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SUPPLEMENTARY MATERIAL TO

Enhancement of ultrafiltration of milk proteins by application of twisted tapes: A sensitivity analysis using a response surface methodology

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TABLE S-I. Box–Behnken design and responses

Run	*c* mass % (X_1)	*CFR* L min^{-1} (X_2)	*AR* (X_3)	*TMP* kPa (X_4)	J_{NTP*} L m^{-2} h^{-1}	J_{TT} L m^{-2} h^{-1}	*FI* / % (Y_1)	*E* kW h m^{-3} (Y_2)
1	2.0	1.0	2.5	100.0	10.4	31.0	198	0.30
2	3.0	1.0	2.5	100.0	8.2	27.7	238	0.33
3	2.0	3.0	2.5	100.0	30.9	80.3	160	1.58
4	3.0	3.0	2.5	100.0	19.2	63.1	229	2.01
5	2.5	2.0	1.0	50.0	15.1	60.3	299	1.06
6	2.5	2.0	4.0	50.0	15.1	37.0	145	0.99
7	2.5	2.0	1.0	150.0	15.1	59.1	269	1.08
8	2.5	2.0	4.0	150.0	15.1	48.3	202	0.76
9	2.5	2.0	2.5	100.0	15.8	53.2	237	0.84
10	2.0	2.0	2.5	50.0	17.4	55.3	218	0.81
11	3.0	2.0	2.5	50.0	13.9	42.8	208	1.04
12	2.0	2.0	2.5	150.0	18.7	59.4	218	0.75
13	3.0	2.0	2.5	150.0	12.3	45.5	270	0.98
14	2.5	1.0	1.0	100.0	9.1	34.6	280	0.36
15	2.5	3.0	1.0	100.0	23.9	88.4	270	2.00
16	2.5	1.0	4.0	100.0	9.1	21.6	137	0.32
17	2.5	3.0	4.0	100.0	23.9	57.0	138	1.78
18	2.5	2.0	2.5	100.0	15.8	47.1	198	0.95
19	2.0	2.0	1.0	100.0	18.8	68.8	266	0.93
20	3.0	2.0	1.0	100.0	13.0	51.5	296	1.24
21	2.0	2.0	4.0	100.0	18.8	42.9	128	0.85
22	3.0	2.0	4.0	100.0	13.0	33.2	155	1.01
23	2.5	1.0	2.5	50.0	9.5	27.9	194	0.33

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24	2.5	3.0	2.5	50.0	22.7	71.3	214	1.78
25	2.5	1.0	2.5	150.0	8.8	26.2	198	0.35
26	2.5	3.0	2.5	150.0	23.8	74.5	212	1.70
27	2.5	2.0	2.5	100.0	15.8	52.4	232	0.85

* NTP without promoter

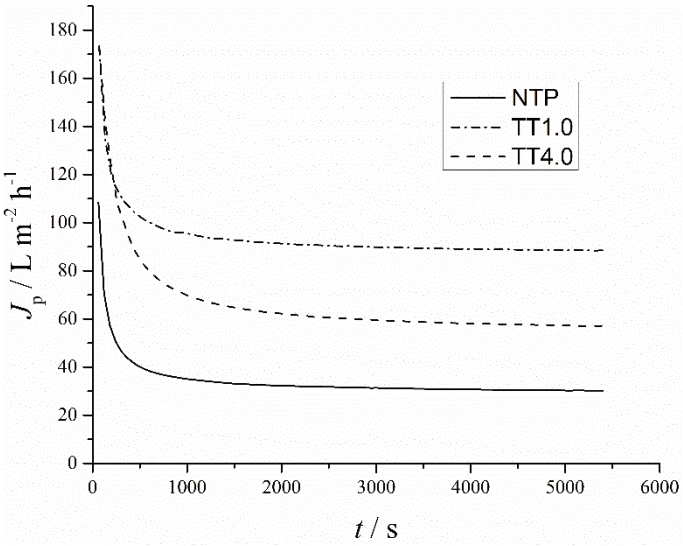

Fig. S-1. Flux dependency in time for the operation without promoter, NTP, and with twisted tapes of two aspect ratios, 1.0 and 4.0; 2.5 mass % concentration of proteins, cross-flow rate of 3 L min^{-1} and transmembrane pressure of 100 kPa.

MATHEMATICAL MODELS USED FOR FITTING THE EXPERIMENTAL DATA:

$$FI = 416.1 - 5.5\,c + 28\,CFR - 68.1\,AR - 2.5\,TMP - 9.37\,c^2 - 16.9\,CFR^2 - \\ - AR^2 - 0.002\,TMP^2 - 14.5c\,CFR - c\,AR + 0.62c\,TMP + 1.83\,CFR\,AR - \\ - 0.03\,CFR\,TMP - 0.29\,AR\,TMP - 0.03\,CFR\,TMP - 0.29\,AR\,TMP \quad \text{(S-1)}$$

$$E = 0.695 - 0.52c - 0.24\,CFR - 0.05\,AR - 0.003\,TMP - 0.15\,c^2 + \\ + 0.15\,CFR^2 + 0.042\,AR^2 + 0.2\,c \cdot CFR - 0.05\,c\,AR - 0.00006\,c\,TMP - \\ - 0.03\,CFR\,AR - 0.0005\,CFR\,TMP + 0.0008\,AR\,TMP \quad \text{(S-2)}$$

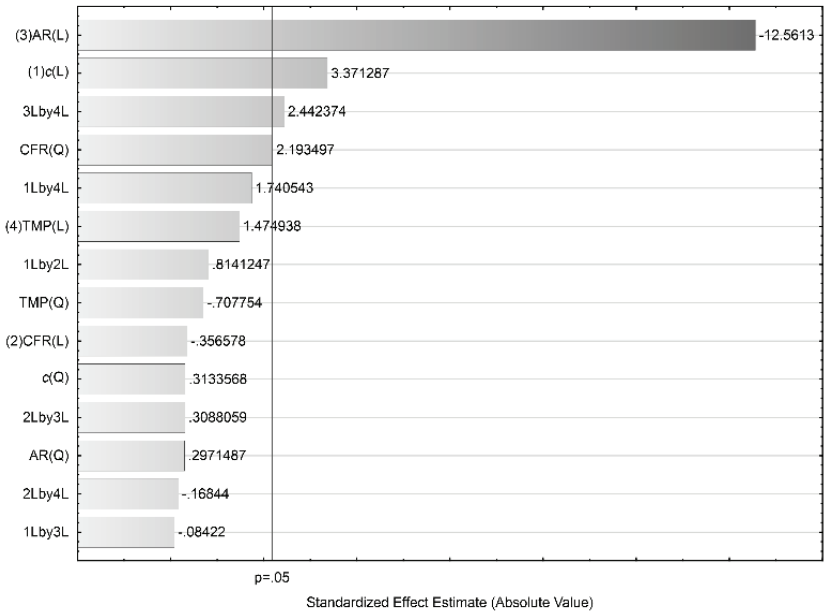

Fig. S-2. Pareto chart of standardized effects for flux improvement ((L) –linear; (Q) – quadratic).

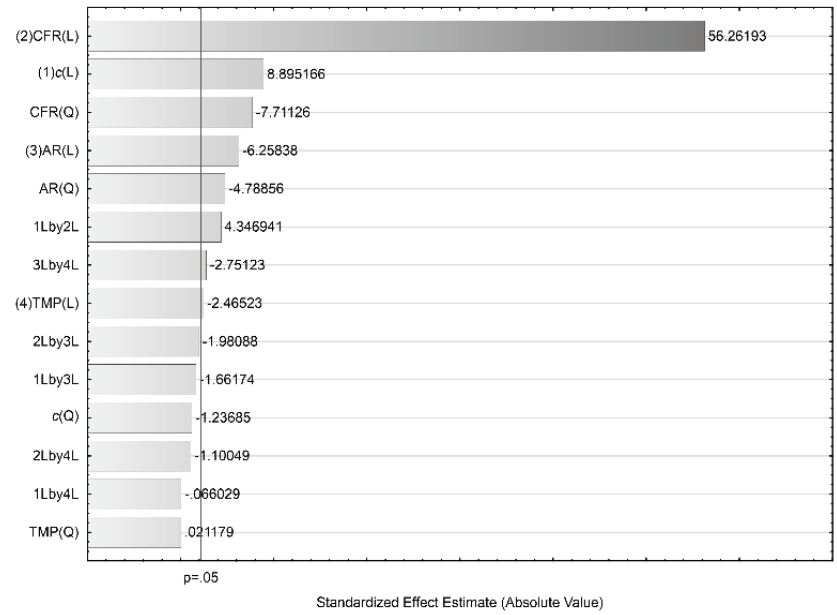

Fig. S-3. Pareto chart of standardized effects for specific energy consumption ((L) –linear; (Q) – quadratic).