MANUAL FOR THE FOOD PROCESSING

PILOT PLANT AT KIRIBATI

Report Part II

Project: Product Development for the Food Processing Pilot Plant

Apilame Cegumalua
Institute of Applied Science
University of the South Pacific
Suva, Fiji.
2008
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Topics</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Introduction</td>
<td>4</td>
</tr>
<tr>
<td>1.1</td>
<td>Objective and Scope</td>
<td>4</td>
</tr>
<tr>
<td>2.0</td>
<td>Pandanus</td>
<td>5</td>
</tr>
<tr>
<td>2.1</td>
<td>Processing Steps</td>
<td>5</td>
</tr>
<tr>
<td>2.2</td>
<td>Preprocessing of Pandanus Pulp</td>
<td>7</td>
</tr>
<tr>
<td>2.3</td>
<td>Processing of Pandanus Juice</td>
<td>8</td>
</tr>
<tr>
<td>2.4</td>
<td>Processing of Pandanus Nectar</td>
<td>10</td>
</tr>
<tr>
<td>2.5</td>
<td>Processing of Pandanus Jam</td>
<td>12</td>
</tr>
<tr>
<td>2.6</td>
<td>Processing of Pandanus Fruit Lather</td>
<td>13</td>
</tr>
<tr>
<td>3.0</td>
<td>Banana</td>
<td>16</td>
</tr>
<tr>
<td>3.1</td>
<td>Processing Steps</td>
<td>16</td>
</tr>
<tr>
<td>3.2</td>
<td>Processing of Banana Pulp</td>
<td>16</td>
</tr>
<tr>
<td>3.3</td>
<td>Processing of Banana Jam</td>
<td>17</td>
</tr>
<tr>
<td>3.4</td>
<td>Processing of Banana Fruit Lather</td>
<td>18</td>
</tr>
<tr>
<td>3.5</td>
<td>Processing of Banana Creamy Paste</td>
<td>19</td>
</tr>
<tr>
<td>3.6</td>
<td>Processing of Banana Chips</td>
<td>20</td>
</tr>
<tr>
<td>3.7</td>
<td>Processing of Banana Flour</td>
<td>22</td>
</tr>
<tr>
<td>4.0</td>
<td>Breadfruit</td>
<td>26</td>
</tr>
<tr>
<td>4.1</td>
<td>Processing of Breadfruit Chips</td>
<td>26</td>
</tr>
<tr>
<td>4.2</td>
<td>Processing of Breadfruit flour from Off cuts</td>
<td>27</td>
</tr>
<tr>
<td>5.0</td>
<td>Babai or Giant Swamp Taro</td>
<td>29</td>
</tr>
<tr>
<td>5.1</td>
<td>Processing of Babai Chips</td>
<td>29</td>
</tr>
<tr>
<td>5.2</td>
<td>Processing of Babai Flour</td>
<td>30</td>
</tr>
<tr>
<td>6.0</td>
<td>Pumpkin</td>
<td>31</td>
</tr>
<tr>
<td>6.1</td>
<td>Processing of Pumpkin Jam</td>
<td>31</td>
</tr>
<tr>
<td>6.2</td>
<td>Processing of Pumpkin Sauce</td>
<td>31</td>
</tr>
<tr>
<td>7.0</td>
<td>Other Products</td>
<td>31</td>
</tr>
<tr>
<td>8.0</td>
<td>Guideline of Hygiene Practice in the Pilot Plant</td>
<td>33</td>
</tr>
<tr>
<td>8.1</td>
<td>Personal Hygiene</td>
<td>33</td>
</tr>
<tr>
<td>8.2</td>
<td>Hygiene of Infrastructure</td>
<td>34</td>
</tr>
<tr>
<td>8.3</td>
<td>Design of the Building</td>
<td>35</td>
</tr>
<tr>
<td>8.4</td>
<td>Hygiene of the Building and Department</td>
<td>36</td>
</tr>
<tr>
<td>8.5</td>
<td>Hygiene Design of Equipment and Tools</td>
<td>36</td>
</tr>
<tr>
<td>8.6</td>
<td>Water quality</td>
<td>37</td>
</tr>
<tr>
<td>8.7</td>
<td>Pest and Rodent Control</td>
<td>38</td>
</tr>
<tr>
<td>8.8</td>
<td>Cleaning and Sanitation</td>
<td>38</td>
</tr>
<tr>
<td>8.9</td>
<td>Organic Waste Material and/or By Products</td>
<td>39</td>
</tr>
<tr>
<td>8.10</td>
<td>Others</td>
<td>39</td>
</tr>
<tr>
<td>8.11</td>
<td>Training</td>
<td>39</td>
</tr>
<tr>
<td>9.0</td>
<td>Production and Processing of Kiribati Produce</td>
<td>39</td>
</tr>
<tr>
<td>9.1</td>
<td>Production and Growing of Foods both Regular</td>
<td>40</td>
</tr>
</tbody>
</table>
1.0 Introduction

This processing manual has been prepared as part of the project on Product Development in Kiribati. These procedures described and formulations derived are original to the processing plant and the project work. Other valuable information that assisted the consultant and her team were from
literatures, text books and various consultancy reports of the study of Kiribati local foods. In addition the discussions provided through consultations with Mr. Betarim Rimon, Mr. Kietau Tabwebwelti, The Food Processing Committee in Kiribati, Dr Lois Engelberg, Dr Richard Beyer, Mr. Jeyom Segaram, Mr. Dirk Schulz, Prof. Bill Aalbersberg, the Local Counterparts Emire Kabuta, Iowane Ubaitoi and Tiua Ieremia, the factory workers and the Kiribati farmers.

1.1 Objective and Scope

The objective of this processing guide is to enable the Local Counterparts (LCs), the factory workers at the Pilot Plant, through the application of this document, to ensure safe processing of products and compliance to quality parameters.

The processing guide is from harvesting to packaging, covering post harvest practices, food handling, product development, processing and packaging. The summary of the Hazard analysis is also shown for compliance.

The LCs and management of the plant; the Food Committee (FC) and the Supervisors; have the responsibility to provide evidence in its commitment to the development and implementation of this manual and to continue to improve effectiveness by ensuring that relevant training and education is conducted and all personnel have a responsibility to report issues that may affect quality and safety of products.

![Figure 1: Products produced from local Produce](image)

2.0 Pandanus

2.1 Processing Steps
2.1.1. Selection of fruits

a) Before processing ensure that all equipment to be used are thoroughly clean and ready.
b) Weigh selected pandanus bunch or keys that meet the specification criteria, record weight in the daily processing log book, note date and time and list workers involved.

2.1.2 Washing

a) Fill up portable water in the Number 1 Machine, Fruit washer, turn on the aerator, wash pandanus thoroughly, lift out the perforated washing basket, let it stand for 5 minutes to drain well.

Remarks: Use portable water only.

2.1.3 Cutting or Trimming

a) Fill up s/s trays and place on the s/s table. Using s/s sharp knives or trimmers, trim ripe portion of the fruit into small pieces and weigh, record weight.

2.1.4 Blanching

a) Bring the water to boil in the blancher, Machine number 2, Blancher, and Blanch the pandanus pieces for 2 minutes.
b) Drain well by lifting up the perforated basket and let it stand for 5 minutes.

Remarks: Use portable water only.

2.1.5 Pulping

a) Check the pulper, Machine No.8, and ensure it is clean and nuts and bolts are tightly in place.
b) Ensure that the receiving plastic tub or s/s tray is placed well below the outlet to receive pandanus pulp.
c) Turn on power and pass the pandanus pieces through the pulping machine, a kg at a time, be careful not to jam the pulper.
d) Collect pulp, weigh and record weight on log book or production sheet (refer example).

Remarks: The pulper is capable of pulping only 10 kg of pandanus pieces at a time because of the fibrous nature of the pandanus. To avoid damaging the machine carry out small pulping activity for pandanus, 18 kg of initial raw materials at a time.

2.1.6 Screening and Separating
a) Check the Separating and Screening Machine Number 6 and ensure it is clean and all nuts and bolts are tightly in place.
b) Place two clean receiving s/s trays at each outlet, one for the pulp and the other for the fiber.
c) Turn on power and pass the pandanus pulp through the separator screen.
d) Collect the pulp, weigh and record.
e) Take a sample and check pH and Brix and record.
f) Collect the fiber, weigh and record and discard in the appropriate manner as earlier discussed.

2.1.7 Remarks and Recommendation

The pulp is further processed into juice, nectar or jams or preprocess for freezing and use at a later date.

Figure 2: Pandanus pulping
2.2 Preprocessing of Pandanus Pulp

a) Weigh and record weight of pulp and pour into the Evaporator (Cooker) Machine No 4.
b) Consult engineer to operate boiler, Machine No 15 for generating heating steam.
c) Turn on steam and stirrer for the evaporator and apply heat to pulp until reaches 85-90 degree C and let it be heated for a further 15 sec, stirring continuously, then allow to cool to 45 degree C before packing into food grade plastic buckets or plastic bags for freezing and use at a later date.
d) Cool buckets immediately in a tub of cold running water.
e) Weigh and record.
f) Label well, the product name and type of product, batch number, date, time and weight.
g) Measure pH and Brix and record.
h) pH of pandanus pulp average of 4.3 and Brix and average of 14
i) Place buckets in Freezer (-18 to -25 degree C)
j) To export frozen pulp, add citric acid to reduce pH level to 3.5 or lower and ascorbic acid to improve quality and maintain good colour during processing.

2.2.1 Remarks and Recommendation

a) When packing hot product into plastic bags and plastic buckets, allow the product to cool first to about 45 degree C and then fill. To avoid burning and collapsing of plastic buckets and bags allow the receiving containers to be placed on clean cold water while being filled and after filling for proper cooling before placing it in the freezer.

b) This practice can be carried out in the islands to avoid high product losses through transportation and to ensure the freshness of produce is still maintained when delivered to the processing plant.

2.3 Processing of Pandanus Juice

2.3.1 Ingredients Listing:

Basic formulation that was used for product development:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>53.4%</td>
</tr>
<tr>
<td>Pandanus pulp</td>
<td>35.0%</td>
</tr>
<tr>
<td>Sugar</td>
<td>11.5%</td>
</tr>
<tr>
<td>Citric acid</td>
<td>0.20%</td>
</tr>
<tr>
<td>The pH level was high</td>
<td>3.9</td>
</tr>
</tbody>
</table>

2.3.2 Remarks

a) pH of juice to be <3.5

b) Measure pH and Brix of pulp before mixing and then after mixing, before heating.

Adjust pH level

if need be by slightly increasing citric acid level

2.3.3 From Product development:

Pulp was reduced to 25 % and citric acid increased to 0.35 %

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>60.0%</td>
</tr>
<tr>
<td>Pandanus pulp</td>
<td>25.0%</td>
</tr>
<tr>
<td>Sugar (brown sugar)</td>
<td>14.97%</td>
</tr>
<tr>
<td>Citric acid</td>
<td>0.35% (Level to accomplish pH level of 3.5 or below)</td>
</tr>
</tbody>
</table>

2.3.4 Materials required:

- Weighing balance
- pH meter
- Refractometer
Thermometer
Bowls or basins for weighing ingredients
Spoons
S/S trays
Packaging bottles and lids
Hot gloves

2.3.5 Processing steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer
d) Weigh all ingredients (refer formulation, work out weights from percent values).
e) Mix all ingredients together in the evaporator, measure pH and Brix and record (pH for juice must be around 3.5 before heating)
f) Heat juice in the evaporator, stirring the juice all the time

g) Pasteurize the juice by heating to 85 -90 degree C and holding at that temperature for 15 seconds, keep stirring all the time
h) Turn off steam but keep the stirrer on.
i) Allow to cool to 45 degree C, put on the gloves and then fill in PET bottles and close tightly. PET Bottles are to be filled while partly submerged on the clean cold water bath.
j) Place in the cooler for storage.

2.3.6 Remarks and Recommendation

a) If glass bottles with proper lids are available, then the juice can be filled hot at 85 degree C, close lids tightly and cool immediately in a water bath.
b) Ingredients are listed in % value, so anyone can work out easily the formula for whatever amount of juice one wants to prepare
c) The pH before heating, 3.3, after heating pH 3.3 and Brix reading before heating 11.8, after heating Brix 16.4
Yield 95% of initial volume

2.3.7 Comments: The juice produced was acceptable in sweetness, acidity level, and smoothness.

2.3.8 Sterilization of Pandanus Juice

Follow procedure as above and using glass bottles and heat resistant packages.

a) Pasteurize juice to 85 -90 degree C for 15 seconds, fill hot and close bottles loosely.
b) Subject bottles in to a hot water boiling bath and heat for 30 -45 minutes.
c) At the end of heating, remove bottles, close lid tightly, place in a warm water bath before introducing cold water and cool quickly. Ensure that bottle mouth is not submerged.
d) Remove after cooling, dry well, label and store in cool dry place.

e) Withdraw reference samples for test and future storage references.

2.4 Processing of Pandanus nectar

Basic formulation that was used for product development:

2.4.1 Ingredients:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>55.8%</td>
</tr>
<tr>
<td>Pulp</td>
<td>35.2%</td>
</tr>
<tr>
<td>Sugar</td>
<td>8.5%</td>
</tr>
<tr>
<td>Citric acid</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

2.4.2 Materials required:

- Weighing balance
- pH meter
- Refractometer
- Thermometer
- Bowls or basins for weighing ingredients
- Spoons
- S/s trays
- Packaging bottles and lids
- Colloid mill
- Finer screen separator
- Hot gloves

2.4.3 Processing steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer.
d) Weigh all ingredients (refer formulation, work out weights from percentage values).
e) Mix all ingredients together and pass ingredients through the colloid mill and blend for 2-3 minutes.
f) Pour the mixture into the evaporator, measure pH and Brix and record (pH for nectar must be around 3.5 before heating)
g) Heat nectar slowly in the evaporator, stirring the mixture all the time
h) Pasteurize the nectar by heating to 85-90 degree C and holding at that temperature for 15 seconds keep stirring all the time
i) Turn off steam but keep the stirrer on.
j) Allow cooling to 45 degree C and then using the hot gloves, open the valve at the bottom of the cooker and fill into sterile jugs.
k) Using the jars then fill in PET bottles and close tightly. PET Bottles are to be filled while partly submerged in the clean cold water bath.
l) Once cooled, drain well and dry the bottles.
m) Label the bottles and store in a cool storage.

2.4.4 Remarks

a) If glass bottles with proper lids are available, then the juice can be filled hot at 85 degree C, close lids tightly and cool immediately in a water bath.
b) Ingredients are listed in % value, so anyone can work out easily the formula for whatever amount of juice one wants to prepare (refer examples in the appendix).
c) The pH before heating 3.3, after heating pH 3.3, Brix reading before heating 11.8, after heating, Brix 16.4. Very sweet, smooth and thick nectar.
Yield or Output 80% of total volume

2.4.5 Comments: The nectar produced was acceptable very smooth and good thickness, moderately sweet and have a good acidic touch.

2.4.6 Remarks and recommendation:

a) Nectar can be re formulated to have reduced pulp quantity to 30%, if consumers find the nectar too thick. For commercial purposes, this would be advisable to gain more output from the pulp.

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>55.8%</td>
</tr>
<tr>
<td>Pulp</td>
<td>30.0%</td>
</tr>
<tr>
<td>Sugar</td>
<td>8.5%</td>
</tr>
<tr>
<td>Citric acid</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

b) The pandanus pulp is very sweet, so sweetness is not affected and pH level is still within pH 3.5. The smoothness is still maintained but thickness has reduced slightly but still maintains good body texture.

2.4.7 Sterilization of Pandanus Nectar

Follow procedure as above and using glass bottles and heat resistant bottles.

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer.
d) Weigh all ingredients (refer formulation, work out weights from percentage values).
e) Mix all ingredients together and pass ingredients through the colloid mill and blend for 2-3 mins.
f) Pour the mixture into the evaporator, measure pH and Brix and record (pH for nectar must be around 3.5 before heating)
g) Heat nectar slowly in the evaporator, stirring the mixture all the time
h) Pasteurize the nectar by heating to 85-90 degree C and holding at that temperature for 15 seconds keep stirring all the time
i) Fill hot in glass bottles and close bottles loosely.
j) Subject bottles in to a hot water boiling bath and heat for 30 -45 minutes. Ensure that hot water level is at the bottle neck.
k) At the end of heating, remove bottles, close lid tightly, place in a warm water bath before introducing cold water and cool quickly. Ensure that bottle mouth is not submerged. Remove after cooling.
l) Dry well, label and store in cool dry place.
m) Withdraw reference samples for test and future storage assessment.

2.5 Processing of Pandanus Jam

2.5.1 Basic formulation that was used for product development:

Ingredients:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>33.3%</td>
</tr>
<tr>
<td>Pulp</td>
<td>33.3%</td>
</tr>
<tr>
<td>Sugar</td>
<td>33.3%</td>
</tr>
<tr>
<td>Citric acid</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

2.5.2 Materials required:

- Weighing balance
- pH meter
- Refractometer
- Thermometer
- Bowls or basins for weighing ingredients
- Spoons
- s/s trays or buckets
- Packaging bottles with lids
- A pair of (hot) gloves

2.5.3 Processing steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer.
d) Weigh all ingredients (refer formulation, work out weights from percentage values).
e) Mix all ingredients together, measure the pH and Brix and record, (pH for pandanus jam mixture must be around 3.5 before heating)
f) Pour the mixture into the evaporator, turn on the stirrer and open the steam inlet.
g) Heat the jam mixture slowly in the evaporator, stirring the mixture all the time
h) Keep on heating the mixture until it starts to boil then simmer by reducing steam flow
i) Continue to stir and heat slowly, measuring the brix level constantly. When the Brix reading reaches 63 degree brix, turn off steam but keep the stirrer on.

j) Assemble the jam empty bottles on a tray, open the valve beneath the evaporator (outlet) and using the hot glove, commence filling the jam in the bottles one by one. Care must be taken so as not to burn.

k) Fill the jam right to the neck of the bottle and close the lid immediately.

l) Turn the bottle upside down to sterilize the space above the bottle.

m) When cool turn the bottle upright again and wash off any jam spills on the bottles.

n) Label and store in cool dry place.

2.5.4 Remarks

a) pH reading before heating 3.5, after heating 3.3 and
   Brix reading before heating 30.4, after heating 65 degree
   Output approximately 55%.
   The jam is sweet, smooth and easily spreadable with a good color and texture.

2.6 Pandanus Fruit Leather

2.6.1 Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pandanus Pulp</td>
<td>60.0%</td>
</tr>
<tr>
<td>Sugar</td>
<td>25.0%</td>
</tr>
<tr>
<td>Water</td>
<td>15.0%</td>
</tr>
<tr>
<td>Sodium Metabisulphite (SMS)</td>
<td>0.1%</td>
</tr>
<tr>
<td>Potassium Sorbate</td>
<td>0.05%</td>
</tr>
<tr>
<td>Guar gum</td>
<td>0.015%</td>
</tr>
</tbody>
</table>

2.6.2 Materials/Equipment Required

Measuring jug
2 Cooking pots, a large and a smaller size
Gas Stove
Sterilized s/s trays
Weighing balance
Oil
pH meter
Refractometer
Thermometer
Bowls or basins for weighing ingredients
Spoons
Hot gloves

2.6.3 Processing Steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned.
d) Weigh all ingredients (refer formulation, work out weights from percentage values).
e) In the small pot, mix the SMS and water thoroughly; ensuring all SMS particles is dissolved before mixing with other ingredients.
f) Pour the rest of the ingredients into the smaller pot and mix thoroughly together.
g) Measure the pH and Brix and record, (pH for bananas leather mixture must be around 3.5 before heating, if not adjust by adding small amounts of citric acid)
h) Fill the water in the larger pot and put on the heating stove and bring water to boil
i) Once water is boiling then lower the smaller pot filled with the ingredients into the boiling water and heat the fruit leather stirring all the time until cook and desired consistency is reached, Brix above 65
j) Brush the oil on the s/s trays and using the hot glove remove the pot from the stove and pour mixture to prepared s/s/trays, thickness up to 2 mm high. Care must be taken so as not to burn.
k) Place trays in the heat pump dryer and heat at 45 degree C until the leather is properly dry. Test by lifting out of the tray.
l) Cool and place leather in a plastic sheet and roll up the lather. Weigh and record.
m) Cut the leather into small rolls and pack and seal.
n) Label and store in cool dry place.

2.6.4 Remarks:

Pandanus leather has a bright attractive natural deep orange color, sweet taste, good soft texture with the right elasticity, easily rolled and holds well. A good snack for children.
3.1 Processing Steps

Basic steps used for product development
3.1.1 Ingredients:

Good ripe bananas that is not over ripe.
SMS

3.1.2 Materials/Equipment required

Weighing balance
pH meter
Refractometer
Thermometer
S/s Bucket or plastic bucket, 20L size
Sodium Metabisulphite (SMS) (salt can be used be used instead)
Bowls or basins for weighing ingredients
Spoons
Knives
S/s trays
Packaging plastic materials
Fruit Washer Tank
Pulper Machine No 7
Finer screen separator (optional for finer screening)
Hot gloves

3.2 Processing of the Banana Pulp

3.2.1 Processing steps

a) Check raw materials and remove any defects or soft bananas, weigh and record.
b) Check the packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer.
d) Wash the ripe bananas in the Fruit washer tank and drain well.
e) In a 20 L bucket, fill up 15 L water and measure SMS powder to make up a 0.5% SMS solution, mix well.
f) Using the sharp s/s knives peel off the skin and weigh the peeled bananas and record weight.
g) Slice bananas thinly and soak in the SMS solution for an hour.
h) Drain well removing any excess SMS solution and blanch in the hot water Blancher for 1 min.
i) Drain to remove excess water and pass through the pulping Machine No 7.
j) Collect pulp, weigh and record weight.
k) Measure amount to be used for jam and the rest of the pulp can be processed by heating up to 85 – 90 degrees Celsius for 15 seconds, cooled to 45 degree C and packed in plastic bags, record weight and store in freezer for later use.

3.3 Processing of Banana Jam
3.3.1 Basic Formula used

Ingredients
Water 49.7%
Banana pulp 25%
Sugar 25%
Citric acid 0.35%

3.3.2 Materials used

Weighing balance
pH meter
Refractometer
Thermometer
Bowls or basins for weighing ingredients
Spoons
Packaging bottles
Hot gloves
Evaporator

3.3.3 Processing steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer.
d) Weigh all ingredients (refer formulation, work out weights from percentage values).
e) Mix all ingredients together, measure the pH and Brix and record, (pH for bananas jam mixture must be around 3.5 before heating, if not adjust by increasing citric acid)
f) Pour the mixture into the evaporator, turn on the stirrer and open the steam inlet.
g) Heat the jam mixture slowly in the evaporator, stirring the mixture all the time
h) Keep on heating the mixture until it starts to boil then simmer by reducing steam flow
i) Continue to stir and heat slowly, measuring the brix level constantly. When the Brix reading reaches 63 degree brix, turn off steam but keep the stirrer on.
j) Assemble the jam empty bottles on a tray, open the valve beneath the evaporator (outlet) and using the hot glove, commence filling the jam in the bottles one by one. Care must be taken so as not to burn.
k) Fill the jam right to the neck of the bottle and close the lid immediately.
l) Turn the bottle upside down to sterilize the space above the bottle.
m) When cool turn the bottle upright again and wash off any jam spills on the bottles.
n) Label and store in cool dry place.

3.3.4 Remarks

a) The banana jam has a nice deep purplish color, good consistency, spreadable easily and sweet taste with banana flavor.
b) Brix reading 65 degree Brix and pH 3.5

c) Yield 55% of initial volume

3.4 Processing of Banana Fruit Lather

3.4.1 Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana Pulp</td>
<td>60%</td>
</tr>
<tr>
<td>Sugar</td>
<td>25%</td>
</tr>
<tr>
<td>Water</td>
<td>15%</td>
</tr>
<tr>
<td>Sodium Metabisulphite</td>
<td>0.1%</td>
</tr>
<tr>
<td>Potassium Sorbate</td>
<td>0.05%</td>
</tr>
<tr>
<td>Guar gum</td>
<td>0.015%</td>
</tr>
</tbody>
</table>

3.4.2 Materials/Equipment Required

- Measuring jug
- 2 Cooking pots, a large and a smaller size
- Gas Stove
- Colloid mill
- Sterilized s/s trays
- Weighing balance
- Oil
- pH meter
- Refractometer
- Thermometer
- Bowls or basins for weighing ingredients
- Spoons
- Hot gloves

3.4.3. Processing Steps

a) Check all ingredients and ensure all are available in quantity and quality.

b) Check all packaging materials and ensure all are cleaned with no damages.

c) Check all equipment and ensure all are in working order and are cleaned.

d) Weigh all ingredients (refer formulation, work out weights from percentage values).

e) In the small pot, mix the SMS and water thoroughly; ensuring all SMS particles is dissolved before mixing with other ingredients.

f) Thoroughly mix the sugar and guar gum together, add the rest of the ingredients

g) Pour the mixture in the colloid mill to blend well before heating

h) Tip mixture back into the pot and measure the pH and Brix and record, (pH for bananas lather mixture must be around 3.5 before heating, if not adjust by adding small amount of citric acid)

i) Fill the water in the larger pot and put on the heating stove and bring water to boil

j) Once water is boiling then lower the smaller pot filled with the ingredients into the boiling water and heat the fruit leather stirring all the time until desired consistency is reached, Brix above 65 degree
j) Brush the oil on the s/s trays and using the hot glove remove the pot from the stove and pour mixture to prepared s/s/trays, thickness up to 2 mm high. Care must be taken so as not to burn.
m) Place trays in the heat pump dryer and heat at 45 degree C until the leather is properly dry. Test by lifting out of the tray.
n) Cool and place leather in a plastic sheet and roll up the latter. Weigh and record.
o) May cut the leather into small rolls and pack and seal for children snack.
p) Label and store in cool dry place.

Remarks:

Banana leather has a good slightly dark grayish purple color, sweet taste, good soft texture with the right elasticity, easily rolled and holds well. A good snack for children. Yield 95%.

3.5 Processing of Banana Creamy Paste

3.5.1 Ingredients

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banana Pulp</td>
<td>75%</td>
</tr>
<tr>
<td>Water</td>
<td>17%</td>
</tr>
<tr>
<td>Sugar</td>
<td>7.5%</td>
</tr>
<tr>
<td>Guar gum</td>
<td>0.05%</td>
</tr>
<tr>
<td>Potassium Sorbate</td>
<td>0.04%</td>
</tr>
<tr>
<td>Carboxymethyl cellulose</td>
<td>0.025%</td>
</tr>
<tr>
<td>(CMC)</td>
<td></td>
</tr>
</tbody>
</table>

3.5.2 Materials /Equipment Required

- Weighing balance
- pH meter
- Refractometer
- Thermometer
- Bowls or basins for weighing ingredients
- Spoons
- S/s trays
- Packaging bottles and lids
- Two cooking pots, a large and smaller size
- Cooking stove
- Hot gloves
- Measuring jars
- Labels

3.5.3 Processing steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned.
d) Weigh all ingredients (refer formulation, work out weights from percentage values).
e) Thoroughly mix the sugar and guar gum together, add the rest of the ingredients
f) Pour the mixture in the colloid mill to blend well before heating
g) Tip mixture back into the pot and measure the pH and Brix and record, (pH for
   bananas paste mixture must be around 3.5 before heating, if not adjust by adding
   small amount of citric acid)
h) Fill the water in the larger pot and put on the heating stove and bring water to boil
i) Once water is boiling then lower the smaller pot filled with the ingredients into the
   boiling water and heat the fruit paste stirring all the time until desired consistency is
   reached.
j) Once brix reaches 65 degree, remove from heat and fill into glass sterilize bottles.
k) Care must be taken so as not to burn.
l) Cool, weigh and record.
m) Label and store in cool dry place.

3.5.4 Remarks:

Banana creamy paste has a white nice color, smooth consistency and sweet taste. A good spread for
bread. Yield 95 %, pH 3.5 and brix above 65

3.6 Processing of Banana Chips

3.6.1 Ingredients for Banana Chips Process

Wholesome and mature green bananas
Salt
Sodium Metabisulphite (0.5% solution)
Water
Cooking oil

3.6.2 Materials required:

Weighing balance
Bowls or basins for weighing ingredients
20L Buckets
S/s trays
S/s knives
Heat pump dryer
Frying pan with perforated basket
Hot gloves
Manual Operated Plastic Sealer
Packaging plastic materials
Labels
Disposal gloves
3.6.3 Processing steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer.
d) Weigh the green bananas, record weight.
e) Peel of skin and slice peeled bananas into thin slices, weigh and record.
f) Mix the SMS solution, dissolve properly well in the bucket of water, mix well.
g) Place the banana slices in the bucket and soak overnight.
h) Drain well removing excess SMS solution and blanch in the Blancher Machine No 2 for 1 min.
i) Drain well removing excess water.

OPTION: Either a) dry the chips and store and this can be fried later when needed OR pass the dried chips through the hammer mill using the finer screen and grind the chips into flour.

OPTION b) fry immediately as banana chips, pack and store.

3.6.4 Dry and fry later

a) Spread the banana slices thinly on the drying trays.
b) Dry the banana slices using the Heat pump dryer at 45 degree C, drying time about 8 hrs.
c) Cool thoroughly and pack in plastic bags.
d) Label, noting date, weight, time and product name.
e) Store in cool dry place until required for frying.

3.6.5 Fry immediately

a) Heat up oil until blue smoke arises and carefully place frying basket fill with banana chips into hot oil.
b) Constantly shake the basket to ensure all chips are cooked thoroughly.
c) Continue frying until golden brown and remove from heat drain off excess oil and pour chips into absorbent paper to remove excess oil.
d) Cool and sprinkle salt (optional).
e) Using a disposal sterile glove, pack in plastic bags. Weigh and record.
f) Label well and store in dry cool place, note yield and record, date, weight and product name.

3.6.6 Remarks and recommendation

a) Dried banana chips can then be fried following steps above for Option ii)
b) From observation and taste panels, Option 1 process produced good crispy banana chips, good natural color and taste.
c) The banana chips that first dried in the heat pump drier and then fried gave a better quality in texture and more crispy than that which was fried immediately after blanching.
d) Ensure that after blanching the chips are dried thoroughly using a clean towel or absorbent paper before frying

d) Dried chips can also be reconstituted with water and then boiled dry with concentrated coconut cream to replace rice.

**Yield**  5% (this yield is calculated from the small amount of produce used in the trial)

### 3.7 Processing of Banana Flour

#### 3.7.1 Ingredients

Dried Banana chips from 3.2.2 process

#### 3.7.2 Materials /Equipment Required

- Hammer mill
- Plastic bags
- Disposal gloves
- Basins
- Weighing scales
- Manual operated plastic sealer
- Labels
- Receiving container or a large plastic bag

#### 3.7.3 Processing Steps.

a) Check Hammer mill, Machine No 9 and ensure it is dry and clean and that all bolts and nuts are tightly in place.
b) Weigh dried banana chips, record weight.
c) Place a dry receiving container at the outlet of the mill
d) Using disposal gloves, feed the hammer mill with dried chips
e) Cover inlet with a plastic bag to avoid pieces blowing out, also place the receiving container closer to the outlet to ensure all grinded powder fall into the bag or container.
f) When complete, collect all the dried powder and weigh and record weight.
g) Pack in clean plastic bags, and label well noting product name, weight and date.

#### 3.7.4 Remarks

a) The banana flour has a grayish white color, with some black specks that may have derived from the seeds.
b) The banana flour can be incorporated with wheat flour to make banana cake and other bakery products, a 30: 70 proportion (banana to wheat)
c) Banana flour yield, 12%  (Yield is calculated from the small amount produce used)
Fig. 5 Ripe Banana Processing

- Reception
- Sorting
- Weighing
- Washing
Fig. 6 Green Banana Processing
4.0 Breadfruit Chips

4.1 Production

Basic formulation that was used for product development:

4.1.1. Ingredients:

- Wholesome and mature breadfruit
- Salt
- Sodium Metabisulphite (0.5% solution)
- Water
- Cooking oil
4.1.2 Materials required:

- Weighing balance
- Bowls or basins for weighing ingredients
- 20L Buckets
- S/s trays
- S/s knives
- Heat pump dryer
- Hot gloves
- Frying pan with perforated basket
- Manual Operated Plastic Sealer
- Packaging plastic materials
- Labels
- Disposal gloves

4.1.3 Processing steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer.
d) Weigh the breadfruit and record weight.
e) Peel of skin, remove middle core and slice into thinly into breadfruit sticks, weigh and record.
f) Save the breadfruit pieces, off cuts, not suitable for chips and weigh and record.
g) Using two buckets, mix a solution of 0.5 % SMS in each bucket and dip breadfruit chips in one while the off cuts in the other.
h) Soak overnight.
i) Drain well removing excess SMS solution and blanch in the Blancher Machine No 2 for 1 min.
j) Drain well removing excess water.
k) Dry the chips well before frying.
l) Heat the oil in the frying pan and wait until the blue smoke appears the lower the basket filled with breadfruit chips for frying.
m) Constantly shaking the basket to allow the chips to be fried evenly and remove once reaching golden brown color.

n) Drain well above frying pan, removing excess oil and pour into absorbent paper.
o) Cool, sprinkle salt (optional) weigh, pack into bags noting down weights, label and store.

4.1.4 Remarks and recommendation

a) Breadfruit chips are best made fresh rather than dried and fried.
b) Breadfruit chips have a nice golden colour and crispy texture.
c) When frying do not overcooked.
d) For frying chips use only fresh cooking oil, not the used one.
e) Yield 4%
4.2 Breadfruit Flour from Off cuts:

4.2.1 Process

a) Drain off cuts from SMS solution removing excess SMS and blanch in the Blancher Machine No 2 for 1 min
b) Remove and drain well
c) Spread over the drying trays thinly and dry in the Heat Pump dryer for 8 hrs at 45 Degree C.
d) Once dried, remove from dryer, cool and using the sterilized disposal gloves pack into plastic bag, weigh and record weight.
e) The off cuts is then pass through the hammer mill for milling into flour
f) The flour is collected, weighed in a plastic bag, record weight
g) Label well noting the product name, weight and date.
h) Yield 11%

4.2.2 Remarks and recommendation.

a) These dried off cuts is then be subjected to the hammer mill for production of breadfruit flour OR be reconstituted with water and boiled dry with coconut cream to replace rice.
b) The breadfruit flour has a very slight yellowish appearance.
c) The breadfruit flour can be incorporated with wheat flour for bakery purposes A proportion of 30: 70 (breadfruit: wheat) is suggested for use.

Yield of both chips and flour from breadfruit 15.0 % (this yield is calculated from the small amount of breadfruit received)

Fig. 7 Breadfruit Processing
5.0 Babai (Giant Swamp)

5.1 Processing of Babai Chips

5.1.1 Ingredients

Wholesome mature babai
Oil
Salt
Sodium Metabisulphite
Water

5.1.2 Materials /Equipment required

Weighing balance
Bowls or basins for weighing ingredients
20L Buckets
S/s trays
S/s knives
Heat pump dryer
Hot gloves
Frying pan with perforated basket
Manual Operated Plastic Sealer
Packaging plastic materials
Labels
Disposal gloves

5.1.3 Processing steps

a) Check all ingredients and ensure all are available in quantity and quality.
b) Check all packaging materials and ensure all are cleaned with no damages.
c) Check all equipment and ensure all are in working order and are cleaned, liaise with Engineer.
d) Weigh the babai roots and record weight.
e) Peel skin and slice thinly into babai 6 cm long sticks, and 0.25 cm thickness, weigh and record.
f) Mix a solution of 0.5 % SMS with water in the bucket and dip babai chips overnight.
h) Drain well removing excess SMS solution and blanch in the Blancher Machine No 2 for 1 min.
i) Drain well removing excess water.
j) Dry the chips using a clean towel before frying.
k) Heat the oil in the frying pan and wait until the blue smoke appears then lower the basket filled with babai chips for frying
l) Constantly shaking the basket to allow the chips to be fried evenly and remove once reaching golden brown color.
m) Drain well above frying pan, removing excess oil and pour chips into absorbent paper
n) Cool, sprinkle salt (optional) weigh, pack into bags noting down weights, label and store.

5.1.4 Remarks and Recommendation

a) Dry the Babai chips well with a clean towel before frying.
b) Babai chips have a nice brown colour and crispy texture.
c) When frying do not overcooked.
d) For frying chips use only fresh cooking oil, not the used one
   Yield from chips 6%

5.2 Processing of Babai Flour
5.2.1 Processing Steps

a) Follow process steps a) –d) above and slice babai into thin flakes, weigh and record.
b) Mix a solution of 0.5% SMS with water in the bucket and dip slices overnight.
c) Drain well removing excess SMS solution and blanch in the Blancher Machine No 2 for 1 min.
d) Drain well removing excess water.
e) Spread over the drying trays thinly and dry in the Heat Pump dryer for 8 hrs at 45 Degree C.
f) Once dried, remove from dryer, cool and using the sterilized disposal gloves pack into plastic bag, weigh and record weight.
g) Label well noting the product name, weight and date for use at a later date OR
h) Pass the dry slices through the hammer mill, Machine No. 9, ensuring that the machine is dry and clean before use.
i) Cover inlet well to avoid babai flakes from being blown out, at the same time ensure that the receiving container is placed closely to the outlet to collect all flour.
j) After completing milling, collect all the flour and weigh in a plastic bag, record weight.
k) Label well, noting down product name, date and weight.

5.2.2 Remarks and Recommendation.

a) The dried babai flour is very white in color. Good soft texture. Yield is at 13% (yield is taken from the small amount of babai that was used)
b) The Babai dried slices can also be reconstituted with water and boiled dry with coconut cream to replace rice.

6.0 Pumpkin

Pumpkin skin is peeled and seeds removed and the rest of the process follows the same pattern as ripe bananas. The pulp is then processed into pumpkin jam, sauce and also combined with other products for processing of other products.

6.1 Processing of Pumpkin Jam

**Ingredients**
- Pumpkin pulp 33%
- Sugar 33%
- Water 33%
- Citric acid 0.35%

**Materials and Procedure**: Similar to the making of Banana jam

6.2 Processing of Pumpkin Sauce
Ingredients

Water  40%
Pumpkin Pulp  30.4%
Sugar  15%
Avongel Polar  5.74%
Salt  5.74%
Vinegar  4%
Spices  0.05%

Mix all ingredients together and bring mixture to boil, simmer and keep heating and stirring until brix reaches 72 deg. Fill hot into sterilize bottles, cool and label well and store. (rub avongel polar with sugar thoroughly before mixing with other ingredients.

7.0 Other Products Developed

a) Noni based Products, sauces, drinks, jam
b) Tody based products
c) Combined products recipes including pandanus, bananas, papaya.

This will not be discussed here but local counterparts have been trained well in product development and the quality control issues of development and finished goods and have all information on recipes and process methods.

Fig. 8: Babai (Giant Swamp Taro) Processing
8.0 Guideline for Hygienic Practice in the Process Plant

8.1 Personal Hygiene

8.1.1. Health Status of Personal

a) The health status of the worker at the processing plant is of prime importance.

8.1.2 Hygiene of Personal

a) Every person working and handling food is to maintain a high degree of personal cleanliness and to wear suitable, clean and where necessary protective clothing.

b) The person handling processed food and juice are to be in good health.

c) NO person suffering or recognized and suspected of being affected by an illness which can be transmitted through the food product or who has, for example infected wounds, skin diseases or
infections, sores or is suffering from diarrhea or cold is authorized to work in any position as long as there exists a direct or indirect probability of contaminating the food with pathogenic bacteria.

d) The personnel is to wear protective clothes like footwear and hairnets where and if appropriate.

e) The personnel must wash his or her hands thoroughly using soap and water prior to commencing work activities and after visiting the toilet. Hands and arms must be dried thoroughly with a hand towel or paper towels.

f) It is required that all personnel remove all jewelry (except plain wedding rings) before engaging in the handling of food products, fruit, pulp, juices, chips, powder and leather.

g) All personnel to wear protective footwear appropriate to the type of processing. Bare feet are not allowed.

h) The use of paper towels are allowed for drying of hands after washing and these paper towels must be discarded properly in a closed container.

i) A first aid kit is to be available at the factory.

j) Smoking is not allowed in the factory and on the factory premises. The management might allow smoking in a designated area.

k) Personal have passed basic training on personal hygiene (Records are available)

8.2 Hygiene of the Infrastructure

8.2.1 Hygiene of the Indirect Environment

Definition: The Indirect Environment is outside the factory premises

a) The factory is located in a clean environment free of contamination from this environment. If not, the Food Committee or management has to take essential measures to avoid any contamination.

b) The management and the Food Committee is to be aware of the industrial of agricultural activities of the neighbor and ensures there is no possibility of any possibility of any contamination from these neighboring activities.

8.2.2. Hygiene of the Direct Environment of the factory or food processing plant and premises.

Definition: The direct or immediate environment is on the factory premises.
a) The direct or immediate environment is free of obsolete materials like old equipment, timber, wood, used bottles and sacks.
b) The direct or immediate environment of the factory is maintained in good order, this means the grass is cut, free of products and product residues, paper, glass or any other material.
c) The factory has a minimum of plantation growth on the premises and plants growing against the factory wall are not permitted.
d) The premises have proper drainage to ensure the factory cannot be flooded during high rainfall
e) The factory has enclosed containers where waste materials are collected.
f) Waste containers are placed at a distances from the processing equipment to prevent any cross contamination
g) Cats and dogs are not allowed in the factory or on the factory premises.
h) Pigs and other animals are not allowed on the factory premises and the direct environment of the premises.
i) Manure of animals, pigs, dogs and cats if found should be removed and not cause any source of cross contamination on the premises.
j) Pandanus, Banana, Babai and Pumpkin waste is to be dumped at such a distant that it does not pose a risk to the environment where food processing is carried out.

8.3 Design of the building

a) The building and facilities are of adequate size for the handling and processing of the food products (pandanus fruits, babai, bananas, fig and pumpkin) and the processing of these food products and storage of the finished products.
b) The processing and storage rooms have sufficient ventilation preferably openings at opposite walls.
c) The ventilation openings are protected with insect proof screens to prevent the entrance of flies and pests.
d) The wall surfaces are made of impervious, non-absorbent, washable, durable and non toxic materials and require a smooth surface up to a height appropriate for the operations.
e) Wooden walls are not allowed.
f) The processing floors both inside and outside the buildings are made of concrete.
g) Floors are either covered with tiles, properly plastered concrete or made of a coating suitable for the purpose of processing pandanus juice, banana, babai and breadfruit products.
h) Damaged concrete or tiles where dirt and water collect are not allowed.
i) Door entrances have concrete floorings. Sand or unpaved entrances are not allowed.
j) Tiles if applied are of sufficient height to suit its purposes.
k) Floors can be covered with a protective coating.
l) Windows to be constructed to prevent accumulation of dirt. Windows that can be opened are to be fitted with insect proof screens.

m) Doors are made of smooth and non absorbent materials and easy to clean.

n) Wooden beams for construction purposes have no signs of infestation of wood – worm.

o) Steel beams have no sign of rust.

p) Washing and rinsing water is drained off from the factory floor and building through appropriate drains.

q) The floor has a proper slope to avoid ensuring NO water residues remain.

r) The floor surface is smooth, well plastered and without cracks so that water and product residues cannot remain trapped.

s) The floor has proper drains without cracks so that water and products residues cannot remain behind.

t) Floor drains have proper protection to prevent entrance of pests from outside.

u) The factory has adequate number of flush toilets and is not open directly into the room in which food is handled.

v) Sanitary conveniences are to have adequate natural or mechanical ventilation.

w) Adequate number of washbasins with cleaning soap is available, suitable located and designated for cleaning hands.

x) Handling and processing of pandanus fruits and other food products and storage of the final products can be in the same building provided there is a logical sequence of the flow of processing and there is no possibility of cross contamination.

y) Lamps are at such height that there is no possibility of damage and the lamps are protected with cover.

8.3.1 Remarks and recommendation

a) Door entrance to have concrete flooring to avoid sand and dirt being transferred to the factory floor.

b) The left windows are to be covered to avoid dust flowing into the processing area from passing vehicles.

c) The floor surface is to be well plastered to remove cracks and avoid build up of filth.

d) Old equipment in the freezer units to be sorted out and stored at a designated place.

e) Freezer and cooler units to be repaired for the purpose of storage.

f) Well water must be used only to wash the floor and rain water to wash fruits and food products as well as for processing.

g) Round edges at the floor connecting the floor and the walls and in drains are recommended to facilitate cleaning.

h) All doors including screen doors to have door handles placed to allow easy opening.

i) Holes in the ceiling and that made for electrical wiring to be covered up to avoid entry of rodents into the factory.

j) For safety purposes, label all power switches especially for the boiler.

8.4 Hygiene of the Building and Department
a) All the departments in the factory area are free of cobwebs, free of moldy spots, free of rusts, no signs of pests, no sign of infestation and the department are clean.
b) The departments are free of structural condensation.

8.5 Hygiene Design of Equipment and Tools

8.5.1 Processing Equipment
a) Lubricants or grease for the lubrication of the processing equipment with the possibility to be in direct contact with the fruits and or use are food grade and certificates stating Food Grade are available.

8.5.2 Storage tanks, containers and other recipients
a) Those parts of the Processing Equipment coming into direct contact with the pandanus juice and other food products are made of a durable food grade plastic or stainless steel.
b) The factory can demonstrate certificates of food grade quality of the plastic materials.

8.5.3 Material Specifications of the details and smaller tools
Improper materials used for food contact surfaces may allow migration of deleterious substances, impart of off flavors and colors, or may absorb food Materials and become a source of contamination.

a) Surfaces in contact with fruits, juices and other food products are either stainless steel, Non Toxic Food Grade materials or nylon.
b) Those parts made for the separating screens in the pulper, perforated baskets for washing of fruits and perforated for blanching are made of stainless steel.
c) The materials for the drying racks in direct contact with fruits and food are made of food grade materials such as plastic, nylon or stainless steel.
d) Drying frames are maintained and have no sign of rust.
e) Equipment and tools like containers, paddles and buckets are made of wood, durable plastic and stainless steel.
f) Drying racks have no sign of rust.
g) Sieve is made of stainless steel.
h) Tables are of stainless steel materials.
i) Household materials are allowed provided they are in good condition, clean, without cracks, without damages and not worn out.
j) Cleaning materials are made of durable plastic materials and can be washed out in hot water if necessary.
k) Aluminum containers are not allowed.
l) Steel brushes and other cleaning material made of steel are not allowed.
m) Plastic containers are suitable for its purposes; household materials should not be used for industrial purposes.

8.6 Water Quality

a) For processing, cleaning and rinsing only portable water is to be used
b) With town water, a certificate of analysis on yearly basis

c) Rain water used for processing is subject to chlorination or the management to demonstrate the water is portable by subjecting microbiological and chemical analysis at least on a yearly basis or otherwise, Records are maintained.

d) Well water used for above purposes to be subject to microbiological and Chemical analysis to be carried out at least twice yearly. Records are maintained.

8.6.1 Remarks and Recommendation.

a) The well water is to be used only for washing of the floor.

b) When well water is used for washing equipment it must be thoroughly rinsed with boiled rain water or town water.

c) Rain water is to be boiled before using it for rinsing equipment and cooling processed products.

d) Proper labeling of outlet to distinguish rain water from well water is to be carried out.

e) Rain water used for processing must be thoroughly filtered before use.

8.7 Pest and Rodent Control

a) Pest and rodents (in particular flies) are controlled through maintaining a clean and dry environment.

b) Obsolete materials are absent inside the factory and outside the factory in the direct neighborhood of the processing facilities.

c) Windows are equipped with appropriate mesh to protect from incoming pests.

d) Ceiling and wall gaps and holes are covered to avoid entry of rodents.

e) Doors are securely closed with appropriate mesh to prevent entry of pests.

f) Processing areas with open space (in particular receiving area of raw materials) Take immediate action to ensure absence of bee and wasp nests

g) Open baits are not allowed

h) The management or the Food Processing Committee must demonstrate due diligence in the control of pests.

i) Rodent and mice baits are used, if necessary

j) Fly lamps or insectocutors are to be used if necessary and maintained and cleaned at regular intervals

k) A checklist is in place (record)

8.8 Cleaning and Sanitation

a) The factory and the premises are to be kept clean

b) The factory, inside and outside in the direct neighborhood of the processing facilities and its premises are to be free of any obsolete materials
c) The management of the Food Processing Unit and or the Food Processing Committee is to demonstrate due diligence to keep the factory clean; establish a cleaning schedule, working instructions and a checklist.

d) The cleaning schedule documents the subjects which need to be cleaned and kept clean. This cleaning schedule indicates what needs to be cleaned, how, the frequency, methodology and detergent and sanitizing method (See example of cleaning schedule).

e) Cleaning and sanitizing agents are not to be stored where food is handled.

f) A checklist is in place to ensure hygiene and cleanliness (record.)

g) Cleaning and sanitizing agents are properly identified.

h) Unidentified containers containing cleaning agents are NOT allowed.

8.9 Organic Waste Materials and/or by products

a) The waste materials from Pandanus are largely contributed from the green outer inedible portion and fiber after screening, peelings and core of breadfruit and peelings of bananas and babai. This dry enough make good materials for compost.
b) The compost is to be made at a distance from the processing factory.
c) Unsuitable waste is to be discarded at sufficient distances from the premises to prevent any contamination to the factory.

8.9.1 Other Waste Materials

a) Any other waste products like cans, plastics, paper, glass and PET bottles is to be discarded properly.
b) Waste materials are to be temporarily stored in enclosed containers.
c) The factory and factory premises are to be free of waste materials.
d) Waste facilities and tools are to be cleaned and maintained on a regular basis.

8.9.2 Waste water

a) There must be no signs of waste water and water residues in and around the factory.

8.10 Others

a) The use of glass mercury thermometers is not allowed.
b) Broken glass windows is not allowed.

8.11 Training

a) The local counterparts and workers have been trained on Personal Hygiene, Factory Hygiene, Food Processing, Food Preservation, Product Development, Consumer Survey and Product Costing.
b) Training of staff has been documented; the content of the training, the trainer, date and the participants.

9.0 Production and Processing of Food Produce in Kiribati (Pandanus, Breadfruit, Bananas, Babai).

The processing guideline is the result of the four (4) week Operational Training on Product Development and Food Processing and Preservation incorporated with Quality Control, Quality Assurance and HACCP.

9.1 Production and growing of foods both regular and organic

a) Fruits, vegetables and roots which are grown organically must ensure absence of pesticides and herbicides.
b) The processors must ensure that growers and their suppliers of fruits, vegetables and root crops are aware of activities of neighboring farmers in terms of use of herbicides, pesticides and insecticides. Due diligence has to be demonstrated.

9.1.1. Remarks and Recommendation

The Organic farmers were briefly trained on Good Post Harvest Practices and the importance of meeting Product Specification set by the Food Processing Plant. Growers aim for organic certification of their produce.

9.2 Harvesting of Produce

9.2.1 Pandanus,

a) Pick only three quarter ripe pandanus,
b) Do not pick pandanus keys that have fallen on the ground. These contain dirt and might contain larvae of the fruit fly.
c) When picking pandanus, avoid the use of sticks which will damage the fruits and avoid dropping the fruits on the ground which will result in bruising.
d) Do not use green immature or damaged and bruised fruits.
e) Do not use fruits that are moldy or infected with insects.

9.2.2 Breadfruit,

a) Pick only mature breadfruit.
b) When picking breadfruit, avoid the use of sticks which will damage the fruits
c) Avoid dropping the fruits on the ground which will result in bruising.
d) Do not use green immature breadfruit or damaged and bruised fruits.
e) Do not use fruits that are moldy or infected with insects.
f) Breadfruit must be harvested and delivered on the day of processing.

9.2.3 Bananas

a) Pick only mature bananas.
b) When harvesting, use a sharp knife and ensure that the bunch do not fall on the ground which will result in bruising.
c) Do not use green immature or damaged and bruised fruits.
d) Do not use fruits that are mouldy or infected with insects.

9.2.4 Babai

a) Harvest only mature babai
b) Ensure that during harvesting (digging with fork or stick) the babai is not damaged or bruised.
c) Select only good wholesome roots free of rot, bruises and damages.

9.2.5 For all produce a) to d) above

a) During harvesting, pigs and dogs must not be allowed near the produce to avoid contamination through animal waste.
b) The source of the fruits is recorded to ensure traceability. Records are in place.
c) Pickers and those involved in harvesting and primary handling of fruits are made aware of the quality aspects of the fruits through awareness programs e.g. training and product specification leaflets.

9.2.6 Remarks and Recommendation

a) Producers in the outer islands must be trained and be made aware of the harvesting and product specification required by the food processing plant.

9.3 Produce Packaging

a) Clean plastic tubs, crates, cartons or bags are allowed.
b) Unclean used bags (jute, plastic), containers, crates from unknown sources are not allowed.
c) Perforated containers and crates are recommended to allow good air ventilation.

9.4 Transportation

a) The produce must be handled with care, no throwing or crushing or used for seating
during transportation.
b) The produce must be covered to avoid contamination from the environment.
c) Care must be taken for fruits being transported from outer islands; it must arrive at the factory wholesome.

9.4.1 Remarks and Recommendation
a) For fruits, pandanus, bananas and papaya that are supplied from the outer islands; due to irregular shipping and the duration it takes to reach Tarawa, one to two weeks at the most, it is recommended that pre processing (pulping and/or drying, depending on end use of product required) is carried out in the islands before transportation. From recent experience most products supplied from the islands for the project was unfit for processing and was rejected (refer photos). Farmers are trained to know of the quality of the produce required.

9.5 Raw Material Processing

9.5.1 Reception and Sorting

At the collection point at the processing plant the raw materials are checked according to the following criteria as per raw material specification.

a) Only good wholesome produce is allowed
b) Immature pandanus, bananas and breadfruit are not allowed.
c) Overripe fruits are rejected. Overripe fruits are likely to have more yeast causing fermentation that will affect product quality taste.
d) Damaged, open and bruised fruits are rejected
e) Twigs and leaves, dirt and soils are removed
f) Some samples are tested for pH and Brix of the fruits. Information is recorded for the supplier. Results are recorded.
g) Traceability starts and the respective suppliers are recorded. A number of farmers, a district or island can represent.
h) Packaging materials are checked upon arrival according to the required specifications.
i) The source of the produce/fruits is recorded to ensure traceability. Records are in place.
j) Weigh the accepted produce for processing. Record weight for payment.
k) Weigh the rejected produce/fruits, record and communicate with the supplier or agent and agriculture officer.

9.5.2 Washing

a) The fruits are washed mechanically with portable water.
b) Air is pumped in to the washing tank to allow gentle washing of fruits.

9.5.3 Peeling, Trimming and Cutting
The produce are peeled or trimmed and cut into small pieces and weighed. Record weight.

9.5.4 SMS dip

Produce are soaked in 0.5% SMS solution (applies to breadfruit, babai, green and ripe bananas)

9.5.5 Blanching

Produce after trimming (applies to pandanus) and SMS dipping are blanched in hot water and drained well

9.5.6 Pulping and screening

Hygienic conditions and Good Manufacturing Practices are applied.

9.5.7 Pasteurization

a) Pasteurization can be flash pasteurization or open pot pasteurization

b) For the pandanus juice, open type pasteurization is carried out at 85 - 90 degree C for 5 min - 10 mins (note time is increased in this situation because water used as ingredient is not portable at the factory and water used for washing is well water). Until and when portable water is supplied to the factory and all hygienic standards are complied (less handling) and then pasteurization time is to be reduced to 15 seconds.

c) Keep records.

d) Pasteurization is a CCP so pasteurization must be carried out as per instruction documented attached

9.5.8 Cooling

a) Pasteurized product is cooled openly to 45 degree C before filling because plastic bottled (PET) are used. Cooling must be carried out as quickly as possible. Filled bottles are placed in a basin of clean cold water bath; ensure the top end of the bottle is not submerged.

9.5.9 Filling

a) Empty bottles and lids must be sterilized and kept dry in a cool clean place before use

b) Hygienic practice must be applied when filling.

9.5.10 Sterilization

a) When glass bottles or heat resistant packages are used, the pandanus juice is pasteurized to 85 degree C for 5 seconds, filled hot into glass bottles or other heat resistant packages, closed loosely and then subjected to a hot water boiling bath for 30 mins. Bottles are closed tightly and cooled immediately by first dipping in warm water and then cold water.
b) Sterilization is a CCP, so sterilization must be carried as documented.

c) Bottles are dried thoroughly, labeled and packed in cartons

9.6 Storage

a) Products are stored in a cool dry place.

b) Reference samples are withdrawn from each batch and stored separately for future reference and tests. Number of samples withdrawn depends on the batch size, 4 bottles is recommended for the small batch at the factory.

9.7 Labeling

i) Ensure label requirements are met.

Name of company
Country of Origin
Botanical Name
Common name
Batch or Lot Number
Manufacturing date
Use by Date
Volume or Weight
Storage Conditions
Instruction on how to use the product

9.8 Dispatch

Ensure the packages are labeled well with appropriate information.

9.9 Distribution

Contact with direct sunlight must be avoided throughout the distribution channel

9.10 Validation

a) Once the hygiene is implemented and the processing guideline is in compliance with the requirements of the standard, the microbiological tests are to be conducted.

b) Carry out the quality parameters and record the results

10.0 Hazard Analysis Critical Control Point (HACCP) Exercise
The following process steps have been identified as the Critical Control Points (CCPs) in the processing of Pandanus juice.

a) Reception and collection of raw materials; overripe, damaged, moldy and infested produce will affect product quality and safety.

b) Pasteurization; pathogens is hazardous to consumers.

c) Sterilization; micro organisms and bacterial spores will affect safety and quality of products.

d) Glass filling because of glass breakages

10.1. HACCP for Pandanus Juice.

10.1.1 Hazard are classified into

i) Physical - foreign materials that may have contaminated the product e.g metals, glass, nuts and bolts

ii) Chemical - pesticides, insecticides, some chemical additives that may cause to consumers

iii) Microbiological - pathogenic bacteria and bacterial spores

<table>
<thead>
<tr>
<th>Step</th>
<th>Reason for CCP</th>
<th>Critical limit</th>
<th>Correction</th>
<th>Corrective Action</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reception of fruits</td>
<td>Mycotoxins</td>
<td>No bruised &amp; overripe fruits</td>
<td>Recheck the fruits</td>
<td>Reinforce awareness</td>
<td>Material losses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No infestation of moulds</td>
<td>Rejection of fruits</td>
<td>Training program</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Monitor losses closely</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ensure 100%</td>
<td></td>
</tr>
<tr>
<td>Processing</td>
<td>Coli forms</td>
<td>Pasteurization at 85 deg C for 5 mins (PET bottle packaging)</td>
<td>Put on hold and re pasteurize</td>
<td>Identify root causes of problems and prevent occurrence</td>
<td>Pasteurization records</td>
</tr>
<tr>
<td></td>
<td>Bacterial spores</td>
<td>Pre pasteurize at 85 Deg for 5 sec. then sterilize for 30mins over hot water bath</td>
<td>Put on Hold and re sterilize</td>
<td>Sterilization records</td>
<td></td>
</tr>
<tr>
<td>Glass filling</td>
<td>Glass breakages</td>
<td>No glass splinters</td>
<td>Discard empty and filled bottles within</td>
<td>Identify root cause of problems and prevent occurrence</td>
<td>Non conformance reports</td>
</tr>
</tbody>
</table>
10.1.2 Safety Checks

The following tests are to be conducted after implementing the hygiene and processing guide.

a) Microbiological analysis (specification for any fruit juice according to CODEX standard)
b) Records of Pasteurization
c) Raw material rejection documents
d) Records of Non conformance

10.1.3 Quality Checks

The local counterpart or supervisor carries out the following in house checks for the juice Brix, pH, Color, Texture and Taste

a) Brix

**Definition:** Degree Brix (symbol ° Bx) is a measurement of the mass ratio of dissolved sucrose to water in a liquid. In this exercise it is measured with a refractometer. A 25 ° Brix solution has 25g of sucrose per 100g of liquid OR there are 25 g of sucrose sugar and 75 g of water in the 100g of solution.

b) pH

**Definition:** Is a measure of the activity of hydrogen ions (H⁺) in a solution and therefore its acidity or alkalinity. An aqueous solution with a pH values lower than 7 are considered acidic, while pH values higher than 7 are considered alkaline. *(An aqueous solution is a solution in which the solvent is water)*

**Example:**

<table>
<thead>
<tr>
<th>Table II: Product pH Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
</tr>
<tr>
<td>Lemon juice</td>
</tr>
<tr>
<td>Vinegar</td>
</tr>
<tr>
<td>Orange juice</td>
</tr>
<tr>
<td>Beer</td>
</tr>
<tr>
<td>Tea</td>
</tr>
<tr>
<td>Milk</td>
</tr>
<tr>
<td>Pure Water</td>
</tr>
<tr>
<td>Sea water</td>
</tr>
<tr>
<td>Hand soap</td>
</tr>
</tbody>
</table>

c) Color

The color is a unique feature and quality of the fruit or produce. It is the original characteristic of a fruit, indication of freshness, distinguishes the varieties, indication of the standard of processing procedures implemented, overcooking may show dark coloration.
The manufacturer must establish a standard color code for comparison.

**Taste**
The juice of freshly produced before release for sale and reference sample juice throughout shelf life is tasted.

a) Identify acid taste or any off flavors
b) Check for guarantee of shelf life

Juice is to be tested for taste and results to be recorded.

11.0 Consumer Assessment

The consumer assessment for any product developed is carried out using the Hedonic scale (Appendix 2) to establish product quality and or consumer acceptance of the formula

a) Different formulations of one particular product is tested to identify which formula is more acceptable by the consumer
b) For comparison of developed products against similar commercial products to test level of acceptance and comparability.

Analyzing the consumer assessment will indicate acceptance or non acceptance, comparability or otherwise with similar type of products.

These results will enable one to make proper decision on the next steps to be followed for product developed.

12.0 References:


**Appendix 1: Testing Equipment**
Balance for weighing

Hand held pH meter

Hand held Refractometer

Temperature Probe

Appendix II: Poor Quality Items to be avoided
Appendix III: Hedonic Scale Form
Product: Drink Samples

Instructions:

Please taste the drinks coded A, B, C, D, E.

Then place the sample drink code beside the words that best describe your opinion of the sample.

- Very acceptable
- Moderately acceptable
- Slightly acceptable
- Neither acceptable nor unacceptable
- Slightly unacceptable
- Moderately unacceptable
- Very unacceptable

Why did you rate the product this way?

A

B

C

D

E

Thank you for your help!

Appendix IV: Standard Operating Procedures

A) Measuring the Brix Using the Hand Held Refractometer

(Adapted from IAS Standard Operating Procedure)

1.0 SCOPE:
1.1 To determine the total soluble solids in foodstuffs by using a Hand Refractometer. The procedure is applicable to a wide range of fresh and canned fruits, fruit jellies, marmalades, pastes and sugar syrups etc.

2.0 DEFINITIONS:

2.1 Brix value gives the percentage of total soluble solids present in samples such as those mentioned in the scope. In case of syrups the brix value is the total sugar content as percentage. With fruits preserved in sugar the brix value is mostly sugar with some solids coming from the fruit themselves if the brix of the entire homogenized fruit and syrup is measured. In such cases the brix value is close to the total sugar content if the sugars are determined by a separate method such as the HPLC method SOP FC 318.

2.2 Hand Refractometers: These are small and potable but very handy piece of equipment especially for the food manufacturing and processing companies who usually want to check brix levels of syrups and fruits etc every hour or on each batch of samples as they are processed. The equipment is not as accurate as the HPLC method for sugar determination. However, if calibrated well they do produce reasonably accurate results. They are usually used with high sugar containing samples where ± 1.0 to 2.0% from the real value is still satisfactory.

2.3 A few drops of the syrup sample (extracted from solid foods where necessary) or a thin film of a sample paste (e.g. tomato paste) is placed onto the prism of the calibrated refractometer. The lid for the prism is closed and the reading for % brix or m/m sugars is taken as seen from the eye piece of the instrument against ordinary light.

2.4 The instrument works on the theory that when incident light passes through a film of the sample it is refracted (bends). Refraction occurs due to the fact that the speed of light after hitting the sample film is different from the reference speed of light in air. The refractometer measures the position of the light beam relative to the reference incident light. The refractometer is calibrated with standard sugar solutions.

2.5 The speed of light in vacuum is 3.00 x 10^8 cm/sec. In a medium other than a vacuum, the speed of light is different from that in vacuum. This creates refraction. The technique is known as refractometry and measured parameter is commonly referred to as refractive index.

3.0 PROCEDEURE:

Prepare a homogenous sample

3.1 Sample Measurements:
3.1.1 Once the refractometer is calibrated, place a thin film of the homogenized sample paste on to the refractometer prism, close the lid and read the brix. Be sure to clean the refractometer with distilled water after each sample or standard readings are taken. This will prevent sugar carry over from one sample to the next. Dry the refractometer prism and lid carefully using a soft tissue, such as (Snowtex or Kleenex) before reading the next sample.

4.0 CALCULATION:

4.1 The refractometer gives a direct % (m/m) readout of the brix therefore the value as obtained from the refractometer is reported.

4.2 Report results to one decimal place.

5.0 NOTES:
The refractometer is a delicate instrument. Take all precautions to avoid damage to the glass prism and other optics. It should be well cared for. Clean the glass prism and the lid area after each sample or standard reading. After all readings have been taken thoroughly clean the refractometer with more distilled water, wipe dry, place it into its appropriate box and store away. Avoid shocks as this is an optical instrument.

B) Measuring pH using the hand held pH meter

(Method Adapted from IAS Standard operating procedure)

1.0 SCOPE

This method describes the operational procedure for the Hanna pH meter. It also describes the pH meter’s calibration procedure that is to be conducted prior to using the meter for analysis.

2.0 APPLICATION
2.1 This method details the operational procedure to use the instrument in performing routine analysis of pH in Food.

3.0 PRINCIPLE

3.1 The basic principle of electromagnetic pH measurement is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode. The instrument is calibrated using two buffers and its performance is checked using a third buffer.

4.0 APPARATUS

4.1 The Hanna pH meter is a microprocessor-based bench meter for pH and temperature measurement.

5.0 PROCEDURE

5.1 Instrument Setup

Note: To prevent damage to the electrode, remove the pH electrode from the solution before turning off the meter. If the meter is OFF, detach the electrode.

5.1.1 The instrument is to be calibrated:

(i) Whenever the pH electrode is replaced.
(ii) At least once a week.
(iii) After testing aggressive chemicals.
(iv) After pressing RESET.
(v) If higher accuracy is required.

5.2 Preparation of Buffers

5.2.1 Prepare fresh buffers on a two monthly basis. Before changing buffers, perform old versus new buffers checks, and record results on the pH meter Calibration Log Book. Also record the batch numbers of newly prepared buffers.

5.2.2 Notes:

(i) *Prepared buffers maybe used past the two months expiration date provided there is data to show they are still within the acceptable pH range.
(ii) pH Buffers are to be kept free of contamination by keeping its bottles tightly sealed when not in use.

* This is a modification of the reference method that recommends that prepared buffers have a shelf life of one month.
5.3 Calibration Procedure

Manual calibration with two buffers is described below. The performance of the pH meter will be checked with the third buffer.

5.3.1 Use pH 7.00 as the first buffer. If you are measuring in the acid range, use pH 4.01 as second buffer, if you are measuring in the alkaline range, use pH 9.2 as second buffer.

5.3.2 Rinse both the pH and temperature electrode with distilled water, blot dry using tissue papers. Immerse both the probes approximately 4 cm into the buffer 7.00 solution and stir gently. The temperature probe should be close to the pH electrode.

5.3.3 When the reading is stable, record the displayed pH reading.

5.3.4 After the first calibration is confirmed, rinse electrodes with distilled water, blot dry using tissue papers. Immerse the pH electrode and temperature probe approximately 4 cm in the second buffer solution and stir gently. The temperature probe should be close to the pH electrode.

5.3.5 If necessary press "Δ°C" or "∇°C" to select a different buffer value.

5.3.6 Press RANGE to display the temperature reading on the LCD during calibration. Record the temperature reading on the pH Meter Calibration Log Book.

5.3.7 Remove electrode from second buffer, rinse thoroughly with distilled water and dry electrode with tissue papers. Immerse in a third buffer 7.0 (after rinsing with third buffer) and measure pH value. The reading should be within 0.1 unit for the pH of the third buffer. Record the pH and reading on the primary LCD in the pH meter Calibration Log Book.

5.3.8 If meter response shows a difference greater than 0.1 unit from the expected value, electrode may need to be cleaned (refer to 5.6.3).

6.0 pH Measurement Procedure

Once pH meter is calibrated, remove electrode from buffer, rinse with distilled water and rinse with sample to be measured.

8.4 Electrode Storage: To ensure a quick response and free-flowing liquid junction, the sensing element and reference junction must not be allowed to dry out. The electrode must be stored by soaking in pH Electrode Storage Solution. As an alternative, use potassium chloride (KCl) solution (which is prepared by adding 1 gram of KCl to 200 ml of pH 7 buffer (non-colored). If KCl solution is not available, appropriate substitutes in order of preference are pH 4 buffer or tap water. Never store the electrodes in distilled water.

6.0.1 Electrode Maintenance: Inspect electrode for scratches, cracks, salt build-up, or membrane/junction deposits on a monthly basis. Rinse any salt build-up with distilled water. Record details of monthly inspection on the pH meter Calibration Log Book.

6.0.2 Electrode Cleaning Procedure: The solution used to clean a pH electrode depends on the possible contaminants
6.0.3 For general cleaning, soak in electrode cleaning solution for 15 minutes and rinse four times with distilled water. Alternatively, soak the electrode in 0.1 M HCl or 0.1 M HNO₃ for 30 minutes.

6.0.4 For removal of protein deposits, soak the electrode in 0.1 M tetra sodium EDTA for 15 minutes.

6.0.5 For oil and grease removal rinse with mild detergent or 10% methanol solution.

After any of the cleaning procedures, thoroughly rinse the electrode with distilled water, drain & refill the reference chamber. Soak the electrode in storage solution for at least 1 hour.