

Tailoring lignin nanoparticle properties: The effects of pH and salt on shape and antioxidant capacity

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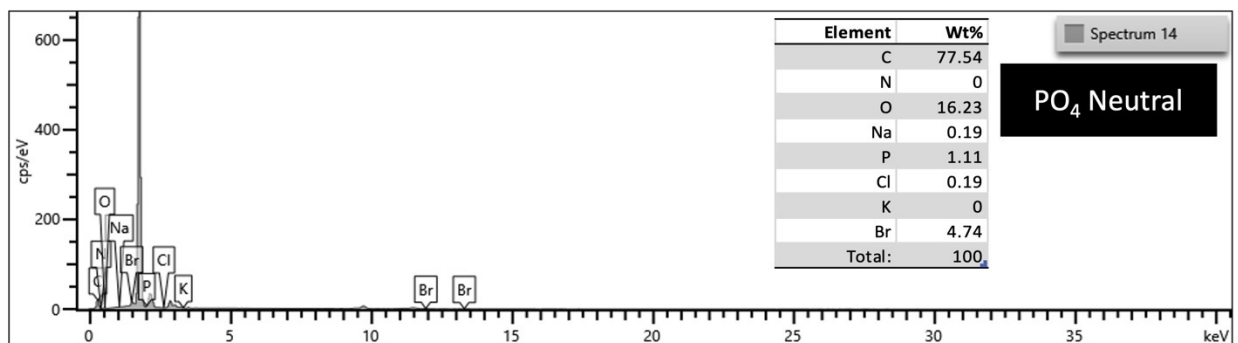
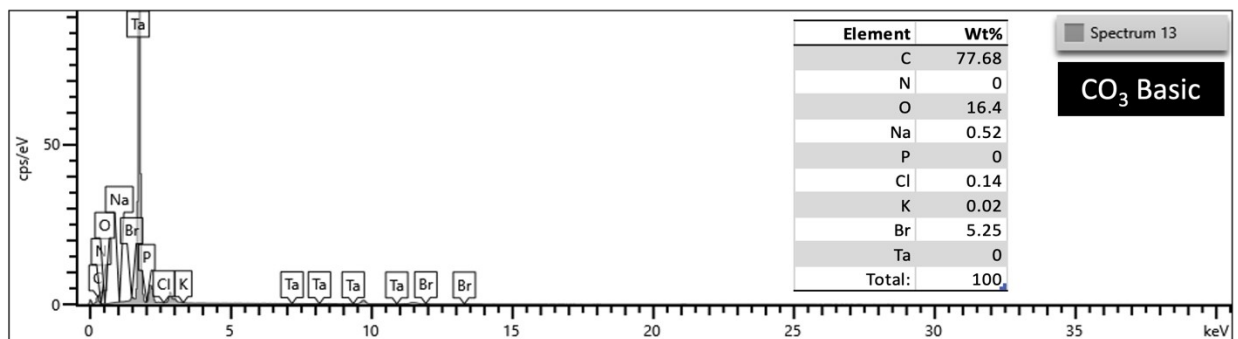
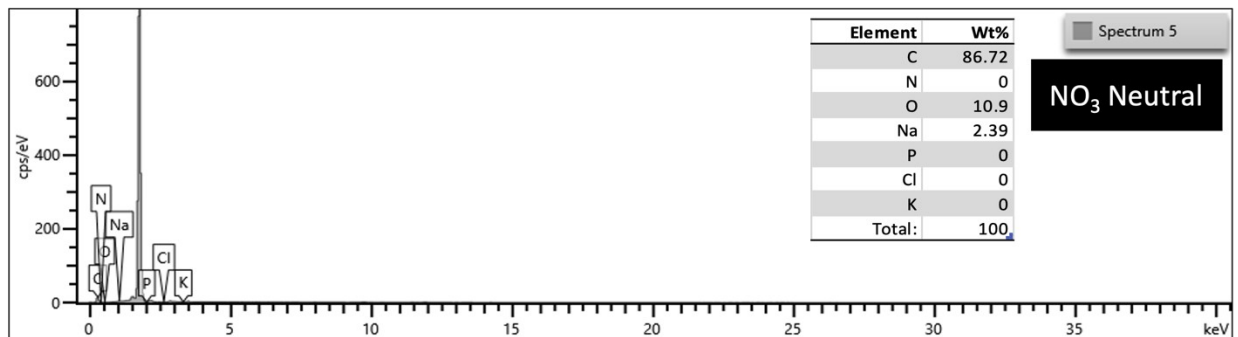
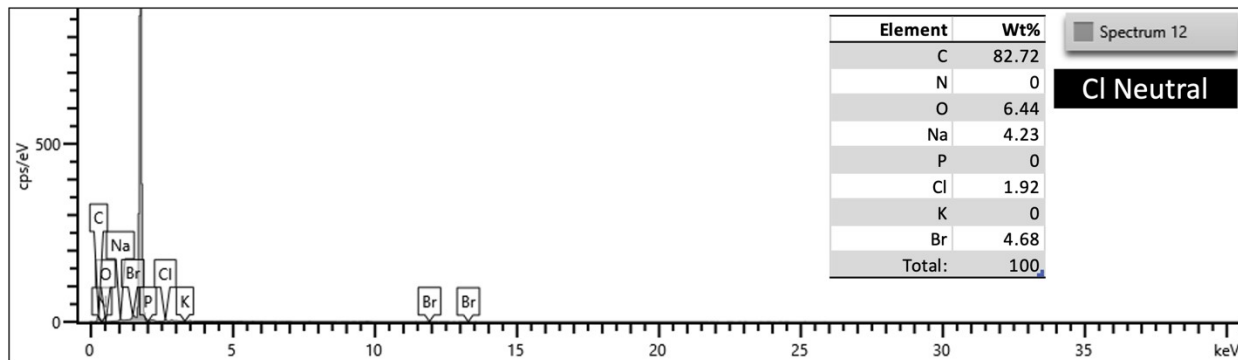


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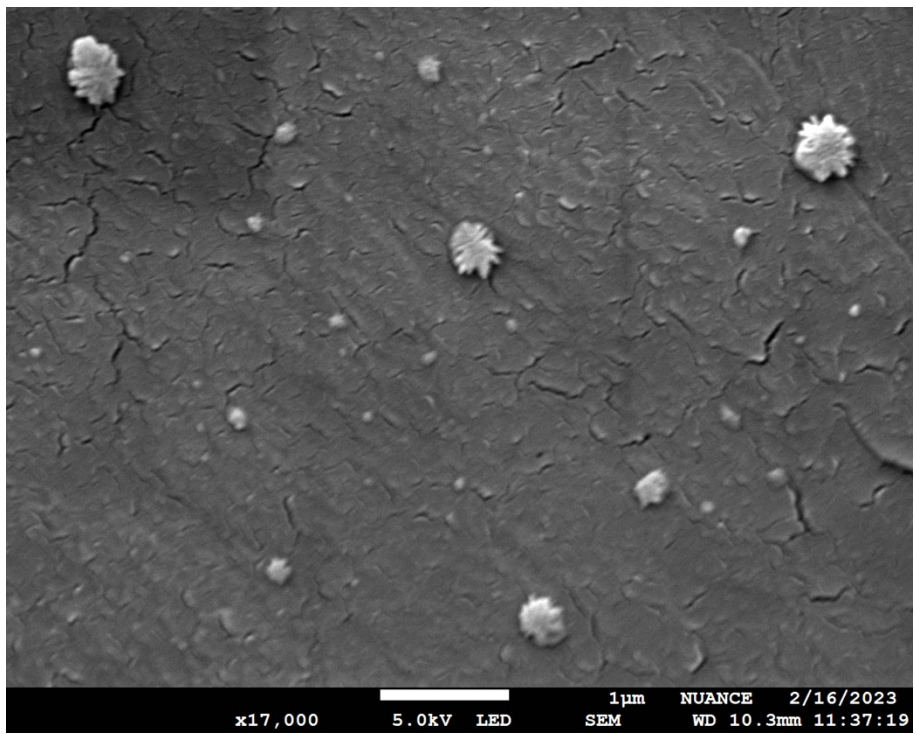


Figure S2. SEM image of dialyzed carbonate LNPs, we see that the flower-like micelle is intact.

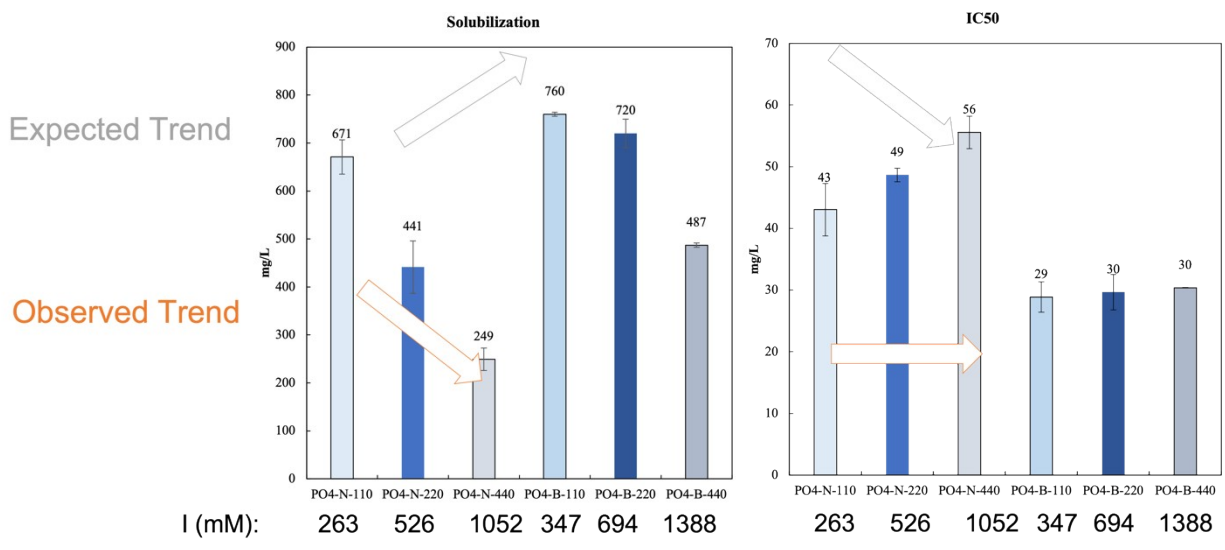


Figure S3. Ionic strength effects for phosphate salt in basic and neutral conditions. Ionic strength was modified with changes to the concentration. The gray arrow indicates what the expected trend is and the orange line indicates the observed trend. We see that the expected and observed trends are not in agreement, indicating that the ionic strength is not responsible for the differences in LNP properties.

Table S1. Anion and pH of a 220 mM salt solution at day 7 at basic, neutral, and acidic pH. We see overall solubilization as measured by uv-vis and calibrated with completely dissolved lignin at pH 14. LNP concentration is determined through NTA, using methods described in the manuscript. We see nearly complete dissolution of lignin in most solutions and a high conversion into LNPs.

Anion	pH	Sol (mg/L)	LNP (mg/L)	Sol SE	LNP SE
Cl	Basic	1080.7	245.0	98.0	32.5
Cl	Neutral	948.7	515.8	66.4	47.0
NO3	Basic	1075.0	252.4	100.6	17.5
NO3	Neutral	952.5	328.9	125.6	21.6
NO3	Acidic	1028.3	409.1	79.2	31.5
CO3	Basic	1170.9	156.3	202.3	21.9
CO3	Neutral	895.4	354.8	54.9	17.0
PO4	Basic	998.9	445.5	63.0	1.1
PO4	Neutral	428.8	879.1	2.9	1.6
PO4	Acidic	96.8	272.3	2.2	62.4

Table S2. Summary of the experiments that were performed in this section. This includes the naming convention (label) which subsequent figures use, the salt type, the day of measurement, the concentration, the pH, and the ionic strength.

Label	Salt	Day	Conc (M)	pH	Ionic Strength (M)
Cl-B	Sodium Chloride	0	0.220	10.8	0.220
Cl-B-7	Sodium Chloride	7	0.220	10.8	0.220
Cl-N	Sodium Chloride	0	0.220	7	0.220
Cl-N-7	Sodium Chloride	7	0.220	7	0.220
NO3-B	Sodium Nitrate	0	0.220	10.8	0.220
NO3-B-7	Sodium Nitrate	7	0.220	10.8	0.220
NO3-N	Sodium Nitrate	0	0.220	7	0.220
NO3-N-7	Sodium Nitrate	7	0.220	7	0.220
NO3-A	Sodium Nitrate	0	0.220	3.8	0.220
NO3-A-7	Sodium Nitrate	7	0.220	3.8	0.220
CO3-B	Sodium Carbonate/ Sodium Bicarbonate	0	0.220	10.8	0.529
CO3-B-7	Sodium Carbonate/ Sodium Bicarbonate	7	0.220	10.8	0.529
CO3-N	Sodium Carbonate/ Sodium Bicarbonate	0	0.220	7	0.185
CO3-N-7	Sodium Carbonate/ Sodium Bicarbonate	7	0.220	7	0.185
PO4-B	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	0	0.220	10.8	0.694
PO4-B-7	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	7	0.220	10.8	0.694
PO4-N	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	0	0.220	7	0.526
PO4-N-7	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	7	0.220	7	0.526
PO4-A	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	0	0.220	3.8	0.222
PO4-A-7	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	7	0.220	3.8	0.222
PO4-B-110	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	0	0.110	10.8	0.347
PO4-B-110-7	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	7	0.110	10.8	0.347
PO4-N-110	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	0	0.110	7	0.263
PO4-N-110-7	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	7	0.110	7	0.263
PO4-B-440	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	0	0.440	10.8	1.388
PO4-B-440-7	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	7	0.440	10.8	1.388
PO4-N-440	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	0	0.440	7	1.052
PO4-N-440-7	Potassium Phosphate Monobasic/ Sodium Phosphate Dibasic	7	0.440	7	1.052

Table S3. The correction values for the absorbances due to the effect of phosphate and carbonate at basic pH.

Phosphate (Basic)		Carbonate (Basic)	
Concentration	Absorbance Correction	Concentration	Absorbance Correction
Between 0-20 mg/L	0	2 mg/L	0.041
40 mg/L	0.054	6 mg/L	0.076
60 mg/L	0.115	10 mg/L	0.137
80 mg/L	0.141	14 mg/L	0.186
100 mg/L	0.223	16 mg/L	0.204
140 mg/L	0.278	18 mg/L	0.225
160 mg/L	0.31	20 mg/L	0.227
Over 200 mg/L	0.405	40 mg/L	0.326
		Over 60 mg/L	0.441