

Table S1: Optimization method for the inner phase of emulsion.

Run	Factor X ₁ Oil (ml)	Factor X ₂ Temperature (°C)	Factor X ₃ Homogenization (RPM) ^a	Response 1 CPI30 ^b	Response 2 ESI ^c (%)
1	17.5 (0)	47.5 (0)	20000 (0)	25	27.3±0.4
2	5 (-1)	25 (-1)	15000 (-1)	90	91.0±1.4
3	17.5 (0)	47.5 (0)	20000 (0)	25	27.4±0.2
4	17.5 (0)	15 (-α)	20000 (0)	95	89.0±1.4
5	5 (-1)	25 (-1)	25000 (+1)	100	99.0±1.4
6	30 (+1)	70 (+1)	15000 (-1)	10	0.0±0.0
7	17.5 (0)	47.5 (0)	20000 (0)	25	25.8±1.1
8	17.5 (0)	47.5 (0)	20000 (0)	25	29.3±1.1
9	17.5 (0)	47.5 (0)	20000 (0)	25	27.3±0.4
10	17.5 (0)	47.5 (0)	20000 (0)	25	27.4±0.2
11	30 (+1)	25 (-1)	15000 (-1)	50	89.8±0.4
12	17.5 (0)	47.5 (0)	28000 (+α)	32	34.5±0.7
13	2 (-α)	47.5 (0)	20000 (0)	50	35.0±0.3
14	30 (+1)	70 (+1)	25000 (+1)	0	0.0±0.0
15	30 (+1)	25 (-1)	25000 (+1)	95	95.9±0.1
16	17.5 (0)	47.5 (0)	11591 (-α)	31	20.0±0.7
17	5 (-1)	70 (+1)	15000 (-1)	5	9.6±0.5
18	17.5 (0)	85.3 (+α)	20000 (0)	0	0.0±0.0
19	5 (-1)	70 (+1)	25000 (-1)	8	5.1±0.1
20	38 (+α)	47.5 (0)	20000 (0)	28	21.5±0.7

^a RPM - rotations per minute. ^b CPI₃₀ - creaming index after 30 days of storage. ^c ESI - emulsion stability index.

Table S2: Optimization method for multiple emulsions.

Run	Factor X ₁ Oil (ml)	Factor X ₂ Emulsifier (ml)	Factor X ₃ Homogenization (RPM) ^a	Response 1 CPI ₃₀ ^b	Response 2 ESI ^c (%)
1	50 (0)	0.55 (0)	6500 (0)	95	90.3±0.4
2	70 (+1)	0.1 (-1)	12000 (+1)	40	45.2±0.1
3	30 (-1)	0.1 (-1)	12000 (+1)	0	45.4±0.2
4	30 (-1)	1 (+1)	1000 (-1)	95	49.8±0.4
5	70 (+1)	0.1 (-1)	1000 (-1)	90	14.8±0.4
6	50 (0)	0.55 (0)	6500 (0)	90	95.3±0.4
7	50 (0)	0.55 (0)	6500 (0)	100	95.5±0.7
8	50 (0)	0.55 (0)	6500 (0)	90	95.2±0.5
9	50 (0)	0.55 (0)	15 000 (+ α)	85	100.0±0.0
10	50 (0)	0.55 (0)	0 (- α)	85	0.0±0.0
11	30 (-1)	1 (+1)	12000	100	99.9±0.1
12	70 (+1)	1 (+1)	1000 (-1)	15	50.6±0.8
13	70 (+1)	1 (+1)	12000 (+1)	0	99.3±1.1
14	16 (- α)	0.55 (0)	6500 (0)	30	95.3±0.4
15	30 (-1)	0.1 (-1)	1000 (-1)	15	15.3±0.4
16	85 (+ α)	0.55 (0)	6500 (0)	100	80.8±1.1
17	50 (0)	1.3 (+ α)	6500 (0)	95	99.0±1.4
18	50 (0)	0 (- α)	6500 (0)	90	0.0±0.0
19	50 (0)	0.55 (0)	6500 (0)	95	90.5±0.7
20	50 (0)	0.55 (0)	6500 (0)	95	90.8±0.4

^a RPM - rotations per minute. ^b CPI₃₀ - creaming index after 30 days of storage.

^c ESI - emulsion stability index.

Table S3: Results of encapsulation efficiency of multiple emulsions during the storage period.

Sample	EE (%) ¹			
	0 day	15 day	30 day	50 day
DEO ²	92.29±0.40 ^{Aa}	88.14±0.43 ^{Ab}	81.51±2.06 ^{Ab}	75.44±1.21 ^{Ac}
DES ³	89.32±2.10 ^{Aa}	82.35±1.09 ^{Aa}	71.92±2.39 ^{Aa}	63.88±2.72 ^{Aa}
DEF ⁴	90.80±3.35 ^{Aa}	84.31±1.49 ^{Aa}	75.36±1.20 ^{Aa}	70.43±0.43 ^{Ab}
DEP ⁵	94.08±0.58 ^{Aa}	86.85±0.86 ^{Ab}	79.46±0.98 ^{Ac}	72.54±0.30 ^{Ad}
DEK ⁶	93.79±1.03 ^{Aa}	93.58±0.78 ^{Ba}	92.69±0.67 ^{Ba}	90.96±0.82 ^{Bb}

¹ EE - encapsulation efficiency. ² DEO - double emulsion with olive oil. ³ DES - double emulsion with sunflower oil. ⁴ DEF - double emulsion with flaxseed oil. ⁵ DEP - double emulsion with pumpkin oil. ⁶ DEK - double emulsion with coconut oil.

^a Means within a row (the difference between stored time of one sample); comparing the same followed by different lowercase superscript letters differ significantly ($P < 0.05$). ^A Means within a column (the difference between the samples); comparing the same followed by different superscript letters differ significantly ($P < 0.05$).

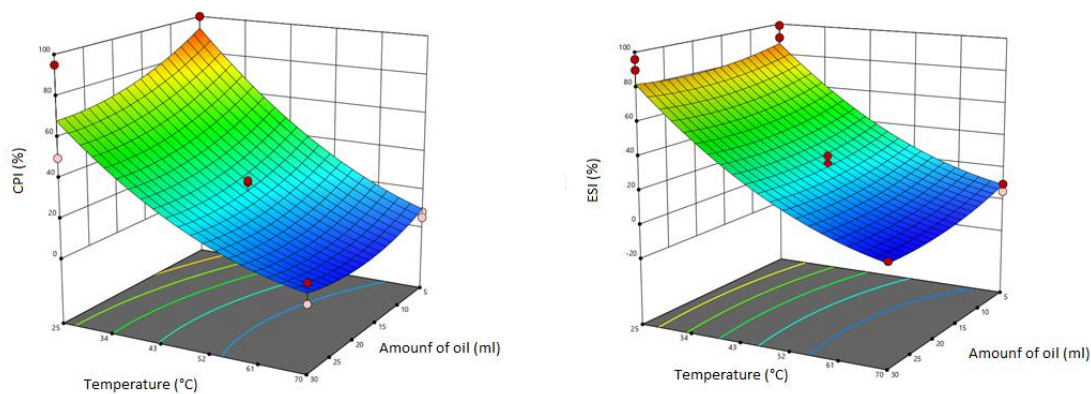


Figure S1: Response surface plots showing the effect of preparation temperature, oil amount, and homogenization method on creaming index CPI (%) and emulsion stability index ESI (%) for multiple emulsion optimization.

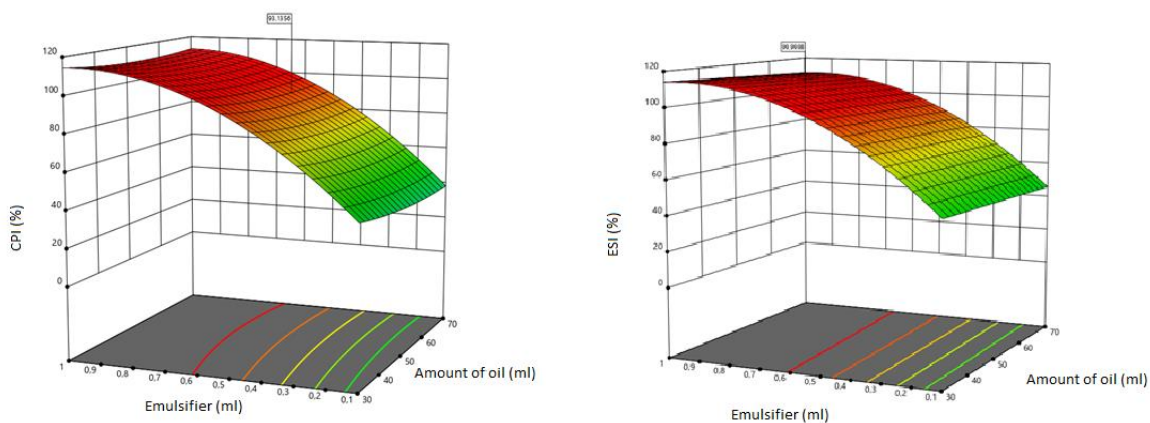


Figure S2: Response surface plots showing the effect of emulsifier amount, oil amount, and homogenization method on creaming index CPI (%) and emulsion stability index ESI (%) for multiple emulsion optimization.