SUPPLEMENTARY FILE

Optimization of Spray Drying Process in Microencapsulated Cream Powder Production

Ahsen Burcin Himmetagaoglu[1], Serap Berktas[2], Mustafa Cam[2], Zafer Erbay[1,*]

[1] *Department of Food Engineering, Faculty of Engineering, Adana Science and Technology University, 01250 Adana, Turkey.*

[3] *Department of Food Engineering, Faculty of Engineering, Erciyes University, 38039 Kayseri, Turkey.*

*Corresponding author: Zafer Erbay

Mailing address: Department of Food Engineering, Faculty of Engineering, Adana Science and Technology University, 01250, Saricam, Adana, Turkey, Tel: +90 332 4550000 (2080), Fax: +90 332 4550009

E-mail: zafererbay@yahoo.com

Supplementary Table 1. Results of statistical analysis for verification of optimization of microencapsulated cream powder production.

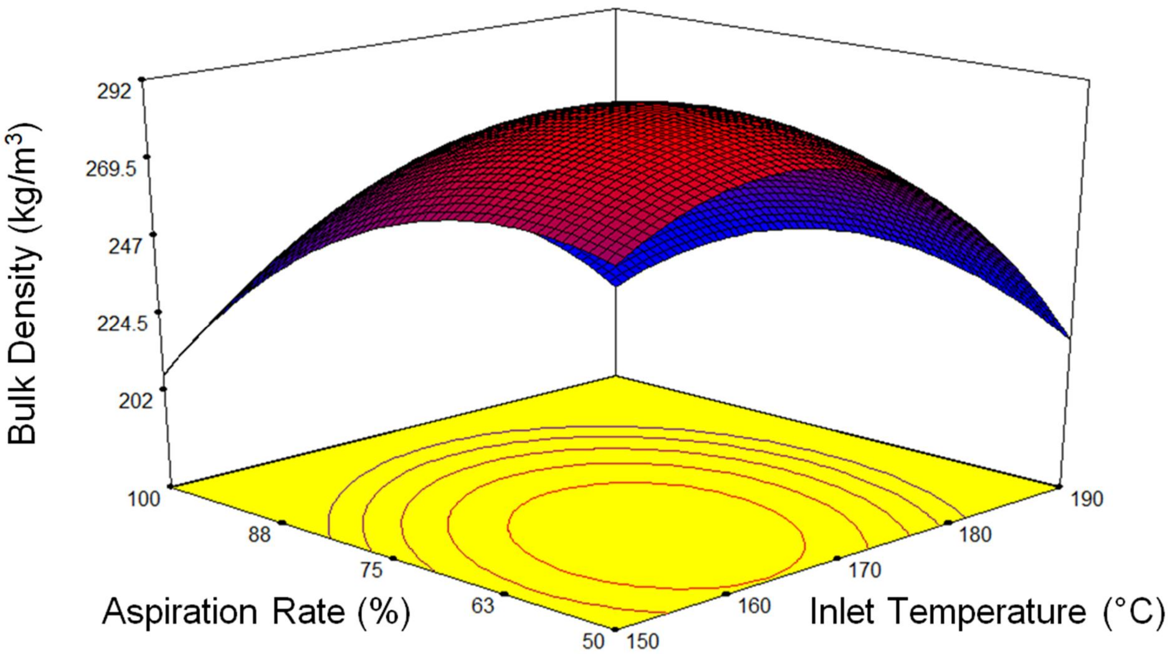
Response	Predicted Values	Experimental Values[†]	SE[‡]	Difference	%Error[§]	*P*-value
Yield (%)	36.37	35.31 ± 1.67	0.749	-1.06	3.01	0.229
Bulk Density (kg/m^3)	269.9	270.5 ± 5.4	2.396	0.6	0.21	0.821
Wettability (s)	115.2	119.6 ± 12.0	5.354	4.4	3.68	0.457
Surface Fat (%)	26.20	26.52 ± 0.36	0.159	0.32	1.21	0.115

[†] Experimental values were expressed as mean ± standard deviation.
[‡] Mean standard error.
[§] $\%Error = \left|y_{exp} - y_{pre}\right| / y_{exp} \times 100$

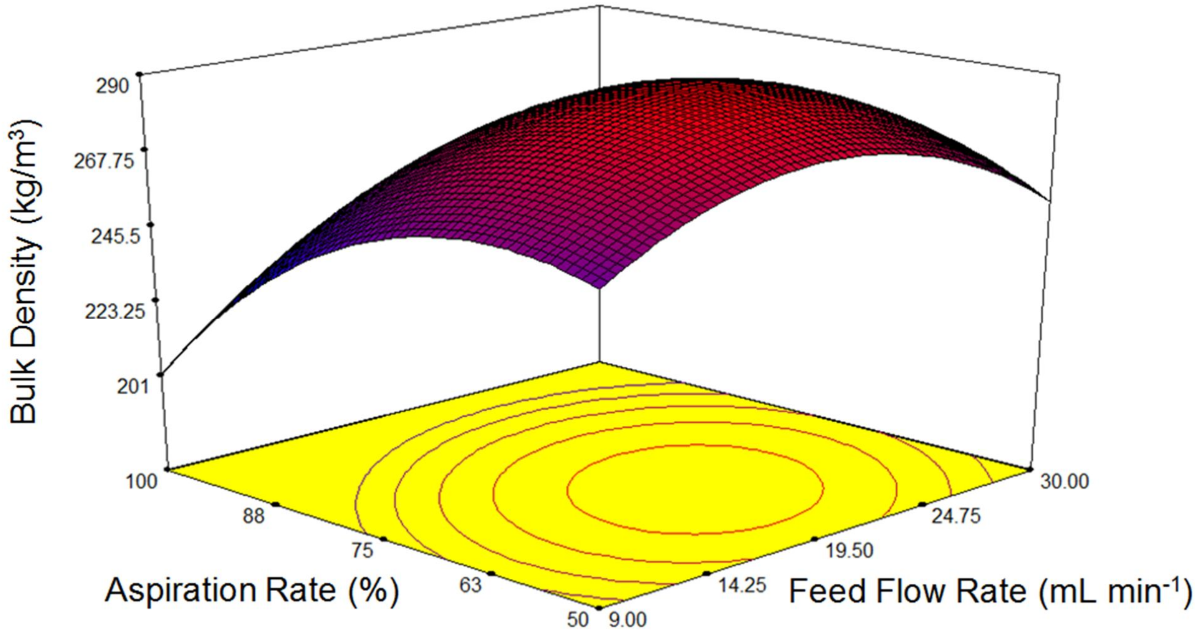
Supplementary Table 2. The physical properties and free fatty acid composition for the microencapsulated cream powder produced at optimum spray drying conditions. †

Physical Properties		**Free Fatty Acid Composition (mg/100 g fat)**	
Water Activity	0.175 ± 0.006	Butyric acid ($C_{4:0}$)	2.92 ± 0.28
Solubility (%)	51.7 ± 0.6	Caproic acid ($C_{6:0}$)	1.90 ± 0.06
Tapped Density (kg/m^3)	483.2 ± 9.5	Caprylic acid ($C_{8:0}$)	2.07 ± 0.09
HR[1]	1.79 ± 0.01	Capric acid ($C_{10:0}$)	5.42 ± 0.28
CI (%)[2]	44.0 ± 0.3	Lauric acid ($C_{12:0}$)	7.56 ± 0.34
Particle Density (kg/m^3)	1150.0 ± 50.1	Myristic acid ($C_{14:0}$)	24.34 ± 1.11
Color Properties[3]		Palmitic acid ($C_{16:0}$)	125.0 ± 6.3
L	95.05 ± 0.05	Stearic acid ($C_{18:0}$)	57.54 ± 8.19
A	-0.16 ± 0.01	Oleic acid ($C_{18:1}$)	119.0 ± 9.4
B	7.53 ± 0.04	Linoleic acid ($C_{18:2}$)	11.88 ± 1.20
Chroma	7.53 ± 0.04	Linolenic acid ($C_{18:3}$)	1.90 ± 0.11
BI	7.94 ± 0.04	VFFA[4]	12.31 ± 0.47
ΔE-cream	77.88 ± 0.05	MLCFFA[5]	347.2 ± 17.5
ΔE-emulsion	54.92 ± 0.05	TFFA[6]	359.5 ± 17.7

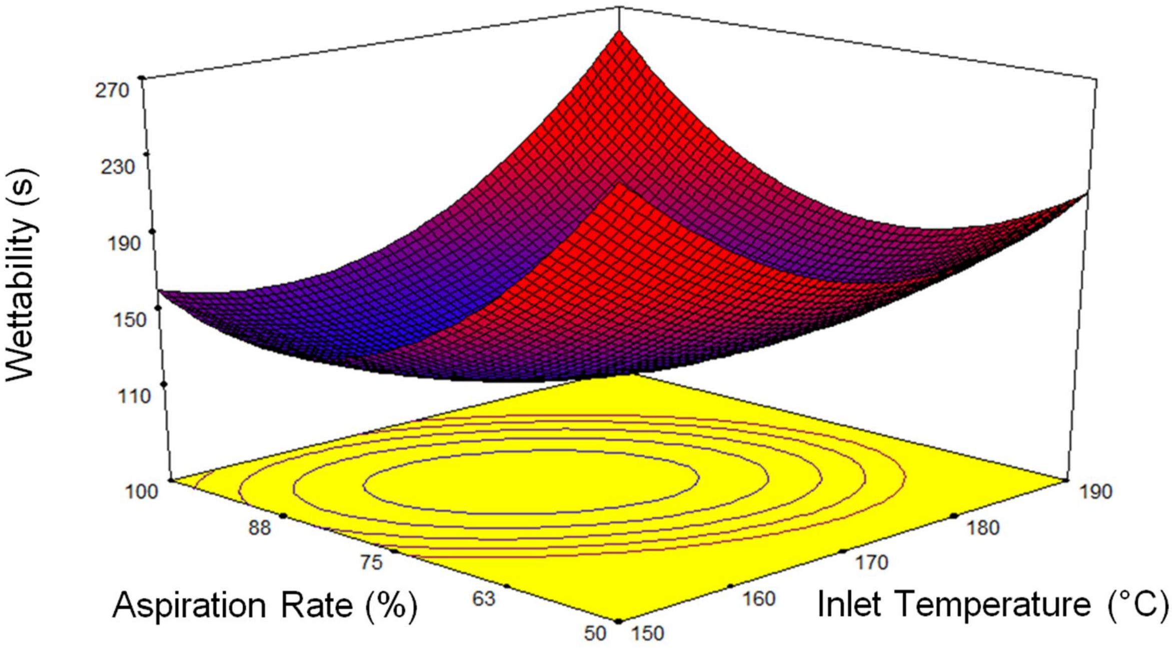
† Experimental values were expressed as mean ± standard deviation.
[1] HR: Hausner Ratio
[2] CI: Carr Index
[3] *L*: lightness; *a*: redness/greenness; *b*: yellowness/blueness; ΔE-cream: color difference with cream as reference; ΔE-emulsion: color difference with emulsion as reference; BI: Browning Index
[4] VFFA: Total volatile free fatty acids ($C_{4:0}$-$C_{10:0}$)
[5] MLCFFA: Total medium- and long-chain fatty acids ($C_{12:0}$-$C_{18:3}$)
[6] TFFA: Total free fatty acids



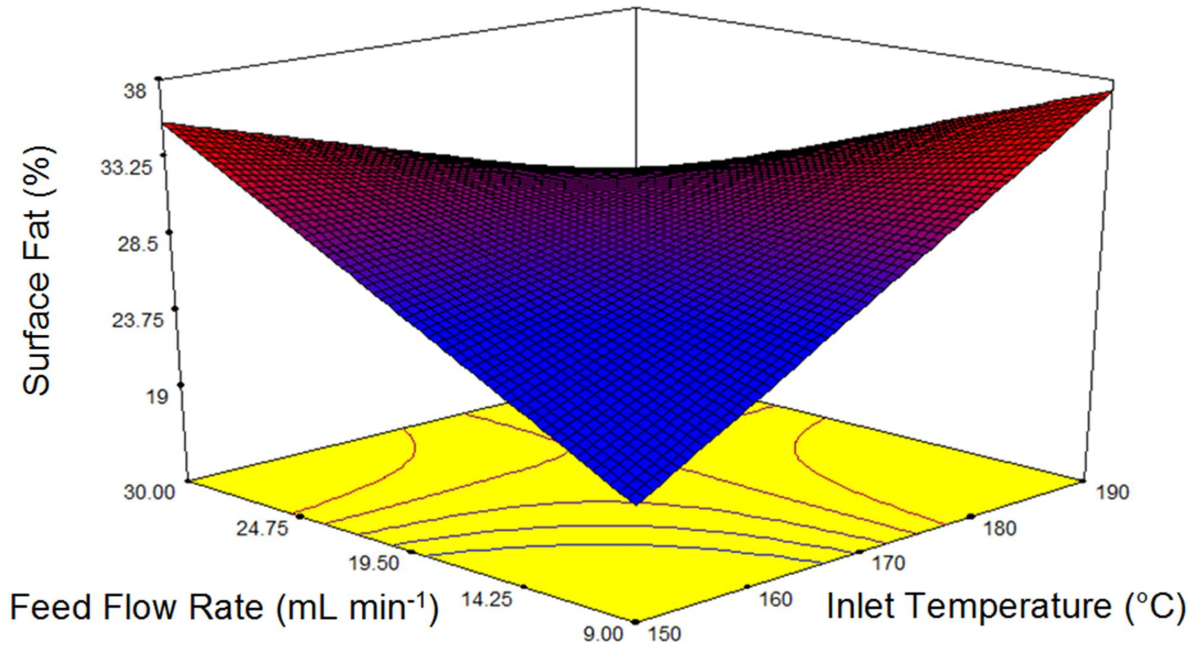
Supplementary Fig. 1. Response surface and contour plot for the effects of inlet temperature and aspiration rate on the bulk density at constant feed flow rate (19.50 mL/min).



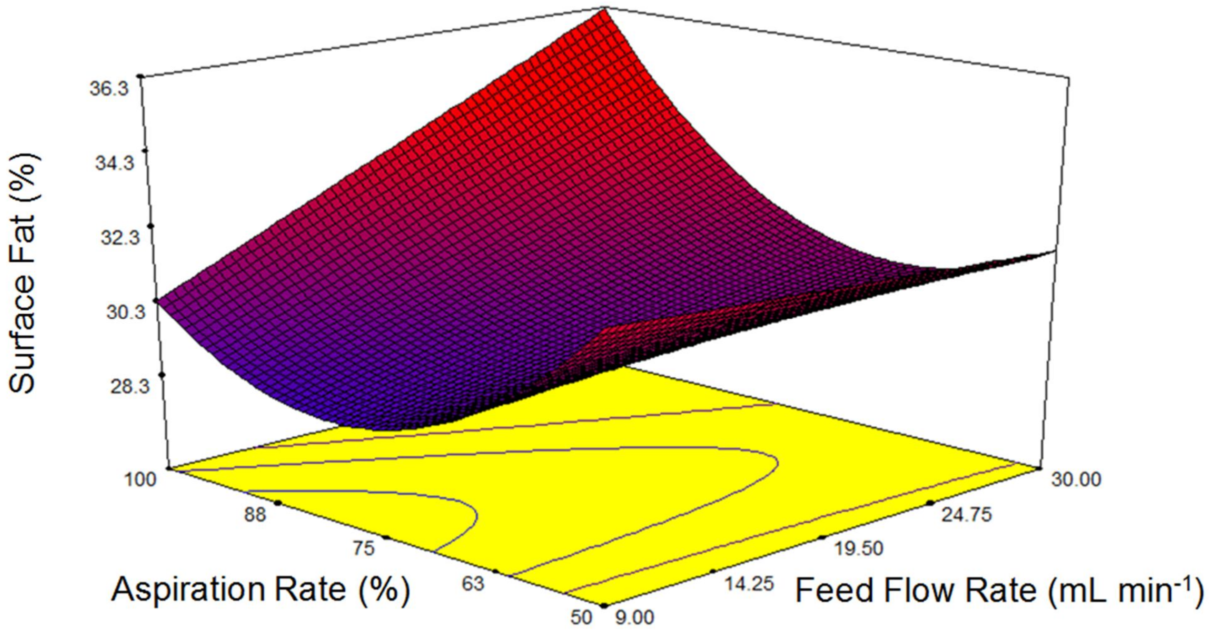
Supplementary Figure 2. Response surface and contour plot for the effects of feed flow rate and aspiration rate on the bulk density at constant inlet temperature (170 °C).



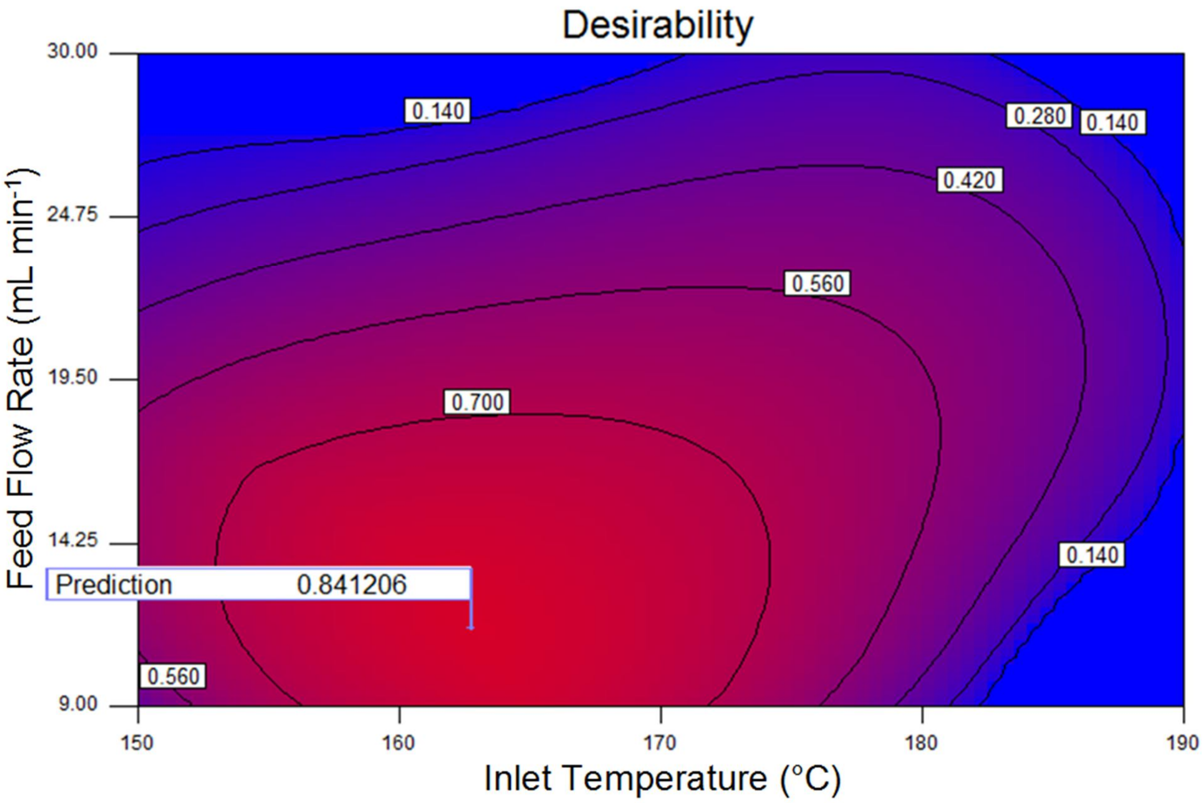
Supplementary Figure 3. Response surface and contour plot for the effects of inlet temperature and aspiration rate on the wettability at constant feed flow rate (19.50 mL/min).



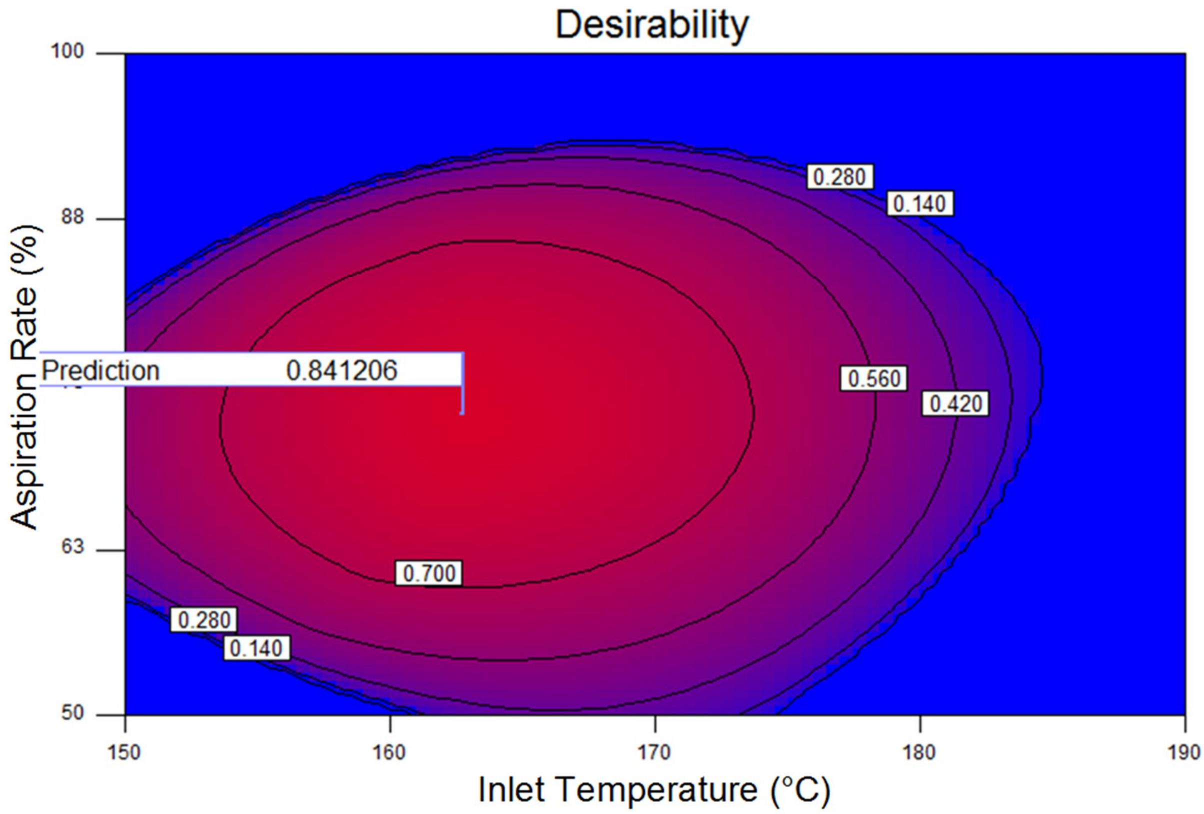
Supplementary Figure 4. Response surface and contour plot for the effects of inlet temperature and feed flow rate on surface fat at constant aspiration rate (75%).



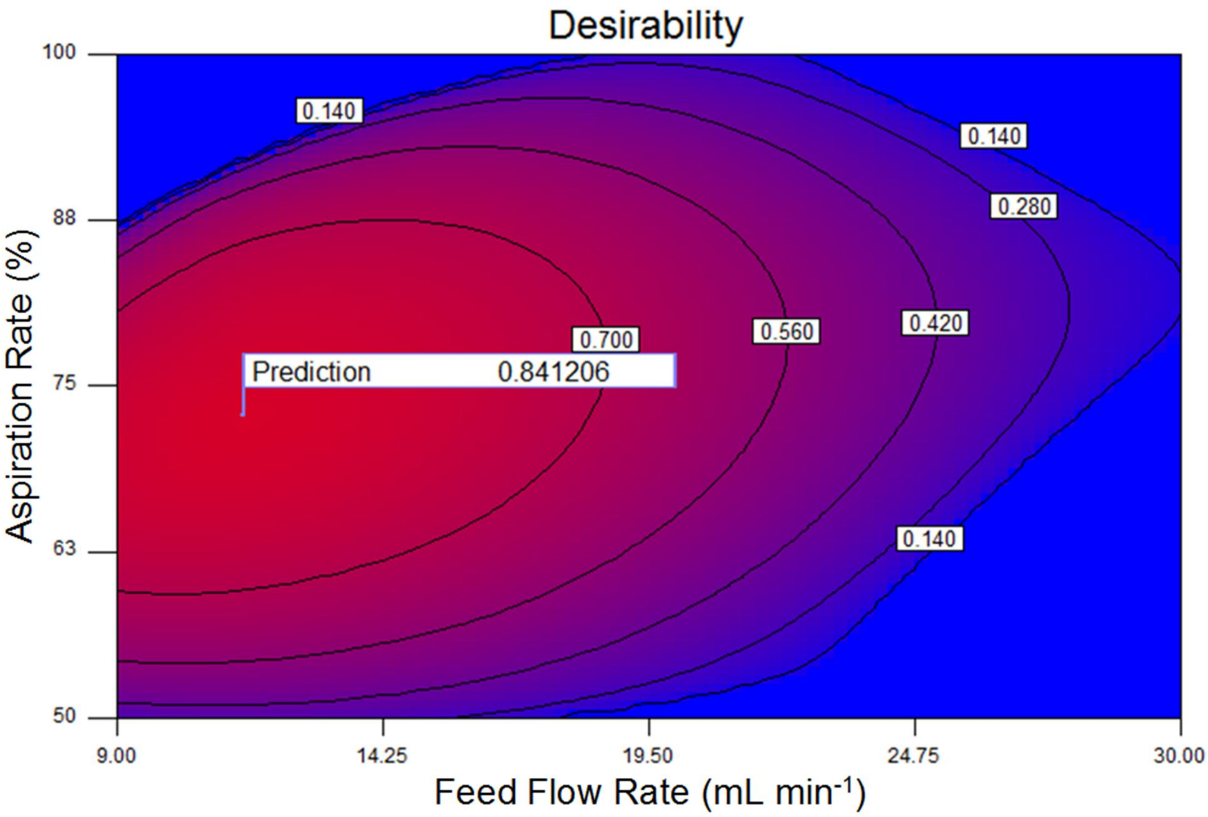
Supplementary Figure 5. Response surface and contour plot for the effects of feed flow rate and aspiration rate on surface fat at constant inlet temperature (170 °C).



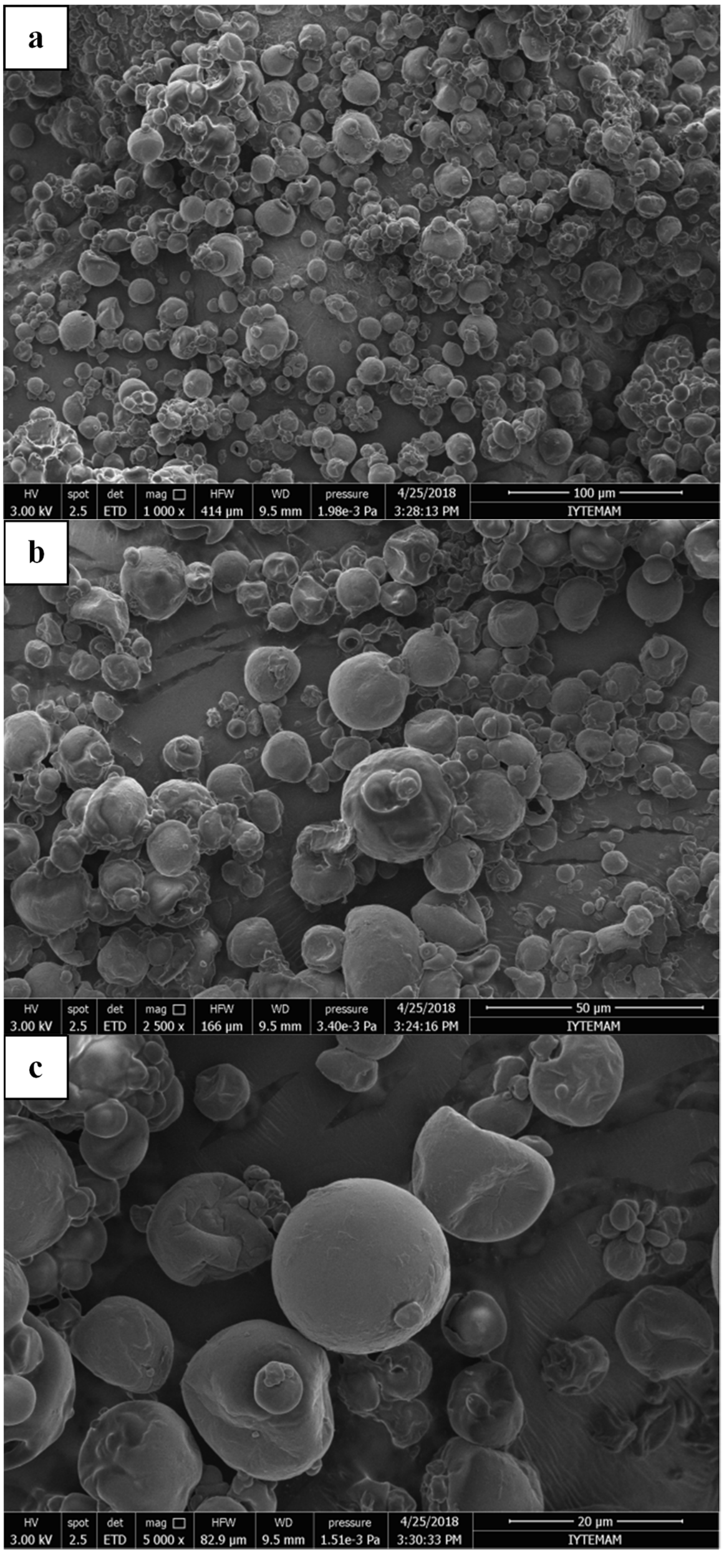
Supplementary Figure 6. Contour plot for the effects of inlet temperature and feed flow rate on desirability function of the optimization process at constant aspiration rate (75%).



Supplementary Figure 7. Contour plot for the effects of inlet temperature and aspiration rate on desirability function of the optimization process at constant feed flow rate (19.50 mL/min).



Supplementary Figure 8. Contour plot for the effects of feed flow rate and aspiration rate on desirability function of the optimization process at constant inlet temperature (170 °C).



Supplementary Figure 9. Scanning electron micrographs of powder particles dried at optimum spray drying conditions. The magnifying ratios were 1000x (a), 2500x (b), and 5000x (c).