Electronic Supporting Information (ESI)

Tuning mucoadhesion and mucopenetration in self-assembled poly(lactic acid)-block-poly(oligoethylene glycol methacrylate) block copolymer nanoparticles by controlling side-chain lengths

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1. **Modified Ussing Chamber Diffusion System**

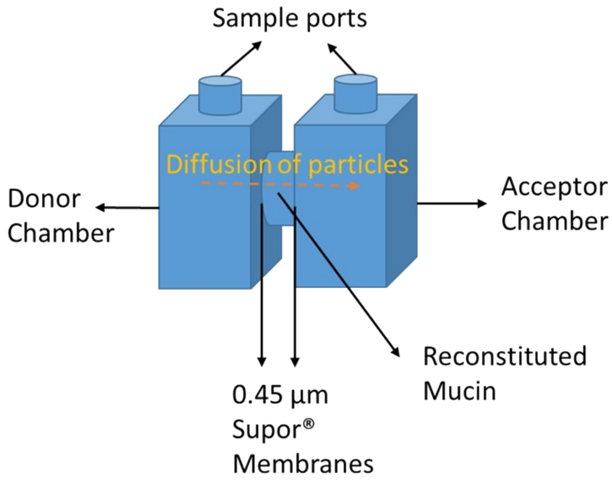

Figure S1: Schematic of modified Ussing chamber diffusion system used to measure nanoparticle diffusion through a mucosal membrane.

2. PLA-POEGMA$_n$ Polymer GPC Traces

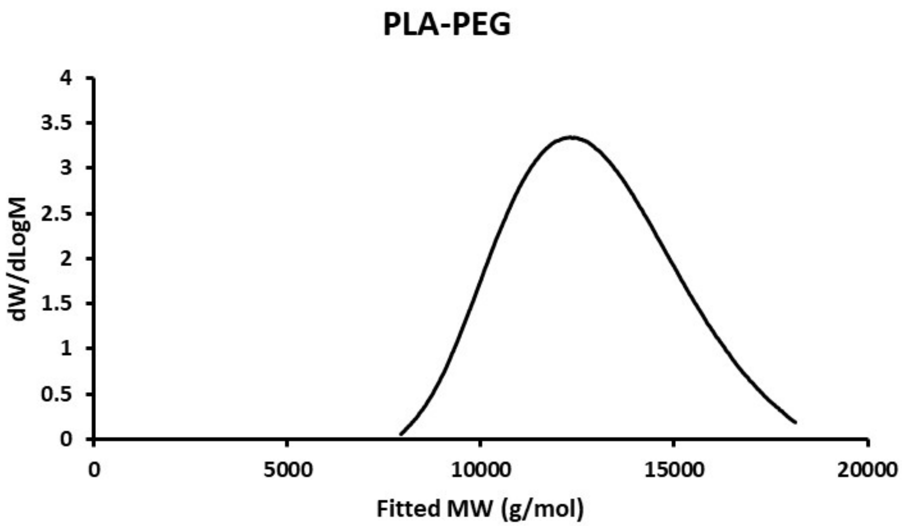

Figure S2: Molecular weight distribution of PLA-PEG polymer dissolved in DMF with 25 mM LiBr (2 mg/mL polymer concentration).

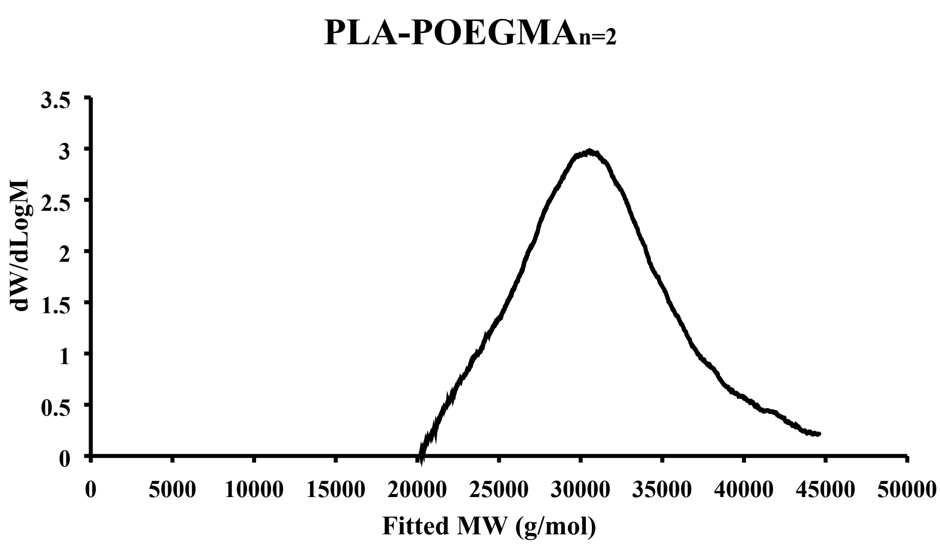

Figure S3: Molecular weight distribution of PLA-POEGMA$_{n=2}$ polymer dissolved in DMF with 25 mM LiBr (2 mg/mL polymer concentration).

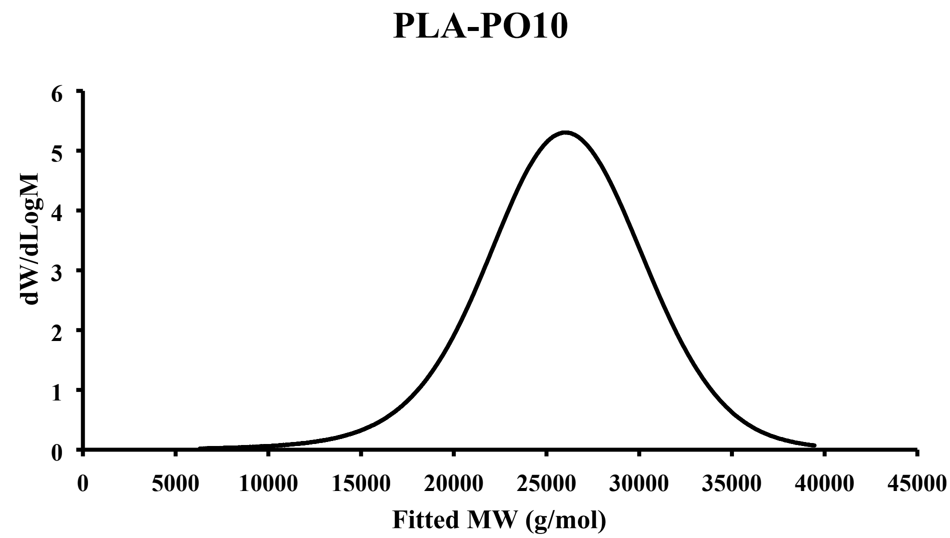

Figure S4: Molecular weight distribution of PLA-PO10 polymer dissolved in DMF with 25 mM LiBr (2 mg/mL polymer concentration).

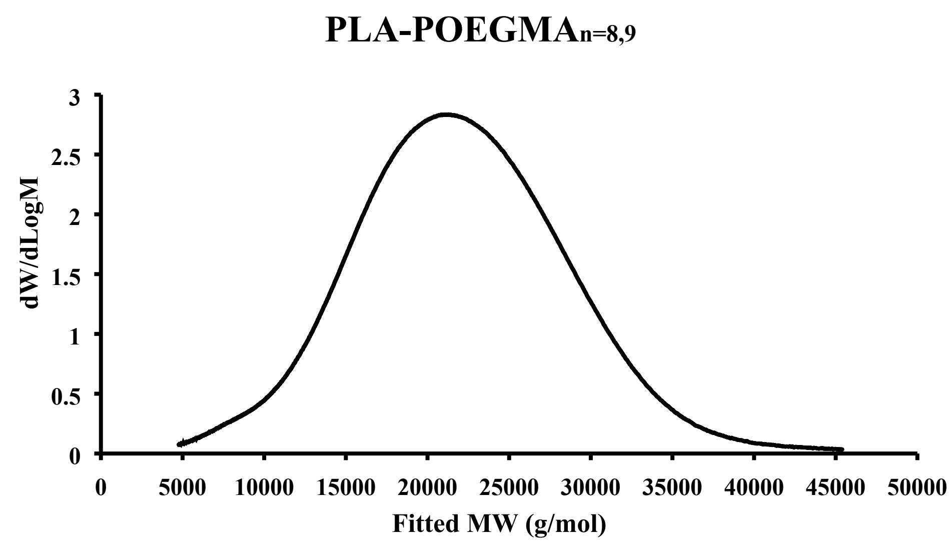

Figure S5: Molecular weight distribution of PLA-POEGMA$_{n=8,9}$ polymer dissolved in DMF with 25 mM LiBr (2 mg/mL polymer concentration).

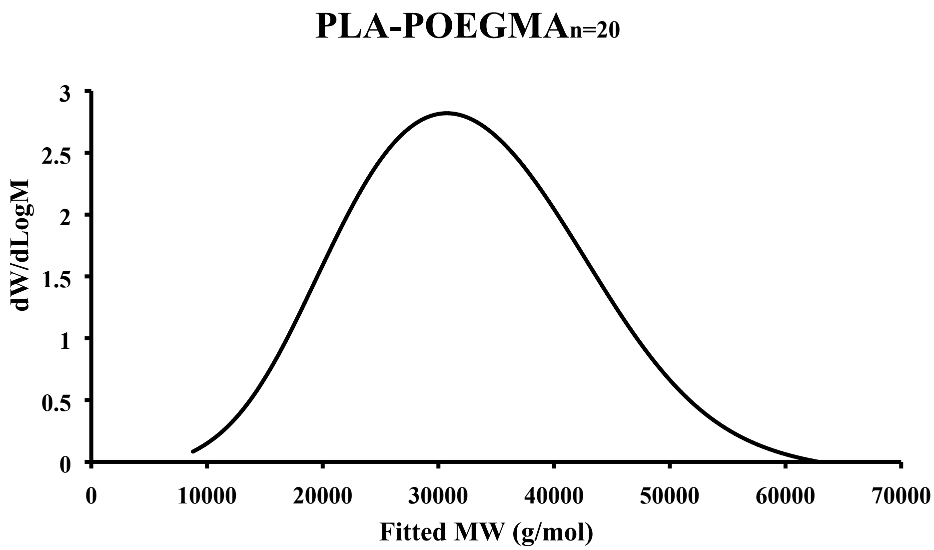

Figure S6: Molecular weight distribution of PLA-POEGMA$_{n=20}$ polymer dissolved in DMF with 25 mM LiBr (2 mg/mL polymer concentration).

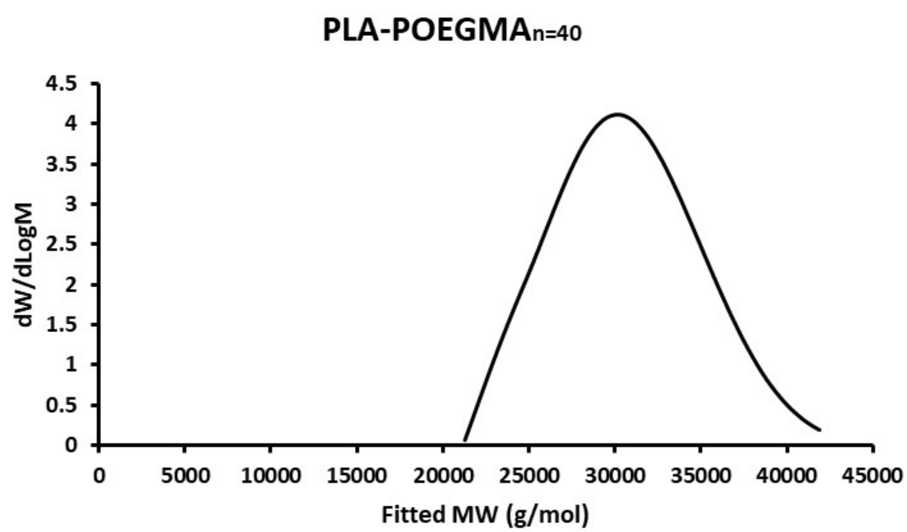

Figure S7: Molecular weight distribution of PLA-POEGMA$_{n=40}$ polymer dissolved in DMF with 25 mM LiBr (2 mg/mL polymer concentration).

3. PLA-POEGMA$_n$ Polymer ^{1}H NMR Spectra

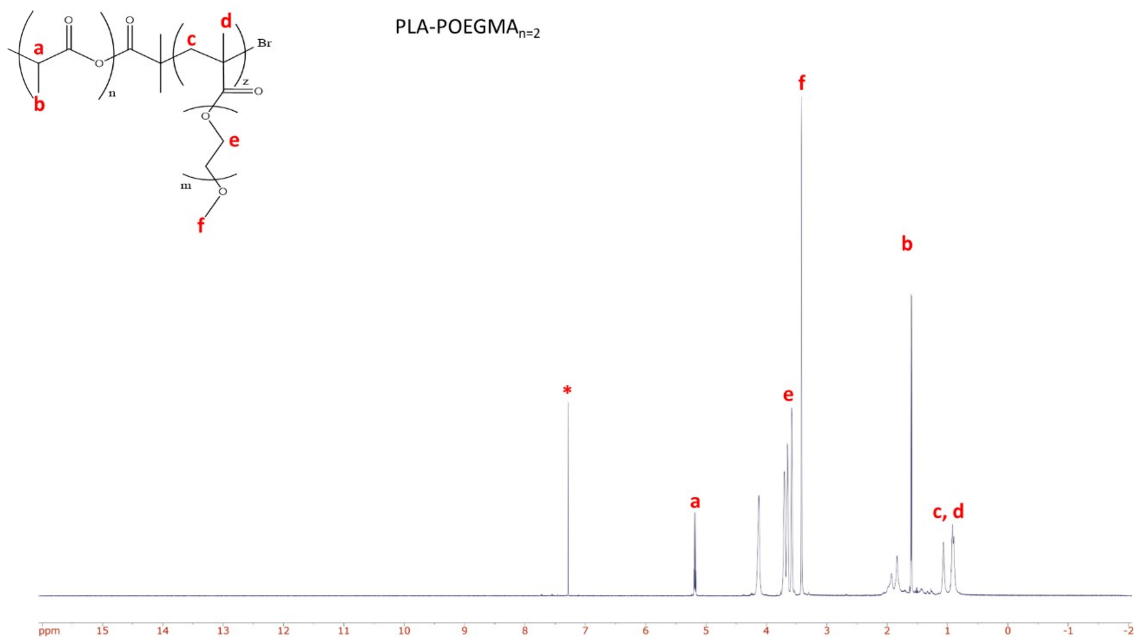

Figure S8: ^{1}H NMR spectra of PLA-POEGMA$_{n=2}$ polymer dissolved in deuterated chloroform (10 mg/mL polymer concentration).

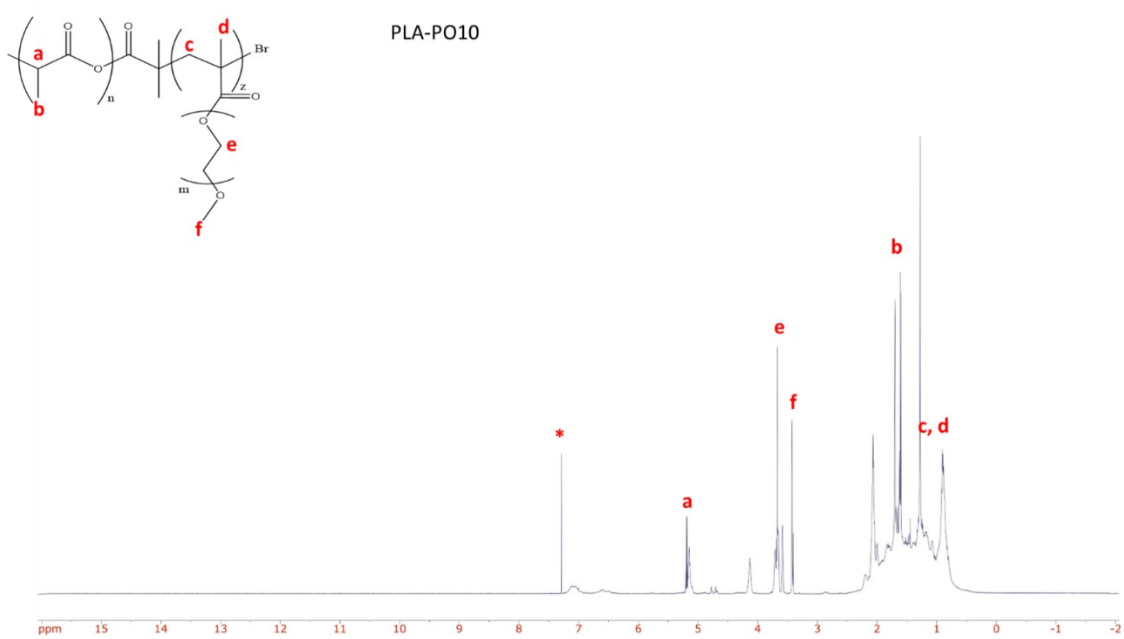

Figure S9: ^{1}H NMR spectra of PLA-PO10 polymer dissolved in deuterated chloroform (10 mg/mL polymer concentration).

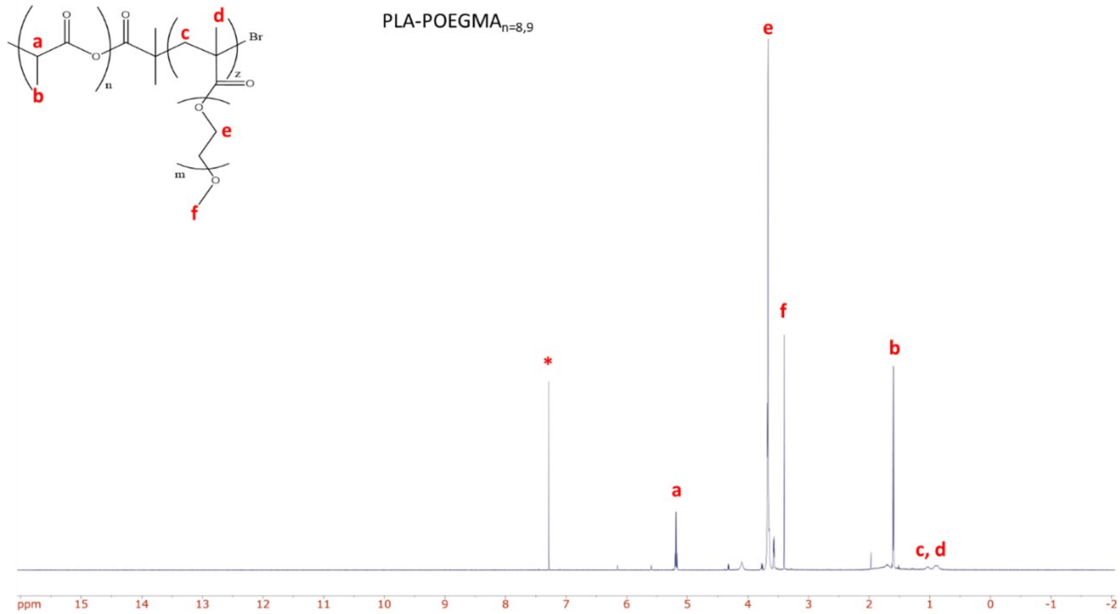

Figure S10: ^{1}H NMR spectra of PLA-POEGMA$_{n=8,9}$ polymer dissolved in deuterated chloroform (10 mg/mL polymer concentration).

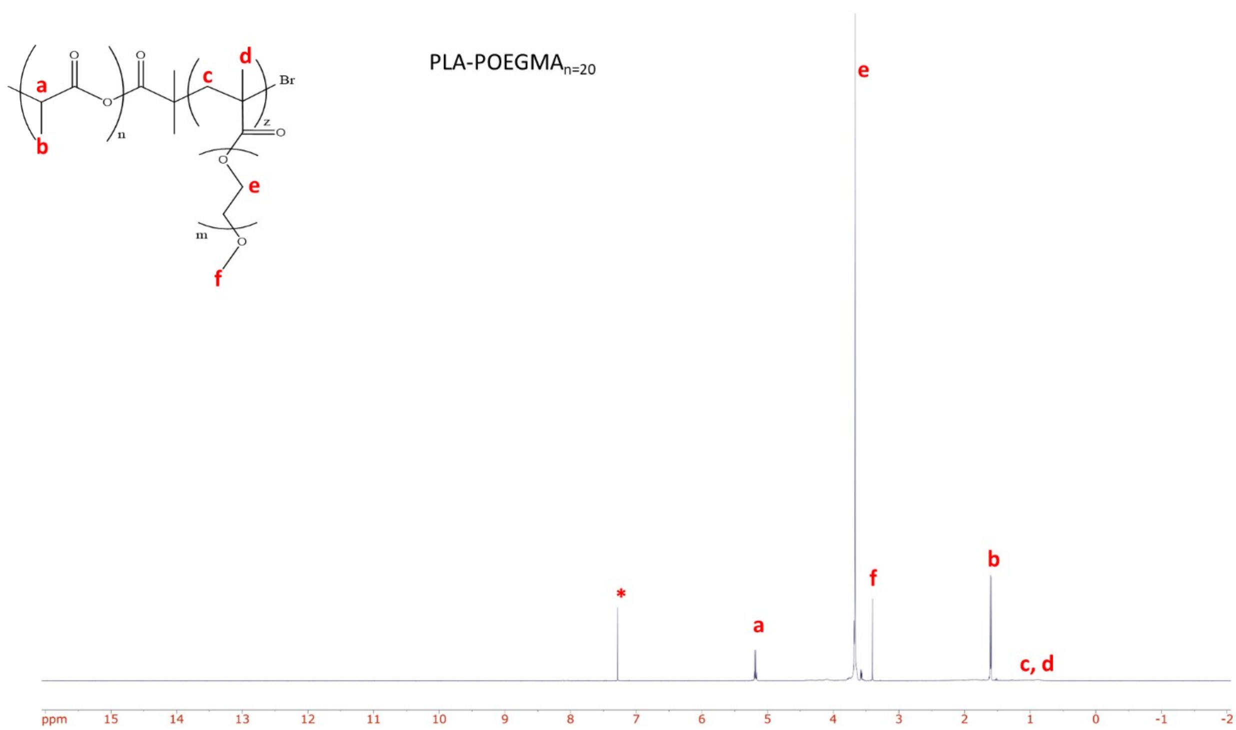

Figure S11: ^{1}H NMR spectra of PLA-POEGMA$_{n=20}$ polymer dissolved in deuterated chloroform (10 mg/mL polymer concentration).

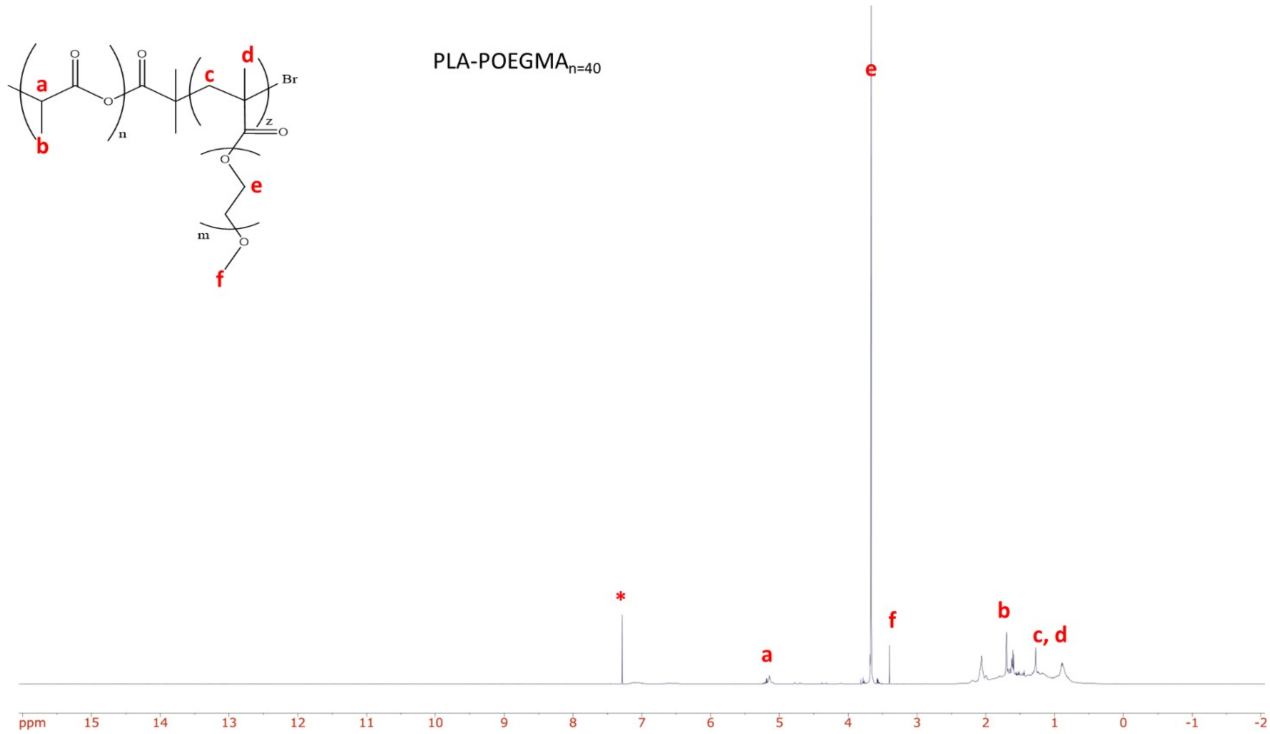

Figure S12: ^{1}H NMR spectra of PLA-POEGMA$_{n=40}$ polymer dissolved in deuterated chloroform (10 mg/mL polymer concentration).

4. Rheological Synergism Measurements – Viscosity

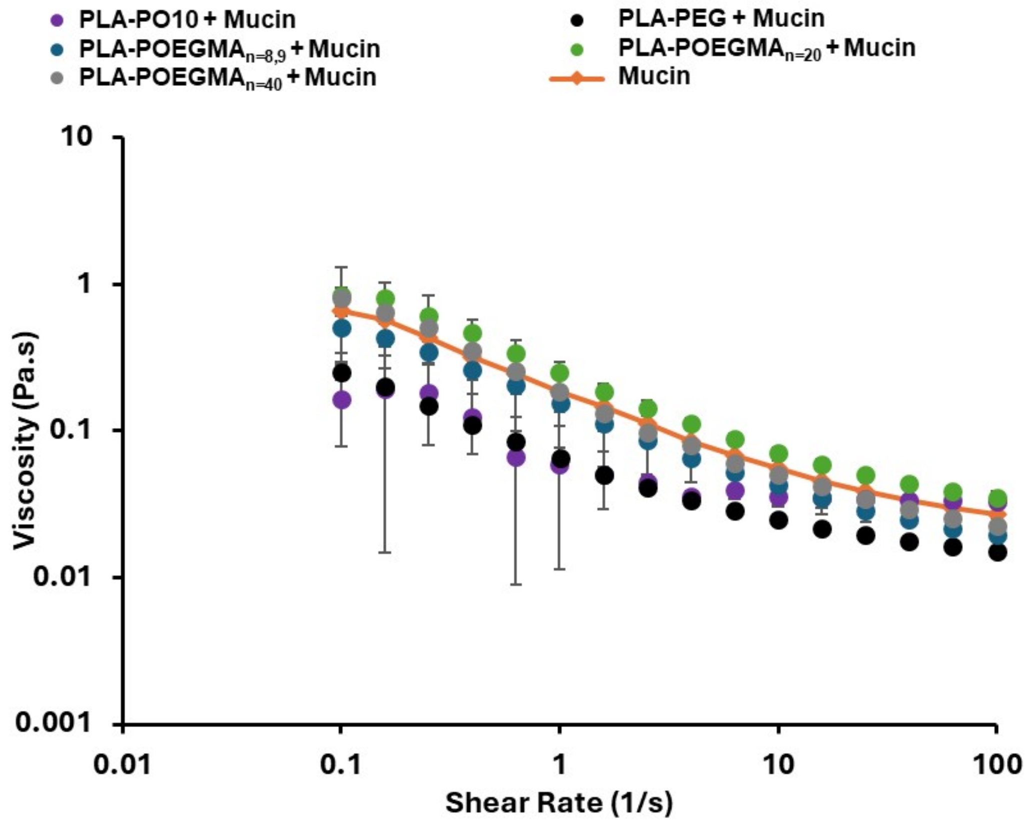

Figure S13: Viscosity as a function of shear rate for PLA-POEGMA$_n$ NPs incubated with 10 w/w% of mucin.

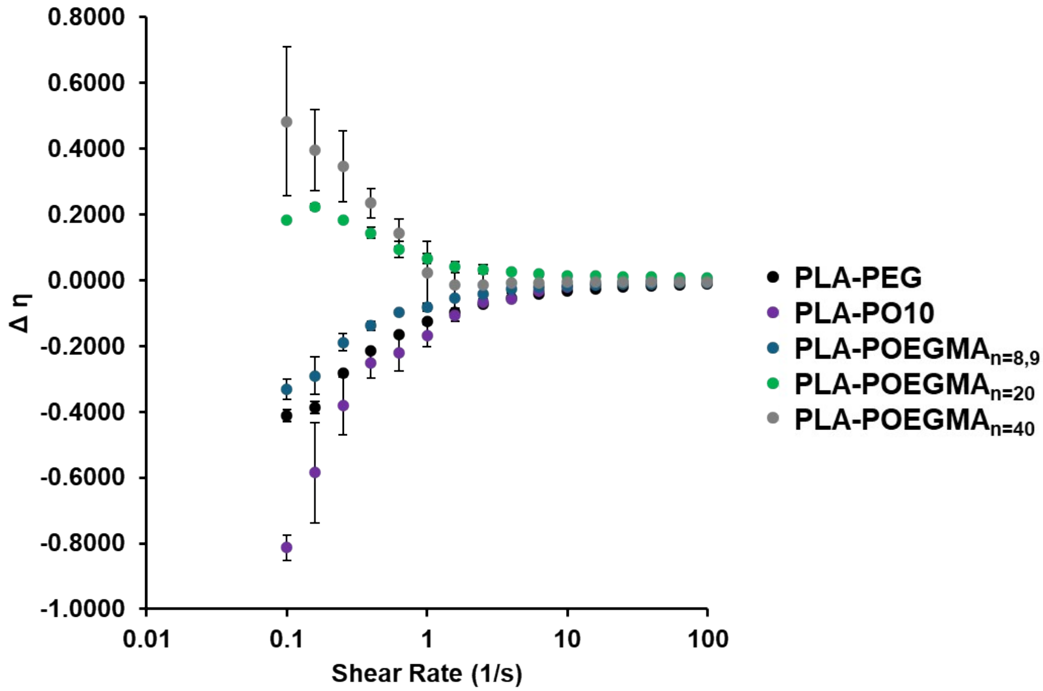

Figure S14: Viscosity synergism parameter as a function of shear rate for PLA-POEGMA$_n$ NPs incubated with 10 w/w% of mucin.

5. Rheological Synergism Measurements - Oscillatory Rheology

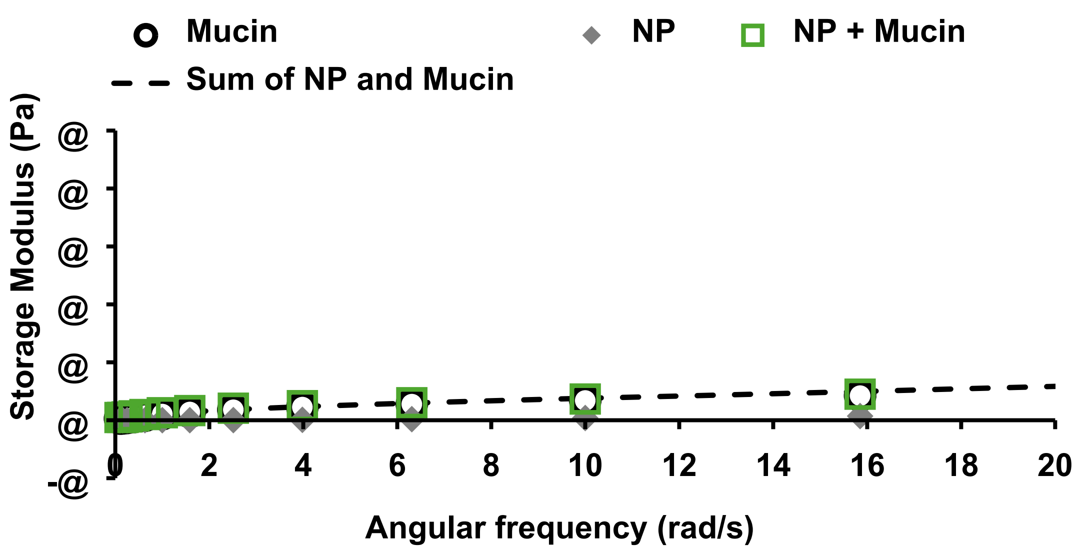

Figure S15: Storage modulus as a functional of angular frequency for PLA-POEGMA$_{n=2}$ NPs incubated with 10 w/w% mucin.

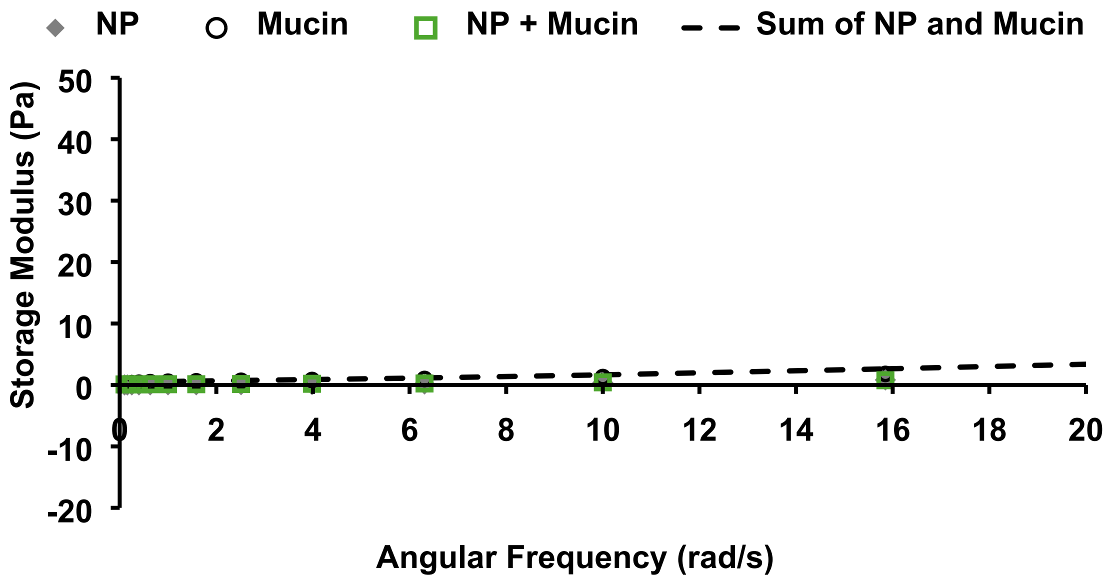

Figure S16: Storage modulus as a functional of angular frequency for PLA-PO10 NPs incubated with 10 w/w% mucin.

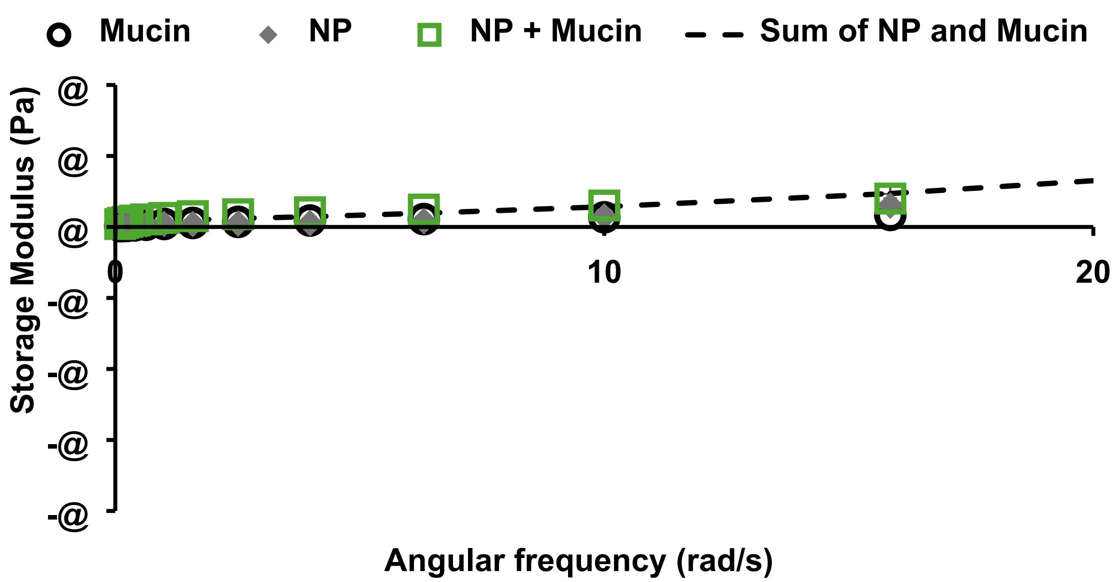

Figure S17: Storage modulus as a functional of angular frequency for PLA-POEGMA$_{n=8,9}$ NPs incubated with 10 w/w% mucin.

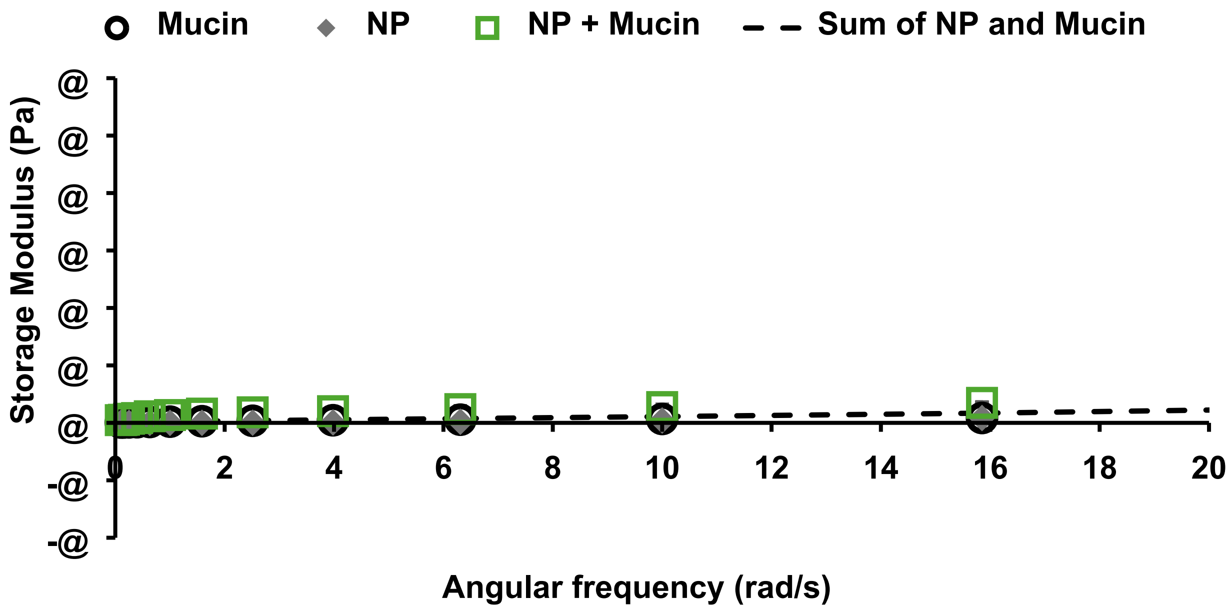

Figure S18: Storage modulus as a functional of angular frequency for PLA-POEGMA$_{n=20}$ NPs incubated with 10 w/w% mucin.

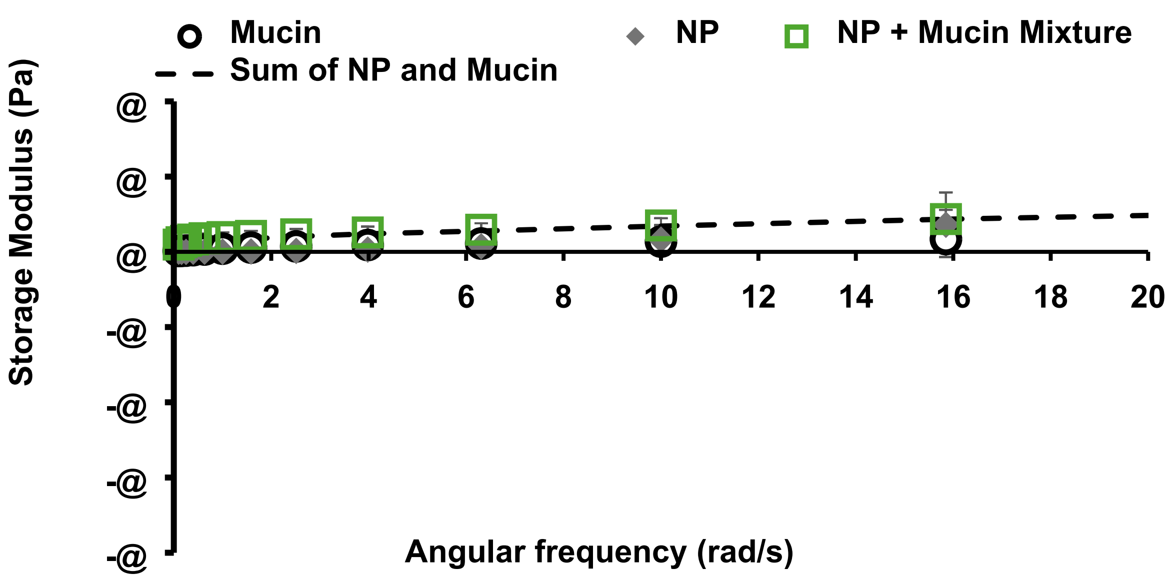

Figure S19: Storage modulus as a functional of angular frequency for PLA-POEGMA$_{n=40}$ NPs incubated with 10 w/w% mucin.

6. Raw Thermograms of Isothermal Titration Calorimetry Studies

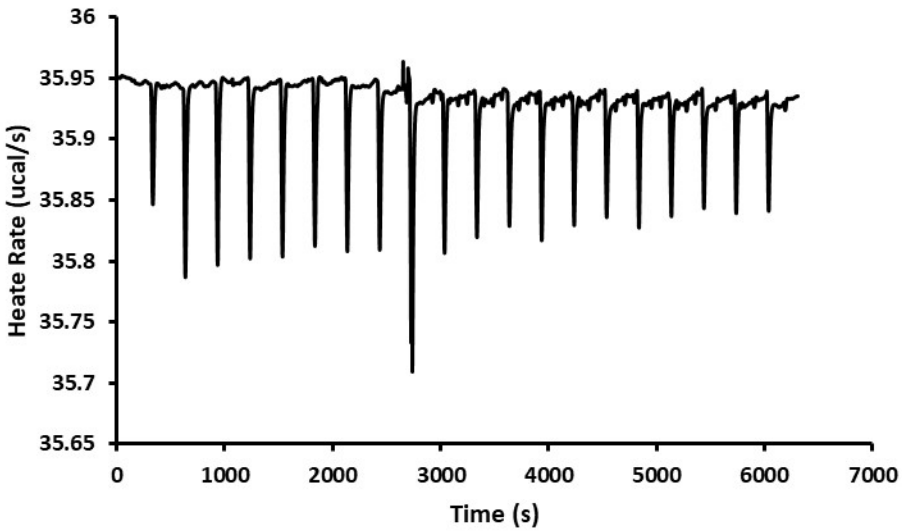

Figure S20: Heat rate as a functional of time for PLA-PO10 NPs injected into 0.1 mg/mL mucin over 20 injections and a period of 100 mins.

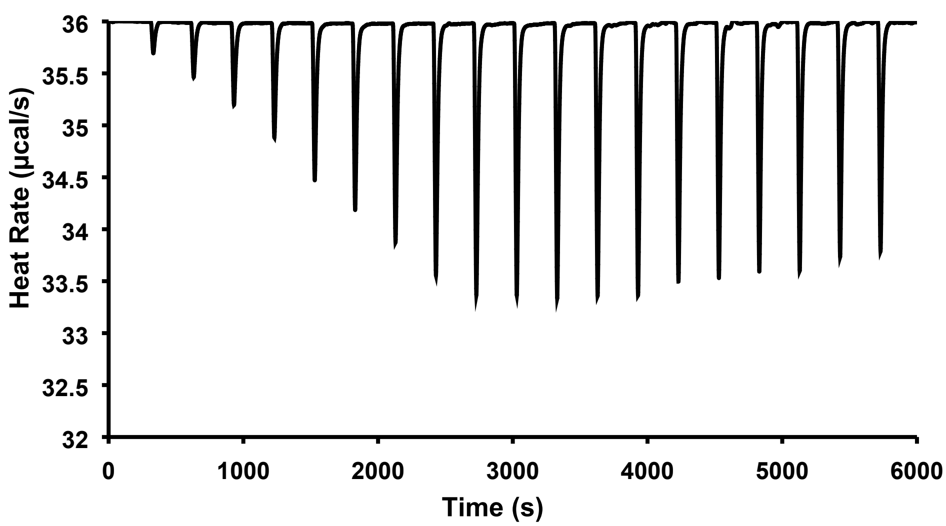

Figure S21: Heat rate as a functional of time for PLA-POEGMA$_{n=8,9}$ NPs injected into 0.1 mg/mL mucin over 20 injections and a period of 100 mins.

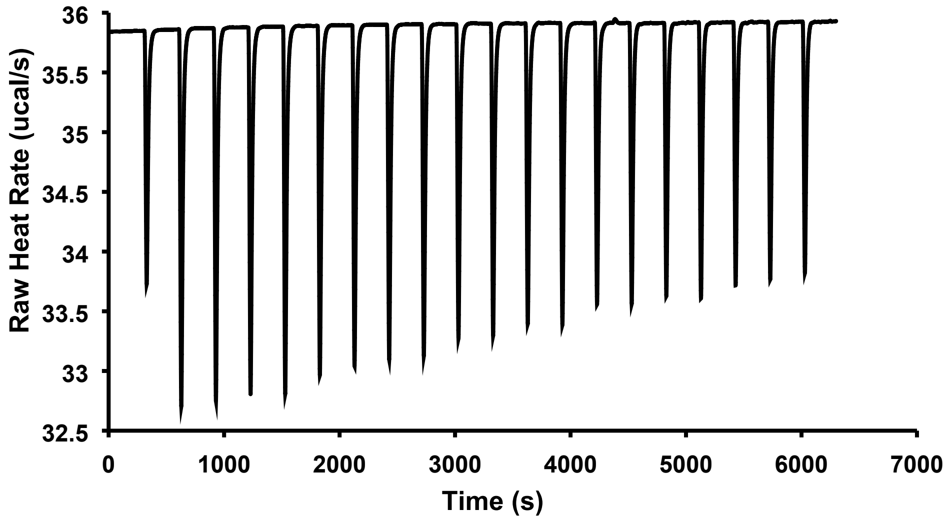

Figure S22: Heat rate as a functional of time for PLA-POEGMA$_{n=20}$ NPs injected into 0.1 mg/mL mucin over 20 injections and a period of 100 mins.

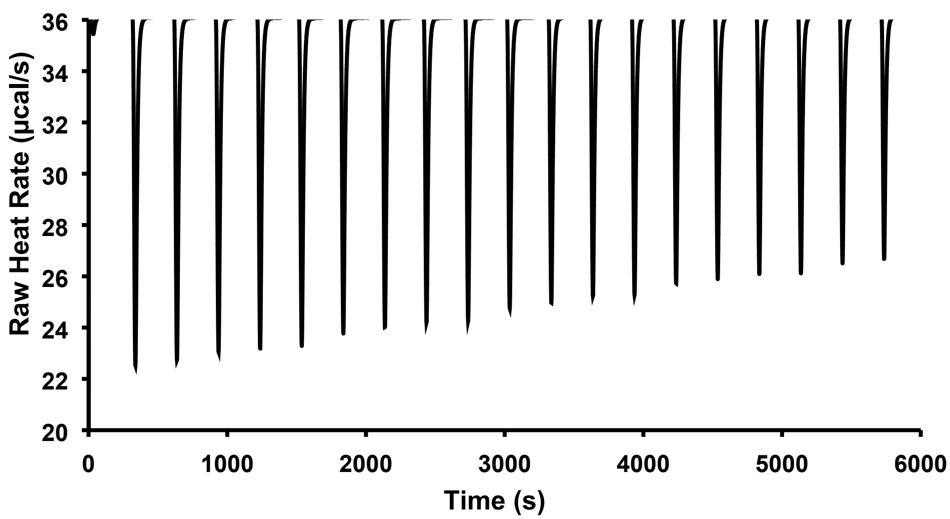

Figure S23: Heat rate as a functional of time for PLA-POEGMA$_{n=40}$ NPs injected into 0.1 mg/mL mucin over 20 injections and a period of 100 mins.

7. Mucoadhesive Screening via Particle Size Measurements

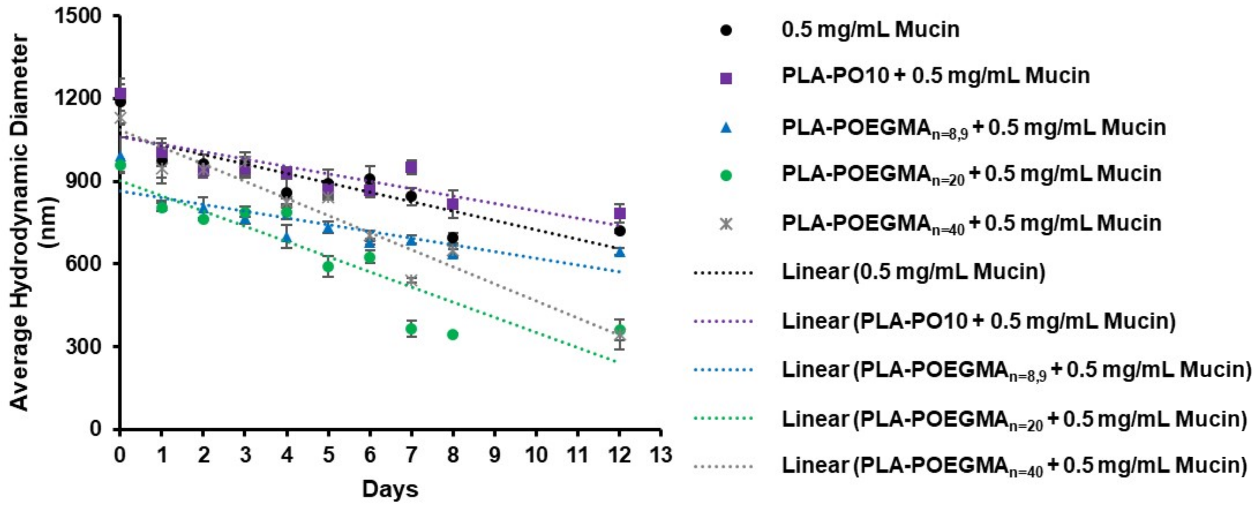

Figure S24: Particle size data for PLA-POEGMA$_n$ particles (suspended in MIQ at a concentration of 0.25 mg/mL) incubated with mucin (0.5 mg/mL) over a 12-day observation period.

8. H&E Staining of Corneas Following Nanoparticle Treatment

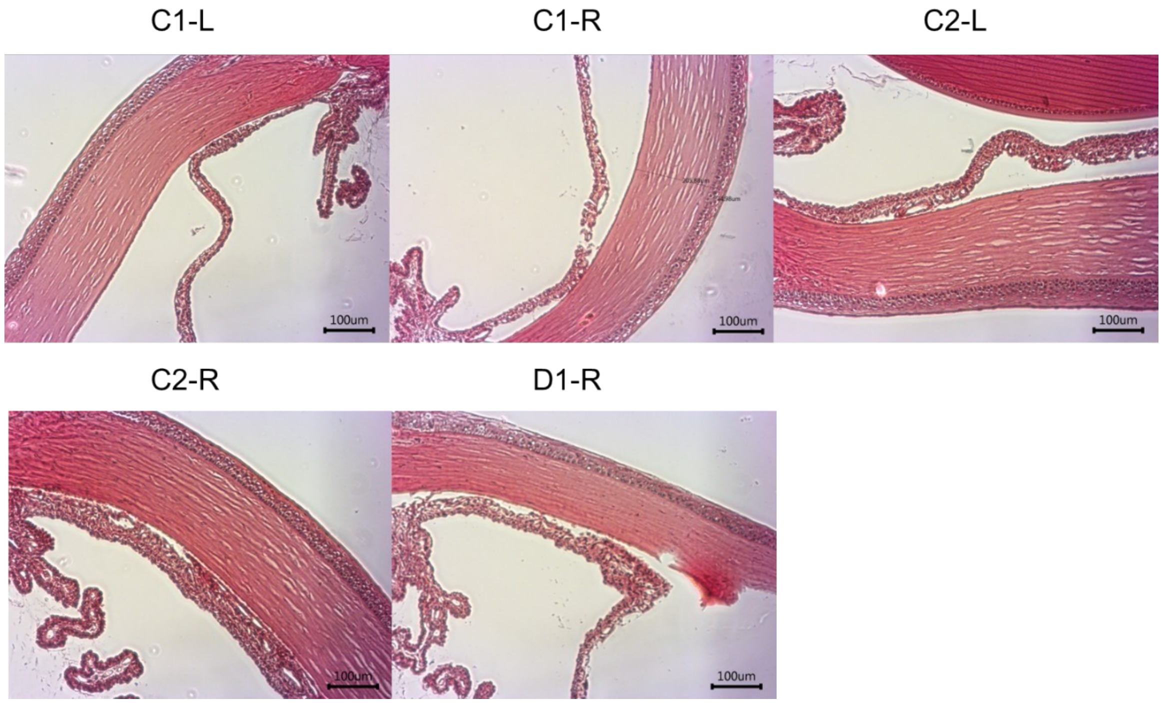

Figure S25: H&E-stained histology slices for rat eyes treated with PLA-PO10 NPs daily with an instillation of 20 µL of 5 mg/mL over a 7-day period.

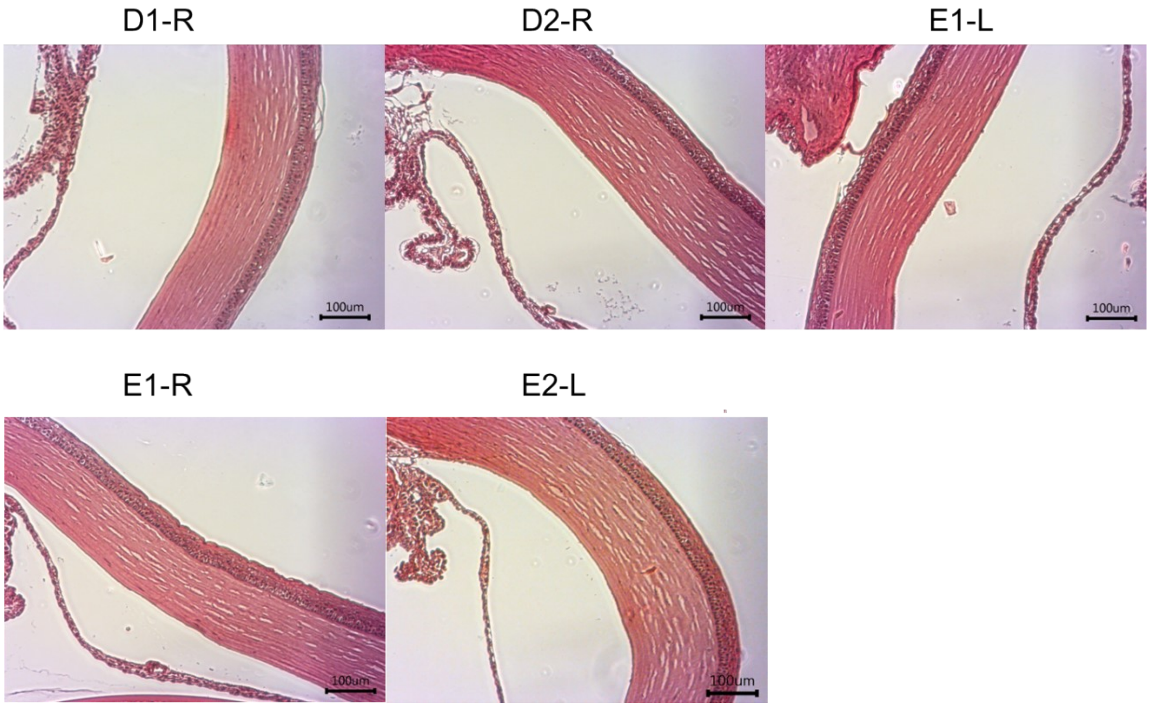

Figure S26: H&E-stained histology slices for rat eyes treated with PLA-POEGMA$_{n=8,9}$ NPs daily with an instillation of 20 μL of 5 mg/mL over a 7-day period.

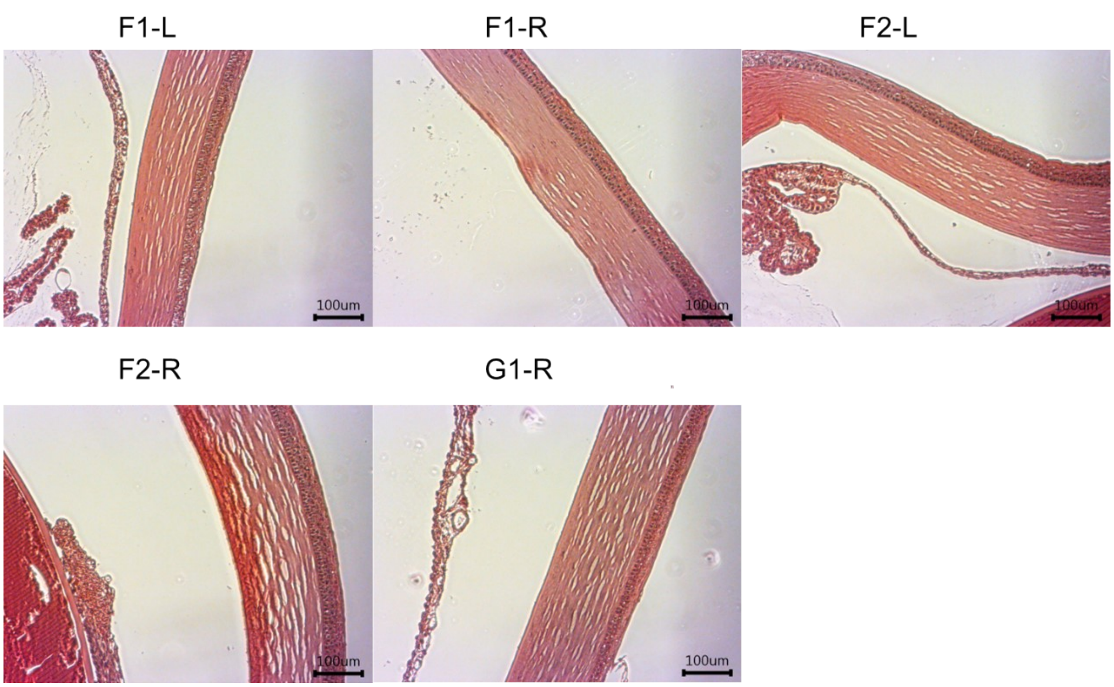

Figure S27: H&E-stained histology slices for rat eyes treated with PLA-POEGMA$_{n=20}$ NPs daily with an instillation of 20 μL of 5 mg/mL over a 7-day period.

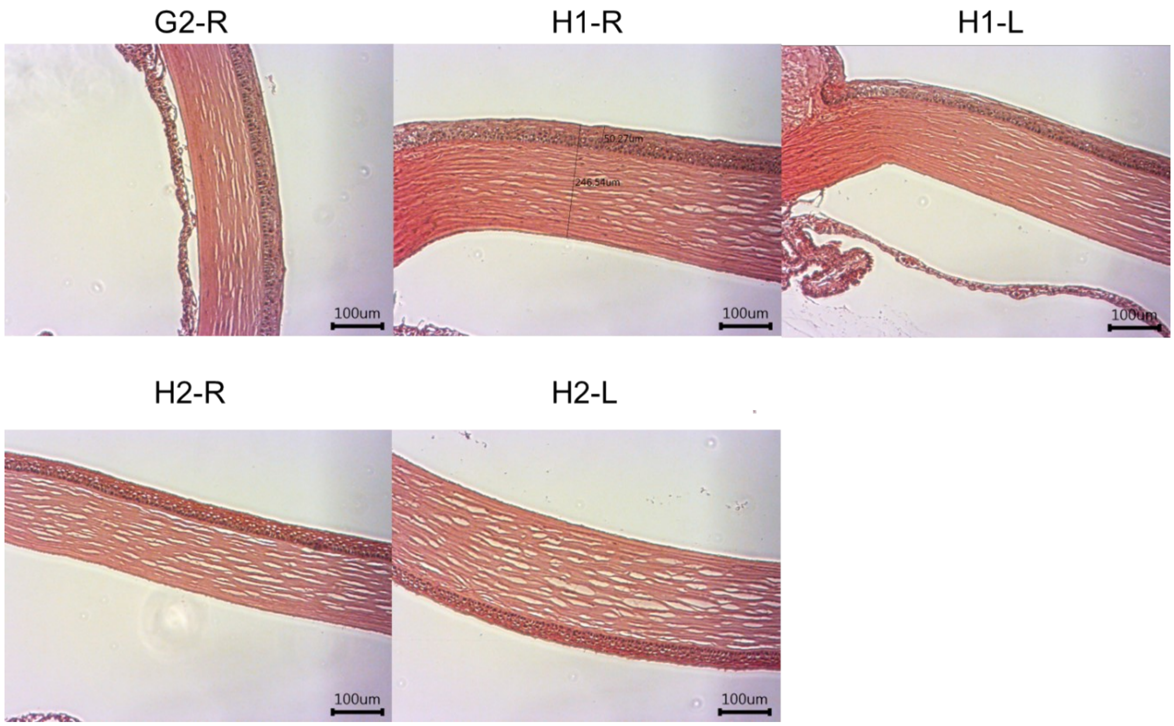

Figure S28: H&E-stained histology slices for rat eyes treated with PLA-POEGMA$_{n=40}$ NPs daily with an instillation of 20 μL of 5 mg/mL over a 7-day period.

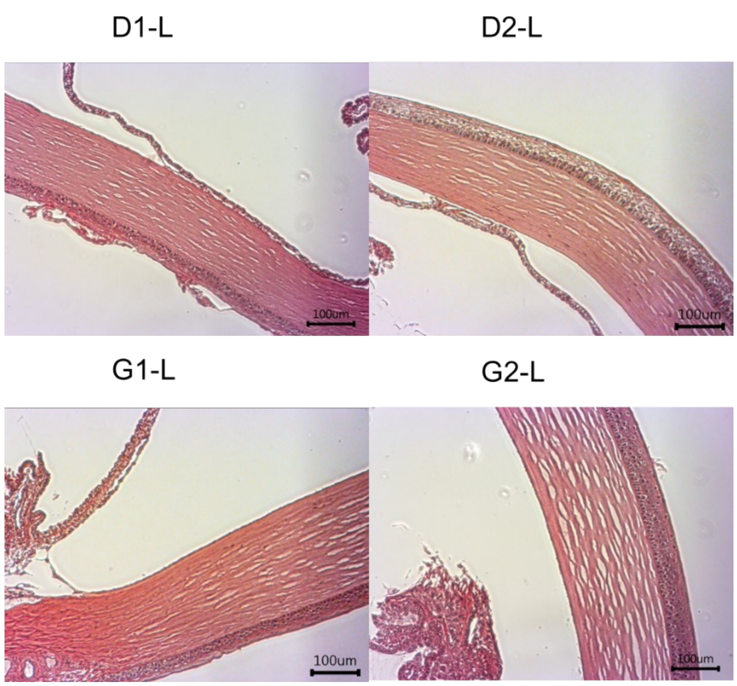

Figure S29: H&E-stained histology slices for rat eyes treated with saline as a control daily with an instillation of 20 μL of 5 mg/mL over a 7-day period.