TARO AS FOOD IN PALAU

MARERO AND TARO 2013

TARO AS FOOD IN PALAU

By: Lydia M. Marero and
Thomas Taro

Published by the
Cooperative Research and Extension
Palau Community College
P.O. Box 9, Koror, Palau 96940
2013

PALAU COMMUNITY COLLEGE

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

Authors

Lydia M. Marero, Ph.D. is a Researcher-Food Technologist at the Palau Community College - Cooperative Research and Extension, P.O. Box 9, Koror, Palau 96940.

Thomas Taro is Vice President at the Palau Community College-Cooperative Research and Extension, P.O. Box 9, Koror, Palau 96940.

Taro as Food in Palau

Lydia Marero
Thomas Taro

Palau Community College
2013

United States Department of Agriculture
National Institute of Food and Agriculture

USP Library Cataloguing-in-Publication Data

Marero, Lydia.
Taro as food in Palau / Lydia Marero and Thomas Taro. -- Koror, Palau :
Palau Community College, 2013.
78 p. ; 24 cm.
ISBN 978-982-9801-92-0
1. Taro--Processing--Palau. 2. Taro--Palau. I. Taro, Thomas. II. Title.
TP444.T3M37 2013
664.805209966--c23

Palau Community College

ISBN 978-982-9801-92-0
9 789829 801920

Title : Taro as food in Palau

Message

It is with great pleasure on my part as Executive Director of the College of Micronesia Land Grant Programs to welcome initiatives from researchers to write books as standard outputs of their researches.

This book, Taro as Food in Palau is an outcome of a research project on the "Processing of Root Crops in the Republic of Palau" funded by the Hatch Act of 1887 administered by the National Institute of Food and Agriculture of the United States Department of Agriculture (NIFA-USDA)

The book can serve as a practical application of research knowledge and giving of instruction and practical demonstrations of technologies in taro processing. The impact of the research is to provide local foods that can nourish family members, as well as provide product ideas for food business entrepreneurs.

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

Foreword

This publication embraces a wide variety of information on taro processing and preservation. The knowledge that may be derived from this book has been selected for dissemination and best adoption particularly for those who are interested in the field of food microenterprise. Most of the information include the results of studies conducted at the Food Technology Laboratory of the Cooperative Research and Extension (CRE) of Palau Community College (PCC).

There is a vital need for a closer working relationship between PCC-CRE and the government as a whole and the people, for the maximum utilization of our resources. Taro is a very valuable food resource in Palau, being a food staple served daily at home and during custom events.

The goal of this publication is to help Palauan farmers increase the utilization of taro. The ingredients and processes are very simple, and the equipment used in food processing are available in the kitchen or they can be sourced from the local stores. Aside from providing food for their families, the valuable information also opens opportunities for starting a food business to increase income thereby upgrading the quality of life of Palauans.

PATRICK U. TELLEI, EdD
President
Palau Community College

ACKNOWLEDGMENTS

For making this publication possible, due acknowledgments are extended to:

Palau Community College-Cooperative Research and Extension Department and Dr. Singeru Singeo Executive Director, College of Micronesia Land Grant Programs for administrative support and for facilitating the funding of the printing of this book;

Dr. Nelson M. Esguerra for painstakingly editing the book;

Food tasters during sensory evaluation of the processed products for their valuable comments in the improvement and reformulation of the foods prepared from taro;

Graphic Design: Ian C. Auacay

Lyndon Masami, Extension Agent of PCC-CRE, for conducting starch value of taro;

CRE staff Dr. Aurora del Rosario, Dr. Nelson Esguerra, Felix Sengebau, Maria Teruzi, Dilyaur Franz, Franzon Oiterung, Itwong Ngiraikelau, Habeam Madlutk, Leory Franz, Dalton Thomas, Tyler Tellei, Rusky Remoket, Leilani Rechelluul, Lavenda Oshima, and Kazue Joseph for their various support in the conduct of this research.

LYDIA M.MARERO
THOMAS TARO

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

INTRODUCTION

The increase in the consumption of imported foods in the Republic of Palau has led to an overall decline in local food production, resulting in trade imbalance. For example, the contribution of Palau Gross Domestic Product (GDP) from the agriculture, aquaculture, and marine resources declined from 9.9% in 1983 to 2.9% in 1992 (Plan of Work FY 2000-2004, COM-LGP). It is thus urgent to focus R & D efforts on the production and utilization of local foods, particularly taro, to deter the fast decline in the GDP.

Taro, *Colocasia esculenta* (L.) Schott, (sweet taro) locally known as kukau is an important staple food in Palau, as well as in other island countries in the Pacific. PCC-CRE has focused its research activities on this local food resource in Palau. The Research and Development (R & D) Station located in Ngermeskang, Ngeremlengui State has served as a repository of about 81 varieties of taro in Palau. A research project on the "Processing of Rootcrops in the Republic of Palau" funded by the Hatch Act under USDA, focused on the utilization of taro into various processed food products.

Taro 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. Taro processing plays a major role in upgrading the conditions of rootcrop growers in Palau, by providing:

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

The Palau Economic Development Plan (2020) 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 export and local markets. Development of taro into processed food products will ensure a stable supply that will redound to food security in the Republic.

In achieving Palau's sovereign goal of economic reliance, the development and utilization of food products from taro for the local and export markets will benefit the country and people in meeting the needs for high quality food items, creating job opportunities, supporting the tourism industry with local foods from taro, increasing additional tax revenues, and helping in the overall economic improvement and quality of life of Palauans.

TARO PRODUCTION IN PALAU

In 1996, taro production in Palau was 924,366 lbs. valued at US $ 600,838.50 and produced by 695 farmers of which 60% was sold in the market, 26% was for home use, and 17% for custom events. (IESL Survey, 1996). Due to its cultural and social significance, taro production has continuously increased in Palau, as shown by the increase in price from US $0.65/lb in 1996 to $0.75/lb in 1998 and $1.00/lb in 2001 (Agricultural Census, 1994).

Yield of several taro varieties are higher in sers /dry type of land (2,692 to 12,157 kg/ha) than in R&D Station data, where culturally plantings of taro were done (Del Rosario and Esguerra, 2003), the yield depending on the variety planted.

Taro is planted in a majority of States in Palau. Most households have a taro patch and the women farmers are responsible to plant and grow taro for consumption.

Fig. 1 shows the pictures of three types of land where taro are produced.

SERS

MESEI

DECHEL

Fig. 1. Different types of land for growing sweet taro

TARO VARIETIES IN PALAU

Eighty one (81) varieties of taro are collected and propagated at the PCC-CRE Research and Development (R & D) Station in Ngermeskang, Ngeremlengui State, and their sensory qualities, are shown in Table 1.

Table 1. Collection of taro varieties propagated at the R & D Station and their sensory characteristics.

Variety	Color	Size	Shape	Taste	Texture
Bechesei	purple	medium	oblong	bland	starchy
Bsachel	purple	medium	round	bland	starchy
BL-PNG 3	white	small	round	bland	starchy
BL-SM 10	purple	small	round	sweet	sticky
BL-SM 12	purple	small	round	sweet	sticky
Columba	purple	medium	oblong	bland	starchy
Dait	purple	small	oblong	sweet	sticky
Dilisor	white	medium	round	sweet	sticky
Dirchoiremech	purple	medium	round	bland	starchy
Dirrubong	purple	small	round	bland	starchy
Dois	purple	medium	oval	sweet	sticky
Dois urungel	purple	medium	oval	sweet	starchy
Dungersuul	white	big	oval	starchy	sweet
Dung ra miuako	purple	big	round	sticky	sweet
Dung ra terrakakl	white	big	oblong	sticky	sweet
Ebechab	white	small	round	sticky	sweet
Emausei	purple	medium	round	sticky	sweet
Erederid	white	small	round	sticky	sweet
Esuuch	white	small	oblong	sticky	sweet
Fiji	purple	medium	oblong	starchy	bland
Hawaiian Ngkeklau	purple	medium	round	sticky	sweet
Hawaii Tasia	purple	medium	round	sticky	sweet
Homusted	pink	small	oblong	sticky	sweet

Variety	Color	Size	Shape	Taste	Texture
JP-06	yellow	small	round	sticky	sweet
Kerdeu	purple	small	oblong	sticky	sweet
Kirang	purple	big	oblong	sticky	sweet
Kirang Redil	purple	big	oblong	sticky	sweet
Kirang Sechal	purple	big	oblong	sweet	sticky
Kosrae	white	medium	round	bland	starchy
MAL-12	white	small	round	sweet	sticky
Merii	white	medium	oblong	bland	starchy
Metengel A Ngas	purple	medium	oblong	sweet	sticky
Meseinsank	purple	medium	oblong	sweet	sticky
Meuarch	purple	medium	oblong	sweet	sticky
Miuako	pink	big	oblong	sweet	sticky
Miuako Ngkeklau	pink	big	oblong	sweet	sticky
Miuako Ouburburs	white	medium	irregular	bland	sticky
Modekngei	purple	small	oblong	bland	starchy
Ngardmau	white	medium	oblong	bland	starchy
Ngemekeang	white	medium	oblong	sweet	sticky
Ngerbachel	white	medium	oblong	sweet	sticky
Ngerdibus	white	small	round	bland	starchy
Ngeruuch Red	pink	big	oblong	sweet	sticky
Ngeruuch	white	medium	round	bland	starchy
Ngesuas	purple	big	oblong	sweet	sticky
Ngetmadai	white	big	oblong	sweet	sticky
Ngirchoilang	purple	big	round	bland	starchy
Ochab	pink	medium	round	bland	starchy
Okelang	purple	big	oblong	bland	starchy
Oiremech	white	small	oblong	sweet	sticky
Oisca	white	big	round	bland	starchy
Ordil	purple	small	round	sweet	sticky
PAL-04	white	small	round	bland	starchy
PAL-05	white	small	round	bland	starchy
PAL-06	white	small	round	bland	starchy

Variety	Color	Size	Shape	Taste	Texture
PAL-07	white	small	round	bland	starchy
PAL-10	white	small	round	bland	starchy
PAL-13	white	small	round	bland	starchy
PAL-20	white	small	round	bland	starchy
Pastora	purple	medium	oblong	bland	starchy
Prak	yellow	medium	oblong	sweet	sticky
Petepwet	purple	small	round	bland	starchy
Renged	pink	big	oblong	sweet	sticky
Rasech	purple	small	round	sweet	sticky
Rota	white	medium	oblong	bland	starchy
Rriu	pink	small	round	bland	starchy
Ruk	purple	small	oblong	sweet	sticky
Saikere	pink	medium	round	bland	starchy
Saikere	white	medium	round	bland	starchy
Sawamwang	pink	small	oblong	bland	starchy
TAN-MAL 14	yellow	medium	round	sweet	sticky
Terebkul	pink	big	oblong	bland	starchy
T-29	yellow	small	round	sweet	sticky
T-90	white	medium	oblong	bland	starchy
T-102	purple	medium	oblong	sweet	sticky
Ungil Dil	pale yellow	big	oblong	sweet	sticky
Ulechem	purple	small	round	bland	starchy
Urungel	white	small	round	bland	starchy

Sticky varieties of taro were found suitable for boiling, ready-to-eat slices, and salad. Starchy varieties were good materials for baking and flour preparations.

The new varieties that were recently added to the collection were sourced from Fiji. These new varieties include the following: BL-PNG3, BL-SM10, BL-SM12, JP-06, MAL-12, PAL-04, PAL-05, PAL-06, PAL-07, PAL 10, PAL- 13, PAL-20,T-29,T-90 and T-102. The PAL varieties originally came from Palau but now grown in Fiji.

Ngesuas variety is the most favored taro by the Palauans due to its characteristic sweet taste, pleasant aroma and nice purple color.

NUTRITIONAL VALUE OF TARO

Taro mostly consists of about 65% water and has an energy value of 141 kcal. Table 2 shows the nutritional composition of sweet taro.

Table 2. Nutritional composition of taro (FNRI, 1997).

Nutrient	Raw	Boiled
Edible portion, %	77	69
Water,%	64.1	73.1
Energy, kcal	141	104
Protein,%	2.3	1.5
Fat,%	0.2	0.1
Carbohydrate,%	32.6	24.4
Crude Fiber,%	2.8	2.2
Ash,%	0.8	0.6
Calcium, mg%	39	37
Phosphorus, mg%	62	41
Iron, mg%	0.9	0.7
Retinol, mg%	0	0
B-carotene, mg%	30	5
Total Vit. A (RE), mcg%	5	1
Thiamin, mg%	0.17	0.08
Riboflavin, mg%	0.04	0.01
Niacin, mg%	1.2	1.0
Ascorbic acid, mg%	9	6

All the day's nutritional requirements for a 2,200 calorie diet would be exceeded if one consumes 5 lbs of taro. As shown in Table 2, taro has all the nutrients , particularly energy value, dietary fiber, vitamin C, potassium, riboflavin, thiamin, magnesium, iron, calcium, sodium, and protein.

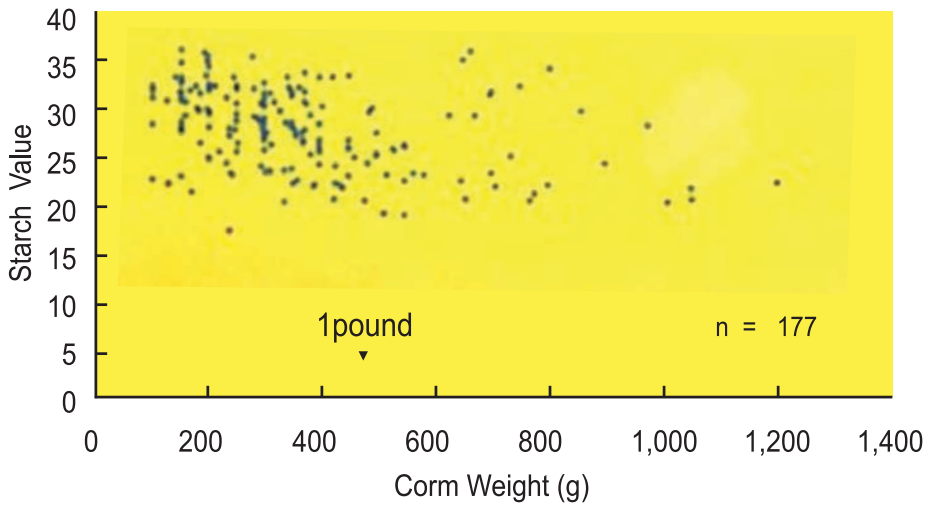
A recent finding in the literature on taro showed that taro contains phytoestrogen, about 300 mg with 20% estrogen (Goldberg, 1994). Women after menopause do not produce estrogen anymore so they can get this hormone from eating taro. Another important functional component of taro is hyaluronic acid, the water-gelling molecule of the human body. One thousand (1,000) mg of pure hyaluronic acid can gel 6 quarts of water, so it can cleanse the colon (Dreher, 1987). Eastwood and Morris (1992) describe dietary fiber as a "water-laden sponge" moving through the intestine. 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.

Figures 2 to 5 show the starch value of taro. This value is important in the preparation of taro alcohol as there is a direct relationship between starch value and alcohol content. As more starch is obtained from the taro corms, the less moisture content the corms contain, as shown in Fig. 2.

Fig. 3 shows that the size of taro corms does not affect the starch value, so it does not matter if taro corms are small or big.

Fig. 4 shows that wet cultivation *(mesei)* has higher starch value than semi-wet *(dechel).*

Fig. 5 shows that the starch value of taro that was grown for 8 months is almost the same as that grown for 11 months, therefore to save on field maintenance, taro corms can be harvested at 8 months.



The relation of Corn Weight and Starch Value

Fig.2. Relationship between taro corm weight and starch value.

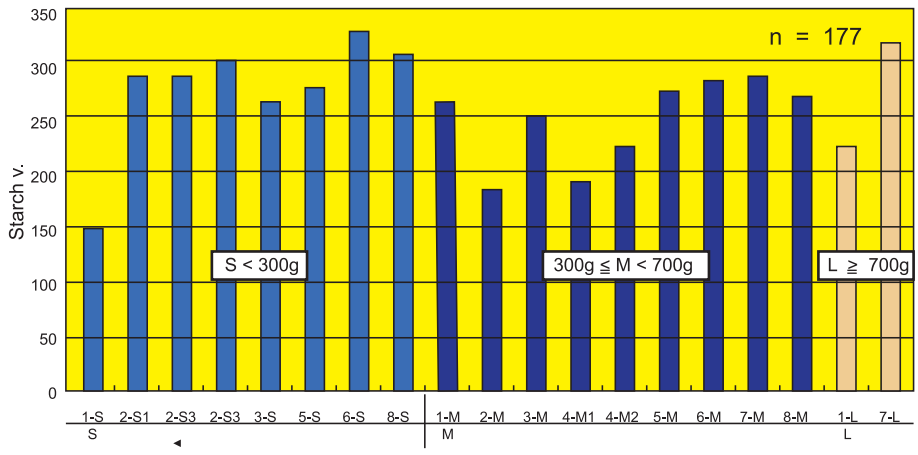


Fig. Corm size(SML) and starch v.

Fig. 3. Relationship between corm size and starch value.

Starch v. & land type

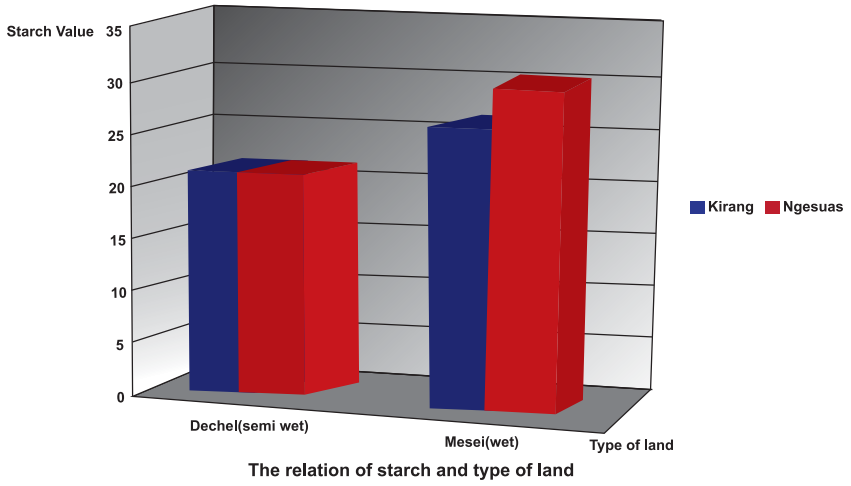


Fig. 4. Relationship between type of land cultivation and starch value.

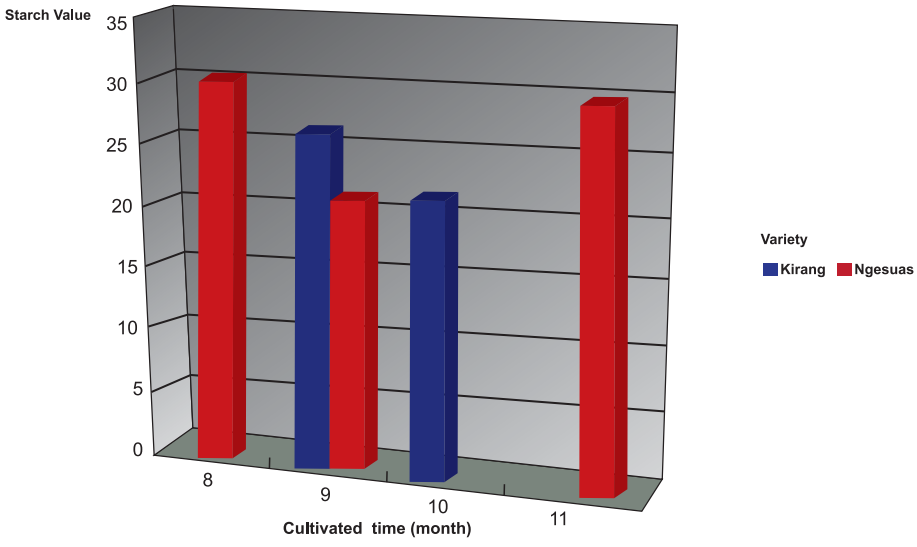


Fig. 5. Relationship between maturity and starch value of taro.

PROCESSING OF TARO PRODUCTS

Thirty one (31) processed food products with good market potentials from selected taro varieties were developed and standardized at the Food Technology Laboratory of PCC-CRE R & D Station. These products are listed in Table 3.

Table 3. Developed and standardized processed food products from sweet taro (kukau) varieties

PROCESSES			
Drying	**Freezing**	**Cooking/ Baking/Frying**	**Fermenting**
Flour	Ice Cream	Pizza	Vinegar
Pancake Mix	Ice Candy	Salad	Wine
Steamed Cake Mix		Pudding	Sauce
Doughnut Mix	Ready-to Eat	Candy/Pastilles	
Tama Mix	Smoothie	Crepes	
Pasta Mix		*Sushi*	
Cookie Mix		Chips	
Brownie Mix		Turn-over	
Bread Mix		Hashbrowns	
Muffin Mix		Fries	
Cupcake Mix		Fritters	
		Pie	
		Pastry/*hopia*	

Frozen ready-to-eat taro slices using 81 varieties of taro were prepared from boiled taro, which was peeled, washed, and sliced into serving portions, then packed with vacuum in thick (0.5 mil) polyethylene or polypropylene bags. Packaged taro was stored in the freezer (<0° C) and studied for their storage properties. Packing boiled taro slices in microwaveable or boilable bags were found to be a very convenient process in storing taro, as they can be served immediately upon reheating when needed to be served.

Taro flour was prepared by boiling taro corms for 3 hours, peeling, slicing, grinding in a food processor, drying in the sun for 8 hours, grinding into flour through a blender, sifting, and packing in thick (0.5 mil) polyethylene plastic bags. Packed taro flour was also studied for its shelf-life at room temperature (27° to 32° C).

PROCESSING OF TARO PRODUCTS
A. DRIED PRODUCTS

TARO FLOUR

Fig. 6. Flour prepared from sweet taro *(kukau)*.

Ingredients:

Taro, any variety (preferably starchy ones)

Procedure:

- Clean and wash taro corms.
- Boil taro for 2 to 3 hours, peel and rinse.
- Grind taro in a food processor or any grinder or grate.
- Dry taro in the sun until crisp.
- Blend/grind dried taro until fine and sift.
- Pack in thick (0.5 mil) plastic bags , seal, and label.
- Store at room temperature (27° to 32° C) in a clean, dry place.

TARO PANCAKE MIX

Fig. 7. Taro pancake mix.

Ingredients:

2	cups	taro 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.

TARO PANCAKES

Fig. 8. Taro pancakes.

Ingredients:

1	pack	Taro 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 a frying pan, cook both sides until brown. Serve taro pancakes with syrup, jam, margarine, or peanut butter.

TARO STEAMED CAKE MIX

Fig. 9. Taro steamed cake mix.

Ingredients:

2- ½	cups	taro 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.

TARO STEAMED CAKE

Fig. 10 Taro steamed cakes.

Ingredients:

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

Procedure:

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

TARO DOUGHNUT MIX

Fig. 11. Taro doughnut mix.

Ingredients:

3	cups	taro 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.

TARO DOUGHNUTS

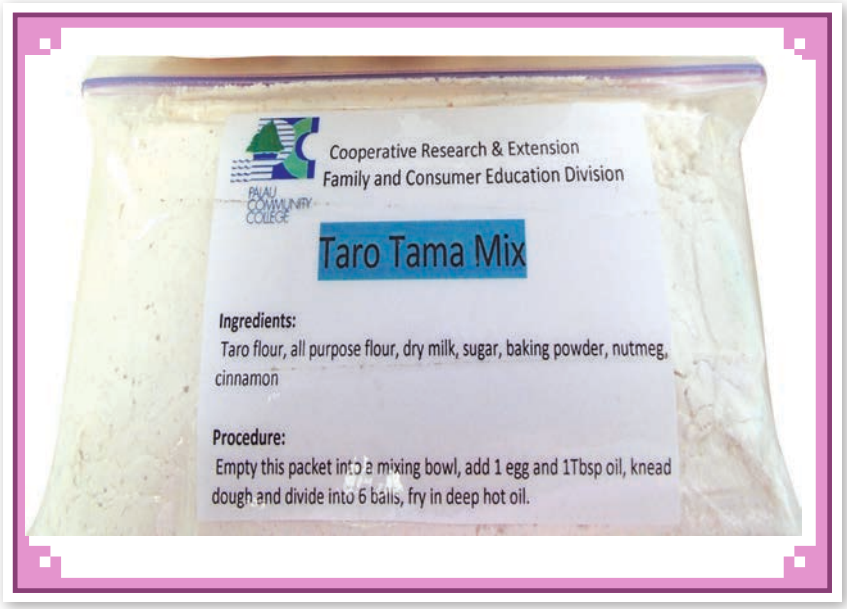
Fig. 12. Taro doughnuts.

Ingredients:

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

Procedure:

- Empty 1 pack Taro 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.



TARO TAMA MIX

Fig. 13. Taro *tama* mix .

Ingredients:

3	cups	taro 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.

TARO TAMA

Fig. 14. Taro tama.

Ingredients:

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

Procedure:

- Empty 1 pack of Taro 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.

TARO PASTA MIX

Fig. 15 Taro pasta mix

Ingredients:

2- ½	cups	taro 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.

TARO PASTA

Fig. 16 Taro pasta.

Ingredients:

1	pack	Taro Pasta Mix
1	pc	egg

Procedure:

- Empty 1 pack of Taro 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 or pasta maker.
- Drop taro pasta in boiling water and cook until pasta floats (about 2 minutes). Drain, add 1 Tbsp. oil, and toss.

TARO PASTA WITH SAUCE

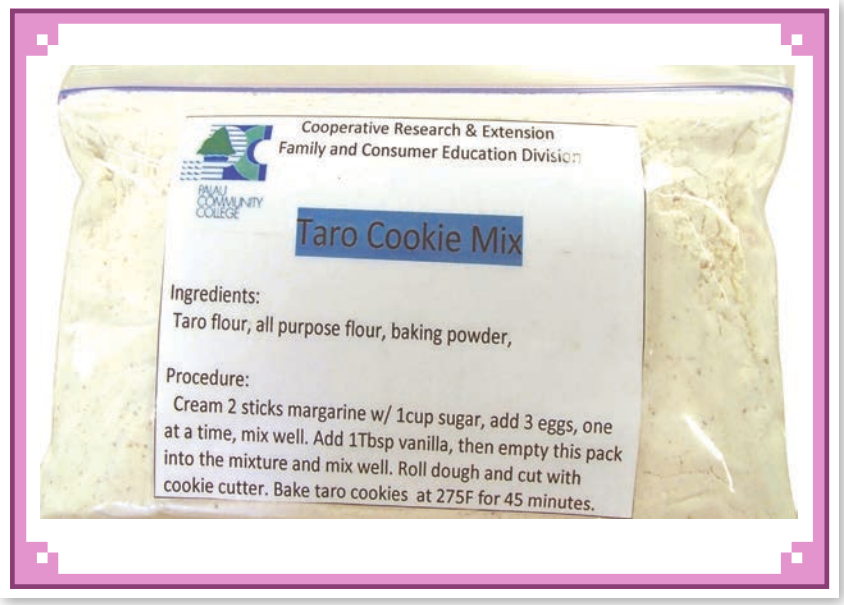
Fig. 17. Taro pasta with sauce.

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.



TARO COOKIE MIX

Fig. 18. Taro cookie mix.

Ingredients:

6	cups	taro 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 Taro Cookie Mix into thick (0.5 mil) plastic bags, seal, and label.
- Store in a clean, dry place.

TARO COOKIES

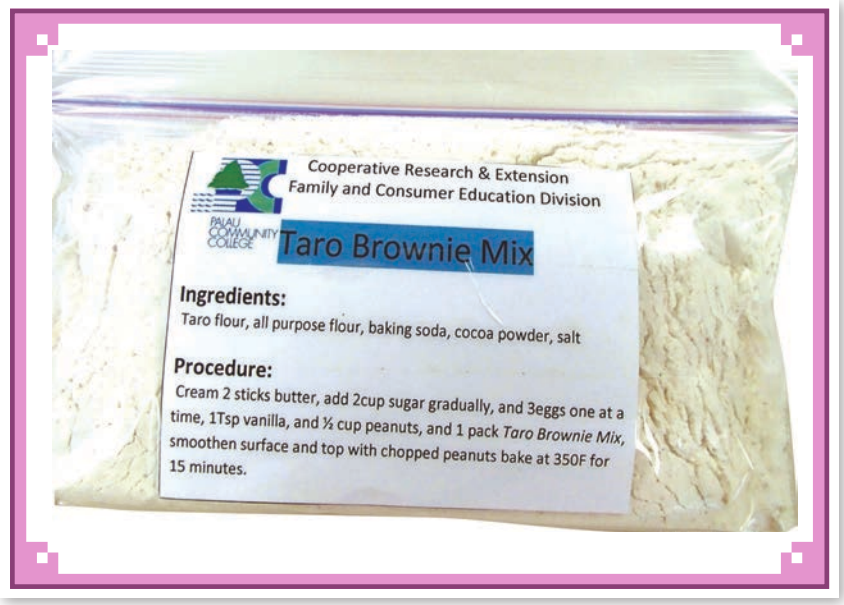
Fig. 19. Taro cookies.

Ingredients:

1	pack	Taro 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 Taro 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.



TARO BROWNIE MIX

Fig. 20. Taro brownie mix

Ingredients:

3	cups	taro 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.

TARO BROWNIES

Fig 21 Taro brownies.

Ingredients:

1	pack Taro Brownie Mix	3	pcs	eggs
1	cup butter	1	tsp	vanilla
2	cups sugar	1	cup	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 Taro 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.

TARO MUFFIN MIX

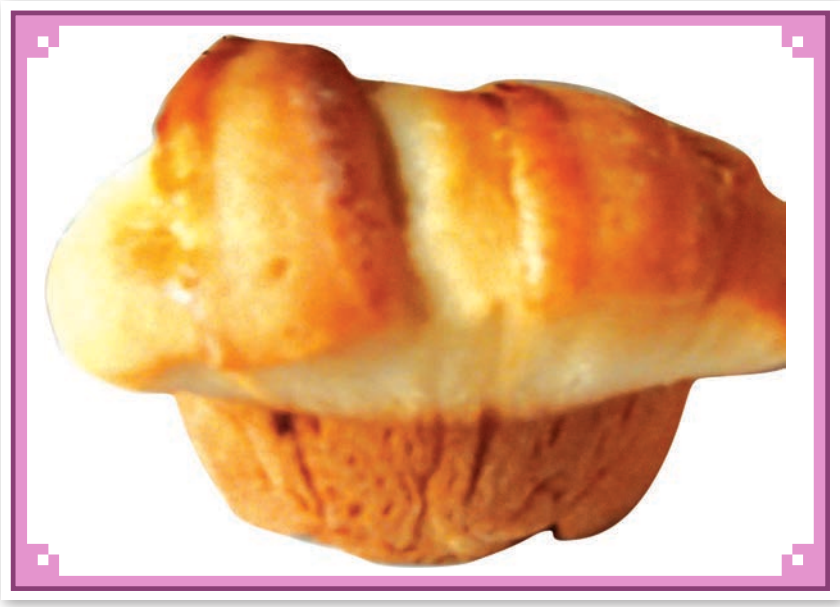
Fig. 22 Taro muffin mix

Ingredients:

3	cups	taro 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.



TARO MUFFINS

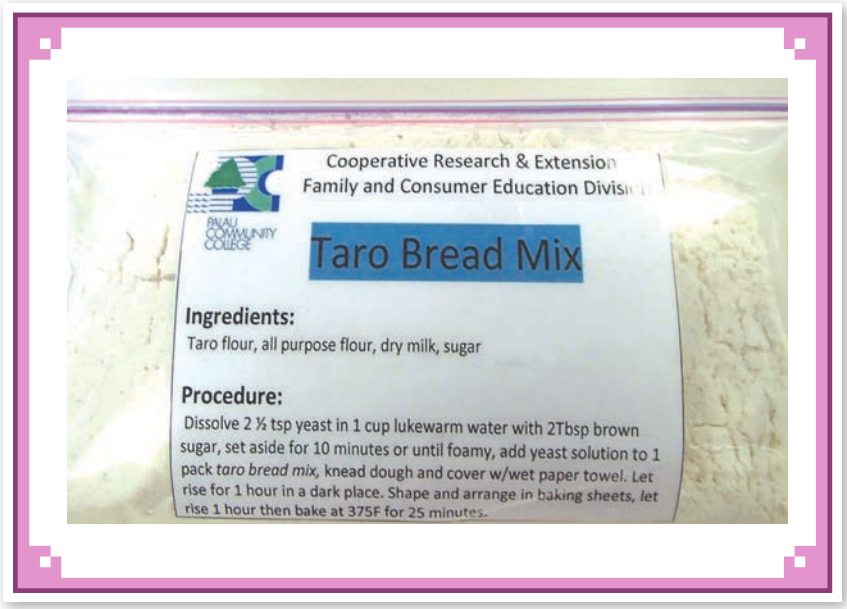
Fig. 23 Taro muffins.

Ingredients:

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

Procedure:

- Preheat oven to 350° F.
- Combine margarine, egg, and yoghurt. Add 1 pack Taro 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.



TARO BREAD MIX

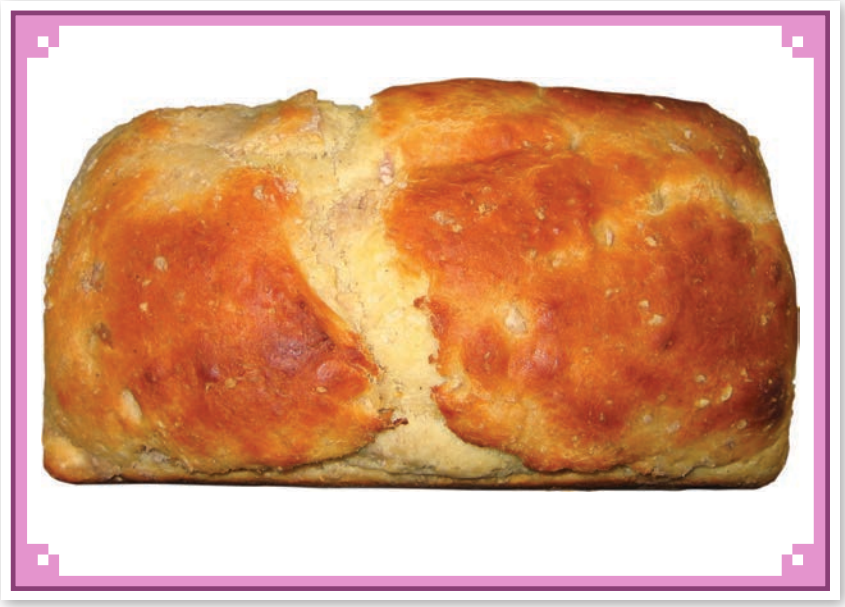
Fig. 24 Taro bread mix

Ingredients:

10	cups	taro 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.



TARO BREAD

Fig. 25. Taro bread

Ingredients:

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

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 Taro 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.

TARO CUPCAKE MIX

Fig. 26. Taro cupcake mix

Ingredients:

5	cups	taro 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.

TARO CUPCAKES

Fig. 27. Taro cupcakes.

Ingredients:

1	pack	Taro Cupcake Mix	2	pcs	eggs
½	cup	sugar	3	Tbsp	nuts
¼	cup	butter	1	tsp	vanilla

Procedure:

- Beat margarine until fluffy. Add sugar gradually and eggs one at a time. Mix well.
- Add taro cupcake mix and nuts and mix well.
- Pour ¾ full in muffin pans lined with cupcake paper. Top with chopped nuts. Bake at 375° F for 25 minutes.

B. FROZEN PRODUCTS

TARO ICE CREAM

Fig. 28. Taro ice cream.

Ingredients:

10	cups	taro puree	1	cup	powdered milk
1	can	evaporated milk			
1	can	Nestle's Cream	1- ½	cups	sugar

Procedure:

- Boil taro for 2 hours, peel and slice into small pieces.
- Place 2 cups sliced taro in a blender , add 1 cup water and blend until smooth. Mix all ingredients together and freeze.
- Cut frozen taro mixture into pieces and mix with a hand mixer until foamy.
- Transfer ice cream into plastic cups with cover and freeze.

TARO ICE CANDY

Fig. 29. Taro ice candy

Ingredients:

3	kg	taro, boiled ,pureed	1	gal	water
1	kg.	sugar	1	tsp	baking soda
2	cans	evaporated milk			
1	pack	coffee creamer			

Procedure:

- Boil taro, peel, and slice into small pieces. Place 1 cup sliced taro and 1 cup water in a blender and blend until smooth.
- Boil sugar in equal amount of water to make syrup.
- Mix taro puree, syrup, coffee creamer and baking soda.
- Transfer into ice candy bags and freeze.

READY-TO-EAT VACUUM-PACKED SLICED TARO

Fig. 30. Ready-to-eat vacuum-packed sliced taro

Ingredients:

Taro, any variety

Procedure:

- Boil taro for 2 hours.
- Peel and slice into serving pieces.
- Pack into thick (0.5 mil) boilable or microwaveable bags.
- Seal with vacuum.
- Freeze. To serve, thaw in microwave for 3 minutes.

TARO SMOOTHIE

Fig. 31. Taro smoothie

Ingredients:

2	lbs	taro, boiled and pureed
1	can	evaporated milk
1	cup	sugar

Procedure:

- Boil taro for 2 hours, peel and slice into small pieces.
- Place 1 cup sliced taro and 1 cup water in a blender and blend until smooth. Add milk and sugar to taro puree. Transfer into ice trays and freeze.
- Chop frozen taro into pieces and blend until smooth.

C. COOKED/BAKED/FRIED PRODUCTS

TARO PIZZA

Fig. 32. Taro pizza

Ingredients:

1 lb	taro, boiled and diced	1 cup	tomato paste
1 pack	pepperoni	1 lb	ground beef
1 cup	flour	5 Tbsp	yoghurt
1 pc	bell pepper	1 pc	onion
1 tsp	salt	1 tsp	black pepper
1/2 Tbsp	sugar	1 Tbsp	shortening

Procedure:

- Prepare crust by mixing flour, yoghurt, shortening, salt and sugar into dough.
- Lay out toppings on pizza crust and arrange ingredients.
- Bake for 25 minutes at 350° F.

TARO SALAD

Fig. 33. Taro salad

Ingredients:

2	lbs.	taro, boiled , diced	½	tsp	salt
1/3	cup	yoghurt	½	tsp	pepper
¼	cup	mayonnaise	2	pcs	boiled eggs, diced
¼	cup	chicken broth	3	Tbsp	vinegar
4	pcs.	spring onion, chopped			

Procedure:

- Boil taro for 2 hours, peel and dice
- Combine all ingredients with the diced taro.
- Toss until uniformly mixed.
- Garnish with diced boiled egg,

TARO PUDDING

Fig.34. Taro pudding

Ingredients:

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

Procedure:

- Boil taro for 2 hours, peel and grate.
- Transfer to a big skillet and mix the other ingredients together.
- Cook with constant stirring in slow fire until very thick.
- Transfer into a container like plate or packaging material and smoothen surface with margarine.

TARO CANDY/PASTILLES

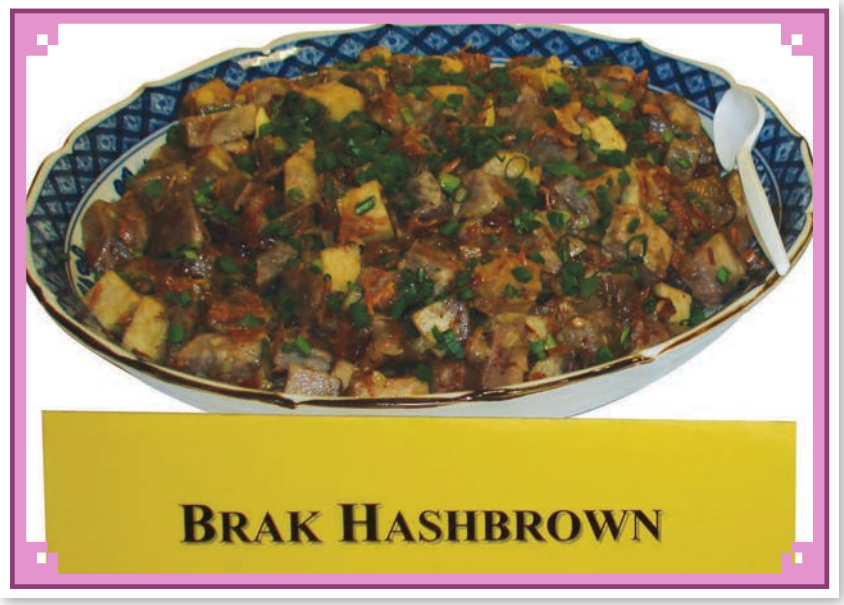
Fig. 35. Taro candy/pastilles

Ingredients:

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

Procedure:

- Boil taro for 2 hours, peel 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.



TARO HASH BROWNS

Fig. 36. Taro hashbrowns.

Ingredients:

2	lbs.	taro, cooked and diced
1	pc.	onion, chopped
1	pc	bell pepper, chopped
1	clove	garlic
1	Tbsp.	olive oil
¾	tsp.	salt
½	tsp.	pepper

Procedure:

- Cook taro for 2 hours, peel, and dice. Saute garlic, onion, and green pepper in oil.
- Add taro and season with salt and pepper.

TARO PIE

Fig. 37. Taro pie

Ingredients:

Crust:			**Filling:**		
2- ½	cups	all-purpose flour	5	cups	grated taro
2- ½	Tbsp.	sugar	2	cups	coconut
½	tsp	salt	1	cup	cream
¾	cup	shortening	1	cup	flour
1/3	cup	ice-cold water	2/3	cup	sugar
1	pc	egg yolk	3	Tbsp.	butter

Procedure:

Crust:

- Combine flour, sugar and salt in a mixing bowl. Cut in shortening until mixture is crumbly. Mix in cold water and slightly beaten egg yolk.
- Knead into a dough , form into a ball, and refrigerate for 30 minutes

Filling:

- Stir together all ingredients and transfer into a dough-lined pie plate, cover with flattened dough and cut edges with fork tines.
- Bake at 375° F for 45 to 60 minutes.

TARO PASTRY

Fig. 38. Taro pastry (Hopia).

Ingredients:

Filling:

4 lbs	cooked taro,grated
1lb.	ground pork
3 cups	sugar
¾ cup	water
¾ cup	oil
1 bundle	spring onions, chopped

Wrapper:

3 cups	all-purpose flour
¾ cup	oil
¾ cup	water

Procedure:

- Wrapper: Mix wrapper ingredients and set for 10 minutes.
- Roll dough, flatten, and cut into pieces.
- Filling: Stir-fry pork until brown, put in onions and mix well.
- Add rest of the ingredients and stir while cooking.
- Wrap 1 Tbsp filling and bake at 350° F for 20 minutes.

TARO SUSHI

Fig.39. Taro sushi

Ingredients:

2 lbs taro, cooked and grated
1 stick margarine
1 can spam
1 pack *nori* wrapper
oil for frying

Procedure:

- Boil taro for 2 hours, peel and grind with margarine.
- Thickly flatten taro with rolling pin and cut with spam cans.
- Fry cut taro pieces and sliced spam.
- Prepare taro sandwiched with fried spam slices and wrap with nori.

TARO FRITTERS

Fig. 40. Taro (prak) fritters.

Ingredients:

2 lbs taro, boiled
oil for frying

Procedure:

- Boil taro for 2 hours, peel and grind.
- Thickly flatten taro with rolling pin and cut with spam cans.
- Fry in deep, hot oil.

TARO FRIES

Fig. 41. Taro fries.

Ingredients:

2	lbs.	taro, boiled
		oil for frying

Procedure:

- Cook taro for 2 hours, peel, and slice into sticks.
- Deep-fry in hot oil.

TARO CHIPS

Fig. 42. Taro chips

Ingredients:

2	lbs.	taro, boiled
1	cup	sugar
		oil for frying

Procedure:

- Boil taro for 2 hours, peel, and slice thinly.
- Prepare syrup by mixing 1 cup sugar and 1 cup water and boil.
- Fry taro slices in hot oil (first frying).
- Dip fried taro in syrup and drain.
- Fry until crisp (second frying)
- Cool, pack and label.

TARO CREPES

Fig. 43. Taro crepes.

Ingredients:

1	lb taro, cooked , grated		1 pc . egg
¾	cups	flour	2 Tbsp. brown sugar
1	tsp	sugar	1 Tbsp. butter
1	tsp	salt	2 Tbsp. sour cream
1	cup	milk	

Procedure:

- Combine flour, sugar, and salt. Whisk in milk, egg, and butter. This is batter. Heat non-stick pan at medium, place ¼ cup batter and tilt to cover bottom of pan.
- Transfer crepes to a plate and cover with a sheet of wax paper.
- In a large skillet combine brown sugar, taro, sour cream and scoop out mixture at the center of crepes, roll up end and serve with juices from cooking.

TARO TURNOVER

Fig. 44. Taro turnover.

Ingredients:

Wrapper:		Filling:	
1 cup	flour	4 cups	taro, cooked,diced
1 Tbsp.	sugar	1 cup	chicken, diced
½ tsp.	baking powder	1 can	green peas
¼ tsp.	salt	1 Tbsp.	cooking oil
3 Tbsp.	butter	1 tsp.	garlic
2 Tbsp.	shortening	2 Tbsp.	onion
1/3 cup	ice water	½ tsp.	salt
4 Tbsp.	yoghurt	½ tsp	black pepper

Procedure:

Wrapper:

- Combine flour, sugar, baking powder, and salt.
- Cut in shortening and butter until mixture is like a coarse meal.
- Stir in yoghurt and sprinkle on ice water, shape into a dough and refrigerate 1 hour.

Filling:

- Saute garlic and onion in oil. Add chicken, taro, and green peas.
- Season with salt and pepper.
- Wrap 2 Tbsp. mixture in round-shaped wrappers and seal edges with fork tines.
- Fry in deep oil.

D. FERMENTED PRODUCTS

Fig. 45. Taro wine.

TARO WINE

Ingredients:

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

Procedure:

- Boil taro in water for 2 hours, peel and cut into small pieces.
- Place 1 cup taro and 1 cup water in a blender and blend for 2 minutes. This is taro puree.
- Dissolve yeast in 1 cup lukewarm water and add brown sugar. Let stand 10 minutes or until foamy.
- Mix taro 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 taro wine.
- Pasteurize taro wine by heating to 90° C for 15 minutes.
- Cool, bottle, seal, and label.

TARO VINEGAR

Fig. 46. Taro vinegar.

Ingredients:

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

Procedure:

- Boil taro in water for 2 hours, peel and cut into small pieces.
- Place 1 cup taro and 1 cup water in a blender and blend for 2 minutes. This is taro puree.
- Dissolve yeast in 1 cup lukewarm water and add brown sugar. Let stand 10 minutes or until foamy.
- Mix taro 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. The filtrate is taro vinegar.
- Pasteurize taro vinegar by heating at 90° C for 15 minutes.
- Cool, bottle, seal, and label.

TARO SAUCE

Fig. 47. Taro sauce

Ingredients:

5	lbs.	taro, 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 taro in water for 2 hours, peel and cut into small pieces.
- Place 1 cup taro and 1 cup water in a blender and blend for 2 minutes. This is taro puree.

- Dissolve yeast in 1 cup lukewarm water and add brown sugar. Let stand 10 minutes or until foamy.
- Mix taro 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 2 months and filter. Dissolve salt in the filtrate.
- Melt brown sugar in slow fire until black. This is caramel coloring.
- Stir in coloring to the salted filtrate and transfer in bottles, seal and label.

SENSORY EVALUATION OF TARO PRODUCTS

Taro ice cream utilizing the varieties of sweet taro and taro 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(OBF), 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 both products 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 taro food products and they signified their interest in buying these foods if sold in the market.

Fig. 48. PCC-CRE food products being tasted by visitors.

PACKAGING STUDIES AND SHELF-LIFE OF PROCESSED TARO PRODUCTS

Taro food products and their suitable packaging materials were studied and results are shown in Table 4.

Table 4. Selected 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
Ready-to-eat slices	PP bags, 0.5 mil
Fermented products	PET (polyethylene terepthalate) plastic bottles
Frozen products	PET containers, PP bags

Taro flour and dry mixes were found stable when packed in 0.5 mil thick PE or PP bags and stored at room temperature. Taro Chips were found stable in 0.5 mil PE plastic bags. Frozen products like ready-to-eat slices of taro was suitably packed in 0.5 mil PP bags. Taro Ice Cream kept well in PET plastic containers with cover stored in the freezer.

Fig.49. Taro food products under storage.

Results of storage studies of processed taro food products are shown in Table 5.

Table 5. Shelf-life of selected taro 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	1 month
	Refrigeration temperature, 10° C	3 months
Cooked products	Refrigeration temperature, 10° C	2 weeks
	Freezing temperature, <0° C	6 months

The processed products kept well in their respective suitable packaging materials for a period of one year or longer for the frozen and dried products. These include ice cream, ice candy, frozen ready-to-eat slices of taro when packed in 0.5 mil boilable plastic bags.

Taro Flour and dry mixes also kept for one year or longer at room temperature (27° to 32° C) when packed in thick (0.5 mil) plastic bags.

Baked/cooked/fried taro products like cookies, biscuits, and chips, had a shelf-life of one month at room temperature (27°-32° C). Cooked products like taro pudding kept for two weeks at refrigeration temperature (10° C) and 6 months at freezing temperature (<0° C).

Fermented products like wine, vinegar, and sauce packed in PET bottles were found to be stable at room temperature (27°-32° C) for more than 2 years or longer.

TECHNOLOGY TRANSFER OF TARO PRODUCTS

All 31 taro food products were taught to 636 participants (to date, October, 2013) 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 6.

Among the trained participants, some went into a food business microenterprise. Ms. Sandy Toribiong utilized taro flour which she learned from the Food Technology Class into taro sub sandwich, being served at her restaurant. School chefs served some of the processed food products at the PCC Cafeteria and elementary schools of Ngeremlengui, Melekeok, and Ngiwal States.

Participants of Ngiwal State Food Technology Class sold taro doughnuts in the different offices in the State. Other trainees served the food items during custom events like funerals and birth ceremonies. Women prepared the products for their families, guests, and tourists visiting their places.

Table 6. Places and number of participants of Food Technology Classes.

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**

Fig. 50. Participants of the Food Technology Classes in Koror State.

REFERENCES

Agricultural Census, Republic of Palau. 1994. Department of Agriculture. Ministry of Resources and Development.

Del Rosario, A.G. and N.M. Esguerra, 2003. Crop Profile for *Colocasia* Taro in the Republic of Palau. PCC-CRE Publication 27/03 (3.0 C) 26pp.

Dreher, M.L. 1987. Physicochemical and functional properties of dietary fiber as related to bowel function and food use. In: Handbook of Dietary Fiber- An Applied Approach, pp.137-182. New York:Marcel and Decker Inc.

Eastwood, M.A. and E.R. Morris, 1992. Physical Properties of Dietary Fiber that Influence Physiological Function: Model for polymers along the gastrointestinal ract. Am. J. Clin. Nutr. 55:436-442.

Food and Nutrition Research Institute (FNRI), 1997. Food Composition Tables, Department of Science and Technology, Bicutan, Taguig, Metro Manila, Philippines.

Goldberg, Israel, 1994. Functional Foods. Chapman and Hall, New York. 521 pp.

IESL, 1996. Informal Employment for Sustainable Livelihood Program Survey, 1996. Project of Palau Community Action Agency (PCAA), Koror, Palau.

Palau Economic Development Plan 1995-1999. Koror, Palau. Vols. I and II.

Palau Statistical Yearbook, 1998. Koror, Palau.

Plan of Work FY 2000-2004. College of Micronesia Land Grant Programs Research, Extension, and Education al Programs.

Republic of Palau Economic Development Plan, 1995-1999. Vols. I and II.

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.