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Design of potent Mincle signalling agonists based on an alkyl β-glucoside template

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Contents

Experimental

General

Pyridine was distilled over KOH before use. Dichloromethane and THF were dried over alumina according to the method of Pangborn *et al*.[1] Reactions were monitored using TLC, performed with silica gel 60 F_{254}. Detection was effected by charring in a mixture of 5% sulfuric acid in methanol, 10% phosphomolybdic acid in EtOH, and/or visualizing with UV light. Flash chromatography was performed according to the method of Still et al.[2] using silica gel 60. $[\alpha]_D$ values are given in deg 10^{-1} cm^2 g^{-1}. NMR experiments were conducted on 400, 500 or 600 MHz instruments, with chemical shifts referenced relative to residual protiated solvent and are in ppm. $^1H-^1H$ COSY spectra were used to confirm proton assignments and HMQC and HMBC spectra used for carbon assignments. Mass spectra were acquired in the ESI-QTOF mode.

Ethyl 2-(cholesteryloxy)-ethanoate (12)

Boron trifluoride etherate (31 μL, 0.25 mmol) was added to a cold solution of cholesterol (1.00 g, 2.59 mmol) and ethyl diazoacetate (2.42 mL, 2.85 mmol) in dry CH_2Cl_2 (10 mL). The solution was stirred overnight at 20 °C and then poured into saturated aqueous $NaHCO_3$ (30 mL), and the product was extracted with CH_2Cl_2 (225 mL). The organic phase was dried (Na_2SO_4) and concentrated under reduced pressure. The crude product was purified by flash chromatography (ethyl acetate/petroleum ether) afforded **12** as an amorphous solid (760 mg, 62%). ^1H NMR (400 MHz, $CDCl_3$) δ 1.28 (3 H, t), 0.65–2.41 (43 H, m), 4.11 (2 H, s), 3.24 (1 H, m), 4.21 (2 H, q, *J* 7.2 Hz), 5.35 (1 H, m); ^{13}C NMR (100 MHz , $CDCl_3$) δ 11.9, 14.2, 18.7, 19.3, 21.1, 22.6, 22.8, 23.8, 24.3, 28.0, 28.1, 28.2, 31.9, 31.9, 35.8, 36.2, 36.8, 37.1, 38.7, 39.5, 39.8, 42.3, 50.2, 56.1, 56.8, 60.8, 65.8, 80.0, 121.9, 140.5, 170.9.

2-(Cholesteryloxy)-ethanoic acid (13)

Aqueous sodium hydroxide (2 M, 320 μl) was added to **12** (200 mg, 0.42 mmol) in ethanol (2.5 ml) and stirred at rt overnight. The solution was neutralized with Dowex 50WX8-200, then filtered and the filtrate concentrated under reduced pressure to give **13** as a glass that was used without further purification. ^1H NMR (400 MHz, $CDCl_3$) δ 0.62–2.43 (44 H, m), 3.31 (1 H, m), 4.14 (2 H, s), 5.37 (1 H, m); ^{13}C NMR (100 MHz, $CDCl_3$) δ 11.8, 18.7, 19.3, 21.1, 22.5, 22.8, 23.8, 24.3, 28.0, 28.1, 28.2, 31.8, 31.9, 35.8, 36.2, 36.7, 36.9, 38.7, 39.5, 39.7, 42.3, 50.1, 56.1, 56.7, 65.2, 80.5, 122.5, 139.8.

General procedure for the synthesis of 6-*O*-acyl-β-D-glucosides:

Carboxylic acid (1.2 equiv.) was added to a suspension of HBTU (1.2 equiv.) in pyridine (approx. 10 mL/mmol) and the mixture was stirred for 20-30 min before addition of the glycoside (1 equiv.). The

solution was stirred for 2-3 d and then concentrated. Flash chromatography of the residue (pet. spirits/EtOAc/MeOH) afforded the 6-*O*-acyl-β-D-glucoside.

Octyl 6-*O*-octanoyl-β-D-glucoside (3)

Octyl β-D-glucoside (50 mg, 0.171 mmol) and octanoic acid (32 μL, 0.205 mmol) according to the General procedure afforded **3** as a colourless glass (44 mg, 61%). $[\alpha]_D^{25}$ -36.5 (c 2.2, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.81 (6 H, t, *J* 6.5 Hz, $CH_2CH_2CH_3$), 1.23 (18 H, m, alkyl), 1.50–1.60 (4 H, m, β-CH_2), 2.27 (3 H, t, *J* 7.6 Hz, CO_2CH_2), 3.19–3.32 (2 H, m, H2,4), 3.35–3.42 (2 H, m, H3,5), 3.43–3.51 (1 H, m, OCH_2CH_2), 3.73–3.84 (1 H, m, OCH_2CH_2), 4.20 (2 H, m, H1,6), 4.27 (0.2 H, s, OH), 4.32 (1 H, m, H6), 4.65 (0:2 H, s, OH), 4.87 (0.2 H, s, OH); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 14.0, 14.0, 22.6, 22.6, 24.9, 25.9, 28.9, 29.1, 29.3, 29.4, 29.6, 31.7, 31.8, 34.2 (alkyl), 63.6 (C6), 70.2 (C4), 70.3 (OCH_2CH_2), 73.4 (C2), 73.8 (C3), 76.3 (C5), 102.7 (C1), 174.4 (CO_2); HRMS (ESI$^+$) calcd for $C_{22}H_{42}O_7$ $[M + H]^+$ 419.3003. Found 419.3005.

Octyl 6-*O*-palmitoyl-β-D-glucoside (4)

Octyl β-D-glucoside (50 mg, 0.171 mmol) and palmitic acid (53 mg, 0.205mol) according to the General procedure afforded **4** as a colourless glass (30 mg, 33%). $[\alpha]_D^{25}$ -33.7 (c 1.5, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.82 (6 H, t, *J* 6.7 Hz, $CH_2CH_2CH_3$), 1.15–1.32 (34 H, m, alkyl), 1.51–1.62 (4 H, m, β-CH_2), 2.28 (2 H, t, *J* 7.6 Hz, CO_2CH_2), 3.20–3.31 (2 H, m, H2,4), 3.36–3.43 (2 H, m, H3,5), 3.46 (1 H, dt, *J* 9.5, 7.0 Hz, OCH_2CH_2), 3.80 (1 H, dt, *J* 9.5, 7.0 Hz, OCH_2CH_2), 4.19 (1 H, d, *J* 7.8 Hz, H1), 4.22 (1 H, dd, *J* 12.1, 6.1 Hz, H6), 4.32 (1 H, dd, *J* 12.1, 2.1 Hz, H6); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 14.07, 14.09, 22.67, 22.70, 24.96, 25.93, 29.18, 29.27, 29.33, 29.38, 29.43, 29.52, 29.64, 29.68, 29.69, 29.72, 31.8, 31.9, 34.2 (alkyl), 63.6 (C6), 70.2 (C4), 70.4 (OCH_2CH_2), 73.5 (C2), 73.9 (C3), 76.3 (C5), 102.8 (C1), 174.5 (CO_2); HRMS (ESI$^+$) calcd for $C_{30}H_{58}O_7$ $[M + H]^+$ 531.4255. Found 531.4260.

Octyl 6-*O*-behenoyl-β-D-glucoside (5)

Octyl β-D-glucoside (50 mg, 0.171 mmol) and behenic acid (70 mg, 0.205 mmol) according to the General procedure afforded **5** as a colourless glass (49 mg, 47%). $[\alpha]_D^{25}$ -29.3 (c 1.6, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.82 (6 H, t, *J* 6.7 Hz, $CH_2CH_2CH_3$), 1.00 –1.32 (46 H, m, alkyl), 1.51–1.61 (4 H, m, β-CH_2), 2.28 (2 H, t, *J* 7.6 Hz, CO_2CH_2), 3.20–3.32 (2 H, m, H2,4), 3.36–3.43 (2 H, m, H3,5), 3.47 (1 H, dt, *J* 7.0, 9.4 Hz, OCH_2CH_2), 3.80 (1 H, dt, *J* 7.0, 9.4 Hz, OCH_2CH_2), 4.19 (1 H, d, *J* 8.0 Hz, H1), 4.17–4.26 (1 H, m, H6), 4.32 (1 H, dd, *J* 2.1, 11.9 Hz, H6); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 14.07, 14.10, 22.67, 22.71, 25.0, 25.9, 29.2, 29.27, 29.34, 29.38, 29.43, 29.5, 29.6, 29.68, 29.71, 29.73, 31.8, 31.9, 34.2 (alkyl), 63.6 (C6), 70.2 (C4), 70.4 (OCH_2CH_2),

73.5 (C2), 73.9 (C3), 76.3 (C5), 102.8 (C1), 174.5 (CO_2); HRMS (ESI^+) calcd for $C_{36}H_{70}O_7$ $[M + H]^+$ 615.9154. Found 615.9156.

Octyl 6-*O*-cholesteryloxyacetyl-β-D-glucoside (14)

Octyl β-D-glucoside (25 mg, 0.086 mmol) and **13** (46 mg, 0.103 mmol) according to the General procedure afforded **14** as a colourless glass (29 mg, 47%). ^1H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.62 (3 H, s), 0.74–1.66 (48 H, m, alkyl, cholesterol), 1.71–2.00 (5 H, m), 2.20 (1 H, m, H4'), 2.33 (1 H, m, H4'), 3.16–3.49 (6 H, m, OCH_2CH_2,H2,3,4,5,3'), 3.79 (1 H, dt, *J* 6.9, 9.5 Hz, OCH_2CH_2), 4.11 (2 H, s, $O{=}CCH_2O$), 4.20 (1 H, d, *J* 7.7 Hz, H1), 4.30 (1 H, dd, *J* 5.5, 11.9 Hz, H6), 4.39 (1 H, dd, *J* 2.2, 11.9 Hz, H6), 5.28–5.32 (1 H, m, HC=H); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 11.8, 14.0, 18.6, 19.2, 21.0, 22.4, 22.6, 22.7, 23.7, 24.2, 25.8, 27.9, 28.0, 28.1, 29.2, 29.4, 29.5, 31.76, 31.79, 31.84, 35.7, 36.1, 36.7, 37.0, 38.5, 39.4, 39.7, 42.2, 50.1, 56.1, 56.7 (alkyl, cholesterol), 63.8 (C6), 65.3 ($O{=}CCH_2O$), 69.9 (C4), 70.3 (OCH_2CH_2), 73.3 (C2), 73.6 (C3), 76.2 (C5), 80.1 (C3'), 102.7 (C1), 122.0 (HC=C), 140.2 (C=CH), 171.2 (CO_2); HRMS (ESI^+) calcd for $C_{43}H_{74}O_8$ $[M + H]^+$ 719.5457. Found 719.5456.

Octyl 6-*O*-(2-hexadecyloctadecanoyl)-β-D-glucoside (9)

Octyl β-D-glucoside (25 mg, 0.086 mmol) and 2-hexadecyloctadecanoic acid (52 mg, 0.103 mmol) according to the General procedure afforded **9** as a colourless glass (11 mg, 15%). ^1H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.82 (9 H, t, *J* 6.8 Hz, $CH_2CH_2CH_3$), 1.14–1.33 (66 H, m, acyl), 1.33–1.45 (2 H, m, β-CH_2), 1.55 (4 H, m, β-CH_2), 2.31 (1 H, tt, *J* 5.4, 8.6 Hz, CO_2CH), 3.19–3.30 (2 H, m, H2,4), 3.35–3.50 (3 H, m, OCH_2CH_2,H3,5), 3.81 (1 H, dt, *J* 6.9, 9.6 Hz, OCH_2CH_2), 4.17 (1 H, dd, *J* 6.6, 11.8 Hz, H6), 4.20 (1 H, d, *J* 7.8 Hz, H1), 4.39 (1 H, dd, *J* 2.0, 11.9 Hz, H6); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 13.97, 13.99, 22.57, 22.60, 25.9, 27.3, 29.2, 29.3, 29.36, 29.43, 29.5, 29.56, 29.58, 29.60, 29.63, 31.75, 31.84, 32.26, 32.28 (alkyl), 45.7 (α-acyl), 63.5 (C6), 70.1 (C4), 70.3 (OCH_2CH_2), 73.4 (C2), 73.9 (C3), 76.2 (C5), 102.6 (C1), 177.1 (CO_2); HRMS (ESI^+) calcd for $C_{48}H_{94}O_7$ $[M + H]^+$ 783.7072. Found 783.7073.

Lauryl 6-*O*-octanoyl-β-D-glucoside (6)

Lauryl β-D-glucoside (50 mg, 0.143 mmol) and octanoic acid (27 μL, 0.172 mmol) according to the General procedure afforded **6** as a colourless glass (38 mg, 56%). $[\alpha]_D^{25}$ -24.9 (c 1.3, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.82 (6 H, t, *J* 6.6 Hz, $CH_2CH_2CH_3$), 1.16 –1.30 (26 H, m, alkyl), 1.51–1.61 (4 H, m, β-CH_2), 2.29 (2 H, t, *J* 7.6 Hz, CO_2CH_2), 3.21–3.31 (2 H, m, H2,4), 3.36–3.43 (2 H, m, H3,5), 3.47 (1 H, dt, *J* 7.0, 9.5 Hz, OCH_2CH_2), 3.80 (1 H, dt, *J* 7.0, 9.5 Hz, OCH_2CH_2), 4.20 (1 H, d, *J* 7.8 Hz, H1), 4.22 (1 H, dd, *J* 6.0, 12.1 Hz, H6), 4.32 (1 H, dd, *J* 2.1, 11.9 Hz, H6); ^{13}C

NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 14.0, 14.1, 22.6, 22.7, 24.9, 25.9, 29.0, 29.1, 29.4, 29.5, 29.63, 29.65, 29.66, 29.70, 31.7, 31.9, 34.2 (alkyl), 63.6 (C6), 70.2 (C4), 70.4 (OCH_2CH_2), 73.5 (C2), 73.9 (C3), 76.3 (C5), 102.8 (C1), 174.5 (CO_2); HRMS (ESI^+) calcd for $C_{26}H_{50}O_7$ $[M + H]^+$ 475.3629. Found 479.3630.

Lauryl 6-*O*-palmitoyl-β-D-glucoside (7)

Lauryl β-D-glucoside (50 mg, 0.143 mmol) and palmitic acid (44 mg, 0.172 mmol) according to the General procedure afforded **7** as a colourless glass (39 mg, 46%). $[\alpha]_D^{25}$ -26.6 (c 1.3, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.82 (6 H, t, *J* 6.7 Hz, $CH_2CH_2CH_3$), 1.13–1.31 (42 H, m, alkyl), 1.50–1.62 (4 H, m, β-CH_2), 2.28 (2 H, t, *J* 7.6 Hz, CO_2CH_2), 3.21–3.31 (2 H, m, H2,4), 3.36–3.43 (2 H, m, H3,5), 3.47 (1 H, dt, *J* 7.1, 9.5 Hz, OCH_2CH_2), 3.80 (1 H, dt, *J* 7.0, 9.5 Hz, OCH_2CH_2), 4.20 (1 H, d, *J* 7.8 Hz, H1), 4.22 (1 H, dd, *J* 6.1, 12.1 Hz, H6), 4.32 (1 H, dd, *J* 2.1, 12.0 Hz, H6); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 14.1, 22.7, 25.0, 25.9, 29.2, 29.3, 29.4, 29.50, 29.52, 29.64, 29.65, 29.67, 29.70, 29.71, 29.71, 29.73, 31.9, 34.2 (alkyl), 63.6 (C6), 70.2 (C4), 70.4 (OCH_2CH_2), 73.5 (C2), 73.9 (C3), 76.3 (C5), 102.8 (C1), 174.5 (CO_2); HRMS (ESI^+) calcd for $C_{34}H_{66}O_7$ $[M + H]^+$ 587.4881. Found 587.4880.

Lauryl 6-*O*-behenoyl-β-D-glucoside (8)

Lauryl β-D-glucoside (50 mg, 0.143 mmol) and behenic acid (59 mg, 0.172 mmol) according to the General procedure afforded **8** as a colourless glass (45 mg, 47%). $[\alpha]_D^{25}$ -24.4 (c 1.5, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.82 (6 H, t, *J* 6.7 Hz, $CH_2CH_2CH_3$), 1.14 –1.31 (54 H, m, alkyl), 1.51–1.62 (4 H, m, β-CH_2), 2.28 (2 H, t, *J* 7.6 Hz, CO_2CH_2), 3.21–3.31 (2 H, m, H2,4), 3.36–3.43 (2 H, m, H3,5), 3.47 (1 H, dt, *J* 7.0, 9.5 Hz, OCH_2CH_2), 3.80 (1 H, dt, *J* 7.0, 9.5 Hz, OCH_2CH_2), 4.20 (1 H, d, *J* 7.7 Hz, H1), 4.22 (1 H, dd, *J* 6.1, 12.1 Hz, H6), 4.32 (1 H, dd, *J* 2.2, 12.0 Hz, H6); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 14.1, 22.7, 25.0, 25.9, 29.2, 29.3, 29.4, 29.50, 29.53, 29.64, 29.65, 29.67, 29.69, 29.71, 29.74, 32.0, 34.2 (alkyl), 63.6 (C6), 70.2 (C4), 70.4 (OCH_2CH_2), 73.5 (C2), 73.9 (C3), 76.3 (C5), 102.8 (C1), 174.5 (CO_2); HRMS (ESI^+) calcd for $C_{40}H_{78}O_7$ $[M + H]^+$ 671.5820. Found 671.5822.

Lauryl 6-*O*-cholesteryloxyacetyl-β-D-glucoside (15)

Lauryl β-D-glucoside (25 mg, 0.072 mmol) and **13** (38 mg, 0:086 mmol) according to the General procedure afforded **15** as a colourless glass (25 mg, 45%). ^1H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.63 (3 H, s), 0.76–1.61 (56 H, m, alkyl, cholesterol), 1.73–2.01 (5 H, m), 2.17–2.26 (1 H, m, H4'), 2.30–2.37 (1 H, m, H4'), 3.17–3.51 (6 H, m, OCH_2CH_2,H2,3,4,5,3'), 3.80 (1 H, dt, *J* 6.9, 9.5 Hz, OCH_2CH_2), 4.12 (2 H, O=CCH_2O), 4.21 (1 H, d, *J* 7.7 Hz, H1), 4.32 (1 H, dd, *J* 5.7, 11.9 Hz, H6),

4.40 (1 H, dd, *J* 2.3, 11.9 Hz, H6), 5.31 (1 H, m, HC=H); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 11.8, 14.0, 18.6, 19.2, 21.0, 22.5, 22.6, 22.7, 23.8, 24.2, 25.9, 27.9, 28.0, 28.2, 29.3, 29.5, 29.57, 29.60, 29.64, 31.8, 31.85, 31.86, 35.7, 36.1, 36.7, 37.0, 38.5, 39.4, 39.7, 42.3, 50.1, 56.1, 56.7 (alkyl, cholesterol), 63.8 (C6), 65.4 (O=CCH_2O), 69.9 (C4), 70.3 (OCH_2CH_2), 73.4 (C2), 73.6 (C3), 76.2 (C5), 80.1 (C3'), 102.7 (C1), 122.0 (HC=C), 140.2 (C=CH), 171.2 (CO_2); HRMS (ESI$^+$) calcd for $C_{47}H_{82}O_8$ $[M + H]^+$ 775.6083. Found 775.6080.

Lauryl 6-*O*-(2-hexadecyloctadecanoyl)-β-D-glucoside (10)

Lauryl β-D-glucoside (25 mg, 0.072 mmol) and 2-hexadecyloctadecanoic acid (44 mg, 0.086 mmol) according to the General procedure afforded **10** as a colourless glass (7 mg, 12%). ^{1}H NMR (400 MHz, $CDCl_3$:CD_3OD 95:5) δ 0.83 (9 H, t, *J* 6.7 Hz), 1.10–1.33 (74 H, m, alkyl), 1.33–1.45 (2 H, m, β-CH_2), 1.48–1.61 (4 H, m, β-CH_2), 2.31 (1 H, tt, *J* 5.5, 8.7 Hz, CO_2CH), 3.21–3.29 (2 H, m, H2,4), 3.37–3.49 (3 H, m, OCH_2CH_2,H3,5), 3.80 (1 H, dt, *J* 6.9, 9.5 Hz, OCH_2CH_2), 4.17 (1 H, dd, *J* 6.7, 11.9 Hz, H6), 4.20 (1 H, d, *J* 7.8 Hz, H1), 4.39 (1 H, dd, *J* 2.1, 12.0 Hz, H6); ^{13}C NMR (100 MHz, $CDCl_3$:CD_3OD 95:5) δ 14.0, 22.6, 25.9, 27.3, 29.3, 29.4, 29.5, 29.58, 29.61, 29.63, 31.8, 32.3 (alkyl), 45.7 (α-acyl), 63.5 (C6), 70.1 (C4), 70.3 (OCH_2CH_2), 73.4 (C2), 73.9 (C3), 76.2 (C5), 102.6 (C1), 177.1 (CO_2); HRMS (ESI$^+$) calcd for $C_{52}H_{102}O_7$ $[M + H]^+$ 839.7698. Found 839.7698.

References

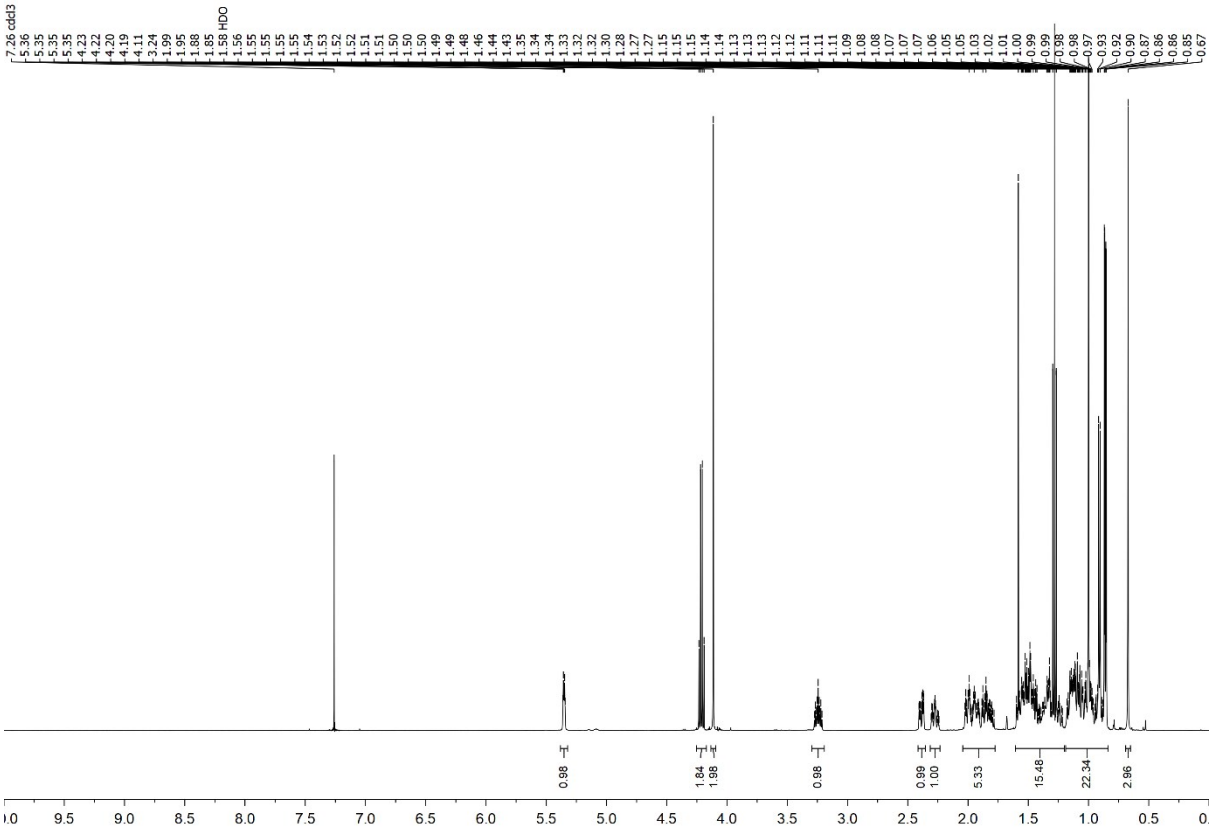
1 A. B. Pangborn, M. A. Giardello, R. H. Grubbs, R. K. Rosen and F. J. Timmers, *Organometallics*, 1996, **15**, 1518.

2 W. C. Still, M. Kahn and A. M. Mitra, *J. Org. Chem.*, 1978, **43**, 2923.

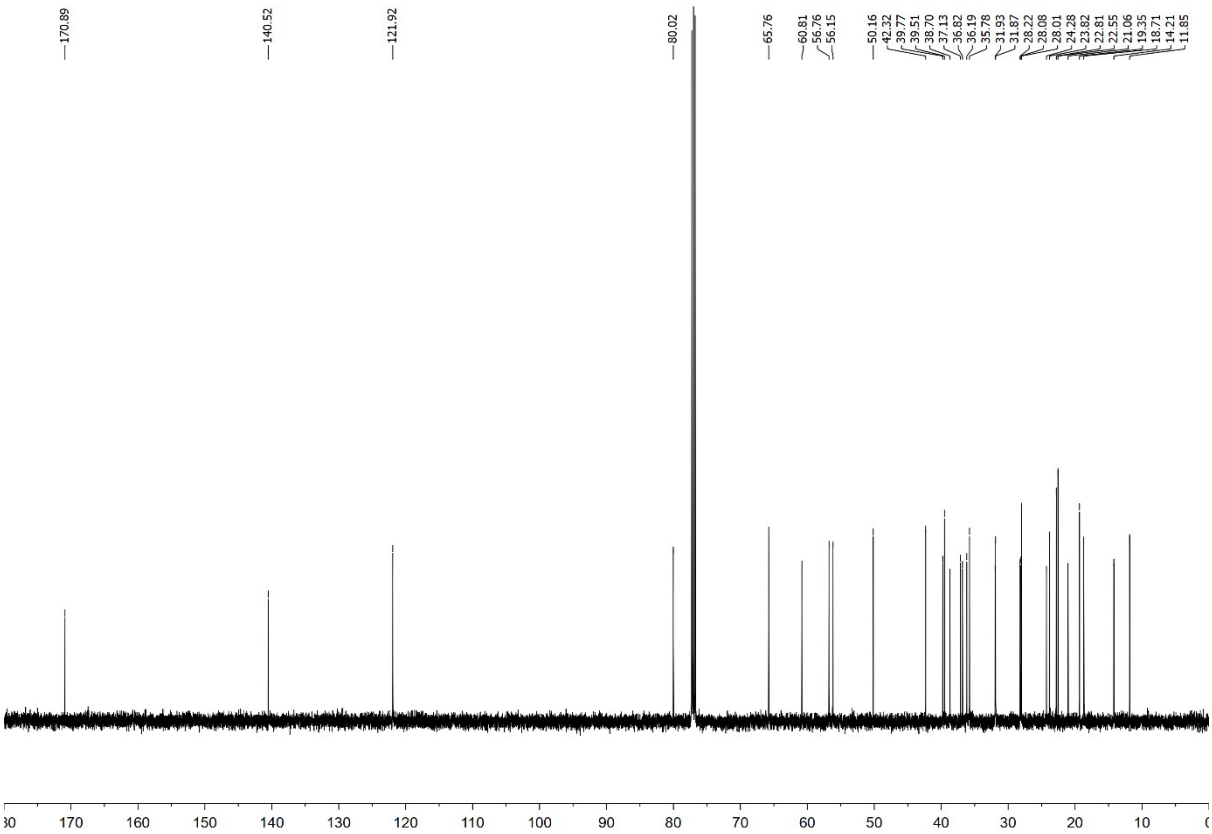
NMR spectra

Ethyl 2-(cholesteryloxy)-ethanoate (12)

^{1}H NMR

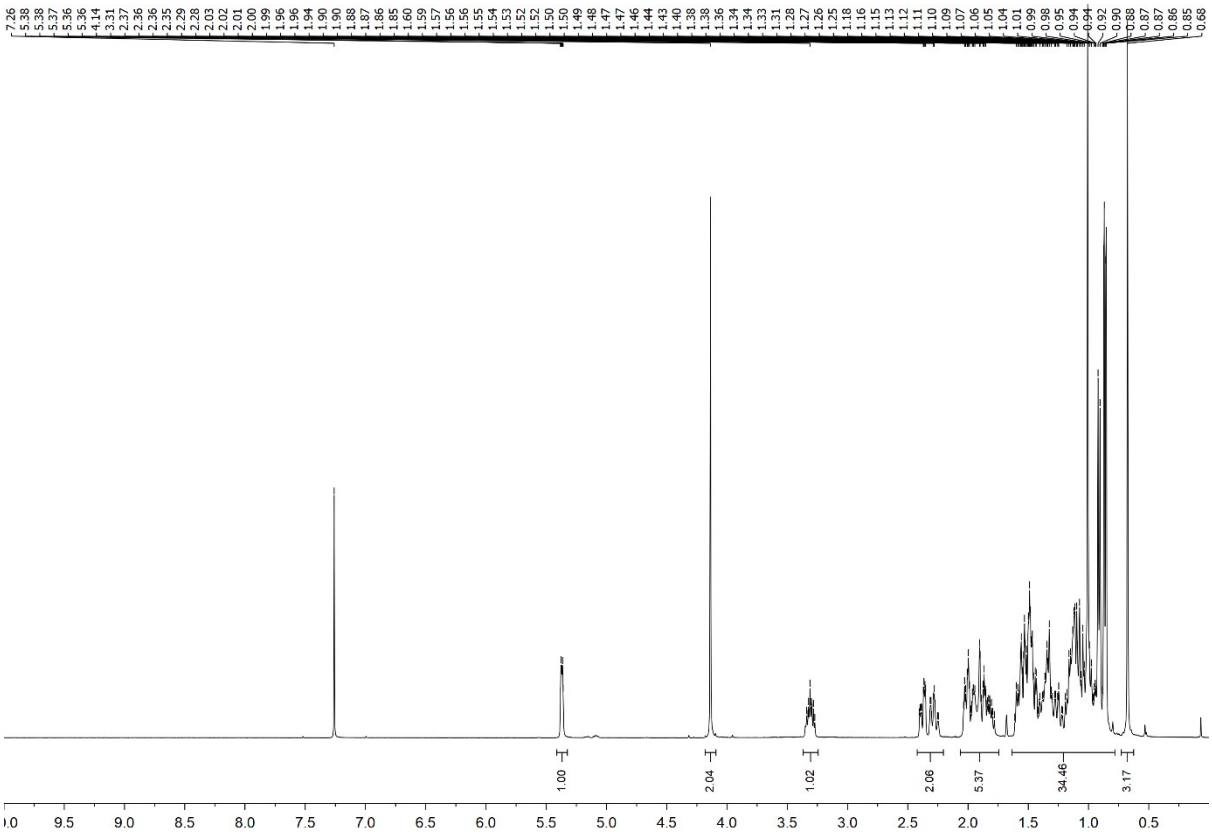


^{13}C NMR



2-(Cholesteryloxy)-ethanoic acid (13)

^{1}H NMR



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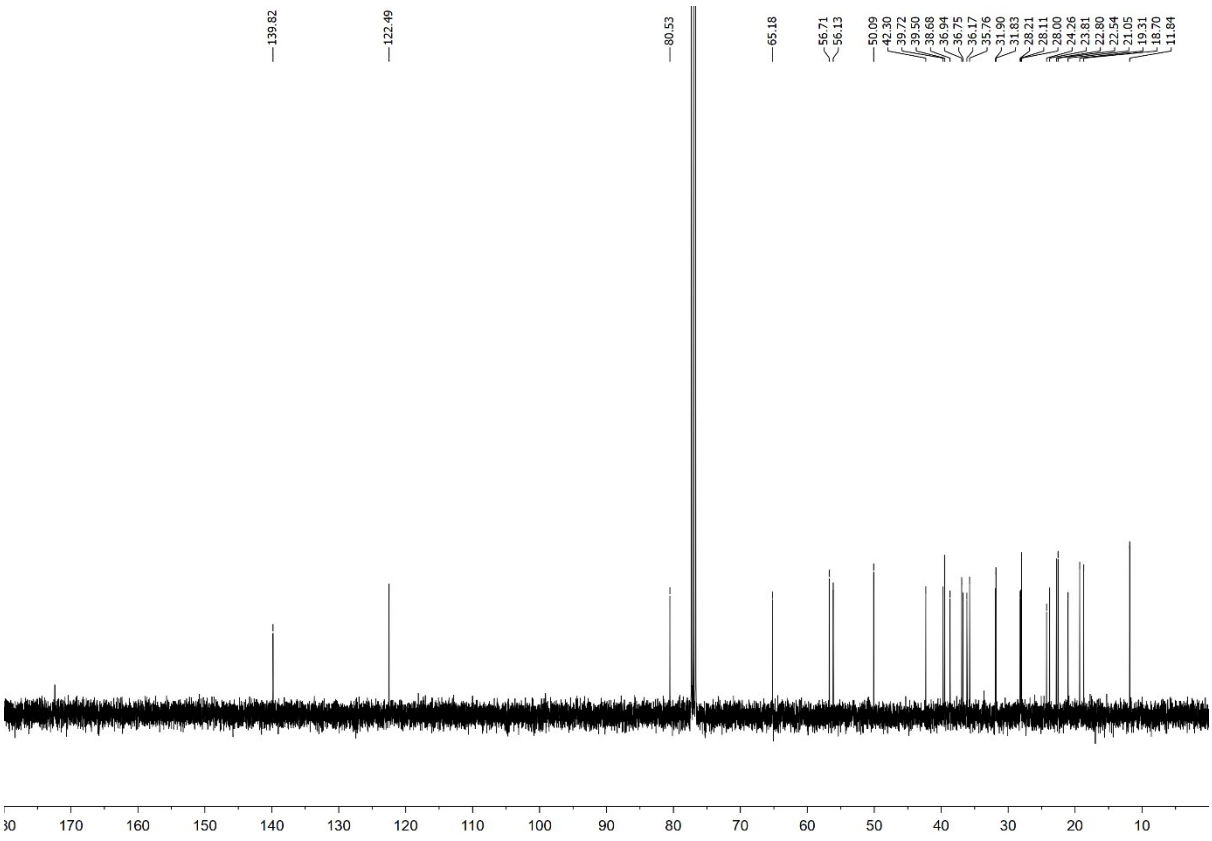
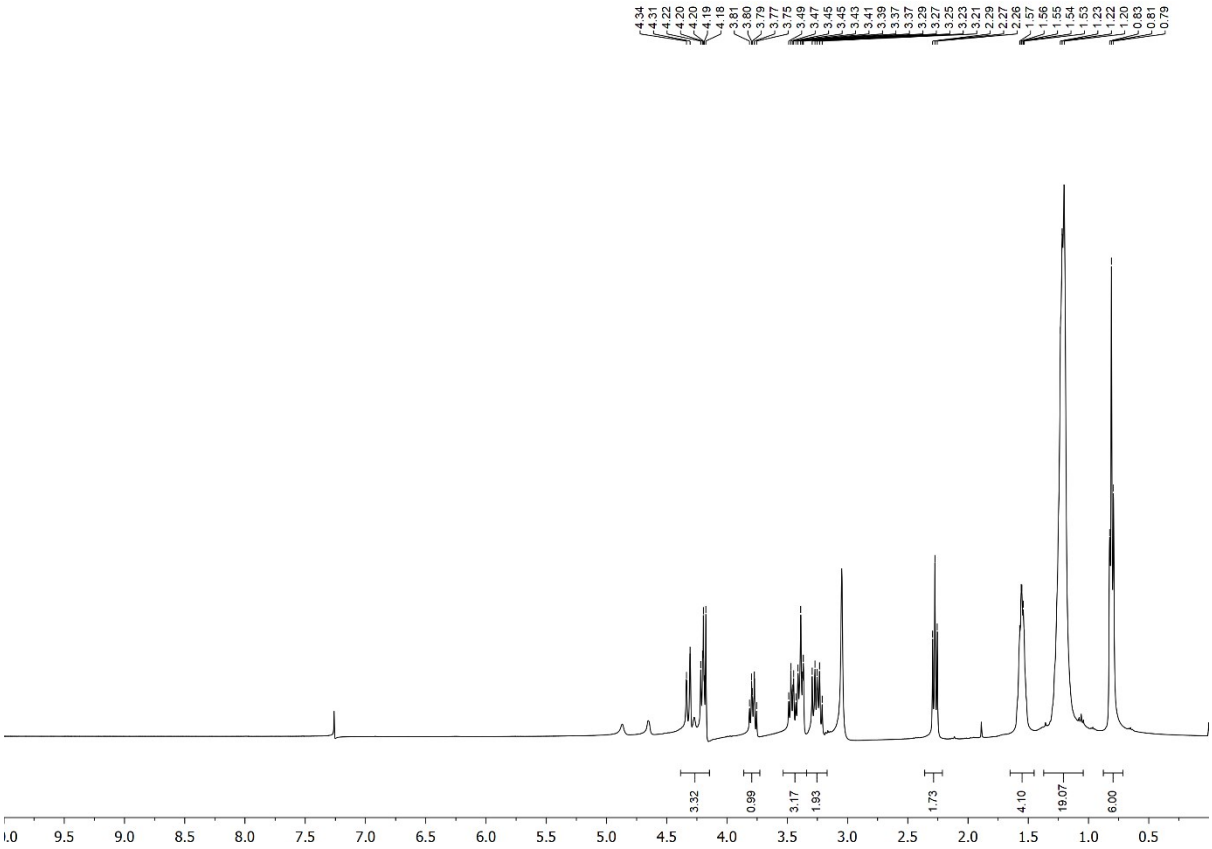
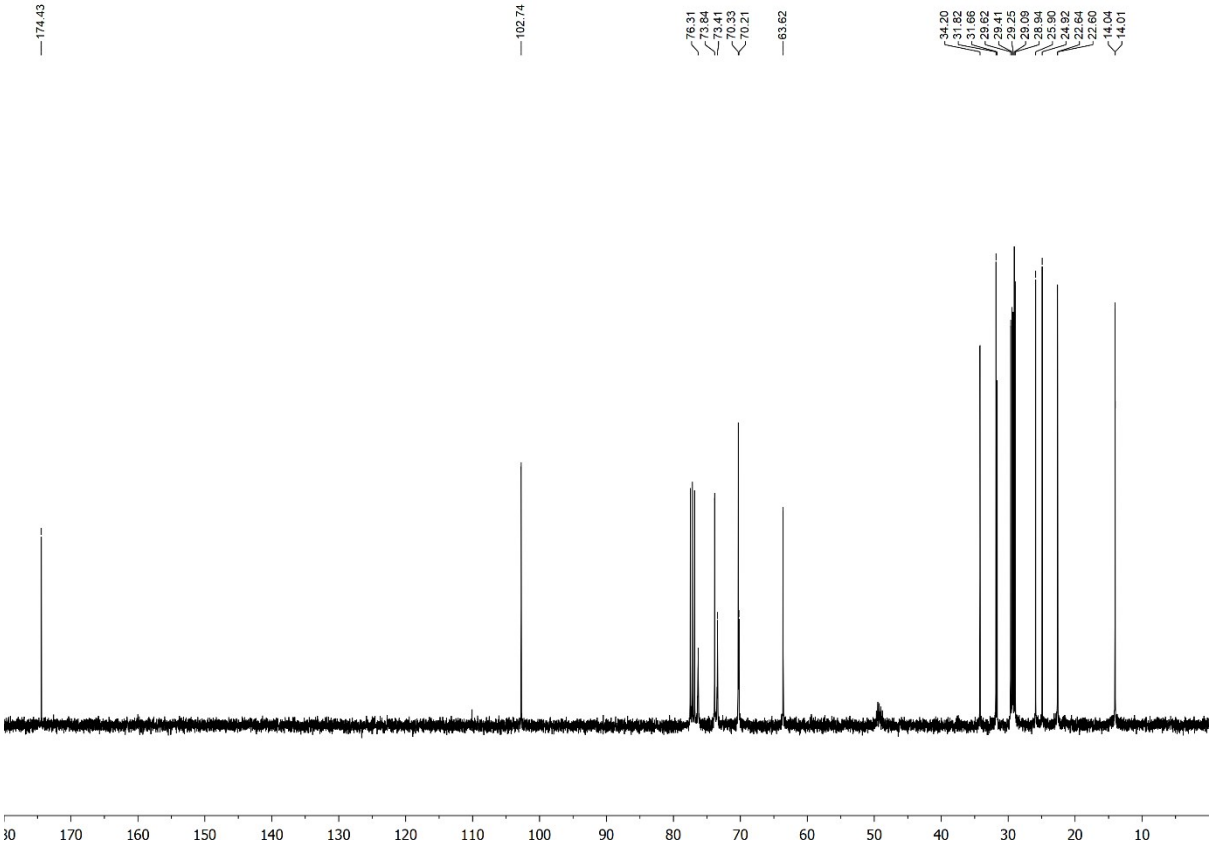


Octyl 6-*O*-octanoyl-β-D-glucoside (3)

^{1}H NMR

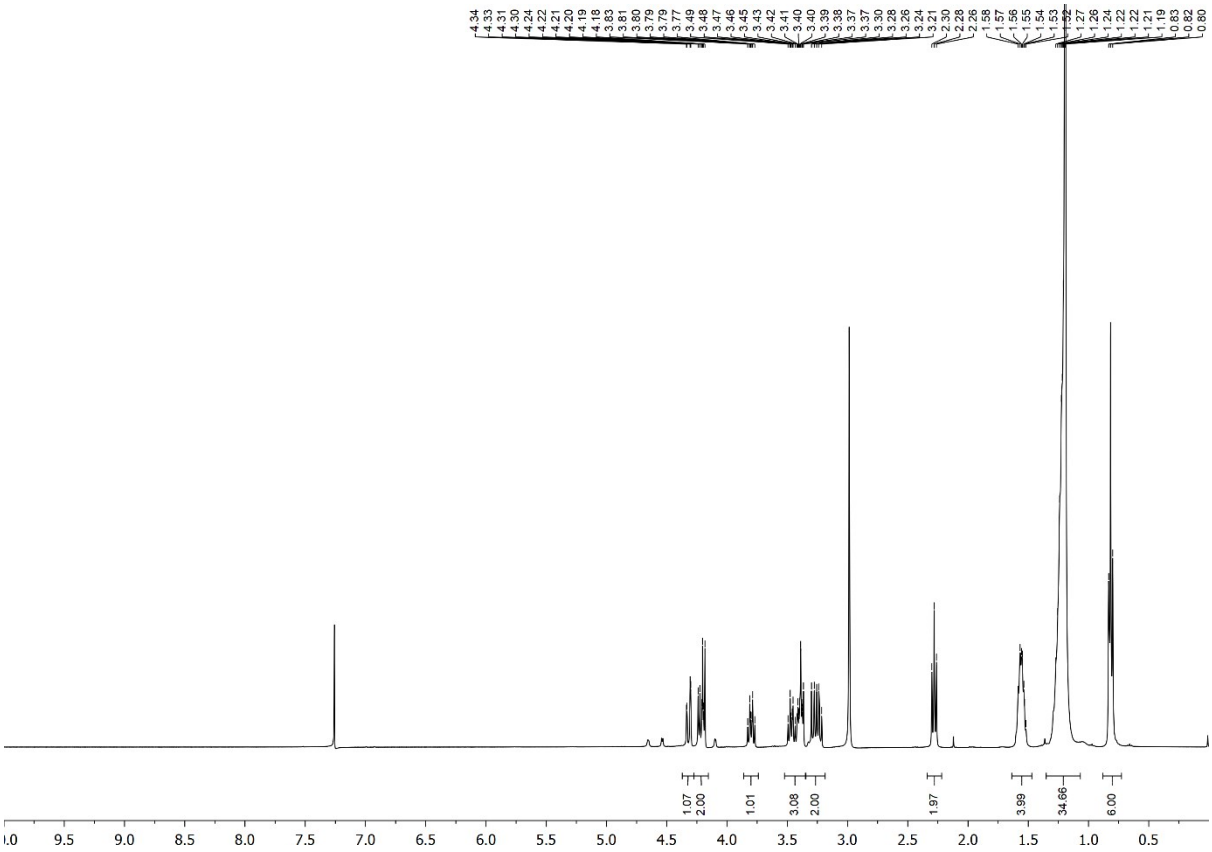


^{13}C NMR

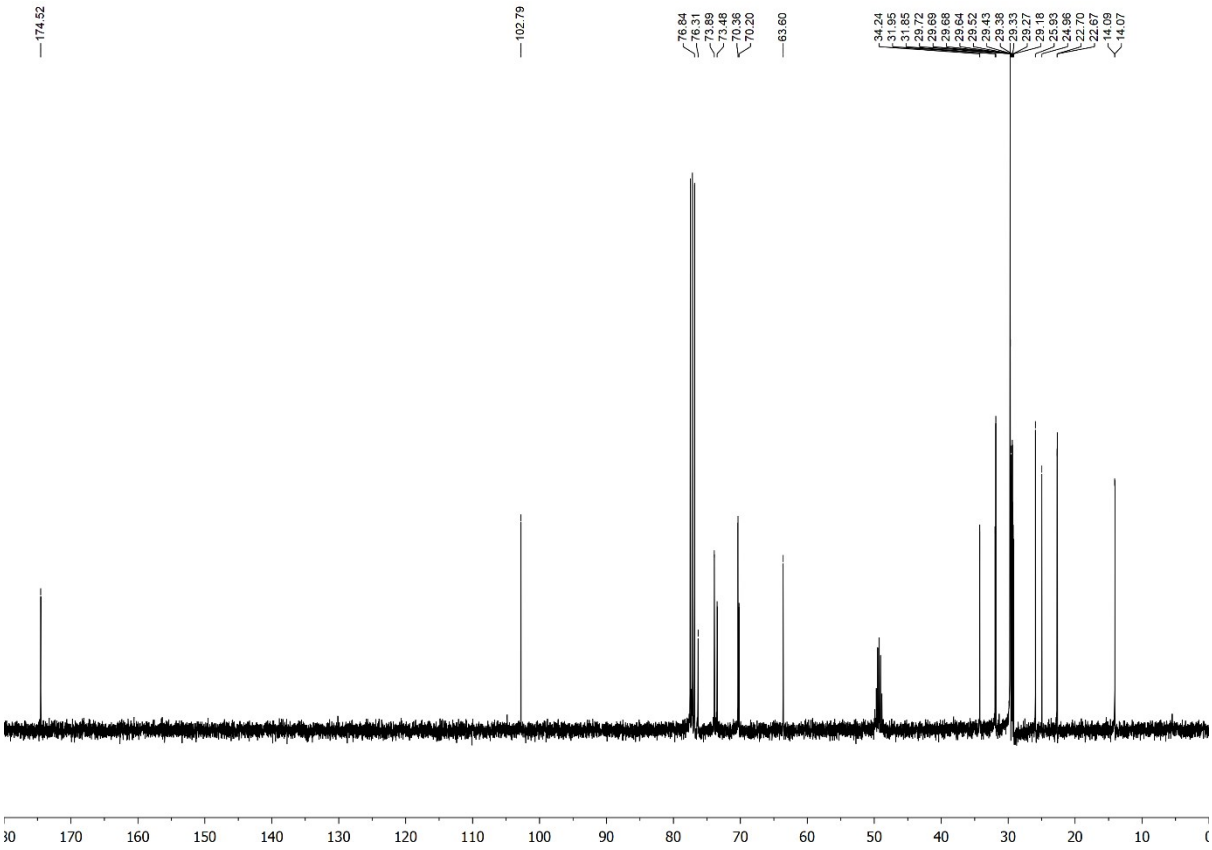


Octyl 6-*O*-palmitoyl-β-D-glucoside (4)

^{1}H NMR

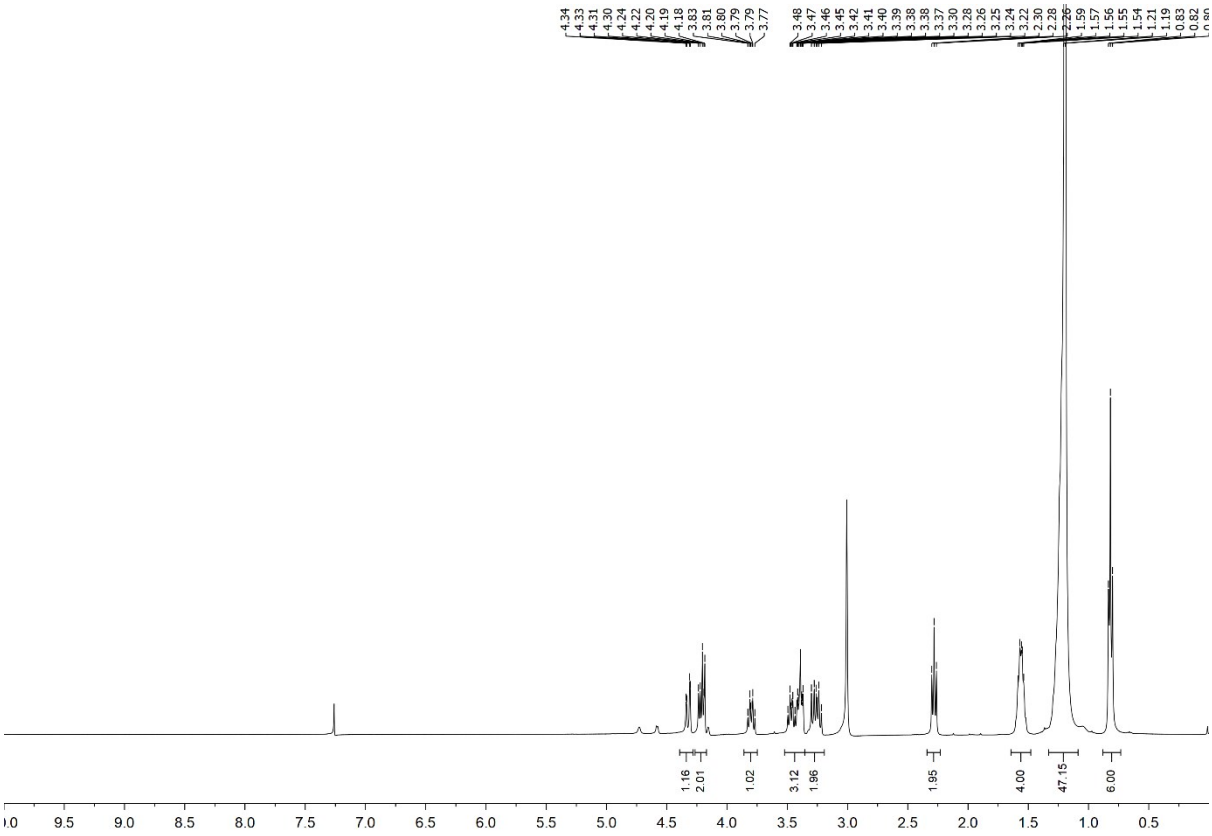


^{13}C NMR

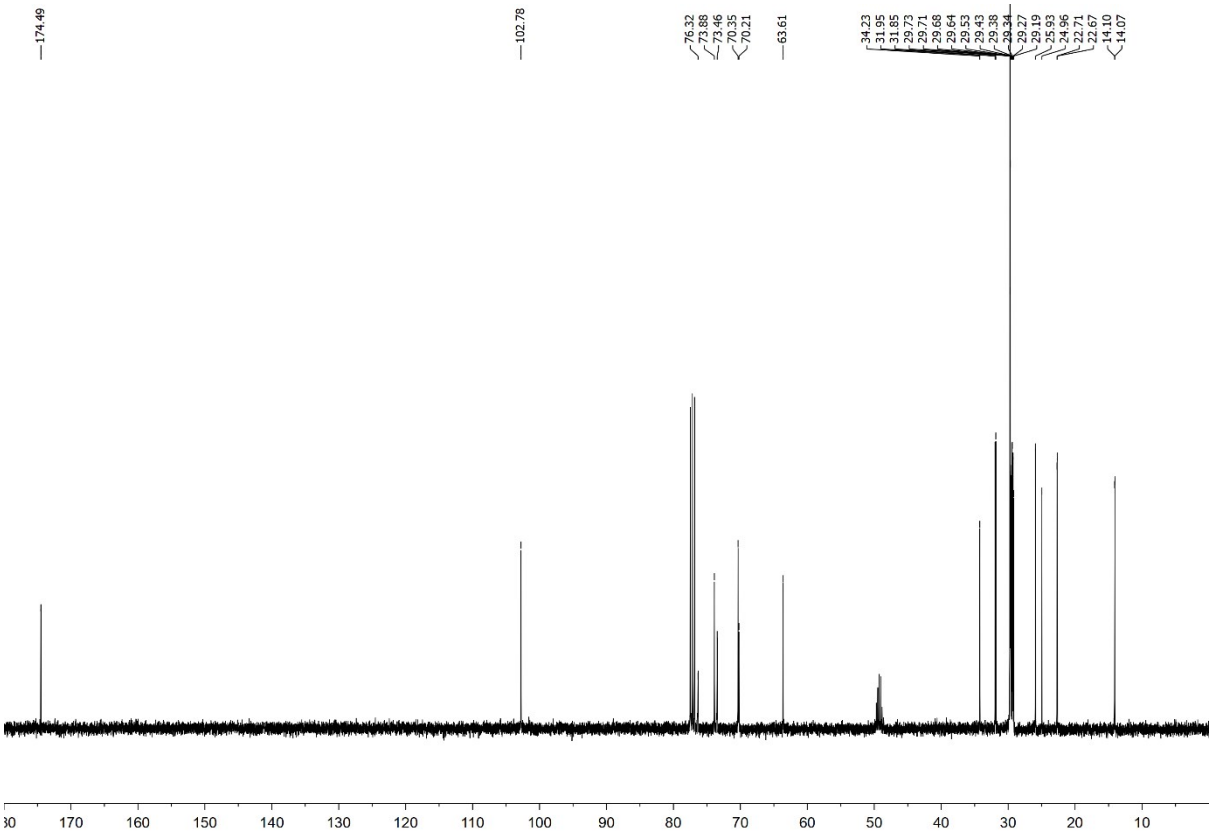


Octyl 6-*O*-behenoyl-β-D-glucoside (5)

^{1}H NMR

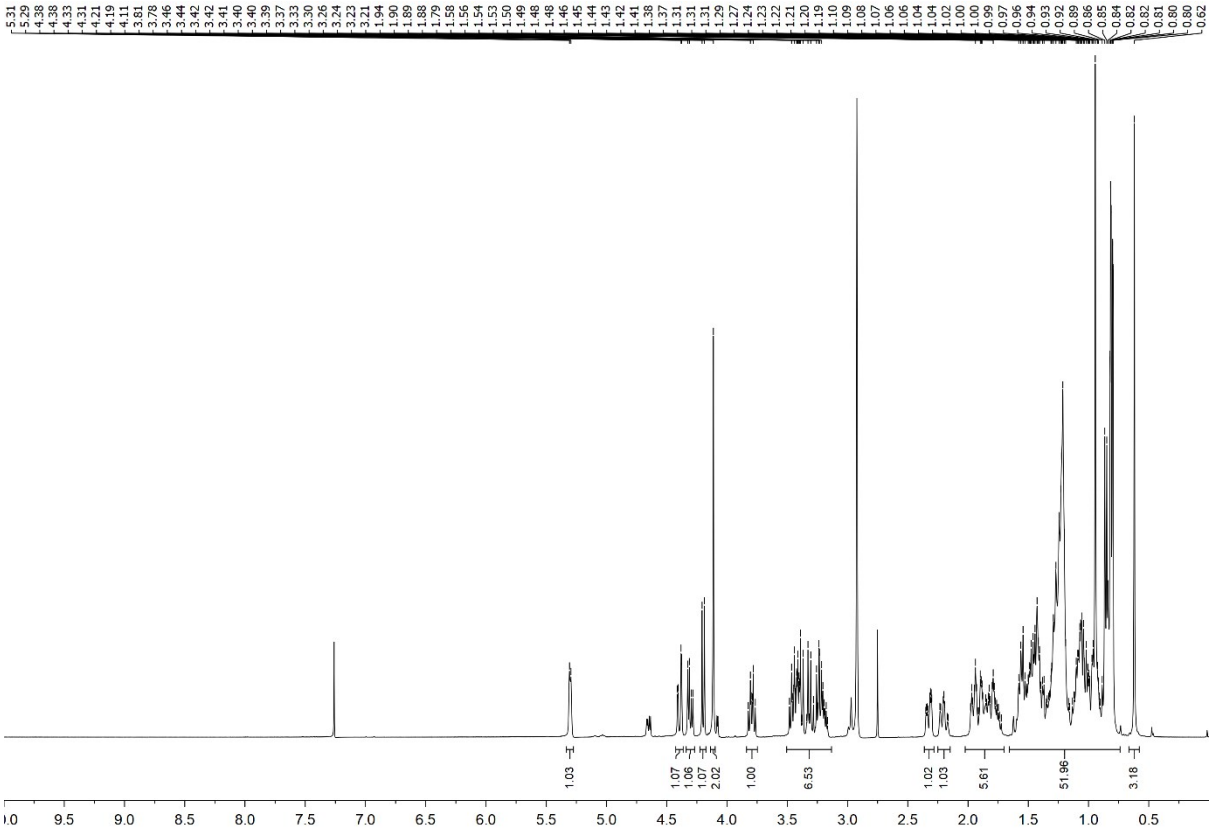


^{13}C NMR

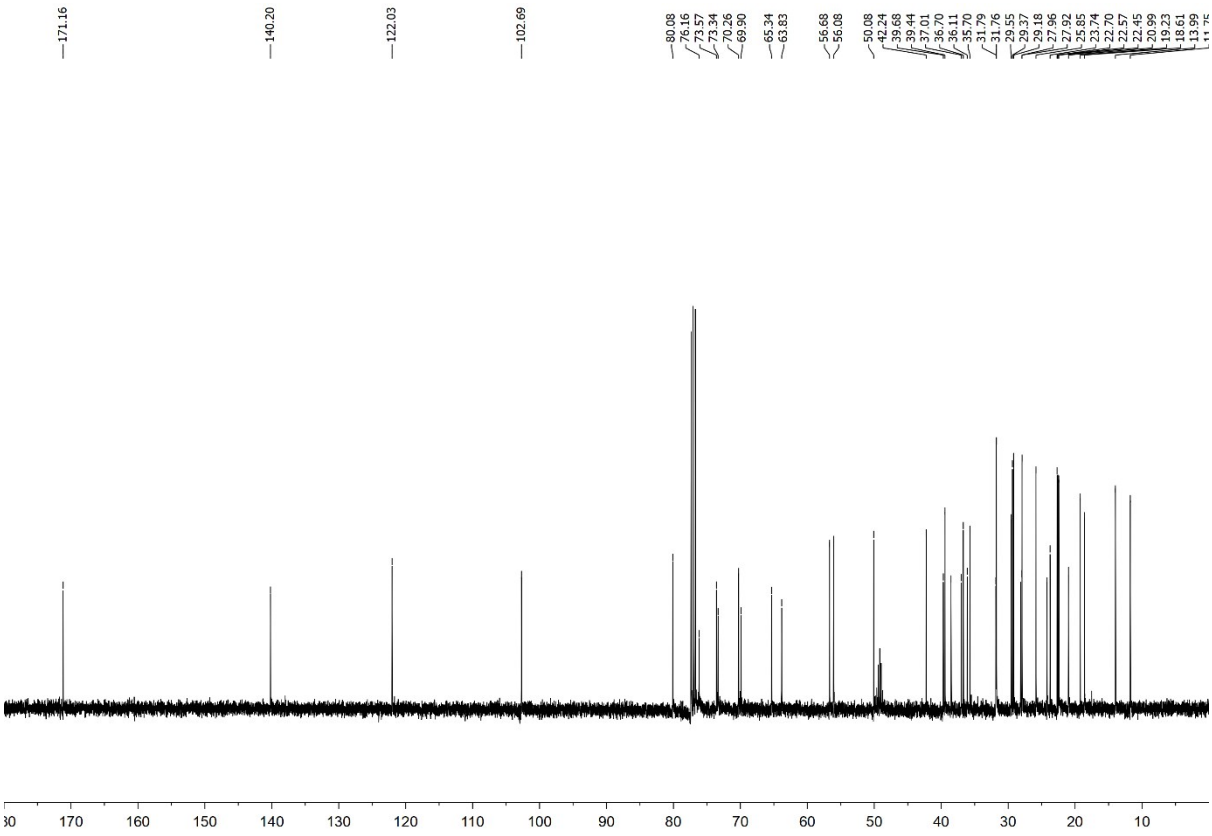


Octyl 6-*O*-cholesteryloxyacetyl-β-D-glucoside (14)

^{1}H NMR

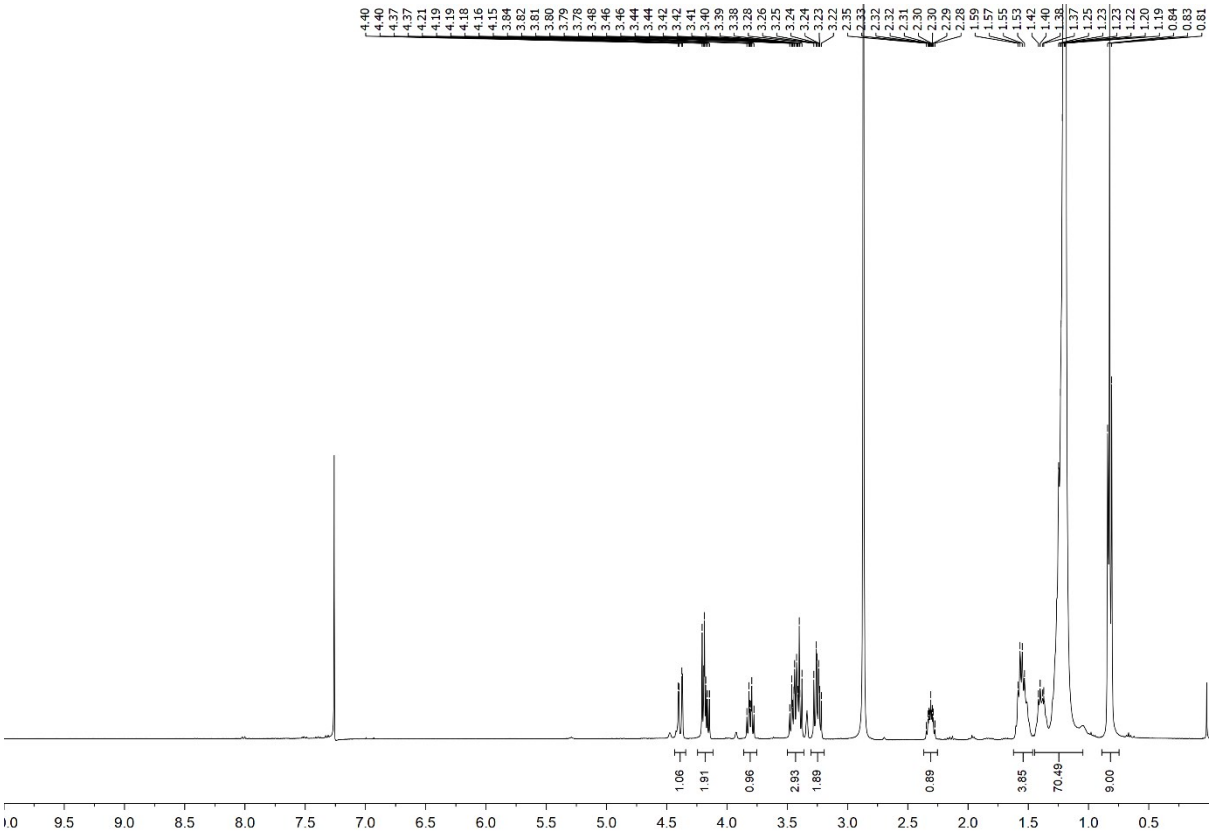


^{13}C NMR

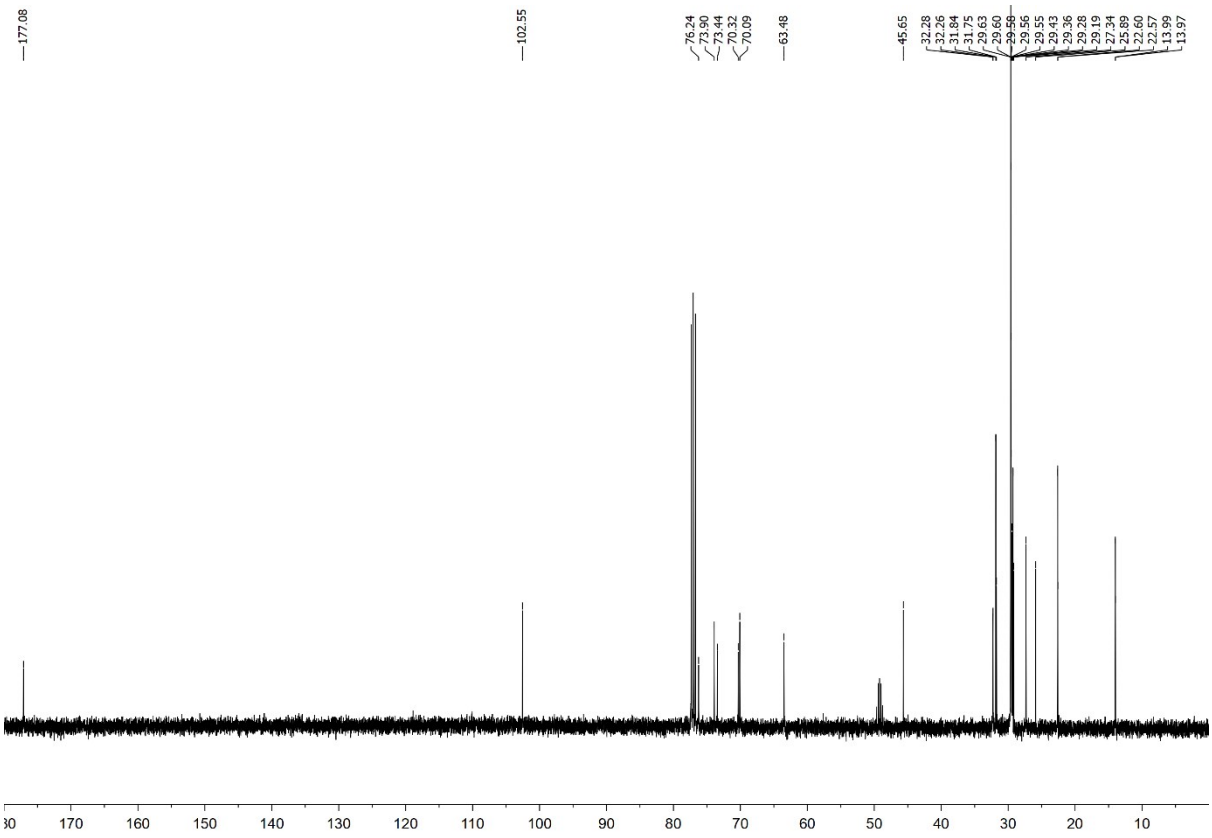


Octyl 6-*O*-(2-hexadecyloctadecanoyl)-β-D-glucoside (9)

^{1}H NMR

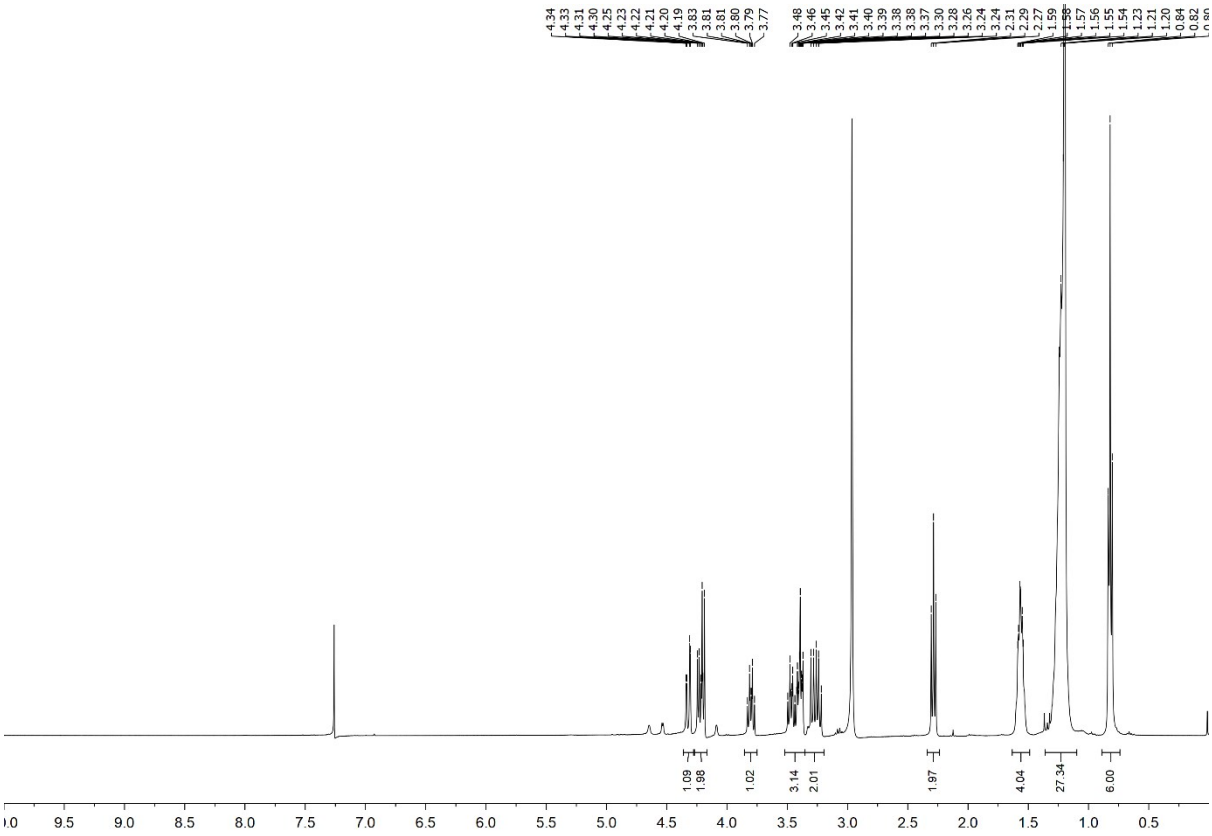


^{13}C NMR

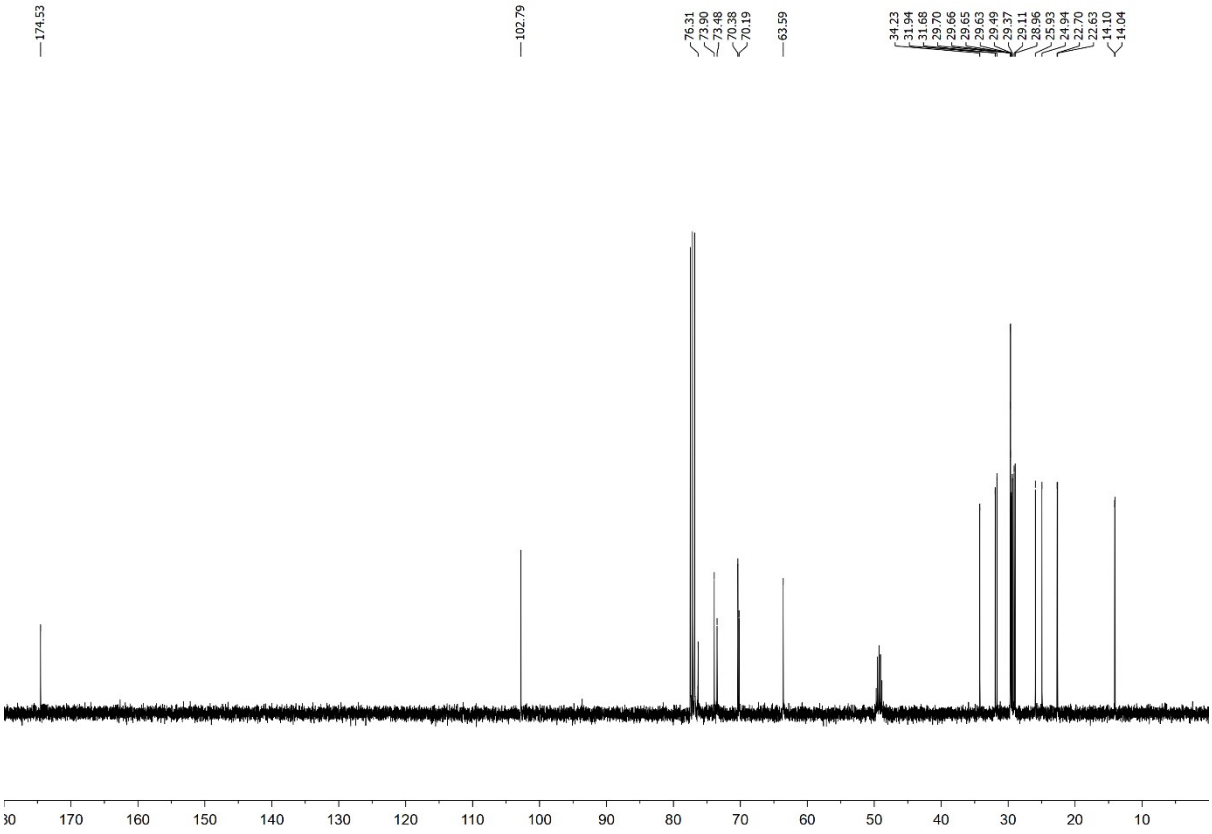


Lauryl 6-*O*-octanoyl-β-D-glucoside (6)

^{1}H NMR

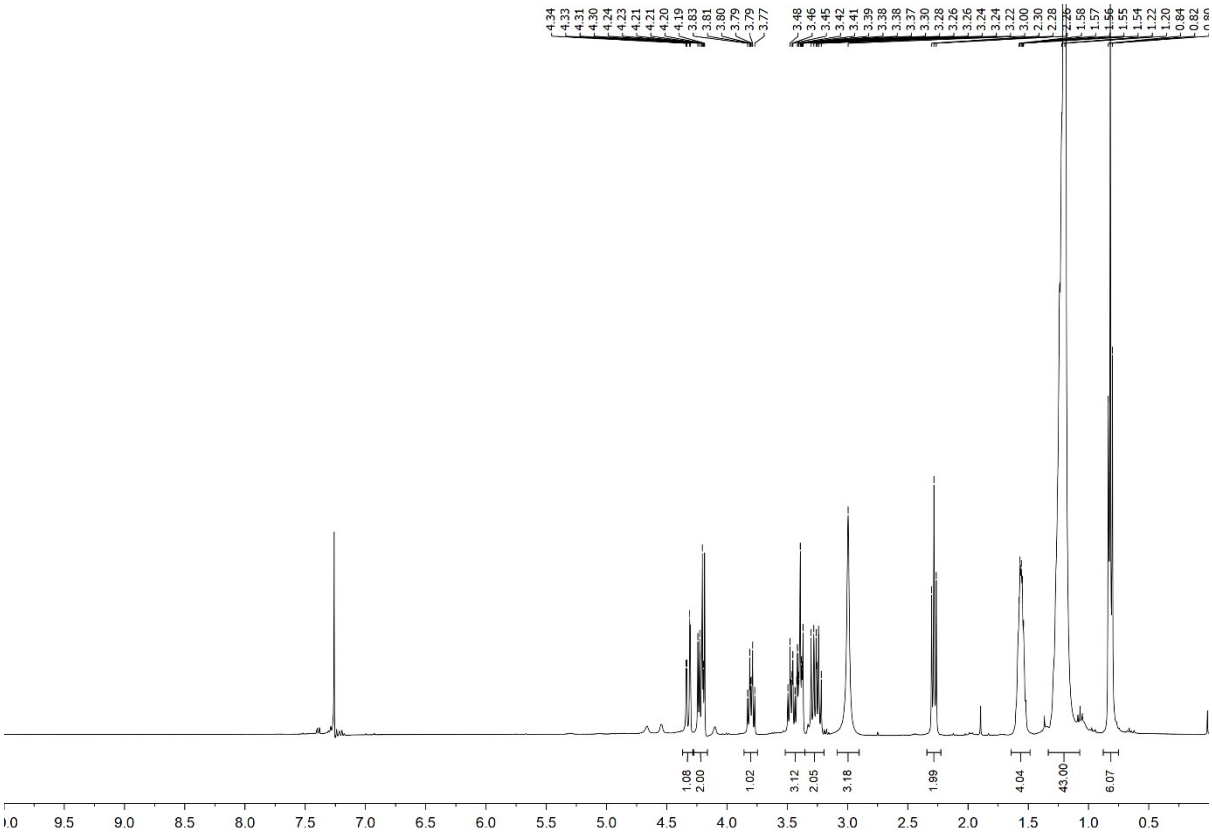


^{13}C NMR

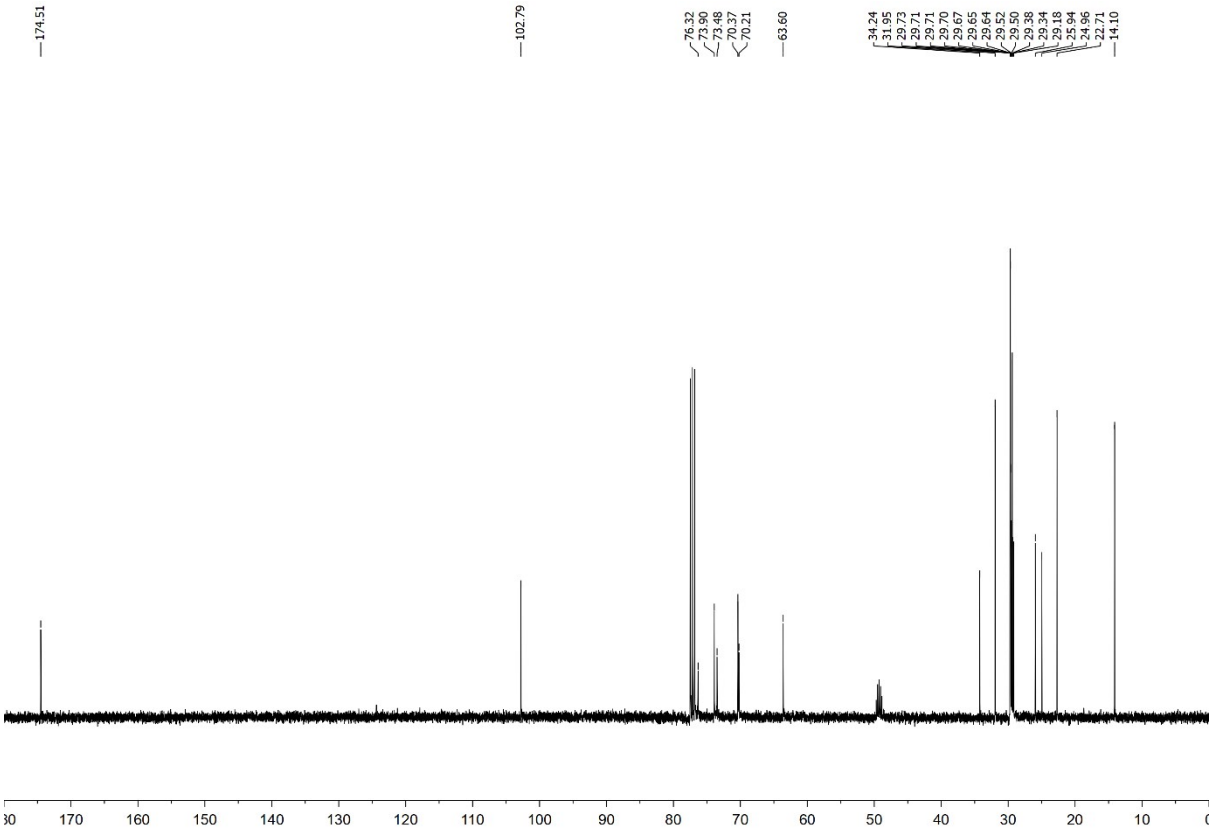


Lauryl 6-*O*-palmitoyl-β-D-glucoside (7)

^{1}H NMR

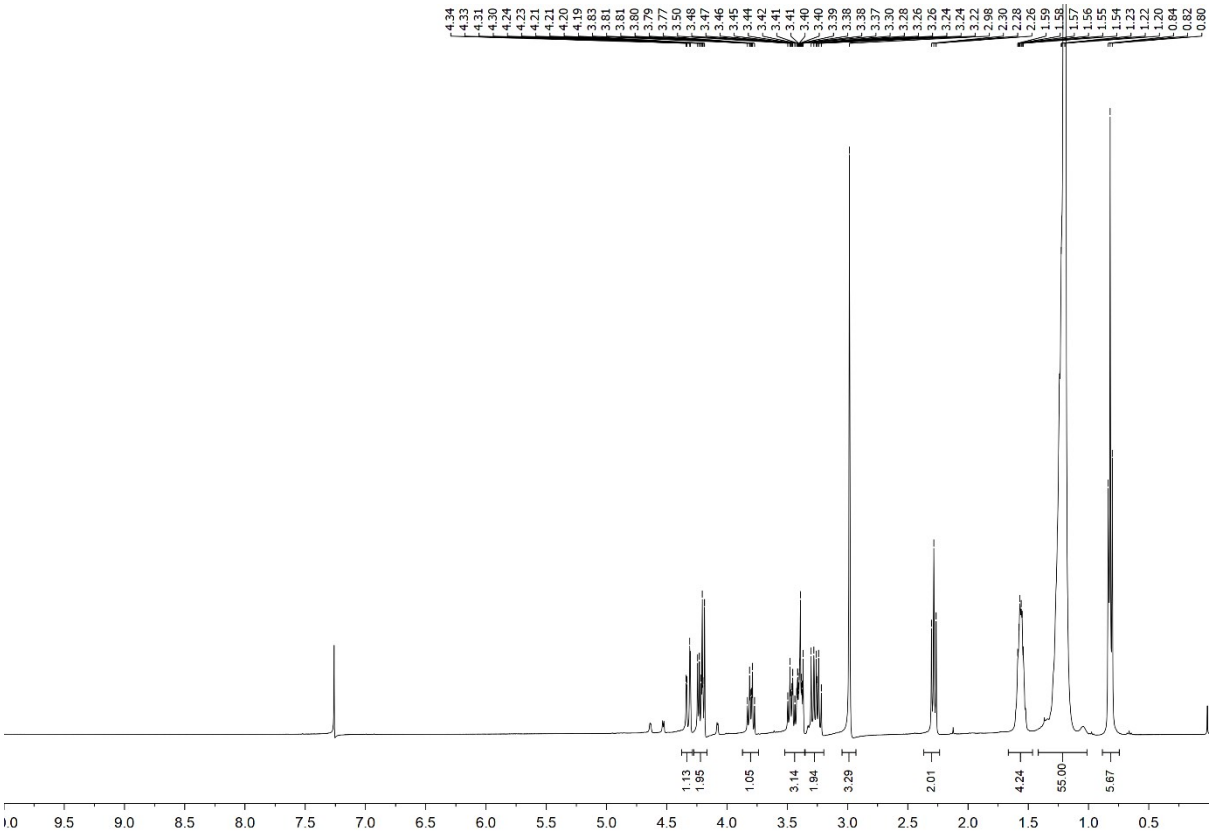


^{13}C NMR

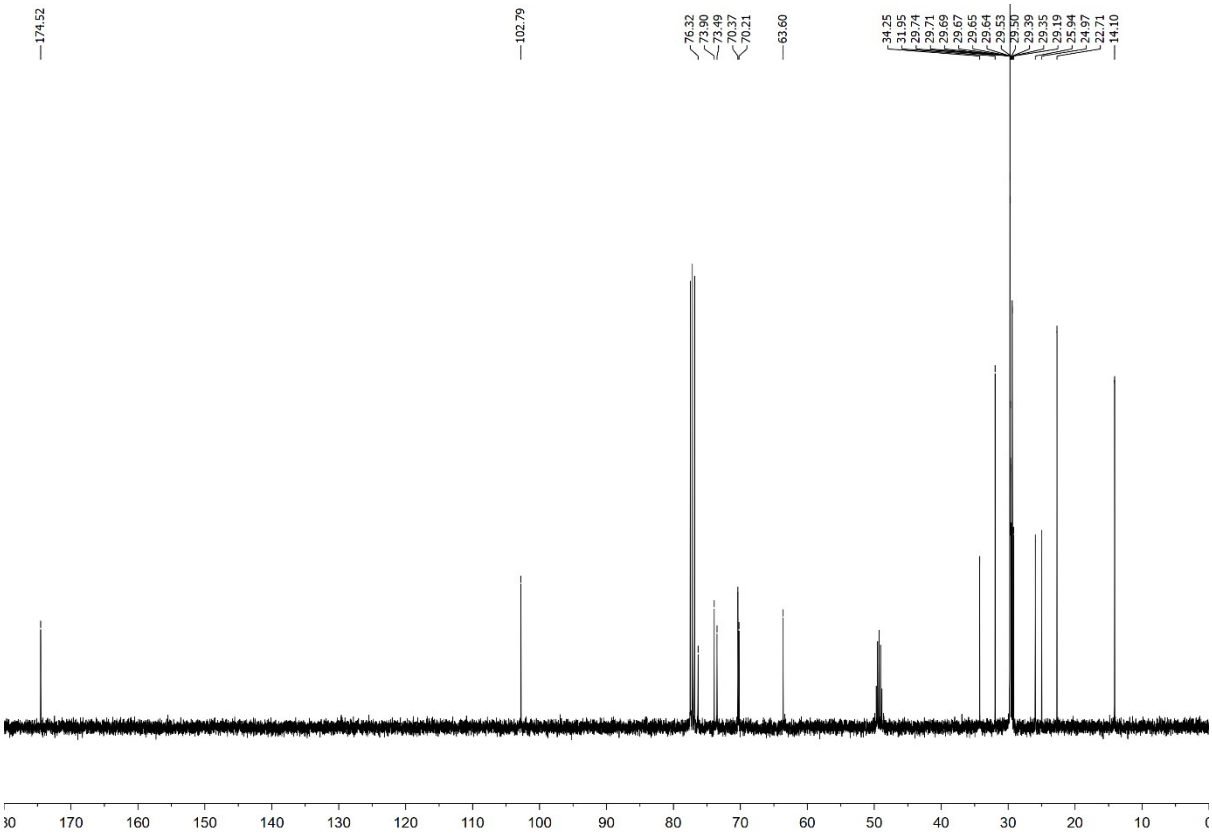


Lauryl 6-*O*-behenoyl-β-D-glucoside (8)

^{1}H NMR

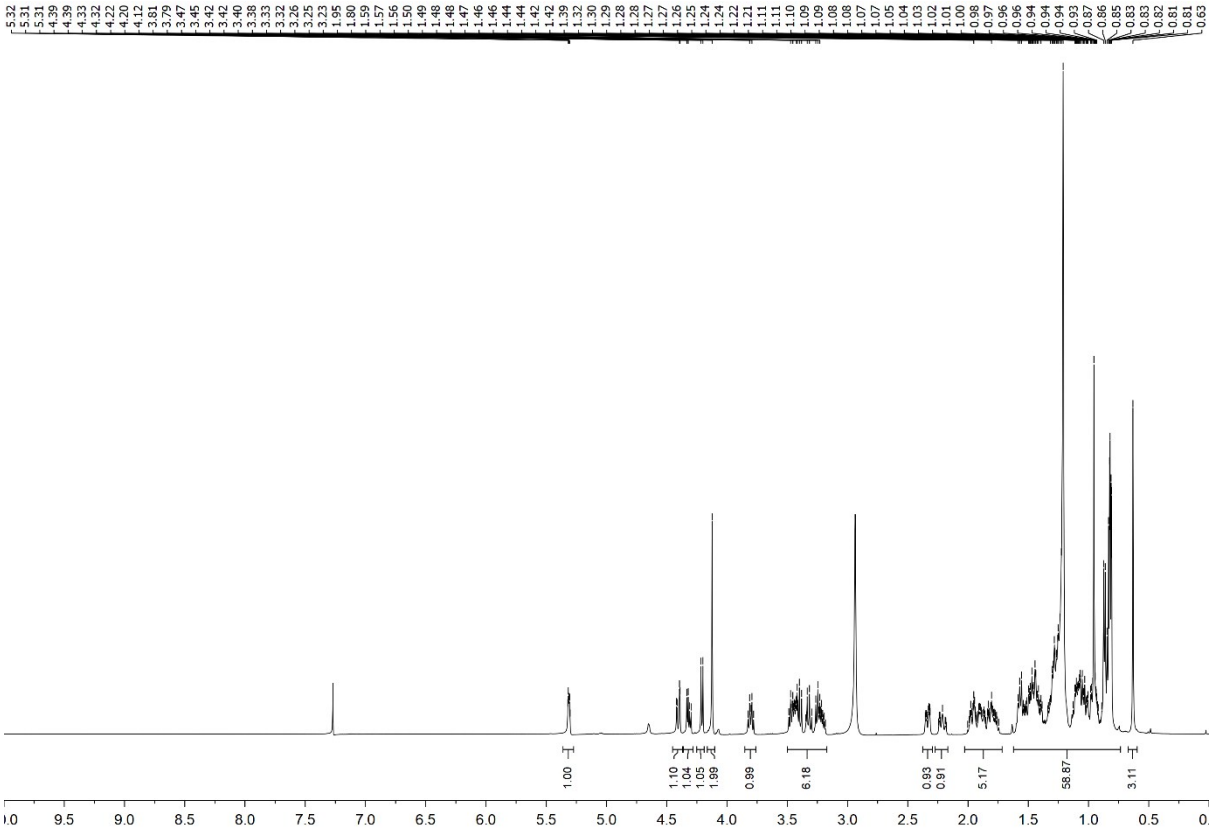


^{13}C NMR

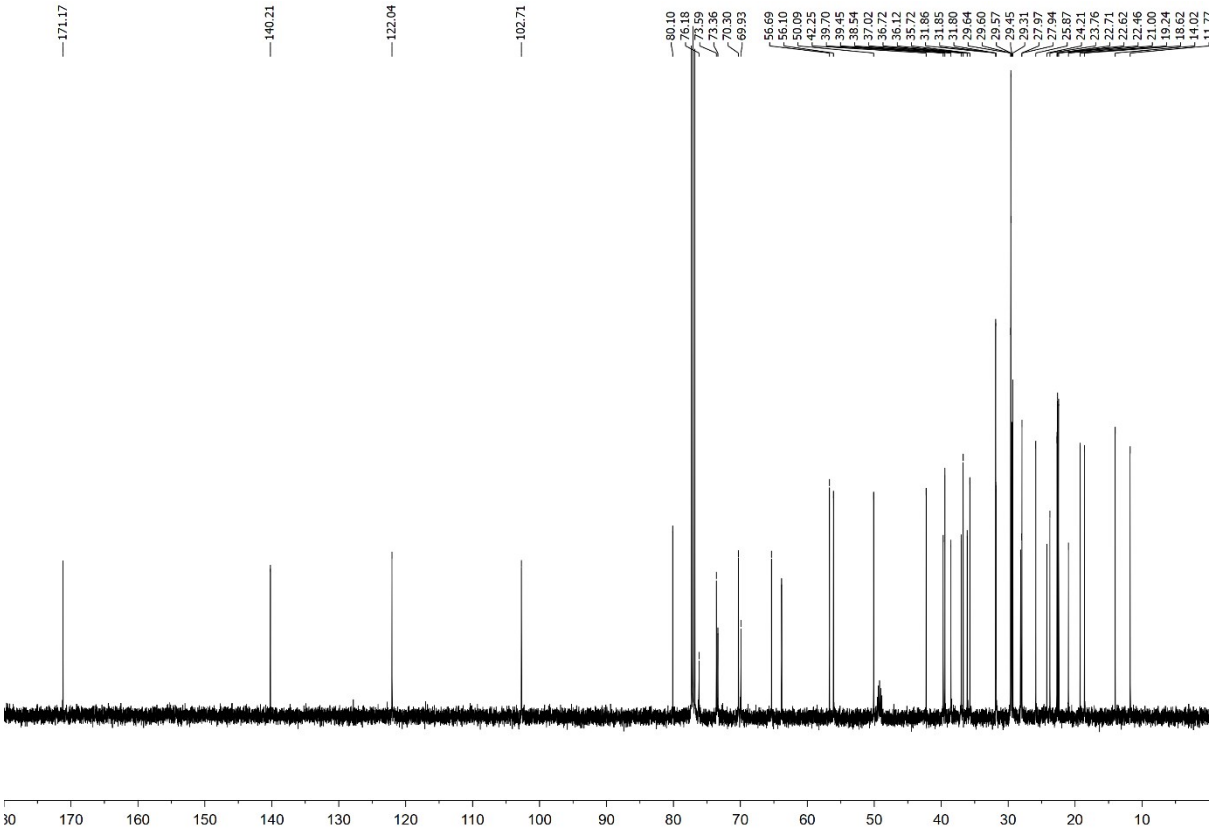


Lauryl 6-*O*-cholesteryloxyacetyl-β-D-glucoside (15)

^{1}H NMR

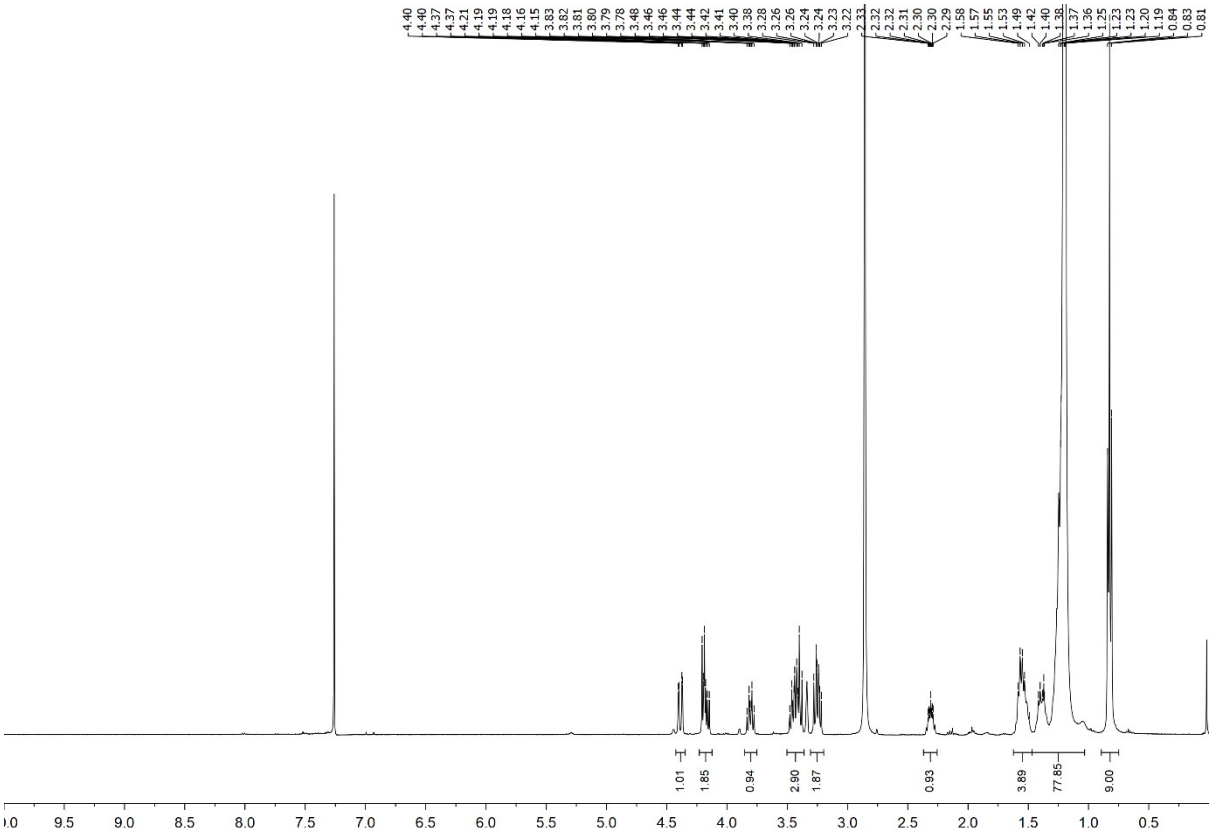


^{13}C NMR



Lauryl 6-*O*-(2-hexadecyloctadecanoyl)-β-D-glucoside (10)

^{1}H NMR



^{13}C NMR