

Supplementary material

Table S1 Results of preliminary studies on NE properties at different stages of homogenization.

NE without curcumin	MDD	PDI	ZP
Sonication	523.1 ± 12.1*	0.65 ± 0.02	-39.0 ± 0.3
HPH 5 cycles	208.7 ± 1.9	0.10 ± 0.00	-31.9 ± 2.3
HPH 10 cycles	196.1 ± 2.5	0.10 ± 0.02	-27.4 ± 0.5

Results are presented as mean ± SD (n = 3); HPH – high-pressure homogenization; * - the appearance of the second fraction of droplet size.

Table S2 The CQA of developed NEs in two independent processes.

	Number of process	NE-1	NE-2	NE-3	NE-4	NE-5
C_{KOL} [%]	-	-	0.25	1.0	2.5	5
MDD [nm]	1	149.9 ± 1.4	141.0 ± 1.6	114.8 ± 1.6	99.6 ± 0.3	87.0 ± 0.4
	2	159.1 ± 0.3	144.8 ± 1.8	113.5 ± 0.6	90.3 ± 1.2	83.4 ± 0.5
PDI	1	0.09 ± 0.00	0.10 ± 0.01	0.11 ± 0.01	0.12 ± 0.01	0.21 ± 0.01
	2	0.11 ± 0.01	0.10 ± 0.02	0.09 ± 0.01	0.11 ± 0.01	0.14 ± 0.00
ZP [mV]	1	-24.5 ± 0.4	-25.6 ± 0.7	-23.0 ± 0.3	-19.9 ± 0.6	-15.8 ± 0.6
	2	-30.6 ± 1.0	-23.3 ± 0.5	-22.1 ± 0.7	-16.9 ± 0.2	-15.4 ± 1.0

Table S3 Change in CQA in developed NEs after 130 days of storage.

	NE-1	NE-2	NE-3	NE-4	NE-5
Δ MDD (%)	$\uparrow 1.87 \pm 1.1$	$\uparrow 2.00 \pm 1.2$	$\uparrow 1.70 \pm 1.5$	$\uparrow 1.63 \pm 1.1^*$	$\uparrow 0.00 \pm 0.19$
Δ ZP ¹ (%)	$\uparrow 4.9 \pm 2.0$	$\downarrow 22.5 \pm 2.9^*$	$\uparrow 22.2 \pm 7.3^*$	$\uparrow 5.5 \pm 7.9$	$\uparrow 59.1 \pm 25.0^*$
Δ PDI (%)	$\uparrow 3.5 \pm 8.4$	$\downarrow 7.2 \pm 25.5$	$\downarrow 8.0 \pm 15.6$	$\downarrow 7.5 \pm 15.4$	$\uparrow 8.5 \pm 1.3$

¹ - absolute value; *- result statistically significant compared to the control measurement at time t = 0 (p=0.05)

Table S4 Results of polydispersity index (PDI), pH, and osmolality (OSM) in mid-term stability for studied NEs at 4 °C ± 1°C.

Time (day)	Parameters	NE-1	NE-2	NE-3	NE-4	NE-5
T = 0	PDI	0.09	0.10	0.11	0.13	0.14
	pH	7.47	7.78	7.75	7.62	7.51
	OSM (mOsm/kg)	348	325	333	361	390
T = 7	PDI	0.10	0.08	0.10	0.11	0.15
	pH	7.39	7.62	7.67	7.52	7.41
	OSM (mOsm/kg)	351	324	336	366	395
T = 14	PDI	0.10	0.08	0.10	0.10	0.12
	pH	7.36	7.57	7.05	7.58	7.44
	OSM (mOsm/kg)	356	328	342	372	403
T = 21	PDI	0.12	0.10	0.11	0.12	0.14
	pH	7.18	7.30	6.84	7.12	7.03
	OSM (mOsm/kg)	356	327	342	374	398
T = 28	PDI	0.10	0.12	0.10	0.12	0.12
	pH	6.75	6.69	6.40	6.42	6.60
	OSM (mOsm/kg)	351	327	341	375	395
T = 130	PDI	0.10	0.09	0.10	0.12	0.15
	pH	5.78	5.80	5.36	5.34	5.20
	OSM (mOsm/kg)	348	325	345	372	390

Table S5 Results of retention rate (RR) of CUR during 60 days of storage at $4 \pm 1^\circ\text{C}$ without light exposure of studied NEs; SD – standard deviation.

Storage condition	Time (day)	RR (%) \pm SD				
		NE-1	NE-2	NE-3	NE-4	NE-5
$4 \pm 1^\circ\text{C}$	0	100.00 \pm 0.00	100.00 \pm 0.00	100.00 \pm 0.00	100.00 \pm 0.00	100.00 \pm 0.00
	4	95.49 \pm 0.55	95.59 \pm 0.10	102.42 \pm 1.93	98.99 \pm 3.31	101.20 \pm 0.93
	11	95.07 \pm 1.12	96.66 \pm 0.46	99.56 \pm 2.19	96.86 \pm 0.42	100.02 \pm 2.05
	60	92.41 \pm 1.26	95.09 \pm 2.61	96.47 \pm 1.57	96.22 \pm 5.55	98.28 \pm 1.96
$25 \pm 1^\circ\text{C}$	0	100.00 \pm 0.00	100.00 \pm 0.00	100.00 \pm 0.00	100.00 \pm 0.00	100.00 \pm 0.00
	4	95.50 \pm 1.08	95.73 \pm 0.24	101.7 \pm 2.04	99.15 \pm 4.08	103.15 \pm 5.20
	11	92.18 \pm 1.18	96.23 \pm 0.74	99.97 \pm 0.68	96.99 \pm 0.76	101.40 \pm 1.98
	60	89.95 \pm 0.23	89.67 \pm 1.19	98.24 \pm 1.30	92.84 \pm 0.67	97.43 \pm 3.81

Table S6 Results of retention rate (RR) of CUR in NEs under stress conditions: acidic environment (0.5 M HCl), temperature ($65 \pm 1^\circ\text{C}$), alkaline environment (0.5 M NaOH), and oxidation (30 % H_2O_2).

Sample	RR (%) \pm SD				
	Time (h)	Temperature	Alkaline environment	Acidic environment	Oxidation
NE-1	0	100.00 \pm 0.00	81.47 \pm 8.70	95.51 \pm 1.14	90.18 \pm 2.62
	24	90.10 \pm 1.35	64.42 \pm 0.43	89.96 \pm 1.28	85.64 \pm 2.61
	48	76.31 \pm 1.04	37.33 \pm 1.99	83.38 \pm 0.42	84.29 \pm 2.45
	168	48.83 \pm 0.43	7.30 \pm 0.68	75.79 \pm 1.54	77.16 \pm 1.16
NE-2	0	100.00 \pm 0.00	79.72 \pm 5.38	95.49 \pm 1.32	80.57 \pm 2.58
	24	89.77 \pm 0.49	58.59 \pm 4.55	89.41 \pm 3.03	74.70 \pm 1.39
	48	73.21 \pm 1.72	31.57 \pm 4.69	88.41 \pm 3.14	75.92 \pm 2.74
	168	46.62 \pm 0.46	7.55 \pm 0.82	84.44 \pm 1.20	62.58 \pm 0.92
NE-3	0	100.00 \pm 0.00	93.06 \pm 1.36	94.20 \pm 1.12	94.19 \pm 2.14
	24	100.74 \pm 0.60	77.18 \pm 4.02	93.75 \pm 2.43	93.35 \pm 0.37
	48	87.06 \pm 0.66	49.34 \pm 2.46	94.79 \pm 1.99	95.29 \pm 0.50
	168	63.25 \pm 1.25	7.34 \pm 1.00	95.80 \pm 1.06	74.54 \pm 3.08
NE-4	0	100.00 \pm 0.00	90.57 \pm 8.61	92.58 \pm 4.87	94.83 \pm 0.89
	24	101.73 \pm 1.40	79.73 \pm 2.45	94.23 \pm 2.64	92.19 \pm 2.09
	48	89.85 \pm 2.90	53.76 \pm 3.29	91.38 \pm 4.03	94.18 \pm 2.69
	168	69.26 \pm 4.05	7.77 \pm 1.45	95.83 \pm 1.33	74.26 \pm 1.35
NE-5	0	100.00 \pm 0.00	93.61 \pm 1.22	89.66 \pm 3.67	90.60 \pm 1.17
	24	102.47 \pm 1.93	77.82 \pm 3.53	88.98 \pm 0.23	87.52 \pm 2.49
	48	91.95 \pm 1.26	56.56 \pm 2.66	90.53 \pm 2.27	87.67 \pm 3.05
	168	71.04 \pm 0.88	7.72 \pm 1.30	93.49 \pm 2.90	69.09 \pm 0.98

Table S7 Mean droplet diameter (MDD) result of NE-1 and NE-5 under alkaline (ALK) and acidic (ACI) environment at t = 0 and t = 168 hours.

Time (h)	NE-1		NE-5	
	ALK	ACI	ALK	ACI
MDD (nm) \pm SD				
0	193.1 \pm 2.45	327.0 \pm 11.45	83.2 \pm 1.48	82.77 \pm 1.43
168	173.1 \pm 0.81	1791.0 \pm 34.22	822 \pm 285.65	120.27 \pm 0.46

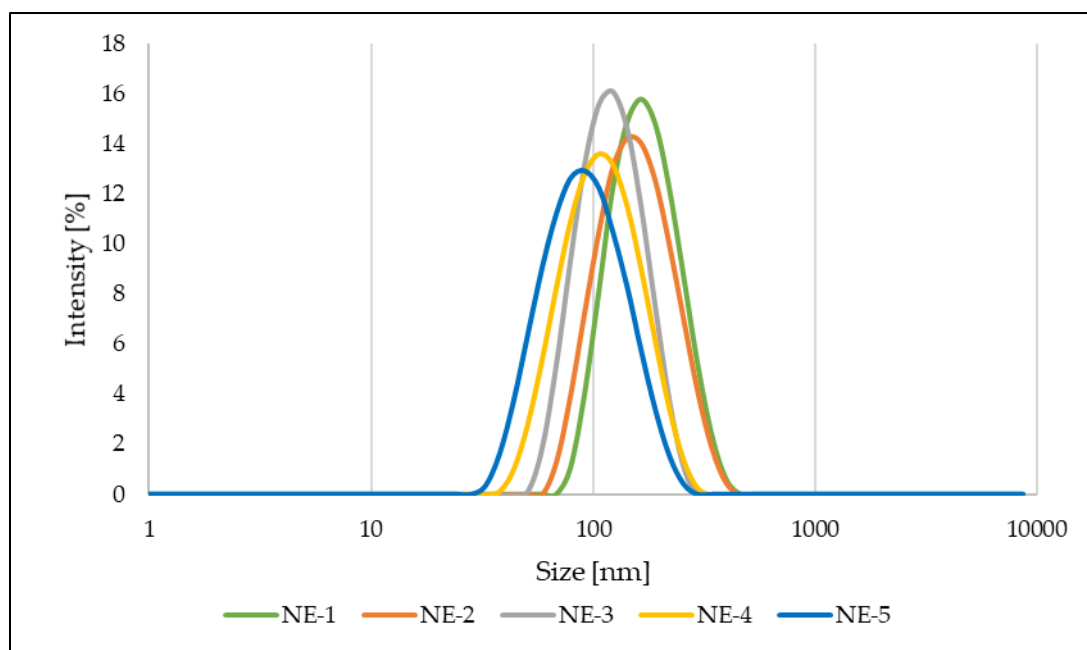


Figure S1 Particle size distribution of developed NEs.

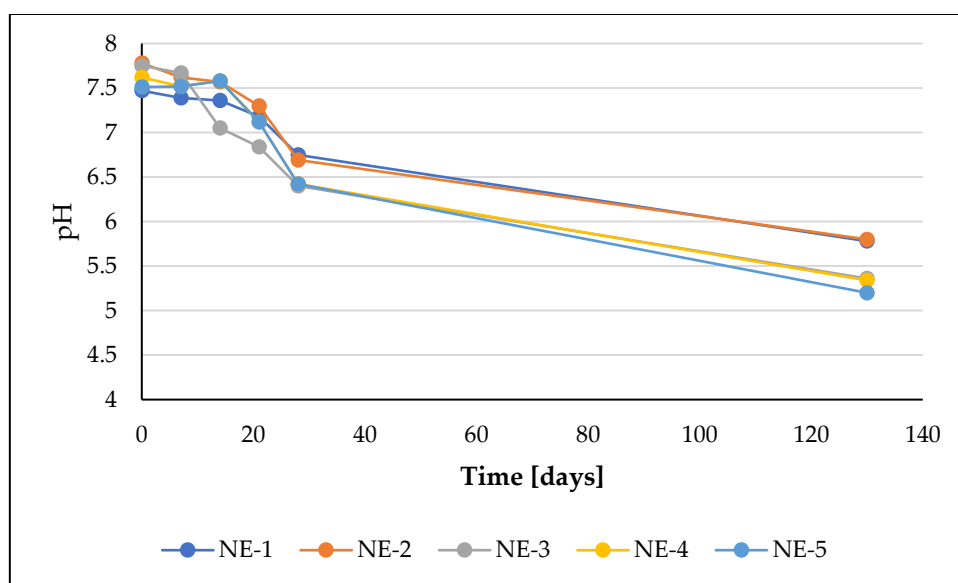


Figure S2 Changes in pH during mid-term stability studies of developed NE.