

## APPENDIX A

### Fermentation Values for all Parameters

Table 1: Fermentation at different temperature (grape)

Temperature		PH		TSS		Glucose		Ethanol
		<i>before</i>	<i>after</i>	<i>Before</i>	<i>after</i>	<i>Before</i>	<i>After</i>	<i>After</i>
28°C	R1	5.7	3.4	11	5.8	14.5	6.8	12.3
	R2	5.8	3.5	10.9	5.5	14.6	6.5	12.1
	R3	5.8	3.3	11.2	5.9	14.5	6.7	12.2
	<b>Ave</b>	5.8	3.4	11	5.8	14.5	6.8	<b>12</b>
32°C	R1	5.9	2.80	11.3	4.11	14.32	4.9	<b>13.1</b>
	R2	5.4	2.32	11.2	4.4	14.5	4.9	<b>13.2</b>
	R3	5.8	2.8	11	4.6	14.6	5	<b>13</b>
	<b>Ave</b>	5.8	2.8	11	4.6	14.5	5	<b>13</b>
35°C	R1	5.8	3.8	11.23	6.2	14.6	8.2	<b>11.11+</b>
	R2	5.8	3.9	11.5	5.99	14.7	7.8	<b>11.32+</b>
	R3	5.8	3.9	11.11	6	14.5	8	<b>11.32+</b>
	<b>Ave</b>	5.8	3.9	11	6	14.5	8	<b>11.32+</b>

Table 2: Fermentation at different yeast concentration(grape)

yeast concentration		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>after</i>	<i>Before</i>	<i>After</i>	<i>After</i>
2 gm	R1	5.8	3.3	11.3	5.11	14.5	7.2	<b>11.3</b>
	R2	5.8	3.3	11.5	5.11	14.6	6.9	<b>11.5</b>
	R3	5.8	3.3	11.10	5.11	14.5	7.10	<b>11.5</b>
	<b>Ave</b>	5.8	3.3	11	5.11	14.5	7.2	<b>11.5</b>
3 gm	R1	5.8	2.8	11.1	4.3	14.8	5.5	<b>12.3</b>
	R2	5.8	2.8	11.2	4.8	14.5	5.2	<b>12.2</b>
	R3	5.8	2.8	11.2	4.5	14.4	5.3	<b>12.12</b>
	<b>Ave</b>	5.8	2.8	11	4.6	14.5	5.3	<b>12</b>
4 gm	R1	5.8	2.18	11.0	4.3	14.0	4.5	<b>13.5</b>
	R2	5.8	2.11	11.2	4.1	14.5	4.3	<b>13.5</b>
	R3	5.8	2.31	11.2	4.12	14.4	4.5	<b>13.3</b>
	<b>Ave</b>	5.8	2.1	11	4	14.5	4.5	<b>13.5</b>

Table 3: Fermentation at different PH (grape)

PH		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	<i>After</i>
4ph	R1	4.0	2.9	11.3	6.5	14.5	7.2	<b>9.12</b>
	R2	4.1	3.1	11.2	6.3	14	7.5	<b>9.18</b>
	R3	4.3	3.2	11.1	6.3	14.6	7.2	<b>9.00</b>
	<b>Ave</b>	4	3.1	11	6.3	14.5	7.	<b>9</b>
5ph	R1	5.2	2.7	11.5	5.2	14.7	6.6	<b>10.22</b>
	R2	5.0	2.7	11.5	5.01	14.5	6.2	<b>10.61</b>
	R3	5.1	2.5	11.9	5.01	14.5	6	<b>10.70</b>
	<b>Ave</b>	5	2.7	11	5	14.5	6	<b>10.7</b>
6ph	R1	6.1	2.1	11.5	4.2	14.6	4.21	<b>13.24</b>
	R2	6.1	2.2	11.2	4.3	14.5	4.54	<b>13.21</b>
	R3	6.2	2.2	11	4.2	14.2	4.34	<b>13.00</b>
	<b>Ave</b>	6	2	11	4.2	14.5	4.5	<b>13</b>

Table 4: Fermentation at different fruit condition(grape)

Fruit condition		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>After</i>	<i>Before</i>	<i>after</i>	<i>After</i>
Fresh	R1	5.8	3.5	10.2	5.6	11.2	8.1	<b>11.6</b>
	R2	5.8	3.6	10.1	5.9	11.2	8.4	<b>11.5</b>
	R3	5.8	3.1	10.1	5.9	11.4	7.9	<b>11.5</b>
	<b>Ave</b>	5.8	3.5	10.2	5.9	11.2	8	<b>11.5</b>
Rotten	R1	5.8	2.3	11.5	4.7	14.9	5	<b>13.2</b>
	R2	5.8	2.8	11.3	4.8	14.5	5.2	<b>13.1</b>
	R3	5.8	2.9	11.2	4.8	14.8	5.4	<b>13.1</b>
	<b>Ave</b>	5.8	2.8	11.5	4.8	14.5	5	<b>13</b>

Table 5: Fermentation at different days(grape)

Days		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>after</i>	<i>Before</i>	<i>after</i>	<i>After</i>
1day	R1	5.8	3.5	11.2	6.2	14.5	6.2	<b>11.8</b>
	R2	5.8	3.5	11.2	6.2	14.6	6.2	<b>11.9</b>
	R3	5.8	3.5	11.4	6.6	14.5	6.1	<b>11.9</b>
	<b>Ave</b>	5.8	3.5	11	6.4	14.5	6	<b>11.9</b>
2days	R1	5.8	2.2	11.2	4.	14.6	4.9	<b>13.5</b>
	R2	5.8	2.1	11.3	4.2	14.5	4.9	<b>13.2</b>
	R3	5.8	2.3	11.2	4.3	14.7	4.8	<b>13.4</b>
	<b>Ave</b>	5.8	2.11	11	4.2	14.5	4.9	<b>13.5</b>
3days	R1	5.8	2.8	11.1	5.3	14.1	5.3	<b>12.2</b>
	R2	5.8	2.9	11.3	5.2	14.3	5.2	<b>12.1</b>
	R3	5.8	2.8	11	5.1	14.6	5.1	<b>12.1</b>
	<b>Ave</b>	5.8	2.8	11	5.2	14.5	5.3	<b>12</b>

Table 6: Fermentation whit enzymatic hydrolysis(grape)

Enzyme		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>After</i>	<i>Before</i>	<i>after</i>	<i>After</i>
yeast	R1	5.8	2.5	12	5.2	15.5	6.2	<b>13.1</b>
	R2	5.8	2.5	12.1	5.3	15.4	6.1	<b>13</b>
	R3	5.8	2.4	12.2	5.2	15.5	6.1	<b>13.1</b>
	<b>Ave</b>	5.8	2.5	12	5.2	15.5	6	<b>13</b>
cellulase	R1	5.8	4.2	12	7.6	15.3	8.2	<b>11.1</b>
	R2	5.8	4.1	12.1	7.5	15.2	8.2	<b>11.3</b>
	R3	5.8	4.1	12.1	7.4	15.2	8.1	<b>11.1</b>
	<b>Ave</b>	5.8	4.1	12	7.5	15.5	8	<b>11</b>
amylase	R1	5.8	3.2	12.0	6.11	15.5	7.1	<b>12.2</b>
	R2	5.8	3.3	12.1	6.13	15.5	7.2	<b>12.12</b>
	R3	5.8	3.0	12.3	6.11	15.3	7.2	<b>12.0</b>
	<b>Ave</b>	5.8	3.2	12	6.11	15.5	7	<b>12</b>

Table 7: Fermentation of different fruit part(grape)

Fruit Part		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>After</i>	<i>Before</i>	<i>after</i>	<i>After</i>
Skin	R1	5.8	3.8	10.4	9.1	11.1	9.8	<b>10.2</b>
	R2	5.8	3.5	10.5	9.3	11.2	9.9	<b>10.1</b>
	R3	5.8	3.7	10.5	9.3	11.2	9.8	<b>10.3</b>
	<b>Ave</b>	5.8	3.8	10.5	9.3	11.2	9.8	<b>10.3</b>
pulp	R1	5.8	2.6	12.4	6.2	15.6	5.5	<b>13.2</b>
	R2	5.8	2.5	12.6	6.2	15.3	5.2	<b>13.2</b>
	R3	5.8	2.2	12.5	6.8	15.1	5.3	<b>13.0</b>
	<b>Ave</b>	5.8	2.5	12.5	6.5	15.3	5.5	<b>13</b>
Maxi	R1	5.8	3.1	11.5	7.4	13.1	6.1	<b>11</b>
	R2	5.8	3.2	11.5	7.5	13.1	6.2	<b>11</b>
	R3	5.8	3.1	11.5	7.5	13	6.2	<b>11.2</b>
	<b>Ave</b>	5.8	3.11	11.5	7.5	13	6.2	<b>11</b>

Table 8: Fermentation at different temperature(apple)

Temperature		PH		TSS		Glucose		Ethanol
		<i>before</i>	<i>after</i>	<i>before</i>	<i>after</i>	<i>Before</i>	<i>After</i>	<i>After</i>
28°C	R1	5.8	3.8	10.1	4.8	12.1	6.3	<b>7.5</b>
	R2	5.8	3.8	10.3	4.9	12.3	6.3	<b>7.5</b>
	R3	5.8	3.7	10.3	4.9	12.2	6.2	<b>7.4</b>
	<b>Ave</b>	5.8	3.8	10	4.9	12	6.3	<b>7.5</b>
32°C	R1	5.8	3.2	10.2	4.1	12.2	5.4	<b>9.2</b>
	R2	5.8	3.2	10.2	4.2	12	5.5	<b>9.3</b>
	R3	5.8	3	10.0	4.0	12	5.6	<b>9.4</b>
	<b>Ave</b>	5.8	3	10	4	12	5.5	<b>9.3</b>
35°C	R1	5.8	4.4	10.2	5.3	12.4	7.7	<b>6.4</b>
	R2	5.8	4.1	10.1	5.2	12.2	7.8	<b>6.8</b>
	R3	5.8	4.1	10	5.3	12	7.8	<b>6.7</b>
	<b>Ave</b>	5.8	4.1	10	5.3	12	7.8	<b>6.8</b>



Table 9: Fermentation at different yeast concentration(apple)

yeast concentration		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>after</i>	<i>Before</i>	<i>After</i>	<i>After</i>
<b>2 gm</b>	R1	5.8	3	10.2.	6.2	12.2	6.2	<b>7.5</b>
	R2	5.8	3.2	10.3	6.2	12.1	6.4	<b>7.4</b>
	R3	5.8	3.2	10.1	6	12	6.2	<b>7.5</b>
	<b>Ave</b>	5.8	3.1	10	6	12.1	6	<b>7.5</b>
<b>3 gm</b>	R1	5.8	2.8	10.1	4.7	12.3	5.5	<b>8.5</b>
	R2	5.8	2.8	10.1	4.8	12.2	5.6	<b>8.5</b>
	R3	5.8	2.7	10.1	4.8	12	5.5	<b>8.5</b>
	<b>Ave</b>	5.8	2.8	10.1	4.8	12	5.5	<b>8.5</b>
<b>4 gm</b>	R1	5.8	2.3	10.0	4.2	12.3	4.8	<b>9.7</b>
	R2	5.8	2.3	10.1	4.0	12.3	4.6	<b>9.43</b>
	R3	5.8	2.4	10.1	4.1	12.1	4.7	<b>9.92</b>
	<b>Ave</b>	5.8	2.3	10	4.1	12	4.8	<b>9.8</b>

Table 10: Fermentation at different PH(apple)

PH		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>After</i>	<i>Before</i>	<i>After</i>	
4ph	R1	4.1	3.4	10.4	7.7	10.2	7.2	<b>7.60</b>
	R2	4.2	3.2	10.4	7.5	10.2	7	<b>7.70</b>
	R3	4.1	3.4	10.4	7.5	10.2	7.1	<b>7.70</b>
	<b>Ave</b>	4.0	3.4	10.4	7.5	12.2	7	<b>7.70</b>
5ph	R1	5.0	3.2	10.8	5.1	11.8	5.5	<b>8.40</b>
	R2	5.1	3.1	10.8	5.2	11.8	5.6	<b>8.55</b>
	R3	5.0	3.1	10.8	5.5	11.8	5.8	<b>8.52</b>
	<b>Ave</b>	5.0	3.1	10.8	5.5	11.8	5.7	<b>8.5</b>
6ph	R1	6.1	2.2	10.8	4.5	12.5	4.9	<b>9.82</b>
	R2	6.0	2.0	10.8	4.7	12.5	5.0	<b>9.83</b>
	R3	6.0	2.4	10.8	4.2	12.5	4.7	<b>9.90</b>
	<b>Ave</b>	6.0	2.2	10.8	4.5	12.2	4.9	<b>9.90</b>

Table 11: Fermentation at different fruit condition(apple)

Fruit condition		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>After</i>	<i>Before</i>	<i>after</i>	<i>After</i>
Fresh	R1	5.8	3.8	10	6.3	11.2	8.4	7.8
	R2	5.8	4.0	10	6.4	11.1	8.3	7.8
	R3	5.8	3.9	10	6.1	11.4	8.2	7.6
	<b>Ave</b>	5.8	3.8	10	6.3	11.4	8.3	7.8
Rotten	R1	5.8	3	11.5	4.8	12.2	5.5	<b>9.3</b>
	R2	5.8	3	11.5	4.6	12.1	5.5	<b>9.2</b>
	R3	5.8	3	11.5	5	12	5.5	<b>9.2</b>
	<b>Ave</b>	5.8	3	11.5	4.9	12	5.5	<b>9.2</b>

Table 12: Fermentation at different days(apple)

Days		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>after</i>	<i>Before</i>	<i>after</i>	<i>After</i>
1day	R1	5.8	3.7	10	6.4	12	7.1	<b>6.23</b>
	R2	5.8	3.8	10	6.3	12	7.2	<b>6.22</b>
	R3	5.8	3.8	10	6.3	12	7.0	<b>6.23</b>
	<b>Ave</b>	5.8	3.8	10	6.3	12	7	<b>6.23</b>
2days	R1	5.8	2.12	10	4.5	12	5.2	<b>9.21</b>
	R2	5.8	2.13	10	4.9	12	5.2	<b>9.22</b>
	R3	5.8	2.12	10	4.9	12	5.1	<b>9.22</b>
	<b>Ave</b>	5.8	2.11	10	4.9	12	5.2	<b>9.22</b>
3days	R1	5.8	3.1	10	5.4	12	5.8	<b>7.42</b>
	R2	5.8	3.2.5	10	5.2	12	5.9	<b>7.44</b>
	R3	5.8	3.0	10	5.4	12	5.9	<b>7.43</b>
	<b>Ave</b>	5.8	3.0	10	5.4	12	5.9	<b>7.42</b>

Table 13: Fermentation whit enzymatic hydrolysis(apple)

Enzyme		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>Before</i>	<i>after</i>	<i>before</i>	<i>After</i>	<i>Before</i>	<i>after</i>	<i>After</i>
yeast	R1	5.8	2.8	11	6.9	12.5	8.5	<b>9.7</b>
	R2	5.8	2.9	11	6.8	12.5	8.7	<b>9.6</b>
	R3	5.8	2.8	11	6.8	12.5	8.6	<b>9.6</b>
	<b>Ave</b>	5.8	2.8	11	6.8	12.5	8.6	<b>9.6</b>
cellulase	R1	5.8	3.7	11	9	12.5	9.9	<b>6.32</b>
	R2	5.8	3.9	11	9.3	12.5	9.8	<b>6.42</b>
	R3	5.8	3.7	11	9	12.5	9.9	<b>6.12</b>
	<b>Ave</b>	5.8	3.7	11	9	12.5	9.9	<b>6.42</b>
amylase	R1	5.8	3.3	11	7.9	12.5	9.2	<b>8.2</b>
	R2	5.8	3.2	11	7.8	12.5	9.1	<b>8.1</b>
	R3	5.8	3.2	11	7.8	12.5	9.2	<b>8.2</b>
	<b>Ave</b>	5.8	3.2	11	7.8	12.5	9.2	<b>8.2</b>

Table 14: Fermentation of different fruit part(apple)

Fruit Part		PH		TSS%		Glucose Mg/ml		Ethanol (V/V)%
		<i>before</i>	<i>after</i>	<i>before</i>	<i>After</i>	<i>Before</i>	<i>after</i>	<i>After</i>
Skin	R1	5.8	4.2	10.2	9.1	11.2	8.2	<b>6.37</b>
	R2	5.8	4.2	10.2	9.3	11.2	8.1	<b>6.27</b>
	R3	5.8	4.2	10.2	9.2	11.2	8.0	<b>6.17</b>
	<b>Ave</b>	5.8	4.2	10.2	9.2	11.2	8	<b>6.17</b>
pulp	R1	5.8	2.8	11.5	6.7	15	6.2	<b>9.5</b>
	R2	5.8	2.9	11.5	6.4	15	6.2	<b>9.5</b>
	R3	5.8	2.8	11.5	6.8	15	6.0	<b>9.4</b>
	<b>Ave</b>	5.8	2.8	11.5	6.8	15	6.0	<b>9.5</b>
Maxi	R1	5.8	3.7	11	7.8	14.2	7.3	<b>8.8</b>
	R2	5.8	3.8	11	7.8	14.2	7.3	<b>8.8</b>
	R3	5.8	3.8	11	7.9	14.2	7.2	<b>8.9</b>
	<b>Ave</b>	5.8	3.8	11	7.8	14.2	7.3	<b>8.8</b>

## List of Publications

Norah, HA. Sharif, ABMH and Hadeel, MA. (2011). Bioethanol production from rotten apple fruit biomass. Scientific Research and Essay (Under review).

Hossain ABMS, Ahmed S, Hadeel Alyamani, Norah Ahmed and M. Sufian. 2011. Bioethanol fuel production from rotten banana as an environmental waste management and sustainable energy. African Journal of Microbiology Research. 5:596-598. (ISI).

Hadeel A, ABMS Hossain, K. Latifa A. Norah. 2011. Bioethanol fuel production from rambutan fruit biomass as reducing agent of global warming and greenhouse gases. Afr. J. Biotech. 10: 10157-10165. (ISI).

Hadeel, MA, Sharif, ABMH, and Norah, HA. (2011). Bioethanol production from rotten rambutan fruit biomass. 2011. African Journal of Biotechnology. (Accepted).