Electronic Supplementary Material (ESI) for Polymer Chemistry.

Supporting info for:

Cationic and hydrolysable branched polymers by RAFT for complexation and controlled release of dsRNA

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Table S1. Experimental conditions used for the synthesis of the branched and linear polymers and copolymers, and also linear equivalents.

Sample	Branched pDMAEA	Branched pDMAPA	Branched pDMAEMA	Branched p(DMAEMA$_{40}$-co-DMAEA$_{10}$)	Branched p(DMAEMA$_{10}$-co-DMAEA$_{40}$)	Linear p(DMAEMA$_{40}$-co-DMAEA$_{10}$)	Linear p(DMAEMA$_{10}$-co-DMAEA$_{40}$)
[M]:[M]:[B]:[CTA]:[I]	50:0:2.5:1:0.1	50:0:2.5:1:0.1	50:0:0.95:1:0.025	40:10:1.5:1:0.05	10:40:1.5:1:0.05	40:10:0:1:0.05	10:40:0:1:0.05
Mass DMAEMA (mg)	-	-	1000	503	125.8	503	125.8
Mass DMAPA (mg)	-	333	-	-	-	-	-
Mass DMAEA (mg)	1000	-	-	114.6	458.2	114.6	458.2
Brancher	DEGDA	DEGDA	EGDMA	EGDMA	DEGDA	-	-
Mass Brancher (mg)	74.8	22.7	24	23.76	25.68	-	-
CTA	PABTC	PABTC	CPAETC	CPAETC	CPAETC	CPAETC	CPAETC
Mass CTA (mg)	33.3	10.1	33.5	21.06	21.06	21.06	21.06
Initiator	ACVA	ACVA	VA-088	ACVA	ACVA	ACVA	ACVA
Mass Initiator (mg)	3.9	1.2	0.78	1.12	1.12	1.12	1.12
Solvent	Dioxane	Dioxane	Dioxane	Dioxane	Dioxane	Dioxane	Dioxane
Temperature (°C)	70	70	90	70	70	70	70
Time (hr)	24	24	24	24	24	24	24
V. total (mL)	2.245	0.681	2.045	1.33	1.33	1.333	1.333

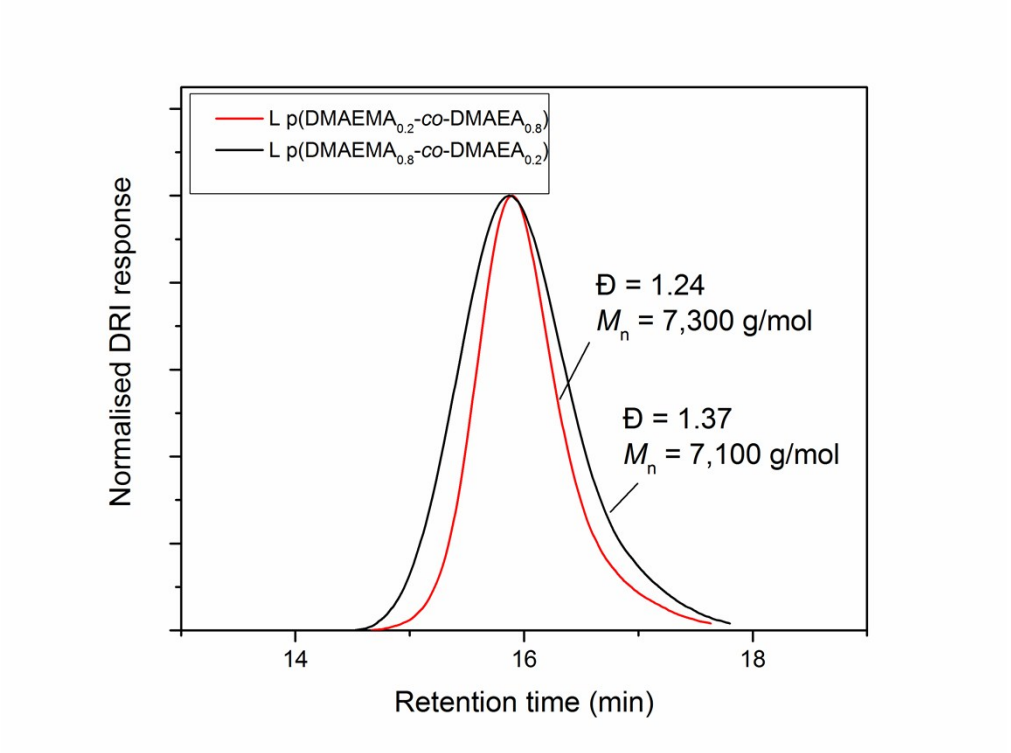

Figure S1. Size exclusion chromatograms of linear copolymers of DMAEMA and DMAEA (from $CHCl_3$ SEC, DRI detector, linear PS standard).

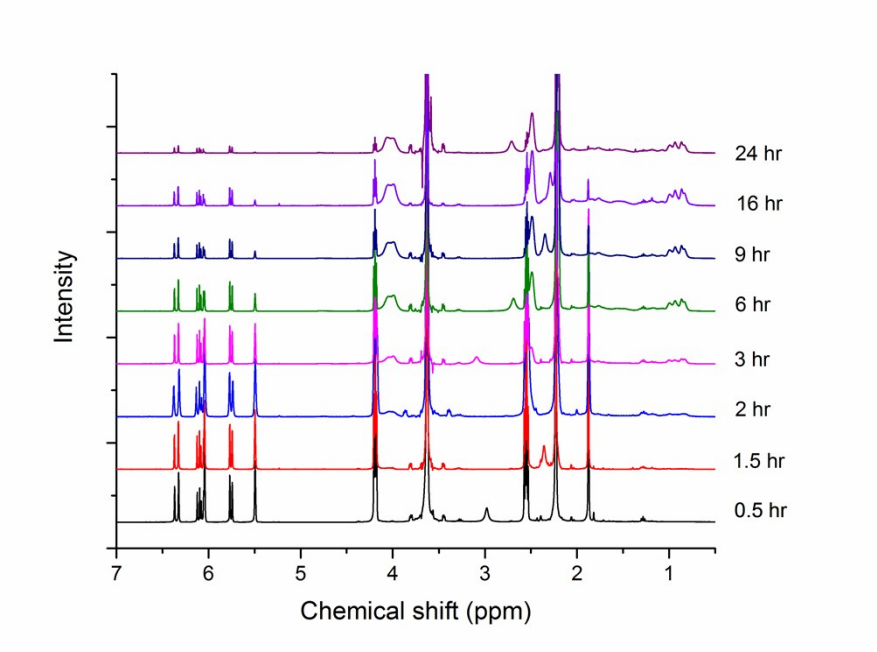

Figure S2. Kinetic analysis of copolymerisation of DMAEMA and DMAEA (DP = 50, 50:50 ratio) as determined using ^{1}H NMR Spectroscopy. Polymerisation conditions = CPAETC RAFT agent, ACVA initiator, 70 ^{o}C.

Table S2. Summary of kinetic of copolymerisation of DMAEMA and DMAEA (DP = 50, 50:50 ratio) as determined using ^{1}H NMR Spectroscopy. Polymerisation conditions = CPAETC RAFT agent, ACVA initiator, 70 ^{o}C.

Time (hr)	Conv. DMAEMA (%)	Conv. DMAEA (%)	Total conv. (%)
0	0	0	0
0.5	4.0	2.8	3.7
1.5	7.0	3.0	5.3
2	20	10	16
3	41	23	33
6	77	48	63
9	89	61	75
18	93	71	82
24	98	83	91

Table S3. Experimental conditions for synthesis of linear DMAEMA/DMAEA copolymers used for ^{1}H NMR kinetic study and reactivity ratio calculations.

Sample	Linear p(DMAEMA$_{10}$-co-DMAEA$_{90}$)	Linear p(DMAEMA$_{30}$-co-DMAEA7$_{0}$)	Linear p(DMAEMA$_{50}$-co-DMAEA$_{50}$)	Linear p(DMAEMA$_{70}$-co-DMAEA$_{30}$)	Linear p(DMAEMA$_{90}$-co-DMAEA$_{10}$)
[M]:[M]:[CTA]:[I]	5:45:1:0.05	15:35:1:0.05	25:25:1:0.05	35:15:1:0.05	45:5:1:0.05
Mass DMAEMA (mg)	31.4	94.3	157.2	220.1	283
Mass DMAEA (mg)	257.8	200.5	143.2	57.3	28.6
CTA	CPAETC	CPAETC	CPAETC	CPAETC	CPAETC
Mass CTA (mg)	10.53	10.53	10.53	10.53	10.53
Initiator	ACVA	ACVA	ACVA	ACVA	ACVA
Mass Initiator (mg)	0.56	0.56	0.56	0.56	0.56
Solvent	Dioxane	Dioxane	Dioxane	Dioxane	Dioxane
Temperature (^{o}C)	70	70	70	70	70
Time (hr)	24	24	24	24	24
V. total (mL)	0.667	0.667	0.667	0.667	0.667

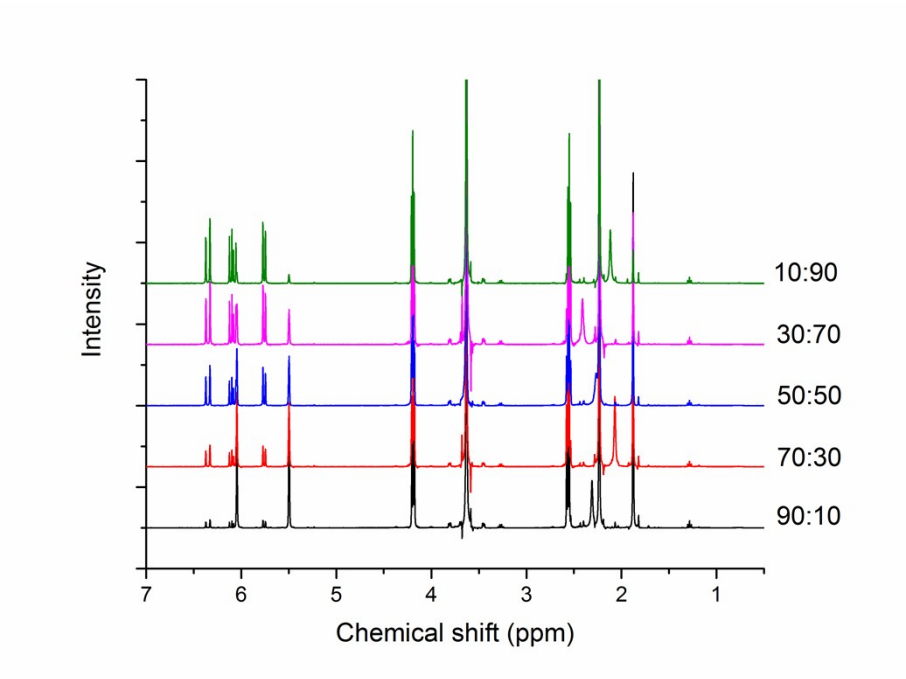

Figure S3. ^{1}H NMR spectra of polymerisation reaction of linear DMAEMA/DMAEA copolymers used for reactivity ratio calculations at time = 0 hour.

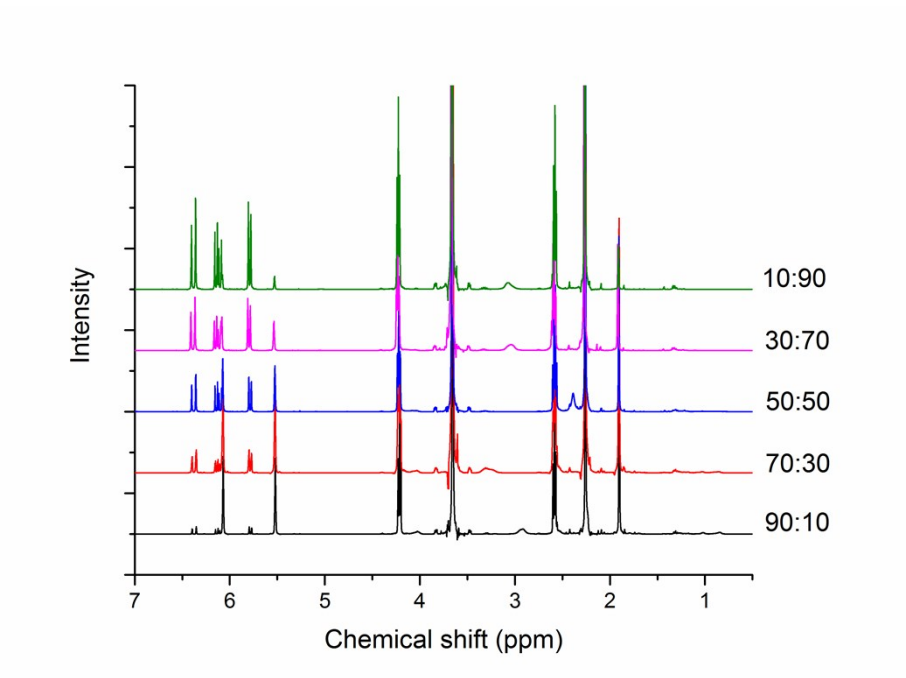

Figure S4. ^{1}H NMR spectra of polymerisation reaction of linear DMAEMA/DMAEA copolymers used for reactivity ratio calculations at time = 1 hour.

Table S4. Parameters from the synthesis of linear DMAEMA/DMAEA copolymers used for reactivity ratio calculations.

f_1 (DMAEMA)	f_2 (DMAEA)	F_1 (DMAEMA)	F_2 (DMAEA)	Total conv. (%)
0.000	1.000	0.000	1.000	-
0.102	0.898	0.156	0.844	9.5
0.314	0.686	0.426	0.574	5.8
0.502	0.498	0.674	0.326	5.2
0.704	0.296	0.806	0.194	6.9
0.901	0.099	0.957	0.043	6.5
1.000	0.000	1.000	0.000	-

The monomer feed ratio and incorporation ratios were then used to calculate reactivity ratios by the Fineman-Ross method, Kelen-Tudos method, and by fitting with a non-linear least squares fit (solver in MS Excel) of the copolymer equation: $$F_1 = \frac{r_1 f_1^2 + f_1 f_2}{r_1 f_1^2 + 2 f_1 f_2 + r_2 f_2^2}$$

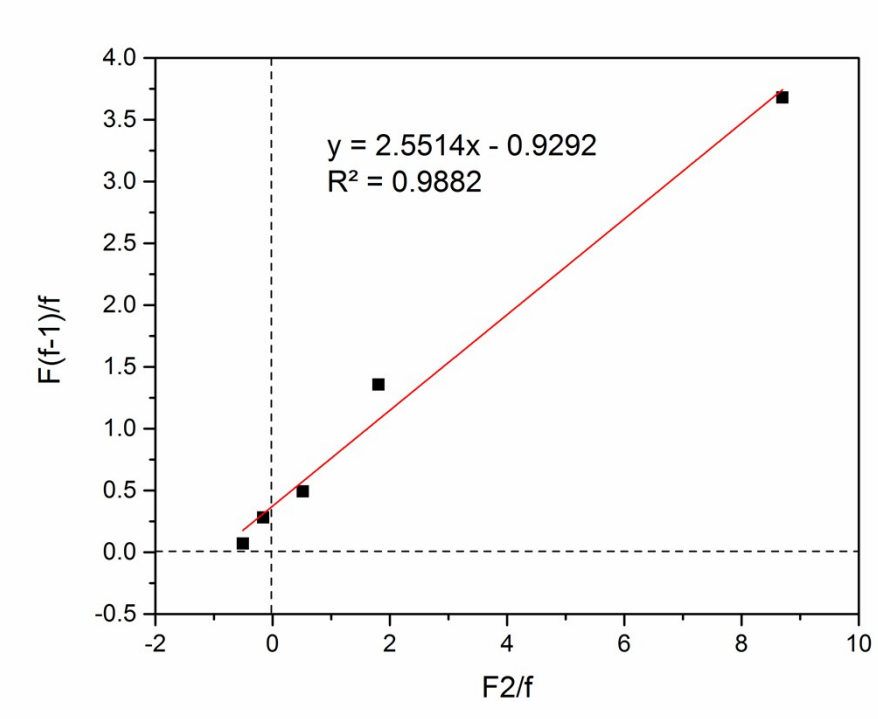

Figure S5. Fineman-Ross plot for estimation of reactivity ratios for linear copolymerisation of DMAEMA and DMAEA (DP = 50, 50:50 ratio). Polymerisation conditions = CPAETC RAFT agent, ACVA initiator, 70 °C.

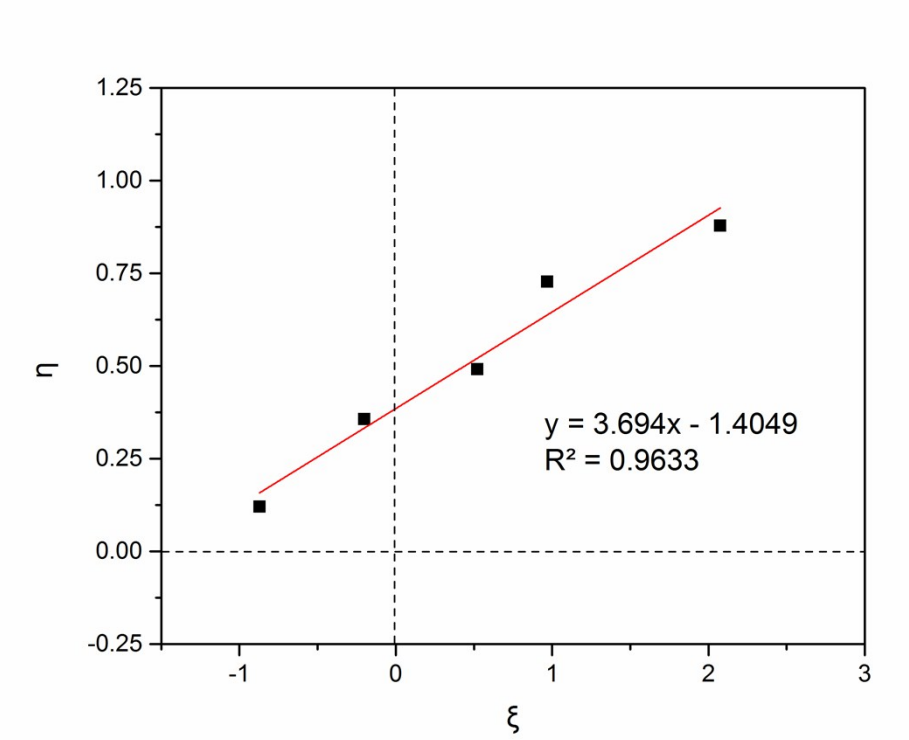

Figure S6. Kelen-Tudos plot for estimation of reactivity ratios for linear copolymerisation of DMAEMA and DMAEA (DP = 50, 50:50 ratio). Polymerisation conditions = CPAETC RAFT agent, ACVA initiator, 70 °C.

Table S5. Reactivity ratio values calculated from three different methods for linear copolymerisation of DMAEMA and DMAEA (DP = 50, 50:50 ratio). Polymerisation conditions = CPAETC RAFT agent, ACVA initiator, 70 °C.

	Non linear least squares	Fineman Ross	Kelen Tudos
r_1 (DMAEMA)	2.13	2.55	2.29

r_2 (DMAEA)	0.69	0.93	0.71

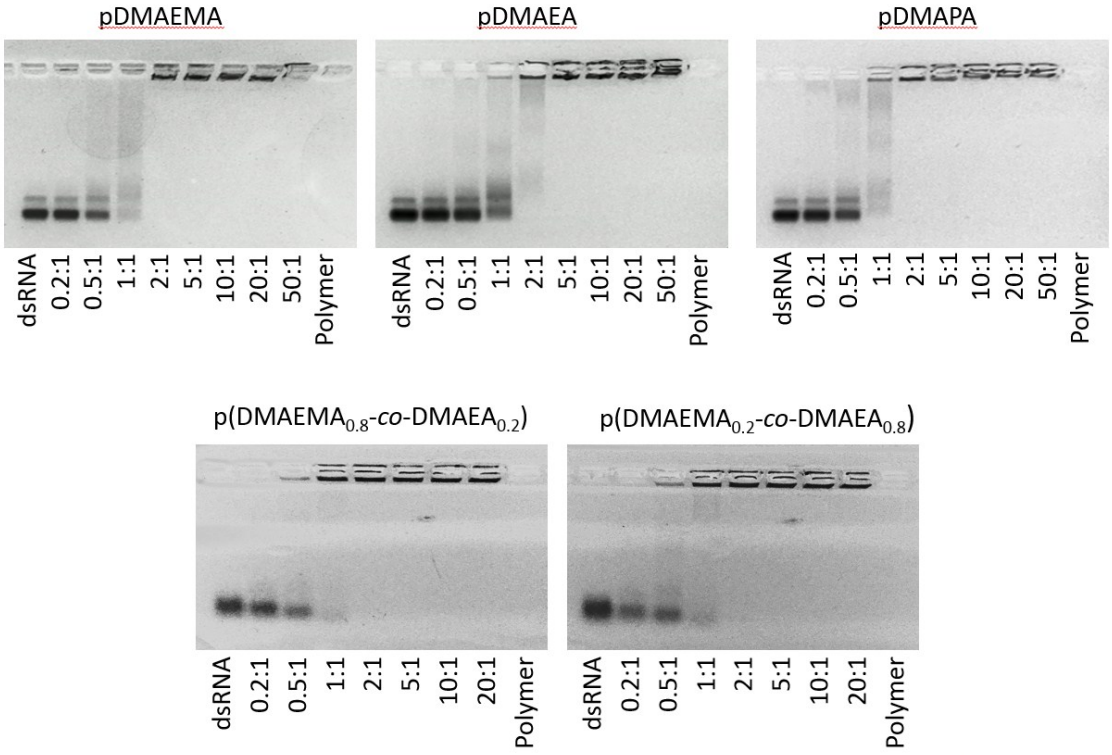

Figure S7. Agarose gel electrophoresis images of polyplex formation of synthesised branched polymers with dsRNA, with varying N/P ratios.

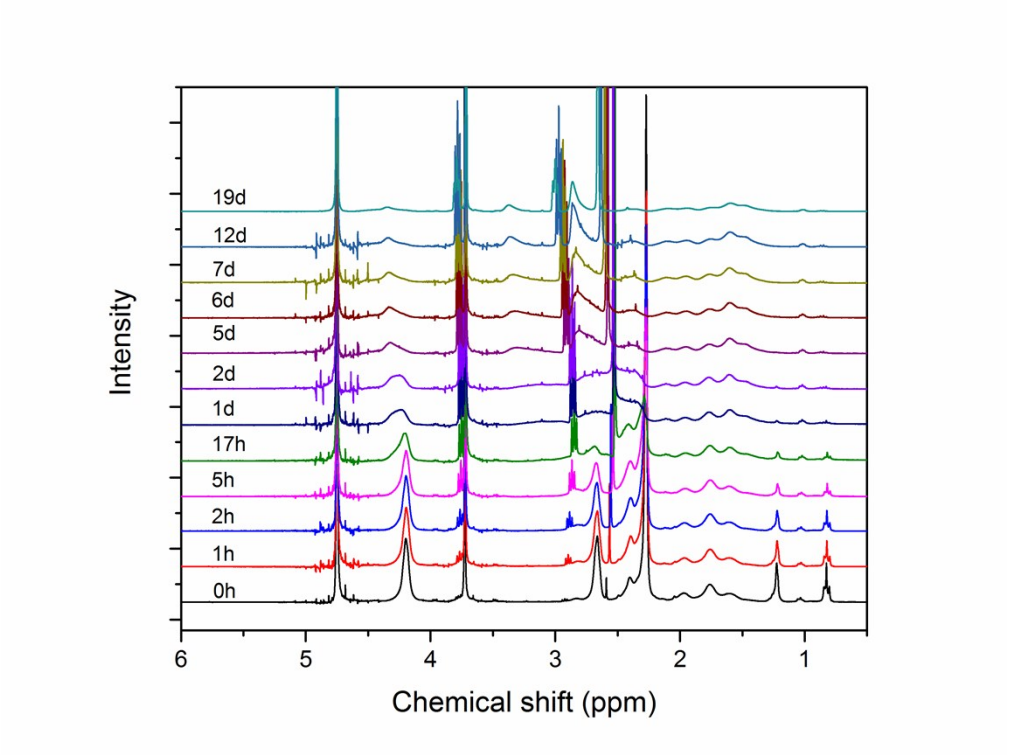

Figure S8. Hydrolysis of branched pDMAEA in D_2O (pH = 7.4) as determined using ^1H NMR spectroscopy.

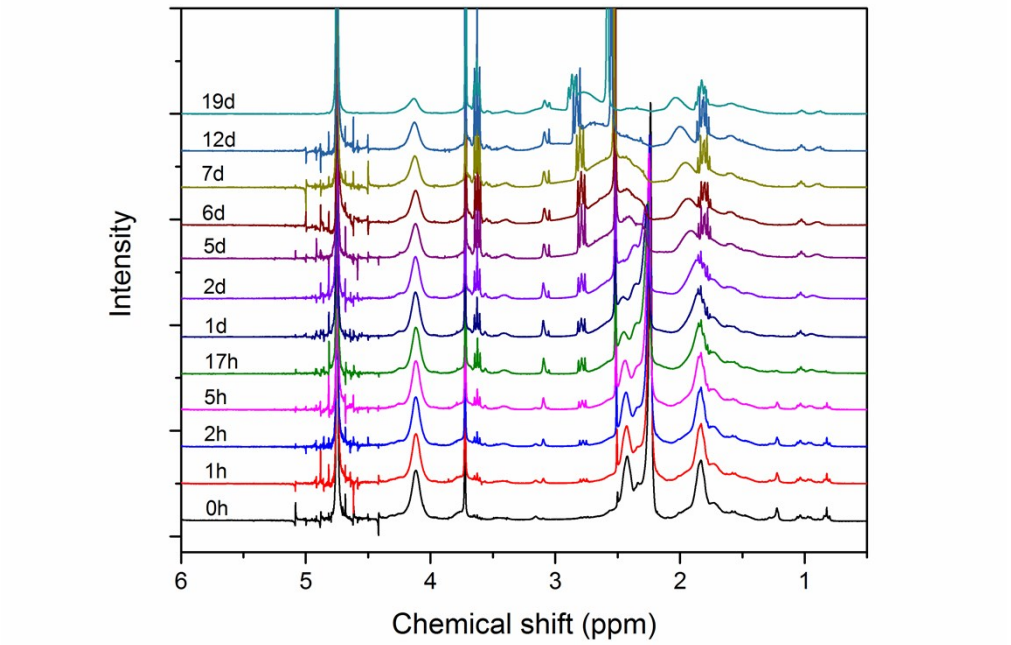

Figure S9. Hydrolysis of branched pDMAPA in D_2O (pH = 7.4) as determined using ^1H NMR spectroscopy.

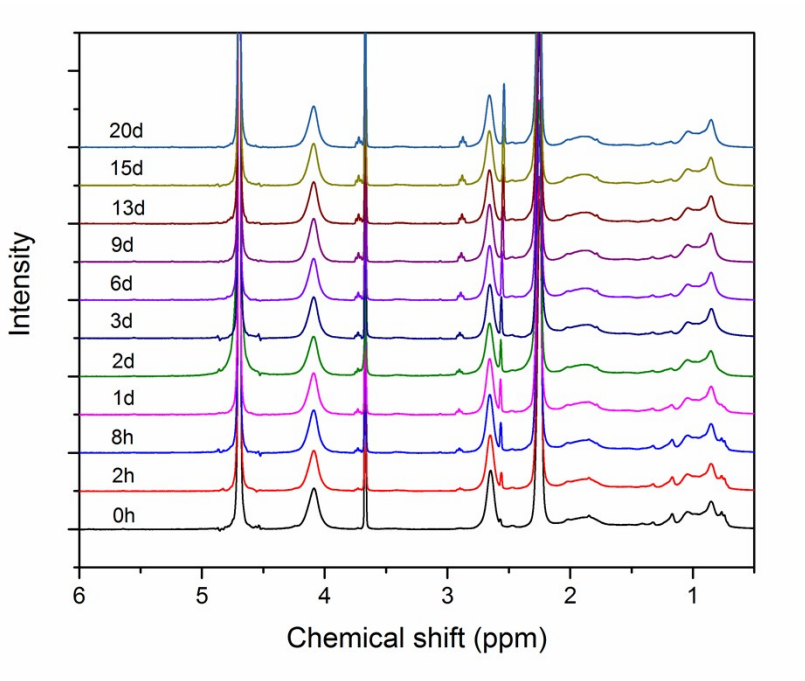

Figure S10. Hydrolysis of linear p(DMAEMA$_{40}$-*co*-DMAEA$_{10}$) in D_2O (pH = 7.4) as determined using ^{1}H NMR spectroscopy.

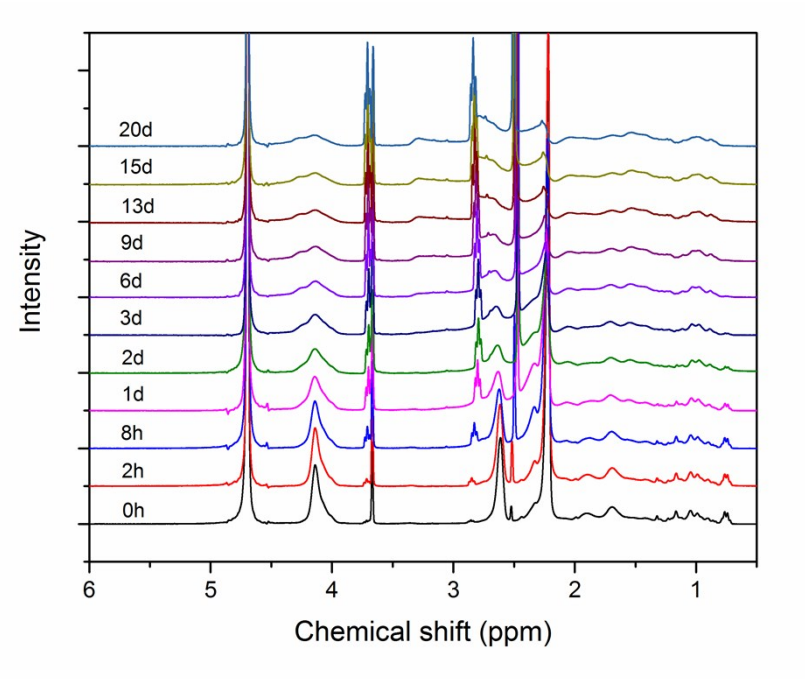

Figure S11. Hydrolysis of linear p(DMAEMA$_{10}$-*co*-DMAEA$_{40}$) in D_2O (pH = 7.4) as determined using ^{1}H NMR spectroscopy.

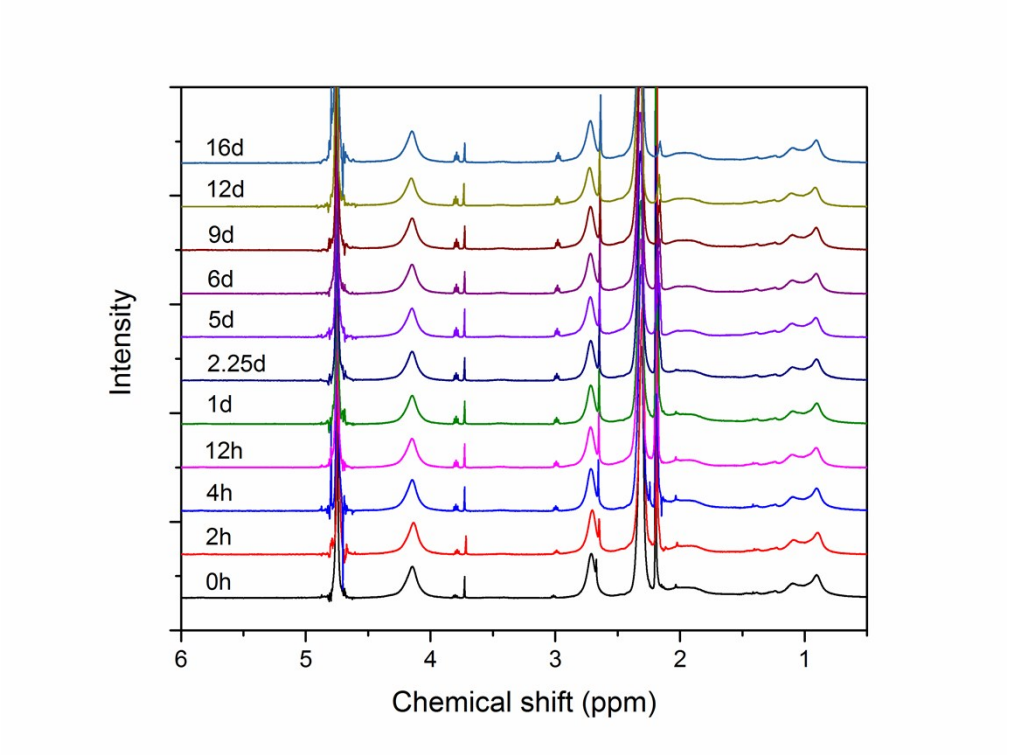

Figure S12. Hydrolysis of branched p(DMAEMA$_{40}$-*co*-DMAEA$_{10}$) in D_2O (pH = 7.4) as determined using ^{1}H NMR spectroscopy.