



SUPPLEMENTARY MATERIAL TO
**Optimizing fabrication of pharmaceutical capsule shell: a factorial
design of corncob-MCC/Carrageenan/starch biofilm**

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Table SI ANOVA parameter for tensile strength response

Source	Sum of squares	df	Mean square	F-value	p-value	
Model	38.27	7	5.47	9.33	0.0005	significant
A-Carrageenan	0.0582	1	0.0582	0.0993	0.7581	
B-MCC	5.53	1	5.53	9.44	0.0097	
C-Glycerol	31.09	1	31.09	53.06	< 0.0001	
AB	0.4621	1	0.4621	0.7885	0.3920	
AC	0.0136	1	0.0136	0.0233	0.8813	
BC	0.3514	1	0.3514	0.5996	0.4537	
ABC	0.7634	1	0.7634	1.30	0.2760	
Residual	7.03	12	0.5860			
Lack of Fit	3.06	1	3.06	8.46	0.0142	significant
Pure Error	3.97	11	0.3613			
Cor Total	45.31	19				

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Table SII ANOVA parameter for elongation response

Source	Sum of squares	df	Mean square	F-value	p-value	
Model	247.89	7	35.41	58.86	< 0.0001	significant
A-Carrageenan	84.33	1	84.33	140.17	< 0.0001	
B-MCC	7.37	1	7.37	12.26	0.0044	
C-Glycerol	18.39	1	18.39	30.57	0.0001	
AB	12.59	1	12.59	20.93	0.0006	
AC	79.06	1	79.06	131.41	< 0.0001	
BC	32.00	1	32.00	53.19	< 0.0001	
ABC	14.15	1	14.15	23.51	0.0004	
Residual	7.22	12	0.6016			
Lack of Fit	1.34	1	1.34	2.50	0.1419	not significant
Pure Error	5.88	11	0.5346			
Cor Total	255.11	19				

Table SIII ANOVA parameter for Young modulus response

Source	Sum of squares	df	Mean square	F-value	p-value	
Model	9755.36	7	1393.62	30.50	< 0.0001	significant
A-Carrageenan	2300.62	1	2300.62	50.35	< 0.0001	
B-MCC	1142.15	1	1142.15	25.00	0.0003	
C-Glycerol	4075.90	1	4075.90	89.20	< 0.0001	
AB	93.98	1	93.98	2.06	0.1771	
AC	1990.57	1	1990.57	43.56	< 0.0001	
BC	100.82	1	100.82	2.21	0.1632	
ABC	51.33	1	51.33	1.12	0.3101	
Residual	548.34	12	45.69			
Lack of Fit	19.88	1	19.88	0.4138	0.5332	not significant
Pure Error	528.46	11	48.04			
Cor Total	10303.70	19				

Table SIV Fit statistics of each response

Parameter	TS	EL	YM
Standard deviation	0.7655	0.7756	6.79
Mean	4.05	10.10	43.75
C.V. %	18.91	7.68	15.52
R ²	0.8448	0.9717	0.9418
Adjusted R ²	0.7543	0.9552	0.9149
Predicted R ²	0.6776	0.9112	0.8748
Adequate precision	9.3391	26.9560	18.1185

Based on Table SIV, the C.V for tensile strength (18.91%) and Young's modulus (15.52%) indicate moderate experimental variability, which is commonly observed in mechanically tested polymer-based and biopolymer films due to inherent material heterogeneity, minor thickness variations, non-uniform

plasticizer distribution, and sensitivity to testing conditions. Despite this variability, the mechanical trends and statistically significant factor effects remain consistent, indicating acceptable methodological reproducibility for a factorial design. Model adequacy was assessed using ANOVA significance, lack-of-fit tests, and residual diagnostics; although one of the three responses exhibited a significant lack of fit, this suggests limitations of the linear model for that specific response rather than invalidating the overall trends, and higher-order models or additional experiments would be required only if greater predictive accuracy were sought.

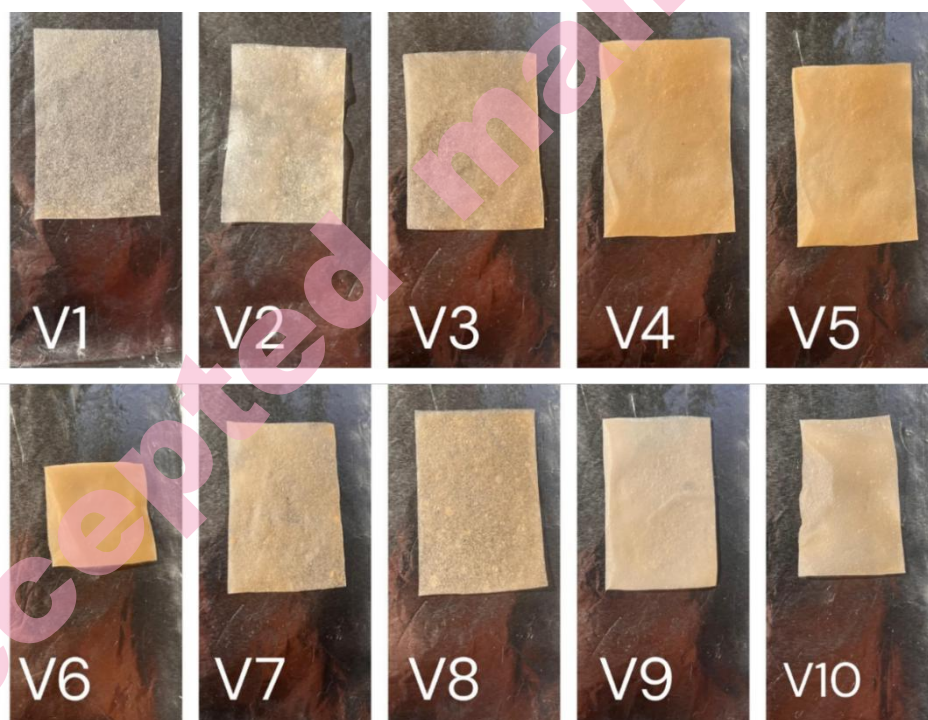


Fig. S1 Appearance of the sample produced

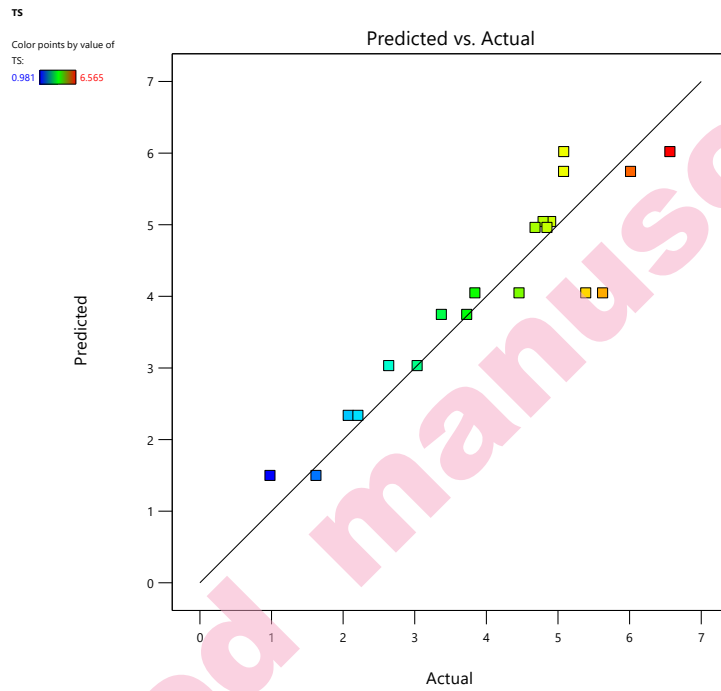


Fig. S2 Predicted vs actual scatter plot of TS response

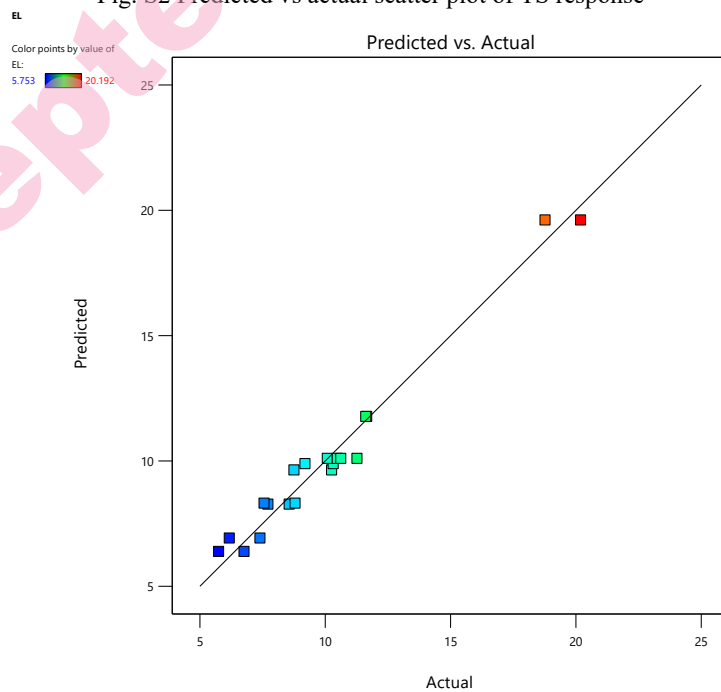


Fig. S3 Predicted vs actual scatter plot of EL response

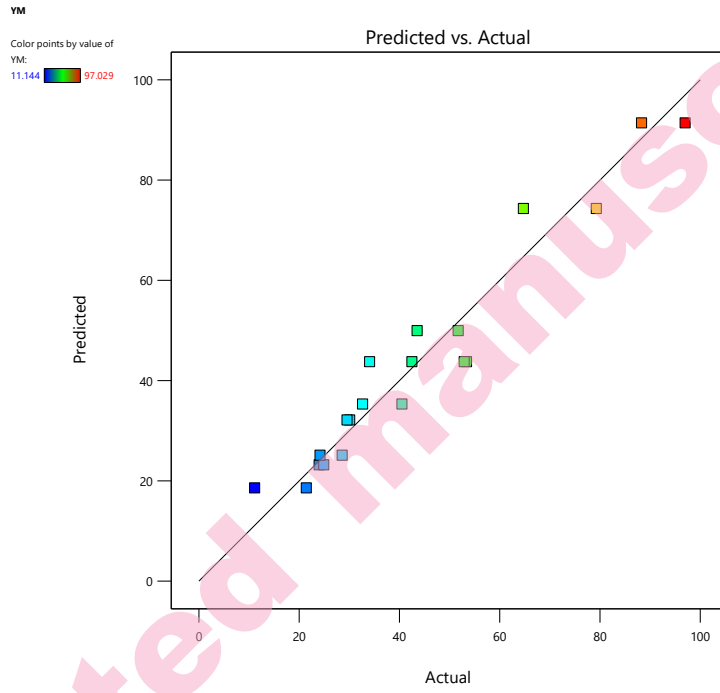


Fig. S4 Predicted vs actual scatter plot of YM response

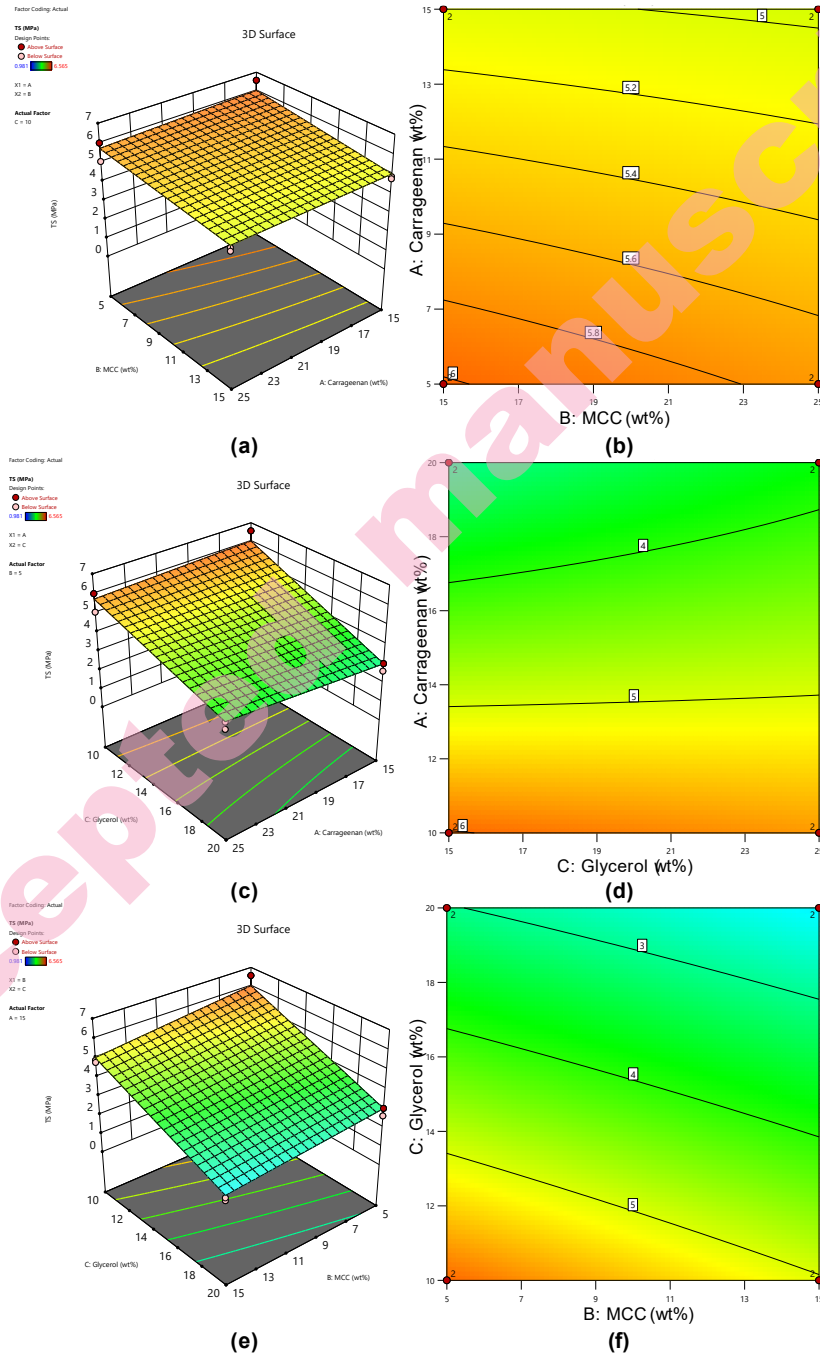


Fig. S5 Surface plot and contour plot of factor influenced on TS: (a,b) carrageenan and MCC, (c,d) carrageenan and glycerol, (e,f) MCC and glycerol.

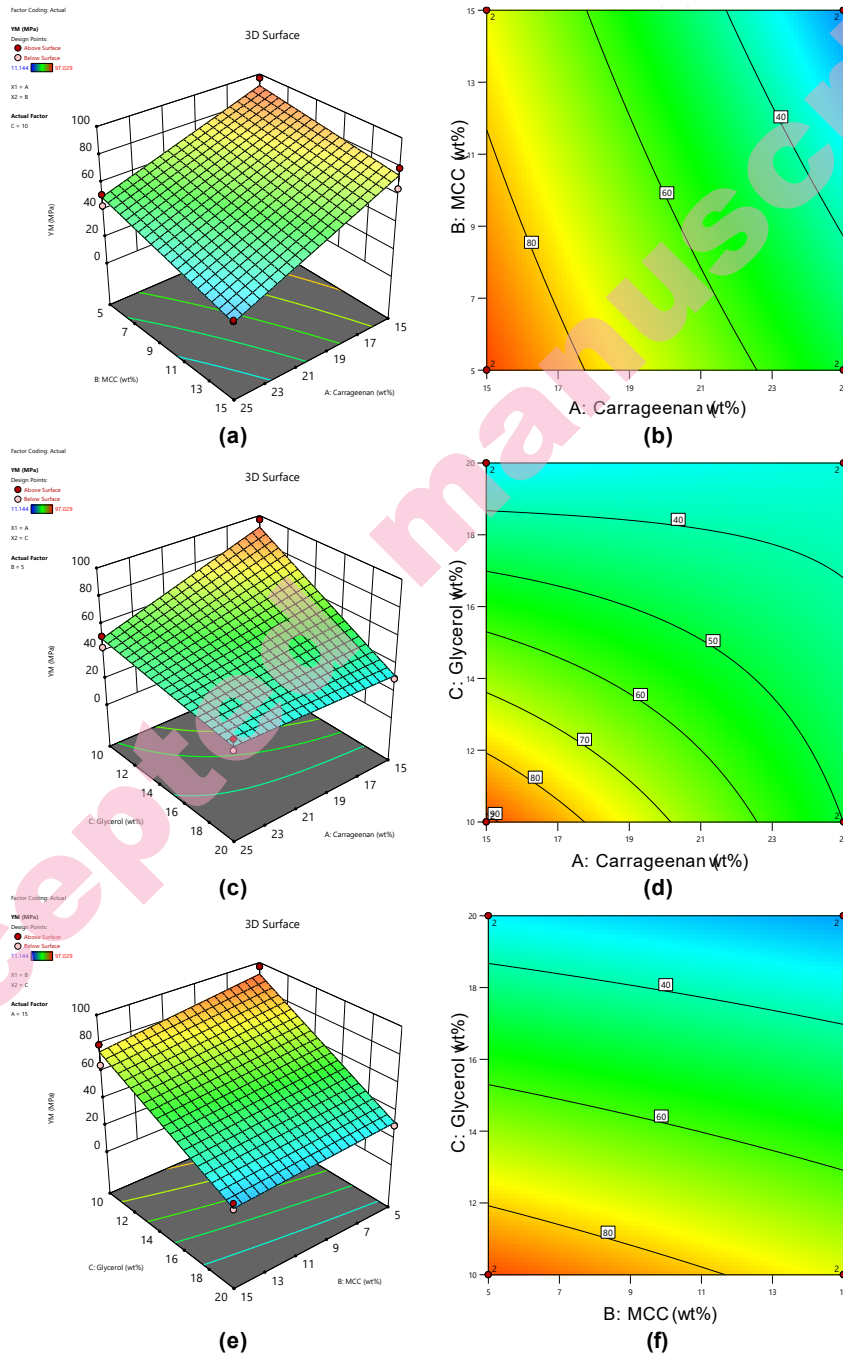


Fig. S6 Surface plot and contour plot of factor influenced on YM: (a,b) carrageenan and MCC, (c,d) carrageenan and glycerol, (e,f) MCC and glycerol.