**Biomass composition in C-limited condition**

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| Table S1. Overall macromolecular composition of *Y. lipolytica* (Zhang et al., 2016) | | |
| Component | Cellular content% (w/w) | GAM (mmol ATP/gDCW) |
| Protein | 40.3 | 16.7245 |
| Carbohydrates | 33.5 | 4.288 |
| RNA | 6.8 | 1.768 |
| DNA | 1.2 | 0.312 |
| Lipid | 8.7 |  |
| Others | 9.5 |  |
| Total | 100 | 23.09 |

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| Table S2. Amino acid composition of *Y. lipolytica* (Zhang et al., 2016) | | |  |
| Amino acid | Composition (% of total protein) | MW (g/mol) | Content (mmol/gDCW) |
| Alanine | 11.5 | 71 | 0.097846697 |
| Arginine | 5 | 157 | 0.019238758 |
| Asparagine | 5.6 | 114 | 0.02967494 |
| Aspartate | 5.6 | 114 | 0.02967494 |
| Cysteine | 0.1 | 103 | 0.000586502 |
| Glutamine | 8.1 | 128 | 0.038228013 |
| Glutamate | 8.1 | 128 | 0.038228013 |
| Glycine | 8.7 | 57 | 0.092204279 |
| Histidine | 1.9 | 137 | 0.008377988 |
| Isoleucine | 2.7 | 113 | 0.014434176 |
| Leucine | 5.8 | 113 | 0.031006749 |
| Lysine | 9.2 | 129 | 0.043082887 |
| Methionine | 1.5 | 131 | 0.006917141 |
| Phenylalanine | 3.1 | 147 | 0.012739461 |
| Proline | 5.4 | 97 | 0.033630142 |
| Serine | 6.8 | 87 | 0.047216777 |
| Threonine | 5.7 | 101 | 0.034092603 |
| Tryptophan | 0.1 | 186 | 0.000324783 |
| Tyrosine | 1.7 | 163 | 0.006300398 |
| Valine | 4.6 | 99 | 0.028069154 |

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| Table S3. RNA composition of 1 gram of *Y. lipolytica* cell (Feist et al., 2007) | | | |
| Metabolite | mRNA (%) | MW (g/mol) | Content (mmol/g DCW) |
| cmp | 0.245 | 323 | 0.007731684 |
| gmp | 0.245 | 363 | 0.006879708 |
| ump | 0.255 | s324 | 0.008022426 |
| amp | 0.255 | 347 | 0.00749068 |
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| Table S4. DNA composition of 1 gram of *Y. lipolytica* cell (GC content of *Y. lipolytica* is 49%) (Zhang et al., 2016) | | | |
| Metabolite | Composition (%) | MW (g/mol) | Content (mmol/g DCW) |
| damp | 0.255 | 331 | 0.001385782 |
| dcmp | 0.245 | 307 | 0.001435524 |
| dgmp | 0.245 | 347 | 0.001270046 |
| dtmp | 0.255 | 322 | 0.001424516 |

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| Table S5. Carbohydrate composition of *Y. lipolytica* (Xue et al., 2013) | | | |
| Carbohydrate | Content in dry cell(mg/g) | MW (g/mol) | Content (mmol/gDCW) |
| chitin(monomer) | 52.6 | 203 | 0.259113 |
| Trehalose | 0.7 | 342 | 0.002047 |
| Mannan | 11.4 | 162 | 0.07037 |
| glucan | 45.6 | 162 | 0.281481 |

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| Table 6. Fatty acid composition of *Y. lipolytica* (Zhang et al., 2016) | | | |
|  |  |  |  |
| Fatty Acid | Content %(w/w) | MW (g/mol) | mol/g FA |
| C16:0 | 9.789607019 | 255.4 | 0.000383305 |
| C16:1 | 5.929269577 | 253.4 | 0.000233989 |
| C18:0 | 2.366317961 | 283.5 | 8.3468E-05 |
| C18:1 | 48.66082548 | 281.5 | 0.001728626 |
| C18:2 | 33.25397996 | 279.5 | 0.001189767 |
| Avg MW of FA |  |  | 276.3076452 |

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| Table 7. Detailed lipid composition of *Y. lipolytica* (Kerkhoven et al., 2016) | | | |
| Lipid | Content (mg/gDCW) | MW (g/mol) | Content (mmol/gDCW) |
| TAG(Triacylglycerol) | 9.880239521 | 912.758 | 0.023403363 |
| E(ergosterol) | 6.467065868 | 396.6484 | 0.035250723 |
| SE(steryl esters : zymosterol) | 0.538922156 | 384.6377 | 0.003029289 |

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| Table 8. Phospholipid content of *Y. lipolytica* (Kerkhoven et al., 2016) | |  |
| Phospholipids | Composition (mg/gDCW) | Content (mmol/gDCW) |
| PA (Phosphatidate) | 1.796407186 | 0.005774757 |
| PINS (phosphatidyl-1D-myo-inositol) | 2.335329341 | 0.007507185 |
| PS | 1.077844311 | 0.003464854 |
| PE | 7.365269461 | 0.023676505 |
| PC | 10.77844311 | 0.034648544 |

Final biomass equation in C-limited condition

0.281481 13BDglcn[c] + 0.0978466971830986 ala\_L[c] + 0.0482 amp[c] + 0.0192387579617834 arg\_L[c] + 0.0296749403508772 asn\_L[c] + 0.0296749403508772 asp\_L[c] + 23.09 atp[c] + 0.0368 cmp[c] + 0.000586501941747573 cys\_L[c] + 0.00138578247734139 damp[c] + 0.00143552442996743 dcmp[c] + 0.00127004610951009 dgmp[c] + 0.00142451552795031 dtmp[c] + 0.035250723 ergst[c] + 0.03822801328125 gln\_L[c] + 0.03822801328125 glu\_L[c] + 0.0922042789473684 gly[c] + 0.259113 chitin[c] + 0.0593 gmp[c] + 23.09 h2o[c] + 0.00837798759124088 his\_L[c] + 0.0144341761061947 ile\_L[c] + 0.0310067486725664 leu\_L[c] + 0.0430828868217054 lys\_L[c] + 0.07037 mannan[c] + 0.00691714122137404 met\_L[c] + 0.00005774757 pa\_SC[c] + 0.00034648544 pc\_SC[c] + 0.00023676505 pe\_SC[c] + 0.0127394605442177 phe\_L[c] + 0.0336301422680412 pro\_L[c] + 0.00003464854 ps\_SC[c] + 0.00007507185 ptd1ino\_SC[c] + 0.0472167770114943 ser\_L[c] + 0.02 so4[c] + 0.034092602970297 thr\_L[c] + 0.002047 tre[c] + 0.00023403363 triglyc\_SC[c] + 0.000324783333333333 trp\_L[c] + 0.0063003981595092 tyr\_L[c] + 0.0397 ump[c] + 0.0280691535353535 val\_L[c] + 0.003029289 zymst[c] -> 23.09 adp[c] + 23.09 pi[c] + 23.09 h[c]

**Biomass composition in N-limited condition**

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| Table 1. Overall Macromolecular composition of *Y. lipolytica* (Zhang et al., 2016) | | |
| Component | Cellular content% (w/w) | GAM (mmol ATP/gDCW) |
| Protein | 35.7 | 14.8155 |
| Carbohydrates | 30.6 | 3.9168 |
| RNA | 4.8 | 1.248 |
| DNA | 1.3 | 0.338 |
| Lipid | 14.3 |  |
| Others | 13.3 |  |
| Total | 100 | 20.31 |

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| Table 2. Amino acid composition of *Y. lipolytica* (Zhang et al., 2016) | | |  |
| Amino acid | Composition (% of total protein) | MW (g/mol) | Content (mmol/gDCW) |
| Alanine | 12.6 | 71 | 0.094969039 |
| Arginine | 5.3 | 157 | 0.018065337 |
| Asparagine | 5.6 | 114 | 0.026287726 |
| Aspartate | 5.6 | 114 | 0.026287726 |
| Cysteine | 0.1 | 103 | 0.000519556 |
| Glutamine | 7.7 | 128 | 0.032192196 |
| Glutamate | 7.7 | 128 | 0.032192196 |
| Glycine | 8.8 | 57 | 0.082618568 |
| Histidine | 1.8 | 137 | 0.007031076 |
| Isoleucine | 2.9 | 113 | 0.013733758 |
| Leucine | 6.1 | 113 | 0.02888825 |
| Lysine | 7.6 | 129 | 0.031527805 |
| Methionine | 0.7 | 131 | 0.002859543 |
| Phenylalanine | 3.3 | 147 | 0.012013414 |
| Proline | 5.2 | 97 | 0.028688078 |
| Serine | 7.6 | 87 | 0.046748124 |
| Threonine | 6 | 101 | 0.031790673 |
| Tryptophan | 0.1 | 186 | 0.000287711 |
| Tyrosine | 1.9 | 163 | 0.006237863 |
| Valine | 4.8 | 99 | 0.025946327 |

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| --- | --- | --- | --- |
| Table 3. RNA Composition of 1 Gram of *Y. lipolytica* Cell (Feist et al., 2007) | | | |
| Metabolite | mRNA | MW (g/mol) | Content (mmol/g DCW) |
| cmp | 0.245 | 323 | 0.001478116 |
| gmp | 0.245 | 363 | 0.001315238 |
| ump | 0.255 | 324 | 0.001533699 |
| amp | 0.255 | 347 | 0.001432042 |
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| Table 4. DNA Composition of 1 Gram of *Y. lipolytica* Cell (GC content of *Y. lipolytica* is 49%) (Zhang et al., 2016) | | | |
| Metabolite | Composition (molar fraction) | MW (g/mol) | Content (mmol/g DCW) |
| damp | 0.255 | 331 | 0.016513908 |
| dcmp | 0.245 | 307 | 0.017106666 |
| dgmp | 0.245 | 347 | 0.015134716 |
| dtmp | 0.255 | 322 | 0.016975477 |

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| Table 5. Carbohydrate composition of *Y. lipolytica* (Xue et al., 2013) | | | | | | |
| Carbohydrate | Content in dry cell(mg/g) | | MW (g/mol) | | Content (mmol/gDCW) | |
| chitin(monomer) | 52.6 | | 203 | | 0.236682322 | |
| Trehalose | 0.7 | | 342 | | 0.001869797 | |
| Mannan | 11.4 | | 162 | | 0.064278269 | |
| glucan | 45.6 | | 162 | | 0.257113988 | |
| Table 6. Fatty acid composition of *Y. lipolytica* (Zhang et al., 2016) | | | | | | |
|  | |  | |  | |  |
| Fatty Acid | | Content %(w/w) | | MW (g/mol) | | mol/g FA |
| C16:0 | | 10.32515551 | | 255.4 | | 0.000404274 |
| C16:1 | | 8.354765148 | | 253.4 | | 0.000329707 |
| C18:0 | | 2.744364422 | | 283.5 | | 9.6803E-05 |
| C18:1 | | 56.58024994 | | 281.5 | | 0.002009956 |
| C18:2 | | 21.99546498 | | 279.5 | | 0.000786958 |
| Avg. MW of FA | |  | |  | | 275.657005 |

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| Table 7. Detailed lipid composition of *Y. lipolytica* (Kerkhoven et al., 2016) | | | | | |
|  | | | | | |
| Lipid | Content (mg/gDCW) | | MW (g/mol) | | Content (mmol/gDCW) |
| TAG(Triacylglycerol) | 47.25111441 | | 912.758 | | 0.038910587 |
| E(ergosterol) | 32.00594354 | | 396.6484 | | 0.060650767 |
| SE(steryl esters : zymosterol) | 1.783060921 | | 384.6377 | | 0.003484382 |
| Table 8. Phospholipid content of *Y. lipolytica* (Kerkhoven et al., 2016) | | | |  | |
| Phospholipids | | Composition (mg/gDCW) | | Content (mmol/gDCW) | |
| PA (Phosphatidate) | | 7.578008915 | | 0.008468939 | |
| PINS (phosphatidyl-1D-myo-inositol) | | 11.2332838 | | 0.012553956 | |
| PS | | 9.806835067 | | 0.010959803 | |
| PE | | 28.88558692 | | 0.057788053 | |
| PC | | 51.70876672 | | 0.057788053 | |

Final biomass equation in N-limited condition

0.257113988 13BDglcn[c] + 0.09496 ala\_L[c] +0.001432042 amp[c] + 0.018065337 arg\_L[c] + 0.026287726 asn\_L[c] + 0.026287726 asp\_L[c] + 20.31 atp[c] + 0.001478116 cmp[c] + 0.000519556 cys\_L[c] + 0.016513908 damp[c] + 0.017106666 dcmp[c] + 0.015134716 dgmp[c] + 0.016975477 dtmp[c] + 0.060650767 ergst[c] + 0.032192196 gln\_L[c] + 0.032192196 glu\_L[c] +0.082618568 gly[c] + 0.236682322 chitin[c] + 0.001315238 gmp[c] + 20.31 h2o[c] + 0.007031076 his\_L[c] + 0.013733758 ile\_L[c] + 0.02888825 leu\_L[c] + 0.031527805 lys\_L[c] + 0.064278269 mannan[c] + 0.002859543 met\_L[c] + 0.00008468939 pa\_SC[c] + 0.00057788053 pc\_SC[c] + 0.00057788053 pe\_SC[c] + 0.012013414 phe\_L[c] + 0.028688078 pro\_L[c] + 0.00010959803 ps\_SC[c] + 0.00012553956 ptd1ino\_SC[c] + 0.046748124 ser\_L[c] + 0.02 so4[c] + 0.031790673 thr\_L[c] + 0.001869797 tre[c] + 0.00038910587 triglyc\_SC[c] + 0.000287711 trp\_L[c] + 0.006237863 tyr\_L[c] + 0.001533699 ump[c] + 0.025946327 val\_L[c] + 0.003484382 zymst[c] -> 20.31 adp[c] + 20.31 pi[c] + 20.31 h[c]

**Non-growth associated ATP maintenance (NGAM) requirement**

The NGAM is the quantum of ATP required for the maintenance of cell machinery even when not actively dividing. It is predominantly used for maintaining the membrane potential. In this study, we determined the NGAM requirement from the chemostat experiment using a conventional method of finding the y-intercept of the plot of glycerol uptake rate against dilution rate (Pirt, 1982).

By maximizing ATP turnover under the glycerol uptake constraint of 1 mmol/gDCW-hr, the ATP yield is evaluated as YATP, max = 6 mol ATP/ mol glycerol. Using this value and the y-intercept (0.8387 mmol glycerol/gDCW-hr), we can calculate the NGAM requirement to be about 5.03 mmol ATP/gDCW-hr.

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