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APPENDICES

Appendix A Detection of glucose by HPLC before and after enzymatic hydrolysis

Table A1 Glucose detection before and after addition of cellulase from *Trichoderma reesei*

Treatment	Retention Time (min)	Peak Area	Concentration (g/l)	Dilution	Final Concentration (g/l)
Before Enzymatic Hydrolysis	9.384	7515270	10.640	1	10.640
	9.375	7995447	11.318	1	11.318
	9.322	7900162	11.184	1	11.184
After Enzymatic Hydrolysis	9.301	1737362	2.482	10	24.820
	9.297	1732013	2.474	10	24.744
	9.294	1600025	2.288	10	22.880

Appendix B Detection of glucose during overliming process

Table B1 Glucose detection on the effect of overliming

Treatment	Retention Time (min)	Peak Area	Concentration (g/l)	Dilution	Final Concentration (g/l)
Before Overliming	9.349	3768825	5.350	10	53.503
	9.337	3837945	5.448	10	54.479
	9.337	3884538	5.514	10	55.137
Overliming at pH 8	9.338	3731320	5.297	10	52.974
	9.337	3778663	5.364	10	53.642
	9.335	3735804	5.304	10	53.037
Overliming at pH 9	9.201	3759328	5.337	10	53.369
	9.196	3768825	5.350	10	53.503
	9.338	3731320	5.297	10	52.974
Overliming at pH 10	9.335	3146398	4.471	10	44.715
	9.301	3768825	5.350	10	53.503
	9.336	3587620	5.094	10	50.945
Overliming at pH 11	9.337	1711515	2.445	10	24.455
	9.335	1721463	2.460	10	24.595
	9.335	1768284	2.526	10	25.256
Overliming at pH 12	9.336	1312539	1.882	10	18.816
	9.337	1375336	1.970	10	19.702
	9.334	1349019	1.933	10	19.331

Appendix C Yeast population count at various overliming pH

Table C1 Yeast population count when overliming was done at pH 8

pH 8	Yeast count														
Hours	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch,2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	90	68	55	23	8	23	7	3	12	6	11	12	6	6	13
2	65	65	57	8	12	25	15	6	5	9	16	12	10	18	12
3	79	65	63	12	10	23	6	8	9	9	6	9	12	8	10
4	76	61	66	19	15	4	9	7	12	6	7	12	13	14	15
5	76	78	73	19	5	16	5	11	12	11	16	10	11	8	14
6	82	67	76	19	6	24	10	11	8	7	20	11	16	12	12
7	79	65	75	14	18	26	15	14	13	7	11	6	16	8	17
8	80	65	62	15	20	17	8	18	12	6	14	21	12	11	10
9	53	60	75	24	15	22	9	7	12	9	16	20	11	9	7
10	88	66	76	11	13	22	8	6	10	11	20	11	8	10	9
Average	**77**	**66**	**68**	**16**	**12**	**20**	**9**	**9**	**11**	**8**	**14**	**12**	**12**	**10**	**12**
Dilutions	1	1	1	10	10	10	20	20	20	20	20	20	20	20	20
CellxDilutions	77	66	68	164	122	202	184	182	210	162	274	248	230	208	238
x4 (x10^6)	307	264	271	656	488	808	736	728	840	648	1096	992	920	832	952
in x10^8	3.072	2.64	2.712	6.56	4.88	8.08	7.36	7.28	8.4	6.48	10.96	9.92	9.2	8.32	9.52
Average (in x10^8)	2.81			6.51			7.68			9.12			9.01		
Standard Dev	0.23			1.60			0.62			2.34			0.62		

pH 9	Yeast count														
Hours	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	50	59	36	7	17	13	5	3	21	7	8	18	10	17	21
2	53	78	40	7	24	8	12	6	18	18	8	11	11	9	6
3	50	95	49	13	22	11	12	5	19	9	5	8	16	15	14
4	50	69	61	9	23	6	12	6	26	17	6	19	19	9	8
5	46	84	48	11	14	6	16	13	9	9	10	10	7	7	14
6	41	74	52	18	23	16	8	4	12	14	16	8	5	16	9
7	44	98	51	6	10	8	20	10	15	11	11	12	12	11	12
8	44	76	55	8	15	2	15	8	10	16	17	11	12	7	11
9	51	87	43	9	22	7	20	7	10	22	16	15	21	20	26
10	46	84	54	7	31	9	8	11	18	10	11	13	13	8	17
Average	**48**	**80**	**49**	**10**	**20**	**9**	**13**	**7**	**16**	**13**	**11**	**13**	**13**	**12**	**14**
Dilutions	1	1	1	10	10	10	20	20	20	20	20	20	20	20	20
CellxDilutions	48	80	49	95	201	86	256	146	316	266	216	250	252	238	276
x4 (x10^6)	190	322	196	380	804	344	1024	584	1264	1064	864	1000	1008	952	1104
in x10^8	1.9	3.216	1.956	3.8	8.04	3.44	10.24	5.84	12.64	10.64	8.64	10	10.08	9.52	11.04
Average (in x10^8)	2.36			5.09			9.57			9.76			10.21		
Standard Dev	0.74			2.56			3.45			1.02			0.77		

pH 10	Yeast count														
Hours	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	108	82	52	25	32	30	20	15	10	21	22	27	17	21	11
2	101	75	68	31	36	41	12	16	17	16	11	14	15	18	22
3	96	79	50	33	26	31	20	16	7	22	14	11	21	18	14
4	77	82	82	34	33	22	18	14	27	14	29	21	14	10	24
5	101	81	64	40	37	34	14	19	8	10	11	27	28	23	15
6	88	117	90	31	34	28	15	12	18	22	26	20	11	15	23
7	96	89	59	45	30	40	18	19	13	13	24	19	24	12	6
8	87	73	53	36	39	40	11	24	14	19	20	25	28	17	13
9	93	73	74	25	41	41	19	16	20	17	9	16	34	18	21
10	108	84	72	38	33	34	11	22	17	11	13	27	19	7	26
Average	**96**	**84**	**66**	**34**	**34**	**34**	**16**	**17**	**15**	**17**	**18**	**21**	**21**	**16**	**18**
Dilutions	1	1	1	10	10	10	20	20	20	20	20	20	20	20	20
CellxDilutions	96	84	66	338	341	341	316	346	302	330	358	414	422	318	350
x4 (x10^6)	382	334	266	1352	1364	1364	1264	1384	1208	1320	1432	1656	1688	1272	1400
in x10^8	3.82	3.34	2.656	13.52	13.64	13.64	12.64	13.84	12.08	13.2	14.32	16.56	16.88	12.72	14.00
Average (in x10^8)	3.27			13.60			12.85			14.69			14.53		
Standard Dev	0.58			0.07			0.90			1.71			2.13		

pH 11	Yeast count														
Hours	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	77	108	56	28	20	21	19	15	12	6	20	5	10	12	5
2	84	107	48	30	34	12	17	22	11	12	27	12	13	15	8
3	127	87	45	31	29	17	15	20	6	19	18	10	12	18	10
4	87	99	49	24	29	12	15	20	5	11	14	9	16	14	12
5	95	120	46	29	28	20	6	12	10	11	21	12	19	18	8
6	103	119	59	33	26	17	22	18	7	14	18	10	10	15	15
7	87	109	50	22	31	10	7	18	7	14	13	4	16	23	11
8	111	89	34	39	34	11	7	8	5	14	15	5	20	12	8
9	85	115	46	25	34	17	19	15	3	18	9	14	15	19	8
10	104	89	48	23	25	10	17	14	5	20	14	9	15	24	17
Average	**96**	**104**	**48**	**28**	**29**	**15**	**14**	**16**	**7**	**14**	**17**	**9**	**15**	**17**	**10**
Dilutions	1	1	1	10	10	10	20	20	20	20	20	20	20	20	20
CellxDilutions	96	104	48	284	290	147	288	324	142	278	338	180	292	340	204
x4 (x10^6)	384	417	192	1136	1160	588	1152	1296	568	1112	1352	720	1168	1360	816
in x10^8	3.84	4.168	1.924	11.36	11.6	5.88	11.52	12.96	5.68	11.12	13.52	7.2	11.68	13.6	8.16
Average (in x10^8)	3.31			9.61			10.05			10.61			11.15		
Standard Dev	1.21			3.24			3.86			3.19			2.76		

pH 12	Yeast count														
Hours	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	43	114	38	11	37	18	4	22	8	3	14	6	9	13	9
2	52	111	39	11	48	12	4	23	6	4	18	3	7	25	5
3	63	89	44	13	37	12	6	16	5	7	24	7	5	18	5
4	49	127	50	15	28	11	8	25	2	4	30	2	8	19	3
5	43	104	40	5	35	13	0	19	6	5	28	10	8	26	2
6	48	112	48	12	43	13	5	26	4	6	23	8	4	31	8
7	41	112	43	12	31	9	9	39	8	8	17	7	3	19	8
8	58	107	43	9	40	13	4	25	6	7	14	7	8	20	5
9	59	101	38	18	40	10	9	16	7	5	15	2	10	20	4
10	55	107	39	5	40	14	11	12	4	6	21	5	7	27	12
Average	**51**	**108**	**42**	**11**	**38**	**13**	**6**	**22**	**6**	**6**	**20**	**6**	**7**	**22**	**6**
Dilutions	1	1	1	10	10	10	20	20	20	20	20	20	20	20	20
CellxDilutions	51	108	42	111	379	125	120	446	112	110	408	114	138	436	122
x4 ($x10^6$)	204	434	169	444	1516	500	480	1784	448	440	1632	456	552	1744	488
in $x10^8$	2.044	4.336	1.688	4.44	15.16	5	4.8	17.84	4.48	4.4	16.32	4.56	5.52	17.44	4.88
Average (in $x10^8$)	2.69			8.20			9.04			8.43			9.28		
Standard Dev	1.44			6.03			7.62			6.84			7.07		

Appendix D Detection of glucose when mission grass hydrolyzate was overliming at various pH

Table D1 Glucose detection when overliming was performed at pH 8

Sample	Time (h)	Glucose				
		Retention time (min)	Peak area	Concentration (g/l)	Dilution	Final Concentration (g/l)
TISTR 5049 pH 8 Batch 1	0	9.23	3768825	5.350	10	53.503
	24	9.251	18514546	26.171	1	26.171
	48	9.229	1047445	1.508	1	1.508
	72	9.204	567246	0.830	1	0.830
	96	8.96	486157	0.715	1	0.715
TISTR 5049 pH 8 Batch 2	0	9.227	3768825	5.350	10	53.503
	24	9.241	19316557	27.303	1	27.303
	48	9.232	1199550	1.723	1	1.723
	72	9.205	551885	0.808	1	0.808
	96	8.946	714407	1.038	1	1.038
TISTR 5049 pH 8 Batch 3	0	9.211	3768825	5.350	10	53.503
	24	9.248	16615130	23.489	1	23.489
	48	9.227	752437	1.091	1	1.091
	72	9.201	538263	0.789	1	0.789
	96	8.968	596524	0.871	1	0.871

Table D2 Glucose detection when overliming was performed at pH 9

Sample	Time (h)	Glucose				
		Retention time (min)	Peak area	Concentration (g/l)	Dilution	Final Concentration (g/l)
TISTR 5049 pH 9 Batch 1	0	9.201	3759328	5.337	10	53.369
	24	9.235	26285211	37.143	1	37.143
	48	9.231	575399	0.841	1	0.841
	72	9.212	567656	0.830	1	0.830
	96	8.775	452373	0.668	1	0.668
TISTR 5049 pH 9 Batch 2	0	9.196	3768825	5.350	10	53.503
	24	9.232	14956735	21.147	1	21.147
	48	9.226	1781429	2.544	1	2.544
	72	9.217	747502	1.084	1	1.084
	96	8.858	758860	1.100	1	1.100
TISTR 5049 pH 9 Batch 3	0	9.237	3759328	5.337	10	53.369
	24	9.237	26066123	36.833	1	36.833
	48	9.229	557584	0.816	1	0.816
	72	9.226	645756	0.941	1	0.941
	96	8.875	398959	0.592	1	0.592

Table D3 Glucose detection when overliming was performed at pH 10

Sample	Time (h)	Glucose				
		Retention time (min)	Peak area	Concentration (g/l)	Dilution	Final Concentration (g/l)
TISTR 5049 pH 10 Batch 1	0	9.31	3768825	5.350	10	53.503
	24	9.207	1248720	1.792	1	1.792
	48	9.175	1130918	1.626	1	1.626
	72	9.37	798178	1.156	1	1.156
	96	9.3	549736	0.805	1	0.805
TISTR 5049 pH 10 Batch 2	0	9.301	3768825	5.350	10	53.503
	24	9.285	898218	1.297	1	1.297
	48	9.175	858249	1.241	1	1.241
	72	9.419	663874	0.966	1	0.966
	96	9.242	535832	0.785	1	0.785
TISTR 5049 pH 10 Batch 3	0	9.292	4217224	5.983	10	59.834
	24	9.285	9955982	14.086	1	14.086
	48	9.175	493151	0.725	1	0.725
	72	9.435	609839	0.890	1	0.890
	96	9.333	521627	0.765	1	0.765

Table D4 Glucose detection when overliming was performed at pH 11

Sample	Time (h)	Glucose				
		Retention time (min)	Peak area	Concentration (g/l)	Dilution	Final Concentration (g/l)
TISTR 5049 pH 11 Batch 1	0	9.231	3768825	5.350	10	53.503
	24	9.165	2495717	3.553	1	3.553
	48	9.138	2392666	3.407	1	3.407
	72	9.134	2921332	4.154	1	4.154
	96	9.12	2414018	3.437	1	3.437
TISTR 5049 pH 11 Batch 2	0	9.234	3768825	5.350	10	53.503
	24	9.167	2459784	3.502	1	3.502
	48	9.134	2365294	3.369	1	3.369
	72	9.132	2642458	3.760	1	3.760
	96	9.122	2465494	3.510	1	3.510
TISTR 5049 pH 11 Batch 3	0	9.236	3759328	5.337	10	53.369
	24	9.168	4216060	5.982	1	5.982
	48	9.139	1502613	2.151	1	2.151
	72	9.135	1780484	2.543	1	2.543
	96	9.124	1831437	2.615	1	2.615

Table D5 Glucose detection when overliming was performed at pH 12

Sample	Time (h)	Glucose				
		Retention time (min)	Peak area	Concentration (g/l)	Dilution	Final concentration (g/l)
TISTR 5049 pH 12 Batch 1	0	9.319	3759328	5.337	10	53.369
	24	9.535	2980960	4.238	1	4.238
	48	9.489	2510875	3.574	1	3.574
	72	9.417	2846624	4.667	1	4.667
	96	9.584	3285064	0.029	1	0.029
TISTR 5049 pH 12 Batch 2	0	9.312	3768825	5.350	10	53.503
	24	9.53	3612045	5.129	1	5.129
	48	9.472	3298503	4.686	1	4.686
	72	9.367	3771837	5.355	1	5.355
	96	9.582	3269665	4.646	1	4.646
TISTR 5049 pH 12 Batch 3	0	9.307	3759328	5.337	10	53.369
	24	9.532	3488497	4.954	1	4.954
	48	9.473	2408878	3.430	1	3.430
	72	9.4	2730264	3.884	1	3.884
	96	9.582	3093442	4.397	1	4.397

Appendix E Detection of ethanol when mission grass hydrolyzate was overliming at various pH

Table E1 Ethanol detection when overliming was performed at pH 8

Sample	time (h)	Ethanol				
		Retention time (min)	Area %	Injection Vol. (µl)	EtOH vol. per injection (µl)	Ethanol (g/l)
pH 8	0	0	0	0.5	0	0
Batch 1	24	8.689	0.60311	0.5	0.00603	6.03
	48	8.591	1.21087	0.5	0.01211	12.11
	72	8.591	0.84152	0.5	0.00842	8.42
	96	8.592	1.05856	0.5	0.01059	10.59
pH 8	0	0	0	0.5	0	0
Batch 2	24	8.69	0.63574	0.5	0.00636	6.36
	48	8.692	1.26305	0.5	0.01263	12.63
	72	8.628	0.89061	0.5	0.00891	8.91
	96	8.618	0.94291	0.5	0.00943	9.43
pH 8	0	0	0	0.5	0	0
Batch 3	24	8.681	0.60765	0.5	0.00608	6.08
	48	8.58	1.19862	0.5	0.01199	11.99
	72	8.568	0.84999	0.5	0.00850	8.50
	96	8.595	1.06355	0.5	0.01064	10.64

Table E2 Ethanol detection when overliming was performed at pH 9

Sample	time (h)	Ethanol				
		Retention time (min)	Area %	Injection Vol. (μl)	EtOH vol. per injection (μl)	Ethanol (g/l)
pH 9 Batch 1	0	0	0	0.5	0	0
	24	8.628	0.13806	0.5	0.00138	1.38
	48	8.686	1.30381	0.5	0.01304	13.04
	72	8.62	0.88638	0.5	0.00886	8.86
	96	8.589	0.60412	0.5	0.00604	6.04
pH 9 Batch 2	0	0	0	0.5	0	0
	24	8.684	0.18758	0.5	0.00188	1.88
	48	8.712	1.28629	0.5	0.01286	12.86
	72	8.62	0.90762	0.5	0.00908	9.08
	96	8.604	0.63553	0.5	0.00636	6.36
pH 9 Batch 3	0	0	0	0.5	0	0
	24	8.658	0.20218	0.5	0.00202	2.02
	48	8.712	1.30551	0.5	0.01306	13.06
	72	8.616	1.01981	0.5	0.01020	10.20
	96	8.598	0.62167	0.5	0.00622	6.22

Table E3 Ethanol detection when overliming was performed at pH 10

Sample	time (h)	Ethanol				
		Retention time	Area %	Injection Vol. (uL)	EtOH vol. per injection (uL)	Ethanol (g/L)
pH 10 Batch 1	0	0	0	0.5	0	0
	24	8.428	1.35645	0.5	0.01356	13.56
	48	8.591	1.52299	0.5	0.01523	15.23
	72	8.499	0.76682	0.5	0.00767	7.67
	96	8.514	0.56217	0.5	0.00562	5.62
pH 10 Batch 2	0	0	0	0.5	0	0
	24	8.514	1.35878	0.5	0.01359	13.59
	48	8.602	1.54422	0.5	0.01544	15.44
	72	8.516	0.77966	0.5	0.00780	7.80
	96	8.549	0.61782	0.5	0.00618	6.18
pH 10 Batch 3	0	0	0	0.5	0	0
	24	8.54	1.43527	0.5	0.01435	14.35
	48	8.633	1.69619	0.5	0.01696	16.96
	72	8.532	1.0802	0.5	0.01080	10.80
	96	8.549	0.74627	0.5	0.00746	7.46

Table E4 Ethanol detection when overliming was performed at pH 11

Sample	time (h)	Ethanol				
		Retention time	Area %	Injection Vol. (uL)	EtOH vol. per injection (uL)	Ethanol (g/L)
pH 11 Batch 1	0	0	0	0.5	0	0
	24	8.593	0.75246	0.5	0.00752	7.52
	48	8.528	0.9086	0.5	0.00909	9.09
	72	8.535	0.27869	0.5	0.00279	2.79
	96	8.543	0.29663	0.5	0.00297	2.97
pH 11 Batch 2	0	0	0	0.5	0	0
	24	8.674	0.73723	0.5	0.00737	7.37
	48	8.544	0.80211	0.5	0.00802	8.02
	72	8.534	0.33066	0.5	0.00331	3.31
	96	8.545	0.08503	0.5	0.00085	0.85
pH 11 Batch 3	0	0	0	0.5	0	0
	24	8.696	0.67346	0.5	0.00673	6.73
	48	8.715	0.54435	0.5	0.00544	5.44
	72	8.503	0.16789	0.5	0.00168	1.68
	96	8.615	0.18619	0.5	0.00186	1.86

Table E5 Ethanol detection when overliming was performed at pH 12

Sample	time (h)	Ethanol				
		Retention time	Area %	Injection Vol. (uL)	EtOH vol. per injection (uL)	Ethanol (g/L)
pH 12 Batch 1	0	0	0	0.5	0	0
	24	8.54	0.38369	0.5	0.00384	3.84
	48	8.436	0.32678	0.5	0.00327	3.27
	72	8.518	0.31511	0.5	0.00315	3.15
	96	8.595	0.20343	0.5	0.00203	2.03
pH 12 Batch 2	0	0	0	0.5	0	0
	24	8.611	0.53175	0.5	0.00532	5.32
	48	8.432	0.51365	0.5	0.00514	5.14
	72	8.495	0.29555	0.5	0.00296	2.96
	96	8.518	0.13109	0.5	0.00131	1.31
pH 12 Batch 3	0	0	0	0.5	0	0
	24	8.594	0.23916	0.5	0.00239	2.39
	48	8.449	0.44542	0.5	0.00445	4.45
	72	8.508	0.40756	0.5	0.00408	4.08
	96	8.561	0.34622	0.5	0.00346	3.46

Appendix F Yeast population count at various yeast strains (*Saccharomyces cerevisiae*)

Table F1 *Saccharomyces cerevisiae* TISTR 5049 population count

TISTR	Yeast count														
5049	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	51	50	41	32	30	42	18	24	8	19	20	16	18	17	15
2	59	46	57	23	59	33	26	26	23	13	12	20	21	20	21
3	55	58	40	32	43	33	24	14	13	29	26	21	17	18	12
4	55	57	55	34	30	27	31	27	19	30	21	19	30	22	21
5	46	61	56	45	35	31	15	14	17	18	11	22	27	8	22
6	56	47	52	45	32	41	18	18	11	14	31	19	11	20	22
7	67	54	60	30	25	40	24	25	19	23	24	22	21	27	19
8	52	59	46	37	48	27	12	28	20	29	17	32	27	23	24
9	50	40	61	44	26	30	19	18	23	36	19	20	25	11	19
10	56	55	65	36	27	36	24	14	18	17	20	23	29	19	17
Average	55	53	53	36	36	34	21	21	17	23	20	21	23	19	19
Dilutions	1	1	1	10	10	10	20	20	20	20	20	20	20	20	20
CellxDilutions	55	53	53	358	355	340	422	416	342	456	402	428	452	370	384
x4 (x10^6)	219	211	213	1432	1420	1360	1688	1664	1368	1824	1608	1712	1808	1480	1536
in x10^8	2.188	2.108	2.132	14.32	14.2	13.6	16.88	16.64	13.68	18.24	16.08	17.12	18.08	14.8	15.36
Average (in x10^8)	2.14			14.04			15.73			17.15			16.08		
Standard Dev	0.04			0.39			1.78			1.08			1.75		

Table F2 *Saccharomyces cerevisiae* TISTR 5339 population count

TISTR	Yeast count														
5339	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	59	33	22	19	25	4	15	10	14	14	14	8	13	4	8
2	62	36	29	13	23	32	17	31	3	8	14	1	10	9	9
3	51	33	54	21	27	21	9	31	12	6	6	6	15	6	11
4	60	50	58	22	34	16	17	10	19	9	12	6	4	19	13
5	50	54	43	46	20	23	10	6	9	10	15	9	19	6	8
6	50	60	66	48	18	47	18	21	13	5	2	9	12	15	12
7	47	63	55	20	40	40	7	20	15	4	11	2	14	5	21
8	46	52	33	22	44	21	8	8	25	2	2	8	26	6	34
9	71	82	51	30	26	41	16	24	25	7	20	15	15	11	18
10	46	60	62	24	15	12	17	10	21	10	7	19	19	18	15
Average	54	52	47	27	27	26	13	17	16	8	10	8	15	10	15
Dilutions	1	1	1	10	10	10	10	10	10	20	20	20	20	20	20
CellxDilutions	54	52	47	265	272	257	134	171	156	150	206	166	294	198	298
x4 (x10^6)	217	209	189	1060	1088	1028	536	684	624	600	824	664	1176	792	1192
in x10^8	2.168	2.092	1.892	10.6	10.88	10.28	5.36	6.84	6.24	6	8.24	6.64	11.76	7.92	11.92
Average (in x10^8)	2.05			10.59			6.15			6.96			10.53		
Standard Dev	0.14			0.30			0.74			1.15			2.26		

Table F3 *Saccharomyces cerevisiae* TISTR 5596 population count

TISTR	Yeast count														
5596	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	44	16	22	23	29	27	22	17	28	15	11	16	12	17	9
2	53	22	22	28	35	35	22	24	18	11	18	20	15	8	19
3	51	40	38	37	38	23	18	21	22	12	4	19	16	12	11
4	53	31	32	19	25	22	20	18	28	8	13	5	14	20	15
5	53	54	36	27	22	14	17	31	29	23	5	11	18	18	10
6	41	53	50	29	33	17	25	26	18	12	20	26	12	14	16
7	49	50	41	23	22	17	21	19	27	9	13	27	19	14	17
8	64	37	42	21	19	25	13	23	31	19	15	17	15	14	12
9	75	50	44	38	25	21	18	15	26	16	15	11	18	14	18
10	42	53	49	22	23	19	24	23	24	15	19	24	10	18	20
Average	53	41	38	27	27	22	20	22	25	14	13	18	15	15	15
Dilutions	1	1	1	10	10	10	10	10	10	20	20	20	20	20	20
CellxDilutions	53	41	38	267	271	220	200	217	251	280	266	352	298	298	294
x4 (x10^6)	210	162	150	1068	1084	880	800	868	1004	1120	1064	1408	1192	1192	1176
in x10^8	2.1	1.624	1.504	10.68	10.84	8.8	8	8.68	10.04	11.2	10.64	14.08	11.92	11.92	11.76
Average (in x10^8)	1.74			10.11			8.91			11.97			11.87		
Standard Dev	0.32			1.13			1.04			1.85			0.09		

Table F4 *Saccharomyces cerevisiae* TISTR 5606 population count

TISTR	Yeast count														
5606	0			24			48			72			96		
	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3	batch 1	batch 2	batch 3
1	24	14	14	5	9	11	4	9	4	3	1	13	3	10	1
2		16	18	4	3	10	14	13	6	6	1	1	6	13	3
3	13	91	15	1	2	1	9	7	5	1	2	1	4	4	8
4		28	14	6	39	14	3	8	4	1	1	1	3	7	8
5	19	6	6	15	11	6	5	19	7	1	0	1	5	3	1
6	14	8	10	24	1	11	7	6	7	3	1	10	4	2	2
7	61	46	13	5	1	1	14	22	6	0	3	2	3	5	1
8	30	47	15	1	4	24	4	10	5	10	9	9	1	1	3
9	12	20	13	4	8	1	8	3	3	5	0	1	3	2	2
10		31	13	1	49	48	4	12	8	5	2	3	1	3	2
Average	**25**	**31**	**13**	**7**	**13**	**13**	**7**	**11**	**6**	**4**	**2**	**4**	**3**	**5**	**3**
Dilutions	1	1	1	10	10	10	10	10	10	10	10	10	10	10	10
CellxDilutions	25	31	13	66	127	127	72	109	55	35	20	42	33	50	31
x4 ($x10^6$)	99	123	52	264	508	508	288	436	220	140	80	168	132	200	124
m $x10^8$	0.988571	1.228	0.524	2.64	5.08	5.08	2.88	4.36	2.2	1.4	0.8	1.68	1.32	2	1.24
Average (m $x10^8$)	0.91			4.27			3.15			1.29			1.52		
Standard Dev	0.36			1.41			1.10			0.45			0.42		

Appendix G Detection of glucose consumption by each strain of *S. cerevisiae*

Table G1 Detection of glucose consumption by *S. cerevisiae TISTR 5049*

Sample	Time (h)	Glucose				
		Retention Time	Peak Area	Concentration	Dilution	Final Concentration
TISTR 5049 Batch 1	0	9.23	3205534	4.555	10	45.550
	24	9.251	435429	0.644	1	0.644
	48	9.229	412161	0.611	1	0.611
	72	9.204	417333	0.618	1	0.618
	96	8.96	294217	0.444	1	0.444
TISTR 5049 Batch 2	0	9.23	3205534	4.555	10	45.550
	24	9.251	641693	0.935	1	0.935
	48	9.229	341615	0.511	1	0.511
	72	9.204	371641	0.554	1	0.554
	96	8.96	324828	0.488	1	0.488
TISTR 5049 Batch 3	0	9.23	3205534	4.555	10	45.550
	24	9.251	1247469	1.790	1	1.790
	48	9.229	399155	0.592	1	0.592
	72	9.204	388550	0.577	1	0.577
	96	8.96	384569	0.572	1	0.572

Table G2 Detection of glucose consumption by *S. cerevisiae TISTR 5339*

Sample	Time (h)	Glucose				
		Retention Time	Peak Area	Concentration	Dilution	Final Concentration
TISTR 5339 Batch 1	0	9.23	3269490	4.645	10	46.453
	24	9.251	6630046	9.390	1	9.390
	48	9.229	747628	1.084	1	1.084
	72	9.204	842511	1.218	1	1.218
	96	8.96	533865	0.783	1	0.783
TISTR 5339 Batch 2	0	9.23	3269490	4.645	10	46.453
	24	9.251	8668748	12.269	1	12.269
	48	9.229	698767	1.016	1	1.016
	72	9.204	901253	1.301	1	1.301
	96	8.96	553987	0.811	1	0.811
TISTR 5339 Batch 3	0	9.23	3269490	4.645	10	46.453
	24	9.251	6855403	9.708	1	9.708
	48	9.229	840014	1.215	1	1.215
	72	9.204	817867	1.184	1	1.184
	96	8.96	479560	0.706	1	0.706

Table G3 Detection of glucose consumption by *S. cerevisiae TISTR 5596*

Sample	Time (h)	Glucose				
		Retention Time	Peak Area	Concentration	Dilution	Final Concentration
TISTR 5596 Batch 1	0	9.23	3269490	4.645	10	46.453
	24	9.251	836269	1.210	1	1.210
	48	9.229	707964	1.028	1	1.028
	72	9.204	647212	0.943	1	0.943
	96	8.96	478326	0.704	1	0.704
TISTR 5596 Batch 2	0	9.23	3269490	4.645	10	46.453
	24	9.251	835635	1.209	1	1.209
	48	9.229	696973	1.013	1	1.013
	72	9.204	671547	0.977	1	0.977
	96	8.96	449695	0.664	1	0.664
TISTR 5596 Batch 3	0	9.23	3269490	4.645	10	46.453
	24	9.251	759724	1.102	1	1.102
	48	9.229	712158	1.034	1	1.034
	72	9.204	679459	0.988	1	0.988
	96	8.96	573534	0.839	1	0.839

Table G4 Detection of glucose consumption by *S. cerevisiae TISTR 5606*

Sample	Time (h)	Glucose				
		Retention Time	Peak Area	Concentration	Dilution	Final Concentration
TISTR 5606 Batch 1	0	9.23	3269490	4.645	10	46.453
	24	9.251	11492480	16.256	1	16.256
	48	9.229	2355683	3.355	1	3.355
	72	9.204	521132	0.765	1	0.765
	96	8.96	490532	0.721	1	0.721
TISTR 5606 Batch 2	0	9.23	3269490	4.645	10	46.453
	24	9.251	7067606	10.008	1	10.008
	48	9.229	1247722	1.791	1	1.791
	72	9.204	588568	0.860	1	0.860
	96	8.96	487633	0.717	1	0.717
TISTR 5606 Batch 3	0	9.23	3269490	4.645	10	46.453
	24	9.251	9299381	13.159	1	13.159
	48	9.229	1558854	2.230	1	2.230
	72	9.204	506779	0.744	1	0.744
	96	8.96	492704	0.725	1	0.725

Appendix H Detection of ethanol produced by various strains of *Saccharomyces cerevisiae*

Table H1 Ethanol production by *S. cerevisiae* TISTR 5049

Sample	Time (h)	Ethanol				
		Retention time	Area %	Injection Vol. (uL)	EtOH vol. per injection (uL)	Ethanol (g/L)
TISTR 5049 Batch 1	0	0	0	0.5	0	0
	24	8.428	0.76370	0.5	0.00764	7.64
	48	8.591	0.16548	0.5	0.00165	1.65
	72	8.499	0.13888	0.5	0.00139	1.39
	96	8.514	0	0.5	0	0
TISTR 5049 Batch 2	0	0	0	0.5	0	0
	24	8.514	0.92656	0.5	0.00927	9.27
	48	8.602	0.66982	0.5	0.00670	6.70
	72	8.516	0.66635	0.5	0.00666	6.66
	96	8.549	0.58794	0.5	0.00588	5.88
TISTR 5049 Batch 3	0	0	0	0.5	0	0
	24	8.54	0.95927	0.5	0.00959	9.59
	48	8.633	0.60346	0.5	0.00603	6.03
	72	8.532	0.64419	0.5	0.00644	6.44
	96	8.549	0.58991	0.5	0.00590	5.90

Table H2 Ethanol production by *S. cerevisiae* TISTR 5339

Sample	Time (h)	Ethanol				
		Retention time	Area %	Injection Vol. (uL)	EtOH vol. per injection (uL)	Ethanol (g/L)
TISTR 5339 Batch 1	0	0	0	0.5	0	0
	24	8.428	0.86328	0.5	0.00863	8.63
	48	8.591	1.29895	0.5	0.01299	12.99
	72	8.499	1.06711	0.5	0.01067	10.67
	96	8.514	0.93369	0.5	0.00934	9.34
TISTR 5339 Batch 2	0	0	0	0.5	0	0
	24	8.514	0.79230	0.5	0.00792	7.92
	48	8.602	1.38807	0.5	0.01388	13.88
	72	8.516	1.05203	0.5	0.01052	10.52
	96	8.549	0.81309	0.5	0.00813	8.13
TISTR 5339 Batch 3	0	0	0	0.5	0	0
	24	8.54	0.89408	0.5	0.00894	8.94
	48	8.633	1.21788	0.5	0.01218	12.18
	72	8.532	1.04838	0.5	0.01048	10.48
	96	8.549	0.99587	0.5	0.00996	9.96

Table H3 Ethanol production by *S. cerevisiae* TISTR 5596

Sample	Time (h)	Ethanol				
		Retention time	Area %	Injection Vol. (uL)	EtOH vol. per injection (uL)	Ethanol (g/L)
TISTR 5596 Batch 1	0	0	0	0.5	0	0
	24	8.428	1.62582	0.5	0.01626	16.26
	48	8.591	1.48052	0.5	0.01481	14.81
	72	8.602	1.08455	0.5	0.01085	10.85
	96	8.591	1.01780	0.5	0.01018	10.18
TISTR 5596 Batch 2	0	0	0	0.5	0	0
	24	8.514	1.61266	0.5	0.01613	16.13
	48	8.602	1.37180	0.5	0.01372	13.72
	72	8.591	1.11749	0.5	0.01117	11.17
	96	8.602	1.11092	0.5	0.01111	11.11
TISTR 5596 Batch 3	0	0	0	0.5	0	0
	24	8.54	1.62344	0.5	0.01623	16.23
	48	8.633	1.46290	0.5	0.01463	14.63
	72	8.602	1.05845	0.5	0.01058	10.58
	96	8.591	1.11061	0.5	0.01111	11.11

Table H4 Ethanol production by *S. cerevisiae* TISTR 5606

Sample	Time (h)	Ethanol				
		Retention time	Area %	Injection Vol. (uL)	EtOH vol. per injection (uL)	Ethanol (g/L)
TISTR 5606 Batch 1	0	0	0	0.5	0	0
	24	8.428	0.74095	0.5	0.00741	7.41
	48	8.591	1.24664	0.5	0.01247	12.47
	72	8.602	1.16947	0.5	0.01169	11.69
	96	8.591	0.97110	0.5	0.00971	9.71
TISTR 5606 Batch 2	0	0	0	0.5	0	0
	24	8.514	1.03378	0.5	0.01034	10.34
	48	8.602	1.36972	0.5	0.01370	13.70
	72	8.591	1.17366	0.5	0.01174	11.74
	96	8.602	1.20306	0.5	0.01203	12.03
TISTR 5606 Batch 3	0	0	0	0.5	0	0
	24	8.54	0.91620	0.5	0.00916	9.16
	48	8.633	1.24326	0.5	0.01243	12.43
	72	8.602	1.15735	0.5	0.01157	11.57
	96	8.591	1.14028	0.5	0.01140	11.40

CURRICULUM VITAE

Name: Ms. Darin Khumsupan

Date of Birth: January 1, 1989

Nationality: Thai

University Education:

2007–2011 Bachelor Degree of Biochemistry, Department of Chemistry and Biochemistry, California State University Long Beach, Long Beach, CA, U.S.A.

Work Experience:

2009 – 2011	Position:	Student researcher
	Company name:	California State University Long Beach
2010	Position:	Intern
	Company name:	NHK Laboratory Inc.
2011 – Present	Position:	English and general science tutor
	Company name:	Krutoo International Homeschool

Publications:

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2. Khumsupan, D.; Narayanaswami, V., (2010) Reconsituted High Density Lipoprotein: a Nanovehicle to Transport and Delivery of the Antioxidant Piperine. Poster presentation at Annual Student Research Symposium, California State University Long Beach 2010, Long Beach, CA, U.S.A.
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