

SUPPLEMENTARY FILES

Table S1- Independent variables with 3 levels

Symbol	Independent variables	-1	0	1
A	Essential oil (mL/100mL NE)	5	10	15
B	Tween 80 (mL/100mL NE)	5	10	15
C	Curcumin (g/100mL NE)	0.1	0.3	0.5

-1= minimum level; 0= medium level; 1 = maximum level

Table S2- ANOVA table for DPPH free radical scavenging activity

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	Remarks
Model	2568.76	9	285.42	68.9	<0.0001	significant
A-Essential oil	1954.06	1	1954.06	471.68	<0.0001	
B-Tween 80	69.97	1	69.97	16.89	0.0045	
C-Curcumin	415.44	1	415.44	100.28	<0.0001	
AB	19.8	1	19.8	4.78	0.065	
AC	63.28	1	63.28	15.28	0.0058	
BC	5.11	1	5.11	1.23	0.3035	
A ²	0.84	1	0.84	0.2	0.6657	
B ²	28.69	1	28.69	6.92	0.0338	
C ²	10.28	1	10.28	2.48	0.1591	
Residual	29	7	4.14			not significant
Lack of Fit	19.73	3	6.58	2.84	0.1699	
Pure Error	9.27	4	2.32			
Cor Total	2597.76	16				
R ²				0.9888		

$$Y_1(\text{DPPH free radical scavenging activity}) = +60.86 + 15 \times A + 2.96 \times B + 7.21 \times C - 2.23 \times A \times B - 3.98 \times A \times C - 1.13 \times B \times C - 0.45 \times A^2 + 2.61 \times B^2 + 1.56 \times C^2 \quad (S1)$$

Table S3- ANOVA table for turbidity

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	Remarks
Model	65.78			9	7.31	42.88 <0.0001 significant
A-Essential oil	10.76			1	10.76	63.16 <0.0001
B-Tween 80	5.8			1	5.8	34.01 0.0006
C-Curcumin	27.49			1	27.49	161.29 < .0001
AB	0.85			1	0.85	4.97 0.0611
AC	2.5			1	2.5	14.65 0.0065
BC	2.27			1	2.27	13.29 0.0082
A ²	0.03			1	0.03	0.18 0.6862
B ²	1.55			1	1.55	9.11 0.0194
C ²	13.83			1	13.83	81.13 < .0001
Residual	1.19			7	0.17	
Lack of Fit	0.7			3	0.23	1.86 0.2768 not significant
Pure Error	0.5			4	0.12	
Cor Total	66.97			16		
R ²					0.9822	

$$Y_2 \text{ (Turbidity)} = +5.64 + 1.16 \times A - 0.85 \times B + 1.85 \times C + 0.46 \times A \times B + 0.79 \times A \times C - 0.75 \times B \times C - 0.085 \times A^2 - 0.61 \times B^2 - 1.81 \times C^2 \quad (S2)$$

Table S4- ANOVA table for stability

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	Remarks
Model	1471.04			9	163.45	26.48 0.0001 significant
A-Essential oil	392			1	392	63.52 0.0001
B-Tween 80	800			1	800	129.63 0.0001
C-Curcumin	98			1	98	15.88 0.0053
AB	9			1	9	1.46 0.2664
AC	1			1	1	0.16 0.6993
BC	25			1	25	4.05 0.084
A ²	107.38			1	107.38	17.4 0.0042
B ²	17.69			1	17.69	2.87 0.1342
C ²	10.12			1	10.12	1.64 0.2412
Residual	43.2			7	6.17	
Lack of Fit	22			3	7.33	1.38 0.3691 not significant
Pure Error	21.2			4	5.3	
Cor Total	1514.24			16		
R ²					0.9715	

$$Y_3 (\text{Stability}) = + 79.6 + 7 \times A + 10 \times B - 3.5 \times C + 1.5 \times A \times C + 0.5 \times A \times C + 2.5 \times B \times C - 5.05 \times A^2 - 2.05 \times B^2 - 1.55 \times C^2 \quad (\text{S3})$$

Table S5 – Model validation

Responses	Predicted value	Experimental value	Relative deviation (%) *
DPPH free radical scavenging activity (%)	74.86	79.53±0.15	5.87
Turbidity (cm ⁻¹)	1.41	1.45±0.20	2.75
Stability (%)	73.02	79±0.13	7.56

*The deviation between predicted and experimental values is acceptable till 10%.

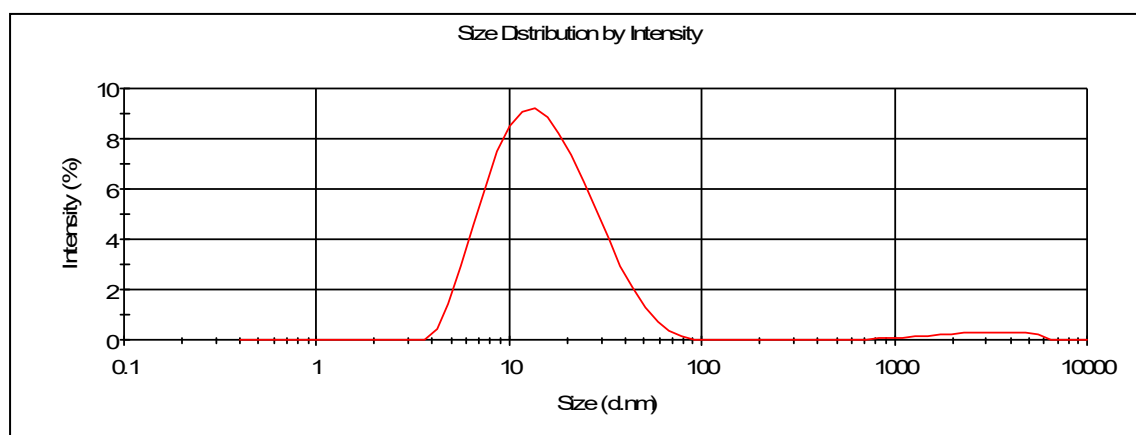
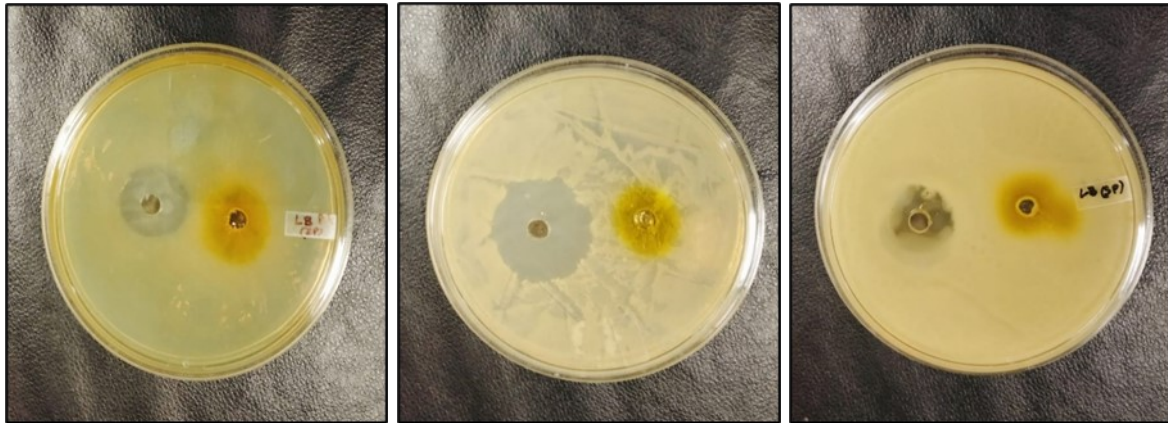


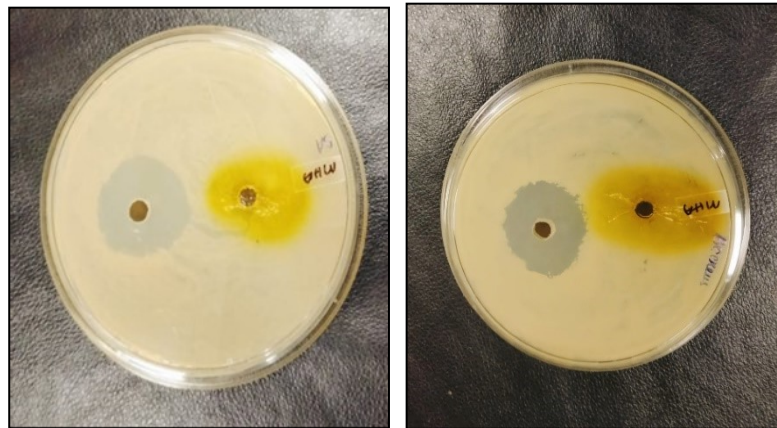
Fig.S1.Size distribution curve of optimized nanoemulsion



a)

b)

c)



d)

e)

Fig.S2. Antimicrobial activity of optimized nanoemulsion a) *Bacillus cereus*, b) *Salmonella typhimurium*, c) *Staphylococcus aureus*, d) *Pseudomonas aeruginosa* and e) *Escherichia coli*