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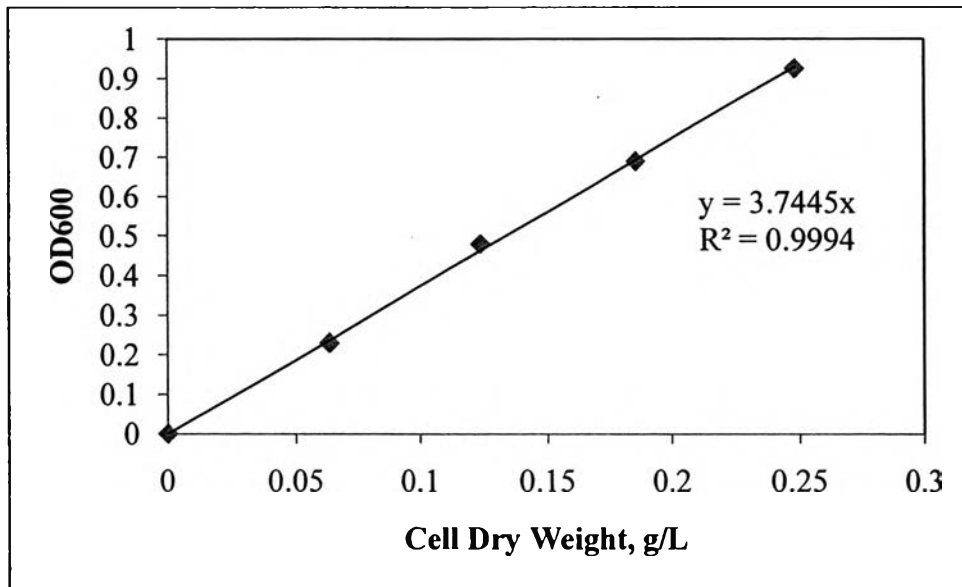
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APPENDICES

APPENDIX A

CALIBRATION CURVE

A-1 Calibration curve of cell dry weight



APPENDIX B

EXPERIMENTAL DATA

Table B.1 Experimental data of *L. salivarius* growth curve

Time, h	Cell dry weight, g/L	Glucose, g/L	L-Lactic acid, g/L
0	0.095	50.50	0.22
2	0.249	50.50	1.06
4	1.074	45.00	5.90
6	2.088	34.35	13.90
8	3.018	26.15	23.10
10	2.767	18.00	28.90
12	2.329	13.20	32.40
14	2.099	9.20	34.20
16	2.072	6.70	35.60
22	2.056	1.49	40.00
24	2.062	0.27	42.90

Table B.2 Experimental data of the effect of CaCO₃ percentages on lactic acid production

Time, h	SC		SC+2.5%CaCO ₃		SC+5.0%CaCO ₃	
	Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L
0	23.80	0.14	23.40	0.14	23.40	0.14
4	23.70	0.21	23.10	0.22	23.10	0.22
6	23.20	0.61	22.40	0.76	22.80	0.76
9	21.20	3.19	21.00	3.70	21.40	3.93
12	20.50	4.27	18.20	6.29	18.20	7.22
21	19.10	5.94	12.20	12.88	11.08	14.80
24	18.40	6.20	10.16	14.36	8.44	16.08
30	17.80	6.86	6.28	17.24	4.52	19.92
36	17.30	7.03	3.02	19.32	1.32	22.04
48	16.70	7.11	0.16	20.20	0.17	22.48
60	16.40	7.27	0.19	21.08	0.19	22.84
74	16.00	7.07	0.19	22.04	0.19	23.00
96	16.10	7.36	0.19	22.16	0.19	22.96
122	16.00	7.36	0.19	22.20	0.19	23.00

Table B.3 Experimental data of Effect of initial glucose concentration on lactic acid production

Time, h	20 g/L		20 g/L + 5%CaCO ₃		40 g/L + 5%CaCO ₃	
	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L
0	0.18	24.20	0.18	24.20	0.20	40.40
3	1.95	21.20	2.04	21.80	1.92	38.20
6	3.26	20.20	4.78	19.56	4.34	35.80
9	4.32	19.54	7.74	15.96	7.08	33.00
12	5.12	19.24	10.16	12.64	9.38	30.40
15	5.70	18.58	12.28	10.24	11.88	29.08
21	6.48	18.06	12.54	5.52	15.24	23.96
24	6.86	17.86	12.56	3.48	17.32	22.60
27	7.08	17.40	12.60	1.42	18.80	19.76
36	7.70	16.68	12.54	0.12	22.88	14.72
48	8.40	16.54	12.48	0.11	28.16	9.68
60	8.46	15.96	12.58	0.12	31.04	6.15
73	8.62	15.96	12.58	0.12	31.44	4.04
99	8.52	15.62	12.70	0.12	31.92	2.60

Table B.3 Experimental data of Effect of initial glucose concentration on lactic acid production (Cont.)

Time, h	50 g/L + 5%CaCO ₃		70 g/L + 5%CaCO ₃		90 g/L + 5%CaCO ₃	
	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L
0	0.21	51.80	0.21	72.40	0.22	91.00
3	1.72	50.60	1.30	70.80	1.06	87.00
6	4.16	49.40	3.42	69.60	2.92	85.50
9	7.20	47.00	5.92	66.40	5.45	84.00
12	9.36	42.60	7.96	64.00	7.30	80.50
15	11.44	40.20	10.24	63.20	9.25	79.00
21	15.32	36.20	13.36	60.40	12.45	76.00
24	16.96	34.60	14.92	57.60	13.90	74.50
27	18.64	31.88	16.56	55.68	15.25	73.00
36	22.72	26.84	20.56	51.84	19.05	70.00
48	27.52	21.80	25.28	47.12	23.35	66.00
60	30.88	17.80	27.20	40.80	27.20	62.70
73	32.56	15.32	30.40	39.68	29.50	60.00
99	33.76	13.32	32.08	37.60	31.40	57.20

Table B.3 Experimental data of Effect of initial glucose concentration on lactic acid production (Cont.)

Time, h	100 g/L + 5%CaCO ₃	
	L-Lactic acid, g/L	Glucose, g/L
0	0.23	102.00
3	0.96	101.00
6	2.65	98.50
9	4.97	96.00
12	6.95	95.00
15	8.65	93.50
21	11.75	91.00
24	12.95	88.00
27	14.55	88.00
36	17.95	84.50
48	21.90	81.50
60	25.30	78.30
73	29.80	76.50
99	30.20	75.00

Table B.4 Experimental data of cell-immobilized on loofa sponge

	Time, h	L1		L2		L3		
		Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L	
MB (R0)	0	48.60	0.00	48.30	0.00	49.00	0.00	
	2	47.30	0.32	47.80	0.38	48.60	0.31	
	4	45.90	3.15	46.20	3.03	46.20	2.62	
	6	42.00	6.43	42.60	6.15	41.60	5.66	
	8	37.90	8.92	38.20	8.40	36.80	8.31	
	10	34.10	12.15	34.80	11.47	33.30	11.38	
	12	29.30	15.15	31.30	13.97	28.80	14.28	
	14	25.50	18.75	27.50	18.47	25.60	19.38	
	16	21.20	20.95	22.10	21.27	20.40	22.38	
	24	12.00	25.95	12.80	25.47	11.40	28.18	
R1	24	47.20	0.00	48.50	0.00	47.00	0.00	
	26	45.00	1.55	45.90	1.67	44.90	1.52	
	28	43.00	3.14	43.80	3.47	41.60	3.52	
	30	40.90	5.46	40.20	6.07	39.00	6.36	
	32	38.20	7.46	36.70	8.33	36.30	9.37	
	34	34.60	9.56	33.20	11.13	33.50	11.87	
	36	31.80	11.26	28.70	13.93	29.70	15.07	
	44	20.30	19.26	17.50	21.33	17.30	23.17	
		48	15.10	24.26	9.67	25.63	9.68	27.47
R2	48	50.90	0.00	49.80	0.00	50.10	0.00	
	50	48.20	1.68	48.20	1.00	49.20	0.28	
	52	45.70	3.16	46.90	2.30	47.80	1.13	
	56	39.70	8.29	41.40	6.93	40.30	5.93	
	58	34.60	13.19	33.70	11.33	34.60	9.83	
	68	18.50	23.09	17.90	20.73	17.70	20.03	
		72	13.60	25.69	12.30	23.33	12.70	22.63
R3	72	45.10	0.00	46.70	0.00	48.00	0.00	
	74	42.60	3.94	42.10	2.84	44.20	3.42	
	78	34.40	9.80	33.20	9.44	34.20	9.98	
	82	26.70	14.60	26.10	13.94	26.60	14.68	
	86	19.40	19.20	19.10	19.14	20.60	17.68	
	92	10.70	25.50	9.81	23.64	11.40	22.98	
		96	8.48	26.20	6.50	25.04	8.76	23.98
	R4	96	47.00	0.00	47.20	0.00	48.10	0.00
98		44.40	1.95	44.40	1.32	45.10	1.20	
102		37.20	7.02	36.90	6.84	37.50	6.54	
106		30.30	11.52	29.10	11.94	29.80	11.74	
116		11.60	21.92	9.28	24.34	10.30	22.24	
		120	7.76	24.92	5.49	26.24	7.36	23.54
R5	120	49.00	0.00	48.20	0.00	49.00	0.00	
	122	45.00	3.59	46.00	3.73	45.80	3.34	
	126	34.70	7.77	37.60	8.41	36.00	7.91	
	130	29.50	10.27	31.90	12.41	32.30	12.61	
	140	13.50	21.77	13.10	21.81	14.40	22.81	
		144	7.39	24.37	6.25	26.61	7.56	25.31
R6	144	49.61	0.00	49.72	0.00	50.05	0.00	
	168	9.11	20.16	9.50	19.73	9.72	20.90	
R7	168	50.82	0.00	50.38	0.00	50.16	0.00	
	192	7.32	17.66	7.66	16.84	8.51	17.70	
R8	192	48.20	0.00	47.70	0.00	48.70	0.00	
	216	4.35	11.45	5.04	10.02	3.50	12.33	

Table B.4 Experimental data of cell-immobilized on loofa sponge (Cont.)

	Time, h	L4		L5	
		Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L
MB (R0)	0	49.50	0.00	49.00	0.00
	2	48.20	0.37	48.80	0.50
	4	46.10	3.13	45.90	3.62
	6	42.20	5.55	43.60	6.51
	8	38.00	9.45	38.80	9.26
	10	34.00	12.65	35.10	12.21
	12	28.20	15.35	30.30	15.61
	14	25.60	19.15	26.00	17.81
	16	22.50	20.65	23.70	20.21
	24	12.20	27.75	12.70	27.41
R1	24	48.30	0.00	46.60	0.00
	26	46.60	1.36	45.20	1.66
	28	43.20	3.40	42.40	3.69
	30	40.60	6.05	37.60	5.80
	32	35.90	8.30	33.80	8.97
	34	31.90	10.50	29.80	11.47
	36	27.60	13.30	26.40	14.67
	44	16.10	23.20	14.30	22.67
	48	14.00	28.10	7.93	26.67
	R2	48	51.00	0.00	49.40
50		49.00	0.29	48.20	0.27
52		46.90	0.73	46.70	0.82
56		39.50	5.44	39.30	5.95
58		34.20	9.44	32.90	10.55
68		17.70	19.44	16.80	20.55
72		12.50	21.84	9.88	24.25
R3	72	47.40	0.00	49.40	0.00
	74	41.70	4.99	43.00	3.27
	78	33.20	10.97	32.90	10.38
	82	24.60	16.57	24.00	15.08
	86	15.80	19.87	15.00	18.38
	92	6.12	23.77	5.56	25.18
	96	1.80	25.87	0.49	27.48
R4	96	46.90	0.00	45.90	0.00
	98	44.50	1.08	43.30	1.20
	102	38.30	5.82	35.70	6.58
	106	30.10	11.72	27.90	11.18
	116	8.07	24.42	6.24	23.18
	120	4.31	26.02	2.94	24.68
R5	120	49.40	0.00	47.70	0.00
	122	46.40	3.37	42.70	4.04
	126	38.60	8.94	34.60	8.78
	130	31.80	13.54	28.70	13.38
	140	12.70	22.94	8.31	22.48
	144	5.23	26.74	1.59	24.68
R6	144	50.05	0.00	50.49	0.00
	168	10.18	20.63	9.34	20.55
R7	168	50.60	0.00	52.91	0.00
	192	9.04	17.79	7.08	18.48
R8	192	48.10	0.00	47.00	0.00
	216	4.33	12.17	5.08	12.08

Table B.5 Experimental data of cell-immobilized on sugarcane bagasse

	Time, h	B1		B2		B3	
		Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L
MB (R0)	0	46.00	0.00	50.30	0.00	48.60	0.00
	2	43.30	1.95	46.40	2.19	45.50	2.81
	4	40.10	4.95	43.20	4.40	41.90	4.48
	6	36.40	6.85	39.20	6.54	38.60	6.30
	8	33.60	8.65	36.10	8.90	35.90	9.05
	10	30.50	11.05	31.90	11.40	33.40	11.05
	12	27.80	13.05	28.80	13.90	30.90	12.65
	14	25.40	14.95	24.80	16.30	28.00	14.65
	16	23.20	16.45	22.80	18.30	25.30	16.15
	24	14.30	20.95	12.80	24.30	15.30	22.45
R1	24	43.50	0.00	47.70	0.00	46.60	0.00
	26	35.70	6.38	39.90	4.87	41.00	4.50
	28	31.10	9.38	35.10	7.85	35.80	7.90
	30	27.70	11.48	31.90	10.95	30.20	11.10
	34	20.80	15.48	25.60	15.25	23.00	15.70
	38	14.80	18.28	20.70	17.85	16.60	19.10
	42	10.20	20.38	18.40	19.95	11.40	21.80
	48	5.35	22.38	14.00	21.45	6.01	23.20
R2	48	46.40	0.00	47.80	0.00	47.50	0.00
	50	39.60	4.47	44.70	2.83	43.20	3.78
	54	32.90	10.52	37.20	7.29	36.70	9.12
	58	27.50	14.72	30.10	12.09	30.70	13.02
	62	22.60	17.52	24.20	15.49	25.10	15.82
	72	9.64	24.22	13.50	22.79	12.90	22.92
R3	72	46.20	0.00	50.30	0.00	50.20	0.00
	74	41.40	4.65	44.50	4.09	44.80	4.22
	78	35.60	9.67	36.50	8.89	36.60	8.64
	82	29.70	13.37	30.20	12.19	29.20	12.74
	86	22.90	15.87	24.30	14.89	23.60	16.14
	96	11.10	20.87	13.90	21.79	11.90	22.74
R4	96	45.90	0.00	50.20	0.00	48.50	0.00
	98	37.60	4.88	43.10	5.14	42.40	5.10
	102	31.10	9.01	35.20	9.31	34.90	10.31
	106	26.30	11.81	30.20	11.81	30.20	12.81
	110	22.50	14.41	26.40	13.91	26.00	14.51
	120	13.50	17.91	15.50	18.41	16.90	18.41
R5	120	47.41	0.00	47.41	0.00	49.17	0.00
	144	19.58	16.19	18.37	16.98	15.73	17.35
R6	144	49.83	0.00	49.72	0.00	49.83	0.00
	168	18.04	13.61	13.86	13.90	14.74	15.81
R7	168	52.69	0.00	53.90	0.00	52.69	0.00
	192	8.95	11.67	9.23	12.11	8.75	11.77

Table B.5 Experimental data of cell-immobilized on sugarcane bagasse (Cont.)

	Time, h	B4		B5	
		Glucose, g/L	L-Lactic acid, g/L	Glucose, g/L	L-Lactic acid, g/L
MB (R0)	0	51.00	0.00	48.70	0.00
	2	47.40	3.42	44.80	3.64
	4	43.20	5.29	41.50	5.51
	6	39.90	7.30	38.00	7.35
	8	36.20	9.64	36.00	9.97
	10	32.90	11.74	33.10	11.77
	12	29.60	13.84	29.50	13.97
	14	27.00	15.24	27.30	15.47
	16	24.20	17.04	24.30	16.57
	24	14.40	22.54	15.60	21.87
R1	24	43.10	0.00	44.40	0.00
	26	38.00	4.23	39.10	3.38
	28	33.10	8.23	34.90	6.98
	30	29.50	11.33	28.50	10.48
	34	21.30	15.33	21.90	14.48
	38	15.30	18.43	15.10	17.28
	42	10.80	21.23	10.90	20.18
	48	5.74	23.43	6.10	22.28
R2	48	47.50	0.00	47.80	0.00
	50	43.30	4.24	42.90	4.14
	54	35.90	9.60	36.30	10.00
	58	29.50	13.30	29.60	13.60
	62	24.40	16.50	24.00	16.20
R3	72	12.60	23.00	12.20	21.70
	72	51.30	0.00	49.70	0.00
	74	43.90	4.60	41.70	4.96
	78	35.90	10.72	34.20	10.13
	82	29.60	14.22	28.20	13.73
R4	86	23.40	17.22	22.50	16.93
	96	12.40	22.32	12.30	22.13
	96	48.50	0.00	49.30	0.00
	98	41.00	5.59	42.70	5.33
	102	34.70	11.04	33.60	10.41
R5	106	30.20	14.34	28.30	13.51
	110	25.70	16.44	24.90	15.61
	120	16.60	20.34	17.80	18.71
	120	48.84	0.00	48.29	0.00
	144	17.49	17.51	15.84	17.37
R6	144	51.37	0.00	49.39	0.00
	168	16.28	14.87	11.22	15.36
R7	168	54.67	0.00	55.11	0.00
	192	8.86	13.14	6.97	13.12

VITA

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