

Figure S1. Graphical representation of the reduced viscosity as a function of chitosan (CS) concentration. The intercept, 4.7136 dL/g represents the intrinsic viscosity of CS.

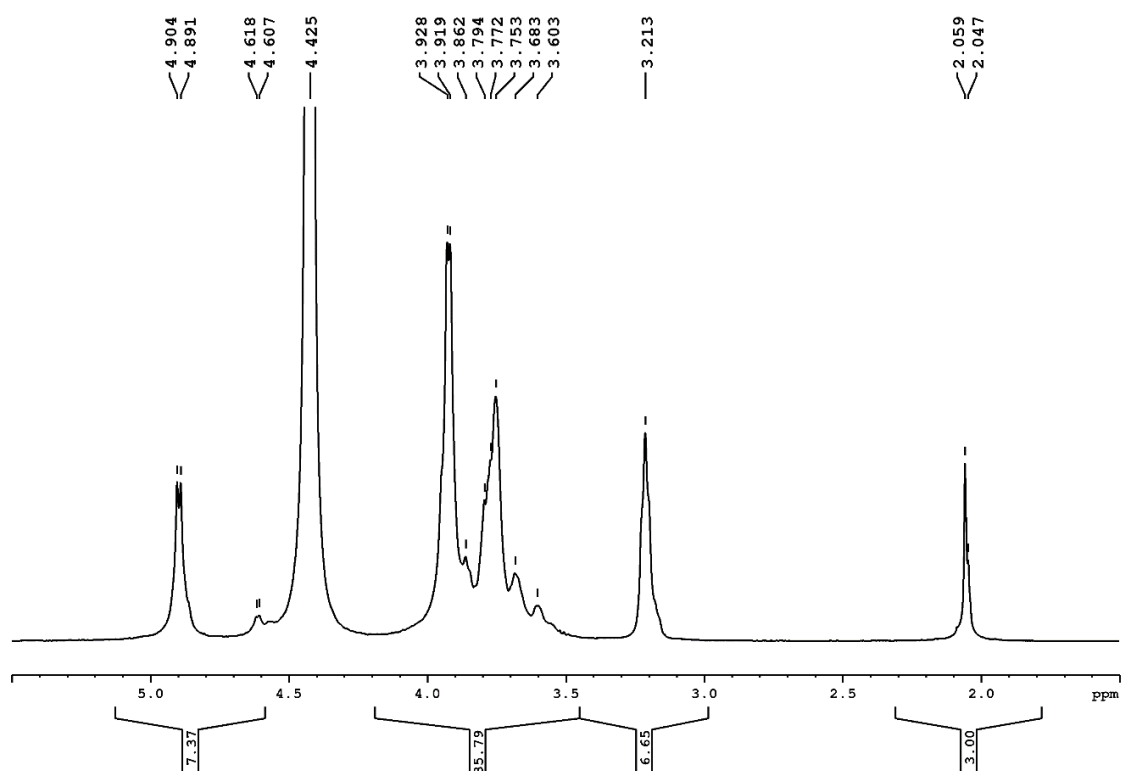


Figure S2. ¹H NMR spectrum of fungal chitosan (CS) used in this study

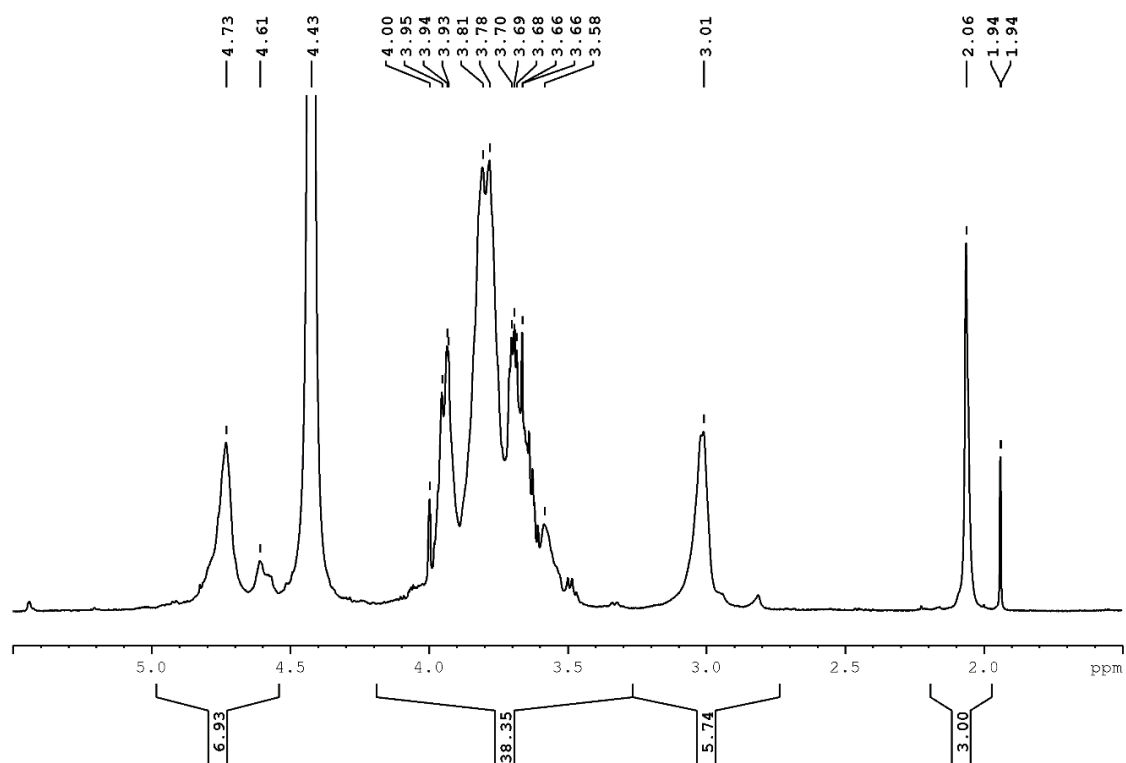


Figure S3. ¹H NMR spectrum of CSFa(-), i.e., without addition of ferulic acid in the reaction (non-grafted chitosan)

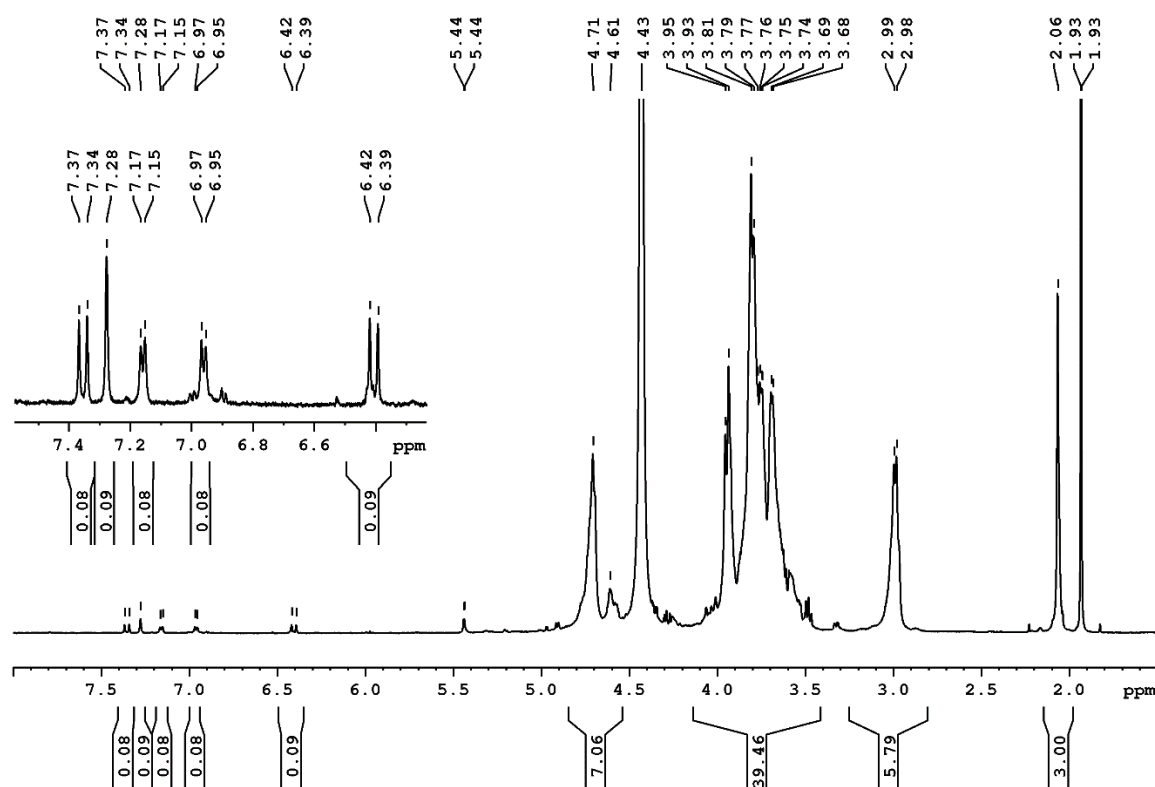


Figure S4. ^1H NMR spectrum of CSFa(+), i.e., with addition of ferulic acid in the reaction (grafted chitosan)

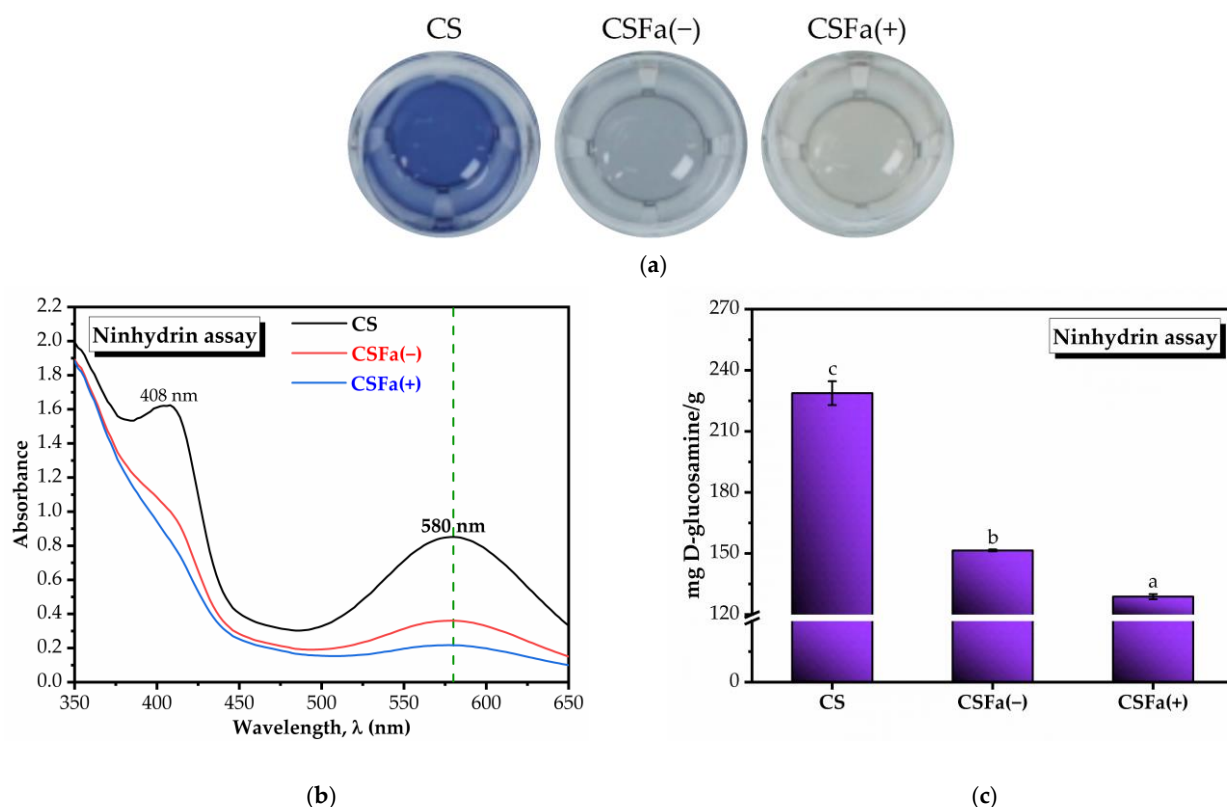


Figure S5. Ninhydrin assay: (a) The appearance of chitosan solutions following the ninhydrin assay; (b) The absorbance spectra of chitosan samples following the ninhydrin assay; (c) Quantification of free amino groups by ninhydrin assay (\pm error bars, $\alpha < 0.05$, $n = 3$, different letters show statistically significant differences between samples); CS: initial chitosan; CSFa(-): non-grafted chitosan, CSFa(+): ferulic acid-grafted chitosan.

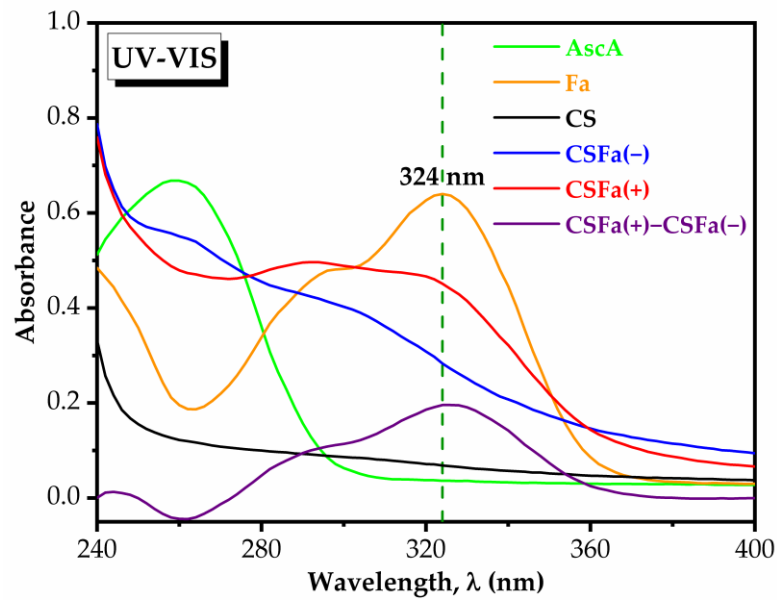
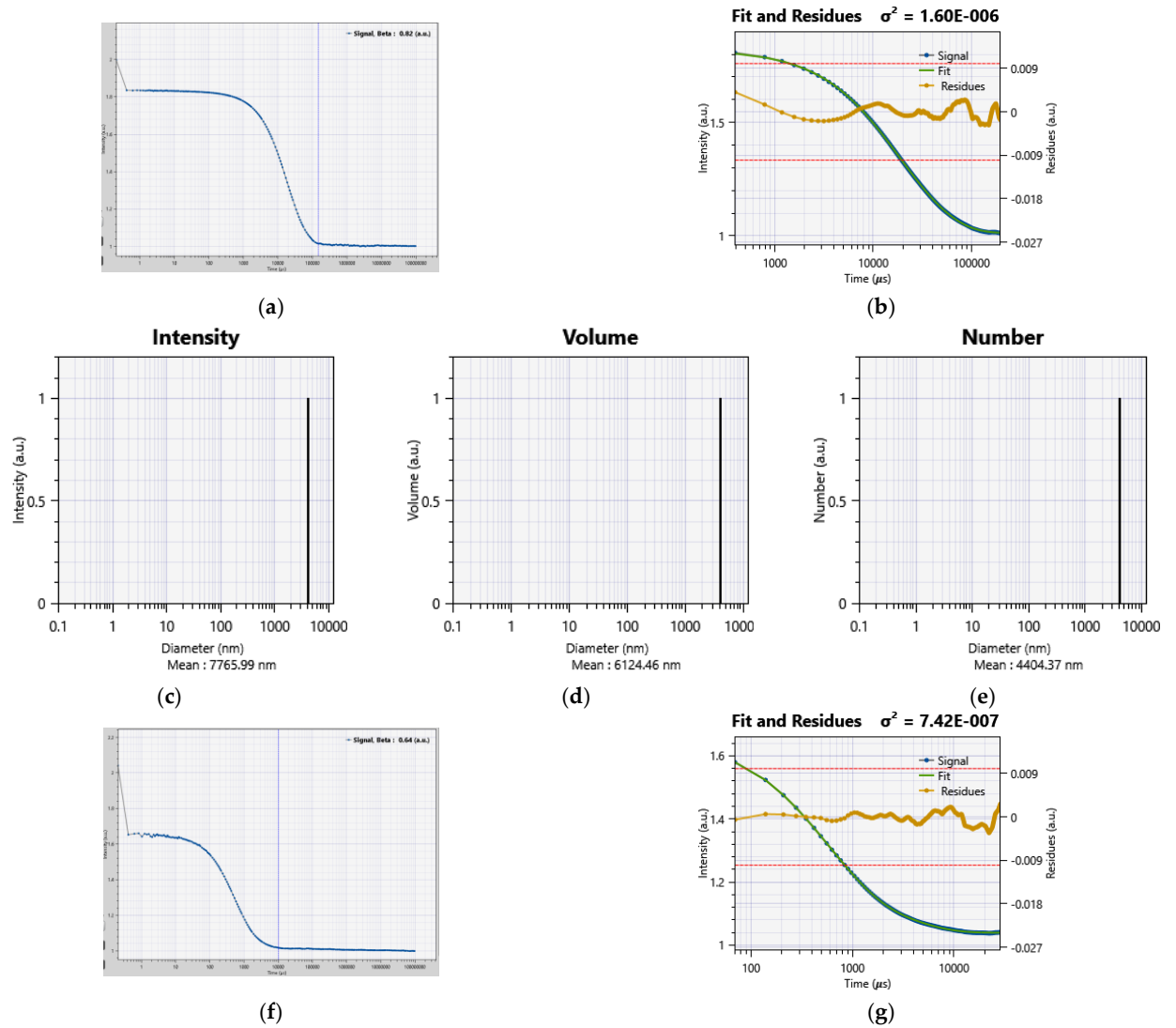


Figure S6. UV-VIS spectroscopy; AscA: ascorbic acid, Fa: ferulic acid, CS: initial chitosan; CSFa(-): non-grafted chitosan, CSFa(+): ferulic acid-grafted chitosan.



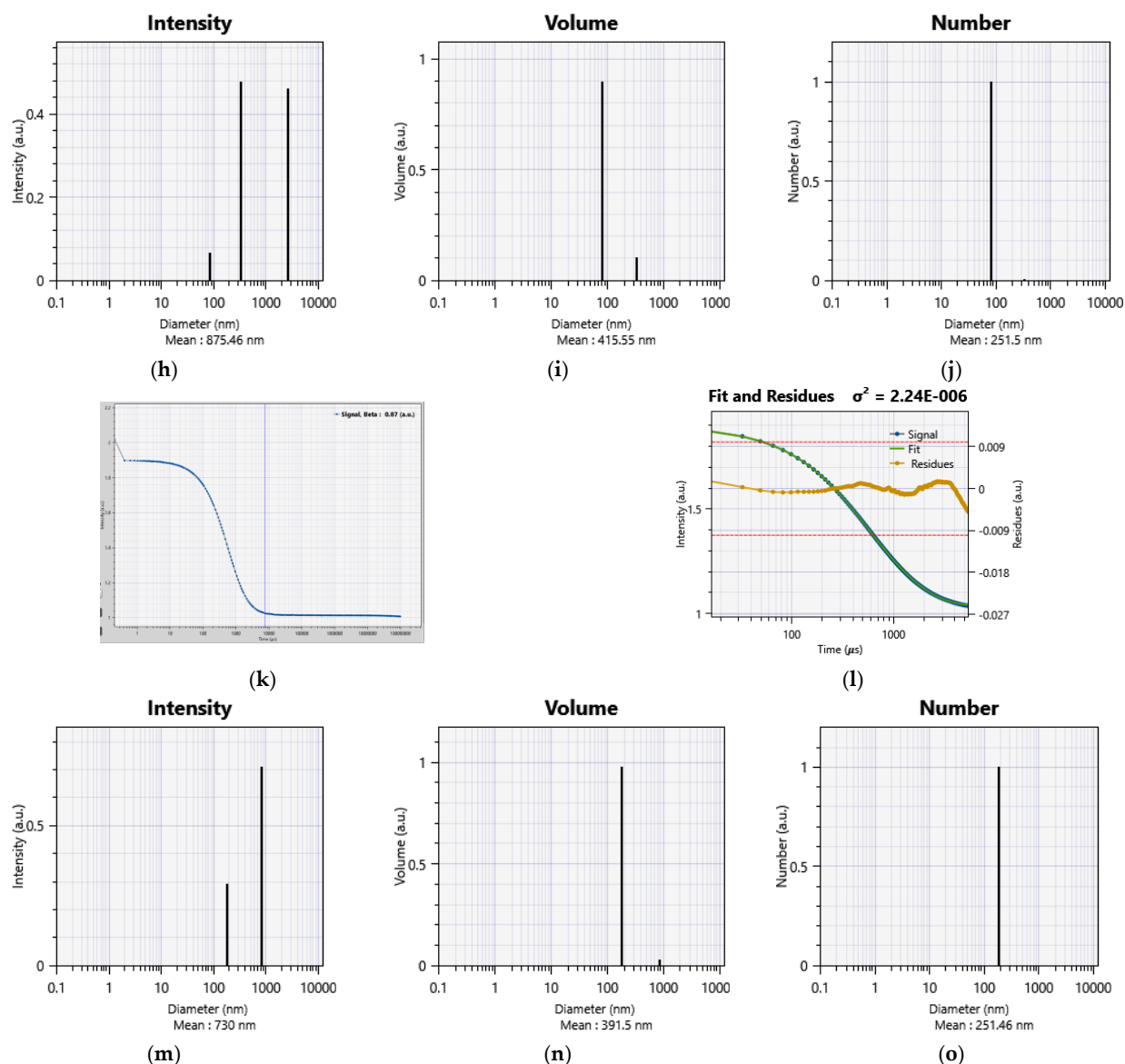
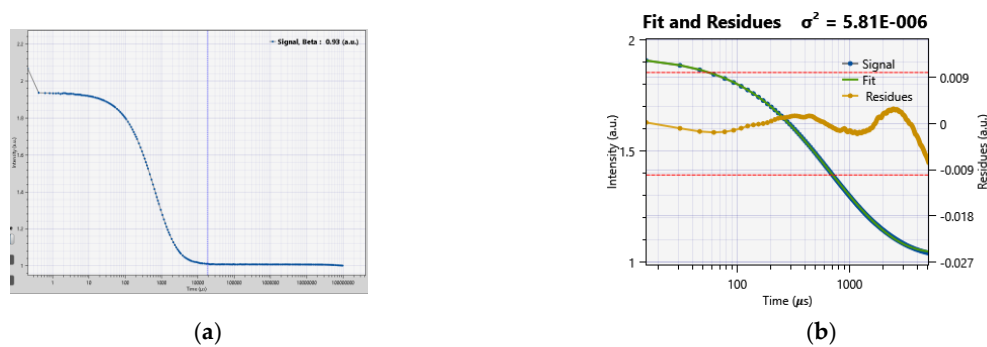


Figure S7. DLS analysis in 2% AcOH using the Pade Laplace (PD) method: (a) autocorrelation function for CS; (b) simulation of autocorrelation function for CS; (c) Intensity for CS; (d) Volume for CS; (e) Number for CS; (f) autocorrelation function for CSFa(-); (g) simulation of autocorrelation function for CSFa(-); (h) Intensity for CSFa(-); (i) Volume for CSFa(-); (j) Number for CSFa(-); (k) autocorrelation function for CSFa(+); (l) simulation of autocorrelation function for CSFa(+); (m) Intensity for CSFa(+); (n) Volume for CSFa(+); (o) Number for CSFa(+); CSFa(-): without ferulic acid addition in the reaction (non-grafted chitosan); CSFa(+): ferulic acid-grafted chitosan.



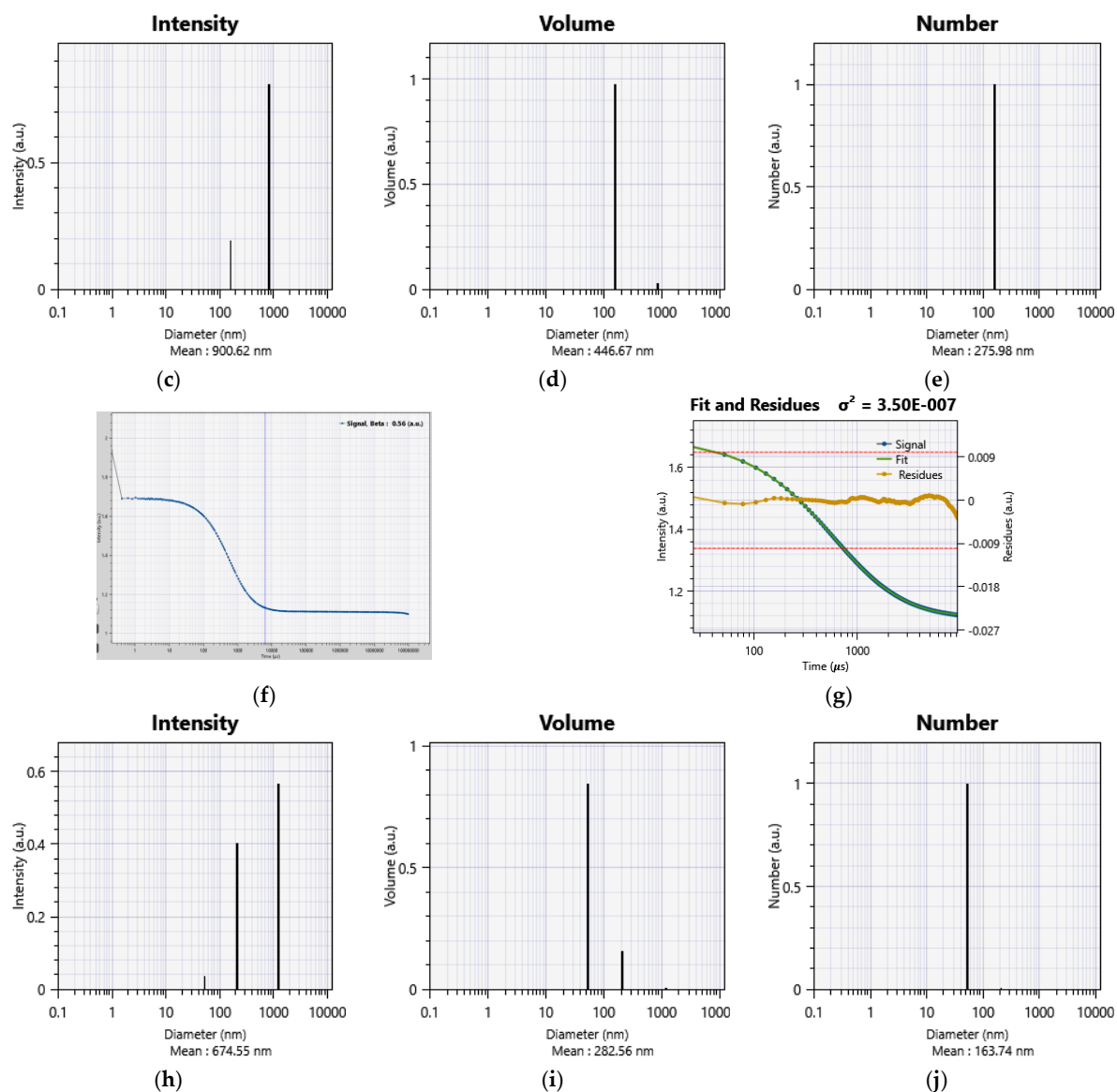


Figure S8. DLS analysis in ddH₂O using the Pade Laplace (PD) method: (a) autocorrelation function for CSFa(-); (b) simulation of autocorrelation function for CSFa(-); (c) Intensity for CSFa(-); (d) Volume for CSFa(-); (e) Number for CSFa(-); (f) autocorrelation function for CSFa(+); (g) simulation of autocorrelation function for CSFa(+); (h) Intensity for CSFa(+); (i) Volume for CSFa(+); (j) Number for CSFa(+); CSFa(-): without ferulic acid addition in the reaction (non-grafted chitosan); CSFa(+): ferulic acid-grafted chitosan.

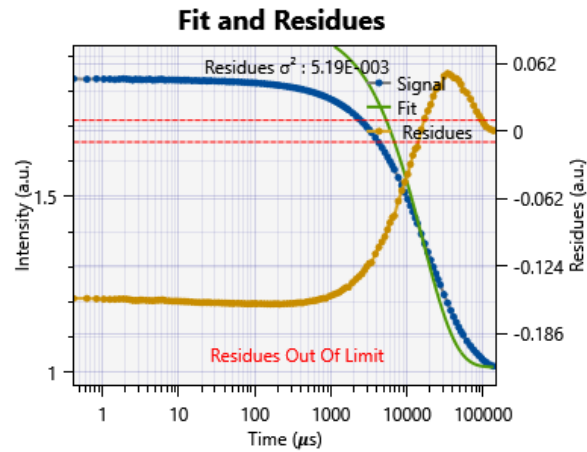
Table S1. DLS analysis of CS: initial chitosan; CSFa(-): non-grafted chitosan, CSFa(+): ferulic acid-grafted chitosan in 2% AcOH using the Pade Laplace (PD) method.

Sample	Size (nm)	Intensity (a.u.)	Volume (a.u.)	Number (a.u.)
CS	3935.03	0.24	1	1
	18399.11	0.76	-	-
CSFa(-)	80.88	0.06	0.9	1
	331.93	0.48	0.1	1.8e ⁻³
	2567.24	0.46	2.0e ⁻⁴	6.6e ⁻⁹
CSFa(+)	178.69	0.29	0.98	1
	811.29	0.71	0.02	2.6e ⁻⁴

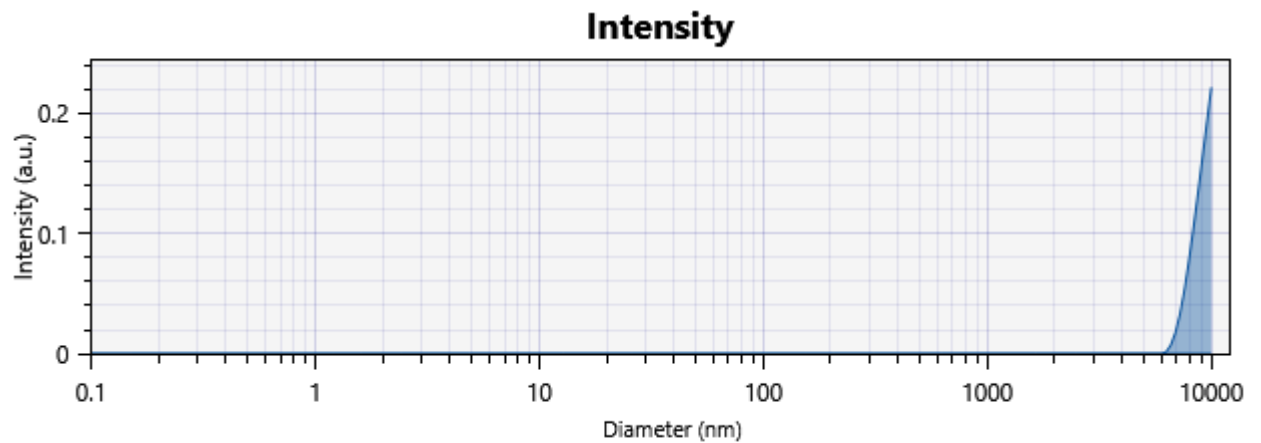
Table S2. DLS analysis of CSFa(-): non-grafted chitosan, CSFa(+): ferulic acid-grafted chitosan in ddH₂O using the Pade Laplace (PD) method.

Sample	Size (nm)	Intensity (a.u.)	Volume (a.u.)	Number (a.u.)
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CSFa(-)	156.7	0.19	0.97	1
	812.77	0.81	0.03	1.9e ⁻⁴
CSFa(+)	51.67	0.03	0.84	1
	201.02	0.40	0.16	2.9e ⁻³
	1384.76	0.57	1.1e ⁻³	1.1e ⁻⁷

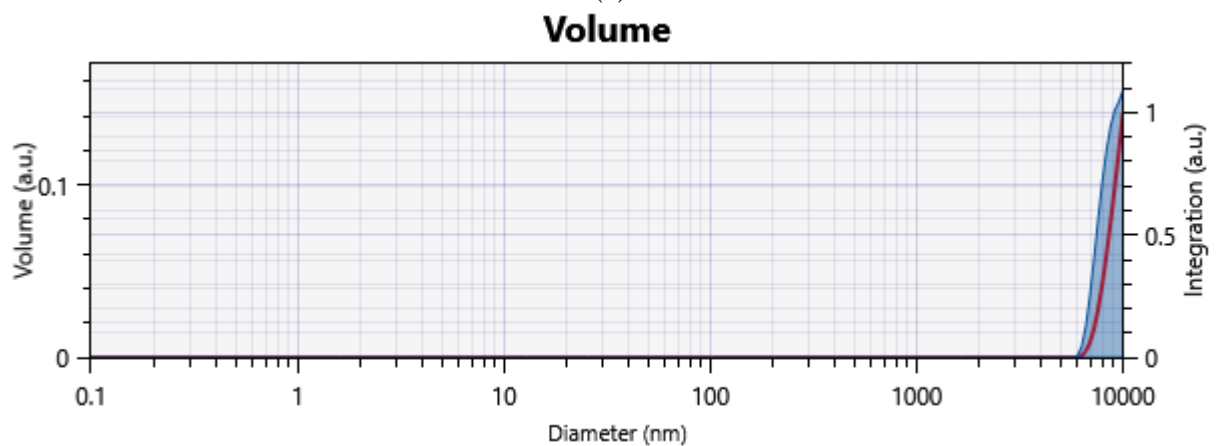


(a)



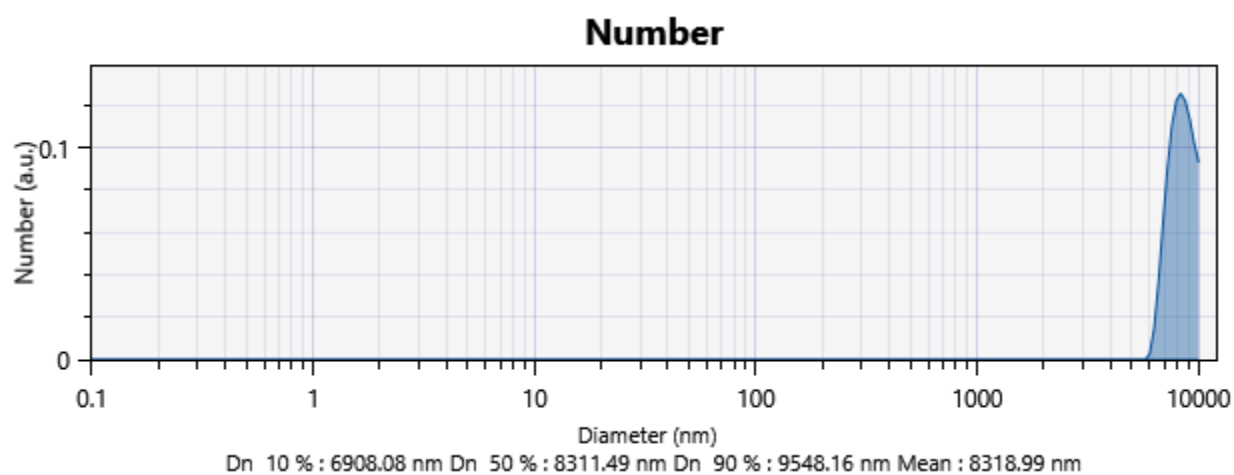
Di 10 % : 7577.36 nm Di 50 % : 9116.74 nm Di 90 % : 10000 nm Mean : 8962.25 nm

(b)

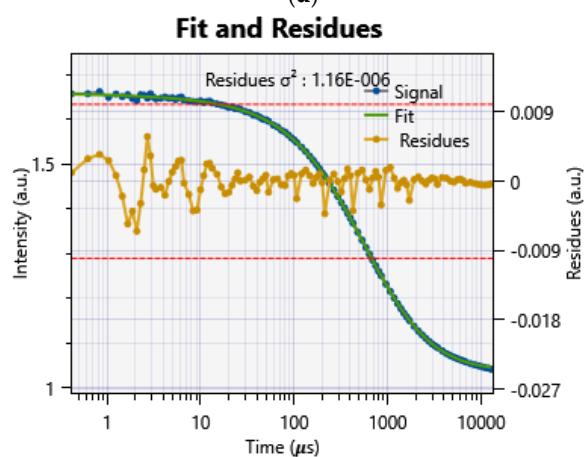


Dv 10 % : 7234.99 nm Dv 50 % : 8704.8 nm Dv 90 % : 10000 nm Mean : 8671.03 nm

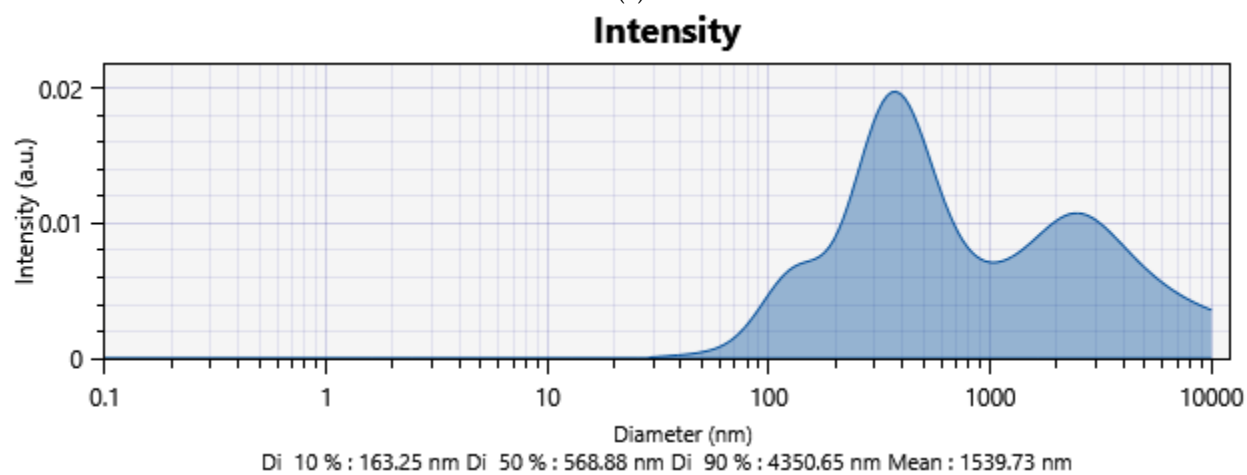
(c)



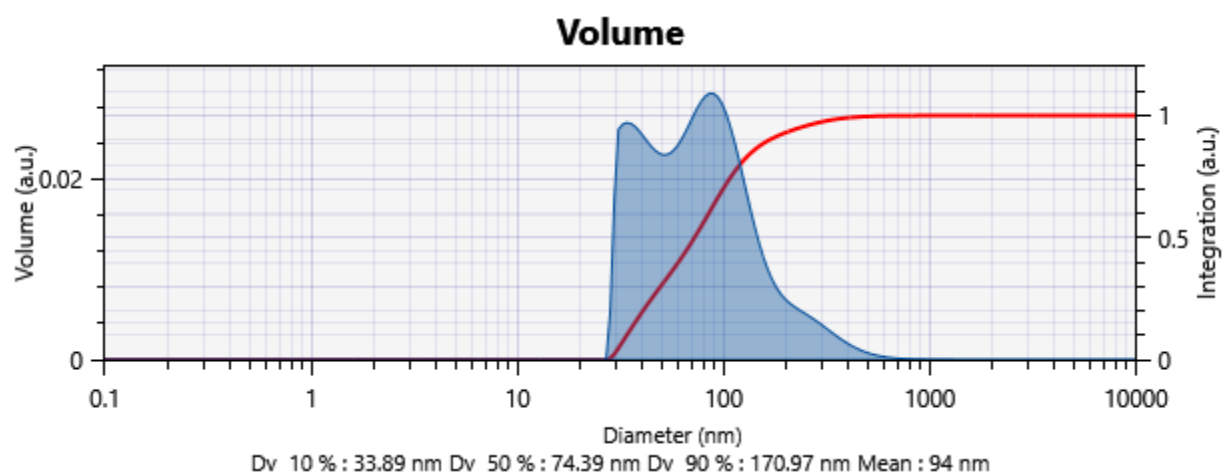
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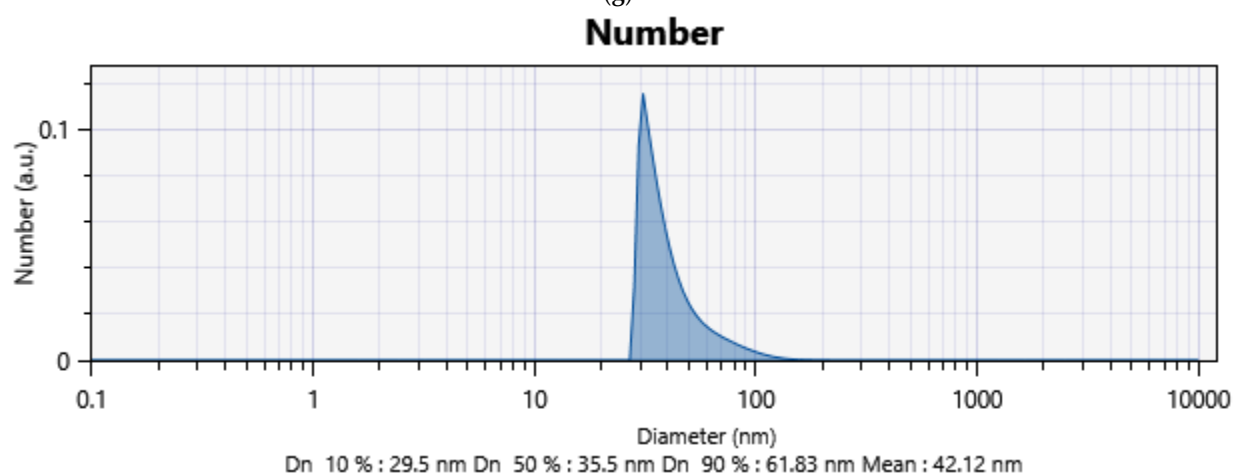
(e)



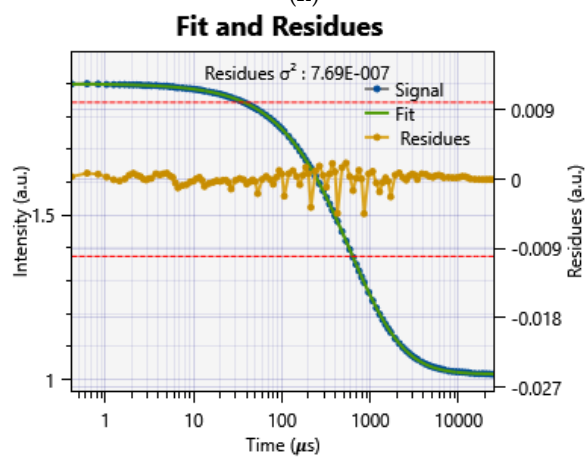
(f)



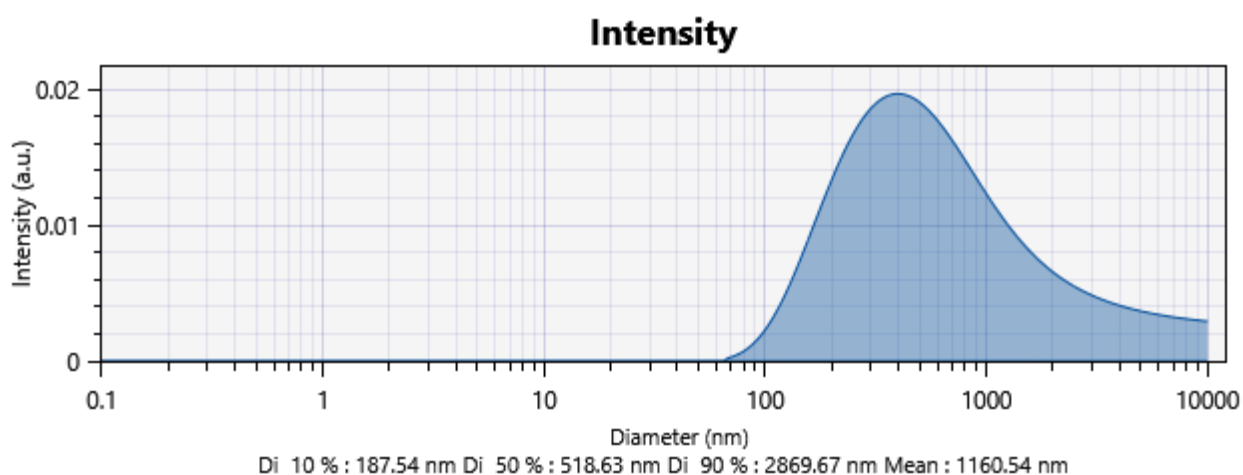
(g)



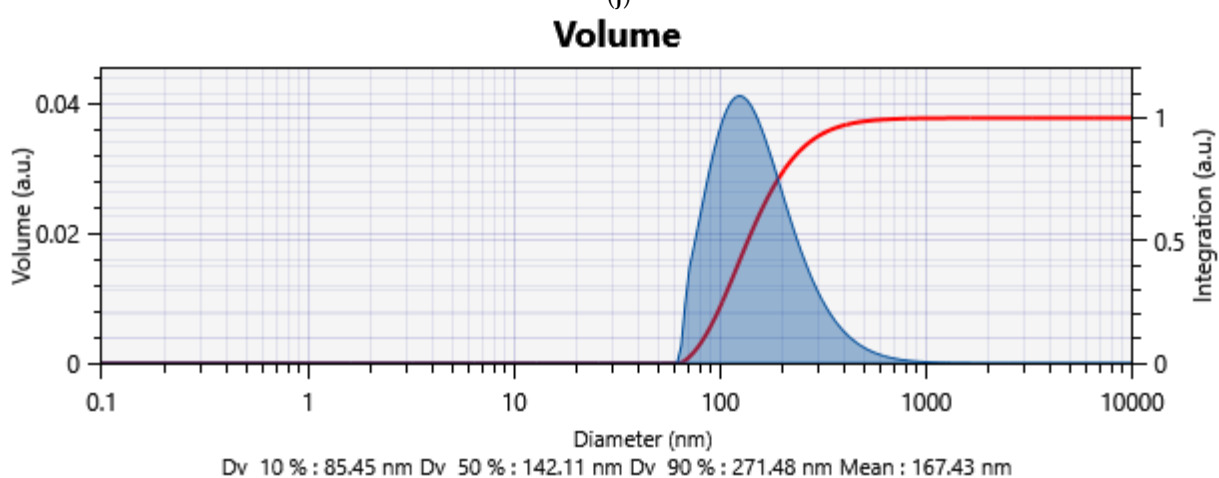
(h)



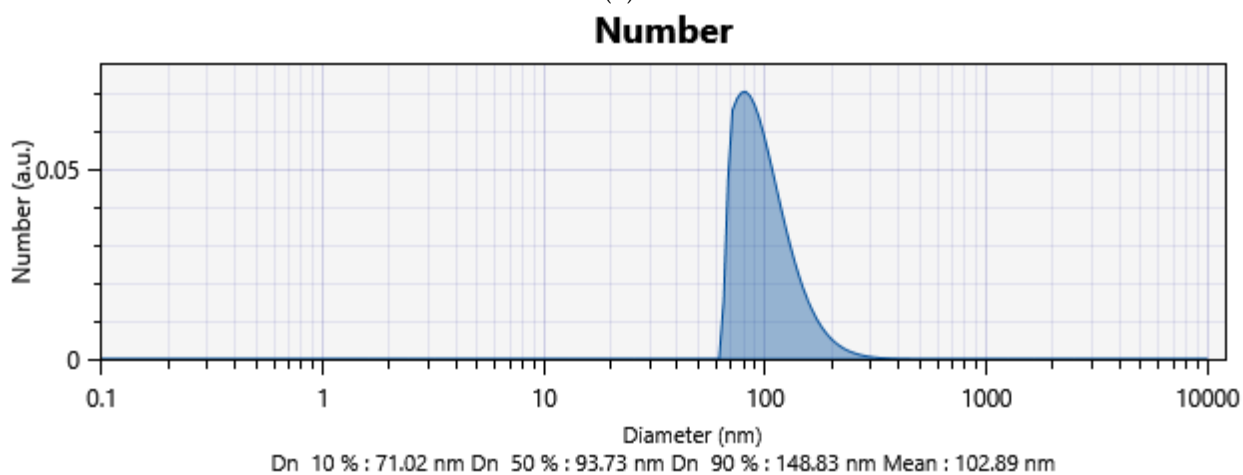
(i)



(j)

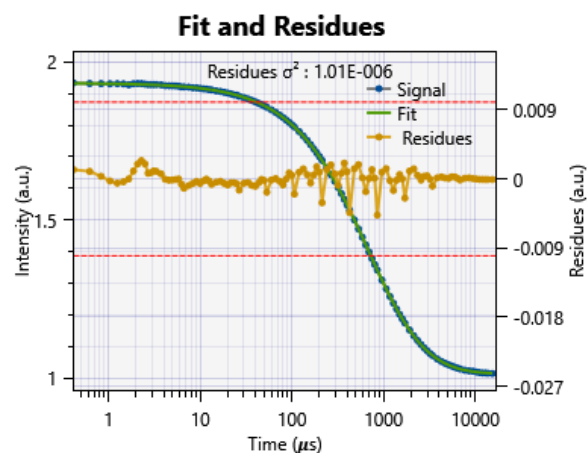


(k)

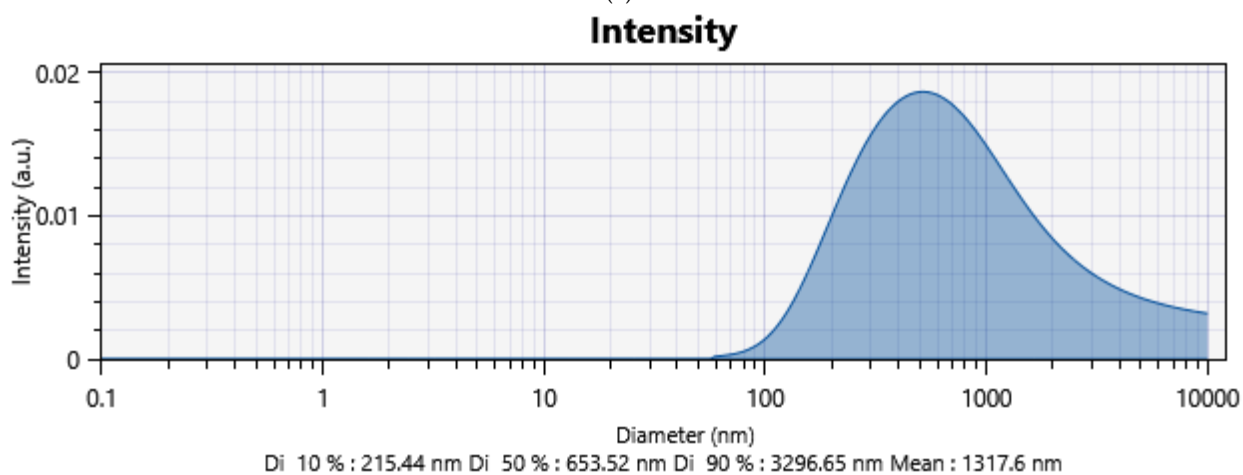


(l)

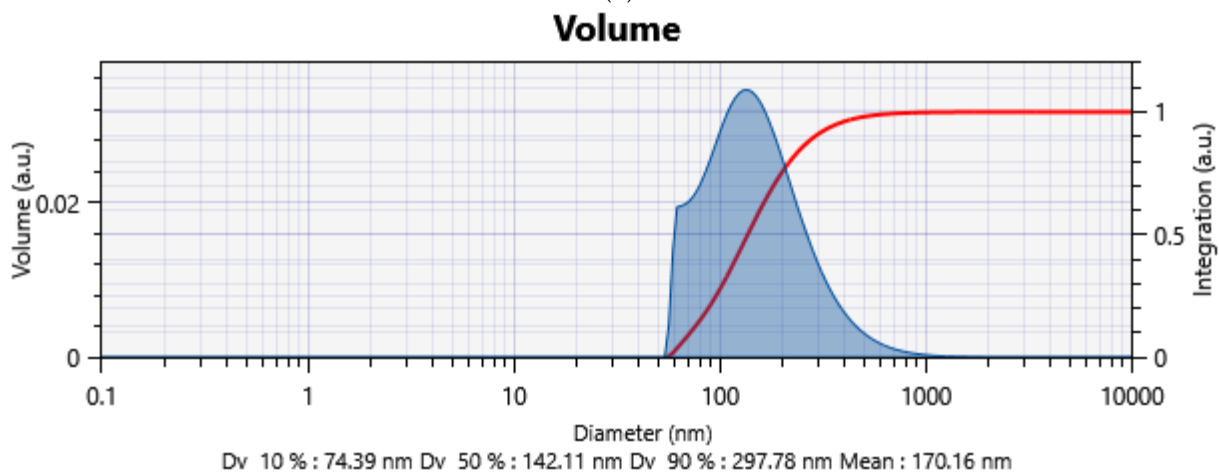
Figure S9. DLS analysis in 2% AcOH using the SBL method: (a) simulation of autocorrelation function for CS; (b) Intensity for CS; (c) Volume for CS; (d) Number for CS; (e) simulation of autocorrelation function for CSFa(-); (f) Intensity for CSFa(-); (g) Volume for CSFa(-); (h) Number for CSFa(-); (i) simulation of autocorrelation function for CSFa(+); (j) Intensity for CSFa(+); (k) Volume for CSFa(+); (l) Number for CSFa(+); CSFa(-): without ferulic acid addition in the reaction (non-grafted chitosan); CSFa(+): ferulic acid-grafted chitosan.



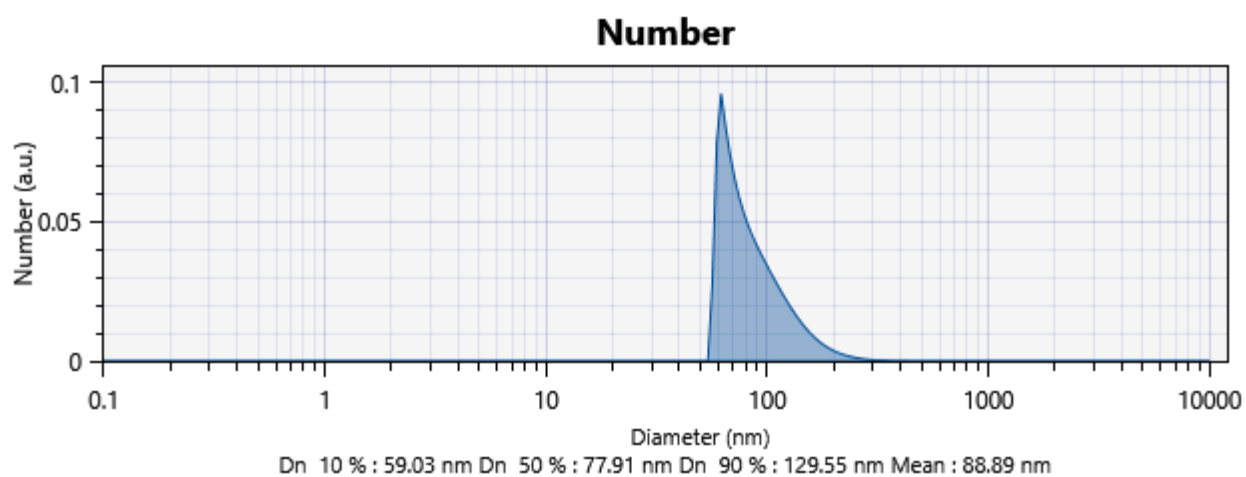
(a)



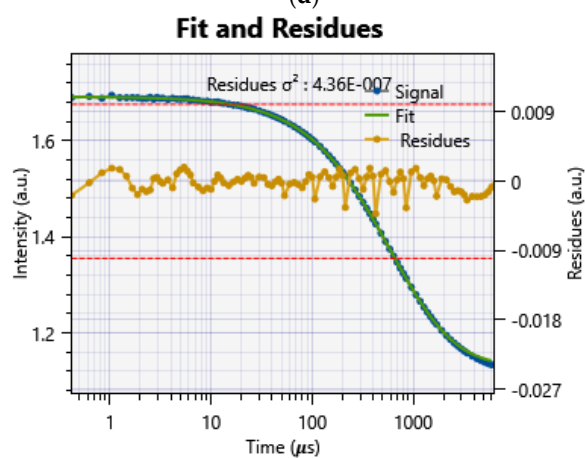
(b)



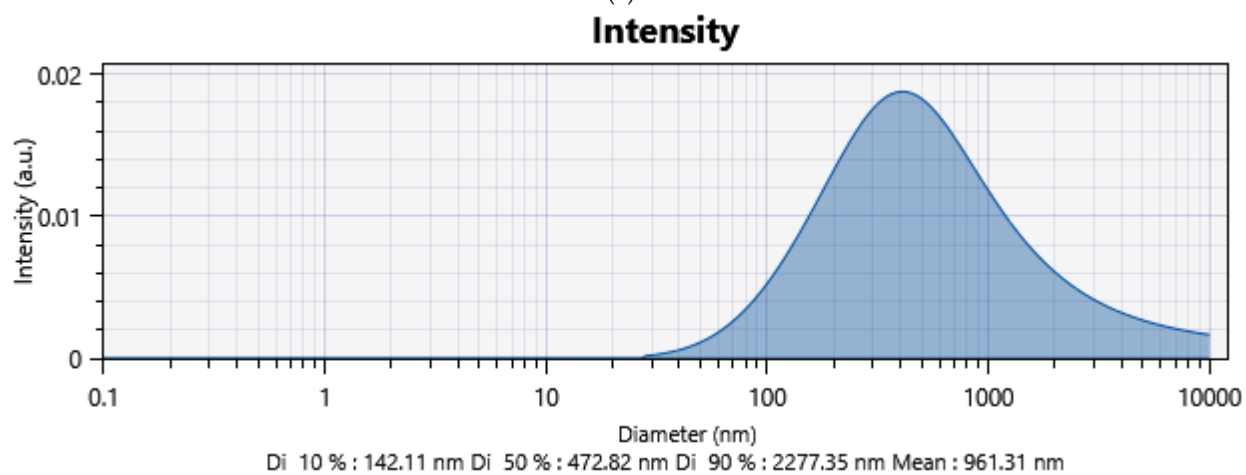
(c)



(d)



(e)



(f)

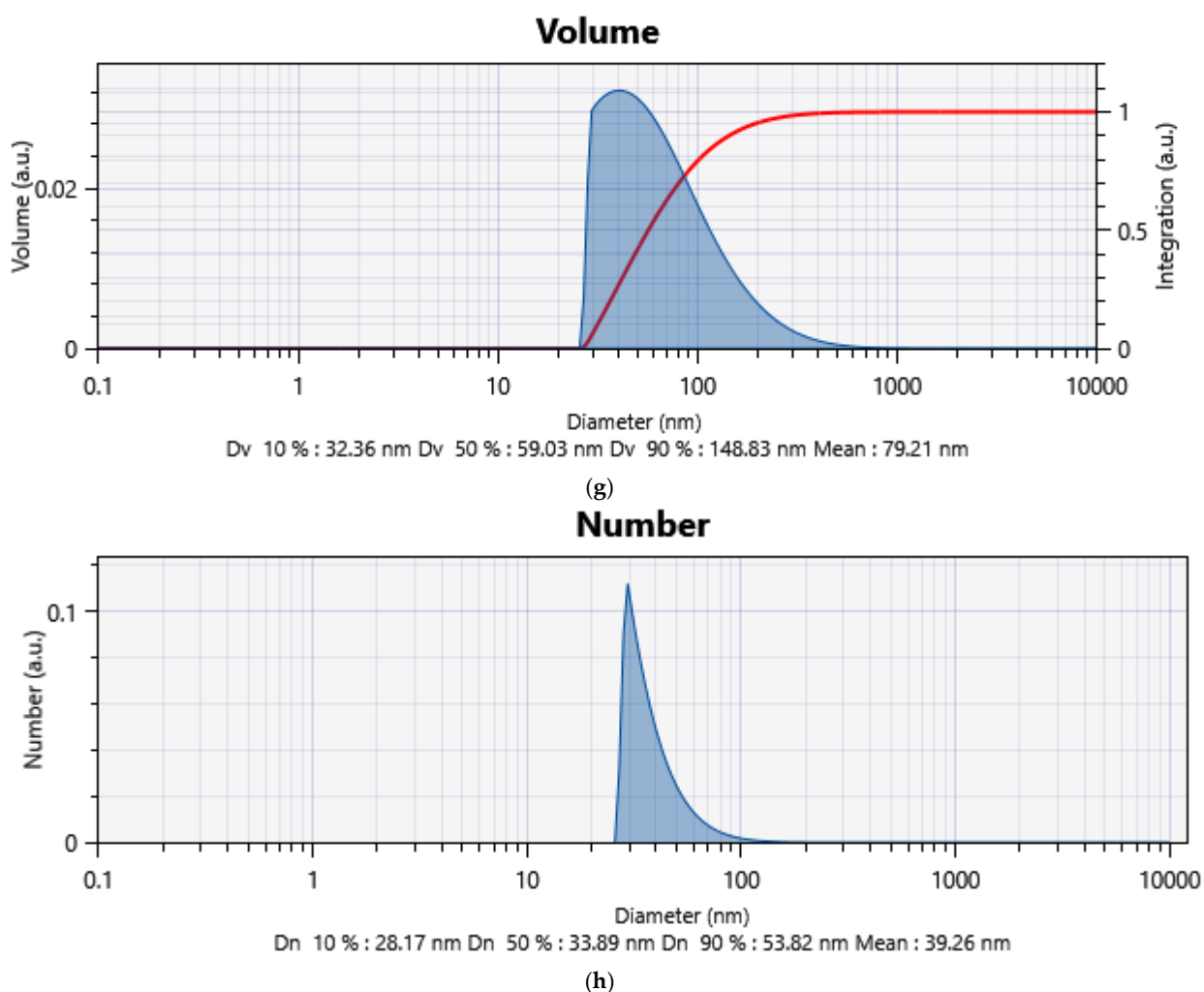


Figure S10. DLS analysis in ddH₂O using the SBL method: (a) simulation of autocorrelation function for CSFa(-); (b) Intensity for CSFa(-); (c) Volume for CSFa(-); (d) Number for CSFa(-); (e) simulation of autocorrelation function for CSFa(+); (f) Intensity for CSFa(+); (g) Volume for CSFa(+); (h) Number for CSFa(+); CSFa(-): without ferulic acid addition in the reaction (non-grafted chitosan); CSFa(+): ferulic acid-grafted chitosan.

Table S3. DLS analysis of CS: initial chitosan; CSFa(-): non-grafted chitosan, CSFa(+): ferulic acid-grafted chitosan in 2% AcOH using the SBL method.

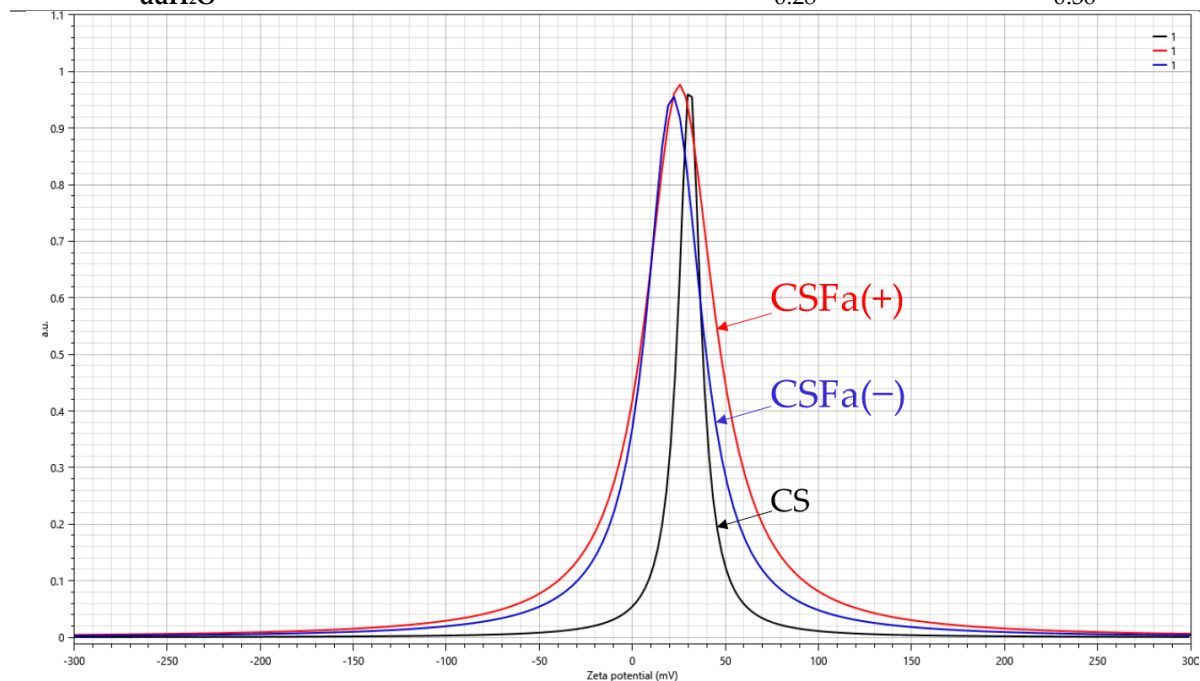
Sample	Mean size (nm)	Intensity (a.u.)	Volume (a.u.)	Number (a.u.)
CS	8519.74	56.86	-	-
	9600.65	43.14	-	-
	8713.04	-	100	-
	7947.98	-	-	65.49
	9416.25	-	-	34.51
CSFa(-)	389.9	61.52	-	-
	3444.66	38.48	-	-
	39.22	-	31.23	-
	117.59	-	68.77	-
	42.15	-	-	100
CSFa(+)	1184.73	100	-	-
	167.55	-	100	-
	102.96	-	-	100

Table S4. DLS analysis of CSFa(-): non-grafted chitosan, CSFa(+): ferulic acid-grafted chitosan in ddH₂O using the SBL method.

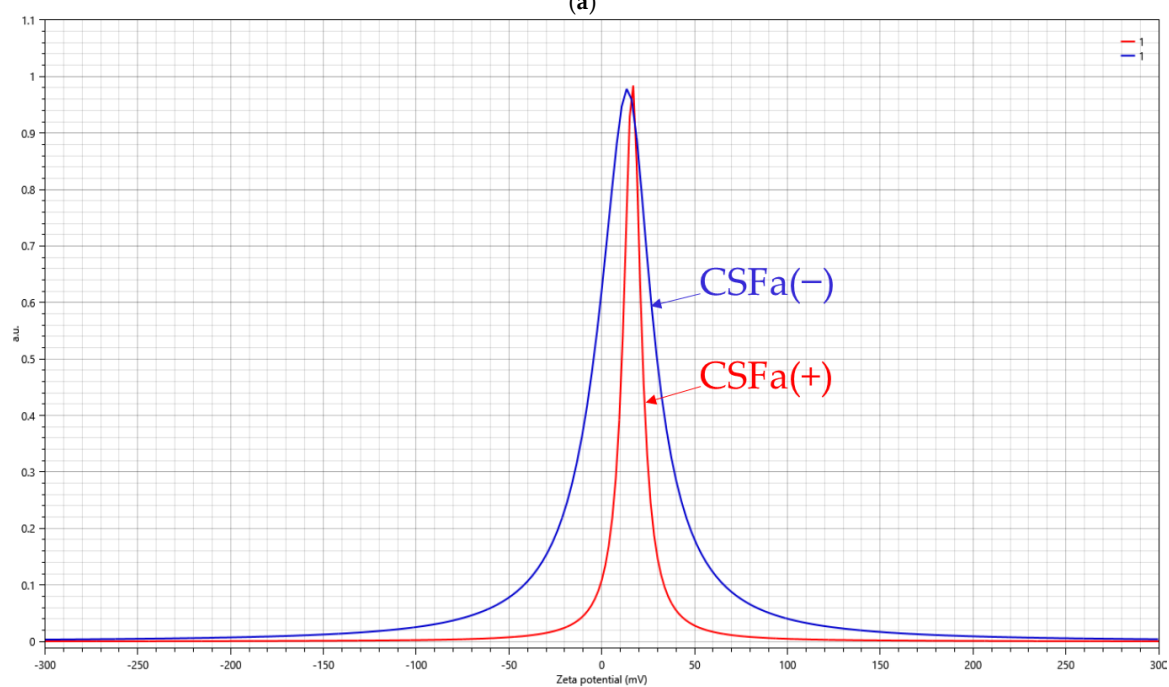
Sample	Mean size (nm)	Intensity (a.u.)	Volume (a.u.)	Number (a.u.)
CSFa(-)	1343.55	100	-	-
	170.28	-	100	-
	88.95	-	-	100
CSFa(+)	976.02	100	-	-
	79.26	-	100	-
	39.23	-	-	100

Table S5. Polydispersity Index, PDI (a.u.)

Solvent	CS	CSFa(-)	CSFa(+)
2% AcOH	0.34	0.30	0.24
ddH ₂ O	-	0.28	0.36



(a)

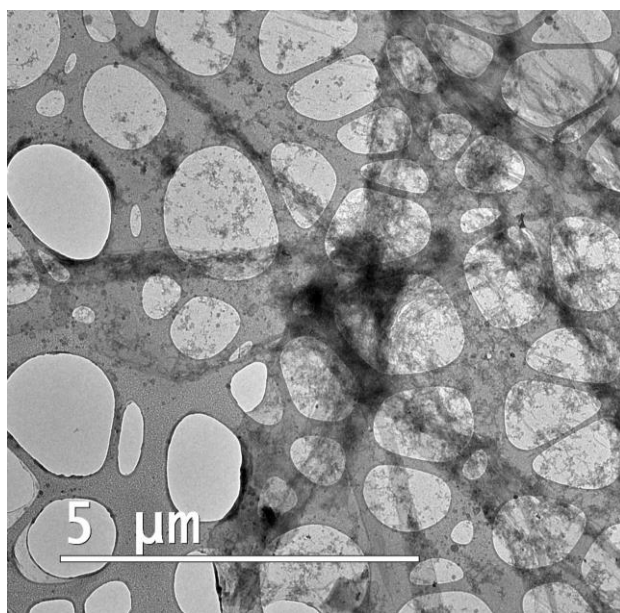


(b)

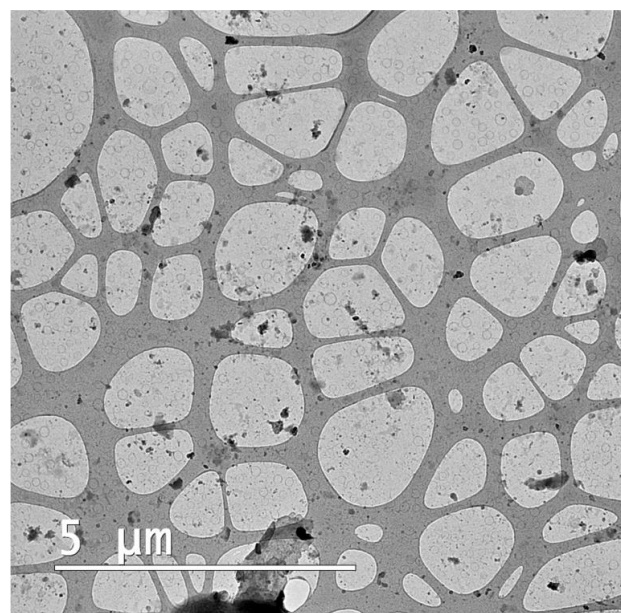
Figure S11. Zeta potential: (a) in 2% acetic acid (AcOH); (b) in double-distilled water (ddH₂O); CS: initial chitosan; CSFa(-): non-grafted chitosan; CSFa(+): ferulic acid-grafted chitosan.

Table S6. Zeta potential, ζ (mV) \pm standard deviation ($n=6$) of CS: initial chitosan; CSFa(-): non-grafted chitosan, CSFa(+): ferulic acid-grafted chitosan.

Solvent	CS	CSFa(-)	CSFa(+)
2% AcOH	30.66 \pm 1.12	22.38 \pm 3.54	25.69 \pm 3.91
ddH ₂ O	-	12.66 \pm 2.95	16.38 \pm 0.61

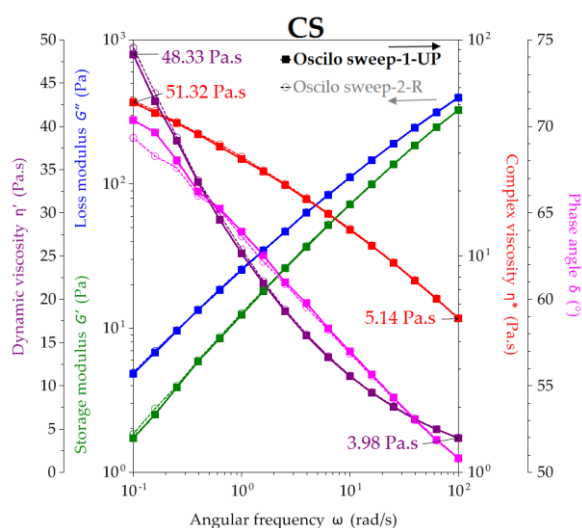


(a)

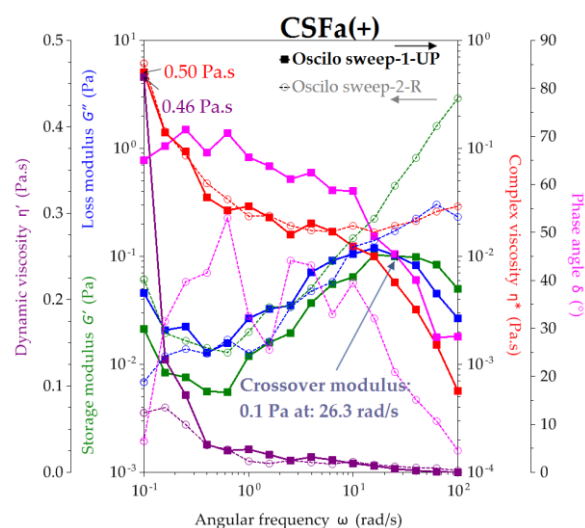


(b)

Figure S12. TEM analysis: (a) CSFa(-), i.e., without ferulic acid addition in the reaction (non-grafted chitosan); (b) CSFa(+), i.e., ferulic acid-grafted chitosan in water.



(a)



(b)

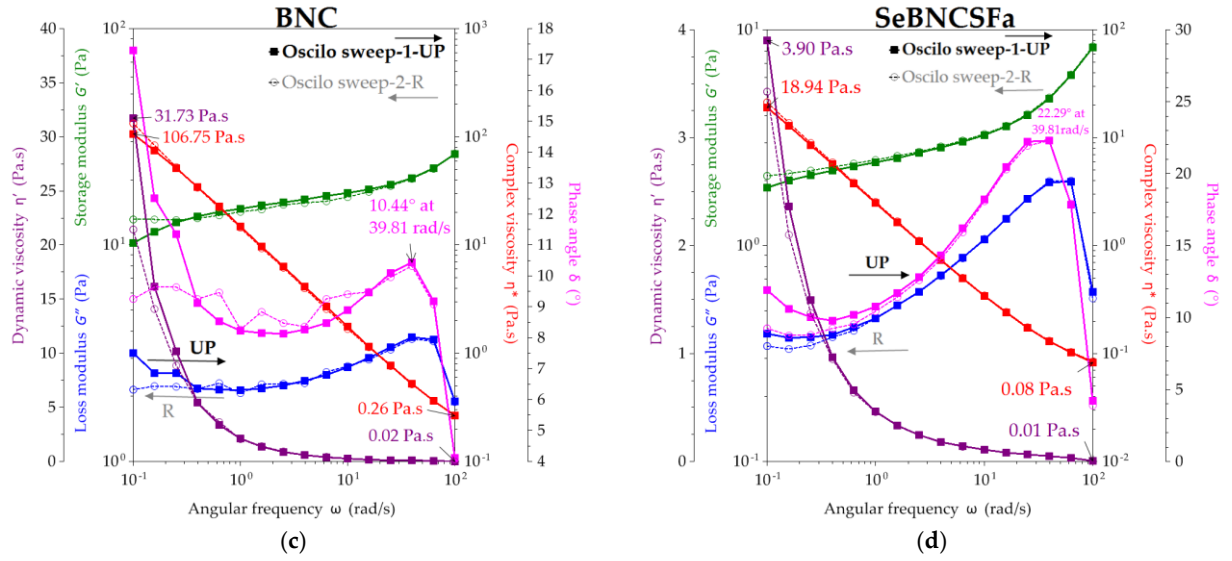


Figure S13. Rheology experiments in oscillatory sweep mode: (a) CS; (b) CSFa(+); (c) BNC; (d) SeBNCSFa; CS: chitosan; CSFa(-): non-grafted chitosan; CSFa(+): ferulic acid-grafted chitosan; SeBNCSFa: hydrogel formulation based on ferulic acid-grafted chitosan and bacterial nanocellulose enriched with 2.5 $\mu\text{g/mL}$ SeNPs from Kombucha fermentation.

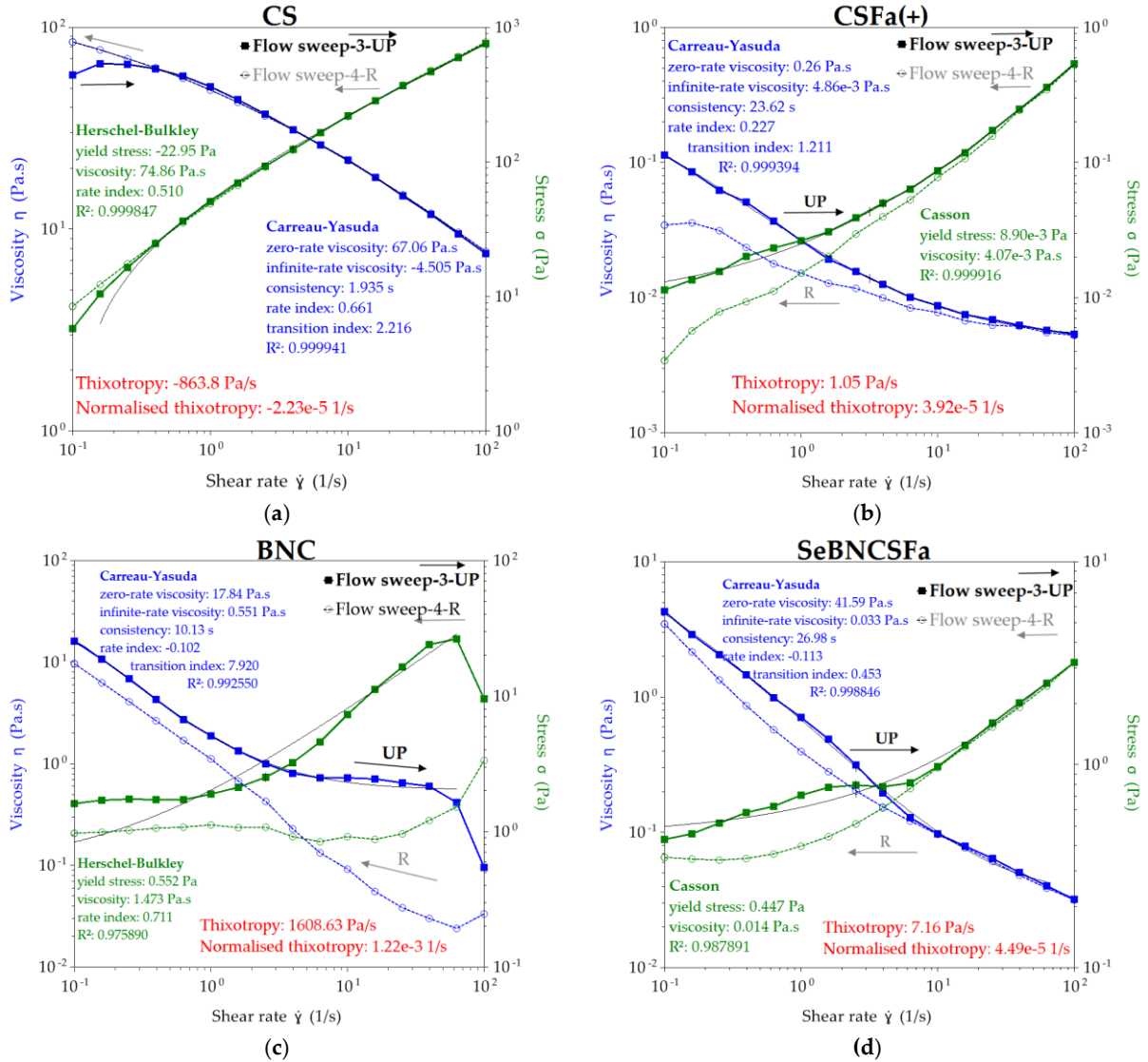
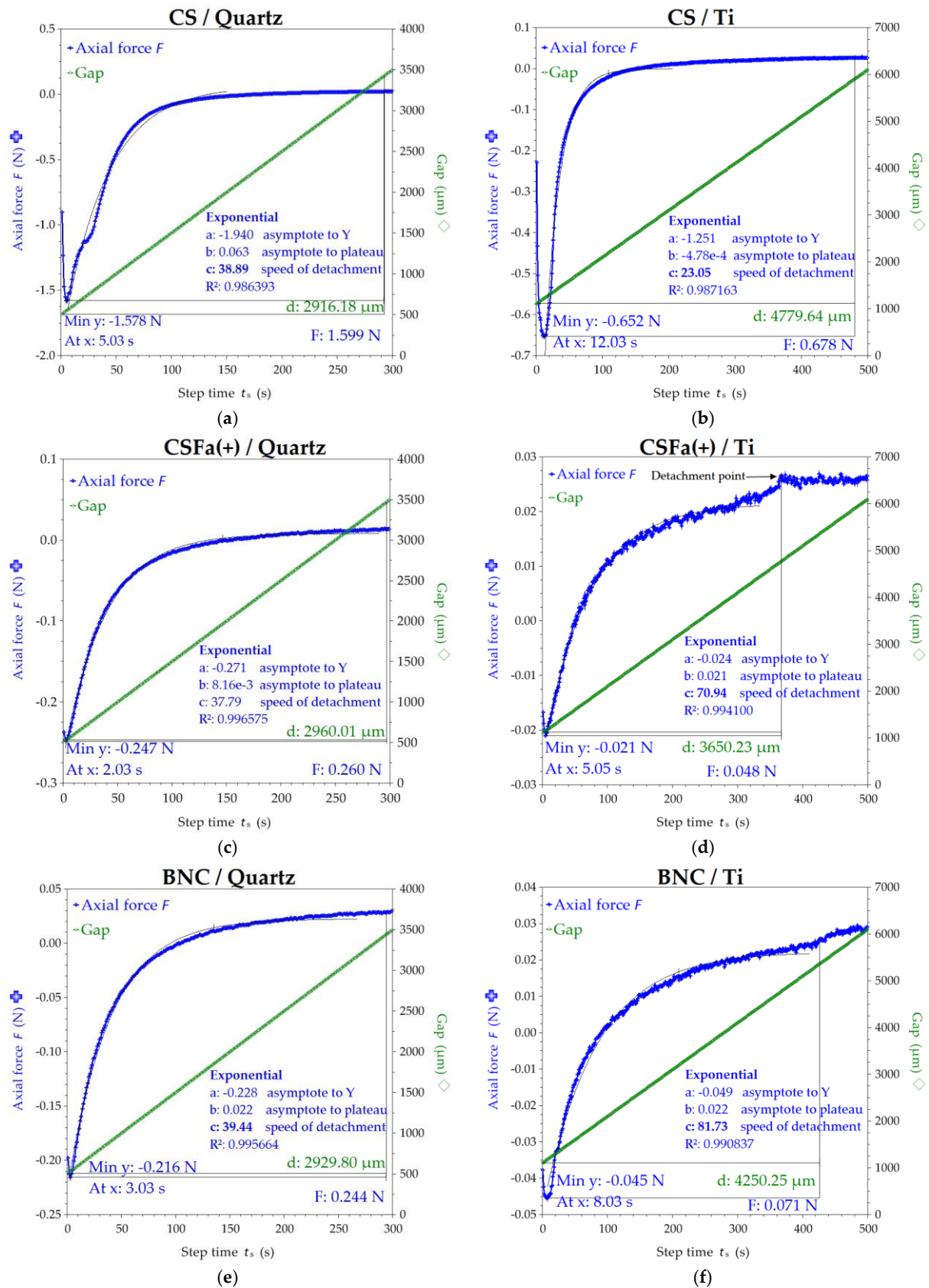


Figure S14. Rheology experiments in flow sweep mode: (a) CS; (b) CSFa(+); (c) BNC; (d) SeBNCSFa; CS: chitosan; CSFa(-): non-grafted chitosan; CSFa(+): ferulic acid-grafted chitosan; SeBNCSFa: hydrogel formulation based on ferulic acid-grafted chitosan and bacterial nanocellulose enriched with 2.5 $\mu\text{g/mL}$ SeNPs from Kombucha fermentation.



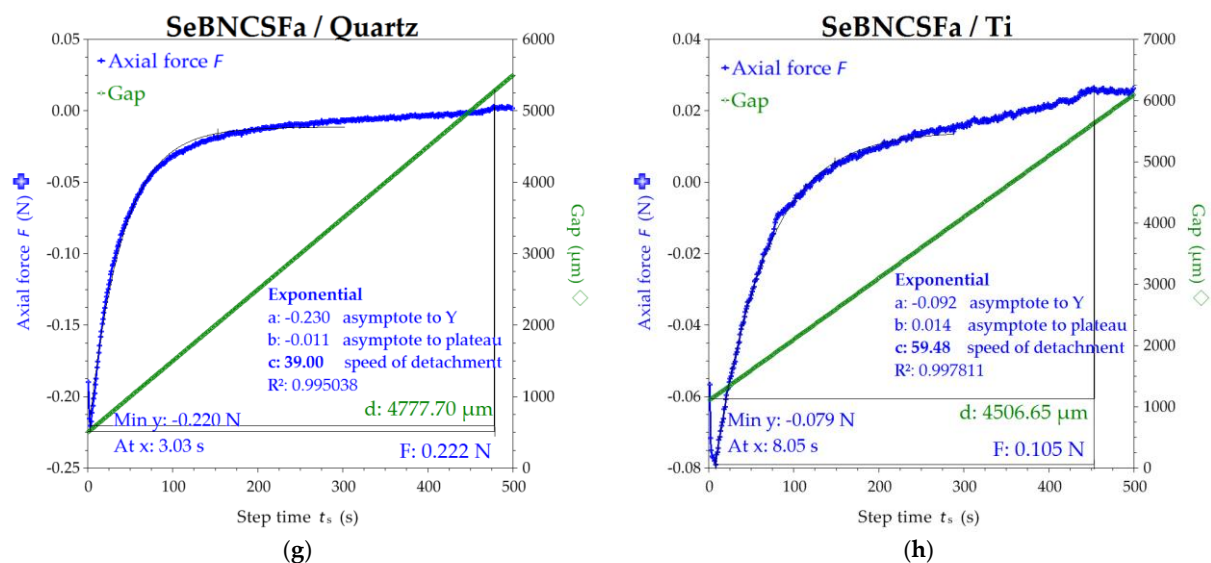
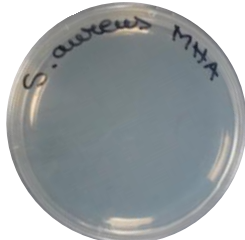

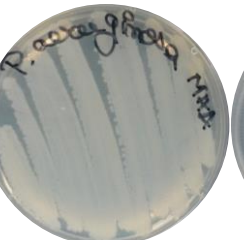
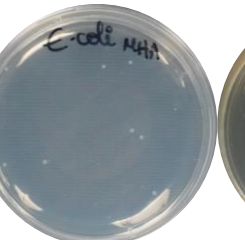
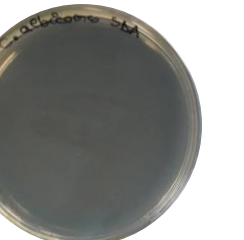


Figure S15. Rheology experiments in axial mode: (a) CS/Quartz; (b) CS/Ti; (c) CSFa(+)/Quartz; (d) CSFa(+)/Ti; (e) BNC/Quartz; (f) BNC/Ti; (g) SeBNCSFa/Quartz; (h) SeBNCSFa/Ti; CS: chitosan; CSFa(+): ferulic acid-grafted chitosan; BNC: bacterial nanocellulose; SeBNCSFa: hydrogel formulation based on ferulic acid-grafted chitosan and bacterial nanocellulose enriched with 2.5 $\mu\text{g/mL}$ SeNPs from Kombucha fermentation.

Table S7. Screening of the bactericidal effect of SeBNCSFa.

Strain	<i>S. aureus</i>	<i>B. cereus</i>	<i>P. aeruginosa</i>	<i>E. coli</i>	<i>C. albicans</i>
SeBNCSFa*	+	-	-	-	+
					

* SeBNCSFa: hydrogel formulation based on ferulic acid-grafted chitosan and bacterial nanocellulose enriched with 2.5 $\mu\text{g/mL}$ selenium nanoparticles from Kombucha fermentation.

+ means bactericidal effect.

- means bacteriostatic effect.