

Tables

2.1	Activities of glycolytic and anaplerotic enzymes in response to carbon sources and DO levels	60
2.2	Activities of PP and E-D pathway enzymes in response to carbon sources and DO levels	61
2.3	Activities of fermentative enzymes in response to carbon sources and DO levels	61
2.4	Activities of TCA cycle and glyoxylate shunt enzymes in response to carbon sources and DO levels	62
2.5	Specific activity of enzymes of <i>E. coli</i> metabolic pathways in minimal media under aerobic growth conditions at different phases of growth	82
3.1	Growth parameters for <i>E. coli</i> BW25113 and its <i>cra</i> mutant cultivated at the dilution rate of 0.2 h^{-1} where feed glucose concentration was 4 g/l	106
3.2	Gene expressions of <i>cra</i> mutant as compared with the wild type strain	107
3.3	Effects of dilution rate on fermentation characteristics of wild type <i>E. coli</i>	112
3.4	Effects of the specific gene mutation on the fermentation characteristics at the dilution rate of $0.2 > \text{h}^{-1}$	115
3.5	Fermentation characteristics of the wild-type <i>E. coli</i> and its <i>phoB</i> and <i>phoR</i> mutants in the aerobic chemostat culture under different phosphate concentrations at the dilution rate of 0.2 h^{-1} at pH 7.0	133
3.6	Growth parameters of <i>E. coli</i> BW25113 and <i>arcB</i> mutant in aerobic batch cultures	140
3.7	Specific rate of <i>soxR</i> and <i>soxS</i> mutants, and parent <i>E. coli</i> , grown on glucose under aerobic conditions	150
3.8	Regulators involved in regulating glutamate-dependent acid resistance	156
3.9	Fermentation parameters for the aerobic chemostat culture of the wild type <i>E. coli</i> BW25113 at the dilution rate of 0.2 h^{-1}	160

3.10	Batch cultivation characteristics of the parent and the <i>fadR</i> mutant <i>E. coli</i> in glucose minimal medium under aerobic conditions	165
3.11	Differentially expressed proteins in the <i>fadR</i> mutant <i>E. coli</i> compared to the parent strain	166
3.12	Specific enzyme activities in cell extracts of the parent and the <i>fadR</i> mutant <i>E. coli</i> at the exponential phase grown in glucose minimal medium under aerobic conditions	168
3.13	Intracellular metabolite concentrations in the parent and the <i>fadR</i> mutant <i>E. coli</i> at the exponential phase grown in glucose minimal medium under aerobic conditions	170
3.14	Growth parameters of <i>E. coli</i> BW25113 (parent strain) and <i>E. coli</i> JWK 2711 (<i>rpoS</i> mutant) under aerobic growth conditions in LB media	180
3.15	Growth parameters of <i>E. coli</i> BW25113 (parent strain) and <i>E. coli</i> JWK 2711 (<i>rpoS</i> mutant) under aerobic growth conditions in LB media	181
3.16	Ratio of specific activities of enzymes of <i>E. coli</i> BW25113 (parent strain) and <i>E. coli</i> JWK 2711 (<i>rpoS</i> mutant) during exponential and early stationary phases of growth	183
4.1	Reactions in the networks of three different types of metabolism of <i>Chlorella</i> cell	224
4.2	Biochemical reactions for <i>Chlorella</i> cell	225
4.3	The consumption of glucose, CO ₂ production, and O ₂ uptake of <i>C. pyrenoidosa</i> under different cultivation conditions	231
4.4	The generation and utilization of ATP in the autotrophic, heterotrophic, and mixotrophic cultures	236
4.5	Theoretical yields of biomass on ATP and ATP maintenance requirements in the autotrophic, heterotrophic, and mixotrophic cultures	236
4.6	Contributions of light energy and glucose to ATP production in the exponential phase of mixotrophic cultures	237
4.7	Biomass yields on the supplied energy ($Y_{X/SE}$) in the autotrophic, mixotrophic, and cyclic autotrophic/heterotrophic culture experiments	240
4.8	Comparison of fermentation results	245
4.9	Comparison of enzyme activities	245

4.10 Comparison of intracellular metabolite concentrations in <i>E. coli</i> mutants	247
4.11 Effect of a single-gene knockout on the flux distribution	249
4.12 Effect of a single-gene knockout on flux partitions	250
4.13 Deviation index for LDH flux	253
5.1 Metabolic reactions for acetate metabolism	287
5.2 Metabolic reactions for glucose metabolism	288
5.3 Sensitivity of mass distribution (fragment [M-159] ⁺ of glutamate) upon changes in fluxes of Icl (<i>aceA</i>)	292
5.4 Sensitivity of mass distribution (fragment [M-159] ⁺ of glutamate) upon changes in exchange coefficients of Pck (<i>pckA</i>)	292
5.5 Experimental determined (exp)* and calculated (cal) fragment mass distribution of TBDMS-derived amino acids from <i>E. coli</i> K12 hydrolysates (chemostat culture by using acetate and glucose as the carbon source; D = 0.22 h ⁻¹)	293
5.6 90% confidence limits for estimated net fluxes and exchange coefficients in acetate metabolism	294
5.7 90% confidence limits for estimated net fluxes and exchange coefficients in glucose metabolism	294
5.8 Growth parameters of <i>E. coli</i> K12 at a D of 0.11 and 0.22 h ⁻¹ , where acetate is used as the sole carbon source	297
5.9 Growth parameters of <i>E. coli</i> K12 at a D of 0.11 and 0.22 h ⁻¹ , where glucose is used as the sole carbon source	297
5.10 Transformation matrix K for calculating f values	304
5.11 Growth parameters of chemostat cultures of <i>E. coli</i> wild-type W3110 and <i>pck</i> mutant (JWK3366)	307
5.12 Origins of metabolic intermediates in chemostat cultures of <i>E. coli</i> W3110 and <i>pck</i> mutant JWK3366 determined by flux ratio analysis	308
5.13 Specific enzymatic activities in chemostat cultures of <i>E. coli</i> W3110 and <i>pck</i> mutant JWK3366	313
5.14 Intracellular metabolite concentrations of <i>E. coli</i> W3110 and <i>pck</i> mutant JWK3366 in the continuous cultures	314
5.15 Growth parameters of glucose (C)- and ammonia (N)-limited chemostat cultures of <i>E. coli</i> wild-type strain W3110, the <i>pgi</i> mutant, and the <i>zwf</i> mutant	321
5.16 Protein, RNA, and glycogen contents of glucose (C)- and ammonia (N)-limited chemostat cultures of <i>E. coli</i> wild-type strain W3110, the <i>pgi</i> mutant, and the <i>zwf</i> mutant	322

5.17	Origins of metabolic intermediates in glucose (C)- and ammonia (N)-limited chemostat cultures of <i>E. coli</i> wild-type strain W3110, the <i>pgi</i> mutant, and the <i>zwf</i> mutant, as determined by flux ratio analysis	324
5.18	Relative abundances of intact carbon fragments at the carbon positions used for identification of the glyoxylate shunt activity in <i>E. coli</i> wild-type strain W3110 and the <i>pgi</i> mutant	325
5.19	Relative abundances of intact carbon fragments at the carbon positions used for identification of the ED pathway activity in glucose (C)- and ammonia (N)-limited cultures of the <i>pgi</i> mutant	328
5.20	Relative abundances of intact carbon fragments at the carbon positions used for identification of the origin of P5P and E4P pools in glucose (C)- and ammonia (N)-limited cultures of the <i>zwf</i> mutant	329
5.21	Stoichiometric reactions for cyanobacteria	335
5.22	Relative intensities of ^{13}C multiplet components of amino acids	338
5.23	Mass isotopomer distribution of ECF-derived amino acids	340
5.24	Independent constraints on the isotopomer distribution of amino acids available from labeling measurements	342
5.25	Growth parameters of exponentially growing <i>Synechocystis</i>	344
5.26	Estimated values and 90% confidence regions for estimated free fluxes	345
5.27	Estimated production and consumption of NADPH	349
5.28	Estimated production and consumption of ATP	350
6.1	Cell growth parameters of the wild-type <i>E. coli</i> and its <i>ppc</i> mutant grown on glucose under aerobic conditions	362
6.2	Specific enzyme activities of the wild-type <i>E. coli</i> and its <i>ppc</i> mutant grown on glucose under aerobic conditions	363
6.3	Intracellular metabolite concentrations in the wild-type <i>E. coli</i> and its <i>ppc</i> mutant grown on glucose under aerobic conditions	364
6.4	The NMR spectra of cellular amino acids in the wild-type <i>E. coli</i> and its <i>ppc</i> mutant	367
6.5	Exponential growth rates of <i>E. coli</i> wild-type (WT) and mutant cultures on glucose/pyruvate media	369
6.6	Metabolic parameters of <i>E. coli</i> continuous cultures at $D = 0.2 \text{ h}^{-1}$	369

6.7	Activities of enzymes located at key branch points and involved in NADPH formation	370
6.8	Absolute metabolic fluxes at several key branch points in the central metabolic pathways, when glucose or pyruvate were used as sole carbon sources	371
6.9	Fragment mass distribution of t-butyldimethylsilyl (TBDMS)-derived amino acids from the <i>pykF</i> mutant	378
6.10	Measured and simulated values of the NMR spectra of cellular amino acids	379
6.11	Growth characteristics of <i>E. coli</i> BW25113 at the dilution rate of 0.2 h^{-1} and its <i>lpdA</i> mutant at the dilution rate of 0.22 h^{-1} in continuous culture	386
6.12	Growth characteristics of parent strain <i>E. coli</i> BW25113 and its <i>sucA</i> , <i>sucC</i> mutants in the continuous culture at the dilution rate of 0.2 h^{-1}	392
6.13	Specific rate of parent and <i>icd</i> mutant grown on different carbon sources under different culture conditions	402
6.14	Summary of MALDI-TOF mass spectrometry data for protein spots showing altered expression levels on 2D gels for parent <i>E. coli</i> (WT) and <i>icd</i> mutant	403
6.15	Specific enzyme activities in cell extracts of parent and <i>icd</i> mutant grown on glucose under aerobic conditions	405
6.16	Measurement of intracellular metabolites for parent <i>E. coli</i> and <i>icd</i> mutant grown on glucose under aerobic conditions	408
6.17	The specific carbon source uptake rates and product formation rates for the <i>E. coli pflA</i> mutant using different carbon sources under microaerobic conditions	416
6.18	The yields (<i>Y</i>) of cell mass (<i>x</i>) and metabolites for different carbon sources for the <i>E. coli pflA</i> mutant grown under the microaerobic and the anaerobic conditions	417
6.19	Enzyme activities for the <i>E. coli pflA</i> mutant grown on different carbon sources under microaerobic conditions	419
6.20	Intracellular metabolite concentrations in cells grown on glucose	421
6.21	Intracellular metabolite concentrations in the <i>E. coli pflA</i> mutant grown on different carbon sources in microaerobic conditions	422
6.22	Specific rates of parent and <i>ldhA</i> mutant <i>E. coli</i> grown on glucose under anaerobic conditions	430

- 6.23 Specific enzyme activities in cell extracts of parent and *ldhA* mutant *E. coli* grown on glucose under anaerobic conditions 431
- 6.24 Comparison between the ratios of gene expressions, enzyme activities, and metabolic fluxes in *E. coli* grown on glucose under anaerobic conditions 439