Research on Food processing producing flour from Bananas, Taro, Breadfruit and Pumpkin

Island Food Community of Pohnpei (IFCP)

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Summary

The research results showed that a high quality, nutrient rich flour can be produced from local crops like bananas, breadfruit and swamp taro with skin and without skin for a competitive price.

A major finding was that most of the banana, taro and breadfruit flour produced with or without skin were of good taste. Only banana flour from Utimwas and Utin Iap had a bitter taste to some people.

In average 4.8 pounds bananas, 3.9 pounds breadfruit and 2.8 pounds swamp taro are needed to produce one pound of flour. Banana, taro and breadfruit with skin and core not removed produce 10% to 19 % more flour.

The cost to produce flour from banana, swamp taro and breadfruit is between $ 0.51 to $ 0.92 per pound using on-farm prices, and $ 0.97 to $ 2.00 per pound using market prices.

Drying of bananas, taro and breadfruit can be a challenge if there is no sun and no electric dehydrator. A combination, sun and dehydrator give best results.

Laboratory results showed that banana, taro and breadfruit flour are very high in Potassium, Magnesium, Protein and Vitamins. Flour produced from bananas, taro and breadfruit with skin and core not removed had a higher nutritional values.

Besides producing flour from banana, swamp taro and breadfruit, flour was also produced from coconut and pumpkin. The biggest challenge in coconut flour production is drying and milling. Milling of coconut flour is difficult because the coconut rasp does not get very dry due to oil residue.

To produce pumpkin flour up to 10 pounds of fruits are required to make one pound of flour. The cost of pumpkin flour will be up to $ 10.00 per pound.

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From dehydrated bananas,4.6 pound of ripe bananas is required to produce one pound of dried bananas. Some people reported itchiness from Utin Iap and Karat bananas, all other cultivars were of good eating quality. To produce one pound of dehydrated banana will costs $ 1.61 market price or $ 0.51 farm price. Sun drying is a challenge, best is a combination of sun and dehydration. Dried bananas should be promoted as a healthy snack for school feeding.

Vacuum packed banana and breadfruit was produced from Utin Ruk, Taiwang, Karat and breadfruit. When bananas where cooked for 10 minutes, dipped in lime juice and dried in low heat for 5-6 hrs., there was less chemical reaction and the package stayed vacuumed. Breadfruit was more difficult and it was not possible to keep it vacuumed. When bananas were tasted after 50 and 140 days stored in room temperature, refrigerator and freezer, it was obvious that bananas stored in room temperature had bitter or sour fermented taste. Bananas stored in the refrigerator or freezer were of good taste.

1. Background:

There are several crops like breadfruit, banana, taro and coconut which can be processed into flour and kept in storage as non-perishable food for a long time. Sometimes, some of the crops are in abundance, e.g. breadfruit season, and are not utilized and get spoiled. On some of the outer islands of Pohnpei and Chuuk breadfruit is fermented and stored underground for a long time, this is a good way to secure food for times when fresh produce is not available or during disaster like typhoons or drought. In addition to breadfruit fermentation, processing of bananas, breadfruit, taro and coconut can be made into flour for food security. Banana cultivars like Utin Ruk, Taiwang and Iemwahn are high yielding and are often in abundance, there is good potential for flour production. Breadfruit get often spoiled when in season and can be made into flour and stored. In early 2000 Dr. Lois Englberger had fresh bananas and taro analyzed for nutrient values. Englberger found out that yellow bananas were extremely high in beta-carotene and other nutritional properties. In 2017 processed banana, taro and breadfruit flour was analyzed, and similarly to fresh produce, flour was very high in Dietary Fiber, Calcium, Magnesium, Potassium, and some Vitamins. Local flours have a much better nutritional value than imported wheat flour, plus they are Gluten Free. Attachment 16,17,18,19,20

2. Banana Flour Production

FSM has 42 banana cultivars which can be used for flour production.

Bananas for flour production must be in hard green condition, ripe soft bananas will not dry easy and will be difficult for milling.

2.1 Washing bananas with skin not removed should be soaked for 10 minutes in Clorox bleach (Sodium hypochlorite), mixing 1 table spoon of Clorox in 1 gallon of water. After soaking in Clorox fruits must be rinsed in clean water.

2.2 Peeling bananas can be a challenge, sometimes it is easier to peel bananas after they have been in boiling water for 5 minutes.

2.3 Cutting bananas into small pieces will allow fast drying. Large pieces will be difficult to dry and mill.

2.4 Drying of bananas can be a challenge if there is no sun and no electric dehydrator. Some cultivars take longer to dry than others. Under the sun; it takes 1 to 2 days for peeled bananas and 2-3 days for bananas with skin to dry. Bananas cut into thin and small pieces dry faster than thick and large pieces. If a dehydrator is available it can be used at times when there is no sun or at night time. It is very important to get the sample very dry otherwise the flour gets moldy and spoiled.

Using an electric dehydrator is another possibility, which will take 6-8 hours for peeled bananas and 9 t0 10 hours for unpeeled bananas to dry. A combination of sun and dehydrator is a good way to get the samples dry, for example if sample are half way dry and it starts to rain, the sample can be placed in the dehydrator for 2-4 hours to compete the drying process.

2.5 Banana flour, in average out of 74 trials, 4.8 pounds of green bananas was required to produce one pound of flour. Bananas with skin removed require 5.1 pound green bananas to produce one pound of flour (average of 47 trials). Bananas with skin require 4.5 pound green bananas (average of 27trials) to produce one pound of flour. Flour from bananas with skin produced 12% more flour compared to bananas where the skin was removed. Attachment 1, 4 & 5

2.6 Milling Banana Flour

Island Food Community of Pohnpei (IFCP) has distributed 11small hand operated flour mills to some of the Outer Islands and Municipalities in Pohnpei. For small sample for household usage this small mills are suitable. In one hour about 3-4 pound of flour can be milled, it is hard work. Usually bananas with skin are harder to mill.

For commercial milling an electric mill will be more suitable. There is one electric mill at COM land Grant in Pohnpei.

2.7 Maturity

Bananas for flour productions must be hard green, if they are ripe or soft; it is very difficult to get them dry and hard. It is very difficult or impossible to mill bananas which are not hard and dry.

2.8 Cost of Banana flour

There is a large variation in banana prices, Table 1 shows on-farm and market prices from two markets, the highest market price was for Akadahn $ 0.65 market and $ 0.30 farm prices per pound and the lowest was Taiwang and Utin Ruk $ 0.35 market and $ 0.10 farm price per pound. This high price difference reflects the cost of flour production, to produce one pound Taiwang costs $ 1.43 market and $ 0.46 farm price for Akadahn it costs $ 2.16 market and $ 1.19 retail prices.

In average, the cost to produce one pound of flour from banana with skin removed was $ 1.93 using the market price and $ 0.99 using farm prices. Banana where the skin and was not removed, the cost was $ 1.67 using the market price and $ 0.70 using farm price. Banana flour with skin not removed is 12% cheaper compared with breadfruit where the skin and core were removed. Attachment 1, 2, 4 & 5

To compare prices from imported flour, Golden Medal white flour is sold for $ 1.25 per pound; banana flour in Australia costs $ 10.00 per pound.

2.9 Storage

Banana flour can be stored for a long time in a dry place or refrigerator. If flour is not dry it will get moldy and is not good for consumption.

2.10 Taste

As it can be seen in attachment 3, more than 100 people tasted different dishes made from banana flour with skin and with skin removed. From the 16 cultivars itchiness was reported in two cases using Utin Iab and two cases using Utimwas all other taste report were scored very good and good. Attachment 3

2.11 Nutritional Analysis

Five banana cultivars have been sent to a Laboratory in New Zealand for analyses. The results showed that flour produced from bananas were very high in nutritional values compared to wheat flour. Flour from Karat was very high in Ribofavin (Vit B2), all cultivars were high in Potassium, Calcium and Magnesium. Flour produced from bananas with skin were generally higher in nutritional values. Attachment 18, 21, 22

3. Breadfruit Flour Production

FSM has over 100 breadfruit cultivar (Raynor 1989), all of them can be used for making flour.

In the research activities, conducted by K. Englberger, IFCP in 2017, breadfruit flour was produced from fruits without removing the skin and core and with removing the skin and core. Breadfruit for flour production must be in hard green, mature condition, soft fruits will be difficult to dry and mill.

3.1 Washing breadfruit, especially the one with skin and core not removed should to be soaked for 10 minutes in Clorox bleach (Sodium hypochlorite) mixing 1 table spoon of Clorox in 1 gallon of water. After soaking the fruit must be rinsed in clean water.

3.2 Cutting breadfruit into small pieces will allow fast drying. Large pieces will be difficult to dry and mill.

3.3 Drying breadfruit takes 1-2 days in the sun or 6-8 hours in a dehydrator; breadfruit with skin will take half a day longer in the sun or 10-12 hours in the dehydrator. Attachment 7.

3.4 Milling breadfruit flour is about the same as banana milling; it is hard work if milling is done by a small hand mill without electric motor.

3.5. Maturity of breadfruit for flour productions must be hard green, if they are over ripe and soft; it is very difficult to get them dry and hard. It is very difficult or impossible to mill breadfruit which is not hard and dry.

3.6 Breadfruit flour, on average, out of 35 trials, 3.9 pounds of breadfruit was required to produce one pound of flour. From 18 trials where the skin and core wasnot removed, the average was 3.5 pounds, and from 17 trials where the skin and core was removed the average was 4.3 pounds to produce one pound of flour. Flour produced from breadfruit with skin and core produced 19% more flour compared to flour produced from breadfruit where the skin and core was removed. Attachment 1, 7 & 8

3.7 Cost of Breadfruit flour, the average cost to produce one pound of flour from breadfruit with skin and core not removed was $ 1.11using the market price and $ 0.92using farm prices. For breadfruit where the skin and core was removed, the cost was $ 2.00 using the market price and $ 1.11 using farm price. Breadfruit flour with skin and core not removed is 19 % cheaper compared with breadfruit where the skin and core were removed. Attachment 1, 2 & 7

3.8 Storage of breadfruit flour can be stored for a long time in a dry place or refrigerator. If flour is not dry it will get moldy and is not good for consumption

3.9. Breadfruit Taste As it can be seen in attachment 6, around 50 people tasted different dishes made from breadfruit flour with skin & core and with skin and core removed. There was no significant difference in taste of breadfruit flour with skin and core and with skin and core removed. All taste reports scored very high, good and acceptable.Attachment 6.

3.10 Nutritional Analysis, one breadfruit cultivars, Meiniwe was sent to a Laboratory in New Zealand for analyses. The results showed that breadfruit flour with skin and core not removed is very high in vitamin C, Potassium and Protein.Attachment 19 & 21,22

4. Swamp Taro Flour Production

There are many swamp taro cultivars, according to Englberger et al 2005, there are 47 cultivars of *Cyrtosperma sp.* recorded. In this research, flour was only produced from swamp taro, *Cyrtosperma* sp.

In the research activities, conducted by K. Englberger, IFCP in 2017, taro flour was produced from corms with skin and with skin removed.

4.1 Washing taro with skin not removed need to be soaked for 10 minutes in Clorox bleach (Sodium hypochlorite) mixing 1 table spoon of Clorox in 1 gallon of water. After soaking rinse the fruit in clean water.

4.2 Cutting or grinding taro into small pieces will allow fast drying. Large pieces will be difficult to dry and mill.

4.3 Drying of Taro is similar to bananas and breadfruit it is very important to cut taro into small pieces and dry it very well. Drying of taro can take takes 2 to 4 days, depending on the sun taro with the skin removed take about 2-3 days and taro with skin take 3-4 days. Attachment 10.

4.4 Milling Taro Flour is about the same as banana milling; it is hard work if milling is done by a small hand mill without electric motor.

4.5. Maturity of taro for flour productions must be fresh, if it is over mature and soft or rotten it is very difficult to get them dry and hard.

4.6 Taro flour in average out of 14 trials requires 2.8 pounds of taro to produce one pound of flour. Flour produced from taro with skin produced required 2.7 pound to produce one pound of flour and taro with skin removed required 3.0 pounds, 10% more flour, Attachment 1, 10 & 11.

4.7. Cost of Taro flour is the same ($ 0.35 market price and $ 0.20 farmer's price) in the two major markets for all the cultivars. The average cost to produce one pound of swamp taro flour is $ 1.02 using market price and $ 0.64 using farm price. Attachment 1, 2 &10

4.8 Storage for taro flour can be stored for a long time in a dry place or refrigerator. If flour is not dry it will get moldy and is not good for consumption

4.9 Taste of Swamp Taro Flour, all taste reports scored very high, good and acceptable. More than 100 people tasted different dishes made from swamp taro flour with skin and with skin removed. There was no significant difference in taste of taro flour with skin and with skin removed. Attachment 9.

4.10 Nutritional Analysis, one samples of swamp taro variety Sounpwong weneu or Six month), with skin and one without skin have been sent to a Laboratory in New Zealand for food analysis. The results showed that taro is very high Protein and Calcium. Attachment 20, 21, 2

5. Pumpkin Flour Production

Two trials were conducted to produce pumpkin flour. It was almost impossible to dry pumpkins; it took 4-5 days for drying. Pumpkins have high water content, wet to dry weight was 1:10, and meaning from 10 lbs. wet weight only 1 lbs. flour can be made. The cost to produce one pound flour will be around $ 10 per pound. Attachment 15

6. Dehydrated banana or dried fruits

Dehydrated bananas were produced from 10 trials with 5 cultivars (Utin Iap, Karat, Taiwang, Akadahn and Utin Ruk). In average from five trials, 4.6 pound of ripe bananas is required to produce one pound of dried bananas. Some people reported itchiness from Utin Iap and Karat bananas, all other cultivars were of good eating quality. Taiwang and Akadahn were sweeter than others. Dried bananas would be very suitable as **a healthy snack food for school feeding.** Attachment 1, 13

To produce one pound of dehydrated banana costs $ 1.61 market price or $ 0.51 retail price per pound. Taiwang with a market price of $ 0.35, compared to $ 0.65 for Akadahn is more economic to use for dried bananas. Attachment 1, 13

Sun drying is a challenge, best is a combination of sun and dehydration, especially during rainy days a dehydrator is most suitable, for more information. Attachment 13

7. Coconut Flour Production

Coconut flour was produced from 4 trials, in average, 2.3 pounds of coconut rasp or 3 to 4 nuts were required to produce one pound flour. To produce one pound of coconut flour costs $ 1.25 using the market price or $ 0.64 farmer's prices. The cost per nut is $ 0.40 market price and $ 0.20 farm price.

The biggest challenge in coconut flour making is drying and milling. Because there is still some oil in the coconut rasp it takes a very long time for drying. Milling of flour is very hard work because the coconut rasp is not very dry due to oil residue. To produce coconut flour a good oil press is required to remove the liquid and a dehydrator to speed up the drying process. Attachment 12

8. Vacuum packed banana for possible export

Several trials have been conducted with vacuum packaged bananas; (Utin Ruk, Taiwan, Karat) and breadfruit, cooked and uncooked. It was observed that the next day the bags were not any longer vacuumed and there was air inside. There must be a chemical process causing this reaction. Attachment 14.

When bananas where cooked for 10 minutes, dipped in lime juice and dried in low heat for 5-6 hrs., there was less chemical reaction and the package stayed vacuumed. Breadfruit was more difficult and it was not possible to keep the package vacuumed.

When bananas Uten Ruk, Taiwan, Karat and Inahsio) were tasted after 50 and 140 days stored in room temperature, refrigerator and freezer, it was obvious that bananas stored in room temperature had bitter or sour fermented taste. Bananas stored in the refrigerator or freezer were of good taste.

It can be concluded that vacuum packaged bananas in room temperature are not of good taste.

9. Outreach

Outreach for public awareness is the next step after finding out in the research results that a high quality, nutrient rich flour can be produced from local products like bananas, breadfruit and swamp taro for a competitive price several demonstrations were made for COM students and visitors to demonstrate how to make flour from local products. Also during two food tastings, people learned about flour making and were able to taste the locally made product.

Many flour samples were made from bananas, taro and breadfruit and were given out to public for tasting. Good feedback was provided; a good example is Ms. Lauren Schmeisser's letter, Attachment 23.

Island Food Community of Pohnpei (IFCP) with the funding from US Department of Interior, distributed 11 hand operated flower mills to the Municipalities in Pohnpei and Outer Islands. At the same time demonstrations were made on how to use the mills. At this stage only some people make use of the flour mills, there is a need to make more publicity and education on the use of flour mill and the value of the nutrient rich flour.

Another important step is to work with local markets on how to make flour for local markets and export. IFCP is providing information on nutrient value of the different products and how to make the flour from bananas, swamp taro and breadfruit. There will be also recipes available on how to use the flours.

The IFCP Researcher prepared a power point presentation which was shown to communities, students, Government Officials and market owners.

8. Recommendations

11.1 Funding should be provided to analyze 15 more samples of banana, taro and breadfruit flour with skin and without skin and dehydrated bananas.

In the current study analysis were only done for one breadfruit, one taro and two banana cultivars with and without skin. There are big differences in nutritional values amongst cultivars and with and without skin. The cost for analyses is US $ 1,000.

11.2 The present **outreach** activities to demonstrate to communities on how to make flour from banana, taro and breadfruit with and without skin should continue.

All the municipalities including the outer islands received hand operated flour mills, only some people make use of them. There is a need to continue demonstrations on how to use and maintain the flour mills.

11.3 Demonstrate and support interested **private businesses** on how to make flour from bananas, taro and breadfruit with and without skin, to market locally made flour for local consumption and possible export.

The research showed that flour from bananas, taro and breadfruit with and without skin *have high nutritional value.*

11.4 Demonstrate how to use flour from bananas, taro and breadfruit in **food preparation** and inform the public on the high nutritional value and health benefits.

Food tasting has shown that food prepared from banana, taro and breadfruit with and without skin were of good eating quality. Laboratory analysis of banana, taro and breadfruit with and without skin showed that they are high in nutritional values.

11.5 Locally produced flour and dehydrated bananas should be included in **school food programs.**

For example local flour can be used to make gravy, thickener in soups or pancakes. Dehydrated bananas would be a healthy snack food.

11.6 In addition to the hand operated flower mills, Municipalities should be supplied with locally made **solar dryers.**

Drying of banana, taro or breadfruit can be challenge, having a dryer will help to dry faster and to protect from rain and insects.

Attachment 1, Table 1: Number pounds required to produce one pound of flour and cost of one pound of flour.

Product	Number of lbs. to get 1 pound flour	Farmers price per lbs.	Price per pound market
Banana with skin	**4.8** pounds average 27 samples	**$ 0.70** pound average of 27 sample	**$ 1.67** pound average of 27 samples
Banana with skin removed	**5.1**pounds average 47 samples	**$ 0.99** per pound average of 47 samples	**$ 1.93** per pound average of 47 samples
Breadfruit with skin & core	**3.5** average 17 samples	**$ 0.90** average of 17samples	**$ 1.10** average of 17 samples
BF with skin &removed	**4.3** average 16 samples	**$ 1.10** average of 16 samples	**$ 2.20** average of 16 samples
Swamp taro with skin	**2.7**average of 9 samples	**$ 0.56** average of 9 samples	**$ 0.97**average of 9 samples
S taro with skin removed	**3.0**average of 5 samples	**$ 0.72** average of 5 samples	**$ 1.07**average of 5 samples
Dehydrated bananas	**4.6** average out of 10 samples	**$ 0.51** average of 10 samples	**$ 1.61** average of 10 samples

Attachment 2, Table 2 Market Prices, January to July 2017

	Ellen's Market		Simon's Market	
Produce	**Farmers price US $/ lbs.**	**Market price $/lbs.**	**Farmers price US $/lbs.**	**Marker price $ /lbs**
Banana, Karat	0.25	0.50	0.25	0.45
Banana, Akadahn	0.40	0.65-0.75	0.25	0.45
Banana Utim was			0.25	0.45
Banana Taiwang	0.10	0.35	0.15	0.35
Banana Menihle	0.20	0.40	0.15	0.35
Banana Fiji	0.20	0.40	0.15	0.35
Banan Utin Ruk	0.15 to 0.20	0.30	0.10	0.25
Banana Fiji	0.20	0.40	0.15	0.35
Banana Mangat	0.20	0.45		
Banana Inahsio	0.15	0.30	0.10	0.25
Banana Uht Rais			0.15	0.35
Bread Fruit	0.25	0.50	0.25	0.50
Swamp Taro	0.20	0.35	0.25	0.50
Breadfruit	0.25	0.50	0.25	0.50
Pumpkin	0.50	0.95		

Attachment 3, Banana tasting

Taiwang**,** two reported excellent

- Bread with no yeast and sugar was made, 24 people tasted it on April 7.2017. The score was the following: 1 very good, 7 good, 8 acceptable and 5 no like.
- Emihner Johnson reported, that 30 people tasted banana bread from Taiwang the result was very good.

Akadahn, March 22, 2017, 5 people reported excellent, (75% Akadahn flour and 25% Wheat flour) made by Emihner.

Akadahn green skin removed, two people reported excellent

Akadahn green skin removed, 5 people (March 21.17) reported excellent, (75% Akadahn flour and 25% Wheat flour) made by Emihner Johnson.

Akadahn green skin removed (#7) banana cake was made and 24 people tasted it on April 7.2017. the score was the following: 15 very good, 7 good and 2 acceptable

Akadahn green with skin (# 8) banana cake was made and 24 people tasted it on April 7.2017. the score was the following: 12 good, 9 very good and 3 acceptable.

Akadahn green with skin (# 11) bread was made (1/3 Akadahn flour 1/3 whole wheat and 1/3 white flour) 24 people tasted it on April 7.2017. The score was the following: 7 very good, 10 good, 4 acceptable and 1 no good.

Akadahn green skin removed, on June 13. 217, 15 students tasted Dr. Ypye's crepe and scored the following: 33% very good, 47% good and 20% acceptable.

Akadahn green skin not removed, on June 13. 217, 15 students tasted Dr. Ypye's crepe and scored the following: 40% very good, 33% good, 20% acceptable and 7% not acceptable (weird taste).

Karat Pako skin removed (# 3) banana cake was made and 24 people tasted it on April 7.2017. The score was the following: 15 very good, 8 good and 1 acceptable.

Karat Pako with skin (# 4) banana cake was made and 24 people tasted it on April 7.2017. the score was the following: 16 very good ,7 good and 1 acceptable.

Uht Rais, Kudud,

- KE made bread ½ Uht Rais flour and half wheat flour; four people tasted, three reported good and one reported itchiness.

- Dana Leeling reported excellent
- banana cake was made and 24 people tasted it on April 7.2017. the score was the following: 12 very good,11 good and 1 acceptable

Utin Ruk with skin cake was made and 24 people tasted it on April 7. 2017. the score was the following:12 very good, 10 good and 2 acceptable.

Eminer Johnson reported, that 30 people tasted UtinRuk with and without skin, everyone liked it.

Utin Iap and Utimwas, 2 people reported **itchiness** several other people liked it and did not experience itchiness

Utimwas with skin removed, 15 students tasted Emi's cookies on June 13.2017 and cored the following: 40% very good, 40% good, 13% acceptable and 7% (one person) not good

Utimwas with skin not removed, 15 students tasted Emi's cookies on June 13.2017 and cored the following: 33% very good, 33% good, 13% acceptable and **20% not acceptable reported itchiness.**

Iemwahn, 1 reported (Dana Leeling) excellent

Attachment 4, Table 3 Green Banana for flour production

No.	Name of cultivar	Price US$/ lbs	Date	Bunch weight	Fruit weight peeled	# of finger	Dry weight	Drying time solar/ sun	Drying time Dehyd	Cost of flour per lbs
GB1	Akadahn white,		1.25.17	2,281g 6.2 lbs.						
GB 2	Akadahn white	0.25 0.45	1.27.17	1,904 g 4.2			325 g (5.8)	1 day	4 hrs.	1.46 2.64
GB 3	Taiwang green		1.31.17	2,678 g 5.9 lbs.	1,296 g	34				
GB 4	Utin Ruk green	$ 0.15 0.30	2.1.17	3,738 g 8.23 lbs.	1,936 g	31	737 (5.1)	6 hrs.	4 hrs.	0.75 1.52
GB 5	Taiwang green	$ 10-0.35	2.02.17	2,952g 6.5 lbs.	1,542 g		492 g (6.0)	6 hrs.	4 hrs.	$0.60 - 2.00
GB 6	Utin Ruk	$0.15-0.30	2.08.17	3.888g 8.56 lbs.	1.852 g	28	718 (5.4)	3 hrs.	4 hrs.	$0.81 - 1.62
GB 7	Fiji		2.09.17	4,665 g 10 lbs.	2,921 g	39	818 g (5.7)	6 hrs.	2 hrs.	$0.86 - 2.00

GB 8	Inahsio	0.10-0.25	2.10.17	5,049 g 11 lbs.	2,968 g	26	946 (5.3)	6 hrs.	2 hrs.	$0.53 - 1.33
GB 9	Taiwang	0.10-0.35	2.11.17	5,445 g 11.99	2,962 g	44	898 g (6)	2 days	-	$0.60-2.12
GB10	Karat Pako	0.25-0.45	2.14.17	5,853g 12.9 lbs	2,711 g	19	1,485 (4)	1 day	2 hrs.	0.98 - 1.74
GB 11	Kartat Pwehu	0.25-0.45	2.15.17	2,974 g 6.5 lbs.		12	502 g 1(5.9)	1 days	3 hrs.	$ 1.47 - $.2.65
GB 12	Kai Mana	0.10-0.30	2,16.17	6,541 g 14 lbs.	4,165g	49	1,485g (4.4)	1 day only		$ 0.44 1.32
GB 13	Fiji	$0.15-0.35	2.17.17	3,975 g 8.7 lbs.		66	737 g (5.4)	1 day	3 hrs.	$ 0.80 1.60
GB 14	Taiwang	0.10-0.35	2.18.17	3,707 g 7.6 lbs.	3,459g	49	569 g (6.5)	1 day		$ 0.60 2.12
GB 15	Karat Pwehu	0.25-0.45	2.19.17	2,965 g 6.5 lbs.	2,842 g	13	546 g (5.4)	1.5 days		$ 1.62 2.92
GB 16	Karat Pako	0.25-0.45	2.21.17	3,795 g 8.6 lbs.	3,311g	16	574 g (6.6)	7 hrs.	4 hrs.	$ 1.70-$3.06
GB 17	Uten Menihle	0.20 0.40	2.22.17	3,595 g 7.9 lbs.	3.399g	33	759 g (4.7)	7 hrs.	4 hrs.	$ 0.95-1.90
GB 18	Utimwas	0.25 0.45	2.23.17	3,876 g 8.5 lbs.	3,493	87	533 g (7.3)	6	4 hrs.	$ 1.80-3.25
GB 19	Iemwahn with skin	0.15 0.35	2.24.17	2,374 g 5.23lbs.	2,310g	12	424 g (5.6)	2 days		$ 0.84 1.96
GB 20	Iemwahn peeled	0.15 0.35	2.24.17	2,482 g 5.5 lbs.	2,380g	15	322 g 7.7)	3 days		$ 1.16 2.71
GB 21	Utin Iap With skin	0.25-0.45	2.28.17	2,036 g 4.5 lbs.		23	445 g (4.6)$	1 day	8 hrs.	$ 1.15 2.06
GB 22	UtinIap peeled	0.10-0.35	2.28.17	2,224 g 4.9 lbs.	1,808g	25	499 g (4.5)	1 day	3 hrs.	$ 1.11 2.00
GB 23	Utin Ruk	0.15-0.30	03.4.17	5,537 g 12.2 lbs.	2,541 g	40	1,087 (5.1)	1 day	4 hrs.	$ 0.76 1.53
GB 24	Utin Iap peeled	0.10-0.35	03.5.17	5,129 g 11.3 lbs.	3,493 g	41	1,163 (4.4)	0.5 day	5 hrs.	$ 0.44 1.54
GB 25	Akadahn green	0.25 0.45	03.6.17	4.936 10.8 lbs.	2,755g	42	713 g (6.9)	0.5 day	6 hrs.	$ 1.72 3.01
GB 26	Karat Pwehu	0.25-0.45	03.7.17	3,684 8.11 lbs.	1,215g	23	862 g (4.3)	2 days		$ 1.07 1.92

GB 27	Utin Menihle with skin	0.20 0.40	3.8.17	4,911 g 10.8 lbs.	4,148	54	1,189g (4.1)	2 days		$ 0.82 1.64
GB 28	Akadahn with skin	0.25 0.45	3.12.17	5,274 g 11.6 lbs.	4,509	40	1,074g (4.2)	2 days	6 hrs.	$ 1.23-2.20
BG 29	Taiwang	0.10-0.35	3.14.17	3,752 g 8.3 lbs.	1.797g	45	506g (7.4)	2 days		$ 0.74 2.06
GB 30	Inahsio	0.10-0.25	3.15.17		1.918g 4.2 lbs.	35	447 g 4.3	1.5 days		$ 0.43-1.06
GB 31	Taiwang with Skin	0.10-0.35	3.16.17	3,487 g 6.8 lbs.	3,086g	44	781g (4.5)	2.5 days		$ 0.39 1.38
GB 32	Utin Ruk	$0.15-0.30	3.17.17	4,380 9.6 lbs.	3,084	38	760 g (5.7)	1.5 days		$ 0.57 1.72
GB 33	Karat Pako with Skin	0.25-0.50	3.20.17	5,997 g 13.2 lbs.	5,842 g	13	1,098g (5.5)	2 days	6 hrs.	$ 1.36 2.72
GB 34	Utimwas	$0.15-0.30	3.21.17	2,384 g 5.4 lbs.	1,137 g	65	437 g (5.4)	05 day	5 hrs.	$ 0.84 1.68
GB 35	Uht Rais, Kudud with skin	$ 0.25 0.45	3.22.17	4,192 g 9.23 lbs.		63	1,017 g (4.1)	2 day	4 hrs.	$ 1.05 1.85
GB 36	Uht Rais, Kudud	$ 0.25 0.45	3.23.17	2,562 g 5.64 lbs.	1,763 g	52	515 g (4.9)	1.5 day		$ 1.24 2.23
GB 37	Utin Ruk with skin	$0.15-0.30	3.23.17	5,118 g 11.3lbs	1,232 g		1,054 g (4.8)	2.5 days		$ 0.73 1.45
GB 38	Karat Pako with skin	0.25-0.50	3.26.17	3,886 g 8.56 lbs.		13	819 g (4.7)	2 days	6 hrs.	$ 1.18 2.37
GB 39	Akadahn Weitahta with skin	0.25 0.45	3.28.17	3,351 g 7.48 lbs.		25	710 g (4.7)	1.5 days	8 hrs.	$ 1.19 2.20
GB 40	Mangat with skin	0.25 0.45	4.2.17	4,376 g 9.6 lbs.		18	1,250 (3.5)	2 days		$ 0.87 1.22
GB 41	Taiwang	$ 10-0.35	04.4.17	3,412 g 7.51 lbs.	1,668 g	47				
GB 42	Akadahn green	0.25 0.45	04.5.17	4,869 g 10.7 lbs.	2,857g	49	835 g (5.8)	2 days		$ 1.45-2.62
GB 43	Uht Rais	0.25 0.45	04,6.17	2,145 g 4.72 lbs.	1,224g	36	415 g (5.1)	2 days		$ 1.29-2.32
GB 44	Akadahn with skin	0.25 0.45	04.7.17	4,073 g 8.9 lbs.		36	864 g (4.7)	3 days	2 hrs.	$ 1.17-2.10

GB 45	Utin Ruk	$0.15-0.30	04.8.17	4,127 g 9.1 lbs.	2,421g	51	782 g (5.3)	2 days		$ 0.72-1.58
GB 46	Taiwang	$ 10-0.35	4.17.17	2,834 g 6.2 lbs.	1,243 g	41	401 (7.1)	1 day	5 hrs.	$ 0.70 2.45
GB 47	Fiji	$0.15-0.35	4.24.17	2,452 g 5.4	1,479g	47	461 g (5.3)	1.5 days		$ 0.79 1.86
GB 48	Inahsio	0.10-0.25	4.26.17	3,775 g 8.3 lbs.	2,115 g	27	556 g (6.7)	1 day	2 hr.	$ 0.67 1.69
GB 49	Taiwang	0.10-0.25	4.28.17	3.700 g 8.1 lbs.	1,681g	58	534 g (6.9)	2 days		$ 0.68 1.72
GB 50	Inahsio with skin	0.10-0.25	5.2.17	3,666g 8.1 lbs.		13	1,019g (3.6)	2 days	2 hrs.	$ 0.36 0.90
GB 51	Karat with skin	0.25-0.45	5.5.17	4,189g 9.2 lbs.		17	789g (5.3)	2 days		1.30-2.38
GB 52	Karat en Iab with skin	0.25-0.45	5.11.17	3,585g 7.89lbs		8	787 g (4.5)	2 days	3 hrs.	$ 1.14-2.00
GB 53	Utin Ruk with skin	$0.15-0.30	5.22.17	3,468 g 7.63 lbs.		33	839 g (4.1)	2 days	2 hrs.	$ 0.62 1.24
GB 54	Utin Ruk	$0.15-0.30	5.24.17	3,112g 6.85 lbs.	1,787g	32	608 g (5.1)	1.5 days	2 hrs.	$ 0.77 1.79
GB 55	Taiwang	0.10-0.25	6.03.17	2,135 g 4.7 lbs.	1,105 g	33	355 g (6.0)	2 days	2 hrs.	$0.60 2.10
GB 56	Taiwang with skin	0.10-0.25	6.03.17	2,662 g 5.86 lbs.		43	542 g (4.9)	2 days	4 hrs.	$ 0.49 1.71
GB 57	Fiji with skin	$0.15-0.35	6.05.17	3,286 g 7.2 lbs.		58	684 g (4.8)	2 days	2 hrs.	$ 0.71 1.67
GB 58	Fiji skin removed	$0.15-0.35	6.07.17	2,954g 6.5 lbs.	2,078 g	50	593 g (4.9)	1 day	4 hrs.	$ 0.75 1.74
GB 59	Fiji skin removed	$0.15-0.35	6.12.17	3,021g 6.65 lbs.	1,912	48	695 g (4.3)	1 day	3 hr.	$ 0.65 1.52
GB 60	Utin Ruk skin removed	$0.15-0.30	6.16.17	3,690g 8.12 lbs.	2,509g	31	761 g (4.8)	1 day 4 hrs.		$ 0.72 1.45
GB 61	Utin Ruk with skin	$0.15-0.30	6.17.17	3,960 g 8.7 lbs.		36	1,003 g (3.9)	2 days	2 hrs.	$ 0.59 1.37
GB 62	Utin Ruk skin removed	$0.15-0.30	6.20.17	3,358g 7.4 lbs.	1,884g	31	592 g (5.7)	1 day	5 hrs.	$ 0.85 1.70
GB 63	Utin Ruk with skin	$0.15-0.30	6.20.17	2,353 g 5.2 lbs.		24	541 g (4.35	2 days	4 hrs.	$ 0.65 1.30

GB 64	Utin Ruk removed	$0.15-0.30	6.21.17	3,191g 7.0 lbs.	1,893g	36	592 g (5.4)	1 day	6 hrs.	$ 0.81 1.62
GB 65	Utin Ruk Skin removed	$0.15-0.30	6.22.17	3,963g 8.2 lbs.	2,252 g	33	777 g (5.1)	2 days	5 hrs.	$ 0.72 1.44
GB 66	Utin Ruk with skin	$0.15-0.30		3,680 g 8.1 lbs.		24	916 g 4.0	2 days	2 hrs.	$ 0.60 1.20
GB 67	Taiwang with skin	0.10-0.25	7.5.17	1,896 g 4.2 lbs.		28	383 g 4.2	1 day	5 hrs.	$ 0.50 1.24
GB 68	Taiwang	0.10-0.25	7.5.17	2,380 g 5.2	1,243 g	38	755 g 3.1	1 day	2 hrs.	$ 0.31 0.78
GB 69	Karat with skin	0.25-0.45	7.8.17	3,169 g 6.9		12	553g 5.7	2 days	3 hours	$1.41 2.55
GB 70	Fiji skin removed	0.15-0.35	7.13.17	2,797g 6.2 lbs.	1,803 g	58	533g 5.3	3 days	4 hrs.	$ 0.79 1.58
GB 71	Inahsio with skin	0.10-0.25	7.17.17	2,861 g 6.3 lbs.		18	530g 5.4	2 days	4 hrs.	$ 0.54 1.35
GB 72	Utimwas	0.10 0.35	7.24.17	3,079 g 6.8 lbs	2.143 g	60	550 g 5.6	1	3 hrs.	0.56 1.96
GB 73	Utin Ruk	$0.15-0.30	8.28.17	4,139 g 9.1	2,322 g	45	832 g 4.9	1 day	4 hrs.	0.74 1.50
GB 74	Utin Ruk	$0.15-0.30	8.29.17	3,327 g 7.3	1,970g	41	685 g 4.8	1 day	2 hrs.	$ 0.72 1.44
GB 75	Inahsio with skin	$0.15-0.30	8.31.17	3,291 g 7.2		13	770 g 4.3	1 day	1 hrs.	$ 0.64 1.28
GB 76	Uten Menihle with skin	$ 020 0.40	9.1.17	3,077 g 6.8			863 g 3.5	1 day	3 hrs.	$0.72 1.44
GB 77	Akadahn Weitahta With skin	0.25 0.45	9.8.17	3,020g 6.6		35	608 g 4.9		8 hrs.	$ 1.24 2.22
GB 78	Akadahn Weitahta	0.25 0.45	9.12.17	3,800 g 8.4	2,381g	30	770g 5.0	1 day	2 hrs.	$ 1.25 2.25
GB 79	Akadahn Weitahta	0.25 0.45	9.13.17	3,301g 7.3	2,029g	28	583 g 5.6	0.5 day	4hrs.	$ 1.43 2.56
GB 80	Fiji skin removed	0.15-0.35	9.22.17	3,125 g 6.9 lbs.	2,156 g	54	688 g 4.6		7 hrs.	$ 0.69 1.61
GB 81	Fiji with skin	0.15-0.35	9.24.17	2,601 g 5.7 lbs.		43	584 g 4.4		8 hrs.	$ 0.68 1.58

Attachment 5 Average amount of green bananas to produce 1 pound of flour and average cost per pound of flour

Cultivars	Pounds greenBmake 1 lbs flour	# of samples	Cost of 1 lbs flour using farmers price	Cost of 1 lbsflour Using market price
Uten Ruk with skin	4.2	5	$ 0.65	$ 1.29
Utin Ruk skin removed	5.1	10	$ 0.76	$ 1.52
Taiwang with skin	4.5	3	$ 0.46	$ 1.43
Taiwang skin removed	6.1	8	$ 0.60	$ 1.93
Karat with skin	5.1	5	$ 1.28	$ 2.40
Karat skin removed	5.2	5	$ 1,37	$ 2.46
Akadahn with skin	4.5	3	$ 1.19	$ 2.16
Akadahn skin removed	6.2	3	$ 1.54	$ 2.75
Fiji with skin	4.6	2	$ 0.70	$ 1.63
Fiji skin removed	5.1	7	$ 0.77	$ 1.77
Inahsiowith skin	4.5	2	$ 0.45	$ 1.12
Inahsio skin removed	5.4	3	$ 0.54	$ 1.36
Utin Iap with skin	4.3	1	$ 0.43	$ 1.50
Utin lap skin removed	4.5	2	$ 0.45	$ 1.57
Mangad with skin	3.8	1	$ 0.87	$ 1.22
Uht Rais with skin	4.1	1	$ 1.05	$ 1.85
Uht Rais skin removed	5.0	2	$ 1.26	$ 2.29
Kaimana with skin	4.4	1	$ 0. 44	$ 1.32
Utin Menihle with skin	3.8	1	$ 0. 77	$ 1.54
Utin Menihle skin rem	4.7	1	$ 0.95	$ 1.90
Utimwas skin removed	6.1	3	$ 1.07	$ 2.29
Lenwahn with skin	5.6	1	$ 0.84	$ 1.96
Lenwahn skin removed	7.7	1	$ 1.16	$ 2.71
Akadahn Weitahta with skin	4.9	1	$ 1.24	$ 2.22
Akadahn Weitahta skin removed	5.3	2	$ 1.43	$ 2.56
Average/total	**4.8** 4.5 5.1	**74**	**$ 0.89** $0.70 $ 1.67	**$ 1.87** $ 0.99 $ 1.93

Total number of cultivars: 14

Average of 74 samples of green banana required 4.8lbs.to make 1 pound of flour.

Average of 47 samples of green bananas with skin removed required 5.1lbs.to make 1 pound flour, and average of 27 samples of green bananas with skin required 4.5 lbs. to make 1 pound of flour.

Average cost to produce 1 lbs flower is $ 0.85 using farm price and $ 1.86 using market prices.

In average bananas wit skin produces 19 % more flour

Attachment 6 Breadfruit tasting

Mainiwe, D. Luker made pancake half Meiniwe and half white flour result was good

Meiuhgw skin and core removed, 15 students tasted on June 13.2017 Linn's pancakes, 13% scored very good, 53% good and 7 % (one person) not good.

Meiuhgw skin and core not removed, 15 students tasted on June 13.2017 Linn's pancakes, 26% scored very good, 53% good, 13 acceptable and 7 % (one person) not good, too sweet.

Meiuhgw skin and core removed, 15 students tasted on June 13.2017, tasted Dr.Ypye's bread and scored the following: 26 % very good, 53% good and 20% acceptable.

Meiuhgw skin and core not removed, 15 students tasted on June 13.2017, tasted Dr.Ypye's bread and scored the following: 20 % very good, 33% good and 47% acceptable

Attachment 7, Table 4 Breadfruit Flour production

No	Name of cultivar	Cost per pound	Date	Total weight	Weight Without skin& co	No of fruits	Dry weight	Drying time sun	Drying time Dehyd	Cost of flour per lbs.
BF 1	Meiniwe With skin & core	$ 0.25 (0.50)	2.17.17	1,222 g		1	466 g (2.6)	3 days		$ .80 - 1.62
BF 2	Meiniew Skin removed	$ 0.25 (0.50)	2.17.17	1,506 g		1	379 g (3.9)	3 days		$0.99- 1.98
BF 3	Meiniwe With skin & core	$ 0.25 $ 0.50	2.22.17	1.669 g 3.7 lbs.		1	554 g (3.0)	3 days		$ 0.76 1.52
BF 4	Meiniwe Skin removed	$ 0.25 $ 0.50	2.22.17	1.761 3.9 lbs.	1.298 g	1	490 g (3.6)	4 days		$ 0.90 1.80

BF 5	Meiniwe with skin &core	$ 0.25 $ 0.50	2.27.17	2,062 g 4.5 lbs.		1	585 g (3.5)	1 day	7 hr.	$ 0.87 1.74
BF 6	Meikalak skin core removed	$ 0.25 $ 0.50	3.7.17	1,518 g 3.35 lbs.	1,162 g	1	358 g (4.2)	2.5 days		$ 1.06 2.12
BF 7	Meikalak with skin core	$ 0.25 $ 0.50	3.7.17	1,311 g 2.88 lbs.		1	383 g (3.4)	3 days		$ 0.85 1.70-
BF 8	Meiuhpw with skin and core	0.25-0.50	05.4.17	1,961 g 4.32 lbs.		2	616 g (3.2)	3 days		$ 0.79 1.58
BF 9	Meiuhpw Skin core removed	0.25-0.50	05.4.17	1,908 g 4.2 lbs.	1,238 g	2	508 g (3.7)	2 days		$ 0.94 1.88
BF 10	Meikalak with skin&cor	$ 0.25 $ 0.50	05.9.17	1,392 g 3.0			324 g (4.3)	3 days		$ 1.05 2.10
BF 11	Meikalak skin & core removed	$ 0.25 $ 0.50	05.9.17	1,373 3.2 lbs.	985 g		249 g (5.5)	3 days	2 hr.	$ 1.46 2.90
BF 12	Meiuhpw with skin &core	$ 0.25 $ 0.50	5.17.17	1,540g 3.4 lbs.		2	441 g (3.5)	3 days	4 hrs.	$ 0.97-1.75
BF 13	Meiuhpw skin core removed	$ 0.25 $ 0.50	5.17.17	1,347 g 2.9 lbs.	939 g	2	309 g (4.4)	2 days	2 hrs.	$ 1.06-2.13
BF 14	Meiuhpw with skin & core	$ 0.25 $ 0.50	5.18.17	1,625 g 3.58 lbs.		2	495 g (3.3)	3 days	3 hrs.	$ 0.82 1.64
BF 15	Meiuhpw skin core removed	$ 0.25 $ 0.50	5.18.17	2,625 g 5.78 lbs.	2,162g	2.5	710 g (3.7)	3 days	1 hr.	$ o.92 1.84
BF 16	Meiniwe With skin & core	$ 0.25 $ 0.50	5.25.17	1,483 g 3.3 lbs.		2	451g (3.3)	2 days	2 hr.	$ 0.83 1.66
BF 17	Meiuhpw with skin & core	$ 0.25 $ 0.50	5. 2717	1,642 g 3.6 lbs.		2	557 g (2.9)	3 days	2 hrs.	$ 0.73 1.46
BF 18	Meiniwe with skin and core	$ 0.25 $ 0.50	6.01.17	2,008 g 4.4 lbs.		1	578 g (3.5)	2 days	3 hrs.	$ 0.86 1.72

BF 19	Meiniwe Skin & core removed	$ 0.25 $ 0.50	6.01.17	1,872 g 4.1 lbs.	1,289 g	1	381 g (4.9)	2 days	1 hr.	$ 1.22 2.44
BF 20	Meiuhpw skin core removed	$ 0.25 $ 0.50	6.08.17	3,224 g 7.1 lbs.	2,254 g	4	593 (5.4)	2 days	1 hr.	$ 1.36 2.72
BF 21	Meiniwe with skin & core	$ 0.25 $ 0.50	6.21.17	2,912 g 6.4 lbs.		2	794 g (3.7)	3 days	1 hr.	$ 0.91 1.83
BF 22	Meiniwe with skin & core	$ 0.25 $ 0.50	6.27.17	2,505 g 5.5 lbs.		1	649 g (3.8)	3 days	1 hr.	$ 0.96 1.92
BF 23	Meiniwe Skin removed	$ 0.25 $ 0.50	6.28.17	3,070 g 6.7 lbs.	2.540 g	2	588 g (5.2)	2 days	2 hrs.	$1.29 2.58
BF 24	Meilukiwal with skin and core	$ 0.25 $ 0.50	7.10.17	1,870 g 4.1 lbs.		0.5	372 g (5.0)	2 days	3 hrs.	$ 1.25 2.50
BF 25	Meilukiwal removed	$ 0.25 $ 0.50	7.10.17	2,274 g 5.0 lbs.	1,539	0.5	332 g (6.8)	2 days	2 hrs.	$ `1.70 3.40
BF 26	Meikohi with skin core	$ 0.25 $ 0.50	7.17.17	1.319 g 2.9 lbs.		1	383 g (3.4)	1 day	6 hrs.	$ 0.86 1.72
BF 27	Meikohi skin core removed	$ 0.25 $ 0.50	7.18.17	1.247 g 2.7 lbs.	969 g	1	280 g (4.4)	1 day	5 hrs.	$ 1.09 2.18
BF 28	Meiniwe skin removed	$ 0.25 $ 0.50	7.19.17	1.823 g 4.0 lbs.	1.283 g	1	420 g 4.3	1 day	5 hrs.	$ 1.08 2.16
BF 29	Meikohiwit h skin & core	$ 0.25 $ 0.50	7.21.17	1,030 g 2.26 lbs.		1	255 g 4.0	1 day	2 hrs.	$ 1.00 2.00
BF 30	Meilukiwal skin core removed	$ 0.25 $ 0.50	8.30.17	2,962 g 6.5 lbs.	2,062 g	2	696 g 4.2	1 day	2 hrs.	$ 0.86 1.44
BF 31	Mei en sahrek with skin	$ 0.25 $ 0.50	9. 1.17	1,506 g 3.3 lbs.		1	426 3.5	1 day	3 hrs.	$ 0.87 1.74
BF 32	Mei ensahrek skin core removed	$ 0.25 $ 0.50	9.2.17	1,555 3.4 lbs.		1	435 3.6		8 hrs	$ 0.88 1.76

BF 33	Meilukiwal with skin	$ 0.25 $ 0.50	9.3.17	1,781g 3.9		1	516g 3.4	1 day	4 hrs.	$0.85 1.70
BF 34	Mei lukiwalwith skin & core	$ 0.25 $ 0.50	9.13.17	2,011g 4.4		1	674 g 2.9		7 hrs.	$ 0.74 1.58
BF 35	Mei lukiwal peeled	$ 0.25 $ 0.50	9.14.17	1,950g 4.3	1,432 g	1	551 g 3.5		7 hrs.	$ 0.89 1.75

Attachment 8 Average amount of breadfruit to produce 1 pound of flour and average cost per pound of flour.

Cultivars	**Pounds of BFmake 1 lbs. flour**	**# of samples**	**Cost of 1 lbs. flour using farmers price**	**Cost of 1 lbs. flour Using market price**
Meiniwe with skin & core	3.3 lbs.	6	$ 0.84	$ 1.68
Meiniwe skin & core removed	4.3 lbs.	6	$ 1.09	$ 2.18
Meikalak with skin & core	3.8 lbs.	2	$ 0.95	$ 1.90
Meikalak skin & core removed	4.8 lbs.	2	$ 1.20	$ 2.51
Meiuhpw with skin & core	3.2 lbs.	4	$ 0.83	$ 1.60
Meiuhpw skin core removed	4.3 lbs.	4	$ 1.07	$ 2.14
Meilukiwal with skin &	3.5 lbs.	3	$ 0.87	$ 1.75
Meilukiwal skin core removed	4.5 lbs.	3	$ 1.12	$2.25
Meikohiwith skin & core	3.7 lbs.	2	$ 0.93	$ 1.86
Meikohi skin core removed	4.4 lbs.	1	$ 1.09	$ 2.18
Mei ensahrekwith skin & core	3.5 lbs.	1	$ 0.87	$ 1.74
Mei ensahrek skin core removed	3.6 lbs.	1	$ 0.88	$ 1.76
Average/Total	**3.9 lbs** 3.5 lbs. 4.3lbs.	**35**	$ 1.00 $ 0.90 $ 1.10	$ 2.00 $ 1.80 $ 2.20

Total number of cultivars: 6

Average of 33samples of breadfruit requires 4.0 lbs. to make 1 pound of flour.

Average of 16 samples of breadfruit with skin & core removed required 4.5 lbs. to make 1 pound flour, and average of 17 samples of breadfruit with skin& core required 3.6lbs.to make 1 pound of flour.

Average cost to produce 1 lbs. flower is $ 1.00 using farm price and $ 2.00 using market prices

Breadfruit with skin produces 19 % more flour.

Attachment 9 Swamp Taro Tasting

Palau with skin, 5 people reported excellent 75% taro flour with skin and 25% Wheat flour) made by Eminer.

Pwiliat(#9) skin removed banana cake was made and 24 people tasted it on April 7.2017. The score was the following: 9 very good, 12 good and 3 acceptable.

Pwiliat(#10)) with skin banana cake was made and 24 people tasted it on April 7.2017. The score was the following: 8 very good, 12 good and 2 acceptable

Sounpwong weneu or Six month (#2) with skin mushroom soup was made 24 people tasted it on April 7.2017. The score was the following: 15 very good, 6 good and 3 acceptable.

Sounpwong weneu or Six month with skin and core, one report from Dena Liling was excellent

Six month or Sounpwong weneu(#1) skin removed mushroom soup was made 24 people tasted it on April 7.2017. the score was the following: 15 very good, 6 good and 3 acceptable

Eminer Johnson reported, that 30 people tasted taro with and without skin no difference between the two all tasted good.

Mwahngen Palau skin without skin, 15 students (June 13.2017) tasted Mona's brownies, 80 % scored very good, 20% good a

Mwahngen Palau skin with skin, 15 students (June 13.2107) tasted Mona's brownies, 67% scored very good and 53% good.

Attachment 10, Table 5 Giant Swamp Taro for flour production

No.	Name of cultivar	Cost per pound	Date	Total weight	Grinded weight	Dry weight	Drying time sun	Cost of flour per lbs
ST 1	Mwahngen Palau with skin	0.20-0.35	1.27.17	3,026 g 6.66 lbs.	2,310 g	1,112 g (2.0)	3 days	$0.54-0.95
ST 2	Sounpwong Weneu or Six Month with skin	0.20 -0.35	2.03.17	16 lbs. 7,264 g	13.8 lbs. 6,283 g	2,655 g (2.7)	3.5 days	$ 0.54 0.95
ST 3	Sounpwong Weneu or Six Month without skin	0.20-0.35	2.09.17	12.2 lbs. 5,539g	5,487 g	2,205 (2.5)	3 days	$ 0.50 0.88
ST 4	MwahngPwiliet Peeled	0.20 -0.35	2.7.17	1,998 g Half corm	1,872 g	732 g (2.7)	3.5 days	$ 0.54 – 0.95
ST 5	Mwahng Pwiliet With skin	0.20-0.35	2.07.17	2,066g Half corm	1,979 g	772 g (2.6)	3.5 days	$ 0.52 0.93
ST 6	Mwahngen Palau with skin	0.20-0.35	2.28.17	4,436 g 9.77 lbs.		1,417 g (3.1)	3 days	$ 0.62 1.09
ST 7	MwahngenPalau with skin & core	0.20-0.35	3.10.17	4,445 9.79 lbs.		1,593 g (2.8)	2 days	$ 0.56 0.97
ST 8	Mwahngen Palau with skin	0.20-0.35	3.19.17	4,099 g 9.03 lbs.		1,.120g (3.6	3 days	$ 0.72 1.28
ST 9	MwahngenPalau with skin	0.20-0.35	3.30.17	6,434 g 14.2 lbs.		2,207 g (2.9)	3.5 days	$ 0.58 1.02
ST 10	Six Month	.0.20-.0.35	4.8.17	8,392 g 18.5 lbs.		2,755 g (3.0)	3 days	$ 0.76-1.06
ST 11	Sounpwong Weneu or Six Month with skin	.0.20-0.35	4.17.17	3,221 g 7.1 lbs.		1,152 g (2.8)	3 days	$ 0.70 0.98
ST 12	MwahngenPalau Skin removed	.0.25-0.35	5.26.17	2,538 g 5.6 lbs.	2,120 g	720 g (3.5)	3 days	$ 0.88 1.23
ST 13	Mwahngen Palau skin removed	.0.20-0.35	6.11.17	5,286g 11.6 lbs.	4,820g	1,912 g (2.7)	3 days	$ 0.69 0.96
14	Sounpwong Weneu or Six Month with skin	.0.20-0.35	6.29.17	3,862 g 8.5 lbs.		1,047 g (3.6	3 days	$ 0.92 1.30

Attachment 11Average amount of swamp taro to produce 1 pound of flour and average cost per pound of flour

Cultivars	Pounds of taro to make 1 lbs flour	# of samples	Cost of 1 lbs flour using farmers price	Cost of 1 lbs flour Using market price
Mwahngen Palau with skin	2.9	5	$ 0.60	$ 1.06
Mwahngen Palau skin removed	3.1	2	$ 0.78	$ 1.09
Sounpwong Weneu or Six month with skin	2.6	3	$ 0.58	$ 0.94
Sounpwong Weneu or Six month skin removed	3.3	2	$ 0.84	$ 1.18
Mwahng Pwiliet with skin	2.6	1	$ 0.52	$ 0.93
Mwahng Pwiliet skin removed	2.7	1	$ 0.54	$ 0.94
Average/ Total	**2.8** 2.7 3.0	**14**	**$ 0.64** $ 0.56 $0.72	**$ 1.02** $0.97 $ 1.07

Total number of cultivars: 3

Average of 14 samples of swamp taro required 2.8lbs to make 1 pound of flour.

Average of 5 samples of with skin removed required 3.3lbs to make 1 pound flour, and average of 9 samples of taro with skin required 2.7lbs.to make 1 pound of flour.

Average cost to produce 1 lbs. flower is $ 0. 64 using farm price and $ 1.02 using market prices.

In average taro with skin produces 10 % more flour.

Attachment 12 Table 6 Coconut for flour production

No	Name of cultivar	Cost per nut	Date	Total weight	Grinded weight	Dry weight	Drying time solar/sun	Cost of flour per lbs.
CF 1	Local tall		01.27.17	3 nuts	1,066			
CF 2	tall	0.20-0.40	02.11.17	3 nuts	1,281 g	763 g (1.7)	2.5 days	$ 0.36- $ 0.71
CF 3			03.09.17	4 nuts	1,167 g 734 g	392 g (2.9)	2	$ 0.93 1.85
CF4			04.12.17	4	1,248 g 894	438 g		

Attachment 13 Table 7 Dehydrated bananas

Samp No.	Name of cultivar	Date	Price per lbs.	Bunch weight	Fruit weight	# of fingers	Dry weight	Drying time solar	Cost per pound	Remarks
DB 1	Karat Pako ripe	1.23.17								itchy
DB 2	Taiwang ripe	1.23.17	0.10-O.35	4.6 lbs. 2,086 g			544g (3.8)		$ 0.38- $1.34	Very good
DB 3	Utimwas ripe	1.24.17								itchy
DB 4	Taiwang	1.26.17								Very good
DB 5	Akadahn weitahta	1.30.17	0.25-0.65	1,323 g						Good and sweet
DB 6	Taiwang	2.04.17	0.10-0.35	2,179 g	1,329g	30	444 (4.9)		$ 0.49- $ `1.70	Good and sweet
DB 7	Taiwang	2.06.17		2,548 g	1,578g	30	521g (4.8)		$ 0.48- $ 1.71	Good and sweet
DB 8	Taiwang	2.13.17	0.10-O.35	2,109 g	1,588g	33	458g (4.6)	2.5 days	$0.46- $1.58	Good and sweet
DB 9	Fiji	2.20.17	0.15-0.35		3,166g	60	636g (4.9)	1.5 days	$ 0.75- $ 1.74	OK
DB 10	Taiwang	4.03.17	0.15-0.35	2,045 g	1,248	30				

Attachment 14 Table 8: Vacuum packed banana

No	Name of cultivar	Date	Cooked /uncooked	citric	drying		Remarks
VP 1	Karat	04.11.17	cooked				05.2.17 bad
VP 2	Taiwang	04.11.17	cooked				05.2,17 very good
VP 3	Utin Ruk	04.12.17	cooked				05.2.17 very good
VP 4	Karat	04.12.17	cooked				Bad air inside
VP 5	Utin Ruk	04.19.17	uncooked	No citric.	No drying		Bad on 4/24/17
VP 6	Utin Ruk	04.19.17	cooked	Citric 30 minute			Still good after 5 days
VP 7	Utin Ruk	04.20.17	uncooked				No good after 4 days
VP 8	Utin Ruk	04.20.17	uncooked	Citric 30 minute			No good
VP 9	Utin Ruk	04.20.17	uncooked	citric	30 min drying		No good air inside
VP 10	Utin Ruk	04.20.17	Cooked				Some air inside
VP11	Utin Ruk	04.20.17	cooked	citric			Some air
VP12	Utin Ruk	04.20.17	cooked	citric	30 min. drying		Little air
VP 13	Utin Ruk	04.24.17	Cooked 5 minutes				Some air no good
VP 14	Utin Ruk	04.24.17	cooked		Drying 1 hr.		Some air no good
VP 15	Karat	04.24.17	cooked		Drying 1 hr.		Some air no good
VP 16	Utin Ruk	04.26.17	Cooked 15 minutes	Citri 30 minute	Sun drying 2 hours		No air good
VP 17	Karat	04.26.17	Cooked 15 minute	Citri 30 minute	Sun drying 2 hours		No air good

VP 18	Inashio	04.27.17	Cooked 10 minute	Citri 30 minute	Drying 2 hours	Sample in Refrigerat	Taste good after 50 days Tastes no good after 140 days
VP 19	Inashio	04.27.17	Cooked 10 minute	Citri 30 minute	Drying 2 hours	Sample in Freezer	Taste good after 50 days Taste good after 140 days
VP 20	Inashio	04.27.17	Cooked 10 minute	Citri 30 minute	Drying 2 hours	Sample outside	Taste bitter after 50 days in room temperature Tastes bitter after 140 days
VP 21	Utin Ruk	04.28.17	Cooked 10 minute	Citri 30 minute	Drying 2 hours	Sample in Refrigerat	Taste good after 50 days
VP 22	Utin Ruk	04.28.17	Cooked 10 minute	Citri 30 minute	Drying 2 hours	Sample in Freezer	Taste good after 50 days
VP 23	Utin Ruk	04.28.17	Cooked 10 minute	Citri 30 minute	Drying 2 hours	Sample outside	Kept vacuum but had a bitter taste after 50 days in room temperature

Attachment 15 Table 9 Pumpkin Flour Production

No	**Name of cultivar**	**Cost per nut**	**Date**	**Total weight**	**No of fruits**	Dry weigh t	Drying time solar	Drying time Dehyd	**Cost of flour per lbs.**	**Remarks**
PF 1	Local	0.45-0.85	3.29.17	3.499 g 7.7 lbs.	1	293 g (11.9)	4 days	6 hrs.	$ 5.38 10.14	
PF 2	Local with skin	0.45-0.85	3.31.17	3,951 g 8.7 lbs.	1	373 g (10.6)	5 days	8 hrs.	$ 4.76 9.00	Was not able to make flour, it never become hard and dry

Attachment 16 Samples sent to Hill Laboratories

Sample No.	Crop	Cultivar	With skin	Skin removed	Amount	Date of sending
GB 23	Banana	Utin Ruk		1	2 x 100 g	3.6.17
GB 37	Banana	Utin Ruk	1		2 x 100 g	4.12.17
GB 24	Banana	Utin Iap	1		2 x 100 g	4.12.17
GB 26	Banana	Pako		1	2 x 100 g	3.6.17
GB 34	Banana	Pako	1		2 x 100 g	4.12.17
BF 5	Breadfruit	Meiniwe	1		2 x 100 g	4.12.17
BF 4	Breadfruit	Meiniwe		1	2 x 100 g	4.12.17
ST 10	Swamp Taro	Six Month		1	2 x 100 g	4.12.17
ST 11	Swamp Taro	Six Month	1		2 x 100 g	4.12.17

Attachment 17 Samples in Storage for possible Laboratory Analysis

No of samples	Name of cultivar	With skin and core	Skin & core removed	Date
2	Breadfruit Meikohi	1	1	7.19.17
5	Breadfruit Meiuhpw	3	2	5.17.17
4	Breadfruit Meikalak	2	2	5.13.17
2	Breadfruit Meiniwe	1	1	2.20.17
3	Breadfruit Meilukiwal	2	3	6.14.17
4	Breadfrit Meiensahrek	2	2	9.3.17
7	Mwahngen Palau	7		3.13.17
3	Banana Dehydrated Taiwang		3	3.6.17
5	Banana Taiwang	1	4	3.19.17
2	Banana Mangat	1	1	4.4.17
5	Banana Akadahn	3	2	4.30.17
2	Banana Utin Rais		2	3.26.17
3	Banana Utin Menihle	2	1	9.1.17
2	Banana Fiji		2	2.9.17
2	Banana Karat Yap	2		5.15.17
1	Banan Karat Pwehu		1	2.16.17
1	Banana Kai Mana		1	2.17.17
1	Bananan Uht Rais	1		3.23.17
3	Banana Lemwahn	2	1	2.27.17
2	Banana Inahsio	1	2	2.13.17
2	Banana Utimwas		2	2.24.17
1	Banana UtenIap		1	2.3.17
2	Swamp taro Mwahngen Palau		2	April 2017
2	Banana AkadahnWeitahta		2	9.14.17

Attachment 18Table 10 Nutritional Analysis of Banana Flour

Test results 100 g measure	Banana UtinRuk without skin GB 23	Banana UtenRuk with skin GB 37	Banana UtinIap without skin GB 24	Banana Karat Pako without skin GB 26	Karat Pako with skin GB 34	* PIFC Table 2nd edition	White flour
Moisture	8.7	11.4	13.4	11.8	10.7		
Ash	1.99	3.7	2.7	2.4	3.4		
Total Protein	3.8	4.2	2.9	3.9	4.4	0.9	2.4
Total Fat	0.70	2.1	0.80	0.80	1.20	0.2	1.6
To Dietary Fiber	7.3	12.0	13.0	15.0	16.0	0.7	3.6
T Carbohydrate	78	67	67	66	64	29.8	72.1
Energy kj/100g	1,467	1,377	1,327	1,339	1,341	512	1,460
Energy Cal/100g	351	329	317	320	321		349
Calcium mg/100g	24	154	121	79	102	18	17
Magnesium mg/100g	118	154	108	186	250	36	13
Potassium mg/100g	930	1,580	1,210	1,050	1,410	489	174
Sodium mg/100gmg	< 5		< 5	< 5		4	2
Iron mg/100g	1.7	1.4	4.3	1.6	3.4		1.3
Vit. A(as Retinol)	< 10	< 10	< 10	< 10	< 10		0
Vit.B2 (Ribofavin)	0.070	0.040	0.45	3.7	4.5	0.06	0.03
Vit. C (Ascorbic acid)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	11	0

*PIFC The Pacific Island Food Composition Table. Edition

Attachment 19Table 11: Nutritional Analysis of Breadfruit Flour

Test results 100 g measure	BF 5 Mei Niwe with skin& core	BF 4 Mei Niwe	Breadfruit from Hawaii *	White rice	White flour	PIFC Table 2nd edition
Moisture	7.5	13.2				
Ash	3.5	2.7				
Total Protein	6.8	3.3	4.0	2.4	2.4	1.5
Total Nitrogen	1.09	0.53				
Total Fat	1.4	0.90			1.6	0.4
To Dietary Fiber	15.0	13.0	5.4	0.3	3.6	2.5
T Carbohydrate	66	67	31.9	28.6	72.1	23.6
Energy k.J/100 Energy Cal/100	1,406 336	1,331 318			1,463 349	450 107
Calcium	93	48	16.8	3.0	17	25
Magnesium	120	70	34.3	13.0	13	24
Potassium	1,530	1,320	376.7	29.0	174	480
Iron	3.4	2.3	0.5	0.20	2	1
Vit. A(as Retinol)	< 1.0	< 1.0	1.4	0	1.3	0
Vit.B2 (Ribofavin)	0.30	0.090	0.0	0.0016	0	0.06
Vit. C (Ascorbic acid)	50	3.3	2.4 mg.	0.0	0.03	20
$-Carotene ug			15.1	0	0	

*Average of three Hawaiian cultivars (“Ulul, Ma’afala, and Meinpadahk

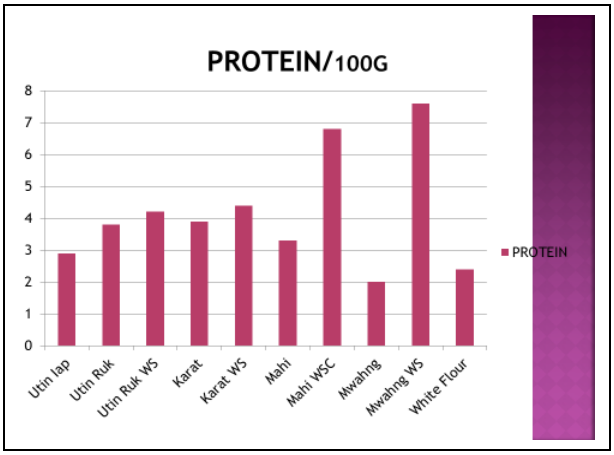
Attachment 20 Table 12 Nutritional Analysis of Taro

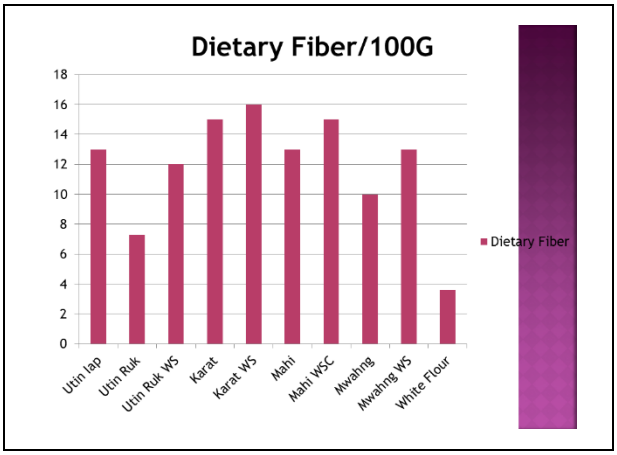
Test results	Six Month skin removed	Six month with skin	White Flour
Moisture	12.7	9.1	
Ash	2.1	2.6	
Total Protein	2.0	7.6	2.4
Total Fat	0.90	0.80	1.6
To Dietary Fiber	10.0	13.0	3.6
T Carbohydrate	72	67	72.1
Energy k.J/100 Energy Cal/100	1,377 329	1,399 335	1,460
Calcium	230	400	349
Magnesium	59	117	17
Potassium	730	760	13
Iron	4.0	14.6	1.3
Vit. A(as Retinol)	< 10	< 10	2
Vit.B2 (Ribofavin)	0.090	0.31	1.3
Vit. C (Ascorbic acid)	1.36	2.2	0

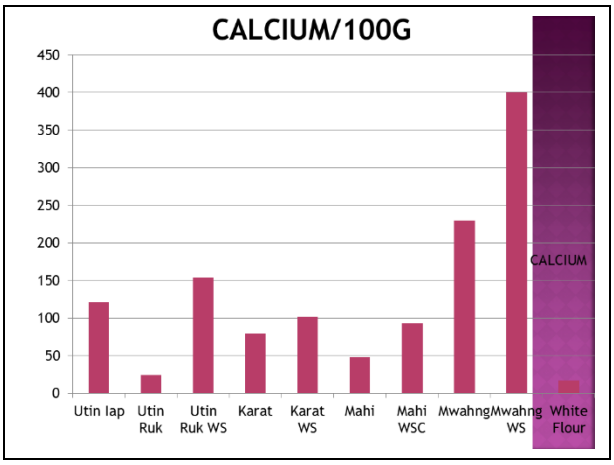
Attachment 21 Nutritional Analysis of Banana, Taro and Breadfruit with and without skin

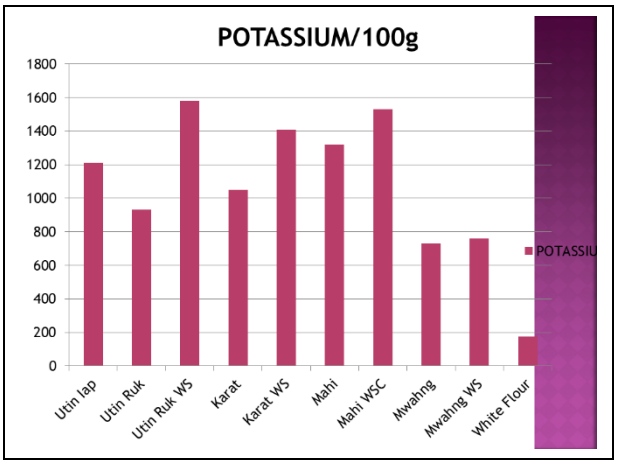
Test results 100 g measure	Banana UtinRuk without skin GB 23	Banana UtenRuk with skin GB 37	Banana UtinIap without skin GB 24	Banana Karat Pako Without skin GB 26	Banana Karat Pako with skin GB 34	S.Taro Six Month without skin	S.Taro Six month with skin	B.Fruit Mei Niwe with skin& core BF 5	BFruit Mei Niwe Without skin & core BF 4	White flour
Moisture	8.7	11.4	13.4	11.8	10.7	12.7	9.1	7.5	13.2	
Ash	1.99	3.7	2.7	2.4	3.4	2.1	2.6	3.5	2.7	
Total Protein	3.8	4.2	2.9	3.9	4.4	2.0	7.6	6.8	3.3	2.4
Total Fat	0.70	2.1	0.80	0.80	1.20	0.90	0.80	0.90	1.4	1.6
To Dietary Fiber	7.3	12.0	13.0	15.0	16.0	10.0	13.0	10.0	15.0	3.6
T Carbohydrate	78	67	67	66	64	72	67	72	66	72.1
Energy kj/100g	1,467	1,377	1,327	1,339	1,341	1,377	1,399	1,406	1,331	1,460
Energy Cal/100g	351	329	317	320	321	329	335	336	318	349
Calcium mg/100g	24	154	121	79	102	230	400	93	48	17
Magnesium mg/100g	118	154	108	186	250	59	117	120	70	13
Potassium mg/100g	930	1,580	1,210	1,050	1,410	730	760	1,530	1,320	174
Iron mg/100g	1.7	1.4	4.3	1.6	3.4	4.0	14.6	3.4	2.3	1.3
Vit. A(as Retinol)	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 1.0	< 1.0	0
Vit.B2 (Ribofavin)	0.070	0.040	0.45	3.7	4.5	0.090	0.31	0.30	0.090	0.03
Vit. C (Ascorbic acid)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.36	2.2	50	3.3	0

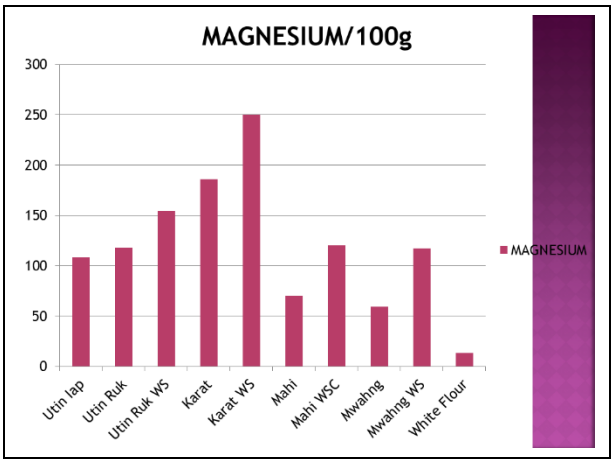
Attachment 22 Nutritional Analysis of Banana, Taro and Breadfruit with and without skin

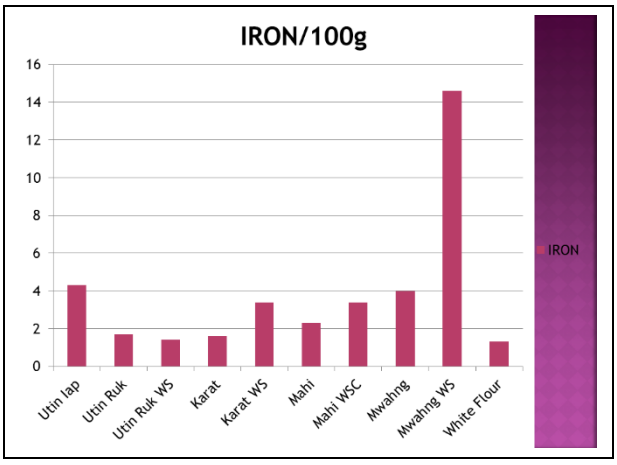












Graphs produced by Emihner Johnson

Attachment 23 Letter from Lauren Schmeisser on Food Tasting

Hello Emihner,

I hope this email finds you well. I'm Lauren Schmeisser- I visited you at Island Food community back in the middle of March when my fellow students and I from University of Washington were working on climate change education in Pohnpei with PREL and some local teachers. You were kind enough to give me a sample of the banana flour, and I'd love to give you my feedback! Please see below.

Date: April 8, 2017 (date on bag says March 21, 2017)

Name of flour: Banana flour karat pako w/ skin GB34 (sorry the marker from the label rubbed off a little in my suitcase on the way back- I think this is what it said!)

What kind of dish: Chocolate chip pecan banana bread

How did you make it?

I followed the recipe directly as is (http://www.foodnetwork.com/recipes/tyler-florence/banana-bread-with-pecans-recipe), but substituted 75% of the flour with banana flour, and 25% with regular all-purpose wheat flour. I also added some chocolate chips because my fiancé loves chocolate chip banana bread :)

Did you experience itchiness or allergies: No, none at all!

What would you recommend on how to use it?

I loved the extra banana flavor added to the bread by the banana flour- I think bread is a great use for the banana flour! I also think the ratio of banana flour to regular flour that I used worked well, though I would like to try the recipe again with all banana flour.

Name: Lauren Schmeisser, +1(303)947-1589, Lauren.schmeisser@gmail.com

Attachment 24 Photos



Breadfruit with skin &core



Drying Banana, UtinRuk with skin



Vacuum packet bananas for storage testing



Dehydrated ripe bananas for healthy snack food



Vacuum packed breadfruit for shelf life testing



Drying pumpkin for flour production

Equipment used for Flour processing



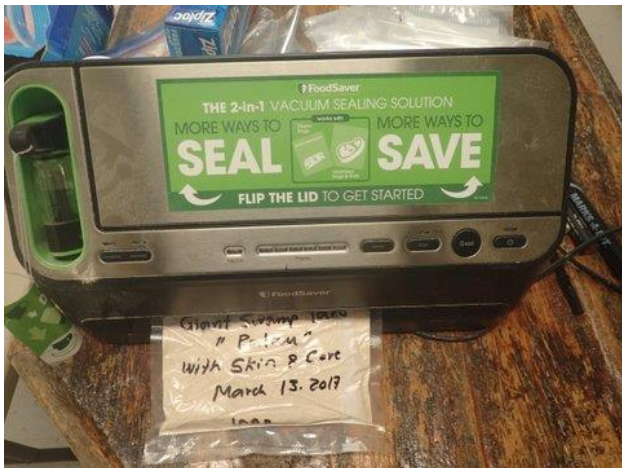
Locally made solar dryer



Dehydrator



Hand operated Milling Machine



Vacuum sealer



Left:

Electric taro grinder

Food tasting and Training











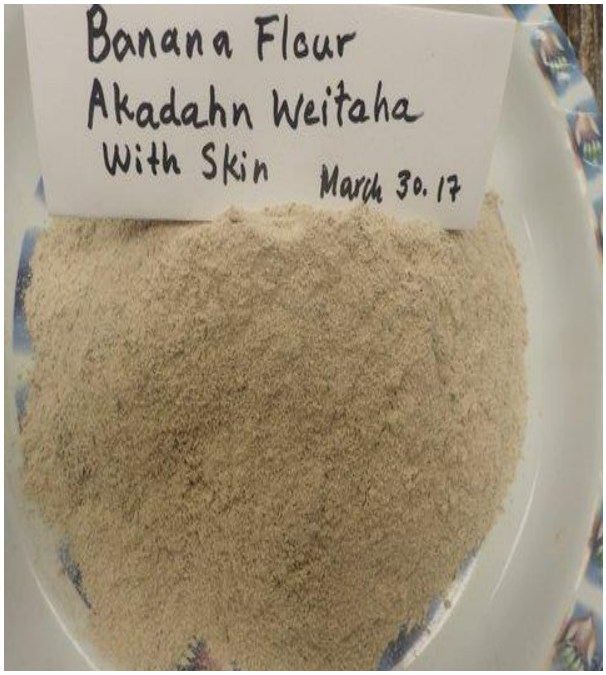
Hands- on training



IFCP Staff presentation of Food Security

Display of flour samples





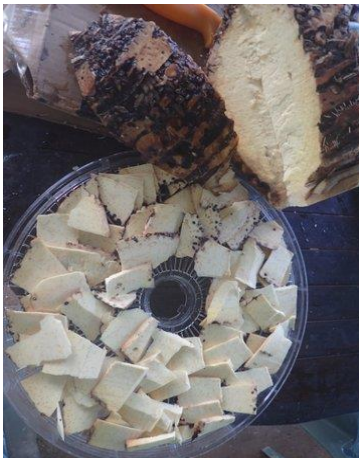
Vacuum packed flour samples





Karat Banana drying





Top: Swamp taro grinded for drying.

Bottom: Swamp taro chipped ready for drying