CASSAVA AS A STAPLE FOOD IN PALAU

MARERO AND TARO

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BY: LYDIA M. MARERO and
THOMAS TARO

TAPIoca FLOUR
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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
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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LYDIA M. MARERO
THOMAS TARO
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   In Koror State
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.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Color</th>
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<tbody>
<tr>
<td>Aderuangel</td>
<td>white</td>
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<tr>
<td>Angaur Red</td>
<td>white</td>
</tr>
<tr>
<td>Belau Ra Metengel</td>
<td>white</td>
</tr>
<tr>
<td>Blorang</td>
<td>white</td>
</tr>
<tr>
<td>Chemeraech</td>
<td>white</td>
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<tr>
<td>Cheual Rul</td>
<td>white</td>
</tr>
<tr>
<td>Coop</td>
<td>white</td>
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<tr>
<td>Ngerab</td>
<td>white</td>
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<tr>
<td>Ngerair</td>
<td>white</td>
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<td>Ngerduais</td>
<td>white</td>
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<tr>
<td>Ngeremlengui</td>
<td>white</td>
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<tr>
<td>Ngesuong</td>
<td>yellow</td>
</tr>
<tr>
<td>Ngkud</td>
<td>white</td>
</tr>
<tr>
<td>Ochobirang</td>
<td>yellow</td>
</tr>
<tr>
<td>Oles</td>
<td>white</td>
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<tr>
<td>Olik</td>
<td>white</td>
</tr>
<tr>
<td>Oreor</td>
<td>white</td>
</tr>
<tr>
<td>Saibal</td>
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<tr>
<td>Sers</td>
<td>white</td>
</tr>
<tr>
<td>Shimizu</td>
<td>white</td>
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<tr>
<td>Smiich</td>
<td>white</td>
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<tr>
<td>Stebania</td>
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<tr>
<td>Terue</td>
<td>white</td>
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<tr>
<td>Tikei</td>
<td>white</td>
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<tr>
<td>Uchulaluk</td>
<td>yellow</td>
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<tr>
<td>Ulang</td>
<td>white</td>
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<tr>
<td>Umad</td>
<td>white</td>
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<tr>
<td>Yasireng</td>
<td>white</td>
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</table>
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.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Raw</th>
<th>White, cooked</th>
<th>Yellow, cooked</th>
</tr>
</thead>
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<tr>
<td>Edible portion, %</td>
<td>74</td>
<td>71</td>
<td>85</td>
</tr>
<tr>
<td>Water, %</td>
<td>63</td>
<td>71.8</td>
<td>61.0</td>
</tr>
<tr>
<td>Energy, Kcal</td>
<td>145</td>
<td>111</td>
<td>155</td>
</tr>
<tr>
<td>Protein, %</td>
<td>0.6</td>
<td>0.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Fat, %</td>
<td>0.2</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Carbohydrate, %</td>
<td>35.3</td>
<td>27.1</td>
<td>37.7</td>
</tr>
<tr>
<td>Crude Fiber, (Dietary Fiber), %</td>
<td>1.8</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Ash, %</td>
<td>0.9</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Calcium, mg%</td>
<td>30</td>
<td>10</td>
<td>37</td>
</tr>
<tr>
<td>Phosphorus, mg%</td>
<td>41</td>
<td>22</td>
<td>47</td>
</tr>
<tr>
<td>Iron, mg%</td>
<td>1.1</td>
<td>0.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Retinol, ug%</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B-carotene, ug%</td>
<td>10</td>
<td>Trace</td>
<td>155</td>
</tr>
<tr>
<td>Total Vit,A ug%</td>
<td>2</td>
<td>Trace</td>
<td>26</td>
</tr>
<tr>
<td>Thiamin, mg%</td>
<td>0.06</td>
<td>0.03</td>
<td>0.01</td>
</tr>
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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 1 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:**

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Ingredient</th>
</tr>
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<tbody>
<tr>
<td>1 pack</td>
<td>Tapioca Cookie Mix</td>
</tr>
<tr>
<td>1 cup (2 sticks)</td>
<td>margarine</td>
</tr>
<tr>
<td>1 cup</td>
<td>sugar</td>
</tr>
<tr>
<td>3 pcs</td>
<td>eggs</td>
</tr>
<tr>
<td>1 Tbsp.</td>
<td>vanilla</td>
</tr>
</tbody>
</table>

**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.
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 1 hour.
- 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.
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 sandwiched 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.
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 Table 3.

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

<table>
<thead>
<tr>
<th>Food Product</th>
<th>Packaging Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch, flour, and flour products</td>
<td>polyethylene (PE) and poly propylene (PP) bags, 0.5 mil</td>
</tr>
<tr>
<td>Chips</td>
<td>PP bags, 0.5 mil</td>
</tr>
<tr>
<td>Fermented products</td>
<td>PET(poly ethylene terephthalate) plastic bottles</td>
</tr>
<tr>
<td>Frozen Products</td>
<td>PET containers with cover, bags</td>
</tr>
</tbody>
</table>

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.
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.

<table>
<thead>
<tr>
<th>Food Product</th>
<th>Storage Conditions</th>
<th>Shelf-Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frozen products</td>
<td>Freezing temperature, &lt;0° C</td>
<td>1 year</td>
</tr>
<tr>
<td>Dried products</td>
<td>Room temperature, 28° to 32° C</td>
<td>1 year</td>
</tr>
<tr>
<td>Baked products</td>
<td>Room temperature, 27°-32° C</td>
<td>2 wks</td>
</tr>
<tr>
<td>Cooked products</td>
<td>Refrigeration temperature, 10° C</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Fermented prods</td>
<td>Room temperature</td>
<td>1 year</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Place</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ngeremlengui State Old Age Center</td>
<td>23</td>
</tr>
<tr>
<td>Melekeok State Old Age Center</td>
<td>17</td>
</tr>
<tr>
<td>Airai State Ked Center</td>
<td>19</td>
</tr>
<tr>
<td>Airai State Abai</td>
<td>17</td>
</tr>
<tr>
<td>Koror State PCC Campus</td>
<td>18</td>
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<tr>
<td>Koror State Ngarachamayong Cultural Center</td>
<td>16</td>
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<tr>
<td>Koror State Maibrel Center</td>
<td>18</td>
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<tr>
<td>Ngeremlengui State Old Age Center</td>
<td>9</td>
</tr>
<tr>
<td>Ngeremlengui State Training Center</td>
<td>23</td>
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<tr>
<td>Ngiwal State School Cafeteria</td>
<td>23</td>
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<tr>
<td>Nkatpang State</td>
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<td>Ngerbeched, Koror</td>
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<td>Ngardmau State</td>
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<td>R &amp; D Station</td>
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<td>Angaur State</td>
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<td>Emmaus High School</td>
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<td>Palau Parents Empowered</td>
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<td>Bethania High School</td>
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<tr>
<td>Ngarchelong Head Start Parents</td>
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<td>Meyuns Head Start Parents</td>
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<tr>
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<tr>
<td>Ngerbeched Head Start Parents</td>
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<td>Expats Group I</td>
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<tr>
<td>Expats Group II</td>
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<tr>
<td>Cafeteria Staff</td>
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<tr>
<td>Ngaraard Ongall Group</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>636</strong></td>
</tr>
</tbody>
</table>
REFERENCES


ABOUT THE AUTHORS

LYDIA MARERO

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.

THOMAS TARO

Thomas Taro was Director of the Research and Development Station, PCC-CRE and presently Vice-President of Palau Community College-Cooperative Research and Extension. He obtained his Master of Arts Degree in Education at the San Diego State University.