

# Supplementary Information

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## 1. Synthetic Procedure

### 1.1. Chitosan Mesylate (Mes-CS) ( $2^{i-v}$ )

Free base chitosan ( $1^{i-v}$ ) (1 g, 6 mmol) was suspended in methanesulfonic acid ( $\text{CH}_3\text{SO}_3\text{H}$ ) (10 mL, 0.153 mol) and cooled to 10 °C. To the reaction mixture,  $\text{H}_2\text{O}$  (~10 mL) was added dropwise until a clear homogeneous solution was obtained. The reaction mixture was then stirred for 1 h before precipitating with EtOH (40 mL) resulting in a gel-like precipitate. The precipitate was filtered under suction using a sintered funnel and washed with EtOH ( $3 \times 25$  mL), followed by washing with acetone ( $3 \times 20$  mL). The material was then allowed to air-dry for 1 h. This salt precipitate was redissolved in a minimum quantity of  $\text{H}_2\text{O}$  (5–10 mL) and reprecipitated using acetone (60 mL), filtered, washed with acetone ( $2 \times 30$  mL) and the obtained material further dried in a vacuum oven at 40 °C overnight to afford corresponding finely powdered off-white chitosan mesylate salt ( $2^{i-v}$ ) (1.39 g, 90%). FT-IR (KBr):  $\nu$  3439 (O–H), 2935 (C–H), 1636 (C=O amide I), 1526 (C=O amide II), 1384 (C–H), 1198–1059 (C–C, C–O)  $\text{cm}^{-1}$ .  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ):  $\delta$  2.06 (s,  $\text{CH}_3\text{C}=\text{O}$  (Glc–NAc)), 2.81 (s,  $\text{CH}_3\text{S}$ ), 3.17 (m, H-2 (GlcN)), 3.6–4.1 (m, H-2 (GlcNAc), H-3–H-6'), 4.86 (H-1, partially overlapped with the HOD peak) ppm.

### 1.2. 3,6-di-O-tert-Butyldimethylsilyl-chitosan (diTBDMS-CS) ( $3^{i-v}$ )

Chitosan mesylate ( $2^{i-v}$ ) (1 g, 3.97 mmol) was dissolved in dry DMSO (15 mL) under  $\text{N}_2$  atmosphere. To this reaction mixture, imidazole (2.71 g, 39.74 mmol) and TBDMSCl (2.99 g, 19.87 mmol) in dry DMSO (13 mL) were added dropwise, and the resulting mixture was stirred at 25 °C. During the addition of the reagents, the reaction mixture turned cloudy, and eventually, sometime after completion of the addition, a solid gel-type material separated out from the solution. The reaction mixture was stirred for 24 h at 25 °C and then filtered by using a sintered funnel, and the solid obtained was continuously triturated while washing with  $\text{H}_2\text{O}$  ( $5 \times 30$  mL), followed by washing with  $\text{CH}_3\text{CN}$  ( $3 \times 20$  mL). The material was air dried and then further dried in a vacuum oven at 40 °C overnight, to afford corresponding off-white finely powdered silyl protected DiTBDMS-CS compound ( $3^{i-v}$ ) (1.46 g, 96%). FT-IR (KBr):  $\nu$  3403 (N–H), 2957–2858 (C–H), 1668 (C=O amide I), 1568 (C=O amide II), 1474 (C–H), 1390–1362 (C–H), 1258 (Si– $\text{CH}_3$ , C–N), 1109–1050 (C–O, Si–O), 836–777 (Si–C)  $\text{cm}^{-1}$ .  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.04–0.12 (br s, 12H,  $(\text{CH}_3)_2\text{Si}$ ), 0.89–0.90 (br s, 18H,  $(\text{CH}_3)_3\text{C}$ ), 1.99 (br s,  $\text{CH}_3\text{C}=\text{O}$  (GluNAc)), 2.71 (br s, H-2), 3.32 (br s, H-5), 3.49 (br s, H-3), 3.67 (br s, H-4), 3.85–3.90 (br s, H-6, H-6'), 4.29 (br s, H-1) ppm.

### 1.3. N-(Bromoacetyl)-3,6-di-O-TBDMS-chitosan (BrA-diTBDMS-CS) ( $4^{i-v}$ )

Silyl chitosan  $3^{i-v}$  (1 g, 2.6 mmol) was dissolved in dry  $\text{CH}_2\text{Cl}_2$  (15 mL) under  $\text{N}_2$  atmosphere. The reaction mixture was cooled to –20 °C by using a salt-ice cooling mixture. To the reaction mixture,  $\text{Et}_3\text{N}$  (1.81 mL, 13 mmol) was added, followed by the slow dropwise addition of bromoacetyl bromide (0.91 mL, 10 mmol). Stirring was continued for 1 h at a constant temperature maintained at –20 °C before the reaction mixture was diluted with  $\text{CH}_2\text{Cl}_2$  (30 mL) and concentrated *in vacuo*. The crude material obtained was triturated and stirred in  $\text{CH}_3\text{CN}$  (15 mL), filtered and washed with  $\text{CH}_3\text{CN}$

(3 × 15 mL) and air-dried. Dry material was redissolved in CH<sub>2</sub>Cl<sub>2</sub> (45 mL) and washed with H<sub>2</sub>O (3 × 30 mL) and brine (20 mL). The organic layer was dried over anhydrous Na<sub>2</sub>SO<sub>4</sub> and concentrated *in vacuo* to afford corresponding pale yellow powdered bromoacetyl intermediate **4<sup>i-v</sup>** (1.2 g, 92%). FT-IR (KBr):  $\nu$  3401 (N–H), 2957–2858 (C–H), 1682 (C=O amide I), 1530 (C=O amide II), 1473 (C–H), 1391–1362 (C–H), 1259 (Si–CH<sub>3</sub>, C–N), 1101–1050 (C–O, Si–O), 837–778 (Si–C) cm<sup>−1</sup>. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>):  $\delta$  0.07–0.14 (br s, 12H, (CH<sub>3</sub>)<sub>2</sub>Si), 0.88–0.89 (br s, 18H, (CH<sub>3</sub>)<sub>3</sub>C), 2.0 (br s, CH<sub>3</sub>C=O (GluNAc)), 3.25–4.02 (m, H-2–H-6' and –CH<sub>2</sub>Br), 4.43 (br s, H-1) ppm.

#### 1.4. *N*-(2-(*N,N,N*-Trimethylammoniumyl)acetyl)-3,6-di-*O*-TBDMS-chitosan Bromide (**5<sup>i-v</sup>**)

Freshly prepared bromoacetyl intermediate **4<sup>i-v</sup>** (450 mg, 0.9 mmol) was dissolved in CH<sub>2</sub>Cl<sub>2</sub> (10 mL) under N<sub>2</sub> atmosphere. Excess Me<sub>3</sub>N (4.2 molar in EtOH) (10 mL) was added, and the resulting mixture was stirred for 24 h at 25 °C. The reaction mixture was concentrated *in vacuo* to isolate the corresponding crude Product **5<sup>i-v</sup>**. These crude materials were used directly for the next deprotection step without any purification and characterization.

#### 1.5. *N*-(2-(1-Pyridiniumyl)acetyl)-3,6-di-*O*-TBDMS-chitosan Bromide (**7<sup>i-v</sup>**)

Freshly prepared bromoacetyl intermediate **4<sup>i-v</sup>** (400 mg, 0.8 mmol) was dissolved in CH<sub>2</sub>Cl<sub>2</sub> (5 mL) and stirred in excess pyridine (15 mL) for 24 h at 25 °C under N<sub>2</sub> atmosphere. The reaction mixture was concentrated completely *in vacuo* to isolate the corresponding crude product (**7<sup>i-v</sup>**). These crude materials were used directly for the next deprotection stage without any further purification or characterization.

## 2. General Procedures for *N*-Quaternized-hexanoyl-chitosan Derivatives

### 2.1. *N*-(6-Bromohexanoyl)-3,6-di-*O*-TBDMS-chitosan (*BrHA-diTBDMS-CS*) (**9<sup>i-v</sup>**)

Silyl chitosan **3<sup>i-v</sup>** (0.5 g, 1.3 mmol) was dissolved in dry CH<sub>2</sub>Cl<sub>2</sub> (15 mL) under N<sub>2</sub> atmosphere. The reaction mixture was cooled to −20 °C by using a salt-ice mixture. To the reaction mixture, Et<sub>3</sub>N (0.91 mL, 6.5 mmol) was added followed by the slow dropwise addition of 6-bromohexanoyl chloride (0.8 mL, 5.2 mmol). The stirring continued for 1 h while constantly maintaining a temperature at −20 °C. The reaction mixture was diluted with CH<sub>2</sub>Cl<sub>2</sub> (35 mL) and concentrated *in vacuo*. The isolated crude product was triturated and stirred with CH<sub>3</sub>CN (30 mL), filtered and the solid obtained washed with fresh CH<sub>3</sub>CN (3 × 20 mL) before air-drying to afford the bromohexanoyl intermediate (**9<sup>i-v</sup>**) as a white solid (504 mg, 68.5%). FT-IR (KBr):  $\nu$  3342 (N–H), 2956–2858 (C–H), 1677 (C=O amide I), 1527 (C=O amide II), 1473 (C–H), 1390–1362 (C–H), 1257 (Si–CH<sub>3</sub>, C–N), 1096–1054 (C–O, Si–O), 838–778 (Si–C) cm<sup>−1</sup>. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>):  $\delta$  0.06–0.12 (br s, 12 H, (CH<sub>3</sub>)<sub>2</sub>Si), 0.88–0.89 (br s, 18H, (CH<sub>3</sub>)<sub>3</sub>C), 1.46 (br m, 2H, –CH<sub>2</sub>–<sup>a</sup>), 1.66 (br m, 2H, –CH<sub>2</sub>–<sup>a</sup>), 1.87 (br m, 2H, –CH<sub>2</sub>–<sup>a</sup>), 2.0 (br s, CH<sub>3</sub>C=O (GluNAc)), 2.23 (br m, 2H, COCH<sub>2</sub>–), 3.39 (br s, 2H, –CH<sub>2</sub>Br), 3.56–4.32 (br m, 7H, H-1–H-6') ppm. (Please refer to Figure 4C)

## 2.2. *N*-(6-(*N,N,N*-Trimethylammoniumyl)hexanoyl)-3,6-di-*O*-TBDMS-chitosan Bromide/Iodide (**10<sup>i-v</sup>**)

Freshly prepared bromohexanoyl compound (**9<sup>i-v</sup>**) (450 mg, 0.8 mmol) was dissolved in CH<sub>2</sub>Cl<sub>2</sub> (12 mL) under N<sub>2</sub> atmosphere. To the reaction mixture, excess Me<sub>3</sub>N (4.2 molar in EtOH) (15 mL) was added, and the resulting mixture was stirred for 24 h at 25 °C. Some white precipitate was formed as the reaction progressed, and this increased after the addition of a catalytic amount of KI. The stirring was continued further for 24 h. The reaction mixture was concentrated *in vacuo* to isolate the corresponding crude Product **10<sup>i-v</sup>**. These crude materials were washed with diethyl ether, filtered, dried and then used directly for the next deprotection stage without any further purification or characterization.

## 2.3. *N*-(6-(1-Pyridiniumyl)hexanoyl)-3,6-di-*O*-TBDMS-chitosan Bromide/Iodide (**12<sup>i-v</sup>**)

Freshly prepared bromohexanoyl compound (**9<sup>i-v</sup>**) (400 mg, 0.71 mmol) was dissolved in CH<sub>2</sub>Cl<sub>2</sub> (5 mL) under N<sub>2</sub> atmosphere. To the reaction mixture, excess quantity of pyridine (15 mL) and catalytic amount of KI was added, and the resulting mixture continued to be stirred for 48 h at 25 °C. The reaction mixture was concentrated completely *in vacuo* to isolate the corresponding crude product (**12<sup>i-v</sup>**). These crude materials were washed with diethyl ether, filtered, dried and then used directly for the next deprotection stage without any purification and characterization.

## 2.4. General TBDMS Deprotection Procedure to Give the Final Quaternary Ammonium and Pyridinium Derivatives (**6<sup>i-v</sup>**, **8<sup>i-v</sup>**, **11<sup>i-v</sup>**, **13<sup>i-v</sup>**)

The compounds (**5<sup>i-v</sup>**, **7<sup>i-v</sup>**, **10<sup>i-v</sup>** or **12<sup>i-v</sup>**) (300 mg) were dissolved in MeOH (4–5 mL), and conc HCl (1–2 mL) was added. The reaction mixture was stirred for 12 h at 25 °C, diluted with H<sub>2</sub>O (10 mL) and, then, ion exchanged by adding 10% NaCl (aqueous) (w/v) (15 mL), and the resulting mixture was stirred for 1 h at 25 °C. The colorless solution was then dialyzed against 5% aqueous NaCl solution for one day and then against deionized water for two days, before it was freeze-dried to afford the corresponding deprotected water-soluble, white, fluffy quaternized product (**6<sup>i-v</sup>**, **8<sup>i-v</sup>**, **11<sup>i-v</sup>** or **13<sup>i-v</sup>**). The deprotection was repeated if needed to remove traces of silyl impurities that could be observed in <sup>1</sup>H NMR after the first round.

*N*-(2-(*N,N,N*-trimethylammoniumyl)acetyl)-chitosan chloride (TMA-CS) (**6<sup>i-v</sup>**). FT-IR (KBr):  $\nu$  3419 (O–H, N–H), 2956 (C–H), 1684 (C=O amide I), 1568 (C=O amide II), 1476 (C–H), 1067 (C–O) cm<sup>-1</sup>. <sup>1</sup>H NMR (400 MHz, D<sub>2</sub>O):  $\delta$  2.05 (br s, CH<sub>3</sub>C=O (GluNAc)), 3.32 (br s, <sup>+</sup>N(CH<sub>3</sub>)<sub>3</sub>), 3.5–3.9 (m, H-2–H-6'), 4.17 (br s, CH<sub>2</sub>C=O), 4.63 (br s, H-1) ppm. *N*-(2-(1-pyridiniumyl)acetyl)-chitosan chloride (PyA-CS) (**8<sup>i-v</sup>**). FT-IR (KBr):  $\nu$  3400 (O–H, N–H), 3060, 2930 (C–H), 1685 (C=O amide I), 1636 (C=C, aryl subst.), 1567 (C=O amide II), 1490 (C=C–C, aromatic ring), 1363–1228 (C–N, aryl), 1071 (C–O) cm<sup>-1</sup>. <sup>1</sup>H NMR (400 MHz, D<sub>2</sub>O):  $\delta$  2.06 (br s, CH<sub>3</sub>C=O (GluNAc)), 3.5–4.0 (m, H-2–H-6' and Py<sup>+</sup>CH<sub>2</sub>C=O), 4.71 (br s, H-1, partially overlapped with HOD peak), 8.16 (br t, *J* = 8 Hz, 2H, Py<sup>+</sup>*m*-CH), 8.67 (br t, *J* = 8 Hz, 1H, Py<sup>+</sup>*p*-CH), 8.82 (br d, *J* = 8 Hz, 1H, Py<sup>+</sup>*o*-CH) ppm. *N*-(6-(*N,N,N*-trimethylammoniumyl)hexanoyl)-chitosan chloride (**11<sup>i-v</sup>**). FT-IR (KBr):  $\nu$  3424 (O–H, N–H), 2950–2871 (C–H), 1652 (C=O amide I), 1555 (C=O amide II), 1481 (C–H), 1069 (C–O) cm<sup>-1</sup>. <sup>1</sup>H NMR (400 MHz, D<sub>2</sub>O):  $\delta$  1.41 (br p, 2H, –CH<sub>2</sub>–<sup>a</sup>), 1.68 (br p, 2H, –CH<sub>2</sub>–<sup>a</sup>), 2.07 (br s, CH<sub>3</sub>C=O (GluNAc)), 2.36 (br q, 2H, –COCH<sub>2</sub>–<sup>a</sup>), 3.12 (br s, <sup>+</sup>N(CH<sub>3</sub>)<sub>3</sub>),

3.32 (brt, 2H,  $-\text{CH}_2\text{NMe}_3^{+a}$ ), 3.5–4.0 (br m, H-2–H-6'), 4.58 (br s, H-1) ppm. ("See Figure 4D). *N*-(6-(1-pyridiniumyl)hexanoyl)-chitosan chloride (**13<sup>i-v</sup>**). FT-IR (KBr):  $\nu$  3423 (O–H, N–H), 3062, 2936–2867 (C–H), 1651 (C=O amide I), 1556 (C=O amide II), 1488 (C=C–C, aromatic ring), 1374–1316 (C–N, aryl), 1068 (C–O)  $\text{cm}^{-1}$ .  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ):  $\delta$  1.39 (br p, 2H,  $-\text{CH}_2^{-a}$ ), 1.65 (br m, 2H,  $-\text{CH}_2^{-a}$ ), 2.06 (br p, 2H ( $-\text{CH}_2^{-a}$ ) overlapped with  $\text{CH}_3\text{C}=\text{O}$  (GluNAc)), 2.30 (br m, 2H,  $-\text{COCH}_2^{-a}$ ), 3.4–4.0 (br m, H-2–H-6'), 4.55 (br s, H-1), 4.61 (br t, 2H,  $-\text{CH}_2\text{Py}^{+a}$ ), 8.09 (br t,  $J = 8$  Hz, 2H,  $\text{Py}^+m\text{-CH}$ ), 8.57 (br t,  $J = 8$  Hz, 1H,  $\text{Py}^+p\text{-CH}$ ), 8.84 (br d,  $J = 8$  Hz, 1H,  $\text{Py}^+o\text{-CH}$ ) ppm. ("See Figure 4E).

### 3. General Procedure for *N*-Quaternized-chitosan

#### 3.1. *N,N,N*-Trimethyl-3,6-di-*O*-TBDMS-chitosan Iodide (**14<sup>i-v</sup>**)

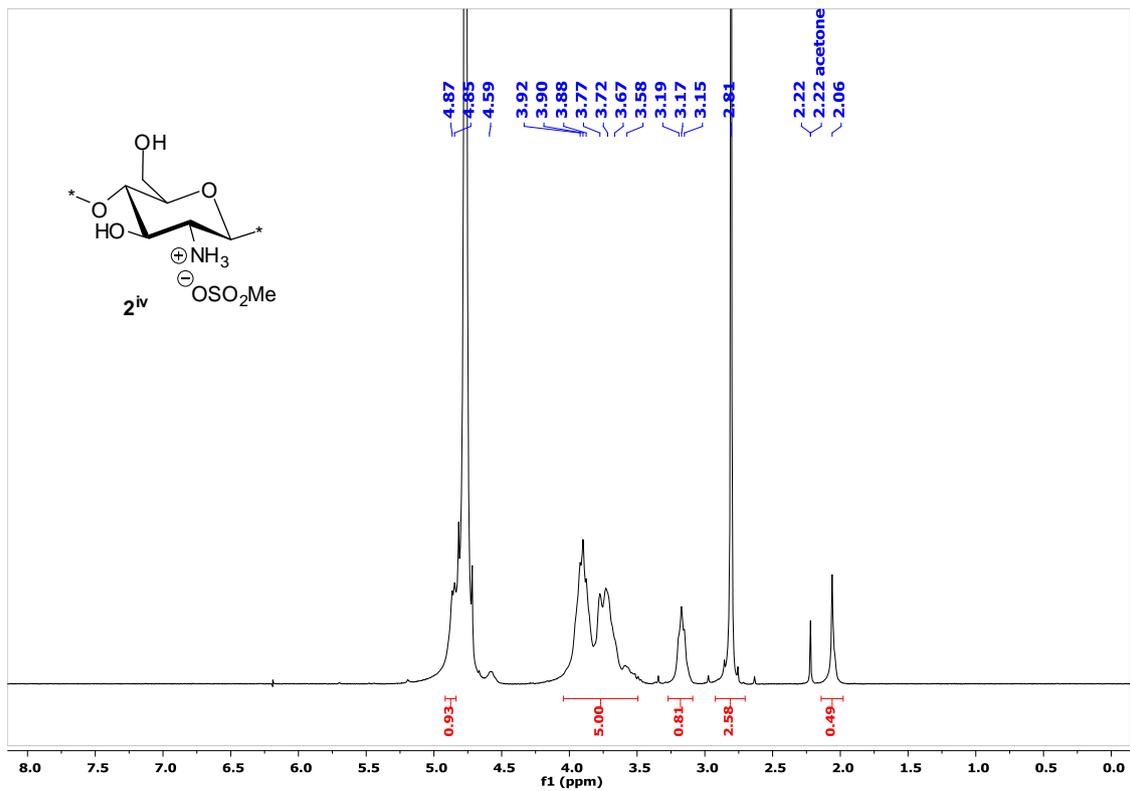
Silyl chitosan **3<sup>i-v</sup>** (1.42 g, 3.6 mmol) was dissolved in dry NMP (20 mL). To the reaction mixture, cesium carbonate ( $\text{Cs}_2\text{CO}_3$ ) (4.63 g, 14.2 mmol) was added and the solution stirred for 1 h, followed by dropwise addition of  $\text{CH}_3\text{I}$  (1.11 mL, 17.8 mmol) under cooling. The reaction was carried out in a closed reaction vial at 50 °C for 48 h. The solution was then dialyzed against deionized water for two days and freeze-dried to afford a dark red product (**14<sup>i-v</sup>**) (1.85 g, 93%).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ):  $\delta$  0.01–0.31 ( $(\text{CH}_3)_2\text{Si}$ ), 0.86–0.90 ( $(\text{CH}_3)_3\text{C}$ ), 3.64 ( $^+\text{N}(\text{CH}_3)_3$ ) partially overlapped by H-1 to H-6') ppm.

#### 3.2. *N,N,N*-Trimethyl Chitosan Chloride (TMC) (**15<sup>i-v</sup>**)

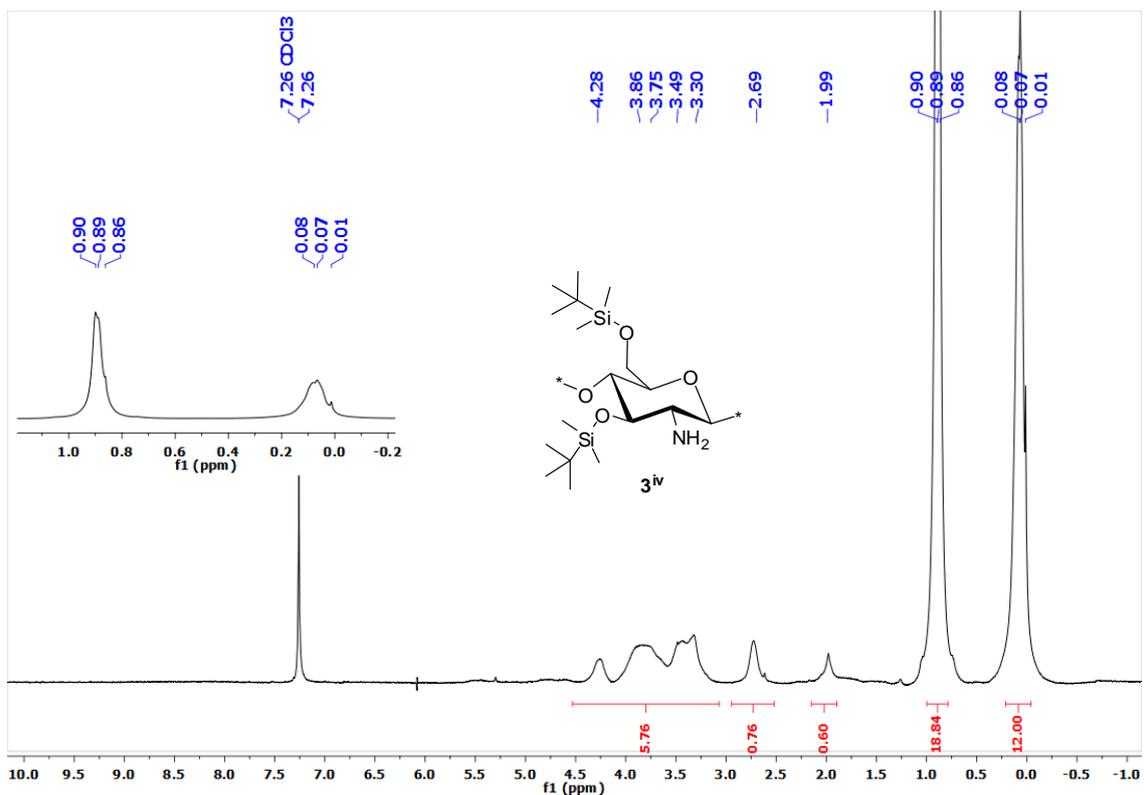
Compound **14<sup>i-v</sup>** (1.85 g, 3.30 mmol) was deprotected by treatment with tetrabutyl ammonium fluoride (TBAF) (1 molar) solution in NMP (10 mL) at 50 °C for 48 h. The resulting solution was dialyzed for two days against deionized water, then ion-exchanged with 10% NaCl (aqueous) (w/v) overnight, and this was then followed by dialysis against deionized water for another two days. The resulting compound was then freeze-dried, giving a light brown and fluffy trimethylated CS (**15<sup>i-v</sup>**) (650 mg, 74.2%). In cases where  $^1\text{H}$  NMR analysis showed that the trimethylated chitosan was not fully deprotected, the deprotection process was repeated. FT-IR (KBr):  $\nu$  3422 (O–H), 2923 (C–H), 1653 (C=O amide I), 1488 (C–H), 1051 (C–O)  $\text{cm}^{-1}$ .  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ):  $\delta$  2.08 ( $\text{CH}_3\text{C}=\text{O}$ , GlcNAc), 3.35 ( $^+\text{N}(\text{CH}_3)_3$ ), 3.75 (H-2), 3.90 (H-6), 3.99 (H-5), 4.36 (H-4), 4.47 (H-3), 5.49 (H-1) ppm.

#### 4. Figures S1–S4: $^1\text{H}$ NMR Spectra of Key Chitosan Intermediates Compounds

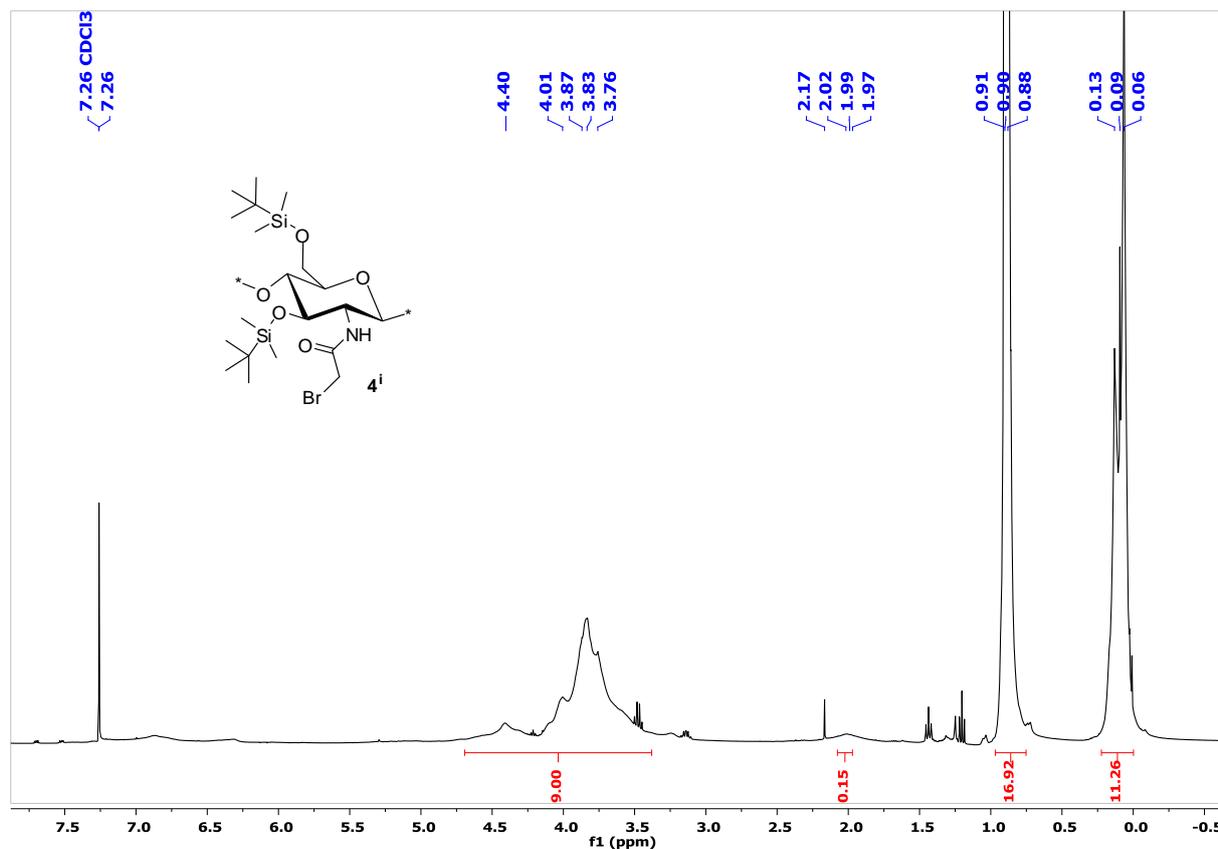
**Figure S1.** Representative  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $2^{\text{iv}}$  (Mes-CS $^{\text{iv}}$ ).



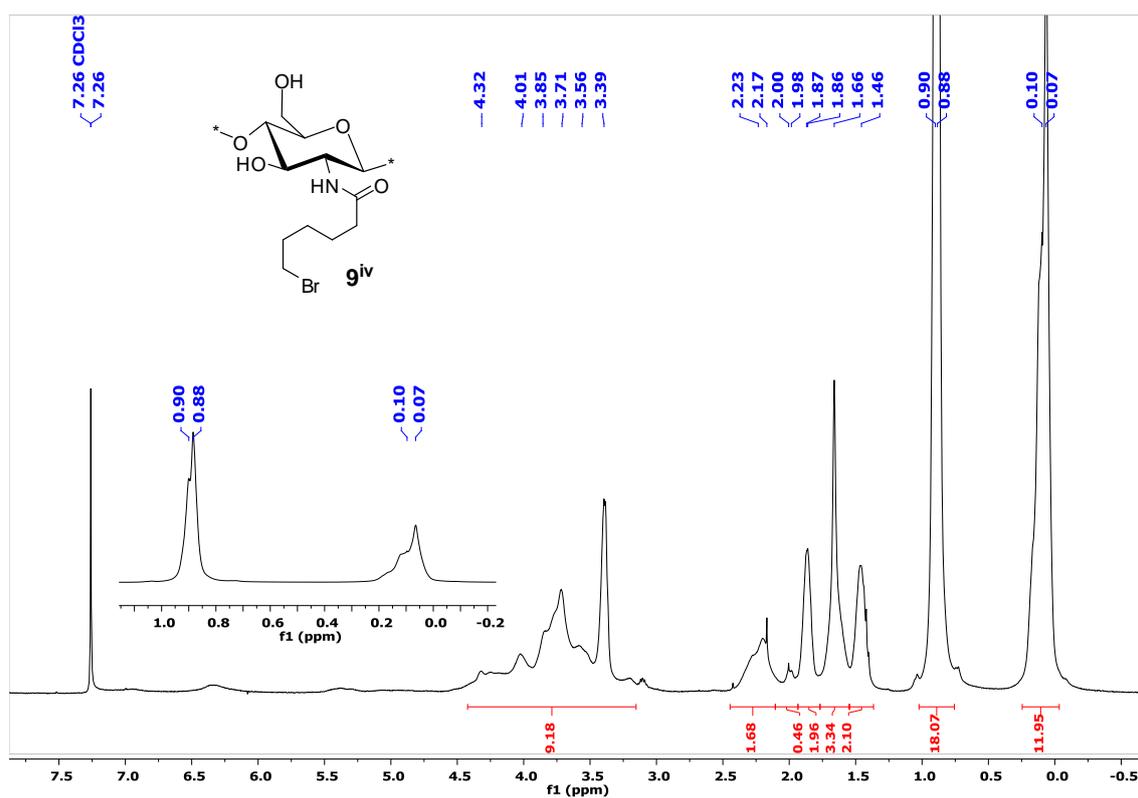
**Figure S2.** Representative  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) spectrum of compound  $3^{\text{iv}}$  (diTBDMS-CS $^{\text{iv}}$ ).

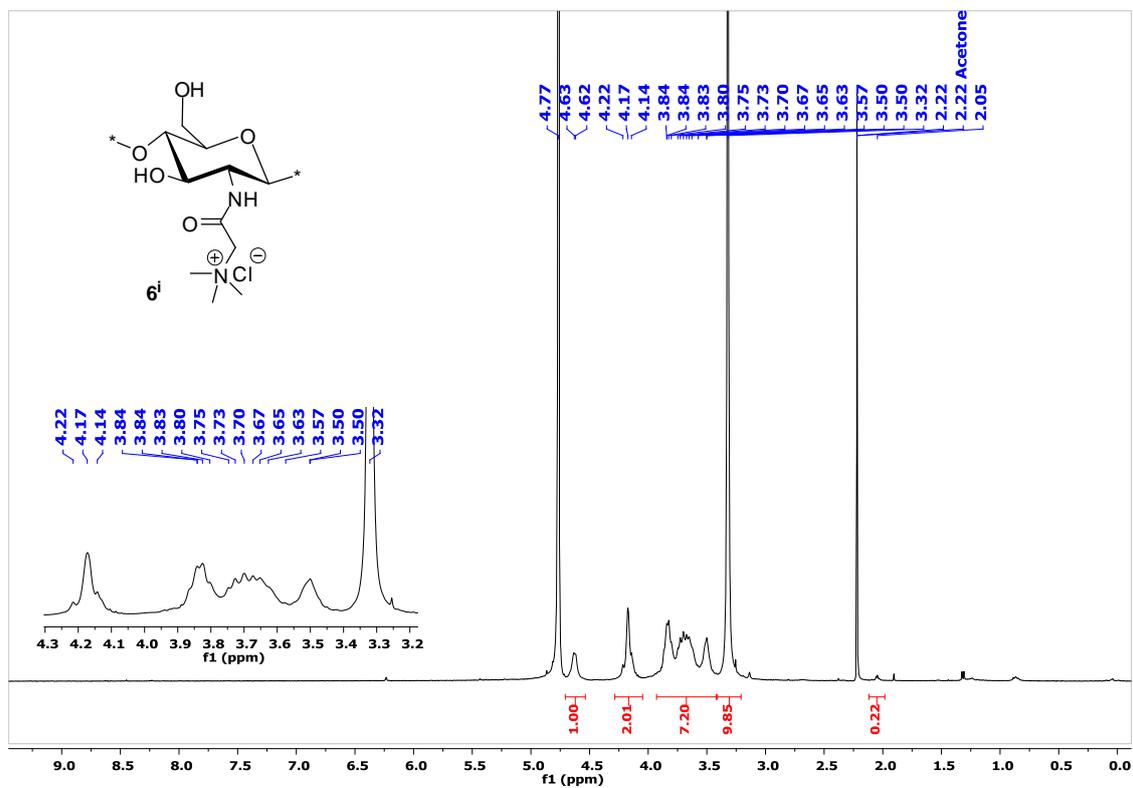
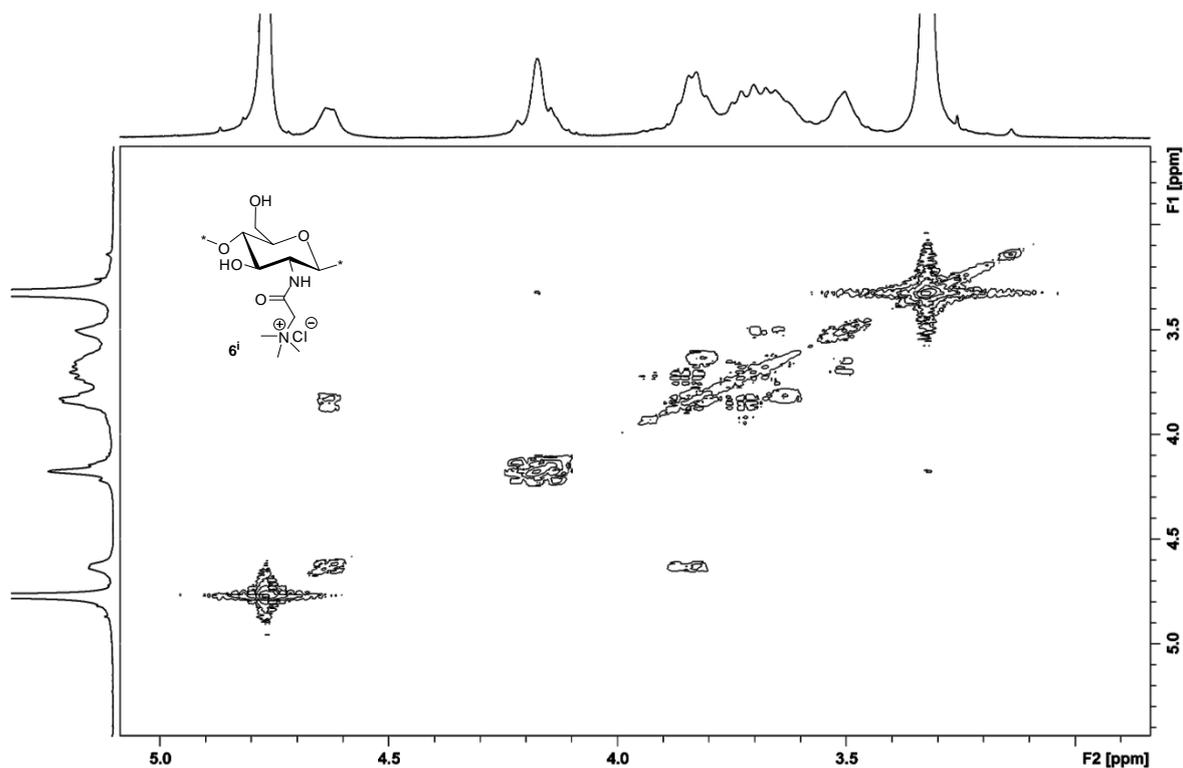


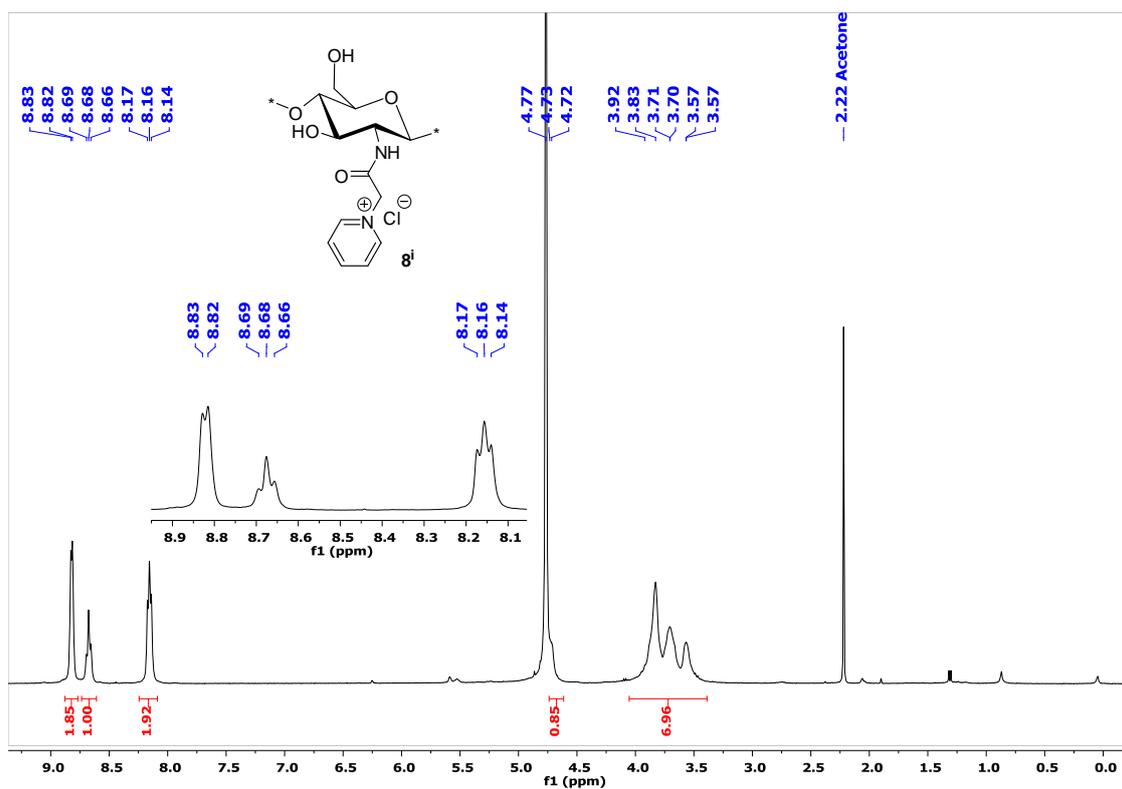
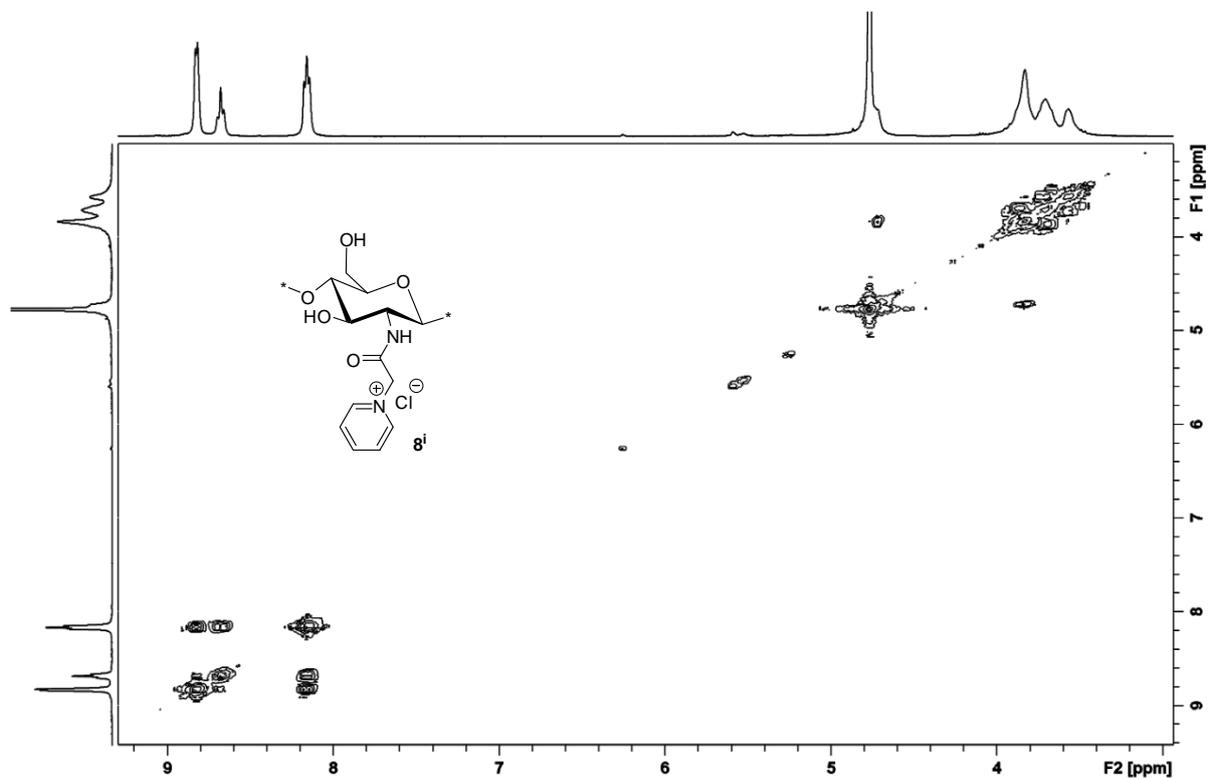
**Figure S3.** Representative  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) spectrum of compound  $4^i$  (BrA-diTBDMS-CS $^i$ ).



**Figure S4.** Representative  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ ) spectrum of the key intermediate compound  $9^{iv}$  (BrHA-diTBDMS-CS $^{iv}$ ).



5. Figures S5–S32:  $^1\text{H}$ NMR Spectra of Final Chitosan DerivativesFigure S5.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $6^i$  (TMA- $\text{CS}^i$ ).Figure S6.  $^1\text{H}$ - $^1\text{H}$  COSY NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $6^i$  (TMA- $\text{CS}^i$ ).

**Figure S7.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound **8<sup>i</sup>** (PyA-CS<sup>i</sup>).**Figure S8.**  $^1\text{H}$ - $^1\text{H}$  COSY (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound **8<sup>i</sup>** (PyA-CS<sup>i</sup>).

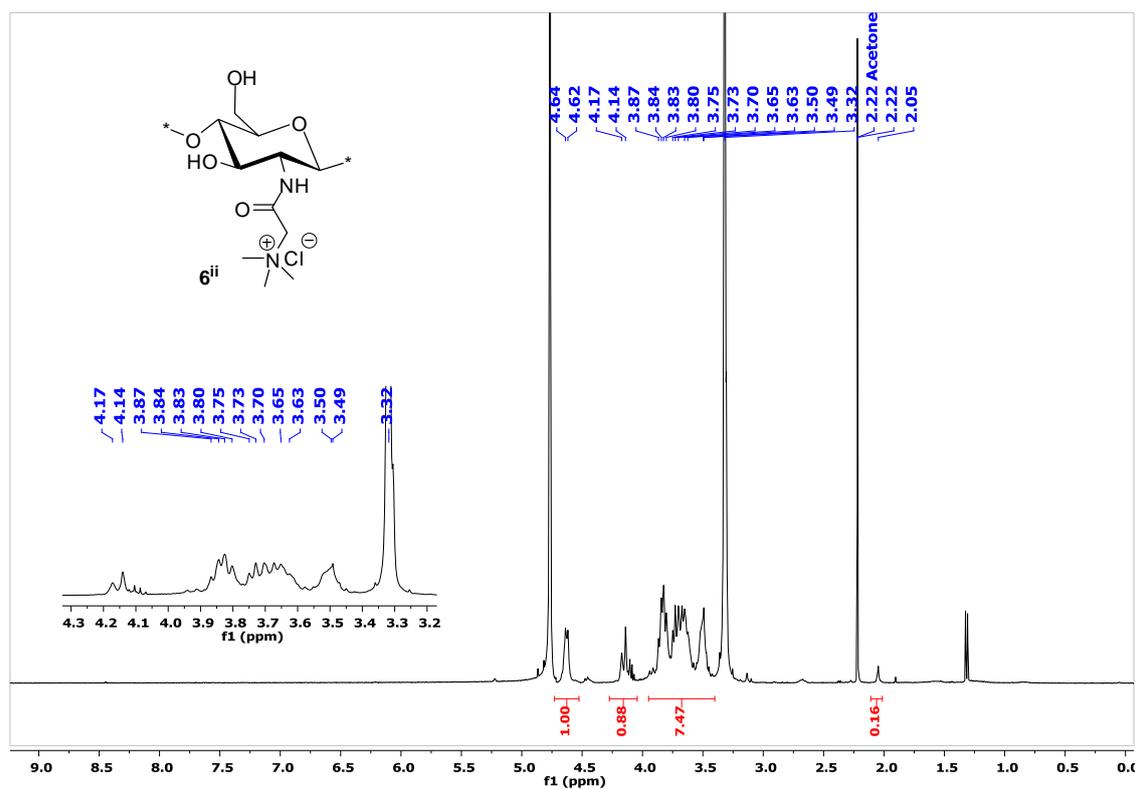
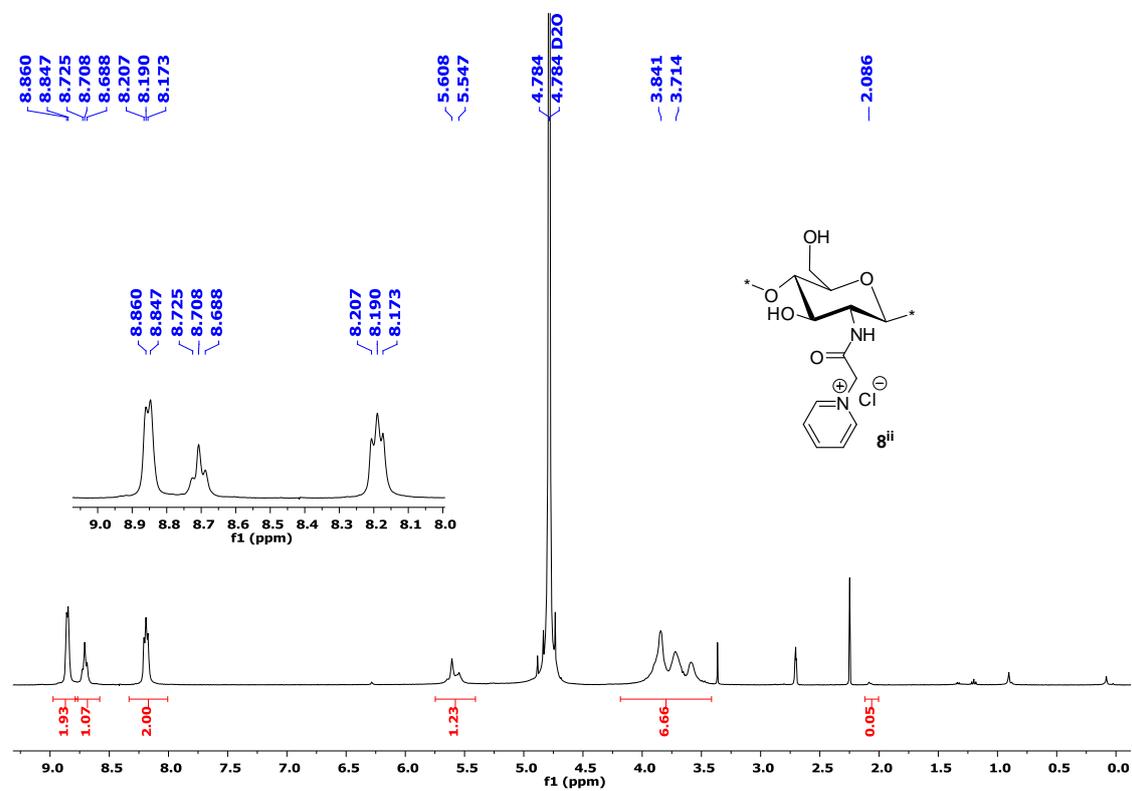
**Figure S9.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound **6<sup>ii</sup>** (TMA-CS<sup>ii</sup>).**Figure S10.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$  + 1 drop DCl) spectrum of compound **8<sup>ii</sup>** (PyA-CS<sup>ii</sup>).

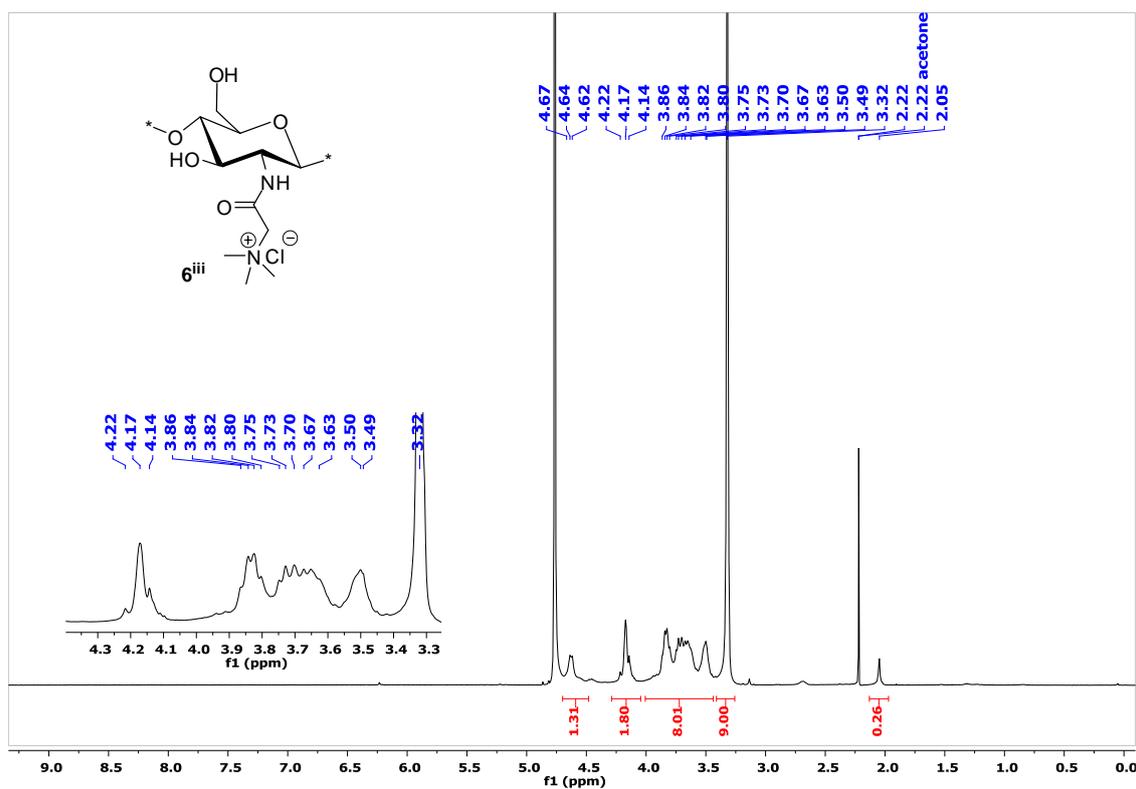
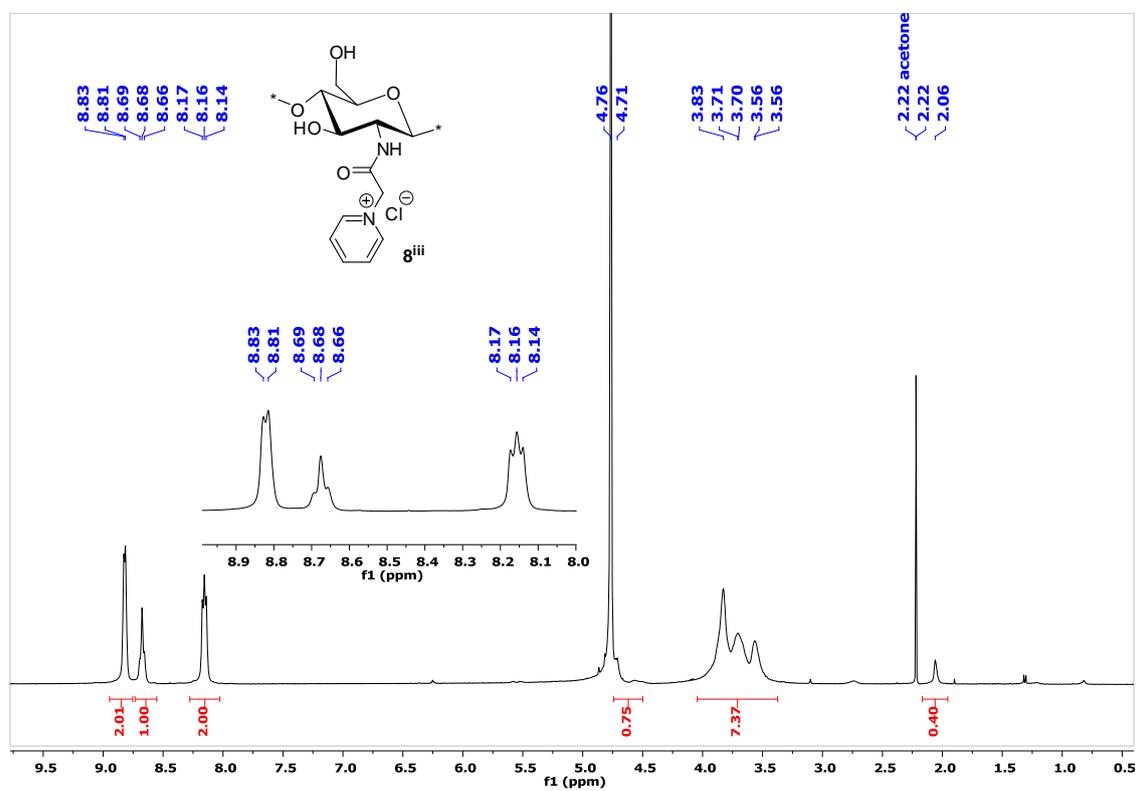
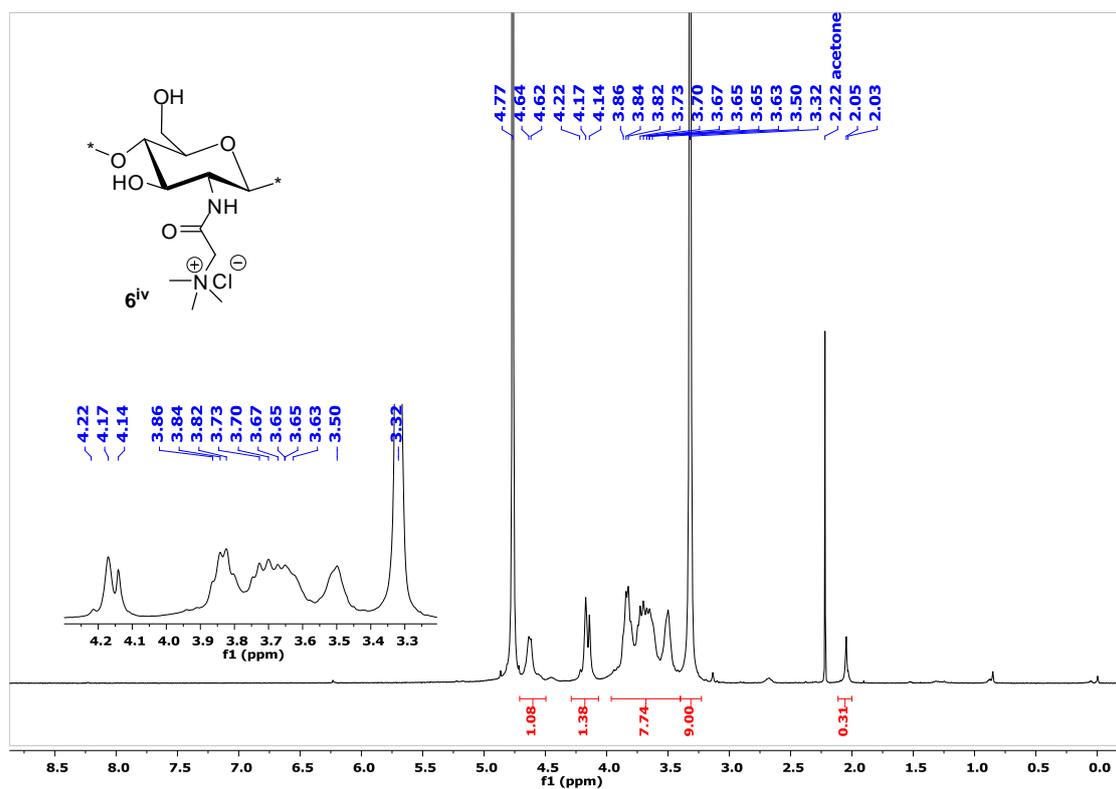
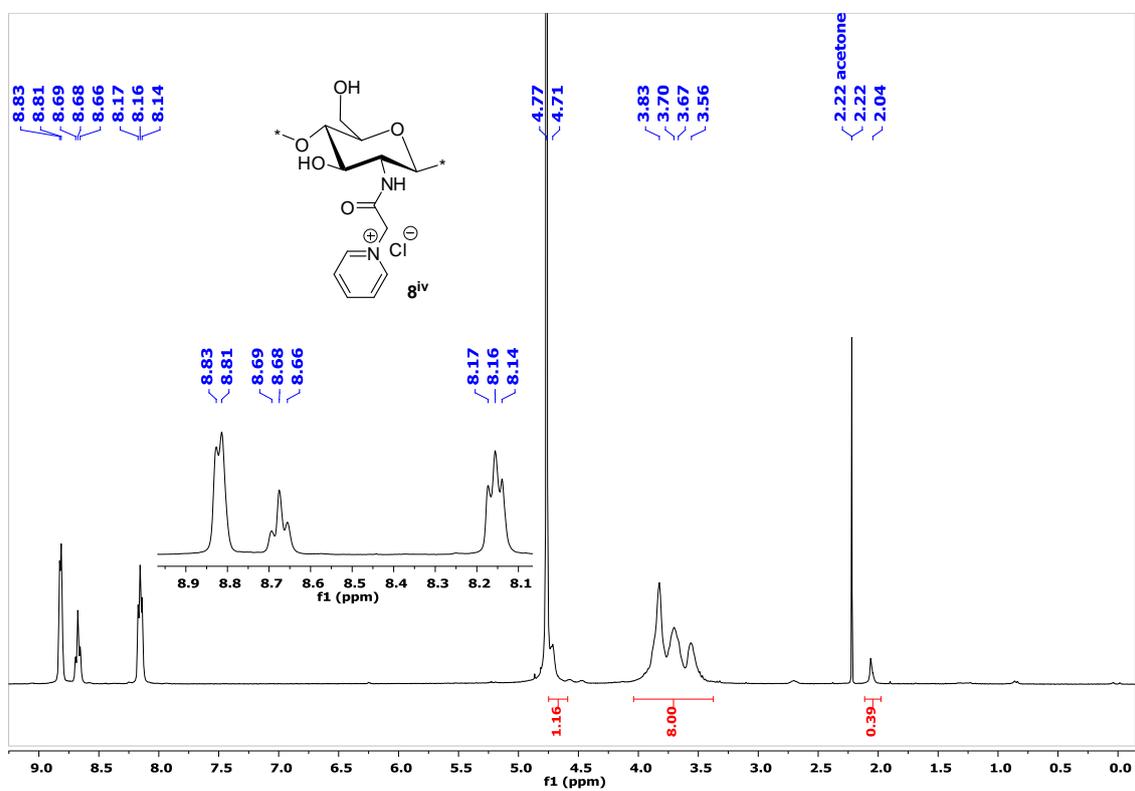
Figure S11.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound **6<sup>iii</sup>** (TMA-CS<sup>iii</sup>).Figure S12.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound **8<sup>iii</sup>** (PyA-CS<sup>iii</sup>).

Figure S13.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $6^{\text{iv}}$  (TMA-CS $^{\text{iv}}$ ).Figure S14.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $8^{\text{iv}}$  (PyA-CS $^{\text{iv}}$ ).

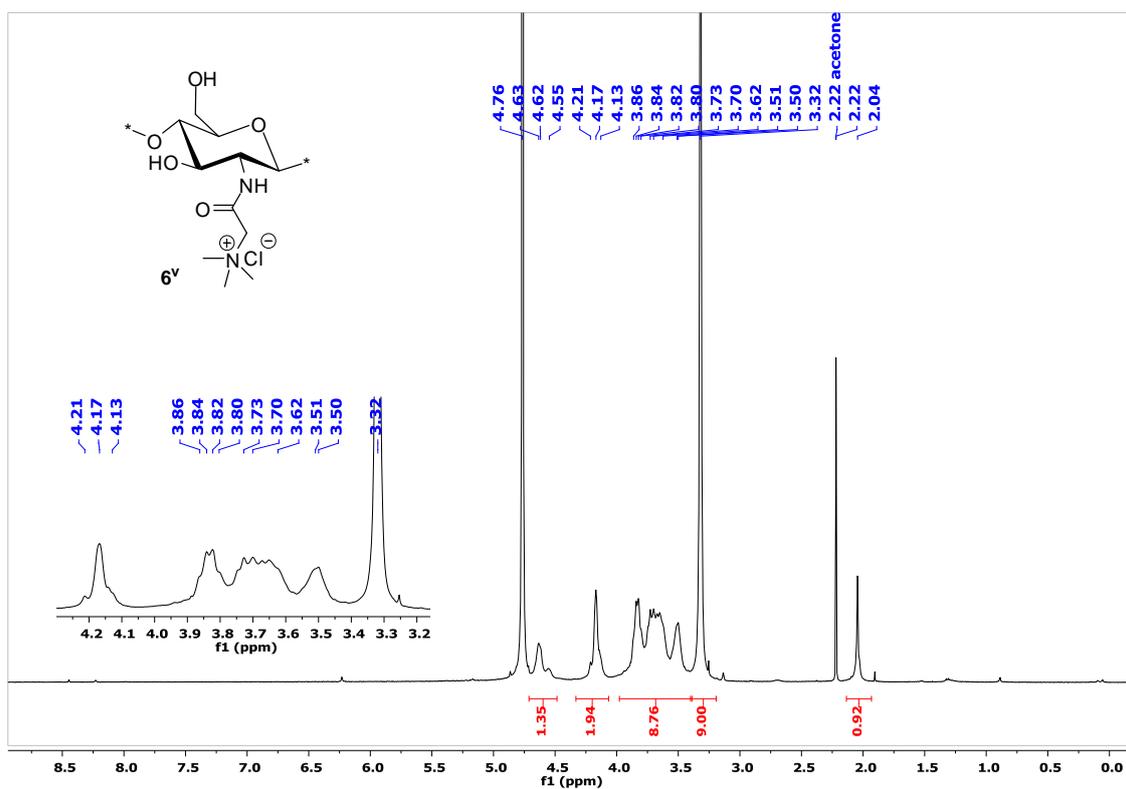
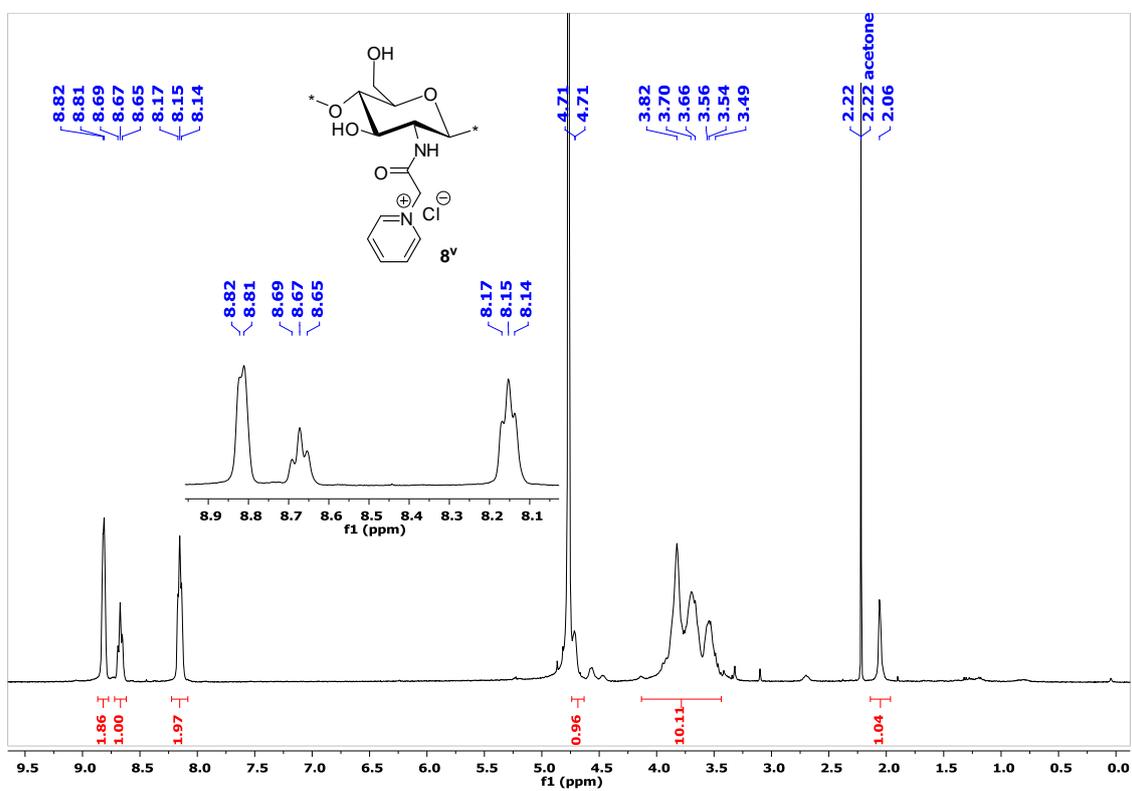
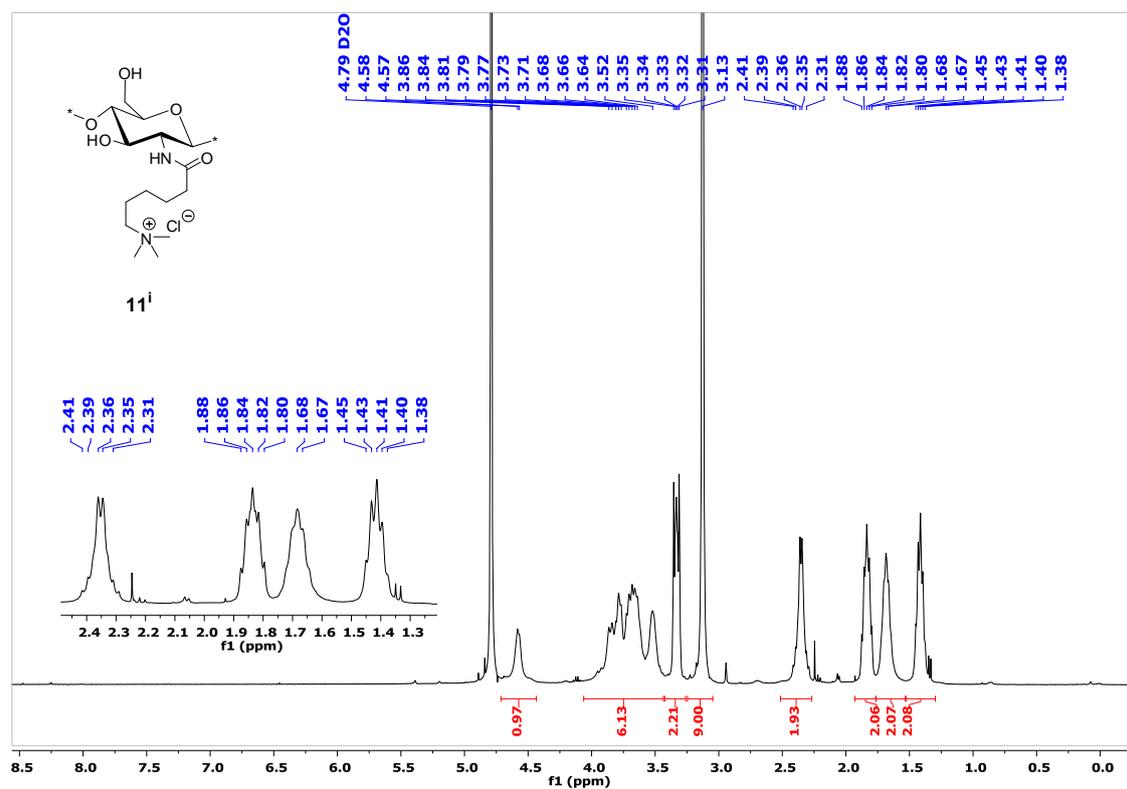
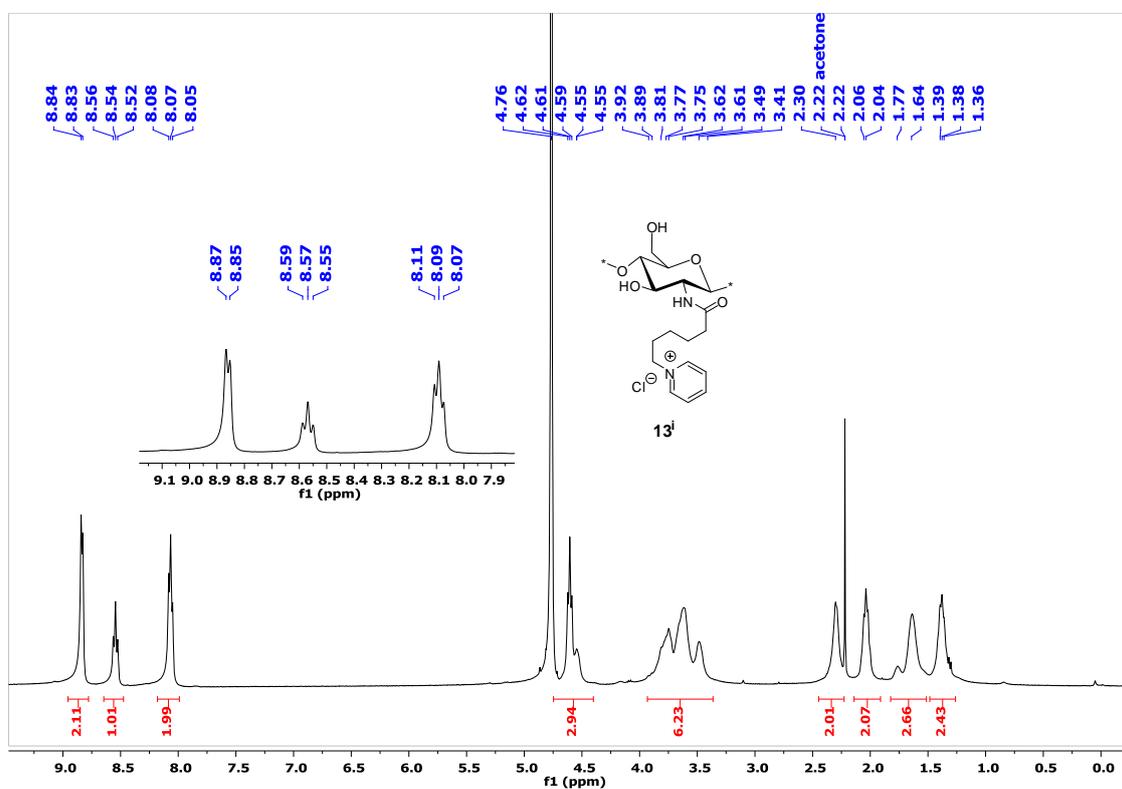
**Figure S15.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of \_compound **6<sup>v</sup>** (TMA-CS<sup>v</sup>).**Figure S16.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of \_compound **8<sup>v</sup>** (PyA-CS<sup>v</sup>).

Figure S17.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $11^i$  (TMHA-CS $^i$ ).Figure S18.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $13^i$  (PyHA-CS $^i$ ).

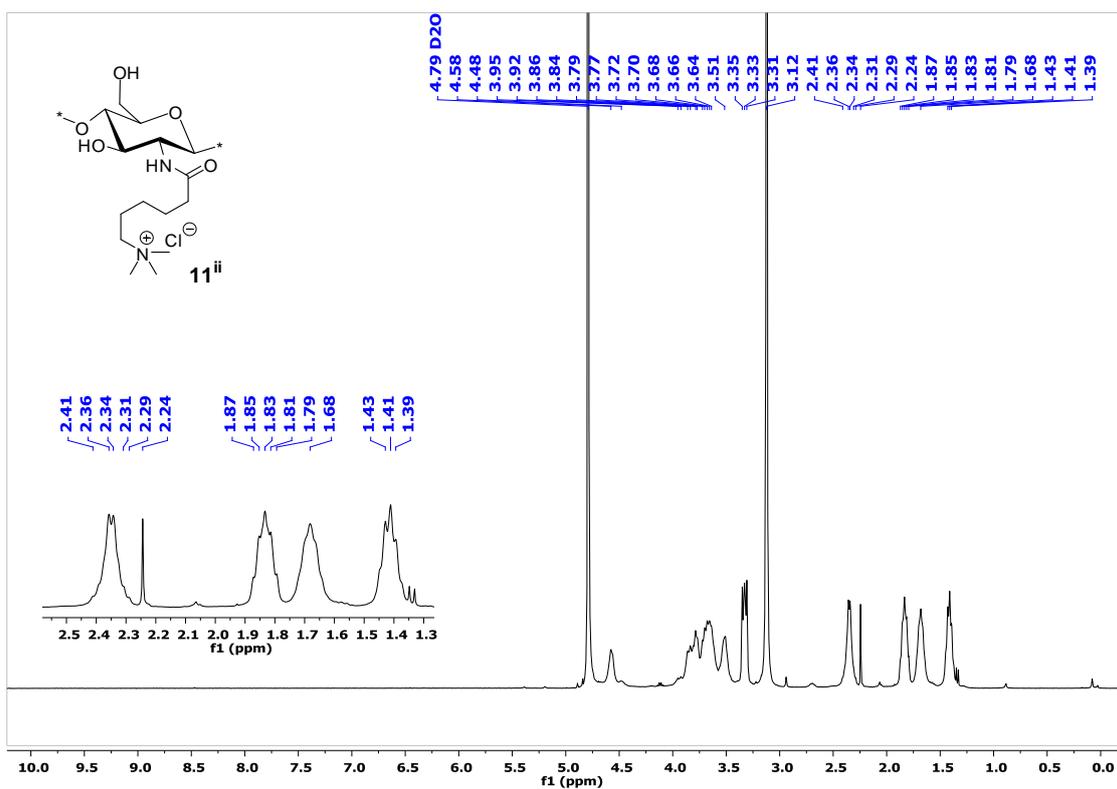
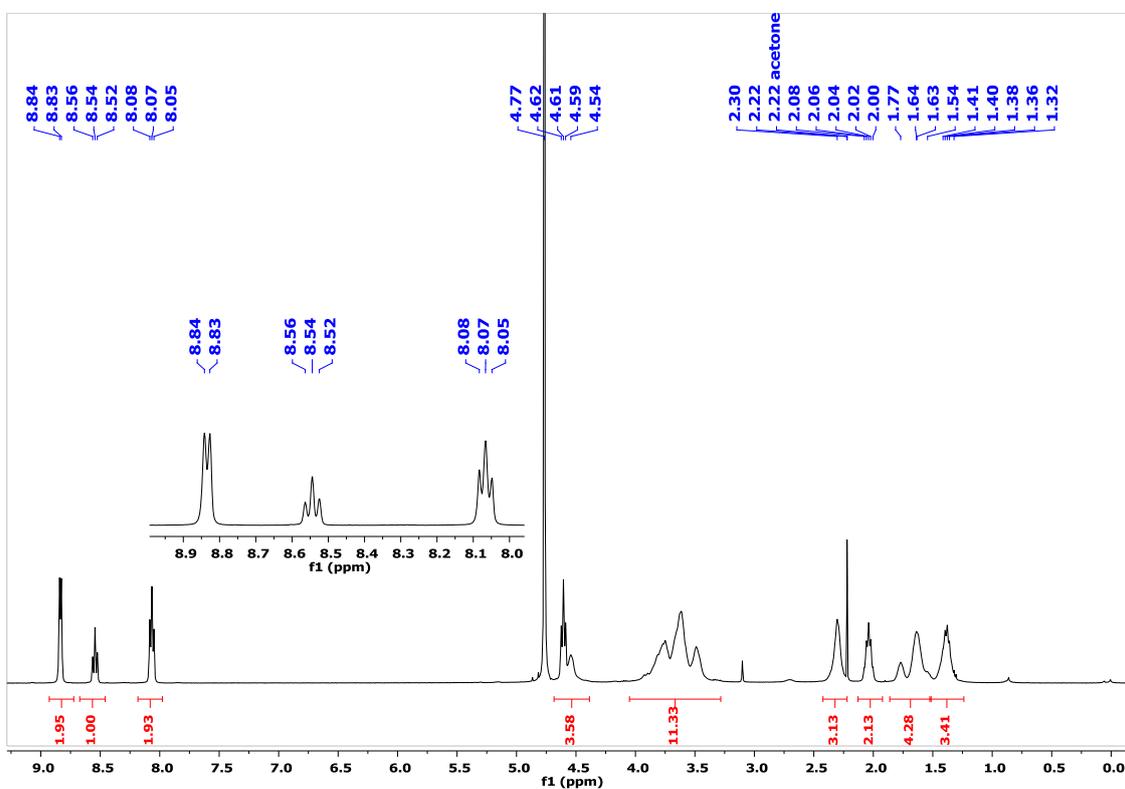
**Figure S19.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound **11<sup>ii</sup>** (TMHA-CS<sup>ii</sup>).**Figure S20.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound **13<sup>ii</sup>** (PyHA-CS<sup>ii</sup>).

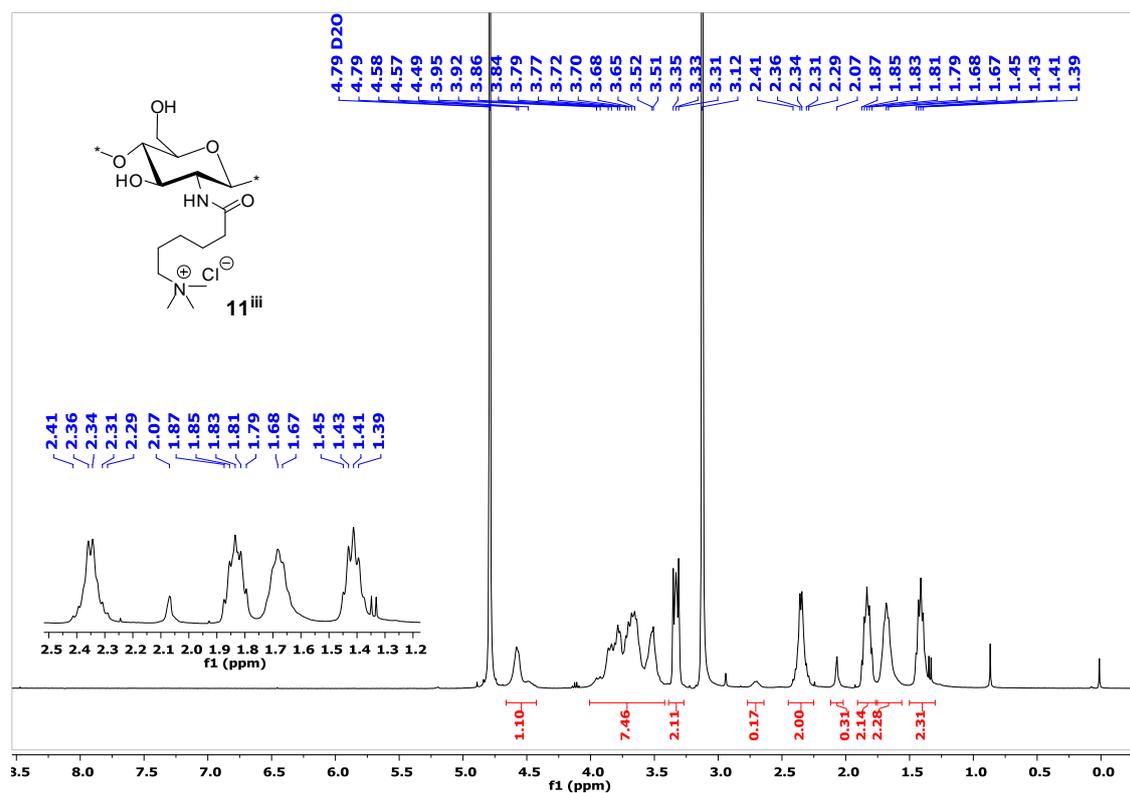
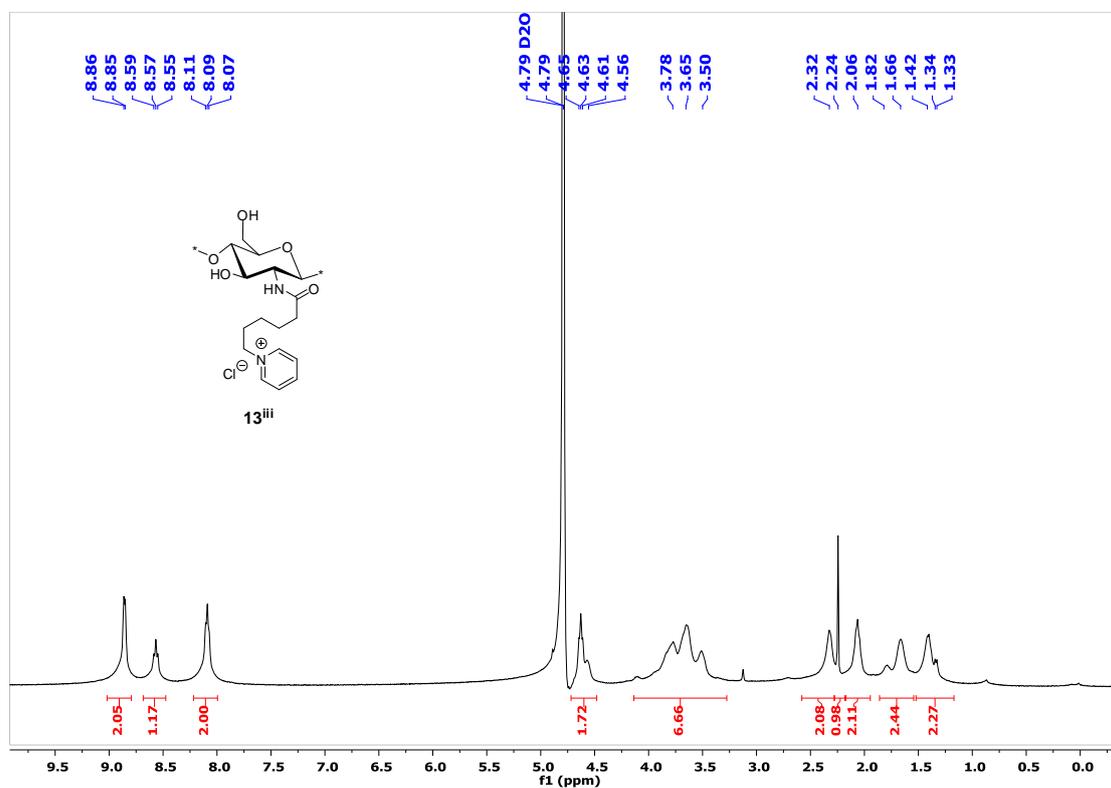
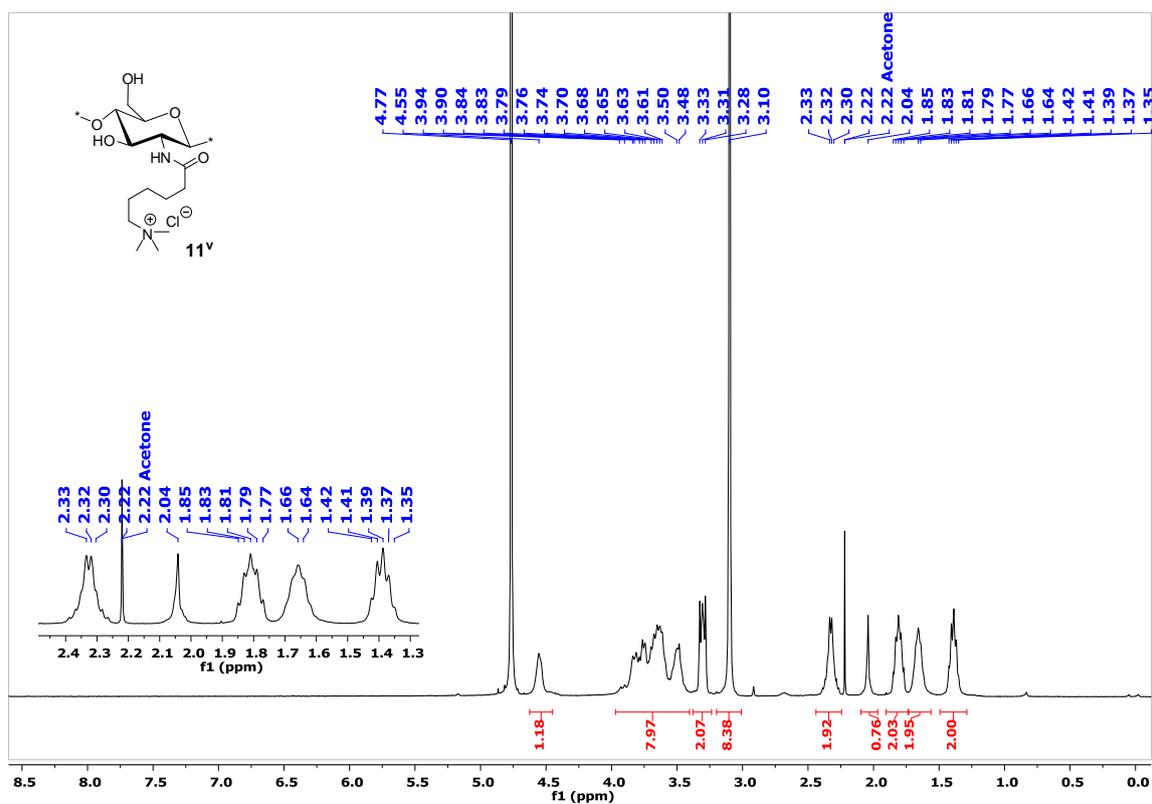
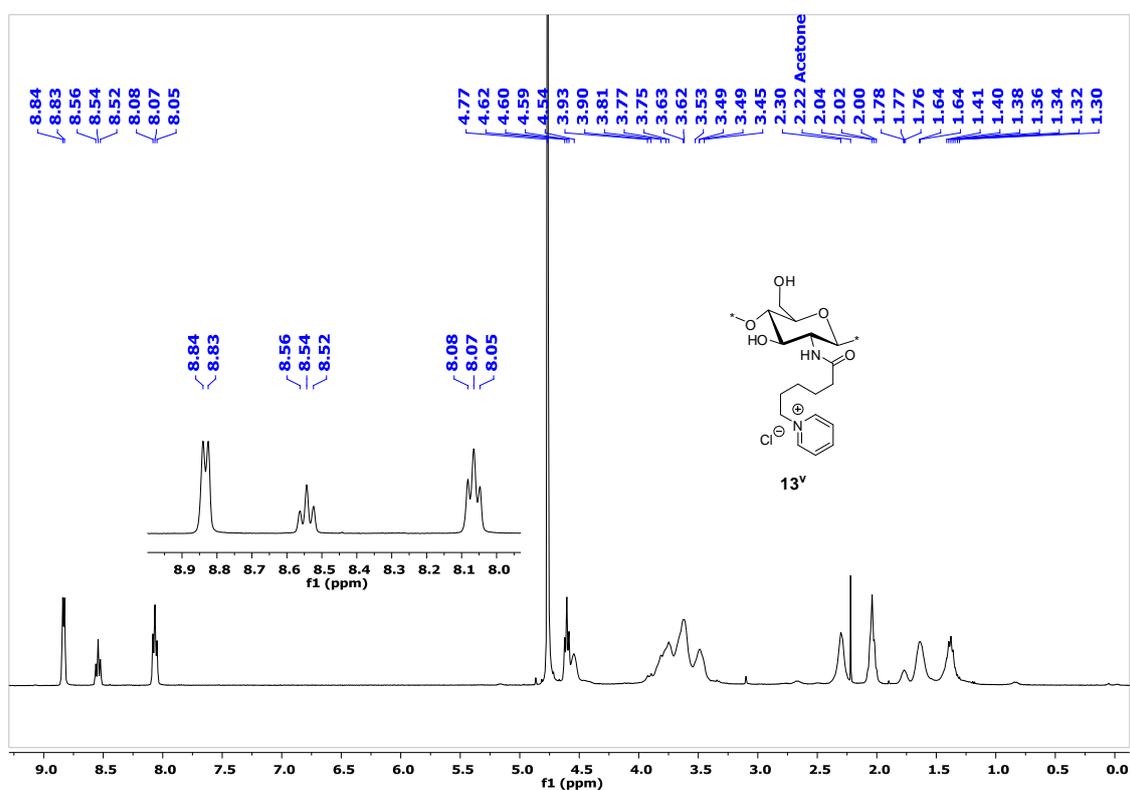
Figure S21.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of \_compound **11<sup>iii</sup>** (TMHA-CS<sup>iii</sup>).Figure S22.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of \_compound **13<sup>iii</sup>** (PyHA-CS<sup>iii</sup>).



Figure S25.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $11^{\text{v}}$  (TMHA- $\text{CS}^{\text{v}}$ ).Figure S26.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $13^{\text{v}}$  (PyHA- $\text{CS}^{\text{v}}$ ).

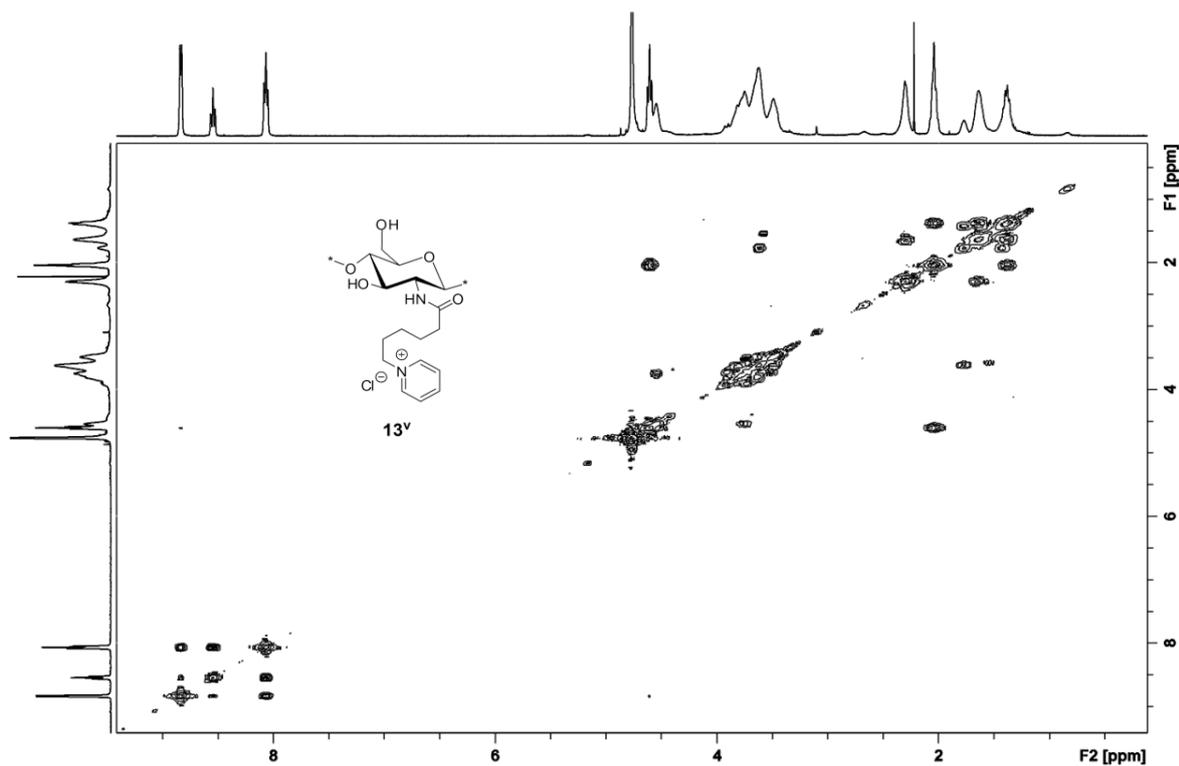
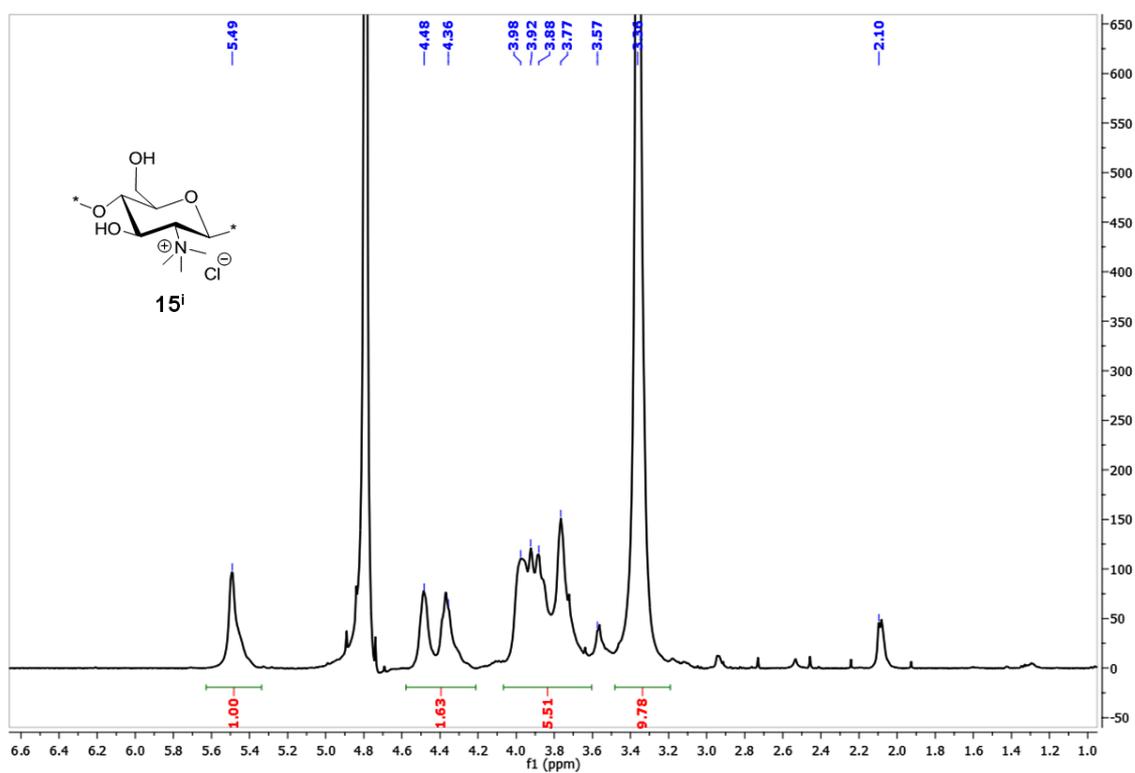
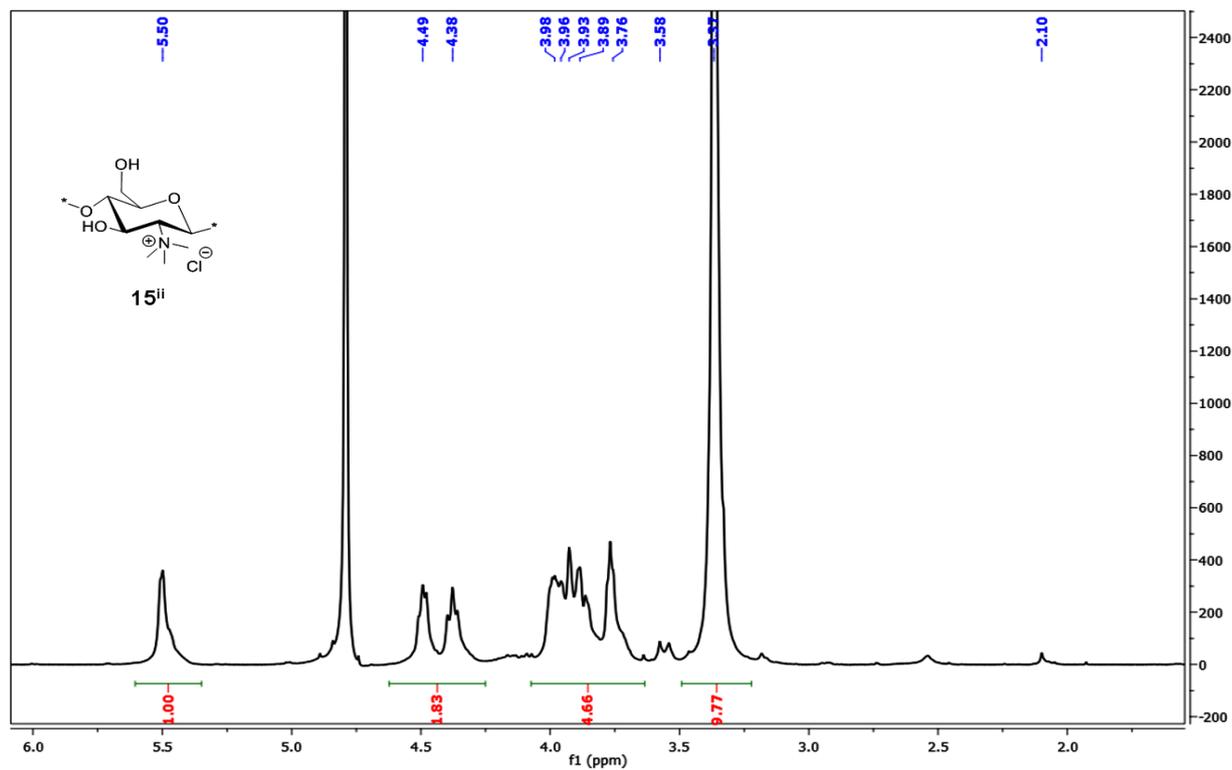
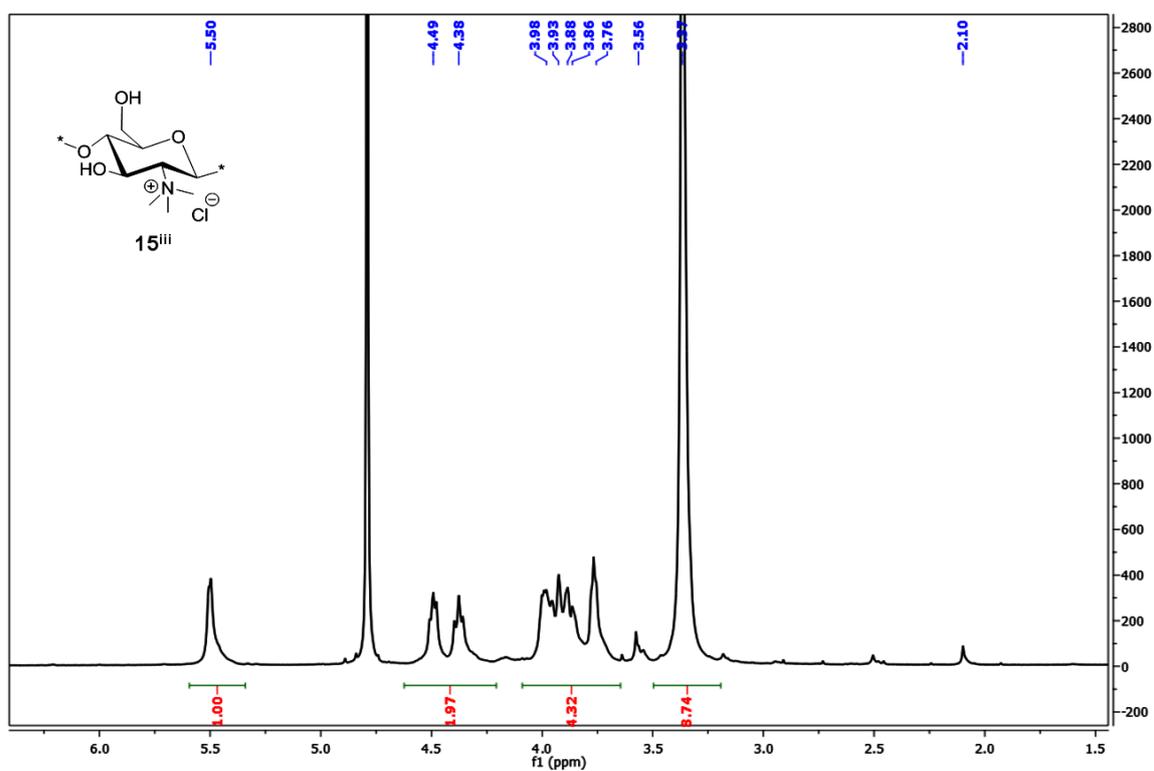
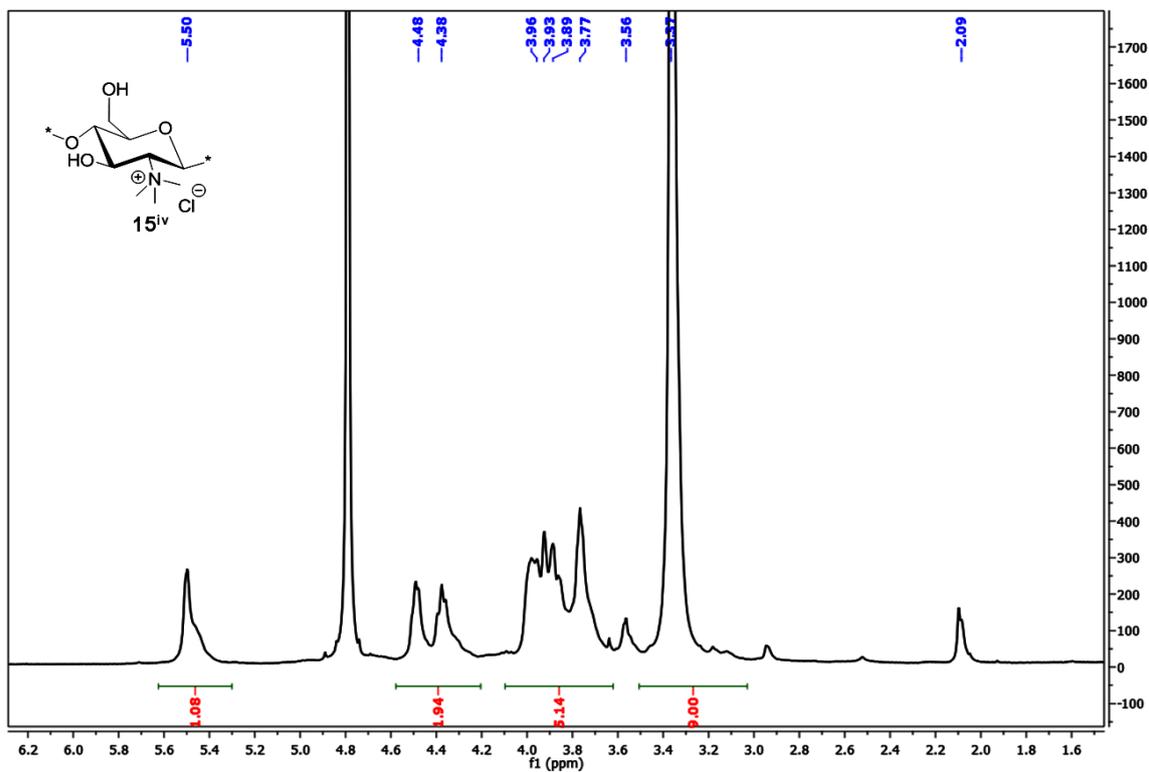
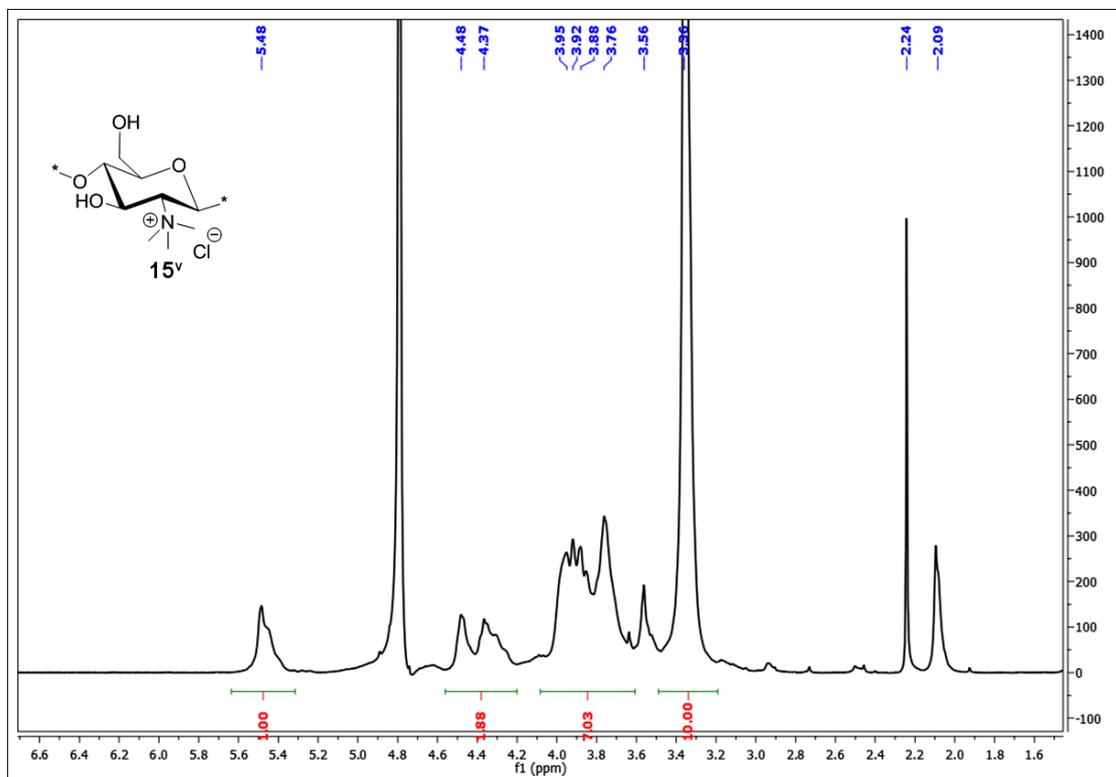
**Figure S27.**  $^1\text{H}$ - $^1\text{H}$  COSY (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $13^{\text{v}}$  (PyHA-CS $^{\text{v}}$ ).**Figure S28.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $15^{\text{i}}$  (TMC $^{\text{i}}$ ).

Figure S29.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $15^{\text{ii}}$  ( $\text{TMC}^{\text{ii}}$ ).Figure S30.  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $15^{\text{iii}}$  ( $\text{TMC}^{\text{iii}}$ ).

**Figure S31.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $15^{\text{iv}}$  ( $\text{TMC}^{\text{iv}}$ ).**Figure S32.**  $^1\text{H}$  NMR (400 MHz,  $\text{D}_2\text{O}$ ) spectrum of compound  $15^{\text{v}}$  ( $\text{TMC}^{\text{v}}$ ).

6. Graphs for Hemolysis Rate

Figure S33. Hemolysis rate (%) for Series 6<sup>i-v</sup> (TMA-chitosan<sup>i-v</sup>).

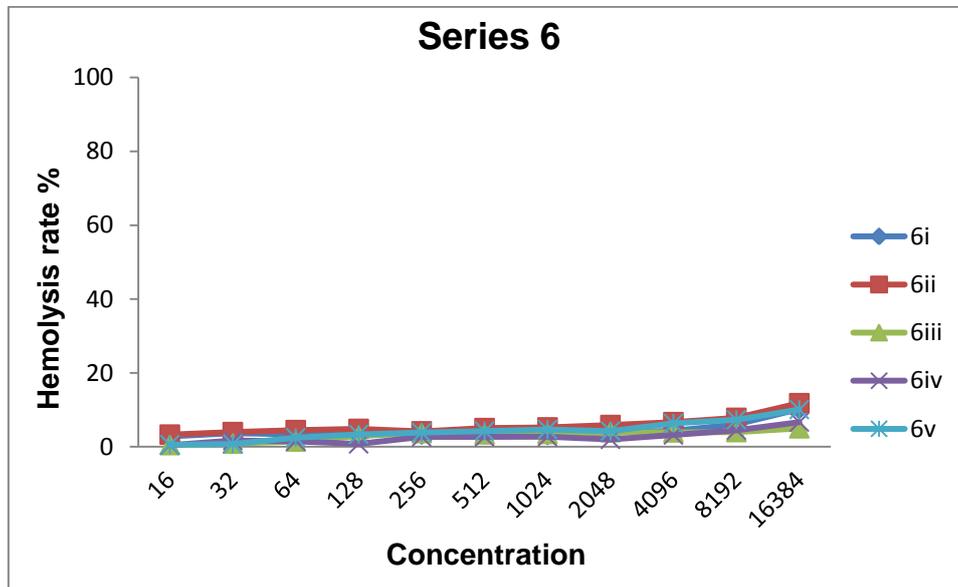


Figure S34. Hemolysis rate (%) for Series 8<sup>i-v</sup> (PyA-chitosan<sup>i-v</sup>).

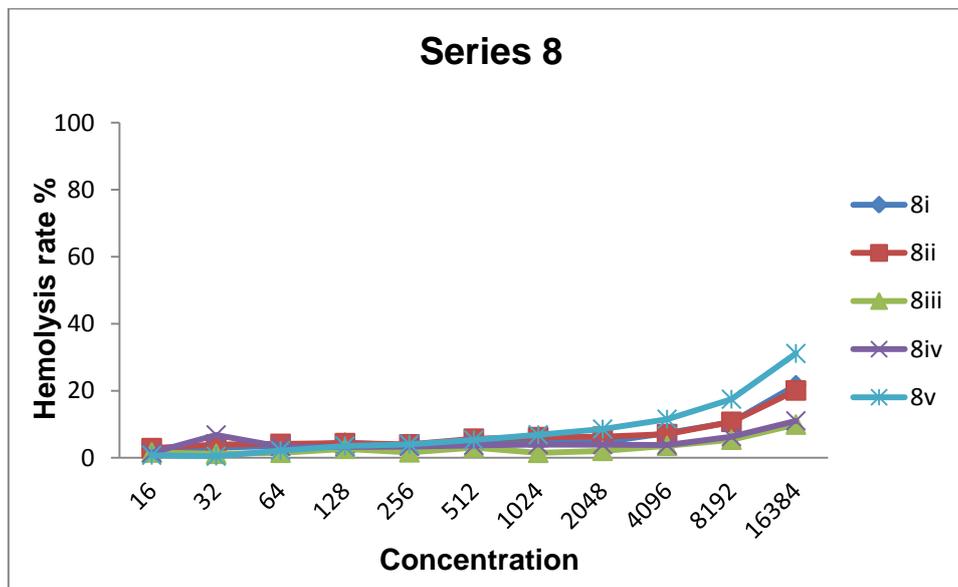


Figure S35. Hemolysis rate (%) for Series 11<sup>i-v</sup> (TMHA-chitosan<sup>i-v</sup>).

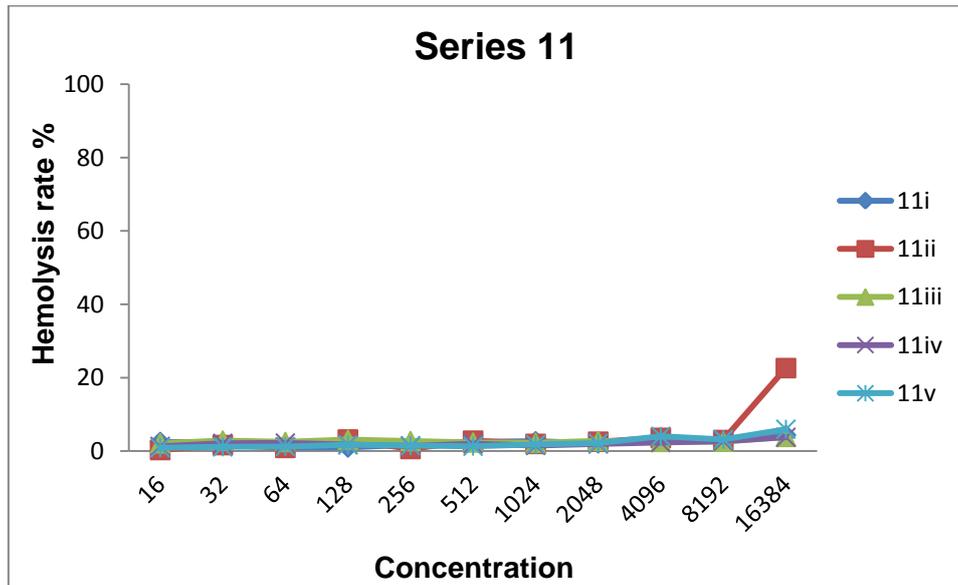
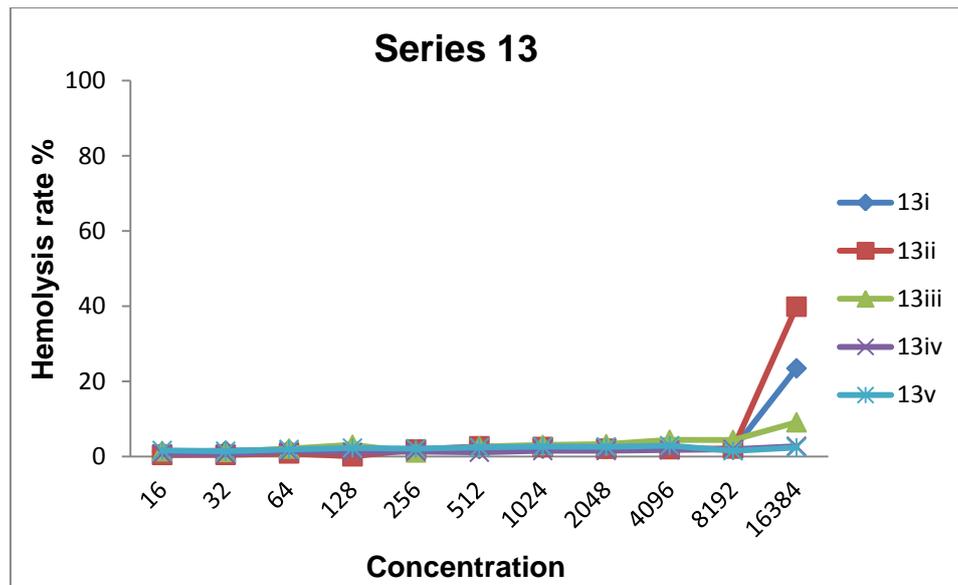
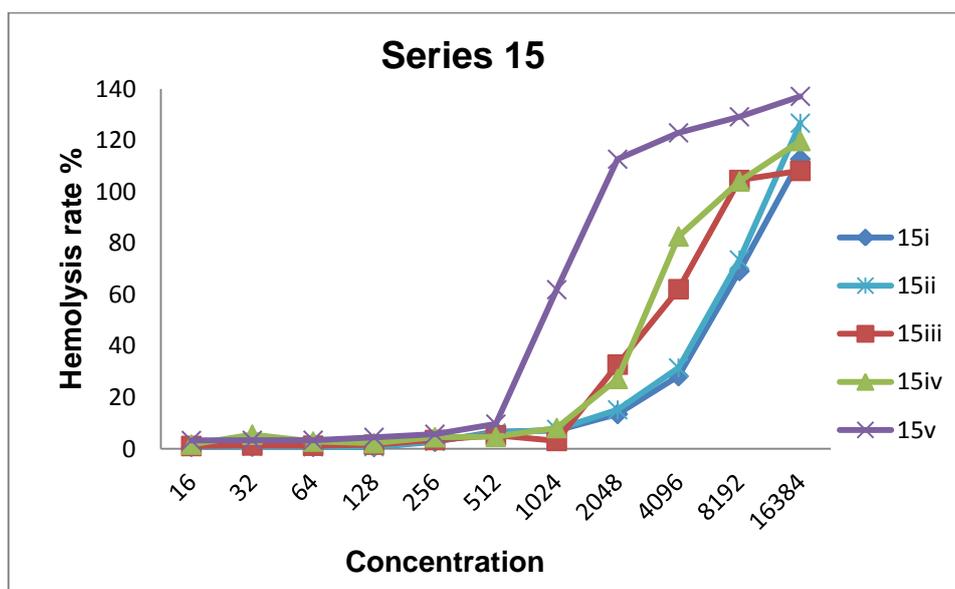


Figure S36. Hemolysis rate (%) for Series 13<sup>i-v</sup> (PyHA-chitosan<sup>i-v</sup>).



**Figure S37.** Hemolysis rate (%) for Series 15<sup>i-v</sup> (TMC<sup>i-v</sup>).

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