

Supplementary Materials

Leuconostoc mesenteroides M13: Optimization of Bioprocesses and Antioxidant

Property for Food Industry Application

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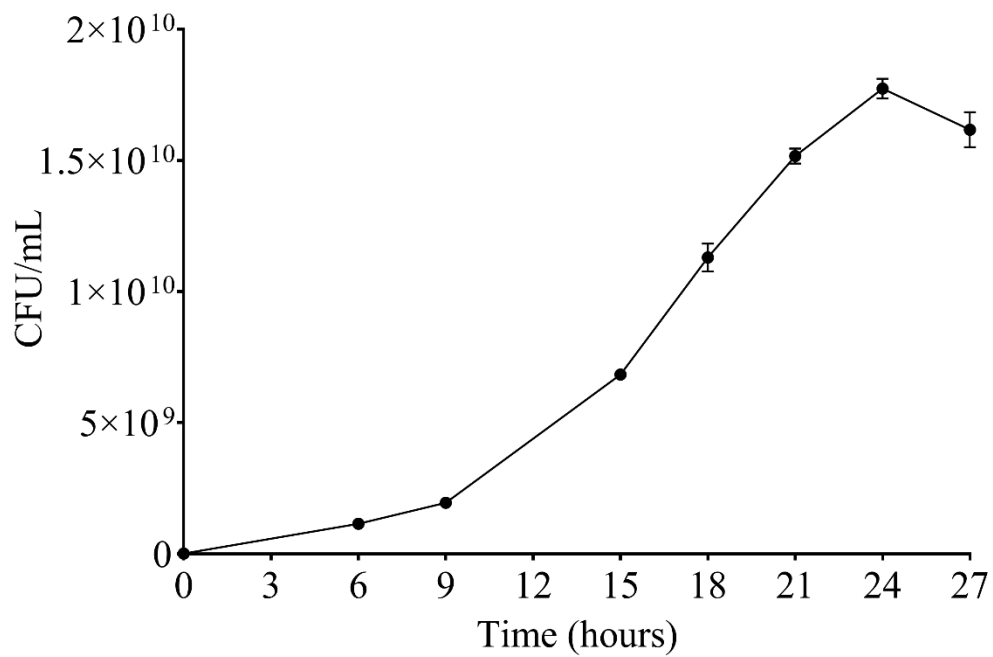


Figure S1. Growth curve of *L. mesenteroides* M13.

Table S1. Experimental design of the fractional factorial design of the *L. mesenteroides* M13 strain.

Assay	Yeast extract (g L⁻¹)	Peptone (g L⁻¹)	Mg (g L⁻¹)	Mn (g L⁻¹)
1	0 (-1)	0 (-1)	0 (-1)	0 (-1)
2	10 (+1)	0 (-1)	0 (-1)	0.08 (+1)
3	0 (-1)	10 (+1)	0 (-1)	0.08 (+1)
4	10 (+1)	10 (+1)	0 (-1)	0 (-1)
5	0 (-1)	0 (-1)	0.4 (+1)	0.08 (+1)
6	10 (+1)	0 (-1)	0.4(+1)	0 (-1)
7	0 (-1)	10 (+1)	0.4 (+1)	0 (-1)
8	10 (+1)	10 (+1)	0.4 (+1)	0.08 (+1)
9	5 (0)	5 (0)	0.2 (0)	0.04 (0)
10	5 (0)	5 (0)	0.2 (0)	0.04 (0)
11	5 (0)	5 (0)	0.2 (0)	0.04 (0)
12	5 (0)	5 (0)	0.2 (0)	0.04 (0)

Mg: magnesium sulfate Mn: manganese sulfate

Table S2. Central composite rotatable design of *L. mesenteroides* M13 strain.

Assay	Yeast extract (g L ⁻¹)	Mg (g L ⁻¹)
1	3.782486	0.202513
2	17.21751	0.202513
3	3.782486	0.697487
4	17.21751	0.697487
5	10.5	0.45
6	10.5	0.45
7	10.5	0.45
8	1	0.45
9	20	0.45
10	10.5	0.1
11	10.5	0.8
12	10.5	0.45
13	10.5	0.45
14	10.5	0.45

Mg: magnesium sulfate

Table S3. CFU mL⁻¹ of the fractional factorial of the *L. mesenteroides* M13 strain.

Assay	Yeast extract (g L ⁻¹)	Peptone (g L ⁻¹)	Mg (g L ⁻¹)	Mn (g L ⁻¹)	CFU mL ⁻¹
1	0	0	0	0	1.05 x 10 ⁹
2	10	0	0	0.08	1.10 x 10 ¹⁰
3	0	10	0	0.08	8.50 x 10 ⁹
4	10	10	0	0	9.80 x 10 ⁹
5	0	0	0.4	0.08	1.29 x 10 ⁹
6	10	0	0.4	0	2.35 x 10 ¹⁰
7	0	10	0.4	0	7.60 x 10 ⁹
8	10	10	0.4	0.08	1.85 x 10 ¹⁰
9	5	5	0.2	0.04	1.73 x 10 ¹⁰
10	5	5	0.2	0.04	1.69 x 10 ¹⁰
11	5	5	0.2	0.04	1.81 x 10 ¹⁰
12	5	5	0.2	0.04	1.79 x 10 ¹⁰

Mg: magnesium sulfate Mn: manganese sulfate

Table S4. Fractional factorial analysis of variance of *L. mesenteroides* M13 strain.

Parameters	df	SS	MS	F-value	p-value
Model	8	5.65154 x 10 ²⁰	7.06442 x 10 ¹⁹	232.89	0.000
Linear	4	2.03610 x 10 ²⁰	5.09025 x 10 ¹⁹	167.81	0.001
Yeast extract (g L ⁻¹)	1	3.72100 x 10 ¹⁹	3.72100 x 10 ¹⁹	122.67	0.002
Peptone (g L ⁻¹)	1	9.61000 x 10 ¹⁸	9.61000 x 10 ¹⁸	31.68	0.011
Mg (g L ⁻¹)	1	1.12360 x 10 ²⁰	1.12360 x 10 ²⁰	370.42	0.000
Mn (g L ⁻¹)	1	3.61000 x 10 ¹⁸	3.61000 x 10 ¹⁸	11.90	0.041
Second order interactions	3	1.12583 x 10 ²⁰	3.75277 x 10 ¹⁹	123.72	0.001
Yeast extract (g L ⁻¹)*Peptone (g L ⁻¹)	1	4.98002 x 10 ¹⁹	4.98002 x 10 ¹⁹	164.18	0.001
Yeast extract (g L ⁻¹)*Mg (g L ⁻¹)	1	5.97324 x 10 ¹⁹	5.97324 x 10 ¹⁹	196.92	0.001
Yeast extract (g L ⁻¹)*Mn (g L ⁻¹)	1	3.05045 x 10 ¹⁸	3.05045 x 10 ¹⁸	10.06	0.050
Error	3	9.10000 x 10 ¹⁷	3.03333 x 10 ¹⁷		

Total	11	5.66064 x 10 ²⁰
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df: degrees of freedom; SS: sum of square; MS: mean square.

Table S5. Fractional factorial regression coefficients for *L. mesenteroides* M13 strain.

Term	Effect	Coefficient	T-value	p-value
Constant		1415000000 0	36.66	0.000
Yeast extract	1220000000 0	6100000000	11.08	0.002
Peptone	- 6200000000	- 3100000000	-5.63	0.011
Mg	1060000000 0	5300000000	19.25	0.00
Mn	- 1900000000	-950000000	-3.45	0.041
Yeast extract*Peptone	-1.99600 x 10 ¹⁰	- 9980000000	-12.81	0.001
Yeast extract*Mg	1093000000 0	5465000000	14.03	0.001
Yeast extract*Mn	- 2470000000	- 1235000000	-3.17	0.050
Yeast extract*Peptone*Mg*Mn		7395000000	21.93	0.000

Table S6. Results in CFU mL⁻¹ of the central composite rotatable design obtained for the *L. mesenteroides* M13 strain.

Assay	CFU mL ⁻¹	
	Real	Predicted
1	1.02 x 10 ¹⁰	9.06 x 10 ⁹
2	2.2 x 10 ¹⁰	2.19 x 10 ¹⁰
3	1.4 x 10 ¹⁰	1.39 x 10 ¹⁰
4	2.4 x 10 ¹⁰	2.5 x 10 ¹⁰
5	2.5 x 10 ¹⁰	2.4 x 10 ¹⁰
6	2.3 x 10 ¹⁰	2.4 x 10 ¹⁰
7	2.41 x 10 ¹⁰	2.4 x 10 ¹⁰
8	3.4 x 10 ⁹	4.22 x 10 ⁹
9	2.2 x 10 ¹⁰	2.13 x 10 ¹⁰
10	1.9 x 10 ¹⁰	1.98 x 10 ¹⁰
11	2.62 x 10 ¹⁰	2.54 x 10 ¹⁰
12	2.39 x 10 ¹⁰	2.42 x 10 ¹⁰
13	2.41 x 10 ¹⁰	2.42 x 10 ¹⁰
14	2.48 x 10 ¹⁰	2.42 x 10 ¹⁰

Table S7. Central composite rotatable design analysis of variance of *L. mesenteroides*

M13 strain.

Font	df	SS		MS		F-value	p-value
Model	6	5.67184	x	9.45307	x	89.36	0.000
		10 ²⁰		10 ¹⁹			
Linear	2	3.21183	x	1.60592	x	151.80	0.000
		10 ²⁰		10 ²⁰			
Yeast extract	1	2.89254	x	2.89254	x	273.42	0.000
		10 ²⁰		10 ²⁰			
Mg	1	3.19294	x	3.19294	x	30.18	0.001
		10 ¹⁹		10 ¹⁹			
Quadratic	2	2.45104	x	1.22552	x	115.84	0.000
		10 ²⁰		10 ²⁰			
Yeast extract+Yeast extract	1	2.44154	x	2.44154	x	230.79	0.000
		10 ²⁰		10 ²⁰			
Mg+Mg	1	4.72615	x	4.72615	x	4.47	0.072
		10 ¹⁸		10 ¹⁸			
Second order interactions	1	8.10000	x	8.10000	x	0.77	0.411
		10 ¹⁷		10 ¹⁷			
Yeast extract+Mg	1	8.10000	x	8.10000	x	0.77	0.411
		10 ¹⁷		10 ¹⁷			
Error	7	7.40535	x	1.05791	x		
		10 ¹⁸		10 ¹⁸			
Lack of adjustment	3	4.95202	x	1.65067	x	2.69	0.181
		10 ¹⁸		10 ¹⁸			

Pure error	4	2.45333	x	6.13333	x
		10^{18}		10^{17}	

df: degrees of freedom; SS: sum of square; MS: mean square.

Table S8. Validation of the central composite rotatable design for *L. mesenteroides*

M13 strain.

Strain	Condition 1		Condition 2	
	Bias	Accuracy	Bias	Accuracy
	Factors	Factors	Factors	Factors
M13	1.026	1.026	0.966	0.966