BT5441 - Elements of Biopharmaceutical Manufacturing

Assignment 2 (Supplementary Plots)

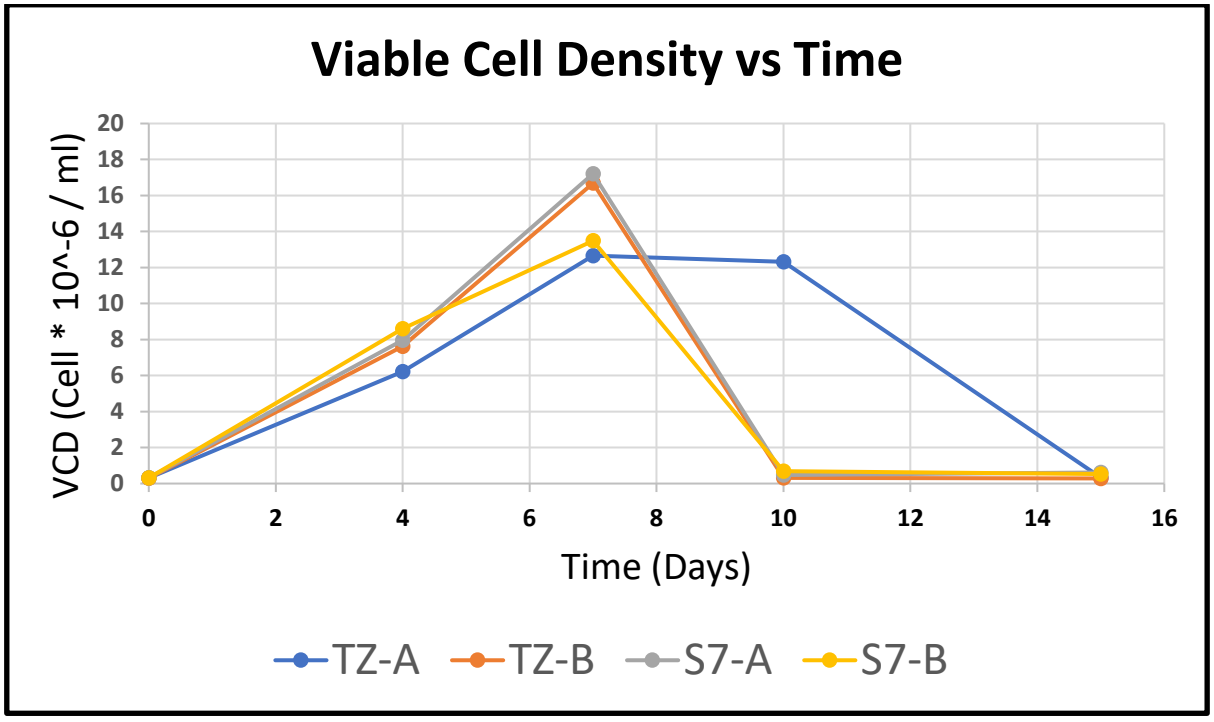


Figure 1 (A): VCD vs Time

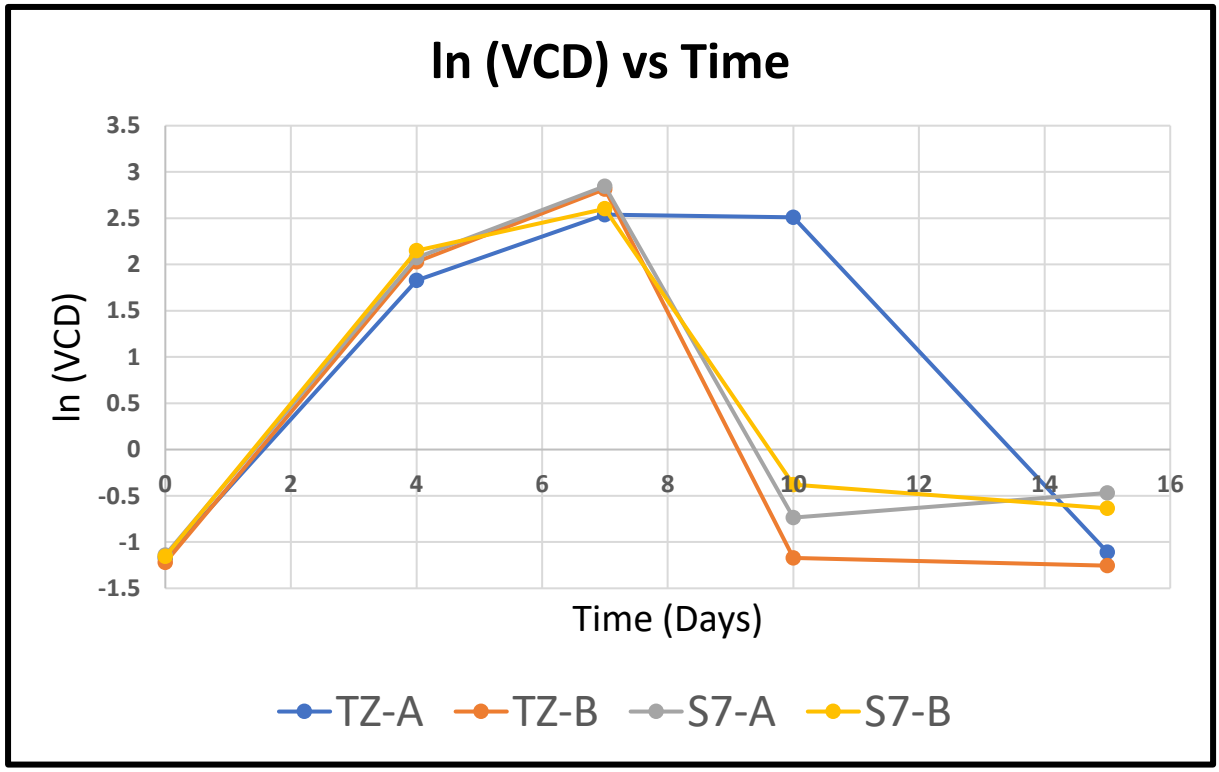
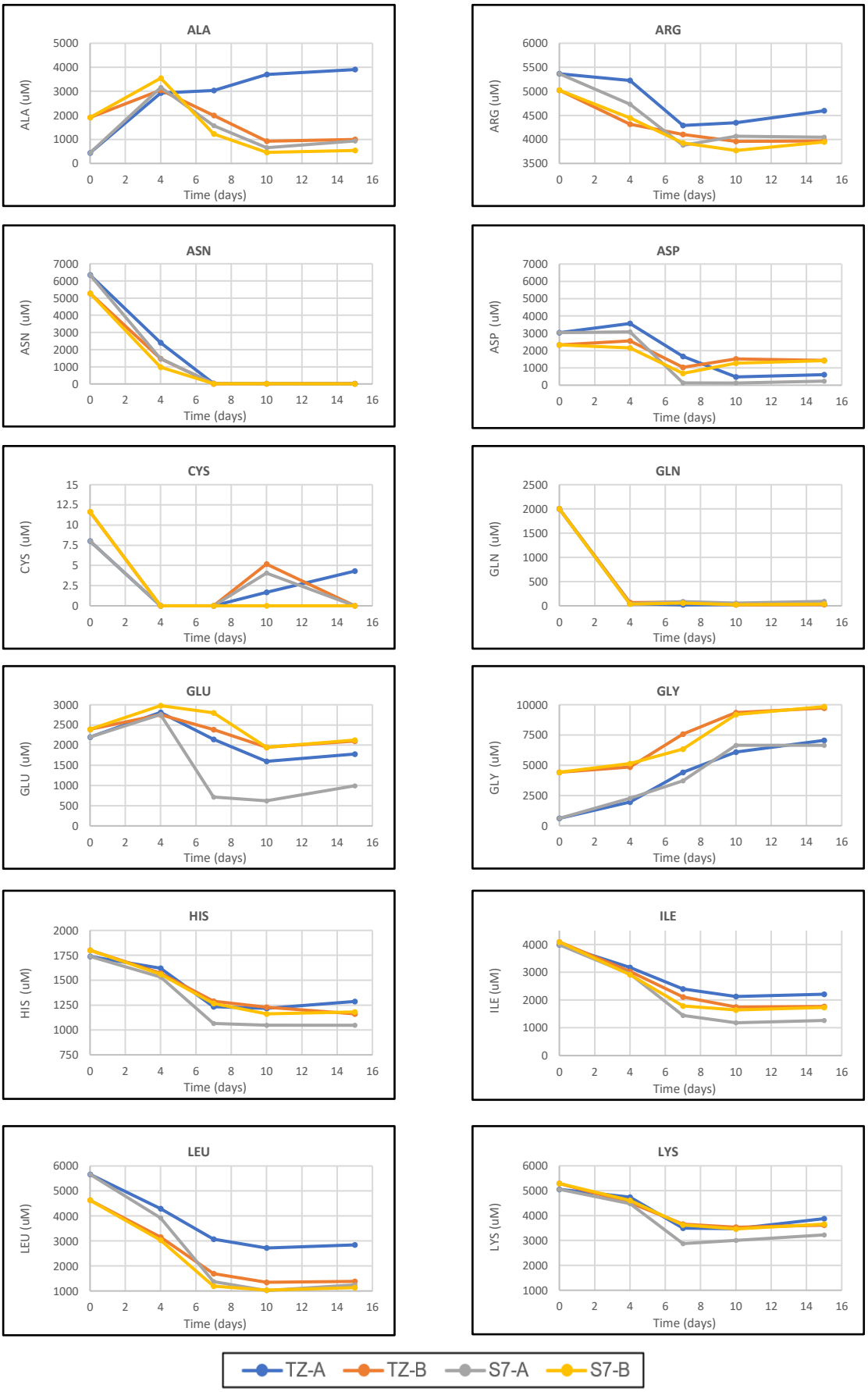


Figure 1 (B): ln(VCD) vs Time


ALA
ALA (uM)
Time (days)
ARG
ARG (uM)
Time (days)
ASN
ASN (uM)
Time (days)
ASP
ASP (uM)
Time (days)
CYS
CYS (uM)
Time (days)
GLN
GLN (uM)
Time (days)
GLU
GLU (uM)
Time (days)
GLY
GLY (uM)
Time (days)
HIS
HIS (uM)
Time (days)
ILE
ILE (uM)
Time (days)
LEU
LEU (uM)
Time (days)
LYS
LYS (uM)
Time (days)
TZ-A
TZ-B
S7-A
S7-B

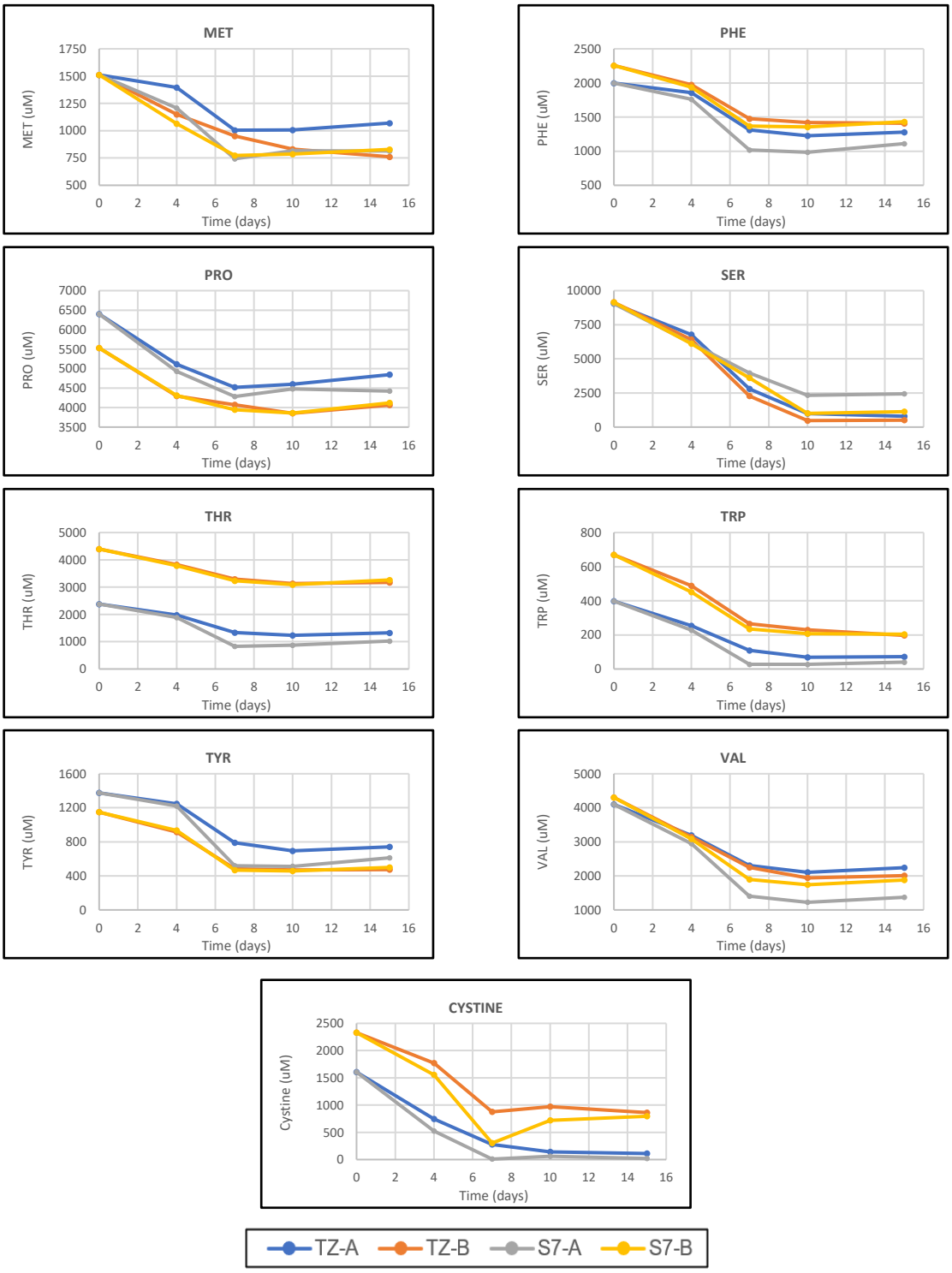


Figure 1 (C): Amino Acid Concentration over Time

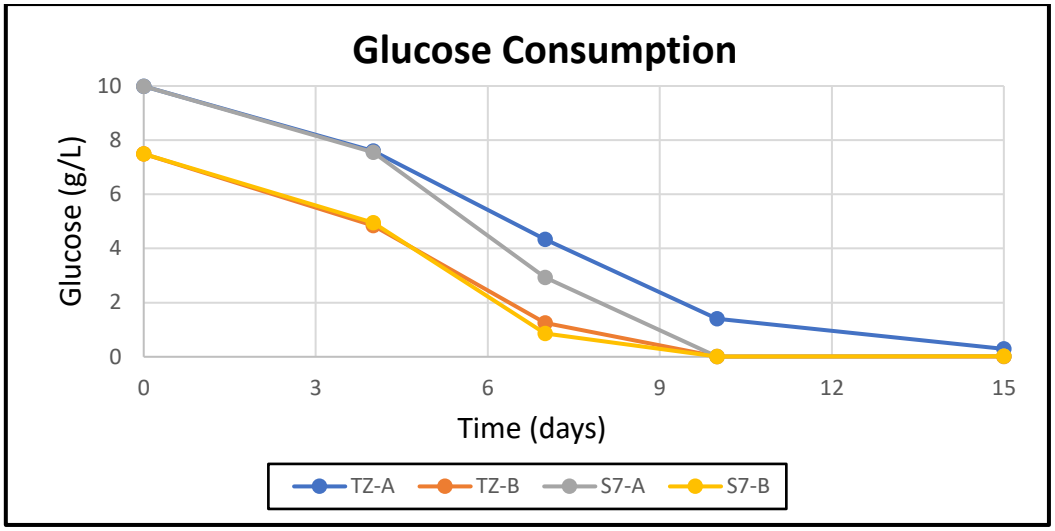


Figure 1 (D): Glucose Consumption over Time

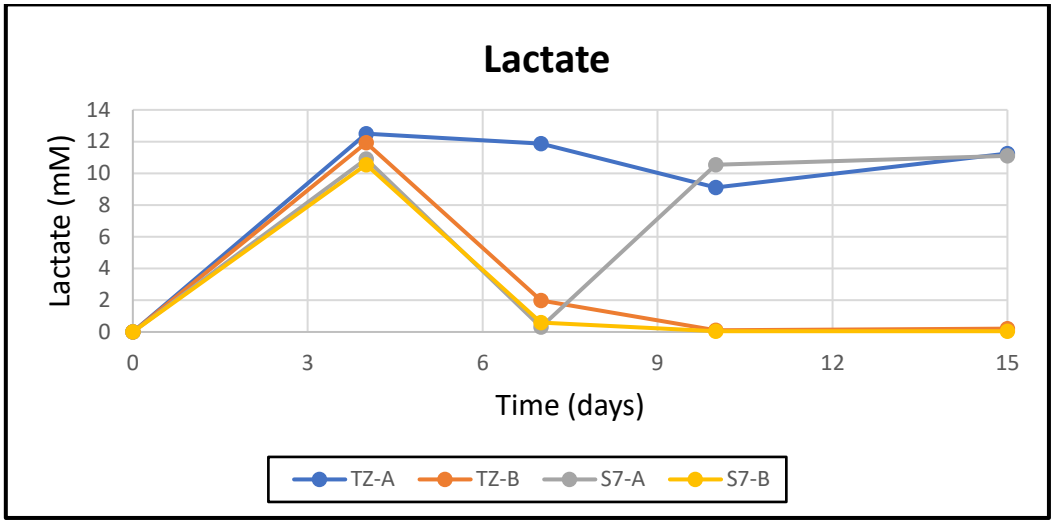


Figure 1 (E): Lactate Concentration over Time

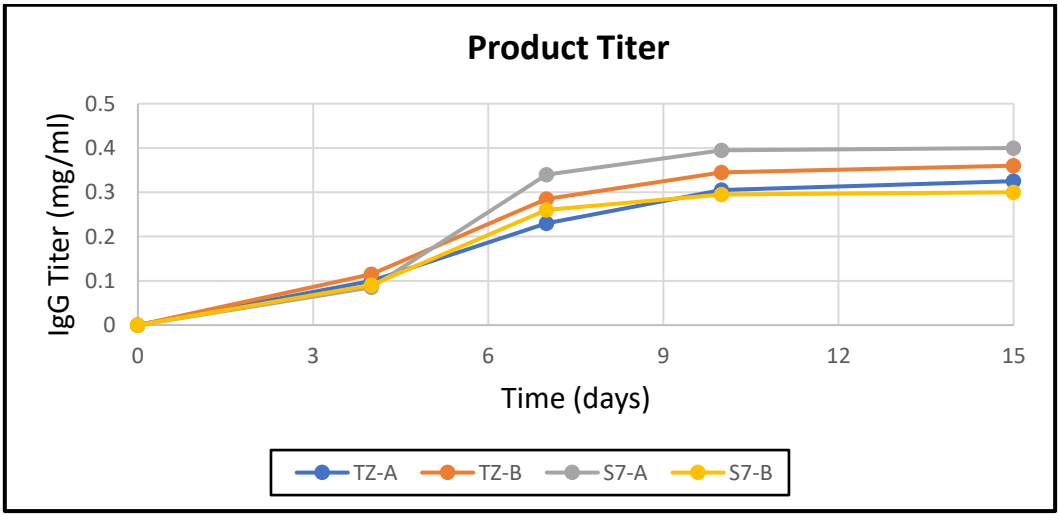


Figure 1 (F): Antibody Titer over Time

		TZ-A	TZ-B	S7-A	S7-B
Specific Rates (pmol cell^{-1} day^{-1})	q_{ALA}	0.19042391	0.07193400	0.16432963	0.09183883
	q_{ARG}	-0.01077505	-0.04472690	-0.03821057	-0.03248793
	q_{ASN}	-0.30105205	-0.24087505	-0.29375275	-0.24092511
	q_{ASP}	0.04011901	0.01471105	0.00246467	-0.00968434
	q_{CYS}	-0.00061318	-0.00073509	-0.00048395	-0.00065259
	q_{GLN}	-0.14941144	-0.12237889	-0.11819225	-0.11010396
	q_{GLU}	0.04664243	0.02291850	0.03358906	0.03289828
	q_{GLY}	0.10297890	0.02701149	0.10024408	0.04009294
	q_{HIS}	-0.00896234	-0.01467885	-0.01238433	-0.01362197
	q_{ILE}	-0.06270918	-0.06711443	-0.06362620	-0.06618597
	q_{LEU}	-0.10491528	-0.09332174	-0.10539206	-0.08963533
	q_{LYS}	-0.02420720	-0.04882231	-0.03508691	-0.03806833
	q_{MET}	-0.00882121	-0.02281999	-0.01835800	-0.02504689
	q_{PHE}	-0.01073507	-0.01785423	-0.01423253	-0.01790043
	q_{PRO}	-0.09860701	-0.07790596	-0.08869713	-0.06835750
	q_{SER}	-0.17375595	-0.17184603	-0.17499502	-0.16964630
	q_{THR}	-0.03044097	-0.03592189	-0.02948835	-0.03444117
	q_{TRP}	-0.01102566	-0.01147385	-0.01023811	-0.01219832
	q_{TYR}	-0.00986265	-0.01475675	-0.00922700	-0.01205987
	q_{VAL}	-0.06949427	-0.07331094	-0.06942454	-0.06837949
	$q_{CYSTINE}$	-0.06599301	-0.03539231	-0.06539175	-0.04349980
	$q_{GLUCOSE}$	-1.01717507	-0.93029362	-0.81939855	-0.79224268
	$q_{LACTATE}$ **By-Product**	0.95638868	0.75379267	0.65821256	0.59203143
	q_p (pg cell^{-1} day^{-1}) **Specific Productivity**	7.65110941	7.26927939	5.13285024	5.05050505
	μ (day^{-1}) **Specific Growth Rate**	0.74993911	0.81272498	0.80346582	0.82659082

Table 2: Specific Rates computed during the Exponential Phase

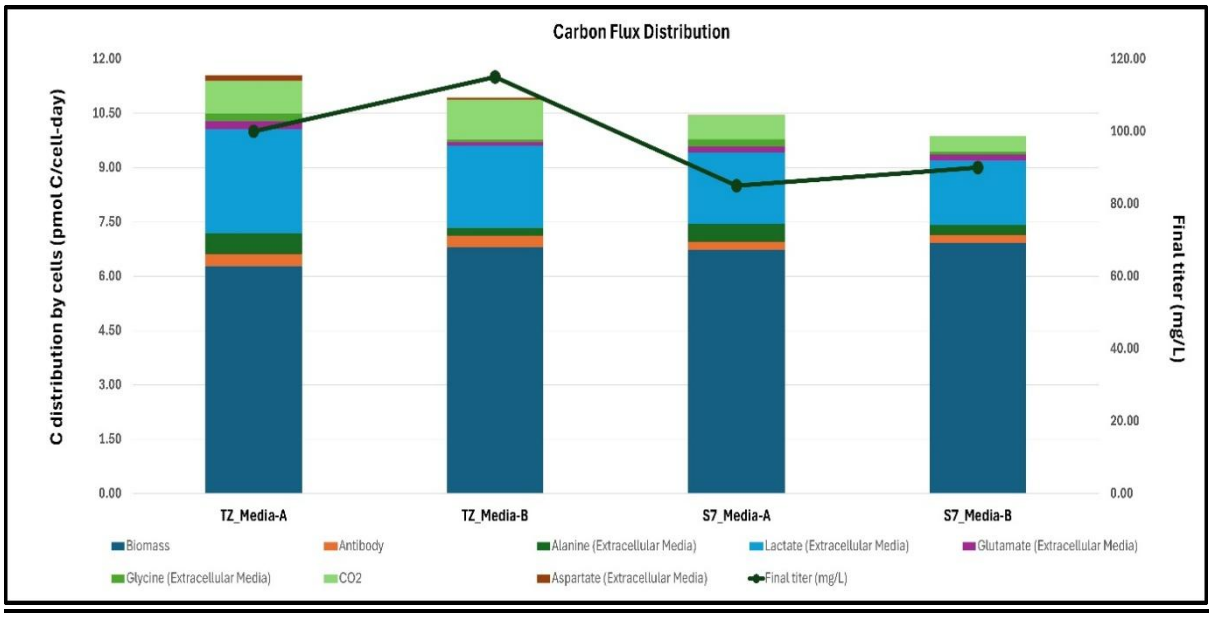


Figure 3 (A): Carbon Flux Distribution (Product Titer overlaid)

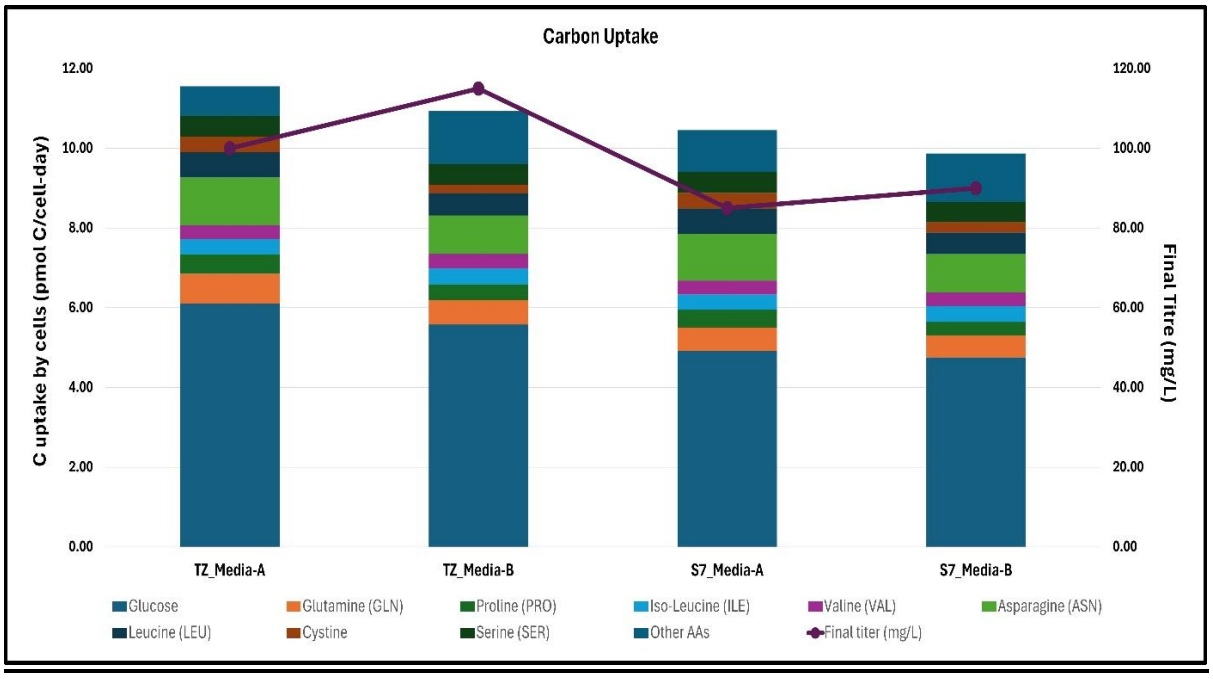


Figure 3 (B): Carbon Uptake (Product Titer overlaid)

C distribution by cells (pmol C/cell-day)				
Biomass components	TZ, Media A	TZ, Media B	S7, Media A	S7, Media B
Biomass	6.277760	6.803343	6.725834	6.919414
Antibody	0.337482	0.320640	0.226404	0.222772
Alanine (Extracellular Media)	0.571272	0.215802	0.492989	0.275516
Lactate (Extracellular Media)	2.869166	2.261378	1.974638	1.776094
Glutamate (Extracellular Media)	0.233212	0.114592	0.167945	0.164491
Glycine (Extracellular Media)	0.205958	0.054023	0.200488	0.080186
CO2	0.900508	1.104200	0.655301	0.430341
Final titer (mg/L)	100.00	115.00	85.00	90.00
Aspartate (Extracellular Media)	0.160476	0.058844	0.009859	0.000000
Specific productivity (pg/cell-day)	7.651109	7.269279	5.132850	5.050505
Lac/biomass	0.457037	0.332392	0.293590	0.256683
lac/total fixed C	0.269271	0.230081	0.201532	0.188176
lac/total uptake C	0.248287	0.206843	0.188898	0.179970
lac/CO2	3.186165	2.047978	3.013328	4.127183
Bio/total C	0.543255	0.622286	0.643408	0.701139
lac+ala	3.029642	2.320222	1.984496	1.776094
lac+ala/tot C	0.262174	0.212225	0.189841	0.179970
Antibody/total C (%)	2.920444	2.932816	2.165830	2.257333

Table 3 (A): Carbon distribution by cells

C uptake by cells (pmol C/cell-day)				
	TZ, Media A	TZ, Media B	S7, Media A	S7, Media B
Glucose	6.103050	5.581762	4.916391	4.753456
Glutamine (GLN)	0.747057	0.611894	0.590961	0.550520
Proline (PRO)	0.493035	0.389530	0.443486	0.341788
Iso-Leucine (ILE)	0.376255	0.402687	0.381757	0.397116
Valine (VAL)	0.347471	0.366555	0.347123	0.341897
Asparagine (ASN)	1.204208	0.963500	1.175011	0.963700
Leucine (LEU)	0.6294917	0.5599304	0.6323523	0.537812
Cystine	0.395958	0.212354	0.392350	0.260999
Serine (SER)	0.521268	0.515538	0.524985	0.508939
Other AAs	0.738039	1.329072	1.049041	1.212588
Final titer (mg/L)	100.00	115.00	85.00	90.00
Lactate	0.0	0.0	0.0	0.0
Exponential phase	11.555834	10.932822	10.453458	9.868815
AA/glucose	0.893452	0.958669	1.126246	1.076135
Sp.prod/C uptake	0.662099	0.664904	0.491019	0.511764

Table 3 (B): Carbon uptake by cells

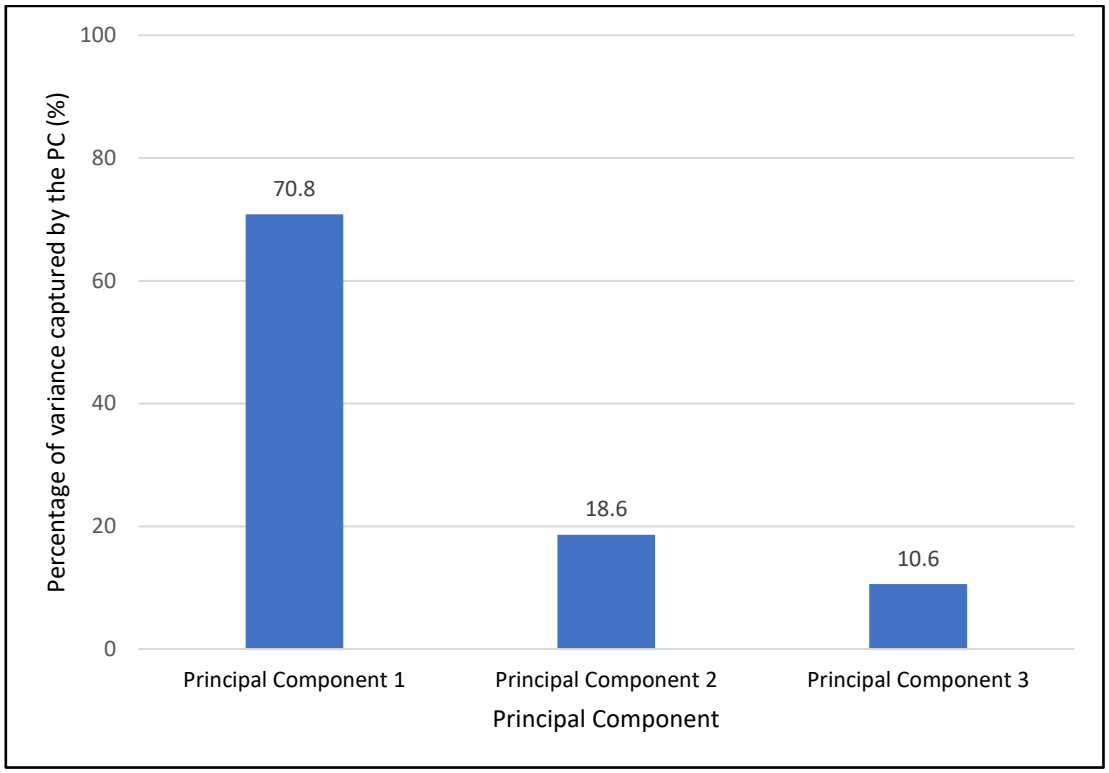
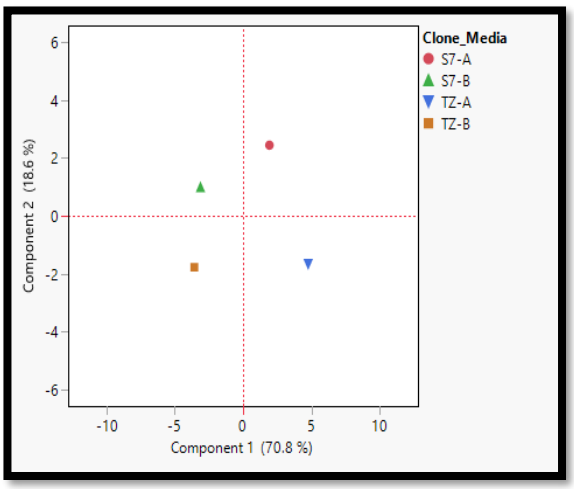
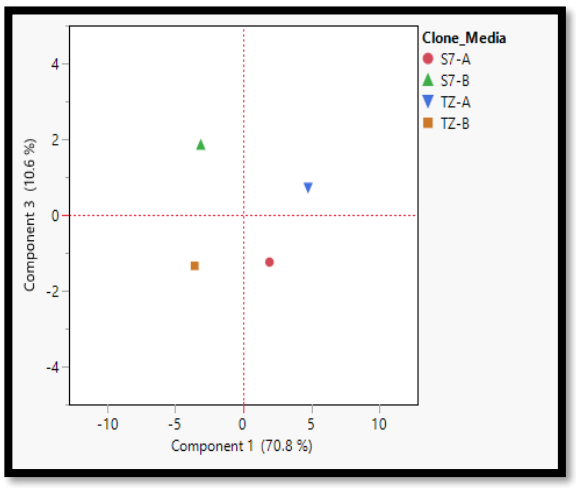


Figure 4.1 (A): % Variance captured by each Principal Component



i) PCA score plot of Component 1 vs Component 2



ii) PCA score plot of Component 1 vs Component 3

Figure 4.1 (B): PCA Score Plot

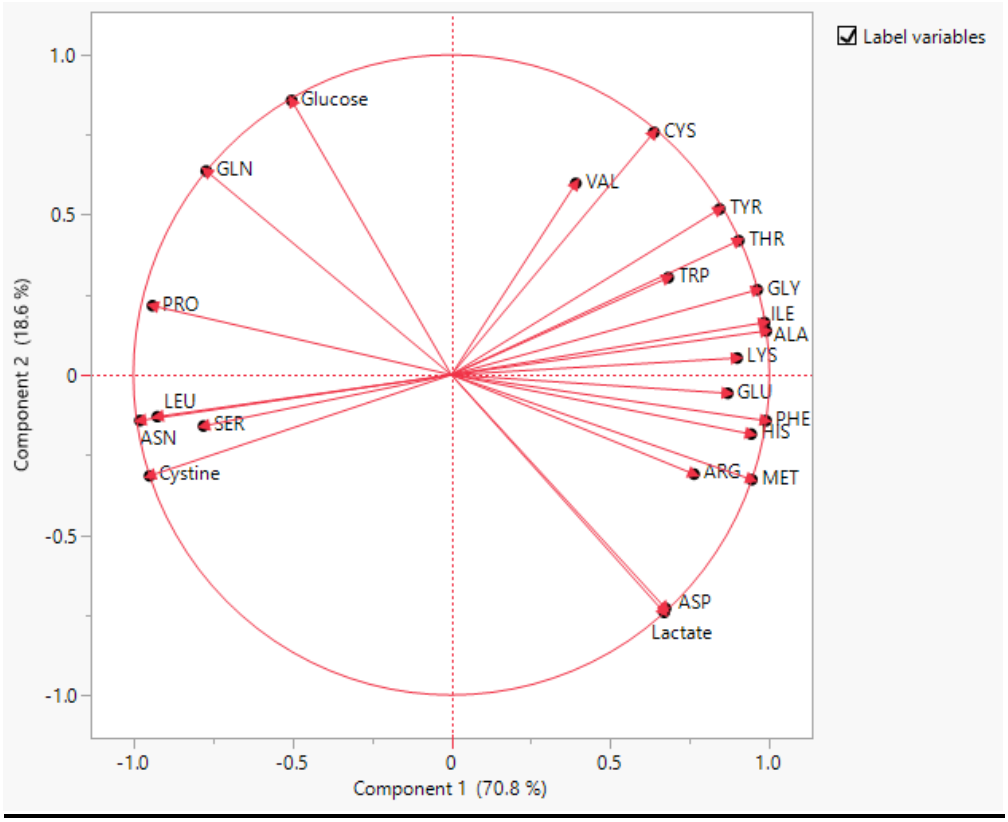


Figure 4.1 (C): PCA Loading Plot

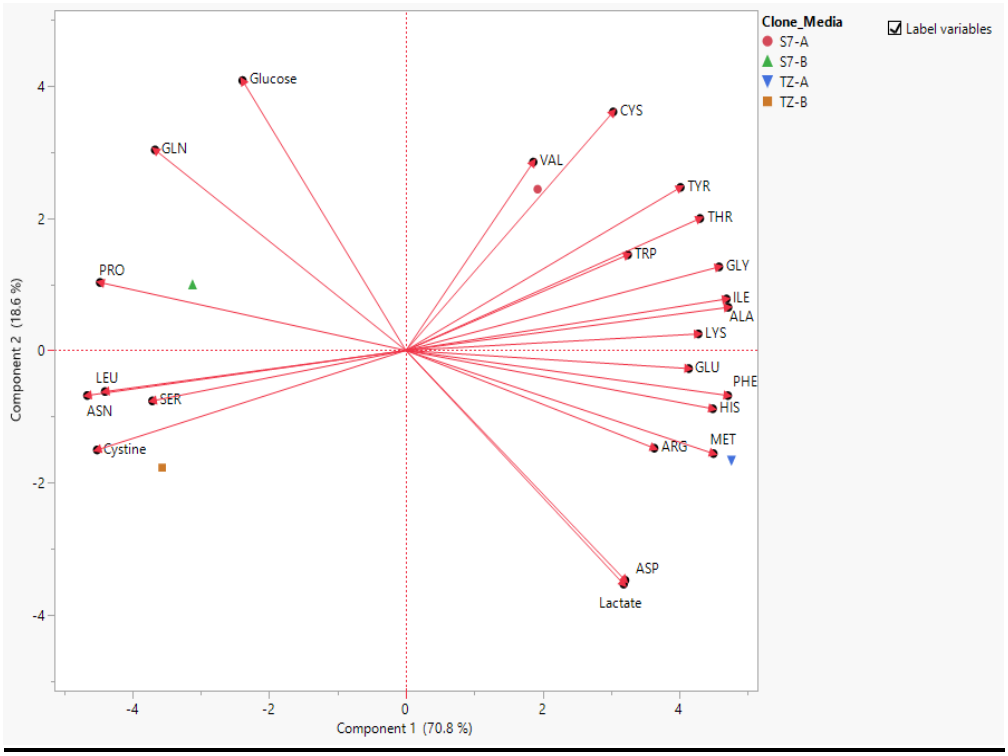


Figure 4.1 (D): PCA Biplot

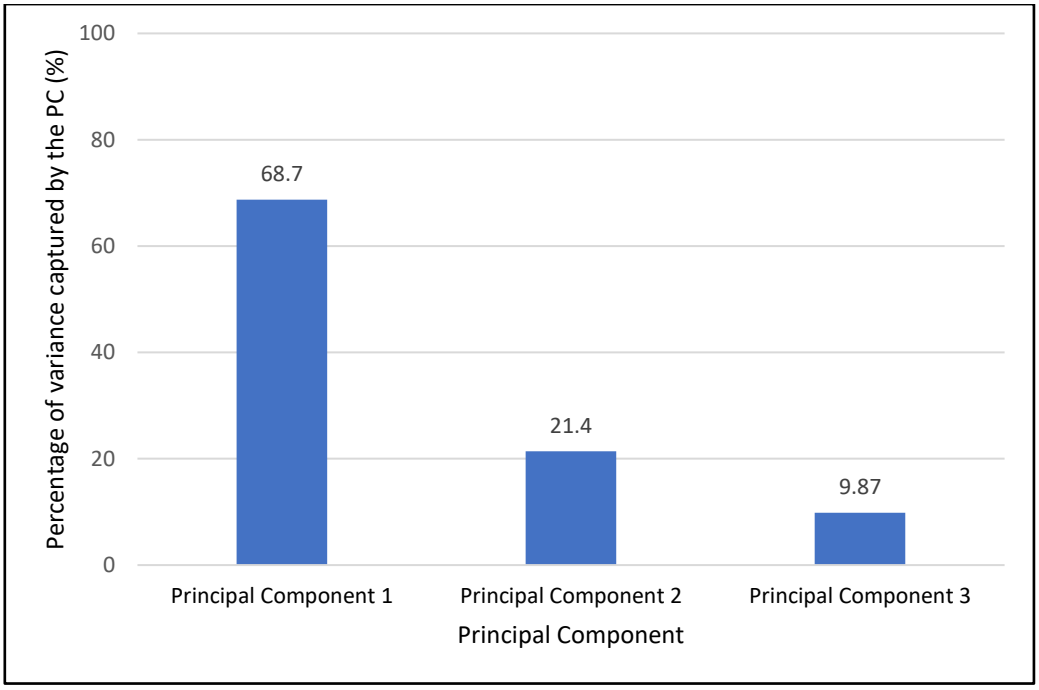
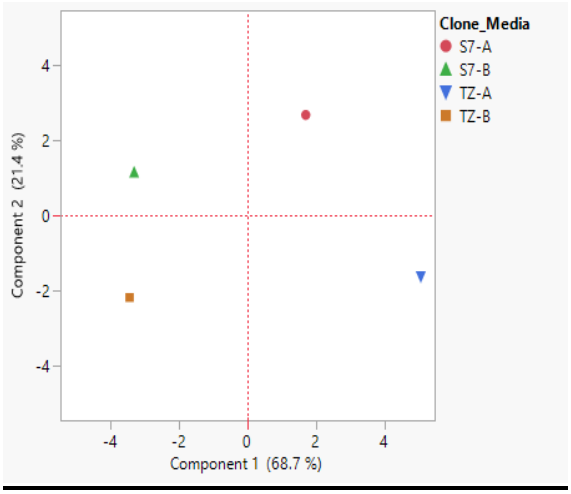
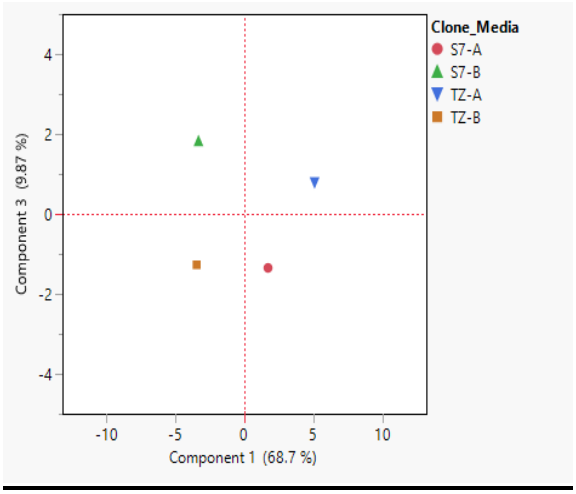


Figure 4.2 (A): % Variance captured by each Principal Component



i) PCA score plot of Component 1 vs Component 2



ii) PCA score plot of Component 1 vs Component 3

Figure 4.2 (B): PCA Score Plot

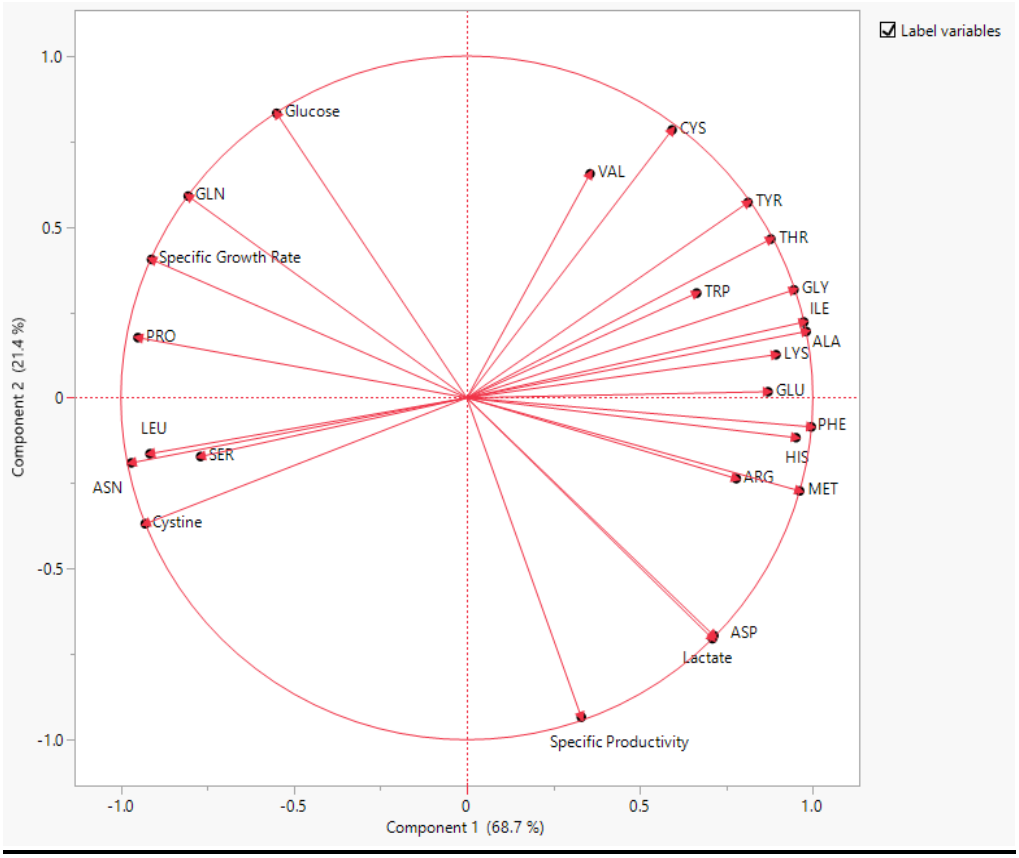


Figure 4.2 (C): PCA Loading Plot

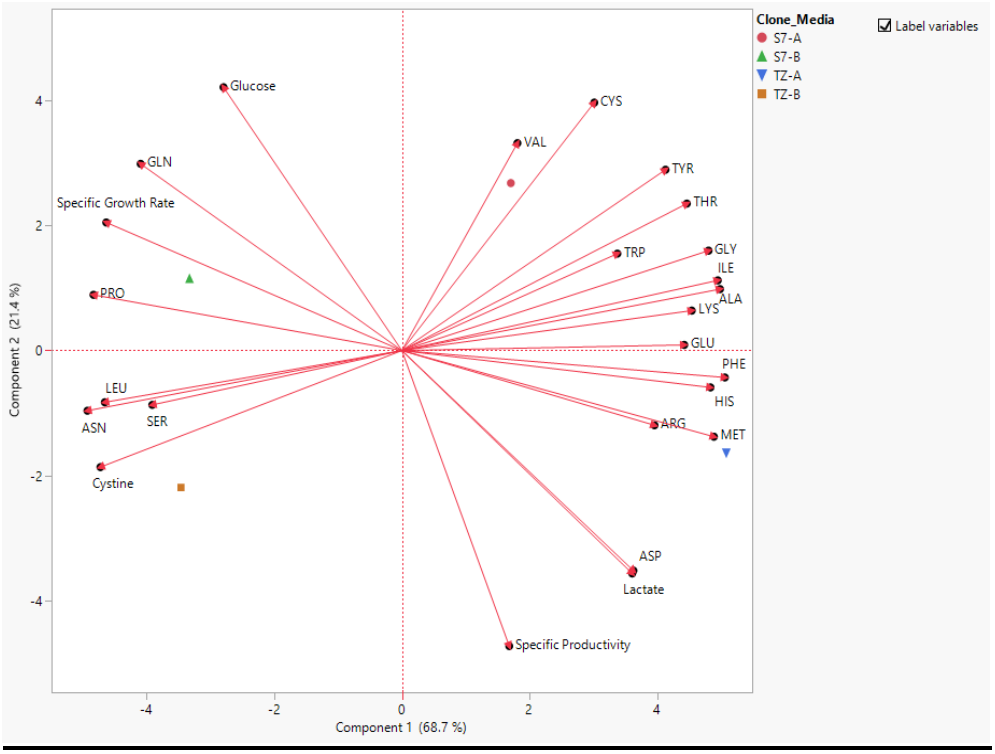


Figure 4.2 (D): PCA Biplot

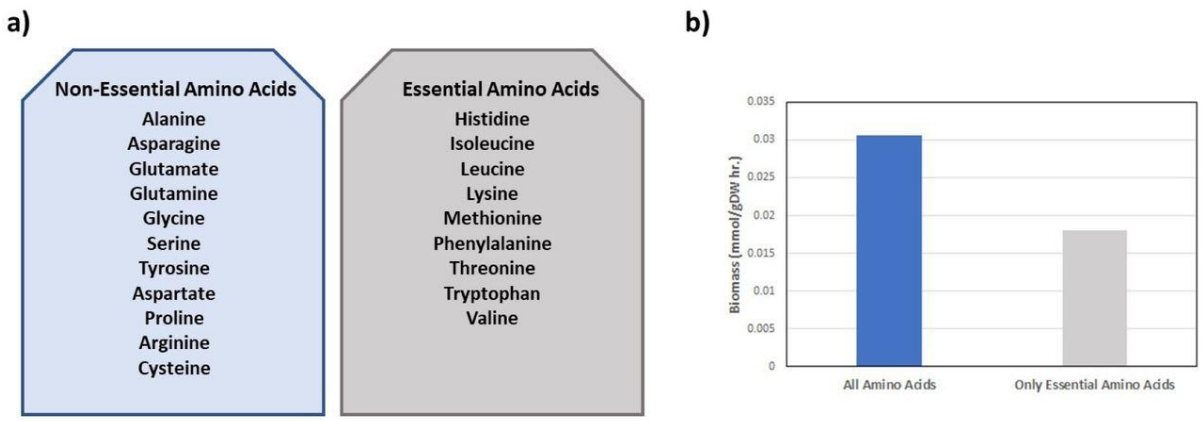


Figure 5: Essential Amino Acids in CHO cells

References:

1. https://www.biorxiv.org/content/10.1101/796490v1.full (Reference to Figure 5)