

APPENDICES

APPENDIX A

STANDARD CURVE FOR SUGAR ANALYSIS

Table 1 Standard Curve Data for Sucrose, Fructose, and Glucose in Sugar Analysis for BC Production with Various Teas and Additives.

Sugar (g/L)	Peak Area		
	Sucrose	Glucose	Fructose
0	0	0	0
3	136,661	235,880	192,231
6	262,110	488,085	394,293
9	409,466	713,853	580,040
12	547,536	950,286	771,482
RL Equation	$y=45596x - 24208$	$y = 79285x + 1911.8$	$y = 64359x + 1454.6$
R ²	0.9994	0.9998	0.9998

Remark: Retention times (minutes) of spectra peaks for Sucrose (± 14.94), Glucose (± 16.14), and Fructose (± 17.89), and Glycerol (± 18.70)

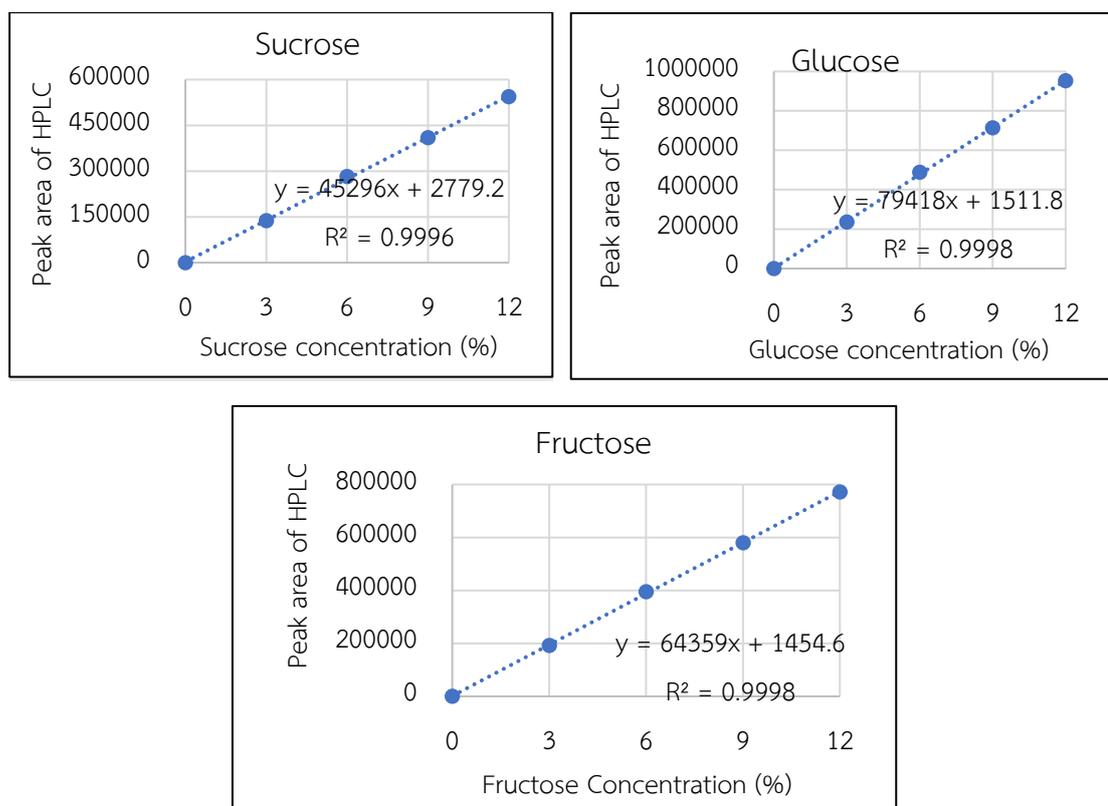


Figure 1. Standard Curve for Sugar Analysis of Kombucha Samples with Various Types of Tea and Additives.

Table 2 Standard Curve Data for Sucrose, Fructose, Glucose, and Glycerol in Sugar Analysis for BC Production with Various Carbon Sources Combinations.

Sugar (g/L)	Peak Area			Glycerol (g/L)	Peak Area
	Sucrose	Glucose	Fructose		
0	0	0	0	0	0
3	136,661	235,880	192,231	2.5	117,356
6	262,110	488,085	394,293	5.0	239,595
9	409,466	713,853	580,040	7.5	352,241
12	547,536	950,286	771,482	10.0	470,883
RL Equation	$y = 45596x - 24208$	$y = 79285x + 1911.8$	$y = 64359x + 1454.6$	RL Equation	$y = 47066x + 684.8$
R^2	0.9994	0.9998	0.9998	R^2	0.9999

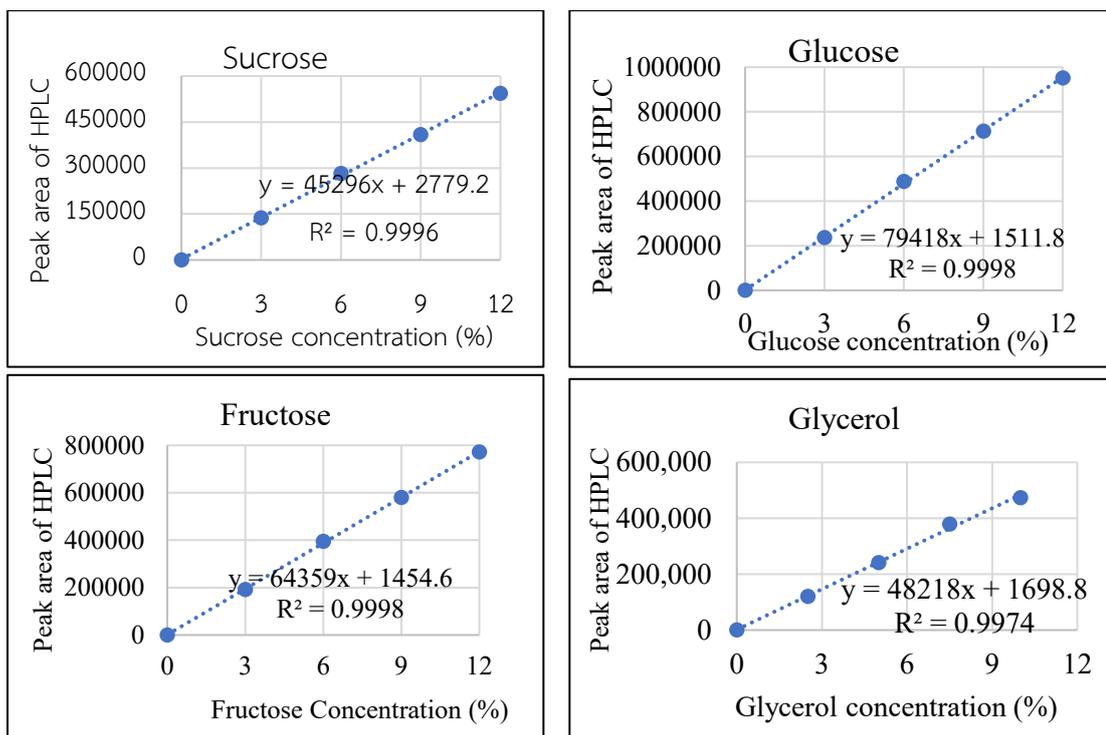


Figure 2 Standard Curve for Sugar Analysis of Kombucha Samples with Various Types of Carbon Sources Combinations.

APPENDIX B

DATA OF THE FIBER SIZE ANALYSIS OF BC FROM SEM IMAGE

USING “ImageJ” SOFTWARE

Table 3 Data analysis of the BC particle size distribution from kombucha with different types of tea

No	Diameter size (nm)				
	NDC -Fiber	RTC-C	GTC	BTC-30k	RBTH
1	21.148	18.127	19.866	25.953	22.009
2	21.960	19.654	21.645	27.815	22.009
3	23.212	20.668	23.392	28.230	22.848
4	24.199	23.464	24.492	28.562	24.241
5	24.383	23.742	24.561	28.930	24.369
6	24.866	23.945	25.146	29.874	24.561
7	25.133	24.538	25.255	30.483	24.832
8	25.588	24.803	25.499	31.899	25.315
9	26.318	24.884	25.850	32.050	25.514
10	26.445	25.779	26.907	32.329	25.645
11	27.586	26.424	27.727	32.743	26.488
12	28.067	26.483	27.954	32.842	26.945
13	28.272	26.504	28.774	32.892	26.945
14	28.435	26.586	29.034	33.083	27.721
15	28.435	26.656	29.040	33.139	27.840
16	28.724	26.764	30.617	34.501	27.942
17	28.915	26.779	31.132	34.752	28.085

Table 3 Data analysis of the BC particle size distribution from kombucha with different types of tea (Continued)

No	Diameter size (nm)				
	NDC -Fiber	RTC-C	GTC	BTC-30k	RBTH
18	29.271	26.948	31.192	34.940	28.427
19	30.024	27.022	31.445	35.090	28.746
20	30.842	27.669	31.601	35.426	29.042
21	31.034	27.880	31.843	36.347	29.912
22	31.656	28.166	32.265	36.471	30.197
23	31.908	28.166	32.691	37.115	30.280
24	32.001	28.186	32.832	37.640	30.572
25	32.019	28.706	33.297	37.813	30.632
26	32.279	29.522	33.746	38.100	30.979
27	34.958	29.592	34.059	38.290	31.089
28	35.651	29.923	34.099	38.573	31.742
29	36.094	31.002	34.324	39.759	31.993
30	36.248	31.075	34.602	40.122	32.188
31	36.248	32.718	35.185	40.663	32.540
32	36.656	32.836	35.978	41.035	33.096
33	36.656	32.874	36.016	42.151	33.251
34	36.800	33.973	36.061	42.479	34.047
35	37.109	34.052	36.136	42.699	34.223
36	37.813	34.262	36.262	43.139	35.215
37	37.948	34.393	38.606	43.440	35.489
38	39.013	34.700	38.614	44.202	35.537
39	40.213	34.878	39.460	44.725	35.587
40	40.213	35.855	39.835	45.720	36.299
41	40.982	35.892	40.389	46.446	37.351

Table 3 Data analysis of the BC particle size distribution from kombucha with different types of tea (Continued)

No	Diameter size (nm)				
	NDC -Fiber	RTC-C	GTC	BTC-30k	RBTH
42	48.399	36.095	41.249	47.830	37.367
43	48.766	36.334	42.340	48.130	37.610
44	49.425	36.805	47.401	48.328	37.867
45	50.913	38.562	47.861	51.230	38.330
46	53.643	39.047	51.356	51.470	38.782
47	53.864	41.530	51.598	51.569	41.651
48	55.709	44.263	57.119	54.948	41.855
49	56.134	46.506	57.548	55.187	43.135
50	56.134	47.139	58.844	56.031	44.903
Mean	35.166	30.647	34.855	39.144	31.465
SD	9.700	6.463	9.189	7.782	5.692
Min	21.148	18.127	19.866	25.953	22.009
Max	56.134	47.139	58.844	56.031	44.903

Table 4 Data analysis of the BC particle size distribution from kombucha with different types of additives

No	Diameter size (nm)						
	NDC- Fiber	RTC- EtOH	RTC-SPI	RTC-YE	RTC-Vit C	RTC-PC	RTC-C
1	21.148	30.658	23.353	25.005	13.738	21.322	19.356
2	21.960	30.918	23.508	25.422	15.520	26.946	19.825
3	23.212	32.039	27.525	26.858	18.050	41.898	20.019
4	24.199	33.709	27.688	26.909	19.352	35.927	21.460

Table 4 Data analysis of the BC particle size distribution from kombucha with different types of additives (Continued)

No	Diameter size (nm)						
	NDC-Fiber	RTC-EtOH	RTC-SPI	RTC-YE	RTC-Vit C	RTC-PC	RTC-C
5	24.383	34.218	27.902	27.073	20.059	37.38	22.108
6	24.866	34.462	28.609	27.574	20.063	31.424	22.608
7	25.133	34.833	29.360	27.640	20.219	41.356	23.862
8	25.588	35.866	30.533	27.662	20.875	34.507	24.307
9	26.318	36.783	30.697	27.711	21.008	27.184	25.022
10	26.445	36.923	31.373	28.096	21.313	30.696	25.423
11	27.586	38.506	32.385	28.469	21.757	27.335	26.638
12	28.067	38.746	32.540	28.676	22.450	18.004	26.693
13	28.272	39.565	33.124	30.286	22.450	28.792	26.895
14	28.435	39.763	33.136	30.716	22.838	51.847	26.912
15	28.435	39.768	33.751	30.786	23.009	45.053	27.177
16	28.724	40.842	33.751	31.123	23.182	36.859	27.919
17	28.915	40.842	33.751	31.137	23.250	29.021	28.312
18	29.271	41.242	33.916	31.265	23.564	38.862	28.328
19	30.024	41.349	34.508	31.351	23.599	54.841	28.554
20	30.842	43.283	37.132	32.361	23.812	39.52	28.740
21	31.034	43.578	37.392	33.088	24.413	30.906	28.775
22	31.656	43.725	37.491	33.180	24.779	40.168	28.815
23	31.908	44.776	37.767	33.381	25.725	45.017	28.970
24	32.001	44.883	38.267	34.209	25.918	43.411	29.347
25	32.019	45.346	38.788	34.457	25.959	40.168	29.447
26	32.279	45.467	39.684	34.590	25.965	34.131	29.661
27	34.958	45.663	40.964	34.878	25.965	34.554	29.736

Table 4 Data analysis of the BC particle size distribution from kombucha with different types of additives (Continued)

No	Diameter size (nm)						
	NDC-Fiber	RTC-EtOH	RTC-SPI	RTC-YE	RTC-Vit C	RTC-PC	RTC-C
28	35.651	46.705	40.964	35.095	25.986	31.424	29.873
29	36.094	47.115	41.594	35.187	25.986	47.731	29.912
30	36.248	47.285	43.970	35.367	26.132	45.854	30.027
31	36.248	47.420	44.165	36.097	26.681	38.341	30.046
32	36.656	47.791	44.195	36.464	26.816	34.751	30.951
33	36.656	48.722	44.595	36.529	27.145	40.876	31.118
34	36.800	48.886	44.991	36.547	27.164	52.215	31.146
35	37.109	49.180	45.393	36.794	27.241	56.299	31.465
36	37.813	49.538	45.905	36.862	27.448	28.842	31.726
37	37.948	50.149	46.028	37.094	27.661	36.107	32.602
38	39.013	50.943	47.934	37.211	27.703	39.101	33.723
39	40.213	51.841	48.765	37.451	27.774	32.357	33.965
40	40.213	52.429	49.032	37.516	27.788	28.06	34.132
41	40.982	54.207	49.065	37.646	27.979	28.06	34.333
42	48.399	54.207	49.328	37.763	27.985	17.964	34.533
43	48.766	54.473	50.042	38.524	28.368	32.335	34.914
44	49.425	56.553	51.063	39.528	31.125	29.627	35.445
45	50.913	60.047	51.816	39.965	31.418	41.898	36.180
46	53.643	60.896	56.807	39.984	33.059	41.003	36.287
47	53.864	61.211	57.849	41.459	34.218	36.107	36.524
48	55.709	66.050	62.746	41.621	35.201	30.591	37.999
49	56.134	67.230	66.053	42.830	36.380	32.534	39.138
50	56.134	68.436	74.896	44.859	38.461	21.928	44.216

Table 4 Data analysis of the BC particle size distribution from kombucha with different types of additives (Continued)

No	Diameter size (nm)						
	NDC-Fiber	RTC-EtOH	RTC-SPI	RTC-YE	RTC-Vit C	RTC-PC	RTC-C
Mean	35.166	45.981	40.922	33.846	25.491	37.737	29.703
SD	9.700	9.380	10.923	4.901	4.915	6.447	5.172
Min	21.148	30.658	23.353	25.005	13.738	24.112	19.356
Max	56.134	68.436	74.896	44.859	38.461	53.342	44.216

Table 5 Data analysis of the BC particle size distribution from red Thai tea kombucha with different types of carbon source combination.

No	Diameter size (nm)					
	NDC -Fiber	RTC-C	RTC-SD	RTC-SF	RTC-Gly	RTC-Glu
1	21.148	19.356	26.756	22.237	22.413	23.317
2	21.960	19.825	27.199	22.801	25.275	23.374
3	23.212	20.019	28.585	24.524	25.431	24.485
4	24.199	21.460	28.794	25.779	26.419	24.919
5	24.383	22.108	29.464	27.746	26.737	24.919
6	24.866	22.608	30.305	28.128	26.868	25.208
7	25.133	23.862	31.944	28.441	27.460	25.389
8	25.588	24.307	32.055	29.835	27.538	26.213
9	26.318	25.022	33.216	30.257	27.560	26.898
10	26.445	25.423	33.333	30.334	27.848	27.494
11	27.586	26.638	33.355	30.875	28.017	27.577
12	28.067	26.693	34.090	31.406	28.081	28.496
13	28.272	26.895	34.359	32.994	29.095	29.589

Table 5 Data analysis of the BC particle size distribution from red Thai tea kombucha with different types of carbon source combination (Continued)

No	Diameter size (nm)					
	NDC -Fiber	RTC-C	RTC-SD	RTC-SF	RTC-Gly	RTC-Glu
14	28.435	26.912	35.240	33.526	29.830	30.072
15	28.435	27.177	35.395	34.682	31.023	30.175
16	28.724	27.919	35.675	34.725	31.868	30.553
17	28.915	28.312	36.285	34.759	31.868	30.715
18	29.271	28.328	36.770	35.113	31.944	30.945
19	30.024	28.554	36.924	35.113	31.944	31.357
20	30.842	28.740	37.268	35.749	32.268	31.887
21	31.034	28.775	37.287	35.913	32.320	32.234
22	31.656	28.815	37.590	37.071	33.827	32.268
23	31.908	28.970	37.881	37.233	34.151	32.338
24	32.001	29.347	38.114	38.190	35.592	32.926
25	32.019	29.447	38.341	38.190	35.659	33.000
26	32.279	29.661	38.392	38.308	36.413	33.323
27	34.958	29.736	38.434	38.776	36.529	33.803
28	35.651	29.873	38.631	38.969	37.620	33.866
29	36.094	29.912	39.930	39.544	37.892	34.489
30	36.248	30.027	41.071	40.035	37.956	35.020
31	36.248	30.046	41.802	40.334	38.225	35.044
32	36.656	30.951	41.802	40.594	38.852	35.714
33	36.656	31.118	41.807	41.618	40.001	35.725
34	36.800	31.146	41.938	41.763	40.293	36.047
35	37.109	31.465	42.333	41.942	40.346	36.498
36	37.813	31.726	42.857	42.193	41.058	37.363
37	37.948	32.602	44.176	43.353	41.247	37.477

Table 5 Data analysis of the BC particle size distribution from red Thai tea kombucha with different types of carbon source combination (Continued)

No	Diameter size (nm)					
	NDC -Fiber	RTC-C	RTC-SD	RTC-SF	RTC-Gly	RTC-Glu
38	39.013	33.723	45.527	43.353	41.888	38.852
39	40.213	33.965	46.360	45.020	41.960	39.698
40	40.213	34.132	46.975	45.220	42.075	39.819
41	40.982	34.333	48.049	47.173	42.744	40.540
42	48.399	34.533	48.082	48.088	42.913	41.190
43	48.766	34.914	48.343	48.555	43.956	41.494
44	49.425	35.445	52.732	48.555	43.984	41.773
45	50.913	36.180	53.093	48.679	44.011	42.075
46	53.643	36.287	54.222	49.657	44.353	43.918
47	53.864	36.524	54.398	53.785	46.324	44.713
48	55.709	37.999	57.143	55.329	47.558	50.862
49	56.134	39.138	61.652	55.600	49.071	53.891
50	56.134	44.216	63.275	55.923	54.868	57.335
Mean	35.166	29.703	40.385	38.560	35.863	34.338
SD	9.700	5.172	8.654	8.514	7.357	7.564
Min	21.148	19.356	26.756	22.237	22.413	23.317
Max	56.134	44.216	63.275	55.923	54.868	57.335

APPENDIX C

DATA ON THE OPTIMIZED SOLUTION FORMULA FOR BC

PRODUCTION GENERATED BY SOFTWARE

Table 6. Predicted Optimized Formula Solution for BC Production Generated by Software

No	Sucrose	Tea	Ethanol	Wet yield	Dry yield	WHC	Desirability
1	7.973	1.405	1.595	630.159	5.238	119.265	0.939
2	7.973	1.405	1.589	630.061	5.231	119.423	0.939
3	7.973	1.405	1.581	629.927	5.221	119.643	0.939
4	7.973	1.405	1.573	629.787	5.210	119.864	0.939
5	7.973	1.405	1.566	629.668	5.201	120.046	0.938
6	7.947	1.405	1.595	630.790	5.243	119.289	0.938
7	7.973	1.405	1.557	629.507	5.190	120.29	0.938
8	7.951	1.406	1.595	630.571	5.242	119.275	0.938
9	7.973	1.405	1.543	629.228	5.171	120.686	0.938
10	7.932	1.405	1.590	631.076	5.239	119.436	0.938
11	7.923	1.405	1.595	631.377	5.247	119.312	0.938
12	7.973	1.410	1.595	629.580	5.236	119.214	0.938
13	7.973	1.405	1.519	628.78	5.142	121.289	0.937
14	7.973	1.405	1.505	628.487	5.123	121.66	0.937
15	7.973	1.405	1.474	627.831	5.086	122.427	0.936
16	7.973	1.405	1.449	627.281	5.056	123.016	0.935
17	7.847	1.405	1.595	633.162	5.260	119.378	0.935
18	7.973	1.405	1.444	627.171	5.050	123.129	0.935

Table 6. Predicted Optimized Formula Solution for BC Production Generated by Software (Continued)

No	Sucrose	Tea	Ethanol	Wet yield	Dry yield	WHC	Desirability
19	7.973	1.405	1.436	626.996	5.041	123.304	0.935
20	7.84	1.405	1.589	633.224	5.254	119.539	0.935
21	7.973	1.418	1.595	628.637	5.231	119.131	0.935
22	7.973	1.405	1.415	626.502	5.017	123.774	0.934
23	7.926	1.405	1.461	628.616	5.078	122.787	0.934
24	7.973	1.405	1.406	626.299	5.008	123.961	0.934
25	7.968	1.42	1.595	628.480	5.231	119.109	0.934
26	7.791	1.405	1.595	634.458	5.269	119.425	0.933
27	7.973	1.405	1.349	624.844	4.945	125.153	0.932
28	7.973	1.43	1.594	627.133	5.223	119.004	0.931
29	7.973	1.405	1.278	622.875	4.872	126.466	0.93
30	7.973	1.437	1.595	626.274	5.22	118.918	0.928
31	7.973	1.405	1.212	620.884	4.81	127.523	0.927
32	7.598	1.405	1.595	638.700	5.301	119.571	0.927
33	7.973	1.405	1.158	619.093	4.761	128.294	0.925
34	7.536	1.405	1.595	639.992	5.31	119.612	0.924
35	7.973	1.405	1.133	618.231	4.74	128.613	0.924
36	7.973	1.405	1.11	617.452	4.722	128.877	0.922
37	7.493	1.405	1.594	640.876	5.317	119.645	0.922
38	7.973	1.405	1.104	617.225	4.717	128.949	0.922
39	7.973	1.405	1.068	615.902	4.689	129.335	0.92
40	7.973	1.405	1.061	615.624	4.683	129.409	0.92
41	7.826	1.405	1.16	621.87	4.778	128.511	0.919

Table 6. Predicted Optimized Formula Solution for BC Production Generated by Software (Continued)

No	Sucrose	Tea	Ethanol	Wet yield	Dry yield	WHC	Desirability
42	7.973	1.405	1.02	614.071	4.654	129.777	0.918
43	7.969	1.466	1.589	622.673	5.196	118.736	0.918
44	7.973	1.405	0.971	612.104	4.62	130.147	0.915
45	7.973	1.405	0.936	610.653	4.598	130.359	0.913
46	7.260	1.407	1.595	645.117	5.35	119.754	0.912
47	7.973	1.405	0.881	608.26	4.565	130.609	0.91
48	7.973	1.405	0.855	607.104	4.551	130.69	0.909
49	7.973	1.405	0.812	605.083	4.529	130.775	0.906
50	7.973	1.405	0.787	603.91	4.518	130.795	0.904
51	7.973	1.405	0.777	603.406	4.513	130.796	0.903
52	7.973	1.405	0.638	596.306	4.461	130.465	0.894
53	7.973	1.405	0.580	593.081	4.446	130.125	0.889

Glucose was added to sucrose to achieve a total sugar concentration of 10%. Formulas No. 1, 46, and 53 were selected for laboratory validation