

Datasheet for

Conversion of CO₂ into organic acids by engineered autotrophic yeast

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Table 1. Growth, itaconic and lactic acid production (Figure 1E-F)

Growth (OD)							
Time	0	24	96	120	144	168	192
control	5.00	5.15	9.00	10.50	11.25	11.45	11.80
ita	4.67	4.03	7.87	9.50	10.17	11.23	11.13
lac	3.03	3.27	5.27	6.30	6.83	7.13	7.03
Production (mg/L)							
Time	0	24	96	120	144	168	192
control	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ita	0.00	6.37	129.26	228.35	345.31	454.60	530.49
lac	0.00	0.00	70.22	127.47	146.95	164.05	195.93

Table 2. Growth and itaconic acid production (Figure 2).

Growth (OD)							
Time	0	25	96	120.5	142.5	168	190
ita	4.00	4.40	8.75	9.75	11.05	13.70	14.70
ita mttA strong	4.13	3.73	4.63	4.80	5.07	5.07	5.10
ita mttA medium	4.07	3.97	7.89	8.43	9.17	10.53	11.45
ita mttA weak	4.43	4.23	8.17	9.37	10.23	11.87	13.07
control	4.30	4.90	8.60	9.70	10.60	12.60	13.80
Production [mg/L] itaconic acid							
Time	0	96	120.5	142.5	168	190	
ita	0.00	124.72	205.14	302.29	412.07	525.14	
ita mttA strong	0.00	72.66	101.10	126.43	164.60	194.53	
ita mttA medium	0.00	214.76	341.00	471.39	634.47	754.81	
ita mttA weak	0.00	132.26	229.68	327.75	429.67	562.18	

Table 3. Growth and lactic acid consumption (Figure 3).

Growth (OD)					
Time	0	25	77.5	122	174
ldh	3.26	4.79	7.21	7.83	7.55
ldh dCYB2	3.30	3.46	3.87	3.91	4.11
dCYB2	3.49	3.11	2.96	2.87	2.85
Lactic acid consumption [g/L]					
Time	0	25	77.5	122	174
ldh	9.11	7.72	5.44	4.63	4.18
ldh dCYB2	9.11	8.72	8.35	8.13	7.76
dCYB2	9.11	9.05	9.14	9.19	9.10

Table 4. Growth, lactic and glycolic acid production (Figure 4).

Growth (OD)							
Time	0.00	20.50	93.50	141.50	165.00	189.00	256.50
ldh	3.03	3.27	5.27	6.30	6.83	7.13	7.03
ldh dCYB2	3.20	3.25	5.50	6.90	7.58	8.00	9.23
dCYB2	3.23	3.13	5.83	7.43	8.43	9.03	10.50
Production [mg/L] Lactic acid							
Time	0.00	20.50	93.50	141.50	165.00	189.00	256.50
ldh	0.00	0.00	70.22	127.47	146.95	164.05	195.93
ldh dCYB2	0.00	0.00	126.23	256.68	292.13	325.46	356.29
dCYB2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Production [mg/L] Glycolic acid							
Time	0	20.5	93.5	141.5	165	189	256.5
ldh	0	0	0	0	0	0	0
ldh dCYB2	0	0	39.1793422	69.2718148	83.1941962	100.076249	148.963004
dCYB2	0	0	44.8004804	84.3012772	106.017956	132.449979	197.685748

Table 5. Labeling degree of the produced organic acid (Figure 5).

Labeling Deg (%)			
Time [day]	3	5	8
ita mttA medium	35.40	23.33	18.49
Δ RuBisCO control ita	79.67		75.18
ldh dCYB2	13.48	10.77	10.11
Δ RuBisCO control lac	78.20		67.57

Table 6. Growth, itaconic and lactic acid production (Figure 6).

Growth (OD) 5 % CO ₂									
Time	0.00	24	48	96	120	144	168	192	
ita mttA medium OD4	3.85	3.80	4.50	6.00	6.45	7.10	7.50	8.05	
ita mttA medium OD10	11.13	10.25	10.88	12.75	13.00	14.25	15.63	14.00	
ita mttA medium OD20	20.00	17.25	18.50	20.00	20.50	21.50	23.25	23.38	
Growth (OD) 10% CO ₂									
Time	0	24	48	72	96	120	144	168	192
ita mttA medium OD4	4.40	4.40	4.95	6.00	6.00	7.20	7.15	8.38	8.75
ita mttA medium OD10	11.88	10.50	13.75	11.75	12.25	13.50	14.13	14.75	14.00
ita mttA medium OD20	21.63	20.63	22.25	19.38	19.38	20.13	21.63	21.38	21.50
Growth (OD) 5% CO ₂									
Time	0	22	44	70	92	116	139	164	189
ldh dCYB2 OD4	4.30	4.95	6.40	6.22	7.25	6.78	7.44	8.10	8.29
ldh dCYB2 OD8	8.60	9.40	12.05	12.52	13.84	13.56	14.03	15.07	15.16
ldh dCYB2 OD12	12.25	12.85	17.75	17.38	19.88	18.38	18.63	19.63	19.50
ldh dCYB2 OD16	17.14	18.46	21.38	20.50	24.25	23.25	22.00	22.13	23.00
Growth lac 10% CO ₂									
Time	0	21	45.5	71	94	121.5	142.5	166	191.5
ldh dCYB2 OD4	4.65	5.65	7.25	8.10	7.82	9.32	9.79	10.36	10.92
ldh dCYB2 OD8	8.15	9.50	12.05	13.94	13.56	16.20	16.57	17.14	16.39
ldh dCYB2 OD12	13.09	16.10	17.16	18.66	19.65	22.26	21.52	22.26	20.52
ldh dCYB2 OD16	17.04	20.25	21.02	22.51	22.89	25.99	25.37	26.12	24.13
Production [mg/L] itaconic acid 5% CO ₂									
Time	0.00	24	48	96	120	144	168	192	
ita mttA medium OD4	0.00	4.97	20.07	104.51	186.53	286.29	417.96	553.38	
ita mttA medium OD10	0.00	10.46	41.16	216.78	348.71	521.09	704.30	908.68	
ita mttA medium OD20	0.00	11.42	55.08	250.31	385.86	482.31	782.99	1025.66	
Production [mg/L] itaconic acid 10% CO ₂									
Time	0	24	48	72	96	120	144	168	192
ita mttA medium OD4	0	11.51	52.42	134.32	250.55	423.76	535.94	705.85	886.39
ita mttA medium OD10	0	33.44	120.65	301.66	535.17	852.21	1064.25	1349.70	1611.05
ita mttA medium OD20	0	59.12	202.88	411.03	689.18	1086.69	1353.11	1707.48	1979.99
Production [mg/L] lactic acid 5% CO ₂									
Time	0	22	44	70	92	116	139	164	189
ldh dCYB2 OD4	0	0.00	25.52	79.79	181.78	330.17	462.69	579.77	640.94
ldh dCYB2 OD8	0	14.92	44.72	124.31	260.68	416.45	446.83	389.99	316.38
ldh dCYB2 OD12	0	19.60	56.95	142.31	253.30	272.53	249.03	213.54	182.71
ldh dCYB2 OD16	0	22.43	67.10	162.35	258.67	232.86	217.47	194.86	172.94

Production [mg/L] lactic acid 10% CO2									
Time	0	21	45.5	71	94	121.5	142.5	166	191.5
ldh dCYB2 OD4	0	0	20.48	66.30	132.66	226.66	297.36	361.14	413.11
ldh dCYB2 OD8	0	0	36.39	93.33	174.70	283.77	346.56	358.73	330.51
ldh dCYB2 OD12	0	15.09	50.21	111.44	192.28	290.09	307.19	283.59	260.00
ldh dCYB2 OD16	0	17.97	58.69	121.65	198.53	279.36	279.26	252.93	239.13
Production [mg/L] glycolic acid 5% CO2									
Time	0	22	44	70	92	116	139	164	189
ldh dCYB2 OD4	0	0	18.01	34.86	51.00	66.07	81.12	97.96	116.78
ldh dCYB2 OD8	0	0	28.38	53.96	78.64	99.69	123.00	143.44	176.90
ldh dCYB2 OD12	0	0	32.26	59.80	84.17	104.09	122.99	146.55	168.90
ldh dCYB2 OD16	0	0	36.49	68.26	96.01	117.13	134.11	146.14	164.64
Production [mg/L] glycolic acid 10% CO2									
Time	0	21	45.5	71	94	121.5	142.5	166	191.5
ldh dCYB2 OD4	0	0	0	19.03	27.27	39.54	48.30	59.05	72.19
ldh dCYB2 OD8	0	0	0	26.23	39.06	56.94	71.41	86.50	96.37
ldh dCYB2 OD12	0	0	17.02	31.34	46.64	66.75	80.38	93.46	112.71
ldh dCYB2 OD16	0	0	19.25	35.33	50.73	71.84	84.69	95.71	111.24

Table 7. Growth, itaconic and lactic acid production in the bioreactor cultivations (Figure 7)

Growth (OD)													
Time	0	23.68	28.53	48.23	52.08	70.93	74.53	120.53	124.67	144.1	148.63	173.63	192.69
DO20%	34.4	32.2	28.6	31.4	29.6	29.6	29	29.8	28	31.2	28.6	28.6	28.4
Time	0	18.5	22	45	47	91	94	118	137	141	166	184	
DO 8%	21.6	20.7	19.7	20	19.9	20.1	19.5	18.9	21	18.6	19.2	18.2	
Production [mg/L] itaconic acid													
Time	0	23.68	28.53	48.23	52.08	70.93	74.53	120.53	124.67	144.1	148.63	173.63	192.69
DO20%	0	75.56	99.20	115.86	116.63	129.25	130.83	163.98	171.34	194.10	202.43	219.60	241.67
Time	0	18.5	22	45	47	91	94	118	137	141	166	184	
DO 8%	0	53.57	67.46	158.50	150.43	293.37	303.56	372.94	424.46	432.33	490.29	527.72	

Growth (OD)																	
Time	0	18.33	22	41	65.33	120.45	161.40	189.00	215.50	234.60	304.80	328.30	352.30	376.80	405.33	473.25	497.17
21% Oxygen	2.28	2.22	2.36	2.60	3.15	4.02	4.21	4.34	4.63	4.69	4.79	5.07	4.98	5.04	5.17	5.33	5.36
5% Oxygen	2.16	2.1	2.31	2.46	3.25	4.28	5.11	5.36	6.13	6.38	8.03	9.02	9.54	9.98	11.34	12.22	12.48
Production [mg/L] lactic acid																	
21% Oxygen	0	0	0	8.29	14.96	44.74	69.29	85.62	100.50	109.04	153.28	167.34	181.66	196.13	213.57	253.80	266.21
5% Oxygen	0	0	0	9.18	14.67	23.25	31.95	37.72	44.91	48.82	72.42	79.05	88.38	95.44	104.33	133.56	139.99
Production [mg/L] glycolic acid																	
21% Oxygen	0	0	0	8.98	13.84	28.41	39.91	48.41	57.04	62.87	86.78	94.87	102.48	110.89	120.28	144.56	151.34
5% Oxygen	0	0	0	5.08	5.68	7.61	11.07	13.00	14.89	15.78	22.24	23.72	25.74	28.10	30.38	38.60	40.31