,  $J = 14.0, 5.5$  Hz); 2.77 (1H, d x d,  $J = 14.7, 5.5$  Hz); 3.07 and 3.09 (2 x 3H, 2 x s); 3.37 (1H, d x d,  $J = 14.0, 7.7$  Hz); 3.41 (1H, d x d,  $J = 14.7, 7.4$  Hz); 4.52 and 4.56 (2 x 2H, 2 x s); 4.63 and 4.68 (2 x 1H, 2 x d,  $J = 4.4$  Hz); 4.74 (2 x 1H, 2 x d,  $J = 4.4$  Hz); 7.19-7.38 (20H, m); 7.70 and 7.76 (2 x 1H, 2 x m).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  18.0; 18.3; 29.8; 30.0; 40.4; 40.6; 45.9; 57.9; 62.4; 62.7; 65.1; 85.5; 126.8; 127.3; 128.4; 128.5; 133.8; 134.0; 139.3; 139.4; 163.8; 164.0; 167.45; 167.50. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1750$ ;  $\nu_{\text{C=N}} = 1665$ ;  $\nu_{\text{max}} = 2928, 1455, 1401, 1072, 734, 698$ . MS (70eV):  $m/z$  (%) 337 ( $\text{M}^+ + 1, 100$ ).

***cis*-4-(4-Chlorophenyl)-1-(4-isopropylimino-2-methylbutyl)-3-phenoxyazetid-2-one 6f.**

Yellow oil. Yield 98%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.97 and 0.99 (2 x 3H, 2 x d,  $J = 6.3$  Hz); 1.07, 1.09, 1.13 and 1.15 (4 x 3H, 4 x d,  $J = 6.1$  Hz); 2.05-2.10 and 2.21-2.29 (4H and 2H, 2 x m); 2.76 (1H, d x d,  $J = 14.2, 5.8$  Hz); 2.81 (1H, d x d,  $J = 13.8, 5.5$  Hz); 3.16-3.34 (2H, m); 3.40 (1H, d x d,  $J = 14.2, 7.7$  Hz); 3.46 (1H, d x d,  $J = 13.8, 6.6$  Hz); 4.94 and 4.96 (2 x 1H, 2 x d,  $J = 4.4$  Hz); 5.46 (2H, d,  $J = 4.4$  Hz); 6.71-6.75, 6.87-6.92, 7.12-7.17 and 7.23-7.30 (18H, 4 x m); 7.59 and 7.64 (2 x 1H, 2 x t,  $J = 4.8$  Hz).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  17.9; 18.0; 24.06; 24.12; 24.2; 29.9; 30.3; 40.1; 40.3; 46.0; 46.4; 61.4; 62.1; 62.6; 81.8; 115.4; 122.1; 128.5; 129.3; 130.1; 131.67; 131.73; 134.6; 156.7; 159.6; 159.8; 166.2. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1757$ ;  $\nu_{\text{C=N}} = 1666$ ;  $\nu_{\text{max}} = 2965, 1492, 1234, 1090, 752, 690$ . MS (70eV):  $m/z$  (%) 399/401 ( $\text{M}^+ + 1, 100$ ).

Detectable signals derived from the mixtures of *major* and *minor* isomers **7** (due to hindered rotation across the amido moiety):

***N*-[4-(*cis*-3-Benzylloxy-2-oxo-4-phenylazetid-1-yl)-but-1-enyl]-*N*-isopropyl-2-phenoxy-acetamide 7b.**

Light-yellow oil.  $R_f = 0.19$  (hexane/EtOAc 1/1). Yield 68%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  1.03 and 1.17 (2 x 3H, 2 x d,  $J = 6.6$  Hz); 2.11-2.29 (2H, m); 2.93 (1H, d x d x d,  $J = 14.0, 6.9,$

6.9 Hz); 3.38 (1H, d x d x d,  $J= 14.0, 7.3, 7.3$  Hz); 3.98-4.09 (1H, m); 4.03 and 4.17 (2 x 1H, 2 x d,  $J= 11.0$  Hz); 4.51 (2H, s); 4.63 (1H, d,  $J= 4.4$  Hz); 4.75 (1H, d,  $J= 4.4$  Hz); 5.35-5.44 (1H, m); 6.01 (1H, d,  $J= 13.8$  Hz); 6.78-6.88 and 7.07-7.32 (15H, 2 x m).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  20.0; 28.6; 40.0; 46.7; 62.5; 67.5; 72.4; 83.8; 114.9; 121.6; 126.1; 127.4; 127.9; 128.2; 128.3; 128.6; 128.7; 128.9; 129.6; 133.9; 136.4; 158.2; 167.0; 167.2. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1750$ ;  $\nu_{\text{C=C}} = 1672$ ;  $\nu_{\text{max}} = 2925, 1649, 1495, 1216, 753, 736, 698$ . MS (70eV):  $m/z$  (%) 499 ( $\text{M}^+ + 1$ , 100). Anal. Calcd. for  $\text{C}_{31}\text{H}_{34}\text{N}_2\text{O}_4$ : C 74.67, H 6.87, N 5.62. Found C 74.83, H 7.01, N 5.48.

**2-Benzoyloxy-*N*-[4-(*cis*-4-(4-chlorophenyl)-2-oxo-3-phenoxyazetid-1-yl)-but-1-enyl]-*N*-propylacetamide 7c.**

Light-yellow oil.  $R_f = 0.20$  (hexane/EtOAc 3/2). Yield 63%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.90 and 0.92 (2 x 3H, 2 x t,  $J= 7.6$  Hz, major + minor); 1.48-1.61 (4H, m, major + minor); 2.20-2.32 (4H, m, major + minor); 2.95-3.12 and 3.22-3.70 (2H and 6H, 2 x m, major + minor); 4.24 (2H, s, minor); 4.27 (2H, s, major); 4.56-4.68 (4H, m, major + minor); 4.82-4.97 (4H, m, major + minor); 5.35 and 5.41 (2 x 1H, 2 x d,  $J= 4.4$  Hz, major + minor); 6.57 (2H, d,  $J= 13.8$  Hz, major + minor); 6.63-6.74, 6.87-6.92 and 7.11-7.35 (28H, 3 x m, major + minor).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  11.3; 11.4; 20.0; 20.9; 28.9; 29.8; 40.7; 40.9; 44.7; 45.9; 61.6; 62.0; 69.4; 69.5; 73.3; 73.7; 82.0; 107.7; 107.9; 115.5; 122.3; 127.6; 128.0; 128.1; 128.3; 128.6; 128.8; 129.4; 130.0; 131.7; 134.8; 137.1; 156.8; 167.8; 170.1. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1755$ ;  $\nu_{\text{C=C}} = 1676$ ;  $\nu_{\text{max}} = 2933, 1648, 1493, 1232, 1090, 752, 693$ . MS (70eV):  $m/z$  (%) 533/5 ( $\text{M}^+ + 1$ , 100). Anal. Calcd. for  $\text{C}_{31}\text{H}_{33}\text{ClN}_2\text{O}_4$ : C 69.85, H 6.24, N 5.26. Found C 69.99, H 6.41, N 5.03.

***N*-[4-(*cis*-3-Benzoyloxy-2-oxo-4-phenylazetid-1-yl)-3-methylbut-1-enyl]-*N*-cyclohexyl-2-phenoxyacetamide 7d.**

Colourless oil.  $R_f = 0.09$  (hexane/EtOAc 3/1). Yield 35%.  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.99 (3H, d,  $J= 6.6$  Hz); 1.11-1.89 (10H, m); 2.47-2.60 (1H, m); 2.77 (1H, d x d,  $J= 14.0, 5.8$  Hz); 3.28-3.51 (1H, m); 3.47 (1H, d x d,  $J= 14.0, 9.1$  Hz); 4.12 and 4.24 (2 x 1H, 2 x d,  $J= 11.0$  Hz); 4.59 (2H, s); 4.73 and 4.81 (2 x 1H, 2 x d,  $J= 4.2$  Hz); 5.46 (1H, d x d,  $J= 13.8, 8.3$  Hz); 6.07 (1H, d,  $J= 13.8$  Hz); 6.86-7.05 and 7.18-7.43 (15H, 2 x m).  $^{13}\text{C}$  NMR (75 MHz, ref =  $\text{CDCl}_3$ ):  $\delta$  18.5; 25.4; 25.6; 25.7; 29.8; 30.6; 33.8; 45.3; 54.5; 62.7; 67.3; 72.3; 84.9; 114.8; 121.5; 125.4; 128.0; 128.25; 128.34; 128.5; 128.7; 128.9; 129.7; 133.5; 135.4; 136.3; 158.1; 167.1; 167.3. IR (ATR,  $\text{cm}^{-1}$ ):  $\nu_{\text{C=O}} = 1749$ ;  $\nu_{\text{C=C}} = 1672$ ;  $\nu_{\text{max}} = 2927, 1649, 1495, 1220, 753,$

698. MS (70eV):  $m/z$  (%) 553 ( $M^+ + 1$ , 100). Anal. Calcd. for  $C_{35}H_{40}N_2O_4$ : C 76.06, H 7.29, N 5.07. Found C 76.32, H 7.41, N 4.83.

***N*-Benzyl-*N*-[4-(*cis*-3-methoxy-2-oxo-4-phenylazetid-1-yl)-3-methylbut-1-enyl]-2-phenoxyacetamide 7e.**

Colourless oil.  $R_f$  = 0.17 (hexane/EtOAc 3/1). Yield 33%.  $^1H$  NMR (300 MHz,  $CDCl_3$ ):  $\delta$  0.91 (3H, d,  $J$  = 6.6 Hz); 2.30-2.45 (1H, m); 2.71 (1H, d x d,  $J$  = 13.9, 5.8 Hz); 3.03 (3H, s); 3.34 (1H, d x d,  $J$  = 13.9, 8.8 Hz); 4.36 (1H, d,  $J$  = 4.4 Hz); 4.49 (1H, d,  $J$  = 4.4 Hz); 4.72 (2H, s); 4.82-4.93 (3H, m); 6.73-7.36 (15H, m).  $^{13}C$  NMR (75 MHz, ref =  $CDCl_3$ ):  $\delta$  19.1; 33.9; 45.7; 47.2; 58.2; 62.3; 67.8; 85.6; 114.8; 117.3; 122.1; 125.8; 126.8; 127.1; 128.5; 128.6; 128.7; 128.8; 129.8; 133.6; 136.6; 157.8; 167.3; 167.5. IR (ATR,  $cm^{-1}$ ):  $\nu_{C=O}$  = 1748;  $\nu_{C=C}$  = 1668;  $\nu_{max}$  = 2921, 1657, 1414, 1208, 1072, 750, 691. MS (70eV):  $m/z$  (%) 485 ( $M^+ + 1$ , 100). Anal. Calcd. for  $C_{30}H_{32}N_2O_4$ : C 74.36, H 6.66, N 5.78. Found C 74.57, H 6.81, N 5.61.

**2-Benzoyloxy-*N*-[4-(*cis*-4-(4-chlorophenyl)-2-oxo-3-phenoxyazetid-1-yl)-3-methylbut-1-enyl]-*N*-isopropylacetamide 7f.**

Light-yellow oil.  $R_f$  = 0.15 (hexane/EtOAc 3/1). Yield 31%.  $^1H$  NMR (300 MHz,  $CDCl_3$ ):  $\delta$  1.00 (3H, d,  $J$  = 6.6 Hz); 1.10-1.30 (6H, m); 2.46-2.58 (1H, m); 2.77 (1H, d x d,  $J$  = 14.0, 5.2 Hz); 3.50 (1H, d x d,  $J$  = 14.0, 9.6 Hz); 4.10 and 4.21 (2 x 1H, 2 x d,  $J$  = 13.8 Hz); 4.60 (2H, s); 4.59-4.75 (1H, m); 4.79-4.86 (1H, m); 5.30-5.42 (2H, m); 6.00-6.19 (1H, m); 6.62-6.71, 6.85-6.90 and 7.08-7.37 (14H, 3 x m).  $^{13}C$  NMR (75 MHz, ref =  $CDCl_3$ ):  $\delta$  18.8; 20.2; 34.0; 45.5; 46.5; 61.9; 69.6; 73.2; 82.0; 115.5; 122.2; 125.1; 128.1; 128.2; 128.6; 128.7; 129.4; 130.0; 130.1; 131.4; 134.8; 137.5; 156.7; 166.1; 168.4. IR (ATR,  $cm^{-1}$ ):  $\nu_{C=O}$  = 1748;  $\nu_{C=C}$  = 1668;  $\nu_{max}$  = 2967, 1644, 1493, 1236, 1090, 735, 691. MS (70eV):  $m/z$  (%) 547/9 ( $M^+ + 1$ , 100). Anal. Calcd. for  $C_{32}H_{35}ClN_2O_4$ : C 70.25, H 6.45, N 5.12. Found C 69.93, H 6.71, N 4.98.