CASSAVA AS A STAPLE FOOD IN PALAU

MARERO AND TARO

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CASSAVA AS A STAPLE FOOD IN PALAU

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Message

I am pleased to acknowledge the writing of this book on "Cassava as Staple Food in Palau" by researchers of the College of Micronesia-Palau Community College.

This is a standard outcome of researches funded by the Hatch Act of 1887 and administered by the National Institute of Food and Agriculture-United States Department of Agriculture (NIFA-USDA), one of the programs of the College of Micronesia Land Grant.

Processing of cassava is not only beneficial to the Republic of Palau, but also to the rest of the Pacific Island Nations using cassava as staple food.

Dr. Singeru Singeo
Executive Director
College of Micronesia Land Grant Programs

Foreword

The Cooperative Research and Extension (CRE) Department of the Palau Community College (PCC) spearheaded the conduct of researches on the production and processing of cassava, locally known as tapioca or diokang, as a food staple in Palau.

The processing of tapioca into various food preparations was conducted at the Food Technology Laboratory of PCC-CRE located at the R & D Station in Ngermeskang, Ngeremlengui State. Cassava processed products were developed through the USDA-approved project on the Processing of Rootcrops in the Republic of Palau, under the Hatch Act program.

The goal of this publication is to help Palauan farmers increase the utilization of tapioca. Aside from providing food for the families, the valuable information also opens opportunities for starting a food business to increase income of farmers. Product development of local foods also supports the tourism industry, the lifeblood of Palau economy, with the availability of ethnic foods from tapioca.

PATRICK U. TELLEI, EdD
President
Palau Community College

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Introduction

Low agricultural productivity, coupled with large food importation in Palau presented avenues for focusing research activities on local food processing. Increasing production and utilization of local foods could create surpluses that can be converted into value-added products for the market.

Cassava (*Manihot esculenta* Crantz), also known locally as tapioca or diokang, is a staple food in Palau. It ranks second to taro in terms of production and value. The Cooperative Research and Extension (CRE) Department of the Palau Community College (PCC) has conducted researches on the production of tapioca for the past fifteen years of its existence. Utilization of tapioca into processed food products started in 2001 and several food items are ready for technology transfer to prospective food entrepreneurs,

The Research and Development (R & D) Station located in Ngermeskang, Ngeremlengui State, Palau, has served as a repository of fifty two (52) varieties of cassava in Palau. Planting materials are given away to farmers during civic events like Olechotel Belau Fair, Earth Day, Career Awareness Week, Women's Month, Independence Day, and many other occasions.

Tapioca greatly abound in the Republic of Palau all year-round. Its utilization into value-added processed products can lead to microenterprise development and market potentials. Tapioca processing plays a major role in upgrading the conditions of root crop growers in Palau, by providing:

- Improved tapioca products and processes workable in small-scale industries;
- New product concepts for domestic and export markets;
- Training in tapioca-based food processing; and
- Livelihood opportunities by establishing a food microenterprise for additional income.

The Palau Economic Development Plan (1995-1999) calls for a market oriented sustainable agriculture with emphasis on self-sufficiency, import substitution, and export markets. Production and utilization of local foods should be increased. This in turn, should create surpluses that can be converted into value-added products for the local and export markets. Development of tapioca into processed food products will ensure a stable supply that will redound to food security in the Republic.

Cassava and tapioca are terms used interchangeably throughout this publication, since tapioca is the more popular term used by the Palauans in referring to cassava. Tapioca is actually a term used for a pearl-like processed cassava, used in the preparation of desserts.

Cassava Production in Palau

In 1996, a total of 301,496 lbs. of cassava with a value of $196,972.50 was produced in Palau (IESL, 1996). Of this production, 69% was sold in the market, 16% was used by the family, and 15% was for traditional customs.

Fifty two (52) varieties of cassava are included in the collection at the PCC-CRE R & D Station, although some of the varieties are the same, but known in other names (Del Rosario, 2003). These varieties and their respective cooked colors are shown in Table 1.

Table 1. Varieties of cassava grown at the PCC-CRE R & D Station, with their respective cooked colors.

Variety	Color
Aderuangel	white
Angaur Red	white
Belau Ra Metengel	white
Blorang	white
Chemeraech	white
Cheual Ruil	white
Coop	white
Ngerab	white
Ngerair	white
Ngerduais	white
Ngeremlengui	white
Ngesuong	yellow
Ngkud	white
Ochobirang	yellow
Oles	white
Olik	white
Oreor	white
Saibal	white
Sers	white
Shimizu	white
Smiich	white
Stebania	white
Terue	white
Tikei	white
Uchulaluk	yellow
Ulang	white
Umad	white
Yasireng	white

Nutritional Value of Cassava

Cassava is mainly used as "ongraol" (carbohydrate source) in Palau. It is usually prepared into *"billum"* (grated tapioca with oil wrapped with ti or coconut leaves and boiled) or just plainly boiled. Its nutritional composition is shown in Table 2.

Cassava tubers of any variety are peeled and washed immediately after harvest, and must be kept frozen until they are used in food preparations. If cassava is not peeled and frozen right away and just left at room temperature, onset of deterioration, like blackening, starts. This condition produces hydrocyanide, which is poisonous. Blackened cassava are also good medium for the growth of a deadly mold called *Aspergillus flavus,* responsible for the development of aflatoxin. Aflatoxin, if ingested, accumulates in the liver and was reported to cause liver cancer.

Cassava is usually eaten as plainly cooked or as *billum* in Palau, and served during custom events like funerals and birth ceremonies. Tapioca contains soluble fibers, a form of dietary fiber. Soluble fibers are highly fermentable and are associated with carbohydrate and lipid metabolism. Particle size, water holding capacity, viscosity, cation exchange capability, and binding potential are specific for every fiber source (Dreher, 1987). Eastwood and Morris (1992) describe dietary fiber as a "water-laden sponge" moving through the intestine.

Table 2. Nutrient composition of raw and cooked tapioca.

Nutrient	Raw	White, cooked	Yellow, cooked
Edible portion, %	74	71	85
Water, %	63	71.8	61.0
Energy, Kcal	145	111	155
Protein, %	0.6	0.4	0.7
Fat, %	0.2	0.1	0.2
Carbohydrate, %	35.3	27.1	37.7
Crude Fiber, (Dietary Fiber),%	1.8	1.3	1.4
Ash, %	0.9	0.6	0.4
Calcium, mg%	30	10	37
Phosphorus, mg%	41	22	47
Iron, mg%	1.1	0.3	1.0
Retinol, ug%	0	0	0
B-carotene, ug%	10	Trace	155
Total Vit,A ug%	2	Trace	26
Thiamin, mg%	0.06	0.03	0.01

Adapted from FCT-FNRI, 1997.

The structure and surface activity contributed by the water-insoluble fibers combined with the gel-forming viscous properties of the water-soluble fiber network provide the fiber matrix with the ability to carry out such activities as cation exchange and gel filtration.

Tapioca fibers are fermented in the large intestines to produce hydrogen, methane, carbon dioxide, and short-chain fatty acids. The short-chain fatty acids are rapidly absorbed from the gastrointestinal tract and contribute to the energy balance of the body (Cunningham, 1991).

Processing of Cassava/Tapioca Products

A. Dried Products

Tapioca Starch

Fig. 1 Tapioca starch.

Ingredients:
Tapioca, any variety

Procedure:
- Clean and wash tapioca tubers. Grate.
- Place grated tapioca in a container and add enough water to cover tapioca.
- Squeeze tapioca and save wash water.
- Leave wash water for 5 hours or overnight to settle starch.
- Decant water and transfer tapioca starch into drying trays.
- Dry starch in the sun for 8 hours or until very dry.
- Pack starch, seal and label.
- Store tapioca starch at room temperature (27°-32° C) in a clean, dry place.

Tapioca Flour

Fig. 2. Tapioca flour

Ingredients:

Tapioca ***(diokang)***, any variety

Procedure:

- Clean and wash tapioca tubers, peel, and grate.
- Dry grated tapioca in the sun until crisp.
- Grind dry tapioca, sift, and pack in thick (0.5 mil) plastic bags and seal.
- Store at room temperature (27° to 32° C) in a clean, dry place.

Tapioca Pancake Mix

Fig.3. Tapioca pancake mix

Ingredients:

2	cups	tapioca flour
2	cups	all-purpose flour
1	cup	sugar
1	cup	dry milk
¼	cup	baking powder
1	tsp.	salt

Procedure:

- Mix together all ingredients in a plastic bag.
- Pack 1 cup mixture in thick (0.5 mil) plastic bags, seal and label. Store in a clean, dry place.

Tapioca Pancakes

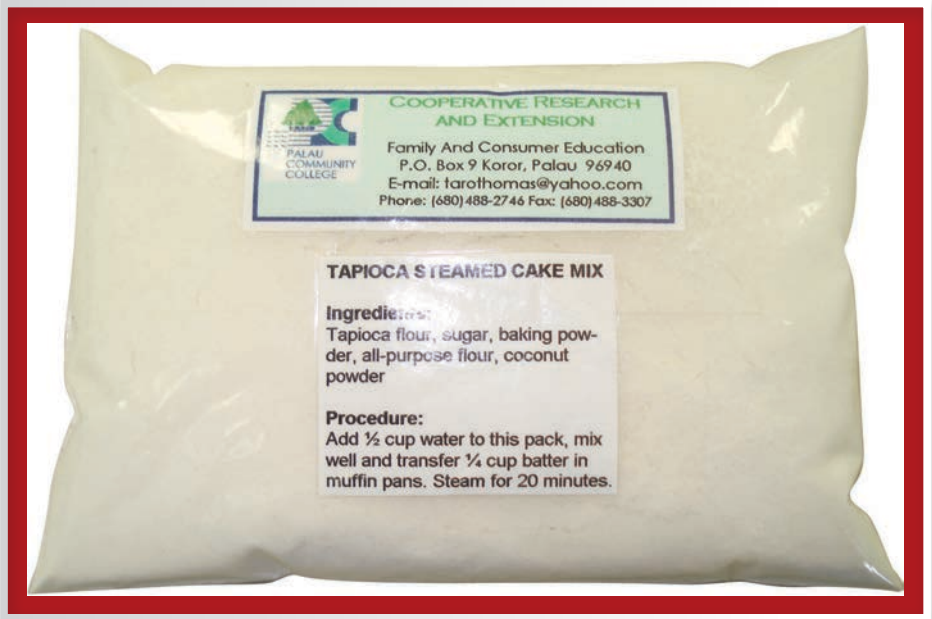
Fig. 4. Tapioca pancakes.

Ingredients:

1	pack	Tapioca Pancake Mix
1	pc	egg
½	cup	water
¼	cup	oil

Procedure:

- Mix all ingredients in a mixing bowl to form a batter.
- Pour ¼ cup batter into frying pans, cook both sides.
- Serve tapioca pancakes with syrup, jam, margarine, or peanut butter.



Tapioca Steamed Cake Mix

Fig. 5. Tapioca steamed cake mix.

Ingredients:

2- ½	cups	tapioca flour
2- ½	cups	all-purpose flour
2	cups	sugar
¼	cup	baking powder
1	pack	coconut powder

Procedure:

- Mix all ingredients in a plastic bag.
- Measure 1 cup mixture and pack in thick plastic bags, seal, label and store in a clean, dry place.

Tapioca Steamed Cakes

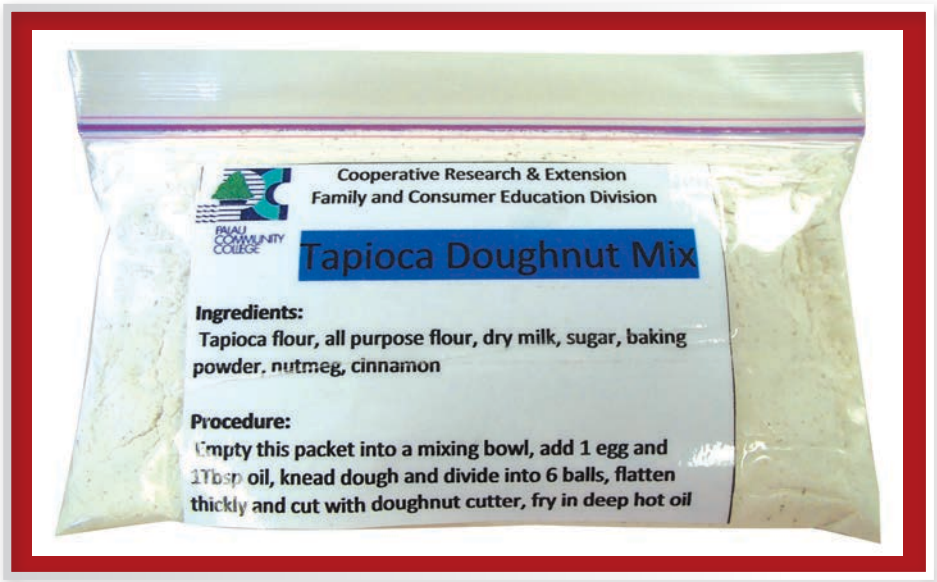
Fig. 6. Tapioca steamed cakes.

Ingredients:

1	pack	Tapioca Steamed Cake Mix
¾	cup	water
1	Tbsp	grated cheese

Procedure:

- Mix Tapioca Steamed Cake Mix with water and transfer ¼ cup mixture into muffin pans. Top with grated cheese.
- Steam for 20 minutes.



Tapioca Doughnut Mix

Fig. 7. Tapioca doughnut mix .

Ingredients:

3	cups	tapioca flour
3	cups	all-purpose flour
1	cup	dry milk
1	cup	sugar
4	Tbsp.	baking powder
½	tsp.	nutmeg powder
½	tsp.	cinnamon powder

Procedure:

- Mix all ingredients in a plastic bag.
- Pack one cup (240 g) in thick (0.5 mil) plastic bag, seal, and label.
- Store in a clean, dry place.

Tapioca Doughnut

Fig. 8. Tapioca doughnuts.

Ingredients:

1	pack	Tapioca Doughnut Mix
1	pc	egg
2	Tbsp.	oil

Procedure:

- Empty 1 pack Tapioca Doughnut Mix into a mixing bowl, add I egg and 2 Tbsp. oil.
- Knead and divide dough into 6 balls.
- Flatten thickly and cut with doughnut cutter or form into rings.
- Deep fry in hot oil.

Tapioca Tama Mix

Fig. 9. Tapioca ***tama*** mix.

Ingredients:

3	cups	tapioca flour
3	cups	all-purpose flour
1	cup	dry milk
1	cup	sugar
4	Tbsp.	baking powder
1	tsp.	salt

Procedure:

- Mix all ingredients in a plastic bag.
- Pack 1 cup (240 g) in thick (0.5 mil) plastic bag, seal, label and store in a clean, dry place.

Tapioca Tama

Fig. 10. Tapioca ***tama***

Ingredients:

1	pack	Tapioca Tama Mix
1	pc	egg
2	Tbsp.	oil

Procedure:

- Empty 1 pack of Tapioca Tama Mix into a mixing bowl, add 1 egg and 2 Tbsp. oil.
- Mix well , knead and divide dough into 6 balls.
- Deep fry in hot oil.

Tapioca Pasta Mix

Fig. 11. Tapioca pasta mix.

Ingredients:

2- ½ cups tapioca flour
2- ½ cups all purpose flour
1 Tbsp. salt

Procedure:

- Mix all ingredients in a plastic bag. Shake bag well to obtain a uniform mixture.
- Pack 1 cup mixture in a thick plastic bag, seal, label, and store in a clean, dry place.

Tapioca Pasta

Fig. 12. Tapioca pasta.

Ingredients:

1	pack	Tapioca Pasta Mix
1	pc	egg

Procedure:

- Empty 1 pack of Tapioca Pasta Mix into a mixing bowl , add 1 egg, and mix well to form dough.
- Roll dough on a floured cutting board with a rolling pin, and cut into pasta with a knife.
- Drop tapioca pasta in boiling water and cook until pasta floats (about 2 minutes).
- Drain, add 1 Tbsp. oil, and toss.

Tapioca Pasta with Sauce

Fig. 13. Tapioca pasta with sauce.

Ingredients:

1	cup	chicken, cooked, and diced
¼	cup	onion, chopped
1	Tbsp.	garlic, minced
¼	tsp.	black pepper
1	can	Nestle's Cream
1	Tbsp.	oil
1	cup	chicken stock
	sprig	parsley or green onions

Procedure:

- Saute garlic, onion, and chicken in vegetable oil.
- Add chicken stock, salt, pepper, and Nestle's cream. Cook for 5 minutes.
- Pour over cooked pasta. Garnish with parsley or chopped green onions

Tapioca Cookie Mix

Fig. 14. Tapioca cookie mix.

Ingredients:

6	cups	tapioca flour
6	cups	all-purpose flour
¼	cup	baking powder

Procedure:

- Mix all ingredients in a plastic bag and shake well to obtain a uniform mixture.
- Measure 4 cups of Tapioca Cookie Mix into thick (0.5 mil) plastic bags, seal, and label.
- Store in a clean, dry place.

Tapioca Cookies

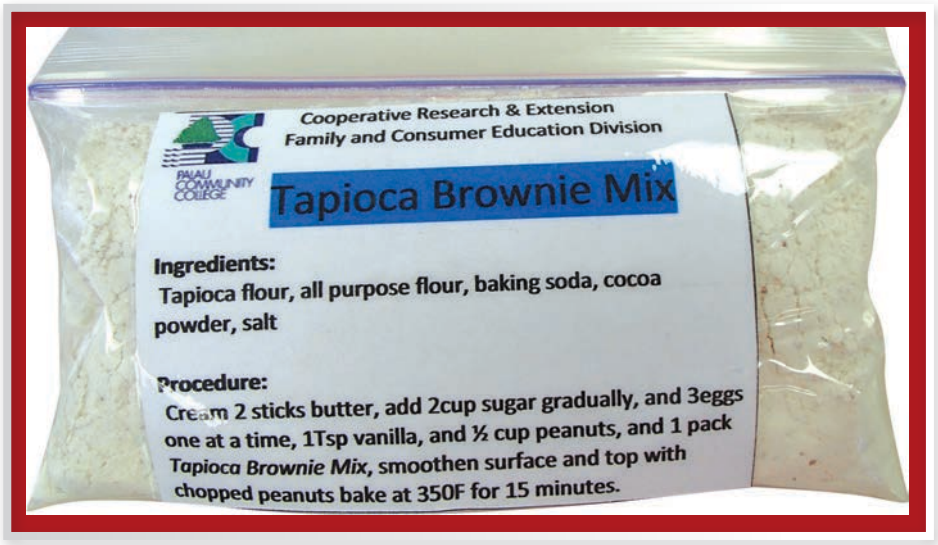
Fig. 15. Tapioca cookies

Ingredients:

1	pack	Tapioca Cookie Mix
1	cup (2 sticks)	margarine
1	cup	sugar
3	pcs	eggs
1	Tbsp.	vanilla

Procedure:

- Cream margarine with 1 cup sugar.
- Add eggs, one at a time, and mix well.
- Add 1 Tbsp. vanilla and mix well.
- Empty 1 pack Tapioca Cookie Mix into the mixture, and knead into dough.
- Roll with a rolling pin and cut with cookie cutter.
- Bake taro cookies at 275° F for 45 min.
- Pack in thick plastic bags, seal, and label.



Tapioca Brownie Mix

Fig. 16. Tapioca brownie mix

Ingredients:

3	cups	tapioca flour
3	cups	all-purpose flour
3	tsp.	baking Soda
3	cups	cocoa powder
3	tsp.	salt

Procedure:

- Mix all ingredients in a plastic bag.
- Measure 2 cups mixture and pack in thick (0.5 mil) plastic bags, seal, and label.
- Store at room temperature in a clean, dry place.

Tapioca Brownies

Fig 17. Tapioca brownies

Ingredients:

1	pack	Tapioca Brownie Mix
1	cup	butter
2	cups	sugar
3	pcs.	eggs
1	tsp.	vanilla
1	cup	chopped nuts

Procedure:

- Cream butter, then add sugar gradually.
- Add eggs one at a time mixing very well after each addition. Mix in vanilla.
- Add 1 pack Tapioca Brownie Mix and mix well.
- Add 1/8 cup chopped nuts.
- Pour mixture into greased pan. Smoothen surface with a rubber scraper and top with the remaining nuts.
- Bake at 350° F for 15 minutes.

Tapioca Muffin Mix

Fig. 18. Tapioca muffin mix

Ingredients:

3	cups	tapioca flour
3	cups	all-purpose flour
4	tsp.	baking soda
1	tsp.	salt

Procedure:

- Mix all ingredients in a plastic bag.
- Measure 2 cups mixture and pack in thick plastic bags, seal, and label.
- Store at room temperature in a clean, dry place.

Tapioca Muffins

Fig 19. Tapioca muffins

Ingredients:

1	pack	Tapioca Muffin Mix
½	cup	raisins, chopped
½	cup	nuts, chopped
1	cup	yoghurt
1	pc.	egg
2	Tbsp.	margarine
½	cup	brown sugar

Procedure:

- Preheat oven to 350° F.
- Combine margarine, egg, and yoghurt. Add 1 pack Tapioca Muffin Mix and mix with a few strokes.
- Fold in chopped nuts and raisins.
- Fill greased muffin pans ½ full.
- Bake at 350°F for 20 min. or until toothpick comes out clean.

Tapioca Bread Mix

Fig. 20. Tapioca bread mix

Ingredients:

10	cups	tapioca flour
10	cups	all-purpose flour
1	cup	dry milk
1	cup	sugar
1	tsp.	salt

Procedure:

- Mix all ingredients in a plastic bag.
- Measure 5 cups mixture, pack in thick plastic bags, seal, and label.
- Store at room temperature in a clean, dry place.

Tapioca Bread

Fig.21. Tapioca bread.

Ingredients:

1	pack	Tapioca Bread Mix
2- ½	tsp.	yeast
1	cup	lukewarm water
2	Tbsp.	brown sugar
¼	cup	shortening

Procedure:

- Dissolve yeast and brown sugar in 1 cup lukewarm water. Let stand for 10 minutes or until foamy.
- Add yeast solution to 1 pack of Tapioca Bread Mix, knead until dough is smooth.
- Place in a dark place covered with wet paper towel, and let rise for one hour.
- Shape and arrange on baking sheets. Let rise for one hour.
- Bake at 375° F for 25 minutes.

Tapioca Cupcake Mix

Fig. 22. Tapioca cupcake mix

Ingredients:

5	cups	tapioca flour
5	cups	all-purpose flour
5	tsp.	baking powder
5	tsp.	salt

Procedure:

- Mix all ingredients in a plastic bag.
- Measure 2 cups mixture, pack in thick plastic bags, seal, and label.
- Store at room temperature in a clean, dry place.

Tapioca Cupcake

Fig. 23. Tapioca cupcakes.

Ingredients:

1	pack	Tapioca Cupcake Mix
½	cup	sugar
¼	cup	butter
2	pcs	eggs
3	Tbsp.	nuts, chopped
1	tsp.	vanilla

Procedure:

- Beat margarine until fluffy. Add sugar gradually and eggs one at a time. Add Tapioca Cupcake Mix and nuts and mix well.
- Pour ¾ full in muffin pans line with cupcake paper. Top with chopped nuts.
- Bake in a pre-heated oven at 350° F for 35 min.

B. Frozen Products

Tapioca Fries

Fig. 24. Tapioca fries

Ingredients:

2	lbs.	tapioca, boiled
		oil for frying

Procedure:

- Cook tapioca for 1 hour.
- Grind and flatten thickly with a rolling pin.
- Cut with spam cans and then into sticks.
- Pack, label, and freeze until used in preparing tapioca fries.
- To prepare tapioca fries, thaw frozen tapioca fries and deep fry in hot oil.

Tapioca Fritters

Fig. 25. Tapioca fritters.

Ingredients:

2 lbs. tapioca, boiled
oil for frying

Procedure:

- Cook tapioca for 1hour.
- Grind and flatten thickly with a rolling pin and cut with a spam can.
- Pack, label, and freeze until used in preparing tapioca fritters.
- To prepare tapioca fritters, thaw frozen tapioca fritters and deep fry in hot oil.

Billum

Fig. 26. ***Billum.***

Ingredients:

4	cups	tapioca, grated
1	cup	sugar

Procedure:

- Wash, peel, and grate tapioca.
- Mix all ingredients and wrap ¼ cup mixture in ti or coconut leaves. Arrange wrapped tapioca in a cooking pan and boil for 2 hours.
- Cool by hanging ***billum*** in wire or rope line.
- Pack, seal, label, and freeze.
- To prepare, steam or boil frozen billum for 20 minutes.

C. Cooked/Baked/Fried Products

Tapioca Patties

Fig. 27. Tapioca patties.

Ingredients:

1	cup	tapioca, grated
1	cup	***pandan*** water
1	cup	sugar
3	cups	grated coconut

Procedure:

- Wash tapioca tubers and grate.
- Boil 3 pieces of ***pandan*** leaves in 3 cups water.
- Combine grated tapioca, pandan water, and sugar and steam for 30 minutes.
- Scoop ¼ cup steamed tapioca and roll in grated coconut.

Tapioca Chips

Fig. 28. Tapioca chips.

Ingredients:

2	lbs	cassava tubers
1	cup	sugar
		oil for frying

Procedure:

- Peel and wash tapioca tubers.
- Slice thinly using a food processor.
- Deep-fry in deep oil (first frying)
- Soak fried chips in syrup made of 1 cup sugar dissolved in 1 cup boiling water.
- Deep fry in hot oil (second frying) until crisp.
- Cool, pack, seal and label.

Tapioca Cake

Fig. 29. Tapioca cake

Ingredients:

Cake:

3	cups	tapioca, grated
1	cup	coconut milk
1	cup	brown sugar
2	Tbsp.	grated cheese

Topping:

1	can	condensed milk
1	can	coconut milk
2	Tbsp.	cheese

Procedure:

- Wash, peel, and grate tapioca tubers and measure.
- Mix tapioca, coconut milk, and brown sugar and steam for 45 minutes.
- Mix topping ingredients and pour over steamed tapioca, top with cheese and put in the broiler part of the oven, then broil until top is brown.

Tapioca Pastilles

Fig. 30. Tapioca pastilles

Ingredients:

2	lbs	tapioca, boiled and grated
1	can	condensed milk
1	can	evaporated milk
1	cup	dry milk
2	cups	sugar
¼	cup	margarine

Procedure:

- Boil tapioca for 1 hour and grate.
- Transfer to a big skillet and mix the other ingredients together.
- Cook with constant stirring in slow fire until very thick.
- Wrap 1 Tbsp in colored cellophane or tissue.

Tapioca Sushi

Fig. 31. Tapioca sushi

Ingredients:

2	lbs	tapioca, boiled
		oil for frying

Procedure:

- Boil tapioca for 2 hours, and grind.
- Thickly flatten tapioca with rolling pin and cut with spam cans.
- Fry in deep, hot oil.
- Slice spam into 8 pieces and make a tapioca fritter sand wiched with fried spam slices.
- Wrap with nori.

D. Fermented Products

Tapioca Wine

Fig. 32. Tapioca wine

Ingredients:

5	lbs.	tapioca, boiled and grated
5	cups	sugar
20	cups	water
2	Tbsp.	yeast
1	Tbsp.	brown sugar

Procedure:

- Boil tapioca in water for 2 hours, peel and cut into small pieces.
- Place 1 cup tapioca and 1 cup water in a blender and blend for 2 minutes. This is tapioca puree.
- Dissolve yeast in 1 cup lukewarm water and add brown sugar. Let stand 10 minutes or until foamy. Mix tapioca puree with equal amount of water and stir in sugar and yeast solution.
- Transfer the mixture to a bottle and cover with paper towel secured with a rubber band. Ferment for 1 month and filter. The filtrate is tapioca wine. Pasteurize tapioca wine by heating to 90° C for 15 minutes. Cool, bottle, seal, and label.

Tapioca Vinegar

Fig. 33. Tapioca vinegar

Ingredients:

5	lbs.	tapioca, boiled and grated
5	cups	sugar
20	cups	water
2	Tbsp.	yeast
1	Tbsp.	brown sugar

Procedure:

- Boil tapioca in water for 2 hours, peel and cut into small pieces and blend to make puree.
- Dissolve yeast in 1 cup lukewarm water . Mix tapioca puree with equal amount of water and stir in sugar and yeast solution. Transfer the mixture to a bottle and cover with paper towel secured with a rubber band.
- Ferment for 3 months and filter. Pasteurize at 90° C for 15 minutes. Cool, bottle, seal and label.

Tapioca Sauce

Fig.34. Tapioca sauce

Ingredients:

5	lbs.	tapioca, boiled and grated
5	cups	sugar
20	cups	water
2	Tbsp.	yeast
1	Tbsp.	brown sugar
1	lb	salt
1	lb	brown sugar

Procedure:

- Boil peeled tapioca cut into small pieces and blend.
- Dissolve yeast and let stand 10 minutes, Mix tapioca puree, water , sugar and yeast solution.
- Ferment for 2 months and filter. Dissolve salt in the filtrate.
- Melt brown sugar in slow fire until black as coloring, transfer in bottles, seal and label.

SENSORY EVALUATION OF TAPIOCA PRODUCTS

Tapioca cookies were evaluated by about 5,000 respondents in a span of five years. The products were served to the public during events like Earth Day, Career Awareness Week, Women's Month, Tourism Week, Olechotel Belau Fair, World Food Day, Independence Day, as well as a main visitors' item at the PCC-CRE R & D Station, served to school children, students, parents, teachers, and other guests All food tasters liked the product very well.

The food products, particularly the dry mixes, were put on exhibit at the 2002 and 2006 Japan Food Expo, Hawaii in 2006,Guam in 2007, and Italy Food Expo in 2007. During the 2006 "Taste of Palau" event, the tourists tasted the tapioca food products and they signified their interest in buying these foods if sold in the market.

Fig, 35. School children tasting tapioca cookies.

PACKAGING STUDIES AND SHELF-LIFE OF PROCESSED TAPIOCA PRODUCTS

Tapioca food products and their suitable packaging materials were studied and results are shown in Table3.

Table 3. Selected tapioca food products and their suitable packaging materials.

Food Product	Packaging Material
Starch, flour, and flour products	polyethylene(PE) and poly propylene (PP) bags, 0.5 mil
Chips	PP bags, 0.5 mil
Fermented products	PET(poly ethylene terephtha-late) plastic bottles
Frozen Products	PET containers with cover,bags bags

Tapioca flour and dry mixes were found stable when packed in 0.5 mil thick PE or PP bags and stored at room temperature. Tapioca Chips was found stable in 0.5 mil PE plastic bags. Frozen products were suitably packed in 0.5 mil PP bags.

Fig, 36. Shelf-life studies of tapioca food products.

Results of storage studies of processed tapioca food products are shown in Table 4.

Table 4. Shelf-life of selected tapioca food products in different storage conditions.

Food Product	Storage Conditions	Shelf-Life
Frozen products	Freezing temperature, <0° C	1 year
Dried products	Room temperature, 28° to 32° C	1 year
Baked products	Room temperature, 27°-32° C	2 wks
Cooked products	Refrigeration temperature, 10° C	2 weeks
Fermented prods	Room temperature	1 year

TECHNOLOGY TRANSFER OF PROCESSED TAPIOCA PRODUCTS

All tapioca food products were taught to 636 participants in PCC-CRE Food Technology Classes in a 24-hour training period, usually done in a three-week, 2-hour per day sessions. The number of participants and places of training are shown in Table 5.

Fig. 37. Participants of Food Technology Class in Koror State.

Table 5. Number of participants and places where Food Technology Classes were held.

Place	Number
Ngeremlengui State Old Age Center	23
Melekeok State Old Age Center	17
Airai State Ked Center	19
Airai State Abai	17
Koror State PCC Campus	18
Koror State Ngarachamayong Cultural Center	16
Koror State Maibrel Center	18
Ngeremlengui State Old Age Center	9
Ngeremlengui State Training Center	23
Ngiwal State School Cafeteria	23
Ngatpang State	12
Ngerbeched, Koror	23
Kayangel State	17
Peleliu State	19
Airai State	11
Ngardmau State	12
R & D Station	3
Angaur State	23
Ngeremlengui Elementary School	53
Emmaus High School	24
Palau High School Special Education	12
Upward Bound Math- Science	18
Palau Parents Empowered	16
Bethania High School	27
Ngarchelong Head Start Parents	19
Meyuns Head Start Parents	24
Madalaii Head Start Parents	14
Peleliu Head Start Parents	19
Ngerbeched Head Start Parents	24
Expats Group I	22
Expats Group II	26
Cafeteria Staff	20
Ngaraard Ongall Group	15
Total	**636**

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Lydia Marero worked as Researcher-Food Technologist at the Palau Community College-Cooperative Research and Extension (PCC-CRE) for ten years. She developed about 150 processed food products from taro, cassava, sweet potato, fish, coconut, and banana and taught food technology classes as an extension program of PCC-CRE. She obtained three USDA grants for her projects on the utilization of root crops and product development of local foods and rabbit fish. A food scientist, an educator and a scholar, Lydia earned a Bachelor's Degree in Food Technology at the De La Salle-Araneta University Foundation, graduating cum laude. Under a PCARRD scholarship, she pursued a Master's Degree in Food Science at the University of the Philippines in Los Baños. She obtained her Doctoral Degree in Food Science from the Ochanomizu Women's University in Tokyo, Japan as a Monbusho scholar and JSPS fellow. She further obtained a Post-Doctoral Degree in Food Science as a KOSEF fellow at the Seoul National University in South Korea.

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