Electronic Supplementary Information

Neutral fabrication of UV-blocking and antioxidation lignin-stabilized high internal phase emulsion encapsulates for high efficient antibacterium of natural curcumin

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It Includes 16 Pages, 5 Tables, 8 Figures.

Table S1 The reaction condition and yield of sulfomethylating modification of EHL

EHL (g)	Water (mL)	pH	37% HCHO wt%	Na_2SO_3 wt%	Yield (%)
6.0	40	12.0	15	5	48.3%
6.0	40	12.0	15	10	56.7%
6.0	40	12.0	15	20	61.7%
6.0	40	12.0	15	40	66.7%
6.0	40	12.0	15	60	83.3%

Table S2 Experimental factors & levels for HIPEs stabilized with lignin derivatives.

Samples	Lignin derivatives	Lignin content wt%	APG wt%	Oil vol%
HIPEs-1	EHL-5S	0.5	3.5	80.0
HIPEs-2		1.0	3.5	80.0
HIPEs-3		2.0	3.5	80.0
HIPEs-4		3.0	3.5	80.0
HIPEs-5		5.0	3.5	80.0
HIPEs-6	EHL-10S	0.5	3.5	80.0
HIPEs-7		1.0	3.5	80.0
HIPEs-8		2.0	3.5	80.0
HIPEs-9		3.0	3.5	80.0
HIPEs-10		5.0	3.5	80.0
HIPEs-11	EHL-20S	0.5	3.5	80.0
HIPEs-12		1.0	3.5	80.0
HIPEs-13		2.0	3.5	80.0
HIPEs-14		3.0	3.5	80.0
HIPEs-15		5.0	3.5	80.0
HIPEs-16	EHL-40S	0.5	3.5	80.0
HIPEs-17		1.0	3.5	80.0
HIPEs-18		2.0	3.5	80.0
HIPEs-19		3.0	3.5	80.0
HIPEs-20		5.0	3.5	80.0
HIPEs-21	EHL-40S	0.5	3.5	80.0
HIPEs-22		1.0	3.5	80.0
HIPEs-23		2.0	3.5	80.0
HIPEs-24		3.0	3.5	80.0

HIPEs-25		5.0	3.5	80.0
HIPEs-26		0.5	3.5	80.0
HIPEs-27		1.0	3.5	80.0
HIPEs-28	EHL-60S	2.0	3.5	80.0
HIPEs-29		3.0	3.5	80.0
HIPEs-30		5.0	3.5	80.0
HIPEs-31		0.5	3.5	80.0
HIPEs-32		1.0	3.5	80.0
HIPEs-33	LS	2.0	3.5	80.0
HIPEs-34		3.0	3.5	80.0
HIPEs-35		5.0	3.5	80.0
HIPEs-36		2.0	3.5	75.0
HIPEs-37	EHL-20S	2.0	3.5	78.0
HIPEs-38		2.0	3.5	82.0

Table S3 Physicochemical parameters of EHL, EHL-XS and LS

Samples	M_w (Da)	M_n (Da)	PDI	Water solubility	Ph-OH (mmol/g)	-COOH (mmol/g)	$-SO_3^-$ (mmol/g)
EHL	3100	1100	2.82	−	1.54±0.04	1.82±0.0	0.00
EHL-5S	8000	2900	2.76	+++	1.51±0.09	1.87±0.0	0.58±0.03
EHL-10S	8100	2900	2.79	+++	1.50±0.03	1.87±0.0	0.76±0.01
EHL-20S	8200	3000	2.73	+++	1.55±0.07	1.79±0.0	0.89±0.02
EHL-40S	8500	3200	2.65	+++	1.58±0.04	1.83±0.0	1.05±0.01
EHL-60S	8700	4400	1.98	+++	1.54±0.05	1.87±0.0	1.47±0.01
LS	11000	3900	2.82	+++	1.86±0.24	2.18±0.0	2.21±0.02

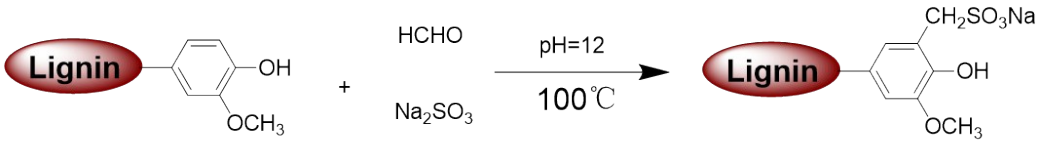
[α]PDI = polydispersity index; +++ = fully dissolved in 10% (w/v) concentration; − = insoluble.

Table S4 The elemental contents and contacts angle of EHL, EHL-XS and LS.

Samples	N%	C%	H%	S%	Contact angle
EHL	0.77	52.99	6.11	0.00	45°±1°
EHL-5S	0.73	44.52	5.74	1.25	39°±1°
EHL-10S	0.57	43.99	6.09	2.20	36°±2°
EHL-20S	0.53	44.07	6.00	2.81	35°±2°
EHL-40S	0.59	43.51	5.98	3.22	32°±1°
EHL-60S	0.43	42.32	6.36	4.80	24°±2°
LS	0.00	40.87	5.54	6.43	16°±2°

Table S5 Viscoelastic parameters of the EHL-XS-based HIPEs, as determined by amplitude sweep tests at 1 Hz frequency.

Critical parameters					
EHL-XS wt%	**APG wt%**	**Oil vol%**	**γ_c%**	**$\lvert\eta^*\rvert_{LVE}$ Pa.s**	**$\tan\delta_{LVE}$**
0.5-5S	3.5	80.0	0.16	80.82	0.03
1.0-5S	3.5	80.0	0.17	98.28	0.03
2.0-5S	3.5	80.0	0.12	28.22	0.11
3.0-5S	3.5	80.0	0.11	22.56	0.12
0.5-10S	3.5	80.0	0.17	105.40	0.02
1.0-10S	3.5	80.0	0.15	87.15	0.03
2.0-10S	3.5	80.0	0.12	43.18	0.11
3.0-10S	3.5	80.0	0.12	35.49	0.12
0.5-20S	3.5	80.0	0.20	115.00	0.02
1.0-20S	3.5	80.0	0.17	102.30	0.03
2.0-20S	3.5	80.0	0.12	97.57	0.04
3.0-20S	3.5	80.0	0.07	8.81	0.46
0.5-40S	3.5	80.0	0.16	91.04	0.03
1.0-40S	3.5	80.0	0.15	81.57	0.02
2.0-40S	3.5	80.0	0.11	76.42	0.05
3.0-40S	3.5	80.0	0.11	45.52	0.08
0.5-60S	3.5	80.0	0.15	82.98	0.02
1.0-60S	3.5	80.0	0.16	76.43	0.02
2.0-60S	3.5	80.0	0.10	37.45	0.07
3.0-60S	3.5	80.0	0.09	16.73	0.11
2.0-20S	3.5	75.0	0.05	53.74	0.09
2.0-20S	3.5	78.0	0.05	51.39	0.07



EHL Sulfomethylation EHL

Scheme. S1 The sulfomethylating modification of EHL.

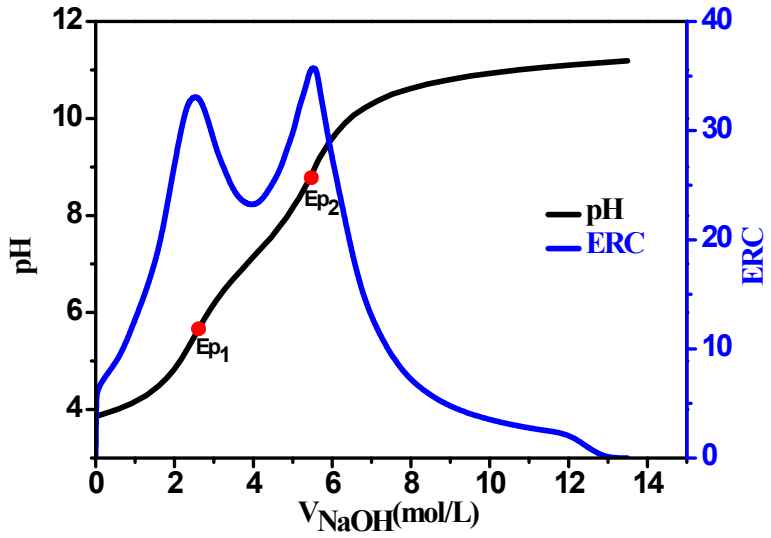


Figure S1. The diagrammatic curve of EHL by aqueous titration.

Figure S2. The appearances of the HIPEs stabilized by different EHL concentrations at 3.5 wt% APG, 80 vol% oil and water phase pH of 7.0.

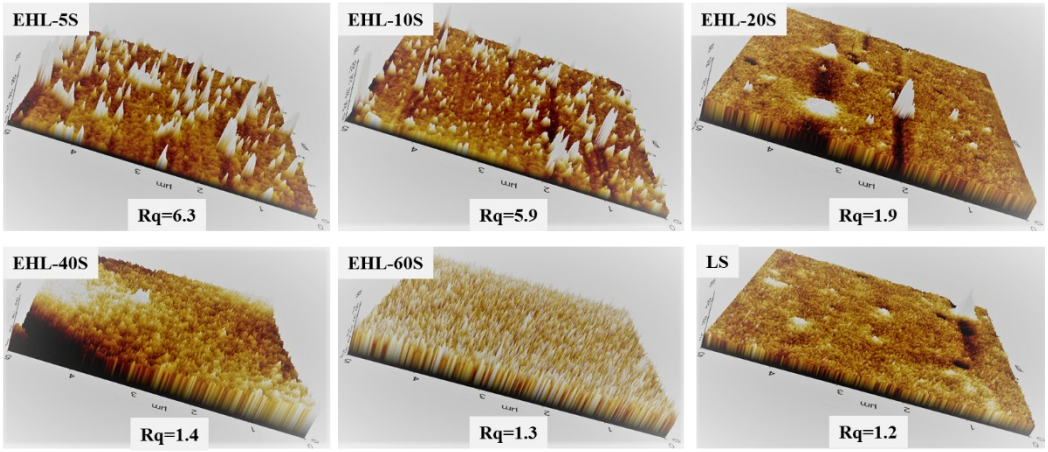


Figure S3. The topography images of EHL-XS with different sulfonation degrees and LS that coated on mica plates.

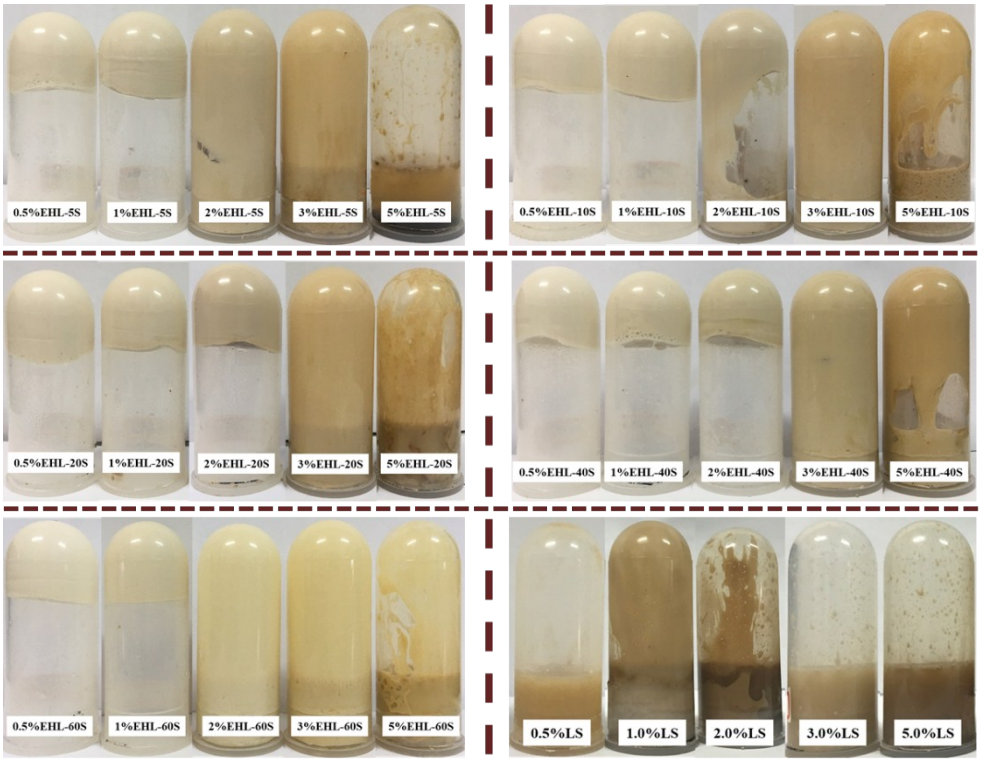


Figure S4. The appearances of the HIPEs stabilized by 0.5, 1, 3, 5wt% of EHL-XS (X=5, 10, 20, 40, 60) and LS at 3.5 wt% APG, 80 vol% oil and water phase pH of 6.75.

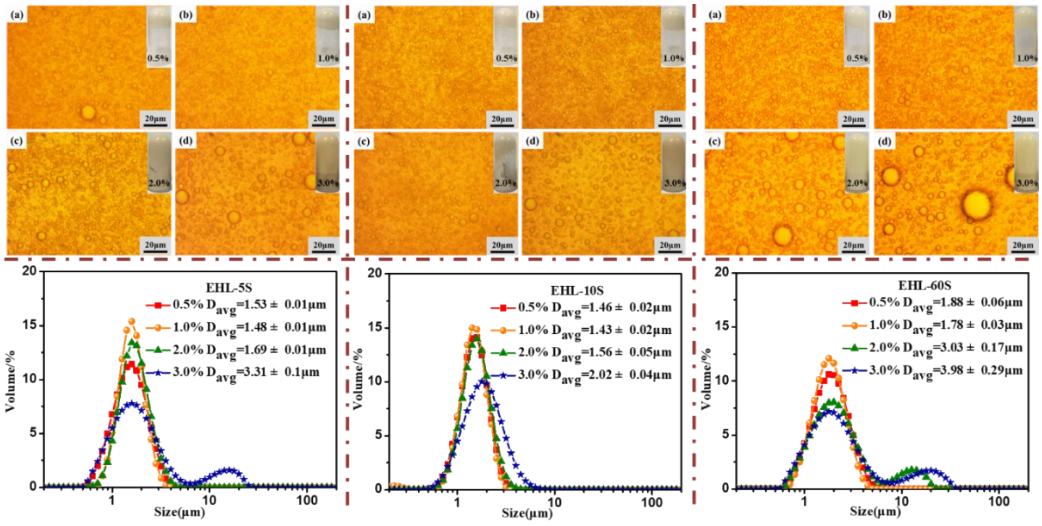


Figure S5. Optical microscope images and droplet size distributions of the HIPEs stabilized by EHL-XS (X=5, 10, 60) with different concentrations at 3.5 wt% APG, 80 vol% oil and water phase pH of 6.75.

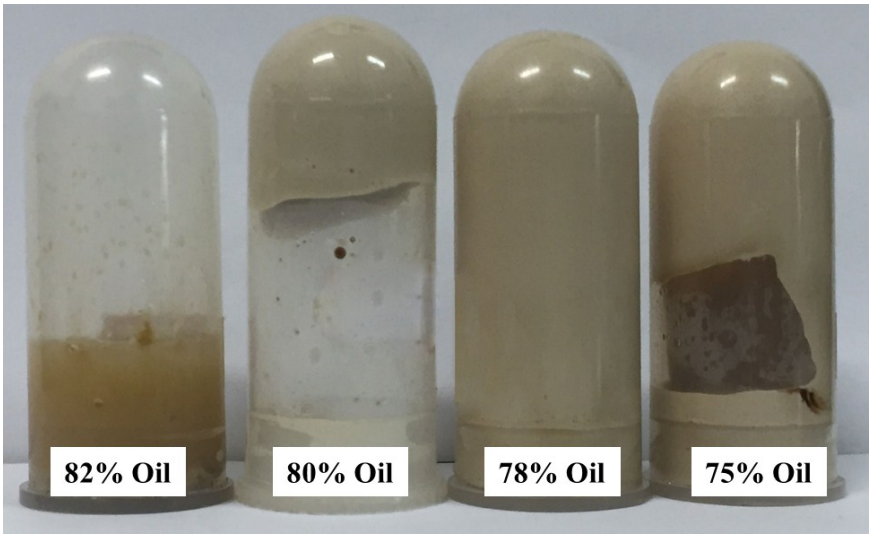


Figure S6. The appearances of the HIPEs stabilized by 2.0 wt% EHL-20S and 3.5 wt% APG with different internal phase volume fractions.

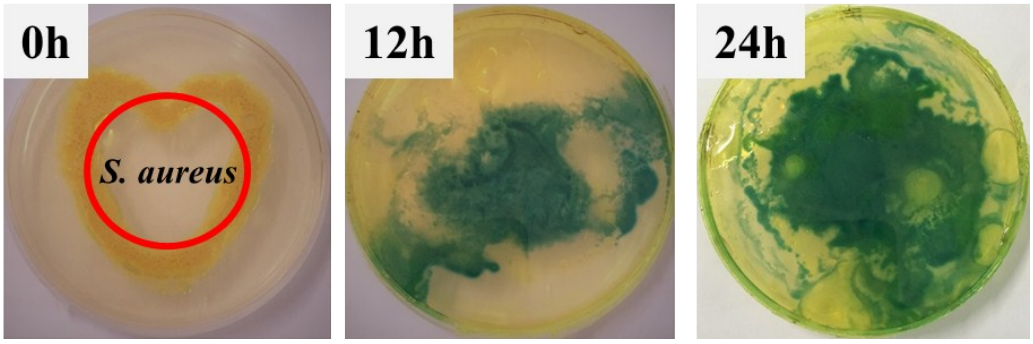


Figure S7. The growth of *S. aureus* with different incubation time in the presence of the HIPEs without curcumin.

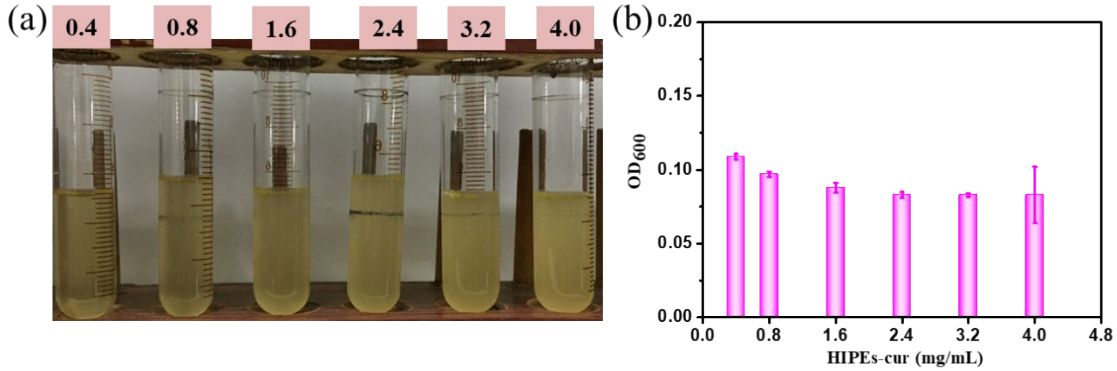


Figure S8. The appearances (a) and OD_{600} values (b) of suspensions with different concentrations of EHL-20S-based HIPEs-cur.