Supplementary 2: Cell biomass composition

The composition of macromolecular cellular composition of mouse cell lines can be found elsewhere.[1-5] Following table shows the percentage composition of important macromolecules which make up the cell.

Calculated cellular composition	
Macromolecules	%DCW
DNA	1.9
RNA	5.8
Lipids	7.7
Carbohydrates	7.0
Proteins	70.6

Amino Acids Composition for proteins

The amino acids content of the cell proteins were obtained from Bonarius *et al*.[6] Altamirano *et al*,[1] and Zupke *et al*.[7] Free amino acids in the cell were assumed to be negligible as it comprises only a small portion of the total cell components.

Amino Acids	MWt	Average Contribution to protein		
	g/mol	Mole Fraction	g/mol	mmol/gDCW
Ala	89.000	8.450	7.521	0.457
Arg	174.200	5.475	9.537	0.296
Asp	133.000	5.225	6.949	0.282
Asn	132.110	4.175	5.516	0.226
Cys	121.000	1.725	2.087	0.093
Gln	146.150	4.750	6.942	0.257
Glu	147.130	5.675	8.350	0.307
Gly	75.000	7.875	5.906	0.426
His	210.000	1.975	4.148	0.107
Ile	131.000	4.625	6.059	0.250
Leu	131.000	8.225	10.775	0.444
Lys	183.000	8.250	15.098	0.446
Met	149.000	2.150	3.204	0.116
Phe	165.000	3.350	5.528	0.181
Pro	115.000	5.100	5.865	0.276
Ser	105.000	6.150	6.458	0.332
Thr	119.000	5.375	6.396	0.290
Trp	204.000	0.550	1.122	0.030

Tyr	225.000	2.550	5.738	0.138
Val	117.000	5.900	6.903	0.319

Monomers for DNA and RNA

The nucleotide compositions were adopted from Gambhir *et al.*[8] and Sheikh *et al.*[3] The composition of monomers which make up DNA and RNA are listed below.

Avg Mwt	Average Composition	Components	Mole fraction		
g/mol	g/mol		(mol/mol)	g/mol	mmol/gDCW
323.107	DNA	DAMP	0.289	95.723	0.014
	0.590	DGMP	0.217	75.347	0.010
		DCMP	0.207	63.590	0.010
		DMMP	0.287	88.448	0.014
338.150	RNA	AMP	0.294	102.083	0.045
	2.122	GMP	0.198	71.918	0.030
		CMP	0.214	69.165	0.033
		UMP	0.293	94.985	0.045

Lipid Composition

The important components of lipids were obtained from literature.[9,10] The detailed composition of individual monomers were calculated and shown below.

Lipid Composition	Mwt	wt%	gm/mol	mol/mol	mmol/gDCW
Cholesterol	386.350	7.000	50.725	0.131	0.019
Phosphatidylcholine	769.000	53.000	384.058	0.499	0.070
Phosphatidylethanolamine	727.000	19.000	137.681	0.189	0.027
Phosphatidylinositol	845.000	8.000	57.971	0.069	0.010
Phosphatidylserine	770.000	2.000	14.493	0.019	0.003
Phosphatidylglycerol	757.000	1.000	7.246	0.010	0.001
Diphosphatidylglycerol	1422.100	4.000	28.986	0.020	0.003
Sphingomyelin	731.610	6.000	43.478	0.059	0.008
Av Mwt	724.638		0.138		

Fatty Acid Composition

Fatty acid composition was obtained from Bonarius *et al*.[6] and Sheikh *et al*.[3] The detailed composition is given below.

Fatty Acid	(w/w) %	MW	Contribution to avg FA		
		g/mol	g/mol	mmol/g lipid	mol/mol
C14:0	1.875	228.36	5.787	0.035	0.025
C16:1	6.562	254.420	20.253	0.110	0.080
C16:0	12.187	256.420	37.614	0.202	0.147
C18:2	0.310	280.470	0.957	0.005	0.003
C18:1	52.813	282.470	163.003	0.796	0.577
C18:0	9.063	284.470	27.972	0.136	0.098
C20:3	0.938	306.530	2.895	0.013	0.009
C20:2	1.250	308.530	3.858	0.017	0.013
C20:1	4.063	310.530	12.540	0.056	0.040
C20:0	0.000	312.530	0.000	0.000	0.000
C22:1	0.938	338.550	2.895	0.012	0.009

Carbohydrate composition

Glycogen was assumed to be the main carbohydrate content of the cell and its composition is given below.

Carbohydrate	Mwt	wt%	mmol/gDCW
Glycogen	162	6.15	0.38

Theoretical ATP requirement for cell biomass production

Since biosynthesis of cell components require energy in the form of ATP, it is necessary to include ATP demand as well. The biosynthetic ATP demand was adopted from Xie and Wang.[11]

Theoretical maximum ATP demand for cell biomass formation			
		ATP Demand (mmol ATP/gDCW)	Percentage
Biosynthesis		18.618	
	Cellular proteins	16.610	78.173
	Carbohydrates	0.247	1.162

Lipids	1.138	5.355
RNA	0.439	2.066
DNA	0.184	0.865

Other important cell components:

Apart from the main cellular components, there are others such as cofactors, vitamins and polyamines, the details of which for mouse cell lines were not available. However such values were adopted from other literature sources.

Overall Cellular Composition for Mouse:

The overall average cell composition can be obtained from the calculation of individual macromolecular compositions and the detailed list of average cell composition is given below

Biomass Composition					
CELL COMPONENTS	**METABOLITES**	**Composition (mmol/gDCW)**	**CELL COMPONENTS**	**METABOLITES**	**Composition (mmol/gDCW)**
PROTEINS	ALA	0.457000	RNA	CTP	0.033000
	ARG	0.296000		UTP	0.045000
	ASP	0.282000	**LIPIDS**	CHOLESTEROL	0.019000
	ASN	0.226000		PHOSPHATIDYLCHOLINE	0.070000
	CYS	0.093000		PHOSPHATIDYLETHANOLAMINE	0.027000
	GLN	0.257000		PHOSPHATIDYLINOSITOL	0.010000
	GLU	0.307000		PHOSPHATIDYLSERINE	0.003000
	GLY	0.426000		PHOSPHATIDYLGLYCEROL	0.001000
	HIS	0.107000		DIPHOSPHATIDYLGLYCEROL	0.003000
	ILE	0.250000		SPHINGOMYELIN[8]	0.008000
	LEU	0.444000	**ENERGY**	ATP	43.15300
	LYS	0.446000	**CARBOHYDRATES**	GLYCOGEN	0.380000
	MET	0.236000		H2O	43.15300
	PHE	0.181000	**COFACTORS**	NAD	0.002150
	PRO	0.276000		NADP	0.000130
	SER	0.332000		FAD	0.000010
	THR	0.290000		NADH	0.000050
	TRP	0.030000		NADPH	0.000400
	TYR	0.138000		SUCCOA	0.000003
	VAL	0.319000		ACCOA	0.000050
DNA	DATP	0.014000		COA	0.000056
	DGTP	0.010000		MTHF	0.050000
	DCTP	0.010000	**POLYAMINES**	PTRSC	0.035000

	DMTP	0.014000	SPRMD	0.007000
RNA	AMP	0.045000	ANA	0.008500
	GTP	0.030000		

References

1. C. Altamirano, A. Illanes, A. Casablancas, X. Gamez, J. J. Cairo and C. Godia, *Biotechnol. Prog.*, 2001, **17**, 1032-1041.
2. B. D. Follstad, R. R. Balcarcel, G. Stephanopoulos and D. I. C. Wang, *Biotechnol. Bioeng.*, 1999, **63**, 675-683.
3. K. Sheikh, J. Forster and L. K. Nielsen, *Biotechnol. Prog.*, 2005, **21**, 112-121.
4. L. Xie and D. I. C. Wang, *Biotechnol. Bioeng.*, 1994, **43**, 1164-1174.
5. L. Xie and D. I. C. Wang, *Biotechnol. Bioeng.*, 1996, **52**, 579-590.
6. H. P. J. Bonarius, V. Hatzimanikatis, K. P. H. Meesters, C. D. d. Gooijer, G. Schmid and J. Tramper, *Biotechnol. Bioeng.*, 1996, **50**, 299-318.
7. C. Zupke, A. J. Sinskey and G. Stephanopoulos, *Appl. Microbiol. Biotechnol.*, 1995, **44**, 27-36.
8. A. Gambhir, R. Korke, J. Lee, P.-C. Fu, A. F. Europa and W.-S. Hu, *J. Biosci. Bioeng.*, 2003, **95**, 317-327.
9. A. A. Spector and M. A. Yorek, *J. Lipid Res.*, 1985, **26**, 1015-1035.
10. Y. Nimura and I. Ishizuka, *Biochemica et Biophysica Acta*, 1981, **663**, 266-278.
11. L. Xie and D. I. C. Wang, *Biotechnol. Bioeng.*, 1996, **52**, 591-601.