Table S2. Model Variables.

№	Name	Initial value	Units	Description	Reference
1	A	14.3993864097363	1	Mathematical simplification	[1]
2	ACEex	0.0	mM	External acetate concentration	[1]
3	ACEex_gl	0.0	g/L	External acetate concentration (g/L)	[2]
4	A_in_down	0.0	mmolA/h	Acetate influx from lower module	[2]
5	A_in_up	0.0	mmolA/h	Acetate influx from upper module	[2]
6	A_out_down	0.0	mmolA/h	Acetate efflux to lower module	[2]
7	A_out_up	0.0	mmolA/h	Acetate efflux to upper module	[2]
8	AcCoA	0.6117	mM	Acetyl-CoA concentration	[1]
9	AcP	1.103	mM	Acetyl phosphate concentration	[1]
10	AceK	2.865E-5	mM	Isocitrate dehydrogenase phosphatase/kinase concentration	[1]
11	Acs	1.689E-4	mM	Acetyl coenzyme A synthetase concentration	[1]
12	B	1.02974443292705	1	Mathematical simplification	[1]
13	Cra	1.14787948086613E-9	mM	Catabolite repressor/activator concentration	[1]
14	CraFBP	2.99998852120519E-4	mM	Catabolite repressor/activator with fructose-1,6-bisphosphate complex concentration	[1]
15	Crp	0.0109865113845734	mM	cAMP receptor protein concentration	[1]
16	CrpcAMP	5.13488615426609E-4	mM	cAMP receptor protein with cAMP complex concentration	[1]
17	Cs	0.002777	mM	Citrate synthase concentration	[1]
18	E4P	0.09702	mM	Erythrose-4-phosphate concentration	[1]
19	EIIA	0.06245	mM	Unphosphorylated Pts protein EIIA concentration	[1]
20	EIIAP	0.01445	mM	Phosphorylated Pts protein EIIA concentration	[1]
21	F6P	0.5684	mM	Fructose-6-phosphate concentration	[1]
22	FADH2	0.0	mM	Intracellular FADH2 concentration	[2]
23	FBP	15.03	mM	Fructose-1,6-bisphosphatase concentration	[1]
24	FUM	0.1199	mM	Fumarase concentration	[1]
25	F_P_g	0.0	m^3/s	Pumping capacity, aerated	[2]
26	F_P_g_down	0.0	m^3/s	Pumping capacity from lower module	[2]
27	F_S_feed	0.0	gS/h	Substrate feed rate	[2]

28	F_ex	0.0	L/h	Exchange flow	[2]
29	F_ex_down	0.0	L/h	Exchange flow with the lower compartment	[2]
30	F_ex_up	0.0	L/h	Exchange flow with the upper compartment	[2]
31	Fba	0.02342	mM	Fructose-1,6-bisphosphate aldolase class II concentration	[1]
32	Fbp	2.966E-4	mM	Fructose-1,6-bisphosphatase concentration	[1]
33	Fr	0.0	1	Froude number	[2]
34	Fum	0.002105	mM	Fumarase concentration	[1]
35	G6P	3.479	mM	Glucose-6-phosphate concentration	[1]
36	GAP	0.2182	mM	Glyceraldehyde-3-phosphate concentration	[1]
37	GLC	2.845	mM	Glucose concentration	[1]
38	GLCex	21.44	mM	External glucose concentration	[1]
39	GLCex_gl	0.0	g/L	External glucose concentration (g/L)	[2]
40	GLCfeed	0.0	mM	Glucose concentration in feeding medium	[2]
41	GOX	0.08051	mM	Glyoxylate concentration	[1]
42	Gapdh	0.04028	mM	Glyceraldehyde 3-phosphate dehydrogenase concentration	[1]
43	Glk	0.003066	mM	Glucokinase concentration	[1]
44	H	3.16227766016838E-5	M	H^+ concentration	[1]
45	ICIT	0.1099	mM	Isocitrate concentration	[1]
46	Icdh	0.1721	mM	Isocitrate dehydrogenase concentration	[1]
47	IcdhP	0.1195	mM	Phosphorylated isocitrate dehydrogenase concentration	[1]
48	Icl	0.01204	mM	Isocitrate lyase concentration	[1]
49	KDPG	1.041	mM	2-keto-3-deoxy-6-phosphogluconate concentration	[1]
50	MAL	1.432	mM	Malate concentration	[1]
51	MaeB	1.869E-4	mM	Malic enzyme concentration	[1]
52	Mdh	0.00735	mM	Malate dehydrogenase concentration	[1]
53	Ms	0.003618	mM	Malate synthase concentration	[1]
54	N	0.0	s-1	Stirrer speed (rps)	[2]
55	O	0.0	mmolO/L	Intracellular oxygen concentration	[2]
56	OAA	0.6507	mM	Oxaloacetate concentration	[1]
57	OPFADH2	132631.659222817	mM/h	FADH2 production rate	[1]

58	OPNADH	8.05702369790134E7	mM/h	NADH production rate	[1]
59	OTR	0.0	mmolO/L/h	Oxygen transfer rate	[2]
60	OUC	0.0	mmolO/gX/h	Oxygen uptake capacity	[2]
61	O_crit	0.0	gS/gX/h	Critical oxygen concentration	[2]
62	O_in_down	0.0	mmolO/h	Oxygen influx from lower module	[2]
63	O_in_up	0.0	mmolO/h	Oxygen influx from upper module	[2]
64	O_out_down	0.0	mmolO/h	Oxygen efflux to lower module	[2]
65	O_out_up	0.0	mmolO/h	Oxygen efflux to upper module	[2]
66	O_satur	0.0	mmol/L	Saturation concentration of oxygen	[2]
67	Oex	0.2095	mmol/L	Dissolved oxygen concentration	[2]
68	Oex_gl	0.0	g/L	External oxygen concentration (g/L)	[2]
69	PEP	0.4028	mM	Phosphoenol pyruvate concentration	[1]
70	PYR	1.765	mM	Pyruvate concentration	[1]
71	P_s	0.0	W	Power input from stirring per impeller	[2]
72	Pck	6.727E-4	mM	Phosphoenolpyruvate carboxykinase concentration	[1]
73	Pdh	5.3E-4	mM	Pyruvate dehydrogenase concentration	[1]
74	PdhR	1.59834107498341E-6	mM	Pyruvate dehydrogenase complex repressor concentration	[1]
75	PdhRPYR	6.50016589250166E-5	mM	Pyruvate dehydrogenase complex repressor with pyruvate complex concentration	[1]
76	Pfk	0.001432	mM	Phosphofructokinase concentration	[1]
77	Pg_by_P0	0.0	1	Ratio between aerated and unaerated power input	[2]
78	Ppc	3.417E-6	mM	Phosphoenolpyruvate carboxylase concentration	[1]
79	Pps	0.003863	mM	Phosphoenolpyruvate synthase concentration	[1]
80	Pyk	0.00288	mM	Pyruvate kinase I concentration	[1]
81	QEdapH	1.0	1	Enzyme pH efficiency	[1]
82	QEddpH	1.10975216842223	1	Enzyme pH efficiency	[1]
83	Q_g	0.0	m^3/s	Volumetric gas flow	[2]
84	R5P	0.3979	mM	Ribose-5-phosphate concentration	[1]
85	RU5P	0.1586	mM	Ribulose-5-phosphate concentration	[1]
86	Re	0.0	1	Reynolds number	[2]
87	S7P	0.06627	mM	Sedoheptulose-7-phosphate concentration	[1]

88	SUC	0.5734	mM	Succinate concentration	[1]
89	S_in_down	0.0	mmolS/h	Substrate influx from lower module	[2]
90	S_in_up	0.0	mmolS/h	Substrate influx from upper module	[2]
91	S_out_down	0.0	mmolS/h	Substrate efflux to lower module	[2]
92	S_out_up	0.0	mmolS/h	Substrate efflux to upper module	[2]
93	Sdh	0.05954	mM	Succinate dehydrogenase concentration	[1]
94	V_L	0.0	m^3	Liquid volume in the whole reactor	[2]
95	V_L_1	0.0	m^3	Liquid volume in compartment 1	[2]
96	V_L_2	0.0	m^3	Liquid volume in compartment 2	[2]
97	V_L_3	0.0	m^3	Liquid volume in compartment 3	[2]
98	V_L_4	0.0	m^3	Liquid volume in compartment 4	[2]
99	V_L_i	0.0	m^3	Liquid volume	[2]
100	X	1.0	g/L	External biomass concentration	[2]
101	X5P	0.1878	mM	Xylulose-5-phosphate concentration	[1]
102	X_in_down	0.0	gX/h	Biomass influx from lower module	[2]
103	X_in_up	0.0	gX/h	Biomass influx from upper module	[2]
104	X_out_down	0.0	gX/h	Biomass efflux to lower module	[2]
105	X_out_up	0.0	gX/h	Biomass efflux to upper module	[2]
106	aKG	0.4418	mM	a-ketoglutarate concentration	[1]
107	akgdh	0.002612	mM	a-keto-D-gluconate dehydrogenase concentration	[1]
108	cAMP	0.01963	mM	Cyclic AMP concentration	[1]
109	default_NADH	0.0	mM	Intracellular NADH concentration	[2]
110	gO	0.0	mmolO/Lcell/h	Oxygen uptake rate	[2]
111	gas_flow	0.0	mol/s	Molar gas flow rate	[2]
112	gas_holdup	0.0	1	Gas hold-up according to Noorman et al.	[2]
113	h	0.0	m	Height of liquid above compartment	[2]
114	k_ACE_AcCoA	0.5	1	Fraction of acetate uptake rate directed to AcCoA synthesis	[2]
115	k_ACE_AcP	0.5	1	Fraction of acetate uptake rate directed to AcP synthesis	[2]
116	k_La	0.0	1/s	Specific mass transfer coefficient	[2]
117	k_Nonpts	0.5	1	Fraction of glucose uptake rate directed to the Non-PTS system	[2]
118	k_O	0.0	1	External to critical oxygen ratio	[2]
119	k_Pts4	0.5	1	Fraction of glucose uptake rate directed to the PTS system	[2]
120	k_S	0.0	1	Non-PTS to PTS maximal reaction	[2]

				rate ratio	
121	mu	1307.62930090833	1/h	Growth rate	[2]
122	mu_add	0.0	1/h	Bioreactor specific addition to growth rate	[2]
123	n_g	0.0	mol	Amount of moles in the gas phase	[2]
124	p_abs	0.0	bar	Absolute pressure	[2]
125	q_A_c	0.0	gA/gX/h	Specific acetate consumption rate	[2]
126	q_A_c_mM	0.0	mM/h	Specific acetate consumption rate (mM/h)	[2]
127	q_A_can	0.0	gA/gX/h	Specific acetate consumption rate towards anabolism	[2]
128	q_A_can_mM	0.0	mM/h	Specific acetate consumption rate towards anabolism (mM/h)	[2]
129	q_A_canth	0.0	gA/gX/h	Theoretical specific acetate consumption rate for the anabolism	[2]
130	q_A_cen	0.0	gA/gX/h	Specific acetate consumption rate towards energy metabolism	[2]
131	q_A_cen_mM	0.0	mM/h	Specific acetate consumption rate towards energy metabolism (mM/h)	[2]
132	q_A_cth	0.0	gA/gX/h	Theoretical specific acetate consumption rate	[2]
133	q_A_p	0.0	gA/gX/h	Specific acetate production rate	[2]
134	q_A_p_mM	0.0	mM/h	Specific acetate production rate (mM/h)	[2]
135	q_O	0.0	mmolO/gX/h	Specific oxygen consumption rate	[2]
136	q_O_S	0.0	mmolO/gX/h	Specific oxygen uptake rate for substrate oxidation	[2]
137	q_S	0.0	gS/gX/h	Specific substrate uptake rate	[2]
138	q_S_feed	0.08	gS/gX/h	Biomass specific feed rate	[2]
139	q_S_mM	0.0	mM/h	Specific substrate uptake rate (mM/h)	[2]
140	q_S_of	0.0	gS/gX/h	Specific substrate uptake rate of the overflow metabolism	[2]
141	q_S_ofan	0.0	gS/gX/h	Specific substrate uptake rate of the anabolic overflow metabolism	[2]
142	q_S_ofen	0.0	gS/gX/h	Specific substrate uptake rate of the energy overflow metabolism	[2]
143	q_S_ox	0.0	gS/gX/h	Specific substrate uptake rate of the oxidative metabolism	[2]
144	q_S_oxan	0.0	gS/gX/h	Specific substrate uptake rate of the anabolic oxidative metabolism	[2]

145	q_S_oxanth	0.0	gS/gX/h	Theoretical specific substrate uptake rate of the anabolic oxidative metabolism	[2]
146	q_S_oxen	0.0	gS/gX/h	Specific substrate uptake rate of the energy oxidative metabolism	[2]
147	q_S_oxenth	0.0	gS/gX/h	Theoretical specific substrate uptake rate of the energy oxidative metabolism	[2]
148	q_m	0.0	gS/gX/h	Specific maintenance rate	[2]
149	q_m_tmp	0.0	gS/gX/h	Mathematical simplification	[2]
150	rateOf_vEAck	5262.31990873481	mM/h	Rate of the reaction catalyzed by Ack	[1]
151	rateOf_vEAcs	0.0	mM/h	Rate of the reaction catalyzed by Acs	[1]
152	ro_g	0.0	kg/m^3	Gas density	[2]
153	sixPG	3.457	mM	6-phosphogluconate concentration	[1]
154	sixPGL	1.607	mM	6-phosphogluconolactonase concentration	[1]
155	vATP	1.03780103246693E8	mM/h	ATP production rate	[1]
156	vFADH2	0.0	mM/h	FADH2 production rate	Adapted from [1]
157	vFum1max	8041.1	mM/h	Maximal rate of the reaction catalyzed by Fum	[1]
158	vFum2max	8041.1	mM/h	Maximal rate of the reaction catalyzed by Fum	[1]
159	vMdh1max	169050.0	mM/h	Maximal rate of the reaction catalyzed by Mdh	[1]
160	vMdh2max	169050.0	mM/h	Maximal rate of the reaction catalyzed by Mdh	[1]
161	vNADH	0.0	mM/h	NADH production rate	Adapted from [1]
162	vSdh1max	116698.4	mM/h	Maximal rate of the reaction catalyzed by Sdh	[1]
163	vSdh2max	116698.4	mM/h	Maximal rate of the reaction catalyzed by Sdh	[1]
164	v_g	0.0	m/s	Superficial gas velocity	[2]
165	y_O	0.2095	1	Mole fraction of oxygen in the gas phase	[2]
166	y_O_down	0.0	1	Special case for yO to account for yO "below" the bottom compartment	[2]

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