SUPPORTING INFORMATION FOR:

Antiproliferative activities of tricyclic amides derived from β-caryophyllene via Ritter reactions against MDA-MB-231 breast cancer cells

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Materials: Reagents and analytical grade solvents and Caryophyllene 1 were purchased from Sigma–Aldrich (Castle Hill, NSW, Australia). Monoepoxide 4 was prepared from 1 according to the reported method.\textsuperscript{[25]} Compounds were purified by column chromatography using flash silica gel (60 – 80 μm, Merck) with isocratic elution. TLC was performed on silica gel 60 F\textsubscript{254} plates (Merck). Melting points were measured on a Stuart SMP10 melting point apparatus. The purity of compounds was determined by \textsuperscript{1}H NMR and GC/MS. \textsuperscript{1}H and \textsuperscript{13}C NMR spectra were recorded on an Agilent 500 MHz spectrometer (500 MHz 1H, 125 MHz \textsuperscript{13}C) in deuterated chloroform (CDCl\textsubscript{3}) unless otherwise specified. NMR assignments were based on COSY, HSQC, NOESY and DEPT experiments. \textsuperscript{1}H and \textsuperscript{13}C NMR assignments are based on the numbering system used in the systematic name. Low-resolution mass spectra were obtained on an Agilent 6890GC fitted with 5% polysilphenylene, 95% polydimethylsiloxane column, and an Agilent 5973n MS (EI) spectrometer. High-resolution mass spectra were obtained on an Agilent 6510 Accurate-Mass Q-TOF Mass Spectrometer, equipped with an ESI source.

4.2 Chemistry

General Procedure for the Preparation of Ritter Compounds Using Caryophyllene 1: A mixture of 98 % H\textsubscript{2}SO\textsubscript{4} (2 mL) and nitrile reagent (5-time excess) in 100 mL round-bottomed flask fitted with a condenser and drying tube was stirred at 0 °C. Caryophyllene 1 (1.00 g, 4.89 mmol) was dissolved in benzene (5 mL) and added to the mixture drop-wise but rapidly. The reaction mixture was stirred at 0 °C for 30 min, then at room temperature overnight. Water was added to the mixture and stirring was continued for a further 30 min. The mixture was extracted with diethyl ether. The aqueous layer was washed with NaOH (18 mL, 1 M) or saturated NaHCO\textsubscript{3} solution, and extracted with chloroform. The organic layer was dried over Na\textsubscript{2}SO\textsubscript{4} and the solvent removed under reduced pressure to give the crude product, which was purified by column silica flash chromatography using 60% ethyl acetate: hexane as the eluent to yield the amide product.

\textbf{N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0\textsubscript{2}5]dodecanyl]acetamide (2a):} Yield (0.46 g, 36 %) as a white waxy solid. \textit{Rf} (7:3 ethyl acetate/hexane) 0.46; [\textgreek{a}]\textsubscript{589}^\circ = 49.6 \circ (c 1.0, CHCl\textsubscript{3}); \textsuperscript{1}H NMR $\delta$ 5.40 (br s, 1H, NH), 2.26-2.36 (m, 2H, H-2, H-11a), 1.87 (s, 3H, CH\textsubscript{3}-18), 1.65-1.80 (m, 3H, H-5, H-3a, H-10a), 1.24-1.60 (m, 8H, 2H-6, 2H-7, 2H-9, H-10b, H-11b), 1.10 (s, 2H, 2H-12), 1.00-1.08 (m, 1H, H-3b), 0.93 (s, 3H, CH\textsubscript{3}-13), 0.92 (s, 3H, CH\textsubscript{3}-14), 0.82 (s, 3H, CH\textsubscript{3}-15); \textsuperscript{13}C NMR $\delta$ 169.2 (C=O), 55.6 (C-1), 46.4 (CH\textsubscript{2}-12), 46.3 (CH-5), 41.3 (CH-2), 38.3 (CH-3), 38.2 (CH-7), 37.6 (CH-9), 35.9 (CH-11), 34.4 (C-8), 34.4 (C-4), 34.2 (CH-15), 30.7 (CH-14), 24.5 (CH\textsubscript{3}-18), 23.2 (CH\textsubscript{2}-6), 20.9 (CH\textsubscript{3}-13), 20.2 (CH\textsubscript{2}-10); FT-IR $\nu_{\text{max}}$ (neat) 3254, 3067, 2945, 2926, 2915, 2861, 1637, 1558, 1457, 1364, 1303, 1221, 1181, 1092, 965, 749 cm$^{-1}$; HRMS (ESI): found 264.2340 [M+H]+, C\textsubscript{15}H\textsubscript{30}NO required 264.2327, [M+H]+.

\textbf{N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-tricyclo[6.3.1.0\textsubscript{2}5]dodecanyl]acetamide (3a):} Yield (0.46 g, 36 %) as a white waxy solid. \textit{Rf} (7:3 ethyl acetate/methanol) 0.34; [\textgreek{a}]\textsubscript{589}^\circ = -24.4 \circ (c 1.0, CHCl\textsubscript{3}); \textsuperscript{1}H NMR $\delta$ 5.27 (br d, J = 8.5, 1H, NH), 4.12 (ddd, J = 12.5, 8.5, 6.0 Hz, 1H, H-2), 1.99 (s, 3H, CH\textsubscript{3}-18), 1.61 (dd, J = 12.5, 6.0 Hz, 1H, H-3a), 1.40-1.58 (m, 2H, 2H-10), 1.05-1.41 (m, 10H, S2
N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.02,5]dodecan-1-yl]propanamide (2b): Yield (0.75 g, 55%) as a pale yellow waxy solid. Rf (4:6 diethyl ether/hexane) 0.40; [α]$_{D}^{21}$ +21.9° (c 1.0, CHCl$_3$); $^{1}$H NMR δ 5.11 (br s, 1H, NH), 2.27-2.31 (m, 2H, H-2, H-11a), 2.13 (q, J = 7.5 Hz, 2H, H-18), 1.78-1.82 (m, 1H, H-5), 1.74-1.77 (m, 1H, H-10a), 1.71 (dd, J = 10.0, 8.0 Hz, 1H, H-7a), 1.11-1.62 (m, 9H, 2H-6, H-7b, 2H-9, H-10b, H-11b), 1.24 (s, 2H, 2H-12), 1.12 (t, J = 7.5 Hz, 3H, CH$_3$-19), 0.98 (s, 3H, CH$_3$-13), 0.97 (s, 3H, CH$_3$-14), 0.88 (s, 3H, CH$_3$-15); $^{13}$C NMR δ 172.9 (C=O), 55.3 (C-1), 46.3 (CH-5), 46.3 (CH$_2$-18), 41.3 (CH-2), 38.2 (CH$_2$-12), 38.1 (CH$_3$-2), 37.6 (CH$_2$-7), 36.0 (CH$_3$-15), 34.5 (CH$_2$-9), 34.4 (C-8), 34.2 (C-4), 30.8 (CH$_3$-13), 30.7 (CH$_2$-11), 23.1 (CH$_2$-6), 21.9 (CH$_3$-14), 20.2 (CH$_2$-10), 10.4 (CH$_3$-19); FT-IR $v_{max}$ (neat) 3282, 3070, 2946, 2922, 2863, 1642, 1547, 1457, 1360, 1285, 1237, 1180, 1071, 938, 691 cm$^{-1}$; HRMS (ESI): found 278.2475, [M+H]$^+$, C$_{18}$H$_{32}$NO required 278.2383, [M+H]$^+$.

N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-tricyclo[6.3.1.02,5]dodecan-1-yl]propanamide (3b): Yield (0.38 g, 28%) as a pale yellow waxy solid. Rf (4:6 diethyl ether/hexane) 0.34; [α]$_{D}^{21}$ +22.7° -4.3° (c 1.0, CHCl$_3$); $^{1}$H NMR δ 5.25 (br d, J = 8.5, 1H, NH), 4.14 (ddd, J = 12.5, 8.5, 6.0 Hz, 1H, H-2), 2.21 (q, J = 7.5 Hz, 2H, H-18), 1.61 (dd, J = 11.5, 6.0 Hz, 1H, H-3a), 1.46-1.59 (m, 2H, 2H-10), 1.65 (t, J = 7.5 Hz, 3H, CH$_3$-19), 1.02 (s, 3H, CH$_3$-15), 1.10-1.42 (m, 8H, H-3b, H-5, H-6a, 2H-7, H-9a, H-11a, H-12a), 0.94-1.08 (m, 4H, H-6b, H-9b, H-11b, H-12b), 0.90 (s, 3H, CH$_3$-13), 0.87 (s, 3H, CH$_3$-14); $^{13}$C NMR δ 173.3 (C=O), 57.9 (CH-2), 51.5 (CH-5), 46.3 (CH$_2$-3), 44.2 (C-1), 43.5 (CH$_2$-12), 40.7 (CH$_2$-9), 47.9 (C-4), 33.6 (CH$_2$-11), 33.4 (CH$_3$-7), 33.0 (CH$_3$-14), 31.8 (CH$_3$-15), 31.1 (C-8), 30.4 (CH$_2$-18), 24.9 (CH$_3$-13), 20.8 (CH$_2$-6), 19.1 (CH$_2$-10), 10.2 (CH$_3$-19); FT-IR $v_{max}$ (neat) 3258, 3082, 2944, 2920, 2860, 1639, 1559, 1460, 1379, 1332, 1277, 1198, 1070, 965, 774 cm$^{-1}$; HRMS (ESI): found 278.2371, [M+H]$^+$, C$_{18}$H$_{32}$NO required 278.2383, [M+H]$^+$.

2-chloro-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.02,5]dodecan-1-yl]acetamide (2c): Yield (0.92 g, 63%) as a yellow waxy solid. Rf (7:3 chloroform/ethyl acetate) 0.50; [α]$_{D}^{21}$ +21.9° (c 1.0, CHCl$_3$); $^{1}$H NMR δ 6.31 (br s, 1H, NH), 3.95 (s, 2H, H-18), 2.38 (ddd, J = 19.0, 11.0, 8.0 Hz, 1H, H-2), 2.19-2.24 (m, 1H, H-11a), 1.75-1.85 (m, 2H, H-5, H-10a), 1.72 (dd, J = 9.5, 8.0 Hz, 1H, H-9a), 1.42-1.68 (m, 6H, H-3a, H-6a, 2H-7, H-10b, H-11b), 1.32-1.40 (m, 3H, H-6b, 2H-12), 1.26 (ddd, J = 11.0, 8.0 Hz, 1H, H-3b), 1.10-1.19 (m, 1H, H-9b), 1.00 (s, 3H, CH$_3$-13), 0.99 (s, 3H, CH$_3$-14), 0.90 (s, 3H, CH$_3$-13); $^{13}$C NMR δ 164.8 (C=O), 56.0 (C-1), 46.4 (CH-5), 45.6 (CH$_2$-12), 43.2 (CH$_2$-18), 41.3 (CH-2), 38.2 (CH$_2$-3), 37.8 (CH$_2$-7), 37.4 (CH$_2$-9), 35.3 (CH$_2$-11), 34.5 (C-8), 34.5 (C-4), 34.2 (CH$_3$-15), 30.7 (CH$_3$-14), 23.1 (CH$_2$-6), 20.8 (CH$_3$-13), 20.1 (CH$_2$-10); FT-IR $v_{max}$

**2-chloro-N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-tricyclo[6.3.1.0²,5]dodecanyl]acetamide (3c):**

Yield (0.41 g, 28%) as a yellow waxy solid. Rf (7.3 chloroform/ethyl acetate) 0.43; [α]D² -3.9⁰ (c 1.0, CHCl₃); ¹H NMR δ 6.46 (br d, J = 8.5, 1H, NH), 4.00-4.15 (m, 1H, H-2), 4.07 (s, 2H, H-18), 1.65 (dd, J = 11.5, 6.0 Hz, 1H, H-3a), 1.50-1.60 (m, 1H, H-3b), 1.15-1.43 (m, 9H, H-2, H-6, 2H-7, H-9a, 2H-11, 2H-12), 1.05 (s, 3H, CH₃-15), 0.96-0.99 (m, 2H, H-9b, H-12b), 0.92 (s, 3H, CH₃-13), 0.88 (s, 3H, CH₃-14); ¹³C NMR δ 165.4 (C=O), 58.5 (CH-2), 51.4 (CH-5), 46.0 (CH₂-3), 44.4 (C-1), 43.5 (CH₂-12), 45.6 (CH₂-18), 40.6 (CH₂-9) 38.1 (C-4), 33.4 (CH₂-11), 33.3 (CH₂-7), 33.0 (CH₃-14), 31.1 (CH₃-15), 30.8 (C-8), 24.9 (CH₃-13), 20.8 (CH₂-6), 19.0 (CH₂-10); FT-IR vₚₚₚ (neat) 3283, 3084, 2945, 2921, 2862, 1652, 1541, 1457, 1364, 1334, 1237, 1153, 1095, 968, 856, 778, 711 cm⁻¹; HRMS (ESI): found 298.1943, [M+H]+, C₁₇H₂₉CINO required 298.1938, [M+H]+.

**N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0²,5]dodecanyl]benzamide (2d):**

Yield (0.91 g, 57%) as a white glassy solid. Rf (3.2 ethyl acetate/hexane) 0.70; [α]D² +27.3⁰ (c 1.0, CHCl₃); ¹H NMR δ 7.70-7.773 (m, 1H, H-21), 7.44-7.48 (m, 2H, H-19), 7.38-7.43 (m, 2H, H-20), 5.86 (br s, 1H, NH), 2.40-2.50 (m, 2H, H-2, H-11a), 1.92 (dt, J = 13.0, 2.0 Hz, 1H, H-12a), 1.78-1.89 (m, 3H, H-5, H-3a, H-10a), 1.63-1.70 (m, 1H, H-10b), 1.12-1.62 (m, 9H, H-3b, 2H-6, 2H-7, 2H-9, H-11b, H-12b), 1.01 (s, 3H, CH₃-13), 0.97 (s, 3H, CH₃-14), 0.92 (s, 3H, CH₃-15); ¹³C NMR δ 166.8 (C=O), 136.8 (C-18), 131.1 (2CH-19), 128.6 (2CH-20), 126.9 (CH-21), 56.0 (C-1), 46.5 (CH₂-12), 46.3 (CH-5), 41.7 (CH-2), 38.3 (CH₂-3), 38.27 (CH₂-7), 37.5 (CH₂-9), 35.9 (CH₂-11), 34.5 (C-8), 34.47 (C-4), 34.2 (CH₃-15), 30.7 (CH₃-14), 23.2 (CH₂-6), 20.9 (CH₃-13), 20.2 (CH₂-10); FT-IR vₚₚₚ (neat) 3306, 2945, 2917, 2861, 1638, 1601, 1527, 1486, 1457, 1358, 1304, 1190, 1148, 1072, 1000, 919, 859, 798, 710, 690 cm⁻¹; HRMS (ESI): found 326.2495, [M+H]+, C₂₂H₃₂NO required 326.2484, [M+H]+.

**N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-tricyclo[6.3.1.0²,5]dodecanyl]benzamide (3d):**

Yield (0.30 g, 19%) as a white glassy solid. Rf (3.2 ethyl acetate/hexane) 0.66; [α]D² +18.0⁰ (c 1.0, CHCl₃); ¹H NMR δ 7.70-7.779 (m, 1H, H-21), 7.47-7.52 (m, 2H, H-19), 7.39-7.46 (m, 2H, H-20), 6.00 (br d, J = 8.5, 1H, NH), 4.35 (ddd, J = 12.5, 8.5, 6.0 Hz, 1H, H-2), 1.72 (dd, J = 12.5, 6.0 Hz, 1H, H-3a), 1.52-1.57 (m, 2H, H-2, H-10), 1.48-1.51 (m, 1H, H-3b), 1.12-1.44 (m, 1H, H-5, 2H-6, 2H-7, H-9a, 2H-11, 2H-12), 1.06 (s, 3H, CH₃-14), 0.96-1.00 (m, 1H, H-9b), 0.96 (s, 3H, CH₃-13), 0.89 (s, 3H, CH₃-15); ¹³C NMR δ 165.2 (C=O), 135.3 (C-18), 131.5 (2CH-19), 128.7 (2CH-20), 127.0 (CH-21), 58.5 (CH-2), 51.5 (CH-5), 46.3 (CH₂-3), 44.7 (C-1), 43.6 (CH₂-12), 40.69 (CH₂-9), 38.1 (C-4), 33.7 (CH₂-11), 33.4 (CH₂-7), 32.9 (CH₃-15), 31.1 (CH₃-14), 30.4 (C-8), 24.9 (CH₃-13), 20.8 (CH₂-6), 19.1 (CH₂-10); FT-IR vₚₚₚ (neat) 3309, 2942, 2921, 2861, 1631, 1534, 1488, 1457, 1371, 1309, 1290, 1216, 1155, 1071, 923, 800, 691 cm⁻¹; HRMS (ESI): found 326.2469, [M+H]+, C₂₂H₃₂NO required 326.2484, [M+H]+.
**N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0²,5]dodecanyl]pentanamide (2e):** Yield (0.87 g, 58 %) as a pale yellow waxy solid. Rf (7:3 ethyl acetate/hexane) 0.51; [α]_{D}^{21} = 50.7° (c 1.0, CHCl₃); ¹H NMR δ 5.15 (br s, 1H, NH), 2.26-2.36 (m, 2H, H-2, H-11a), 2.10 (t, J = 8.0 Hz, 2H, H-18), 1.74-1.83 (m, 2H, H-5, H-10a), 1.71 (dd, J = 9.5, 8.0 Hz, 1H, H-7a), 1.06-1.62 (m, 15H, 2H-3, 2H-6, H-7b, H-9, H-10b, H-11b, 2H-12, 2H-19, 2H-20), 0.98 (s, 3H, CH₃-13), 0.97 (s, 3H, CH₃-14), 0.92 (s, J = 7.5 Hz, 3H, CH₃-21), 0.88 (s, 3H, CH₃-15); ¹³C NMR δ 172.6 (C=O), 55.4 (C-1), 46.3 (CH₂-12), 46.28 (CH₅), 41.3 (CH-2), 38.3 (CH₂-18), 38.2 (CH₂-3), 37.6 (CH₂-7), 37.5 (CH₂-9), 36.0(CH₂-11), 34.4 (C-8), 34.3 (C-4), 34.2 (CH₃-15), 30.7 (CH₃-14), 28.3 (CH₂-19), 23.1 (CH₂-20), 22.6 (CH₃-6), 20.9 (CH₃-21), 20.2 (CH₂-10), 14.0 (CH₃-13); FT-IR vₘₐₓ (neat) 3276, 2946, 2924, 2860, 1637, 1544, 1457, 1362, 1341, 1269, 1104, 937, 809, 728, 691 cm⁻¹; HRMS (EI): found 306.2786, [M+H]⁺, C₂₀H₃₆NO required 306.2797, [M+H]⁺.

**5-chloro-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0²,5]dodecanyl]pentanamide (2f):** Yield (0.98 g, 59 %) as a pale yellow waxy solid. Rf (7:3 ethyl acetate/hexane) 0.49; [α]_{D}^{21} = 27.7° (c 1.0, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 5.13 (br s, 1H, NH), 3.59 (t, J = 6.0 Hz, 2H, H-2), 3.55 (t, J = 6.0 Hz, 2H, H-18), 2.27-2.36 (m, 2H, H-2, H-11a), 1.92-1.98 (m, 2H, 2H-20), 1.69-1.89 (m, 6H, 2H-12, H-7a, H-10a), 1.30-1.64 (m, 6H, H-10b, 2H-6, H-11b, H-9a, H-7b), 1.21-1.25 (m, 2H, H-3a, H-5), 1.08-1.17 (m, 2H, H-3b, H-9b), 0.98 (s, 3H, CH₃-13), 0.97 (s, 3H, CH₃-14), 0.88 (s, 3H, CH₃-15); ¹³C NMR δ 171.4 (C=O), 55.6 (C-1), 46.4 (CH₅), 46.3 (CH₂-12), 44.9 (CH₂-21), 43.8 (CH₂-20), 41.3 (CH-2), 38.3 (CH₂-3), 38.2 (CH₂-7), 37.5 (CH₂-9), 36.6 (CH₂-11), 36.1 (C-8), 34.4 (C-4), 34.9 (CH₃-15), 34.3 (CH₂-19), 31.2 (CH₂-18), 30.7 (CH₃-14), 22.9 (CH₂-6), 20.9 (CH₃-13), 20.2 (CH₂-10); FT-IR vₘₐₓ (neat) 3295, 2946, 2926, 2864, 1643, 1541, 1457, 1362, 1341, 1281, 1134, 1101, 963, 727 cm⁻¹; HRMS (EI): found 340.2420, [M+H]⁺, C₂₀H₃₆ClNO required 340.2407, [M+H]⁺.

**3-chloro-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0²,5]dodecanyl]propanamide (2g):** Yield (0.44 g, 29%) as a yellow viscous liquid; Rf (7:3 ethyl acetate/hexane) 0.44; [α]_{D}^{21} = 32.3° (c 1.0, CHCl₃); ¹H NMR δ 5.25 (br s, 1H, NH), 3.78 (t, J = 6.5 Hz, 2H, H-2), 2.55 (t, J = 6.5 Hz, 2H, H-18), 2.32 (m, 2H, H-2, H-11a), 1.80-1.85 (m, 5H, H-15), 1.73-1.80 (m, 1H, H-10a), 1.71 (dd, J = 10.0, 8.0 Hz, 1H, H-3a), 1.61-1.66 (m, 1H, H-10b), 1.26-1.60 (m, 6H, H-3b, 2H-6, H-7a, H-9a, H-11b), 1.24 (s, 2H, H-12), 1.08-1.18 (m, 2H, H-7b, H-9b), 0.99 (s, 3H, CH₃-13), 0.97 (s, 3H, CH₃-14), 0.88 (s, 3H, CH₃-15); ¹³C NMR δ 170.8 (C=O), 58.6 (C-1), 48.8 (CH₁₂), 48.7 (CH₅), 43.6 (CH₂-2), 43.2 (CH₂-19), 43.1 (CH₂-18), 40.7 (CH₂-3), 40.6 (CH₂-7), 40.0 (CH₂-9), 38.4 (CH₂-11), 36.9 (C-8), 36.9 (C-4), 36.6 (CH₃-15), 33.2 (CH₃-14), 25.5 (CH₂-6), 23.4 (CH₃-13), 22.6 (CH₂-10); FT-IR vₘₐₓ (neat) 3293, 2945, 2923, 2863, 1644, 1551, 1457, 1376, 1333, 1286, 1219, 1154, 1101, 988, 944, 813, 778, 654 cm⁻¹; HRMS (EI): found 312.2097, [M+H]⁺, C₁₈H₃₁ClNO required 312.2094, [M+H]⁺.

**2-amino-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0²,5]dodecanyl]acetamide (2h):** The amide was synthesised from carophyllene 1 (1.00 g, 4.89 mmol) and aminooctonitrile hydrogen sulfate (5-mole equiv.) via the Ritter reaction as described in the general procedure. The product was purified by column chromatography to yield amide (1.09 g, 75 %) as a brown
viscous liquid. \( R_f \) (4:1 ethyl acetate/methanol) 0.33; \([\alpha]\)\(_{D}^{25}\) -21.0° (c 1.0, CHCl\(_3\)); \(^1\)H NMR \( \delta \) 7.54 (br s, 1H, NH), 3.29 (br s, 2H, 2H-18), 2.47-2.53 (m, 2H, H-2, H-11a), 1.80-1.90 (m, 1H, H-3a), 1.56-1.67 (m, 4H, H-7a, 2H-10, H-11b), 1.40-1.55 (m, 2H, 2H-9), 1.16-1.40 (m, 7H, H-3b, H-5, 2H-6, H-7b, 2H-12), 1.28 (s, 3H, CH\(_3\)-13), 1.24 (s, 3H, CH\(_3\)-14), 1.05 (s, 3H, CH\(_3\)-15); \(^{13}\)C NMR \( \delta \) 170.5 (C=O), 57.1 (CH-5), 56.0 (C-1), 53.6 (C-8), 49.1 (CH\(_2\)-18), 44.2 (CH\(_2\)-12), 35.8 (C-4), 31.8 (CH\(_3\)-14), 31.5 (CH\(_3\)-15), 30.6 (CH\(_2\)-3), 30.4 (CH\(_2\)-7), 29.9 (CH\(_2\)-9), 29.1 (CH-2), 22.2 (CH\(_3\)-13), 21.9 (CH\(_2\)-11), 21.7 (CH\(_2\)-6), 28.0 (CH\(_2\)-10); FT-IR \( v_{\text{max}} \) (neat) 3391, 2921, 2867, 1654, 1521, 1449, 1370, 1241, 1223, 1189, 1020, 992, 919, 807, 729 cm\(^{-1}\); HRMS (ESI): found 279.2446, [M+H]\(^+\), \( C_{12}H_{21}N_{2}O \) required 279.2436, [M+H]\(^+\).

**S-methyl-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0\(_2\)2,5]dodecanyl]carbamothioate (2i):** The amide was synthesised from caryophyllene 1 (1.00 g, 4.89 mmol) and methyl thiocyanate (5-mole equiv.) via the Ritter reaction as described in the general procedure. The product was purified by column chromatography to yield amide (0.015 g, 1%) as an orange viscous liquid. \( R_f \) (7:3 ethyl acetate/hexane) 0.42; \([\alpha]\)\(_{D}^{25}\) 31.0° (c 1.0, CHCl\(_3\)); \(^1\)H NMR \( \delta \) 3.20 (s, 3H, CH\(_3\)-18), 2.16-2.22 (m, 2H, H-2, H-11a), 1.82-1.86 (m, 2H, H-3a, H-5), 1.50-1.80 (m, 6H, 2H-6, H-9a, H-11b, 2H-10), 1.44-1.50 (m, 1H, H-3b), 1.34-1.42 (m, 3H, 2H-7, H-9b), 1.12-1.20 (m, 2H, H-12), 1.02 (br s, 6H, CH\(_3\)-15, CH\(_3\)-14), 0.98 (s, 3H, CH\(_3\)-13); \(^{13}\)C NMR \( \delta \) 209.4 (C=O), 68.9 (C-1), 46.9 (CH-5), 44.8 (CH-2), 43.0 (CH\(_2\)-12), 33.6 (CH\(_2\)-3), 32.9 (CH\(_2\)-7), 32.1 (CH\(_2\)-9), 31.4 (CH\(_3\)-15), 31.3 (C-8), 30.0 (C-4), 26.3 (CH\(_2\)-11), 24.6 (CH\(_3\)-13), 23.0 (CH\(_3\)-14), 17.4 (CH\(_2\)-6), 14.3 (CH\(_2\)-10), 12.1 (CH\(_3\)-18); FT-IR \( v_{\text{max}} \) (neat) 3196, 2924, 2861, 1647, 1558, 1449, 1396, 1363, 1190, 1165, 1070, 1037, 963, 789 cm\(^{-1}\); HRMS (ESI): found 296.2057, [M+H]\(^+\), \( C_{17}H_{30}N_{2}OS \) required 296.2048, [M+H]\(^+\).

**N-[(1S,2S,5S,8S)-9-hydroxy-4,4,8-trimethyl-2-tricyclo[6.3.1.0\(_2\)2,5]dodecanyl]acetamide (5a):** A mixture of 98% H\(_2\)SO\(_4\) (2 mL), and acetonitrile (5-time excess) in 100 mL round-bottomed flask fitted with a condenser and drying tube, was stirred at 0 °C. Monoepoxide 4 (0.250 g, 1.14 mmol) was dissolved in benzene (5 mL) and added to the mixture drop-wise but rapidly. The reaction mixture was stirred at 0 °C for 4 min. The reaction mixture was stirred for 4 min at 0°C then washed with saturated NaHCO\(_3\) and extracted with chloroform. The organic layer was dried over Na\(_2\)SO\(_4\) and the solvent removed under reduced pressure. The product was purified by column chromatography to yield the amide product. Yield (0.06 g, 20%) as a white glassy solid. \( R_f \) (1:1 ethyl acetate/hexane) 0.28; \([\alpha]\)\(_{D}^{25}\) -28.7° (c 1.0, CHCl\(_3\)); \(^1\)H NMR \( \delta \) 5.31 (br d, J = 9.5, 1H, NH), 4.14 (ddd, J = 12.5, 9.5, 6.0 Hz, 1H, H-2), 3.47 (q, J = 7.0 Hz, 1H, H-9), 1.98 (s, 3H, CH\(_3\)-18), 1.80-2.00 (m, 1H, H-10a), 1.71 (br s, OH), 1.56 (d, J = 13.0 Hz, 1H, H-12a), 1.54-1.66 (m, 2H, H-3a, H-10b), 1.44-1.50 (m, 1H, H-11a), 1.35-1.45(m, 5H, H-3b, H-5, 2H-6, H-7a), 1.06-1.14 (m, 2H, H-7b, H-12b), 1.02 (s, 3H, CH\(_3\)-14), 0.94 (s, 3H, CH\(_3\)-15), 0.91 (s, 3H, CH\(_3\)-13), 0.84-1.00 (m, 1H, H-11b); \(^{13}\)C NMR \( \delta \) 169.9 (C=O), 75.3 (CH-9), 57.8 (CH-2), 50.7 (CH-5), 46.1 (CH\(_2\)-3), 43.70 (C-1), 37.8 (C-4), 35.7 (CH\(_2\)-12), 35.0 (C-8), 33.2 (CH\(_2\)-7), 31.1 (CH\(_3\)-14), 28.33 (CH\(_3\)-15), 27.8 (CH\(_2\)-11), 25.6 (CH\(_2\)-10), 24.8 (CH\(_3\)-13), 23.9 (CH\(_3\)-18), 20.7 (CH\(_2\)-6); FT-IR \( v_{\text{max}} \) (neat) 3586, 3288, 2950, 2930, 2867, 1650, 1544, 1532, 1456.
1366, 1222, 1219, 1160, 1033, 966, 911, 775, 725 cm\(^{-1}\); HRMS (ESI): found 280.2273, [M+H]\(^+\), C\(_{17}\)H\(_{30}\)NO\(_2\) required 280.2276, [M+H]\(^+\).

**General Procedure for the Preparation of diamides from Monoepoxide 4:** A mixture of 98 % H\(_2\)SO\(_4\) (2 mL) and nitrile reagent (5-time excess) in 100 mL round-bottomed flask fitted with a condenser and drying tube was stirred at 0 °C. Monoepoxide 4 (1.00 g, 4.89 mmol) was dissolved in benzene (5 mL) and added to the mixture drop-wise but rapidly. The reaction mixture was stirred at 0 °C for 30 min, then at room temperature overnight. Water was added to the mixture and stirring was continued for a further 30 min. The mixture was extracted with diethyl ether. The aqueous layer was washed with NaOH (18 mL, 1 M) or saturated NaHCO\(_3\) solution, and extracted with chloroform. The organic layer was dried over Na\(_2\)SO\(_4\) and the solvent removed under reduced pressure. The product was purified by column chromatography to yield the amide product.

**N-[(1S,2S,5S,8S)-2-acetamido-4,4,8-trimethyl-9-tricyclo[6.3.1.01,5]dodecanyl]acetamide (6a):** Yield (0.26 g, 71%) as a white glassy solid. R\(_f\) (7:3 ethyl acetate/hexane) 0.51; [\(\alpha\)\(_{589}^\circ\)]= 54.4\(^\circ\) (c 1.0, CHCl\(_3\)); \(^1\)H NMR \(\delta\) 5.73 (br d, \(J = 9.0\) Hz, 1H, H-16/19), 5.36 (br d, \(J = 9.0\) Hz, 1H, H-16/19), 4.12 (dd d, \(J = 12.5, 9.0, 5.5\) Hz, 1H, H-2), 3.67 (br d, \(J = 9.0\) Hz, 1H, H-9), 2.03 (s, CH\(_3\)18/21), 1.99 (CH\(_3\)18/21), 1.50-1.64 (m, 4H, H-3a, 2H-10, H-7a), 1.40-1.50 (m, 1H, H-6a), 1.24-1.45 (m, 4H, H-7b, H-3b, H-5, H-12a), 1.18-1.24 (m, 1H, H-11a), 1.03 (s, 3H, CH\(_3\)-13), 0.96-1.04 (m, 2H, H-6b, H-11b), 0.91 (s, 3H, CH\(_3\)-13), 0.87 (s, 3H, CH\(_3\)-14), 0.86-0.89 (m, 1H, H-12b); \(^{13}\)C NMR \(\delta\) 170.2 (C-17/20), 169.9 (C-17/20), 58.4 (CH-2), 53.4 (CH-9), 51.1 (CH-5), 46.2 (CH-3), 43.8 (C-1), 37.94 (C-4), 37.9 (CH\(_2\)-12), 34.3 (CH\(_2\)-7), 33.5 (C-8), 30.8 (CH\(_3\)-15), 29.0 (CH\(_2\)-11), 28.7 (CH\(_3\)-14), 24.8 (CH\(_3\)-13), 23.9 (CH\(_3\)-18/21), 23.84 (CH\(_3\)-18/21), 23.8 (CH\(_2\)-10), 20.6 (CH\(_2\)-6); FT-IR \(v_{\text{max}}\) (neat) 3289, 2935, 2859, 1635, 1540, 1455, 1372, 1222, 1102, 1030, 911, 859, 736 cm\(^{-1}\); HRMS (ESI): found 321.2551, [M+H]\(^+\), C\(_{19}\)H\(_{33}\)N\(_2\)O\(_2\) required 321.2542, [M+H]\(^+\).

**2-chloro-N-[(1S,2S,5S,8S)-2-[2-chloroacetyl]amino]-4,4,8-trimethyl-9-tricyclo[6.3.1.01,5]dodecanyl]acetamide (6b):** Yield (0.15 g, 34%) as a yellow glassy solid; R\(_f\) (7:3 ethyl acetate/hexane) 0.52; [\(\alpha\)\(_{589}^\circ\)]= -15.4\(^\circ\) (c 1.0, CHCl\(_3\)); \(^1\)H NMR \(\delta\) 6.78 (d, \(J = 9.0\) Hz, 1H, H-16), 6.44 (d, \(J = 9.5\) Hz, 1H, H-19), 4.12 (dd d, \(J = 12.5, 9.0, 6.0\) Hz, 1H, H-2), 4.07 (s, 2H, H-18), 4.05 (s, 2H, H-21), 3.52 (br d, \(J = 9.5\) Hz, 1H, H-9), 2.01-2.08 (m, 1H, H-10a), 1.68 (dd, \(J = 11.5, 6.0\) Hz, 1H, H-3a), 1.60-1.65 (m, 4H, H-3b, H-5, 2H-6), 1.30-1.35 (m, 1H, H-7b), 1.24-1.28 (m, 2H, 2H-12), 1.10-1.20 (m, 2H, 2H-11), 1.07 (s, 3H, CH\(_3\)-15), 0.94 (s, CH\(_3\)-13), 0.89 (s, CH\(_3\)-14); \(^{13}\)C NMR \(\delta\) 165.9 (C-17/20), 165.4 (C-17/20), 58.3 (CH-2), 53.4 (CH-9), 50.9 (CH-5), 45.6 (CH-3), 44.0 (C-1), 43.2 (CH\(_2\)-18/21), 43.0 (CH\(_2\)-18/21), 38.2 (C-4), 47.6 (CH\(_2\)-12), 34.0 (CH\(_2\)-7), 33.7 (C-8), 30.9 (CH\(_3\)-15), 28.7 (CH\(_2\)-11), 28.5 (CH\(_3\)-14), 24.7 (CH\(_3\)-13), 23.5 (CH\(_2\)-10), 20.5 (CH\(_2\)-6); FT-IR \(v_{\text{max}}\) (neat) 3284, 2949, 2928, 2865, 1653, 1540, 1457, 1410, 1365, 1229, 1167, 1037, 968, 773, 730 cm\(^{-1}\); HRMS (ESI): found 389.1746, [M+H]\(^+\), C\(_{19}\)H\(_{31}\)Cl\(_2\)N\(_2\)O\(_2\) required 389.1762, [M+H]\(^+\).
**N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-(pentanoylamino)-9-tricyclo[6.3.1.01,5]dodecanyl]pentanamide (6c):** Yield (0.04 g, 9%) as a white glassy solid; Rf (7:3 ethyl acetate/hexane) 0.67; \( [\alpha]_{D}^{25} = -63.9^\circ \) (c 1.0, CHCl3); \(^1^H\) NMR δ 5.60 (d, J = 9.0 Hz, 1H, H-16/22), 5.35 (d, J = 9.0 Hz, 1H, H-16/22), 4.12 (ddd, J = 12.5, 9.0, 6.0 Hz, 1H, H-2), 3.64 (br d, J = 9.0 Hz, 1H, H-9), 2.20 (t, J = 7.5 Hz, 2H, H-18/24), 2.13 (t, J = 7.5 Hz, 2H, H-18/24), 1.92-2.00 (m, 1H, H-10a), 1.52-1.67 (m, 6H, H-3a, H-10b, 2H-19, 2H-25), 1.46-1.52 (m, 2H, 2H-7), 1.40-1.46 (m, 2H, 2H-6), 1.28-1.40 (m, 10H, H-3b, H-5, 2H-11, 2H-12, 2H-20, 2H-26), 1.02 (s, 3H, CH3-15), 0.92 (t, J = 7.0 Hz, 3H, CH3-21/27), 0.90 (s, J = 7.0 Hz, 3H, CH3-21/27), 0.90 (s, 3H, CH3-13), 0.85 (s, CH3-14); \(^1^C\) NMR δ 173.3 (C-17/23), 172.9 (C-17/23), 58.2 (CH-2), 53.2 (CH-9), 51.1 (CH-5), 46.2 (CH2-3), 43.9 (C-1), 38.0 (C-4), 37.9 (CH2-12), 37.1 (CH2-18/24), 36.9 (CH2-18/24), 34.3 (CH2-7), 33.4 (C-8), 30.8 (CH3-15), 28.9 (CH2-11), 28.8 (CH3-14), 28.3 (CH2-19/25), 28.1 (CH2-19/25), 24.8 (CH3-13), 23.8 (CH2-10), 22.61 (CH2-20/26), 22.6 (CH2-20/26), 20.6 (CH2-6), 14.0 (CH3-21 and CH3-27); FT-IR \( v_{\text{max}} \) (neat) 3296, 2952, 2925, 2860, 1636, 1541, 1458, 1376, 1270, 1223, 1193, 1106, 993, 950, 853 cm\(^{-1}\); HRMS (ESI): found 405.3478, [M+H]+, \( C_{25}H_{45}N_{2}O_{2} \) required 405.3481, [M+H]+.

**N-[(1S,2S,5S,8S)-2-benzamido-4,4,8-trimethyl-9-tricyclo[6.3.1.01,5]dodecanyl]benzamide (6d):** Yield (0.09 g, 17%) as a yellow viscous liquid; Rf (3:2 ethyl acetate/hexane) 0.80; \( [\alpha]_{D}^{25} = 0.36^\circ \) (c 1.0, CHCl3); \(^1^H\) NMR δ 7.75 (d, J = 7.0 Hz, 2H, 2H-19/27), 7.66 (d, J = 7.0 Hz, 2H, 2H-19/27), 7.50 (t, J = 7.0 Hz, 1H, H-21/29), 7.46 (t, J = 7.0 Hz, 1H, H-21/29), 7.40 (t, J = 7.0 Hz, 2H, 2H-20/28), 7.33 (t, J = 7.0 Hz, 2H, 2H-20/28), 6.31 (d, J = 9.0 Hz, 1H, H-24), 5.32 (d, J = 8.5 Hz, 1H, H-16), 4.36 (ddd, J = 12.5, 8.5, 6.0 Hz, 1H, H-2), 3.86 (br d, J = 9.0 Hz, 1H, H-9), 2.10-2.03 (m, 1H, H-10a), 1.68-1.76 (m, 2H, H-3a, H-10b), 1.56-1.62 (m, 2H, H-7a, H-12a), 1.46-1.56 (m, 3H, H-6a, H-3b, H-5), 1.34-1.44 (m, 4H, H-6b, H-11a, H-7b, H-12b), 1.12-1.20 (m, 1H, H-11b), 1.07 (s, 3H, CH3-15), 0.97 (s, 3H, CH3-13), 0.96 (s, 3H, CH3-14); \(^1^C\) NMR δ 167.7 (C-17/25), 167.3 (C-17/25), 135.3 (C-18/26), 134.8 (C-18/26), 131.7 (C-21/29), 131.4 (C-21/29), 128.8 (2CH-20), 128.7 (2CH-28), 127.0 (2CH-19), 126.9 (2CH-27), 58.8 (CH2-2), 53.9 (CH-9), 51.3 (CH-5), 46.1 (CH2-3), 44.4 (C-1), 38.2 (C-4), 38.1 (CH2-12), 34.2 (CH2-7), 33.8 (C-8), 30.8 (CH3-15), 29.0 (CH2-11), 28.9 (CH3-14), 24.8 (CH3-13), 23.7 (CH2-10), 20.6 (CH2-6); FT-IR \( v_{\text{max}} \) (neat) 3296, 2947, 2923, 2863, 1633, 1577, 1521, 1486, 1464, 1309, 1287, 1222, 1026, 995, 840, 798, 690 cm\(^{-1}\); HRMS (ESI): found 445.2870, [M+H]+, \( C_{29}H_{39}N_{2}O_{2} \) required 445.2855, [M+H]+.

**N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-(propanoylamino)-9-tricyclo[6.3.1.01,5]dodecanyl]propanamide (6e):** Yield (0.22 g, 56%) as a white glassy solid; Rf (1:1 chloroform/ethyl acetate) 0.57; \( [\alpha]_{D}^{25} = -33.4^\circ \) (c 1.0, CHCl3); \(^1^H\) NMR δ 6.65 (d, J = 8.5 Hz, 1H, H-16), 5.32 (d, J = 9.0 Hz, 1H, H-20), 4.13 (ddd, J = 12.0, 8.5, 6.0 Hz, 1H, H-2), 3.67 (br d, J = 9.0 Hz, 1H, H-9), 2.24 (q, J = 7.5 Hz, 2H, 2H-18), 2.19 (q, J = 7.5 Hz, 2H, 2H-22), 1.94-2.02 (m, 1H, H-10a), 1.63 (dd, J = 12.0, 6.0 Hz, 1H, H-3a), 1.54-1.60 (m, 1H, H-10b), 1.51 (dt, J = 11.0, 2.5 Hz, 1H, H-7a), 1.43-1.48 (m, 1H, H-6a), 1.35-1.42 (m, 2H, H-3b, H-5), 1.22-1.34 (m, 3H, H-7b, 2H-12), 1.18 (t, J = 7.5 Hz, 3H, CH3-19), 1.14 (t, J = 7.5 Hz, 3H, CH3-23), 1.14-1.18 (m, 1H, H-11a), 1.03 (s, 3H, CH3-15), 0.98-1.00 (m, 1H, H-11b), 0.94-0.98 (m, 1H, H-6b), 0.91 (s, CH3-13), 0.87 (s, CH3-14); \(^1^C\) NMR δ 174.0 (C-17), 173.5 (C-21), 77.4 (CH-2), 58.2 (CH-9); 53.2

S8
General procedure for amide cleavage under mild conditions using thiourea: Amide 2c, 3c (0.10 g, 0.34 mmol) or 6a (0.10 g, 0.26 mmol) was dissolved in dry EtOH (15 mL) and placed in a round bottom flask fitted with a drying tube, thiourea (5 mol eqv.), and NaBH₄ (10 mol eqv.) was added slowly. A few drops of acetic acid were added, and the mixture was stirred overnight at room temperature. The reaction was quenched with saturated NaHCO₃ (20 mL), extracted with CHCl₃ (20 mL x 2), and washed with saturated NaCl (20 mL). The organic layer was dried with Na₂CO₃ and solvent was removed under reduced pressure. The product was purified by washing with hexane to yield the amine product.

**1(1R,2S,5R,8R)-4,4,8-trimethyltricyclo[6.3.1.0²,5]dodecan-1-amine (7):**

Yield (0.04 g, 58%) as a brown viscous liquid; [α]²²D0.99 -8.6° (c 1.0, CHCl₃); ¹H NMR δ 2.37 (dd, J = 12.0, 11.0, 8.0 Hz, 1H, H-2), 1.84-1.96 (m, 2H, H-5, H-10a), 1.73-1.78 (m, 2H, 2H-12), 1.67-1.73 (m, 1H, H-10b), 1.1-1.66 (m, 10H, 2H-3, 2H-6, 2H-7, 2H-9, 2H-11), 1.05 (s, 3H, CH₃-13), 1.04 (s, 3H, CH₃-14), 0.92 (s, 3H, CH₃-15); ¹³C NMR δ 54.0 (C-1), 47.9 (CH₂-12), 46.4 (CH₅), 39.8 (CH₂-3), 38.5 (CH₂-7), 37.7 (CH₂-9), 36.3 (CH₂-11), 36.0 (C-8), 35.5 (C-4), 34.1 (CH₃-15), 30.7 (CH₃-14), 23.3 (CH₂-6), 21.1 (CH₃-13), 20.0 (CH₂-10); FT-IR νₘₐₓ (neat) 3296, 3190, 2945, 2921, 2862, 1638, 1542, 1457, 1376, 1363, 1286, 1223, 1199, 1100, 1064, 987, 922, 871, 733, 655 cm⁻¹; HRMS (ESI): found 222.2214, [M+H]+, C₁₅H₂₈N required 222.2222 [M+H]+.

**1(1S,2S,5S,8S)-4,4,8-trimethyltricyclo[6.3.1.0²,8]dodecan-2-amine (8):** Yield (0.05 g, 65%) as a brown viscous liquid; [α]²²D0.99 9.2° (c 1.0, CHCl₃); ¹H NMR δ 2.86 (dd, J = 12.0, 5.5 Hz, 1H, H-2), 1.57 (dd, J = 12.0, 5.5 Hz, 1H, H-3a), 1.50-1.60 (m, 2H, 2H-10), 1.04-1.26 (m, 9H, H-3b, H-5, 2H-6, 2H-7, 2H-9a, H-11a, H-12a), 1.01 (s, 3H, CH₃-14), 0.89 (s, 3H, CH₃-13), 0.84 (s, 3H, CH₃-15), 0.85-0.96 (m, 3H, H-9b, H-11b, H-12b); ¹³C NMR δ 61.7 (CH₂-7), 51.8 (CH₅), 49.5 (CH₂-3), 43.5 (C-1), 41.2 (CH₂-12), 37.5 (CH₂-9), 33.4 (C-4), 33.2 (CH₂-11), 31.5 (CH₂-7), 31.4 (CH₃-15), 30.6 (CH₃-14), 25.3 (C-8), 20.9 (CH₃-13), 19.0 (CH₂-10), 14.3 (CH₂-6); FT-IR νₘₐₓ (neat) 3294, 2942, 2928, 2860, 1641, 1552, 1467, 1388, 1366, 1276, 1202, 1100, 1064, 998, 852, 781, 667 cm⁻¹; HRMS (ESI): found 222.2213, [M+H]+, C₁₅H₂₈N required 222.2222 [M+H]+.

**1(1S,2S,5S,9R)-4,4,8-trimethyltricyclo[6.3.1.0²,5]dodecan-2,9-diamine (9):** Yield (0.02 g, 33%) as a brown viscous liquid; [α]²²D0.99 -13.3° (c 1.0, CHCl₃); ¹H NMR δ 2.87 (dd, J = 12.5, 6.0 Hz, 1H, H-2), 2.50 (br s, 1H, H-9), 1.97-2.05 (m, 1H, H-10a), 1.38-1.60 (m, 6H, H-3a, H-6a, H-8a);
General Procedure for the Reductive Alkylation of Amine 7: Amine 7 (0.10 g, 0.45 mmol) was dissolved in DCM (5 mL) and placed in a round bottom flask fitted with a drying tube, aldehyde (5 mol equiv.), and NaBH(OAc)₃ (10 mol equiv.) was added slowly. The pH of the reaction mixture was adjusted to pH = 4 via the addition of acetic acid. The mixture was stirred overnight at room temperature. The reaction was quenched with saturated NaHCO₃ (20 mL), extracted with CHCl₃ (20 mL x 2), and washed with saturated NaCl (20 mL). The organic layer was dried with Na₂SO₄ and solvent was removed under reduced pressure. The product was purified by column chromatography to yield the amine.

(1R,2S,5R,8R)-N,N,4,4,8-pentamethyltricyclo[6.3.1.0²,5]dodecan-1-amine (10a): Yield (0.08 g, 71%) as a viscous liquid; Rₛ (1: diethyl ether/hexane) 0.62; [α]ᵣ°₂⁰° -8.6º (c 1.0, CHCl₃); ¹H NMR δ 2.21 (br s, 6H, CH₃-17, CH₃-18), 2.16 (ddd, J = 14.5, 12.0, 9.0 Hz, 1H, H-2), 1.85 (ddd, J = 14.5, 12.5, 7.0 Hz, 1H, H-5), 1.72-1.80 (m, 1H, H-10a), 1.68-1.72 (m, 2H, 2H-3), 1.59-1.65 (m, 1H, H-10b), 1.51-1.58 (m, 2H, H-9a, H-12a), 1.36-1.48 (m, 3H, H-6a, H-7a, H-11a), 1.22-1.35 (m, 2H, H-6b, H-11b), 1.16-1.12 (m, 1H, H-9b), 1.10-1.08 (m, 2H, H-7b, H-12b), 0.99 (s, 3H, CH₃-13), 0.96 (s, 3H, CH₃-14), 0.87 (s, 3H, CH₃-15); ¹³C NMR δ 57.9 (C-1), 46.1 (CH-5), 45.3 (CH₂-12), 40.7 (CH-2), 39.7 (2CH₃-17 and 18), 38.9 (CH-3), 37.2 (CH₂-7), 35.0 (CH₂-9), 34.4 (C-8), 34.2 (C-4), 30.4 (CH₃-15), 30.4 (CH₃-13), 28.1 (CH₂-11), 22.4 (CH₂-10), 21.0 (CH₃-14), 20.2 (CH₂-6); FT-IR νₓ(max (neat) 2923, 2861, 1560, 1458, 1377, 1364, 1284, 1228, 1021, 989, 816, 700 cm⁻¹; HRMS (ESI): found 250.2341, [M+H]+, C₁₅H₂₁N₂ required 250.2353, [M+H]+.

(1R,2S,5R,8R)-4,4,8-trimethyl-N-propyl-tricyclo[6.3.1.0²,5]dodecan-1-amine (10b): Yield (0.08 g, 69%) as a viscous liquid; Rₛ (7: diethyl ether/hexane) 0.45; [α]ᵣ°₂⁰° 0.1º (c 1.0, CHCl₃); ¹H NMR δ 2.68 (ddd, J = 16.0, 11.0, 6.0 Hz, 1H, H-17a, splitting due to slow rotation), 2.43 (ddd, J = 16.0, 11.0, 6.0 Hz, 1H, H-17b, splitting due to slow rotation), 2.13-2.20 (m, 1H, H-2), 1.94-2.02 (m, 1H, H-5), 1.84-1.88 (m, 1H, H-12a), 1.62-1.74 (m, 6H, H-7a, H-9a, 2H-10, 2H-18), 1.38-1.54 (m, 4H, H-3a, H-6a, H-7b, H-9b), 1.26-1.34 (m, 1H, H-6b), 1.20-1.22 (m, 1H, H-12b), 1.07-1.16 (m, 2H, H-3b, H-11a), 1.03 (s, 3H, CH₃-13), 0.98-0.99 (m, 1H, H-11b), 0.97 (s, 3H, CH₃-14), 0.89 (t, J = 7.0 Hz, 3H, CH₃-19), 0.86 (s, 3H, CH₃-15); ¹³C NMR δ 57.5 (C-1), 46.0 (CH₂-12), 44.2 (CH-5), 39.8 (CH₂-17), 38.2 (CH-2), 37.5 (CH₂-3), 37.4 (CH₂-7), 35.2 (C-8), 34.5 (C-4), 34.4 (CH₂-9), 34.2 (CH₃-15), 32.7 (CH₂-11), 30.2 (CH₃-13), 23.3 (CH₂-6), 22.3 (CH₂-18), 20.7
(CH₃-14), 20.2 (CH₂-10), 12.0 (CH₃-19); FT-IR 𝜈_{max} (neat) 2921, 2863, 1559, 1457, 1397, 1288, 1222, 1121, 1020, 964, 752 cm⁻¹; HRMS (ESI): found 264.2688, [M+H]+, C₁₈H₃₄N required 264.2691, [M+H]+.

(1R,2S,5R,8R)-N-butyl-4,4,8-trimethyl-tricyclo[6.3.1.0²,5]dodecan-1-amine (10c): Yield (0.06 g, 50 %) as a viscous liquid; Rf (7:3 diethyl ether/hexane) 0.50; [𝛼]_{23}^{20} 589 0º (c 1.0, CHCl₃);

¹H NMR δ 2.88 (ddd, J = 16.5, 11.5, 6.5 Hz, 1H, H-17a, due to slow rotation), 2.59 (ddd, J = 16.5, 11.5, 6.5 Hz, 1H, H-17b, due to slow rotation), 2.24 (ddd, J = 12.5, 8.0, 5.0 Hz, 1H, H-2), 1.70-1.76 (m, 2H, H-10a, H-11a), 1.57-1.66 (m, 1H, H-11b), 1.48-1.54 (m, 3H, H-3a, H-6a, H-12b), 1.40-1.46 (m, 1H, H-9a), 1.28-1.38 (m, 2H, H-6b, H-10b), 1.16-1.22 (m, 2H, H-3b, H-9b), 1.10 (s, 3H, CH₃-14), 0.99 (s, 3H, CH₃-13), 0.92 (s, 3H, CH₃-15), 0.92 (t, J = 8.0 Hz, 3H, CH₃-20); ¹³C NMR δ 60.8 (C-1), 46.0 (CH-5), 44.1 (CH₂-12), 42.3 (CH₂-17), 39.3 (CH-2), 38.4 (CH₂-3), 37.6 (CH₂-7), 36.8 (CH₂-9), 35.4 (C-8), 34.5 (C-4), 34.3 (CH₃-15), 32.9 (CH₂-11), 28.5 (CH₂-18), 23.4 (CH₂-19), 20.5 (CH₂-6), 19.8 (CH₃-13), 18.5 (CH₂-10), 13.6 (CH₂-21); FT-IR 𝜈_{max} (neat) 2949, 2925, 2865, 2728, 1583, 1458, 1379, 1363, 1264, 1121, 1093, 1001, 897, 797, 735 cm⁻¹; HRMS (ESI): found 278.2835, [M+H]+, C₁₉H₃₆N required 278.2848, [M+H]+.

(1R,2S,5R,8R)-4,4,8-trimethyl-N-pentyl-tricyclo[6.3.1.0²,5]dodecan-1-amine (10d): Yield (0.10 g, 79 %) as a viscous liquid; Rf (1:1 diethyl ether/hexane) 0.53; [𝛼]_{23}^{20} 589 2.0º (c 1.0, CHCl₃);

¹H NMR δ 5.65 (br s, 1H, NH), 2.64 (ddd, J = 16.5, 11.0, 9.0 Hz, 1H, H-17a, splitting due to slow rotation), 2.41 (ddd, J = 16.5, 11.0, 9.0 Hz, 1H, H-17b, splitting due to slow rotation), 2.18 (ddd, J = 12.0, 8.0, 5.5 Hz, 1H, H-2), 1.86-1.96 (m, 1H, H-5), 1.67-1.80 (m, 6H, 2H-10, H-11a, H-12a, 2H-9),1.65 (dd, J = 12.0, 3.0 Hz, 1H, H-11b), 1.06-1.62 (m, 11H, H-3a, 2H-7, H-11b, H-12b, 2H-18, 2H-19, 2H-20), 0.87 (s, 3H, CH₃-14), 0.99 (s, 3H, CH₃-13), 0.92 (t, J = 7.0 Hz, 3H, CH₃-21), 0.87 (s, 3H, CH₃-15); ¹³C NMR δ 47.3 (C-1), 46.1 (CH-5), 42.6 (CH₂-12), 40.0 (CH₂-17), 37.9 (CH-2), 37.2 (CH₂-3), 35.4 (CH₂-7), 34.5 (CH₂-9), 34.3 (CH₂-11), 30.5 (C-8), 30.0 (C-4), 23.1 (CH₃-15), 22.8 (CH₃-14), 22.7 (CH₂-18,19 and 20), 20.8 (CH₃-13 and CH₂-6), 20.4 (CH₂-10), 14.3 (CH₃-21); FT-IR 𝜈_{max} (neat) 2949, 2925, 2865, 2728, 1583, 1458, 1379, 1363, 1264, 1121, 1093, 1001, 897, 797, 735 cm⁻¹; HRMS (ESI): found 292.3008 [M+H]+, C₂₀H₃₈N required 292.3004, [M+H]+.

General Procedure for the Reductive Alkylation of Amine 8: Amine 8 (0.10 g, 0.45 mmol) was dissolved in DCM (5 mL) and placed in a round bottom flask fitted with a drying tube, aldehyde (5 mol eqv.), and NaBH(OAc)₃ (10 mol eqv.) was added slowly. The pH of the reaction mixture was adjusted to pH = 4 via the addition of acetic acid. The mixture was stirred overnight at room temperature. The reaction was quenched with saturated NaHCO₃ (20 mL), extracted with CHCl₃ (20 mL x 2), and washed with saturated NaCl (20 mL). The organic layer was dried with Na₂CO₃ and solvent was removed under reduced pressure. The product was purified by column chromatography to yield the amine product.
1S,2S,5S,8S)-N,N,N,4,4,8-pentamethyltricyclo[6.3.1.01,5]dodecan-2-amine (11a): Yield (0.10 g, 91 %) as a viscous liquid; Rf (1:1 diethyl ether/hexane) 0.56; [α]_{23}^{D} +17.3º (c 1.0, CHCl₃); ¹H NMR δ 2.31 (br s, 6H, CH₃-17, CH₃-18), 2.20 (br m, J = 12.0, 6.0 Hz, 1H, H-2), 1.46-1.58 (m, 4H, 2H-3, 2H-10), 1.16-1.40 (m, 10H, H-5, 2H-6, 2H-7, H-9a, 2H-11, 2H-12), 0.96-0.99 (m, 3H, CH₃-15), 0.88 (s, 3H, CH₃-13), 0.84 (s, 3H, CH₃-14); ¹³C NMR δ 76.4 (CH-2), 52.6 (CH-5), 46.6 (2CH₃-17 and 18), 45.1 (CH₂-3), 44.9 (CH₂-12), 44.4 (C-1), 41.2 (C-4), 37.2 (CH₂-9), 33.3 (CH₂-13), 33.0 (CH₂-11), 32.7 (CH₂-7), 31.3 (CH₃-15), 30.5 (C-8), 25.4 (CH₃-14), 20.8 (CH₂-10), 18.9 (CH₂-6); FT-IR vₘₐₓ (neat) 2942, 2922, 2861, 2813, 2764, 1457, 1364, 1278, 1247, 1163, 1037, 966, 876, 778 cm⁻¹; HRMS (ESI): found 250.2543, [M+H]^+; C₁₇H₃₂N required 250.2535, [M+H]^+.

1S,2S,5S,8S)-N,N-dibutyl-4,4,8-trimethyl-tricyclo[6.3.1.01,5]dodecan-2-amine (11b): Yield (0.09 g, 57 %) as a viscous liquid; Rf (1:1 diethyl ether/hexane) 0.66; [α]_{23}^{D} +13.9º (c 1.0, CHCl₃); ¹H NMR δ 2.59 (dd, J = 13.0, 5.5 Hz, 1H, H-2), 2.46-2.53 (m, 2H, 2H-17/18), 2.34-2.30 (m, 2H, 2H-17/18), 1.46-1.52 (m, 3H, 2H-10, H-12a), 1.12-1.42 (m, 17H, H-5, 2H-6, 2H-7, H-9a, 2H-11, 2H-12b, 2H-19, 2H-20, 2H-21, 2H-22), 1.14-1.17 (m, 2H, 2H-3), 1.02 (s, 3H, CH₃-14), 0.93-1.00 (m, 1H, H-9b), 0.93 (s, 3H, CH₃-23, CH₃-24), 0.86 (s, 3H, CH₃-13), 0.83 (s, 3H, CH₃-15); ¹³C NMR δ 71.3 (CH-2), 55.2 (2CH₂-17 and 18), 51.3 (CH-5), 45.3 (C-1), 44.7 (CH₂-3), 41.1 (CH₂-12), 41.0 (CH₂-9), 37.1 (C-4), 33.4 (CH₂-11), 33.37 (CH₂-7), 33.3 (CH₃-15), 31.8 (CH₂-13), 30.4 (2CH₂-19 and 20), 30.3 (C-8), 25.3 (CH₃-15), 20.8 (CH₂-10), 18.9 (CH₂-6); FT-IR vₘₐₓ (neat) 2925, 2863, 1653, 1541, 1457, 1364, 1232, 1182, 1076, 1005, 989, 813, 778, 734 cm⁻¹; HRMS (ESI): found 334.3486, [M+H]^+; C₂₃H₄₄N required 334.3474, [M+H]^+.

1S,2S,5S,8S)-N-benzyl-4,4,8-trimethyl-tricyclo[6.3.1.01,5]dodecan-2-amine (11c): Yield (0.09 g, 66 %) as a viscous liquid; Rf (1:1 diethyl ether/hexane) 0.66; [α]_{23}^{D} +32.4º (c 1.0, CHCl₃); ¹H NMR δ 7.40 (d, J = 7.5 Hz, 2H, 2H-19), 7.33 (t, J = 7.5 Hz, 2H, 2H-20), 7.28 (t, J = 7.5 Hz, 1H, H-21), 3.98 (d, J = 13.0 Hz, 1H, H-17a), 3.84 (d, J = 13.0 Hz, 1H, H-17b), 2.76 (dd, J = 12.0, 5.5 Hz, 1H, H-2), 1.70 (dd, J = 12.0, 5.5 Hz, 1H, H-3a), 1.43-1.60 (m, 3H, H-3b, 2H-10), 1.30-1.40 (m, 5H, H-5, H-6a, 2H-7, H-11a), 1.10-1.30 (m, 5H, H-6b, H-9a, H-11b, 2H-12), 1.02 (s, 3H, CH₃-15), 0.96-1.00 (m, 1H, H-9b), 0.87 (s, CH₃-13), 0.77 (s, CH₃-14); ¹³C NMR δ 128.8 (2CH-19), 128.7 (2CH-20 and CH-21), 127.6 (C-18), 77.4 (C-2), 53.1 (CH-5), 51.9 (CH₂-17), 44.0 (CH₂-3), 43.9 (C-1), 43.2 (C-4), 40.9 (CH₂-12), 37.9 (CH₂-9), 33.3 (CH₂-11), 33.1 (CH₃-13), 32.7 (CH₂-7), 31.2 (CH₂-15), 30.4 (C-8), 25.2 (CH₃-14), 20.7 (CH₂-10), 18.9 (CH₂-6); FT-IR vₘₐₓ (neat) 2921, 2861, 1494, 1452, 1381, 1331, 1131, 1064, 1026, 967, 746, 696 cm⁻¹; HRMS (ESI): found 312.2681, [M+H]^+; C₂₂H₃₄N required 312.2691, [M+H]^+.
**General reagents for cell culture:** Penicillin and Streptomycin, Trypsin and fetal bovine serum were purchased from Thermo Fisher Scientific (Scoresby, Vic, Australia). Dulbecco’s Modified Eagle’s Medium (DMEM), phosphate-buffered saline (PBS) and DMSO were purchased from Sigma-Aldrich (Castle Hill, NSW, Australia). The CellTiter 96® AQueous One Solution Reagent was purchased from Promega (Alexandria, NSW, Australia). Human MDA-MB-231 breast cancer cells were obtained as a gift from Prof. Michael Murray (University of Sydney), who purchased them from American Type Culture Collection (ATCC). Cells were grown at 37°C in a humidified atmosphere of 5% CO₂ in DMEM supplemented with 10 % fetal bovine serum and 1% Penicillin/Streptomycin. Confluent cells (80 – 90%) were harvested using trypsin/EDTA after washing with PBS.

**Cell Viability Assays:** For the MTS assay, cells were seeded in 96-well flat-bottom plates at a density of 7 x 10³ cells/well. Serum was removed after 24 hours, after which cells were treated with various concentrations of drug candidates (1 – 50 µM) in DMSO (maximum concentration 0.1%) for 48 hours; control cells received solvent alone. MTS activity was determined spectrophotometrically. The absorbance of all wells was determined by measuring optical density at 550 nm after 4 hours incubation at 37°C. Each compound was tested in triplicates of triplicates for each concentration.

**Flow Cytometry Assays:** Cell cycle distribution was evaluated in MDA-MB-231 cells that were seeded in 6-well flat-bottom plates at a density of 5 x 10⁵ cells/well. Serum was removed after 24 hours, after which the cells were treated with 3c (10 µM) or 6b (9 µM) for 24 hours. Treated cells were fixed overnight at 0°C in 80% ethanol, centrifuged at 500 g for 10 minutes at 4 °C and 0.1 M PBS containing 0.1 NP40 and 0.1 mg/mL RNAse A was added. After staining with PI (50 µg/mL), cells were incubated for 30 minutes and subjected to flow cytometry (BD LSRFortessa X-20).

**Apoptosis/Necrosis:** Annexin-V-FITC/PI staining was evaluated in MDA-MB-231 cells that were seeded in 6-well plates at a density of 1 x 10⁵ cells/well. 24 hours after serum removal the cells were then treated with 3c (20 µM) or 6b (20 µM) for 48 hours. Treated cells were trypsinised and washed twice with cold PBS. The cells were then resuspended in binding buffer (0.1 mL) and transferred to 96 well plates. Annexin V-FITC reagent (Beckman Coulter Australia) and PI (50 µg/mL) were added. The cells were subjected to flow cytometry, as described above.

**Cytotoxicity against VERO cells:** Cytotoxicity of Compounds 3c and 6b against VERO cells (African Green Monkey kidney cell lines) was determined externally by Bioassay Laboratory,
Briefly, VERO cells were treated with test compounds at a single concentration of 50 µl/ml in media/DMSO (final DMSO concentration 0.5%) for 72 h; control cells were treated with 0.5% DMSO alone. Cell viability was assessed using the resazurin assay and was reported as a percentage of control.

**Statistical Analysis:** All measurements were performed at least in triplicates unless otherwise stated. Data from multiple treatments were analysed by one-way ANOVA in combination with Fisher’s Protected Least Significant Difference test.
$^1$H NMR of N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0^{2,5}]dodecanyl]acetamide (2a)
13C NMR spectrum for 2a
$^1$H NMR of N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0$_{2,5}$]dodecanyl]propanamide (2b)
$^{13}$C NMR spectrum for 2b
$^1$H NMR 2-chloro-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0$^{2,5}$]dodecanyl]acetamide (2c)
$^{13}$C NMR spectrum for 2c
$^1$H NMR of N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0^{2,5}]dodecanyl]benzamide (2d)
$^{13}$C NMR spectrum for 2d
\(^1\text{H NMR of N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0^{2,5}]dodecanyl]pentanamide (2e)}\)
$^{13}$C NMR spectrum for 2e
$^1$H NMR of 5-chloro-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0$^{2,5}$]dodecanyl]pentanamide (2f)

compound 2f is contaminated with Cl($\text{CH}_2$)$_2$CONH$_2$, signal at 3.59 (t) and 2.35 (t)
$^{13}$C NMR spectrum for 2f
$^1$H NMR of 3-chloro-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0$^{2,5}$]dodecanyl]propanamide (2g)
$^1$H NMR of 2-amino-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0^{2,5}]dodecanyl]acetamide (2h)
$^{13}$C NMR spectrum for 2h
$^1$H NMR of S-methyl-N-[(1R,2S,5R,8R)-4,4,8-trimethyl-1-tricyclo[6.3.1.0^2,5]dodecanyl]carbamothioate (2i)
$^{13}$C NMR spectrum for $2i$
$^1$H NMR of N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-tricyclo[6.3.1.0^{1,5}]dodecanyl]acetamide (3a)
$^{13}$C NMR spectrum for $3a$
$^1$H NMR of N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-tricyclo[6.3.1.0$^{1,5}$]dodecanyl]propanamide (3b)
\[ 13\text{C NMR spectrum for 3b} \]
$^1$H NMR of 2-chloro-N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-tricyclo[6.3.1.01,5]dodecanyl]acetamide (3c)
\(^1\)H NMR of N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-tricyclo[6.3.1.0\(1,5\)]dodecanyl]benzamide (3d)
$^{13}$C NMR spectrum for 3d
$^1$H NMR of N-[(1S,2S,5S,8S)-9-hydroxy-4,4,8-trimethyl-2-tricyclo[6.3.1.0$_{1,5}$]dodecanyl]acetamide (5a)
$^{13}$C NMR spectrum for 5a
$^1$H NMR of N-[(1S,2S,5S,8S)-2-acetamido-4,4,8-trimethyl-9-tricyclo[6.3.1.0$^{1,5}$]dodecanyl]acetamide (6a)
$^{13}$C NMR spectrum for 6a
$^1$H NMR of 2-chloro-N-[(1S,2S,5S,8S)-2-[(2-chloroacetyl)amino]-4,4,8-trimethyl-9-tricyclo[6.3.1.0$^{1,5}$]dodecanyl]acetamide (6b)
$^{13}$C NMR spectrum for 6b
$^1$H NMR of N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-(pentanoylamino)-9-tricyclo[6.3.1.0^{1,5}]dodecanyl]pentanamide (6c)
$^{13}$C NMR spectrum for 6c
$^1$H NMR of N-[(1S,2S,5S,8S)-2-benzamido-4,4,8-trimethyl-9-tricyclo[6.3.1.0$^{1}$,5]dodecanyl]benzamide (6d)
$^{13}$C NMR spectrum for 6d
$^1$H NMR of N-[(1S,2S,5S,8S)-4,4,8-trimethyl-2-(propanoylamino)-9-tricyclo[6.3.1.0^{1,5}]dodecanyl]propanamide (6e)
$^{13}$C NMR spectrum for 6e
$^1$H NMR of (1R,2S,5R,8R)-4,4,8-trimethyltricyclo[6.3.1.0$^{2,5}$]dodecan-1-amine (7)
$^{13}$C NMR spectrum for 7
1H NMR of (1S,2S,5S,8S)-4,4,8-trimethyltricyclo[6.3.1.01,5]dodecan-2-amine (8)
$^1$H NMR of (1S,2S,5S,8S,9R)-4,4,8-trimethyltricyclo[6.3.1.01,5]dodecan-2,9-diamine (9)
$^{13}$C NMR spectrum for 9
^{1}H NMR of (1R,2S,5R,8R)-N,N,4,4,8-pentamethyltricyclo[6.3.1.0^{2,5}]dodecan-1-amine (10a)
$^{13}$C NMR spectrum for 10a
$^1$H NMR of ((1R,2S,5R,8R)-4,4,8-trimethyl-N-propyl-tricyclo[6.3.1.0$^2_2,5$]dodecan-1-amine (10b)
$^13$C NMR spectrum for 10b
\(^1\text{H NMR of}\) \((1R,2S,5R,8R)\text{-N-butyl-4,4,8-trimethyl-tricyclo[6.3.1.0^{2,5}]dodecan-1-amine} \,(10c)\)
13C NMR spectrum for 10c
$^1$H NMR of ((1R,2S,5R,8R)-4,4,8-trimethyl-N-pentyl-tricyclo[6.3.1.0$^{2,5}]$dodecan-1-amine (10d)
$^{13}$C NMR spectrum for 10d
\(^1\text{H NMR of} ((1S,2S,5S,8S)-N,N,4,4,8-pentamethyltricyclo[6.3.1.0^{1,5}]dodecan-2-amine (11a)
$^{13}$C NMR spectrum for 11a
$^1$H NMR of (1S,2S,5S,8S)-N,N-dibutyl-4,4,8-trimethyl-tricyclo[6.3.1.0¹,5]dodecan-2-amine (11b)
$^{1}$H NMR of (1S,2S,5S,8S)-N-benzyl-4,4,8-trimethyl-tricyclo[6.3.1.0$^1$5]dodecan-2-amine (11c)
$^{13}$C NMR spectrum for 11c