

**Consultancy Report on Banana Processing
to the Island Food Community of Pohnpei**

By

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Executive summary

1. Pohnpei is an island rich in tropical horticultural crops.
2. A large number of seasonal crops such as mango, breadfruit, soursop etc are underutilized and wasted during the cropping season.
3. A number of seasonal and other crops could be easily semi-processed for further processing and value-adding.
4. Bananas are harvested throughout the year, and a number of nutritious and value-added products could be prepared from this crop.
5. Drying is a simple and effective means of preserving banana and other crops.
6. A number of dried products such as banana figs (dried whole banana) and banana roll-ups (banana and other fruits blended and dried in the form of a thin sheet) could be made from ripe bananas and banana powder could be made from green mature bananas.
7. Unique nectar blends could be made by blending non-acid bananas with acid fruits such as mango, pineapple, calamansi, soursop etc.
8. These acidified nectar blends could be preserved by filling into pre-sterilized 300 ml bottles, closing the cap tightly and sterilizing in a boiling water bath for 30 minutes.
9. Bottles so sterilized could be stored for at least 4-6 months if kept in a cool dry place.
10. The most important point to remember in this process is to ensure that the final pH of the nectar is below 4.5, preferably, between 4.0-4.2.
11. The pH should be measured accurately using a standardized pH-meter.
12. Banana powder made from dried green banana could be stored in an air-tight container for several months. Banana powder could be utilized to partially substitute imported wheat flour for a number of products such as pancakes, doughnuts, and bakery products. For pancakes, it could be substituted at the rate of 1:1, and in bread, it could be substituted at the rate of up to 25% without significant changes in bread volume and crumb structure.
13. Seasonal crops, such as mango and sour sop, could be semi processed by extracting the pulp and mixing potassium metabisulfite (a preservative) at the rate of 0.25% of the weight of pulp. Semi-processed pulps could be held in 25 liter food-grade plastic cans tightly sealed with lids, for several months. They should be stored in a cool dry place, but do not require refrigeration.
14. Stringent sanitary and hygiene standards should be maintained at all times during the manufacture and storage of the semi-processed pulps.
15. Before the semi-processed pulps could be used for the manufacture of nectars or dried fruit roll-up or any other products, it is important to boil the pulp in an open stainless-steel pan to evaporate off the sulfur dioxide (the active component in potassium metabisulfite).
16. The above operations, including the measurement of pH should preferably be done under the direction of an experienced food technologist, in order to avoid undue spoilage, contamination or overdosing.
17. Mature but unripe breadfruit also could be peeled, cored and cut into slices of 1.5-2.0 mm thickness and solar-dried for further use. Dried breadfruit could be ground and used as a partial substitute for wheat in bread, pancakes, and other baked products.
18. A number of solar dryer designs were developed by the consultant and built by Capitol Manufacturers. These could be used with greater efficiency than by just drying in the

open sun. Different solar dryers could be used for drying different products such as relatively large pieces (e.g. whole ripe bananas in the manufacture of banana figs), slices, grated products, or pulps.

19. If browning is a problem, as may occur in the case of making sliced green breadfruit, the problem could be overcome by immersing the cut pieces/slices in a solution of 0.05% potassium metabisulfite in water.

Recommendations

1. **That the Island Food Community of Pohnpei (IFCP) and Pohnpei Agriculture in conjunction with the College of Micronesia-FSM (COM-FSM) promote the production of different blends of fruit juices, nectars and dried products made at the workshop, even at the home scale.** Rice used in rice-soup served at funerals and other functions could be replaced with dried grated breadfruit or taro.
2. The technical know-how in food processing and food preservation is seriously lacking in Pohnpei in order to assist and guide the entrepreneurs in safe and hygienic methods of food processing and preservation. **Therefore, an experienced, food scientist/technologist passionate in helping island food communities, who is able to work under limited resources, who can work across a number of organizations such as COM-FSM, Pohnpei Agriculture, and IFCP, and the Pohnpei Business Development Center (PBDC), should be hired.**
 - (i). This person should preferably be based at the COM-FSM, and should take an active role in teaching some of the Food Processing courses offered by COM-FSM.
 - (ii). Besides teaching at COM-FSM, this person also should take an active role in promoting simple methods of food processing and preservation to the community and act as a resource person for entrepreneurs in food processing in collaboration with Agriculture, IFCP and PBDC.
3. There is also a lack of basic food processing equipment and facilities for simple food analyses. **Therefore, it is recommended that a central food processing pilot-plant facility be set up at the COM-FSM.**
 - (i). The pilot-plant facility will have small-scale horticultural processing machinery such as for pulping, pulp-extracting, blending and homogenizing, pressing, bottle-capping, sterilizing, centrifuging and drying (a small vacuum dryer would be very useful). It will also have small-scale processing machinery for small-goods such as sausages, ham and bacon. These may include sausage cutter, sausage filler, brine tanks for curing of ham and bacon.
 - (ii). The pilot-plant should also have adequate freezing (-20°C) and cold-room (4°C) facilities. However, in order avoid cross contamination, animal products should not be stored with plant products at any time.
 - (ii). To avoid cross contamination, there should be separate stainless-steel tables, cutting knives, cutting boards, utensils and tools for plant products and animal products.
 - (iii). Preferably the plant product processing area should be physically separated from the animal products processing area for the same reason (to avoid cross contamination).
4. **A Food analytical facility should be established to do simple analyses, and should be located close to the pilot-plant facility.** It should have the following basic instruments:

- (i) Burettes, pipettes, measuring cylinders, beakers, Erlenmeyer flask, volumetric flasks, all of different sizes.
- (ii) pH meters
- (iii) Refractometers (1-45 °Brix and 45-90 °Brix)
- (iv) Color comparator
- (v) Bausch & Lomb UV-Visible spectrophotometer (optional)
- (vi) Basic laboratory chemicals: sodium hydroxide, hydrochloric acid, phenolphthalein indicator, etc., etc.

5. All food processing efforts by COM-FSM, IFCP, and Pohnpei Agriculture of the Office of Economic Affairs should involve PBDC, who could advice the entrepreneurs on appropriate pricing, promotion, and sustainability.

Acknowledgement

My visit to Pohnpei was not possible without the help and support of many. First, I would like to thank the Secretariat of the Pacific Community, Forest and Trees Programme for their financial contribution, which made my visit possible. Secondly, I would like to thank the Island Food Community of Pohnpei (IFCP), the Pohnpei Agriculture of the Office of Economic Affairs, and the College of Micronesia-Federated State of Micronesia Cooperative Extension Services for coordinating my visit.

I would like to place on record, special thanks to Dr Lois Englberger for initiating my visit when she visited New Zealand two years ago and persistently working with the funding agencies for making my visit to Pohnpei a reality. Her dedication, enthusiasm, and passion to improve nutrition of the local Pohnpeians by substituting imported foods with local foods deserve special commendation. One of the primary purposes of my visit was to demonstrate that possibility by way of workshops and advice to individual entrepreneurs on processing of locally grown products, in particular, karat banana. I hope this was achieved to her satisfaction.

I would also like to express my special thanks to Mr. Adelino Lorens, Pohnpei Chief of Agriculture and chairman of IFCP, for his friendship, support and timeless dedication to this project, in spite of his busy schedule. His leadership, rapport with the community, and his friendly manner touched me very much and we developed a special bonding, and friendship, which I am sure, will continue for a long time to come.

I am also indebted to Mr. Engly Ioanis for assisting with the planning of my visit and for his keen enthusiasm and interest in disseminating food processing information to the community through his extension agents, and for accompanying me to the pilot farm.

Last but not least, I would like to thank, Mr. Jim Currie, Vice President of the College of Micronesia – FSM and his staff and colleagues for their enthusiasm on food processing and supporting my recommendation on establishing a pilot-plant food processing facility at the College of Micronesia - FSM, to further advance the dream of preserving and adding value to island food products.

1. Terms of Reference

The Contractor, Dr. Conrad Perera, will in consultation with the Island Food Community of Pohnpei provide training and assistance with the small-scale processing of local food products, focusing on banana and other local crops. Specifically, the Contractor will:

- Work with approximately ten entrepreneurs and provide them with advice and training on the technical aspects of the manufacturing process, paying special attention to hygiene, safety and quality of processed products.
- Demonstrate the possibilities of making a number of products (at least four basic products including banana powder and jam) using simple equipment available in the country.
- Provide advice on the equipment needed to produce products on a relatively large industrial-scale processing.
- Provide information on simple quality parameters of processed products and their measurements where applicable.
- Provide advice on product pricing, marketing, distribution, and margins.

2. Schedule of visit

Monday, Nov 26.

Arrive in Pohnpei at 12.58 pm

Met by Dr Lois Englberger at the airport and brought to Pohnpei Agriculture, Office of Economic Affairs.

PM - Meet with Mr. Adelino Lorens, Chief of Agriculture and Mr Engly Ionais, head of Agriculture Extension at the College of Micronesia-FSM.

Tuesday, Nov 27.

AM - Attend the Sub-Regional workshop on Agro-forestry and Plant Propagation in the Northern Pacific.

Visit food processors, produce markets and grocery shops.

PM - visit Mr. Namio Nanpei of the Coconut Development Authority.

Meet Mr. Kikuo Apis, Administrator, Office of Economic Affairs.

Visit Mr. Bing and his brother Red to discuss the modifications to improve the solar dryers that they made.

Wednesday, Nov 28.

AM - Meet Mrs. Penny Weilbacher, Director, College of Micronesia –FSM Pohnpei Campus

PM - visit Pohnpei Pilot Farm. Observe preparation of Maher (traditional fermented breadfruit) for baking in the Uhmw (traditional hot stone oven)

Thursday, Nov 29.

AM - Review-meeting with Adelino, Lois and Engly at Agriculture conference room to detail out the items for the workshop.

PM – Visit Mr. Sei’s pepper processing facility.
Prepare items for the workshop

Friday, Nov 30.

Workshop at Agriculture Conference Room

Saturday, 01 Dec.

Free day

Sunday, 02 Dec.

Free day

Monday, 03 Dec.

AM – Board Meeting of IFCP

PM – Visit Mr. Sei’s pepper farm in Kitt.
Discuss with Mr. Bing about further improving the efficiency of the solar dryer design

Tuesday, 04 Dec.

AM - Attend Pandanas Workshop given by Mrs. Ione deBrum of the Marshall Islands

PM – Meeting with Mr. Kyoshi Phillips, Dean of Agriculture at the College of Micronesia-FSM to discuss curriculum on food processing.

Wednesday, 05 Dec.

AM – Attend the Pandanas Workshop
Visit former facilities of the Pohnpei Agriculture & Trade School (PATS)

PM – Report writing and visit Mr. Bing to check the improved solar dryers.

Thursday, 06 Dec.

AM - De-briefing with Adelino, Lois, Jim Currie (Vice President-CRE, College of Micronesia-FSM) and Herman Semes (Coordinator, Pohnpei Business Development Center)
PM – meeting with Herman Semes regarding small scale processing of horticultural products

Friday, 07 Dec.

AM - Demonstrate the manufacture of dried breadfruit and preparation of powder thereof, and the use of breadfruit powder in pancake making to St Joseph’s Church sisters and local ladies at Awak village.

PM – Discuss new solar drying designs with Mr. Bing, for drying of purees, grated products and pieces.

Saturday, 08 Dec.

Free day

Sunday, 09 Dec.

Free day

Monday, 10 Dec.

Meeting with Adelino, Lois, Engly and Jim Curry

Tuesday, 11 Dec.

Report, writing & last meetings

Wednesday, 12 Dec.

Report writing & last meetings

Thursday, 13 Dec.

Return to New Zealand

3. Workshop synopsis

The workshop was attended by about 30 individuals, comprising of Agriculture Extension Agents, entrepreneurs, and other interested parties.

All objectives stated were met

The hygiene aspects discussed for Good Manufacturing Practices (GMP), were well taken by the participants of the workshop.

There was widespread interest in juice/nectar manufacture, drying and other value added products that were made.

Three designs of solar dryers were given to Mr. Bing of Capitol Manufacturers, the manufacturer of the solar drying systems for Island Food Community of Pohnpei. Two designs are for drying of solid products, and the third is more suitable for drying of grated products and purees.

Pohnpei is an island that seems to be rich in agriculture and a number of tropical products such as bananas, breadfruit, mango, sour sop, pineapple, guava, taro and yam seemed to be in plentiful. At the time of the workshop, very few locally processed products appeared in the market, and I was made aware that during the season a lot of local produce such as bananas, mangoes and breadfruit go to waste.

My visit was mainly concerned with the preservation of bananas, but I was able to advise a few entrepreneurs and prospective processors how to semi-process products in abundance, and hold at ambient conditions for further processing at a later stage.

3.1 Workshop preparation

(a) Before the workshop, mature, but unripe Karat bananas were peeled, and cut into about 1.5 – 2 mm thick slices. They were dried in a dehydrator for about 3 hours at 56°C. By that time, they were fully dried and quite crisp. The dried banana slices were stored sealed in zip-lock bags.

(b) Ripe Taiwang bananas were peeled, and dried in a solar dryer for a day and were also finished off in a dehydrator overnight at 50°C. The whole dried bananas were at a final moisture content of about 15%, when they would be quite stable for a few months provided they are well packaged, sealed and stored in a cool dry place. These dried bananas were known as banana figs and are a good source of vitamins, minerals and other nutrients. They could be used as a substitute for dates, or raisins, or other imported dried fruits in baked goods such as cakes, muffins, buns etc. They were also used to demonstrate another use for excess ripe bananas.

3.2 Ways in which food deteriorate

The participants were introduced to the basic principles by which food deteriorates:

1. Microbiological
2. Chemical
3. Biochemical
4. Physical

Microbiological deteriorations: The participants were told how foods undergo deterioration by microorganisms. If foods are left without preservation or processing, microorganisms will grow in our foods. When undesirable microorganisms grow in our foods, they become putrefied, and inedible. In some instances, consumption of foods contaminated with food-borne pathogens could cause serious health problems to individuals. Fortunately most pathogens do not grow at low pH (high acid) environment.

Therefore one of the fundamental principles in food preservation is to divide the foods into two categories, namely acid foods and non-acid foods.

Those foods that have a pH less than 4.5 are categorized as acid foods and those that have a pH of more than 4.5 are categorized as non-acid foods.

Foods that have a pH of less than 4.5 can be processed and preserved at boiling water temperatures, while those that have a pH of greater than 4.5 need to be processed at temperatures as high as 121°C.

In this workshop, we are concerned with only the acid foods. Certain foods like banana, pandanas, papaya etc., have pH values higher than 4.5. However, their pH could be lowered by blending with acid fruits such as calamanci, pineapple or sour sop or by adding citric acid to bring the pH of the final blend below 4.5, so that they could be processed and preserved in a simple boiling water bath. This type of blending to reduce the pH of non-acid fruits, also improves the flavor profile of the finished product.

Chemical deteriorations: A good example of chemical deterioration is the loss of vitamin C during storage of juices or dried products. The browning that occurs during storage of some dried products, is also another example. One needs to understand how to control or minimize such deteriorations.

Biochemical deteriorations: When certain fruits like bananas, are peeled or cut, and exposed to air, brown discoloration takes place very quickly. Severe discolorations lead to not only loss of aesthetic appeal, but also vitamins and other nutrients in the product. Therefore biochemical deteriorations need to be controlled. One of the best methods of minimizing such deteriorations is to minimize the oxygen that is available for the reaction to take place. This is done by immersing the cut or peeled product in water. The water used for this purpose may contain about 1% salt, or preferably, 0.05% sodium metabisulfite dissolved in it.

Physical deteriorations: When certain low moisture products such as biscuits, breakfast cereal products, crisps etc., are exposed to the atmosphere, they absorb moisture from the atmosphere and become soft or lose their crispiness. From a product-quality point of view, this is unacceptable, even though the product is perfectly OK for consumption. This type of deterioration can take place in low moisture products such as dried fruits. If too much moisture is absorbed from the atmosphere, eventual mold deterioration of the product may occur. Therefore, good packaging is essential to keep atmospheric moisture out of the product. Therefore dried products should be stored in sealed, water-vapor impermeable containers.

3.3 Good manufacturing practices (GMP)

Elements of GMP in order to produce safe and hygienic food products were discussed with the participants. Some of them are elaborated below.

Selecting a suitable site and building facilities for food manufacture: Selecting a suitable site for food manufacturing operations is crucial, for producing high-quality finished products.

The site should be clear of over-grown trees and should be at a reasonable elevation, so that flooding may not occur when it rains.

The pathway to the entrance to the building should be paved, so that there are no puddles of water and people entering the building will not carry dirt, and grime into the building.

No rubbish should be strewn around the grounds to attract insects and pests. All rubbish should be kept in a closed bin outside the building. Good toilet facilities should be provided for workers. The floor of the processing area should be designed in such a way that no stagnation of water takes place. The floor should be painted with a non-slip resin material and the walls should be painted up to windowsills with a washable paint. The processing room should have a ceiling and should be equipped with covered electrical lighting.

The processing room should have access to potable water supply and a separate area should be available for cleaning of utensils and other processing equipment.

The layout of equipment should be in such a way that there is natural flow to the different processing operations involved as shown in Figure 1.

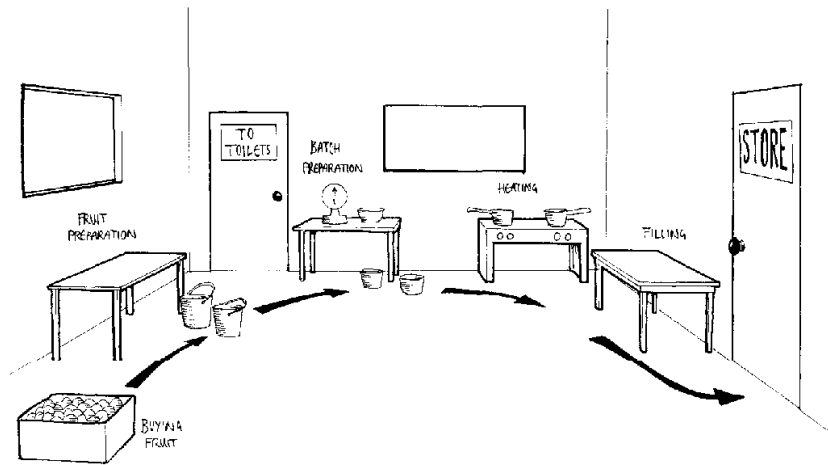


Figure 1. Layout of equipment and flow of operation
Personal Hygiene, Proper attire & Behavior

Personal hygiene is paramount to food safety and safety of processed food products. All food handlers should maintain good personal hygiene standards at all times. This includes, washing of hands, covering of hair, proper attire and behavior in the processing hall.

Food handlers should refrain from chewing of betel nut, smoking and spitting.

The proper way to wash hands is shown in Figure 2.



Figure 2. Proper way to wash hands.

4. Workshop procedures

The participants at the workshop were divided into 5 groups and were given the task of preparing different fruits for processing. The different fruits used were:

- Banana- ripe bananas were peeled and were blended in a blender
- Pineapple – ripe pineapples were peeled and cut into small pieces
- Sour sop – ripe sour sop was washed and the soft locales were removed and pulp extracted
- Calamansi – calamansis were washed and cut into two and juice was extracted
- Mango – ripe mangoes were washed, peeled and cut into pieces.

The above prepared fruits and those that were dried earlier (green banana, banana figs and breadfruit) were prepared into the following food products.

5. Banana nectars

(a) Banana/mango/calamansi nectar:

- 1 cup of banana puree
- 1 cup of mango pulp

¼ cup of calamansi juice

Mix the above to a smooth paste in a blender and check that the pH is below 4.5 (preferably 4.2), using a pH meter. If pH is high, add more calamansi juice and mix until the pH is preferably around 4.2. Fill into sterilized jars. Leave a head-space of about 1 cm and close the cap tightly.

Sterilize in a boiling water bath for 30 minutes. Remove from the water bath and cool in a clean basin of cold water. Label and store in a cool dry place. If the operations were carried out hygienically, and as per the directions, the product would be safe for use for about 6 months or more.

(b) Banana/sour sop/mango nectar:

1 cup banana puree
½ cup sour sop pulp
1 cup mango pulp

Mix the above to a smooth paste in a blender and check that the pH is below 4.5, using a pH meter. If pH is high, add calamansi juice and mix until the pH is preferably around 4.2. Fill into sterilized jars. Leave a head-space of about 1 cm and close the cap tightly.

Sterilize in a boiling water bath for 30 minutes. Remove from the water bath and cool in a clean basin of cold water. Label and store in a cool dry place. If the operations were carried out hygienically, and as per the directions, the product would be safe for use for about 6 months or more.

(c) Banana/mango/pineapple nectar:

1 cup banana puree
1 cup pineapple pulp
1 cup mango pulp

Mix the above to a smooth paste in a blender and check that the pH is below 4.5, using a pH meter. If pH is high, add calamansi juice and mix until the pH is preferably around 4.2. Fill into sterilized jars. Leave a head-space of about 1 cm and close the cap tightly.

Sterilize in a boiling water bath for 30 minutes. Remove from the water bath and cool in a clean basin of cold water. Label and store in a cool dry place. If the operations were carried out hygienically, and as per the directions, the product would be safe for use for about 6 months or more.

5.1 Banana Powder

Mature, but unripe karat bananas were peeled, and cut into about 1.5 – 2 mm thick slices. They were dried in a dehydrator for about 3 hours at 56°C, or in a solar dryer until they were fully dried and crisp.

Grind to a fine powder using an electric grinder, or pound in the traditional way and use a sieve to sift into a fine powder.

The flow diagram for making banana flour on a relatively large scale is shown in Figure 3.

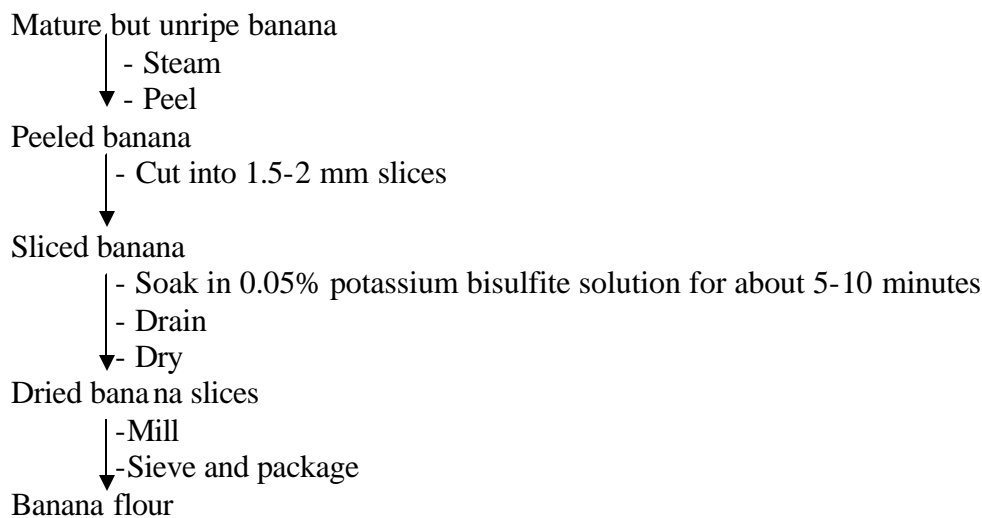


Figure 3. Flow diagram for making banana flour on a large scale

(a) Banana pancake recipe:

1 cup wheat flour
1 cup banana powder
1 teaspoon of baking powder
½ teaspoon of salt
2 teaspoons of oil
4 ripe bananas mashed through a 2 mm sieve to obtain a smooth creamy puree
Water as needed

Directions: measure all of the above except ripe banana into a clean bowl and mix well with a whisk. Add the banana puree and whisk. Add enough water to obtain a thick batter.

Prepare a skillet at medium heat and add a little oil. Spread the oil evenly with a paper towel and pour a table spoon of the batter on to the heated skillet. Cover and cook for about a minute or two and turn over and cook the other side for a further minute or two or until light brown.

(b) Banana/breadfruit pancake recipe:

Dry mature breadfruit by cutting thin slices from peeled and cored wedges. Dry until crispy dry as for green bananas. Grind to a fine powder using an electric grinder, or pound in the traditional way and use a sieve to sift into a fine powder.

1 cup wheat flour
1 cup breadfruit powder
1 teaspoon of baking powder
½ teaspoon of salt
2 teaspoons of oil
4 ripe bananas mashed through a 2 mm sieve to obtain a smooth creamy puree
Water as needed

Directions: measure all of the above except ripe bananas into a clean bowl and mix well with a whisk. Add the banana puree and whisk. Add enough water to obtain a thick batter.

Prepare a skillet at medium heat and add a little oil. Spread the oil evenly with a paper towel and pour a table spoon of the batter on to the heated skillet. Cover and cook for about a minute or two and turn over and cook the other side for a further minute or two or until light brown.

5.2 Instant banana or breadfruit flour:

Instant banana or breadfruit flour can be made by first steam cooking green bananas or breadfruit before cutting them into thin slices and drying until crispy and grinding or pounding them in to a powder as before.

A number of innovative dishes could be prepared from such pre-cooked banana or breadfruit. For example, they could be used in instant gravy mixes, instant breakfast products and instant soup mixes. The instant flours could be mixed with dried vegetables, such as dried peli, dried beans, salt and spices to taste and reconstituted by adding hot water as in the case of instant noodles, to produce delicious wholesome soup mixes.

5.3 Banana Chips (savory)

Savory banana chips are prepared from hard, green bananas. Clean, peel, and slice the bananas to about 1.5mm thickness. Soak in cooking oil, turning frequently to prevent sticking. Place the banana chips in a strainer, allowing the oil to drip while heating cooking oil in a pan. Dip & Fry until light brown, then lift the strainer and allow the oil to drip. Oil to chips ratio should be about 4:1. For savory banana chips, sprinkle salt/savory flavor mix after frying. Let cool before packing or placing in bottles, cans, or plastic bags.

5.4 Banana Chips (sweet)

Sweet banana chips are prepared from hard, green bananas. Clean, peel, and slice the bananas to about 1.5mm thickness. Soak in cooking oil, turning frequently to prevent sticking. Place the banana chips in a strainer, allowing the oil to drip while heating cooking oil in a pan. Dip & Fry until light brown, then lift the strainer and allow the oil to drip. Oil to chips ratio should be about 4:1.

Prepare sugar syrup for sweetened chips by mixing three parts of sugar for every one part of water. Soak the fried chips in sugar syrup for two to three minutes. Let the syrup drip, and fry again until the chips become shiny. Let cool before packing or placing in bottles, cans, or plastic bags.

5.5 Banana Figs

Select thin, ripe bananas such as Taiwang variety. Peel, and place bananas on a solar dryer and dry for about a week or until the bananas have shrunk to a volume or weight to about one third of the original volume/weight. The dried banana-figs when properly dry can be handled without sticking to the fingers.

5.6 Banana Jam

Recipe:

- 2 table spoons of corn starch
- 2 ounces of sugar
- 4 cups of ripe banana cut into small slices
- 3 tablespoons of lime or calamanci juice
- 2 cloves
- 2 inch stick of cinnamon

Directions:

Combine cornstarch and sugar in a heavy saucepan and half a cup of water; stir until smooth. Add remaining ingredients, stirring well. Cook over medium heat, stirring constantly, until thickened and bubbly. Cook an additional 3 to 5 minutes. Remove cloves and cinnamon stick and discard.

Quickly spoon hot banana mixture into hot water sterilized jars, leaving ¼ inch headspace. Cover at once with metal lids, and screw tightly. Turn upside down and leave for about 15-20 minutes. Cool and store jam in a cool dry place. Yield: 2 half pints

5.7 Banana Jam (Philippines recipe)

Recipe:

- 3 cups water
- 3 cups Honey
- 8 bananas (mashed)
- 3 lemons (juiced)
- Zested rind of 3 lemons
- 3 cloves
- 1 teaspoon ginger (dried)

Directions:

Using a large saucepan over a high heat, add the water and honey, bring to a boil. Let boil for about 10 minutes then add the bananas, lemon rind, lemon juice, cloves, and ginger. Let the mixture simmer for about an hour until well thickened while skimming off the scum that may

rise to the surface. Remove the cloves. Then pour the hot mixture into pre-sterilized jam jars and seal. Place in a boiling water bath for 20 minutes and cool.

5.8 Banana and other fruit rollups

Select good ripe bananas and other fruits such as pineapple or mango. Wash well in clean water. Peel and cut into pieces. Boil the peeled and sliced fruits in a ratio of one part of fruit to one part of 5% sugar solution. When soft, turn off heat and allow to cool. Blend using a kitchen blender (with about 5% honey, if required). Pour onto greased trays to a thickness of about 5 mm, and dry in a dehydrator at 55°C, or in a solar dryer until dry (final moisture content of 15-17 %). Cut into strips, roll each of the strips and pack in a cellophane sheet. Store in an air-tight container, in a cool dry place.

5.9 Banana (or any fruit) wine

Peel ripe bananas and slice thinly. To every one part sliced bananas, add one-and-a-half parts water. Boil for 30 minutes or longer depending upon the quantity of the pulp. Add sugar to the extract (one part sugar to every three parts extract). Stir and boil to dissolve the sugar. Total sugar content of the boiled product should be between 22-24 %. Allow to cool. Place in clean glass container. Inoculate with yeast (one tablespoon wine yeast to every 40 liters of boiled sweetened juice). Plug mouth of container with a clean piece of paper towel to protect from dust and insects. Ferment for a month. Siphon out the clear fermented liquid. Filter and transfer to a sterilized bottles for aging. Cover mouth with a wooden plug and seal with melted paraffin. Age for two years, or longer to mature.

5.9.1 Clarification of wine.

To make sparkling-clear wines, one needs to clarify the wine prepared above. Use eight egg-whites for every 30 liters of wine.

Procedure: Beat the egg whites well. Heat the wine in a water bath to about 55-60°C, while adding the well beaten egg white. Stir with a clean spoon or ladle and maintain the temperature of the wine around 55-60°C for about 15- 20 minutes. Cool, and filter the wine. Fill into clean, sterilized bottles by siphoning.

Annex 1.

The Federated States of Micronesia (FSM), composed of four states, Pohnpei, Chuuk, Yap, and Kosrae, and population of ~107,000, has dramatic problems of nutrition problems including micronutrient malnutrition as well as overnutrition and serious chronic non-communicable disease problems. Over half of the children have vitamin A deficiency in Chuuk, Pohnpei, and Kosrae, and in Yap over a third of the children have vitamin A deficiency, and thus are vulnerable to infection and other vitamin A deficiency disorders such as night blindness. Among

the Pohnpei adult population, chronic diseases (diabetes, heart disease, and cancer) have become rampant, along with lifestyle changes and decreased physical activity.

Yet the agricultural resources are rich. Island Food Community of Pohnpei (IFCP) has identified certain varieties of bananas (*Karat* and others) that are unique in their content of pro-vitamin A carotenoids and vitamin B2 (riboflavin). There is great need for developing private sector niche products of these nutritious local foods. There would be a great potential in developing healthy snacks that can be more easily stored and transported. Dried bananas offer potential as they can easily be stored and transported and are convenient and tasty. Bananas are very well liked by children due to the soft texture and sweet taste.

The Island Food Community of Pohnpei (IFCP) is a non-governmental organization, established in January 2004. IFCP's vision is to promote the production and consumption of local island foods to improve self-reliance, food security, health, cultural preservation, and human dignity (IFCP website and brochure). A focus is on awareness-raising, along with conservation of rare varieties, assessment of local foods for their nutrient content, and development of small-scale food processing of local foods.

There is a great need for adding value to local food crops in Micronesia and particularly to *Karat* and other carotenoid-rich banana varieties. *Karat* has been the traditional infant food in Pohnpei and has great cultural value. Yet it has been neglected and to date there are few local food products from carotenoid-rich varieties. *Karat* is rich in beta-carotene, a precursor to vitamin A, and has been a valuable food source to the local population. However, because of the lack of post-harvest technologies needed to extend the shelf life of this crop for export, it is currently being under-utilized.

A number of value-added products can be processed from *Karat* banana for both local consumption and export. One such product is baby-food, and another is dried banana and banana powder. In fact, a gamut of processed banana products could be prepared for both local consumption and export. Some of these processed banana products could easily substitute a number of imported food products such as snack foods, baby foods and some others could be used as ingredients in baking, cooking, juices and beverages such as shakes. Processed banana products used as ingredients, would enable the creation of a number of interesting and innovative new products as import substitutes or for export. Such products would include, sweet and savory snacks, fruit drink cocktails, shakes, bakery products, jams, fruit candy, fruit leather (roll-ups), and many more products that are familiar to the local population. Efficient and effective use of local raw materials would encourage farmers to produce more, create employment and wealth in the community, thereby improving the living standards of the ordinary people contributing to the vision of the Island Food Community of Pohnpei.

In any processing and preservation method employing food, safety and hygiene are paramount, especially if they are designated for the very young, the elderly and vulnerable populations such as the sick, pregnant and lactating mothers. Consistent quality is the other important criterion for economic success of a product or process. Therefore it is very important that the participants and the workers are knowledgeable in Good Manufacturing Practices (GMP) including basic

principles of food hygiene and safety practices. These will be addressed during the training sessions.

Aims

1. To encourage entrepreneurship.
2. To provide technical know-how and knowledge required, to add value to local food crops.
3. To understand what the quality parameters are and how to control them
4. To improve awareness of basic principles involved in managing a successful business.
5. To create business opportunities, thereby adding to local livelihoods.

Activities

1. Select a few entrepreneurs and provide them with intensive training on the technical aspects of the manufacturing process, paying special attention to hygiene, safety and quality of processed products.
2. Demonstrate the possibilities of making a number of products (at least four basic products) using simple equipment available in the country
3. Provide advice on the equipment needed to produce products on a relatively large industrial-scale processing.
4. Provide information on simple quality parameters of processed products and their measurements where applicable.
5. Provide advice on product pricing, marketing, distribution, and margins

Key Performance indicators

1. Participants are familiar with the technical aspects of the process. Reference material including written notes are provided
2. Participants are familiar with the processed banana products they are going to manufacture and how they can be used to develop innovative food products to suit requirements/needs
3. Participants are familiar with the type of equipment they require to manufacture products, power, water requirements and batch size they can handle safely and profitably
4. Participants know the important quality parameters of the processed product and how to achieve them by measuring and controlling them.
5. Participants are familiar with how to do simple costing and calculate profit/loss and sales projections for the future.

Annex 2.

Irritant Effects of dried Karat and Utin Iap bananas

During the workshop a few people noted that the dried banana figs made from Utin Iap and pancakes made out of dried Karat banana powder, caused an irritation in the mouth. Conrad Perera has previously published on the irritant effect in dried kiwifruit, which was due to the presence of raphides of calcium oxalate, formed in the shape of fine needles. In kiwifruit, the raphides are found arranged in bundles inside cells known as idioblasts. Kiwifruit raphides are surrounded by a mucilage, within the idioblasts and so when fresh kiwifruits are consumed, no irritation is perceived. However, when kiwifruits are dried, the mucilage shrinks and the raphides protrude and tend to get trapped in the hardened mucilage, which now can interact with the mucous membranes in the mouth, when consumed. Therefore an irritation is perceived in dried kiwifruit.

A similar mechanism was suspected in Karat and Utin Iap bananas and indeed upon examination of tissues of these ripe bananas under a microscope, an abundant number of idioblasts were observed. Upon disruption of the idioblasts, the raphides were released and were clearly observed. So it is clear from Conrad Perera's previous work on raphides in different plant products such as, kiwifruit, pineapple and taro that the irritant effect found in Karat & Utin Iap bananas are due to the presence of these raphides of calcium oxalate.

Calcium oxalate is generally found in the bark and leaves of trees, but is generally absent in most fruits, except kiwifruit, and pineapple. This finding of raphides in Karat and Utin Iap is new, at least to my knowledge. Unfortunately, nothing can be done to eradicate this problem, except that if karat banana powder is used for pancakes, or other products, they could be blended in such a way that the effect could be minimized (e.g. blending 2 parts of wheat flour with one part of karat banana flour).